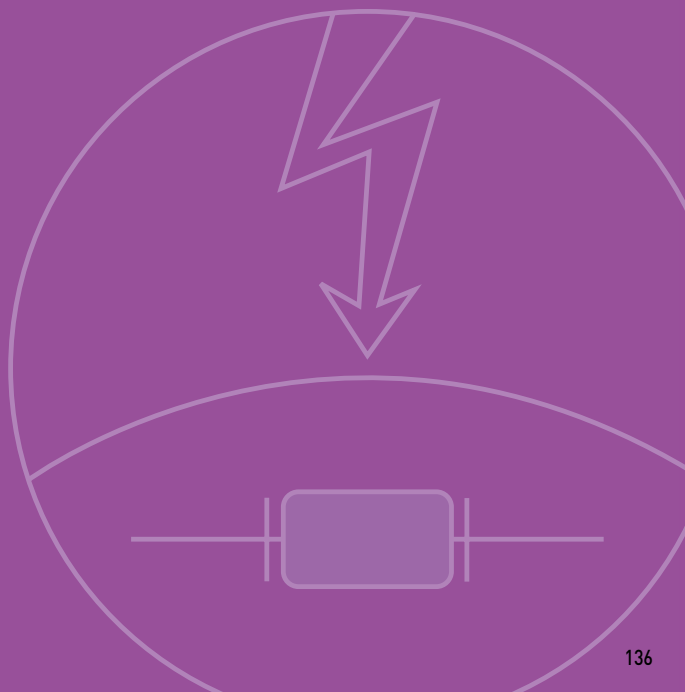
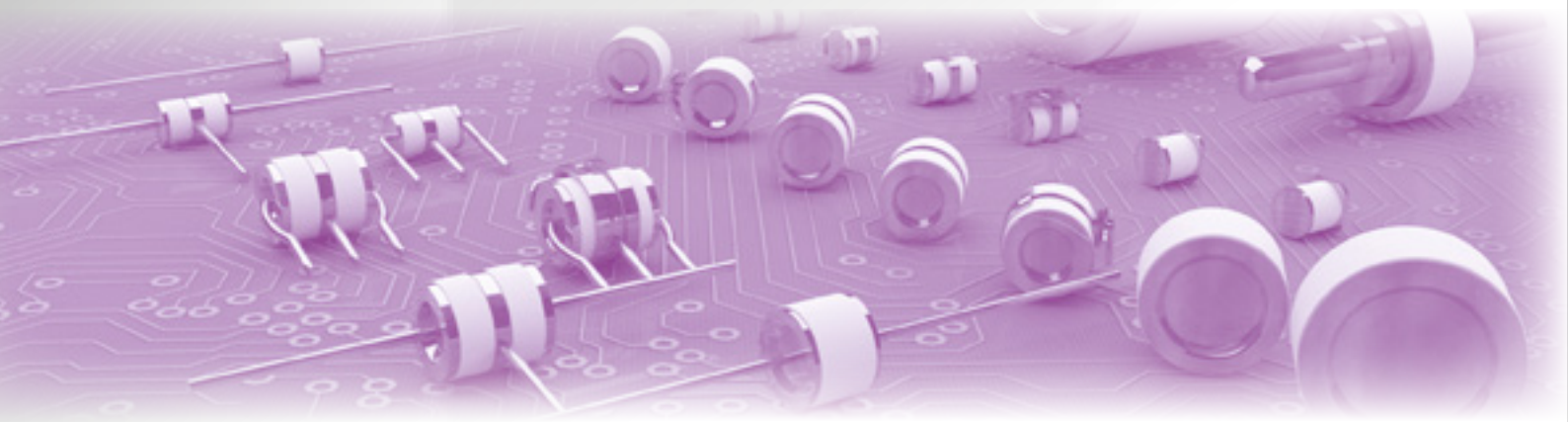
CITEL

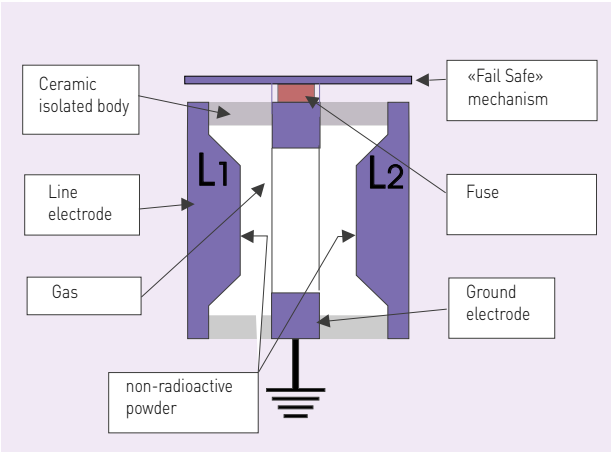
GAS DISCHARGE TUBE



Gas Discharge Tubes



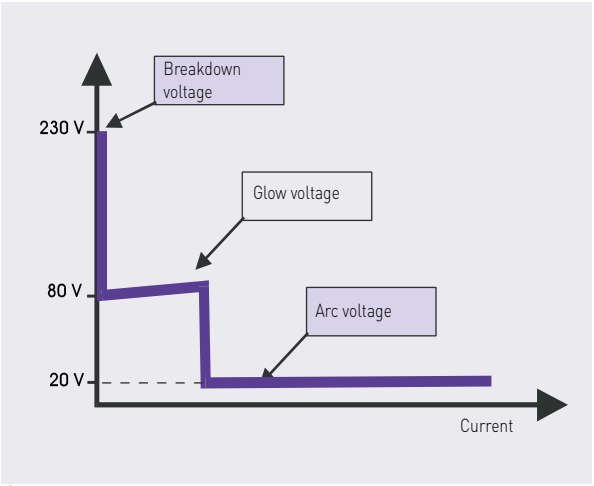
The Gaz Discharge Tube (or GDT) are passive components made of two or three electrodes in an enclosure filled with a (non-radioactive) rare gas at a controlled pressure.
The enclosure is a ceramic tube with its ends closed off by metal caps that also serve as electrodes.
Their main use is to protect telecommunications lines, but other uses are possible.



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.



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).

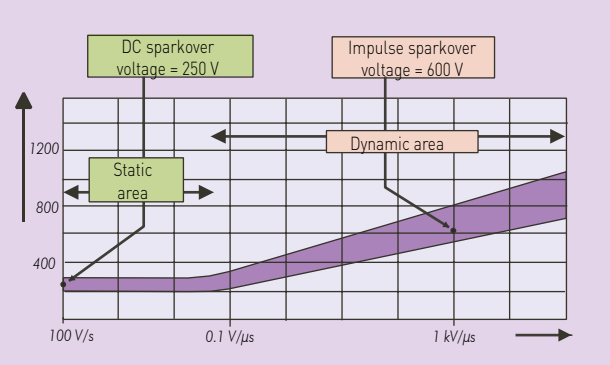
DC sparkover voltage

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 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 ± 20%. .



DC and Impulse sparkover voltages

ischarge 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 GDT and the one that distinguishes it from other protection devices (Varistor, Zener diode, etc.): 5 to 20kA with an 8/20µs 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/µs): 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 (>10 Gohm), capacitance very low (<1 pF).

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 (± 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 gas tube 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 5 kA impulses of each polarity).
On the other hand, a sustained strong current (e.g. 10 A rms for 15 seconds, simulating the fall of a AC power line onto a telecommunication 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 main telecom operators and with the ITU-T K12 international recommendation and standards IEC 61643-311.
CITEL gas discharge tubes are also compliant with the RoHS Directive

Gas Discharge Tubes

Mechanical characteristics

CITEL gas discharge tubes are available in several mechanical configurations to adapt to the desired set-up:

- Bare version for mounting adapted support
- "S" version wire output (diameter 0.8 or 1 mm) for mounting on printed circuit
- "SMD" version for surface mounting, with optional "SQ" version (anti-roll square electrode).
- Specific versions: output by cable or rod

Surface mounting

Most of CITEL range of gas discharge tubes are available for surface mounting (SMD), with optional "anti-rolling" version with square electrode (SQ). The welding profile with reflow must follow the recommended curve (opposite).

The 3-poles BMSQ CMS FL gas tube is particularly adapted to surface-mount technology, with its "anti-rolling" electrode and its exclusive external short-circuit system adapted to this type of mounting.

Printed circuit mounting

The majority of CITEL gas discharge tube ranges are available with wire output (diameter 0.8 or 1 mm) for mounting on a printed circuit board. Different types of output possible according to the range: axial, radial, straight output, folded output..... Wave solder mounting must be done following the recommended profile (opposite)

Radial Taping

The CITEL gas discharge tubes with wire output are provided in a radial tape in a pack of 500 components according to the ranges (plan opposite) and in line with the IEC 286-1 specification.

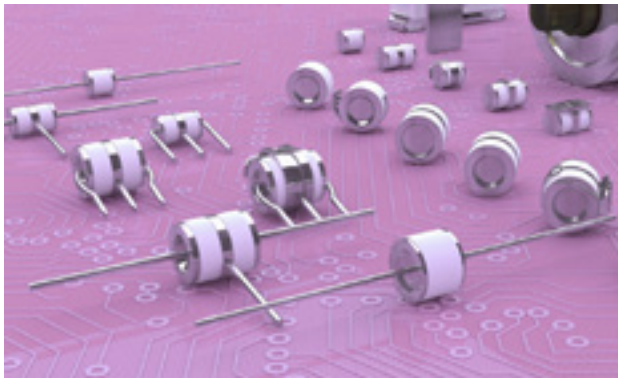
Tape and Reel

The CITEL gas discharge tubes with SMT mounting are provided in a Tape and Reel pack, reel of 500, 800 or 1000 components (plan opposite) and in line with the IEC 286-1 specification

The CITEL line

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

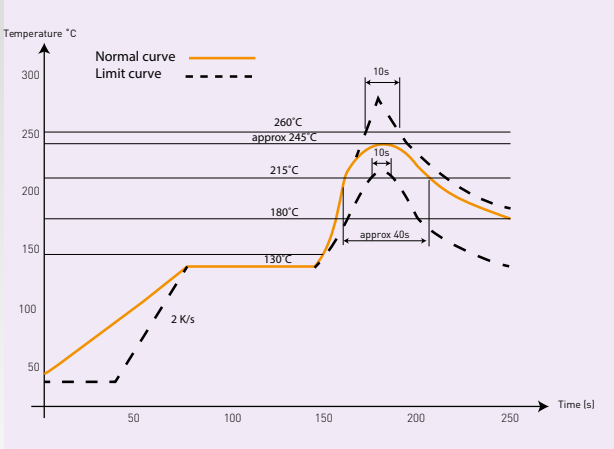
- 2- and 3-electrode gas discharge tubes
- Sparkover voltages from 75 to 3000 V
- Discharge capacities from 5 to 150 kA (8/20µs)
- Optional external short-circuit device
- Installation on support, on printed circuit, or surface-mounted devices.



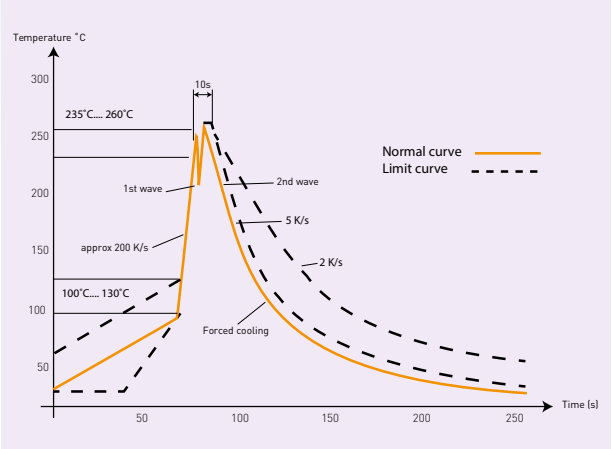
GSG series

Thanks to our inherent knowledge and experience in the field of gas discharge tubes, CITEL has developed a specific technology:
GSG (**G**as-filled **S**park **G**ap).
These components are designed to be used on an AC network: they have an increased extinction capability and a higher current discharge capability with either a 8/20us or 10/350us waveform.
The GSG components are the heart of the VG technology which insures matching performance with allair gap technologies without any of downside.

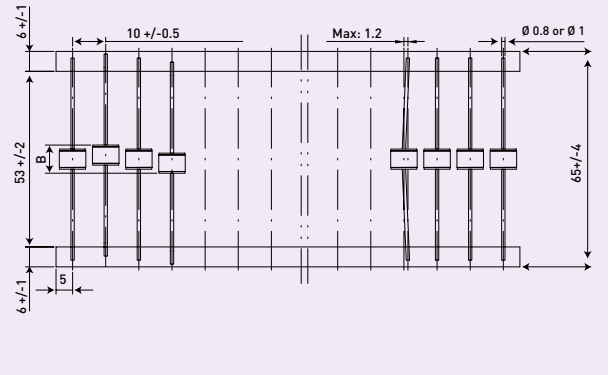
Welding curve by reflow for SMT gas discharge tubes



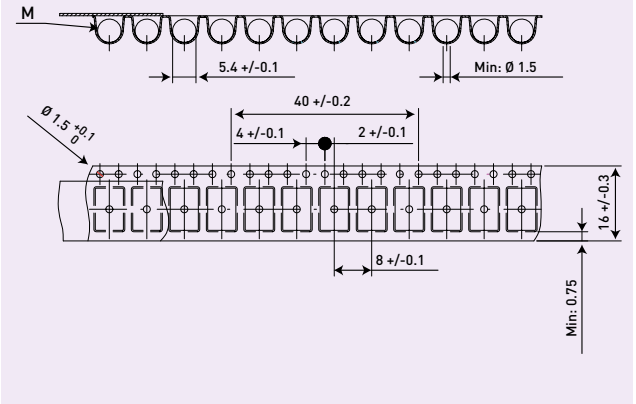
Wave soldering cycle for gas discharge tubes



Radial Taping layout for gas discharge tubes with wire output (IEC 286-1)

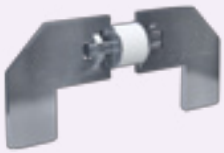


Tape & Reel for gas discharge tubes with SMD mounting (IEC 286-3)

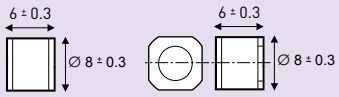


Selection guide

2-ELECTRODE

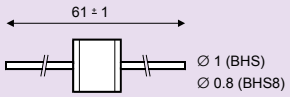
Range	CITEL model	DC sparkover voltage (100V/s)	Impulse sparkover voltage (1kV/µs)	Insulation resistance (100Vdc)	Capacitance	Holdover voltage (R = 300 ohms in serie R = 150 ohms; 100nF in parrallel)	AC dsicharge current (50Hz)	Max. discharge current (8/20µs ; 1 fois)	Nominal discharge current (8/20µs ; 10 fois)	Mechanical
BH	**BH75**	65-95 V	<620 V	>10GΩ	<0.8 pF	>60 V	20 A	30 kA	15 kA	
	BH90	72-108 V	<580 V	>10GΩ	<0.8 pF	>80 V	20 A	40 kA	20 kA	
 BH	**BH230**	184-276 V	<700 V	>10GΩ	<0.8 pF	>80 V	20 A	40 kA	20 kA	
	BH350	280-420 V	<850 V	>10GΩ	<0.8 pF	>80 V	20 A	40 kA	20 kA	
	BH470	376-564 V	<1000 V	>10GΩ	<0.8 pF	>80 V	20 A	40 kA	20 kA	
 BH > 1000V	**BH500**	400-600 V	<1200 V	>10GΩ	<0.8 pF	>80 V	20 A	40 kA	20 kA	
	BH600	480-720 V	<1200 V	>10GΩ	<0.8 pF	>80 V	20 A	40 kA	20 kA	
 BHSQ	**BH800**	640-690 V	<1400 V	>10GΩ	<0.8 pF	>80 V	10 A	25 kA	10 kA	
	BH1400	1120-1680 V	<2100 V	>10GΩ	<0.8 pF	>120 V	10 A	25 kA	10 kA	
	BH1500	1200-1800 V	<2300 V	>10GΩ	<0.8 pF	>120 V	10 A	25 kA	10 kA	
 BHS	**BH2500**	2000-3000 V	<3800 V	>10GΩ	<0.8 pF	>120 V	10 A	25 kA	10 kA	
	BH3000	2400-3600 V	<4600 V	>10GΩ	<0.8 pF	>120 V	10 A	25 kA	10 kA	
CA8BC	**CA8BC-230**	184-276 V	<1000 V	>1GΩ	<10 pF	>72 V	20 A	25 kA	10 kA	
	CA8BC-250	220-280 V	<1000 V	>1GW	<10 pF	>72 V	20 A	25 kA	10 kA	
	CA8BC-350	280-420 V	<1000 V	>1GW	<10 pF	>72 V	20 A	25 kA	10 kA	
CA8BB	CA8BB-250	220-280 V	<750 V	>1GW	<10 pF	>72 V	20 A	25 kA	10 kA	
	CA8BB-300	240-360 V	<800 V	>1GW	<10 pF	>72 V	20 A	25 kA	10 kA	

BH



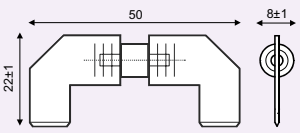
BHSQ CMS

BHS

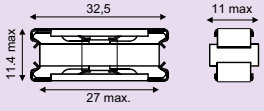


Options :
- Lead termination(Ø 1 ou 0.8 mm) : **BHS** or **BHS8**
- BHS Tape & Reel : 500 p.
- External short-circuit: **BHC**
- Square electrode/ SMD : **BHSQ CMS**
- BHSQ CMS Tape & Reel : 500 p.

CA8BC



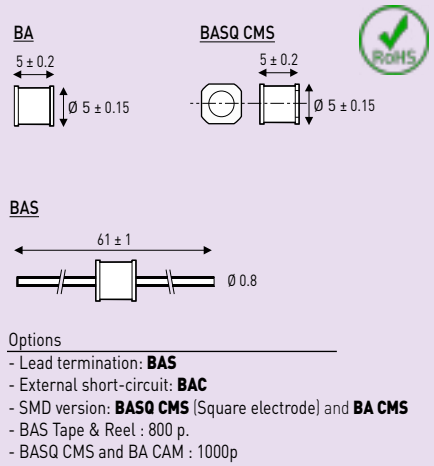
CA8BB



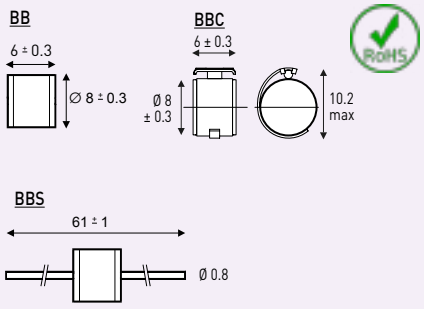
Selection guide

2-ELECTRODE

Range	CITEL model	DC sparkover voltage (100V/s)	Impulse sparkover voltage (1kV/µs)	Insulation resistance (100Vdc)	Capacitance	Holdover voltage (R = 300 ohms in serie R = 150 ohms; 100nF in parrallel)	AC dsicharge current (50Hz)	Max. discharge current (8/20µs ; 1 fois)	Nominal discharge current (8/20µs ; 10 fois)	Mechanical
BA	**BA75**	65-95 V	<640 V	>10GΩ	<0.3 pF	>60 V	10 A	25 kA	10 kA	
 BA	**BA90**	72-108 V	<600 V	>10GΩ	<0.3 pF	>60 V	10 A	25 kA	10 kA	
 BASQ	**BA150**	120-180V	<700 V	>10GΩ	<0.3 pF	>80 V	10 A	25 kA	10 kA	
 BAC	**BA230**	184-276 V	<700 V	>10GΩ	<0.3 pF	>80 V	10 A	25 kA	10 kA	
	BA300	240-360 V	<900 V	>10GΩ	<0.3 pF	>80 V	10 A	25 kA	10 kA	
 BAS	**BA350**	280-420 V	<900 V	>10GΩ	<0.3 pF	>80 V	10 A	25 kA	10 kA	
	BA550	440-660 V	<1200 V	>10GΩ	<0.3 pF	>80 V	10 A	25 kA	10 kA	
BB	**BB75**	65-95 V	<620 V	>10GΩ	<0.8 pF	>60 V	10 A	25 kA	10 kA	
 BB	**BB90**	72-108 V	<580 V	>10GΩ	<0.8 pF	>60 V	10 A	25 kA	10 kA	
	BB150	120-180 V	<640 V	>10GΩ	<0.8 pF	>75 V	10 A	25 kA	10 kA	
 BBC	**BB230**	184-276 V	<700 V	>10GΩ	<0.8 pF	>80 V	10 A	25 kA	10 kA	
	BB350	280-420 V	<850 V	>10GΩ	<0.8 pF	>80 V	10 A	25 kA	10 kA	
 BBS	**BB500**	400-600 V	<1200 V	>10GΩ	<0.8 pF	>80 V	10 A	25 kA	10 kA	
	BB600	480-720 V	<1200 V	>10GΩ	<0.8 pF	>80 V	10 A	25 kA	10 kA	



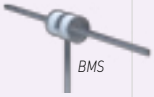
Options
- Lead termination: **BAS**
- External short-circuit: **BAC**
- SMD version: **BASQ CMS** (Square electrode) and **BA CMS**
- BAS Tape & Reel : 800 p.
- BASQ CMS and BA CAM : 1000p

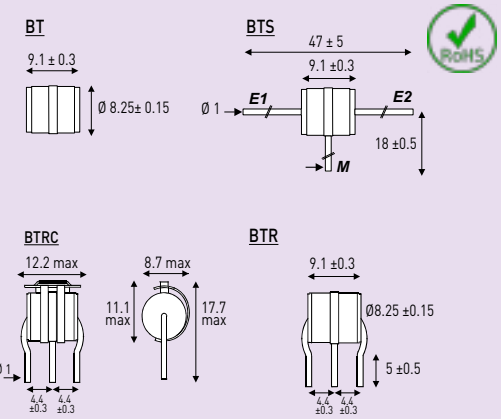


Options
- Lead termination: **BBS**
- External short-circuit: **BBC**
- BBS Tape & Reel : 500p.

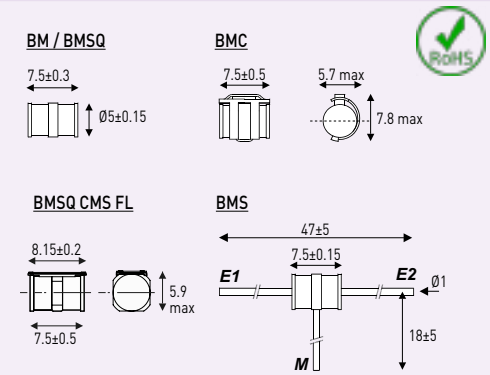
Selection guide

3-ELECTRODE

Range	CITEL model	DC sparkover voltage (100V/s)	Impulse sparkover voltage (1kV/µs)	Insulation resistance (100Vdc)	Capacitance	Holdover voltage (R = 300 ohms in serie R = 150 ohms; 100nF in parrallel)	AC dsicharge current (50Hz)	Max. discharge current (8/20µs ; 1 fois)	Nominal discharge current (8/20µs ; 10 fois)	Mechanical
BT	BT90	72-108 V	<620 V	>10GΩ	<0.9 pF	>70 V	20 A	25 kA	20 kA	
 BT	BT150	120-180 V	<600 V	>10GΩ	<0.9 pF	>80 V	20 A	25 kA	20 kA	
	BT230	184-276 V	<680 V	>10GΩ	<0.9 pF	>80 V	20 A	25 kA	20 kA	
 BTC	BT350	280-420 V	<800 V	>10GΩ	<0.9 pF	>80 V	20 A	25 kA	20 kA	
	BT500	400-600 V	<1100 V	>10GΩ	<0.9 pF	>80 V	20 A	25 kA	20 kA	
 BTR										
 BTS										
BM	BM90	72-108 V	<560 V	>10GΩ	<0.5 pF	>60 V	10 A	25 kA	10 kA	
 BM	BM150	120-180 V	<600 V	>10GΩ	<0.5 pF	>80 V	10 A	25 kA	10 kA	
	BM230	184-276 V	<680 V	>10GΩ	<0.5 pF	>80 V	10 A	25 kA	10 kA	
 BMSQ CMS FL	BM350	280-420 V	<900 V	>10GΩ	<0.5 pF	>80 V	10 A	25 kA	10 kA	
	BM500	400-600 V	<1100 V	>10GΩ	<0.5 pF	>80 V	10 A	25 kA	10 kA	
 BM SQ										
 BMS										
 BMS5										



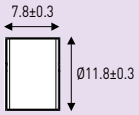
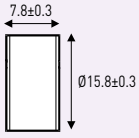
Options
- Axial wire output: **BTS**
- Radial wire output: **BTR**
- External short-circuit: **BTC, BTRC,**



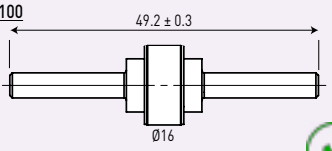
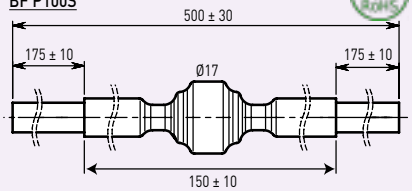
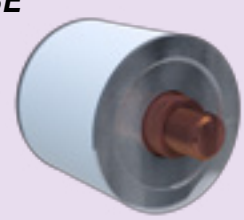
Options
- Lead termination: **BMS, BMS5**
- External short-circuit: **BMC, BM..FL**
- SMD : **BMSQ CMS** (Square electrode) and **BM CMS**
- Tape & Reel CMS : 1000 p.

Selection guide

GSG

Range	CITEL part number	DC sparkover voltage (100V/s)	Impulse sparkover voltage (1.2/50µS / 6kV)	Insulation resistance (100Vdc)	Follow current interrupting capability (Ifi) (under voltage AC)	Nominal discharge current (In) 8/20µs, following IEC 61643-11)	Max. discharge current (Imax) (8/20µs ; following IEC 61643-11°)	Max. impulse current (Iimp) (10/350µs ; following IEC 61643-11)	Mechanical
BG 	BG600	450-800V	<1500 V	>10GΩ	> 100 A	60 kA	100 kA	15 kA	
	BG800	650-1000 V	<1500 V	>10GΩ	> 100 A	60 kA	100 kA	15 kA	
	BG1000	850-1200 V	<1800 V	>10GΩ	> 100 A	60 kA	100 kA	15 kA	
	BG1300	1100-1600 V	<2000V	>10GΩ	> 100 A	60 kA	100 kA	15 kA	
BF 	BF800	650-1000 V	<1500 V	>10GΩ	> 100 a	80 kA	150 kA	50 kA	
	BF1300	1100-1600 V	<2500 V	>10 GΩ	> 100 A	80 kA	150 kA	50 kA	

GSG (IEC 61643-11)

Range	CITEL part number	DC sparkover voltage (100V/s)	Impulse sparkover voltage (1.2/50µS / 6kV)	Insulation resistance (100Vdc)	Nominal discharge current (In) 8/20µs, suivant IEC 61643-11)	Max. discharge current (Imax) (8/20µs ; suivant IEC 61643-11)	Max. impulse current (Iimp) (10/350µs ; suivant IEC 61643-11)	Mechanical
BF P100 	BFP100-230	184-276 V	<900 V	>10 GΩ	80 kA	150 kA	50 kA	BF P100  BF P100S 
	BFP100-250	200-300 V	<900 V	>10 GΩ	80 kA	150 kA	50 kA	
	BFP100-350	280-420 V	<1000 V	>10 GΩ	80 kA	150 kA	50 kA	
	BFP100-500	400-600 V	<1200 V	>10 GΩ	80 kA	150 kA	50 kA	
	BFP100-600	480-720 V	<1300 V	>10 GΩ	80 kA	150 kA	50 kA	
	BFP100-750	600-900 V	<1500 V	>10 GΩ	80 kA	150 kA	50 kA	
BE 	BE 800	650-1000 V	<1500 V	>1 GΩ	100 kA	150 kA	100 kA	BE