

Application Note: ITU K Series Telecommunications Recommendations

Introduction

The International Telecommunications Union (ITU), formerly CCITT, is an organization with a truly international membership who work together defining how the telecommunications network should be operated and tested. The ITU K series are recommendations for Protection against Interference. The K recommendations cover every aspect of the telecommunications system and include protection components. The ITU and IEC work closely together with the common aim of providing worldwide standardization. The difference between the IEC and ITU is that the IEC produce standards and the ITU recommendations.

The actual K series recommendations for resistibility tests discussed in this application note are K.20, K.21, K.44 and K.45.

The recommendations K.43 and K.48 for the EMC aspects emission and immunity are not covered by this application note.

ITU Recommendations for resistibility tests

Resistibility is the ability of telecommunication equipment to withstand, in general, without any damage, the effects of overvoltages or overcurrents, up to a defined level, and in accordance with a specified criterion.

The overvoltages and overcurrents discussed here include

- surges due to lightning on or near the line plant
- inductively coupled interferences due to lightning currents near the internal wiring of telecom systems
- short-term induction of alternating voltages from adjacent electric power lines or electrified railway systems
- earth potential rises due to power faults
- direct contact between telecommunication lines and power lines
- electrostatic discharges

K.44 Resistibility tests for telecommunication equipment exposed to overvoltages and overcurrents - Basic recommendation

This recommendation is intended to be used in the same way as the IEC basic standards. That is in detail:

- test equipment
- acceptance criteria
- typical waveforms
- test procedure
- test set-up
- range of test levels (only for issues not covered by product recommendations)

It does not define test levels for a particular EUT. For each part of the telecommunication system, a recommendation exists which defines the exact tests to be performed and the test levels with reference to recommendations in K.44.

K.20, K.21 and K.45 Resistibility of telecommunication equipment to overvoltages and overcurrents.

These recommendations are product standards. The recommendations contain details of:

- the EUT ports to be tested
- number of ports of the same type to be tested
- test connections
- availability of primary (external) protection
- impulse types
- test levels

In addition to lightning surge, the recommendations contain the following tests:

- ESD
- power induction
- earth potential rise
- neutral potential rise
- mains power contact

Network Interfaces

The ITU define very clearly interfaces between elements of the telecommunication system. These are given in graphic form as Fig. I.3-1 in recommendation K.44 and are listed here.

Actual product recommendations:

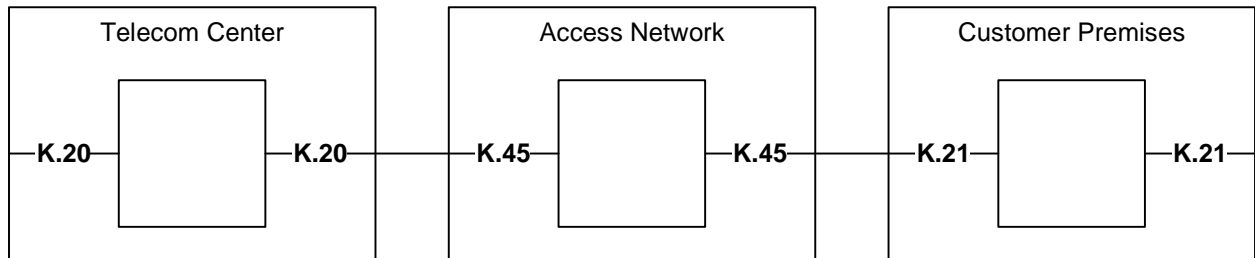
- K.20** Resistibility of telecommunication equipment installed in a telecommunications center to overvoltages and overcurrents.
- K.21** Resistibility of telecommunication equipment installed in customer premises to overvoltages and overcurrents.
- K.45** Resistibility of telecommunication equipment installed in the access and trunk networks to overvoltages and overcurrents.

Withdrawn recommendations:

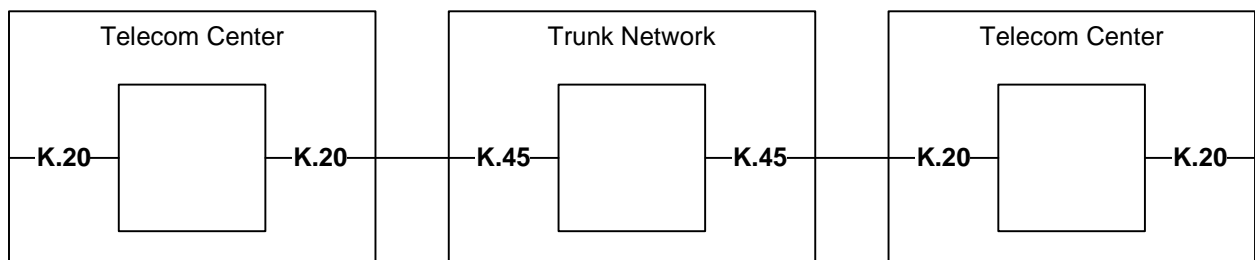
- K.17** replaced by K.44 and K.45
- K.22** replaced by K.21
- K.41** replaced by K.20

Two example configurations are shown

1. Connection between a telecommunications center, via Network Access equipment to a customer Premises:



2. Connection between two telecommunication centers:



Resistibility Requirements

Resistibility defines the EUTs ability to withstand interference signals. This is influenced by factors of location and degree of built-in protection. The end user must choose from one of two resistibility levels:

- Basic: - equipment for use in low exposure areas, protection is integrated. Can also be used in higher exposure areas with added primary protection.
- Enhanced: - equipment for use in severe exposure areas, where the integrated protection is not adequate

Acceptance Criteria

Once the resistibility requirements have been selected, two Pass/Fail criterion have to be met:

- A Equipment shall not be damaged and continue to operate after the test.
- B The equipment shall not become a fire hazard and damage shall be limited to the immediate vicinity.

What has to be tested?

Terminals to be tested are defined in recommendation K.44 and all subsidiary recommendations such as K.20, K.21 and K.45. They are categorized as follows:

- symmetrical twisted pairs
- coaxial cables
- dedicated power feeds (AC or DC)
- mains power ports
- internal ports

Impulse Types

ITU K.44 recommends the following impulse types, which will be referenced from the relevant product standard K.20, K.21 and K.45.

Generic requirements

Voltage waveshape in K.44	Current waveshape in K.44	Comments
10/700 μ s	<i>Not defined</i>	20 μ F capacitor
1.2/50 μ s	<i>Not defined</i>	1 μ F capacitor
<i>Not defined</i>	2/10 μ s	2 outputs
1.2/50 μ s	8/20 μ s	Combination wave
<i>Not defined</i>	8/20 μ s	Max. 30kA
<i>Not defined</i>	10/350 μ s	Proposed only. Discharge capacitor 1000 μ F.

Product standard requirements (as of July 2003)

Recommendation	Impulse Shape	Basic test levels	Enhanced test levels	Comments
K20	10/700 μ s	1..4	1.5...6	
	8/20 μ s	1kA/wire	5kA/wire	limited to 6kA (basic) and 30kA (extended)
	Combination Wave	0.5...6kV	1.0...10kV	
K21	10/700 μ s	1.5...4kV	1.5...6kV	
	8/20 μ s	1kA/wire	5kA/wire	limited to 6kA (basic) and 30kA (extended)
	Combination Wave	1...6kV	1.5...10kV	
K45	10/700 μ s	1.5..4kV	1.5...6kV	
	8/20 μ s	1kA/wire	5kA/wire	limited to 6kA (basic) and 30kA (extended)
	Combination Wave	2.5...6kV	6...10kV	

Test Conditions

- All tests are type tests and are tested under standard operating conditions unless otherwise specified .
- Alternating polarity must be employed with one pulse of each polarity up to the maximum specified number of pulses.
- In all cases where a maximum voltage, current or specific energy is specified, tests shall also be performed at lower values to be sure that all parts of the protection work properly.

The Haefely Solution

Two system types may be necessary to address all the ITU requirements, very much dependant upon individual EUT test requirements.

The Haefely Surge Platform meets ALL basic surge test requirements:

Module	Art. No.	Short description	Maximum impulse amplitude	Comments
PSURGE 8000	249900	Surge Platform mainframe	8kV DC	contains control unit and HV Dc source
PIM 100	249902	Combination wave module 1.2/50us - 8/20us	7.4kV	exceeds most requirements
PCD 100	249904	Automatic single phase CDN	7.4kV	together with PIM 100
PCD 130	249964	Automatic three phase CDN	7.4kV	together with PIM 100
PIM 120	249940	10/700us impulse module	7.4kV	exceeds ALL requirements
PCD 120	249941	Automatic coupling network for symmetrical lines according ITU K.44	7.4kV	together with PIM 120 only
PIM 130	249976		7.4kV	According Fig. A.3-2/K.44
PIM 200	249949	Current impulse module 8/20us & 10/1000us	12kA (8/20us)	
PIM 900	249931	Impulse module 2/10us	2.75kV	
PCD 900	249932	CDN for data lines	2.75kV	Correspond to surge 4 in Telcordia (Bellcore) GR-1089-CORE. Used for earth voltage drop test according clause II.3.3/K.44

There are some decoupling units for control and data lines:

Module	Art. No.	Short description	Maximum impulse amplitude	Comments
DEC 5	249014	Decoupling network with current compensated inductors as decoupling elements according IEC 61000-4-5 and ITU K.44	6.6kV	used together with PCD 120
DEC 6	249015	Decoupling network for data and control lines according ITU K.44	6.6kV	used together with PCD 120

For enhanced surge test requirements, the PSURGE 30 or similar system is necessary:

Module	Art. No.	Short description	Maximum impulse amplitude	Comments
PSURGE 30.2	249320	Impulse generator mainframe	30kV/30kA	exceeds ALL requirements
PS30-CWG	249321	Impulse module combination wave 1.2/50us - 8/20us	30kV/15kA	
PS30-8x20	249322	Current impulse module 8/20us	30kA	
FP-SURGE 3010	249452	Single phase CDN	30kV/15kA	combination wave 1.2/50us - 8/20us only

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