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**Road vehicles - Supply voltage of 48 V - Electrical requirements
and tests**

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1 Scope

This document specifies the electrical requirements and test methods for electrical and electronic components in road vehicles with a nominal voltage of 48 V DC.

This document applies to the electrical performance of components supplied with a DC 48 V power supply. For energy storage systems, the electrochemical components are not tested. Only the management system is tested as a separate DUT.

This document includes general requirements, voltage range, voltage variations and fluctuations for 48 V DC electrical systems, but does not include electromagnetic compatibility (EMC).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 20967, Non-destructive testing -- Visual testing -- General principles

GB/T 28046.2, Road vehicles -- Environmental conditions and testing for electrical and electronic equipment -- Part 2.Electrical loads (GB/T 28046.2-2019, ISO 16750-2:2012, MOD)

ISO 16750-1, Road vehicles -- Environmental conditions and testing for electrical and electronic equipment -- Part 1.General

NOTE: GB/T 28046.1-2011, Road vehicles -- Environmental conditions and testing for electrical and electronic equipment -- Part 1.General (ISO 16750-1:2006, MOD)

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

component

Parts that are installed directly in the vehicle.

TRT

The ambient temperature in the laboratory during the test.

3.11

test temperature

T_{test}

The ambient temperature of the DUT during the test.

4.1 General

A component may include multiple functions. These functions may have different functional states for the same influencing parameter. The influencing parameter specified in this document is the supply voltage, which specifies the minimum functional state requirements for the component.

The functional behavior (including performance degradation) of components related to each selected functional state level and customer perception (e.g., visual, auditory, tactile, and thermal sensation) shall be negotiated between the supplier and the purchaser and described in the required component specifications. See Annex A for application examples.

4.2 Functional state 1 (FS1)

Components shall meet the specified functional requirements, have no performance deviation, and are not allowed to experience performance degradation or shutdown.

4.3 Functional state 2 (FS2)

Components must meet the specified functional requirements. It is permissible to exceed the specified tolerances for one or more performance parameters, but shutdown is not permitted.

4.4 Functional state 3 (FS3)

The component fails to meet the specified functional requirements. Performance degradation or shutdown is permissible. If the necessary operating conditions are met, functionality shall be automatically restored, and performance shall return to the specified level.

4.5 Functional state 4 (FS4)

The component fails to meet the specified functional requirements. Performance degradation or shutdown is permissible. Functionality shall automatically recover and performance shall return to the specified level after a change in vehicle operating conditions (e.g., change in ignition state, vehicle restart) and the necessary operating conditions are met.

4.6 Functional state 5 (FS5)

One or more functions of the component may fail, but spontaneous combustion shall not occur. After testing, the component must be repaired or replaced before continued use.

5 Power supply voltage range

The power supply voltage range is shown in Figure 1.

- High overvoltage range ($58\text{ V} < U_{48} \leq 60\text{ V}$). This voltage range may indicate a control error.
- Overvoltage range ($54\text{ V} < U_{48} \leq 58\text{ V}$). This voltage range may indicate (short- term) power return or a control error. The system can only operate within this range for short periods.
- High slack voltage range ($52\text{ V} < U_{48} \leq 54\text{ V}$). This voltage range is used to calibrate the storage medium and absorb recovered energy. The system can only operate within this range for short periods.
- Nominal voltage range ($36\text{ V} \leq U_{48} \leq 52\text{ V}$). The system operates within this range most of the time.
- Low slack voltage range ($31\text{ V} \leq U_{48} < 36\text{ V}$). This voltage range may occur during boost or cold start. The system can only operate within this range for short periods.
- Undervoltage range ($24\text{ V} \leq U_{48} < 31\text{ V}$). This voltage range may occur during cold start. The system can only operate within this range for short periods.
- Low undervoltage range ($0\text{ V} \leq U_{48} < 24\text{ V}$). Storage protection. This voltage range may be applicable during short-term intermittent power supply or long-term shutdown.

6 Functional categories

Performance requirements (e.g., motor torque or pump flow rate) shall be specified for each function of the DUT. The corresponding functional state level shall be determined based on these performance requirements. Examples of different functional categories are shown in Table 1. The functional states corresponding to each functional category under different supply voltages are shown in Table 2.

7 Operating modes

Unless otherwise specified, all electrical connections shall be made on the DUT.

Operate at test voltages U_N and U_{48N} .

If the component requires a cooling system, the necessary operations and adjustments can