



EUROPEAN
TELECOMMUNICATION
STANDARD

ETS 300 254

May 1994

Source: ETSI TC-SES

Reference: DE/SES-05001

ICS: 33.060.30

Key words: LMES, LBRDC

**Satellite Earth Stations and Systems (SES);
Land Mobile Earth Stations (LMESs)
operating in the 1,5/1,6 GHz bands
providing Low Bit Rate Data Communications (LBRDCs)**

ETSI

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Foreword

This European Telecommunication Standard (ETS) has been produced by the Satellite Earth Stations and Systems (SES) Technical Committee of the European Telecommunications Standards Institute (ETSI).

Every ETS prepared by ETSI is a voluntary standard. This ETS may contain text concerning type approval of the equipment to which it relates. This text does not make this ETS mandatory in its status as a standard. However, this ETS can be referenced, wholly or in part, for mandatory application by decisions of regulatory bodies.

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1 Scope

This European Telecommunication Standard (ETS) provides specifications for the standardisation of the characteristics of Land Mobile Earth Stations (LMESs) with both transmit and receive capabilities in order to ensure general safety and to limit interference to radio communications services.

The geostationary satellite networks referred to in this ETS operate under the Land Mobile Satellite Service (LMSS). The LMESs operate as part of a geostationary satellite network providing Low Bit Rate Data Communications (LBRDC).

The frequency bands under which the LMESs operate should be within the following bands:

LMES transmit frequencies	LMES receive frequencies
1 626,5 MHz to 1 645,5 MHz and 1 656,5 MHz to 1 660,5 MHz	1 525,0 MHz to 1 544,0 MHz and 1 555,0 MHz to 1 559,0 MHz

These LMESs generally have the following characteristics:

- the LMESs could be either vehicle mounted or portable equipment;
- the LMESs could consist of a number of modules including a keyboard interface to the user.

The main specifications are contained in three categories related to:

- safety: to protect personnel, public and goods from unsafe operating conditions or equipment;
- unwanted emissions: to protect terrestrial and satellite radio services from harmful interference;
- LMES control and monitoring: to specify a minimum set of Control and Monitoring Functions (CMF) that shall be implemented on each LMES in order to minimise the probability that they originate unwanted transmissions that may give rise to harmful interference to other systems.

This ETS deals with two types of specification:

a) Essential normative requirements (indicated in Clause 4)

Requirements are specified in order to protect other users of the frequency spectrum from unacceptable interference. In addition, requirements are specified for the purposes of general safety.

b) Recommendations (indicated in Clause 5)

Recommendations are specified relating to matters of general safety, minimisation of interference to other users of the radio spectrum and for the provision of protection of the LMESs against electromagnetic interference from other systems.

All tests related to the requirements shall be performed and the results entered in the data sheets of the test report. The ability to comply with the recommendations shall also be noted in the data sheets of the test report. All parameters and operational conditions declared by the manufacturer shall be entered in the test report.

2 Normative references

This ETS incorporates, by dated or undated references, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

- [1] IEC 215 (1987): "Safety requirements for radio transmitting equipment".
- [2] CISPR Publication No. 22 (1985): "Limits and methods of measurement of radio interference characteristics of information technology equipment".
- [3] IEC 510-2-1 (1978): "Methods of measurement for radio equipment used in satellite earth stations, Part 2: Measurement for sub-systems".
- [4] ETS 300 282: "Satellite Earth Stations and Systems (SES); Network Control Facilities (NCFs) for Land Mobile Earth Stations (LMESs) operating in the 1,5/1,6 GHz and 11/12/14 GHz bands providing Low Bit Rate Data Communications (LBRDCs)".
- [5] IEC 801-3 (1984): "Electromagnetic compatibility for industrial-process measurement and control equipment, Part 3: Radiated electromagnetic field requirements".
- [6] CISPR Publication No. 16 (1987): "CISPR" specification for radio interference measuring apparatus and measurement methods".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of this ETS, the following definitions apply:

Installable Equipment (IE), Internally Mounted Equipment (IME) and Externally Mounted Equipment (EME): an Installable Equipment (IE) is an equipment which is intended to be installed in a vehicle. An IE may consist of one or several interconnected modules. The manufacturer shall indicate which modules are intended to be Externally Mounted Equipment (EME); the remaining module(s) will then be defined as Internally Mounted Equipment (IME). Where different specifications apply to IME and EME, this is noted in the text.

Nominated bandwidth: the bandwidth of the LMES radio frequency transmission is nominated by the manufacturer. The nominated bandwidth shall encompass all close-in spectral elements of the transmission which have a level greater than the specified spurious levels. The nominated bandwidth shall be wide enough to take account of the transmit carrier frequency stability. The nominated bandwidth shall be within the LMSS transmit frequency band within which the LMES operates. The value of the nominated bandwidth shall be entered on the data sheet of the test report.

Portable Equipment (PE): a Portable Equipment (PE) is generally intended to be self-contained, free standing and portable. A PE would normally consist of a single module, but may consist of several interconnected modules. In some cases different specifications will apply to PE and this is noted in the text.

Unwanted emissions: unwanted emissions are those falling outside the nominated bandwidth.

3.2 Abbreviations

For the purposes of this ETS, the following abbreviations apply:

CMF	Control and Monitoring Function
EIRP	Equivalent Isotropically Radiated Power
EM	Electro-Magnetic
EME	Externally Mounted Equipment
EUT	Equipment Under Test
IE	Installable Equipment
IME	Internally Mounted Equipment
LBRDC	Low Bit Rate Data Communication
LMSS	Land Mobile Satellite Service
LMES	Land Mobile Earth Station
NCF	Network Control Facility
PE	Portable Equipment
RF	Radio Frequency
rms	root mean square
STE	Special Test Equipment

4 Requirements

4.1 Safety

4.1.1 Mechanical construction

Purpose:

Protection of operating personnel, the public and goods from insecure or unsafe structures.

Specification:

For Installable Equipment (IE) and Portable Equipment (PE) the mechanical design, construction and finish of the equipment shall conform to IEC 215 [1], section 3, paragraph 9.1.

Verification:

Verification shall be demonstrated by documentary evidence and visual inspection.

4.1.2 Electrical safety, power voltages

Purpose:

Protection of operating personnel and the public from electric shock.

Specification:

The electrical safety of the equipment shall be in accordance with paragraphs 13, 14, 15 and 16, and Appendix B of IEC 215 [1].

Verification:

Conformance shall be determined by documentary evidence and visual inspection.

4.1.3 Radio frequency radiation protection

Purpose:

To indicate the distance from the LMES below which RF power densities in excess of 8 W/m² may be experienced, when averaged over a 6 minute period.

Specification:

The radiating part of the equipment (which includes the exterior of any radome or other antenna enclosure where fitted) shall be labelled with a warning notice which shall be clearly visible when the equipment is in its normal operating configuration. This notice shall indicate the closest distance to the radiating part within which a person may approach the equipment without experiencing radio frequency power density levels in excess of 8 W/m^2 , when under worst case conditions (e.g. maximum power, maximum on/off ratio), averaged over a 6 minute period. This notice shall also state that before approaching the radiating part within any distance closer than that indicated, the LMES equipment shall be switched off or otherwise disabled so that it shall not transmit.

Where the equipment is vehicle mounted a warning notice providing the same information as that affixed to the radiating part shall be provided for fixing in the vehicle near to and clearly visible from the normal operating position of the IME. In addition, for vehicle mounted equipment where the radiating part is mounted in a position where it is not normally visible to a person standing on the ground next to the vehicle, further warning notices shall be provided with instructions that they be attached to the vehicle so as to be clearly visible to anyone attempting to climb on to the part of the vehicle where the radiating part of the equipment is mounted.

In the case where the antenna is enclosed in a radome, or other antenna enclosure, and when no RF power density greater than 8 W/m^2 , when under worst case conditions (e.g. maximum power, maximum on/off ratio), averaged over a 6 minute period, is produced outside of this radome, or antenna enclosure, then it is not necessary to label the radiating part or provide labels for the vehicle in the manner indicated above. Instead, the radiating part shall be clearly labelled with a warning that the LMES equipment shall be switched off, or otherwise disabled, so that it shall not transmit before any work requiring the removal of the radome or antenna enclosure takes place. Where the equipment is vehicle mounted, a label containing the same warning shall be provided, to be mounted in the vehicle near to, and clearly visible from, the normal operating position of the IME.

Verification:

Verification of the distance below which exist RF power densities in excess of 8 W/m^2 , when under worst case conditions (e.g. maximum power, maximum on/off ratio) averaged over a 6 minute period, shall be by documentary evidence. The manufacturer shall quantify the worst case conditions.

Conformance with the labelling requirements of this subclause shall be demonstrated by visual inspection of the radiating part and, if relevant, an examination of the notices provided by the manufacturer for affixing to vehicles, and the instructions provided relating to the affixing of these notices.

4.2 Radio Frequency (RF)

Whenever a change of limit between adjacent frequency bands occurs in this subclause, the lower of the two limits shall apply at the transition frequency.

4.2.1 Unwanted emissions outside the bands 1 626,5 - 1 645,5 MHz and 1 656,5 - 1 660,5 MHz

Purpose:

Protection of terrestrial and satellite services from emissions caused by LMESs outside the bands 1 626,5 - 1 645,5 MHz and 1 656,5 - 1 660,5 MHz.

Specification:

The unwanted emissions from the LMES outside the bands 1 626,5 - 1 645,5 MHz and 1 656,5 - 1 660,5 MHz within which the LMES is designed to operate shall be below the following limits.

For unwanted emissions below 960 MHz, the LMES shall meet the requirements of CISPR Publication No. 22 [2] for class B equipment, with carrier on.

Table 1

Limits of radiated emissions at a test distance of 10m in a 120 kHz bandwidth	
Frequency (MHz)	Quasi-peak Limits (dB μ V/m)
30 to 230	30
230 to 960	37

The unwanted emissions EIRP above 960 MHz in the measurement bandwidth and in all directions shall not exceed the following limits:

Table 2

Frequency range MHz	Carrier On		Carrier Off	
	EIRP limit (dBpW)	Measurement bandwidth (kHz)	EIRP limit (dBpW)	Measurement bandwidth (kHz)
960 - 1 525	49	100	48	100
1 525 - 1 559	49	100	17	3
1 559 - 1 600	49	100	48	100
1 600 - 1 623,5	74	100	48	100
1 623,5 - 1 626	74 (NOTE 1)	100 (NOTE 1)	48	100
1 626 - 1 626,5	84	3	48	100
1 645,5 - 1 645,6	104	3	57	3
1 645,6 - 1 646,1	84	3	57	3
1 646,1 - 1 655,9	74	3	57	3
1 655,9 - 1 656,4	84	3	57	3
1 656,4 - 1 656,5	104	3	57	3
1 660,5 - 1 661	84	3	48	100
1 661 - 1 663,5	74 (NOTE 1)	100 (NOTE 1)	48	100
1 663,5 - 1 690	74	100	48	100
1 690 - 3 400	49 (NOTE 2)	100	48	100
3 400 - 10 700	55 (NOTE 3)	100	48	100
10 700 - 21 200	61	100	54	100
21 200 - 40 000	67	100	60	100

NOTE 1: These figures shall be 74 dBpW/3kHz prior to 1st January 1996.

NOTE 2: In the band 3 253,0 - 3 321,0 MHz the maximum EIRP in one, and only one, 100 kHz measurement bandwidth shall not exceed 82 dBpW. Prior to 1st January 1996 this figure shall be 92 dBpW. Elsewhere in this band the power limit in this table shall be applied.

NOTE 3: In each of the bands 4 879,5 - 4 981,5 MHz, 6 506,0 - 6 642,0 MHz and 8 132,5 - 8 302,5 MHz the maximum EIRP in one, and only one, 100 kHz measurement bandwidth shall not exceed 72 dBpW. Prior to 1st January 1996 this figure shall be 82 dBpW. Elsewhere in these bands the power limit in this table shall be applied. In the band 9 759,0 - 9 963,0 MHz the maximum power in one, and only one, 100 kHz measurement bandwidth shall not exceed 61 dBpW. Prior to 1st January 1996 this figure shall be 71 dBpW. Elsewhere in this band the power limit in this table shall be applied.

Verification:

By measurement of unwanted emissions generated by an operating LMES.

All RF tests in this subclause shall be carried out at ambient environmental conditions and for a nominal power supply voltage.

All tests with carrier on shall be undertaken with the transmitter operating at full power and with the maximum transmit burst rate where applicable.

To enable the performance tests to be carried out, the use of Special Test Equipment (STE), made available by the manufacturer or system provider, may be necessary. Since this test equipment will be specific for the particular system, it is not possible to provide detailed specifications in this ETS. However, the following baseline is provided:

- if the LMES requires to receive a modulated carrier from the satellite in order to transmit, then special test arrangements are required to simulate the satellite signal, thus enabling the LMES to transmit to allow measurement of transmission parameters;
- any characteristic of these special test arrangements which may have direct or indirect effects on the parameters to be measured shall be clearly stated by the manufacturer.

Test procedure:

Below 960 MHz, the test procedures set out in CISPR Publication No. 22 [2], paragraphs 5, 6, 7, 8 and 10 shall be used.

Above 960 MHz, the full system shall be tested according to the test procedure given in Annex B.

Where possible, up to four LMES transmit frequencies shall be used for this test; the frequencies shall be selected to be as close as possible to the upper and lower limits of the transmit frequency sub-band(s) of the LMES declared by the manufacturer, to be intended for operational use of the LMES. The upper and lower extremes of the tuning range stated by the manufacturer shall be entered in the test report.

4.2.2 Maximum unwanted emission within the 1 626,5 - 1 645,5 MHz and 1 656,5 - 1 660,5 MHz bands

Purpose:

Protection of satellite and terrestrial services operating in the above frequency bands.

Specification:

The unwanted emissions EIRP in any 3 kHz band within the 1 626,5 - 1 645,5 MHz and 1 656,5 - 1 660,5 MHz bands in which the LMES is designed to transmit, but outside the nominated bandwidth, shall not exceed the following limits:

- when the carrier is off: 57 dBpW;
- when the carrier is on as follows:

Offset from the edge of the band of the nominated bandwidth (kHz)	Maximum EIRP (dBpW)
0	117
100	104
200	84
greater than 700	74

Verification:

Conformance shall be determined by direct measurement.

The conditions (environment, power, Special Test Equipment (STE) etc.) set out in the verification section of subclause 4.2.1 of this ETS shall apply.

Test procedure:

The measurement shall be performed by either of the two following methods:

- a) in the first method, the full system shall be tested according to the test procedure presented in Annex C;

- b) in the second method, the power of the unwanted emissions at the interface point between the antenna and the remaining EME shall be measured according to the alternative measurement method in Annex C. The antenna on-axis gain shall be measured according to the measurement methods in IEC 510-2-1 [3]. The EIRP of the unwanted radiation shall be calculated from the above two measurements.

4.2.3 Electromagnetic immunity

Purpose:

To limit interference to radio communications services and to protect the LMES when the LMES is subjected to interfering electromagnetic fields up to 2 GHz caused by other equipment. Beyond 2 GHz, a recommendation is given under subclause 5.2 of this ETS.

Specification:

The LMES shall have an adequate level of intrinsic immunity to enable it to operate with the control and monitoring functions specified in subclause 4.3 of this ETS when it is exposed to the following electrical field strengths (except that it is not expected that the LMES continues successfully to receive the control messages addressed to it when in the presence of blocking Electro Magnetic (EM) fields):

- 1 V/m in the frequency range 150 kHz to 50 MHz;
- 3 V/m in the frequency range 50 MHz to 2 GHz.

Verification:

Conformance shall be determined by a measurement method based on IEC 801-3 [5], Clauses 6 to 9, but taking into account the EMC frequency ranges defined above. The Equipment Under Test (EUT) shall be as in Annex B, Clause B.3. For the test set-up up see also Annex B, Clause B.5, paragraphs 1, 2, and 3.

The LMES shall be considered to satisfy this specification if the following conditions are met when the disturbing EM field is applied:

- a) the control and monitoring functions continue to function normally;
- b) when the LMES is in the carrier-off state there shall be no change in the signal level;
- c) when the LMES is in the carrier-on state there shall be no change in the signal level and frequency.

Test procedure:

Conformance shall be determined according to the test procedure set out in IEC 801-3 [5]. The manufacturer shall provide the test house with a method for determining the correct functioning of the control and monitoring functions.

4.2.4 Protection of the radio astronomy service from the LMES operating in the band 1 660,0 - 1 660,5 MHz

Purpose:

Protection of the radio astronomy observations taking place in the band 1 660,0 - 1 660,5 MHz.

Specification:

The LMES shall provide means of suppressing transmission in the band 1 660,0 - 1 660,5 MHz when needed.

Verification:

By documentary evidence and demonstration.

It shall be demonstrated that a transmitting LMES can suppress transmissions in the band 1 660,0 - 1 660,5 MHz, when it has received a disable command or other indication that the radio astronomy service is required to be protected, and transmissions remain suppressed until an appropriate enable command or indication has been received.

4.3 LMES Control and Monitoring Functions (CMFs)

This subclause defines a minimum set of CMFs which shall be implemented on LMESs in order to minimise the probability that they originate unwanted transmissions that may give rise to harmful interference to other systems.

There shall be a CMF at each LMES and a separate Network Control Facility (NCF) which is the subject of ETS 300 282 [4].

4.3.1 Monitoring functions

4.3.1.1 Processor monitoring

Purpose:

To ensure that the LMES can suppress transmissions in the event of a processor sub-system failure.

Specification:

An LMES shall incorporate a processor monitoring function for each of its processors involved in the manipulation of traffic and in control and monitoring functions.

The processor monitoring function shall detect any failure of the processor hardware and software.

No later than one second after any fault condition occurs, the transmissions shall be suppressed until the processor monitoring function has determined that the fault condition has been cleared.

Verification:

Compliance shall be verified by documentary evidence and demonstration.

The demonstration shall show that all transmissions are suppressed within 1 second following a controllable processor induced fault (e.g. processor board disconnected).

The manufacturer shall provide the test house with a test procedure to demonstrate this transmission shutdown.

4.3.1.2 Transmit frequency sub-system

Purpose:

To verify the correct operation of the transmit frequency generation sub-system and to inhibit transmissions should the sub-system fail.

Specification:

An LMES shall monitor the operation of its transmit frequency generation sub-system.

The failure of the transmit frequency generation sub-system for a period longer than 5 seconds shall result in transmissions being suppressed until the fault condition has been cleared.

Verification:

Compliance shall be verified by documentary evidence and demonstration.

The demonstration shall show that all transmissions are suppressed within 6 seconds following a controllable transmit frequency generation sub-system fault (e.g. replacement of frequency reference).

The manufacturer shall provide the test house with a test procedure to demonstrate this transmission shutdown.

4.3.2 Power on/reset

Purpose:

To demonstrate that the LMES shall achieve a controlled non-transmitting state following the POWER ON/RESET or restart of the unit.

Specification:

Following POWER ON/RESET the LMES shall enter a controlled, non-transmitting state.

Verification:

Compliance shall be verified by documentary evidence and demonstration.

4.3.3 Network control reception and authorisation

4.3.3.1 Network control authorisation

Purpose:

To ensure that the LMES cannot transmit unless it receives an appropriate enable indication.

Specification:

- a) Without reception of an appropriate enable signal to the LMES via an authorised control channel it shall not be possible to initiate message transmission.
- b) Transmissions shall not continue for longer than 30 seconds unless further enables are received. For half-duplex transmission systems in operation before 1st January 1994 this period of time shall be 15 minutes.

Verification:

By documentary evidence and demonstration.

It shall be demonstrated that a transmitting LMES suppresses transmissions when it has not received a suitable enable for a period of time longer than 30 seconds and the LMES transmissions shall remain suppressed until a further enable is received.

For half-duplex systems in operation before 1st January 1994 this period of time shall be 15 minutes.

It shall be demonstrated that after POWER ON/RESET of the LMES, it is not possible to initiate message transmission until an appropriate enable signal is received by the LMES.

4.3.3.2 Network control reception

Purpose:

These requirements ensure that the LMES shall be capable of:

- receiving and implementing commands from the NCF through its correct reception of the appropriate control channel(s);
- retaining a unique identification in the network and transmitting it upon reception of an appropriate request.

Specification:

The LMES shall hold, in non-volatile memory, the unique identification codes of the terminal itself.

The LMES shall be enabled or disabled through control channels.

Failure to receive an authorised control channel (either a command or a signal) for a period longer than 30 seconds shall inhibit message transmission. For half-duplex systems in operation before 1st January 1994, this period of time shall be 15 minutes.

The LMES shall be capable of receiving and acting upon the control messages that are addressed to it which contain transmitter enabling and disabling information. The LMES shall be capable of transmitting its identification code upon reception of an appropriate control message addressed to the LMES.

Verification:

The method of setting and storing the LMES identification codes shall be verified by documentary evidence.

The other requirements shall be verified by documentary evidence and demonstration showing that the LMES is capable of receiving appropriate signals from the NCF to implement enables, disables and identification functions.

The manufacturer shall provide the test house with a test procedure to demonstrate the implementation of enables, disables and identification functions.

4.4 Initial burst rate transmission

Purpose:

To limit disturbance duration and period to other services when interference occurs.

Specification:

For systems which do not inhibit initial burst transmission from the LMES after reset or power on:

- the transmission of the initial burst shall not exceed 1% of the time;
- each burst shall not last more than one second.

Verification:

By documentary evidence and demonstration.

5 Recommendations

5.1 Electrical safety while loading and unloading hazardous fuels or gases

Purpose:

Protection of operating personnel and the public from danger of fire and explosion.

Specification:

The use of components that may, under normal operating conditions, produce arcs or sparks or excessive heat should be avoided.

In the situation where such a component is part of the LMES, a clear reference should be noted in the users' documentation by the manufacturer.

The manufacturer shall state whether the equipment meets any standard relevant to the protection of operating personnel and the public from danger of fire and explosion while loading and unloading hazardous fuels or gases.

Verification:

By visual inspection of the users' documentation for the equipment provided by the manufacturer.

The standards relevant to the protection of operating personnel and the public from danger of fire and explosion while loading and unloading hazardous fuels or gases, stated as met by the manufacturer shall be recorded in the test report.

5.2 Electromagnetic immunity - General immunity between 2 GHz and 3 GHz

Purpose:

To limit interference to radio communications services and to protect the LMES when the LMES is subjected to interfering electromagnetic fields between 2 GHz and 3 GHz caused by other equipment.

Specification:

The LMES should have an adequate level of intrinsic immunity to enable it to operate with the control and monitoring functions specified in subclause 4.3 of this ETS when it is exposed to the following electrical field strengths:

- 3 V/m in the frequency range 2 GHz to 3 GHz.

NOTE: It is not expected that the LMES continues successfully to receive the control messages addressed to it when in the presence of blocking EM fields.

Verification:

Compliance shall be demonstrated as specified in subclause 4.2.3.

5.3 Compliance with RF specifications under conditions of shock and vibration

Purpose:

To ensure that the in-band unwanted emission parameters of the LMES remain within specification when the LMES is subjected to mechanical shock or vibration.

Specification:

The manufacturer should design the LMES so that the in-band unwanted emissions specifications set out in subclause 4.2.2 are met after the LMES has been subjected to the mechanical shocks and vibrations set out in Annex A, Clause A.1, items b), c) and d).

Verification:

After the LMES has been subjected to the specified mechanical shocks and vibrations, the verification procedure given in subclause 4.2.2 shall be applied. The tests in subclause 4.2.2 may be performed after mechanical shocks and vibrations, if the manufacturer so requests. The test conditions given in Annex A, Clause A.2 paragraphs b), c) and d) shall apply.

5.4 Method of attachment to the vehicle of the Externally Mounted Equipment (EME)

Purpose:

To ensure that the EME is capable of being adequately attached to the vehicle for reasons of general safety.

Specification:

The method of attaching the EME to the vehicle, recommended by the manufacturer in the LMES documentation, shall be sufficiently strong such that the EME will not break away or be torn from the vehicle when subject to the wind loading, mechanical shock and vibration conditions specified in Annex A, Clause A.1.

Verification:

The test conditions given in Annex A, Clause A.2 shall apply.

6 Network Control Facilities (NCFs) for LMES networks

Relevant information is contained in ETS 300 282 [4].

Annex A (normative): Environmental conditions

A.1 Environmental conditions

The following requirements specify various environmental conditions to which certain of the requirements and recommendations of this ETS refer:

- a) wind loading: relative wind speeds up to 200 km/hour;
- b) vibration: random vibration: 5 to 20 Hz at 0,005 g²/Hz;
20 to 150 Hz at - 3 dB/oct (0,5 g RMS);
- c) mechanical shock: half sine wave shock with a peak of 20 g and a duration of 11 ms;
- d) induced acceleration: maximum tangential or linear acceleration of up to 2 g.

All requirements are applicable to IE.

Requirements a) and d) do not apply to PE.

Requirement a) does not apply to the IME of IE.

A.2 Test conditions

The following requirements specify various test conditions to which certain of the requirements and recommendations of this ETS refer:

- a) wind loading: relative wind speeds up to 200 km/hour;
- b) vibration: random vibration: 5 to 20 Hz at 0,005 g²/Hz;
20 to 150 Hz at - 3 dB/oct (0,5 g RMS).
Vibration to be performed for a period of 2 hours in each of 3 mutually perpendicular axes;
- c) mechanical shock: half sine wave shock with a peak of 20 g and a duration of 11 ms.
A total of 18 shocks shall be performed (6 shocks in each of 3 mutually perpendicular axes);
- d) induced acceleration: maximum tangential or linear acceleration of up to 2 g.

All requirements are applicable to IE.

Requirements a) and d) do not apply to PE.

Requirement a) does not apply to the IME of IE.

Annex B (normative): Out-of-band unwanted emissions above 960 MHz - test procedure

B.1 Introduction

This Annex describes the measurement procedure of unwanted emissions from 960 MHz to 40 GHz generated by an LMES terminal under operating conditions (as specified in subclause 4.2.1).

B.2 Measuring apparatus

In order to carry out the test, the following elements are required, as a minimum:

- a set of calibrated reference antennas covering the frequency range of interest (960 MHz to 40 GHz);
- the necessary post reference antenna pre-amplification and amplification devices;
- spectrum analyser(s) with sweep/store capability covering the frequency range of interest (960 MHz to 40 GHz).

For the apparatus utilised, it shall be verified that:

- the response of the apparatus, including any antenna and associated amplification system, to a constant amplitude sine wave signal remains within ± 1 dB of calibration across the frequency range of interest;
- the screening performance of the measuring apparatus shall be such that when the measuring antenna/post-antenna equipment is removed, and the input to the measuring apparatus is screened, the measured power density shall fall to a value at least 60 dB below the measured value (see CISPR Publication No. 16 [6], section 6.2).

B.3 Equipment Under Test (EUT)

For purpose of the test, the LMES terminal comprises, for IE:

- the EME;
- the IME;
- a connection cable between IME and EME unit;
- the necessary power supply cables and any other cable ensuring a proper functioning of the terminal.

For PE, the LMES terminal comprises:

- for a single module PE, the module itself with any deployable parts in their normal operating configuration;
- for a multiple module PE, all such modules with all necessary interconnecting cables of lengths as normally supplied by the manufacturer; again any deployable parts should be in their normal operating configuration.

B.4 Special Test Equipment (STE)

In order to measure the system radiation under operational (transmitting) conditions, proper arrangement shall be made available (by the manufacturer) to put the LMES terminal in its normal operating mode (in particular in the normal transmit mode with maximum transmit burst rate and with maximum transmitter power). This may require the use of STE provided by the manufacturer (see subclause 4.2).

B.5 Test set-up

The tests shall be carried out at ambient environmental conditions and for a nominal power supply voltage.

For IE, EME and IME shall be installed with a separation of about 0,5 m. Between the two equipments, the maximum length connection cable specified by the manufacturer shall be installed. The height of the cable shall be between 0,5 and 1 m. The cable shall be maintained in that position by non-metallic means. The EME shall be set, in its normal operating configuration on a non-metallic table at a height between 0,5 and 1 m. The IME shall be set on a non-metallic table at a height between 0,5 and 1 m. Any associated equipment, e.g. portable computer or data terminal if required for operation of the LMES, shall be placed next to, and at the same height as the IME.

For PE, the equipment shall be arranged in its normal operating configuration as recommended by the manufacturer on a non-metallic table at a height between 0,5 and 1 m.

The measuring antenna shall be installed in the horizontal plane of the radiating part of the LMES. Each antenna shall be positioned to be outside the near field of the other antenna.

In addition, it shall be verified that the test site shall be suitable with respect to ambient noise which shall be at least 6 dB lower than the lowest specification value being measured.

B.6 Measuring procedure

The EUT shall be switched on and the STE (if used) activated. The measuring equipment shall be set to an appropriate measuring bandwidth and the measured EIRP given in the nominated bandwidth. Where a spurious emission is detected that is near to the specification limits a measuring bandwidth not exceeding (e.g. twice) the nominated bandwidth shall be used.

The measuring antenna shall be placed at a fixed height and an appropriate distance from the EUT. Measurements shall be made around the EUT to detect unwanted emissions. A suitable test procedure follows.

Testing should first be performed in angular steps of 90° while varying the height of the measuring antenna between 1 m and 4 m. For those directions and frequencies, or frequency bands, where unwanted emissions are detected that are near to the specified limits, additional tests shall be performed for each detected emission by varying the height of the measuring antenna between 1 m and 4 m and rotating the EUT through 360° to maximise the emission value.

These measurements shall be carried out with the measuring antenna in both planes (vertical and horizontal) of polarisation to ensure that the values of measured EIRP obtained are maximised.

The received power density shall be measured over the entire frequency range from 960 MHz to 40 GHz in measurement ranges appropriate to the test equipment being used. The precise knowledge of distance between the EUT and the reference antenna, the reference antenna gain and the amplification/attenuation characteristics of the post reference antenna network allow the determination of the unwanted EIRP density radiated by the EUT.

B.7 Alternative measuring procedure

For the case in which it is desired to measure the power of the emissions from the LMES by direct coupling at the interface point between the antenna and the rest of the LMES, the method set out in this Annex shall apply except that the test set-up will need to be modified to allow direct coupling of the measuring equipment to the antenna feed and references to the positioning of the measuring antenna shall be ignored. The LMES maximum antenna gain at the measurement frequency shall be taken into account.

For this test set-up up it may also be necessary to arrange for the coupling of signals from the STE to the LMES in order to put the LMES into its normal transmit mode, as described in Clause C.4.

Annex C (normative): In-band unwanted emissions - test procedure

C.1 Introduction

The test procedure consists of the measurement of in-band unwanted emissions (as specified in subclause 4.2.2) radiated from the EUT by means of a reference antenna whose gain is accurately known across the frequency range of interest.

C.2 Measuring apparatus

In order to carry out the test, the following elements are required, as a minimum:

- a reference antenna calibrated across the frequency range of interest;
- the necessary post reference antenna pre-amplification and amplification devices;
- a spectrum analyser with sweep/store capability.

For the apparatus utilised, it shall be verified that the specifications set out in Annex B, Clause B.2 of this ETS are met.

C.3 Equipment Under Test (EUT)

The EUT comprises those units with all necessary cables ensuring a proper functioning of the equipment as specified in Annex B, Clause B.3 of this ETS.

C.4 Special Test Equipment (STE)

In order to measure the system radiation under operational (transmitting) conditions, proper arrangement shall be made available (by the manufacturer) to put the LMES terminal in its normal operating mode (in particular in the normal transmit mode with maximum transmit burst rate). This may require the use of STE provided by the manufacturer (see subclause 4.2).

C.5 Test set-up

The tests shall be carried out at ambient environmental conditions and for a nominal power supply voltage.

For IE, EME and IME shall be installed with a separation of about 0,5 m. Between the two equipment, the maximum length connection cable specified by the manufacturer shall be installed. The height of the cable shall be between 0,5 and 1 m. The cable shall be maintained in that position by non-metallic means. The EME shall be set, in its normal operating configuration on a non-metallic table at a height between 0,5 and 1 m. The IME shall be set on a non-metallic table at a height between 0,5 and 1 m.

For PE, the equipment shall be arranged in its normal operating configuration as recommended by the manufacturer on a non-metallic table at a height between 0,5 and 1 m.

Each antenna shall be positioned to be outside the near field of the other antenna.

In addition, it shall be verified that the test site shall be suitable with respect to ambient noise which shall be at least 6 dB lower than the lowest specification value being measured.

C.6 Measuring procedure

The EUT shall be switched on and the STE (if used) activated. The measuring antenna shall be placed at the specified distance from the EUT. Measurements shall be made in the horizontal plane around the EUT to detect unwanted emission within the specified bands in order to obtain the position where the power spectral density is maximum. The height of the measuring antenna shall be varied between 1 m and 4 m and the EUT shall be rotated through 360° to maximise the emissions. Measurements shall be carried out with the measuring antenna in both planes of polarisation (vertical and horizontal) to ensure that the values obtained are maximised. The precise knowledge of distance between the two antennas, the reference antenna gain and the amplification/attenuation characteristics of the post reference antenna network allow the determination of the unwanted EIRP density radiated by the EUT.

C.7 Alternative measuring procedure

For the case in which it is desired to measure the power of the emissions from the LMES by direct coupling at the interface point between the antenna and the rest of the LMES, the method set out in this Annex shall apply except that the test set-up will need to be modified to allow direct coupling of the measuring equipment to the antenna feed and references to the positioning of the measuring antenna shall be ignored. The LMES maximum antenna gain at the measurement frequency shall be taken into account.

For this test set-up up it may also be necessary to arrange for the coupling of signals from the STE to the LMES in order to put the LMES into its normal transmit mode, as described in Clause C.4.

History

Document history	
May 1994	First Edition
January 1996	Converted into Adobe Acrobat Portable Document Format (PDF)