

**Electromagnetic compatibility  
and Radio spectrum Matters (ERM);  
ElectroMagnetic Compatibility (EMC) for  
Receive Only Mobile Earth Stations (ROMES) operating  
in the 1,5 GHz band providing data communications**

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*European Telecommunications Standards Institute*

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## Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM), and is now submitted for the Voting phase of the ETSI standards Two-step Approval Procedure.

The present document has been produced by ETSI in response to a mandate from the European Commission issued under Council Directive 83/189/EEC (as amended) laying down a procedure for the provision of information in the field of technical standards and regulations.

The present document, together with ETS 300 487, is intended to become a Harmonized Standard, the reference of which will be published in the Official Journal of the European Communities referencing the Council Directive on the approximation of the laws of the Member States relating to electromagnetic compatibility ("the EMC Directive") (89/336/EEC as amended).

Technical specifications relevant to the EMC Directive are given in annex A.

| <b>Proposed national transposition dates</b>   |                                 |
|--|---------------------------------|
| Date of latest announcement of this EN (doa):  | 3 months after ETSI publication |
| Date of latest publication of new National Standard or endorsement of this EN (dop/e): | 6 months after doa              |
| Date of withdrawal of any conflicting National Standard (dow):                         | 6 months after doa              |

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# 1 Scope

The present document provides ElectroMagnetic Compatibility (EMC) specifications for the standardization of Receive Only Mobile Earth Stations (ROMES). Specifications relating to emissions from the antenna port and emissions from the enclosure port of the ROMES (figure 1) are not included in the present document. Specifications for emissions from the antenna port and from the enclosure port of the ROMESs are included in ETS 300 487 [15].

The present document applies to ROMESs which operate in the Land Mobile Satellite Service (LMSS) space to earth bands, 1 525 MHz to 1 544 MHz and 1 555 MHz to 1 559 MHz, allocated by the ITU Radio Regulations [1]. The ROMESs operate as part of a satellite system providing one way data communications.

ROMESs can have several configurations, including:

- portable equipment;
- fixed equipment;
- a number of modules including a display/control interface to the user.

The present document specifies the applicable EMC tests, their method of measurement, the limits and the minimum performance criteria for ROMESs. The performance criteria used in the present document requires that the satellite communications system of which the ROMES is a part provides reliable delivery of data or messages.

The environment classification used in the present document refers to the environment classification used in Generic Standards EN 50081-1 [2] and EN 50082-1 [3], except the vehicular environment class which refers to ISO 7637-1 [11] and ISO 7637-2 [12].

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

The present document may not cover those cases where a potential source of interference which is producing individually repeated transient phenomena or a continuous phenomena is permanently present, e.g. a radar or broadcast site in the near vicinity. In such a case it may be necessary to use special protection applied to either the source of interference or the interfered part or both.

Compliance of radio equipment to the requirements of the present document does not signify compliance to any requirements related to spectrum management .

Compliance to the present document does not signify compliance to any safety requirements. However, it is the responsibility of the assessor of the equipment to ensure that any observation regarding the equipment becoming dangerous or unsafe as a result of the application of the tests of the present document should be recorded.

In addition to the technical specifications of the present document, there may be published in the Official Journal of the European Community references to other Harmonized EMC standards that apply to the products covered by the present document in their own right.

The present document is based on the considerations and guidance given in ETR 238 [16].

---

## 2 Normative references

References may be made to:

- a) specific versions of publications (identified by date of publication, edition number, version number, etc.), in which case, subsequent revisions to the referenced document do not apply; or
- b) all versions up to and including the identified version (identified by "up to and including" before the version identity); or
- c) all versions subsequent to and including the identified version (identified by "onwards" following the version identity); or
- d) publications without mention of a specific version, in which case the latest version applies.

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] ITU Radio Regulations.
- [2] EN 50081-1 (1992): "Electromagnetic compatibility - Generic emission standard - Part 1: Residential, commercial and light industry".
- [3] EN 50082-1 (1993): "Electromagnetic compatibility - Generic immunity standard - Part 1: Residential, commercial and light industry".
- [4] 89/336/EEC: "Council Directive on the approximation of the laws of the Member States relating to electromagnetic compatibility".
- [5] EN 55022 (1994): "Limits and methods of measurement of radio disturbance characteristics of information technology equipment".
- [6] CISPR Publication 16-1: "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1: Radio disturbance and immunity measuring apparatus".
- [7] EN 61000-4-3 (modified): "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 3: Radiated, radio-frequency, electromagnetic field immunity test".
- [8] EN 61000-4-2: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 2: Electrostatic discharge immunity test".
- [9] EN 61000-4-4: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 4: Electrical fast transient/burst immunity test".
- [10] EN 61000-4-6: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 6: Immunity to conducted disturbances, induced by radio-frequency fields".
- [11] 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".
- [12] 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".
- [13] EN 61000-4-11: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 11: Voltage dips, short interruptions and voltage variations immunity tests".
- [14] EN 61000-4-5: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 5: Surge immunity test".

- [15] ETS 300 487: "Satellite Earth Stations and Systems (SES); Receive-Only Mobile Earth Stations (ROMESs) operating in the 1,5 GHz band providing data communications; Radio Frequency (RF) specifications".
- [16] ETR 238: "ETSI/CENELEC standardization programme for the development of Harmonized Standards related to Electro-Magnetic Compatibility (EMC) in the field of telecommunications".

## 3 Definitions and abbreviations

### 3.1 Definitions

For the purposes of the present document, the following definitions apply:

**ancillary equipment:** Equipment (apparatus) used in connection with a ROMES is considered as an ancillary equipment (apparatus):

- if the equipment is intended for use in conjunction with a ROMES to provide additional operational and/or control features to the ROMES, (e.g. to extend control to another position or location); and
- if the equipment cannot be used on a stand alone basis to provide user functions independently of a ROMES; and
- if the ROMES to which it is connected is capable of providing some intended operation such as receiving without the ancillary equipment (i.e. it is not a sub unit of the main equipment essential to the main equipment basic functions).

**enclosure port:** The physical boundary of the apparatus through which electromagnetic fields may radiate or impinge (see figure 1).

**manufacturer:** The legal entity responsible under the terms of the Council Directive, 89/336/EEC [4], for placing the product on the market.

**mobile equipment:** A ROMES capable of being powered by the main battery of a vehicle for intended use attached to a vehicle either temporarily or permanently.

**port:** A particular interface of the specified equipment (apparatus) with the electromagnetic environment (see figure 1).

**portable equipment:** A ROMES with internal power supplies which is intended to be carried by the user.

**standby mode:** Mode of operation in which the receiver is capable of receiving calls.

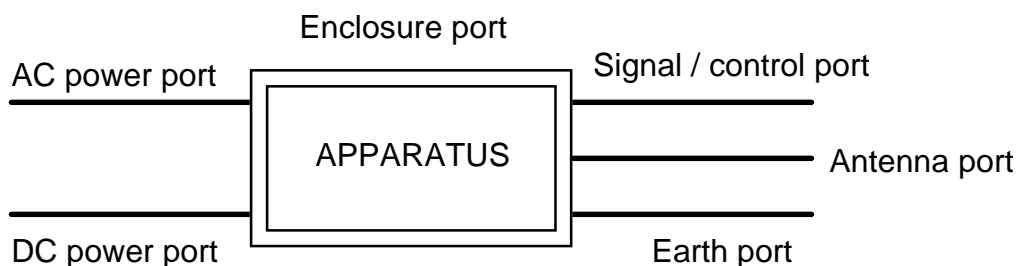


Figure 1: Examples of ports

### 3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

|      |                                       |
|------|---------------------------------------|
| CR   | Continuous phenomena applied to ROMES |
| EMC  | ElectroMagnetic Compatibility         |
| EUT  | Equipment Under Test                  |
| LISN | Line Impedance Stabilizing Network    |

|       |                                      |
|-------|--------------------------------------|
| LMSS  | Land Mobile Satellite Service        |
| RF    | Radio Frequency                      |
| ROMES | Receive Only Mobile Earth Station    |
| TR    | Transient phenomena applied to ROMES |

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## 4 Test conditions

### 4.1 General

The ROMES shall be tested under conditions contained in the relevant product and basic standards and in the information accompanying the equipment. The tests shall be carried out at a point within the specified normal operating environmental range and at the rated supply voltage for the equipment.

The test conditions and configuration shall be as close to normal intended use as possible and shall be recorded in the test report.

### 4.2 Normal test modulation

The test modulation signal to be used for the calling function shall be a signal representing selective messages generated by a signal generator. The signal generator may be supplied by the manufacturer.

### 4.3 Arrangements for test signals at the input of a ROMES

The manufacturer may, at the time of submitting the ROMES for testing, supply, if necessary, a test fixture and a message generator to generate the wanted input signal.

The source of the wanted input signal, modulated with normal test modulation (subclause 4.2), shall be located outside the test environment and the signal level used shall be chosen to be a value significantly above the threshold sensitivity but below the overload characteristics of the ROMES (the threshold sensitivity and overload characteristic shall be specified by the manufacturer). Adequate measures shall be taken to protect the measuring equipment from the effect of the test environment.

Where the receiver incorporates a Radio Frequency (RF) antenna connector, the RF signal source shall be coupled to the input of the ROMES via a shielded transmission line such as a coaxial cable.

Where the ROMES does not incorporate an RF connector, the RF signal source shall be presented to the ROMES from another antenna located within the test environment. This antenna shall be coupled to the RF signal source via an appropriate attenuate.

### 4.4 Arrangements for test signals at the output of the ROMES

For the performance check before and after the test it shall be possible to assess the performance of the ROMES from the presented messages and/or the call received alert signal(s) of the ROMES.

During the spot frequency test of the radio frequency immunity test (subclause 9.2) the call received alert signal output of the ROMES shall be coupled to the outside of the test environment and it shall be possible to assess the performance of the equipment from the call received alert signal(s) of the ROMES.

### 4.5 Exclusion bands for ROMES

Exclusion bands are determined frequency bands for which the Equipment Under Test (EUT) is excluded from RF immunity tests.

There are no exclusion bands for ROMES as the operating frequency of a ROMES falls outside the range of frequencies specified for RF immunity tests.

## 4.6 Narrow band responses on ROMES

No immunity tests shall be carried out on frequencies of identified unwanted narrowband responses (spurious responses) of the receiver. These narrowband responses (spurious responses) are identified by the following method.

If during the test the unwanted signal causes a non acceptable degradation in performance (subclause 6.2), it is necessary to establish whether this is due to a narrow band response or to a wideband phenomena. Therefore, the unwanted signal frequency is increased by an amount equal to twice the nominal bandwidth of the receiver pre-demodulation filter, as declared by the manufacturer. The test is repeated with the frequency of the unwanted signal decreased by the same amount.

If the degradation in performance becomes acceptable again (subclause 6.2), then the response is considered to be a narrow band response.

If the degradation in performance is still not acceptable, 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 adjusted two and a half times the bandwidth previously referred to. If the degradation in performance remains unacceptable (subclause 6.2), the phenomena is considered wideband and therefore an EMC problem and the equipment fails the test.

Each type of equipment shall fulfil the requirements of the present document on all frequency channels over which it is intended to operate.

---

## 5 Performance assessment

### 5.1 General

If the ROMES has several optional features or configurations, tests shall be performed on the minimum representative configuration of the EUT.

In all cases, the minimum configuration of the EUT as marketed, shall comply with the EMC requirements of the present document.

The manufacturer shall keep on record information about the ancillary equipment intended for use with the ROMES and make this information available to the user.

The manufacturer shall keep on record the following information:

- the ancillary equipment to be combined with the ROMES;
- 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;
- an exhaustive list of ports, classified as either AC power, DC power or signal/control including the maximum allowed length of cable connected thereto;
- the bandwidth of the IF-filter immediately preceding the demodulator;
- the operating frequency bands over which the equipment is intended to operate;
- the optional features of the equipment and the actual features of the equipment which are assessed for the performance or degradation of performance.

### 5.2 Standard ROMES equipment

If the equipment is a ROMES of a non specialized nature or ROMES equipment combined with an ancillary equipment, the test modulation, test arrangements etc. as required in clause 4 shall apply.

## 5.3 Special equipment and stand alone tested ancillary equipment

For ROMES of a specialized nature and/or ancillary equipment tested on a stand alone basis 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. Under these circumstances the manufacturer will also provide the following information:

- the primary functions of the equipment to be tested during and after EMC stress;
- the intended functions of the EUT which shall be in accordance with the documentation accompanying the equipment;
- the pass/failure criteria for the equipment;
- the method of observing a degradation of performance of the equipment.

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

## 5.4 Equipment classification

ROMES equipment, or combinations of equipment declared as capable of being powered for intended use by the main battery of a vehicle shall additionally be considered as a vehicular mobile equipment.

ROMES equipment or combinations of equipment declared as being capable of being powered for intended use by AC mains shall be considered as fixed equipment.

## 5.5 Conformance of ancillary equipment

At the manufacturer's discretion an ancillary equipment may be:

- tested separately from a receiver to all the applicable immunity and emission clauses of the present document;
- tested to another appropriate notified EMC standard;
- tested with it connected to a ROMES, in which case compliance shall be demonstrated to the appropriate clauses of the present document.

In each case, compliance enables the ancillary equipment to be used with different ROMES.

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# 6 Performance criteria

## 6.1 General

The equipment shall meet the minimum performance criteria as specified in subclauses 6.2 and 6.3 of the present document.

The ROMES, for all immunity tests according to the present document, except the spot frequency test of the radio frequency immunity test (subclause 9.2), shall be assessed for:

- the storage of messages in the memory of the ROMES at the start of the test;
- unintentional responses of the ROMES during the test;
- the maintenance of the ROMES memory assessed at the conclusion of the test;
- the ability to receive and store messages at the conclusion of the test.

For the spot frequency test of the radio frequency immunity test (subclause 9.2) the ROMES shall be assessed by monitoring the accuracy of the call received alert signal.

## 6.2 Performance criteria for Continuous phenomena applied to ROMES (CR)

For ROMES, excluding spot frequency tests (subclause 9.2):

- during the test no false calls shall occur;
- at the conclusion of the test comprising the series of individual exposures the ROMES shall operate as intended with no loss of functions or stored data (messages), as declared by the manufacturer.

For the spot frequency test of the radio frequency immunity test (subclause 9.2) the ROMES shall be assessed by monitoring the accuracy of the call received alert signal.

## 6.3 Performance criteria for Transient phenomena applied to ROMES (TR)

For ROMES:

- during the test no false calls shall occur;
- at the conclusion of the test comprising the series of individual exposures, the ROMES shall operate as intended with no loss of function and/or stored data (messages), as declared by the manufacturer.

---

# 7 Applicability overview tables

## 7.1 Emission

**Table 1: Applicability of emission requirements**

| Application port | Equipment test requirement                  |   |  | Reference subclause in the present document | Reference standard             |
|------------------|---|---|--|---|--------------------------------|
|                  | ROMES and ancillary equipment for fixed use | ROMES and ancillary equipment for vehicular use | ROMES and ancillary equipment for portable use |   |                                |
| Enclosure        | applicable to ancillary equipment           | applicable to ancillary equipment               | applicable to ancillary equipment              | 8.2   | EN 55022 [5]                   |
| DC power         | applicable                                  | applicable                                      | not applicable                                 | 8.3   | EN 55022 [5]<br>CISPR 16-1 [6] |
| AC power         | applicable                                  | not applicable                                  | not applicable                                 | 8.4   | EN 55022 [5]                   |

## 7.2 Immunity

**Table 2: Applicability of Immunity phenomena to equipment ports**

| Phenomena                                      | Application port                       | Equipment test requirement                  |   |  | Reference subclause in the present document | Reference document               |
|--|--|---|---|--|---|----------------------------------|
|  |  | ROMES and ancillary equipment for fixed use | ROMES and ancillary equipment for vehicular use | ROMES and ancillary equipment for portable use |   |                                  |
| RF electromagnetic field (80 MHz - 1 000 MHz)  | Enclosure                              | applicable                                  | applicable                                      | applicable                                     | 9.2   | EN 61000-4-3 [7]                 |
| Electrostatic discharge                        | Enclosure                              | applicable                                  | applicable                                      | applicable                                     | 9.3   | EN 61000-4-2 [8]                 |
| Fast transients, common mode                   | Signal and control, DC power, AC power | applicable                                  | not applicable                                  | not applicable                                 | 9.4   | EN 61000-4-4 [9]                 |
| RF common mode, 0,15 MHz - 80 MHz              | Signal and control, DC power, AC power | applicable                                  | applicable                                      | not applicable                                 | 9.5   | EN 61000-4-6 [10]                |
| Transient and surge in a vehicular environment | DC power                               | not applicable                              | applicable                                      | not applicable                                 | 9.6   | ISO 7637-1 [11], ISO 7637-2 [12] |
| Voltage dips and interruption                  | AC power                               | applicable                                  | not applicable                                  | not applicable                                 | 9.7   | EN 61000-4-11 [13]               |
| Surges, common and differential mode           | AC power                               | applicable                                  | not applicable                                  | not applicable                                 | 9.8   | EN 61000-4-5 [14]                |

## 8 Test methods and limits for emission tests

### 8.1 Test configuration

This subclause defines the requirements for test configurations for tests in the following subclauses. The requirements are as follows:

- measurements shall be made in the operational mode producing the largest emission in the frequency band being investigated consistent with normal applications;
- the message memory shall be loaded with recognizable messages;
- the equipment shall be configured in a manner which is representative of a normal operation, where practical;
- an attempt shall be made to maximize the detected radiated emission, e.g. by moving the cables of the equipment;
- 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 representative configuration of ancillary equipment necessary to exercise the ports;
- the configuration and mode of operation during measurements shall be precisely noted in the test report;
- if the equipment has a large number of ports, then a sufficient number shall be selected to simulate actual operational conditions and to ensure that all the different types of termination are covered;
- ports which in normal operation are connected shall be connected to an ancillary equipment or to a representative piece of cable terminated to simulate the impedance of the ancillary equipment. RF input/output ports shall be correctly terminated.

## 8.2 Enclosure port

This test is applicable to ancillary equipment not incorporated in the ROMES equipment.

This test shall be performed on a representative configuration of the equipment (subclause 8.1).

### 8.2.1 Definition

This test assesses the ability of ancillary equipment to limit its internal noise from being radiated from the enclosure.

### 8.2.2 Test method

The test method shall be in accordance with EN 55022 [5].

### 8.2.3 Limits

The EUT shall meet the limits according to EN 55022 [5] (10 m measuring distance) shown in table 3.

**Table 3: Limits for spurious radiations**

| Frequency range       | Quasi-peak      |
|-----------------------|-----------------|
| 30 MHz - 230 MHz      | 30 dB $\mu$ V/m |
| > 230 MHz - 1 000 MHz | 37 dB $\mu$ V/m |

## 8.3 DC power input/output ports

This test is applicable to ROMES and ancillary equipment which may have DC cables longer than 3 m. If the DC power cable of the ROMES and/or the ancillary equipment is less than 3 m in length, and intended for direct connection to a dedicated DC power supply, then the measurement shall be performed on the AC power input port of that power supply as specified in subclause 8.4. If the DC power cable may be greater than 3 m in length, then the measurement shall additionally be performed on the DC power port.

This test shall be performed on a representative configuration of the equipment (subclause 8.1).

### 8.3.1 Definition

This test assesses the ability of ROMES and ancillary equipment to limit its internal noise from being present on the DC power input/output ports.

### 8.3.2 Test method

For equipment with a current consumption below 16 A, the test method shall be in accordance with EN 55022 [5] and the Line Impedance Stabilizing Networks (LISN) shall be connected to a DC power source.

A measuring receiver shall be connected to each LISN measurement port in turn and the conducted emission shall be recorded. The LISN measurement ports not being used for measurement shall be terminated with a 50  $\Omega$  load. The equipment shall be installed with a ground plane as defined in EN 55022 [5]. 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 CISPR 16-1 [6].

### 8.3.3 Limits

The equipment shall meet the limits below 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. 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 is unnecessary.

The EUT shall meet the limits according to EN 55022 [5], shown in table 4.

**Table 4: Limits for conducted RF signals**

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

## 8.4 AC power input/output ports

This test is applicable for fixed ROMES and fixed ancillary equipment.

This test shall be performed on a representative configuration of the equipment (subclause 8.1).

### 8.4.1 Definition

This test assesses the ability of ROMES and ancillary equipment to limit its internal noise from being present on the AC power ports.

### 8.4.2 Test method

The test method shall be in accordance with EN 55022 [5].

### 8.4.3 Limits

The EUT shall meet the limits according to EN 55022 [5] shown in table 4.

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## 9 Test methods and levels for immunity tests

### 9.1 Test configuration

This subclause defines the requirements for test configurations for tests in the following subclauses and are as follows:

- the measurement shall be made in operational mode as required in clause 4;
- for ROMES the message memory shall be loaded with recognizable messages. The ROMES shall operate in the standby mode, except for the spot frequency test of the radio frequency immunity test (subclause 9.2) where repetitive calls shall be coupled to the input of the receiver;
- if the equipment is part of a system, or can be connected to ancillary equipment, then it shall be acceptable to test the equipment connected to the minimum representative configuration of ancillary equipment necessary to exercise the port or ports;
- for the immunity tests of ancillary equipment, without a separate pass/fail criteria, a ROMES coupled to the ancillary equipment shall be used to judge whether the ancillary equipment passes or fails;
- the configuration and mode of operation during measurements shall be precisely noted in the test report;
- if an equipment has a large number of ports, then a sufficient number shall be selected to simulate actual operational conditions and to ensure that all the different types of termination are covered;
- control ports (figure 1) which in normal operation are connected, shall be connected to an ancillary equipment or to a representative piece of cable terminated to simulate the input/output characteristics of the ancillary equipment. RF signal ports (figure 1) shall be correctly terminated.

## 9.2 Radio frequency electromagnetic field (80 MHz - 1 000 MHz)

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

This test shall be performed on a representative configuration of the equipment (subclause 9.1).

### 9.2.1 Definition

This test assesses the ability of ROMESs and ancillary equipment to operate as intended in the presence of a radio frequency electromagnetic field disturbance.

### 9.2.2 Test method

The test method shall be in accordance with EN 61000-4-3 [7].

The following requirements and evaluation of test results shall apply.

- the test level shall be 3 V/m (measured unmodulated). The test signal shall be amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1 000 Hz.
- for ROMESs, the stepped frequency increments shall be 1 % of the momentary frequency. The test shall be performed over the frequency range 80 MHz to 1 000 MHz.
- the spot frequency test shall be performed at the following frequencies:
  - 80 MHz;
  - 104 MHz;
  - 136 MHz;
  - 165 MHz;
  - 200 MHz;
  - 260 MHz;
  - 330 MHz;
  - 430 MHz;
  - 560 MHz;
  - 715 MHz  $\pm$  1 MHz;
- a spot frequency test shall be performed at 920 MHz  $\pm$  1 MHz using a test level of 3 V/m (measured unmodulated) 100 % modulated by 200 Hz pulses of equal mark to space ratio;
- responses on ROMES occurring at discrete frequencies which are narrow band responses (subclause 4.6) are disregarded in the test.

### 9.2.3 Performance criteria

For ROMESs the general performance criteria (subclause 6.1) and CR performance criteria (subclause 6.2) shall apply.

For ancillary equipment the pass/fail criteria supplied by the manufacturer shall apply, unless the ancillary equipment is tested in connection with a ROMES in which case the corresponding performance criteria above shall apply.

## 9.3 Electrostatic discharge

This test is applicable to fixed, mobile, portable and ancillary equipment.

This test shall be performed on a representative configuration of the equipment (subclause 9.1).

### 9.3.1 Definition

This test assesses the ability of ROMESs and ancillary equipment to operate as intended in the event of an electrostatic discharge.

### 9.3.2 Test method

The test method shall be in accordance with EN 61000-4-2 [8].

For ROMESs and ancillary equipment the following requirements and evaluation of test results shall apply:

- the test severity level for ESD contact discharge shall be 4 kV and for air discharge 8 kV.

### 9.3.3 Performance criteria

For ROMESs the performance criteria TR (subclause 6.3) shall apply.

For ancillary equipment the pass/fail criteria supplied by the manufacturer shall apply, unless the ancillary equipment is tested in connection with a ROMES in which case the corresponding performance criteria above shall apply.

## 9.4 Fast transients, common mode

This test is applicable to fixed ROMESs and fixed ancillary equipment.

This test shall be performed on signal ports, control ports and DC power ports (figure 1) if associated cables are longer than 3 m.

This test shall be performed on AC power ports (figure 1).

This test shall be performed on a representative configuration of the equipment (subclause 9.1).

### 9.4.1 Definition

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

### 9.4.2 Test method

The test method shall be in accordance with EN 61000-4-4 [9].

For ROMESs and ancillary equipment which have cables longer than 3 m, or which have an AC power port (figure 1), the following test requirements and evaluation of test results shall apply:

- the test level for signal and control ports (figure 1) shall be 1 kV open circuit voltage as given in EN 61000-4-4 [9];
- the test level for DC power ports (figure 1) shall be 1 kV open circuit voltage as given in of EN 61000-4-4 [9];
- the test level for AC power ports (figure 1) shall be 2 kV open circuit voltage as given in of EN 61000-4-4 [9].

### 9.4.3 Performance criteria

For ROMESs the performance criteria TR (subclause 6.3) shall apply.

For ancillary equipment the pass/fail criteria supplied by the manufacturer shall apply, unless the ancillary equipment is tested in connection with a ROMES in which case the corresponding performance criteria shall apply.

## 9.5 Radio frequency common mode (150 kHz - 80 MHz)

This test is applicable to fixed, mobile and ancillary equipment.

This test shall be performed on signal, control and DC power ports (figure 1) of mobile and ancillary equipment, which may have cables longer than 2 m.

This test shall be performed on signal, control, and DC power ports (figure 1) of fixed ROMESs and fixed ancillary equipment, which may have cables longer than 1 m.

This test shall be performed on AC power ports (figure 1).

This test shall be performed on a representative configuration of the equipment (subclause 9.1).

### 9.5.1 Definition

This test assesses the ability of ROMESs and ancillary equipment to operate as intended in the presence of a radio frequency electromagnetic disturbance on the input/output ports (figure 1). This test replaces radiated radio frequency electromagnetic immunity testing, in the frequency range 150 kHz to 80 MHz.

### 9.5.2 Test method

The test method shall be in accordance with EN 61000-4-6 [10].

The following requirements and evaluation of test results shall apply.

- current clamp injection or direct connection methods may be used. The selection and technical justification of the test method shall be included in the test report with reference to the guidelines in EN 61000-4-6 [10];
- intrusive methods of measurement should not be used on multiway unscreened busses carrying high speed data or clocks;
- the test shall be performed over the frequency range 150 kHz to 80 MHz;
- the test signal shall be amplitude modulated to a depth of 80 % by a sinusoidal signal of 1 000 Hz;
- for ROMESs the stepped frequency increments shall be 50 kHz in the frequency range 150 kHz to 5 MHz and 1 % frequency increment of the momentary frequency in the frequency range 5 MHz to 80 MHz;
- the test signal level shall be severity level 2 as defined in EN 61000-4-6 [10], equivalent to 3 V RMS unmodulated;
- responses on ROMES occurring at discrete frequencies, which are narrow band responses, shall be disregarded from the test (subclause 4.6).

### 9.5.3 Performance criteria

For ROMESs the performance criteria CR (subclause 6.2) shall apply.

For ancillary equipment the pass/fail criteria supplied by the manufacturer shall apply, unless the ancillary equipment is tested in connection with ROMESs in which case the corresponding performance criteria above shall apply.

## 9.6 Transients and surges in a vehicular environment

These tests are applicable to mobile and ancillary equipment intended for use in a vehicular environment.

These tests shall be performed on 12 V and 24 V DC power ports of mobile and ancillary equipment intended for vehicular use.

ROMES and ancillary equipment designed to operate at both DC power voltages shall be tested in both configurations.

These tests shall be performed on a representative configuration of the radio equipment (subclause 9.1).

### 9.6.1 Definition

These tests assess the ability of ROMESs and ancillary equipment to operate as intended in the event of transients and surges present on the DC power ports (figure 1) in a vehicular environment.

### 9.6.2 Test method

The test method shall be in accordance with ISO 7637-1 [11] for 12 V DC powered equipment and ISO 7637-2 [12] for 24 V DC powered equipment.

#### 9.6.2.1 Test requirements for 12 V DC powered equipment

Where the manufacturer in his installation documentation requires the EUT to have a direct connection to the 12 V main vehicle battery the requirements a) shall apply.

Where the manufacturer does not require the EUT to have a direct connection to the 12 V main vehicle battery the requirements a) and b) apply:

- a) Pulse 3a and 3b, level II, with the test time reduced to 5 minutes for each;

Pulse 4, level II, 5 pulses, with the characteristics as follows:

$$V_s = 5 \text{ V}, \quad V_a = 2,5 \text{ V}, \quad t_6 = 25 \text{ ms}, \quad t_8 = 5 \text{ s}, \quad t_f = 5 \text{ ms};$$

- b) Pulse 1, level II,  $t_1 = 2,5 \text{ s}$ , 10 pulses;

Pulse 2, level II,  $t_1 = 2,5 \text{ s}$ , 10 pulses;

Pulse 7, level II, 5 pulses.

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

#### 9.6.2.2 Test requirements for 24 V DC powered equipment

Where the manufacturer in his installation documentation requires the EUT to have a direct connection to the 24 V main vehicle battery the requirements c) shall apply.

Where the manufacturer does not require the EUT to have a direct connection to the 24 V main vehicle battery the requirements c) and d) apply:

- c) Pulse 3a and 3b, level II, with the test time reduced to 5 minutes for each;

Pulse 4, level II, 5 pulses, with the characteristics as follows:

$$V_s = 10 \text{ V}, \quad V_a = 5 \text{ V}, \quad t_6 = 25 \text{ ms}, \quad t_8 = 5 \text{ s}, \quad t_f = 5 \text{ ms};$$

- d) Pulse 1a, level II,  $t_1 = 2,5 \text{ s}$ ,  $R_i = 25 \Omega$  10 pulses;

Pulse 1b, level II,  $t_1 = 2,5 \text{ s}$ ,  $R_i = 100 \Omega$  10 pulses.

Where the manufacturer declares that the EUT requires a direct connection to the vehicular battery and the tests in accordance with the requirements d) are not carried out, this shall be stated in the test report.

### 9.6.3 Performance criteria

For pulse 3a and 3b the performance criteria CR (subclause 6.2) shall apply. For pulse 1, 1a, 1b, 2, 4 and 7 the performance criteria TR (subclause 6.3) shall apply, with the exception that a communication link need not to be maintained during exposure and may have to be re-established.

For ancillary equipment the pass/failure criteria supplied by the manufacturer shall apply, unless the ancillary equipment is tested in connection with a ROMES in which case the corresponding performance criteria above shall apply.

## 9.7 Voltage dips and interruptions

These tests are applicable for fixed ROMES and fixed ancillary equipment, powered by AC.

These tests shall be performed on AC power ports (figure 1).

These tests shall be performed on a representative configuration of the equipment (subclause 9.1).

### 9.7.1 Definition

These tests assess the ability of ROMESs and ancillary equipment to operate as intended in the event of voltage dips and interruptions present on the AC power ports.

### 9.7.2 Test method

The following requirements and evaluation of test results shall apply.

The test method shall be in accordance with EN 61000-4-11 [13].

The test levels shall be:

- a voltage dip corresponding to a reduction of the supply voltage of 30 % for 10 ms; and
- a voltage dip corresponding to a reduction of the supply voltage of 60 % for 100 ms; and
- 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 following performance criteria apply:

- for ROMES the performance criteria CR (subclause 6.2) shall apply;
- for ancillary equipment the pass/fail criteria supplied by the manufacturer shall apply, unless the ancillary equipment is tested in connection with a ROMES in which case the corresponding performance criteria above shall apply.

For a voltage dip corresponding to a reduction of the supply voltage of 60 % for 100 ms the following performance criteria apply:

- for ROMESs the performance criteria TR (subclause 6.3);
- for ancillary equipment the pass/fail criteria supplied by the manufacturer shall apply, unless the ancillary equipment is tested in connection with a ROMES in which case the corresponding performance criteria above shall apply.

For a voltage interruption corresponding to a reduction of the supply voltage of  $> 95\%$  for 5 000 ms the following performance criteria apply:

- in the case where the equipment is powered solely from the AC mains supply (without the use of a parallel battery back-up) volatile user data may have been lost and if applicable the communication link need not to be maintained. Lost functions shall be recoverable by the user or operator;
- no unintentional responses should occur at the end of the test.

In the event of loss of function(s) or in the event of loss of user stored data, this fact shall be recorded in the test report, the product description and the user documentation.

## 9.8 Surges, common and differential mode

These tests are applicable for fixed ROMESs and fixed ancillary equipment.

These tests shall be performed on AC power ports (figure 1).

These tests shall be performed on a representative configuration of the equipment (subclause 9.1).

### 9.8.1 Definition

These tests assess the ability of ROMESs and ancillary equipment to operate as intended in the event of surges present on the AC power ports (figure 1).

### 9.8.2 Test method

The following requirements and evaluation of test results shall apply.

The test method shall be in accordance with EN 61000-4-5 [14]:

- the test level shall be 1 kV open circuit voltage for common mode and 0,5 kV open circuit voltage for differential mode.

### 9.8.3 Performance criteria

For ROMESs the performance criteria TR (subclause 6.3) shall apply.

For ancillary equipment the pass/fail criteria supplied by the manufacturer shall apply, unless the ancillary equipment is tested in connection with a ROMES in which case the corresponding performance criteria above shall apply.

## Annex A (normative):

### Subclauses of the present document relevant for compliance with the essential requirements of relevant EC Council Directives

**Table A.1: Subclauses of the present document relevant for compliance with the essential requirements of relevant EC Council Directives**

| Clause/subclause number and title |  | Corresponding article of Council Directive 89/336/EEC | Qualifying remarks |
|-----------------------------------|--|---|--------------------|
| 8                                 | Test methods and limits for emission tests                 |   |                    |
| 8.2                               | Enclosure port   | 4(a)  |                    |
| 8.3                               | DC power input/output ports                                | 4(a)  |                    |
| 8.4                               | AC power input/output ports                                | 4(a)  |                    |
| 9                                 | Test methods and levels for immunity tests                 |   |                    |
| 9.2                               | Radio frequency electromagnetic field (80 MHz - 1 000 MHz) | 4(b)  |                    |
| 9.3                               | Electrostatic discharge                                    | 4(b)  |                    |
| 9.4                               | Fast transients, common mode                               | 4(b)  |                    |
| 9.5                               | Radio frequency common mode (150 kHz - 80 MHz)             | 4(b)  |                    |
| 9.6                               | Transients and surges in a vehicular environment           | 4(b)  |                    |
| 9.7                               | Voltage dips and interruptions                             | 4(b)  |                    |
| 9.8                               | Surges, common and differential mode                       | 4(b)  |                    |

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## History

| Document history |               |                                 |          |                          |
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|                  |               |                                 |          |                          |