Final draft ETSI EN 301 489-28 V2.1.1 (2024-09)

ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 28: Specific conditions for wireless digital video links; Harmonised Standard for ElectroMagnetic Compatibility

Reference
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Foreword

This final draft European Standard (EN) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM), and is now submitted for the Vote phase of the ETSI Standardisation Request deliverable Approval Procedure.

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.3] 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 28 of a multi-part deliverable. Full details of the entire series can be found in part 1 [1].

Proposed national transposition dates	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	18 months after doa

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.

1 Scope

The present document specifies the applicable test conditions, performance assessment and performance criteria for wireless digital video links operating in the frequency band 1,3 GHz to 50 GHz and the associated ancillary equipment, in respect of electromagnetic compatibility.

Technical specifications related to the antenna port and emissions from the enclosure port of the radio equipment are not included in the present document. Such technical specifications are found in the relevant product standard for the effective use of the radio spectrum, see table 1.

Table 1: Radio Technologies in scope of the present document

Technology	ETSI Standard
Wireless Video Links operating in the 1,3 GHz to 50 GHz frequency band	ETSI EN 302 064 [i.2]

Technical specifications related to conducted emission EMC requirements below 9 kHz on the AC mains port of radio equipment are not included in the present document.

NOTE 1: Such technical specifications are normally found in the relevant product family standards for AC mains powered equipment (e.g. EN IEC 61000-3-2/A2 [i.4] and EN 61000-3-3/A2 [i.5]).

NOTE 2: The relationship between the present document and essential requirements of article 3.1(b) of Directive 2014/53/EU [i.1] is given in annex A.

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 (V2.2.3) (11-2019): "ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements; Harmonised Standard for ElectroMagnetic Compatibility".

2.2 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] ETSI EN 302 064: "Wireless Digital Video Links operating in the 1,3 GHz to 50 GHz frequency band; Harmonised Standard for access to radio spectrum".

[i.3] 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.4] EN IEC 61000-3-2:(2019)/A2:(2024): "Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)", (produced by CENELEC).

[i.5] EN 61000-3-3:(2013)/A2:(2021): "Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection", (produced by CENELEC).

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:

ancillary equipment: electrical or electronic equipment, that is intended to be used with a receiver or transmitter

NOTE 1: It is considered as an ancillary equipment if:

- the equipment is intended for use with a receiver or transmitter to provide additional operational and/or control features to the radio equipment (e.g. to extend control to another position or location);
- the ancillary equipment cannot be used without being connected to radio equipment to provide user functions independently of a receiver or transmitter; and
- the receiver or transmitter, to which it is connected, is capable of providing some intended operation such as transmitting and/or receiving without the ancillary equipment (i.e. it is not a sub-unit of the main equipment essential to the main equipment basic functions).

NOTE 2: An example of ancillary equipment would be a docking station for radio equipment whose interface is dedicated to a particular product or range of products.

integral antenna: antenna designed to be connected to the equipment without the use of a 50 Ω external connector and considered to be part of the equipment

NOTE: An integral antenna may be fitted internally or externally to the equipment.

quasi-error-free: transmission error rate less than one uncorrected event per hour, which corresponds to a specific BER threshold for each signal type

switching range: maximum frequency range over which the receiver or transmitter can be operated without reprogramming or realignment

3.2 Symbols

Void.

3.3 Abbreviations

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

AC	Alternating Current
BER	Bit Error Rate
DC	Direct Current
DVB-S2	Digital Video Broadcast - Satellite (second generation)
DVB-T	Digital Video Broadcast - Terrestrial
DVB-T2	Digital Video Broadcast - Terrestrial (second generation)
EFTA	European Free Trade Association
EMC	ElectroMagnetic Compatibility
EUT	Equipment Under Test
FEC	Forward Error Correction
LDPC	Low Density Parity Check
LONM	Loss Of Noise Margin
QEF	Quasi-Error-Free
RF	Radio Frequency
TS	Transport Stream

4 Test conditions

4.1 General

For the purposes of the present document, the test conditions of ETSI EN 301 489-1 [1], clause 4 shall apply as appropriate. Further product related test conditions for wideband data communications systems are specified in clauses 4.2 to 4.3.

Whenever the EUT is provided with a detachable antenna, it shall be tested with the antenna fitted in a manner typical of normal intended use.

For immunity tests, if the equipment is of a category which permits it, a communications link shall be established at the start of the test and maintained during the test.

The environmental classification and the emission and immunity requirements used in the present document are as stated in ETSI EN 301 489-1 [1], except for any special conditions included in the present document.

The test conditions shall be as follows:

- the transmitter shall be operated at its normal maximum RF output power modulated with a test signal which represents the normal operation of the equipment for its intended use (see clause 4.2.1);
- for standalone receivers or receivers of transceivers operating in simplex mode, the wanted RF input signal, coupled to the receiver, shall be modulated with a test signal which represents the normal operation of the equipment for its intended use (see clause 4.2.3);

- for duplex transceivers, the wanted RF input signal, coupled to the receiver, shall be modulated with a test signal which represents the normal operation of the equipment for its intended use (see clause 4.2.3). The transmitter shall be operated at its normal maximum output power, modulated with the test modulation signal, coupled to the transmitter from the output of the receiver (repeater mode).

4.2 Arrangements for test signals

4.2.1 Arrangements for test signals at the input of transmitters

The provisions of ETSI EN 301 489-1 [1], clause 4.2.1 shall apply.

4.2.2 Arrangements for test signals at the output of transmitters

The provisions of ETSI EN 301 489-1 [1], clause 4.2.2 shall apply.

4.2.3 Arrangements for test signals at the input of receivers

The provisions of ETSI EN 301 489-1 [1], clause 4.2.3 shall apply.

4.2.4 Arrangements for test signals at the output of receivers

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

4.2.5 Arrangements for testing transmitter and receiver together (as a system)

The provisions of ETSI EN 301 489-1 [1], clause 4.2.0 shall apply.

4.3 Exclusion bands

4.3.1 General

For EUT that operate above 6 GHz there is no exclusion band specified as test ranges stop at 6 GHz.

4.3.2 Receiver and receivers of transceivers Exclusion band

The exclusion band for receivers and receiver sections of transceivers is the band of frequencies over which no immunity tests with radiated RF are made as defined in clause 4.3.3 of ETSI EN 301 489-1 [1].

4.3.3 Transmitter and transmitters of transceivers Exclusion band

The exclusion band for transmitters and transmitter sections of transceivers is the band of frequencies over which no immunity tests with radiated RF are made.

The exclusion band for transmitters is as defined in clause 4.3.2 of ETSI EN 301 489-1 [1].

5 Performance assessment

5.1 General

At the time of submission of the equipment for test, the following parameters of the intended use should be supplied to be recorded in the test report:

- the coupling means to be used for the application of the modulation signal to the EUT and for monitoring the output of the EUT; and
- level and description of the RF test signal for the establishment of the communications link;
- description of test fixtures;
- the type of the equipment, for example: stand-alone or plug-in radio device;
- Any host equipment to be combined with the radio equipment for testing;
- the minimum performance level under the application of EMC stress (see clause 6).

5.2 Ancillary equipment

The provision of ETSI EN 301 489-1 [1], clause 5 shall apply.

5.3 Assessment procedures

The performance assessment shall be based upon:

- maintaining the function(s);
- the way the eventual loss of function(s) can be recovered;
- unintentional behaviour of the EUT.

The test system shall set up a communications link in the same manner as the Equipment Under Test's (EUT) intended use.

Any user defined data fields in the memory or storage of the EUT shall be filled in a way representative of intended use.

The assessment procedure shall verify that the communications link is maintained and that there is no loss of user control functions or loss of critical stored data.

Where the EUT is capable of operation in multiple frequency bands, each band shall be subject to assessment.

Where the EUT is capable of operating in multiple radio technologies, the operation of each technology shall be assessed.

For radio technologies within the scope of the present document that are intended to be permanently operational, assessing the radio in idle mode is not considered necessary.

6 Performance criteria

6.1 General performance criteria

6.1.1 General

The equipment shall meet the performance criteria specified in the present clause and clauses 6.2 and 6.3 as appropriate.

Establishing and maintaining a communications link shall be assessed using an indicator which may be part of the test system or the EUT. This communications link and the assessment of loss of noise margin at the Quasi-Error-Free (QEF) point are used as performance criteria to ensure that all primary functions of the transmitter and receiver are evaluated during the immunity tests. In addition, the test shall also be performed in idle mode to ensure the transmitter does not unintentionally operate.

6.1.2 Choice of measurement device and QEF methods

There are two methods that can be used to determine the QEF threshold, each is suited to a different type of measurement device. The choice of method depends the interfaces accessible on the receiver:

1) Direct method:

   - For receivers where the received TS data is available, the packets are compared to those transmitted from the signal generator and the TS BER will be computed. When this method is used the QEF condition corresponds to TS BER of 1×10^{-11}. The measurement device for this method may be a Transport Stream Analyser or a BER test mode of the "wanted" signal generator using a "loop back" cable from the EUT.

2) Indirect method:

   - For receivers where the received TS data is unavailable but BER telemetry from the output of the inner FEC decoder is, then this data may be used to determine the QEF condition. The measurement device for this method may be a diagnostic mode of the receiver or other data terminal equipment required to interrogate the BER registers within the receiver. The specific BER threshold for QEF depends on the signal type used:

     - For DVB-T systems, the output of the Viterbi decoder shall be monitored where a BER of 2×10^{-4} corresponds to the QEF condition.

     - For DVB-T2 & DVB-S2 systems, the output of the LDPC decoder shall be monitored where a BER of 1×10^{-7} corresponds to the QEF condition.

     - For other systems, the necessary threshold BER at the output of the inner decoder may be calculated from the outer FEC performance at a TS BER of 1×10^{-11}.

6.2 Performance criteria for Continuous phenomena

A communication link shall be established at the start of the test, and maintained during the test, see clauses 4.2.2, 4.2.3, 4.2.4 and 4.2.5.

Prior to the test, the attenuator at the support receiver input shall be adjusted to obtain operation at the QEF point.

During the test, the attenuator shall be readjusted so that the communication link is again operating at the QEF point.

The degree of the attenuator adjustment required to achieve this shall be noted. This shall be known as the Loss Of Noise Margin (LONM).

The LONM shall not exceed 3 dB.

6.3 Performance criteria for Transient phenomena

A communications link shall be established at the start of the test, see clauses 4.2.2, 4.2.3, 4.2.4 and 4.2.5.

Prior to the test, the attenuator at the support receiver input shall be set to obtain operation at the QEF point.

During the test, the attenuator may be readjusted so that the communication link is operating at the QEF point. The degree of the attenuator adjustment required to achieve this shall be noted. This is known as the Loss Of Noise Margin (LONM).

The LONM shall not exceed 3 dB.

7 Applicability overview

7.1 Emission

7.1.1 General

The following emission requirements set out in table 2 shall apply.

The EUT test configuration shall be in accordance with ETSI EN 301 489-1 [1], clause 8.1.2.

Table 2: Emission requirements

Phenomenon	Port	Applicability			Reference clause
		Fixed equipment	Vehicular equipment	Portable equipment	
radiated emission	enclosure of ancillary equipment	applicable	applicable	applicable	ETSI EN 301 489-1 [1], clause 8.2
conducted emission	DC power input/output	applicable	applicable	not applicable	ETSI EN 301 489-1 [1], clause 8.3
conducted emission	AC mains input/output	applicable	not applicable	not applicable	ETSI EN 301 489-1 [1], clause 8.4
conducted emission	signal, wired network and control	applicable	not applicable	not applicable	ETSI EN 301 489-1 [1], clause 8.7

Portable equipment, or combinations of equipment, capable of being powered for intended use by the main battery of a vehicle shall additionally be considered as vehicular equipment.

Portable or vehicular equipment, or combinations of equipment, capable of being powered for intended use by AC mains shall additionally be considered as fixed equipment.

7.1.2 Special conditions

The following special conditions set out in table 3, relate to the emission test methods used in ETSI EN 301 489-1 [1], clause 8 and shall apply.

Table 3: Special conditions for EMC 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
8.1.2 Test configuration; Methods of measurement and limits for EMC emissions	The radio equipment shall be operated on one channel frequency, at the lowest, middle and upper frequency for each operating band. In transmit mode of operation, the transmitter shall be operated to obtain its maximum rated RF power.

7.2 Immunity

7.2.1 General

The following immunity requirements set out in table 4 shall apply.

Table 4: Immunity test requirements

Phenomenon	Port	Applicability			Reference clause	Performance Criteria clauses
		Fixed equipment	Vehicular equipment	Portable equipment		
RF electromagnetic field (80 MHz to 6 000 MHz)	Enclosure	applicable	applicable	applicable	ETSI EN 301 489-1 [1], clauses 9.2.1 and 9.2.2	6.2
electrostatic discharge	Enclosure	applicable	applicable	applicable	ETSI EN 301 489-1 [1], clauses 9.3.1 and 9.3.2	6.3
fast transients common mode	Signal, wired network and control	applicable	not applicable	not applicable	ETSI EN 301 489-1 [1], clauses 9.4.1 and 9.4.2	6.3
	DC power	applicable	not applicable (see note 1)	not applicable		6.3
	AC mains power	applicable	not applicable	not applicable		6.3
RF common mode 0,15 MHz to 80 MHz	Signal, wired network and control	applicable	applicable	not applicable	ETSI EN 301 489-1 [1], clauses 9.5.1 and 9.5.2	6.2
	DC power	applicable	applicable	not applicable		6.2
	AC mains power	applicable	applicable	not applicable		6.2
transients and surges in Vehicular environment	DC power input	not applicable	applicable	not applicable	ETSI EN 301 489-1 [1], clauses 9.6.1 and 9.6.2	6.3 (see note 2)
voltage dips and interruptions	AC mains power input	applicable	not applicable	not applicable	ETSI EN 301 489-1 [1], clauses 9.7.1 and 9.7.2	6.3
surges, line to line and line to ground	AC mains power input	applicable	not applicable	not applicable	ETSI EN 301 489-1 [1], clauses 9.8.1 and 9.8.2	6.3
	Wired network	applicable	not applicable (see note 1)	not applicable		6.3
NOTE 1: This requirement is covered by the transients and surges test on DC power input ports. NOTE 2: For pulses 3a & 3b, the performance criteria for continuous phenomena shall apply (see clause 6.2).						

Portable equipment, or combinations of equipment, capable of being powered for intended use by the main battery of a vehicle shall additionally be considered as vehicular equipment. Portable or vehicular equipment, or combinations of equipment, capable of being powered for intended use by AC mains shall additionally be considered as fixed equipment.

7.2.2 Special conditions

The following special conditions set out in table 5, relate to the immunity test methods and performance criteria used in ETSI EN 301 489-1 [1], clause 9 and shall apply.

Table 5: Special conditions for 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
9.1 Test configuration; Test methods and levels for immunity tests	For immunity tests of transmitters, the transmitter shall be operated at its maximum rated RF output power.

Annex A (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.3] 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.

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

Harmonised Standard ETSI EN 301 489-28					
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)	7.1	U	
2	Emissions: DC power input/output ports	3.1(b)	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)	7.1	C	Only where equipment has AC mains power input and/or output ports
4	Emissions: Signal, wired network and control ports	3.1(b)	7.1	C	Only applies to fixed equipment with a cable length greater than 3 m
5	Immunity: Radio frequency electromagnetic field (80 MHz to 6 000 MHz)	3.1(b)	7.2	U	
6	Immunity: Electrostatic discharge	3.1(b)	7.2	U	
7	Immunity: Fast transients common mode	3.1(b)	7.2	C	Only applies to fixed equipment
8	Immunity: Radio frequency common mode	3.1(b)	7.2	C	Only applies to fixed equipment
9	Immunity: Transients and surges in the vehicular environment	3.1(b)	7.2	C	Only applies to vehicular where equipment
10	Immunity: Voltage dips and interruptions	3.1(b)	7.2	C	Only where equipment has AC mains power input ports
11	Immunity: Surges, line to line and line to ground	3.1(b)	7.2	C	Only applies to fixed equipment

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 (informative): Change history

Version	Information about changes
2.1.1	• Alignment with ETSI EN 301 489-1 (V2.2.3). • New methods to determine the QEF threshold. • Removing manufacturer defined test conditions • Added emission requirements for signal and control ports • Excluding emission requirement below 9 kHz

History

Document history				
V1.1.1	September 2004	Publication		
V2.1.0	November 2022	EN Approval Procedure	AP 20230216:	2022-11-18 to 2023-02-16
V2.1.1	September 2024	SRdAP process	VA 20241119:	2024-09-20 to 2024-11-19