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## **EMC requirements for telecommunication equipment – Product family Recommendation**

ITU-T Recommendation K.48



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# ITU-T Recommendation K.48

## EMC requirements for telecommunication equipment – Product family Recommendation

### Summary

This Recommendation specifies the emission and immunity requirements for switching, transmission, power, digital mobile base station, wireless LAN, digital radio relay system, digital subscriber line (xDSL) and supervisory equipment. It also describes operational conditions for emission and immunity testing. Performance criteria for immunity tests are also specified.

### Source

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# ITU-T Recommendation K.48

## EMC requirements for telecommunication equipment – Product family Recommendation

### 1 Scope

This Recommendation specifies the emission and immunity requirements for switching, transmission, power, digital mobile base station, wireless LAN, digital radio relay system, digital subscriber line (xDSL) and supervisory equipment. It also describes operational conditions for emission and immunity testing. Performance criteria for immunity tests are also specified. The general operational condition and performance criteria are recommended in ITU-T Rec. K.43. This Recommendation describes the specific testing conditions to be applied to telecommunication network equipment.

### 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. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- [1] ITU-T Recommendation G.703 (2001), *Physical/electrical characteristics of hierarchical digital interfaces*.
- [2] ITU-T Recommendation G.712 (2001), *Transmission performance characteristics of pulse code modulation channels*.
- [3] ITU-T Recommendation G.798 (2004), *Characteristics of optical transport network hierarchy equipment functional blocks*.
- [4] ITU-T Recommendation G.812 (2004), *Timing requirements of slave clocks suitable for use as node clocks in synchronization networks*.
- [5] ITU-T Recommendation G.813 (2003), *Timing characteristics of SDH equipment slave clocks (SEC)*.
- [6] ITU-T Recommendation G.991.1 (1998), *High bit rate digital subscriber line (HDSL) transceivers*.
- [7] ITU-T Recommendation G.991.2 (2003), *Single-pair high-speed digital subscriber line (SHDSL) transceivers*.
- [8] ITU-T Recommendation G.992.3 (2005), *Asymmetric digital subscriber line transceivers 2 (ADSL2)*.
- [9] ITU-T Recommendation G.992.5 (2005), *Asymmetric Digital Subscriber Line (ADSL) transceivers – Extended bandwidth ADSL2 (ADSL2plus)*.
- [10] ITU-T Recommendation G.993.1 (2004), *Very high speed digital subscriber line transceivers (VDSL)*.
- [11] ITU-T Recommendation G.961 (1993), *Digital transmission system on metallic local lines for ISDN basic rate access*.
- [12] ITU-T Recommendation G.996.1 (2001), *Test procedures for digital subscriber line (DSL) transceivers*.

- [13] ITU-T Recommendation K.27 (1996), *Bonding configurations and earthing inside a telecommunication building*.
- [14] ITU-T Recommendation K.34 (2003), *Classification of electromagnetic environmental conditions for telecommunication equipment – Basic EMC Recommendation*.
- [15] ITU-T Recommendation K.38 (1996), *Radiated emission test procedure for physically large systems*.
- [16] ITU-T Recommendation K.43 (2003), *Immunity requirements for telecommunication equipment*.
- [17] ITU-T Recommendation O.150 (1996), *General requirements for instrumentation for performance measurements on digital transmission equipment*.
- [18] ITU-T Recommendation O.41 (1994), *Psophometer for use on telephone-type circuits*.
- [19] ITU-R Recommendation SM.329-10 (2003), *Unwanted emissions in the spurious domain*.
- [20] ITU-T Recommendation I.430 (1995), *Basic user-network interface – Layer 1 specification*.
- [21] ITU-T Recommendation I.431 (1993), *Primary rate user-network interface – Layer 1 specification*.
- [22] ITU-T Recommendation Q.552 (2001), *Transmission characteristics at 2-wire analogue interfaces of digital exchanges*.
- [23] ITU-T Recommendation V.10 (1993), *Electrical characteristics for unbalanced double-current interchange circuits operating at data signalling rates nominally up to 100 kbit/s*.
- [24] ITU-T Recommendation V.11 (1996), *Electrical characteristics for balanced double-current interchange circuits operating at data signalling rates up to 10 Mbit/s*.
- [25] ITU-T Recommendation V.24 (2000), *List of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE)*.
- [26] ITU-T Recommendation V.28 (1993), *Electrical characteristics for unbalanced double-current interchange circuits*.
- [27] ITU-T Recommendation V.36 (1998), *Modems for synchronous data transmission using 60-108 kHz group band circuits*.
- [28] ITU-T Recommendation X.24 (1988), *List of definitions for interchange circuits between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) on public data networks*.
- [29] ITU-T Recommendation X.25 (1996), *Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit*.
- [30] IEC CISPR 22 (2005 Fifth edition), *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement*.
- [31] IEC 60050-161:1990, *International Electrotechnical Vocabulary – Chapter 161: Electromagnetic compatibility*.
- [32] IEC 60050-714:1992, *International Electrotechnical Vocabulary – Chapter 714: Switching and signalling in telecommunications*.
- [33] IEC 61000-3-2:2005, *Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current up to and including 16 A per phase)*.

- [34] IEC 61000-3-3:2005, *Electromagnetic compatibility (EMC) – Part 3-3: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current up to and including 16 A per phase and not subject to conditional connection.*
- [35] IEC 61000-4-2:2001, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test.*
- [36] IEC 61000-4-3:2006, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test.*
- [37] IEC 61000-4-4:2004, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test.*
- [38] IEC 61000-4-5:2005, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test.*
- [39] IEC 61000-4-6:2006, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields.*
- [40] IEC 61000-4-11:2004, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests.*
- [41] IEC 61000-4-29:2000, *Electromagnetic compatibility (EMC) – Part 4-29: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests.*
- [42] ETSI TS 125 101:2001, *Universal Mobile Telecommunications System (UMTS); UE radio transmission and reception (FDD).*
- [43] ETSI TS 125 102:2001, *Universal Mobile Telecommunications System (UMTS); UTRA (UE) TDD; Radio transmission and reception.*
- [44] ETSI TS 101 087:2005, *Digital cellular telecommunications system (Phase 2+); Base Station System (BSS) equipment specification; Radio aspects.*
- [45] TIA/EIA/IS-2000.2-C (2002), *Physical Layer Standard for cdma2000® Spread Spectrum Systems – Release C.*
- [46] TIA/EIA-97-D-2001, *Recommended Minimum Performance Standards for Base Stations Supporting Dual Mode Spread Spectrum Systems.*
- [47] ISO/IEC 8802-3 (2000), *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.*
- [48] ITU-T Recommendation G.997.1 (2006), *Physical layer management for digital subscriber line (DSL) transceivers.*

### 3 Definitions

The following definitions apply only in the context of this Recommendation, except where the reference to the International Electrotechnical Vocabulary [31] is given adjacent to the subclause title.

**3.1 aggregate signal:** Digital signal related to the transmission of data derived by the aggregation of tributary signal, service channels, and other information necessary to the functionality of a transmission system.

- 3.2 burst (161-02-07):** A sequence of a limited number of distinct pulses or an oscillation of limited duration.
- 3.3 cable port:** A point at which a conductor or a cable is connected to the equipment.
- 3.4 characteristic severity:** A severity that has only a low probability (generally less than 1%) of being exceeded for a certain parameter in an environmental class. This term relates to duration, rate of occurrence, or location. It applies to environmental and immunity requirements.
- 3.5 connection:** A temporary association of transmission channels or telecommunication circuits, switching or other functional units set up to provide for the transfer of information between two or more points in telecommunication networks [32].
- 3.6 continuous disturbance (161-02-11):** Electromagnetic disturbance whose effects on a particular device or piece of equipment cannot be resolved into a succession of distinct effects.
- 3.7 discontinuous interference (161-02-13):** Electromagnetic interference occurring during certain time intervals separated by interference-free intervals.
- 3.8 coupling and decoupling networks:** Coupling and Decoupling Networks (CDN) which terminates a cable with a common mode impedance to ground. The CDN shall not unduly affect the functional signals.
- 3.9 duration (of a pulse) (161-08-03):** The interval of time between the first and last instants when the instantaneous value of a pulse reaches 50% of the pulse magnitude.
- 3.10 enclosure port:** The physical boundary of the equipment through which electromagnetic fields may radiate or impinge. For plug-in units the physical boundary will be defined by the host equipment.
- 3.11 host equipment:** Any equipment which has a complete user functionality when not connected to a radio communications equipment, and to which this radio equipment provides additional functionality, and to which connection is necessary for this radio equipment to offer additional functionality, and in which the transceiver part of the radio equipment is physically installed.
- NOTE – This also covers any device that would accept a variety of radio modules, where the original user functionality of the host equipment is not effected.
- 3.12 integral antenna:** Antenna which may not be removed during the tests, according to the manufacturer's statement.
- 3.13 immunity (to a disturbance) (161-01-20):** The ability of a device, equipment, or system to perform without degradation in the presence of an electromagnetic disturbance.
- 3.14 impulsive disturbance (161-02-09):** Electromagnetic disturbance which, when incident on a particular device or piece of equipment, manifests itself as a succession of distinct pulses or transients.
- 3.15 period:** A unit of duration equal to one cycle of AC supply frequency (used in IEC 61000-4-11 [40]).
- 3.16 plug-in radio device:** Equipment, including slide-in radio cards, intended to be used with or within a variety of host systems, using their control functions and power supply.
- 3.17 port:** Particular interface of the specified equipment with the external electromagnetic environment.
- 3.18 ports in telecommunication (indoor port, outdoor port, enclosure port, DC power port, AC power port):** See Figure 1.

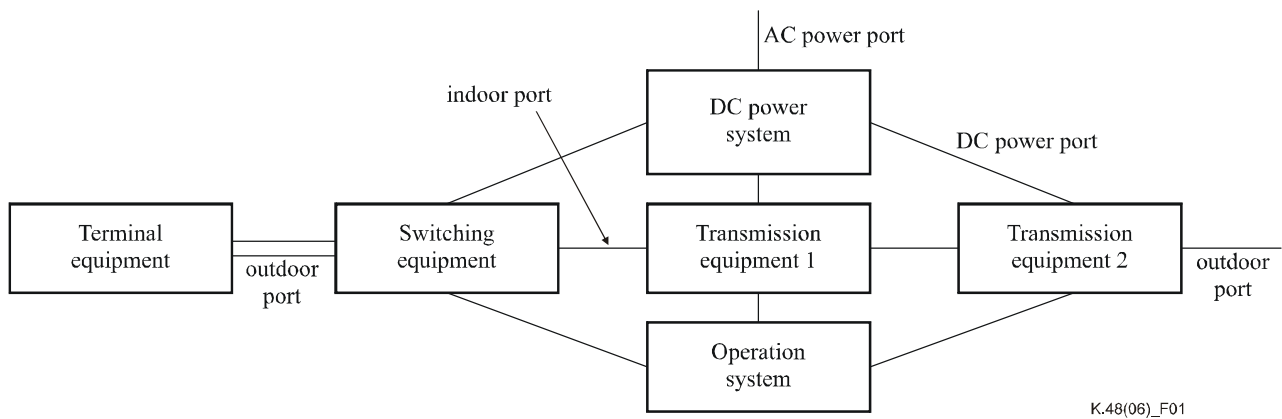


**Figure 1/K.48 – Ports in telecommunication**

**3.19 power supply:** A power source to which telecommunication equipment is intended to be connected.

**3.20 pulse (161-02-02):** An abrupt short-duration variation in a physical quantity followed by a rapid return to the initial value.

**3.21 radio communications equipment:** Telecommunications equipment which includes one or more radio transmitters and/or receivers and/or parts thereof for use in a fixed, mobile or portable application. It can be operated with ancillary equipment but if so, is not dependent on it for basic functionality.

**3.22 radio frequencies (RF):** The frequency range above 9 kHz.

**3.23 removable antenna:** Antenna which may be removed for the test according to the manufacturer statement.

**3.24 shielding effectiveness:** For a given external source, the ratio of electric or magnetic field strength at a point before and after the placement of the shield in question.

**3.25 SNR margin:** The modem's estimate of the maximum amount by which the receiver noise (internal and external) could be increased without causing the modem BER to fail the BER requirement.

**3.26 stand-alone radio equipment:** Equipment that is intended primarily as communications equipment and that is normally used on a stand-alone basis.

**3.27 surge (voltage) (161-08-11):** A transient voltage wave propagating along a line or a circuit and characterized by a rapid increase followed by a slower decrease of the voltage.

**3.28 telecommunication centre:** Electromagnetic environment of a telecommunication centre is described in ITU-T Rec. K.34 [14].

**3.29 telecommunication network:** A network operated under a licence granted by a national telecommunications authority which provides telecommunications between network termination points (NTPs) (i.e., excluding terminal equipment beyond the NTPs).

**3.30 transient (adjective or noun) (161-02-01):** Pertaining to or designating a phenomenon or a quantity that varies between two consecutive steady states during a time interval that is short compared with the time-scale of interest.

**3.31 tributary signal:** Digital signal related to the transmission of data at a bit rate defined by an ITU-T Recommendation and coming from a multiplexer equipment; e.g., a signal at 2.048 Mbit/s in line with ITU-T Rec. G.703 [1].

## 4 Abbreviations

This Recommendation uses the following abbreviations:

|          |                                                                   |
|----------|-------------------------------------------------------------------|
| AC       | Alternating Current                                               |
| ACK      | ACKnowledgement                                                   |
| ADSL     | Asymmetric Digital Subscriber Line                                |
| AE       | Auxiliary Equipment                                               |
| AMN      | Artificial Mains Network                                          |
| ARQ      | Automatic Retransmission reQuest                                  |
| BER      | Bit Error Rate                                                    |
| BLER     | Block Error Ratio                                                 |
| BS       | Base Station                                                      |
| CDMA     | Code Division Multiple Access                                     |
| CDN      | Coupling and Decoupling Network                                   |
| CHS      | Channel Separation                                                |
| CRT      | Cathode Ray Tube                                                  |
| DC       | Direct Current                                                    |
| DSL      | Digital Subscriber Line                                           |
| DSLAM    | Digital Subscriber Line Access Multiplexer                        |
| EM       | Electromagnetic                                                   |
| EMC      | ElectroMagnetic Compatibility                                     |
| ESD      | Electrostatic Discharge                                           |
| EUT      | Equipment Under Test                                              |
| FER      | Frame Error Rate                                                  |
| HDSL     | High bit rate Digital Subscriber Line                             |
| IMT-2000 | International Mobile Telecommunications-2000                      |
| ITU-R    | International Telecommunication Union – Radiocommunication Sector |
| Iub      | Interface between RNC and BS                                      |
| MUS      | Maximum Usable Sensitivity                                        |
| NACK     | Not ACKnowledgement                                               |
| NTP      | Network Termination Point                                         |
| POTS     | Plain Old Telephone Service                                       |
| PRBS     | Pseudo Random Bit Sequence                                        |
| RF       | Radio Frequency                                                   |
| RNC      | Radio Network Controller                                          |
| SNR      | Signal-to-Noise Ratio                                             |
| STP      | Shielded Twisted Pair                                             |
| UPS      | Uninterruptible Power Supply                                      |

|       |                                                                                       |
|-------|---------------------------------------------------------------------------------------|
| UTP   | Unshielded Twisted pair                                                               |
| VDSL  | Very high speed Digital Subscriber Line                                               |
| VDU   | Video Display Unit                                                                    |
| xDSL  | Generic term covering the family of all DSL technologies, e.g., DSL, HDSL, ADSL, VDSL |
| XTU   | xDSL Transceiver Unit                                                                 |
| XTU-C | XTU at the central office end (i.e., network operator)                                |
| XTU-R | XTU at the remote terminal end (i.e., CP)                                             |

## 5 Test methods and limits

Both emission and immunity should be tested in accordance with ITU-T Rec. K.43 [16] or the appropriate basic standards.

### 5.1 Emission

The general requirements for test methods and limits apply, according to CISPR 22 [30]. Tables A.3 and A.4 are recommended for equipment in telecommunication centres and outdoor location. ITU-T Rec. K.38 [15] should be applied to large equipment tests.

Conduction emission measurement at power input and/or output should be made using the artificial mains network (AMN) at each port.

Conduction emission from telecommunication ports should be made using the impedance stabilization networks (ISN), if available, as detailed in document CISPR 22.

#### 5.1.1 Emission from radio equipment

The radio equipment, excluding digital mobile base station, shall be classified in the following categories:

- Category 1 Equipment with an integral antenna;
- Category 1.1 Equipment with transmitter frequency below 1 GHz;
- Category 1.2 Equipment with transmitter frequency above 1 GHz;
- Category 2 Equipment with a non-integral antenna.

Digital mobile base station shall fulfil the limits of spurious emission reported in ITU-R Rec. SM. 329-10 [19]. The radiated emission test shall be in line with CISPR 22 [30], the limits reported in Tables A.3 and A.4 shall be applied to equipment of categories 1.2 and 2. For those types of radio equipment, if applicable, the exclusion band shall be considered during the test.

Equipment in category 1.1 shall fulfil the limits of spurious emission reported in ITU-R Rec. SM. 329-10 [19].

The choice of the correct limits reported in ITU-T Rec. SM. 329-10 [19] shall be done in accordance with the National Radio Regulatory authority.

During the test the power transmitted of the radio equipment shall be regulated at the maximum output power in accordance with the normal functional range.

### 5.2 Immunity

The immunity test requirements for telecommunication equipment are given on a port by port basis.

For immunity testing, the general test methods and test levels in ITU-T Rec. K.43 [16] apply. Test levels for telecommunication network equipment are shown in Tables A.1 and A.2. Test levels for

specific installation should be selected based on the electromagnetic environment referred to in ITU-T Rec. K.34 [14].

Conducted immunity test shall be applied to one port at a time.

Conducted immunity testing shall be performed on power input and output ports and on signal ports.

If a Mesh Bonding Network (Mesh-BN) or Mesh Isolated Bonding Network (Mesh-IBN) according to ITU-T Rec. K.27 [13] is used throughout the installation, only ports connected to intersystem cables are to be tested. The manufacturer remains responsible for ensuring that no degradation in system immunity results from internal cabling (where the manufacturer controls both ends); this internal cabling is not subjected to the immunity test.

If requested, it is allowed to test equipment with the primary protection installed. The test condition should be added in the test report.

Line to line test for telecommunication line surges should not be applied for equipment which has a protection system which does not generate line to line voltage.

If the specified maximum length of the connected line is less than 3 m, no conducted immunity test is necessary. For surge tests on indoor signal lines, no test is necessary if the specified maximum length is less than 10 m.

One signal port of each type found on the equipment shall be tested. If, in normal installation practice, multi-pair cables (e.g.,  $64 \times$  balanced pairs) and/or composite cables (e.g., a combination of fibre and copper) are used, they are to be tested as one single cable. Cables bundled for aesthetic or routing purposes are to be tested individually.

For multi-pair cables where multi-pair CDN does not exist, the test shall be applied to a single pair using an appropriate CDN, the remaining pairs should be considered to have been tested indirectly.

During the surge test, the EUT and all ports (other than the one connected to the generator) shall comply with the given compliance criteria. After the surge has been applied, the generator shall be disconnected from the port and the port checked against the compliance criteria. The compliance criteria shall contain functional aspects.

For screened cable, surges are applied directly to the screen.

During immunity testing using continuous phenomena, the appropriate exclusion band shall be applied to radio equipment.

## **6 General operational conditions and test configuration**

The EUT have to be configured and operated in accordance with relevant basic EMC standards and clause 5/K.43 [16].

EUT with different components mounted in the enclosure like transmission equipment, which can be configured to transmit signals over different carriers (optical fibre or radio carrier), should be configured with all the units necessary to obtain the maximum system configuration and/or expansion. As an alternative, it is possible not to use the maximum system configuration if it is technically demonstrated that the insertion of other cards/units in the configuration under test do not change the emission level or the grade of immunity of the EUT.

The equipment test conditions have to be as close as possible to the installed conditions. Wiring should be consistent with the specifications. The signal or control ports have to be correctly terminated, either by auxiliary equipment necessary to exercise the ports, or in their nominal impedance.

A sufficient number of ports have to be correctly terminated to ensure that the test is representative of normal operating conditions.

Only cables that are permanently connected have to be included.

The test configuration and mode of operation have to represent the intended use and have to be recorded in the test report.

The test conditions and test configuration have to be recorded in the test report.

The following information has to be recorded in the test report:

- The primary functions of the equipment to be assessed during and after the EMC exposure;
- The intended functions of the equipment which has to be in accordance with the documentation accompanying the equipment;
- The user control functions and stored data that are required for normal operation and the method to be used to assess whether these have been lost after the EMC exposure;
- An exhaustive list of ports, with the maximum cable lengths allowed, classified as either power or telecommunication/signal/control. Power ports have to be further classified as AC or DC power;
- The method to be used to verify that a communication link is established and maintained (if appropriate);
- Any equipment thermal limitation which prevents continuous testing of the EUT;
- The environment(s) in which the equipment is intended to be used;
- The types of cables connected to the EUT and the types of ports connected to the cables.

For radio equipment, the following information also has to be recorded in the test report:

- The type of modulation, the characteristics of the transmission used for testing (random bit stream, message format, etc.) and the necessary test equipment delivered to enable the assessment of the EUT;
- The ancillary equipment to be combined with the radio equipment for testing (where applicable);
- The operating frequency bands over which the equipment is intended to operate.

## **7 Specific operational conditions and test configurations**

Each product has to be tested in the appropriate-specific conditions as reported in the following clauses.

### **7.1 Operational conditions for switching equipment**

As indicated in the general operating conditions, special additional equipment e.g., a traffic simulator, and/or software must often be used to reduce the test time and simulate traffic conditions.

The tariff and billing part should be included.

When it is impractical to test all ports, one of each type may be selected for testing.

The tested ports should be configured for connection to another port at the other port's nominal impedance. Auxiliary equipment may be used to simulate the functional termination of the ports.

The switching system should be adequately loaded for performance measurement during immunity testing.

When the EUT is a distributed processing system consisting of both central and peripheral processing subsystems, the test load should be applied only to the portion of the EUT affected by

the particular test. Portions of the EUT that are judged to be unaffected by a particular test may be operated at lower load levels for that test. However, all units should be loaded to some extent.

For high-capacity processing systems, it may be impractical to increase the load on the EUT up to the prescribed level using only special additional equipment. In such cases, it is acceptable to generate additional traffic by using internal traffic simulation software, or other artificial means, to bring the call processing load up to the prescribed level. However, the minimum capability to detect and report call processing errors in the artificial traffic must be comparable to that for traffic generated by the use of special additional equipment.

Exercising equipment, e.g., a traffic simulator used for testing of other functions, can also be used as exercising equipment for tariff and billing function.

For switching equipment with less than 32 subscriber lines (analogue or digital), all the lines have to be driven. For switching equipment with more than 32 subscriber lines (analogue or digital), a choice of at least 32 lines shall be made among the available lines. In this case, as it is impossible to do tests at all ports, single ports of each type shall be selected for the testing. At least one port of each type shall be tested.

The ports have to be configured with their nominal impedance for a connection to another port. Auxiliary equipment may be used to simulate the functional termination of the ports.

Connections have to be provided which should be established before the start of the tests and then maintained.

Other switching system functions, such as data transfer and maintenance routines, have to be continued during immunity testing.

## 7.2 Operational conditions for transmission equipment

Typically, the equipment will be configured as shown in Figure 2. As indicated in the general operating conditions, special additional equipment must often be used, e.g., line attenuator, line loop, path simulator.

The test configuration has to cover a representative set up of tributary signals within the aggregate interface signals.

In Figure 2, a test signal is derived from the test equipment A and looped through the EUT. If the EUT supports several identical channels, these may be connected in series and the test signal may be looped through all the channels.

The test equipment may be a digital or analogue signal analyser as required. The test equipment may also loop back the test signal.

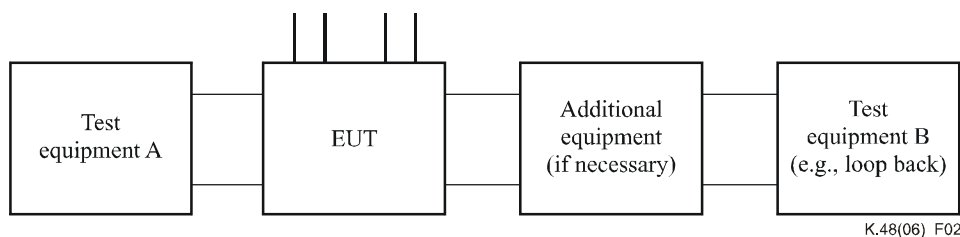


**Figure 2/K.48 – Typical test configuration for transmission equipment**

An appropriate test signal should be used. The test signal should be stated in the test report. The preferred digital transmission signal is the Pseudo Random Bit Sequence (PRBS) appropriate for the bit rate of the channel.

The modes of operation during testing have to be recorded in the test report.

An immunity test shall be performed at nominal values of all signal conditions and with typical value of line/path attenuation specified for the equipment.

When it is impractical to test all ports, one of each type may be selected for the testing.

### **7.3 Operational conditions for power equipment**

The EUT load should be resistive unless otherwise specified by the manufacturer.

Uninterruptible power supplies (UPS) should be tested in both the conditions: AC mains on and off.

The signal or control ports should be correctly terminated either by auxiliary equipment necessary to exercise the ports, or by its nominal impedance.

The test shall be carried out at the input nominal voltage.

#### **7.3.1 Emission**

The measurements should be made in the operating mode, producing the largest emission consistent with normal applications.

The EUT load should be adjusted within the normal operating range in order to maximize the emission.

Conducted emission is measured on the power input and output ports with artificial mains networks on both ports, and on one signal/control interface of each type found on the equipment.

#### **7.3.2 Immunity**

Testing may be performed with the EUT operating at reduced output power (50% is recommended). The actual output power level for each test must be stated in the test report.

Conducted immunity testing should be performed on the power input and output ports, and on one control port of each type found on the equipment.

Power and control cables no longer than 3 m (according to the manufacturer's specifications) need not be subjected to conducted immunity testing. However, cables that may be connected to an extensive network are subject to such testing.

Interconnecting cables between units of the same power supply system do not need to be tested.

### **7.4 Operational conditions for supervisory equipment**

As indicated in the general operating conditions, special additional equipment must often be used, e.g., a traffic simulator, and/or software, to reduce the test time and simulate traffic conditions.

### **7.5 Specific operational condition and test configuration for wireless LAN**

The radio equipment may take forms which may require special software and/or test fixtures. Equipment that requires connection to a host equipment to function, has to be tested with the host; the test configuration is defined by the manufacturer. In all cases, the EUT has to be exercised in a manner representative of normal intended use.

#### **7.5.1 Arrangements for test signals**

Adequate measures have to be taken to avoid the effect of immunity test signals on both the measuring equipment and the signal sources for the wanted signals located outside the test environment.