



HARMONISED EUROPEAN STANDARD

**Satellite Earth Stations and Systems (SES);  
Harmonised Standard for Vehicle-Mounted  
Earth Stations (VMES)  
operating in the 14/12 GHz frequency bands  
covering the essential requirements  
of article 3.2 of the Directive 2014/53/EU**

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## Foreword

This Harmonised European Standard (EN) has been produced by ETSI Technical Committee Satellite Earth Stations and Systems (SES).

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.5] to provide one voluntary means of conforming to the essential requirements of Directive 2014/53/EU on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC [9].

Once the present document is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of the present document given in table A.1 confers, within the limits of the scope of the present document, a presumption of conformity with the corresponding essential requirements of that Directive, and associated EFTA regulations.

National transposition dates	
Date of adoption of this EN:	12 May 2016
Date of latest announcement of this EN (doa):	31 August 2016
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	28 February 2017
Date of withdrawal of any conflicting National Standard (dow):	28 February 2018

## 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).

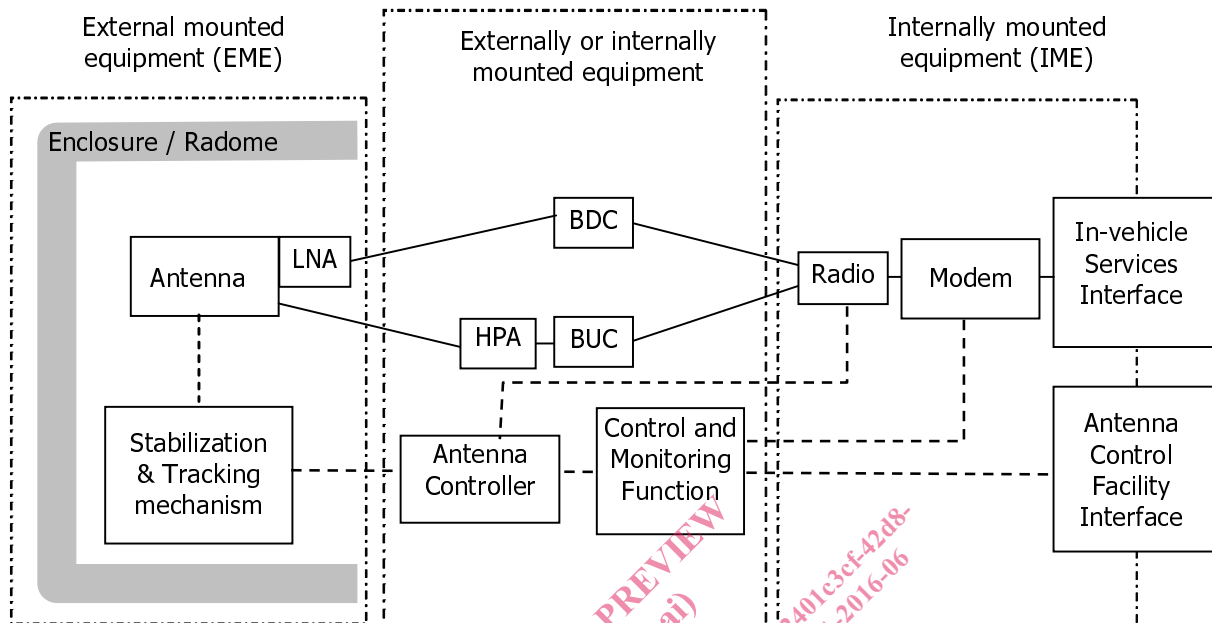
"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

## Introduction

The present document is part of a set of standards developed by ETSI and is designed to fit in a modular structure to cover all radio equipment within the scope of the RE Directive [9]. The modular structure is shown in ETSI EG 201 399 [i.2].

# 1 Scope

The present document applies to Earth Stations located on board Vehicles, which have the following characteristics.



**Figure 1: VMES System Overview**

- The VMES may transmit and receive data when the vehicle is in motion and also when the vehicle is stationary.
- The VMES operates on wheeled or tracked vehicles and, therefore, may be subject to occasional disturbances and interruptions in the satellite link.
- The VMES is operating as part of a satellite network (e.g. star, mesh or point-to-point) used for the distribution and/or exchange of information.
- The VMES is comprised of all the equipment, electrical and mechanical, from the antenna itself to the interface with other communications equipment on a vehicle (usually referred to as the terrestrial interface).
- The VMES transmits on single carrier in the frequency range 14,00 GHz to 14,50 GHz, which is a band allocated to the Fixed Satellite Services (FSS) (Earth-to-space) among other services. However, operation of the VMES is intended to be restricted to the lower half of the band in and near those countries that have allocated Fixed Service (FS) to the upper half. Local regulation may permit operation in the upper half of the band.

NOTE 1: For the purposes of the present specification, OFDM modulation is considered as a single carrier.

- The VMES receives in one or more frequencies within the range from 10,70 GHz to 12,75 GHz in bands allocated to the Fixed Satellite Services (FSS) (space-to-Earth) or the Broadcast Satellite Service (BSS) (space-to-Earth), depending on the ITU Region where the VMES is located.
- The VMES uses linear or circular polarization.
- The VMES is designed to operate through a geostationary satellite (or a cluster of co-located geostationary satellites) that is at least 3° away from any other geostationary satellite operating in the same frequencies and over the same coverage area.

NOTE 2: Satellites may be spaced closer than 3°. In such cases, the satellite operator will inform the VMES client of the requirements of the system coordination agreements.

- The VMES transmits at elevations greater than or equal to 7° relative to the local horizon.
- The VMES is designed for unattended operation.
- The VMES is designed for both mobile and stationary operation. In the case of stationary operation, the VMES should not be accessible to the general public and operated safely.
- The VMES is controlled and monitored by an Antenna Control Facility (ACF). This function may be performed centrally (e.g. for a network of VMESs with a central hub) or it could be performed within the VMES for autonomous control. The ACF is outside the scope of the present document.

The present document applies to the VMES with its ancillary equipment and its various telecommunication ports, and when operated within the boundary limits of the operational environmental profile as declared by the applicant and when installed as required by the applicant's declaration or in the user documentation.

The present document is intended to cover the provisions of Directive 2014/53/EU [9] (RE Directive) article 3.2, which states that "... radio equipment shall be so constructed that it both effectively uses and supports the efficient use of radio spectrum in order to avoid harmful interference".

NOTE 3: Operational requirements are defined by national administrations and by relevant ECC Decisions.

In addition to the present document, other ENs that specify technical requirements in respect of essential requirements under other parts of article 3 of the Directive 2014/53/EU [9] (RE Directive) may apply to equipment within the scope of the present document.

NOTE 4: A list of such ENs is included on the web site <http://www.newapproach.org/>.

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## 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 referenced 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] | Void.   |
| [2] | CISPR 16-1-1 Ed. 2.2 (2007): "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-1: Radio disturbance and immunity measuring apparatus - Measuring apparatus".                           |
| [3] | CISPR 16-1-5 (2003): "Specification for radio disturbance and immunity measuring apparatus and methods; Part 1-5: Radio disturbance and immunity measuring apparatus - Antenna calibration test sites for 30 MHz to 1 000 MHz". |
| [4] | CENELEC EN 60529 (1991): "Degrees of protection provided by enclosures (IP code)".  |
| [5] | CENELEC EN 60068-2-6 (2008): "Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)".   |
| [6] | CENELEC EN 60068-2-11 (1999): "Environmental testing - Part 2-11: Tests - Test Ka: Salt mist".  |
| [7] | CENELEC EN 60068-2-27 (2007): "Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock".   |



- [8] MIL STD 810F (2000): "DOD Test Method Standard for Environmental Engineering Considerations and Laboratory Tests".
- [9] Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC (RE Directive).

## 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 referenced document (including any amendments) applies.

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

- [i.1] Void.
- [i.2] ETSI EG 201 399: "Electromagnetic compatibility and Radio spectrum Matters (ERM); A guide to the production of Harmonized Standards for application under the Radio & Telecommunication Terminal Equipment Directive 1999/5/EC (R&TTE) and a first guide on the impact of the Radio Equipment Directive 2014/53/EU (RED) on Harmonized Standards".
- [i.3] ETSI TR 102 375: "Satellite Earth Stations and Systems (SES); Guidelines for determining the parts of satellite earth station antenna radiation patterns concerned by the geostationary satellite orbit protection".
- [i.4] ETSI TR 102 215: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Recommended approach, and possible limits for measurement uncertainty for the measurement of radiated electromagnetic fields above 1 GHz".
- [i.5] Commission implementing decision C(2015) 5376 final of 4.8.2015 on a standardisation request to the European Committee for Electrotechnical Standardisation and to the European Telecommunications Standards Institute as regards radio equipment in support of Directive 2014/53/EU of the European Parliament and of the Council.

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## 3 Definitions, symbols and abbreviations

### 3.1 Definitions

For the purposes of the present document, the terms and definitions given in Directive 2014/53/EU [9] and the following apply:

**ancillary equipment:** equipment used in connection with a VMES is considered as ancillary if the three following conditions are met:

- the equipment is intended for use in conjunction with the VMES to provide additional operational and/or control features (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 the VMES; and
- the absence of the equipment does not inhibit the operation of the VMES.

**Antenna Control Facility (ACF):** set of functional entities that, at system level, monitor and control the correct operation of the VMES and, if appropriate, all of the VMESs in a network

**antenna controller:** equipment used to maintain antenna stabilization and tracking accuracy based on inputs from the Control and Monitoring Function

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

**carrier-off radio state:** radio state in which the VMES may transmit and does not transmit any carrier

NOTE 1: The phrase "the VMES may transmit" means that all the conditions for transmission are satisfied (e.g. in a state where transmissions are permitted, no failure detected, and the VMES is correctly pointed towards the satellite).

NOTE 2: The existence of a "Carrier-off" radio state depends on the system of transmission used. For VMESs designed for continuous transmission mode there may be no "Carrier-off" state.

**carrier-on radio state:** radio state in which the VMES may transmit and transmits a carrier

**Control Channel (CC):** channel or channels by which VMESs receive control information from the ACF

**EIRP<sub>max</sub>:** maximum e.i.r.p. capability of the VMES as declared by the applicant

**emissions-disabled radio state:** radio state in which the VMES does not emit

NOTE: Examples of cases where the VMES is in this radio state: before system monitoring pass, before the control channel is received, when a failure is detected, when a VMES is commanded to disable, and when the VMES is in a location requiring cessation of emissions.

**external control channel:** control channel which is either:

- (i) carried by the VMES network via the same or another satellite, but not within the internal protocol of the VMES system; or
- (ii) carried by any other radio communication system.

**external response channel:** response channel which is either:

- (i) carried by the VMES network via the same or another satellite, but not within the internal protocol of the VMES system; or
- (ii) carried by any other radio communication system.

**Externally Mounted Equipment (EME):** that part of the VMES intended to be installed on the outside of the vehicle (usually the roof), as declared by the applicant, or as indicated in the user documentation

NOTE 1: The EME unit is usually comprised of the following main parts:

- a) The antenna sub-system which converts the incident radiation field into a guided wave and vice versa.
- b) The Low Noise Amplifier (LNA) which is a device that amplifies, with very low internal noise, the received signals in the Radio Frequency (RF) band.
- c) The stabilization and tracking mechanics that ensure pointing of the antenna main beam towards the satellite within the required accuracy.
- d) The radome for protecting the antenna subsystem, if required for normal operation.

NOTE 2: The LNA could be replaced by an LNB, which includes the block down converter. Optionally, the EME may include the following elements (otherwise they will be part of the IME):

- a) A Block Up Converter (BUC) and High Power Amplifier (HPA) which convert from the intermediate frequency to RF and amplify the low level RF signals for transmission through the antenna subsystem.
- b) The Antenna Controller Processor.
- c) The Control and Monitoring Function.

NOTE 3: The installation equipment (means of attachment) is outside the scope of the present document. However, the antenna structures and other components directly mounted on the antenna and forming an integral part of it, are subject to the specifications of the present document.

NOTE 4: Certain configurations may include more than one EME per VMES. As for example, the VMES may have separate transmit and receive antennas or it may have redundant transmit/receive antenna units.

**integral antenna:** antenna which may not be removed during the tests according to the applicant's statement

**internal control channel:** control channel which is carried by the VMES network via the same satellite as used for transmission of user data and within the internal protocol structure of the VMES system

**internal response channel:** response channel which is carried by the VMES network via the same satellite as used for transmission of user data and within the internal protocol structure of the VMES system

**Internally Mounted Equipment (IME):** part of the VMES equipment which is installed inside the vehicle and its connection cables with the EME

NOTE: The IME is usually comprised of:

- a) the modem and the IF radio equipment;
- b) the interfaces to equipment and services onboard the vehicle.

Optionally the IME may include the following elements (otherwise they will be included in the EME):

- c) a Block Down Converter (BDC), which converts the RF signals to intermediate frequencies;
- d) a Block Up Converter (BUC) and High Power Amplifier (HPA) which convert from the intermediate frequency to RF and amplify the low level RF signals for transmission through the antenna subsystem;
- e) the Antenna Controller Processor;
- f) the Control and Monitoring Function.

**maximum relative wind speed:** addition of the magnitudes of the maximum wind speed and the maximum vehicle velocity

**nominal antenna diameter:** antenna diameter declared by the manufacturer that is a parameter in performance characteristics and that allows reference to a certain performance

NOTE: An antenna with circular aperture of diameter equal to the nominal diameter does typically have the performance specified. Network operators might request antennas of a certain diameter. Then an antenna that is compliant with the requirement for nominal antenna diameter equal to the requested antenna diameter can be used. Manufacturers can mark their equipment with antenna diameters used in the requirements during compliance test.

**nominated bandwidth:** bandwidth of the VMES radio frequency transmission nominated by the applicant

NOTE 1: The nominated bandwidth is centred on the transmit frequency and does not exceed 5 times the occupied bandwidth.

NOTE 2: The nominated bandwidth is wide enough to encompass all spectral elements of the transmission which have a level greater than the specified spurious radiation limits. The nominated bandwidth is wide enough to take account of the transmit carrier frequency stability. This definition is chosen to allow flexibility regarding adjacent channel interference levels which will be taken into account by operational procedures depending on the exact transponder carrier assignment situation.

**off-axis angle:** angle between the direction of the axis of the antenna main beam and the considered direction

**removable antenna:** antenna which may be removed during the tests according to the applicant's statement

**Response Channel (RC):** channel by which VMES transmit monitoring information to the ACF

**spurious radiation:** any radiation outside the nominated bandwidth

**transmission-disabled state:** VMES is in this state when it is not authorized by the ACF to transmit

**transmission-enabled state:** VMES is in this state when it is authorized by the ACF to transmit

**Wanted signal occupied Bandwidth (BW):**

- for a digital modulation scheme: the width of the signal spectrum 10 dB below the maximum in-band density;
- for an analogue modulation scheme: the width of a frequency band such that, below the lower and above the upper frequency limits, the mean power emitted is equal to 0,5 % of the total mean power of the emission.

## 3.2 Symbols

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

dBc	ratio expressed in decibels relative to the e.i.r.p. of the unmodulated carrier
dBi	ratio of an antenna gain to the gain of an isotropic antenna, expressed in decibels
dBsd	ratio expressed in decibels relative to the spectral density
dBW	ratio of a power to 1 watt, expressed in decibels
dBpW	ratio of a power to 1 picowatt, expressed in decibels
dB $\mu$ V/m	ratio of an electric field to 1 $\mu$ V/m, expressed in decibels (20 log(electric field / 1 $\mu$ V/m))

## 3.3 Abbreviations

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

ACF	Antenna Control Facility
BDC	Block Down Converter
Bo	occupied Bandwidth
BSS	Broadcast Satellite Service
BUC	Block Up Converter
BW	Bandwidth
CC	Control Channel
CCF	Control Channel reception Failure
CCR	Control Channel correctly Received
CENR	Cessation of Emissions Not Requested
CEPT	Conférence Européenne des Postes et Télécommunications (European Conference of Postal and Telecommunications Administrations)
CER	Cessation of Emissions Requested
CISPR	Comité International Spécial des Perturbations Radioélectriques (International Special Committee on Radio Interference)
CMF	Control and Monitoring Functions
e.i.r.p.	equivalent isotropically radiated power
ECC	Electronic Communications Committee (of CEPT)
EIRP	Equivalent Isotropically Radiated Power
EMC	Electro-Magnetic Compatibility
EME	Externally Mounted Equipment
EN	European Standard
EU	European Union
EUT	Equipment Under Test
FEC	Forward Error Correction
FS	Fixed Service
FSS	Fixed Satellite Service
GSO	Geostationary Satellite Orbit
HPA	High Power Amplifier
IME	Internally Mounted Equipment
IPR	Intellectual Property Rights
ITU	International Telecommunications Union
LNB	Low Noise Block down converter
LO	Local Oscillator
LV	Low Voltage

OFDM	Orthogonal Frequency Division Multiplexing
PAME	Polarization Angle Misalignment Error
R&TTE	Radio and Telecommunications Terminal Equipment
RC	Response Channel
RE	Radio Equipment
RED	Radio Equipment Directive
RF	Radio Frequency
SMF	System Monitoring Fail
SMP	System Monitoring Pass
STE	Special Test Equipment
TDMA	Time Division Multiple Access
TxD	Transmission Disable command
TxE	Transmission Enable command
VMES	Vehicle-Mounted Earth Station
XPD	Cross-Polarization Discrimination

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## 4 Technical requirements specifications

### 4.1 General

#### 4.1.1 Environmental profile

The applicant shall declare the environmental profile of the VMES equipment and it shall include conditions for both survivability and operation. The declared environmental profile shall include, but not be limited to, a statement of conditions regarding: vehicle velocity, tangential and longitudinal acceleration, temperature range, damp heat, dry heat, relative humidity stress, shock and vibration, antenna pressure pulses and pressure gradients.

The equipment shall comply with the performance requirements of the present document under all operational environmental conditions as specified in the following table. The VMES shall not show any sign of permanent distortion that could affect the radiation subsystem after the application of the load under the maximum values declared by the applicant for parameters below, including the maximum relative wind speed.

Two classes of VMES are specified and the applicant shall designate the class(es) under which they are compliant.