Draft ETSI EN 303 417 V1.1.0 (2016-12)

Wireless power transmission using technologies other than radio frequency beam in the 19 - 21 kHz, 59 - 61 kHz, 79 - 90 kHz, 100 - 300 kHz, 6 765 - 6 795 kHz ranges; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU

Reference
DEN/ERM-TG28-527

Keywords
Harmonised standard, radio, WPT, testing

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Contents

Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (https://ipr.etsi.org/).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Foreword

This draft Harmonised European Standard (EN) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM), and is now submitted for the combined Public Enquiry and Vote phase of the ETSI standards EN Approval Procedure.

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.6] 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.3].

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.

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.

Introduction

The present document has been prepared to conform to the requirements of the new Radio Equipment Directive 2014/53/EU [i.3]. The present document covers wireless power transmission (WPT) systems using technologies other than radio frequency beam in the frequency ranges 19 - 21 kHz, 59 - 61 kHz, 79 - 90 kHz, 100 - 300 kHz, 6 765 - 6 795 kHz.

In the context of the present document "power transmission via radio frequency beam" means power transmission by radio waves.

The present document is structured as follows:

Clauses 1 through 3 provide a general description on the types of equipment covered by the present document and the definitions, symbols and abbreviations used.

Clause 4 provides the technical requirements specifications, limits and conformance relative to transmitter and receiver.

Clauses 5 specifies the conditions for testing of the equipment and interpretation of the measurement results with the maximum measurement uncertainty values.

Clause 6 specifies the required measurement methods.

Annex A (informative) provides the relationship between the present document and the essential requirements of Directive 2014/53/EU [i.3].

Annex B (normative) provides the measurement setup specifically for Electric Vehicles.

1 Scope

The present document specifies technical characteristics and methods of measurements for wireless power transmission (WPT) systems using technologies other than radio frequency beam in the 19 - 21 kHz, 59 - 61 kHz, 79 - 90 kHz, 100 - 300 kHz, 6 765 - 6 795 kHz ranges.

For the purpose of the present document WPT systems are classified into three different cases according to Table 1.

Table 1: Distinction between WPT systems cases with regard to the communication technology

WPT Cases (see note 3)	RE-D article 3.2	RE-D article 3.1b	EMC-D
1: only energy transmission, no data communication	N/A	N/A	CENELEC EN 55011 [i.7] Group 2 (or more specific CENELEC standard if applicable), see note 1
2: energy transmission and data communication in frequency ranges covered by the present document	ETSI EN 303 417 (the present document)	ETSI EN 301 489-1 [i.8] ETSI EN 301 489-3 [i.9]	N/A
3: energy transmission in frequency ranges covered by the present document and data communication in different frequency ranges	Based on the communication function, this case is a "combined equipment" according to RE-D (see ETSI EG 203 367 [i.5]). Therefore, two options for homologation could be used: • Option 1: energy transmission frequencies (the present document), data communication frequencies: related ETSI standard • Option 2: energy transmission frequencies CENELEC EN 55011 [i.7] (see note 1 and note 2), data communication frequencies: related ETSI standard		
NOTE 1: WPT systems are expected to be included in future revision of CENELEC EN 55011 [i.7]. NOTE 2: CENELEC EN 55011 [i.7] are to be listed under the related articles in the OJEU for RE-D. NOTE 3: The division into these three cases could change once ITU has finalized their work on WPT-systems in response to Question ITU-R 210-3/1 and WRC 19 Agenda Item 9.1, Issue 9.1.6 [i.11].			

The present document covers wireless power transfer systems according to cases 2 and 3 of Table 1, i.e. systems which consist of:

1) A power transmitter, with additional communication capability to control the charge function in conjunction with the receiving part. The power transmitter could also be named as charger.

2) A receiver, which supplies the received energy to a battery and performs a control/supervision function for the battery status and charge operation.

Both parts in combination are able to transmit and receive data in addition to the power transfer mode e.g. to control the battery status and to optimize the transfer mode.

These radio equipment types are capable of operating in the permitted frequency bands below 30 MHz as specified in Table 2.

The present document covers fixed systems, mobile and portable systems.

The limits and the frequency ranges of the present document are based on 2013/752/EU [i.2] and ERC/REC 70-03 [i.1].

For the clarification of open questions for high power wireless power transmission systems to charge vehicles a SRdoc ETSI TR 103 409 [i.4] was prepared. New specific requirements for such systems (e.g. higher H-field emission limits in the 79 - 90 kHz band) will be reflected within a future revision of the present document.

Table 2: WPT devices within the permitted frequency bands below 30 MHz

	Frequency Bands	Applications
Transmit and Receive	19 kHz to 21 kHz	WPT systems
Transmit and Receive	59 kHz to 61 kHz	WPT systems
Transmit and Receive	79 kHz to 90 kHz	WPT systems
Transmit and Receive	100 kHz to 119 kHz	WPT systems
Transmit and Receive	119 kHz to 140 kHz	WPT systems
Transmit and Receive	140 kHz to 148,5 kHz	WPT systems
Transmit and Receive	148,5 kHz to 300 kHz	WPT systems
Transmit and Receive	6765 kHz to 6795 kHz	WPT systems

NOTE 1: Ranges listed in Table 2 are also used for SRD, inductive devices, generic use.

NOTE 2: It should be noted that Table 2 represents the most widely implemented position within the European Union and the CEPT countries. At the time of preparation of the present document the frequency usage condition for all frequency bands were harmonised in the European Union.

NOTE 3: In addition, it should be noted that other frequency bands may be available in a country within the frequency range below 30 MHz.

The present document contains covers the essential requirements of article 3.2 of Directive 2014/53/EU [i.3] under the conditions identified in annex A.

2 References

2.1 Normative references

References are specific, identified by date of publication and/or edition number or version number. Only the cited version 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 300 330 (V2.1.1) (11-2016): "Short Range Devices (SRD); Radio equipment in the frequency range 9 kHz to 25 MHz and inductive loop systems in the frequency range 9 kHz to 30 MHz; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU".

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] CEPT/ERC/REC 70-03: "Relating to the use of Short Range Devices (SRD)".

[i.2] EC Decision 2013/752/EU: "Commission implementing Decision of 11 December 2013 amending Decision 2006/771/EC on harmonisation of the radio spectrum for use by short-range devices and repealing Decision 2005/928/EC.

[i.3] 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 Text with EEA relevance.

[i.4] ETSI TR 103 409: "System Reference document (SRdoc); Wireless Power Transmission (WPT) systems for Electric Vehicles (EV) operating in the frequency band 79 - 90 kHz".

[i.5] ETSI EG 203 367: "Guide to the application of harmonised standards covering articles 3.1b and 3.2 of the Directive 2014/53/EU (RED) to multi-radio and combined radio and non-radio equipment".

[i.6] 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.7] CENELEC EN 55011: " Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement".

[i.8] ETSI EN 301 489-1: "ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements; Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU and the essential requirements of article 6 of Directive 2014/30/EU".

[i.9] ETSI EN 301 489-3: "ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 3: Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 246 GHz; Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU".

[i.10] CISPR document CIS/B/663/CD: "Amendment 2 (f1) to CISPR 11: Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement - Requirements for air-gap wireless power transfer (WPT)".

[i.11] Question ITU-R 210-3/1 and WRC 19 Agenda Item 9.1, Issue 9.1.6.

NOTE: Available at http://www.itu.int/pub/R-QUE-SG01.210.

3 Definitions, Symbols and Abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in ETSI EN 300 330 [1] and the following apply:

alignment: process of finding or mechanical implementation of the relative position of transmitter and receiver coil which allows a safe and efficient power transfer

NOTE: This alignment leads to the mechanical arrangement in which WPT system is designed to operate.

battery: transmitting/receiving mobile part of the Wireless Power Transmission (WPT) system, a combination of a coil, communication device and energy storage in one housing

charger: transmitting/receiving stationary part of the Wireless Power Transmission (WPT) system

co-Location: WPT systems are designed to work within an alignment

NOTE: All operation mode have such a close proximity between the parts of the WPT system compared to the wave-length that the parts of the WPT system (charger/battery) can be seen as co-located.

Electric Vehicle (EV): vehicle using one or more electric motors for propulsion

power transfer via radio frequency beam: power transfer by radio waves

test volume: volume in which the representative geometrical WPT system is in, including all cables, auxiliaries etc.

vehicle emulator: necessary transmitting/receiving parts for a EV Wireless Power Transmission (WPT) system (coil, communication device and representative mechanical vehicular arrangement)

worst-case alignment: alignment of primary coil (in the charger) and secondary coil (on the EV) which represents the worst case (e.g. with regards to emissions or efficiency)

NOTE: Typically, this is the case of lowest coupling between primary and secondary coil.

WPT system: combination of charger and battery as declared for the typical use-case

3.2 Symbols

For the purposes of the present document, the symbols given in ETSI EN 300 330 [1] apply.

L1, L2 connection points for ISN

NOTE: See clause 6.2.4.

3.3 Abbreviations

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

CISPR	Comité International Spécial des Perturbations Radioélectriques
EUT	Equipment Under Test
EV	Electric Vehicle
ISN	Impedance Stabilization Network
OATS	Open Area Test Site
OBW	Operating BandWidth
OOB	Out-Of-band
SAC	Semi Anechoic Chamber
WPT	Wireless Power Transmission

4 Technical requirements

4.1 Environmental conditions

The technical requirements of the present document apply under the environmental profile for operation of the equipment, which shall be declared by the manufacturer. The equipment shall comply with all the technical requirements of the present document which are identified as applicable in annex A at all times when operating within the boundary limits of the declared operational environmental profile. The test conditions are defined in clause 5.3.

4.2 General

4.2.1 Background information

In this clause all general considerations for the testing of wireless power transmission (WPT) systems using technologies other than radio frequency beam in the 19 - 21 kHz, 59 - 61 kHz, 79 - 90 kHz, 100 - 300 kHz, 6 765 - 6 795 kHz ranges are given. The tests cover all different operational modes, as described in clause 4.2.3.

All permitted ranges of operation of the equipment (see clause 4.3.2) shall be declared by the equipment manufacturer.

The modulation and energy transfer of the WPT system during testing should be representative of normal use of the equipment. The manufacturer shall employ each implemented mode of operation of the equipment (see clause 4.2.3) which results in power transmission out of the WPT system which would be available in operation, and should ensure that the requirements in clause 4.3 and clause 4.4 are fulfilled.

4.2.2 Wanted performance criteria

A WPT system always consists of a charger and a battery which are in proximity to each other. The performance of a WPT system is dependent on the related operational mode, see clause 4.2.3.

Based on the different specific operational modes, additional dedicated RX requirements (e.g. blocking, ACS) cannot be specified for WPT systems, see clause 4.4.

Therefore, the manufacturer shall declare and publish the performance criteria used to determine the performance of the receiving parts inside the WPT system (related to the mode).

4.2.3 WPT operational modes

Because of the close interaction between charger and battery the manufacturer shall provide all necessary parts for the presentation of equipment and for testing purposes. The description of the setup including the positioning and mechanical orientation of both parts shall be provided since this affects the radiated emissions. For using different batteries or power receiving parts with one charger, the manufacturer shall declare the typical and the worst case combinations with regard to radiated emissions and provide such combinations for testing.

In certain cases it may be not possible to provide the necessary samples of batteries due to unavailability. In these cases the manufacturer has to declare that the charger was developed based on certain batteries and such charger/battery combinations shall be provided for testing.

The manufacturer shall declare for each possible operation mode of the WPT system (overview see Table 3):

a) charging mode/power transfer/system in resonance;

b) communication mode (data transmission from and to the battery);

c) determination of the charging action e.g. to find the resonance frequency of the system or optimal charging parameters of the WPT systems.

Additional declarations to establish the appropriate test conditions:

a) the mechanical setup/alignment;

b) the maximum allowed values for the x-y-z offset within the alignment (worst-case alignment)

c) the mechanical orientation;

d) the permitted range of frequencies;

e) the range of operating conditions including the duty cycle or pulsing operational parameter;

f) power requirements;

g) information about which part of the WPT System can be interpreted as transmitter (mode dependent).

The measurements itself shall be done on these actual set-up and operating conditions for each mode.

NOTE: If during the initial establishment of the charging mode (mode 2 from Table 3), no or very low emission are occurring, this initialization mode can be declared as irrelevant for the test.

Table 3: Overview of operational modes within a WPT system

Operational Mode	Set-up	Function of charging pad / charger	Function of battery	Test scenario	Conformance Requirements
Mode 1: charger in stand-by, idle mode	single device	Transmitter	Not applicable	Single radiation test (TX) with the charger/charging pad. The test set-up as described in clause 6.1.2 shall be used	• Operating frequency range (clause 4.3.3) • H-Field emission (clause 4.3.4) • TX spurious (clauses 4.3.5 and 4.3.6) • Performance criteria test (RX test) (clause 4.4)
Mode 2: Communication before charging, adjustment charging mode / position	In combination	TX and RX	TX and RX	Specific test setup, declared by the manufacturer. Manufacturer shall declare the maximal distance between charger and battery the WPT system is able to communicate This distance could larger as in the worst case alignment. The test setup- up shall be performed with the largest communication distance The test set-up as described in clause 6.1.3 shall be used	• Operating frequency range (clause 4.3.3) • H-Field emission (clause 4.3.4) • TX spurious (clauses 4.3.5 and 4.3.6) • Wanted performance criteria test (RX test) (clause 4.4)
Mode 3: Communication during charging	WPT system alignment	TX and RX	TX and RX	Worst case alignment Both tests can be performed within one set-up, worst-case alignment The test set-up as described in clause 6.1.4 shall be used	• Operating frequency range (clause 4.3.3) • H-Field emission (clause 4.3.4) • TX spurious (clauses 4.3.5 and 4.3.6) • Wanted Performance criteria test (RX test) (clause 4.4)
Mode 4: Charging	WPT system alignment	TX	RX		

4.2.4 Presentation of equipment for testing purposes

4.2.4.1 General

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

The manufacturer shall declare the permitted frequency ranges (see clause 4.4.2), the range of operating conditions and power requirements as applicable, to establish the appropriate test conditions.

Additionally, technical documentation and operating manuals, sufficient to make the test, shall be supplied.

If a WPT system is designed to operate with different system mode (see clause 4.2.3), measurement of each mode shall be performed, according to the present document, on samples of equipment defined in clause 4.2.4.2.

To simplify and harmonize the testing procedures between different testing laboratories, measurements shall be performed, according to the present document, on samples defined in clauses 4.2.4.2 to 4.2.4.4.

4.2.4.2 Choice of model for testing

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

Standalone WPT systems shall be offered by the manufacturer complete with any ancillary equipment needed for testing.

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

The performance of the WPT system submitted for testing shall be representative of the performance of the corresponding production model.

4.2.4.3 Testing of WPT systems

If a family of WPT systems has alternative radiated field strengths provided by the use of separate power modules or add on stages, then these shall be declared by the manufacturer. Each module or add on stage shall be tested in combination with the equipment. As a minimum, measurements of the radiated H-field strength and spurious emissions shall be performed for each combination and shall be stated in the test report.

The manufacturer has to submit the necessary parts as charger and battery for the test. The test shall be done in the worst case setup/mechanical arrangement.

4.2.4.4 On-site testing

In certain cases it may not be possible to provide representative samples of antennas and/or equipment due to physical constraints. In these cases equivalent measurements to the present document shall be made at a representative installation of the equipment (on-site).

4.2.5 Mechanical and electrical design

4.2.5.1 General

Based on the possible operation mode declared by the manufacturer (see clause 4.2.3) the transmitter (charger) and receiver (battery or battery emulator) shall be tested as described in 4.2.3, Table 3.

4.2.5.2 Controls

Those controls which, if maladjusted, might increase the interfering potentialities of the equipment shall not be easily accessible to the user.

4.2.5.3 Shut-off facility

If the WPT system is equipped with an automatic shut-off facility (for communication and/or power transfer), it should be made inoperative for the duration of the test.

If this would be not possible, e.g. to avoid the damage of the battery, the test shall be performed during normal operation.

4.3 Transmitter conformance requirements

4.3.1 General

A WPT system could work in different mode (see clause 4.2.3, Table 3) and this could influence the radiated emission. Depending on the operation mode of the WPT system the manufacturer has to declare the operational modes (e.g. combination charger/battery or stand-alone charger), see clause 4.2.3, Table 3. The emission test shall be performed for all operational modes (see Table 3).

4.3.2 Permitted range of operating frequencies

4.3.2.1 Applicability

This applies to all WPT systems.

4.3.2.2 Description

The permitted range of operating frequencies are the frequency range over which the equipment is intentionally emitting.

4.3.2.3 Limits

The permitted range of operating frequency range(s) for intentional emissions shall be within 19 - 21 kHz, 59 - 61 kHz, 79 - 90 kHz, 100 - 300 kHz, 6 765 - 6 795 kHz, see Table 2.

4.3.2.4 Conformance

The manufacturer shall declare the ranges in which the WPT system is designed to operate. The justification/test shall be performed for Operating frequency ranges, see clause 4.3.3.

4.3.3 Operating frequency range(s) (OFR)

4.3.3.1 Applicability

This applies to all WPT systems.

4.3.3.2 Description

The operating frequency range is the frequency range over which the equipment is intentionally emitting (all operational modes, see clause 4.2.3, Table 3).

4.3.3.3 Limits

The operating frequency range(s) are the frequency range(s) over which the WPT system is emitting. The operating frequency range(s) of the WPT system are determined by the lowest (f_L) and highest frequency (f_H) as occupied by the power envelope.

The operating frequency range for emissions shall be within one of the following limits: 19 - 21 kHz, 59 - 61 kHz, 79 - 90 kHz, 100 - 300 kHz, 6765 - 6 795 kHz.

For the spurious emission measurement procedure as described in clause 4.3.5 the bandwidth of the OFR shall be calculated as $BW = f_H - f_L$, and the centre frequency as: $f_C = (f_H + f_L)/2$.

4.3.3.4 Conformance

The conformance test suite for Operating frequency ranges shall be as defined in clause 6.2.1.

The manufacturer shall declare all necessary information (distance, orientation) which are necessary to set-up the different alignments as defined in clause 6.1.1 for each operational mode as defined in clause 4.2.3, Table 3.

Conformance shall be established under test conditions to be declared by the manufacturer according to clause 4.1. The interpretation of the results for the measurements uncertainty shall be as given in clause 5.11.

4.3.4 H-field requirements

4.3.4.1 Applicability

This applies to all WPT systems.

4.3.4.2 Description

The radiated H-field is defined in the direction of maximum field strength under specified conditions of measurement.

4.3.4.3 Limits

The H-field limits are provided in Table 4.

The H-field limits in Table 4 are EU wide harmonised according to 2013/752/EU [i.2]. Further information is available in ERC/REC 70-03 [i.1].

Table 4: H-field limits

Frequency range [MHz]	H-field strength limit [dBµA/m at 10 m]	comments
0,019 ≤ f < 0,021	72	
0,059 ≤ f < 0,061	72 descending 10 dB/dec above 0,03 MHz	See note 1
0,079 ≤ f < 0,090	72 descending 10 dB/dec above 0,03 MHz	See note 2
0,100 ≤ f < 0,135	66 descending 10 dB/dec above 0,119 MHz	See note 1
0,135 ≤ f < 0,140	42	
0,140 ≤ f < 0,1485	37,7	
0,1485 ≤ f < 0,30	-5	
6,765 ≤ f < 6,795	42	
NOTE 1: Limit is 42 dBµA/m for the following spot frequencies: 60 kHz ± 250 Hz and 129,1 kHz ± 500 Hz. NOTE 2: At the time of preparation of the present document the feasibility of increased limits for high power wireless power transmission systems to charge vehicles [i.4] was prepared. New specific requirements for such systems (e.g. higher H-field emission limits in the 79 - 90 kHz band) will be reflected within a future revision of the present document.		

4.3.4.4 Conformance

The conformance test suite for H-field requirements shall be as defined in clause 6.2.1.

The manufacturer shall declare all necessary information (distance, orientation) which are necessary to set-up the different alignments as defined in clause 6.1.1 for each operational mode as defined in clause 4.2.3, Table 3.

Conformance shall be established under test conditions to be declared by the manufacturer according to clause 4.1. The interpretation of the results for the measurements uncertainty shall be as given in clause 5.11.

4.3.5 WPT system unwanted radiated emissions

4.3.5.1 Applicability

This applies to all WPT systems.

4.3.5.2 Description

WPT system unwanted radiated emissions are given for frequencies outside the used operating frequency band given in clause 4.3.3.

4.3.5.3 Limits

The radiated field strength of unwanted emissions below 30 MHz shall not exceed the generated H-field given in Table 5.

Table 5

State (see note)	Frequency 9 kHz ≤ f < 10 MHz	Frequency 10 MHz ≤ f < 30 MHz
Operating	27 dBµA/m at 9 kHz descending 10 dB/dec	-3,5 dBµA/m
Standby	5,5 dBµA/m at 9 kHz descending 10 dB/dec	-25 dBµA/m
NOTE: "Operating" means mode 2, 3 and 4 according to Table 3; "standby" means mode 1 according to Table 3.		

The power of any radiated unwanted emission between 30 MHz and 1 GHz shall not exceed the values given in Table 6.

Table 6

State (see note)	47 MHz to 74 MHz 87,5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 790 MHz	Other frequencies between 30 MHz to 1 000 MHz
Operating	4 nW	250 nW
Standby	2 nW	2 nW
NOTE: "Operating" means mode 2, 3 and 4 according to Table 3; "standby" means mode 1 according to Table 3.		

4.3.5.4 Conformance

The conformance test suite for unwanted emissions shall be as defined in clause 6.2.1.

The manufacturer shall declare all necessary information (distance, orientation) which are necessary to set-up the different alignments as defined in clause 6.1.1 for each operational mode as defined in clause 4.2.3, Table 3.

Conformance shall be established under test conditions to be declared by the manufacturer according to clause 4.1. The interpretation of the results for the measurements uncertainty shall be as given in clause 5.11.

4.3.6 WPT system unwanted conducted emissions

4.3.6.1 Applicability

This applies to all WPT systems which have a cable between the off board power supply and the primary coil that exceeds 3 m in length (see Figure B.1).

4.3.6.2 Description

WPT system unwanted conducted emissions are based on the emissions of the unwanted common mode current on the cable between the off board power supply and the primary coil seen as a monopole radiator driven against the power supply.

4.3.6.3 Limits

The common mode current (I_{CM}) between 1 MHz and 30 MHz shall not exceed the following limit:

$$I_{CM} = 47 - 8 \times \log(f)\ dB\mu A$$

f is the frequency in MHz.

4.3.6.4 Conformance

The conformance test suite for common mode current shall be as defined in clause 6.2.4.

The manufacturer shall declare all necessary information (distance, orientation) which are necessary to set-up the different alignments as defined in clause 6.1.1 for each operational mode as defined in clause 4.2.3, Table 3.

Conformance shall be established under test conditions to be declared by the manufacturer according to clause 4.1. The interpretation of the results for the measurements uncertainty shall be as given in clause 5.11.

4.4 Receiver Conformance requirements

4.4.1 General

Based on the close proximity/colocation of receiver and transmitter in a WPT system only the wanted performance criteria tests (see clause 4.4.2) are applicable for a WPT system.

Based on this close proximity/colocation the unwanted emissions of the RX part within a WPT system will be measured together with the unwanted emissions tests of the TX-part.

4.4.2 Wanted performance criteria

4.4.2.1 Applicability

This requirement applies to all WPT systems operation in Mode 1, Mode 2 and Mode 3.

4.4.2.2 Description

This clause presents the method of measurement to test the WPT system capability to handle external signals (e.g. adjacent, co-channel) when in normal operation.

The WPT system shall be able to operate under this environment under all operational modes (see clause 4.2.3, Table 3).

4.4.2.3 Limits

The WPT system shall achieve the wanted performance criterion, see clause 4.2.2, in the presence of unwanted signals defined in clause 6.3.2.

If the wanted performance criterion is not achieved then the WPT System shall move into a safe operation state (to be declared by the manufacturer).

4.4.2.4 Conformance

The conformance test suite for performance criterion test shall be as defined in clause 6.3.2 and within the test-set-ups as defined in clause 6.1.

Conformance shall be established under test conditions to be declared by the manufacturer according to clause 4.1.

The interpretation of the results for the measurements uncertainty shall be as given in clause 5.11.

5 Testing for compliance with technical requirements

5.1 Environmental conditions for testing

Tests defined in the present document shall be carried out at representative points within the boundary limits of the declared operational environmental profile.

Where technical performance varies subject to environmental conditions, tests shall be carried out under a sufficient variety of environmental conditions (within the boundary limits of the declared operational environmental profile) to give confidence of compliance for the affected technical requirements. The reasoning for choosing the given variety shall be noted in the test report.

5.2 General conditions for testing

5.2.1 Product information

When submitting equipment for testing, the manufacturer shall supply the necessary information required by the laboratory.

5.3 Normal and extreme test conditions

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

The test conditions and procedures shall be as specified in clauses 5.4 to 5.6.

5.4 Test power source

The conditions for the test power source shall be as given in ETSI EN 300 330 [1], clause 5.4.

5.5 Normal test conditions

The normal test conditions shall be as given in ETSI EN 300 330 [1], clause 5.5.

5.6 Extreme test conditions

The extreme test conditions f shall be as given in ETSI EN 300 330 [1], clause 5.6.

5.7 Auxiliary test equipment

All necessary test signal sources and set-up information shall be accompanied to the WPT system when it is submitted for testing.

5.8 Normal test signals and test modulation

The WPT system shall be used in the typical operational mode declared by the manufacturer.

5.9 Test sites and general arrangements for radiated measurements

For guidance on radiation test sites, see ETSI EN 300 330 [1], annex D. Detailed descriptions of radiated measurement arrangements are included in ETSI EN 300 330 [1], annex D.

5.10 Measuring receiver

The requirements for the measuring receiver shall be as given in ETSI EN 300 330 [1], clause 5.4.

5.11 Measurement uncertainty

The conditions for the measurement uncertainty shall be as given in ETSI EN 300 330 [1], clause 5.14.

6 Conformance methods of measurement for transmitters and receivers

6.1 Measurement setup and alignment conditions

6.1.1 General

All essential requirements shall be tested under radiated testing conditions. Requirements concerning the test environment (OATS or SAC) shall be fulfilled as required in ETSI EN 300 330 [1], annex D.

For the WPT system all relevant parts (e.g. primary coil, primary side power electronics, secondary coil, secondary side power electronics, electronic load / battery, cables, etc.) shall be used to measure the emissions of the WPT system in the related mode (see Table 3).

The measurement distance for each WPT system mode (see clauses 6.1.2 to 6.1.5) shall be 10 m. Where this is not practical, e.g. due to physical size of the equipment including the antenna or with use of special field cancelling antenna, then other distances may be used. When another distance is used, the used distance and the field strength value measured shall be stated in the test report. In this case, the measured value at actual test distance shall be extrapolated to 10 m according to ETSI EN 300 330 [1], Annex I and these calculations shall be stated in the test report.

If specific software is necessary to put the WPT system into a specific operational mode that shall be stated in the test report. The emissions during the test mode shall represent the typical emissions of the WPT part/system during normal operation.

6.1.2 Mode 1: idle mode

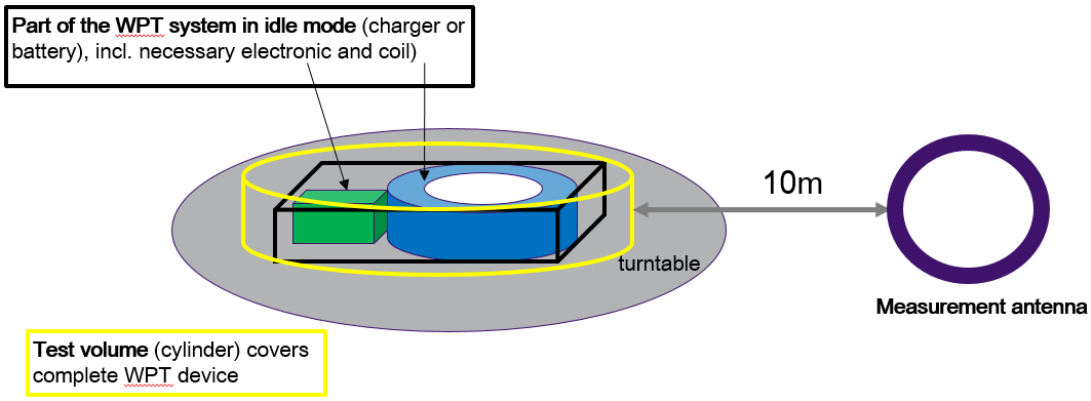

Figure 1: Setup for idle mode

For this test:

1) the WPT system part which is able to run in the idle mode shall be put onto a turntable (see Figure 1).

2) all listed requirements (see Table 3) shall be measured.

6.1.3 Mode 2: charging adjustment

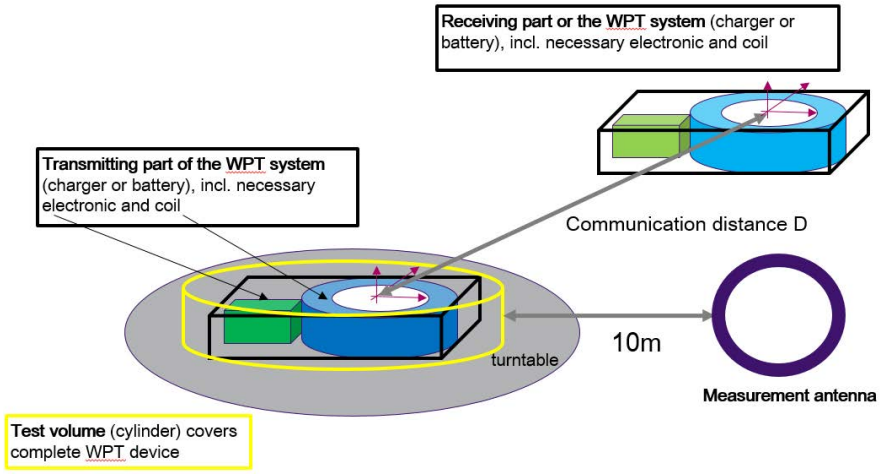

Figure 2: Setup for charging adjustment mode

For this test:

1) The transmitting part of the WPT system shall be placed onto a turntable and the all listed requirements (see Table 3) shall be measured.

2) The manufacturer shall declare the maximal distance D. At this distance D the WPT system is able to start the communication within the adjustment mode (see Figure 2).

   - If the distance D is < 1 m, the WPT system shall be tested with the set-up described in clause 6.1.4.

   - If the distance D is > 1 m, each transmitting part shall be tested separately.

3) If in the adjustment mode both WPT system parts are able to transmit, the manufacturer shall declare in which way the emissions of each part could be measured (e.g. specific test mode).

6.1.4 Mode 3 and Mode 4: power transmission arrangement

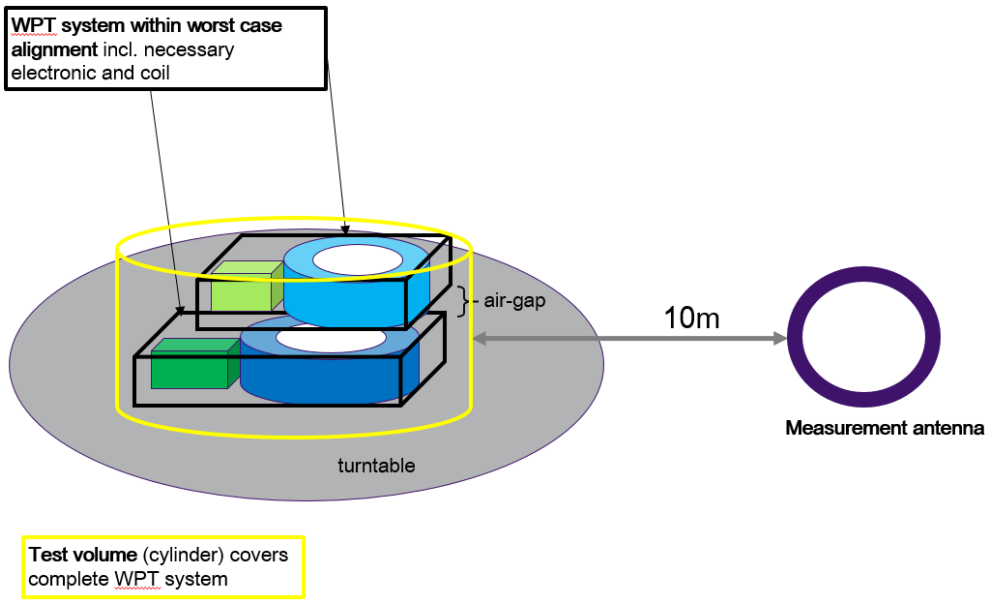

Figure 3: Setup for power transmission arrangement

For this test:

1) All relevant parts of the WPT system or a complete WPT system shall be placed together (in worst case alignment arrangement) and put onto a turntable (see Figure 3).

2) Al listed requirements (see Table 3) shall be measured.

3) The manufacturer shall declare the possibility to differentiate mode 3 and mode 4 of the WPT system (e.g. with specific test software). Each mode shall be tested separately.

4) A bi-directional communication during mode 3 (see Table 3) shall be seen as a single transmission.

A detailed mechanical arrangement for a WPT system for EV is given in annex B.

6.1.5 Wanted performance criteria test

The same test set-up arrangement related to the operational mode (see clause 4.2.3, Table 3) and clauses 6.1.2, 6.1.3 and 6.1.4 shall be used. The only difference for mode 2 (see clause 6.1.3) is, that the RX part of the WPT system shall be placed onto the turntable and the TX part shall be placed at the distance D away from the RX part.

The position of the unwanted transmitter shall be in 10 m distance from the receiving part of the WPT system. If the used test signal source (incl. test antenna) cannot reach the necessary field strength at the receiving part, a shorter distance may be used.

It is important that the specified field strength limits, defined in clause 6.3.2.3 will be reached at the point of the receiving part of the WPT-system, as descripted in the clauses 6.1.2 till 6.1.4.

6.2 Conformance methods of measurement for transmitting parts within the WPT system

6.2.1 General

The following test is required for the transmitting parts of the WPT system:

- Operating frequency range(s), see clause 4.3.3

- Transmitter H-field requirements within the operating frequency range(s), see clause 4.3.4
- Transmitter unwanted radiated emissions, see clause 4.3.5
- Transmitter unwanted conducted emissions, see clause 4.3.6

The WPT system shall be put into the alignment according to the operational mode as specified in clause 6.1. This set-up could be different for each mode.

The WPT system shall be modulated with its typical modulation for each mode (e.g. communication, charging, ping). The internal modulation of the WPT system shall be used.

Where applicable, the equipment under test shall operate with modulation. Where this is not applicable (e.g. charging), it shall be stated in the test report.

The measurements of the transmissions shall be made on a test site as specified in clause 6.1.1. Any measured values shall be at least 6 dB above the ambient noise level.

The radiated transmissions shall be measured with a shielded loop antenna connected to a measurement receiver. The measuring bandwidth and detector type of the measurement receiver shall be in accordance with clause 6.2.2.

The maximum radiated transmissions to be recorded are the maximum transmissions from the three possible orthogonal orientations (x/y/z) of the shielded loop antenna in the direction of the maximum radiation of the WPT system.

The measuring receiver used to test the unwanted radiated emissions below 30 MHz (see clause 4.3.5) shall be tuned over the frequency range 9 kHz to 30 MHz, except for the OFR (see clause 4.3.3) on which the WPT system is intended to operate.

At each frequency at which relevant unwanted radiated emissions are detected the equipment under test and the test antenna shall be rotated until maximum field strength is indicated on the measuring receiver. This level shall be noted.

A specific test procedure for unwanted radiated emissions above 30 MHz shall be used as described in clause 6.2.3.

A specific test procedure for unwanted conducted emissions between 1 MHz and 30 MHz shall be used as described in clause 6.2.4.

6.2.2 Measurement receiver

A spectrum analyser with the following settings shall be used in the test set-up.

- Start frequency: lower than the lower edge of the permitted frequency range / requested by the essential requirements in clause 4.
- Stop frequency: higher than the upper edge of the permitted frequency range / requested by the essential requirements in clause 4.
- Resolution Bandwidth: See ETSI EN 300 330 [1], clause 5.12, Table 3
- Video Bandwidth: > Resolution bandwidth.
- Detector mode: See ETSI EN 300 330 [1], clause 5.12, Table 3
- Display mode: Max. hold.

Additional setup for OFR test see clause 4.3.3.

The OBW function of the spectrum analyser shall be used with a limit of 99 % to determine the operating frequency range:

- f_H is the frequency of the upper marker resulting from the OBW.
- f_L is the frequency of the lower marker resulting from the OBW.

6.2.3 WPT system unwanted radiated emissions > 30 MHz

The test antenna shall be oriented for vertical polarization. The output of the test antenna shall be connected to a measuring receiver.

Step 1: The transmitter shall be switched on with normal modulation, and the measuring receiver shall be tuned over the frequency range 30 MHz to 1 000 MHz.

Step 2: At each frequency at which a relevant spurious component is detected, the test antenna shall be raised and lowered through the specified range of heights until a maximum signal level is detected on the measuring receiver.

Step 3: The transmitter shall then be rotated through 360° in the horizontal plane, until the maximum signal level is detected by the measuring receiver.

Step 4: The maximum signal level detected by the measuring receiver shall be noted.

Step 5: The EUT shall be then replaced by a substitution antenna. The substitution antenna shall be oriented for vertical polarization and calibrated for the frequency of the spurious component detected.

Step 6: The frequency of the calibrated signal generator shall be set to the frequency of the spurious component detected. The input attenuator setting of the measuring receiver shall be adjusted in order to increase the sensitivity of the measuring receiver, if necessary.

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

When a test site according to clause D.1.1 of ETSI EN 300 330 [1] is used, there is no need to vary the height of the antenna.

Step 7: The input signal to the substitution antenna shall be adjusted until a level equal to that detected from the WPT transmitter obtained on the measuring receiver at step 4.

Step 8: The input signal to the substitution antenna shall be recorded as a power level and corrected for any change of input attenuator setting of the measuring receiver.

Step 9: The test antenna shall be oriented for horizontal polarization and step 1 to step 8 be repeated.

Step 10: The measure of the effective radiated power of the unwanted emission is the larger of the two power levels recorded for each spurious component at the input to the substitution antenna, corrected for the gain of the substitution antenna if necessary.

If an unmodulated carrier cannot be obtained then the measurements shall be made with the transmitter modulated by the normal test signal (see clause 5.8.2) in which case this fact shall be recorded in the test report.

If standby mode is available, the measurements shall be repeated in that mode.

6.2.4 WPT system unwanted conducted emissions

The measurement setup as described in Figure 4 shall be used to measure the common mode current on the cable between the off board power supply and the primary coil.

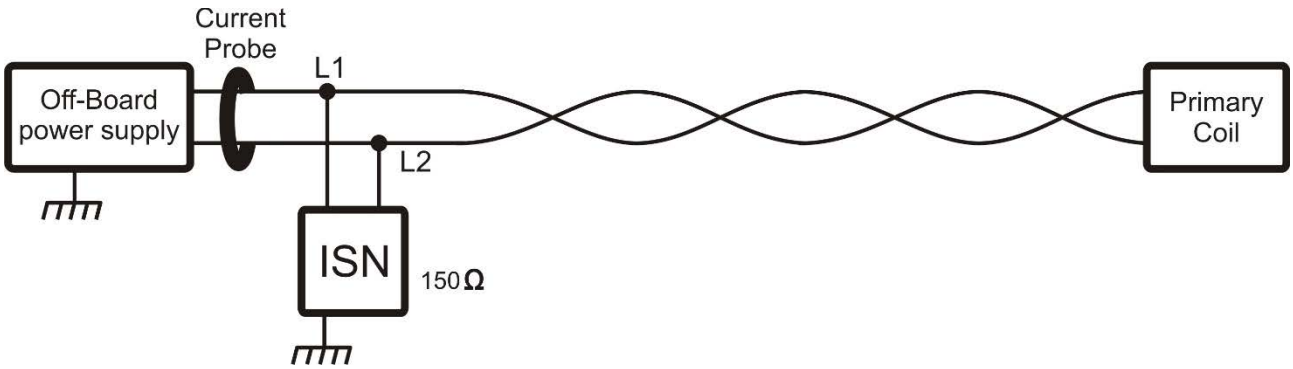

Figure 4: Measurement setup for unwanted conducted emissions

The ISN shall provide a common mode path to ground with an impedance of 150 Ω. An example is given in Figure 5. If another ISN is used, this shall be noted in the test report.

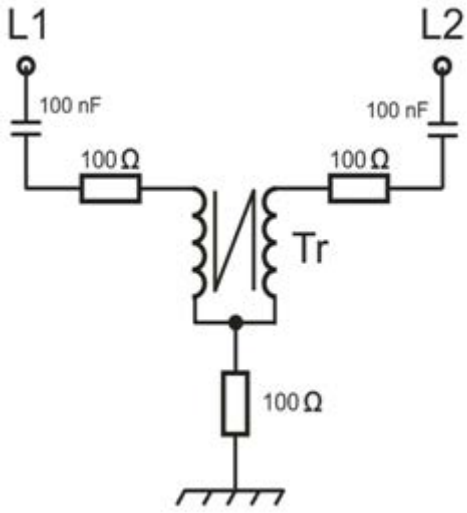

Figure 5: Example of a 150 Ω ISN

6.3 Conformance methods of measurement for the receiving parts with a WPT System

6.3.1 Receiver spurious emissions

Not applicable, see clause 4.4.1.

6.3.2 Wanted performance criterion test

6.3.2.1 Test set-up

The test set-up is described in clause 6.1.5.

6.3.2.2 Test procedure

The WPT system shall be set-up depending the operational mode (see clause 4.2.3) and the related set-up as described in clause 6.1.

The signal source for the interfering signal shall be configured in a way that it generates the required field strengths from table 7 at the EUT.

The WPT system shall be powered ON and working in the relevant operational mode as declared by the manufacturer. Achievement of the relevant wanted performance criterion shall be verified.

The unwanted signal transmitter shall be powered ON at a frequency and a power level as specified in clause 6.3.2.3.

To simulate real use-cases, the unwanted signals level shall be increased in 5 dB steps until either the relevant wanted performance criterion is not met or the specified unwanted signal level in clause 6.3.2.3 is reached. The unwanted signal (see clause 6.3.2.3) shall be held at each power step for at least 5 s.

The measurement procedure shall be done again for each unwanted signal transmitter frequency mode, as defined in clause 6.3.2.3.

6.3.2.3 Unwanted signals specification

The following signal characteristics shall be used.

The unwanted signal transmitter shall be able to transmit continuous wave signals at different frequencies, as described in Table 7.

Table 7: Unwanted signal

	In-band signal	OOB signal	Remote-band signal
Frequency	Centre frequency (f_c) of the WPT system (see clause 4.3.3)	$f = f_c \pm F$ (see note)	$f = f_c \pm 10 \times F$ (see note)
Signal level field strength at the EUT	72 dBµA/m	72 dBµA/m	82 dBµA/m
NOTE: F = OFR.			

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.6] 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.

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 [i.3]

Harmonized Standard ETSI EN 303 417				
Requirement			Requirement Conditionality	
No	**Description**	**Reference: Clause No**	**U/C**	**Condition**
1	Permitted range of operating frequencies	4.3.2	U	
2	Operating frequency ranges	4.3.3	U	
3	H-field requirements	4.3.4	U	
4	WPT system unwanted radiated emissions	4.3.5	U	
5	WPT system unwanted conducted emissions	4.3.6	C	Only for equipment which has a cable between the off board power supply and the primary coil which is longer than 3m
6	Wanted performance criteria	4.4.2	C	Only for Mode 1, Mode 2 and Mode 3 (see Table 3)

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.

Clause Number 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): Measurement setup for EV WPT systems

In addition to the measurement setup described in clause 6.1.4, Figure B.1 shows an example EUT setup which can be used for electric vehicles (source: CISPR document CIS/B/663/CD [i.10]).

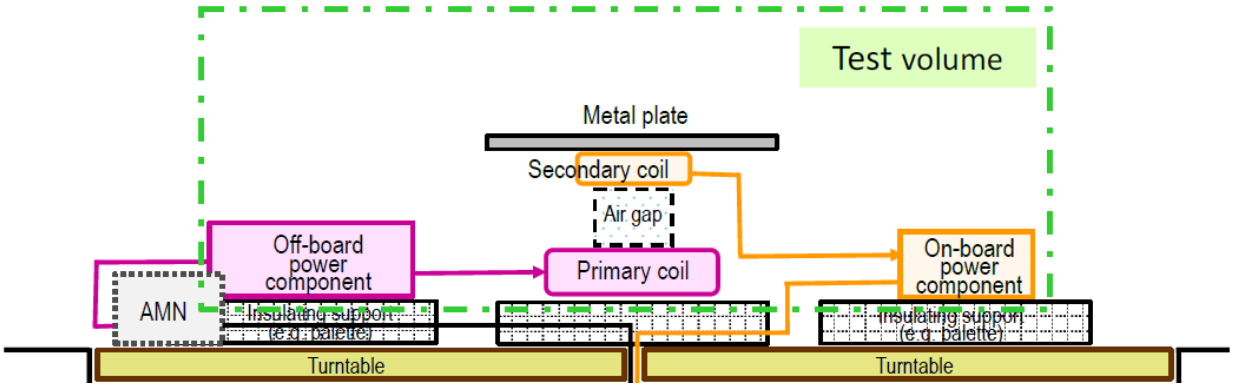

Figure B.1: Example EUT setup for electric vehicle WPT

NOTE 1: The electronic load (or the battery) into which the energy of the secondary side is fed from the on-board power component is not shown in this figure. That electronic load (or battery) may be located in a pit underneath the turntable, or may also be located on the turntable.

Figure B.2 (source: CISPR document CIS/B/663/CD [i.10]) shows an overview of how the measurement distance should be interpreted: A virtual circle (indicted as a dotted green line) is drawn in such a way that it contains all components of the EUT. Then, the 10 m (or 3 m) measurement distance is measured from that circle to the centre point of the antenna.

NOTE 2: The electronic load (or the battery) into which the energy of the secondary side is fed from the on-board power component is not considered as being a part of the EUT for this approach, as can be seen in Figure B.2 (as the dotted green line cuts through the load).

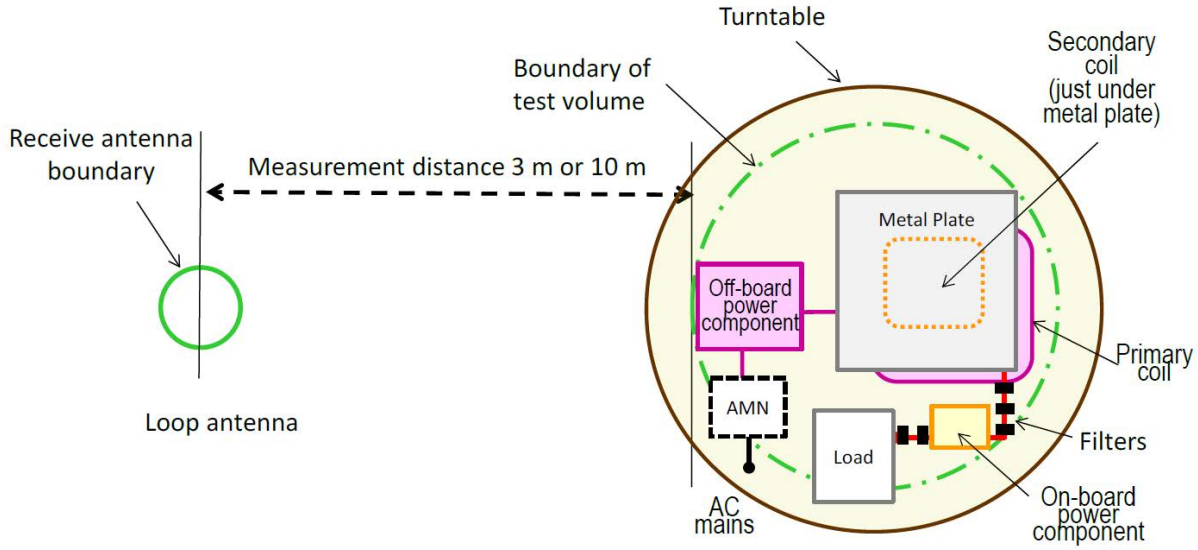

Figure B.2: Example measurement setup for electric vehicle WPT

History

Document history			
V1.1.0	December 2016	EN Approval Procedure	AP 20170315: 2016-12-15 to 2017-03-15