INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

K.48

(07/2003)

SERIES K: PROTECTION AGAINST INTERFERENCE

EMC requirements for each telecommunication equipment – Product family Recommendation

ITU-T Recommendation K.48

ITU-T Recommendation K.48

EMC requirements for each 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 and supervisory equipment. It also describes operational conditions for emission and immunity testing. Performance criteria for immunity tests are also specified.

Source

ITU-T Recommendation K.48 was approved by ITU-T Study Group 5 (2001-2004) under the ITU-T Recommendation A.8 procedure on 29 July 2003.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 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.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

CONTENTS

ITU-T Recommendation K.48

EMC requirements for each 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 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 K.43 (2003), *Immunity requirements for telecommunication equipment*.

[2] ITU-T Recommendation K.34 (2003), *Classification of electromagnetic environmental conditions for telecommunication equipment – Basic EMC Recommendation*.

[3] IEC CISPR 22 (1997), *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement*.

[4] ITU-T Recommendation K.38 (1996), *Radiated emission test procedure for physically large systems*.

[5] ITU-T Recommendation O.150 (1996), *General requirements for instrumentation for performance measurements on digital transmission equipment*.

[6] ITU-T Recommendation K.27 (1996), *Bonding configurations and earthing inside a telecommunication building*.

[7] IEC 60050-161:1990, *International Electrotechnical Vocabulary – Chapter 161: Electromagnetic compatibility*.

[8] IEC 60050-714:1992, *International Electrotechnical Vocabulary – Chapter 714: Switching and signalling in telecommunications*.

[9] IEC 61000-4-11:2001, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests*.

[10] ITU-T Recommendation G.703 (2001), *Physical/electrical characteristics of hierarchical digital interfaces*.

[11] ITU-R Recommendation SM 329-10 (2003), *Unwanted emissions in the spurious domain*.

[12] ETSI TS 101 087 (2003), *Digital cellular telecommunications system (Phase 2 and Phase 2+) (GSM); Base Station System (BSS) equipment specification; Radio aspects*.

[13] TIA/EIA/IS-2000.2-C (2002), *Physical Layer Standard for cdma2000® Spread Spectrum Systems – Release C*.

[14] TIA/EIA-97-D-2001 (2001), *Recommended Minimum Performance Standards for Base Stations Supporting Dual Mode Spread Spectrum Systems*.

[15] ETSI TS 125.101.0 (2000), *Universal Mobile Telecommunications System (UMTS); UE radio transmission and reception (FDD)*.

[16] ETSI TS 125.102 0 (2000), *Universal Mobile Telecommunications System (UMTS); UTRA (UE) TDD; Radio transmission and reception*.

[17] IEC 61000-3-2:2001, *Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current up to and including 16 A per phase)*.

[18] IEC 61000-3-3:1994, *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*.

3 Definitions

The following definitions apply only in the context of this Recommendation, except where the reference to the International Electrotechnical Vocabulary [7] 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 [8].

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 [9]).

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 (see Figure 1).

3.18 ports in telecommunication (indoor port, outdoor port, enclosure port, DC power port, AC power port): See Figure 1.

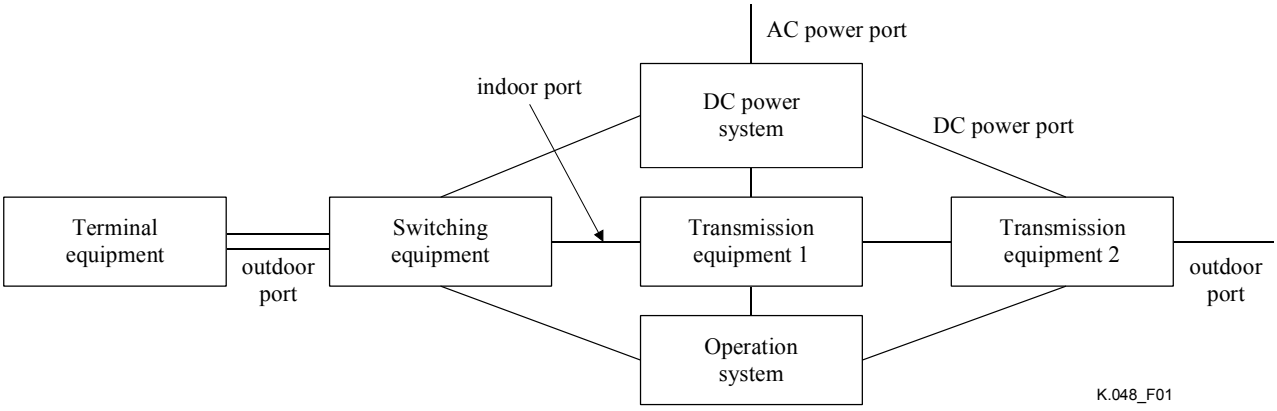


Figure 1/K.48 – Ports in telecommunication

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

3.26 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.

3.27 telecommunication centre: Electromagnetic environment of a telecommunication centre is described in ITU-T Rec. K.34 [2].

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

3.29 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.

3.30 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 [10].

4 Abbreviations

This Recommendation uses the following abbreviations:

AC Alternating Current

ACK ACKnowledgement

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

EM Electromagnetic

EMC ElectroMagnetic Compatibility

ESD Electrostatic Discharge

EUT Equipment Under Test

FER Frame Error Rate

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

PRBS Pseudo Random Bit Sequence

RF Radio Frequency

RNC Radio Network Controller

UPS Uninterruptible Power Supply

VDU Video Display Unit

5 Test methods and limits

Both emission and immunity should be tested in accordance with ITU-T Rec. K.43 [1] or the appropriate basic standards.

5.1 Emission

The general requirements for test methods and limits apply, according to [3]. Tables A.3 and A.4 are recommended for equipment in telecommunication centres and outdoor location. ITU-T Rec. K.38 [4] 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.

5.1.1 Emission from radio equipment

The radio equipment shall be classified in the following categories:

Category 1 Equipment with a 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.

The radiated emission test in line with CISPR 22 [3], the limits are 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 [11].

The choice of the correct limits reported in ITU-T Rec. SM 329-10 [11] shall be done in accordance with the National Radio Regulatory authority.

During the test the power transmitted of the radio equipment shall be regulate 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 [1] 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 [2].

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 [6] 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.

It is possible to test equipment with primary protection if it is requested. 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 × 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.

Therefore, the test serves two purposes:

a) the immunity test of the EUT;

b) a test of resistibility of the port to which the generator is connected.

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

During immunity testing using continuous phenomena, some or all of the following selected frequencies shall be investigated, in addition to the sweep, when applicable:

– the clock frequencies inside the specified frequency band of the test;

– 80, 120, 160, 230, 434, 460, 600, 863. 900 and 1800 MHz (±1%) (RF field);

– 0.2, 1.0, 7.1, 13.56, 21.0, 27.12, 40.68 MHz (±1%) (RF voltage).

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 4/K.43 [1].

EUT with different components mounted in the enclosure like transmission equipment, that can be configured to transmit signals over different carriers (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 signal or control ports have to be correctly terminated, either by auxiliary equipment necessary to exercise the ports, or in their nominal impedance.

The equipment test conditions have to be as close as possible to the installed conditions. Wiring should be consistent with the specifications. If the equipment is designed to be mounted in a rack or cabinet, it should be tested in this configuration.

A sufficient number of ports have to be correctly terminated to ensure that the test is representative of normal operating conditions, and the selection of ports has to be recorded in the test report.

Only cables that are permanently connected have to be included.

The types of cables connected to the EUT have to be indicated in the test report.

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.

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 hit-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 must often be used, e.g., a traffic simulator, and/or software, 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 analyzer as required. The test equipment may also loop back the test signal.

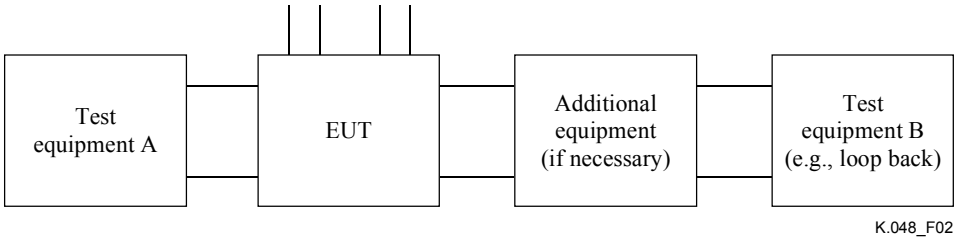


Figure 2/K.48 – Typical test configuration for transmission equipment

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 each 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 which 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.

7.5.2 Arrangements for test signals at the input of transmitters

The signal source providing the transmitter under test with the modulation signal for the normal test modulation, has to be located outside the test environment, unless the transmitter is modulated by its own internal source.

The wanted signals and/or controls required to establish a communications link has to be defined by the manufacturer. The transmitter has to be operated at maximum rated power.

7.5.3 Arrangements for test signals at the output of transmitters

The measuring equipment for the wanted RF output signal from the transmitter under test has to be located outside the test environment.

For transmitters with an integral antenna, the wanted RF output signal to establish a communication link has to be delivered from the EUT to an antenna located within the test environment. This antenna should be connected to the external measuring equipment by a coaxial cable.

For transmitters with a removable antenna, the wanted RF output signals to establish a communication link, have to be delivered from the antenna connector to the external measuring equipment by a shielded transmission line, such as a coaxial cable. Adequate measures have to be taken to minimize the effect of unwanted common mode currents on the external conductor of the transmission line at the point of entry to the transmitter.

The manufacturer may provide a suitable companion receiver that can be used to receive messages or to set up a communication link.

7.5.4 Arrangements for test signals at the input of receivers

The signal source providing the receiver under test with the wanted RF input signal has to be located outside the test environment.

The signal source has to be modulated with normal test modulation as specified in the relevant part of this Recommendation for the particular type of radio equipment.

For receivers with an integral antenna, the wanted RF input signal to establish a communication link has to be presented to the EUT from an antenna located within the test environment. This antenna has to be connected to the external RF signal source by a coaxial cable.

For receivers with a removable antenna, the wanted RF input signal to establish a communication link has be presented to the antenna connector of the EUT by a shielded transmission line, such as a coaxial cable. The transmission line has to be connected to the external RF signal source. Adequate

measures have to be taken to minimize the effect of unwanted common mode currents on the external conductor of the shielded transmission line at the point of entry to the receiver.

The wanted signals required to establish a communication link have be defined by the manufacturer.

The level of the wanted signal at the input of the receiver has to be 30 dB above the declared Maximum Usable Sensitivity (MUS). This level should be measured while the power amplifiers generating the EM disturbance are switched on, but without excitation. This increased level of the wanted RF input signal is expected to represent a normal operation signal level and should be sufficient to avoid the broadband noise from the power amplifiers generating the EM disturbance from influencing the measurement.

7.5.5 Arrangements for test signals at the output of receivers

The measuring equipment for the output signal from the receiver under test has to be located outside the test environment.

It has to be possible to assess the performance of the equipment by appropriately monitoring the receiver output.

If the receiver has an output connector or port providing the wanted output signal, then this port has to be used via a cable, consistent with the standard cable used in normal operation, connected to the external measuring equipment outside the test environment.

The measuring equipment may be supplied by the manufacturer.

Precautions should be taken to minimize any effect on the test caused by the coupling means.

The manufacturer may provide a suitable companion transmitter that can be used to transmit messages or to set up a communication link.

7.5.6 Arrangements for testing transmitter and receiver together (as a system)

Transmitters and receivers may be tested for immunity as a system when combined as a transceiver, or the combined equipment is of a size which allows simultaneous testing. In this case, the transceiver or transmitter and receiver should be located inside the test environment and have to be exposed simultaneously to the immunity test signals.

The manufacturer may provide a suitable companion transceiver or transmitter and receiver that can be used to send and receive messages, or to set up a communication link.

Both the EUT and the companion equipment shall transmit the normal test modulation. Further, the output of the radio equipment under test has to be monitored by the test system.

7.5.7 Exclusion band

No exclusion bands apply to wireless LAN.

7.5.8 Narrow-band responses on receivers or receivers which are part of transceivers

Responses on receivers or the receiver part of (duplex) transceivers occurring during the immunity tests at discrete frequencies which are narrow-band responses (spurious responses), are identified by the following method:

If, during the test, the immunity RF test signal causes non-compliance of the receiver with the specified performance criteria, it is necessary to establish whether this non-compliance is due to a narrow-band response or a wideband phenomenon. Therefore, the frequency of the test signal is increased by an amount equal to twice the nominal 6 dB bandwidth of the IF filter immediately preceding the demodulator of the receiver, or if appropriate, the bandwidth over which the apparatus is intended to operate, as declared by the manufacturer. The test is repeated with the frequency of the test signal decreased by the same amount.

If the receiver is then, in either or both frequency offset cases, in compliance with the specified performance criteria, the response is considered as a narrow-band response.

If the receiver still does not comply with the specified performance criteria, this may be due to the fact that the offset has made the frequency of the unwanted signal correspond to the frequency of another narrow-band response. Under these circumstances, the procedure is repeated with an increase and decrease of the frequency of the test signal adjusted two and a half times the bandwidth referred to above.

If the receiver still does not comply with the specified performance criteria in either or both frequency offset cases, the phenomena is considered wideband and, therefore, an EMC problem, and the equipment fails the test.

For immunity tests, narrow-band responses have to be disregarded.

7.5.9 Normal test modulation

The modulated test signal has to represent normal intended use, and may contain data formatting, error detection and correction information.

7.5.10 Performance assessment

At the time of submission of the equipment for test, the manufacturer has to supply the information required in clause 6 as well as the following, which shall be recorded in the test report:

- the operating frequency range(s) of the equipment and, where applicable, band(s) of operation;
- the type of the equipment, for example: stand-alone or plug-in radio device;
- the host equipment to be combined with the radio equipment for testing;
- the minimum performance level under the application of EMC stress;
- the normal test modulation, the format, the type of error correction and any control signals e.g., ACKnowledgement (ACK)/Not ACKnowledgement (NACK) or Automatic Retransmission reQuest (ARQ);
- the nominal 6 dB bandwidth of the IF filter immediately preceding the demodulator of the receiver.

7.5.11 Arrangements for the assessment of host-dependant equipment and plug-in cards

For equipment parts for which integration with host equipment is necessary in order to offer functionality, two alternative approaches defined in clauses 7.5.11.1 and 7.5.11.2 may be used. The manufacturer shall declare which alternative is used.

7.5.11.1 Alternative A: composite equipment

A combination of the radio equipment part and a specific type of host equipment may be used for assessment according to this Recommendation.

Where a specific combination of host equipment and a radio equipment part is tested as a composite system for compliance, repeat testing shall not be required for:

- those other combinations of hosts and radio equipment parts which are based on substantially similar host models, in such cases where the variations in mechanical and electrical properties between host models are unlikely to significantly influence the intrinsic immunity and the unwanted emissions of the radio equipment part;
- the radio equipment part which cannot be used without mechanical, electrical, or software modification in variations of host equipment different from those represented by the units for which compliance to this Recommendation has been demonstrated.

For all other combinations, each combination has to be tested separately.

7.5.11.2 Alternative B: use of a test jig or host

Where the radio equipment part is intended for use with a variety of host systems, the manufacturer has to supply a suitable test configuration consisting of either a host system intended for normal use, or a test jig that is representative of the range of host systems in which the device may be used. The test jig has to allow the radio equipment part to be powered and stimulated in a way similar to the way it would be powered and stimulated when connected to or inserted into host equipment.

7.5.12 Assessment procedures

The performance assessment shall be based upon:

– maintenance of function(s);

– the way the eventual loss of function(s) can be recovered;

– unintentional behaviour of the EUT.

The test system has to set up a communications link in the same manner as the Equipment Under Test's (EUT) normal intended use.

Any user-defined data fields in the memory or storage of the EUT shall be filled in a way representative of normal intended use.

The assessment procedure shall verify that the communications link is maintained and that there is no loss of user control functions as declared by the manufacturer or loss of the stored user-defined data.

7.6 Specific operational condition and test configuration for digital mobile Base Station (BS)

7.6.1 General

For the purposes of this Recommendation, the test conditions of 4.1 shall apply as appropriate.

For a EUT which contains more than one BS, it is sufficient to perform tests relating to connectors of each representative type of the BS forming part of the EUT.

For test purposes, it is recommended that any integral antenna be disconnected from the BS, and any antenna connector shall be correctly terminated, either by connection to the test equipment, or to an appropriate non-radiating load.

Precautions should be taken to ensure that the cables connecting antenna connectors to test equipment, or termination, do not influence the test results.

7.6.2 Arrangements for test signals

The wanted RF signal nominal frequency shall be selected by setting the Frequency Channel Number to an appropriate number.

A communication link shall be set up with a suitable test system capable of evaluating the EUT using the specified performance criteria at the air interface and/or the Iub, A or Abis interface. The test system shall be located outside of the test environment.

When the EUT is required to be in the transmit/receive mode, the following conditions shall be met:

- the EUT shall be commanded to operate at maximum rated transmit power;
- adequate measures shall be taken to avoid the effect of the unwanted signal on the measuring equipment.

Adequate measures shall 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.

7.6.3 Arrangements for test signals at the input of transmitters

The signal source providing the transmitter under test with the modulation signal for the normal test modulation shall be located outside the test environment, unless the transmitter is modulated by its own internal source.

7.6.4 Arrangements for test signals at the output of transmitters

The measuring equipment for the wanted RF output signal from the transmitter under test shall be located outside the test environment.

For transmitters with an integral antenna, the wanted RF output signal to establish a communication link shall be delivered from the EUT to an antenna located within the test environment. This antenna shall be connected to the external measuring equipment by a coaxial cable.

For transmitters with a removable antenna, the wanted RF output signal to establish a communication link shall be delivered from the antenna connector to the external measuring equipment by a shielded transmission line, such as a coaxial cable. Adequate measures shall be taken to minimize the effect of unwanted common mode currents on the external conductor of the transmission line at the point of entry to the transmitter.

Unless otherwise specified in the relevant part of this Recommendation for the particular type of radio equipment, the level of the wanted RF output signal in transmit mode of operation shall be set to the maximum rated RF power for the EUT, modulated with the normal test modulation.

All transmitters in the EUT shall be operated at the maximum rated output power, modulated with normal test modulation. A communication link shall be established.

7.6.5 Arrangements for test signals at the input of receivers

The signal source providing the receiver under test with the wanted RF input signal shall be located outside the test environment.

The signal source shall be modulated with normal test modulation as specified in the relevant part of this Recommendation for the particular type of radio equipment.

For receivers with an integral antenna, the wanted RF input signal to establish a communication link shall be presented to the EUT from an antenna located within the test environment. This antenna shall be connected to the external RF signal source by a coaxial cable.

For receivers with a removable antenna, the wanted RF input signal to establish a communication link shall be presented to the antenna connector of the EUT by a shielded transmission line, such as a coaxial cable. The transmission line shall be connected to the external RF signal source. Adequate measures shall be taken to minimize the effect of unwanted common mode currents on the external conductor of the shielded transmission line at the point of entry to the receiver.

The wanted input signal level shall be set to a level where the performance is not limited by the receiver noise floor or strong signal effects e.g., 15 dB above the reference sensitivity level to provide a stable communication link.

7.6.6 Arrangements for test signals at the output of receivers

The measuring equipment for the output signal from the receiver under test shall be located outside the test environment.

The output signal shall be coupled via an output connector or port providing the wanted output signal, this port shall be used via a cable, consistent with the standard cable used in normal operation, connected to the external measuring equipment outside the test environment.

Precautions shall be taken to minimize any effect on the test caused by the coupling means.

7.6.7 Arrangements for testing transmitter and receiver together (as a system)

Transmitters and receivers may be tested for immunity as a system when combined as a transceiver or the combined equipment is of a size which allows simultaneous testing. In this case, the transceiver or transmitter and receiver shall be located inside the test environment and shall be exposed simultaneously to the immunity test signals.

For the immunity tests of base stations, including duplex filters, the wanted input signal, coupled to the receiver, shall be modulated with normal test modulation. The transmitter(s) shall be operated at the maximum rated output power. A communication link shall be established.

7.6.8 Arrangements for testing repeaters

For the immunity tests of repeaters, the wanted RF input signal shall be coupled to one antenna port at a level which will result, when measured, in the maximum rated RF output power per channel, as declared by the manufacturer. The test shall either be repeated with a wanted signal coupled to the other antenna port, or a single test shall be performed with the specified input signals being simultaneously coupled to both antenna ports.

7.6.9 Exclusion band of radio communications equipment

7.6.9.1 Transmitter exclusion band

The frequency bands, including in-band emissions and out-of-band emissions, are covered by the RF spectral mask specification and need no further consideration:

- For the purpose of EMC specifications, this shall be the transmitter exclusion band from:

  Lower carrier frequency –12.5 MHz to upper carrier frequency +12.5 MHz
- For CDMA Multi-carrier equipment, the transmitter exclusion band shall be the carrier centre frequency ± (2.5 × Necessary Bandwidth).

7.6.9.2 Receiver exclusion band

The receiver exclusion band for terminals extends from the lower frequency of the allocated receiver band minus 20 MHz to the upper frequency of the allocated receiver band plus 20 MHz. The exclusions bands, for example, are as set out below:

UTRA/FDD

a) 1900-2000 MHz (ITU-R, Region 1)

b) 1830-1930 MHz (ITU-R, Region 2)

UTRA/TDD

a) 1880-1940 MHz 1990-2045 MHz (ITU-R, Region 1)

b) 1830-2010 MHz (ITU-R, Region 2)

c) 1890-1950 MHz (ITU-R, Region 2)

For CDMA Multicarrier equipment, the receiver exclusion band shall be the carrier centre frequency ± (2.5 × Necessary Bandwidth).

7.6.9.3 Repeater and ancillary RF amplifier exclusion band

The exclusion band for repeaters and ancillary RF amplifiers is the band of frequencies over which no tests of radiated immunity of the EUT are made.

The exclusion band for a repeater or ancillary RF amplifier is the range (or ranges) of frequencies for which at least one of the following conditions are met:

– the gain (measured in either direction between two RF ports) is greater than 25 dB;

– the gain (measured in either direction between two RF ports) is no more than 25 dB below the gain measured at the centre of a manufacturer's declared operating band.

A range of frequencies is only considered to be an operating band if the measured gain at the centre of this band is greater than 0 dB.

7.6.10 Narrow-band responses of receivers

Responses on receivers or duplex transceivers occurring during the immunity test at discrete frequencies which are narrow-band responses (spurious responses), are identified by the following method:

- if, during an immunity test, the quantity being monitored goes outside the specified tolerances (see 6.1), it is necessary to establish whether the deviation is due to a narrow-band response or to a wideband (EMC) phenomenon. Therefore, the test shall be repeated with the unwanted signal frequency increased, and then decreased by 10 MHz;
- if the deviation disappears in either or both of the above 10 MHz for IMT-2000 equipment 400 KHz for other equipment offset cases, then the response is considered as a narrow-band response;
- if the deviation does not disappear, this may be due to the fact that the offset has made the frequency of the unwanted signal correspond to the frequency of another narrow-band response. Under these circumstances, the procedure is repeated with the increase and decrease of the frequency of the unwanted signal set to 12.5 MHz;
- if the deviation does not disappear with the increased and/or decreased frequency, the phenomenon is considered wideband and, therefore, an EMC problem and the equipment fails the test.

Narrow-band responses are disregarded.

7.6.11 Normal test modulation

The normal test modulation shall be delivered by a suitable mobile station or base station system test equipment (hereafter called "the test system").

For CDMA Multi-carrier equipment, the normal test modulation should be set up according to the Radio Configuration (RC) supported by the base station under test using full data rate only (see clause 1.3 in [14]).

7.6.12 Performance assessment

For the immunity tests of ancillary equipment, without a separate pass/fail criteria, the receiver, transmitter or transceiver coupled to the fixed ancillary equipment shall be used to judge whether the ancillary equipment passes or fails.

The assessment of degradation of performance which has to be carried out during and/or at the conclusion of the tests, shall be simple, but at the same time give adequate proof that the essential functions of the equipment are operational.

7.6.12.1 GSM equipment

7.6.12.1.1 Assessment of BER at the output of a transmitter

The BER at the output of the transmitter may be assessed using either of the techniques described below.

7.6.12.1.1.1 Assessment of BER using static layer 1 functions

The transmitter under test shall be operated according to the test case of [12], clause 6.1.2.

The bit sequence from the output of the transmitter shall be monitored by the test system, and the BER of the class 2 bits for TCH/FS assessed. The BER shall not exceed the values specified in 8.6.1.1.

If the EUT does not support TCH/FS, the manufacturer shall declare the logical channel for which the performance shall be assessed, and the corresponding performance criteria.

7.6.12.1.1.2 Assessment of BER using RXQUAL

The output of the transmitter shall be connected to an equipment for the assessment of RXQUAL. The level of the signal supplied to the equipment should be within the range for which the assessment of RXQUAL is not impaired. The RXQUAL shall be monitored during the test. The RXQUAL shall not exceed the values specified in 8.6.1.1.

7.6.12.1.2 Assessment of BER at the output of a receiver

The BER at the output of the receiver may be assessed using either of the techniques described below.

7.6.12.1.2.1 Assessment of BER using RXQUAL

The value of the RXQUAL reported by the BS or BSS shall be monitored using suitable test equipment.

7.6.12.1.2.2 Assessment of BER using reported BER

The BER of the class 2 bits at the output of the receiver shall be assessed using suitable test equipment.

If the EUT does not support TCH/FS, the manufacturer shall declare the logical channel for which the performance shall be assessed, and the corresponding performance criteria.

NOTE – This can be performed by a "test loopback" which uses the transmitter of the BS to return the data which has been decoded by the receiver back to the test equipment which generated the bit sequence. For immunity tests of signal ports, the "test loopback" includes an external connection between signal ports.

7.6.12.2 IMT-2000 equipment

7.6.12.2.1 Assessment of BLER/FER in Downlink

In order to assess the BLER of the bearer used during the immunity tests, the output of the transmitter shall be connected to an equipment which meets the requirements for the BLER assessment of [15] in case of FDD, and [16] in case of TDD.

In order to asses the FER for CDMA Multi-carrier equipment during the immunity tests, the output of the transmitter shall be connected to a test system which meets the requirements for the FER assessment in accordance with [13] and [14].

The level of the signal supplied to the equipment should be within the range for which the assessment of BLER/FER is not impaired. Power control shall be off during the immunity testing.

7.6.12.2.2 Assessment of BLER/FER in Uplink

The value of the BLER or the FER at the output of the receiver reported by the BS shall be monitored using a suitable test equipment.

7.6.12.2.3 Assessment of RF gain variations of repeaters

The parameter used for the performance assessment of a repeater is the RF gain within the operating frequency band.

7.7 Specific operational condition and test configuration for digital radio relay system

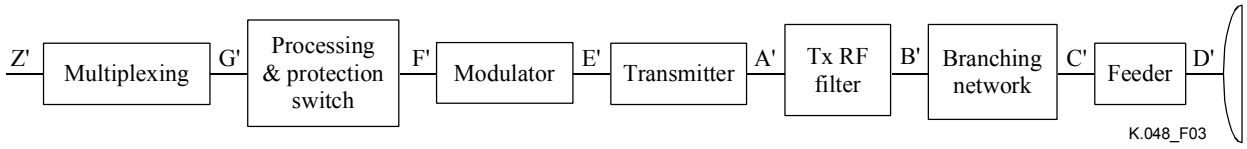
7.7.1 General

For emission and immunity tests, the test modulation, test arrangements, etc., as specified in clauses 5 and 6 shall apply.

7.7.2 Test conditions and configurations

This clause defines the test conditions and configurations for the emission and immunity tests as follows:

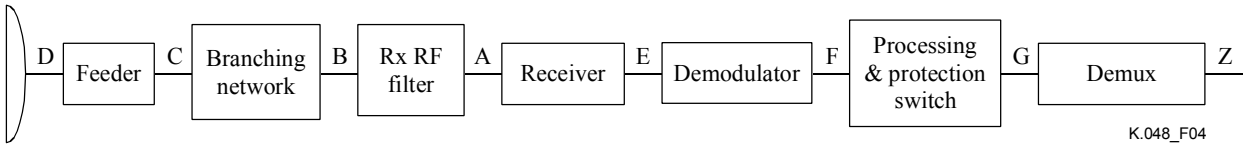
– A transmitter shall, as a minimum, comprise the element between E' and A' of Figure 3. Additionally, the transmitter may comprise any of the other elements from the transmitter chain shown in Figure 3. If these additional elements are part of the transmitter or system, they shall also meet the requirements of this Recommendation;



NOTE 1 – For the purposes of defining the reference points, the branching network (B' to C') does not include a hybrid.
NOTE 2 – Points B' and C' may coincide, dependent on the equipment configuration.

Figure 3/K.48 – Elements of a transmitter

– A receiver shall, as a minimum, comprise the element between A and E of Figure 4. Additionally, the receiver may comprise any of the other elements from the receiver chain shown in Figure 4. If these additional elements are part of the receiver or system, they shall also meet the requirements of this Recommendation;



NOTE 1 – For the purposes of defining the reference points, the branching network (B to C) does not include a hybrid.
NOTE 2 – Points B and C may coincide, dependent on the equipment configuration.

Figure 4/K.48 – Elements of a receiver

– A transceiver shall comprise, as a minimum, the elements E' to A' and A to E shown in Figures 3 and 4, and additionally it may comprise any combinations of the other elements. If these additional elements are part of the transceiver, they shall also meet the requirements of this Recommendation;
– The equipment shall be tested under conditions which are within the manufacturer's declared range of humidity, temperature and supply voltage;
– If the equipment is part of a system, or can be connected to ancillary equipment, then it shall be acceptable to test the equipment while connected to the minimum configuration of ancillary equipment necessary to exercise the ports;
– Ports, which in normal operation are connected to ancillary or other equipment, shall be connected either to such equipment, or to a representative termination to simulate the input/output characteristics of the ancillary or other equipment. Radio Frequency (RF) input/output ports shall be correctly terminated.

7.7.3 Emission tests

The provisions of 5.1 shall apply.

For Point-to-Multipoint systems, a communications link shall be established, which shall comprise of the Central Station and a minimum of one Terminal Station. These stations are tested separately.

7.7.4 Immunity tests

The provisions of 5.2 shall apply.

For transmitters, the test configuration shall be in accordance with the principle of Figure 5, and for receivers it shall be in accordance with the principle of Figure 6, and for transceivers, it shall be in accordance with the principle of Figure 7.

The measuring equipment shall be located outside the test environment. Adequate measures shall be taken to avoid any effects of the unwanted signals on the measuring equipment.

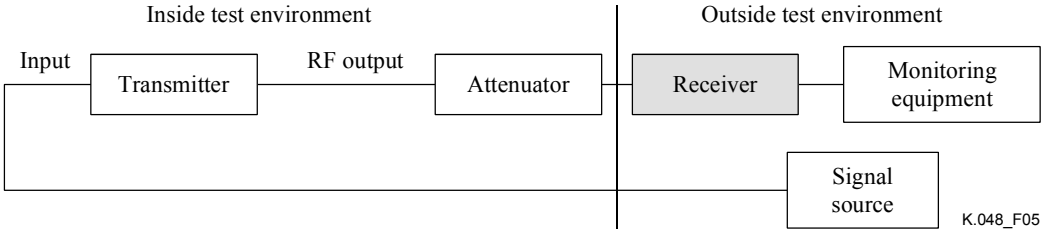


Figure 5/K.48 – Elements of a transmitter test configuration for transmitters

During immunity tests, the transmitter shall be operated at its rated output power. The input to the transmitter shall be in accordance with 7.7.5.1 (see Figure 5). A communication link shall be established at the start of the test and be maintained during the test.

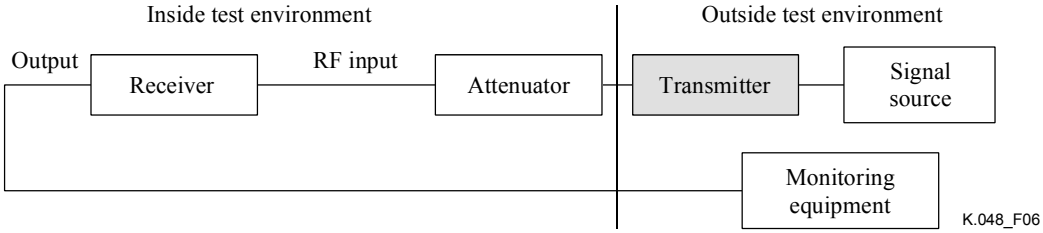


Figure 6/K.48 – Test configuration for receivers

During immunity tests for receivers, the wanted RF input signal, coupled to the receiver, shall be in accordance with 7.7.5.3 (see Figure 6). A communication link shall be established at the start of the test and be maintained during the test.

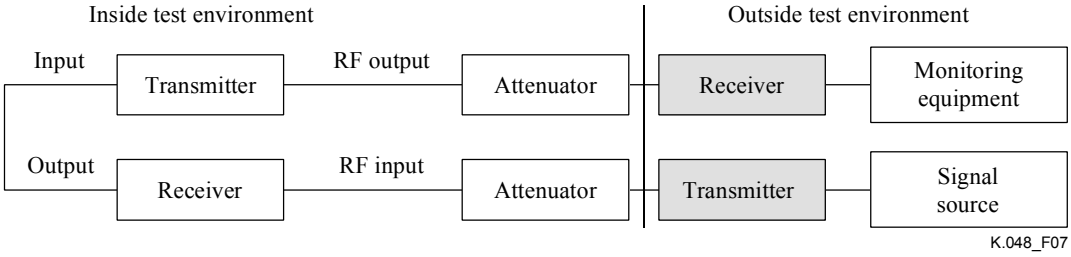


Figure 7/K.48 – Test configuration of transceivers

In the case of duplex transceivers where the transmitter and receiver cannot operate at the same radio frequency, the wanted input signal, coupled to the receiver, shall be in accordance with 7.7.5.1. The transmitter shall be operated at its rated output power, and with its input coupled to the output of the receiver (repeater mode) (see Figure 7).

The same test configuration also applies where the transmitters and receivers operate at the same radio frequency.

The measurement shall be made in the mode of operation as required in this clause.

A communication link shall be established at the start of the test and be maintained during the test.

For the immunity tests of ancillary equipment without a separate pass/fail criteria, the receiver, transmitter or transceiver coupled to the ancillary equipment, shall be used to judge whether the ancillary equipment passes or fails.

For Point-to-Multipoint systems, the minimum configuration shall comprise of one Central Station and one terminal station, unless more terminal stations are required to establish a representative test configuration.

A communication link shall be established at the start of the test and maintained during the test, between the Central Station and a Terminal Station(s).

These stations are tested separately.

7.7.5 Arrangements for test signals

Adequate measures shall 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.

7.7.5.1 Arrangements for test signals at the input of the transmitter

The signal source providing the transmitter under test with the modulation signal for the normal test modulation shall be located outside the test environment, unless the transmitter is modulated by its own internal source.

The input of the transmitter shall be coupled via the normal input connector to the signal source, as shown in Figures 5 and 7.

The wanted signal(s) shall be (a) representative baseband input signal(s) corresponding to normal operation.

7.7.5.2 Arrangements for test signals at the output of the transmitter

To establish a communication link, the wanted output signal shall be delivered from the transmitter RF output via suitable attenuation through a coaxial cable or waveguide. Adequate measures shall be taken to minimize the effects of unwanted currents on the external conductor of the coaxial cable or waveguide at the point of entry to the EUT. Mismatch errors may be avoided by placing the attenuators close to the EUT.

If the transmitter RF output cannot be recovered via connection, another antenna of the same type may be used to retrieve the wanted output signal from the transmitter.

The level of the wanted RF output signal in transmit mode of operation shall be set to the maximum rated RF power for the EUT.

7.7.5.3 Arrangements for test signals at the input of the receiver

The wanted signal shall be a representative modulated RF input signal corresponding to normal operation.

To establish a communication link, the wanted input signal shall be applied to the RF input of the receiver via a coaxial cable or waveguide. Adequate measures shall be taken to minimize the effects

of unwanted currents on the external conductor of the coaxial cable or waveguide at the point of entry to the EUT. Mismatch errors may be avoided by placing the attenuators close to the EUT.

If the receiver RF input cannot be applied via connection, another antenna of the same type may be used to apply the wanted input signal to the receiver. The source of the wanted input signal shall be located outside of the test environment.

For digital equipment, including Point to Multipoint equipment, the input signal level shall be at a nominal value of 15 dB above the receiver input level for a Bit Error Ratio (BER) of 1×10^{-5}.

The input signal level for analogue equipment shall be set to 15 dB above the input signal level that produces the reference signal to noise ratio. If the reference signal to noise ratio is not specified in the appropriate product standard, the level specified by the manufacturer shall be used.

These levels are close to normal operation and sufficient to avoid the broadband noise from the power amplifiers, which generate the disturbing EM phenomena, from influencing the measurement.

7.7.5.4 Arrangements for test signals at the output of the receiver

The measuring equipment for the output signal from the receiver under test shall be located outside the test environment.

The receiver output connector or port providing the wanted output signal shall be connected via a standard cable used in normal operation to the external measuring equipment outside the test environment.

Precautions shall be taken to ensure that any effect on the test due to the coupling means is minimized.

7.7.6 Exclusion bands

7.7.6.1 Exclusion bands for receivers

The exclusion band is the relevant operating frequency band, extended at each end by ±5% of the centre frequency.

7.7.6.2 Exclusion bands for transmitters

Exclusion bands shall not be applied when measuring transmitters in standby mode.

For the purpose of this Recommendation, the exclusion band shall extend over the frequencies above and below the fundamental transmitting frequency, but separated from the centre frequency of the emission by 250% of the relevant Channel Separation (CHS) of the radio-frequency channel arrangement where the system is to be placed. When the CHS is not defined, the exclusion band shall extend over the frequencies above and below the fundamental transmitting frequency but separated from the centre frequency of the emission by 250% of the necessary bandwidth.

8 Performance criteria

The general performance criteria of clause 5/K.43 [1] apply.

Performance criterion A

The equipment shall continue to operate as intended. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the equipment is used as intended. In some cases, the performance level may be replaced by a permissible loss of performance. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and what the user may reasonably expect from the equipment, if used as intended.

Performance criterion B

After the test, the equipment shall continue to operate as intended. No degradation of performance is allowed after the application of the phenomena below a performance level specified by the manufacturer, when the equipment is used as intended. In some cases, the performance level may be replaced by a permissible loss of performance. During the test, degradation of performance or loss of function is allowed. However, no change of actual operating state or stored data is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and what the user may reasonably expect from the equipment if used as intended.

Performance criterion C

Loss of function is allowed, provided the function is set recoverable or can be restored by the operation of the controls by the user in accordance with the manufacturer's instructions. Functions and information protected by a battery backup shall not be lost.

8.1 Performance criteria for switching equipment

For the switching equipment, the following main signal ports are recognized.

– Analogue port (e.g., analogue subscriber's line, analogue interfaces to transmission equipment).

– Digital port (e.g., digital subscribers lines (ISDN), digital connection to transmission equipment).

The interfaces shall operate as described in the following subclauses.

8.1.1 Analogue ports

The performance of the equipment shall be verified for analogue voice frequency signal ports:

– by measuring the audio signal break-through (demodulated 1 kHz) on the signal port during continuous exposures, in both signal path directions, covering both analogue to digital conversion, and digital to analogue conversion;

– by testing the functionality of the main signal port and the other signal ports after the transient exposures;

– by verifying that corruption of software and data held in memory has not occurred.

1) *Performance criterion A*

   – The connection must be maintained throughout testing.

     • During a sweep over the entire frequency range, the noise level measured at each two-wire analogue port at 600 Ω ignoring the normal impedance of the port for practical reason) must be less than –40 dBm.

     • The measurement shall be done selectively with a bandwidth ≤100 Hz at 1 kHz.

   – Dialling tones shall be available.

     At these selected frequencies:

     • It should be possible to establish a connection between any two ports (e.g., between subscriber lines and between a subscriber line and a transmission port).

     • It should be possible to terminate a connection in a controlled manner.

2) *Performance criterion B*

- Connections shall be maintained throughout the test.
- It should be possible to establish a connection between any two ports (e.g., between subscriber lines and between a subscriber line and a transmission port) after the application of the transients; short delays in making a connection are acceptable.
- It should be possible to clear a connection in a controlled manner after the application of the transients.

3) *Performance criterion C*

- The general performance criterion C applies.

8.1.2 Digital ports

The performance of the equipment shall be verified for digital signal ports:

- by measuring the number of induced bit errors on the main signal port during all exposures;
- by testing the functionality of the main signal port and the other signal ports during selected frequency tests and after the exposures;
- by verifying that corruption of software and data held in memory has not occurred.

1) *Performance criterion A*

During the sweep:

- The established connections shall be maintained throughout the testing.
- The number of bit errors at the end of each individual disturbance exposure shall not exceed the maximum number of errors expected for normal operation.
- The number of errors is calculated as: (the maximum bit error ratio specified by the manufacturer) × (bit rate) × (test time).
- The test time is taken to be the dwell time at each frequency of the exposure.
- For reduction of the test time, a criterion in Table 1 may be adopted.

Table 1/K.48 – Criterion for test time reduction

Bit rate	Criterion
64 kbit/s	0
2 Mbit/s	0
NOTE – The bit error rate "0" means that no additional bit errors are measured during each individual disturbance exposure.	

At selected frequencies:

- it should be possible to establish a connection between any two ports (e.g., between subscriber lines and between a subscriber line and a transmission port);
- it should be possible to clear a connection in a controlled manner.

2) *Performance criterion B*

- The established connection shall be maintained throughout the testing.
- It shall be possible to establish a connection between two ports after the end of transient disturbances.
- It shall be possible to clear a connection in a controlled manner after the end of a test signal.

3) *Performance criterion C*

– The general performance criterion C applies.

8.2 Performance criteria for transmission equipment

The performance criteria for transmission equipment are as follows.

8.2.1 Analogue ports

The performance of the equipment shall be verified for analogue voice frequency signal ports:

– by measuring the audio signal break-through (demodulated 1 kHz) on the signal port during continuous exposures in both signal path directions covering both analogue to digital conversion and digital to analogue conversion;

– by testing the functionality of the main signal port and the other signal ports after the transient exposures;

– by verifying that corruption of software and data held in memory has not occurred.

1) *Performance criterion A*

– The connection must be maintained throughout testing.

– During a sweep over the entire frequency range, the noise level measured at each two-wire analogue port at 600 Ω (ignoring the normal impedance of the port for practical reason) must be less than –40 dBm. The measurement shall be done selectively with a bandwidth ≤100 Hz at 1 kHz.

2) *Performance criterion B*

– Connections shall be maintained throughout the test. The EUT shall return automatically to normal performance after the cessation of the exposure.

3) *Performance criterion C*

– The general performance criterion C applies.

8.2.2 Digital ports

The performance of the equipment shall be verified for digital signal ports:

– by measuring the number of induced bit errors on the main signal port during all exposures;

– by testing the functionality of the main signal port and the other signal ports after the exposure;

– by verifying that corruption of software and data held in memory has not occurred.

1) *Performance criterion A*

During the sweep:

– When applicable, the established connections shall be maintained throughout the testing.

– The number of bit errors at the end of each individual disturbance exposure shall not exceed the maximum number of errors expected for normal operation.

– The number of errors is calculated as: (the maximum bit error ratio specified by the manufacturer) × (bit rate) × (test time).

– The test time is taken to be the dwell time at each frequency of the exposure.

– For reduction of the test time, a criterion in Table 1 may be adopted.

At selected frequencies:

– When applicable, it should be possible to establish a connection between any two ports to be connected.

– It should be possible to clear a connection in a controlled manner (when this function exists).

2) *Performance criterion B*

– Loss of frame alignment or loss of synchronization is not allowed during each individual exposure. The above does not apply to surge testing where some loss of frame alignment may be expected. For this test, the EUT shall operate as intended following the cessation of the exposure.

– Connections shall be maintained throughout the test. The EUT shall return automatically to normal performance after the cessation of the exposure.

3) *Performance criterion C*

– The general performance criterion C applies.

8.2.3 Specific performance criteria

8.2.3.1 SDH and PDH interfaces

The criteria specified in 8.2.2 apply to the interfaces specified in ITU-T Recs G.703 and G.958 (optical interfaces).

8.2.3.2 ISDN interfaces

8.2.3.2.1 Primary rate access ISDN interfaces

The criteria specified in 8.2.2 apply to the interfaces specified in ITU-T Rec. I.431.

8.2.3.2.2 Network termination NT1 for ISDN "U" interfaces

The criteria specified in 8.2.2 apply to the interfaces specified in ITU-T Rec. G.961.

8.2.3.2.3 Network termination NT1 for ISDN "S/T" interfaces

The criteria specified in 8.2.2 apply to the interfaces specified in ITU-T Rec. I.430.

8.2.3.3 Analogue interface

8.2.3.3.1 Trunk interfaces and leased line interfaces

The criteria specified in 8.2.1 apply to the interfaces specified in ITU-T Rec. G.712.

8.2.3.3.2 Subscriber interfaces

The criteria specified in 8.2.1 apply to the interfaces specified in ITU-T Rec. Q.552.

8.2.3.4 V.10, V.11, V.24, V.28, V.35, V.36, X.24 and similar V- and X-series interfaces

The criteria specified in 8.2.2 apply to the interfaces specified in ITU-T Recs V.10, V.11, V.24, V.28, V.35, V.36 and X.24.

8.2.3.5 Ethernet and packet-data interfaces

To the interfaces specified in ISO/IEC 8802-3 and ITU-T Rec. X.25, the criteria below apply:

1) *Performance criterion A*

For interfaces which are intended for the transmission of third party data traffic, a selected port shall be connected to test equipment (e.g., a data communications analyzer) as a single point-to-point data link. This will avoid excessive failed transmission attempts caused by data collisions and bus contention problems.

The interface shall be suitably exercised and monitored throughout the test period for erroneous frames.

No more than 5% additional erroneous frames above the quiescent level shall be permitted during the exposure.

2) *Performance criterion B*

The data link connection shall be maintained.

8.2.3.6 Service and maintenance interfaces

The functional performance of ports of this type, not intended to be permanently connected and, therefore, not subjected to immunity testing, shall be verified according to the manufacturer's specification following cessation of the electromagnetic exposure on other ports.

8.2.3.7 Synchronization interfaces

The performance of slave clocks specified in ITU-T Recs G.812 and G.813 shall be checked with the equipment synchronized with an external source.

1) *Performance criterion A*

During the exposure, synchronization shall not be lost.

2) *Performance criterion B*

No alarm indications shall persist after the exposure.

The functional performance according to the manufacturer's specification shall be verified following cessation of the exposure.

8.2.3.8 Remote alarm interfaces

These interfaces are defined by the manufacturer.

1) *Performance criterion A*

No false alarms shall occur during continuous exposures.

2) *Performance criterion B*

No false alarm indications shall persist after the exposure.

8.3 Performance criteria for power supply equipment

The performance criteria for power supply equipment are as follows.

The power supply equipment ports to be monitored during testing can be categorized as:

– DC secondary interface ports;

– AC secondary interface ports;

– control/signal ports.

8.3.1 General performance criteria for power supply equipment

1) *Performance criterion A*

– During the application of immunity tests, the EUT output voltage range shall be in accordance with the normal service condition.

– During and after the exposure, the EUT shall operate without alarms, false alarm indications (power supply failure, protection failure, etc.) or false display indications.

2) *Performance criterion B*

– After the application of the test signal, the power supply shall operate as intended.

– During the test, the output voltage shall never reach a level high enough to damage telecommunication equipment usually connected to power supply equipment and it

shall be in accordance with the normal service condition, just after the disturbance application.

– Just after the exposure, the EUT shall operate without alarms, false alarm indications (power supply failure, protection failure, etc.) or false display indications.

3) *Performance criterion C*

Loss of supervised or alarm function is allowed. Nevertheless, after the application of the test, all functions shall operate as intended. The output voltage range shall be in accordance with the normal service condition.

8.3.2 Particular performance criteria for power supply equipment

The particular performance criteria for power supply equipment are defined for DC secondary output ports and AC secondary output ports as follows.

8.3.2.1 DC secondary output port

1) *Performance criterion A*

The maximum level of wideband noise on the DC secondary interface shall not exceed 10 mV. The noise should be measured by psophometer conforming to ITU-T Rec. O.41.

8.3.2.2 AC secondary output port

1) *Performance criterion A*

During the application of immunity tests, the voltage fluctuation must be less than ±10% of nominal voltage.

8.4 Performance criteria for supervisory equipment

The following performance criteria specific for supervisory equipment apply.

1) *Performance criterion A*

– The connections between the supervising and supervised equipment must be maintained.

– No supervisory functions shall be affected by immunity testing.

– No false alarms, such as signal lamps and printer misprints, shall occur.

2) *Performance criterion B*

– The supervisory equipment shall not affect the normal operation of the equipment being supervised.

– The operating speed of the supervising equipment may be reduced.

– Any minor priority supervisory function may be affected during immunity testing. These functions shall resume normal performance at cessation of the exposure. For example, false alarms shall reset.

8.5 Performance criteria for wireless LAN

The performance criteria are:

– performance criterion A for immunity tests with phenomena of a continuous nature;

– performance criterion B for immunity tests with phenomena of a transient nature;

– performance criterion C for immunity tests with power interruptions exceeding a certain time.

The equipment shall meet the minimum performance criteria as specified in the following clauses.

8.5.1 Performance criteria for continuous phenomena applied to transmitters

The performance criterion A shall apply.

Tests shall be repeated with the EUT in standby mode (if applicable) to ensure that unintentional transmission does not occur. In systems using acknowledgement signals, it is recognized that an ACKnowledgement (ACK) or Not ACKnowledgement (NACK) transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

Table 2/K.48 – Wireless LAN performance criteria

Criteria	During test	After test
A	Shall operate as intended May show degradation of performance (Note 1) Shall be no loss of function Shall be no unintentional transmissions	Shall operate as intended Shall be no degradation of performance (Note 2) Shall be no loss of function Shall be no loss of stored data or user programmable functions
B	May show loss of function (one or more) May show degradation of performance (Note 1) No unintentional transmissions	Functions shall be self-recoverable Shall operate as intended after recovering Shall be no degradation of performance (Note 2) Shall be no loss of stored data or user programmable functions
C	May be loss of function (one or more)	Functions shall be recoverable by the operator Shall operate as intended after recovering Shall be no degradation of performance (Note 2)

NOTE 1 – Degradation of performance during the test is understood as a degradation to a level not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases, the specified minimum performance level may be replaced by a permissible degradation of performance.

If the minimum performance level or the permissible performance degradation is not specified by the manufacturer, then either of these may be derived from the product description and documentation (including leaflets and advertising), and what the user may reasonably expect from the apparatus, if used as intended.

NOTE 2 – No degradation of performance after the test is understood as no degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases, the specified minimum performance level may be replaced by a permissible degradation of performance. After the test, no change of actual operating data or user retrievable data is allowed.

If the minimum performance level or the permissible performance degradation is not specified by the manufacturer, then either of these may be derived from the product description and documentation (including leaflets and advertising), and what the user may reasonably expect from the apparatus if used as intended.

8.5.2 Performance criteria for transient phenomena applied to transmitters

The performance criterion B shall apply, except for voltage dips of 100 ms and voltage interruptions of 5000 ms duration, for which performance criterion C shall apply.

Tests shall be repeated with the EUT in standby mode (if applicable) to ensure that unintentional transmission does not occur. In systems using acknowledgement signals, it is recognized that an acknowledgement (ACK) or not-acknowledgement (NACK) transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

8.5.3 Performance criteria for continuous phenomena applied to receivers

The performance criterion A shall apply.

Where the EUT is a transceiver, under no circumstances shall the transmitter operate unintentionally during the test. In systems using acknowledgement signals, it is recognized that an ACK or NACK transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

8.5.4 Performance criteria for transient phenomena applied to receivers

The performance criterion B shall apply, except for voltage dips of 100 ms and voltage interruptions of 5000 ms duration for which performance criterion C shall apply.

Where the EUT is a transceiver, under no circumstances, shall the transmitter operate unintentionally during the test. In systems using acknowledgement signals, it is recognized that an ACK or NACK transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

8.6 Specific performance criteria for digital mobile base station

8.6.1 GSM equipment

The establishment and maintenance of a communications link, and the assessment of RXQUAL or BER, are used as the performance criteria to ensure that all the primary functions of the transmitter and receiver of a BS are evaluated during the immunity tests. The parameter used as performance criteria for repeaters and ancillary RF amplifiers is the gain.

The equipment shall meet the performance criteria as specified in the following clauses as appropriate.

If an equipment is of a specialized nature, such that the performance criteria described in the following clauses are not appropriate, then the manufacturer shall declare, for inclusion in the test report, his own specification for an acceptable level of performance or degradation of performance during and/or after testing. The performance specification shall be included in the product description and documentation. The performance criteria specified by the manufacturer shall, however, give the same degree of immunity protection as called for in the following clauses.

8.6.1.1 Performance criterion A for GSM transmitters

A communications link shall be established at the start of the test, and maintained during the test.

The BER of the downlink shall be assessed during the test according to one of the test methods of 7.6.12.1.1.

If the test method of 7.6.12.1.1.1 is used, the measured BER of the class 2 bits of TCH/FS shall not exceed 1.6% during the test.

If the test method of 7.6.12.1.2 is used, the value of RXQUAL shall not exceed 3 during the test.

At the conclusion of the test, the EUT shall operate as intended with no loss of user control functions or stored data, and the communication link shall have been maintained.

8.6.1.2 Performance criterion B for GSM transmitters

A communications link shall be established at the start of the test.

At the conclusion of each exposure, the EUT shall operate with no user noticeable loss of the communication link.

At the conclusion of the total test comprising the series of individual exposures, the EUT shall operate as intended with no loss of user control functions or stored data, as declared by the manufacturer, and the communication link shall have been maintained.

8.6.1.3 Performance criterion A for GSM receivers

A communications link shall be established at the start of the test, and maintained during the test.

The BER of the uplink shall be assessed during the test according to one of the test methods of 7.6.12.1.2.

If the test method of 7.6.12.1.2.1 is used, the value of RXQUAL shall not exceed 3 during the test.

If the test method of 7.6.12.1.2.2 is used, the measured BER of the class 2 bits of TCH/FS shall not exceed 1.6% during the test.

NOTE – This BER is the upper limit in ETS 300 578 for RXQUAL = 3.

For a base station, the RXQUAL of the uplink shall not exceed three (3) measured during the test sequence.

At the conclusion of the test, the EUT shall operate as intended with no loss of user control functions or stored data, and the communication link shall have been maintained.

8.6.1.4 Performance criterion B for GSM receivers

A communications link shall be established at the start of the test.

At the conclusion of each exposure, the EUT shall operate with no user noticeable loss of the communication link.

At the conclusion of the total test comprising the series of individual exposures, the EUT shall operate as intended with no loss of user control functions or stored data, as declared by the manufacturer, and the communication link shall have been maintained.

8.6.2 ITU 2000 equipments

8.6.2.1 Performance criterion A for Base Stations (BS)

The BLER calculation shall be based on evaluating the CRC on each transport block.

During immunity tests of the BS Uplink and Downlink paths, the observed BLER shall be less than 1×10^{-2} and the BS shall operate as intended. If the Uplink and Downlink paths are evaluated as one loop, then the criteria is less than 2×10^{-2}.

For CDMA equipment, the following clause has to be applied:

During the immunity test, the observed Frame Error Rate (FER) of the BS forward link and reverse link shall not exceed 1.0% with 95% confidence (see clause 6.8 in [14], and the BS shall operate as intended.

After each test case, the BS shall operate as intended with no loss of user control functions or stored data, the communications link shall be maintained.

8.6.2.2 Performance criterion B for Base Station (BS)

During immunity tests of the BS Uplink and Downlink paths, the observed BLER may temporarily be greater than 1×10^{-2}. If the Uplink and Downlink paths are evaluated as one loop, then the criteria may temporarily be greater than 2×10^{-2}.

For CDMA equipment, the following clauses have to be applied:

– During each individual exposure in the test sequence, the observed Frame Error Rate (FER) of the BS forward link and reverse link may temporarily exceed 1.0% with 95% confidence.

– After each test case, the BS shall operate as intended with no loss of user control functions or stored data, the communications link shall be maintained.

8.6.3 Repeaters and ancillary RF amplifiers

8.6.3.1 Performance criterion A for repeaters and ancillary RF amplifiers

The gain of the EUT shall be measured throughout the period of exposure to the phenomenon.

The gain measured during the test shall not change from the gain measured before the test by more than ±1 dB.

At the conclusion of the test, the EUT shall operate as intended with no loss of user control functions or stored data.

8.6.3.2 Performance criterion B for repeaters and ancillary RF amplifiers

The gain shall be measured before the test, and after each exposure. At the conclusion of each exposure, the gain of the EUT shall not have changed by more than ±1 dB.

At the conclusion of the total test comprising the series of individual exposures, the EUT shall operate as intended with no loss of user control functions or stored data, as declared by the manufacturer, and the gain of the EUT shall not have changed by more than ±1 dB.

8.7 Specific performance criteria for digital radio relay systems

8.7.1 Analogue ports

The performance of the equipment shall be verified for analogue voice frequency signal ports:

– by measuring the audio signal break-through (demodulated 1 kHz) on the signal port during continuous exposures in both signal path directions, covering both analogue-to-digital conversion and digital-to-analogue conversion;

– by testing the functionality of the main signal port and the other signal ports after the transient exposures;

– by verifying that corruption of software and data held in memory has not occurred.

1) *Performance criterion A*

   – The connection must be maintained throughout testing.

   – During a sweep over the entire frequency range, the noise level measured at each two-wire analogue port at 600 Ω (ignoring the normal impedance of the port for practical reason) must be less than −40 dBm. The measurement shall be done selectively with a bandwidth ≤100 Hz at 1 kHz.

2) *Performance criterion B*

   – Connections shall be maintained throughout the test. The EUT shall return automatically to normal performance after the cessation of the exposure.

3) *Performance criterion C*

- A connection is maintained but communication may not be possible because of high noise levels.
- The EUT shall return automatically to normal performance after the cessation of the exposure.

8.7.2 Digital ports

The performance of the equipment shall be verified for digital signal ports:

– by measuring the number of induced bit errors on the main signal port during all exposures;

– by testing the functionality of the main signal port and the other signal ports after the exposure;

– by verifying that corruption of software and data held in memory has not occurred.

To allow for background errors which may occur at any time, the test can be repeated up to three times to determine any correlation between eventual errors and the EMC phenomena.

1) *Performance criterion A*

During the sweep:

- When applicable, the established connections shall be maintained throughout the testing.
- The number of bit errors at the end of each individual disturbance exposure shall not exceed the maximum number of errors expected for normal operation.
- The number of errors is calculated as: (the maximum bit error ratio specified by the manufacturer) × (bit rate) × (test time).
- The test time is taken to be the dwell time at each frequency of the exposure.
- For reduction of the test time, a criterion in Table 1 may be adopted.

2) *Performance criterion B*

- Loss of frame alignment or loss of synchronization is not allowed during each individual exposure. The above does not apply to surge testing where some loss of frame alignment may be expected. For this test, the EUT shall operate as intended following the cessation of the exposure.
- Connections shall be maintained throughout the test. The EUT shall return automatically to normal performance after the cessation of the exposure.

3) *Performance criterion C*

- Temporary loss of function is allowed. The EUT shall return automatically to normal performance after the cessation of the exposure.

8.7.3 Specific performance criteria

8.7.3.1 SDH and PDH interfaces

The criteria specified in 8.7.2 apply to the interfaces specified in ITU-T Recs G.703 and G.958 (optical interfaces).

8.7.3.2 ISDN interfaces

8.7.3.2.1 Primary rate access ISDN interfaces

The criteria specified in 8.7.2 apply to the interfaces specified in ITU-T Rec. I.431.

8.7.3.2.2 Network termination NT1 for ISDN "U" interfaces

The criteria specified in 8.7.2 apply to the interfaces specified in ITU-T Rec. G.961.

8.7.3.2.3 Network termination NT1 for ISDN "S/T" interfaces

The criteria specified in 8.7.2 apply to the interfaces specified in ITU-T Rec. I.430.

8.7.3.3 Analogue interface

8.7.3.3.1 Trunk interfaces and leased line interfaces

The criteria specified in 8.2.1 apply to the interfaces specified in ITU-T Rec. G.712.

8.7.3.3.2 Subscriber interfaces

The criteria specified in 8.7.1 apply to the interfaces specified in ITU-T Rec. Q.552.

8.7.3.4 V.10, V.11, V.24, V.28, V.35, V.36, X.24 and similar V- and X-series interfaces

The criteria specified in 8.7.2 apply to the interfaces specified in ITU-T Recs V.10, V.11, V.24, V.28, V.35, V.36 and X.24.

8.7.3.5 Ethernet and packet-data interfaces

To the interfaces specified in ISO/IEC 8802-3 and ITU-T Rec. X.25, the criteria below apply:

1) *Performance criterion A*

   For interfaces which are intended for the transmission of third party data traffic, a selected port shall be connected to test equipment (e.g., a data communications analyzer) as a single point-to-point data link. This will avoid excessive failed transmission attempts caused by data collisions and bus contention problems.

   The interface shall be suitably exercised and monitored throughout the test period for erroneous frames.

   No more than 5% additional erroneous frames above the quiescent level shall be permitted during the exposure.

2) *Performance criterion B*

   The data link connection shall be maintained.

8.7.3.6 Service and maintenance interfaces

The functional performance of ports of this type, not intended to be permanently connected and, therefore, not subjected to immunity testing, shall be verified according to the manufacturer's specification following cessation of the electromagnetic exposure on other ports.

8.7.3.7 Synchronization interfaces

The performance of slave clocks specified in ITU-T Recs G.812 and G.813 shall be checked with the equipment synchronized with an external source.

1) *Performance criterion A*

   During the exposure, synchronization shall not be lost.

2) *Performance criterion B*

   No alarm indications shall persist after the exposure.

   The functional performance according to the manufacturer's specification shall be verified following cessation of the exposure.

8.7.3.8 Remote alarm interfaces

These interfaces are defined by the manufacturer.

1) *Performance criterion A*

No false alarms shall occur during continuous exposures.

2) *Performance criterion B*

No false alarm indications shall persist after the exposure.

Annex A

Immunity test levels

Table A.1/K.48 – Equipment for telecommunication centre

Environmental phenomena	Test levels	Units	Basic standard	Performance criteria	Remarks
Enclosure port					
Radio frequency electro-magnetic field	3 10 3 10	V/m	IEC 61000-4-3	A	80-800 MHz 800-960 MHz 960-1000 MHz 1400-2000 MHz (Note 1)
Electrostatic discharge	4	kV	IEC 61000-4-2	B	Contact and air discharge
Outdoor telecommunication ports					
Radio frequency conducted continuous	3	V	IEC 61000-4-6	A	0.15-80 MHz (Notes 2, 3 and 5)
Surges	0.5 (line to line) 1 (line to ground)	kV	IEC 61000-4-5	B	10/700 µs (Note 4)
Fast transients	0.5	kV	IEC 61000-4-4	B	
Indoor telecommunication ports					
Radio frequency conducted continuous	3	V	IEC 61000-4-6	A	0.15-80 MHz (Notes 2, 3 and 5)
Surges	0.5 (line to ground)	kV	IEC 61000-4-5	B	1.2/50 (8/20) µs (Note 4)
Fast transients	0.5	kV	IEC 61000-4-4	B	
DC power ports					
Radio frequency conducted continuous	3	V	IEC 61000-4-6	A	0.15-80 MHz (Notes 2, 3 and 5)
Fast transients	0.5	kV	IEC 61000-4-4	B	

Table A.1/K.48 – Equipment for telecommunication centre

Environmental phenomena	Test levels	Units	Basic standard	Performance criteria	Remarks
DC power ports (continued)					
Voltage dips	0 0.004	% of nominal voltage s	IEC 61000-4-29	A (Note 11)	high impedance (output impedance of test generator)
	0 0.01 and 0.1	% of nominal voltage s	IEC 61000-4-29	C (Notes 7, 8, 11)	
	0 0.004	% of nominal voltage s	IEC 61000-4-29	A (Note 11)	low impedance (output impedance of test generator)
	0 0.01 and 0.1	% of nominal voltage s	IEC 61000-4-29	C (Notes 7, 8, 11)	
Abnormal Voltage	0 to 90 1	% of nominal voltage s		C (Notes 9, 10, 11)	
	110 to 125 1	% of nominal voltage s		C (Notes 9, 10, 11)	
Voltage Variation	From 100 to 90 2	% of nominal voltage s		A	The test simulates a change in the DC voltage: is not a hole but a change from the nominal value to a lower value
	From 100 to 110 2	% of nominal voltage s		A	The test simulates a change in the DC voltage: is not a hole but a change from the nominal value to a higher value

Table A.1/K.48 – Equipment for telecommunication centre

Environmental phenomena	Test levels	Units	Basic standard	Performance criteria	Remarks
AC power ports					
Radio frequency conducted continuous	3	V	IEC 61000-4-6	A	0.15-80 MHz (Note 5)
Surges	0.5 (line to line) 1 (line to ground)	kV	IEC 61000-4-5	B	1.2/50 (8/20) µs
Fast transients	1.0	kV	IEC 61000-4-4	B	
Voltage dips	>95 0.5	% reduction period	IEC 61000-4-11	B	(Note 6)
	30 25	% reduction period	IEC 61000-4-11	C	(Note 6)
Voltage interruption	95 250	% reduction period	IEC 61000-4-11	C	(Note 6)

NOTE 1 – The test may be performed with a start frequency lower than 80 MHz, but not less than 27 MHz.

NOTE 2 – The lower test level above 10 MHz can be applied. The specific level is under study.

NOTE 3 – The test level can be defined as equivalent current into 150 Ω.

NOTE 4 – This test may not be applied for unscreened cable when appropriate CDN does not exist.

NOTE 5 – It is recognized that radio frequency electromagnetic fields and conducted continuous voltages are 1 V/m and 1 V respectively in major telecommunication centres.

NOTE 6 – This test applies to equipment having a rated input current not exceeding 16 A per phase.

NOTE 7 – In some sensitive equipment, momentary and temporary interruption of the service may occur as a result of such transients. Lengthening of the interruption to service (equipment is not functioning as intended) due to the recovery of software shall be taken in account. More detailed information about the service interruption shall be provided by the manufacturer on the request of the operator.

NOTE 8 – To prevent system malfunctioning, additional arrangements concerning the power supply system may be necessary.

For example:

– dual feeding system;

– high Ohmic distribution system;

– independent power distribution.

NOTE 9 – Following the restoration of the supply to the normal voltage range, the power conversion and management systems shall automatically restore service. The telecommunication equipment shall then resume operation according to its specifications. The abnormal service voltage shall not lead to the disconnection of the power supply e.g., by causing circuit breakers, fuses or other such devices to operate.

NOTE 10 – For equipment with a low priority of service, it is acceptable to use the following performance criteria during the test: "Loss of function is allowed, the function can be restored by a manual operation of the user in accordance with the manufacturer's instructions. Functions and information protected by a battery backup shall not be lost."

NOTE 11 – This test is applicable only in equipments in which the battery back-up is not permanently connected to the DC distribution system.

Table A.2/K.48 – Equipment for outdoor locations

Environmental phenomena	Test levels	Units	Basic standard	Performance criteria	Remarks
Enclosure port					
Radio frequency electro-magnetic field	3 10 3 10	V/m	IEC 61000-4-3	A	80-800 MHz 800-960 MHz 960-1000 MHz 1400-2000 MHz (Notes 1 and 5)
Electrostatic discharge	4	kV	IEC 61000-4-2	B	Contact and air discharge
Telecommunication ports					
Radio frequency conducted continuous	3	V	IEC 61000-4-6	A	0.15-80 MHz (Notes 2 and 3)
Surges	0.5 (line to line) 1 (line to ground)	kV	IEC 61000-4-5	B	10/700 µs (Note 4)
Fast transients	0.5	kV	IEC 61000-4-4	B	
DC power ports					
Radio frequency conducted continuous	3	V	IEC 61000-4-6	A	0.15-80 MHz (Notes 2 and 3)
Voltage dips	0 0.004	% of nominal voltage s	IEC 61000-4-29	A (Note 11)	high impedance (output impedance of test generator)
	0 0.01 and 0.1	% of nominal voltage s	IEC 61000-4-29	C (Notes 7, 8, 11)	
	0 0.004	% of nominal voltage s	IEC 61000-4-29	A (Note 11)	low impedance (output impedance of test generator)
	0 0.01 and 0.1	% of nominal voltage s	IEC 61000-4-29	C (Notes 7, 8, 11)	
Abnormal voltage	0 to 90 1	% of nominal voltage s		C (Notes 9, 10, 11)	
	110 to 125 1	% of nominal voltage s		C (Notes 9, 10, 11)	

Table A.2/K.48 – Equipment for outdoor locations

Environmental phenomena	Test levels	Units	Basic standard	Performance criteria	Remarks
DC power ports (continued)					
Voltage variation	From 100 to 90 2	% of nominal voltage s		A	The test simulates a change in the DC voltage: is not a hole but a change from the nominal value to a lower value
	From 100 to 110 2	% of nominal voltage s		A	The test simulates a change in the DC voltage: is not a hole but a change from the nominal value to a higher value
Fast transients	0.5	kV	IEC 61000-4-4	B	
AC power ports					
Radio frequency conducted continuous	3	V	IEC 61000-4-6	A	0.15-80 MHz (Notes 2 and 3)
Surges	0.5 (line to line) 1 (line to ground)	kV	IEC 61000-4-5	B	1.2/50 (8/20) µs
Fast transients	1.0	kV	IEC 61000-4-4	B	
Voltage dips	>95 0.5	% reduction period	IEC 61000-4-11	B	(Note 6)
	30 25	% reduction period	IEC 61000-4-11	C	(Note 6)
Voltage interruption	95 250	% reduction period	IEC 61000-4-11	C	(Note 6)
	30 25	% reduction period	IEC 61000-4-11	C	(Note 6)

NOTE 1 – The test may be performed with a start frequency lower than 80 MHz, but not less than 27 MHz.

NOTE 2 – The lower test level above 10 MHz can be applied. The specific level is under study.

NOTE 3 – The test level can be defined as equivalent current into 150 Ω.

NOTE 4 – This test may not be applied for unscreened cable when appropriate CDN does not exist.

NOTE 5 – In cases where mobile communications are permitted, radio field immunity higher than 10 V/m may be requested at communication frequencies.

NOTE 6 – This test applies to equipment having a rated input current not exceeding 16 A per phase.

Table A.2/K.48 – Equipment for outdoor locations

NOTE 7 – In some sensitive equipment, momentary and temporary interruption of the service may occur as a result of such transients. Lengthening of the interruption to service (equipment is not functioning as intended) due to the recovery of software shall be taken in account. More detailed information about the service interruption shall be provided by the manufacturer on the request of the operator.NOTE 8 – To prevent system malfunctioning additional arrangements concerning the power supply system may be necessary.

For example:

– dual feeding system;

– high Ohmic distribution system;

– independent power distribution.

NOTE 9 – Following the restoration of the supply to the normal voltage range, the power conversion and management systems shall automatically restore service. The telecommunication equipment shall then resume operation according to its specifications. The abnormal service voltage shall not lead to the disconnection of the power supply e.g., by causing circuit breakers, fuses or other such devices to operate.

NOTE 10 – For equipment with a low priority of service it is acceptable to use the following performance criteria during the test: "Loss of function is allowed, the function can be restored by a manual operation of the user in accordance with the manufacturer's instructions. Functions and information protected by a battery back-up shall not be lost."

NOTE 11 – This test is applicable only in equipments in which the battery back-up is not permanently connected to the DC distribution system.

Table A.3/K.48 – Equipment for telecommunication centre (Emission)

	Frequency	Quasi-peak limit	Average limit	Basic standard	Remarks
Enclosure port					
Radiated electromagnetic field	30 to 230 MHz	40 dB(μV/m)	N/A	CISPR Pub. 22	Physically large systems should be tested according to ITU-T Rec. K.38
	230 to 1000 MHz	47 dB(μV/m)			
Telecommunication ports (outdoor and indoor)					
Conducted disturbance voltage	0.15 to 0.5 MHz	97 to 87 dB(μV)	84 to 74 dB(μV)	CISPR Pub. 22	(Notes 1, 2 and 3)
	0.5 to 30 MHz	87 dB(μV)	74 dB(μV)		
AC power ports					
Conducted disturbance voltage	0.15 to 0.5 MHz	79 dB(μV)	66 dB(μV)	CISPR Pub. 22	(Note 2)
	0.5 to 30 MHz	73 dB(μV)	60 dB(μV)		
DC power ports					
Conducted disturbance voltage	0.15 to 0.5 MHz	79 dB(μV)	66 dB(μV)	CISPR Pub. 22	(Note 2)
	0.5 to 30 MHz	73 dB(μV)	60 dB(μV)		

Table A.3/K.48 – Equipment for telecommunication centre (Emission)

NOTE 1 – The limits decrease linearly with the logarithm of the frequency. NOTE 2 – Equivalent current limit can be applied. NOTE 3 – Provisionally, a relaxation of 10 dB over the frequency range of 6 MHz to 30 MHz is allowed for high-speed service having significant spectral density in this band. However, this is restricted to the common mode disturbance converted by the cable for the wanted signal.

Table A.4/K.48 – Equipment for outdoor location (Emission)

	Frequency	Quasi-peak limit	Average limit	Basic standard	Remarks
Enclosure port					
Radiated electro-magnetic field	30 to 230 MHz	30 dB(μV/m)	N/A	CISPR Pub. 22	Physically large systems should be tested according to ITU-T Rec. K.38
	230 to 1000 MHz	37 dB(μV/m)			
Telecommunication ports (outdoor and indoor)					
Conducted disturbance voltage	0.15 to 0.5 MHz	84 to 74 dB(μV)	74 to 64 dB(μV)	CISPR Pub. 22	(Notes 1, 2 and 3)
	0.5 to 30 MHz	74 dB(μV)	64 dB(μV)		
AC power ports					
Conducted disturbance voltage	0.15 to 0.5 MHz	66 to 56 dB(μV)	56 to 46 dB(μV)	CISPR Pub. 22	(Notes 1 and 2)
	0.5 to 5 MHz	56 dB(μV)	46 dB(μV)		
	5 to 30 MHz	60 dB(mV)	50 dB(μV)		
DC power ports					
Conducted disturbance voltage	0.15 to 0.5 MHz	66 to 56 dB(μV)	56 to 46 dB(μV)	CISPR Pub. 22	(Notes 1 and 2)
	0.5 to 5 MHz	56 dB(μV)	46 dB(μV)		
	5 to 30 MHz	60 dB(μV)	50 dB(μV)		
NOTE 1 – The limits decrease linearly with the logarithm of the frequency. NOTE 2 – Equivalent current limit can be applied. NOTE 3 – Provisionally, a relaxation of 10 dB over the frequency range of 6 MHz to 30 MHz is allowed for high-speed service having significant spectral density in this band. However, this is restricted to the common mode disturbance converted by the cable for the wanted signal.					

Appendix I

Equipment within the scope of the present Recommendation

Switching equipment

This category covers, for example, switching central units, cross-connect equipment.

Transmission equipment

This category covers, for example, fibre optic transmission equipment.

Supervisory equipment

This category covers, for example, OMC system of radiomobile networks and TMN system for transmission equipment.

Power equipment

This category covers, for example, rectifier units, power station, DC distribution system.

Wireless LAN

This category covers, for example, Wideband transmission systems operating in the 2.4 GHz ISM band using spread spectrum techniques, HIgh PErformance Radio Local Area Networks (HIPERLAN) type 1 operating in the 5 GHz frequency band.

Radio base station equipment

This category covers, for example, IMT-2000 CDMA Direct Spread (UTRA) Base Station (BS), IMT-2000 CDMA Multi-carrier Base Stations and ancillary equipment, GSM and DCS equipment, PCS equipment.

Radio fixed link equipment

This category covers, for example, Digital radio fixed links operating in the frequency band from 1 to 58 GHz, with Traffic capacities from 9.6 kbit/s to 622 Mbit/s with typical application point-to-point (P-P) connections; long haul (trunk), rural and urban low/medium/high capacity links stand alone antennas for all the above applications when integral antennas are not employed, and point-to-multipoint (P-MP) connections; rural or urban for narrow-band and/or wideband links for fixed wireless access (FWA) and infrastructure support.

SERIES OF ITU-T RECOMMENDATIONS

Series A	Organization of the work of ITU-T
Series B	Means of expression: definitions, symbols, classification
Series C	General telecommunication statistics
Series D	General tariff principles
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	Transmission systems and media, digital systems and networks
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	Cable networks and transmission of television, sound programme and other multimedia signals
Series K	**Protection against interference**
Series L	Construction, installation and protection of cables and other elements of outside plant
Series M	TMN and network maintenance: international transmission systems, telephone circuits, telegraphy, facsimile and leased circuits
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Telephone transmission quality, telephone installations, local line networks
Series Q	Switching and signalling
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks and open system communications
Series Y	Global information infrastructure and Internet protocol aspects
Series Z	Languages and general software aspects for telecommunication systems

Printed in Switzerland
Geneva, 2003