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Automotive ultrasonic sensor assembly

汽车用超声波传感器总成

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Automotive ultrasonic sensor assembly

1 Scope

This Standard specifies the requirements, test methods and inspection rules for automotive ultrasonic sensor assembly.

This Standard applies to ultrasonic sensor assembly (hereinafter referred to as the assembly) used in automobiles.

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 2828.1, *Sampling procedures for inspection by attributes -- Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

GB/T 18655-2018, *Vehicles, boats and internal combustion engines - Radio disturbance characteristics - Limits and methods of measurement for the protection of on-board receivers*

GB/T 19951-2019, *Road vehicles - Disturbances test methods for electrical/electronic component from electrostatic discharge*

GB/T 21437.2-2021, *Road vehicles - Test method of electrical disturbances from conduction and coupling - Part 2: Electrical transient conduction along supply lines only*

GB/T 21437.3-2021, *Road vehicles - Test method of electrical disturbances from conduction and coupling - Part 3: Electrical transient transmission by capacitive and inductive coupling via lines other than supply lines*

GB/T 28046.2-2019, *Road vehicles - Environmental conditions and testing for electrical and electronic equipment - Part 2: Electrical loads*

GB/T 28046.3-2011, *Road vehicles - Environmental conditions and testing for electrical and electronic equipment - Part 3: Mechanical loads*

GB/T 28046.4-2011, *Road vehicles - Environmental conditions and testing for electrical and electronic equipment - Part 4: Climatic loads*

GB/T 28046.5-2013, *Road vehicles - Environmental conditions and testing for electrical and electronic equipment - Part 5: Chemical loads*

GB/T 30038-2013, *Road vehicles - Degrees of electrical equipment protection (IP-Code)*

GB 34660-2017, *Road vehicles - Requirements and test methods of electromagnetic compatibility*

ISO 4892-2:2013, *Plastics - Methods of exposure to laboratory light sources-Part 2: Xenon-arc lamps*

ISO 11124-2:2018, *Preparation of steel substrates before application of paints and related products - Specifications for metallic blast-cleaning abrasives - Part 2: Chilled-iron grit*

ISO 20567-1, *Paints and varnished - Determination of stone-chip resistance of coating – Part 1: Multi-impact testing*

3 Terms and definitions

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

3.1 ultrasonic sensor assembly

In-vehicle electronic devices used to transmit, receive and process ultrasonic signals and obtain information such as target distance and orientation.

NOTE: The ultrasonic sensor assembly can be divided into individual sensors or the integration of sensors and control units.

3.2 standard test tube

Standard test setup for reflected ultrasonic signals.

3.3 ring time

The inertia damping decay time of the ultrasonic drive signal emitted by the assembly.

3.4 field of view

The three-dimensional space area that the assembly can detect under specified conditions.

3.5 detection coverage rate

The effective field of view of the assembly as a percentage of the required field of view.

3.6 resolution

The ability of the assembly to distinguish the minimum change distance of the target.

3.7 starting signal

The command signal used to start the work of the assembly according to the established communication protocol.

3.8 transceiver device

A test device used to send a start signal to the assembly or send a data frame according to the established communication protocol, and receive the distance, azimuth and other signals returned by the assembly, and give instructions by auditory or visual means.

4 Symbols and abbreviations

The following symbols and abbreviations apply to this document.

DUT: device under test

$T_{\max}$: maximum operating temperature

$T_{\min}$: minimum operating temperature

U_N : nominal voltage

U_t : test voltage

$U_{S\max}$: maximum supply voltage

$U_{S\min}$: minimum supply voltage

5 Requirements

5.1 Appearance and structural requirements

5.1.1 Appearance

Test according to 6.2. The appearance of the assembly shall meet the following requirements:

- a) The outer surface of each component shall be smooth and flat, without dents, scratches, cracks, deformation, burrs, mildew and other defects;
- b) The surface of metal parts shall have a uniform protective layer, without blistering, cracking, peeling, corrosion and mechanical damage;

NOTE: For the assembly with overvoltage protection function, the output signal in the test shall be determined through negotiation between the supplier and the purchaser.

5.4.2.4 Superimposed AC Voltage

Test according to 6.5.2.4. During the test and after the test, the functional state shall meet the requirements of 5.4.1.1.

5.4.2.5 Slow drop and slow rise of supply voltage

Test according to 6.5.2.5. During the test, when the voltage is at U_{Smin} and after the test, the functional state shall meet the requirements of 5.4.1.1.

5.4.2.6 Slow drop and fast rise of supply voltage

Test according to 6.5.2.6. During the test, when the voltage is within the range of $U_{Smin} \sim U_{Smax}$ and after the test, the functional state shall meet the requirements of 5.4.1.1.

5.4.2.7 Supply voltage transients

5.4.2.7.1 Instantaneous drop in voltage

Test according to 6.5.2.7.1. During the test, when the voltage is at U_{Smin} and after the test, the functional state shall meet the requirements of 5.4.1.1.

5.4.2.7.2 Reset performance to voltage dips

Test according to 6.5.2.7.2. When the voltage is restored to U_{Smin} during the test and after the test, the functional state shall meet the requirements of 5.4.1.1.

5.4.2.7.3 Startup feature

Test according to 6.5.2.7.3. During the test, when the voltage is at U_N and after the test, the functional state shall meet the requirements of 5.4.1.1.

5.4.2.7.4 Load dump

Test according to 6.5.2.7.4. During the test, when the voltage is within the range of $U_{Smin} \sim U_{Smax}$ and after the test, the functional state shall meet the requirements of 5.4.1.1.

5.4.2.8 Reverse voltage

Test according to 6.5.2.8. The functional state after the test shall meet the requirements of 5.4.1.1.

5.4.2.9 Open circuit

5.4.2.9.1 Single-wire open circuit

5.4.6.6 Damp heat requirements

5.4.6.6.1 Damp heat cycle

Test according to 6.5.6.5.1. During the test, the functional state installed inside the passenger compartment shall meet the requirements of 5.4.1.1. The appearance after the test shall meet the requirements of 5.1.1. The functional state shall meet the requirements of 5.4.1.1.

Assemblies or units installed outside the vehicle are not required.

5.4.6.6.2 Combined temperature/humidity cycle

Test according to 6.5.6.5.2. During the test, the functional state installed outside the vehicle shall meet the requirements of 5.4.1.1. The appearance after the test shall meet the requirements of 5.1.1. The functional state shall meet the requirements of 5.4.1.1.

Assemblies or units installed inside the passenger compartment are not required.

5.4.6.6.3 Steady-state damp heat

Test according to 6.5.6.5.3. The functional state of the last 1h in the test shall meet the requirements of 5.4.1.1. The appearance after the test shall meet the requirements of 5.1.1. The functional state shall meet the requirements of 5.4.1.1.

5.4.7 Ice water shock

Test according to 6.5.7. After the test, the appearance of the assembly or unit installed outside the vehicle shall meet the requirements of 5.1.1. The functional state shall meet the requirements of 5.4.1.1.

Assemblies or units installed inside the passenger compartment are not required.

5.4.8 Salt spray corrosion resistance

5.4.8.1 Corrosion

Test according to 6.5.8.1. After the test, the appearance of the assembly or unit installed outside the vehicle shall meet the requirements of 5.1.1. The functional state shall meet the requirements of 5.4.1.1.

There are no requirements for assemblies or units installed in the passenger compartment.

5.4.8.2 Penetration and functionality

Test according to 6.5.8.2. After the test, the appearance of the assembly shall meet the requirements of 5.1.1. The functional state shall meet the requirements of 5.4.1.1.

Figure 6 -- Schematic diagram of detection scene without obstacle**6.5.2 Electrical performance test****6.5.2.1 DC supply voltage**

Arrange the test environment according to 6.5.1.1.1. DUT is tested in working mode B2. First adjust the voltage of the DC stabilized power supply to U_N . Then gradually adjust the voltage to U_{Smin} to stabilize for 10min. Gradually adjust the voltage to U_{Smax} and stabilize for 10min. Carry out a functional state inspection during and after the test.

6.5.2.2 Quiescent sleep current

The DUT is in the working mode B1. The ammeter is connected to the power supply line for testing.

6.5.2.3 Overvoltage**6.5.2.3.1 At ($T_{max}-20^{\circ}C$)**

Arrange the test environment according to 6.5.1.1.1. The DUT is tested in working mode B2. The DUT whose U_N is 12V shall be tested according to the method in 4.3.1.1.2 of GB/T 28046.2-2019. The DUT whose U_N is 24V shall be tested according to the method in 4.3.2.2 of GB/T 28046.2-2019. Carry out a functional state inspection during and after the test.

6.5.2.3.2 At room temperature

Arrange the test environment as in 6.5.1.1.1. The DUT is tested in operating mode B2. The DUT whose U_N is 12V shall be tested according to the method in 4.3.1.2.2 of GB/T 28046.2-2019. Carry out a functional state inspection during and after the test.

6.5.2.4 Superimposed AC voltage

Arrange the test environment according to 6.5.1.1.1. The DUT is tested in working mode B2. Test according to 4.4.2 Severity 1 in GB/T 28046.2-2019. Carry out a functional state inspection during and after the test.

6.5.2.5 Slow drop and slow rise of supply voltage

Arrange the test environment according to 6.5.1.1.1. The DUT is tested in operating mode B2. Test according to the method in 4.5.2 of GB/T 28046.2-2019. Carry out a functional state inspection during and after the test.

6.5.2.6 Slow drop and fast rise of supply voltage

Arrange the test environment according to 6.5.1.1.1. The DUT is tested in working mode B2.

The test procedure is as follows:

- a) In the falling stage, drop from U_{Smax} to 0V at a rate of $(0.5 \pm 0.1)V/min$;
- b) In the rising stage, the voltage rises rapidly from 0V to U_{Smax} within 0.5s.

Carry out a functional state inspection during and after the test.

6.5.2.7 Supply voltage transients

6.5.2.7.1 Voltage dips

Arrange the test environment according to 6.5.1.1.1. The DUT is tested in working mode B2 according to the method in 4.6.1.2 of GB/T 28046.2-2019. Carry out a functional state inspection during and after the test.

6.5.2.7.2 Reset performance for voltage dips

Arrange the test environment according to 6.5.1.1.1. The DUT is tested in working mode B2 according to the method in 4.6.2.2 of GB/T 28046.2-2019. Carry out a functional state inspection during and after the test.

6.5.2.7.3 Startup characteristics

Arrange the test environment according to 6.5.1.1.1. The DUT is tested in working mode B2 according to the method of 4.6.3.2 Level II in GB/T 28046.2-2019. Carry out a functional state inspection during and after the test.

6.5.2.7.4 Load dump

Arrange the test environment according to 6.5.1.1.1. The DUT is tested in working mode B2 according to the method in 4.6.4.2 of GB/T 28046.2-2019. Carry out a functional state inspection during and after the test.

6.5.2.8 Reverse voltage

Arrange the test environment according to 6.5.1.1.1. The DUT is tested in working mode B2 according to the method in 4.7.2.3 of GB/T 28046.2-2019. After the test, carry out a functional state inspection.

6.5.2.9 Open circuit

6.5.2.9.1 Single wire open circuit

Arrange the test environment according to 6.5.1.1.1. The DUT is tested in working mode B2 according to the method in 4.9.1.2 of GB/T 28046.2-2019. After the test, carry out a functional state inspection.

6.5.2.9.2 Multi-wire open circuit

2021 and the methods of pulses 1, 2a, 2b, 3a, 3b. Carry out a functional state inspection during and after the test.

6.5.3.2.2 Electrical transient immunity by capacitive coupling of conductors other than power lines

Arrange the test environment according to 6.5.1.1.1 and 6.5.1.2. The DUT is tested in working mode B2, according to the CCC mode in Table B.1, Table B.2 of GB/T 21437.3-2021 as well as the requirements for Level III and the method of 4.5. Carry out a functional state inspection during and after the test.

6.5.3.3 Immunity to electromagnetic radiation

Arrange the test environment according to 6.5.1.1.1 and 6.5.1.2. The DUT is tested in working mode B2, according to the anechoic chamber method, the immunity test strength of high current injection method in 4.7 of GB 34660-2017 and the method in 5.7.

6.5.3.4 Radio disturbance characteristics

6.5.3.4.1 Conducted emissions

The DUT is tested in working mode B2 according to the methods in 6.3 and 6.4 of GB/T 18655-2018.

6.5.3.4.2 Radiated emissions

The DUT is tested in working mode B2 according to the method in 6.5 of GB/T 18655-2018.

6.5.4 Mechanical property tests

6.5.4.1 Mechanical vibration

Arrange the test environment according to 6.5.1.1.1. The DUT is tested in working mode B2 according to the method in 4.1.2.4.2 or 4.1.2.7.2 in GB/T 28046.3-2011. Carry out the ring time and functional state inspections during the test. After the test, carry out a functional state inspection.

6.5.4.2 Mechanical shock

Arrange the test environment according to 6.5.1.1.1. The DUT is tested in working mode B2 according to the method in 4.2.2.2 of GB/T 28046.3-2011. Carry out the ring time and functional state inspections during the test. After the test, carry out a functional state inspection.

6.5.4.3 Free fall

Arrange the test environment according to 6.5.1.1.1. The DUT is tested in working

the method in 5.1.1.1.2 of GB/T 28046.4-2011 with the lower limit of storage temperature and working mode A1 in Table 4. After the test, let it stand for 2h and return to normal temperature. Carry out a functional state inspection for the DUT in the working mode B2.

6.5.6.1.2 Low temperature operation

Arrange the test environment according to 6.5.1.1.2. The DUT is tested with $T_{\min}$ and working mode B2 according to the method in 5.1.1.2.2 of GB/T 28046.4-2011. During the test and after the test, after standing for 2h to restore normal temperature, carry out a functional state inspection.

6.5.6.2 High temperature test

6.5.6.2.1 High temperature storage

Arrange the test environment according to 6.5.1.1.2. The DUT is tested according to the method of 5.1.2.1.2 in GB/T 28046.4-2011 with the upper limit of storage temperature and working mode A1 in Table 4. After the test, let it stand for 2h and return to normal temperature. Carry out a functional state inspection for the DUT in the working mode B2.

6.5.6.2.2 High temperature operation

Arrange the test environment according to 6.5.1.1.2. The DUT is tested with $T_{\max}$ and working mode B2 according to the method in 5.1.2.2.2 of GB/T 28046.4-2011. During the test and after the test, after standing for 2h to restore normal temperature, carry out a functional state inspection.

6.5.6.3 Temperature gradient

Arrange the test environment according to 6.5.1.1.2. The DUT is tested in the working mode B2 in the range of $T_{\min} \sim T_{\max}$, according to the method in 5.2.2 of GB/T 28046.4-2011. During the test and after the test, after standing for 2h to restore normal temperature, carry out a functional state inspection.

6.5.6.4 Temperature cycling

6.5.6.4.1 Temperature cycling with specified rate of change

Arrange the test environment according to 6.5.1.1.2. The DUT is tested in the working mode B2 in the range of $T_{\min} \sim T_{\max}$ according to the method in 5.3.1.2 of GB/T 28046.4-2011. During the test and after the test, after standing for 2h to restore normal temperature, carry out a functional state inspection.

6.5.6.4.2 Rapid temperature change with specified transition time

The DUT is tested in the working mode A1 in the range of $T_{\min} \sim T_{\max}$, according to the

method in 5.3.2.2 of GB/T 28046.4-2011. After the test, let it stand for 2h and return to normal temperature. Arrange the test environment according to 6.5.1.1.1. Carry out a functional state inspection for the DUT in the working mode B2.

6.5.6.5 Damp heat

6.5.6.5.1 Damp heat cycle

Arrange the test environment according to 6.5.1.1.2. The DUT is tested in working mode B2 according to the method in 5.6.2.2 of GB/T 28046.4-2011. During the test and after the test, after standing for 2h to restore normal temperature, carry out a functional state inspection.

6.5.6.5.2 Combined temperature/humidity cycle

Arrange the test environment according to 6.5.1.1.2. The DUT is tested in working mode B2 according to the method in 5.6.2.3 of GB/T 28046.4-2011. During the test and after the test, after standing for 2h to restore normal temperature, carry out a functional state inspection.

6.5.6.5.3 Steady-state damp heat

Arrange the test environment according to 6.5.1.1.2. The DUT is tested in working mode A2 according to the method in 5.7.2 of GB/T 28046.4-2011. In the last 1h of the test, the output signal is checked in the working mode B2. After the test, let it stand for 2h and return to normal temperature. Carry out a functional state inspection in the working mode B2.

6.5.7 Ice water shock

The DUT is tested in working mode B2 according to the method in 5.4.2.1 of GB/T 28046.4-2011. After the test, let it stand for 2h and return to normal temperature. Arrange the test environment according to 6.5.1.1.1. Carry out a functional state inspection.

6.5.8 Salt spray corrosion resistance test

6.5.8.1 Corrosion

The DUT is tested in working mode A2 according to the method in 5.5.1.2 of GB/T 28046.4-2011. After the test check according to 6.2.1. Arrange the test environment according to 6.5.1.1.1. Carry out a functional state inspection for the DUT in the working mode B2.

6.5.8.2 Leakage and function

The DUT is tested in working mode B2 according to the method in 5.5.2.2 of GB/T 28046.4-2011. Arrange the test environment according to 6.5.1.1.1. After the test, carry

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