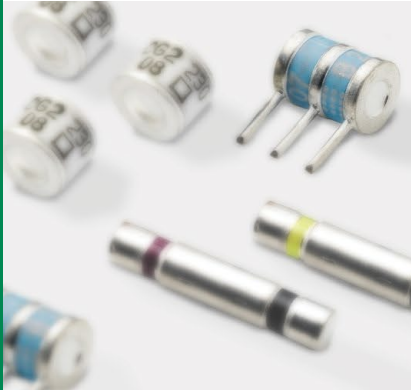




Expertise Applied | Answers Delivered



## PRODUCT CATALOG & DESIGN GUIDE



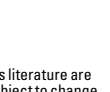
# GDT

**Gas Discharge Tube (GDT)  
Products**



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## GDT Characteristics, Terms and Consideration Factors Legal Disclaimers

| Series Name <sup>1</sup>  |                                                                                     | DC Breakover Voltage Range (Nom V <sub>BO</sub> ) | Max AC Surge Rating | Peak Pulse Current (8x20μs) | Max Capacitance | Operating Temperature Range | # Terminals | Mounting Options |         |            |             |                | RoHS Compliant | Lead Free |
|---------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------|---------------------|-----------------------------|-----------------|-----------------------------|-------------|------------------|---------|------------|-------------|----------------|----------------|-----------|
|                           |                                                                                     |                                                   |                     |                             |                 |                             |             | Mini Tube        | Surface | Axial Lead | Radial Lead | Cartridge Clip |                |           |
| High Voltage GDTs         |                                                                                     |                                                   |                     |                             |                 |                             |             |                  |         |            |             |                |                |           |
| CG4                       |    | 800 - 3000                                        | 3A                  | 3000A                       | 0.8pF           | -40°C to +90°C              | 2           |                  | •       |            |             |                | •              | •         |
| AC                        |    | 285 - 600                                         | NA                  | 5000A                       | 1.5pF           |                             | 2           |                  |         | •          |             |                | •              |           |
| CG3                       |                                                                                     | 1000 - 7500                                       |                     | 5000A                       | 1.5pF           |                             | 2           |                  |         | •          |             |                | •              |           |
| Low to Medium Surge GDTs  |                                                                                     |                                                   |                     |                             |                 |                             |             |                  |         |            |             |                |                |           |
| CG7                       |    | 75 - 470                                          | 1A                  | 1000A                       | 0.3pF           | -40°C to +90°C              | 2           |                  | •       |            |             |                | •              | •         |
| CG6                       |    | 75 - 600                                          | 3A                  | 3000A                       | 0.3pF           |                             | 2           |                  | •       |            |             |                | •              | •         |
| CG5                       |   | 90 - 600                                          | 5A                  | 5000A                       | 1.5pF           |                             | 2           | •                | •       | •          |             |                | •              |           |
| SL0902A                   |                                                                                     | 90 - 600                                          | 5A                  | 5000A                       | 1.5pF           |                             | 2           | •                | •       |            |             |                | •              | •         |
| SL1002A                   |  | 75 - 600                                          | 5A                  | 5000A                       | 1.2pF           |                             | 2           | •                | •       |            |             |                | •              | •         |
| SL1003A                   |  | 90 - 500                                          | 10A*                | 10,000A                     | 1.5pF           |                             | 3           | •                | •       |            | •           |                | •              | •         |
| SL1010A                   |  | 75 to 470                                         |                     | 5000A                       | 1.5pF           |                             | 3           |                  | •       |            |             |                | •              | •         |
| SL1011A                   |  | 75 - 600                                          | 5A                  | 5000A                       | 1.5pF           | 2                           |             | •                | •       |            |             | •              | •              |           |
| Medium to High Surge GDTs |                                                                                     |                                                   |                     |                             |                 |                             |             |                  |         |            |             |                |                |           |
| SL1122A                   |  | 90 - 260                                          | 10A*                | 10000A*                     | 100-270pF       | -40°C to +90°C              | 3           |                  |         |            | •           |                | •              |           |
| SL1021A                   |  | 75 - 600                                          | 10A*                | 20000A*                     | 1.5pF           |                             | 3           |                  | •       |            | •           |                | •              | •         |
| SL1411A                   |  | 75 - 600                                          | 10A                 | 10000A                      | 1.5pF           |                             | 2           |                  | •       | •          |             |                | •              | •         |
| CG/CG2                    |  | 75 - 1000                                         | 20A                 | 20000A                      | 1.5pF           |                             | 2           | •                | •       | •          |             |                | •              |           |
| Very High Surge GDTs      |                                                                                     |                                                   |                     |                             |                 |                             |             |                  |         |            |             |                |                |           |
| SL1021B                   |  | 75 - 600                                          | 10A*                | 20000A*                     | 1.5pF           | -40°C to +90°C              | 3           |                  | •       |            | •           |                | •              | •         |
| SL1026                    |  | 275 - 700                                         | 10A*                | 40000A*                     |                 |                             | 3           |                  |         |            |             | •              | •              | •         |
| Squared GDTs              |                                                                                     |                                                   |                     |                             |                 |                             |             |                  |         |            |             |                |                |           |
| SE                        |  | 140 to 500                                        |                     | 0.5KA                       | 0.5pF           | -40°C to +90°C              | 2           |                  |         |            |             |                | •              | •         |
| SG                        |                                                                                     | 75 to 600                                         |                     | 1KA / 2KA                   | 1pF             |                             | 2           |                  |         |            |             |                | •              | •         |
| SH                        |  | 75 - 600                                          | 5A                  | 5000A                       | 0.7pF           |                             | 2           |                  | •       |            |             |                | •              | •         |

(1) Please refer to product data in our datasheets for detailed information by part number.

\* Total current through center (ground) terminal

## GDT Characteristics, Terms and Consideration Factors

### Surge Arresters

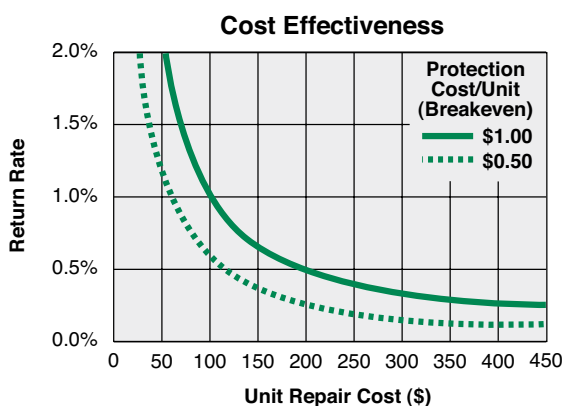
Littelfuse gas discharge tube (GDT) surge arrester devices protect personnel and electrical equipment from damaging high voltage transients induced by lightning, inductive switching, or electrostatic discharge. Depending upon the application, Littelfuse offers a variety of two and three electrode GDTs for protecting telecommunication, test, computer, power supply, medical, and cable television equipment. Along with protecting circuits, GDTs can also be used as switches to create a discharge voltage in circuits used for medical, gas ignition, and HID lighting applications.

### Why Use Surge Protection?

Surge protectors protect personnel and equipment from damaging high-voltage surges from lightning, inductive switching, nuclear electromagnetic pulse, electrostatic discharge, or interference from power supply lines. From a design point of view, protection circuits only cost money and, if customer requirements or regulatory agencies do not require them, they will easily be forgotten. Yet, appropriate surge protection is beneficial. Protected equipment will not be affected by the high-voltage surges listed above. This will result in:

- Reduced field failures
- Improved product quality and reliability
- Reduced cost of quality

The figure below illustrates the cost effectiveness of adding surge protection by demonstrating the unit repair cost to break even over a range of return rates for added protection costs of \$0.50/unit and \$1.00/unit.



Through ongoing research and engineering improvements, Littelfuse has developed a family of Surge Protection Products that offer impressive characteristics for a variety of applications. Four differentiating characteristics are found in every Littelfuse Surge Protection Product:

- High surge current rating
- Long life
- Fast response
- Rugged construction

### A Comparison of Surge Arrester Technologies

In today's world of sensitive electronics, an increasingly important topic has become the protection of electronic components from overvoltage surges. There is a multitude of devices on the market for this purpose but what are the differences between them and which is best for what application? The following describes, analyzes, and compares these devices in detail.

Basically there are two types of surge protection classifications with each consisting of its own group of devices:

#### CROWBAR

- Air Gap
- Carbon Block
- Gas Discharge Tube (GDT)
- Silicon Controlled Rectifier (SCR)

#### CLAMP

- Zener (Avalanche) Diode
- Metal Oxide Varistor (MOV)

**CROWBAR PROTECTION:** A crowbar device limits the energy delivered to the protected circuit by abruptly changing from a high impedance state to a low impedance state in response to an elevated voltage level. Having been subjected to a sufficient voltage level the crowbar begins to conduct. While conducting, the voltage across the crowbar remains quite low (typically less than 15 volts for gas discharge tubes usually higher for the air gap and carbon block protectors) and thus, the majority of the transient's power is dissipated in the circuit's resistive elements and not in the protected circuit nor the crowbar itself. This allows the crowbar to be able to withstand and protect loads from higher voltage and/or higher current levels for a greater duration of time than clamping devices.

**AIR GAP PROTECTOR:** An air gap protector consists of two conductive surfaces with a spacing between them that will permit an arc when a specified potential is placed across the surfaces. The air gap is not a sealed device and therefore it must operate at atmospheric pressure and under the effects of the environment. Since the electrodes are exposed to the environment, they will often experience oxidation and corrosion which is not a problem common to a gas tube such as Littelfuse's GDT. These factors contribute to the air gap's high nominal breakdown voltage, wide breakdown voltage tolerance, and poor impulse response. Often an air gap is placed in parallel with a gas discharge tube or carbon block protector to provide back up protection in the event that the primary protection fails.

## GDT Characteristics, Terms and Consideration Factors (continued)

**CARBON BLOCK PROTECTOR:** A carbon block protector consists of a pair of carbon elements separated by a 0.003-0.004 inch air gap. When a specified potential is placed across the carbon surfaces an arc will be initiated. Like the air gap protector, the carbon block is an unsealed device and its performance suffers in the same manner as the air gap. Carbon block protectors are used mainly for telephone line protection but are being replaced, in most installations, with the more reliable and consistent gas discharge tubes.

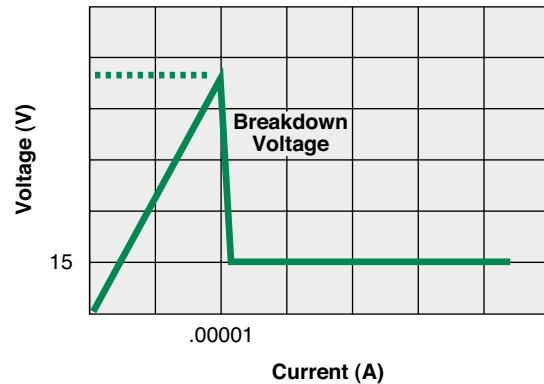
### GDT GAS DISCHARGE TUBE:

Littelfuse's GDT, a hermetically sealed gas filled ceramic tube with metal electrodes, is recognized for:

- Stable electrical parameters
- High insulation resistance
- Low capacitance
- High current capability
- Low leakage current
- Low arc voltages

For a gas tube to begin conduction, an electron within the sealed device must gain sufficient energy to initiate the ionization of the gas. Complete ionization of the gas takes place through electron collision. The events leading up to this phenomenon occur when a gas tube is subjected to a rising voltage potential. Once the gas is ionized, breakdown occurs and the gas tube changes from a high impedance state to a virtual short circuit and thus, any transient will be diverted from and will not reach the protected circuit. The arc voltage (the voltage across the gas tube while the gas tube is conducting) will typically be 15 volts. After the transient has passed, the GDT will extinguish and again appear as an open circuit. In order to insure gas tube turn off at the zero crossing in AC applications, the current through the GDT once the transient has passed, must be less than the follow-on current rating of the gas tube. The follow-on current requirement can easily be met by placing a resistor in series with the gas tube. Littelfuse's AC series gas discharge tube surge arresters were developed specifically to protect AC power lines and normally will not require additional components to limit follow-on current. In DC applications, the gas discharge tube will extinguish as long as the device is operated within the specified holdover conditions. Holdover conditions involve the maximum bias voltage that can appear across a gas discharge tube under specified current conditions and still allow the gas discharge tube to turn off. Under normal operating conditions, the GDT shunted across a circuit, will act like an open switch with a high insulation resistance.

**Comgap Gas Discharge Tube  
Voltage vs. Current Characteristics**



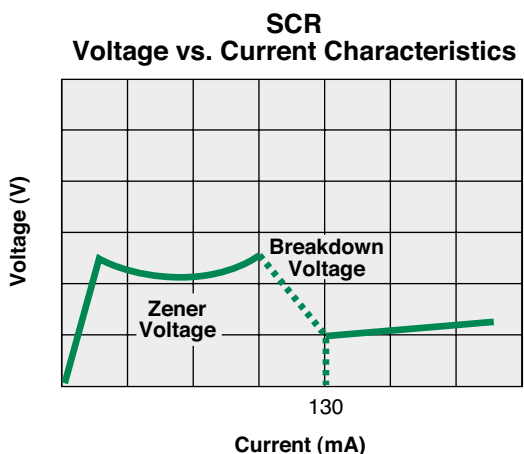
The GDT's breakdown voltage is determined by electrode spacing, gas type (usually neon and/or argon), gas pressure (less than atmospheric), and the rate of rise of the transient. Breakdown voltage is defined as that voltage at which a crowbar type of surge arrester changes from a high impedance state to a low impedance state. The GDT series is categorized by the breakdown voltage of each gas tube when a slowly rising transient is applied. For example: Littelfuse's CG2-230L gas tube will breakdown at 230V (+/- 15% to 20%) when subjected to a ramp with a rate of rise of 100V/second. The breakdown voltage response of a crowbar to transients with ramp rates of 1V/microsecond or less is referred to as the DC breakdown voltage level. Due to the nature of gas discharge tubes, the same gas tube will experience breakdown at a higher voltage as a transient's ramp rate increases. For example: At 100V/microsecond, the CG2-230L gas tube will breakdown at 600V maximum. The breakdown voltage response of a crowbar to transients with ramp rates greater than 1V/microsecond is referred to as the impulse breakdown voltage level.

Due to the GDT's rugged construction, it can handle currents that far surpass other transient suppressors' capabilities - greater than 10 pulses of a 20,000 peak amperes pulse having a rise time of 8 microseconds decaying to half value in 20 microseconds (also referred to as an 8/20 wave form). The surge life of the GDT is at least 1000 shots of a 500 amperes peak 10/1000 pulse. GDT is the practical device for the protection of telephone circuits, AC power lines, modems, power supplies, CATV and almost any application where protection from large and/or unpredictable transients is desired.

## GDT Characteristics, Terms and Consideration Factors (continued)

### SILICON CONTROLLED RECTIFIER (SCR):

Unlike the crowbar devices discussed above, the SCR is a semiconductor. Like the GDT, the SCR will have a very low voltage drop across it while conducting. The SCR does require a trigger signal when a surge is present before it can begin to conduct. This trigger signal is usually supplied through the use of a zener diode. Packages that combine the SCR and zener diode are now available. These packages are monolithic devices and often contain an SCR-type thyristor with a gate region that acts like the avalanche diode. Once triggered, the SCR begins to conduct, dropping the voltage across the zener diode to a value below the zener's operating voltage and thus causing the zener to stop conducting. The SCR will conduct until the applied voltage drops to zero (zero crossing of AC) or until the current falls below a specified value (sometimes referred to as a holding current).



Although typically having a faster response time than a GDT, the SCR package is subject to higher leakage current and capacitance. The SCR package can handle currents of several hundred amperes of an 8/20 wave form and packages are available that offer bi-directional protection.

**CLAMPING PROTECTION:** A clamping device actually limits the voltage transient to a specified level by varying its internal resistance in response to the applied voltage. A clamping device must absorb the transient's energy and therefore, cannot withstand very high current levels. Although these devices have quick response times, they are subject to leakage currents and their capacitance values are higher than those found in the GDT.

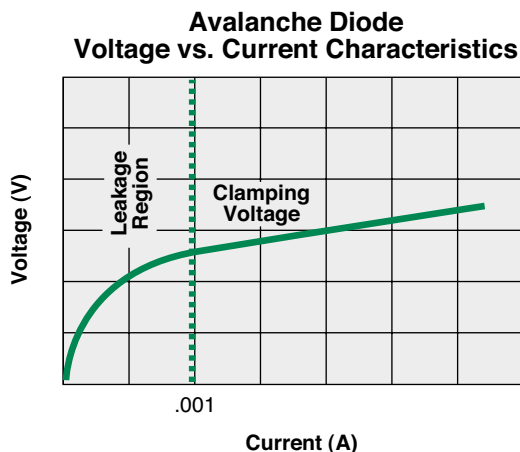
**ZENER (AVALANCHE) DIODE:** The zener diode comes closest to modeling the ideal constant voltage clamp. It responds quickly to a fast rising voltage potential and is available for a fairly wide range of clamping voltages (from less than 10 volts up

to several hundred volts). The zener is placed in parallel with the circuit to be protected and will not operate until a surge exceeds the zener's breakdown voltage. The surge, causing the zener to conduct will be clamped to the zener's rated

voltage. The zener is a good protector for circuits operating at low voltages. Caution is advised when designing the device into RF circuits due to the diode's high capacitance.

Also available are silicon avalanche suppressers which are referred to as transient voltage suppressers (TVS) diodes. These diodes consist of fairly large junction zeners which have been designed specifically for surge protection. The TVS diodes are rated for higher current surges than zener diodes and they can carry these currents for periods of 2-10 microseconds.

For use in AC signal lines, two zeners are required. These are available as packaged devices. Avalanche diodes are often used to protect IC's from static discharge and other forms of transients in power supplies computer buses, and data lines.



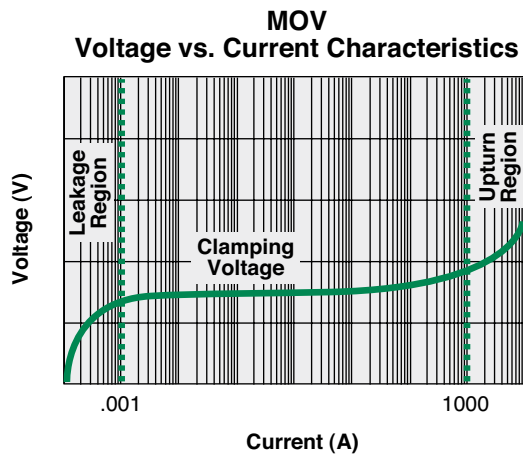
**MOV (METAL OXIDE VARISTOR):** As its name suggests, the MOV is a voltage variable resistor made from sintered metal oxides. The grains produced in the sintered metal oxide material of the MOV can be thought of as a network of series and parallel diodes. As the voltage potential across the MOV increases, some of the diodes experience avalanche breakdown and begin to conduct and as a result, reduce the net resistance of the MOV.

The MOV can handle current pulses of higher peak values and for a longer duration than a diode, but the MOV can experience cumulative degradation and performance changes after it is exposed to large current pulses when not properly selected. The high peak current surges tend to fuse the oxide grains and thus alter the MOV's performance. Some engineers recommend that a fuse be used with an MOV as a large current surge could damage the grain structure, fuse the grains together and result in the protected circuit being shorted out.

The MOV is available in a wide range of voltages and experiences a quick turn on time when subjected to a fast rising surge. The MOV is subject to leakage current and high capacitance (10's to 1000's of picofarads). When designing with a MOV it is necessary to remember that as the current

## GDT Characteristics, Terms and Consideration Factors (continued)

through the device increases, the voltage which the MOV clamps at is greatly increased.



**GDT and MOV PROTECTION:** In summary, there is no one ideal surge arrester device type that meets all of the key performance parameters for every application. Due to their complementary performance characteristics, however, a GDT and MOV can be combined in a circuit to provide the ultimate in surge suppression performance. The MOV quickly clamps a fast rising voltage surge while the GDT crowbars to safely dissipate the large peak current to ground. (See Application Note entitled "Surge Protection of AC Power Lines".)

### SUMMARIZED COMPARISON OF TECHNOLOGIES

|                                                     | GASTUBE<br>CG2-230L | SCR       | MOV          | DIODE        |
|-----------------------------------------------------|---------------------|-----------|--------------|--------------|
| Type of Device                                      | CROWBAR             | CROWBAR   | CLAMP        | CLAMP        |
| Response Speed                                      | <1 $\mu$ SEC.       | <100nSEC. | <100nSEC.    | <100nSEC.    |
| Capacitance                                         | 1pF MAX.            | 50pF      | 45pF         | 50pF         |
| Leakage Current                                     | <1 pAMP             | 50 nAMPS  | 10,000 nAMPS | 10,000 nAMPS |
| Maximum Surge Current<br>(8/20 $\mu$ sec wave form) | 20,000 AMPS         | 500 AMPS  | 200 AMPS     | 50 AMPS      |
| Relative Cost                                       | \$1.00              | \$1.50    | \$0.50       | \$1.50       |

The CLARE product engineering department provides objective technical expertise and application assistance to designer's of switching surge protection systems. Our mission is to assist you in designing the best solution to your specific application problem, regardless manufacturer. To access our team of engineering professionals call toll free 1-800 CPCLARE.

**CONSTRUCTION:** Gas Discharge Tube (GDT) surge arresters commonly employ hermetically-sealed enclosures utilizing either ceramic-to-metal or glass-to-metal seals. The many advantages of ceramic-to-metal units have made them the norm for gas discharge tube surge arresters such as Littelfuse's GDTs. Along with being low cost, they offer high product uniformity capable of handling extreme levels of shock, vibration, and temperature.

The ceramic for GDTs is alumina ranging from 94- 98%  $\text{Al}_2\text{O}_3$ . The ceramic-to-metal seals are prepared by moly-manganese or tungsten metallizing processes with nickel

plating and the final seal is made in a gasfilled vacuum furnace using braze preforms made of copper-silver eutectic. The electrodes used for GDTs are either copper or a nickel-iron alloy, often with a coating to lower the work function and/or add gettering capability. Stripes or bands of semi-conductive material are applied to the inner surfaces of the ceramic to improve stability and high-speed response.

In contrast, most devices in Littelfuse's High Energy Devices product line are glass-to-metal units. This allows greater flexibility in configuration and is ideal for the production of standard and custom parts in more limited quantities. The electrodes of High Energy Devices are usually made of refractory metals such as tungsten or molybdenum to meet more extreme life and surge capacity requirements.

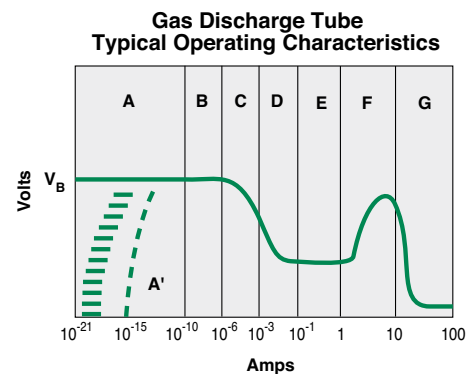


Figure 1. A generic V-I characteristic of a plasma device.

## GDT Characteristics, Terms and Consideration Factors (continued)

### THEORY

The basic operation of gas tube surge arrestors such as Littelfuse's GDTs is best understood by referring to the schematic form of the voltage-current (V-i) relationship of a generic gas discharge device such as the one depicted in Figure 1.

- A** For voltages below the breakdown voltage, the gas provides a good insulator. Very low leakage currents (10-12A) occasionally encountered result from ionization by cosmic rays, high energy photons, etc; and is, therefore, subject to statistical fluctuations. A1 The current is higher due to supplementary electron sources such as photoemission.
- B** The discharge is self-sustaining due to gas ionization –if external agents such as those mentioned for regions A and A1 are removed, the current will not change (Townsend discharge). This occurs at the breakdown voltage of the device.
- C** The transition region. As the electric field increases, more secondary electrons are generated, decreasing the voltage drop until the glow voltage (region D) is reached. Stable operation can only be maintained with active current regulation because of the negative slope of the V-i characteristic.
- D** The glow region (or normal glow region). In this region, the glow voltage is roughly constant with respect to small changes in current.
- E** The abnormal glow region. In contrast to the normal glow region, the glow voltage begins to increase as the current is increased.
- F** The glow-to-arc transition region.
- G** The arc region. In this region, the arc voltage will quickly drop and the arc current will quickly increase within the limitations of the drive energy and impedance.

If the current through the gas discharge device is adjusted over the range of values of 10-18 to 102 amps, the voltage across the device will also vary. When a gas discharge device is operated as a transient voltage protector, the modes of operation of greatest significance are in regions A, F, and G. The applied voltage is normally less than the breakdown voltage of the device, VBD, at which time the current through the device is in the A region. The charged carriers of electric current in this mode originate from the cathode by photon emission and within the fill gas by collisions of gas particles with cosmic rays (or radioactive decay particles if an isotope is used in the device).

As soon as the applied voltage across the device exceeds the breakdown voltage, the current through the device increases rapidly to values of several amps or greater. The rate of current rise and the level reached is limited by the source capacity and the series impedance of the circuit. The voltage across the device at this time is very low with typical values of 20V or less.

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### CG4 Series



#### Agency Approvals

| AGENCY | AGENCY FILE NUMBER |
|--------|--------------------|
|        | E320116            |
|        | E320116            |

#### Two Electrode GDT Graphical Symbol



#### Additional Information



**Datasheet**



**Resources**



**Samples**

#### Description

The Littelfuse CG4 Gas Discharge Tubes (GDT) series provides high levels of protection against fast rising transients caused by lightning disturbances. Offered in a miniature surface mount package, it has a surge rating of 3kA 8/20μs.

Littelfuse CG4 mini GDTs are high voltage (800-3000V) components designed for surge protection and high isolation applications. It is also suitable for applications for which bias voltage or signal levels of several hundred volts are normally present. CG4 mini GDTs can be used in conjunction with Littelfuse MOVs (Metal Oxide Varistors) to provide superior protection performance for AC applications.

#### Features

- Voltage Ranges 800V to 3000V
- Excellent response to fast rising transients
- 3kA 8/20μs surge capability pulse as defined by IEC 61000-4-5, 2<sup>nd</sup> edition
- UL 1449 recognized
- Offered in SMD package with square terminals
- Non-Radioactive
- Ultra Low capacitance (<0.8pF)
- RoHS compliant and Lead-free

#### Applications

- CATV equipment
- Antennas
- Air conditioning
- EV Power Station
- Inverters/Variable Frequency Drives (VFD)
- IEEE 803.2 compliant Ethernet interfaces
- Power Supplies
- Medical electronics
- Test Equipment
- Renewable Energy

### Electrical Characteristics

| Part Number | Device Specifications (at 25°C) |      |      |                                        |                                        |                       | Life Ratings        |                                        |                                 |                                         |                                           |                                 |
|-------------|---------------------------------|------|------|----------------------------------------|----------------------------------------|-----------------------|---------------------|----------------------------------------|---------------------------------|-----------------------------------------|-------------------------------------------|---------------------------------|
|             | DC Breakdown in Volts (@100V/s) |      |      | Impulse Break-down in Volts (@100V/μs) | Impulse Break-down In Volts (@1 kV/μs) | Insulation Resistance | Capacitance (@1MHz) | Max Impulse Discharge Current (8/20μs) | AC Discharge Current (50Hz, 1s) | AC Discharge Current (Single, 9 Cycles) | Arc Voltage (On State Voltage @ 1A, 1Min) | Impulse Life (10/1000μs) (100A) |
|             | MIN                             | TYP  | MAX  | MAX                                    |                                        | MIN                   | MAX                 |                                        | MIN                             | MIN                                     |                                           | MIN                             |
| CG40.8      | 640                             | 800  | 960  | 1200                                   | 1300                                   | 1GΩ*                  | 0.8pF               | ±5 Shots (@ 3kA)<br>1 Shot at 5kA      | 3A                              | 10A                                     | 20V                                       | 300 Shots                       |
| CG41.0      | 800                             | 1000 | 1200 | 1400                                   | 1500                                   |                       |                     |                                        |                                 |                                         |                                           |                                 |
| CG41.2      | 960                             | 1200 | 1440 | 1700                                   | 1800                                   |                       |                     |                                        |                                 |                                         |                                           |                                 |
| CG41.8      | 1440                            | 1800 | 2160 | 2700                                   | 2800                                   |                       |                     |                                        |                                 |                                         |                                           |                                 |
| CG42.0      | 1600                            | 2000 | 2400 | 3100                                   | 3200                                   |                       |                     |                                        |                                 |                                         |                                           |                                 |
| CG42.5      | 2000                            | 2500 | 3000 | 3700                                   | 4000                                   |                       |                     |                                        |                                 |                                         |                                           |                                 |
| CG42.7      | 2160                            | 2700 | 3240 | 3800                                   | 4200                                   |                       |                     |                                        |                                 |                                         |                                           |                                 |
| CG43.0      | 2400                            | 3000 | 3600 | 4100                                   | 4500                                   |                       |                     |                                        |                                 |                                         |                                           |                                 |

Note:

\* Insulation resistance measured at:

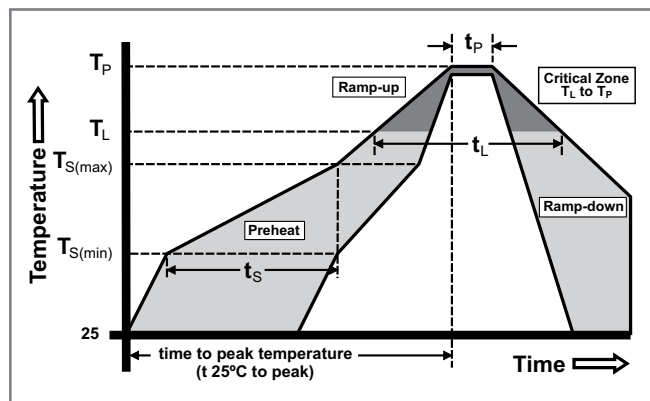
- 250Vdc for CG40.8,
- 500Vdc for CG41.0 8, CG41.0, CG41.8 and CG42.0,
- 1000Vdc for CG42.5, CG42.7 and CG43.0

### Product Characteristics

|                                            |                                                                          |
|--------------------------------------------|--------------------------------------------------------------------------|
| <b>Materials</b>                           | Device Tin Plated 17.5 ± 12.5 Microns<br>Construction: Ceramic Insulator |
| <b>Storage and Operational Temperature</b> | -40 to +90°C                                                             |

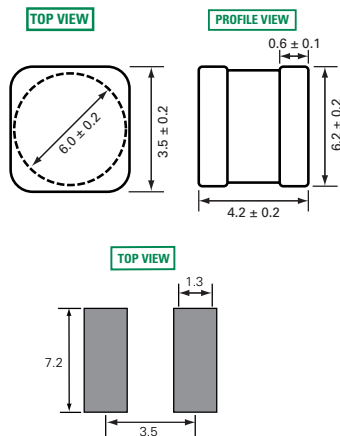
### Soldering Parameters - Reflow Soldering (Surface Mount Devices)

|                                                        |                                    |                         |
|--------------------------------------------------------|------------------------------------|-------------------------|
| Reflow Condition                                       |                                    | Pb – Free assembly      |
| Pre Heat                                               | - Temperature Min ( $T_{s(min)}$ ) | 150°C                   |
|                                                        | - Temperature Max ( $T_{s(max)}$ ) | 200°C                   |
|                                                        | - Time (Min to Max) ( $t_s$ )      | 60 – 180 secs           |
| Average ramp up rate (Liquidus Temp ( $T_L$ ) to peak) |                                    | 3°C/second max          |
| $T_{s(max)}$ to $T_L$ - Ramp-up Rate                   |                                    | 5°C/second max          |
| Reflow                                                 | - Temperature ( $T_L$ ) (Liquidus) | 217°C                   |
|                                                        | - Temperature ( $t_L$ )            | 60 – 150 seconds        |
| Peak Temperature ( $T_p$ )                             |                                    | 260 <sup>+0/-5</sup> °C |
| Time within 5°C of actual peak Temperature ( $t_p$ )   |                                    | 10 – 30 seconds         |
| Ramp-down Rate                                         |                                    | 6°C/second max          |
| Time 25°C to peak Temperature ( $T_p$ )                |                                    | 8 minutes Max.          |
| Do not exceed                                          |                                    | 260°C                   |



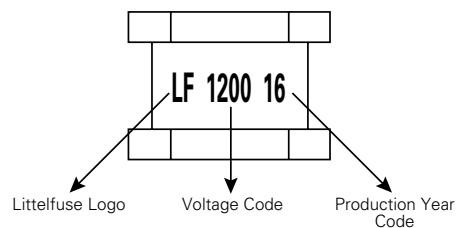
### Device Dimensions

Dimensions in millimeters

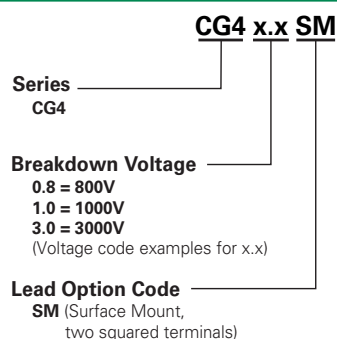


Recommended Soldering Pad Layout

### Product Marking



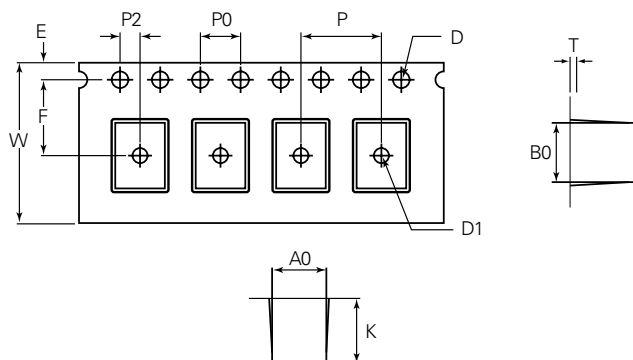
### Part Numbering System and Ordering Information



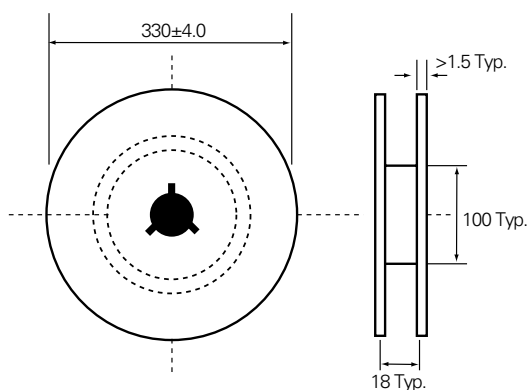
### Taping and Reel Specifications

Unit = mm

| Item | Spec           | Item | Spec              |
|------|----------------|------|-------------------|
| P    | $8.0 \pm 0.1$  | E    | $1.75 \pm 0.1$    |
| P0   | $4.0 \pm 0.1$  | D    | $1.50 + 0.1/-0.0$ |
| P2   | $2.0 \pm 0.1$  | D1   | $1.50 + 0.1/-0.0$ |
| W    | $16.0 \pm 0.3$ | K0   | $6.5 \pm 0.1$     |
| F    | $7.5 \pm 0.1$  | T    | $0.4 \pm 0.05$    |
| A0   | $4.9 \pm 0.1$  | B0   | $6.5 \pm 0.1$     |

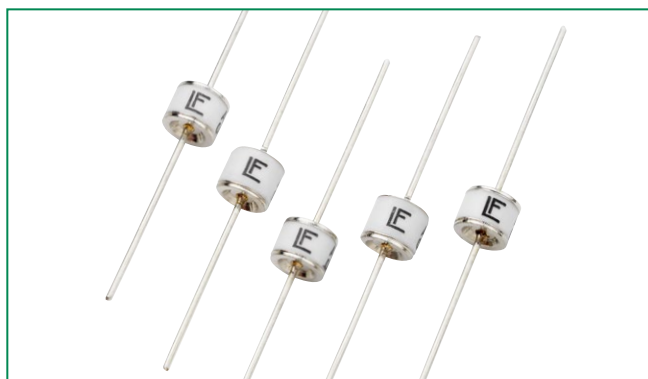


**Packaging Quantity:** 1000 pcs per reel (13")  
1 reels per inner box  
10 inners box per carton  
10,000 pcs per full carton



**Disclaimer Notice** - Information furnished is believed to be accurate and reliable. However, users should independently evaluate the suitability of and test each product selected for their own applications. Littelfuse products are not designed for, and may not be used in, all applications. Read complete Disclaimer Notice at: [www.littelfuse.com/disclaimer-electronics](http://www.littelfuse.com/disclaimer-electronics).

## AC and CG3 Series



### Agency Approvals

| AGENCY | AGENCY FILE NUMBER |
|--------|--------------------|
|        | E320116*           |

\*NOTE: CG3 7.5 product UL approval is currently pending

### 2 Electrode GDT Graphical Symbol



### Additional Information



**Datasheet  
AC Series**



**Resources  
AC Series**



**Samples  
AC Series**



**Datasheet  
CG3 Series**



**Resources  
CG3 Series**



**Samples  
CG3 Series**

### Description

Littelfuse AC series two-electrode line protectors provide a high degree of surge protection in AC line applications. The two models, AC120 and AC240 are designed for use with 120VAC and 240VAC lines respectively. They are able to extinguish AC follow-on currents of at least 200A.

Littelfuse CG3 two electrode high voltage (1.0 - 7.5 KV) devices are designed for surge protection and high isolation applications, and for applications for which bias voltages or signal levels of several hundred volts are normally present.

### Features

- Rugged ceramic-metal construction
- Available in tape-and-reel packaging
- Low capacitance (<1.5 pF)
- Available with or without leads

### Applications

#### AC Series:

- Long branch circuits (AC wall outlet)
- Short branch circuits (at breaker box, computer, etc)
- Power supplies
- Test equipment
- Submersible pumps
- Medical electronics

#### CG3 Series:

- CRT terminals
- CATV equipment
- Antennas
- Power supplies
- Medical electronics

### Electrical Characteristics

| Part Number              | Device Dimension Type | Device Specifications (at 25°C)    |      |      |                                           |                                             |                       |                        | Life Ratings                                   |                                    |                                                     |                                             |                                                             |                                             |
|--------------------------|-----------------------|------------------------------------|------|------|-------------------------------------------|---------------------------------------------|-----------------------|------------------------|------------------------------------------------|------------------------------------|-----------------------------------------------------|---------------------------------------------|-------------------------------------------------------------|---------------------------------------------|
|                          |                       | DC Breakdown in Volts<br>(@100V/s) |      |      | Impulse Break-down in Volts<br>(@100V/μs) | Impulse Break-down In Volts<br>(@1 Kv/μsec) | Insulation Resistance | Capacitance<br>(@1MHz) | Arc Voltage<br>(on state Voltage)<br>@1Amp Min | Max Follow On Current <sup>3</sup> | Nominal AC Discharge Current<br>(10x1 sec @50-60Hz) | AC Discharge Current<br>(1 x 50Hz 9 cycles) | Nominal Impulse Discharge Current <sup>4</sup><br>(@8/20μs) | Max Surge Current <sup>5</sup><br>(@8/20μs) |
|                          |                       | MIN                                | TYP  | MAX  | MAX                                       |                                             | MIN                   | MAX                    | TYP                                            |                                    |                                                     |                                             |                                                             |                                             |
| AC120 <sup>1</sup>       | A                     | 230                                | 285  | 340  | 500                                       | 550                                         | 10 GΩ<br>(at 100V)    | <1.5 pf                | ~ 25 V                                         | 200 Amps                           | 5 A                                                 | 65 A                                        | 10 shots 5kA                                                | 1 shot 10kA                                 |
| AC240 <sup>1</sup>       | A                     | 480                                | 600  | 720  | 1100                                      | 1200                                        |                       |                        |                                                |                                    |                                                     |                                             |                                                             |                                             |
| CG3 1.0 <sup>1</sup>     | A                     | 800                                | 1000 | 1200 | 1400                                      | 1500                                        | 10 GΩ<br>(at 100V)    | <1.5 pf                | ~ 25 V                                         | 200 Amps                           | N/A                                                 | N/A                                         | 10 shots 5kA                                                | 1 shot 10kA                                 |
| CG3 1.1 <sup>1</sup>     | A                     | 880                                | 1100 | 1320 | 1600                                      | 1700                                        |                       |                        |                                                |                                    |                                                     |                                             |                                                             |                                             |
| CG3 1.2 <sup>1</sup>     | A                     | 960                                | 1200 | 1440 | 1700                                      | 1800                                        |                       |                        |                                                |                                    |                                                     |                                             |                                                             |                                             |
| CG3 1.3 <sup>1</sup>     | A                     | 1040                               | 1300 | 1560 | 1800                                      | 1900                                        |                       |                        |                                                |                                    |                                                     |                                             |                                                             |                                             |
| CG3 1.5 <sup>1</sup>     | A                     | 1200                               | 1500 | 1800 | 1800                                      | 2000                                        |                       |                        |                                                |                                    |                                                     |                                             |                                                             |                                             |
| CG3 2.0 <sup>1</sup>     | A                     | 1600                               | 2000 | 2400 | 2500                                      | 2750                                        |                       |                        |                                                |                                    |                                                     |                                             |                                                             |                                             |
| CG3 2.5 <sup>1</sup>     | A                     | 2000                               | 2500 | 3000 | 3200                                      | 3500                                        |                       |                        |                                                |                                    |                                                     |                                             |                                                             |                                             |
| CG3 2.7 <sup>1</sup>     | A                     | 2160                               | 2700 | 3240 | 3600                                      | 4000                                        |                       |                        |                                                |                                    |                                                     |                                             |                                                             |                                             |
| CG3 3.0 <sup>1</sup>     | A                     | 2400                               | 3000 | 3600 | 4000                                      | 4200                                        |                       |                        |                                                |                                    |                                                     |                                             |                                                             |                                             |
| CG3 3.3 <sup>1</sup>     | A                     | 2640                               | 3300 | 3960 | 4600                                      | 4700                                        |                       |                        |                                                |                                    |                                                     |                                             |                                                             |                                             |
| CG3 4.0 <sup>2</sup>     | B                     | 3200                               | 4000 | 4800 | 5800                                      | 6000                                        |                       |                        |                                                |                                    |                                                     |                                             |                                                             |                                             |
| CG3 4.5 <sup>2</sup>     | B                     | 3600                               | 4500 | 5400 | 6150                                      | 6500                                        |                       |                        |                                                |                                    |                                                     |                                             |                                                             |                                             |
| CG3 5.0 <sup>2</sup>     | B                     | 4000                               | 5000 | 6000 | 7500                                      | 8000                                        |                       |                        |                                                |                                    |                                                     |                                             |                                                             |                                             |
| CG3 6.2 <sup>2,7</sup>   | B                     | 4960                               | 6200 | 7440 | 8100                                      | 9500                                        |                       |                        |                                                |                                    |                                                     |                                             |                                                             |                                             |
| CG3 6.5 <sup>2,7</sup>   | B                     | 5200                               | 6500 | 7800 | 9500                                      | 10000                                       |                       |                        |                                                |                                    |                                                     |                                             |                                                             |                                             |
| CG3 7.5 <sup>2,6,7</sup> | B                     | 6000                               | 7500 | 9000 | 10000                                     | 10600                                       |                       |                        |                                                |                                    |                                                     |                                             |                                                             |                                             |

#### NOTES:

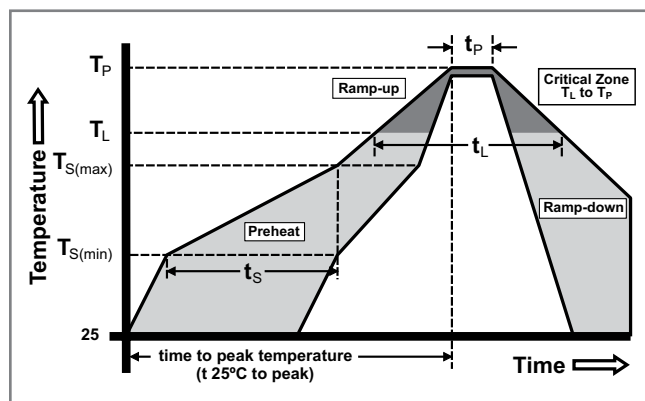
1. Refer to Production Dimensions section, outline A devices
2. Refer to Production Dimensions section, outline B devices
3. Tested to UL1449 – 120V r.m.s. for AC120, 230V r.m.s. all others.  
Conducted with suitable MOV connected in series.
4. 10 x [5(+) and 5(-)] applications 5kA @ 8/20μs
5. 1 x [1(+) and 1(-)] application 10kA @ 8/20μs
6. CG3 7.5 product UL approval is currently pending
7. When ordering this item, use suffix code D004 when entering the part number.  
The older product version without D004 suffix code has been discontinued.  
Refer to Part Numbering System section for additional information.

### Product Characteristics

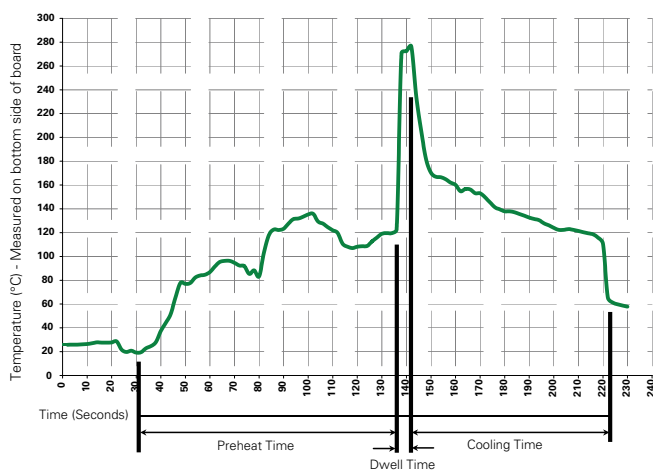
|                                            |                                                                                                                                                                          |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Materials</b>                           | <b>Core Outline A &amp; B items:</b><br>Device: Tin Plated 17.5±12.5 Microns<br><br><b>Axial Outline A &amp; B items:</b><br>Device & Wire: Tin Plated 17.5±12.5 Microns |
| <b>Product Marking</b>                     | LF Logo, Voltage and date code;<br>Black ink positive print                                                                                                              |
| <b>Glow to arc transition current</b>      | < 0.5Amps                                                                                                                                                                |
| <b>Glow Voltage</b>                        | ~ 140 Volts                                                                                                                                                              |
| <b>Storage and Operational Temperature</b> | -40 to +90                                                                                                                                                               |

### Soldering Parameters - Reflow Soldering (Surface Mount Devices)

|                                                       |                                    |                         |
|-------------------------------------------------------|------------------------------------|-------------------------|
| Reflow Condition                                      |                                    | Pb – Free assembly      |
| Pre Heat                                              | - Temperature Min ( $T_{s(min)}$ ) | 150°C                   |
|                                                       | - Temperature Max ( $T_{s(max)}$ ) | 200°C                   |
|                                                       | - Time (Min to Max) ( $t_s$ )      | 60 – 180 secs           |
| Average ramp up rate (Liquidus Temp ( $T_L$ ) to peak |                                    | 3°C/second max          |
| $T_{s(max)}$ to $T_L$ - Ramp-up Rate                  |                                    | 5°C/second max          |
| Reflow                                                | - Temperature ( $T_L$ ) (Liquidus) | 217°C                   |
|                                                       | - Temperature ( $t_L$ )            | 60 – 150 seconds        |
| Peak Temperature ( $T_p$ )                            |                                    | 260 <sup>+0/-5</sup> °C |
| Time within 5°C of actual peak Temperature ( $t_p$ )  |                                    | 10 – 30 seconds         |
| Ramp-down Rate                                        |                                    | 6°C/second max          |
| Time 25°C to peak Temperature ( $T_p$ )               |                                    | 8 minutes Max.          |
| Do not exceed                                         |                                    | 260°C                   |



### Soldering Parameters - Wave Soldering (Thru-Hole Devices)



### Recommended Process Parameters:

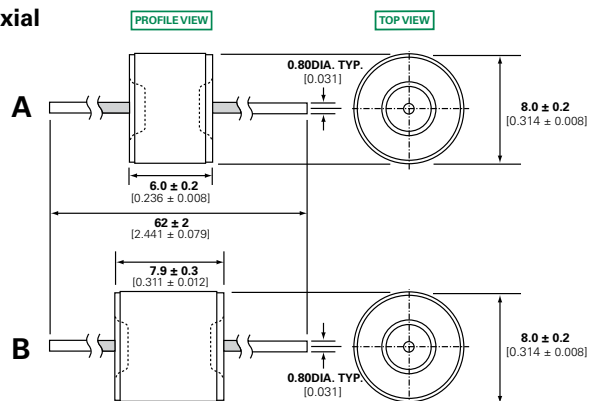
| Wave Parameter                           | Lead-Free Recommendation          |
|------------------------------------------|-----------------------------------|
| <b>Preheat:</b>                          |                                   |
| (Depends on Flux Activation Temperature) | (Typical Industry Recommendation) |
| Temperature Minimum:                     | 100° C                            |
| Temperature Maximum:                     | 150° C                            |
| Preheat Time:                            | 60-180 seconds                    |
| <b>Solder Pot Temperature:</b>           | 280° C Maximum                    |
| <b>Solder Dwell Time:</b>                | 2-5 seconds                       |

### Soldering Parameters - Hand Soldering

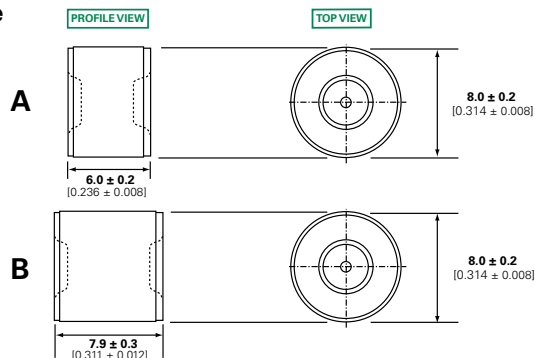
Solder Iron Temperature: 350° C +/- 5°C  
Heating Time: 5 seconds max.

### Device Dimensions

#### Axial



#### Core



### Part Numbering System and Ordering Information

#### AC XXX XXX

**Series** — AC XXX XXX

**AC Line Voltage**

120 = 120V  
240 = 240V

**Lead / Packaging Option**

= Core (no leads) / Bulk pack, 400 pcs per bag  
L = Leaded / Bulk pack, 50 pcs per tray  
LTR = Leaded / Tape & Reel, 500 pcs per reel

#### CG3 X.X XXX D004

**Series** — CG3

**Breakdown Voltage**

1.0 = 1000V  
1.1 = 1100V  
1.2 = 1200V  
1.3 = 1300V  
1.5 = 1500V  
2.0 = 2000V  
2.5 = 2500V  
2.7 = 2700V  
3.0 = 3000V  
3.3 = 3300V  
4.0 = 4000V  
4.5 = 4500V  
5.0 = 5000V  
6.2 = 6200V  
6.5 = 6500V  
7.5 = 7500V

**Lead / Packaging Option**

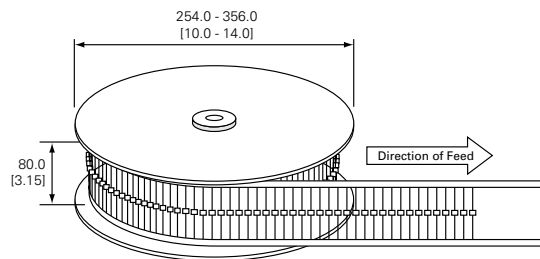
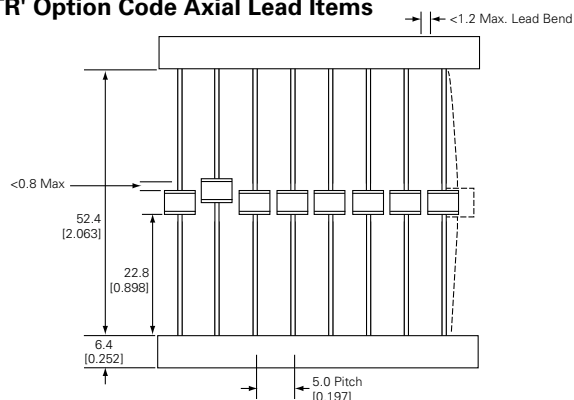
= Core (no leads) / Bulk pack, 400 pcs per bag  
L = Leaded / Bulk pack, 50 pcs per tray  
LTR = Leaded / Tape & Reel, 500 pcs per reel

**Special Suffix Code**

Enter this D004 special suffix code when placing orders for CG36.2, CG36.5 and CG37.5 only

### Packaging Dimensions

#### For 'LTR' Option Code Axial Lead Items



### CG7 Series



#### Agency Approvals

| AGENCY | AGENCY FILE NUMBER |
|--------|--------------------|
|        | E128662            |
|        | E320116            |

#### Two Electrode GDT Graphical Symbol



#### Additional Information



**Datasheet**



**Resources**



**Samples**

#### Description

The Littelfuse CG7 series GDT is a miniature surface mount device with a 1kA 8/20μS surge rating. Its low insertion loss and thus low off-state capacitance makes it compatible with high bandwidth applications up to the GHz RF range. This GDT's crowbar characteristic protects sensitive ICs from surges as defined in ITU K.20/21/45 Basic and Enhanced Recommendations, GR-1089-CORE first level lightning Port Type 1 and 3, and IEC 61000-4-5 2<sup>nd</sup> edition. It is hermetically sealed using non-radioactive materials Classes 1-3 and some Class 4 & 5 cases and is thus environmentally safe. Its 2.8mm diameter size makes it the world's smallest two-electrode single chamber GDT available.

#### Features

- RoHS compliant and Lead-free
- Excellent Surge Withstanding Capability
- Excellent response to fast rising transients.
- Ultra Low Insertion Loss and low off-state capacitance for GHz bandwidth compatibility
- Ultra small devices offered in SMD package
- 1kA 8/20μS surge capability pulse as defined by IEC 61000-4-5 2<sup>nd</sup> edition
- Ultra Low capacitance (<0.3pF)
- Voltage Range 75V to 470V
- UL recognized

#### Applications

- Set top box
- Cable Modem
- Embedded Multimedia Terminal Adapter (EMTA)
- RF Connector
- Multimedia over Coax Alliance (MoCA)
- Base Station RF antenna transmitter
- G.Fast 106MHz and 212 MHz bandplans compatible
- CATV/Broadband equipment
- Data lines and Ethernet (up to 10GbE)
- Telecom line protection
- Broadband equipment
- xDSL equipment, including ADSL2, ADSL, VDSL, VDSL2 30a bandplan compatible
- IAD (Integrated Access Device)
- Aerospace and Automotive

### Electrical Characteristics

| Part Number | Device Specifications (at 25°C)    |     |     |                                           |                                          |                       |                        | Life Ratings                                         |                                             |                                         |                                            |                                    |
|-------------|------------------------------------|-----|-----|-------------------------------------------|------------------------------------------|-----------------------|------------------------|------------------------------------------------------|---------------------------------------------|-----------------------------------------|--------------------------------------------|------------------------------------|
|             | DC Breakdown in Volts<br>(@100V/s) |     |     | Impulse Break-down in Volts<br>(@100V/μs) | Impulse Break-down In Volts<br>(@1kV/μs) | Insulation Resistance | Capacitance<br>(@1MHz) | Max Impulse Discharge Current<br>(8/20μs)            | Max Impulse Discharge Current<br>(10/700μs) | AC Discharge Current<br>(9 cycle @50Hz) | DC Holdover Voltage<br>( $<150\text{ms}$ ) | Impulse Life<br>(8/20μs)<br>(100A) |
|             | MIN                                | TYP | MAX | MAX                                       |                                          | MIN                   | MAX                    |                                                      |                                             | MIN                                     |                                            | MIN                                |
| CG775       | 60                                 | 75  | 90  | 600                                       | 700                                      | 1GΩ@50V               | 0.3pf                  | 10 Shots<br>(@1kA) <sup>1</sup><br><br>1 Shot at 2kA | 10 Shots<br>(@ 100A/4kV) <sup>2</sup>       | 1A                                      | 52V                                        | 300 Shots                          |
| CG790       | 72                                 | 90  | 108 | 600                                       | 700                                      |                       |                        |                                                      |                                             |                                         | 52V                                        |                                    |
| CG7120      | 96                                 | 120 | 144 | 600                                       | 700                                      |                       |                        |                                                      |                                             |                                         | 80V                                        |                                    |
| CG7150      | 120                                | 150 | 180 | 600                                       | 700                                      |                       |                        |                                                      |                                             |                                         | 80V                                        |                                    |
| CG7200      | 160                                | 200 | 240 | 600                                       | 700                                      |                       |                        |                                                      |                                             |                                         | 135V                                       |                                    |
| CG7230      | 186                                | 230 | 276 | 600                                       | 700                                      |                       |                        |                                                      |                                             |                                         | 135V                                       |                                    |
| CG7250      | 200                                | 250 | 300 | 600                                       | 700                                      |                       |                        |                                                      |                                             |                                         | 135V                                       |                                    |
| CG7350      | 280                                | 350 | 420 | 750                                       | 900                                      |                       |                        |                                                      |                                             |                                         | 135V                                       |                                    |
| CG7400      | 360                                | 400 | 480 | 850                                       | 1000                                     |                       |                        |                                                      |                                             |                                         | 135V                                       |                                    |
| CG7470      | 376                                | 470 | 564 | 900                                       | 1100                                     | 1GΩ@250V              |                        |                                                      |                                             |                                         | 135V                                       |                                    |

Notes:

UL Pending for CG775 and CG7470.

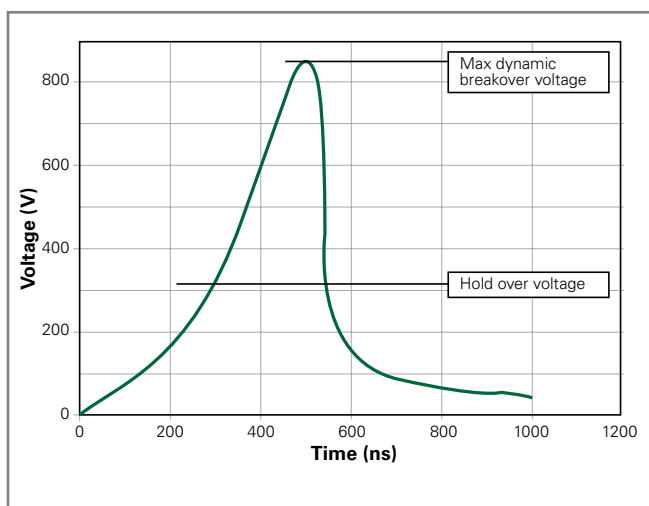
1. 5 x (+) and 5 x (-) applications of 1kA 8/20μs sec.

2. 5 x (+) and 5 x (-) applications of 100A 10/700μs sec.

### Product Characteristics

|                                            |                                                                          |
|--------------------------------------------|--------------------------------------------------------------------------|
| <b>Materials</b>                           | Device Tin Plated 17.5 ± 12.5 Microns<br>Construction: Ceramic Insulator |
| <b>Storage and Operational Temperature</b> | -40 to +90°C                                                             |

### Voltage Vs. Time Characteristic



Note: Tested per 1kV/μs waveform

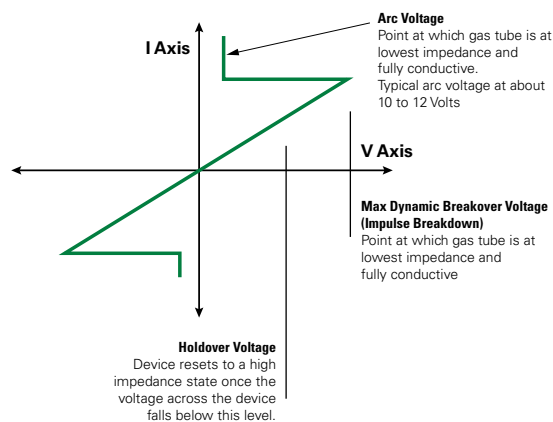
### Typical Insertion Loss

|                  |
|------------------|
| @1.0GHz = 0.02dB |
| @1.4GHz = 0.03dB |
| @1.8GHz = 0.05dB |
| @2.0GHz = 0.06dB |
| @2.4GHz = 0.07dB |
| @2.8GHz = 0.08dB |
| @3.1GHz = 0.09dB |
| @3.5GHz = 0.10dB |
| @4.0GHz = 0.12dB |

Note: Insertion data for customer reference only, application testing needed for verification.

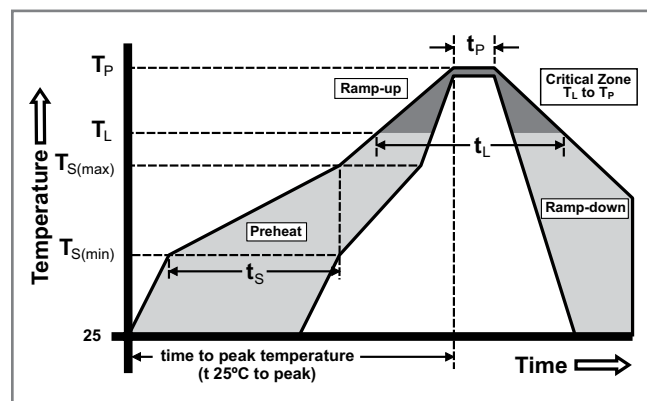
### V-I Characteristic Curve

Characteristics of Gas Plasma -response to transient condition



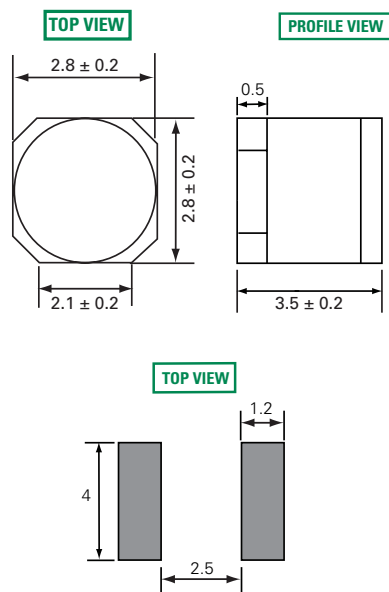
### Soldering Parameters - Reflow Soldering (Surface Mount Devices)

|                                                       |                                    |                         |
|-------------------------------------------------------|------------------------------------|-------------------------|
| Reflow Condition                                      |                                    | Pb – Free assembly      |
| Pre Heat                                              | - Temperature Min ( $T_{s(min)}$ ) | 150°C                   |
|                                                       | - Temperature Max ( $T_{s(max)}$ ) | 200°C                   |
|                                                       | - Time (Min to Max) ( $t_s$ )      | 60 – 180 secs           |
| Average ramp up rate (Liquidus Temp ( $T_L$ ) to peak |                                    | 3°C/second max          |
| $T_{s(max)}$ to $T_L$ - Ramp-up Rate                  |                                    | 5°C/second max          |
| Reflow                                                | - Temperature ( $T_L$ ) (Liquidus) | 217°C                   |
|                                                       | - Temperature ( $t_L$ )            | 60 – 150 seconds        |
| Peak Temperature ( $T_p$ )                            |                                    | 260 <sup>+0/-5</sup> °C |
| Time within 5°C of actual peak Temperature ( $t_p$ )  |                                    | 10 – 30 seconds         |
| Ramp-down Rate                                        |                                    | 6°C/second max          |
| Time 25°C to peak Temperature ( $T_p$ )               |                                    | 8 minutes Max.          |
| Do not exceed                                         |                                    | 260°C                   |



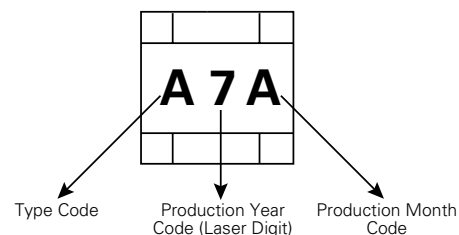
### Device Dimensions

Dimensions in millimeters



Recommended Soldering Pad Layout

### Product Marking



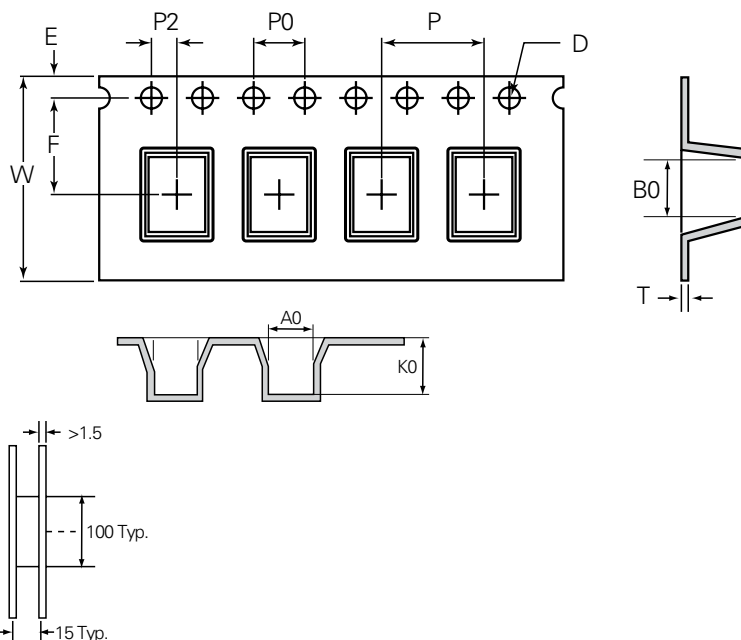
| Type Code |        |
|-----------|--------|
| A         | CG775  |
| B         | CG790  |
| T         | CG7120 |
| C         | CG7150 |
| O         | CG7200 |
| D         | CG7230 |
| R         | CG7250 |
| G         | CG7350 |
| I         | CG7400 |
| P         | CG7470 |

| Month Code |           |
|------------|-----------|
| A          | January   |
| B          | February  |
| C          | March     |
| D          | April     |
| E          | May       |
| F          | June      |
| G          | July      |
| H          | August    |
| I          | September |
| J          | October   |
| K          | November  |
| L          | December  |

## Taping and Reel Specifications

Unit = mm

| Item | Spec           | Item | Spec              |
|------|----------------|------|-------------------|
| P    | $8.0 \pm 0.1$  | E    | $1.75 \pm 0.1$    |
| P0   | $4.0 \pm 0.1$  | D    | $1.50 + 0.1/-0.0$ |
| P2   | $2.0 \pm 0.1$  | B0   | $3.9 \pm 0.1$     |
| W    | $12.0 \pm 0.3$ | K0   | $3.2 \pm 0.1$     |
| F    | $5.5 \pm 0.1$  | T    | $0.4 \pm 0.1$     |
| A0   | $3.2 \pm 0.1$  | 10P0 | $4.0 \pm 0.2$     |



**Packaging Quantity:**  
2500 pcs per reel (13")  
1 reels per inner box  
10 inner boxes per carton  
25,000 pcs per full carton

## Part Numbering System and Ordering Information

**CG7 XXX MS**

**Series**

CG7

**Breakdown Voltage**

70 = 70V

90 = 90V

120 = 120V

150 = 150V

200 = 200V

230 = 230V

350 = 350V

400 = 400V

470 = 470V

**Surface Mount**

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### CG6 Series



#### Agency Approvals

| AGENCY | AGENCY FILE NUMBER |
|--------|--------------------|
|        | E128662            |
|        | E320116            |

#### Two Electrode GDT Graphical Symbol



#### Additional Information



**Datasheet**



**Resources**



**Samples**

#### Description

The Littelfuse CG6 series GDT is a miniature surface-mount device with a 3kA 8/20 surge rating. This ITU-T K.12 Class 1, Type 1 GDT provides protection against fast rising transients typically caused by nearby lightning events. Its low insertion loss and thus low off-state capacitance makes it compatible with high bandwidth applications up to the GHz RF range. This GDT's crowbarbing characteristic protects sensitive ICs from surges as defined in ITU K.20/21/45 Basic and Enhanced Recommendations, GR-1089-CORE first level lightning Port Type 1,3, and 5, and IEC 61000-4-5, 2<sup>nd</sup> edition Level 5 and below. It is hermetically sealed using non-radioactive materials and is thus environmentally safe.

#### Features

- RoHS compliant and Lead-free
- Excellent Surge Withstanding Capability
- Excellent response to fast rising transients.
- Ultra Low Insertion Loss and low off-state capacitance for GHz bandwidth compatibility
- 3kA 8/20µs surge capability
- Compact SMD package offered in two squared terminals
- Non-Radioactive
- Ultra Low capacitance (<0.3pF)
- Voltage Range 75V to 600V
- UL recognized
- Characterized according to ITU-T K.12 as a Class X, Type 1 GDT

#### Applications

- Broadband equipment
- CATV/Broadband equipment
- Data lines and Ethernet (up to 10GbE)
- xDSL equipment, including ADSL2, ADSL, VDSL, VDSL2 30a bandplan compatible
- IAD (Integrated Access Device)
- Set Top Box (STB)
- General telecom equipment
- Embedded Multimedia Terminal Adapter (EMTA)
- RF Connector
- Multimedia over Coax Alliance (MoCA)
- Base Station RF antenna transmitter
- G.Fast 106MHz and 212 MHz bandplans compatible
- Aerospace and Automotive

### Electrical Characteristics

| Part Number | Device Specifications (at 25°C)    |     |     |                                           |                                           |                       |                        | Life Ratings                                       |                                             |                                      |                                            |                                            |                                  |
|-------------|------------------------------------|-----|-----|-------------------------------------------|-------------------------------------------|-----------------------|------------------------|----------------------------------------------------|---------------------------------------------|--------------------------------------|--------------------------------------------|--------------------------------------------|----------------------------------|
|             | DC Breakdown in Volts<br>(@100V/s) |     |     | Impulse Break-down in Volts<br>(@100V/μs) | Impulse Break-down In Volts<br>(@1 kV/μs) | Insulation Resistance | Capacitance<br>(@1MHz) | Max Impulse Discharge Current<br>(8/20μs)          | Max Impulse Discharge Current<br>(10/700μs) | AC Discharge Current<br>(50Hz, 1sec) | AC Discharge Current<br>(Single, 9 Cycles) | DC Holdover Voltage<br>( $<150\text{ms}$ ) | Impulse Life<br>(10/1000μs (50A) |
|             | MIN                                | TYP | MAX | MAX                                       |                                           | MIN                   | MAX                    |                                                    |                                             | MIN                                  | MIN                                        |                                            | MIN                              |
| CG675       | 60                                 | 75  | 90  | 600                                       | 700                                       | 1GΩ @50V              | 0.3pf                  | 10 Shots @ (3kA) <sup>1</sup><br><br>1 Shot at 5kA | 10 Shots @ (150A/6kV) <sup>2</sup>          | 3A                                   | 6A                                         | 52V                                        | 300 Shots                        |
| CG690       | 72                                 | 90  | 108 | 600                                       | 700                                       |                       |                        |                                                    |                                             |                                      |                                            | 52V                                        |                                  |
| CG6145      | 116                                | 145 | 174 | 600                                       | 700                                       | 1GΩ @100V             |                        |                                                    |                                             |                                      |                                            | 52V                                        |                                  |
| CG6230      | 186                                | 230 | 276 | 600                                       | 700                                       |                       |                        |                                                    |                                             |                                      |                                            | 80V                                        |                                  |
| CG6250      | 200                                | 250 | 300 | 600                                       | 700                                       |                       |                        |                                                    |                                             |                                      |                                            | 80V                                        |                                  |
| CG6300      | 240                                | 300 | 360 | 650                                       | 800                                       |                       |                        |                                                    |                                             |                                      |                                            | 135V                                       |                                  |
| CG6350      | 280                                | 350 | 420 | 750                                       | 900                                       |                       |                        |                                                    |                                             |                                      |                                            | 135V                                       |                                  |
| CG6400      | 360                                | 400 | 480 | 850                                       | 1000                                      |                       |                        |                                                    |                                             |                                      |                                            | 135V                                       |                                  |
| CG6470      | 376                                | 470 | 564 | 900                                       | 1100                                      |                       |                        |                                                    |                                             |                                      |                                            | 135V                                       |                                  |
| CG6600      | 480                                | 600 | 720 | 1000                                      | 1200                                      |                       |                        |                                                    |                                             |                                      |                                            | 1GΩ@250V                                   |                                  |

Note:

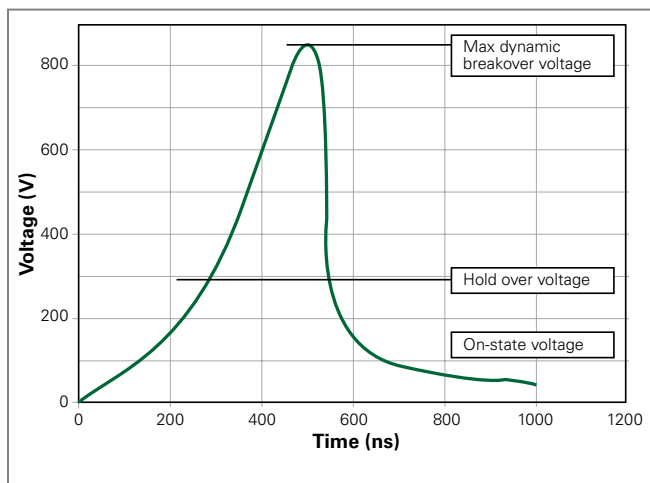
1. 5 x (+) and 5 x (-) applications of 3kA 8/20μs sec.

2. 5 x (+) and 5 x (-) applications of 150A 10/700μs sec.

### Product Characteristics

|                                            |                                                                          |
|--------------------------------------------|--------------------------------------------------------------------------|
| <b>Materials</b>                           | Device Tin Plated 17.5 ± 12.5 Microns<br>Construction: Ceramic Insulator |
| <b>Storage and Operational Temperature</b> | -40 to +90°C                                                             |

### Voltage Vs. Time Characteristic



Note: Tested per 1kV/μs waveform

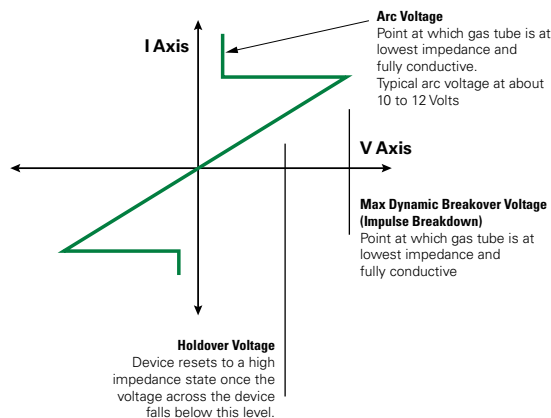
### Typical Insertion Loss

|                  |
|------------------|
| @1.0GHz = 0.03dB |
| @1.4GHz = 0.06dB |
| @1.8GHz = 0.09dB |
| @2.0GHz = 0.11dB |
| @2.4GHz = 0.13dB |
| @2.8GHz = 0.15dB |
| @3.1GHz = 0.17dB |
| @3.5GHz = 0.19dB |
| @4.0GHz = 0.22dB |

Note: Insertion data for customer reference only, application testing needed for verification.

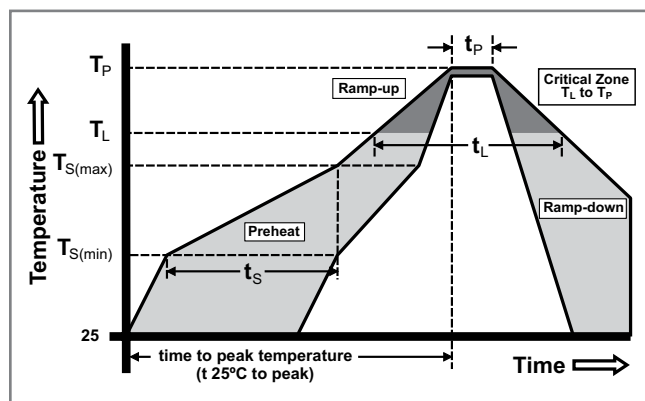
### V-I Characteristic Curve

Characteristics of Gas Plasma -response to transient condition



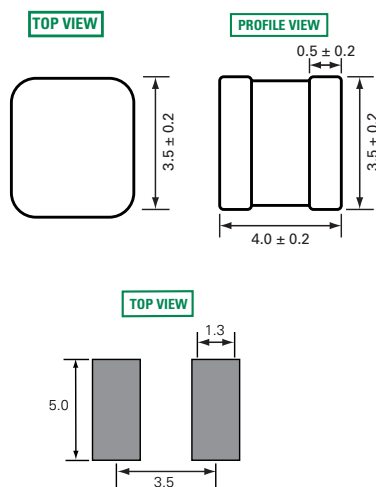
### Soldering Parameters - Reflow Soldering (Surface Mount Devices)

|                                                       |                                    |                         |
|-------------------------------------------------------|------------------------------------|-------------------------|
| Reflow Condition                                      |                                    | Pb – Free assembly      |
| Pre Heat                                              | - Temperature Min ( $T_{s(min)}$ ) | 150°C                   |
|                                                       | - Temperature Max ( $T_{s(max)}$ ) | 200°C                   |
|                                                       | - Time (Min to Max) ( $t_s$ )      | 60 – 180 secs           |
| Average ramp up rate (Liquidus Temp ( $T_L$ ) to peak |                                    | 3°C/second max          |
| $T_{s(max)}$ to $T_L$ - Ramp-up Rate                  |                                    | 5°C/second max          |
| Reflow                                                | - Temperature ( $T_L$ ) (Liquidus) | 217°C                   |
|                                                       | - Temperature ( $t_L$ )            | 60 – 150 seconds        |
| Peak Temperature ( $T_p$ )                            |                                    | 260 <sup>+0/-5</sup> °C |
| Time within 5°C of actual peak Temperature ( $t_p$ )  |                                    | 10 – 30 seconds         |
| Ramp-down Rate                                        |                                    | 6°C/second max          |
| Time 25°C to peak Temperature ( $T_p$ )               |                                    | 8 minutes Max.          |
| Do not exceed                                         |                                    | 260°C                   |



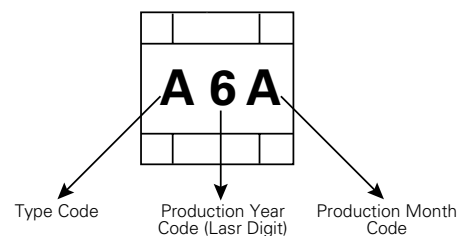
### Device Dimensions

Dimensions in millimeters



Recommended Soldering Pad Layout

### Product Marking



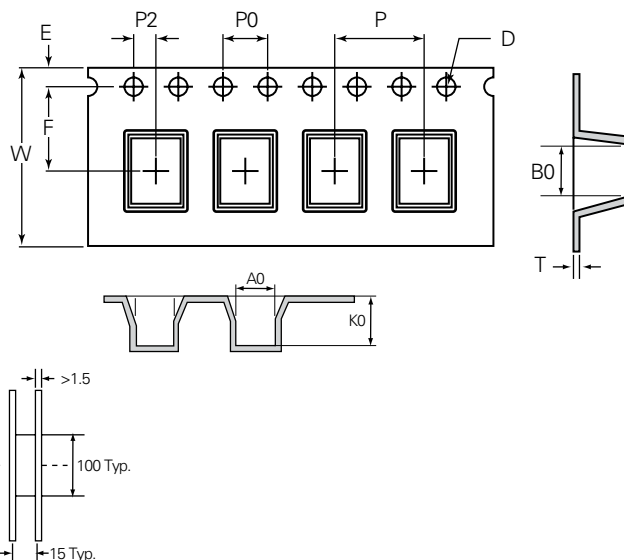
| Type Code |        |
|-----------|--------|
| A         | CG675  |
| B         | CG690  |
| S         | CG6145 |
| D         | CG6230 |
| R         | CG6250 |
| E         | CG6300 |
| G         | CG6350 |
| I         | CG6400 |
| P         | CG6470 |
| V         | CG6600 |

| Month Code |           |
|------------|-----------|
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| G          | July      |
| H          | August    |
| I          | September |
| J          | October   |
| K          | November  |
| L          | December  |

### Taping and Reel Specifications

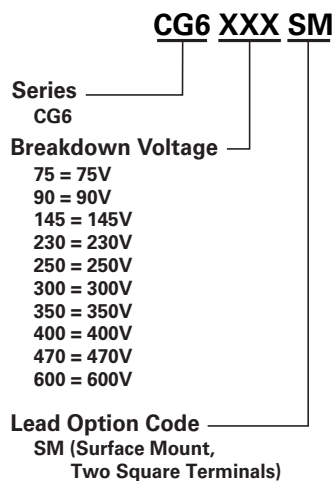
Unit = mm

| Item | Spec           | Item | Spec              |
|------|----------------|------|-------------------|
| P    | $8.0 \pm 0.1$  | E    | $1.75 \pm 0.1$    |
| P0   | $4.0 \pm 0.1$  | D    | $1.50 + 0.1/-0.0$ |
| P2   | $2.0 \pm 0.1$  | B0   | $4.5 \pm 0.1$     |
| W    | $12.0 \pm 0.3$ | K0   | $3.9 \pm 0.1$     |
| F    | $5.5 \pm 0.1$  | T    | $0.4 \pm 0.1$     |
| A0   | $3.9 \pm 0.1$  | 10P0 | $4.0 \pm 0.2$     |



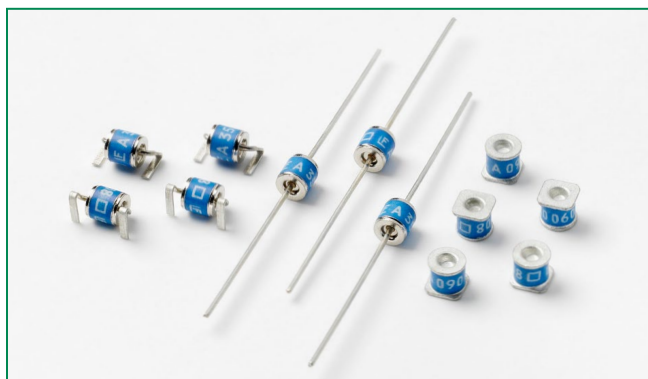
**Packaging Quantity:**  
2000 pcs per reel (13")  
1 reels per inner box  
10 inners box per carton  
20,000 pcs per full carton

### Part Numbering System and Ordering Information



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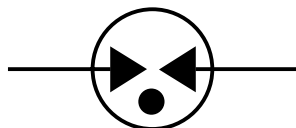
## CG5 and SL0902A Series



### Agency Approvals

| AGENCY                                                                            | AGENCY FILE NUMBER         |
|-----------------------------------------------------------------------------------|----------------------------|
|  | E128662 (exception: CG550) |

### 2 Electrode GDT Graphical Symbol



### Additional Information



**Datasheet**  
CG5 Series



**Datasheet**  
SL0902A



**Resources**  
CG5 Series



**Resources**  
SL0902A



**Samples**  
CG5 Series



**Samples**  
SL0902A

### Description

Littelfuse Broadband Optimized™ SL0902A Series offers high surge ratings in a miniature package. Special design features provide high levels of protection against fast rising transients in the 100V/μs to 1kV/μs range usually caused by lightning disturbances. Low insertion loss is perfectly suited to broadband equipment applications. The capacitance does not vary with voltage, and will not cause operational problems with ADSL2+, where capacitance variation across Tip and Ring is undesirable. These devices are extremely robust and are able to divert a 2500A pulse without destruction. For AC Power Cross of long duration, overcurrent protection is recommended.

Littelfuse CG5 MS mini surge arresters are specifically designed for protection of electrical and communication equipment against over voltage transients in surface mount assembly applications. This series offers the most cutting edge protection using non-radioactive elements.

### Features

- RoHS compliant and Lead-free
- GHz working frequency
- Excellent stability on multiple pulse duty cycle
- Excellent response to fast rising transients.
- Ultra Low Insertion Loss
- 5KA surge capability tested with 8/20μS pulse as defined by IEC 61000-4-5, 2nd edition
- Ultra small devices offered in a variety of mounting lead forms
- Non-Radioactive
- Low capacitance (<1pF)
- Voltage Ranges 90V to 600V
- UL Recognized
- Conforms to ITU-T K12, IEC 61000-4-5, 2nd edition

### Applications

- Communication equipment
- CATV equipment
- Test equipment
- Data lines
- Power supplies
- Telecom SLIC protection
- Broadband equipment
- ADSL equipment, including ADSL2+
- XDSL equipment
- Satellite and CATV equipment
- General telecom equipment

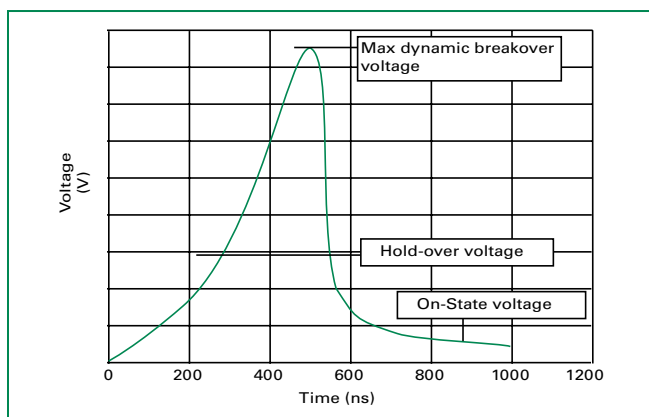
### Electrical Characteristics

| Part Number       | Device Specifications (at 25°C)    |     |     |                                          |                                            |                              | Life Ratings            |                           |                                               |                                                    |                                         |                                                             |
|-------------------|------------------------------------|-----|-----|------------------------------------------|--------------------------------------------|------------------------------|-------------------------|---------------------------|-----------------------------------------------|----------------------------------------------------|-----------------------------------------|-------------------------------------------------------------|
|                   | DC Breakdown in Volts<br>(@100V/s) |     |     | Impulse Breakdown in Volts<br>(@100V/μs) | Impulse Breakdown In Volts<br>(@1 Kv/μsec) | Insulation Resistance        | Capacitance<br>(@1 MHz) | Surge Life<br>(10/1000μs) | Nominal Impulse Discharge Current<br>(8/20μs) | Nominal AC Discharge Current<br>(10x1sec @50-60Hz) | AC Discharge Current<br>(9 cycle @50Hz) | Max Impulse Discharge Current<br>(1 Application @ 10/350μs) |
|                   | MIN                                | TYP | MAX | MAX                                      |                                            | MIN                          | MAX                     |                           |                                               |                                                    |                                         |                                                             |
| SL0902A090 CG590  | 72                                 | 90  | 108 | 550                                      | 700                                        | 10 <sup>10</sup> Ω (at 50V)  | 1.5 pf                  | 300 shots (@100A)         | 10 shots (@5kA)                               | 5 A                                                | 10 A                                    | 0.5kA                                                       |
| CG5145            | 116                                | 145 | 174 | 550                                      | 650                                        | 10 <sup>10</sup> Ω (at 100V) |                         |                           |                                               |                                                    |                                         |                                                             |
| CG5150            | 120                                | 150 | 180 | 550                                      |                                            |                              |                         |                           |                                               |                                                    |                                         |                                                             |
| SL0902A230 CG5230 | 184                                | 230 | 276 | 550                                      | 650                                        |                              |                         |                           |                                               |                                                    |                                         |                                                             |
| CG5250            | 200                                | 250 | 300 | 600                                      |                                            |                              |                         |                           |                                               |                                                    |                                         |                                                             |
| CG5270            | 216                                | 270 | 324 | 650                                      |                                            |                              |                         |                           |                                               |                                                    |                                         |                                                             |
| SL0902A350 CG5350 | 280                                | 350 | 420 | 800                                      | 900                                        |                              |                         |                           |                                               |                                                    |                                         |                                                             |
| CG5400            | 320                                | 400 | 480 | 900                                      |                                            |                              |                         |                           |                                               |                                                    |                                         |                                                             |
| SL0902A420        | 336                                | 420 | 504 | 900                                      | 1000                                       |                              |                         |                           |                                               |                                                    |                                         |                                                             |
| CG5470            | 376                                | 470 | 564 | 1000                                     | 1200                                       |                              |                         |                           |                                               |                                                    |                                         |                                                             |
| SL0902A600 CG5600 | 480                                | 600 | 720 | 1350                                     | 1500                                       |                              |                         |                           |                                               |                                                    |                                         |                                                             |

### Product Characteristics

|                  |                                                                                                                                                                                                             |                                            |                                |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|--------------------------------|
| <b>Materials</b> | <b>CG5xxxLS (Outline 500), CG5xxxLTR &amp; CG5350L-03TR (Outline 502), and CG5xxxL-02 (Outline 503):</b> Device Nickel Plated 2–5 Microns Wire Tin Plated 17.5±12.5 Microns Construction Ceramic Insulator. | <b>Product Marking</b>                     | LF Logo, Voltage and date code |
|                  | <b>CG5xxx (Outline 501), and CG5xxxMS &amp; SL0902AxxxSM (Outline 505):</b> Device Tin Plated 17.5±12.5 Microns Construction Ceramic Insulator.                                                             | <b>Glow to arc transition current</b>      | < 0.5Amps                      |
|                  |                                                                                                                                                                                                             | <b>Glow Voltage</b>                        | 140 Volts                      |
|                  |                                                                                                                                                                                                             | <b>Storage and Operational Temperature</b> | -40 to +90                     |

### Voltage vs. Time Characteristic

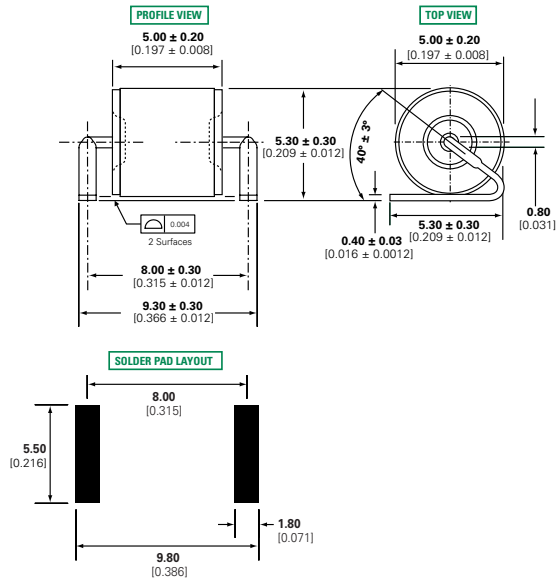


### Typical Insertion Loss

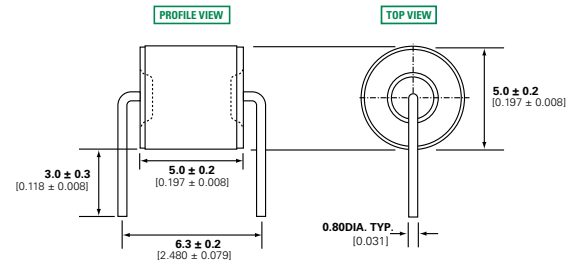
|                     |
|---------------------|
| @ 1.0 GHz = 0.01 dB |
| @ 1.4GHz = 0.1 dB   |
| @ 1.8 GHz = 0.53 dB |
| @ 2.1 GHz = 0.81 dB |
| @ 2.45 GHz= 1 dB    |
| @ 2.8 GHz = 1.2 dB  |
| @ 3.1 GHz = 1.5 dB  |
| @ 3.5 GHz = 2.1 dB  |

### Device Dimensions

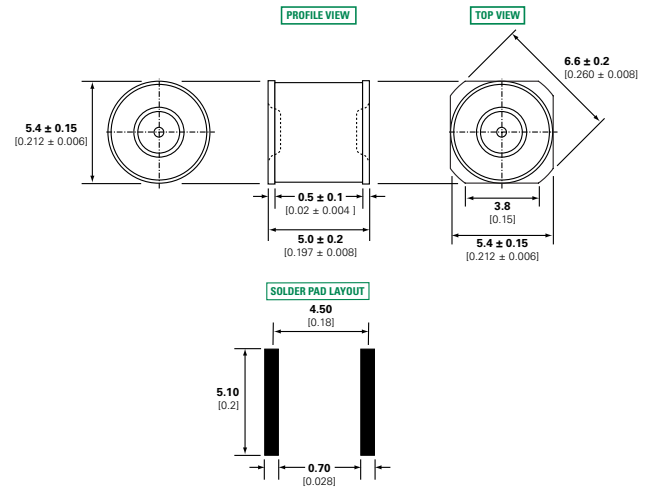
#### Outline 500 - CG5xxxLS



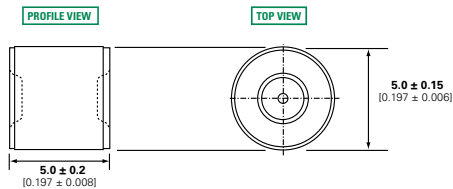
#### Outline 503 - CG5xxxL-02 (except CG5600L-02, see Outline 502)



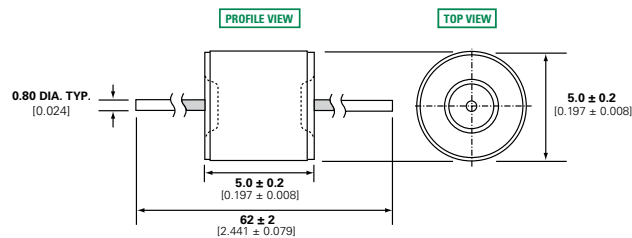
#### Outline 505 - CG5xxxMS and SL0902AxxxSM



#### Outline 501 - CG5xxx

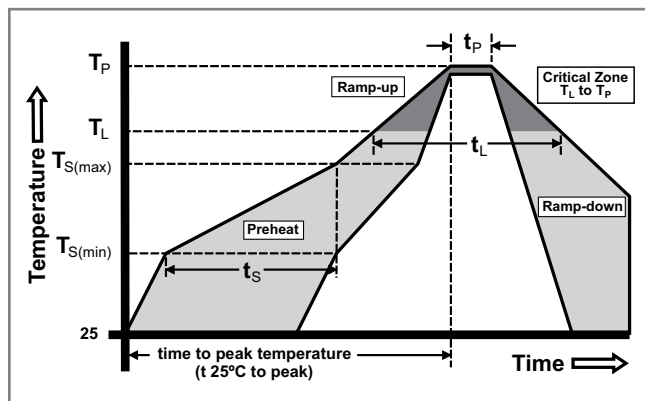


#### Outline 502 - CG5xxxLTR (also CG5350L-03TR, CG5600L-02)



### Soldering Parameters - Reflow Soldering (Surface Mount Devices)

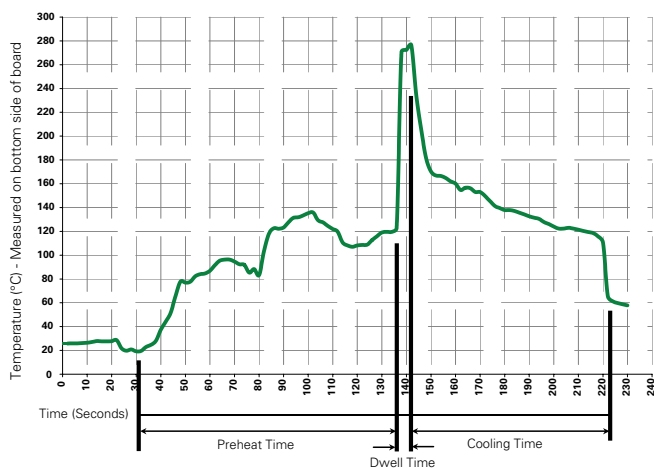
|                                                       |                                    |                         |
|-------------------------------------------------------|------------------------------------|-------------------------|
| Reflow Condition                                      |                                    | Pb – Free assembly      |
| Pre Heat                                              | - Temperature Min ( $T_{s(min)}$ ) | 150°C                   |
|                                                       | - Temperature Max ( $T_{s(max)}$ ) | 200°C                   |
|                                                       | - Time (Min to Max) ( $t_s$ )      | 60 – 180 secs           |
| Average ramp up rate (Liquidus Temp ( $T_L$ ) to peak |                                    | 3°C/second max          |
| $T_{s(max)}$ to $T_L$ - Ramp-up Rate                  |                                    | 5°C/second max          |
| Reflow                                                | - Temperature ( $T_L$ ) (Liquidus) | 217°C                   |
|                                                       | - Temperature ( $t_L$ )            | 60 – 150 seconds        |
| Peak Temperature ( $T_p$ )                            |                                    | 260 <sup>+0/-5</sup> °C |
| Time within 5°C of actual peak Temperature ( $t_p$ )  |                                    | 10 – 30 seconds         |
| Ramp-down Rate                                        |                                    | 6°C/second max          |
| Time 25°C to peak Temperature ( $T_p$ )               |                                    | 8 minutes Max.          |
| Do not exceed                                         |                                    | 260°C                   |



### Soldering Parameters - Hand Soldering

Solder Iron Temperature: 350° C +/- 5°C  
Heating Time: 5 seconds max.

### Soldering Parameters - Wave Soldering (Thru-Hole Devices)

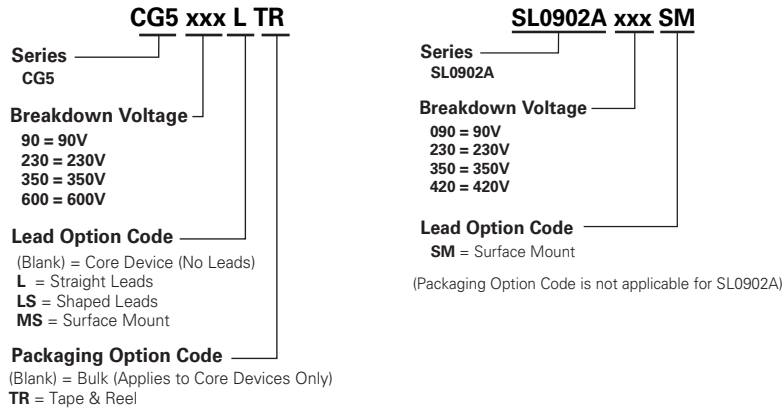


### Recommended Process Parameters:

| Wave Parameter                                                                                | Lead-Free Recommendation |
|-----------------------------------------------------------------------------------------------|--------------------------|
| <b>Preheat:</b><br>(Depends on Flux Activation Temperature) (Typical Industry Recommendation) |                          |
| Temperature Minimum:                                                                          | 100° C                   |
| Temperature Maximum:                                                                          | 150° C                   |
| Preheat Time:                                                                                 | 60-180 seconds           |
| Solder Pot Temperature:                                                                       | 280° C Maximum           |
| Solder Dwell Time:                                                                            | 2-5 seconds              |

**Note: These devices are not recommended for IR or Convection Reflow process.**

### Part Numbering System and Ordering Information



### Packaging

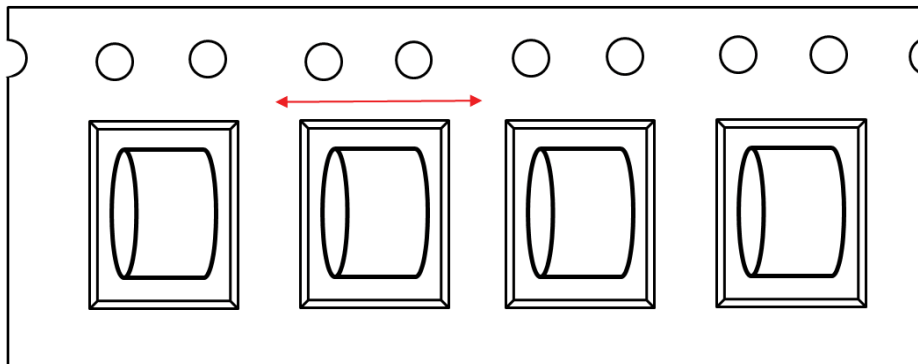
| Part Number and Device Type |                      | Device Dimensions Reference | Quantity and Packaging Description |
|-----------------------------|----------------------|-----------------------------|------------------------------------|
| CG5xxx                      | Core                 | Outline 501                 | 1000pcs/bag in bulk packaging      |
| CG5xxxLS                    | Shaped Leads         | Outline 500                 | 900pcs/reel in carrier and tape*   |
| CG5xxxLTR<br>CG5xxxL-03TR** | Straight Axial Leads | Outline 502                 | 1000pcs/reel in tape and reel*     |
| CG5xxxL-02**                | Bent Radial Leads    | Outline 503                 | 50pcs/tray in tray and cover       |
| CG5xxxMS<br>SL0902AxxxSM    | Surface mount        | Outline 505                 | 900pcs/reel in carrier and tape*   |

\* For tape specifications and dimensions, please contact factory.

\*\* Special order items not available for general sale. Please contact Littelfuse for details.

### Surface Mount Device Orientation

Note: Surface Mount device orientation on carrier tape as shown below



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## SL1002A Series



### Agency Approvals

| AGENCY | AGENCY FILE NUMBER |
|--------|--------------------|
|        | E128662            |

### 2 Electrode GDT Graphical Symbol



### Additional Information



**Datasheet**



**Resources**



**Samples**

### Description

The Broadband Optimized™ SL1002A series has been especially developed for use in broadband equipment. Special design features provide high levels of protection against fast rising transients in the 100V/μs to 1kV/μs range usually caused by lightning disturbances. These devices have ultra low capacitance (typically 1.2pF or less) and present insignificant signal losses up to 1.5GHz. These devices are extremely robust and are able to divert a 5000A pulse without destruction. For AC Power Cross of long duration, overcurrent protection is recommended.

### Features

- RoHS compliant/Lead-free
- Ultra low insertion loss
- Surface mountable
- 5kA surge capability tested with 8/20μs–Pulse as defined by IEC 61000-4-5
- Excellent response to fast rising transients
- Can be used to meet Telcordia GR1089 without series resistance
- 10/700 6kV capability, as per ITU-T Rec. K.21, enhanced test level
- 2000 A 2/10μs surge rating
- Meet FCC part 68 10/160μs waveform, 200A test and 10/560μs waveform 100A test
- Halogen-free

### Applications

- Broadband equipment
- ADSL equipment
- XDSL equipment
- Satellite and CATV equipment
- General telecom equipment

### Electrical Characteristics

| Part Number  | Device Specifications (at 25°C)                   |     |     |                                                         |                                                        |                                |                                   |                                                | Life Ratings                       |                                               |                                                     |                                  |                                                  |             |
|--------------|---------------------------------------------------|-----|-----|---------------------------------------------------------|--------------------------------------------------------|--------------------------------|-----------------------------------|------------------------------------------------|------------------------------------|-----------------------------------------------|-----------------------------------------------------|----------------------------------|--------------------------------------------------|-------------|
|              | DC Breakdown in Volts <sup>1,2</sup><br>(@100V/s) |     |     | Impulse Breakdown in Volts <sup>3,4</sup><br>(@100V/μs) | Impulse Breakdown in Volts <sup>3,4</sup><br>(@1kV/μs) | Insulation Resistance          | Capacitance<br>(@1MHz<br>0V Bias) | Arc Voltage<br>(on state voltage)<br>@1Amp Min | Surge Life<br>(@100A<br>10/1000μs) | Nominal Impulse Discharge Current<br>(8/20μs) | Nominal AC Discharge Current<br>(10x1s<br>@50-60Hz) | DC Holdover Voltage <sup>5</sup> | Max Impulse Discharge Current<br>(1 Application) |             |
|              | MIN                                               | TYP | MAX | MAX                                                     |                                                        | MIN                            | MAX                               | TYP                                            |                                    |                                               |                                                     | TYP                              | @ 2/10 μs                                        | @ 10/350 μs |
| SL1002A075   | 60                                                | 75  | 90  | 400                                                     | 650                                                    | 10 <sup>9</sup> Ω<br>(at 50V)  | 1.2 pF                            | ~15 V                                          | 300<br>shots <sup>6</sup>          | 10 shots <sup>7</sup><br>(@ 5kA)              | 5 A                                                 | 50 V                             | 2 kA                                             | 1.5 kA      |
| SL1002A090   | 72                                                | 90  | 108 |                                                         |                                                        |                                |                                   |                                                |                                    |                                               |                                                     |                                  |                                                  |             |
| SL1002A230   | 184                                               | 230 | 276 | 600                                                     | 700                                                    | 10 <sup>9</sup> Ω<br>(at 100V) |                                   |                                                |                                    |                                               |                                                     |                                  |                                                  |             |
| SL1002A250   | 200                                               | 250 | 300 |                                                         |                                                        |                                |                                   |                                                |                                    |                                               |                                                     |                                  |                                                  |             |
| SL1002A260   | 210                                               | 260 | 310 |                                                         |                                                        |                                |                                   |                                                |                                    |                                               |                                                     |                                  |                                                  |             |
| SL1002A350   | 280                                               | 350 | 420 | 800                                                     | 900                                                    |                                |                                   |                                                |                                    |                                               |                                                     |                                  |                                                  |             |
| SL1002A470   | 376                                               | 470 | 564 | 900                                                     | 1000                                                   |                                |                                   |                                                |                                    |                                               |                                                     |                                  |                                                  |             |
| SL1002A600   | 480                                               | 600 | 720 | 1100                                                    | 1200                                                   |                                |                                   |                                                |                                    |                                               |                                                     |                                  |                                                  |             |
| SL1002A600SP | 570                                               | 600 | 780 | 1200                                                    | 1300                                                   | 10 <sup>9</sup> Ω<br>(at 500V) |                                   |                                                |                                    |                                               |                                                     |                                  |                                                  |             |

Notes:

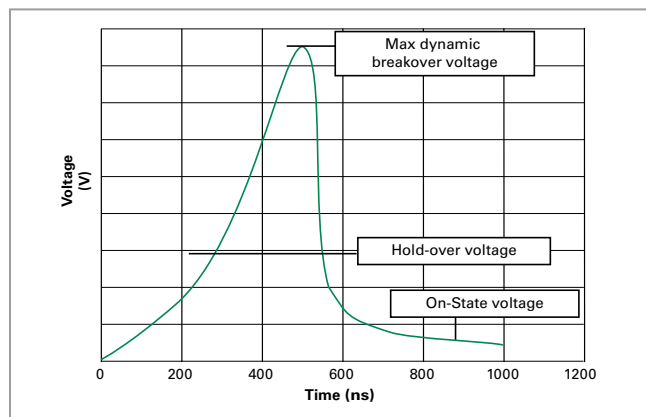
- At delivery AQL 0.65 level II, DIN ISO 2859
- In ionized mode
- In ionized mode, tested according to ITU-T Rec. K.12
- Comparable to the silicon measurement Switching Voltage (Vs)
- Reference REA PE-80, 0.2A. Tested to ITU-T Rec. K.12 and REA PE-80 < 150 msecs.
- 300 Applications [150(+) & 150(-)]
- 10x[5x (+) & 5x (-)] Applications

### Product Characteristics

|                        |                                                                                                        |
|------------------------|--------------------------------------------------------------------------------------------------------|
| <b>Materials</b>       | <b>Construction</b> = Ceramic Insulator<br><b>Device Finish</b> = Dull Tin-plated 17.5 +/-12.5 microns |
| <b>Product Marking</b> | Littelfuse 'LF' Mark, voltage and date code                                                            |

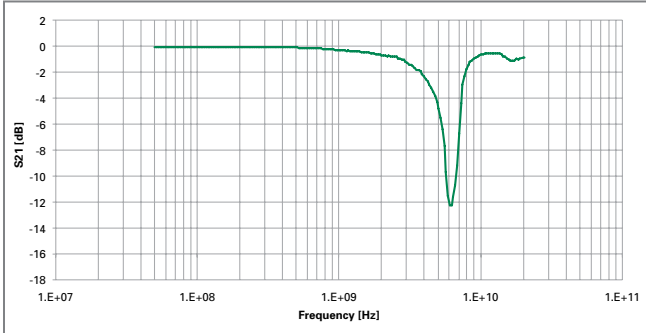
|                                            |                 |
|--------------------------------------------|-----------------|
| <b>Glow to Arc Transition Current</b>      | < 0.5 Amps      |
| <b>Glow Voltage</b>                        | ~60 - 140 Volts |
| <b>Storage and Operational Temperature</b> | -40 to +90°C    |

### Voltage vs. Time Characteristics

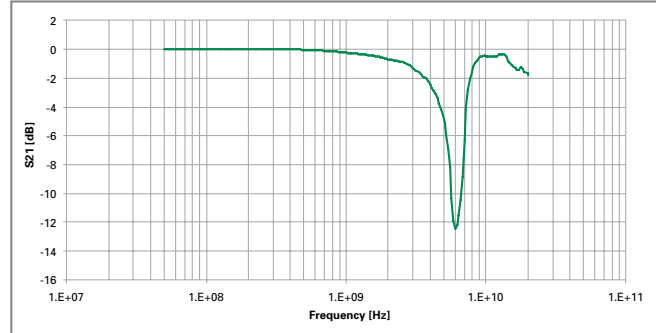


## Insertion Loss Characteristics

### Typical Insertion Loss Characteristics (90V)



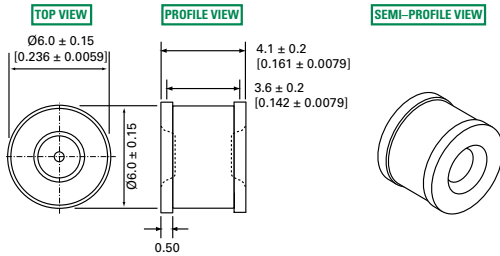
### Typical Insertion Loss Characteristics (600V)



## Device Dimensions

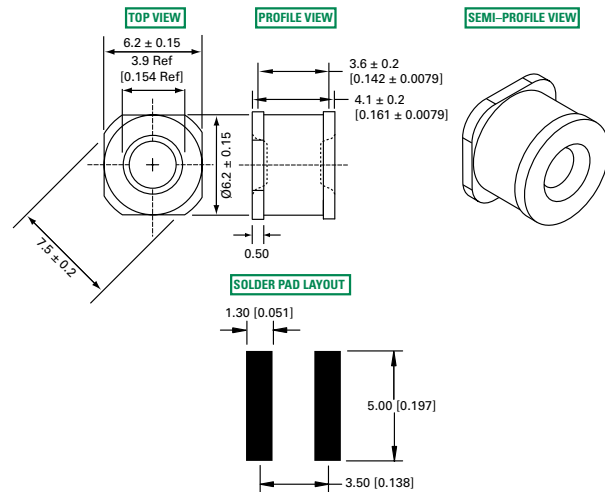
### 'C' Type Core Devices

Dimensions are in millimeters [and inches]



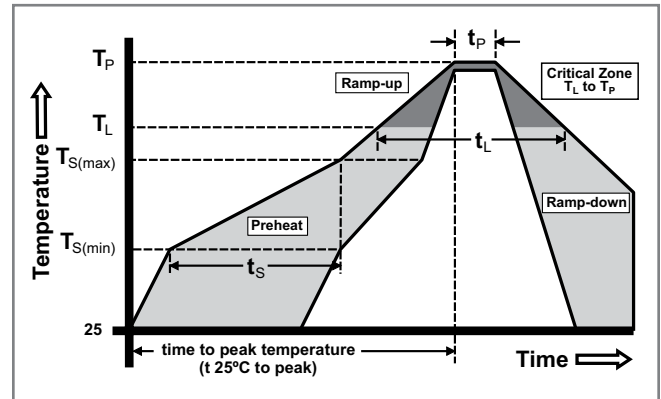
### 'SM' Type Surface Mount Devices

Dimensions are in millimeters [and inches]

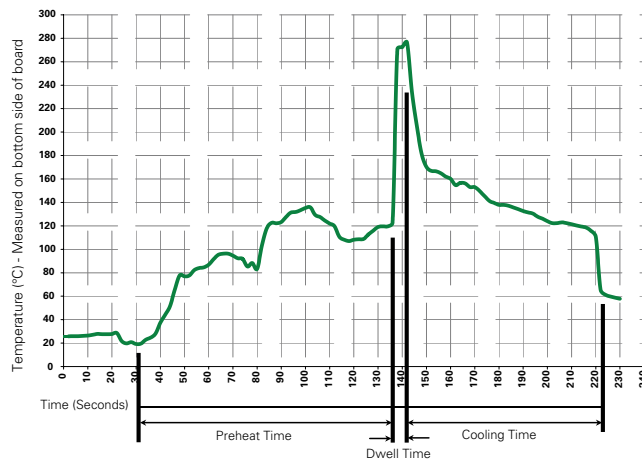


### Soldering Parameters - Reflow Soldering (Surface Mount Devices)

|                                                        |                                    |                         |
|--------------------------------------------------------|------------------------------------|-------------------------|
| Reflow Condition                                       |                                    | Pb-free assembly        |
| Pre Heat                                               | - Temperature Min ( $T_{s(min)}$ ) | 150°C                   |
|                                                        | - Temperature Max ( $T_{s(max)}$ ) | 200°C                   |
|                                                        | - Time (Min to Max) ( $t_s$ )      | 60 – 180 seconds        |
| Average Ramp-up Rate (Liquidus Temp ( $T_L$ ) to peak) |                                    | 3°C/second max.         |
| $T_{s(max)}$ to $T_L$ - Ramp-up Rate                   |                                    | 5°C/second max.         |
| Reflow                                                 | - Temperature ( $T_L$ ) (Liquidus) | 217°C                   |
|                                                        | - Temperature ( $t_L$ )            | 60 – 150 seconds        |
| Peak Temperature ( $T_p$ )                             |                                    | 260 <sup>+0/-5</sup> °C |
| Time within 5°C of Actual Peak Temperature ( $t_p$ )   |                                    | 10 – 30 seconds         |
| Ramp-down Rate                                         |                                    | 6°C/second max.         |
| Time 25°C to Peak Temperature ( $T_p$ )                |                                    | 8 minutes max.          |
| Do not exceed                                          |                                    | 260°C                   |



### Soldering Parameters - Wave Soldering (Thru-Hole Devices)



### Recommended Process Parameters:

| Wave Parameter                           | Lead-Free Recommendation          |
|------------------------------------------|-----------------------------------|
| <b>Preheat:</b>                          |                                   |
| (Depends on Flux Activation Temperature) | (Typical Industry Recommendation) |
| Temperature Minimum:                     | 100° C                            |
| Temperature Maximum:                     | 150° C                            |
| Preheat Time:                            | 60-180 seconds                    |
| <b>Solder Pot Temperature:</b>           | 280° C Maximum                    |
| <b>Solder Dwell Time:</b>                | 2-5 seconds                       |

### Soldering Parameters - Hand Soldering

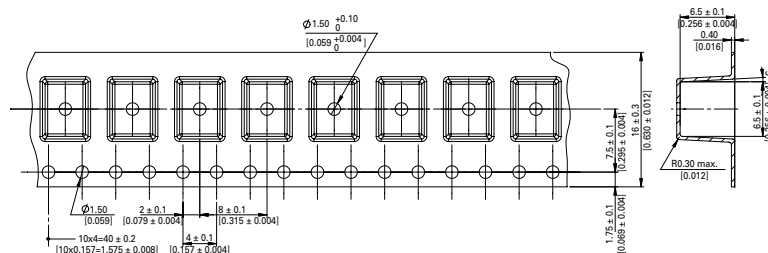
Solder Iron Temperature: 350° C +/- 5°C  
Heating Time: 5 seconds max.

### Packaging

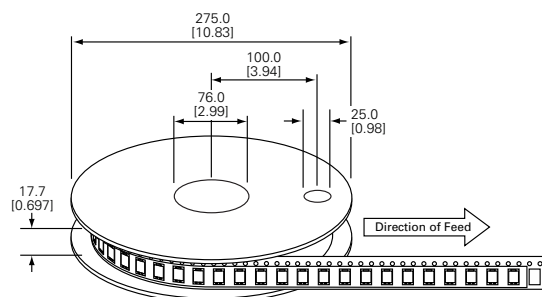
**'C' Type Core Items:** Package bulk pack in polybag, 1000 pcs/bag

**'SM' Type Surface Mount Items:** Packaged tape and reel carrier, 1000 pcs/reel (specifications below)

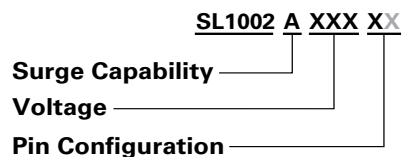
Dimensions are in millimeters [and inches]



Dimensions are in millimeters [and inches]



### Part Numbering System and Ordering Information



**C** = Core (Packed in polybag, 1000pcs/bag)

**SM** = Surface Mount (Packed in carrier and tape, 1000pcs/reel)

## SL1003A Series



### Agency Approvals

| AGENCY                                                                            | AGENCY FILE NUMBER |
|-----------------------------------------------------------------------------------|--------------------|
|  | E128662            |

### 3 Electrode GDT Graphical Symbol



### Additional Information



Datasheet



Resources



Samples

### Description

The SL1003A series has been especially developed for Broadband equipment. Special design features provide high levels of protection against fast rising transients in the 100V/ $\mu$ s to 1kV/ $\mu$ s range usually caused by lightning disturbances.

These devices have ultra low capacitance 1.5pF and present insignificant signal losses up to 1.5GHz. These devices are extremely robust and are able to divert a 5000A pulse without destruction. For AC Power Cross of long duration, over-current protection is recommended.

### Features

- RoHS compliant
- Low insertion loss
- Surface mountable
- 5kA surge capability tested with 8/20/ $\mu$ s pulse as defined by IEC 61000-4-5
- GHz working frequency
- Excellent response to fast rising transients
- Can be used to meet Telcordia GR1089 without series resistance
- 10/700 6kV capability, as per ITU-Tk.21, enhanced test level
- 2000 Amp 2/10/ $\mu$ s surge rating

### Applications

- Broadband equipment
- ADSL equipment
- XDSL equipment
- Satellite and CATV equipment
- General telecom equipment

### Electrical Characteristics

| Part Number | Device Specifications (at 25°C)                        |     |     |                                                               |                                                              |                                |                                        |                                                      | Life Ratings                          |                                                        |                                                           |                                                    |                                        |                                                        |  |  |  |  |  |  |  |
|-------------|--------------------------------------------------------|-----|-----|---------------------------------------------------------------|--------------------------------------------------------------|--------------------------------|----------------------------------------|------------------------------------------------------|---------------------------------------|--------------------------------------------------------|-----------------------------------------------------------|----------------------------------------------------|----------------------------------------|--------------------------------------------------------|--|--|--|--|--|--|--|
|             | DC Breakdown<br>in Volts <sup>1,2,3</sup><br>(@100V/s) |     |     | Impulse<br>Breakdown<br>in Volts <sup>2,3</sup><br>(@100V/μs) | Impulse<br>Breakdown<br>In Volts <sup>2,3</sup><br>(@1kV/μs) | Insulation<br>Resistance       | Capaci-<br>tance<br>(@1MHz<br>0V Bias) | Arc<br>Voltage<br>(on state<br>Voltage)<br>@1Amp Min | Surge<br>Life<br>(@200A<br>10/1000μs) | Nominal<br>Impulse<br>Discharge<br>Current<br>(8/20μs) | Nominal<br>AC<br>Discharge<br>Current<br>(10x1s<br>@50Hz) | AC<br>Discharge<br>Current<br>(9 Cycles @<br>50Hz) | DC<br>Holdover<br>Voltage <sup>4</sup> | Max Impulse<br>Discharge<br>Current<br>(1 Application) |  |  |  |  |  |  |  |
|             | MIN                                                    | TYP | MAX | MAX                                                           |                                                              | MIN                            | MAX                                    | TYP                                                  |                                       |                                                        |                                                           |                                                    | TYP                                    | @ 10/350μs                                             |  |  |  |  |  |  |  |
| SL1003A090  | 72                                                     | 90  | 108 | 600                                                           | 700                                                          | 10 <sup>9</sup> Ω<br>(at 50V)  | 1.5 pF                                 | ~10 to<br>35 V                                       | 300<br>shots                          | 10 shots<br>(@10kA)                                    | 10 A                                                      | 30 A                                               | 50 V                                   | 2 kA                                                   |  |  |  |  |  |  |  |
| SL1003A230  | 184                                                    | 230 | 276 |                                                               | 750                                                          | 10 <sup>9</sup> Ω<br>(at 100V) |                                        |                                                      |                                       |                                                        |                                                           |                                                    | 135 V                                  |                                                        |  |  |  |  |  |  |  |
| SL1003A250  | 200                                                    | 250 | 300 |                                                               |                                                              |                                |                                        |                                                      |                                       |                                                        |                                                           |                                                    |                                        |                                                        |  |  |  |  |  |  |  |
| SL1003A260  | 210                                                    | 260 | 310 |                                                               |                                                              |                                |                                        |                                                      |                                       |                                                        |                                                           |                                                    |                                        |                                                        |  |  |  |  |  |  |  |
| SL1003A300  | 240                                                    | 300 | 360 | 750                                                           | 850                                                          |                                |                                        |                                                      |                                       |                                                        |                                                           |                                                    | 135 V                                  |                                                        |  |  |  |  |  |  |  |
| SL1003A350  | 280                                                    | 350 | 420 | 800                                                           | 900                                                          |                                |                                        |                                                      |                                       |                                                        |                                                           |                                                    |                                        |                                                        |  |  |  |  |  |  |  |
| SL1003A400  | 320                                                    | 400 | 480 | 850                                                           | 950                                                          |                                |                                        |                                                      |                                       |                                                        |                                                           |                                                    |                                        |                                                        |  |  |  |  |  |  |  |
| SL1003A450  | 360                                                    | 450 | 540 | 900                                                           | 1000                                                         |                                |                                        |                                                      |                                       |                                                        |                                                           |                                                    |                                        |                                                        |  |  |  |  |  |  |  |
| SL1003A500  | 400                                                    | 500 | 600 | 1100                                                          | 1400                                                         |                                |                                        |                                                      |                                       |                                                        |                                                           |                                                    |                                        |                                                        |  |  |  |  |  |  |  |

Notes:

- At delivery AQL 0.65 level II, DIN ISO 2859
- In ionized mode, tested according to ITU-T Rec. K.12
- Comparable to the silicon measurement Switching Voltage (Vs)
- Reference REA PE-80, 0.2A. Tested to ITU-T Rec. K.12 and REA PE-80 < 150 msecs.

### Product Characteristics

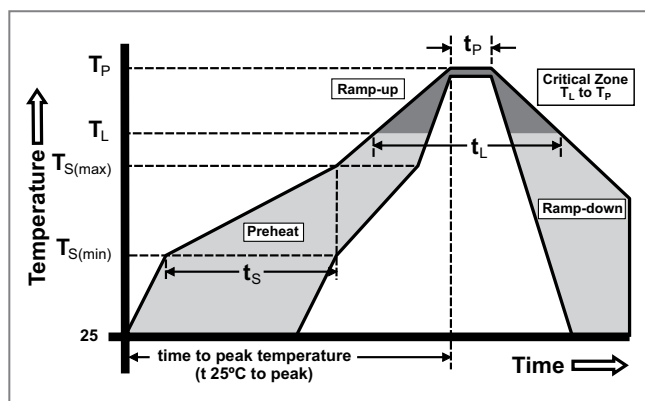
|                        |                                                                                                   |
|------------------------|---------------------------------------------------------------------------------------------------|
| <b>Materials</b>       | <b>Leaded Device:</b><br>Tin-plated copper wire<br><b>Core and Surface Mount:</b> Dull Tin-plated |
| <b>Product Marking</b> | Littelfuse 'LF' Mark, voltage and date code                                                       |

|                                            |                  |
|--------------------------------------------|------------------|
| <b>Glow to Arc Transition Current</b>      | ~1 Amp           |
| <b>Glow Voltage</b>                        | ~60 to 200 Volts |
| <b>Storage and Operational Temperature</b> | -40 to +90°C     |

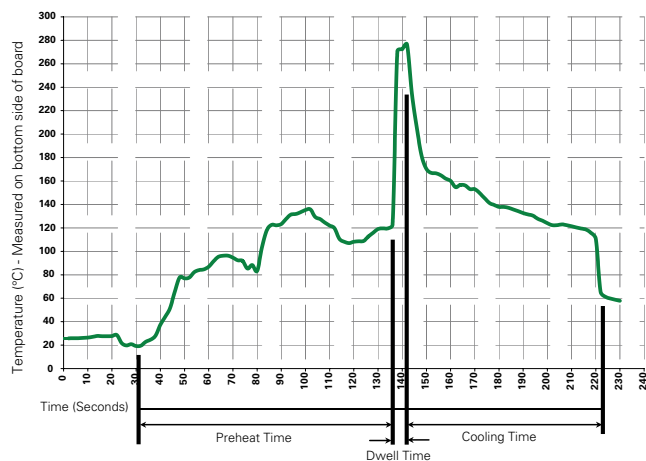
Dimensions are in millimeters [and inches]

### Soldering Parameters - Reflow Soldering (Surface Mount Devices)

|                                                        |                                    |                         |
|--------------------------------------------------------|------------------------------------|-------------------------|
| Reflow Condition                                       |                                    | Pb-free assembly        |
| Pre Heat                                               | - Temperature Min ( $T_{s(min)}$ ) | 150°C                   |
|                                                        | - Temperature Max ( $T_{s(max)}$ ) | 200°C                   |
|                                                        | - Time (Min to Max) ( $t_s$ )      | 60 – 180 seconds        |
| Average Ramp-up Rate (Liquidus Temp ( $T_L$ ) to peak) |                                    | 3°C/second max.         |
| $T_{s(max)}$ to $T_L$ - Ramp-up Rate                   |                                    | 5°C/second max.         |
| Reflow                                                 | - Temperature ( $T_L$ ) (Liquidus) | 217°C                   |
|                                                        | - Temperature ( $t_L$ )            | 60 – 150 seconds        |
| Peak Temperature ( $T_p$ )                             |                                    | 260 <sup>+0/-5</sup> °C |
| Time within 5°C of Actual Peak Temperature ( $t_p$ )   |                                    | 10 – 30 seconds         |
| Ramp-down Rate                                         |                                    | 6°C/second max.         |
| Time 25°C to Peak Temperature ( $T_p$ )                |                                    | 8 minutes max.          |
| Do not exceed                                          |                                    | 260°C                   |



### Soldering Parameters - Wave Soldering (Thru-Hole Devices)



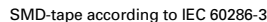
### Recommended Process Parameters:

| Wave Parameter                           | Lead-Free Recommendation          |
|------------------------------------------|-----------------------------------|
| <b>Preheat:</b>                          |                                   |
| (Depends on Flux Activation Temperature) | (Typical Industry Recommendation) |
| Temperature Minimum:                     | 100° C                            |
| Temperature Maximum:                     | 150° C                            |
| Preheat Time:                            | 60-180 seconds                    |
| <b>Solder Pot Temperature:</b>           | 280° C Maximum                    |
| <b>Solder Dwell Time:</b>                | 2-5 seconds                       |

### Soldering Parameters - Hand Soldering

Solder Iron Temperature: 350° C +/- 5°C  
Heating Time: 5 seconds max.

**'SM' Type Surface Mount Items:** Packaged tape and reel carrier, 700 pcs/reel (specifications below)



**C** = Core type (Packed in polybag, 500pcs/bag)  
**R** = Radial Lead without Failsafe (Packed in tray, 100pcs/tray)  
**RF** = Radial Lead with Failsafe (Packed in tray, 100pcs/tray)  
**SM** = Surface Mount (Packed in carrier and tape, 700pcs/reel)

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Specifications are subject to change without notice.  
Revised: 12/12/17

## SL1010A Series



### Description

The SL1010A Series Gas Discharge Tube (GDT) offers a compact, three-terminal, surface mount component that's just 5mm in diameter. It is rated for 10 hits ( $\pm 5$  repetitions) of a 5kA 8/20 $\mu$ s surge event with a low off-state capacitance of 1.5pF. Its low arc voltage parameter of 10V reduces thermal accumulation during long-term power fault events.

### Agency Approvals

| AGENCY | AGENCY FILE NUMBER |
|--------|--------------------|
|        | E128662            |

### 3 Electrode GDT Graphical Symbol



### Additional Information



**Datasheet**



**Resources**



**Samples**

### Features

- 5mm diameter size
- Low insertion loss
- Fast response time
- Single component balanced protector (T-grd & R-grd)
- High current rating
- Stable performance over lifetime
- Lead-free and RoHS compliant
- UL Recognized

### Applications

- Data lines
- Broadband interfaces such as ADSL2/VDSL2
- xDSL equipment
- Satellite and CATV equipment
- General telecom equipment
- Industrial automation
- Home gateway

### Electrical Characteristics

| Part Number | Device Specifications (at 25°C)                  |     |     |                                                      |                                                     |                       |                             | Nominal Impulse Discharge Current (x10@8/20μs) | Nominal Impulse Discharge Current (x1@10/350μs) |
|-------------|--------------------------------------------------|-----|-----|------------------------------------------------------|-----------------------------------------------------|-----------------------|-----------------------------|------------------------------------------------|-------------------------------------------------|
|             | DC Breakdown in Volts <sup>1,2,3</sup> (@100V/s) |     |     | Impulse Breakdown in Volts <sup>2,3</sup> (@100V/μs) | Impulse Breakdown In Volts <sup>2,3</sup> (@1kV/μs) | Insulation Resistance | Capacitance (@1MHz 0V Bias) | Arc Voltage (on state Voltage) @1Amp Min       |                                                 |
|             | MIN                                              | TYP | MAX | MAX                                                  |                                                     | MIN                   | MAX                         |                                                |                                                 |
| SL1010A075  | 60                                               | 75  | 90  | 450                                                  | 600                                                 | >1GΩ (at 50VDC)       | <1.5 pF                     | ~10 V                                          | 5kA                                             |
| SL1010A090  | 72                                               | 90  | 108 | 550                                                  | 700                                                 |                       |                             |                                                |                                                 |
| SL1010A170  | 136                                              | 170 | 204 | 580                                                  | 750                                                 |                       |                             |                                                |                                                 |
| SL1010A230  | 184                                              | 230 | 276 | 850                                                  | 1000                                                |                       |                             |                                                |                                                 |
| SL1010A350  | 280                                              | 350 | 420 | 650                                                  | 850                                                 |                       |                             |                                                |                                                 |
| SL1010A420  | 335                                              | 420 | 504 | 800                                                  | 950                                                 |                       |                             |                                                |                                                 |
| SL1010A470  | 376                                              | 470 | 564 |                                                      |                                                     |                       |                             |                                                |                                                 |

Notes:

1. At delivery AQL 0.65 level II, DIN ISO 2859

2. In ionized mode, tested according to ITU-T Rec. K.12

3. Comparable to the silicon measurement Switching Voltage (Vs)

4. Total current through center electrode at 10kA, through side electrode respectively at 5kA

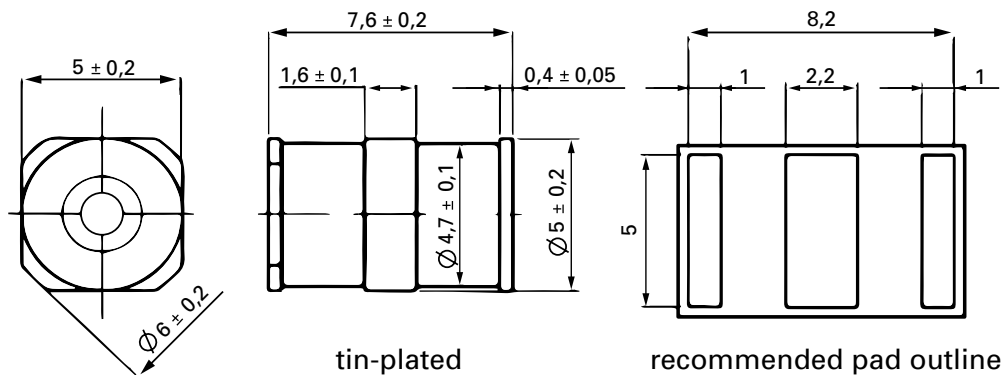
### Product Characteristics

|                        |                                                                |                                            |              |
|------------------------|----------------------------------------------------------------|--------------------------------------------|--------------|
| <b>Materials</b>       | <b>Construction:</b> Ceramic Insulator                         | <b>Glow to Arc Transition Current</b>      | ~1 Amp       |
|                        | <b>Device Finish:</b> Dull Tin-plated<br>17.5 +/- 12.5 microns |                                            |              |
| <b>Product Marking</b> | Littelfuse 'LF' Mark, voltage and date code                    | <b>Glow Voltage</b>                        | ~60 Volts    |
|                        |                                                                | <b>Storage and Operational Temperature</b> | -40 to +90°C |

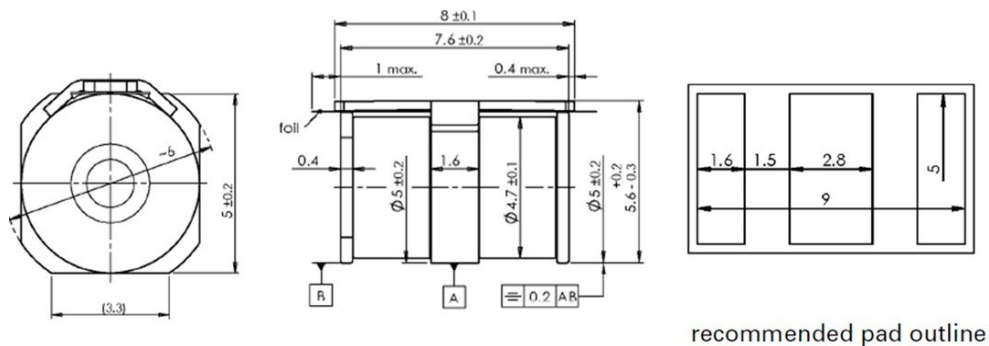
### Device Dimensions

For SL1010A series:

Dimensions are in millimeters [and inches]

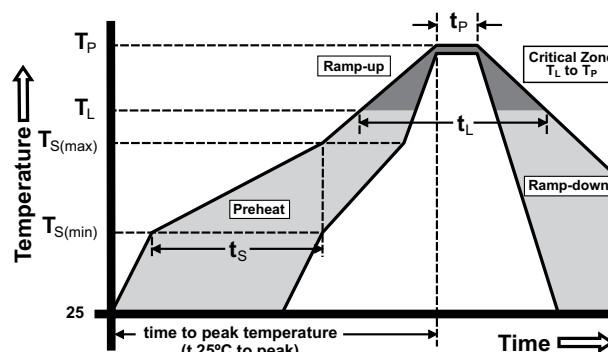


For SL1010A series failsafe version:



### Soldering Parameters - Reflow Soldering (Surface Mount Devices)

|                                                        |                                    |                         |
|--------------------------------------------------------|------------------------------------|-------------------------|
| Reflow Condition                                       |                                    | Pb-free assembly        |
| Pre Heat                                               | - Temperature Min ( $T_{s(min)}$ ) | 150°C                   |
|                                                        | - Temperature Max ( $T_{s(max)}$ ) | 200°C                   |
|                                                        | - Time (Min to Max) ( $t_s$ )      | 60 – 180 seconds        |
| Average Ramp-up Rate (Liquidus Temp ( $T_L$ ) to peak) |                                    | 3°C/second max.         |
| $T_{s(max)}$ to $T_L$ - Ramp-up Rate                   |                                    | 5°C/second max.         |
| Reflow                                                 | - Temperature ( $T_L$ ) (Liquidus) | 217°C                   |
|                                                        | - Temperature ( $t_L$ )            | 60 – 150 seconds        |
| Peak Temperature ( $T_p$ )                             |                                    | 260 <sup>+0/-5</sup> °C |
| Time within 5°C of Actual Peak Temperature ( $t_p$ )   |                                    | 10 – 30 seconds         |
| Ramp-down Rate                                         |                                    | 6°C/second max.         |
| Time 25°C to Peak Temperature ( $T_p$ )                |                                    | 8 minutes max.          |
| Do not exceed                                          |                                    | 260°C                   |

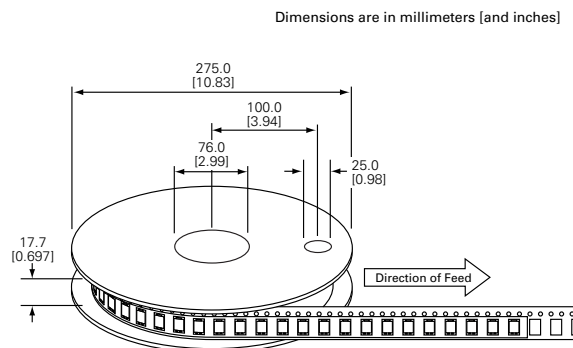
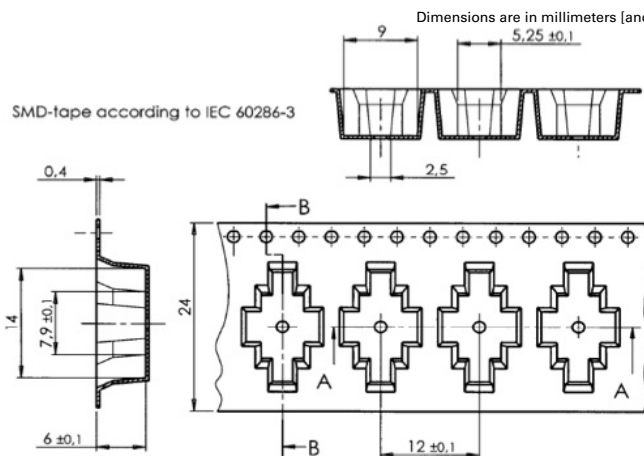


### Soldering Parameters - Hand Soldering

Solder Iron Temperature: 350° C +/- 5°C  
Heating Time: 5 seconds max.

### Packaging

**'SM' Type Surface Mount Items:** Packaged tape and reel carrier, 900 pcs/reel (specifications below)



### Part Numbering System and Ordering Information

**SL1010A XXX XX**

**SL1010A Series**

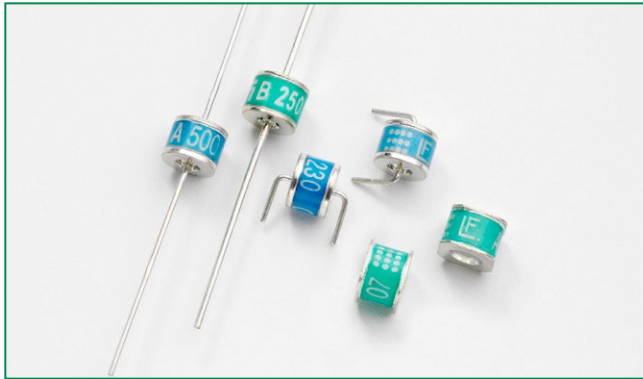
**Voltage**

**Pin Configuration**

- F** = with Failsafe (Packed in carrier and tape, 900pcs/reel)
- SM** = Surface Mount (Packed in carrier and tape, 900pcs/reel)
- SMF** = Surface Mount with Failsafe (Packed in carrier and tape, 900pcs,

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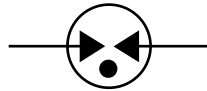
### SL1011A and SL1411A Series



#### Agency Approvals

| AGENCY | AGENCY FILE NUMBER |
|--------|--------------------|
|        | E128662            |

#### 2 Electrode GDT Graphical Symbol



#### Additional Information



**Datasheet  
SL1011A**



**Datasheet  
SL1411A**



**Resources  
SL1011A**



**Resources  
SL1411A**



**Samples  
SL1011A**



**Samples  
SL1411A**

#### Description

The SL1011A and SL1411A series provides high levels of protection against fast rising transients in the 100V/μs to 1kV/μs range usually caused by lightning disturbances.

The SL1011A and SL1411A series offers low capacitance (< 1.5pf) which provides low insertion loss at high frequencies.

SL1011A offers 5kA protection without destruction whereas the SL1411A offer 10kA surge protection without destruction (maximum single surge of 12kA @ 8/20μs).

#### Features

- Lead-free and RoHS compliant
- Low insertion loss
- Excellent response to fast rising transients
- Ultra low capacitance
- 5kA (SL1011A) or 10kA (SL1411A) surge capability tested with 8/20μs pulse as defined by IEC 61000-4-5 2nd edition

#### Applications

- Broadband equipment
- ADSL equipment
- XDSL equipment
- Satellite and CATV equipment
- General telecom equipment

### Electrical Characteristics

| Part Number | Device Specifications (at 25°C)                   |     |     |                                                       |                                         |                                |                        |                                                | Life Ratings                       |                                               |                                                     |                                              |                                  |                                                  |            |
|-------------|---------------------------------------------------|-----|-----|-------------------------------------------------------|-----------------------------------------|--------------------------------|------------------------|------------------------------------------------|------------------------------------|-----------------------------------------------|-----------------------------------------------------|----------------------------------------------|----------------------------------|--------------------------------------------------|------------|
|             | DC Breakdown in Volts <sup>1,2</sup><br>(@100V/s) |     |     | Impulse Breakdown in Volts <sup>3</sup><br>(@100V/μs) | Impulse Breakdown In Volts<br>(@1kV/μs) | Insulation Resistance          | Capacitance<br>(@1MHz) | Arc Voltage<br>(on state Voltage)<br>@1Amp Min | Surge Life<br>(@100A<br>10/1000μs) | Nominal Impulse Discharge Current<br>(8/20μs) | Nominal AC Discharge Current<br>(10x1s<br>@50-60Hz) | AC Discharge Current<br>(9 Cycles @<br>50Hz) | DC Holdover Voltage <sup>4</sup> | Max Impulse Discharge Current<br>(1 Application) |            |
|             | MIN                                               | TYP | MAX | MAX                                                   |                                         | MIN                            | MAX                    | TYP                                            |                                    |                                               |                                                     |                                              | TYP                              | @ 8/20μs                                         | @ 10/350μs |
| SL1011A075  | 60                                                | 75  | 90  | 500                                                   | 700                                     | 10 <sup>10</sup> Ω<br>(at 50V) | 1.5 pF                 | ~20 V                                          | 300 shots                          | SL1011A:<br>10 shots<br>(@5kA)                | SL1011A:<br>5 A                                     | SL1011A:<br>20 A                             | 50 V                             | SL1411A:<br>12 kA                                | 1 kA       |
| SL1411A075  |                                                   |     |     |                                                       |                                         |                                |                        |                                                |                                    |                                               |                                                     |                                              |                                  |                                                  |            |
| SL1011A090  | 72                                                | 90  | 108 | 500                                                   | 600                                     |                                |                        |                                                |                                    |                                               |                                                     |                                              |                                  |                                                  |            |
| SL1411A090  |                                                   |     |     |                                                       |                                         |                                |                        |                                                |                                    |                                               |                                                     |                                              |                                  |                                                  |            |
| SL1011A145  | 116                                               | 145 | 174 | 500                                                   | 650                                     |                                |                        |                                                |                                    |                                               |                                                     |                                              |                                  |                                                  |            |
| SL1011A150  | 120                                               | 150 | 180 | 500                                                   | 650                                     |                                |                        |                                                |                                    |                                               |                                                     |                                              |                                  |                                                  |            |
| SL1411A150  |                                                   |     |     |                                                       |                                         |                                |                        |                                                |                                    |                                               |                                                     |                                              |                                  |                                                  |            |
| SL1011A230  | 184                                               | 230 | 276 | 550                                                   | 700                                     |                                |                        |                                                |                                    |                                               |                                                     |                                              |                                  |                                                  |            |
| SL1411A230  |                                                   |     |     |                                                       |                                         |                                |                        |                                                |                                    |                                               |                                                     |                                              |                                  |                                                  |            |
| SL1011A250  | 200                                               | 250 | 300 | 600                                                   | 800                                     |                                |                        |                                                |                                    |                                               |                                                     |                                              |                                  |                                                  |            |
| SL1411A250  |                                                   |     |     |                                                       |                                         |                                |                        |                                                |                                    |                                               |                                                     |                                              |                                  |                                                  |            |
| SL1011A260  | 210                                               | 260 | 310 | 600                                                   | 800                                     |                                |                        |                                                |                                    |                                               |                                                     |                                              |                                  |                                                  |            |
| SL1011A350  | 280                                               | 350 | 420 | 800                                                   | 900                                     |                                |                        |                                                |                                    |                                               |                                                     |                                              |                                  |                                                  |            |
| SL1411A350  |                                                   |     |     |                                                       |                                         |                                |                        |                                                |                                    |                                               |                                                     |                                              |                                  |                                                  |            |
| SL1011A470  | 376                                               | 470 | 564 | 1000                                                  | 1100                                    |                                |                        |                                                |                                    |                                               |                                                     |                                              |                                  |                                                  |            |
| SL1411A470  |                                                   |     |     |                                                       |                                         |                                |                        |                                                |                                    |                                               |                                                     |                                              |                                  |                                                  |            |
| SL1011A500  | 400                                               | 500 | 600 | 1100                                                  | 1200                                    |                                |                        |                                                |                                    |                                               |                                                     |                                              |                                  |                                                  |            |
| SL1011A600  | 480                                               | 600 | 720 | 1200                                                  | 1400                                    |                                |                        |                                                |                                    |                                               |                                                     |                                              |                                  |                                                  |            |
| SL1411A600  |                                                   |     |     |                                                       |                                         |                                |                        |                                                |                                    |                                               |                                                     |                                              |                                  |                                                  |            |

#### Notes:

1. At delivery AQL 0.65 level II, DIN ISO 2859
2. In ionized mode
3. Comparable to the silicon measurement Switching Voltage (Vs)
4. Tested according to ITU-T Rec. K.12 < 150 msecs.

### Product Characteristics

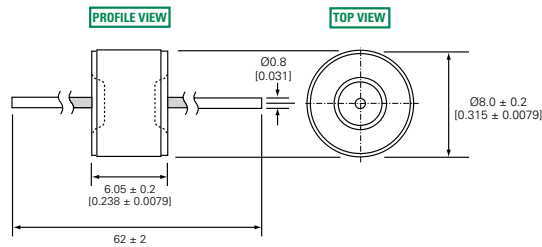
|                        |                                                                                                             |
|------------------------|-------------------------------------------------------------------------------------------------------------|
| <b>Materials</b>       | <b>Leaded Device:</b> Nickel-plated with Tin-plated wires<br><b>Core and Surface Mount:</b> Dull Tin-plated |
| <b>Product Marking</b> | Littelfuse 'LF' Mark, voltage and date code                                                                 |

|                                            |              |
|--------------------------------------------|--------------|
| <b>Glow to Arc Transition Current</b>      | < 0.5 Amps   |
| <b>Glow Voltage</b>                        | ~60 Volts    |
| <b>Storage and Operational Temperature</b> | -40 to +90°C |

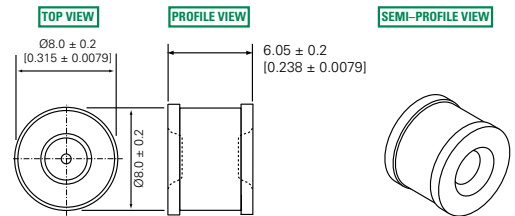
### Device Dimensions

#### For SL1011A Series:

##### 'A' Type Axial Lead Devices

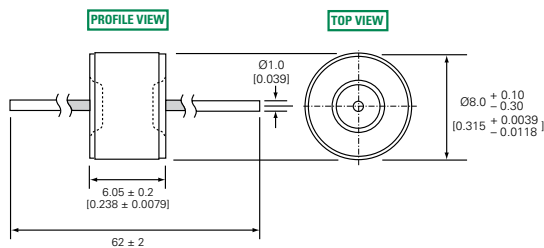


##### 'C' Type Core Devices

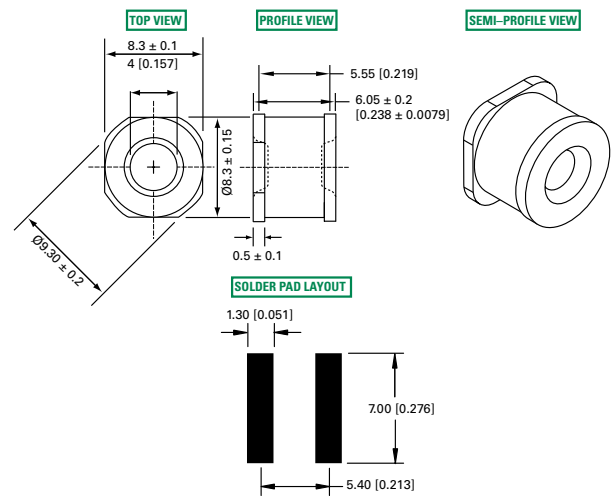


#### For SL1411A series:

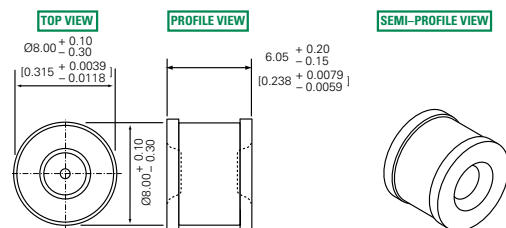
##### 'A' Type Axial Lead Devices



##### 'SM' Type Surface Mount Devices

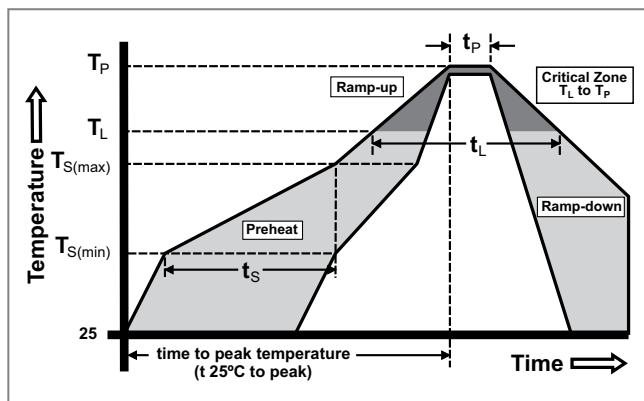


##### 'C' Type Core Devices

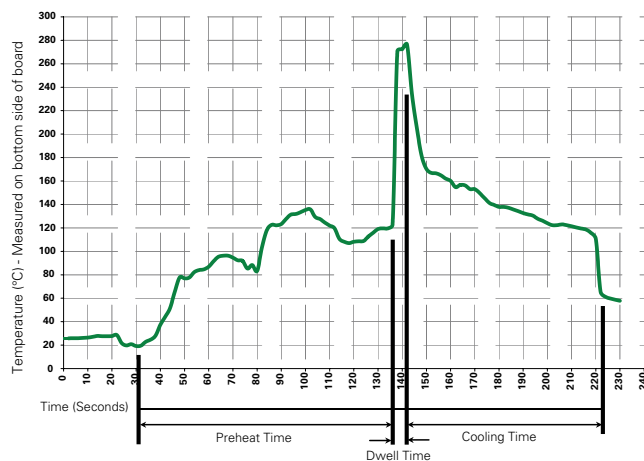


### Soldering Parameters - Reflow Soldering (Surface Mount Devices)

|                                                        |                                    |                         |
|--------------------------------------------------------|------------------------------------|-------------------------|
| Reflow Condition                                       |                                    | Pb-free assembly        |
| Pre Heat                                               | - Temperature Min ( $T_{s(min)}$ ) | 150°C                   |
|                                                        | - Temperature Max ( $T_{s(max)}$ ) | 200°C                   |
|                                                        | - Time (Min to Max) ( $t_s$ )      | 60 – 180 seconds        |
| Average Ramp-up Rate (Liquidus Temp ( $T_L$ ) to peak) |                                    | 3°C/second max.         |
| $T_{s(max)}$ to $T_L$ - Ramp-up Rate                   |                                    | 5°C/second max.         |
| Reflow                                                 | - Temperature ( $T_L$ ) (Liquidus) | 217°C                   |
|                                                        | - Temperature ( $t_L$ )            | 60 – 150 seconds        |
| Peak Temperature ( $T_p$ )                             |                                    | 260 <sup>+0/-5</sup> °C |
| Time within 5°C of Actual Peak Temperature ( $t_p$ )   |                                    | 10 – 30 seconds         |
| Ramp-down Rate                                         |                                    | 6°C/second max.         |
| Time 25°C to Peak Temperature ( $T_p$ )                |                                    | 8 minutes max.          |
| Do not exceed                                          |                                    | 260°C                   |



### Soldering Parameters - Wave Soldering (Thru-Hole Devices)



### Recommended Process Parameters:

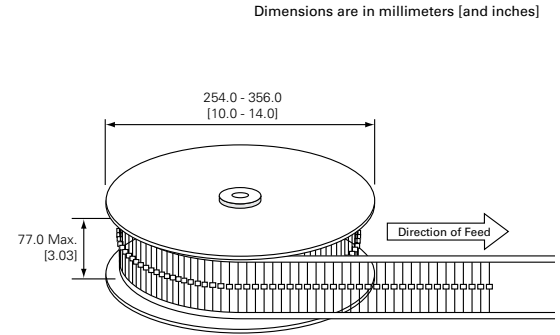
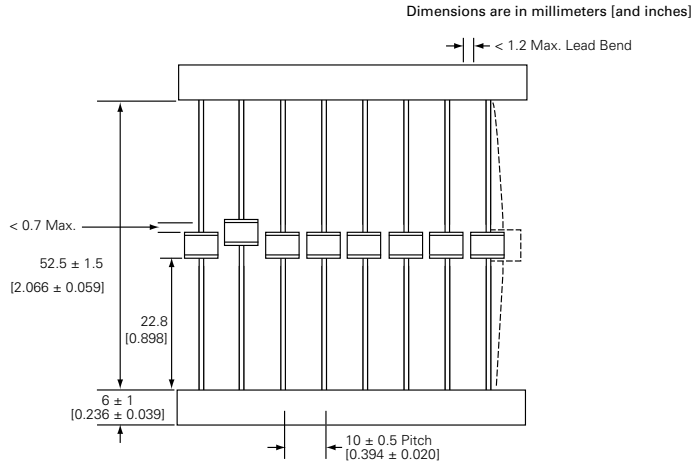
| Wave Parameter                           | Lead-Free Recommendation          |
|------------------------------------------|-----------------------------------|
| <b>Preheat:</b>                          |                                   |
| (Depends on Flux Activation Temperature) | (Typical Industry Recommendation) |
| Temperature Minimum:                     | 100° C                            |
| Temperature Maximum:                     | 150° C                            |
| Preheat Time:                            | 60-180 seconds                    |
| <b>Solder Pot Temperature:</b>           | 280° C Maximum                    |
| <b>Solder Dwell Time:</b>                | 2-5 seconds                       |

### Soldering Parameters - Hand Soldering

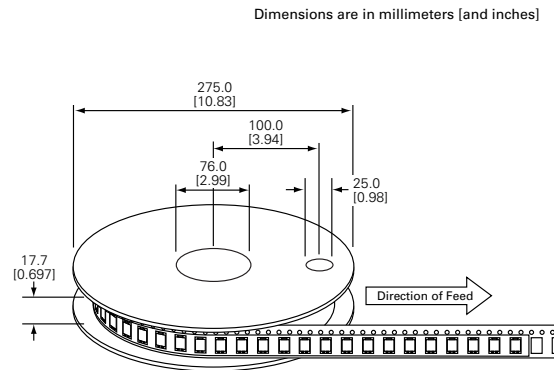
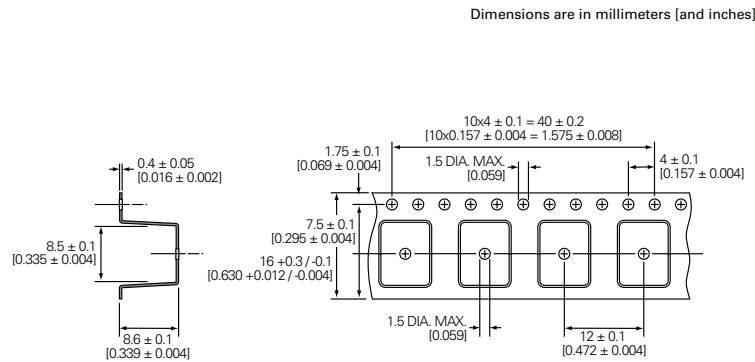
Solder Iron Temperature: 350° C +/- 5°C  
Heating Time: 5 seconds max.

### Packaging Dimensions

#### For Axial Lead Items



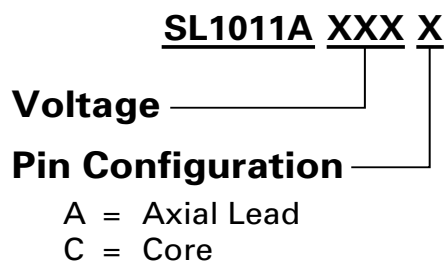
#### For 'SM' Type Surface Mount Items (SL1411A series only)



#### For 'C' Type Core Items: Packed in plastic bag (500 pcs)

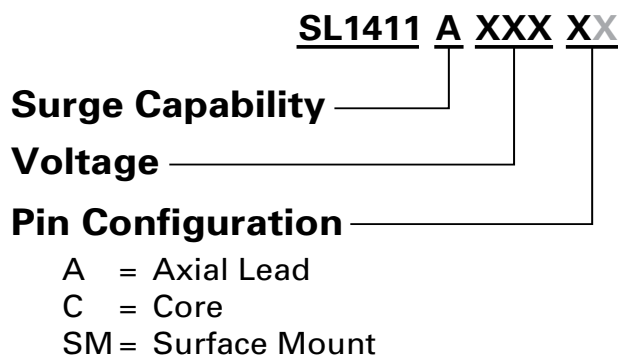
### Part Numbering System and Ordering Information

#### For SL1011A series:



Remarks: Formed leads are available on request

#### For SL1411A series:



### SL1122A Series Hybrid



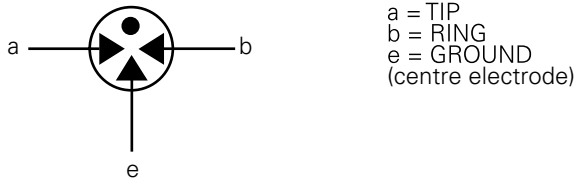
#### Description

The SL1122A series Hybrid features a high performance Alpha Gas Plasma Tube in conjunction with a MOV. These devices are matched so that high speed pulses are initially clamped by the MOV, then as the current rises, the transient energy is switched through the gas tube. The Hybrid offers high levels of performance on fast rising transients in the domain of 100V/μs to 10 kV/μs, so eliminates the dv/dt switching delay normally exhibited by standard GDTs. These devices are extremely robust and are able to divert a 10,000 Amp pulse without destruction.

#### Agency Approvals

| AGENCY | AGENCY FILE NUMBER |
|--------|--------------------|
|        | E128662            |

#### 2 Electrode GDT Graphical Symbol



#### Features

- RoHs Compliant
- Excellent response to fast rising transients
- Flat response up to 10kV/μs
- 10kA surge capability tested with 8/20μs pulse as defined by IEC 61000-4-5
- Thermal failsafe

#### Applications

- MDF protection
- ADSL equipment
- XDSL equipment
- Alarm panels
- General telecom equipment

#### Additional Information



Datasheet



Resources



Samples

#### Electrical Characteristics

| Part Number | Device Specifications (at 25°C)                       |     |     |                                                   |                               |                                                    | Arc Voltage<br>(on state voltage)<br>@1Amp Min | Life Ratings                                       |                                             |                                                                 |                                        |
|-------------|-------------------------------------------------------|-----|-----|---------------------------------------------------|-------------------------------|----------------------------------------------------|------------------------------------------------|----------------------------------------------------|---------------------------------------------|-----------------------------------------------------------------|----------------------------------------|
|             | DC Breakdown<br>in Volts <sup>1, 2</sup><br>(@100V/s) |     |     | DC Voltage <sup>2</sup><br>(1kV/μs Ignition Time) | Insulation<br>Resistance      | Capacitance<br>(@1MHz, 0V bias,<br>1V oscillation) |                                                | Surge Life <sup>1</sup><br>(10/1000μs<br>300x +/-) | Surge Current <sup>1</sup><br>(8/20μs x 10) | Nominal<br>AC Discharge<br>Current <sup>1</sup><br>(10x1s@50Hz) | DC Holdover<br>Voltage<br>(<150msecs.) |
|             | MIN                                                   | TYP | MAX |                                                   | MIN                           | MAX                                                |                                                | TYP                                                |                                             |                                                                 | TYP                                    |
| SL1122A090  | 72                                                    | 90  | 108 | 200 (< 10μs)                                      | > 10 <sup>8</sup> Ω (at 50V)  | 270 pF                                             | ~10 to 35<br>Volts                             | 200 A                                              | 10 kA                                       | 10 A                                                            | 50 V                                   |
| SL1122A230  | 184                                                   | 230 | 276 | 350 (< 10μs)                                      | > 10 <sup>8</sup> Ω (at 100V) | 100 pF                                             |                                                |                                                    |                                             |                                                                 | 135 V                                  |
| SL1122A260  | 210                                                   | 260 | 310 | 400 (< 10μs)                                      |                               |                                                    |                                                |                                                    |                                             |                                                                 |                                        |

Tested in accordance with ITU-T Rec K.12

Notes:

1. Total current through centre electrode
2. Maximum Peak Break Over Voltage

### Product Characteristics

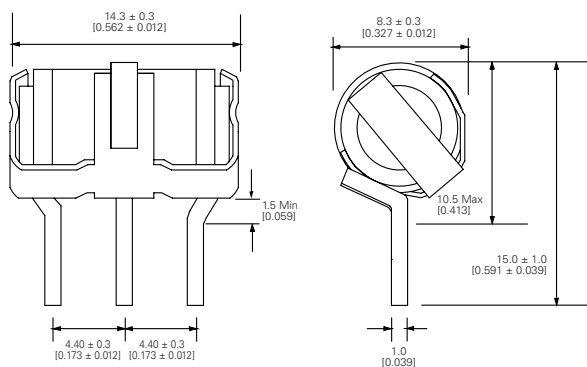
|                        |                                                                                               |
|------------------------|-----------------------------------------------------------------------------------------------|
| <b>Materials</b>       | <b>Electrode Base:</b> Copper<br><b>Electrode Plating:</b> Bright Tin<br><b>Body:</b> Ceramic |
| <b>Product Marking</b> | Littelfuse 'LF' Mark, voltage and date code. Red.                                             |

|                                            |                                           |
|--------------------------------------------|-------------------------------------------|
| <b>Glow to Arc Transition Current</b>      | ~1 Amp                                    |
| <b>Glow Voltage</b>                        | ~60 to 200 Volts                          |
| <b>Storage and Operational Temperature</b> | -40 to +90°C                              |
| <b>Transverse Voltage (Delay Time)</b>     | < 0.2 µSec.<br>(Tested to ITU-T Rec.K.12) |

### Device Dimensions

#### Radial Lead Devices

Dimensions are in millimeters [and inches]



### Packaging Dimensions

For Radial Lead Items: Packed in tray (100 pcs)

### Part Numbering System and Ordering Information

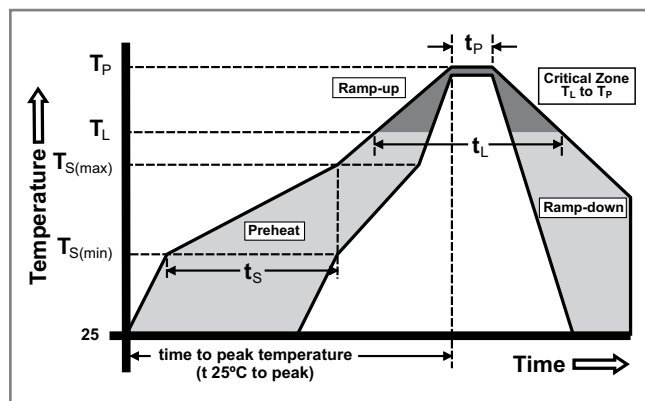
**SL1122A XXX X**

**Voltage** ————

**Pin Configuration** ————

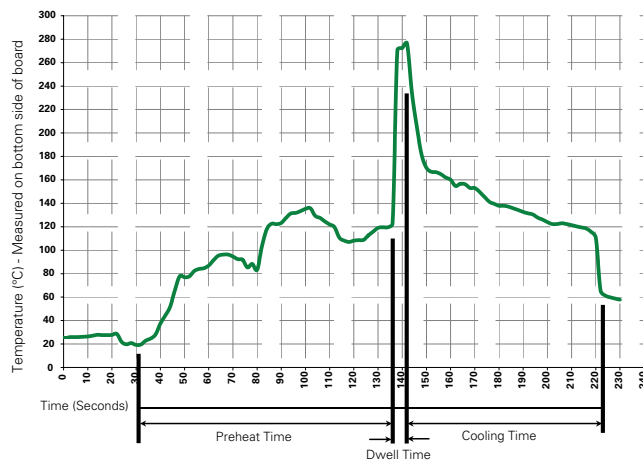
### Soldering Parameters - Reflow Soldering

|                                                        |                                    |                         |
|--------------------------------------------------------|------------------------------------|-------------------------|
| Reflow Condition                                       |                                    | Pb-free assembly        |
| Pre Heat                                               | - Temperature Min ( $T_{s(min)}$ ) | 150°C                   |
|                                                        | - Temperature Max ( $T_{s(max)}$ ) | 200°C                   |
|                                                        | - Time (Min to Max) ( $t_s$ )      | 60 – 180 seconds        |
| Average Ramp-up Rate (Liquidus Temp ( $T_L$ ) to peak) |                                    | 3°C/second max.         |
| $T_{s(max)}$ to $T_L$ - Ramp-up Rate                   |                                    | 5°C/second max.         |
| Reflow                                                 | - Temperature ( $T_L$ ) (Liquidus) | 217°C                   |
|                                                        | - Temperature ( $t_L$ )            | 60 – 150 seconds        |
| Peak Temperature ( $T_p$ )                             |                                    | 260 <sup>+0/-5</sup> °C |
| Time within 5°C of Actual Peak Temperature ( $t_p$ )   |                                    | 10 – 30 seconds         |
| Ramp-down Rate                                         |                                    | 6°C/second max.         |
| Time 25°C to Peak Temperature ( $T_p$ )                |                                    | 8 minutes max.          |
| Do not exceed                                          |                                    | 260°C                   |



\* Devices that are soldered require inspection before use.

### Soldering Parameters - Wave Soldering (Thru-Hole Devices)



### Recommended Process Parameters:

| Wave Parameter                                                                                | Lead-Free Recommendation |
|-----------------------------------------------------------------------------------------------|--------------------------|
| <b>Preheat:</b><br>(Depends on Flux Activation Temperature) (Typical Industry Recommendation) |                          |
| Temperature Minimum:                                                                          | 100° C                   |
| Temperature Maximum:                                                                          | 150° C                   |
| Preheat Time:                                                                                 | 60-180 seconds           |
| <b>Solder Pot Temperature:</b>                                                                | 280° C Maximum           |
| <b>Solder Dwell Time:</b>                                                                     | 2-5 seconds              |

### Soldering Parameters - Hand Soldering

Solder Iron Temperature: 350° C +/- 5°C  
Heating Time: 5 seconds max.

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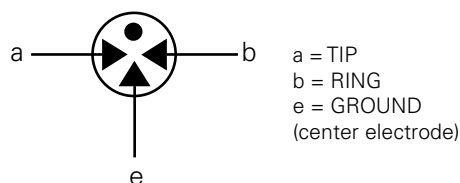
## SL1021A/B Series



### Agency Approvals

| AGENCY | AGENCY FILE NUMBER |
|--------|--------------------|
|        | E128662            |

### 3 Electrode GDT Graphical Symbol



### Features

- RoHS compliant
- Low insertion loss
- Excellent response to fast rising transients
- Ultra low capacitance
- 10KA (A suffix devices) / 20KA (B suffix devices) surge capability tested with 8/20μs pulse as defined by IEC 61000-4-5
- Available with thermal failsafe option (add 'F' suffix to part number)

### Applications

- SL1021:**
- Broadband equipment
  - ADSL equipment
  - XDSL equipment
  - Satellite and CATV equipment
  - Splitters
  - General telecom equipment
  - Telecom network interfaces
  - Telephone line cards
  - Repeaters
  - Modems
  - Line test equipment

### Description

GDT circuit protection devices dissipate electrical surge energy safely within a contained plasma gas. Commonly used to help protect sensitive telecom and networking equipment and lines, GDTs protect from damage that may result from lightning strikes and equipment switching operations.

The Littelfuse GDT series described in this document are available in a variety of leaded and surface mount forms and offered with and without optional fail-safe clip. Please refer to the electrical specifications, dimension and packaging options section of this document for additional information.

### SL1021A/B Series:

SL1021A/B series GDTs are designed to offer high levels of performance on fast rising transients in the range of 100V/μs to 1KV/μs, which are those most likely created by induced lightning disturbances.

These devices feature ultra low capacitance (typically 1.5pF or less) and are extremely robust with SL1021A devices able to divert a 10,000 Amp pulse without destruction, and SL1021B suffix devices able to divert a 20,000 Amp pulse without destruction.

These series offer optimized internal geometry which provide low insertion loss at high frequencies, ideal for the protection of broadband and other high speed transmission equipment.

### Product Characteristics

|                                          |                                                                                                          |
|------------------------------------------|----------------------------------------------------------------------------------------------------------|
| <b>Materials</b>                         | Dull Tin Plate 17.5 ± 12.5 Microns. with ceramic insulator                                               |
| <b>Product Marking</b>                   | 'LF' mark, voltage & date code:<br>SL1021A - <b>Red</b> /White text<br>SL1021B - <b>Blue</b> /White text |
| <b>Glow to arc transition current</b>    | ~ 1Amp                                                                                                   |
| <b>Glow Voltage</b>                      | ~60-200 Volts                                                                                            |
| <b>Storage and Operation Temperature</b> | -40 to +90°C                                                                                             |
| <b>Transverse Voltage (Delay Time)</b>   | < 0.2μSec (Tested to ITU-T Rec. K.12)                                                                    |
| <b>Arc Voltage</b>                       | ~10 to 35 Volts                                                                                          |
| <b>Holdover Voltage</b>                  | <150mS (Tested to ITU-T Rec. K.12)                                                                       |

### Electrical Characteristics

| Device Specifications (at 25°C) |                      |     |     |                         |                       |                     | Life Ratings          |                           |                             |                            |                              |                              |
|---------------------------------|----------------------|-----|-----|-------------------------|-----------------------|---------------------|-----------------------|---------------------------|-----------------------------|----------------------------|------------------------------|------------------------------|
| Part Number                     | DC Voltage 100V/Sec. |     |     | DC Voltage 100 V/ μSec. | DC Voltage 1kV/ μSec. | Capacitance (@1Mhz) | Insulation Resistance | AC Current 50Hz 1Sec.x10¹ | Surge Current 8/20μSec x10¹ | Max Single Surge 8/20μSec¹ | Max Single Surge 10/350μSec¹ | Surge Life 10/1000 μSecx300¹ |
|                                 | MIN                  | TYP | MAX |                         |                       |                     | MIN                   |                           |                             |                            |                              |                              |
| SL1021B075                      | 60                   | 75  | 90  | 500                     | 650                   | <1.5pF              | >10¹⁰ Ω (at 50V)      | 10Amps                    | 10kA² 20kA³                 | 15kA² 25kA³                | 4kA² 5kA³                    | 200Amps                      |
| SL1021A090<br>SL1021B090        | 72                   | 90  | 108 |                         | 600                   |                     | >10¹⁰ Ω (at 100V)     |                           |                             |                            |                              |                              |
| SL1021A145<br>SL1021B145        | 116                  | 145 | 174 |                         |                       |                     |                       |                           |                             |                            |                              |                              |
| SL1021A150<br>SL1021B150        | 120                  | 150 | 180 |                         |                       |                     |                       |                           |                             |                            |                              |                              |
| SL1021A200                      | 150                  | 200 | 250 | 450                     | 650                   |                     |                       |                           |                             |                            |                              |                              |
| SL1021A230<br>SL1021B230        | 184                  | 230 | 276 |                         |                       |                     |                       |                           |                             |                            |                              |                              |
| SL1021A250<br>SL1021B250        | 200                  | 250 | 300 | 500                     | 700                   |                     |                       |                           |                             |                            |                              |                              |
| SL1021A260<br>SL1021B260        | 210                  | 260 | 310 | 550                     |                       |                     |                       |                           |                             |                            |                              |                              |
| SL1021A300<br>SL1021B300        | 240                  | 300 | 360 | 650                     |                       |                     | 850                   |                           |                             |                            |                              |                              |
| SL1021A350<br>SL1021B350        | 280                  | 350 | 420 | 700                     | 900                   |                     |                       |                           |                             |                            |                              |                              |
| SL1021A400<br>SL1021B400        | 320                  | 400 | 480 | 850                     | 950                   |                     |                       |                           |                             |                            |                              |                              |
| SL1021A420<br>SL1021B420        | 345                  | 420 | 500 |                         |                       |                     |                       |                           |                             |                            |                              |                              |
| SL1021A450<br>SL1021B450        | 360                  | 450 | 540 | 900                     | 1000                  |                     |                       |                           |                             |                            |                              |                              |
| SL1021A500<br>SL1021B500        | 400                  | 500 | 600 | 950                     | 1100                  |                     |                       |                           |                             |                            |                              |                              |
| SL1021A600                      | 480                  | 600 | 720 | 1000                    | 1200                  |                     |                       |                           |                             |                            |                              |                              |

#### NOTES:

1. Total current through centre electrode, tested in accordance with ITU-T Rec K.12
2. SL1021A series
3. SL1021B series

### Additional Information



**Datasheet  
SL1021A**



**Datasheet  
SL1021B**



**Resources  
SL1021A**



**Resources  
SL1021B**

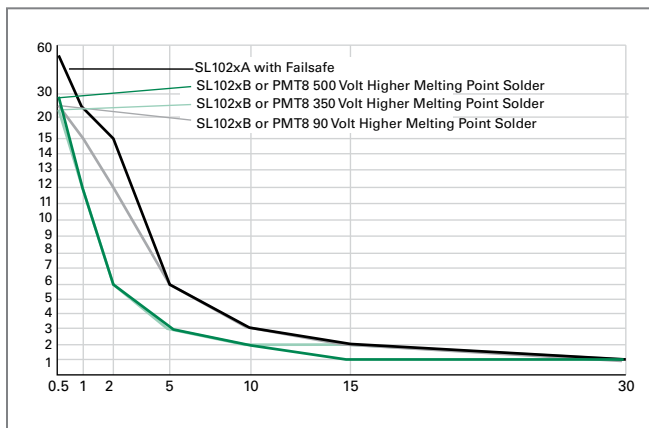


**Samples  
SL1021A**

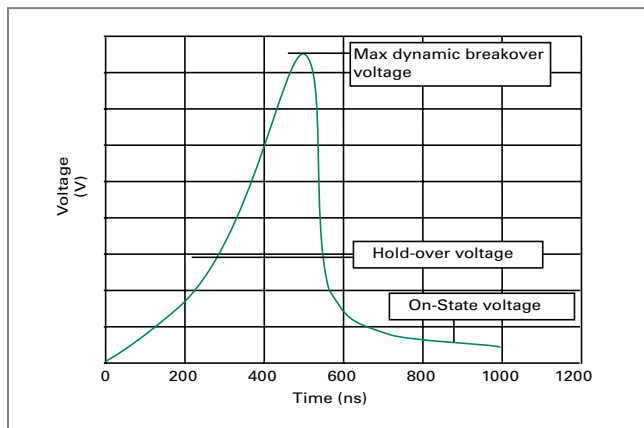


**Samples  
SL1021B**

### Time vs. Current for Failsafe

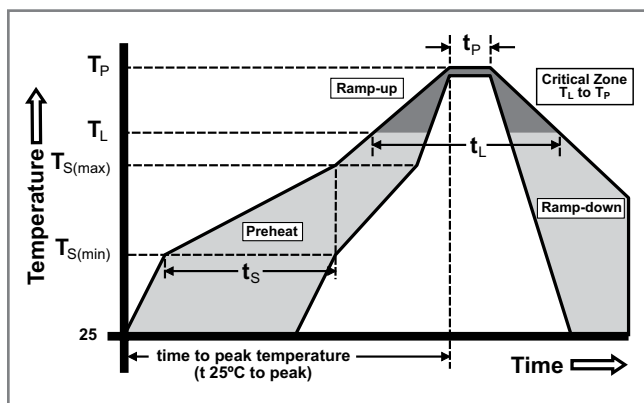


### Voltage vs. Time Characteristic



### Soldering Parameters - Reflow Soldering (Surface Mount Devices)

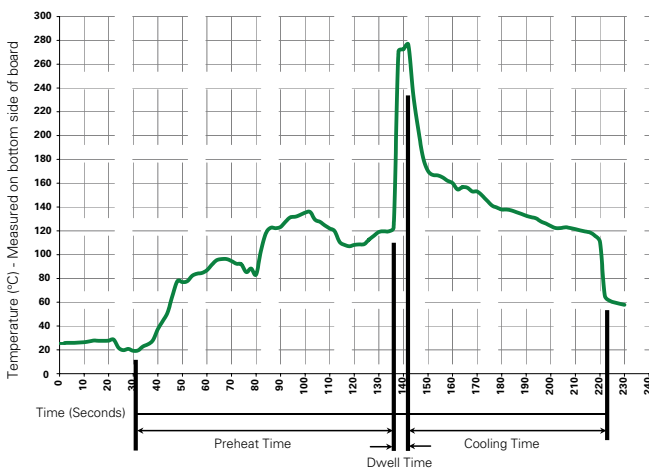
|                                                        |                                    |                         |
|--------------------------------------------------------|------------------------------------|-------------------------|
| Reflow Condition                                       |                                    | Pb – Free assembly      |
| Pre Heat                                               | - Temperature Min ( $T_{s(min)}$ ) | 150°C                   |
|                                                        | - Temperature Max ( $T_{s(max)}$ ) | 200°C                   |
|                                                        | - Time (Min to Max) ( $t_s$ )      | 60 – 180 secs           |
| Average ramp up rate (Liquidus Temp ( $T_L$ ) to peak) |                                    | 3°C/second max          |
| $T_{s(max)}$ to $T_L$ - Ramp-up Rate                   |                                    | 5°C/second max          |
| Reflow                                                 | - Temperature ( $T_L$ ) (Liquidus) | 217°C                   |
|                                                        | - Temperature ( $t_L$ )            | 60 – 150 seconds        |
| Peak Temperature ( $T_p$ )                             |                                    | 260 <sup>+0/-5</sup> °C |
| Time within 5°C of actual peak Temperature ( $t_p$ )   |                                    | 10 – 30 seconds         |
| Ramp-down Rate                                         |                                    | 6°C/second max          |
| Time 25°C to peak Temperature ( $T_p$ )                |                                    | 8 minutes Max.          |
| Do not exceed                                          |                                    | 260°C                   |



### Soldering Parameters - Hand Soldering

Solder Iron Temperature: 350° C +/- 5°C  
Heating Time: 5 seconds max.

### Soldering Parameters - Wave Soldering (Thru-Hole Devices)



### Recommended Process Parameters:

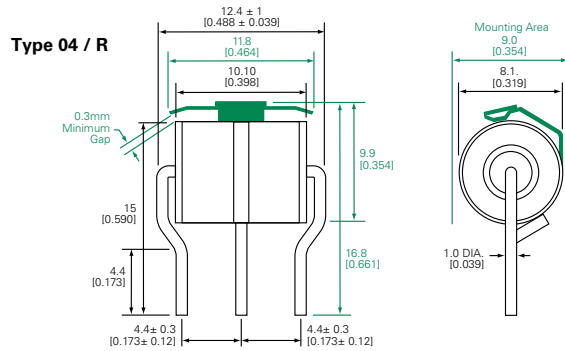
| Wave Parameter                                              | Lead-Free Recommendation |
|-------------------------------------------------------------|--------------------------|
| <b>Preheat:</b><br>(Depends on Flux Activation Temperature) |                          |
| Temperature Minimum:                                        | 100° C                   |
| Temperature Maximum:                                        | 150° C                   |
| Preheat Time:                                               | 60-180 seconds           |
| <b>Solder Pot Temperature:</b>                              |                          |
| Solder Dwell Time:                                          | 2-5 seconds              |

Note: Surge Arrestors with a Failsafe mechanism should be individually examined after soldering

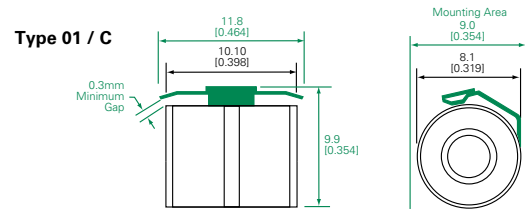
### Device Dimensions

NOTE: Failsafe option dimensions shown in green.

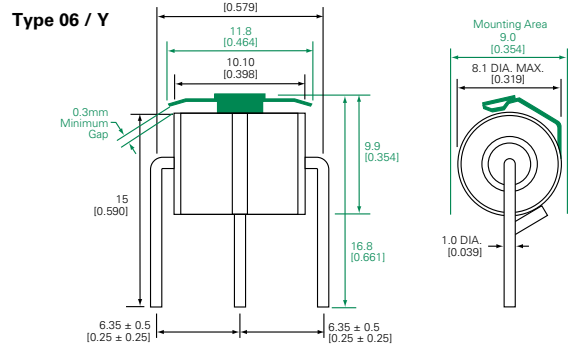
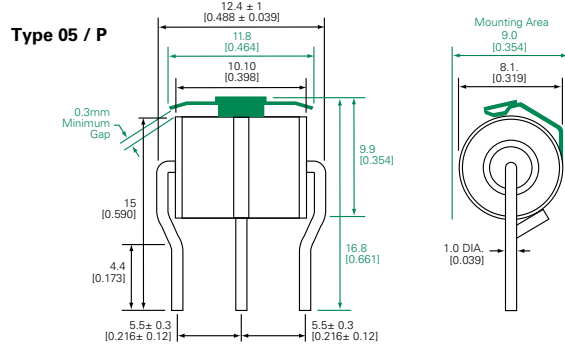
#### Shaped Radial Leaded Devices:



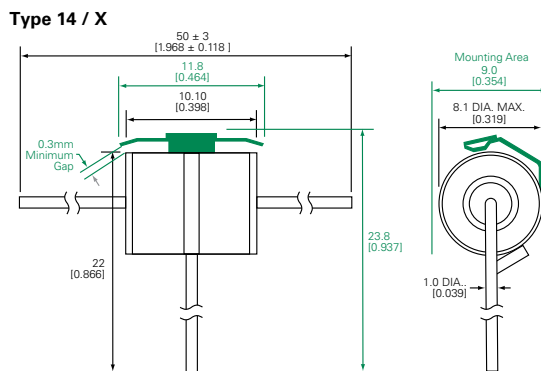
#### Core Devices:



#### Straight Radial Leaded Devices:



#### Straight "T" Leaded Devices:



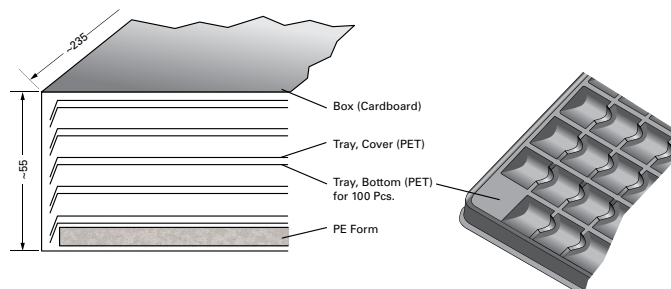
Type "R" is available for SL1021B075 device only.

### Part Numbering System and Ordering Information

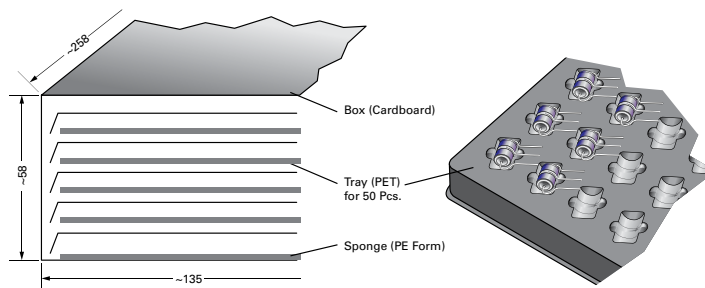
| SL102x x xxx x x                                                                                                                                                                                | PMT8 xxx x x                                                                           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Series<br>SL1021<br>SL1024                                                                                                                                                                      | Series<br>PMT8                                                                         |
| Surge Capability<br>A = 10kA<br>B = 20kA                                                                                                                                                        |                                                                                        |
| Breakdown Voltage<br>090 = 90V 300 = 300V<br>145 = 145V 350 = 350V<br>150 = 150V 400 = 400V<br>200 = 200V 420 = 420V<br>230 = 230V 450 = 450V<br>250 = 250V 500 = 500V<br>260 = 260V 600 = 600V | Breakdown Voltage<br>090 = 90V<br>230 = 230V<br>250 = 250V<br>350 = 350V<br>400 = 400V |
| Configuration Code<br>(See Device Dimensions section)<br>C Y<br>R X<br>P                                                                                                                        | Configuration Code<br>(See Device Dimensions section)<br>01 10<br>04 14<br>05 60<br>06 |
| Option Code<br>Blank = No Fail-safe<br>F or G = With Fail-safe                                                                                                                                  | Option Code<br>Blank = No Fail-safe<br>F = With Fail-safe                              |

### Packaging

#### For 'SL1021A/B' device type C, R, P, Y packing



#### For 'SL1021A/B' device type X packing

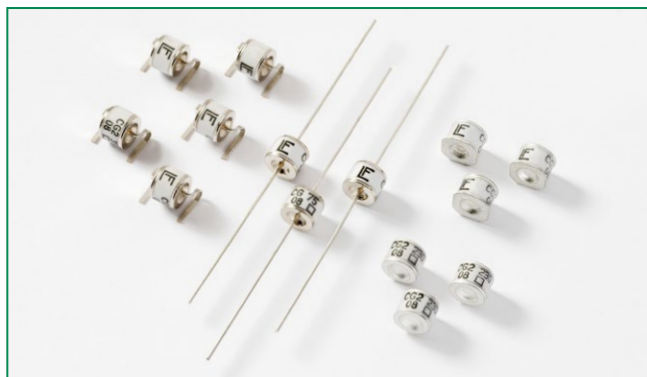


| Device Type | Description                      | Quantity |
|-------------|----------------------------------|----------|
| Type C      | 100pcs/tray x 5 trays per carton | 500      |
| Type R      | 100pcs/tray x 5 trays per carton | 500      |
| Type P      | 100pcs/tray x 5 trays per carton | 500      |
| Type Y      | 100pcs/tray x 5 trays per carton | 500      |
| Type X      | 50pcs/tray x 5 trays per carton  | 250      |

\* Please contact the factory for further packaging information.

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## CG/CG2 Series



### Agency Approvals

| AGENCY | AGENCY FILE NUMBER   |
|--------|----------------------|
|        | E128662 <sup>1</sup> |
|        | E320116 <sup>2</sup> |

**NOTES:**

1. Certified to UL 497B.

2. Only CG2300, CG2470, CG2600, CG2800 and CG221000. Certified to UL 1449.

### 2 Electrode GDT Graphical Symbol



### Additional Information



**Datasheet**



**Resources**



**Samples**

### Description

Littelfuse's highly reliable CG/CG2 Series GDTs provide a high degree of surge protection in a small size ideal for board level circuit protection.

GDTs function as switches which dissipate a minimum amount of energy and therefore handle currents that far surpass other types of transient voltage protection. Their gas-filled, rugged ceramic metal construction make them well suited to adverse environments.

The CG/CG2 series comes in a variety of forms including surface mount, core, straight and shaped leads, to serve a variety of mounting methods.

The CG Series (75V-110V) is ideal for protection of test and communication equipment and other devices in which low voltage limits and extremely low arc voltages are required.

The CG2 Series (145V-1000V) is ideal for protecting equipment where higher voltage limits and holdover voltages are necessary.

### Features

- RoHS and Lead-free compliant
- Rugged Ceramic-Metal construction
- Low Capacitance (<1.5pf)
- Meets REA PE-80
- Available in surface mount, and a variety of lead options options
- RoHS Compliant and Lead-Free

### Applications

- Communication lines and equipment
- CATV equipment
- Test equipment
- Data lines
- Power supplies
- Instrumentation circuits
- Medical electronics
- ADSL equipment
- Telecom SLIC protection

### Electrical Characteristics

| Part Number            | Device Specifications (at 25°C)    |      |      |                                           |                                             |                                 |                        | Life Ratings                                   |                                    |                                               |                                                    |                                         |                                  |                                                             |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|------------------------|------------------------------------|------|------|-------------------------------------------|---------------------------------------------|---------------------------------|------------------------|------------------------------------------------|------------------------------------|-----------------------------------------------|----------------------------------------------------|-----------------------------------------|----------------------------------|-------------------------------------------------------------|-------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
|                        | DC Breakdown in Volts<br>(@100V/s) |      |      | Impulse Break-down in Volts<br>(@100V/μs) | Impulse Break-down In Volts<br>(@1 Kv/μsec) | Insulation Resistance           | Capacitance<br>(@1MHz) | Arc Voltage<br>(on state Voltage)<br>@1Amp Min | Surge Life<br>(@500A<br>10/1000μs) | Nominal Impulse Discharge Current<br>(8/20μs) | Nominal AC Discharge Current<br>(10x1sec @50-60Hz) | AC Discharge Current<br>(9 cycle @50Hz) | DC Holdover Voltage <sup>2</sup> | Max Impulse Discharge Current<br>(1 Application @ 10/350μs) |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                        | MIN                                | TYP  | MAX  | MAX                                       |                                             | MIN                             | MAX                    | TYP                                            |                                    |                                               |                                                    |                                         | TYP                              |                                                             |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CG75                   | 60                                 | 75   | 90   | 400                                       | 650                                         | 10 <sup>10</sup> Ω<br>(at 50V)  | 1.5 pf                 | 15 V                                           | 400 shots                          | 5 shots<br>(@20kA)                            | 20 A                                               | 100 A                                   | 52 V                             | 4kA                                                         |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CG90                   | 72                                 | 90   | 108  | 400                                       | 600                                         |                                 |                        |                                                |                                    |                                               |                                                    |                                         | 80 V                             | 2.5kA                                                       |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CG90 SN                | 72                                 | 90   | 108  | 400                                       | 600                                         |                                 |                        |                                                |                                    |                                               |                                                    |                                         |                                  |                                                             | 135 V |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CG110                  | 88                                 | 110  | 132  | 450                                       | 600                                         | 10 <sup>10</sup> Ω<br>(at 100V) |                        |                                                |                                    |                                               |                                                    |                                         |                                  |                                                             |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CG2145                 | 116                                | 145  | 174  | 500                                       | 600                                         |                                 |                        |                                                |                                    |                                               |                                                    |                                         |                                  |                                                             |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CG2145 SN              | 120                                | 145  | 174  | 500                                       | 600                                         |                                 |                        |                                                |                                    |                                               |                                                    |                                         |                                  |                                                             |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CG2230 <sup>1</sup>    | 195                                | 230  | 265  | 600                                       | 700                                         |                                 |                        |                                                |                                    |                                               |                                                    |                                         |                                  |                                                             |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CG2230 SN <sup>1</sup> | 184                                | 230  | 276  | 600                                       | 700                                         |                                 |                        |                                                |                                    |                                               |                                                    |                                         |                                  |                                                             |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CG2250                 | 213                                | 250  | 288  | 625                                       | 725                                         |                                 |                        |                                                |                                    |                                               |                                                    |                                         |                                  |                                                             |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CG2250 SN              | 200                                | 250  | 300  | 625                                       | 725                                         |                                 |                        |                                                |                                    |                                               |                                                    |                                         |                                  |                                                             |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CG2300                 | 255                                | 300  | 345  | 700                                       | 800                                         |                                 |                        |                                                |                                    |                                               |                                                    |                                         |                                  |                                                             |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CG2300 SN              | 240                                | 300  | 360  | 700                                       | 800                                         |                                 |                        |                                                |                                    |                                               |                                                    |                                         |                                  |                                                             |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CG2350                 | 297                                | 350  | 403  | 750                                       | 900                                         |                                 |                        |                                                |                                    |                                               |                                                    |                                         |                                  |                                                             |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CG2350 SN              | 280                                | 350  | 420  | 750                                       | 900                                         |                                 |                        |                                                |                                    |                                               |                                                    |                                         |                                  |                                                             |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CG2420                 | 357                                | 420  | 483  | 800                                       | 1000                                        |                                 |                        |                                                |                                    |                                               |                                                    |                                         |                                  |                                                             |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CG2470 <sup>1</sup>    | 400                                | 470  | 540  | 850                                       | 1200                                        |                                 |                        |                                                |                                    |                                               |                                                    |                                         |                                  |                                                             |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CG2470 SN <sup>1</sup> | 376                                | 470  | 564  | 850                                       | 1200                                        |                                 |                        |                                                |                                    |                                               |                                                    |                                         |                                  |                                                             |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CG2600 <sup>1</sup>    | 510                                | 600  | 690  | 1000                                      | 1400                                        |                                 |                        |                                                |                                    |                                               |                                                    |                                         |                                  |                                                             |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CG2600 SN <sup>1</sup> | 480                                | 600  | 720  | 1000                                      | 1400                                        |                                 |                        |                                                |                                    |                                               |                                                    |                                         |                                  |                                                             |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CG2800 <sup>1</sup>    | 680                                | 800  | 920  | 1200                                      | 1500                                        |                                 |                        |                                                |                                    |                                               |                                                    |                                         |                                  |                                                             |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CG21000 <sup>1</sup>   | 850                                | 1000 | 1150 | 1500                                      | 1600                                        |                                 |                        |                                                |                                    |                                               |                                                    |                                         |                                  |                                                             |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

#### NOTES:

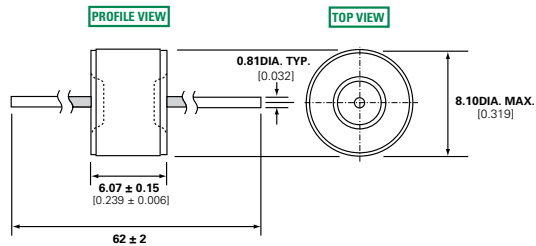
1. Certified to UL 1449.
2. Reference REA PE-80, 0.2A. Tested to ITU-T Rec K.12 and REA PE 80 < 150 mSec.
3. 5 x [5 (+) or 5 (-)] applications 20kA 8/20μSec. (75 to 600 volt devices.)  
 10 x [5 (+) and 5 (-)] applications 10kA 8/20μSec. (800 and 100 volt devices.)

### Product Characteristics

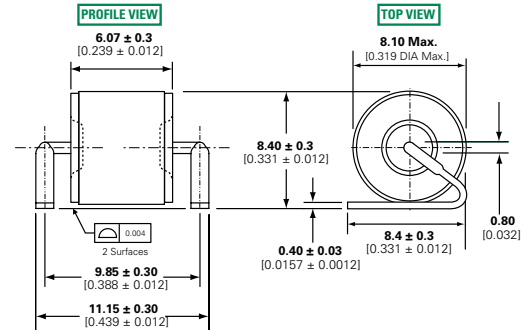
|                        |                                                                                                                                      |                                              |                                                                                     |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|-------------------------------------------------------------------------------------|
| <b>Materials</b>       | <b>LS, Axial:</b><br>Device: Tin Plated 2–5 Microns<br>Lead Wires: Tin Plated 17.5 ± 12.5 Microns<br>Construction: Ceramic Insulator | <b>Glow to arc transition current</b>        | < 0.5Amps                                                                           |
|                        | <b>Core:</b><br>Device: Tin Plated 17.5 ± 12.5 Microns.<br>Construction: Ceramic Insulator                                           | <b>Glow Voltage</b>                          | 60-160 Volts                                                                        |
| <b>Product Marking</b> | LF Logo, Voltage and date code; Black in positive print                                                                              | <b>Storage and Operational Temperature</b>   | -40 to +90                                                                          |
|                        |                                                                                                                                      | <b>Maximum Follow On Current<sup>1</sup></b> | 230 Volts r.m.s, 200 Amps.<br>(800V and 1000V devices tested to UL1449 3rd edition) |

### Device Dimensions

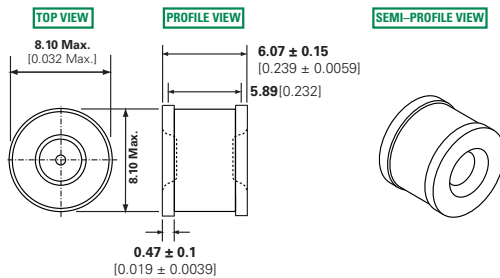
#### Leaded 'L' Type Straight Axial Devices



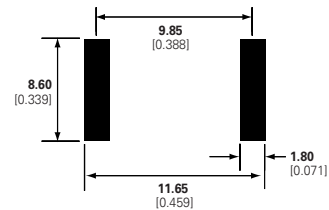
#### Leaded 'LS' Type Shaped Lead Devices



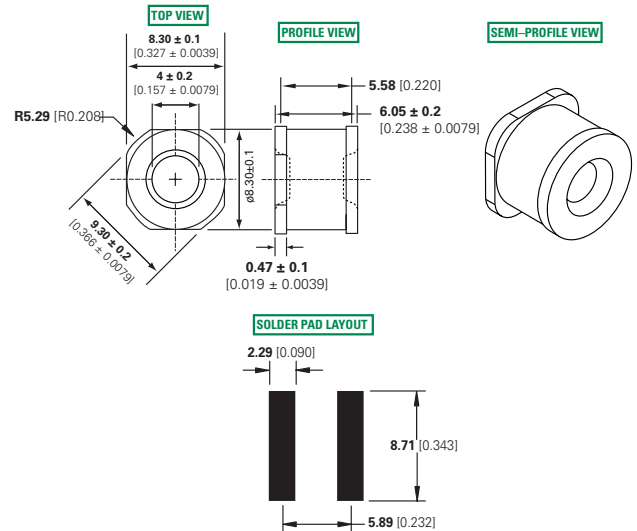
#### Core Devices



#### SOLDER PAD LAYOUT

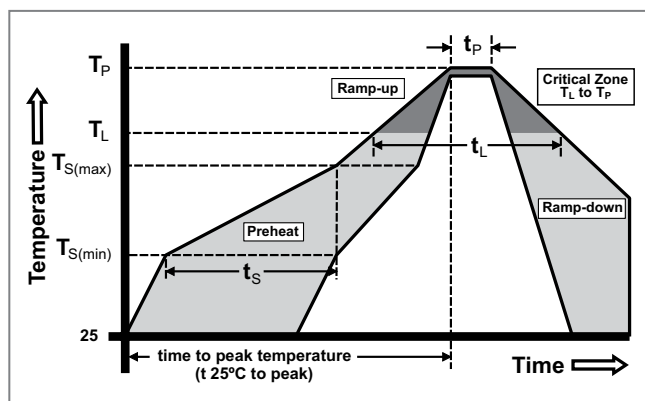


#### 'MS' Type Devices

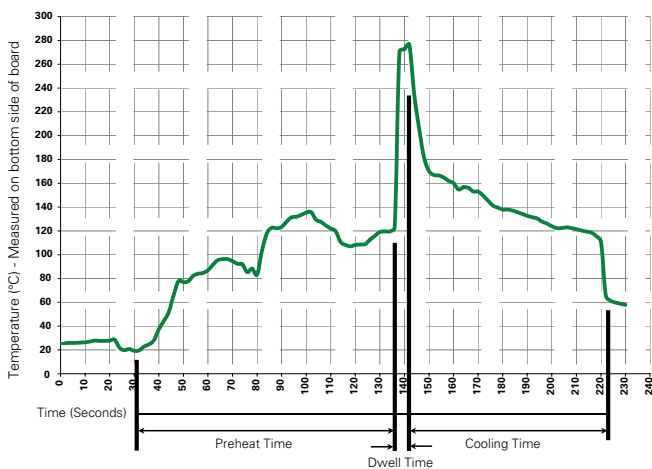


### Soldering Parameters - Reflow Soldering (Surface Mount Devices)

|                                                       |                                    |                         |
|-------------------------------------------------------|------------------------------------|-------------------------|
| Reflow Condition                                      |                                    | Pb – Free assembly      |
| Pre Heat                                              | - Temperature Min ( $T_{s(min)}$ ) | 150°C                   |
|                                                       | - Temperature Max ( $T_{s(max)}$ ) | 200°C                   |
|                                                       | - Time (Min to Max) ( $t_s$ )      | 60 – 180 secs           |
| Average ramp up rate (Liquidus Temp ( $T_L$ ) to peak |                                    | 3°C/second max          |
| $T_{s(max)}$ to $T_L$ - Ramp-up Rate                  |                                    | 5°C/second max          |
| Reflow                                                | - Temperature ( $T_L$ ) (Liquidus) | 217°C                   |
|                                                       | - Temperature ( $t_L$ )            | 60 – 150 seconds        |
| Peak Temperature ( $T_p$ )                            |                                    | 260 <sup>+0/-5</sup> °C |
| Time within 5°C of actual peak Temperature ( $t_p$ )  |                                    | 10 – 30 seconds         |
| Ramp-down Rate                                        |                                    | 6°C/second max          |
| Time 25°C to peak Temperature ( $T_p$ )               |                                    | 8 minutes Max.          |
| Do not exceed                                         |                                    | 260°C                   |



### Soldering Parameters - Wave Soldering (Thru-Hole Devices)



### Recommended Process Parameters:

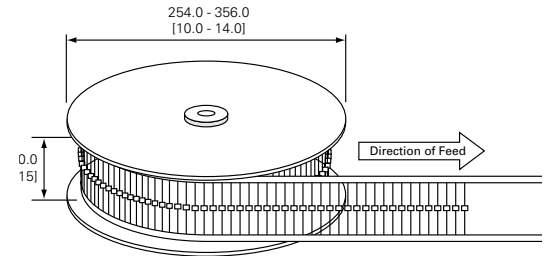
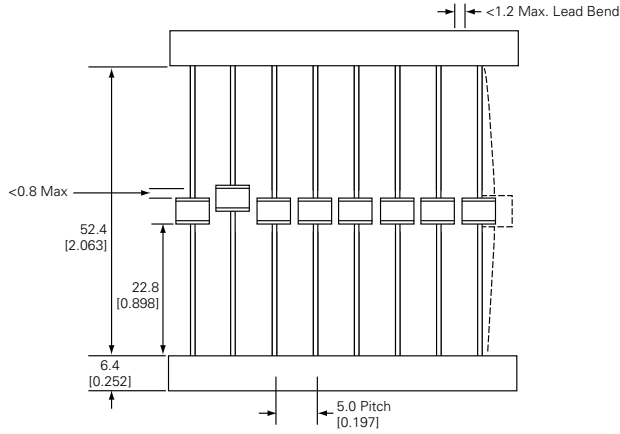
| Wave Parameter                                                                                | Lead-Free Recommendation |
|-----------------------------------------------------------------------------------------------|--------------------------|
| <b>Preheat:</b><br>(Depends on Flux Activation Temperature) (Typical Industry Recommendation) |                          |
| Temperature Minimum:                                                                          | 100° C                   |
| Temperature Maximum:                                                                          | 150° C                   |
| Preheat Time:                                                                                 | 60-180 seconds           |
| <b>Solder Pot Temperature:</b>                                                                | 280° C Maximum           |
| <b>Solder Dwell Time:</b>                                                                     | 2-5 seconds              |

### Soldering Parameters - Hand Soldering

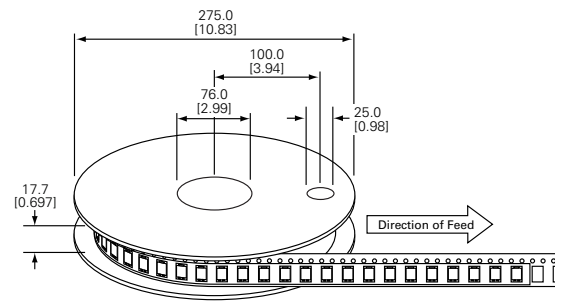
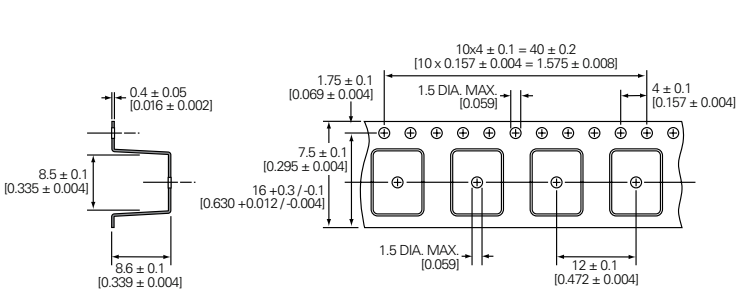
Solder Iron Temperature: 350° C +/- 5°C  
Heating Time: 5 seconds max.

### Packaging Dimensions

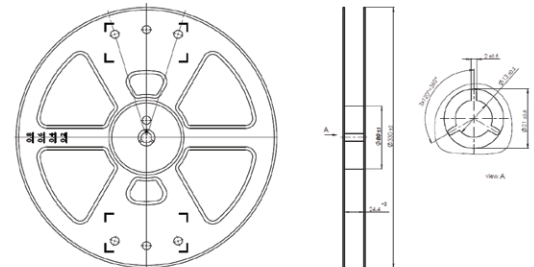
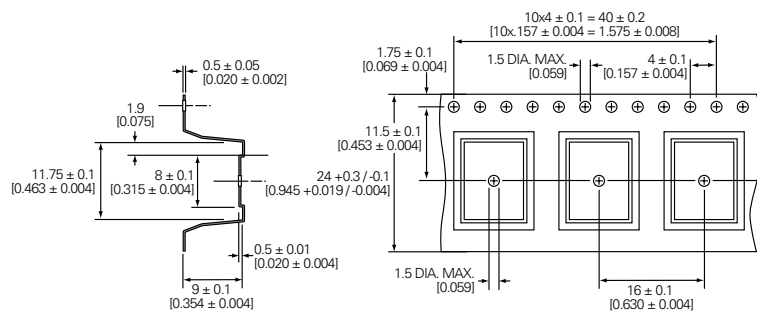
#### For 'L' Type Axial Lead Items



#### Core and 'MS' Type Items



#### For 'LS' Type Shaped Lead Items



### Part Numbering System and Ordering Information

**CG2 XXX XX \* XX**

#### Series

**CG** – for 75, 90, or 110V  
**CG2** – for 145V to 1000V

#### Breakdown Voltage

|            |             |
|------------|-------------|
| <b>75</b>  | <b>300</b>  |
| <b>90</b>  | <b>350</b>  |
| <b>110</b> | <b>470</b>  |
| <b>145</b> | <b>600</b>  |
| <b>230</b> | <b>800</b>  |
| <b>250</b> | <b>1000</b> |

#### Lead Option Code

(Blank) = No Leads / Core  
**L** = Straight Leads  
**LS** = Shaped Leads  
**MS** = Surface Mount

#### Option Code\*

SN = may have different DC Breakover Voltage Limit. Please refer to Electrical Characteristics table for additional information.

#### Packaging Option Code

(Blank) = No Leads / Core, Bulk Bag - 400 pcs  
L(Blank) = Straight Lead, Tray - 50 pcs  
**LTR** = Straight Lead, Tape & Reel per EIA RS-296-E - 500 per reel  
LS(Blank) = Shaped Lead (see LS dimensions), Tape & Reel - 500 per reel

#### Examples:

**CG75** – A non-leaded 75V device

**CG2230L** – A leaded 230V device

**CG2800LTR** – A leaded 800V device, tape-and-reel (per EIA standard RS-296-D)

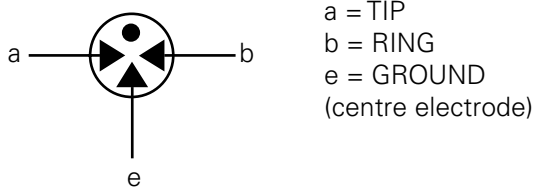
#### Notes:

CG/CG2 devices with other breakdown voltages in the 75-1000 V range are available upon request.

## SL1026 Series



### 3 Electrode GDT Graphical Symbol



### Additional Information



Datasheet



Resources



Samples

### Description

The SL1026 Series is a heavy-duty transient suppressor using Gas Plasma technology. In response to transients that exceed the device's breakover voltage, the device changes from a very high impedance state to a low impedance state to conduct harmful current away from the protected system. The SL1026 is designed to protect electrical and electronic equipment such as communications, control and railway systems. Carefully designed geometry ensures against short circuiting if a failure occurs due to conditions and events beyond the design criteria. Optional electrical mounting clip (part SL1053 ) is available to aid mounting and connection.

### Features

- RoHS compliant
- 55 kA surge capability (single shot) tested with 8/20 $\mu$ S pulse as defined by IEC 61000-4-5
- 40 kA surge capability (repetitive)
- Will protect against Trapezoidal waveforms as specified in RIA 12.
- Will protect against capacitor discharge voltage transient waveforms as specified in RIA 12.
- Will protect against double exponential voltage transient waveforms as specified in IEC 571.

### Applications

- Signaling equipment.
- Communication equipment
- Control gear.
- Trackside cabinets.
- Cell phone base stations

### Electrical Characteristics

| Part Number* | DC Voltage<br>100 V/sec |     | DC<br>Voltage<br>1kV/ $\mu$ s | <sup>1</sup> AC<br>Current<br>9 cycles<br>@ 50-60Hz<br>(Amps) | <sup>1</sup> AC<br>Current<br>50Hz<br>1 sec x10<br>(Amps) | <sup>1</sup> Surge<br>Current<br>8/20 $\mu$ Sec<br>x 10<br>(kAmps) | <sup>1,2</sup> Max<br>Single<br>Surge<br>8/20 $\mu$ Sec<br>(kAmps) | <sup>1</sup> Max Single<br>Surge<br>10/350 $\mu$ Sec<br>(kAmps) | <sup>1</sup> 150(+) and 150(-)<br>10/1000 $\mu$ Sec<br>(Amps) |
|--------------|-------------------------|-----|-------------------------------|---------------------------------------------------------------|-----------------------------------------------------------|--------------------------------------------------------------------|--------------------------------------------------------------------|-----------------------------------------------------------------|---------------------------------------------------------------|
|              | MIN                     | MAX |                               |                                                               |                                                           |                                                                    |                                                                    |                                                                 |                                                               |
| SL1026-275   | 200                     | 350 | 800                           | 200                                                           | 10                                                        | 20                                                                 | 40                                                                 | 8                                                               | 200                                                           |
| SL1026-400   | 300                     | 500 | 900                           | 200                                                           | 10                                                        | 20                                                                 | 40                                                                 | 8                                                               | 200                                                           |
| SL1026-700   | 560                     | 840 | 1300                          | 200                                                           | 10                                                        | 20                                                                 | 40                                                                 | 8                                                               | 200                                                           |

#### NOTES:

End of life limits

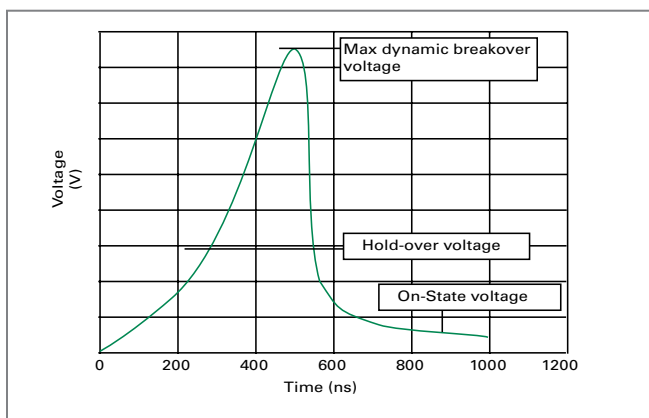
– DC: 50% of minimum initial DC breakdown voltage limit to 150% of maximum initial DC breakdown voltage limit.

– Impulse: less than 150% of initial impulse breakdown voltage limit.

1. Total current through center electrode, tested using SL1053B-NL holder

2. Exceeds capability of SL1053B-NL holder

### Voltage vs. Time Characteristic



### Electrical Specifications

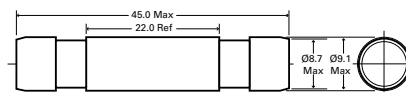
|                                        |                                                                      |
|----------------------------------------|----------------------------------------------------------------------|
| <b>Insulation Resistance</b>           | > 10GΩ at 100 Volts                                                  |
| <b>Capacitance:</b>                    | <=2.5pf, 1MHz 0 Volts Bias                                           |
| <b>Holdover Voltage:</b>               | <150mS, tested at 130 volts according to ITU-T Rec. K.12 & REA PE 80 |
| <b>Arc Voltage:</b>                    | ~35 Volts, On State Voltage at 1 Amp (Depending on Voltage Type)     |
| <b>Glow to Arc Transition Current:</b> | ~1 Amp                                                               |
| <b>Glow Voltage:</b>                   | > 150 Volts, depending on Voltage Type                               |

### Physical Specifications

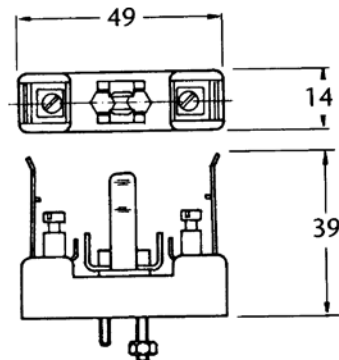
|                                           |                                                                                                  |
|-------------------------------------------|--------------------------------------------------------------------------------------------------|
| <b>Weight:</b>                            | 11g (0.388 oz.)                                                                                  |
| <b>Materials:</b>                         | Electrode Base: Nickel Iron Alloy<br>Electrode Plating: Nickel<br>Body: Ceramic                  |
| <b>Part Marking:</b>                      | Color coded body<br>SL1026-275: Black/Black<br>SL1026-400: Black/Yellow<br>SL1026-700: Black/Red |
| <b>Storage and Operating Temperature:</b> | -40°C to +90°C                                                                                   |

### Product Dimensions

#### SL1026 GDT Series Profile



#### Type 1053 Holder Profile



All dimensions in mm

### Part Numbering System

SL 1026          

Voltage          

### Packaging

GDT devices are provided as bulk pack in poly bag – 20 pieces per bag and 5 bags per carton.

## SE Series



### Agency Approvals

| AGENCY | AGENCY FILE NUMBER |
|--------|--------------------|
|        | E128662            |

### 2 Electrode GDT Graphical Symbol



### Additional Information



**Datasheet**



**Resources**



**Samples**

### Description

Littelfuse SE series GDT offers high surge ratings in a miniature package. It's designed for surface mounting on PCB with small size 3.2x1.6x1.6mm. Low insertion loss is perfectly suited to broadband equipment applications. The capacitance does not vary with voltage, and will not cause operational problems with ADSL2+, where capacitance variation across Tip and Ring is undesirable. These devices are extremely robust and are able to divert a 500A-600A pulse in a miniature package 1206 without destruction.

### Features

- RoHS compliant and Lead-free
- GHz working frequency
- Excellent stability on multiple pulse duty cycle
- Excellent response to fast rising transients.
- Ultra Low Insertion Loss
- 0.5-0.6KA surge capability tested with 8/20μS pulse as defined by IEC 61000-4-5
- Ultra small devices offered in a variety of mounting lead forms
- Non-Radioactive
- Low capacitance (<0.5pF)
- Voltage Ranges 140V to 500V
- UL recognized
- Conforms to ITU-T K12, IEC 1000-4-5
- Square Outline

### Applications

- Communication equipment
- CATV equipment
- Test equipment
- Data lines
- Power supplies
- Telecom SLIC protection
- Broadband equipment
- ADSL equipment, including ADSL2+
- XDSL equipment
- Satellite and CATV equipment
- General telecom equipment

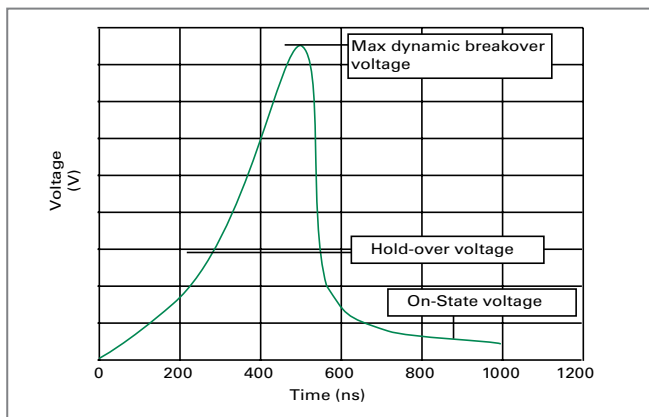
### Electrical Characteristics

| Part Number | Device Specifications (at 25°C) |     |     |                                       |                                         |                       |                     |                   | Life Ratings                   |              |
|-------------|---------------------------------|-----|-----|---------------------------------------|-----------------------------------------|-----------------------|---------------------|-------------------|--------------------------------|--------------|
|             | DC Breakdown in Volts (@100V/s) |     |     | Impulse Breakdown in Volts (@100V/μs) | Impulse Breakdown in Volts (@1 Kv/μsec) | Insulation Resistance | Capacitance (@1MHz) | Arc Voltage (@1A) | Glow to Arc Transition Current | Glow Voltage |
|             | MIN                             | TYP | MAX | MAX                                   |                                         | MIN                   | MAX                 |                   |                                |              |
| SE140       | 98                              | 140 | 182 | 800                                   | 900                                     | >1GΩ (at 100VDC)      | <0.5 pf             | ~10 V             | <1.0 A                         | ~60 V        |
| SE200       | 140                             | 200 | 260 | 700                                   | 1100                                    |                       | <0.3 pf             |                   | <1.0 A                         |              |
| SE230       | 172                             | 230 | 276 | 600                                   | 800                                     |                       | <0.5 pf             |                   | <1.0 A                         |              |
| SE350       | 265                             | 350 | 495 | 900                                   | 1150                                    |                       | <0.5 pf             |                   | <1.0 A                         |              |
| SE470       | 329                             | 470 | 611 | 1050                                  | 1200                                    |                       | <0.3 pf             |                   | <1.0 A                         |              |
| SE500       | 400                             | 500 | 600 | 1050                                  | 1200                                    |                       | <0.3 pf             |                   | <1.0 A                         |              |
|             |                                 |     |     |                                       |                                         |                       |                     |                   | 0.5 kA                         |              |
|             |                                 |     |     |                                       |                                         |                       |                     |                   | 0.5 kA                         |              |
|             |                                 |     |     |                                       |                                         |                       |                     |                   | 0.5 kA                         |              |
|             |                                 |     |     |                                       |                                         |                       |                     |                   |                                | 150 A        |

### Product Characteristics

|                                            |                                                                        |
|--------------------------------------------|------------------------------------------------------------------------|
| <b>Materials</b>                           | Device Tin Plated 17.5±12.5 Microns<br>Construction Ceramic Insulator. |
| <b>Storage and Operational Temperature</b> | -40 to +90 °C                                                          |

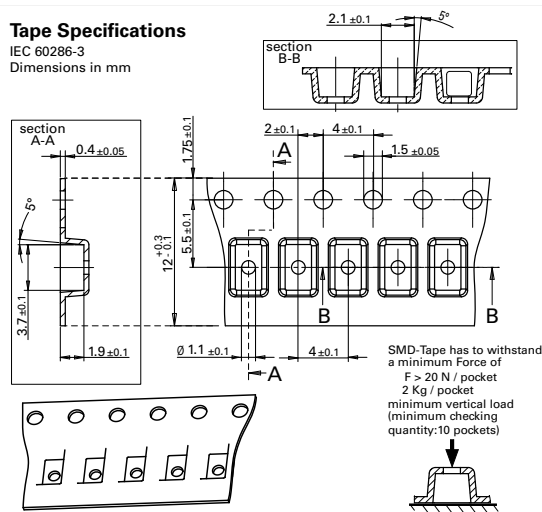
### Voltage vs. Time Characteristic



### Tape and Reel Dimensions (IEC 60286-3, dimension in mm)

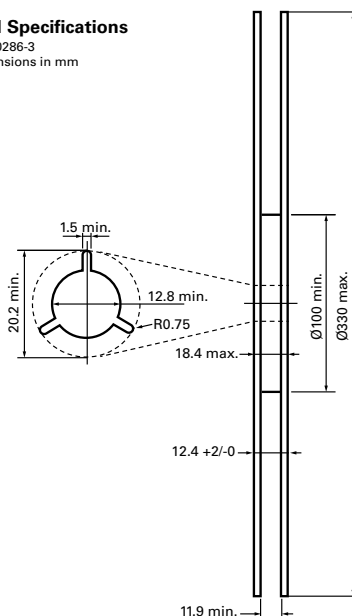
#### Tape Specifications

IEC 60286-3  
Dimensions in mm



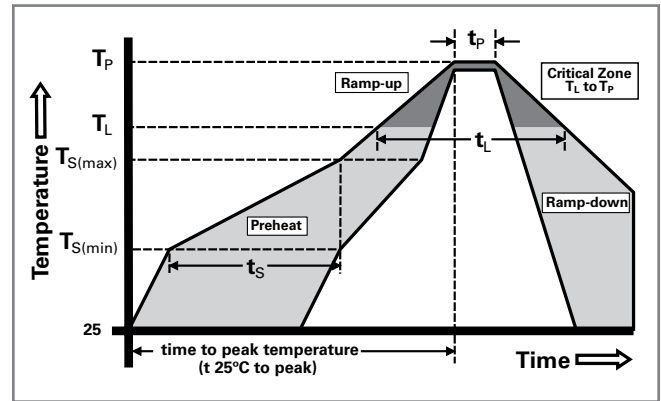
#### Reel Specifications

IEC 60286-3  
Dimensions in mm

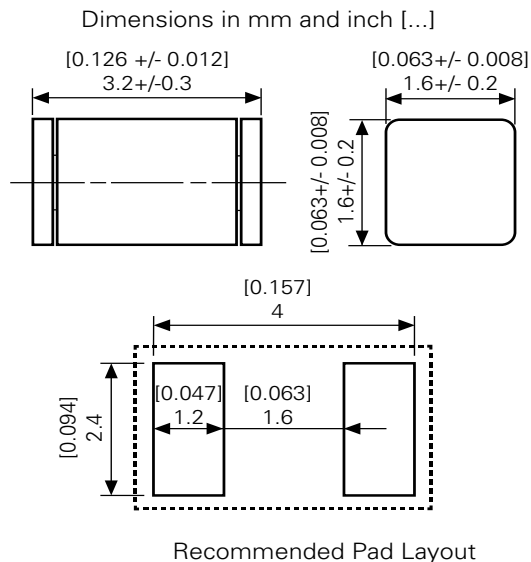


### Soldering Parameters - Reflow Soldering (Surface Mount Devices)

|                                                       |                                    |                         |
|-------------------------------------------------------|------------------------------------|-------------------------|
| Reflow Condition                                      |                                    | Pb – Free assembly      |
| Pre Heat                                              | - Temperature Min ( $T_{s(min)}$ ) | 150°C                   |
|                                                       | - Temperature Max ( $T_{s(max)}$ ) | 200°C                   |
|                                                       | - Time (Min to Max) ( $t_s$ )      | 60 – 180 secs           |
| Average ramp up rate (Liquidus Temp ( $T_L$ ) to peak |                                    | 3°C/second max          |
| $T_{s(max)}$ to $T_L$ - Ramp-up Rate                  |                                    | 5°C/second max          |
| Reflow                                                | - Temperature ( $T_L$ ) (Liquidus) | 217°C                   |
|                                                       | - Temperature ( $t_L$ )            | 60 – 150 seconds        |
| Peak Temperature ( $T_p$ )                            |                                    | 260 <sup>+0/-5</sup> °C |
| Time within 5°C of actual peak Temperature ( $t_p$ )  |                                    | 10 – 30 seconds         |
| Ramp-down Rate                                        |                                    | 6°C/second max          |
| Time 25°C to peak Temperature ( $T_p$ )               |                                    | 8 minutes Max.          |
| Do not exceed                                         |                                    | 260°C                   |



### Device Dimensions



### Part Numbering System and Ordering Information

**SE xxx**

Series ———

1206 Square GDT

Breakdown Voltage ———

140 = 140V  
200 = 200V  
230 = 230V  
350 = 350V  
470 = 470V  
500 = 500V

### Packaging

| Part Number | Packaging Option | Quantity |
|-------------|------------------|----------|
| SE140       | Tape and Reel    | 3,000    |
| SE200       | Tape and Reel    | 3,000    |
| SE230       | Tape and Reel    | 3,000    |
| SE350       | Tape and Reel    | 3,000    |
| SE470       | Tape and Reel    | 3,000    |
| SE500       | Tape and Reel    | 3,000    |

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### SG Series



#### Agency Approvals

| AGENCY | AGENCY FILE NUMBER |
|--------|--------------------|
|        | E128662            |

#### 2 Electrode GDT Graphical Symbol



#### Additional Information



Datasheet



Resources



Samples

#### Description

Littelfuse SG series GDT offers high surge ratings in a miniature package. It's designed for surface mounting on PCB with small size 4.5x3.2x2.7mm. Low insertion loss is perfectly suited to broadband equipment applications. The capacitance does not vary with voltage, and will not cause operational problems with ADSL2+, where capacitance variation across Tip and Ring is undesirable. These devices are extremely robust and are able to divert a 1000A pulse without destruction.

#### Features

- RoHS compliant and Lead-free
- GHz working frequency
- Excellent stability on multiple pulse duty cycle
- Excellent response to fast rising transients.
- Ultra Low Insertion Loss
- 1-2KA surge capability tested with 8/20μS pulse as defined by IEC 61000-4-5
- Ultra small devices offered in a variety of mounting lead forms
- Non-Radioactive
- Low capacitance (<1pF)
- Voltage Ranges 75V to 600V
- UL recognized
- Conforms to ITU-T K12, IEC 1000-4-5
- Square Outline

#### Applications

- Communication equipment
- CATV equipment
- Test equipment
- Data lines
- Power supplies
- Telecom SLIC protection
- Broadband equipment
- ADSL equipment, including ADSL2+
- XDSL equipment
- Satellite and CATV equipment
- General telecom equipment

### Electrical Characteristics

| Part Number | Device Specifications (at 25°C)    |     |     |                                          |                                            |                       |                        |                      |                                | Life Ratings |                                             |                                                    |                                                             |
|-------------|------------------------------------|-----|-----|------------------------------------------|--------------------------------------------|-----------------------|------------------------|----------------------|--------------------------------|--------------|---------------------------------------------|----------------------------------------------------|-------------------------------------------------------------|
|             | DC Breakdown in Volts<br>(@100V/s) |     |     | Impulse Breakdown in Volts<br>(@100V/μs) | Impulse Breakdown In Volts<br>(@1 Kv/μsec) | Insulation Resistance | Capacitance<br>(@1MHz) | Arc Voltage<br>(@1A) | Glow to Arc Transition Current | Glow Voltage | Nominal AC Discharge Current<br>(x10 @50Hz) | Nominal Impulse Discharge Current<br>(x10 @8/20μs) | Nominal Impulse Discharge Current<br>(10/1000μs 100 cycles) |
|             | MIN                                | TYP | MAX | MAX                                      |                                            | MIN                   | MAX                    |                      |                                |              |                                             |                                                    |                                                             |
| SG75        | 52                                 | 75  | 98  | 500                                      | 650                                        | >1GΩ<br>(at 50VDC)    | <1 pf                  | ~10 V                | ~1.0 A                         | ~60 V        | 2 A                                         | 2kA                                                | 10 A                                                        |
| SG90        | 63                                 | 90  | 117 | 500                                      | 600                                        |                       |                        |                      |                                |              |                                             |                                                    |                                                             |
| SG150       | 105                                | 150 | 195 | 500                                      | 600                                        |                       |                        |                      |                                |              |                                             |                                                    |                                                             |
| SG200       | 140                                | 200 | 260 | 550                                      | 700                                        | >1GΩ<br>(at 100VDC)   | <1 pf                  | ~12 V                | ~0.5 A                         | ~90 V        | 2.5 A                                       | 1kA                                                |                                                             |
| SG230       | 172                                | 230 | 288 | 650                                      | 800                                        | >1GΩ<br>(at 50VDC)    |                        |                      |                                |              |                                             |                                                    |                                                             |
| SG300       | 225                                | 300 | 375 | 700                                      | 850                                        |                       |                        |                      |                                |              |                                             |                                                    |                                                             |
| SG300Q      | 210                                | 300 | 390 | 580                                      | 650                                        |                       |                        |                      |                                |              |                                             |                                                    |                                                             |
| SG350       | 263                                | 350 | 437 | 750                                      | 900                                        | <0.8 pf               | ~12 V                  | ~0.5 A               | ~90 V                          | 2 A          |                                             |                                                    |                                                             |
| SG350Q      | 263                                | 350 | 437 | 600                                      | 700                                        |                       |                        |                      | ~140 V                         | NA*          |                                             |                                                    |                                                             |
| SG400       | 300                                | 400 | 500 | 800                                      | 950                                        |                       |                        |                      | ~90 V                          | 2 A          |                                             |                                                    |                                                             |
| SG420       | 315                                | 420 | 525 | 800                                      | 1000                                       | <1 pf                 | ~10 V                  | <1.0 A               | ~60 V                          | 2 A          |                                             |                                                    |                                                             |
| SG420Q      | 315                                | 420 | 525 | 650                                      | 750                                        |                       | ~20 V                  |                      | NA*                            |              |                                             |                                                    |                                                             |
| SG450Q      | 370                                | 450 | 500 | 680                                      | 750                                        |                       | ~20 V                  |                      | 1 A                            |              |                                             |                                                    |                                                             |
| SG500Q      | 400                                | 500 | 600 | 950                                      | 1050                                       | >1GΩ<br>(at 100VDC)   | <0.5 pf                | ~16 V                | ~0.1 A                         | ~140 V       | 2 A                                         |                                                    |                                                             |
| SG600Q      | 450                                | 600 | 750 | 1100                                     | 1200                                       |                       | <1 pf                  | ~20 V                | <0.5 A                         |              |                                             |                                                    |                                                             |

\* Specification is not applicable for quick response (SGxxxQ) version of product

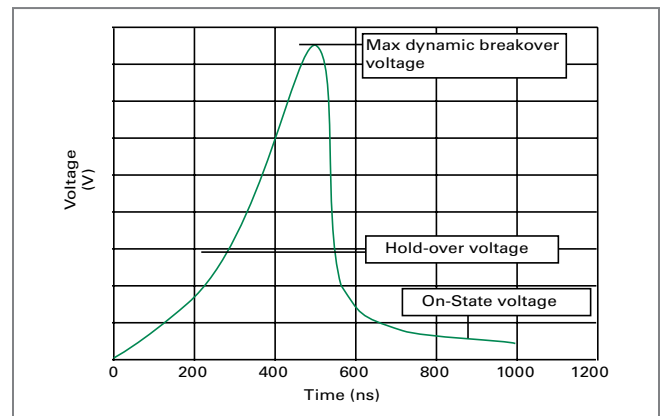
### Product Characteristics

|                                            |                                                                        |
|--------------------------------------------|------------------------------------------------------------------------|
| <b>Materials</b>                           | Device Tin Plated 17.5±12.5 Microns<br>Construction Ceramic Insulator. |
| <b>Storage and Operational Temperature</b> | -40 to +90 °C                                                          |

### Typical Insertion Loss

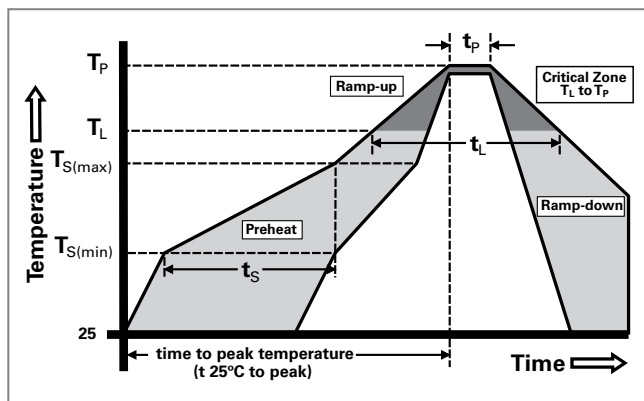
|                     |
|---------------------|
| @ 1.0 GHz = 0.01 dB |
| @ 1.4GHz = 0.1 dB   |
| @ 1.8 GHz = 0.53 dB |
| @ 2.1 GHz = 0.81 dB |
| @ 2.45 GHz= 1 dB    |
| @ 2.8 GHz = 1.2 dB  |
| @ 3.1 GHz = 1.5 dB  |
| @ 3.5 GHz = 2.1 dB  |

### Voltage vs. Time Characteristic

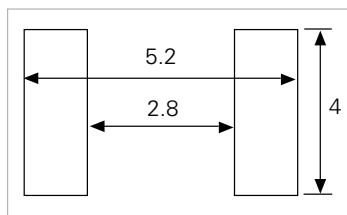
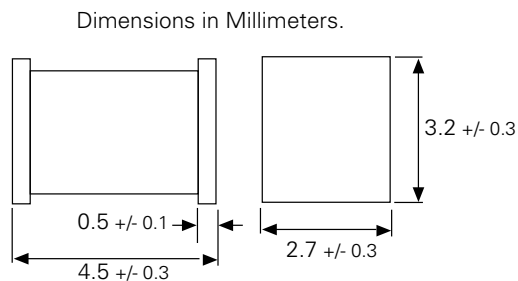


## Soldering Parameters - Reflow Soldering (Surface Mount Devices)

|                                                       |                                    |                         |
|-------------------------------------------------------|------------------------------------|-------------------------|
| Reflow Condition                                      |                                    | Pb – Free assembly      |
| Pre Heat                                              | - Temperature Min ( $T_{s(min)}$ ) | 150°C                   |
|                                                       | - Temperature Max ( $T_{s(max)}$ ) | 200°C                   |
|                                                       | - Time (Min to Max) ( $t_s$ )      | 60 – 180 secs           |
| Average ramp up rate (Liquidus Temp ( $T_L$ ) to peak |                                    | 3°C/second max          |
| $T_{s(max)}$ to $T_L$ - Ramp-up Rate                  |                                    | 5°C/second max          |
| Reflow                                                | - Temperature ( $T_L$ ) (Liquidus) | 217°C                   |
|                                                       | - Temperature ( $t_L$ )            | 60 – 150 seconds        |
| Peak Temperature ( $T_p$ )                            |                                    | 260 <sup>+0/-5</sup> °C |
| Time within 5°C of actual peak Temperature ( $t_p$ )  |                                    | 10 – 30 seconds         |
| Ramp-down Rate                                        |                                    | 6°C/second max          |
| Time 25°C to peak Temperature ( $T_p$ )               |                                    | 8 minutes Max.          |
| Do not exceed                                         |                                    | 260°C                   |

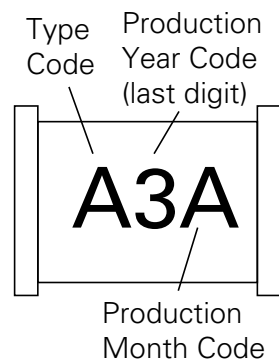


## Device Dimensions



Recommended Soldering Pad Layout

## Device Marking

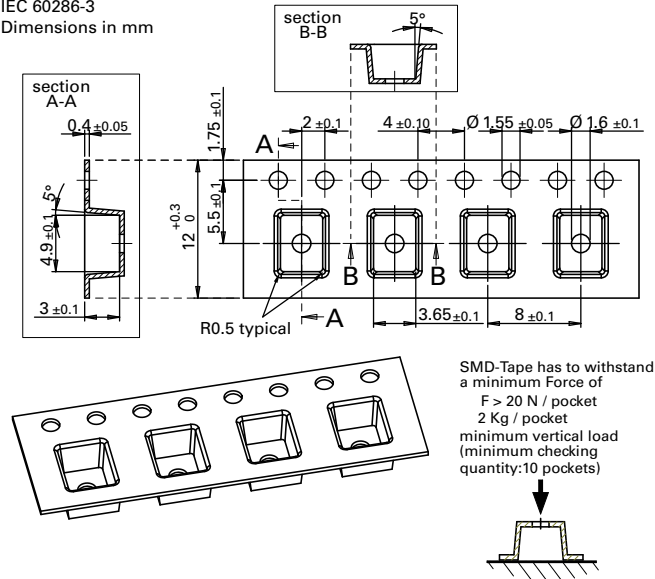


| Type Code | Month Code  |
|-----------|-------------|
| A SG75    | A January   |
| B SG90    | B February  |
| C SG150   | C March     |
| D SG230   | D April     |
| E SG300   | E May       |
| F SG300Q  | F June      |
| G SG350   | G July      |
| H SG350Q  | H August    |
| I SG400   | I September |
| J SG420   | J October   |
| K SG420Q  | K November  |
| L SG450Q  | L December  |
| M SG500Q  |             |
| N SG600Q  |             |
| O SG200   |             |

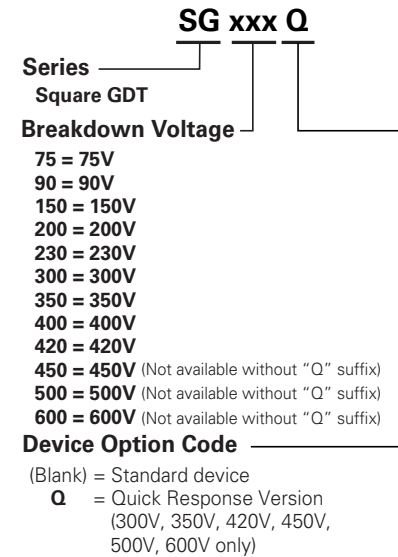
### Tape and Reel Dimensions (IEC 60286-3, dimension in mm)

#### Tape Specifications

IEC 60286-3  
Dimensions in mm

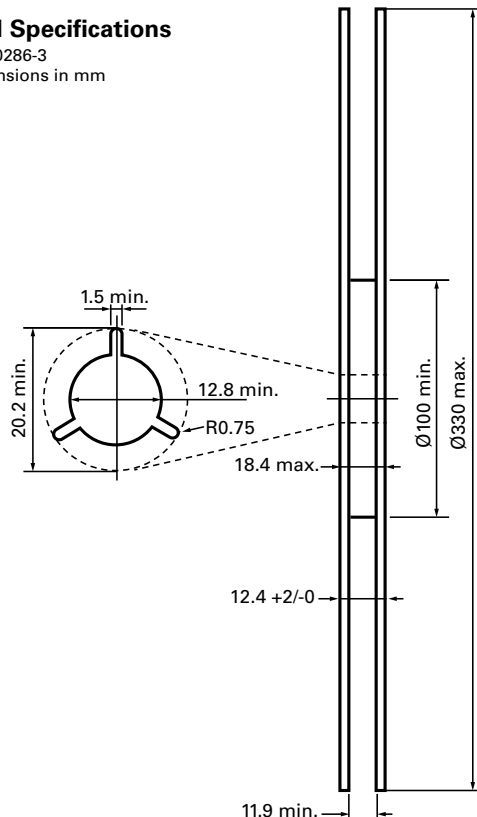


### Part Numbering System and Ordering Information



#### Reel Specifications

IEC 60286-3  
Dimensions in mm



### Packaging

| Part Number and Device Type |               | Quantity and Packaging Description |
|-----------------------------|---------------|------------------------------------|
| SGxxx                       | Surface mount | 2000pcs/reel in tape and reel      |

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### SH Series



#### Agency Approvals

| AGENCY | AGENCY FILE NUMBER |
|--------|--------------------|
|        | Pending            |
|        | E320116            |

#### Two Electrode GDT Graphical Symbol



#### Additional Information



Datasheet



Resources



Samples

#### Description

The Littelfuse SH Gas Discharge Tubes (GDT) series provides high levels of protection against fast rising transients caused by lightning disturbances. It has a surge rating of 5kA, 8/20 $\mu$ s. Offered in a Squared Surface Mount package, which helps to make pick and place on PCB process easier.

This GDT series is perfectly suited for broadband equipment applications. The GDT's low off-state capacitance is compatible with high bandwidth applications and this capacitance loading value does not vary if the voltage across the GDT changes.

The Littelfuse SH Gas Discharge Tube (GDT) series are specifically designed for protection of electrical, multimedia, and communication equipment against over voltage transients in surface mount assembly applications.

#### Features

- Excellent response to fast rising transients
- GHz working frequency
- 5kA, 8/20 $\mu$ s surge capability as defined by IEC 61000-4-5 2<sup>nd</sup> Edition
- UL recognized
- Offered with squared body package
- Non-Radioactive
- Ultra Low capacitance (<0.7pF)
- Lead-free and RoHS compliant

#### Applications

- CATV equipment
- Antennas
- RS 485
- Telecom Base Station
- Power Supply AC Main
- G.fast
- EV power Charging
- Inverter/Variable Frequency Drivers (VFDs)
- IEEE 802.3 compliant Ethernet interfaces
- Broad Band equipment
- xDSL, ADSL, ADSL2, VDSL, and VDSL2
- Medical Electronics
- Test Equipment
- General Telecom Equipment
- Renewable Energy

### Electrical Characteristics

| Part Number | Component Specifications (at 25°C) |     |     |                                    |          |                                            |                       |                     | Life Ratings                            |                                   |                                       |                               |                                 |      |
|-------------|------------------------------------|-----|-----|------------------------------------|----------|--------------------------------------------|-----------------------|---------------------|-----------------------------------------|-----------------------------------|---------------------------------------|-------------------------------|---------------------------------|------|
|             | DC Breakdown in Volts (@100V/s)    |     |     | Maximum Impulse Break-down Voltage |          | Maximum Impulse Discharge Current (8/20μs) | Insulation Resistance | Capacitance (@1MHz) | Impulse Discharge Current (8/20μs)      | AC Discharge Current (50Hz, 1sec) | AC Discharge Current (9 Cycles @50Hz) | DC Holdover Voltage (<150ms)* | Impulse Life (10/1000μs) (100A) |      |
|             | MIN                                | TYP | MAX | @100V/μs                           | 1000V/μs | 1 Time                                     | MIN                   | MAX                 | MAX                                     | MIN                               | MIN                                   |                               | MIN                             |      |
|             |                                    |     |     |                                    |          |                                            |                       |                     |                                         |                                   |                                       |                               |                                 |      |
| SH75        | 60                                 | 75  | 90  | 600                                | 700      | 6kA                                        | 1GΩ @50V              | 0.7pf               | 10 Shots @ (5kA)<br><br>1 Shot at 6kA** | 5A                                | 15A                                   | 52V                           | 300 Shots                       |      |
| SH90        | 72                                 | 90  | 108 | 600                                | 700      |                                            |                       |                     |                                         |                                   |                                       |                               |                                 | 52V  |
| SH145       | 116                                | 145 | 174 | 600                                | 700      |                                            |                       |                     |                                         |                                   |                                       |                               |                                 | 52V  |
| SH230       | 186                                | 230 | 276 | 600                                | 700      |                                            |                       |                     |                                         |                                   |                                       |                               |                                 | 80V  |
| SH250       | 200                                | 250 | 300 | 600                                | 700      |                                            |                       |                     |                                         |                                   |                                       |                               |                                 | 135V |
| SH300       | 240                                | 300 | 360 | 650                                | 800      |                                            |                       |                     |                                         |                                   |                                       |                               |                                 | 135V |
| SH350       | 280                                | 350 | 420 | 750                                | 900      |                                            |                       |                     |                                         |                                   |                                       |                               |                                 | 135V |
| SH400       | 360                                | 400 | 480 | 850                                | 1000     |                                            |                       |                     |                                         |                                   |                                       |                               |                                 | 135V |
| SH470       | 376                                | 470 | 564 | 900                                | 1100     |                                            |                       |                     |                                         |                                   |                                       |                               |                                 | 150V |
| SH600       | 480                                | 600 | 720 | 1000                               | 1200     |                                            |                       |                     |                                         |                                   |                                       |                               |                                 | 150V |

Note:

\* Reference REA PE-80, 0.2A, tested to ITU-T Rec K.12 and REA PE 80 <150 ms.

\*\* DC spark-over may exceed  $\pm 25\%$  after discharge, but will continue to protect without venting

### Product Characteristics

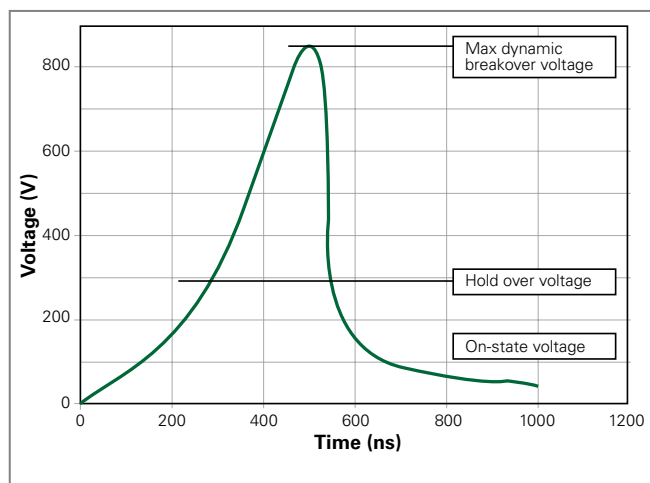
|                                            |                                                                             |
|--------------------------------------------|-----------------------------------------------------------------------------|
| <b>Materials</b>                           | Device Tin Plated $175 \pm 12.5$ Microns<br>Construction: Ceramic Insulator |
| <b>Storage and Operational Temperature</b> | -40 to +90°C                                                                |

### Typical Insertion Loss

|                  |
|------------------|
| @1.0GHz = 0.08dB |
| @1.4GHz = 0.16dB |
| @1.8GHz = 0.26dB |
| @2.0GHz = 0.33dB |
| @2.4GHz = 0.47dB |
| @2.8GHz = 0.59dB |
| @3.1GHz = 0.70dB |
| @3.5GHz = 0.89dB |
| @4.0GHz = 1.24dB |

Note: Insertion data for customer reference only, application testing needed for verification.

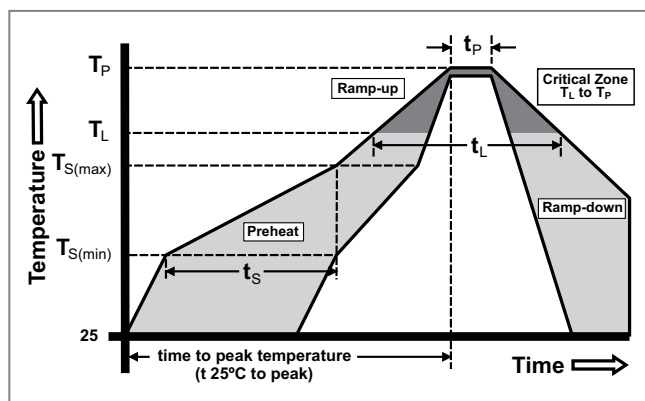
### Voltage Vs. Time Characteristic



Note: Tested per 1kV/ $\mu$ s waveform

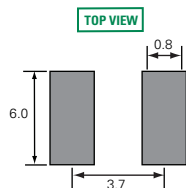
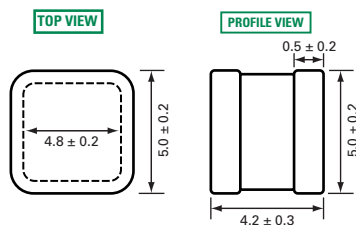
### Soldering Parameters - Reflow Soldering (Surface Mount Devices)

|                                                       |                                    |                         |
|-------------------------------------------------------|------------------------------------|-------------------------|
| Reflow Condition                                      |                                    | Pb – Free assembly      |
| Pre Heat                                              | - Temperature Min ( $T_{s(min)}$ ) | 150°C                   |
|                                                       | - Temperature Max ( $T_{s(max)}$ ) | 200°C                   |
|                                                       | - Time (Min to Max) ( $t_s$ )      | 60 – 180 secs           |
| Average ramp up rate (Liquidus Temp ( $T_L$ ) to peak |                                    | 3°C/second max          |
| $T_{s(max)}$ to $T_L$ - Ramp-up Rate                  |                                    | 5°C/second max          |
| Reflow                                                | - Temperature ( $T_L$ ) (Liquidus) | 217°C                   |
|                                                       | - Temperature ( $t_L$ )            | 60 – 150 seconds        |
| Peak Temperature ( $T_p$ )                            |                                    | 260 <sup>+0/-5</sup> °C |
| Time within 5°C of actual peak Temperature ( $t_p$ )  |                                    | 10 – 30 seconds         |
| Ramp-down Rate                                        |                                    | 6°C/second max          |
| Time 25°C to peak Temperature ( $T_p$ )               |                                    | 8 minutes Max.          |
| Do not exceed                                         |                                    | 260°C                   |



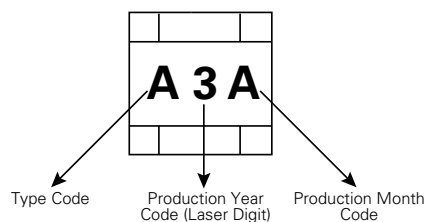
### Product Dimensions

Dimensions in millimeters



Recommended Soldering Pad Layout

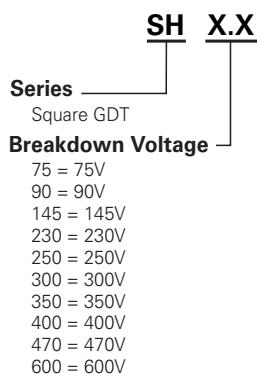
### Product Marking



| Type Code |       |
|-----------|-------|
| <b>A</b>  | SH75  |
| <b>B</b>  | SH90  |
| <b>S</b>  | SH145 |
| <b>D</b>  | SH230 |
| <b>R</b>  | SH250 |
| <b>E</b>  | SH300 |
| <b>G</b>  | SH350 |
| <b>I</b>  | SH400 |
| <b>P</b>  | SH470 |
| <b>V</b>  | SH600 |

| Month Code |           |
|------------|-----------|
| <b>A</b>   | January   |
| <b>B</b>   | February  |
| <b>C</b>   | March     |
| <b>D</b>   | April     |
| <b>E</b>   | May       |
| <b>F</b>   | June      |
| <b>G</b>   | July      |
| <b>H</b>   | August    |
| <b>I</b>   | September |
| <b>J</b>   | October   |
| <b>K</b>   | November  |
| <b>L</b>   | December  |

### Part Numbering System and Ordering Information

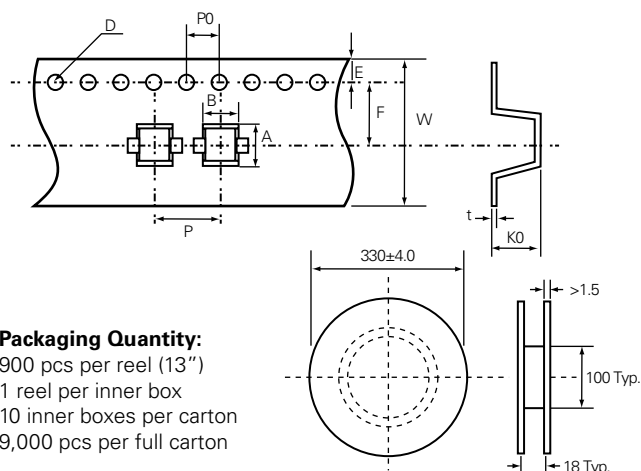


### Taping and Reel Specifications

#### Taping

Unit = mm

| Item | Spec     | Item | Spec       |
|------|----------|------|------------|
| P    | 12.0±0.1 | D    | Ø1.55±0.05 |
| P0   | 4.0±0.1  | W    | 16.0±0.3   |
| A    | 5.4±0.1  | K0   | 5.4±0.1    |
| B    | 4.6±0.1  | t    | 0.5±0.05   |



#### Packaging Quantity:

900 pcs per reel (13")  
1 reel per inner box  
10 inner boxes per carton  
9,000 pcs per full carton

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