CUDIS GUIDE TO SURGE PROTECTION
What is a surge?

A surge is a rapid change from the nominal operating voltage.

The greater the over voltage, the greater the risk of disruption, degradation and damage to the equipment connected to the electrical installation.
Where do surges come from?

Lightning

There are 5,000 storms around the world at any time, with an average lightning current of 30kA, but could reach up to 200kA (200,000 Amps)

70,000 lightning bolts recorded over the UK in one weekend in May 2018.

Concentration of lightning strikes over UK in 2018. Source: Met Office
Direct and Indirect Lightning Strikes

Lightning can still be disruptive to a building's electrical installation even if the building is at a low risk of being struck.

Direct Strike
An installation fitted with a Lightning Protection System or close to an object susceptible to a strike.

Ground Lightning Strike
Cables and bonded services in the ground within 2km of the lightning strike could be affected.

Direct Coupling Lightning Strike
A lightning strike to a connected cable or equipment (e.g., overhead lines).
Transient Voltage Surges

Voltage surges can also be created by non-weather phenomena. Such as:

Externally
- Transformer centre switching
- Power station, sub station and distribution faults
- Unregulated generators

Internally
- Lifts
- Drive motors
- Arc welding equipment
- Photocopiers
- Refrigeration Equipment
- Air Conditioners
Why do I need surge protection?

Transient surges can cause damage ranging from premature ageing of electrical products to complete destruction of equipment. In this modern age, more and more products rely on sensitive electronics.

- Computer Equipment
- CCTV
- PLC Controlled Equipment Systems
- Wireless Transmitters & Receivers
- Fire and Burglar Alarm Systems
- Medical Equipment
- Laboratory and Test Equipment
- Building Management
- Telecoms
- Servers

61% of all electrical damage is caused by surges. A critical failure of one of these could cost a company £millions.
**Where do I need to install Surge Protection?**

The IET Wiring Regulations (BS7671:2018) require all new electrical system designs and installations, as well as alterations and additions to existing installations, to be assessed against transient over voltage risks and where necessary, installing appropriate surge protection devices.

<table>
<thead>
<tr>
<th>Consequences caused by an overvoltage surge.</th>
<th>Examples of where surge protection will be required.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serious injury to or loss of human life.</td>
<td>Hospitals, Care Homes, Home Medical Equipment (dialysis, respiratory aids, etc)</td>
</tr>
<tr>
<td>Interruption of public services and or damage to cultural heritage.</td>
<td>Power Stations, Data Centres, Castles, Museums, Libraries, Art Galleries</td>
</tr>
<tr>
<td>Interruption of commercial or industrial activity.</td>
<td>Banks, Hotels, Supermarkets, Industrial Plants, Farms, large scale manufacturing</td>
</tr>
<tr>
<td>Interruption to an installation with a large number of co-located individuals.</td>
<td>Offices, Universities, Schools, Colleges, Nurseries, Residential Tower Blocks / Flats / Apartments</td>
</tr>
</tbody>
</table>
In all other cases a **RISK ASSESSMENT** must be carried out as per section **443** of the BS7671:2018 IET Wiring Regulations.

No Risk Assessment?
Then Surge Protection **MUST** be provided.
**How Does a Surge Protection Device Work?**

The purpose of an SPD is to divert as much of a transient overvoltage away from the load as possible.

- In most cases the use of a metal oxide varistor (MOV) inside the SPD provides this path to ground/earth.

- Under normal conditions the MOV is a HIGH impedance component and will not draw any current but when subjected to a surge the MOV quickly becomes LOW impedance and opens a path to earth to divert the surge away from your sensitive devices.

- An MOV reacts in nanoseconds, 1000 times faster than the incoming surge, therefore the path to ground is open well before the surge can affect any other circuits.
What Type of Surge Protection is Available?

Surge protection when used most efficiently should be used in 3 stages. These stages are known by the definition of “TYPES” or “CLASSES” of SPD, which when used together in an electrical installation provides the optimum protection needed.
TYPE 1 / CLASS I

Type 1 SPD’s can discharge direct (with aid from an installed LPS system), indirect and induced, high energy lightning impulses with a typical waveform of 10/350µs.

Typically installed at the origin or incoming power supply panel, where the risk of damage from a lightning strike is at its highest, particularly buildings with Lightning Protection Systems installed.
The 10/350µs waveform is used to characterize the current wave from a direct lightning strike. Typically associated with Type 1 / Class I SPDs.

10 microseconds duration for the surge to rise to peak current
350 microseconds duration of the surge to fall to 50% of its peak current

10/350µs waveform
TYPE 2 / CLASS II

Intended to be used in sub distribution boards located downstream of a Type 1 protective device OR at incoming supply panels in installations with a low exposure risk to lightning, where the building has no LPS fitted.

TYPE 3 / CLASS III

Type 3 SPDs are always installed downstream of a Type 2 device, close to sensitive equipment or/and if equipment is located more than 10 meters downstream of the circuits Type 2 protection.
The 8/20µs waveform is used to characterize the current wave from transient surges. Typically associated with Type 2 / Class II and Type 3 / Class III SPDs.

8 microseconds duration for the surge to rise to peak current
20 microseconds duration of the surge to fall to 50% of its peak current

8/20µs waveform
Protection Parameters

Limp – Impulse Current
Peak current in 10/350µs waveform which the SPD can withstand (associated with Type 1 SPDs)

Imax – Maximum Discharge Current
Peak current in 8/20µs waveform which the SPD can withstand (associated with Type 2 SPDs)

In – Nominal Current
Peak current in 8/20µs waveform which the SPD can withstand up to 20 times

Up – Voltage Protection Level
The amount of Voltage that is not suppressed by the SPD and passes through to the load. (above 1.5KV can damage category 1 sensitive electronic equipment)
Surge Protection Installations

The connecting conductors of the SPD should be kept as short as possible to prevent reducing the performance by increasing the let through voltage.

Cable length should preferably not exceed 0.5m but in no case exceed 1m

Inspection and Testing

The SPD could cause inaccurate readings during testing of installations, therefore it is recommended a circuit breaker be fitted to isolate the SPD.

The SPD should be inspected periodically to ensure it is still operational.

GREEN – Serviceable
RED – Unserviceable
If the visual indicator is RED the product has reached its End of Life and requires replacement.
Surge Protection Installations – Single Phase Applications

MCU225-60TI-W-7(Surge TT)
Surge Protection Installations – Single Phase Applications

MCU225-80/I-W-75Surge TT(Internal Wiring)
Surge Protection Installations – Single Phase Applications

MCU14-RCBO-2 (Surge TN5)
Surge Protection Installations – Single Phase Applications
Surge Protection Installations – Three Phase Installations
Surge Protection Installations – Retro Fitted Installations

MCU04-W-8(Surge TT)
(Retrofit wiring to a full consumer unit)

TN-C-S

TN-S

TT

The addition of the circuit breaker (MD163B) in the main consumer unit is added to protect the cable between the two units (as it is in trunking). This MCB may not be necessary, dependent on the customer's installation.
Surge Protection Installations – Retro Fitted Installations