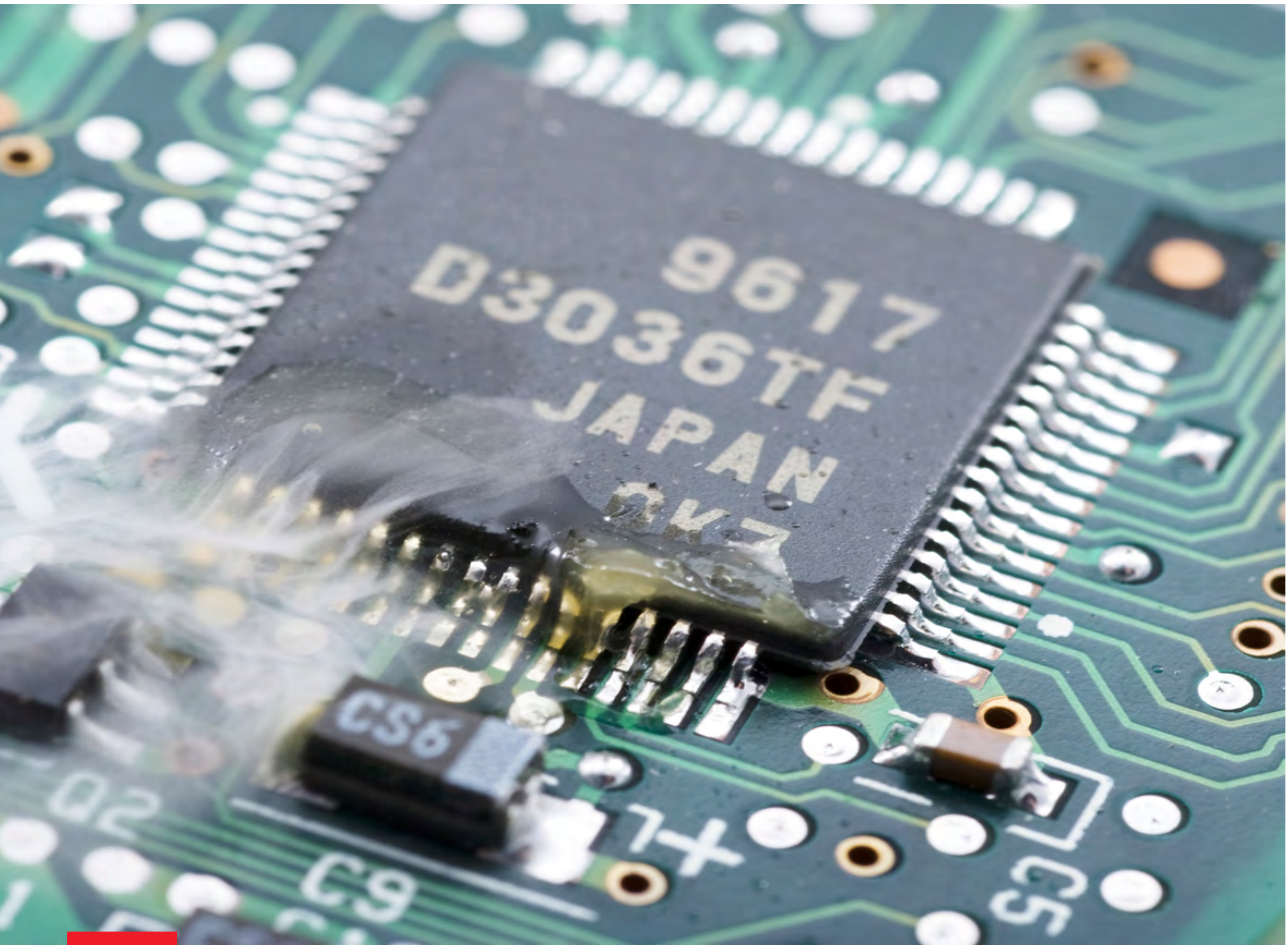


IET Wiring regulations

BS 7671 18th edition

Transient overvoltage protection

The IET Wiring Regulations require all new electrical system designs and installations, as well as alterations and additions to existing installations, to be assessed against transient overvoltage risk and, where necessary, protected using appropriate surge protection measures (in the form of Surge Protection Devices SPDs).

Transient overvoltage protection Introduction

Based on the IEC 60364 series, the 18th Edition of BS 7671 Wiring regulations covers the electrical installation of buildings including the use of surge protection.

The 18th Edition of BS 7671 applies to the design, erection and verification of electrical installations, and also to additions and alterations to existing installations. Existing installations that have been installed in accordance with earlier editions of BS 7671 may not comply with the 18th edition in every respect. This does not necessarily mean that they are unsafe for continued use or require upgrading.

A key update in the 18th Edition relates to Sections 443 and 534, which concern protection of electrical and electronic systems against transient overvoltages, either as a result of atmospheric origin (lightning) or electrical switching events.

Essentially, the 18th Edition requires all new electrical system designs and installations, as well as alterations and additions to existing installations, to be assessed against transient overvoltage risk and, where necessary, protected using appropriate protection measures (in the form of SPDs).

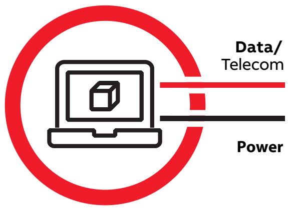
Within BS 7671:
- **Section 443** defines the criteria for risk assessment against transient overvoltages, considering the supply to the structure, risk factors and rated impulse voltages of equipment
- **Section 534** details the selection and installation of SPDs for effective transient overvoltage protection, including SPD Type, performance and co-ordination

Readers of this guide should be mindful of the need to protect all incoming metallic service lines against the risk of transient overvoltages.

BS 7671 provides focussed guidance for the assessment and protection of electrical and electronic equipment intended to be installed on AC mains power supplies.

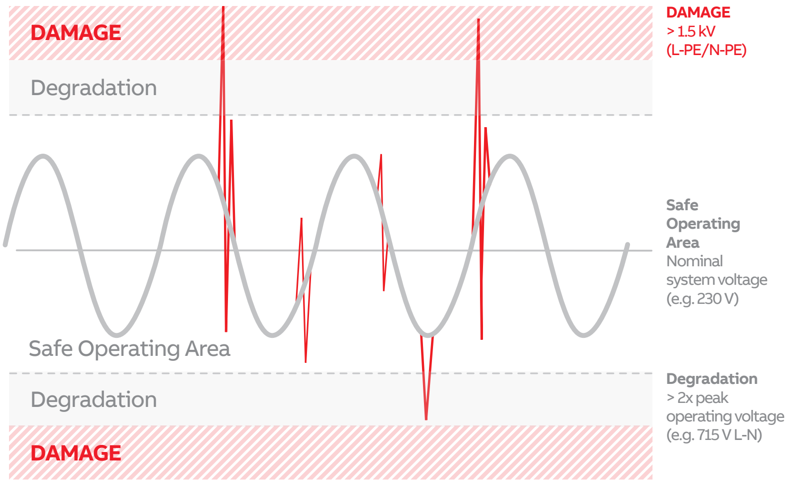
In order to observe the Ligntning Protection Zone LPZ concept within BS 7671 and BS EN 62305, all other incoming metallic service lines, such as data, signal and telecommunications lines, are also a potential route through which transient overvoltages to damage equipment. As such all such lines will require appropriate SPDs.

BS 7671 clearly points the reader back to BS EN 62305 and BS EN 61643 for specific guidance. This is covered extensively in the Furse guide to BS EN 62305 Protection Against Lightning.



IMPORTANT:
Equipment is ONLY protected against transient overvoltages if all incoming / outgoing mains and data lines have protection fitted.

Transient overvoltage protection
Safeguarding your electrical systems



01

Why is transient overvoltage protection so important?

Transient overvoltages are short duration surges in voltage between two or more conductors (L-PE, L-N or N-PE), which can reach up to 6 kV on 230 Vac power lines, and generally result from:

- Atmospheric origin (lightning activity through resistive or inductive coupling (see Figures 02 & 03), and/or
- Electrical switching of inductive loads

Transient overvoltages significantly damage and degrade electronic systems. Outright damage to sensitive electronic systems, such as computers etc, occurs when transient overvoltages between L-PE or N-PE exceed the withstand voltage of the electrical equipment (i.e. above 1.5 kV for Category I equipment to BS 7671 Table 443.2).

Equipment damage leads to unexpected failures and expensive downtime, or risk of fire/electric shock due to flashover, if insulation breaks down.

Degradation of electronic systems, however, begins at much lower overvoltage levels and can cause data losses, intermittent outages and shorter equipment lifetimes (see Figure 01).

Where continuous operation of electronic systems is critical, for example in hospitals, banking and most public services, degradation must be avoided by ensuring these transient overvoltages, which occur between L-N, are limited below the impulse immunity of equipment. This can be calculated as twice the peak operating voltage of the electrical system, if unknown (i.e. approximately 715 V for 230 V systems).

Protection against transient overvoltages can be achieved through installation of a coordinated set of SPDs at appropriate points in the electrical system, in line with BS 7671 Section 534 and the guidance provided in this publication.

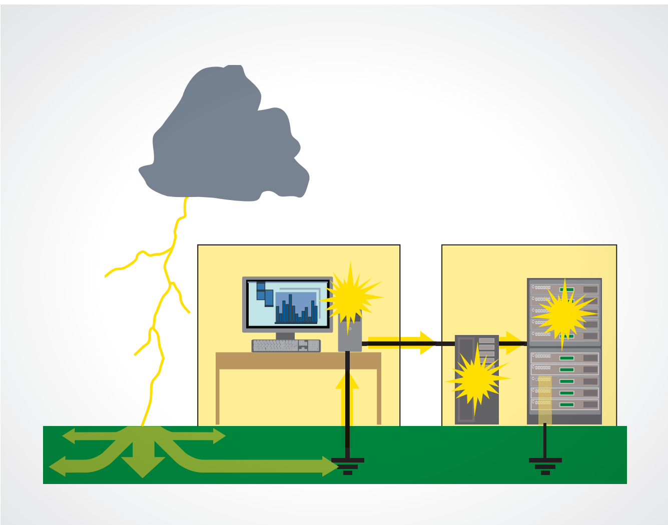
Selecting SPDs with lower (i.e. better) voltage protection levels (U_p) is a critical factor, especially where continuous usage of electronic equipment is essential.

01 Equipment risk – Degradation of electronic systems begins at lower transient overvoltage levels and affects critical electronic systems whenever the impulse immunity of the equipment is compromised.

02 Resistive coupling – Resistively coupled transients are caused by differences in potential between two connected earths.

03 Inductive coupling – Inductively coupled transients are caused by electromagnetic pick-up.

02



03

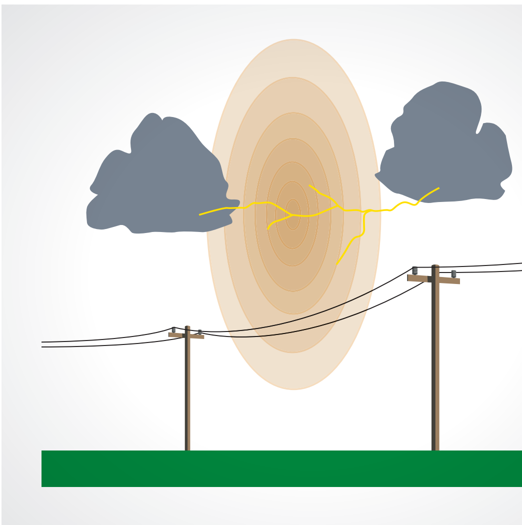


Table 1 – Examples of overvoltage protection requirments to BS 7671

Consequence caused by overvoltage	Examples	Typical facilities	Overvoltage protection required?
Serious injury to or loss of human life	Loss of safety services, medical care facilities	Hospitals, care homes, home dialysis equipment	Yes
Interruption of public services and/or damage to cultural heritage	Loss of utility and IT services, damage to historic buildings	Power stations, data centres, heritage status buildings like museums, castles	Yes
Interruption of commercial or industrial activity	Loss of electronic systems within service sectors, manufacturing processes	Banks, hotels, supermarkets, industrial plants, farms	Yes
Interruption to an installation with a large number of co-located individuals	Loss of safety systems for fire/ security and access control, IT systems	Offices, universities, schools, residential tower blocks	Yes
Consequences caused by overvoltage for a single dwelling unit where an assessment shows the total value of electrical installation and connected equipment does not necessitate the cost of SPD protection (443.4)	Loss of household electronics does not warrant cost of overvoltage protection	Residential homes	No
Interruption to all other cases than detailed above	Loss of systems to small business	Home based office, convenience store	Perform risk assessment of 443.5 to determine Calculated Risk Level CRL No if CRL ≥ 1000 Yes if CRL < 1000 Yes if no risk assessment is performed

Risk assessment

As far as Section 443 is concerned, the full BS EN 62305-2 risk assessment method must be used for high risk installations such as nuclear or chemical sites where the consequences of transient overvoltages could lead to explosions, harmful chemical or radioactive emissions thus affecting the environment.

Outside of such high risk installations, if there is a risk of a direct lightning strike to the structure itself or to overhead lines to the structure SPDs will be required in accordance with BS EN 62305.

Section 443 takes a direct approach for protection against transient overvoltages which is determined based on the consequence caused by overvoltage as per Table 1 above.

Calculated Risk Level CRL – BS 7671
BS 7671 clause 443.5 adopts a simplified version of risk assessment derived from the complete and complex risk assessment of BS EN 62305-2.
A simple formula is used to determine a Calculated Risk Level CRL.

The CRL is best seen as a probability or chance of an installation being affected by transient overvoltages and is therefore used to determine if SPD protection is required.

If the CRL value is less than 1000 (or less than a 1 in 1000 chance) then SPD protection shall be installed. Similarly if the CRL value is 1000 or higher (or greater than a 1 in 1000 chance) then SPD protection is not required for the installation.

The CRL is found by the following formula:

$$CRL = f_{env} / (L_P \times N_g)$$

Where:
- f_{env} is an environmental factor and the value of f_{env} shall be selected according to Table 443.1
- L_P is the risk assessment length in km
- N_g is the lightning ground flash density (flashes per km^2 per year) relevant to the location of the power line and connected structure (see Lightning flash Density Ng map of UK in Figure 05)

The f_{env} value is based on the structure's environment or location. In rural or suburban environments, structures are more isolated and therefore more exposed to overvoltages of atmospheric origin compared to structures in built up urban locations.

Table 2 – Determination of f_{env} value based on environement (Table 443.1 BS 7671)

Environment	Definition	Example	f_{env} value
Rural	Area with a low density of buildings	Countryside	85
Suburban	Area with a medium density of buildings	Town outskirts	85
Urban	Area with a high density of buildings or densely populated communities with tall buildings	Town centre	850

04 Lengths to consider for the calculation of L_p (Figure 443.3 BS 7671)

Risk assessment length L_p

The risk assessment length L_p is calculated as follows:

$$L_P = 2\,L_{PAL} + L_{PCL} + 0.4\,L_{PAH} + 0.2\,L_{PCH}\ (km)$$

Where:

- L_{PAL} is the length (km) of low-voltage overhead line
- L_{PCL} is the length (km) of low-voltage underground cable
- L_{PAH} is the length (km) of high-voltage overhead line
- L_{PCH} is the length (km) of high-voltage underground cable

The total length (L_{PAL} + L_{PCL} + L_{PAH} + L_{PCH}) is limited to 1 km, or by the distance from the first overvoltage protective device installed in the HV power network (see Figure 04) to the origin of the electrical installation, whichever is the smaller.

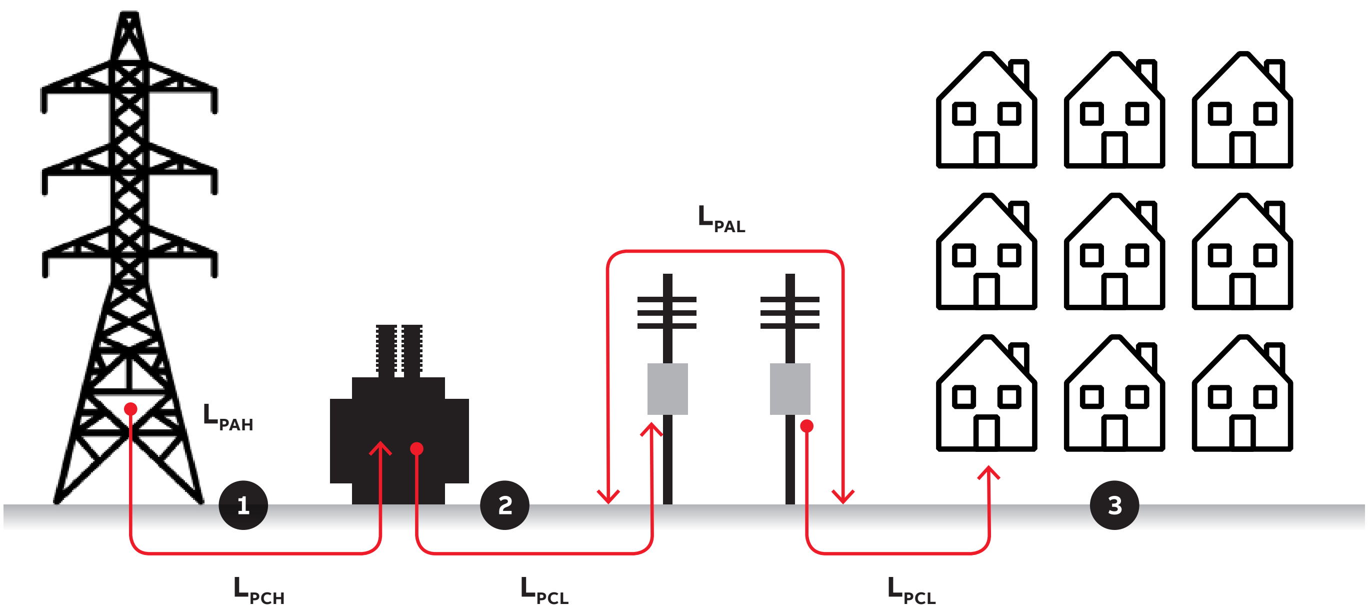
If the distribution network's lengths are totally or partially unknown then L_{PAL} shall be taken as equal to the remaining distance to reach a total length of 1 km. For example, if only the distance of underground cable is known (e.g. 100 m), the most onerous factor L_{PAL} shall be taken as equal to 900 m. An illustration of an installation showing the lengths to consider is shown in Figure 04 (Figure 443.3 of BS 7671).

Ground flash density value N_g

The ground flash density value N_g can be taken from the UK lightning flash density map in Figure 05 (Figure 443.1 of BS 7671) – simply determine where the location of the structure is and choose the value of N_g using the key. For example, central Nottingham has an N_g value of 1. Together with the environmental factor f_{env}, the risk assessment length L_P, the N_g value can be used to complete the formula data for calculation of the CRL value and determine if overvoltage protection is required or not.

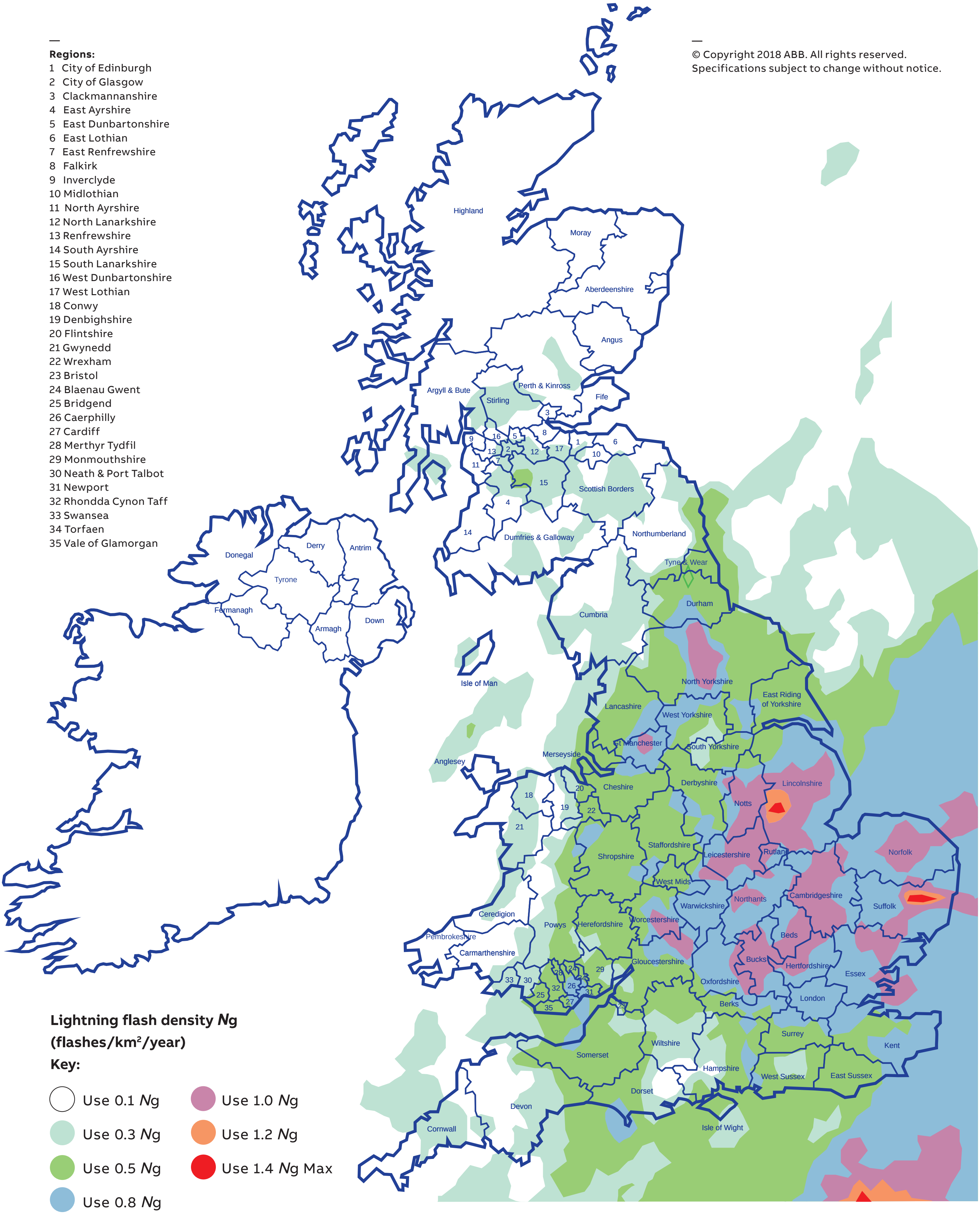
The UK lightning flash density map (Figure 05) and a summary flowchart (Figure 06) to aid the decision making process for the application of Section 443 (with guidance to the Types of SPD guide to Section 534) follows. Some risk calculation examples are also provided.

04



Key
1) Surge arrestor (overvoltage protective device) on the overhead HV system
2) HV/LV transformer
3) Origin of the electrical installation

—
Regions:
1 City of Edinburgh
2 City of Glasgow
3 Clackmannanshire
4 East Ayrshire
5 East Dunbartonshire
6 East Lothian
7 East Renfrewshire
8 Falkirk
9 Inverclyde
10 Midlothian
11 North Ayrshire
12 North Lanarkshire
13 Renfrewshire
14 South Ayrshire
15 South Lanarkshire
16 West Dunbartonshire
17 West Lothian
18 Conwy
19 Denbighshire
20 Flintshire
21 Gwynedd
22 Wrexham
23 Bristol
24 Blaenau Gwent
25 Bridgend
26 Caerphilly
27 Cardiff
28 Merthyr Tydfil
29 Monmouthshire
30 Neath & Port Talbot
31 Newport
32 Rhondda Cynon Taff
33 Swansea
34 Torfaen
35 Vale of Glamorgan



Lightning flash density *Ng* (flashes/km²/year)
Key:

Use 0.1 *Ng*
Use 0.3 *Ng*
Use 0.5 *Ng*
Use 0.8 *Ng*
Use 1.0 *Ng*
Use 1.2 *Ng*
Use 1.4 *Ng* Max

—
05 UK lightning flash density map (Figure 443.1 BS 7671)

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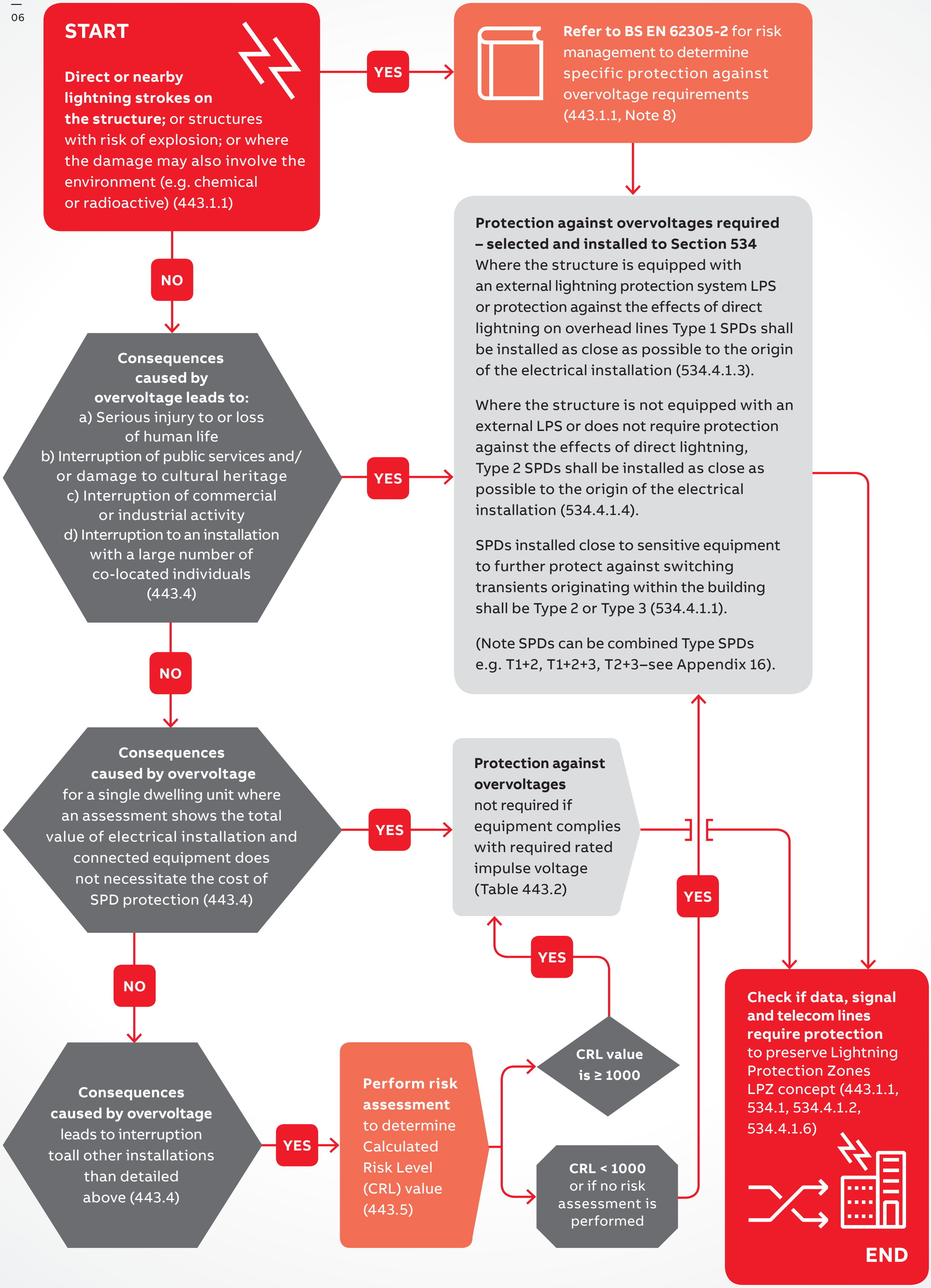
06


START
Direct or nearby lightning strokes on the structure; or structures with risk of explosion; or where the damage may also involve the environment (e.g. chemical or radioactive) (443.1.1)
YES
Refer to BS EN 62305-2 for risk management to determine specific protection against overvoltage requirements (443.1.1, Note 8)
NO
Consequences caused by overvoltage leads to:
a) Serious injury to or loss of human life
b) Interruption of public services and/ or damage to cultural heritage
c) Interruption of commercial or industrial activity
d) Interruption to an installation with a large number of co-located individuals
(443.4)
YES
Protection against overvoltages required – selected and installed to Section 534
Where the structure is equipped with an external lightning protection system LPS or protection against the effects of direct lightning on overhead lines Type 1 SPDs shall be installed as close as possible to the origin of the electrical installation (534.4.1.3).
Where the structure is not equipped with an external LPS or does not require protection against the effects of direct lightning, Type 2 SPDs shall be installed as close as possible to the origin of the electrical installation (534.4.1.4).
SPDs installed close to sensitive equipment to further protect against switching transients originating within the building shall be Type 2 or Type 3 (534.4.1.1).
(Note SPDs can be combined Type SPDs e.g. T1+2, T1+2+3, T2+3–see Appendix 16).
NO
Consequences caused by overvoltage for a single dwelling unit where an assessment shows the total value of electrical installation and connected equipment does not necessitate the cost of SPD protection (443.4)
YES
Protection against overvoltages not required if equipment complies with required rated impulse voltage (Table 443.2)
YES
NO
YES
Consequences caused by overvoltage leads to interruption toall other installations than detailed above (443.4)
YES
Perform risk assessment to determine Calculated Risk Level (CRL) value (443.5)
CRL value is ≥ 1000
CRL < 1000 or if no risk assessment is performed
Check if data, signal and telecom lines require protection to preserve Lightning Protection Zones LPZ concept (443.1.1, 534.1, 534.4.1.2, 534.4.1.6)
END

—
06 **Risk assement**
SPD decision flow chart for installations within the scope of this BS 7671 18th Edition.

Examples of calculated risk level CRL for the use of SPDs (BS 7671 informative Annex A443).

Example 1 - Building in rural environment in Notts with power supplied by overhead lines of which 0.4 km is LV line and 0.6 km is HV line
Ground flash density N_g for central Notts = 1 (from Figure 05 UK flash density map).

Environmental factor f_{env} = 85 (for rural environment – see Table 2)

Risk assessment length L_P

$$L_P = 2\,L_{PAL} + L_{PCL} + 0.4\,L_{PAH} + 0.2\,L_{PCH}$$

$$L_P = (2 \times 0.4) + (0.4 \times 0.6)$$

$$L_P = 1.04$$

Where:
- L_{PAL} is the length (km) of low-voltage overhead line = 0.4
- L_{PAH} is the length (km) of high-voltage overhead line = 0.6
- L_{PCL} is the length (km) of low-voltage underground cable = 0
- L_{PCH} is the length (km) of high-voltage underground cable = 0

Calculated Risk Level (CRL)

$$CRL = f_{env} / (L_P \times N_g)$$

$$CRL = 85 / (1.04 \times 1)$$

$$CRL = 81.7$$

In this case, SPD protection shall be installed as the CRL value is less than 1000.

Example 2 - Building in suburban environment located in north Cumbria supplied by HV underground cable
Ground flash density Ng for north Cumbria = 0.1 (from Figure 05 UK flash density map)
Environmental factor f_{env} = 85 (for suburban environment – see Table 2)

Risk assessment length L_P

$$L_P = 2\,L_{PAL} + L_{PCL} + 0.4\,L_{PAH} + 0.2\,L_{PCH}$$

$$L_P = 0.2 \times 1$$

$$L_P = 0.2$$

Where:
- L_{PAL} is the length (km) of low-voltage overhead line = 0
- L_{PAH} is the length (km) of high-voltage overhead line = 0
- L_{PCL} is the length (km) of low-voltage underground cable = 0
- L_{PCH} is the length (km) of high-voltage underground cable = 1

Calculated Risk Level (CRL)

$$CRL = f_{env} / (L_P \times N_g)$$

$$CRL = 85 / (0.2 \times 0.1)$$

$$CRL = 4250$$

In this case, SPD protection is not a requirement as CRL value is greater than 1000.

Example 3 - Building in urban environment located in southern Shropshire – supply details unknown
Ground flash density N_g for southern Shropshire = 0.5 (from Figure 05 UK flash density map).

Environmental factor f_{env} = 850 (for urban environment – see Table 2)

Risk assessment length LP

$$L_P = 2\,L_{PAL} + L_{PCL} + 0.4\,L_{PAH} + 0.2\,L_{PCH}$$

$$L_P = (2 \times 1)$$

$$L_P = 2$$

Where:
- L_{PAL} is the length (km) of low-voltage overhead line = 1 (details of supply feed unknown – maximum 1 km)
- L_{PAH} is the length (km) of high-voltage overhead line = 0
- L_{PCL} is the length (km) of low-voltage underground cable = 0
- L_{PCH} is the length (km) of high-voltage underground cable = 0

Calculated Risk Level CRL

$$CRL = f_{env} / (L_P \times N_g)$$

$$CRL = 850 / (2 \times 0.5)$$

$$CRL = 850$$

In this case, SPD protection shall be installed as the CRL value is less than 1000.

Example 4 - Building in urban environment located in London supplied by LV underground cable
Ground flash density N_g for London = 0.8 (from Figure 05 UK flash density map)

Environmental factor f_{env} = 850 (for urban environment – see Table 2)

Risk assessment length L_P

$$L_P = 2\,L_{PAL} + L_{PCL} + 0.4\,L_{PAH} + 0.2\,L_{PCH}$$

$$L_P = 1$$

Where:
- L_{PAL} is the length (km) of low-voltage overhead line = 0
- L_{PAH} is the length (km) of high-voltage overhead line = 0
- L_{PCL} is the length (km) of low-voltage underground cable = 1
- L_{PCH} is the length (km) of high-voltage underground cable = 0

Calculated Risk Level (CRL)

$$CRL = f_{env} / (L_P \times N_g)$$

$$CRL = 850 / (1 \times 0.8)$$

$$CRL = 1062.5$$

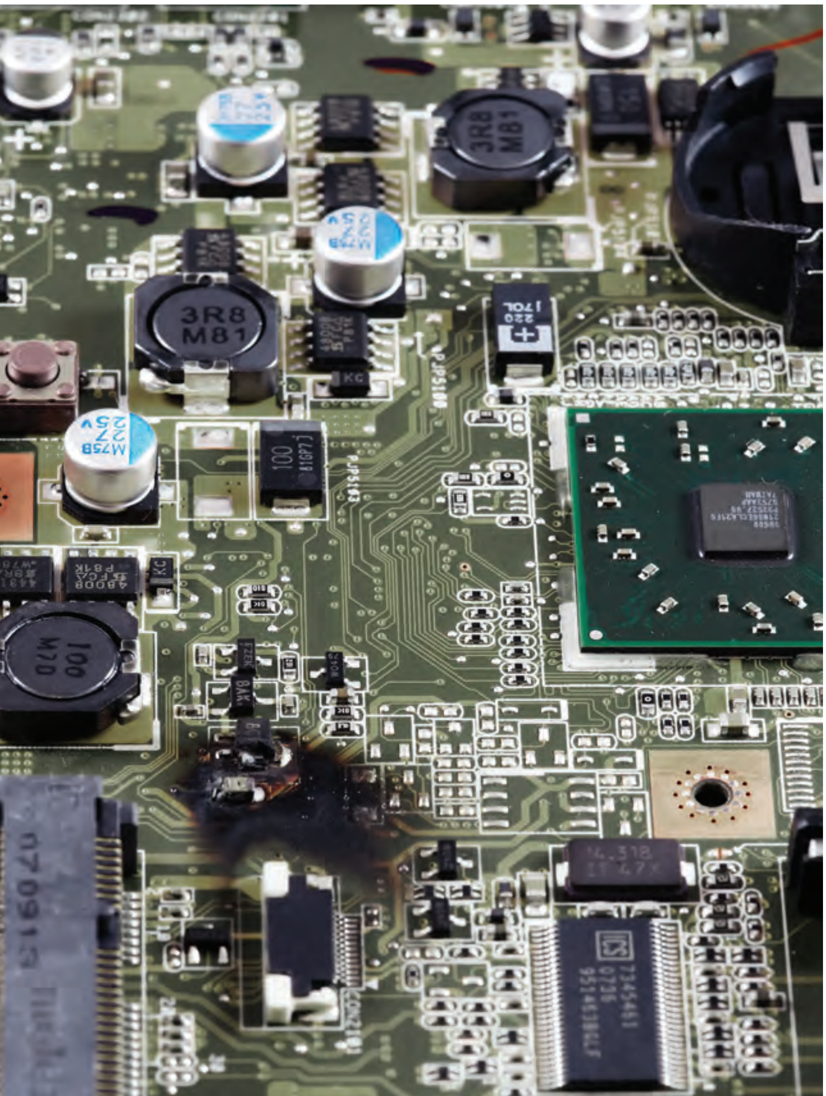
In this case, SPD protection is not a requirement as the CRL value is greater than 1000.

Transient overvoltage protection
Selection of SPDs to BS 7671

Selection of SPDs to BS 7671
The scope of Section 534 of BS 7671 is to achieve overvoltage limitation within AC power systems to obtain insulation co-ordination, in line with Section 443, and other standards, including BS EN 62305-4.

Overvoltage limitiation is achieved through installation of SPDs as per the recommendations in Section 534 (for AC power systems), and BS EN 62305-4 (for other power and data, signal or telecommunications lines).

Selection of SPDs should achieve the limitation of transient overvoltages of atmospheric origin, and protection against transient overvoltages caused by direct lightning strikes or lightning strikes in the vicinity of a building protected by a structural Lightning Protection System LPS.



SPD selection
SPDs should be selected according to the following requirements:
- Voltage protection level (U_P)
- Continuous operating voltage (U_C)
- Temporary overvoltages (U_{TOV})
- Nominal discharge current (I_{nspd}) and impulse current (I_{imp})
- Prospective fault current and the follow current interrupt rating

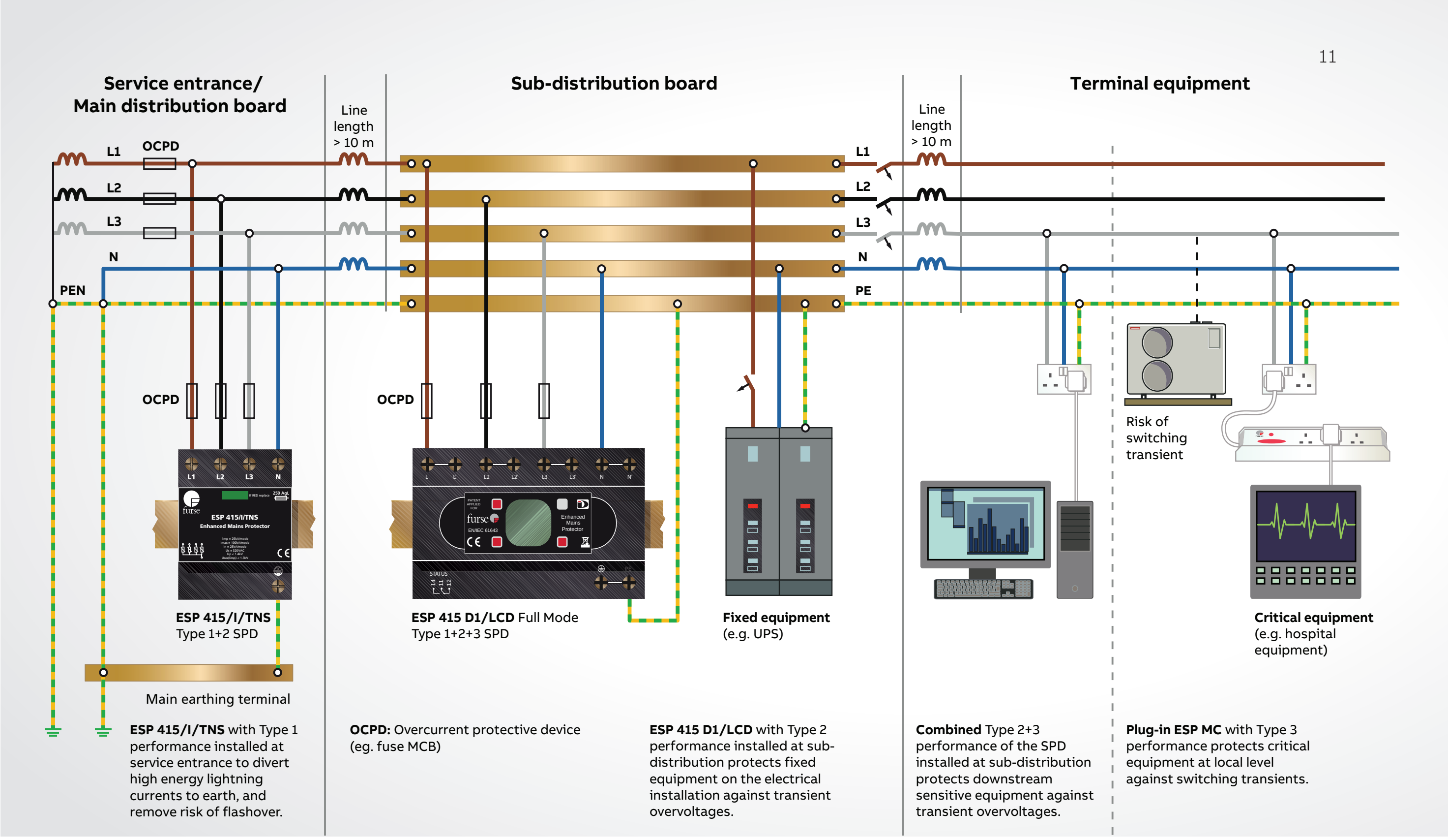
The most important aspect in SPD selection is its voltage protection level (U_P). The SPD's voltage protection level (U_P) must be lower than the rated impulse voltage (U_W) of protected electrical equipment (defined within Table 443.2), or for continuous operation of critical equipment, its impulse immunity.

Where unknown, impulse immunity can be calculated as twice the peak operating voltage of the electrical system (i.e. approximately 715 V for 230 V systems). Non-critical equipment connected to a 230/400 V fixed electrical installation (e.g. a UPS system) would require protection by an SPD with a U_P lower than Category II rated impulse voltage (2.5 kV). Sensitive equipment, such as laptops and PCs, would require additional SPD protection to Category I rated impulse voltage (1.5 kV).

These figures should be considered as achieving a minimal level of protection. SPDs with lower voltage protection levels (U_P) offer much better protection, by:
- Reducing risk from additive inductive voltages on the SPD's connecting leads
- Reducing risk from voltage oscillations downstream which could reach up to twice the SPD's U_P at the equipment terminals
- Keeping equipment stress to a minimum, as well as improving operating lifetime

In essence, an enhanced SPD (SPD* to BS EN 62305) would best meet the selection criteria, as such SPDs offer voltage protection levels (U_P) considerably lower than equipment's damage thresholds and thereby are more effective in achieving a protective state.

As per BS EN 62305, all SPDs installed to meet the requirements of BS 7671 shall conform to the product and testing standards (BS EN 61643 series).



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07

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07 Typical installation on a 230/400 V TN-C-S/TN-S system, using Furse SPDs, to meet the requirements of BS 7671.

Compared to standard SPDs, enhanced SPDs offer both technical and economic advantages:
- Combined equipotential bonding and transient overvoltage protection (Type 1+2 & Type 1+2+3)
- Full mode (common and differential mode) protection, essential to safeguard sensitive electronic equipment from all types of transient overvoltage - lightning & switching and
- Effective SPD co-ordination within a single unit versus installation of multiple standard Type SPDs to protect terminal equipment

—

Compliance to BS EN 62305/BS 7671

BS 7671 Section 534 focuses guidance on selection and installation of SPDs to limit transient overvoltages on the AC power supply.

BS 7671 Section 443 states that, transient overvoltages transmitted by the supply distribution system are not significantly attenuated downstream in most installations BS 7671 Section 534 therefore recommends that SPDs are installed at key locations in the electrical system:
- As close as practicable to the origin of the installation (usually in the main distribution board after the meter)
- As close as practicable to sensitive equipment (sub-distribution level), and local to critical equipment

Figure 07 shows a typical installation on a 230/400 V TN-CS/TN-S system using Furse SPDs, to meet the requirements of BS 7671.

Figure 07 demonstrates how effective protection comprises a service entrance SPD to divert high energy lightning currents to earth, followed by coordinated downstream SPDs at appropriate points to protect sensitive and critical equipment.

Selecting appropriate SPDs
SPDs are classified by Type within BS 7671 following the criteria established in BS EN 62305.

Where a building includes a structural LPS, or connected overhead metallic services at risk from a direct lightning strike, equipotential bonding SPDs (Type 1 or Combined Type 1+2) must be installed at the service entrance, to remove risk of flashover.

Installation of Type 1 SPDs alone however does not provide protection to electronic systems. Transient overvoltage SPDs (Type 2 and Type 3, or Combined Type 1+2+3 and Type 2+3) should therefore be installed downstream of the service entrance.These SPDs further protect against those transient overvoltages caused by indirect lightning (via resistive or inductive coupling) and electrical switching of inductive loads.

Combined Type SPDs (such as the Furse ESP D1 Series and ESP M1/M2/M4 Series) significantly simplify the SPD selection process, whether installing at the service entrance or downstream in the electrical system.

ABB Furse ESP range of SPDs
Enhanced solutions to BS EN 62305/BS 7671

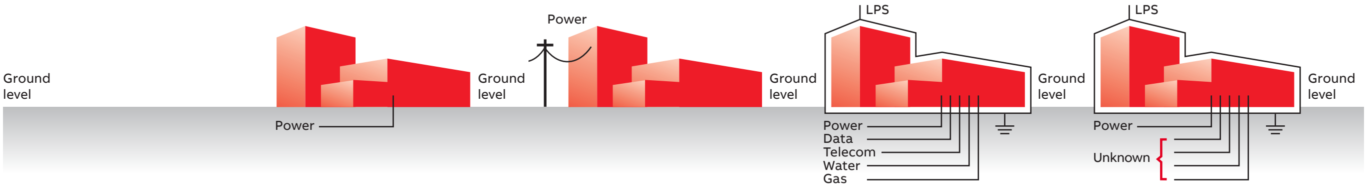
The Furse ESP range of SPDs (power, data and telecom) are widely specified in all applications to ensure the continuous operation of critical electronic systems. They form part of a complete lightning protection solution to BS EN 62305. Furse ESP M and ESP D power SPD products are Type 1+2+3 devices, making them suitable for installation at the service entrance, whilst giving superior voltage protection levels (enhanced to BS EN 62305) between all conductors or modes.

The active status indication informs the user of:
- Loss of power
- Loss of phase
- Excessive N-E voltage
- Reduced protection

—
The SPD and supply status can also be monitored remotely via the volt-free contact.

—
Protection for 230/400 V TN-S or TN-C-S supplies

Supply type	**Example 1**	**Example 2**	**Example 3**	**Example 4**
	No external lightning protection system fitted	No external lightning protection system fitted	External lightning protection system fitted	External lightning protection system fitted
	Underground mains supply feed	Exposed overhead mains supply feed	Multiple connected metallic services	No. of services unknown



Main distribution board (MDB)	**Type 1+2+3**	**Type 1+2 OR Type 1+2+3**	**Type 1+2+3**	**Type 1+2 OR Type 1+2+3**
3 Phase 400 V Service entrance, after electricity meter (Main distribution board (MDB)). Type 1+2+3 SPDs such as the ESP M and D series are used where the MDB directly feeds critical electronics	  ESP 415 D1 Series **OR** ESP 415 M1 Series	  ESP 415/III/TNS **OR** ESP 415 M2 Series for critical electronics	  ESP 415 D1 Series **OR** ESP 415 M1 Series	  For LPL I & II: ESP 415/I/TNS LPL III or IV: ESP 415/III/TNS **OR** ESP 415 M4 Series for critical electronics

Sub-distribution board (SDB) — **Type 1+2+3**

Located >10 m from MDB feeding electronic equipment

 **OR** 

For 3 Phase 400 V
ESP 415 D1 Series, or
ESP 415 M1 Series

 **OR** 

For 1 Phase 230 V
ESP 240 D1 Series, or
ESP 240 M1 Series

Final circuit equipment	**For 13 A sockets** (e.g. servers)	**Fused spurs**	**Consumer units**
Located >10 m from SDB	 ESP MC ESP MC/TN/RJ11 ESP MC/Cat-5e	 ESP 240D-10A ESP 240D-32A	 Furse MMP 2C275/1+1T

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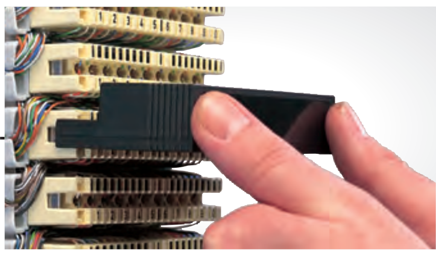
Protection for data signal and telecoms applications



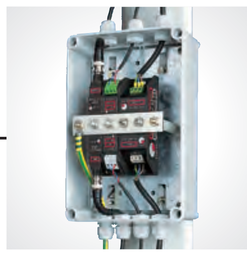


ABB OVR power SPDs
Cost effective protection to BS 7671

The ABB OVR range of SPDs compliment ABB's DIN rail product solutions offering cost effective protection for commercial, industrial and domestic installations.

Safety reserve system

- Two protection components in parallel inside a cartridge guarantee best possible protection
- When one component is damged, the mechanical indicator will switch to half green / half red, triggering the volt-free contact
- At this stage the product should be replaced, but the user still has protection during the ordering and installation process
- When both components are damaged, the end of life indicator will become completely red

Main section board

Part No. / Order code	Description
OVR T1-T2 3N 12.5-275s P TS QS / 2CTB815710R0700 TNS/TT 230/400V 3Ph+N networks	Type 1+2 ABB surge protective devices have a high impulse current (10/350 waveform) withstand capacity whilst ensuring a low (better) voltage protection level (U_p)

Characteristics

ALARM RES ON | COMPACT SPACE SAVING DESIGN | I_{imp} 12.5kA | Plug-in MODULE | IEC61643-11 EN61643-11 | TS AUXILIARY CONTACT

Features
Multi-mode protection
End of life SPD visual indicator with safety reserve
DIN rail mounting for quick installation
Compact design
Auxillary contact TS for remote status indication
Quicksafe® disconnection at end of life

Sub-distribution board

Part No. / Order code	Description
OVR T2 3N 40-275s P TS QS / 2CTB815704R0800 TNS/TT 230/400V 3Ph+N networks	Type 2 ABB surge protective devices are designed to protect electrical installations and sensitive equipment against indirect surge currents

Characteristics

ALARM RES ON | I_{max} 40kA | Plug-in MODULE | IEC61643-11 EN61643-11 | TS AUXILIARY CONTACT

Features
Multi-mode protection
End of life SPD visual indicator with safety reserve
Plug-in cartridge
DIN rail mounting for quick installation
Auxillary contact TS for remote status indication
Quicksafe® disconnection at end of life

Consumer unit

Part No. / Order code	Description
OVR T2 1N 40-275s P TS QS / 2CTB815704R0200 TNS/TT 230V 1Ph+N networks	Type 2 ABB surge protective devices are designed to protect electrical installations and sensitive equipment against indirect surge currents

Characteristics

ALARM RES ON | I_{max} 20kA | Plug-in MODULE | IEC61643-11 EN61643-11 | TS AUXILIARY CONTACT

Features
Multi-mode protection
End of life SPD visual indicator with safety reserve
Plug-in cartridge
DIN rail mounting for quick installation
Auxillary contact TS for remote status indication
Quicksafe® disconnection at end of life

Installation of SPDs
Section 534, BS 7671



Table 3 – Compatible overcurrent protection – Product selection guide

Type	OCPD series		ESP 415/I/TNS	ESP 415/III/TNS	ESP 415 M4***
Order code			7TCA085460R0101	7TCA085460R0103	7TCA085460R0124
Application	**MCB**	**Min - Max. rated current**			
Domestic	SH201B	6A - 40A	–	–	–
Control / Commercial	S201C	6A - 63A	–	–	–
Commercial / Industrial	S201MC	6A - 63A	–	–	–
Control / Commercial	S203C	6A - 63A	•	•	•
Commercial / Industrial	S203MC	6A - 63A	•	•	•
	Fuse				
Control / Commercial	E 91/32	6A - 32 A	–	–	–
Commercial / Industrial	E 93/32	6A - 32 A	•	•	•
Control / Commercial	E 91/50	6A - 50A	–	–	–
Commercial / Industrial	E 93/50	6A - 50A	•	•	•
Control / Commercial	E 91/125	6A - 125A	–	–	–
Commercial / Industrial	E 93/125	6A - 125A	•	•	•
	MCCB				
Commercial / Industrial	XT1 125A	16A - 125A	•	•	•
Commercial / Industrial	XT1 160A	16A - 160A	•	•	•
Commercial / Industrial	XT3 250A	63A - 250A	•	•	•

Key: • Suitable / – Not suitable.
Maximum OCPD ratings must be in accoradance with the installation to follow co-ordination rules with main or upstream short-circuit protection.

* For ESP 240 M1 (7TCA085460R0089) and ESP 415 M1R (7TCA085460R0115), use same overcurrent protection selection as ESP 415 M1.

** For ESP 415 M2R (7TCA085460R0123) use same overcurrent protection selection as ESP 415 M2 .

***For ESP 415 M4R (7TCA085460R0126) use same overcurrent protection selection ESP 415 M4.

**** For Furse MMP 2C275/1+1T (7TCA085460R0185) use same overcurrent protection selection as OVR T2 1N 40-275sP TS QS.

Installation of SPDs to BS 7671

Critical length of connecting conductors
An installed SPD will always present a higher let through voltage to equipment compared with the voltage protection level (U_P) stated on a manufacturer's data sheet, due to additive inductive voltage drops across the conductors on the SPD's connecting leads.

Therefore, for maximum transient overvoltage protection the SPD's connecting conductors must be kept as short as possible.

BS 7671 defines that for SPDs installed in parallel (shunt), the total lead length between line conductors, protective conductor and SPD preferably should not exceed 0.5 m and never exceed 1 m. See Figure 08 (overleaf) for example.

For SPDs installed in-line (series), the lead length between the protective conductor and SPD preferably should not exceed 0.5 m and never exceed 1 m.

Best practice
Poor installation can significantly reduce effectiveness of SPDs. Therefore, keeping connecting leads as short as possible is vital to maximise performance, and minimise additive inductive voltages.

Best practice cabling techniques, such as binding together connecting leads over as much of their length as possible, using cable ties or spiral wrap, is highly effective in cancelling inductance.

The combination of an SPD with low voltage protection level (U_P), and short, tightly bound connecting leads ensure optimised installation to the requirements of BS 7671.

Cross-sectional area of connecting conductors
For SPDs connected at the origin of the installation (service entrance) BS 7671 requires the minimum cross-sectional area size of SPDs connecting leads (copper or equivalent) to PE/live conductors respectively to be:
- 16 mm^2/6 mm^2 for Type 1 SPDs
- 6 mm^2/2.5 mm^2 for Type 2 SPDs






ESP 415 M2**	ESP 415 M1*	ESP 415 D1	OVR T1-T2 3N 12.5-275s P TS QS	OVR T2 3N 40-275s P TS QS	OVR T2 1N 40-275s P TS QS****
7TCA085460R0119	7TCA085460R0112	7TCA085460R0105	2CTB815710R0700	2CTB815704R0800	2CTB815704R0200
–	–	–	–	–	•
–	–	–	–	–	•
–	–	–	–	–	•
•	•	•	•	•	–
•	•	•	•	•	–
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•	•	•	•	•	–
•	•	•	•	•	–
•	–	–	•	•	–
•	–	–	–	–	–

—
01 **ESP SL Series**
For protection of twisted pair signalling applications.
—
02 **ESP Cat 6 Series**
For protection of local area networks up to Cat 6 including Power over Ethernet (PoE).
—
03 **ESP TN/JP Series**
For protection of equipment connected to BT telephone (BS 6312) socket.

These cross-sectional area values are based on the surge current that these SPD connecting leads need to handle, not the supply current. However, in the event of a short circuit, for example due to the end of life condition of the SPD, the connecting leads to the SPD would need to be protected by a suitable Overcurrent Protective Device (OCPD).

Fault protection

BS 7671 defines requirements to ensure that fault protection shall remain effective in the protected installation even in the case of failure of SPDs.

Therefore an SPD needs to be protected against short circuits through the use of an appropriate OCPD capable of eliminating the short-circuit. In effect, the SPD should have a dedicated OCPD installed in-line on its connecting leads, ensuring that this OCPD to the SPD discriminates with the upstream OCPD of the main supply.

SPD manufacturers should provide clear guidance for the selection of the correct ratings of over current protection devices OCPDs in their SPD installation instructions.

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Other products to consider
(see page 17)

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01

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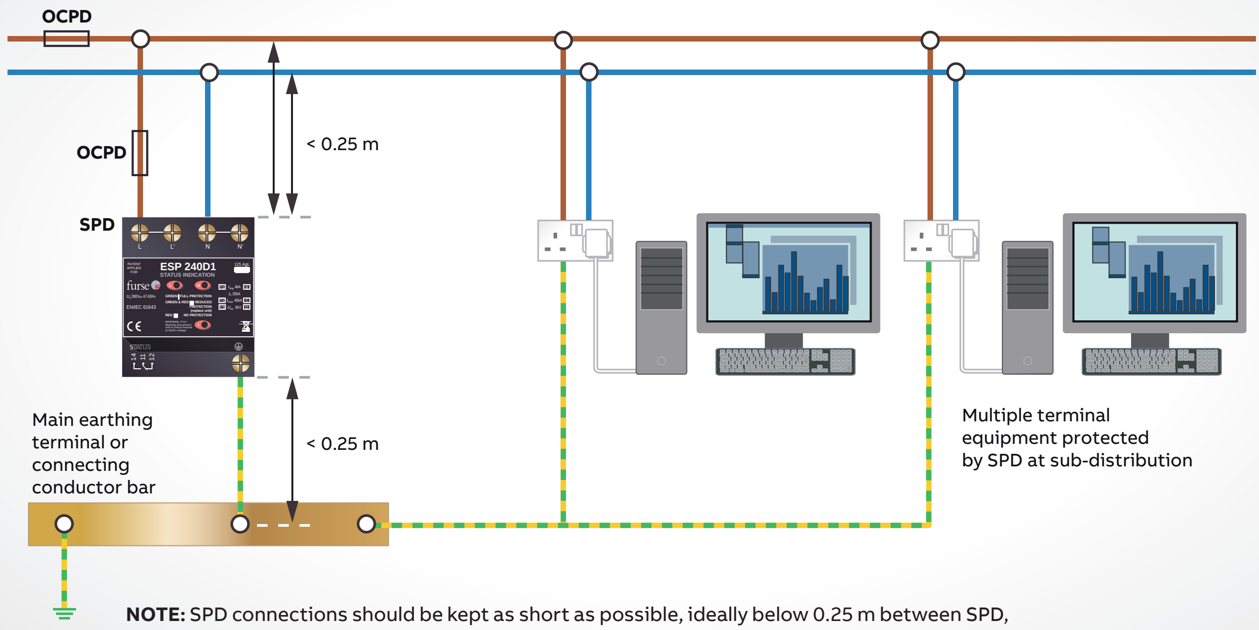

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08

—
08 Total lead length for SPDs installed in parallel.
—
01 ESP 415 D1/LCD.

The OCPD must be coordinated with the SPD to ensure reliable operation and continuity of service. The OCPD, being in-line with the SPD, must withstand the surge current whilst limiting its residual voltage, and most importantly the OCPD must ensure effective protection against all types of overcurrents.

In accordance with BS EN 61643 SPD product test standards, SPD manufacturers have to declare the maximum OCPD rating that can safely be used with their SPD.

The OCPD rating is selected as part of the SPD testing process to ensure that the full SPD preconditioning and operating duty tests, including the maximum SPD surge current test, do not cause the OCPD to operate.

It is important to ensure that the maximum OCPD rating delared by the SPD manufacturer is never exceeded. However, the maximum OCPD value declared by the SPD manufacturer does not consider the need to discriminate the SPD's OCPD from that of the upstream supply.

Selection of the appropriate OCPD in-line with the SPD must must therefore be in accordance with the installation to follow co-ordination rules with the main or upstream short circuit protection. Table 3 (see p.14) details the suitable ABB OCPD series for the Furse and ABB range of SPDs.

Installers should refer to OCPD manufacturers' operating characteristics to ensure discrimination, particularly where an installation includes a mixture of types of OCPD.

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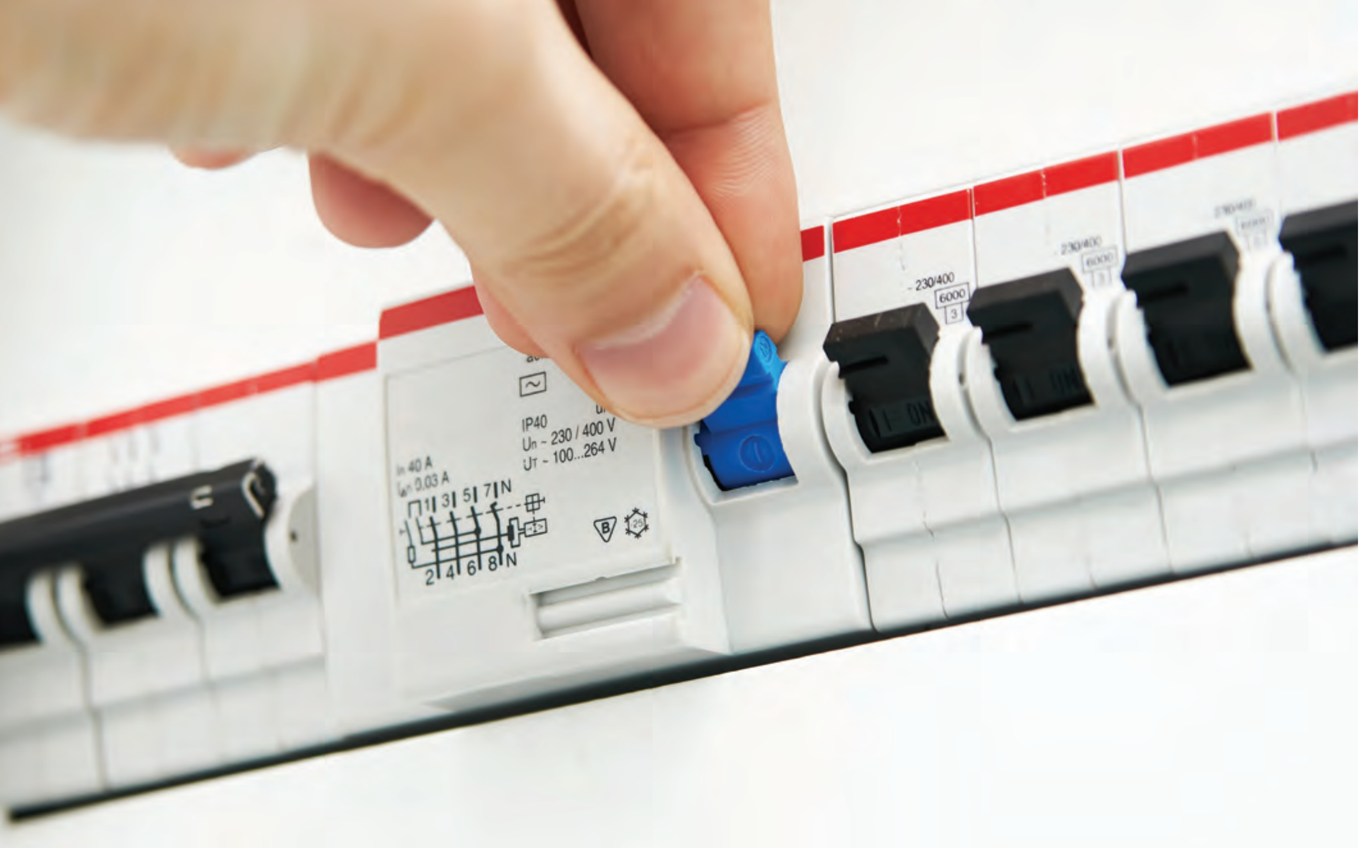
01



Other products to consider

ESP SL Series – for protection of twisted pair signalling applications

	Product range	Description	Features
	**ESP SL Series**	Two stage removable protection module with simple quick release mechanism allows partial release for easy line commissioning and maintenance, as well as full removal for protection replacement	Available in 6 V, 15 V, 30 V, 50 V, 110 V and analogue telephone variants
			Earthed and isolated screen versions available
			Optional LED status indication available
			15 V and 30 V models versions available with ATEX / IECEx approvals

ESP Cat-5e / 6 series – for protection of local area networks

	Product range	Features
	**ESP Cat-5e/6 Series**	Different models available to protect Cat-5e / Cat-6 and PoE versions of both
		Will protect all PoE powering modes A and B
		Suitable for shielded or unshielded twisted pair installations
		Will not impair the system's normal operation

ESP TN/JP – for protection of equipment connected to BT telephone (BS 6312) socket

	Part No.	Features
	**ESP TN/JP**	Comes with BT (BS 6312) jack-plug for ease of installation
		Also available with RJ11 connectors
		RJ11 and JP versions suitable for use on lines with a maximum ringing voltage of 296 V
		ISDN suitable models with RJ45 connectors available

Efficiency you can touch

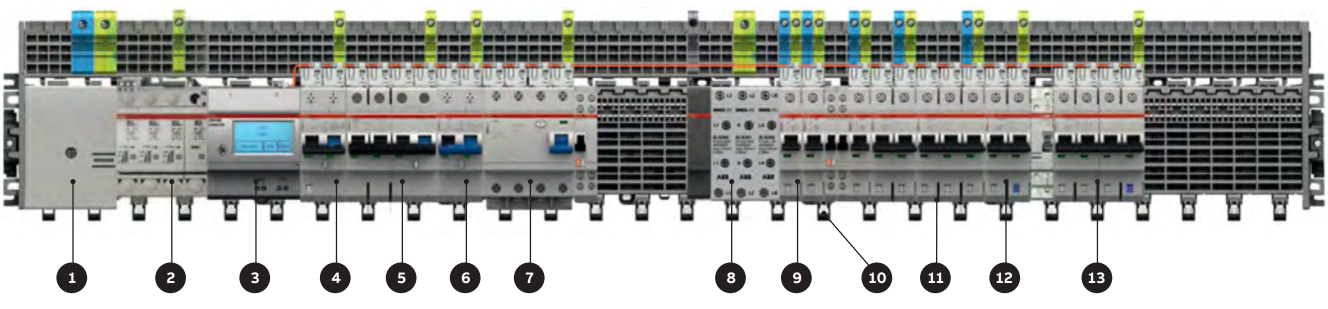
Plug in components during ongoing operation

Even safer: Protection against electrical hazards
We have upgraded our unique SMISSLINE socket system even further through the addition of a pioneering innovation. With the new SMISSLINE TP system, components can now be plugged in or unplugged load-free without any risk from electrical current running through the body. The SMISSLINE TP pluggable socket system is completely finger-safe (IP20B) – when devices are plugged in and un- plugged, the system is always touch-proof. This means that SMISSLINE TP prevents any danger to personnel from switching arcs or accidental arcing.

Even more flexible: make additions and changes during ongoing operation
Pluggable devices can be added and changed quickly, safely and simply during ongoing operation. And this can be done without any need for personal protective equipment. This means that you benefit from more flexibility, savings on installation and maintenance – and improved safety. SMISSLINE TP provides greater availability and operating safety than conventional systems.

—
SMISSLINE Type 2 Surge protector

I_{sn} (8/20 µs) (ka)	Product type	Order code	EAN No.	Packaging unit	Module	Weight (g)
20	OVR404 4L 40-275 P TS QS	2CCF606000R0001	761 227 145 5491	1	1	470
20	OVR404 3N 40-275 P TS QS	2CCF606002R0001	761 227 145 5507	1	1	450
20	OVR404 4L 40-440 P TS QS	2CCF606000R0003	761 227 146 5322	1	1	470



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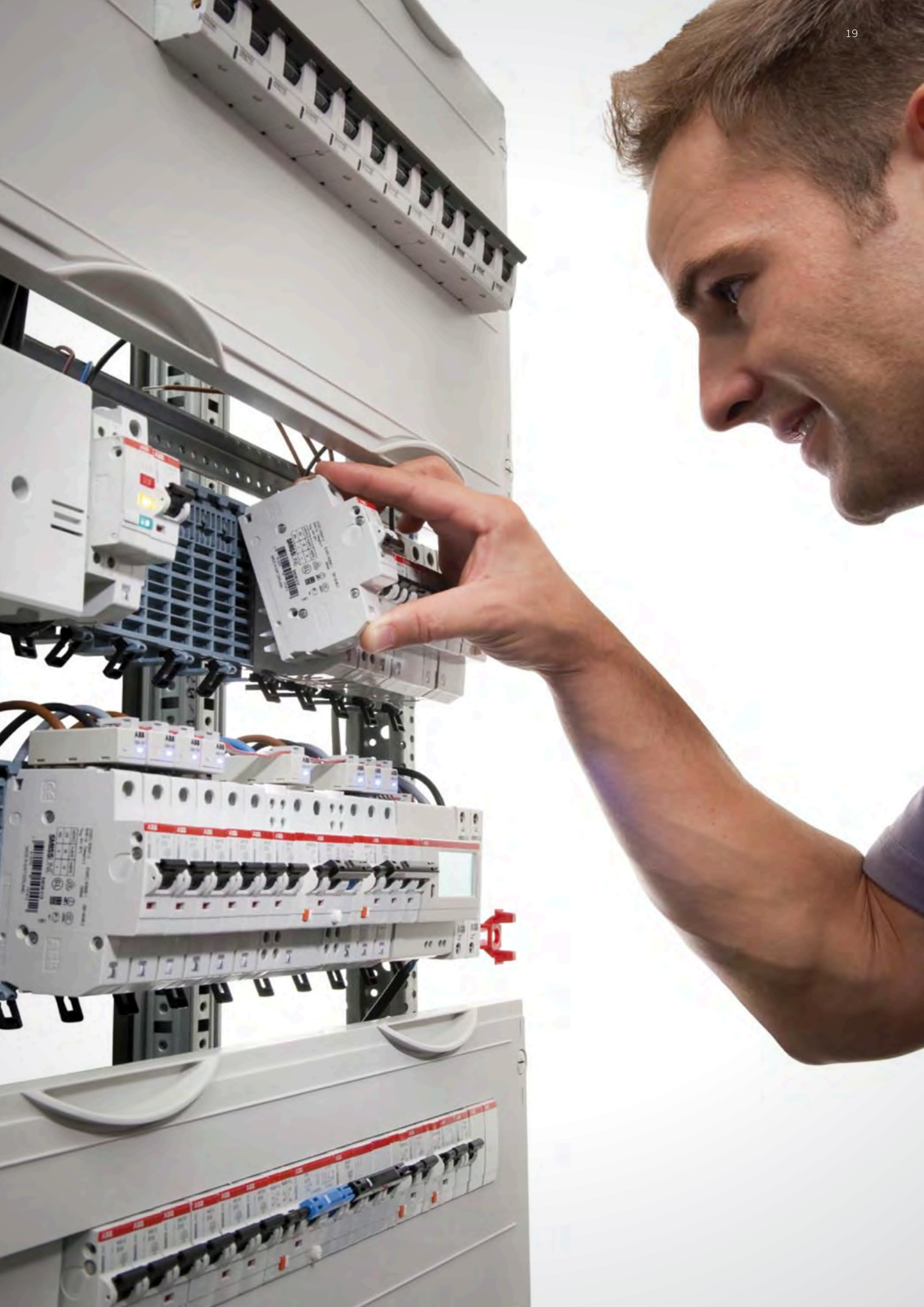
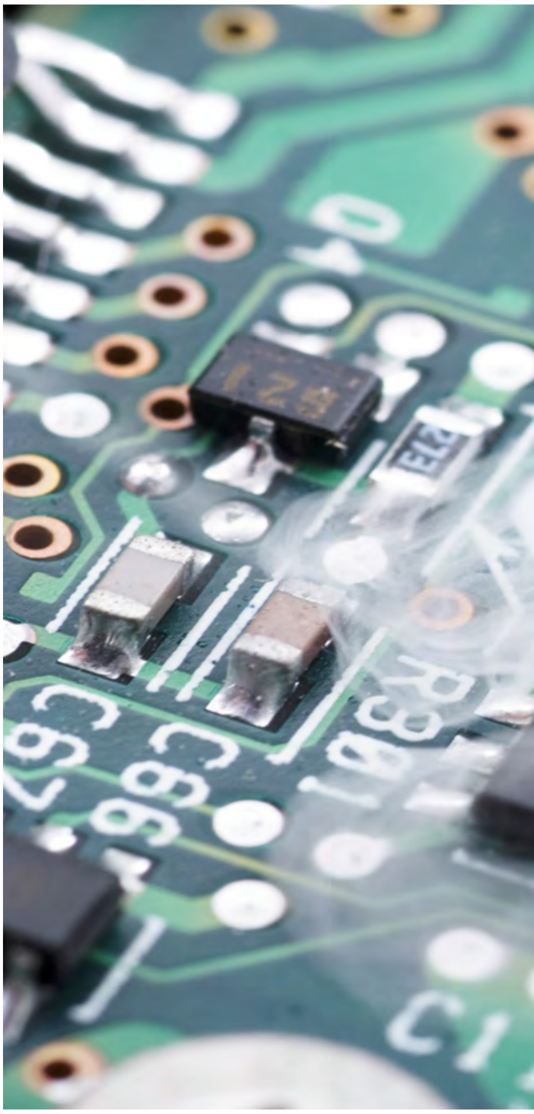
01 Incoming block 100/160 A.
—
02 Surge arrester.
—
03 Control unit for current measurement system.
—
04 2-pole residual current operated circuit breaker with overcurrent protection.
—
05 4-pole residual current operated circuit breaker with overcurrent protection.
—
06 2-pole residual current operated circuit breaker.
—
07 4-pole residual current operated circuit breaker.
—
08 Incoming block 63 A.
—
09 Miniature circuit breaker 1 pole.
—
10 Device latch.
—
11 Miniature circuit breaker 3 poles.
—
12 Miniature circuit breaker 2 poles.
—
13 4-pole residual current operated circuit breaker with overcurrent protection.





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