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SERIES K: PROTECTION AGAINST INTERFERENCE

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**Conducted immunity test method and level at  
fundamental power frequencies**

ITU-T Recommendation K.54

(Formerly CCITT Recommendation)

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## **ITU-T Recommendation K.54**

### **Conducted immunity test method and level at fundamental power frequencies**

#### **Summary**

This Recommendation presents the simplified immunity test method, the test procedure and the immunity test level for equipment with telecommunication ports connected to external telecommunication lines against conducted disturbances which can be induced on telecommunication lines by a.c. power or electrified railway lines under normal operating conditions.

#### **Source**

ITU-T Recommendation K.54 was prepared by ITU-T Study Group 5 (1997-2000) and approved by the World Telecommunication Standardization Assembly (Montreal, September 27 – October 6, 2000).

## FOREWORD

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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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## **Introduction**

Disturbances at fundamental power frequencies ( $16\frac{2}{3}$ , 50 or 60 Hz) can be induced on telecommunication lines by a.c. power and electrified railway lines under normal operating conditions. Therefore there is a need to define immunity requirements at these frequencies of equipment with telecommunication ports connected to external telecommunication lines.

This Recommendation presents the immunity test method, the test procedure and the immunity test levels for telecommunication equipment.

The test set-up is based on the "Handbook on interference measuring techniques" [1].

Other coupling networks are possible.

## ITU-T Recommendation K.54

### Conducted immunity test method and level at fundamental power frequencies

#### 1 Scope

This Recommendation refers to long-term (i.e. longer than 1 second) voltages induced by a.c. power or electrified railway lines on telecommunication lines.

The Recommendation defines:

- the immunity level which a telecommunication equipment shall have;
- the test method and procedure which shall be used to verify the immunity level.

The tests are applicable to telecommunication ports connected to external metallic telecommunication lines.

#### 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; 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 Handbook on interference measuring techniques*, Part A, February 2000.
- [2] *ITU-T Directives Concerning the Protection of Telecommunication Lines against Harmful Effects from Electric Power and Electrified Railway Lines*, Volume VI: *Danger and disturbance*.
- [3] ITU-T K.43 (1998), *Immunity requirements for telecommunication equipment*.

#### 3 Definitions

This Recommendation defines the following terms:

**3.1 common mode induced disturbances:** Voltage induced on telecommunication line by an a.c. power or electrified railway line in normal operating conditions between the equipment telecommunication port and a reference earth.

**3.2 test frequency:** The test frequency is the fundamental power frequency used in the area, where the telecommunication plant is located, i.e. 16  $\frac{2}{3}$ , 50 or 60 Hz.

**3.3 external telecommunication line:** Telecommunication line which leaves a telecommunication centre or shelter or customer building.

**3.4 reference earth:** A point in the soil, whose electrical potential is presumed to be zero. This concept is used both in the calculation and measurement of voltages, considered as difference of the potential induced in the telecommunication plant and the potential of the soil.

Other definitions are found in ITU-T K.43.

#### 4 Immunity test conditions

The immunity level of conducted long-term disturbances at fundamental power frequencies is the r.m.s. level of the common mode voltage between telecommunication port and earth.

The immunity level is 60 V.

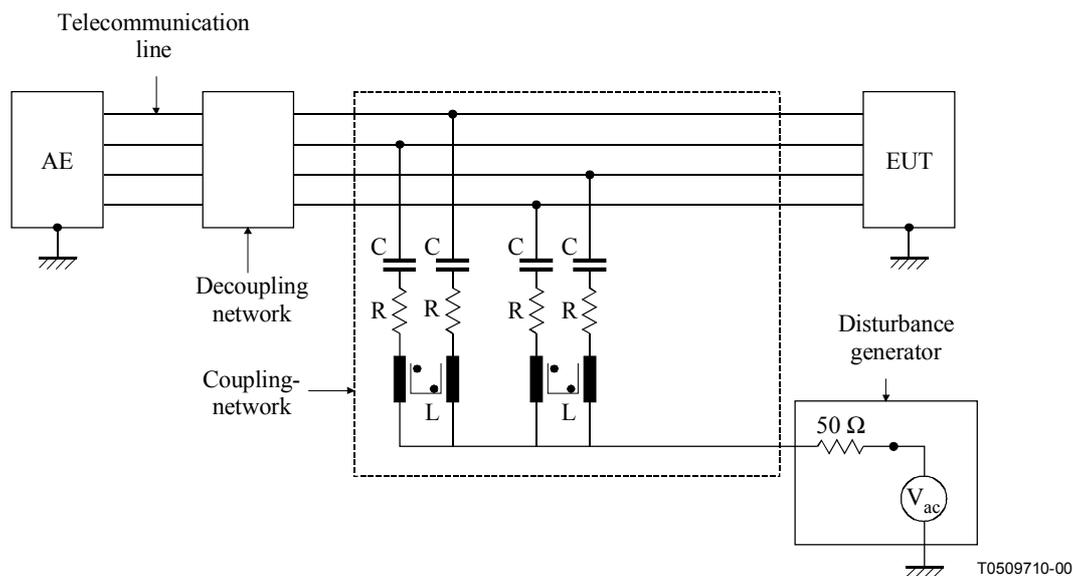
The test duration shall not be less than 1 minute and shall not exceed 15 minutes.

## 5 Performance criterion

During the test, the EUT (Equipment Under Test) shall meet its performance requirements.

## 6 Test method and procedure

A simplified test circuit is shown in Figure 1 for symmetrical pair ports (unshielded or shielded cable) whereas it is under study for coaxial pairs.



**Figure 1/K.54 – Test circuit for symmetrical pair ports**

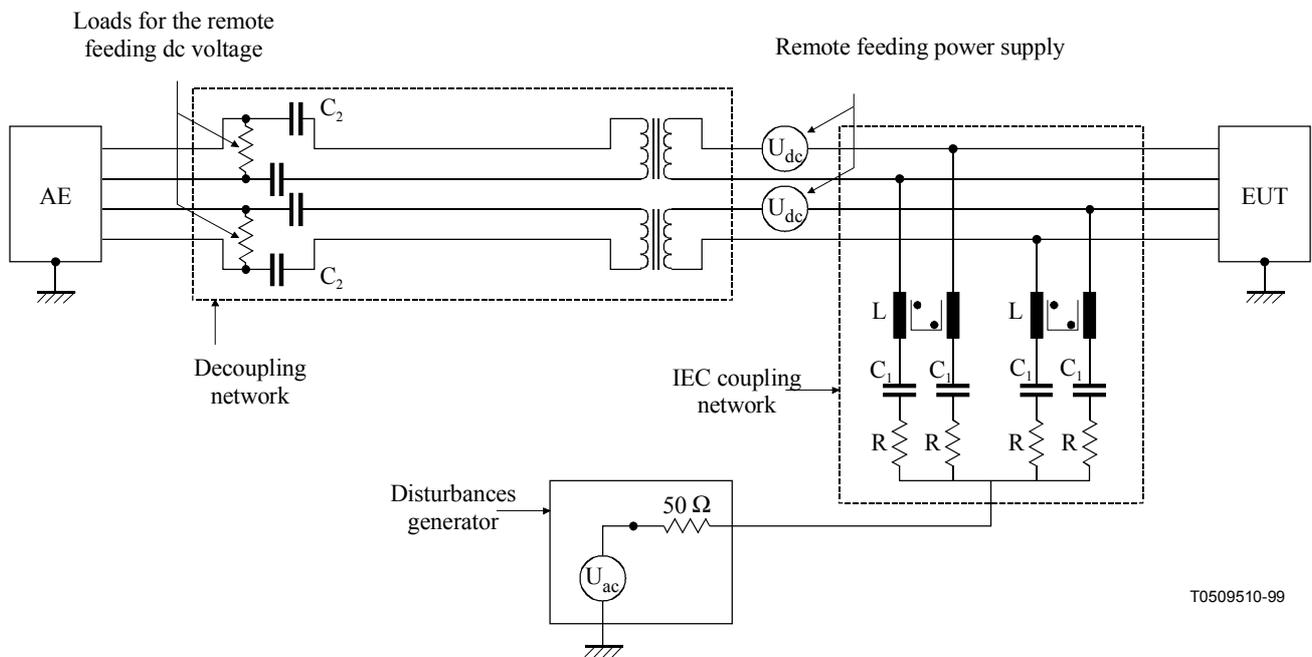
In Figure 1 the open circuit voltage of the test generator,  $U_{ac}$ , is the required immunity level.

When the common mode impedance of the EUT is low, the common mode voltage occurring at the port of the EUT is significantly lower than the voltage of the test generator.

The earthing connections of the EUT shall be implemented according to the real installation conditions.

The coupling network and the test generator, shown in the test circuits, are based on Figure A.6 of the "Handbook on interference measuring techniques" [1].

If the Auxiliary Equipment (AE) has a lower immunity level than that required to the EUT, it is necessary to use a decoupling network to isolate the AE from the common mode disturbance. For this purpose, it is possible to use common mode transformers on the telecommunication lines. In this case, if the EUT is powered by a remote feeding circuit through the telecommunication line, the d.c. voltage generator on the line shall be used to supply the EUT. An example of decoupling network, using transformers with remote feeding circuits, is shown in Figure 2.



**Figure 2/K.54 – Example of test set-up with decoupling network using transformers with remote feeding d.c. circuits**

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The EUT test conditions (operating state, earthing connections, wiring, etc.) should be as close as possible to the real installation conditions. If the EUT is designed to be mounted in a rack or cabinet, it should be tested in this configuration.

The signal or control ports shall be correctly terminated either by auxiliary equipment necessary to exercise the ports or in their nominal impedance. Auxiliary equipment may be used to simulate the functional termination of the ports. Special additional equipment, e.g. a traffic simulator, and/or software, line attenuator, line simulator, may be used to simulate the operating conditions.

NOTE – The operation of the test simulator shall be verified for correct operation before applying the disturbing voltage.

In Figure 1, the following values of the components should be used:

$$R_g \leq 50 \Omega$$

$$R = 300 \Omega$$

$$C = 60 \text{ nF}$$

This value takes into account the worst-case conditions concerning line lengths, number of pairs and centre of exposure.

The inductance L should provide a high impedance compared with the differential mode impedance of the EUT.

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