

Q/SZ

上海思致汽车工程技术有限公司企业标准

Q/SZ N11-9-2018

高压电器部件电磁兼容测试规范

Specification for HV

Electromagnetic Compatibility of
Electrical Components

2018-05-30 发布

2018-06-30 实施

上海思致汽车工程技术有限公司 发 布

目 次

前 言 / Preface.....	II
1 范围	1
2 规范性引用文件.....	1
3 术语和定义.....	3
4 测试要求	7
5 辐射发射测试 RE01	20
6 传导发射测试	36
7 低频辐射发射 RE02	37
8 瞬态传导发射 CE10	40
9 充电端口的附加试验	43
10 辐射抗扰度测试 RI01	52
11 大电流注入测试 RI02	52
12 发射器射频抗扰度测试 RI03.....	52
13 低频磁场抗扰度测试 RI04	52
14 电源线瞬态传导抗扰度测试 CI01.....	52
15 信号线瞬态传导抗扰度测试 CI02.....	53
16 静电放电测试 ESD01	53
17 磁场近场测试	53

前 言 / Preface

本标准由上海思致汽车工程技术有限公司提出。

This standard is proposed by Shanghai Cotech Automotive Engineering Technology Co., Ltd..

本标准由上海思致汽车工程技术有限公司归口。

This standard by Shanghai Cotech Automotive Engineering Co., Ltd. centralized.

本标准起草部门：电子电器

This standard drafting department: EE

本标准主要起草人：覃宝山。

Author: qin baoshan.

本标准首次发布。

This standard is released for the first time.

高压电器部件电磁兼容测试规范

Specification for HV system Electromagnetic Compatibility of Electrical Components

1 范围

本标准规定了上海思致汽车工程技术有限公司（简称：思致）关于高压（直流供电 60V~1000V 供电或交流供电）系统电器部件电磁兼容性测试，规定发射测试和抗扰度的测试目的、测试条件、测试布置、测试程序和要求。

本标准适用于上海思致汽车工程技术有限公司所有高压（直流 60V~1000V 供电或交流供电）系统的汽车电子电气部件和子系统的电磁兼容性，如电机控制器、车载充电机、DC-DC 转换器、高压电池、电机、电加热器、空调压缩机，充电端口设备以及实现以上功能的集成部件

2 规范性引用文件

下列文件对于本文件的应用是必不可少的。凡是注日期的引用文件，仅注日期的版本适用于本文件。凡是不注日期的引用文件，其最新版本（包括所有的修改单）适用于本文件。

GB/T 18387 电动车辆的电磁场发射强度的限值和测量方法, 宽带, 9 kHz ~ 30 MHz

Scope

This specification defines the test methods and limits for HV system (DC 60~1000V and AC) electromagnetic compatibility of electrical components in Shanghai Cotech Automobile Engineering Technology Co., Ltd. (Abbreviation: Cotech).

This specification applies to the HV system (DC 60~1000V and AC) electromagnetic compatibility of all automotive electronics and electrical components and subsystems. for example Motor controller, Vehicle Charger device, DC to DC, High voltage battery pack, Motor, Electric heater, Air condition compressor, HV supply ports and the components of the above functions.

Reference Specifications

The following documents for the application of this document is essential. For dated references, only the dated version applies to this document. For undated references, the latest edition (including all amendments) applies to this document.

GB/T 18387 Limits and test method of magnetic and electric field strength from electric vehicles, broadband, 9kHz to 30MHz

CISPR 25 车辆、船舶和内燃机-无线电干扰特性-车载接收机保护用测量的限值和方法

CISPR 25 Radio disturbance characteristics for the protection of receivers used on-board vehicles, boats and on devices- Limits and methods of measurement

ISO 7637-2 道路车辆—由传导和耦合引起的电骚扰. 第 2 部分: 沿电源线的电瞬态传导

ISO 7637-2 Road vehicles, Electrical disturbance by conduction and coupling Part 2-Vehicles with nominal 12V or 24V supply voltage-Electrical transient transmission by capacitive and inductive coupling via supply lines.

ISO 11452-2 道路车辆窄带辐射的电磁能量产生的电干扰的部件试验方法. 第 2 部分: 吸波屏蔽外壳

ISO 11452-2 Road vehicles, Electrical disturbances by narrowband radiated electromagnetic energy- Component test methods Part 2- Absorber-lined shielded enclosure.

ISO 11452-4 道路车辆窄带辐射电磁能量产生的电子干扰用部件试验方法. 第 4 部分 : 大电流注入

ISO 11452-4 Road vehicles- Component test methods for electrical disturbances from narrowband radiated electromagnetic energy- Part 4: Bulk current injection.

ISO/IEC 17025 检测和校准实验室能力的通用要求

ISO/IEC 17025 (General requirements for the competence of testing and calibration laboratories

ISO 10605 道路车辆. 静电放电引起的电干扰的试验方法

ISO 10605 Road vehicles - Test methods for electrical disturbances from ESD

ECE R10 关于车辆电磁兼容认证的统一规定

Uniform provisions concerning the approval of vehicles with regard to Electromagnetic compatibility

ISO 11452-8 道路车辆. 窄带辐射电磁能量的电干扰元部件试验方法. 第8部分: 磁场抗扰度

Road vehicles - Component test methods for electrical disturbances from narrowband radiated electromagnetic energy - Part 8: Immunity to magnetic fields

ISO 11452-9 道路车辆. 窄带辐射电磁能量的电干扰元部件试验方法. 第8部分: 便携式发射机

Road vehicles – Component test methods for electrical disturbances from narrowband radiated electromagnetic energy – Part 9: portable transmitters

3 术语和定义

Terms and Definitions

3.1

ALSE.

带吸波材料的屏蔽室

Absorber-lined shielded enclosure

3.2

BB

宽带辐射

Broad band emissions

3.3

BCI.

大电流注入。

Bulk current injection

3.4

CE.

传导发射测试

Conducted emission

3.5

CI.

传导抗扰度测试

Conducted immunity

3.6

DUT.

被测设备, 可能是任何的电器部件

Devices under test

3.7

EMI.

电磁干扰

Electro Magnetic Interference

3.8

ESD.

静电放电

Electrical static discharge

3.9

HF.

高频

High Frequency

3.10

I/O.

输入和输出

Input and Output

3.11

NB.

窄带辐射

Narrow band emissions

3.12

PCB.

印刷电路板

Printed Circuit Board

3.13

RE.

辐射发射

Radiated emission

3.14

RI.

辐射抗扰度

Radiated immunity

3.15

其他定义如下表 1 所示 / Other definitions are shown in Table 1 below.

表 1 其他定义 Table 10 ther Definitions

定义	解释
短时工作电机. Motor - Short- Operating Duration	需要人为控制, 工作时间短的电机, 如车窗电机、后视镜调节电机等。 A motor that operates for short periods of time under operator control. Examples are power window or mirror motors
长时工作电机. Motor - Long- Operating Duration	工作时间长的电机, 如雨刮电机、暖通电机。 A motor that is expected to be in operation for extended periods of time. Examples are blower and wiper motors
电磁环境. Electromagnetic Environment	存在于给定场所的所有电磁现象的总和。 The sum of all electromagnetic phenomena that is present at a given place.
断电状态. Power-Down State	被测设备未与蓄电池连接, 断开所有接头, 所有可开启功能未开启。 Device under test is not connected to the battery, the connectors are disconnected, and all openable functions are not turned on.
电控电机. Electronically Controlled Motor	内部包含有源器件的电机。 A motor that has active electronic devices as part of the motor package
峰值检波器. Peak Detector	Peak detector 输出电压为所施加信号峰值的检波器。 A detector that outputs voltage of the peak value of an applied signal
激励. Stimulus	被测设备电气环境的一种变化。这种变化可能是施加的电压、交流信号或无线电场。 A change induced in the electrical environment of the DUT. This change may be an applied voltage level, ac signal or RF field.

绝缘层. Insulation Spacer	相对介电常数 <1.4 , 厚度为 $50\pm 5\text{mm}$ 的非传导材料。 Non-conductive material with relative dielectric constant < 1.4 .
感性设备. Inductive Device	将能量存储在磁场中的机电设备, 如线圈、继电器。 An electromechanical device that stores energy in a magnetic field, such as a coil or a relay.
屏蔽室. Shielded enclosure	专门设计用来隔离内外电磁环境的网状或薄板金属壳体。 Mesh or sheet metallic housing designed specifically for the purpose of separating the internal and the external electromagnetic environment.
人工电源网络. Artificial Mains Network (LISN)	串接在 DUT 电源线上的网络, 它在给定频率范围内提供规定的负载阻抗, 并使 DUT 与电网相互隔离。 The network in series connection with DUT power line, provide a specified impedance in certain frequency range and isolate DUT and the electrical network. Also known as a Line Impedance Stabilization Network, LISN].
失效. Failure	被测设备性能偏离设计要求或偏离测试计划中规定要求的现象。 The performance of DUT deviates from the design requirements or its phenomenon deviates from the requirements specified in the test plan.
替代法. Substitution Method	一种确定在实验室内规定参考点产生需要的无线电场强所需要的能量的办法。被测设备放置到实验室后, 使用先前确定的能量来产生需要的场强。 A method for mapping out the power required to produce target RF field intensity in lab at a designated reference position. After placing the DUT into lab, RF field is generated using the power mapped out before the test.
稳定性. Stability	存在激励时, 被测设备的某一功能维持在要求指标内的能力。 The ability of test object to maintain a function within specification when there is an excitation.
响应. Response	处于某种激励下时, 发生的可观测的 DUT 性能变化。 The observable performance change happened under a certain excitation.
自动循环电机. Motor - Auto Cycle	不需要人为控制输入, 能够自动循环工作的电机, 如散热器风扇、ABS。对于电磁兼容性, 将这类电机看作长时工作设备。 A motor that cycles automatically without direct operator input. These motors are considered to be the same as long operating duration motors for EMC performance. Examples are radiator fan or ABS pump motors.

4 测试要求

Testing Requirements

4.1 总则

General Provision

本规范中关于汽车电器部件电磁兼容的测试方法和限值要求以第 2 节中参考的标准为基础, 若本规范与参考标准之间发生矛盾, 以本规范规定为准。

The test methods and limits for the electromagnetic compatibility of automotive electrical components in this specification are based on the standards referenced in Section 2. If there is a conflict between this specification and the reference standard, this specification shall prevail.

思致有权根据公司需求修改本规范, 若该规范发生变更, 由思致提前三个月通知供应商, 三个月后开始执行修改后的规范要求。

Cotech has the right to modify the specification per the needs of the company. If the specification changes, Cotech informs the supplier three months in advance of the change, and the change becomes effective after three months of the revision of the specification.

思致电磁兼容小组负责对电器部件测试规范变更(如 DUT 测试状态的变化)的可行性进行验证, 并记录到产品设计说明中。

Cotech EMC team is responsible for verifying the feasibility of changes to the specification of electrical components, such as changes in the DUT test status, and recorded into product design instructions.

供应商根据本规范制订测试计划, 并提交给思致电磁兼容小组对测试计划进行审核。供应商需在思致认可的电磁兼容试验室完成测试计划中规定的所有测试内容, 且测试结果满足要求。

The supplier shall develop a test plan in accordance with this specification and submit it to the EMC team for review prior to the test. The supplier shall complete all the test contents specified in the test plan at the approved electromagnetic compatibility laboratory and the test results shall meet the requirements.

满足本规范规定的要求后，供应商提供的电器部件在安装到汽车上后必须满足 GB 14023 车辆、船和内燃机，无线电骚扰特性，用于保护车外接收机的限值和测量方法、GB 18387 电动车辆的电磁场发射强度的限值和测量方法，宽带，9 kHz ~ 30 MHz 的要求以及思致公司的整车标准测试要求。

思致公司保留为进一步确定电磁兼容问题而追加相关测试的权利，有权随时到测试现场对测试过程进行评估。

本规范最终解释权归思致电磁兼容小组。

思致认可的电磁兼容实验室所有测试设备必须根据 ISO/IEC 17025 进行标定。

所有电器部件在进行测试前，必须准备好经过思致电磁兼容小组认可签字的测试计划。

After satisfying the requirements of this specification, electrical components provided by the supplier must meet the following specs after the installation to a vehicle: GB 14023: Vehicles, boats and internal combustion engine - Radio disturbance characteristics - Limits and methods of measurement for the protection of off-board receivers, GB 18387: Limits and test method of magnetic and electric field strength from electric vehicles, broadband, 9kHz to 30MHz and the vehicle EMC test specification of Cotech

Cotech reserves the right to add additional testing to further determine the issue of electromagnetic compatibility and is entitled to evaluate the testing process of the test site at any time

The final interpretation of this specification is done by Cotech's EMC team.

Tests shall be conducted by EMC test laboratories approved by Cotech. All test equipment must be calibrated in accordance with ISO 17025.

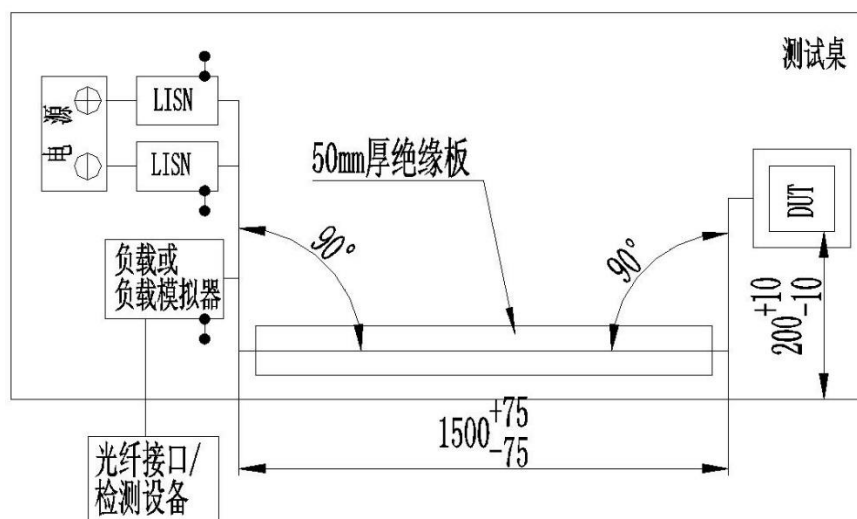
All electrical components must have their test plan approved by Cotech EMC team ready before the test.

4.2 负载模拟器

供应商负责提供模拟 DUT 在实车上工作时负载和环境的模拟器，它能够对 DUT 的功能进行检测。在对 DUT 进行测试时，负载或者负载模拟器不能造成负面影响。负载或者负载模拟器与 DUT 等之间的一般连接关系如图 1 所示。如有需要，负载或者负载模拟器可以放置在屏蔽盒内。

Load Simulator

The supplier is responsible for providing a simulator for simulating the load and environment of the DUT on actual vehicle, which can monitor the function of the DUT. The load simulator cannot be adversely affected when testing the DUT. The general connection between the load simulator and the DUT is shown in Figure 1. If necessarily, The load simulator should be placed in the shield room.



注 1: 图中尺寸单位为 mm The dimensions in figure is mm

注 2: ●● 接地 Grounding

图 1 负载模拟器与 DUT 的连接关系 Figure 1 Connection Relationship of Load Simulator with DUT

如果可以的话, 建议使用汽车上的实际部件来模拟负载, 尤其对于感性和脉宽调制电路。在实际负载难以实现的情况下, 才选择负载模拟器。供应商提供的模拟器必须能够正确模拟 DUT 的负载特性, 如等效的电阻、电容和电感。简单的电阻不能作为负载模拟器, 除非能够说明实车条件下 DUT 的负载与之一致。

如果 DUT (如传感器) 由其它电器部件供电, 那么负载模拟器可包含有源设备以给 DUT 供电, 但要求能够正确模拟给该 DUT 供电的电器部件的电源特性。同时, 要注意避免负载模拟器中的有源器件对辐射发射测试结果和测试设备造成影响。采用光纤通信时, 必须保证光纤通信产生辐射骚扰要低于限值 6 dB。

4.3 功能划分和性能等级要求

4.3.1 功能划分

If possible, it is recommended to use the actual parts on the vehicle to simulate the load, especially for the inductive and pulse width modulation circuit. In the case that actual load is difficult to achieve, select to use the load simulator. The simulator provided by the supplier must be able to correctly simulate the load characteristics of the DUT, such as equivalent resistance, capacitance and inductance. A simple resistor cannot be used as a load simulator unless it can be described as equivalent to the load of DUT under an actual vehicle.

If the DUT, such as sensor, is powered from other electrical components, the load simulator may contain an active device to supply the power to the DUT, but it is required to be able to correctly simulate the power characteristics of the electrical components connected to the DUT. At the same time, care should be taken to avoid the effects of active devices on the radiation emission test results and test equipment in the load simulator. When using optical fiber communication, it is necessary to ensure that the radiation interference of the optical fiber communication is lower than the limit value 6dB.

Functional Class and Performance Level Requirements

Functional Class

根据电器部件在汽车行驶过程中的重要性，本规范将电器部件的功能划分为以下 4 类：（功能类型划分的例子参见附录 A。）

A 类：提供操作方便性的功能

B 类：能够增强或帮助驾驶员驾驶或控制车辆，但并非驾驶员驾驶或控制车辆所必须的功能

C 类：会影响驾驶员驾驶或控制车辆、影响驾驶员主观感受或者会影响道路其它使用者的功能以及驾驶员和乘客能主观感受的功能

D 类：电动助力转向系统、发动机转速稳定性、主动安全系统、被动安全系统、底盘稳定系统、刹车系统及其相关的功能。例如：安全气囊系统、自适应巡航控制 (ACC)、车道保持辅助 (LKA)、大灯随动转向控制 (APS)、大灯自动高度调节 (ALS) 等；能够避免与缓解碰撞的低速/高速自动紧急刹车与行人保护 (AEB)、主动安全带 (ASB)、高速公路车队跟随系统等。

In accordance with the importance of electrical components in the process of car driving, this specification divides the electrical components into the following four classes based on their functions (Example of functional classes are given in Appendix A):

A-Class: The function of providing operational convenience

B-Class: The function to enhance or assist the driver in driving or controlling the vehicle, but the function is not necessary for driver's driving or controlling of the vehicle

C-Class: The function will affect the driver driving or controlling the vehicle, affecting the subjective feeling of the driver or affecting other users on the road as well as the subjective feeling of the driver and passengers

D-Class: This function can bring about an impediment or sever trouble to vehicle control, and or affect safety of passengers and/or of other road users. Electric power steering system, engine speed stability, active safety system, passive safety system, chassis stability system, brake system and related functions. Such as: airbag system, adaptive cruise control (ACC), lane keeping assist (LKA), headlight follow-up steering control (APS), headlamp automatic height adjustment (ALS), etc.; to avoid collisions with low speed / high speed Automatic emergency braking and pedestrian protection (AEB), active seat belt (ASB), freeway fleet follow-up system and more.

2.1.1 性能等级要求

将 DUT 置于一定外部干扰下, 本规范将 DUT 功能的性能要求划分为 5 级

I 级 :装置或系统在施加骚扰期间和之后, 能执行其预先设计的所有功能。

II 级 : 装置或系统在施加骚扰期间, 能执行其预先设计的所有功能 ;然而, 可以有一项或多项指标超出规定的偏差。所有功能在停止施加骚扰之后, 自动恢复到正常工作范围内。存储功能应维持 I 级水平。

III 级 : 装置或系统在施加骚扰期间, 不执行其预先设计的一项或多项功能, 但在停止施加骚扰之后能自动恢复到正常操作状态。

IV 级 : 装置或系统在施加骚扰期间, 不执行其预先设计的一项或多项功能, 直到停止施加骚扰之后, 并通过简单的“操作或使用”复位动作, 才能自动恢复到正常操作状态。

Performance Level Requirement

Based on requirements for DUT to operate under certain stresses from external disturbance, this specification categorizes the electrical components into five levels of DUT functional performance requirements:

Level I : The device or system can perform all of its designed functions during and after the application of disturbance

Level II : The device or system can perform all of its designed functions under the application of disturbance. However, there may be one or multiple parameters that may deviate from the specified range. All functions are automatically restored to normal operating range after stopping the application of disturbance. The storage function should be maintained at Status I.

Level III : The device or system does not perform one or more of its designed functions during the application of disturbance, but automatically resume normal operation after removed disturbance.

Level IV : The device or system does not perform one or more of its designed functions during the application of disturbance and does not restore to normal operation until a simple “operation or use” reset action is performed.

V级：装置或系统在施加骚扰期间和之后，不执行其预先设计的一项或多项功能，且如果不修理或不替换装置或系统，则不能恢复其正常操作。

4.4 DUT 布置

DUT 应放置在不导电性、低相对介电常数材料（介电常数 < 1.4 ）上，距接地平面上方 50 ± 5 mm 的位置。

DUT 的外壳不接地，除非用于模拟实际车辆结构。

进行辐射发射测试时，若已知 DUT 辐射最大的面，那么应该让该面朝向天线，若不能确定最大辐射面，按思致公司认可的测试计划进行测试，且要在测试报告中说明。

当电流回线超过 200 mm 时，采用远端接地方式；当电流回线小于 200 mm 时，采用近端接地方式。

Level V : The device or system does not perform one or more of its designed functions during and after the application of disturbance, and does not resume its normal operation unless the device or system is repaired or replaced.

DUT Layout

The DUT shall be placed on a non-conductive, low relative permittivity material (< 1.4), at (50 ± 5) mm above the reference ground plane.

The case of the DUT shall not be grounded to the reference ground plane unless it is intended to simulate the actual vehicle configuration.

In radiated emission test, if the surface of maximum radiation from DUT is known, it should be tested with that surface directed to the antenna. If the maximum radiating surface is not known, it shall be tested according to the test plan approved by Cotech and the test report shall include the description of the DUT orientations.

If the current return line exceeds 200mm, use remote grounding. If the current return line is less than 200mm, use local grounding, and the LISN for negative [power return] line should not be used.

4.5 测试过程

测试前应使用符合本规范 3.3 节中要求的负载模拟器来检查 DUT 的所有功能，只有所有功能满足技术开发要求的电器部件才允许继续测试。

测试过程中，需要确保 DUT 发射出正常工况下可能产生的最大的骚扰能量，根据 DUT 在汽车上的实际工作条件设置不小于额定负荷 80%的机械负载。为保证 DUT 在测试过程中正常工作，测试过程中 DUT 所有连接传感器、执行器等负载的接口需连接能够模拟整车负载条件的负载模拟器。

温湿度：室温 $(23 \pm 5)^\circ\text{C}$ ，相对湿度 20% ~ 60%

Test Procedure

The load simulator that meets the requirements of Section 3.3 of this code should be used to check all functions of the DUT prior to testing. Only the electrical components that meet the technical development requirements should be allowed to continue the test.

During the test, it is necessary to ensure that the DUT emits the maximum level disturbance under normal operating conditions. According to the DUT's actual operating conditions on the vehicle, a mechanical load should not be less than 80% of the rated load. To ensure that the DUT is operating properly during the test, the DUT is connected to a load simulator capable of simulating vehicle load conditions and of monitoring the DUT status.

Temperature and Humidity: Room temperature $(23 \pm 5)^\circ\text{C}$ $(73 \pm 9)^\circ\text{F}$, Relative Humidity 20% to 60%

实验室背景噪声 :测试之前, 应检查背景噪声 (即打开除 DUT 之外的所有设备, 包括输入信号) 至少应低于测试项目相应限值线 6dB, 如果背景噪声不能满足上述要求, 则在排除测试布置的问题之前不得进行测试。在某些输入脉冲或转速信号的测试中, 可能需要在信号发生器输出端串联带通滤波器或衰减器以满足底噪要求。测试布置底噪的图表应包含在测试报告中。

Laboratory background noise: Prior to testing, background noise should be checked (ie, all devices except DUT, including the input signal) should be at least 6dB below the corresponding limit line of the test item. If the background noise does not meet the above requirements, Test Layouts should not be tested before. In some tests of input pulse or speed signals, it may be necessary to have a bandpass filter or attenuator in series at the signal generator output to meet noise floor requirements. Charts of test layout noise floor should be included in the test report.

4.6 测试计划和测试报告

Test Plan and Test Report

测试计划中的任何与本规范不一致的改动均要在测试前征得思致公司电磁兼容小组同意。

Any changes in the test plan that are inconsistent with this specification are subject to the consent of the EMC team prior to testing.

测试计划至少需要包含以下信息

The test plan must contain at least the following information :

(测试计划模版参见附录 B 《思致 XX(车型)XX 系统/部件 EMC 测试计划》

See Test Program Template "Cotech XX (vehicle) XX the system / component EMC Test Plan")

- 1) 零部件信息, 如制造商、样式、序列号、软硬件版本等
- 2) 每个管脚的电压、电流和阻抗信息
- 3) 测试样本数量; 每个测试项目的测试样件最少不得低于 2 个, 且每个产品都需要通过测试计划中要求的所有项目的测试并符合要求

Parts information, such as manufacturer, style, serial number, hardware and software version

The voltage, current and impedance information of each pin

The number of test samples. Each test item must have a minimum of 2 test samples and each product needs to pass the test of all the items required in the test plan and meet the requirements.

- | | |
|-------------------------------|---|
| 4) 需要进行的测试内容、功能等级和限值要求、工作状态 | The required test content, performance level and limit requirements, operating status |
| 5) 定义功能等级和失效的准则 | Definition of the performance level and failure criteria |
| 6) 重要的负载要求, 如 CAN、LIN 总线, 电机等 | Important load requirements, such as CAN, LIN bus, a motor or the like |
| 7) 重要的可能会影响 DUT 测试的工作参数 | Important operating parameters that may affect the DUT |
| 8) 负载模拟器信息 | Load simulator information |
| 9) 针对电磁兼容问题所采取措施的说明 | Description of the measures taken for electromagnetic compatibility problems; |
| 10) 其它对部件进行合理测试需要的信息 | Other information that is reasonably required for component test |

在测试完成后 5 日内, 供应商必须将测试结果提交给思致公司电磁兼容小组。在测试完成 30 日内, 供应商必须将完整的测试报告提交给思致电磁兼容小组。

Within 5 days from the test completion, the supplier must submit the test results to the EMC team of Cortech. Within 30 days from the test completion, the supplier must submit a complete test report to the EMC team of Cortech.

测试报告应包含以下内容

The test report should contain the following :

- | | |
|-------------------------------|--|
| 1) 产品基本信息 | Product basic informaton; |
| 2) 保证整个试验过程均符合本规范的声明 | Statement that the entire test is performed in accordance with this specification; |
| 3) 测试系统和测试过程中使用的所有负载详细文档信息和照片 | Detailed description of the test system and load, with the photos of the test setup; |
| 4) 测试过程中 DUT 工作状态的信息 | DUT' s operating state during the test ; |
| 5) 设备型号列表 | Test equipment model list; |

6) 抗扰度测试时, 产生异常动作的频带和异常动作的详细描述

For immunity tests, detailed description of the observed abnormal operation and frequency at which abnormal operation occurred;

7) 所有测试数据、曲线和实验室背景噪声曲线

All test data, test measurement plot. background noise measurement plot.

4.7 测试内容

Test Content

并非所有电器部件要进行本规范中规定的所有测试。对于不同类型的电器部件需要进行的测试内容见表 2(打“√”表示需要进行该项测试)。

Not all electrical parts are subject to all tests specified in this specification. Test content for different types of electrical components required in Table 1 (“√”mark indicates the need for this test).

表 2 电器部件 EMC 测试项选择表 Table 2 Electrical Component EMC Measurement Target Selection Table

测试项目 Test item	代号 ID	高压电气部件种类					
		驱动电机 控制器 Motor controller	车载充 电机 Vehicle Charger device	DC-DC 转换器 DC to DC	高压电 池 High voltage battery pack	电加 热器 Elec tric heat er	电空调压缩 机 Air condition compressor
低频辐射发射 Low-Frequency Radiated Emission	RE02	√	√	√	√	√	√
静电放电 ESD	ESD	√	√	√	√	√	√
辐射抗扰度 Radiated Immunity Test RI01	RI01	√	√	√	√	√	√
电源线传导发射 Conducted Emission Test on Power Lines	CE01	√	√	√	√	√	√
控制与信号线传导发射 Control Line Conducted Emission	CE02	√	√	√	√	√	√
辐射发射 Radiated Emission Test	RE01	√	√	√	√	√	√
磁场近场测试 Magnetic near field test	MFI	√	√	√	√	√	√

大电流注入 Bulk Current Injection Test	RI02	√	√	√	√	√	√
发射器射频抗扰 Transmitter RF Immunity	RI03	√	√	N/A	N/A	N/A	√
低频磁场抗扰度 Low Frequency Magnetic Field Immunity	RI04	√	N/A	N/A	√	N/A	N/A
电源线瞬态传导抗扰度 Power Line Transient Immunity	CI01	√	√	√	√	√	√
信号线瞬态传导抗扰度 Signal Line Transient Immunity	CI02	√	√	√	√	√	√
瞬态发射测量 Transient Emission	CE10	√	√	√	√	√	√
快速瞬变/脉冲的抗扰度 immunity to electrical fast transient / burst disturbances	CI11	N/A	√	N/A	√	N/A	N/A
浪涌抗扰度 Immunity of surge test	CI12	N/A	√	N/A	√	N/A	N/A
谐波发射 Emission of harmonics generated on AC power lines	CE11	N/A	√	N/A	N/A	N/A	N/A
电压变化, 电压波动和闪烁 Emission of voltage changes, voltage fluctuations and flicker	CI13	N/A	√	N/A	N/A	N/A	N/A
主电源线的传导发射—保护车外接收机 Emission of radiofrequency conducted disturbances on AC or DC power lines	CE12	N/A	√	N/A	√	N/A	N/A
信号线到主电源的传导发射—保护车外接收机	CE13	N/A	√	N/A	√	N/A	N/A

Emission of radiofrequency conducted disturbances on network and telecommunication access							
---	--	--	--	--	--	--	--

4.8 测试仪器

测量设备应符合 CISPR16-1-1, 手动和自动频率扫描方式均可。扫描接收机驻留时间应设定用于 CISPR 频段和检波模式, 测量仪器的本底噪声值至少比所选限值低 6 dB。要求的驻留时间、最大步长和带宽如表 3 所示。

Test Instruments

The measuring equipment shall comply with CISPR16-1-1, and manual and automatic frequency scanning methods can be used. The dwell time of the scanning receiver shall be adjusted for the CISPR frequency band and detection mode used. Minimum measurement time should meet the requirements of CISPR16-2-3. The noise floor of measuring instruments should be lower than the applicable limit by at least 6dB. Required measurement time, maximum step size and bandwidth are shown in Table 3.

表 3 扫描接收机的参数设置 Table 3 Scan Receiver's Parameter Settings

频带 (MHz)	峰值检波 / Peak Detection			准峰值检波 / Quasi-Peak Detection			均值检波 / Average Detection		
	BW	步长 / Step Size	驻留时间 / Measurement Time	BW	步长 / Step Size	驻留时间 / Measurement Time	BW	步长 / Step Size	驻留时间 / Measurement Time
0.15~30	9 KHz	5 KHz	50 ms	9 KHz	50 KHz	1000 ms	9 KHz	5 KHz	50 ms
>30	120 KHz	50 KHz	5 ms	120 KHz	1 MHz	1000 ms	120 KHz	50 KHz	5 ms

5 辐射发射测试 RE01

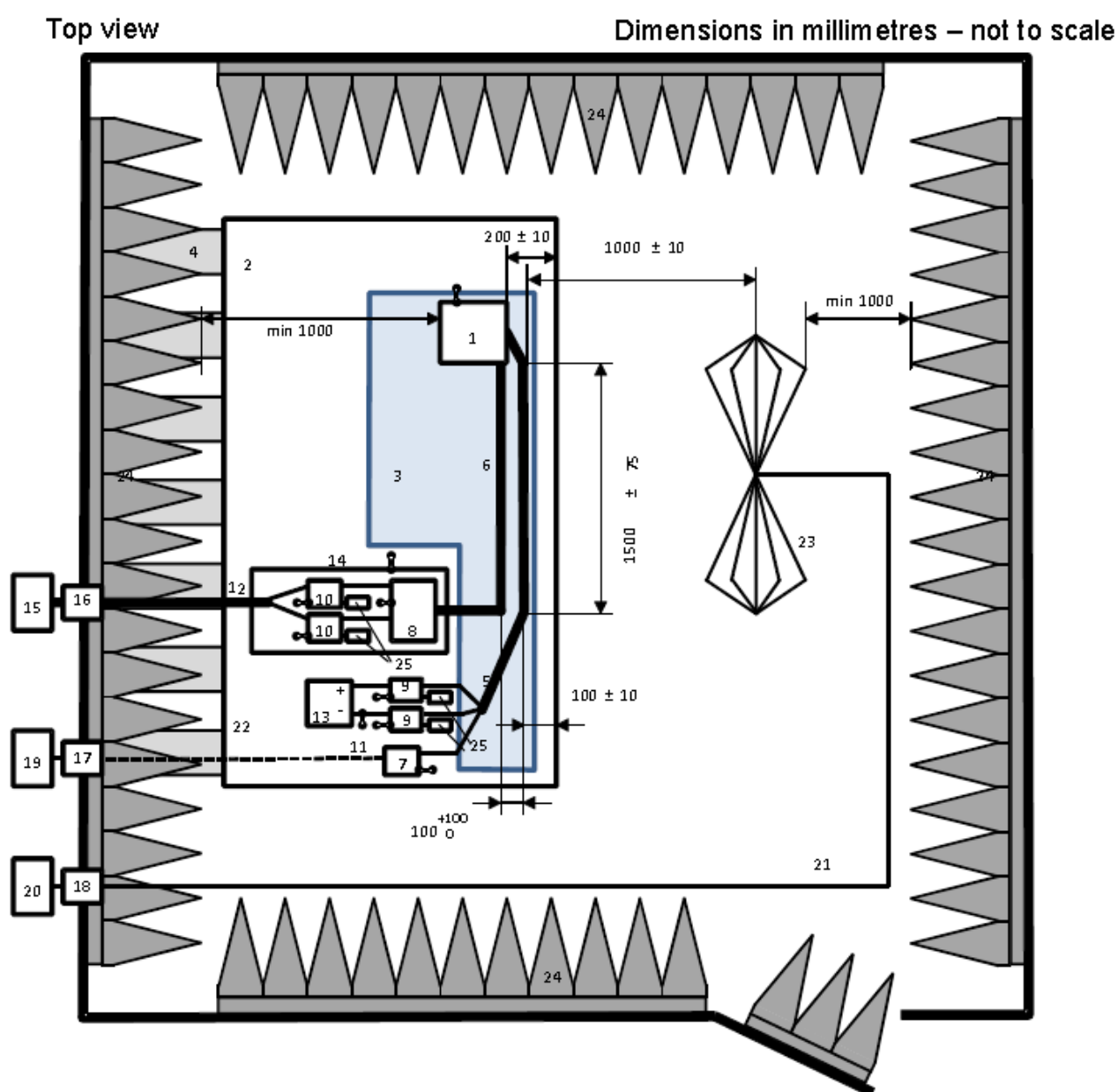
Radiated Emission Test RE01

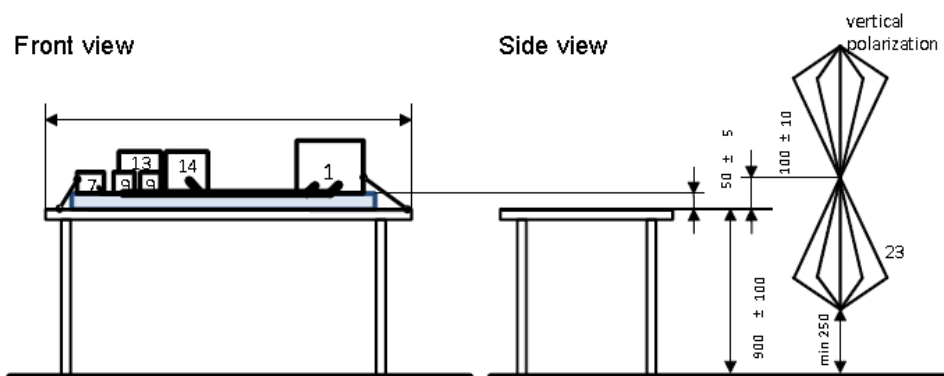
5.1 辐射发射测试布置

Layout for Radiated Emission Test

电器部件辐射发射测试可参照 CISPR 25 : 2016 标准中的 ALSE 方法进行。其一般布置如下所示。

Radiated emission test of electrical components can be carried out in accordance with CISPR 25 standard's "Radiated emissions from components/modules - ALSE method". General Layout is shown below.



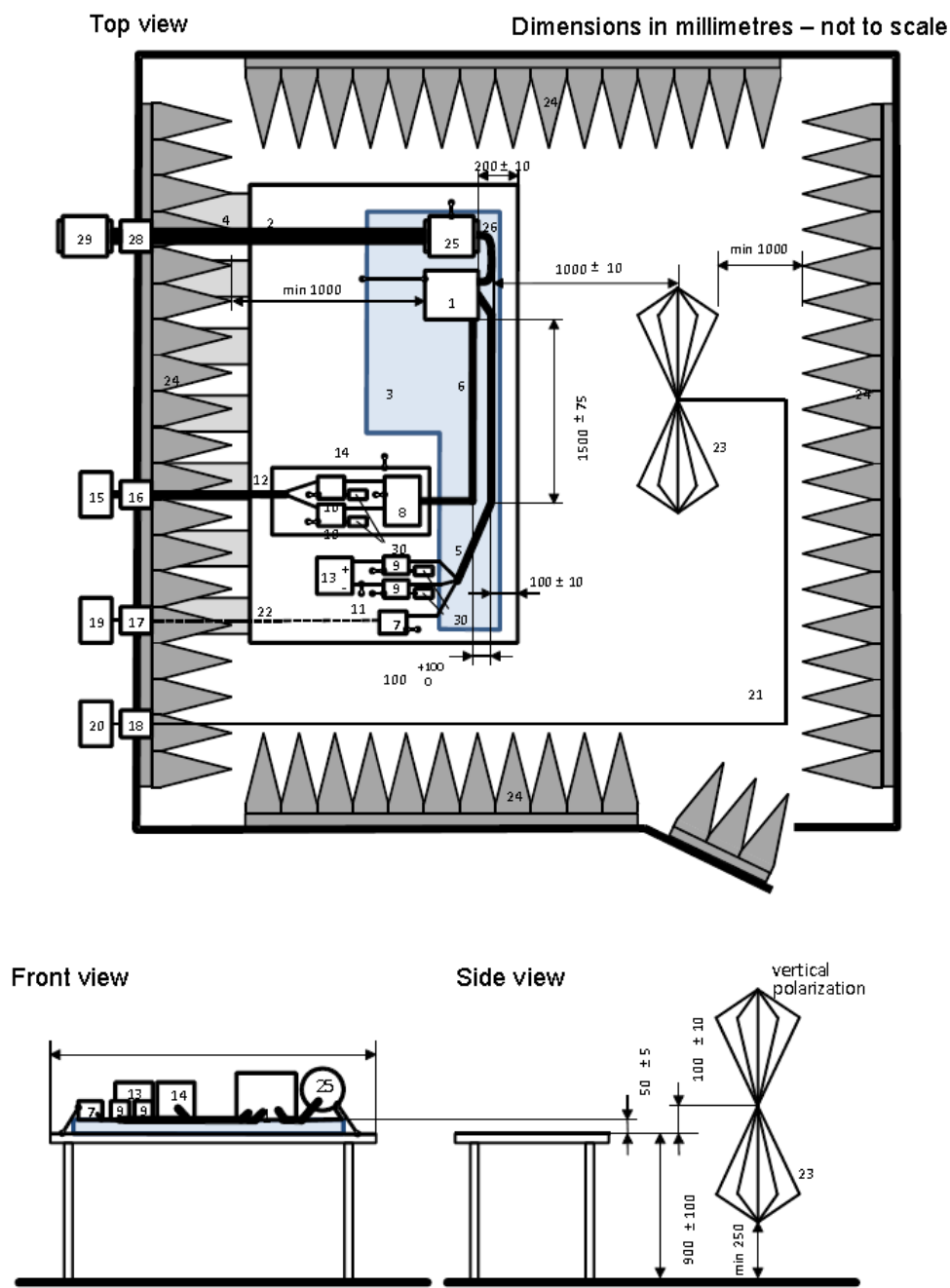


- | | |
|---|------------------------------|
| 1 受试设备 EUT | 14 附加屏蔽盒 shielded box |
| 2 地平面 ground plane | 15 高压电源 HV power supply |
| 3 绝缘支撑物 Low relative permittivity support | 16 电力线滤波器 Filter |
| 4 接地线 grounding line | 17 馈通滤波器 Filter |
| 5 低压线束 LV harness | 18 隔板连接器 Bulk head connector |
| 6 高压线 (HV+line,HV- line) | 19 辅助/监控设备 motivation |
| 7 低压负载模拟器 LV load simulation | 20 测量设备 receiver |
| 8 阻抗匹配网络 (可选) Impedance matching | 21 同轴电缆 (50Ω) coaxial cable |
| 9 低压人工网络 LV LISN | 22 光纤 Optical |
| 10 高压人工网络 HV LISN | 23 天线 antenna |
| 11 低压供电线 LV power lines | 24 射频吸收材料 Absorbing material |
| 12 高压供电线 HV power lines | 25 50Ω负载 50Ω load |
| 13 低压电源 12V/24V/48V(应放在凳子上) LV power supply | |

图 2 辐射发射-带屏蔽电源供应系统的受试设备使用双锥天线测量的试验布置 Figure 2 Radiated emission – test setup measurement with biconical antenna for EUTs with shielded power supply systems

注1：高压电池充电状态按照本图进行布置，在放电状态下，应测量高压直流输出端口，高压电源变更为高压负载。

Note 1 : setup for battery charging. In the discharge condition, the high voltage DC output port should be measured, and the high voltage power supply should be changed to load simulator.



1 受试设备 EUT

2 地平面 ground plane

3 支持低相对介电常数 ($\epsilon_r \leq 1.4$)

Low relative permittivity support

4 接地铜带 Ground straps

5 低压线束 LV lines

16 电源线滤波器 Power line filter

17 馈通滤波器 Fibre optic feed through

18 隔板连接器 Bulk head connector

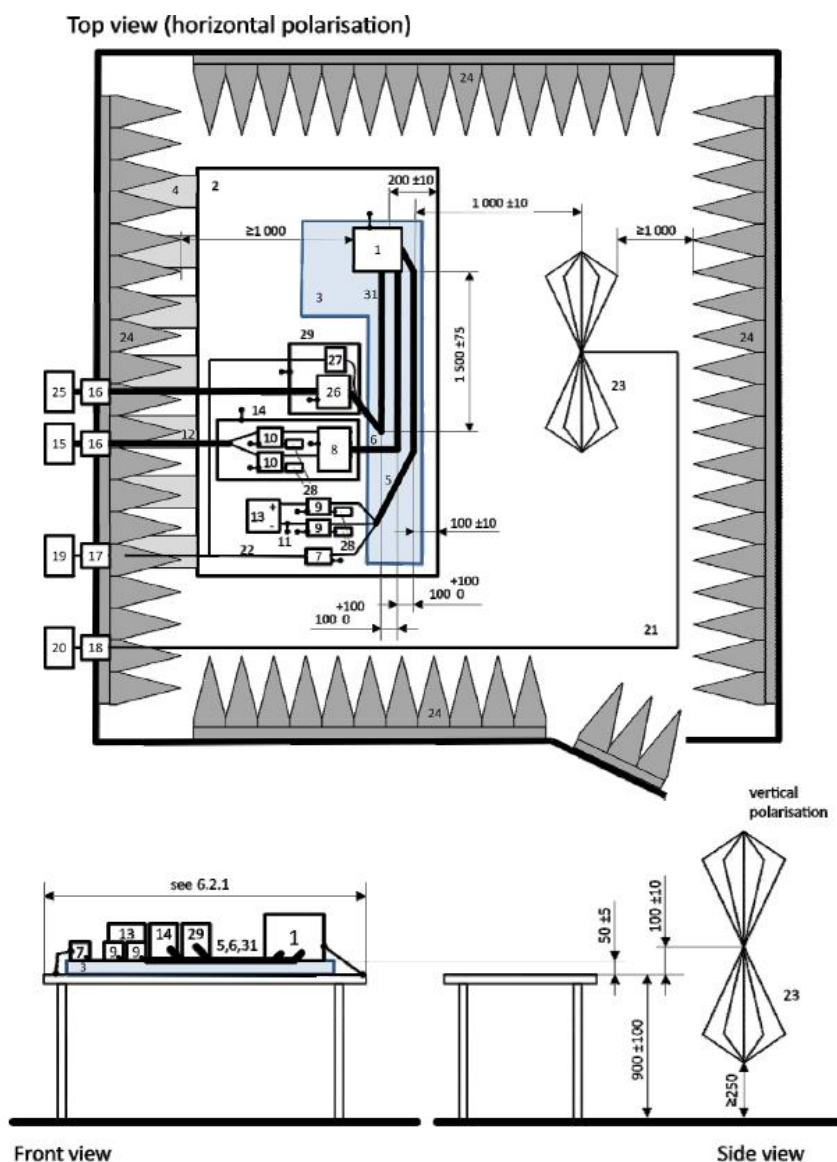
19 辅助/监控设备 Stimulating and monitoring system

20 测量设备 Measuring instrument

21 同轴电缆 (50Ω) High quality coaxial

- | | |
|-------------------------------------|--|
| 6 高压线HV+,HV- | 22 光纤Optical fibre |
| 7 低压负载模拟器 LV load simulator | 23 双锥形天线Biconical antenna |
| 8 阻抗匹配网络Impedance matching network | 24 射频吸收材料RF absorber material |
| 9 低压人工网络 LV LISN | 25 电机Electric motor |
| 10 高压人工网络 HV LISN | 26 三相电机供电线Three phase motor supply lines |
| 11 低压供电线 LV power lines | 27 机械连接Mechanical connection |
| 12 高压供电线 HV power lines | 28 过滤的机械轴承Filtered mechanical bearing |
| 13 低压电源 12V/24V/48V LV power supply | 29 制动或推进电动机 Brake or propulsion motor |
| 14 附加屏蔽盒 Additional shielded box | 30 50Ω负载 50Ω load |
| 15 高压电源（置于ALSE内的屏蔽）HV power supply | |

图3 辐射发射-带屏蔽电源供电的电机控制器使用双锥天线测量的试验布置 Figure 3 Radiated emission – Example of test setup measurement with biconical antenna for EUTs with shielded power supply systems with electric motor attached to the bench.



- | | |
|--|---|
| 1 受试设备 EUT | 15 高压电源HV power supply |
| 2 接地平面 Reference ground plane | 16 电源滤波器Power line filter |
| 3 绝缘支撑 Low relative permittivity support | 17 连通滤波器Fibre optic feed through |
| 4 接地铜带Ground straps | 18 隔板连接器Bulk head connector |
| 5 低压线束 LV harness | 19 模拟监控系统 Stimulating and monitoring system |
| 6 高压线束 LV harness | 20 接收机Measuring instrument |
| 7 低压负载模拟器 LV load simulator | 21 高频线缆 High quality coaxial cable |
| 8 高压线路阻抗稳定网络 (可选) Impedance matching network | 22 光纤滤波器Optical fibre |

- | | |
|-------------------------------------|--|
| 9 低压人工电源网络 LV AN | 23 天线 Biconical antenna |
| 10 高压人工电源网络 HV AN | 24 吸波材料 RF absorber material |
| 11 低压电源线 LV supply lines | 25 交流电网 AC power mains |
| 12 高压电源线 HV supply lines | 26 交流人工电源网络 AMN for AC power mains |
| 13 低压电源 12V,24V,48V LV power supply | 27 交流充电模拟负载 AC charging load simulator |
| 14 附加的屏蔽箱 Additional shielded box | 28 50 Ω 负载 load |

图4 辐射发射-车载充电机 使用双锥天线测量的试验布置 Figure 4 Radiated emission – test setup measurement with biconical antenna for EUTs with charger device

5.2 辐射发射限值要求 Limits of Radiated Emission Test

参照 Q/SZ N11-1-2018 标准要求，所有类型的电器部件需要满足限值 level 3 的要求。

Refer to the Q/SZ N11-1-2018 standard, All types of electrical components need to meet the limit level 3 requirements

6 传导发射测试

Conducted Emission Test

6.1 电源线的传导发射 CE01

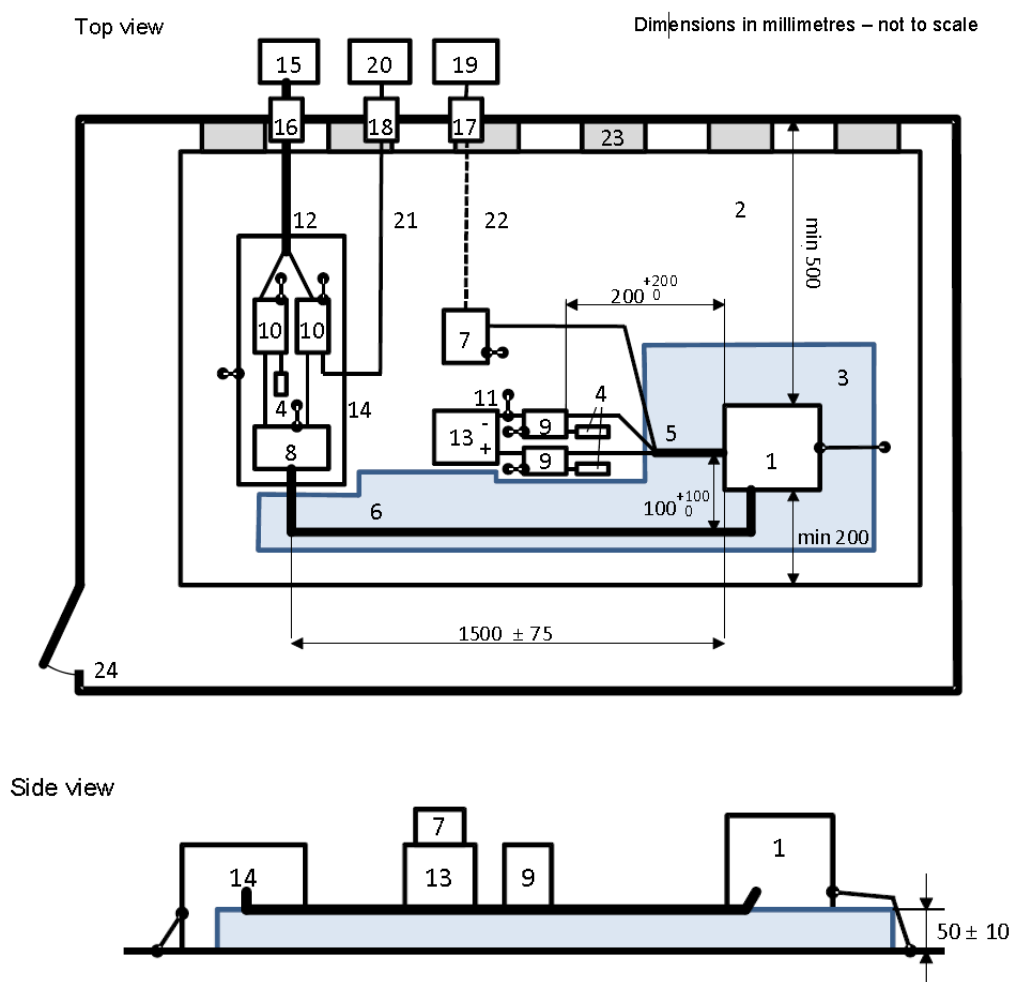
Conducted Emission Test: CE01

6.1.1 电源线传导发射的测试布置

Layout for Conducted Emission Test on Power Lines

电器部件电源线传导发射的测试可参照 CISPR 25 标准中关于车辆零部件和模块的电压测量方法进行。其一般布置如下所示。

Conducted emission test on power lines can be carried out in accordance with CISPR25 standard's "Conducted emissions from components/modules - Voltage method". General Layout is shown in Figure 5.



1 受试设备EUT

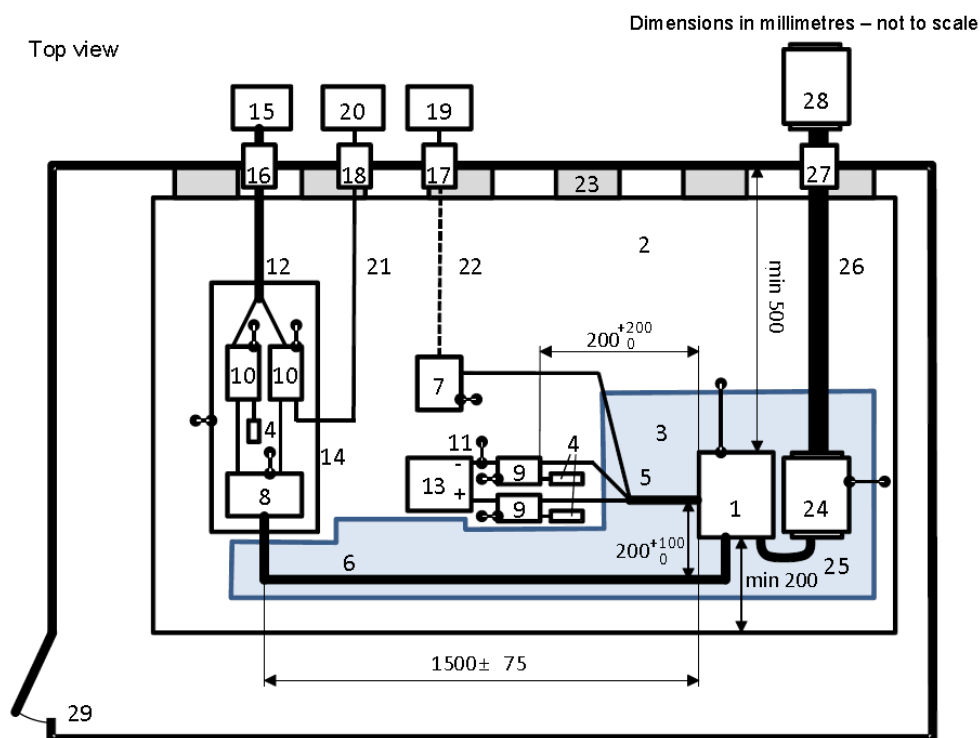
14 附加屏蔽盒 Additional shielded box

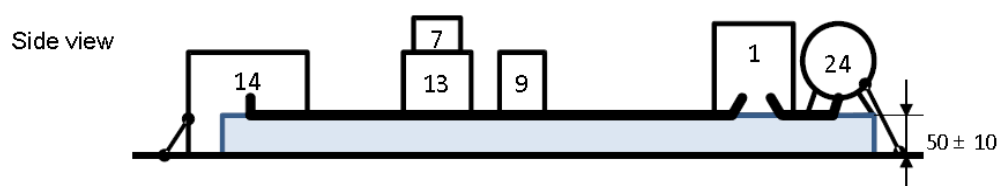
2 地平面 Ground plane

15 高压电源 HV power supply

- | | |
|---|-----------------------------------|
| 3 支持低相对介电常数 ($\epsilon_r \leq 1.4$) Low relative permittivity support | |
| 4 50Ω负载 50 Ω load | 16 电源线滤波器 Power line filter |
| 5 低压线束LV harness | 17 馈通滤波器 Fibre optic feed through |
| 6 高压线 (HV+,HV-) HV lines | 18 隔板连接器 |
| 7 低压负载模拟器 LV load simulator | 19 辅助/监控设备 |
| 8 阻抗匹配网络 (可选) Impedance matching network | 20 测量设备 |
| 9 低压人工网络 LV AN | 21 同轴电缆 (50Ω) |
| 10 高压人工网络 HV AN | 22 光纤 |
| 11 低压供电线 LV supply lines | 23 接地铜带 |
| 12 高压供电线 HV supply lines | 24 屏蔽外壳 |
| 13 低压电源 12V/24V/48V LV power supply | |

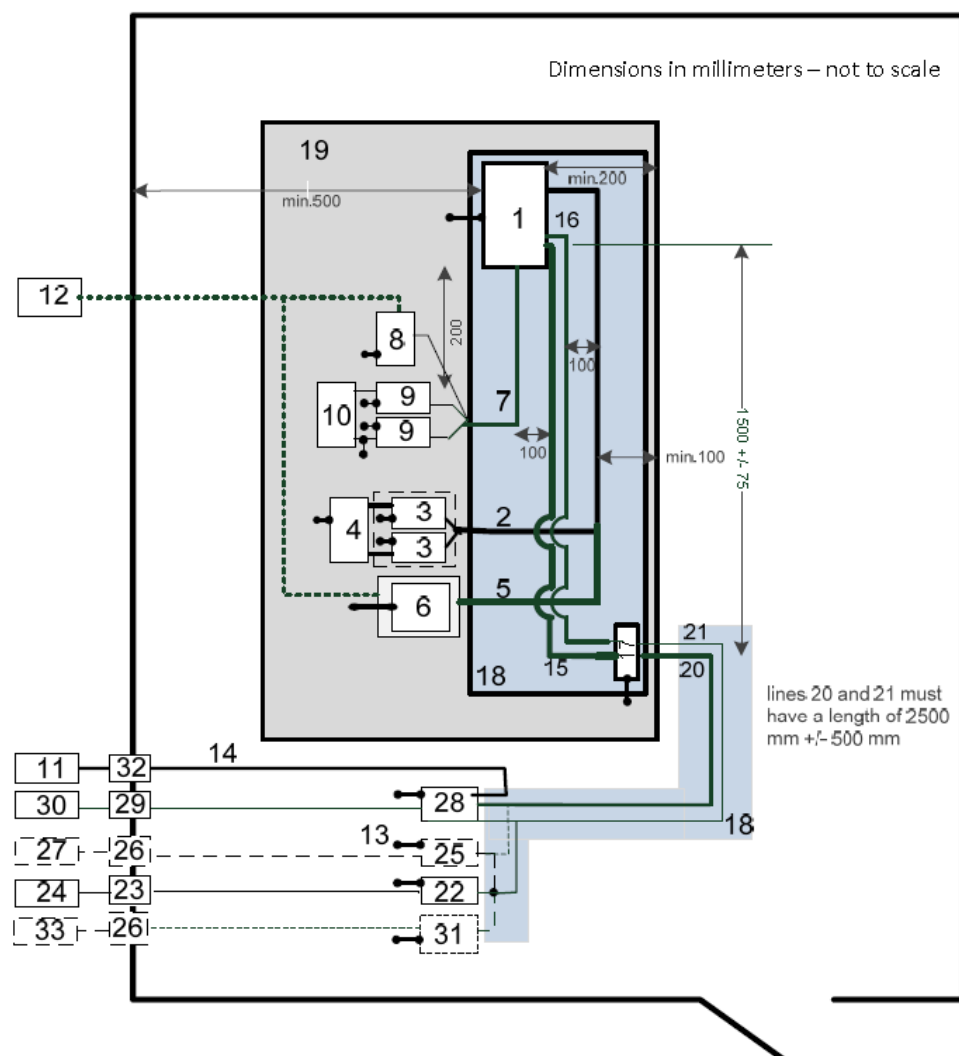
注1：高压电池充电状态按照本图进行布置，在放电状态下，应测量高压直流输出端口，高压电源变更为高压负载。Note 1 : setup for battery charging. In the discharge condition, the high voltage DC output port should be measured, and the high voltage power supply should be changed to load simulator





- | | |
|--|---|
| 1 受试设备EUT | 16 电源线滤波器 Power line filter |
| 2 地平面Ground plane | 17 馈通滤波器 Fibre optic feed through |
| 3 支持低相对介电常数Low relative permittivity support | 18 隔板连接器 Bulk head connector |
| 4 50Ω负载 50 Ω load | 19 辅助/监控设备Stimulating and monitoring system |
| 5 低压线束LV harness | 20 测量设备Measuring instrument |
| 6 高压线 (HV+,HV-) HV lines | 21 同轴电缆 (50Ω) High quality coaxial cable |
| 7 低压负载模拟器 LV load simulator | 22 光纤Optical fibre |
| 8 阻抗匹配网络 (可选) Impedance matching network | 23 接地铜带 Ground straps |
| 9 低压人工网络 LV AN | 24 电机Electric motor |
| 10 高压人工网络 HV AN | 25 电机三相线Three phase motor supply lines |
| 11 低压供电线 LV supply lines | 26 机械连接Mechanical connection |
| 12 高压供电线 HV supply lines | 27 过滤的机械轴承Filtered mechanical bearing |
| 13 低压电源 12V/24V/48V LV power supply | 28 制动或驱动电机Brake or propulsion motor |
| 14 附加屏蔽盒 Additional shielded box | 29 屏蔽外壳Shielded enclosure |
| 15 高压电源 HV power supply | |

图6 传导骚扰电压法-电机控制器试验布置 Figure 6 Conducted emission –test setup for EUTs with shielded power supply systems with electric motor



- | | |
|--------------------------------------|---|
| 1 受试设备 EUT | 19 地平面 (车辆) ground plane |
| 2 高压蓄电池线束 HV supply lines | 20 交流/直流充电电缆 AC power lines |
| 3 高压线路阻抗稳定网络 HV AN | 21 Pilot / CHAdeMO通信电缆 telecommunications lines |
| 4 高压负载(蓄电池和蓄电池模拟器) HV load simulator | 22 Pilot ISN |
| 5 高压线束 HV lines | 23 馈通同轴电缆连接器 coaxial cable connector |
| 6 高压负载模拟器 HV load simulator | 24 Pilot发生器 |
| 7 低压线束 LV harness | 25 PLC耦合器 |

- | | |
|--|---|
| 8 低压负载模拟器 LV load simulator | 26 馈通连接 connector |
| 9 低压线路阻抗稳定网络 LV AN | 27 模拟器PLC |
| 10 低压蓄电池 LV battery | 28 AC人工电源网络/DC人工网络 AC/DC AN |
| 11 测量接收机 receiver | 29 滤波器 filter |
| 12 监控/激励 motivation | 30 高压AC或高压DC电源 AC/DC power supply |
| 13 参考接地 Ground straps | 31 CHAdeMO通讯的LISN telecommunications lisn |
| 14 同轴电缆 coaxial lines | 32 隔板连接器 Bulk head connector |
| 15 AC/DC充电线束 AC/DC charge lines | 33 通讯模拟器 telecommunications simulator |
| 16 Pilot / Proxy/CHAdeMO或其他通信 | |
| 17 汽车充电连接器 charge connector | |
| 18 支持低相对介电常数 ($\epsilon_r \leq 1.4$) 厚度为50mm Low relative permittivity support | |

注：如果车载充电机存在放电状态，则在放电状态也应进行测试，此时，高压负载换成高压直流电源或者高压电池，高压电源换成高压交流阻性负载。

Note: if the vehicle charger has a charging function, it should be tested with discharging also. The high voltage load should transform high DC voltage power supply or high voltage battery, high voltage power supply should transform high AC voltage load.

图7 车载充电机测量试验布置 Figure 7 Conducted emission –test setup for EUTs with charger device

6.1.2 电源线传导发射的限值要求 / Limits of Conducted Emission Test on Power Lines

该测试参考CISPR25:2016。应当依次对输入和输出的HVDC线进行测试。

This test is referred to CISPR25:2016. All the input and output HVDC lines should be tested.

被测件的耦合衰减可根据 CISPR 25 附录 I.5.3 的测试方法所得。计算公式如下：

The coupling attenuation of the measured parts can be obtained according to appendix I.5.3 of CISPR 25:2016. The calculation formula is below

$$U_{Limit,HV} = U_{Limit,LV} + S$$

其中 $U_{Limit,HV}$ 是高压限值， $U_{Limit,LV}$ 是低压部件限值， S 是被测件的耦合衰减，详细见 6.1.2 和 6.1.3。

Where $U_{Limit,HV}$ is the LV limits, $U_{Limit,LV}$ is the LV limits, S is the coupling attenuation

所有类型的电器部件需要满足限值 level 3A1 的要求。

All types of electrical components need to meet the limit level 3A1 requiremen

表 4 屏蔽 HV 线的传导发射平均值和峰值或平均值和准峰值的限值—电压法 Table 4

Quasi-peak and peak limits of conducted voltage measurements at shielded power supply devices (HV-LV decoupling class A5)

Service / Band	Frequency MHz	Levels in dB(μV)		
		Class 3A5		
		PeakPeak	Quasipeak	Average
BROADCAST				
LW	0,15 – 0,30	127	114	107
MW	0,53 – 1,8	100	87	80
SW	5,9 – 6,2	89	76	69
FM	76 – 108	62	49	42
TV Band I	41 – 88	59	/	49
MOBILE SERVICES				
CB	26 – 28	73	60	53
VHF	30 – 54	71	58	51
VHF	68 – 87	63	50	43

6.2 信号/控制线的传导发射 CE02

Signal / Control Line Conducted Emission

6.2.1 控制/信号线传导发射的测试布置

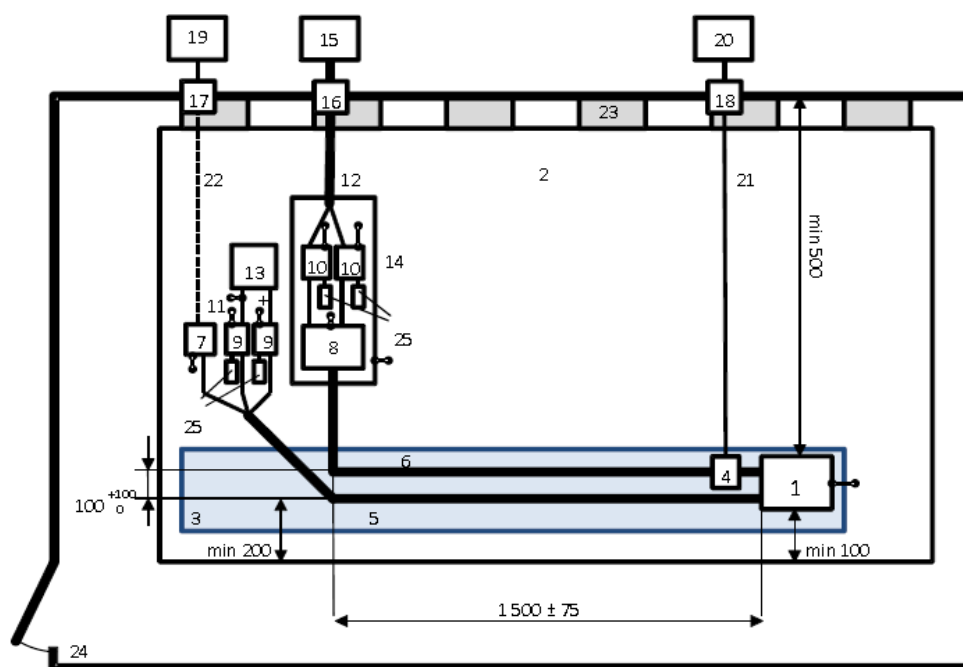
Layout for Conducted Emission Test on Control and Signal Lines

电器部件控制/信号线的传导发射的测试可参照 CISPR 25 标准中关于车辆零部件和模块的电流探头测量方法进行。其一般布置如图 X 所示。

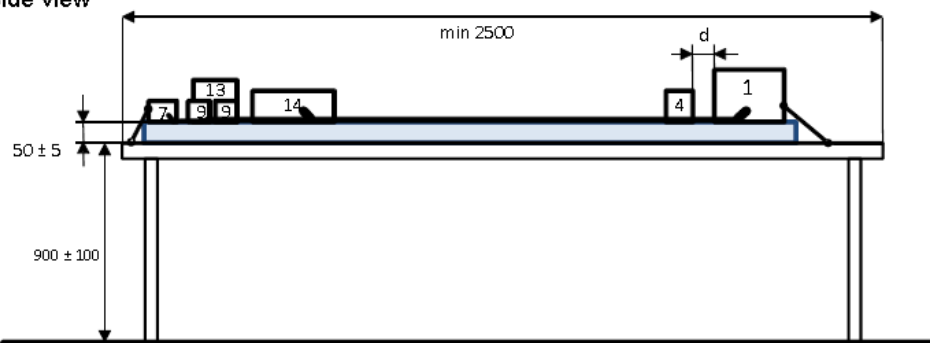
Conducted emission test on control and signal lines can be carried out in accordance with CISPR25 standard’s “Conducted emissions from components/modules - current probe method”. General Layout is shown in Figure X.

Top view

Dimensions in millimetres – not to scale



Side view



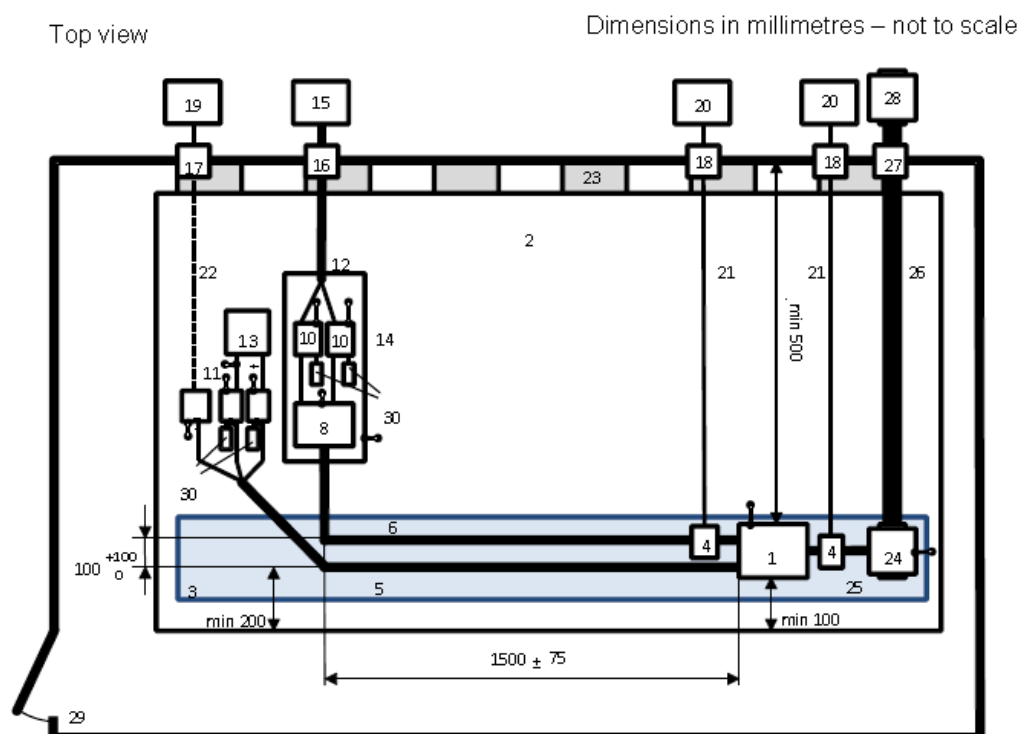
- | | |
|--|---|
| 1 受试设备 EUT | 16 电源线滤波器 Power line filter |
| 2 地平面 Reference ground plane | 17 馈通滤波器 Fibre optic feed through |
| 3 支持低相对介电常数Low relative permittivity support | 18 隔板连接器Bulk head connector |
| 4 电流探头 Current probe | 19 辅助/监控设备Stimulating and monitoring system |
| 5 低压线束 LV harness | 20 测量设备Measuring instrument |
| 6 高压线 (HV+,HV-) HV lines | 21 同轴电缆 (50Ω) High quality coaxial cable |
| 7 低压负载模拟器LV load simulator | 22 光纤Optical fibre |
| 8 阻抗匹配网络 (可选) Impedance matching network | 23 接地铜带Ground straps |
| 9 低压人工网络 LV AN | |

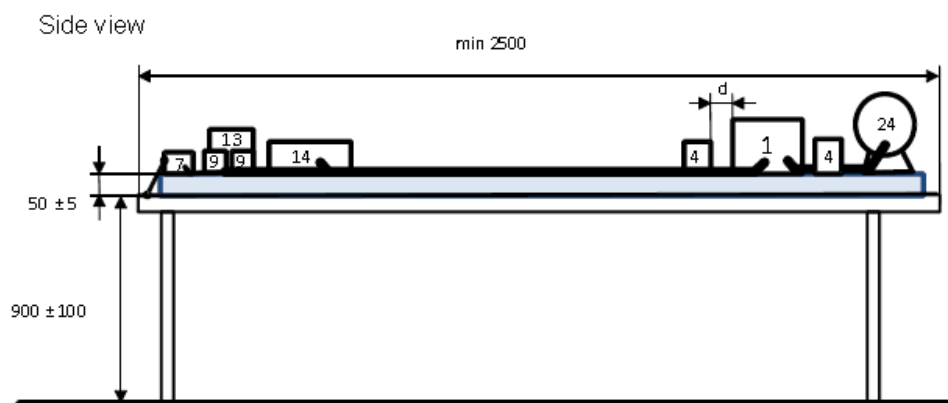
- 10 高压人工网络 HV AN 24屏蔽外壳Shielded enclosure
- 11 低压供电线 LV supply lines 25 50Ω负载 load
- 12 高压供电线 HV supply lines
- 13 低压电源 12V/24V/48V(应置于台架上) LV power supply
- 14 附加屏蔽盒 Additional shielded box
- 15 高压电源 (置于ALSE内的应屏蔽) HV power supply

注1：高压电池充电状态按照本图进行布置，在放电状态下，应测量高压直流输出端口，高压电源变更为高压负载。

Note 1: setup for battery charging. In the discharge condition, the high voltage DC output port should be measured, and the high voltage power supply should be changed to load simulator

图8 传导骚扰电源系统试验布置 Figure 8 Conducted emission –test setup for EUTs with shielded power supply systems

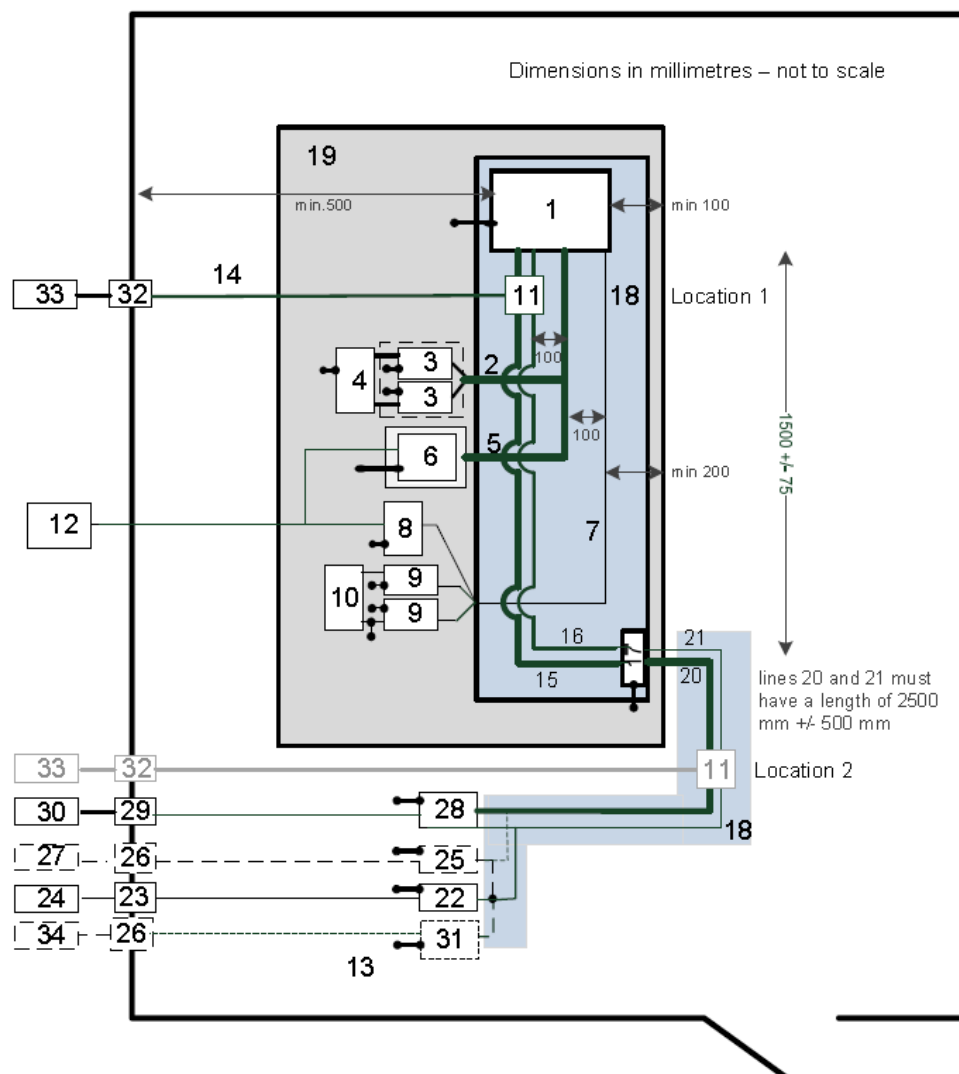




- | | |
|---|---|
| 1 受试设备 EUT | 16 电源线滤波器 Power line filter |
| 2 地平面Reference ground plane | 17 馈通滤波器Fibre optic feed through |
| 3 支持低相对介电常数 ($\epsilon_r \leq 1.4$) 厚度为50mm Low relative permittivity support | |
| 4 电流探头Current probe | 18 隔板连接器Bulk head connector |
| 5 低压线束 LV harness system | 19 辅助/监控设备Stimulating and monitoring system |
| 6 高压线 (HV+,HV-) HV lines | 20 测量设备Measuring instrument |
| 7 低压负载模拟器 LV load simulator cable | 21 同轴电缆 (50 Ω) High quality coaxial cable |
| 8 阻抗匹配网络 (可选) Impedance matching network | 22 光纤Optical fibre |
| 9 低压人工网络 LV AN | 23 接地铜带 Ground straps |
| 10 高压人工网络 LV AN | 24 电机 Electric motor |
| 11 低压供电线LV supply lines supply lines | 25 三相电机供电线Three phase motor |
| 12 高压供电线LV supply lines | 26 机械连接Mechanical connection |
| 13 低压电源 LV power supply bearing | 27 过滤的机械轴承 Filtered mechanical |
| 14 附加屏蔽盒 Additional shielded box motor | 28 制动或驱动电机 Brake or propulsion |
| 15 高压电源 (置于ALSE内的应屏蔽) HV power supply | 29 屏蔽外壳Shielded enclosure |
| | 30 50 Ω 负载 load |

图11 传导骚扰电流法-电机控制器试验布置 Conducted emission – test setup current probe

measurement on HV lines for EUTs with shielded power supply systems with electric motor



- | | |
|--------------------------------------|---|
| 1 受试设备 EUT | 19 地平面 (车辆) ground plane |
| 2 高压蓄电池线束 HV supply lines | 20 交流/直流充电电缆 AC power lines |
| 3 高压线路阻抗稳定网络 HV AN | 21 Pilot / CHAdeMO通信电缆 telecommunications lines |
| 4 高压负载(蓄电池和蓄电池模拟器) HV load simulator | 22 Pilot ISN |
| 5 高压线束 HV lines | 23 馈通同轴电缆连接器 coaxial cable connector |
| 6 高压负载模拟器 HV load simulator | 24 Pilot发生器 |
| 7 低压线束 LV harness | 25 PLC耦合器 |

- | | |
|---------------------------------|---|
| 8 低压负载模拟器 LV load simulator | 26 馈通连接 connector |
| 9 低压线路阻抗稳定网络 LV AN | 27 模拟器PLC |
| 10 低压蓄电池 LV battery | 28 AC人工电源网络/DC人工网络 AC/DC AN |
| 11 测量接收机 receiver | 29 滤波器 filter |
| 12 监控/激励 motivation | 30 高压AC或高压DC电源 AC/DC power supply |
| 13 参考接地 Ground straps | 31 CHAdeMO或其他通讯的LISN telecommunications lisen |
| 14 同轴电缆 coaxial lines | 32 隔板连接器 Bulk head connector |
| 15 AC/DC充电线束 AC/DC charge lines | 33 通讯模拟器 telecommunications simulator |
| 16 Pilot / Proxy/CHAdeMO或其他通信 | |
| 17 汽车充电连接器 charge connector | |

注：车载充电机充电状态按照本图进行测试，如果车载充电机存在放电状态，则在放电状态也应进行测试，此时，高压负载换成高压直流电源或者高压电池，高压电源换成高压交流阻性负载。

Note: if the vehicle charger has a charging function, it should be tested with discharging also. The high voltage load should transform high DC voltage power supply or high voltage battery, high voltage power supply should transform high AC voltage load.

图9 传导发射电流法-车载充电机的试验布置 Figure 9 Conducted emission – Example of test setup current probe measurement on HV lines for EUTs with shielded power supply systems and inverter/charger device

6.2.2 控制/信号线传导发射的限值要求

Limits of Conducted Emission Test on Control and Signal Lines

测试限值参考低压系统的限制要求，所有部件需要满足限值要求等级3。

Refer to the Q/SZ N11-1-2018 standard, All types of electrical components need to meet the limit level 3 requirements.

7 低频辐射发射 RE02

Low-Frequency Radiated Emission RE02

7.1 测试布置

Test Layout

应对被测件进行电场和磁场的测试。电场采用符合 CISPR 25:2016 的棒状天线进行测量，如图 10。磁场采用符合 GB/T6113.104 标准规定的环天线进行测量，如图 11。

DUT should be test with the electric fields and magnetic fields. The electric field is measured by a rod antenna that accorded with CISPR 25:2016 , General Layout is shown in Figure 10. The magnetic field is measured by a loop antenna that accorded with GB/T6113.104, General Layout is shown in Figure 11.

电场测量时，杆天线距离线束中心 100mm，且底板连接至测试桌的接地平板。

For Electric field test, the distances from the center of the harness to the rod antenna should be 100 mm, grounding plate and bottom plate connected on the test table.

磁场测量时，要求环天线在两个位置变换三个极性进行测量。第一个位置是距离线束中心 1m 处，第二个位置是正对被测件中心位置处。

For magnetic field test, Loop antenna should be test in the center of the harness and the center of DUT, Loop antenna should test with three directions for each position.

Top view

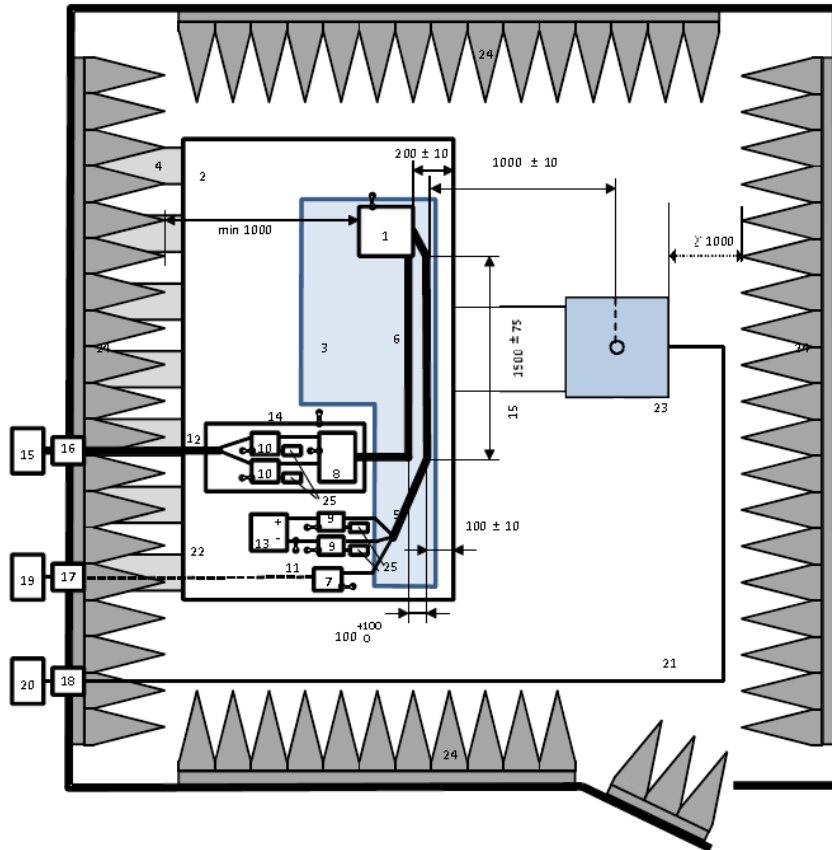


图 10:棒状天线测试布置 Figure 10 setup of rod antenna

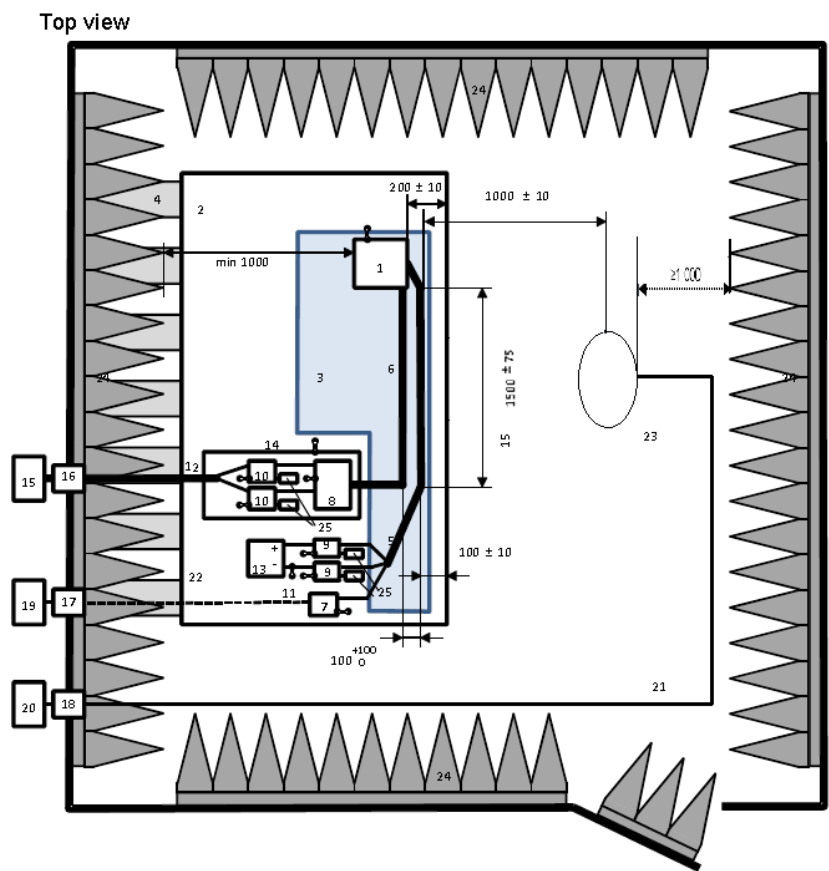


图11:环天线测试布置 Figure 11 setup of loop antenna

7.2 测试程序 Measurement

接收机设置如下表 5 所示： Receiver Setting requirements in the table 5.

表 5 接收机设置 Table 5 Receiver Setting

频率 (MHz) frequency	RBW	Step size	Time
0.009~0.15	200Hz	≤100Hz	≥5ms
0.15~4.77	10kHz	≤5kHz	≥5ms
4.77~15.92			
15.92~20			
20~30			

7.3 测试结果评价 / Evaluation of Test Results

测试结果要求符合以下电场和磁场的限值。

Test results meet the following limits of electric field and magnetic field.

表 6 低频辐射发射电场限值 Table 6 limits of electric field .

频率 (MHz)	电场限值 (dB μ V/m)
0.009~0.15	95.5-20log (f/0.009)
0.15~4.77	104-20log (f/0.15)
4.77~15.92	74-40log (f/4.77)
15.92~20	53.1-20log (f/15.92)
20~30	51.1

表 7 低频辐射发射磁场限值 Table 7 limits of magnetic field.

频率 (MHz) frequency	磁场限值 (dB μ A/m) limits of magnetic field.
0.009~0.15	44-20log (f/0.009)
0.15~4.77	52.6-20log (f/0.15)
4.77~15.92	22.5-40log (f/4.77)
15.92~20	1.6-20log (f/15.92)
20~30	-0.4
注：公式中 f 的单位是 MHz/ The unit of frequency in the formula is MHz.	

8 瞬态传导发射 CE10

Transient Emission CE10

8.1 瞬态传导发射测试布置

Layout for Conducted Transient Emission Test

低压直流 12V 端口按照 QSZ N11-1-2018 标准要求进行试验。

The DC 12V voltage port can be carried out in accordance with the QSZ N11-1-2018 standard

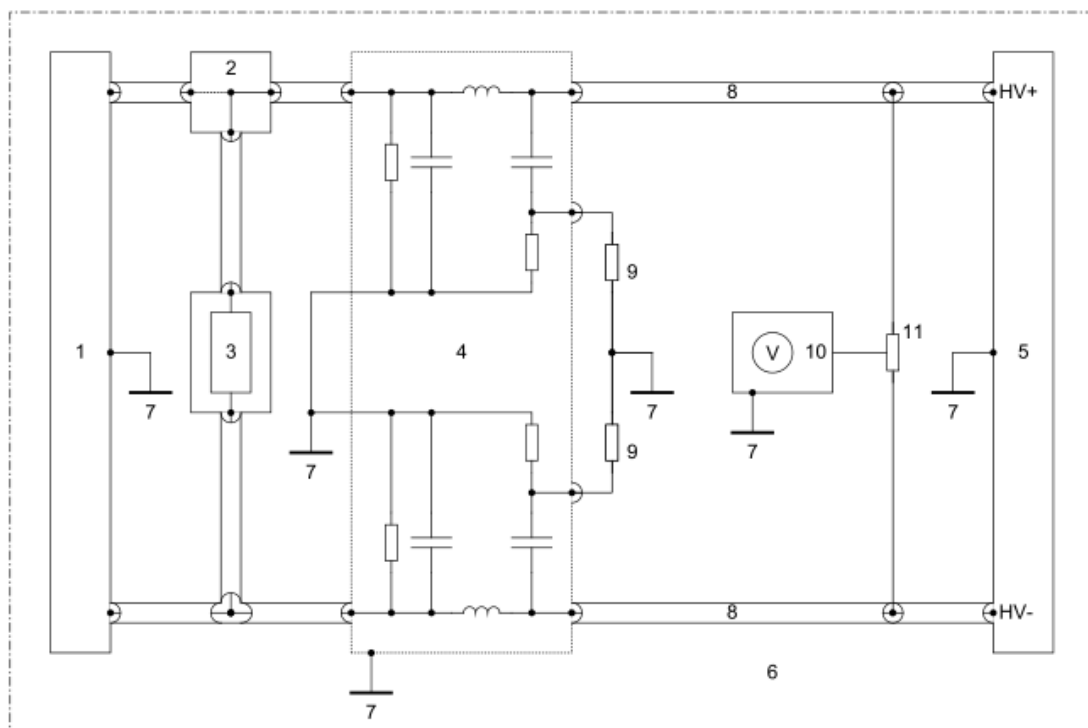
高压直流端口应满足以下要求：

the HV DC ports should be met the following requirements:

高压线缆的长度应参考整车布线，推荐500mm+200/-0mm 长度的原车高压线缆。该长度应在测试计划中定义。EUT 的接地连接的线长度和直径应根据整车应用情况。

The length of the high voltage cable should be referred to the vehicle wiring or the 500mm+200/-0mm length of the original high voltage cable should be used. This cable should be defined in the test plan. The length and diameter of the grounding connection of EUT shall be based on the vehicle.

图 12 高压直流线路上的瞬变测量布置 Figure 12 setup of transient emission for the HV port



- | | |
|--|---|
| 1 高压电源 HV power supply | 6 参考接地平面 grounded plane |
| 2 高压开关 HV SW | 7 接地 grounding |
| 3 高压电池负载 (如果需要的话) HV load (if necessary) | 8 高压供电线 HV lines |
| 4 屏蔽高压人工网络 LV LISN | 9 50 欧姆终端 50Ω load |
| 5 EUT | 10 示波器 oscilloscope |
| | 11 高压差分探头 High pressure differential probe. |

8.2 测试过程

测试过程按照 QSZ N11-1-2018 标准要求进行试验。

Test Procedure

The test procedure can be carried out in accordance with the QSZ N11-1-2018 standard

高压端口的测试，探头尽可能靠近EUT端口。

For HV port measurement, The oscilloscope's probe should be nearly to the EUT port.

开关切换次数最低10次，相邻两次开关切换的时间间隔要大于EUT恢复的时间。

All tests were repeated 10times. The minimum interval time for the test should be more than the DUT reset's.

测量应在HV+和HV-之间、HV+和地、HV-和地之间进行。

For HV+ to HV-, HV+ to grounding, grounding to HV-, Measurement should be carry out,

8.3 瞬态传导发射限值要求

Limit of Conducted Transient Emission Test

电器部件在开关断开和闭合瞬间所产生的快变瞬态脉冲电压必须在-100 V ~ +75 V 之间。

Transient voltages generated by the DUT through switch opening and closing must be within -100 and +75V.

9 充电端口的附加试验

Conducted Emission Test

9.1 快速瞬变/脉冲的抗扰度 CI11

immunity to electrical fast transient /
burst disturbances conducted along AC and
DC power lines

9.1.1 快速瞬变/脉冲的抗扰度的测试布置

Method for fast transient / burst
disturbances conducted along AC and DC power
lines

试验布置参照 ECE R10.05 中附录 15。

This test method can be carried out in
accordance with ECE R10 standard' s Annexes
15.

9.1.2 快速瞬变/脉冲的抗扰度的要求

Requirement of fast transient / burst
disturbances conducted along AC and DC power
lines.

测试结果必须满足表 8 的要求。

Test results should be met the following
limits of Table 8.

表8 测试等级 Table 8 test level

测试项目 Test item	测试等级 ⁽¹⁾ Test level	功能状态 Function class
高压交流电源线 AC power lines	2kV	I
高压直流电源线 DC power lines	2kV	I
信号线 signal lines	1kV	I

9.2 浪涌冲击试验 CI12

Immunity of surge test

9.2.1 浪涌冲击试验方法

Method for immunity of surge test

试验方法依据 ECE R10.05 中附录 16 执行。

This test method can be carried out in accordance with ECE R10 standard's Annexes 16

9.2.2 浪涌冲击试验要求

Requirement of immunity of surge Test

DUT 必须满足表 9 中的要求。

Test results should be met the following limits of Table 9.

每个浪涌需要按照1分钟间隔时间。

Each surge should be test with a interval of one minute.

表9 浪涌测试等级 Table 9 immunity of surge test level

测试项目 Test item	测试次数 Test time	角度 phase angle	测试等级 ⁽¹⁾ Test level	功能状态 Function class
高压交流电源线的脉冲-线到地 AC power lines to grounding lines	5	0°, 90°, 180, 270°	2kV	II
高压交流电源线的脉冲-线到线 Between AC power lines	5	0°, 90°, 180, 270°	1kV	II
(1) 这个试验需要对每个测试等级从1kV到2kV分别进行试验 this test level should be tested one by one form 1kV to 2kV.				

9.3 高压交流主电源线的谐波发射 OE11

Emission of harmonics generated on AC power lines

9.3.1 高压交流主电源线的谐波发射测试布置

Layout for emission of harmonics generated on AC powerlines

试验方法依据 ECE R10.05 中附录 11 执行。

This test method can be carried out in accordance with ECE R10 standard's Annexes 11.

9.3.2 高压交流主电源线的谐波发射的限值要求

Requirement of emission of harmonics generated on AC power lines

表10 输入电流 $\leq 16A$ 的限值 Table 10 limits of input current $\leq 16A$

谐波数 harmonic number	最大授权的谐波电流(单位A) Maximum authorized harmonic current (unit A)
奇次谐波 Odd harmonic	
3	2.30
5	1.14
7	0.77
9	0.40
11	0.33
13	0.21
$15 \leq n \leq 39$	$0.15 \times 15/n$
偶次谐波 Even harmonic	
2	1.08
4	0.43
6	0.30
$8 \leq n \leq 40$	$0.23 \times 8/n$

表19 输入电流 $> 16A$ 且 $\leq 75A$ 的限值 table 19 limits of current $> 16A$ and current $\leq 75A$

R_{sce}	I_n/I_1 %	%
-----------	-------------	---

	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

9.4 电压变化, 电压波动和闪变 CI13

Emission of voltage changes , voltage fluctuations and flicker on AC power lines

9.4.1 电压变化, 电压波动和闪变的测试布置

Layout for emission of voltage changes , voltage fluctuations and flicker on AC power lines

试验方法依据 ECE R10.05 中 Annexes12 执行

This test method can be carry out accordance with ECE R10 standard' s Annexes 12.

9.4.2 电压变化, 电压波动和闪变的限值要求

Requirement of emission of voltage changes , voltage fluctuations and flicker.

表11 电压变化, 电压波动和闪烁的限值要求 Table 11 limit of emission of voltage changes, voltage fluctuations and flicker 。

测试项目 Test item	限值 limit			
高压交流电源线的 电压变化, 电压波 动和闪烁 Emission of voltage changes , voltage fluctuation and flicker on AC power lines	测试项目	限值	测试项目	限值
	电压变化期间 Duration of voltage change $d(t) > 3.3\%$	500 ms	短期闪烁指示值 Short period voltage flicker value Pst	1
	相对稳态电压变化 Steady state voltage changes dc	3.3%	长期闪烁指示值 Long period voltage flicker value P1t	0.65
	最大相对电压变化 Max voltage changes dmax	4%	/	/

9.5 高压交流主电源, 高压直流主电源线的传导发射 CE12

Emission of radiofrequency conducted disturbances on AC or DC power lines

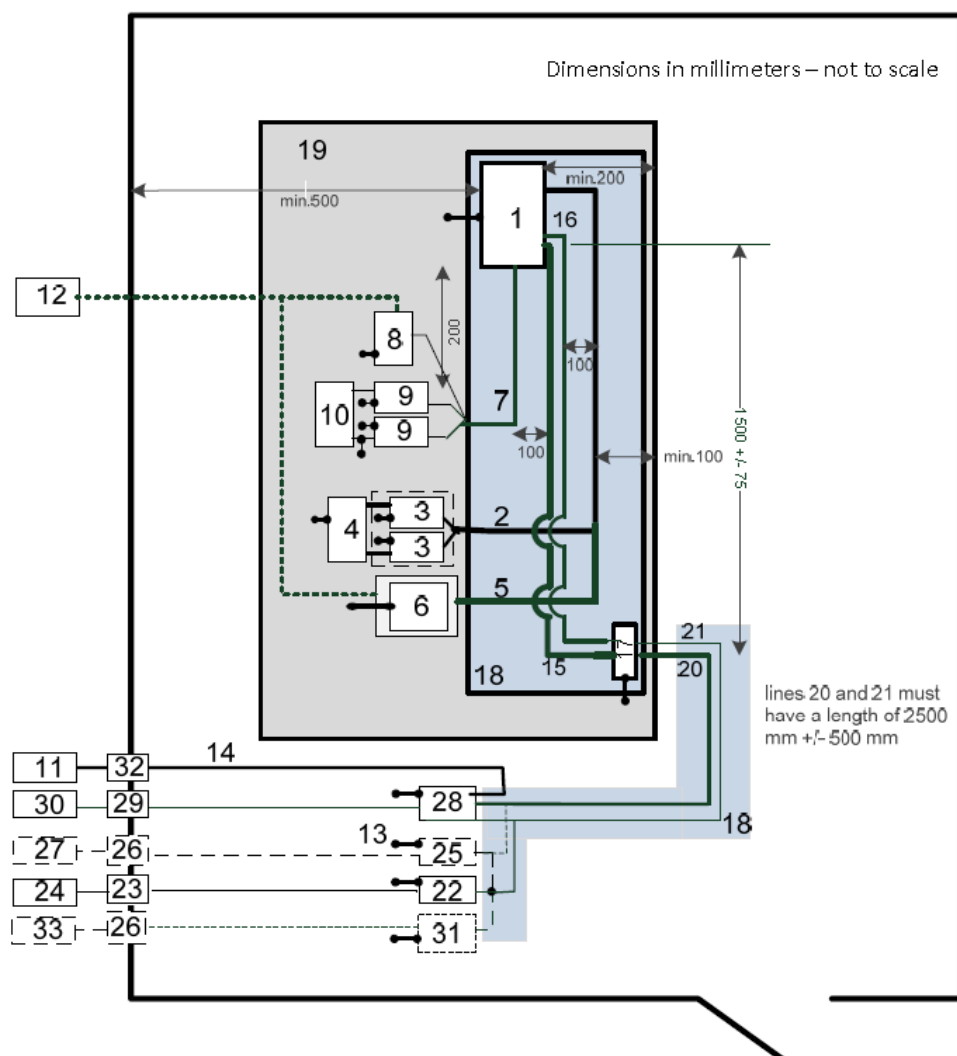
9.5.1 高压交流主电源, 高压直流主电源线的传导发射的测试布置

Layout for emission of radiofrequency conducted disturbance on AC or DC power lines

试验方法依据 ECE R10.05 中 Annexes13 执行

This test method can be carry out accordance with ECE R10 standard' s Annexes 13.

图13 AC和/或DC电源测量的试验布置。Figure 13 Setup for emission of radio frequency conducted disturbance on AC or DC power lines



1 受试设备 EUT

19 地平面 (车辆) ground plane

- | | |
|--|---|
| 2 高压蓄电池线束 HV supply lines | 20 交流/直流充电电缆 AC power lines |
| 3 高压线路阻抗稳定网络 HV AN | 21 Pilot / CHAdeMO通信电缆 telecommunications lines |
| 4 高压负载(蓄电池和蓄电池模拟器) HV load simulator | 22 Pilot ISN |
| 5 高压线束 HV lines | 23 馈通同轴电缆连接器 coaxial cable connector |
| 6 高压负载模拟器 HV load simulator | 24 Pilot发生器 |
| 7 低压线束 LV harness | 25 PLC耦合器 |
| 8 低压负载模拟器 LV load simulator | 26 馈通连接 connector |
| 9 低压线路阻抗稳定网络 LV AN | 27 模拟器PLC |
| 10 低压蓄电池 LV battery | 28 AC人工电源网络/DC人工网络 AC/DC AN |
| 11 测量接收机 receiver | 29 滤波器 filter |
| 12 监控/激励 motivation | 30 高压AC或高压DC电源 AC/DC power supply |
| 13 参考接地 Ground straps | 31 CHAdeMO或其他通讯的LISN telecommunications lisen |
| 14 同轴电缆 coaxial lines | 32 隔板连接器 Bulk head connector |
| 15 AC/DC充电线束 AC/DC charge lines | 33 通讯模拟器 telecommunications simulator |
| 16 Pilot / Proxy/CHAdeMO或其他通信 | |
| 17 汽车充电连接器 charge connector | |
| 18 支持低相对介电常数 ($\epsilon_r \leq 1.4$) 厚度为50mm Low relative permittivity support | |

9.5.2 高压交流主电源, 高压直流主电源线的传导发射的限值要求

Limits of emission of radio frequency conducted disturbance on AC or DC power lines

表 12 交流电源线上的射频传导干扰限值 Table 12 limits for conducted disturbance on AC power lines

频率 frequency (MHz)	限值 limits
0.15-0.5	66-56 dB μ V (QP) 56-46 dB μ V (AV)
0.5-5	56 dB μ V (QP) 46 dB μ V (AV)
5-30	60 dB μ V (QP) 50 dB μ V (AV)

表 13 直流电源线上最大允许的射频传导干扰 Table 13 limits for conducted disturbance on DC power lines

频率 frequency (MHz)	限值 limits
0.15-0.5	79 dB μ V (QP) 66 dB μ V (AV)
0.5-30	73 dB μ V (QP) 60 dB μ V (AV)

9.6 通讯端口的传导发射 CE13

Emission of radiofrequency conducted disturbances on network and telecommunication access

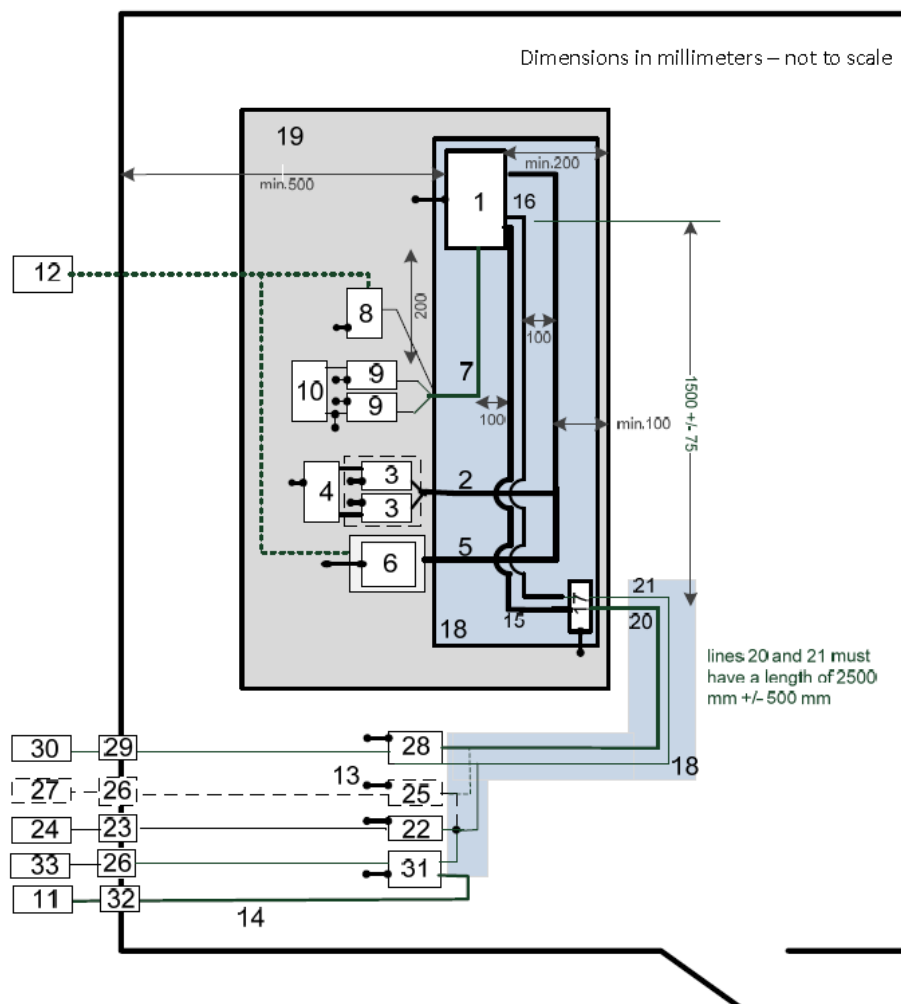
9.6.1 通讯端口的传导发射的测试布置

Layout for emission of radiofrequency conducted disturbance on network and telecommunication access

试验方法依据ECE R10.05 中Annexes14 执行

This test method can be carry out accordance with ECE R10 standard' s Annexes 14.

图14 通讯网络端口测量的试验布置。Figure 14 Setup for emission of radio frequency conducted disturbance on network and telecommunications access



- | | |
|--------------------------------------|---|
| 1 受试设备 EUT | 19 地平面 (车辆) ground plane |
| 2 高压蓄电池线束 HV supply lines | 20 交流/直流充电电缆 AC power lines |
| 3 高压线路阻抗稳定网络 HV AN | 21 Pilot / CHAdeMO通信电缆 telecommunications lines |
| 4 高压负载(蓄电池和蓄电池模拟器) HV load simulator | 22 Pilot ISN |
| 5 高压线束 HV lines | 23 馈通同轴电缆连接器 coaxial cable connector |
| 6 高压负载模拟器 HV load simulator | 24 Pilot发生器 |
| 7 低压线束 LV harness | 25 PLC耦合器 |
| 8 低压负载模拟器 LV load simulator | 26 馈通连接 connector |
| 9 低压线路阻抗稳定网络 LV AN | 27 模拟器PLC |

Limits of Conducted Emission Test on network and telecommunications access

表 14 通讯端口的传导发射限值 Table 14 limits of conducted emission test on network and telecommunications access

频率 frequency (MHz)	电压限值 voltage method Limits	电流限值 current method limits
0.15-0.5	84-74 dBμV (QP) 74-64 dBμV (AV)	40-30 dBμA (QP) 30-20 dBμA (AV)
0.5-30	74 dBμV (QP) 64 dBμV (AV)	30 dBμA (QP) 20 dBμA (AV)

10 辐射抗扰度测试 RI01**Radiated Immunity Test RI01**

该试验中，高压部件的试验要求参照低压部件 Q/SZ N11-1-2018 的标准要求。

For this test , the HV components system test method should Refer to the LV components test method from Q/SZ N11-1-2018 standard

11 大电流注入测试 RI02**Bulk Current Injection Test RI02**

该试验中，高压部件的试验要求参照低压部件 Q/SZ N11-1-2018 的标准要求。

For this test , the HV components system test method should Refer to the LV components test method from Q/SZ N11-1-2018 standard

12 发射器射频抗扰度测试 RI03**RF Transmitter Immunity Test RI03**

该试验中，高压部件的试验要求参照低压部件 Q/SZ N11-1-2018 的标准要求。

For this test , the HV components system test method should Refer to the LV components test method from Q/SZ N11-1-2018 standard

13 低频磁场抗扰度测试 RI04**Low Frequency Magnetic Field Immunity Test**

该试验中，高压部件的试验要求参照低压部件 Q/SZ N11-1-2018 的标准要求。

For this test , the HV components system test method should Refer to the LV components test method from Q/SZ N11-1-2018 standard

14 电源线瞬态传导抗扰度测试 CI01**Power Line Transient Immunity Test CI01**

该试验中，高压部件的试验要求参照低压部件 Q/SZ N11-1-2018 的标准要求。

For this test , the HV components system test method should Refer to the LV components test method from Q/SZ N11-1-2018 standard

15 信号线瞬态传导抗扰度测试 CI02

Signal Line Transient Conducted Immunity Test
CI02

该试验中，高压部件的试验要求参照低压部件
Q/SZ N11-1-2018 的标准要求。

For this test , the HV components system test
method should Refer to the LV components
test method from Q/SZ N11-1-2018 standard

16 静电放电测试 ESD01

Electrostatic Discharge Test ESD01

该试验中，高压部件的试验要求参照低压部件
Q/SZ N11-1-2018 的标准要求。

For this test , the HV components system test
method should Refer to the LV components
test method from Q/SZ N11-1-2018 standard

17 磁场近场测试

Magnetic near field test

该试验中，高压部件的试验要求参照低压部件
Q/SZ N11-1-2018 的标准要求。

For this test , the HV components system test
method should Refer to the LV components
test method from Q/SZ N11-1-2018 standard
