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for Mobile terminals and ancillary equipment

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**3rd Generation Partnership Project;
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for Mobile terminals and ancillary equipment
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Postal address

Office address

Internet

secretariat@3gpp.org
Individual copies of this deliverable
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Foreword

This Technical Specification has been produced by the 3GPP TSG-T1 EMC subworking group.

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of this TS, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

- x the first digit:
 - 1 presented to TSG for information;
 - 2 presented to TSG for approval;
 - 3 Indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the specification;

1. Scope

This present document establishes the essential EMC requirements for mobile terminal equipment and ancillary accessories in combination with a 3GPP terminal.

Equipment conforming to the requirements laid out in the present document and used in its usual electromagnetic environment in accordance with the manufacturers instructions

- does not generate electromagnetic disturbances at a level which may interfere with the intended operation of other equipment;
- has an adequate level of intrinsic immunity to electromagnetic disturbances to operate as intended;

Technical specifications related to the antenna port and emissions from the enclosure port of radio equipment are found in the related product standards for the effective use of the radio spectrum.

The present document specifies the applicable EMC tests, the methods of measurement, the frequency range, the limits and the minimum performance criteria for “3rd generation” digital cellular mobile and portable radio equipment and accessories, transmitting and/or receiving information.

Base station equipment operating within network infrastructure is outside the scope of the present document. However, the present document does cover mobile and portable equipment that is intended to be operated in a fixed location while connected to the AC mains.

The EMC requirements have been selected to ensure an adequate level of compatibility for apparatus in residential, commercial, light industrial and vehicular environments. The levels however, do not cover extreme cases which may occur in any location but with low probability of occurrence.

The environment classification used in the present document refers to the environment classification used in the Generic Standards IEC 61000-6-1 [1], IEC 61000-3 [2], except the vehicular environment class which refers to ISO 7637 Part 1 [3] and Part 2 [4].

Compliance of radio equipment to the requirements of the present document does not signify compliance to any requirement related to the use of the equipment (i.e. licensing requirements).

Compliance to the requirements of the present document does not signify compliance to any safety requirement. However, any temporary or permanent unsafe condition caused by EMC is considered as non-compliance.

2. References

The following documents contain provisions, which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific;
- For a specific reference, subsequent revisions do not apply;
- For a non-specific reference, subsequent revisions do apply;

A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

- [1] IEC 61000-6-1 (1997): "Electromagnetic compatibility (EMC) – Part 6: Generic standards - Section 1: Immunity standard for residential, commercial and light-industrial environments".
- [2] IEC 61000-6-3 (1996): "Electromagnetic compatibility (EMC) – Part 6: Generic standards - Section 3: Emission standard for residential, commercial and light-industrial environments.
- [3] ISO 7637-1 (1990): "Road vehicles - Electrical disturbance by conduction and coupling - Part 1: Passenger cars and light commercial vehicles with nominal 12 V supply voltage - Electrical transient conduction along supply lines only".
- [4] ISO 7637-2 (1990): "Road vehicles - Electrical disturbance by conduction and coupling - Part 2: Commercial vehicles with nominal 24 V supply voltage - Electrical transient conduction along supply lines only".
- [4] EN 300 827 V1.1.1 (1998-03) "Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for Terrestrial Trunked Radio (TETRA) and ancillary equipment Road vehicles - Electrical disturbance by conduction and coupling - Part 2: Commercial vehicles with nominal 24 V supply voltage - Electrical transient conduction along supply lines only".

3. Definitions, symbols and abbreviations

3.1. Definitions

TBD

4. Test conditions

4.1. General

The equipment shall be tested under normal test conditions according to the relevant product and basic standards or to the information accompanying the equipment, which are within the manufacturers declared range of humidity, temperature and supply voltage. The test conditions shall be recorded in the test report.

Whenever the Equipment under test (EUT) is provided with a detachable antenna, the EUT shall be tested with the antenna fitted in a manner typical of normal intended use, unless specified otherwise.

Where the equipment incorporates an external 50 Ω RF antenna connector that is normally connected via a coaxial cable, then the wanted signal to establish a communication link shall be delivered from that connector by a coaxial cable;

Where the equipment incorporates an external 50 Ω RF antenna connector but this port is not normally connected via a coaxial cable and where the equipment does not incorporate an external 50 Ω RF connector (integral antenna equipment), then the wanted signal, to establish a communication link, shall be delivered from the equipment to an antenna located within the test environment;

4.2 Arrangements for establishing a communication link

The wanted RF input signal nominal frequency shall be selected by setting the Absolute Radio Frequency Channel Number (ARFCN) to an appropriate number.

A communication link shall be set up with a suitable base station simulator (hereafter called "the test system"). 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 transmit power;
- the DTX shall be disabled.
- Adequate measures shall be taken to avoid the effect of the unwanted signal on the measuring equipment;
- The wanted input signal level shall be set to 40 dB above the reference sensitivity level as defined in TS xx.xxx [ref], to provide a stable communication link..

When the EUT is required to be in the idle mode, the following conditions shall be met:

- the test system shall simulate a Base Station (BS) with Broadcast Control Channel/Common Control Channel (BCCH/CCCH) on one carrier;
- The EUT shall be synchronised to the BCCH, listening to the CCCH and able to respond to paging messages;
- Periodic Location Updating shall be disabled;

For immunity tests subclauses 4.3 to 4.5, shall apply and the conditions shall be as follows:

4.3 Receiver exclusion band

The exclusion band for the receiver is the band of frequencies over which no radiated immunity tests are made.

The lower frequency of the exclusion band is the lower frequency of the receive band of the EUT minus 5 % of that frequency.

The upper frequency of the exclusion band is the upper frequency of the receive band of the EUT plus 5 % of that frequency.

4.4 Transmitter exclusion band

The exclusion band for the transmitter over which no radiated immunity test is made. The exclusion band for the transmitter extends three times the channel separation ($3 \times 5 \text{ MHz} = 15 \text{ MHz}$) centred on the nominal operating frequency of the transmitter.

4.5 Narrow band responses on receivers

Responses on receivers or duplex transceivers occurring during the 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, it is necessary to establish whether the deviation is due to a narrow band response or to a wide band (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 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 wide band and therefore an EMC problem and the equipment fails the test.

Narrow band responses are disregarded.

5 Performance assessment

5.1 General

The manufacturer shall at the time of submission of the equipment for test, supply the following information to be recorded in the test report:

- the primary functions of the radio equipment to be tested during and after the EMC testing;
- if applicable, the method to be used to verify that a communications link is established and maintained;
- the intended functions of the radio equipment which shall 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 EMC stress;
- the ancillary equipment to be combined with the radio equipment for testing (where applicable);
- the information about ancillary equipment intended to be used with the radio equipment;
- an exhaustive list of ports, classified as either power or signal/control. Power ports shall further be classified as AC or DC power;

5.2 Equipment which can provide a continuous communication link

The test arrangement and signals, given in clause 4, apply to radio equipment or a combination of radio equipment and ancillary equipment that permits the establishment of a communication link.

5.2.1 Equipment with analogue speech circuits

The assessment of the equipment performance shall be based on a voice call.

5.2.2 Equipment without analogue speech circuits

The assessment of the equipment performance shall be specified by the manufacturer.

5.3 Equipment which can only provide a discontinuous communication link (packet data/transmission)

If the equipment does not permit or allow for a communications link to be established and maintained during the EMC tests (as in subclause 5.2), the manufacturer shall define the performance assessment. The manufacturer shall provide the method of observing the degradation of performance of the equipment.

5.4 Equipment which does not provide a communication link

If the equipment is of a specialised nature which does not permit a communication link to be established, the manufacturer shall define the method of test to determine the acceptable level of performance or degradation of performance during and/or after the test. The manufacturer shall provide the method of observing the degradation of performance of the equipment.

The performance assessment carried out shall be simple, but at the same time give adequate proof that the primary functions of the equipment are operational.

5.5 Conformance of ancillary equipment

Ancillary equipment shall be tested with it connected to a receiver, transmitter or transceiver in which case compliance shall be demonstrated to the appropriate clauses of the present document.

5.6 Equipment classification

Equipment is classified according to the source of power.

- If power is derived from a fixed AC or DC supply network installation the equipment is classified “for fixed use”;
- If power is derived from a vehicular power supply (Car battery + alternator) the equipment is classified “for vehicular use”;
- If power is derived from an integral battery the equipment is classified “for portable use”;

6 Performance criteria

The maintenance of a communications link shall be assessed by using an indicator which may be part of the test system or the equipment under test.

Specifically the equipment shall meet the minimum performance criteria as specified in the following subclauses as appropriate.

Portable equipment intended for use whilst powered by the main battery of a vehicle shall additionally fulfil the applicable requirements set out by the present document for mobile equipment for vehicular use.

Portable equipment intended for use whilst powered by AC mains shall additionally fulfil the applicable requirements set out by the present document for equipment for fixed use.

If an equipment is of such nature, that the performance criteria described in the following subclauses 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, as required by the present document. The performance specification shall be included in the product description and documentation.

The performance criteria specified by the manufacturer shall give the same degree of immunity protection as called for in the following subclauses.

In addition, the test shall also be performed in idle mode to ensure the transmitter does not unintentionally operate.

6.1 Performance criteria for Continuous phenomena

A communication link shall be established at the start of the test, and maintained during the test, subclauses 4.1 and 4.2.

For V+D (Voice+Data) equipment the performance criteria can be one of the following:

If a voice call is established the uplink and downlink speech output levels shall be at least 35 dB less than the recorded reference levels, when measured through an audio band pass filter of width 200 Hz, centred on 1 kHz (Annex A).

NOTE: When there is a high level noise background noise present the filter bandwidth can be reduced down to a minimum of 40 Hz.

- if error- correcting systems are not present, the Bit Error Ratio (BER), Message Error Ratio (MER) or error rate using continuous data streams shall not exceed 0.1% , during the test sequence; or

- if effective error- correcting systems are present, transmission time shall not increase more than 100%, compared to data throughput time that is defined by the manufacturer. No corruption of data is allowed.

For PDE(Packet Data Equipment) and non voice equipment the performance criteria can be one of the following:

- if error- correcting systems are not present, the Bit Error Ratio (BER), Message Error Ratio (MER) or error rate using continuous data streams shall not exceed 0.1% during the test sequence; or

- if effective error- correcting systems are present, transmission time shall not increase more than 100%, compared to data throughput time that is defined by the manufacturer. No corruption of data is allowed.

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.

In addition to confirming the above performance during a call, the test shall be performed in idle mode, and the transmitter shall not unintentionally operate.

6.2 Performance criteria for Transient phenomena

A communications link shall be established at the start of the test, subclauses 4.1 and 4.2.

For V+D (Voice+Data) equipment the performance criteria can be one of the following:

- if error- correcting systems are not present, the Bit Error Ratio (BER), Message Error Ratio (MER) or error rate using continuous data streams shall not exceed 0.1% , during the test sequence; or

- if effective error- correcting systems are present, transmission time shall not increase more than 100%, compared to data throughput time that is defined by the manufacturer. No corruption of data is allowed.

For PDE(Packet Data Equipment) and non voice equipment the performance criteria can be one of the following:

- if error- correcting systems are not present, the Bit Error Ratio (BER), Message Error Ratio (MER) or error rate using continuous data streams shall not exceed 0.1% during the test sequence; or

- if effective error- correcting systems are present, transmission time shall not increase more than 100%, compared to data throughput time that is defined by the manufacturer. No corruption of data is allowed.

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.

In addition to confirming the above performance during a call, the test shall also be performed in idle mode, and the transmitter shall not unintentionally operate.

7 Applicability overview tables

7.1 Emission

Table 1: Emission applicability

Phenomenon	Application	Equipment test requirement			Reference subclause in this TS	Reference Standard
		Equipment connected to fixed AC or DC power installations	Equipment connected to vehicular DC supplies	Equipment powered by integral battery		
Radiated emission	Enclosure	applicable	applicable	applicable	8.2	3GPP xxx []
Conducted emission	DC power input/output port	applicable	applicable	not applicable	8.3	CISPR 22 [], CISPR 16-1 []
Conducted emission	AC mains input/output port	applicable	not applicable	not applicable	8.4	CISPR 22 []
Harmonic current emissions	AC mains input port	applicable	not applicable	not applicable	8.5	IEC 61000-3-2 []
Voltage fluctuations and flicker	AC mains input port	applicable	not applicable	not applicable	8.6	IEC 61000-3-3 []

7.2 Immunity

Table 2: Immunity applicability

Phenomenon	Application	Equipment test requirement			Reference subclause in this TS	Reference standard
		Equipment connected to fixed AC or DC power installations	Equipment connected to vehicular DC supplies	Equipment powered by integral battery		
RF electro-magnetic field (80 - 1000 MHz)	Enclosure	applicable	applicable	applicable	9.2	IEC 61000-4-3 []
Electrostatic discharge	Enclosure	applicable	applicable	applicable	9.3	IEC 61000-4-2 []
Fast transients common mode	Signal and control ports, DC and AC power input ports	applicable	not applicable	not applicable	9.4	IEC 61000-4-4 []
RF common mode 0,15 - 80 MHz	Signal and control ports, DC and AC power input ports	applicable	applicable	applicable	9.5	IEC 61000-4-6 []
Transients and surges, vehicular environment	DC power input ports	not applicable	applicable	not applicable	9.6	ISO 7637 Part 1 [] and Part 2 []
Voltage dips and interruptions	AC mains power input ports	applicable	not applicable	not applicable	9.7	IEC 61000-4-11 []
Surges, common and differential mode	DC and AC power input ports	applicable	not applicable	not applicable	9.8	IEC 61000-4-5 []

8 Methods of measurement and limits for EMC emissions

8.1 Test configurations

This sub-clause defines the configurations for emission tests as follows:

- the equipment shall be tested under normal test conditions as specified in the functional standards;
- the test configuration shall be as close to normal intended use as possible;
- 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;
- if the equipment has a large number of ports, then a sufficient number shall be selected to simulate actual operation conditions and to ensure that all the different types of termination are tested;
- the test conditions, test configuration and mode of operation shall be recorded in the test report;
- ports which in normal operation are connected shall be connected to an ancillary equipment or to a representative piece of cable correctly terminated to simulate the input/output characteristics of the ancillary equipment, Radio Frequency (RF) input/output ports shall be correctly terminated;

- Ports that are not connected to cables during normal operation, e.g. service connectors, programming connectors, temporary connectors etc. shall not be connected to any cables for the purpose of EMC testing. Where cables have to be connected to these ports, or interconnecting cables have to be extended in length in order to exercise the EUT, precautions shall be taken to ensure that the evaluation of the EUT is not affected by the addition or extension of these cables;
- the test arrangements for transmitter and receiver sections of the transceiver are described separately for the sake of clarity. However, where possible the test of the transmitter section and receiver section of the EUT may be carried out simultaneously to reduce test time;

8.2 Radiated and Conducted Emission

This test is applicable to ancillary equipment and radio communications equipment.

This test shall be performed on a representative configuration of the ancillary equipment.

8.2.1 Definition

This test assesses the ability of ancillary equipment and radio equipment to limit unwanted emissions from the enclosure and the antenna port.

8.2.2 Test method

The test method shall be in accordance with 3GPP Spurious emission definition.[.].

(GSM 11.10 radiated emission test case??)

Define the use of OATS, Semi anechoic and anechoic chambers regarding measurement distance and variation in height

8.2.3 Limits

The value of the limits from 3GPP (or above) Spurious emission definition [.] shall be used.

The frequency boundary and the detailed transitions of the limits between the requirement for out band emissions and spectrum emissions are based on ITU-R Recommendations SM.329.

Table 8a: Conducted Spurious emissions requirements

Frequency Bandwidth	Resolution Bandwidth Idle/traffic	Minimum requirement	Minimum requirement
		Idle mode	Traffic mode
$9 \text{ kHz} \leq f < 150 \text{ kHz}$	1 kHz/ 1KHz	-57dBm	-36 dBm
$150 \text{ kHz} \leq f < 30 \text{ MHz}$	10 kHz / 10 kHz	-57dBm	-36 dBm
$30 \text{ MHz} \leq f < 1000 \text{ MHz}$	100 kHz / 100 kHz	-57dBm	-36 dBm
$1 \text{ GHz} \leq f < 12.75 \text{ GHz}$	100kHz / 1 MHz	-47dBm	-30 dBm

Table 8b: Conducted Spurious emissions regional requirements

Frequency Bandwidth	Resolution Bandwidth	Minimum requirement	Minimum requirement
		Idle mode	Traffic mode

1893.5 MHz <f<1910 MHz	300 kHz	-47dBm	-40 dBm
925 MHz ≤ f ≤ 935 MHz	100 kHz	-67 dBm *?	-67 dBm *
935 MHz < f ≤ 960 MHz	100 kHz	-79 dBm *?	-79 dBm *
1805 MHz ≤ f ≤ 1880 MHz	100 kHz	-71 dBm *?	-71 dBm *
2110.2 MHz ≤ f ≤ 2199.8 MHz	3.84 MHz	-60 dBm	-60 dBm

As exceptions, up to five measurements in traffic mode with a level up to -36 dBm are permitted for each ARFCN used in the measurement.

Table 8c: Radiated Spurious emissions requirements

Frequency Bandwidth	Resolution Bandwidth	Minimum requirement	Minimum req
		Idle mode	Traffic n
30 MHz ≤ f < 1000 MHz	100 kHz	-57dBm	-36 dl
1 GHz ≤ f < 12.75 GHz	1 MHz	-47dBm	-30 dl

8.3 Conducted emission DC power input/output port

This test is applicable to equipment, which may have DC cables longer than 3 m.

If the DC power cable of the radio and/or the ancillary equipment is intended to be less than 3 m in length, and intended only for direct connection to a dedicated AC to DC power supply, then the measurement shall be performed only on the AC power input of that power supply as specified in sub-clause 8.4.

This test shall be performed on a representative configuration of the radio equipment or a representative configuration of the combination of radio and ancillary equipment.

8.3.1 Definition

This test assesses the ability of transmitters, receivers, transceivers and ancillary equipment to limit internal noise from the DC power input/output ports.

8.3.2 Test method

The test method shall be in accordance with CISPR 22 [] and the Line Impedance Stabilising Networks (LISN) shall be connected to a DC power source.

In the case of DC output ports, the ports shall be connected via a LISN to a load drawing the rated current of the source.

A measuring receiver shall be connected to each LISN measurement port in turn and the conducted emission recorded. The LISN measurement ports not being used for measurement shall be terminated with a 50 Ω load.

The equipment shall be installed with a ground plane as defined in CISPR 22 []. The reference earth point of the LISNs shall be connected to the reference ground plane with a conductor as short as possible.

The measurement receiver shall be in accordance with the requirements of section one of CISPR 16-1 [].

8.3.3 Limits

The equipment shall meet the limits defined in table 4 (including the average limit and the quasi-peak limit) when using, respectively, an average detector receiver and a quasi-peak detector receiver and measured in accordance with the method described in subclause 8.2.2 above. If the average limit is met when using a quasi-peak detector, the equipment shall be deemed to meet both limits and measurement with the average detector receiver is not necessary.

Table 4: Limits

Frequency range	Quasi-peak	Average
> 0,15-0,5 MHz	66 - 56 dB μ V	56 - 46 dB μ V
> 0,5- 5 MHz	56 dB μ V	46 dB μ V
> 5-30 MHz	60 dB μ V	50 dB μ V
NOTE: The limit decreases linearly with the logarithm of the frequency in the range 0,15 MHz to 0,50 MHz.		

8.4 Conducted emissions, AC mains power input/output port

This test is applicable to equipment powered by the AC mains.

This test is not applicable to AC output ports which are connected directly (or via a switch or circuit breaker) to the AC input port.

This test shall be performed on a representative configuration of the radio equipment or a representative configuration of the combination of radio and ancillary equipment.

8.4.1 Definition

This test assesses the ability of transmitters, receivers, transceivers and ancillary equipment to limit internal noise from the AC mains power input/output ports.

8.4.2 Test method

The test method shall be in accordance with CISPSR 22 [].

Mains connected ancillary equipment which is not part of the EUT shall be connected to the mains via a separate LISN. According to clause 11.9 of CISPR 16-1 [], the Protective Earth (PE) wire shall also be terminated by a 50 Ω /50 μ H common mode RF impedance.

8.4.3 Limits

The equipment shall meet the limits defined in table 5 (including the average limit and the quasi-peak limit) when using, respectively, an average detector receiver and a quasi-peak detector receiver and measured in accordance with the method described in subclause 8.3.2 above. If the average limit is met when using a quasi-peak detector, the equipment shall be deemed to meet both limits and measurement with the average detector receiver is not necessary.

Table 5: Limits for conducted emissions

Frequency range	Quasi-peak	Average
> 0,15-0,5 MHz	66 - 56 dB μ V	56 - 46 dB μ V
> 0.5- 5 MHz	56 dB μ V	46 dB μ V
> 5-30 MHz	60 dB μ V	50 dB μ V
NOTE: The limit decreases linearly with the logarithm of the frequency in the range 0,15 MHz to 0,50 MHz.		

8.5 Harmonic current emissions (AC mains input port)

The requirements of IEC 61000-3-2 [] for harmonic current emission apply for equipment covered by the scope of the present document.

8.6 Voltage fluctuations and flicker (AC mains input port)

The requirements of IEC 61000-3-3 [] for voltage fluctuations and flicker apply for equipment covered by the scope of the present document.

9 Test methods and levels for immunity tests

9.1 Test configurations

This sub-clause defines the configurations for immunity tests as follows:

- the equipment shall be tested under normal test conditions as specified in the functional standards;
- the test configuration shall be as close to normal intended use as possible;
- 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;
- if the equipment has a large number of ports, then a sufficient number shall be selected to simulate actual operation conditions and to ensure that all the different types of termination are tested;
- the test conditions, test configuration and mode of operation shall be recorded in the test report;
- ports which in normal operation are connected shall be connected to an ancillary equipment or to a representative piece of cable correctly terminated to simulate the input/output characteristics of the ancillary equipment, Radio Frequency (RF) input/output ports shall be correctly terminated;
- ports which are not connected to cables during normal operation, e.g. service connectors, programming connectors, temporary connectors etc. shall not be connected to any cables for the purpose of EMC testing. Where cables have to be connected to these ports, or interconnecting cables have to be extended in length in order to exercise the EUT, precautions shall be taken to ensure that the evaluation of the EUT is not affected by the addition or extension of these cables;
- the test arrangements for transmitter and receiver sections of the transceiver are described separately for the sake of clarity. However, where possible the test of the transmitter section and receiver section of the EUT may be carried out simultaneously to reduce test time.
- Immunity tests shall be performed in two modes of operation:
 - with a communication link established (call mode); and
 - in the idle mode.

See subclauses 6.1 and 6.2.

9.2 RF electromagnetic field (80 MHz - 1000 MHz)

The test shall be performed on a representative configuration of the equipment or a representative configuration of the combination of radio and ancillary equipment.

9.2.1 Definition

This test assesses the ability of transmitters, receivers, transceivers and ancillary equipment to operate as intended in the presence of a radio frequency electromagnetic field disturbance at the enclosure.

9.2.2 Test method and level

The test method shall be in accordance with IEC 61000-4-3 []:

- for transmitters, receivers, transceivers and ancillary equipment the following requirements shall apply:
- the test level shall be 3 V/m amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1 kHz;
- the stepped frequency increments shall be 1 % of the momentary frequency;
- when using the max hold detector method at each test frequency step initially an unmodulated test signal shall be applied. Then the test modulation shall be applied;
- the test shall be performed over the frequency range 80 MHz - 1 000 MHz
- responses in stand alone receivers or receivers which are part of transceivers occurring at discrete frequencies which are narrow band responses, shall be disregarded, see subclause 4.5;
- the frequencies selected during the test shall be recorded in the test report.

9.2.3 Performance criteria

The performance criteria of subclause 6.1, shall apply.

9.3 Electrostatic discharge

The test shall be performed on a representative configuration of the equipment or a representative configuration of the combination of radio and ancillary equipment.

9.3.1 Definition

This test assesses the ability of transmitters, receivers, transceivers and ancillary equipment to operate as intended in the event of an electrostatic discharge.

9.3.2 Test method and level

The test method shall be in accordance with IEC 61000-4-2 []:

- for contact discharge, the equipment shall pass at ± 2 kV and ± 4 kV;
- for air discharge shall pass at ± 2 kV, ± 4 kV and ± 8 kV, see IEC 61000-4-2 [].

NOTE: Ensure that the EUT is fully discharged between each ESD exposure.

9.3.3 Performance criteria

The performance criteria of subclause 6.2 shall apply.

9.4 Fast transients common mode

The test shall be performed on AC mains power input ports.

This test shall be performed on signal ports, control ports and DC power input/output ports if the cables may be longer than 3 m.

Where this test is not carried out on a port or any other ports because the manufacturer declares that it is not intended to be used with cables longer than 3 m, a list of ports which were not tested for this reason shall be included in the test report.

This test shall be performed on a representative configuration of the equipment or a representative configuration of the combination of radio and ancillary equipment.

9.4.1 Definition

This test assesses the ability of transmitters, receivers, transceivers and ancillary equipment to operate as intended in the event of fast transients present on one of the input/output ports.

9.4.2 Test method and level

The test method shall be in accordance with IEC 61000-4-4 []:

- the test level for signal and control ports shall be 0,5 kV open circuit voltage as given in IEC 61000-4-4 [];
- the test level for DC power input/output ports shall be 1 kV open circuit voltage as given in IEC 61000-4-4 [];
- the test level for AC mains power input ports shall be 2 kV open circuit voltage as given in IEC 61000-4-4 [].

For AC and DC power input ports the transients shall be applied (in parallel) to all the wires in the cable with reference to the cabinet reference ground (true common mode) and the source impedance shall be 50 Ω .

9.4.3 Performance criteria

The performance criteria of subclause 6.2 shall apply.

9.5 RF common mode (0,15 MHz - 80 MHz)

Current clamp Injection

This test is applicable for base station, mobile, portable and ancillary equipment.

This test shall be performed on signal, control and DC power input/output ports of mobile, portable and ancillary equipment, which may have cables longer than 2 m.

This test shall be performed on signal, control, DC power and AC mains power input/output ports of base station and fixed ancillary equipment, which may have cables longer than 1 m.

Where this test is not carried out on a port or any other ports because the manufacturer declares that it is not intended to be used with cables longer than stated above, a list of ports which were not tested shall be included in the test report.

This test shall be performed on a representative configuration of the equipment or a representative configuration of the combination of radio and ancillary equipment.

NOTE: This test can also be performed using the intrusive method, where appropriate, see IEC 61000-4-6 [].

9.5.1 Definition

This test assesses the ability of transmitters, receivers, transceivers and ancillary equipment to operate as intended in the presence of a radio frequency electromagnetic disturbance.

9.5.2 Test method and level

The test method should be the current clamp injection method in accordance with EN 61000-4-6 [1]. Alternatively, an intrusive or direct connection may be made to any of the lines of any input/output port where it is practical and the performance of the equipment is not degraded.

- the test signal shall be amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1 kHz;
- the stepped frequency increments shall be 50 kHz or 1 % frequency increment of the momentary frequency in the frequency range 150 kHz - 5 MHz and 1 % frequency increment of the momentary frequency in the frequency range 5 MHz - 80 MHz;
- the test level shall be severity level 2 as given in IEC 61000-4-6 [1] corresponding to 3 V rms, at a transfer impedance of 150 Ω ;
- the test shall be performed over the frequency range 150 kHz - 80 MHz;
- responses of stand alone receivers or receivers which are part of transceivers occurring at discrete frequencies which are narrow band responses, shall be disregarded, see subclause 4.5;
- the frequencies selected during the test and the test method used shall be recorded in the test report.

9.5.3 Performance criteria

The performance criteria of subclause 6.1 shall apply.

9.6 Transients and surges, vehicular environment

The tests are applicable to equipment intended for use in a vehicular environment.

These tests shall be performed on 12 V and 24 V DC power input.

These tests shall be performed on a representative configuration of the equipment or a representative configuration of the combination of radio and ancillary equipment.

9.6.1 Definition

These tests assess the ability of transmitters, receivers, transceivers and ancillary equipment to operate as intended in the event of transients and surges present on the DC power input ports in a vehicular environment.

9.6.2 Test method and level

The test method shall be in accordance with ISO 7637-1 [3] for 12 V DC powered equipment and ISO 7637-2 [4] for 24 V DC powered equipment. The requirements are detailed as follows:

9.6.2.1 12 V DC powered equipment:

- a) where the manufacturer in his installation documentation requires the EUT to have a direct connection to the 12 V main vehicle battery the following requirements in accordance with ISO 7637-1 [3] shall apply:
 - pulse 3a and 3b, level II (± 50 V), with the test time reduced to 5 minutes for each;
 - pulse 4, level II, 5 pulses, with the characteristics as follows:
 $V_s = -5$ V, $V_a = -2,5$ V, $t_6 = 25$ ms, $t_8 = 5$ s, $t_f = 5$ ms.
- b) where the manufacturer does not require the EUT to have a direct connection to the 12 V main vehicle battery, the following pulses apply, in addition to the pulses in a):
 - pulse 1, level II (-50 V), $t_1 = 2,5$ s, 10 pulses;
 - pulse 2, level II (+50 V), $t_1 = 2,5$ s, 10 pulses.

Where the manufacturer declares that the EUT requires a direct connection to the vehicle battery, and the tests according to 1) b) are not carried out therefore, this shall be stated in the test report.

9.6.2.2 24 V DC powered equipment:

a) where the manufacturer in his installation documentation requires the EUT to have a direct connection to the 24 V main vehicle battery the following requirements in accordance with ISO 7637-2 [4] shall apply:

- pulse 3a and 3b, level II (± 70 V), with the test time reduced to 5 minutes for each;
- pulse 4, level II, 5 pulses, with the characteristics as follows:
 $V_s = -10$ V, $V_a = -5$ V, $t_G = 25$ ms, $t_g = 5$ s, $t_f = 5$ ms.

b) where the manufacturer does not require the EUT to have a direct connection to the 12 V main vehicle battery, the following pulses apply, in addition to the pulses in a):

- pulse 1, level II (-100 V), $t_1 = 2,5$ s, 10 pulses;
- pulse 1b, level II (-550 V), $t_1 = 2,5$ s, 10 pulses $R_1 = 100 \Omega$;
- pulse 2, level II (+50 V), $t_1 = 2,5$ s, 10 pulses.

Where the manufacturer declares that the EUT requires a direct connection to the vehicle battery, and the tests according to b) are not carried out therefore, this shall be stated in the test report.

For radio and ancillary equipment designed to operate at both DC power voltages both requirement 9.6.2.1 and 9.6.2.2 shall apply.

For radio equipment designed to operate at 12 V DC power supply, but operating from a 24 V DC power adapter ancillary, then the radio equipment shall comply with the requirements in 9.6.2.1 and the configuration of the radio equipment and the power adapter shall comply with the requirements of 9.6.2.2.

9.6.3 Performance criteria

The performance criteria of subclause 6.2 shall apply.

For pulses 1, 1a, 1b, 2 and 4 the link need not have been maintained during exposure and may have to be re-established.

9.7 Voltage dips and interruptions

The tests shall be performed on AC mains power input ports.

These tests shall be performed on a representative configuration of the equipment or a representative configuration of the combination of radio and ancillary equipment.

9.7.1 Definition

These tests assess the ability of transmitters, receivers, transceivers and ancillary equipment to operate as intended in the event of voltage dips and interruptions present on the AC mains power input ports.

9.7.2 Test method and level

The following requirements shall apply.

The test method shall be in accordance with IEC 61000-4-11 [].

The test levels shall be:

- a voltage dip corresponding to a reduction of the supply voltage of 30 % for 10 ms;

- a voltage dip corresponding to a reduction of the supply voltage of 60 % for 100 ms;
- a voltage interruption corresponding to a reduction of the supply voltage of > 95 % for 5 000 ms.

9.7.3 Performance criteria

For a voltage dip corresponding to a reduction of the supply voltage of 30 % for 10 ms the performance criteria of subclause 6.2 shall apply:

For a voltage dip corresponding to a reduction of the supply voltage of 60 % for 100 ms and/or a voltage interruption corresponding to a reduction of the supply voltage of > 95 % for 5 000 ms the performance criteria of subclause 6.2 shall apply:

In the case where the equipment is powered solely from the AC mains supply (without the use of a parallel battery back-up the communications link need not be maintained and may have to be re-established and volatile user data may have been lost.

In the event of loss of the communications link or in the event of loss of user data, this fact shall be recorded in the test report, the product description and the user documentation.

9.8 Surges, common and differential mode

The tests shall be performed on AC mains power input ports.

These tests shall be performed on a representative configuration of the equipment or a representative configuration of the combination of radio and ancillary equipment.

9.8.1 Definition

These tests assess the ability of transmitters, receivers, transceivers and ancillary equipment to operate as intended in the event of surges being present at the AC mains power input ports.

9.8.2 Test method and level

The test method shall be in accordance with IEC 61000-4-5 [1].

The following requirements and evaluation of test results shall apply:

- the test level for ac mains power input ports shall be 1 kV line to ground and 0,5 kV line to line with the output impedance of the surge generator as given in the IEC61000-4-5 [1];
- the test generator shall provide the 1,2/50 µsec pulse as defined in IEC 61000-4-5 [1].

9.8.3 Performance criteria

The performance criteria of sub-clause 6.2 shall apply.

Annex A: Performance assessment voice call. Audio break through

A.1 Calibration of audio levels

For the portable the audio calibration is performed as follows:

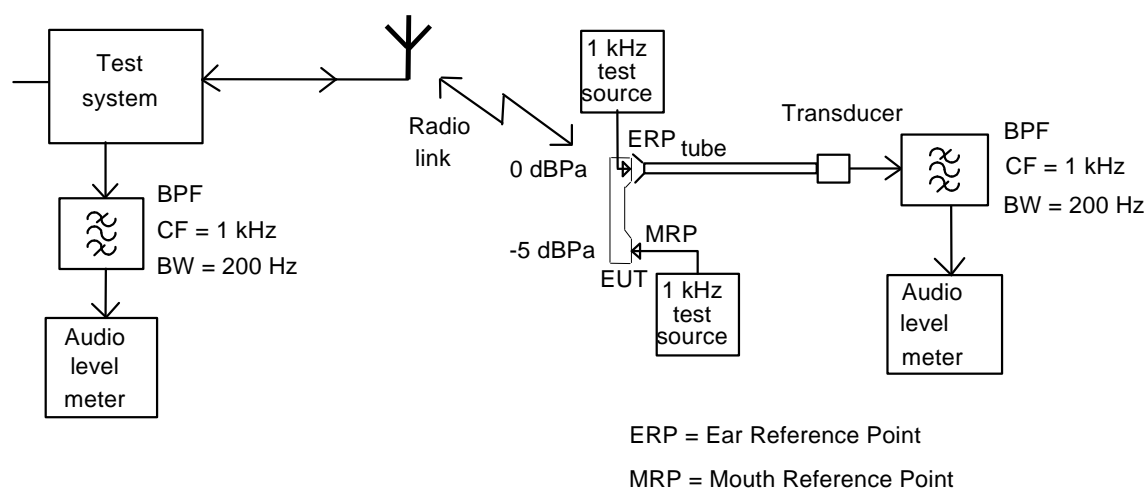
Set the EUT volume to provide the nominal audio level if specified by the manufacturer. If no such level is specified, the centre volume step shall be used.

Prior to the test sequence, the reference level of the speech output signal on both the downlink and uplink shall be recorded on the test instrumentation, as shown in figure A.1. The reference level shall be equivalent to the SPL of 0 dBPa at 1 kHz at the Ear Reference Point (ERP) defined in ITU-T P.64 [] for the downlink, and -5 dBPa at 1 kHz at the Mouth Reference Point (MRP) defined in ITU-T P.64 [] for the uplink.

NOTE 1: The ERP and MRP are both defined with respect to an artificial head defined in ITU-T P 76 [] The handset shall be mounted on the artificial head such that the ear piece is centred at the artificial ear.

NOTE 2: If the equipment does not include acoustical transducers (e.g. a microphone or loudspeaker) the equivalent electrical reference levels shall be specified by the manufacturer.

The voice processor may often apply noise and echo cancellation algorithms which attempt to eliminate or reduce steady state audio signals as e.g. the 1 kHz calibration signals. These algorithms may be disabled during the calibration procedure. Specialised test software may be required. If the algorithms can not be disabled then the reference level shall be measured using a max-hold detection on the audio level meter in order to determine the level before the noise and echo cancellation algorithms become effective.



NOTE: The EUT is in position during calibration of the uplink, but not during calibration of the downlink where the EUT is replaced by the 1 kHz test audio source. During calibration of the uplink the mouthpiece shall be placed with respect to the MRP in a way representing intended use.

Figure A.1: Audio breakthrough measurement, calibration set-up for portable equipment

In handsfree applications an external loudspeaker is used. The SPL from the external loudspeaker is normally much higher than from the ear piece of the portable in order to overcome a high ambient noise level. The downlink

reference level shall be increased in order to compensate for the difference. Alternatively, the distance between the loudspeaker and the measuring microphone shall be adjusted during the measurement procedure in accordance with the manufacturers specification. It is important that the dynamic range of the test instrumentation is not exceeded.

Normally no corrections are made to the uplink reference level. In case it is not possible to perform the above calibration (e.g., a PC card with headset) the manufacturer shall specify the distance between the MRP and the microphone.

A.2 Measurement of audio levels

When the audio levels are measured during testing the EUT software shall be configured for voice applications. If the algorithms for noise and echo cancellation are not disabled, then the level shall be measured using a max-hold detection on the audio level meter in order to determine the level before the noise and echo cancellation algorithms become effective.

The level of the output signal from the downlink speech channel of the EUT at the mobile or portable's ear piece shall be assessed by measuring the Sound Pressure Level (SPL) as shown in figure A.2. When an external loudspeaker is used the acoustical coupler shall be fixed to the loudspeaker in the position used during the calibration. The level of the decoded output signal from the uplink speech channel of the EUT at the analogue output of the test system shall be measured. Pick up of extraneous background noise by the microphone of the EUT shall be minimised.

NOTE: If the equipment is designed for use with external transducers, they shall be included in the test configuration. If the equipment does not include acoustical transducers the line voltage developed across specified termination impedance may be measured

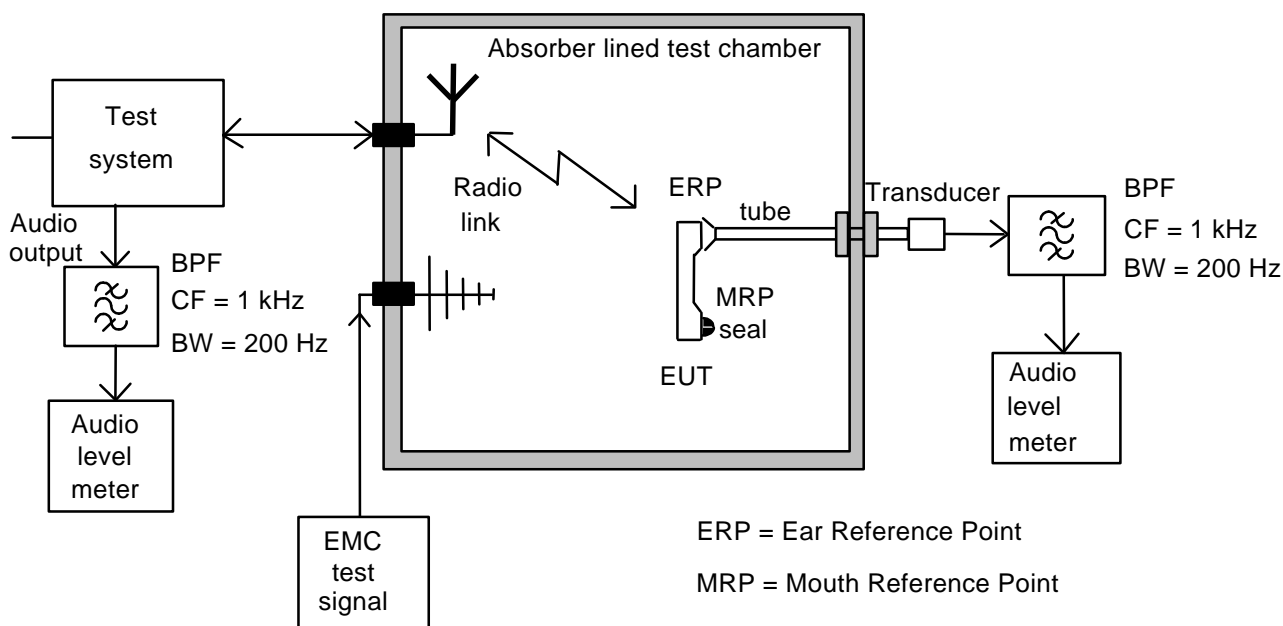


Figure A.2: Audio breakthrough measurement, test set-up for portable equipment

Annex B: Performance assessment data call. Bit Error Ratio.

B.1 Calibration of data call

For the EUT, calibration of the data call may be performed by assessing the Bit Error Ratio (BER), Block Error Ratio (BLER) or Message Error Ratio (MER) etc. before applying EMC test signal

B.2 Measurement of Bit Error Ratio

The manufacturer shall provide the method for calculating the Bit Error Ratio. Known Data patterns shall be transferred bi-directionally (UL and DL will be exercised). **Performance assessment shall be made at each frequency step.** Comparison between transmitted known data and received data shall result in the Bit Error Ratio.

$$\text{BitErrorRatio} = \left(\frac{\text{erroneuos(bits, bytes, symbols, etc.)}}{\text{correct(bits, bytes, symbols, etc.)}} * 100 \right) = n\%$$

. (In case that high BERs exist, ensure that errors are consequence of EMC stress).

B.3 EUT without data application ancillary

Definition of data application ancillary: ancillary which allows inputting/outputting of user data.

Data application Devices (1, 2) are here considered as part of the Test System. Arrangements should be made by the manufacturer, if needed, to couple the Data application Device 2 by a method which does not affect the radiated electromagnetic field (e.g. ultra sonic or optical).

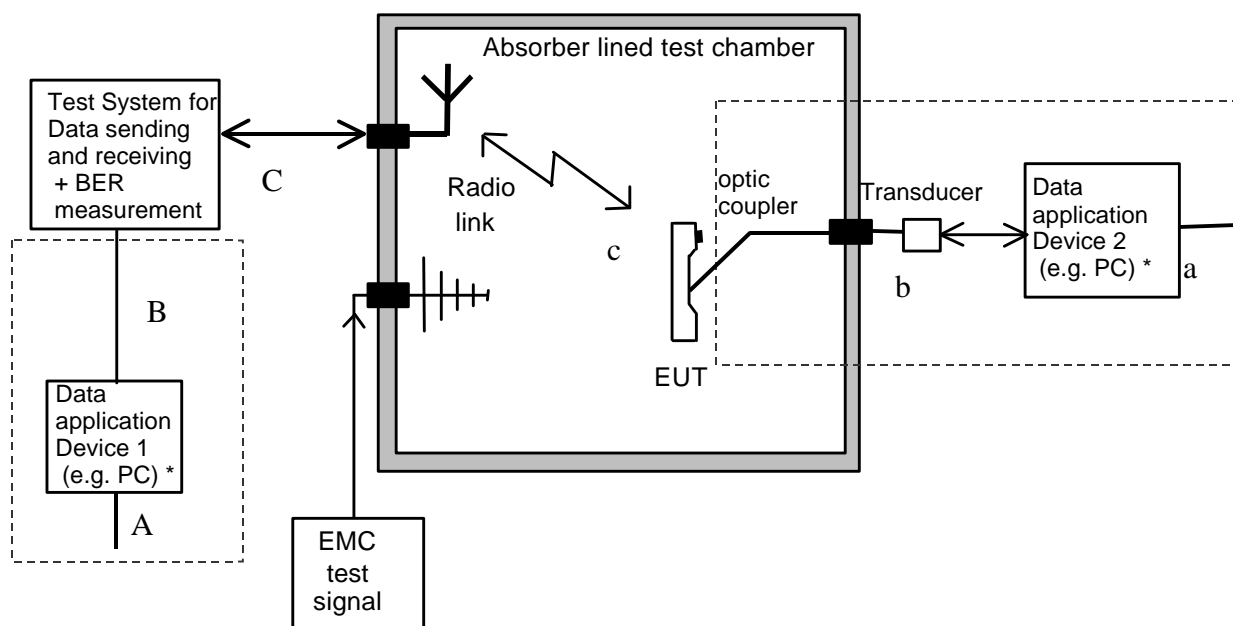


Figure B.1: Bit Error measurement, test set-up for EUT without data application ancillary.

B.4 EUT with data application ancillary

Definition of data application ancillary: ancillary which allows inputting/outputting of user data.

The Data application Device (1) is here considered as a part of Test System. The Data application ancillary should be part of the data transfer (UL and DL) link and is included in the EUT configuration..

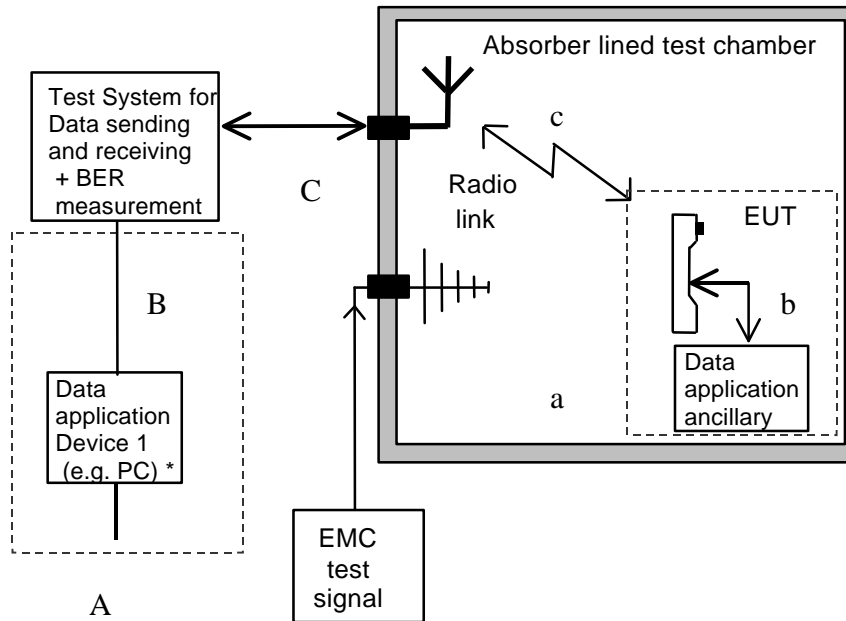


Figure B.2: Bit Error measurement, test set-up for EUT with data application ancillary.

B.5 Access points for Bit Error measurement

The manufacturer shall define the access points (A,a or B,b or C,c) where the equipment shall be tested in order to make the measurements on data patterns. Possible error- correction systems on these access points shall be recorded in the test report

- the characteristics of the signal used for testing (BER, continuous data stream, message format, etc.) and the necessary test equipment delivered to enable the assessment of the EUT;

Annex C: Informative Notes

C.1 Purpose

It's the purpose of this annex to give the users of this standard, additional information about considerations in making the standard.

C.2 Scope

The following statement in the scope was left until a final decision on spurious emission and radiated emission was defined. It's left as it is in the text.

Technical specifications related to the antenna port and emissions from the enclosure port of radio equipment are found in the related product standards for the effective use of the radio spectrum

Receivers only are intended to be covered by the last part of the following sentence.

The present document specifies the applicable EMC tests, the methods of measurement, the frequency range, the limits and the minimum performance criteria for "3rd generation" digital cellular mobile and portable radio equipment and accessories, transmitting and/or receiving information.

C.3 Item 2 and 3

This has been left for the moment in order to go through when the most of the standard is finalised.

C.4 Test Conditions

4.1 Not consider until the scope for this standard concludes on the spurious emission testing.

4.2 The arrangements for establishing a communications link will be brought up in line with the specification from the RF group.

4.3 In the event of adding spurious emission testing to this standard the transmitter exclusion band might be revised.

C.5 Spurious emission

The appropriated methods in 8.2.2 and 8.2.3 needs to be furthered explained and referred to.

C.6 Radiated immunity

Limited to 1GHz until basic standard adopts method up to 2GHz

C.7 Fast transient 9.4

Only applicable for fixed installations as shown in 7.2.

History

Document history		
Version 1.0.0	July 1999	TS xx.xxx 1 st draft
Version 1.0.1	August 1999	TS xx.xxx 2 nd draft
Version 0.0.1	August 1999	TS 34.124: equal to TS xx.xxx v1.0.1 with format changes
Version 1.0.0	September 1999	Approved at TSG T1 #4