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Meteorological Aids (Met Aids);
Radiosondes to be used in the 400,15 MHz to 406 MHz frequency range with power levels ranging up to 200 mW;
Part 1: Technical characteristics and test methods

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Contents

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Foreword

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

For non EU countries the present document may be used for regulatory (Type Approval) purposes.

The present document is part 1 of a multi-part deliverable covering digitally modulated Radiosonde transmitters in the Meteorological Aids frequency band from 400,15 MHz to 406 MHz, as identified below:

Part 1: "Technical characteristics and test methods";

Part 2: "Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU".

National transposition dates	
Date of adoption of this EN:	22 October 2015
Date of latest announcement of this EN (doa):	31 January 2016
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 July 2016
Date of withdrawal of any conflicting National Standard (dow):	31 July 2017

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Introduction

Meteorological aids, Radiosondes, are light weight, disposable precision measurement instruments mainly used for *in situ* upper air measurements of meteorological variables (pressure, temperature, relative humidity, wind speed and direction) in the atmosphere up to an altitude of 36 km. The measurements are vital to international weather forecasting capability (and hence severe weather warning services for the public involving protection of life and property). The Radiosonde systems provide simultaneous measurements of the vertical profile of temperature, relative humidity as well as wind speed and direction. The variation of these meteorological variables in the vertical contains the majority of the critical information for weather forecasting. These systems are the only meteorological observing systems able to regularly provide the vertical resolution that meteorologists need for all five variables.

Typically the Radiosonde observations are produced by Radiosondes measuring atmosphere for approximately 2 hours and carried by ascending balloons launched from land stations or ships. Radiosonde observations are carried out routinely by almost all countries, two to four times a day. The observation data is then circulated immediately to all other countries within a few hours via the WMO (World Meteorological Organization) Global Telecommunications System (GTS). The observing systems and data dissemination are all organized under the framework of the World Weather Watch Programme of WMO.

The observation stations are required, worldwide, at a horizontal spacing of less than or equal to 250 km, during the first decade of the twenty-first century, with a frequency of observation of from one to four times per day.

Remotely sensed measurements from satellites do not have the vertical resolution available from Radiosondes. Successful derivation of vertical temperature structure from these satellite measurements usually requires a computation initialized either directly from Radiosonde statistics or from the numerical weather forecast itself. In the latter case, the Radiosonde measurements ensure that the vertical structure in these forecasts remains accurate and stable with time. In addition, the Radiosonde measurements are used to calibrate satellite observations by a variety of techniques.

Radiosonde observations are thus seen to remain absolutely necessary for meteorological operations for the foreseeable future.

Other applications, independent of the main civilian meteorological organizations include environmental pollution, hydrology, radioactivity in the free atmosphere, significant weather phenomena (e.g. winter storms, thunderstorms, etc.) and investigation of a range of physical and chemical properties of the atmosphere.

About 150 000 Radiosondes are annually used in Europe, about 90 % of them are in 403 MHz band. This use is not decreasing with time, since with modern automation it is now much easier to successfully operate systems without highly skilled operators and a large amount of supporting equipment.

The Radiosondes use unidirectional transmission on two frequency bands: 403 MHz band covers primary and co-primary allocations from 400,15 MHz to 406 MHz and 1 680 MHz band from 1 668,4 MHz to 1 690 MHz. The 403 MHz Radiosonde technology applies GNSS (Global Navigation Satellite Systems) for wind measurement, whereas the 1 680 MHz systems may base the wind measurement on balloon tracking with a Radio Direction Finding antenna. Because the 403 MHz wind measurement depends on the availability of the GNSS signals, many operators do not consider this technology secure enough for critical applications (e.g. defence and national security), and consequently prefer 1 680 MHz systems.

National regulatory conditions may apply regarding the, channel/frequency separations, and the inclusion of an automatic transmitter shut-off feature as a condition of an individual or general license, or, as a condition of use under license exemption. The automatic transmitter shut-off facility of the Radiosonde may be based on elapsed time from the beginning of the sounding, or atmospheric pressure or height measured by the Radiosonde.

1 Scope

The present document defines the technical requirements for transmitters used in Radiosondes operating in the range from 400,15 MHz to 406 MHz and with power levels ranging up to 200 mW.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

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

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] CISPR 16-1-1: "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-1: Radio disturbance and immunity measuring apparatus - Measuring apparatus".

[2] ETSI TS 103 052 (V1.1.1) (2011-03): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Radiated measurement methods and general arrangements for test sites up to 100 GHz".

[3] ETSI EN 300 220-1 (V2.4.1) (2012-05): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Radio equipment to be used in the 25 MHz to 1 000 MHz frequency range with power levels ranging up to 500 mW; Part 1: Technical characteristics and test methods".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

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The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

Not applicable.

3 Definitions, symbols and abbreviations

3.1 Definitions

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

conducted measurements: measurements which are made using a direct 50 Ω connection to the equipment under test

dedicated antenna: removable antenna supplied and type tested with the radio equipment, designed as an indispensable part of the equipment

integral antenna: permanent fixed antenna, which may be built-in, designed as an indispensable part of the equipment

radiated measurements: measurements which involve the absolute measurement of a radiated field

telemetry: use of radio communication for indicating or recording data at a distance

3.2 Symbols

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

dB	decibel
E	Field strength
˚C	Temperature in degrees Celsius
hPa	Atmospheric pressure in hecto Pascal
%RH	Air relative humidity in percentage
λ	Wavelength

3.3 Abbreviations

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

CISPR	International Special Committee on Radio Interference
EU	European Union
EUT	Equipment Under Test
FAR	Fully Anechoic Room
GNSS	Global Navigation Satellite Systems
GTS	Global Telecommunications System
ICAO	International Civil Aviation Organization
ITU-R	International Telecommunication Union - Radiocommunication Sector
MSS	Mobile Satellite Service
RF	Radio Frequency
RH	Relative Humidity
VSWR	Voltage Standing Wave Ratio
WMO	World Meteorological Organization

4 Technical requirement specifications

4.1 Presentation of equipment for testing purposes

4.1.1 General Considerations

Each equipment submitted for testing shall fulfil the requirements of the present document on all frequencies over which it is intended to operate.

Testing shall be carried out on the highest and lowest frequencies within the equipment's intended operating range. If an equipment is designed to operate with different carrier powers, measurement of each transmitter parameter shall be performed at the highest power level at which the transmitter is intended to operate.

To simplify and harmonize the testing procedures between the different testing laboratories, measurements shall be performed, according to the present document.

4.1.2 Choice of model for testing

The manufacturer shall provide one or more samples of the equipment, as appropriate, for testing.

If an equipment has several optional features, considered not to affect the RF parameters then tests need only be performed on the equipment configured with that combination of features considered to be the most complex, as proposed by the manufacturer and agreed by the test laboratory.

Where practicable, equipment offered for testing shall provide a 50 Ω connector for conducted RF power measurements.

In the case of integral antenna equipment, if the equipment does not have an internal permanent 50 Ω connector then it is permissible to supply a second sample of the equipment with a temporary 50 Ω antenna connector fitted to facilitate testing.

4.1.3 Testing of equipment with alternative power levels

If a family of equipment has alternative output power levels provided by the use of separate power modules or add on stages, then each module or add on stage shall be tested in combination with the equipment. The necessary samples and tests shall be proposed by the manufacturer and/or test laboratory and shall be agreed with the Administration(s), based on the requirements of clause 4.1.

4.1.4 Testing of equipment that does not have an external 50 Ω RF connector (integral antenna equipment)

4.1.4.1 Equipment with an internal permanent or temporary antenna connector

The means to access and/or implement the internal permanent or temporary antenna connector shall be stated by the manufacturer and the access method shall be recorded in the test report.

No connection shall be made to any internal permanent or temporary antenna connector during the performance of radiated emissions measurements.

4.1.4.2 Equipment with an internal permanent antenna

Manufacturer shall state and describe the method to connect test equipment to antenna port and this method shall be recorded in the test report.

4.2 Mechanical and electrical design

4.2.1 Marking (equipment identification)

4.2.1.1 Equipment identification

The marking shall include as a minimum:

- the name of the manufacturer or his trademark;
- the type designation.

4.2.1.2 Marking

The equipment shall be marked in a visible place, unless the equipment is too small to carry the marking, This marking shall be legible and durable. Relevant information shall be provided in the user manual.

4.2.2 Auxiliary test equipment

All necessary auxiliary test equipment and set-up information shall accompany the EUT, when it is submitted for testing.

5 Test conditions, power sources and ambient temperatures

5.1 Normal and extreme test conditions

Testing shall be performed under normal test conditions, and also, where stated, under extreme test conditions.

The test conditions and procedures shall be as specified in clauses 5.2 to 5.4.

5.2 Test power source

5.2.1 External test power source

During tests, except radiated emission tests, the power source of the equipment shall be replaced by an external test power source capable of producing normal and extreme test voltages as specified in clauses 5.3.2 and 5.4.4. The internal impedance of the external test power source shall be low enough for its effect on the test results to be negligible. For the purpose of the tests, the voltage of the external test power source shall be measured. The external test power source shall be suitably de-coupled and applied as close to the equipment battery terminals as practicable.

During tests, the external test power source voltages shall be within a tolerance < ±1 % relative to the voltage at the beginning of each test.

5.2.2 Internal test power source

During normal operation (in flight) Radiosondes use only internal power source.

For radiated measurements internal power source with adequate capacity high enough capacity to carry on the planned test without interruptions shall be used. The internal power source used should shall be as supplied or recommended by the manufacturer. At the end of each test the internal power source voltage should shall be verified to be within the range specified for the EUT.

5.3 Normal test conditions

5.3.1 Normal temperature and humidity

The normal temperature and humidity conditions for tests shall be any combination of temperature and humidity within the ranges stated below, unless it is impracticable to carry out tests under these conditions. Any deviation from these ranges shall be recorded.

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

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests, shall be recorded and stated.

5.3.2 Normal test power source

During testing normal test voltage shall be within the range specified for the EUT and values shall be recorded and stated in the test report.

5.4 Extreme test conditions

5.4.1 General

Tests at extreme conditions simulate the extreme atmospheric conditions which apply to the Radiosondes in normal operations. The atmospheric model, ICAO Standard Atmosphere, gives -56,5 °C as lower extreme temperature (see table 1).

Table 1: Extreme atmospheric conditions

Upper extreme temperature:	+55 °C ±3 °C
Pressure: corresponding earth surface conditions	980 hPa ±30 hPa
Relative humidity: Note the reading	Non condensing
Lower extreme temperature:	-56,5 °C ±3 °C
Pressure: corresponding to about 16 km altitude	100 hPa ±30 hPa
Relative humidity: Note the reading	Non condensing

5.4.2 Procedure for tests at extreme conditions

Radiosondes are designed either for burst or continuous transmit modes. Thermally the difference between the modes is negligible, hence the test procedure is the same for all types of radiosondes.

Before measurements are made, the EUT shall have reached thermal balance in the test chamber. The EUT shall be switched off during the temperature stabilizing period.

Radiosondes typically have good or very good thermal insulation. If the thermal balance is not checked by measurements, a temperature stabilizing period of at least two hours, or such period as may be decided by the test laboratory, shall be allowed. The sequence of measurements shall be chosen, and the humidity content in the test chamber shall be controlled so that excessive condensation does not occur.
Also a heat producing element (e.g. water activated battery) may be included in the normal use configuration, consequently the internal temperature, where the transmitter stays in normal use may be higher than the ambient temperature given in table 1:

- for tests at the upper extreme temperature (table 1), the EUT shall be placed in the test chamber and left until thermal balance is attained. The EUT shall then be switched on in the transmit condition for a period of 15 minutes, after which the EUT shall meet the specified requirements;

- for tests at the lower extreme temperatures (table 1), the EUT shall be left in the test chamber until thermal balance is attained, then switched on for a period of one minute after which the EUT shall meet the specified requirements. In case the internal temperature at the lower extreme temperature is known, the manufacturer shall state what is the true transmitter temperature during the normal use in conditions given in table 1. The stated true temperature shall then be used as the lower extreme temperature during the test and the temperature recorded in the test report.

5.4.3 Special Radiosondes

Special Radiosondes, which are used for low altitude profiling (less than 100 hPa), may not be intended to operate in lower extreme temperature given in table 1, consequently the extreme conditions testing shall be agreed upon based on the intended application profile specified by the manufacturer of the EUT.

5.4.4 Extreme test source voltages

5.4.4.1 Power sources using batteries

The lower extreme test voltages for equipment with power sources using batteries will be as follows:

- for equipment with a battery indicator, the end point voltage shall be as indicated;
- for equipment without a battery indicator, the following end point voltage shall be used:
  - for the Leclanché or the lithium type of battery:
    - 0,85 multiplied by the nominal voltage of the battery;
  - for the nickel-cadmium type of battery:
    - 0,9 multiplied by the nominal voltage of the battery;
  - for other types of battery, the equipment manufacturer shall declare the lower extreme test voltage for the discharged condition.

The high end of nominal voltage is considered to be the upper extreme test voltage in this case.

5.4.4.2 Other power sources

For equipment using other power sources, or capable of being operated from a variety of power sources, the extreme test voltages shall be those agreed at the time of test and should be recorded in the test report.

6 General conditions

6.1 Normal test signals and test modulation

Modulation test signals only apply to products with an external modulation connector. For equipment without an external modulation connector, normal operating modulation shall be used in all tests with modulation.

6.2 Artificial antenna

Where applicable, tests shall be carried out using an artificial antenna which shall be a substantially non-reactive non-radiating load with a 50 Ω connected to the antenna connector. The Voltage Standing Wave Ratio (VSWR) at the 50 Ω connector shall not be greater than 1,2: 1 over the frequency range of the measurement.

6.3 Test fixture

With equipment intended for use with an integral antenna, and not equipped with a 50 Ω RF output connector, the manufacturer may supply a test fixture.

This test fixture is a radio frequency coupling device for coupling the integral antenna to a 50 Ω radio frequency terminal at the working frequencies of the equipment under test. This allows certain measurements to be performed using conducted measuring methods, however, use of test fixture provides only relative measurement results.

In addition, the test fixture shall provide, where applicable:

- a connection to an external power supply;
- a connection to a data interface.

Test fixture properties and validation shall be as specified in the clause 6.3 of ETSI EN 300 220-1 [3].

6.4 Test sites and general arrangements for radiated measurements

Radiated measurement test sites and general arrangements shall be as specified in the clause 5 of ETSI TS 103 052 [2].

6.5 Modes of operation of the transmitter

For practical reasons, measurements shall be performed only at the highest power level at which the transmitter is intended to operate.

The measurement shall be performed preferably in the absence of modulation.

When it is not possible to measure it in the absence of modulation, this fact shall be stated in test reports.

The transmitter shall be set in continuous transmission mode. If this is not possible, the measurements shall be carried out in a period shorter than the duration of the transmitted burst. It may be necessary to extend the duration of the burst.

The transmitter shall be connected to an artificial antenna and the power delivered to this artificial antenna shall be measured.

The equivalent isotropically radiated power is then calculated from the measured value, the known antenna gain, relative to an isotropic antenna, and if applicable, any losses due to cables and connectors in the measurement system.

6.6 Measuring receiver

The term measuring receiver refers to either a selective voltmeter or a spectrum analyser. The bandwidth of the measuring receiver shall be as given in table 2.

Table 2

Frequency being measured: f	Measuring receiver bandwidth (6 dB)	Spectrum analyser bandwidth (3 dB)
f < 150 kHz	200 Hz or	1 kHz
150 kHz ≤ f < 25 MHz	9 kHz or	10 kHz
25 MHz ≤ f < 1 000 MHz	120 kHz or	100 kHz
1 000 MHz ≤ f		1 MHz

7 Methods of measurement and limits for transmitter parameters

7.1 General

Where the transmitter is designed with an adjustable carrier power, then all transmitter parameters shall be measured using the highest power level, as declared by the manufacturer.

If the EUT is supplied with both a permanent external 50 Ω RF connector and a dedicated or integral antenna, then full tests shall be carried out using the external connector. In addition, the following tests shall be carried out with the dedicated or integral antenna:

- effective radiated power (radiated) (see clause 7.4);
- spurious emissions (see clause 7.6).

The submitted EUT shall fulfil the requirements of the stated measurement.

7.2 Frequency error

7.2.1 Definitions

The frequency error of the transmitter is the difference between the measured unmodulated carrier frequency and the nominal frequency as stated by the manufacturer under normal and extreme conditions (see clauses 5.3 and 5.4).

7.2.2 Method of measurement

The carrier frequency shall be measured with the transmitter connected to an artificial antenna. A transmitter without a 50 Ω output connector may be placed in the test fixture (see clause 6.3) connected to an artificial antenna. The measurement shall be made under normal test conditions (see clause 5.3) and extreme test conditions (see clause 5.4) (extreme temperature and supply voltage simultaneously).

If the EUT is not capable of producing an unmodulated carrier, then the frequency error shall be measured using the modulated carrier.

7.2.3 Limit

The frequency error or drift shall not exceed ±20 kHz (corresponds to ±50 ppm @ 403 MHz).

7.3 Carrier power (conducted)

7.3.1 Definition

The carrier power is the average power delivered to the artificial antenna (see clause 6.2) during one radio frequency cycle in the absence of modulation.

7.3.2 Method of measurement

This method applies only to EUT with an antenna connector.

These measurements shall be performed at the highest power level at which the transmitter is intended to operate

The transmitter shall be connected to an artificial antenna (see clause 6.2) and the carrier or mean power delivered to this artificial antenna shall be measured under normal test conditions (see clause 5.3) and extreme test conditions as specified in clause 5.4 (extreme temperature and supply voltage simultaneously).

In the case of pulse modulation equipment where it is not possible to make the measurement in the absence of modulation, the measurement shall be carried out by the use of a measuring receiver with bandwidth as stated in clause 6.6 and peak detector set in accordance with the specification of CISPR 16-1-1 [1] section one for the bands C and D.

7.3.3 Limits

Under normal and extreme test conditions, the carrier output power (conducted) shall not exceed 200 mW.

7.4 Effective radiated power

7.4.1 Definition

The effective radiated power is the power radiated in the direction of the maximum level under specified conditions of measurements in the absence of modulation.

7.4.2 Methods of measurement

This method applies to equipment with an integral antenna and to equipment supplied with a dedicated antenna.

These measurements shall be performed at the highest power level at which the transmitter is intended to operate.

The measurement shall be carried out under normal test conditions only.

On a test site, selected from ETSI TS 103 052 [2], the EUT shall be placed at the specified height on a support, and in the orientation closest to normal use as declared by the manufacturer.

The test antenna shall be oriented initially for vertical polarization and shall be chosen to correspond to the frequency of the transmitter.

The output of the test antenna shall be connected to the measuring receiver.

If possible, the transmitter shall be switched on without modulation. The measuring receiver shall be tuned to the frequency of the transmitter under test.

In case of pulse modulation equipment where it is not possible to make the measurement in the absence of modulation, the measurement shall be carried out by the use of a measuring receiver with bandwidth as stated in clause 6.6 and peak detector shall be set in accordance with the specification of CISPR 16-1-1 [1], section one for the bands C and D.

The test antenna shall be raised and lowered through the specified range of height until the measuring receiver detects a maximum signal level.

The transmitter shall then be rotated through 360° in the horizontal plane, until the measuring receiver detects the maximum signal level.

The test antenna shall be raised and lowered again through the specified range of height until the measuring receiver detects a maximum signal level.

The transmitter shall be replaced by a substitution antenna as specified in the clause 5.3.2 of ETSI TS 103 052 [2].

The substitution antenna shall be orientated for vertical polarization and the length of the substitution antenna shall be adjusted to correspond to the frequency of the transmitter.

The substitution antenna shall be connected to a calibrated signal generator.

If necessary, the input attenuator setting of the measuring receiver shall be adjusted in order to increase the sensitivity of the measuring receiver.

The test antenna shall be raised and lowered through the specified range of height to ensure that the maximum signal is received.

The input signal to the substitution antenna shall be adjusted to the level that produces a level detected by the measuring receiver, that is equal to the level noted while the transmitter radiated power was measured, corrected for the change of input attenuator setting of the measuring receiver.

The input level to the substitution antenna shall be recorded as power level, corrected for any change of input attenuator setting of the measuring receiver.

The measurement shall be repeated with the test antenna and the substitution antenna orientated for horizontal polarization.

The measure of the effective radiated power is the larger of the two levels recorded at the input to the substitution antenna, corrected for gain of the substitution antenna if necessary.

7.4.3 Limit

The effective radiated power shall not exceed 200 mW.

7.5 Modulation bandwidth

7.5.1 Definition

The range of modulation bandwidth includes all associated side bands above the appropriate spurious level and the frequency error or drift under extreme test conditions. The requirement is that the emission limits are met under both normal and extreme conditions.

Radiosondes do not have channel assignments. Table 3 suggests that 200 kHz is required to provide needed protection from interference in the case another Radiosonde is in the vicinity of the receiver, and the Radiosonde to be received is at long distance (up to 350 km).

7.5.2 Method of measurement

If the tests in this section are conducted under extreme conditions then the frequency error tests in clause 7.2 may be omitted. If the tests are conducted under normal conditions then the upper and lower frequency error results obtained in clause 7.2 shall be added and subtracted to each frequency measurement obtained in these tests.

In case of EUT with integral antenna, the equipment shall be placed in the test fixture (see clause 6.3). The RF output of the EUT or the test fixture shall be connected to a spectrum analyser via a 50 Ω connector and attenuator.

These measurements shall be performed at the highest power level at which the transmitter is intended to operate. The attenuator shall be adjusted to an appropriate level displayed on the spectrum analyser screen.

The transmitter shall be modulated with test modulation as appropriate, (see clause 6.1). The modulation used shall be recorded in the test report. During the test, the transmitter shall be set in continuous transmission mode. If this is not possible, the measurements shall be carried out in a period shorter than the duration of the transmitted burst. It may be necessary to extend the duration of the burst.
The output power of the transmitter, with or without a test fixture, shall first be measured using a spectrum analyzer resolution bandwidth large enough to accept all major modulation side bands. The power level calibration of the spectrum analyzer shall then be related to the power level measured in clauses 7.3 or 7.4. The calculated relation will be used to calculate absolute levels of RF power.

The resolution bandwidth shall be set to 1 kHz, and video bandwidth to 100 Hz. The spectrum analyser shall be put in "Maximum hold" mode and peak power detection.

7.5.3 Limits

The permitted range of modulation bandwidth including the frequency error or drift as measured in clause 7.2 shall be within the limits shown in table 3.

Table 3

Frequency relative to the nominal carrier	Maximum relative power in the 1 kHz bandwidth
±50 kHz to 100 kHz	-34 dBc/1 kHz
±100 kHz to 200 kHz	-40 dBc/1 kHz
±200 kHz to 300 kHz	-48 dBc/1 kHz

7.6 Spurious emissions

7.6.1 Definition

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

7.6.2 Methods of measurement

7.6.2.0 General requirement

In the case of pulse modulation equipment where it is not possible to make the measurement in the absence of modulation, the measurement shall be carried out by the use of a measuring receiver with bandwidth as stated in clause 6.6 and quasi-peak detector set in accordance with the specification of CISPR 16-1-1 [1] section one for the bands C and D. For measurements above 1 000 MHz the peak value shall be measured using a spectrum analyser.

The level of spurious emissions shall be measured as:

a) either:

   i) their power level in a specified load (conducted spurious emission); and

   ii) their effective radiated power when radiated by the cabinet and structure of the equipment (cabinet radiation);

b) or:

   - their effective radiated power when radiated by the cabinet and the integral antenna, in the case of portable equipment fitted with such an antenna and no external RF connector.

7.6.2.1 Method of measuring the power level in a specified load, clause 7.6.2.0 a) i)

This method applies only to equipment with a permanent antenna connector.

The transmitter shall be connected to a 50 Ω power attenuator. The output of the power attenuator shall be connected to a measuring receiver. The transmitter shall be switched on with modulation, in the case of pulse modulation, and without modulation, for other types of modulation. If an unmodulated carrier cannot be obtained, then the measurements shall be made with the transmitter modulated by the normal test signal (see clause 6.1) in which case this fact shall be recorded in the test report.

The measuring receiver (see clause 6.6) shall be tuned over the frequency range 9 kHz to 4 GHz. To improve the accuracy of the measurement, a RF pre-selector may be added in order to avoid harmonic components being introduced by the mixer in the receiver.

At each frequency at which a spurious component is detected, the power level shall be recorded as the conducted spurious emission level delivered into the specified load. Exception is the band, where the transmitter under test transmits and the band ±1 000 kHz around it, as specified by table 4.

The measurements shall be repeated with the transmitter on stand-by, if applicable.

7.6.2.2 Method of measuring the effective radiated power, clause 7.6.2.0 a) ii)

This method applies only to equipment with an external antenna connector.

On a test site, selected from ETSI TS 103 052 [2], the EUT shall be placed at the specified height on a non-conducting support and in the position closest to normal use as declared by the manufacturer.

The transmitter antenna connector shall be connected to an artificial antenna (see clause 6.2). The test antenna shall be orientated for vertical polarization and the length of the test antenna shall be chosen to correspond to the instantaneous frequency of the measuring receiver. The output of the test antenna shall be connected to a measuring receiver.

The transmitter shall be switched on with modulation, in the case of pulse modulation, and without modulation, for other types of modulation. If an unmodulated carrier cannot be obtained then the measurements shall be made with the transmitter modulated by the normal test signal (see clause 6.1) in which case this fact shall be recorded in the test report.

The measuring receiver shall be tuned over the frequency range 25 MHz to 4 GHz. At each frequency at which a spurious component is detected, the test antenna shall be raised and lowered through the specified range of heights until a maximum signal level is detected on the measuring receiver.

The transmitter shall then be rotated through 360° in the horizontal plane, until the measuring receiver detects the maximum signal level and the test antenna height shall be adjusted again for maximum signal level.

The maximum signal level detected by the measuring receiver shall be noted.

The transmitter shall be replaced by a substitution antenna as specified in the clause 5.3.2 of ETSI TS 103 052 [2].

The substitution antenna shall be orientated for vertical polarization and calibrated for the frequency of the spurious component detected.

The substitution antenna shall be connected to a calibrated signal generator.

The frequency of the calibrated signal generator shall be set to the frequency of the spurious component detected. The input attenuator setting of the measuring receiver shall be adjusted in order to increase the sensitivity of the measuring receiver, if necessary.

The test antenna shall be raised and lowered through the specified range of heights to ensure that the maximum signal is received.

When a fully anechoic room (FAR) test site according to clause 5.2.1.2 of ETSI TS 103 052 [2] is used, the height of the antenna need not be varied.

The input signal to the substitution antenna shall be adjusted to the level that produces a level detected by the measuring receiver, that is equal to the level noted while the spurious component was measured, corrected for any change of input attenuator setting of the measuring receiver.

The input level to the substitution antenna shall be recorded as a power level, corrected for any change of input attenuator setting of the measuring receiver.

The measurement shall be repeated with the test antenna and the substitution antenna orientated for horizontal polarization.

The measure of the effective radiated power of the spurious components is the larger of the two power levels recorded for each spurious component at the input to the substitution antenna, corrected for the gain of the substitution antenna if necessary.

If applicable, the measurements shall be repeated with the transmitter on standby.

7.6.2.3 Method of measuring the effective radiated power, clause 7.6.2.0 b)

This method applies only to equipment without an external antenna connector. The method of measurement shall be performed according to clause 7.6.2.2, except that the transmitter output shall be connected to the integral antenna or dedicated antenna, and not to an artificial antenna.

7.6.3 Limits

The power of any spurious emission, conducted or radiated, shall not exceed the values given in table 4.

Table 4

State	47 MHz to 74 MHz 87,5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 862 MHz	Other frequencies below 1 000 MHz	Frequencies above 1 000 MHz
Operating	200 nW	1 µW	1 µW
Standby	20 nW	20 nW	20 nW

7.7 Frequency stability under low voltage conditions

7.7.1 Definition

The frequency stability under low voltage condition is the ability of the equipment to remain on the assigned operating frequency band, when the battery voltage falls below the lower extreme voltage level.

7.7.2 Method of measurement

This test is for the EUT operated with battery.

The carrier frequency shall be measured, where possible in the absence of modulation, with the transmitter connected to an artificial antenna. A transmitter without a 50 Ω output connector may be placed in a test fixture (see clause 6.3) connected to an artificial antenna. The measurement shall be made under normal conditions (see clause 5.3), the voltage from the test power source shall be reduced below the lower extreme test voltage limit towards zero. Whilst the voltage is reduced the carrier frequency shall be monitored.

7.7.3 Limits

The equipment shall either:

a) transmit with a carrier frequency within the limits of ±10 ppm whilst the radiated or conducted power is below the spurious emission limits; or

b) automatically cease to function below the manufacturer's declared operating voltage.

History

Document history		
V1.1.1	March 2003	Publication
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