Protection from electro magnetic pulses as a result of lightning and switching

Surge Protection Devices
Introduction to Surge Protection Devices

The inclusion of Surge Protection Devices (SPDs) in the 17th edition of the BS EN 7671 Wiring Regulations amendment 1 shows how far the complexity and concern for personal safety of modern installation has come.

To be clear, SPDs do not protect an installation from lightning strikes, only a fitted lightning protection system to BS EN 62305 will prevent a direct strike from damaging the property. SPDs provide protection from two forms of surge:-

LEMP – Lightning Electro Magnetic Pulse
SEMP – Switching Electro Magnetic Pulse

What are surges?

Surges are short-term high voltage impulses often called ‘spikes’, ‘transients’ or ‘glitches’. The duration of these surges are typically measured in micro seconds.

Surges are typically produced from internal tripping events such as a lift motor in a hotel or office, lighting being turned on and off. When there is a high energy inrush, this generates a surge and continues on around the circuits and can damage sensitive electronic equipment.

Lightning strikes also produce huge surges, up to 2km away from the direct strike. Surges can be induced in cabling systems, even when there is no direct connection to the point of a lightning strike.

The consequences of a surge

Without adequate protection the greatest consequence is a risk to human life, particularly in circumstances where medical equipment is involved and could be damaged. Secondly, there is the potential downtime in production e.g. in a workshop, retail outlet or office. Finally, there is the inconvenience of replacing valuable and sensitive equipment, insurance claims, and increased insurance premiums.

Note:- Currently, cabling for data, telephones and satellites are outside the scope of the 17th edition, but installers and specifiers should still consider providing surge protection for these systems.

Changes to 17th Edition BS 7671 Wiring Regulations amendment 1

Two specific sections of the regulations are pertinent to SPDs, and it is important to understand these in more detail:

Section 443 refers to why and when SPDs should be fitted.
Section 534 refers to device selection.

Section 443 is simply a risk assessment, and asks the question if not installing an SPD, represents an issue to human life, public service or industrial activity. If the answer is ‘Yes’ then fitting of the SPD is mandatory.

Where some confusion arises is the reference to risk of lightning in relation to the number of thunderstorm days per year. The UK on a whole has less than 25 thunderstorm days per year. Therefore, it is not generally required to fit SPDs to all domestic properties. However, where higher risk to personal injury or prevention of commercial activity, further risk assessment is required.

The main driver for installation of SPDs will be insurance companies, with the potential for reduced premiums if SPDs are fitted or possibility non-payment of insurance in the event of a damage or injury if not fitted.

Section 534: Refers to how to divert the surge current to earth before this surge has a way to propagate about the wiring of the installation and cause damage, by considering which device to install.

A house or building is split into Lightning Protection Zones (LPZ), as a potential surge passes between one zone to another, this is where the appropriate SPD should be fitted, e.g. between the outside (LPZ0A) to the inside of a building (LPZ1) – SPD must be fitted or possibility non-payment of insurance in the event of a damage or injury if not fitted.

Areas where SPDs should be considered and further risk assessment required:
- Large residential – flats
- Commercial – depending on location, cabling system etc.

The following is where high risk and SPD’s must be fitted:
- Risk to human life – places where people are receiving medical treatment, safety equipment used, properties with overhead TT systems
- Public services – museums, IT centres, libraries
- Commercial and industrial – factories, offices, shops

Installation as defined in the standard is simple enough, the device is connected with cables to and from the unit no longer represents an issue to human life, public service or industrial activity. If the answer is ‘Yes’ then fitting a SPD is mandatory.

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There are three types of SPD, called Type (or Class) 1, 2 and 3:
1. Type 1
   - Used on buildings that has an overhead (TT) supply or a lightning protection system fitted on the roof.
   - Suitable for all other installations at the incoming or after a type 1 SPD at sub distribution levels.
   - The modern home with an underground cable supply would typically use a type 2 unit.

2. Type 2
   - Used after a type 2 for localised over voltage protection in control cabinets or sensitive or valuable electronic equipment. E.g. A surge protected extension lead to a large plasma TV, is an example of the type 3 device.

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Note, if a Type 2 SPD is installed and cable lengths are less than 10m, then there is no longer a requirement to fit Type 3 surge protected extension leads. If greater than 10m then type 3 surge protection should be fitted.

For the most part a simple two pole device for single phase TT or TNS will be enough. In TNCS systems a single pole unit may be sufficient as only the live conductor comes to the property that can bring a threat from outside influences affecting that supply.
**Features**

- The type 1 and 2 SPDs are a parallel connection so it fails safe or in a way to not take out the supply, some additional fuse may be needed in the SPD “spur” in larger installations.
- Devices have indicators to advise end of life of the device.
- The SPD can be installed in a consumer unit on the DIN rail or beside in an additional enclosure that gives some separation from the clean circuits. This may also help to meet the 1 metre* total installation cable length requirements of the standard.

**10 YEAR Guarantee**

The SPD range is guaranteed against faulty materials and workmanship for a period of 10 years from date of delivery - Contact BG for more details.

The pre-assembled Consumer Unit and Enclosure provide a simple one stop shop for wholesalers and contractors. The CUSPD6609 is a solution for new builds where SPDs are required, and the SPD enclosure can be fitted next to any existing or new consumer unit of any brand where surge protection is required.

**Selection Guide**

START: Lightning protection system installed to BS EN 62305

- Overhead supply?
  - NO
  - YES

- Type 1 SPD
  - NO
  - YES

- Type 2 SPDs
  - ADDITIONALLY
  - Sub Distribution boards >10m cable distance away?
    - NO
    - YES

- Type 3 Surge Extension Leads

Note :- Within section 534 there is the 10m rule, about the voltage protection level of an SPD. E.g. if there was an SPD in the consumer unit, after this point the SPD has an effective protection distance of up to 10m as defined in the BS7671 amendment 1, this means that a PC in a study >10m from the main SPD will need local over voltage protection. This can be provided by standard surge protection extension leads – see current range in the catalogue.

* According to BS 7671 (443.2.4 note 2), there is no need to perform a risk assessment calculation for levels of consequence, because this calculation always leads to the result that protection is required.

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The Range

The BG range has been selected to cater for the majority of domestic/commercial applications with the minimal of range, in order to keep selection simple and minimise stock holding for potential stockists.

Type 1 & 2 - Surge Protection Devices

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CUSPD1110-01</td>
<td>Type 1 and 2, 2 Module, TT, TN and TNCS</td>
</tr>
<tr>
<td>CUSPD2070-01</td>
<td>Type 2, 1 Module, TNCS</td>
</tr>
<tr>
<td>CUSPD2110-01</td>
<td>Type 2, 2 Module, TT, TN and TNCS</td>
</tr>
<tr>
<td>CUSPDA01-01</td>
<td>Accessory - Cable stacker kit, allows cables to enter in &amp; out of SPD</td>
</tr>
</tbody>
</table>

Type 1 & 2 - Retrofit Surge and Lightning Protection Enclosure

- Stand alone enclosure to be fitted to existing consumer units / enclosures, to provide lightning and surge protection. For domestic and commercial installations
- Supplied with 100A mains switch to enable SPD and consumer unit to be isolated
- Enclosure is weatherproof to IP65 and accepts both mini-trunking and conduit entry

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Product Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>CUSPDE01-01</td>
<td>SPD Enclosure kit</td>
<td>c/w SPD Type 1/2 (CUSPD1110-01), TT, TN and TNCS, 100A Main Switch</td>
</tr>
</tbody>
</table>

*Note: SPD enclosure kit is used to provide surge protection to existing fitted consumer units.

Type 1 - Pre-assembled Consumer Unit

- Dual RCD consumer unit, pre-fitted with Type 2 SPD, to provide surge protection for domestic installations
- Providing up to 9 useable ways

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CUSPD6609-01</td>
<td>SPD insulated consumer unit - Dual RCD</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CUSPD2070-01</td>
<td>SPD Type 2 (CUSPD2070-01) 100A Main Switch, 2 x 63A 30mA RCDs</td>
</tr>
</tbody>
</table>

Type 3 protection is required in accordance to 17th Edition Wiring Regulations if cabling distance from a Type 1 or 2 SPD is greater than 10m, or if simply peace of mind that valuable or sensitive equipment need to be protected from surges and damage.

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Type 3 - Surge Protection Extension Leads

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRG42-MS</td>
<td>Four gang surge protected, 2 metre cable, white</td>
</tr>
<tr>
<td>SRG62-MS</td>
<td>Six gang surge protected, 2 metre cable, white</td>
</tr>
<tr>
<td>SRGAUSBPB-MP</td>
<td>USB Charger with plug-through surge socket</td>
</tr>
<tr>
<td>SRGDU62PB-MP</td>
<td>Six gang surge protected with 2xUSB charger outputs</td>
</tr>
</tbody>
</table>

Nexus are market leaders in supplying portable power, please refer to the BG catalogue or contact BG directly for full details of other surge protected products available. Below is a selection of the more popular Type 3 surge protected extension leads.
**Technical information**

<table>
<thead>
<tr>
<th>CUSPD1110</th>
<th>CUSPD2070</th>
<th>CUSPD2110</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPD according to EN 61643</td>
<td>Type 1 / Class I</td>
<td>Type 2 / Class II</td>
</tr>
<tr>
<td>Max continuous operating AC voltage Uc</td>
<td>255V</td>
<td>275V</td>
</tr>
<tr>
<td>Nominal discharge current (8/20µS) In</td>
<td>-</td>
<td>20kA</td>
</tr>
<tr>
<td>Max discharge current (8/20 µS)Imax</td>
<td>-</td>
<td>40kA</td>
</tr>
<tr>
<td>Voltage protection level Up</td>
<td>≤1.5kV</td>
<td>≤1.25kV</td>
</tr>
<tr>
<td>Voltage protection level at 5kA Up</td>
<td>-</td>
<td>≤1kV</td>
</tr>
<tr>
<td>Response time tₐ</td>
<td>≤100nS</td>
<td>≤25nS</td>
</tr>
<tr>
<td>Max mains-side over current protection</td>
<td>160A gL/gG</td>
<td>125A gL/gG</td>
</tr>
<tr>
<td>Short circuit withstand</td>
<td>-</td>
<td>50kA rms</td>
</tr>
<tr>
<td>Operating temperature range Tₑ</td>
<td>-40° to 80°C</td>
<td>-40° to 80°C</td>
</tr>
<tr>
<td>Cross sectional area</td>
<td>1.5 to 35mm²</td>
<td>1.5 to 35mm²</td>
</tr>
<tr>
<td>Enclosure material</td>
<td>Flame retardant</td>
<td>Flame retardant</td>
</tr>
<tr>
<td>IP rating</td>
<td>IP20</td>
<td>IP20</td>
</tr>
<tr>
<td>Width</td>
<td>2 Module</td>
<td>1 Module</td>
</tr>
</tbody>
</table>

*Note: The type 1 SPD has an Iₛ value of 12.5kA*

**Considerations**

- SPDs protect against switching and lightning magnetic pulses and do not protect against direct lightning strikes.
- Though the regulations refer to protection for LV supplies, we also need to consider total protection for the satellite, data cabling and phone lines.
- The inclusion of surge protection with amendment 1 of the 17th edition wiring regulations is only the start, with further changes to regulation expected in the future, but the real driving force behind driving installation of SPDs into more homes and business will be the insurance companies and individuals wanting peace of mind.