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Item 8 of the provisional agenda
UN Regulation No. 10 (Electromagnetic Compatibility)

Proposal for a new 07 series of amendments to UN Regulation No. 10 (Electromagnetic compatibility)

Submitted by the expert from by the Informal Working Group on Electromagnetic Compatibility*

The text reproduced below was prepared by the experts from the Informal Working Group on Electromagnetic Compatibility (IWG EMC), with the aim to develop a new 07 series of amendments to UN Regulation No.10. The proposed modifications to the current text of the UN Regulation are marked in bold for new or strikethrough for deleted characters.

* In accordance with the programme of work of the Inland Transport Committee for 2024 as outlined in proposed programme budget for 2024 (A/78/6 (Sect. 20), table 20.5), the World Forum will develop, harmonize and update UN Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

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I. Proposal

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Paragraph 1.3., amend to read:

"1.3. It covers:

(a) Requirements regarding the immunity to radiated and conducted disturbances for functions related to direct control of the vehicle, related to driver, passenger and other road users' protection, related to disturbances, which would cause confusion to the driver or other road users, related to vehicle data bus functionality, related to disturbances, which would affect vehicle statutory data;

(b) Requirements regarding the control of unwanted radiated and conducted emissions to protect the intended use of electrical or electronic equipment at own or adjacent vehicles or nearby, and the control of disturbances from accessories that may be retrofitted to the vehicle;

(c) Additional requirements for vehicles and ESAs providing coupling systems for charging the REESS regarding the control of emissions and immunity from this connection between vehicle and power grid.

Note: The immunity levels stated in this regulation ensure robustness of vehicle systems in the electromagnetic environment and therefore addresses one of the external environments to be considered for functional safety (e.g. in ISO 26262)."

Paragraph 2.12., amend to read:

"2.12. "*Immunity related functions*" are the following functions; this list is not exhaustive and shall be adapted to the technical evolution of vehicle/technology:

(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, indirect vision systems, blind spot systems.

(b) Functions related to driver, passenger and other road user protection:

(i) E.g. airbag and safety restraint systems, emergency call**ing** systems (e-call, AECS, ERA GLONASS, …);

(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) For vehicle test: by leading to unexpected vehicle motion;

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

Paragraph 2.20., amend to read:

"2.20. "*Signal/control port"* means port intended for the interconnection of components of an ESA, or between an ESA and local AE (~~Ancillary~~ **Auxiliary Equipment**) and used in accordance with relevant functional specifications (for example for the maximum length of cable connected to it). Examples include RS-232, Universal Serial Bus (USB), High-Definition Multimedia Interface (HDMI), IEEE Standard 1394 ("Fire Wire"). For vehicle in charging mode this includes Control Pilot signal, PLC technology used on Control Pilot signal line, CAN."

Insert new paragraphs 2.26. to 2.32., to read:

"**2.26 *"Automated Driving System (ADS)"* means the vehicle hardware and software that are collectively capable of performing the entire Dynamic Driving Task (DDT) on a sustained basis.** **(1)**

NOTE: ADS means the driver, during the driving, is not responsible for Dynamic Driving Task, unless otherwise specified in other UN Regulations.

2.27. ***"Dynamic Driving Task (DDT)"*** **means the real-time operational and tactical functions required to operate the vehicle.** [(1)]

2.28. ***"Failure situations"*** **involve those in which the ADS or another vehicle system experiences a fault or failure that removes or reduces the ADS's ability to perform the DTT, such as sensor or computer failure or a failed propulsion system.**

2.29. ***"Residential environment"*** **refers to clause 3.1.14 of IEC 61000-6-3: 2020.**

Area of land designated for domestic dwellings where the mains power within these locations is directly connected to the low-voltage (lower than 1000Va.c. and 1500 Vd.c.) public mains network.

Note 1 to entry: Examples of residential locations are: houses, apartments, farm buildings housing people.

Note 2 to entry: A dwelling can be a single building, separate building or a separate section of a larger building.

Note 3 to entry: Within these locations it is expected to operate a radio receiver within a distance of 10 m from the equipment.

Note 4 to entry: Domestic dwellings are places for one or more people to live.

2.30. ***"Non-residential environment"*** **refers to clause 3.1.12 of IEC 61000-6-4: 2018.**

Location characterized by a separate power network, supplied from a high- or medium-voltage transformer, dedicated for the supply of the installation

Note 1 to entry: Industrial locations can generally be described by the existence of an installation with one or more of the following characteristics:

- **items of equipment installed and connected together and working simultaneously;**
- **significant amount of electrical power generated, transmitted and/or consumed;**
- **frequent switching of heavy inductive or capacitive loads;**
- **high currents and associated magnetic fields;**
- **presence of industrial, high power scientific and medical (ISM) equipment (for example, welding machines).**

The electromagnetic environment at an industrial location is predominantly produced by the equipment and installation present at the location. There are types of industrial locations where some of the electromagnetic phenomena appear in a more severe degree than in other installations.

Example locations include metalworking, pulp and paper, chemical plants, car production, farm building, high voltage areas of airports.

2.31. ***"Acoustic Vehicle Alerting System (AVAS)"*** **as defined in the latest series of amendments to UN Regulation No. 138.**

2.32. ***"Accident Emergency Call Systems (AECS)"*** **as defined in the latest series of amendments to UN Regulation No. 144.**

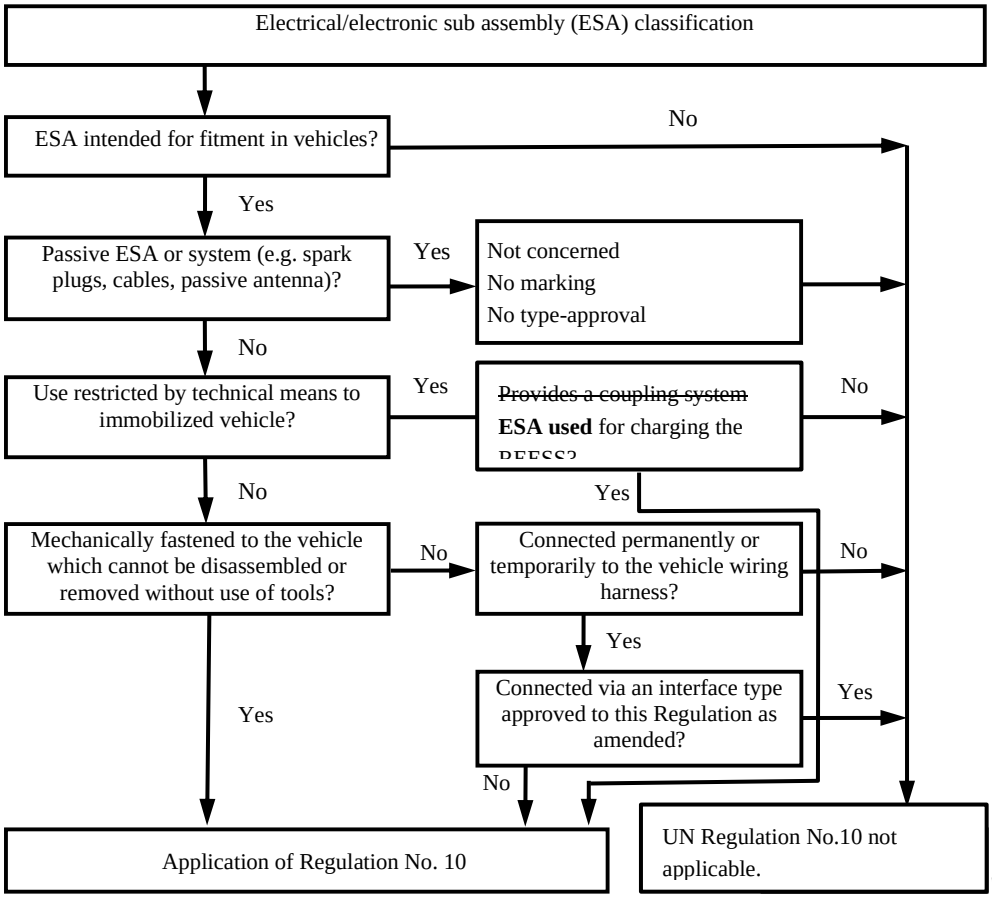
2.33. ***"Auxiliary Equipment (AE)"*** **means equipment needed to exercise or monitor the operation of the test object.**"

Insert a new footnote (1), to read:

"**(1): Those definitions are based on the definitions contained in ECE/TRANS/WP.29/2022/58, Annex 1.**"

Paragraph 3.2.1., amend to read:

"3.2.1. Applicability of this Regulation to ESA:



"

Paragraph 6.1.2., amend to read:

"6.1.2. 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.

Depending on the intended operating conditions of the propulsion system, the test plan shall define the minimum number of steady state operating conditions of the vehicle, selectable by the driver or by the control system. The test conditions shall consider multiple propulsion system operating strategies which can be activated permanently by the driver or the vehicle control system and shall be based on documentation provided in Annexes 2A and 2B (e.g. risk analysis)."

Paragraph 6.3.2.4., to be deleted.

Paragraph 6.4.2.1., amend to read:

"6.4.2.1. If tests are made using the method described in Annex 6, **in accordance with ISO 11451-2,** 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. **The field strength shall be 10 volts/m rms in over 90 per cent of the 2,000 to 6,000 MHz frequency band and a minimum of 8 volts/m rms over the whole 2,000 to 6,000 MHz frequency band.**

If tests are made using the method described in Annex 6, in accordance with ISO 11451-4 BCI the current shall be 60 mA rms in over 90 per cent of the 20 to 2,000 MHz frequency band and a minimum of 50 mA rms over the whole 20 to 2,000 MHz frequency band."

Paragraph 6.8.2.1., amend to read:

"6.8.2.1. ~~If tests are made using the methods described in Annex 9, 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 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.~~

The immunity to electromagnetic radiation of ESA representative of its type shall be tested by the method(s) as described in Annex 9.:

Test severity in over 90 per cent of the 20 to 6,000 MHz frequency band are given in Table 2a.

Test severity for the minimum test Level over the whole 20 to 6,000 MHz frequency band given in Table 2b.

Table 2a

	Test Level in over 90 per cent of the 20 to 6,000 MHz frequency band				
Frequency range	***Stripline***	***TEM cell***	***BCI***	***ALSE***	***Reverberation chamber***
20 to 2,000 MHz	**60 V/m**	**75 V/m**	**60 mA**	**30 V/m**	**21 V/m**
2,000 to 6,000 MHz	**Not applicable**	**Not applicable**	**Not applicable**	**10 V/m**	**7 V/m**

Table 2b

	Minimum Test Level over the whole 20 to 6,000 MHz frequency band				
Frequency range	***Stripline***	***TEM cell***	***BCI***	***ALSE***	***Reverberation chamber***
20 to 2,000 MHz	**50 V/m**	**62,5 V/m**	**50 mA**	**25 V/m**	**18 V/m**
2,000 to 6,000 MHz	**Not applicable**	**Not applicable**	**Not applicable**	**8 V/m**	**6 V/m**

"

Paragraph 6.9.1., amend to read:

"6.9.1. Method of testing

The immunity of ESA representative of this type shall be tested by the method(s) according to ISO 7637-2**:2004 for pulse 4 and ISO 7637-2:2011 for pulses 1, 2a, 2b, 3a and 3b,** as described in Annex 10**,** with the test levels given in Table**s** ~~2~~**3a and 3b**. **Functional Performance Status Classification (FPSC) as in ISO 7637-1 shall be applied.**

Immunity of ESA
Table ~~2~~**3a**

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

Table 3b

Test pulse number	*Immunity test level*		*Test duration / number of pulses*	*FPSC for systems:*	
	12V system	*24V system*		*Related to immunity related functions*	*Not related to immunity related functions*
1	**-75 V**	**-450 V**	**500 pulses**	**III**	**III**
2a	**+37 V**	**+37 V**	**500 pulses**	**I**	**III**
2b	**+10 V**	**+ 20 V**	**10 pulses**	**II**	**III**
3a	**-112 V**	**-150 V**	**1 h**	**I**	**III**
3b	**+ 75 V**	**+150 V**	**1 h**	**I**	**III**

Pulse 4 is only applicable to ESAs that could be installed in vehicles with internal combustion engines which are started with a 12V/24V starter motor. "

Insert a new paragraph 6.10.8., to read:

"**6.10.8. Trolleybuses: AC / DC mains portion of the vehicle propulsion system shall be excluded from this Regulation.**"

Paragraph 7.1.2., amend to read:

"7.1.2. 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.

Depending on the available charging modes of the REESS, the test plan shall define the minimum number of test conditions of the vehicle, selectable by the driver or by the control system and shall be based on documentation provided in Annexes 2A and 2B (e.g. risk analysis). Refer to flow charts in Annexes where REESS charge mode is applicable."

Paragraph 7.1.3., amend to read:

"7.1.3. A vehicle in configuration "REESS charging mode coupled to the power grid" should be tested with the charging harness delivered by the manufacturer **in line with flow charts provided in Annexes 4, 6, 11, 12, 13, 15 and 16.** ~~In this case, the cable shall be type approved as part of the vehicle.~~"

Paragraph 7.1.4., amend to read:

"7.1.4. Artificial networks

AC Power mains shall be applied to the vehicle / ESA through 50 µH/50 Ω AMN(s) as defined in Appendix 8 clause 4.

DC Power mains shall be applied to the vehicle / ESA through 5 µH/50 Ω DC-charging-AN(s) as defined in Appendix 8 clause 3.

High voltage power line shall be applied to the ESA through a 5 µH/50 Ω HV-AN(s) as defined in Appendix 8 clause 2.

Signal port lines, control port lines or wired network port lines should be applied to the vehicle / ESA through an AAN as defined in Appendix 8 clause 5."

Paragraph 7.3.2.1., amend to read:

"7.3.2.1. If measurements are made using the method described in Annex 11, the limits for input current ≤ 16 A per phase are those defined in IEC 61000-3-2 and given in Table ~~3~~**4**.

Table ~~3~~**4**
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 ≤ n ≤ 39	0.15x15/n
Even harmonics	
2	1.08
4	0.43
6	0.30
8 ≤ n ≤ 40	0.23x8/n

"

Paragraph 7.3.2.2., amend to read:

"7.3.2.2. If measurements are made using the method described in Annex 11, the limits for input current > 16 A and ≤ 75 A per phase are those defined in IEC 61000-3-12, and given in given in Table ~~4~~**5**, Table ~~5~~**6** and Table ~~6~~**7**.

Table ~~4~~**5**
Maximum allowed harmonics (input current > 16 A and ≤ 75 A per phase) for single phase or 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 Total Harmonic ~~Distorsion~~**Distortion** (THD) and Partial Weighted Harmonic ~~Distorsion~~**Distortion** (PWHD) the same way than odd harmonics.

Linear interpolation between successive values of Short Circuit Ratio of an Equipment (R_{sce}) is authorized.

Table ~~5~~**6**
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~~**7**
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**.**"

Paragraphs 7.5.2. to 7.5.2.2., amend to read:

"7.5.2. Vehicle type approval limit **for vehicle charged in residential environment**

7.5.2.1. If measurements are made using the method described in Annex 13, the limits on AC power lines are those defined in IEC 61000-6-3 and given in Table ~~7~~**8**.

Table ~~7~~**8**
Maximum allowed radiofrequency conducted disturbances on AC power lines

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

7.5.2.2. If measurements are made using the method described in Annex 13, the limits on DC power lines are those defined in IEC 61000-6-3 and given in Table ~~8~~**9**.

Table ~~8~~**9**
Maximum allowed radiofrequency conducted disturbances on DC power lines

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

"

Insert new paragraphs 7.5.3. to 7.5.3.4., to read:

"**7.5.3 Vehicle type approval limit for vehicle charged in other non-residential environment.**

7.5.3.1. For specific vehicles which are charged only with charging stations located in area characterized by a separate power network, supplied from a high or medium voltage transformer, dedicated for the supply of the installation (buses, heavy duty trucks, etc..), limits from IEC 61000-6-4 shall be applied.

7.5.3.2. In this case, the manufacturer shall provide a statement that the vehicle can be used in "REESS charging mode coupled to the power grid" only in area characterized by a separate power network, supplied from a high or medium voltage transformer, dedicated for the supply of the installation. The manufacturer shall provide a statement that the vehicle shall be charged in non-residential environment only. This information shall be made publicly available following the type-approval.

7.5.3.3 If measurements are made using the method described in Annex 13, the limits on AC power lines are those defined in IEC 61000-6-4 and given in Table 10.

Table 10
Maximum allowed radiofrequency conducted disturbances on AC power lines

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

7.5.3.4. If measurements are made using the method described in Annex 13, the limits on DC power lines are those defined in IEC 61000-6-4 and given in Table 11.

Table 11
Maximum allowed radiofrequency conducted disturbances on DC power lines

Frequency (MHz)	*Limits and detector*
0.15 to 0.5	**89 dBµV (quasi-peak)** **76 dBµV (average)**
0.5 to 30	**83 dBµV (quasi-peak)** **70 dBµV (average)**

"

Paragraph 7.6., amend to read:

"7.6. Specifications concerning emission of radiofrequency conducted disturbances on wired network port from vehicles.

No longer applicable."

Paragraphs 7.6.1. to 7.6.2.1., to be deleted.

Paragraph 7.7.2.1., amend to read:

"7.7.2.1. If tests are made using the method described in Annex 6, 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. **The field strength shall be 10 volts/m rms in over 90 per cent of the 2,000 to 6,000 MHz frequency band and a minimum of 8 volts/m rms over the whole 2,000 to 6,000 MHz frequency band.**

If tests are made using the method described in Annex 6, with ISO 11451-4 BCI method the current shall be 60 mA rms in over 90 per cent of the 20 to 2,000 MHz frequency band and a minimum of 50 mA rms over the whole 20 to 2,000 MHz frequency band."

Paragraph 7.8.2.2., amend to read:

"7.8.2.2. The vehicle representative of its type shall be considered as complying with immunity requirements if, during the tests performed in accordance with Annex 15, there shall be no degradation of performance of "immunity related functions", according to ~~paragraph 2.2. of Annex 6~~ **paragraph 2.1.2. of Annex 15**."

Paragraph 7.9.2.1., amend to read:

"7.9.2.1. If tests are made using the methods described in Annex 16, 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 µs / 50 µs),~~ with a rise time (Tr) of 1.2 µs, and a hold time (Th) of 50 µs. Each surge shall be applied five times with a maximum delay of 1 minute between each pulse. This has to be applied for the following phases: 0, 90, 180 and 270°,

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

Paragraph 7.9.2.2., amend to read:

"7.9.2.2. The vehicle representative of its type shall be considered as complying with immunity requirements if, during the tests performed in accordance with Annex 16, there shall be no degradation of performance of "immunity related functions", according to ~~paragraph 2.2. of Annex 6~~ **paragraph 2.1.2. of Annex 16**."

Paragraph 7.11.2.1., amend to read:

"7.11.2.1. If measurements are made using the method described in Annex 17, the limits for input current ≤ 16 A per phase are those defined in IEC 61000-3-2 and given in Table 1~~2~~**0**.

Table 1~~2~~**0**
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 ≤ n ≤ 39	0.15x15/n
Even harmonics	
2	1.08
4	0.43
6	0.30
8 ≤ n ≤ 40	0.23x8/n

"

Paragraph 7.11.2.2., amend to read:

"7.11.2.2. If measurements are made using the method described in Annex 17, the limits for input current > 16 A and ≤ 75 A per phase are those defined in IEC 61000-3-12 and given in Table 1~~3~~**1**, Table 1**4**~~2~~ and Table 1~~5~~**3**.

Table 1~~3~~**1**

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

	Acceptable individual harmonic current I_n/I_1 %						*Maximum current harmonic ratio %*	
Minimum R_{sce}	*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 1~~4~~**2**

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

	Acceptable individual harmonic current I_n/I_1 %				*Maximum current harmonic ratio %*	
Minimum R_{sce}	*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 1~~5~~**3**

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

	Acceptable individual harmonic current I_n/I_1 %				*Maximum current harmonic ratio %*	
Minimum R_{sce}	*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."

"

Paragraph 7.13.2.1., amend to read:

"7.13.2.1. If measurements are made using the method described in Annex 19, the limits on AC power lines are those defined in IEC 61000-6-3 and given in Table 1**6**~~4~~.

Table 1~~6~~4
Maximum allowed radiofrequency conducted disturbances on AC power lines

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

"

Paragraph 7.13.2.2., amend to read:

"7.13.2.2. If measurements are made using the method described in Annex 19, the limits on DC power lines are those defined in IEC 61000-6-3 and given in Table 1~~7~~5.

Table 1~~7~~5
Maximum allowed radiofrequency conducted disturbances on DC power lines

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

"

Paragraph 7.14., amend to read:

"7.14. Specifications concerning emission of radiofrequency conducted disturbances wired network port from ESA

No longer applicable."

Paragraphs 7.14.1. to 7.14.2.1., to be deleted.

Paragraph 7.15.2.2., amend to read:

"7.15.2.2. The ESA representative of its type shall be considered as complying with immunity requirements if, during the tests performed in accordance with Annex 21, there shall be no degradation of performance of ~~"immunity related functions", according to paragraph 2.2. of Annex 9~~ **the charging function as defined in paragraph 2.1. of Annex 21**."

Paragraph 7.16.2.1., amend to read:

"7.16.2.1. If tests are made using the methods described in Annex 22, 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 µs / 50 µs),~~ with a rise time (Tr) of 1.2 µs, and a hold time (Th) of 50 µs. Each surge shall be applied five times with a maximum delay of 1 minute between each pulse. This has to be applied for the following phases: 0, 90, 180 and 270°,

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

Paragraph 7.16.2.2., amend to read:

"7.16.2.2. The ESA representative of its type shall be considered as complying with immunity requirements if, during the tests performed in accordance with Annex 22, there shall be no degradation of performance of ~~"immunity related~~

~~functions", according to paragraph 2.2. of Annex 9~~ **the charging function as defined in paragraph 2.1. of Annex 22**."

Paragraph 7.17.1., amend to read:

"7.17.1. Method of testing

The emission of ESA representative of its type shall be tested by the method(s) according to ISO 7637-2, as described in Annex 10 for the levels given in Table 1**8**~~7~~.

Table 1**8**~~7~~
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

"

Paragraph 7.18.2.1., amend to read:

"7.18.2.1. ~~If tests are made using the methods described in Annex 9, 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.~~

The immunity to electromagnetic radiation of ESA representative of its type shall be tested by the method(s) as described in Annex 9:

- **for the levels in over 90 per cent of the 20 to 6,000 MHz frequency band given in Table 19a.**
- **for the minimum test Level over the whole 20 to 6,000 MHz frequency band given in Table 19b.**

Table 19a

	Test Level in over 90 per cent of the 20 to 6,000 MHz frequency band				
Frequency range	***Stripline***	***TEM cell***	***BCI***	***ALSE***	***Reverberation chamber***
20 to 2,000 MHz	**60 V/m**	**75 V/m**	**60 mA**	**30 V/m**	**21 V/m**
2,000 to 6,000 MHz	**Not applicable**	**Not applicable**	**Not applicable**	**10 V/m**	**7 V/m**

Table 19b

	Minimum Test Level over the whole 20 to 6,000 MHz frequency band				
Frequency range	***Stripline***	***TEM cell***	***BCI***	***ALSE***	***Reverberation chamber***
20 to 2,000 MHz	**50 V/m**	**62,5 V/m**	**50 mA**	**25 V/m**	**18 V/m**
2,000 to 6,000 MHz	**Not applicable**	**Not applicable**	**Not applicable**	**8 V/m**	**6 V/m**

"

Paragraph 7.18.2.2., amend to read:

"7.18.2.2. The ESA representative of its type shall be considered as complying with immunity requirements if, during the tests performed in accordance with Annex 9, there shall be no degradation of performance of ~~"immunity related functions"~~**the charging function as defined in paragraph 2.3. of Annex 9**."

Paragraph 7.19.1., amend to read:

"7.19.1 Method of testing

The immunity of ESA representative of its type shall be tested by the method(s) according to ISO 7637-2, as described in Annex 10 with the test levels given in Table ~~18~~**20**.

Table ~~18~~**20**
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~~

Test pulse number	***Immunity test level***		***Test duration / Number of pulses***	***FPSC for systems:***	
	12V system	***24V system***		***Related to immunity related functions***	***Not related to immunity related functions***
1	**-75 V**	**-450V**	**500 pulses**	**III**	**III**
2a	**+37 V**	**+37 V**	**500 pulses**	**I**	**III**
2b	**+10 V**	**+ 20 V**	**10 pulses**	**II**	**III**
3a	**-112 V**	**-150 V**	**1 h**	**I**	**III**
3b	**+ 75 V**	**+150 V**	**1 h**	**I**	**III**

"

Paragraphs 7.20.1. to 7.20.3., to be deleted.

Paragraphs 7.20.4. and 7.20.5., renumber to read:

"7.20.**41**. 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 (cable between the DC charging station and the vehicle plug) shorter than 30 m do not have to fulfil the requirements of paragraphs 7.5., 7.8., 7.9., 7.13., 7.15., 7.16.

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.

7.20.~~5~~**2**. Vehicles and / or ESA which are intended to be used in "REESS charging mode coupled to the power grid" in the configuration connected to a local / private DC-charging station without additional participants do not have to fulfil requirements of paragraphs 7.5., 7.8., 7.9., 7.13., 7.15., 7.16.

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.
"

Insert new paragraphs 13.3. to 13.3.5., to read:

"[13.3 Transitional provisions applicable to the 07 series of amendments

For vehicles

13.3.1. As from the official date of entry into force of the 07 series of amendments, no Contracting Party applying this Regulation shall refuse to grant or

refuse to accept type approvals under this Regulation as amended by the 07 series of amendments.

13.3.2. **As from 1 September 2029, Contracting Parties applying this Regulation shall not be obliged to accept type approvals to the preceding series of amendments, first issued after 1 September Date 2029.**

13.3.3. **Contracting Parties applying this Regulation shall continue to accept type approvals issued according to the preceding series of amendments to this Regulation first issued before 1 September 2029.**

13.3.4. **Notwithstanding paragraph 13.3, Contracting Parties applying this Regulation shall continue to accept type approvals issued according to the preceding series of amendments to this Regulation, for the vehicles/vehicle systems which are not affected by the changes introduced by the 07 series of amendments.**

13.3.5. **Contracting Parties applying this Regulation may grant type approvals according to any preceding series of amendments to this Regulation.**

13.3.6. **Contracting Parties applying this Regulation shall continue to grant extensions of existing approvals to any preceding series of amendments to this Regulation.**

For ESAs

13.3.7. **As from the official date of entry into force of the 07 series of amendments, no Contracting Party applying this Regulation shall refuse to grant or refuse to accept type approvals under this Regulation as amended by the 07 series of amendments.**

13.3.8. **As from 1 September Date 2029, Contracting Parties applying this Regulation shall not be obliged to accept type approvals to the preceding series of amendments, first issued after 1 September 2029.**

13.3.9. **Contracting Parties applying this Regulation shall continue to accept type approvals to the preceding series of amendments to this Regulation, first issued before 1 September 2029.**

13.3.10. **Notwithstanding paragraph 13.3.9., Contracting Parties applying this Regulation shall continue to grant and accept type approvals for devices (equipment and parts) on the basis of any previous series of amendments, provided that the devices (equipment and parts) are intended as replacements for fitting to vehicles in use and that it is not technically feasible for the devices (equipment and parts) in question to satisfy the new requirements contained in this Regulation as amended by the 07 series of amendments.**

13.3.11. **Notwithstanding paragraph 13.3.9., Contracting Parties applying this Regulation shall continue to accept type approvals of the equipment or parts issued according to the preceding series of amendments to this Regulation which are not affected by the 07 series of amendments**

13.3.12. **Contracting Parties applying this Regulation shall not refuse to grant type approvals according to any preceding series of amendments to this Regulation or extensions thereof.]"**

Appendix 1, amend to read:

"Appendix 1

List of standards referred to in this Regulation

1. CISPR 12 "Vehicles', motorboats' and spark-ignited engine-driven devices' radio disturbance characteristics - Limits and methods of measurement", fifth edition 2001 and A~~md~~**MD**1:2005.

2. CISPR 16-1-4 "Specifications for radio disturbance and immunity measuring apparatus and methods - Part 1: Radio disturbance and immunity measuring apparatus apparatus - Antennas and test sites for radiated disturbances mesaurements", ~~third~~**fourth** edition ~~2010~~**2019+AMD1:2020+AMD2:2023**.

3. CISPR 25 "Limits and methods of measurement of radio disturbance characteristics for the protection of receivers used on board vehicles", second edition 2002 and corrigendum 2004.

4. **ISO 7637-1 "Road vehicles - Electrical disturbance from conduction and coupling - Part 1: Definitions and general configurations", third edition 2015.**

   ISO 7637-2 "Road vehicles - Electrical disturbance from conduction and coupling - Part 2: Electrical transient conduction along supply lines only on vehicles with nominal 12 V or 24 V supply voltage", second edition 2004.

   ISO 7637-2 "Road vehicles - Electrical disturbance from conduction and coupling - Part 2: Electrical transient conduction along supply lines only", third edition 2011.

5. ISO/**IEC** ~~EN~~ 17025 "General requirements for the competence of testing and calibration laboratories", ~~second~~**third** edition **2017**~~2005 and Corrigendum: 2006~~.

6. ISO 11451 "Road vehicles - Electrical disturbances by narrowband radiated electromagnetic energy - Vehicle test methods":

   Part 1: General and definitions (ISO 11451-1, ~~third~~**fourth** edition ~~2005 and Amd1: 2008)~~**2015**;
   Part 2: Off-vehicle radiation source (ISO 11451-2, fourth edition 2015);

   Part 4: Bulk current injection (BCI) (ISO 11451-4, ~~third~~**fourth** edition ~~2013~~**2022**).

7. ISO 11452 "Road vehicles - Electrical disturbances by narrowband radiated electromagnetic energy - Component test methods":

   Part 1: General and definitions (ISO 11452-1, ~~third~~**fourth** edition ~~2005 and Amd1: 2008)~~**2015**;
   Part 2: Absorber-lined chamber (ISO 11452-2, ~~second~~**third** edition ~~2004~~**2019**);

   Part 3: Transverse electromagnetic mode (TEM) cell (ISO 11452-3, third edition 2016);
   Part 4: Bulk current injection (BCI) (ISO 11452-4, ~~third~~**fifth** edition ~~2011~~**2020**);
   Part 5: Stripline (ISO 11452-5, second edition 2002).
   Part 11: Reverberation chamber (ISO 11452-11, first edition 2010).

8. ITU Radio Regulations, edition ~~2008~~**2020**.

9. IEC 61000-3-2 "Electromagnetic Compatibility (EMC) - Part 3-2 - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)", edition ~~3.2 - 2005 + A1: 2008 + A2: 2009.~~ **5.1 – 2018+AMD1:2020.**

10. IEC 61000-3-3 "Electromagnetic Compatibility (EMC) - Part 3-3 - Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage systems for equipment with rated current ≤ 16 A per phase and not

subjected to conditional connection", edition ~~2.0 2008~~ **3.2 – 2013+AMD1:2017+AMD2:2021+COR1:2022**.

11. IEC 61000-3-11 "Electromagnetic Compatibility (EMC) - Part 3-11 - Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage systems - Equipment with rated current ≤ 75 A per phase and subjected to conditional connection", edition ~~1.0 2000~~ **2.0 - 2017**.

12. IEC 61000-3-12 "Electromagnetic Compatibility (EMC) - Part 3-12 - Limits for harmonic current emissions produced by equipment connected to public low-voltage systems with input current > 16 A and ≤ 75 A per phase", edition ~~1.0 2004~~ **2.1 – 2011+AMD1:2021**.

13. IEC 61000-4-4 "Electromagnetic Compatibility (EMC) - Part 4-4 - Testing and measurement techniques - Electrical fast transients/burst immunity test", edition ~~2.0 2004~~ **3.0 - 2012**.

14. IEC 61000-4-5 "Electromagnetic Compatibility (EMC) - Part 4-5 - Testing and measurement techniques - Surge immunity test", edition ~~2.0 2005~~ **3.1 – 2014+AMD1:2017**.

15. IEC 61000-6-3 "Electromagnetic Compatibility (EMC) - Part 6-3 - Generic standards Emission standard for residential, commercial and light-industrial environments", edition ~~2.0 2006~~ **3.0 - 2020**.

16. IEC 61000-6-4 "Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments", edition 3.0 – 2018.

1~~6~~**7**. CISPR 16–2–1 "Specification for radio disturbances and immunity measuring apparatus and methods - Part 2-1 - Methods of measurement of disturbances and immunity - Conducted disturbances measurement", edition ~~2.0 2008~~ **3.1 – 2014+AMD1:2017+COR1:2020**.

~~17. CISPR 22 "Information Technology Equipment – Radio disturbances characteristics – Limits and methods of measurement", edition 6.0 2008.~~

18. CISPR 16-1-2 "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-2: Radio disturbance and immunity measuring apparatus - Ancillary equipment - Conducted disturbances", edition 2.~~0~~**1 –** 2014**+AMD1:2017**.

19. IEC 61851-1 "Electric vehicle conductive charging system – Part 1: General requirements ", edition 3.0 - 2017.

20. IEC 61851-21-2 "Electric vehicle conductive charging system - Part 21-2: Electric vehicle requirements for conductive connection to an AC/DC supply - EMC requirements for off board electric vehicle charging systems", edition 1.0 - 2018.

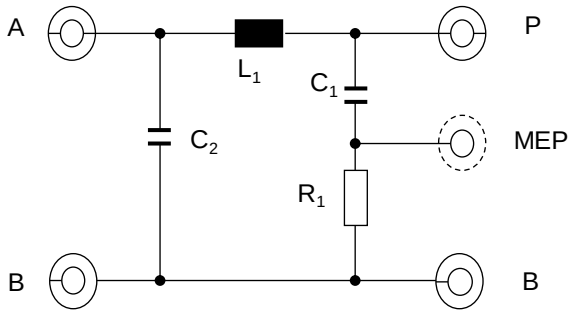
2~~0~~**1**. CISPR 32 "Electromagnetic compatibility of multimedia equipment – Emission requirements", edition 2.~~0~~**1** – 2015**+AMD1:2019**.

22. CISPR 16-1-1 "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-1: Radio disturbance and immunity measuring apparatus - Measuring apparatus ", edition 4.0 2015-09."

Appendix 8,

Paragraph 1., figure 1, amend to read:

"Figure 1
Example of 5 µH AN schematic



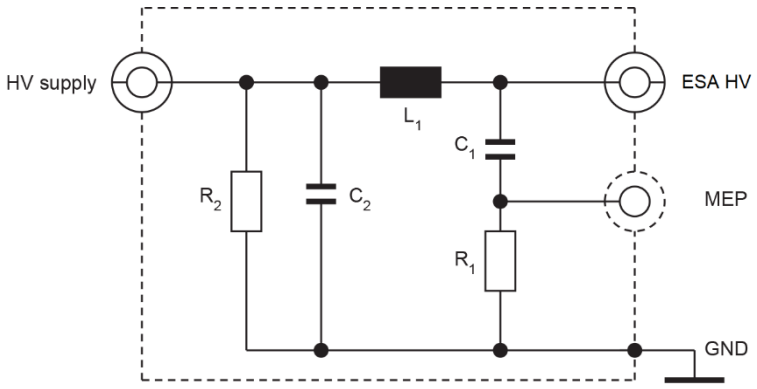
Legend

L_1: 5 µH	A: Port to power supply
C_1: 0,1 µF	P: Port to ~~Vehicle or~~ ESA
C_2: 1 µF (default value)	B: Ground
R_1: 1 kΩ	MEP: Measuring Port"

“

Paragraph 2., figures 3, 4 and 5, amend to read:

"Figure 3
Example of 5 µH / HV-AN schematic

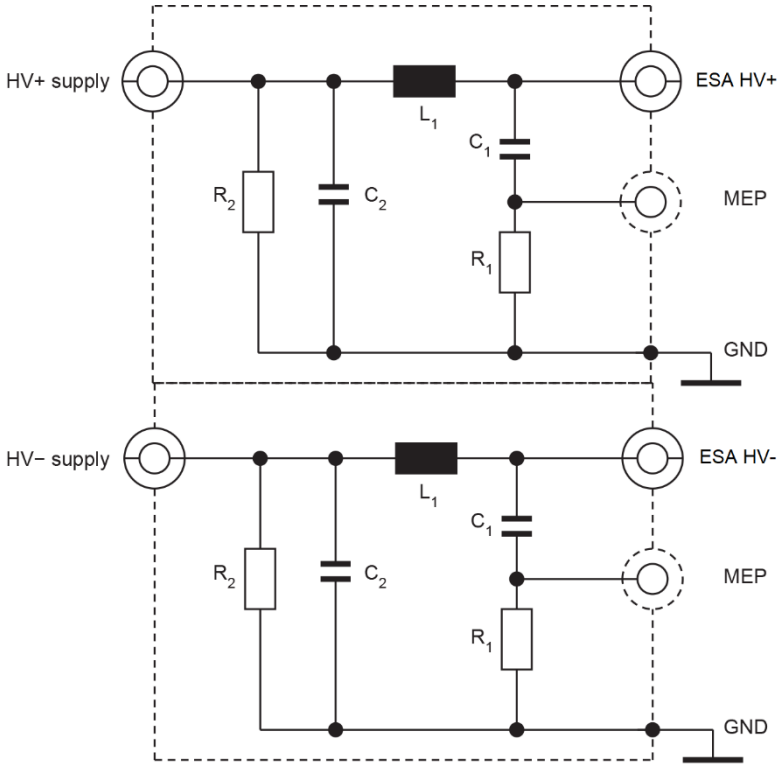


Legend

L_1: 5 µH	HV supply: High Voltage power supply
C_1: 0,1 µF	~~Vehicle /~~ ESA HV: High Voltage of ~~Vehicle or~~ ESA
C_2: 0,1 µF (default value)	MEP: Measuring Port
R_1: 1 kΩ	GND: Ground
R_2: 1 MΩ (discharging C_2 to > 50 V_{dc} within 60 s)	

If unshielded HV ANs are used in a single shielded box, then there shall be an inner shield between the HV ANs as described in Figure 4."

"Figure 4
Example of 5 µH HV AN combination in a single shielded box



Legend

L_1: 5 µH

C_1: 0,1 µF

C_2: 0,1 µF (default value)

R_1: 1 kΩ

R_2: 1 MΩ (discharging C_2 to > 50 V_{dc} within 60 s)

HV supply: High Voltage power supply (positive and negative)

~~Vehicle /~~ ESA HV: High Voltage of ~~Vehicle or~~ ESA (positive and negative)

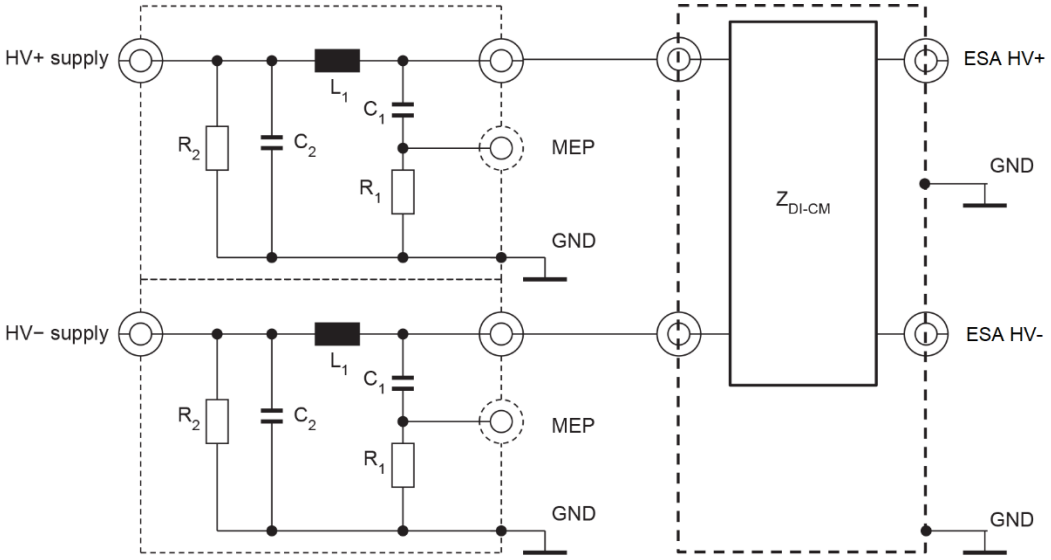
MEP: Measuring Port

GND: Ground

An optional impedance matching network may be used to simulate common mode / differential mode impedance seen by the ESA plugged on HV power supply (see Figure 5)."

"Figure 5

Impedance matching network attached between HV ANs and ESA



Legend

L_1: 5 µH	HV supply: High Voltage power supply (positive and negative)
C_1: 0,1 µF	~~Vehicle /~~ ESA HV: High Voltage of ~~Vehicle or~~ ESA (positive and negative)
C_2: 0,1 µF (default value)	MEP: Measuring Port
R_1: 1 kΩ	GND: Ground
R_2: 1 MΩ (discharging C_2 to > 50 V_{dc} within 60 s)	Z_{DI-CM}: Differential and common-mode impedance"

Paragraph 3., amend to read:

"3. Direct Current charging Artificial Networks (DC-charging-AN)

For a vehicle/**ESA** in charging mode connected to a DC power supply, a 5 µH / 50 Ω DC-charging-AN as defined in Figure 6 shall be used.

Measurement ports of DC-charging-AN(s) shall be terminated with 50 Ω loads.

The DC-charging-AN impedance ZPB (tolerance ±20 %) in the measurement frequency range of 0,1 MHz to 100 MHz is shown in Figure 7. It is measured between the terminals "Vehicle/ESA HV" and "GND" (of Figure 6) with a 50 Ω load on the measurement port and with terminals "HV Supply" and "GND" (of Figure 6) short circuited.

…"

Paragraph 4., amend to read:

"4. Artificial Mains networks (AMN)

For a vehicle/**ESA** in charging mode connected to an AC power mains, a 50 µH / 50 Ω-AMN as defined in CISPR 16-1-2 clause 4.4 shall be used.

Measurement ports of AMN(s) shall be terminated with 50 Ω loads. "

Paragraph 5., amend to read:

"5. Asymmetric artificial network (AAN)

Currently, different technologies for signal/control port lines and/or wired network port lines are used for the communication between charging station and vehicle/**ESA.** Therefore, a distinction between some specific signal/control port lines and/or wired network port lines (for example, control pilot line, CAN lines) is necessary.

Measurement ports of AAN(s) shall be terminated with 50 Ω loads.

AANs that are defined in 5.1., 5.2., 5.3. and 5.4. are used for unshielded signal/control port lines and/or wired network port lines.

If shielded signal/control port lines are used, then shielded AANs defined in CISPR 32:2015 Annex G, Figures G.10 and G.11 should be used."

Paragraph 5.1., amend to read:

"5.1. Signal/Control port with symmetric lines

An asymmetric artificial network (AAN) to be connected between the vehicle and the charging station or any ~~associated~~ **auxiliary equipment** (AE) used to simulate communication is defined in CISPR 16-1-2 Annex E clause E.2 (T network circuit) (see example in Figure 8).

…"

Paragraph 5.2., amend to read:

"5.2. Wired network port with PLC on power lines

If an original charging station can be used for the test, an AAN and/or AMN/DC-charging-AN might not be required for PLC communication.

If the presence of the AMN/DC-charging-AN prevents proper PLC communication with the original charging station or if the PLC communication needs to be simulated by means of a piece of ~~associated~~ **auxiliary equipment** (e.g. a PLC modem) instead of the original charging station, it is necessary to add an AAN between the AE (e.g. the PLC modem) and the AMN/DC-charging-AN output (vehicle side), as shown in Figure 9.

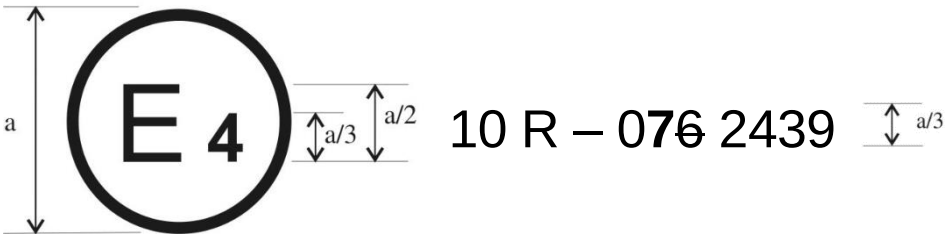
…"

Annex 1, amend to read:

"**Examples of approval marks**

Model A

(See paragraph 5.2. of this Regulation)

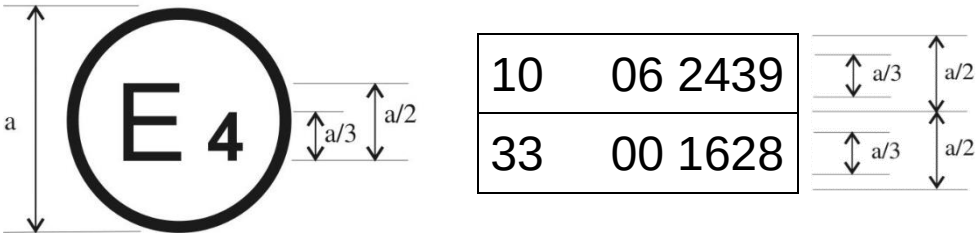


a = 6 mm **min**

The above approval mark affixed to a vehicle or ESA shows that the vehicle type concerned has, with regard to electromagnetic compatibility, been approved in the Netherlands (E 4) pursuant to Regulation No. 10 under approval No. 07~~5~~ 2439. The approval number indicates that the approval was granted according to the requirements of Regulation No. 10 as amended by the 07~~6~~ series of amendments.

Model B

(See paragraph 5.2. of this Regulation)



a = 6 mm min

The above approval mark affixed to a vehicle or ESA shows that the vehicle type concerned has, with regard to electromagnetic compatibility, been approved in the Netherlands (E 4) pursuant to Regulations Nos. 10 and 33.[1] The approval numbers indicate that, at the date when the respective approvals were given, Regulation No. 10 included the 06 series of amendments and Regulation No. 33 was still in its original form."

Annex 2A,

Item 10, amend to read:

"10**a.** ~~Internal combustion engine~~**List propulsion systems, auxiliary engines and components of the charging system**: ……... "

[1] The second number is given merely as an example.

Insert a new item 10b, to read:

"**10b. List modes of operations (selectable by the driver or the system) which are selected during the type approval test:……** "

Item 64, amend to read:

"64. Vehicle equipped with 24 GHz short-range radar equipment: yes/no/optional.[1]

~~The applicant for type approval shall also supply, where appropriate:~~

~~Appendix 1 A list with make(s) and type(s) of all electrical and/or electronic components concerned by this Regulation (see paragraphs 2.9. and 2.10. of this Regulation) and not previously listed.~~

~~Appendix 2: Schematics or drawing of the general arrangement of electrical and/or electronic components (concerned by this Regulation) and the general wiring harness arrangement.~~

~~Appendix 3: Description of vehicle chosen to represent the type:~~

~~Body style: .....~~

~~Left or right hand drive: .....~~

~~Wheelbase: .....~~

~~Appendix 4: Relevant test report(s) supplied by the manufacturer from a test laboratory accredited to ISO 17025 and recognized by the Type Approval Authority for the purpose of drawing up the type approval certificate.~~"

Item 66, amend to read:

"66. **List every available charging mode (**~~Charging current:~~ direct current / alternating current**,** (number of phases/frequency): [1] .....
"

Item 67, amend to read:

"67. Maximum ~~nominal~~**charging** current (in each mode ~~if necessary)~~:.....
"

Item 68, amend to read:

"68. Nominal charging voltage **in each mode**:.....
"

Add a new item 73, to read:

"**73. Environment of charging (residential, non-residential)**"

Add new sub-paragraph, to read:

"**The applicant for type approval shall also supply, where appropriate:**

Appendix 1 A list with make(s) and type(s) of all electrical and/or electronic components concerned by this Regulation (see paragraphs 2.9. and 2.10. of this Regulation) and not previously listed.

Appendix 2: Schematics or drawing of the general arrangement of electrical and/or electronic components (concerned by this Regulation) and the general wiring harness arrangement.

Appendix 3: Description of vehicle chosen to represent the type:

Body style: .....

Left or right hand drive: .....

Wheelbase: .....

Appendix4: Relevant test report(s) supplied by the manufacturer from a test laboratory accredited to ISO 17025 and recognized by the Type-Approval Authority for the purpose of drawing up the type approval certificate."

Annex 3A, amend to read:

"Annex 3A

Communication

(Maximum format: A4 (210 x 297 mm))

issued by: Name of administration:
.....
.....
.....

Concerning:[3] Approval granted
Approval extended
Approval refused
Approval withdrawn
Production definitively discontinued

of a type of vehicle/component/separate technical unit[2] with regard to Regulation No. 10.

Approval No.: ……..... Extension No.: .....

1. Make (trade name of manufacturer):.....
2. Type: .....
3. Means of identification of type, if marked on the vehicle/component/separate technical unit[2].....
- 3.1. Location of that marking:.....
4. Category of vehicle: .....
5. Name and address of manufacturer:.....
6. In the case of components and separate technical units, location and method of affixing of the approval mark:.....
7. Address(es) of assembly plant(s): .....
8. Additional information (where applicable): See appendix below
9. Technical Service responsible for carrying out the tests:.....
   .....
10. Date of test report: .....
11. Number of test report:.....
12. Remarks (if any): See appendix below
13. Place:.....

[2] Distinguishing number of the country which has granted/extended/refused or withdrawn approval (see Regulation, provisions on approval).

[3] Strike out what does not apply.

14. Date:.....

15. Signature:.....

16. The index to the information package lodged with the Approval Authority, which may be obtained on request is attached:.....

17. Reasons for extension:.....

Appendix to type approval communication form No.....
concerning the type approval of a vehicle under UN Regulation No. 10

1. Additional information:.....

2. Electrical system rated voltage: .....V. pos/neg ground[2]

3. Environment of charging for REESS of EV and PHEV:

Type of vehicle valid for residential environment:.....

Type of vehicle valid for non-residential environment:.....

~~3~~**4**. Type of bodywork:.....

~~4~~**5**. List of electronic systems installed in the tested vehicle(s) not limited to the items in the information document:.....

~~4~~**5**.1. Vehicle equipped with 24 GHz short-range radar equipment: yes/no/optional[2]

~~5~~**6**. Laboratory accredited to ISO 17025 and recognized by the Approval Authority responsible for carrying out the tests: .....

~~6~~**7**. Remarks: (e.g. valid for both left-hand drive and right-hand drive vehicles): ....."

Annex 4,

Paragraph 2., amend to read:

"2. Vehicle state during tests

For two-wheeled vehicles, a non-conductive insulating support with a thickness of 5 – 20mm shall be used between stand and ground plane."

Paragraph 2.1.1., amend to read:

"2.1.1. Engine

The engine shall be in operation according to CISPR 12.

For vehicle with an electric propulsion motor or hybrid propulsion system, if this is not appropriate (e.g. in case of busses, trucks, two- and three wheel vehicles), transmission shafts, belts or chains may be disconnected to achieve the same operation condition for the propulsion.

If operating mode defined in CISPR 12 (i.e. 40 km/h) does not activate all traction motors or auxiliary battery charging engines, an alternative, steady state operating mode shall be agreed between the Technical Service and vehicle manufacturer. "

Paragraph 2.2., amend to read:

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

The vehicle shall be tested in the charging mode configuration (if available on vehicle) as defined in flowchart of figure 1

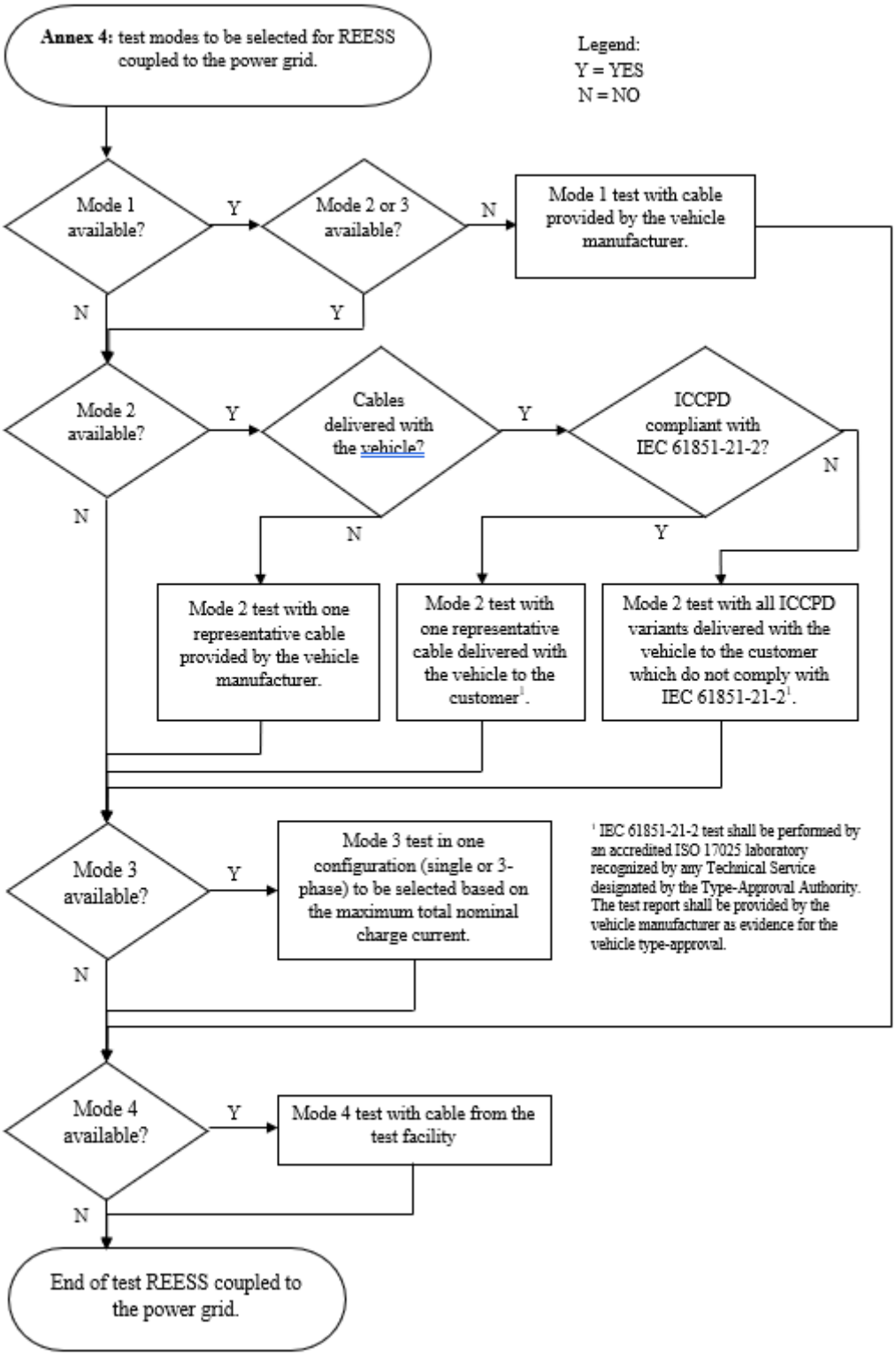


Figure 1
Charging mode configuration for Annex 4

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 splitting 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~~ **maximum rated charging/input current** value for AC charging.

If the current consumption can be adjusted, then the current shall be set to at least ~~80~~ **20** per cent of its nominal value **or to a minimum of 16 A (if the 20 per cent of its nominal value cannot be achieved in the test facility)** for DC charging unless another value is agreed with the type approval authorities.

In case of multiple batteries the average state of charge must be considered.

The vehicle shall be immobilized, the engine(s) (ICE and / or electrical engine) shall be OFF and in charging mode. All other equipment which can be switched ON by the driver or passengers shall be OFF.

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

Paragraph 2.3.3., amend to read:

"2.3.3. Power charging harness

The power charging harness shall be placed in a straight line between the AMN(s) and the vehicle charging plug and shall be routed perpendicularly to the vehicle longitudinal axis (see Figure 3~~d~~**a** and Figure 3c). The projected harness length from the side of the AMN(s) to the side of the vehicle shall be 0,8 (+0,2 / -0) m as shown in Figure 3~~d~~**b** and Figure 3~~e~~**d**.

~~For a longer harness the extraneous length shall be "Z-folded" in a less than 0,5 m width approximately around the middle of the AMN to vehicle distance. If it is impractical to do so because of harness bulk or stiffness, or because the testing is being done at a user's installation, the disposition of the excess harness shall be precisely noted in the test report.~~

For a longer cable, the extraneous length shall be "Z-folded" symmetrically. No contact or overlap is allowed between windings. The width of the Z-folded cable shall be between 500 mm and 1 000 mm. If it is impractical to do so because of cable bulk or stiffness, or because the testing is being done at a user's installation, the disposition of the excess cable length shall be precisely noted in the test report.

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

The whole harness shall be placed on a non-conductive, low relative permittivity (dielectric-constant) material ($\varepsilon r \leq 1{,}4$), at (100 ± 25) mm above the ground plane (ALSE) or floor (OTS)."

Paragraphs 2.4.3. and 2.4.4., amend to read:

"2.4.3. Asymmetric artificial network

Local/private communication lines connected to signal/control ports and lines connected to wired network ports shall be applied to the vehicle through AAN(s).

The various AAN(s) to be used are defined in Appendix 8, clause 5:

- Clause 5.1 for signal/control port with symmetric lines;
- Clause 5.2 for wired network port with PLC on power lines;
- Clause 5.3 for signal/control port with PLC (technology) on control pilot; and
- Clause 5.4 for signal/control port with control pilot.

The AAN(s) shall be mounted directly on the ground plane. The case of the AAN(s) shall be bonded to the ground plane (ALSE) or connected to the protective earth (OTS, e.g. an earth rod).

The measuring port of each AAN shall be terminated with a 50 Ω load.

If a charging station is used, AAN(s) are not required for the signal/control ports and/or for the wired network ports. The local/private communication lines between the vehicle and the charging station shall be connected to the ~~associated~~ **auxiliary equipment** on the charging station side to work as designed. If communication is emulated and if the presence of the AAN prevents proper communication then no AAN should be used

2.4.4. Power charging / local/private communication harness

The power charging local/private communication harness shall be laid out in a straight line between the AMN(s) / DC-charging-AN(s) / AAN(s) and the vehicle charging socket and shall be routed perpendicularly to the vehicle's longitudinal axis (see Figure 3~~f~~**e** and Figure 3g). The projected harness length from the side of the AMN(s) to the side of the vehicle shall be 0,8 (+0,2 / -0) m **as shown in Figure 3f and Figure 3h.**

~~For a longer harness the extraneous length shall be "Z-folded" in less than 0,5 m width. If it is impractical to do so because of harness bulk or stiffness, or because the testing is being done at a user installation, the disposition of the excess harness shall be precisely noted in the test report.~~

For a longer cable, the extraneous length shall be "Z-folded" symmetrically. No contact or overlap is allowed between windings. The width of the Z-folded cable shall be between 500 mm and 1 000 mm. If it is impractical to do so because of cable bulk or stiffness, or because the testing is being done at a user's installation, the disposition of the excess cable length shall be precisely noted in the test report.

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

The whole harness shall be placed on a non-conductive, low relative permittivity (dielectric-constant) material ($\varepsilon r \leq 1{,}4$), at (100 ± 25) mm above the ground plane (ALSE) or floor (OTS)."

Paragraphs 4.3. and 4.4., amend to read:

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

Spectrum analysers and FFT-based instruments, that meet the requirements of CISPR 16-1-1, may be used for conformity measurements. FFT-based measuring instruments shall continuously record and evaluate the signal during the measurement time. If using FFT-based instruments, the minimum measurement time shall be 1 s per analysis frequency band (in real-time mode) of the FFT instrument.

Table 1
Spectrum analyser parameters

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

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

Table 2
Scanning receiver parameters

Frequency range MHz	*Peak detector*			*Quasi-peak detector*			*Average detector*		
	BW at -6 dB	*Step size* [a]	*Minimum ~~scan~~ **dwell** time*	*BW at -6 dB*	*Step size* [a]	*Minimum Dwell time*	*BW at -6 dB*	*Step size* [a]	*Minimum ~~scan~~ **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.

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 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 **A**~~a~~nnex.

For configuration "REESS charging mode coupled to the power grid", 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 for all the available charging modes configurations defined in 2.2, the Technical Service may perform tests only for one of the available charging mode configuration defined in 2.2 and 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."

Paragraph 4.6., amend to read:

"4.6. Antenna position

Measurements shall be made on the left and right sides of the vehicle.

The horizontal distance is from the reference point of the antenna to the nearest part of the vehicle body.

Multiple antenna positions may be required (both for 10 m and 3 m antenna distance) depending on the vehicle length. The same positions shall be used for both horizontal and vertical polarization measurements. The number of antenna positions and the position of the antenna with respect to the vehicle shall be documented in the test report.

- If the length of the vehicle is smaller than the 3 dB beamwidth of the antenna, only one antenna position is necessary. The antenna shall be aligned with the middle of the total vehicle (see Figure 4);

- If the length of the vehicle is greater than the 3 dB beamwidth of the antenna, multiple antenna positions are necessary in order to cover the total length of

the vehicle (see Figure 5). The number of antenna positions shall allow to meet the following condition:

$$N \cdot 2 \cdot D \cdot \tan(\beta) \geq L \quad (1)$$

With:

N: Number of antenna positions;

D: Measurement distance (3 m or 10 m);

2·β: 3 dB antenna beamwidth angle in the plane parallel to ground (i.e. the E-plane beamwidth angle when the antenna is used in horizontal polarization, and the H-plane beamwidth angle when the antenna is used in vertical polarization);

L: Total vehicle length~~;~~ **covers the whole dimensions including tires, bumpers and lights, etc.**

Depending of the chosen values of N (number of antenna positions) different set-up shall be used:

if N=1 (only one antenna position is necessary) and the antenna shall be aligned with the middle of the total vehicle length (see Figure 4).

if N>1 (more than one antenna position is necessary) and multiple antenna positions are necessary in order to cover the total length of the vehicle (see Figure 5). The antenna positions shall be symmetric in regard to the vehicle perpendicular axis."

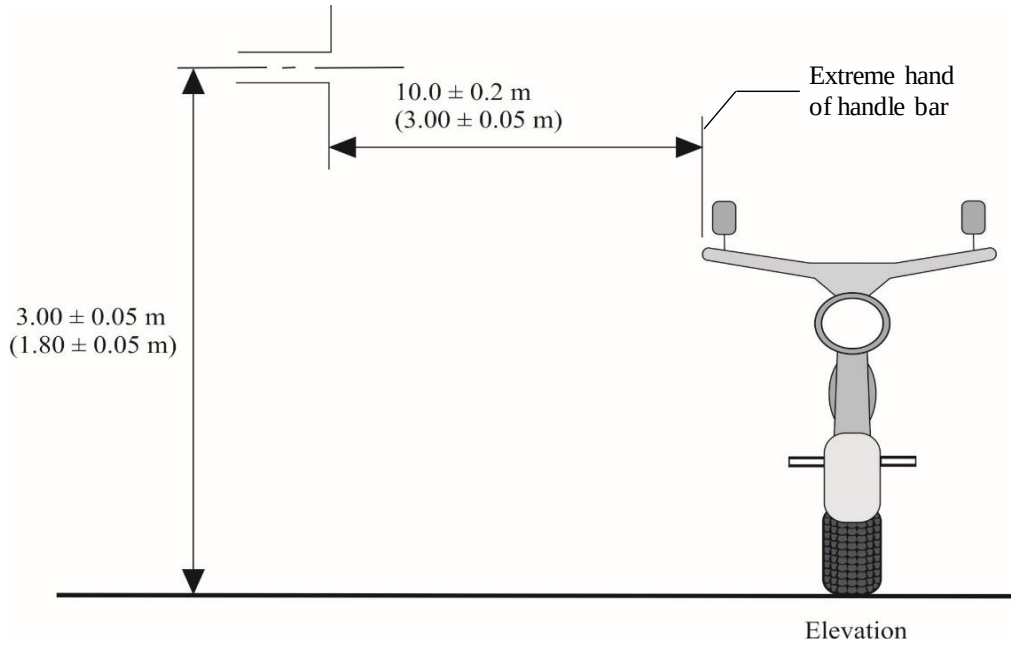
Annex 4, Appendix 1, amend to read:

"Annex 4 – Appendix 1

Figure 2
Position of antenna in relation to the vehicle:

~~Figure 2a~~
~~**Dipole antenna in position to measure the vertical radiation components**~~

-



~~Figure 2b~~

~~Dipole antenna in position to measure the horizontal radiation components~~

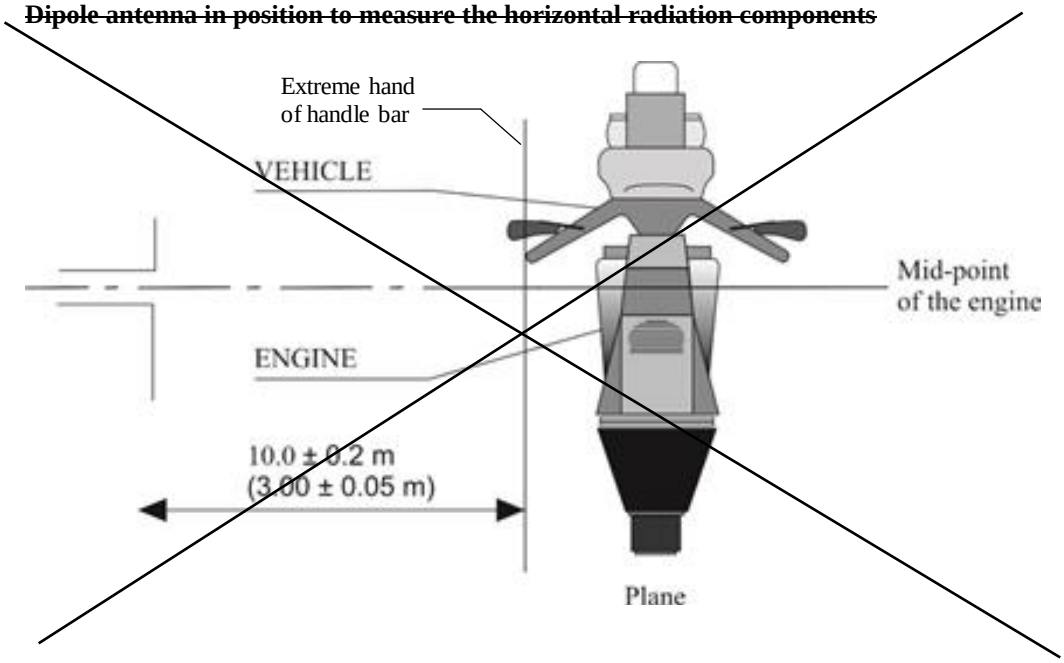
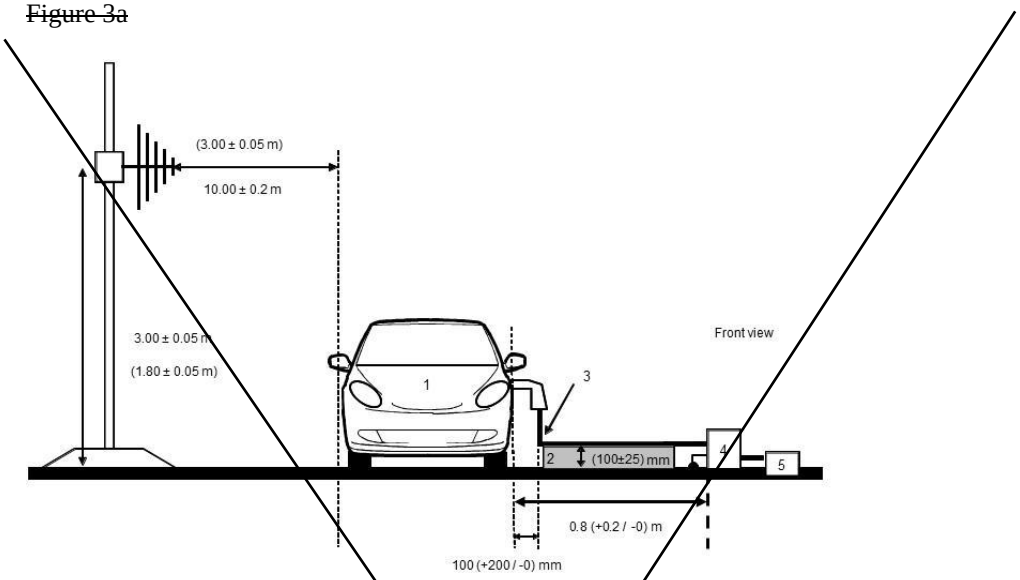


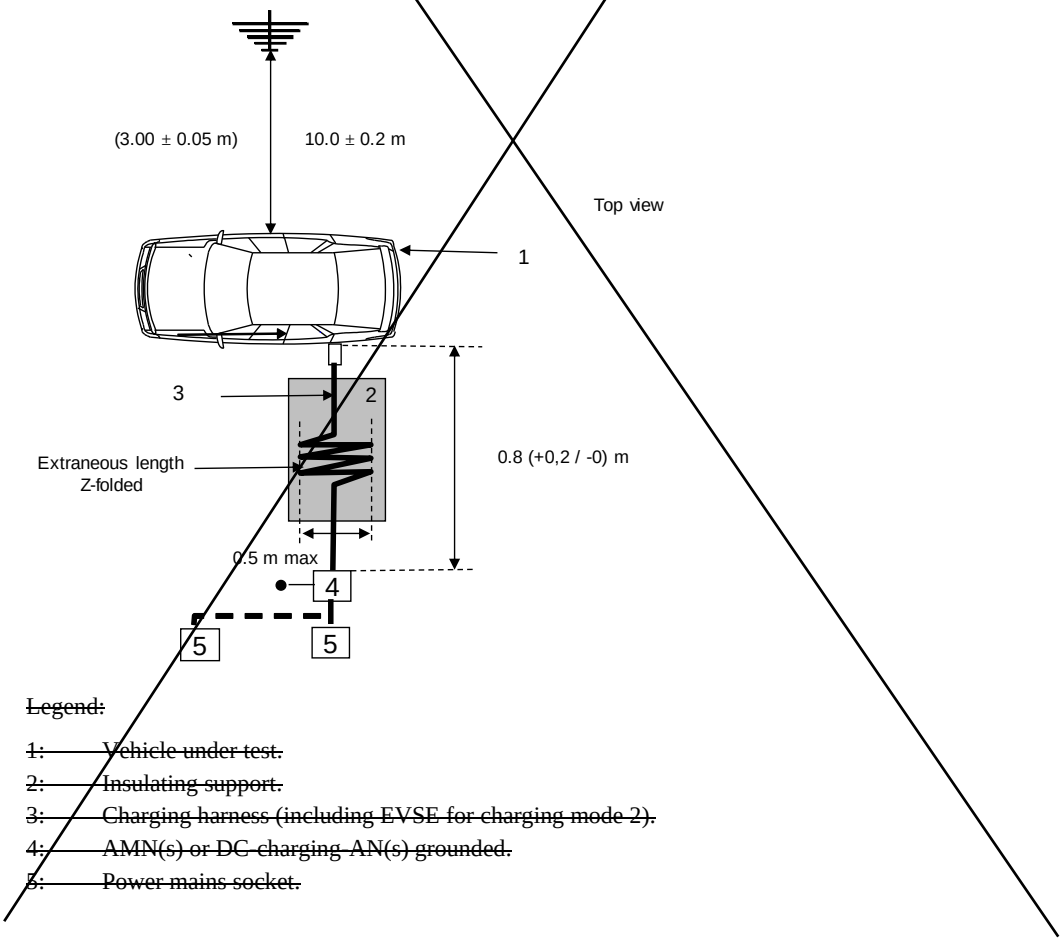
Figure 3
Vehicle in configuration "REESS charging mode" coupled to the power grid:

Example of test setup for vehicle with socket located on vehicle side (charging mode 1 or 2, AC powered, without communication).

~~Figure 3a~~



~~Figure 3b~~



~~Legend:~~

~~1: Vehicle under test.~~
~~2: Insulating support.~~
~~3: Charging harness (including EVSE for charging mode 2).~~
~~4: AMN(s) or DC charging AN(s) grounded.~~
~~5: Power mains socket.~~

Figure 3a

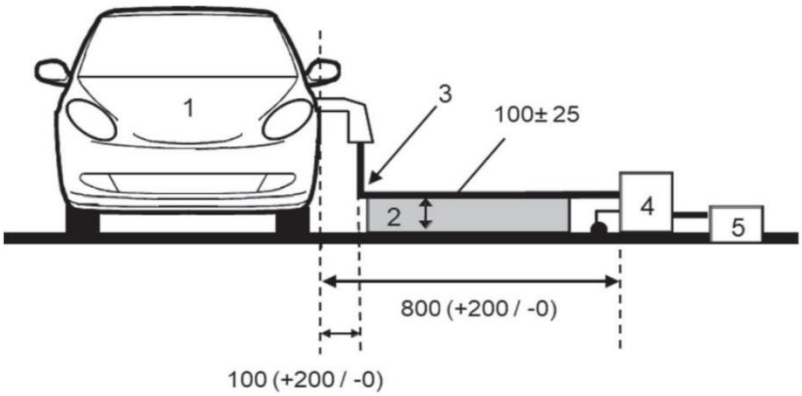
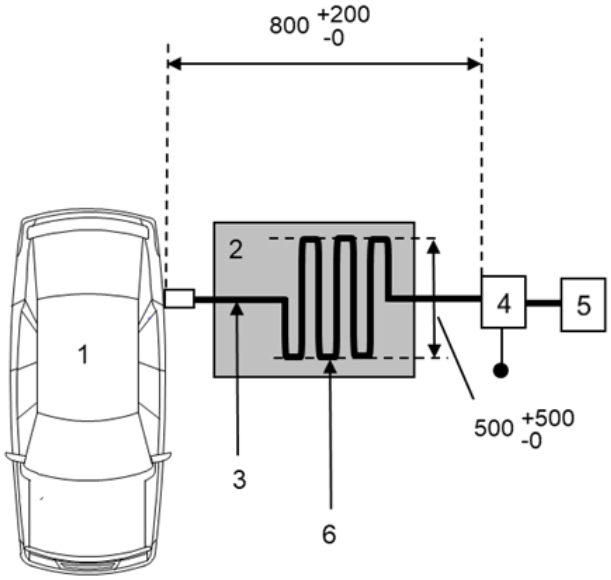


Figure 3b



Key

1 vehicle under test

2 insulating support

3 charging cable (including EVSE for charging mode 2)

4 artificial mains network(s) grounded

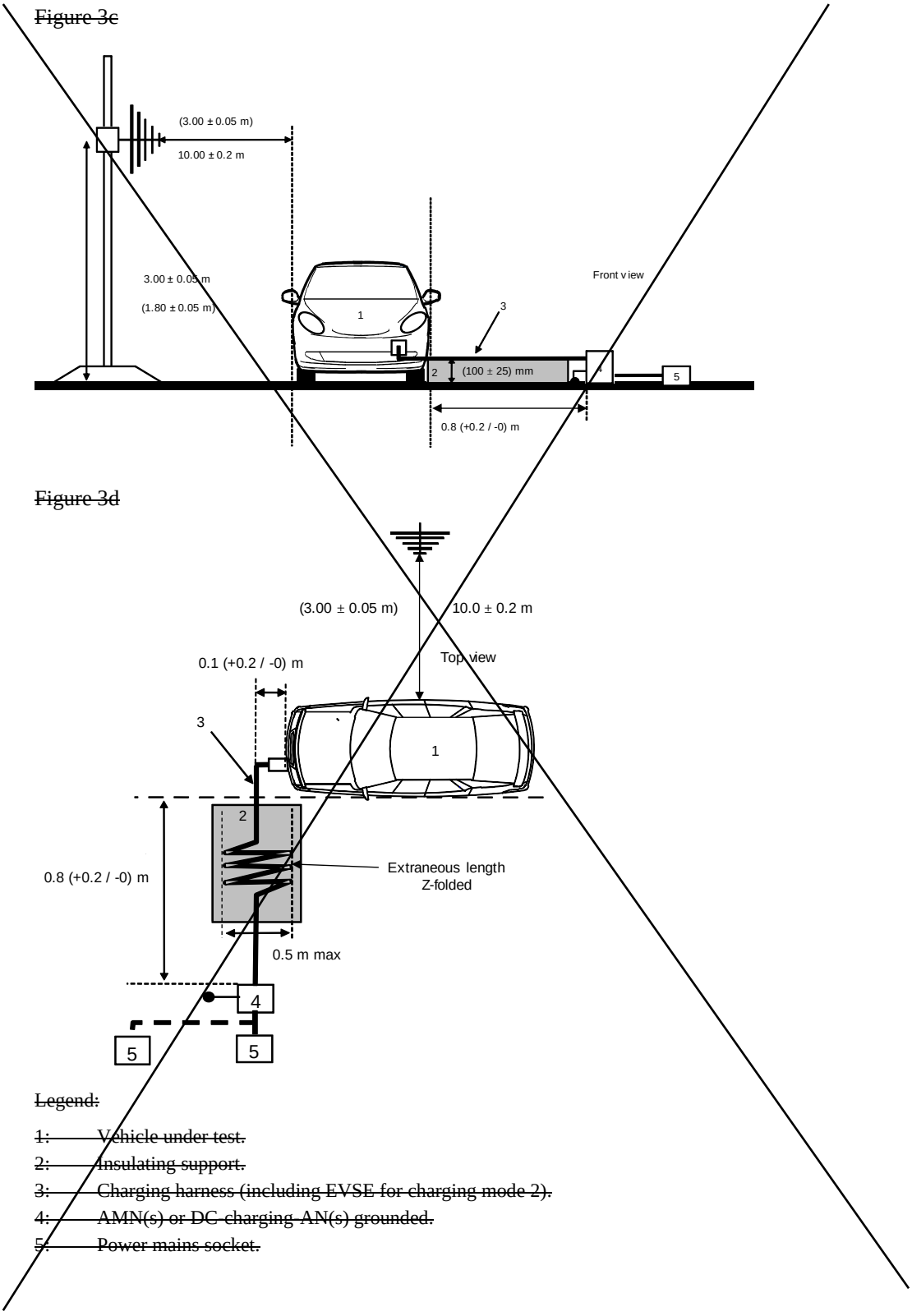
5 power mains socket (see 7.3.2.2)

6 extraneous length Z-folded

NOTE: The cable between the AC mains and the AMN need not be aligned in same direction as the cable between the AMN and the EV.

Example of test setup for vehicle with socket located front / rear of vehicle (charging mode 1 or 2, AC powered, without communication).

~~Figure 3c~~



~~Figure 3d~~

~~Legend:~~

~~1: Vehicle under test.~~
~~2: Insulating support.~~
~~3: Charging harness (including EVSE for charging mode 2).~~
~~4: AMN(s) or DC charging AN(s) grounded.~~
~~5: Power mains socket.~~

Figure 3c

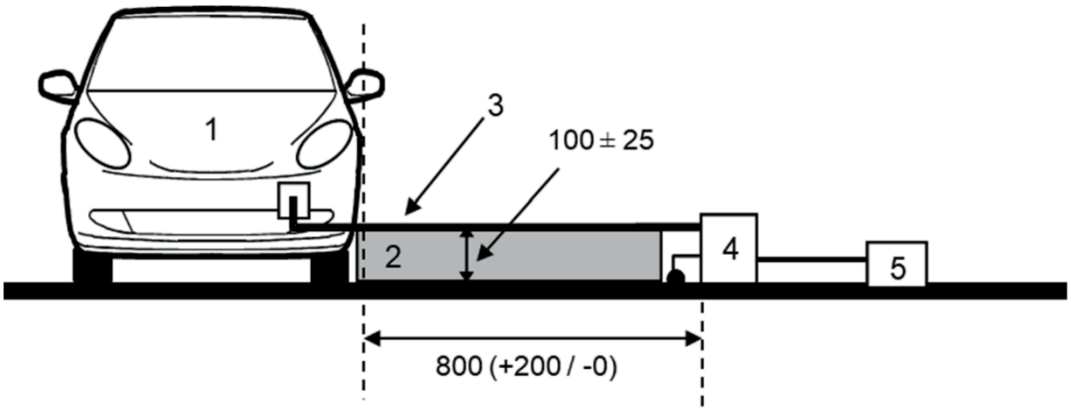
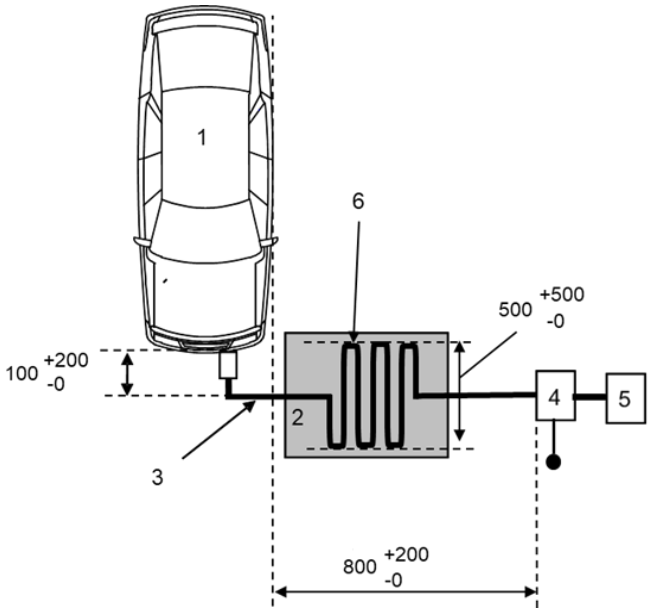


Figure 3d



Key

1 vehicle under test

2 insulating support

3 charging cable (including EVSE for charging mode 2)

4 artificial mains network(s) grounded

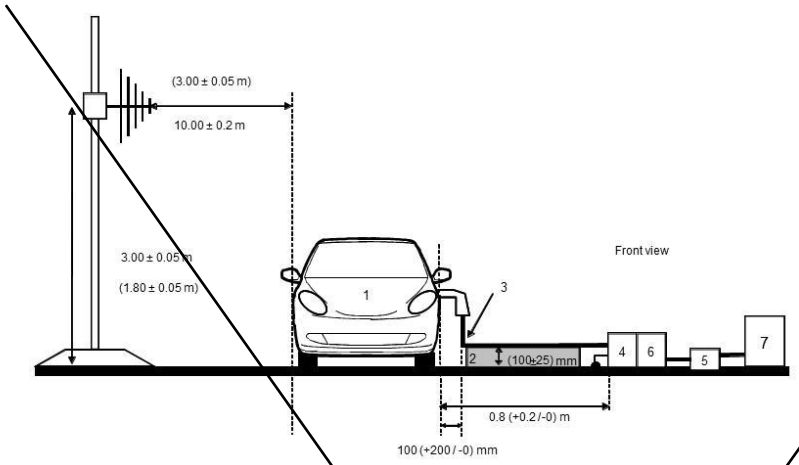
5 power mains socket (see 7.3.2.2)

6 extraneous length Z-folded

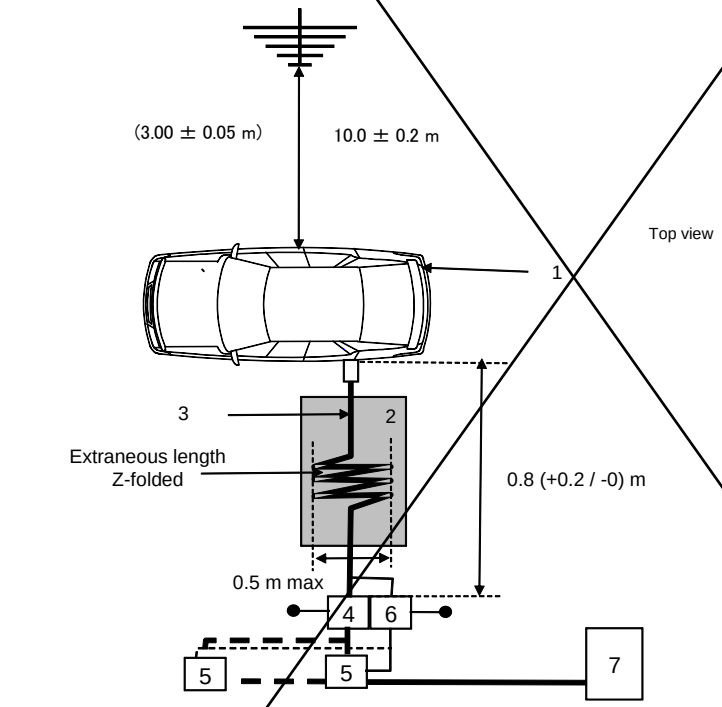
NOTE: The cable between the AC mains and the AMN need not be aligned in same direction as the cable between the AMN and the EV.

Example of test setup for vehicle with socket located on vehicle side (charging mode 3 or mode 4, with communication)

~~Figure 3e~~



~~Figure 3f~~



~~Legend:~~

~~1: Vehicle under test.~~
~~2: Insulating support.~~
~~3: Charging harness with local/private communication lines.~~
~~4: AMN(s) or DC charging AN(s) grounded.~~
~~5: Power mains socket.~~
~~6: AAN(s) grounded (optional).~~
~~7: Charging station.~~

Figure 3e

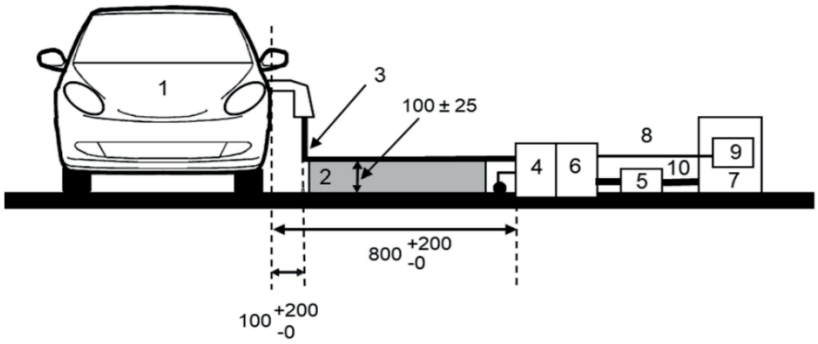
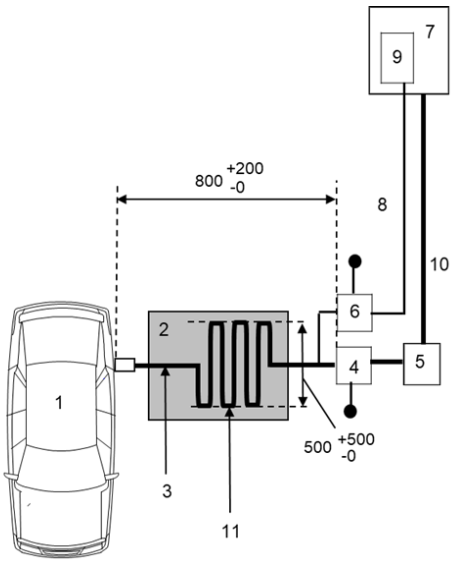


Figure 3f



Key

1 vehicle under test

2 insulating support

3 charging harness with communication lines

4 AMN(s) or DC-charging-AN(s), grounded

5 power mains / supply socket (optional, see 7.3.3.2)

6 AAN(s), grounded (optional, not represented in the front view)

7 charging station (can be emulated)

8 communication lines

9 communication module

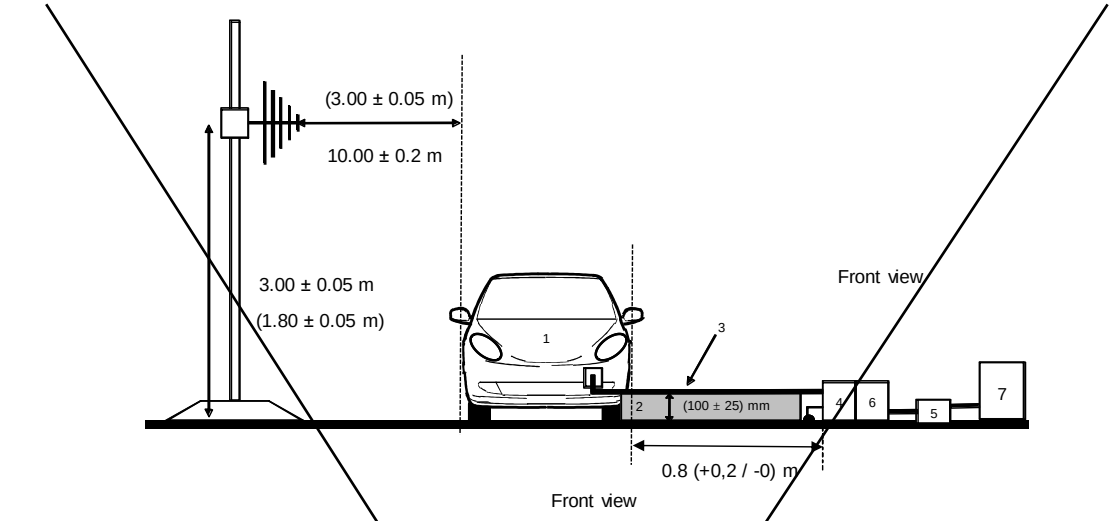
10 power cable

11 extraneous length Z-folded

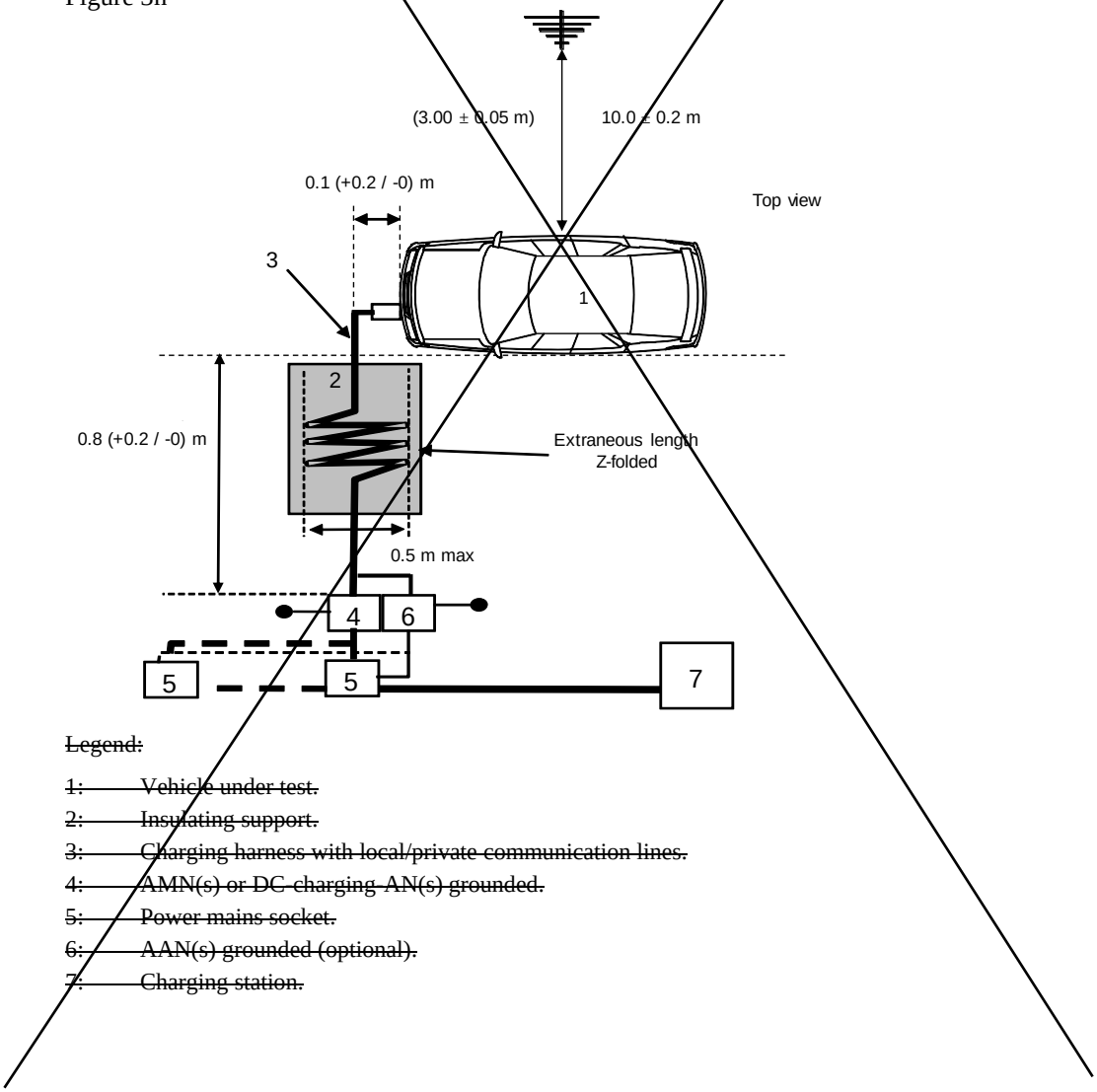
NOTE: The cable between the AC/DC mains/supply and the AMN/DC-charging-AN need not be aligned in same direction as the cable between the AMN/DC-charging-AN and the EV.

Example of test setup for vehicle with socket located front / rear of vehicle (charging mode 3 or mode 4, with communication)

~~Figure 3g~~



~~Figure 3h~~



~~Legend:~~

~~1: Vehicle under test.~~
~~2: Insulating support.~~
~~3: Charging harness with local/private communication lines.~~
~~4: AMN(s) or DC charging AN(s) grounded.~~
~~5: Power mains socket.~~
~~6: AAN(s) grounded (optional).~~
~~7: Charging station.~~

Figure 3g

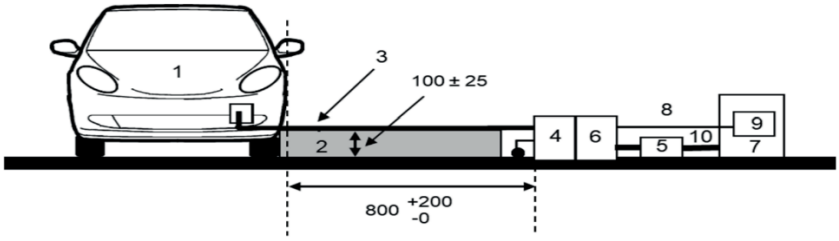
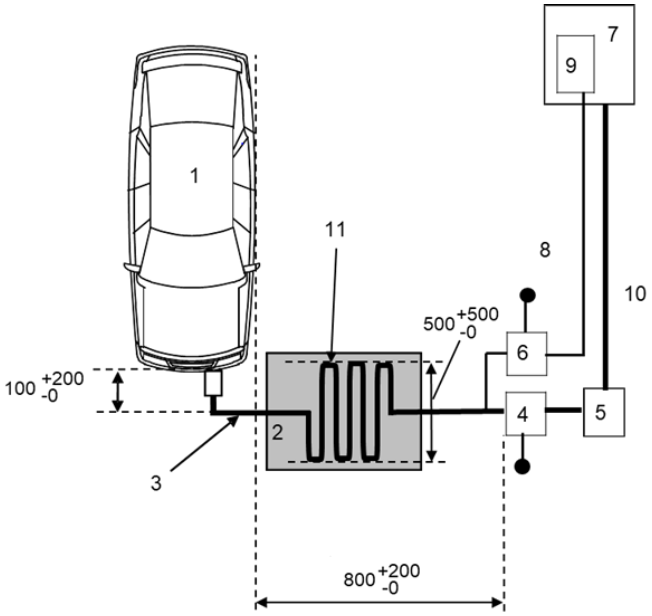


Figure 3h



Key

1 vehicle under test

2 insulating support

3 charging harness with communication lines

4 AMN(s) or DC-charging-AN(s), grounded

5 power mains / supply socket (optional, see 7.3.3.2)

6 AAN(s), grounded (optional, not represented in the front view)

7 charging station (can be emulated)

8 communication lines

9 communication module

10 power cable

1 extraneous length Z-folded

1

NOTE: The cable between the AC/DC mains/supply and the AMN/DC-charging-AN need not be aligned in same direction as the cable between the AMN/DC-charging-AN and the EV.

…"

Paragraph 1.3., to be deleted.

Paragraph 1.4., renumber and amend to read:

"1.**3**4. ~~As an alternative~~ **f**For vehicles of category L the measurement location can be chosen according to Annex 4, paragraphs 3.1. and 3.2."

Paragraph 2.1., amend to read:

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

For two-wheeled vehicles, a non-conductive insulating support with a thickness of 5 – 20mm shall be used between stand and ground plane."

Paragraph 4.3., amend to read:

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

Spectrum analysers and FFT-based instruments, that meet the requirements of CISPR 16-1-1, may be used for conformity measurements. FFT-based measuring instruments shall continuously record and evaluate the signal during the measurement time. If using FFT-based instruments, the minimum measurement time shall be 1 s per analysis frequency band (in real-time mode) of the FFT instrument.

Table 1
Spectrum analyser parameters

Frequency range MHz	*Peak detector*		*Average detector*	
	RBW at -3 dB	*Minimum scan time*	*RBW at -3 dB*	*Minimum scan time*
30 to 1,000	100/120 kHz	100 ms/MHz	100/120 kHz	100 ms/MHz

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

Table 2
Scanning receiver parameters

Frequency range MHz	*Peak detector*			*Average detector*		
	BW at -6 dB	*Step size*	*Minimum ~~scan~~ **Dwell** time*	*BW at -6 dB*	*Step size*	*Minimum ~~scan~~ **Dwell** time*
30 to 1,000	120 kHz	50 kHz	5 ms	120 kHz	50 kHz	5 ms

"

Paragraph 4.6., amend to read:

"4.6. Antenna position

Measurements shall be made on the left and right sides of the vehicle.

The horizontal distance is from the reference point of the antenna to the nearest part of the vehicle body.

Multiple antenna positions may be required (both for 10 m and 3 m antenna distance) depending on the vehicle length. The same positions shall be used for both horizontal and vertical polarization measurements. The number of antenna positions and the position of the antenna with respect to the vehicle shall be documented in the test report.

- If the length of the vehicle is smaller than the 3 dB beamwidth of the antenna, only one antenna position is necessary. The antenna shall be aligned with the middle of the total vehicle (see Figure 1).
- If the length of the vehicle is greater than the 3 dB beamwidth of the antenna, multiple antenna positions are necessary in order to cover the

total length of the vehicle (see Figure 2). The number of antenna positions shall allow to meet the following condition:

$$N \cdot 2 \cdot D \cdot \tan(\beta) \geq L \quad (1)$$

With:

N: number of antenna positions.

D: measurement distance (3 m or 10 m).

2·β: 3 dB antenna beamwidth angle in the plane parallel to ground (i.e. the E-plane beamwidth angle when the antenna is used in horizontal polarization, and the H-plane beamwidth angle when the antenna is used in vertical polarization).

L: Total vehicle length **covers the whole dimensions including tires, bumpers and lights, etc**.

Depending of the chosen values of N (number of antenna positions) different set-up shall be used:

if N=1 (only one antenna position is necessary) and the antenna shall be aligned with the middle of the total vehicle length (see Figure 1).

if N>1 (more than one antenna position is necessary) and multiple antenna positions are necessary in order to cover the total length of the vehicle (see Figure 2). The antenna positions shall be symmetric in regard to the vehicle perpendicular axis."

Paragraphs 1.1. to 1.3., amend to read:

"1.1. The test method described in this **A**~~a~~nnex shall only be applied to vehicles. This method concerns both configurations of vehicle:

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

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

A vehicle is considered to be a "large vehicle", if it is longer than 12 m and/or wider than 2.60 m and/or higher than 4.00 m.

1.2. **Regular** ~~T~~**t**est 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 **A**~~a~~nnex. The vehicle shall be monitored during the tests.

If not otherwise stated in this **A**~~a~~nnex the test shall be performed according to ISO 11451-2~~.~~ **in an ALSE:**

- **with front irradiation for vehicle not considered as "large vehicles". Rear irradiation is specified in paragraph 5.1.3.**
- **with front irradiation and with additional antenna positions for "large vehicles". Additional antenna position(s) shall be chosen by the manufacturer in conjunction with the Type-Approval Authority after considering the distribution of electronic systems with immunity related functions and the layout of any wiring harness. Tests shall be performed with levels defined in paragraph 6.4.2.1. of this Regulation. For REESS charging mode, only the electronic systems and wiring harnesses required for charging mode shall be considered for antenna positions.**

1.3. Alternative test methods

The test may be alternatively performed in an outdoor test site for all vehicles **(including "large vehicles")**. The test facility shall comply with (national)

legal requirements regarding the emission of electromagnetic fields. **The test shall be performed according to ISO 11451-2 in an OTS:**

- **with front irradiation for vehicle not considered as "large vehicles"**
- **with front irradiation and with additional antenna positions for "large vehicles". Additional antenna position(s) shall be chosen by the manufacturer in conjunction with the Type-Approval Authority after considering the distribution of electronic systems with immunity related functions and the layout of any wiring harness. Tests shall be performed with levels defined in paragraph 6.4.2.1. of this Regulation.**

For "large vehicles", the following alternative methods may be chosen by the manufacturer in conjunction with the Type-Approval Authority:

- **Harness excitation methods (BCI) according to ISO 11451-4 in the frequency range 20 to 2,000 MHz and immunity to external sources according to ISO 11451-2 in ALSE or OTS in the frequency range 2,000 to 6,000 MHz with additional antenna position(s). Additional antenna positions shall be chosen by the manufacturer in conjunction with the Type-Approval Authority after considering the distribution of electronic systems with immunity related functions and the layout of any wiring harness. Tests shall be performed with levels defined in paragraph 6.4.2.1. of this Regulation.**
- **Harness excitation methods (BCI) according to ISO 11451-4 in the frequency range 20 to 2,000 MHz and ESA immunity to external sources according to Annex 9 in the frequency range 2,000 to 6,000 MHz for all ESA involved in immunity related functions. ESA involved in immunity related functions shall be chosen by the manufacturer in conjunction with the Type-Approval Authority. Vehicle test shall be performed with levels defined in paragraph 6.4.2.1. of this Regulation. ESA shall be performed with levels defined in paragraph 6.8.2.1. of this Regulation.**
- **Immunity to external sources according to ISO 11451-2 in ALSE or OTS in the frequency range 20 to 6,000 MHz with front irradiation and ESA immunity to external sources according to Annex 9 in the frequency range 20 to 6,000 MHz for ESA with immunity related functions out antenna beamwidth. Concerned ESA shall be chosen by the manufacturer in conjunction with the Type-Approval Authority Vehicle test shall be performed with levels defined in paragraph 6.4.2.1. of this Regulation. ESA tests shall be performed with levels defined in paragraph 6.8.2.1. of this Regulation.**

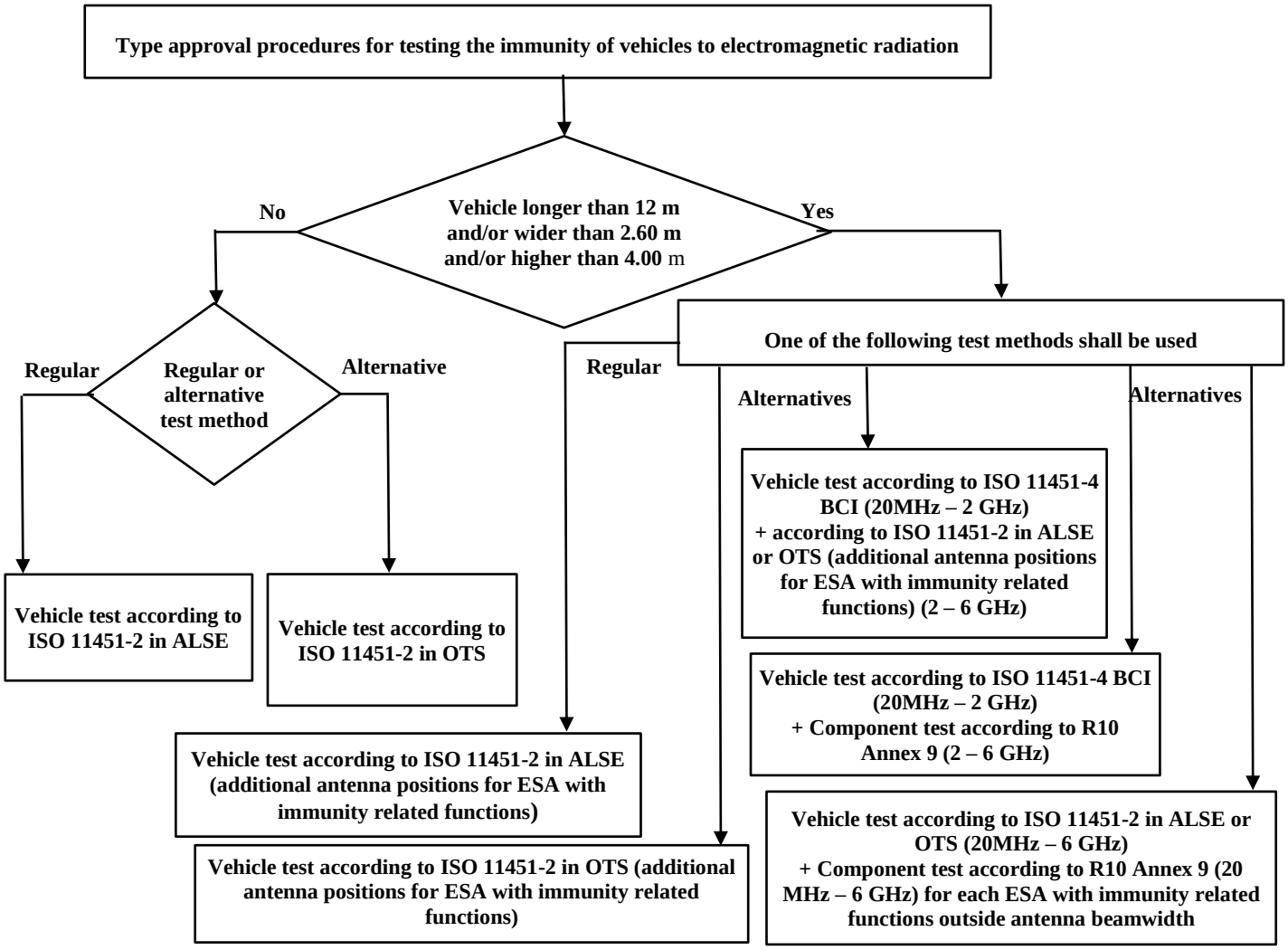
Alternative method using ESA immunity to external sources according to Annex 9 does not require E-marking of the concerned ESA. The test report shall be prepared or approved by a laboratory accredited to ISO 17025 and recognized by the Type-Approval Authority responsible for carrying out the tests and provided along with the information document shown in Annex 2B. The same test method (vehicle type approval in combination with ESA test report for Annex9) shall be applied during Conformity of Production test or any applicable test method according to this Annex.

~~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 shall be used in the frequency range 20 to 2,000 MHz with levels defined in paragraph 6.8.2.1. of this Regulation.~~"

Insert a new paragraph 1.4., to read:

"**1.4 Applicability of test methods:**

Figure 1



"

Paragraph 2., amend to read:

"2. Vehicle state during tests

For two-wheeled vehicles, a non-conductive insulating support with a thickness of 5 – 20mm shall be used between stand and ground plane."

Paragraph 2.1.1.2., amend to read:

"2.1.1.2. Basic vehicle conditions

The paragraph defines minimum test conditions (as far as applicable) and failure 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.

"50 km/h mode" vehicle test conditions	*Failure criteria*
Vehicle speed 50 km/h (respectively 25 km/h for L_1, L_2 vehicles) ±20 per cent (vehicle driving the rollers). If the vehicle is equipped with a cruise control system, it shall be used to maintain the required constant vehicle speed and maintained without any deactivation.	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 light and rear light)
Specific warning (e.g Rotating/flashing light, signaling bar, siren…) ON	Specific warning OFF
Cluster operate in normal mode	Unexpected warning Inconsistent variation of the odometer
Rear view system	Unexpected movement of rear view mirror Loss or freezing of the display (CMS)
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 pedal not depressed	Unexpected activation of brake and unexpected activation of stop lights
ADS shall be operational [(1)]	**ADS failure situation**
[(1)]: ADS are turned on by the driver but some or all ADS functions may revert to a mode where system is monitoring sensors but is not actively 'driving' the vehicle due to plausibility issues caused by the EMC laboratory environment.	

"Brake mode" vehicle test conditions	*Failure criteria*
Vehicle in a state that allows the braking system to operate normally, parking brake released, vehicle speed 0 km/h. Brake pedal depressed to activate the brake function and the stop lights without any dynamic cycle.	Stop lights inactivated during mode Brake warning light ON with loss of brake function.

"Brake mode" vehicle test conditions	*Failure criteria*
Day running light (DRL) ON	DRL inactivated during mode
ADS shall be operational [(1)]	**ADS failure situation**
[(1)]: ADS are turned on by the driver but some or all ADS functions may revert to a mode where system is monitoring sensors but is not actively 'driving' the vehicle due to plausibility issues caused by the EMC laboratory environment.	

AECS vehicle test conditions before and after immunity test	*Failure criteria*
A manual emergency call shall be triggered according to the vehicle manufacturer's instructions, both before and after conducting the 50km/h or brake mode test.	**An emergency call is not established.**
Once the MSD has been received the emergency call is established, voice communication shall be evaluated, but only if voice communications are available in the AECS system.	**The voice originating inside the vehicle cannot be heard clearly by the remote listener with satisfactory intelligibility.** **The speech of the remote speaker cannot be heard clearly in the vehicle with satisfactory intelligibility.**
After the evaluation of the voice call, the emergency call shall be terminated. Subsequently, the transmitted Minimum Set of Data (MSD) shall be evaluated.	**Vehicle location data is NOT transmitted, or position error is greater than 150m.** **Time stamp is not transmitted, or time error is greater than 60 seconds.** **Vehicle identification number is not transmitted correctly.**

AECSs vehicle test conditions during immunity test	*Failure criteria*
During the 50km/h or brake test mode, the warning signal device (also known as the tell-tale, which provides a failure indication), and all other displays used for indicating AECS faults, shall be monitored. There is no requirement for a cellular network or satellite navigation signals during these tests.	**Emergency calling systems does not operate as intended as indicated by:** **Failure indication of AECS warning signal device or other vehicle displays.** **Diagnostic trouble code, which is related to emergency calling systems failure indication, stored in device memory.**

AVAS test conditions	*Failure criteria*
Vehicle is tested in an operating state where the AVAS Function/sound active (if applicable) [(1)]	**Loss of AVAS function (sound or system error indicator)**
(1) This test may be incorporated into Brake or 50 km/h mode if AVAS system is active in these modes. If AVAS system is not operational during these two modes, the operating conditions (e.g. vehicle speed) shall be agreed between the Technical Service and the Vehicle Manufacturer.	

"

Insert a new paragraph 2.1.1.5., to read:

"**2.1.1.5. If the vehicle is equipped with an ADS, the immunity test shall demonstrate the vehicle stays in a failure safe mode or expected failure operational mode during the test in 50km/h mode or Brake mode. If it is not possible to activate the ADS due to another function (e.g. turn lamp, wiper, etc), these function(s) may be turned off. Then additional test run(s) may be necessary to cover untested function(s) (e.g. turn lamp, wiper, etc). Lateral and longitudinal vehicle motion control and braking may be deactivated if necessary to ensure a safe test environment.**"

Insert a new paragraph 2.1.1.6., to read:

"2.1.1.6. If the vehicle is equipped with an Accident Emergency Call Systems (AECS) according to UN R-144, it shall be tested over the air for the transmission of Minimum Set of Data (MSD) and voice call via a real Public Land Mobile Network (PLMN) or via a network simulator before and after 50 km/h or brake mode and using a private safety answering point (PSAP).

In case of a voice call via a real PLMN, emergency call number should be changed to dedicated PSAP number in order to avoid false calls to the emergency services. Only one specific cellular configuration, including one frequency band and one channel, within a single cellular technology (e.g. 2G, 3G, 4G, 5G.) shall be tested.

Vehicle manufacturer and Technical Service shall review the AECS warning signal strategy if it will detect AECS system faults even when there is no network coverage. If it is not possible to distinguish between lack of network coverage and a system fault, alternative arrangements shall be made to enable this. "

Paragraph 2.2.1.1., amend to read:

"2.2.1.1. The vehicle shall be immobilized, the engine(s) (ICE and / or electrical engine) shall be OFF and in charging mode.

The vehicle shall be tested in the charging mode configuration (if available on vehicle) as defined in flowchart of figure 2

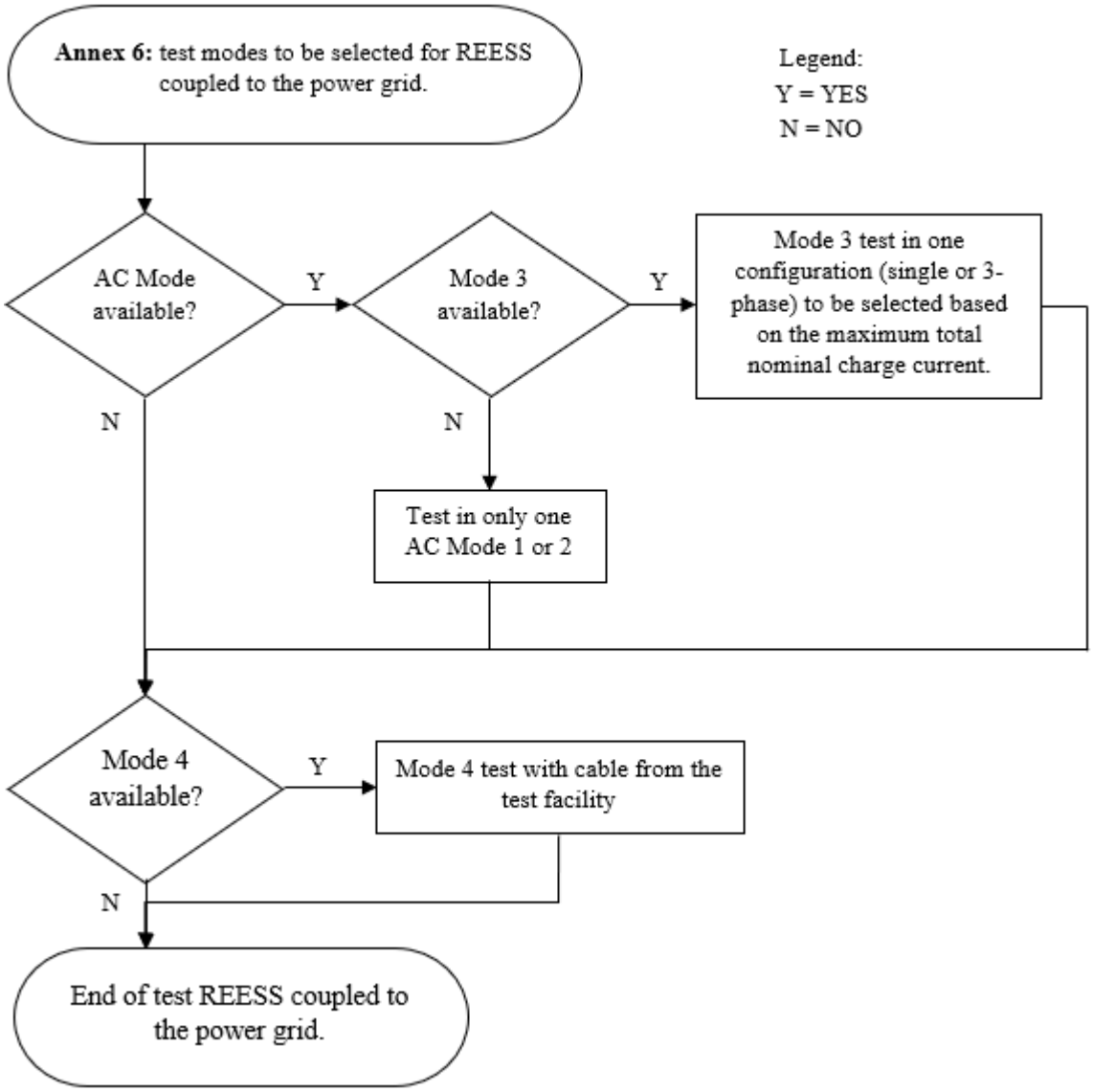


Figure 2
Charging mode configuration for Annex 6"

Paragraph 2.2.1.2., amend to read:

"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~~ **maximum rated charging/input current** value **for AC charging.** **If the current consumption can be adjusted, then the current shall be set to at least 20 per cent of its nominal value or to a minimum of 16 A (if the 20 per cent of its nominal value cannot be achieved in the test facility) for DC charging unless another value is agreed with the Type-Approval Authorities.** In case of multiple batteries the average state of charge must be considered.	Vehicle sets in motion. Unexpected release of the parking brake. Loss of Parking position for automatic transmission**.**

"

Paragraph 2.3.3., amend to read:

"2.3.3. Power charging harness

The power charging harness shall be placed in a straight line between the AMN(s) and the vehicle charging plug and shall be routed perpendicularly to the vehicle longitudinal axis (see Figure ~~3d~~**5a** and Figure ~~3e~~**5c**). The projected harness length from the side of the AMN(s) to the side of the vehicle shall be 0,8 (+0,2 / -0) m as shown in Figure ~~3d~~**5b** and Figure ~~3e~~**5d**.

~~For a longer harness the extraneous length shall be "Z-folded" in a less than 0,5 m width approximately around the middle of the AMN to vehicle distance. If it is impractical to do so because of harness bulk or stiffness, or because the testing is being done at a user's installation, the disposition of the excess harness shall be precisely noted in the test report.~~

For a longer cable, the extraneous length shall be "Z-folded" symmetrically. No contact or overlap is allowed between windings. The width of the Z-folded cable shall be between 500 mm and 1 000 mm. If it is impractical to do so because of cable bulk or stiffness, or because the testing is being done at a user's installation, the disposition of the excess cable length shall be precisely noted in the test report.

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

The whole harness shall be placed on a non-conductive, low relative permittivity (dielectric-constant) material ($\varepsilon r \leq 1,4$), at (100 ± 25) mm above the ground plane (ALSE) or floor (OTS)."

Paragraphs 2.4.3. and 2.4.4., amend to read:

"2.4.3. Asymmetric artificial network

Local/private communication lines connected to signal/control ports and lines connected to wired network ports shall be applied to the vehicle through AAN(s).

The various AAN(s) to be used are defined in Appendix 8, clause 5:

- Clause 5.1. for signal/control port with symmetric lines;
- Clause 5.2. for wired network port with PLC on power lines;

- Clause 5.3. for signal/control port with PLC (technology) on control pilot; and
- Clause 5.4. for signal/control port with control pilot.

The AAN(s) shall be mounted directly on the ground plane. The case of the AAN(s) shall be bonded to the ground plane (ALSE) or connected to the protective earth (OTS, e.g. an earth rod).

The measuring port of each AAN shall be terminated with a 50 Ω load.

If a charging station is used, AAN(s) are not required for the signal/control ports and/or for the wired network ports. The local/private communication lines between the vehicle and the charging station shall be connected to the ~~associated~~ **auxiliary equipment** on the charging station side to work as designed. If communication is emulated and if the presence of the AAN prevents proper communication then no AAN should be used

2.4.4. Power charging / local/private communication harness

The power charging local/private communication harness shall be laid out in a straight line between the AMN(s) / DC-charging-AN(s) / AAN(s) and the vehicle charging socket and shall be routed perpendicularly to the vehicle's longitudinal axis (see Figure ~~3f~~**5e** and Figure ~~3~~**5**g). The projected harness length from the side of the AMN(s) to the side of the vehicle shall be 0,8 (+0,2 / - 0) m **as shown in Figure 5f and Figure 5h.**

~~For a longer harness the extraneous length shall be "Z-folded" in less than 0,5 m width. If it is impractical to do so because of harness bulk or stiffness, or because the testing is being done at a user installation, the disposition of the excess harness shall be precisely noted in the test report.~~

For a longer cable, the extraneous length shall be "Z-folded" symmetrically. No contact or overlap is allowed between windings. The width of the Z-folded cable shall be between 500 mm and 1 000 mm. If it is impractical to do so because of cable bulk or stiffness, or because the testing is being done at a user's installation, the disposition of the excess cable length shall be precisely noted in the test report.

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

The whole harness shall be placed on a non-conductive, low relative permittivity (dielectric-constant) material ($\varepsilon r \leq 1{,}4$), at (100 ± 25) mm above the ground plane (ALSE) or floor (OTS)."

Insert a new paragraph 3.4., to read:

"**3.4.** **If a vehicle is longer than 12 m and/or wider than 2.60 m and/or higher than 4.00 m, and tested according to ISO 11451-2, then additional reference point(s) shall be chosen by the manufacturer in conjunction with the Type-Approval Authority after considering the distribution of electronic systems with immunity related functions and the layout of any wiring harness (see Appendix 1, Figure 5).**"

Paragraphs 4.1. and 4.1.1., amend to read:

"4.1. Frequency range, dwell times, polarization.

The vehicle shall be exposed to electromagnetic radiation in the 20 to ~~2~~**6**,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 µs, period 4,600 µs in the 800 to 2,000 MHz frequency range.~~

(b) PM2 (pulse modulation type 2), Ton 3 µs, period 3,333 µs in the 2,700 to 3,100 MHz frequency range; and

(c) PM3 (pulse modulation type 3), Ton 500 µs, period 1,000 µs in the 800 to 2,700 MHz and the 3,100 to 6,000 MHz frequency ranges.

If not otherwise agreed between Technical Service and vehicle manufacturer.

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

4.1.1. The Technical Service shall perform the test at the intervals specified in ISO 11451-1 throughout the frequency range 20 to ~~2~~**6**,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 Type 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**, 2,360, 2,600, 3,000, 3,600, 5,200 and 5,900** MHz**)** to confirm that the vehicle meets the requirements of this **A**~~a~~nnex.

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 for all the charging modes configurations defined in paragraph 2.2.1.1, the Technical Service may perform tests only for one charging mode configurations defined in paragraph 2.2.1.2 and for 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, 1,800 2,360, 2,600, 3,000, 3,600, 5,200 and 5,900 MHz to confirm that the vehicle meets the requirements of this Annex.

If a vehicle fails the test defined in this **A**~~a~~nnex, it shall be verified as having failed under the relevant test conditions and not as a result of the generation of uncontrolled fields."

Paragraph 5.1.3., amend to read:

"5.1.3. Test phase

The vehicle shall be positioned with the centre line of the vehicle on the vehicle reference point or line. The vehicle shall normally face a fixed antenna. However, where electronic control units with immunity related functions and the associated wiring harness are predominantly in the rear half of the vehicle, the test should normally be carried out with the vehicle 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. In the case of ~~long~~**"large** vehicles**"** ~~(i.e. excluding vehicles of categories L, M_1 and N_1),~~ which have electronic control units with immunity related functions and associated wiring harness **which are not located in the region illuminated at the default reference point of the regular test method** ~~predominantly towards the middle of the vehicle~~, ~~a~~ **then additional** reference point**(s)** may be established**.** ~~based on either the right side surface or the left side surface of the vehicle.~~ **The additional** ~~This~~ reference point**(s)** 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 Type Approval 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 shall be noted in the test report."

Annex 6, Appendix 1, amend to read:

"Annex 6 – Appendix 1

Figure 1

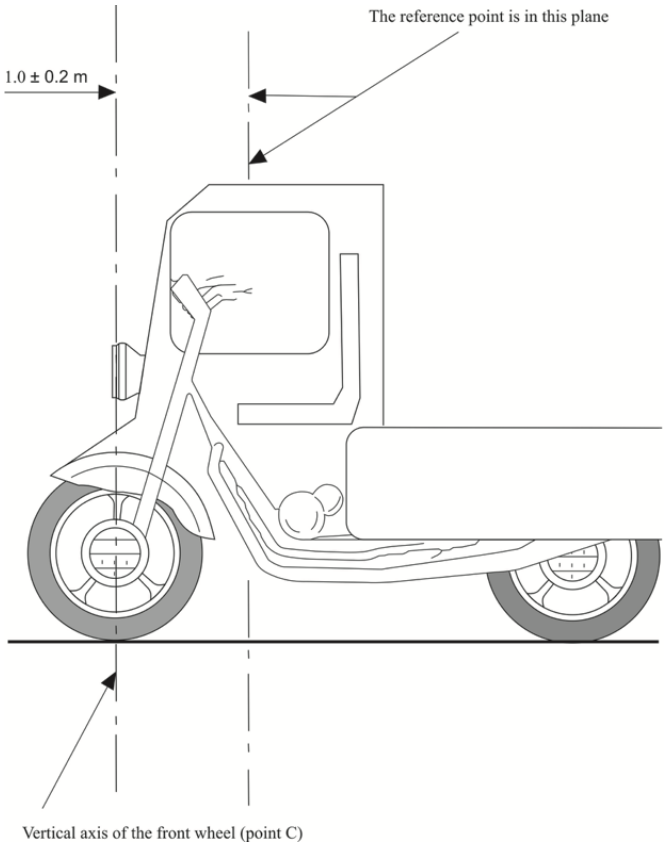


Figure 2

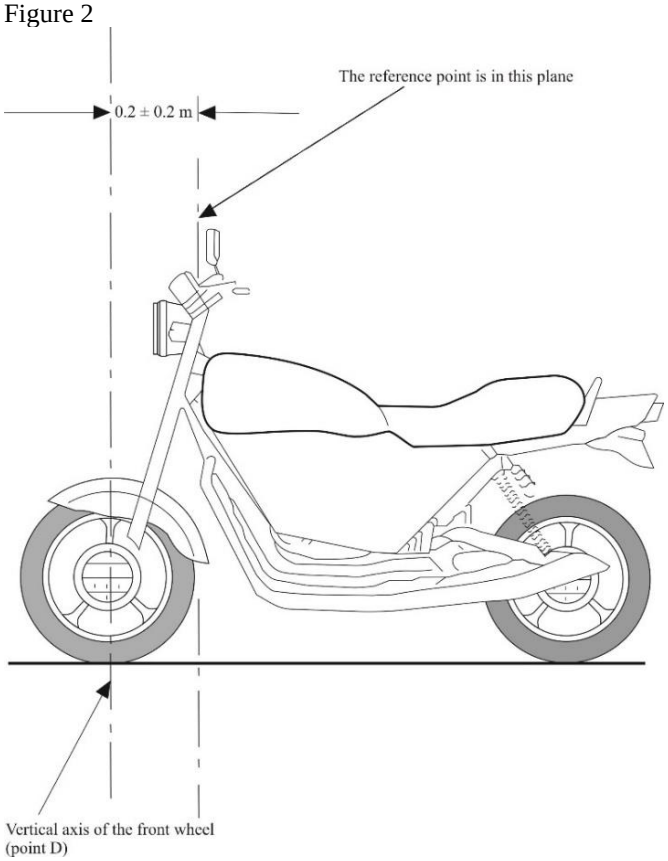

The reference point is in this plane
0.2 ± 0.2 m
Vertical axis of the front wheel
(point D)

Figure 3

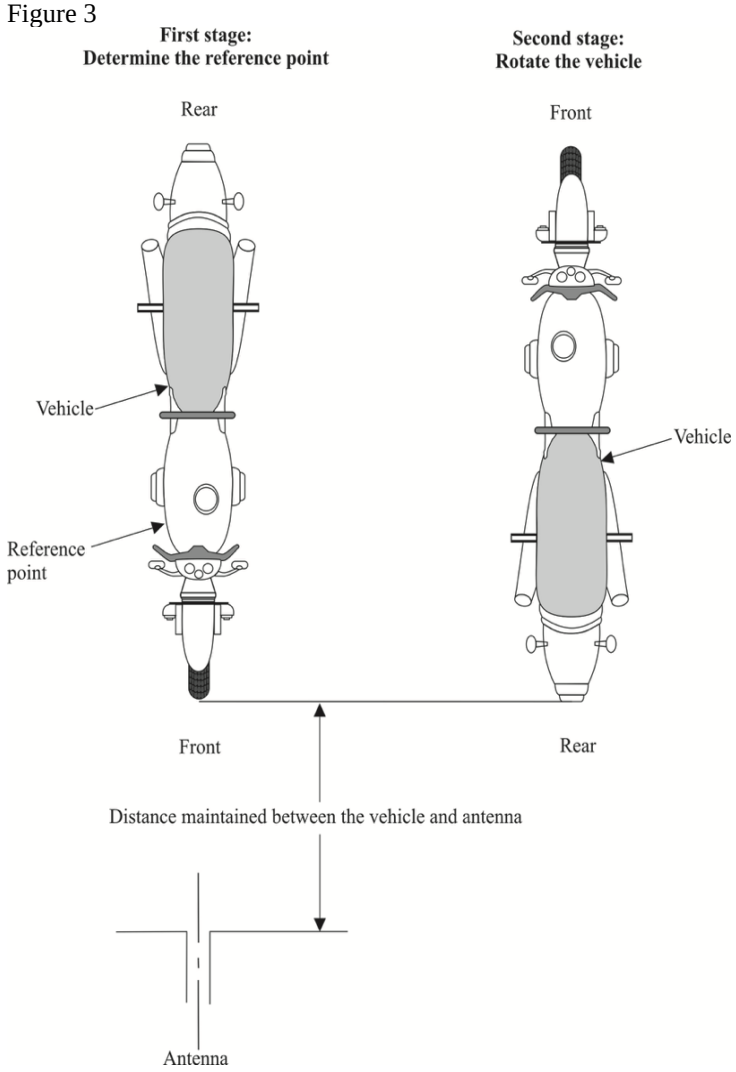
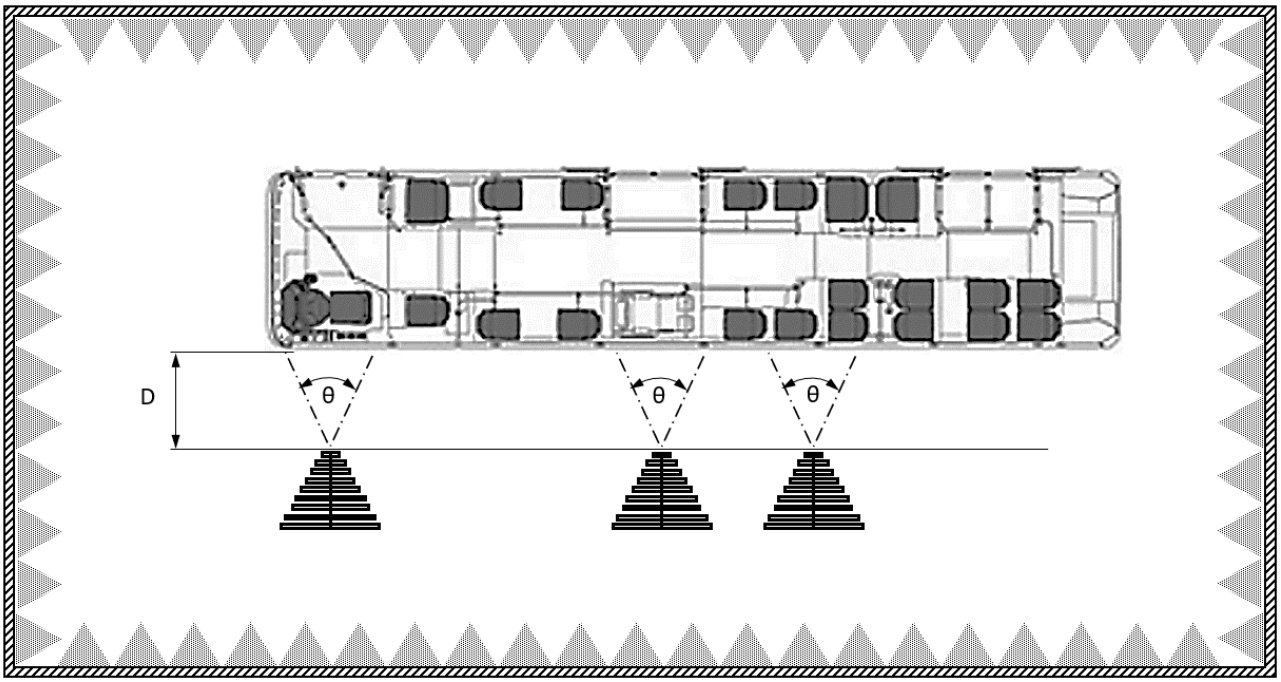


Figure 4 - Example of a selection of antenna placements for lateral illumination of a large vehicle



Key
θ: 3 dB antenna beamwidth

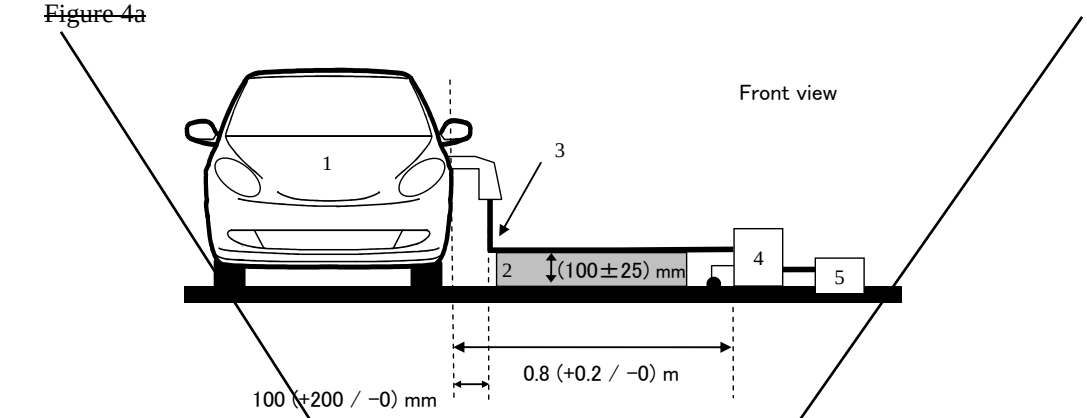
D: the distance between the tip or phase centre of the antenna and the nearest part of the vehicle body without considering small extruding elements (such as side mirrors or fenders)

]

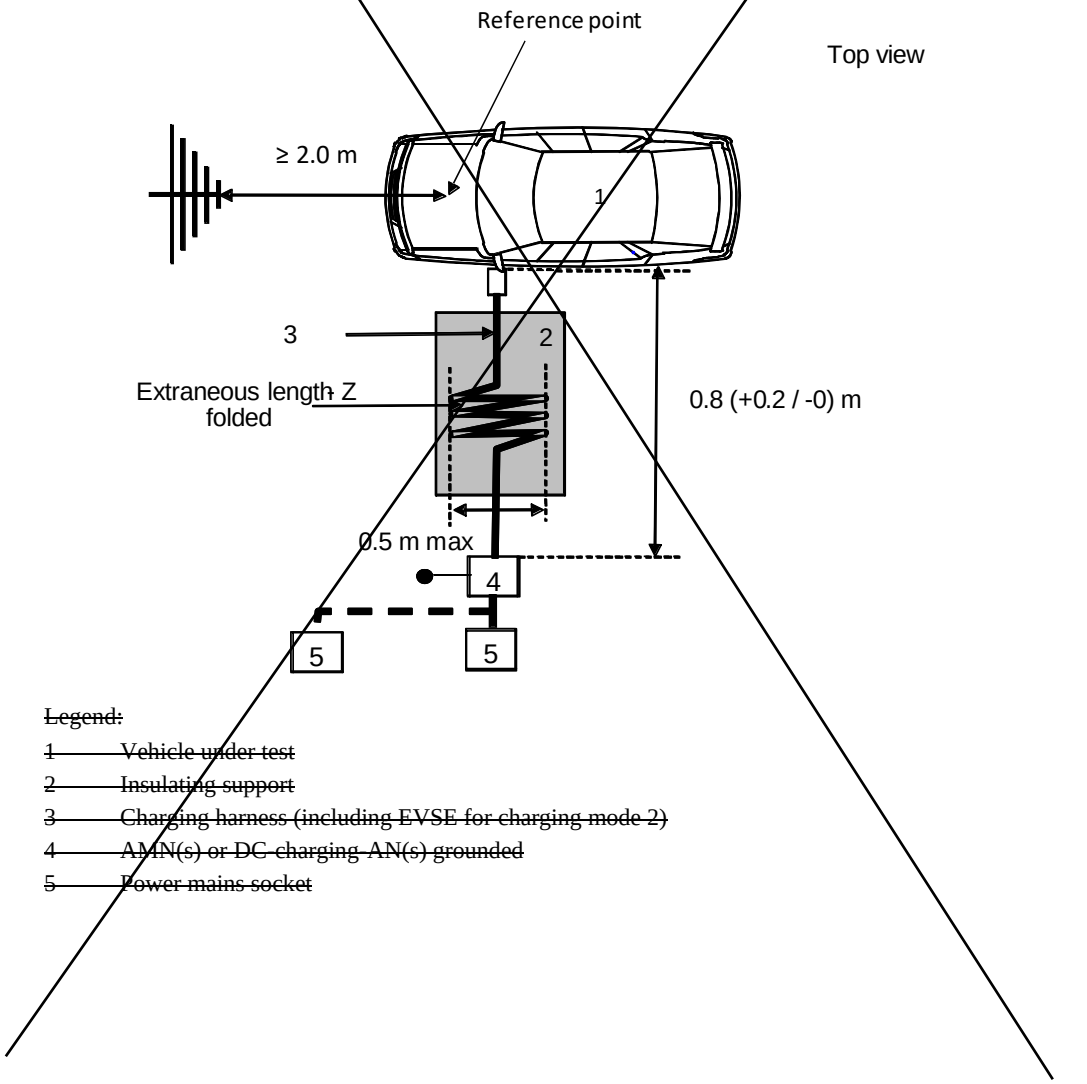
Figure 45
Vehicle in configuration "REESS charging mode coupled to the power grid"

Example of test setup for vehicle with socket located on vehicle side (charging mode 1 or 2, AC powered, without communication)

~~Figure 4a~~



~~Figure 4b~~



~~Legend:~~

~~1 Vehicle under test~~
~~2 Insulating support~~
~~3 Charging harness (including EVSE for charging mode 2)~~
~~4 AMN(s) or DC charging AN(s) grounded~~
~~5 Power mains socket~~

Figure 5a

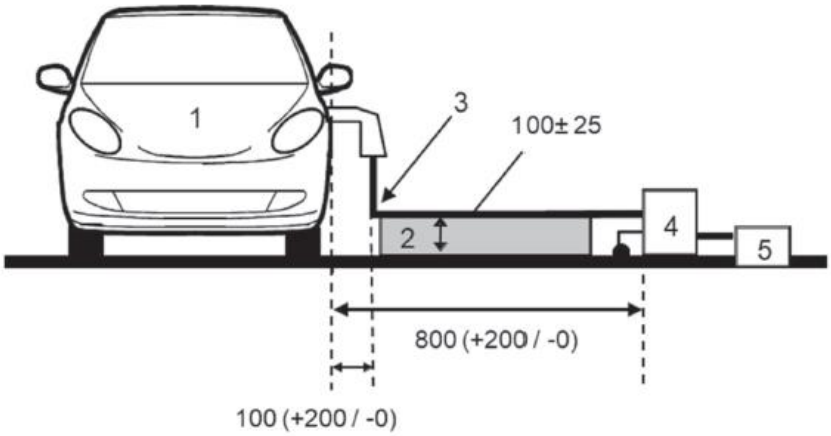
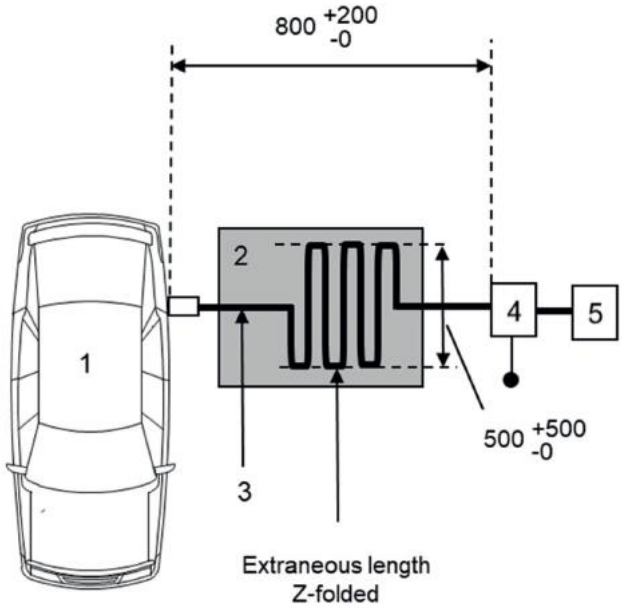


Figure 5b



Key

1 vehicle under test

2 insulating support

3 charging cable (including EVSE for charging mode 2)

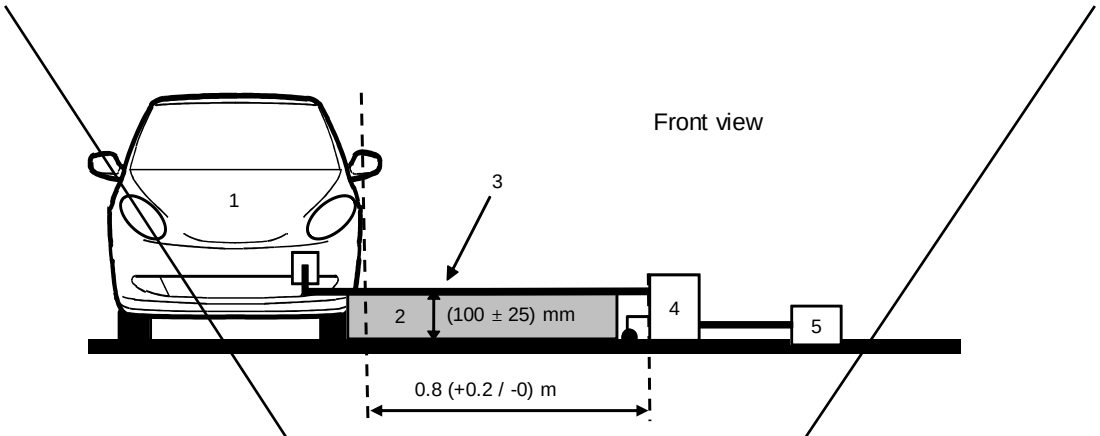
4 artificial mains network(s) grounded

5 power mains socket

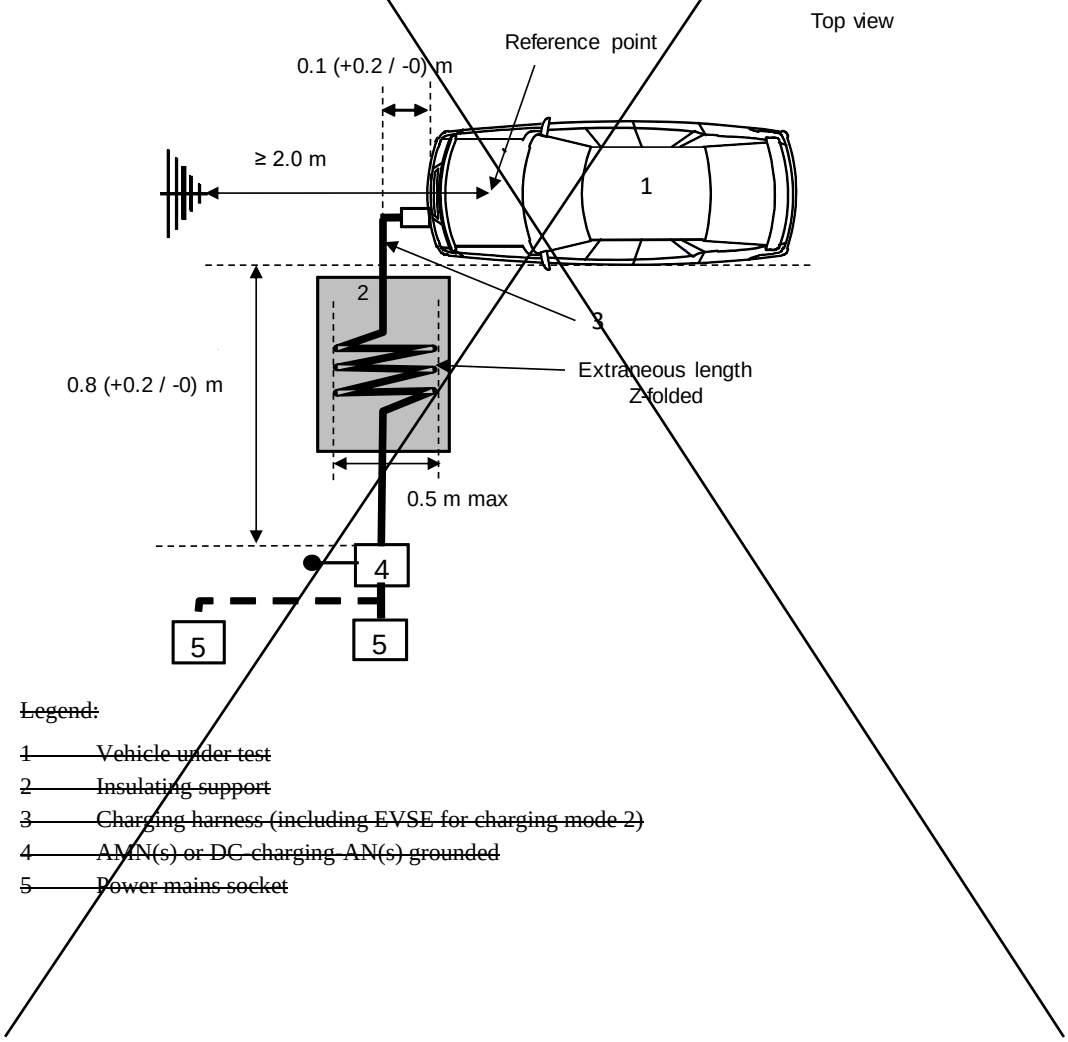
NOTE: The cable between the AC mains and the AMN need not be aligned in the same direction as the cable between the AMN and the EV.

Example of test setup for vehicle with socket located front / rear of vehicle side (charging mode 1 or 2, AC powered, without communication)

~~Figure 4c~~



~~Figure 4d~~



~~Legend:~~

~~1 Vehicle under test~~
~~2 Insulating support~~
~~3 Charging harness (including EVSE for charging mode 2)~~
~~4 AMN(s) or DC charging AN(s) grounded~~
~~5 Power mains socket~~

Figure 5c

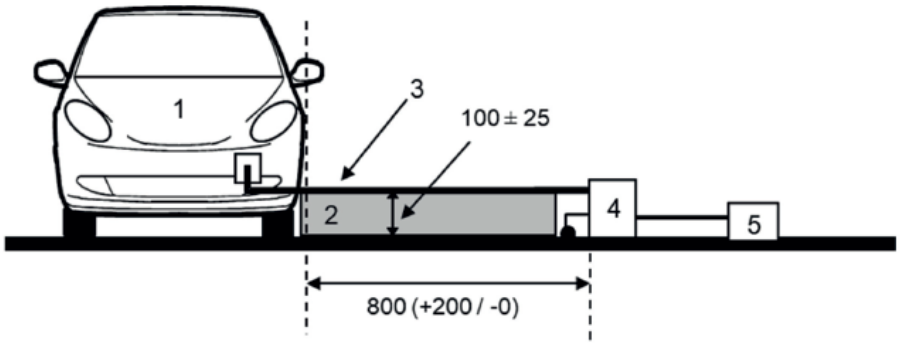
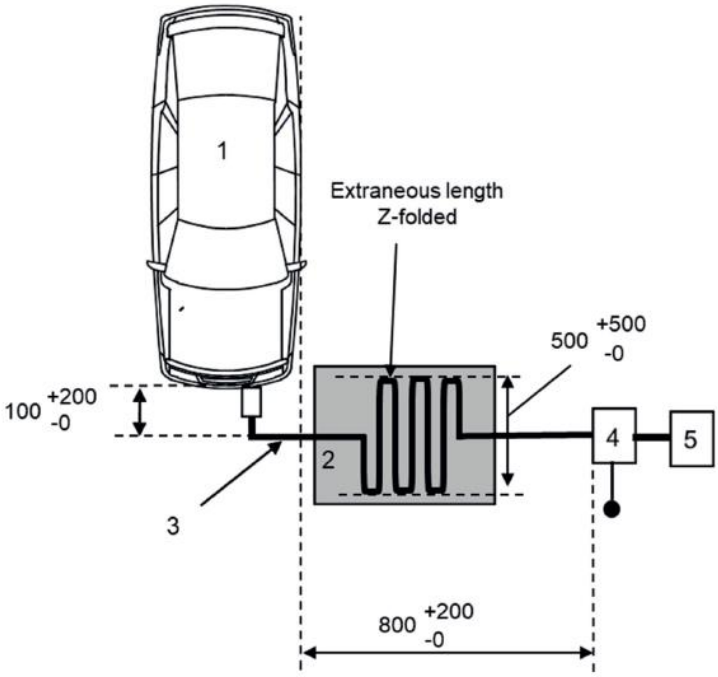


Figure 5d



Key

1 vehicle under test

2 insulating support

3 charging cable (including EVSE for charging mode 2)

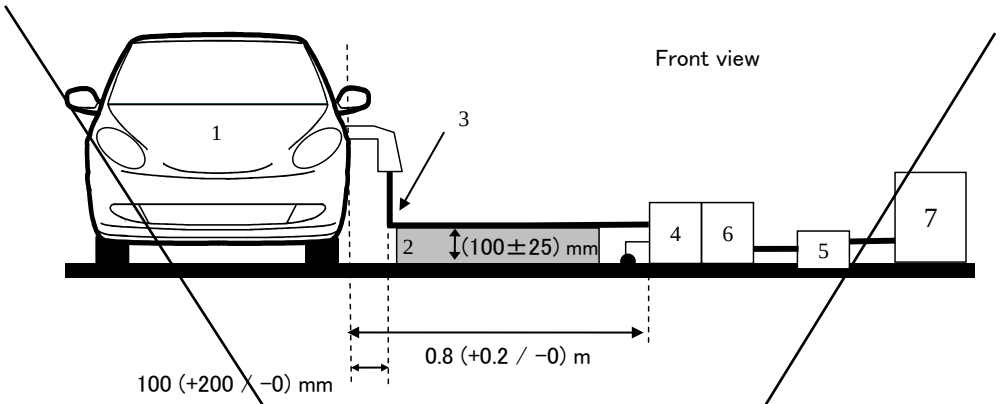
4 artificial mains network(s) grounded

5 power mains socket

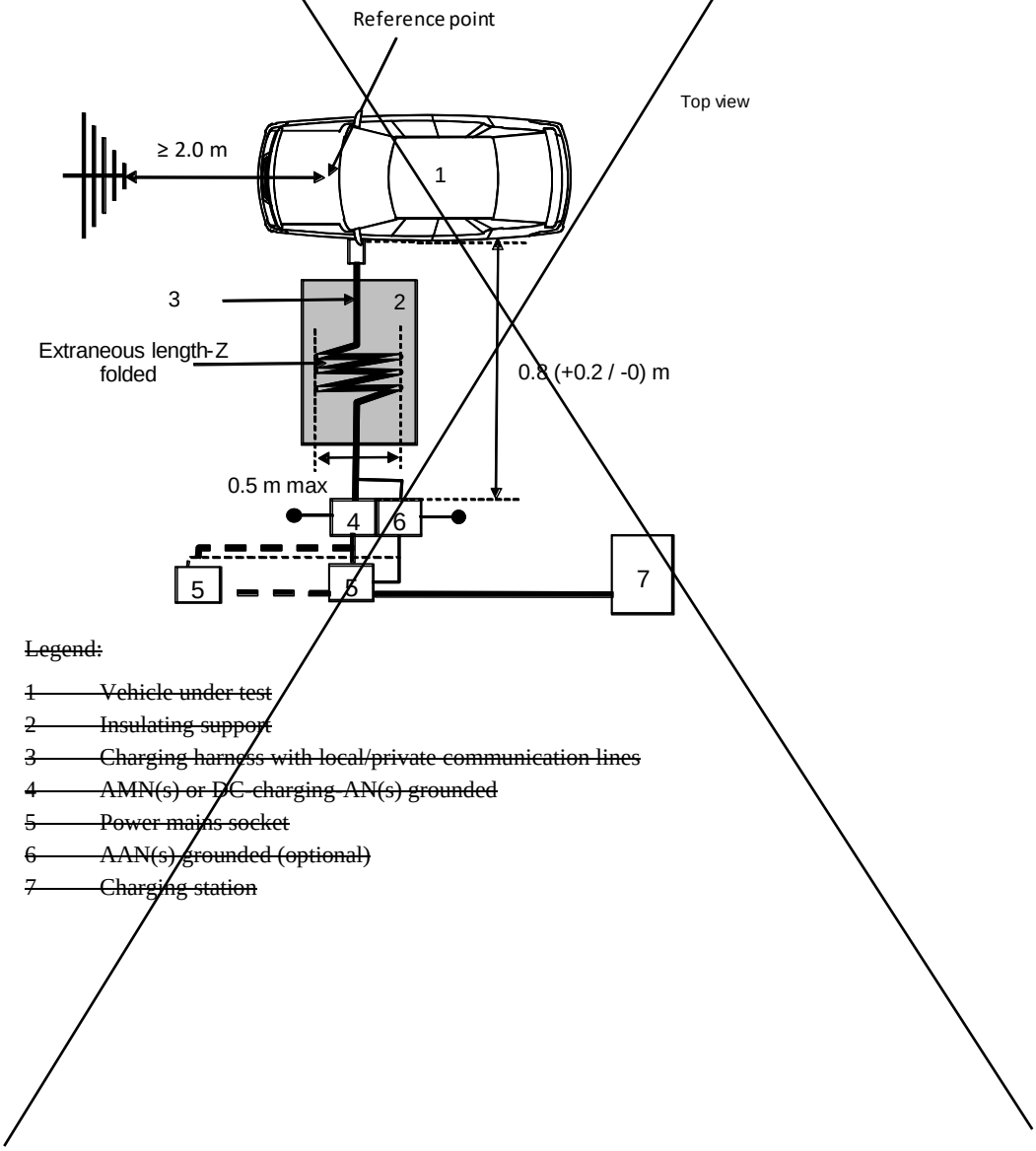
NOTE: The cable between the AC mains and the AMN need not be aligned in the same direction as the cable between the AMN and the EV.

Example of test setup for vehicle with socket located on vehicle side (charging mode 3 or mode 4, with communication)

~~Figure 4e~~



~~Figure 4f~~



~~Legend:~~

~~1 Vehicle under test~~
~~2 Insulating support~~
~~3 Charging harness with local/private communication lines~~
~~4 AMN(s) or DC charging AN(s) grounded~~
~~5 Power mains socket~~
~~6 AAN(s) grounded (optional)~~
~~7 Charging station~~

Figure 5e

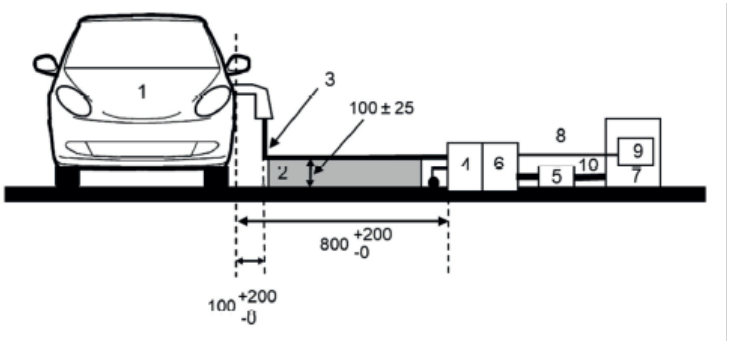
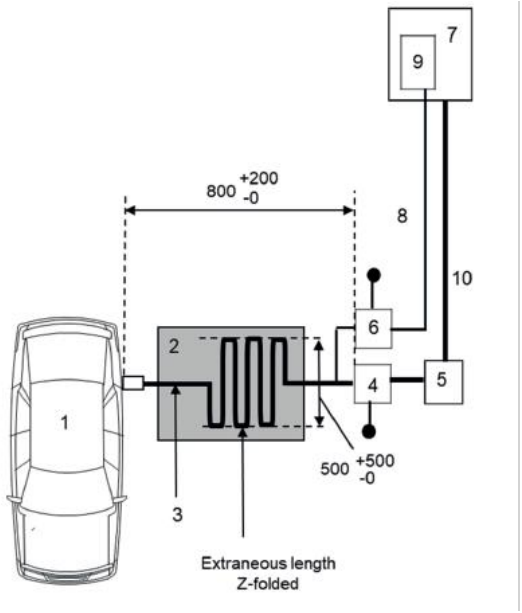


Figure 5f



Key

1 vehicle under test

2 insulating support

3 charging harness with communication lines

4 AMN(s) or DC-charging-AN(s), grounded

5 power mains / supply socket (optional)

6 AAN(s) grounded (optional, not represented in the front view)

7 charging station (can be emulated)

8 communication lines

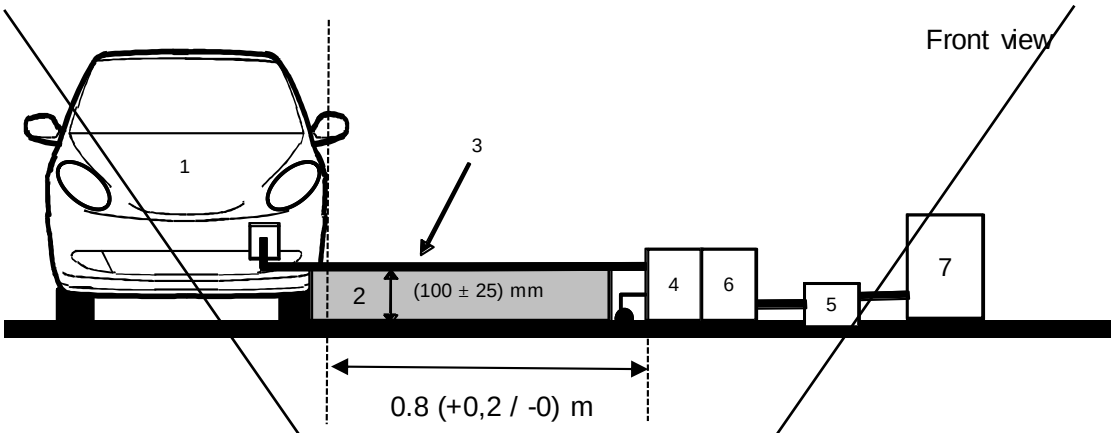
9 communication module

10 power cable

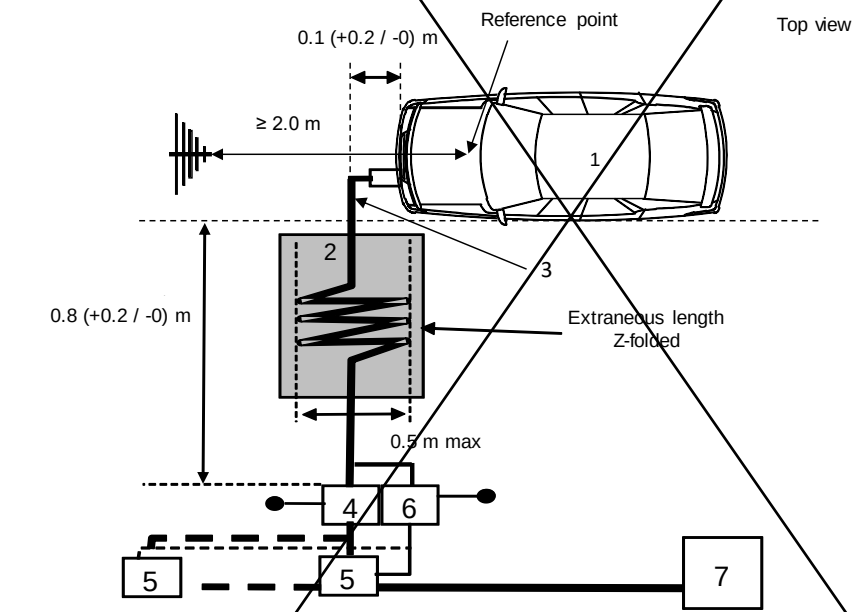
NOTE: The cable between the AC/DC mains/supply and the AMN/DC-charging-AN need not be aligned in the same direction as the cable between the AMN/DC-charging-AN and the EV.

Example of test setup for vehicle with socket located front / rear of the vehicle side (charging mode 3 or mode 4, with communication)

~~Figure 4g~~



~~Figure 4h~~



~~Legend:~~

~~1 Vehicle under test~~
~~2 Insulating support~~
~~3 Charging harness with local/private communication lines~~
~~4 AMN(s) or DC charging AN(s) grounded~~
~~5 Power mains socket~~
~~6 AAN(s) grounded (optional)~~
~~7 Charging station~~

Figure 5g

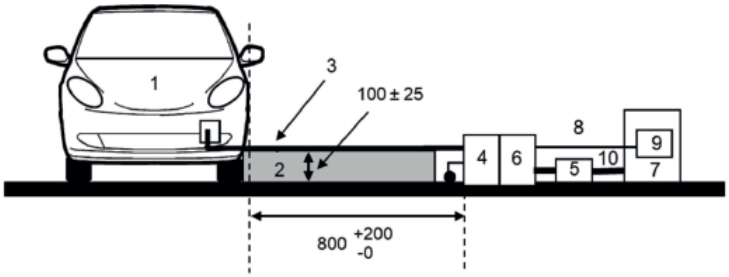
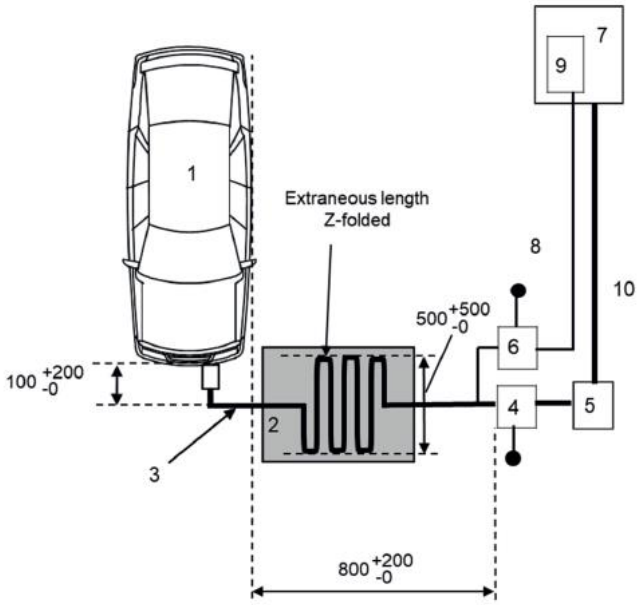


Figure 5h



Key

1 vehicle under test

2 insulating support

3 charging harness with communication lines

4 AMN(s) or DC-charging-AN(s), grounded

5 power mains / supply socket (optional, see 7.3.3.2)

6 AAN(s) grounded (optional, not represented in the front view)

7 charging station (can be emulated)

8 communication lines

9 communication module

10 power cable

NOTE: The cable between the AC/DC mains/supply and the AMN/DC-charging-AN need not be aligned in the same direction as the cable between the AMN/DC-charging-AN and the EV."

Annex 7,

Paragraph 2.1., amend to read:

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

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

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

If the test is not performed with a REESS the ESA should be tested at rated current.

If the current consumption can be adjusted, then the current shall be set to at least 80 per cent of its ~~nominal~~ **maximum rated charging/input current** value for AC charging.

If the current consumption can be adjusted, then the current shall be set to at least ~~80~~ **20** per cent of its nominal value **or to a minimum of 16 A (if the 20 per cent of its nominal value cannot be achieved in the test facility)** for DC charging unless another value is agreed with the type approval authorities. "

Paragraph 4.3., amend to read:

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

Spectrum analysers and FFT-based instruments, that meet the requirements of CISPR 16-1-1, may be used for conformity measurements. FFT-based measuring instruments shall continuously record and evaluate the signal during the measurement time. If using FFT-based instruments, the minimum measurement time shall be 1 s per analysis frequency band (in real-time mode) of the FFT instrument.

Table 1
Spectrum analyser parameters

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

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

Table 2
Scanning receiver parameters

Frequency range MHz	*Peak detector*			*Quasi-peak detector*			*Average detector*		
	BW at -6 dB	*Step size*[a]	*Minimum dwell time*	*BW at -6 dB*	*Step size*[a]	*Minimum dwell time*	*BW at -6 dB*	*Step size*[a]	*Minimum 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.

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."

Paragraph 4.3., amend to read:

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

Spectrum analysers and FFT-based instruments, that meet the requirements of CISPR 16-1-1, may be used for conformity measurements. FFT-based measuring instruments shall continuously record and evaluate the signal during the measurement time. If using FFT-based instruments, the minimum measurement time shall be 1 s per analysis frequency band (in real-time mode) of the FFT instrument.

Table 1
Spectrum analyser parameters

Frequency range MHz	*Peak detector*		*Average detector*	
	RBW at -3 dB	*Minimum scan time*	*RBW at -3 dB*	*Minimum scan time*
30 to 1,000	100/120 kHz	100 ms/MHz	100/120 kHz	100 ms/MHz

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

Table 2
Scanning receiver parameters

Frequency range MHz	*Peak detector*			*Average detector*		
	BW at -6 dB	*Step size*	*Minimum dwell time*	*BW at -6 dB*	*Step size*	*Minimum dwell time*
30 to 1,000	120 kHz	50 kHz	5 ms	120 kHz	50 kHz	5 ms

"

Annex 9,

Paragraph 1.2.1., amend to read:

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

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

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

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

(d) Stripline testing according to ISO 11452-5;

~~(e) 800 mm stripline according to paragraph 4.5. of this annex.~~

(e) Reverberation chamber test according to ISO 11452-11;

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

(Frequency range and general test conditions shall be based on ISO 11452-1)."

Paragraph 2.2., amend to read:

"2.2. The ESA under test shall be switched on and shall be stimulated to be in normal operation condition. It shall be arranged as defined in this **A**~~a~~nnex unless individual test methods dictate otherwise.

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

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

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

Insert a new paragraph 2.3. to read:

"**2.3. The paragraph defines minimum test conditions for ESAs involved in "REESS charging mode coupled to the power grid"**

"REESS charging mode" ESA 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 maximum rated charging/input current value for AC charging. **If the current consumption can be adjusted, then the current shall be set to at least 20 per cent of its nominal value or to a minimum of 16 A (if the 20 per cent of its nominal value cannot be achieved in the test facility) for DC charging unless another value is agreed with the Type-Approval Authorities.** **In case of multiple batteries the average state of charge must be considered.**	**Temporary loss of charging function is allowed, provided that there is no incorrect charging condition (e.g. over-current, overvoltage) and the function can be restored by a simple intervention, without the use of tools, such as turning off/on the DUT, after the disturbance is removed.**

"

Paragraphs 2.3. to 2.5.(former), renumber to read:

"2.~~3~~**4**. Any extraneous equipment required to operate the ESA under test shall not be in place during the calibration phase. No extraneous equipment shall be closer than 1 m from the reference point during calibration.

2.~~4~~**5**. To ensure reproducible measurement results are obtained when tests and measurements are repeated, the test signal generating equipment and its layout shall be to the same specification as that used during each appropriate calibration phase.

2.~~5~~**6**. 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."

Paragraphs 3.1. and 3.2., amend to read:

"3.1. Frequency range, dwell times

Measurements shall be made in the 20 to ~~2~~**6**,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; ~~and~~

~~(b) PM (pulse modulation), Ton 577 µs, period 4,600 µs in the 800 to 2,000 MHz frequency range.~~

(b) PM2 (pulse modulation type 2), Ton 3 µs, period 3,333 µs in the 2,700 to 3,100 MHz frequency range; and

(c) PM3 (pulse modulation type 3), Ton 500 µs, period 1,000 µs in the 800 to 2,700 MHz and the 3,100 to 6,000 MHz frequency ranges.

If not otherwise agreed between Technical Service and ESA manufacturer.

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

3.2. The Technical Service shall perform the test at the intervals specified in ISO 11452-1, throughout the frequency range 20 to ~~2~~**6**,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 Type 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**, 2,360, 2,600, 3,000, 3,600, 5,200 and 5,900** MHz**)** to confirm that the ESA meets the requirements of this **A**~~a~~nnex."

Paragraph 4.2., amend to read:

"4.2. TEM cell testing (see Appendix ~~2~~**1** to this **A**~~a~~nnex)"

Paragraph 4.3.2.1., amend to read:

"4.3.2.1. For ESAs in configuration "REESS charging mode coupled to the power grid", an example of test arrangement (for substitution method) is given in Appendix ~~4~~**3** to this **A**~~a~~nnex (figure 1 for substitution method and figure 2 for closed loop method)."

Paragraphs 4.5. to 4.5.2.4., to be deleted.

Insert new paragraphs 4.5. to 4.5.2., to read:

"**4.5. Reverberation chamber test**

4.5.1. Test method

This test method allows the testing of vehicle electrical/electronic systems by exposing an ESA to statistically homogeneous and isotropic electromagnetic fields created by injected and stirred mechanically.

4.5.2. Test methodology

The test shall be performed according ISO 11452-11.

Unless otherwise specified, the reverberation chamber testing method shall be carried out using a test setup with ground plane."

Annex 9, Appendix 1, to be deleted.

Annex 9, Appendices 2, 3 and 4, renumber to 1, 2 and 3, accordingly.

Annex 10, paragraph 2., amend to read:

"2. Immunity against transient disturbances conducted along 12/24 V supply lines.

Apply the test pulses 1, 2a, 2b, 3a~~,~~ **and** 3b ~~and 4~~ according to the International Standard ISO 7637-2, **third edition 2011** to the supply lines as well as to other connections of ESAs which may be operationally connected to supply lines.

Apply the test pulses 4 according to the International Standard ISO 7637-2, second edition 2004 to the supply lines as well as to other connections of ESAs which may be operationally connected to supply lines.

ESAs that are exclusively reserved for mounting on electric vehicles (vehicles without 12V/24V starter motor) are not subject to pulse 4."

Annex 11,

Paragraph 2.1., amend to read:

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

For two-wheeled vehicles, a non-conductive insulating support with a thickness of 5 – 20mm shall be used between stand and ground plane.

The vehicle shall be tested in the charging mode configuration (if available on vehicle) as defined in flowchart of figure 1

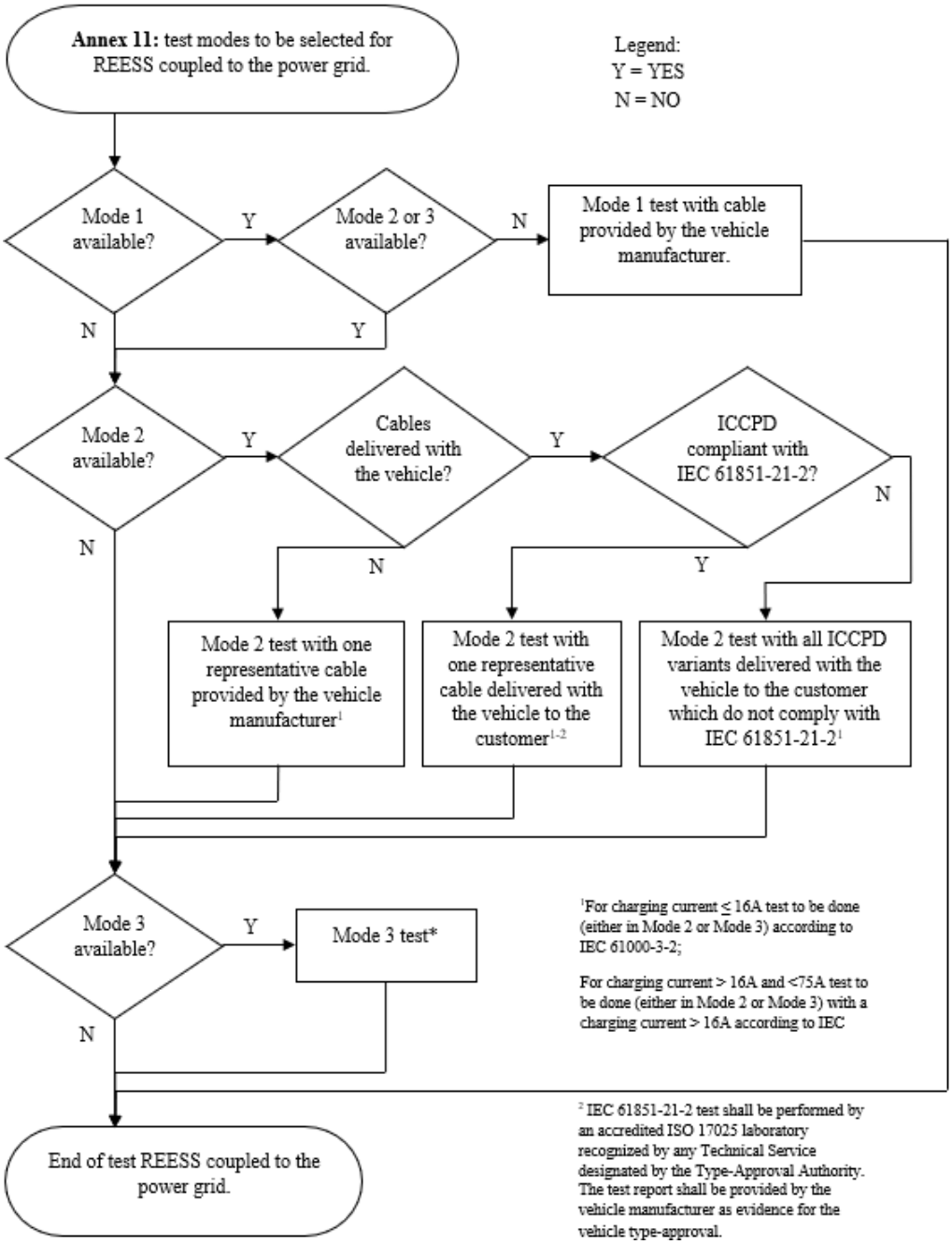


Figure 1
Charging mode configuration for Annex 11

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 splitting 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~~ **maximum rated charging/input current** value for AC charging.

In case of multiple batteries the average state of charge must be considered.

The vehicle shall be immobilized, the engine(s) (ICE and / or electrical engine) shall be OFF and in charging mode.

All other equipment which can be switched ON by the driver or passengers shall be OFF."

Paragraphs 4.2. to 4.5., amend to read:

"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 Table ~~3~~**4** of paragraph 7.3.2.1. of this Regulation.

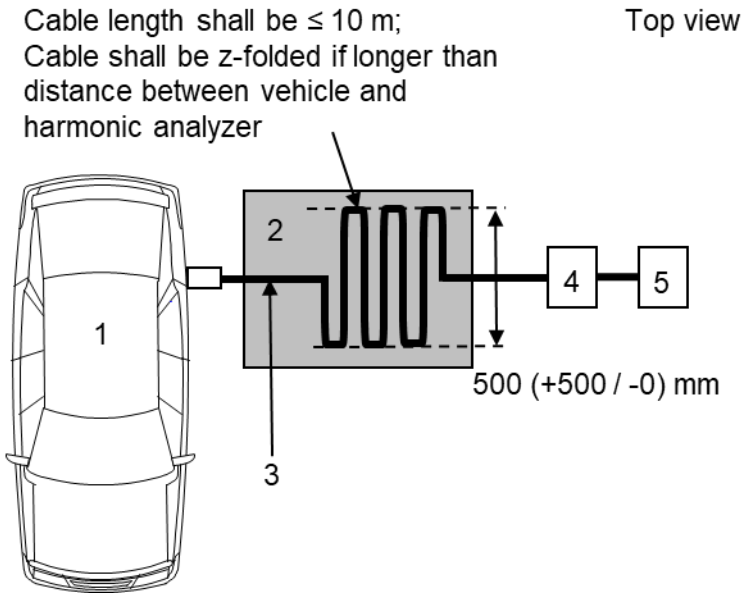
4.3. The limits for single phase or other than balanced three-phase "REESS charging mode coupled to the power grid" with input current > 16 A and ≤ 75 A per phase are given in Table ~~4~~**5** of paragraph 7.3.2.2. of this Regulation.

4.4. The limits for balanced three-phase "REESS charging mode coupled to the power grid" with input current > 16 A and ≤ 75 A per phase are given in Table ~~5~~**6** of paragraph 7.3.2.2. of this Regulation.

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) or c) described in paragraph 5.2. of IEC 61000-3-12 is fulfilled, then the limits given in Table ~~6~~**7** of paragraph 7.3.2.2. of this Regulation can be applied."

Annex 11, Appendix 1, Figure 1b, amend to read:

"Figure 1b

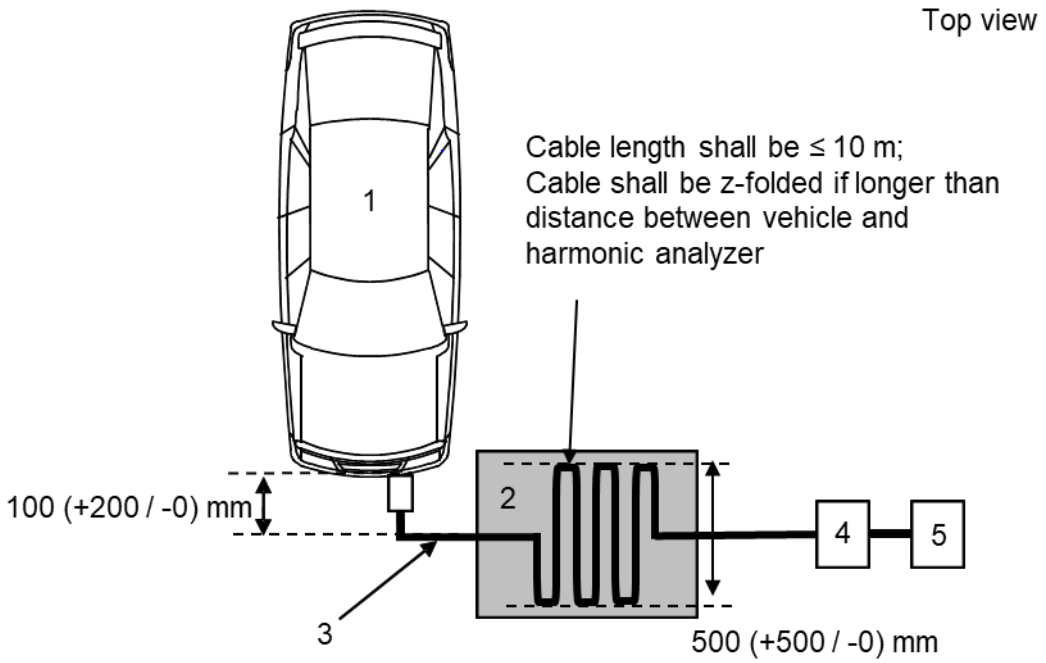


Legend:

1 Vehicle under test
2 Insulating support
3 Charging harness
4 Harmonic analyzer
5 Power supply"

Figure 1d, amend to read:

"Figure 1d



Legend:

1 Vehicle under test
2 Insulating support
3 Charging harness
4 Harmonic analyzer
5 Power supply"

Annex 12,

Paragraph 2.1., amend to read:

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

For two-wheeled vehicles, a non-conductive insulating support with a thickness of 5 – 20mm shall be used between stand and ground plane.

The vehicle shall be tested in the charging mode configuration (if available on vehicle) as defined in flowchart of figure 1

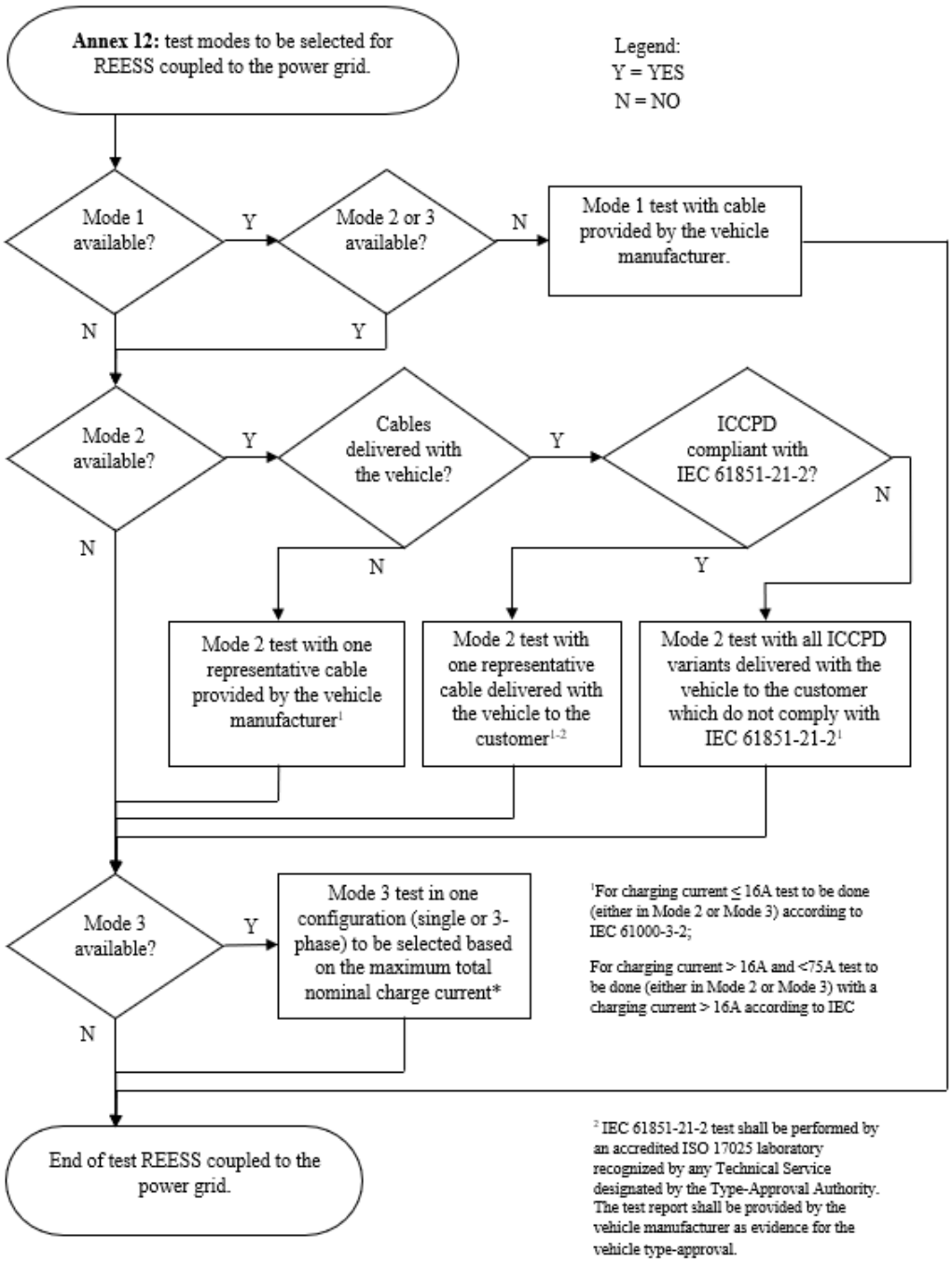


Figure 1
Charging mode configuration for Annex 12

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 splitting 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**~~ **maximum rated charging/input current** value for AC charging.

In case of multiple batteries the average state of charge must be considered.

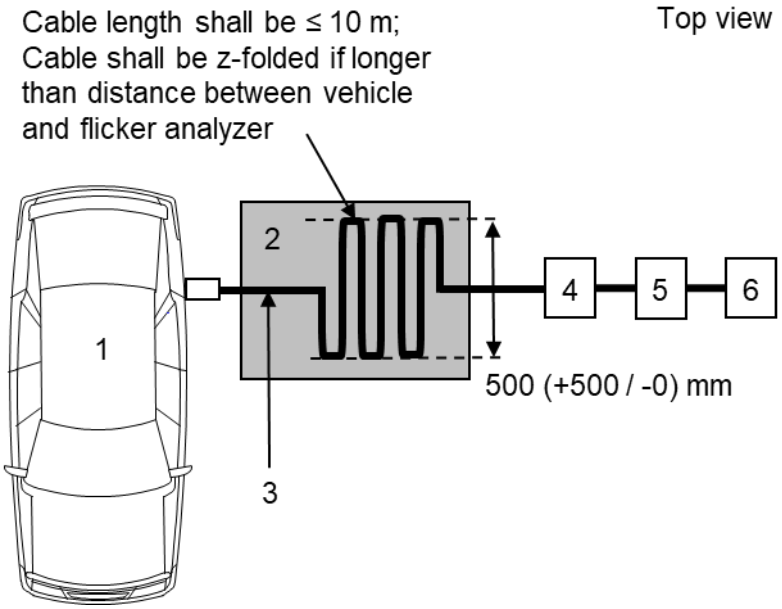
The vehicle shall be immobilized, the engine(s) (ICE and / or electrical engine) shall be OFF and in charging mode.

All other equipment which can be switched ON by the driver or passengers shall be OFF."

Annex 12, Appendix 1,

Figure 1b, amend to read:

"Figure 1b

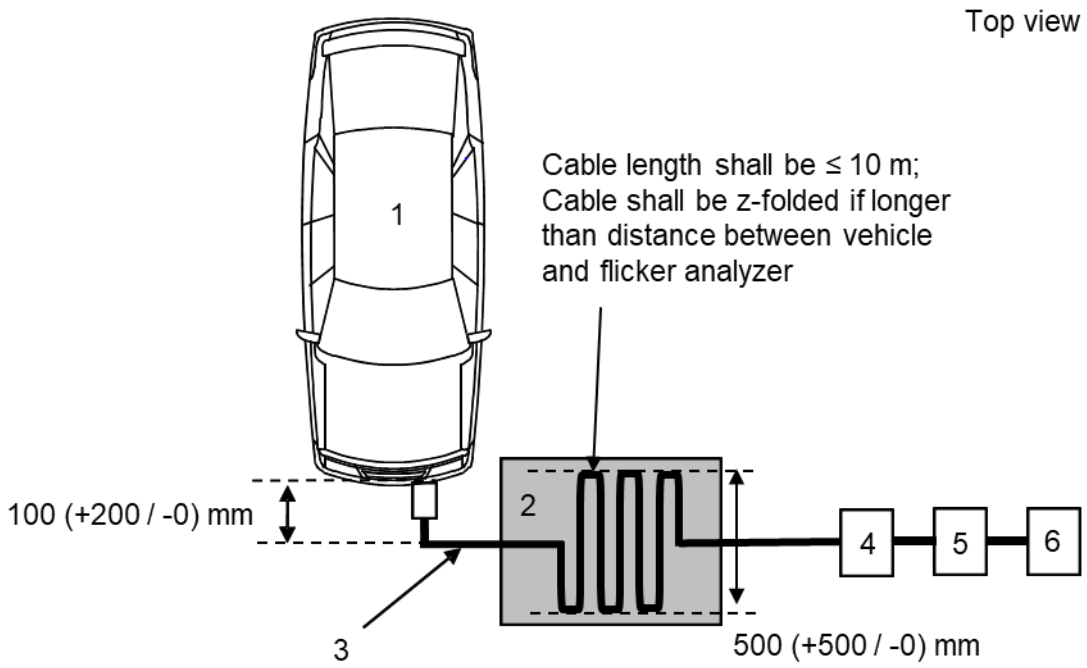


Legend:

1 Vehicle under test
2 Insulating support
3 Charging harness
4 Flicker analyzer
5 Impedance simulator
6 Power supply"

Figure 1d, amend to read:

"Figure 1d



Legend:

1 Vehicle under test
2 Insulating support
3 Charging harness
4 Flicker analyzer
5 Impedance simulator
6 Power supply"

Annex 13,

Paragraph 2.1., amend to read:

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

For two-wheeled vehicles, a non-conductive insulating support with a thickness of 5 – 20mm shall be used between stand and ground plane.

The vehicle shall be tested in the charging mode configuration (if available on vehicle) as defined in flowchart of figure 1

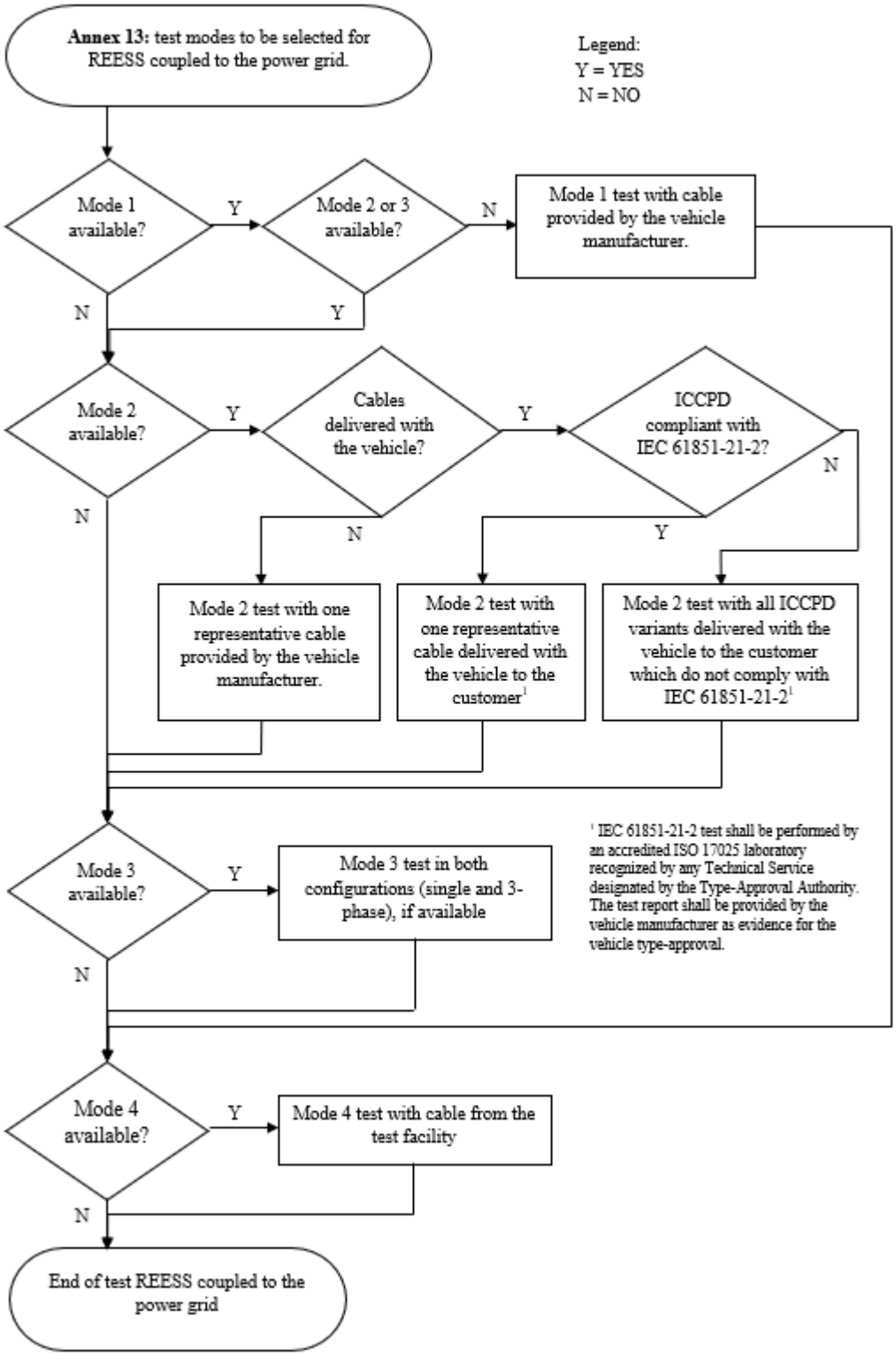


Figure 1: Charging mode configuration for Annex 13

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 splitting 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~~ **maximum rated charging/input current** value for AC charging.

If the current consumption can be adjusted, then the current shall be set to at least ~~80~~ **20** per cent of its nominal value **or to a minimum of 16 A (if the 20 per cent of its nominal value cannot be achieved in the test facility) for DC charging unless another value is agreed with the Type-Approval Authorities**.

In case of multiple batteries the average state of charge must be considered.

The vehicle shall be immobilized, the engine(s) (ICE and / or electrical engine) shall be OFF and in charging mode.

All other equipment which can be switched ON by the driver or passengers shall be OFF."

Paragraph 3.5., amend to read:

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

Spectrum analysers and FFT-based instruments, that meet the requirements of CISPR 16-1-1, may be used for conformity measurements. FFT-based measuring instruments shall continuously record and evaluate the signal during the measurement time. If using FFT-based instruments, the minimum measurement time shall be 1 s per analysis frequency band (in real-time mode) of the FFT instrument.

Table 1
Spectrum analyser parameters

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

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

Table 2
Scanning receiver parameters

	Peak detector			*Quasi-peak detector*			*Average detector*		
Frequency range MHz	*BW at -6 dB*	*Step size*	*Minimum dwell time*	*BW at -6 dB*	*Step size*	*Minimum dwell time*	*BW at -6 dB*	*Step size*	*Minimum dwell time*
0.15 to 30	9 kHz	5 kHz	50 ms	9 kHz	5 kHz	1 s	9 kHz	5 kHz	50 ms

"

Paragraph 4.2., amend to read:

"4.2. Measurements shall be performed with average and either quasi-peak or peak detectors. The limits are given in paragraph 7.5. of this Regulation.

Table ~~7~~**8** for AC lines and Table ~~8~~**9** for DC lines. If peak detectors are used a correction factor of 20 dB as defined in CISPR 12 shall be applied."

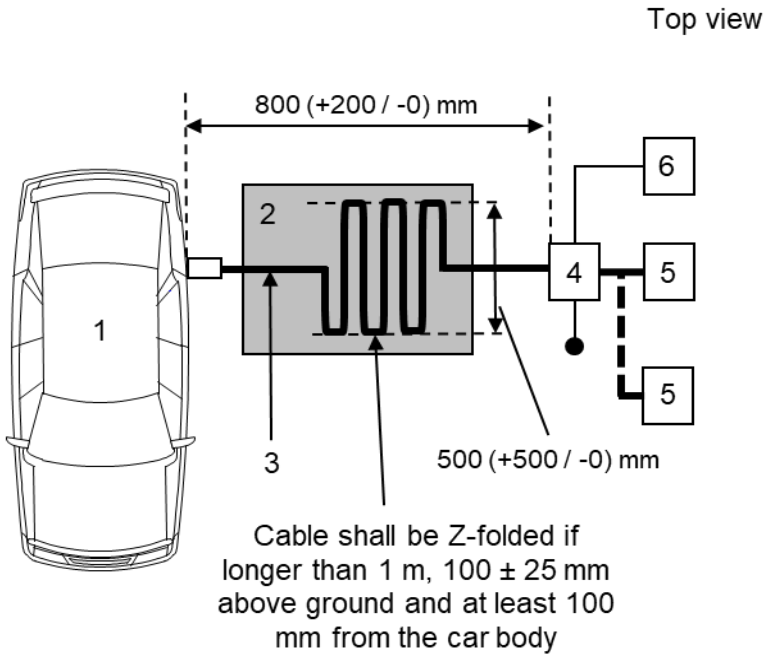
Insert a new paragraph 4.3., to read:

"**4.3. If the manufacturer provides measurement data for the whole frequency band for all applicable charging mode configurations from a test laboratory accredited to the applicable parts of ISO 17025 and recognized by the Type-Approval Authority for all the available charging modes configurations defined in paragraph 2.1, the Technical Service may perform tests only for one of the available charging mode configuration defined in paragraph 2.1 to confirm that the vehicle meets the requirements of this Annex.**"

Annex 13, Appendix 1,

Figure 1b, amend to read:

"Figure1b

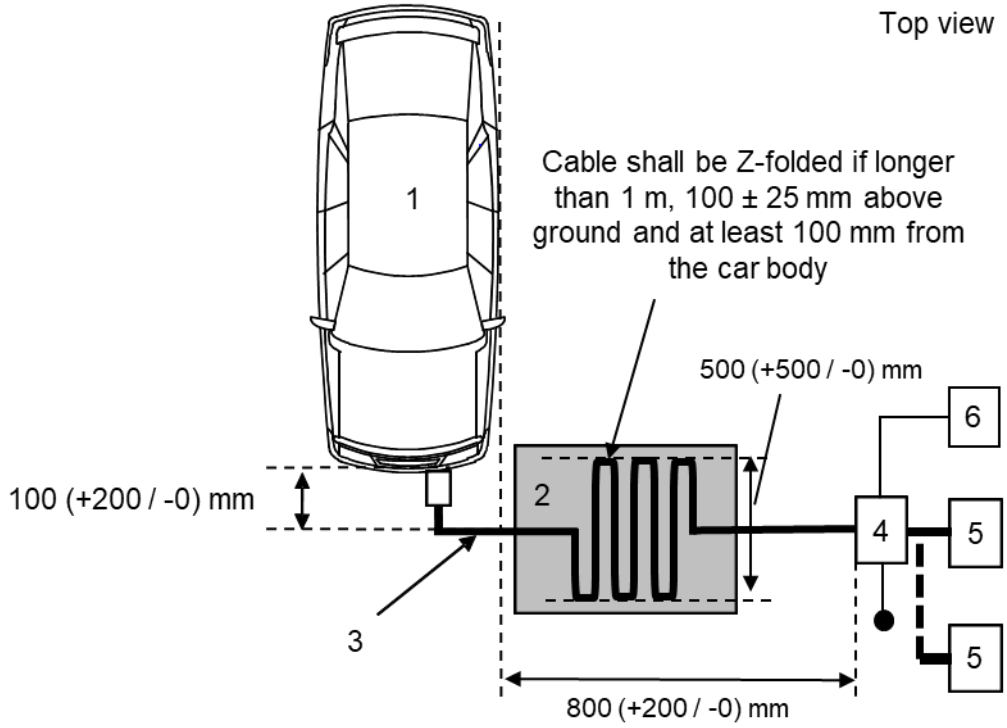


Legend:

1 Vehicle under test
2 Insulating support
3 Charging harness
4 AMN(s) or DC-charging-AN(s) grounded
5 Power mains socket
6 Measuring receiver"

Figure 1d, amend to read:

"Figure 1d



Legend:

1 Vehicle under test
2 Insulating support
3 Charging harness
4 AMN(s) or DC-charging-AN(s) grounded
5 Power mains socket
6 Measuring receiver"

Annex 14, amend to read:

"Annex 14 (RESERVED)

~~Method(s) of testing for emission of radiofrequency conducted disturbances on wired network port from vehicles~~

~~1. General~~

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

~~1.2. Test method~~

~~This test is intended to measure the level of radio frequency conducted disturbances generated by vehicle in configuration "REESS charging mode coupled to the power grid" through its wired network port 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.~~

~~2. Vehicle/ state during tests~~

~~2.1. The vehicle shall be in configuration "REESS charging mode coupled to the power grid". The state of charge (SOC) of the traction battery shall be kept between 20 per cent and 80 per cent of the maximum SOC during the whole frequency range measurement (this may lead to splitting 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 for AC charging.~~

~~If the current consumption can be adjusted, then the current shall be set to at least 80 per cent of its nominal value for DC charging unless another value is agreed with the type approval authorities.~~

~~In case of multiple batteries the average state of charge must be considered.~~

~~The vehicle shall be immobilized, the engine(s) (ICE and / or electrical engine) shall be OFF and in charging mode.~~

~~All other equipment which can be switched ON by the driver or passengers shall be OFF.~~

~~3. Test arrangements~~

~~3.1. The test set-up shall be performed according to paragraph 5. of CISPR 22 for conducted emissions.~~

~~3.2. Measuring location~~

~~A shielded enclosure or an absorber-lined shielded enclosure (ALSE) or an open area test site (OATS) which complies with the requirements of CISPR 16-1-4 may be used.~~

~~3.3. Local/private communication lines connected to signal/control ports and lines connected to wired network ports shall be applied to the vehicle through AAN(s).~~

~~The various AAN(s) to be used are defined in Appendix 8, clause 5:~~

~~— Clause 5.1. for signal/control port with symmetric lines;~~

~~— Clause 5.2. for wired network port with PLC on power lines;~~

- Clause 5.3. for signal/control port with PLC (technology) on control pilot; and

- Clause 5.4. for signal/control port with control pilot.

The AAN(s) shall be mounted directly on the ground plane. The case of the AAN(s) shall be bonded to the ground plane (ALSE) or connected to the protective earth (OTS, e.g. an earth rod).

The measuring port of each AAN shall be terminated with a 50 Ω load.

If a charging station is used, AAN(s) are not required for the signal/control ports and/or for the wired network ports. The local/private communication lines between the vehicle and the charging station shall be connected to the associated equipment on the charging station side to work as designed. If communication is emulated and if the presence of the AAN prevents proper communication then no AAN should be used.

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

If it is impossible to guarantee the functionality of vehicle, due to introduction of AAN, an alternate method described in CISPR 22 (according to Figures 2a to 2d of Appendix 1 to this annex) shall be applied.

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

Table 1
Spectrum analyser parameters

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

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

Table 2
Scanning receiver parameters

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

4. Test requirements

4.1. The limits apply throughout the frequency range 0.15 to 30 MHz for measurements performed in a shielded enclosure or an absorber lined shielded enclosure (ALSE) or an open area test site (OATS).

4.2. Measurements shall be performed with average and either quasi peak or peak detectors. The limits are given in Table 9 of paragraph 7.6. If peak detectors are used a correction factor of 20 dB as defined in CISPR 12 shall be applied.
"

Annex 14, Appendix 1, to be deleted.

Annex 15,

Paragraph 2., amend to read:

"2. Vehicle state during tests in configuration "REESS in charging mode coupled to the power grid"

The vehicle shall be tested in the charging mode configuration (if available on vehicle) as defined in flowchart of figure 1

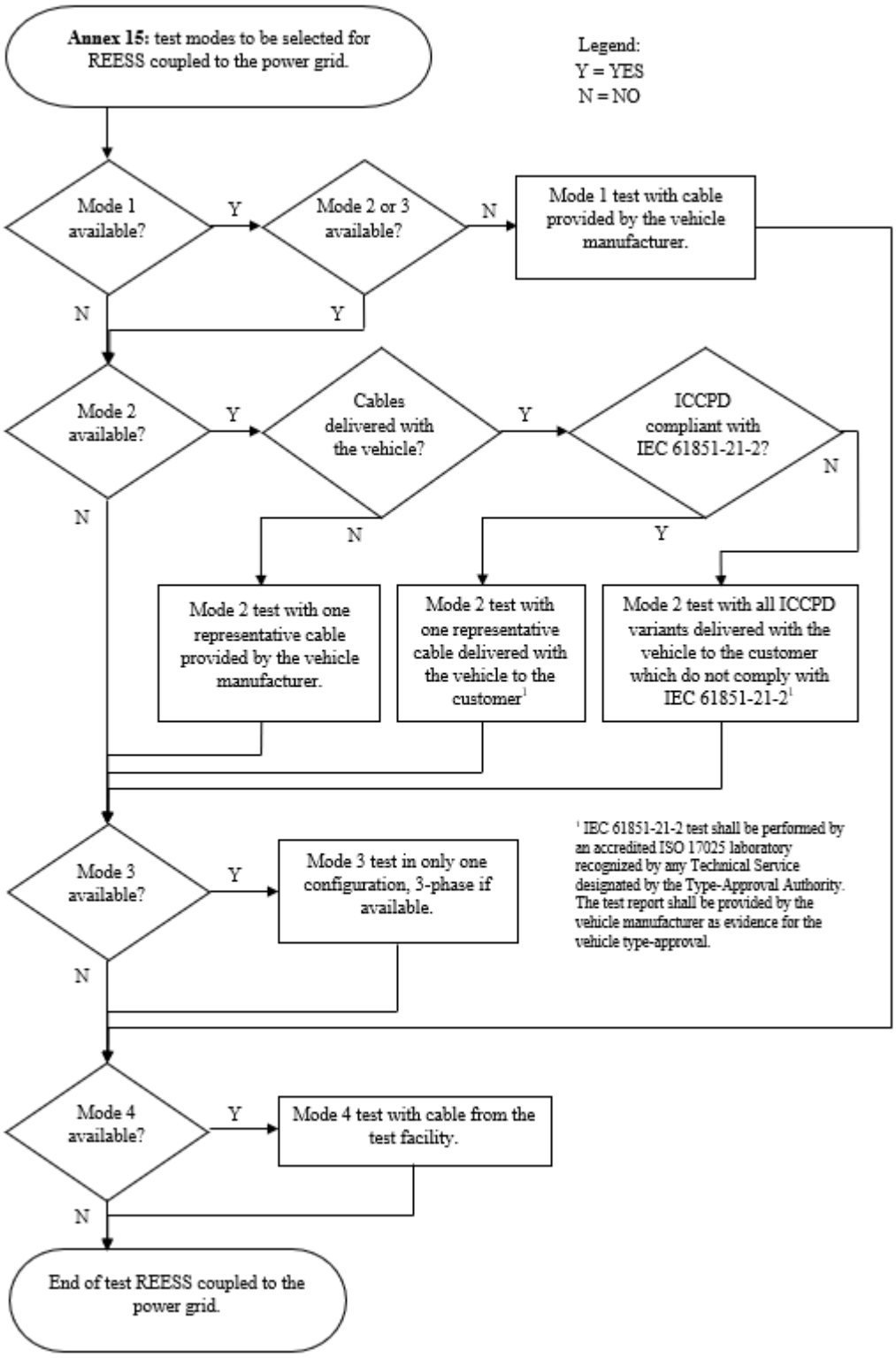


Figure 1
Charging mode configuration for Annex 15"

Paragraph 2.1.2., amend to read:

"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 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~~ **maximum rated charging/input current** value **for AC charging**. **If the current consumption can be adjusted, then the current shall be set to at least 20 per cent of its nominal value or to a minimum of 16 A (if the 20 per cent of its nominal value cannot be achieved in the test facility) for DC charging unless another value is agreed with the Type-Approval Authorities.** In case of multiple batteries the average state of charge must be considered.	Vehicle sets in motion. Unexpected release of the parking brake. Loss of Parking position for automatic transmission**.**

"

Paragraph 4.2., amend to read:

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

For two-wheeled vehicles, a non-conductive insulating support with a thickness of 5 – 20mm shall be used between stand and ground plane."

Paragraph 5.1.1., amend to read:

"5.1.1. T~~he t~~est **shall be conducted in accordance with** ~~method according to~~ IEC 61000-4-4 ~~shall be used to establish the test level requirements~~. **Test shall be performed only at the severity levels given in 7.8.2.1.**"

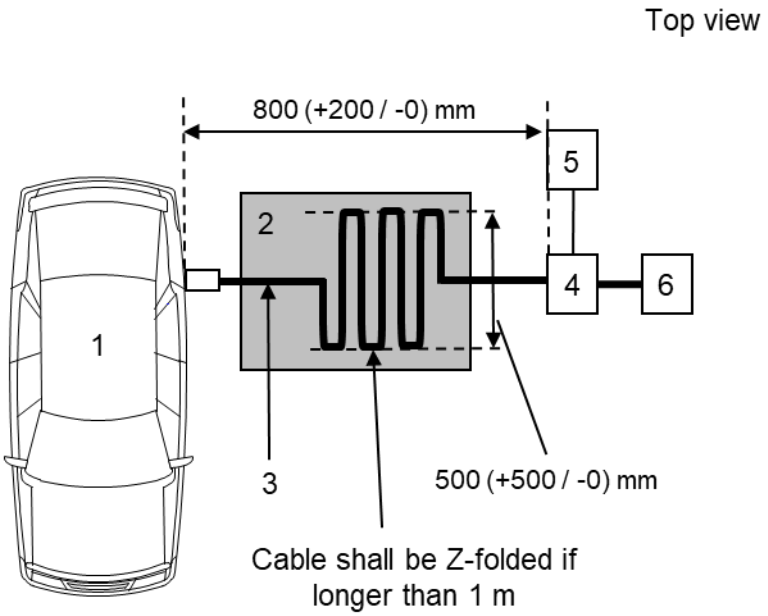
Insert a new paragraph 6., to read:

"**6. If the manufacturer provides measurement data for all applicable charging mode configurations from a test laboratory accredited to the applicable parts of ISO 17025 and recognized by the Type-Approval Authority for all the available charging modes configurations defined in paragraph 2.1, the Technical Service may perform tests only for one of the available charging mode configuration defined in paragraph 2.1 to confirm that the vehicle meets the requirements of this Annex.**"

Annex 15, Appendix 1,

Figure 1b, amend to read:

"Figure 1b

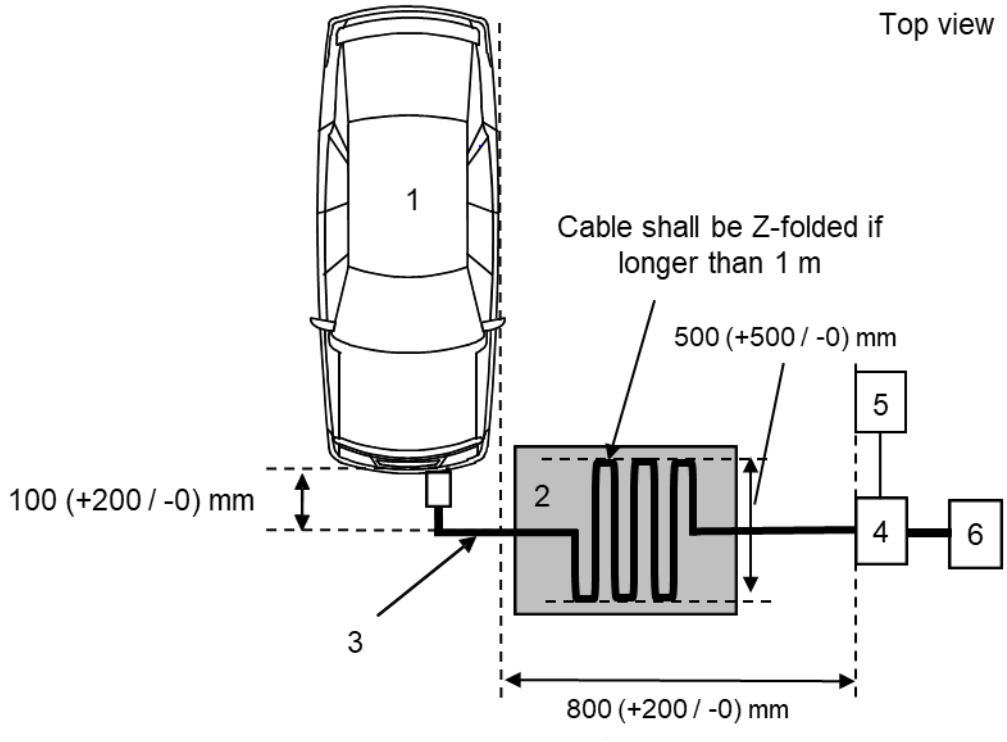


Legend:

1 Vehicle under test
2 Insulating support
3 Charging harness
4 CDN
5 Fast Transients / Burst generator
6 Power supply"

Figure 1d, amend to read:

"Figure 1d



Legend:

1 Vehicle under test
2 Insulating support
3 Charging harness
4 CDN
5 Fast Transients / Burst generator
6 Power supply

"

Annex 16,

Paragraph 2., amend to read:

"2. Vehicle state during tests in configuration "REESS in charging mode coupled to the power grid"

The vehicle shall be tested in the charging mode configuration (if available on vehicle) as defined in flowchart of figure 1

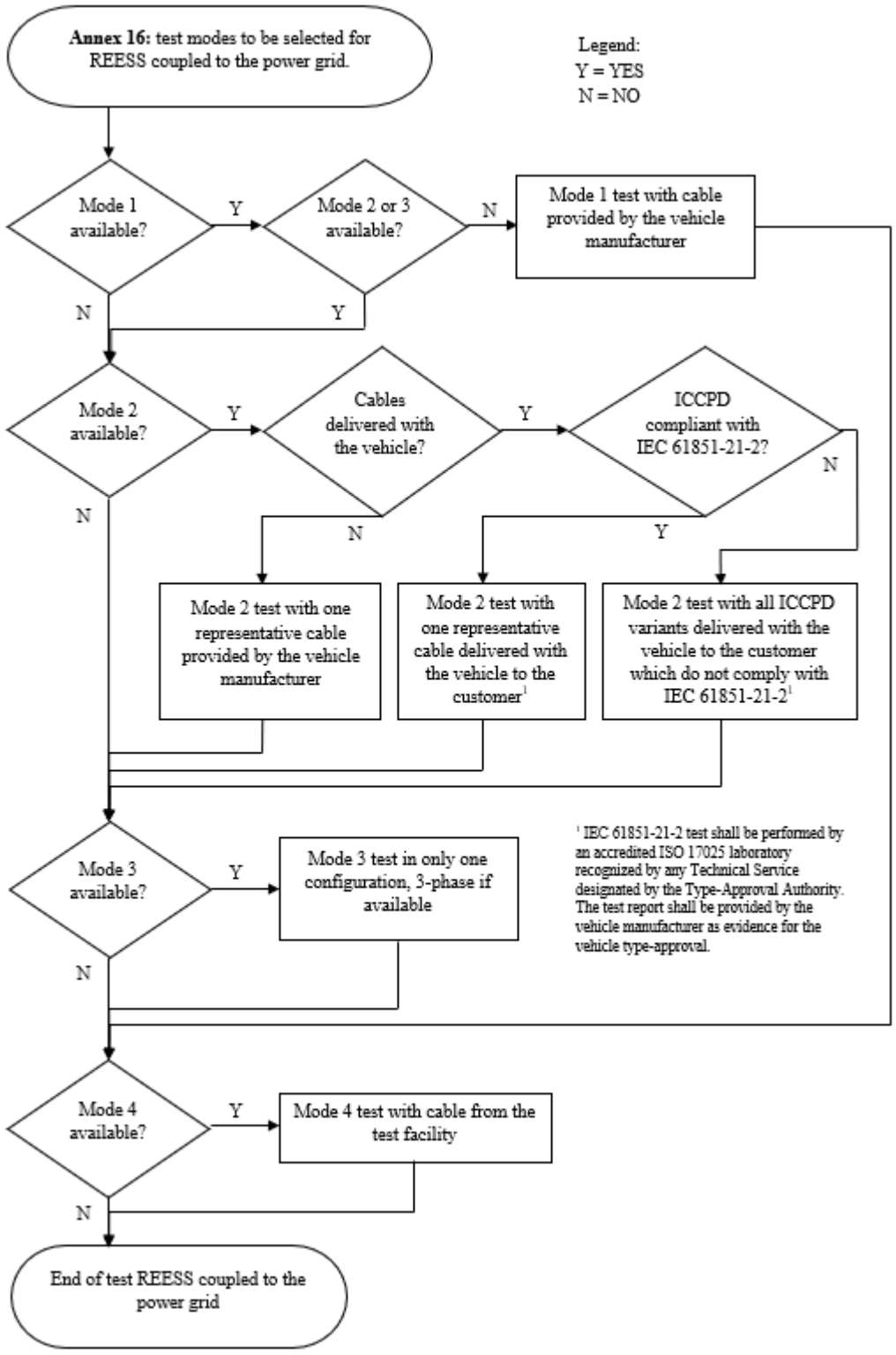


Figure 1
Charging mode configuration for Annex 16"

Paragraph 2.1.2., amend to read:

"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 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~~ **maximum rated charging/input current** value **for AC charging**. **If the current consumption can be adjusted, then the current shall be set to at least 20 per cent of its nominal value or to a minimum of 16 A (if the 20 per cent of its nominal value cannot be achieved in the test facility) for DC charging unless another value is agreed with the Type-Approval Authorities.** In case of multiple batteries the average state of charge must be considered.	Vehicle sets in motion Unexpected release of the parking brake. Loss of Parking position for automatic transmission**.**

"

Paragraph 4.2., amend to read:

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

For two-wheeled vehicles, a non-conductive insulating support with a thickness of 5 – 20mm shall be used between stand and ground plane."

Paragraph 5.1.1., amend to read:

"5.1.1. T~~he t~~est **shall be performed in accordance with** method according to IEC 61000-4-5 **only at the severity levels specified in 7.9.2.1.** ~~shall be used to establish the test level requirements.~~"

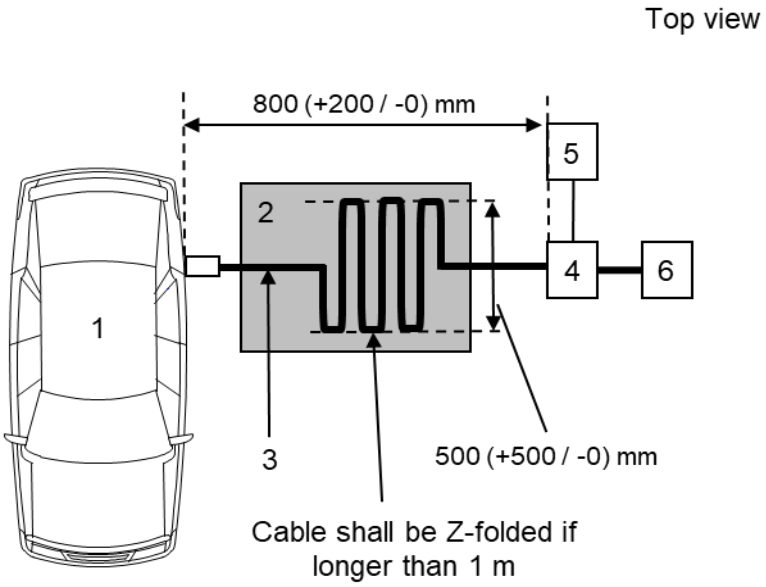
Insert a new paragraph 6., to read:

"6. If the manufacturer provides measurement data for all applicable charging mode configurations from a test laboratory accredited to the applicable parts of ISO 17025 and recognized by the Type-Approval Authority for all the available charging modes configurations defined in 2.1, the Technical Service may perform tests only for one of the available charging mode configuration defined in 2.1 to confirm that the vehicle meets the requirements of this Annex."

Annex 16, Appendix 1,

Figure 1b, amend to read:

"Figure 1b

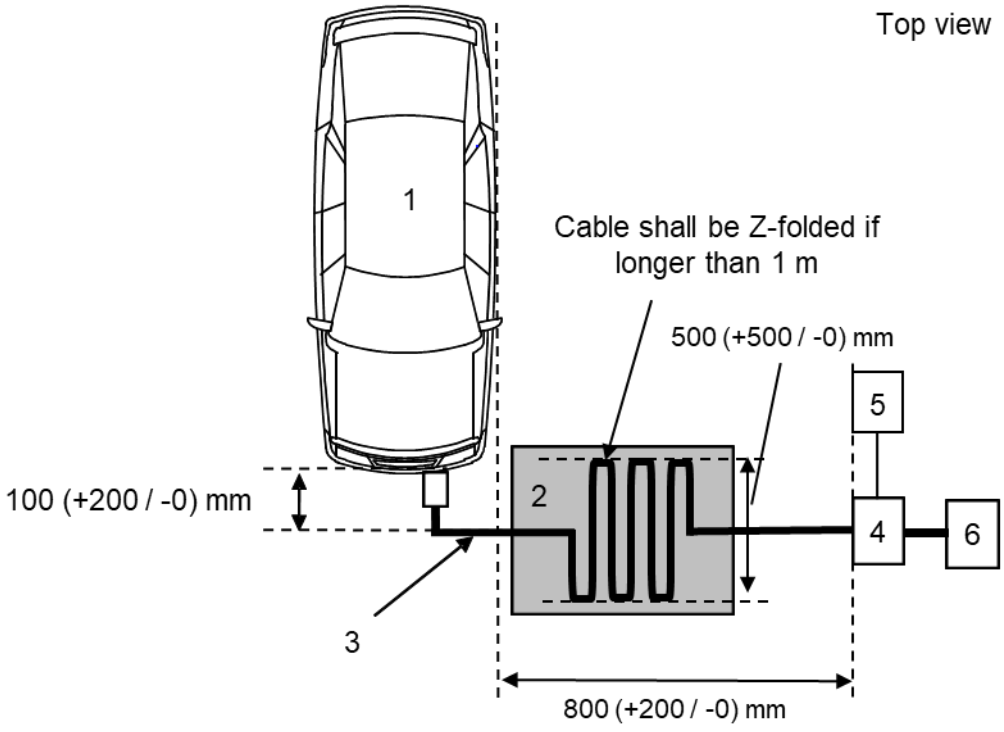


Legend:

1	Vehicle under test
2	Insulating support
3	Charging harness
4	CDN
5	Surge generator
6	Power supply"

Figure 1d, amend to read:

"Figure 1d



Legend:

1 Vehicle under test
2 Insulating support
3 Charging harness
4 CDN
5 Surge generator
6 Power supply "

Annex 17,

Paragraph 2.1., amend to read:

"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~~ **maximum rated charging/input current** value for AC charging."

Paragraphs 4.2. to 4.5., amend to read:

"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 1~~2~~**0** of paragraph 7.11.2.1. of this Regulation.

4.3. The limits for single phase or other than balanced 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 1~~3~~**1** of paragraph 7.11.2.2. of this Regulation.

4.4. The limits for balanced 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 paragraph Table 1~~4~~**2** of 7.11.2.2. of this Regulation.

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 paragraph 5.2. of IEC 61000-3-12 is fulfilled, then the limits given in Table 1~~5~~**3** of paragraph 7.11.2.2. of this Regulation can be applied."

Annex 18, paragraph 2.1., amend to read:

"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~~ **maximum rated charging/input current** value for AC charging. "

Annex 19, paragraph 2.1., amend to read:

"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~~ **maximum rated charging/input current** value for AC charging.

If the current consumption can be adjusted, then the current shall be set to at least ~~80~~ **20** per cent of its nominal value **or to a minimum of 16 A (if the 20 per cent of its nominal value cannot be achieved in the test facility) for DC charging unless another value is agreed with the Type-Approval Authorities.** "

Annex 19,

Paragraph 3.4., amend to read:

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

Spectrum analysers and FFT-based instruments, that meet the requirements of CISPR 16-1-1, may be used for conformity measurements. FFT-based measuring instruments shall continuously record and evaluate the signal during the measurement time. If using FFT-based instruments, the minimum measurement time shall be 1 s per analysis frequency band (in real-time mode) of the FFT instrument.

Table 1
Spectrum analyser parameters

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

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

Table 2
Scanning receiver parameters

Frequency range MHz	*Peak detector*			*Quasi-peak detector*			*Average detector*		
	BW at -6 dB	*Step size*	*Minimum dwell time*	*BW at -6 dB*	*Step size*	*Minimum dwell time*	*BW at -6 dB*	*Step size*	*Minimum dwell time*
0.15 to 30	9 kHz	5 kHz	50 ms	9 kHz	5 kHz	1 s	9 kHz	5 kHz	50 ms

"

Paragraph 4.2., amend to read:

"4.2. Measurements shall be performed with average and either quasi-peak or peak detectors. The limits are given in Table 1**64** of paragraph 7.13.2.1. of this Regulation for AC lines and in Table 1~~7~~**5** of paragraph 7.13.2.2. of this Regulation for DC lines. If peak detectors are used a correction factor of 20 dB as defined in CISPR 12 shall be applied."

Annex 20, amend to read:

"Annex 20 (RESERVED)

~~Method(s) of testing for emission of radiofrequency conducted disturbances on wired network port from an ESA~~

~~1. General~~

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

~~1.2. Test method~~

~~This test is intended to measure the level of radio frequency conducted disturbances generated by ESA in configuration "REESS charging mode coupled to the power grid" through its wired network port 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~~

~~2. ESA state during tests~~

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

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

If the test is not performed with a REESS the ESA should be tested at rated current.

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

If the current consumption can be adjusted, then the current shall be set to at least 80 per cent of its nominal value for DC charging unless another value is agreed with the type approval authorities.

3. Test arrangements

3.1 Local/private communication lines connected to signal/control ports and lines connected to wired network ports shall be applied to the vehicle through AAN(s).

The various AAN(s) to be used are defined in Appendix 8, clause 5:

- Clause 5.1. for signal/control port with symmetric lines;
- Clause 5.2. for wired network port with PLC on power lines;
- Clause 5.3. for signal/control port with PLC (technology) on control pilot; and
- Clause 5.4. for signal/control port with control pilot.

The AAN(s) shall be mounted directly on the ground plane. The case of the AAN(s) shall be bonded to the ground plane (ALSE) or connected to the protective earth (OTS, e.g. an earth rod).

The measuring port of each AAN shall be terminated with a 50 Ω load.

If a charging station is used, AAN(s) are not required for the signal/control ports and/or for the wired network ports. The local/private communication lines between the vehicle and the charging station shall be connected to the associated equipment on the charging station side to work as designed. If communication is emulated and if the presence of the AAN prevents proper communication then no AAN should be used

3.2 Measuring location

A shielded enclosure or an absorber lined shielded enclosure (ALSE) or an open area test site (OATS) which complies with the requirements of CISPR 16-1-4 may be used.

3.3 The test set-up (floor standing equipment) for the connection of the ESA in configuration "REESS charging mode coupled to the power grid" is shown in Figure 1 of Appendix 1 to this annex.

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

Table 1
Spectrum analyser parameters

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

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

~~Table 2~~
~~Scanning receiver parameters~~

	~~*Peak detector*~~			~~*Quasi-peak detector*~~			~~*Average detector*~~		
~~*Frequency range MHz*~~	~~*BW at -6 dB*~~	~~*Step size*~~	~~*Minimum dwell time*~~	~~*BW at -6 dB*~~	~~*Step size*~~	~~*Minimum dwell time*~~	~~*BW at -6 dB*~~	~~*Step size*~~	~~*Minimum dwell time*~~
~~0.15 to 30~~	~~9 kHz~~	~~5 kHz~~	~~50 ms~~	~~9 kHz~~	~~5 kHz~~	~~1 s~~	~~9 kHz~~	~~5 kHz~~	~~50 ms~~

~~4. Test requirements~~

~~4.1. The limits apply throughout the frequency range 0.15 to 30 MHz for measurements performed in a shielded enclosure or an absorber lined shielded enclosure (ALSE) or an open area test site (OATS).~~

~~4.2. Measurements shall be performed with average and either quasi-peak or peak detectors. The limits are given in Table 16 of paragraph 7.14.2.1. of this Regulation. If peak detectors are used a correction factor of 20 dB as defined in CISPR 12 shall be applied.~~"

Annex 20, Appendix 1, to be deleted.

Annex 21, Paragraph 2.1., amend to read:

"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~~ **maximum rated charging/input current** value **for AC charging**. **If the current consumption can be adjusted, then the current shall be set to at least 20 per cent of its nominal value or to a minimum of 16 A (if the 20 per cent of its nominal value cannot be achieved in the test facility) for DC charging unless another value is agreed with the Type-Approval Authorities.**	~~Incorrect charging condition (e.g. over-current, overvoltage)~~ **Temporary loss of charging function is allowed, provided that there is no incorrect charging condition (e.g. over-current, overvoltage) and the function can be restored by a simple intervention, without the use of tools, such as turning off/on the DUT, after the disturbance is removed.**

"

Annex 21, paragraph 5.1.1., amend to read:

"5.1.1. T~~he t~~est **shall be conducted in accordance with** ~~method according to~~ IEC 61000-4-4 ~~shall be used to establish the test level requirements~~. **Test shall be performed only at the severity levels given in 7.15.2.1.**"

Annex 22,

Paragraph 2.1., to be deleted.

Paragraph 2.1.2., renumber and amend to read:

"2.1.~~2.~~ 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~~ **maximum rated charging/input current** value **for AC charging**. **If the current consumption can be adjusted, then the current shall be set to at least 20 per cent of its nominal value or to a minimum of 16 A (if the 20 per cent of its nominal value cannot be achieved in the test facility) for DC charging unless another value is agreed with the Type-Approval Authorities.**	~~Incorrect charging condition (e.g. over-current, overvoltage)~~ **Temporary loss of charging function is allowed, provided that there is no incorrect charging condition (e.g. over-current, overvoltage) and the function can be restored by a simple intervention, without the use of tools, such as turning off/on the DUT, after the disturbance is removed**.

"

Paragraph 5.1.1., amend to read:

"5.1.1. T~~he t~~est **shall be conducted in accordance with** ~~method according to~~ IEC 61000-4-4 ~~shall be used to establish the test level requirements~~. **Test shall be performed only at the severity levels given in 7.16.2.1.** "

II. Justification

1. Editorial changes were made in the whole regulation: renumbering paragraphs and references to other paragraphs, tables and figures.

2. In paragraph 1.3., a note on functional safety was introduced to clarify the relationship with EMC.

3. In paragraph 2.12., the definition of emergency calling systems was generalised to ensure applicability for all existing systems.

4. In paragraph 2.20., the abbreviation AE was updated to “Auxiliary Equipment” for consistency with international EMC standards.

5. In paragraphs 2.26 to 2.28., definitions regarding automated driving systems (ADS) were introduced, as laid down in the guidelines ECE/TRANS/WP.29/2022/58, Annex 1. A note was added to clarify the responsibility of the driver and that ADS is not same as a driving assistance system. Paragraph 2.28. is an additional definition suggested by the Informal Working Group on Functional Requirements for Automated and Autonomous Vehicles (IWG FRAV).

6. In paragraphs 2.29. and 2.30., definitions for “residential environment” and “non-residential environment” were proposed to clarify the applicability of different emission limits.

7. In paragraphs 2.31. and 2.32., the definitions of AVAS and AECS were included, because new failure criteria were added to Annex 6.

8. In paragraph 3.2.1., the flowchart was updated for clarification of the wording “coupling system”. Furthermore, it may be necessary to apply other EMC regulations if UN Regulation No.10 is not applicable.

9. Paragraph 6.1.2. was amended to clarify the minimum number of steady state operating conditions of vehicle propulsion systems which must be considered in the test plan. This is necessary because the default test conditions may not trigger all intended operating modes. For example, in some vehicles only one propulsion mode is active at a constant speed of 40 km/h.

10. In paragraph 6.9.1., due to calibration and availability of test equipment, the reference to ISO 7637-2 has to be updated. The test levels referred in the 06 series of amendments to UN Regulation No.10 match the immunity test level I/II of the 2011 edition. As Pulse 4 is no longer included in ISO 7637-2:2011, the reference to the 2004 edition should be kept. Pulse 4 (start pulse) will be only applied to vehicles with combustion engine.

11. For the same reason, paragraph 7.1.2. was amended for the rechargeable energy storage system (REESS) charging mode coupled to the power grid. Annex 2A was amended as a consequence of these new requirements, requesting vehicle manufacturers to provide further information.

12. Paragraph 6.3.2.4 was deleted, because measuring only in the frequency modulation (FM) band from 76 to 108 MHz is not sufficient to determine the narrowband emission for the whole frequency band from 30 to 1000 MHz.

13. The frequency range of electromagnetic immunity test (vehicle and electrical/electronic sub-assembly - ESA) was extended to 6 GHz in order to ensure robustness regarding state-of-the-art mobile services (e.g. long-term evolution (LTE) standard, 5G, Wi-Fi). The test level of 10 V/m was determined based on the requirements in IEC 61000-6-2:2015 multiplied by 3 as it is for the lower frequencies.

14. In paragraph 6.8.2.1., the 800 mm stripline for ESA immunity test was suppressed. This method is no longer used by EMC laboratories.

15. In paragraph 6.8.2.1., the reverberation chamber for ESA electromagnetic immunity test according to ISO 11452-11 was introduced. This test method is a state-of-the-art immunity test method. The extension of the frequency range to 6 GHz requires additional test time. This method helps to keep the test time at an acceptable range. The test level of 21 V/m was derived from detailed studies comparing currents induced in vehicle harnesses with reverberation and the absorber-lined shielded enclosure (ALSE) (ISO 11452-2) test methods.

16. In paragraph 6.8.2.1., the wording concerning ESA electromagnetic immunity test methods was replaced by two tables in order to give a better overview and to clarify the test severity and applicability of five different test methods in two frequency ranges.

17. Paragraph 6.10.7. introduced a new exception for configurations other than REESS charging mode coupled to the power grid: “Trolleybuses: AC / DC mains portion of the vehicle propulsion system shall be excluded from this Regulation”, because other product standards, e.g. railway standards apply.

18. Paragraph 7.1.3. was updated to account for the changes introduced by the new flow charts in each concerned annex to clarify which REESS charge mode must be conducted with which cable.

19. In paragraph 7.1.4. the asymmetric artificial network (AAN) for signal port lines, control port lines or wired network port lines was added to the list of artificial networks for termination purposes.

20. With regard to paragraphs 7.6. and 7.14., measuring conducted emissions on signal port lines is not applicable, because AC or DC power lines are combined with signal port lines in one cable harness. Therefore, paragraphs 7.6 and 7.14 were deleted with the suppression of Annexes 14 and 20. State-of-the-art and future passenger cars are not connected directly to a communication network. In general, the signalling between charging equipment is always a peer-to-peer connection. It was confirmed by all IWG EMC members the method is not applied for any type-approval test.

21. In paragraph 7.5.3., new conducted emission limits were introduced for vehicles which are charged only in non-residential environments. These limits were adopted from the generic standard IEC 61000-6-4. They are not applicable for the majority of vehicles, e.g. passenger cars or motorbikes. But the limits may be applicable for large vehicles where the manufacturer provides a statement that the vehicle shall be charged in non-residential environment only (see Annex 3A).

22. For paragraph 7.7.2.1., the same test method can be used for REESS in charging mode.

23. For the transitional provisions in paragraph 13., proposed changes (especially the extension of the frequency range and failure criteria for ADS) for radiated immunity tests require a significant change not only to vehicle electronics, but also to test laboratories. Vehicle manufacturers requested a five-year transition period to implement the necessary changes. For ADS a special test software may be necessary to set the sensors in an operational state.

24. OICA proposes to update the transitional provisions in the 07 series of amendments to UN Regulation No.10 in accordance with the World Forum (WP.29) General Guidelines for United Nations Regulatory Procedures and Transitional Provisions in UN Regulations, Annex 1, Part II. For that purpose, explicit transitional provisions should be included in order to cover any potential gaps that may have existed in informal document GRE-89-17 for:

- Vehicles, vehicle systems and the installation of equipment and parts in new vehicles
- Equipment and parts (ESAs).

25. “Replacement parts” are already covered as “spare parts” in paragraph 3.2.8. of the 06 series of amendments to UN Regulation No. 10. However, their definition is not in line with WP.29 in the sense that they are *“equipment or part is intended as a replacement for fitting on vehicles in use”.* Instead of adding a separate section for replacement parts in the transitional provisions, we propose to amend paragraph 3.2.8. to read:

“ESA which are brought to the market as replacement parts ***intended as a replacement for fitting on vehicles*** *in use do not need type approval if they are obviously marked as a replacement part by an identification number and if they are identical and from the same manufacturer as the corresponding Original Equipment Manufacturer (OEM) part for an already type approved vehicle.”*

26. In Appendix 1, updating of all other references to the latest version is considered to ensure state-of-the art tests. When referring to an international standard the standardization organizations require to take the latest standards. This reduces efforts for management and calibration of test laboratories and ensures availability of test equipment.

27. In Appendix 8, the figures and legend are corrected, because a high-voltage artificial network (HV-AN) is never applied to vehicle tests. For DC charging tests on vehicle or ESA level the DC-charging-AN is applied. This is consistent with standard CISPR 25.

28. In Annex 1, the diameter requirement of approval marks was corrected. The given value for the diameter is a minimum requirement. The wording must be updated for the 07 series of amendments.

29. In Annex 4:

(a) For two-wheeled vehicles, a non-conductive insulating support with a thickness of 5 – 20 mm shall be used between the stand and ground plane. This is necessary because the vehicle is normally not electrically grounded when it is parked on a public road. The only ground connection then is the charging interface.

(b) New requirement to ensure all traction motors or auxiliary battery charging engines are activated during the measurements.

(c) Introduction of a flow chart for clarification of the charging mode configurations to be tested:

- If a vehicle is equipped with charging mode 2 or 3, this will also cover mode 1. The test cable for mode 1 must be provided by the vehicle manufacturer for the EMC measurements.
- It is very common that the vehicles offer the possibility to be charged in mode 2 via an In Cord – Control and Protection Device (ICCPD). The only difference to mode 3 is the portability of mode 2 cables. But the electronics inside the ICCPD is comparable to a common wall box (see also IEC 61851-1). They are interchangeable and an extensive range of products are commercially available on the market. It is not possible to type approve all vehicle and ICCPD cables combinations. Flowcharts have been introduced in order to find a suitable way to ensure vehicles comply with the emission limits in all charge modes. Flowcharts offer three paths to ensure at least one test is carried out in mode 2:
  - If charging mode 2 is available and the cable is not delivered with the vehicle to the customer, then the test shall be carried out with one representative cable provided by the vehicle manufacturer.
  - The 06 series of amendments does not offer any test setup for ICCPD cables because the international standards CISPR 25 (component emission) and ISO 11452 series (component immunity) do not provide test setups for ICCPD cables. The relevant product standard for ICCPD cables is IEC 61851-21-2. If the emission and immunity was tested according to the IEC standard before one representative cable shall be used for the vehicle test in order to type approve the vehicle mode 2 interface.
  - If the cables do not comply with IEC 61851-21-2 then the flow chart offers the possibility to test the vehicle with ICCPD(s) representing the types sold with the vehicle.
- Footnote 1 in Flowcharts:
  - The IEC 61851-21-1 test shall be performed by an ISO 17025 accredited laboratory recognized by **any** technical service designated by the Type-Approval Authority. The vehicle manufacturer will submit the test report as evidence for vehicle type approval. This paragraph is included in the UN Regulations in many places.
  - This means that any technical service designated by the Type-Approval Authority can accept any ISO 17025 laboratory accredited for IEC 61851-21-1 that it trusts.
  - The importance of including this phrase is a matter of responsibility of the technical service, and therefore of the Type-Approval Authority, and on the other hand, of trust in its accredited laboratory.
  - The group proposes to include charging cables in the approval without testing them according to the regulations, accepting test reports external to the vehicle approval supervision process, and this responsibility is the responsibility of the Type-Approval Authority and the technical services designated and recognized by this Authority.
  - For mode 3 it is sufficient to perform tests with at least 80 per cent of the maximum total nominal charge current to cover the main influence of AC current level.
  - Normally mode 4 cables are not delivered to the customer with the vehicle because they are part of the DC charging station. Therefore, the test facility should provide the charging infrastructure including the cable.

(d) Reduction of the charging current to at least 20 per cent for DC charging; Results of multiple measurement confirmed that the major contribution to the electromagnetic emission comes from the communication between charging station and vehicle and not from the DC current. At the same time, EMC test laboratories face practical issue around delivering ever increasing DC fast charge currents with existing infrastructure. Expensive investments would have been necessary for high power DC charging stations which are suitable for the EMC environment. It was therefore agreed that if the 20 per cent of its nominal value cannot be achieved in the test facility, it would be sufficient to charge with 16A.

(e) The requirements for test setups with longer charging cables were updated for consistency with ISO (e.g. first edition of ISO 11451-5) and CISPR standards.

(f) Introduction of Fast Fourier Transform (FFT) based measuring instruments, because they are state of the art and have been verified to produce the same outcome as legacy measurement methods.

(g) Introduction of an alternative approach where the vehicle manufacturer provides measurement data for each charging mode and the technical service confirms by a spot check.

(h) Clarification of the total vehicle length.

(i) Figure 2b for two-wheeled vehicles to be deleted because it provides no additional information. Furthermore, the location of the mid-point of the engine is not correct. According to paragraph 4.6 the antenna shall be aligned with the middle of the total vehicle (in many cases the length of two-wheeled vehicles is smaller than the 3 dB beamwidth of the antenna).

(j) Updates of figures 3a to 3h for consistency with ISO (e.g. first edition of ISO 11451-5) and CISPR standards.

30. In Annex 5:

(a) Paragraph 1.3. is supressed (see paragraph 6.3.2.4.).

(b) For two-wheeled vehicles, a non-conductive insulating support with a thickness of 5 – 20 mm shall be used between the stand and ground plane. This is necessary because the vehicle is normally not electrically grounded when it is parked on a public road. The only ground connection then is the charging interface.

(c) Introduction of FFT-based measuring instruments, because they are state of the art and have been verified to produce the same outcome as legacy measurement methods.

(d) Clarification of the total vehicle length.

31. In Annex 6:

(a) The definition “long vehicle” was changed to “large vehicle” because height and width of test vehicles also contribute to the reasons why alternative test methods are required. The fundamental dimensions remain unchanged.

(b) In regard to the frequency range extension the alternative test modes were updated and a flow chart was introduced.

- For normal and large vehicle, the regular test mode according to ISO 11451-2 could be applied in an ALSE or outdoor test site (OTS) with front and rear illumination (if applicable). For large vehicles additional reference points shall be established if ESAs with immunity related functions are not illuminated by the antenna in the region of the default reference point.
- For large vehicles three alternative test methods can be chosen:
  - Vehicle BCI test up to 2 GHz (same as in the 06 series of amendments) complimented with vehicle radiated immunity test from 2 to 6 GHz with additional antenna positions.

- Vehicle BCI test up to 2 GHz (same as in the 06 series of amendments) complimented with ESA radiated immunity test from 2 to 6 GHz according to Annex 9
- Vehicle radiated immunity test as the regular front exposure test method complimented with ESA radiated immunity test for each ESA with immunity related functions outside antenna beamwidth according to Annex 9 instead of establishing additional antenna reference points for vehicle level.

- The combination of different test methods provides more flexibility to the test facilities when the vehicle is too large to be tested in an ALSE or OTS according to the regular test method.
- Replacing the vehicle test for individual ESA tests is acceptable because a vehicle can be fully type approved by only type approving ESA. But the aim here is only to replace the radiated immunity test. It is not necessary to do a full ESA type approval by E-marking the ESA. To ensure proper quality of the ESA test, the test report shall be prepared or approved by a laboratory accredited to ISO 17025 and recognized by the Approval Authority responsible for carrying out the tests and provided along with the information document shown in Annex 2B.

(c) For two-wheeled vehicles, a non-conductive insulating support with a thickness of 5 – 20mm shall be used between stand and ground plane. This is necessary because the vehicle is normally not electrically grounded when it is parked on a public road. The only ground connection then is the charging interface.

(d) Additional operating conditions and failure criteria have been defined for Autonomous Driving System, Accident Emergency Calling Systems and Acoustic Vehicle Alerting System.

(e) A flow chart was introduced for clarification of the charging mode configurations to be tested. The failure criteria for charging are not related to the charging mode but to vehicle control systems. It is therefore sufficient to test the vehicle once in AC and again in DC charge modes.

(f) For reduction of the charging current: see Annex 4.

(g) The requirements for test setups with longer charging cables were updated for consistency with ISO (e.g. first edition of ISO 11451-5) and CISPR standards.

(h) The pulse modulations (PM) were updated according to a decision by the ISO body TC22/SC32/WG3 to suppress “PM1” and introduce “PM2” and “PM3”. ISO 11451-1 is currently under revision in a draft international standard (DIS) stage and it is likely to be published in 2024.

(i) Introduction of an alternative test method where the vehicle manufacturer provides measurement data for each charging mode and the technical service confirms by a spot check. The frequencies selected are based on existing mobile services.

(j) Figures 5a to 5h were updated for consistency with ISO (e.g. the first edition of ISO 11451-5) and CISPR standards.

32. In Annex 6, paragraph 2.1.1.5., IWG FRAV recommends changing ‘automated steering’ by ‘lateral and longitudinal vehicle motion control’.

33. In Annex 7:

(a) For reduction of the charging current: see Annex 4.

(b) FFT-based measuring instruments were introduced as stated earlier in Annex 4.

34. In Annex 8, FFT-based measuring instruments were introduced as stated earlier in Annex 4.

35. In Annex 9 the following modifications were made:

(a) Suppression of 800 mm stripline and introduction of reverberation chamber test (see 11 and 12). The default test condition in reverberation chamber test should be a test setup with ground plane for comparability to ALSE component test.

(b) For reduction of the charging current: see Annex 4.

(c) Introduction of new failure criteria that no incorrect charging condition shall occur. This is different to the vehicle failure criteria because it is not possible to check the reaction of the vehicle system by a single ESA test.

(d) Update of the pulse modulations according to decision from the ISO body TC22/SC32/WG3 to suppress “PM1” and introduce “PM2” and “PM3”. ISO 11452-1 is currently under revision in a DIS stage and it is likely to be published in 2024.

36. An alternative test method was introduced where the vehicle manufacturer provides measurement data for each charging mode and the technical service confirms by a spot check. The frequencies selected are based on the existing mobile services.

37. In Annex 10, Pulse 4 is not relevant for electric vehicles (the start impulse of the combustion engine).

38. In Annex 11:

(a) For two-wheeled vehicles, a non-conductive insulating support with a thickness of 5 – 20 mm should be used between the stand and ground plane (refer to Annex 4).

(b) A flow chart was introduced for clarification of the charging mode configurations to be tested. For general explanation of the flow chart see Annex 4 with the following deviation:

- It is sufficient to test the harmonics of the vehicle interface in one AC mode 2 or 3 for each range of the charging current. The harmonics of the vehicle interface are independent from the charging equipment, which can be tested separately. For ICCPD cables IEC 61851-21-2 is the applicable product standard.

(c) Figures 1a and 1d were updated for consistency with international ISO (e.g. first edition of ISO 11451-5) and CISPR standards.

39. In Annex 12:

(a) For two-wheeled vehicles, a non-conductive insulating support with a thickness of 5 – 20 mm shall be used between the stand and ground plane (see Annex 4).

(b) A flow chart was introduced for clarification of the charging mode configurations to be tested. For general explanation of the flow chart see Annex 4 with the following deviation:

- It is sufficient to test the emission of voltage changes, voltage fluctuations and flicker on AC power lines from the vehicle interface in one AC mode 2 or 3 for each range of the charging current. The emissions from the vehicle interface are independent from the charging equipment, which can be tested separately. For ICCPD cables IEC 61851-21-2 is the applicable product standard.

(c) Figures 1a and 1d were updated for consistency with international ISO (e.g. first edition of ISO 11451-5) and CISPR standards.

40. For Annex 13, see explanations to Annex 4.

41. Annex 14 is to be suppressed, see para. 17 above.

42. In Annexes 15 and 16 the following modifications were made:

(a) A flow chart is introduced for clarification of the charging mode configurations to be tested. For general explanation of the flow chart see Annex 4 with the following additional explanation:

- It is sufficient to test the immunity of the vehicle charging interface to fast transient/burst and surge in one AC mode 2 and 3. The scope of this test must be the vehicle interface independent from the charging equipment, which can be

tested separately. For ICCPD cables IEC 61851-21-2 is the applicable product standard.

(b) For reduction of the charging current: see Annex 4.

(c) For two-wheeled vehicles, a non-conductive insulating support with a thickness of 5 – 20 mm should be used between stand and ground plane. This is necessary because the vehicle is normally not electrically grounded when it is parked on a public road. The only ground connection then is the charging interface.

(d) Editorial changes to remove duplications by specifying that the test should be conducted in accordance with the applicable IEC standard and test severity specified in the body of the Regulation. In the test method specification, the details on pulse shape and pulse application are provided. Since the testing is made corresponding to vehicle standstill, and with the Regulation strictly being a safety requirement (related to ISO 26262)

- The testing needs only verify that the vehicle does not turn into a dangerous state.
- From a safety perspective, only the highest test levels are needed for verification, to check that no dangerous situation arises.

(e) Introduction of an alternative test method where the vehicle manufacturer provides measurement data for each charging mode and the technical service confirms by a spot check.

(f) Figures 1a and 1d were updated for consistency with international ISO (e.g. first edition of ISO 11451-5) and CISPR standards.

43. In Annexes 17 and 18, only an editorial improvement of the wording regarding the required input current was made.

44. In Annex 19:

(a) For reduction of the charging current: see Annex 4.

(b) Introduction of FFT-based measuring instruments: see Annex 4.

45. Annex 20 is to be suppressed, see para. 17 above.

46. In Annexes 21 and 22, new failure criteria were introduced that no incorrect charging condition shall occur, but loss of charging function is allowed. This is different to the vehicle failure criteria because it is not possible to check the whole charging system by single ESA test. Editorial changes to remove duplications by specifying that the tests shall be conducted in accordance with the applicable IEC standard and test severity specified in the body of the Regulation.