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SERIES K: PROTECTION AGAINST INTERFERENCE

**Values of induced voltages on
telecommunication installations to establish
telecom and a.c. power and railway operators
responsibilities**

ITU-T Recommendation K.53

(Formerly CCITT Recommendation)

ITU-T RECOMMENDATION K.53

VALUES OF INDUCED VOLTAGES ON TELECOMMUNICATION INSTALLATIONS TO ESTABLISH TELECOM AND A.C. POWER AND RAILWAY OPERATORS RESPONSIBILITIES

Summary

This Recommendation gives permissible voltages on a telecommunications line caused by influence from a nearby a.c. power or railway plant during normal operation and fault condition. These values set the maximum permissible voltages and durations that a.c. power and railway operators are allowed to cause by any type of electromagnetic coupling on a telecommunications line without being responsible for mitigation measures.

Source

ITU-T Recommendation K.53 was prepared by ITU-T Study Group 5 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on 25 February 2000.

FOREWORD

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The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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Foreword

The electromagnetic interference between a.c. power and electrified railway plants and telecommunication plants may appear through the mechanisms of inductive, capacitive and conductive coupling which causes voltages on the telecommunication plants in the power and audio frequency range.

Voltage levels are here defined in order to guarantee satisfactory coexistence between telecommunication systems and power and railway systems, taking into account that these voltages can represent a danger to the personnel working on the telecommunication plant and may produce damage, malfunction or disturbance to the equipment installed in it.

In defining these levels, telecommunication systems as well as power and railway systems are seen as a whole, without seeing their details (cables, equipment, etc).

This means that the levels do not concern a particular part of the telecommunication system, but the whole system.

From another point of view, the levels represent an agreement between the owners of the systems (the so called operators). Thus, such an agreement is of interest for the operators and of those companies involved in the design and the maintenance of the telecommunication, power and railway plants.

Introduction

This Recommendation sets permissible voltages in telecommunication lines caused by the electromagnetic influence from nearby a.c. power and railway plants during normal operation and fault condition. They are related to the worst interference situation.

The permissible voltages are those, which a.c. power and electrified railways systems are allowed to cause to a telecommunications line, without the operators of a.c. power and electrified railways systems being responsible for mitigation measures.

The levels set in this Recommendation will be reproduced in the Directives Vol. VI [2] in an appropriate way.

Recommendation K.53

VALUES OF INDUCED VOLTAGES ON TELECOMMUNICATION INSTALLATIONS TO ESTABLISH TELECOM AND A.C. POWER AND RAILWAY OPERATORS RESPONSIBILITIES

(Geneva, 2000)

1 Scope

This Recommendation specifies the maximum allowed voltages caused by inductive, capacitive and conductive coupling for which a.c. power and railway operators shall not bear the responsibility for mitigation measures. It covers the levels of influence from the fundamental frequency of power and railways systems and the psophometric level. When the electromagnetic interference is such that more than one coupling are acting at the same time, the permissible voltages apply to the total interference results.

They establish an official agreement between telecommunication operators and power and railway operators in order to clearly share responsibilities, and, as a consequence, if necessary, the relevant expenses for mitigation measures. The latter is out of the scope of this Recommendation. However the principle of priority (first coming), national regulations and existing agreements between operators should be taken into account.

The limit values only apply to the frequency(-ies) used in the area, where the telecommunication plant is located, i.e. 16²/3, 50 or 60 Hz, and the psophometric noise. They only apply to parts of telecommunications systems that may be exposed to a.c. power and railway systems (e.g. outdoor lines, exchanges).

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

- [1] ITU-T Recommendation K.33 (1996), *Limits for people safety related to coupling into telecommunications systems from a.c. electric power and a.c. electrified railway installations in fault conditions.*
- [2] CCITT Directives concerning the protection of telecommunication lines against harmful effects from electric power and electrified railway lines, Volume VI: Danger and disturbance, 1990.
- [3] ITU-T Recommendation K.10 (1996), *Low frequency interference due to unbalance about earth of telecommunication equipment.*

3 Definitions

This Recommendation defines the following terms:

3.1 Induced voltage: The induced voltage in a given point of a telecommunications installation is the voltage caused in that point by the electromagnetic coupling with nearby a.c. power or electrified railway line. It can be a voltage to earth if calculated or measured as the difference between the potential caused in that point by all the electromagnetic coupling phenomena acting together, and the potential of earth. It can be a voltage between two metallic elements of the telecommunication installation if calculated or measured as difference between the potentials caused in such two metallic elements (e.g. voltage between the two wires of a pair, wire to sheath voltage, etc.) by all the electromagnetic coupling phenomena acting together.

The frequency is the one used in the area, where the telecommunication plant is located, i.e. $16^{2/3}$, 50 or 60 Hz.

3.2 Induced psophometric voltage: The induced psophometric voltage in a given point of a telecommunications line caused by a nearby a.c. power or electrified railway line by all the electromagnetic coupling phenomena acting together, is the voltage, U_p , in that point appearing between the two wires of the pair given by the expression:

$$U_p = \frac{1}{P_{800}} \sqrt{\sum (p_f U_f)^2}$$

in which:

U_f is the component at frequency "f" of the voltage due to the presence of the power line and measured between those two wires;

p_f is the weighting for this frequency given in the weighting table associated with the psophometer specification. The table gives values of p_f for the various frequencies, when p_{800} is equal by convention to 1000.

NOTE – The table of the psophometric weightings is given in the Directives Vol. VI.

3.3 Reference earth: A point in the soil whose electrical potential is zero. This concept applies both to calculation and measurement of voltages, considered as difference of the potential of the induced telecommunication plant and the potential of the soil.

4 Permissible induced voltages on a telecommunications line

4.1 Long-term levels

4.1.1 Fundamental frequency

The long-term permissible induced voltage with respect to the reference earth at any point of a telecommunications line is $60 V_{\text{rms}}$.

By long-term is meant more than 1 s in this context.

4.1.2 Noise

The long-term permissible induced psophometric voltage between the two wires of a pair is 0.5 mV at any terminal of a telecommunications line.

The LCL of the telecommunications installation shall be in accordance with Recommendation K.10 [3].

NOTE – LCL values as indicated in clause 6/K.10 lead to a permissible induced psophometric longitudinal voltage of 200 mV at any terminal of a telecommunications line.

By long-term is meant more than 1 s in this context.

4.2 Short-term levels

4.2.1 General

The short-term permissible induced voltage at any point of a telecommunications line is indicated in 4.2.2 and 4.2.3 for typical and severe situation respectively. The meaning of typical or severe situation is given in Recommendation K.33 [1].

4.2.2 Typical situation

If the line has metallic signal conductors or remote feeding telecommunication (RFT) circuit, the permissible short-term induced voltage at any point of a telecommunications line is stated in Table 1.

Table 1/K.53 – Permissible short-term induced voltages for typical situation

| Induced duration t[s] | Induced voltage U_1 [V _{rms}] |
|-----------------------|---|
| $t \leq 0.2$ | 1030 |
| $0.2 < t \leq 0.35$ | 780 |
| $0.35 < t \leq 0.5$ | 650 |
| $0.5 < t \leq 1.0$ | 430 |

NOTE – U_1 is derived from the same dissipation in components connected to the line as for 650 V, 0.5 s, which has been used until now.

If the metallic element of the line is not intended for transmitting signals or for the supply of power to equipment, the permissible short-term induced voltage at any point of a telecommunications line is stated in Table 2.

Table 2/K.53 – Exceptional permissible short-term induced voltages for typical situation

| Induced duration t[s] | Induced voltage U_2 [V _{rms}] |
|-----------------------|---|
| $t \leq 0.2$ | 1500 |
| $0.2 < t \leq 0.35$ | 1000 |
| $0.35 < t \leq 0.5$ | 650 |
| $0.5 < t \leq 1.0$ | 430 |

NOTE – U_2 has been derived from Recommendation K.33 for typical situation.

4.2.3 Severe situation

The permissible short-term induced voltage at any point of a telecommunications line is stated in Table 3.

Table 3/K.53 – Permissible short-term induced voltages for severe situation

| Induced duration t[s] | Induced voltage U_3 [V_{rms}] |
|--|---|
| $t < 0.1$ | 430 |
| $0.1 \leq t \leq 1$ | 300 |
| NOTE – U_3 has been derived from Recommendation K.33 for severe situation. | |

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