

**Amendment No. 1 (09/2022)**  
**To**  
**AIS 004 (Part 3) (Rev.1): Automotive Vehicles Requirements for Electromagnetic Compatibility**

**1 Clause No. 5.3.2.1:**

Substitute following text for existing text:

If measurements are made using the method described in Annex 3 using a vehicle-to-antenna spacing of  $10.0 \pm 0.2$  m, the limits shall be 28 dB microvolts/m in the 30 to 230 MHz frequency band and 35 dB microvolts/m in the 230 to 1,000 MHz frequency band.

**2 Clause No. 5.3.2.2:**

Substitute following text for existing text:

If measurements are made using the method described in Annex 3 using a vehicle-to-antenna spacing of  $3.0 \pm 0.05$  m, the limits shall be 38 dB microvolts/m in the 30 to 230 MHz frequency band and 45 dB microvolts/m in the 230 to 1,000 MHz frequency band.

**3 APPENDIX 4, VEHICLE NARROWBAND REFERENCE LIMITS:**

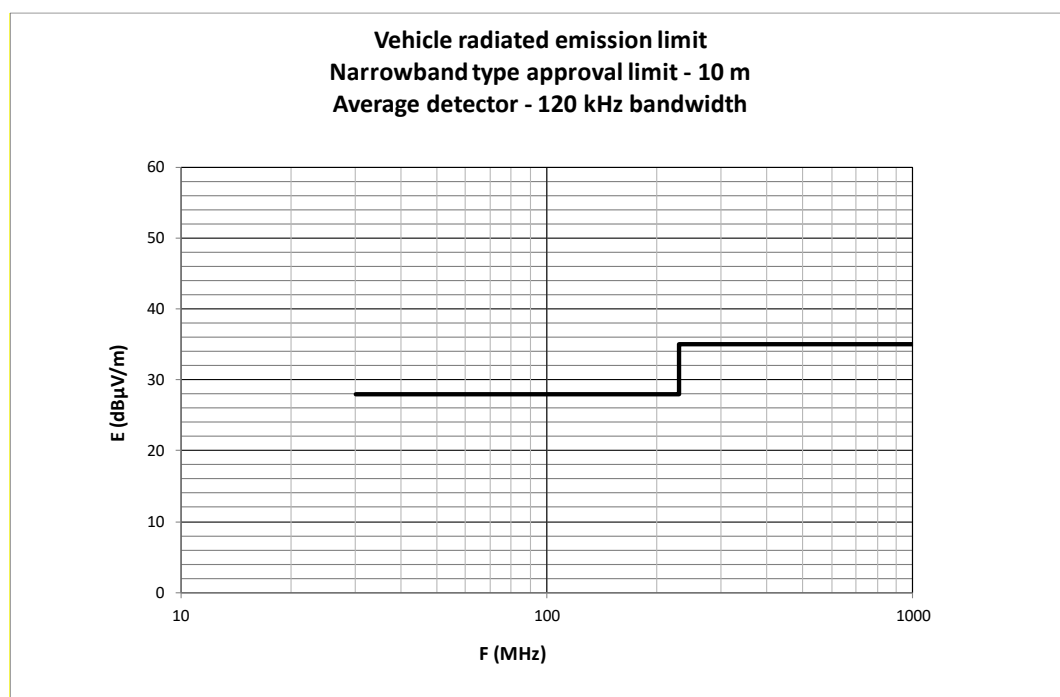
Substitute following APPENDIX 4 for existing APPENDIX 4:

**APPENDIX 4**

**VEHICLE NARROWBAND REFERENCE LIMITS**

**Antenna-Vehicle Separation: 10 m**

<b>Limit E (dBμV/m) at frequency F (MHz)</b>	
<b>30-230 MHz</b>	<b>230-1,000 MHz</b>
<b>E = 28</b>	<b>E = 35</b>



Frequency – megahertz - logarithmic

(See paragraph 5.3.2.1 of this standard)

#### 4 APPENDIX 5, VEHICLE NARROWBAND REFERENCE LIMITS:

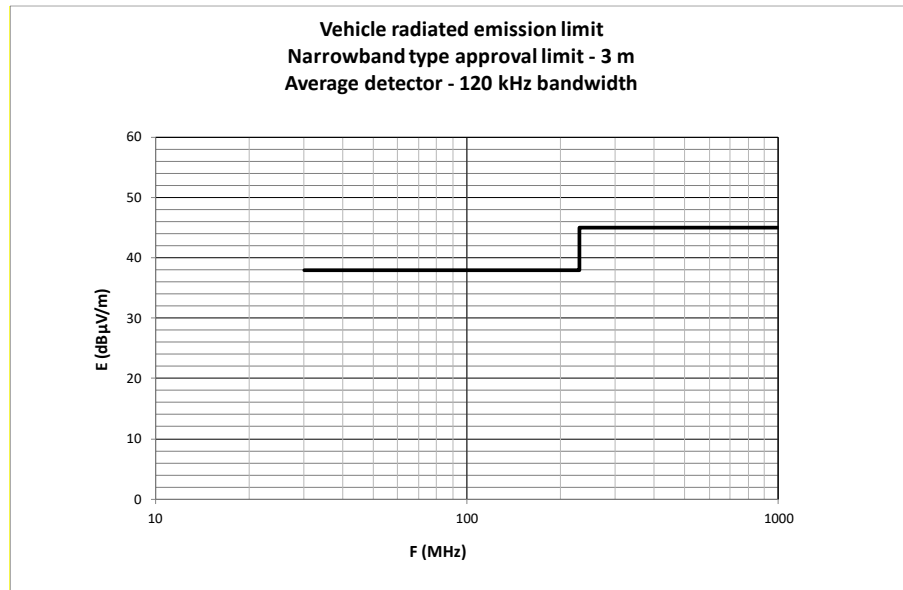
Substitute following APPENDIX 5 for existing APPENDIX 5:

#### APPENDIX 5

#### VEHICLE NARROWBAND REFERENCE LIMITS

**Antenna-Vehicle Separation: 3 m**

Limit $E$ ( $\text{dB}\mu\text{V/m}$ ) at frequency $F$ (MHz)	
30-230 MHz	230-1,000 MHz
$E = 38$	$E = 45$



Frequency – megahertz - logarithmic

(See paragraph 5.3.2.2 of this standard)

PRINTED BY  
 THE AUTOMOTIVE RESEARCH ASSOCIATION OF INDIA  
 P. B. NO. 832, PUNE 411 004

ON BEHALF OF AUTOMOTIVE INDUSTRY STANDARDS COMMITTEE

UNDER  
 CENTRAL MOTOR VEHICLE RULES - TECHNICAL STANDING COMMITTEE  
 SET-UP BY

MINISTRY OF ROAD TRANSPORT & HIGHWAYS  
 (DEPARTMENT OF ROAD TRANSPORT & HIGHWAYS)  
 GOVERNMENT OF INDIA

29<sup>th</sup> September 2022

**AUTOMOTIVE INDUSTRY STANDARD**

**AUTOMOTIVE VEHICLES -  
REQUIREMENTS FOR  
ELECTROMAGNETIC  
COMPATIBILITY**

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Sept 2020

## **INTRODUCTION**

The Government of India felt the need for a permanent agency to expedite the publication of standards and development of test facilities in parallel when the work on the preparation of the standards is going on, as the development of improved safety critical parts can be undertaken only after the publication of the standard and commissioning of test facilities. To this end, the erstwhile Ministry of Surface Transport (MOST) has constituted a permanent Automotive Industry Standards Committee (AISC) vide order No. RT-11028/11/97-MVL dated September 15, 1997. The permanent CMVR Technical Standing Committee (CTSC) will approve the standards prepared by AISC. After approval, the Automotive Research Association of India, (ARAI), Pune, being the Secretariat of the AIS Committee, has published this standard. For better dissemination of this information ARAI may publish this document on their web site.

To ensure that the electromagnetic radiations emitted by vehicle and by its various electronic sub-systems do not cause any undue interference with external systems, a standard on the permissible limits of such radiations, AIS-004 (Part 1) was in force under CMVR w.e.f. 1<sup>st</sup> July 2003.

With the advancement of automotive technology electronic content in automotive vehicles, especially in engine control, braking control is increasing. Hence a need is felt to formulate requirements of immunity of vehicles and their electronic sub-systems to external electromagnetic radiations from e.g. Radio / TV / Mobile Transmitters. Accordingly, immunity test standard AIS-004 (Part 2) “Electromagnetic Radiated Immunity of Automotive Vehicles – Requirements and Methods of Tests” is prepared by the panel constituted by AISC.

While preparing this AIS considerable assistance was derived from following UN R 10 (Rev.2 ) (Amd. 2) (Supp. 2 to 02 series of Amendment, Date of entry into force 12<sup>th</sup> August, 2004) : Uniform provisions concerning the Approval of Vehicles with regard to Electromagnetic Compatibility. As this Standard was undergoing revision to Rev.3 in European Union. Hence the same AISC panel has been entrusted with the task of formulating new consolidated standard for the requirements of radiated emissions and immunity for automotive vehicles in line with UN R 10 (Rev.3).

Subsequently, UNR R 10 (Rev. 3) has been further revised to Rev.5 in European Union. Hence, the same AISC panel has been entrusted with the task of formulating new revision of AIS-004 (Part 3) in line with UN R 10 (Rev.5) (05 series of amendments – Date of Entry into force 9<sup>th</sup> October 2014). Requirements for Emission and Immunity tests for vehicle and component in normal mode which are present in AIS-004 (Part 3), are preserved in AIS-004 (Part 3) (Rev.1). New tests added are for vehicles providing coupling systems for charging the REESS regarding the control of emissions and immunity from this connection between vehicle and power grid. For vehicles not having coupling system connecting vehicle to grid for charging the REESS, these additional tests in charging mode do not apply.

Composition of the Panel and Automotive Industry Standards Committee (AISC) responsible for preparation and approval of this standard are given in Annex 23 & 24 respectively.

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## Automotive Vehicles –Requirements for Electromagnetic Compatibility

### 1.0 SCOPE

This standard applies to:

- 1.1 Vehicles of categories L, M, N and T (Refer IS 14272 for vehicle category definitions) with regard to electromagnetic compatibility;
- 1.2 Components and separate technical units intended to be fitted in these vehicles with the limitation given in paragraph 3.2.1 with regard to electromagnetic compatibility.
- 1.3 It covers:
  - (a) Requirements regarding the immunity to radiated and conducted disturbances for functions related to direct control of the vehicle, related to driver, passenger and other road users' protection and related to disturbances, which would cause confusion to the driver or other road users, related to vehicle data bus functionality, related to disturbances, which would affect vehicle statutory data;
  - (b) Requirements regarding the control of unwanted radiated and conducted emissions to protect the intended use of electrical or electronic equipment at own or adjacent vehicles or nearby, and the control of disturbances from accessories that may be retrofitted to the vehicle.
  - (c) Additional requirements for vehicles and ESAs providing coupling systems for charging the REESS regarding the control of emissions and immunity from this connection between vehicle and power grid.

### 2.0 DEFINITIONS

For the purposes of this standard:

- 2.1 **"Electromagnetic compatibility"** means the ability of a vehicle or component(s) or separate technical unit(s) to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.
- 2.2 **"Electromagnetic disturbance"** means any electromagnetic phenomenon which may degrade the performance of a vehicle or component(s) or separate technical unit(s), or of any other device, unit of equipment or system operated in vicinity of a vehicle. An electromagnetic disturbance may be electromagnetic noise, an unwanted signal or a change in the propagation medium itself.
- 2.3 **"Electromagnetic immunity"** means the ability of a vehicle or component(s) or separate technical unit(s) to operate without degradation of performance in the presence of (specified) electromagnetic disturbances which includes wanted radio frequency signals from radio transmitters or

radiated in-band emissions of industrial-scientific-medical (ISM) apparatus, internal or external to the vehicle.

- 2.4     **"Electromagnetic environment"** means the totality of electromagnetic phenomena existing at a given location.
- 2.5     **"Broadband emission"** means an emission, which has a bandwidth greater than that of a particular measuring apparatus or receiver (International Special Committee on Radio Interference (CISPR) 25, second edition).
- 2.6     **"Narrowband emission"** means an emission which has a bandwidth less than that of a particular measuring apparatus or receiver (CISPR 25, second edition).
- 2.7     **"Electrical / electronic system"** means an electrical and / or electronic device or set of devices together with any associated electrical connections which form part of a vehicle but which is not intended to be type approved separately from the vehicle.
- 2.8     **"Electrical / electronic sub-assembly"** (ESA) means an electrical and / or electronic device or set(s) of devices intended to be part of a vehicle, together with any associated electrical connections and wiring, which performs one or more specialized functions. An ESA may be approved at the request of a manufacturer or his authorized representative as either a "component" or a "separate technical unit (STU)".
- 2.9     **"Vehicle type"** in relation to electromagnetic compatibility, means vehicles which do not differ essentially in such respects as:
  - 2.9.1     The overall size and shape of the engine compartment;
  - 2.9.2     The general arrangement of the electrical and / or electronic components and the general wiring arrangement;
  - 2.9.3     The primary material of which the body or shell of the vehicle is constructed (for example, a steel, aluminum or fiberglass body shell). The presence of panels of different material does not change the vehicle type provided the primary material of the body is unchanged. However, such variations must be notified.
- 2.10    An **"ESA type"** in relation to electromagnetic compatibility means ESAs, which do not differ in such essential respects as:
  - 2.10.1    The function performed by the ESA;
  - 2.10.2    The general arrangement of the electrical and / or electronic components, if applicable.
- 2.11    **"Vehicle wiring harness"** means supply voltage, bus system (e.g. CAN), signal or active antenna cables, which are installed by the vehicle manufacturer.

2.12 **"Immunity related functions"** are:

- (a) Functions related to the direct control of the vehicle:
  - (i) By degradation or change in: e.g. engine, gear, brake, suspension, active steering, speed limitation devices;
  - (ii) By affecting drivers position: e.g. seat or steering wheel positioning;
  - (iii) By affecting driver's visibility: e.g. dipped beam, windscreen wiper.
- (b) Functions related to driver, passenger and other road user protection:
  - (i) e.g. airbag and safety restraint systems.
- (c) Functions which when disturbed cause confusion to the driver or other road users:
  - (i) Optical disturbances: incorrect operation of e.g. direction indicators, stop lamps, end outline marker lamps, rear position lamp, light bars for emergency system, wrong information from warning indicators, lamps or displays related to functions in subparagraphs (a) or (b) which might be observed in the direct view of the driver;
  - (ii) Acoustical disturbances: incorrect operation of e.g. anti-theft alarm, horn.
- (d) Functions related to vehicle data bus functionality:
  - (i) By blocking data transmission on vehicle data bus-systems, which are used to transmit data, required to ensure the correct functioning of other immunity related functions.
- (e) Functions which when disturbed affect vehicle statutory data: e.g. tachograph, odometer.
- (f) Functions related to charging mode when coupled to power grid:
  - (i) For vehicle test: by leading to unexpected vehicle motion;
  - (ii) For ESA test: by leading to an incorrect charging condition (e.g. over-current, over-voltage)

2.13 **"REESS"** means the rechargeable energy storage system that provides electric energy for electric propulsion of the vehicle.

2.14 **"Portable Charger"** means portable EV supply equipment for charging, delivered by the manufacturer along with each vehicle.

2.15 **"Coupling system for charging the REESS"** means the electrical circuit installed in the vehicle and portable charger used for charging the REESS.

- 2.16 **"REESS charging mode coupled to the power grid"** means the normal charging operation mode of the vehicle and / or charging system.

### **3.0 APPLICATION FOR APPROVAL**

#### **3.1 Approval of a Vehicle Type**

- 3.1.1 The application for approval of a vehicle type, with regard to its electromagnetic compatibility, shall be submitted by the vehicle manufacturer.
- 3.1.2 The technical specifications to be submitted at the time of applying for type approval are as given in Annex 1A.
- 3.1.3 The vehicle manufacturer shall draw up a schedule describing all relevant vehicle electrical / electronic systems or ESAs, body styles, variations in body material, general wiring arrangements, engine variations, and wheelbase versions. Relevant vehicle electrical / electronic systems or ESAs are those which may emit significant broadband or narrowband radiation and / or those which are involved in immunity related functions of the vehicle (see paragraph 2.12.) and those which provide coupling systems for charging the REESS.
- 3.1.4 A vehicle representative of the type to be approved shall be selected from this schedule by mutual agreement between the manufacturer and the Test Agency. The choice of vehicle shall be based on the electrical / electronic systems offered by the manufacturer. One or more vehicles may be selected from this schedule if it is considered by mutual agreement between the manufacturer and the Test Agency that different electrical / electronic systems are included which are likely to have a significant effect on the vehicle's electromagnetic compatibility compared with the first representative vehicle.
- While deciding combinations of different makes, elements having radio interference control equipment (resistive elements, shielded cap etc.) as specified by vehicle manufacturer shall only be considered for radiated emission testing. Different makes of elements not contributing to radio interference control (non-resistive HT coil, Non-resistive HT cable, magneto, CDI, non-resistive spark plug, non-resistive spark plug cap etc.) shall not be considered in the combinations to be tested.
- 3.1.5 The choice of the vehicle(s) in conformity with paragraph 3.1.4 above shall be limited to vehicle / electrical / electronic system combinations intended for actual production.
- 3.1.6 The manufacturer may supplement the application with a report on tests which have been carried out. Any such data provided may be used by the Test Agency for the purpose of issuing type-approval.

3.1.7 If the Test Agency responsible for the type approval test carries out the test itself, then a vehicle representative of the type to be approved according to paragraph 3.1.4. shall be provided.

3.1.8 For vehicles of categories M, N, and T, the vehicle manufacturer shall provide a statement of frequency bands, power levels, antenna positions and installation provisions for the installation of radio frequency transmitters (RF-transmitters), even if the vehicle is not equipped with an RF transmitter at the time of type approval. This should cover all mobile radio services normally used in vehicles. This information must be made publicly available following the type approval.

Vehicle manufacturers shall provide evidence that vehicle performance is not adversely affected by such transmitter installations.

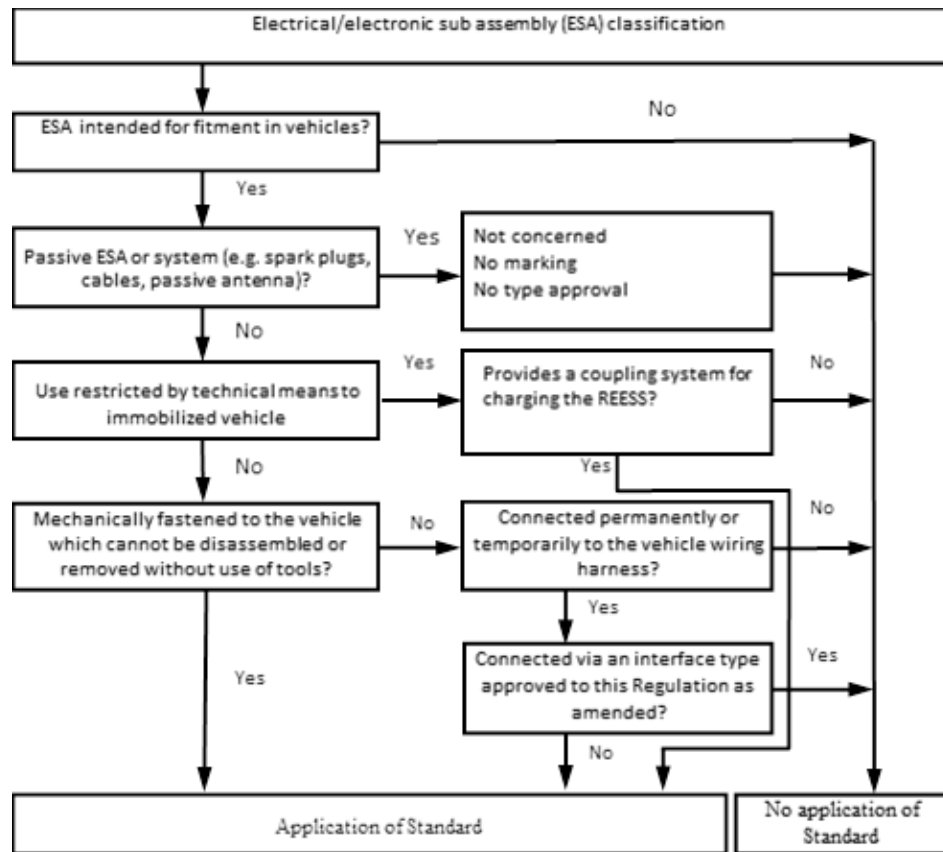
Note: 1) The above need be declared only for recommended fitments of RF transmitters.

2) These requirements are deemed to have met if vehicle manufacturer specifies that there is no provision of fitting RF transmitters on the vehicle.

3.19 Vehicle type approval shall be applied for both REESS and coupling system for charging the REESS as they are considered as electrical / electronic systems.

## **3.2 ESA Type Approval**

3.2.1 Applicability of this standard to ESA:



- 3.2.2 The application for approval of a type of ESA with regard to its electromagnetic compatibility shall be submitted by the vehicle manufacturer or by the manufacturer of the ESA.
- 3.2.3 The technical specifications to be submitted at the time of applying for type approval are as given in Annex 1B.
- 3.2.4 The manufacturer may supplement the application with a report on tests which have been carried out. Any such data provided may be used by the Test Agency for the purpose of issuing type-approval.
- 3.2.5 If the Test Agency responsible for the type approval test carries out the test itself, then a sample of the ESA system representative of the type to be approved shall be provided, if necessary, after discussion with the manufacturer on, e.g., possible variations in the layout, number of components, number of sensors. If the Test Agency deems it necessary, it may select a further sample.
- 3.2.6 The sample(s) must be clearly and indelibly marked with the manufacturer's trade name or mark and the type designation.
- 3.2.7 Where applicable, any restrictions on use should be identified. Any such restrictions should be included in Annex 1B.

3.2.8 ESA which are brought to the market as spare parts need no type approval if they are obviously marked as a spare part by an identification number and if they are identical and from the same manufacturer as the corresponding original equipment manufacturer (OEM) part for an already type approved vehicle.

3.2.9 Components sold, as aftermarket equipment and intended for the installation in motor vehicles need no type approval if they are not related to immunity related functions (see paragraph 2.12). In this case, a declaration shall be issued by the manufacturer that the ESA fulfils the requirements of this standard and in particular the limits defined in paragraphs 5.5, 5.6, 5.7, 5.8 and 5.9.

## **4.0 APPROVAL**

### **4.1 Type Approval Procedures**

#### **4.1.1 Type Approval of a Vehicle**

The following alternative procedures for vehicle type approval may be used at the discretion of the vehicle manufacturer.

##### **4.1.1.1 Approval of a Vehicle Installation**

A vehicle installation may be type approved directly by following the provisions laid down in paragraph 5 of this standard and if applicable paragraph 6. If this procedure is chosen by a vehicle manufacturer, no separate testing of electrical / electronic systems or ESA(s) is required.

##### **4.1.1.2 Approval of Vehicle Type by Testing of Individual ESA's**

A vehicle manufacturer may obtain approval for the vehicle by demonstrating to the Test Agency that all the relevant (See paragraph 3.1.3. of this standard) electrical / electronic systems or ESAs have been approved in accordance with this standard and have been installed in accordance with any conditions attached thereto.

4.1.1.3 A manufacturer may obtain approval according to this standard if the vehicle has no equipment of the type, which is subject to immunity or emission tests. Such approvals do not require testing.

#### **4.1.2 Type Approval of an ESA**

Type approval may be granted to an ESA to be fitted either to any vehicle type (component approval) or to a specific vehicle type or types requested by the ESA manufacturer (separate technical unit approval).

4.1.3 ESAs, which are intentional RF transmitters, which have not received type approval in conjunction with a vehicle manufacturer, must be supplied with suitable installation guidelines

## **4.2 Granting of Type Approval**

### **4.2.1 Vehicle**

4.2.1.1 If the representative vehicle fulfils the requirements of paragraph 5 of this standard, type approval shall be granted.

### **4.2.2 ESA**

4.2.2.1 If the representative ESA system(s) fulfil(s) the requirements of paragraph 5 and if applicable paragraph 6 of this standard, type approval shall be granted.

## **5.0 SPECIFICATION IN CONFIGURATIONS OTHER THAN REESS CHARGING MODE COUPLED TO THE POWER GRID**

### **5.1 General Specifications**

5.1.1 A vehicle and its electrical / electronic system(s) or ESA(s) shall be so designed, constructed and fitted as to enable the vehicle, in normal conditions of use, to comply with the requirements of this standard.

5.1.1.1 A vehicle shall be tested for radiated emissions and for immunity to radiated disturbances. No tests for conducted emissions or immunity to conducted disturbances are required for vehicle type approval.

5.1.1.2 ESA(s) shall be tested for radiated and conducted emissions, for immunity to radiated and conducted disturbances.

5.1.2 Before testing the Test Agency has to prepare a test plan in conjunction with the manufacturer, which contains at least mode of operation, stimulated function(s), monitored function(s), pass / fail criterion (criteria) and intended emissions.

### **5.2 Specifications Concerning Broadband Electromagnetic Radiation from Vehicles**

#### **5.2.1 Method of Measurement**

The electromagnetic radiation generated by the vehicle representative of its type shall be measured using the method described in Annex 2. The method of measurement shall be defined by the vehicle manufacturer in accordance with the Test Agency.

#### **5.2.2 Vehicle broadband type approval limits**

5.2.2.1 If measurements are made using the method described in Annex 2 using a vehicle-to-antenna spacing of  $10.0 \pm 0.2$  m, the limits shall be 32 dB microvolts/m in the 30 to 75 MHz frequency band and 32 to 43 dB microvolts/m in the 75 to 400 MHz frequency band, this limit increasing logarithmically with frequencies above 75 MHz as shown in Appendix 2. In the 400 to 1,000 MHz frequency band the limit remains constant at 43 dB microvolts/m



5.2.2.2 If measurements are made using the method described in Annex 2 using a vehicle-to-antenna spacing of  $3.0 \pm 0.05$  m, the limits shall be 42 dB microvolts/m in the 30 to 75 MHz frequency band and 42 to 53 dB microvolts/m in the 75 to 400 MHz frequency band, this limit increasing logarithmically with frequencies above 75 MHz as shown in Appendix 3. In the 400 to 1,000 MHz frequency band the limit remains constant at 53 dB microvolts/m.

5.2.2.3 On the vehicle representative of its type, the measured values, expressed in dB microvolts/m shall be below the type approval limits

### **5.3 Specifications Concerning Narrowband Electromagnetic Radiation from Vehicles**

#### **5.3.1 Method of Measurement**

The electromagnetic radiation generated by the vehicle representative of its type shall be measured using the method described in Annex 3. These shall be defined by the vehicle manufacturer in accordance with the Test Agency.

#### **5.3.2 Vehicle narrowband type approval limits**

5.3.2.1 If measurements are made using the method described in Annex 3 using a vehicle-to-antenna spacing of  $10.0 \pm 0.2$  m, the limits shall be 22 dB microvolts/m in the 30 to 75 MHz frequency band and 22 to 33 dB microvolts/m in the 75 to 400 MHz frequency band, this limit increasing logarithmically with frequencies above 75 MHz as shown in Appendix 4. In the 400 to 1,000 MHz frequency band the limit remains constant at 33 dB microvolts/m.

5.3.2.2 If measurements are made using the method described in Annex 3 using a vehicle-to-antenna spacing of  $3.0 \pm 0.05$  m, the limit shall be 32 dB microvolts/m in the 30 to 75 MHz frequency band and 32 to 43 dB microvolts/m in the 75 to 400 MHz frequency band, this limit increasing logarithmically with frequencies above 75 MHz as shown in Appendix 5. In the 400 to 1,000 MHz frequency band the limit remains constant at 43 dB microvolts/m

5.3.2.3 On the vehicle representative of its type, the measured values, expressed in dB microvolts/m, shall be below the type approval limit.

5.3.2.4 Notwithstanding the limits defined in paragraphs 5.3.2.1, 5.3.2.2 and 5.3.2.3 of this standard, if, during the initial step described in paragraph 1.3. of Annex 3, the signal strength measured at the vehicle broadcast radio antenna is less than 20 dB microvolts over the frequency range 76 to 108 MHz measured with an average detector, then the vehicle shall be deemed to comply with the limits for narrowband emissions and no further testing will be required.

**5.4 Specifications Concerning Immunity of Vehicles to Electromagnetic Radiation.**

5.4.1 Method of Testing

The immunity to electromagnetic radiation of the vehicle representative of its type shall be tested by the method described in Annex 4.

5.4.2 Vehicle Immunity Type Approval Limits.

5.4.2.1 If tests are made using the method described in Annex 4, the field strength shall be 30 volts/m rms (root mean squared) in over 90 percent of the 20 to 2,000 MHz frequency band and a minimum of 25 volts/m rms over the whole 20 to 2,000 MHz frequency band.

5.4.2.2 The vehicle representative of its type shall be considered as complying with immunity requirements if, during the tests performed in accordance with Annex 4, there shall be no degradation of performance of "immunity related functions

**5.5 Specifications Concerning Broadband Electromagnetic Interference Generated by ESAs.**

5.5.1 Method of Measurement

The electromagnetic radiation generated by the ESA representative of its type shall be measured by the method described in Annex 5.

5.5.2 ESA Broadband Type Approval limits

5.5.2.1 If measurements are made using the method described in Annex 5, the limits shall be 62 to 52 dB microvolts/m in the 30 to 75 MHz frequency band, this limit decreasing logarithmically with frequencies above 30 MHz, and 52 to 63 dB microvolts/m in the 75 to 400 MHz band, this limit increasing logarithmically with frequencies above 75 MHz as shown in Appendix 6. In the 400 to 1,000 MHz frequency band the limit remains constant at 63 dB microvolts/m.

5.5.2.2 On the ESA representative of its type, the measured values, expressed in dB microvolts/m, shall be below the type approval limits.

**5.6 Specifications Concerning Narrowband Electromagnetic Interference Generated by ESAs.**

5.6.1 Method of Measurement

The electromagnetic radiation generated by the ESA representative of its type shall be measured by the method described in Annex 6.

5.6.2 ESA narrowband type approval limits

- 5.6.2.1 If measurements are made using the method described in Annex 6, the limits shall be 52 to 42 dB microvolts/m in the 30 to 75 MHz frequency band, this limit decreasing logarithmically with frequencies above 30 MHz, and 42 to 53 dB microvolts/m in the 75 to 400 MHz band, this limit increasing logarithmically with frequencies above 75 MHz as shown in Appendix 7. In the 400 to 1,000 MHz frequency band the limit remains constant at 53 dB microvolts/m.
- 5.6.2.2 On the ESA representative of its type, the measured values, expressed in dB microvolts/m, shall be below the type approval limits.
- 5.7 **Specifications Concerning Immunity of ESAs to Electromagnetic Radiation.**
  - 5.7.1 Method(s) of Testing

The immunity to electromagnetic radiation of the ESA representative of its type shall be tested by the method(s) chosen from those described in Annex 7.
  - 5.7.2 ESA immunity type approval limits
    - 5.7.2.1 If tests are made using the methods described in Annex 7, the immunity test levels shall be 60 volts/m for the 150 mm stripline testing method, 15 volts/m for the 800 mm stripline testing method, 75 volts/m for the Transverse Electromagnetic Mode (TEM) cell testing method, 60 mA for the bulk current injection (BCI) testing method and 30 volts/m for the free field testing method in over 90 per cent of the 20 to 2,000 MHz frequency band, and to a minimum of 50 volts/m for the 150 mm stripline testing method, 12.5 volts/m for the 800 mm stripline testing method, 62.5 volts/m for the TEM cell testing method, 50 mA for the bulk current injection (BCI) testing method and 25 volts/m for the free field testing method over the whole 20 to 2,000 MHz frequency band.
    - 5.7.2.2 The ESA representative of its type shall be considered as complying with immunity requirements if, during the tests performed in accordance with Annex 7, there shall be no degradation of performance of "immunity related functions".
- 5.8 **Specifications Concerning the Immunity to Transient Disturbances Conducted along Supply Lines.**
  - 5.8.1 Method of testing

The immunity of ESA representative of its type shall be tested by the method(s) according to ISO 7637-2, second edition 2004 as described in Annex 8 with the test levels given in table 1.

**Table 1****Immunity of ESA**

<b>Test pulse number</b>	<b>Immunity test level</b>	<b>Functional status for systems:</b>	
		<b>Related to immunity related functions</b>	<b>Not related to immunity related functions</b>
1	III	C	D
2a	III	B	D
2b	III	C	D
3a/3b	III	A	D
4	III	B  (For ESA which must be operational during engine start phases)  C  (For other ESA)	D

## 5.9 Specifications Concerning the Emission of Transient Conducted Disturbances

### 5.9.1 Method of testing

The emission of ESA representative of its type shall be tested by the method(s) according to ISO 7637-2, second edition 2004 as described in Annex 8 for the levels given in table 2.

Table 2

## Maximum allowed pulse amplitude

Polarity of pulse amplitude	Maximum allowed pulse amplitude for	
	Vehicles with 12 V systems	Vehicles with 24 V systems
Positive	+75	+150
Negative	-100	- 450

## 5.10 Exceptions

- 5.10.1 Where a vehicle or electrical / electronic system or ESA does not include an electronic oscillator with an operating frequency greater than 9 kHz, it shall be deemed to comply with paragraphs 5.3.2 or 5.6.2 above and to Annexes 3 and 6.
- 5.10.2 Vehicles which do not have electrical / electronic systems with "immunity related functions" need not be tested for immunity to radiated disturbances and shall be deemed to comply with paragraph 5.4 and with Annex 4 to this standard.
- 5.10.3 ESAs with no immunity related functions need not be tested for immunity to radiated disturbances and shall be deemed to comply with paragraph 5.7 and with Annex 7 to this standard.
- 5.10.4 Electrostatic Discharge
- For vehicles fitted with tyres, the vehicle body / chassis can be considered to be an electrically isolated structure. Significant electrostatic forces in relation to the vehicle's external environment occur only at the moment of occupant entry into or exit from the vehicle. As the vehicle is stationary at these moments, no type approval test for electrostatic discharge is deemed necessary.
- 5.10.5 Conducted Emission
- ESAs that are not switched, contain no switches or do not include inductive loads need not be tested for conducted emission and shall be deemed to comply with paragraph 5.9.
- 5.10.6 The loss of function of receivers during the immunity test, when the test signal is within the receiver bandwidth (RF exclusion band) as specified for the specific radio service / product in the harmonized international EMC standard, does not necessarily lead to fail criteria.

- 5.10.7 RF transmitters shall be tested in the transmit mode. Wanted emissions (e.g. from RF transmitting systems) within the necessary bandwidth and out of band emissions are disregarded for the purpose of this standard. Spurious emissions are subject to this standard.
- 5.10.7.1 "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 (Article 1, No. 1.152 of the ITU Radio Standards).
- 5.10.7.2 "Out-of-band Emissions": Emission on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process, but excluding spurious emissions (Article 1, No. 1.144 of the ITU Radio Standards).
- 5.10.7.3 "Spurious Emission": In every modulation process additional undesired signals exist. They are summarized under the expression "spurious emissions". Spurious emissions are emissions on a frequency or frequencies, which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions (Article 1 No. 1.145 of the ITU Radio Standards)."

## **6.0 ADDITIONAL SPECIFICATIONS IN THE CONFIGURATION "REESS CHARGING MODE COUPLED TO THE POWER GRID"**

### **6.1 General specifications**

- 6.1.1 A vehicle and its electrical / electronic system(s) or ESA(s) shall be so designed, constructed and fitted as to enable the vehicle, in configuration "REESS charging mode coupled to the power grid", to comply with the requirements of this standard.
- 6.1.1.1 A vehicle in configuration "REESS charging mode coupled to the power grid" shall be tested for radiated emissions, immunity to radiated disturbances, conducted emissions and immunity to conducted disturbances.
- 6.1.1.2 ESAs in configuration "REESS charging mode coupled to the power grid" shall be tested for radiated and conducted emissions, for immunity to radiated and conducted disturbances
- 6.1.2 Before testing the Test Agency has to prepare a test plan in conjunction with the manufacturer, for the configuration "REESS charging mode coupled to the power grid" configuration which contains at least mode of operation, stimulated function(s), monitored function(s), pass / fail criterion (criteria) and intended emissions.

- 6.1.3 A vehicle in configuration "REESS charging mode coupled to the power grid" should be tested with the charging cable delivered by the manufacturer. In this case, the cable shall be type approved as part of the vehicle.
- 6.1.4 Artificial networks
- AC Power mains shall be applied to the vehicle / ESA through 50  $\mu$ H / 50-AN(s) as defined in CISPR 16-1-2 paragraph 4.3.
- DC Power mains shall be applied to the vehicle / ESA through 5  $\mu$ H / 50 - AN(s) as defined in CISPR 25.
- High voltage power line shall be applied to the ESA through a 5  $\mu$ H / 50 -HV-AN(s) as defined in Appendix 8. E/ECE/324/Add.9/Rev.5 E/ECE/TRANS/505/Add.9/Rev.5
- 6.2 **Specifications concerning broadband electromagnetic radiation from vehicles**
- 6.2.1 Method of measurement
- The electromagnetic radiation generated by the vehicle representative of its type shall be measured using the method described in Annex 2. The method of measurement shall be defined by the vehicle manufacturer in accordance with the Test Agency.
- 6.2.2. Vehicle broadband type approval limits
- 6.2.2.1 If measurements are made using the method described in Annex 2 using a vehicle-to-antenna spacing of  $10.0 \pm 0.2$  m, the limits shall be 32 dB microvolts/m in the 30 to 75 MHz frequency band and 32 to 43 dB microvolts/m in the 75 to 400 MHz frequency band, this limit increasing logarithmically with frequencies above 75 MHz as shown in Appendix 2. In the 400 to 1,000 MHz frequency band the limit remains constant at 43 dB microvolts/m.
- 6.2.2.2 If measurements are made using the method described in Annex 2 using a vehicle-to-antenna spacing of  $3.0 \pm 0.05$  m, the limits shall be 42 dB microvolts/m in the 30 to 75 MHz frequency band and 42 to 53 dB microvolts/m in the 75 to 400 MHz frequency band, this limit increasing logarithmically with frequencies above 75 MHz as shown in Appendix 3. In the 400 to 1,000 MHz frequency band the limit remains constant at 53 dB microvolts/m.
- On the vehicle representative of its type, the measured values, expressed in dB microvolts/m shall be below the type approval limits.
- 6.3 **Specifications concerning emission of harmonics on AC power lines from vehicles**

**6.3.1 Method of measurement**

The harmonics emission on AC power lines generated by the vehicle representative of its type shall be measured using the method described in Annex 9. The method of measurement shall be defined by the vehicle manufacturer in accordance with the Test Agency.

**6.3.2 Vehicle type approval limit**

**6.3.2.1** If measurements are made using the method described in Annex 9, the limits for input current  $\leq 16$  A per phase are those defined in IEC 61000-3-2 and given in Table 3.

**Table 3**

**Maximum allowed harmonics (input current  $\leq 16$  A per phase)**

Harmonic number (n)	Maximum authorized harmonic current A
Odd harmonics	
3	2.3
5	1.14
7	0.77
9	0.40
11	0.33
13	0.21
$15 \leq n \leq 39$	$0.15 \times 15/n$
Even harmonics	
2	1.08
4	0.43
6	0.30
$8 \leq n \leq 40$	$0.23 \times 8/n$

**6.3.2.2** If measurements are made using the method described in Annex 9, the limits for input current  $> 16$  A and  $\leq 75$  A per phase are those defined in IEC 61000-3-12, and given in given in Table 4, Table 5 and Table 6.



**Table 4**

**Maximum allowed harmonics (input current  $> 16$  A and  $\leq 75$  A per phase) for equipment other than balanced three-phase equipment**

Minimum Rsce	Acceptable individual harmonic current $I_n/I_1$ %						Maximum current harmonic ratio %	
	I3	I5	I7	I9	I11	I13	THD	PWHD
33	21.6	10.7	7.2	3.8	3.1	2	23	23
66	24	13	8	5	4	3	26	26
120	27	15	10	6	5	4	30	30
250	35	20	13	9	8	6	40	40
$\geq 350$	41	24	15	12	10	8	47	47

Relative values of even harmonics lower or equal to 12 shall be lower than  $16/n$  %. Even harmonics greater than 12 are taken into account in the Total Harmonic Distortion (THD) and Partial Weighted Harmonic Distortion (PWHD) the same way than odd harmonics.

Linear interpolation between successive values of Short Circuit Ratio of an Equipment (Rsce) is authorized.

**Table 5**

**Maximum allowed harmonics (input current  $> 16$  A and  $\leq 75$  A per phase) for balanced three-phase equipment**

Minimum Rsce	Acceptable individual harmonic current $I_n/I_1$ %				Maximum current harmonic ratio %	
	I5	I7	I11	I13	THD	PWHD
33	10.7	7.2	3.1	2	13	22
66	14	9	5	3	16	25
120	19	12	7	4	22	28
250	31	20	12	7	37	38
$\geq 350$	40	25	15	10	48	46

Relative values of even harmonics lower or equal to 12 shall be lower than  $16/n$  %. Even harmonics greater than 12 are taken into account in the THD and PWHd the same way than odd harmonics.

Linear interpolation between successive values of  $R_{sce}$  is authorized.

**Table 6**

**Maximum allowed harmonics (input current  $> 16$  A and  $\leq 75$  A per phase) for balanced three-phase equipment under specific conditions**

Minimum $R_{sce}$	Acceptable individual harmonic current $I_n/I_1$ %				Maximum current harmonic ratio %	
	I5	I7	I11	I13	THD	PWHD
33	10.7	7.2	3.1	2	13	22
$\geq 120$	40	25	15	10	48	46

Relative values of even harmonics lower or equal to 12 shall be lower than  $16/n$  %. Even harmonics greater than 12 are taken into account in the THD and PWHd the same way than odd harmonics

#### 6.4 **Specifications concerning emission of voltage changes, voltage fluctuations and flicker on AC power lines from vehicles.**

##### 6.4.1 Method of measurement

The emission of voltage changes, voltage fluctuations and flicker on AC power lines generated by the vehicle representative of its type shall be measured using the method described in Annex 10. The method of measurement shall be defined by the vehicle manufacturer in accordance with the Test Agency.

##### 6.4.2. Vehicle type approval limit

6.4.2.1 If measurements are made using the method described in Annex 10, the limits for rated current  $\leq 16$  A per phase and not subjected to conditional connection are those defined in IEC 61000-3-3, paragraph 5.

6.4.2.2 If measurements are made using the method described in Annex 10, the limits for rated current  $> 16$  A and  $\leq 75$  A per phase and subjected to conditional connection are those defined in IEC 61000-3-11, paragraph 5.

#### 6.5 **Specifications concerning emission of radiofrequency conducted disturbances on AC or DC power lines from vehicles**

## 6.5.1 Method of measurement

The emission of radiofrequency conducted disturbances on AC or DC power lines generated by the vehicle representative of its type shall be measured using the method described in Annex 11. The method of measurement shall be defined by the vehicle manufacturer in accordance with the Test Agency.

## 6.5.2 Vehicle type approval limit

6.5.2.1 If measurements are made using the method described in Annex 11, the limits on AC power lines are those defined in IEC 61000-6-3 and given in Table 7.

**Table 7**

**Maximum allowed radio frequency conducted disturbances on  
AC power lines**

Frequency (MHz)	Limits and detector
0.15 to 0.5	66 to 56 dB $\mu$ V (quasi-peak) 56 to 46 dB $\mu$ V (average) (Linearly decreasing with logarithm of frequency)
0.5 to 5	56 dB $\mu$ V (quasi-peak) 46 dB $\mu$ V (average)
5 to 30	60 dB $\mu$ V (quasi-peak) 50 dB $\mu$ V (average)

6.5.2.2 If measurements are made using the method described in Annex 11, the limits on DC power lines are those defined in IEC 61000-6-3 and given in Table 8.

**Table 8**

**Maximum allowed radiofrequency conducted disturbances on DC  
power lines**

Frequency (MHz)	Limits and detector
0.15 to 0.5	79 dB $\mu$ V (quasi-peak)
	66 dB $\mu$ V (average)
0.5 to 30	73 dB $\mu$ V (quasi-peak)
	60 dB $\mu$ V (average)

## 6.6 Specifications concerning emission of radiofrequency conducted disturbances on network and telecommunication access from vehicles

## 6.6.1 Method of measurement

The emission of radiofrequency conducted disturbances on network and telecommunication access generated by the vehicle representative of its type shall be measured using the method described in Annex 12. The method of

measurement shall be defined by the vehicle manufacturer in accordance with the Test Agency.

**6.6.2 Vehicle type approval limit**

6.6.2.1 If measurements are made using the method described in Annex 12, the limits on network and telecommunication access (telecommunication access as defined in paragraph 3.1.32 of CISPR 32) are those defined in IEC 61000-6-3 and given in Table 9.

**Table 9**

**Maximum allowed radiofrequency conducted disturbances on network and telecommunication access**

<b>Frequency (MHz)</b>	<b>Voltage limits (detector)</b>	<b>Current limits (detector)</b>
0.15 to 0.5	84 to 74 dB $\mu$ V (quasi-peak)	40 to 30 dB $\mu$ A (quasi-peak)
	74 to 64 dB $\mu$ V (average) (linearly decreasing with logarithm of frequency)	30 to 20 dB $\mu$ A (average) (linearly decreasing with logarithm of frequency)
0.5 to 30	74 dB $\mu$ V (quasi-peak)	30 dB $\mu$ A (quasi-peak)
	64 dB $\mu$ V (average)	20 dB $\mu$ A (average)

**6.7 Specifications concerning immunity of vehicles to electromagnetic radiation**

**6.7.1 Method of testing**

The immunity to electromagnetic radiation of the vehicle representative of its type shall be tested by the method described in Annex 4.

**6.7.2 Vehicle immunity type approval limits**

6.7.2.1 If tests are made using the method described in Annex 4, the field strength shall be 30 volts/m rms (root mean squared) in over 90 per cent of the 20 to 2,000 MHz frequency band and a minimum of 25 volts/m rms over the whole 20 to 2,000 MHz frequency band.

6.7.2.2 The vehicle representative of its type shall be considered as complying with immunity requirements if, during the tests performed in accordance with Annex 4, there shall be no degradation of performance of "immunity related functions", according to paragraph 2.2. of Annex 4.

- 6.8      **Specifications concerning the immunity of vehicles to Electrical Fast Transient / Burst disturbances conducted along AC and DC power lines.**
- 6.8.1    Method of testing
- 6.8.1.1    The immunity to Electrical Fast Transient / Burst disturbances conducted along AC and DC power lines of the vehicle representative of its type shall be tested by the method described in Annex 13.
- 6.8.2    Vehicle immunity type approval limits
- 6.8.2.1    If tests are made using the methods described in Annex 13, the immunity test levels, for AC or DC power lines, shall be:  $\pm 2$  kV test voltage in open circuit, with a rise time ( $T_r$ ) of 5 ns, and a hold time ( $T_h$ ) of 50 ns and a repetition rate of 5 kHz for at least 1 minute.
- 6.8.2.2    The vehicle representative of its type shall be considered as complying with immunity requirements if, during the tests performed in accordance with Annex 13, there shall be no degradation of performance of "immunity related functions", according to paragraph 2.2. of Annex 4.
- 6.9      **Specifications concerning the immunity of vehicles to surge conducted along AC or DC power lines.**
- 6.9.1    Method of testing
- 6.9.1.1    The immunity to surge conducted along AC / DC power lines of the vehicle representative of its type shall be tested by the method described in Annex 14.
- 6.9.2    Vehicle immunity type approval limits
- 6.9.2.1    If tests are made using the methods described in Annex 14, the immunity test levels shall be:
  - (a) For AC power lines:  $\pm 2$  kV test voltage in open circuit between line and earth and  $\pm 1$  kV between lines (pulse 1.2  $\mu$ s / 50  $\mu$ s), with a rise time ( $T_r$ ) of 1.2  $\mu$ s, and a hold time ( $T_h$ ) of 50  $\mu$ s. Each surge shall be applied five times with a maximum delay of 1 minute between each pulse. This has to be applied for the following phases: 0, 90, 180 and 270°,
  - (b) For DC power lines:  $\pm 0.5$  kV test voltage in open circuit between line and earth and  $\pm 0.5$  kV between lines (pulse 1.2  $\mu$ s / 50  $\mu$ s) with a rise time ( $T_r$ ) of 1.2  $\mu$ s, and a hold time ( $T_h$ ) of 50  $\mu$ s. Each surge shall be applied five times with a maximum delay of 1 minute.
- 6.9.2.2    The vehicle representative of its type shall be considered as complying with immunity requirements if, during the tests performed in accordance with Annex 14, there shall be no degradation of performance of "immunity related functions", according to paragraph 2.2. of Annex 4.
- 6.10    **Specifications concerning broadband electromagnetic interference caused by ESAs**

## 6.10.1 Method of measurement

The electromagnetic radiation generated by the ESA representative of its type shall be measured by the method described in Annex 5.

## 6.10.2 ESA broadband type approval limits

6.10.2.1 If measurements are made using the method described in Annex 5, the limits shall be 62 to 52 dB  $\mu\text{V/m}$  in the 30 to 75 MHz frequency band, this limit decreasing logarithmically with frequencies above 30 MHz, and 52 to 63 dB  $\mu\text{V/m}$  in the 75 to 400 MHz band, this limit increasing logarithmically with frequencies above 75 MHz as shown in Appendix 6. In the 400 to 1,000 MHz frequency band the limit remains constant at 63 dB  $\mu\text{V/m}$ .

6.10.2.2 On the ESA representative of its type, the measured values, expressed in dB  $\mu\text{V/m}$ , shall be below the type approval limits.

6.11 **Specifications concerning emission of harmonics on AC power lines from ESAs**

## 6.11.1 Method of measurement

The harmonics emission on AC power lines generated by the ESA representative of its type shall be measured using the method described in Annex 15. The method of measurement shall be defined by the manufacturer in accordance with the Test Agency.

## 6.11.2 ESA type approval limit

6.11.2.1 If measurements are made using the method described in Annex 15, the limits for input current  $\leq 16$  A per phase are those defined in IEC 61000-3-2 and given in Table 10.

**Table 10**  
**Maximum allowed harmonics (input current  $\leq 16$  A per phase)**

Harmonic number, n	Maximum authorized harmonic current, A
Odd harmonics	
3	2.3
5	1.14
7	0.77
9	0.40
11	0.33
13	0.21
$15 \leq n \leq 39$	$0.15 \times 15/n$
Even harmonics	
2	1.08
4	0.43
6	0.30
$8 \leq n \leq 40$	$0.23 \times 8/n$

6.11.2.2. If measurements are made using the method described in Annex 15, the limits for input current  $> 16$  A and  $\leq 75$  A per phase are those defined in IEC 61000-3-12 and given in Table 11, Table 12 and Table 13.

**Table 11**

**Maximum allowed harmonics (input current > 16 A and  $\leq$  75 A per phase) for equipment other than balanced three-phase equipment.**

Minimum Rsce	Acceptable individual harmonic current $I_n/I_1$ %						Maximum current harmonic ratio %	
	I3	I5	I7	I9	I11	I13	THD	PWHD
33	21.6	10.7	7.2	3.8	3.1	2	23	23
66	24	13	8	5	4	3	26	26
120	27	15	10	6	5	4	30	30
250	35	20	13	9	8	6	40	40
$\geq 350$	41	24	15	12	10	8	47	47

Relative values of even harmonics lower or equal to 12 shall be lower than  $16/n$  %. Even harmonics greater than 12 are taken into account in the THD and PWHD in the same way than odd harmonics.

Linear interpolation between successive values of Rsce is authorized.

**Table 12**

**Maximum allowed harmonics (input current > 16 A and  $\leq$  75 A per phase) for balanced three-phase equipment.**

Minimum Rsce	Acceptable individual harmonic current $I_n/I_1$ %				Maximum current harmonic ratio %	
	I5	I7	I11	I13	THD	PWHD
33	10.7	7.2	3.1	2	13	22
66	14	9	5	3	16	25
120	19	12	7	4	22	28
250	31	20	12	7	37	38
$\geq 350$	40	25	15	10	48	46

Relative values of even harmonics lower or equal to 12 shall be lower than  $16/n$  %. Even harmonics greater than 12 are taken into account in the THD and PWH in the same way as odd harmonics.

Linear interpolation between successive values of  $R_{sce}$  is authorized.

**Table 13**

**Maximum allowed harmonics (input current  $> 16$  A and  $\leq 75$  A per phase) for balanced three-phase equipment under specific conditions**

Minimum $R_{sce}$	Acceptable individual harmonic current $I_n/I_1$ %				Maximum current harmonic ratio %	
	$I_5$	$I_7$	$I_{11}$	$I_{13}$	$THD$	$PWHD$
33	10.7	7.2	3.1	2	13	22
$\geq 120$	40	25	15	10	48	46

Relative values of even harmonics lower or equal to 12 shall be lower than  $16/n$  %. Even harmonics greater than 12 are taken into account in the THD and PWH in the same way as odd harmonics.

## **6.12 Specifications concerning emission of voltage changes, voltage fluctuations and flicker on AC power lines from ESAs**

### **6.12.1 Method of measurement**

The emission of voltage changes, voltage fluctuations and flicker on AC power lines generated by the ESA representative of its type shall be measured using the method described in Annex 16. The method of measurement shall be defined by the ESA manufacturer in accordance with the Test Agency.

### **6.12.2 ESA type approval limit**

6.12.2.1 If measurements are made using the method described in Annex 16, the limits for rated current  $\leq 16$  A per phase and not subjected to conditional connection are those defined in IEC 61000-3-3, paragraph 5.

6.12.2.2 If measurements are made using the method described in Annex 16, the limits for rated current  $> 16$  A and  $\leq 75$  A per phase and subjected to conditional connection are those defined in IEC 61000-3-11, paragraph 5.

## **6.13 Specifications concerning emission of radiofrequency conducted disturbances on AC or DC power lines from ESA**



## 6.13.1 Method of measurement

The emission of radiofrequency conducted disturbances on AC or DC power lines generated by the ESA representative of its type shall be measured using the method described in Annex 17. The method of measurement shall be defined by the ESA manufacturer in accordance with the Test Agency.

## 6.13.2 ESA type approval limit

## 6.13.2.1 If measurements are made using the method described in Annex 17, the limits on AC power lines are those defined in IEC 61000-6-3 and given in Table 14.

**Table 14****Maximum allowed radiofrequency conducted disturbances on AC power**

<b>Lines Frequency (MHz)</b>	<b>Limits and detector</b>
0.15 to 0.5	66 to 56 dB $\mu$ V (quasi-peak) 56 to 46 dB $\mu$ V (average) (linearly decreasing with logarithm of frequency)
0.5 to 5	56 dB $\mu$ V (quasi-peak) 46 dB $\mu$ V (average)
5 to 30	60 dB $\mu$ V (quasi-peak) 50 dB $\mu$ V (average)

If measurements are made using the method described in Annex 17, the limits on DC power lines are those defined in IEC 61000-6-3 and given in Table 15.

**Table 15****Maximum allowed radiofrequency conducted disturbances on DC power lines**

<b>Frequency (MHz)</b>	<b>Limits and detector</b>
0.15 to 0.5	79 dB $\mu$ V (quasi-peak) 66 dB $\mu$ V (average)
0.5 to 30	73 dB $\mu$ V (quasi-peak) 60 dB $\mu$ V (average)

**6.14 Specifications concerning emission of radiofrequency conducted disturbances on network and telecommunication access from ESA**

## 6.14.1 Method of measurement

The emission of radiofrequency conducted disturbances on network and telecommunication access generated by the ESA representative of its type shall be measured using the method described in Annex 18. The method of measurement shall be defined by the ESA manufacturer in accordance with the Test Agency.

## 6.14.2 ESA type approval limit

- 6.14.2.1 If measurements are made using the method described in Annex 18, the limits on network and telecommunication access (telecommunication access as defined in paragraph 3.1.32 of *CISPR 32*) are those defined in IEC 61000-6-3 and given in Table 16.

Table 16

**Maximum allowed radiofrequency conducted disturbances on network and telecommunication access**

Frequency (MHz)	Voltage limits (detector)	Current limits (detector)
0.15 to 0.5	84 to 74 dB $\mu$ V (quasi-peak) 74 to 64 dB $\mu$ V (average)  (linearly decreasing with logarithm of frequency)	40 to 30 dB $\mu$ A (quasi-peak) 30 to 20 dB $\mu$ A (average)  (linearly decreasing with logarithm of frequency)
0.5 to 30	74 dB $\mu$ V (quasi-peak) 64 dB $\mu$ V (average)	30 dB $\mu$ A (quasi-peak) 20 dB $\mu$ A (average)

**6.15 Specifications concerning the immunity of ESAs to electrical fast transient/burst disturbances conducted along AC and DC power lines.**

## 6.15.1 Method of testing

- 6.15.1.1 The immunity to Electrical Fast Transient / Burst disturbances conducted along AC and DC power lines of the ESA representative of its type shall be tested by the method described in Annex 19.

## 6.15.2 ESA immunity type approval limits

- 6.15.2.1 If tests are made using the methods described in Annex 19, the immunity test levels, for AC or DC power lines, shall be:  $\pm 2$  kV test voltage in open circuit, with a rise time ( $T_r$ ) of 5 ns, and a hold time ( $T_h$ ) of 50 ns and a repetition rate of 5 kHz for at least 1 minute.
- 6.15.2.2 The ESA representative of its type shall be considered as complying with immunity requirements if, during the tests performed in accordance with Annex 19, there shall be no degradation of performance of "immunity related functions", according to paragraph 2.2. of Annex 7.

**6.16 Specifications concerning the immunity of ESAs to surge conducted along AC or DC power lines**

## 6.16.1 Method of testing

6.16.1.1 The immunity to surge conducted along AC / DC power lines of the ESA representative of its type shall be tested by the method described in Annex 20.

6.16.2 ESA immunity type approval limits

6.16.2.1 If tests are made using the methods described in Annex 20, the immunity test levels shall be:

(a) For AC power lines:  $\pm 2$  kV test voltage in open circuit between line and earth and  $\pm 1$  kV between lines (pulse 1.2  $\mu$ s / 50  $\mu$ s), with a rise time (Tr) of 1.2  $\mu$ s, and a hold time (Th) of 50  $\mu$ s. Each surge shall be applied five times with a maximum delay of 1 minute between each pulse. This has to be applied for the following phases: 0, 90, 180 and 270°,

(b) For DC power lines:  $\pm 0.5$  kV test voltage in open circuit between line and earth and  $\pm 0.5$  kV between lines (pulse 1.2  $\mu$ s / 50  $\mu$ s) with a rise time (Tr) of 1.2  $\mu$ s, and a hold time (Th) of 50  $\mu$ s. Each surge shall be applied five times with a maximum delay of 1 minute.

6.16.2.2 The ESA representative of its type shall be considered as complying with immunity requirements if, during the tests performed in accordance with Annex 20, there shall be no degradation of performance of "immunity related functions", according to paragraph 2.2. of Annex 7.

**6.17 Specifications concerning the emission of transient conducted disturbances generated by ESAs on 12 / 24 V supply lines**

6.17.1 Method of testing

The emission of ESA representative of its type shall be tested by the method(s) according to ISO 7637-2, as described in Annex 8 for the levels given in Table 17.

**Table 17**

**Maximum allowed pulse amplitude**

	<b>Maximum allowed pulse amplitude for</b>	
<b>Polarity of pulse amplitude</b>	<b>Vehicles with 12 V systems</b>	<b>Vehicles with 24V systems</b>
Positive	+75 V	+150 V
Negative	−100 V	−450 V

**6.18 Specifications concerning immunity of ESAs to electromagnetic radiation**

**6.18.1 Method(s) of testing**

The immunity to electromagnetic radiation of the ESA representative of its type shall be tested by the method(s) chosen from those described in Annex 7.

**6.18.2 ESA immunity type approval limits**

**6.18.2.1** If tests are made using the methods described in Annex 7, the immunity test levels shall be 60 volts/m rms for the 150 mm stripline testing method, 15 volts/m rms for the 800 mm stripline testing method, 75 volts/m rms for the Transverse Electromagnetic Mode (TEM) cell testing method, 60 mA rms for the Bulk Current Injection (BCI) testing method and 30 volts/m rms for the free field testing method in over 90 per cent of the 20 to 2,000 MHz frequency band, and to a minimum of 50 volts/m rms for the 150 mm stripline testing method, 12.5 volts/m rms for the 800 mm stripline testing method, 62.5 volts/m rms, for the TEM cell testing method, 50 mA rms for the bulk current injection (BCI) testing method and 25 volts/m rms for the free field testing method over the whole 20 to 2,000 MHz frequency band.

**6.18.2.2** The ESA representative of its type shall be considered as complying with immunity requirements if, during the tests performed in accordance with Annex 7, there shall be no degradation of performance of "immunity related functions".

**6.19 Specifications concerning the immunity of ESAs to transient disturbances conducted along 12 / 24 V supply lines.**

**6.19.1 Method of testing**

The immunity of ESA representative of its type shall be tested by the method(s) according to ISO 7637-2, as described in Annex 8 with the test levels given in Table 18.

<b>Table 18</b> <b>Immunity of ESA</b>			
Test pulse number	Immunity test level	Functional status for systems:	
		Related to immunity related functions	Not related to immunity related functions
1	III	C	D
2a	III	B	D
2b	III	C	D
3a/3b	III	A	D
4	III	B (for ESA which shall be operational during engine start phases)  C (for other ESA)	D

## 6.20 Exceptions

- 6.20.1 When there is no direct connection to a telecommunication network which includes telecommunication service additional to the charging communication service, Annex 12 and Annex 18 shall not apply.
- 6.20.2 When network and telecommunication access of the vehicle uses power line Transmission (PLT) on its AC/DC power lines, Annex 12 shall not apply.
- 6.20.3 When network and telecommunication access of the ESA uses Power Line Transmission (PLT) on its AC/DC power lines, Annex 18 shall not apply.
- 6.20.4 Vehicles and / or ESA which are intended to be used in "REESS charging mode coupled to the power grid" in the configuration connected to a DC-charging station with a length of a DC network cable shorter than 30 m do not have to fulfil the requirements of Annex 11, Annex 13, Annex 14, Annex 17, Annex 19 and Annex 20.

In this case, the manufacturer shall provide a statement that the vehicle and/or ESA can be used in "REESS charging mode coupled to the power grid" only with cables shorter than 30 m. This information shall be made publicly available following the type approval.

- 6.20.5 Vehicles and / or ESA which are intended to be used in "REESS charging mode coupled to the power grid" in the configuration connected to a local / private DC-charging station without additional participants do not have to fulfil requirements of Annexes 11, 13, 14, 17, 19 and 20.

In this case, the manufacturer shall provide a statement that the vehicle and / or ESA can be used in "REESS charging mode coupled to the power grid" only with a local/private DC charging station without additional participants. This information shall be made publicly available following the type approval.

## **7.0 AMENDMENT OR EXTENSION OF A VEHICLE TYPE APPROVAL FOLLOWING ESA ADDITION OR SUBSTITUTION**

- 7.1 Where a vehicle manufacturer has obtained type approval for a vehicle installation and wishes to fit an additional or substitutional electrical / electronic system or ESA which has already received approval under this standard, and which will be installed in accordance with any conditions attached thereto, the vehicle approval may be extended without further testing. The additional or substitutional electrical / electronic system or ESA shall be considered as part of the vehicle for conformity of production purposes.
- 7.2 Where the additional or substitutional part(s) has (have) not received approval pursuant to this standard, and if testing is considered necessary, the whole vehicle shall be deemed to conform if the new or revised part(s) can be shown to conform to the relevant requirements of paragraph 5 or if, in a comparative test, the new part can be shown not to be likely to adversely affect the conformity of the vehicle type.
- 7.3 The addition by a vehicle manufacturer to an approved vehicle of standard domestic or business equipment, other than mobile communication equipment, which conforms to other standards, and the installation, substitution or removal of which is according to the recommendations of the equipment and vehicle manufacturers, shall not invalidate the vehicle approval. This shall not preclude vehicle manufacturers fitting communication equipment in accordance with suitable installation guidelines developed by the vehicle manufacturer and / or manufacturer(s) of such communication equipment. The vehicle manufacturer shall provide evidence (if requested by the Test Agency) that vehicle performance is not adversely affected by such transmitters. This can be a statement that the power levels and installation are such that the immunity levels of this standard offer sufficient protection when subject to transmission alone i.e. excluding transmission in conjunction with the tests specified in paragraph 5. This standard does not authorize the use of a communication transmitter when other requirements on such equipment or its use apply.

## **8.0 CONFORMITY OF PRODUCTION**

- 8.1 Conformity of Production Procedures of a Vehicle fitted with ESA

- 8.1.1 A vehicle approved under this standard shall be so manufactured as to conform to the type approved by meeting the relevant requirements set forth in this standard.
- 8.1.2 Whole vehicle conformity of production procedures shall be applicable as and when notified by the Government (Ministry of Road Transport & Highways).
- 8.2 Conformity of Production Procedures of an ESA
  - 8.2.1 ESA approved under this standard shall be so manufactured as to conform to the type approved by meeting the relevant requirements set forth in this standard.
  - 8.2.2 Conformity of production procedures as and when notified by the Government (Ministry of Road Transport & Highways) shall be applicable
- 9.0 MODIFICATION AND EXTENSION OF TYPE APPROVAL OF A VEHICLE OR ESA**
  - 9.1 Every modification pertaining to the information, even if the changes are not technical in nature declared in accordance with 3.0, shall be intimated by the manufacturer to the Test Agency.

If the changes are in parameters not related to the provisions, no further action will be taken.

If the changes are in parameters related to the provisions, the testing agency which has issued the certificate of compliance shall then consider whether
  - 9.1.1 The model with the changed specifications still complies with provisions or
  - 9.1.2 Any further verification or testing is required to establish compliance.
  - 9.2 For considering whether testing is required or not, guidelines given in Annex 21A & 22B (Worst Case Criteria (WCC) & Criteria for Extension of Approval) shall be used.
  - 9.3 In case of 9.1.2, tests for only those parameters which are affected by the modifications need to be carried out.
  - 9.4 In case of fulfillment of criterion of para 9.1.1, or after results of further verification as per para 9.1.2 are satisfactory, the approval of compliance shall be extended for the changes carried out.

**10.0 AMENDMENTS TO ECE REGULATIONS AFTER THE LEVEL DESCRIBED**

**10.1 Supplements**

In case of changes in ECE regulation, which are issued as supplements (Supplements do not affect the earlier type approvals) at the request of applicant, approval of compliance to this standard shall be issued taking into account the changes arising out of such supplement(s) to ECE regulation with approval from Chairman AISC.

This shall be incorporated in the test report.

Note: Such changes will be considered for inclusion in this standard at the time of its next amendment /revision.

**10.2 Series of amendments**

Changes in ECE regulation, which are issued as series of amendments

(series of amendments may affect the earlier type approvals) will not be considered for issuing approval to this standard. However, Chairman, AISC may, on a case to case basis, permit to accept latest series of amendments. This shall be incorporated in the test report.

Note: Such changes will be considered for inclusion in this standard at the time of its next revision.

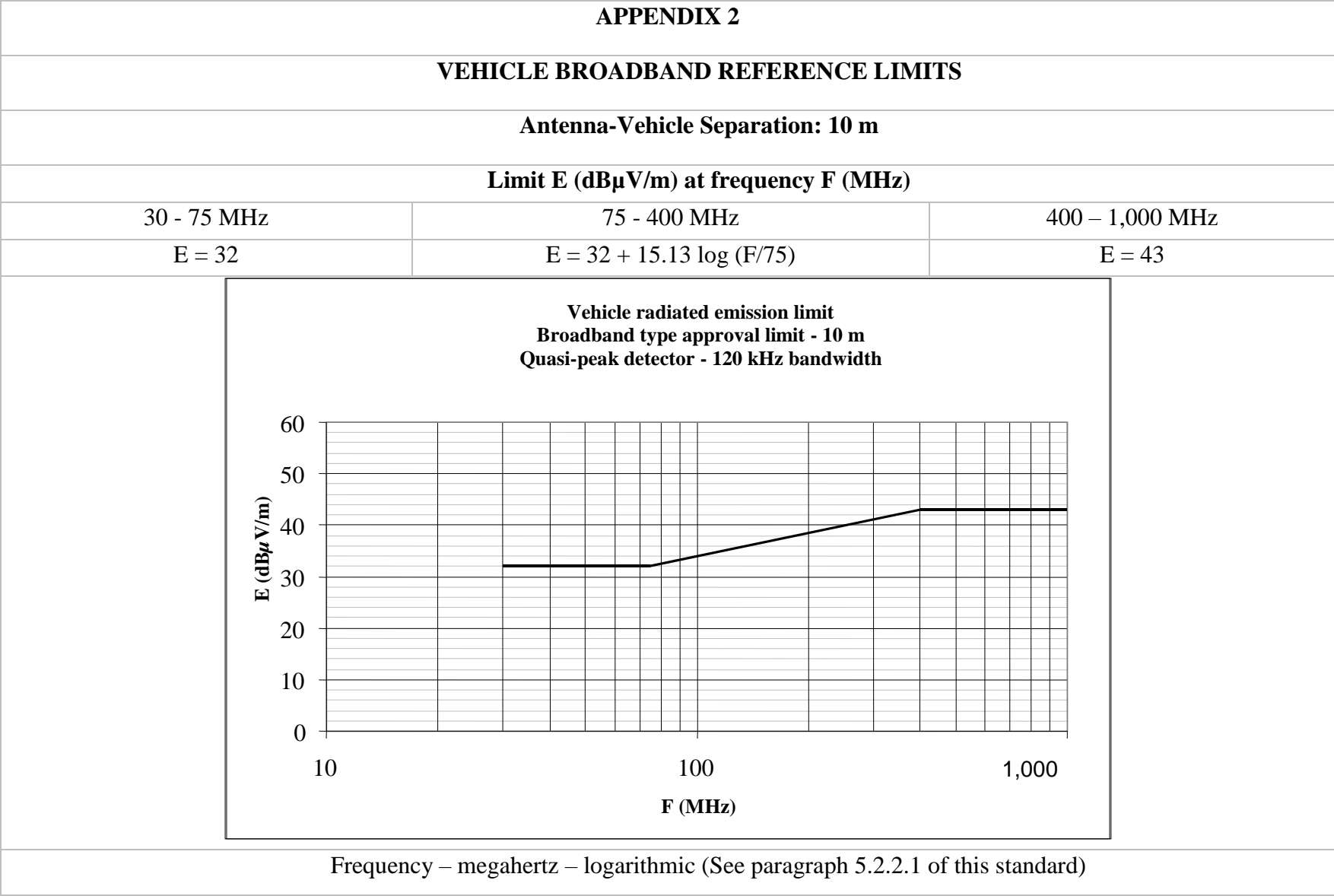


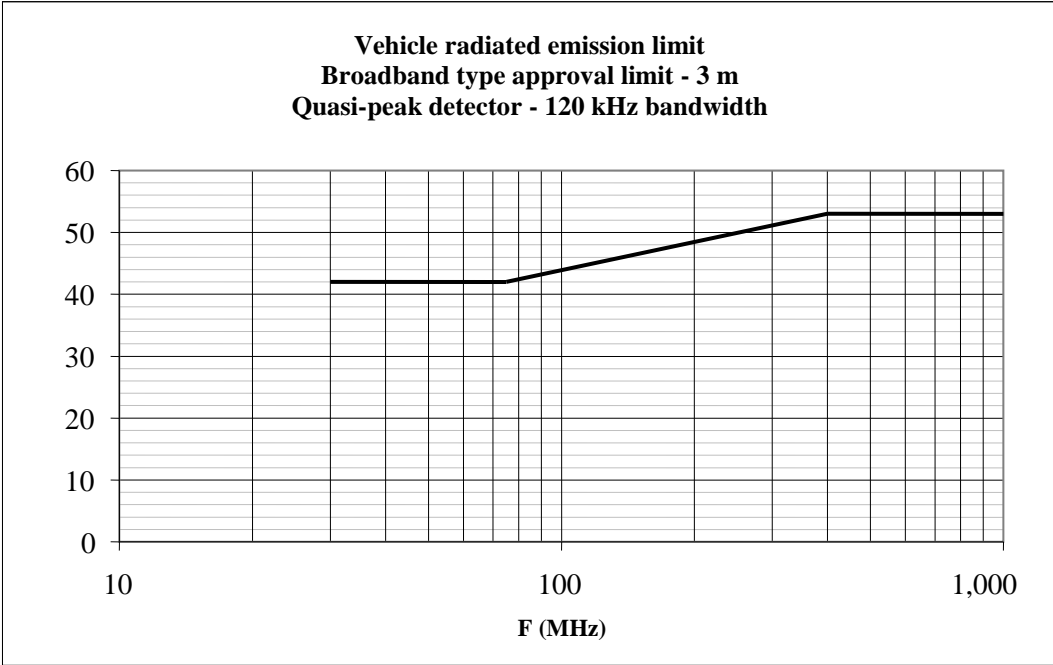
## **APPENDIX 1**

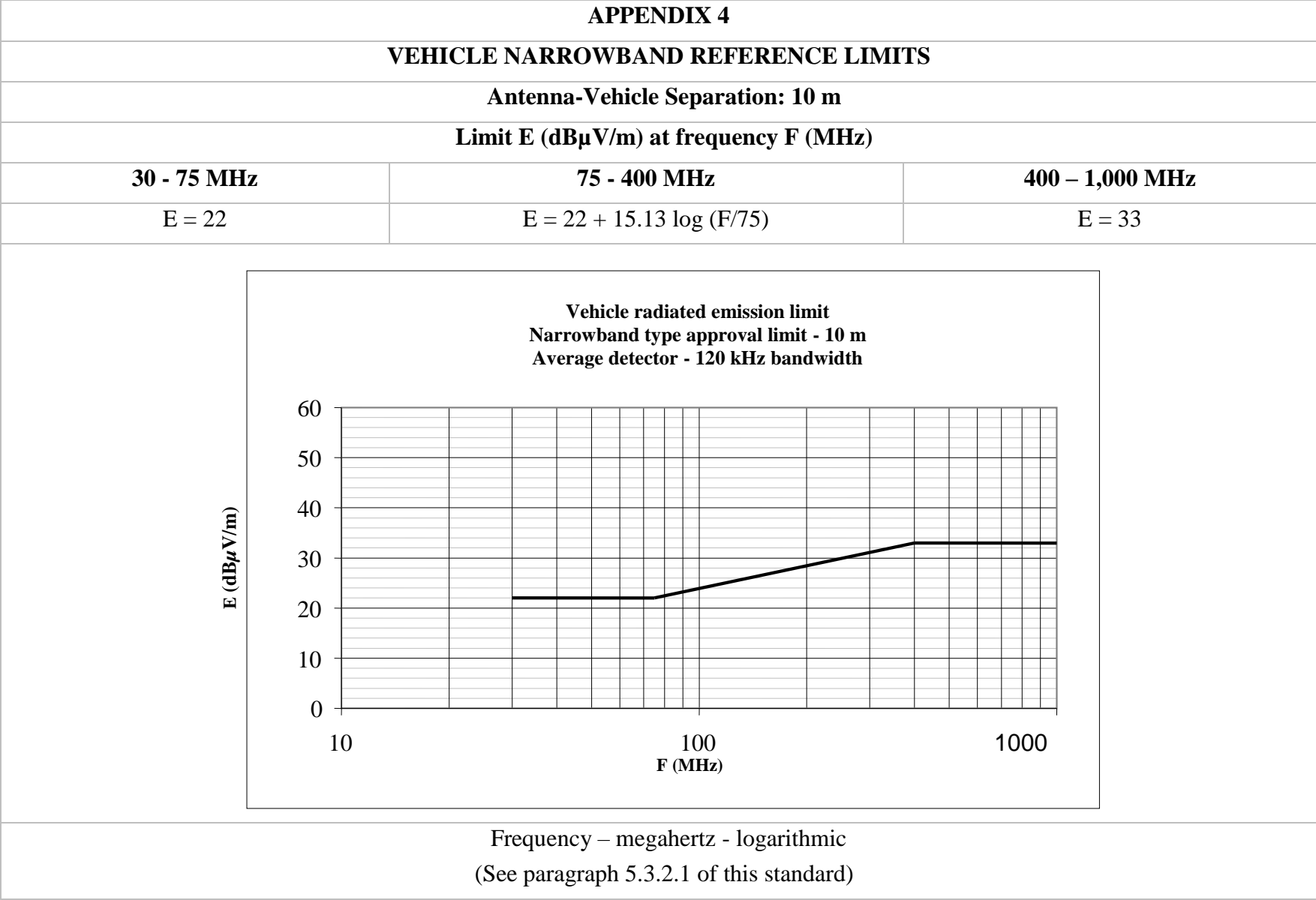
### **LIST OF STANDARDS REFERRED TO IN THIS STANDARD**

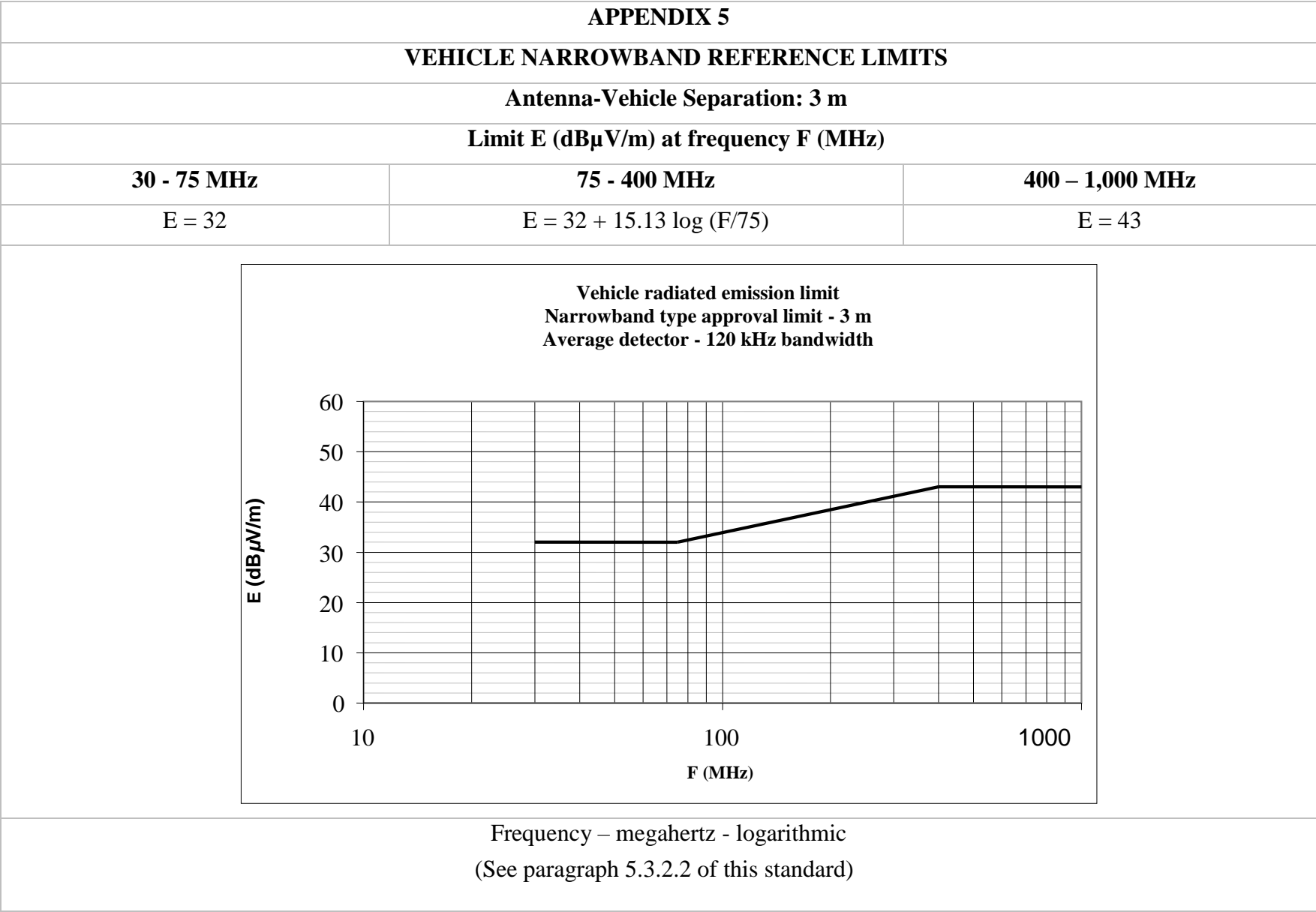
- 1.0 CISPR 12 "Vehicles', motorboats' and spark-ignited engine-driven devices' radio disturbance characteristics - Limits and methods of measurement", fifth edition 2001.
- 2.0 CISPR 16-1-4 "Specifications for radio disturbance and immunity measuring apparatus and methods - Part 1: Radio disturbance and immunity measuring apparatus", Edition 1.1. 2004.
- 3.0 CISPR 25 "Limits and methods of measurement of radio disturbance characteristics for the protection of receivers used on board vehicles", second edition 2002.
- 4.0 ISO 7637-1 "Road vehicles - Electrical disturbance from conduction and coupling - Part 1: Definitions and general considerations", second edition 2002.
- 5.0 ISO 7637-2 "Road vehicles - Electrical disturbance from conduction and coupling - Part 2: Electrical transient conduction along supply lines only on vehicles with nominal 12 V or 24 V supply voltage", second edition 2004.
- 6.0 ISO EN 17025 "General requirements for the competence of testing and calibration laboratories", second edition 2005 and Corrigendum:2006. Third Edition 2017
- 7.0 ISO 11451 "Road vehicles - Electrical disturbances by narrowband radiated electromagnetic energy - Vehicle test methods":  
  
Part 1: General and definitions (ISO 11451-1, third edition 2005);  
  
Part 2: Off-vehicle radiation source (ISO 11451-2, third edition 2005);  
  
Part 4: Bulk current injection (BCI) (ISO 11451-4, first edition 1995).
- 8.0 ISO 11452 "Road vehicles - Electrical disturbances by narrowband radiated electromagnetic energy - Component test methods":  
  
Part 1: General and definitions (ISO 11452-1, third edition 2005);  
  
Part 2: Absorber-lined chamber (ISO 11452-2, second edition 2004);  
  
Part 3: Transverse electromagnetic mode (TEM) cell (ISO 11452-3, third edition 2001);  
  
Part 4: Bulk current injection (BCI) (ISO 11452-4, third edition 2005);  
  
Part 5: Stripline (ISO 11452-5, second edition 2002).
- 9.0 ITU Radio Standards, edition 2001.

- 10 IEC 61000-3-2 "Electromagnetic Compatibility (EMC) - Part 3-2 - Limits for harmonic current emissions (equipment input current  $\leq 16$  A per phase)", edition 3.2 - 2005 + A1: 2008 + A2: 2009
- 11 IEC 61000-3-3 "Electromagnetic Compatibility (EMC) - Part 3-3 - Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage systems for equipment with rated current  $\leq 16$  A per phase and not subjected to conditional connection", edition 2.0 - 2008.
- 12 IEC 61000-3-11 "Electromagnetic Compatibility (EMC) - Part 3-11 - Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage systems - Equipment with rated current  $\leq 75$  A per phase and subjected to conditional connection", edition 1.0 - 2000.
- 13 IEC 61000-3-12 "Electromagnetic Compatibility (EMC) - Part 3-12 – Limits for harmonic current emissions produced by equipment connected to public low-voltage systems with input current  $> 16$  A and  $\leq 75$  A per phase", edition 1.0 - 2004.
- 14 IEC 61000-4-4 "Electromagnetic Compatibility (EMC) - Part 4-4 - Testing and measurement techniques - Electrical fast transient's/burst immunity test", edition 2.0 - 2004.
- 15 IEC 61000-4-5 "Electromagnetic Compatibility (EMC) - Part 4-5 - Testing and measurement techniques - Surge immunity test", edition 2.0 – 2005.
- 16 IEC 61000-6-2 "Electromagnetic Compatibility (EMC) - Part 6-2 - Generic Standards Immunity for industrial environments", edition 2.0 - 2005.
- 17 IEC 61000-6-3 "Electromagnetic Compatibility (EMC) - Part 6-3 - Generic Standards Emission standard for residential, commercial and light-industrial environments", edition 2.0 - 2006.
- 18 CISPR 16–2–1 "Specification for radio disturbances and immunity measuring apparatus and methods - Part 2-1 - Methods of measurement of disturbances and immunity - Conducted disturbances measurement", edition 2.0 - 2008.
- 19 CISPR 32 "Information Technology Equipment - Radio disturbances characteristics - Limits and methods of measurement", edition 2.0 - 2015.
- 20 CISPR 16-1-2 "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-2: Radio disturbance and immunity measuring apparatus - Ancillary equipment - Conducted disturbances", edition 1.2: 2006.



APPENDIX 3																
VEHICLE BROADBAND REFERENCE LIMITS																
Antenna-Vehicle Separation: 3 m																
Limit E (dBμV/m) at frequency F (MHz)																
30 - 75 MHz	75 - 400 MHz	400 – 1,000 MHz														
E = 42	$E = 42 + 15.13 \log (F/75)$	E = 53														
<div><p>Vehicle radiated emission limit Broadband type approval limit - 3 m Quasi-peak detector - 120 kHz bandwidth</p><table><caption>Data points for the emission limit graph</caption><tr><th>Frequency F (MHz)</th><th>Limit E (dBμV/m)</th></tr><tr><td>30</td><td>42</td></tr><tr><td>75</td><td>42</td></tr><tr><td>100</td><td>44.13</td></tr><tr><td>200</td><td>48.26</td></tr><tr><td>400</td><td>53</td></tr><tr><td>1000</td><td>53</td></tr></table></div>			Frequency F (MHz)	Limit E (dBμV/m)	30	42	75	42	100	44.13	200	48.26	400	53	1000	53
Frequency F (MHz)	Limit E (dBμV/m)															
30	42															
75	42															
100	44.13															
200	48.26															
400	53															
1000	53															
Frequency – megahertz - logarithmic (See paragraph 5.2.2.2 of this standard)																





APPENDIX 6												
ELECTRICAL/ELECTRONIC SUB-ASSEMBLY												
Broadband Reference Limits												
Limit E (dBµV/m) at frequency F (MHz)												
30 - 75 MHz	75 - 400 MHz	400 – 1,000 MHz										
E = 62 – 25.13 log (F/30)	E = 52 + 15.13 log (F/75)	E = 63										
<div><div>ESA radiated emission limit Broadband type approval limit - 1 m Quasi-peak detector - 120 kHz bandwidth</div><div><table><caption>ESA radiated emission limit data points</caption><tr><th>Frequency F (MHz)</th><th>Limit E (dBµV/m)</th></tr><tr><td>30</td><td>62</td></tr><tr><td>75</td><td>52</td></tr><tr><td>400</td><td>63</td></tr><tr><td>1000</td><td>63</td></tr></table></div></div>			Frequency F (MHz)	Limit E (dBµV/m)	30	62	75	52	400	63	1000	63
Frequency F (MHz)	Limit E (dBµV/m)											
30	62											
75	52											
400	63											
1000	63											
Frequency – megahertz - logarithmic (See paragraph 5.5.2.1 of this standard)												

APPENDIX 7												
ELECTRICAL/ELECTRONIC SUB-ASSEMBLY												
Narrow band Reference Limits												
Limit E (dBµV/m) at frequency F (MHz)												
30 - 75 MHz	75 - 400 MHz	400 – 1,000 MHz										
E = 52 – 25.13 log (F/30)	E = 42 + 15.13 log (F/75)	E = 53										
<div><div>ESA radiated emission limit Narrowband type approval limit - 1 m Average detector - 120 kHz bandwidth</div><div><table><caption>Limit Data Points</caption><tr><th>F (MHz)</th><th>E (dBµV/m)</th></tr><tr><td>30</td><td>52</td></tr><tr><td>75</td><td>42</td></tr><tr><td>400</td><td>53</td></tr><tr><td>1000</td><td>53</td></tr></table></div></div>			F (MHz)	E (dBµV/m)	30	52	75	42	400	53	1000	53
F (MHz)	E (dBµV/m)											
30	52											
75	42											
400	53											
1000	53											
Frequency – megahertz - logarithmic (See paragraph 5.6.2.1 of this standard)												



APPENDIX 8  
HV ARTIFICIAL NETWORK

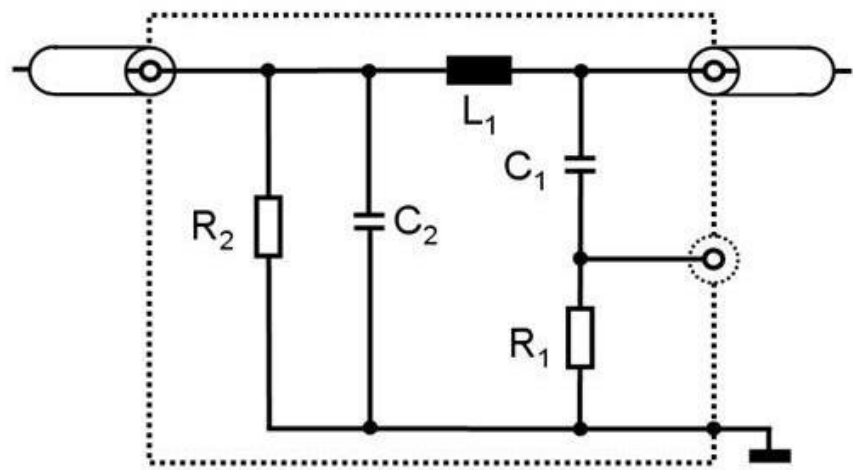


Figure 1

HV artificial network

Legend	C2: 0.1 $\mu$ F
L1: 5 $\mu$ H	R1: 1 k $\Omega$
C1: 0.1 $\mu$ F	R2: 1 M $\Omega$ (discharging C2 to < 50 Vdc within 60 s)

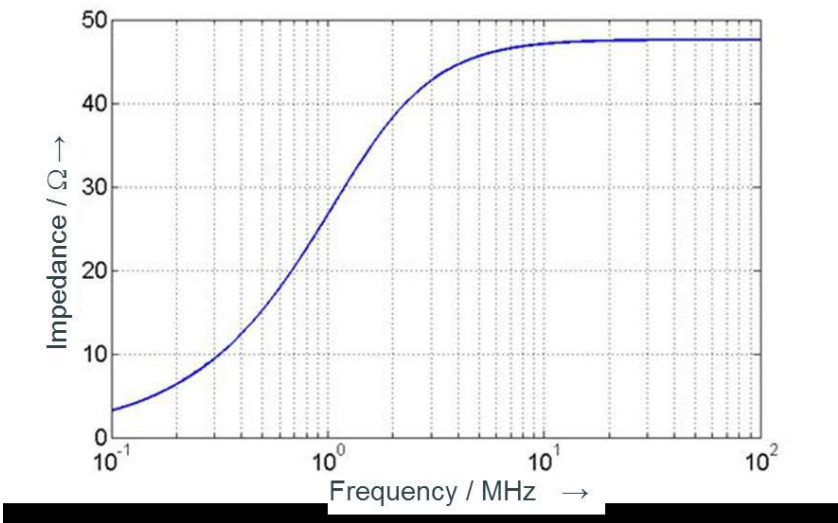
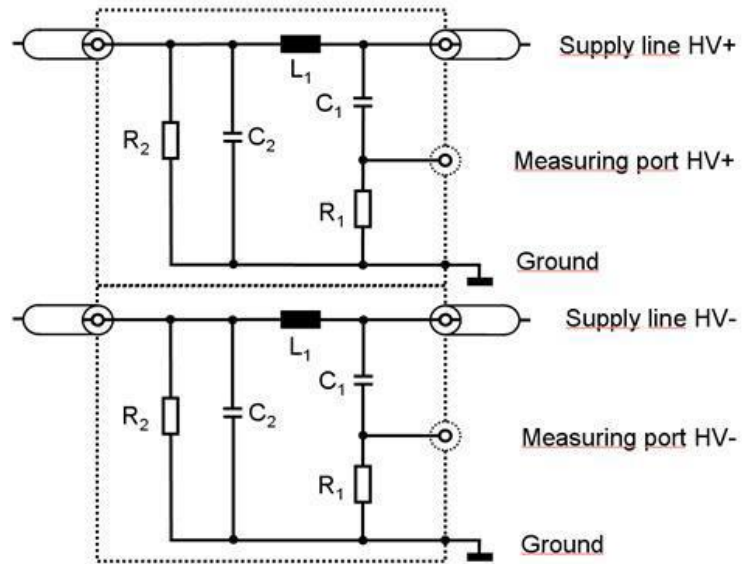


Figure 2

Impedance of HV artificial network



**Figure 3**

**Combination of HV artificial network**

**ANNEX 1A**

**TECHNICAL SPECIFICATIONS FOR TYPE-APPROVAL OF A VEHICLE  
WITH RESPECT TO ELECTROMAGNETIC COMPATIBILITY**

(See 3.1.2)

The following information, if applicable, shall be supplied in triplicate and shall include a list of contents.

Any drawings shall be supplied in appropriate scale and in sufficient detail on size A 4 or in a folder of A4 format.

Photographs, if any, shall show sufficient detail.

If the systems, components or separate technical units have electronic controls, information concerning their performance shall be supplied.

**GENERAL**

- 1 Make (trade name of manufacturer):
- 2 Type:
- 3 Category of vehicle:
- 4 Name and address of manufacturer:
- 5 Name and address of authorized representative, if any:
- 6 Address (es) of assembly plant(s):

**GENERAL CONSTRUCTION CHARACTERISTICS OF THE VEHICLE**

- 6 Photograph(s) and/or drawing(s) of a representative vehicle:
- 7 Position and arrangement of the engine:

**POWER PLANT**

- 8 Manufacturer:
- 9 Manufacturer's engine code as marked on the engine:
- 10 Internal combustion engine:
- 11 Working principle: positive ignition/compression ignition,  
four-stroke/two stroke
- 12 Number and arrangement of cylinders:

- 13 FUEL FEED:
- 14 By fuel injection (compression ignition only): yes/no
- 15 Electronic control unit:
- 16 Make(s):
- 17 Description of the system:
- 18 By fuel injection (positive ignition only): yes/no
- 19 Electrical system:
- 20 Rated voltage: (V, positive/negative ground)
- 21 Generator:
- 22 Type:
- 23 Ignition:
- 24 Make(s):
- 25 Type(s):
- 26 Working principle:
- 27 LPG fuelling system: yes/no
- 28 Electronic engine management control unit for LPG fuelling:
- 29 Make(s):
- 30 Type(s):
- 31 CNG fuelling system: yes/no
- 32 Electronic engine management control unit for CNG fuelling:
- 33 Make(s):
- 34 Type(s):
- 35 Electric motor:
- 36 Type (winding, excitation):
- 37 Operating voltage:

Gas fuelled engines (in the case of systems laid-out in a different manner, supply equivalent information)

38 Electronic control unit (ECU):

39 Make(s):

40 Type(s):

**TRANSMISSION**

41 Type (mechanical, hydraulic, electric, etc.):

42 A brief description of the electrical/electronic components (if any):

**SUSPENSION**

43 A brief description of the electrical/electronic components (if any):

**STEERING**

44 A brief description of the electrical/electronic components (if any):

**BRAKES**

45 Anti-lock braking system: yes/no/optional

46 For vehicles with anti-lock systems, description of system operation (including any electronic parts), electric block diagram, hydraulic or pneumatic circuit plan:

**BODYWORK**

47 Type of bodywork:

48 Materials used and methods of construction:

49 Windscreen and other windows:

50 Rear-view mirrors (state for each mirror):

A brief description of the electronic components (if any) of the adjustment system:

51 Safety belts and/or other restraint systems:

52 A brief description of the electrical/electronic components (if any):

53 Suppression of radio interference:

54 Description and drawings/photographs of the shapes and constituent materials of the part of the body forming the engine compartment and the part of the passenger compartment nearest to it:

- 55 Drawings or photographs of the position of the metal components housed in the engine compartment (e.g. heating appliances, spare wheel, air filter, steering mechanism, etc.):
- 56 Table and drawing of radio interference control equipment:
- 57 Particulars of the nominal value of the direct current resistance and, in the case of resistive ignition cables, of their nominal resistance per meter:

## **LIGHTING AND LIGHT SIGNALLING DEVICES**

- 58 A brief description of electrical/electronic components other than lamps (if any):

## **MISCELLANEOUS**

- 59 Devices to prevent unauthorized use of the vehicle:
- 60 A brief description of the electrical/electronic components (if any):
- 61 Table of installation and use of RF transmitters in the vehicle(s), if applicable (see paragraph 3.1.8. of this Standard):

frequency bands [Hz]	max. output power [W]	antenna position at vehicle, specific conditions for installation and/or use

- 62 Vehicle equipped with 24 GHz short-range radar equipment: yes/no/optional

The application for type approval shall also include, where appropriate:

Appendix 1:

A list with make(s) and type(s) of all electrical and/or electronic components concerned by this standard (see paragraphs 2.9. and 2.10. of this standard) and not previously listed.

Appendix 2:

Schematics or drawing of the general arrangement of electrical and/or electronic components (concerned by this Standard) and the general wiring harness arrangement.

Appendix 3:

Description of vehicle chosen to represent the type:

Body style:

Wheelbase:

Appendix 4:

Relevant test report(s) supplied by the manufacturer from a test laboratory accredited to ISO 17025 and recognized by the Test Agency for the purpose of drawing up the type approval certificate.

- 63 Charger: on board/external/without:
- 64 Charging current: direct current / alternating current (number of phases/frequency):
- 65 Maximal nominal current (in each mode if necessary):
- 66 Nominal charging voltage:
- 67 Basic vehicle interface functions: ex: L1/L2/L3/N/E/control pilot:
- 68 Minimum Rsce value (see paragraph 7.3.)
- 69 Charging cable delivered with the vehicle: yes/no
- 70 If charging cable delivered with the vehicle:  
Length (m).  
Cross sectional area (mm<sup>2</sup>)
- 71 Portable charger delivered with the vehicle: yes/no
- 72 Portable Charger Make, Model, Part Number

**ANNEX 1B**

**TECHNICAL SPECIFICATIONS FOR TYPE-APPROVAL OF AN  
ELECTRIC/ELECTRONIC SUB-ASSEMBLY WITH RESPECT TO  
ELECTROMAGNETIC COMPATIBILITY**

(See 3.1.3)

The following information, if applicable, shall be supplied in triplicate and must include a list of contents. Any drawings shall be supplied in appropriate scale and in sufficient detail on size A4 or on a folder of A4 format. Photographs, if any, shall show sufficient detail.

If the systems, components or separate technical units have electronic controls, information concerning their performance shall be supplied.

- 1 Make (trade name of manufacturer):
- 2 Type:
- 3 Means of identification of type, if marked on the component/separate technical unit:
  - 3.1 Location of that marking:
- 4 Name and address of manufacturer:  
Name and address of authorized representative, if any:
- 5 In the case of components and separate technical units, location and method of affixing of the approval mark:
- 6 Address(s) of assembly plant(s):
- 7 This ESA shall be approved as a component/STU
- 8 Any restrictions of use and conditions for fitting:
- 9 Electrical system rated voltage: (V, positive/negative 2/ ground.)

Appendix 1:

Description of the ESA chosen to represent the type (electronic block diagram and list of main component constituting the ESA (e.g. make and type of microprocessor, crystal, etc.).

Appendix 2:

Relevant test report(s) supplied by the manufacturer from a test laboratory accredited to ISO 17025 and recognized by the Test Agency for the purpose of drawing up the type approval certificate."



- 10 Charger: on board/external / portable
- 11 Charging current: direct current / alternating current (number of phases / frequency)
- 12 Maximal nominal current (in each mode if necessary)
- 13 Nominal charging voltage
- 14 Basic ESA interface functions: ex. L1 / L2 / L3 / N / PE / control pilot
- 15 Minimum Rsce value (see paragraph 6.11. of this Standard)

## ANNEX 2

### METHOD OF MEASUREMENT OF RADIATED BROADBAND ELECTROMAGNETIC EMISSIONS FROM VEHICLES

(See 5.2.1 and 6.2)

#### 1.0 GENERAL

1.1 The test method described in this Annex shall only be applied to vehicles.

This method concerns both configurations of the vehicle:

(a) Other than "REESS charging mode coupled to the power grid".

(b) "REESS charging mode coupled to the power grid"

#### 1.2 Test Method

This test is intended to measure the broadband emissions generated by electrical or electronic systems fitted to the vehicle (e.g. ignition system or electric motors).

If not otherwise stated in this annex the test shall be performed according to CISPR 12 (Amendment 1 fifth edition 2005).

#### 2.0 VEHICLE STATE DURING TESTS

2.1 Vehicle in configuration other than "REESS charging mode coupled to the power grid".

##### 2.1.1 Engine

The engine shall be in operation according to CISPR 12.

##### 2.1.2 Other vehicle systems

All equipment capable of generating broadband emissions which can be switched on permanently by the driver or passenger should be in operation in maximum load, e.g. wiper motors or fans. The horn and electric window motors are excluded because they are not used continuously.

For vehicles equipped with an internal combustion engine, the engine shall be in operation according to CISPR 12, clause 5.3.2. Typically for single cylinder engines, the engine speed shall be  $2500 \pm 10\%$  rpm and for multi-cylinder (>1 cylinder) engines, the engine speed shall be  $1500 \pm 10\%$  rpm.

For vehicles equipped with an electric propulsion motor, the vehicle shall be driven on a dynamometer without a load, or on non-conductive axle stands, with a constant speed of 40 km/h, or the maximum speed, if this is less than 40 km/h.

**2.2 Vehicle in configuration "REESS charging mode coupled to the power grid".**

The state of charge (SOC) of the traction battery shall be kept between 20 per cent and 80 per cent of the maximum SOC during the whole frequency range measurement (this may lead to split the measurement into different sub-bands with the need to discharge the vehicle's traction battery before starting the next sub-bands). If the current consumption can be adjusted, then the current shall be set to at least 80 per cent of its nominal value.

The test set-up for the connection of the vehicle in configuration "REESS charging mode coupled to the power grid" is shown in Figures 3a to 3h (depending of AC or DC power charging mode, location of charging plug and charging with or without communication) of Appendix 1 to this annex

**2.3 Charging station / Power mains**

The charging station may be placed either in the test location or outside the test location.

Note 1: If the communication between the vehicle and the charging station could be simulated, the charging station may be replaced by the supply from power mains.

In both case, duplicated power mains and communication lines socket(s) shall be placed in the test location with the following conditions:

- (a) It shall be placed on the ground plane.
- (b) The length of the harness between the power mains/communication lines socket and the AN(s)/IS(s) shall be kept as short as possible.
- (c) The harness between the power mains/communication lines socket and the AN(s)/IS(s) shall be placed as close as possible to the ground plane.

Note 2: The power mains and communication lines socket(s) should be filtered.

If the charging station is placed inside the test location, then the harness between charging station and the power mains / communication lines socket shall be placed with the following conditions:

- (a) The harness on charging station side shall hang vertically down to the ground plane.
- (b) The extraneous length shall be placed as close as possible to the ground plane and "Z-folded" if necessary.

Note 3: The charging station should be placed outside the beam width of the receiving antenna.

**2.4 Artificial networks**

The AN(s) shall be mounted directly on the ground plane. The cases of the AN(s) shall be bonded to the ground plane.

The measuring port of each AN shall be terminated with a 50-ohm load.

The AN shall be placed as defined in Figures 3a to 3h.

## **2.5 Impedance stabilization**

Communication lines shall be applied to the vehicle through IS(s).

The impedance stabilization (IS) to be connected in the network and communication cables is defined in CISPR 32, paragraph C.4.1.2.

The IS(s) shall be mounted directly on the ground plane. The case of the IS(s) shall be bonded to the ground plane.

The measuring port of each IS shall be terminated with a 50  $\Omega$  load.

The IS shall be placed as defined in Figures 3e to 3h.

## **2.6 Power charging / communication cable**

The power charging / communication cable shall be placed in a straight line between the AN(s) / IS(s) and the vehicle charging plug. The projected cable length shall be 0.8 m (+0.2/-0 m).

If the length of the cable is longer than 1 m, the extraneous length shall be "Z-folded" in less than 0.5 m width.

The charging / communication cable at vehicle side shall hang vertically at a distance of 100 mm (+200/-0 mm) from the vehicle body.

The whole cable shall be placed on a non-conductive, low relative permittivity (dielectric-constant) material ( $\epsilon_r \leq 1.4$ ), at 100 mm ( $\pm 25$  mm) above the ground plane

## **3.0 MEASURING LOCATION**

- 3.1 As an alternative to the requirements of CISPR 12 (amendment 1, fifth edition 2005) for vehicles of category L the test surface may be any location that fulfils the conditions shown in the figure 1 in the appendix to this annex. In this case the measuring equipment must lie outside the part shown in the figures 1 and 2 of Appendix 1 to this annex.

- 3.2 Enclosed test facilities may be used if correlation can be shown between the results obtained in the enclosed test facility and those obtained at an outdoor site. Enclosed test facilities do not need to meet the dimensional requirements of the outdoor site other than the distance from the antenna to the vehicle and the height of the antenna.

#### 4.0 TEST REQUIREMENTS

- 4.1 The limits apply throughout the frequency range 30 to 1,000 MHz for measurements performed in a semi anechoic chamber or an outdoor test site.

- 4.2 Measurements can be performed with either quasi-peak or peak detectors.

The limits given in paragraphs 5.2 and 5.5 of this standard are for quasi-peak detectors. If peak detectors are used a correction factor of 20 dB as defined in CISPR 12 (amendment 1, fifth edition 2005) shall be applied.

- 4.3 The measurements shall be performed with a spectrum analyser or a scanning receiver. The parameters to be used are defined in Table 1 and Table 2

**Table 1**  
**Spectrum analyser parameters**

Frequency Range, MHz	Peak detector		Quasi-peak detector		Average detector	
	RBW at -3 dB	Scan time	RBW at -6 dB	Scan time	RBW at -3 dB	Scan time
30 to 1,000	100/120 kHz	100 ms/MHz	120 kHz	20 s/MHz	100/120 kHz	100 ms/MHz

Note: If a spectrum analyser is used for peak measurements, the video bandwidth shall be at least three times the resolution bandwidth (RBW).

**Table 2**  
**Scanning receiver parameters**

Frequency Range, MHz	Peak detector			Quasi-peak detector			Average detector		
	BW at -6 dB	Step Size <sup>(a)</sup>	Dwell time	BW at -6 dB	Step size <sup>(a)</sup>	Dwell time	BW at -6 dB	Step size <sup>(a)</sup>	Dwell time
30 to 1,000	120 Hz	50 kHz	5 ms	120 kHz	50 kHz	1 s	120 kHz	50 kHz	5 ms

<sup>(a)</sup> For purely broadband disturbances, the maximum frequency step size may be increased up to a value not greater than the bandwidth value.

#### 4.4 Measurements

The Test Agency shall perform the test at the intervals specified in the CISPR 12 (amendment 1, fifth edition 2005) standard throughout the frequency range 30 to 1,000 MHz.

Alternatively, if the manufacturer provides measurement data for the whole frequency band from a test laboratory accredited to the applicable parts of ISO 17025 and recognized by the Test Agency, the Test Agency may divide the frequency range in 14 frequency bands 30 – 34, 34 – 45, 45 – 60, 60 – 80, 80 – 100, 100 – 130, 130 – 170, 170 – 225, 225 – 300, 300–400, 400 – 525, 525 – 700, 700 – 850, 850 – 1,000 MHz and perform tests at the 14 frequencies giving the highest emission levels within each band to confirm that the vehicle meets the requirements of this annex.

In the event that the limit is exceeded during the test, investigations shall be made to ensure that this is due to the vehicle and not due to background radiation.

#### 4.5 Readings

The maximum of the readings relative to the limit (horizontal and vertical polarization and antenna location on the left and right-hand sides of the vehicle) in each of the 14 frequency bands shall be taken as the characteristic reading at the frequency at which the measurements were made.

ANNEX 2 - APPENDIX 1

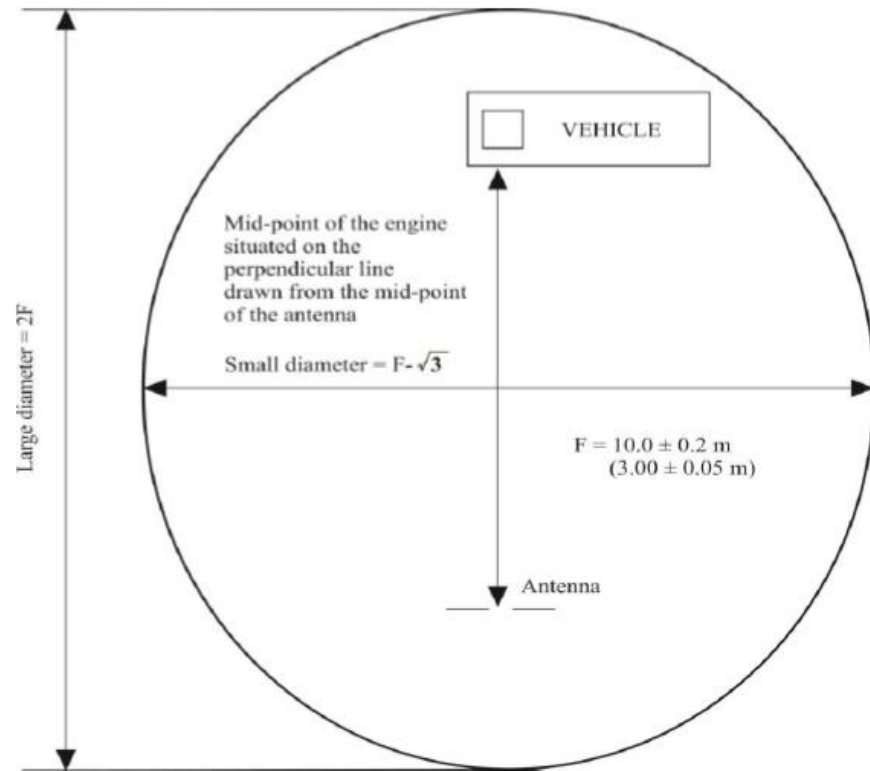


Figure 1

**Clear Horizontal Surface Free of Electromagnetic Reflection  
delimitation of the Surface Defined by an Ellipse**



Figure 2

Position of Antenna in Relation to the Vehicle

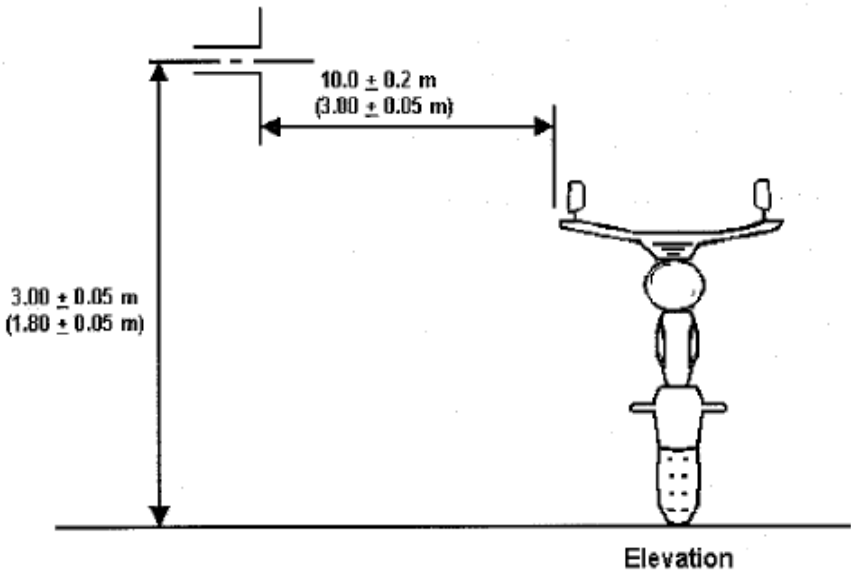


Figure 2a

Dipole antenna in position to measure the vertical radiation components

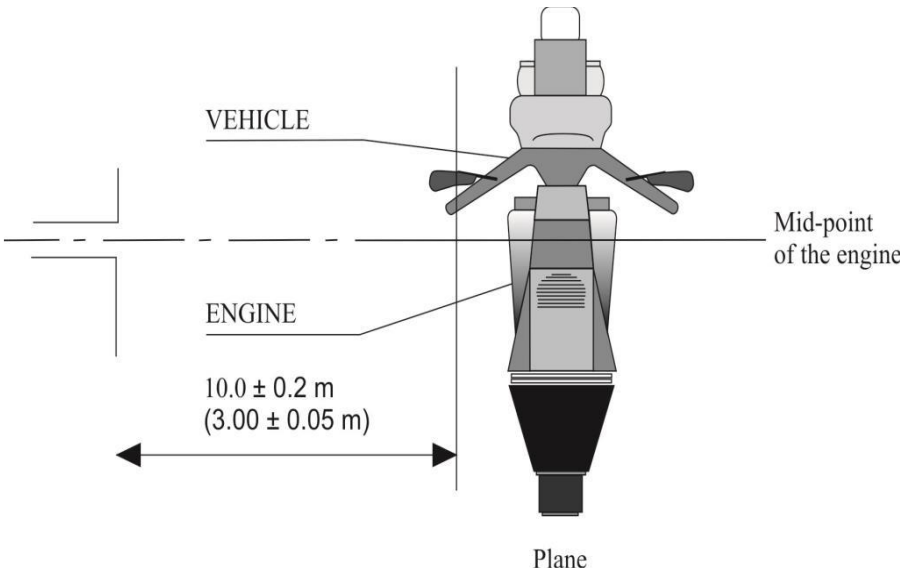


Figure 2b

Dipole antenna in position to measure the horizontal radiation components

Figure 3

Vehicle in configuration "REESS charging mode" coupled to the power grid:

Example of test set-up for vehicle with plug located on vehicle side (AC powered without communication)

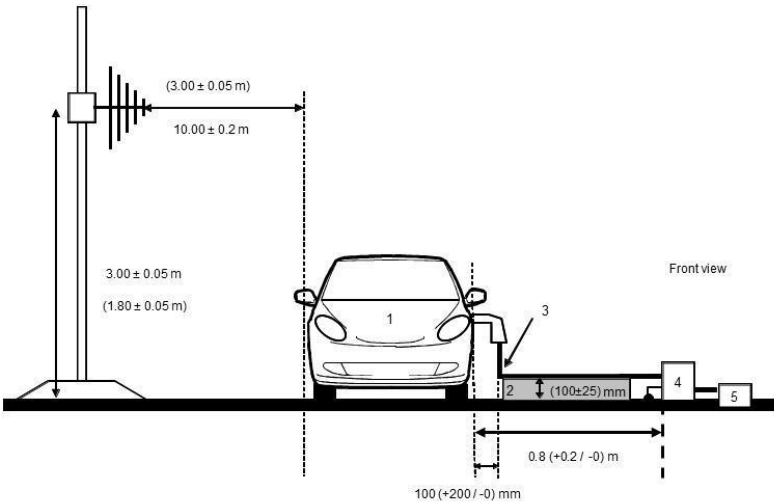


Figure 3a – Front View

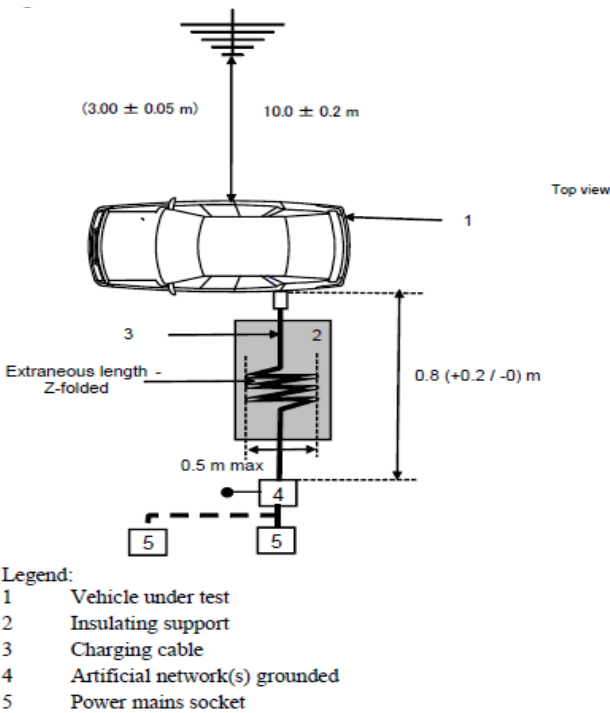


Figure 3b – Top View

Vehicle in configuration "REESS charging mode" coupled to the power grid

Example of test setup for vehicle with plug located front / rear of vehicle  
(AC powered without communication)

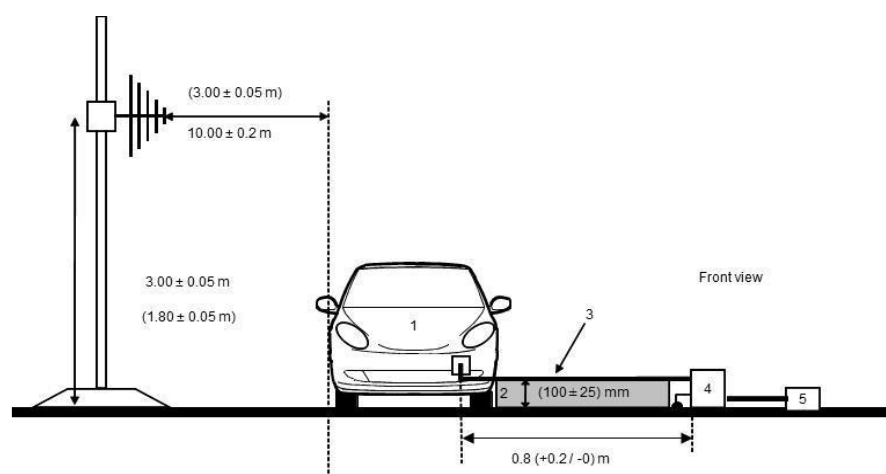
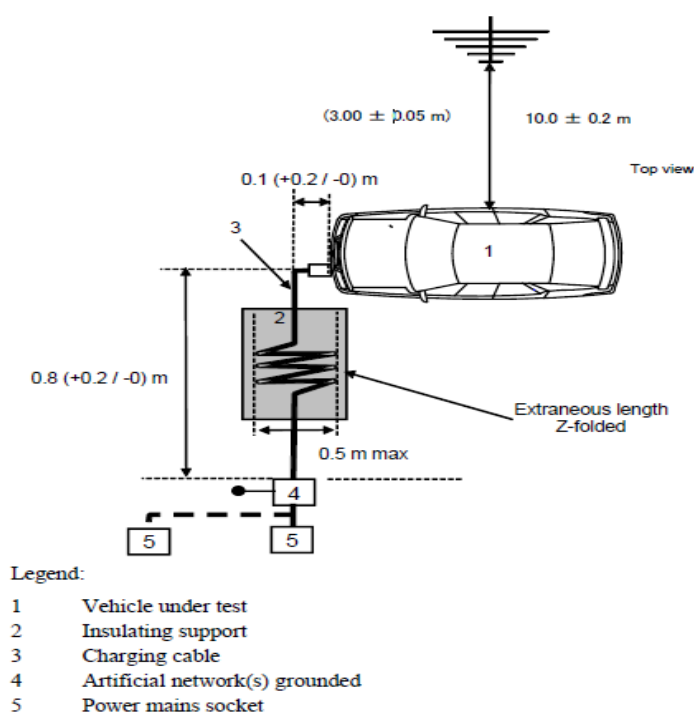


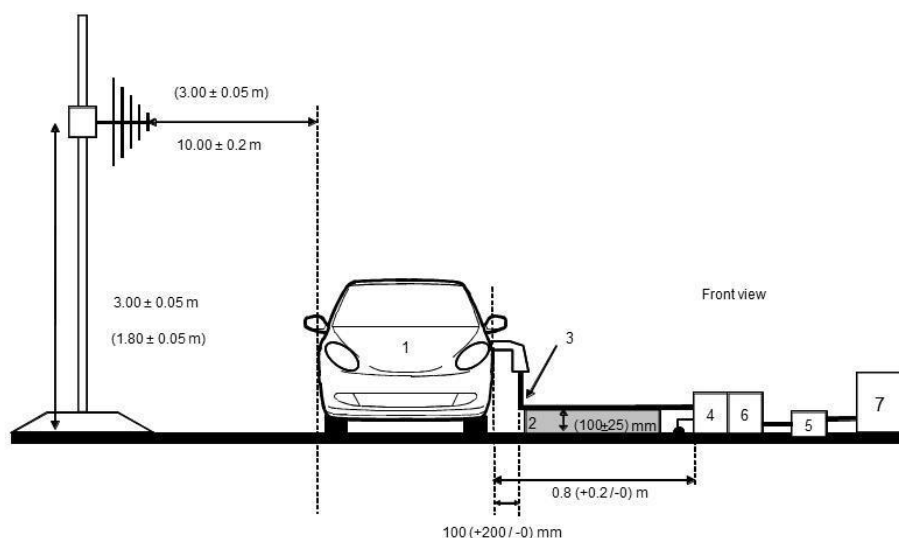
Figure 3c – Front View



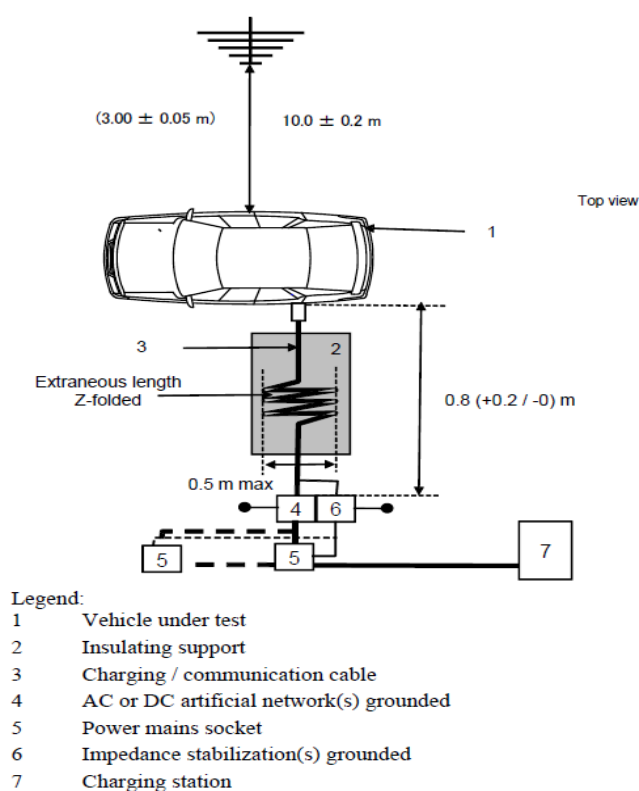
**Vehicle in configuration "REESS charging mode" coupled to the power grid**

Example of test set-up for vehicle with plug located on vehicle side (AC or DC powered with communication)

Figure 3d – Top View



**Figure 3e – Front View**



### Vehicle in configuration "REESS charging mode" coupled to the power grid

Example of test setup for vehicle with plug located front/rear of the vehicle (AC or DC powered with communication)

**Figure 3f – Top View**

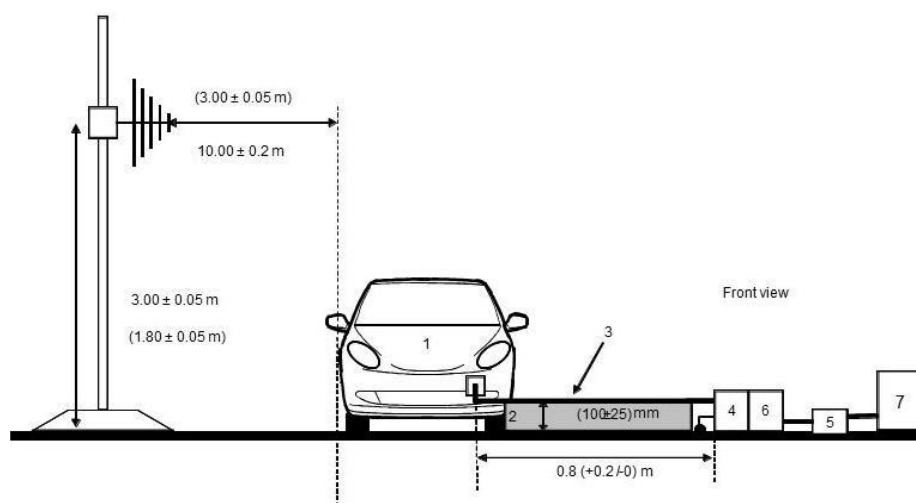
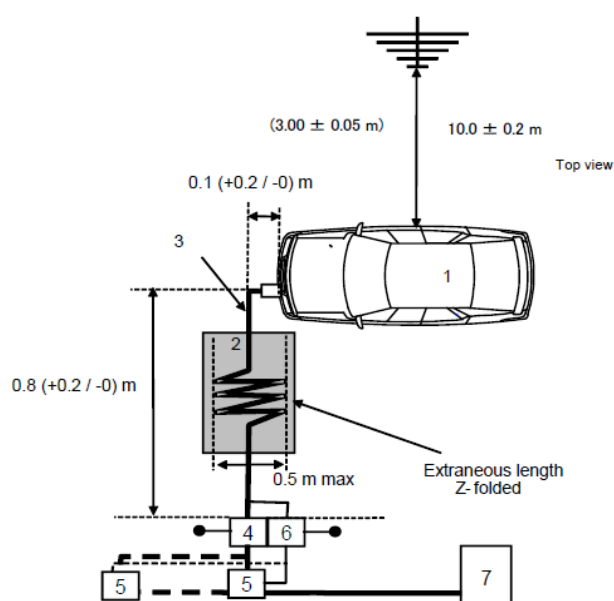


Figure 3g – Front View



Legend:

- 1 Vehicle under test
- 2 Insulating support
- 3 Charging / communication cable
- 4 AC or DC artificial network(s) grounded
- 5 Power mains socket
- 6 Impedance stabilisation(s) grounded
- 7 Charging station

Figure 3h – Top View

## **ANNEX 3**

### **METHOD OF MEASUREMENT OF RADIATED NARROWBAND ELECTROMAGNETIC EMISSIONS FROM VEHICLES**

(See 5.3.1)

#### **1.0 GENERAL**

1.1 The test method described in this annex shall only be applied to vehicles.

This method concerns only the configuration of the vehicle other than "REESS charging mode coupled to the power grid".

#### **1.2 Test Method**

This test is intended to measure the narrowband electromagnetic emissions such as might emanate from microprocessor-based systems or other narrowband source.

If not otherwise stated in this annex the test shall be performed according to CISPR 12 (amendment 1, fifth edition 2005) or to CISPR 25 (second edition 2002).

1.3 As an initial step the levels of emissions in the FM frequency band (76 to 108 MHz) shall be measured at the vehicle broadcast radio antenna with an average detector. If the level specified in paragraph 5.3.2.4 of this standard is not exceeded, then the vehicle shall be deemed to comply with the requirements of this annex in respect of that frequency band and the full test shall not be carried out.

1.4 As an alternative for vehicles of category L the measurement location can be chosen according to Annex 2, paragraphs 3.1 and 3.2.

#### **2.0 VEHICLE STATE DURING TESTS**

2.1 The ignition switch shall be switched on. The engine shall not be operating.

2.2 The vehicle's electronic systems shall all be in normal operating mode with the vehicle stationary.

2.3 All equipment which can be switched on permanently by the driver or passenger with internal oscillators > 9 kHz or repetitive signals should be in normal operation.

#### **3.0 TEST REQUIREMENTS**

3.1 The limits apply throughout the frequency range 30 to 1,000 MHz for measurements performed in a semi anechoic chamber or an outdoor test site.

3.2 Measurements shall be performed with an average detector.

3.3 The measurements shall be performed with a spectrum analyser or a scanning receiver. The parameters to be used are defined in Table 1 and Table 2.

**Table 1**  
**Spectrum analyser parameters**

Frequency range MHz	Peak detector		Quasi-peak detector		Average detector	
	RBW at -3 dB	Scan time	RBW at -6 dB	Scan time	RBW at -3 dB	Scan time
30 to 1,000	100/120 kHz	100 ms/MHz	120 kHz	20 s/MHz	100/120 kHz	100 ms/MHz

Note: If a spectrum analyser is used for peak measurements, the video bandwidth shall be at least three times the resolution bandwidth (RBW).

**Table 2**  
**Scanning receiver parameters**

Frequency range MHz	Peak detector			Quasi-peak detector			Average detector		
	BW at -6 dB	Step size <sup>(a)</sup>	Dwell time	BW at -6 dB	Step size <sup>(a)</sup>	Dwell time	BW at -6 dB	Step size <sup>(a)</sup>	Dwell time
30 to 1,000	120 kHz	50 kHz	5 ms	120 kHz	50 kHz	1 s	120 kHz	50 kHz	5 ms

<sup>(a)</sup> For purely broadband disturbances, the maximum frequency step size may be increased up to a value not greater than the bandwidth value.

3.4 Measurements

The Test Agency shall perform the test at the intervals specified in the CISPR 12 (amendment 1, fifth edition 2005) standard throughout the frequency range 30 to 1,000 MHz.

Alternatively, if the manufacturer provides measurement data for the whole frequency band from a test laboratory accredited to the applicable parts of ISO 17025 and recognized by the Test Agency, the Test Agency may divide the frequency range in 14 frequency bands 30 – 34, 34 – 45, 45 – 60, 60 – 80, 80 – 100, 100 – 130, 130 – 170, 170 – 225, 225 – 300, 300 – 400, 400 – 525, 525 – 700, 700 – 850, 850 – 1,000 MHz and perform tests at the 14 frequencies giving the highest emission levels within each band to confirm that the vehicle meets the requirements of this annex.

In the event that the limit is exceeded during the test, investigations shall be made to ensure that this is due to the vehicle and not due to background radiation including broadband radiation from any ESA.

### 3.5 Readings

The maximum of the readings relative to the limit (horizontal and vertical polarization and antenna location on the left and right-hand sides of the vehicle) in each of the 14 frequency bands shall be taken as the characteristic reading at the frequency at which the measurements were made.



## ANNEX 4

### METHOD OF TESTING FOR IMMUNITY OF VEHICLES TO ELECTROMAGNETIC RADIATION

(See 5.4.1 and 6.7)

#### 1.0 GENERAL

1.1 The test method described in this annex shall only be applied to vehicles.

This method concerns both configurations of vehicle:

- (a) Other than "REESS charging mode coupled to the power grid".
- (b) "REESS charging mode coupled to the power grid".

#### 1.2 Test Method

This test is intended to demonstrate the immunity of the vehicle electronic systems. The vehicle shall be subjected to electromagnetic fields as described in this annex. The vehicle shall be monitored during the tests.

If not otherwise stated in this annex the test shall be performed according to ISO 11451-2, third edition 2005.

#### 1.3 Alternative test methods

The test may be alternatively performed in an outdoor test site for all vehicles. The test facility shall comply with (national) legal requirements regarding the emission of electromagnetic fields.

If a vehicle is longer than 12 m and/or wider than 2.60 m and/or higher than 4.00 m, BCI (bulk current injection) method according to ISO 11451-4 (first edition 1995) can be used in the frequency range 20 to 2,000 MHz with levels defined in paragraph 5.7.2.1 of this standard.

#### 2.0 VEHICLE STATE DURING TESTS

2.1 Vehicle in configuration other than "REESS charging mode coupled to the power grid"

2.1.1 The vehicle shall be in an unladen condition except for necessary test equipment.

2.1.1.1 The engine shall normally turn the driving wheels at a steady speed of 50 km/h if there is no technical reason due to the vehicle to define a different condition. For vehicles of categories L1, L5 and L7 the steady speed shall normally be turned at 25 km/h. The vehicle shall be on an appropriately loaded dynamometer or alternatively supported on insulated axle stands with minimum ground clearance if no dynamometer is available. Where appropriate, transmission shafts, belts or chains may be disconnected (e.g. trucks, two- and three wheel vehicles).

## 2.1.1.2 Basic vehicle conditions

The paragraph defines minimum test conditions (as far as applicable) and failures criteria for vehicle immunity tests. Other vehicle systems, which can affect immunity related functions must be tested in a way to be agreed between manufacturer and Test Agency.

<b>"50 km/h cycle" vehicle test conditions</b>	<b>Failure criteria</b>
Vehicle speed 50 km/h (respectively 25 km/h for L1, L5 and L7 vehicles) $\pm 20$ per cent (vehicle driving the rollers). If the vehicle is equipped with a cruise control system, it shall be operational.	Speed variation greater than $\pm 10$ per cent of the nominal speed. In case of automatic gearbox: change of gear ratio inducing a speed variation greater than $\pm 10$ per cent of the nominal speed.
Dipped beams ON (manual mode)	Lighting OFF
Front wiper ON (manual mode) maximum speed	Complete stop of front wiper
Direction indicator on driver's side ON	Frequency change (lower than 0.75 Hz or greater than 2.25 Hz). Duty cycle change (lower than 25 per cent or greater than 75 per cent).
Adjustable suspension in normal position	Unexpected significant variation
Driver's seat and steering wheel in medium position	Unexpected variation greater than 10 per cent of total range
Alarm unset	Unexpected activation of alarm
Horn OFF	Unexpected activation of horn
Airbag and safety restraint systems operational with inhibited passenger airbag if this function exists	Unexpected activation
Automatic doors closed	Unexpected opening
Adjustable endurance brake lever in normal position	Unexpected activation

<b>"Brake cycle" vehicle test conditions</b>	<b>Failure criteria</b>
To be defined in brake cycle test plan. This must include operation of the brake pedal (unless there are technical reasons not to do so) but not necessarily an anti-lock brake system action.	Stop lights inactivated during cycle Brake warning light ON with loss of function. Unexpected activation

- 2.1.1.3. All equipment which can be switched on permanently by the driver or passenger should be in normal operation.
- 2.1.1.4. All other systems which affect the driver's control of the vehicle shall be (on) as in normal operation of the vehicle.
- 2.1.2 If there are vehicle electrical/electronic systems which form an integral part of the direct control of the vehicle, which will not operate under the conditions described in paragraph 2.1., it will be permissible for the manufacturer to provide a report or additional evidence to the Test Agency that the vehicle electrical/electronic system meets the requirements of this standard. Such evidence shall be retained in the type approval documentation.
- 2.1.3 Only non-perturbing equipment shall be used while monitoring the vehicle. The vehicle exterior and the passenger compartment shall be monitored to determine whether the requirements of this annex are met (e.g. by using (a) video camera(s), a microphone, etc.).
- 2.2 Vehicle in configuration "REESS charging mode coupled to the power grid".
  - 2.2.1 The vehicle shall be in an unladen condition except for necessary test equipment.
    - 2.2.1.1 The vehicle shall be immobilized, engine OFF and in charging mode.
    - 2.2.1.2 Basic vehicle conditions

The paragraph defines minimum test conditions (as far as applicable) and failures criteria for vehicle immunity tests. Other vehicle systems, which can affect immunity related functions, shall be tested in a way to be agreed between manufacturer and Test Agency.

<b>"REESS charging mode" vehicle test conditions</b>	<b>Failure criteria</b>
The RESS shall be in charging mode. The RESS State of charge (SOC) shall be kept between 20 percent and 80 percent of the maximum SOC during the whole frequency range measurement (this may lead to split the measurement in different sub-bands with the need to discharge the vehicle's traction battery before starting the next sub-bands). If the current consumption can be adjusted, then the current shall be set to at least 20 percent of its nominal value.	Vehicle sets in motion.

- 2.2.1.3 All other equipment which can be switched on permanently by the driver or passenger should be OFF.
- 2.2.2 Only non-perturbing equipment shall be used while monitoring the vehicle. The vehicle exterior and the passenger compartment shall be monitored to determine whether the requirements of this annex are met (e.g. by using (a) video camera(s), a microphone, etc.).
- 2.2.3 The test set-up for the connection of the vehicle in configuration "REESS charging mode coupled to the power grid" is shown in Figures 4a to 4h (depending of AC or DC power charging mode, location of charging plug and charging with or without communication) of Appendix 1 to this annex.

## **2.3 Charging station / Power mains**

The charging station may be placed either in the test location or outside the test location.

Note 1: If the communication between the vehicle and the charging station could be simulated, the charging station may be replaced by the supply from power mains.

In both case duplicated power mains and communication lines socket(s) shall be placed in the test location with the following conditions:

- (a) It shall be placed on the ground plane;
- (b) The length of the harness between the power mains / communication lines socket and the AN(s) / IS(s) shall be kept as short as possible;
- (c) The harness between the power mains / communication lines socket and the AN(s) / IS(s) shall be placed as close as possible of the ground plane.

Note 2: The power mains and communication lines socket(s) should be filtered. If the charging station is placed inside the test location, then harness between charging station and the power mains / communication lines socket shall be placed with the following conditions:

- (a) The harness at charging station side shall hang vertically down to the ground plane;
- (b) The extraneous length shall be placed as close as possible of the ground plane and "Z-folded" if necessary.

Note 3: The charging station should be placed outside the beam width of the emitting antenna.

## **2.4 Artificial networks**

The AN(s) shall be mounted directly on the ground plane. The cases of the AN(s) shall be bonded to the ground plane.

The measuring port of each AN shall be terminated with a 50  $\Omega$  load.

The AN shall be placed as defined in Figures 4a to 4h.

## **2.5 Impedance stabilization**

Communication lines shall be applied to the vehicle through IS(s).

The impedance stabilization (IS) to be connected in the network and communication cables is defined in CISPR 32 paragraph C.4.1.2.

The IS(s) shall be mounted directly on the ground plane. The case of the IS(s) shall be bonded to the ground plane.

The measuring port of each IS shall be terminated with a 50  $\Omega$  load.

The IS shall be placed as defined in Figures 4e to 4h.

## **2.6 Power charging / Communication cable**

The power charging / communication cable shall be placed in a straight line between the AN(s) / IS(s) and the vehicle charging plug. The projected cable length shall be 0.8 m (+0.2/-0 m).

If the length of the cable is longer than 1 m, the extraneous length shall be "Z-folded" in less than 0.5 m width.

The charging / communication cable at vehicle side shall hang vertically at a distance of 100 mm (+200/-0 mm) from the vehicle body.

The whole cable shall be placed on a non-conductive, low relative permittivity (dielectric-constant) material ( $\epsilon_r \leq 1.4$ ), at 100 mm ( $\pm 25$  mm) above the ground plane.

## **3.0 REFERENCE POINT**

3.1 For the purposes of this annex, the reference point is the point at which the field strength shall be established and shall be defined as follows:

3.2 For category L7, M, N, T vehicles according to ISO 11451-2, third edition 2005.

3.3 For category L vehicles (except L7):

3.3.1 At least 2 m horizontally from the antenna phase centre or at least 1 m vertically from the radiating elements of a transmission-line-system (TLS);

- 3.3.2 On the vehicle's centre line (plane of longitudinal symmetry);
- 3.3.3 At a height of  $1.0 \pm 0.05$  m above the plane on which the vehicle rests or  $2.0 \pm 0.05$  m if the minimum height of the roof of any vehicle in the model range exceeds 3.0m,
- 3.3.4 Either at  $1.0 \pm 0.2$  m behind the vertical centerline of the vehicle's front wheel (point C in figure 1 of Appendix 1 to this annex) in the case of three-wheeled vehicles, or at  $0.2 \pm 0.2$  m behind the vertical centerline of the vehicle's front wheel (point D in figure 2 of Appendix 1 to this annex) in the case of two-wheeled vehicles.
- 3.3.5 If it is decided to radiate the rear of the vehicle, the reference point shall be established as in paragraphs 3.3.1. to 3.3.4. The vehicle shall then be installed facing away from the antenna and positioned as if it had been horizontally rotated 180 around its centre point, i.e. such that the distance from the antenna to the nearest part of the outer body of the vehicle remains the same. This is illustrated in figure 3 of Appendix 1 to this annex.

#### **4.0 TEST REQUIREMENTS**

##### **4.1 Frequency range, dwell times, polarization**

The vehicle shall be exposed to electromagnetic radiation in the 20 to 2,000 MHz frequency ranges in vertical polarization.

The test signal modulation shall be:

- (a) AM (amplitude modulation), with 1 kHz modulation and 80 percent modulation depth in the 20 to 800 MHz frequency range, and
- (b) PM (pulse modulation),  $t$  on 577  $\mu$ s, period 4,600  $\mu$ s in the 800 to 2,000 MHz frequency range,

if not otherwise agreed between Test Agency and vehicle manufacturer.

Frequency step size and dwell time shall be chosen according to ISO 11451-1, third edition 2005.

- 4.1.1 The Test Agency shall perform the test at the intervals specified in ISO 11451-1, third edition 2005 throughout the frequency range 20 to 2,000 MHz.

Alternatively, if the manufacturer provides measurement to data for the whole frequency band from a test laboratory accredited to the applicable parts of ISO 17025 and recognized by the Test Agency, the Test Agency may choose a reduced number of spot frequencies in the range, e.g. 27, 45, 65, 90, 120, 150, 190, 230, 280, 380, 450, 600, 750, 900, 1,300, and 1,800 MHz to confirm that the vehicle meets the requirements of this annex.

If a vehicle fails the test defined in this annex, it must be verified as having failed under the relevant test conditions and not as a result of the generation of uncontrolled fields.

## **5.0 GENERATION OF REQUIRED FIELD STRENGTH**

### **5.1 Test methodology**

5.1.1 The substitution method according to ISO 11451-1, third edition 2005 shall be used to establish the test field conditions.

#### **5.1.2 Calibration**

For TLS one field probe at the facility reference point shall be used.

For antennas four field probes at the facility reference line shall be used.

#### **5.1.3 Test phase**

The vehicle shall be positioned with the centre line of the vehicle on the facility reference point or line. The vehicle shall normally face a fixed antenna. However, where the electronic control units and the associated wiring harness are predominantly in the rear of the vehicle, the test should normally be carried out with the vehicle facing away from the antenna. In the case of long vehicles (i.e. excluding vehicles of categories L, M1 and N1), which have electronic control units and associated wiring harness predominantly towards the middle of the vehicle, a reference point may be established based on either the right side surface or the left side surface of the vehicle. This reference point shall be at the midpoint of the vehicle's length or at one point along the side of the vehicle chosen by the manufacturer in conjunction with the Test Agency after considering the distribution of electronic systems and the layout of any wiring harness.

Such testing may only take place if the physical construction of the chamber permits. The antenna location must be noted in the test report.

ANNEX 4 – APPENDIX 1

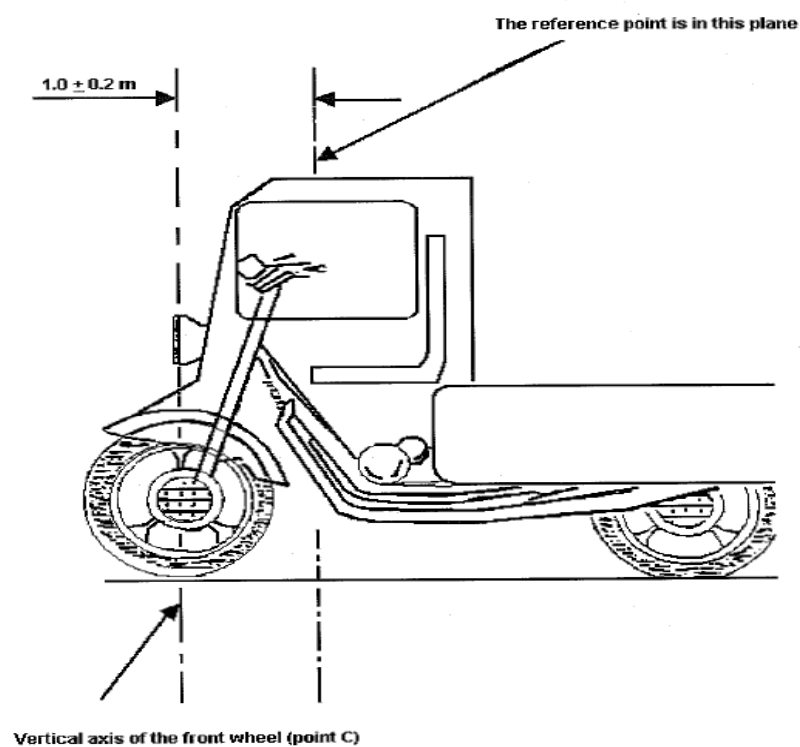


Figure 1

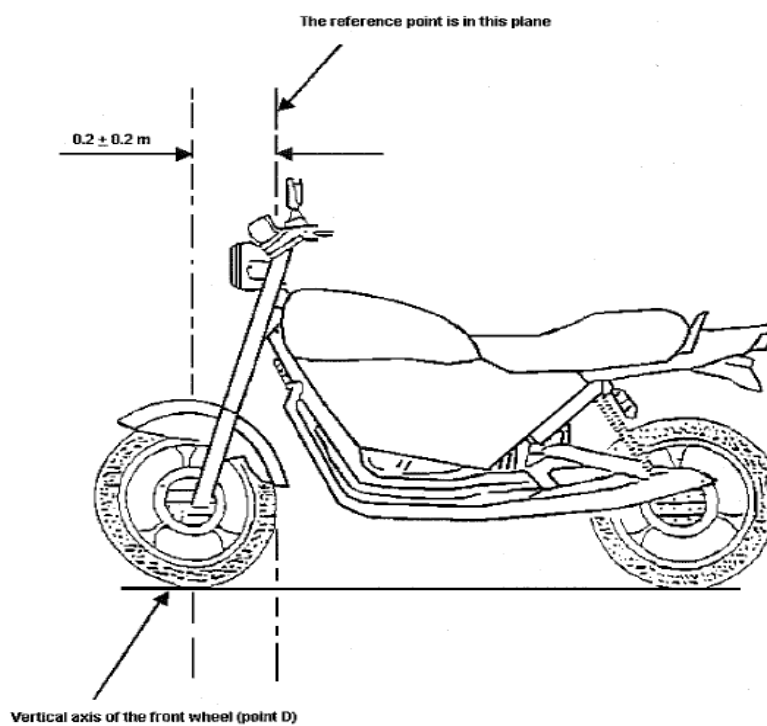


Figure 2



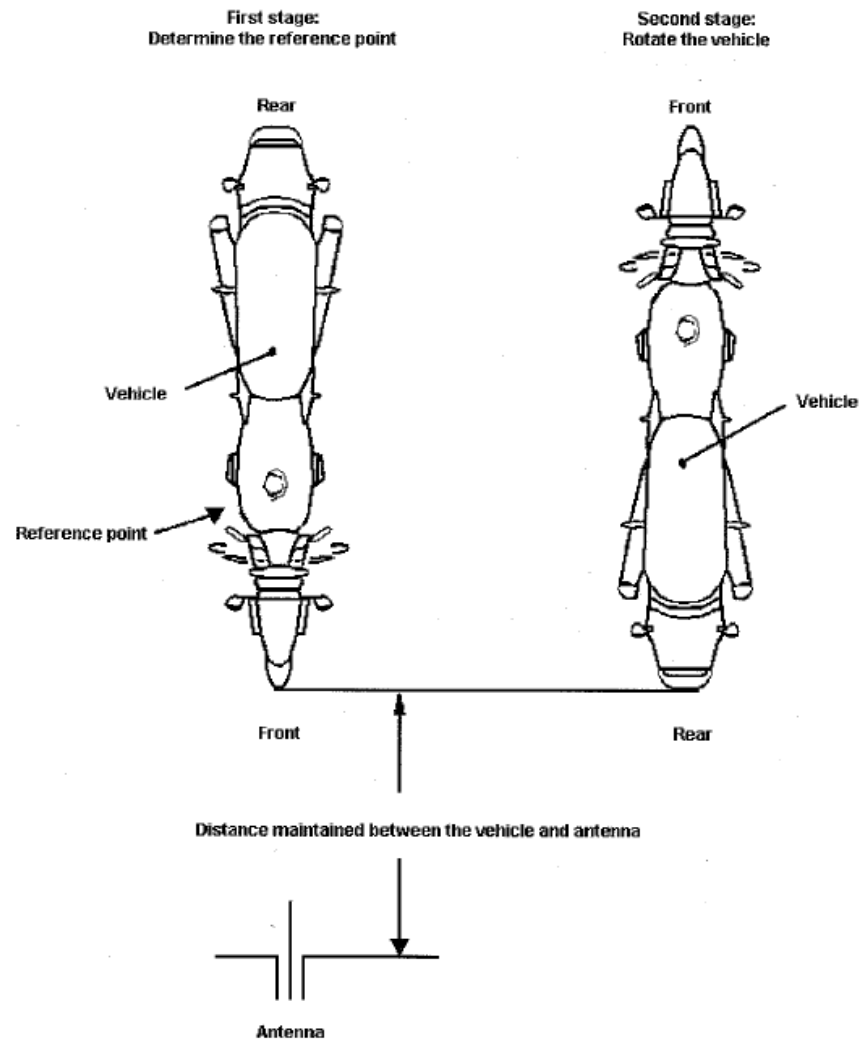
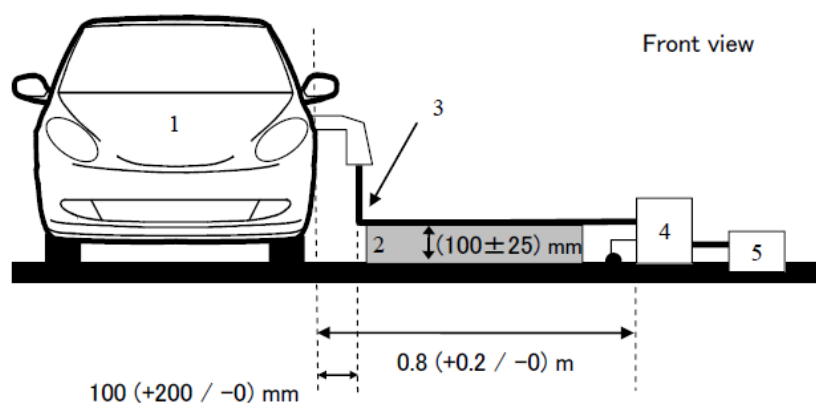
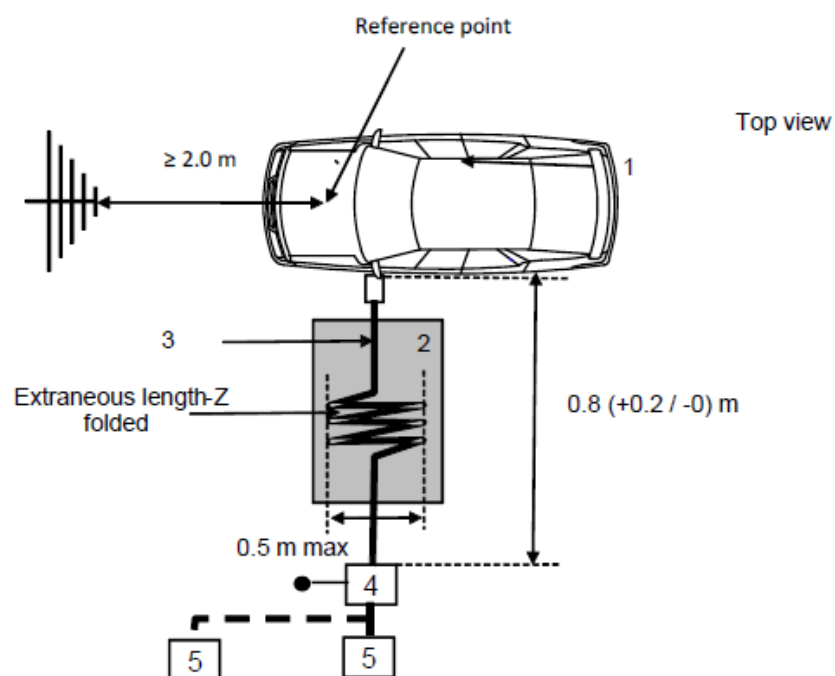


Figure 3

**Figure 4****Vehicle in configuration "REESS charging mode coupled to the power grid"**

Example of test set-up for vehicle with plug located on the vehicle side (AC power charging without communication)

**Figure 4a – Front View****Legend:**

- 1 Vehicle under test
- 2 Insulating support
- 3 Charging cable
- 4 Artificial network(s) grounded
- 5 Power mains socket

**Figure 4b – Top View**

Example of test set-up for vehicle with plug located front / rear of vehicle (AC power charging without communication)

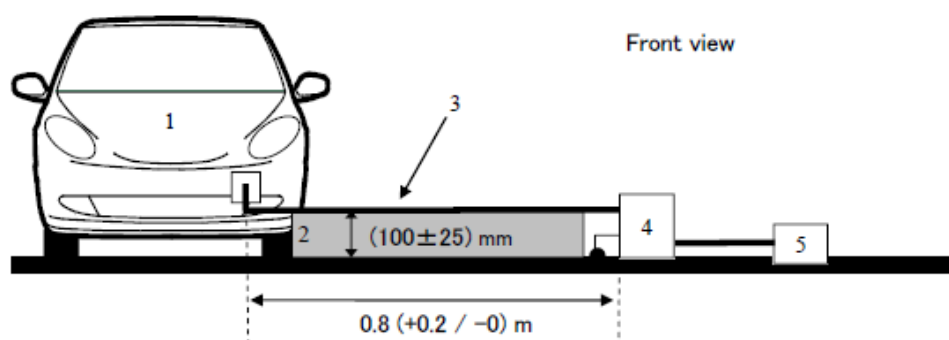
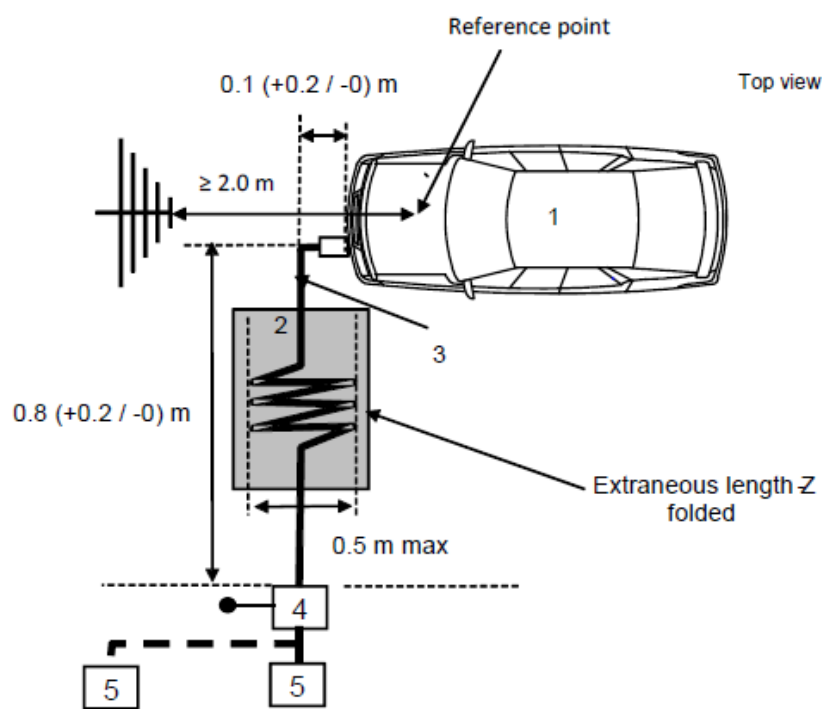


Figure 4c – Front View



Legend:

- 1 Vehicle under test
- 2 Insulating support
- 3 Charging cable
- 4 Artificial network(s) grounded
- 5 Power mains socket

Figure 4d – Top View

Example of test set-up for vehicle with plug located on vehicle side (AC or DC power charging with communication)

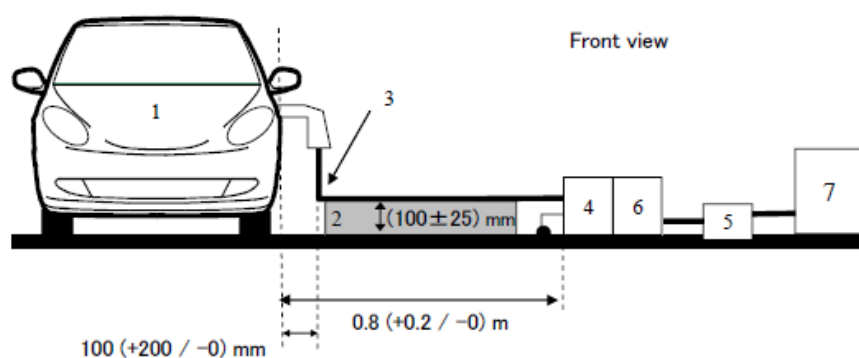
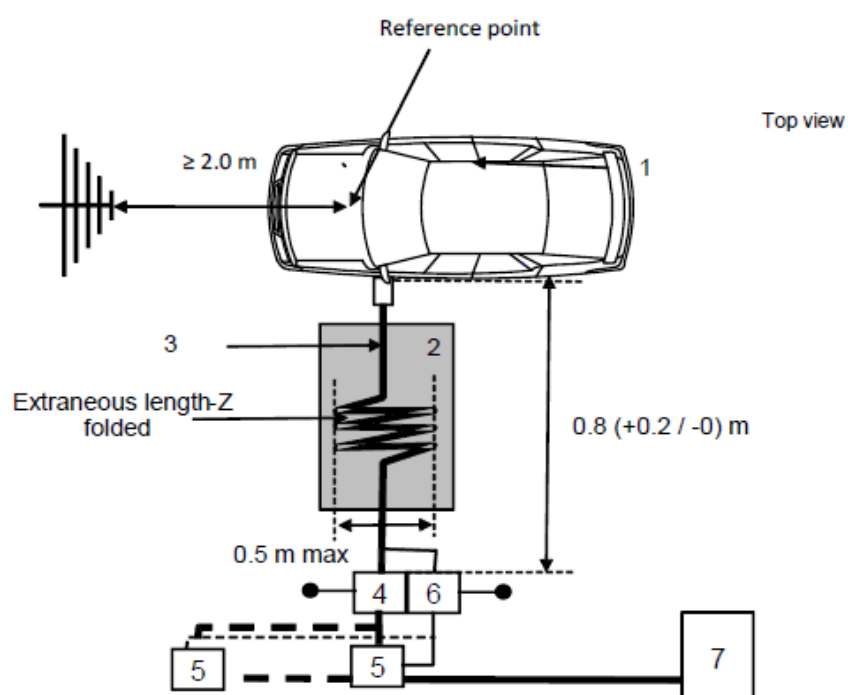


Figure 4e – Front View



Legend:

- 1 Vehicle under test
- 2 Insulating support
- 3 Charging / communication cable
- 4 AC or DC artificial network(s) grounded
- 5 Power mains socket
- 6 Impedance stabilisation(s) grounded
- 7 Charging station

Figure 4f – Top View

Example of test set-up for vehicle with plug located front / rear of the vehicle (AC or DC power charging with communication)

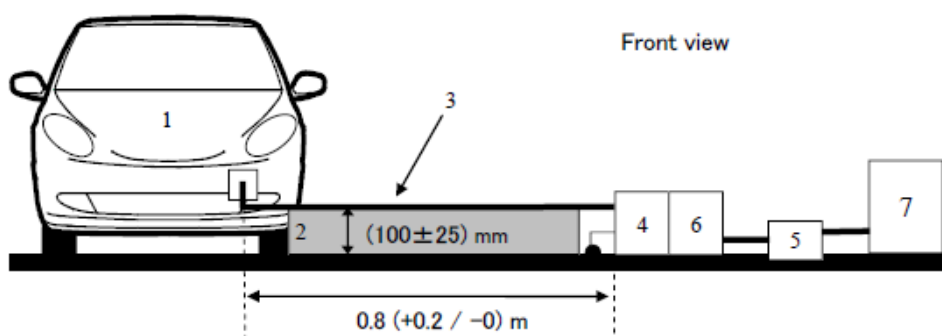
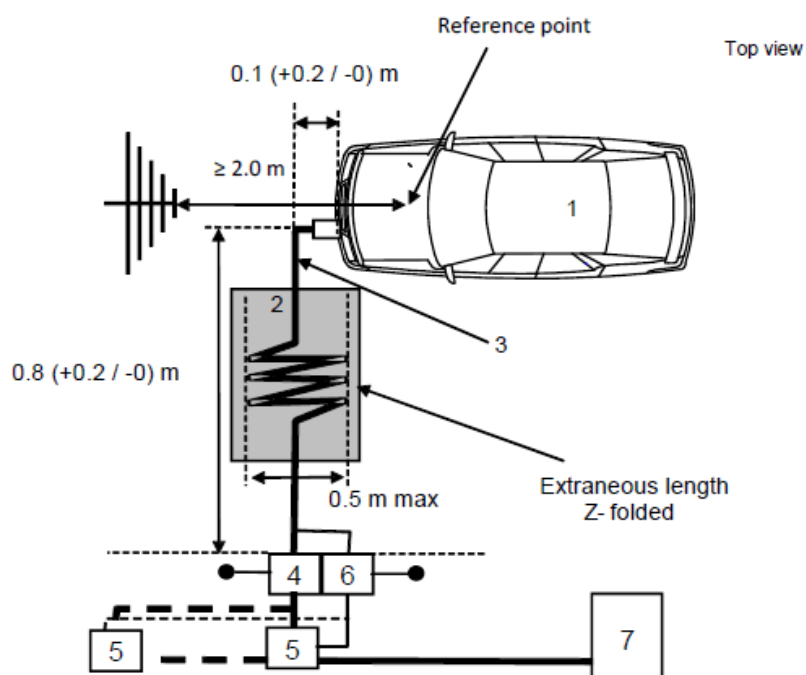


Figure 4g – Front View



Legend:

- 1 Vehicle under test
- 2 Insulating support
- 3 Charging / communication cable
- 4 AC or DC artificial network(s) grounded
- 5 Power mains socket
- 6 Impedance stabilisation(s) grounded
- 7 Charging station

Figure 4h – Top View

## **ANNEX 5**

(See 5.5.1 and 6.10)

### **METHOD OF MEASUREMENT OF**

### **RADIATED BROADBAND ELECTROMAGNETIC EMISSIONS FROM ELECTRICAL/ELECTRONIC SUB-ASSEMBLIES**

#### **1.0 GENERAL**

- 1.1 The test method described in this annex may be applied to ESAs which may be subsequently fitted to vehicles, which comply with Annex 2.
- 1.2 This method concerns both kinds of ESA:
  - (a) Other ESAs than involved in "REESS charging mode coupled to the power grid".
  - (b) ESAs involved in "REESS charging mode coupled to the power grid".

Test method

This test is intended to measure broadband electromagnetic emissions from ESAs (e.g. ignition systems, electric motor, etc.).

If not otherwise stated in this annex the test shall be performed according to CISPR 25 (second edition 2002).

#### **2.0 ESA STATE DURING TESTS**

- 2.1 The ESA under test shall be in normal operation mode, preferably in maximum load.

ESAs involved in "REESS charging mode coupled to the power grid" shall be in charging mode.

The state of charge (SOC) of the traction battery shall be kept between 20 per cent and 80 per cent of the maximum SOC during the whole frequency range measurement (this may lead to split the measurement in different sub-bands with the need to discharge the vehicle's traction battery before starting the next sub-bands)

If the test is not performed with a REESS the ESA should be tested at rated current. If the current consumption can be adjusted, then the current shall be set to at least 80 per cent of its nominal value.

#### **3.0 TEST ARRANGEMENTS**

- 3.1 For ESA other than involved in "REESS charging mode coupled to the power grid" the test shall be performed according to CISPR 25 (second edition 2002) clause 6.4. - ALSE method.

- 3.2 For ESAs in configuration "REESS charging mode coupled to the power grid" the test arrangement shall be according to Figure 2 of the appendix to this annex.
- 3.2.1 The shielding configuration shall be according to the vehicle series configuration. Generally, all shielded High Voltage (HV) parts shall be properly connected with low impedance to ground (e. g. AN, cables, connectors etc.). ESAs and loads shall be connected to ground. The external HV power supply shall be connected via feed-through-filtering.
- 3.2.2 Unless otherwise specified the length of the Low Voltage (LV) harness and the HV harness parallel to the front edge of the ground plane shall be 1,500 mm ( $\pm 75$  mm). The total length of the test harness including the connector shall be 1,700 mm ( $+300/-0$  mm). The distance between the LV harness and the HV harness shall be 100 mm ( $+100/-0$  mm).
- 3.2.3 All of the harnesses shall be placed on a non-conductive, low relative permittivity material ( $\epsilon_r \leq 1.4$ ), at 50 mm ( $\pm 5$  mm) above the ground plane.
- 3.2.4 Shielded supply lines for HV+ and HV- line and three phase lines may be coaxial cables or in a common shield depending on the used plug system. The original HV-harness from the vehicle may be used optionally.
- 3.2.5 Unless otherwise specified, the ESA case shall be connected to the ground plane either directly or via defined impedance.
- 3.2.6 For onboard chargers, the AC/DC power lines shall be placed the furthest from the antenna (behind LV and HV harness). The distance between the AC/DC power lines and the closest harness (LV or HV) shall be 100 mm ( $+100/-0$  mm).

### 3.3 **Alternative measuring location**

As an alternative to an absorber lined shielded enclosure (ALSE) an open area test site (OATS), which complies with the requirements of CISPR 16-1-4 may be used (see appendix to this annex).

### 3.4 **Ambient**

To ensure that there is no extraneous noise or signal of a magnitude sufficient to affect materially the measurement, measurements shall be taken before or after the main test. In this measurement, the extraneous noise or signal shall be at least 6 dB below the limits of interference given in paragraph 5.5.2.1 of this standard, except for intentional narrowband ambient transmissions.

## 4.0 **TEST REQUIREMENTS**

- 4.1 The limits apply throughout the frequency range 30 to 1,000 MHz for measurements performed in a semi anechoic chamber or an outdoor test site.

4.2 Measurements can be performed with either quasi-peak or peak detectors.

The limits given in paragraphs 5.2 and 5.5 of this standard are for quasi-peak detectors.

If peak detectors are used a correction factor of 20 dB as defined in CISPR 12 (fifth edition 2001) shall be applied.

4.3 The measurements shall be performed with a spectrum analyser or a scanning receiver. The parameters to be used are defined in Table 1 and Table 2.

**Table 1**

<b>Spectrum analyser parameters</b>						
<b>Frequency range MHz</b>	<b>Peak detector</b>		<b>Quasi-peak detector</b>		<b>Average detector</b>	
	<b>RBW at -3 dB</b>	<b>Scan time</b>	<b>RBW at -6 dB</b>	<b>Scan time</b>	<b>RBW at -3 dB</b>	<b>Scan time</b>
30 to 1,000	100/120 kHz	100 ms/MHz	120 kHz	20 s/MHz	100/120 kHz	100 ms/MHz

Note: If a spectrum analyser is used for peak measurements, the video bandwidth shall be at least three times the resolution bandwidth (RBW).

**Table 2**

**Scanning receiver parameters**

<b>Frequency range MHz</b>	<b>Peak detector</b>			<b>Quasi-peak detector</b>			<b>Average detector</b>		
	<b>BW at -6 dB</b>	<b>Step size</b>	<b>Dwell time</b>	<b>BW at -6 dB</b>	<b>Step size <sup>(a)</sup></b>	<b>Dwell time</b>	<b>BW at -6 dB</b>	<b>Step size <sup>(a)</sup></b>	<b>Dwell time</b>
30 to 1,000	120 kHz	50 kHz	5 ms	120 kHz	50 kHz	1 s	120 kHz	50 kHz	5 ms

<sup>(a)</sup> For purely broadband disturbances, the maximum frequency step size may be increased up to a value not greater than the bandwidth value.

Note: For emissions generated by brush commutator motors without an electronic control unit, the maximum step size may be increased up to five times the bandwidth.



**4.4 Measurements**

The Test Agency shall perform the test at the intervals specified in the CISPR 25 (second edition 2002) standard throughout the frequency range 30 to 1,000 MHz.

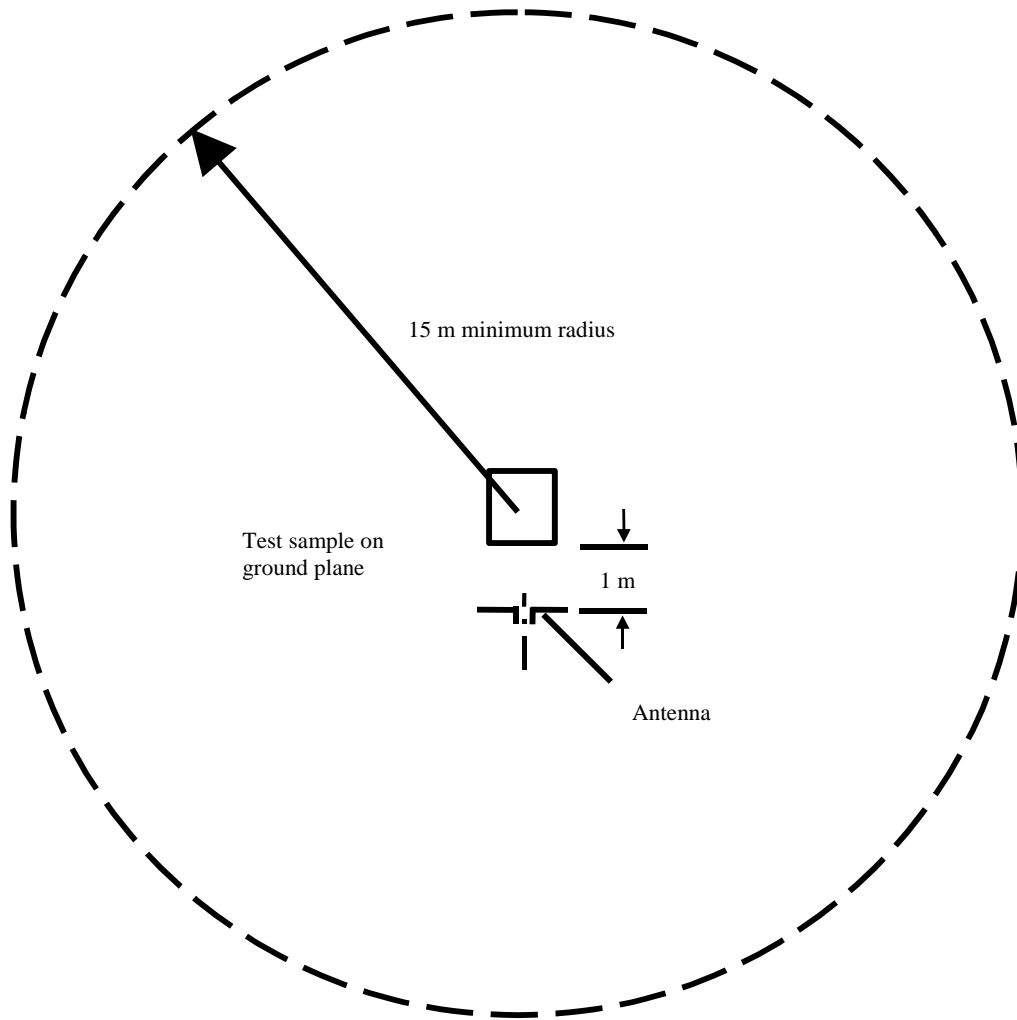
Alternatively, if the manufacturer provides measurement data for the whole frequency band from a test laboratory accredited to the applicable parts of ISO 17025 and recognized by the Test Agency, the Test Agency may divide the frequency range in 13 frequency bands 30–50, 50–75, 75–100, 100–130, 130–165, 165–200, 200–250, 250–320, 320–400, 400–520, 520–660, 660–820, 820–1,000 MHz and perform tests at the 13 frequencies giving the highest emission levels within each band to confirm that the ESA meets the requirements of this annex.

In the event that the limit is exceeded during the test, investigations shall be made to ensure that this is due to the ESA and not to background radiation.

**4.5 Readings**

The maximum of the readings relative to the limit (horizontal / vertical polarization) in each of the 13 frequency bands shall be taken as the characteristic reading at the frequency at which the measurements were made.

ANNEX 5 - APPENDIX 1



**Figure 1**

**Open Area Test Site: Electrical/electronic Sub-Assembly test area boundary  
level clear area free from electromagnetic reflecting surfaces**

Top view (horizontal polarization)

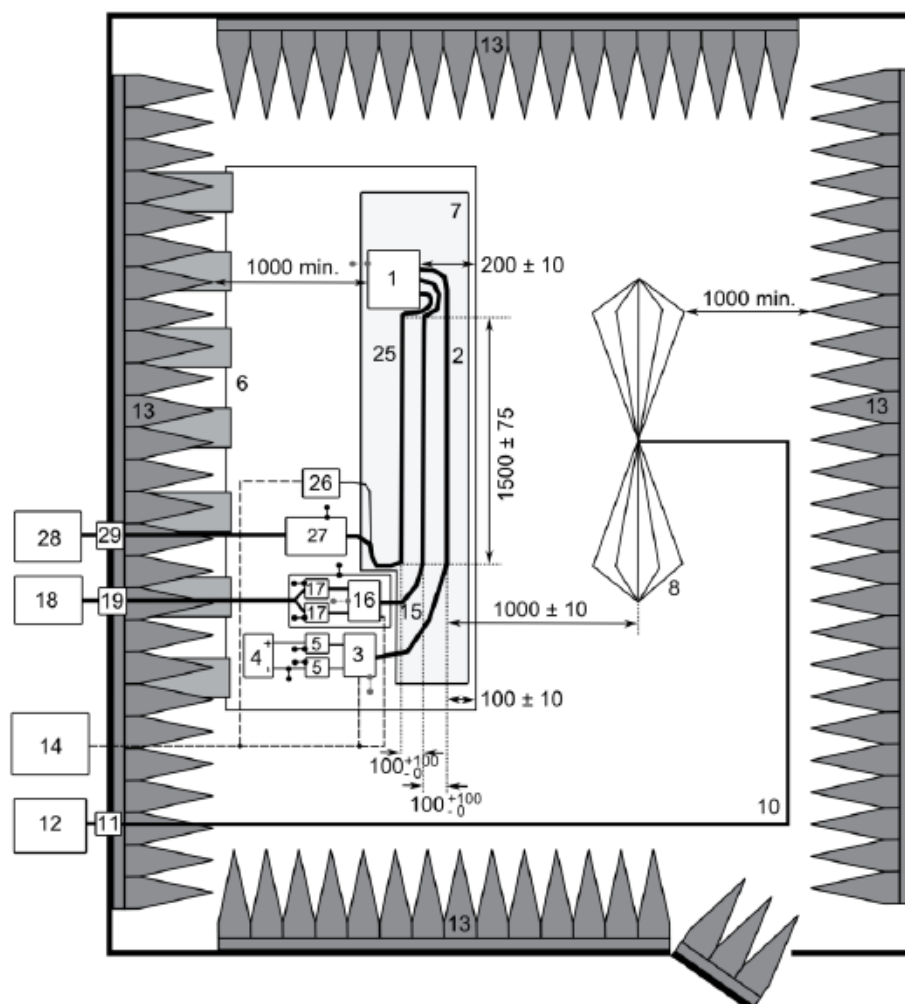


Figure 2

**Test configuration for ESAs involved in "REESS charging mode coupled to the power grid" (example for Bi-conical antenna)**

**Legend:**

1	ESA (grounded locally if required in test plan)	14	Stimulation and monitoring system
2	LV Test harness	15	HV harness
3	LV Load simulator (placement and ground connection according to CISPR 25 paragraph 6.4.2.5)	16	HV load simulator
4	Power supply (location optional)	17	HV AN
5	LV Artificial network (AN)	18	HV power supply
6	Ground plane (bonded to shielded enclosure)	19	HV feed-through
7	Low relative permittivity support ( $\epsilon_r \leq 1.4$ )	25	AC/DC charger harness
8	Biconical antenna	26	AC/DC load simulator (e.g. Programmable Logic Controller (PLC))
10	High-quality coaxial cable e.g. double-shielded (50 $\Omega$ )	27	50 $\mu$ H Line Impedance Stabilization Network (LISN) (AC) or HVAN (DC)
11	Bulkhead connector	28	AC/DC power supply
12	Measuring instrument	29	AC/DC feed-through
13	RF absorber material		

## ANNEX 6

### METHOD OF MEASUREMENT OF RADIATED NARROWBAND ELECTROMAGNETIC EMISSIONS FROM ELECTRICAL/ELECTRONIC SUB-ASSEMBLIES

(See 5.6.1)

#### 1.0 GENERAL

- 1.1 The test method described in this annex shall apply to ESAs, which may be subsequently fitted to vehicles, which comply, with Annex 3.

This method concerns only ESA other than those involved in "REESS charging mode coupled to the power grid".

#### 1.2 Test Method

This test is intended to measure the narrowband electromagnetic emissions such as might emanate from a microprocessor-based system.

If not otherwise stated in this annex the test shall be performed according to CISPR 25 (second edition 2002).

#### 2.0 ESA STATE DURING TESTS

The ESA under test shall be in normal operation mode.

#### 3.0 TEST ARRANGEMENTS

- 3.1 The test shall be performed according to CISPR 25 (second edition 2002) clause 6.4. - ALSE method.

#### 3.2 Alternative measuring location

As an alternative to an absorber lined shielded enclosure (ALSE) an open area test site (OATS) which complies with the requirements of CISPR 16-1 ( second edition 2002) may be used (see Appendix 1 to Annex 5).

#### 3.3 Ambient

To ensure that there is no extraneous noise or signal of a magnitude sufficient to affect materially the measurement, measurements shall be taken before or after the main test. In this measurement, the extraneous noise or signal shall be at least 6 dB below the limits of interference given in paragraph 5.6.2.1 of this standard, except for intentional narrowband ambient transmissions.

#### 4.0 TEST REQUIREMENTS

- 4.1 The limits apply throughout the frequency range 30 to 1,000 MHz for measurements performed in semi anechoic chambers or outdoor test sites.

4.2 Measurements shall be performed with an average detector.

4.3 The measurements shall be performed with a spectrum analyser or a scanning receiver. The parameters to be used are defined in Table 1 and Table 2.

**Table 1**

**Spectrum analyser parameters**

Frequency range MHz	Peak detector		Quasi-peak detector		Average detector	
	RBW at -3 dB	Scan time	RBW at -6 dB	Scan time	RBW at -3 dB	Scan time
30 to 1,000	100/120 kHz	100 ms/MHz	120 kHz	20 s/MHz	100/120 kHz	100 ms/MHz

Note: If a spectrum analyser is used for peak measurements, the video bandwidth shall be at least three times the resolution bandwidth (RBW).

**Table 2**

**Scanning receiver parameters**

Frequency range MHz	Peak detector			Quasi-peak detector			Average detector		
	BW at -6 dB	Step size <sup>(a)</sup>	Dwell time	BW at -6 dB	Step size <sup>(a)</sup>	Dwell time	BW at -6 dB	Step size <sup>(a)</sup>	Dwell time
30 to 1,000	120 kHz	50 kHz	5 ms	120 kHz	50 kHz	1 s	120 kHz	50 kHz	5 ms

<sup>(a)</sup> For purely broadband disturbances, the maximum frequency step size may be increased up to a value not greater than the bandwidth value.

Note: For emissions generated by brush commutator motors without an electronic control unit, the maximum step size may be increased up to five times the band width.

#### **4.4 Measurements**

The Test Agency shall perform the test at the intervals specified in the CISPR 25 (second edition 2002) standard throughout the frequency range 30 to 1,000 MHz.

Alternatively, if the manufacturer provides measurement data for the whole frequency band from a test laboratory accredited to the applicable parts of ISO 17025 and recognized by the Test Agency, the Test Agency may divide the frequency range in 13 frequency bands 30–50, 50–75, 75–100, 100–130, 130–165, 165–200, 200–250, 250–320, 320–400, 400–520, 520–660, 660–820, 820–1,000 MHz and perform tests at the 13 frequencies giving the highest emission levels within each band to confirm that the ESA meets the requirements of this annex. In the event that the limit is exceeded during the test, investigations shall be made to ensure that this is due to the ESA and not due to background radiation including broadband radiation from the ESA.

#### **4.5 Readings**

The maximum of the readings relative to the limit (horizontal/vertical polarization) in each of the 13 frequency bands shall be taken as the characteristic reading at the frequency at which the measurements were made.

**ANNEX 7**

(See 5.7.1 and 6.18)

**METHOD(S) OF TESTING FOR IMMUNITY OF  
ELECTRICAL/ELECTRONIC SUB-ASSEMBLIES TO ELECTROMAGNETIC  
RADIATION**

**1.0 GENERAL**

1.1 The test methods described in this annex shall be applied to ESAs.

1.2 Test Methods

This method concerns both kinds of ESA:

(a) Other ESAs than involved in "REESS charging mode coupled to the power grid";

(b) ESAs involved in "REESS charging mode coupled to the power grid".

1.2.1 ESAs may comply with the requirements of any combination of the following test methods at the manufacturer's discretion provided that this results in the full frequency range specified in paragraph 3.1. of this annex being covered:

(a) Absorber chamber test according to ISO 11452-2, second edition 2004;

(b) TEM cell testing according to ISO 11452-3, third edition 2001;

(c) Bulk current injection testing according to ISO 11452-4, third edition 2005;

(d) Stripline testing according to ISO 11452-5, second edition 2002;

(e) 800 mm stripline according to paragraph 5 of this annex.

ESAs in configuration "REESS charging mode coupled to the power grid" shall comply with the requirements of the combination of the Absorber chamber test according to ISO 11452-2 and Bulk current injection testing according to ISO 11452-4 at the manufacturer's discretion provided that these results in the full frequency range specified in paragraph 3.1. of this annex being covered

(Frequency range and general test conditions shall be based on ISO 11452-1, third edition 2005).

**2.0 STATE OF ESA DURING TESTS**

2.1 The test conditions shall be according to ISO 11452-1, third edition 2005.

- 2.2 The ESA under test shall be switched on and must be stimulated to be in normal operation condition. It shall be arranged as defined in this annex unless individual test methods dictate otherwise.

ESAs involved in "REESS charging mode coupled to the power grid" shall be in charging mode.

The state of charge (SOC) of the traction battery shall be kept between 20 per cent and 80 per cent of the maximum SOC during the whole frequency range measurement (this may lead to split the measurement in different sub-bands with the need to discharge the vehicle's traction battery before starting the next sub-bands).

If the test is not performed with a REESS the ESA should be tested at rated current. If the current consumption can be adjusted, then the current shall be set to at least 20 per cent of its nominal value.

- 2.3 Any extraneous equipment required to operate the ESA under test shall not be in place during the calibration phase. No extraneous equipment shall be closer than 1 m from the reference point during calibration.
- 2.4 To ensure reproducible measurement results are obtained when tests and measurements are repeated, the test signal generating equipment and its layout shall be to the same specification as that used during each appropriate calibration phase.
- 2.5 If the ESA under test consists of more than one unit, the interconnecting cables should ideally be the wiring harnesses as intended for use in the vehicle. If these are not available, the length between the electronic control unit and the AN shall be as defined in the standard. All cables in the wiring harness should be terminated as realistically as possible and preferably with real loads and actuators.

### **3.0 GENERAL TEST REQUIREMENTS**

- 3.1 Frequency range, dwell times

Measurements shall be made in the 20 to 2,000 MHz frequency range with frequency steps according to ISO 11452-1, third edition 2005.

The test signal modulation shall be:

- (a) AM (amplitude modulation), with 1 kHz modulation and 80 per cent modulation depth in the 20 - 800 MHz frequency range;
- (b) PM (pulse modulation),  $t_{on}$  577  $\mu$ s, period 4,600  $\mu$ s in the 800-2,000 MHz frequency range,

if not otherwise agreed between Test Agency and ESA manufacturer.

Frequency step size and dwell time shall be chosen according to ISO 11452-1, third edition 2005.



- 3.2 The Test Agency shall perform the test at the intervals specified in ISO 11452-1 third edition 2005 throughout the frequency range 20 to 2,000 MHz.

Alternatively, if the manufacturer provides measurement to data for the whole frequency band from a test laboratory accredited to the applicable parts of ISO 17025 and recognized by the Test Agency, the Test Agency may choose a reduced number of spot frequencies in the range, e.g. 27, 45, 65, 90, 120, 150, 190, 230, 280, 380, 450, 600, 750, 900, 1,300, and 1,800 MHz to confirm that the ESA meets the requirements of this annex.

- 3.3 If an ESA fails the tests defined in this annex, it must be verified as having failed under the relevant test conditions and not as a result of the generation of uncontrolled fields.

#### **4.0 SPECIFIC TEST REQUIREMENTS**

##### **4.1 Absorber chamber test**

###### **4.1.1 Test method**

This test method allows the testing of vehicle electrical/electronic systems by exposing an ESA to electromagnetic radiation generated by an antenna.

###### **4.1.2 Test methodology**

The "substitution method" shall be used to establish the test field conditions according to ISO 11452-2, second edition 2004.

The test shall be performed with vertical polarization

- 4.1.2.1 For ESAs in configuration "REESS charging mode coupled to the power grid" the test arrangement shall be according to Appendix 3 to this annex.

- 4.1.2.1.1 The shielding configuration shall be according to the vehicle series configuration. Generally, all shielded HV parts shall be properly connected with low impedance to ground (e. g. AN, cables, connectors etc.). ESAs and loads shall be connected to ground. The external HV power supply shall be connected via feed-through-filtering.

- 4.1.2.1.2 Unless otherwise specified the length of the LV harness and the HV harness parallel to the front edge of the ground plane shall be 1,500 mm ( $\pm 75$  mm). The total length of the test harness including the connector shall be 1,700 mm (+300/-0 mm). The distance between the LV harness and the HV harness shall be 100 mm (+100/-0 mm).

- 4.1.2.1.3 All of the harnesses shall be placed on a non-conductive, low relative permittivity material ( $\epsilon_r \leq 1,4$ ), at 50 mm ( $\pm 5$  mm) above the ground plane.

- 4.1.2.1.4 Shielded supply lines for HV+ and HV- line and three phase lines may be coaxial cables or in a common shield depending on the used plug system.

The original HV-harness from the vehicle may be used optionally.

- 4.1.2.1.5 Unless otherwise specified, the ESA case shall be connected to the ground plane either directly or via defined impedance.
- 4.1.2.1.6 For onboard chargers, the AC/DC power lines shall be placed the furthest from the antenna (behind LV and HV harness). The distance between the AC/DC power lines and the closest harness (LV or HV) shall be 100 mm (+100/-0 mm).
- 4.1.2.1.7 Unless otherwise specified, the configuration with the LV harness closer to the antenna shall be tested.

#### **4.2 TEM cell testing (see Appendix 2 to this annex)**

##### **4.2.1 Test method**

The TEM (transverse electromagnetic mode) cell generates homogeneous fields between the internal conductor (septum) and housing (ground plane).

##### **4.2.2 Test methodology**

The test shall be performed according to ISO 11452-3, third edition 2001. Depending on the ESA to be tested the Test Agency shall choose the method of maximum field coupling to the ESA or to the wiring harness inside the TEM-cell.

#### **4.3 Bulk current injection testing**

##### **4.3.1 Test method**

This is a method of carrying out immunity tests by inducing currents directly into a wiring harness using a current injection probe.

##### **4.3.2 Test methodology**

The test shall be performed according to ISO 11452-4, third edition 2005 on a test bench. As an alternative the ESA may be tested while installed in the vehicle according to ISO 11451-4 (first edition 1995) with the following characteristics:

- (a) The injection probe shall be positioned in 150 mm distance to the ESA to be tested;
- (b) The reference method shall be used to calculate injected currents from forward power;
- (c) The frequency range of the method is limited by the injection probe specification.

- 4.3.2.1. For ESAs in configuration "REESS charging mode coupled to the power

grid", the test arrangement shall be according to Appendix 4 to this annex.

- 4.3.2.1.1 The shielding configuration shall be according to the vehicle series configuration. Generally, all shielded HV parts shall be properly connected with low impedance to ground (e. g. AN, cables, connectors, etc.). ESAs and loads shall be connected to ground. The external HV power supply shall be connected via feed-through-filtering.
- 4.3.2.1.2. Unless otherwise specified the length of the LV harness and the HV harness shall be 1,700 mm (+300/-0 mm). The distance between the LV harness and the HV harness shall be 100 mm (+100/-0 mm).
- 4.3.2.1.3. All of the harnesses shall be placed on a non-conductive, low relative permittivity material ( $\epsilon_r \leq 1.4$ ), at  $(50 \pm 5)$  mm above the ground plane.
- 4.3.2.1.4. Shielded supply lines for HV+ and HV- line and three phase lines may be coaxial cables or in a common shield depending on the used plug system. The original HV-harness from the vehicle may be used optionally.
- 4.3.2.1.5. Unless otherwise specified, the ESA case shall be connected to the ground plane either directly or via defined impedance.
- 4.3.2.1.6. Unless otherwise specified the test shall be performed with the injection probe placed around each of the following harnesses:
  - (a) Low voltage harness;
  - (b) High voltage harness;
  - (c) AC power lines if applicable;
  - (d) DC power lines if applicable

#### 4.4 **Stripline testing**

##### 4.4.1 Test method

This test method consists of subjecting the wiring harness connecting the components in an ESA to specified field strengths.

##### 4.4.2 Test methodology

The test shall be performed according to ISO 11452-5, second edition 2002.

#### 4.5 **800 mm Stripline testing**

##### 4.5.1 Test method

The Stripline consists of two parallel metallic plates separated by 800 mm. Equipment under test is positioned centrally between the plates and subjected to an electromagnetic field (see Appendix 1 to this annex).

This method can test complete electronic systems including sensors and actuators as well as the controller and wiring loom. It is suitable for apparatus whose largest dimension is less than one third of the plate separation.

4.5.2 Test methodology

4.5.2.1. Positioning of Stripline

The stripline shall be housed in a screened room (to prevent external emissions) and positioned 2 m away from walls and any metallic enclosure to prevent electromagnetic reflections. RF absorber material may be used to damp these reflections. The stripline shall be placed on non-conducting supports at least 0.4 m above the floor.

4.5.2.2. Calibration of the Stripline

A field-measuring probe shall be positioned within the central one-third of the longitudinal, vertical and transverse dimensions of the space between the parallel plates with the system under test absent.

The associated measuring equipment shall be sited outside the screen room. At each desired test frequency, a level of power shall be fed into the stripline to produce the required field strength at the antenna. This level of forward power, or another parameter directly related to the forward power required to define the field, shall be used for type approval tests unless changes occur in the facilities or equipment, which necessitate this procedure being repeated.

4.5.2.3. Installation of the ESA under test

The main control unit shall be positioned within the central one third of the longitudinal, vertical and transverse dimensions of the space between the parallel plates. It shall be supported on a stand made from non-conducting material.

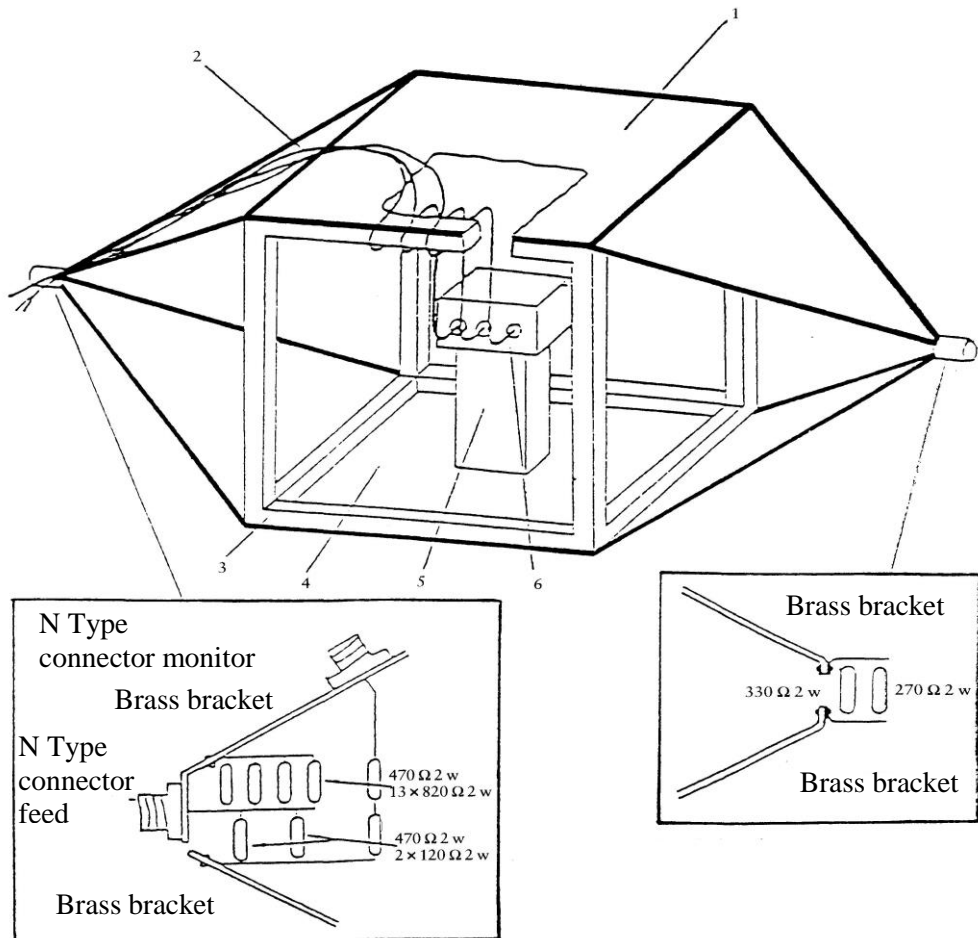
4.5.2.4. Main wiring loom and sensor/actuator cables

The main wiring loom and any sensor/actuator cables shall rise vertically from the control unit to the top ground plate (this helps to maximize coupling with the electromagnetic field). Then they shall follow the underside of the plate to one of its free edges where they shall loop over and follow the top of the ground plate as far as the connections to the stripline feed. The cables shall then be routed to the associated equipment, which shall be sited in an area outside the influence of the electromagnetic field, e.g.: on the floor of the screened room 1 m longitudinally away from the stripline.

# ANNEX 7 - APPENDIX 1

Figure 1

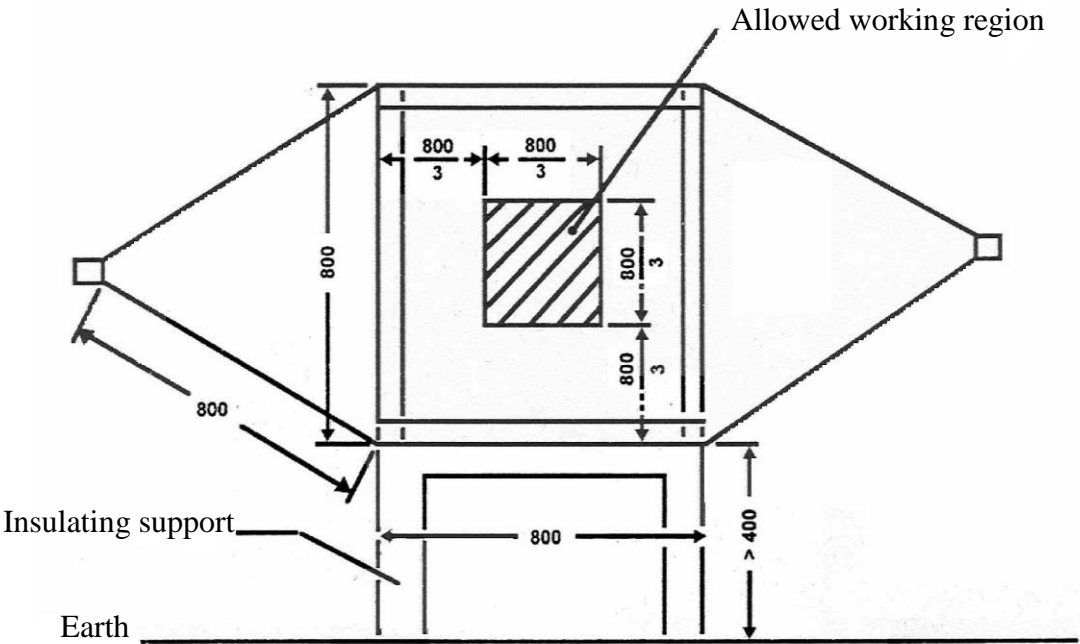
## 800 mm Stripline Testing



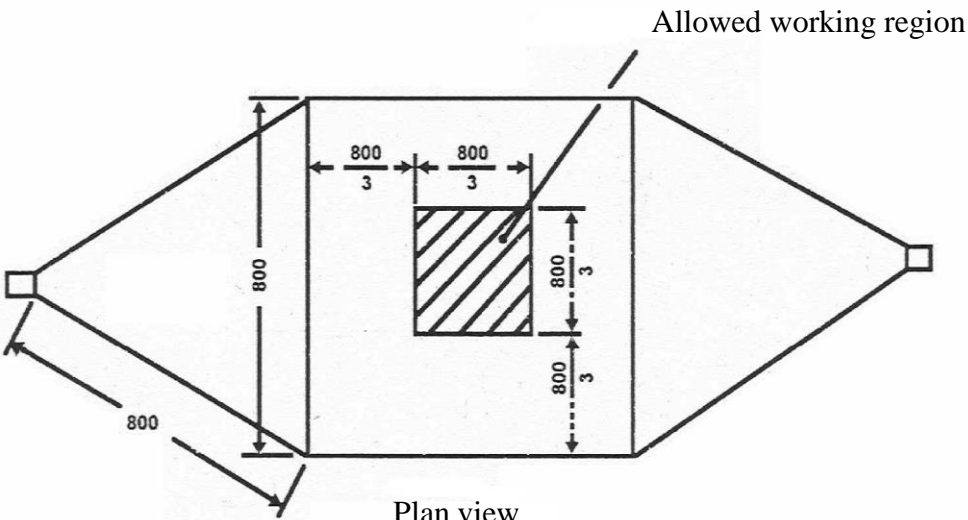
Details of stripline feed

- 1 = Ground plate
- 2 = Main loom and sensor/actuator cables
- 3 = Wooden frame
- 4 = Driven plate
- 5 = Insulator
- 6 = Test object

Figure 2  
800 mm Stripline Dimensions



Side view



Plan view

All Dimensions in mm

ANNEX 7 - APPENDIX 2

TYPICAL TEM CELL DIMENSIONS

The following table shows the dimensions for constructing a cell with specified upper frequency limits:

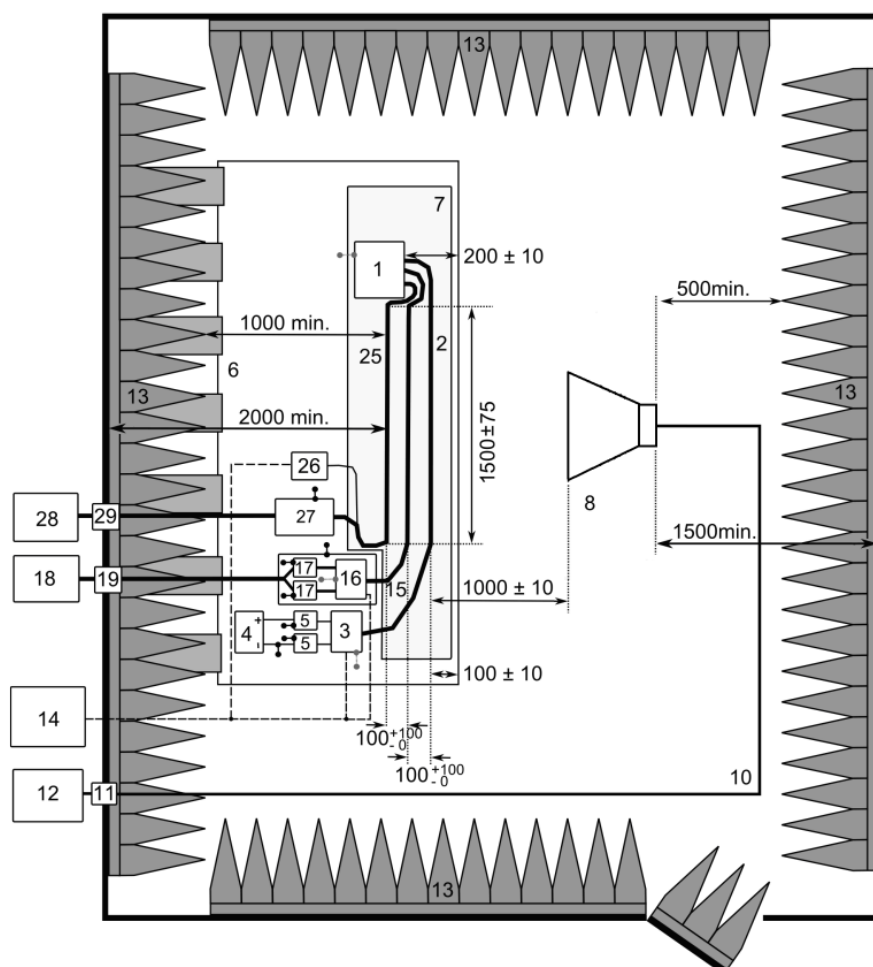
Upper frequency (MHz)	Cell form factor W : b	Cell form factor L/W	Plate separation b (cm)	Septum S (cm)
200	1.69	0.66	56	70
200	1.00	1	60	50

## ANNEX 7 - APPENDIX 3

## ABSORBER CHAMBER TEST

Test configuration for ESA's involved in "REESS charging mode coupled to the power grid". The test shall be performed according to ISO 11452-2.

Top view (Vertical polarization)



Legend:

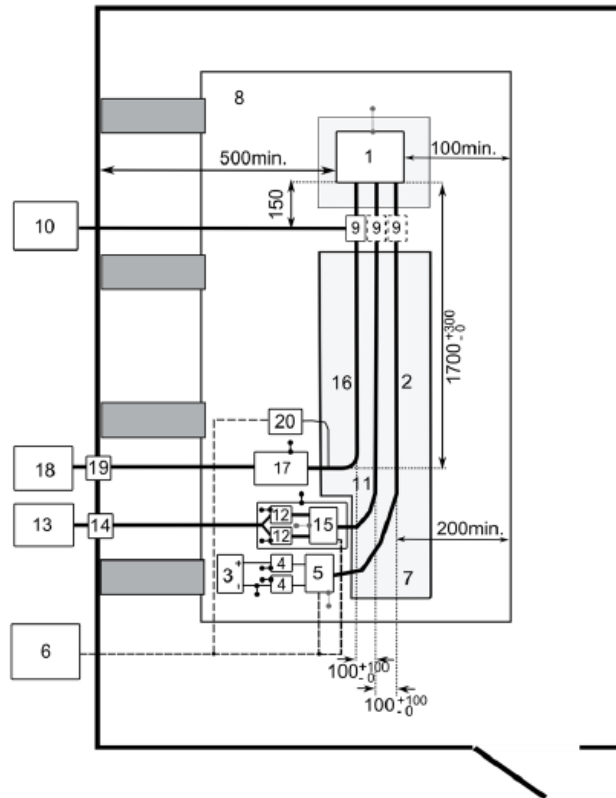
1	ESA (grounded locally if required in test plan)	14	Stimulation and monitoring system
2	LV Test harness	15	HV harness
3	LV Load simulator (placement and ground connection according to CISPR 25 paragraph 6.4.2.5)	16	HV load simulator
4	Power supply (location optional)	17	HV AN
5	LV Artificial network (AN)	18	HV power supply
6	Ground plane (bonded to shielded enclosure)	19	HV feed-through
7	Low relative permittivity support ( $\epsilon_r \leq 1.4$ )	25	AC/DC charger harness
8	Biconical antenna	26	AC/DC load simulator (e.g. Programmable Logic Controller (PLC))
10	High-quality coaxial cable e.g. double-shielded (50 $\Omega$ )	27	50 $\mu$ H Line Impedance Stabilization Network (LISN) (AC) or HVAN (DC)
11	Bulkhead connector	28	AC/DC power supply
12	Measuring instrument	29	AC/DC feed-through
13	RF absorber material		



## ANNEX 7 - APPENDIX 4

## BCI TEST

Test configuration for ESAs involved in "REESS charging mode coupled to the power grid". The test shall be performed according to ISO 11452-4.



## Legend:

1	ESA (grounded locally if required in test plan)	11	HV DC harness
2	LV Test harness	12	HV AN
3	LV supply	13	HV DC load
4	LV LISN	14	HV DC feed-through
5	LV load simulator	15	HV DC load simulator
6	Stimulation and monitoring system	16	HV AC/DC charger harness
7	Low relative permittivity support	17	50 $\mu$ H LISN (AC) or HV AN (DC)
8	Ground plane	18	HV AC/DC power supply
9	Injection probe	19	HV AC/DC feed-through
10	10 RF signal amplifier and generator	20	2HV AC/DC load simulator (e.g. PLC)

**ANNEX 8**

**METHOD(S) OF TESTING FOR IMMUNITY TO AND EMISSION OF  
TRANSIENTS OF ELECTRICAL/ELECTRONIC SUB-ASSEMBLIES**

(See 5.8.1 and 6.19)

**1.0 GENERAL**

This test method shall ensure the immunity of ESAs to conducted transients on the vehicle power supply and limit conducted transients from ESAs to the vehicle power supply.

**2.0 IMMUNITY AGAINST DISTURBANCES CONDUCTED ALONG  
SUPPLY LINES**

Apply the test pulses 1, 2a, 2b, 3a 3b and 4 according to the International Standard ISO 7637-2: 2004 to the supply lines as well as to other connections of ESAs which may be operationally connected to supply lines.

**3.0 EMISSION OF CONDUCTED DISTURBANCES ALONG SUPPLY  
LINES**

Measurement according to the International Standard ISO 7637-2: 2004 on supply lines as well as to other connections of ESAs which may be operationally connected to supply lines.

**ANNEX 9****METHOD(S) OF TESTING FOR EMISSION OF HARMONICS GENERATED  
ON AC POWER LINES FROM VEHICLE**

(See 6.3)

**1.0 GENERAL**

1.1 The test method described in this annex shall be applied to vehicles in configuration "REESS charging mode coupled to the power grid"

1.2 Test method

This test is intended to measure the level of harmonics generated by vehicle in configuration "REESS charging mode coupled to the power grid" through its AC power lines in order to ensure it is compatible with residential, commercial and light industrial environments.

If not otherwise stated in this annex the test shall be performed according to:

- (a) IEC 61000-3-2 for input current in charging mode  $\leq 16$  A per phase for class A equipment;
- (b) IEC 61000-3-12 for input current in charging mode  $> 16$  A and  $\leq 75$  A per phase.

**2.0 VEHICLE STATE DURING TESTS**

2.1 The vehicle shall be in configuration "REESS charging mode coupled to the power grid".

The state of charge (SOC) of the traction battery shall be kept between 20 per cent and 80 per cent of the maximum SOC during the whole time duration of the measurement (this may lead to the measurement being split into different time slots with the need to discharge the vehicle's traction battery before starting the next time slot). If the current consumption can be adjusted, then the current shall be set to at least 80 per cent of its nominal value.

The vehicle shall be immobilized, engine OFF.

And all other equipment which can be switched on permanently by the driver or passenger should be OFF.

**3.0 TEST ARRANGEMENTS**

3.1 The observation time to be used for the measurements shall be as for quasi-stationary equipment as defined in IEC 61000-3-2, Table 4.

3.2 The test set-up for single phase vehicle in configuration "REESS charging mode coupled to the power grid" is shown in Figure 1 of Appendix 1 to this annex.

- 3.3 The test set-up for three-phase vehicle in configuration "REESS charging mode coupled to the power grid" is shown in Figure 2 of Appendix 1 to this annex.

#### **4.0 TEST REQUIREMENTS**

- 4.1 The measurements of even and odd current harmonics shall be performed up to the 40th harmonic.
- 4.2 The limits for single phase or three-phase "REESS charging mode coupled to the power grid" with input current  $\leq 16$  A per phase are given in Table 3 of paragraph 6.3.2.1. of this Standard.
- 4.3 The limits for single phase "REESS charging mode coupled to the power grid" with input current  $> 16$  A and  $\leq 75$  A per phase are given in Table 4 of paragraph 6.3.2.2. of this Standard.
- 4.4 The limits for three-phase "REESS charging mode coupled to the power grid" with input current  $> 16$  A and  $\leq 75$  A per phase are given in Table 5 of paragraph 6.3.2.2. of this Standard.
- 4.5 For three-phase "REESS charging mode coupled to the power grid" with input current  $> 16$  A and  $\leq 75$  A per phase, when at least one of the three conditions a), b) or c) described in paragraph 5.2. of IEC 61000-3-12 is fulfilled, then the limits given in Table 6 of paragraph 6.3.2.2. of this Standard can be applied.

# Annex 9 – Appendix 1

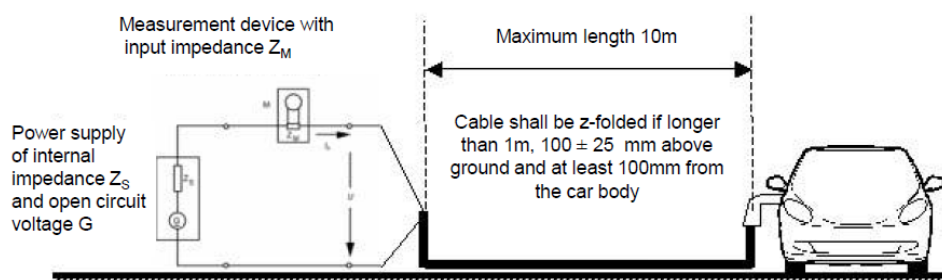


Figure 1

## Vehicle in configuration "REESS charging mode coupled to the power grid" – Single phase charger test set-up

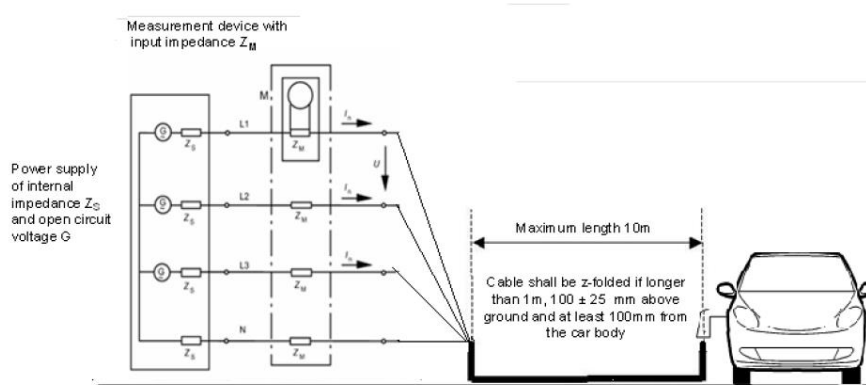


Figure 2

## Vehicle in configuration "REESS charging mode coupled to the power grid" – Three-phase charger test set-up

## ANNEX 10

**METHOD(S) OF TESTING FOR EMISSION OF VOLTAGE CHANGES,  
VOLTAGE FLUCTUATIONS AND FLICKER ON AC POWER LINES FROM  
VEHICLE**

(See 6.4)

**1.0 GENERAL**

1.1 The test method described in this annex shall be applied to vehicles in configuration "REESS charging mode coupled to the power grid"

**1.2 Test method**

This test is intended to measure the level of voltage changes, voltage fluctuations and flicker generated by vehicle in configuration "REESS charging mode coupled to the power grid" through its AC power lines in order to ensure it is compatible with residential, commercial and light industrial environments.

If not otherwise stated in this annex the test shall be performed according to:

(a) IEC 61000-3-3 for rated current in "REESS charging mode"  $\leq 16$  A per phase and not subjected to conditional connection;

(b) IEC 61000-3-11 for rated current in "REESS charging mode"  $> 16$  A and  $\leq 75$  A per phase and subjected to conditional connection.

**2.0 VEHICLE STATE DURING TESTS**

2.1 The vehicle shall be in configuration "REESS charging mode coupled to the power grid".

The state of charge (SOC) of the traction battery shall be kept between 20 per cent and 80 per cent of the maximum SOC during the whole time duration of the measurement (this may lead to the measurement being split into different time slots with the need to discharge the vehicle's traction battery before starting the next time slot). If the current consumption can be adjusted, then the current shall be set to at least 80 per cent of its nominal value.

The vehicle shall be immobilized, engine OFF.

And all other equipment which can be switched on permanently by the driver or passenger should be OFF.

**3.0 TEST ARRANGEMENTS**

3.1 The tests for vehicle in configuration "REESS charging mode coupled to the power grid" with rated current  $\leq 16$  A per phase and not subjected to conditional connection shall be performed according to paragraph 4. of IEC 61000-3-3.

- 3.2 The tests for vehicle in configuration "REESS charging mode coupled to the power grid" with rated current  $> 16$  A and  $\leq 75$  A per phase and subjected to conditional connection shall be performed according to paragraph 6. of IEC 61000-3-11.
- 3.3 The test set-up for vehicle in configuration "REESS charging mode coupled to the power grid" is shown in Figures 1a and 1b of Appendix 1 to this annex.

#### **4.0 TEST REQUIREMENTS**

- 4.1 The parameters to be determined in the time-domain are "short duration flicker value", "long duration flicker value" and "voltage relative variation".
- 4.2 The limits for vehicle in configuration "REESS charging mode coupled to the power grid" with input current  $\leq 16$  A per phase and not subjected to conditional connection are given in paragraph 6.4.2.1. of this Standard.
- 4.3 The limits for vehicle in configuration "REESS charging mode coupled to the power grid" with input current  $> 16$  A and  $\leq 75$  A per phase and subjected to conditional connection are given in paragraph 6.4.2.2. of this Standard.

ANNEX 10 - APPENDIX 1

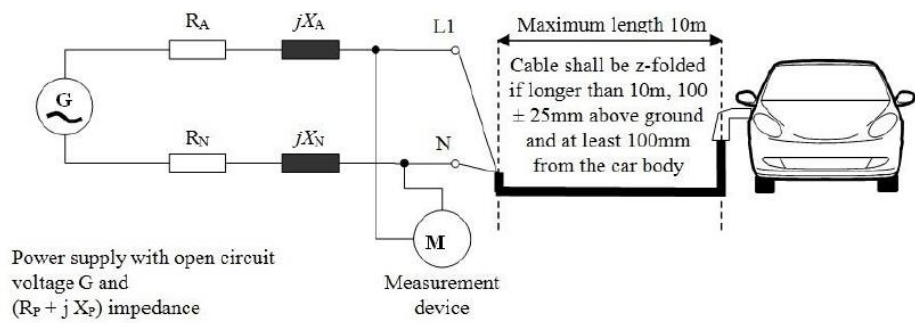


Figure 1a

Vehicle in configuration "REESS charging mode coupled to the power grid" – Single phase test set-up

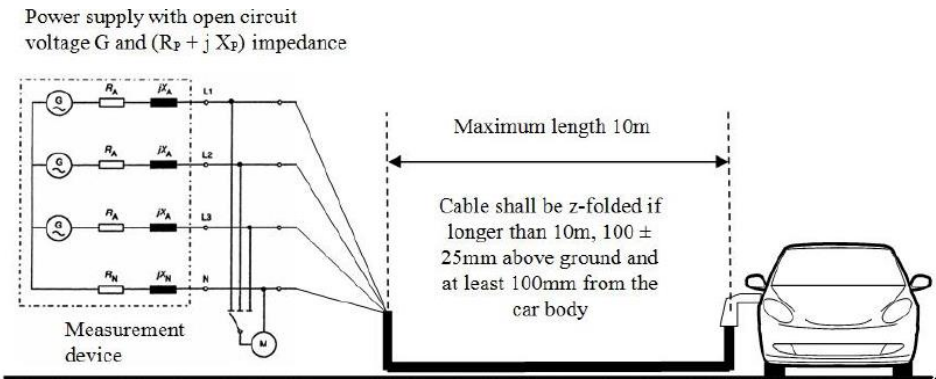


Figure 1b

Vehicle in configuration "REESS charging mode coupled to the power grid" – Three phase test set-up



## ANNEX 11

### **METHOD(S) OF TESTING FOR EMISSION OF RADIO FREQUENCY CONDUCTED DISTURBANCES ON AC OR DC POWER LINES FROM VEHICLES**

(See 6.5)

#### **1.0 GENERAL**

1.1 The test method described in this annex shall be applied to vehicles in configuration "REESS charging mode coupled to the power grid".

1.2 Test method

This test is intended to measure the level of radio frequency conducted disturbances generated by vehicle in configuration "REESS charging mode coupled to the power grid" through its AC or DC power lines in order to ensure it is compatible with residential, commercial and light industrial environments.

If not otherwise stated in this annex the test shall be performed according to CISPR 16-2-1.

#### **2.0 VEHICLE STATE DURING TESTS**

2.1 The vehicle shall be in configuration "REESS charging mode coupled to the power grid".

The state of charge (SOC) of the traction battery shall be kept between 20 per cent and 80 per cent of the maximum SOC during the whole frequency range measurement (this may lead to split the measurement in different sub-bands with the need to discharge the vehicle's traction battery before starting the next sub-bands). If the current consumption can be adjusted, then the current shall be set to at least 80 per cent of its nominal value.

The vehicle shall be immobilized, engine OFF.

And all other equipment which can be switched on permanently by the driver or passenger should be OFF.

#### **3.0 Test arrangements**

3.1 The test shall be performed according to paragraph 6.4.1. of CISPR 16-2-1 as floor-standing equipment.

3.2 The artificial mains network to be used for the measurement on vehicle is defined in paragraph 4.3. of CISPR 16-1-2.

## Artificial networks

The AN(s) shall be mounted directly on the ground plane. The cases of the AN(s) shall be bonded to the ground plane.

The measuring port of each AN shall be terminated with a 50ohm load.

The AN shall be placed as defined in Figures 1a to 1d. of Appendix 1 to this annex.

- 3.3 The test set-up for the connection of the vehicle in configuration "REESS charging mode coupled to the power grid" is shown in Figure 1a to 1d of Appendix 1 to this annex.
- 3.4 The measurements shall be performed with a spectrum analyser or a scanning receiver. The parameters to be used are defined in Table 1 and 2.

**Table 1**

### Spectrum analyzer parameters

Frequency Range, MHz	Peak Detector		Quasi-peak detector		Average Detector	
	RBW at -3dB	Scan Time	RBW at -6dB	Scan Time	RBW at -3dB	Scan Time
0.15 to 30	9/10 kHz	10 s/MHz	9 kHz	200 s/MHz	9/10 kHz	10 s/MHz

Note: If a spectrum analyzer is used for peak measurements, the video bandwidth shall be at least three times the resolution bandwidth (RBW)

**Table 2**

### Scanning receiver parameters

Frequency range, MHz	Peak Detector			Quasi-peak detector			Average Detector		
	BW at -6 dB	Step size <sup>(a)</sup>	Dwell time	BW at -6 dB	Step size <sup>(a)</sup>	Dwell time	BW at -6 dB	Step size <sup>(a)</sup>	Dwell time
0.15 to 30	9 kHz	5 kHz	50 ms	9 kHz	5 kHz	1 s	9 kHz	5 kHz	50 ms

<sup>(a)</sup> For purely broadband disturbances, the maximum frequency step size may be increased up to a value not greater than the bandwidth value.

**4.0 TEST REQUIREMENTS**

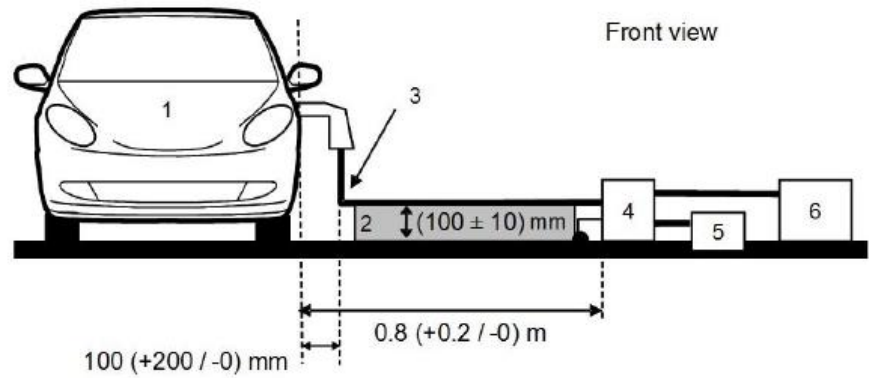
- 4.1 The limits apply throughout the frequency range 0.15 to 30 MHz for measurements performed in a semi anechoic chamber or an outdoor test site.
- 4.2 Measurements shall be performed with average and either quasi-peak or peak detectors. The limits are given in paragraph 6.5. of this Standard.

Table 7 for AC lines and Table 8 for DC lines. If peak detectors are used a correction factor of 20 dB as defined in CISPR 12 shall be applied.

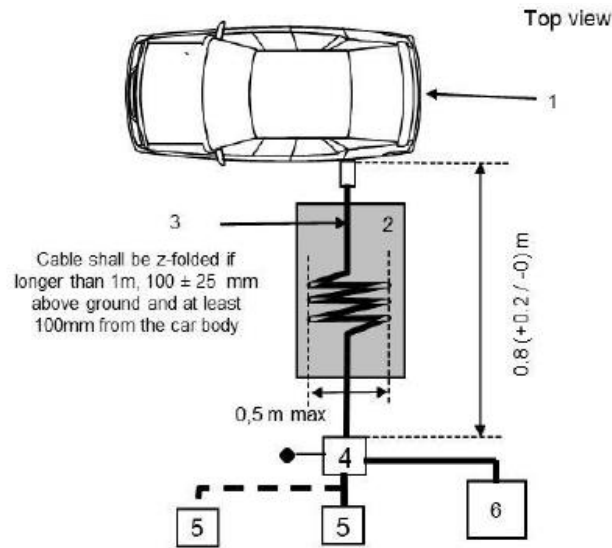
ANNEX 11 - APPENDIX 1

**Figure 1 Vehicle in configuration "REESS charging mode coupled to the power grid"**

Example of test setup for vehicle with plug located on vehicle side (AC powered without communication)



**Figure 1a - Front View**



**Figure1b – Top View**

Legend:

- |   |                    |   |   |
|---|--------------------|---|---|
| 1 | Vehicle under test | 4 | Artificial network(s) grounded (for AC or DC power lines) |
| 2 | Insulating support | 5 | Power mains socket  |
| 3 | Charging cable     | 6 | Measuring receiver  |

Vehicle in configuration "REESS charging mode coupled to the power grid"

Example of test setup for vehicle with plug located front / rear of vehicle (AC powered without communication)

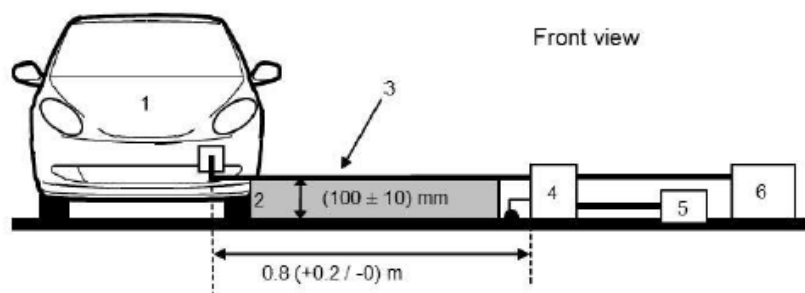


Figure 1c – Front View

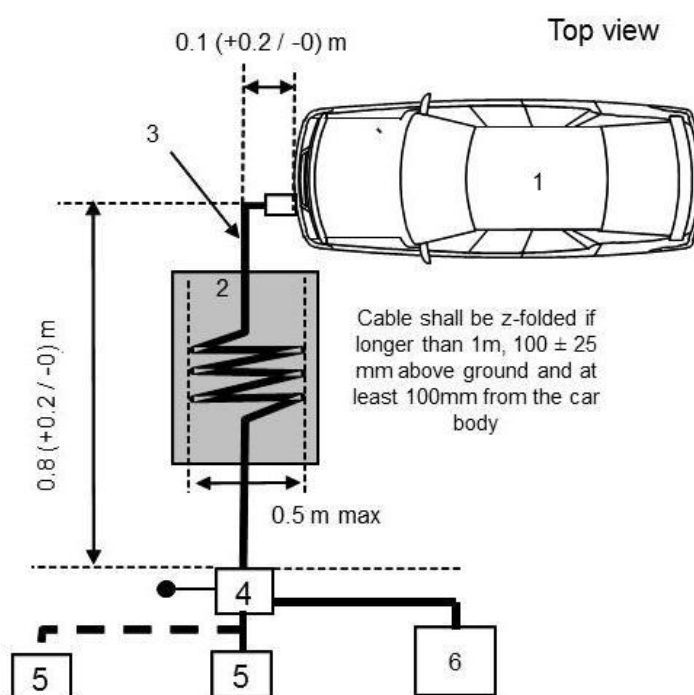


Figure 1d – Top View

Legend:

- |                      |   |
|----------------------|---|
| 1 Vehicle under test | 4 Artificial network(s) grounded (for AC or DC power lines) |
| 2 Insulating support | 5 Power mains socket  |
| 3 Charging cable     | 6 Measuring receiver  |

## ANNEX 12

### METHOD(S) OF TESTING FOR EMISSION OF RADIO FREQUENCY CONDUCTED DISTURBANCES ON NETWORK AND TELECOMMUNICATION ACCESS FROM VEHICLES

(See 6.6)

#### 1.0 GENERAL

1.1 The Test method described in this annex shall be applied to vehicles in configuration "REESS charging mode coupled to the power

1.2 Test method

This test is intended to measure the level of radio frequency conducted disturbances generated by vehicle in configuration "REESS charging mode coupled to the power grid" through its network and telecommunication access in order to ensure it is compatible with residential, commercial and light industrial environments.

If not otherwise stated in this annex the test shall be performed according to CISPR 32.

#### 2.0 VEHICLE/ STATE DURING TESTS

2.1 The vehicle shall be in configuration "REESS charging mode coupled to the power grid". The state of charge (SOC) of the traction battery shall be kept between 20 per cent and 80 per cent of the maximum SOC during the whole frequency range measurement (this may lead to split the measurement in different sub-bands with the need to discharge the vehicle's traction battery before starting the next sub-bands). If the current consumption can be adjusted, then the current shall be set to at least 80 per cent of its nominal value.

The vehicle shall be immobilized, engine OFF.

And all other equipment which can be switched on permanently by the driver or passenger should be OFF.

#### 3.0 TEST ARRANGEMENTS

3.1 The test set-up shall be performed according to paragraph 5. of CISPR 32 for conducted emissions.

3.2 The impedance stabilization to be used for the measurement on vehicle is defined in paragraph C.4.1.2 of CISPR 32.

Impedance Stabilization

Communication lines shall be applied to the vehicle through IS(s).

The IS(s) shall be mounted directly on the ground plane. The case of the IS(s) shall be bonded to the ground plane.

The measuring port of each IS shall be terminated with a 50  $\Omega$  load. The IS shall be placed as defined in Figures 1a to 1d of Appendix 1 to this annex.

3.3 The test set-up for the connection of the vehicle in configuration "REESS charging mode coupled to the power grid" is shown in Figures 1a to 1d of Appendix 1 to this annex.

If it is impossible to guarantee the functionality of vehicle, due to introduction of IS, an alternate method described in CISPR 32 (according to Figures 2a to 2d of Appendix 1 to this annex) shall be applied.

3.4 The measurements shall be performed with a spectrum analyser or a scanning receiver. The parameters to be used are defined in Table 1 and Table 2.

**Table 1**  
**Spectrum analyser parameters**

Frequency range MHz	Peak detector		Quasi-peak detector		Average detector	
	RBW at -3 dB	Scan time	RBW at -6 dB	Scan time	RBW at -3 dB	Scan time
0.15 to 30	9/10 kHz	10 s/MHz	9 kHz	200 s/MHz	9/10 kHz	10 s/MHz

Note: If a spectrum analyser is used for peak measurements, the video bandwidth shall be at least three times the resolution bandwidth (RBW).

**Table 2**  
**Scanning receiver parameters**

Frequency range, MHz	Peak detector			Quasi-peak detector			Average detector		
	BW at -6 dB	Step Size <sup>(a)</sup>	Dwell Time	BW at -6 dB	Step Size <sup>(a)</sup>	Dwell Time	BW at -6 dB	Step Size <sup>(a)</sup>	Dwell Time
0.15 to 30	9 kHz	5 kHz	50 ms	9 kHz	5 kHz	1 s	9 kHz	5 kHz	50 ms

<sup>(a)</sup> For purely broadband disturbances, the maximum frequency step size may be increased up to a value not greater than the bandwidth value.

**4.0 TEST REQUIREMENTS**

- 4.1 The limits apply throughout the frequency range 0.15 to 30 MHz for measurements performed in a semi anechoic chamber or an outdoor test site.
- 4.2 Measurements shall be performed with average and either quasi-peak or peak detectors. The limits are given in Table 9 of paragraph 7.6. If peak detectors are used a correction factor of 20 dB as defined in CISPR 12 shall be applied.



# ANNEX 12 – APPENDIX 1

Figure 1

## Vehicle in configuration "REESS charging mode coupled to the power grid"

Example of test setup for vehicle with plug located on vehicle side (AC or DC powered with communication)

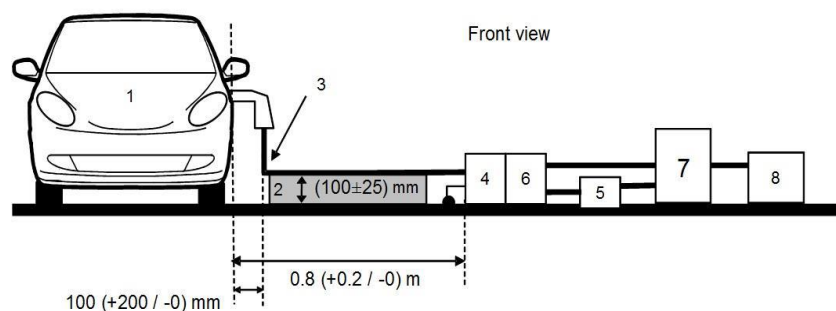


Figure 1a – Front View

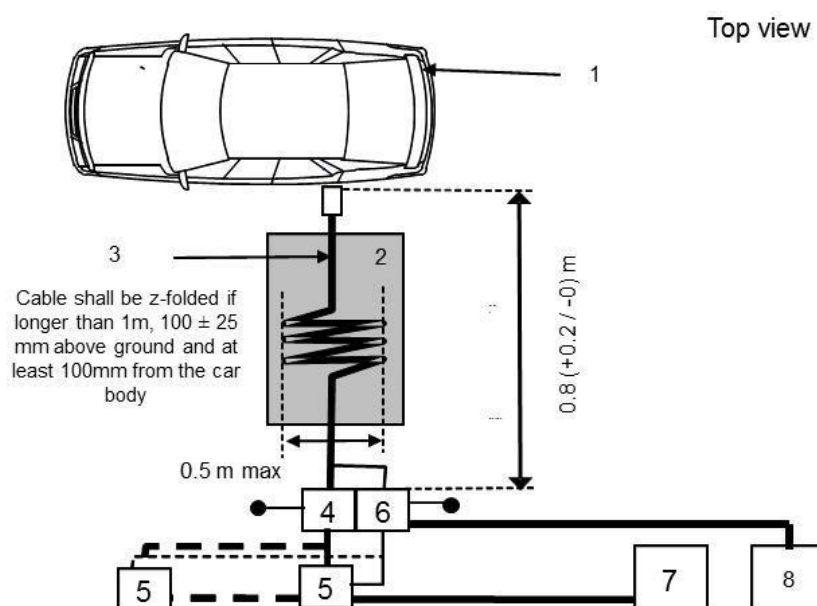


Figure 1b – Top View

Legend:

1	Vehicle under test	5	Power mains socket
2	Insulating support	6	Impedance stabilization(s) grounded (for communication lines)
3	Charging / communication cable	7	Charging station
4	AC or DC artificial network(s) grounded (for AC or DC power lines)	8	Measuring receiver

# Vehicle in configuration "REESS charging mode coupled to the power grid"

Example of test set-up for vehicle with plug located front/rear of vehicle  
(AC or DC powered with communication)

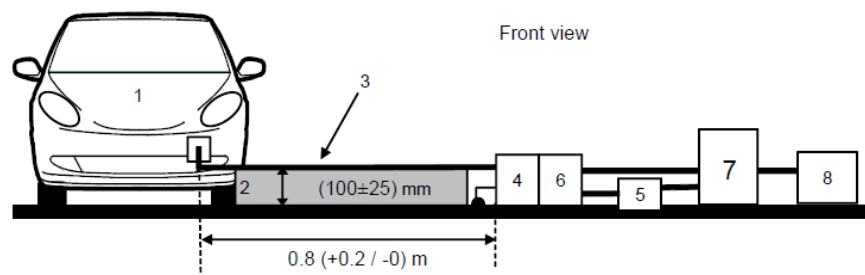


Figure 1c – Front View

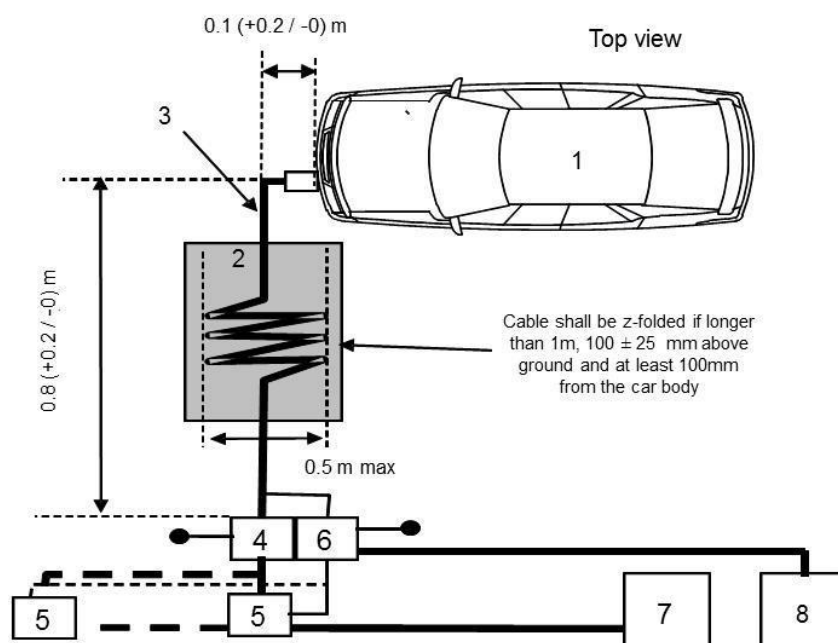


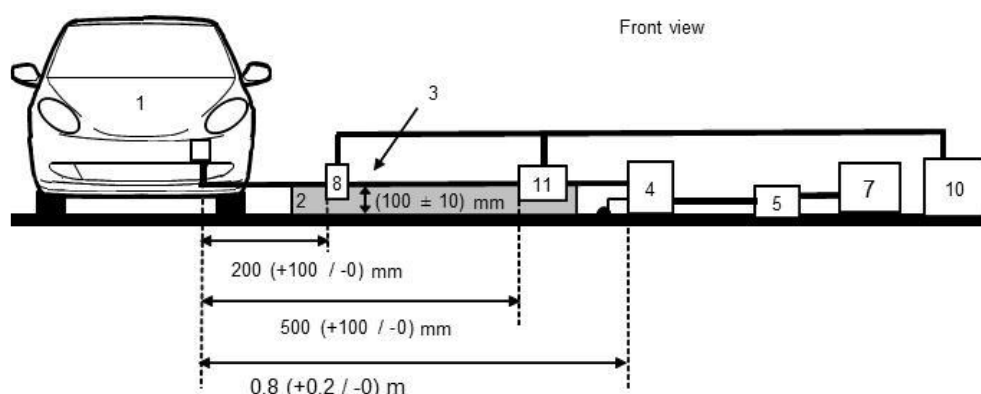
Figure 1d – Top View

Legend:

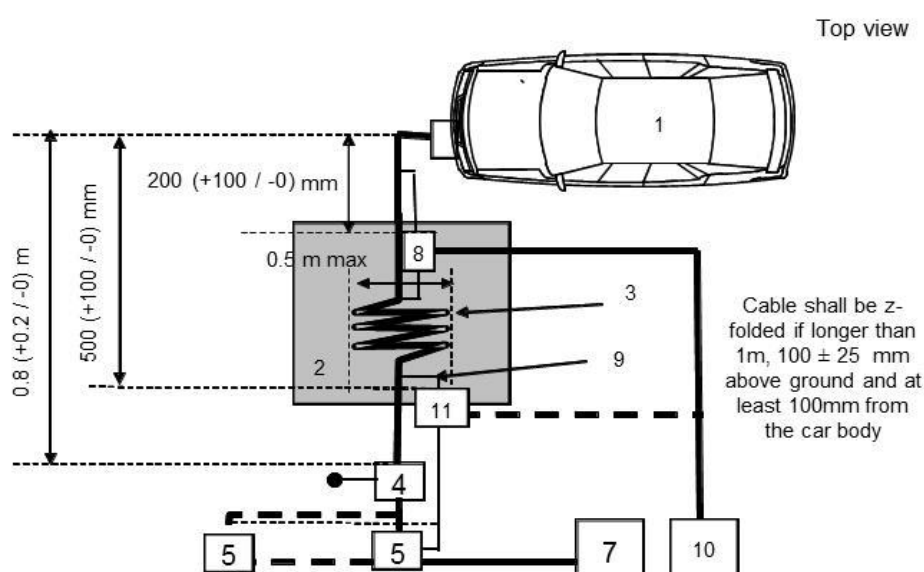
1	Vehicle under test	5	Power mains socket
2	Insulating support	6	Impedance stabilization(s) grounded (for communication lines)
3	Charging / communication cable	7	Charging station
4	AC or DC artificial network(s) grounded (for AC or DC power lines)	8	Measuring receiver

# **Alternative measurement for vehicle in configuration "REESS charging mode coupled in the power grid"**

Example of test setup for vehicle with plug located front / rear of vehicle  
(AC or DC powered with communication)



**Figure 2c – Front View**



**Figure 2d – Top View**

Legend:

- |  |   |
|--|---|
| 1 Vehicle under test   | 7 Charging station                            |
| 2 Insulating support   | 8 Current probe (or capacitive voltage probe) |
| 3 Charging / communication cable                                     | 9 Communication lines                         |
| 4 AC or DC artificial network(s) grounded (for AC or DC power lines) | 10 Measuring receiver                         |
| 5 Power mains socket   | 11 Capacitive voltage probe                   |

## ANNEX 13

**METHOD OF TESTING FOR IMMUNITY OF VEHICLES TO ELECTRICAL  
FAST TRANSIENT/BURST DISTURBANCES CONDUCTED ALONG AC AND  
DC POWER LINES**

(See 6.8)

**1.0 GENERAL**

1.1 The test method described in this annex shall only be applied to vehicles. This method concerns only the configuration of the vehicle with "REESS charging mode coupled to the power grid".

## 1.2 Test method

This test is intended to demonstrate the immunity of the vehicle electronic systems. The vehicle shall be subject to electrical fast transient / burst disturbances conducted along AC and DC power lines of the vehicle as described in this annex. The vehicle shall be monitored during the tests.

If not otherwise stated in this annex the test shall be performed according to IEC 61000-4-4.

**2.0 VEHICLE STATE DURING TESTS IN CONFIGURATION "REESS IN  
CHARGING MODE COUPLED TO THE POWER GRID"**

2.1 The vehicle shall be in an unladen condition except for necessary test equipment.

2.1.1 The vehicle shall be immobilized, engine OFF and in charging mode.

## 2.1.2 Basic vehicle conditions

The paragraph defines minimum test conditions (as far as applicable) and failures criteria for vehicle immunity tests. Other vehicle systems, which can affect immunity related functions, shall be tested in a way to be agreed between manufacturer and Test Agency.

<b>"REESS charging mode" vehicle test conditions</b>	<b>Failure criteria</b>
<p>The REESS shall be in charging mode. The state of charge (SOC) of the traction battery shall be kept between 20 per cent and 80 per cent of the maximum SOC during the whole time duration of the measurement (this may lead to the measurement being split into different time slots with the need to discharge the vehicle's traction battery before starting the next time slot).</p> <p>If the current consumption can be adjusted, then the current shall be set to at least 20 per cent of its nominal value.</p>	<p>Vehicle sets in motion</p>

2.1.3 All other equipment which can be switched on permanently by the driver or passenger should be OFF.

2.2 Only non-perturbing equipment shall be used while monitoring the vehicle.

The vehicle exterior and the passenger compartment shall be monitored to determine whether the requirements of this annex are met (e.g. by using (a) video camera(s), a microphone, etc.).

### **3.0 TEST EQUIPMENT**

3.1 The test equipment is composed of a reference ground plane (a shielded room is not required), a transient/burst generator, Coupling/Decoupling Network (CDN) and capacitive coupling clamp

3.2 The transient/burst generator shall meet the condition defined in paragraph 6.1. of IEC 61000-4-4.

3.3 The Coupling/Decoupling Network shall meet the condition defined in paragraph 6.2. of IEC 61000-4-4. When the Coupling/Decoupling Network cannot be used on AC or DC power lines, the capacitive coupling clamp defined in paragraph 6.3. of IEC 61000-4-4 can be used.

### **4.0 TEST SETUP**

4.1 The vehicle test setup is based on the laboratory type setup as described in paragraph 7.2. of IEC 61000-4-4.

4.2 The vehicle shall be placed directly on the ground plane.

4.3 The Test Agency shall perform the test as specified in paragraph 6.8.2.1. of this Standard.

Alternatively, if the manufacturer provides measurement from a test laboratory accredited to the applicable parts of ISO 17025 and recognized by the Type Approval Authority, the Test Agency may choose not to perform the test to confirm that the vehicle meets the requirements of this annex.

### **5.0 GENERATION OF REQUIRED TEST LEVEL**

5.1 Test methodology

5.1.1 The test method according to IEC 61000-4-4 shall be used to establish the test level requirements.

5.1.2 Test phase

The vehicle shall be positioned on the ground plane. The electrical fast transient/burst (EFT/B) shall be applied on the vehicle on the AC/DC power lines in common modes by using CDN as described in Figure 1 of Appendix 1 to this annex.

The test set-up shall be noted in the test report.

ANNEX 13 - APPENDIX 1

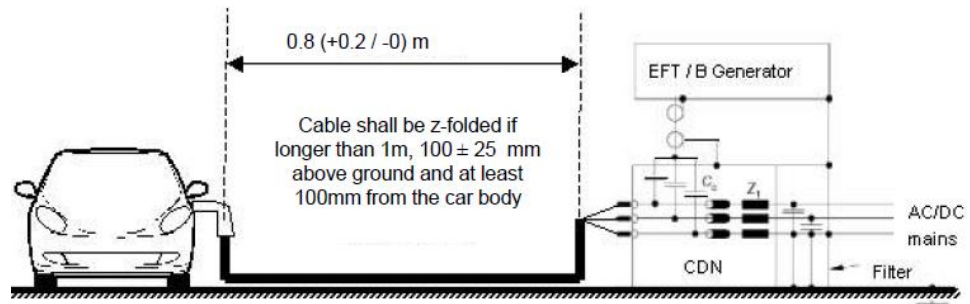


Figure 1

Vehicle in configuration "REESS charging mode" coupled to the power grid coupling

## ANNEX 14

### METHOD OF TESTING FOR IMMUNITY OF VEHICLES TO SURGES CONDUCTED ALONG AC AND DC POWER LINES

(See 6.9)

#### 1.0 GENERAL

1.1 The test method described in this annex shall only be applied to vehicles. This method concerns only the configuration of the vehicle with "REESS charging mode coupled to the power grid".

#### 1.2 Test method

This test is intended to demonstrate the immunity of the vehicle electronic systems. The vehicle shall be subject to surges conducted along AC and DC power lines of the vehicle as described in this annex. The vehicle shall be monitored during the tests.

If not otherwise stated in this annex the test shall be performed according to IEC 61000-4-5.

#### 2.0 VEHICLE STATE DURING TESTS IN CONFIGURATION "REESS IN CHARGING MODE COUPLED TO THE POWER GRID"

2.1 The vehicle shall be in an unladen condition except for necessary test equipment.

2.1.1 The vehicle shall be immobilized, engine OFF and in charging mode.

#### 2.1.2 Basic vehicle conditions

The paragraph defines minimum test conditions (as far as applicable) and failures criteria for vehicle immunity tests. Other vehicle systems, which can affect immunity related functions, shall be tested in a way to be agreed between manufacturer and Test Agency.

"REESS charging mode" vehicle test conditions	Failure criteria
<p>The REESS shall be in charging mode. The state of charge (SOC) of the traction battery shall be kept between 20 per cent and 80 per cent of the maximum SOC during the whole time duration of the measurement (this may lead to the measurement being split into different time slots with the need to discharge the vehicle's traction battery before starting the next time slot).</p> <p>If the current consumption can be adjusted, then the current shall be set to at least 20 per cent of its nominal value.</p>	Vehicle sets in motion

- 2.1.3 All other equipment which can be switched on permanently by the driver or passenger should be OFF.
- 2.2 Only non-perturbing equipment shall be used while monitoring the vehicle. The vehicle exterior and the passenger compartment shall be monitored to determine whether the requirements of this annex are met (e.g. by using (a) video camera(s), a microphone, etc.).

### **3.0 TEST EQUIPMENT**

- 3.1 The test equipment is composed of a reference ground plane (a shielded room is not required), a surge generator and a Coupling/Decoupling Network (CDN).
- 3.2 The surge generator shall meet the condition defined in paragraph 6.1. of IEC 61000-4-5.
- 3.3 The Coupling/Decoupling Network shall meet the condition defined in paragraph 6.3. of IEC 61000-4-5.

### **4.0 TEST SETUP**

- 4.1 The vehicle test setup is based on the setup described in paragraph 7.2. of IEC 61000-4-5.
- 4.2 The vehicle shall be placed directly on the ground plane.
- 4.3 The Test Agency shall perform the test as specified in paragraph 6.9.2.1. of this Standard.

Alternatively, if the manufacturer provides measurement from a test laboratory accredited to the applicable parts of ISO 17025 and recognized by the Type Approval Authority, the Test Agency may choose not to perform the test to confirm that the vehicle meets the requirements of this annex.

### **5.0 GENERATION OF REQUIRED TEST LEVEL**

- 5.1 Test methodology
  - 5.1.1 The test method according to IEC 61000-4-5 shall be used to establish the test level requirements.
  - 5.1.2 Test phase

The vehicle shall be positioned on the ground plane. The electrical surge shall be applied on the vehicle on the AC/DC power lines between each line and earth and between lines by using CDN as described in Figures 1 to 4 of Appendix 1 to this annex.

The test setup shall be noted in the test report.



# ANNEX 14 - APPENDIX 1

## Vehicle in configuration "REESS charging mode coupled to the power grid"

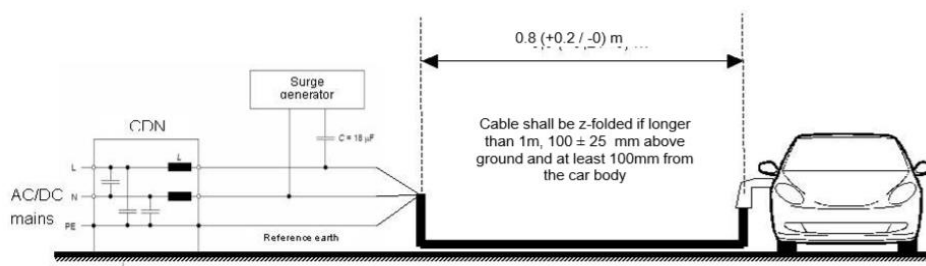


Figure 1

## Vehicle in configuration "REESS charging mode coupled to the power grid" – Coupling between lines for DC or AC (single phase) power lines

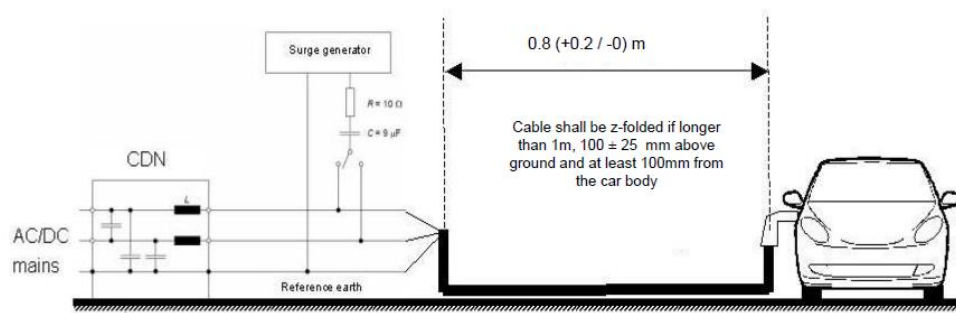


Figure 2

## Vehicle in configuration "REESS charging mode coupled to the power grid" – Coupling between each line and earth for DC or AC (single phase) power lines

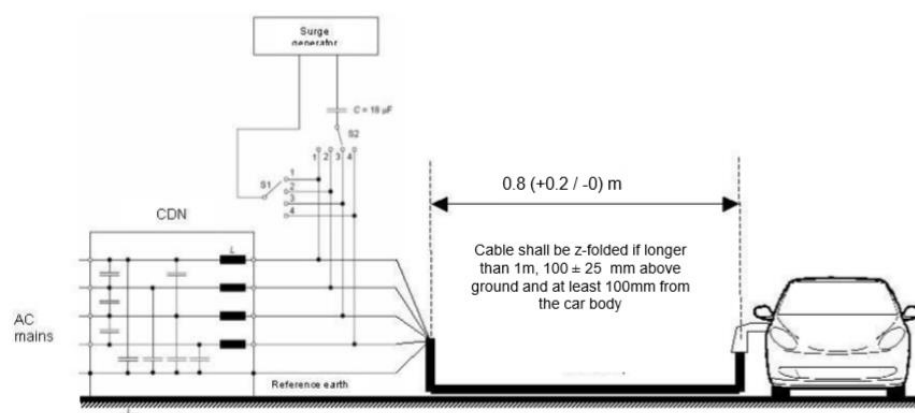
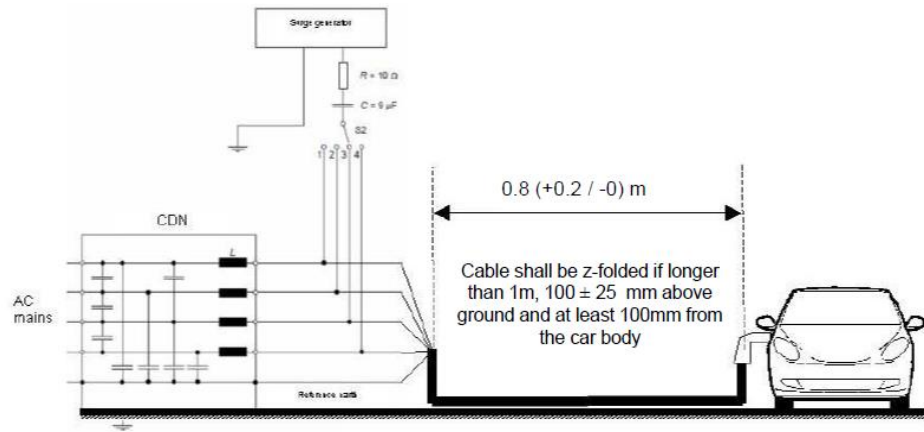


Figure 3

## Vehicle in configuration "REESS charging mode coupled to the power grid" –Coupling between lines for AC (Three Phase) power lines.



**Figure 4**  
**Vehicle in configuration "REESS charging mode coupled to the power grid" – Coupling between each line and earth for AC (three phases) power lines**

## ANNEX 15

**METHOD(S) OF TESTING FOR EMISSION OF HARMONICS GENERATED ON AC POWER LINES FROM AN ESA**

(See 6.11)

**1.0 GENERAL**

1.1 The test method described in this annex shall be applied to ESAs in configuration "REESS charging mode coupled to the power grid"

1.2 Test method

This test is intended to measure the level of harmonics generated by an ESA in configuration "REESS charging mode coupled to the power grid" through its AC power lines in order to ensure it is compatible with residential, commercial and light industrial environments.

If not otherwise stated in this annex the test shall be performed according to:

- (a) IEC 61000-3-2 for input current in charging mode  $\leq 16$  A per phase for class A equipment;
- (b) IEC 61000-3-12 for input current in charging mode  $> 16$  A and  $\leq 75$  A per phase.

**2.0 ESA STATE DURING TESTS**

2.1 The ESA shall be in configuration "REESS charging mode coupled to the power grid".

The state of charge (SOC) of the traction battery shall be kept between 20 per cent and 80 per cent of the maximum SOC during the whole time duration of the measurement (this may lead to the measurement being split into different time slots with the need to discharge the vehicle's traction battery before starting the next time slot).

If the current consumption can be adjusted, then the current shall be set to at least 80 per cent of its nominal value.

**3.0 TEST ARRANGEMENTS**

3.1 The observation time to be used for the measurements shall be as for quasi-stationary equipment as defined in Table 4 of IEC 61000-3-2.

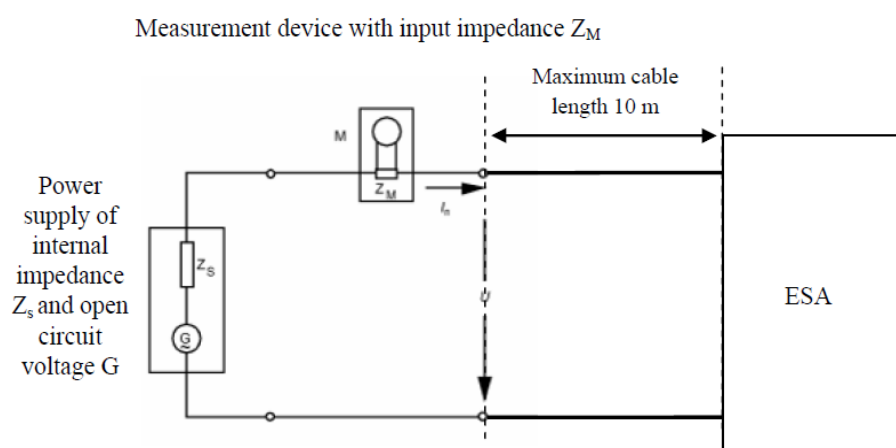
3.2 The test set-up for single phase ESA in configuration "REESS charging mode coupled to the power grid" is shown in Figure 1 of Appendix 1 to this annex.

3.3 The test set-up for three-phase ESA in configuration "REESS charging mode coupled to the power grid" is shown in Figure 2 of Appendix 1 to this annex.

#### **4.0 TEST REQUIREMENTS**

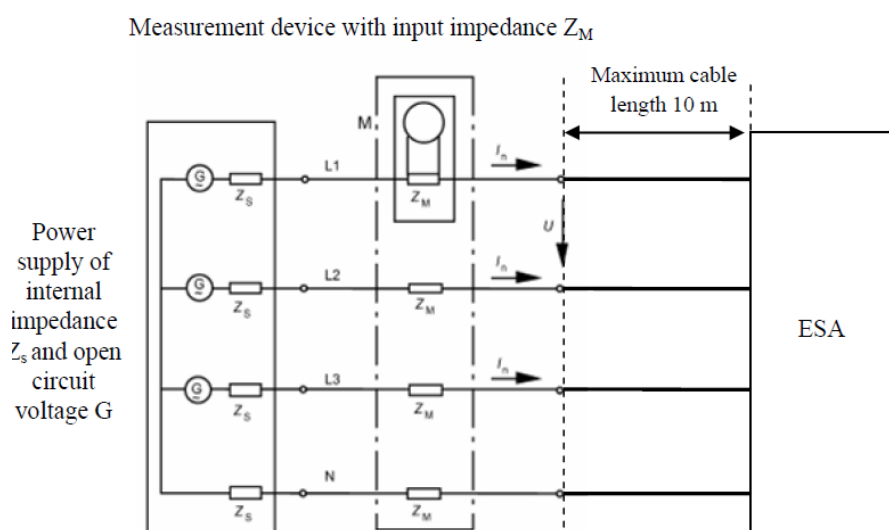
- 4.1 The measurements of even and odd current harmonics shall be performed up to the 40th harmonic.
- 4.2 The limits for single phase or three-phase ESAs in configuration "REESS charging mode coupled to the power grid" with input current  $\leq 16$  A per phase are given in Table 10 of paragraph 6.11.2.1. of this Standard.
- 4.3 The limits for single phase ESAs in configuration "REESS charging mode coupled to the power grid" with input current  $> 16$  A and  $\leq 75$  A per phase are given in Table 11 of paragraph 6.11.2.2. of this Standard.
- 4.4 The limits for three-phase ESAs in configuration "REESS charging mode coupled to the power grid" with input current  $> 16$  A and  $\leq 75$  A per phase are given in paragraph Table 12 of 6.11.2.2. of this Standard.
- 4.5 For three-phase ESAs in configuration "REESS charging mode coupled to the power grid" with input current  $> 16$  A and  $\leq 75$  A per phase, when at least one of the three conditions a), b) or c) described in paragraph 5.2. of IEC 61000-3-12 is fulfilled, then the limits given in Table 13 of paragraph 6.11.2.2. of this Standard can be applied.

# ANNEX 15 – APPENDIX 1



**Figure 1**

**ESA in configuration "REESS charging mode coupled to the power grid" –  
Single phase test set-up**



**Figure 2**

**ESA in configuration "REESS charging mode coupled to the power grid" –  
Three-phase test set-up**

**ANNEX 16**

(See 6.12)

**METHOD(S) OF TESTING FOR EMISSION OF VOLTAGE CHANGES,  
VOLTAGE FLUCTUATIONS AND FLICKER ON AC POWER LINES FROM  
AN ESA****1.0 GENERAL**

1.1 The test method described in this annex shall be applied to ESAs in configuration "REESS charging mode coupled to the power grid"

1.2 Test method

This test is intended to measure the level of voltage changes, voltage fluctuations and flicker generated by ESA in configuration "REESS charging mode coupled to the power grid" through its AC power lines in order to ensure it is compatible with residential, commercial and light industrial environments.

If not otherwise stated in this annex the test shall be performed according to:

- (a) IEC 61000-3-3 for rated current in "REESS charging mode"  $\leq 16$  A per phase and not subjected to conditional connection;
- (b) IEC 61000-3-11 for rated current in "REESS charging mode"  $> 16$  A and  $\leq 75$  A per phase and subjected to conditional connection

**2.0 ESA STATE DURING TESTS**

2.1 The ESA shall be in configuration "REESS charging mode coupled to the power grid"

The state of charge (SOC) of the traction battery shall be kept between 20 per cent and 80 per cent of the maximum SOC during the whole time duration of the measurement (this may lead to the measurement being split into different time slots with the need to discharge the vehicle's traction battery before starting the next time slot).

If the current consumption can be adjusted, then the current shall be set to at least 80 per cent of its nominal value.

**3.0 TEST ARRANGEMENTS**

3.1 The tests for ESA in configuration "REESS charging mode coupled to the power grid" with rated current  $\leq 16$  A per phase and not subjected to conditional connection shall be performed according to paragraph 4. of IEC 61000-3-3.

3.2 The tests for ESA in configuration "REESS charging mode coupled to the power grid" with rated current  $> 16$  A and  $\leq 75$  A per phase and subjected to conditional connection shall be performed according to paragraph 6. of IEC 61000-3-11.

- 3.3 The test set-up for ESA in configuration "REESS charging mode coupled to the power grid" is shown in Figures 1a and 1b of Appendix 1 to this annex.

#### **4.0 Test requirements**

- 4.1 The parameters to be determined in the time-domain are "short duration flicker value", "long duration flicker value" and "voltage relative variation".
- 4.2 The limits for ESA in configuration "REESS charging mode coupled to the power grid" with input current  $\leq 16$  A per phase and not subjected to conditional connection are given in paragraph 6.12.2.1. of this Standard.
- 4.3 The limits for ESA in configuration "REESS charging mode coupled to the power grid" with input current  $> 16$  A and  $\leq 75$  A per phase and subjected to conditional connection are given in paragraph 6.12.2.2. of this Standard.

ANNEX 16 – APPENDIX 1

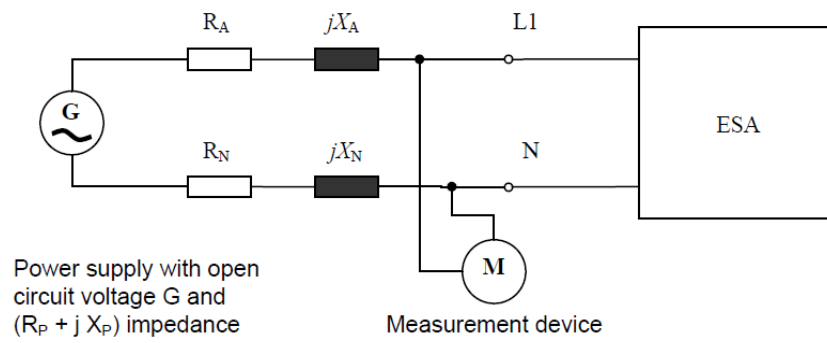


Figure 1a

**ESA in configuration "REESS charging mode coupled to the power grid" - Single phase test set-up**

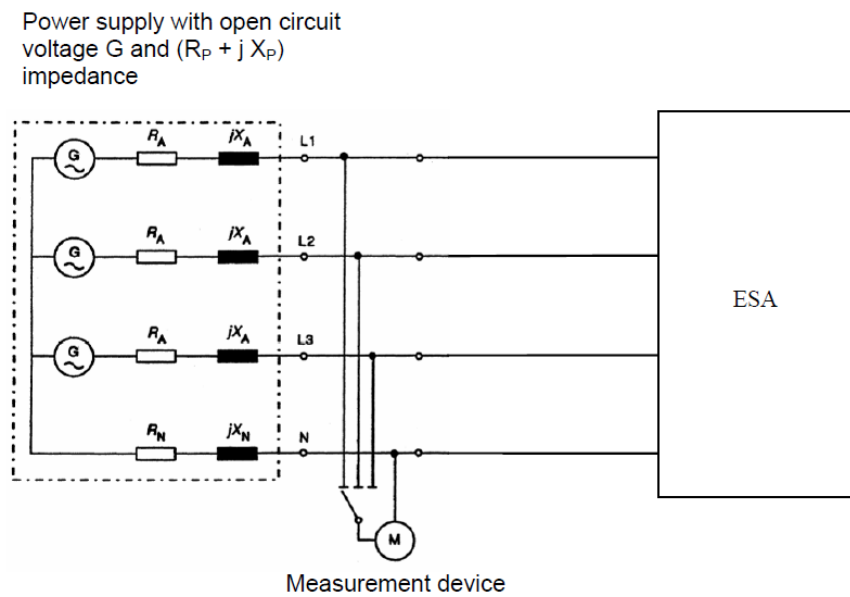


Figure 1b

**ESA in configuration "REESS charging mode coupled to the power grid" - Three-phase test set-up**



## ANNEX 17

**METHOD(S) OF TESTING FOR EMISSION OF RADIOFREQUENCY  
CONDUCTED DISTURBANCES ON AC OR DC POWER LINES FROM AN ESA**

(See 6.13)

**1.0 GENERAL**

The test method described in this annex shall be applied to ESAs in configuration "REESS charging mode coupled to the power grid".

1.1 The test method described in this annex shall be applied to ESAs in configuration "REESS charging mode coupled to the power grid".

**1.2 Test method**

This test is intended to measure the level of radio frequency conducted disturbances generated by ESA in configuration "REESS charging mode coupled to the power grid" through its AC or DC power lines in order to ensure it is compatible with residential, commercial and light industrial environments.

If not otherwise stated in this annex the test shall be performed according to CISPR 16-2-1.

**2.0 ESA STATE DURING TESTS**

2.1 The ESA shall be in configuration "REESS charging mode coupled to the power grid".

The state of charge (SOC) of the traction battery shall be kept between 20 per cent and 80 per cent of the maximum SOC during the whole frequency range measurement (this may lead to split the measurement in different sub-bands with the need to discharge the vehicle's traction battery before starting the next sub-bands).

If the test is not performed with a REESS the ESA should be tested at rated current. If the current consumption can be adjusted, then the current shall be set to at least 80 per cent of its nominal value.

**3.0 TEST ARRANGEMENTS**

3.1 The test shall be performed according to paragraph 7.4.1. of CISPR 16-2-1 as table-standing equipment.

3.2 The artificial mains network to be used for the measurement on vehicle components is defined in paragraph 4.3. of CISPR 16-1-2.

**Artificial networks**

The AN(s) shall be mounted directly on the ground plane. The cases of the AN(s) shall be bonded to the ground plane.

The conducted emissions on AC and DC power lines are measured successively on each power line by connecting the measuring receiver on the measuring port of the related AN, the measuring port of the AN inserted in the other power lines being terminated with a 50  $\Omega$  load.

The AN shall be placed in front, aligned and on the same side of the vehicle power charging plug.

- 3.3 The test set-up for the connection of the ESAs in configuration "REESS charging mode coupled to the power grid" is shown in Figure 1 of Appendix 1 to this annex.
- 3.4 The measurements shall be performed with a spectrum analyser or a scanning receiver. The parameters to be used are defined in Table 1 and Table 2.

**Table 1**  
**Spectrum analyser parameters**

Frequency range MHz	Peak detector		Quasi-peak detector		Average detector	
	RBW at -3 dB	Scan time	RBW at -6 dB	Scan time	RBW at -3 dB	Scan time
0.15 to 30	9/10 kHz	10 s/MHz	9 kHz	200 s/MHz	9/10 kHz	10 s/MHz
Note: If a spectrum analyser is used for peak measurements, the video bandwidth shall be at least three times the resolution bandwidth (RBW).						

**Table 2**  
**Scanning receiver parameters**

Frequency range MHz	Peak detector			Quasi-peak detector			Average detector		
	BW at -6 dB	Step size <sup>(a)</sup>	Dwell time	BW at -6 dB	Step size <sup>(a)</sup>	Dwell time	BW at -6 dB	Step size <sup>(a)</sup>	Dwell time
0.15 to 30	9 kHz	5 kHz	50 ms	9 kHz	5 kHz	1 s	9 kHz	5 kHz	50 ms

<sup>(a)</sup> For purely broadband disturbances, the maximum frequency step size may be increased up to a value not greater than the bandwidth value.

Note: For emissions generated by brush commutator motors without an electronic control unit, the maximum step size may be increased up to five times the bandwidth.

**4.0 Test Requirements**

- 4.1 The limits apply throughout the frequency range 0.15 to 30 MHz for measurements performed in a semi anechoic chamber or an outdoor test site.
- 4.2 Measurements shall be performed with average and either quasi-peak or peak detectors. The limits are given in Table 14 of paragraph 6.13.2.1. of this Standard for AC lines and in Table 15 of paragraph 6.13.2.2. of this Standard for DC lines. If peak detectors are used a correction factor of 20 dB as defined in CISPR 12 shall be applied

## ANNEX 17 – APPENDIX 1

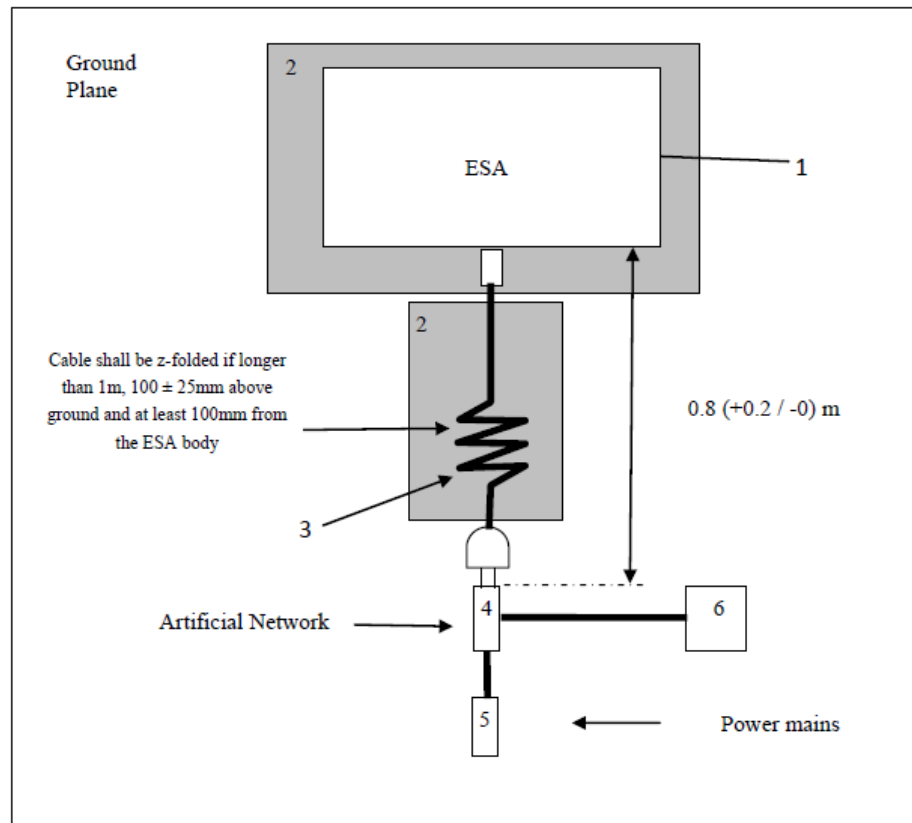


Figure 1

**ESA in configuration "REESS charging mode coupled to the power grid"**

Legend:

- |   |                    |   |   |
|---|--------------------|---|---|
| 1 | ESA under test     | 4 | AC or DC Artificial network(s) grounded |
| 2 | Insulating support | 5 | Power mains socket                      |
| 3 | Charging cable     | 6 | Measuring receiver                      |

**ANNEX 18**

(See 6.14)

**METHOD(S) OF TESTING FOR EMISSION OF RADIOFREQUENCY  
CONDUCTED DISTURBANCES ON NETWORK AND  
TELECOMMUNICATION ACCESS FROM AN ESA****1.0 GENERAL**

- 1.1 The test method described in this annex shall be applied to ESAs in configuration "REESS charging mode coupled to the power grid".

1.2 Test method

This test is intended to measure the level of radio frequency conducted disturbances generated by ESA in configuration "REESS charging mode coupled to the power grid" through its network and telecommunication access in order to ensure it is compatible with residential, commercial and light industrial environments.

If not otherwise stated in this annex the test shall be performed according to CISPR 32.

**2.0 ESA STATE DURING TESTS**

- 2.1 The ESA shall be in configuration "REESS charging mode coupled to the power grid".

The state of charge (SOC) of the traction battery shall be kept between 20 per cent and 80 per cent of the maximum SOC during the whole frequency range measurement (this may lead to split the measurement in different sub-bands with the need to discharge the vehicle's traction battery before starting the next sub-bands).

If the test is not performed with a REESS the ESA should be tested at rated current. If the current consumption can be adjusted, then the current shall be set to at least 80 per cent of its nominal value.

**3.0 TEST ARRANGEMENTS**

- 3.1 The test set-up shall be performed according to paragraphs 8 and 9 of CISPR 32 for conducted emissions.

3.2 Impedance stabilization

Communication lines shall be applied to the ESA through the Impedance Stabilization(s) (IS)(s).

IS to be connected in the network and communication cables is defined in paragraph C.4.1.2. of CISPR 32

The IS(s) shall be mounted directly on the ground plane. The case of the IS(s) shall be bonded to the ground plane.

The conducted emissions on network and telecommunication lines are measured successively on each line by connecting the measuring receiver on the measuring port of the related IS, the measuring port of the IS inserted in the other lines being terminated with a 50  $\Omega$  load.

The IS shall be placed in front, aligned and on the same side of the vehicle power charging plug.

- 3.3 The test set-up for the connection of the ESA in configuration "REESS charging mode coupled to the power grid" is shown in Figure 1 of Appendix 1 to this annex.
- 3.4 The measurements shall be performed with a spectrum analyser or a scanning receiver. The parameters to be used are defined in Table 1 and Table 2.

**Table 1**

**Spectrum analyser parameters**

Frequency range MHz	Peak detector		Quasi-peak detector		Average detector	
	RBW at -3 dB	Scan time	RBW at -6 dB	Scan time	RBW at -3 dB	Scan time
0.15 to 30	9/10 kHz	10 s/MHz	9 kHz	200 s/MHz	9/10 kHz	10 s/MHz
Note: If a spectrum analyser is used for peak measurements, the video bandwidth shall be at least three times the resolution bandwidth (RBW).						

**Table 2**

**Scanning receiver parameters**

Frequency range MHz	Peak detector			Quasi-peak detector			Average detector		
	BW at -6 dB	Step size <sup>(a)</sup>	Dwell time	BW at -6 dB	Step size <sup>(a)</sup>	Dwell time	BW at -6 dB	Step size <sup>(a)</sup>	Dwell time
0.15 to 30	9 kHz	5 kHz	50 ms	9 kHz	5 kHz	1 s	9 kHz	5 kHz	50 ms
<sup>(a)</sup> For purely broadband disturbances, the maximum frequency step size may be increased up to a value not greater than the bandwidth value.									

#### **4.0 TEST REQUIREMENTS**

- 4.1 The limits apply throughout the frequency range 0.15 to 30 MHz for measurements performed in a semi anechoic chamber or an outdoor test site.
- 4.2 Measurements shall be performed with average and either quasi-peak or peak detectors. The limits are given in Table 16 of paragraph 6.14.2.1. of this Standard. If peak detectors are used a correction factor of 20 dB as defined in CISPR 12 shall be applied.

## ANNEX 18 – APPENDIX 1

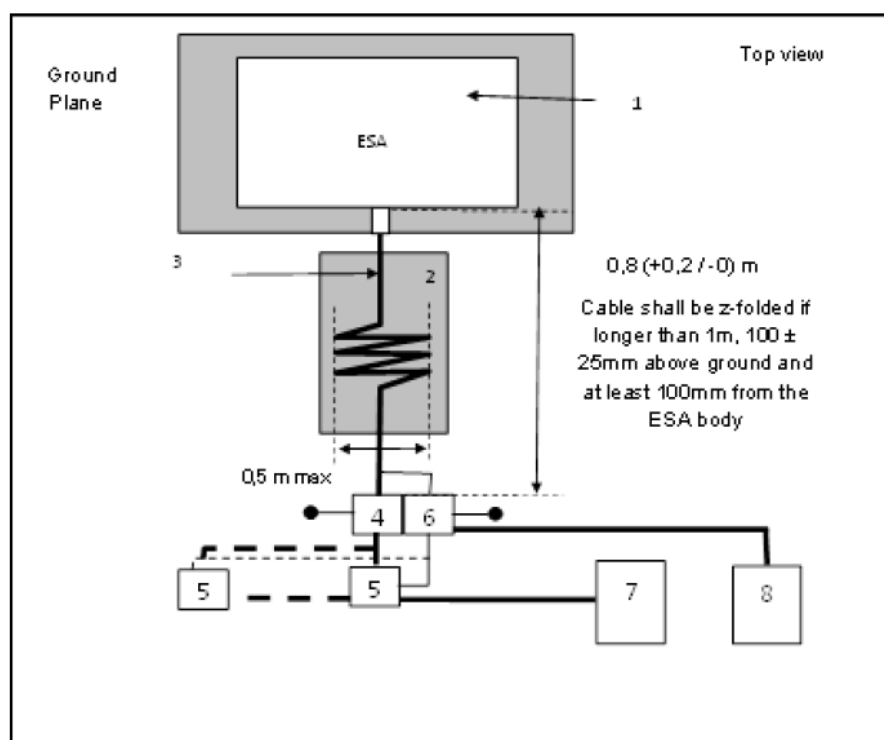


Figure 1

**ESA in configuration "REESS charging mode coupled to the power grid"**

Legend:

- |   |   |   |                                     |
|---|---|---|-------------------------------------|
| 1 | ESA under test                          | 5 | Power mains socket                  |
| 2 | Insulating support                      | 6 | Impedance stabilization(s) grounded |
| 3 | Charging / communication cable          | 7 | Charging station                    |
| 4 | AC or DC Artificial network(s) grounded | 8 | Measuring receiver                  |

## ANNEX 19

(SEE 6.15)

### METHOD OF TESTING FOR IMMUNITY OF AN ESA TO ELECTRICAL FAST TRANSIENT/BURST DISTURBANCES CONDUCTED ALONG AC AND DC POWER LINES

#### 1.0 GENERAL

1.1 The test method described in this annex shall only be applied to ESAs. This method applies only to ESA in configuration "REESS charging mode coupled to the power grid".

#### 1.2 Test method

This test is intended to demonstrate the immunity of the ESA. The ESA shall be subject to Electrical Fast Transient/Burst disturbances conducted along AC and DC power lines of the ESA as described in this annex. The ESA shall be monitored during the tests.

If not otherwise stated in this annex the test shall be performed according to IEC 61000-4-4.

#### 2.0 ESA state during tests in configuration "REESS in charging mode coupled to the power grid"

##### 2.1 Basic ESA conditions

The paragraph defines minimum test conditions (as far as applicable) and failures criteria for ESA immunity tests.

REESS charging mode" ESA test conditions	Failure criteria
<p>ESA shall be in configuration "REESS charging mode coupled to the power grid".</p> <p>The state of charge (SOC) of the traction battery shall be kept between 20 per cent and 80 per cent of the maximum SOC during the whole time duration of the measurement (this may lead to the measurement being split into different time slots with the need to discharge the vehicle's traction battery before starting the next time slot).</p> <p>If the current consumption can be adjusted, then the current shall be set to at least 20 per cent of its nominal value.</p>	<p>Incorrect charging condition (e.g. over-current, overvoltage)</p>



- 2.2 Only non-perturbing equipment shall be used while monitoring the ESA. The ESA shall be monitored to determine whether the requirements of this annex are met (e.g. by using (a) video camera(s), a microphone, etc.).

### **3.0 TEST EQUIPMENT**

- 3.1 The test equipment is composed of a reference ground plane (a shielded room is not required), a transient / burst generator, Coupling Decoupling Network (CDN) and capacitive coupling clamp.
- 3.2 The transient/burst generator shall meet the condition defined in paragraph 6.1. of IEC 61000-4-4.
- 3.3 The Coupling/Decoupling Network shall meet the condition defined in paragraph 6.2. of IEC 61000-4-4. When the Coupling/Decoupling Network cannot be used on AC or DC power lines, the capacitive coupling clamp defined in paragraph 6.3. of IEC 61000-4-4 can be used.

### **4.0 TEST SET-UP**

- 4.1 The ESA test setup is based on the laboratory type set-up as described in paragraph 7.2. of IEC 61000-4-4.
- 4.2 The ESA shall be placed directly on the ground plane.
- 4.3 The Test Agency shall perform the test as specified in paragraph 6.15.2.1. of this Standard.

Alternatively, if the manufacturer provides measurement from a test laboratory accredited to the applicable parts of ISO 17025 and recognized by the Type Approval Authority, the Test Agency may choose not to perform the test to confirm that the ESA meets the requirements of this annex.

### **5.0 GENERATION OF REQUIRED TEST LEVEL**

- 5.1 Test methodology
- 5.1.1 The test method according to IEC 61000-4-4 shall be used to establish the test level requirements.
- 5.1.2 Test phase

The ESA shall be positioned on the ground plane. The Electrical Fast Transient/Burst (EFT/B) shall be applied on the ESA on the AC/DC power lines in common modes by using CDN as described in Figure 1 of Appendix 1 to this annex.

The test setup shall be noted in the test report.

ANNEX 19 – APPENDIX 1

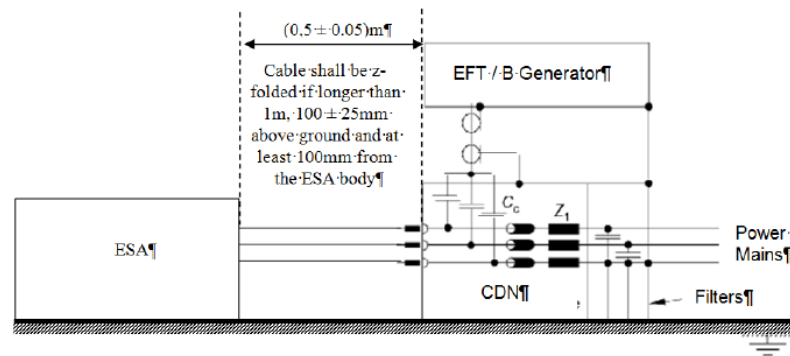


Figure 1

ESA in configuration "REESS charging mode coupled to the power grid"

## ANNEX 20

**METHOD OF TESTING FOR IMMUNITY OF ESAs TO SURGES  
CONDUCTED ALONG AC AND DC POWER LINES**

(See 6.16)

**1.0 GENERAL**

1.1 The test method described in this annex shall only be applied to ESAs. This method applies only to ESAs in configuration "REESS charging mode coupled to the power grid".

**1.2 Test method**

This test is intended to demonstrate the immunity of the ESA. The ESA shall be subject to surges conducted along AC and DC power lines of the ESA as described in this annex. The ESA shall be monitored during the tests.

If not otherwise stated in this annex the test shall be performed according to IEC 61000-4-5.

**2.0 ESA state during tests in configuration "REESS in charging mode coupled to the power grid"**

2.1 The ESA shall be in charging mode

**2.1.2 Basic ESA conditions**

The paragraph defines minimum test conditions (as far as applicable) and failures criteria for ESA immunity tests.

<b>REESS charging mode" ESA test conditions</b>	<b>Failure criteria</b>
ESA shall be in configuration "REESS charging mode coupled to the Power grid". The state of charge (SOC) of the traction battery shall be kept between 20 per cent and 80 per cent of the maximum SOC during the whole time duration of the measurement (this may lead to the measurement being split into different sub-bands with the need to discharge the vehicle's traction battery before starting the next sub-bands). If the current consumption can be adjusted, then the current shall be set to at least 20 per cent of its nominal value.	Incorrect charging condition (e.g. over-current, overvoltage)

- 2.2 Only non-perturbing equipment shall be used while monitoring the ESA. The ESA shall be monitored to determine whether the requirements of this annex are met (e.g. by using (a) video camera(s), a microphone, etc.).

### **3.0 TEST EQUIPMENT**

- 3.1 The test equipment is composed of a reference ground plane (a shielded room is not required), a surge generator and a Coupling/Decoupling Network (CDN).
- 3.2 The surge generator shall meet the condition defined in paragraph 6.1. of IEC 61000-4-5.
- 3.3 The Coupling/Decoupling Network shall meet the condition defined in paragraph 6.3. of IEC 61000-4-5.

### **4.0 TEST SET-UP**

- 4.1 The ESA test set-up is based on the set-up described in paragraph 7.2. of IEC 61000-4-5.
- 4.2 The ESA shall be placed directly on the ground plane.
- 4.3 The Test Agency shall perform the test as specified in paragraph 6.16.2.1. of this Standard.

Alternatively, if the manufacturer provides measurement from a test laboratory accredited to the applicable parts of ISO 17025 and recognized by the Type Approval Authority, the Test Agency may choose not to perform the test to confirm that the ESA meets the requirements of this annex.

### **5.0 GENERATION OF REQUIRED TEST LEVEL**

- 5.1 Test methodology
- 5.1.1 The test method according to IEC 61000-4-5 shall be used to establish the test level requirements.
- 5.1.2 Test phase

The ESA shall be positioned on the ground plane. The electrical surge shall be applied on the ESA on the AC/DC power lines between each line and earth and between lines by using CDN as described in Figures 1 to 4 of Appendix 1 to this annex.

The test set-up shall be noted in the test report

## ANNEX 20 – APPENDIX 1

## ESA in configuration "REESS charging mode coupled to the power grid"

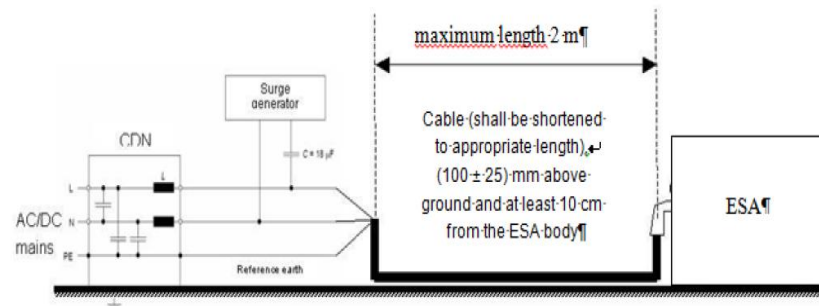


Figure 1

## ESA in configuration "REESS charging mode coupled to the power grid" - Coupling between lines for DC or AC (single phase) power lines

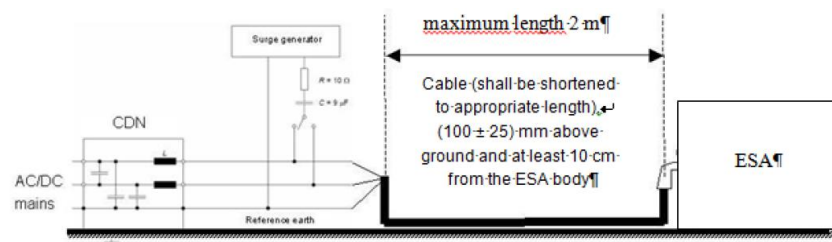


Figure 2

## ESA in configuration "REESS charging mode coupled to the power grid" - Coupling between each line and earth for DC or AC (single phase) power lines

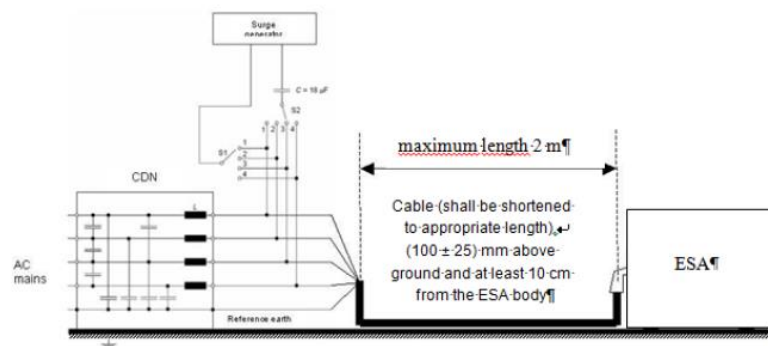


Figure 3

## ESA in configuration "REESS charging mode coupled to the power grid" - Coupling between lines for AC (three phases) power lines

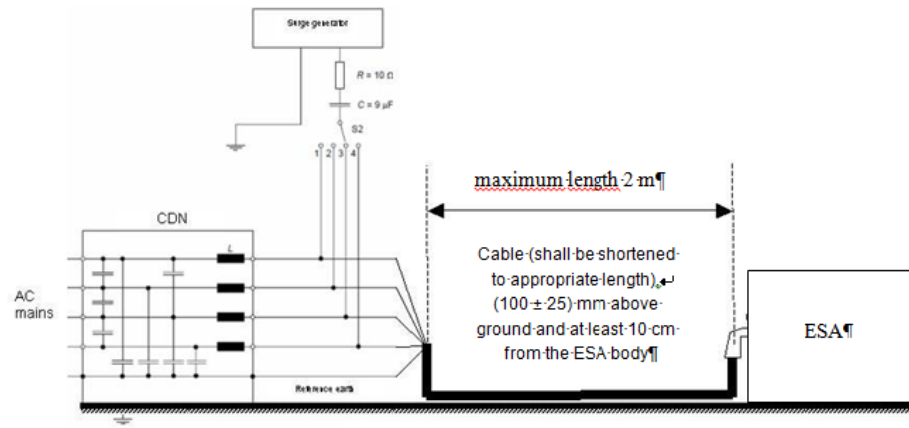


Figure 4

**ESA in configuration "REESS charging mode coupled to the power grid" -  
Coupling between each line and earth for AC (three phases) power lines**

## ANNEX 21A

**GUIDELINES FOR DECIDING APPLICABILITY,  
WORST CASE CRITERIA (WCC) AND CRITERIA FOR  
EXTENSION OF APPROVAL (CEA) FOR RADIATED IMMUNITY TEST**

(See 8.2)

**Applicability:**

- 1. Vehicle fitted with any of the Electronic Sub-Assembly (ESA) as per list given below shall be subjected to immunity test:**

<b>Sr. No.</b>	<b>ESA</b>
1.	Electronic Engine Control Unit (ECU) for
	<ul style="list-style-type: none"> <li>• Fuel injection</li> <li>• Ignition timing control</li> <li>• Combined fuel injection and ignition timing control</li> <li>• Engine valve control</li> <li>• EGR</li> <li>• Idle speed control</li> <li>• Exhaust emission / after-treatment control</li> <li>• Air-fuel ratio control</li> <li>• Electronic carburetor</li> </ul>
2.	Drive by Wire System (Electronic Accelerator Pedal and/or Electronic Brake)
3.	Cruise Control System
4.	Anti-skid Braking System (ABS)
5.	Electronic 4-wheel Drive
6.	Electronic Gear Shift Control System (Automatic Transmission or CVT)
7.	Electronic Steering Control (Electronic Power Steering)
8.	Motor Control Unit in case of BOVs
9.	Electronic Speed Limiter
10.	Air Bag and Safety Restraint System
11.	Electronic Seat Adjustment Control System

12. Electronic Rear View, Side View Mirror Adjustment Control System
13. Electronic Lamp Control Device
14. Electronic Headlamp Leveling / Adjustment System
15. Gas-discharge Headlamp with Electronic Ballast
16. Electronic Rotating Identification Lamp and/or Siren Combination
17. Stop Lamp, Rear Position Lamp, End Outline Marker Lamp using Electronic Components such as LED etc.
18. Electronic Flasher with Direction Indicators
19. Electronic Horn
20. Electronic Anti-Theft Device for Unauthorized Use including RF Immobiliser and Vehicle Alarm System
21. Automatic Door Lock System including Infrared Door Lock System
22. Electronic Suspension Control
23. Electronic Instrument Cluster including on-board indicators related to functions as specified in Cl. 2.12
24. Navigation System
25. Wiper Control System
26. Tire Pressure Monitoring System
27. Digital Tachograph
28. Telematic System

The above list is not exhaustive and it is for guidance only. Due to continuous technological advancements, it is not practicable to list all the ESAs that will require immunity test. In such case, guidelines for immunity related vehicle functions as per Cl. 2.12 shall be considered.

**2. Any change in parameters mentioned below will require separate immunity test as per below table:**

Sr. No.	Parameter	Immunity Test Needed	Remarks
1.	Change in engine location	Yes	Change in position and general mounting arrangement of engine consequent to situations like front engine to rear engine etc.
2.	Change in body style and or material affecting overall shielding of vehicle electronics	Yes	e.g. roof top body, drive away chassis, passenger vehicle to goods vehicle, metallic body to non-metallic body and vice versa etc.



3.	Change in make, identification mark/part number of ESA as a result of change in design of hardware or vendor of ESA or addition of new ESA altogether.	Yes	These changes affect immunity performance of ESA and hence that of the vehicle.
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Changes other than those listed above are considered to be having no adverse effect on Immunity requirements of vehicle.

#### **Worst Case Criteria (WCC):**

Normally base vehicle model shall be subjected to immunity test. Where vehicle model is with one or more variants then the variant with fully loaded version (variant fitted with maximum electronic systems including optional ones) and one with fully open body (e.g. drive away chassis as the case may be) shall be subjected to the immunity test. Bi-fuel vehicle model (e.g. petrol/CNG, petrol/LPG) with petrol mode as limp-home mode shall be tested only in gaseous mode for immunity if it involves ESAs as above. Bi-fuel vehicle model with no limp-home mode shall be tested separately in each fuel mode for immunity if it involves ESAs as above. However, if petrol mode of such vehicle model is tested and type approved for immunity requirements as per this standard earlier, then it shall not be retested in petrol mode again.

#### **Criteria for Extension of Approval (CEA):**

In the whole vehicle testing, ESAs that are fitted to the vehicle gain approval as a separate technical unit specific to that vehicle type. For any change in ESA or addition of new ESA in the vehicle, immunity test can be performed either on ESA as a component or as fitted to the vehicle. ESAs can be tested and approved for immunity requirements as a component and extension of type approval can be granted to vehicle based on component approval when such ESAs are incorporated in the vehicle. ESAs approved as component can be fitted in any vehicle type.

**ANNEX 21B****GUIDELINES FOR DECIDING APPLICABILITY, WORST CASE CRITERIA (WCC) AND CRITERIA FOR EXTENSION OF APPROVAL (CEA) FOR RADIATED EMISSION TEST.**

(See 8.2)

- 1.0 This annex gives factors to be considered for the extension of type approval certificate of one model to changes in technical specifications or its variant (s).
- 2.0 In general, when changes in technical specifications of vehicle do not affect the performance adversely, and is still within the stipulated limits, the type approval certificates can be extended. The changes in parameters that affect the performance are listed in the table below as a guideline.
- 3.0 In the case of following changes, with respect to the vehicle tested, in the details submitted as per Annex 1A, tests are necessary for establishing compliance as follows: -

<b>Sr. No.</b>	<b>Parameter</b>	<b>To be Tested / Not Tested</b>
1	Change in Engine Power	No test, required, if change in power is within 10 % consequent to changes in the design of engine
2	Compression ratio (SI engines)	No test required, if change in compression ratio is within 10 %.
3	Changes in body and cowling	For changes in overall external body shape like closed body to open body (e.g. drive away chassis as the case may be) test needed
4	Changes in size and shape of engine compartment.	Test needed.
5	Location of HT Coil and consequent change in location of HT cable & high tension harness.	Test needed.
6	Change in body material such as metal to non - metal & vice - versa.	Test needed.

7	Change in the position and general mounting arrangement of engine consequent to situations like front engine to rear engine vice - versa etc.	Test needed.
8	Change in radio interference control equipment such as resistive spark plug, resistive suppressor cap, resistive HT cable and shielded cap as declared in sr. no. 56 of Annex 1A and/or their makes	Test needed.
9	Addition of any electronic control unit as defined in Cl. 3.1.3	Test needed.
10	Changes in electronic oscillator frequency of electronic control unit(s) as defined in 5.10.1	Test needed.
11	Addition of AC (air conditioning) variant	Test needed.
12	Significant difference in the clear opening to engine compartment	Test needed.
	- Around wheel or	
	- Due to metal radiator construction change.	
13	Changes in body material affecting RF shielding	Test needed
14	Bi-fuel vehicle model (e.g. petrol/CNG, petrol/LPG) with / without petrol mode as limp-home mode	Test needed in gaseous mode only

4. Above changes are listed for guidance only. It is not practicable to list all the changes those affect EMI.

## ANNEX 22

(See Introduction)

**COMPOSITION OF AISC PANEL ON  
AUTOMOTIVE VEHICLES –REQUIREMENTS FOR  
ELECTROMAGNETIC COMPATIBILITY**

<b>Convener</b>	<b>Organization</b>
Shri A. D. Deshpande	Automotive Research Association of India (ARAI)
<b>Members</b>	<b>Representing</b>
Shri Abhijit Mulay	Automotive Research Association of India (ARAI)
Shri Manoj Desai	Automotive Research Association of India (ARAI)
Shri Kamallesh Patil	Automotive Research Association of India (ARAI)
Shri Nilesh Tagad	Central Institute of Road Transport (CIRT)
Shri S. Ravishankar	Ashok Leyland (SIAM)
Shri Adish Agarwal	Bajaj Auto (SIAM)
Shri Feroz Ali Khan	Hero Motocorp (SIAM)
Shri Vipin Sharma	Honda Motorcycles and Scooters (SIAM)
Shri Gururaj Ravi	Maruti Suzuki (SIAM)
Shri S. J. Dhinagar	Maruti Suzuki (SIAM)
Shri K Kiran Kumar	Mahindra Electric (SIAM)
Shri Nikhil Desai	Mercedes Benz (SIAM)
Shri Rajendra Khile	Renault Nissan (SIAM)
Shri Vijay Dinakaran	Renault Nissan (SIAM)
Shri P S Gowrishankar	TATA Motors Limited (SIAM)
Shri Raju M	Toyota Kirloskar Motors Limited(SIAM)
Shri Venusuresh	Yamaha Motors (SIAM)
Shri Sivakumar Balakrishnan	Ather energy Pvt. Ltd.
Shri Uday Harite	Automotive Component Manufacturing Association (ACMA)

\* At the time of approval of this Automotive Industry Standard

## ANNEX 23

(See Introduction)

## COMMITTEE COMPOSITION\*

## Automotive Industry Standards Committee

<b>Chairperson</b>	
Shri Neelkanth V. Marathe	Officiating Director The Automotive Research Association of India, Pune
<b>Members</b>	<b>Representing</b>
Representative from	Ministry of Road Transport and Highways (Dept. of Road Transport and Highways), New Delhi
Representative from	Ministry of Heavy Industries and Public Enterprises (Department of Heavy Industry), New Delhi
Shri S. M. Ahuja	Office of the Development Commissioner, MSME, Ministry of Micro, Small and Medium Enterprises, New Delhi
Shri Shrikant R. Marathe	Former Chairman, AISC
Shri R.R. Singh	Bureau of Indian Standards, New Delhi
Director	Central Institute of Road Transport, Pune
Director	Global Automotive Research Centre
Director	International Centre for Automotive Technology, Manesar
Director	Indian Institute of Petroleum, Dehra Dun
Director	Vehicles Research and Development Establishment, Ahmednagar
Director	Indian Rubber Manufacturers Research Association
Representatives from	Society of Indian Automobile Manufacturers
Shri R. P. Vasudevan	Tractor Manufacturers Association, New Delhi
Shri Uday Harite	Automotive Components Manufacturers Association of India, New Delhi
Shri K. V. Krishnamurthy	Indian Construction Equipment Manufacturers Association

Member Secretary  
Shri Vikram Tandon  
Dy. General Manager  
The Automotive Research Association of India, Pune

\* At the time of approval of this Automotive Industry Standard (AIS)