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**ElectroMagnetic Compatibility (EMC)
standard for radio equipment and services;
Part 22: Specific conditions for ground based
aeronautical mobile and fixed radio equipment;
Harmonised Standard for ElectroMagnetic Compatibility**

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Foreword

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

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.2] 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 [i.1].

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.

The present document is part 22 of a multi-part deliverable. Full details of the entire series can be found in part 1 [1].

National transposition dates	
Date of adoption of this EN:	8 October 2020
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Date of withdrawal of any conflicting National Standard (dow):	31 July 2022

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).

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1 Scope

The present document, ~~together with EN 301 489-1 [1]~~ covers in respect of ElectroMagnetic Compatibility (EMC), the assessment of:-

- 1) ~~ground base station, ground mobile and hand-held/portable~~based aeronautical VHF radio communications ~~and associated ancillary equipment, in respect of ElectroMagnetic Compatibility (EMC).~~ characterized by the following operating conditions:

~~Technical specifications related to the antenna port and emissions from the enclosure port of the radio equipment covered in this scope, are not included in the present document. Such technical specifications are found in the relevant product standards for the effective use of the radio spectrum.~~

~~The present document also covers EMC requirements for~~ a) operating in the frequency range 118 MHz to 136,975 MHz, at 8,33 kHz or 25 kHz channel spacing;

b) using DSB AM modulation;

- 2) ground-based UHF radio transmitters, receivers and transceivers for the UHF aeronautical mobile service characterized by the following operating conditions:

a) operating in the frequency range 225 MHz to 399,975 MHz at 12,5 kHz or 25 kHz channel spacing;

b) using DSB AM modulation;

- 3) VDL Mode 2 and ground base station radio equipment operating in the frequency range 117,975 MHz to 137,000 MHz;

- 2)4) VDL Mode 4 ground base station radio equipment operating in the frequency range 112,000 MHz to 136,975 MHz.

~~NOTE: The present document specifies the applicable test conditions, performance assessment and performance criteria for ground-based aeronautical radio equipment and associated ancillary equipment.~~

~~Definitions of types of ground base station, ground mobile and hand-held/portable aeronautical VHF radio communications covered by the present document are given in annex A.~~

~~In case of differences (for instance concerning special conditions, definitions, abbreviations)relationship between the present document and EN 301 489-1 [1], the provisions of the present document take precedence.~~

~~The environmental classification and the emission and immunityessential requirements used in the present document are as stated in EN 301 489-1 [1], except for any specific conditions included in the present document. The of article 3.1(b) of Directive 2014/53/EU [1.1] is given in Annex A applicable environments referred to in EN 301 489-1 [1] where equipment covered by the scope of the present document may be used, shall be declared by the manufacturer.~~

~~The EMC requirements have been selected to ensure an adequate level of compatibility for apparatus within aerodrome, en route, vehicular and hand-held/portable operational environments. The levels, however, do not cover extreme cases which may occur in any location but with a low probability of occurrence.~~

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 <https://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] ~~ETSI EN 301 489-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); (V2.2.3) (11-2019); "ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements; Harmonised Standard for ElectroMagnetic Compatibility".~~
- [2] ~~Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on MAC sub-layer~~ ETSI EN 301 841-1 (V1.4.1) (04-2015): "VHF air-ground Digital Link (VDL) Mode 2; Technical characteristics and methods of measurement for ground-based equipment; Part 1: Physical layer and of the Council of 9 March 1999 on MAC sub-layer".
- [3] ~~ETSI EN 301 842-1 (V1.4.1) (04-2015): "VHF air-ground Digital Link (VDL) Mode 4 radio equipment; Technical characteristics and telecommunications terminal equipment and the mutual recognition methods of their conformity (R&TTE Directive); measurement for ground-based equipment; Part 1: EN for ground equipment".~~
- [3] ~~Council Directive 89/336/EEC of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Directive).~~
- [4] ~~ETSI EN 300 676 (V1.3.1): "ElectroMagnetic Compatibility and Radio Spectrum Matters (ERM); -1 (V1.5.2) (03-2011): "Ground-based VHF hand-held, mobile and fixed radio transmitters, receivers and transceivers for the VHF aeronautical mobile service using amplitude modulation; Part 1: Technical characteristics and methods of measurement".~~
- [5] ~~ETSI EN 302 617 (V2.3.1) (07-2018): "Ground-based UHF radio transmitters, receivers and transceivers for the UHF aeronautical mobile service using amplitude modulation; Harmonised Standard for access to radio spectrum".~~

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] ~~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.~~
- [i.2] ~~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.~~
- [i.3] ~~ITU Radio Regulations (19982016).~~
- [6] ~~ITU-T [i.4] Recommendation ITU-T P.53: "Psophometer for use on telephone-type circuits".~~
- [7] ~~Directive 98/34/EC of the European Parliament and of the Council of 22 June 1998 laying down a procedure for the provision of information in the field of technical standards and regulations.~~

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in ETSI EN 301 489-1 [1] and the following apply:

base station: aeronautical radio equipment, used in the aeronautical mobile service, for use with an external antenna and intended for use at a fixed location

centre frequency (Fc): centre of the transmitter necessary bandwidth

integral antenna equipment: radio communications equipment with an antenna integrated into the equipment without the use of an external connector and considered to be part of the equipment

~~NOTE: An integral antenna may be internal or external to the equipment. In equipment of this type, a 50 Ω RF connection point shall be provided for test purposes.~~

necessary bandwidth: for a given class of emission, the width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions ~~(ITU Radio Regulations, clause 146)~~

~~NOTE: This is the definition in the ITU Radio Regulations, clause 146 [i.3].~~

occupied bandwidth: width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage $\beta/2$ of the total mean power of a given emission

~~NOTE: Unless otherwise specified by ITU-R for the appropriate class of emission, the value of $\beta/2$ should be taken as 0,5 % (as defined in the ITU Radio Regulations [5]-i.3).~~

~~simplex: instantaneous one-way communications link~~

~~product standard: functional standard describing frequency management parameters of radio product~~

operating frequency range: range(s) of continuous radio frequencies covered by the Equipment Under Test (EUT)

product standard: functional standard describing frequency management parameters of radio product

simplex: instantaneous one-way communications link

3.2 Symbols

Void.

3.3 Abbreviations

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

AC	Alternating Current
AM	Amplitude Modulation
BER	Bit Error Ratio
BW	BandWidth
D8PSK	Differentially encoded 8 Phase Shift Keying
DC	Direct Current
DSB	Double Side Band full carrier
EM	ElectroMagnetic
EMC	ElectroMagnetic Compatibility
EUT	Equipment Under Test
Fc	centre frequency
GFSK	Gaussian Frequency Shift Keying
PEP	Peak Envelope Power
MPL	Minimum Performance Levels

RF	Radio Frequency
rms	root mean of squares
<u>SINAD</u>	<u>Signal In Noise And Distortion</u>
<u>THD</u>	<u>Total Harmonic Distortion</u>
<u>UHF</u>	<u>Ultra High Frequency</u>
VDL	VHF Digital Link
VHF	Very High Frequency

4 Test conditions

~~For the purpose of the present document, the test conditions of EN 301 489-1 [1], clause 4 shall apply as appropriate. Further product related test conditions for VHF aeronautical radio equipment are specified in the present document.~~

4.1 General

~~For emission and immunity tests the test modulation, test arrangements, etc., as specified in the present document, clauses 4.2 to 4.5, shall apply.~~

The test configuration and mode of operation shall represent the intended use and shall be recorded in the test report.

4.2 Arrangements for test signals

4.2.0 General

The provisions of ETSI EN 301 489-1 [1], clause 4.2 shall apply with the following modification-;

- For integral antenna radio communications equipment a temporary 50 Ω RF connection point ~~shall~~may be provided for connection to the measuring equipment.

4.2.1 Arrangement for test signals at the input to the transmitter

The provisions of ETSI EN 301 489-1 [1], clause 4.2.1 shall apply with the following modification-;

- The transmitter shall be modulated with normal test modulation by an internal or external signal source capable of producing the appropriate drive signal (see clause 4.5).

4.2.2 Arrangements for test signals at the output from the transmitter

The provisions of ETSI EN 301 489-1 [1], clause 4.2.2 shall apply with the following modifications-;

- The transmitter shall be operated at its maximum rated RF carrier output (PEP), or at a level not less than 6 dB relative to that. If the maximum power level in the event of declared cannot be maintained due to thermal limitations, any tests should be paused and the transmitter allowed to cool, until full power can be maintained again.
- The RF output signal of the transmitter shall be coupled to the measuring equipment via a shielded transmission line such as a coaxial cable. The measuring equipment shall comprise a combination of a modulation analyser and an audio distortion meter.

~~For transmitters with an integral antenna, a 50 Ω RF connection point shall be provided for test purposes.~~

4.2.3 Arrangements for test signals at the input to the receiver

The provisions of ETSI EN 301 489-1 [1], clause 4.2.3 shall apply with the following modifications-;

- The wanted RF input signal coupled to the receiver shall be modulated with normal test modulation (see clause-4.5).

~~For receivers with an integral antenna, a 50 Ω RF connection point shall be provided for test purposes.~~

4.2.4 Arrangements for test signals at the output from the receiver

The provisions of ETSI EN 301 489-1 [41], clause 4.2.4 shall apply.

4.2.5 Arrangements for testing transmitters and receivers together (as a system)

The provisions of ETSI EN 301 489-1 [41], clause 4.2.5 shall apply.

4.3 RF exclusion band for radio communications equipment

~~The provisions of EN 301 489-1 [1], clause 4.3 shall apply.~~

4.3.1 General

Frequencies on which radio communications equipment is intended to operate are excluded from immunity tests with radiated RF test signals.

~~The RF test exclusions are referred to as "provisions of ETSI EN 301 489-1 [1], clause 4.3 shall apply with the following modifications:~~

- ~~The transmitter exclusion bands" and are detailed below for the various cases~~ the receiver exclusion bands as defined in clauses 4.3.2 to 4.3.5 shall apply.

4.3.42 Transmitter exclusion bands for EM emission measurements

Exclusion bands shall apply when measuring transmitters in transmit mode of operation.

Exclusion bands shall not apply when measuring transmitters in standby mode of operation.

~~The exclusion band~~ bands for transmitters ~~is~~ are given in table 1.

Table 1: Transmitter exclusion bands for emission measurements

Category of EUT (Channel spacing)	Width of exclusion band (see notes 1 and 2)	Centre of exclusion band
8,33 kHz equipment	2,042 MHz or 2,442 MHz	F _c
12,5 kHz	2,063 MHz or 2,463 MHz	F _c
25 kHz equipment	2,125 MHz or 2,525 MHz	F _c

NOTE 1: The exclusion band is the product of 5 times the ~~receiver bandwidth~~ channel spacing plus 20 times the measurement bandwidth (i.e. 100 kHz, or 120 kHz), for the measurement range 30 MHz to 1 GHz.

NOTE 2: The extension of the exclusion bandwidth for transmitters to include 20 times the measurement bandwidth is needed to accommodate the skirt bandwidth of the filters used in the measurement equipment. A narrower measurement bandwidth may be used. The exclusion band and measurement bandwidth shall be recorded in the test report.

4.3.23 Receiver exclusion bands for EM emission measurements

There shall be no frequency exclusion band applied to EM emission measurements of receivers, ~~or ancillaries.~~

4.3.34 Transmitter exclusion bands for immunity tests

The exclusion band extends plus and minus twice the occupied ~~bandwidth~~ BandWidth (BW) from the centre frequency (F_c ± ~~2BW~~ 2 BW).

For 25 kHz equipment the exclusion band extends ± 50 kHz, ~~and for 8,33 kHz equipment $\pm 16,7$ kHz and for 12,5 kHz equipment ± 25 kHz~~ around the centre frequency (F_c).

4.3.45 Receiver exclusion bands for immunity tests

The exclusion band is the operating frequency range, extended at each end by ± 5 % of the centre frequency (F_c).

EXAMPLE: For the ~~centre~~ equipment intended to operate in the frequency band 118 MHz to 136,975 MHz, the exclusion band extends from 111,625 MHz (i.e. 118 MHz minus ~~6,375~~(127,5 times 0,05) MHz) to 143,35 MHz (i.e. 136,975 MHz plus ~~6,375~~(127,5 times 0,05) MHz).

For the equipment intended to operate in the frequency band 225 MHz to 399,975 MHz, the exclusion band extends from 209,375 MHz (i.e. 225 MHz minus (312,5 times 0,05) MHz) to 415,600 MHz (i.e. 399,975 MHz plus (312,5 times 0,05) MHz).

4.4 Narrow band responses of receivers

Any Responses on receivers or the receiver part of transceivers occurring during the immunity tests at discrete frequencies which are narrow band responses (spurious responses), are identified by the following method.

If during immunity RF test the RF test signal (see ETSI EN 301 489-1 [1], clauses 9.2 and 9.5) causes non-compliance of the receiver, it is necessary to evaluate whether this non-compliance is due to a narrow band response ~~to~~ or a wideband phenomenon. Therefore, the frequency of the test signal is increased by an RF immunity test that has a amount equal to twice the nominal 6 dB bandwidth as defined of the IF filter immediately preceding the demodulator of the receiver, or if appropriate, the bandwidth over which the equipment is intended to operate. The test is repeated with the frequency of the test signal decreased by the same amount.

If the receiver is then in EN 301 489 1 [1], clause 4.4. shall be either or both frequency offset cases in compliance with the specified performance criteria, the response is considered as a narrow band response.

If the receiver still does not comply with the specified performance criteria, 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 procedure is repeated with an increase and decrease of the frequency of the test signal adjusted two and a half times the bandwidth referred to above.

If the receiver still does not comply with the specified performance criteria in either or both frequency offset cases, the phenomena is considered wide band and therefore an EMC problem and the equipment fails the test.

For immunity tests, narrow band responses shall be subject to spurious response rejection tests specified in the relevant product standards for the effective use of the radio spectrum.

4.5 Normal test modulation

The normal test modulation is specified as follows:

- for analogue speech equipment:
 - the receiver input signal shall be set to the nominal operating frequency, modulated with a sinusoidal audio frequency of 1 kHz at 30 % depth and at a level which gives a SINAD ratio of 20 dB, measured at the receiver output using a psophometric telephone filtering network as described in ~~ITU-T~~ Recommendation ITU-T P.53 [6].4];
 - the transmitter shall be modulated with a sinusoidal audio frequency signal of 1 kHz. The level of this audio signal shall be set to obtain at least 80 % modulation depth of the RF output signal;
- for VDL Mode 2 and VDL Mode 4 equipment:
 - the receiver input signal shall be set to the nominal frequency of the receiver, modulated with a test signal ~~specified by the manufacturer~~ which represents normal operation;
 - the transmitter shall be modulated with a test signal which represents the intended normal operation ~~as specified by of the manufacturer equipment~~;

- ~~— the manufacturer may supply the test modulation/demodulation equipment;~~
- the test signal generator (modulation) shall be able to produce a continuous stream of data or a repetitive message as appropriate;
- in the case of data equipment, the test instrumentation shall be able to produce:
 - a readout of BER of a continuous data stream; or
 - a repetitive readout of message acceptance or an indication of data throughput rate in the case of error-corrected systems.

5 Performance assessment

5.1 ~~General~~ Void

The provisions of EN 301 489-1 [1], clause 5.1 shall apply with the following modifications.

In addition, the manufacturer shall supply the following information:

- ~~• a list of service connectors or programming connectors;~~
- ~~— details of the mechanism for manual recovery of normal operation shall be provided in the user documentation;~~
- ~~— the EUT software version used during the test.~~

5.2 Equipment which can provide a continuous communications link

The provisions of EN 301 489-1 [1], clause 5.2 shall apply with the following modification.

For immunity tests of transmitters, the transmitter shall be modulated with normal test modulation (see clause 4.5). A continuous communication link shall be established at the start of the test, and the performance criteria specified in ~~clauses~~ clause 6 to 6.5 shall apply.

For immunity tests of receivers, the wanted RF input signal coupled to the receiver shall be modulated with normal test modulation (see clause 4.5). A continuous communication link shall be established at the start of the test, and the performance criteria specified in clause 6 ~~and its clauses~~ shall apply.

~~5.3 Equipment which does not provide a continuous or duty cycle communications link~~

~~For radio equipment which does not support a continuous or duty cycle communications link the provisions of EN 301 489-1 [1], clauses 5.3 and 6.3 shall apply.~~

5.3 Void

5.4 Ancillary equipment

The provisions of ETSI EN 301 489-1 [1], clause 5.4 shall apply.

5.5 Equipment classification

The provisions of EN 301 489-1 [1], For the purpose of the EMC performance assessment in the present document, the radio equipment and/or associated ancillary equipment under test shall be classified into one of the following three classes:

- equipment for fixed use (e.g. base station equipment); or
- equipment for vehicular use (e.g. mobile equipment); or
- equipment for portable use (e.g. portable equipment);

taking into account the definitions in clause 3.1 of ETSI EN 301 489-1 [1].

This classification determines the extent of applicable EMC tests. However, the following instructions shall also apply to multiple use radio and/or ancillary equipment:

- radio and/or ancillary equipment for portable use or combinations thereof declared as capable of being powered for intended use by the main battery of a vehicle shall additionally be considered as equipment for vehicular use;
- radio and/or ancillary equipment for portable or vehicular use or combinations thereof declared as capable of being powered for intended use by an AC mains or DC network shall additionally be considered as equipment for fixed use.

Subsequently, for multiple use radio and/or ancillary equipment more than one set of equipment test requirements listed in tables 1 and 2 of ETSI EN 301 489-1 [1] has to be taken into account.

~~clause 5.5 shall apply.~~

6 Performance criteria

6.1 General Requirements

The EUT shall meet the performance criteria given in table 2 including the associated notes 1, ~~2~~, and ~~3~~, as detailed in clauses ~~6.1, 6.2, 6.3, or~~ to 6.4 as appropriate.

The performance criteria A, B, and C, as indicated in table 2, shall be used in the following manner:

- performance criteria A for immunity tests with phenomena of a continuous nature;
- performance criteria B for immunity tests with phenomena of a transient nature or where called for in specific clauses of the present document;
- performance criteria C for immunity tests with power interruptions.

Table 2: Performance criteria

Criteria	During test	After test
A	Operate as intended Degradation of performance (see note 1) No loss of function	Operate as intended No degradation of performance (see note 2) No loss of function
B	Loss of function (one or more)	Operate as intended No degradation of performance (see note 2) Functions self-recoverable
C	Loss of function (one or more)	Operate as intended No degradation of performance (see note 2) Functions recoverable by the operator (see note 3)
<p>NOTE 1: Degradation of performance during the test is understood as a degradation to a level not below <u>at the minimum performance level specified by in Annex B of the manufacturer present document for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance.</u></p> <p>NOTE 2: No degradation of performance after the test is understood as no degradation below <u>at the minimum performance level specified by in Annex B of the manufacturer present document for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance.</u> The test shall not cause a change of actual operating data or user retrievable data.</p> <p>NOTE 3: The EUT combined with its test support equipment should provide an indication of the need for manual operation to recover normal functionality of the product following EM stress. Where this is provided, full details of the necessary recovery action and diagnostics provided by the EUT shall be recorded in the test report.</p>		

6.42 Performance criteria A for continuous phenomena applied to transmitters and receivers

The establishment of the communications link at the start of the test, its maintenance during the test, and the assessment of the recovered signal information, e.g. an audio signal, shall be used as performance criteria to ensure that the essential functions of the EUT are evaluated during and after the test.

The performance criteria A specified in table 2 shall apply.

If during an RF immunity test an unwanted signal creates a degradation of the receiver's output ~~such that the SINAD is reduced to 14 dB or less, or causes the data output to be corrupted,~~ as specified in Annex B then the phenomenon is considered an EMC problem and the equipment fails the test.

If during an RF immunity test an unwanted signal creates a degradation of the transmitter's output such that the ~~received audio signal distortion exceeds 10 %, or causes the transmitted data to be corrupted,~~ performance is reduced below that specified in Annex B then the phenomenon is considered an EMC problem and the equipment fails the test.

Where the EUT is a transmitter only, tests shall be repeated with the EUT in standby mode of operation. The transmitter shall not operate unintentionally during the test.

Where the EUT is a transceiver, the transmitter shall not operate unintentionally during the test, under any circumstances.

6.23 Performance criteria B for transient phenomena applied to transmitters and receivers

The performance criteria B specified in table 2 shall apply.

Where the EUT is a transmitter only, tests shall be repeated with the EUT in standby mode of operation. The transmitter shall not operate unintentionally during the test.

Where the EUT is a transceiver, the transmitter shall not operate unintentionally during the test, under any circumstances.

6.34 Performance criteria C for immunity tests with power interruptions

Performance criteria C shall apply to a voltage interruption corresponding to a reduction of the supply voltage of greater than 95 % for 5 s:

- during the EMC exposure:
 - the communications link may be lost and one or more functions may be lost;
 - during the test there shall be no unintended transmission;
- after the EMC exposure:
 - the communications link shall be recoverable either automatically or by operational user control as declared by the manufacturer;
 - the ~~speech quality level performance~~ shall ~~return to a level not recover as no degradation~~ below ~~that the~~ minimum performance level as specified by the manufacturer and/or the digital throughput shall return to its nominal value in Annex B;
 - there shall be no unintended transmission.

~~6.4 Performance criteria for equipment which does not provide a continuous or duty cycle communications link~~

~~The provisions of EN 301 489 1 [1], clause 6.3 shall apply.~~

~~6.5 Performance criteria for ancillary equipment tested on a stand alone basis~~

~~The provisions of EN 301 489 1 [1], clause 6.4 shall apply.~~

7 Applicability overview

7.1 Emission

7.1.1 General

~~EN 301 489 1 [1], table 2, Table 3 below contains the applicability of EMC emission ~~measurements~~ requirements to the relevant ports of radio and/or associated ancillary equipment.~~

~~7.1.2 Special conditions~~

~~The following special conditions set out below relate to the methods of measurement for EM emissions used in EN 301 489 1 [1], clause 8.~~

Table 3: Special conditions for EM emission measurements Emission Requirements and applicability

Phenomenon	Port	Applicability			Reference clause
		Fixed-Use	Vehicle Use	Portable Use	
Reference to clauses in EN 301 489-1 [1] radiated emission	enclosure port of ancillary equipment	applicable	applicable	applicable	Special product-related conditions, additional to or modifying the test conditions in ETSI EN 301 489-1 [1], clause 8.2
conducted emission	DC power input/output port	applicable	applicable	not applicable	ETSI EN 301 489-1 [1], clause 8.3
conducted emission	AC mains input/output port	applicable	not applicable	not applicable	ETSI EN 301 489-1 [1], clause 8.4
8.1: Test configuration; Methods of measurement and limits for EM harmonic current emissions	AC mains input port	applicable	not applicable	not applicable	Modes of operation to be investigated: — on a transmitter, the measurements shall be performed when transmitting at the highest rated power, and whilst in standby mode of operation; — a single tone or a bit stream shall be used to modulate the transmitter as defined in clause 4.5 of the present document. ETSI EN 301 489-1 [1], clause 8.5
voltage fluctuations and flicker	AC mains input port	applicable	not applicable	not applicable	ETSI EN 301 489-1 [1], clause 8.6
conducted emission	wired network port	applicable	applicable	not applicable	ETSI EN 301 489-1 [1], clause 8.7

7.1.2 Methods of measurement and limits modifications

The modifications set out in table 4 below are related to the methods of measurement for EM emissions used in ETSI EN 301 489-1 [1], clause 8.

Table 4: Modifications to EM emission measurements

Reference to clauses in ETSI EN 301 489-1 [1]	Special product-related conditions, additional to or modifying the test conditions in ETSI EN 301 489-1 [1], clause 8
8.1: Test configuration; Methods of measurement and limits for EM emissions	Modes of operation to be investigated: <ul style="list-style-type: none"> • on a transmitter, the measurements shall be performed when transmitting at the highest rated power, and whilst in standby mode of operation; • the transmitter shall be modulated with the normal test modulation (see clause 4.5).
8.2: Enclosure port; Methods of measurement and limits for EM emissions	None
8.3: DC power input/output ports ; Methods of measurement and limits for EM emissions	None
8.4: AC mains power input/output ports ; Methods of measurement and limits for EM emissions	None
8.5: Harmonic current emissions (AC mains input port); Methods of measurement and limits for EM emissions	None
8.6: Voltage fluctuations and flicker (AC mains input port); Methods of measurement and limits for EM emissions	None
8.7: Wired network ports; Methods of measurement and limits for EM emissions	None

7.2 Immunity

7.2.1 General

EN 301 489-1 [1], table 3-Table 5 below contains the applicability of EMC immunity measurements requirements to the relevant ports of radio and/or associated ancillary equipment.

7.2.2 — Special conditions

The following special conditions set out below relate to the immunity test methods and performance criteria used in EN 301 489-1 [1], clause 9.

Table 4: Special conditions for EMC immunity tests

Table 5: Immunity Requirements and applicability

Reference to clauses in EN 301 489-1 [1]	Special product-related conditions, additional to or modifying the test conditions in EN 301 489-1 [1], clause 9
9.2.2: Test method; Radio frequency electromagnetic field	Level of the immunity RF test signal: <ul style="list-style-type: none"> — the test level over the frequency range 80 MHz to 1 400 MHz shall be 10V/m (measured unmodulated); — the test level over the frequency range 1400 MHz-2 000 MHz, shall be 3V/m (measured unmodulated)
9.4.2: Test method; Fast transients, common mode	Level of the immunity test signals: <ul style="list-style-type: none"> — the test level for signal, telecommunications, and control ports shall be 1 kV open circuit voltage; — the test level for DC power input ports shall be 2 kV open circuit voltage; — the test level for AC mains power input ports shall be 2 kV open circuit voltage. Test signal characteristics and application: <ul style="list-style-type: none"> — the test signal shall have 5/50 ns and 5 kHz characteristics; — for AC and DC power input ports the transients shall be applied (in parallel) to all the wires in the cable with reference to the cabinet reference ground (true common mode). The source impedance shall be 50 Ω; — where simultaneous AC and DC supply is possible, the DC supply shall be switched off.
9.5.2: Test method; Radio frequency, common mode	Level of the immunity RF test signal: <ul style="list-style-type: none"> — the test level shall be 10V rms; — where simultaneous AC and DC supply is possible, the DC supply shall be switched off; — when testing the DC power port, the AC supply shall be switched off.
9.7.2: Test method; Voltage dips and interruptions	Test signal characteristics and application: <ul style="list-style-type: none"> — where simultaneous AC and DC supply is possible, the DC supply shall be switched off.
9.8.2: Test method; Surges	Level of the immunity test signals: <ul style="list-style-type: none"> — the test level for telecommunication ports intended to be directly connected to a telecommunications network shall be 1 kV line to ground. In this case, the total output impedance of the surge generator shall be 2 Ω; — the test level for AC mains power input ports shall be 2 kV line to ground and 1 kV line to line, and the characteristics of the surge generator shall be 1,2/50 µs and 8/20. Test signal characteristics and application: <ul style="list-style-type: none"> — where simultaneous AC and DC supply is possible, the DC supply shall be switched off.

Phenomenon	Port	Applicability			Reference clause
		Fixed-Use	Vehicle Use	Portable-Use	
Radio Frequency electromagnetic field (80 MHz to 6 000 MHz)	enclosure port	applicable	applicable	applicable	clause 7.2.2, table 6
electrostatic discharge	enclosure	applicable	applicable	applicable	ETSI EN 301 489-1 [1], clause 9.3
fast transients common mode	signal, wired network and control ports	applicable	not applicable	not applicable	clause 7.2.2, table 6
	DC power ports	applicable	not applicable	not applicable	clause 7.2.2, table 6
	AC power ports	applicable	not applicable	not applicable	clause 7.2.2, table 6
RF common mode 0,15 MHz to 80 MHz	signal, wired network and control ports	applicable	not applicable	not applicable	clause 7.2.2, table 6
	DC power ports	applicable	not applicable	not applicable	clause 7.2.2, table 6
	AC power ports	applicable	not applicable	not applicable	clause 7.2.2, table 6
transients and surges	DC power input ports	applicable	applicable	not applicable	ETSI EN 301 489-1 [1], clause 9.6
voltage dips and interruptions	AC mains power input ports	applicable	not applicable	not applicable	clause 7.2.2, table 6
surges, line to line and line to ground	AC mains power input ports	applicable	not applicable	not applicable	clause 7.2.2, table 6
	wired network ports	applicable	not applicable	not applicable	clause 7.2.2, table 6

7.2.2 Test methods and levels modifications

The modifications set out in table 6 below are related to the immunity test methods and performance criteria used in ETSI EN 301 489-1 [1], clause 9.

Table 6: Modifications to EMC immunity tests

Reference to clauses in ETSI EN 301 489-1 [1]	Special product-related conditions, additional to or modifying the test conditions in ETSI EN 301 489-1 [1], clause 9
9.2: Radio frequency electromagnetic field (80 MHz to 6 000 MHz); Test methods and levels for immunity tests	None
9.2.2: Test method; Radio frequency electromagnetic field	Level of the immunity RF test signal: <ul style="list-style-type: none"> • the test level over the frequency range 80 MHz to 1 400 MHz shall be 10 V/m (measured unmodulated); • the test level over the frequency range 1 400 MHz to 6 000 MHz, shall be 3 V/m (measured unmodulated).
9.3: Electrostatic discharge; Test methods and levels for immunity tests	None
9.4: Fast transients, common mode; Test methods and levels for immunity tests	None
9.4.2: Test method; Fast transients, common mode	Level of the immunity test signals: <ul style="list-style-type: none"> • the test level for signal, telecommunications, and control ports shall be 1 kV open circuit voltage; • the test level for DC power input ports shall be 2 kV open circuit voltage; • the test level for AC mains power input ports shall be 2 kV open circuit voltage. Test signal characteristics and application: <ul style="list-style-type: none"> • the test signal shall have 5/50 ns and 5 kHz characteristics; • for AC and DC power input ports the transients shall be applied (in parallel) to all the wires in the cable with reference to the cabinet reference ground (true common mode). The source impedance shall be 50 Ω; • where simultaneous AC and DC supply is possible, the DC supply shall be switched off.
9.5: Radio frequency, common mode; Test methods and levels for immunity tests	None
9.5.2: Test method; Radio frequency, common mode	Level of the immunity RF test signal: <ul style="list-style-type: none"> • the test level shall be 10V rms; • where simultaneous AC and DC supply is possible, the DC supply shall be switched off; • when testing the DC power port, the AC supply shall be switched off.
9.6: Transients and surges in the vehicular environment; Test methods and levels for immunity tests	None

<u>Reference to clauses in ETSI EN 301 489-1 [1]</u>	<u>Special product-related conditions, additional to or modifying the test conditions in ETSI EN 301 489-1 [1], clause 9</u>
9.7: Voltage dips and interruptions; Test methods and levels for immunity tests	None
9.7.2: Test method; Voltage dips and interruptions	Test signal characteristics and application: <ul style="list-style-type: none"> • where simultaneous AC and DC supply is possible, the DC supply shall be switched off.
9.8: Surges Test methods and levels for immunity tests	None
9.8.2: Test method; Surges	Level of the immunity test signals: <ul style="list-style-type: none"> • the test level for telecommunication ports intended to be directly connected to a telecommunications network shall be 1 kV line to ground. In this case, the total output impedance of the surge generator shall be 2 Ω; • the test level for AC mains power input ports shall be 2 kV line to ground and 1 kV line to line, and the characteristics of the surge generator shall be 1,2/50 μs and 8/20. Test signal characteristics and application: <ul style="list-style-type: none"> • where simultaneous AC and DC supply is possible, the DC supply shall be switched off.

Annex A (normative): Definitions of ground based aeronautical informative): Relationship between the present document and the essential requirements of Directive 2014/53/EU

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.2] 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 communications equipment and repealing Directive 1999/5/EC [i.1].

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.

**A Table A.1: Relationship between the present document and
the essential requirements of Directive 2014/53/EU**

Harmonised Standard ETSI EN 301 489-22					
Requirement				Requirement Conditionality	
No	Description	Essential requirements of Directive	Clause(s) of the present document	U/C	Condition
1	Emissions: Enclosure of ancillary equipment measured on a standalone basis	3.1(b)	Clause 7.1	U	
2	Emissions: DC power input/output ports	3.1(b)	Clause 7.1	C	Only where equipment has DC power input and/or output ports with a cable length greater than 3 m or from a vehicle power supply
3	Emissions: AC mains power input/output ports	3.1(b)	Clause 7.1	C	Only where equipment has AC mains power input and/or output ports
4	Emissions: Harmonic current emission (AC mains input port)	3.1(b)	Clause 7.1	C	Only where equipment has AC mains power input ports
5	Emissions: Voltage fluctuations and flicker (AC mains input ports)	3.1(b)	Clause 7.1	C	Only where equipment has AC mains power input ports
6	Emissions: Wired network ports	3.1(b)	Clause 7.1	C	Only where equipment has wired network ports
7	Immunity: Radio frequency electromagnetic field (80 MHz to 6 000 MHz)	3.1(b)	Clause 7.2	U	
8	Immunity: Electrostatic discharge	3.1(b)	Clause 7.2	U	
9	Immunity: Fast transients common mode	3.1(b)	Clause 7.2	C	Only where equipment has AC mains power input ports or DC power ports or wired network ports with cables longer than 3 m
10	Immunity: Radio frequency common mode	3.1(b)	Clause 7.2	C	Only where equipment has AC mains power input ports or DC power ports or wired network ports with cables longer than 3 m
11	Immunity: Transients and surges in the vehicular environment	3.1(b)	Clause 7.2	C	Only where equipment is fitted to a vehicle power supply
12	Immunity: Voltage dips and interruptions	3.1(b)	Clause 7.2	C	Only where equipment has AC mains power input ports

Harmonised Standard ETSI EN 301 489-22					
Requirement				Requirement Conditionality	
No	Description	Essential requirements of Directive	Clause(s) of the present document	U/C	Condition
13	Immunity: Surges, line to line and line to ground	3.1(b)	Clause 7.2	C	Only where equipment has AC mains power input ports and/or wired network ports

Key to columns:**Requirement:**

No A unique identifier for one row of the table which may be used to identify a requirement.

Description A textual reference to the requirement.

Essential requirements of Directive

Identification of article(s) defining the requirement in the Directive.

Clause(s) of the present document

Identification of clause(s) defining the requirement in the present document unless another document is referenced explicitly.

Requirement Conditionality:

U/C Indicates whether the requirement is unconditionally applicable (U) or is conditional upon the manufacturer's claimed functionality of the equipment (C).

Condition Explains the conditions when the requirement is or is not applicable for a requirement which is classified "conditional".

Presumption of conformity stays valid only as long as a reference to the present document is maintained in the list published in the Official Journal of the European Union. Users of the present document should consult frequently the latest list published in the Official Journal of the European Union.

Other Union legislation may be applicable to the product(s) falling within the scope of the present document.

Annex B (normative): Minimum Performance Levels (MPL)

B.1 Ground based aeronautical VHF and UHF radio communications equipment

~~The present document, applies to ground base station, ground mobile and hand held/portable aeronautical~~The minimum performance levels for VHF and UHF radio communications and associated ancillary equipment, shall be as follows:

- A receiver Signal-to-noise and distortion ratio (SINAD) of 12 dB (minimum value) as defined in clause 8.1 of ETSI EN 300 676-1 [4] and clause 7.1 of ETSI EN 302 617 [5].

~~Ground based aeronautical VHF radio communications equipment in the scope of the present document are characterized by the following operating conditions:~~

- ~~operating in the frequency range 118 MHz to 136,975 MHz, at 8,33 kHz or 25 kHz channel spacing;~~
- ~~using DSB AM, GFSK or D8PSK modulation; and~~

~~comprises ground base station, mobile, and hand held/portable applications.~~

- AA transmitter audio Total Harmonic Distortion (THD) of 10 % (maximum value) as defined in clause 7.4.3 of ETSI EN 300 676-1 [4] and clause 6.4.3 of ETSI EN 302 617 [5].

B.2 Ground based aeronautical VDL VHF Digital Link Mode 2 (VDL Mode 2) and Mode 4 (VDL Mode 4 radio communications equipment 4)

~~The present document also covers EMC requirements for~~minimum performance levels shall be as follows:

For VDL Mode 2:

- Uncorrected BER of 10^{-3} (maximum value) as defined in clause 6.2 of ETSI EN 301 841-1 [2].

For VDL Mode 4:

- BER of 10^{-4} (maximum value) as defined in clause 6.1.2 of ETSI EN 301 842-1 [3].

Annex C (informative): Test Report

The following information should be recorded in the test report:

- the functions of the radio equipment to be assessed during and after the EMC exposure;
- the intended functions of the radio equipment which should be in accordance with the documentation accompanying the equipment;
- the user control functions and VDL Mode 4 ground base station stored data that are required for normal operation and the method to be used to assess whether these have been lost after the EMC exposure;
- the type of modulation, the characteristics of the transmission used for testing (random bit stream, message format, etc.) and the necessary test equipment delivered to enable the assessment of the EUT;
- the ancillary equipment to be combined with the radio equipment- for testing (where applicable);
- an exhaustive list of ports, with the maximum cable lengths allowed, classified as either power or telecommunication/signal/control. Power ports should further be classified as AC or DC power;
- the bandwidth of the IF filter immediately preceding the demodulator or equivalent system bandwidth;
- the method to be used to verify that a communication link is established and maintained (if appropriate);
- the operating frequency bands over which the equipment is intended to operate;
- any equipment thermal limitation which prevent continuous testing of the EUT;
- the environment(s) in which the equipment is intended to be used;
- the occupied bandwidth of the corresponding transmitter signal for non-channelized equipment;
- a list of service connectors or programming connectors;

- details of the mechanism for manual recovery of normal operation should be provided in the user documentation;
- the EUT software version used during the test;
- exclusion bands applied.

Annex D (informative): Change history

<u>Version</u>	<u>Information about changes</u>
<u>2.1.1</u>	<u>First version under the Radio Equipment Directive</u>

History

Document history		
V1.1.1	December 2000	Publication
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V1.3.1	July 2003	One step Approval Procedure OAP 20031121: 2003-07-23 to 2003-11-21
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