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Overvoltage controlled. ANYWHERE.

PRACTICAL GUIDE

R/TV/SAT/IPTV/WLAN commercial receiving systems

Principle of lightning and surge protection

Introduction

The antennas of radio, television or satellite receiving systems are devices which, by the principle of their function, are installed in places exposed to atmospheric disturbances (storms). This automatically makes them equipment that is particularly vulnerable to storm activity and to unwanted voltage potentials arising for example from lightning strikes, induction of a nearby lightning strike or faults in MV or HV power lines.

Antenna systems are galvanically coupled to electronic devices (signal amplifiers, receivers, etc.) which are very sensitive to overvoltages, as their design is adapted to handle high-frequency signals at microvolt to millivolt levels. It is clear that pulse overvoltages of a magnitude of many orders higher than the above have fatal consequences for them. If we want these devices to work reliably and not be destroyed, we need to ensure that surge pulses do not reach their inputs. It follows that we must protect these systems against both lightning strikes and induced voltage surges.

This issue is addressed by set of EN 62305 standards which are in accordance with EN 60728-11 ed. 2.
The EN 60728-11 ed. 2 standards shows in detail the basic principles of the placement of antenna systems on objects (buildings) and their protection against direct lightning strikes and protection against induced overvoltages, including the bonding and earthing solutions.

Although the standard allows for several solutions in terms of reliable protection not only of the building but also of the technology, the basic rule for the protection of antenna systems says that they should be placed in areas protected by the LPS (lightning protection system; the LPZ 0_B zone) while maintaining sufficient distance “s”.

This sufficient (separation) distance “s” to be maintained between the antenna system and the lightning conductor (ATS – Automatic Test System) or the lightning protection (LPS) system, or all parts connected to the LPS, must meet or exceed values required by EN 62305-3. If we simplify the equation from EN 62305-3, part 6.3.1, then for the most stringent criteria (LPS I / air / single LPS lead), we obtain the largest separation distance s = 0.08 * l (m) (where l is the distance from the point at which we calculate “s” to the nearest equipotential bonding bar or earthing point (measured along the LPS lead line). A higher number of LPSs or more LPS downleads then reduces the separation distance similar to better insulators (wall, glass, etc.).

Antenna systems are not allowed to be installed on buildings having a roof covered with easily combustible materials e.g. reeds, thatch, asphalt sheets, etc. Antenna leads (coaxial cables, etc.) and earthing wires are not allowed to be routed through areas where flammable materials such as oil, straw, hay and similar materials are stored or through areas where explosive gases may be generated or collected (e.g. joinery workshop).

Placement of the antenna system and surge protection

Objects with lightning protection (LPS)

If a building is equipped with an LPS (lightning protection system) that complies with EN 62305-3, the antenna system must be installed in the protected area of this LPS (LPZ 0_B zone). This option is shown in *Fig. 1*, where the bonding and earthing is also addressed and the sufficient distance “s” according to EN 62305-3 is observed.

In case the existing LPS does not allow placing the antenna system in the area protected by the LPS (LPZ 0_B zone), the situation can be solved according to *Fig. 2*, when another distant lightning conductor is added to the existing LPS so that the antenna system again returns in the LPZ 0_B zone. The practical implementation is then illustrated in *Fig. 9*.

Fig. 1 Installation of antenna systems in the LPZ 0_B zone (see EN 60728-11 standard, ed.3, Fig. 11)

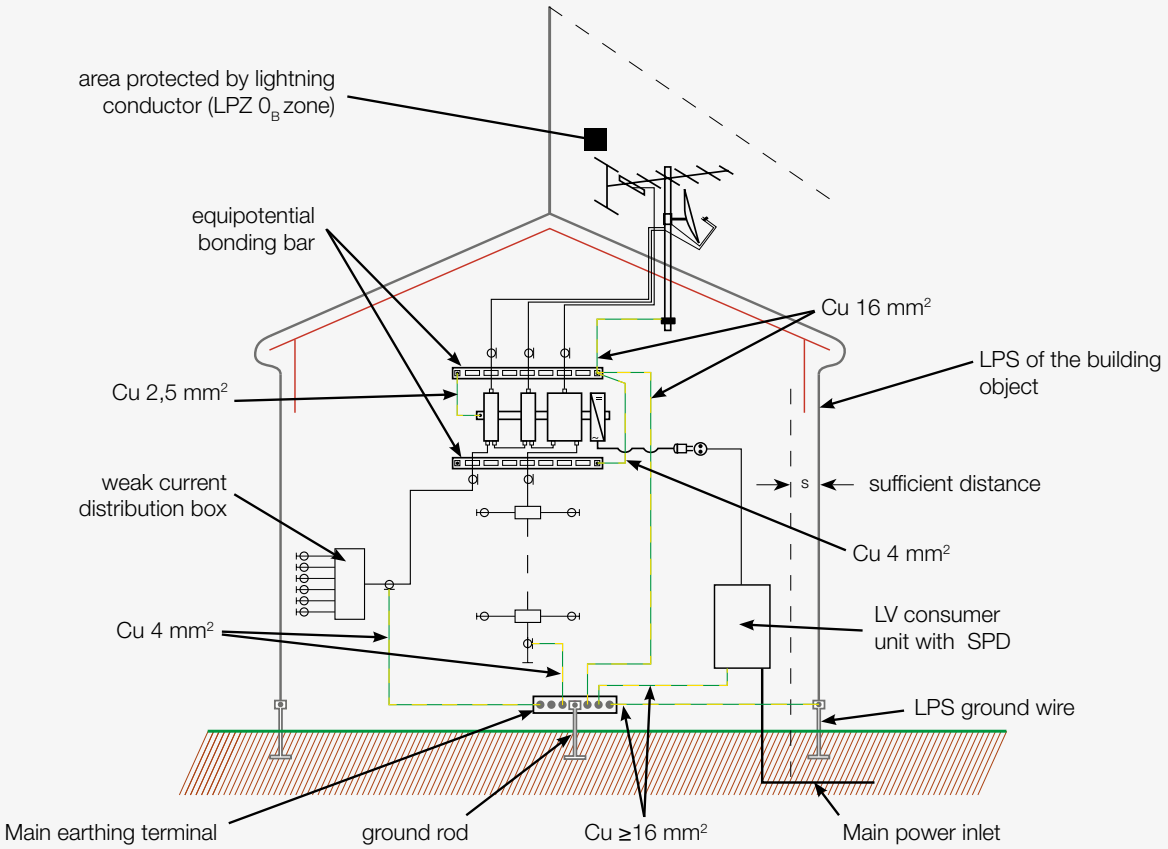
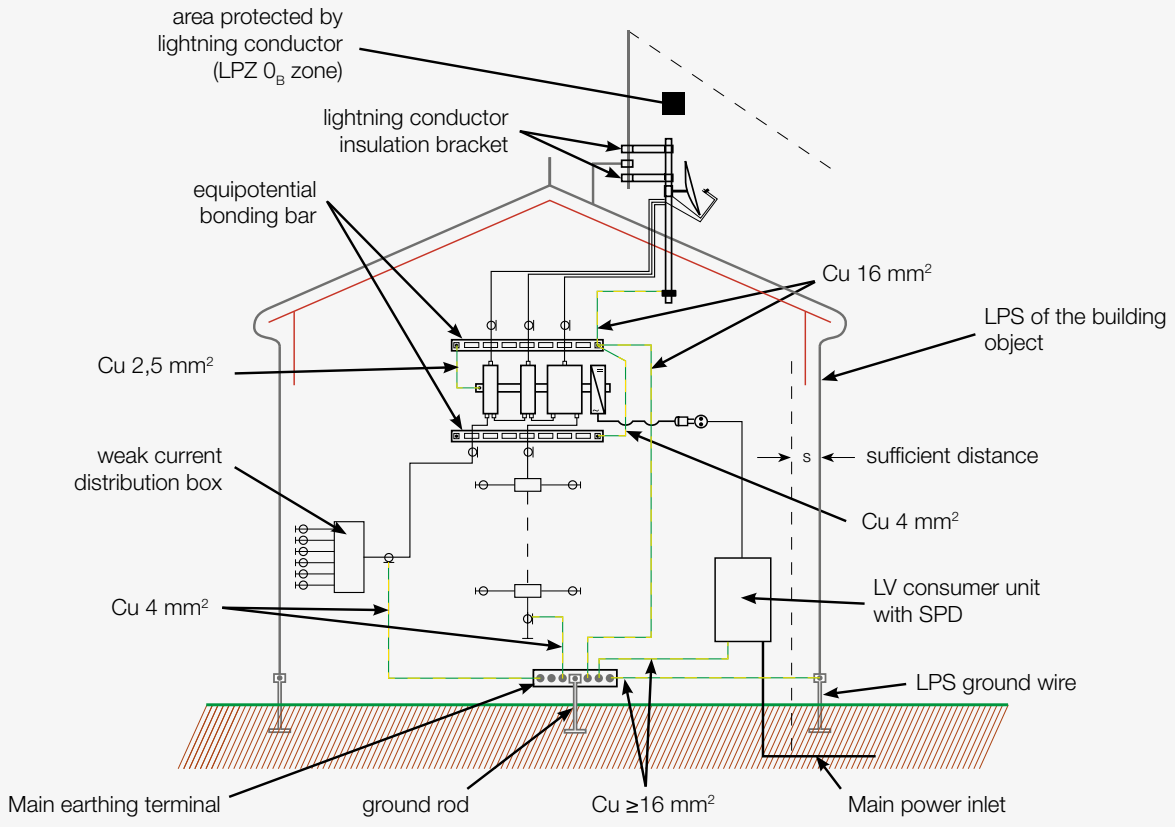


Fig. 2 Installation of an auxiliary lightning rod to protect the antenna systems (see EN 60728-11 standard, ed.3, Fig. 12)



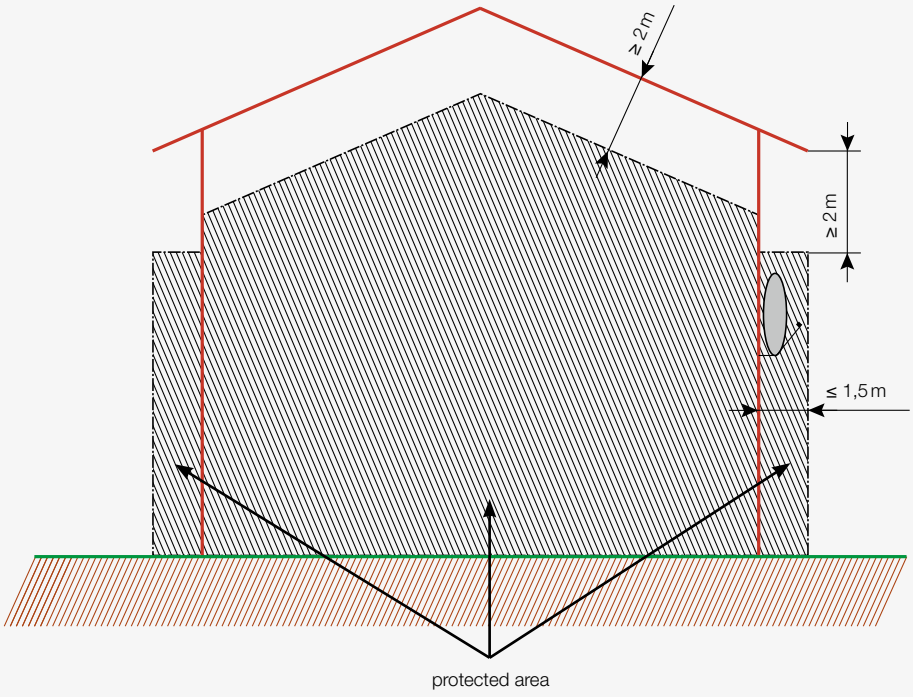
Building objects without lightning strike protection

The EN 60728-11 ed.3 standard also allows the installation of antennas on objects without an LPS. However, such installations cannot be reasonably recommended from the point of view of effective protection of health and property.

In such cases, antenna carriers located usually above the roof of the building (i.e. in LPZ 0_A) often become the main lightning conductor of the building. Conventional antenna systems cannot guarantee galvanic or the “s” distance separation between the antenna body (connected structurally to the antenna carrier) and the signal cable. This cable (coaxial or data cable) thus becomes a parallel pathway along which a part of the lightning energy is discharged, resulting not only in damage to the connected equipment but also in the risk of fire, surges, etc. If we consider the normal values of the earth resistance and especially the inductive reactance characteristics of the usual earthing system between the antenna carrier and the earthing point, the parallel current path through the coaxial (data) cable forms a non-negligible part of conductive network for the transmission of the atmospheric discharge energy between the antenna and the earth.

If the building is completely without a lightning protection system (LPS) and the antenna must be placed above it, then it is advisable to establish a separate, simple LPS at least for the antenna system. When reception conditions permit, it may be an alternative to place the receiving antenna in an area that is protected from direct lightning strikes by the building itself. This space is outlined as shown in *Fig. 3*. If the above recommendations cannot be followed, it is necessary to insert additional protective elements in the coaxial downlead, see *Fig. 6*.

Fig. 3 Areas suitable for placing antennas on a building without LPS.



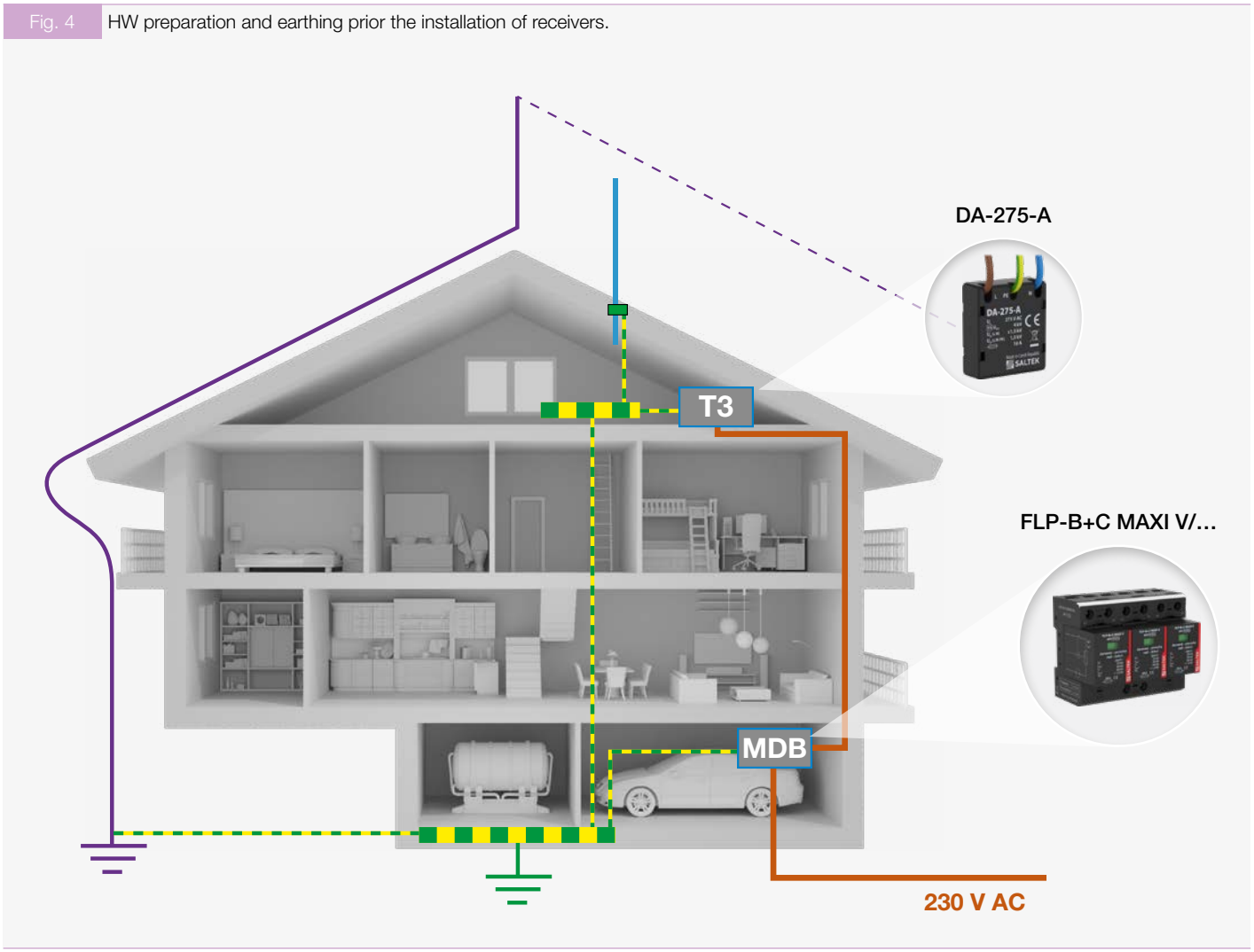
Overvoltage protection

Current receiving technologies are threatened not only by a direct lightning strike on the object, but also by electromagnetic fields from distant lightning strikes (up to a distance of about 3 km) or from faults on MV or HV power lines, and are increasingly sensitive to unwanted induced overvoltages induced in the antenna systems and coaxial lines. Modern digital receivers are designed to work with input signals in the order of magnitude of millivolts or microvolts (or even less). Commercial receivers in particular, with the aim of achieving the lowest possible manufacturing cost, have completely unprotected and simple circuits connected to the antenna connectors. It is thus clear that they are not at all resistant to voltage levels in the kV order caused by atmospheric overvoltage (even induced one).

The protection of receiving equipment against these overvoltages is done in principle by equipotential bonding using surge protection devices (SPD). In this way, an equalization of potentials is achieved between the middle conductor and the shielding (coaxial lines) or, in the case of IPTV, when an UTP (STP) cable is routed to the equipment from the antenna system, to equalize the potential between the individual cores of the cable by short-circuiting the SPD at the moment of the surge pulse.

When implementing surge protection for receiving systems, it is necessary to remember the principle of comprehensive protection, i.e. to protect with surge protectors not only coaxial or data cables leading from the receiving antenna, but also other interfaces of the protected equipment (power supply units, etc.). The installation of receiving systems usually takes place in two steps. The first step consists in the installation of the hardware (antenna carrier) and the LV connections for the amplifiers, active antenna, etc. *Fig. 4* shows an example of the typical hardware preparation in a family house.

Fig. 4 HW preparation and earthing prior the installation of receivers.



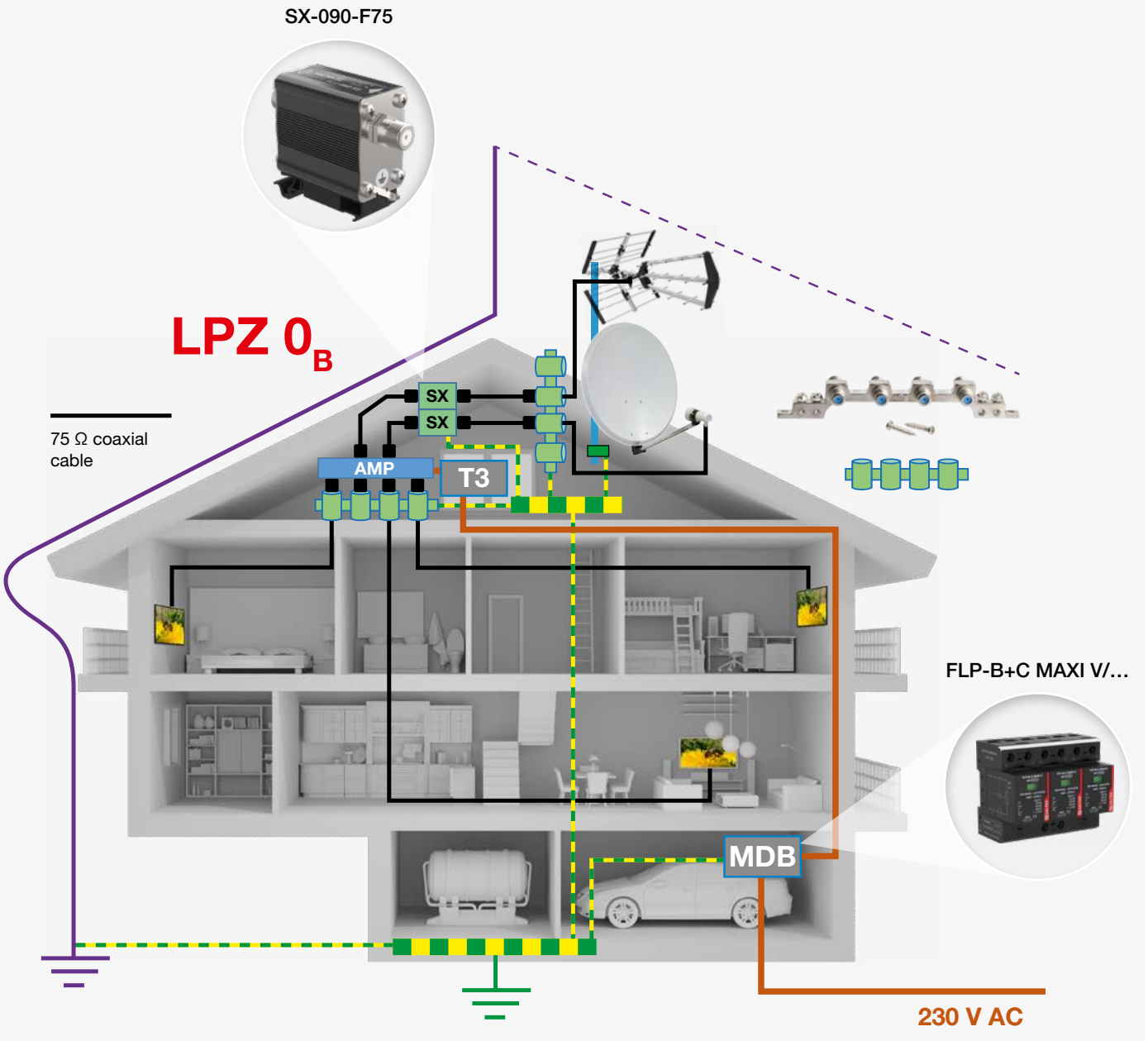
The key approach consists in placing the antenna carrier in the $LPZ0_B$ space and grounding it properly. From the point of view of the principle of comprehensive protection, it is important to check or add surge protection in the main LV switchgear (MDB) - the ideal SPD is a combined type 1 and type 2 (T1+T2) surge protector of the FLP-B+C MAXI V/... or FLP-12.5 V/... series in a configuration according to the specific power distribution system. In case of a long distance between the main LV switchboard and the power supply unit of the active antenna or distribution amplifier (approx. > 10 m), the power supply system can be supplemented with type 3 (T3) SPD of the DA-275-xx series, mounted either in the installation box or on a DIN rail, as close as possible to the protected equipment.

Protection of coaxial systems

The receiving system (antennas, coaxial distribution cabling, distribution amplifiers and, of course, the necessary SPDs, can be connected to the made-ready hardware base - see *Fig. 4*. The basic protection principle of the receiving system based on EN 62305-3 ed.2 is shown in *Fig. 5*.

Coaxial cables from TV or SAT antennas are first brought to the grounding bridge, which grounds all shieldings (outer conductors) of coaxial cables, immediately followed by the SX-090-F75 two-stage surge protector.

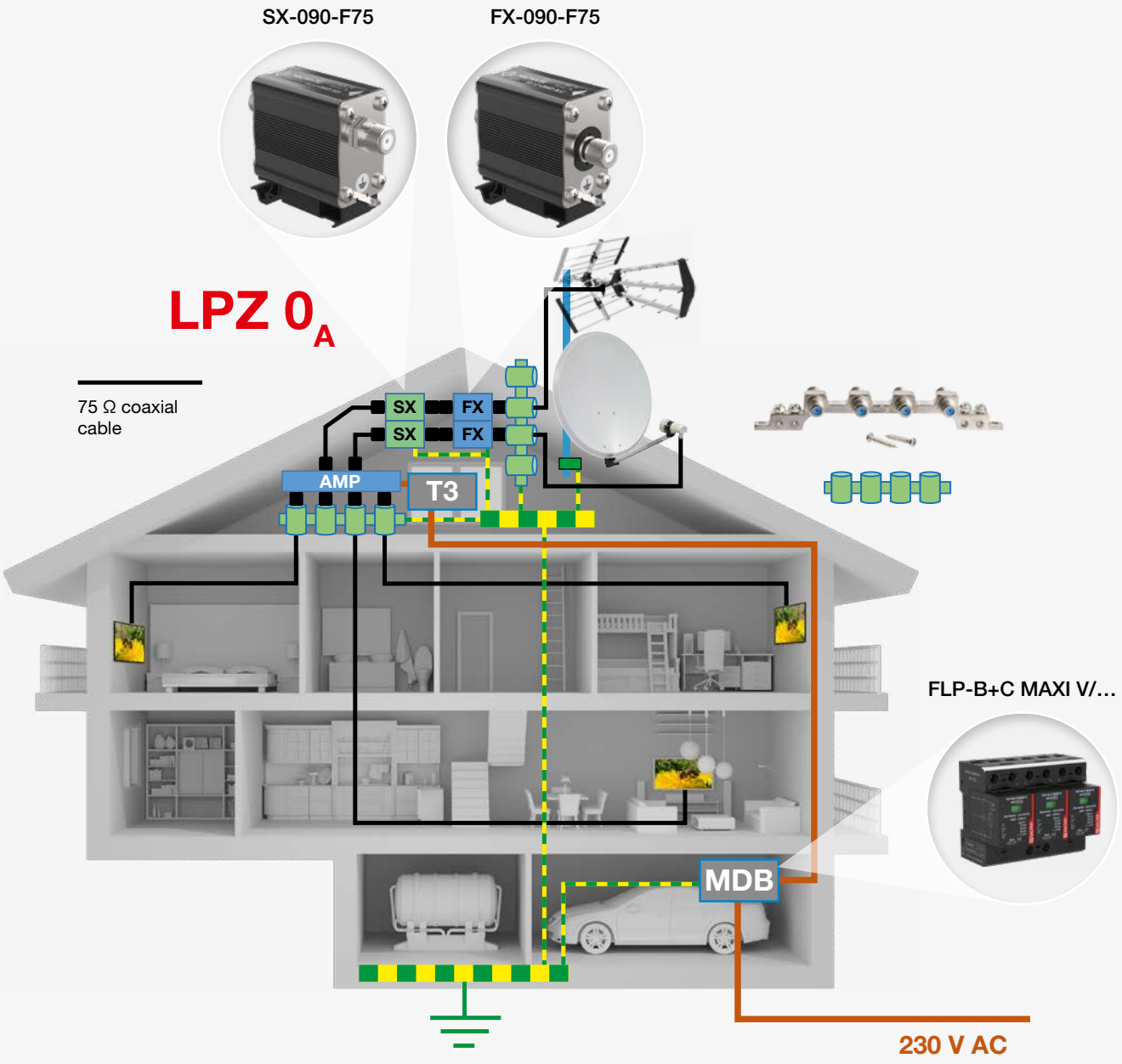
Fig. 5 Protection principle of the R/TV/SAT commercial receiving systems with antenna installed within the LPZ 0_B zone.



If for some reason the receiving system cannot be placed in the LPZ 0_B zone, it is necessary to reinforce the surge protection with the high performance surge protection FX (*Fig. 6.*) The coarse SPD of the FX series has the task of removing the maximum amount of unwanted energy entering the system through the coaxial cable.

The subsequently connected SX type SPDs are able to reduce the residual pulse behind the FX to a voltage value of 80 to 100 V, which represents a completely safe level for the receiver.

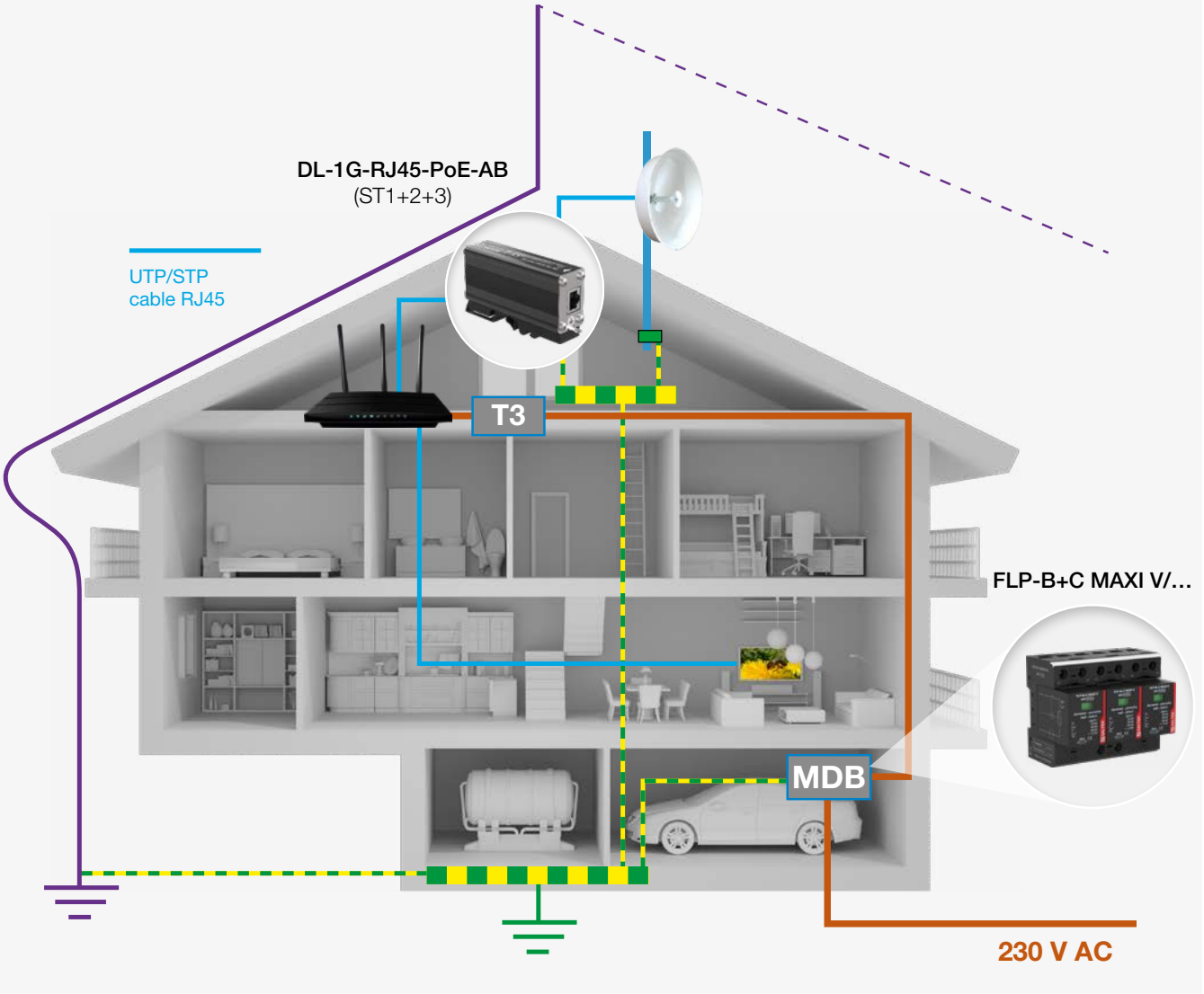
Fig. 6 Protection principle of the R/TV/SAT commercial receiving systems with antenna installed within the LPZ 0_A zone.



Protection of IPTV/WiFi/WLAN systems

Similarly to coaxial systems, the installation and arrangement of surge protection can also be devised for IPTV and WiFi, or WLAN access systems in general. When selecting SPDs, it should be remembered that the vast majority of microwave antennas of today include integrated electronic circuits and these are powered over UTP/STP cable by PoE (Power over Ethernet), i.e. the DC power supply of the active antenna uses twisted pairs of the UTP/STP cable. Therefore, the SPD must be able to not only transfer but also protect both data and also the PoE power supply. A typical installation of the SPD and application arrangement is shown in *Fig. 7*.

Fig. 7 Protection principle of IPTV/WiFi/WLAN systems.



Protection or large-scale coaxial distribution systems

Fig. 8 shows the principle of surge protection for larger systems. Here again, the coaxial cables need to be grounded (their metal shielding) before entering (LPZ0-LPZ1 transition) the building. The basic surge protection at the interface of LPZ0 and LPZ1 is identical to the protection in a single-family house. However, due to the long cables between the main receiving station and the terminal receivers, it is necessary to provide also the internal long cables with a suitable SPD. This is due to the risk of induction overvoltages to the long distribution cables and subsequent damage to the branch distribution amplifiers/repeaters. Usually, surge protectors are installed at both ends of the long cable (at least in front of the distribution amplifier input). A cable > 10 m can be considered to be long.

Fig. 8 Protection of large-scale coaxial distribution systems.

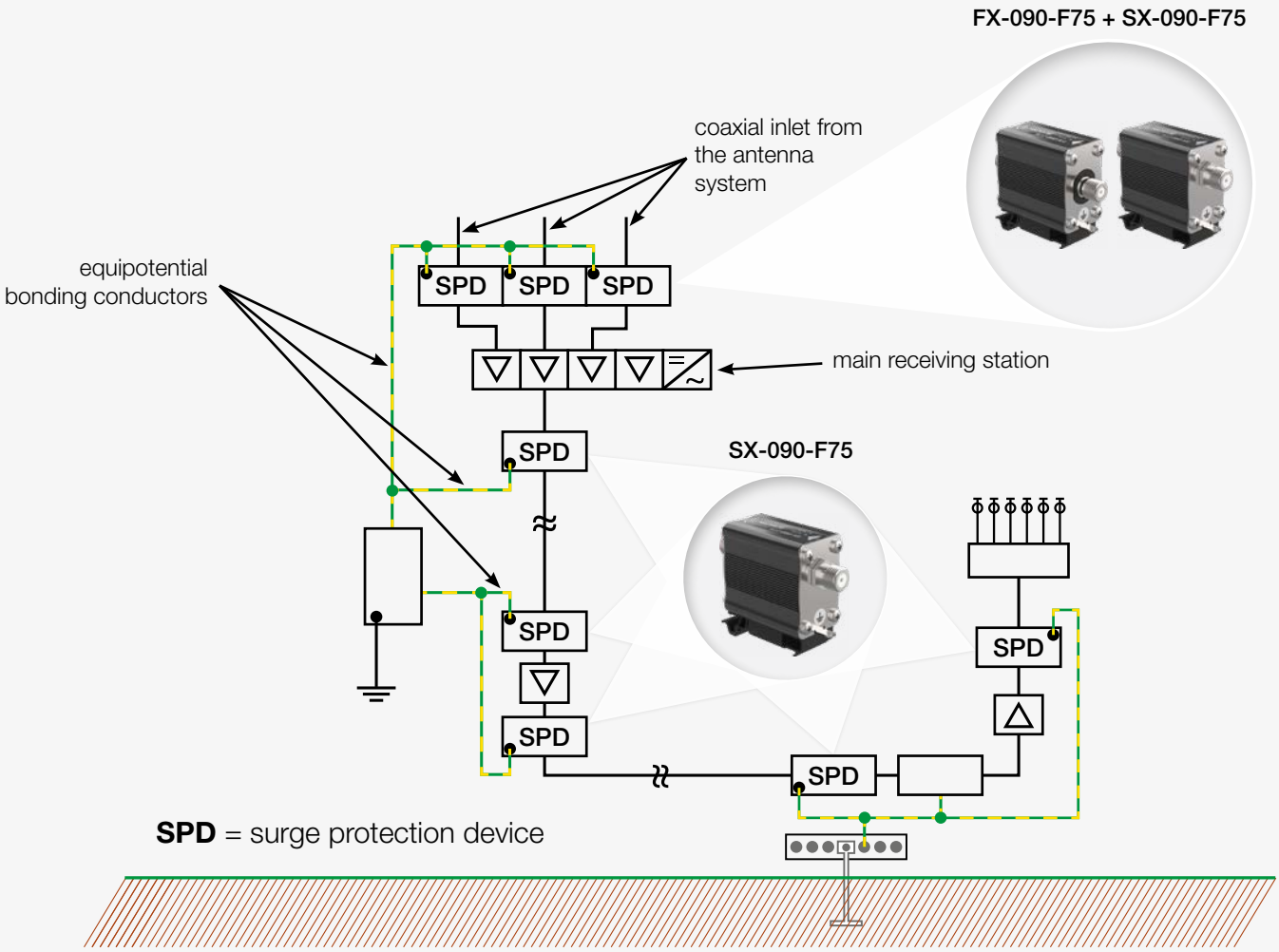


Fig. 9 Example of a properly arranged receiving antenna system installed on a family house (using principles shown in Fig. 2).

The protection principles of professional receiving and transmitting systems (50 Ω) are covered in a separate manual entitled “Telecommunications” (see the **https://www.saltek.eu/en/catalogues-and-brochures** web page).

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