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European Standard (Telecommunications series)

**Electromagnetic compatibility
and Radio spectrum Matters (ERM);
Maritime Mobile Earth Stations (MMES)
operating in the 1,5 GHz and 1,6 GHz bands
providing voice and direct printing for the
Global Maritime Distress and Safety System (GMDSS);
Technical characteristics and
methods of measurement**



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Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

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Introduction

The present document sets out the minimum operational and performance requirements, technical characteristics, methods of testing and required test results, for Maritime Mobile Earth Stations (MMES), capable of transmitting and receiving distress and safety communications using voice and direct-printing, as required by chapter IV, Regulations 8, 9, 10 and 14 of the 1988 amendments to the 1974 International Convention for the Safety of Life at Sea (SOLAS) [4], concerning radio communications for the Global Maritime Distress and Safety System (GMDSS).

NOTE 1: In order to meet the carriage requirements of the GMDSS in respect of receipt of the SafetyNETSM broadcasts, it is necessary to install an additional EGC receiver. SafetyNETSM is a service provided over a dedicated Inmarsat-C carrier, for the dissemination of maritime safety information, such as distress alerts, weather forecasts and coastal warnings.

NOTE 2: When a requirement of the present document is in conflict with one in the MMES System Definition Manual (SDM), reference shall be made to the most recent IMO and ITU applicable documents to resolve the difficulty.

NOTE 3: For the purpose of the present document, the term "MMES" is used in order to align the present document to ITU and IEC terminology. It is defined as a Maritime Mobile Earth Station (MMES) operating in the GMDSS.

The present document incorporates the performance standards of IMO Resolution A.808(19) [6]. It also incorporates the relevant ITU Radio Regulations [7].

The present document takes account of IMO Resolution A694(17) [5], to which EN 60945 [2] is associated. When a requirement in the present document is different from EN 60945 [2], the requirement in the present document shall take precedence.

Compliance to the present document does not signify compliance to any safety requirements. However, it is the responsibility of the assessor of the equipment that any observations regarding the given apparatus becoming dangerous or unsafe as a result of the application of the tests defined in the present document should be included in the test report.

1 Scope

The present document provides specifications for the standardization of transmit/receive Maritime Mobile Earth Stations (MMES) operating in the 1,5 GHz and 1,6 GHz bands under the Global Maritime Distress and Safety Systems (GMDSS) in order to ensure general safety and limit interference to radio communication systems.

NOTE: The present document is for MMES equipment that meets the requirements of IMO A.808(19) [6] based systems only.

The present document applies to MMES radio equipment, which have the following characteristics:

- the MMES is ship mounted;
- these MMES are controlled and monitored by a Network Control Facility (NCF). The NCF is outside the scope of the present document;
- the MMES operates through geostationary satellites as part of a network providing voice, direct printing and data communications;
- the MMES is capable of operating within the frequency ranges given in table 1.

Table 1: Mobile Satellite Service (MSS) frequency bands

Direction of Transmission	MSS frequency bands
Transmit (earth to space)	1 626,5 MHz to 1 660,5 MHz
Receive (space to earth)	1 525,0 MHz to 1 559,0 MHz

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 and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

Referenced documents which are not found to be publicly available in the expected location might be found at <http://docbox.etsi.org/Reference>.

- [1] CISPR 16-1: "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1: Radio disturbance and immunity measuring apparatus" (Annex G: Validation of the open area test site for the frequency range of 30 MHz to 1 000 MHz).
- [2] EN 60945 (1997): "Maritime navigation and radiocommunication equipment and systems; General requirements; Methods of testing and required test results".
- [3] EN 61162-1 (2000): "Maritime navigation and radiocommunication equipment and systems; Digital interfaces; Part 1: Single talker and multiple listeners".
- [4] IMO International Convention on Safety of Life at Sea (SOLAS) (1974).

NOTE: See http://www.imo.org/Conventions/contents.asp?topic_id=257&doc_id=647

- [5] IMO Resolution A.694(17): "General requirements for shipborne radio equipment forming part of the Global Maritime Distress and Safety System (GMDSS) and for electronic navigational aids".
- [6] IMO Resolution A.808(19): "Performance standards for ship earth stations capable of two-way communications".

- [7] ITU Radio Regulations.
- [8] IMO MSC/Circular 862: "Clarification of certain requirements in IMO performance standards for GMDSS equipment 29.6.98".
- [9] IEC 61097-10 (1999): "Global maritime distress and safety system (GMDSS) - Part 10: Inmarsat-B ship earth station equipment - Operational and performance requirements, methods of testing and required test results".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply.

applicant: manufacturer or his authorized representative within the European Community or the person responsible for placing the apparatus on the market

antenna gain: ratio, expressed in decibels, of the power that would have to be supplied to an isotropic radiator to the power supplied to the antenna being considered, so that they produce the same field strength at the same distance in the same direction

carrier-off state: state in which MMES is when either it is authorized by the Network Control Facility (NCF) to transmit but when it does not transmit any signal, or when it is not authorized by the NCF to transmit

carrier-on state: state in which MMES is when it is authorized by the NCF to transmit and when it transmits a signal

carrier to noise density ratio: ratio of un-modulated carrier power to noise power normalized to a 1 Hz bandwidth

conformance test: means whereby the equipment is proved to be in compliance with the specifications

Control Channel (CC): channel or channels by which MMES receive control information from the NCF for their network

environmental profile: range of environmental conditions under which equipment within the scope of EN 301 403 is required to comply with the provisions of EN 301 403

Equipment Under Test (EUT): for the purpose of EN 301 403 the EUT includes all units necessary for intended operation

NOTE: This includes:

- The Externally Mounted Equipment (EME);
- The Internally Mounted Equipment (IME) including the data terminal equipment such as the keyboard;
- Visual Display Unit (VDU), printer, direct printing equipment;
- all interconnecting cables and power supply leads, etc.

Equivalent Isotropically Radiated Power (EIRP): product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna (*absolute or isotropic gain*)

Externally Mounted Equipment (EME): those of the modules of the Installable Equipment which are intended to be mounted externally to the ship as stated by the applicant

NOTE: This equipment is exposed to the weather.

Installable Equipment (IE): equipment which is intended to be fitted to a ship

NOTE: An IE may consist of one or several interconnected modules.

Internally Mounted Equipment (IME): those of the modules of the IE which are not declared by the applicant as EME are defined as Internally Mounted Equipment (IME)

NOTE: This equipment is protected from the weather.

L-band: frequency band in the range 1,4 GHz to 1,7 GHz allocated to the mobile satellite service and in which the EUT transmits and receives

nominated bandwidth: bandwidth of the MMES radio frequency transmission is nominated by the applicant

NOTE 1: The nominated bandwidth is wide enough to encompass all spectral elements of the transmission necessary for communication and which have a level greater than the specified unwanted emissions limits. The nominated bandwidth is wide enough to take account of the transmit carrier frequency stability.

NOTE 2: The nominated bandwidth is within the MSS transmit frequency band within which the MMES operates.

out-of-band emissions: emission on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process, but excluding spurious emissions

ship earth station: MMES on board a ship

Special Test Equipment (STE): specific equipment which enables the tests specified in EN 301 403 to be carried out

spurious emission: emission on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information

NOTE: Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products but exclude out of band emissions.

unwanted emissions: spurious emissions and out of band emissions falling outside the nominated bandwidth in the carrier-on state and those generated in the carrier-off state

3.2 Abbreviations

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

CC	Control Channel
C/No	Carrier to noise density ratio in 1 Hz bandwidth
CMF	Control and Monitoring Functions
CR	Carriage Return
EGC	Enhanced Group Call
EIRP	Equivalent Isotropically Radiated Power
EMC	Electro Magnetic Compatibility
EME	Externally Mounted Equipment
EUT	Equipment Under Test
GMDSS	Global Maritime Distress and Safety System
IE	Installable Equipment
IEC	International Electrotechnical Commission
IME	Internally Mounted Equipment
IMO	International Maritime Organization
ISO	International Standards Organization
ITU	International Telecommunications Union
LES	Land Earth Station
LF	Line Feed
LMES	Land Mobile Earth Station
MMES	Maritime Mobile Earth Station
MSS	Mobile Satellite Service
NCF	Network Control Facility
RF	Radio Frequency
SES	Ship Earth Station
SOLAS	Safety Of Life At Sea

STE Special Test Equipment
VDU Visual Display Unit

4 General and operational requirements

4.1 General

This clause includes the requirements taken from SOLAS [4] and IMO Resolutions A.808(19) [6] and A.694(17) [5] for which no repeatable or verifiable test can be specified or for which the test is limited to the verification of documentation presented by the manufacturer. It contains all operational requirements, and manufacturers shall declare compliance with these requirements and provide documentary evidence. The requirements listed in this clause are in addition to the relevant operational requirements of EN 60945 [2].

The results of all visual and documentary verifications shall be recorded in the test report.

4.2 General requirements

- a) In accordance with SOLAS [4], Chapter IV, Regulation 10.1.1 a maritime mobile earth station (MMES) shall be capable of:
 - 1) transmitting and receiving distress and safety communications using direct-printing;
 - 2) initiating and receiving distress priority calls;
 - 3) maintaining watch for shore-to-ship distress alerts, including those directed to specifically defined geographical areas. This requirement should normally be met by provision of an EGC receiver;
 - 4) transmitting and receiving general radio communications, using either voice or direct-printing.
- b) The equipment shall be approved by the IMO approved MSS operator and shall comply with the environmental conditions specified in its technical requirements for MMES capable of two-way communications, as stated in IMO Resolution A.808(19) [6], clause 2.
- c) The equipment capable of voice and direct printing shall comply with the applicable general requirements set out in IMO Resolution A.694(17) [5] as detailed in EN 60945 [2] and IMO Resolution A.808(19) [6], clause 1.
- d) The equipment shall indicate the status of the distress alert transmission as stated in clause 4.2.9 of EN 60945 [2].
- e) The equipment shall be provided with facilities which permit the testing of all operational indicators (warning, alarm and routine), displays, and audible devices as stated in clause 4.2.9 of EN 60945 [2].

In each case verification shall be performed by inspection of documentary evidence.

4.3 Operational requirements

In order to comply with IMO Resolution A.808 [6], clause 3, a maritime mobile earth station (MMES) shall meet the following requirements or include facilities to allow them to be met on installation:

- a) No control external to the equipment shall be available for alterations of the MMES identity.
- b) It shall be possible to initiate and make distress calls by voice or direct printing from the position at which the ship is normally navigated and from any position designated for distress alerting. In addition, where a room is provided for radio communications, means to initiate distress calls shall also be fitted in that room.
- c) Where no other means of receiving distress, urgency and safety broadcasts or an additional distress alert relay are provided and existing levels of aural signals produced by the telephone or direct printing are considered to be inadequate, the MMES equipment shall be configured to actuate an aural/visual alarm of appropriate level.
- d) It shall be possible to interrupt and initiate distress calls at any time.

- e) A distress call shall be activated only by means of a dedicated distress button. The dedicated button shall:
- be clearly identified; and
 - be protected against inadvertent operation.

NOTE: This button should not be any key of an ITU-T Recommendation E.161 input panel or an ISO keyboard associated with the equipment and should be physically separated from functional buttons/keys used for normal operation. This button should be a single button for no other purpose than to initiate a distress alert as stated in IMO MSC/Circular 862 [8], clause 1.1.

- f) The distress button should be red in colour and marked DISTRESS. Where a non-transparent protective lid or cover is used, it should also be marked DISTRESS, as stated in IMO MSC/Circular 862 [8], clause 1.2.
- g) The required protection of the distress button should consist of a spring loaded lid or cover permanently attached to the equipment by for example hinges. It should not be necessary for the user to remove additional seals or to break the lid or cover in order to operate the distress button, as stated in IMO MSC/Circular 862 [8], clause 1.3.
- h) The distress call initiation shall require at least two independent actions:
- Lifting of the protective lid or cover is considered the first action, as stated in IMO MSC/Circular 862 [8], clause 1.4.
 - Pressing the distress button as specified is considered as the second independent action, as stated in IMO MSC/Circular 862 [8], clause 1.4.
- i) In addition to the operational requirements in g) above, the second action to initiate a distress call shall be by pressing the button once, for at least 3 s. A visual indication shall be provided immediately after a distress call has been initiated. This indication shall be made at all positions from where a distress call may be initiated, irrespective of the radio telephony or direct printing terminal from which the distress call is originated. The indication shall continue until reset manually. This reset facility shall only be available to authorized personnel. It shall be possible to initiate further distress calls without re-setting the first indication. The indication shall function identically during performance testing with distress priority.
- j) On initiation of a distress priority call the equipment shall interrupt any on-going call of lower priority, if necessary, and then set up the distress call automatically.

In each case verification shall be performed by inspection of documentary evidence.

4.4 Inter-operability

In order to comply with IMO Resolution A694(17) [5], clauses 1.2 and 3.5, respectively, a maritime mobile earth station (MMES) shall meet the following requirements:

- a) Where a unit of equipment provides a facility which is additional to the minimum requirements of the present document, the operation and, malfunction of such additional facility shall not degrade the performance of the equipment.
- b) If a unit of equipment is connected to one or more other units of equipment accepted by the manufacturer of the EUT, the performance of each of the latter shall be maintained.

In each case verification shall be performed by inspection of documentary evidence.

4.5 Interfaces

A maritime mobile earth station (MMES) shall meet the following requirements or include facilities to allow them to be met on installation, as stated in IEC 61097-10 [9]:

- a) An interface shall be provided to allow the user to initiate and make distress calls by telephony or direct printing from the position at which the ship is normally navigated and from any position designated for distress alerting. In addition, an interface shall be included to allow the initiation of distress calls from a room provided for radio communications, where such a room is provided onboard.

- b) An output shall be provided to actuate an external aural/visual alarm on the receipt of a distress call (see clause 4.3c).
- c) An MMES shall have an interface to receive information on the ship's position for inclusion in the initial distress alert. Such interface shall comply with EN 61162-1 [3].

Verification shall be performed by inspection of documentary evidence or demonstration.

4.6 Safety

4.6.1 Radio frequency hazards

In order to permit warnings of potential hazards to be displayed in appropriate places, a label shall be attached to the radome indicating the distance at which radiation levels of 100 W/m², 25 W/m² and 10 W/m² exist. The label shall have characters at least 20 mm high and be clearly readable in the normally installed position from a distance of at least 5 m, in accordance with IMO Resolution A.808(19) [6], clause 4.

Conformance to the radiation levels labelling requirements shall be checked by visual inspection of the units.

4.6.2 Safety precautions

The EUT shall satisfy the requirements for safety as stated in IMO Resolution A.694(17) [5], clause 7 and safety precautions as detailed in EN 60945 [2].

4.6.3 Mechanical construction

- a) The equipment shall, as far as practicable, be constructed of non-flammable materials and shall have adequate strength to ensure safety.
- b) Equipment shall be mechanically designed to minimize the possibility of injury to persons, for example, from sharp edges or protruding corners.

Verification shall be performed by visual inspection.

4.6.4 Electrical safety

- a) Accidental access to dangerous voltages shall be prevented. All parts and wiring in which the direct or alternating voltages or both, other than radio frequency voltages, combine to give a peak voltage greater than 50 V shall be protected against accidental access and shall be isolated automatically from all sources of electrical energy when the protective covers are removed. Alternatively, the equipment shall be so constructed that access to such voltages may only be gained after having used a tool for the purpose, such as a spanner or screwdriver, and warning labels shall be prominently displayed both within the equipment and on protective covers.
- b) Means shall be provided for earthing exposed metallic parts of the equipment. This shall not cause any terminal of the source of electrical energy to be earthed.

Verification to the electrical safety requirements shall be checked by visual inspection of the units.

4.7 Marking and identification

A maritime mobile earth station (MMES) shall meet the following requirements, as stated in IEC 61097-10 [9]:

- a) Each unit of the equipment shall be marked externally with the following information, which should be clearly visible in the normal installation position:
 - 1) identification of the manufacturer;
 - 2) equipment type number or model identification; and

- 3) serial number of the unit as stated in IMO Resolution A.694(17) [5], clause 9.
- b) Details of the labelling requirements shall comply with EN 60945 [2].

Verification shall be performed by visual examination.

4.8 Maintenance

As stated in IMO Resolution A.694(17) [5], clause 8, the equipment shall be so:

- a) designed that the main units can be replaced readily, without elaborate re-calibration or readjustment;
- b) constructed that it is readily accessible for inspection and maintenance purposes.

Verification shall be performed by visual examination.

4.9 Storage of software

Any programming material or software that forms part of the MMES and which is necessary for meeting the GMDSS requirements shall be permanently installed in the MMES. Any software needed to fulfil any distress and safety requirements of the GMDSS shall be stored in non-volatile memory and be protected against unauthorized access, modification or corruption.

Programmable functions stored in memory shall not be lost on power down and power up of the equipment.

Verification shall be performed by inspection of documentary evidence.

4.10 Operational controls

- a) The number of operational controls, their design and manner of functions, location, arrangement and size shall provide for simple, quick and effective operation. The controls shall be arranged in a manner which minimizes the chance of inadvertent operation.
- b) All operational controls shall permit normal adjustments to be easily performed and shall be easy to identify from the position at which the equipment is normally operated. Controls not required for normal operations shall not be accessible without special tools.
- c) When a distress alert transmission has been initiated, the equipment shall indicate the status of this transmission.
- d) Adequate adjustable illumination may be provided in the equipment to enable identification of controls and facilitate reading of indicators under low levels of ambient lighting. Means shall be provided for dimming to extinction any equipment light source, which is capable of interfering with navigation. If adequate illumination is not provided this shall be stated in the test report.
- e) The design of the equipment shall be such that misuse of the controls shall not cause damage to the equipment or injury to persons.

Verification shall be performed by documentary evidence and, where applicable, by inspection or demonstration.

4.11 Power supply

In order to comply with IMO Resolution A.808 [6], clause 5, a maritime mobile earth station (MMES) shall meet the following requirements:

- a) The MMES shall normally be powered from the ship's main source of electrical energy. In addition it shall be possible to operate the MMES and all equipment necessary for its normal functioning, including the antenna tracking system, from an alternative source of energy.
- b) Changing from one source of supply to another or any interruption up to 60 s of the supply of electrical energy shall not render the equipment inoperative or require the equipment to be manually re-initialized.

5 Technical requirement specifications

5.1 Unwanted emissions outside the band 1 626,5 MHz to 1 660,5 MHz

5.1.1 Justification

Protection of terrestrial and satellite services from emissions caused by MMES outside the band 1 626,5 MHz to 1 660,5 MHz.

5.1.2 Specification

Unwanted emissions from MMESs outside the band 1 626,5 MHz to 1 660,5 MHz shall be below the following limits.

- 1) The unwanted emissions over the frequency range 30 MHz to 1 000 MHz shall not exceed the limits in table 2.
- 2) The unwanted emissions above 1 000 MHz shall not exceed the limits in table 3.

Table 2: Limits of unwanted emissions up to 1 000 MHz at a measuring distance of 3 m and for a measuring receiver bandwidth of 120 kHz

Frequency (MHz)	Quasi-peak limits (dB(μ V/m))
30 to 156	54
156 to 165	24
165 to 1 000	54

NOTE: In the band 156 MHz to 165 MHz a measuring receiver bandwidth of 9 kHz applies.

The lower limit shall apply at the transition frequency.

Whilst transmitting any carrier at any frequency in the range 1 626,5 MHz to 1 660,5 MHz (inclusive) and at the maximum output power, the MMES shall comply with the following requirements:

- a) The composite spurious and noise output EIRP (excluding any harmonics but including phase noise and modulation sidebands) radiated by MMES in any 4 kHz band shall fall below the spectrum envelope defined by the following data points shown in table 3.

Table 3: Limits of unwanted emissions above 1 000 MHz

Frequency (MHz)	EIRP/4 kHz (dBW)
1 530,0 and below	-60
1 611,5	-55
1 626,5	-27
1 626,5 to 1 660,5	See clause 5.2.2
1 660,5	-27
1 661,5	-55
1 750,0 and above	-60

- b) The EIRP of any radiated Harmonic, in any direction, shall be less than -23 dBW for any frequency up to 18 GHz measured within an appropriate reference bandwidth.

5.1.3 Carrier "off" Level

When the transmitter is in the non-operative (i.e. "idle") state, the radiation from the MMES antenna at any frequency shall not exceed -60 dBW EIRP measured in a 4 kHz bandwidth.

5.2 Maximum unwanted emissions within the 1 626,5 MHz to 1 660,5 MHz bands

5.2.1 Justification

Protection of satellite and terrestrial services operating in the 1 626,5 MHz to 1 660,5 MHz frequency band.

5.2.2 Specifications

Specification 1: Carrier-on state

The power spectral density of all transmissions by the MMES, in the 1 626,5 MHz to 1 660,5 MHz frequency band, shall not exceed the levels shown in figure 1 and table 4.

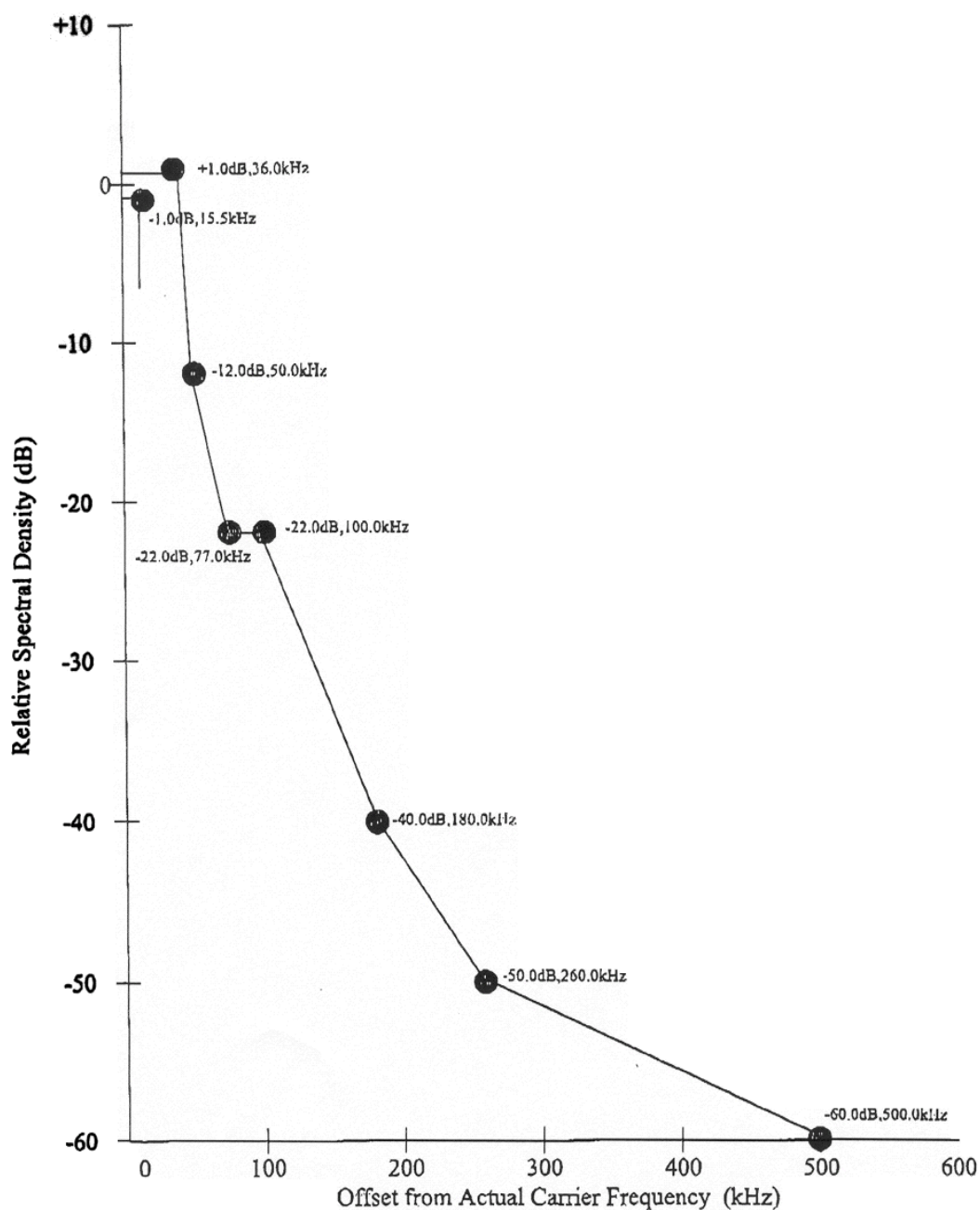


Figure 1: Power Spectral Density Mask within a ± 500 kHz band about the assigned transmitter carrier frequency

Table 4: Power Spectral Density Mask within a ± 500 kHz band about the assigned transmitter carrier frequency

Offset from Assigned Carrier Frequency (kHz)	Minimum relative level (dB)	Maximum relative level (dB)
0 to 15,5	-1	1
15,5 to 36	Not specified	1
36 to 50	Not specified	$1 - (13/14)(F - 36)$
50 to 77	Not specified	$-12 - (10/27)(F - 50)$
77 to 100	Not specified	-22
100 to 180	Not specified	$-22 - (18/80)(F - 100)$
180 to 260	Not specified	$-40 - (10/80)(F - 180)$
260 to 500	Not specified	$-50 - (10/240)(F - 260)$
> 500	Not specified	-60

Where F is the offset frequency from the carrier in kHz.

In the band 1 626,5 MHz to 1 660,5 MHz, excluding a ± 500 kHz band about the assigned transmitter carrier frequency, the composite spurious and noise output EIRP (including phase noise and modulation side bands) radiated by the MMES in any 4 kHz band shall be at least 60 dB below the level of the unmodulated carrier.

Specification 2: Carrier-off state

The EIRP of any emission in any 4 kHz band within the 1 626,5 MHz to 1 660,5 MHz band shall not exceed -60 dBW.

5.3 Control and Monitoring Functions (CMF)

5.3.1 General

The following minimum set of CMF shall be implemented in MMES in order to minimize the probability that they originate unwanted transmissions that may give rise to harmful interference to other systems.

Under any fault condition when the MMES transmissions are being suppressed the limits for carrier-off state shall apply.

5.3.2 Processor monitoring

5.3.2.1 Justification

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

5.3.2.2 Specification

The MMES shall incorporate a processor monitoring function for each of its processors involved in the manipulation of traffic and in Control and Monitoring Functions (CMF).

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 MMES shall enter the carrier-off state until the processor monitoring function has determined that all fault conditions have been cleared.

5.3.3 Transmit sub-system monitoring

5.3.3.1 Justification

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

5.3.3.2 Specification

The MMES shall monitor the operation of its transmit frequency generation sub-system.

No later than 5 s after any fault condition of the transmit frequency generation sub-system occurs, the MMES shall enter the carrier-off state until the transmit sub-system monitoring function has determined that all fault conditions have been cleared.

5.3.4 Power-on/reset

5.3.4.1 Justification

To demonstrate that the MMES achieves a controlled non-transmitting state following the powering of the unit or the occurrence of a reset made by a local operator when this function is implemented.

5.3.4.2 Specification

During and following "power-on" or a manual reset when this function is implemented, the MMES shall remain in the carrier-off state.

5.3.5 Control Channel reception

5.3.5.1 Justification

To ensure that the MMES cannot transmit unless it correctly receives the Control Channel (CC) messages from the NCF.

5.3.5.2 Specification

- a) Without correct reception of the CC messages from the NCF, the MMES shall remain in the carrier-off state.
- b) The MMES shall enter the carrier-off state immediately after a period not exceeding 30 s without correct reception of the CC messages from the NCF.

5.3.6 Network control commands

5.3.6.1 Justification

These requirements ensure that the MMES is capable of:

- a) retaining a unique identification in the network and transmitting it upon reception of an appropriate request;
- b) receiving commands from the NCF through its Control Channel(s) (CCs) and executing those commands.

5.3.6.2 Specification

The MMES shall hold, in non-volatile memory, its unique identification code in the network.

The MMES shall be capable of receiving through its Control Channel(s) (CCs) dedicated messages (addressed to the MMES) from the NCF, and which contain:

- transmission enable commands.

Once a transmission enable command is received the MMES is authorized to transmit.

After power-on or reset the MMES shall remain in the carrier-off state until it receives a transmission enable command. For systems where no transmission enable command is expected after power-on or reset the MMES may only transmit initial bursts (see clause 5.3.7).

5.3.7 Initial burst transmission

5.3.7.1 Justification

To limit disturbance to other services.

5.3.7.2 Specification

For systems where no transmission enable command is expected after power-on or reset the MMES may transmit initial bursts.

- a) The repetition transmission of the initial burst shall not exceed 1 % of the time.
- b) Each burst shall not last more than one second.

5.4 Electromagnetic compatibility

The EUT shall comply with the EMC requirements as detailed in EN 60945 [2].

6 General Test Conditions

6.1 Environmental profile

The technical requirements of the present document apply under the environmental profile for operation of the equipment, which shall be declared by the applicant. The equipment shall comply with all the technical requirements of the present document at all times when operating within the boundary limits of the declared operational environmental profile.

6.2 Manufacturer's declaration

The manufacturer shall state which items of equipment are classified as exposed and which are protected. The equipment normally protected by a radome shall be tested with the radome in situ under the "exposed" environmental conditions as specified in clause 6.1.

The manufacturer shall state what pre-conditioning is necessary before environmental testing, e.g. the activation of cooling fans in advance of testing.

6.3 Special test equipment

The STE shall simulate the network air interface. Since this test equipment will be specific for the particular system, it is not possible to provide detailed specifications in this clause of the document. However, the following baseline is provided:

- special test arrangements are required to simulate the satellite signal, thus enabling the ship earth station to transmit, to allow measurement of transmission parameters;
- any specification of these special test arrangements which may have direct or indirect effects on any specification of the present document shall be clearly stated by the manufacturer;
- the STE shall prevent any radiation of signals, and it shall be approved by the IMO approved MSS operator to be suitable for such a purpose;
- when using STE it shall be ensured that no transmission to the satellite occurs.

6.4 Test report

The test report shall contain:

- the value of the nominated bandwidth declared by the manufacturer;
- the results of the test;
- all parameters and operational test conditions.

7 Environmental testing

7.1 Requirement

To ensure reliable operation in the Marine Environment, the equipment shall be durable and resistant to environmental conditions.

7.2 Testing

Elements of the EUT may be divided into the two categories;

- **IME:** equipment or units designed to be protected from the weather;
- **EME:** equipment or units intended to be exposed to the weather.

The manufacturer shall declare to which category each of the elements of the EUT belongs.

The equipment shall be tested in accordance with EN 60945 [2], clause 8.

7.3 Results required

At the conclusion of each test, the equipment shall be inspected and subjected to a performance test or check as specified in EN 60945 [2], clause 8.

7.4 Performance test and check

7.4.1 Performance test

For the purposes of environmental testing, a performance test is defined as standard tests A, B, C, D and E (see annex A) carried out for both distress and safety priorities.

7.4.2 Performance check

For the purposes of environmental testing, a performance check is defined as standard tests A and D (see annex A) carried out under normal test conditions for distress priority only.

8 Testing of the EUT

8.1 General

It is a requirement of Equipment Certification, that the equipment is approved by the IMO approved MSS operator. The requirements of this clause are in addition to the IMO approved MSS operator requirements for MMES approval, given in the IMO approved MSS operator manual. The manufacturer shall, unless otherwise agreed, set up the equipment and ensure it is operating normally before testing commences.

After compliance with the requirements of the IMO approved MSS operator, compliance with the present document must be demonstrated by carrying out the tests described in the following clauses. These tests shall be conducted using a STE or an alternative method of functionally achieving the same results.

Tests shall be carried out under normal test conditions, referred to in clause 6.1.

8.2 Telex, telephone and priority tests

8.2.1 Test procedure

Conformance tests shall be carried out in accordance with annex A:

- clause A1 contains telex and telephone tests;
- clause A2 contains priority tests.

8.3 Unwanted emissions tests

8.3.1 Measurement uncertainties

The values of measurement uncertainty associated with each measurement parameter apply to all of the test cases described in the present document. The measurement uncertainties shall not exceed the values shown in table 6.

Table 5: Void

Table 6: Maximum measurement uncertainties

Measurement parameter	Maximum uncertainty
Radio Frequency (RF)	± 10 kHz
RF power	$\pm 0,75$ dB
Conducted spurious	± 4 dB
Antenna gain	± 2 dB
Radiated spurious	± 6 dB

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

- if the MMES 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 MMES to transmit allowing 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 applicant.

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

All technical characteristics and operational conditions declared by the applicant shall be entered in the test report.

8.3.2 Measurement of unwanted emissions

Conformance test shall be carried out in accordance with annex B.

8.4 Control and Monitoring Functions (CMF) tests

8.4.1 Processor monitoring

Conformance test shall be carried out in accordance with clause C.1.2.

8.4.2 Transmit sub-system monitoring

Conformance test shall be carried out in accordance with clause C.1.3.

8.4.3 Power-on/reset

Conformance tests shall be carried out in accordance with clause C.1.4.

8.4.4 Control Channel (CC) reception

Conformance tests shall be carried out in accordance with clause C.1.5.

8.4.5 Network control commands

Conformance tests shall be carried out in accordance with clause C.1.6.

8.4.6 Initial burst transmission

Conformance test shall be carried out in accordance with clause C.1.7.

8.5 Electromagnetic compatibility tests

Conformance tests shall be carried out in accordance with EN 60945 [2].

Annex A (normative): Standard Tests

Ship's heading information may need to be provided when carrying out these tests.

All tests shall be performed at a C/No of 51 dB/Hz \pm 2 dB, measured at receive band specified in the scope (see table 1).

A.1 Telex and Telephone Tests

A.1.1 Test A: Duplex telex test (EUT)

The EUT operator shall set up a duplex telex channel with the appropriate priority. Correct exchange of answer backs shall be verified by inspection.

The EUT operator shall transmit the test message:

- "TEST A (LF, CR)
- THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG (FROM EUT) (LF, CR)
- 0123456789 (LF, CR)"

The STE operator shall transmit the test message:

- "TEST A (LF, CR)
- THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG (FROM LES) (LF, CR)
- 0123456789 (LF, CR)"

The EUT operator shall clear the call.

A.1.2 Test B: Duplex telex test (STE)

The STE operator shall set up a duplex telex channel with the appropriate priority. Correct exchange of answer backs shall be verified by inspection.

The STE operator shall transmit the test message:

- "TEST B (LF, CR)
- THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG (FROM LES) (LF, CR)
- 0123456789 (LF, CR)"

The EUT operator shall transmit the test message:

- "TEST B (LF, CR)
- THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG (FROM EUT) (LF, CR)
- 0123456789 (LF, CR)"

The EUT operator shall clear the call.

A.1.3 Test C: Simplex telex test (STE)

The STE operator shall set up a simplex telex channel with the appropriate priority.

The STE operator shall transmit the test message:

- "TEST C (LF, CR)
- THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG (FROM LES) (LF, CR)
- 0123456789 (LF, CR)"

The STE operator shall clear the call.

A.1.4 Test D: Duplex telephone test (EUT)

The EUT operator shall set up a duplex telephone channel with the appropriate priority.

The EUT operator shall say clearly:

- "This is the EUT operator performing Test D, delta. Please report my speech quality. Over"

The STE operator shall reply:

- "This is the STE operator performing Test D, delta. Your speech quality is Good/Poor. Please report my speech quality. Over"

The EUT operator shall reply:

- "Your speech quality is Good/Poor. I am now clearing the channel. Over"

The EUT operator shall clear the call.

A.1.5 Test E: Duplex telephone test (STE)

The STE operator shall set up a duplex telephone channel with the appropriate priority.

The STE operator shall say clearly:

- "This is the STE operator performing Test E, echo. Please report my speech quality. Over"

The EUT operator shall reply:

- "This is the EUT operator performing Test E, echo. Your speech quality is Good/Poor. Please report my speech quality. Over"

The STE operator shall reply:

- "Your speech quality is Good/Poor. I am now clearing the channel. Over"

The STE operator shall clear the call.

A.1.6 Results required

For telex tests, no errors shall be recorded in each direction of communication.

For voice communication tests, it shall be possible to distinguish clearly the content of the voice message.

A.2 Priority tests

A.2.1 Procedure

The following tests shall be performed:

- **Test A with distress priority (see note 1).
- ***Test A with distress priority (see note 2).
- Test A with safety priority.
- Test A with routine priority
- Test A with routine priority with **Test A with distress priority superimposed (see note 1).
- Test A with routine priority with **Test D with distress priority superimposed (see note 1).
- **Test B with distress priority (see note 1).
- Test B with safety priority.
- Test B with routine priority.
- Test C using an area group code and distress priority.
- **Test D with distress priority (see note 1).
- ***Test D with distress priority (see note 2).
- Test D with routine priority.
- Test D with routine priority with **Test D with distress priority superimposed (see note 1).
- Test D with routine priority with **Test A with distress priority superimposed (see note 1).
- **Test E with distress priority (see note 1).
- Test E with routine priority.

NOTE 1: **These test calls shall be set up using a distress button co-located with the EUT.

NOTE 2: ***These tests shall be set up using a remote distress button, located at least 10 m away from the EUT.

A.2.2 Results required

Calls shall be set up and cleared down satisfactorily. For the telex tests, no character errors shall be received. For the telephone tests, voice quality shall be good in both directions.

For the superimposed tests routine priority calls shall clear automatically, distress priority calls shall be set up automatically.

Annex B (normative): Measurement of unwanted emissions

B.1 General

For measurements up to 1 000 MHz the distance between the EUT and the measuring antenna shall be 10 m. for measurements above 1 000 MHz the distance between the EUT and the measuring antenna shall be such that the radiating near-field of each antenna shall not overlap with that of the other.

The highest frequency to which tests shall be performed shall be the 10th harmonic of the highest conversion frequency or ten times the highest transmit frequency, whichever is the greater.

The upper and lower extremes of the tuning range shall be stated by the applicant.

B.2 Test site

The test shall be performed either in an open area test site, a semi-anechoic chamber or an anechoic chamber. Ambient noise levels shall be at least 6 dB below the applicable unwanted emissions limit.

An open area test site shall be flat, free of overhead wires and nearby reflecting structures, sufficiently large to permit aerial placement at the specified measuring distance and provide adequate separation between aerial, test unit and reflecting structures.

A metal ground plane shall be inserted on the natural ground plane and it shall extend at least 1 m beyond the perimeter of the EUT at one end and at least 1 m beyond the measurement antenna at the other end.

B.3 Test method

B.3.1 Installation

The EUT shall be installed with a separation of about 0,5 m between the IME and the EME, the maximum length connection cable specified by the applicant shall be installed. The height of the cable shall be between 0,5 m 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 turntable at a height between 0,5 m and 1 m. The IME shall be set on a non-metallic turn-table at a height of 0,8 m for tests up to 1 000 MHz and between 0,5 m and 1 m for tests above 1 000 MHz. Any associated equipment, e.g. portable computer or data terminal if required for operation of the MMES, shall be placed next to, and at the same height as, the IME.

The EUT shall be terminated with matched impedance at the terrestrial ports if recommended by the applicant in the user documentation and if there is no associated equipment connected to such port.

For frequencies up to 80 MHz the measuring antenna shall be a balanced dipole which has a length equal to the 80 MHz resonant length and shall be matched to the feeder by a suitable transforming device. Measurements with broadband antennas are also possible provided that the test site has been calibrated according to the requirements of CISPR 16-1 [1].

For frequencies between 80 MHz and 1 000 MHz the measuring antenna shall be a balanced dipole which shall be resonant in length. Measurements with broadband antennas are also possible provided that the test site has been calibrated according to the requirements of CISPR 16-1 [1].

For frequencies above 1 000 MHz the antenna shall be a horn radiator of known gain/frequency characteristics. When used for reception the antenna and any associated amplification system shall have an amplitude/frequency response within ± 2 dB of the combined calibration curves across the measurement frequency range considered for the antenna. The antenna is mounted on a support capable of allowing the antenna to be used in either horizontal or vertical polarization and at the specified height

For tests up to 1 000 MHz the receive test equipment shall be a measuring receiver. For tests above 1 000 MHz the receive test equipment shall be a spectrum analyser.

B.3.2 Receive test equipment

B.3.2.1 Measuring receiver for measurements up to 1 000 MHz

Measuring receivers shall conform to the following characteristics:

- the response to a constant amplitude sine wave signal shall remain within ± 1 dB across the frequency range of interest;
- quasi-peak detection shall be used in a -6 dB bandwidth of 120 kHz;
- the receiver shall be operated at more than 1 dB below the compression point during tests/measurements.

B.3.2.2 Spectrum analyser for measurements above 1 000 MHz

The spectrum analyser resolution bandwidth shall be set to the specified measuring bandwidth or as close as possible. If the resolution bandwidth is different from the specified measuring bandwidth, bandwidth correction shall be performed for noise-like wideband signals. The measuring system shall be capable of detecting signals at least 6 dB below the applicable unwanted emissions limit.

B.4 Procedure

B.4.1 Test arrangements

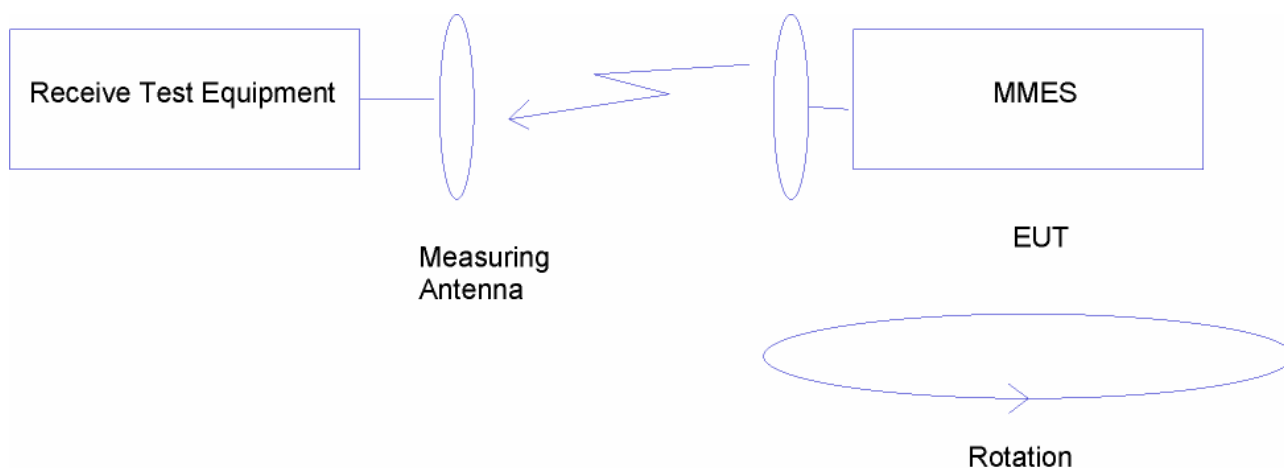


Figure B.1: Test arrangement - emissions measurement, first axis

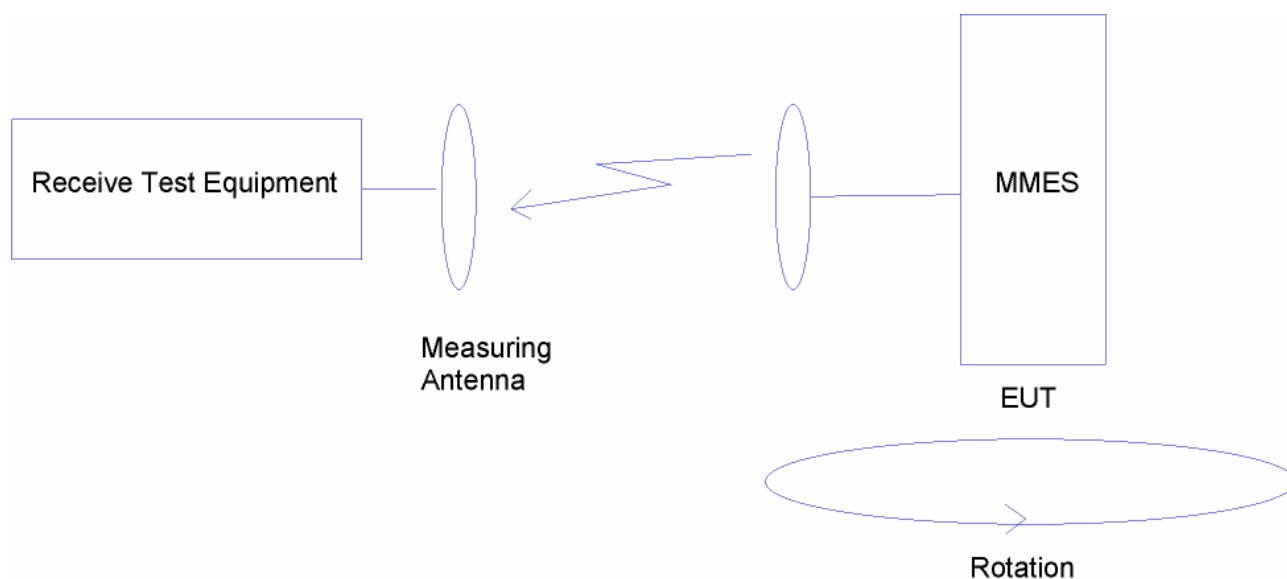


Figure B.2: Test arrangement - emissions measurement, second axis

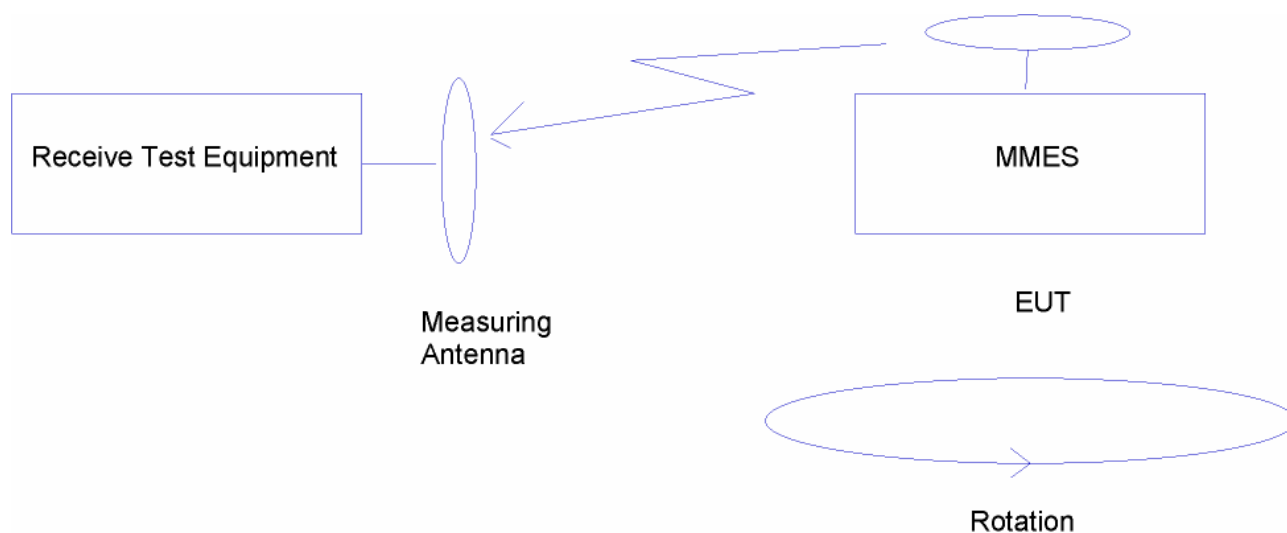


Figure B.3: Test arrangement - emissions measurement, third axis

B.4.2 Unwanted emissions up to 1 000 MHz

- a) The test arrangement shall be as shown in figure B.2 with the measuring receiver installed. EUTs with adjustable antennas shall have the antenna boresight axis in the plane of rotation. The measuring antenna boresight axis shall coincide with the plane of rotation of the boresight of the EUT.
- b) The EUT shall be in the carrier-on state with the carrier at the lowest possible centre frequency.
- c) The EUT shall be rotated through 360 degrees whilst unwanted emissions are measured in frequency and amplitude, over the frequency range 30 MHz to 1 000 MHz. The frequency and amplitude of each signal shall be noted.
- d) The measurements shall be repeated with the measuring antenna in the orthogonal polarization and the signal levels similarly noted.
- e) The tests in c) and d) above shall be repeated with the EUT carrier at the highest possible centre frequency.
- f) The tests in c) and d) above shall be repeated with the carrier-off.

- g) The tests in b) to f) above shall be repeated with the EUT turned so that its axis of rotation is orthogonal to that of the first case, as shown in figure B.3. The EUT antenna boresight axis shall remain in the plane of rotation.
- h) The tests in b) to f) above shall be repeated with the EUT turned so that its axis of rotation is mutually orthogonal to those of the first two cases, as shown in figure B.4. The EUT antenna boresight axis shall be perpendicular to the plane of rotation.

B.4.3 Unwanted emissions above 1 000 MHz

- a) The test arrangement shall be as shown in figure B.2 with the spectrum analyser installed. EUTs with adjustable antennas shall have the antenna boresight axis in the plane of rotation. The measuring antenna boresight axis shall coincide with the plane of rotation of the boresight of the EUT.
- b) The EUT shall be in the carrier-on state with the carrier at the lowest possible centre frequency.
- c) The EUT shall be rotated through 360 degrees whilst unwanted emissions are measured in frequency and amplitude, over the frequency range 1 000 MHz to 40 GHz. The frequency and amplitude of each signal shall be noted.
- d) The measurements shall be repeated with the measuring antenna in the orthogonal polarization and the signal levels similarly noted.
- e) The tests in c) and d) above shall be repeated with the EUT carrier at the highest possible centre frequency.
- f) The tests in c) and d) above shall be repeated with the carrier-off.
- g) The tests in b) to f) above shall be repeated with the EUT turned so that its axis of rotation is orthogonal to that of the first case, as shown in figure B.3. The EUT antenna boresight axis shall remain in the plane of rotation.
- h) The tests in b) to f) above shall be repeated with the EUT turned so that its axis of rotation is mutually orthogonal to those of the first two cases, as shown in figure B.4. The EUT antenna boresight axis shall be perpendicular to the plane of rotation.

Annex C (normative): Testing of MMES control and monitoring functions

C.1 General

If the EUT is a MMES that has been modified by the applicant for these tests then full documentation of such modification(s) shall be provided to prove that the modification(s) will simulate the required test condition.

For the purpose of this test, the EUT is the MMES either with, or without its antenna connected.

The measurement of the EIRP spectral density shall be limited within either the nominated bandwidth or to a 10 MHz bandwidth centred on the carrier frequency whichever is the greater.

C.1.1 Test arrangement

The test arrangement shall be as shown in figures C.1 or C.2. The EUT shall be authorized to transmit and shall be in the carrier-on state at the commencement of each test, unless otherwise stated. The oscilloscope shall monitor by measuring the time difference between the command, or failure, and the occurrence of the expected event (e.g. the transmission suppression). The spectrum analyser and the power meter shall monitor the EUT output level.

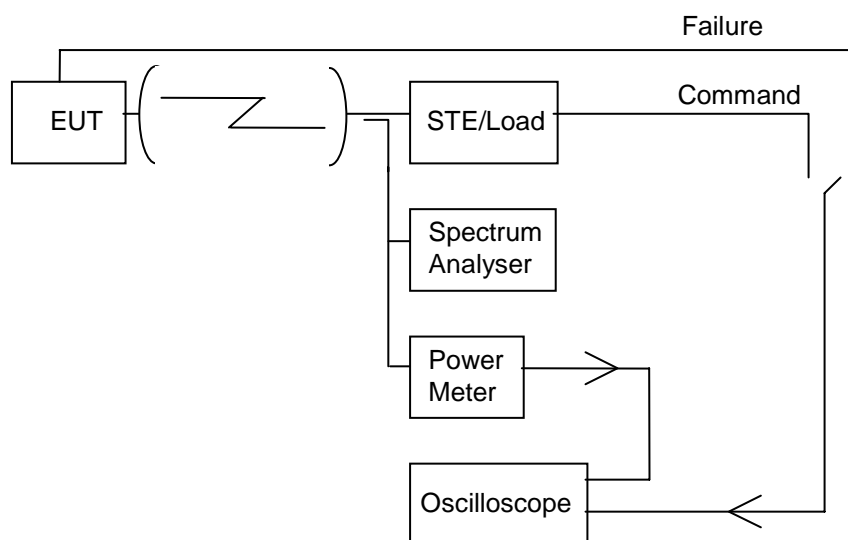


Figure C.1: General test arrangement for control and monitoring tests for radiated measurements

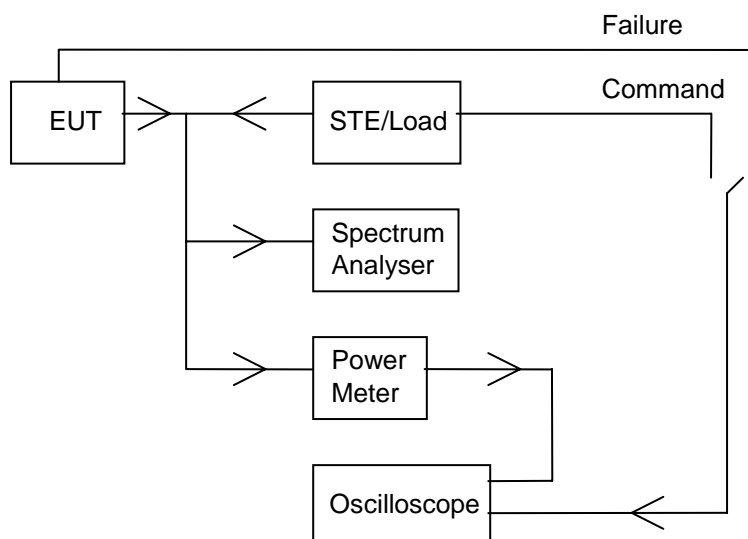


Figure C.2: General test arrangement for control and monitoring tests for conducted measurements

C.1.2 Processor monitoring

C.1.2.1 Test method

- Each of the processors within the EUT shall, in turn, be caused to fail.
- Within 1 second of such failure the EUT shall cease to transmit as measured by the oscilloscope.
- The power meter and spectrum analyser shall be observed to ascertain that the transmissions have been suppressed.
- The failed processor shall be restored to normal working condition and the EUT shall restore automatically to normal working before the next processor shall be induced to fail.

C.1.3 Transmit subsystem monitoring

C.1.3.1 Test method

- The frequency lock subsystem within the EUT shall be caused to fail.
- Within 6 s of such failure the EUT shall cease to transmit as measured by the oscilloscope.
- The power meter and spectrum analyser shall be observed to ascertain that the transmissions have been suppressed.
- The failed elements shall be restored to normal working state and the EUT shall be restored to normal working.
- The frequency generation subsystem within the EUT shall be caused to fail.
- Within 6 s of such failure the EUT shall cease to transmit as measured by the oscilloscope.
- The power meter and spectrum analyser shall be observed to ascertain that the transmissions have been suppressed.
- The failed elements shall be restored to normal working state and the EUT shall be restored to normal working.

C.1.4 Power-on/Reset

C.1.4.1 Test method

- a) The EUT shall be switched off and the STE shall not transmit the CC.
- b) The EUT shall be switched on.
- c) The EUT shall not transmit during and after switching-on, and shall enter the carrier-off state.

The events from a) to c) shall be displayed and verified with the oscilloscope and by measurement of the transmitted signal. If a manual reset function is implemented the following test shall be performed:

- d) The EUT shall be switched on and the STE shall transmit the CC.
- e) A call shall be initiated from the EUT and the EUT shall enter the carrier-on state.
- f) The reset function shall be initiated.
- g) The EUT shall enter the carrier-off state.

The event from e) to g) shall be displayed and verified with the oscilloscope and by measurement of the transmitted signal.

C.1.5 Control Channel reception

C.1.5.1 Test method

The following tests shall be performed:

- case a) where the CC has never been received by the EUT;
- case b) where the CC is lost by the EUT during a transmission period of a call;
- case c) where the CC is lost by the EUT during a period without transmission;
- case d) where the CC is being lost by the EUT and a call is initiated within the Time-Out period T1.

(The Time-Out period T1 used in the tests shall be 30 s).

- a) Case where the CC has never been received by the EUT:
 - a1) The EUT shall be switched off and the STE shall not transmit the CC.
 - a2) The EUT shall be switched on.
 - a3) A call shall be initiated from the EUT.
 - a4) The EUT shall remain in the carrier-off state.

The events from a2) to a4) shall be displayed and verified with the oscilloscope and by measurement of the transmit signal.

- b) Case where the CC is lost by the EUT during a transmission period of a call:
 - b1) The EUT shall be switched-on and the STE shall transmit the CC.
 - b2) A call shall be initiated from the EUT.
 - b3) The STE shall stop transmitting the CC.
 - b4) Within T1 from b3), the EUT shall enter the carrier-off state.

The events from b2) to b4) shall be displayed and verified with the oscilloscope and by measurement of the transmitted signal.

- c) Case where the CC is lost by the EUT during a period without transmission:
 - c1) The EUT shall be switched on and the STE shall transmit the CC.
 - c2) The STE shall stop transmitting the CC.
 - c3) More than T1 later, a call shall be initiated from the EUT.
 - c4) The EUT shall remain in the carrier-off state.

The events from c2) to c4) shall be displayed and verified with the oscilloscope and by measurement of the transmitted signal.

- d) Case where the CC is being lost by the EUT and a call is initiated within the T1 period:
 - d1) The EUT shall be switched on and the STE shall transmit the CC.
 - d2) The STE shall stop transmitting the CC.
 - d3) Within the period T1 from d2), a call shall be initiated from the EUT.
 - d4) The EUT may transmit but within the T1 period the EUT shall enter the carrier-off state.

The events from d2) to d4) shall be displayed and verified with the oscilloscope and by measurement of the transmitted signal.

C.1.6 Network control commands

C.1.6.1 Test method

The network control commands tests shall be performed in sequence:

- a) transmission enable command;
- b) identification request.

These tests shall be performed in accordance with the procedure below:

- a) Transmission enable command:
 - a1) The EUT shall be switched-on and the STE shall transmit the CC.
 - a2) The EUT shall enter the carrier-off state.
 - a3) A call shall be initiated from the EUT, the EUT shall remain in the carrier-off state.
 - a4) The STE shall transmit an enable command to the EUT.
 - a5) A call shall be initiated from the EUT.
 - a6) The EUT shall enter the carrier-on state and shall transmit.

The events from a2) to a6) shall be displayed and verified with the oscilloscope and by measurement of the transmitted signal.

- b) Identification request:
 - b1) The STE shall transmit an identification request.
 - b2) The EUT shall enter the carrier-on state and shall transmit its identification code.

The STE shall display the identification code sent by the EUT.

C.1.7 Initial burst transmission

C.1.7.1 Test method

- a) The EUT shall be switched-off and the STE shall transmit the CC.
- b) The EUT shall be switched-on.
- c) The EUT shall not transmit, except the initial bursts, if any.
- d) Each initial burst shall not last more than 1 second, and the transmission of the initial bursts shall not exceed 1 % of the time.

The events from b) to d) shall be displayed and verified with the oscilloscope and by measurement of the transmitted signal.

Annex D (informative): Antenna siting

- a) It is desirable that the antenna be sited in such a position that no obstacle likely to significantly degrade the performance of the equipment appear in any azimuth down to an angle of elevation of -5° .

The siting of the antenna needs careful consideration, taking into account the adverse effect of high levels of vibration which might be introduced by the use of a tall mast and the need to minimize shadow sectors.

Objects, especially those within 10 m of the radome which cause a shadow sector of greater than 6° , are likely to significantly degrade the performance of the equipment.

The above deck equipment shall be separated, as far as is practicable, from the antennae of other communication and navigation equipment.

- b) That it is readily accessible for inspection and maintenance purposes.

Annex E (informative): Bibliography

ETSI ETS 300 423 (1995): "Satellite Earth Stations and Systems (SES); Land Mobile Earth Stations (LMES) operating in the 1,5/1,6 GHz bands providing voice and/or data communications".

ETSI EN 301 444 v1.1.1 (2000-05): "Satellite Earth Stations and Systems (SES); Harmonized EN for Land Mobile Earth Stations (LMES) operating in the 1,5 GHz and 1,6 GHz bands providing voice and/or data communications".

ITU-T Recommendation E.215: "Telephone/ISDN numbering plan for the Mobile Satellite Services of Inmarsat".

History

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