56-3 Electromagnetic Compatibility

Refer to: R10 05-S1

56-3.1 Effective date and Scope:

56-3.1.1 Effective date from 2019/01/01, the new vehicle variants of category L, M1 and N1 and from 2020/01/01, all vehicle variants of category L, M1 and N1 shall comply with “56-3 Electromagnetic Compatibility”.

56-3.1.1.1 Those existing vehicle variants of category L, M1 and N1 which were not fitted with Coupling system for charging the REESS and were confirmed to “56-2. Electromagnetic Compatibility” regard as conform to this regulation.

56-3.1.2 Effective date from 2020/01/01, the new vehicle variants of categories M2,M3,N2,N3 and O and from 2021/01/01, all vehicle variants of category M2,M3,N2 , N3 and O shall comply with “56-3 Electromagnetic Compatibility.

56-3.1.2.1 Those existing vehicle variants of category M2, M3, N2 , N3 and O which were not fitted with Coupling system for charging the REESS and were confirmed to “56-2. Electromagnetic Compatibility” regard as conform to this regulation.

56-3.1.3 The same applicant applying for low volume safety approval and the amounts of vehicle not exceed 3 at same year and the category symbols M1, N1, L3 or L5 of same variant and specification, could exempt the Electromagnetic immunity requirement of this regulation.

56-3.1.4 The same applicant applying for vehicle-by-vehicle low volume safety approval and the amounts of vehicle not exceed 20 at same year and vehicle of same variant and specification, could exempt the Electromagnetic immunity requirement of this regulation.

56-3.1.5 For the vehicles used by authorities, organizations, schools or individuals for self-use only could exempt from this regulation of 56-3 Electromagnetic Compatibility. Effective date from 2017/1/1, for the vehicles imported by authorities, organizations, institutes or individuals for self-use, if the vehicle registered and owned by the importer for more than six months from abroad, it could exempt from the regulation of "56-3 Electromagnetic Compatibility ".

56-3.1.6 Technical Service can carry out test according to UN Regulations that this direction harmonized with: UN R10 05 Series of

amendments and following amendments of above-mentioned regulations.

56-3.2 Definitions

56-3.2.1 "Electromagnetic compatibility" means the ability of a vehicle or component(s) or separate electrical/electronic technical unit(s) to function satisfactorily in an electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.

56-3.2.2 "Electromagnetic disturbance" means annoy electromagnetic phenomenon which may degrade the performance of a vehicle or component(s) or separate electrical/electronic technical unit(s). An electromagnetic disturbance may be electromagnetic noise or a change in the propagation medium itself.

56-3.2.3 "Electromagnetic immunity" means the ability of a vehicle or component(s) or separate technical unit(s) to perform without degradation of performance in the presence of specified electromagnetic disturbances.

56-3.2.4 "Electromagnetic environment" means the totality of electromagnetic phenomena existing at a given location.

56-3.2.5 "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).

56-3.2.6 "Narrowband emission" means an emission which has a bandwidth less than that of a particul*ar* measuring apparatus or receiver *(*CISPR 25).

56-3.2.7 "Electrical/electronic system" means (an) electrical and/or electronic device(s) or set(s) of *devices* together with any associated *electrical* connections which form part of a *vehicle but* which are not intended to be type *approved* separately from the vehicle.

56-3.2.8 "Electrical/electronic sub-assembly" (ESA) means an electrical and/or electronic device set of devices intended to be part of a vehicle, together with any associated electrical wiring, which performs one or more specialized functions. An ESA may be approved at the request of a manufacturer as either a "component" or a "separate technical unit(STU)".

56-3.2.9 "Vehicle wiring harness" means supply voltage, bus system (e.g. CAN), signal or active antenna cables, which are installed by the

vehicle manufacturer.

56-3.2.10 "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) Function related to charging mode when coupled to the power grid:

(i) by leading to unexpected vehicle motion.

(ii) for ESA test: by leading to an incorrect charging condition (e.g. over-current, over-voltage)

56-3.2.11 "REESS" means the rechargeable energy storage system that provides electric energy for electric propulsion of the vehicle.

56-3.2.12 "Coupling system for charging the REESS " means the electrical circuit installed in the vehicle used for charging the REESS."

56-3.2.13 "REESS charging mode coupled to the power grid" means the normal charging operation mode of the vehicle and/or charging system.

56-3.2.14 "Reference limit" means the nominal level to which type approval and conformity of production limit values are referenced.

56-3.2.15 "Reference antenna" for the frequency range 20 to 80 MHz: means a shortened balanced resonant dipole at 80 MHz, and for the frequency range above 80 MHz: means a balanced half-wave resonant dipole tuned to the measurement frequency.

56-3.2.16 "Broadband electromagnetic disturbances" means electromagnetic disturbances which have a bandwidth greater than the passband of the receiver used.

56-3.2.17 "Narrowband electromagnetic disturbances" means electromagnetic disturbances which have a bandwidth less than the passband of the receiver used.

56-3.3 Electromagnetic Compatibility shall according to suitable types and range of principle are as below：

56-3.3.1 If use completed vehicle for testing, which shall according to suitable variants and range of principle are as below：

56-3.3.1.1 The same vehicle category symbol.

56-3.3.1.2 The same brand and vehicle type series.

56-3.3.1.3 The same chassis brand.

56-3.3.1.4 Chassis manufacturers announced that the same chassis vehicle type series.

56-3.3.1.5 The same type of vehicle propulsion source (internal combustion engine or pure electric motor or hybrid vehicle).

56-3.3.2 If use chassis vehicle instead of completed vehicle for testing, which shall according to suitable variants and range of principle are as below：

56-3.3.2.1 The same vehicle category.

56-3.3.2.2 The same chassis brand.

56-3.3.2.3 Chassis manufacturers announced that the same chassis vehicle type series.

56-3.3.2.4 The same type of vehicle propulsion source (internal combustion engine or pure electric motor or hybrid vehicle).

56-3.3.3 If use Electrical/Electronic sub-assembly(ESA) for testing, which shall according to suitable variants and range of principle are as

below：

56-3.3.3.1 The same ESA brand.

56-3.3.3.2 The same ESA type.

56-3.3.3.3 The same function performed by the ESA.

56-3.3.3.4 The same general arrangement of the electrical and/or electronic components,(If applicable).

56-3.4 Specification in configurations other than REESS charging mode coupled to the power grid

56-3.4.1 General specifications

56-3.4.1.1 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 Regulation.

56-3.4.1.1.1 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.

56-3.4.1.1.2 ESA(s) shall be tested for radiated and conducted emissions, for immunity to radiated and conducted disturbances.

56-3.4.1.2 Before testing, the Technical Service 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.

56-3.4.1.3 Applicants apply for certification test shall provide at least one representative vehicle (or necessary part of electrical/electronic sub-assembly for test) and submit the documents as below:

The applicants applying for low volume safety approval or vehicle-by-vehicle may be exempt from document of paragraph 56-3.4.1.3.3.

56-3.4.1.3.1 The vehicle specification information and / or electrical/electronic devices described in paragraph 56-3.3, and the vehicle photographs and/or electrical/electronic system(s) photographs.

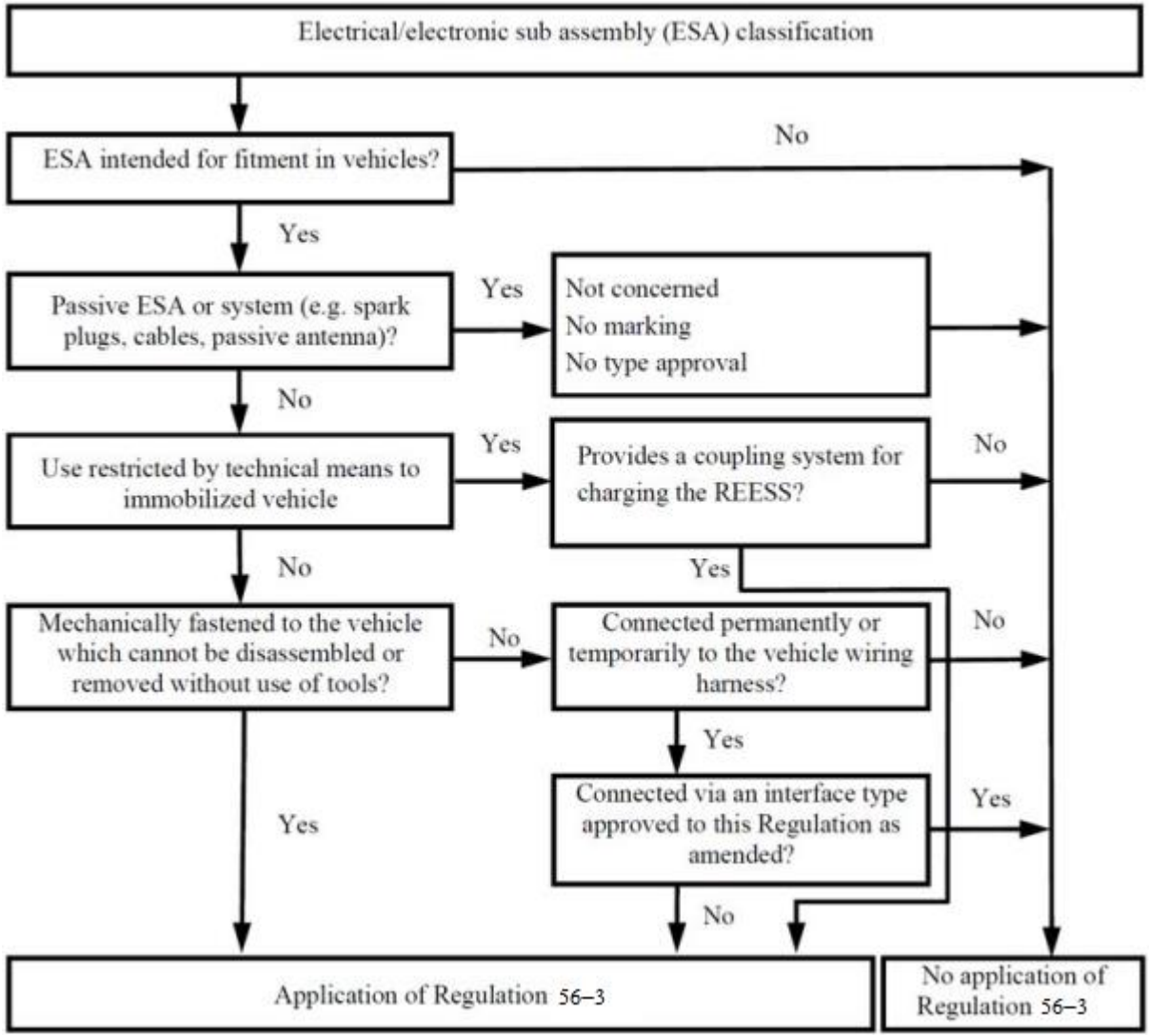
56-3.4.1.3.2 Drawing for outer surface of vehicle and/or electrical/electronic devices to proof complying with this regulation which

required by Technical Service.

56-3.4.1.3.3 The applicant’s documents shall describe all relevant vehicle electrical/electronic systems or ESAs, body styles (If applicable), variations in body material(If applicable), general wiring arrangements, internal combustion engine and/or engine variations, and wheelbase or parts 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 56-3.2.10) and those which provide coupling systems for charging the REESS.

56-3.4.1.3.4 For vehicles of categories M, N, and O the applicant must 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 time of type approval. The applicant must provide evidence that vehicle performance is not adversely affected by such RF-transmitters.

56-3.4.1.3.5 The judgment principle for ESA whether it comply with the provision in these Directions, with reference to the figure as below.



56-3.4.2 Specifications concerning broadband electromagnetic radiation from vehicles.

56-3.4.2.1 Method of measurement

The electromagnetic radiation generated by the vehicle representative of its type shall be measured using the method described in

paragraph 56-3.6. The method of measurement shall be defined by the vehicle manufacturer in accordance with the Technical Service.

56-3.4.2.2 Vehicle broadband type approval limits

56-3.4.2.2.1 if measurements are made using the method described in paragraph 56-3.6 using a vehicle-to-antenna spacing of 10.0 +/- 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 figure 1. In the 400 to 1,000 MHz frequency band the limit remains constant at 43 dB microvolts/m.

56-3.4.2.2.2 If measurements are made using the method described in paragraph 56-3.6 using a vehicle-to-antenna spacing of 3.0 +/- 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 figure 2. In the 400 to 1,000 MHz frequency band the limit remains constant at 53 dB microvolts/m.

56-3.4.2.2.3 On the vehicle representative of its type, the measured values in dB microvolts/m shall be below the type approval limits.

56-3.4.3 Specifications concerning narrowband electromagnetic radiation from vehicles

56-3.4.3.1 Method of measurement

The electromagnetic radiation generated by the vehicle representative of its type shall be measured using the method described in paragraph 56-3.7. These shall be defined by the vehicle manufacturer in accordance with the Technical Service.

56-3.4.3.2 Vehicle narrowband type approval limits

56-3.4.3.2.1 If measurements are made using the method described in paragraph 56-3.7 using a vehicle-to antenna spacing of 10.0 +/- 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 figure 3. In

the 400 to 1,000 MHz frequency band the limit remains constant at 33 dB microvolts/m.

56-3.4.3.2.2 If measurements are made using the method described in paragraph 56-3.7 using a vehicle-to-antenna spacing of 3.0 +/- 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 figure 4. In the 400 to 1,000 MHz frequency band the limit remains constant at 43 dB microvolts/m.

56-3.4.3.2.3 On the vehicle representative of its type, the measured values, expressed in dB microvolts/m, shall be below the type approval limit.

56-3.4.3.2.4 Notwithstanding the limits defined in paragraphs 56-3.4.3.2.1., 56-3.4.3.2.2. and 56-3.4.3.2.3., if, during the initial step described in paragraph 56-3.7, 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.

56-3.4.4 Specifications concerning immunity of vehicles to electromagnetic radiation

56-3.4.4.1 Method of testing

The immunity to electromagnetic radiation of the vehicle representative of its type shall be tested by the method described in paragraph 56-3.10.

56-3.4.4.2 Vehicle immunity type approval limits

56-3.4.4.2.1 If tests are made using the method described paragraph 56-3.10, 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.

56-3.4.4.2.2 The vehicle representative of its type shall be considered as complying with immunity requirements if, during the tests performed in accordance with paragraph 56-3.10, there shall be no degradation of performance of "immunity related

functions"., according to paragraph 56-3.11.2.1.

56-3.4.5 Specification concerning broadband electromagnetic interference generated by ESAs.

56-3.4.5.1 Method of measurement

The electromagnetic radiation generated by the ESA representative of its type shall be measured by the method described in paragraph 56-3.8.

56-3.4.5.2 ESA broadband type approval limits

56-3.4.5.2.1 If measurements are made using the method described in paragraph 56-3.8, 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 figure 5. In the 400 to 1,000 MHz frequency band the limit remains constant at 63 dB microvolts/m.

56-3.4.5.2.2 On the ESA representative of its type, the measured values, expressed in dB microvolts/ m, shall be below the type approval limits.

56-3.4.6 Specifications concerning narrowband electromagnetic interference generated by ESAs.

56-3.4.6.1 Method of measurement

The electromagnetic radiation generated by the ESA representative of its type shall be measured by the method described paragraph 56-3.9.

56-3.4.6.2 ESA narrowband type approval limits

56-3.4.6.2.1 If measurements are made using the method described paragraph 56-3.9, 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 figure 6. In the 400 to 1,000 MHz frequency band the limit remains constant at 53 dB microvolts/m.

56-3.4.6.2.2 On the ESA representative of its type, the measured value, expressed in dB microvolts/ m shall be below the type

approval limits.

56-3.4.7 Specifications concerning the emission of transient conducted disturbances generated by ESAs on 12/24 V supply lines.

56-3.4.7.1 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 paragraph 56-3.12 with the test levels given table 1.

Table 1: Maximum allowed pulse amplitude

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

56-3.4.8 Specifications concerning immunity of ESAs to electromagnetic radiation

56-3.4.8.1 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 paragraph 56-3.11.

56-3.4.8.2 ESA immunity type approval limits

56-3.4.8.2.1 If tests are made using the methods described in paragraph 56-3.11, the immunity test levels shall be 60 volts/m root-mean-square (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 m rms A 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.

56-3.4.8.2.2 The ESA representative of its type shall be considered as complying with immunity requirements if, during the tests performed in accordance with paragraph 56-3.11, there shall be no degradation of performance of "immunity related functions".

56-3.4.9 Specifications concerning the immunity of ESAs to transient disturbances conducted along 12/24 V supply lines.

56-3.4.9.1 Method of testing

The immunity of ESA representative of this type shall be tested by the method(s) according to ISO 7637-2 as described in paragraph 56-3.12 with the test levels given in Table 2.

Table 2: Immunity of ESA

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

56-3.4.10 Exceptions

56-3.4.10.1 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 paragraph 56-3.4.3.2, 56-3.4.6.2, 56-3.7. or 56-3.9.

56-3.4.10.2 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 56-3.4.4. and 56-3.10. to this Regulation.

56-3.4.10.3 ESAs with no immunity related functions need not be tested for immunity to radiated disturbances and shall be deemed to comply with paragraph 56-3 4.8 and paragraph 56-3 11. to this Regulation.

56-3.4.10.4 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 only occur 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.

56-3.4.10.5 Emission of transient conducted disturbances generated by ESAs on 12/24 V supply lines. ESAs that are not switched, contain no switches or do not include inductive loads need not be tested for transient conducted emission and shall be deemed to comply with paragraph 56-3.4.7.

56-3.4.10.6 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 a fail criteria.

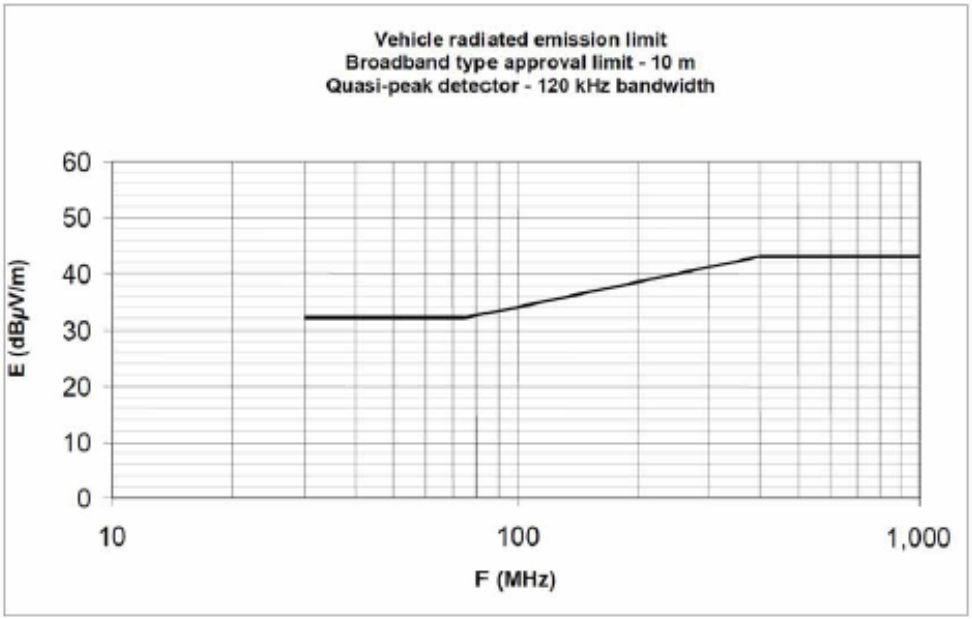
56-3.4.10.7 RF transmitters shall be tested in the transmit mode. Wanted emissions (e.g. from RF transmitting systems) within the necessary bandwidth and out of band emissions are disregarded for the purpose of this Regulation. Spurious emissions are subject to this Regulation.

56-3.4.10.7.1 "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 International Telecommunication Union (ITU) Radio Regulations).

56-3.4.10.7.2 "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. 1.152 of the ITU Radio Regulations).

56-3.4.10.7.3 "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 Regulations).

Limit E (dB muV/m) at frequency F (MHz)		
30 - 75 MHz	75 - 400 MHz	400 - 1,000 MHz
E = 32	E = 32 + 15.13 log (F/75)	E = 43

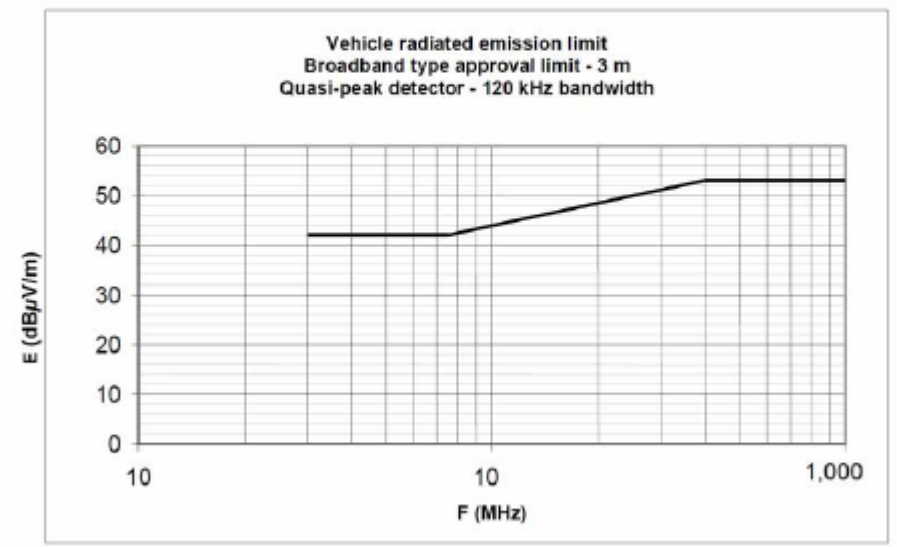


Frequency - megahertz - logarithmic

（See paragraph 4.2.2.1 of this Regulation）

Figure 1: Vehicle broadband reference limits（Antenna-vehicle separation :10 m）

Limit E (dB muV/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

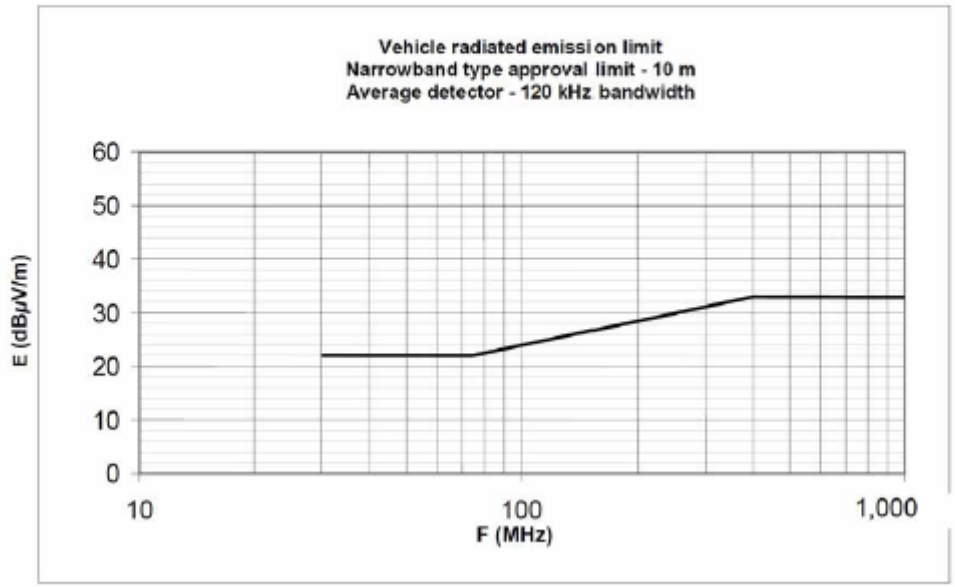


Frequency - megahertz - logarithmic

（See paragraph 4.2.2.2 of this Regulation）

Figure 2: Vehicle broadband reference limits（Antenna-vehicle separation :3 m）

Limit E (dB muV/m) at frequency F (MHz)		
30 - 75 MHz	75 - 400 MHz	400 - 1,000 MHz
E = 22	E = 22 + 15.13 log (F/75)	E = 33

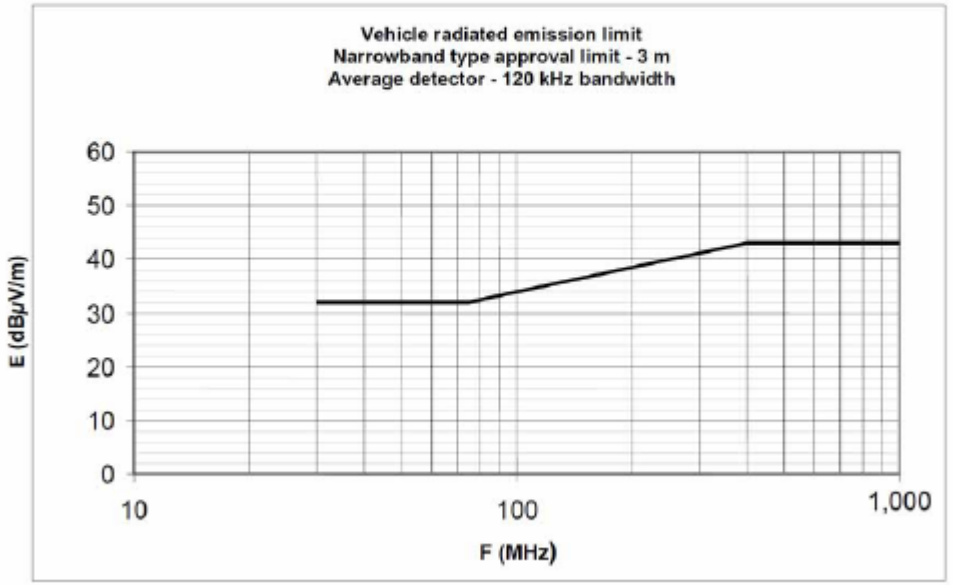


Frequency - megahertz - logarithmic

（See paragraph 4.3.2.1 of this Regulation）

Figure 3: Vehicle narrowband reference limits（Antenna-vehicle separation :10 m）

Limit E (dB muV/m) at frequency F (MHz)		
30 - 75 MHz	75 - 400 MHz	400 - 1,000 MHz
E = 32	E = 32 + 15.13 log (F/75)	E = 43

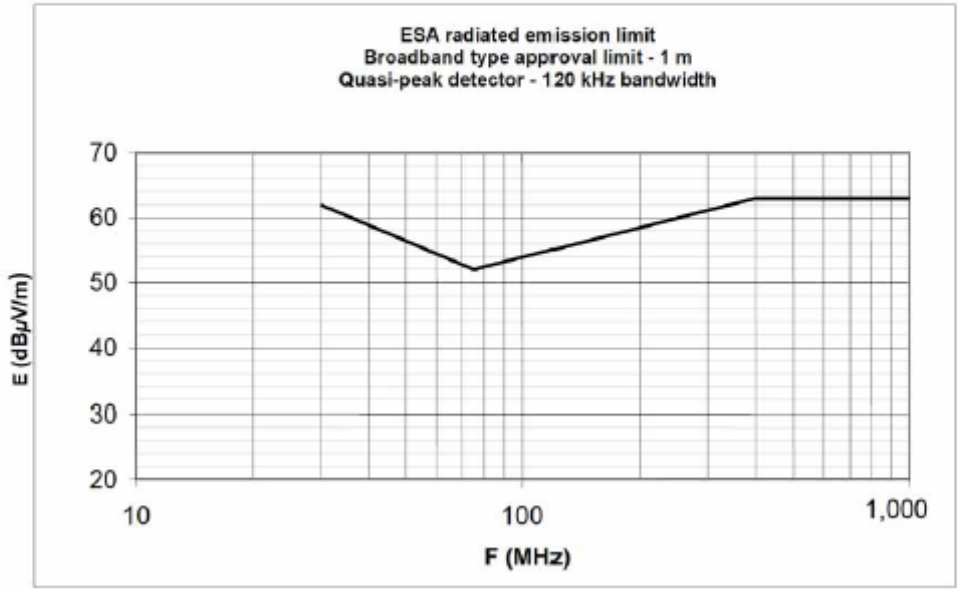


Frequency - megahertz - logarithmic

（See paragraph 4.3.2.2 of this Regulation）

Figure 4: Vehicle narrowband reference limits（Antenna-vehicle separation :3 m）

Limit E (dB muV/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

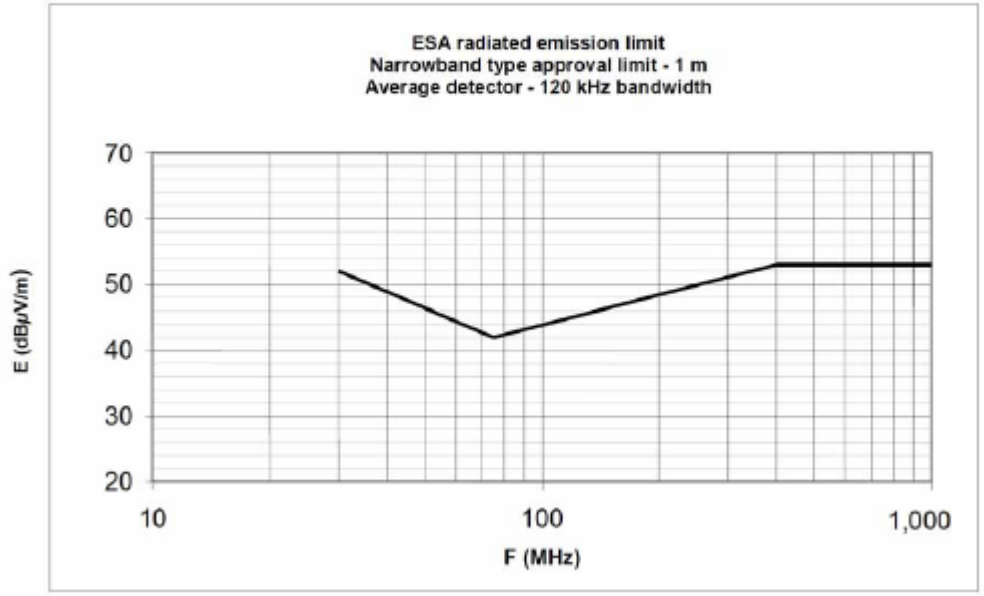


Frequency - megahertz - logarithmic

（See paragraph 4.5.2.1 of this Regulation）

Figure 5: Electrical/electronic sub-assembly

Limit E (dB muV/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



Frequency - megahertz - logarithmic

（See paragraph 4.6.2.1 of this Regulation）

Figure 6: Electrical/electronic sub-assembly

56-3.5 Additional Specifications in the Configuration "REESS charging mode coupled to the power grid.

56-3.5.1 General specifications

56-3.5.1.1 A vehicle and its electrical/electronic system(s) or ESA(s) shall be so designed, constructed and fitted as to enable the

vehicle, in configuration "REESS charging mode coupled to the power grid", to comply with the requirements of this Regulation.

56-3.5.1.1.1 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.

56-3.5.1.1.2 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.

56-3.5.1.2 Before testing the Technical Service 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.

56-3.5.1.3 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.

56-3.5.1.4 Artificial networks

AC Power mains shall be applied to the vehicle / ESA through 50 microhenry/50 ohm AN(s) as defined in CISPR 16-1-2 clause 4.3.

DC Power mains shall be applied to the vehicle / ESA through 5 microhenry/50 ohm AN(s) as defined in CISPR 25.

High voltage power line shall be applied to the ESA through a 5 microhenry/50 ohm HV-AN(s) as defined in paragraph 56-3 5.21.

56-3.5.2 Specifications concerning broadband electromagnetic radiation from vehicles

56-3.5.2.1 Method of measurement

The electromagnetic radiation generated by the vehicle representative of its type shall be measured using the method described in paragraph 56-3.6. The method of measurement shall be defined by the vehicle manufacturer in accordance with the Technical Service.

56-3.5.2.2 Vehicle broadband type approval limits

56-3.5.2.2.1 If measurements are made using the method described in paragraph 56-3.6 using a vehicle-to-antenna spacing of 10.0 +/- 0.2 m, the limits shall be 32 dB microvolts/m in the 30 to 75MHz 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 Figure 1. In the 400 to 1,000 MHz frequency band the limit remains constant at 43dB microvolts/m.

56-3.5.2.2.2 If measurements are made using the method described in paragraph 56-3.6 using a vehicle-to-antenna spacing of 3.0 +/- 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 Figure 2. In the 400 to 1,000 MHz frequency band the limit remains constant at 53dB microvolts/m.

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

56-3.5.3 Specifications concerning emission of harmonics on AC power lines from vehicles

56-3.5.3.1 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 paragraph 56-3.13. The method of measurement shall be defined by the vehicle manufacturer in accordance with the Technical Service.

56-3.5.3.2 Vehicle type approval limit

56-3.5.3.2.1 If measurements are made using the method, the limits for input current ≤ 16 A per phase are those defined in IEC 61000-3-2 and given in table 3.

Table 3: Maximum allowed harmonics (input current ≤ 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
$15 \leq n \leq 39$	0.15x15/n
Even harmonics	
2	1.08
4	0.43
6	0.30
$8 \leq n \leq 40$	0.23x8/n

56-3.5.3.2.2 If measurements are made using the method, the limits for input current > 16 A and ≤ 75 A per phase are those defined in IEC 61000-3-12 (edition 1.0 -2004) and given in table 4, 5 and 6.

Table 4: Maximum allowed harmonics (input current > 16 A and ≤ 75 A per phase) for equipment other than balanced three-phase equipment

Minimum R_{sce}	Acceptable individual harmonic current I_n/I_1 %						Maximum current harmonic ratio %	
	I_3	I_5	I_7	I_9	I_{11}	I_{13}	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
≥ 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 the same way than odd harmonics. Linear interpolation between successive values of R_{sce} is authorized.								

Table 5: Maximum allowed harmonics (input current > 16 A and ≤ 75 A per phase) for balanced three phase equipment

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
66	14	9	5	3	16	25
120	19	12	7	4	22	28
250	31	20	12	7	37	38
≥ 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 ≤ 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
≥ 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						

56-3.5.4 Specifications concerning emission of voltage changes, voltage fluctuations and flicker on AC power lines from vehicles

56-3.5.4.1 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 paragraph 56-3.14. The method of measurement shall be defined by the vehicle manufacturer in accordance with the Technical Service.

56-3.5.4.2 Vehicle type approval limit

56-3.5.4.2.1 If measurements are made using the method, the limits for rated current ≤ 16 A per phase and not subjected to conditional connection are those defined in IEC 61000-3-3, clause 5.

56-3.5.4.2.2 If measurements are made using the method the limits for rated current > 16 A and ≤ 75 A per phase and subjected to conditional connection are those defined in IEC 61000-3-11.

56-3.5.5 Specifications concerning emission of radiofrequency conducted disturbances on AC or DC power lines from vehicles

56-3.5.5.1 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 paragraph 56-3.15. The method of measurement shall be defined by the vehicle manufacturer in accordance with the Technical Service.

56-3.5.5.2 Vehicle type approval limit

56-3.5.5.2.1 If measurements are made using the method described in paragraph 56-3.15, the limits on AC power lines are those defined in IEC 61000-6-3 and given in table 7.

Table 7: Maximum allowed radiofrequency conducted disturbances on AC power lines

Frequency (MHz)	Limits and detector
0.15 to 0.5	66 to 56 dB microvolts (quasi-peak) 56 to 46 dB microvolts (average) (linearly decreasing with logarithm of frequency)
0.5 to 5	56 dB microvolts (quasi-peak) 46 dB microvolts (average)
5 to 30	60 dB microvolts (quasi-peak) 50 dB microvolts (average)

56-3.5.5.2.2 If measurements are made using the method described in paragraph 56-3.15, the limits on DC power lines are those defined in IEC 61000-6-3 and given in table8.

Table 8: Maximum allowed radiofrequency conducted disturbances on DC power lines

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

56-3.5.6 Specifications concerning emission of radiofrequency conducted disturbances on network and telecommunication access from vehicles

56-3.5.6.1 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 paragraph 56-3.16. The method of measurement shall be defined by the vehicle manufacturer in accordance with the Technical Service.

56-3.5.6.2 Vehicle type approval limit

56-3.5.6.2.1 The limits on network and telecommunication access (telecommunication access as defined in clause 3.6. of CISPR22) 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

Frequency (MHz)	Limits and detector	
0.15 to 0.5	84 to 74 dB muV (quasi-peak) 74 to 64 dB muV (average) (linearly decreasing with logarithm of frequency)	40 to 30 dB muA (quasi-peak) 30 to 20 dB muA (average) (linearly decreasing with logarithm of frequency)
0.5 to 30	74 dB muV (quasi-peak) 64 dB muV (average)	30 dB muA (quasi-peak) 20 dB muA (average)

56-3.5.7 Specifications concerning immunity of vehicles to electromagnetic radiation

56-3.5.7.1 Method of testing

The immunity to electromagnetic radiation of the vehicle representative of its type shall be tested by the method described in paragraph 56-3.10.

56-3.5.7.2 Vehicle immunity type approval limits

56-3.5.7.2.1 If tests are made using the method described in paragraph 56-3.10, 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.

56-3.5.7.2.2 The vehicle representative of its type shall be considered as complying with immunity requirements, there shall be no degradation of performance of "immunity related functions", according to paragraph 56-3.10.2.2.

56-3.5.8 Specifications concerning the immunity of vehicles to electrical fast transient/burst disturbances conducted along AC and DC power lines.

56-3.5.8.1 Method of testing

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 paragraph 56-3.17.

56-3.5.8.2 Vehicle immunity type approval limits

56-3.5.8.2.1 If tests are made using the methods described in paragraph 56-3.17, the immunity test levels, for AC or DC power lines, shall be : +/- 2 kV test voltage in open circuit, with a rise time(Tr) of 5 ns, and a hold time (Th) of 50 ns and a repetition rate of 5 kHz for at least 1 minute.

56-3.5.8.2.2 The vehicle representative of its type shall be considered as complying with immunity requirements, there shall be no degradation of performance of "immunity related functions", according to paragraph 56-3.10.2.2.

56-3.5.9 Specifications concerning the immunity of vehicles to surge conducted along AC or DC power lines.

56-3.5.9.1 Method of testing

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 paragraph 56-3.18.

56-3.5.9.2 Vehicle immunity type approval limits

56-3.5.9.2.1 If tests are made using the methods described in paragraph 56-3.18, the immunity test levels shall be:

(a) For AC power lines: +/- 2 kV test voltage in open circuit between line and earth and +/-1 KV between lines (pulse 1.2 microseconds / 50 microseconds), with a rise time (Tr) of 1.2 microseconds, and a hold time (Th) of 50 microseconds. 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 deg,

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

56-3.5.9.2.2 The vehicle representative of its type shall be considered as complying with immunity requirements, there shall be no degradation of performance of "immunity related functions", according to paragraph 56-3.10.2.2.

56-3.5.10 Specifications concerning broadband electromagnetic interference caused by ESAs

56-3.5.10.1 Method of measurement

The electromagnetic radiation generated by the ESA representative of its type shall be measured by the method described in in paragraph 56-3.8.

56-3.5.10.2 ESA broadband type approval limits

56-3.5.10.2.1 If measurements are made using the method described in paragraph 56-3.8, 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. In the 400 to 1,000 MHz frequency band the limit remains constant at 63 dB microvolts/m.

56-3.5.10.2.2 On the ESA representative of its type, the measured values, expressed in dB microvolt/ m, shall be below the type approval limits.

56-3.5.11 Specifications concerning emission of harmonics on AC power lines from ESAs

56-3.5.11.1 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 paragraph 56-3.19. The method of measurement shall be defined by the manufacturer in accordance with the Technical Service.

56-3.5.11.2 ESA type approval limit

56-3.5.11.2.1 If measurements are made using the method described in paragraph 56-3.19, the limits for input current ≤ 16 A per phase are those defined in IEC 61000-3-2 and given in Table 3.

Table 3: Maximum allowed harmonics (input current < 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
$15 \leq n \leq 39$	0.15x15/n
Even harmonics	
2	1.08
4	0.43
6	0.30
$8 \leq n \leq 40$	0.23x8/n

56-3.5.11.2.2 If measurements are made using the method, the limits for input current > 16 A and ≤ 75 A per phase are those defined in IEC 61000-3-12 and given in Table 4, Table 5 and Table 6.

Table 4: Maximum allowed harmonics (input current > 16 A and ≤ 75 A per phase) for equipment other than balanced three-phase equipment.

Minimum R_{sce}	Acceptable individual harmonic current I_n/I_1 %						Maximum current harmonic ratio %	
	I_3	I_5	I_7	I_9	I_{11}	I_{13}	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
≥ 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 R_{sce} is authorized.								

Table 5: Maximum allowed harmonics (input current > 16 A and ≤ 75 A per phase) for balanced three-phase equipment.

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
66	14	9	5	3	16	25
120	19	12	7	4	22	28
250	31	20	12	7	37	38
≥ 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 in the same way as odd harmonics. Linear interpolation between successive values of R_{sce} is authorized.						

Table 6: Maximum allowed harmonics (input current > 16 A and ≤ 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
≥ 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 in the same way as odd harmonics.						

56-3.5.12 Specifications concerning emission of voltage changes, voltage fluctuations and flicker on AC power lines from ESAs

56-3.5.12.1 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 paragraph 56-3.20. The method of measurement shall be defined by the ESA manufacturer in accordance with the Technical Service.

56-3.5.12.2 ESA type approval limit

56-3.5.12.2.1 If measurements are made using the method described in paragraph 56-3.20, the limits for rated current ≤16 A per phase and not subjected to conditional connection are those defined in IEC 61000-3-3, clause 5.

56-3.5.12.2.2 If measurements are made using the method described in paragraph 56-3.20, the limits for rated current > 16 A and ≤ 75 A per phase and subjected to conditional connection are those defined in IEC 61000-3-11, clause 5.

56-3.5.13 Specifications concerning emission of radiofrequency conducted disturbances on AC or DC power lines from ESA

56-3.5.13.1 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 paragraph 56-3.21. The method of measurement shall be defined by the ESA manufacturer in accordance with the Technical Service.

56-3.5.13.2 ESA type approval limit

56-3.5.13.2.1 If measurements are made using the method described in paragraph 56-3.21, the limits on AC power lines are those defined in IEC 61000-6-3 and given in Table 7.

Table 7: Maximum allowed radiofrequency conducted disturbances on AC power lines

Frequency (MHz)	Limits and detector
0.15 to 0.5	66 to 56 dB microvolts (quasi-peak) 56 to 46 dB microvolts (average) (linearly decreasing with logarithm of frequency)
0.5 to 5	56 dB microvolts (quasi-peak) 46 dB microvolts (average)
5 to 30	60 dB microvolts (quasi-peak) 50 dB microvolts (average)

56-3.5.13.2.2 If measurements are made using the method described in paragraph 56-3.21, 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 microvolts (quasi-peak) 66 dB microvolts (average)
0.5 to 30	73 dB microvolts (quasi-peak) 60 dB microvolts (average)

56-3.5.14 Specifications concerning emission of radiofrequency conducted disturbances on network and telecommunication access from ESA

56-3.5.14.1 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 paragraph 56-3.22. The method of measurement shall be defined by the ESA manufacturer in accordance with Technical Service.

56-3.5.14.2 ESA type approval limit

56-3.5.14.2.1 If measurements are made using the method described in paragraph 56-3.22, the limits on network and telecommunication access (telecommunication access as defined in Clause 3.6 of CISPR22) 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

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

56-3.5.15 Specifications concerning the immunity of ESAs to electrical fast transient/burst disturbances conducted along AC and DC power lines.

56-3.5.15.1 Method of testing

56-3.5.15.1.1 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 paragraph 56-3.23.

56-3.5.15.2 ESA immunity type approval limits

56-3.5.15.2.1 If tests are made using the methods described in paragraph 56-3.23, the immunity test levels, for AC or DC power

lines, shall be: +/- 2 kV test voltage in open circuit, with a rise time (Tr) of 5 ns, and a hold time (Th) of 50 ns and a repetition rate of 5 kHz for at least 1 minute.

56-3.5.15.2.2 The ESA representative of its type shall be considered as complying with immunity requirements if, during the tests performed in accordance with paragraph 56-3.23, there shall be no degradation of performance of "immunity related functions", according to paragraph 56-3.11.2.2.

56-3.5.16 Specifications concerning the immunity of ESAs to surge conducted along AC or DC power lines

56-3.5.16.1 Method of testing

56-3.5.16.1.1 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 paragraph 56-3.24.

56-3.5.16.2 ESA immunity type approval limits

56-3.5.16.2.1 The immunity test levels shall be:

(a) For AC power lines: +/- 2 kV test voltage in open circuit between line and earth and +/- 1 kV between lines (pulse 1.2 microseconds / 50 microseconds), with a rise time (Tr) of 1.2 microseconds, and a hold time (Th) of 50 microseconds. 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 deg.,

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

56-3.5.16.2.2 The ESA representative of its type shall be considered as complying with immunity requirements if, during the tests performed in accordance with paragraph 56-3.24, there shall be no degradation of performance of "immunity related functions", according to paragraph 56-3.11.2.2.

56-3.5.17 Specifications concerning the emission of transient conducted disturbances generated by ESAs on 12 / 24 V supply lines

56-3.5.17.1 The emission of ESA representative of its type shall be tested by the method(s) according to ISO 7637-2, as described in paragraph 56-3.12 for the levels given in Table 1.

56-3.5.18 Specifications concerning immunity of ESAs to electromagnetic radiation

56-3.5.18.1 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 paragraph 56-3.11.

56-3.5.18.2 ESA immunity type approval limits

56-3.5.18.2.1 If tests are made using the methods described in paragraph 56-3.11, 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.

56-3.5.18.2.2 The ESA representative of its type shall be considered as complying with immunity requirements if, during the tests performed in accordance with paragraph 56-3.24, there shall be no degradation of performance of "immunity related functions".

56-3.5.19 Specifications concerning the immunity of ESAs to transient disturbances conducted along 12 / 24 V supply lines.

56-3.5.19.1 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

paragraph 56-3.12 with the test levels given in Table 2.

56-3.5.20 Exceptions

56-3.5.20.1 When there is no direct connection to a telecommunication network which includes telecommunication service additional to the charging communication service, paragraph 56-3.16 and paragraph 56-3.22 shall not apply.

56-3.5.20.2 When network and telecommunication access of the vehicle uses power line Transmission (PLT) on its AC/DC power lines, paragraph 56-3.16. shall not be applied.

56-3.5.20.3 When network and telecommunication access of the ESA uses Power Line Transmission (PLT) on its AC/DC power lines, paragraph 56-3.22 shall not apply.

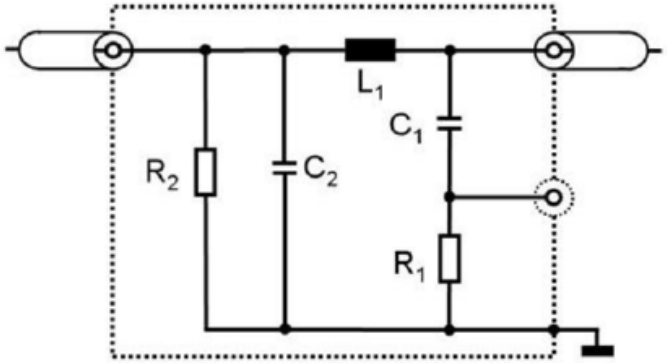
56-3.5.20.4 Vehicles and / or ESA which are intended to be used in "REESS charging mode coupled to the power grid" in the configuration connected to a DC-charging station with a length of a DC network cable shorter than 30 m do not have to fulfill the requirements of paragraph 56-3.15, 56-3.17, 56-3.18, 56-3.21, 56-3.23 and 56-3.24.

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.

56-3.5.20.5 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 fulfill requirements of paragraph 56-3.15, 56-3.17, 56-3.18, 56-3.21, 56-3.23 and 56-3.24.

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.

56-3.5.21 HV artificial network as shown in figure 7,8 and 9.



Legend	C_2: 0.1 microfarads
L_1: 5 microhenries	R_1: 1 kiloohm
C_1: 0.1 microfarads	R_2: 1 megohm (discharging C_2 to < 50 V_{dc} within 60 s)

Figure 7: HV artificial network

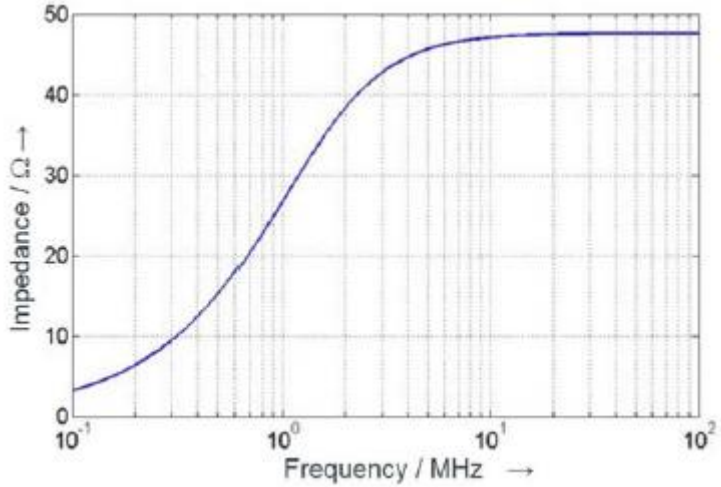


Figure 8: Impedance of HV artificial network

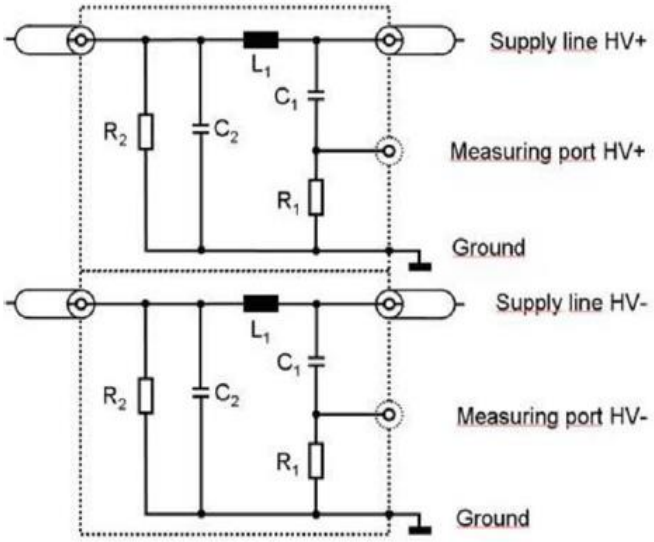


Figure 9: Combination of HV artificial network

56-3.6 Method of measurement of radiated broadband electromagnetic emission from vehicles

56-3.6.1 General

56-3.6.1.1 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 in charging mode coupled to the power grid".

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

56-3.6.1.2 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.

56-3.6.2 Vehicle state during tests

56-3.6.2.1 Vehicle in configuration other than "REESS in charging mode coupled to the power grid.

56-3.6.2.1.1 Engine

The engine shall be in operation according to CISPR 12.

56-3.6.2.1.2 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.

56-3.6.2.2 Vehicle in configuration "REESS in charging mode coupled to the power grid".

The state of charge (SOC) of the traction battery shall be kept between 20 per cent and80 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 10-1,10-2,10-3 and 10-4 (depending of AC or DC power charging mode, location of charging plug and charging with or without communication).

56-3.6.2.3 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.

56-3.6.2.4 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 10-1,10-2,10-3 and 10-4.

56-3.6.2.5 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 22, paragraph 9.6.2.

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 ohm load.

The IS shall be placed as defined in Figures 10-3 and 10-4.

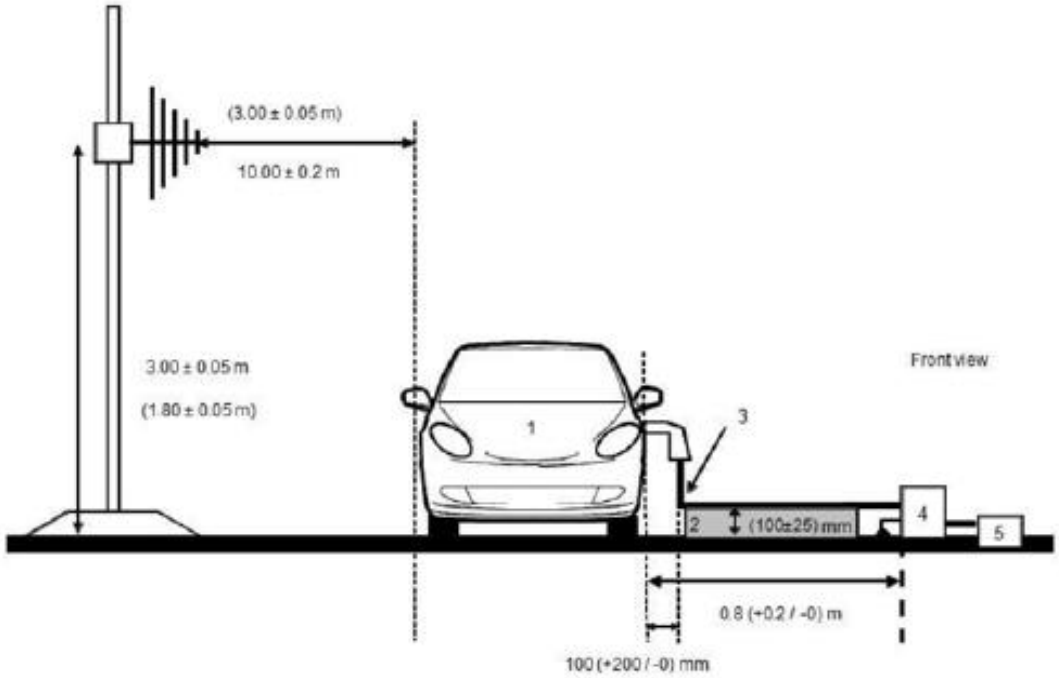
56-3.6.2.6 Power charging / communication cable

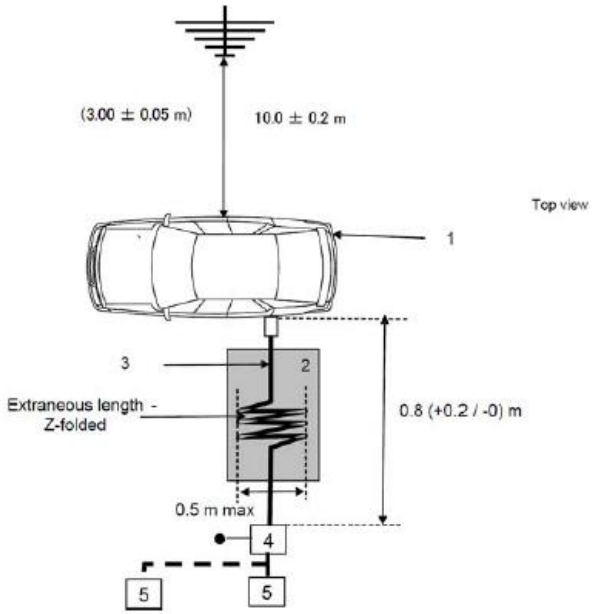
The power charging / communication cable shall be placed in a straight line between the AN(s) / IS(s) and the vehicle charging plug. The projected cable length shall be 0.8 m(+0.2/-0 m).

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 of100 mm (+200/-0 mm) from the vehicle body.

The whole cable shall be placed on a non-conductive, low relative permittivity (dielectric-constant) material (epsilonr ≤ 1.4), at 100 mm (+/- 25 mm) above the ground plane.





Legend:

1 Vehicle under test

2 Insulating support

3 Charging cable

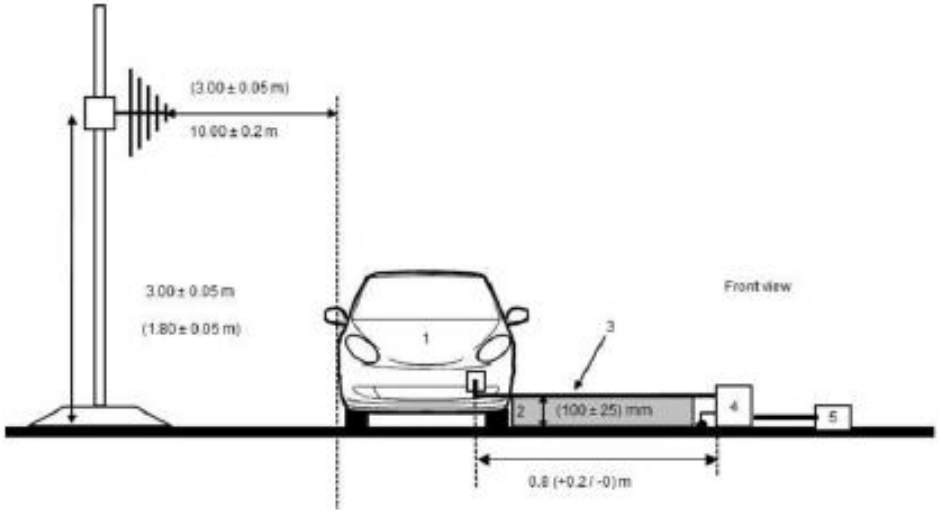
4 Artificial network(s) grounded

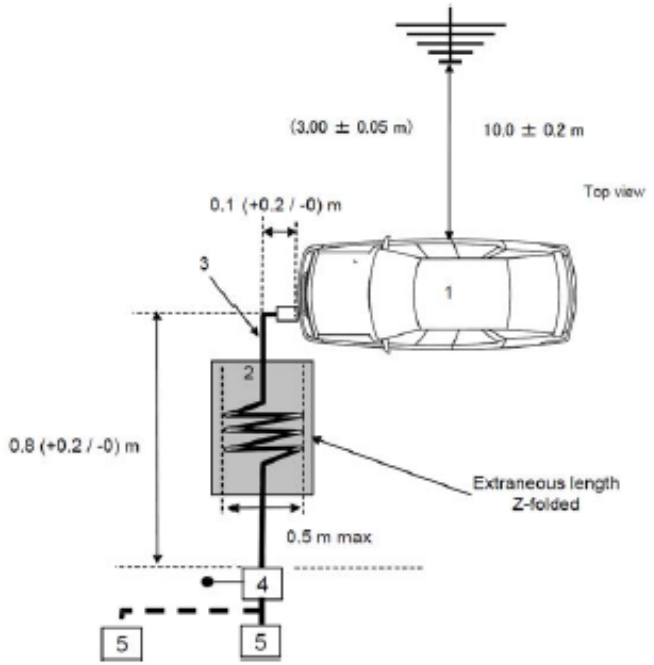
5 Power mains socket

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 10-1: Vehicle in configuration "REESS charging mode" coupled to the power grid


(3.00 ± 0.05 m)
10.00 ± 0.2 m
3.00 ± 0.05 m
(1.80 ± 0.05 m)
Front view
1
2
3
(100 ± 25) mm
4
5
0.8 (+0.2 / -0) m



Legend:

1 Vehicle under test

2 Insulating support

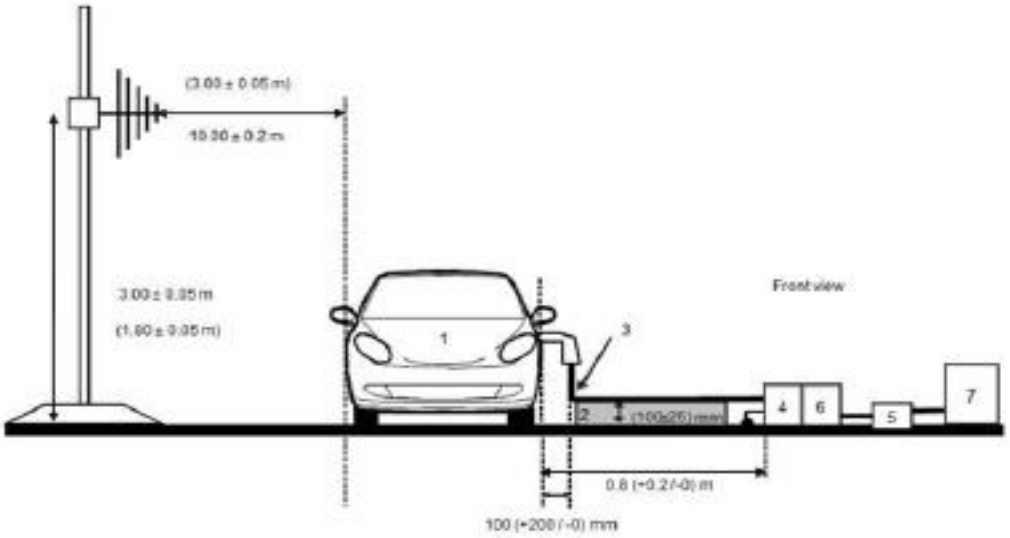
3 Charging cable

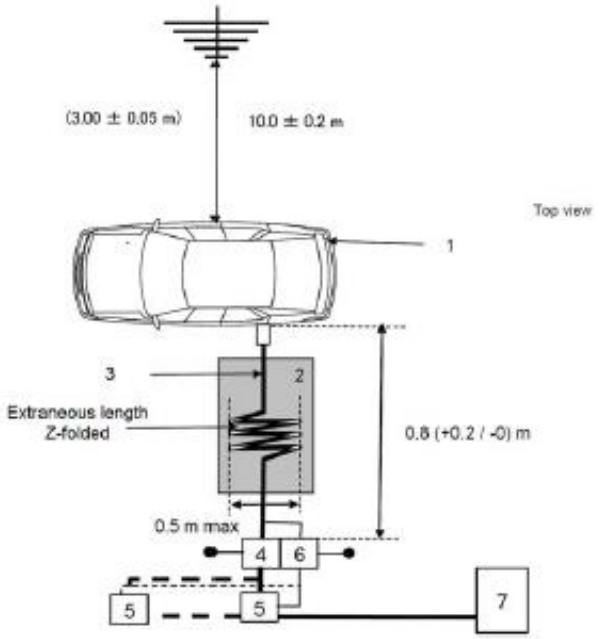
4 Artificial network(s) grounded

5 Power mains socket

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

Figure 10-2: Vehicle in configuration "REESS charging mode" coupled to the power grid


(3.00 ± 0.05 m)
10.00 ± 0.2 m
3.00 ± 0.05 m
(1.60 ± 0.05 m)
Front view
1
2
3
4
5
6
7
0.8 (+0.2/-0) m
100 (+200 / -0) mm



Legend:

1 Vehicle under test

2 Insulating support

3 Charging / communication cable

4 AC or DC artificial network(s) grounded

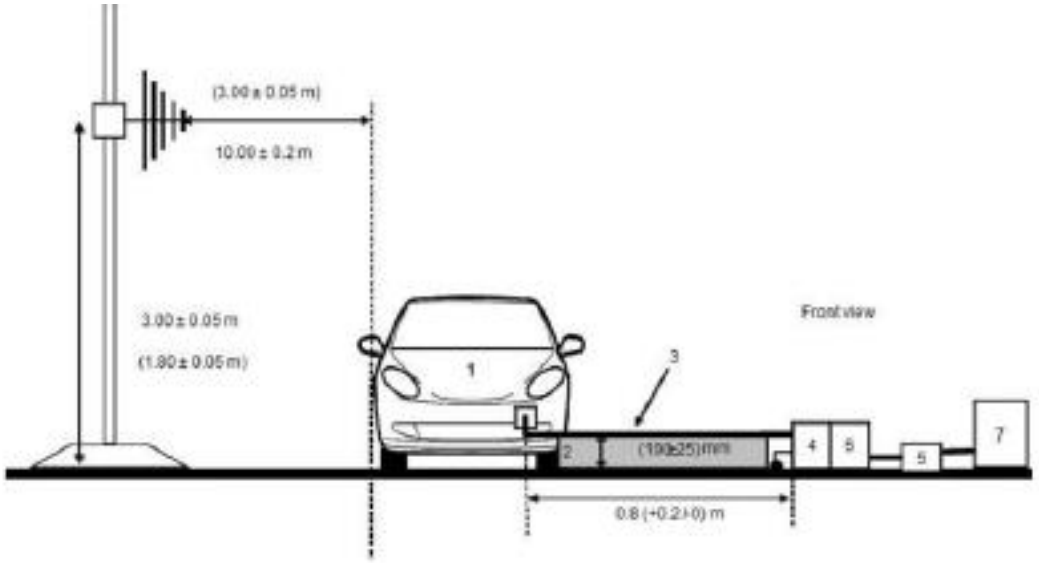
5 Power mains socket

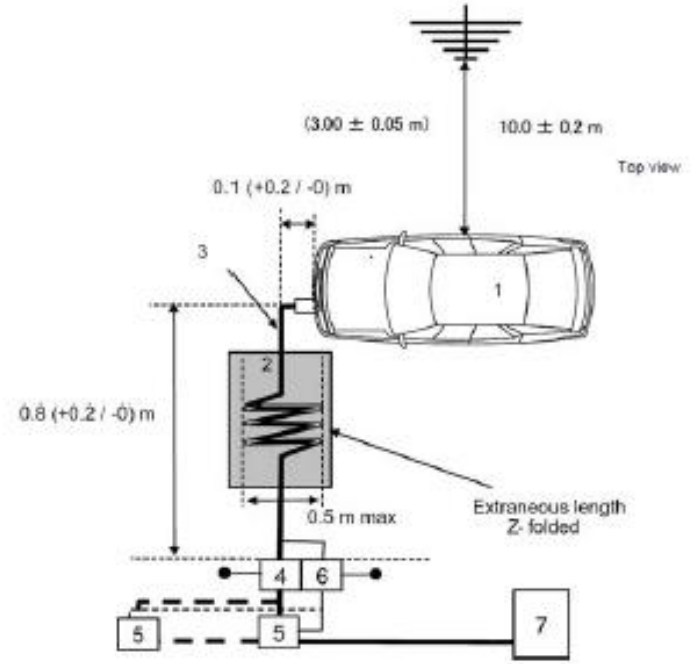
6 Impedance stabilization(s) grounded

7 Charging station

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

Figure 10-3: Vehicle in configuration "REESS charging mode" coupled to the power grid


(3.00 ± 0.05 m)
10.00 ± 0.2 m
3.00 ± 0.05 m
(1.80 ± 0.05 m)
Front view
1
2
3
4
5
6
7
0.8 (+0.2/-0) m



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 10-4: Vehicle in configuration "REESS charging mode" coupled to the power grid

56-3.6.3 Measurement location

56-3.6.3.1 As an alternative to the requirements of CISPR 12 (fifth edition 2001 and Amd1:2005) for vehicles of category L the test surface may be any location that fulfils the conditions shown in the figure 11. In this case the measuring equipment shall lie outside the part shown in the figures 11 and 12.

56-3.6.3.2 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.

56-3.6.4 Testing requirements

56-3.6.4.1 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.

56-3.6.4.2 Measurements can be performed with either quasi-peak or peak detectors. The limits given in paragraphs 56-3.4.2 and 56-3.4.5 of this Regulation are for quasi-peak detectors. If peak detectors are used a correction factor of 20 dB as defined in CISPR 12 shall be applied.

56-3.6.4.3 The measurements shall be performed with a spectrum analyser or a scanning receiver. The parameters to be used are defined in Table 10 and Table 11.

56-3.6.4.4 Measurements

The Technical Service shall perform the test at the intervals specified in the CISPR 12 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 Type Approval Authority, the Technical Service 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 to background radiation.

56-3.6.4.5 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.

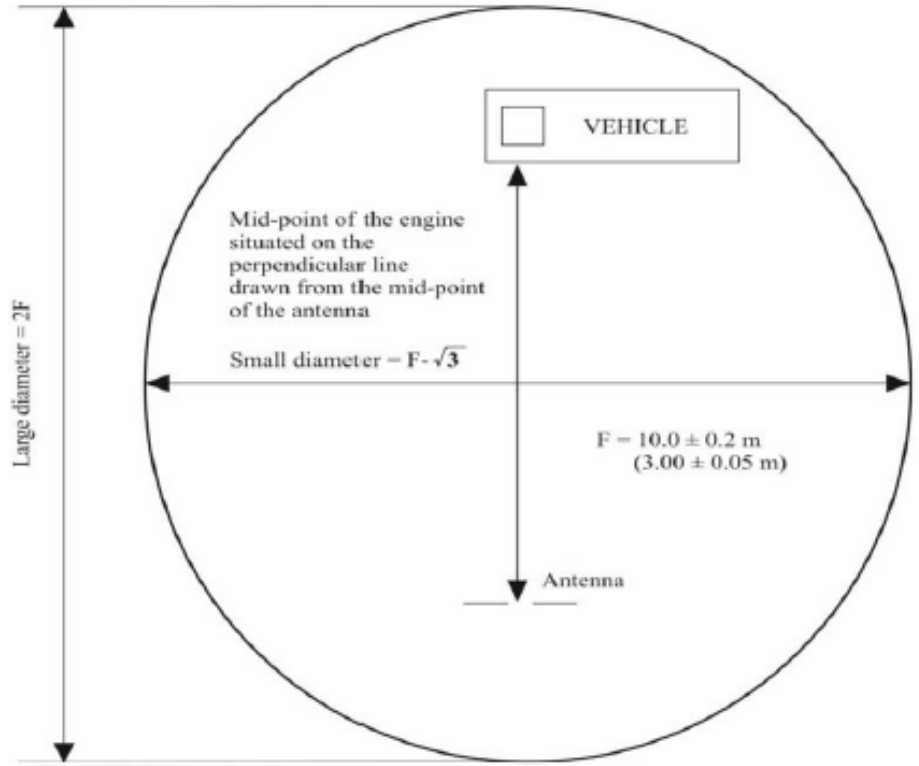


Figure11: Clear horizontal surface free of electromagnetic reflection delimitation of the surface defined by an ellipse

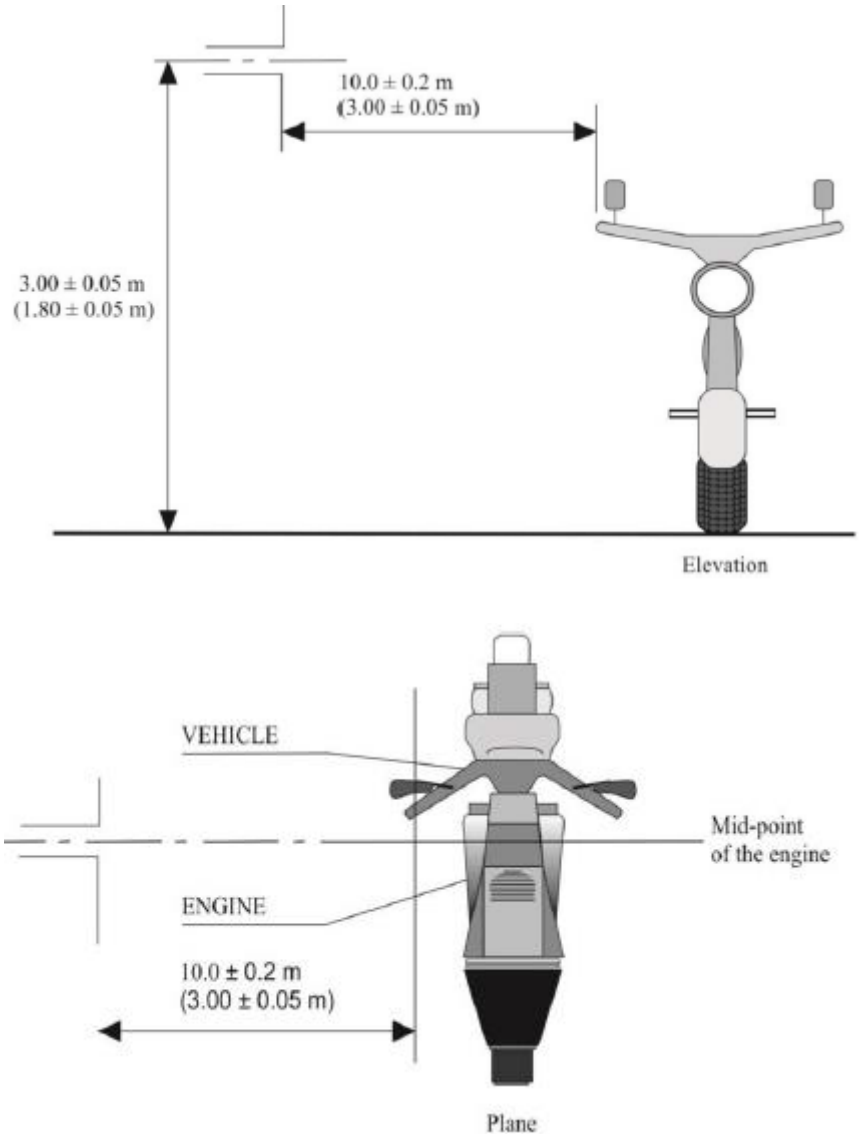


Figure12: Dipole antenna in position to measure the vertical radiation components

Table 10: 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 11: Scanning receiver parameters

Frequency range MHz	Peak detector			Quasi-peak detector			Average detector		
	BW at -6 dB	Step size [a]	Dwell time	BW at -6 dB	Step size [a]	Dwell time	BW at -6 dB	Step size[a]	Dwell time
30 to 1,000	120 kHz	50 kHz	5 ms	120 kHz	50 kHz	1 s	120 kHz	50 kHz	5 ms

[a] For purely broadband disturbances, the maximum frequency step size may be increased up to a value not greater than the bandwidth value.

56-3.7 Method of measurement of radiated narrowband electromagnetic emissions from vehicles

56-3.7.1 General

56-3.7.1.1 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.

56-3.7.1.2 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 or to CISPR 25.

56-3.7.1.3 As an initial step the levels of emissions in the Frequency Modulation (FM) band (76 to 108 MHz) shall be measured at the vehicle broadcast radio antenna with an average detector. If the level specified in paragraph 56-3.4.3.2.4. of this Regulation 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.

56-3.7.1.4 As an alternative for vehicles of category L the measurement location can be chosen according to paragraph 56-3.6.3.1 and 56-3.6.3.2.

56-3.7.2 Vehicle state during tests

56-3.7.2.1 The ignition switch shall be switched on. The engine shall not be operating.

56-3.7.2.2 The vehicle's electronic systems shall all be in normal operating mode with the vehicle stationary.

56-3.7.2.3 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.

56-3.7.3 Test requirements

56-3.7.3.1 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.

56-3.7.3.2 Measurements shall be performed with an average detector.

56-3.7.3.3 The measurements shall be performed with a spectrum analyser or a scanning receiver.

The parameters to be used are defined in Table 10 and Table 11.

56-3.7.3.4 Measurements

The Technical Service shall perform the test at the intervals specified in the CISPR 12 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 Type Approval Authority, the Technical Service 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 and 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 to background radiation including broadband radiation from any ESA.

56-3.7.3.5 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.

56-3.8 Method of measurement of radiated broadband electromagnetic emissions from electrical/electronic sub-assemblies（ESAs）

56-3.8.1 General

56-3.8.1.1 The test method described in this annex may be applied to ESAs, which may be subsequently fitted to vehicles, which comply with paragraph 56-3.6.

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".

56-3.8.1.2 Test method

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

If not otherwise stated in this annex the test shall be performed according CISPR 25.

56-3.8.2 ESA state during tests

56-3.8.2.1 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 and80 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 percent of its nominal value.

56-3.8.3 Test arrangements

56-3.8.3.1 For ESA other than involved in "REESS charging mode coupled to the power grid" the test shall be performed according to the ALSE method described in clause 6.4. of CISPR25.

56-3.8.3.2 For ESAs in configuration "REESS charging mode coupled to the power grid" the test arrangement shall be according to Figure 13.

56-3.8.3.2.1 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.

56-3.8.3.2.2 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 (+/- 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).

56-3.8.3.2.3 All of the harnesses shall be placed on a non-conductive, low relative permittivity material ($epsilon_r \leq 1.4$), at 50 mm (+/- 5 mm) above the ground plane.

56-3.8.3.2.4 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.

56-3.8.3.2.5 Unless otherwise specified, the ESA case shall be connected to the ground plane either directly or via defined impedance.

56-3.8.3.2.6 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).

56-3.8.3.3 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 figure 14).

56-3.8.3.4 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 56-3.4.5.2.1 of this Regulation, except for intentional narrowband ambient transmissions.

56-3.8.4 Test requirements

56-3.8.4.1 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.

56-3.8.4.2 Measurements can be performed with either quasi-peak or peak detectors. The limits given in paragraphs 56-3.4.2 and 56-3.4.5 of this Regulation are for quasi-peak detectors. If peak detectors are used a correction factor of 20 dB as defined in CISPR 12 shall be applied.

56-3.8.4.3 The measurements shall be performed with a spectrum analyser or a scanning receiver.

The parameters to be used are defined in Table 10 and Table 11.

56-3.8.4.4 Measurements

Unless otherwise specified the configuration with the LV harness closer to the antenna shall be tested.

The phase centre of the antenna shall be in line with the centre of the longitudinal part of the wiring harnesses for frequencies up to 1,000 MHz.

The Technical Service shall perform the test at the intervals specified in the CISPR 12 standard throughout the frequency range 30 to 1,000 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 Approval Authority, the Technical Service may divide the frequency range in 14 frequency bands30 - 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 and 850 - 1,000 MHz and

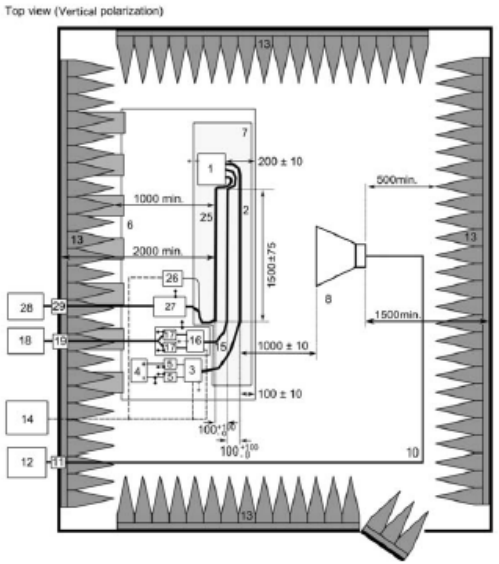
perform tests at the 14 frequencies giving the highest emission levels within each band to confirm that the ESA meets the

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.

56-3.8.4.5 Readings

The maximum of the readings relative to the limit (horizontal/vertical polarization) in each of the 14 frequency bands shall be taken as the characteristic reading at the frequency at which the measurements were made.



Legend:

1 ESA (grounded locally if required in test plan)

2 LV Test harness

3 LV Load simulator (placement and ground connection according to CISPR 25 paragraph 6.4.2.5.)

4 Power supply (location optional)

5 LV Artificial network (AN)

6 Ground plane (bonded to shielded enclosure)

7 Low relative permittivity support ($epsilon_r \leq 1.4$)

8 Horn antenna

10 High-quality coaxial cable e.g. double-shielded (50 ohms)

11 Bulkhead connector

12 RF signal generator and amplifier

13 RF absorber material

14 Stimulation and monitoring system

15 HV harness

16 HV load simulator

17 HV AN

18 HV power supply

19 HV feed-through

25 AC/DC charger harness

26 AC/DC load simulator (e.g. PLC)

27 50 microhenry LISN (AC) or HVAN (DC)

28 AC/DC power supply

29 AC/DC feed-through

Figure13: Test configuration for ESAs involved in "REESS charging mode coupled to the power grid"
(Example for biconical antenna)

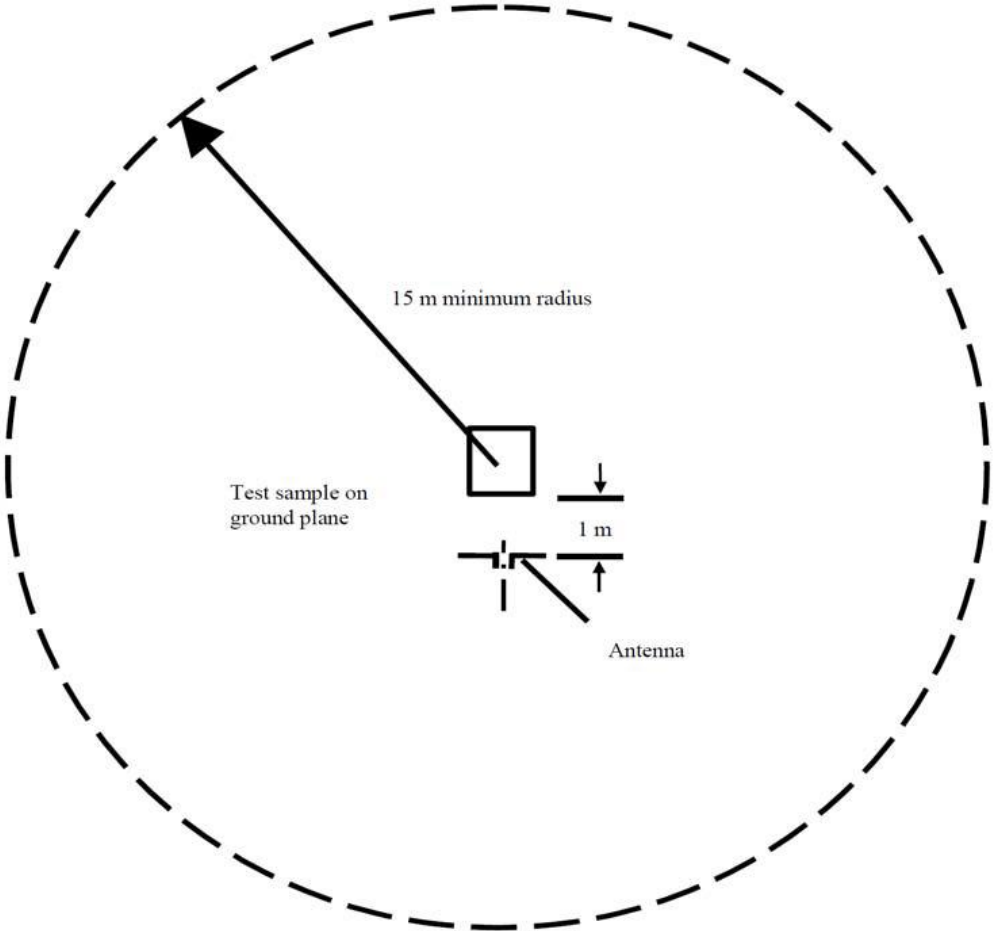


Figure 14

56-3.9 Method of measurement of radiated narrowband electromagnetic emissions from electrical /electronic sub-assemblies（ESAs）.

56-3.9.1 General

56-3.9.1.1 The test method described in this annex may be applied to ESAs, which may be subsequently fitted to vehicles, which

comply, with paragraph 56-3.7.This method concerns only ESA other than those involved in "REESS charging mode coupled to the power grid".

56-3.9.1.2 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.

56-3.9.2 ESA state during tests: The ESA under test shall be in normal operation mode, preferably in maximum load.

56-3.9.3 Test arrangement

56-3.9.3.1 The test shall be performed according CISPR 25 clause 6.4. -ALSE method.

56-3.9.3.2 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 16-1-4 (third edition 2010) may be used (as shown in figure 14.).

56-3.9.3.3 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 56-3.4.6.2.1. of this Regulation, except for intentional narrowband ambient transmissions.

56-3.9.4 Test requirements

56-3.9.4.1 The limits apply throughout the frequency range 30 to 1,000 MHz for measurements performed in semi anechoic chambers or outdoor test sites.

56-3.9.4.2 Measurements shall be performed with an average detector.

56-3.9.4.3 The measurements shall be performed with a spectrum analyser or a scanning receiver. The parameters to be used are defined in Tables 10 and 11.

56-3.9.4.4 Measurements

The Technical Service shall perform the test at the intervals specified in the CISPR 12 standard throughout the frequency range 30 to 1,000 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 Approval Authority, the Technical Service 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 and 850 - 1,000 MHz and perform tests at the 14 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 including broadband radiation from the ESA.

56-3.9.4.5 Readings

The maximum of the readings relative to the limit (horizontal/vertical polarisation) in each of the 14 frequency bands shall be taken as the characteristic reading at the frequency at which the measurements were made.

56-3.10 Method of testing for immunity of vehicles to electromagnetic radiation

56-3.10.1 General

56-3.10.1.1 The test method described in this paragraph shall only be applied to vehicles. This method concerns both configurations of vehicle:

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

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

56-3.10.1.2 Test method

This test is intended to demonstrate the immunity of the vehicle electronic systems. The vehicle shall be subject to electromagnetic fields as described in this paragraph. 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.

56-3.10.1.3 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 can be used in the frequency range 20 to 2,000 MHz with levels defined in paragraph 56-3.4.9.2.1 .of this Regulation.

56-3.10.2 Vehicle state during tests

56-3.10.2.1 Vehicle in configuration other than "REESS in charging mode coupled to the power grid".

56-3.10.2.1.1 The vehicle shall be in an unladen condition except for necessary test equipment.

56-3.10.2.1.1.1 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 and L2 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).

56-3.10.2.1.1.2 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 Technical Service.

"50 km/h cycle" vehicle test conditions	Failure criteria
Vehicle speed 50 km/h (respectively 25 km/h for L1, L2 vehicles) +/- 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 +/- 10 per cent of the nominal speed. In case of automatic gearbox: change of gear ratio inducing a speed variation greater than +/- 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

"Brake cycle" vehicle test conditions	Failure criteria
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

56-3.10.2.1.1.3 All equipment which can be switched on permanently by the driver or passenger should be in normal operation.

56-3.10.2.1.1.4 All other systems which affect the driver's control of the vehicle shall be (on) as in normal operation of the vehicle.

56-3.10.2.1.2 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 56-3.10.2.3. , it will be permissible for the manufacturer to

provide a report or additional evidence to the Technical Service that the vehicle electrical/electronic system meets the requirements of this Regulation. Such evidence shall be retained in the test report.

56-3.10.2.1.3 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 are met (e.g. by using (a) video camera(s), a microphone, etc.).

56-3.10.2.2 Vehicle in configuration "REESS in charging mode coupled to the power grid". (See figure 15-1,15-2,15-3,15-4)

56-3.10.2.2.1 The vehicle shall be in an unladen condition except for necessary test equipment.

56-3.10.2.2.1.1 The vehicle shall be immobilized, engine OFF and in charging mode.

56-3.10.2.2.1.2 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 Technical Service.

"REESS charging mode" vehicle test conditions	Failure criteria
The REESS shall be in charging mode. The REESS State of charge (SOC) 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 20 per cent of its nominal value.	Vehicle sets in motion.

56-3.10.2.2.1.3 All other equipment which can be switched on permanently by the driver or passenger should be OFF.

56-3.10.2.2.2 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.).

56-3.10.2.2.3 The test set-up for the connection of the vehicle in configuration "REESS charging mode coupled to the power grid" is shown in Figures 15-1,15-2,15-3 and 15-4 (depending of AC or DC power charging mode, location of charging plug and charging with or without communication).

56-3.10.2.3 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.

56-3.10.2.4 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 15-1,15-2,15-3 and 15-4.

56-3.10.2.5 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 22 paragraph 9.6.2.

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 ohm load.

The IS shall be placed as defined in Figures 15-3 and 15-4.

56-3.10.2.6 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 of100 mm (+200/-0 mm) from the vehicle body.

The whole cable shall be placed on a non-conductive, low relative permittivity (dielectric-constant) material (epsilonr ≤ 1.4), at 100 mm (+/- 25 mm) above the ground plane.

56-3.10.3 Reference point

56-3.10.3.1 For the purposes of this paragraph, the reference point is the point at which the field strength shall be established and shall be defined as follows:

56-3.10.3.2 For category M, N, O vehicles according to ISO 11451-2.

56-3.10.3.3 For category L vehicles:

56-3.10.3.3.1 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);

56-3.10.3.3.2 on the vehicle's centre line (plane of longitudinal symmetry);

56-3.10.3.3.3 at a height of 1.0 +/- 0.05 m above the plane on which the vehicle rests or 2.0 +/- 0.05m if the minimum height of the roof of any vehicle in the model range exceeds 3.0 m,

56-3.10.3.3.4 At 1.0 +/- 0.2 m below the vertical centerline of the vehicle's front wheel (point C in figure 16) in the case of vehicle of category L2 and L5. ; or at 0.2 +/- 0.2 m behind the vertical centerline of the vehicle's front wheel (point D in figure 16-1) in the case of two-wheeled vehicles.

56-3.10.3.3.5 If it is decided to radiate the rear of the vehicle, the reference point shall be established as in paragraphs 56-3.10.3.3.1. to 56-3.10.3.3.4. 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 17.

56-3.10.4 Test requirements

56-3.10.4.1 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 per cent modulation depth in the 20 to 800 MHz frequency range, and

(b) PM (pulse modulation), Ton 577 microseconds, period 4,600 microseconds in the 800 to 2,000 MHz frequency range, if not otherwise agreed between Technical Service and vehicle manufacturer. Frequency step size and dwell time shall be chosen

according to ISO 11451-1.

56-3.10.4.1.1 The Technical Service shall perform the test at the intervals specified in ISO 11451-1 and Amd1:2008 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 Approval Authority, the Technical Service 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.

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

56-3.10.5 Generation of required field strength

56-3.10.5.1 Test methodology

56-3.10.5.1.1 The substitution method according to ISO 11451-1, shall be used to establish the test field conditions.

56-3.10.5.1.2 Calibration

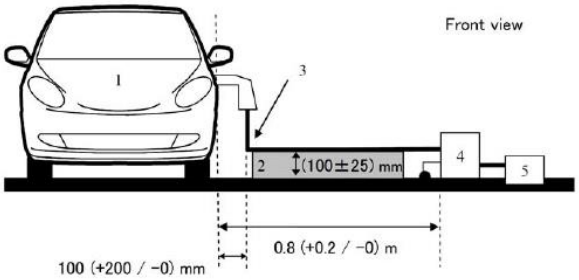
For TLS one field probe at the facility reference point shall be used. For antennas four field probes at the facility reference line shall be used.

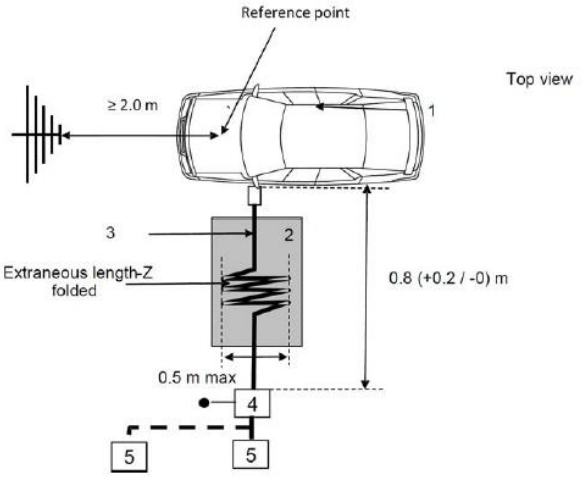
56-3.10.5.1.3 Test phase

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 Competent Authority 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





Legend:

1 Vehicle under test

2 Insulating support

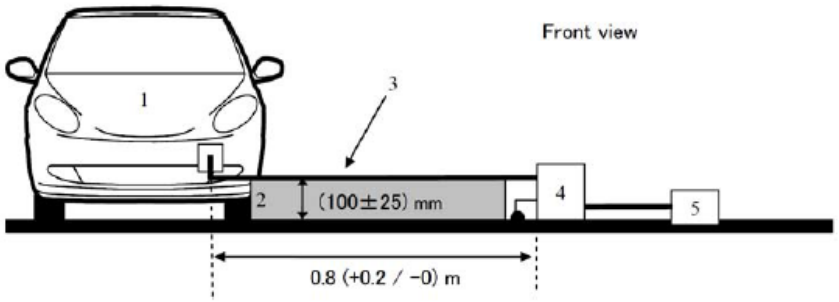
3 Charging cable

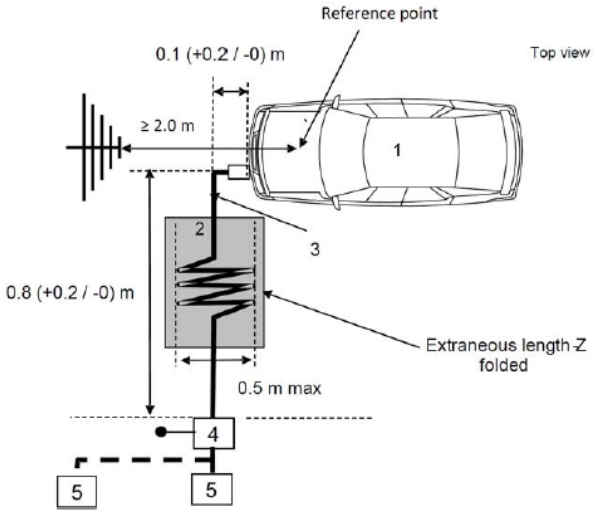
4 Artificial network(s) grounded

5 Power mains socket

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

Figure 15-1: Vehicle in configuration "REESS charging mode coupled to the power grid"





Legend:

1 Vehicle under test

2 Insulating support

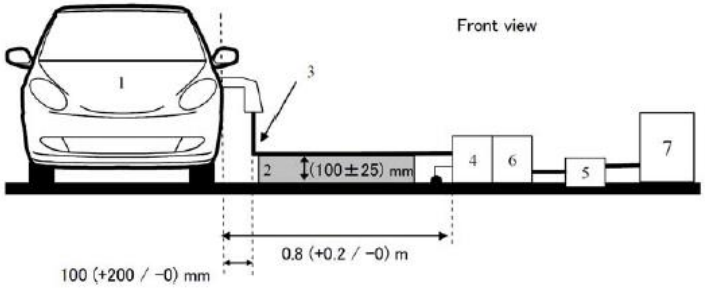
3 Charging cable

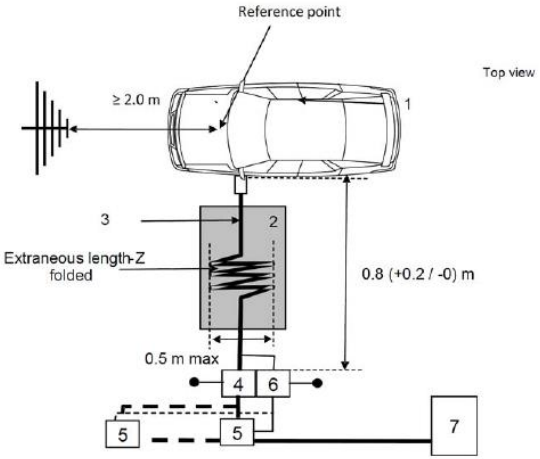
4 Artificial network(s) grounded

5 Power mains socket

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

Figure 15-2: Vehicle in configuration "REESS charging mode coupled to the power grid"





Legend:

1 Vehicle under test

2 Insulating support

3 Charging / communication cable

4 AC or DC artificial network(s) grounded

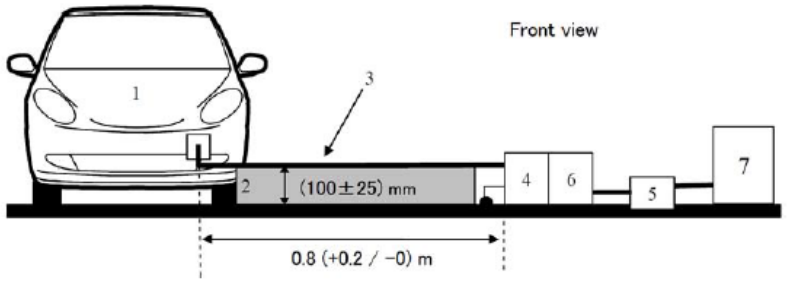
5 Power mains socket

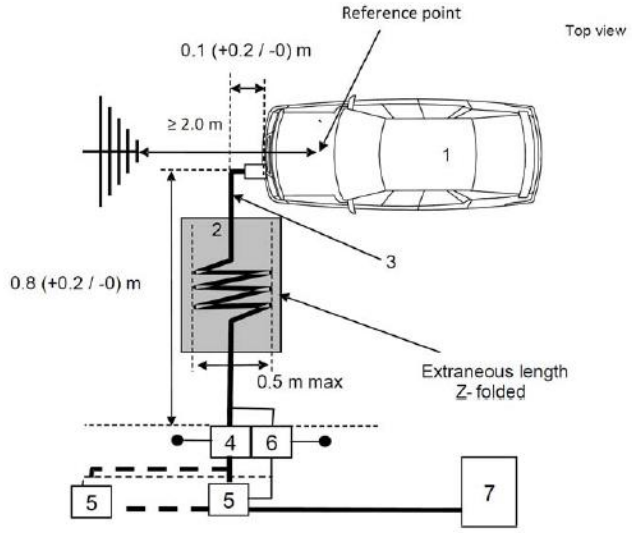
6 Impedance stabilisation(s) grounded

7 Charging station

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

Figure 15-3: Vehicle in configuration "REESS charging mode coupled to the power grid"





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 15-4: Vehicle in configuration "REESS charging mode coupled to the power grid"

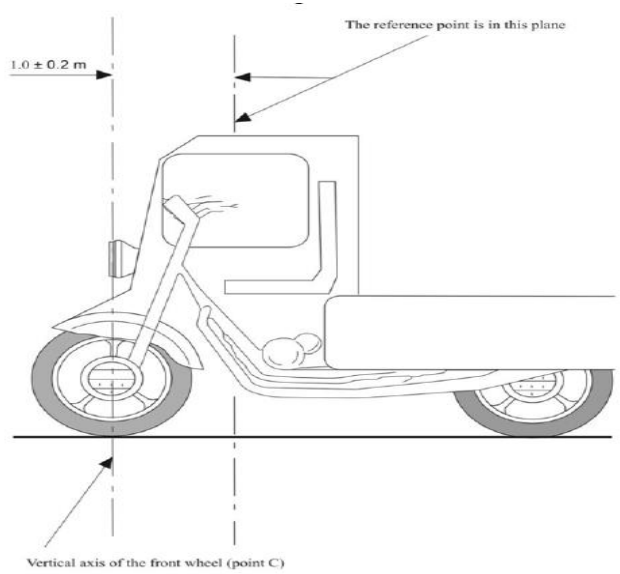


Figure 16

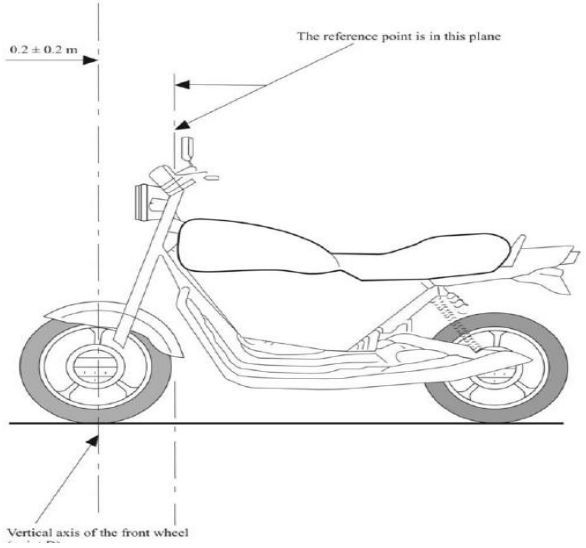


Figure 16-1

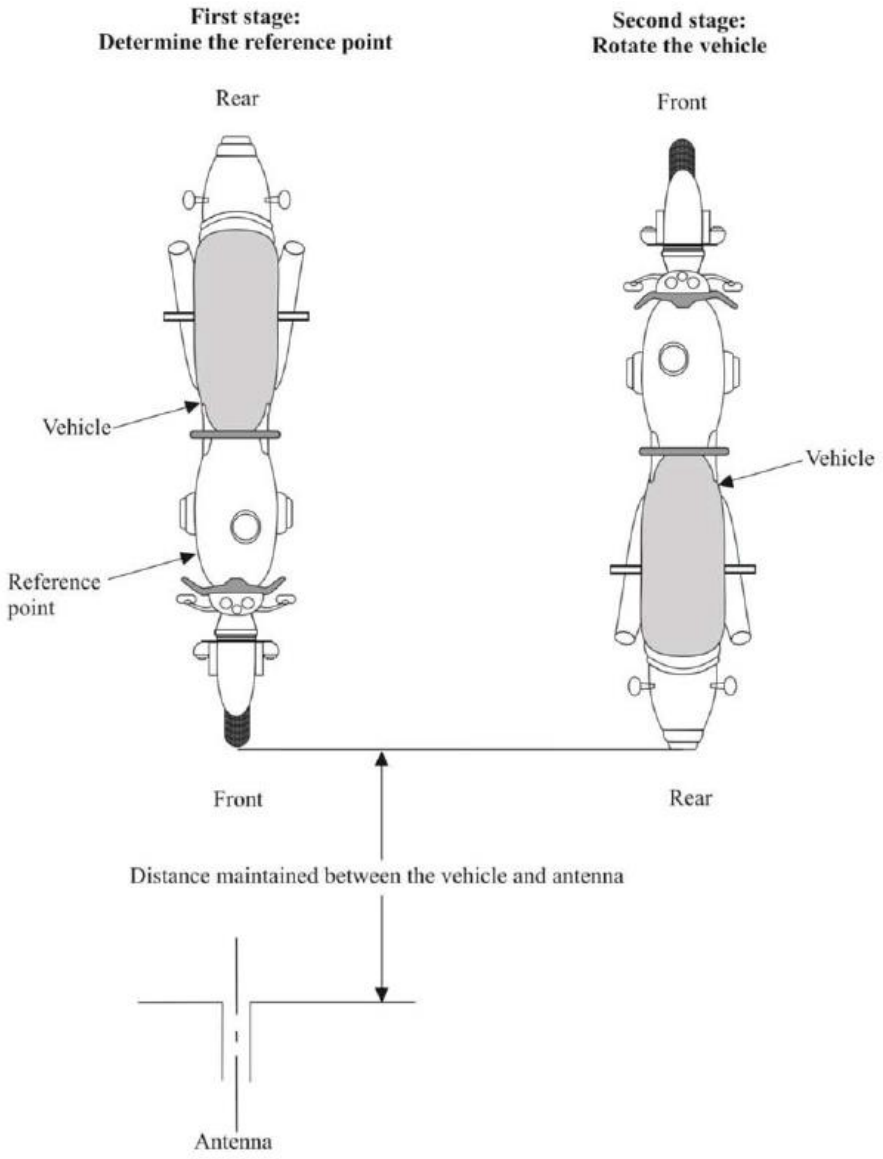

First stage:
Determine the reference point
Second stage:
Rotate the vehicle
Rear
Front
Vehicle
Vehicle
Reference point
Front
Rear
Distance maintained between the vehicle and antenna
Antenna

Figure 17

56-3.11 Method(s) of testing for immunity of electrical/electronic subassemblies to electromagnetic radiation

56-3.11.1 General

56-3.11.1.1 The test method(s) described in this paragraph applies to ESAs.

56-3.11.1.2 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".

56-3.11.1.2.1 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 56-3.11.3.1:

(a) Absorber chamber test according ISO 11452-2;

(b) TEM cell testing according ISO 11452-3;

(c) Bulk current injection testing according ISO 11452-4;

(d) Stripline testing according ISO 11452-5;

(e) 800 mm stripline according paragraph 56-3.10.4.5. of this regulation.

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 ISO11452-2 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 56-3 11.4.5 being covered.

56-3.11.2 State of ESA during tests

56-3.11.2.1 The test conditions shall be according ISO 11452-1.

56-3.11.2.2 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 paragraph 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 percent of its nominal value.

56-3.11.2.3 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.

56-3.11.2.4 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.

56-3.11.2.5 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.

56-3.11.3 General test requirements

56-3.11.3.1 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.The test signal modulation shall be:

(a) AM (amplitude modulation), with 1 kHz modulation and 80 per cent modulation depth in the 20 to 800 MHz frequency range;

(b) PM (pulse modulation), t on 577 microseconds, period 4,600 microseconds in the 800 to 2,000 MHz frequency range, if not otherwise agreed between Technical Service and ESA manufacturer.

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

56-3.11.3.2 The Technical Service shall perform the test at the intervals specified in ISO 11452-1 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 Approval Authority, the Technical Service 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 paragraph.

56-3.11.4 Special test requirements

56-3.11.4.1 Absorber chamber test

56-3.11.4.1.1 Test method

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

56-3.11.4.1.2 Test methodology

The "substitution method" shall be used to establish the test field conditions according ISO 11452-2.
The test shall be performed with vertical polarization.

56-3.11.4.1.2.1 For ESAs in configuration "REESS charging mode coupled to the power grid" the test arrangement shall be according to paragraph 56-3.11.5.

56-3.11.4.1.2.1.1 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.

56-3.11.4.1.2.1.2 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 (+/- 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).

56-3.11.4.1.2.1.3 All of the harnesses shall be placed on a non-conductive, low relative permittivity material ($epsilon_r \leq 1.4$), at 50 mm (+/- 5 mm) above the ground plane.

56-3.11.4.1.2.1.4 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.

56-3.11.4.1.2.1.5 Unless otherwise specified, the ESA case shall be connected to the ground plane either directly or via defined impedance.

56-3.11.4.1.2.1.6 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).

56-3.11.4.1.2.1.7 Unless otherwise specified, the configuration with the LV harness closer to the antenna shall be tested.

56-3.11.4.2 TEM cell testing（see table 12）

56-3.11.4.2.1 Test method

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

56-3.11.4.2.2 Test methodology

The test shall be performed according ISO 11452-3.

Depending on the ESA to be tested the Technical Service shall chose the method of maximum field coupling to the ESA or to the wiring harness inside the TEM-cell.

56-3.11.4.3 Bulk current injection testing

56-3.11.4.3.1 Test method: this is a method of carrying out immunity tests by inducing currents directly into a wiring harness using a

current injection probe.

56-3.11.4.3.2 Test methodology

The test shall be performed according to ISO 11452-4 on a test bench. As an alternative the ESA may be tested while installed in the vehicle according to ISO 11451-4 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.

56-3.11.4.3.2.1 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.

56-3.11.4.3.2.2 Unless otherwise specified the length of the LV harness and the HV harness shall be1,700 mm (+300/-0 mm). The distance between the LV harness and the HV harness shall be 100 mm (+100/-0 mm).

56-3.11.4.3.2.3 All of the harnesses shall be placed on a non-conductive, low relative permittivity material ($epsilon_r \leq 1.4$), at (50 +/-5) mm above the ground plane.

56-3.11.4.3.2.4 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.

56-3.11.4.3.2.5 Unless otherwise specified, the ESA case shall be connected to the ground plane either directly or via defined impedance.

56-3.11.4.3.2.6 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.

56-3.11.4.4 Stripline testing

56-3.11.4.4.1 Test method

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

56-3.11.4.4.2 Test methodology

The test shall be performed according ISO 11452-5.

56-3.11.4.5 800 mm stripline testing

56-3.11.4.5.1 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 figure 18, figure 19）

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.

56-3.11.4.5.2 Test methodology

56-3.11.4.5.2.1 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.

56-3.11.4.5.2.2 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.

56-3.11.4.5.2.3 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.

56-3.11.4.5.2.4 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.

56-3.11.5 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, as shown in figure 20.

56-3.11.6 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, as shown in figure 21.

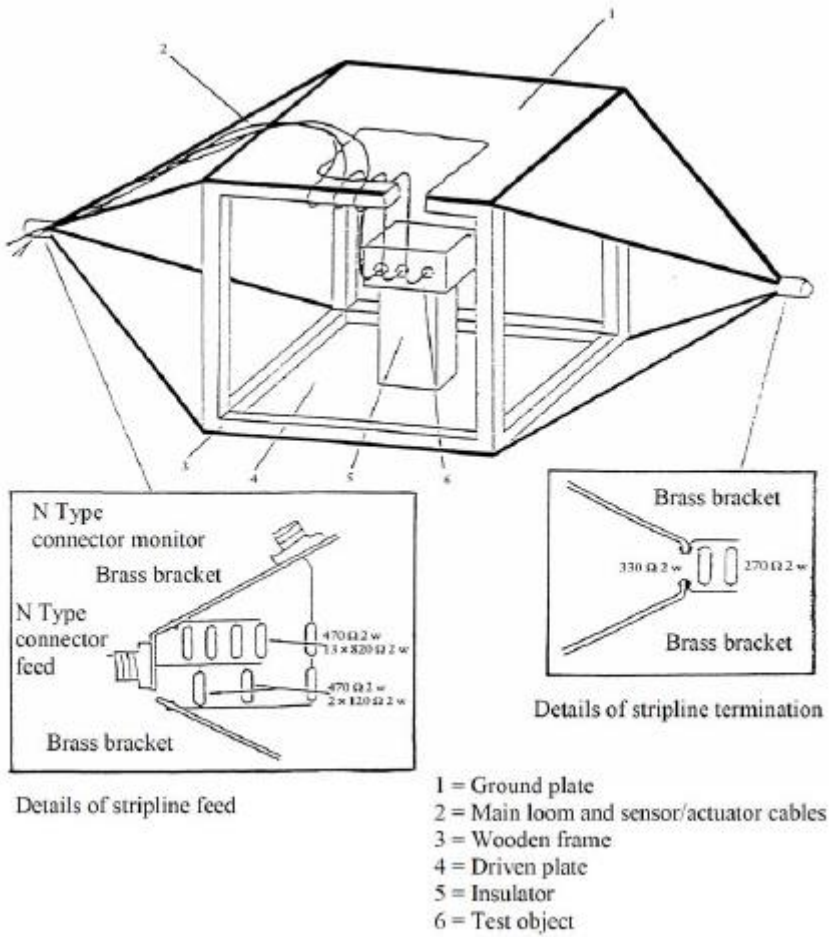


Figure 18: 800 mm Stripline testing

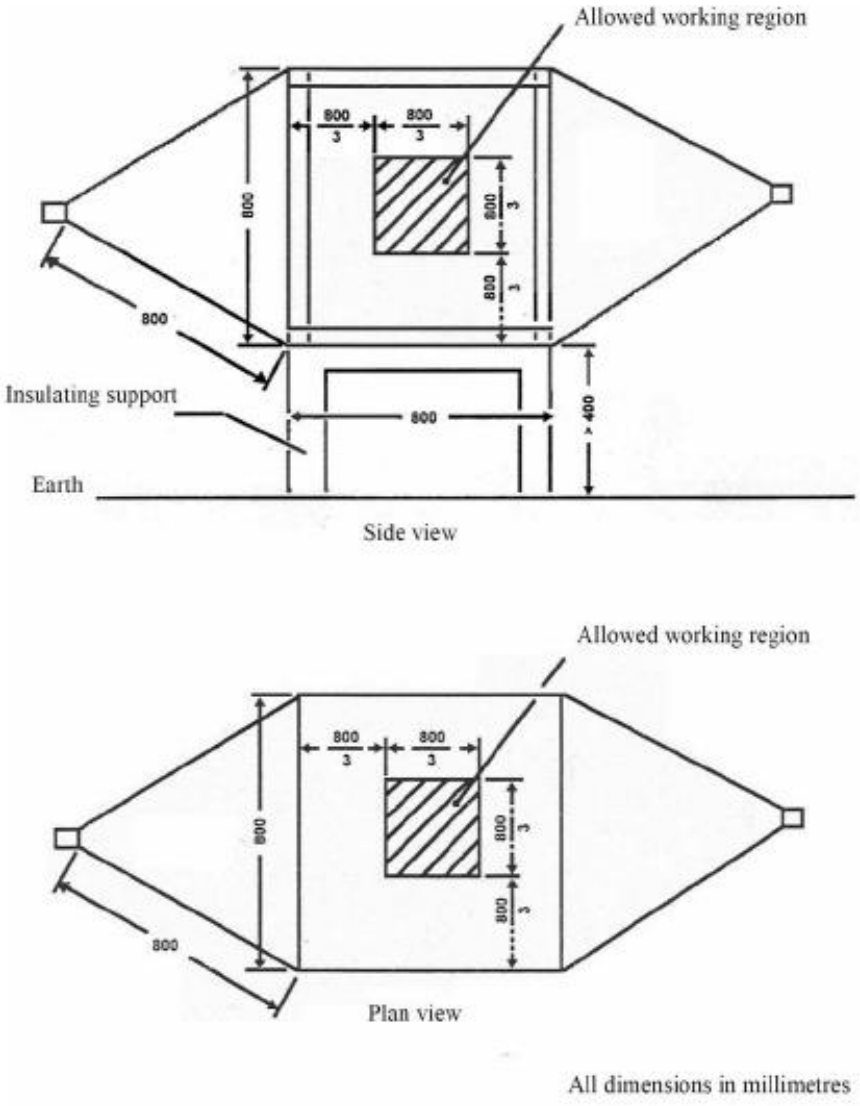
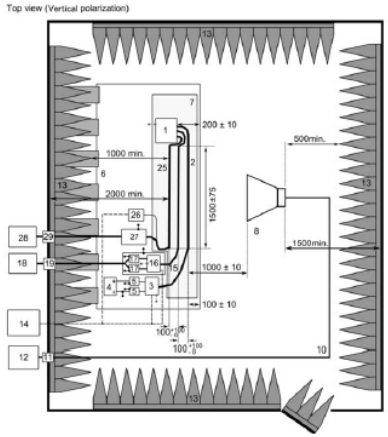


Figure 19: 800 mm stripline dimensions



Legend:

1 ESA (grounded locally if required in test plan)

2 LV Test harness

3 LV Load simulator (placement and ground connection according to CISPR 25 paragraph 6.4.2.5.)

4 Power supply (location optional)

5 LV Artificial network (AN)

6 Ground plane (bonded to shielded enclosure)

7 Low relative permittivity support (epsilon$_r \leq 1.4$)

8 Horn antenna

10 High-quality coaxial cable e.g. double-shielded (50 ohms)

11 Bulkhead connector

12 RF signal generator and amplifier

13 RF absorber material

14 Stimulation and monitoring system

15 HV harness

16 HV load simulator

17 HV AN

18 HV power supply

19 HV feed-through

25 AC/DC charger harness

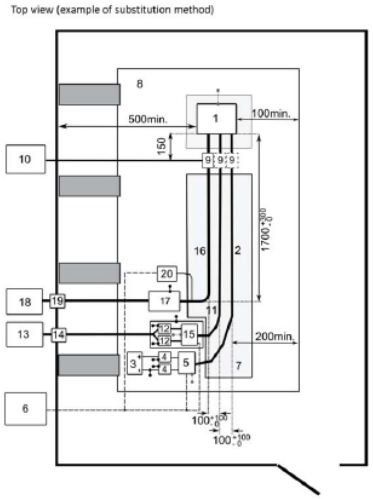
26 AC/DC load simulator (e.g. PLC)

27 50 microhenry LISN (AC) or HVAN (DC)

28 AC/DC power supply

29 AC/DC feed-through

Figure 20:Test configuration for ESA's involved in "REESS charging mode coupled to the power grid".



Legend:

1 ESA (grounded locally if required in test plan)

2 LV Test harness

3 LV supply

4 LV LISN

5 LV load simulator

6 Stimulation and monitoring system

7 Low relative permittivity support

8 Ground plane

9 Injection probe

10 RF signal amplifier and generator

11 HV DC harness

12 HV AN

13 HV DC load

14 HV DC feed-through

15 HV DC load simulator

16 HV AC/DC charger harness

17 50 microhenry LISN (AC) or HV AN (DC)

18 HV AC/DC power supply

19 HV AC/DC feed-through

20 HV AC/DC load simulator (e.g. PLC)

Figure 21:Test configuration for ESAs involved in "REESS charging mode coupled to the power grid".

Table 12: Typical TEM cell dimensions

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

56-3.12 Method(s) of testing for immunity to and emission of transients of electrical/electronic sub-assembles（ESAs）

56-3.12.1 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.

56-3.12.2 Immunity against transient disturbances conducted along 12/24V supply lines

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

56-3.12.3 Emission of transient conducted disturbances along generated by ESAS on 12/24V supply lines

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

56-3.13 Method(s) of Testing for Emission of Harmonics generated on AC power lines from vehicle.

56-3.13.1 General

56-3.13.1.1 The test method described in this annex shall be applied to vehicles in configuration "REESS charging mode coupled to the power grid"

56-3.13.1.2 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 (edition 3.2 - 2005 +Amd1:2008+Amd2:2009) for input current in charging mode ≦ 16 A per phase for class A equipment,

(b) IEC 61000-3-12 (edition 1.0 - 2004) for input current in charging mode > 16 A and ≦ 75 A per phase.

56-3.13.2 Vehicle State during Tests

56-3.13.2.1 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.

56-3.13.3 Test Arrangements

56-3.13.3.1 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.

56-3.13.3.2 The test set-up for single phase vehicle in configuration "REESS charging mode coupled to the power grid" is shown in figure 22.

56-3.13.3.3 The test set-up for three-phase vehicle in configuration "REESS charging mode coupled to the power grid" is shown in figure 23.

56-3.13.4 Test Requirements

56-3.13.4.1 The measurements of even and odd current harmonics shall be performed up to the fortieth harmonic.

56-3.13.4.2 The limits for single phase or three-phase "REESS charging mode coupled to the power grid" with input current ≦ 16 A per

phase are given in paragraph 56-3.5.3.2.1. table 3.

56-3.13.4.3 The limits for single phase "REESS charging mode coupled to the power grid" with input current > 16 A and ≦ 75 A per phase are given in paragraph 56-3.5.3.2.2. table 4.

56-3.13.4.4 The limits for three-phase "REESS charging mode coupled to the power grid" with input current > 16 A and ≦ 75 A per phase are given in paragraph 56-3.5.3.2.2. table 5.

56-3.13.4.5 . For three-phase "REESS charging mode coupled to the power grid" with input current > 16 A and ≦ 75 A per phase, when at least one of the three conditions a), b), c) described in IEC 61000-3-12 clause 5.2, is fulfilled then the limits given in paragraph 56-3.5.3.2.2. table 6 can be applied.

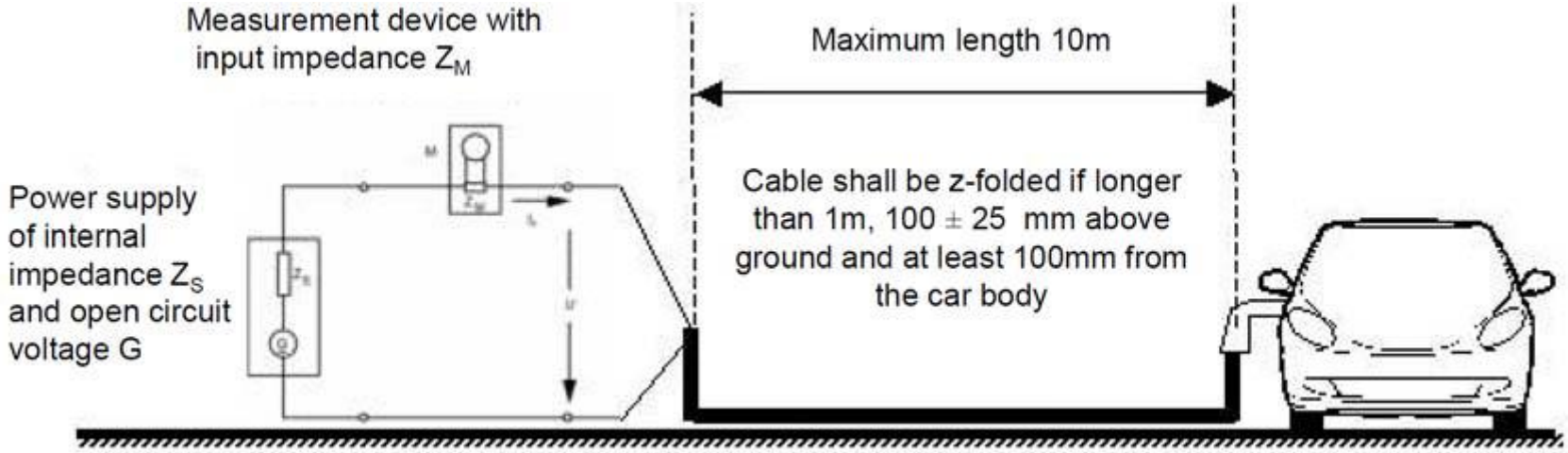


Figure 22: Vehicle in configuration "REESS charging mode coupled to the power grid" - Single phase charger test set-up

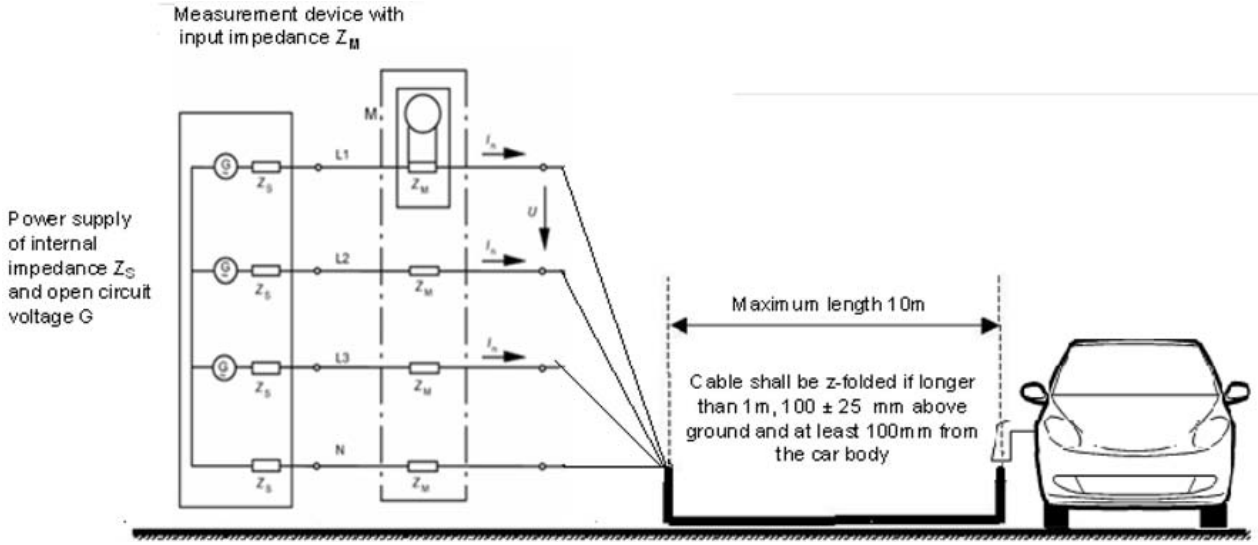


Figure 23: Vehicle in configuration "REESS charging mode coupled to the power grid" - Three-phase charger test set-up

56-3.14 Method(s) of testing for emission of voltage changes, voltage fluctuations and flicker on AC power lines from vehicle

56-3.14.1 General

56-3.14.1.1 The test method described in this annex shall be applied to vehicles in configuration "REESS charging mode coupled to the power grid"

56-3.14.1.2 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" ≦ 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 ≦ 75 A per phase and subjected to conditional connection.

56-3.14.2 Vehicle State during Tests

56-3.14.2.1 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 and80 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.

56-3.14.3 Test Arrangements

56-3.14.3.1 The tests for vehicle in configuration "REESS charging mode coupled to the power grid" with rated current ≦ 16 A per phase and not subjected to conditional connection shall be performed according IEC 61000-3-3 (edition 2.0 - 2008) paragraph 4.

56-3.14.3.2 The tests for vehicle in configuration "REESS charging mode coupled to the power grid" with rated current > 16 A and ≦ 75 A per phase and subjected to conditional connection shall be performed according IEC 61000-3-11 (edition 1.0 - 2000) paragraph 6.

56-3.14.3.3 The test set-up for vehicle in configuration "REESS charging mode coupled to the power grid" is shown in figure 24-1, 24-2.

56-3.14.4 Test Requirements

56-3.14.4.1 The parameters to be determined in the time-domain are "short duration flicker value", "long duration flicker value" and "voltage relative variation".

56-3.14.4.2 The limits for vehicle in configuration "REESS charging mode coupled to the power grid" with input current ≦ 16 A per phase and not subjected to conditional connection are given in paragraph 56-3.5.4.2.1.

56-3.14.4.3 The limits for vehicle in configuration "REESS charging mode coupled to the power grid" with input current > 16 A and ≦ 75 A per phase and subjected to conditional connection are given in paragraph 56-3.5.4.2.2.

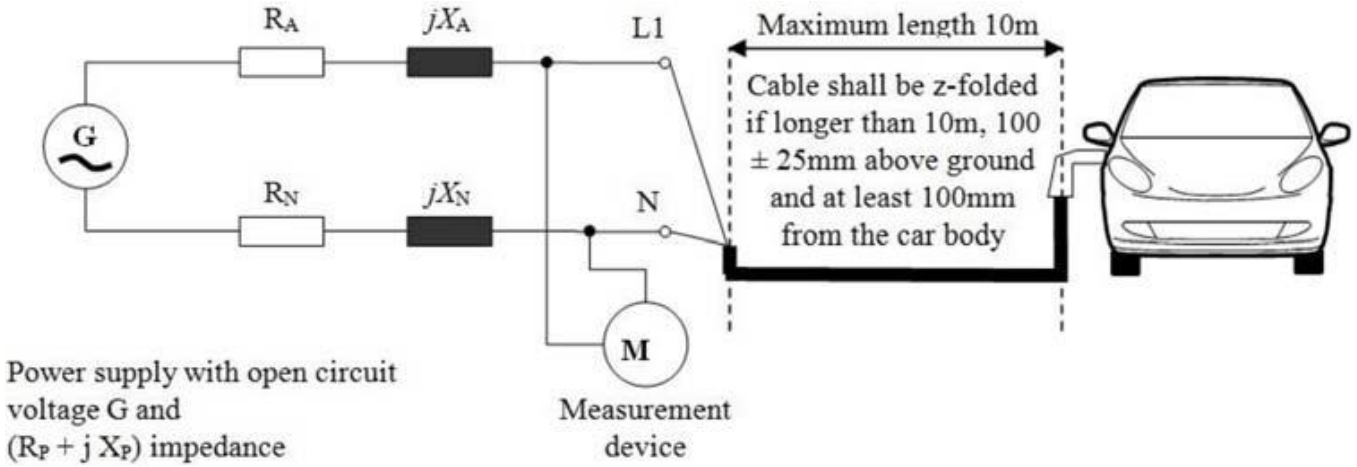


Figure 24-1: Vehicle in configuration "REESS charging mode coupled to the power grid" - Single phase

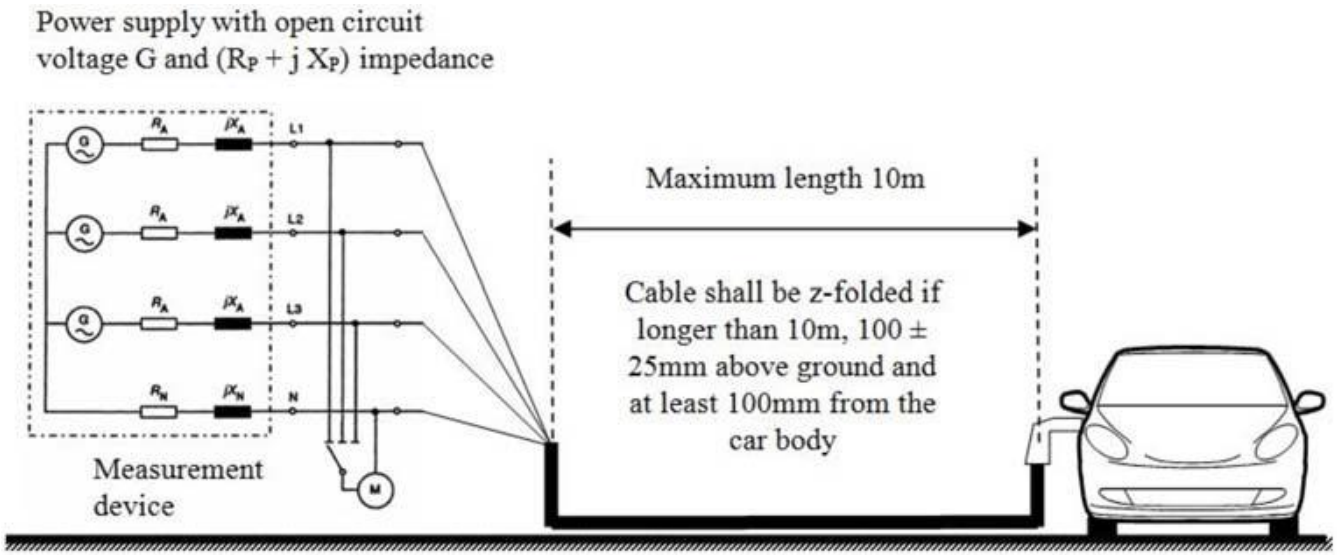


Figure 24-2: Vehicle in configuration "REESS charging mode coupled to the power grid" - Three phasetest set-up

56-3.15 Method(s) of Testing for Emission of Radiofrequency conducted disturbances on AC or DC power lines from vehicle

56-3.15.1 General

56-3.15.1.1 The test method described in this annex shall be applied to vehicles in configuration "REESS charging mode coupled to the power grid".

56-3.15.1.2 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.

56-3.15.2 Vehicle state during tests

56-3.15.2.1 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.

56-3.15.3 Test Arrangements

56-3.15.3.1 The test shall be performed according to CISPR 16-2-1 clause 7.4.1. as floor-standing equipments.

56-3.15.3.2 The artificial mains network to be used for the measurement on vehicle is defined in CISPR 16-1-2, clause 4.3.

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 Figure 25-1 and Figure 25-2.

56-3.15.3.3 The test set-up for the connection of the vehicle in configuration "REESS charging mode coupled to the power grid" is shown in figure 25-1, 25-2.

56-3.15.3.4 The measurements shall be performed with a spectrum analyser or a scanning receiver.

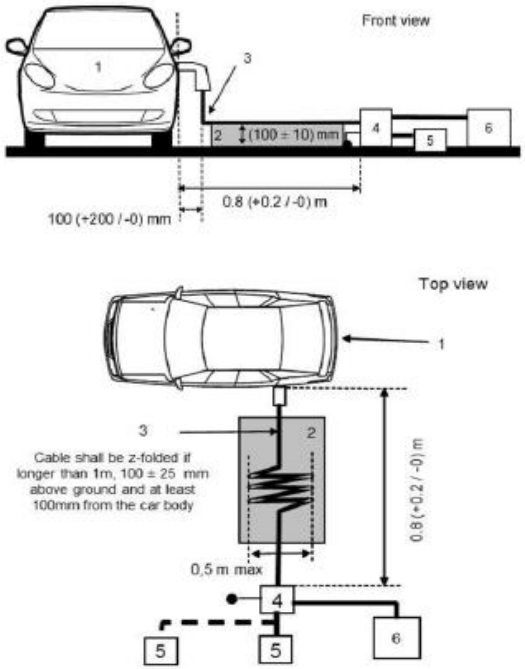
The parameters to be used are defined in Table 13 and Table 14.

56-3.15.4 Test Requirements

56-3.15.4.1 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.

56-3.15.4.2 Measurements shall be performed with average and either or peak detectors.

The limits are given in paragraph 56-3.5.5. 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.



Legend:

1 Vehicle under test

2 Insulating support

3 Charging cable

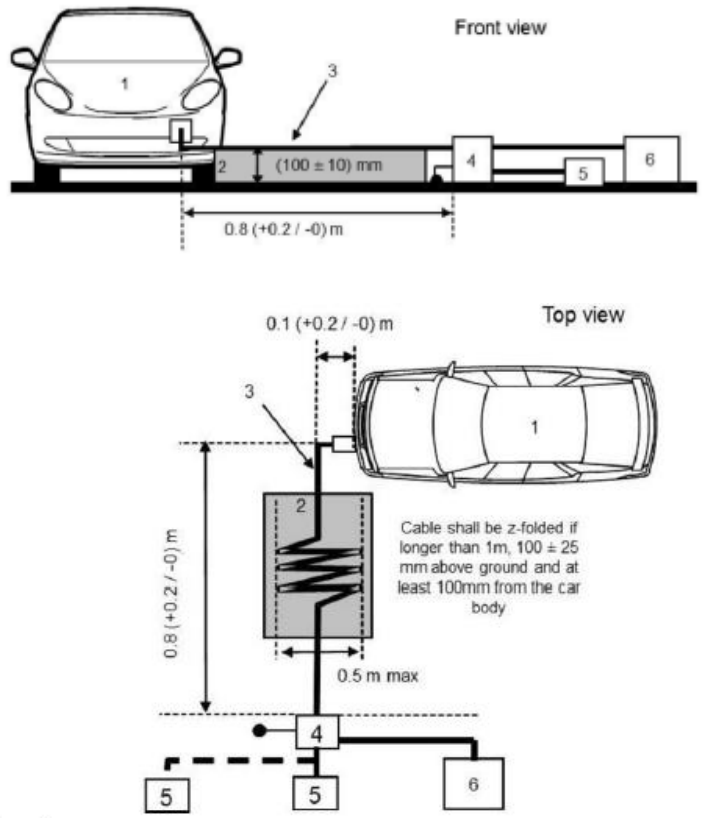
4 Artificial network(s) grounded (for AC or DC power lines)

5 Power mains socket

6 Measuring receiver

Figure 25-1: 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)



Legend:

1 Vehicle under test

2 Insulating support

3 Charging cable

4 Artificial network(s) grounded (for AC or DC power lines)

5 Power mains socket

6 Measuring receiver

Figure 25-2: 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)

Table 13: 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 14: Scanning receiver parameters

Frequency range MHz	Peak detector			Quasi-peak detector			Average detector		
	BW at -6 dB	Step size [a]	Dwell time	BW at -6 dB	Step size [a]	Dwell time	BW at -6 dB	Step size [a]	Dwell time
0.15 to 30	9 kHz	5 kHz	50 ms	9 kHz	5 kHz	1 s	9 kHz	5 kHz	50 ms

[a] For purely broadband disturbances, the maximum frequency step size may be increased up to a value not greater than the bandwidth value.

56-3.16 Method(s) of Testing for Emission of Radiofrequency conducted disturbances on Network and Telecommunication access from Vehicle

56-3.16.1 General

56-3.16.1.1 The test method described in this annex shall be applied to vehicles in configuration "REESS charging mode coupled to the power grid".

56-3.16.1.2 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 22.

56-3.16.2 Vehicle/ ESA State during Tests

56-3.16.2.1 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.

56-3.16.3 Test Arrangements

56-3.16.3.1 The test set-up shall be performed according to CISPR 22 paragraph 5 for conducted emissions.

56-3.16.3.2 The impedance stabilisation to be used for the measurement on vehicle is defined in CISPR 22 paragraph 9.6.2.

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 ohm load. The IS shall be placed as defined in Figure 26-1 to Figure 26-2.

56-3.16.3.3 The test set-up for the connection of the vehicle in configuration "REESS charging mode coupled to the power grid" is shown in figure 26-1 and figure 26-2.

If it is impossible to guarantee the functionality of vehicle, due to introduction of IS, an alternate method described in CISPR 22 (according to Figure 27-1 and Figure 27-2) shall be applied.

56-3.16.3.4 The measurements shall be performed with a spectrum analyser or a scanning receiver. The parameters to be used are defined in Table 13 and Table 14.

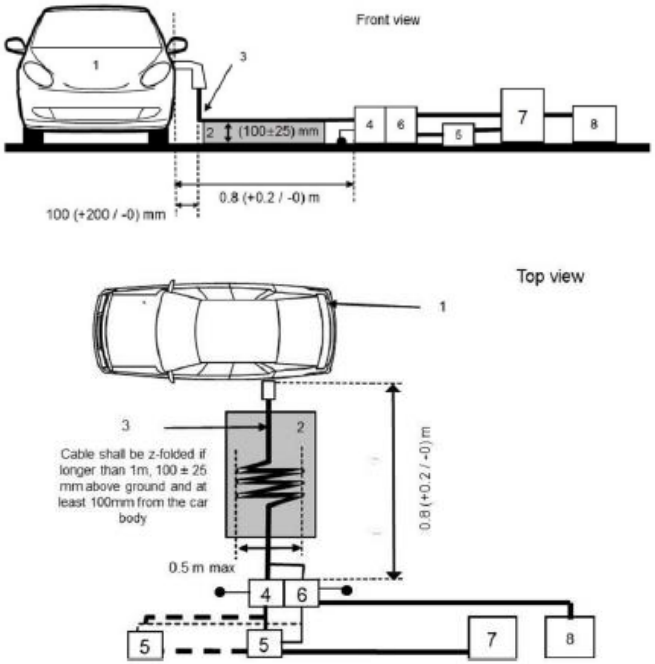
56-3.16.4 Test Requirements

56-3.16.4.1 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.

56-3.16.4.2 Measurements shall be performed with average and either quasi-peak or peak detectors.

The limits are given in paragraph 56-3.5.6. If peak detectors are used a correction factor of 20 dB as defined in CISPR 12 shall be applied.

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



Legend:

1 Vehicle under test

2 Insulating support

3 Charging / communication cable

4 AC or DC artificial network(s) grounded (for AC or DC power lines)

5 Power mains socket

6 Impedance stabilization(s) grounded (for communication lines)

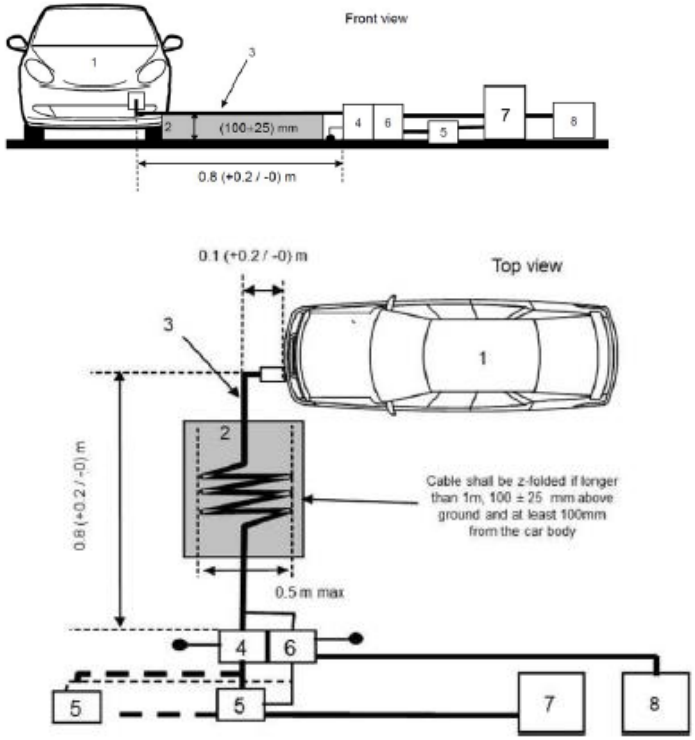
7 Charging station

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 26-1: Vehicle in configuration "REESS charging mode coupled to the power grid"



Legend:

1 Vehicle under test

2 Insulating support

3 Charging / communication cable

4 AC or DC Artificial network(s) grounded (for AC or DC power lines)

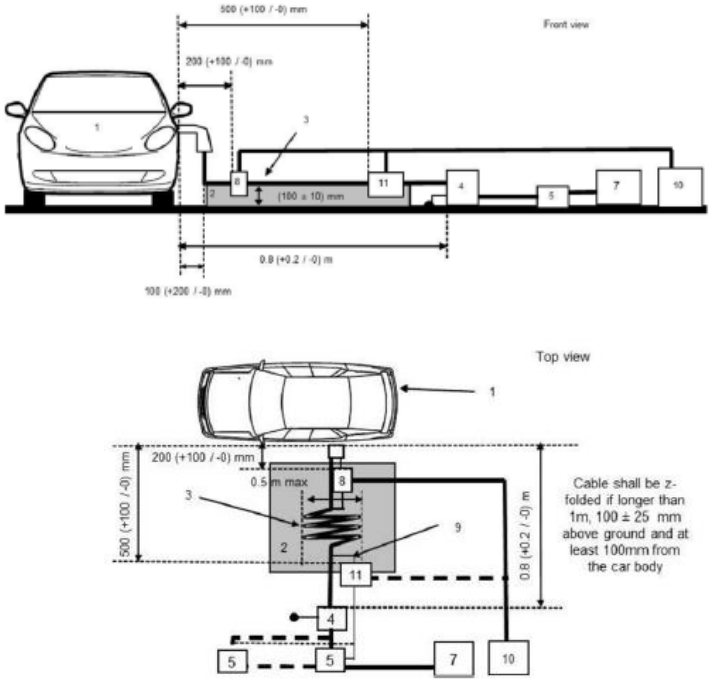
5 Power mains socket

6 Impedance stabilization(s) grounded (for communication lines)

7 Charging station

8 Measuring receiver

Figure 26-2: Vehicle in configuration "REESS charging mode coupled to the power grid"



Legend:

1 Vehicle under test

2 Insulating support

3 Charging / communication cable

4 AC or DC Artificial network(s) grounded (for AC or DC power lines)

5 Power mains socket

7 Charging station

8 Current probe

9 Communication lines

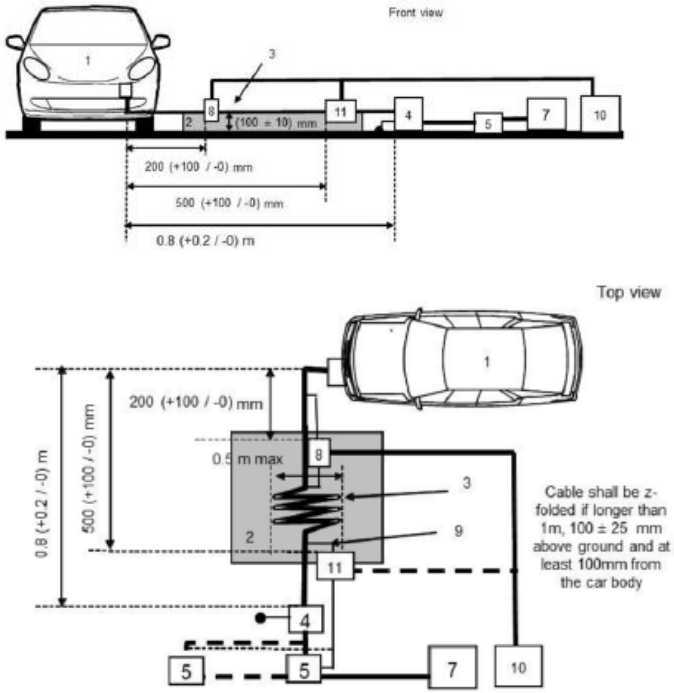
10 Measuring receiver

11 Capacitive voltage probe

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 27-1: Alternative measurement for vehicle in configuration "REESS charging mode coupled in the power grid"



Legend:

1 Vehicle under test

2 Insulating support

3 Charging / communication cable

4 AC or DC Artificial network(s) grounded (for AC or DC power lines)

5 Power mains socket

7 Charging station

8 Current probe (or capacitive voltage probe)

9 Communication lines

10 Measuring receiver

11 Capacitive voltage probe

Figure 27-2: Alternative measurement for vehicle in configuration "REESS charging mode coupled in the power grid"

56-3.17 Method of Testing for immunity of vehicles to electrical fast transient / burst disturbances conducted along AC and DC power lines

56-3.17.1 General

56-3.17.1.1 The test method described in this annex shall only be applied to vehicles. This method concerns only the configuration of the vehicle with "REESS in charging mode coupled to the power grid".

56-3.17.1.2 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: 2nd edition 2004.

56-3.17.2 Vehicle state during tests in configuration "REESS in charging mode coupled to the power grid"

56-3.17.2.1 The vehicle shall be in an unladen condition except for necessary test equipment.

56-3.17.2.1.1 The vehicle shall be immobilized, engine OFF and in charging mode.

56-3.17.2.1.2 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, must be tested in a way to be agreed between manufacturer and Technical Service.

"REESS charging mode" vehicle test conditions	Failure criteria
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). If the current consumption can be adjusted, then the current shall be set to at least 20 per cent of its nominal value.	Vehicle sets in motion

56-3.17.2.1.3 All other equipment which can be switched on permanently by the driver or passenger should be OFF.

56-3.17.2.2 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.).

56-3.17.3 Test Equipments

56-3.17.3.1 The test equipments 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.

56-3.17.3.2 The transient / burst generator shall meet the condition defined in paragraph 6.1 of IEC 61000-4-4.

56-3.17.3.3 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.

56-3.17.4 Test Setup

56-3.17.4.1 The vehicle test setup is based on the laboratory type setup as described in paragraph 7.2. of IEC 61000-4-4.

56-3.17.4.2 The vehicle shall be placed directly on the ground plane.

56-3.17.4.3 The Technical Service shall perform the test as specified in paragraph 56-3.5.7.2.1.

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 Technical Service may choose not to perform the test to confirm that the vehicle meets the requirements of this annex.

56-3.17.5 Generation of required Test Level

56-3.17.5.1 Test methodology

56-3.17.5.1.1 The test method according to IEC 61000-4-4 shall be used to establish the test level requirements.

56-3.17.5.1.2 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 28.

The test setup must be noted in the test report.

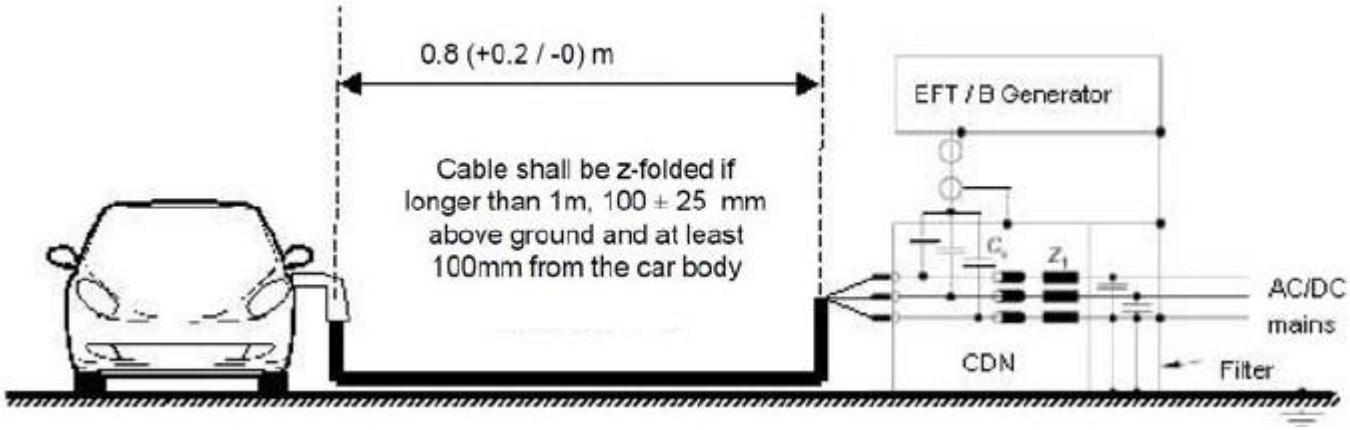


Figure 28:Vehicle in configuration "REESS charging mode" coupled to the power grid coupling on AC/DC power lines

56-3.18 Method(s) of testing for immunity of vehicles to surges conducted along AC and DC power lines

56-3.18.1 General

56-3.18.1.1 The test method described in this annex shall only be applied to vehicles. This method concerns only the configuration of the vehicle with "REESS in charging mode coupled to the power grid".

56-3.18.1.2 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: 2nd edition 2005.

56-3.18.2 Vehicle state during tests in configuration "REESS in charging mode coupled to the power grid"

56-3.18.2.1 The vehicle shall be in an unladen condition except for necessary test equipment.

56-3.18.2.1.1 The vehicle shall be immobilized, engine OFF and in charging mode.

56-3.18.2.1.2 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, must be tested in a way to be agreed between manufacturer and Technical Service.

" REESS charging mode" vehicle test conditions	Failure criteria
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).. If the current consumption can be adjusted, then the current shall be set to at least 20 per cent of its nominal value.	Vehicle sets in motion

56-3.18.2.1.3 All other equipment which can be switched on permanently by the driver or passenger should be OFF.

56-3.18.2.2 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.).

56-3.18.3 Test Equipments

56-3.18.3.1 The test equipments is composed of a reference ground plane (a shielded room is not required), a surge generator and a coupling / decoupling network (CDN).

56-3.18.3.2 The surge generator shall meet the condition defined in paragraph 6.1 of IEC 61000-4- 5.

56-3.18.3.3 The coupling / decoupling network shall meet the condition defined in paragraph 6.3. of IEC 61000-4-5.

56-3.18.4 Test Setup

56-3.18.4.1 The vehicle test setup is based on the setup described in paragraph 7.2. of IEC 61000-4-5.

56-3.18.4.2 The vehicle shall be placed directly on the ground plane.

56-3.18.4.3 The Technical Service shall perform the test as specified in paragraph 56-3.5.8.2.1.

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 Technical Service may choose not to perform the test to confirm that the vehicle meets the requirements.

56-3.18.5 Generation of required Test Level

56-3.18.5.1 Test methodology

56-3.18.5.1.1 The test method according to IEC 61000-4-5 shall be used to establish the test level requirements.

56-3.18.5.1.2 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 29 to 32.

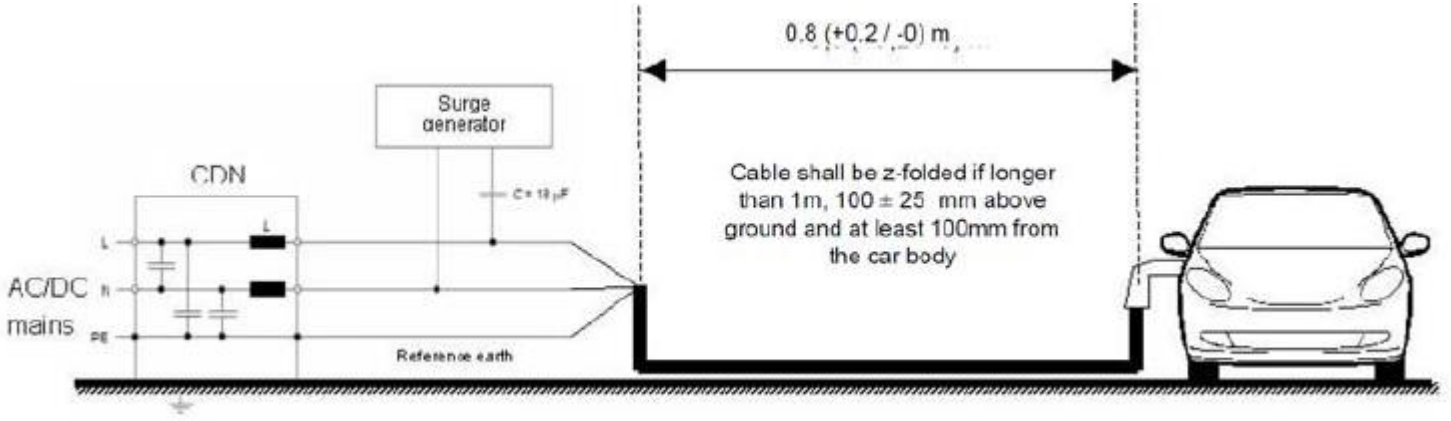


Figure 29: Vehicle in configuration "REESS charging mode coupled to the power grid" – Coupling between line and for DC or AC (single phase) power lines

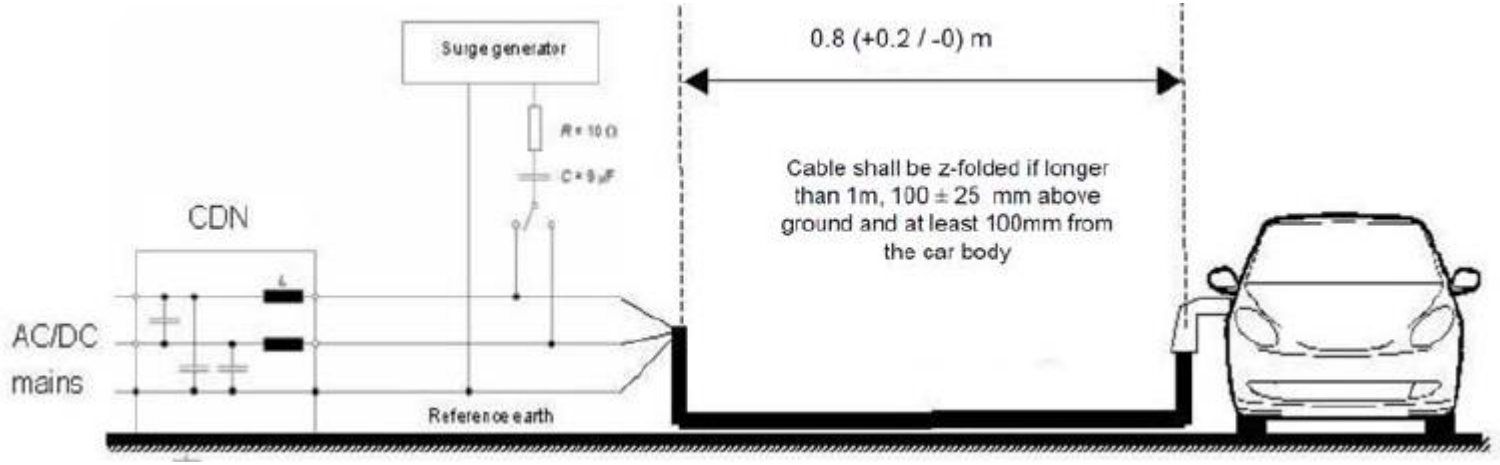


Figure 30: Vehicle in configuration "REESS charging mode coupled to the power grid" – Coupling between each line and earth for DC or AC (single phase) power lines

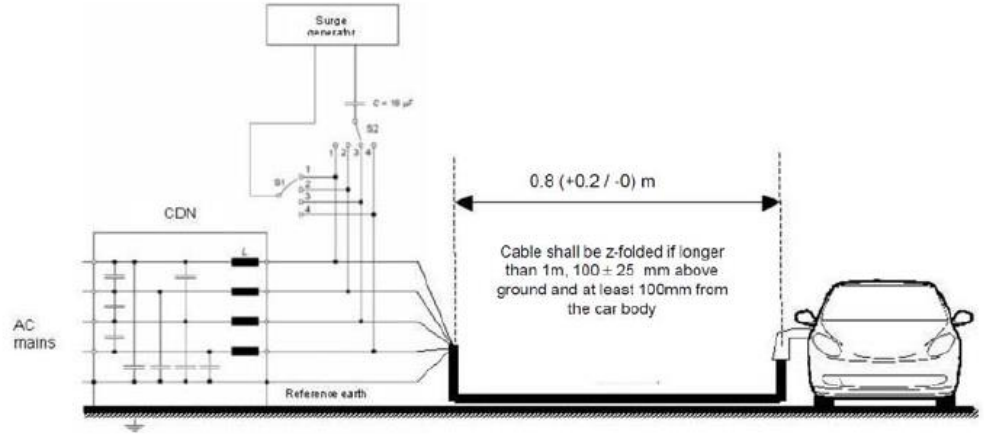


Figure 31: Vehicle in configuration "REESS charging mode coupled to the power grid" – Coupling between lines for AC (three phases) power lines

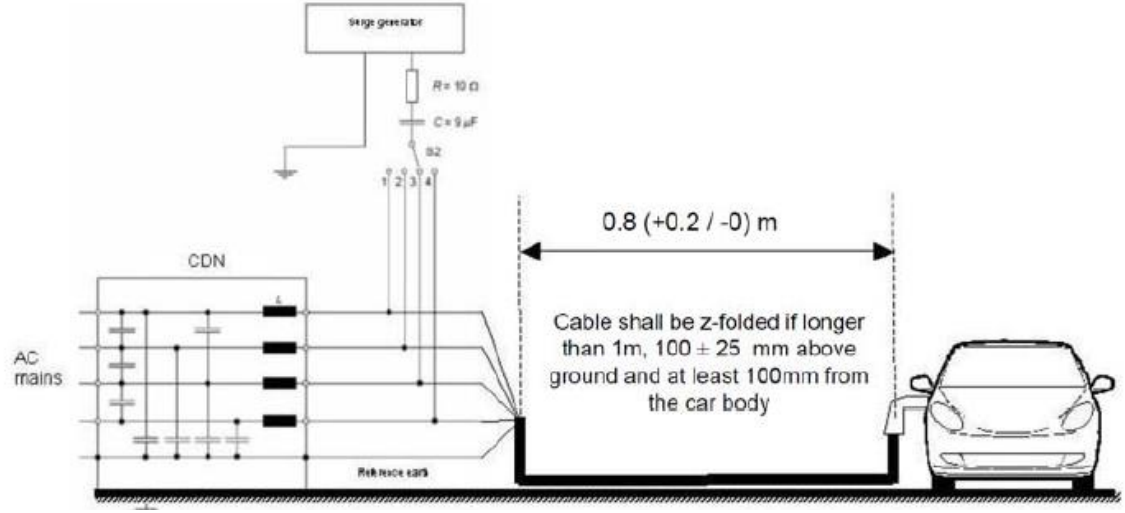


Figure 32: Vehicle in configuration "REESS charging mode coupled to the power grid" – Coupling between each line and earth for AC (three phases) power lines

56-3.19 Method(s) of testing for emission of harmonics generated on AC power lines from an ESA

56-3.19.1 General

56-3.19.1.1 The test method described in this paragraph shall be applied to ESAs in configuration "REESS charging mode coupled to the power grid"

56-3.19.1.2 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 the test shall be performed according to:

(a) IEC 61000-3-2 for input current in charging mode ≤ 16 A per phase for class A equipment;

(b) IEC 61000-3-12 for input current in charging mode > 16 A and ≤ 75 A per phase.

56-3.19.2 ESA state during tests

56-3.19.2.1 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.

56-3.19.3 Test arrangements

56-3.19.3.1 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.

56-3.19.3.2 The test set-up for single phase ESA in configuration "REESS charging mode coupled to the power grid" is shown in Figure 33.

56-3.19.3.3 The test set-up for three-phase ESA in configuration "REESS charging mode coupled to the power grid" is shown in Figure 34.

56-3.19.4 Test requirements

56-3.19.4.1 The measurements of even and odd current harmonics shall be performed up to the 40th harmonic.

56-3.19.4.2 The limits for single phase or three-phase ESAs in configuration "REESS charging mode coupled to the power grid" with input current ≤ 16 A per phase are given in Table 3 of paragraph 56-3.5.11.2.1.

56-3.19.4.3 The limits for single phase ESAs in configuration "REESS charging mode coupled to the power grid" with input current > 16 A and ≤ 75 A per phase are given in Table 4 of paragraph 56-3.5.11.2.2.

56-3.19.4.4 The limits for three-phase ESAs in configuration "REESS charging mode coupled to the power grid" with input current > 16 A and ≤ 75 A per phase are given in Table 5 of paragraph 56-3.5.11.2.2.

56-3.19.4.5 For three-phase ESAs in configuration "REESS charging mode coupled to the power grid" with input current > 16 A and ≤ 75 A per phase, when at least one of the three conditions a), b) or c) described in clause 5.2. of IEC 61000-3-12 is fulfilled, then the limits given in Table 6 of paragraph 56-3.5.11.2.2. can be applied.

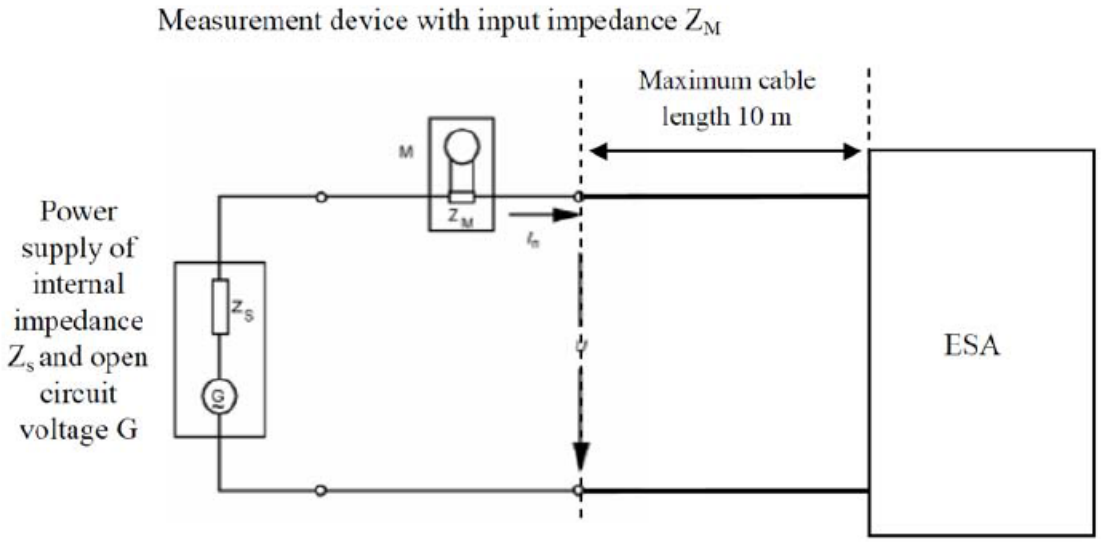


Figure 33: ESA in configuration "REESS charging mode coupled to the power grid" - Single phase test set-up

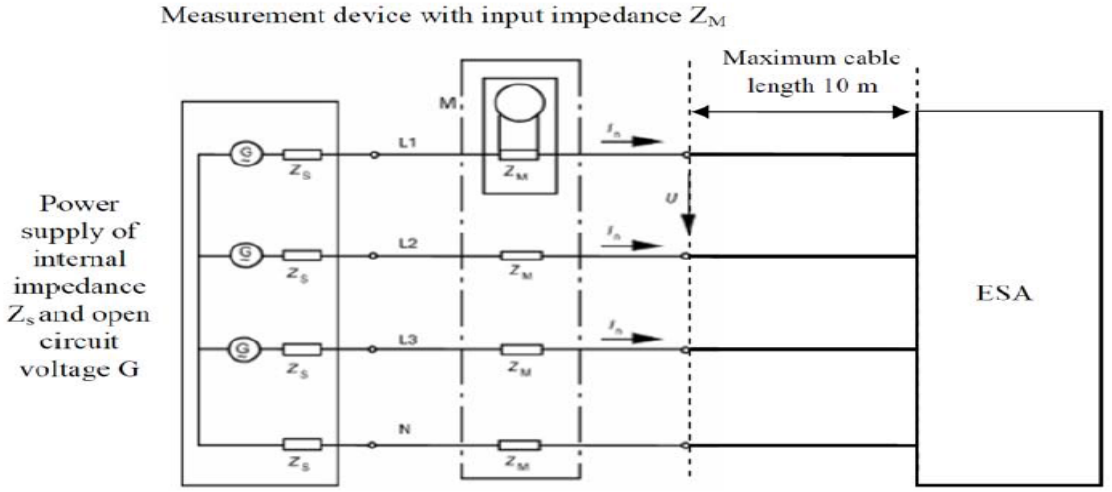


Figure 34: ESA in configuration "REESS charging mode coupled to the power grid" -Three-phase-test set-up

56-3.20 Method(s) of testing for emission of voltage changes, voltage fluctuations and flicker on AC power lines from an ESA

56-3.20.1 General

56-3.20.1.1 The test method described in this annex shall be applied to ESAs in configuration "REESS charging mode coupled to the power grid"

56-3.20.1.2 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 the test shall be performed according to:

(a) IEC 61000-3-3 for rated current in "REESS charging mode" ≤ 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 ≤ 75 A per phase and subjected to conditional connection.

56-3.20.2 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.

56-3.20.3 Test Arrangements

56-3.20.3.1 The tests for ESA in configuration "REESS charging mode coupled to the power grid" with rated current ≤ 16 A per phase and not subjected to conditional connection shall be performed according to paragraph 4. of IEC 61000-3-3.

56-3.20.3.2 The tests for ESA in configuration "REESS charging mode coupled to the power grid" with rated current > 16 A and ≤ 75 A per phase and subjected to conditional connection shall be performed according to paragraph 6. of IEC 61000-3-11.

56-3.20.3.3 The test set-up for ESA in configuration "REESS charging mode coupled to the power grid" is shown in Figures 35-1 and 35-2.

56-3.20.4 Test requirements

56-3.20.4.1 The parameters to be determined in the time-domain are "short duration flicker value", "long duration flicker value" and "voltage relative variation".

56-3.20.4.2 The limits for ESA in configuration "REESS charging mode coupled to the power grid" with input current ≤ 16 A per phase and not subjected to conditional connection are given in paragraph 56-3.5.12.2.1.

56-3.20.4.3 The limits for ESA in configuration "REESS charging mode coupled to the power grid" with input current > 16 A and ≤ 75 A per phase and subjected to conditional connection are given in paragraph 56-3.5.12.2.2.

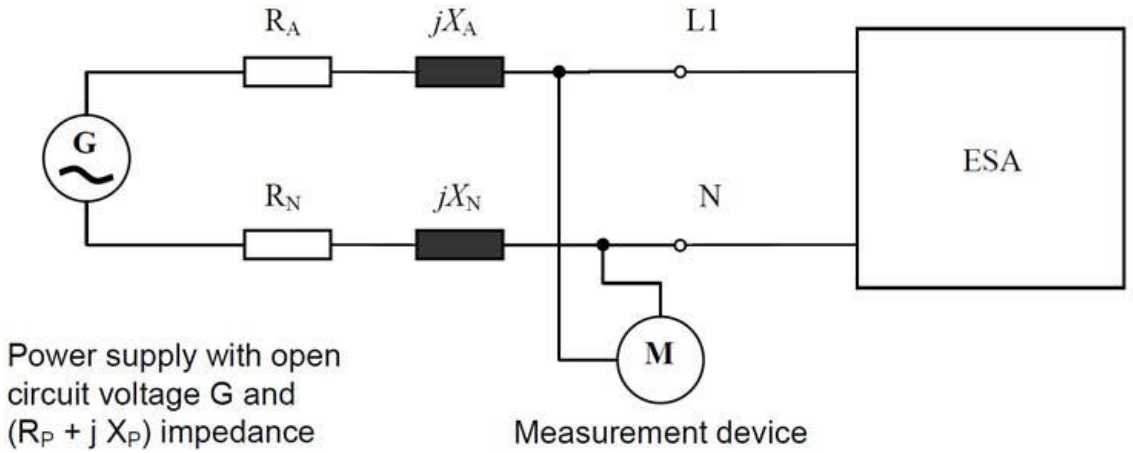


Figure 35-1: ESA in configuration "REESS charging mode coupled to the power grid"- Single phase test set-up

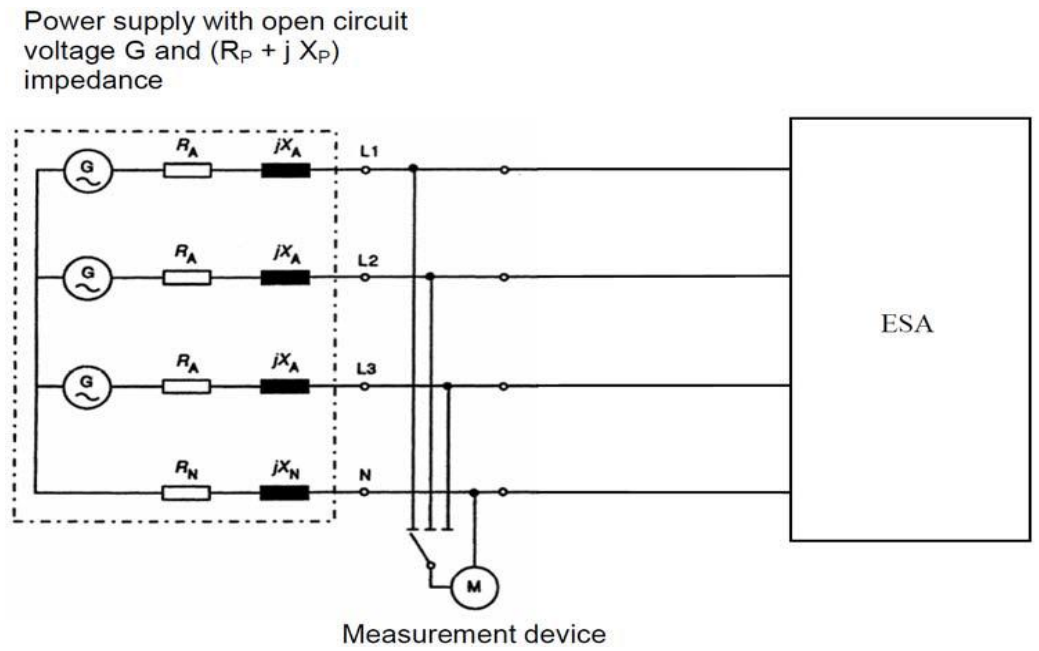


Figure 35-2: ESA in configuration "REESS charging mode coupled to the power grid" - Three-phase test set-up

56-3.21 Method(s) of testing for emission of radiofrequency conducted disturbances on AC or DC power lines from an ESA

56-3.21.1 General

56-3.21.1.1 The test method described in this annex shall be applied to ESAs in configuration "REESS charging mode coupled to the power grid".

56-3.21.1.2 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.

56-3.21.2 ESA state during tests

56-3.21.2.1 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.

56-3.21.3 Test arrangements

56-3.21.3.1 The test shall be performed according to clause 7.4.1. of CISPR 16-2-1 as table-standing equipment.

56-3.21.3.2 The artificial mains network to be used for the measurement on vehicle components is defined in clause 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 ohm load.

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

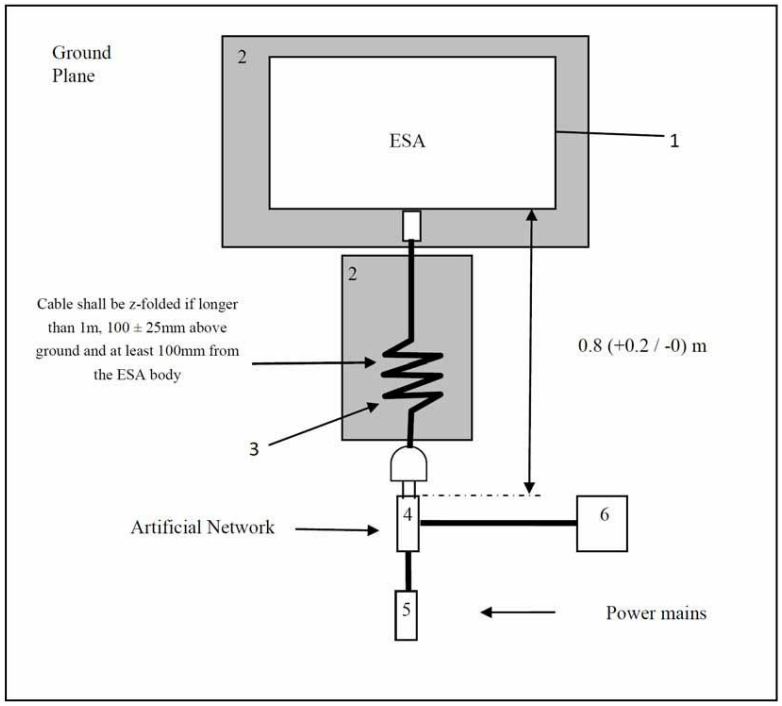
56-3.21.3.3 The test set-up for the connection of the ESAs in configuration "REESS charging mode coupled to the power grid" is shown in Figure 36.

56-3.21.3.4 The measurements shall be performed with a spectrum analyser or a scanning receiver. The parameters to be used are defined in Table 15 and Table 16.

56-3.21.4 Test Requirements

56-3.21.4.1 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.

56-3.21.4.2 Measurements shall be performed with average and either quasi-peak or peak detectors. The limits are given in Table 7 of paragraph 56-3.5.13.2.1 for AC lines and in Table 8 of paragraph 56-3.5.13.2.2 for DC lines. If peak detectors are used a correction factor of 20 dB as defined in CISPR 12 shall be applied.



Legend:

1 ESA under test

2 Insulating support

3 Charging cable

4 AC or DC Artificial network(s) grounded

5 Power mains socket

6 Measuring receiver

Figure 36: ESA in configuration "REESS charging mode coupled to the power grid"

Table 15: 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 16: Scanning receiver parameters

Frequency range MHz	Peak detector			Quasi-peak detector			Average detector		
	BW at -6 dB	Step size [a]	Dwell time	BW at -6 dB	Step size [a]	Dwell time	BW at -6 dB	Step size [a]	Dwell time
0.15 to 30	9 kHz	5 kHz	50 ms	9 kHz	5 kHz	1 s	9 kHz	5 kHz	50 ms

[a] 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.

56-3.22 Method(s) of testing for emission of radiofrequency conducted disturbances on network and telecommunication access from an ESA

56-3.22.1 General

56-3.22.1.1 The test method described in this annex shall be applied to ESAs in configuration "REESS charging mode coupled to the power grid".

56-3.22.1.2 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 22.

56-3.22.2 ESA state during tests

56-3.22.2.1 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.

56-3.22.3 Test arrangements

56-3.22.3.1 The test set-up shall be performed according to paragraphs 8 and 9 of CISPR 22 for conducted emissions.

56-3.22.3.2 Impedance Stabilization

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

The impedance stabilization (IS) to be connected in the network and communication cables is defined in paragraph 9.6.2. of CISPR 22.

The IS(s) shall be mounted directly on 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 ohm load.

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

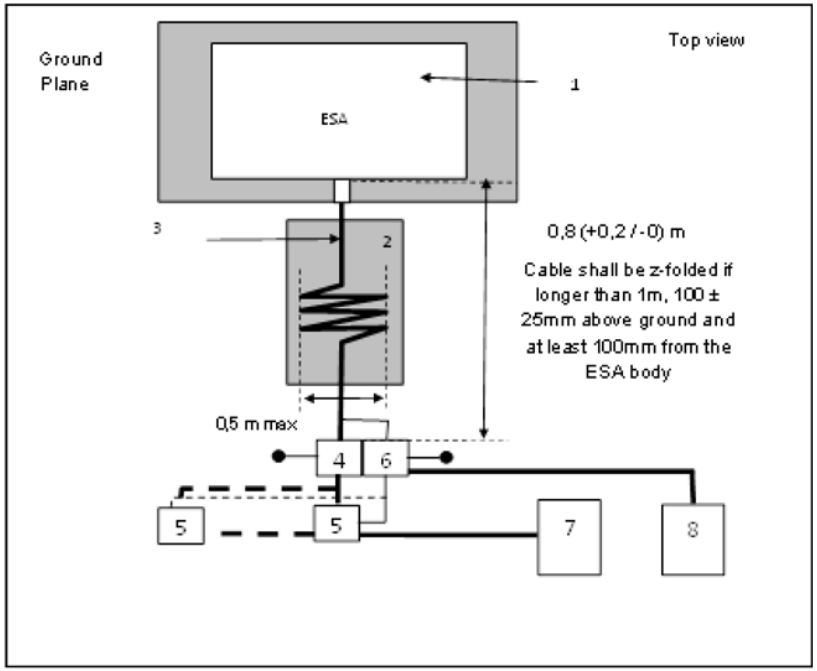
56-3.22.3.3 The test set-up for the connection of the ESA in configuration "REESS charging mode coupled to the power grid" is shown in Figure 37.

56-3.22.3.4 The measurements shall be performed with a spectrum analyser or a scanning receiver. The parameters to be used are defined in Table 13 and Table 14

56-3.22.4 Test Requirements

56-3.22.4.1 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.

56-3.22.4.2 . Measurements shall be performed with average and either quasi-peak or peak detectors. The limits are given in Table 9 of paragraph 56-3.5.14.2.1 If peak detectors are used a correction factor of 20 dB as defined in CISPR 12 shall be applied.



Legend:

1 ESA under test

2 Insulating support

3 Charging / communication cable

4 AC or DC Artificial network(s) grounded

5 Power mains socket

6 Impedance stabilization(s) grounded

7 Charging station

8.Measuring receiver

Figure 37: ESA in configuration "REESS charging mode coupled to the power grid"

56-3.23 Method of testing for immunity of an ESA to electrical fast transient/burst disturbances conducted along AC and DC power lines

56-3.23.1 General

56-3.23.1.1 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".

56-3.23.1.2 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.

56-3.23.2 ESA state during tests in configuration "REESS in charging mode coupled to the power grid"

56-3.23.2.1 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
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 20 per cent of its nominal value.	Incorrect charging condition (e.g. over-current, overvoltage)

56-3.23.2.2 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.).

56-3.23.3 Test equipment

56-3.23.3.1 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.

56-3.23.3.2 The transient/burst generator shall meet the condition defined in paragraph 6.1. of IEC 61000-4-4.

56-3.23.3.3 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.

56-3.23.4 Test set-up

56-3.23.4.1 The ESA test setup is based on the laboratory type set-up as described in paragraph 7.2.of IEC 61000-4-4.

56-3.23.4.2 The ESA shall be placed directly on the ground plane.

56-3.23.4.3 The Technical Service shall perform the test as specified in paragraph 56-3.5.15.2.1.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 Technical Service may choose not to perform the test to confirm that the ESA meets the requirements of this regulation.

56-3.23.5 Generation of required test level

56-3.23.5.1 Test methodology

56-3.23.5.1.1 The test method according to IEC 61000-4-4 shall be used to establish the test level requirements.

56-3.23.5.1.2 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 38.

The test setup shall be noted in the test report.

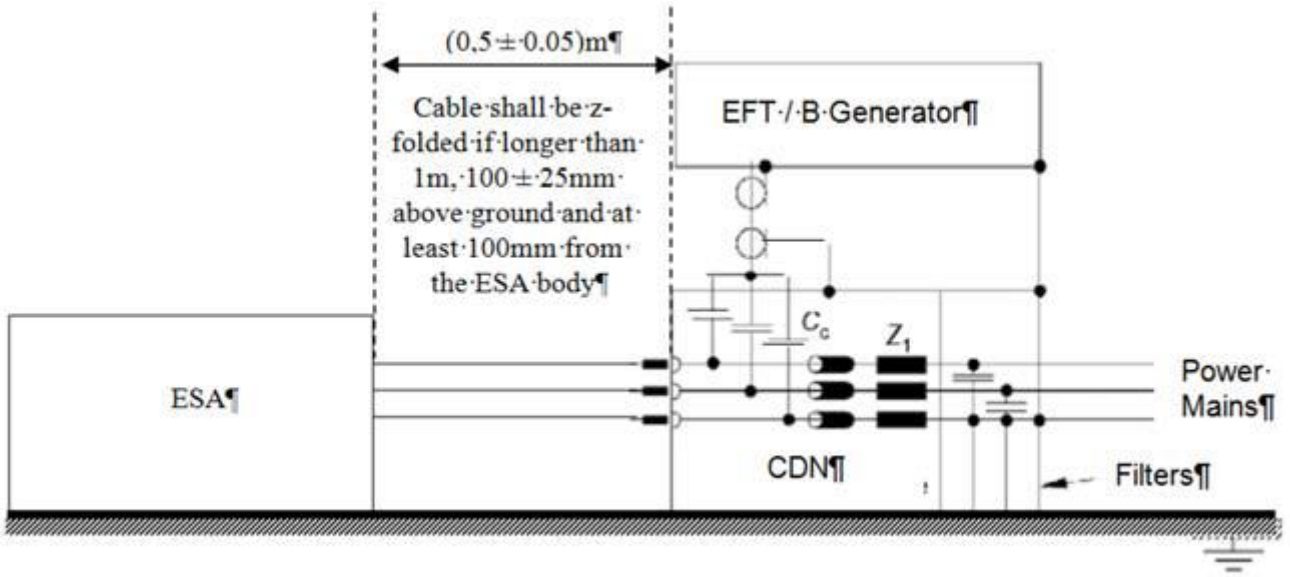


Figure 38: ESA in configuration "REESS charging mode coupled to the power grid"

56-3.24 Method of testing for immunity of ESAs to surges conducted along AC and DC power lines

56-3.24.1 General

56-3.24.1.1 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".

56-3.24.1.2 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.

56-3.24.2 ESA state during tests in configuration "REESS in charging mode coupled to the power grid"

56-3.24.2.1 The ESA shall be in charging mode.

56-3.24.2.1.1 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
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 20 per cent of its nominal value.	Incorrect charging condition (e.g. over-current, overvoltage)

56-3.24.2.2 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.).

56-3.24.3 Test equipment

56-3.24.3.1 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).

56-3.24.3.2 The surge generator shall meet the condition defined in paragraph 6.1. of IEC 61000-4-5.

56-3.24.3.3 The coupling/decoupling network shall meet the condition defined in paragraph 6.3. of IEC 61000-4-5.

56-3.24.4 Test set-up

56-3.24.4.1 The ESA test set-up is based on the set-up described in paragraph 7.2. of IEC 61000-4-5.

56-3.24.4.2 The ESA shall be placed directly on the ground plane.

56-3.24.4.3 The Technical Service shall perform the test as specified in paragraph 56-3.5.16.2.1.

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 Technical Service may choose not to perform the test to confirm that the ESA

meets the requirements of this regulation.

56-3.24.5 Generation of required test level

56-3.24.5.1 Test methodology

56-3.24.5.1.1 The test method according to IEC 61000-4-5 shall be used to establish the test level requirements.

56-3.24.5.1.2 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 39 to 42. The test set-up shall be noted in the test report

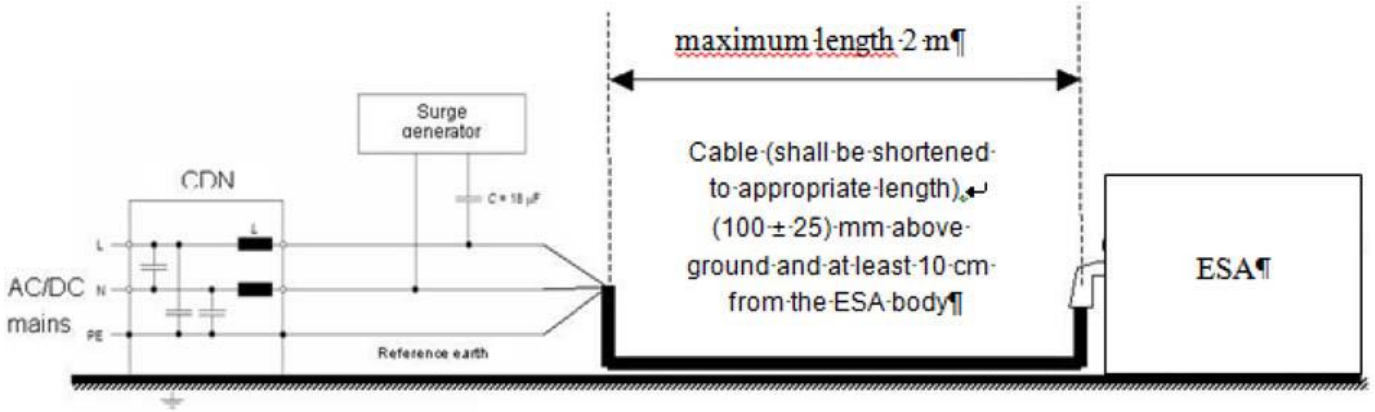


Figure 39: ESA in configuration "REESS charging mode coupled to the power grid"

- Coupling between lines for DC or AC (single phase) power lines

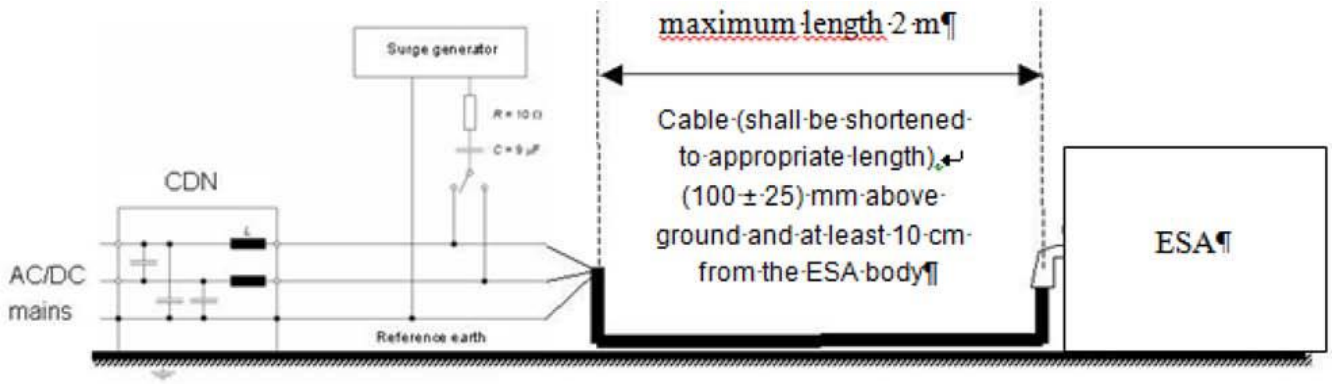


Figure 40: ESA in configuration "REESS charging mode coupled to the power grid"

- Coupling between each line and earth for DC or AC (single phase) power lines

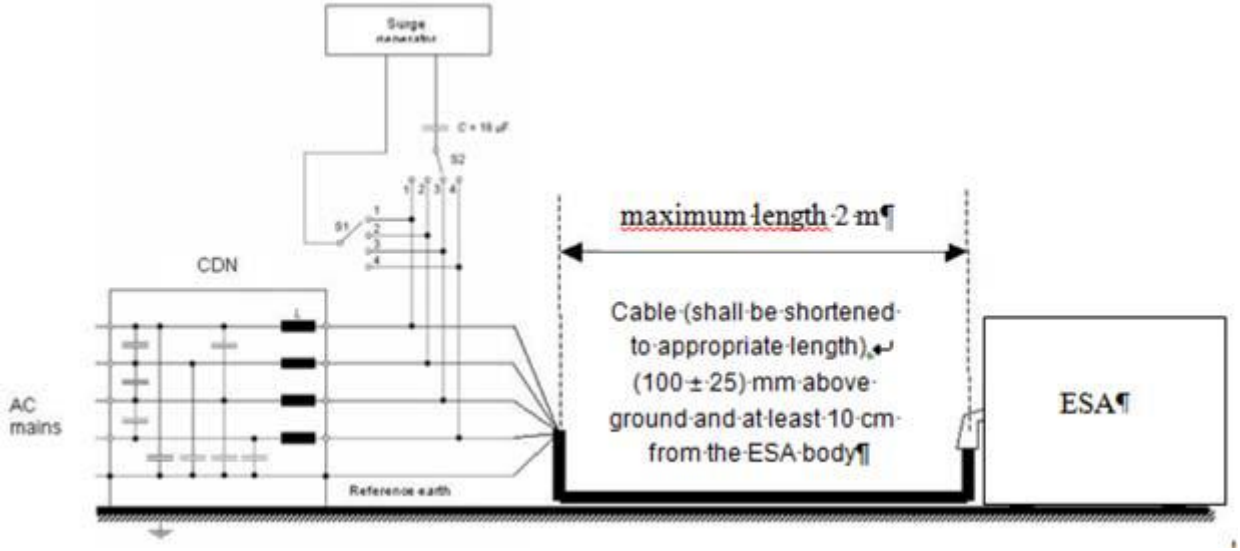


Figure 41: ESA in configuration "REESS charging mode coupled to the power grid"

- Coupling between lines for AC (three phases) power lines

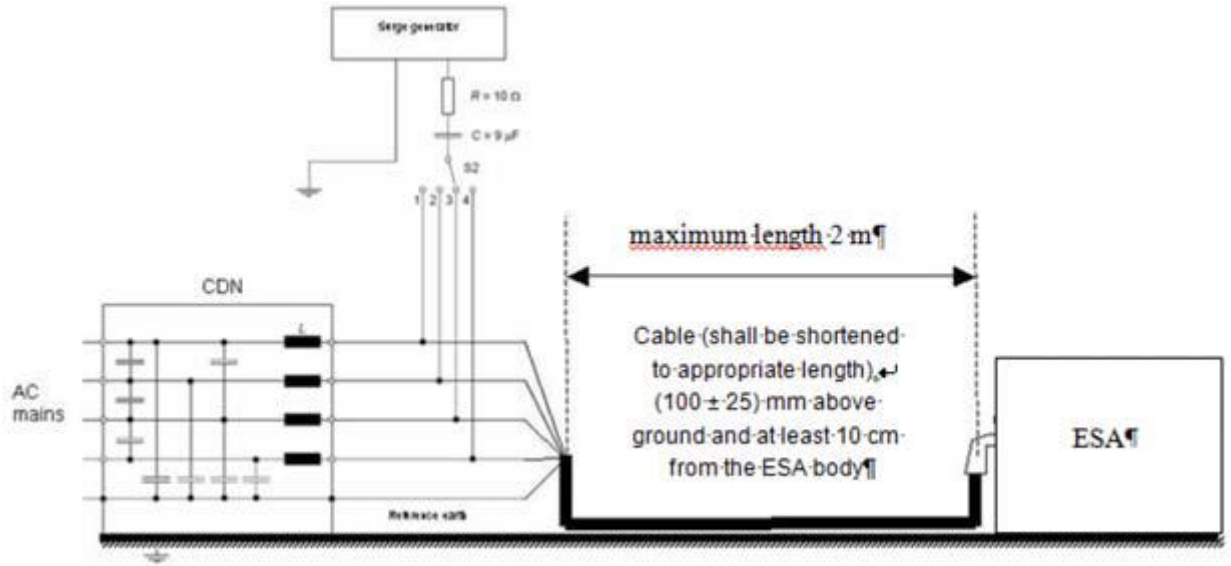


Figure 42: ESA in configuration "REESS charging mode coupled to the power grid" –

Coupling between each line and earth for AC (three phases) power lines