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**Radio Equipment and Systems (RES);
Float-free maritime satellite
Emergency Position Indicating Radio Beacons (EPIRBs)
operating on 406,025 MHz;
Technical characteristics and methods of measurement**

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Foreword

This draft second edition European Telecommunication Standard (ETS) has been produced by the Radio Equipment and Systems (RES) Technical Committee of the European Telecommunications Standards Institute (ETSI) is now submitted for the Unified Approval Procedure phase of the ETSI standards approval procedure.

Every ETS prepared by ETSI is a voluntary standard. This ETS contains text concerning conformance testing of the equipment to which it relates. This text should be considered only as guidance and does not make this ETS mandatory.

Proposed transposition dates	
Date of latest announcement of this ETS (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this ETS (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	6 months after doa

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1 Scope

This ETS sets out the minimum performance requirements and technical characteristics for float-free satellite Emergency Position-Indicating Radio Beacons (EPIRB), operating in the COSPAS-SARSAT satellite system, concerning radio communications for the Global Maritime Distress and Safety System (GMDSS).

The equipment covered by this ETS operates on 406 MHz which is provided with a low power 121,5 MHz homing device.

This ETS incorporates the relevant requirements of the International Telecommunications Union (ITU) and the International Maritime Organisation (IMO).

This ETS is applicable for satellite EPIRBs operating over the temperature ranges of :

- - 40 °C to + 55°C (Class 1); or
- - 20 °C to + 55°C (Class 2);

with a float free release mechanism.

NOTE 1: The Class 2 equipment meets the IMO requirements of chapter IV, regulations 7.1.6 and 14.1 of the 1988 amendments to the 1974 International Convention for Safety of Life at Sea (SOLAS) [2].

NOTE 2: The requirements for non float free satellite EPIRBs can be found in annex A.

2 Normative references

This ETS incorporates by dated or undated reference, provision from other publications. These normative reference are cited at the appropriate place 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] International Telecommunication Union: "Radio Regulations".
- [2] International Convention for Safety of Life at Sea (SOLAS) (1974), as amended 1988.
- [3] IMO Resolution A.694(17): "General requirements for ship borne radio equipment forming part of the global maritime distress and safety system (GMDSS) and for electronic navigational aids".
- [4] IMO Resolution A.763(18): "Performance standards for float-free satellite emergency position-indicating radio beacons (EPIRBs) operating on 406 MHz".
- [5] IMO Resolution A.662(16): "Performance standards for float-free release and activation arrangements for emergency radio equipment".
- [6] IMO Resolution A.696(17): "Type approval of satellite emergency position-indicating radio beacons operating in the COSPAS-SARSAT system".
- [7] IMO Resolution A.658 (16): "Use and fitting of retro-reflective materials on life-saving appliances".
- [8] IMO Resolution A.689(17): "Testing of life-saving appliances".
- [9] ITU-R Recommendation M.633-1: "Transmission characteristics of a satellite emergency position-indicating radio beacon (satellite EPIRB) system operating through a low polar-orbiting satellite system in the 406 MHz band".

- [10] C/S T.001 Issue 2-Revision 5 (September 1993): "Specification for COSPAS-SARSAT 406 MHz distress beacons".
- [11] C/S T.007 Issue 3-Revision 1 (December 1993): "COSPAS-SARSAT 406 MHz distress beacon type approval standard".
- [12] ISO Recommendation 694: "Method B".

3 Definitions and abbreviations

3.1 Definitions

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

satellite EPIRB: An earth station in the Mobile Satellite Service the emissions of which are intended to facilitate search and rescue operations.

release mechanism: An arrangement which allows the satellite EPIRB to float free automatically.

homing device: A 121,5 MHz beacon primarily intended for homing by aircraft.

remote control unit: An unit which allows the satellite EPIRB, while mounted in the release mechanism, to be activated from another position than its installation point.

equipment: A satellite EPIRB which includes the 121,5 MHz homing device, its release mechanism and remote control unit (when provided).

class 1: A satellite EPIRB intended for operation over the frequency range - 40°C to + 55°C.

class 2: A satellite EPIRB intended for operation over the frequency range - 20°C to + 55°C.

3.2 Abbreviations

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

AF	Antenna Factor
BCH	Bose-Chaudhuri-Hocquenghem
CW	Carrier Wave
e.i.r.p.	equivalent isotropically radiated power
EPIRB	Emergency Position Indicating Radio Beacon
EUT	Equipment Under Test
RF	Radio Frequency
GMDSS	Global Maritime Distress and Safety System
ID	Identification
IMO	International Maritime Organisation
ITU-R	International Telecommunication Union, Radiocommunication Sector
LCM	Lowest Common Multiple
LHCP	Left Hand Circularly Polarised
LSB	Least Significant Bit
MID	Maritime Identification Digits
MMSI	Maritime Mobile Station Identity
MSB	Most Significant Bit
NRZ	Non-Return to Zero
PERP	Peak Effective Radiated Power
PLL	Phase Locked Loop
RHCP	Right Hand Circular Polarised
SOLAS	International Convention for Safety of Life at Sea
VSWR	Voltage Standing Wave Ratio

4 General requirements

4.1 Scope

The manufacturer shall declare that compliance to the requirements of clause 4 is achieved and shall provide relevant documentation.

4.2 Operating conditions

The satellite EPIRB shall be mounted in a release mechanism (clause 12) which automatically releases the EPIRB when submerged in water. When so released, the EPIRB shall float to the surface and start transmitting automatically irrespective of the settings of any control.

The satellite EPIRB shall be designed to operate when floating in the sea but shall also operate satisfactorily on a ship's deck and in a survival craft.

The general construction and method of operation shall provide a high degree of proof against inadvertent operation, whilst still providing a simple means of operation in an emergency.

The satellite EPIRB shall be capable of being carried by one person and it shall be possible to release and operate the satellite EPIRB manually.

If the satellite EPIRB is manually removed from its release mechanism, it shall be activated only when floating in the water or manually activated (subclause 4.6).

After automatic or manual activation, no distress signal shall be emitted until at least 47 seconds and at most 5 minutes after the satellite EPIRB has been activated. The satellite EPIRB shall be a single integral unit incorporating a primary battery and a permanently attached antenna. No part of it shall be detachable without the use of tools. The fixed portion of the distress message shall be stored in such a way that it will not be affected by removal of all power sources. Any external connection shall not inhibit the release or activation of the satellite EPIRB.

4.3 Lanyard

The satellite EPIRB shall be provided with a firmly attached line in order that the equipment may be tethered in use. The lanyard shall be capable of floating in sea water and shall be arranged so as to prevent it being trapped in the ship's structure when floating free.

4.4 Colour and surface

The satellite EPIRB shall be finished with a highly visible yellow/orange colour and shall fitted with a band of retro-reflecting material, which shall meet the performance requirements of IMO Resolution A.658 (16) [7], shall be at least 25 mm wide, encircling that part of the satellite EPIRBs body which is normally protruding above the waterline.

4.5 Low duty cycle light

The satellite EPIRB shall be provided with a low duty cycle light which fulfils the requirements of subclause 10.1.

4.6 Controls

All controls shall be of sufficient size for simple and satisfactory operation and also be capable of being operated by a person wearing gloves for immersion suits in accordance with Chapter III Regulation 33 of the 1983 amendments to the 1974 SOLAS Convention [2].

Manual activation of the satellite EPIRB shall break a seal which shall not be replaceable by the user and shall require two simple but independent mechanical actions neither of which, on its own, shall activate the equipment. The seal shall not be broken when using the test facility.

If the satellite EPIRB is installed in its release mechanism the manual activation shall require two simple but independent mechanical actions. The means for manual activation shall be protected against inadvertent activation.

After manual or automatic activation it shall be possible to manually deactivate the satellite EPIRB repetitively.

4.7 Indicators

If the satellite EPIRB is activated, the low duty cycle light (subclause 4.5) shall begin flashing within 10 seconds, in any lighting condition.

The satellite EPIRB shall be provided with either an audible or a visual indication that signals are being emitted. The visual indication could be combined with the low duty cycle light (e.g. triggered by the burst).

4.8 Self-test mode

The satellite EPIRB shall be capable of being tested, without using the satellite system, to determine that the satellite EPIRB is capable of operating properly, i. e. the following items under a full-load condition as a minimum shall be tested:

- the battery voltage is sufficient to meet the power input requirements of the EPIRB;
- the 406 MHz Radio Frequency (RF) output stage is operational; and
- if used, the phase lock of the 406 MHz Phase Locked Loop (PLL).

When the self-test mode is activated, the satellite EPIRB shall emit a single burst which shall be identical to its normal transmission burst except that the frame synchronisation pattern (subclause 9.2.2) shall be "011010000" (i. e. the last 8 bits are complemented and the burst duration shall be 440 ms). Successful completion of the self-test shall be indicated after which the test facility shall deactivate automatically. The test mode shall be functional throughout the operating temperature range.

4.9 Labelling

The satellite EPIRB and its container, if any, shall be provided with a label or labels containing the following information at least in English:

- type designation, serial number, and the type of battery specified by the manufacturer for use in the equipment;
- the date on which the battery will need to be replaced;
- adequate instruction to enable manual activation and deactivation and self-test;
- a warning to the effect that the satellite EPIRB shall not be operated except in an emergency;
- space on which the ship name, Maritime Mobile Station Identity (MMSI) and call sign may be recorded;
- the class of the satellite EPIRB;
- the identity code programmed into the satellite EPIRB, namely hexadecimal representation of bits 26 to 85 of the digital message;
- the compass-safe distance.

Administrations may require additional labelling.

4.10 Operating instructions

The equipment manufacturer shall provide full instructions and information regarding stowage, installation, and operation of the satellite EPIRB. This shall include proper operation, procedures to limit self-testing to

the minimum necessary to ensure confidence in the operation of the satellite EPIRB, battery replacement, and the avoidance of false alarms.

4.11 Homing device

The satellite EPIRB shall be provided with a homing device operating on 121,5 MHz which shall fulfil the requirements of subclause 10.3.

4.12 Accessories

Where a unit of equipment provides a facility which is additional to requirements of this ETS, the operation or malfunction of such an additional facility shall not prevent the satellite EPIRB conforming fully to the requirements of this ETS during normal combined operation.

4.13 Power source

4.13.1 Battery requirements

The battery life as defined by its expiry date shall be at least 3 years.

The expiry date of the battery shall be the battery manufacturing date plus no more than half the useful life of the battery. The expiry date shall be clearly and durably marked.

The useful life of the battery is defined as the period of time after the date of battery manufacture that the battery will continue to meet the input power requirements of the satellite EPIRB.

To define the useful life of the battery, the following losses at the temperature of $+ 20\text{ °C} \pm 5\text{ °C}$ shall be included:

- self testing at a rate of once a week;
- self-discharge of the battery; and
- standby loads, if any.

4.13.2 Safety precautions

It shall not be possible to connect the battery with the polarity reversed.

The battery shall not release toxic or corrosive products outside the satellite EPIRB:

- during or subsequent to storage at temperatures between $- 55\text{ °C}$ and $+75\text{ °C}$;
- during a full or partial discharge at any rate up to and including an external short circuit;
- during a charge or forced discharge of a cell or cells by another cell or cells within the battery;
- after a full or partial discharge.

The battery shall not be hazardous to any person handling, using or performing manufacturer approved servicing of the device or to any vehicle or equipment in which it is transported, housed or installed under any of the conditions specified in this ETS.

5 Test conditions

5.1 General

The requirements of this ETS shall be met after a maximum warm-up period of 15 minutes.

Adequate information shall be provided to enable the equipment to be properly set up, maintained and operated during the conformance testing.

If the equipment contains any additional facilities or auxiliary devices, they shall be operational for the duration of all tests. During testing all audible and visual indications including the low duty cycle light shall be functioning.

5.2 Performance check

For the purpose of this ETS, the term "performance check" shall be taken to mean:

- to determine the characteristic frequency from four measurements of the carrier frequency of the unmodulated signal $f_c^{(1)}$ made under extreme test conditions (subclauses 5.11 and 5.12) during the interval S_1 (figure 5) during four successive transmissions as follows:

$$f_o = f^{(1)} = \frac{1}{4} \sum_{i=1}^4 f_{c i}^{(1)}$$

The characteristic frequency shall be between 406,023 MHz and 406,027 MHz;

- to measure the output power of the satellite EPIRB under normal test conditions. The output power shall be $37 \text{ dBm} \pm 2 \text{ dB}$;
- to measure the output power of the 121,5 MHz homing device under normal test conditions. The output power shall be $17 \text{ dBm} \pm 3 \text{ dB}$;
- to measure the carrier frequency of the 121,5 MHz homing device under normal test conditions. The carrier frequency shall be $121,5 \text{ MHz} \pm 3,5 \text{ kHz}$;
- to check the operation of low duty cycle light.

5.3 Preparation of satellite EPIRB for testing

For the purpose of conformance testing, the satellite EPIRB shall be specially programmed to transmit data bursts encoded using the test user protocol (subclause 9.3.6) when the satellite EPIRB is activated. All homing devices should be prepared for test transmission. Care shall be taken not to transmit distress signals on distress and safety frequencies, for example by frequency offset or test coding.

The manufacturer shall supply a satellite EPIRB which is configured such that the antenna port can be connected to the test equipment by a coaxial cable terminated by a 50Ω load. This connection shall be waterproof and able to withstand all environmental conditions. The configuration of the antenna port may be prepared by the manufacturer before the relevant test.

5.4 Test sequence

The tests shall be carried out in the order described in this ETS and may be combined with the tests as described in the COSPAS-SARSAT specifications C/S T.001 [10], C/S T.007 [11].

All tests shall be performed on a single unit, prepared in accordance with subclause 5.3.

5.5 Test power source

All tests and performance checks shall be carry out using the internal battery.

For conformance tests, three sets of batteries shall be submitted.

5.6 Test site

The test site for radiation measurements shall be an area clear of any obstruction such as trees, bushes or metal fences within an elliptical boundary of dimensions shown in figure 1. Objects outside this boundary may still affect the measurements and care shall be taken to choose a site as far as possible from large objects or metallic objects of any sort.

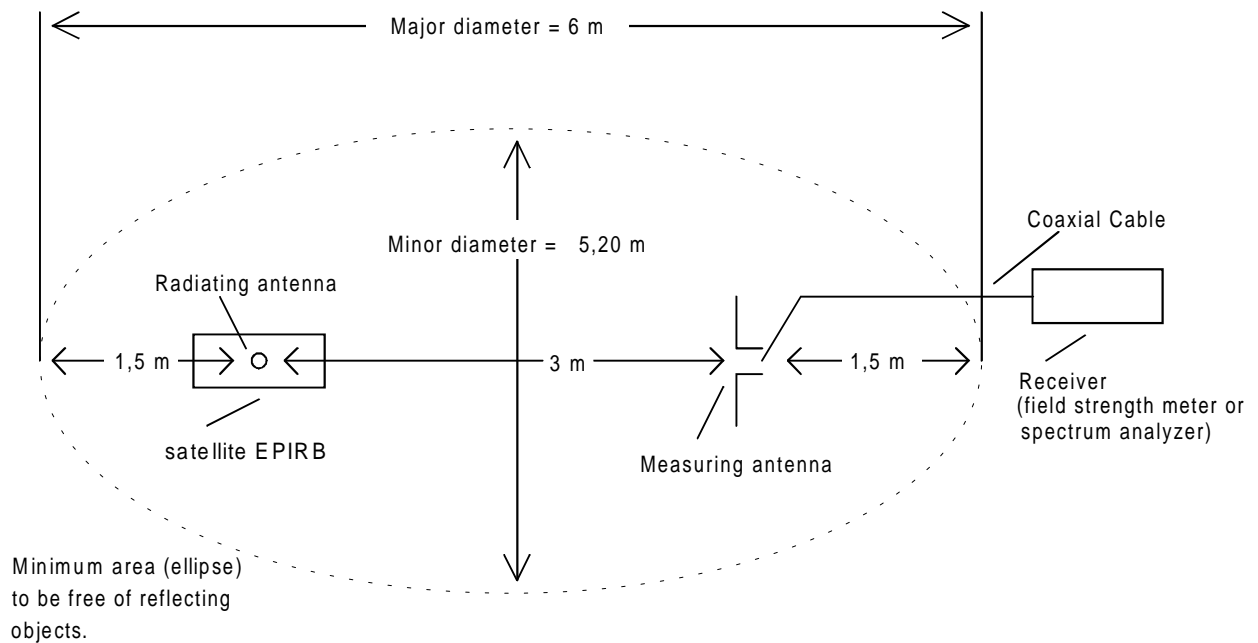


Figure 1: Sample test site

The terrain at an outdoor test site shall be flat. Any conducting object inside the area of the ellipse shall be limited to dimensions less than 7 cm. A metal ground plane or wire mesh covering at least the area of the ellipse and keeping the same major and minor axis as indicated in figure 1 is preferred. All electrical wires and cables should be under the ground plane. The antenna cable shall be extended behind the measuring antenna along the major axis of the test site for a distance of at least 1,5 m from the dipole elements before being routed down to ground level.

All precautions shall be taken to ensure that reflections from surrounding structures are minimized. No personnel above ground shall be within 6 m of the satellite EPIRB during measurements. Test reports shall include a detailed description of the test environment. They shall specifically indicate what precautions were taken to minimize reflections.

Weather protection enclosures may be constructed either partially or entirely over the site. Fibreglass, plastics, treated wood or fabric are suitable materials for construction of an enclosure. Alternatively, the use of anechoic enclosure is acceptable.

5.7 Test set-up

The test set-up, as shown in figure 2, shall be used to simulate water conductivity of the satellite EPIRB.

The satellite EPIRB shall be oriented in a manner in which it is designed to operate and placed on a circular ground plane capable of rotation through 360° in azimuth. As shown in figure 2, the rotating ground plane B shall have a minimum radius of $1,7\lambda$, (125 cm) and be made of highly conductive material (aluminium or copper). It shall be located at a reference height $X = 0,75 \pm 0,10$ m above ground plane A. The satellite EPIRB shall be mounted within the rotating ground plane B to a level such that its float line is aligned with the ground plane B and the antenna of the satellite EPIRB is positioned at the centre. This ground plane shall be extended to fit closely around the satellite EPIRB and to surround the below-waterline portion of the unit (e.g. using metal foil). An adapter plate which has a close fit to the sides of the satellite EPIRB is recommended.

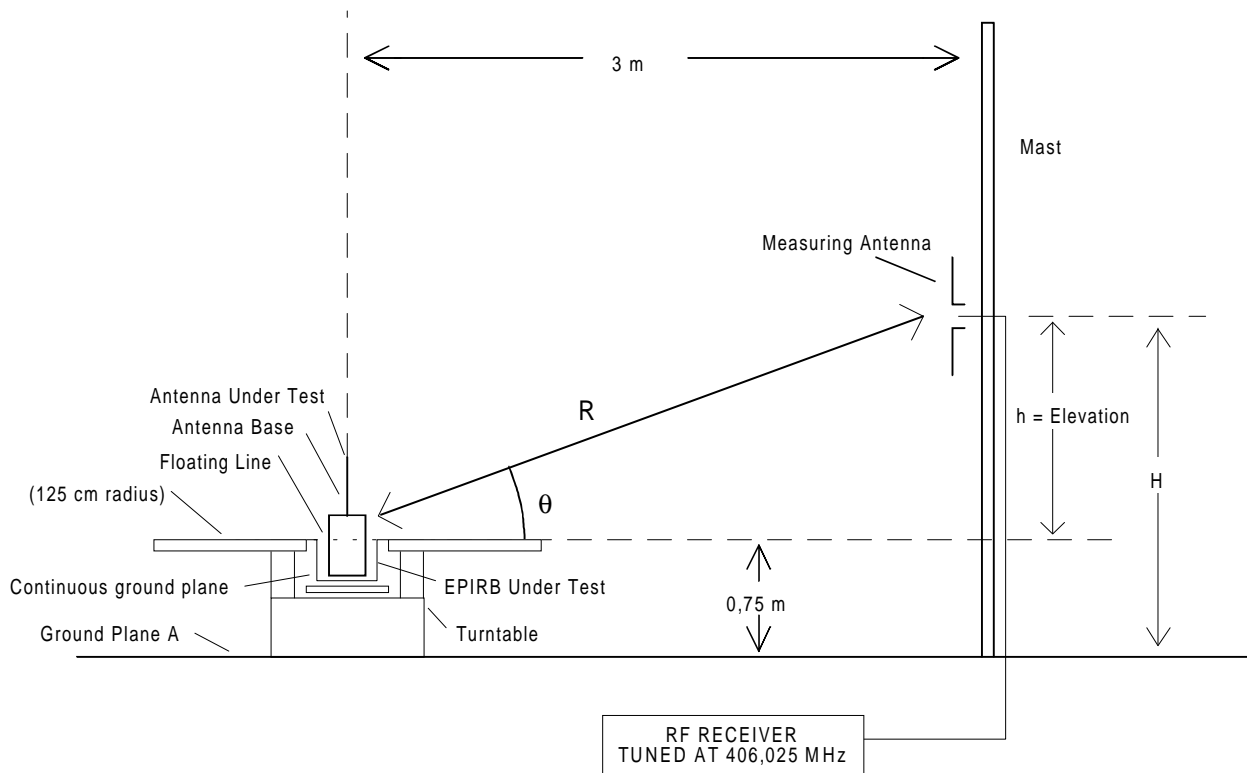


Figure 2: Test set-up

5.8 Test receiver

The test receiver (which may be a field strength meter or a spectrum analyzer) should be calibrated as follows:

- connect the equipment as shown in figure 2. Install the satellite EPIRB as described in subclause 5.7;
- turn on the satellite EPIRB for nominal transmission. Set the receiver bandwidth to measure the power of the transmission. The same receiver bandwidth shall be used during the antenna measurement process. Tune the receiver for maximum received signal. Position the measuring antenna in the plane (horizontal or vertical) that gives the greatest received signal. Rotate the satellite EPIRB antenna and determine an orientation which is representative of the average radiation field strength (not a peak or a null). Record the receiver level;
- disconnect the measuring antenna and feed the calibrated RF source to the receiver through the measuring antenna cable. Adjust the signal source to give the same receiver level recorded in b) above;
- disconnect the calibrated RF source from the measuring antenna cable and measure its RF output with a power meter;
- reconnect the calibrated RF source to the measuring antenna cable and adjust the gain calibration of the receiver for a reading which is equal to the power.

5.9 Measuring antenna

The radiated field of the satellite EPIRB antenna shall be detected and measured using a tuned dipole. This dipole antenna shall be positioned at a horizontal distance of 3 m from the satellite EPIRB antenna and mounted on a non-conducting vertical mast that permits the height of the measuring antenna to be varied from 1,3 to 4,3 m (i.e. from 10 to 50 degrees relative to the ground plane B located at reference height $X = 0,75$ m, figure 2). The height at which the measuring antenna shall be elevated on the supporting mast for a specific angle of elevation is calculated as follows:

$$h_{metres} = 3 \tan \theta \text{ and } H_{metres} = h + X$$

where :

- X is the reference height (0,75 m);
- b is the height of the measuring antenna relative to the reference height X;
- θ is the desired angle of elevation with respect to the rotating ground plane B (at reference height X);
- H is the height of the measuring antenna above the ground plane A.

NOTE: The centre of the measuring dipole antenna is used as the reference to determine its height.

As the measuring antenna is vertically elevated, the distance (R) between the satellite EPIRB antenna and the measuring antenna increases. The distance (R) is a function of the elevation angle (θ) and it is calculated as follows:

$$R_{metres} = \frac{3}{\cos \theta}$$

The antenna factor (AF) of the measuring antenna at 406 MHz shall be known.

This factor is normally provided by the manufacturer of the dipole antenna or from the latest antenna calibration data. It is used to convert the induced voltage measurement into electric field strength.

Since the value of AF depends on the direction of propagation of the received wave relative to the orientation of the receiving antenna, the measuring dipole should be maintained perpendicular to the direction of propagation. In order to minimize errors during measurement, it is recommended to adopt its practice (figure 3) If the measuring antenna cannot be maintained perpendicular to the direction of propagation (figure 4), a correction factor shall be considered due to the gain variation pattern of the measuring antenna. For a dipole, the corrected antenna factor (AF_c) is calculated as follows:

$$AF_c = \frac{AF}{P} \text{ and } P = \frac{\cos(90 \cdot \sin \theta)}{\cos \theta}$$

where:

- AF is the antenna factor of the measuring antenna at 406 MHz;
- θ is the elevation angle;
- P is the correction factor for the dipole antenna pattern.

NOTE: The correction factor (P) is equal to 1 when the measuring antenna elements are maintained perpendicular to the direction of propagation. P is therefore equal to 1 when the measuring antenna is horizontally polarized at any elevation angle. The correction factor applies only to vertically polarized measurements.

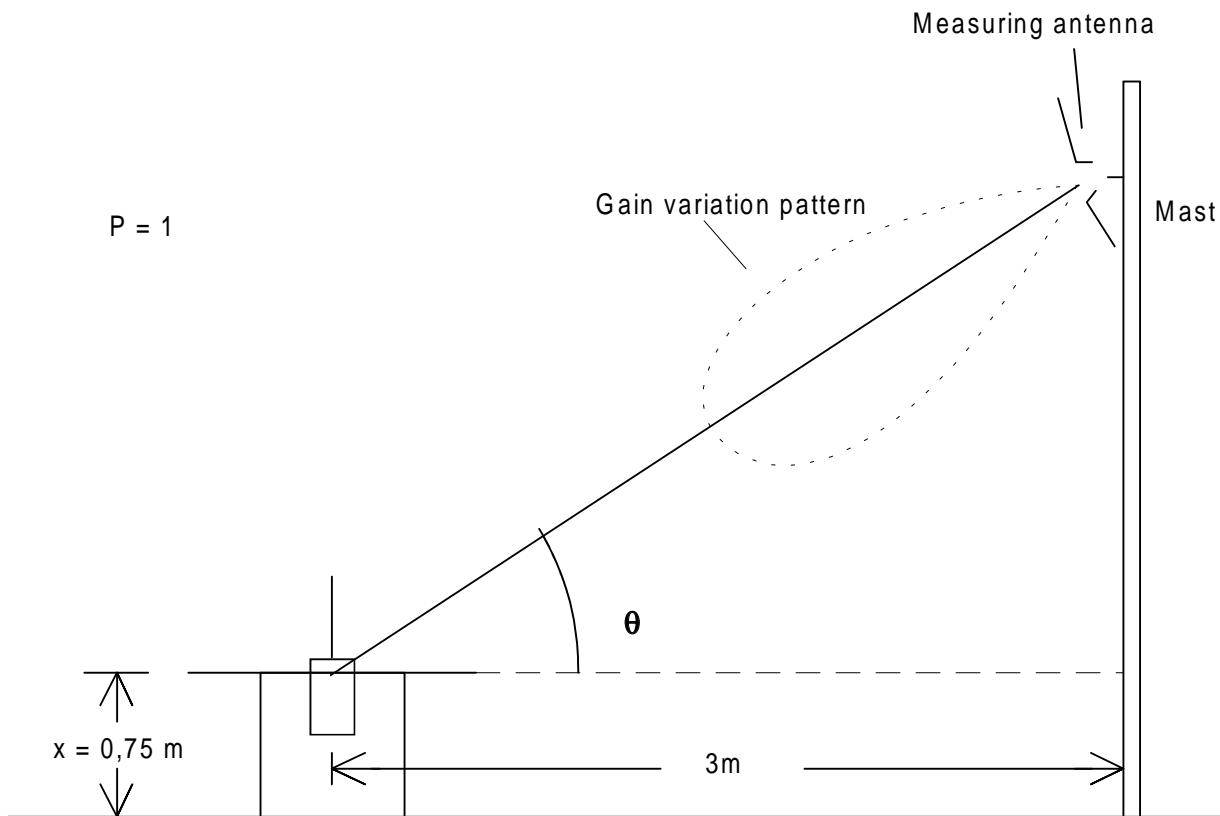


Figure 3: Measuring antenna perpendicular to the direction of propagation

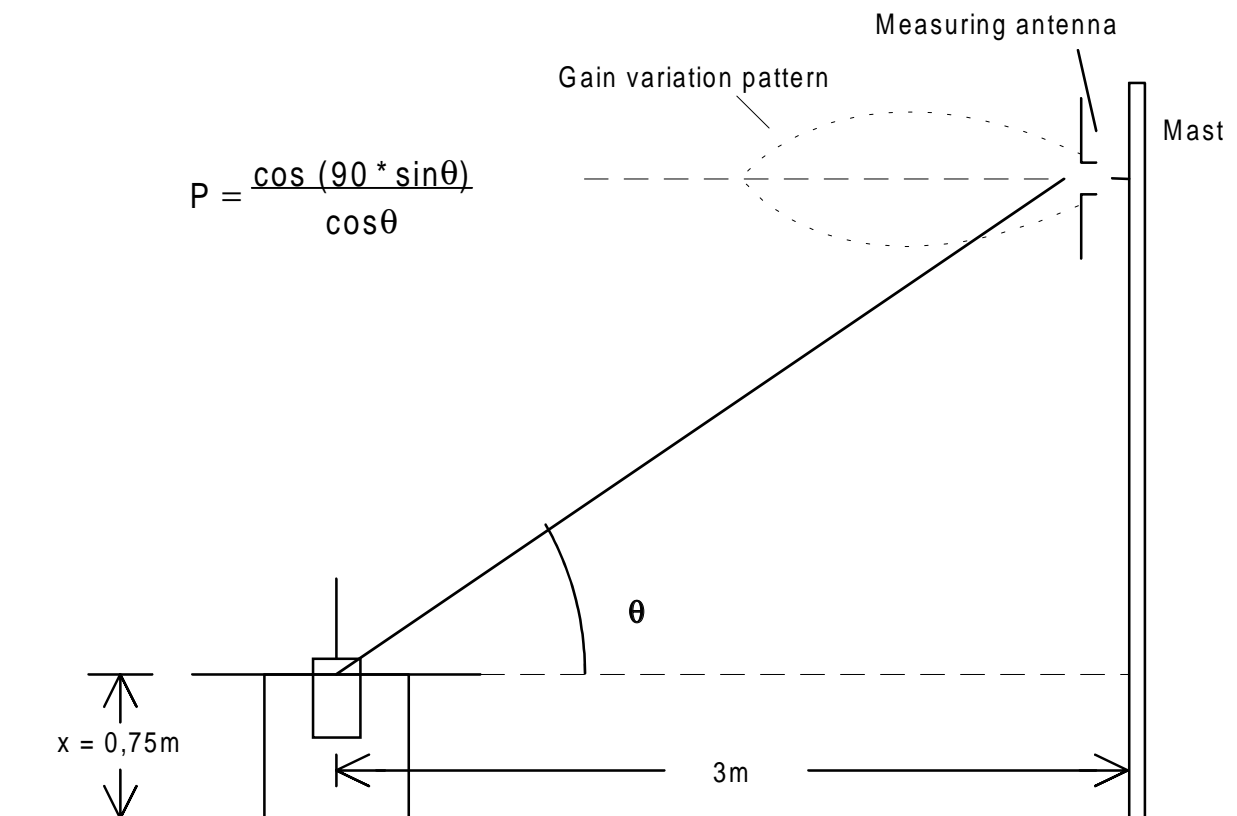


Figure 4: Measuring antenna not perpendicular to the direction of propagation

5.10 Normal test conditions

Normal temperature and humidity conditions for tests shall be any convenient combination of temperature and humidity within the following ranges:

- temperature: +15 °C to 35 °C;
- relative humidity: 20% to 75%.

5.11 Extreme test conditions

For tests at extreme temperatures, measurements shall be made in accordance with the procedure specified in subclause 5.12 at the following lower and upper extreme temperatures:

- for the class 1 EPIRB - 40 C and + 55 C;
- for the class 2 EPIRB - 20 C and + 55 C.

For tests of the release mechanism at extreme temperature, the lower and upper temperature are - 30°C and + 65°C.

5.12 Procedure for tests at extreme temperatures

The equipment shall be switched off during the temperature stabilising period.

Before tests are carried out, the equipment shall have obtained thermal balance in the test chamber and have been switched on for a period of 15 minutes.

NOTE: All electrical and functional tests under extreme temperatures may be combined with the relevant tests of the COSPAS-SARSAT specification (section A.2.1 of C/S T.007 [11]).

5.13 Measurement uncertainties

Table 1: Absolute measurement uncertainties: maximum values

Parameter	Maximum uncertainty
Repetition Time	± 0,01 seconds
Total Transmission Time	± 1,0 ms
CW Preamble	± 1,0 ms
Bit Rate	± 0,6 bit/s
Nominal Frequency	± 100 Hz
Frequency Stability	<1x10 ⁻¹⁰
Transmitted Power	± 0,5 dB
Spectrum mask	± 2 dB
Carrier Rise Time	± 0,5 ms
Modulation Rise	± 25µs
Modulation Symmetry	< 0,01
Phase Modulation	± 0,04 radians
Temperature	± 2°C
Antenna Measurement	± 3 dB

5.14 Interpretation of the measurement results

The interpretation of the results recorded in a test report for the measurements described in this ETS shall be as follows:

- the measured value related to the corresponding limit will be used to decide whether an equipment meets the requirements of this ETS;

- the measurement uncertainty value for the measurement of each parameter shall be included in the test report;
- the recorded value of the measurement uncertainty shall be, for each measurement, equal to or lower than the maximum values given in table 1.

NOTE: This procedure for using maximum acceptable uncertainty values is valid until superseded by other appropriate publications of ETSI covering this subject.

The use of the measured value has been chosen because there is no other ETSI standard covering the subject at the time of publication of this ETS. Therefore the measurement uncertainty shall be used as a quality of the actual measurement. The measurement uncertainty values can also be used by accreditation authorities during their accreditation procedures to ensure compliance/conformance with the requirements of type testing to ETSI standards.

6 Environmental tests

6.1 General

Environmental tests in this clause shall be carried out before any other tests and shall be performed under normal test conditions unless otherwise stated. The satellite EPIRB shall be installed in its release mechanism in operating conditions (subclause 4.2) but not transmitting unless otherwise stated.

The following tests shall be conducted in the order they appear in this clause unless otherwise stated.

6.2 Temperature tests

6.2.1 Definition

The immunity against the effects of temperature is the ability of the equipment to maintain the specified mechanical and electrical performance after the following tests have been carried out.

The maximum rate of raising or reducing the temperature of the chamber in which the equipment is being tested shall be 1°C/minute.

6.2.2 Dry heat test

6.2.2.1 Method of measurement

The equipment shall be placed in a chamber of normal room temperature. Then the temperature shall be raised to and maintained at +70 C ($\pm 3^{\circ}\text{C}$) for a period of between 10 hours and 16 hours.

After this period any climatic control device provided in the equipment may be switched on and the chamber cooled to + 55 C ($\pm 3^{\circ}\text{C}$). The cooling of the chamber shall be completed within 30 minutes.

The equipment shall then be switched on and shall be kept working continuously for a period of 2 hours. The temperature of the chamber shall be maintained at + 55 C ($\pm 3^{\circ}\text{C}$) during the 2 hour 30 minute period. The equipment shall be subjected to a performance check during the last 30 minutes.

At the end of the test, and with the equipment still in the chamber, the chamber shall be brought to room temperature in not less than 1 hour. The equipment shall then be exposed to normal room temperature and humidity for not less than 3 hours before the next test is carried out.

6.2.2.2 Requirement

The requirement for the performance check shall be met.

6.2.3 Damp heat test

6.2.3.1 Method of measurement

The equipment shall be placed in a chamber at normal room temperature and humidity which, steadily, over a period 3 hours ($\pm 0,5$ hours), shall be heated from room temperature to $+ 40^{\circ}\text{C}$ ($\pm 3^{\circ}\text{C}$) and shall during this period be brought to a relative humidity of 93 % (± 2 %).

These conditions shall be maintained for a period of between 10 hours and 16 hours.

The equipment shall be switched on 30 minutes later, and shall then be kept working continuously for a period of 2 hours.

The temperature and relative humidity of the chamber shall be maintained at $+40^{\circ}\text{C}$ ($\pm 3^{\circ}\text{C}$) and 93% ($\pm 2\%$) during the 2 hour 30 minute period. The equipment shall be subjected to a performance check during the last 30 minutes.

At the end of the test, and with the equipment still in the chamber, the chamber shall be brought to room temperature in not less than 1 hour. The equipment shall then be exposed to normal room temperature and humidity for not less than 3 hours, or until moisture has dispersed, whichever is longer, before the performance check is carried out.

6.2.3.2 Requirement

The requirement for the performance check shall be met.

6.2.4 Low temperature test

6.2.4.1 Method of measurement

The equipment shall be placed in a chamber at normal room temperature. Then the temperature shall be reduced to, and maintained at $- 40^{\circ}\text{C}$ ($\pm 3^{\circ}\text{C}$) for class 1 and $- 30^{\circ}\text{C}$ ($\pm 3^{\circ}\text{C}$) for class 2 for a period of between 10 hours and 16 hours.

For class 2 equipment the chamber shall then be heated to $- 20^{\circ}\text{C}$ ($\pm 3^{\circ}\text{C}$).

Any climatic control device provided in the equipment may be switched on. The action of the climatic control device and (for class 2 equipment) the heating of the chamber shall be completed within 25 minutes (± 5 minutes).

The temperature of the chamber shall be then maintained during a period of 2 hours.

The equipment shall be subjected to a performance check during the last 30 minutes of the test.

At the end of the test, and with the equipment still in the chamber, the chamber shall be brought to room temperature in not less than 1 hour. The equipment shall then be exposed to normal room temperature for not less than 3 hours, or until moisture has dispersed, which ever is longer, before the next test is carried out.

Throughout the test the equipment shall be working normally.

6.2.4.2 Requirement

The requirement for the performance check shall be met.

6.3 Vibration test

6.3.1 Definition

The immunity against the effects of vibration is the ability of the equipment to maintain the specified mechanical and electrical performance when the following test is carried out.

6.3.2 Method of measurement

The equipment, complete with any shock absorbers which are part of it, shall be clamped to the vibration table by its normal means of support and in its normal attitude. The equipment may be suspended to compensate for weight not capable of being withstood by the vibration table.

Provision may be made to reduce or nullify any adverse effect on the equipment performance which could be caused by the presence of any electro-magnetic field due to the vibration unit.

The equipment shall be subjected to sinusoidal vertical vibration at all frequencies between:

- 2 Hz (-0/+3 Hz) and 13,2 Hz with an excursion of $\pm 1 \text{ mm} \pm 10\%$ (7 m/s² maximum acceleration at 13,2 Hz); and
- 13,2 Hz and 100 Hz with a constant maximum acceleration of 7 m/s².

The frequency sweep rate shall be slow enough to allow the detection of resonances in any part of the Equipment Under Test (EUT).

A resonance search shall be carried out during the vibration test. If any resonance of any part of any component is observed, the equipment shall be subjected to a vibration endurance test at each resonance frequency with the duration of not less than 2 hours at the vibration level specified above. The test shall be repeated with vibration in each of the mutual perpendicular direction in the horizontal plane.

A performance check at the satellite EPIRB and from the remote control unit (when provided) shall be carried out during and after the test. At the end of the test, the equipment shall be examined for any mechanical deterioration.

6.3.3 Requirement

The satellite EPIRB shall not release from its mounting arrangement nor shall it automatically activate during the vibration test.

The requirement for the performance check shall be met. No damage or mechanical deterioration shall be visible to the naked eye.

6.4 Ruggedness test

6.4.1 Definition

The immunity against the effects of bumps is the ability of the equipment to maintain the specified mechanical and electrical performance after the following test has been carried out.

6.4.2 Method of measurement

The satellite EPIRB and release mechanism installed in its bracket, if any, shall be mounted successively in each method intended for mounting on a ship. The equipment shall be subjected to the ruggedness test according to the following profile:

- peak acceleration: 98 m/s² $\pm 10\%$;
- pulse duration: 18 ms $\pm 20\%$;
- wave shape : half-cycle sine wave;
- test axis: vertical;
- number of bumps: 4 000.

At the end of the test, the equipment shall be examined for any mechanical deterioration. The self-test of the satellite EPIRB (subclause 4.8) shall be carried out.

6.4.3 Requirements

The satellite EPIRB shall not release from its mounting arrangement nor shall it automatically activate during the ruggedness test.

Successful completion of the self-test shall be indicated.

No damage or mechanical deterioration shall be visible to the naked eye.

6.5 Corrosion test

This test need not be carried out if the manufacturer is able to produce sufficient evidence that the components, materials etc. maintain their specified mechanical and electrical performance against the effects of corrosion.

6.5.1 Definition

The immunity against the effects of corrosion is the ability of the equipment to maintain the specified mechanical and electrical performance after the following test has been carried out.

6.5.2 Method of measurement

The equipment shall be placed in a chamber fitted with apparatus capable of spraying in the form of fine mist, such as would be produced by a spray gun, salt solution to the formula in table 2.

Table 2: Salt solution formula

sodium chloride	26,5	g	±10 %
magnesium chloride	2,5	g	±10 %
magnesium sulphate	3,3	g	±10 %
calcium chloride	1,1	g	±10 %
potassium chloride	0,73	g	±10 %
sodium bicarbonate	0,20	g	±10 %
sodium bromide	0,28	g	±10 %
plus distilled water to make the solution up to 1 l.			

Alternatively a 5 % sodium chloride (NaCl) solution may be used. The salt used for the test shall be high quality sodium chloride (NaCl) containing, when dry, not more than 0,1 % sodium iodide and not more than 0,3 % of total impurities.

Salt solution concentration shall be 5 % (± 1 %) by weight. The solution shall be prepared by dissolving 5 parts ± 1 by weight of salt in 95 parts by weight of distilled or de-mineralised water.

The pH value of the solution shall be between 6,5 and 7,2 at temperature of 20 °C (± 2 °C). The pH value shall be maintained within this range during conditioning. For this purpose, diluted hydrochloric acid or sodium hydroxide may be used to adjust the pH value, provided that the concentration of NaCl remains within the prescribed limits. The pH value shall be measured when preparing each new batch of solution.

The spraying apparatus shall be such that the products of corrosion cannot mix with the salt solution contained within the spray reservoir.

The equipment shall be sprayed simultaneously on all its external surfaces with the salt solution for a period of 1 hour. This spraying shall be carried out 4 times with a storage period of 7 days; at 40 °C (± 2 °C) after each spraying. The relative humidity during storage shall be maintained between 90 % and 95 %.

At the end of the total period the equipment shall be examined visually. The self-test of the satellite EPIRB (subclause 4.8) shall be carried out.

6.5.3 Requirements

There shall be no undue deterioration or corrosion of the metal parts, finishes, material, or component parts visible to the naked eye.

In the case of hermetically sealed equipment there shall be no evidence of moisture penetration.

Successful completion of the self-test shall be indicated.

6.6 Drop test into water

6.6.1 Definition

The immunity against the effects of dropping is the ability of the satellite EPIRB to maintain the specified mechanical and electrical performance after being subjected to a series of drops into water.

6.6.2 Method of measurement

The satellite EPIRB shall be removed from the release mechanism or mounting bracket and dropped into water. Three drops shall be performed, namely in normal floating position, satellite EPIRB vertically down and satellite EPIRB in 90° orientation to its normal floating position. The height of the lowest part of the satellite EPIRB relative to the water surface at the moment of release shall be $20\text{ m} \pm 1\text{ m}$.

At the end of the test the self-test of the satellite EPIRB (subclause 4.8) shall be carried out.

6.6.3 Requirement

No damage shall be visible to the naked eye. Successful completion of the self-test shall be indicated.

6.7 Thermal shock test

6.7.1 Definition

The immunity against the effects of thermal shock is the ability of the equipment to maintain the specified mechanical and electrical performance after the following test has been carried out.

NOTE: This test is different from the thermal shock test required by COSPAS-SARSAT Specification C/S T.007 [11].

6.7.2 Method of measurement

The equipment shall be placed in an atmosphere of $+65\text{ °C} (\pm 3\text{ °C})$ for 1 hour. It shall then be immersed in water at $+20\text{ °C} (\pm 3\text{ °C})$ to a depth of 10 cm, measured from the highest point of the equipment to the surface of the water, for a period of 1 hour.

At the end of the test the self-test of the satellite EPIRB (subclause 4.8) shall be carried out.

6.7.3 Requirements

Successful completion of the self-test shall be indicated.

No damage shall be visible to the naked eye.

6.8 Immersion test

6.8.1 Definition

The immunity against the effects of Immersion in water is the ability of the equipment to maintain the specified mechanical and electrical performance after the following test has been carried out.

6.8.2 Method of measurement

A hydraulic pressure of 100 kPa, corresponding to a depth of 10 m shall be applied for a period of 5 minutes.

At the end of the test the self-test of the satellite EPIRB (subclause 4.8) shall be carried out.

6.8.3 Requirements

Successful completion of the self-test shall be indicated.

No damage shall be visible to the naked eye.

6.9 Hose stream test

6.9.1 Definition

The immunity against the effects of the water from the hose stream is the ability of the equipment to maintain the satellite EPIRB in its bracket and not to transmit a distress alert when the following test is carried out.

6.9.2 Method of measurement

The satellite EPIRB and release mechanism installed in its bracket, if any, shall be mounted successively in each method intended for mounting on a ship. A stream from a fire hose shall be directed at the satellite EPIRB for a period of 5 minutes. The hose shall have a nominal diameter of 63,5 mm and a water delivery rate of approximately 2 300 l of water per minute. The end of the hose shall be 3,5 m away from the satellite EPIRB and 1,5 m above the base of the antenna. The hose shall be moved during the test, so that water strikes the satellite EPIRB from all directions in an arc of at least 180° perpendicular to the normal mounting position of the satellite EPIRB.

6.9.3 Requirements

The satellite EPIRB shall not release from its bracket nor shall it automatically activate as a result of the water from the hose stream.

6.10 Buoyancy test

6.10.1 Definition

Buoyancy, expressed as a percentage, is its buoyant force divided by its gravity force.

6.10.2 Method of measurement

Satellite EPIRB shall again be submerged in calm fresh water.

One of the following methods of measurement shall be used:

- the buoyant force shall be measured when the satellite EPIRB is totally submerged in fresh water. The buoyant force shall be then divided by the measured gravity force. The result shall be recorded; or
- the buoyancy may be calculated by dividing the volume of the unit above the waterline by the total volume of the satellite EPIRB. The result shall be recorded.

6.10.3 Requirements

The value of buoyancy shall be at least 5%.

6.11 Solar radiation test

This test need not be carried out if the manufacturer is able to produce sufficient evidence that the components, materials etc. maintain their specified mechanical and electrical performance against the effects of continuous solar radiation.

6.11.1 Definition

The immunity against the effects of continuous solar radiation is the ability of the equipment to maintain the specified mechanical and electrical performance after the following test has been carried out.

6.11.2 Method of measurement

The equipment shall be placed on a suitable support and exposed continuously to a simulated solar radiation source (table 3) for 80 hours.

At the end of the test the self-test of the satellite EPIRB (subclause 4.8) shall be carried out.

The intensity at the test point, which shall also include any radiation reflected from the test enclosure, shall be $1\ 120\ \text{kW/m}^2 \pm 10\ %$ with a spectral distribution given in table 3 below.

Table 3: Spectral distribution

Spectral Region	Ultra-violet B	Ultra-violet A	Visible			Infra-red
			0,40 - 0,52	0,52 - 0,64	0,64 - 0,78	
Bandwidth { μm }	0,28 - 0,32	0,32 - 0,40	0,40 - 0,52	0,52 - 0,64	0,64 - 0,78	0,78 - 3,00
Radiance { W/m^2 }	5	63	200	186	174	492
Tolerance { $\%$ }	± 35	± 25	± 10	± 10	± 10	± 10

NOTE: Radiation shorter than 0,30 μm reaching the earth's surface is insignificant.

6.11.3 Requirements

Successful completion of the self-test shall be indicated.

No harmful deterioration of the equipment, including labelling, shall be visible to the naked eye.

6.12 Oil resistance test

This test need not be carried out if the manufacturer is able to produce sufficient evidence that the components, materials etc. maintain their specified mechanical and electrical performance against the effects of corrosion.

6.12.1 Definition

The immunity against the effects of immersion in mineral oil is the ability of the equipment to maintain the specified mechanical and electrical performance after the following test has been carried out.

6.12.2 Method of measurement

The equipment shall be immersed horizontally for a period of 24 hours under a 100 mm head of mineral oil as specified below at normal room temperature.

- aniline point: 120°C;
- flash point: minimum 240°C;
- viscosity: 10 - 25 sST at 99°C.

The following oils may be used:

- ASTM Oil No. 1;
- ASTM Oil No. 5;
- ISO Oil No. 1.

At the end of the test the self-test of the satellite EPIRB (subclause 4.8) shall be carried out . The satellite EPIRB shall be cleaned in accordance with the manufacturer's instructions.

6.12.3 Requirements

Successful completion of the self-test shall be indicated.

No sign of damage such as shrinking, cracking, swelling, dissolution or change of mechanical qualities of the satellite EPIRB, including labelling, shall be visible to the naked eye.

7 Transmitter

7.1 Output power

7.1.1 Definition

The output power of the satellite EPIRB is the average power delivered to the 50 Ω RF-terminal during one radio frequency cycle.

7.1.2 Method of measurement

The power at the output socket of the satellite EPIRB shall be measured under normal test conditions and noted. This power shall be taken as the reference output power of the satellite EPIRB (P_r).

The measurement shall be repeated under the extreme test conditions. This values shall be recorded.

7.1.3 Limit

The output power shall be 37 dBm within ± 2 dB.

7.2 Characteristic frequency

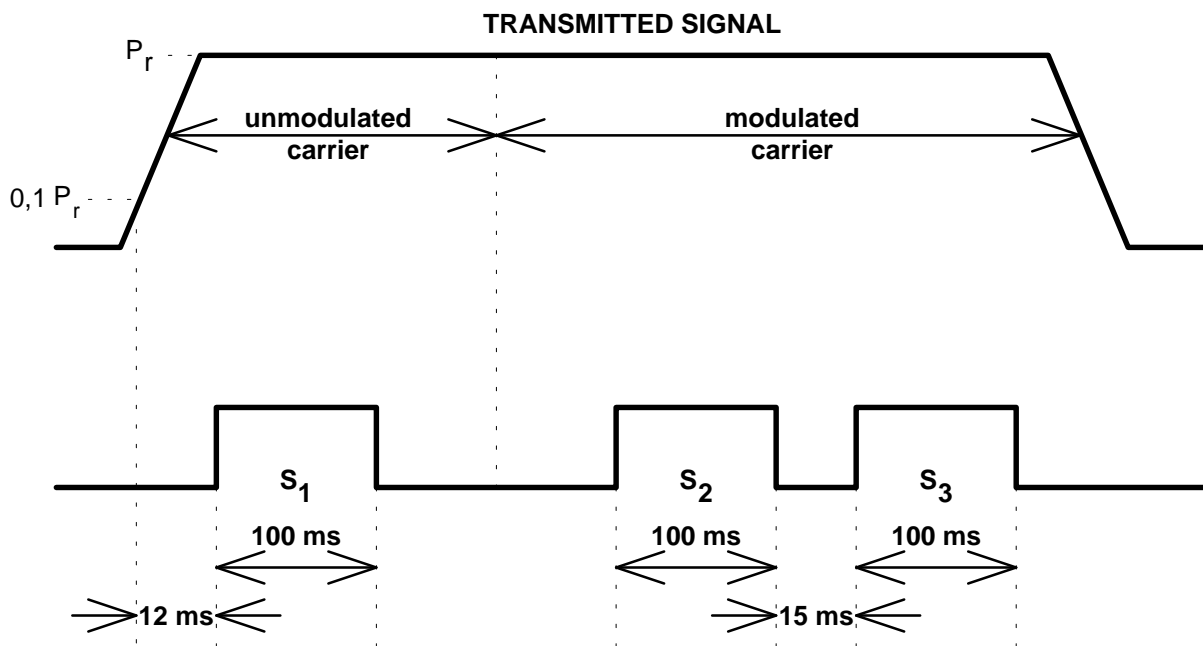
7.2.1 Definition

The characteristic frequency (f_o) is the frequency of the unmodulated signal transmitted by the satellite EPIRB.

7.2.2 Method of measurement

The characteristic frequency (f_o) shall be determined from 18 measurements of the carrier frequency of the unmodulated signal $f_c^{(1)}$ made under extreme test conditions (subclauses 5.11 and 5.12) during the interval S_1 (figure 4) during 18 successive transmissions as follows:

$$f_o = f^{(1)} = \frac{1}{18} \sum_{j=1}^{18} f_{c_j}^{(1)}$$



The S_1 pulse starts 12 ms after the beginning of the unmodulated carrier.

The S_2 pulse starts with bit 23.

The S_3 pulse starts 15 ms after the end of S_2 .

Figure 5: Measurement intervals

7.2.3 Limit

The characteristic frequency shall be between 406,023 MHz and 406,027 MHz.

7.3 Short term frequency stability

7.3.1 Definition

The short term frequency stability is the stability during a predetermined number of transmissions.

7.3.2 Method of measurement

The short term frequency stability is derived from measurements of $f_i^{(2)}$ and $f_i^{(3)}$ made under extreme test conditions (subclauses 5.11 and 5.12) during the intervals S_2 and S_3 (figure 5) during 18 successive transmissions as follows:

$$\sigma_{100ms} = \sqrt{\frac{1}{36} \sum_{i=1}^{18} \left(\frac{f_i^{(2)} - f_i^{(3)}}{f_i^{(2)}} \right)^2}$$

NOTE: The above relationship corresponds to the Allan variance. The measurement conditions used here are different (i.e. dead time between two measurements). Experience, however, has shown that the results obtained are very close to those achieved under the normal measurement conditions for the Allan variance.

To correctly measure the short term frequency stability it is essential that an equal number of positive and negative phase transitions are included in the gating intervals defined as S_2 and S_3 in figure 5, hence these intervals are only approximately 100 ms duration.

7.3.3 Limit

The short term frequency stability shall be better than 2×10^{-9} .

7.4 Medium term frequency stability

7.4.1 Definition

The medium term frequency stability shall be defined by the mean slope of the frequency versus time over a pre-defined period and by the residual frequency variation about the mean slope.

7.4.2 Method of measurement

The medium term frequency stability is derived from measurements of $f_i^{(2)}$ made under extreme test conditions (subclauses 5.11 and 5.12) over successive transmissions at instants t_i for a period of 15 minutes (figure 6).

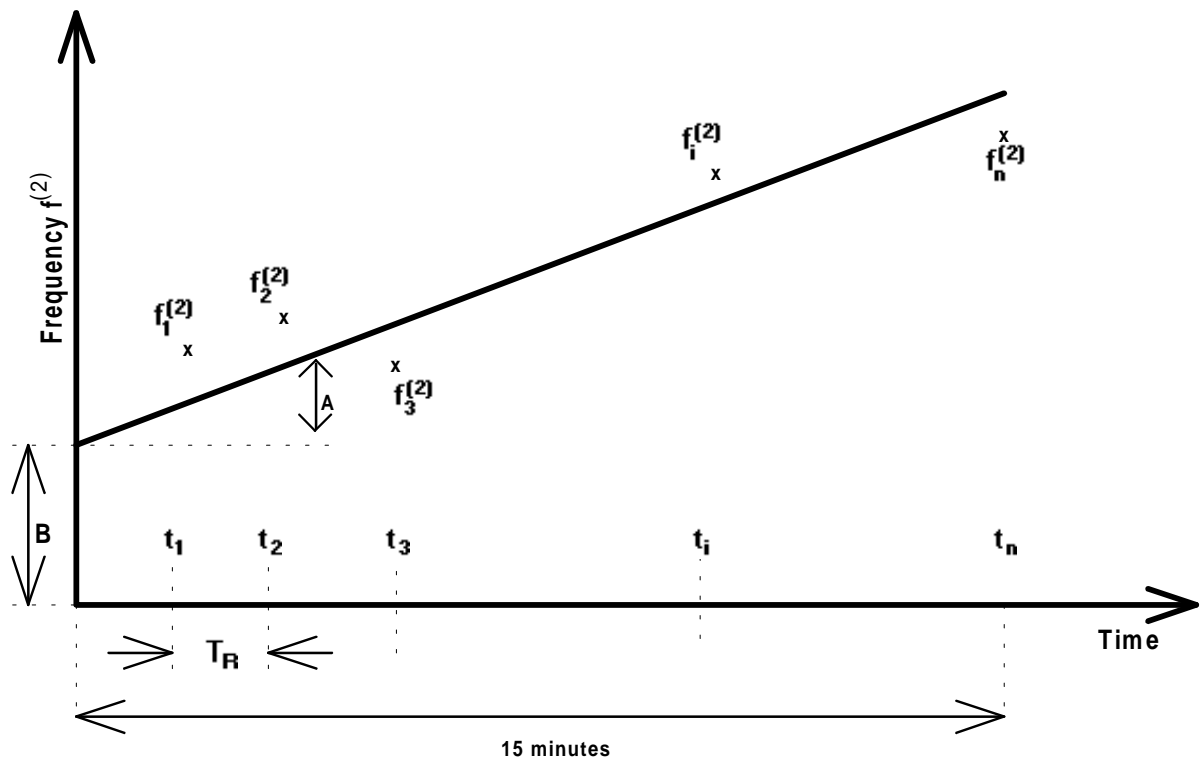


Figure 6: Medium-term frequency stability measurement

For a set of (n) measurements, the medium term frequency stability is defined by the mean slope of the least-squares straight line and the residual frequency variation about that line.

The mean slope is given by:

$$A = \frac{n \sum_{i=1}^n t_i f_i - \sum_{i=1}^n f_i \cdot \sum_{i=1}^n t_i}{n \sum_{i=1}^n t_i^2 - \left(\sum_{i=1}^n t_i \right)^2}$$

The ordinate at the origin of the least-squares straight line is given by:

$$B = \frac{n \sum_{i=1}^n f_i \cdot \sum_{i=1}^n t_i^2 - \sum_{i=1}^n t_i \cdot \sum_{i=1}^n t_i f_i}{n \sum_{i=1}^n t_i^2 - \left(\sum_{i=1}^n t_i \right)^2}$$

The residual frequency variation is given by:

$$\sigma = \sqrt{\frac{1}{n} \sum_{i=1}^n (f_i - At_i - B)^2}$$

With a transmission repetition period of 50 s, there will be 18 measurements during the 15 minute period (i.e. n=18).

7.4.3 Limits

The mean slope shall not exceed 1×10^{-9} .

Residual frequency variation shall not exceed 3×10^{-9} .

7.5 Temperature gradient

7.5.1 Definition

The immunity against the effects of temperature gradient is the ability of the satellite EPIRB to maintain the specified electrical performance when the following test is carried out.

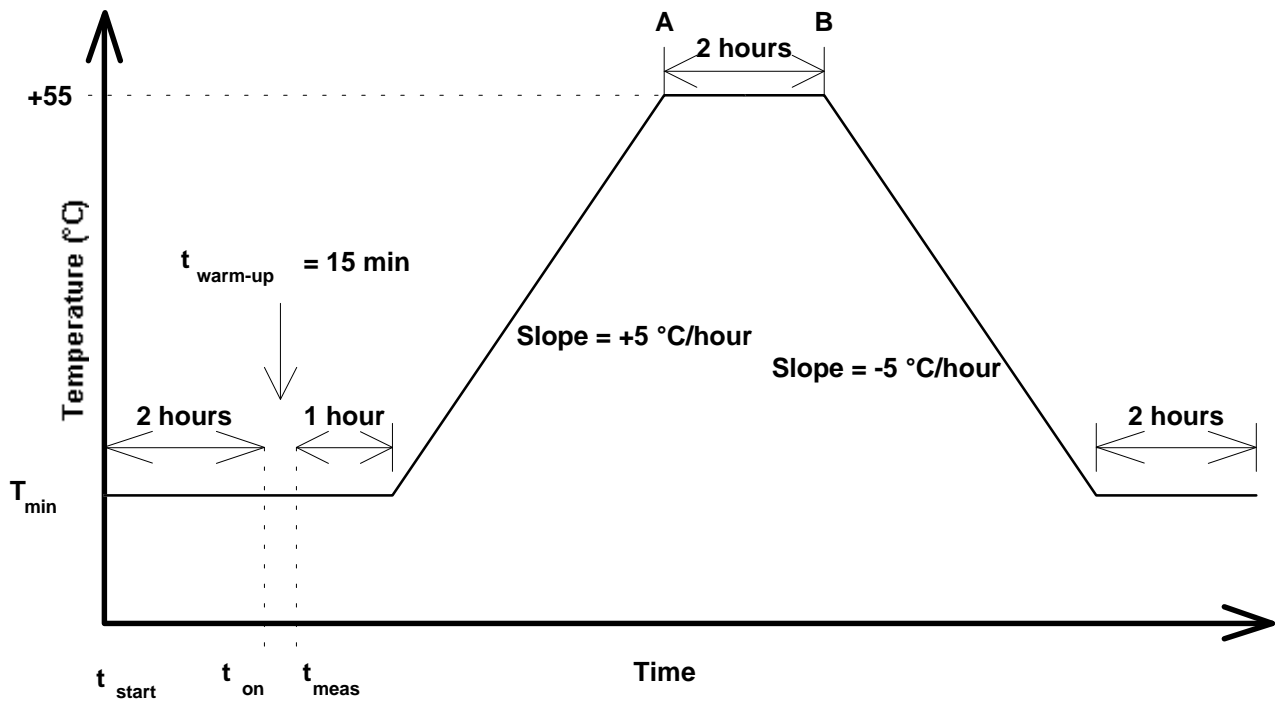
7.5.2 Method of measurement

The satellite EPIRB, while turned off, is allowed to stabilise for 2 hours at the minimum specified operating temperature. It is then turned on and subjected to temperature gradient specified in figure 7 below, during which time the following tests are performed continually on each burst:

- characteristic frequency (subclause 7.2), short term frequency stability (subclause 7.3) and medium term frequency stability (subclause 7.4);
- transmitter output power (subclause 7.1);
- digital message (clause 8).

The 18-sample analysis window of the stability calculations is advanced in time through the period such that each succeeding data set includes the latest frequency sample and drops the earliest one.

When a battery replacement is required, two separate tests are performed. The up-ramp test is from t_{start} to point B (figure 7) and the down-ramp test is from point A to t_{stop} . Before point A of the down-ramp, the satellite EPIRB under test, while turned off, is to stabilise for 2 hours at + 55 °C and is then turned on and allowed a 15 minute warm-up period.



- T_{min} = -40 °C (Class 1 satellite EPIRB)
- T_{min} = -20 °C (Class 2 satellite EPIRB)
- t_{on} = satellite EPIRB turn on after 2 hours "cold soak"
- t_{meas} = start time of frequency stability ($t_{on} + 15$ minutes)

Figure 7 :Temperature gradient

7.5.3 Limits

The requirements of subclauses 7.2 (characteristic frequency), 7.3 (short term frequency stability), 7.4 (medium term frequency stability), 7.1 (output power) and clause 9 (satellite EPIRB coding) shall be met.

7.6 RF spectrum mask

7.6.1 Definition

The RF spectrum mask is defined as the output power, relative to the maximum power in the frequency band 406,0 - 406,1 MHz .

7.6.2 Method of measurement

The equipment is connected to a spectrum analyser.

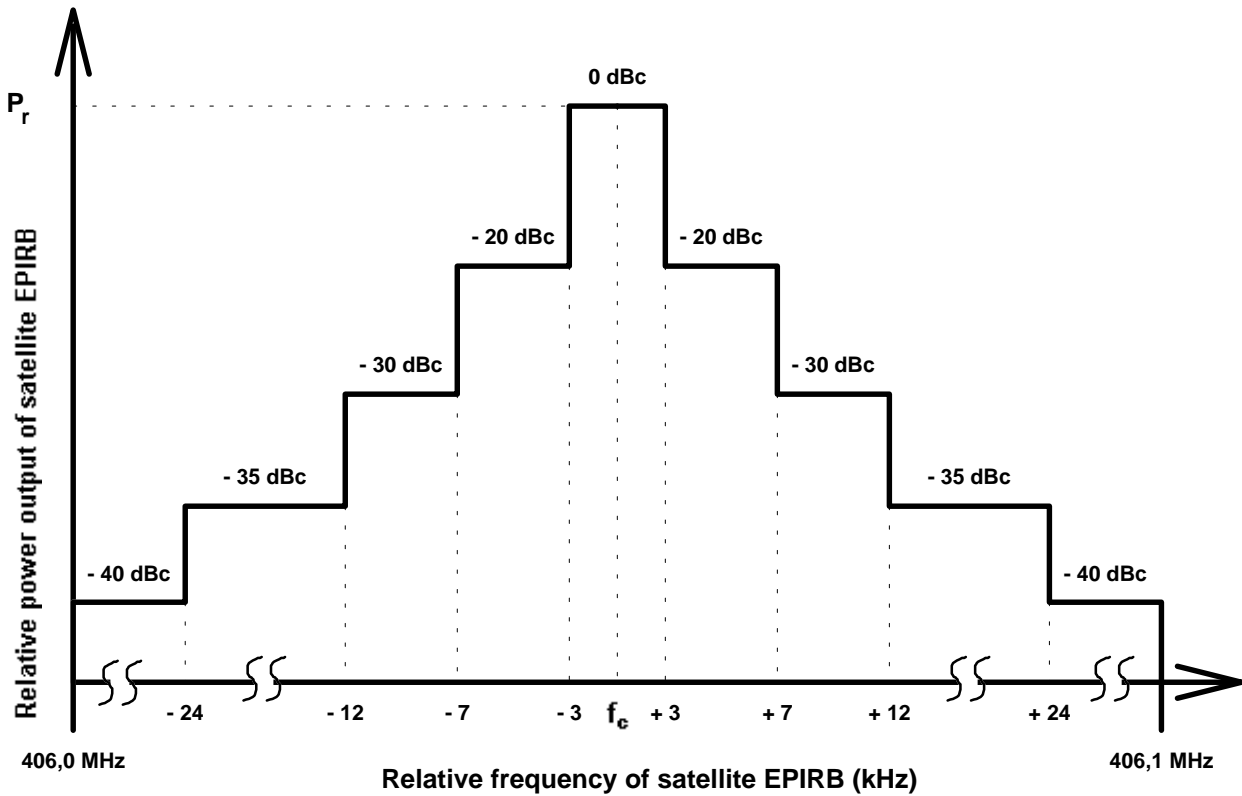
The satellite EPIRB transmits a modulated signal on the frequency f_c . The transmission is checked under extreme test conditions (subclauses 5.11 and 5.12) .

The input impedance of the spectrum analyser shall be 50 Ω . The centre frequency of the spectrum analyser display system shall be the satellite EPIRB carrier frequency. The value of the resolution bandwidth of the spectrum analyser shall be 100 Hz.

The figure displayed on the screen shall be recorded.

7.6.3 Limit

The radiation shall not exceed the levels specified by the spectrum mask in figure 8.



- P_r = Satellite EPIRB unmodulated carrier power output
- f_c = Satellite EPIRB carrier frequency
- dBc = Satellite EPIRB emitted signal power level in dB relative to P_r
(measured in a 100 Hz resolution bandwidth)

Figure 8: Spectrum mask for 406,0 to 406,1 MHz band

7.7 Phase deviation and data encoding

7.7.1 Definition

Phase deviation is the difference between the instantaneous phase of the modulated radio-frequency and the phase of the unmodulated carrier.

7.7.2 Method of measurement

The modulated RF signal shall be applied to the input of a linear demodulator and a decoder.

The extreme values of the phase, ϕ_1 and ϕ_2 in figure 9, are measured under extreme test conditions (subclauses 5.11 and 5.12) not taking into account transients.

7.7.3 Limits

The carrier shall be phase modulated (G1B) positive and negative $1,1 \pm 0,1$ radians peak, referenced to an unmodulated carrier. Modulation sense shall be as shown in figure 9.

The data shall be encoded biphasic L as shown in figure 9.

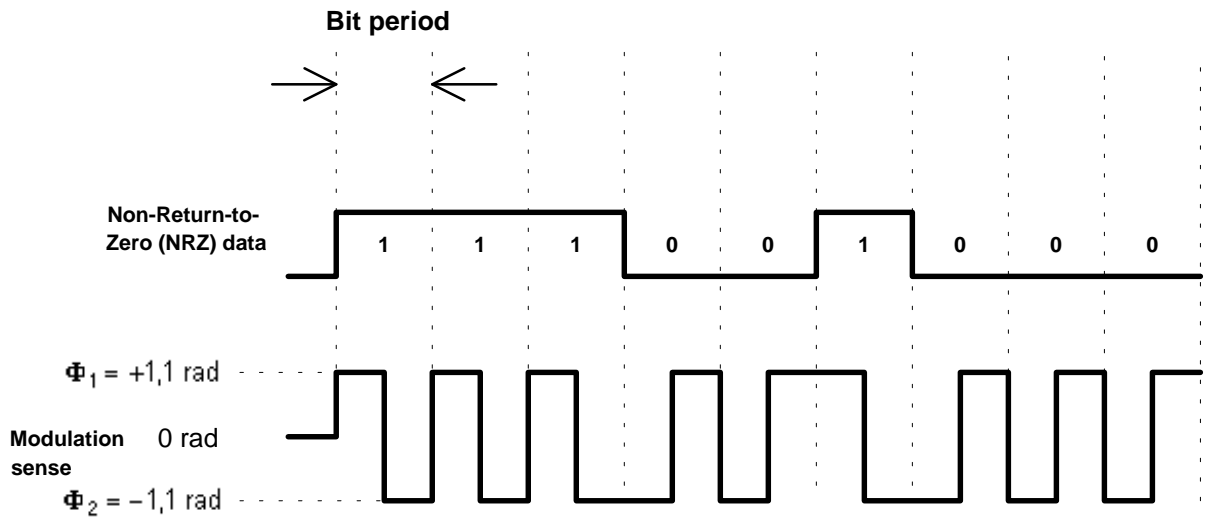


Figure 9: Data encoding and modulation sense

7.8 Rise and fall times

7.8.1 Definition

The rise time (T_R) and the fall time (T_F) of the modulated waveform is the time measured between the 0,9 points of the peak-to-peak phase transition (figure 10).

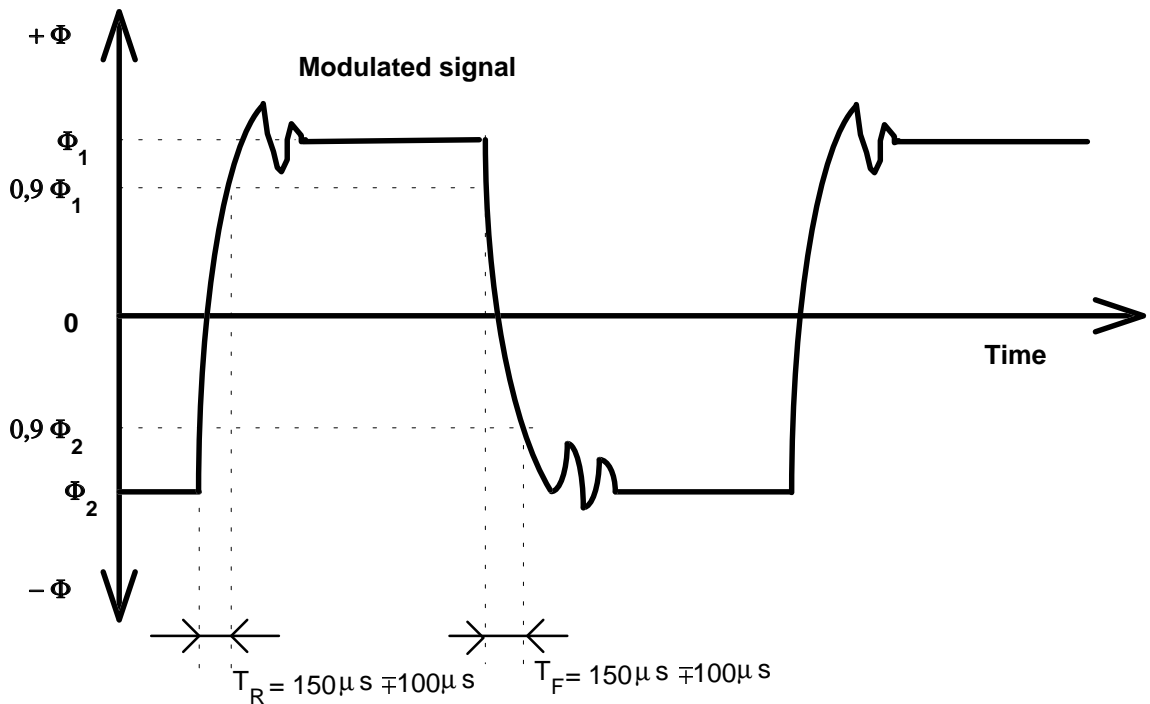


Figure 10: Modulation rise and fall times

7.8.2 Method of measurement

The modulated RF signal shall be applied to the input of a linear demodulator. The rise time (T_R) and the fall time (T_F) shall be measured under extreme test conditions (subclauses 5.11 and 5.12) and recorded.

7.8.3 Limits

The rise (T_R) and fall (T_F) times of the modulated waveform shall be $150 \mu\text{s} \pm 100 \mu\text{s}$.

7.9 Modulation symmetry

7.9.1 Definition

The modulation symmetry is difference between the time durations T_1 and T_2 as defined in figure 11.

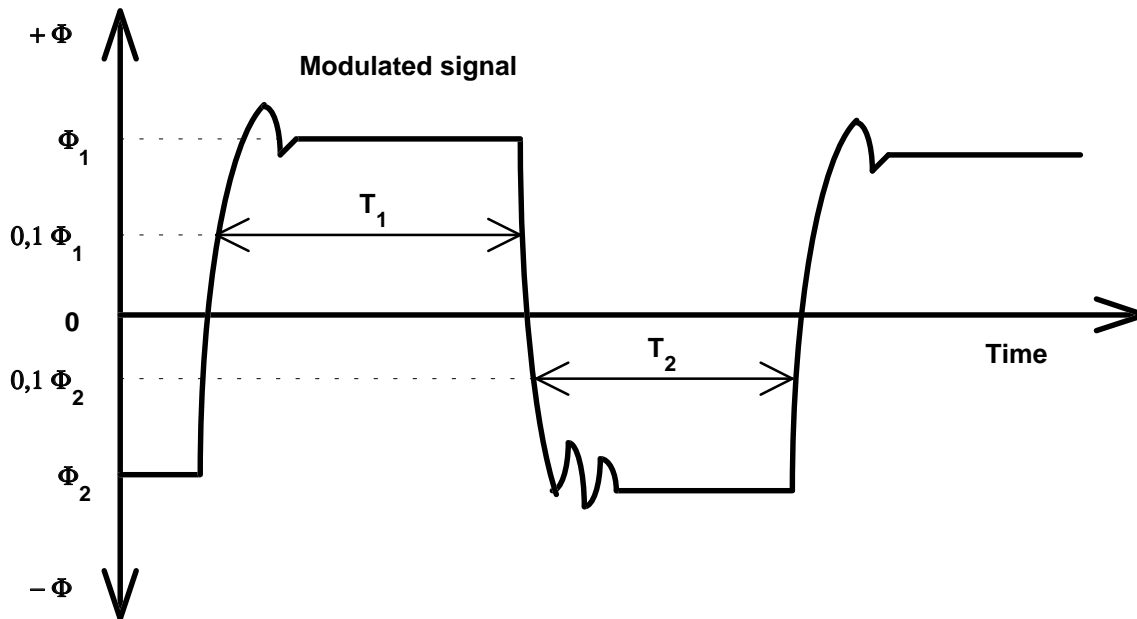


Figure 11: Modulation symmetry

7.9.2 Method of measurement

The modulated RF signal shall be applied to the input of a linear demodulator.

The duration's T_1 and T_2 shall be measured under extreme test conditions (subclauses 5.11 and 5.12) and recorded.

7.9.3 Limit

The modulation symmetry shall be such that: $\frac{|T_1 - T_2|}{T_1 + T_2} \leq 0,05$.

8 Signal format

8.1 General

The emission of the satellite EPIRB is modulated by a digitally coded signal including a preamble, a message, and an error correcting code. The format shall be as defined in this clause.

NOTE: The measurements in clause 8 may be performed on the same set of 18 bursts.

8.2 Repetition period

8.2.1 Definition

The repetition period (T_R) is the time between the 90 % ($0,9 P_N$) power points of two successive transmissions, (figure 12).

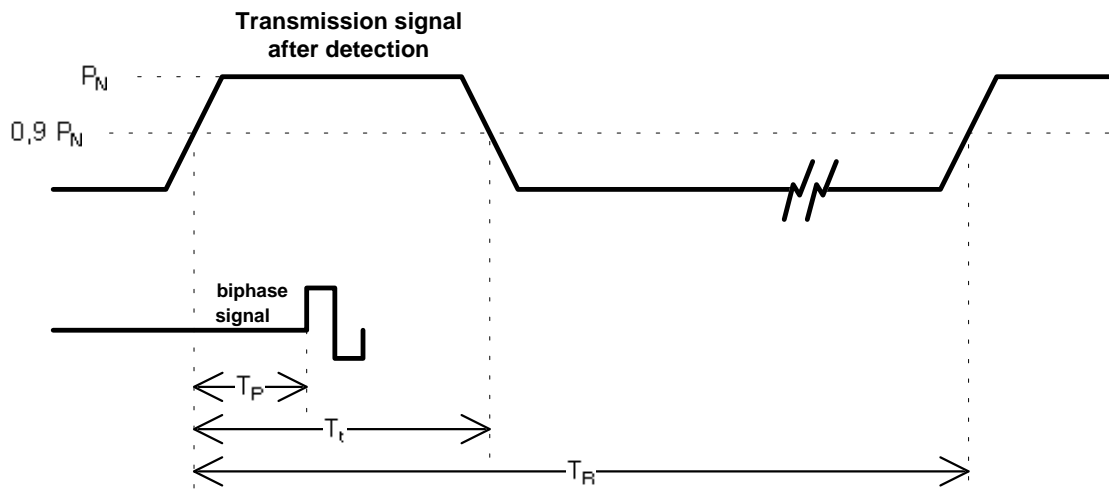


Figure 12: Transmission timing

8.2.2 Method of measurement

The repetition period is measured on 18 successive transmissions. The measurements shall be made under extreme test conditions (subclauses 5.11 and 5.12) and the difference between the maximum and minimum repetition periods shall be more than 1 s. The maximum and minimum values of T_R shall be recorded.

8.2.3 Limit

The values of T_R shall be in the range 47,5 s to 52,5 s.

If the satellite EPIRB has a fixed repetition period, it shall be in the range of 47,5 s to 52,5 s and the satellite EPIRB manufacturer shall provide the test facility with a technical explanation of how the repetition period will be varied to give at least 8 different values in different production runs of satellite EPIRB.

8.3 Total transmission time

8.3.1 Definition

The total transmission time is the time during which power is present on the characteristic frequency during one transmission.

8.3.2 Method of measurement

The total transmission time (T_t) shall be measured under extreme test conditions (subclauses 5.11 and 5.12) between the points where the output carrier power reaches 90% of its end value (figure 12).

8.3.3 Limits

Each of the 18 measurements shall lie within the following range:

- short message 435,6 ms to 444,4 ms;
- long message (optional) 514,8 ms to 525,2 ms.

8.4 Carrier Wave (CW) preamble

8.4.1 Definition

The CW preamble is the unmodulated carrier with a defined duration which precedes each digital message.

8.4.2 Method of measurement

The duration of the CW preamble (T_p) shall be measured under extreme test conditions (subclauses 5.11 and 5.12) between the point where the output carrier power reaches 90% of its end value and the beginning of the digital message (figure 12). This measurement shall be performed at 18 successive transmissions.

8.4.3 Limit

Each of the 18 measurements shall lie within the range 158,4 ms to 161,6 ms.

8.5 Bit rate

8.5.1 Definition

The bit rate is the number of bits/s.

8.5.2 Method of measurement

The bit rate (f_b) is measured under extreme test conditions (subclauses 5.11 and 5.12) over the first 15 bits corresponding to one transmission. This measurement shall be performed at 18 successive transmissions and the bit rate shall be recorded.

8.5.3 Limit

Each of the 18 measurements shall lie within the range 396 bit/s to 404 bit/s.

9 Satellite EPIRB coding

9.1 General

These checks are performed under extreme test conditions (subclauses 5.11 and 5.12).

The content of the digital message defined in this clause shall be checked against the one provided by the manufacturer. The compliance with the format for each data field shall be checked bit by bit. The correctness of the error-correcting code shall also be checked. A sample calculation of Bose-Chaudhuri-Hocquenghem (BCH) error-correcting code is shown in annex B.

The digital message which is transmitted by the satellite EPIRB consists of:

- a) 112 bits for the short message (280 ms \pm 1%);
- b) 144 bits for the long message (360 ms \pm 1%).

These bits are divided into four groups:

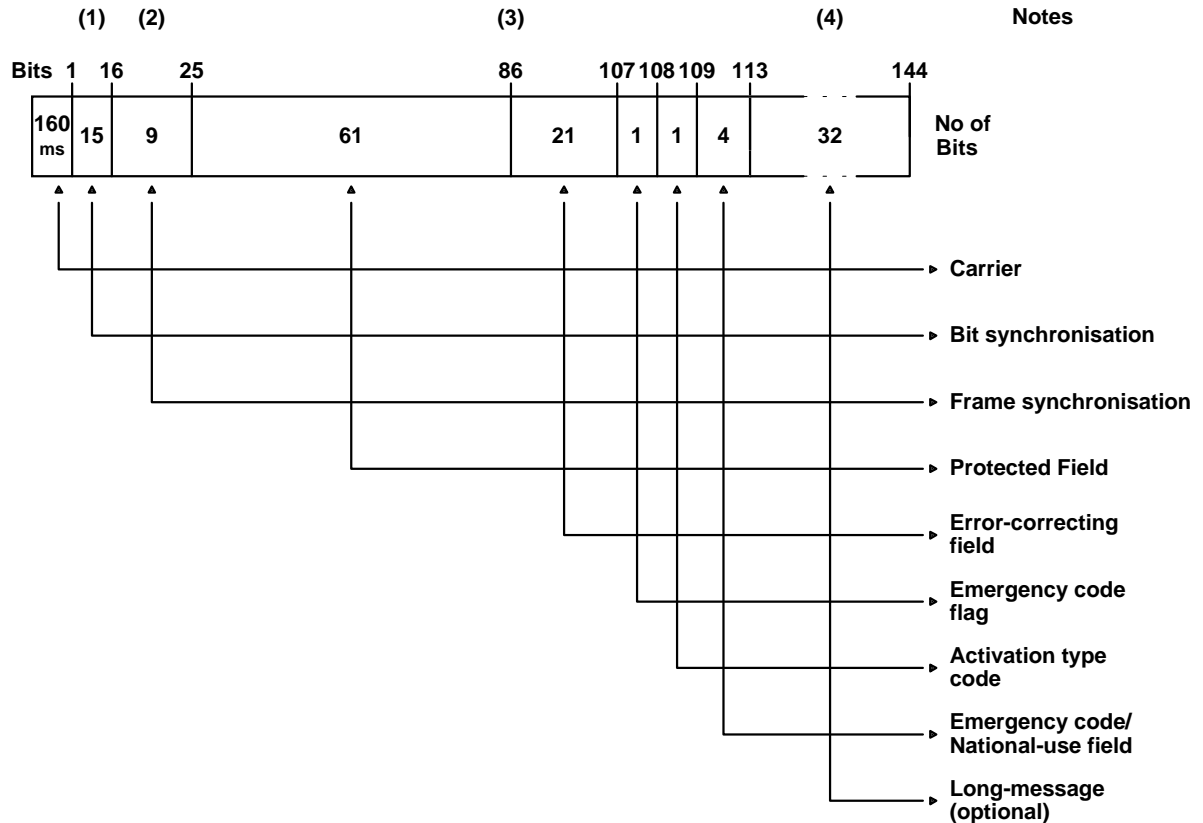
- the first 24 bits transmitted, positions 1 through 24, are system bits and used for the bit and frame synchronisation of the receiving system processor;
- the following 61 bits, positions 25 through 85, are data bits. The first data bit (position 25) indicates if the message is short or long;
- the following 21 bits, positions 86 through 106, are a Bose-Chaudhuri-Hocquenghem (BCH) (82,61) error-correction code calculated for the preceding 61 data bits;
- the last 6 bits (short message) of the message in positions 107 through 112 or the last 38 bits (long message) of the message in positions 107 through 144 are data bits.

The digital message shown in figure 13 is divided into the bit fields shown in table 4:

Table 4: Digital message fields

No.	Bit Field Name	Bit Field Location
1)	Bit synchronisation	bit 1 to bit 15;
2)	Frame synchronisation	bit 16 to bit 24;
3)	Protected field	bit 25 to bit 85;
4)	Error-correcting field	bit 86 to bit 106;
5)	Emergency code field	bit 107 to bit 112;
6)	Long message (optional)	bit 113 to bit 144.

The protected field, the emergency code field, and the long message field are shown in figure 13. Figure 15 summarises all the coding options for the entire message.



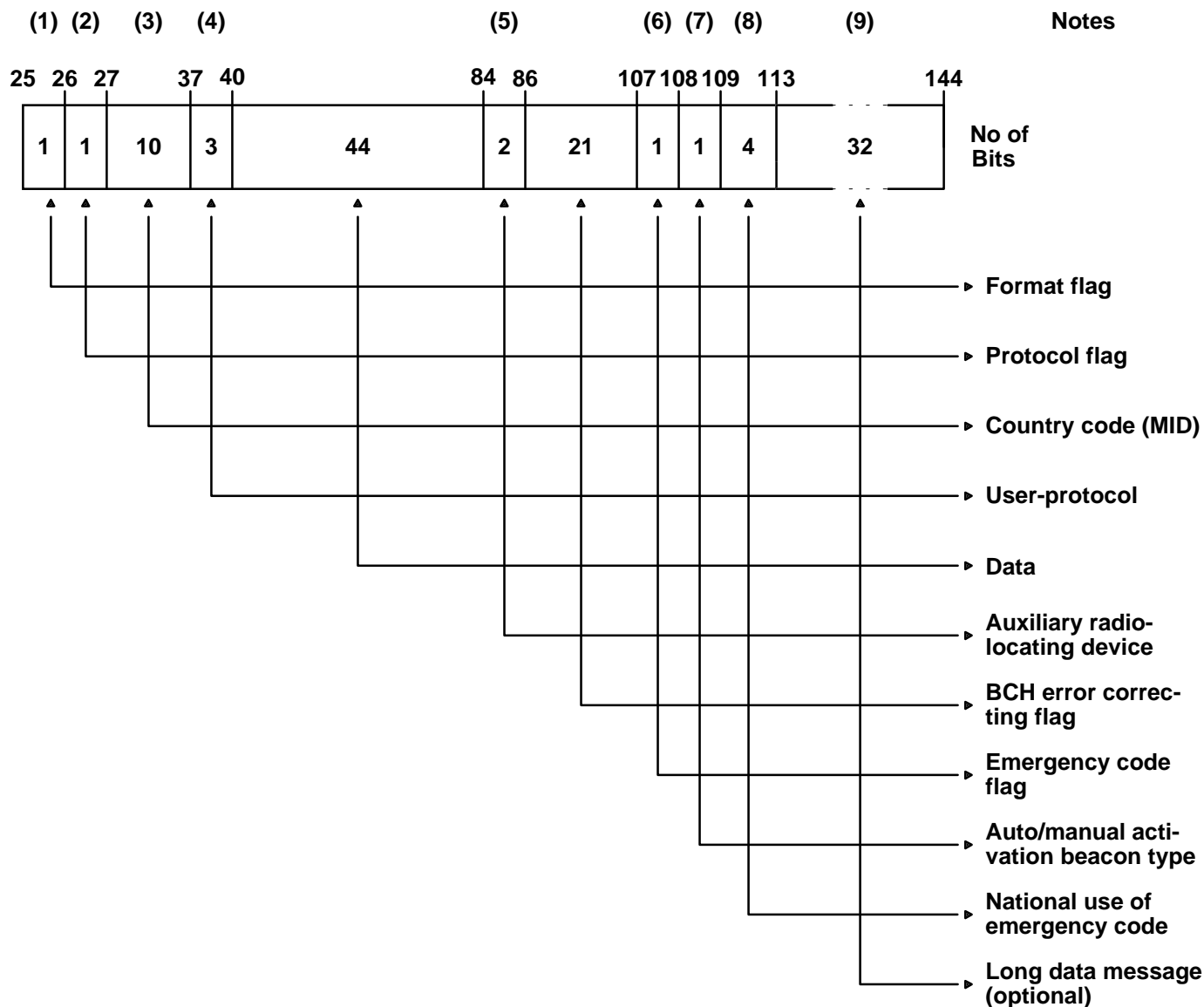
NOTE 1: Bit synchronisation - 15 "1" bits in all satellite EPIRBs.

NOTE 2: Frame synchronisation (for all satellite EPIRBs)-0 0010 1111 in normal operation-0 1101 0000 during on-air self test.

NOTE 3: Bits 25 through 112 from the basic satellite EPIRB codes information.

NOTE 4: Bits 113 through 144 contain supplementary information for the optional long message.

Figure 13: General message format



NOTE 1: "0" for short message and "1" for long message.

NOTE 2: Set to "1" for this format.

NOTE 3: Binary equivalent of the appropriate three digit decimal number (MSB on left), subclause 12.2.2.

NOTE 4: Specific user protocol: maritime, serialised radio call-sign or test

NOTE 5: Specifies which auxiliary radio-locating device is incorporated in the satellite EPIRB.

NOTE 6: "0" for national use or undesignated and "1" for emergency code use.

NOTE 7: "0" for manual activation only and "1" for automatic and manual type satellite EPIRB.

NOTE 8: Four user-suitable bits for national use or for emergency codes as in table 5.

NOTE 9: Optional data giving latitude and longitude of satellite EPIRB in degrees and minutes.

Figure 14: Unique data in the user protocols

b 25:	message format flag (0 = short message, 1 = long message)	
b 26:	protocol flag (1 = user protocol)	
b 27 - b 36: Maritime Identification Digits (MID), Appendix 43 of the ITU Radio Regulations [1]		
	User Protocol (b 26 =1)	
	b 37 - b 39: user protocol type: 010 = Maritime 110 = radio call sign 111 = test	
	Maritime user (b 37 - b39 = 010)	
	b 40 - b 75:	SID or radio call sign (modified Baudot)
	b 76 - b 81:	specific satellite EPIRB (modified Baudot)
	b 82 - b 83:	00 - spare
	b 84 - b 85: auxiliary radio-locating device type(s) (Note); 00 = no auxiliary radio-locating device; 01 = 121,5 MHz (Note); 10 = maritime locating: 9 GHz search and rescue radar transponder; 11 = maritime locating: other auxiliary radio-locating device(s)	
b 86 - b 106: error-correcting code for b 25 - b 85		
b 107:	emergency code use of b 100 - b 112	0 = national use undefined 1 = emergency code-flag
b 108:	0 = manual activation only type of satellite EPIRB; 1 = automatic and manual activation type of satellite EPIRB	
b 109 - 112: nature of distress		
	0000 = unspecified distress	
	0001= fire/explosion	
	0010= flooding	
	0011= collision	
	0100= grounding	
	0101= listing, in danger of capsizing	
	0110= sinking	
	0111= disabled and adrift	
	1000= abandoning ship	
	b 113 - b 144: Optional Long Message for User Protocols	
	b 113 - b114:	00 = latitude/longitude flag; 001,10,11 = spares
	b 115 - b 121:	latitude degrees
	b 122 - b127:	latitude minutes
	b 128:	0 = north, 1 = south
	b 129 - b 136:	longitude degrees
	b 137 - b 142:	longitude minutes
	b 143:	0 = east, 1= west
	b 144:	even parity bit applied to b 113 - b143
NOTE	(relating to "b84-b85" above) If other auxiliary radio-locating device(s) is (are) used in addition to 121,5 MHz , the code for 121,5 MHz (= 01) should be used.	

Figure 15: Summary of Coding Options

9.2 System bit fields

9.2.1 Bit synchronisation

A bit synchronisation pattern consisting of "1's" shall occupy the first 15-bit positions.

9.2.2 Frame synchronisation

A frame synchronisation pattern consisting of 9 bits shall occupy bit positions 16 through 24. The normal frame synchronisation pattern shall be 000101111. In the self-test mode, the frame synchronisation pattern shall be 011010000 (i.e. the last 8 bits are complemented).

9.3 Protected field

9.3.1 General

The protected field consists of 61 bits (i.e. bit 25 to bit 85). The protected field has the structure as given in table 5.

The identification (ID) field which begins at bit 26 after the format flag and ends at bit 85 has the structure as given in table 5 following :

Table 5: Protected field

Bits	Usage
25	format flag
26	protocol flag
27 - 36	MID code
37 - 85	data field

9.3.2 Format flag

The first bit (i.e. bit 25) is a format flag which shows whether the message is short or long using the following code:

0 - short format 1 - long format.

9.3.3 Protocol flag

Bit 26 in the ID field is used to identify the Maritime user protocol (bit 26 = 1).

9.3.4 MID number

Bits 27 to 36 in the ID field designate the 3-digit decimal MID number expressed in a binary notation. These numbers are based on the Maritime Identification Digits (MID), assigned by the ITU from Appendix 43 of the Radio Regulations [1].

Until 1 February 1999, this identification code shall include 3 digit code for the country of registration followed by either:

- a) the trailing 6 digits of the ship station identity in accordance with appendix 43 of ITU Radio Regulation [1]; or
- b) a unique serial number; or
- c) a radio call sign.

Preference is given to method a). After 1 February 1999, all new satellite EPIRB installations shall be in accordance with method a).

NOTE: The code assignment method is to be reviewed prior to 1 February 1995.

9.3.5 Maritime user protocol

The maritime user protocol has the structure as given in table 6.

Table 6: Maritime user protocol

Bits	Usage
26	protocol flag (=1)
27 - 36	MID numbers
37 - 39	user protocol type (=010)
40 - 75	trailing 6 digits of ship station identity
76 - 81	specific satellite EPIRB
82 - 83	spare (=00)
84 - 85	auxiliary radio-locating device

Bits 27- 36 designate the country of vessel registration.

Bits 40 to 75 designate the radio call sign or the trailing six digits of the 9-digit ship station identity using the modified Baudot code shown in table 7. This code enables six characters (6 x 6 = 36) to be encoded using 36 bits. This data will be right justified with a modified Baudot space (100100) being used where no character exists. If all characters are digits, the entry is interpreted as the trailing six digits of the ship station identity.

Bits 76 to 81 are used to identify specific satellite EPIRBs on the same vessel (the first or only float-free satellite EPIRB should be coded with a modified Baudot zero (001101); additional satellite EPIRBs should be numbered consecutively using modified Baudot characters 1 to 9 and A to Z).

Table 7: Modified baudot code

Letter	Code		Figure	Code	
	MSB	LSB		MSB	LSB
A	111000		(-) (Note 1)	001000	
B	110011				
C	101110				
D	110010				
E	110000				
F	110110				
G	101011				
H	100101				
I	101100	8		001100	
J	111010				
K	111110				
L	101001				
M	100111				
N	100110				
O	100011	9	000011		
P	101101	0	001101		
Q	111101	1	011101		
R	101010	4	001010		
S	110100				
T	100001	5	000001		
U	111100	7	011100		
V	101111				
W	111001	2	011001		
X	110111	/	010111		
Y	110101	6	010101		
Z	110001				
() (Note 2)	100100				
NOTE 1:	Hyphen.				
NOTE 2:	Space.				

9.3.6 Test user protocol

All satellite EPIRBs submitted for conformance testing shall be coded with the test user protocol and the remainder of the message shall be coded according to the code provided by the designated national authority.

The test user protocol has the structure as shown in table 8.

Table 8: Test user protocol

Bits	Usage
26	protocol flag (=1)
27- 36	country code (designate the country of satellite EPIRB registration)
37- 39	user protocol type (=111)
40- 83	national use
84- 85	auxiliary radio-locating device type(s)

9.4 Error-correcting field

The error-correcting field consists of 21 bits (i.e. bit 86 through bit 106), which are a Bose-Chaudhuri-Hocquenghem (BCH) (82,61) error-correction code calculated for the preceding 61 data bits. This code is a shortened form of a BCH (127,106) triple error-correcting code obtained from the following generator polynomial:

$$g_5(x) = g_3(x) \cdot (7,4,3,2,0)$$

$$g_3(x) = g_1(x) \cdot (7,3,2,1,0)$$

$$g_1(x) = (7,3,0)$$

Since the message sent will be only 61 bits (i.e. less than the 106 bits), it is assumed that the remaining bits will be set to zero for computation of the error-correction bits. These zero message bits will be thought to be at the beginning of the message and will not be transmitted since they are always zero and contribute no new information.

9.5 Emergency code field

The emergency code field consists of bits 107 to 112. Bit 107 shall be "1" for the emergency code. Bit 108 shall be "1" to indicate that the satellite EPIRB can be activated both manually and automatically.

When used, bits 109 to 112 shall be coded with the International Maritime Organisation (IMO) maritime emergency codes (table 9) for all maritime distresses (i.e. maritime user protocol).

When the emergency code is not implemented, bit 107 shall be set to "0", and bits 109 to 112 shall all be set to "0".

Table 9: Modified IMO maritime emergency codes

Code	Definition
0000	unspecified distress (Note 2)
0001	fire/explosion
0010	flooding
0011	collision
0100	grounding
0101	listing, in danger of capsizing
0110	sinking
0111	disabled and adrift
1000	abandoning ship
1001	undesignated
1010	undesignated
1011	undesignated
1100	undesignated
1101	undesignated
1110	undesignated
1111	undesignated
NOTE 1:	Modification applies only to code "1111" which is used as a "spare" instead of as the "test" code.
NOTE 2:	If no emergency code data has been entered, bit 107 remains set to "0".

9.6 Long message (optional)

The optional long message format permits the inclusion of an additional 32 bits of information in bit positions 113 through 144 of the data message.

Bits 113- 114 define the 32 bit message encoding as follows:

Table 10: Long message encoding

00	latitude/longitude flag;
01	spare;
10	spare;
11	spare.

For the latitude/longitude message, bits 115 through 144 are decoded as given in table 11 following:

Table 11: Long message

Bits	Usage
115-121	degrees latitude
122-127	minutes latitude
128	0 = north; 1 = south
129-136	degrees longitude
137-142	minutes longitude
143	0 = east; 1 = west
144	even parity bit applied to bits 113-143

The message format flag (bit 25) should normally be set to = 0 and a short message be transmitted, however it should switch automatically to = 1 when data is entered in bits 113 to 144 for the long message transmission. This will require two separate BCH codes: one for use with message format flag = 0 (short message format), and one for use with message format flag = 1 (long message format).

10 Other technical requirements

10.1 Effective luminous intensity of the low duty cycle light

10.1.1 Definition

The effective luminous intensity is a calculated value, which is defined by a formula as indicated in IMO Resolution A.689(17) [8].

10.1.2 Method of measurement

The luminous intensity shall be measured under normal and extreme test conditions.

The effective luminous intensity shall be then calculated by the following formula:

$$I_{eff|cd} = \frac{\int_{t_1}^{t_2} I(t) dt}{0,2 + (t_2 - t_1)}$$

where:

- I_{eff} is the effective intensity (candela);
- $I(t)$ is the instantaneous intensity as a function of time;
- $(t_2 - t_1)$ is the flash duration (seconds).

10.1.3 Limit

The effective luminous intensity shall be at least 0,75 cd. The flashing rate shall be at least 20 times per minute, with a flash duration of between 10^{-6} s and 1 s.

The low duty cycle light shall be visible over at least 75 % of the horizontal plane, but may have a cone, whose angle of elevation is not greater than 30° , of lower effective luminous intensity in the vertical direction.

10.2 Battery capacity

10.2.1 Definition

Battery capacity is the ability of the internal power source of the equipment to deliver sufficient power for an uninterrupted operation of the equipment in a specified time period.

10.2.2 Method of measurement

Using a fresh battery pack, the satellite EPIRB shall be activated (at the ambient temperature) for a period of time as stated by the manufacturer to be equivalent to the loss of battery capacity due to self-testing as well as battery pack self-discharge during the useful life of the battery pack (as defined in clause 4.1.3.). The manufacturer shall substantiate the method used to determine this time.

The satellite EPIRB shall be placed in a chamber of normal room temperature. Then the temperature shall be reduced to and maintained at $-40\text{ }^\circ\text{C}$ ($\pm 3\text{ }^\circ\text{C}$) for class 1 or $-30\text{ }^\circ\text{C}$ ($\pm 3\text{ }^\circ\text{C}$) for class 2 equipment for a period of 10 hours.

Any climatic control device provided in the equipment may be switched on and for class 2 equipment the chamber heated to $-20\text{ }^\circ\text{C}$ ($\pm 3\text{ }^\circ\text{C}$), at the conclusion of the period specified above. The action of the climatic control device and for class 2 equipment, the heating of the chamber, shall be complete within 20 minutes.

The equipment shall be activated 30 minutes after this period and shall then be kept working continuously for a period of 48 hours. The temperature of the chamber shall be maintained for the whole of the 48 hour period.

This test may be combined with the relevant environmental tests of the COSPAS-SARSAT specification (clause 4.2 of C/S T.001 [10] and clause A.2.3 of C/S T.007 [11])

10.2.3 Limit

The satellite EPIRB shall comply with the requirements of the subclauses 7.1 (output power) 7.2 (characteristic frequency), 7.3 (short term frequency stability), 7.4 (medium term frequency stability) and 9 (satellite EPIRB coding) for 48 hours.

10.3 Homing device

10.3.1 General

10.3.1.1 Class of emission

The radio frequency transmission shall be amplitude modulated with full carrier and both sidebands (A3X).

10.3.1.2 Modulation frequency

An audio signal shall sweep downward within a range of not less than 700 Hz between 1 600 Hz and 300 Hz.

10.3.1.3 Transmitter duty cycle

The transmitter shall have a continuous duty cycle except that it may be interrupted for up to a maximum of 2 s during transmission of the 406 MHz signal.

10.3.1.4 Sweep repetition rate

The sweep repetition rate of the transmitter shall be 2 Hz to 4 Hz.

10.3.2 Frequency error

10.3.2.1 Definition

The frequency error is the difference between the measured carrier frequency and its nominal value.

10.3.2.2 Method of measurement

The carrier frequency shall be measured under normal and extreme test conditions with a frequency counter or a spectrum analyzer.

10.3.2.3 Limit

The carrier frequency shall be 121,5 MHz \pm 50 ppm.

10.3.3 Modulation duty cycle

10.3.3.1 Definition

Modulation duty cycle is the ratio of the positive modulation peak duration to the period of the instantaneous fundamental audio-modulation frequency observed at the half-amplitude points on the modulation envelope using the following formula:

$$\text{Duty cycle} = \frac{T_1}{T_2} \cdot 100\%$$

where:

- T_1 is the duration of the positive half cycle of the audio modulation measured at the half amplitude points of the modulation envelope; and
- T_2 is the period of the fundamental of the audio modulation.

10.3.3.2 Method of measurement

The transmitter output shall be connected to a storage oscilloscope. T_1 and T_2 shall be measured near the start, midpoint and end of the modulation period. The modulation duty cycle shall be calculated.

10.3.3.3 Limit

The modulation duty cycle shall be between 33 % and 55 %.

10.3.4 Modulation factor

10.3.4.1 Definition

Modulation factor is defined with respect to the maximum and minimum amplitudes of the modulation envelope by the following formula:

$$\text{Modulation factor} = \frac{A + B}{A - B}$$

where :

- A is the maximum value of the envelope curve; and
- B is the minimum value of the envelope curve.

10.3.4.2 Method of measurement

The transmitter output shall be connected to a storage oscilloscope. A and B shall be measured near the start, midpoint and end of the modulation period. The modulation factor shall be calculated.

10.3.4.3 Limit

The modulation factor shall be between 0,85 and 1,0.

10.3.5 Peak effective radiated power

10.3.5.1 Definition

The peak effective radiated power is the average power during one radio frequency cycle at the crest of the modulation envelope.

10.3.5.2 Method of measurement

The measurement shall be performed at normal temperature conditions and shall use a satellite EPIRB whose battery has been on for a minimum of 44 hours. If the test exceeds 4 hours, the battery may be replaced by another which has been preconditioned with at least 44 hours of on time.

For the purpose of testing outside a screened room, care shall be taken not to transmit distress signals on distress and safety frequencies, for example by frequency offset.

The measurement procedure consists in a determination of 12 values of Peak Effective Radiated Power (PERP) made by direct measurement of radiated power.

The measurements are taken at an azimuth angle of $30^\circ \pm 3^\circ$. All PERP measurements shall be made at the same elevation angle; the elevation used shall be the angle between 5° and 20° for which the satellite EPIRB exhibits a maximum antenna gain. The median value of PERP shall be recorded.

10.3.5.3 Limit

The median value peak effective radiated power shall be between 25 mW and 100 mW. The ratio of maximum to minimum of the 11 highest values of PERP shall not exceed 6 dB.

10.3.6 Spurious emissions

10.3.6.1 Definition

Spurious emission is emission on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products, and frequency conversion products, but exclude out-of-band emissions.

10.3.6.2 Method of measurement

Spurious emissions shall be measured in the frequency bands 108 to 137 MHz, 156 to 162 MHz 406,0 to 406,1 MHz and 450 to 470 MHz at the test site described in subclause 5.6.

10.3.6.3 Limit

The power of any spurious emission component shall not exceed 25 μ W on any frequency.

11 Radiation measurements

11.1 General

The radiated power and antenna characteristics of the satellite EPIRB shall be measured in an open field test site (subclause 5.6) or a shielded anechoic room.

The radiated power procedure provides data which characterise the antenna by measuring the vertical and horizontal wave polarisation.

In order to keep the potential disturbance to the COSPAS-SARSAT system to a minimum, these antenna tests shall be conducted using a satellite EPIRB operating at its nominal repetition rate and coded with the test user protocol (subclause 9.3.6).

11.2 Radiated power

11.2.1 Definition

The radiated power is the effective isotropically radiated power (e.i.r.p.). The e.i.r.p. is the apparent power which is radiated through 360° azimuth and at elevation angles between 5° and 60° and expressed as power in Watts (W) \pm variation (dB).

11.2.2 Method of measurement

The satellite EPIRB shall be transmitting normally with a fresh battery. The signal received by the measuring antenna should be coupled to a spectrum analyser or a field strength meter and the radiated power output should be measured during the satellite EPIRB transmission. The receiver should be calibrated according to the range of level expected, as described in subclause 5.8. The satellite EPIRB should be rotated through 360° of azimuth with a minimum of twelve equal steps $30^\circ (\pm 3^\circ)$ and measurements made.

The measuring antenna should be linearly polarized and positioned twice to align with both the vertical and horizontal components of the radiated signal in order to measure the total e.i.r.p.

Measurements are then taken with the measuring antenna positioned at elevation angle ($\pm 3^\circ$) of 10° , 20° , 30° , 40° and 50° for azimuth angles ($\pm 3^\circ$) of 0° to 360° in 30° steps and the induced voltages for both polarisation are measured for each one of the 60 positions.

The values of V_h and V_v for each measured position shall be recorded.

The following steps are performed for each set of measured voltages and the results are recorded:

Step 1: Calculate the total induced voltage V_{rec} in dBV using:

$$V_{rec}(\text{dBV}) = 20\log\sqrt{V_v^2 + V_h^2}$$

where:

- V_v and V_h are the induced voltage measurements (in V) when the measuring antenna is oriented in the vertical and the horizontal plane respectively.

Step 2: Calculate the field strength E in dBV/m at the measuring antenna using:

$$E_{|(\text{dBV/m})} = V_{rec} + 20\log AF_c + L_c$$

where:

- V_{rec} is the calculated signal level from Step 1 (dBV);
- AF_c is the corrected antenna factor of the measuring antenna;
- L_c is the receiver system attenuation and cable loss (dB).

The receiver system attenuation is compensated for when performing the calibration procedure (subclause 5.8). Otherwise, it shall be calculated separately.

Step 3: Calculate the e.i.r.p.:

Calculate the e.i.r.p. for each set of angular co-ordinates from $e.i.r.p._W = \frac{E^2 \cdot R^2}{30}$

where:

- R is the distance between the satellite EPIRB and the measuring dipole antenna;
- E is the field strength converted from Step 2 into V/m.

The measurements shall be performed under normal test conditions.

11.2.3 Limits

The radiated power shall be within the limits of +6 dB and - 5 dB relative to 5 W e.i.r.p.

11.3 Antenna characteristics

11.3.1 Definition

The following antenna characteristics are defined for elevation angles greater than 5° and less than 60° .

11.3.2 Method of measurement

The antenna gain shall be calculated for each set of angular co-ordinates from:

$$G_i = \frac{\text{e.i.r.p.}}{P_t}$$

where:

- e.i.r.p. is the radiated power measured in subclause 11.2;
- P_t is the power transmitted into the satellite EPIRB antenna;
- G_i is the satellite EPIRB antenna numerical gain relative to an isotropic antenna.

An analysis of the raw data (V_v , V_h) obtained during the antenna test should be sufficient to determine if the polarisation of the satellite EPIRB antenna is linear or circular.

If the induced voltage measurements V_v and V_h for each specific angular co-ordinates (azimuth, elevation) differ by at least a factor of 10, the polarisation should be linear. The polarisation will be vertical or horizontal if V_v or V_h is greater respectively.

If the induced voltage measurements (V_v , V_h) are within 10 dB of each other for most of the surface scanned, the satellite EPIRB antenna is considered to be circularly polarized. Since the sense of the polarisation is Right Hand Circular Polarised (RHCP), determine the sense of polarisation using the following method, and report the results.

Compare the signals received using known Right Hand Circularly Polarised (RHCP) and Left Hand Circularly Polarised (LHCP) antennas when the satellite EPIRB antenna is radiating. The antenna resulting in the largest received signal determines the sense of polarisation.

11.3.3 Limits

The antenna shall have the following characteristics:

- pattern: hemispherical;
- polarisation: right hand circular polarised (RHCP) or linear;
- gain (vertical of the plane): between - 3 dBi and +4 dBi over 90% above region;
- gain variation (azimuth plan): less than 3 dB;
- antenna Voltage Standing Wave Ratio (VSWR): not greater than 1,5:1.

12 Release mechanism

12.1 General

12.1.1 Operating conditions

The release mechanism shall be constructed of non-corrosive compatible materials, so as to prevent deterioration which may cause any malfunction of the unit. Galvanising or other forms of metallic coating on parts of the release mechanism shall not be accepted.

The release mechanism shall be designed to minimise the formation of ice and prevent the effects of ice from hindering the release of the satellite EPIRB.

It shall be possible to assess the proper functioning of the automatic release mechanism by a simple method without activation of the satellite EPIRB.

The release mechanism shall be fitted with adequate means to prevent inadvertent release or activation of the satellite EPIRB.

It shall be possible to release the satellite EPIRB manually without tools.

12.1.2 Labelling

The release mechanism shall be provided with a label or labels affixed in such a position as to be visible when the mechanism is installed and containing the following information at least in English:

- type designation;
- operating instructions for manual release of the satellite EPIRB;
- compass safe distance;
- maintenance and/or replacement date for the release mechanism, if applicable.

Administrations may require additional labelling.

If this label or labels are not readily visible in the installed arrangement, they shall be provided in addition, for installation close to the float free arrangement. These instructions may in addition be shown in pictorial form.

12.1.3 Operating instructions

The equipment manufacturer shall provide all instructions and information regarding stowage, installation, and operation of the release mechanism. This shall include a description of the method to assess its proper operation.

12.2 Automatic release of the satellite EPIRB

12.2.1 Definition

Automatic release is the ability of the release mechanism to release the satellite EPIRB after having been submerged in water under specified conditions.

12.2.2 Method of measurement

The satellite EPIRB installed in the release mechanism shall be submerged in non-freezing water. The temperature of the water shall be recorded.

This shall be performed six times with the equipment rotated each time as follows:

- normal mounting position;
- rolling 90° to starboard;
- rolling 90° to port;
- pitching 90° bow down;
- pitching 90° stern down;
- upside-down position.

The test under extreme temperature test conditions (subclause 5.11) shall be performed in the normal mounting position only.

12.2.3 Requirement

The satellite EPIRB shall be automatically released and float free of the mounting before reaching a depth of 4 m at any orientation.

The release mechanism shall be capable of operating throughout the temperature range of - 30°C to + 65°C.

Annex A (normative): Requirements for non float free satellite EPIRBs

Non-float free satellite EPIRBs shall meet all requirements of this ETS but the following subclauses are superseded by:

Table A.1: Requirements for non-float-free satellite EPIRBs

Subclause	Replacement text
4.2 Operating conditions	<p>The satellite EPIRB shall be mounted in a mounting bracket.</p> <p>The satellite EPIRB shall be designed to operate when floating in the sea but shall also operate satisfactorily on a ships deck and in a survival craft. The general construction and method of operation shall provide a high degree of proof against inadvertent operation, whilst still providing a simple means of operation in an emergency.</p> <p>The satellite EPIRB shall be capable of being carried by one person and it shall be possible to release and operate the satellite EPIRB manually.</p> <p>If the satellite EPIRB is manually removed from its mounting bracket, it shall be activated only when floating in the water or manually activated (subclause 4.6).</p> <p>After activation, no distress signal shall be emitted until at least 47 seconds and at most 5 minutes after the satellite EPIRB has been activated.</p> <p>The satellite EPIRB shall be a single integral unit incorporating a primary battery and a permanently attached antenna. No part of it shall be detachable without the use of tools.</p> <p>The fixed portion of the distress message shall be stored in such a way that it will not be affected by removal of all power sources.</p> <p>Any external connection shall not inhibit the activation of the satellite EPIRB.</p>
4.6 Controls	<p>All controls shall be of sufficient size for simple and satisfactory operation and also be capable of being operated by a person wearing gloves for immersion suits in accordance with Chapter III Regulation 33 of the 1983 amendments to the 1974 SOLAS Convention [2].</p> <p>Manual activation of the satellite EPIRB, after it has been removed from the mounting bracket, shall require two simple but independent mechanical actions neither of which, on its own, shall activate the equipment. Manual activation of the satellite EPIRB shall break a seal which shall not be replaceable by the user. This seal shall not be broken when using the test facility.</p> <p>If the satellite EPIRB is installed in its mounting bracket the manual activation shall require two simple but independent mechanical actions. The means for manual activation shall be protected against inadvertent activation.</p> <p>After activation it shall be possible to manually deactivate the equipment.</p>
6.1 General	<p>Environmental tests in this clause shall be carried out before any other tests and shall be performed under normal test conditions unless otherwise stated. The satellite EPIRB shall be installed in its mounting bracket in operating conditions (subclause 4.2) but not transmitting unless otherwise stated.</p> <p>The following tests shall be conducted in the order they appear in this clause unless otherwise stated.</p>
12 Release mechanism	deleted

Annex B (informative): Sample Bose-Chaudhuri-Hocquenghem error-correcting code calculation

The error-correcting code used in the COSPAS-SARSAT system is a shortened form of a (127,106) Bose-Chaudhuri-Hocquenghem (BCH) code. The shortened form (82,61) consists of a protected message of 61 bits followed by a 21-bit triple error-correcting code. The code is used to detect and correct up to three errors in the 61-bit protected field (bits 25 through 85). For the purpose of computing the error-correcting code, the protected message is increased from 61 bits by filling with zeros. The additional bits (45 zeros) will be assumed to be at the beginning of the message.

For the (82,61) BCH code a generator polynomial, $g(X)$ is defined as follows:

$$g(X) = \text{LCM} (m_1 (X) , m_3 (X) , m_5 (X))$$

where LCM = Least Common Multiple

in the above case:

$$m_1 (X) = X^7 + X^3 + 1$$

$$m_3 (X) = X^7 + X^3 + X^2 + X + 1$$

$$m_5 (X) = X^7 + X^4 + X^3 + X^2 + 1$$

from which:

$$\begin{aligned} g(X) &= m_1 (X) m_3 (X) m_5 (X) \\ &= X^{21} + X^{18} + X^{17} + X^{15} + X^{14} + X^{12} + X^{11} + X^8 + X^7 + X^6 + X^5 + X + 1 \end{aligned}$$

a determination of $g(X)$ results in the following 22-bit binary number:

$$g(X) = 1001101101100111100011$$

To generate the BCH code, an information polynomial, $m(x)$ is formed from the 61 protected information bits as follows:

$$m(X) = b_1 X^{60} + b_2 X^{59} + \dots + b_{60} X + b_{61}$$

where b_1 is the first protected bit (i.e., format flag), and b_{61} is the last bit of the ID code.

$m(X)$ is then extended to 82 bits by filling the least significant bits with 21 "0". The resulting 82-bit binary string is then divided by $g(X)$ and the remainder, $r(X)$, becomes the BCH code (the quotient portion of the result of the modulo-2 binary division is discarded).

Annex C (informative): Bibliography

An Introduction to Error Correcting Codes, Shu Lin, Prentice-Hall 1970.

History

Document history	
November 1992	First Edition
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