

Latest ITU-T Recommendations K series: Protection against interference (SG5, WP1, Q2-Q5)

Presented by Mick Maytum

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24-26 March 2015
Huntsville, Alabama

Latest ITU-T
Surge Protection
K Recommendations

This presentation lists recent ITU-T, Study Group 5, K series Recommendations concerned with surge protection from Working Party 1, Questions 2 through 5.

Each new or revised Recommendation is covered in terms of title, URL (if available), summary and points of technical interest.

From the information provided, readers can decide if a document warrants more detailed study.



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New Recommendations:

K.95: Surge parameters of isolating transformers used in telecommunication devices and equipment

K.96: Surge protective components: Overview of surge mitigation functions and technologies

K.97: Lightning protection of distributed base stations

K.98: Overvoltage protection guide for telecommunications equipment installed in customer premises

K.99: Surge protective component application guide - Gas discharge tubes

K.102: Parameters of fixed-voltage thyristor overvoltage protector components used for the protection of telecommunication installations

K.103: Surge protective component application guide - Silicon PN junction clamping components

K.104: Method for identifying the transfer potential of EPR from HV and/or MV to the earthing system or neutral of LV network

K.105: Lightning protection of photovoltaic power supply system feeding a radio base station



K.95 (02/2014): Surge parameters of isolating transformers used in telecommunication devices and equipment

https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-K.95-201402-I!!PDF-E&type=items

Summary:

Telecommunication devices and equipment can use non-linear limiting, linear attenuating, or both types of functions to mitigate surges occurring on services. Isolating transformers attenuate common-mode voltage surges on a service. Recommendation ITU-T K.95 gives test methods and preferred values for the isolating transformer surge parameters that are harmonized with established international standards on insulation coordination levels and test techniques.



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K.95 (02/2014): Surge parameters of isolating transformers used in telecommunication devices and equipment

Rated impulse voltage (kV)	Impulse withstand voltage (kV)
1.5	1.75
2.5	2.92
4	4.92
6	7.39

Main Contents

Surge parameters: Transformer surge mitigation, Common-mode surges, Differential-mode surges

Characteristics: Characteristic measurement, Inter-winding capacitance, Insulation resistance, Signal transformer voltage-time product

Ratings: Rating verification, Rated impulse voltage, Signal transformer rated winding d.c.



K.96 (02/2014): Surge protective components: Overview of surge mitigation functions and technologies

https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-K.96-201402-I!!PDF-E&type=items

Summary:

Recommendation ITU-T K.96 presents information on the basic forms of surge mitigation and component technologies available to device and equipment designers. Following this basic Recommendation, further Recommendations in this surge protective components series will describe the applications principles of specific component technologies.

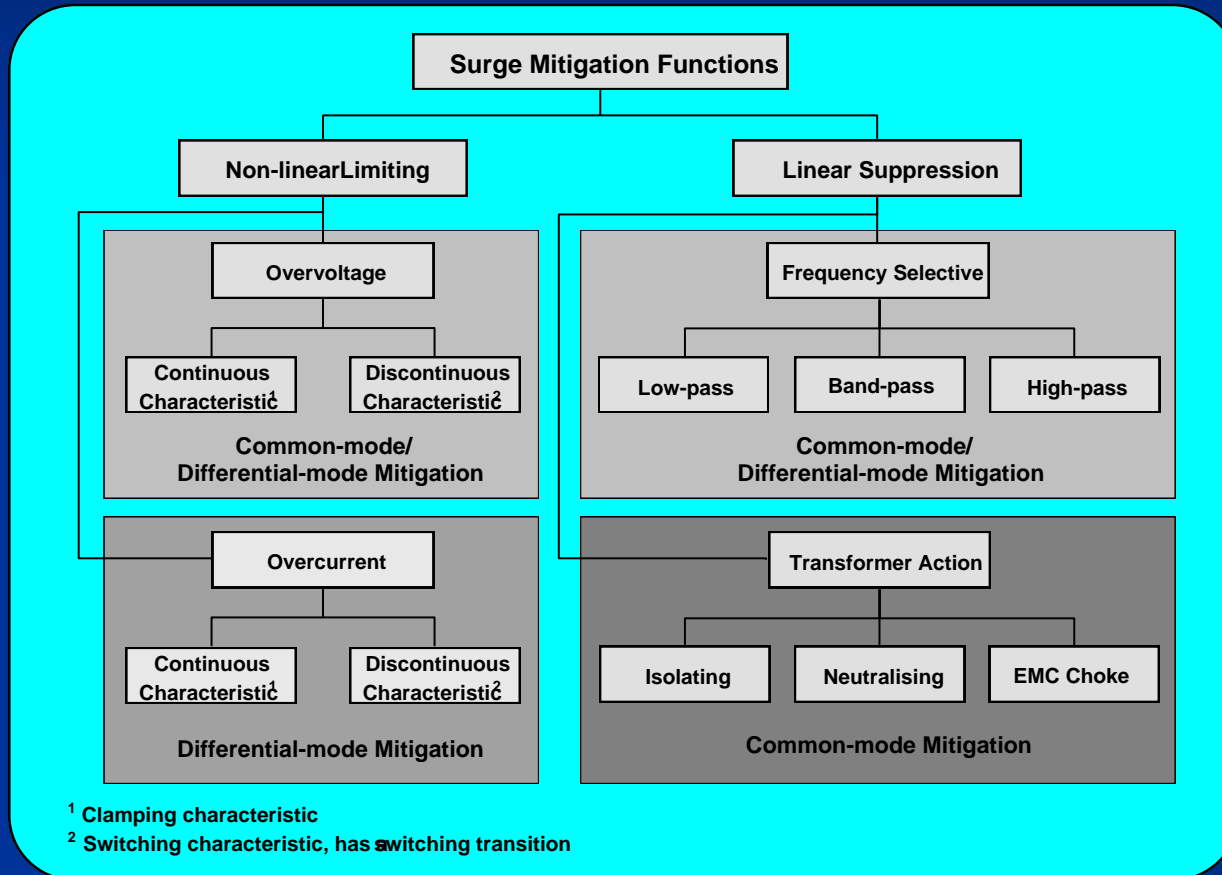


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K.96 (02/2014): Surge protective components: Overview of surge mitigation functions and technologies



K.97 (02/2014): Lightning protection of distributed base stations

https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-K.97-201402-I!!PDF-E&type=items

Summary:

Recommendation ITU-T K.97 deals with lightning protection of a distributed base station (DBS) on the tower site. A DBS is a new type of radio base station which consists of a remote radio unit (RRU) located on the tower, and a base band unit (BBU) inside the shelter at the bottom of the tower.

Lightning protection of DBS is not fully covered by Recommendation ITU-T K.56.

The main objective of this Recommendation is the lightning protection of RRU and rectifier interfaces with direct current (DC) power cable, and bonding of the DBS. Protection of these interfaces is achieved by installing a protection module. Possible protection schemes for such installations are also described. This Recommendation indicates when these protection modules should be used, and provides indication of their withstand current. The surge protective device (SPD) needed on the feeder cable is also indicated.

Bonding configurations of the protection module and of the optical fibre cable are also illustrated.

Appendix I shows an example of an isolated protection solution.



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K.97 (02/2014): Lightning protection of distributed base stations

Key Contents

- Protection of DBS (Distributed Base Station): Protection need, RRU (Remote Radio Unit) protection, Protection of rectifier, The need for feeder SPD
- Bonding of DBS: Bonding RRU and protection module, DC power cable, Bonding configuration of protection module at rectifier side, BBU (Base Band Unit) bonding, Bonding of optical fibre cable
- Appendices: I – Isolated protection solution: Example, II – Assessment of the energy delivered to clamping type SPC used in RRU protection module (see Towering Powering protection problem on Remote Radio Head (RRH) cellular systems, PEG 2012)

The PEG 2012 paper findings were further expanded by [Remote Radio Unit \(RRU\) DC Feed protection](#), which analyses the SPD energy for various lightning waveforms.



K.98 (08/2014): Overvoltage protection guide for telecommunication equipment installed in customer premises

Not freely available: Consented in approval and editing

Summary:

This Recommendation contains the information needed to protect telecommunications equipment installed in customer premises from damage due to lightning strikes to the power and telecommunications lines/cables. It shows that it is possible to protect equipment against a direct strike to the incoming service (power or telecommunications) providing that the strike point is more than a couple of hundred metres from the customer premises in an urban area. The information provided takes into consideration the impact of the different types of power distribution systems. It determines the impact of both the length of the telecommunication Surge Protection Device (SPD) bonding conductor and the resistance to earth at the customer's premise. It also calculates the necessary isolation level for the protection of equipment without the use of primary protection. It recommends the installation of a Multiservice Surge Protective Device (MSPD) or equivalent protection as the first level of protection. When necessary, primary protection is required to protect the MSPD or equivalent protection. For strikes to the services closer to the customer premises an engineering solution is required.



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K.98 (08/2014): Overvoltage protection guide for telecommunication equipment installed in customer premises

Subject of Thursday presentation “Direct Lightning Strike Surge Propagation in Customer Premises Wiring”.

This presentation analyses the contents of ITU-T K.98: Overvoltage protection guide for telecommunications equipment installed in customer premises. K.98 has over 160 pages and over 30 customer premise wiring voltage and current plots for the first 100 μ s or more of the surge. A simulated lightning strike of 5/75 is used based on the findings of CIGRÉ TB 549 (2013) Lightning Parameters for Engineering Applications (covered at PEG 2014). The lightning strike is assumed to be either to the telecommunications line or the a.c. mains supply. This international document considers mains configuration types of TN-S, TN-C, TN-C-S, TT and IT. The effects of various earthing system lead lengths and earth electrode resistances are also considered. The information in K.98 can be used to identify the most at risk customer premise situations for direct lightning damage



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K.99 (08/2014): Surge protective component application guide - Gas discharge tubes

https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-K.99-201408-I!!PDF-E&type=items

Summary:

Recommendation ITU-T K.99 describes the construction, characteristics, ratings and application examples of gas discharge tubes (GDTs) intended for the protection of exchange and outdoor equipment, subscriber or customer equipment and telecommunication lines from surges.



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K.99 (08/2014): Surge protective component application guide - Gas discharge tubes

Key Contents

-Structure

-Electrical characteristics: spark-over voltage, glow voltage, arc voltage, d.c. holdover voltage, capacitance, oscillation

-Electrical ratings: surge current capability, AC discharge current test

-Application examples: Two-electrode and three-electrode GDT comparison, Surge bonding, GDT pass under protection for a.c. fault conditions, GDTs in a.c. mains applications, Hybrid protectors, GDT thermal switch hybrid, GDT backup air gap (BUG) hybrid, Cascaded protection, Series connected GDTs for d.c. power applications



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Unique K.99 ingredient – Added Wolfgang



Hans Wolfgang Oertel, an Internationally recognised surge protection component and device guru, made major contributions to K.99. Since graduating from Berlin Technical University with MS, Metallurgy; Process Engineering he has worked for:

- Siemens, 1971 – 1979, Manufacturing and Development of Surge Protective Components
 - Joslyn Electronic Systems, 1979 – 2001, Lightning protection systems.
 - Bourns, Inc., 2001-2013, General Management, Engineering and Design Management, Production Support and Management
 - Retired and consulting, 2013 to present
- He has contributed to many standards in the IEEE, IEC and ITU-T and received citations & awards from them, e.g. the IEC 1906 award



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K.102 (08/2014): Parameters of fixed-voltage thyristor overvoltage protector components used for the protection of telecommunication installations

https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-K.102-201408-I!!PDF-E&type=items

Summary:

Recommendation ITU-T K.102 defines the basic electrical parameters to be met by fixed-voltage thyristor overvoltage protector components used for the protection of telecommunications equipment or lines from surges. Examples of equipment include those located either within a telecommunications centre [b-ITU-T K.20], customer premises [b-ITU-T K.21], in access or in trunk networks [b-ITU-T K.45]. It is intended that this Recommendation be used for the harmonization of existing or future specifications issued by thyristor surge protective component manufacturers, telecommunication equipment manufacturers, administrations or network operators.



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K.102 (08/2014): Parameters of fixed-voltage thyristor overvoltage protector components used for the protection of telecommunication installations

This Recommendation harmonises with various IEC standards for fixed voltage thyristor schematic symbols, letter symbols, definitions, characteristics and ratings.

It provides a normative reference for the future “Surge protective component application guide – fixed voltage thyristors” document.

Gated thyristors are sufficiently complex to have their own parameter and application guide documents at a future date.



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K.103: Surge protective component application guide - Silicon PN junction components

Not freely available: Consented (12/2014) in approval and editing

Summary:

This Recommendation in the Surge Protective Component Application Guide series covers voltage limiting components, having one or two silicon PN junctions. These surge protective components (SPCs) are clamping type overvoltage protectors [b-ITU-T K.96]. Components covered use the following PN junction technologies; Zener breakdown, avalanche breakdown, fold-back, punch-through and rectification. Guidance is given on construction, characteristics, ratings and application examples.



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**Latest ITU-T
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K.103: Surge protective component application guide - Silicon PN junction components

Key Contents:

- **Construction:** Packaging, Semiconductor junction structure and electrical properties, Single PN junction structure and electrical characteristic, NPN or PNP junction structures and electrical characteristics.
- **Characteristics:** Stand-off or maximum reverse working voltage, Breakdown voltage, Clamping voltage, Punch-through voltage, Snap back voltage, Forward biased PN junction voltage, Junction capacitance, Package inductance.
- **Ratings:** Peak pulse current, Maximum peak pulse power, Power dissipation.
- **Application examples:** Series connection, Parallel connection, DC supply protection, Automotive load dump, Power over Ethernet (PoE), Power frequency protection, Signal protection, Power Line Communication (PLC) power line coupling, USB 2.0 port, USB 3.0 port, Ethernet PHY port, IC data lines, DS1 (T1/E1/J1) HDSL-4 ports, DS3 (T3/E3) Ports, SDSL ports.



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K.104: Method for identifying the transfer potential of EPR from HV and/or MV to the earthing system or neutral of LV network

Not freely available: Consented (12/2014) in approval and editing

Summary:

In the case of earth fault in high or medium voltage a.c. network significant earth potential rise (EPR) can occur in the earthing structure where the current is discharged to the earth, typically in the earthing grid of substation involved in the fault. When the earthing grid is connected metallicly to long conductors like earth wires, neutral conductors, counterpoises, cable sheaths, pipes and rails, the EPR can be transferred far away well beyond the zone of influence. This Recommendation describes the mechanism of potential transfer to the customer's premises with special view of the transfer through the neutral conductor of the low voltage network and the sheath of the telecommunication cable. Calculation techniques are given for the determination of the magnitude of EPR and transferred potential. Mitigation techniques for preventing the transfer of EPR are proposed. Different isolation techniques are proposed as possible mitigation applicable in the telecommunication plant.



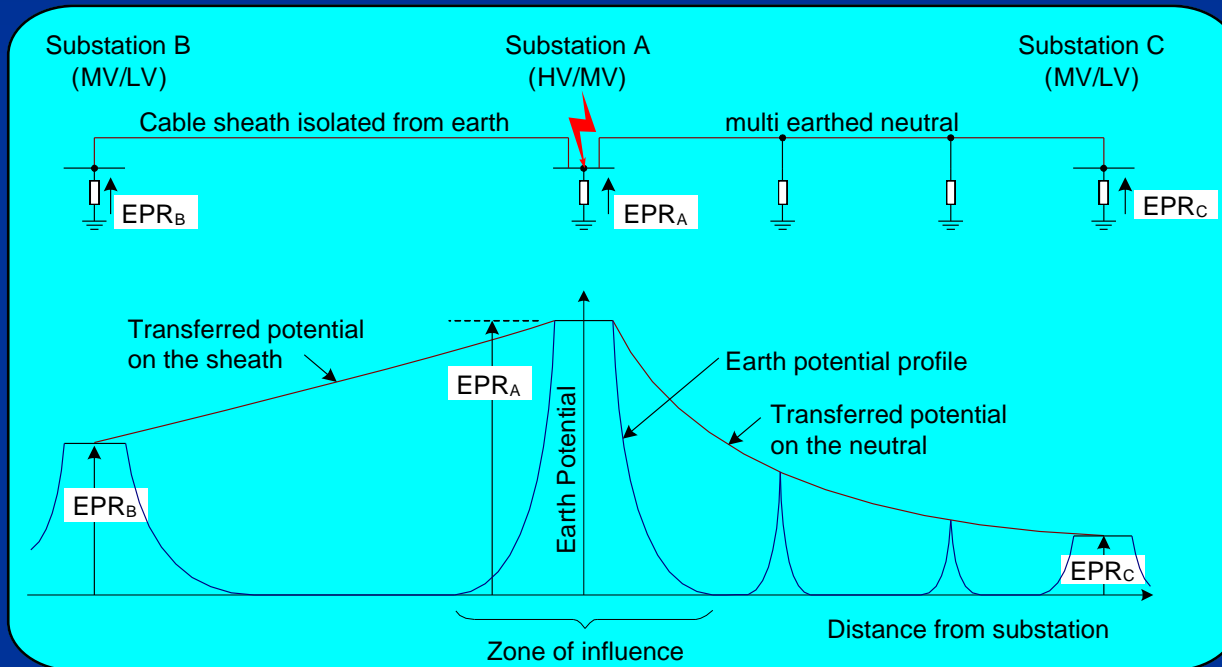
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K.104: Method for identifying the transfer potential of EPR from HV and/or MV to the earthing system or neutral of LV network

This document runs into nearly 90 pages. Below shows an example of transferred EPR.



K.105: Lightning protection of photovoltaic power supply system feeding a radio base station

Not freely available: Consented (12/2014) in approval and editing

Summary:

This Recommendation addresses the lightning protection of a solar photovoltaic power supply system feeding a Radio Base Station. The purpose of this Recommendation is to give guidance on the earthing, bonding and protection of the photovoltaic power supply system feeding Radio Base Station.

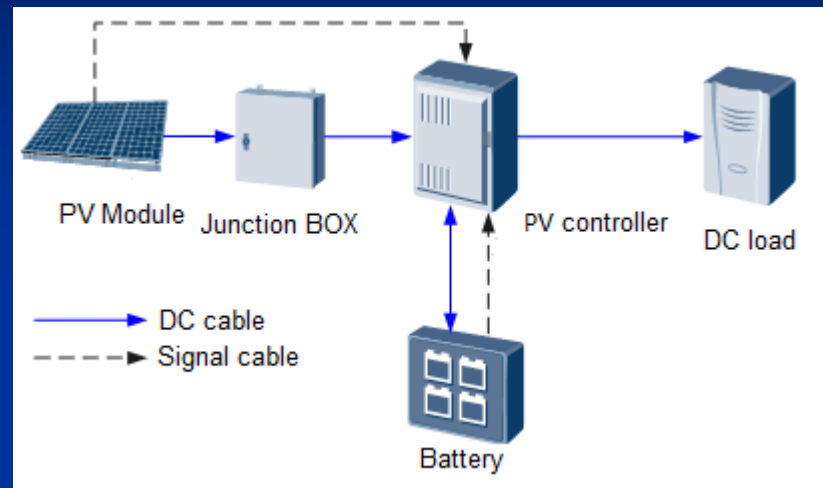


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K.105: Lightning protection of photovoltaic power supply system feeding a radio base station



Contents

- PhotoVoltaic power supply system arrangement
- Lightning protection of PhotoVoltaic power supply system
- Earthing and bonding of the power supply system
- Current capability of protective modules on PV controller ports: signal 3kA 8/20, PV 5 kA 8/20, Non-tower load 5 kA 8/20, Top of tower load 20 kA 8/20.

Recommendation Revisions and Extra Appendixes:

ITU-T K.44 Amd.1: Resistibility tests for telecommunication equipment exposed to overvoltages and overcurrents – Amendment

K.20: Resistibility of telecommunication equipment installed in a telecommunications centre to overvoltages and overcurrents

K.21: Resistibility of telecommunication equipment installed in customer premises to overvoltages and overcurrents

K.45: Resistibility of telecommunication equipment installed in the access and trunk networks to overvoltages and overcurrents

K.27: Bonding configurations and earthing inside a telecommunication building

K.96: Appendix II - Alternative duration measurement method for 1.2/50-8/20 and 10/700 surge generator impulses

Not freely available: Consented (12/2014) in approval and editing. Some values may change



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ITU-T K.44 Amd.1: Resistibility tests for telecommunication equipment exposed to overvoltages and overcurrents – Amendment

Only two changes shown

1.2/50-8/20 generator: replace IEC 61000-4-5 reference with:

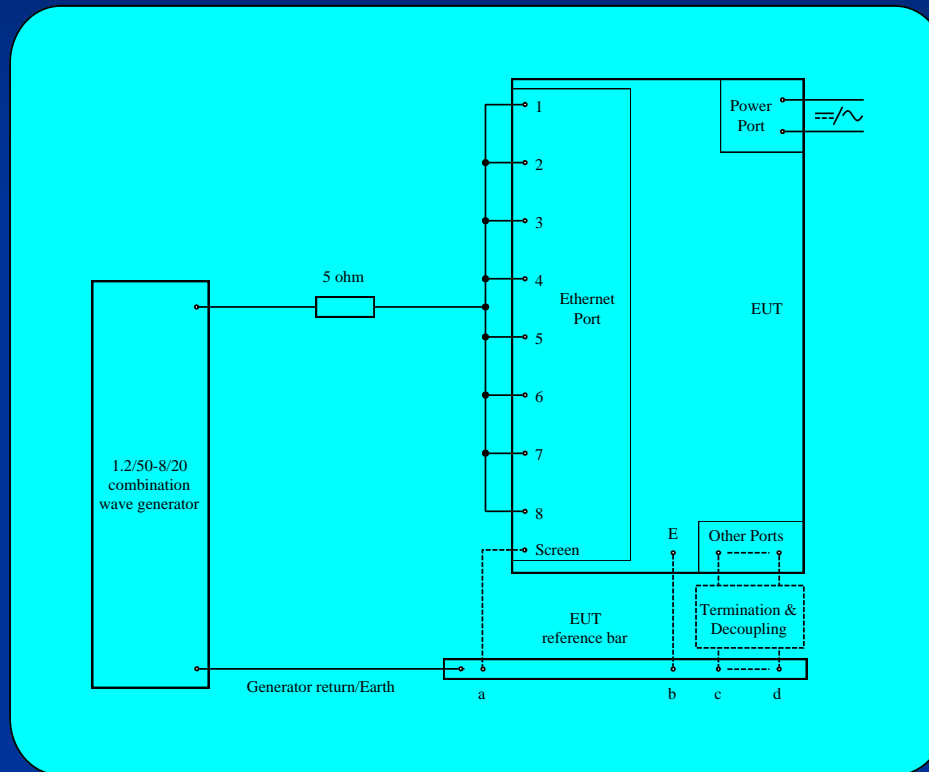
NOTE 1 – The 1.2/50 open-circuit voltage waveshape shall be according to [IEC 60060-1] having a front time of $1.2 \mu\text{s} \pm 30 \%$ and a time to half value of $50 \mu\text{s} \pm 20 \%$

NOTE 2 – The 8/20 short-circuit current waveshape shall be according to [IEC 62475] having a front time of $8 \mu\text{s} \pm 20 \%$ and a time to half value of $20 \mu\text{s} \pm 20 \%$. The opposite polarity current undershoot shall not exceed 30 % of the peak current.

NOTE 3 – The ratio of peak open-circuit voltage to short-circuit current R_i shall be $2 \Omega \pm 10 \%$.



ITU-T K.44 Amd.1: Resistibility tests for telecommunication equipment exposed to overvoltages and overcurrents – Amendment



Add: Figure A.6.7-3a – Ethernet port longitudinal/common mode withstand test circuit

K.20: Resistibility of telecommunication equipment installed in a telecommunications centre to overvoltages and overcurrents

Add:

test requirements for UTP Ethernet

DM (pair) 600 V/1.5 kV, 1.2/50-8/20, 10 Ω

CM 2.5 kV/6 kV, 1.2/50-8/20, 5 Ω

test requirements for STP Ethernet

2.5 kV/6 kV, 1.2/50-8/20, 10 Ω

test requirements for PoE

DM (inter-pair) 600 V/1.5 kV, 1.2/50-8/20, 10 Ω

STP shield testing

2.5 kV/6 kV, 1.2/50-8/20, 10 Ω



K.21: Resistibility of telecommunication equipment installed in customer premises to overvoltages and overcurrents

Add:

test requirements for UTP Ethernet

DM (pair) 600 V/1.5 kV, 1.2/50-8/20, 10 Ω

CM 2.5 kV/6 kV, 1.2/50-8/20, 5 Ω

test requirements for STP Ethernet

2.5 kV/6 kV, 1.2/50-8/20, 10 Ω

test requirements for PoE

DM (inter-pair) 600 V/1.5 kV, 1.2/50-8/20, 10 Ω

STP shield testing

2.5 kV/6 kV, 1.2/50-8/20, 10 Ω



K.45: Resistibility of telecommunication equipment installed in the access and trunk networks to overvoltages and overcurrents

Add:

test requirements for UTP Ethernet

DM (pair) 600 V/1.5 kV, 1.2/50-8/20, 10 Ω

CM 2.5 kV/6 kV, 1.2/50-8/20, 5 Ω

test requirements for STP Ethernet

2.5 kV/6 kV, 1.2/50-8/20, 10 Ω

test requirements for PoE

DM (inter-pair) 600 V/1.5 kV, 1.2/50-8/20, 10 Ω

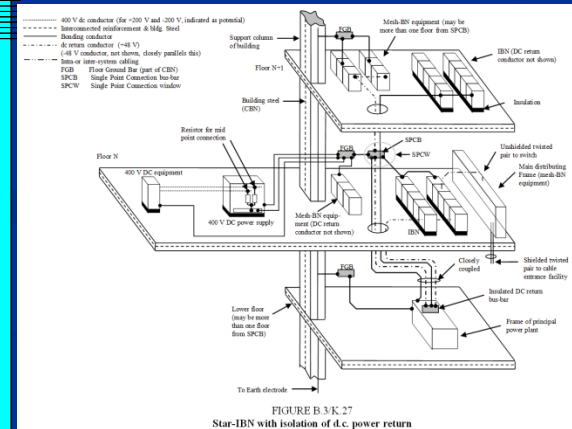
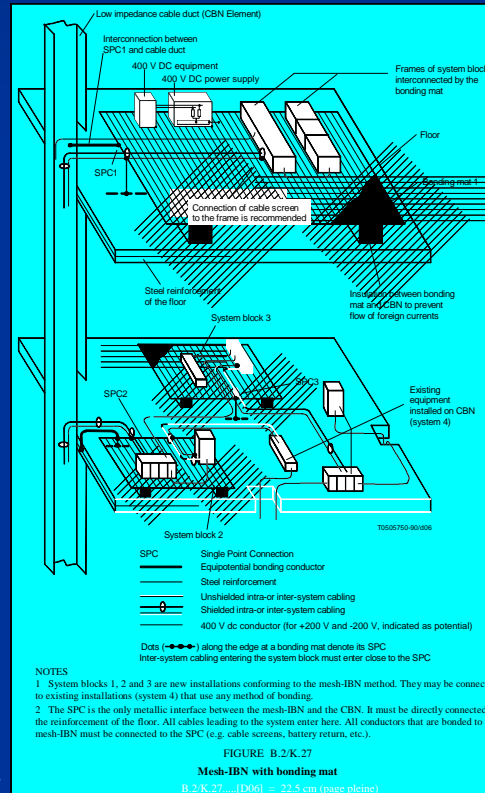
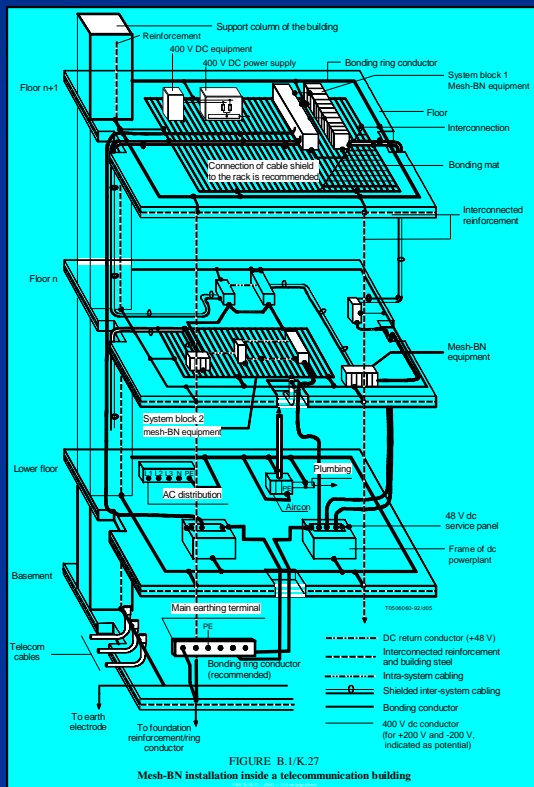
STP shield testing

2.5 kV/6 kV, 1.2/50-8/20, 10 Ω



K.27: Bonding configurations and earthing inside a telecommunication building

Revised Figures B.1, B.2 and B.3, plus surrounding text.



NOTES
 1 System blocks 1, 2 and 3 are new installations conforming to the mesh-IBN method. They may be connected to existing installations (system 4) that use any method of bonding.
 2 The SPC is the only metallic interface between the mesh-IBN and the CBN. It must be directly connected to the reinforcement of the floor. All cables leading to the system enter here. All conductors that are bonded to the mesh-IBN must be connected to the SPC (e.g. cable screens, battery returns, etc.).



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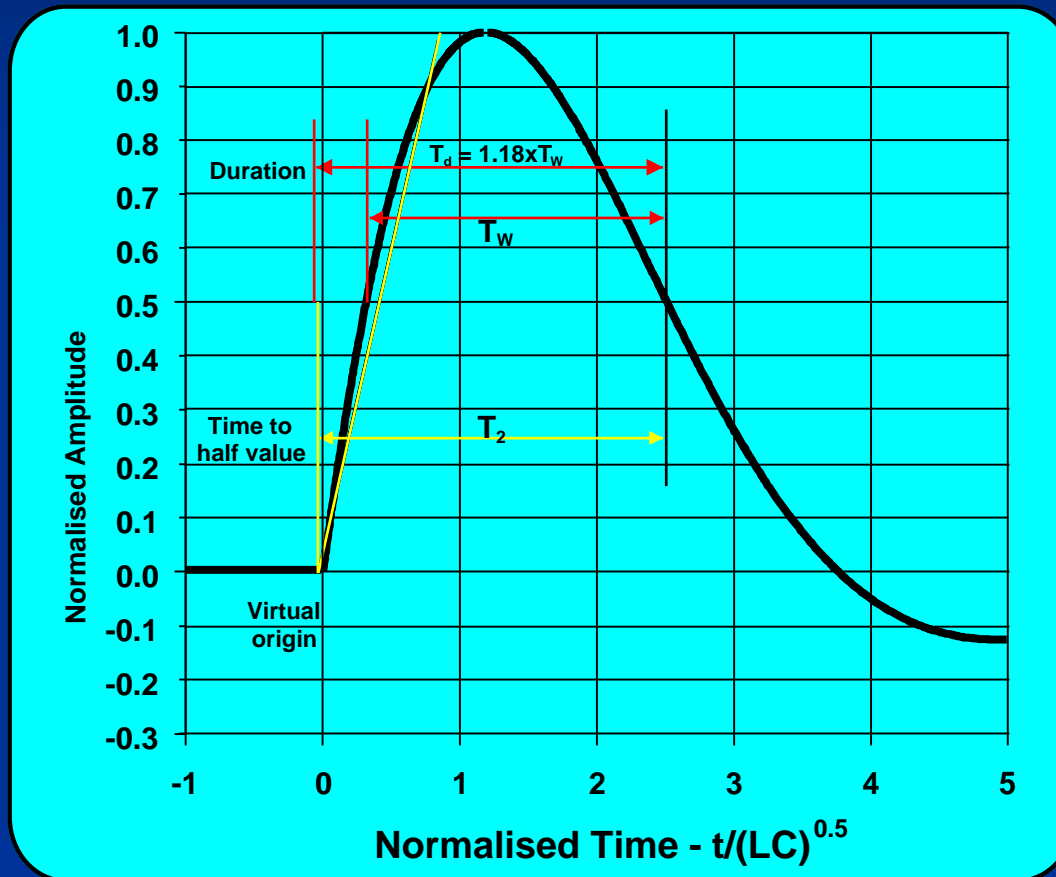
K.96: Appendix II - Alternative duration measurement method for 1.2/50-8/20 and 10/700 surge generator impulses

Summary

The time to half value of a double exponential surge, simulating a lightning impulse, is traditionally measured from a virtual zero point to the 50% amplitude decay point of the waveform, as explained in Appendix I, I.3. The time duration of Electrostatic Discharge (ESD) and Electrical Fast Transient (EFT) impulses is measured as the time for which the impulse exceeds the 50 % amplitude level. The time measured from virtual zero will always be longer than the time between the two waveform 50 % points. Edition 3 of IEC 61000-4-5 (2014) departs from the traditional lightning surge time to half value measurement by specifying the use of the time between the two waveform 50 % points for the 1.2/50-8/20 and 10/700 surge generator waveforms. Amendment 1 to Recommendation ITU-T K.96 introduces Appendix II, which discusses the time value changes caused by the Edition 3 approach and how other standards can be referenced to maintain the tradition measurement method. More details on the change can be found [here](#).



K.96: Appendix II - Alternative duration measurement method for 1.2/50-8/20 and 10/700 surge generator impulses



Latest ITU-T Recommendations K series: Protection against interference (SG5, WP1, Q2-Q5)

This presentation has described

- nine new Recommendations,
- four revised Recommendations,
- one Amendment and
- one new Appendix.

The document topics reflect the ITU-T WP1 members interest in equipment resistibility requirements, Ethernet, distributed base stations, surge protective components and earthing & bonding.

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