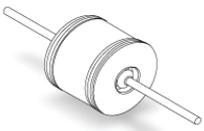
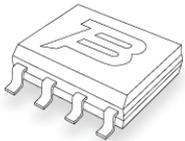


ITU-T Recommendations and the Resistibility of Telecommunication Equipment

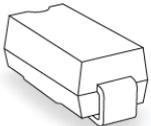
WHITE PAPER



Gas Discharge Tube (GDT)
Surge Arrestors



Thyristor Surge Protectors



Schottky Rectifier Diodes

Introduction

The International Telecommunications Union (ITU-T) developed its ITU-T K Series Recommendations to help designers determine the resistibility of telecommunication equipment to withstand the effect of overvoltage or overcurrent events based on a defined level, and to meet specified criterion. These recommendations cover every aspect of the telecommunications system including the components within the system.

The most familiar ITU-T K Series Recommendations are K.20, K.21 and K.45. In addition to these resistibility tests, there are others that are important to ensure telecom equipment designs are compliant. Therefore, consideration must be given to the selection of the right components in the design of the protection scheme for telecom equipment. Beyond the tests included in the standards, there are many more resources offered by ITU-T that developers may not be aware of.

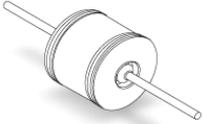
This paper provides an overview of ITU-T Recommendations of resistibility tests for overvoltage and overcurrent events in telecom equipment installed in telecommunication centers, customer premises and in access and trunk networks. To provide further assistance to developers, this paper also presents general protection design guidelines, and solutions available for a particular application. This document introduces the relevant recommendations referring to telecommunication equipment. All recommendations issued by ITU-T are written by experts in the field, and are free for download.

Abbreviations

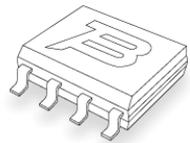
CO	Central Office
CPE	Customer Premises Equipment
GDT	Gas Discharge Tube
ICT	Information and Communication Technologies
POTS	Plain Old Telephone Service
SG	Study Group
SPD	Surge Protective Device
QoS	Quality of Service

ITU-T Recommendations and the Resistibility of Telecommunication Equipment

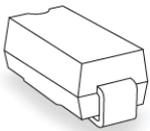
About ITU-T and Regional Applicability



Gas Discharge Tube (GDT)
Surge Arrestors



Thyristor Surge Protectors



Schottky Rectifier Diodes

The ITU-T organization is responsible for studying technical operating and tariff questions and issuing recommendations in these areas with the goal of standardizing telecommunications worldwide. There are many different study groups active in ITU-T, where experts from around the world develop international standards known as ITU-T Recommendations. The recommendations issued by different groups have different prefixes. For the resistibility topics, the Study Group 5 (SG5) work is relevant. This group covers studies on methodologies for evaluating ICT (Information and Communication Technologies) effects on climate change and publishes guidelines for using ICTs in an eco-friendly way.

SG5's four main objectives are to:

- *Protect telecommunication equipment and installations against damage and malfunction due to electromagnetic disturbances, such as those from lightning.*
- *Ensure the safety of personnel and users of networks against current and voltages used in telecommunication networks.*
- *Avoid health risks from electromagnetic fields (EMFs) produced by telecommunication devices and installations.*
- *Guarantee a good quality of service (QoS) for high speed data services by issuing requirements on characteristics of copper cables and on the coexistence of services delivered by different providers.*

Topics for the term “circuit protection” are found in recommendations from the K series.

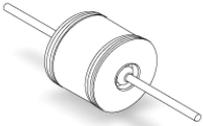
The screenshot shows the ITU-T Recommendations website. The navigation menu includes: Home, General Secretariat, Radiocommunication, Standardization, Development, ITU Telecom, Members' Zone, and Join ITU. The main content area displays "ITU-T Recommendations" and a search bar. Below the search bar, there is a list of ITU-T Recommendations under Study Group 5 responsibility, including:

- SG5 Recommendations
 - K series: Protection against interference
 - K.6: Precautions at crossings
 - K.7: Protection against acoustic shock
 - K.8: Separation in the soil between telecommunication cables and earthing system of power facilities
 - K.9: Protection of telecommunication staff and plant against a large earth potential due to a neighbouring electric traction line
 - K.10: Low frequency interference due to unbalance about earth of telecommunication equipment
 - K.11: Principles of protection against overvoltages and overcurrents
 - K.12: Characteristics of gas discharge tubes for the protection of telecommunications installations
 - K.13: Induced voltages in cables with plastic-insulated conductors
 - K.14: Provision of a metallic screen in plastic-sheathed cables

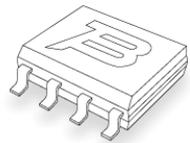
ITU-T Recommendations and the Resistibility of Telecommunication Equipment

Recommendations and the Structure

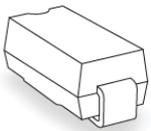
When reviewing the structure of recommendations, it is important to note that the letter designation reflects the time of issue (the higher the letter, the more recent the recommendation was published). Plus, the recommendations are regularly reworked where new issues are added to the existing K designation. A short overview of select recommendations relevant to circuit protection are shown in the following table.



Gas Discharge Tube (GDT)
Surge Arrestors



Thyristor Surge Protectors



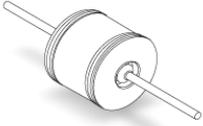
Schottky Rectifier Diodes

K Number	K Title	Description / Related to
K.20	Resistibility of telecommunication equipment installed in a telecommunication center to overvoltages and overcurrents	Tests applicable for CO
K.21	Resistibility of telecommunication equipment installed in customer premises to overvoltages and overcurrents	Tests applicable for CPE
K.45	Resistibility of telecommunication equipment installed in the access and trunk networks to overvoltages and overcurrents	Tests applicable for access and trunk equipment
K.44	Resistibility tests for telecommunication equipment exposed to overvoltages and overcurrents – Basic Recommendation	Gives details and test setup diagrams for the above three (CO, CPE and access network)
K.12	Characteristics of gas discharge tubes for the protection of telecommunications installations	General tests for characterization of GDTs
K.50	Safe limits for operating voltages and currents of telecommunication systems powered over the network	Provides guidance on voltages and currents that may safely be used to power telecommunication systems that are part of the telecommunications service providers' network
K.51	Safety criteria for telecommunication equipment	Provides guidance on safety criteria for telecommunication network infrastructure equipment
K.99	Surge protective component application guide - Gas discharge tubes	GDT application guide
K.67	Expected surges on telecommunications and signalling networks due to lightning	Discusses different lightning events as this threat relates to all three types of the equipment installed (CO, CPE and access network)
K.98	Overvoltage protection guide for telecommunication equipment installed in customer premises	Provides methodology for evaluating the need to protect users of telecommunication equipment in CPE
K.102	Parameters of fixed-voltage thyristor overvoltage protector components used for the protection of telecommunication installations	Provides fixed-voltage thyristor parameters to ease the choice for designers
K.103	Surge protective component application guide - Silicon PN junction components	Guide to selecting PN junction components
K.117	Primary protector parameters for the surge protection of equipment Ethernet ports	This recommendation should be used for the harmonization of existing or future specifications issued by Ethernet surge protective device (SPD) manufacturers, telecommunication equipment manufacturers, administrations or network operators
K.118	Requirements for lightning protection of fiber to the distribution point equipment	Provides the necessary information to enable the protection of the equipment in customer premises implementing gigabit broadband access technology that exploits the existing infrastructure of wire pairs that were originally deployed for plain old telephone service (POTS) services.

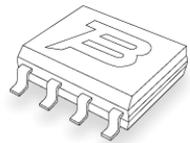
ITU-T Recommendations and the Resistibility of Telecommunication Equipment

ITU-T K-Numbers Explained

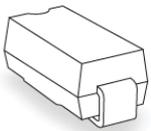
Below are descriptions of popular recommendations listed in the previous table.



Gas Discharge Tube (GDT)
Surge Arrestors



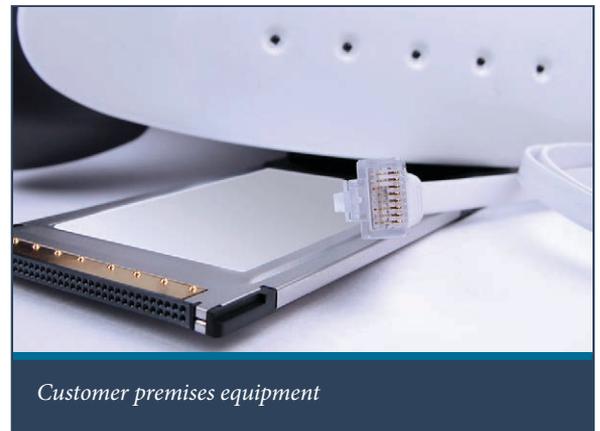
Thyristor Surge Protectors



Schottky Rectifier Diodes

- *K.20: “Resistibility of telecommunication equipment installed in a telecommunication center to overvoltages and overcurrents”*

The ITU-T K.20 Recommendation specifies resistibility requirements and test procedures for telecommunication equipment that is attached to, or installed within a telecommunication center and Central Office (CO). Overvoltage and overcurrent events that are covered by this recommendation include surges due to lightning on or near the line plant, short-term induction from adjacent AC power lines or railway systems, earth potential rise due to power faults, direct contact between telecommunication lines and power lines, and electrostatic discharges (ESDs).



Customer premises equipment

Test requirements given by this recommendation are somewhat less severe than the tests required for the customer premises equipment ITU-T K.21. The reason is that CO installations typically are well-planned and the personnel working there are trained, making this environment more controllable.

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

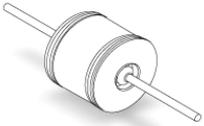


Customer hub equipment

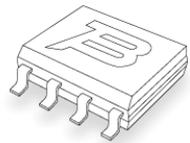
The ITU-T K.21 Recommendation specifies resistibility requirements and test procedures for telecommunication equipment that is attached to or installed within the customer premises. The scope of this recommendation is for the overvoltage and overcurrent events just as in the previously cited ITU-T K.20.

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

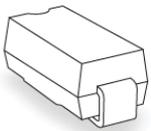
ITU-T Recommendations and the Resistibility of Telecommunication Equipment



Gas Discharge Tube (GDT)
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Schottky Rectifier Diodes

The ITU-T K.45 Recommendation specifies resistibility requirements and test procedures for telecommunication equipment installed between telecommunication centers and between a telecommunication center and the customer premises. It, too, covers overvoltages or overcurrents; only the placement of the equipment is different.

The above three recommendations are not complete. There are tests defined, and the setup for performing the tests and an exhaustive explanation of how to perform the tests is in the K.44 Recommendation.

- K.44: “Resistibility tests for telecommunication equipment exposed to overvoltages and overcurrents – Basic Recommendation”



A Main Distribution Frame, the starting point of the line plant

The ITU-T K.44 Recommendation seeks to establish fundamental test methods and criteria for the resistibility of telecommunication equipment to overvoltages and overcurrents. Overvoltages or overcurrents covered by this recommendation include surges due to lightning on or near the line plant, short-term induction of alternating voltages from adjacent

electric power lines or electrified railway systems, earth potential rise due to power faults and direct contact between telecommunication lines and power lines.

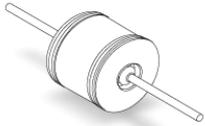
There are other recommendations from the K series which complement the approach to the resistibility tests of the telecommunication equipment. The additional K series recommendations supply guidelines on possible scenarios and also offer insights on component selection for protection of telecommunication equipment, such as application guides for surge protective components and surge protective devices.

To name just two:

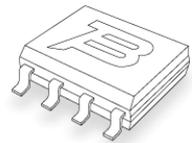
- K.12: “Characteristics of gas discharge tubes for the protection of telecommunications installations”
- K.99: “Surge protective component application guide - Gas discharge tubes”

These recommendations describe the test for characterization and application of Gas Discharge Tubes (GDTs). GDTs are often used for primary protection of telecom applications due to their robustness and low capacitance.

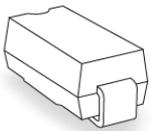
ITU-T Recommendations and the Resistibility of Telecommunication Equipment



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Additional details on characteristics (waveshapes and peak values) of expected surges due to lightning on telecommunication lines of the access network and on signaling lines at the customer premises using metallic conductors are given in:

- K.67: “Expected surges on telecommunications and signaling networks due to lightning”

The ITU-T K.67 and K.98 recommendations can be used as a guide on how to protect telecommunication equipment from overvoltage damage due to lightning strikes to the power and telecommunication lines/cables.

- K.98: “Overvoltage protection guide for telecommunication equipment installed in customer premises”

Further recommendations that offer application guides on protection components are:

- 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 components”

In addition to components used for protection, there are recommendations to assist with ITU-T compliance in other areas of the equipment design. For instance, components tested to fulfill certain functionality, and thus to protect equipment. The ITU-T has tests for Ethernet ports that can be especially sensitive and require added protection:

- K.117: “Primary protector parameters for the surge protection of equipment Ethernet ports”
- K.118: “Requirements for lightning protection of fiber to the distribution point equipment”

Safety recommendations are also included:

- K.50: “Safe limits for operating voltages and currents of telecommunication systems powered over the network”

The ITU-T K.50 Recommendation provides guidance on voltages and currents that may safely be used to power telecommunication systems that are part of the telecommunications service providers’ network.

- K.51: “Safety criteria for telecommunication equipment”

The ITU-T K.51 Recommendation supplies guidance on safety criteria for telecommunication network infrastructure equipment. ITU-T K.51 Recommendation specifies requirements intended to reduce risks of fire, electric shock or injury for specified classes of persons who may come into contact with the equipment. These recommendations refer to the IEC safety standards IEC 60950-1 and IEC 62368-1 and provide additional requirements when these are not covered by the IEC standards.



Lightning event

ITU-T Recommendations and the Resistibility of Telecommunication Equipment

Bourns ITU-T Solutions

As innovators of circuit protection products, Bourns offers a wide range of circuit protection components and solutions for telecom equipment. These products have been proven in ITU-T compliant applications. Bourns delivers quality protection solutions that match a diverse set of functionality and technology requirements.



Bourns® Gas Discharge Tubes (GDTs) provide primary and secondary protection to withstand multiple high current energy surges of 25 kA. Bourns offers standard 8 mm GDTs and a 5 mm mini series GDT in two and three electrode versions. These feature long service life, low capacitance and low insertion loss. An optional, proprietary Switch-Grade Fail-Short is offered on the three-electrode version.

Bourns® Thyristor Surge Protectors are dual or single, unidirectional and bidirectional thyristor surge protectors. Quad and programmable/adjustable gated thyristor surge protectors are also available.



Bourns® Diodes family include a full range of products, from small signal high speed switching diodes with low capacitance and leakage current to power and Schottky diodes for reliable surge protection and voltage rectification. Voltage clamping products are suitable for various applications and packaging, with low power signal rectification.

References

ITU Telecommunication Standardization Sector web portal

<https://www.itu.int/en/ITU-T/Pages/default.aspx>

ITU Telecommunication Standardization Sector Study Group 5 web portal

<https://www.itu.int/en/ITU-T/studygroups/2017-2020/05/Pages/default.aspx>

Recommendation ITU-T A.1: "Working methods for study groups of the ITU Telecommunication Standardization Sector" - <https://www.itu.int/rec/T-REC-A.1>

ADDITIONAL RESOURCES

Please contact your local Bourns Application Engineer or Bourns Sales Representative for additional info.

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