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Electromagnetic compatibility requirements and measurement methods for digital cellular mobile communication base station equipment

Recommendation ITU-T K.114

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Summary

Recommendation ITU-T K.114 specifies the electromagnetic compatibility common requirements and test methods for digital cellular mobile communication base station equipment, repeaters and associated ancillary equipment which are independent of any kind of wireless access technologies, such as 2G, 3G, 4G or others.

Test conditions for base stations used in variety modality are described, e.g., macro base station, distributed base station, micro base station, pico base station, integral antenna base station and active antenna base station. Performance criteria for immunity tests are also specified.

This Recommendation describes the specific testing levels to be applied to radio communication base stations in various environments, such as telecommunication centres, customer premises and outside plants.

History

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Electromagnetic compatibility requirements and measurement methods for digital cellular mobile communication base station equipment

1 Scope

This Recommendation specifies the electromagnetic compatibility common requirements and test methods for digital cellular mobile communication base station equipment, repeaters and associated ancillary equipment which are independent of any kind of wireless access technologies, such as 2G, 3G, 4G or others.

Test conditions for base stations used in variety modality are described, e.g., macro base station, distributed base station, micro base station, pico base station, integral antenna base station and active antenna base station; performance criteria for immunity tests are also specified.

This Recommendation describes the specific testing levels to be applied to radio communication base stations in different environments, such as telecommunication centres, customer premises and outside plants.

Technical specifications relating to unwanted emissions (including spurious emissions and out-of-band emissions) from the enclosure port of radio equipment or from combinations of radio and associated ancillary equipment are not included in this Recommendation. Such technical specifications are found in [ITU-R SM.329-12].

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.

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3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 electromagnetic disturbance [b-IEC 60050-161]: Any electromagnetic phenomenon which may degrade the performance of a device, equipment or system, or adversely affect living or inert matter.

3.1.2 electromagnetic emission [b-IEC 60050-161]: The phenomenon by which electromagnetic energy emanates from a source.

3.1.3 electromagnetic interference (EMI) [b-IEC 60050-161]: Degradation of the performance of an equipment, transmission channel or system caused by an electromagnetic disturbance.

3.1.4 EUT [b-IEC CISPR 16-2-3]: Equipment under test: equipment (devices, appliances and systems) subjected to EMC (emission) compliance (conformity assessment) tests.

3.1.5 immunity (to a disturbance) [b-IEC 60050-161]: The ability of a device, equipment or system to perform without degradation in the presence of an electromagnetic disturbance.

3.1.6 necessary bandwidth [ITU-R SM.329-12]: For a given class of emission, the width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions.

3.1.7 out-of-band emission [ITU-R SM.329-12]: Emission on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process, but excluding spurious emissions.

3.1.8 primary protection [b-ITU-T K.44]: Means by which the majority of the surge stress is prevented from propagating beyond a designated location (preferably the building entrance point).

3.1.9 spurious emission [ITU-R SM.329-12]: Emission on a frequency, or frequencies, which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products but exclude out-of-band emissions.

3.1.10 telecommunications port [b-IEC CISPR 22]: Point of connection for voice, data and signalling transfers intended to interconnect widely-dispersed systems via such means as direct connection to multi-user telecommunications networks (e.g., public switched telecommunications networks (PSTN) integrated services digital networks (ISDN), x-type digital subscriber lines (xDSL)), local area networks (e.g., Ethernet, Token Ring) and similar networks.

NOTE – A port generally intended for interconnection of components of an ITE system under test (e.g., RS-232, IEEE Standard 1284 (parallel printer), Universal Serial Bus (USB), IEEE Standard 1394 ("Fire Wire")) and used in accordance with its functional specifications (e.g., for the maximum length of cable connected to it), is not considered to be a telecommunications/network port under this definition.

3.1.11 unwanted emissions [ITU-R SM.329-12]: Consist of spurious emissions and out-of-band emissions

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 active antenna system (AAS): A base station system which combines an antenna array with an active transceiver unit array. An AAS may include a remote/radio distributed unit or network.

3.2.2 ancillary equipment: Equipment (modules or apparatus), as the part of main system, used in connection/conjunction with radio receiver or transmitter units to assist the base station to work normally, or to provide the additional operational features, e.g., supervisory control, backhaul connection, cooling control, antenna sector control. It could not work stand-alone independently of main system.

3.2.3 base station equipment: A base station is a network element in radio access network, responsible for radio transmission and reception in one or more cells to or from the mobile devices. A base station can have an integrated antenna or be connected to an antenna by feeder cables. Base station is intended for operation at a fixed location and powered directly or indirectly (e.g., via an AC/DC converter or power supply) by AC mains network, or an extended local DC mains network.

3.2.4 customer premises environment: A customer premises environment is a facility in the residential and commercial building, there is no guarantee for good protection, earthing and bonding, and this environment is more abominable than the telecommunication centre, including but not limited to:

– facility in the corridor;

– facility in the weak power wells;

– facility in the distribution room;

– facility in the basement, etc.;

– facility in the lobby of buildings.

3.2.5 distributed base station: The baseband unit and RF unit support standalone installation, the baseband unit can be installed in the vicinity of base station or with other network devices centrally, and be connected to the remote RF unit through the fibre.

3.2.6 integral antenna: Antenna which may not be removed during the tests, according to the manufacturer's statement.

3.2.7 integral antenna base station: Base station with integral antenna, and antenna is portion of the RF unit. For this type of base station antenna port and the enclosure ports are equivalent.

3.2.8 intentional radiator: A transmitter that intentionally generates and emits radio frequency energy by radiation or induction to realize its performance or function.

3.2.9 macro base station: The power modules, baseband unit and RF unit installed in the same cabinet, the antennas are installed out of the cabinet through RF cables, this base station's size is physically larger, and can bear more traffic and cover a wider region.

3.2.10 micro base station: Baseband unit and RF unit integrated in a box, mainly for streets covered, outdoor, hot spot areas, etc., covering small area and few users.

3.2.11 multi-standard radio base station: Base station characterized by the ability of its receiver and transmitter to process two or more carriers in common active RF components simultaneously in a declared RF bandwidth, where at least one carrier is of a different RAT than the other carrier(s).

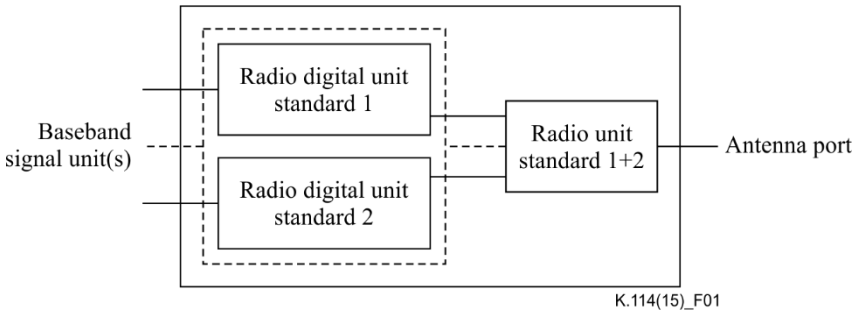


Figure 1 – multi-standard radio base station

3.2.12 non-integral antenna base station: Base station whose antenna may be removed for the test according to the manufacturer's statement, and where the antenna is directly connected to wireless communication base station using the connector, the waveguide flange, or through a feed device. For this type of base station antenna port and enclosure ports are separated.

3.2.13 outside environment: An environment where equipment is exposed to the atmosphere and is more abominable than the customer premises environment, including but not limited to:

– facility on the streets side;

– facility on the roof of buildings;

– facility on the outside wall of buildings;

– facility on the pole, etc.;

– facility on the towers.

3.2.14 pico base station: Pico base station is a derivative of micro base station, generally the power source is the mains, the baseband part and the RF part are integrated in a small enclosure, mainly for indoor area coverage, covering region is small region.

3.2.15 port: Particular interface of the specified equipment with the external electromagnetic environment.

NOTE – An interface, which uses optical fibre, is not a port for the purposes of testing because it does not interact with the electromagnetic environment within the frequency range. An optical fibre interface may still be used in the assessment of performance.

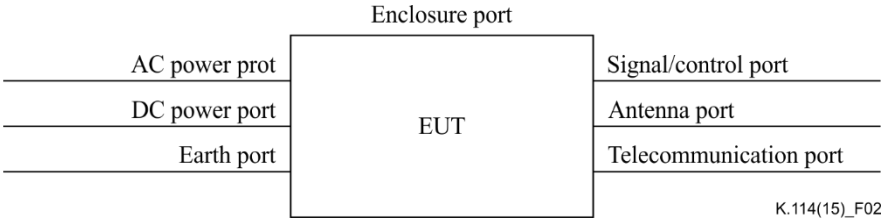


Figure 2 – port

3.2.16 repeater: Device with two RF ports, both of which are intended to be connected to antennas, which are capable of receiving, amplifying and transmitting simultaneously in one direction a signal in a BSS transmit band and in the other direction a signal in the corresponding BSS receive band.

3.2.17 radio communications equipment: Telecommunications equipment which includes one or more 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 done so, is not dependent on it for basic functionality.

3.2.18 telecommunication centre: A facility which is managed and operated exclusively by the telecom operator. This environment is more normative than the customer premises and the outside environment is sufficient to guarantee good protection, earthing and bonding, including but not limited to:

– facility in the centre office;

– facility in the data centre.

3.2.19 throughput: The number of payload bits successfully received per second for a reference measurement channel in a specified reference condition.

3.2.20 unintentional radiator: A transmitter that intentionally generates radio frequency energy for use within the device, or that sends radio frequency signals by conduction to associated equipment via connecting wiring, but which emits RF energy by radiation or induction without intention.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations:

3GPP	3rd Generation Partnership Project
AAS	Active Antenna System
AC	Alternating Current
AM	Amplitude Modulation
BER	Bit Error Ratio
BLER	BLock Error Ratio
BS	Base Station
BSS	Base Station System
BTS	Base Station
CDN	Coupling Decoupling Network
DC	Direct Current
EIRP	Equivalent Isotropically Radiated Power
EMC	Electromagnetic Compatibility
EUT	Equipment Under Test
E-UTRA	Evolved Universal Terrestrial Radio Access
FDD	Frequency Division Duplex
FE	Fast Ethernet
FER	Frame Error Ratio
HVDC	High Voltage Direct Current
MSR	Multi-Standard Radio
PoE	Power over Ethernet
PD	Powered Device
PSE	Power Sourcing Equipment
QoS	Quality of Service
RC	Radio Configuration
RF	Radio Frequency
RAT	Radio Access Technology
RXQUAL	Received Signal Quality
TDD	Time Division Duplex

5 Base station classification

Base station equipment can be classified in several ways. In this Recommendation, the following classifications are used:

– according to application modality: a base station can be classified as a macro base station, distributed base station, micro base station, pico base station or an integrated antenna base station;

– according to the number of carriers, a base station can be classified as either a single-carrier or a multi-carrier base station;
– according to the quantity of the radio access technology (RAT) of the transmitter, a base station can be classified as either a single-standard radio base station or a multi-standard radio (MSR) base station;
– according to the number of bands, a base station can be classified as either single-frequency base stations or multi-frequency base stations.

6 Test methods and limits

6.1 Emission

6.1.1 Radio frequency emission

The general requirements for test methods according to [IEC CISPR 32] shall be applied; the limits reported in Tables A.1 and A.2 are recommended for equipment in telecommunication centres, customer premises and outside plants.

[ITU-T K.38] should be applied to large equipment tests.

Conducted emission measurements at power input and/or output should be taken using the artificial mains network (AMN) at each port. For output port, if the length of cables is over 3 m.

Conducted emission measurements from telecommunication ports should be taken using impedance stabilization networks (ISN), if available, as detailed in [IEC CISPR 32] Annex C.

Radiated emissions from the enclosure and from cables refer to the frequency components which come from unintentional radiators of the base station; this means the emissions are mostly from switching power supply and digital units of the base station system. The digital units include, but are not limited to, the followings: clocks, CPUs, data buses, optical modules, FPGA/RAM/ROM chips, digital modulation modules. The requirements of the radiated emissions are specified in Annex A of this Recommendation.

Radiated spurious emissions and out-of-band emissions are called unwanted emissions and they refer to the frequency components which come from intentional radiator-radio units of the base station. The radio units include, but are not limited to, the following: transmitter, receiver, transceiver, power amplifier, radio frequency (RF) combiner, RF duplexer. The unwanted emissions shall comply with the requirements of [ITU-R SM.329-12]; this is not within the scope of this Recommendation.

6.1.2 Harmonic

The appropriate requirements of [IEC 61000-3-2] for harmonic current emissions apply to any equipment covered by the scope of this Recommendation with an input current up to and including 16A per phase. For equipment with an input current greater than 16A and less than 75A per phase, [IEC 61000-3-12] applies.

6.1.3 Flicker

The appropriate requirements of [IEC 61000-3-3] for voltage fluctuations and flicker apply for equipment covered by the scope of this Recommendation with an input current up to and including 16A per phase. For equipment with an input current greater than 16A and less than 75A per phase, [IEC 61000-3-11] applies.

6.2 Immunity

For immunity testing, the general test methods in [ITU-T K.43] apply. Test levels for base station equipment are shown in Tables B.1, B.2 and B.3 for different environmental classifications.

Radiated immunity tests shall be applied up to 6 GHz considering that high frequency bands e.g., 3.5 GHz for LTE and 5.8 GHz for WiFi have been used in the mobile system. The test method shall be according to [IEC 61000-4-3].

Conducted immunity tests shall be applied to one port at a time and the tests shall be performed on power input, output ports and on all signal ports to which cables are connected in usual use. If requested, it is allowed to test equipment with primary protection installed. The test conditions should be recorded in the test report. For multi-pair cables where multi-pair coupling decoupling network (CDN) does not exist, the test shall be applied to a single pair using an appropriate CDN, the remaining pairs should be tested indirectly one by one. Or the current clamp/EM clamp method could be used for multi-pair cables according to [IEC 61000-4-6].

During the surge test to power port, the equipment under test (EUT) and all signal ports shall comply with the given compliance criteria. For signal port, the port should be checked against the compliance criteria after the surge test has been applied.

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

For the telecommunication centre, typical facilities inside and characteristics of environment are as follows:

– the internal electrical power distribution is a 48V direct current (DC) or high voltage DC source, e.g., 240V/380V nominal and a 220V/230V/400V, or 127V/220V or 100V alternating current (AC) nominal 50 Hz or 60 Hz;
– it is assumed that switching of loads on the DC supply seldom occurs and, therefore, has not been taken into account;
– battery back-up is available at 48V DC port;
– it is assumed that there is no separation between DC power cables and signal cables, while internal AC power cables are kept separate at some distance to DC power cables and signal cables in order to reduce mutual coupling. Normal practice is to use grounded, metallic cable supports;
– a dedicated earthing and bonding network is implemented according to [ITU-T K.27]. Also, the AC power distribution inside the building is in accordance with the requirements of [ITU-T K.34].

Some ESD preventive measures are either incorporated in the building installation (e.g., charge dissipating floors or control of the relative humidity) or through guidelines for handling and operation of the equipment (e.g., use of wrist-straps, charge dissipating shoes).

Some distance to high power broadcast or mobile communication transmitters is assumed. In cases where radio communication transmitters are present at the premises, it is assumed that special precautions are taken in order to prevent exposure of the emitted field. The use of mobile radio equipment such as cell phone, indoor radio distribution system, access point and others are assumed in telecommunication centres. The telecommunication operator cannot control the external radio-frequency environment.

6.2.1 Surge for PoE port

The surge test method requirements for a power over Ethernet (PoE) port of the base station shall be executed according to the requirements of this clause.

NOTE – According to Table 33-2 of [IEEE 802.3at], for PoE port, two conductors such as 1/2, 3/6, 4/5, 7/8 are associated with pairs, and each pair carries the same nominal current in both magnitude and polarity, and the polarity between pairs such as 1/2 and 3/6, or 4/5 and 7/8 are inverse.

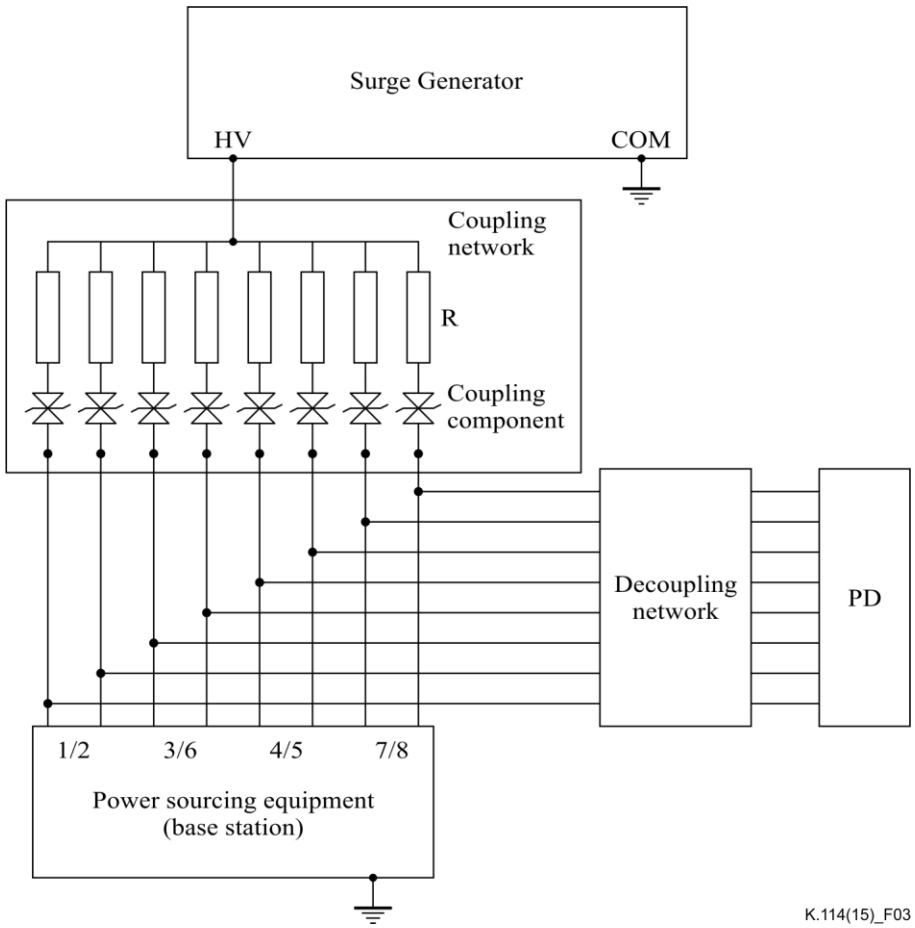
6.2.1.1 Base station – power sourcing equipment

Surge shall be applied to PoE port with supplying power and without supplying power to powered device (PD). Decoupling network performance shall be good enough not to affect the test results. The equipment grounding should be consistent with the actual application.

Test methods for shielded PoE cables shall be performed in accordance with section 7.6 of [IEC 61000-4-5]. Test methods for unshielded PoE cables for both line-to-line and line-to-ground coupling are as follows:

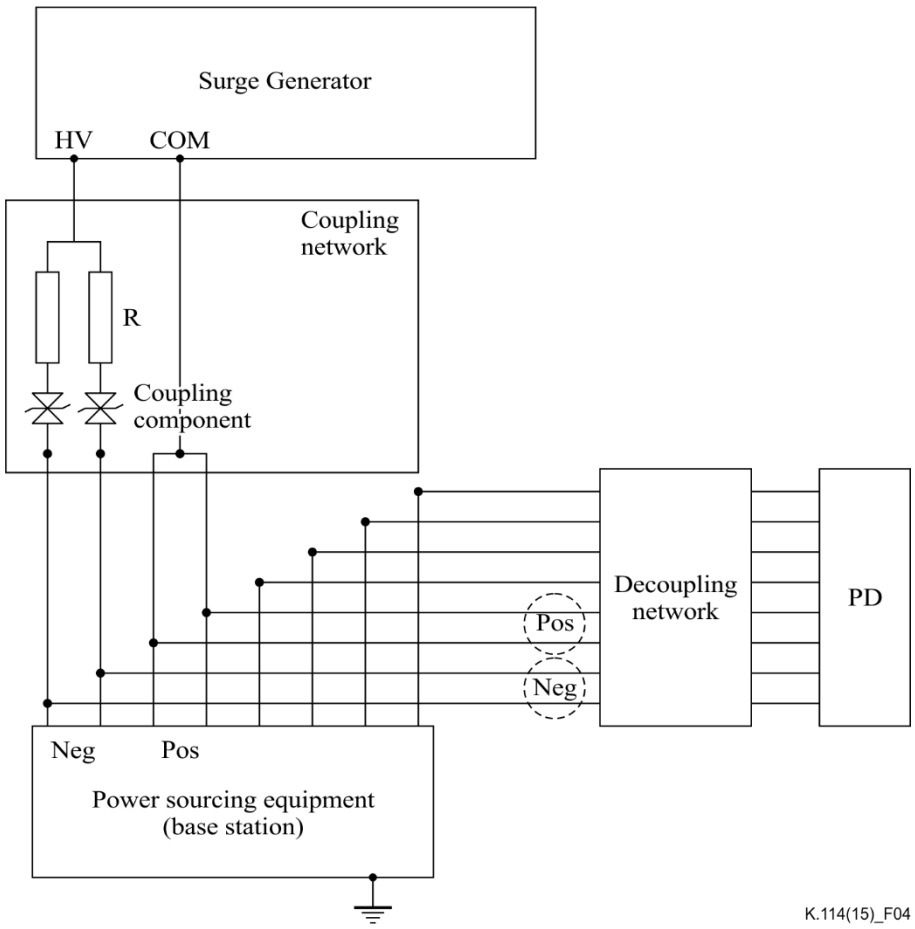
– line-to-ground coupling: All the eight lines to the ground simultaneously; the test setup is given in Figure 3.

– line-to-line coupling: The tests 1/2 to 3/6, and 4/5 to 7/8 shall be performed respectively; the test setup is given in Figure 4.



NOTE – For each coupling network, R shall not exceed 250 Ω with indoor cables and shall be 25 Ω with outdoor cables.
Coupling and decoupling network for power lines in [IEC 61000-4-5] shall be used.
Tests should be performed again after removing the decoupling network and PD.

Figure 3 – Line-to-ground coupling test configuration for PoE of power sourcing base station



NOTE – For each coupling network, R shall be 80 Ω with indoor cable and shall be 25 Ω with outdoor cables.
Coupling and decoupling network for power lines in [IEC 61000-4-5] shall be used.
Tests should be performed again after removing the decoupling network and PD.

Figure 4 – Line-to-line coupling test configuration for PoE of power sourcing base station

6.2.1.2 Base station – powered device

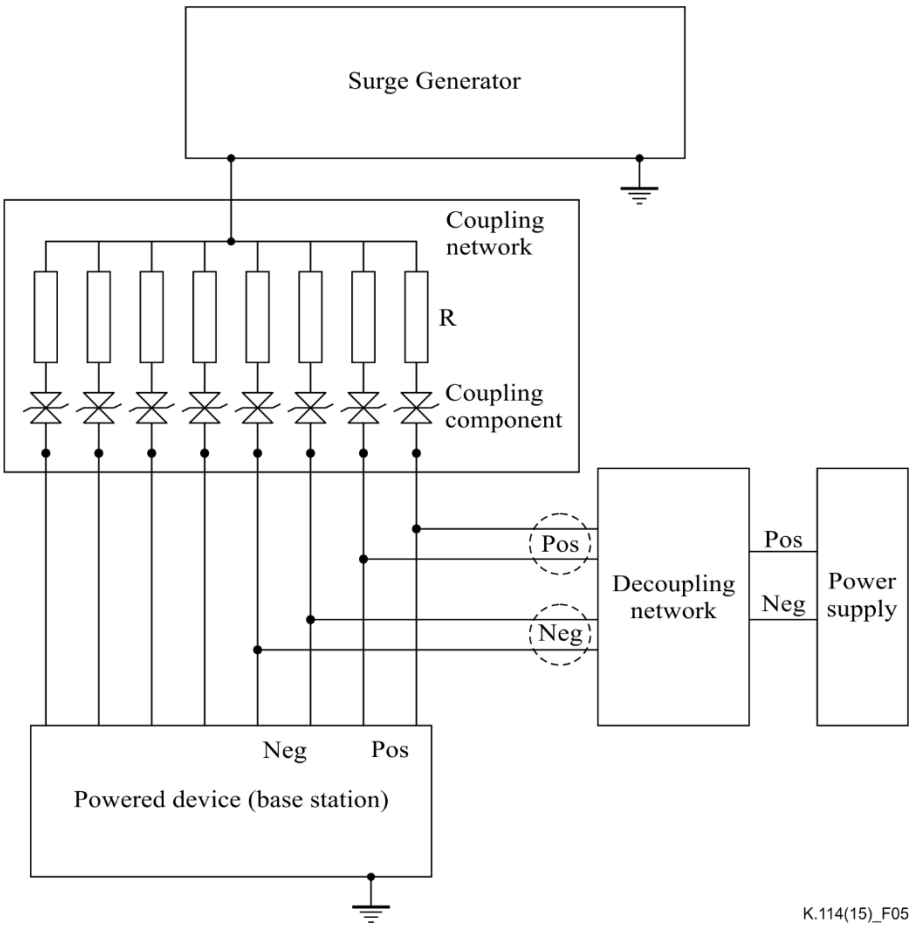
The base station may be powered either by adapter or by PoE. Surge tests shall be conducted for the following two conditions: PoE powered and PoE powered switch off but powered by adaptor if it is possible. When the powered PoE port is under a surge test, the adapter shall be removed. Decoupling network performance shall be good enough to not affect the test results.

Equipment grounding configuration and connection shall be consistent with the real application.

Test methods for shielded PoE cables shall be performed in accordance with [IEC 61000-4-5] section 7.6. Test methods for unshielded PoE cables for both line-to-line and line-to-ground coupling are as follows:

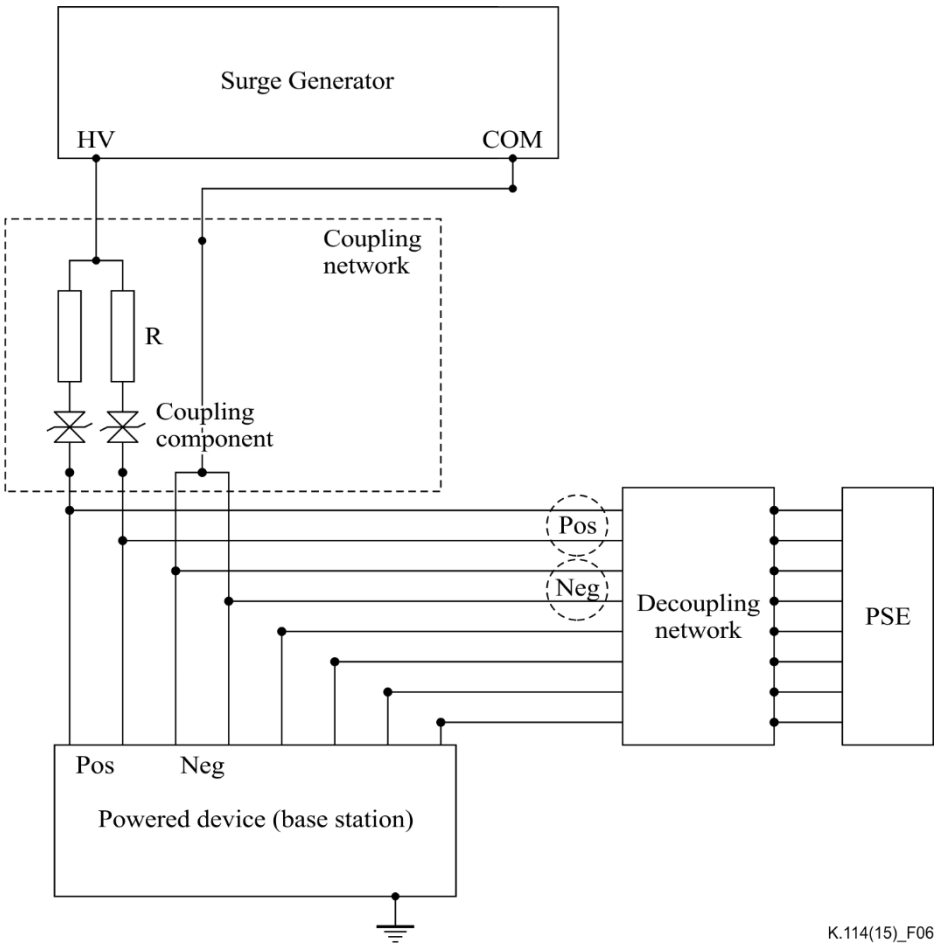
– line-to-ground coupling: All the eight lines to the ground simultaneously; the test setup is given in Figure 5.

– line-to-line coupling: The test 1/2 to 3/6, and 4/5 to 7/8 shall be performed respectively, the test setup is given in Figure 6.



NOTE – For each coupling network, R shall not exceed 250 Ω with indoor cable and shall be 25 Ω with outdoor cables.
Coupling and decoupling network for power lines in [IEC 61000-4-5] shall be used.
Tests should be performed again after switch off power sourcing equipment (PSE) but powered by adaptor.

Figure 5 – Line-to-ground coupling test configuration for PoE of powered base station



NOTE – For each coupling network, R shall be 80 Ω with indoor cable and shall be 25 Ω with outdoor cables.
Coupling and decoupling network for power lines in [IEC 61000-4-5] shall be used.
Tests should not be performed again after switch off PSE.

Figure 6 – Line-to-line coupling test configuration for PoE of powered base station

7 Test conditions

7.1 General conditions

EUT with different modules mounted in the enclosure should be configured with all the radio and ancillary units necessary if it is possible to obtain the worst case of emission or immunity. As an alternative, it is possible not to use the maximum system configuration if it is technically demonstrated that the insertion of other cards/units in the configuration under test do not change the emission level or the grade of immunity of the EUT. The equipment test conditions have to be as close as possible to the actual installation conditions. The test configuration and mode of operation have to represent the intended use. It is suggested that the EUT, base station system and all radio units shall be at the full radio power output status.

Wiring should be consistent with the specifications. The signal or control ports have to be correctly terminated, either by ancillary equipment necessary to exercise the ports, or in their nominal impedance.

A sufficient number of ports have to be correctly terminated to ensure that the test is representative of normal operating conditions. Only cables that are permanently connected have to be included.

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

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

– the type of modulation, the characteristics of the transmission used for testing (random bit stream, message format, etc.) and the necessary test equipment delivered to enable the assessment of the EUT;
– the operating frequency bands over which the equipment is intended to operate and the necessary bandwidth, the quantity of the carriers which used by the base station during the test;
– the RAT-specific active RF modules and other hardware firms for a communication link in MSR BS or other BS supporting more than one RAT;
– a common communication link used by more than one RAT shall be assessed on any one RAT;
– the ancillary equipment to be combined with the radio equipment for testing (where applicable).

7.2 General arrangements for test signals

The test signals should be arranged accordance with clauses 4 of [ETSI EN 301 489-1] and [ETSI EN 301 489-50].

7.2.1 Arrangements for test signals

For emission test, the maximum emission shall be measured. For immunity test, the key performances for all bands shall be covered and monitored.

For the BS supporting more than one RAT, including MSR BS, tests shall be conducted with all the RAT operation one by one or simultaneously. For the base station only one RAT but supporting more than one band, tests shall be conducted with all the bands operation one by one or simultaneously.

For multi-carrier base station, the carrier shall be arranged to highest power, and in the maximum RF necessary bandwidth that the manufacturer declares, all carriers shall be distributed equally spaced but minimum shall cover three frequencies: top, middle, and bottom in the test carrier band.

For single carrier base station, it also shall be arranged to be tested on the top/middle/bottom frequencies of transmit band.

7.2.2 Arrangements for carrier

The wanted RF signal nominal frequency shall be selected by setting the channel number according to the following:

UTRA/E-UTRA/GSM-EDGE/MSR

– the absolute radio-frequency channel number (EARFCN) for evolved universal terrestrial radio access (E-UTRA) carrier;

– the absolute radio-frequency channel number (UARFCN) for UTRA carrier;

– the absolute radio-frequency channel number (ARFCN) for GSM/EDGE carrier.

CDMA

– set the CDMA channel to an appropriate number.

Mobile WiMAX

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

7.2.3 Arrangements for communication link

A communication link shall be set up with a suitable test system capable of evaluating the required performance criteria at the radio interface and telecommunication port/ports (e.g., the S1/Iub/Abis interface).

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

– the EUT shall be set to operate at maximum rated transmit power;

– adequate measures shall be taken to avoid the effect of the unwanted signal on the measuring equipment;

– the wanted RF input signal level shall be set to a level where the performance is not limited by the receiver noise floor or strong signal effects.

  • for E-UTRA, UTRA frequency division duplex (FDD) and time division duplex (TDD), the wanted signal can be set e.g., 15 dB above the reference sensitivity level as defined in [ETSI TS 136 141], [ETSI TS 125 141] or [ETSI TS 125 142] respectively, to provide a stable communication link;

  • for GSM/EDGE, the wanted receiver input signal level shall be set to a nominal value of −47 dBm;

  • for CDMA, a communication link shall be set up with a suitable mobile station simulator (hereafter called "the test system") according to the radio configuration (RC) supported by the base station (see clause 1.3 in [TIA-97-E-1] using full data rate only). The wanted RF signal level at the input of the EUT shall be set to no more than 40 dB above the reference sensitivity level.

For Mobile WiMAX, 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}.

7.2.4 Normal test modulation

A communication link shall be set up with suitable base station system test equipment.

UTRA

The normal test modulation should be a bearer with the characteristics of data rate shown in Table 1.

If the test is not performed using one of these bearers, e.g., none of them are supported by the BS, the characteristics of the bearer used shall be declared by the manufacturer and recorded in the test report.

Table 1 – Bearer information data rate

Bearer information data rate
12.2 kbit/s
64 kbit/s
144 kbit/s
384 kbit/s

E-UTRA

The normal test modulation should be a bearer with the characteristics of data rate shown in Table 2.

If the test is not performed using one of these bearers, (for example none of them are supported by the BS), the characteristics of the bearer used shall be declared by the manufacturer and recorded in the test report.

Table 2 – Bearer information data rate

E-UTRA channel bandwidth [MHz]	Bearer information data rate
1.4	FRC A1-1 in clause A.1 in [ETSI TS 136 104]
3	FRC A1-2 in clause A.1 in [ETSI TS 136 104]
5	FRC A1-3 in clause A.1 in [ETSI TS 136 104]
10	FRC A1-3 in clause A.1 in [ETSI TS 136 104] (see Note)
15	FRC A1-3 in clause A.1 in [ETSI TS 136 104] (see Note)
20	FRC A1-3 in clause A.1 in [ETSI TS 136 104] (see Note)
NOTE – This is the information data rate of a single instance of the bearer mapped to 25 resource blocks. The performance criteria shall be met for each consecutive application of a single instance of the bearer mapped to disjoint frequency ranges with a width of 25 resource blocks each.	

GSM/EDGE

The normal test modulation shall be delivered by a suitable mobile station or base station system test equipment (BSSTE), See [ETSI TS 151 021].

CDMA

A communication link shall be set up with a suitable base station system test equipment. The normal test modulation should be set up according to the RC supported by the base station under test using full data rate only (see clause 1.3 in [TIA-97-E-1]).

Mobile WiMAX

A representative modulated RF signal corresponding to normal operation (see in [IEEE 802.16]).

7.2.5 Arrangements for repeaters

For 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.

7.3 Exclusion band

7.3.1 Transmitter exclusion band

The frequency component products, including spurious emissions and out-of-band emissions, are covered by the RF spectral mask specification or spurious emission requirement according to ITU-R Recommendations and are not considered for compliance to this Recommendation.

For the purpose of EMC testing the following shall apply:

– During the emissions test the exclusion band for transmitter shall be:

$$Fc1 - 2.5 \times BW_{Channel}\ MHz < f < Fc2 + 2.5 \times BW_{Channel}\ MHz$$

Where:

Fc1: Centre frequency of first carrier frequency in one band used by the BS or repeater

Fc2: Centre frequency of last carrier frequency in one band used by the BS or repeater

$BW_{Channel}$: Channel Necessary Bandwidth.

– During the radiated immunity test the following shall apply:

- There shall be no transmitter exclusion band for UTRA, E-UTRA, GSM/Edge, CDMA, Mobile WiMAX and MSR.

7.3.2 Receiver exclusion band

The base station system (BSS) receiver exclusion band is the band of frequencies over which no tests of radiated immunity of a receiver are made. The RF exclusion band applies to radio equipment with an operating frequency up to 6 GHz, or for equipment operating above 6 GHz, but whose RF bandwidth extends to a frequency below 6 GHz.

For equipment operating at frequencies above 6 GHz and whose RF bandwidth does not extend to a frequency below 6 GHz, there is no exclusion band.

The receiver exclusion band 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, could be set out as follows:

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).

CDMA

For CDMA multi-carrier equipment, the receiver exclusion band shall be the carrier centre frequency ± (2.5 × necessary bandwidth).

7.3.3 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 is 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.

7.4 Narrowband responses on receivers

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

– if during an immunity test the quantity being monitored goes outside the specified tolerances (see clause 9), it is necessary to establish whether the deviation is due to a narrowband response or to a wideband (EMC) phenomenon. Therefore, the test shall be repeated with the unwanted signal frequency first increased, and then decreased by an offset, foffset, where:
  - for UTRA, f_{offset} = 10 MHz;
  - for E-UTRA, f_{offset} = 2 × BWChannel, where BWChannel is the channel bandwidth as defined in [ETSI TS 136 104];
  - for GSM/EDGE, f_{offset} = 400 kHz;
  - for CDMA, f_{offset} = 10 MHz, f_{offset} = 12.5 MHz;
  - for mobile WiMAX, f_{offset} = 2 × BWChannel, where BWChannel is the channel bandwidth;
– if the deviation disappears in either or both of the above offset cases, then the response is considered as a narrowband 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 narrowband response. Under these circumstances the procedure is repeated with the increase and decrease of the frequency of the unwanted signal set to 1.25 × f_{offset};
– 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.

Narrowband responses are disregarded.

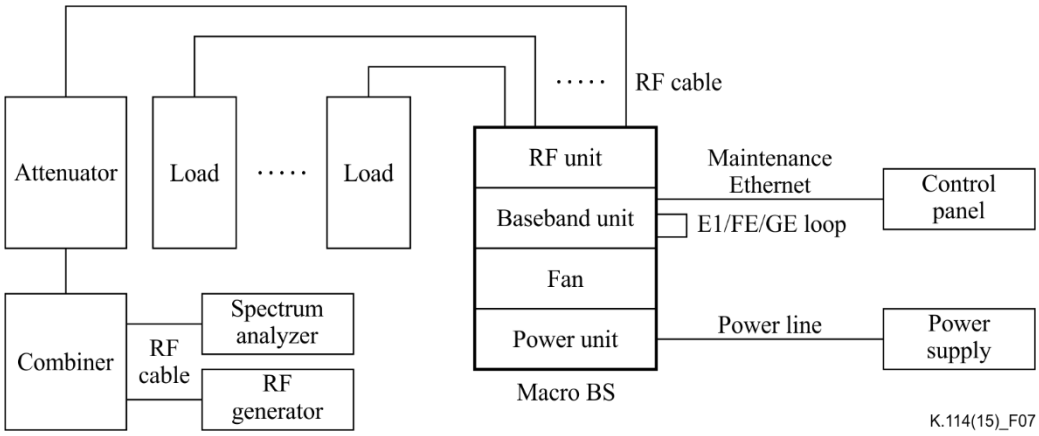
8 Specific test configurations

Test configurations which are not included in this section shall comply with the requirements in clauses 6 and 7.

A BS for 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 shall be located inside the test environment and shall be exposed simultaneously to the immunity test signals. The test system shall be located outside of the test environment.

For transceivers operating at the same frequency in TDD system, the wanted output signal of the transmitter may be used via a suitable attenuator and applied to the input of the receiver as the wanted input signal in the emission test.

8.1 Macro base station



NOTE – E1/FE/GE ports can be connected using a self-test loop or to auxiliary equipment, as long as business functions can be achieved.

Figure 7 – A typical test configuration for macro base stations

Macro base station cabinets need to be intact without deformation, and each unit is well connected in accordance with the product instructions. During the test the door of cabinet shall be closed.

Macro base stations shall be placed on 10 cm insulated support, If it is an inter-unit cable, like the E1/fast Ethernet (FE)/GE cable, where the length is not long enough to drape to the horizontal ground reference plane, the excess length of cables shall be bundled at the approximate centre of the cable with the bundles 30 cm to 40 cm in length. The bundle shall be positioned in such a way that it is either 0.4 m above the horizontal ground reference plane or at the height of the cable entry or connection point, if this is within 0.4 m of the horizontal ground reference plane.

Antenna ports shall be terminated by a non-inductive resistor equal to the value of the nominal impedance or attenuator, and RF leakage is not permitted.

For emission testing, it is recommended to disconnect the maintenance cable in order to avoid the auxiliary equipment impacting the test result. For immunity testing, cables connected to the auxiliary equipment shall be decoupled to prevent auxiliary equipment being susceptible to interference, and equipment performances shall be appropriately monitored.

8.2 Distributed base station

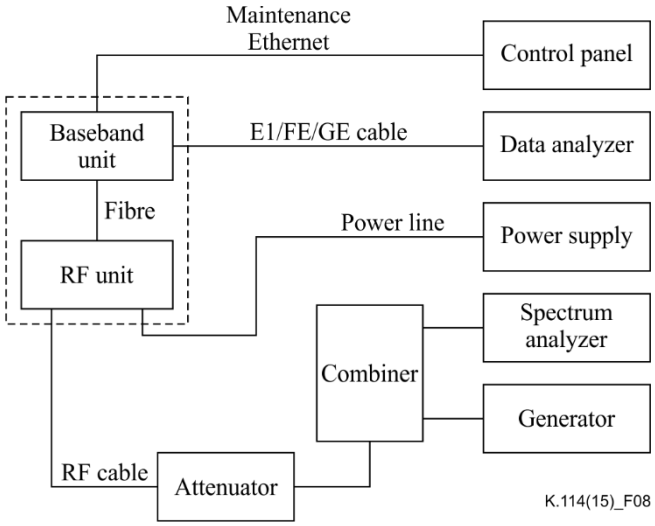


Figure 8 – A typical test configuration for distributed base stations

If the RF unit is the EUT, it shall be hung on a pole away from the horizontal ground reference plane 0.8 m high. The antenna shall be terminated by a non-inductive resistor equal to the value of the nominal impedance or attenuator. Also, RF leakage is not permitted.

If the baseband unit is the EUT, it shall be installed in an open frame away from the horizontal ground reference plane 0.8 m high. For emission testing, it is recommended to disconnect the maintenance cable in order to avoid the auxiliary equipment impacting the test result. For immunity testing, cables connected to the auxiliary equipment shall be decoupled to prevent auxiliary equipment being susceptible to interference, and equipment performances shall be appropriate monitored.

8.3 Micro base station

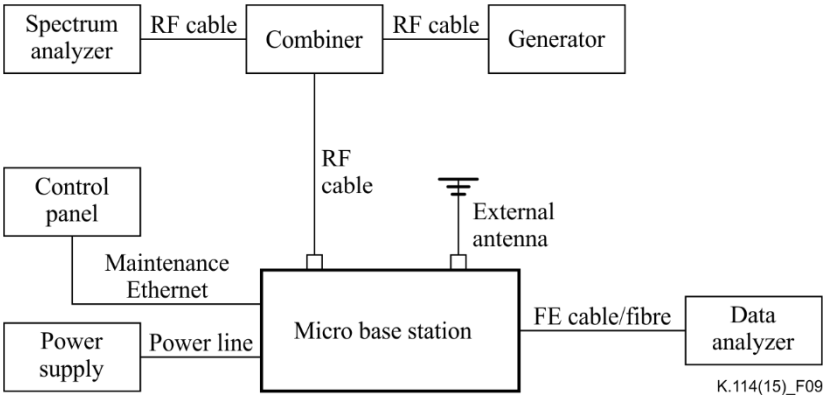


Figure 9 – A typical test configuration for micro base stations

Micro base stations shall be tested as tabletop equipment.

For emission testing, it is recommended to disconnect the maintenance cable in order to avoid the auxiliary equipment impacting the test result.

The micro base station can be tested with the antenna if the total equivalent isotropically radiated power (EIRP) is less than 5 watts.

The antenna port of the micro base station shall match the load if the total EIRP. is greater than 5 watts and the antenna is detachable. The chassis can be punched for built-in antenna to achieve the antenna port connecting to the test instruments.

If the antenna cannot be separated and the EIRP. is greater than 5 watts, for environment protection and test stuff safety, recommend that tests should be performed in the anechoic chamber or shielding room. An antenna shall be installed in the anechoic chamber to build an airport signal chain and to connect to measuring instruments outside, or to create an airport signal loopback by EUT-self. During the radiated emission test, a notch filter which has a working frequency exactly in the transmitting band of a base station shall be installed in the emission receiving path to prevent the receiver overloading. For multi-carrier base stations, an appropriate filter shall be installed in the emission receiving path to prevent the receiver overloading because of intermodulation from multi-carriers through the receiver. Lower power can be used if diminution power influence on the emission measurement results less than 2 dB or does not affect the normal function assessment of the base station.

During immunity testing, cables connected to the auxiliary equipment shall be decoupled to prevent auxiliary equipment being susceptible to interference, and equipment performances shall be appropriate monitored.

8.4 Pico base station

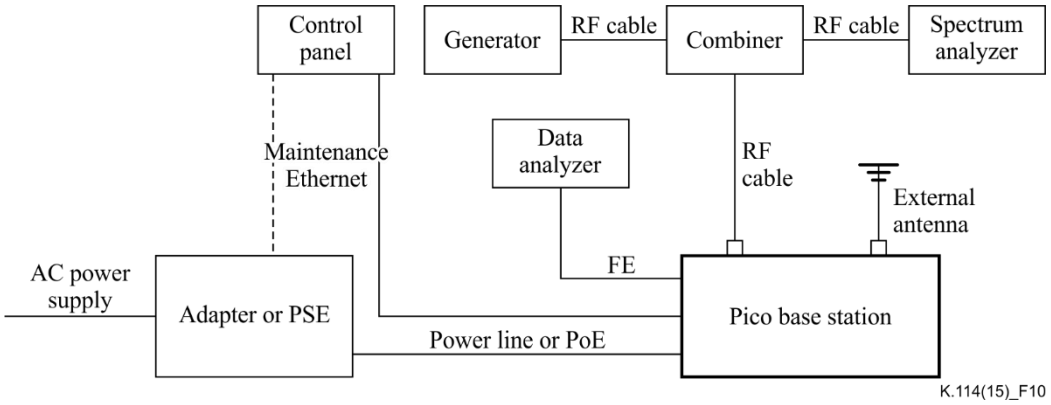


Figure 10 – A typical test configuration for pico base stations

The antenna of pico base stations may be built-in or external, and single-channel or multi-channel. Pico base stations shall be tested as tabletop equipment, and its EIRP. is generally so small that it can be tested with the antenna. It is recommended to create an airport signal loopback by EUT-self.

8.5 Active antenna system base station

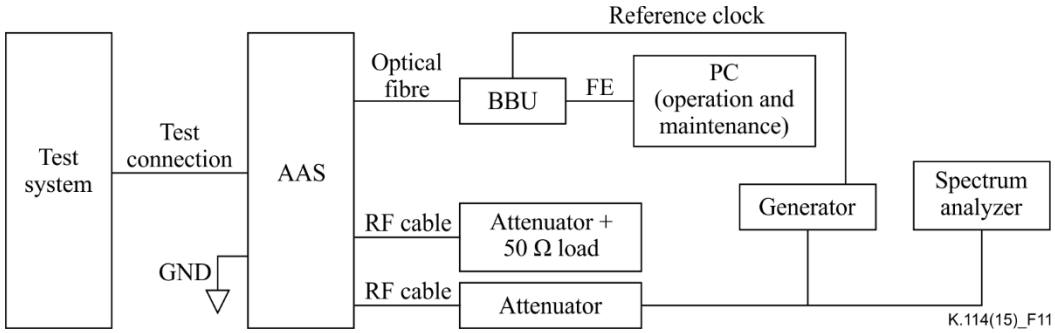


Figure 11 – A typical test configuration for active antenna system base stations

Active antenna system (AAS) base station shall be hung on a pole and it is away from the horizontal ground reference plane 0.1 m high.

If the antenna cannot be separated and EIRP greater than 5 watts, for environmental protection and the safety of test staff , it is recommended that tests are performed in the anechoic chamber or shielding room. An auxiliary antenna shall be installed behind of the receive antenna of anechoic chamber to build an airport signal chain and to connect to measuring instruments outside, or to create an airport signal loopback by EUT-self. During the radiated emission test, a notch filter which has a working frequency exactly in the transmitting band of a base station shall be installed in the emission receiving path to prevent the receiver overloading. For multi-carrier base stations, an appropriate filter shall be installed in the emission receiving path to prevent the receiver overloading because of intermodulation from multi-carriers through the receiver. Lower power can be used if diminution power influence on the emission measurement results less than 2 dB or does not affect the normal function assessment of the base station.

During immunity testing, cables connected to the auxiliary equipment shall be decoupled to prevent auxiliary equipment being susceptible to interference, and equipment performances shall be appropriate monitored. If the antenna can be separated, the antenna port shall be terminated by a non-inductive resistor equal to the value of the nominal impedance or attenuator, and RF leakage is not permitted.

9 Performance assessment

Clause 5 of [ETSI EN 301 489-50] shall apply.

During the immunity test, various performance indicators of EUT operations shall be monitored in real time by appropriate auxiliary equipment, such as BER, block error ratio (BLER), frame error ratio (FER), throughput (the test method according to [ITU-T K.88]). Auxiliary equipment cannot affect the test result. During exposure, the operating environment, operating status, alarms, etc. shall be detected through the signal/control port.

9.1 Assessment of BLER/throughput/BER/FER in downlink

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

For UTRA (BLER)

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 [ETSI TS 125 101] in case of FDD and [ETSI TS 125 102] in case of TDD.

For E-UTRA (throughput)

The output of the transmitter shall be connected to equipment which meet the requirements for the throughput assessment of [ETSI TS 136 101] for the bearer used in the immunity tests.

For CDMA (FER)

For immunity testing, the output of the transmitter shall be connected to a test system which meets the requirements for the FER assessment in accordance with 2-1 of [TIA/EIA/IS-2000 Series] and [TIA-97-E-1]. The level of the signal supplied to the test system shall be attenuated such that it is within the range for which the assessment of FER is not impaired.

For Mobile WiMAX

The output of the transmitter shall be connected to equipment which meets the requirements for throughput assessment.

For GSM/EDGE (BER)

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

Assessment of BER using static layer 1 functions

The transmitter under test shall be operated according to the test case of [ETSI TS 151 021] clause 6.1.2.

The bit sequence from the output of the transmitter shall be monitored by the test system according to the test case of [ETSI TS 151 021] clause 7.1.2, and the BER of the class 2 bits for TCH/FS assessed. The BER shall not exceed the values specified in clause 6.1 of this Recommendation.

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.

Assessment of BER using RXQUAL

The output of the transmitter shall be connected to an equipment which meets the requirements of either [ETSI TS 151 010-1], or [ETSI TS 100 607-1] for the assessment of received signal quality (RXQUAL). The RXQUAL shall be monitored during the test. The RXQUAL shall not exceed the values specified in clause 6.1.

NOTE – This equipment can be a GSM mobile station with suitable provision for the monitoring of RXQUAL

9.2 Assessment of BLER/throughput/BER/FER in uplink

For UTRA (BLER)

The value of the BLER at the output of the receiver reported by the BS shall be monitored at the Iub interface by using suitable test equipment.

For E-UTRA (throughput)

The value of the throughput at the output of the receiver shall be monitored at S1 interface by using suitable test equipment.

For CDMA (FER)

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

For Mobile WiMAX

The value of the throughput at the output of the receiver shall be monitored at the backhaul interface by using suitable test equipment.

For GSM/EDGE (BER)

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

Assessment of BER using RXQUAL

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

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 BTS 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.

9.3 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.

10 Performance criteria

Clause 6 of [ETSI EN 301 489-50] shall apply.

10.1 Performance criteria A for continuous phenomena applied to base stations and repeaters

10.1.1 Base stations (BS)

For UTRA

The BLER calculation shall be based on evaluating the cyclical redundancy check (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}.

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.

For E-UTRA

The test should, where possible, be performed using a bearer with the characteristics of data rate and throughput defined in Table 3. If the test is not performed using one of these bearers (for example, of none of them are supported by the BS), the characteristics of the bearer used shall be recorded in the test report.

The throughput in Table 3 is stated relative to the maximum throughput of the FRC. The maximum throughput for an FRC is equal to the payload size × the number of uplink subframes per second.

The BS uplink and downlink paths shall each meet the performance criteria defined in Table 3 during the test. If the uplink and downlink paths are evaluated as a one loop then the criteria is two times the throughput reduction shown in Table 3. After each test case BS shall operate as intended with no loss of user control function, stored data and the communication link shall be maintained.

Table 3 – BS performance criteria for continuous phenomena for BS

E-UTRA channel bandwidth [MHz]	Bearer information data rate	Performance criteria (see Notes 1 and 2)
1,4	FRC A1-1 in clause A.1 in [ETSI TS 136 104]	Throughput > 95% No loss of service
3	FRC A1-2 in clause A.1 in [ETSI TS 136 104]	Throughput > 95% No loss of service
5	FRC A1-3 in clause A.1 in [ETSI TS 136 104]	Throughput > 95% No loss of service
10	FRC A1-3 in clause A.1 in [ETSI TS 136 104] (see Note 3)	Throughput > 95% No loss of service
15	FRC A1-3 in clause A.1 in [ETSI TS 136 104] (see Note 3)	Throughput > 95% No loss of service
20	FRC A1-3 in clause A.1 in [ETSI TS 136 104] (see Note 3)	Throughput > 95% No loss of service

NOTE 1 – The performance criteria, Throughput > 95% / No loss of service, applies also if a bearer with another characteristics is used in the test.

NOTE 2 – The performance criteria, Throughput > 90% / No loss of service, applies instead if the uplink and downlink paths are evaluated as a one loop.

NOTE 3 – This is the information data rate of a single instance of the bearer mapped to 25 resource blocks. The performance criteria shall be met for each consecutive application of a single instance of the bearer mapped to disjoint frequency ranges with a width of 25 resource blocks each.

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.

For GSM/EDGE

Downlink

The BER of the downlink shall be assessed during the test according to one of the test methods of clause 8.1.

If the test method of clause 8.1.1 is used, the measured BER of the class 2 bits of TCH/FS shall not exceed 1.6% during the test.

NOTE 1 – This BER is the upper limit in [ETSI TS 145 008] for RXQUAL = 3.

If the test method of clause 8.1.2 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.

Uplink

The BER of the uplink shall be assessed during the test according to one of the test methods of clause 8.2.

If the test method of clause 8.2.1 is used, the value of RXQUAL shall not exceed 3 during the test.

If the test method of clause 8.2.2 is used, the measured BER of the class 2 bits of TCH/FS shall not exceed 1.6% during the test.

NOTE 2 – This BER is the upper limit in [ETSI TS 145 008] 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.

For CDMA

During the immunity test, the observed FER of the BS forward link and reverse link shall not exceed 1.0 per cent with 95 per cent confidence (see clause 6.8 in [TIA-97-E-1]), and the BS shall operate as intended. However, in the case of PAMR base stations the observed FER of the BS forward link and reverse link shall not exceed 2.0 per cent with 95 per cent confidence (see clause 6.8 in [TIA-97-E-1]), and the BS shall operate as intended.

For Mobile WiMAX

Table 4 – Mobile WiMAX

Mobile WiMAX channel bandwidth [MHz]	**Performance criteria (see Notes 1 and 2)**
5	Throughput > 95% No loss of service
10	Throughput > 95% No loss of service
NOTE 1 – The performance criteria, Throughput > 95% / No loss of service, applies also if a bearer with another characteristics is used in the test. NOTE 2 – The performance criteria, Throughput > 90% / No loss of service, applies instead if the uplink and downlink paths are evaluated as a one loop.	

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

10.1.2 Repeaters

The RF gain of the EUT shall be measured throughout the period of exposure to the phenomenon. The RF gain measured during the test shall not deviate 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.

10.2 Performance criteria B for transient phenomena for base stations and repeaters

10.2.1 Base stations

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.

10.2.2 Repeaters

The RF gain of the EUT 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.

10.3 Performance criteria for ancillary equipment

10.3.1 Performance criteria A for continuous phenomena for ancillary equipment

The EUT shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed below the performance level specified by the manufacturer, when the apparatus is used as intended.

The performance level may be replaced by a permissible performance loss. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.

10.3.2 Performance criteria B for transient phenomena for ancillary equipment

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

10.4 Performance criteria C

Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls, or in the case of switching equipment, by normal subsequent use.

Annex A

Emission test level

(This annex forms an integral part of this Recommendation.)

Table A.1 – Equipment for telecommunication centre

	Frequency	Quasi-peak limit	Average limit	Basic standard	Remarks
Enclosure port					
Radiated electromagnetic field	30 to 230 MHz	40 dB(μV/m)	N/A	[IEC CISPR 32]	Physically large systems should be tested according to [ITU-T K.38] (Note 3)
	230 to 1000 MHz	47 dB(μV/m)			
	1 to 3 GHz	76 dB(μV/m) (peak limit)	56 dB(μV/m)		(Note 4)
	3 to 6 GHz	80 dB(μV/m) (peak limit)	60 dB(μV/m)		
Telecommunication ports (outdoor and indoor)					
Conducted disturbance voltage	0.15 to 0.5 MHz	97 to 87 dB(μV) or 53 to 43 dB(μA)	84 to74 dB(μV) or 40 to 30 dB(μA)	[IEC CISPR 32]	(Note 1 and Note 2)
	0.5 to 30 MHz	87 dB(μV) or 43 dB(μA)	74 dB(μV) or 30 dB(μA)		(Note 1 and Note 2)
AC power ports					
Conducted disturbance voltage	0.15 to 0.5 MHz	79 dB(μV)	66 dB(μV)	[IEC CISPR 32]	
	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)	[IEC CISPR 32]	
	0.5 to 30 MHz	73 dB(μV)	60 dB(μV)		

NOTE 1 – The limits decrease linearly with the logarithm of the frequency.
NOTE 2 – Equivalent current limit can be applied.
NOTE 3 – The limits are given for 10 metres measurement distance.
NOTE 4 – The limits are given for 3 metres measurement distance.

Table A.2 – Equipment for customer premises and outside plant

	Frequency	Quasi-peak limit	Average limit	Basic standard	Remarks
Enclosure port					
Radiated electromagnetic field	30 to 230 MHz	30 dB(μV/m)	N/A	[IEC CISPR 32]	Physically large systems should be tested according to [ITU-T K.38] (Note 3)
	230 to 1000 MHz	37 dB(μV/m)			
	1 to 3 GHz	70 dB(μV/m) (peak limit)	50 dB(μV/m)		(Note 4)
	3 to 6 GHz	74 dB(μV/m) (peak limit)	54 dB(μV/m)		
Telecommunication ports (outdoor and indoor)					
Conducted disturbance voltage	0.15 to 0.5 MHz	84 to 74 dB(μV) or 40 to 30 dB(μA)	74 to 64 dB(μV) or 30 to 20 dB(μA)	[IEC CISPR 32]	(Note 1 and Note 2)
	0.5 to 30 MHz	74 dB(μV) or 30 dB(μA)	64 dB(μV) or 20 dB(μA)		(Note 1 and Note 2)
AC power ports					
Conducted disturbance voltage	0.15 to 0.5 MHz	66 to 56 dB(μV)	56 to 46 dB(μV)	[IEC CISPR 32]	
	0.5 to 5 MHz	56 dB(μV)	46 dB(μV)		
	5 to 30 MHz	60 dB(μV)	50 dB(μV)		
DC power ports					
Conducted disturbance voltage	0.15 to 0.5 MHz	79 dB(μV)	66 dB(μV)	[IEC CISPR 32]	
	0.5 to 30 MHz	73 dB(μV)	60 dB(μV)		

NOTE 1 – The limits decrease linearly with the logarithm of the frequency.

NOTE 2 – Equivalent current limit can be applied.

NOTE 3 – The limits are given for 10 metres measurement distance.

NOTE 4 – The limits are given for 3 metres measurement distance.

Annex B

Immunity test level

(This annex forms an integral part of this Recommendation.)

Table B.1 – Equipment for telecommunication centre

Environmental phenomena	Units	Test levels	Basic standard	Performance criteria	Remarks
Enclosure port					
Electrostatic discharge	kV kV	4 (contact) 4 (air)	[IEC 61000-4-2]	B	
Radio-frequency electro-magnetic field	MHz V/m %AM(1 kHz)	80~800 3 80	[IEC 61000-4-3]	A	
		800~960 10 80			
		960~1400 3 80			
		1400~2000 10 80			
		2000~6000 3 80			
Outdoor telecommunication ports (Note 1)					
Fast transients	kV (T_r/T_h)ns repetition rate kHz	0.5 5/50 5	[IEC 61000-4-4]	B	Note 3
Radio-frequency conducted continuous	MHz V %AM(1 kHz)	0.15 ~ 80 3 80	[IEC 61000-4-6]	A	Note 4
Surges	(T_r/T_h) µs kV kV	10/700 µs 0.5 (line to line) 1 (line to ground)	[IEC 61000-4-5]	B	Notes 5 and 7
Indoor telecommunication ports					
Fast transients	kV (T_r/T_h) ns repetition rate kHz	0.5 5/50 5	[IEC 61000-4-4]	B	Note 3

Table B.1 – Equipment for telecommunication centre

Environmental phenomena	Units	Test levels		Basic standard	Performance criteria	Remarks
Radio-frequency conducted continuous	MHz V %AM(1 kHz)	0.15~80 3 80		[IEC 61000-4-6]	A	Note 4
Surges	(T_r/T_h)µs kV	1.2/50(8/20) 0.5 (line to ground)		[IEC 61000-4-5]	B	Notes 5 and 6
AC power port						
Fast transients	kV (T_r/T_h)ns kHz	1 5/50 5		[IEC 61000-4-4]	B	Note 3
Radio-frequency conducted continuous	MHz V %AM(1 kHz)	0.15~80 3 80		[IEC 61000-4-6]	A	Note 4
Surges	(T_r/T_h)µs kV kV	1.2/50(8/20) 0.5 (line to line) 1 (line to ground)		[IEC 61000-4-5]	B B	
Voltage dips & interruption	% reduction period	>95 0.5		[IEC 61000-4-11]	B	Note 8
		30 25			C	
		>95 250			C	
DC power port						
Fast transients	kV (T_r/T_h)ns repetition rate kHz	0.5 5/50 5		[IEC 61000-4-4]	B	Note 3
Radio-frequency conducted continuous	MHz V %AM(1 kHz)	0.15~80 3 80		[IEC 61000-4-6]	A	Note 4
Surges	(T_r/T_h)µs kV kV	1.2/50(8/20) 0.5 (line to line) 1 (line to ground)		[IEC 61000-4-5]	B B	
Voltage dips, Voltage interruption, Voltage variation, Abnormal voltage		Residual voltage $\%U_T$	Duration time s	[IEC 61000-4-29]	–	
	Voltage dip	70	0.01		C (Notes 9, 10 and 13)	
			1			
		40	0.01			
			1			
	Voltage interruption	0	0.001			low and high impedance (output impedance of test generator)
			0.1			
			1			
	Voltage	From	0.1		A	The test

Table B.1 – Equipment for telecommunication centre

Environmental phenomena	Units	Test levels		Basic standard	Performance criteria	Remarks
	variation	100 to 90	10			simulates a change in the DC voltage from the nominal value to a lower value
		From 100 to 110	0.1			The test simulates a change in the DC voltage from the nominal value to a higher value
			10			
	Abnormal voltage	0-90	1	[IEC 61000-4-29]	C (Notes 11, 12 and 13)	
		110-125	1			

NOTE 1 – Outdoor lines carrying DC power with superimposed signals shall be treated as outdoor signal lines.

NOTE 2 – Only applies when the overall cable length between the EUT and another item of active equipment may be greater than 3 m.

NOTE 3 – The repetition rate shall be 100 kHz. Re-testing of equipment tested according to the earlier version of the basic standard with the repetition rate of 5 kHz is not required.

NOTE 4 – The test level can be defined as equivalent current into 150 Ω.

NOTE 5 – This test may not be applied for unscreened cable when appropriate CDN does not exist.

NOTE 6 – Only applies when the overall cable length between the EUT and another item of active equipment may be greater than 10 m.

NOTE 7 – The line-to-line test is required only for unbalanced lines as recommended by [IEC 61000-4-5].

NOTE 8 – This test applies to equipment having a rated input current not exceeding 16 A per phase.

NOTE 9 – 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 into account. More detailed information about the service interruption shall be provided by the manufacturer on the request of the operator.

NOTE 10 – 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 11 – Following the restoration of the supply to the normal voltage range, the power conversion and management systems shall automatically restore service. The 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 12 – 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 13 – This test is applicable only in equipment in which the battery backup is not permanently connected to the DC distribution system.

Table B.2 – Equipment for customer premises

Environmental phenomena	Units	Test levels	Basic standard	Performance criteria	Remarks
Enclosure port					
Electrostatic discharge	kV kV	4 (contact) 8 (air)	[IEC 61000-4-2]	B	
Radio-frequency electro-magnetic field	MHz V/m %AM(1 kHz)	80~800 3 80	[IEC 61000-4-3]	A	
		800~960 10 80			
		960~1400 3 80			
		1400~2000 10 80			
		2000~6000 3 80			
Outdoor telecommunication ports (Note 1)					
Fast transients	kV (T_r/T_h)ns repetition rate kHz	0.5 5/50 5	[IEC 61000-4-4]	B	Note 3
Radio-frequency conducted continuous	MHz V %AM(1 kHz)	0.15 ~ 80 3 80	[IEC 61000-4-6]	A	Note 4
Surges	(T_r/T_h)µs kV kV	10/700 us 0.5 (line to line) 1 (line to ground)	[IEC 61000-4-5]	B	Notes 5 and 7
Indoor telecommunication ports					
Fast transients	kV (T_r/T_h) ns repetition rate kHz	0.5 5/50 5	[IEC 61000-4-4]	B	Note 3
Radio-frequency conducted continuous	MHz V %AM(1 kHz)	0.15~80 3 80	[IEC 61000-4-6]	A	Note 4
Surges	(T_r/T_h)µs kV	1.2/50(8/20) 0.5 (line to ground)	[IEC 61000-4-5]	B	Notes 5, 6 and 14

Table B.2 – Equipment for customer premises

Environmental phenomena	Units	Test levels		Basic standard	Performance criteria	Remarks
AC power port						
Fast transients	kV (T_r/T_h)ns kHz	1 5/50 5		[IEC 61000-4-4]	B	Note 3
Radio-frequency conducted continuous	MHz V %AM(1 kHz)	0.15~80 3 80		[IEC 61000-4-6]	A	Note 4
Surges	(T_r/T_h)µs kV kV	1.2/50(8/20) 0.5(line to line) 1(line to ground)		[IEC 61000-4-5]	B B	
Voltage dips & interruption	% reduction period	>95 0.5		[IEC 61000-4-11]	B	Note 8
		30 25			C	
		>95 250			C	
DC power port						
Fast transients	kV (T_r/T_h)ns repetition rate kHz	0.5 5/50 5		[IEC 61000-4-4]	B	Note 3
Radio-frequency conducted continuous	MHz V %AM(1 kHz)	0.15~80 10 80		[IEC 61000-4-6]	A	Note 4
Surges	(T_r/T_h)µs kV kV	1.2/50(8/20) 0.5 (line to line) 1 (line to ground)		[IEC 61000-4-5]	B B	
Voltage dips, Voltage interruption, Voltage variation, Abnormal voltage		Residual voltage $\%U_T$	Duration time s	[IEC 61000-4-29]	–	
	Voltage dip	70	0.01		C (Notes 9, 10 and 13)	
			1			
		40	0.01			
			1			
	Voltage interruption	0	0.001			low and high impedance (output impedance of test generator)
			0.1			
			1			

Table B.2 – Equipment for customer premises

Environmental phenomena	Units	Test levels		Basic standard	Performance criteria	Remarks
	Voltage variation	From 100 to 90	0.1		A	The test simulates a change in the DC voltage from the nominal value to a lower value
			10			
		From 100 to 110	0.1			The test simulates a change in the DC voltage from the nominal value to a higher value
			10			
	Abnormal voltage	0-90	1	[IEC 61000-4-29]	C (Notes 11, 12 and 13)	
		110-125	1			

Table B.2 – Equipment for customer premises

Environmental phenomena	Units	Test levels	Basic standard	Performance criteria	Remarks
NOTE 1 – Outdoor lines carrying DC power with superimposed signals shall be treated as outdoor signal lines. NOTE 2 – Only applies when the overall cable length between the EUT and another item of active equipment may be greater than 3 m. NOTE 3 – The repetition rate shall be 100 kHz. Re-testing of equipment tested according to the earlier version of the basic standard with the repetition rate of 5 kHz is not required. NOTE 4 – The test level can be defined as equivalent current into 150 Ω. NOTE 5 – This test may not be applied for unscreened cable when appropriate CDN does not exist. NOTE 6 – Only applies when the overall cable length between the EUT and another item of active equipment may be greater than 10 m. NOTE 7 – The line-to-line test is required only for unbalanced lines as recommended by [IEC 61000-4-5]. NOTE 8–This test applies to equipment having a rated input current not exceeding 16 A per phase. NOTE 9 – 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 into account. More detailed information about the service interruption shall be provided by the manufacturer on the request of the operator. NOTE 10 – 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 11 – Following the restoration of the supply to the normal voltage range, the power conversion and management systems shall automatically restore service. The 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 12 – 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 13 – This test is applicable only in equipment in which the battery backup is not permanently connected to the DC distribution system. NOTE 14 – The EUT shall not be reset when the powered surge test be conducted for PoE.					

Table B.3 – Equipment for outside plant

Environmental phenomena	Units	Test levels	Basic standard	Performance criteria	Remarks
Enclosure port					
Electrostatic discharge	kV kV	4 (contact) 8 (air)	[IEC 61000-4-2]	B	
Radio-frequency electro-magnetic field	MHz V/m %AM(1 kHz)	80~800 3 80	[IEC 61000-4-3]	A	
		800~960 10 80			
		960~1400 3 80			
		1400~2000 10 80			
		2000~6000 3 80			
Outdoor telecommunication ports (Note 1)					
Fast transients	kV (T_r/T_h)ns repetition rate kHz	1 5/50 5	[IEC 61000-4-4]	B	Note 3
Radio-frequency conducted continuous	MHz V %AM(1 kHz)	0.15 ~ 80 3 80	[IEC 61000-4-6]	A	Note 4
Surges	(T_r/T_h)µs kV kV	10/700 us 0.5 (line to line) 1 (line to ground)	[IEC 61000-4-5]	B	Notes 5 and 7
AC power port					
Fast transients	kV (T_r/T_h)ns kHz	1 5/50 5	[IEC 61000-4-4]	B	Note 3
Radio-frequency conducted continuous	MHz V %AM(1 kHz)	0.15~80 3 80	[IEC 61000-4-6]	A	Note 4
Surges	(T_r/T_h)µs kV kV	1.2/50(8/20) 1 (line to line) 2 (line to ground)	[IEC 61000-4-5]	B B	

Table B.3 – Equipment for outside plant

Environmental phenomena	Units	Test levels		Basic standard	Performance criteria	Remarks
Voltage dips & interruption	% reduction period	>95 0.5		[IEC 61000-4-11]	B	Note 8
		30 25			C	
		>95 250			C	
DC power port						
Fast transients	kV (T_r/T_h)ns repetition rate kHz	0.5 5/50 5		[IEC 61000-4-4]	B	Note 3
Radio-frequency conducted continuous	MHz V %AM(1 kHz)	0.15~80 3 80		[IEC 61000-4-6]	A	Note 4
Surges	(T_r/T_h)µs kV kV	1.2/50(8/20) 1 (line to line) 2 (line to ground)		[IEC 61000-4-5]	 B B	
Voltage dips, Voltage interruption, Voltage variation, Abnormal voltage		Residual voltage $\%U_T$	Duration time s	[IEC 61000-4-29]	–	
	Voltage dip	70	0.01		C (Notes 9, 10 and 13)	
			1			
		40	0.01			
			1			
	Voltage interruption	0	0.001			low and high impedance (output impedance of test generator)
			0.1			
			1			
	Voltage variation	From 100 to 90	0.1		A	The test simulates a change in the DC voltage from the nominal value to a lower value
			10			
		From 100 to 110	0.1			The test simulates a change in the DC voltage from the nominal value to a higher value
			10			

Table B.3 – Equipment for outside plant

Environmental phenomena	Units	Test levels		Basic standard	Performance criteria	Remarks
	Abnormal voltage	0-90	1	[IEC 61000-4-29]	C (Notes 11, 12 and 13)	
		110-125	1			

NOTE 1 – Outdoor lines carrying DC power with superimposed signals shall be treated as outdoor signal lines.

NOTE 2 – Only applies when the overall cable length between the EUT and another item of active equipment may be greater than 3 m.

NOTE 3 – The repetition rate shall be 100 kHz. Re-testing of equipment tested according to the earlier version of the basic standard with the repetition rate of 5 kHz is not required.

NOTE 4 – The test level can be defined as equivalent current into 150 Ω.

NOTE 5 – This test may not be applied for unscreened cable when appropriate CDN does not exist.

NOTE 6 – Only applies when the overall cable length between the EUT and another item of active equipment may be greater than 10 m.

NOTE 7 – The line-to-line test is required only for unbalanced lines as recommended by [IEC 61000-4-5].

NOTE 8 –This test applies to equipment having a rated input current not exceeding 16 A per phase.

NOTE 9 – 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 into account. More detailed information about the service interruption shall be provided by the manufacturer on the request of the operator.

NOTE 10 – 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 11 – Following the restoration of the supply to the normal voltage range, the power conversion and management systems shall automatically restore service. The 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 12 – 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 13 – This test is applicable only in equipment in which the battery backup is not permanently connected to the DC distribution system.

Annex C

Equipment within the scope of the present Recommendation

(This annex forms an integral part of this Recommendation.)

This Recommendation covers types of base station digital cellular mobile communication equipment as set out below.

C.1 Base station equipment for IMT-2000 CDMA DirectSpread (UTRA)

This Recommendation applies to 3rd Generation Partnership Project (3GPP) (UTRA) radio equipment intended for use in digital cellular mobile radio services. Definitions for base station equipment within the scope of this Recommendation are found in the following functional radio specifications:

– [ETSI TS 125 104];

– [ETSI TS 125 105];

– [ETSI TS 125 106].

C.2 Base station equipment for E-UTRA

This Recommendation applies to 3GPP (UTRA) radio equipment intended for use in digital cellular mobile radio services. Definitions for base station equipment within the scope of this Recommendation are found in the following functional radio specifications:

– E-UTRA base stations meeting the requirements of [ETSI TS 136 104], with conformance demonstrated by compliance to [ETSI TS 136 141];

– E-UTRA repeaters meeting the requirements of [ETSI TS 136 106], with conformance demonstrated by compliance to [ETSI TS 136 143].

C.3 GSM base station, ancillary RF amplifiers, and GSM repeaters meeting Phase 2 and 2+

This Recommendation applies to GSM base stations meeting Phase 2 and 2+ requirements of the GSM digital cellular telecommunications system, and operating in the P-GSM 900 MHz, E-GSM 900 MHz or digital cellular system (DCS) 1800 MHz bands.

C.4 Other types of GSM base station, ancillary RF amplifiers, and GSM repeaters equipment

This Recommendation is also applicable to:

– equipment which operates in other frequency bands, provided that the performance requirements (other than operating frequency) are the same as the Phase 2 or 2+ GSM requirements;

– equipment which is designed to meet Phase 1 GSM requirements, provided that it also meets the Phase 2 or 2+ GSM requirements.

NOTE – This provision is particularly intended for equipment, which is designed to meet either the Phase 1 or the Phase 2 or 2+ GSM requirements by a change of software.

C.5 Multi-standard radio base station equipment

This Recommendation applies to MSR base station equipment intended for use in digital cellular mobile radio services. Definitions for base station equipment within the scope of this Recommendation are found in the following functional radio specification:

– the requirements of [ETSI TS 137 104], with conformance demonstrated by compliance to [ETSI TS 137 141].

C.6 WiMAX base station equipment

This Recommendation applies to Broadband Data Transmission System base station equipment.

This equipment can be found in networks operating in a number of frequency bands subject to national licensing conditions. Examples of such frequency bands are 2500 MHz to 2690 MHz, 3400 MHz to 3600 MHz and 3600 MHz to 3800 MHz details of such equipment can be found in the following harmonized standards:

– [ETSI EN 302 544-1];

– [ETSI EN 302 774].

C.7 Mobile WiMAX base station equipment

This Recommendation applies to Mobile WiMAX base station equipment. Definitions of base station equipment within the scope of this Recommendation are found in the following functional radio specifications:

– [ETSI EN 301 908-20];

– [ETSI EN 301 908-22].

C.8 CDMA 1x spread spectrum base stations, repeaters and ancillary equipment

This Recommendation covers types of base stations and repeaters using CDMA 1x spread spectrum technology and associated ancillary equipment. Definitions of examples of base station equipment within the scope of this Recommendation are found in the following functional radio specifications:

– IMT-2000 CDMA multi-carrier radio equipment intended for use in digital cellular mobile radio services operating in any of the band classes described in [TIA-97-E-1];

– CDMA-PAMR radio equipment operating in one or more of the band classes defined in [TIA-97-E-1];

– [ETSI EN 301 908-5];

– [ETSI EN 301 908-7];

– [ETSI EN 301 449];

– [ETSI EN 302 426].

Annex D

Test guide of radiated emission for wireless base station

(This annex forms an integral part of this Recommendation.)

The measurement instruments, test site and test methods shall follow the requirements of [IEC CISPR 32] and the test setup and test arrangement should follow clauses 7 and 8. This appendix will give additional guidance for radiated emission.

D.1 Software of EUT

The software of EUT during the test should fully control the configuration of base station, which may be considered to include but not limited to:

– work mode of EUT: idle mode or traffic mode;

– radio-frequency channel configuration;

– number of carrier frequencies, quantity of RAT, number of band;

– radio power adjustment;

– signal coding, necessary bandwidth and modulation adjustment.

D.2 Reduce overload of test receiver

To reduce the overload by the wireless signal of base station, the special test auxiliary RF components should be included but not limited to:

– RF coaxial attenuator connected after test antenna to attenuate the receiver power of carriers to reduce the overload effect of the receiver. The attenuator should be 6 dB or more;

– band-block or notching filters connected after antenna if the overload still appears even coaxial attenuator was used. The attenuator for radio power should be 50 dB or more;

– high-pass filters also to reduce the overload effect of the receiver for high test frequency above 1 GHz;

– low-pass filters also to reduce the overload effect of the receiver for high test frequency below 1 GHz.

[IEC CISPR32] Annex E provides the procedure on how to detect the appearance of overload of the receiver.

D.3 Pre-test for radiated emission

The purposes of a pre-test measurement are to determine the frequencies at which an EUT produces the highest level of emissions and to help select the configuration(s) to be used in the formal measurements.

The pre-test should be performed on various EUT configurations to find the worst-cases configurations that produces the highest amplitudes with respect to the limit. These configurations should then be used during final measurements. The number of configurations to be considered is dependent upon the complexity of the base station, including: number of carrier, number of RAT, number of band, type of work mode: idle or traffic, type of backhaul: wireless or optical, type of power supply: AC or DC, etc.

This pre-test should also be performed to distinguish radiated emission from radiated spurious emission. Before the test, the test carrier frequencies of base station should be recorded and most of the spurious emission should be calculated in advance: harmonic emissions, parasitic emissions,

intermediation products and frequency conversion products. These spurious emissions would reduce rapidly when base stations transfer work mode from traffic to idle or power off the radio unit. Or if the radio frequency channel of the carrier is changed, the spurious emission frequencies would change synchronously but not for radiated emission frequencies from digital units. The spurious components should be recorded in the pre-test and be ignored in the final test. The frequencies of carriers and within 250 % necessary bandwidth also should be exclusion band.

Therefore, a quick and simple procedure, according to the different kinds of base station, should be established for comparative purposes so that the impact of varying the configuration can be found.

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