CLIPSAL
ELECTRONIC

*Official Provider of Electrical Accessories & Building Automation to the Sydney 2000 Olympic Games*

# POWER RANGE

## surge arresters


**Your best defence against overvoltage damage**

technical **data**

**POWER RANGE**

**surge arresters**

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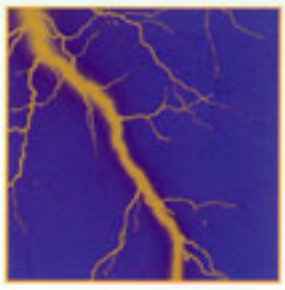


# PREVENT EXPENSIVE POWER STOPPAGES

## POWER RANGE
## surge arresters

Lightning need not score a direct hit of a building or home to cause a huge amount of damage. Overvoltage surges, which can be caused by an indirect lightning strike or defective switching operations in the power supply, result in millions of dollars worth of damage to electrical and electronic equipment and systems every year.

These surges can bring industrial plants, banks and public utilities to a standstill, and can mean the end for a private company. In our homes too, television sets, stereo systems, video recorders and refrigerators all contain electronic circuitry that is too sensitive to withstand overvoltages.

The larger and more networked a system or building, the greater the potential danger from overvoltages and therefore the more comprehensive the protection measures must be.

# WITH POWER RANGE SURGE ARRESTERS

The latest state-of-the-art Clipsal technology provides effective protection against the hazardous and costly effects of lightning flashes and overvoltages.

## Comprehensive protection from over-voltages is available

The causes of overvoltages are many and varied.

The most common cause is through switching operations in the power supply network. Damage caused by thunderstorm overvoltages has shown that electronic systems are at risk due to electro-magnetic fields and line fed overvoltages at a distance of up to 1.5 kilometres from the point of the lightning strike.

Internal lightning protection and more extensive overvoltage protection include measures for reducing the electrical and magnetic effects of the lightning current within the system to be protected.

Clipsal offer a range of devices for switchboard applications to protect against direct lightning strikes and overvoltage conditions.

# THE SAFE PROTECTION CONCEPT

The EMC orientated Lightning Protection Zones (LPZs) concept specifies required locations for Surge Protection Devices (SPDs) and stipulates different requirements for them.

As a first protective measure (LPZ $0_A$ - 1), a barrier is necessary to keep the lightning current out of the system.

Spark gaps respond to the lightning current impulse of 10/350uS at the required level and break it to a current impulse of 8/20uS tolerable for subsequent SPDs.

When using spark gaps in the power supply system, the mains follow on current must be safely extinguished after discharging a current impulse.

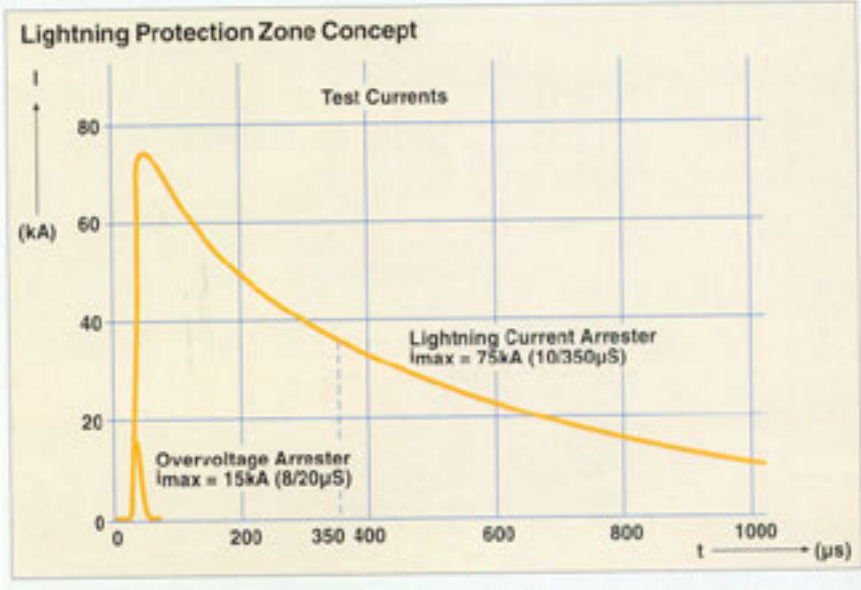
As a second protective measure (LPZ 1 - 2), the remaining current impulse (approx. 8/20uS) is discharged and limited to a voltage level compatible with the system.

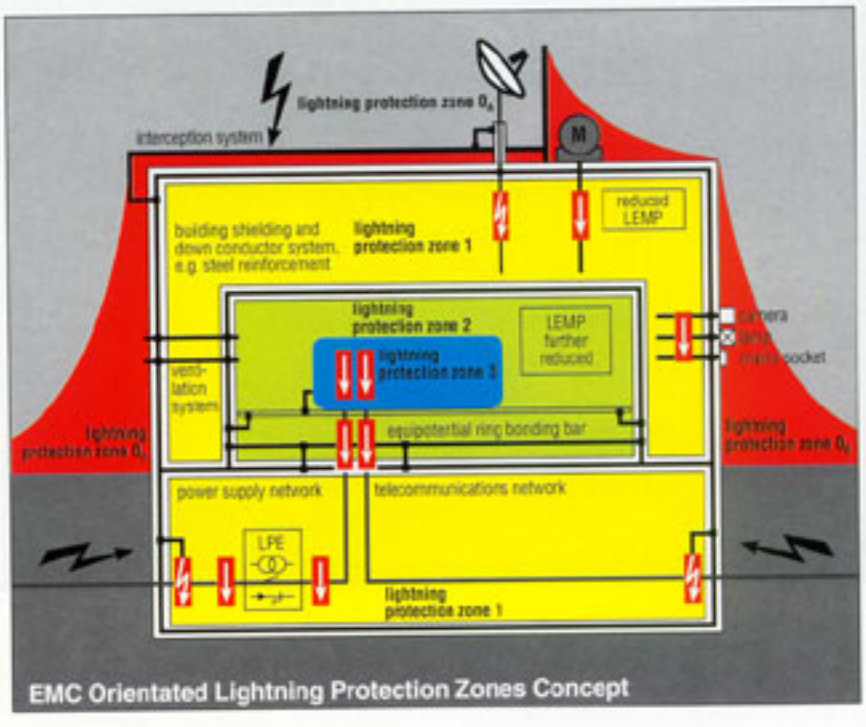
A varistor (non-linear resistor) is ideal for this task. Modern metal oxide varistors are distinguished by their fast sparkover performance and low residual voltage (voltage protection level).

The third protective measure (LPZ 2 - 3) fulfils necessary requirements for the terminal equipment. The circuit is protected by a varistor installed between the phase conductor and earth limiting overvoltages arising by switching operations and induction effects.

In order to permit the combination of these three protection steps, an energy coordination is necessary.

As with the selective grading of MCCBs in mains voltage systems, a selection of lightning current and overvoltage arresters should be used, this prevents overloading of the subsequently arranged SPDs in case of interference.



# LIGHTNING PROTECTION EQUIPOTENTIALISATION, FOR LPZ INTERFACE $0_A$ - 1.

For many people, the term equipotentialisation is synonymous with connecting or bonding of all electrically conductive parts such as water, heating and ventilation pipes to prevent a potential difference between these systems. This protects people against hazardous excess current.

Lightning protection equipotentialisation protects the electrical installation of your building against hazardous lightning currents.

It also connects the electrical conductors carrying the operating voltage to the equipotential bonding system so that lightning current can be conducted.

970/3LCA

970LCA

Power is supplied to the conductors, the phases L1, L2, L3 and sometimes even the neutral conductor N. This avoids inadmissible potential differences between the live conductors, the protective conductor and other metallic systems in the building, even in the event of a direct lightning strike.

Lightning protection equipotentialisation should be implemented at the lightning protection zone interface $0_A$ - 1. This usually means that a connection capable of carrying lightning current is usually made to the equipotent bonding bar as close as possible to the entry of an electrically conductive system into the building.

The conductors of the power supply system are connected via lightning current arresters, for example the Clipsal 970LCA (one pole) or the 970/3LCA (three pole).

These SPDs carry the major part of the lightning current at a level that will not damage the electrical installation. The use of gliding spark gaps breaks down the injected lightning current impulse to ensure the energetic coordination with subsequent overvoltage SPDs.

Lightning current arresters, are used when;

1. The building is protected by an external lightning protection system.
2. When grounded metal parts are used on the exterior of the building, ie antennas, air-conditioning plants and microwave dishes.
3. When LV overhead lines are used to supply mains power.
4. If neighbouring buildings fulfil the above conditions and are within 200m of your premises.

## Pressure controlled encapsulated, gliding spark gap

Blowing out is a thing of the past thanks to encapsulation. Therefore, no longer is a minimum distance required between enclosures and other installed equipment.

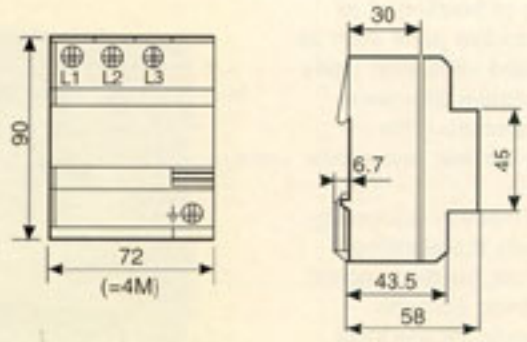
The discharge capability of the pressure controlled encapsulated spark gap is 25kA (10/350uS). A voltage protection level of less than 4kV (1.2/50uS) is matched to the insulation withstand capability of the electrical installation.

The mains follow current is safely quenched by the pressure controlled arc-quenching, with the leakage current free spark gap embedded in a special insulating material with arc-quenching effect. Any resulting pressure increases the arc-quenching capability of the insulating material.

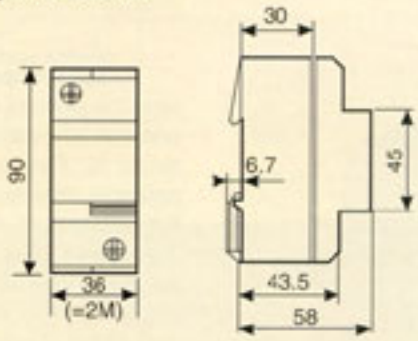
The 970/3LCA is a three pole lightning current arrestor SPD in a compact housing of just 4 modules in width. It is particularly suitable for the widespread MEN (TN-S) system.

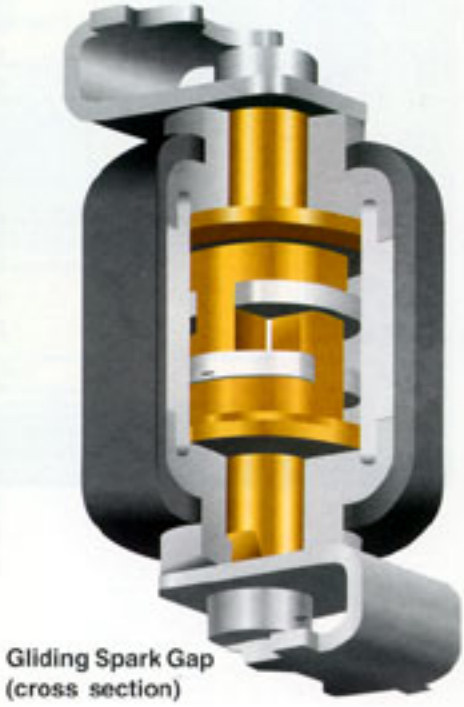
There is also a two modules-wide, one pole lightning current SPD of this type, the 970/LCA, which is suitable for single phase applications.

**Dimensional Diagram 970/3LCA**




**Dimensional Diagram 970LCA**



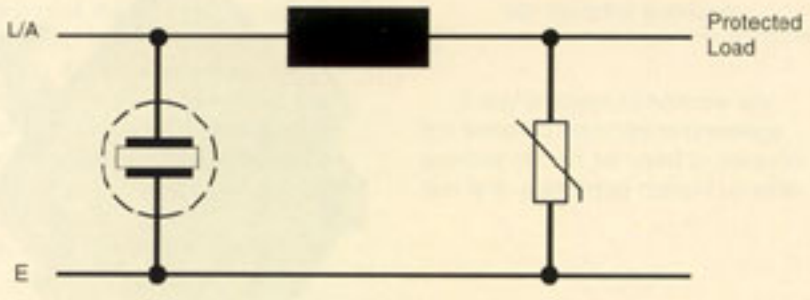
Gliding Spark Gap
(cross section)

| Technical Data | | 970LCA 970/3LCA |
|---|---|---|
| Continuous operating voltage (rated voltage) | $U_C$ | 264V, 50/60Hz |
| Follow current extinguishing capability at $U_C$ | | $1.5kA_{rms}$ |
| Lightning impulse current (10/350) | $I_{imp}$ | 1 pole - 25kA 3 pole - 75kA |
| Voltage protection level (1.2/50) (lightning impulse current) | $U_{p/f}$ | ≤4kV |
| Isolating resistance | $R_{isol}$ | $\geq 10^3$ MΩ |
| Response time | $t_A$ | ≤100nS |
| Backup fuse (only required if not already provided in mains) up to | | 100A gL |
| Short circuit withstand capability with maximum backup fuse | | 50kA/50Hz |
| Conductor cross sectional area | | Min. 1.5mm² single/fine stranded max. 50mm² multi-stranded/35mm² fine stranded |
| Operating temperature range | $T_U$ | -40°C to +80°C |
| Degree of protection | | IP20 |
| Mounting | | 35mm DIN rail |

**Electrical Symbol for LCA Devices**

The lightning current arrester provides protection from direct lightning strikes, with a protection level $u_p \leq 4kV$ and capable of extinguishing follow on currents up to $1.5kA_{rms}$. The decoupling element provides energy coordination between the lightning current arrester SPD and the overvoltage arrester SPD. The overvoltage arrester provides a protection level ≤1.5kV, safe for most electrical and electronic equipment. Using all three devices provides a coordinated protection scheme against lightning currents and overvoltage conditions.

**Equipment Installation**




(Lightning Current Arrester, Decoupling Element and Overvoltage Arrester)

# OVERVOLTAGE PROTECTION IN THE DISTRIBUTION SYSTEM, FOR LPZ INTERFACE 1-2

Protectors with an adjustable degree of protection must be used to protect installations and systems against overvoltages from various sources.

Efficient overvoltage arresters are used in power supply networks at the distribution system often representing the lightning protection zone interface 1 - 2. These varistor type SPDs can be coordinated with lightning current SPDs.

The second protective measure, as outlined on page 4, involves reducing the overvoltage to a level that is safe for the terminal equipment. In the IEC 664/1980, "Insulation Coordination for Electric Equipment in Low Voltage Systems", the surge voltage withstand capability of a device entry in a 240V power supply system is determined by 1.5 - 2.5kV. This value has to be surpassed.

970

970P

The metal oxide varistor (MOV) is an ideal protective device as its non linear resistor is constantly operating and detects the lowest overvoltage, dependent on the value of the current impulse.

With this method the protective component is activated within mere billionths of a second, stopping overvoltages before they can cause any damage.

970RMT

**Metal-oxide varistor**

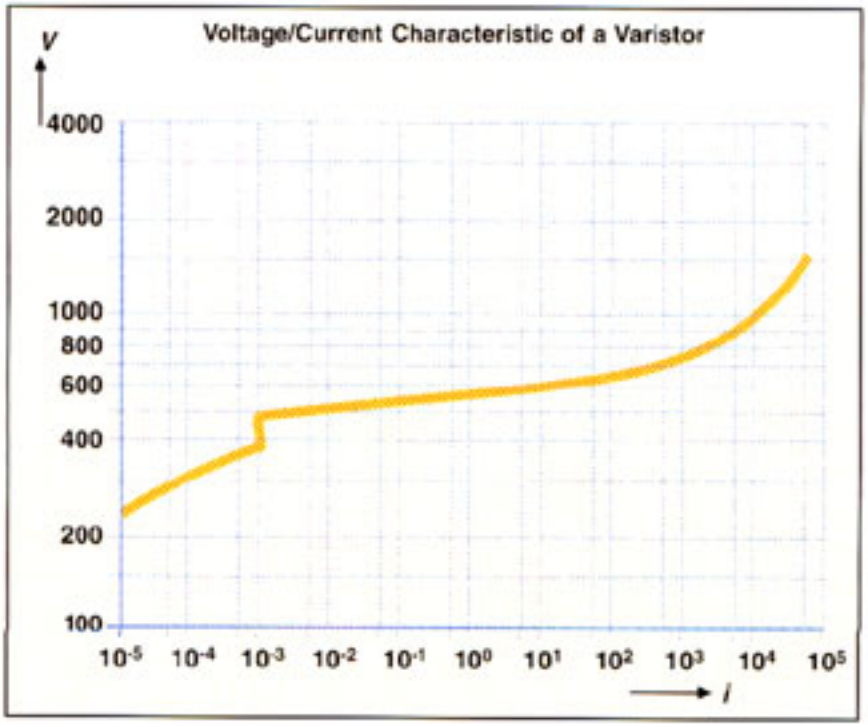

Clipsal's range of products uses a block varistor with a discharge capability of 15kA (8/20uS). The protective component has to withstand this current impulse at least 20 times, non-destructively and without any changes to its characteristic.

When this discharge capability is exceeded due to a direct lightning strike for instance, and there is no spark gap lightning current arrester fitted, the overvoltage varistor will overload. This will cause an automatic disconnection of the electrical power system.

The Clipsal range of overvoltage SPDs include a double effect supervisory system - the thermal dynamic control. A defect can be indicated locally by an indicator flag and via an optional floating changeover contact.

Four products comprise the overvoltage varistor range, including units with removable modules and changeover contacts for remote monitoring.

Clipsal overvoltage arresters are just one module in width when installed in distribution boards. The 970 and 970T are compact one piece devices, the 'T' model having changeover contacts for remote monitoring.




The 970RM and the 970RMT consist of two parts; a cradle and detachable module, which can easily be exchanged if overloaded without interrupting the power supply.

This design also makes it particularly easy to make a megger reading of the system, by simply detaching the module prior to making the measurement.

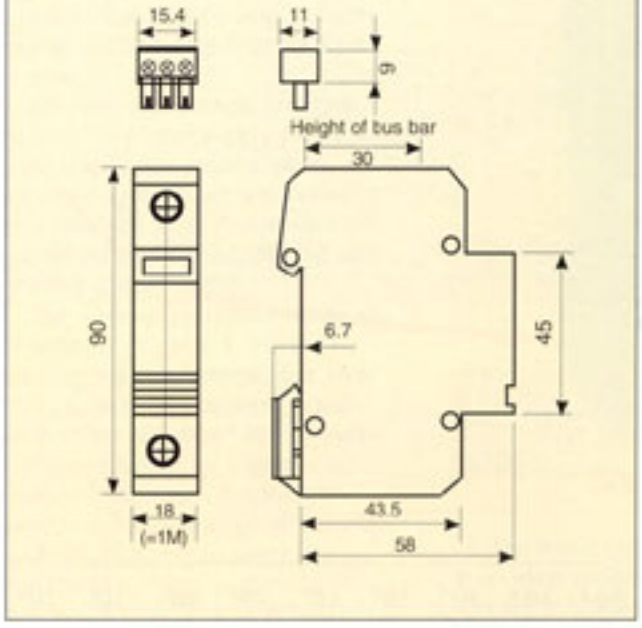
Overvoltage arresters are used in those installations where protection from direct lightning strikes is not required. Overvoltage arresters may be used when;

1. The premises is serviced by an underground LV mains supply.
2. The building is not protected by an external lightning protection system.
3. No external earthed equipment, such as antennas, air-conditioning plants are used on the building.
4. The premises is not in the proximity of another premises (within 200m) which meets one of the above conditions.

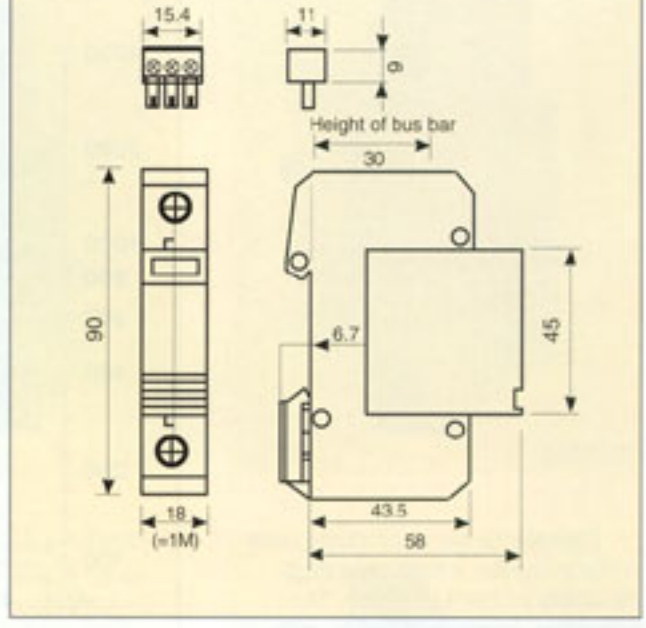
**Electrical Symbol for Varistor Devices**

If any of these conditions are not satisfied then the overvoltage arrester should be used in conjunction with a lightning current arrester.

**Dimensional Diagram of 970 and 970T**




**Dimensional Diagram of 970RM and 970RMT**




| Technical Data | | 970 970RM 970T 970RMT |
|---|---|---|
| Tested to: | | E DIN VDE 0675 Part 6/11.89 and Part 6/A1/03.96 |
| Maximum continuous operating voltage | $U_r$ | 275V~ |
| Nominal discharge current (8/20) | $I_N$ | 15kA |
| Maximum discharge current (8/20) | $i_{smax}$ | 40kA |
| Protection level at - 5kA (8/20) at $I_N$ | $u_{sp}$ | ≤1kV<br>≤1.5kV |
| Short circuit withstand capability with maximum backup fuse | | 50kA/50Hz |
| Response time | $t_A$ | ≤25nS |
| Operating temperature range | $T_U$ | -40°C to +80°C |
| Conductor cross sectional area | | Min. 1.5mm² single/fine stranded max. 35mm² multi-stranded/25mm² fine stranded |
| Backup fuse (only required if not already provided in the mains) | | 125A gL |
| Degree of protection | | IP20 |
| Mounting | | 35mm DIN rail |
| Remote alarm contacts<br>• Type of contact | | Changeover contact |
| • Contact rating $U_N/I_N$ | | 250V~/0.5A<br>250V d.c./0.1A |
| • Cross section of remote alarm (FM) | | Max. 1.5mm² single/fine stranded |

# ENERGY COORDINATION FOR LPZ INTERFACE 2

For the energy coordination of lightning current arresters in the distribution board with overvoltage arresters at the terminal of sub-distribution board, it is necessary to arrange:

- The types of protective components
- The protection circuit
- The response characteristic of the protective components
- The discharge capability

If this is not followed, there could be an overload of the SPD at the terminal equipment, resulting in unnecessary interference of the normal operation.

Usually, varistors and gas filled spark gaps are used as protective components.

The varistors are connected to limit differential mode overvoltages arising between phase conductors and earth. They have to correspond to the varistor type SPD in the distribution board concerning their response characteristic (voltage/ frequency), their voltage protection levels (residual voltage) and their discharge capability.

The gas filled spark gap is used between the live conductors and the protective conductor. It is therefore not necessary to disconnect the overvoltage SPD when checking the insulation in an electrical system.

If the protective components meet these preconditions, a selective surge protection is established.

**Electrical Symbol for Decoupling Element**


970DE

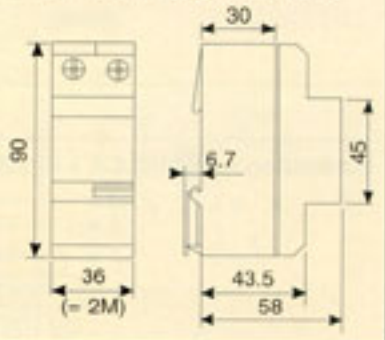
As with energy coordination of lightning protection zone 1, a decoupling component between the SPDs in lightning protection zone 2 should be included. This decoupling component is usually the connecting wire.

The Clipsal arrester family fulfils the coordination requirements mentioned before. All that is required is a line of more than 15m in length for the energy coordination between the overvoltage SPDs in the distribution board and at the terminal equipment.

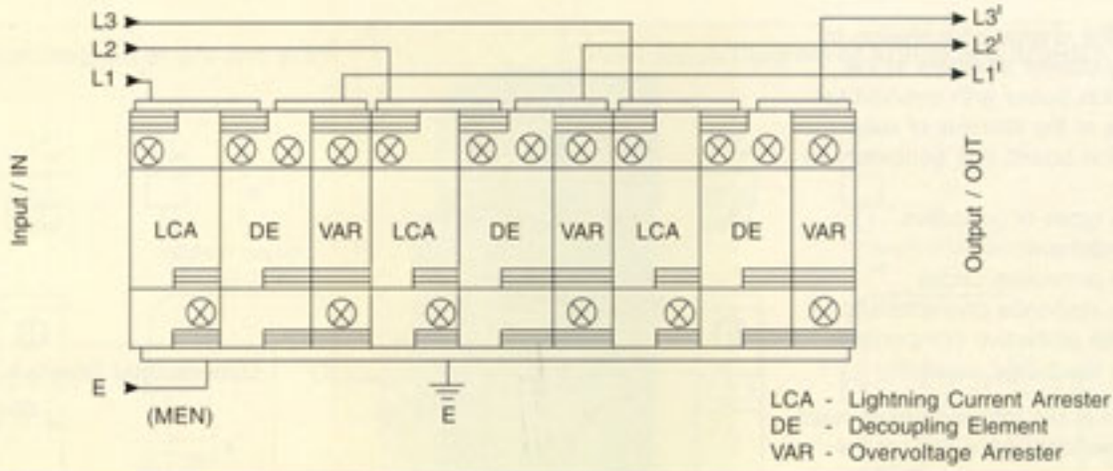
If the lightning current arrester and the overvoltage arrester need to be located side by side in the same switchboard, then a series decoupling element 970DE should be used for energy coordination. The decoupling element is an inductive element of the value 15uH (equivalent to 15m of cable), and has a maximum permissible through current of 35A.

Alternatively for higher current applications, the 970DE63 should be used. The 970DE63 provides energy co-ordination in a 4M wide module with a maximum through current of 63A.

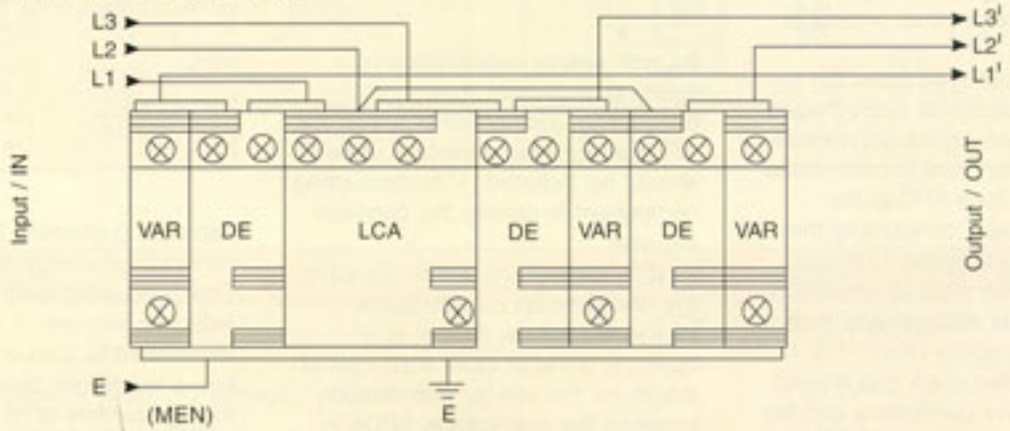
**Dimensional Diagram 970DE**



**Installation for 970LCA + 970DE + 970**




**Installation for 970/3LCA + 970DE + 970**




| Technical Data | | 970DE | 970DE63 |
|---|---|---|---|
| Nominal voltage | $U_N$ | 500V~ | |
| Nominal frequency | $f_N$ | 50/60Hz | |
| Nominal current | $I_N$ | 35A | 63A |
| Nominal inductance | $L_N$ | 15µH +/- 20% | |
| DC resistance | $R_{CU}$ | 4mΩ | 2mΩ |
| Conductor cross sectional area | | Min. 1.5mm² single/fine stranded max. 35mm² multi-stranded/25mm² fine stranded | Min. 10mm² single/fine stranded max. 50mm² multi-stranded/35mm² fine stranded |
| Backup fuse (only required if not already provided in the mains) | | 35A gL | 63A gL |
| Ambient temperature | $T_U$ | -40°C to +40°C | |
| Operating temperature with nominal current | | 45°C + $T_U$ | |
| Degree of protection | | IP20 | |
| Mounting | | 35mm DIN rail | |
| Width | | 2M | 4M |

# OVERVOLTAGE SPDS AT THE TERMINAL EQUIPMENT LPZ 2 - 3

A third protective measure is required if there is any possibility of interference between the distribution board and the terminal equipment.

Overvoltages are evidently coupled in lines between the distribution board and the terminal equipment if the unscreened connecting wire is more than 10 metres long.

A direct lightning flash into the building or nearby lightning flash can cause an interference.

Even consumers switching power on and off can effect overvoltages between phase and neutral conductors, which is potentially harmful to the terminal equipment.

Clipsal offers a range of flush type wall outlets and plug in surge protection devices. These devices are fitted with a visual fault indicator, which is extinguished on a fault condition. The power supply is not interrupted.

These surge devices offer local protection for personal computers, fax machines, televisions, stereo equipment and other sensitive equipment.

463SF

30SFM


25SF


C2025SF

| Technical Data | 30SFM | 463SF |
|---|---|---|
| Normal operating voltage | 250V~, 10A | |
| Maximum operating voltage | 275V~, 369V- | |
| Typical capacitance | 900pF | |
| Peak current (8/20uS) | 6.5kA | |
| Maximum clamping voltage (8/20uS) 100A | 710 volts | |
| Energy absorption (10/1000uS) | 3 x 140J | |
| Complies with | AS3100 (limited testing) | AS3197 |


2025SF

| Catalogue No. | Description |
|---|---|
| **463SF** | 250V~, 10A, Surge Filter Plug Adaptor |
| **30SFM** | Surge Filter Mechanism |
| **25SF** | 250V~, 10A, Standard Range Twin Power Outlet with 30SFM Mechanism |
| **2025SF** | 250V~, 10A, 2000 Series Twin Power Outlet with 30SFM Mechanism |
| **C2025SF** | 250V~, 10A, C2000 Classic Series Twin Power Outlet with 30SFM Mechanism |

# SPARK GAPS FOR LIGHTNING CURRENTS

In addition to the Power Range of switchboard protection against overvoltages, Clipsal offers a range of lightning spark gaps for protection of conductive surfaces.

All conductive surfaces into or out of an installation can carry lightning surge currents. It is necessary to provide surge protection on all pipelines and conductive entries by bonding them to the equipotential earthing system.

Spark gaps can provide the necessary protection and should be used for connecting to the equipotential system whenever direct bonding to the earth is not permitted, for instance in the bridging of insulated flanges.

The Clipsal 951 is for use in non-hazardous locations and this product should not be used on mains potential (live conductors).

951

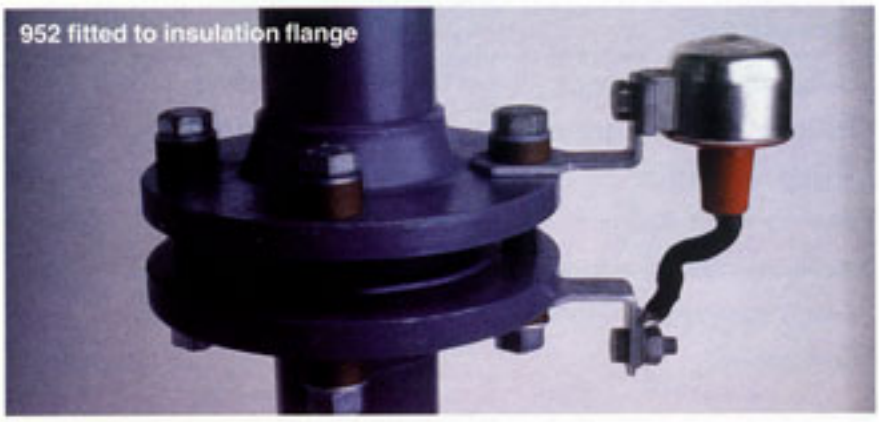
| Technical Data | 951 |
|---|---|
| a.c. Sparkover voltage (50Hz) | ≤2.5kV |
| Impulse sparkover voltage (1.2/50) | ≤5kV |
| Maximum operating voltage (quenching voltage) | 40V |
| Discharge capacity $\int idt$ | 10As |
| Discharge capacity $\int i^2dt$ | $10^5$ $A^2$ s |
| Discharge surge current (8/20) | 50kA |

952

The Clipsal 952 is a high efficiency disconnection spark gap for the protection of insulation pieces of pipelines in an Ex-area.

Cathodically protected pipe sections are separated from earthed system parts with insulating pieces, flanges, screws and pipe sockets.

If lightning strikes the pipeline or its surroundings, the disconnecting spark gap will bridge it and avoid sparkovers and punctures.



952 fitted to insulation flange

| Technical Data | 952 |
|---|---|
| a.c. Sparkover voltage (50Hz) | ≤1kV |
| Impulse sparkover voltage (1.2/50) | ≤2.2kV |
| Maximum operating voltage (quenching voltage) | 40V |
| Nominal discharge impulse current (8/20) | 100kA |
| Discharge capacity $\int idt$ | 20As |
| Discharge capacity $\int i^2dt$ | $2.10^5$ $A^2$ s |
| Ignition group | G4 |

# DEFINITIONS

## Standards

The Clipsal Range of SPDs are designed and tested in accordance with the IEC 61643-1: 1998 and DIN VDE 0675 Part 6, Annexures A1 and A2.

## Definitions

**1. SPDs**
SPDs are devices which mainly consist of voltage-controlled resistors (varistors, suppressor diodes) and/or isolating spark gaps (discharge paths). SPDs are used to protect other electrical equipment and systems against excessive overvoltages and/or to provide equipotentialization.

**2. Continuous operating voltage $U_c$**
The continuous operating voltage or SPD rated voltage/ quenching voltage is the r.m.s. value of the maximum voltage which may be applied in operation to the designated terminals of the SPD. It is the maximum voltage which is present at the SPD in the defined non-conducting state and which ensures its return to this state after responding.

**3. Thermal disconnector**
All SPDs for power supply use which are equipped with a voltage-controlled resistor (varistor) are fitted with an integral disconnector which disconnects the SPD from the mains in the event of a fault and indicates the operating state if necessary.

This disconnector responds to the heat generated by the faulty varistor and trips the SPD at a certain temperature.

The disconnector is used to disconnect the faulty SPD from the mains quickly enough to prevent the risk of fire. It is not the task of the disconnector to provide 'protection against electric shock by indirect contact.'

**4. Response time $t_A$**
The response time mainly describes the response of the individual protection elements used in the SPD. The protection elements with the highest voltage protection level normally have the longest response time, those with a low voltage protection level have the shortest response time.

The response times can vary within certain limits depending on the slope du/dt of the surge voltage or di/dt of the surge current.

**5. Operating temperature range $T_u$**
The operating temperature range (nominal temperature range) indicates the temperature range over which the nominal ratings of the overvoltage protection equipment apply.

**6. Lightning impulse current $I_{imp}$**
The lightning impulse current is a simulated lightning current with a 10/350uS waveform and parameters which form natural lightning currents.

SPDs designed for direct lightning loads such as lightning impulse current at least twice without destruction.

**7. Maximum discharge current $i_{smax}$**
The maximum discharge current is the maximum peak value of the discharge current of 8/20uS waveform which can be discharged by the SPD safely.

**8. Nominal discharge current $i_{sn}$**
The nominal discharge current is the peak value of a discharge current of 8/20uS waveform.

In the working test, the SPD for power supply systems must conduct the nominal discharge current 20 times with the SPD rated voltage $U_c$ without any risk of deterioration of the functioning features.

**9. Nominal voltage $U_n$**
The nominal voltage corresponds to the nominal voltage of the system to be protected. The nominal voltage is indicated to clarify the type of the protection device for information technology systems. It is quoted in r.m.s. values for AC voltages.

**10. Nominal current $I_n$**
The maximum current of an overvoltage SPD is the maximum permissible operating current which may be continuously conducted by the designated terminals of the SPD.

**11. Protection level $u_{sp}$**
The voltage protection level is the peak value of the voltage on the SPD determined by the relevant single tests:

- standard lightning impulse sparkover voltage 1.2/50 (100%)
- sparkover voltage at steepness (1 kV/uS)
- residual voltage ($I_{sn}$)

The voltage protection level characterises the ability of the SPD to limit the overvoltage to a residual level.

**12. Follow on extinguishing capability**
The maximum mains follow on current safely extinguished by the SPD, which permits the device to turn off. Follow on currents above this level are disconnected by the backup fuse.

CLIPSAL ELECTRONIC

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| | Newcastle | 015 298 792 |
| | | 0418 434 169 |
| | | 018 686 040 |
| | Sth West Sydney | 0419 868 353 |
| | Tamworth | 015 214 339 |
| | Wagga Wagga | 018 578 903 |
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