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**Radio Equipment and Systems (RES);
ElectroMagnetic Compatibility (EMC) standard for
VHF FM broadcasting transmitters**

ETSI

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Foreword

This European Telecommunication Standard (ETS) has been produced by the Radio Equipment and Systems (RES) Technical Committee of the European Telecommunications Standards Institute (ETSI).

This European Telecommunication Standard (ETS) has been prepared by the Radio Equipment and Systems (RES) Technical Committee of the European Telecommunications Standards Institute (ETSI) and the European Broadcasting Union (EBU)/ETSI Joint Technical Committee (JTC) in response to European Commission mandate BC-T-353.

This ETS, together with ETS 300 384, is intended to become a harmonized standard, the reference of which is intended to be published in the Official Journal of the European Communities referencing Council Directive 89/336/EEC (EMC Directive).

The technical characteristics which are relevant to the EMC Directive are listed in annex A.

Although all technical specifications that apply to the radiocommunications product on a "mandatory" basis to have it placed on the market and brought into use are included in this ETS and ETS 300 384, not all technical specifications have a similar status:

- compliance with the technical specifications, as referenced to the EMC Directive, allow the affixation of the CE mark and the free circulation of the radiocommunications product;
- the technical specifications referenced in the ERC Decision are for type approval purposes as part of the licensing provisions for bringing the equipment into use.

This latter subset of the technical specifications, although contained in the ETSS, is not harmonized under the terms of the EMC Directive, with the exception of those specifically referenced to the EMC Directive.

Other standards cover radio communications equipment not listed in the scope.

Transposition dates	
Date of adoption:	21 February 1997
Date of latest announcement of this ETS (doa):	30 June 1997
Date of latest publication of new National Standard or endorsement of this ETS (dop/e):	31 December 1997
Date of withdrawal of any conflicting National Standard (dow):	31 December 1997

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1 Scope

This European Telecommunication Standard (ETS) covers the assessment of VHF FM sound broadcasting transmitters and ancillary equipment in respect of ElectroMagnetic Compatibility (EMC). Technical specifications related to the antenna port are not included in this ETS. Such technical specifications are found in the related product standards for the effective use of the radio spectrum. This ETS specifies the applicable EMC tests, test methods, the limits and the minimum performance criteria for VHF FM sound broadcasting transmitters operating in the frequency range 87,5 MHz to 108 MHz, and any associated ancillary equipment.

The EMC requirements have been selected to ensure an adequate level of compatibility for apparatus at broadcast transmitter site environments. The levels however do not cover extreme cases that may occur in any location but with a low probability of occurrence.

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

Compliance of radio equipment to the requirements of this ETS does not signify compliance with the requirement related to the use of the equipment (licensing requirements).

Compliance to this ETS does not signify compliance to any safety requirement. However, it is the responsibility of the assessor of the equipment that any observation regarding the equipment becoming dangerous or unsafe as a result of the application of the tests of this ETS, should be recorded in the test report.

2 Normative references

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

- [1] EN 50081-1 (1992): "Electromagnetic compatibility - Generic emission standard. Part 1: Residential, commercial and light industry".
- [2] EN 50082-1 (1992): "Electromagnetic compatibility - Generic immunity standard. Part 1: Residential, commercial and light industry".
- [3] IEC 244-1 and 1A (1968/1973/1989): "Methods of measurement for radio transmitters - Part 1: General conditions of measurement, frequency, output power and power consumption".
- [4] ITU-R Recommendation 468-4 (1990): "Measurement of audio-frequency noise voltage level in sound broadcasting".
- [5] EN 55022 (1994): "Limits and methods of measurement of radio disturbance characteristics of information technology equipment".
- [6] EN 55011: "Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment".
- [7] CISPR 16-1: "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1: Radio disturbance and immunity measuring apparatus".
- [8] ENV 50140: "Electromagnetic compatibility - Basic immunity standard - Radiated, radio-frequency, electromagnetic field - Immunity test".

- [9] EN 60801-2 (1993): "Electromagnetic compatibility for industrial-process measuring and control equipment - Part 2: Electrostatic discharge requirements".
- [10] IEC 801-4 (1988): "Electromagnetic compatibility for industrial-process measuring and control equipment - Part 4: Electrical fast transient/burst requirements".
- [11] ENV 50141: "Electromagnetic compatibility - Basic immunity standard - Conducted disturbances induced by radio-frequency fields - Immunity test".
- [12] EN 61000-4-11: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 11: Voltage dips, short interruptions and voltage variations immunity tests".
- [13] IEC 1000-4-5: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 5: Surge immunity tests".
- [14] IEC 244-13: "Methods of measurement for radio transmitters - Part 13: Performance characteristics for FM sound broadcasting".

3 Definitions and abbreviations

3.1 Definitions

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

ancillary equipment: Equipment (apparatus), used with a VHF FM sound broadcasting Transmitter, is considered as an ancillary equipment (apparatus) if:

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

dBqps: absolute weighted voltage level measured according to ITU-R Recommendation 468-4 [4] in sound-programme transmission.

manufacturer: The legal entity responsible for placing the product on the market.

port: A particular interface of the specified equipment (apparatus) with the external electromagnetic environment.

switching range: The maximum frequency over which the VHF FM sound broadcasting Transmitter can be operated without change of components or re-alignment.

VHF FM Sound Broadcasting Transmitter (VHF/FM Tx): An active device that, when connected to an antenna, radiates a Frequency Modulated (FM) signal in the frequency band 87,5 MHz to 108 MHz. A VHF/FM Tx is intended to be used at a fixed location and therefore is defined as a fixed equipment. A VHF/FM Tx includes the following categories of equipment:

- a) transmitter: a VHF/FM Tx which consists a base-band fed FM modulator, (exciter), optionally followed by stages of Radio Frequency (RF) amplification. The baseband input may take the form of audio, multiplex, or a digitally-coded signal;

- b) transposer: a VHF/FM Tx which receives an input signal off-air, and re-broadcasts the same signal on a different frequency;
- c) active deflector: a VHF/FM Tx which receives an input signal off-air, and re-broadcasts the same signal on the same frequency;
- d) RF power amplifier: a VHF/FM Tx which comprises an amplifier declared by the manufacturer to be capable of being connected to a radiating antenna system.

3.2 Abbreviations

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

EMC	ElectroMagnetic Compatibility
EUT	Equipment under Test
FM	Frequency Modulation
ISM	Industrial, Scientific And Medical
LISN	Line Impedance Stabilizing Network
RDS	Radio Data System
RF	Radio Frequency
rms	root mean squared
Tx	Transmitter
VHF	Very High Frequency

4 General test conditions

4.1 Test conditions

The equipment shall be tested under normal test conditions contained in the relevant product and basic standards or in the information accompanying the equipment, which are within the manufacturer's declared range of humidity, temperature and supply voltage.

The test conditions shall be in accordance with IEC 244-1 [3] unless otherwise stated, and shall be recorded in the test report.

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

For immunity tests, the output of the VHF/FM Tx shall be monitored as specified in this ETS, subclauses 4.2, 4.3, 4.4, 4.5 and 4.6 shall apply and the conditions shall be as follows:

- the VHF/FM Tx shall be operated at its declared normal maximum output power modulated with a suitable test signal (see subclause 4.2);
- for transposers, RF power amplifiers and active deflectors the wanted RF input signal shall be coupled to the RF input port.

4.2 Arrangements for test signals at the input of the VHF/FM Tx

Any unused baseband input ports shall be terminated according to the manufacturer's instructions.

For the purpose of these tests, no audio modulation is applied to the VHF/FM Tx (quiet channel).

If a VHF/FM Tx incorporates baseband processing and/or coding equipment (e.g. stereo encoder, limiter, Radio Data System (RDS) encoder), this equipment shall be active as in normal operation.

In the case of transposers and active deflectors, the wanted RF input signal shall be set to a level of -27 dBm, and at a frequency determined from the manufacturers' specifications.

In the case of RF power amplifiers, the input shall be delivered from an external exciter provided by the manufacturer. The exciter shall be placed outside the test environment.

4.3 Arrangements for test signals at the output of the VHF/FM Tx

The VHF/FM Tx RF output port shall be connected to a precision 50 Ω load as defined in IEC 244-13 [14] through a coaxial feeder and a calibrated directional coupler.

The test arrangements to determine the performance of the VHF/FM Tx shall be according to figure 1.

The noise meter according to ITU-R Recommendation 468 [4] shall be placed in the weighted mode. The modulation analyser shall be set to 50 μ s de-emphasis.

The input of the modulation analyser shall initially be coupled to a signal generator, modulated with a 1 kHz sinusoidal audio signal, at a peak deviation of 32 kHz, to establish a 0 dB reference for the measurements.

The modulation analyser shall then be coupled to the RF output port of the VHF/FM Tx through a directional coupler and adequate RF attenuation for the actual measurements, as used for the performance criteria, table 1 (subclause 6.1).

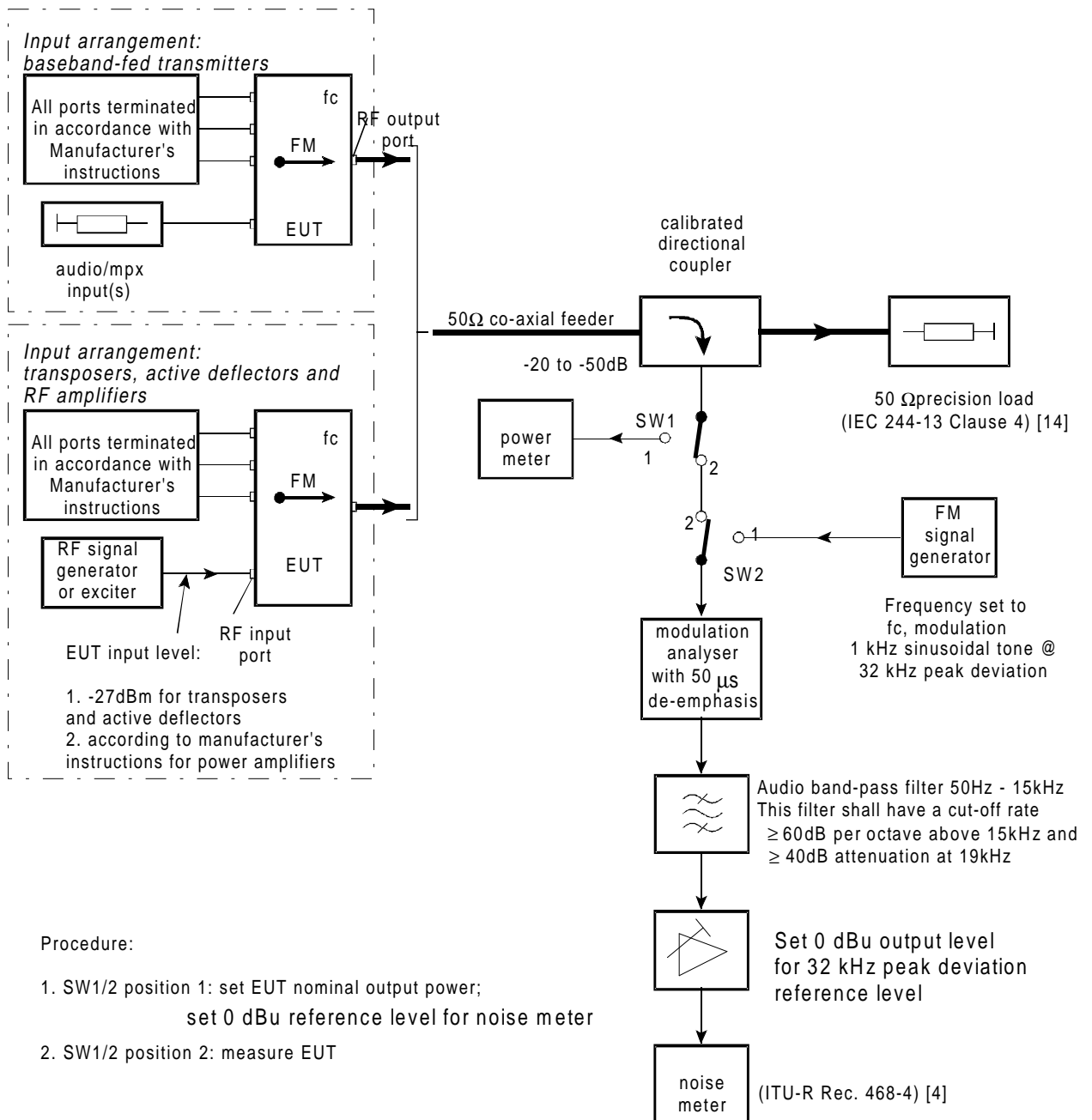


Figure 1: Example arrangement of test equipment to determine the performance criteria of VHF/FM Tx

4.4 Transmitter and RF power amplifier exclusion band

The exclusion band for transmitters and/or power amplifiers extends from $f_c - 300$ kHz to $f_c + 300$ kHz, where f_c is the operating frequency.

4.5 Active deflector exclusion band

The exclusion band for active deflectors is the frequency range determined by the switching range of the receiver, as declared by the manufacturer, extended as follows:

- the lower frequency of the exclusion band is the frequency range determined by the switching range, minus 5 % of the centre frequency of the switching range;
- the upper frequency of the exclusion band is the frequency range determined by the switching range, plus 5 % of the centre frequency of the switching range;

- in the case of an active deflector operating on a single frequency that cannot be changed by the user, the exclusion band extends from -5 % to +5 % of the fixed frequency.

4.6 Transposer exclusion band

The transposer exclusion band shall comprise both the exclusion bands of subclause 4.4 and subclause 4.5.

4.7 Narrow band responses of transposers and active deflectors

Responses occurring during the testing of Transposers and Active Deflectors at discrete frequencies are narrow band responses (spurious responses), and are identified by the following method:

If, during the test, an unwanted signal causes degradation of performance of the output resulting from the wanted signal, it is necessary to establish whether the degradation of performance is due to a narrow band response or to a wide band phenomenon. Therefore, the unwanted signal frequency shall be increased by an amount equal to twice the bandwidth of the IF filter (or RF filter if no IF is used), as declared by the manufacturer. The test shall be repeated with the frequency of the unwanted signal decreased by the same amount.

If the degradation of performance disappears, then the response is considered as a narrow band response.

If the degradation of performance does not disappear, this may be due to the fact that the offset has made the frequency of the unwanted signal correspond to the frequency of another narrow band response. Under these circumstances, the method above is repeated with the increase and decrease of the frequency of the unwanted signal adjusted to two and a half times the bandwidth referred to. If the degradation does not now disappear, the phenomenon is considered wide band and therefore an EMC problem, and the equipment fails the test.

Narrow band responses in transposers and active deflectors are disregarded.

5 Performance assessment

5.1 General

The manufacturer shall, at the time of submission of the equipment for test, declare the following information:

- whether the Equipment under Test (EUT) is intended for installation in a residential, commercial, and light industrial environment or intended to be installed at a remote site;
- the intended functions of the EUT which shall be in accordance with the documentation accompanying the equipment;
- the ancillary equipment and/or host equipment to be used with the radio equipment for testing and the method of connection;
- the user-control functions and stored data that are required for normal operation and the method to be used to assess whether these have been lost after EMC stress;
- an exhaustive list of ports, classified as either power or signal/control. Power ports shall further be classified as AC or DC power;
- the instruction books and block diagrams of the VHF/FM Tx and/or ancillary equipment;
- the nominal characteristics of the VHF/FM Tx such as power, frequency and switching range;
- the frequencies as used in the VHF/FM Tx for oscillators, clocks and intermediate frequencies;
- the bandwidth of the IF filter, or the bandwidth of the RF filter if no IF filter is fitted.

This information shall be recorded in the test report.

5.2 Equipment for which the output signal can be monitored

If the category of the VHF/FM Tx, or combination of VHF/FM Tx with ancillary equipment permits the output signal to be monitored, the test modulation, test arrangements etc. given in clause 4 shall apply.

5.3 Ancillary equipment

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

- declared compliant separately from a VHF/FM Tx to all the applicable immunity and emission clauses of this ETS;
- declared compliant to another appropriate harmonized EMC standard;
- tested with it connected to a VHF/FM Tx, in which case compliance shall be demonstrated to the appropriate clauses of this ETS.

In each case, compliance enables the ancillary equipment to be used with other compatible transmitters.

5.4 Equipment for which the output signal cannot be monitored

In the case of ancillary equipment tested on a stand alone basis for which the output signal cannot be monitored (see clause 6), the manufacturer shall define the method of test to determine the acceptable level of performance or degradation of performance during and/or after the test. The manufacturer shall provide the following:

- the pass/fail criteria for the EUT;
- the method for observing a degradation of performance of the equipment.

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

5.5 Equipment classification

To reflect the performance variation of VHF/FM Txs, they are classified into three categories based on signal-to-noise ratio (dBqps), weighted according to ITU-R Recommendation 468 [4] relative to a peak deviation of 32 kHz. The following categories and limits for continuous phenomena immunity tests apply and are referred to in table 1 (subclause 6.1).

- **category (i):** where the manufacturers declared signal-to-noise ratio is greater than 70 dBqps, the signal-to-noise ratio shall not degrade below 60 dBqps when exposed to a continuous phenomena immunity test;
- **category (ii):** where the manufacturers declared signal-to-noise ratio is between 70 dBqps and 50 dBqps, the signal-to-noise ratio shall not degrade by more than 10 dBqps when exposed to a continuous phenomena immunity test;
- **category (iii):** where the manufacturers declared signal-to-noise ratio is below 50 dBqps, the signal-to-noise ratio shall not degrade below 40 dBqps when exposed to a continuous phenomena immunity test.

6 Performance criteria

The equipment shall meet the performance criteria as specified in subclauses 6.1 and 6.2. The monitoring of the VHF/FM Tx performance shall be used to assess the performance criteria and ensure the primary functions of the VHF/FM Tx are evaluated during and after the test using the arrangements set out in figure 1.

If the equipment is of a specialized nature, such that the performance criteria described in subclauses 6.1 and 6.2 are not appropriate, then the manufacturer shall declare for inclusion in the test report the specification for an acceptable level of performance or degradation of performance during and/or after testing as required by this ETS. The performance specification shall be included in the product description and documentation. The performance criteria specified by the manufacturer shall, however, give the same degree of immunity protection as called for in subclauses 6.1 and 6.2.

6.1 Performance criteria for Continuous phenomena applied to Transmitters (CT)

The parameters specified in table 1 shall be used to assess the performance criteria for continuous phenomena. During each individual exposure in the test sequence, it shall be verified that the characteristics of the output signal remain within the permitted values listed in table 1.

Table 1: Performance criteria for continuous phenomena

Parameter	Values measured during pre-test	Permitted values during immunity test
Signal-to-noise (S/N) ratio of demodulated audio	Category declared by the manufacturer	
	(i) > 70 dBqps (ii) 50 to 70 dBqps (iii) < 50 dBqps	≥ 60 dBqps ≥ (S/N - 10) dBqps ≥ 40 dBqps

At the conclusion of the test comprising the series of individual exposures, the parameters in table 1 shall remain within the manufacturers declared tolerance and the EUT shall operate as intended, with no loss of user control functions or stored data as declared by the manufacturer.

Where the EUT is equipped with a stand-by mode, the exposure shall be repeated in this mode to ensure that no unintentional transmission occurs.

6.2 Performance criteria for Transient phenomena applied to Transmitters (TT)

Transient phenomena in this context includes electrostatic discharge but excludes lightning.

At the conclusion of the total test comprising the series of individual exposures, the EUT shall:

- operate as intended with no loss of user control functions or stored data as declared by the manufacturer; and
- revert to the pre-test performance figures in subclause 6.1, within the tolerances defined by the manufacturers specification.

Where the EUT is equipped with a stand-by mode, the test shall be repeated in this mode to ensure that no unintentional transmission occurs.

7 Applicability overview tables

7.1 Emission

Table 2: Emission applicability

Application	Equipment test requirement Classification by RF output power (note) VHF/FM Tx and ancillary equipment			Reference clause in this ETS	Reference document
	0 to 1 kW	> 1 kW to 5 kW	> 5 kW		
Enclosure	applicable	applicable		8.2	EN 55022 [5]
			applicable		EN 55011 [6]
DC power in/out	applicable	not applicable	not applicable	8.3	EN 55022 [5]; CISPR 16-1 [7]
AC mains	applicable	applicable	not applicable	8.4	EN 55022 [5]

NOTE: The RF power levels used as break-points in this table were derived from mains input power requirements, assuming a nominal transmitter efficiency of 50 %.

7.2 Immunity

Table 3: Immunity applicability

Phenomena	Application	Equipment test requirement Classification by RF output power (note) VHF/FM Tx and ancillary equipment			Reference clause in this ETS	Reference document
		0 to 1 kW	> 1 kW to 5 kW	> 5 kW		
RF electro- magnetic field (80 - 1 000 MHz)	Enclosure	applicable	applicable	not applicable	9.2	ENV 50140 [8]
Electrostatic discharge	Enclosure	applicable	applicable	applicable	9.3	EN 60801-2 [9]
Fast transients common mode	Signal and control ports	applicable	applicable	applicable	9.4	IEC 801-4 [10]
	DC and AC power input/output ports	applicable	applicable	not applicable		
RF common mode 0,15 - 80 MHz (current clamp injection)	Signal and control ports	applicable	applicable	not applicable	9.5	ENV 50141 [11]
	DC and AC power input/output ports	applicable	not applicable	not applicable		
Voltage dips and interruptions	AC mains power input ports	applicable	applicable	not applicable	9.6	EN 61000-4- 11 [12]
Surges, common and differential mode	AC mains power input ports	applicable	applicable	not applicable	9.7	IEC 1000-4-5 [13]

NOTE: The RF power levels used as break-points in this table were derived from mains input power requirements, assuming a nominal transmitter efficiency of 50 %.

8 Test methods and limits for emission tests of VHF/FM TxS and/or ancillary equipment

8.1 Test configuration

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

- measurements shall be made in the operational mode producing the largest emission in the frequency band being investigated consistent with normal applications;
- the equipment shall be configured in a manner which is representative of a normal/typical operation, where practical;
- an attempt shall be made to maximize the detected radiated emission, e.g. by moving the cables of the equipment;
- if the equipment is part of a system, or can be connected to ancillary equipment, then it shall be acceptable to test the equipment while connected to the minimum representative configuration of ancillary equipment necessary to exercise the ports;
- the configuration and mode of operation during measurements shall be precisely noted in the test report;
- if the equipment has a large number of ports, then a sufficient number shall be selected to simulate actual operational conditions and to ensure that all the different types of termination are covered;
- ports which in normal operation are connected, shall be connected to an ancillary equipment or to a representative piece of cable terminated to simulate the impedance of the ancillary equipment. RF input/output ports shall be correctly terminated;
- the tests shall be carried out at a point within the specified normal operating environmental range and at the rated supply voltage for the equipment.

8.2 Enclosure

This test shall be performed on a representative configuration of the equipment, or a representative configuration of the combination of radio and ancillary equipment.

8.2.1 Definition

This test assesses the ability of VHF/FM TxS and ancillary equipment to limit any spurious radiation from the enclosure.

8.2.2 Test method

For VHF/FM TxS with a RF power output of ≤ 5 kW, the test method shall be in accordance with EN 55022 [5].

For VHF/FM TxS with RF power output of > 5 kW, the test method shall be according to EN 55011 [6].

VHF FM TxS with RF power output > 5 kW shall be tested (in order of preference) either:

- 1) at the manufacturers premises; or
- 2) when installed on site.

8.2.3 Limits

The limit measured at 10 m shall be according to table 4.

Table 4: Limits for enclosure spurious radiation

VHF/FM Tx output power Po (Watts)	Limit (dB μ V/m)	Frequency range (MHz)
< 100	50	30 to 1 000
100 to 1 000	(50+10 log(Po/100))	30 to 1 000
> 1 000 to < 5 000	60	30 to 1 000
\geq 5 000	(60+10 log(Po/5000))	30 to 1 000
NOTE: These limits are approximately in line with the levels in EN 55011 (class A), and are designed to be well below the spurious levels radiated from the antenna.		

8.3 DC power input/output port

This test is applicable for VHF/FM Tx's with RF output powers up to 1 kW and ancillary equipment that may have DC cables longer than 3 metres.

This test shall be performed on a representative configuration of the equipment or a representative configuration of the combination of radio and ancillary equipment.

8.3.1 Definition

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

8.3.2 Test method

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

For equipment with a current consumption above 16 A, the DC power ports shall be connected to 5 μ H Line Impedance Stabilizing Networks (LISNs), with 50 Ω impedance measurement ports. The LISNs shall be according to the requirements of CISPR 16-1 [7].

A measuring receiver shall be connected to each LISN measurement port in turn and the conducted emission recorded. The LISN measurement ports not being used for measurement shall be terminated with a 50 Ω load.

The equipment shall be installed with a ground plane as defined in EN 55022 [5], paragraph 10.3. The reference earth point of the LISNs shall be connected to the reference ground plane with a conductor as short as possible.

The measuring receiver shall be according to the requirements of CISPR 16-1 [7].

8.3.3 Limits for conducted RF signals

The equipment shall meet the limits in tables 5 or 6, (including the average limit and the quasi-peak limit) when using, respectively, an average detector receiver and a quasi-peak detector receiver and measured according to the method described in subclause 8.3.2. If the average limit is met when using a quasi-peak detector, the equipment shall be deemed to meet both limits, and measurement with the average detector receiver is unnecessary.

The limits for conducted voltage emissions shall be according to table 5 (class A) for equipment designated for use at sites remote from residential, commercial, or light industrial areas. For equipment designated as suitable for use in these areas, the limits in table 6 (class B) shall apply.

Table 5: Limits for conducted RF signals (class A)

VHF/FM Tx output power Po (Watts)	Class A Limits (dBµV)		Frequency range (MHz)
	Quasi-peak	Average	
< 100	79	66	0,15 to 0,5
	73	60	> 0,5 to 30
100 to 1 000	89	76	0,15 to 0,5
	83	70	> 0,5 to 30

NOTE: The limit decreases linearly with the logarithm of frequency in the range 0,15 to 0,5 MHz.

Table 6: Limits for conducted RF signals (class B)

VHF/FM Tx output power Po (Watts)	Class B Limits (dBµV)		Frequency range (MHz)
	Quasi-peak	Average	
≤ 1000	66 - 56	56 - 46	0,15 to 0,5
	56	46	> 0,5 to 5
	60	50	> 5 to 30

NOTE: The limit decreases linearly with the logarithm of frequency in the range 0,15 to 0,5 MHz.

8.4 AC mains power input/output port

This test is applicable for VHF/FM Tx's of RF output power up to 5 kW and ancillary equipment, powered by the AC mains.

This test shall be performed on a representative configuration of the equipment or a representative configuration of the combination of radio and ancillary equipment.

8.4.1 Definition

This test assesses the ability of VHF/FM Tx's and ancillary equipment to limit its internal noise from being present on the AC mains power input/output ports.

8.4.2 Test method

The test method shall be according to EN 55022 [5].

8.4.3 Limits

The limits for conducted voltage emissions shall be according to table 7 (class A) for equipment designated for use at sites remote from residential, commercial, or light industrial areas. For equipment designated as suitable for use in these areas, the limits in table 8 (class B) shall apply.

Table 7: Limits for conducted RF signals (class A)

VHF/FM Tx output power Po (Watts)	Class A Limit (dB μ V)		Frequency range (MHz)
	Quasi-peak	Average	
< 100	79	66	0,15 to 0,5
	73	60	> 0,5 to 30
100 to 1 000	89	76	0,15 to 0,5
	83	70	> 0,5 to 30
> 1 000 to 5 000	96	83	0,15 to 0,5
	90	77	> 0,5 to 30

NOTE: The limit decreases linearly with the logarithm of frequency in the range 0,15 to 0,5 MHz.

Table 8: Limits for conducted RF signals (class B)

VHF/FM Tx output power Po (Watts)	Class B Limits (dB μ V)		Frequency range (MHz)
	Quasi-peak	Average	
\leq 5 000	66 - 56	56 - 46	0,15 to 0,5
	56	46	> 0,5 to 5
	60	50	> 5 to 30

NOTE: The limit decreases linearly with the logarithm of frequency in the range 0,15 to 0,5 MHz.

9 Test methods and levels for immunity tests of VHF/FM Txs and/or ancillary equipment

9.1 Test configuration

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

- the measurement shall be made in the operational mode as required in subclause 4.1;
- if the equipment is part of a system, or can be connected to ancillary equipment, then it shall be acceptable to test the equipment connected to the minimum representative configuration of ancillary equipment necessary to exercise the ports;
- for the immunity tests of ancillary equipment, without a separate pass/fail criteria, the receiver, VHF/FM Tx or transceiver coupled to the ancillary equipment shall be used to judge whether the ancillary equipment passes or fails;
- the configuration and mode of operation during measurements shall be precisely noted in the test report;
- if the equipment has a large number of ports, then a sufficient number shall be selected to simulate actual operational conditions and to ensure that all the different types of termination are covered;
- ports which in normal operation are connected, shall be connected to an ancillary equipment or to a representative piece of cable terminated to simulate the impedance of the ancillary equipment. RF input/output ports shall be correctly terminated;
- the tests shall be carried out at a point within the specified normal operating environmental range and at the rated supply voltage for the equipment.

9.2 RF electro-magnetic field (80 - 1 000 MHz)

This test is applicable for VHF/FM TxS with output powers up to 5 kW and ancillary equipment.

This test shall be performed on a representative configuration of the equipment or a representative configuration of the combination of radio and ancillary equipment.

9.2.1 Definition

This test assesses the ability of VHF/FM TxS, and ancillary equipment to operate as intended in the presence of a radio frequency electromagnetic field disturbance.

9.2.2 Test method and level

The test method shall be according to ENV 50140 [8], except that the following requirements shall apply:

- the test level shall be 3 V/m amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1 kHz;
- the stepped frequency increments shall be 1 % of the momentary frequency;
- the test shall be performed over the frequency range 80 - 1 000 MHz with the exception of an exclusion band for transmitters and RF power amplifiers, (see subclause 4.4); for active deflectors, (see subclause 4.5), and for transposers, (see subclause 4.6);
- responses in transposers and active deflectors occurring at discrete frequencies which are narrow band responses, shall be disregarded, (see subclause 4.7);
- the frequencies selected during the test shall be recorded in the test report.

9.2.3 Performance criteria

For VHF/FM TxS, the performance criteria CT (see subclause 6.1) shall apply.

For ancillary equipment, the pass/fail criteria supplied by the manufacturer shall apply unless the ancillary equipment is tested with VHF/FM TxS in which case the corresponding performance criteria for VHF/FM TxS shall apply.

9.3 Electrostatic discharge

This test is applicable for VHF/FM TxS and ancillary equipment.

This test shall be performed on a representative configuration of the equipment or a representative configuration of the combination of radio and ancillary equipment.

9.3.1 Definition

This test assesses the ability of VHF/FM TxS and ancillary equipment to operate as intended in the event of an electrostatic discharge.

9.3.2 Test method and level

The test method shall be according to EN 60801-2 [9].

For VHF/FM TxS and ancillary equipment the following requirements shall apply:

- for contact discharge, the equipment shall pass at ± 2 kV and ± 4 kV; for air discharge shall pass at ± 2 kV, ± 4 kV and ± 8 kV, (see EN 60801-2 [9], Clause 5);
- electrostatic discharges shall be applied to all exposed surfaces of the EUT except where the user documentation specifically indicates a requirement for appropriate protective measures, (EN 60801 - 2 [9], subclause 8.3.1).

9.3.3 Performance criteria

For VHF/FM Tx's the performance criteria TT (see subclause 6.2) shall apply.

For ancillary equipment, the pass/fail criteria supplied by the manufacturer shall apply, unless the ancillary equipment is tested with VHF/FM Tx's in which case the corresponding performance criteria for VHF/FM Tx's shall apply.

9.4 Fast transients common mode

This test is applicable for VHF/FM Tx's and ancillary equipment.

For VHF/FM Tx's with output power exceeding 5 kW, these tests shall be carried out at either the manufacturer's premises, or when installed on site.

This test shall be performed on the AC mains and DC power input ports of VHF/FM Tx's with RF output powers up to 5 kW.

This test shall be performed on signal ports, control ports and DC power input/output ports, unless the manufacturer declares that the cables shall be shorter than 3 metres.

Where this test is not carried out on any ports because the manufacturer declares that it is not intended to be used with cables longer than 3 metres, a list of ports that were not tested for this reason shall be included in the test report.

This test shall be performed on a representative configuration of the equipment or a representative configuration of the combination of radio and ancillary equipment.

9.4.1 Definition

This test assesses the ability of VHF/FM Tx's and ancillary equipment to operate as intended in the event of fast transients present on one of the input/output ports.

9.4.2 Test method and level

The test method shall be according to IEC 801-4 [10] except that the following requirements shall apply.

For VHF/FM Tx's and ancillary equipment, which have cables longer than 3 metres, or are connected to the AC mains:

- the test level for signal and control ports shall be severity level 3 corresponding to 1 kV open circuit voltage as given in paragraph 5 of IEC 801-4 [10];
- the test level for DC power input/output ports shall be severity level 2 corresponding to 1 kV open circuit voltage as given in paragraph 5 of IEC 801-4 [10];
- the test level for AC mains power input ports shall be severity level 3 corresponding to 2 kV open circuit voltage as given in paragraph 5 of IEC 801-4 [10].

For AC input and DC power input/output ports the transients shall be applied (in parallel) to all the wires in the cable with reference to the cabinet reference ground, i.e. line-to-ground, (true common mode), with a source impedance of 50 Ω .

9.4.3 Performance criteria

For VHF/FM Tx's the performance criteria TT (see subclause 6.2) shall apply.

For ancillary equipment the pass/fail criteria supplied by the manufacturer shall apply, unless the ancillary equipment is tested with VHF/FM Tx's in which case the corresponding performance criteria for VHF/FM Tx's shall apply.

9.5 RF common mode, 0,15 MHz - 80 MHz (current clamp injection)

This test is applicable to signal and control ports for VHF/FM Tx's with RF output powers up to 5 kW, and to DC power and AC mains ports of VHF/FM Tx's for RF output powers up to 1 kW, and to ancillary equipment.

This test shall be performed on signal, control, AC power and DC power input/output ports of VHF/FM Tx's and ancillary equipment, which may have cables longer than 1 metre.

Where this test is not carried out on any ports because the manufacturer declares that it is not intended to be used with cables longer than 1 metre, a list of ports that were not tested for that reason shall be included in the test report.

This test shall be performed on a representative configuration of the equipment or a representative configuration of the combination of radio and ancillary equipment.

9.5.1 Definition

This test assesses the ability of VHF/FM Tx's and ancillary equipment to operate as intended in the presence of a radio frequency electro-magnetic disturbance on the input/ output ports.

9.5.2 Test method and level

The test method shall be the current clamp injection method according to ENV 50141 [11] except that the following requirements shall apply:

- the test signal shall be amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1 kHz;
- for VHF/FM Tx's, the stepped frequency increments shall be 50 kHz in the frequency range 150 kHz - 5 MHz and 1 % frequency increment of the momentary frequency in the frequency range 5 MHz - 80 MHz;
- the test level shall be severity level 2 as given in ENV 50141 [11] corresponding to 3 V rms, at a transfer impedance of 150 Ω ;
- no intrusive or direct connection shall be made to any of the lines of any input/output port, therefore the current clamp injection method shall be used;
- the test shall be performed over the frequency range 150 kHz - 80 MHz with the exception of an exclusion band for active deflectors, subclauses 4.5, and transposers subclause 4.6.

NOTE: These exclusion bands are normally outside the range 150 kHz - 80 MHz.

- responses in transposers and active deflectors occurring at discrete frequencies which are narrow band responses, shall be disregarded, (see subclause 4.7);
- the frequencies selected during the test shall be recorded in the test report.

9.5.3 Performance criteria

For VHF/FM Tx's the performance criteria CT (see subclause 6.1) shall apply.

For ancillary equipment the pass/fail criteria supplied by the manufacturer shall apply, unless the ancillary equipment is tested with VHF/FM Tx's in which case the corresponding performance criteria for VHF/FM Tx's shall apply.

9.6 Voltage dips and interruptions

These tests are applicable for VHF/FM Tx's with RF output powers up to 5 kW and ancillary equipment powered by the AC mains.

These tests shall be performed on AC mains power input ports.

These tests shall be performed on a representative configuration of the equipment or a representative configuration of the combination of radio and ancillary equipment.

9.6.1 Definition

These tests assess the ability of VHF/FM TxS and ancillary equipment to operate as intended in the event of voltage dips and interruptions present on the AC mains power input ports.

9.6.2 Test method and level

The following requirements shall apply.

The test method shall be according to EN 61000-4-11 [12].

The test levels shall be:

- a voltage dip corresponding to a reduction of the supply voltage of 30 % for 10 ms;
- a voltage dip corresponding to a reduction of the supply voltage of 60 % for 100 ms;
- a voltage interruption corresponding to a reduction of the supply voltage of > 95 % for 5 000 ms.

9.6.3 Performance criteria

For a voltage dip corresponding to a reduction of the supply voltage of 30 % for 10 ms, the following performance criteria shall apply:

- for VHF/FM TxS the performance criteria CT (see subclause 6.1);
- for ancillary equipment, the pass/fail criteria supplied by the manufacturer shall apply, unless the ancillary equipment is tested with VHF/FM TxS in which case the corresponding performance criteria for VHF/FM TxS shall apply.

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

- for VHF/FM TxS the performance criteria TT (see subclause 6.2);
- for ancillary equipment, the pass/fail criteria supplied by the manufacturer shall apply, unless the ancillary equipment is tested with VHF/FM TxS in which case the corresponding performance criteria for VHF/FM TxS shall apply.

For a voltage dip corresponding to a reduction of the supply voltage of > 95 % for 5 000 ms, the following performance criteria shall apply:

- in the case where the equipment is fitted with or connected to a battery back-up, the performance criteria TT (subclause 6.2) apply;
- in the case where the equipment is powered solely from the AC mains supply (without the use of a parallel battery back-up), the communications link need not be maintained and may have to be re-established, and volatile user data may have been lost.

In the event of loss of the output signal or in the event of loss of user data, this fact shall be recorded in the test report, the product description and the user documentation.

9.7 Surges, common and differential mode

These tests are applicable for VHF/FM TxS with RF output powers up to 5 kW and ancillary equipment.

These tests shall be performed on AC mains power input ports.

These tests shall be performed on a representative configuration of the radio equipment or a representative configuration of the combination of radio and ancillary equipment.

9.7.1 Definition

These tests assess the ability of VHF/FM Tx's and ancillary equipment to operate as intended in the event of surges being present at the AC mains power input ports.

9.7.2 Test method and level

The following requirements shall apply.

The test method shall be according to IEC 1000-4-5 [13]:

- the test level shall be severity level 3 corresponding to 2 kV open circuit voltage for line-to-ground, and severity level 3 corresponding to 1 kV open circuit voltage for line-to-line;
- the transients shall be applied (in parallel) to all the wires in the cable with reference to the cabinet reference ground for line-to-ground tests, i.e. true common mode, with a series resistance of 10 Ω .

9.7.3 Performance criteria

For VHF/FM Tx's the performance criteria TT (see subclause 6.2) shall apply.

For ancillary equipment, the pass/fail criteria supplied by the manufacturer shall apply, unless the ancillary equipment is tested in connection with VHF/FM Tx's in which case the corresponding performance criteria for VHF/FM Tx's shall apply.

Annex A (normative): Clauses in this ETS which refer to essential requirements of Council Directive 89/336/EEC

Table A1: Clauses and/or subclauses addressing essential requirements of the EC Council Directive 89/336/EEC

Clause/subclause of this ETS	Title	Essential requirement reference article of EC Directive 89/336/EEC	Qualifying remarks
8	Test methods and limits for emission tests of VHF/FM TxS and/or ancillary equipment		
8.2	Enclosure	4(a)	
8.3	DC power input/output port	4(a)	
8.4	AC mains power input/output port	4(a)	
9	Test methods and levels for immunity tests of VHF/FM TxS and/or ancillary equipment		
9.2	RF electro-magnetic field (80 - 1 000 MHz)	4(b)	
9.3	Electrostatic discharge	4(b)	
9.4	Fast transients common mode	4(b)	
9.5	RF common mode, 0,15 MHz - 80 MHz (current clamp injection)	4(b)	
9.6	Voltage dips and interruptions	4(b)	
9.7	Surges, common and differential mode	4(b)	

History

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