

GAS DISCHARGE TUBES



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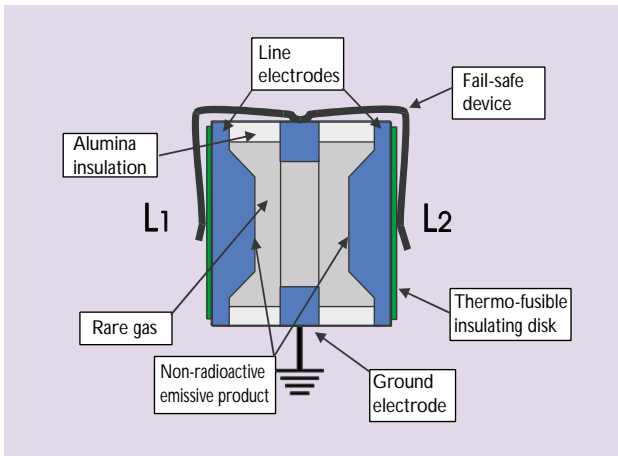


Gas discharge tubes

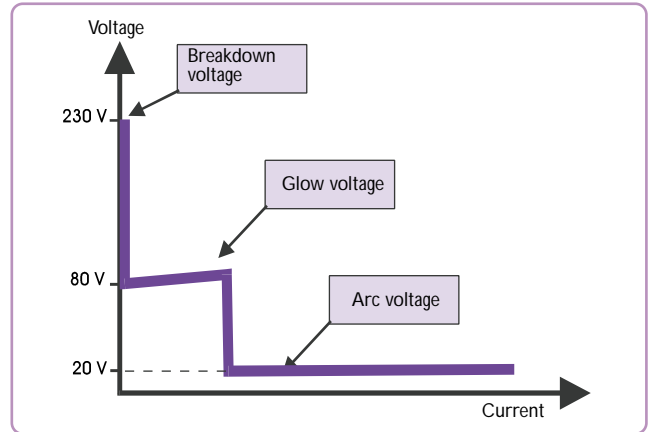
These components are made of two or three electrodes in an enclosure filled with a (non-radioactive) rare gas at a controlled pressure.

The enclosure is a ceramic tube with its ends closed off by metal caps that also serve as electrodes.

Their main use is to protect telecommunications lines.
All CITEL gas discharge tubes are certified radioactive-free.



3-electrode gas discharge tube



Operating regimes

Electrical characteristics

The main electrical characteristics defining a gas discharge tube are:

- DC sparkover voltage (Volts)
- Impulse sparkover voltage (Volts)
- Discharge current capacity (kA)
- Insulation resistance (Gohms)
- Capacitance (pF).

DC sparkover voltage

This is the main characteristic defining the gas discharge tube. It is the voltage at which breakdown will occur between the electrodes when a slowly increasing voltage ($dV/dt = 100 \text{ V/s}$) is applied to the component; it depends on the electrode spacing, the pressure, and the properties of the gas mixture and of the emissive substance.

Range of DC sparkover voltages available:

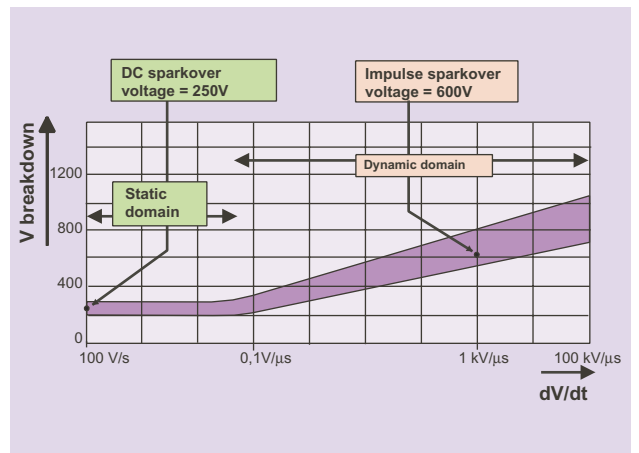
- minimum 75V
- average 230V
- high voltage 500V
- very high voltage 1000 to 3000V

The tolerance on the breakdown voltage is generally $\pm 20\%$.

Operation

The gas discharge tube may be regarded as a sort of very fast switch having conductance properties that change very rapidly, when breakdown occurs, from open-circuit to quasi-short circuit (arc voltage about 20V). There are accordingly four operating domains in the behavior of a gas discharge tube:

- **Non-operating domain**, characterized by practically infinite insulation resistance;
- **Glow domain**. At breakdown, the conductance increases suddenly; if the current drained off by the gas tube is less than about 0.5A (this is a rough value that differs according to the type of component), the glow voltage across the terminals will be in the 80-100V range;
- **Arc regime**: as the current increases, the gas discharge tube shifts from the glow voltage to the arc voltage (20V). It is in this domain that the gas discharge tube is most effective, because the current discharged can reach several thousand amperes without the arc voltage across its terminals increasing.
- **Extinction**: At a bias voltage roughly equal to the glow voltage, the gas tube recovers its initial insulating properties.



DC and Impulse sparkover voltages



Discharge current

This depends on the properties of the gas, the volume, and the material and treatment of the electrodes. It is the major characteristic of the gas discharge tube and the one that distinguishes it from other protection devices (Varistor, Zener diode, etc.): 5 to 20kA with an 8/20 μ s impulse for the standard components. This is the value the device can withstand repeatedly (say for ten impulses) without destruction or alteration of its basic specifications.

Impulse sparkover voltage

Sparkover voltage in the presence of a steep rise front ($dV/dt = 1kV/\mu s$): the impulse sparkover voltage increases with increasing dV/dt .

Insulation resistance and capacitance

These characteristics make the gas discharge tube practically "invisible" in a line in a steady-state context: insulation resistance very high (1 Gohm), capacitance very low (<10pF).

3-electrode configuration

Protecting a two-wire line (for example a telephone pair) with two 2-electrode gas discharge tubes (connected between the wires and ground) may cause the following problem:

The line is subjected to an overvoltage in common mode; because of the dispersion of the sparkover voltages ($\pm 20\%$), one of the gas discharge tubes sparks over a very short time before the other (a few microseconds); the wire that has sparked over is therefore grounded (neglecting the arc voltages), turning the common-mode overvoltage into a differential-mode overvoltage, very dangerous for the terminal equipment. This risk disappears when the second gas discharge tube arcs over (a few microseconds later).

3-electrode geometry eliminates this drawback: the sparkover of one pole causes a "general" breakdown of the device almost instantaneously (a few nanoseconds) because there is only one gas-filled enclosure.

End of life

Gas discharge tubes are designed to withstand several impulses without destruction or loss of the initial characteristics (typical impulse tests: 10 times 5kA impulses of each polarity).

On the other hand, a sustained strong current (e.g. 10A rms for 15 seconds, simulating the fall of a power line onto a telecommunications line) will put the device out of service definitively.

If a fail-safe end of life is desired (i.e. a short-circuit that will report the fault to the user when the line fault is detected), gas discharge tubes with the fail-safe feature (external short-circuit) should be chosen.

Standards

CITEL gas discharge tubes comply with the specifications of most telecom operators (France Telecom, British Telecom, etc.) and with the ITU-T K12 international recommendation.

The CITEL line

CITEL proposes a full line of gas discharge tubes to meet most configuration needs and specifications found on the market:

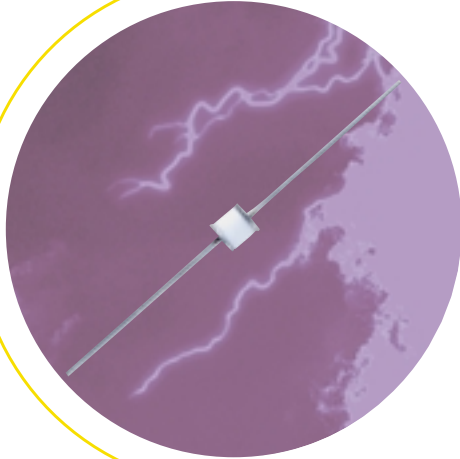
- 2- and 3-electrode gas discharge tubes
- Sparkover voltages from 75 to 3000V
- Discharge capacities from 2.5 to 150kA
- Optional external short-circuit device
- Installation on support, on printed circuit, or surface-mounted devices.





2-electrode Miniature Gas Discharge Tube

BA

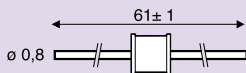


Dimensions (in mm)

BA

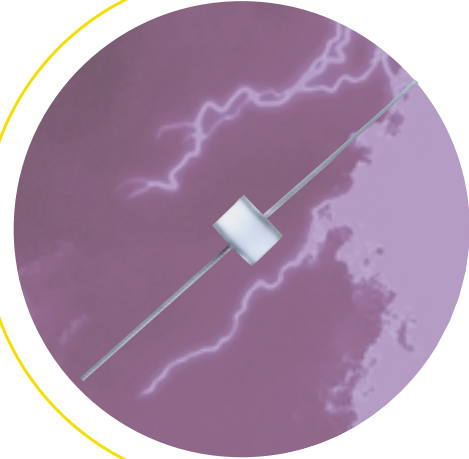


BAS



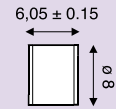
2-electrode Gas Discharge Tube

BB-BBS

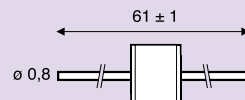


Dimensions (in mm)

BB



BBS



Characteristics

Citel part number	BA90	BA230	BA350
DC sparkover voltage (100V/s)	90V	230V	350V
Tolerance	+/- 20 %	+/- 20 %	+/- 20 %
Impulse sparkover voltage (1kV/μs)	< 700V	< 700V	< 900V
Holdover voltage (R = 330 Ω in series RC = 150 Ω /100 nF in //)	> 80 V	> 80 V	> 80 V
Insulation resistance (at 100Vdc or at 50Vdc for*)	> 1 GΩ*	> 1 GΩ	> 1 GΩ
Capacitance (at 1 MHz)	< 1 pF	< 1 pF	< 1 pF
AC discharge current (50 Hz ; 1 s ; 5 times)	2,5 A	5 A	2,5 A
Nominal discharge current (8/20μs ; 10 times)	2,5 kA	5 kA	2,5 kA
Options	Lead termination : BAS SMD version: BA-CMS		

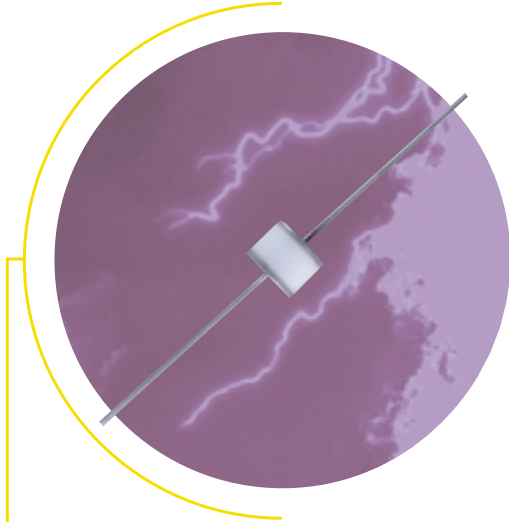
Characteristics

Citel part number	BB75	BB90	BB150	BB230	BB350	BB500
DC sparkover voltage (100V/s)	75V	90V	150V	230V	350V	500V
Tolerance	+/- 20 %	+/- 20 %	+/- 20 %	+/- 20 %	+/- 20 %	+/- 20 %
Impulse sparkover voltage (1kV/μs)	< 700V	< 700V	< 700V	< 750V	< 900V	< 1000V
Holdover voltage (R = 330 Ω in series RC = 150 Ω /100 nF in //)	> 60V	> 80V	> 80V	> 80V	> 80V	> 80V
Insulation resistance (at 100Vdc)	> 1 GΩ	> 1 GΩ	> 1 GΩ	> 1 GΩ	> 1 GΩ	> 1 GΩ
Capacitance (at 1 MHz)	< 5 pF	< 5 pF	< 5 pF	< 5 pF	< 5 pF	< 5 pF
AC discharge current (50 Hz ; 1 s ; 5 times) CA8B6 version	5 A 10 A	5 A 10 A	5 A 10 A	5 A 10 A	5 A 10 A	5 A 10 A
Nominal discharge current (8/20μs ; 10 times) CA8B6 version	5 kA 10 kA	5 kA 10 kA	5 kA 10 kA	5 kA 10 kA	5 kA 10 kA	5 kA 10 kA
Options	Lead termination : BBS					

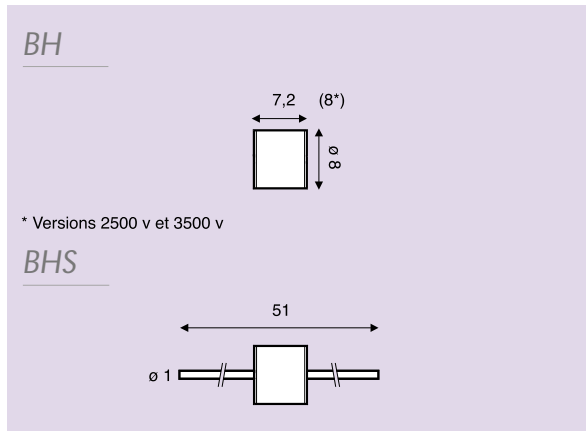


2-electrode Gas Discharge Tube

BH-BHS (High Voltage series)



Dimensions (in mm)

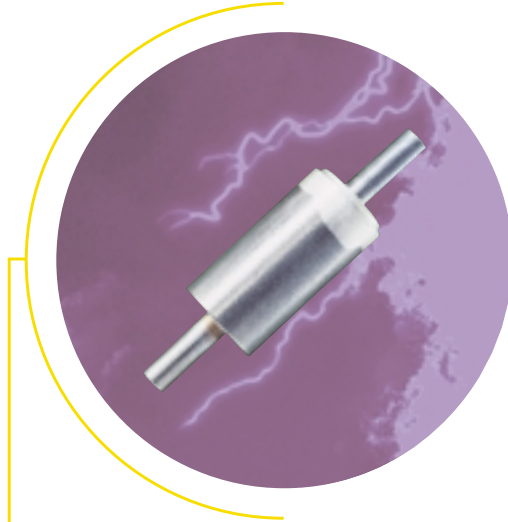


Characteristics

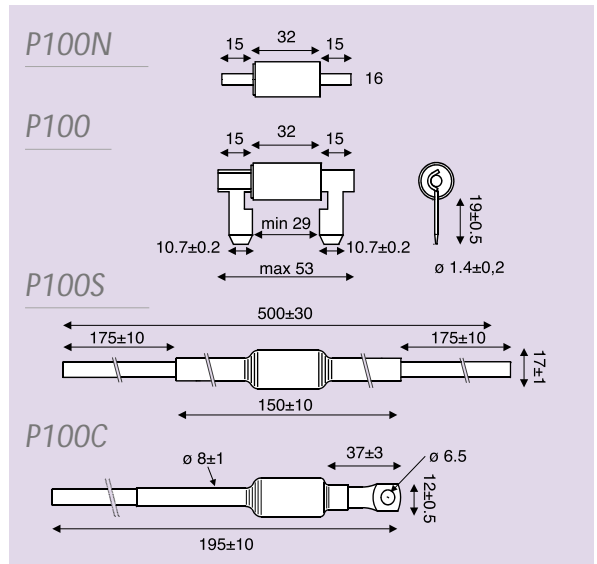
Citel part number	BH600	BH800	BH1400	BH2500	BH3500
DC sparkover voltage (100V/s)	600V	800V	1400V	2500V	3500V
Tolerance	-15/+ 20 %	-15/+ 20 %	+/- 20 %	+/- 20 %	+/- 20 %
Impulse sparkover voltage (1kV/μs)	< 1200V	< 1400V	< 2000V	< 3800V	< 4600V
Holdover voltage (R = 330 Ω in series RC = 150 Ω /100 nF in //)	> 80 V	> 80 V	> 80 V	> 80 V	> 80 V
Insulation resistance (at 100Vdc)	> 1 GΩ	> 1 GΩ	> 1 GΩ	> 1 GΩ	> 1 GΩ
Capacitance (at 1 MHz)	< 1 pF	< 1 pF	< 1 pF	< 1 pF	< 1 pF
AC discharge current (50 Hz ; 1 s ; 5 times)	10 A	5 A	5 A	5 A	5 A
Nominal discharge current (8/20μs ; 10 times)	10 kA	5 kA	5 kA	5 kA	5 kA
Options	Lead termination : BHS				

Heavy duty Gas Discharge Tube

P100



Dimensions (in mm)



Characteristics

Citel part number	P100-350	P100-500	P100-750
DC sparkover voltage (100V/s)	350V	500V	750V
Tolerance	+/- 20 %	+/- 20 %	+/- 20 %
Impulse sparkover voltage (1kV/μs)	< 1000V	< 1500V	< 1700V
Holdover voltage	80V	80V	80V
Insulation resistance (at 100Vdc)	> 1 GΩ	> 1 GΩ	> 1 GΩ
Capacitance (at 1 MHz)	10 pF	10 pF	10 pF
AC discharge current (50 Hz ; 1 s ; 5 times)	100 A	100 A	100 A
Maximum discharge current (8/20μs ; 1 time)	150 kA	150 kA	150 kA
Maximum lightning current (10/350μs ; 1 time)	60 kA	60 kA	60 kA
Options	bare version: P100N blade termination: P100 cable termination: P100S cable/terminal termination: P100C		



2-electrode Gas Discharge Tube

CA8B



Dimensions (in mm)

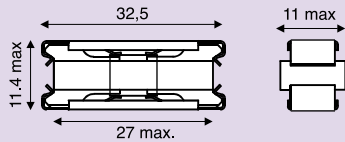
2-electrode glass-metal Gas Discharge Tube

CA5R

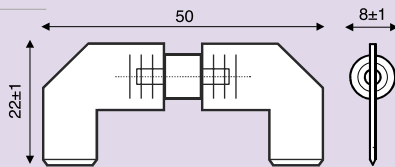


Dimensions (in mm)

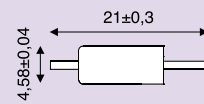
CA8BB



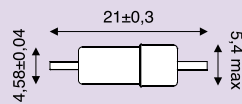
CA8BC



CA5 RA



CA5 RO (p980)



Characteristics

Citel part number	CA8B*230	CA8B*250	CA8B*350	CA8B*540
DC sparkover voltage (100V/s)	230V	250V	350V	540V
Tolerance	+/- 20 %	+/- 12 %	+/- 20 %	+/- 20 %
Impulse sparkover voltage (1kV/μs)	< 750V	< 750V	< 900V	< 1000V
Arc Voltage	< 20V	< 20V	< 20V	< 20V
Insulation resistance (at 100Vdc)	> 1 GΩ	> 1 GΩ	> 1 GΩ	> 1 GΩ
Capacitance (at 1MHz)	< 5 pF	< 5 pF	< 5 pF	< 5 pF
Holdover voltage (R = 330 Ω in series RC = 150 Ω /100 nF in //)	> 72V	> 72V	> 72V	> 72V
AC discharge current (50 Hz : 0,6 s : 10 times)	20 A	20 A	20 A	5 A
Nominal discharge current (8/20μs : 5 times)	10 kA	10 kA	10 kA	5 kA
Options	Sliding version : CA8BB Blade termination : CA8BC			

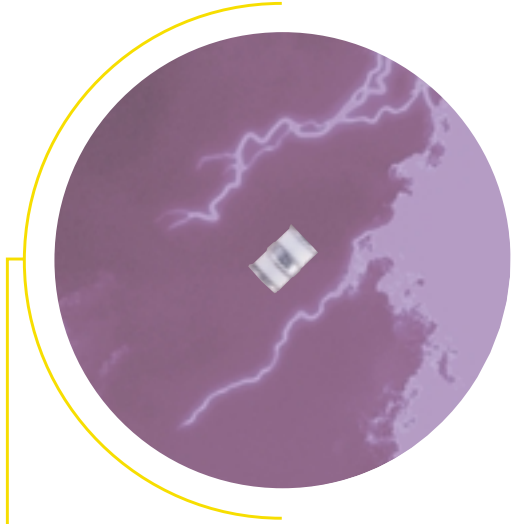
Characteristics

Citel part number	CA5R 230	CA5R 250	CA5R 350
DC sparkover voltage (100V/s)	230V	250V	350V
Tolerance	+/- 20 %	+/- 12 %	+/- 20 %
Impulse sparkover voltage (1kV/μs)	< 1000V	< 1000V	< 1100V
Arc Voltage	< 20V	< 20V	< 20V
Insulation resistance (at 100Vdc)	> 1 GΩ	> 1 GΩ	> 1 GΩ
Capacitance (at 1MHz)	< 10 pF	< 10 pF	< 10 pF
Holdover voltage (R = 330 Ω in series RC = 150 Ω /100 nF in //)	> 72V	> 72V	> 72V
AC discharge current (50 Hz : 1 s : 10 times)	5 A	5 A	5 A
Nominal discharge current (8/20μs : 10 times)	2,5 kA	2,5 kA	2,5 kA
Options	external fail-safe : CA5RO		



3-electrode Miniature Gas Discharge Tube

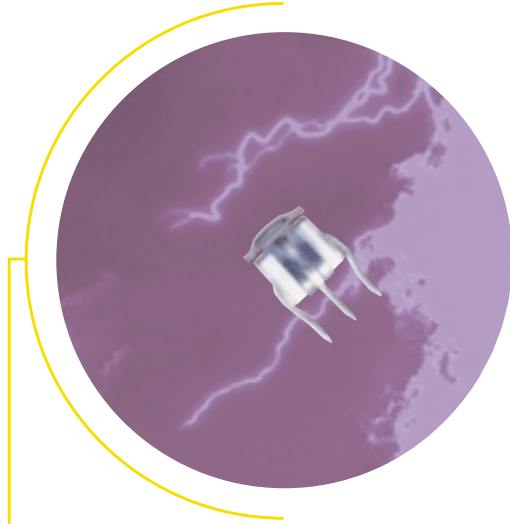
BM



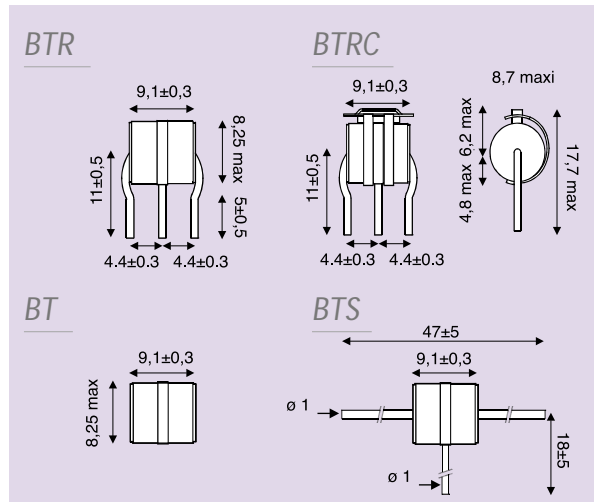
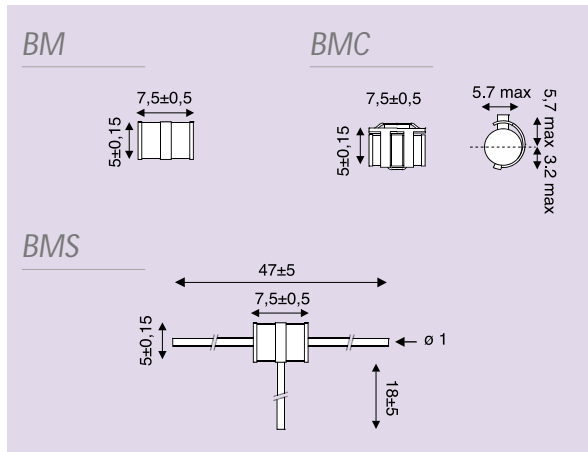
Dimensions (in mm)

3-electrode Gas Discharge Tube

BT



Dimensions (in mm)



F7

Characteristics

Citel part number		BM90	BM230	BM350	BM500
DC sparkover voltage (100V/s)	E/M	90V	230V	350V	500V
Impulse sparkover voltage (1kV/μs)		< 700V	< 800V	< 1100V	< 1200V
Insulation resistance (at 100Vdc or at 50Vdc for *)		> 1 GΩ*	> 1 GΩ	> 1 GΩ	> 1 GΩ
Capacitance (at 1MHz)		< 2 pF	< 2 pF	< 2 pF	< 2 pF
Holdover voltage (R = 330 Ω in series RC = 150 Ω /100 nF in //)		> 60V	> 80V	> 80V	> 80V
AC discharge current (50 Hz ; 1 s ; 10 times)	E1+E2/M	5 A	5 A	5 A	5 A
Nominal discharge current (8/20μs ; 10 times)	E1+E2/M	5 kA	5 kA	5 kA	5 kA
Options		External fail-safe : BMC Axial lead termination : BMS SMD version : BM CMS			

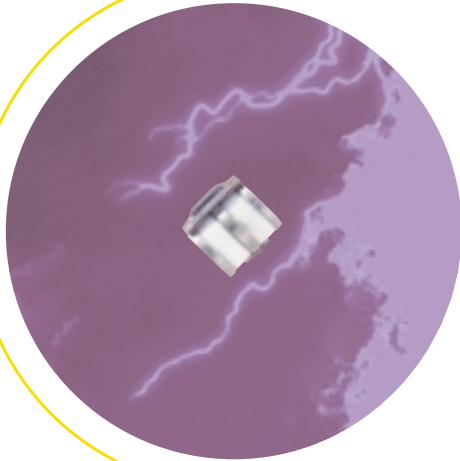
Characteristics

Citel part number		BT90	BT230	BT350	BT500
DC sparkover voltage (100V/s)	E/M	90V	230V	350V	500V
Tolerance		+/- 20 %	+/- 20 %	+/- 20 %	+/- 20 %
Impulse sparkover voltage	E1/E2	70-110V	200-550V	280-700V	400-1000V
Impulse sparkover voltage (1kV/μs)	E/M	< 700V	< 900V	< 1000V	< 1200V
Arc Voltage	E/M: E1/E2	< 25V	< 25V	< 25V	< 25V
Holdover voltage (at 100Vdc or at 50Vdc for *)	E/M: E1/E2	> 1 GΩ*	> 1 GΩ	> 1 GΩ	> 1 GΩ
Capacitance (at 1 MHz)	E/M: E1/E2	< 2 pF	< 2 pF	< 2 pF	< 2 pF
Holdover voltage (R = 330 Ω in series RC = 150 Ω /100 nF in //)	E/M: E1/E2	> 70V	> 70V	> 70V	> 70V
AC discharge current (50 Hz ; 1 s ; 10 times)	E/M E1+E2/M	5 A 10 A	5 A 10 A	5 A 10 A	5 A 10 A
Nominal discharge current (8/20μs ; 10 times)	E/M E1+E2/M	5 kA 10 kA	5 kA 10 kA	5 kA 10 kA	5 kA 10 kA
Options		External fail-safe : B.T.C Radial lead termination : BTR Axial lead termination : BTS			



3-electrode Gas Discharge Tube

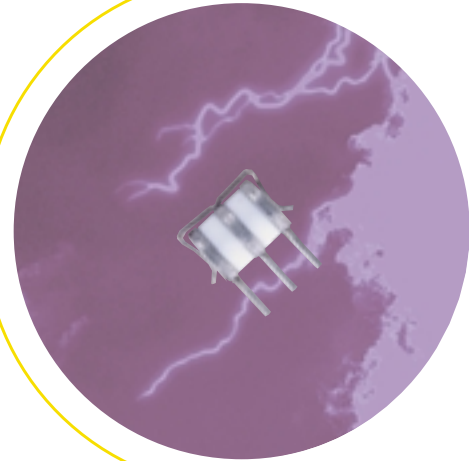
CA8T10



Dimensions (in mm)

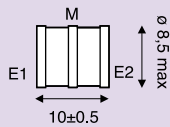
3-electrode Gas Discharge Tube

CA8T11

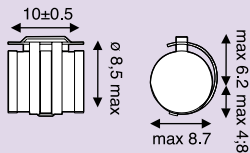


Dimensions (in mm)

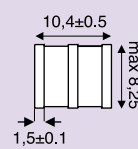
CA8T10



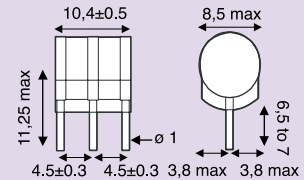
CA8T10C



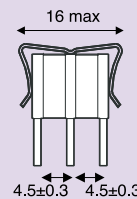
CA8T11



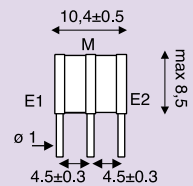
CA8T11RFD



CA8T11RFS



CA8T11R



Characteristics

CA8T10		230	250	260	350	420
DC sparkover voltage (100V/s)	E/M	230V	250V	260V	350V	420V
Tolerance		+/- 20 %	+/- 20 %	+/- 20 %	+/- 20 %	+/- 17 %
Impulse sparkover voltage (1kV/μs)		< 700V	< 700V	< 700V	< 1000V	< 1200V
Insulation resistance (at 100Vdc)		> 1 GΩ	> 1 GΩ	> 1 GΩ	> 1 GΩ	> 1 GΩ
Capacitance (at 1 MHz)		< 5 pF	< 5 pF	< 5 pF	< 5 pF	< 5 pF
Holdover voltage (R = 330 Ω, RC = 150 Ω / 100 nF in //)		> 80V	> 80V	> 80V	> 80V	> 80V
Arc voltage		< 20V	< 20V	< 20V	< 20V	< 20V
Nominal discharge current (8/20μs ; 10 times)	E/M E1+E2/M	10 kA 20 kA	10 kA 20 kA	10 kA 20 kA	10 kA 20 kA	10 kA 20 kA
AC discharge current (50 Hz ; 1 s ; 10 times)	E/M E1+E2/M	10 A 20 A	10 A 20 A	10 A 20 A	10 A 20 A	10 A 20 A
Option		External fail-safe : CA8T10C				

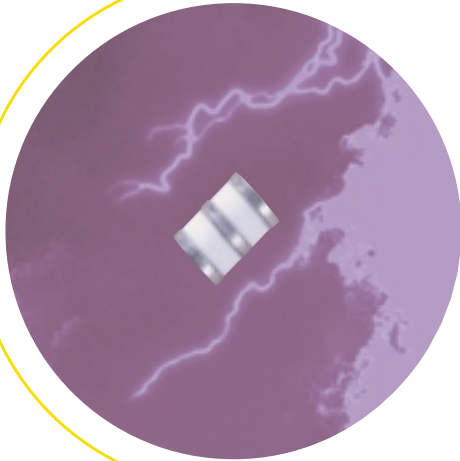
Characteristics

CA8T11		230	250	350	400	420
DC sparkover voltage (100V/s)	E/M	230V	250V	350V	400V	420V
Tolerance		+/- 20 %	+/- 20 %	+/- 20 %	+/- 25 %	+/- 17 %
Impulse sparkover voltage (1kV/μs)		< 700V	< 700V	< 700V	< 1000V	< 1000V
Insulation resistance (at 100Vdc)		> 1 GΩ	> 1 GΩ	> 1 GΩ	> 1 GΩ	> 1 GΩ
Capacitance (at 1 MHz)		< 5 pF	< 5 pF	< 5 pF	< 5 pF	< 5 pF
Holdover voltage (R = 330 Ω, RC = 150 Ω / 100 nF in //)		> 80V	> 80V	> 80V	> 80V	> 80V
Arc voltage		< 20V	< 20V	< 20V	< 35V	< 35V
Nominal discharge current (8/20μs ; 10 times)	E/M E1+E2/M	10 kA 20 kA	10 kA 20 kA	10 kA 20 kA	10 kA 20 kA	10 kA 20 kA
AC discharge current (50 Hz ; 1 s ; 10 times)	E/M E1+E2/M	10 A 20 A	10 A 20 A	10 A 20 A	10 A 20 A	10 A 20 A
Option		Radial lead termination : CA8T11R Radial lead termination + Fail-safe : CA8T11RFS Radial lead termination + Fail-safe : CA8T11RFD				



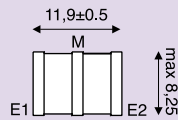
3-electrode Gas Discharge Tube

CA8T12



Dimensions (in mm)

CA8T12



F9

Characteristics

CA8T12	E/M	230	260	420
DC sparkover voltage (100V/s)		230V	260V	420V
Tolerance		+/- 20 %	+/- 20 %	+/- 20 %
Impulse sparkover voltage (1kV/ μ s)		< 550V	< 800V	< 1000V
Insulation resistance (at 100Vdc)		> 1 G Ω	> 1 G Ω	> 1 G Ω
Capacitance (at 1 MHz)		< 5 pF	< 5 pF	< 5 pF
Holdover voltage (R = 600 Ω in series RC = 150 Ω /100 nF in //)		> 70V	> 100V	> 100V
Arc voltage		< 20V	< 20V	< 35V
Nominal discharge current (8/20 μ s ; 10 times)	E/M E1+E2/M	10 kA 20 kA	10 kA 20 kA	10 kA 20 kA
AC discharge current (50 Hz ; 1 s ; 10 times)	E/M E1+E2/M	10 A 20 A	10 A 20 A	10 A 20 A

