

## PROCESS SPECIFICATION

SPEC. NO.

ES-X82010

SUBJECT: GENERAL SPECIFICATION OF ENVIRONMENT TESTS  
ON AUTOMOTIVE ELECTRONIC EQUIPMENT

## 1. Objective

This specification shall designate the test methods of automotive electronic equipment for verifying their electric characteristics and performance under various environmental conditions.

## 2. Application

## 2.1. Scope of Application

This specification shall be applicable to electronic equipment which will be installed on passenger car, station wagon, van, truck and mini-car. If something different from the content or specific indication of test condition is required, it will be indicated in a drawing and a precedence shall be given to such indication.

## 2.2. Effective Date

This specification shall be applicable to a product to be newly designed or modified on a date following an effective date of each revision ~~(Revision L shall be applied effective with a newly designed part to be incorporated into 2000 vehicle.)~~

(However, revision L applies the revision date of revision K because there is no influence on the judgment pass or fail.)  $\Delta$

Q	GA2519	4.8, 4.9.12.3, 4.9.23, 4.9.33)	10 ~ 25	07. 1. 17	M. KANEIDA
P	GW262P	as Q REV.			A. KAWANO
O	BJ4744	4.7, 4.9.1, 4, 4.3	8, 12, 3, 6	01. 12. 12	T. MIYANAGI
N	AW2690	3.4, 4.1, 4.2, 4.6, 4.7, 4.8, 4.9, 4.13, 4.18, 4.25	23, 5, 7, 9, 10, 16, 17, 20, 23	00. 12. 25	T. MIYANAGI
M	WY6570	3.8, 4.2, 4.8, 4.9.1, 4.9.2, 4.9.5, 4.11, 4.14, 4.20 ~ 4.22	23, 3 ~ 9, 11 ~ 2, 14, 16 ~ 18, 21 ~ 23	99. 9. 30	M. KANEIDA
L	WW7553	Modified 4.7, 4.8, 4.9.1, 4.9.3	1, 8 ~ 10, 12, 15 page	'98. 11. 25	T. INUZUKA
K	WB1693	Modified 3, 4.8, 4.9, 4.12 ~ 4.16, 4.24	All page	'98. 7. 31	T. INUZUKA
J	WW0616	Modified 4.1 ~ 4.29	All Page	'98. 1. 13	K. Takabuchi
SYM.	REV. LET.	DESCRIPTION OF CHANGE	REV. PAGE	DATE	REV. BY
REVISION					
REFERENCE		APPROVED BY	CHECKED BY	PREPARED BY	
		M. Tatemoto	K. Takabuchi	K. Takabuchi	
				'98. 1. 13	

### 3. Items of General Requirement

- 1) An EUT shall not have a malfunction when installed in the vehicle except for the case that differs remarkably from a usual use condition of the vehicle. (If a malfunction is noted in a vehicle test, an appropriate countermeasure shall be taken by analyzing the details of malfunction. If such malfunction takes place in a situation apparently different from the test condition stipulated in this specification or a relative drawing, the parties concerned shall negotiate what action should be taken.)
- 2) A dark current in an electronic equipment shall be not larger than 1.0mA when it is measured with a supply voltage at 12.6V. A part, which will be difficult to attain the above value due to a structure of electric circuit, will be specified differently on a drawing by a separate negotiation between a supplier and MMC.
- 3) After the power-supply voltage returns within the range of the operation voltage or after turbulence disappears, EUT must operate immediately and normally without becoming abnormal as long as there is no instruction in specifications.
- 4) The following phenomena caused by the operation of motors, relays, switches, DC-DC converters, or lamps shall not cause malfunction or destruction;
  - Surge noise
  - High frequency noise
  - Ground level change
  - Power supply voltage change
  - Temperature risesFor this, offer to MMC and confirm them if the confirmation using the vehicles is necessary.
- 5) Report to the design section beforehand and obtain approval when there is a necessity for changing software, hardware, and the manufacturing.
- 6) Append the test data of EMC, temperature, and the operation voltage examination for electronic parts installed in prototype vehicles and tested by electronics testing section.  
Submit the circuit diagrams of EUT and the evaluation test data for latch-up of the custom integrated circuits.
- 7) Test equipment needed for conducting the tests in MMC shall be supplied by suppliers.  
EUT: Equipment Under Test.
- 8) The breakdown of one part in EUT must not cause fatal state of EUT.
- 9) Keep the distance between conductors in EUT by 1.0mm or more, except the following;
  - The conductor is insulated with resist.
  - The dampproof coating is spread.
  - The resistance of  $2K\Omega$  is connected between conductors, and there is no influence in the operation when the distance between conductors is 0.65mm or less.

#### 4. Environmental Testing Methods

##### General Conditions

##### 1) Conditions of a testing room

Maintain the ambient temperature during tests at  $(20 \pm 15)^{\circ}\text{C}$  and the relative humidity at  $(65 \pm 20\%)$  unless other values are specified.

##### 2) Power supply voltage

Maintain the power supply voltage of EUT at  $\text{DC}14 \pm 0.5\text{V}$  unless other values are specified.

##### 3) Connection of test equipment

A test shall be performed by connecting a power supply, actual load equipment (such as actuators) and actual sensors to an EUT.

(Not only generator of noises such as a motor and an actuator but also an indicator such as a warning lamp shall be connected, not substituting them for other parts such as a resistance)

An EUT communicating with other systems by serial communication shall be tested the way all functions can be confirmed including communicating functions.

##### 4) Evaluation of test results

- Confirm that an EUT shall operate regularly without a malfunction during and after a test specified in this specification.
- Guarantee an EUT's quality at any level under test levels or at any frequency among test frequency range specified in this specification. (When a maximum test level is 100V, an EUT shall be guarantee at not only 100V but also any voltage under 100V.)
- Guarantee an EUT's quality under all condition (any timing, all operating mode, etc.) regarding the tests described in this specification, unless other values are specified.

##### 5) Report form

Attach the following documents to a test report; a report describing only "OK" or "NG" is not acceptable: (Submit them before the mass production.)

- ① Connections of test equipment, an EUT, electric loads, and sensors with their specifications
- ② Checked items to confirm a normal operation, and their criteria.
- ③ Waveforms measured during a test
- ④ Improvement records from the first stage of development

(A necessary test data must be appended.)

##### 6) Consideration on margin

A test shall be performed on a EUT which could be considered to be at the lowest end of production quality dispersion or a test data which could be enough to certify an acceptable level of products even with a consideration on the production quality dispersion shall be provided.

##### 7) The tests specified in this standard shall be conducted under the same conditions as actual vehicles; the conditions shall be changed when test results differ from MMC's results with vehicles. The condition of grounding EUT shall correspond to the condition with real vehicles in EMC tests and electrostatic discharge tests, etc.

#### 4.1 Normal Power Supply Voltage Test

A test shall be performed with not smaller than 5 pieces of EUT and each one shall suffice the characteristics and performance stipulated in a part specification throughout the whole range of operation voltage stipulated in a relative drawing including the dispersion.

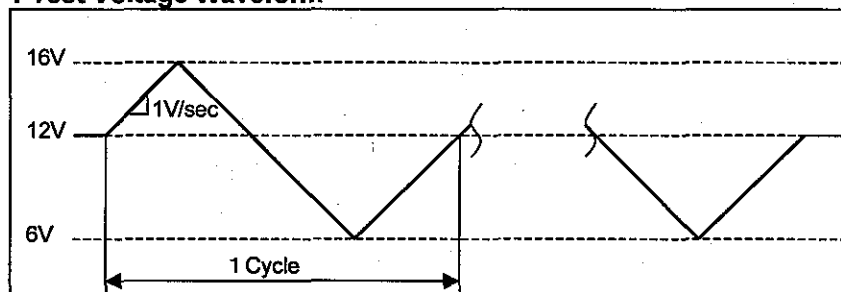
#### 4.2 Supply Voltage Fluctuation Test

##### 1) Voltage Fluctuation Test under Electric Load

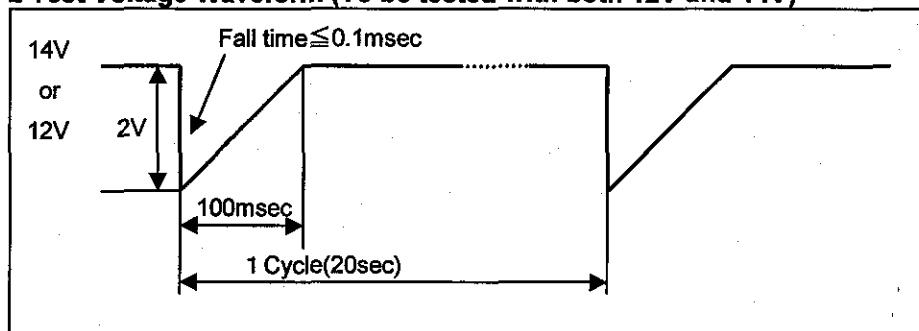
When voltage wave form shown in Figs.1-1, 1-2 and 1-3 are applied to an EUT each for not less than 10 cycles, the unit shall remain without a malfunction. A stop of operation with a supply voltage smaller than the one stipulated in a part specification is permitted; however, a malfunction in an irregular mode is not permitted. In a EUT incorporated with a microcomputer, when the EUT stop operation by waves shown in Figs.1-1, and 1-3 a reset condition shall be recorded in a test report.

- Even when a malfunction takes place in the outside of operation range, the details shall be recorded as a supporting data. An EUT shall operate normally after a test.

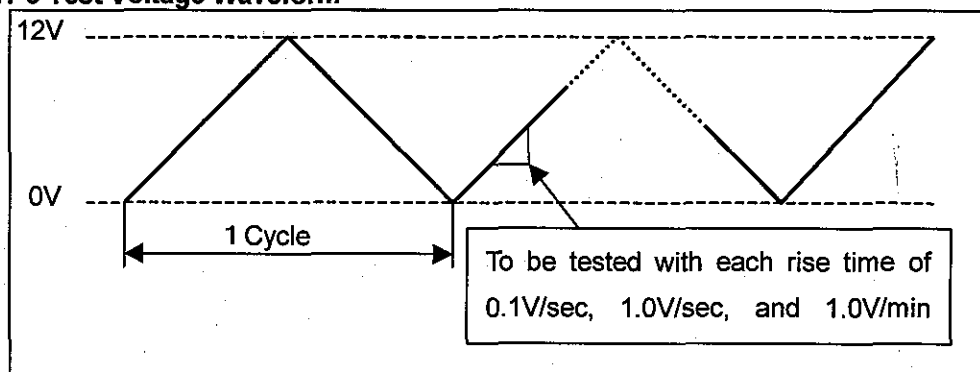
**Fig.1-1 Test Voltage Waveform**



**Fig.1-2 Test Voltage Waveform (To be tested with both 12V and 14V)**



**Fig.1-3 Test Voltage Waveform**



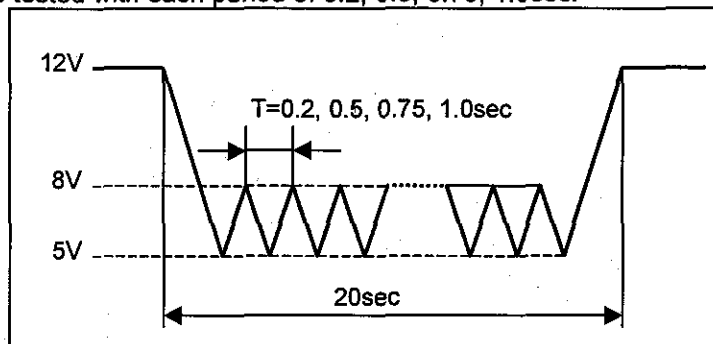
## 2) Voltage Fluctuation Test upon Engine Starting

Test voltage waveform as shown in figs.2-1 and 2-2 is output from a programmable power supply. Each voltage shall be applied to an EUT for 100 cycles. If an operation of the unit is required while an engine is being started (power supplied by IG1 source), it shall not be adversely affected by such voltage application (Group B-1). If an EUT equipped a memory system, its contents shall not be altered (Group B-2). Units which will be turned into an operation (power supplied by IG2 source) shall remain free from a malfunction after the above voltage application (Group A).

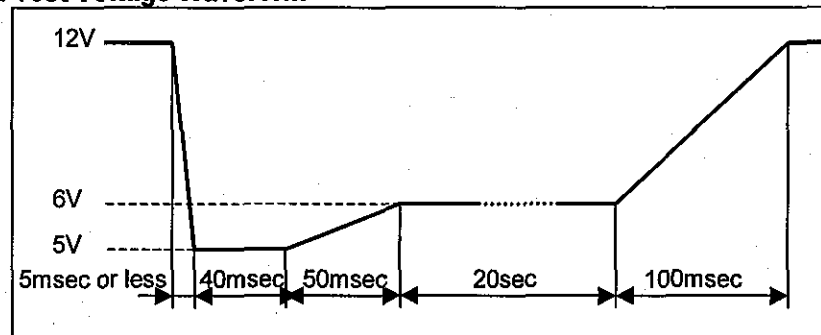
Classification of Equipment	Performance
Group A	Equipment which will be turned into operation when an IG key is turned to IG position. To be operated free from a malfunction even after the voltage application.
Group B	1. Equipment whose operation is required while an engine is being started. To be operated free from a malfunction during and after the voltage application. 2. Equipment with a built-in memory system which needs a power supply constantly. Equipment built with a data storage function shall be free from resetting and alteration of memory after the voltage application.

**Fig.2-1 Test Voltage Waveform**

To be tested with each period of 0.2, 0.5, 0.75, 1.0sec.



**Fig.2-2 Test Voltage Waveform**



A test shall be performed by the method given in 5.1 of JASO D001-94 "General Rules for Environmental Testing Methods of Automotive Electronic Equipment".

## 3) Keeping the memory contents (apply to the memory function of clocks and displays.)

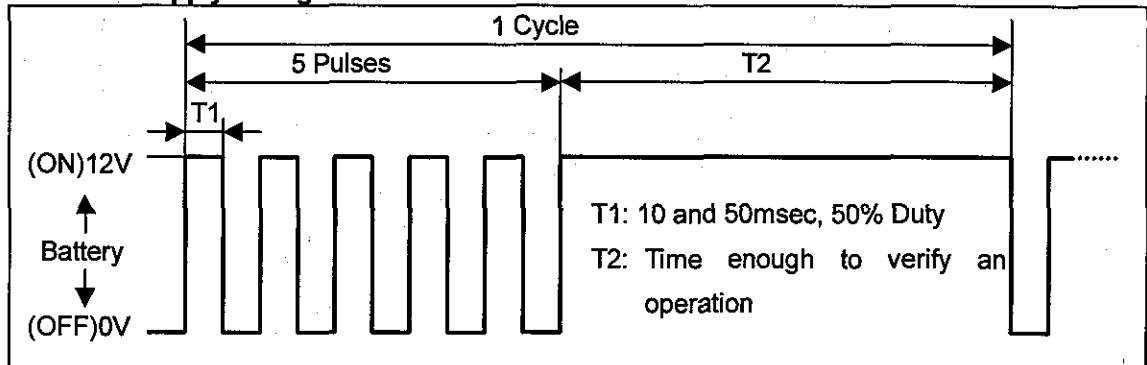
The contents of the memory shall not change after the voltage of the battery voltage decreases from 12.6V to 0V at one second, and returns to 12.6V.

### 4.3 Supply Voltage Intermittent Test

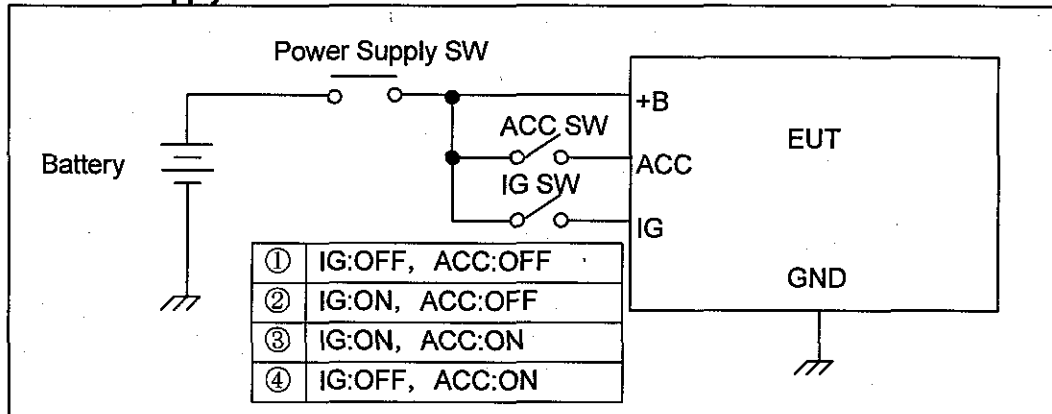
#### 1) Battery Power Supply Chattering Test

An EUT shall be put in an operation by applying a voltage in a rise waveform of power supply as shown in Fig.3-1 to each power supply terminal (+B, IG1, IG2 and Acc). While a supply of such voltage is continued for 10 cycles, the unit shall remain in a normal operation and be free from malfunction. An electronic equipment receiving power through a battery terminal(+B) shall be tested by turning ON and OFF IG key switch and Acc switch in 4 different ways as shown in Fig.3-2.

**Fig.3-1 Power Supply Voltage Rise Waveform**

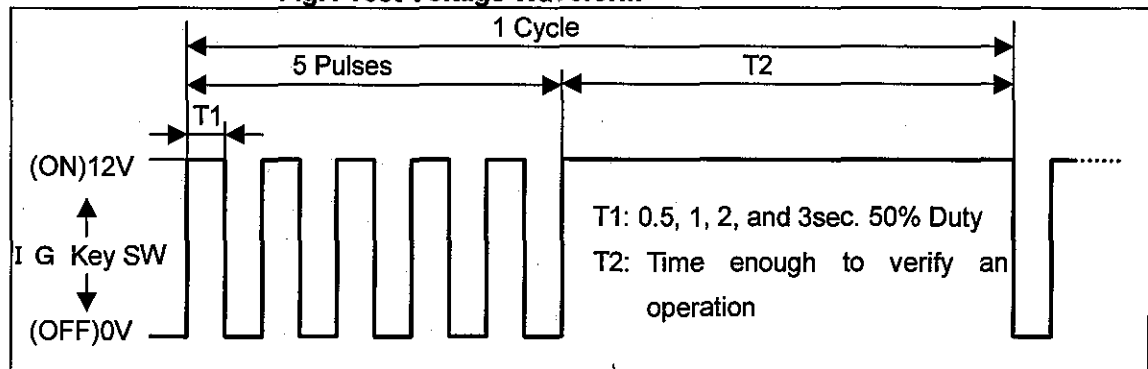


**Fig.3-2 Power Supply Circuit**



#### 2) IG Key Switch Intermittent Test

An EUT shall be operated by applying a voltage in a waveform shown in Fig.4 to each power supply terminal. While a supply of such voltage is continued for 10 cycles, the EUT shall be free from a malfunction. An EUT receiving power through a battery terminal (+B) shall be tested by connecting DC12 to the terminal. The EUT operation shall be monitored while a testing. After the test the EUT shall remain in normal operation and be free from a malfunction.

**Fig.4 Test Voltage Waveform**

#### 4.4 Supply Voltage Reverse Connection Test

After a test voltage at 13V is applied to a power supply terminal in reverse direction for 5min., an EUT shall suffice the characteristics and performance stipulated in a relative part specification. A test shall be performed by the method given in 5.4 of JASO D001-94 "General Rules for Environmental Testing Methods of Automotive Electronic Equipment". If the actual vehicles' wiring harness has a protection device against a battery reverse connection, it is permitted to use the equivalent wiring harness for the test. In that case, the specification of the harness shall be reported as a test condition.

#### 4.5 Over Voltage Test

##### 1) Over Voltage Test (A Method)

During and after DC18V is applied to a power supply terminal of an EUT for 60min., it shall remain free from a malfunction and suffice the characteristics and performance stipulated in a relative part specification. A test shall be performed by Method A given in 5.5 of JASO D001-94 "General Rules for Environmental Testing Methods of Automotive Electronic Equipment".

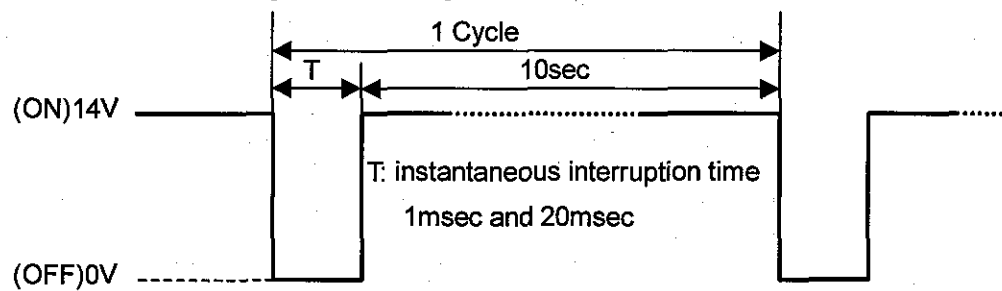
##### 2) Over Voltage Test (B Method)

After DC24V is applied to a power supply terminal of an EUT for 1min., it shall suffice the characteristics and performance stipulated in a relative specification. A test shall be performed by Method B given in 5.6 of JASO D001-94 "General Rules for Environmental Testing Methods of Automotive Electronic Equipment".

#### 4.6 Supply Voltage Instantaneous Interruption

##### 1) Supply Voltage Instantaneous Interruption

A voltage waveform shown in Fig.5 shall be applied separately to a power supply terminal and power supply signal terminals (+B, IG1, IG2 and Acc) each for 5 cycles. An EUT shall remain free from malfunction. If an EUT equipped a memory system, its contents shall not be altered. Stoppage of an operation and cancellation of operation for a safety side of the EUT during an interruption is permitted, however, it can be returned to a normal operation after a test.

**Fig.5 Test Voltage Waveform**

#### 4.7 Transient Voltage Immunity Test

##### 1) Transient Voltage Immunity Test (Along Supply Line Only)

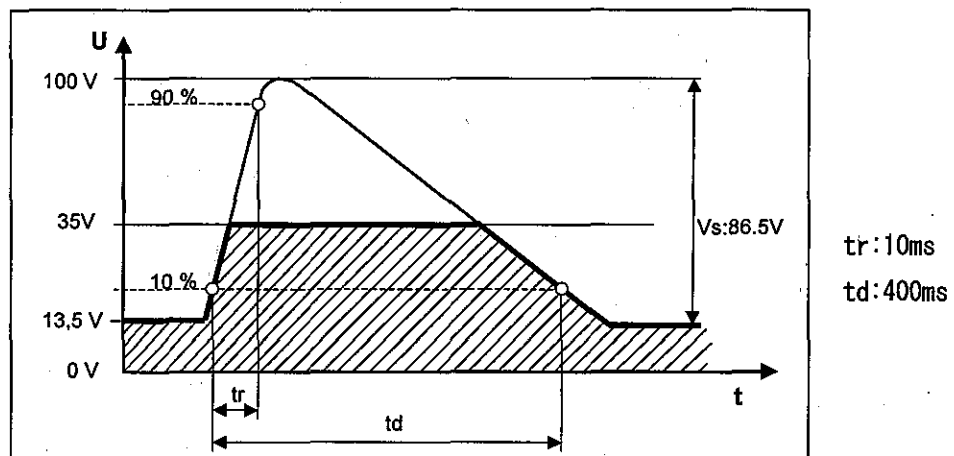
Transient voltage stipulated in ISO-7637 Part 1 1990 and shown in Table 1 shall be applied to a power supply terminal of an EUT. The unit shall be free from malfunction during the test and suffice the characteristics and performance stipulated in a relative part specification after the test.

**Table1 Transient Voltage Test Pulse**

Test Pulse	Test Level	Minimum Number of Pulses/Test Time
1	-100V	5000Pulses
2	+100V	5000Pulses
3a	-150V	1h
3b	+100V	1h
5*1	+86.5 V (+35V*2)	1Pulse

\*1: In a test with a test pulse 5, an output impedance of a test equipment shall be set at  $0.5\Omega$

\*2: In case of the load dump protection in the generator



ISO test method is adopted as a standard transient voltage test in this specification but a test method designated in JASO-D001 and shown in the following could be used by an agreement of the parties concerned. Test voltage pulse stipulated in 5.7 of JASO D001-94 "General Rules for Environmental Testing of Automotive Electronic Equipment" and shown in Table 2 shall be applied to a power supply terminal an EUT. The unit shall be free from malfunction during the test and suffice the characteristics and performance stipulated in a relative part specification after the test. If a lamp bulb



or a fuse is blown off when a transient voltage A-1 is applied, an evaluation shall be determined by a negotiation among the parties concerned. Unless specified particularly in a part specification, test shall be carried out by applying all pulses namely, A-1, A-2, B-1, B-2 and C.

**Table 2 Transient Voltage Test Level**

Type of Transient Voltage Test		Minimum Number of Pulses/Test Time	Remarks
Type A	A-1	1time	
	A-2	10times	
Type B	A-3	94h	To be applied once every 10 seconds
	A-4	94h	
Type C		94h	

**2) Transient Voltage Immunity Test (Except Supply Lines)**

Transient voltage stipulated in ISO-7637 Part 3 1995 and shown in Table 3 shall be applied to a signal line. An EUT shall operate normally during the test and suffice the characteristics and performance stipulated in a relative part specification after the test.

**Table 3 Transient Voltage Test Level**

Test Pulse	Test Level	Test Time
a	-90V	10min
b	+90V	10min

**3) Radiated Transient Voltage Test**

Transient voltage shall be measured by the method designated in ISO-7637 Part 1 1990 and all the values shown in Table 4 shall be sufficed. In an event if the positive and negative amplitude cannot be sufficed due to a problem in design, an evaluation standard should be determined by a negotiation among the parties concerned.

**Table 4 Radiation Transient Voltage**

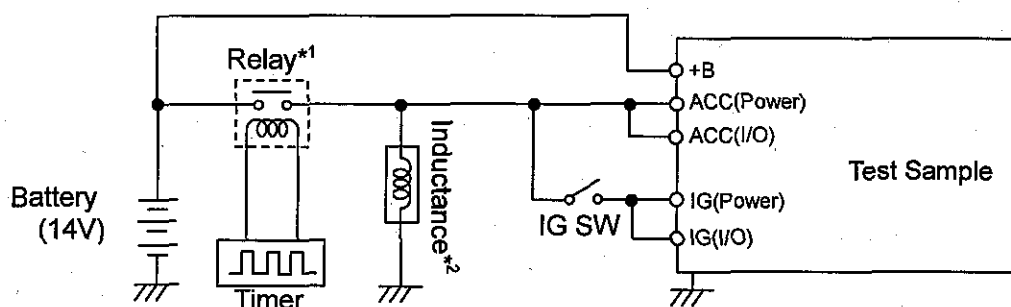
Positive Amplitude (Vs)	Not larger than +25V
Negative Amplitude (Vs)	Not larger than -25V
Sustaining Time (td)	Not longer than 2msec.
Rise/Fall Time (tr)	Not shorter than 5nsec.
Burst Pulse Period (t1)	Not longer than 4msec.
Burst Sustaining Time (t4)	Not longer than 10msec.
Burst Interval (t5)	Not shorter than 90msec.

**4) Transient voltage impression test**

An EUT shall be free from malfunction during and after test when the relay is operated using the following test method. The EUT shall be tested in 2 ways of IG key switch ON or OFF.

1 cycle: Relay on 5min., Relay off 10min.

Test time: Above cycle is repeated for 24 hours



\* 1: The relay employs general-purpose goods equal with G8QN(OMRON).

\* 2: Use the Inductance of 0.3-0.5mH with below 9Ω.

#### 4.8 Electrostatic Discharge Test

The immunity tests against electrostatic discharges shall be carried out in accordance with ISO 10605 for the handling test and IEC 61000-4-2 for the operating test with modifications as given in paragraph 4.8.(2). All DUT shall be subjected to the unpowered handling test and the indirect discharge operating test. DUT that are accessible to the occupants in a vehicle, or in readily accessible underhood or trunk locations, shall be subjected to the direct discharge operating test. For the operating test, the DUT shall be put in operation with all its connected switches, displays, sensors, actuators etc. Wherever possible, production intent parts shall be used. For these tests, the ambient humidity shall be monitored and maintained in the range of 20% to 60% RH. The pulse produced by the ESD simulator shall be characterized using a calibration target as described in IEC 61000-4-2. The pulse shall be measured with a storage scope (sampling rate of 4 giga samples per second minimum, 1GHz analog bandwidth) which shall be shielded from the coaxial target and ground plane assembly. Direct contact characterization shall be used.

##### (1) Handling Test

The DUT, with all leads disconnected, shall be placed on a 50 mm thick nonconductive spacer centered on the HCP. The case, if conductive and case grounded in the vehicle application, shall be similarly connected to the HCP. Use an ESD simulator with a discharge network of 150 pF and 330 ohms.

##### ① Handling test requirements

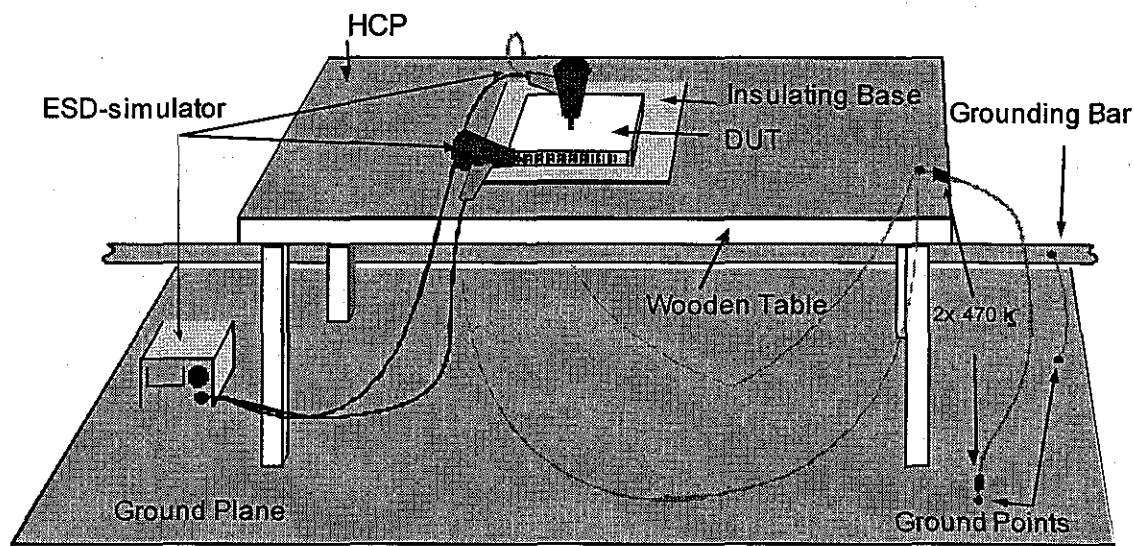
For the handling (unpowered) test, there shall be no damage to the DUT and the DUT shall operate as specified, without effect on stored data, after the test. This is considered Status IV(Temporary malfunctions are allowable if it can be repaired by dealers) in this case as the DUT is not being monitored during the test and no judgment about effects can be made. This is a direct contact discharge test. Refer to the table below.

ESD Immunity Requirements – Handling Test

Test Voltage - Case	Test Voltage – Pins	Status
± 8 kV	± 4 kV	IV

## ② Handling test setup

For a diagram of the test setup, refer to the figure below.



**ESD Handling Test Setup**

- An ESD simulator and contact discharge electrode according to IEC 61000-4-2 shall be used.
- The HCP shall be placed on the test bench and connected to the ground reference plane via two series 470 kohm resistors. The HCP shall be large enough so as to protrude beyond the DUT on all sides by at least 100 mm.

## ③ Handling test conditions

- Before testing commences, the discharge voltage of the ESD simulator shall be verified.
- Discharge points: potentially all points that can be touched by the user during packaging, installation or dismantling. In the case where the connector(s) on the DUT are configured so that individual pins are not readily accessible, or the pins are closely spaced such that discharge to individual pins is not practical, then an extender cable shall be used. This cable shall be 100 mm in length (solid wire recommended) and discharges shall be made to the fanned out leads at the end of this cable. The individual discharge points shall be discussed with related engineers including the electronics testing section.
- For each of the required discharge voltages, 3 discharges of positive and 3 discharges of negative polarity shall be performed at each of the specified discharge points.
- Between two individual discharges, the charge applied shall be removed via a grounded discharge resistor with approximately 1 megohm resistance (e.g.  $2 \times 470$  kohm resistors in series) by touching the discharge point and the housing. Alternatively, at least 5 s can be allowed to pass between two discharges.
- After all discharges have been carried out at each voltage level, a functional performance test shall be conducted. The results shall be documented in the test report.

**(2) Operating Test**

DUT that are accessible to occupants inside the vehicle shall be tested using an ESD simulator with a discharge network of 330 pF and 330 ohms. For DUT that are in underhood or trunk locations use a discharge network of 150 pF and 330 ohms.

**① Operating Test Requirements**

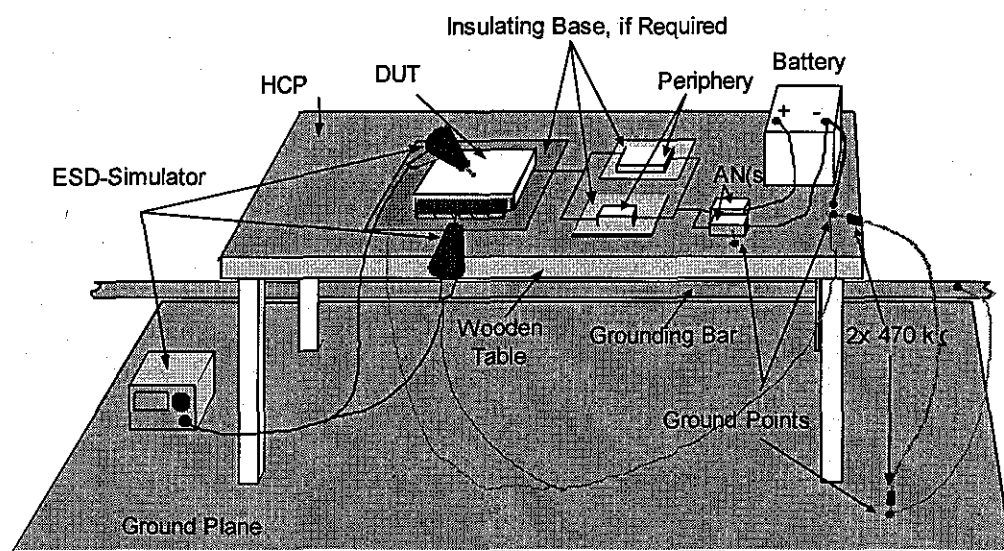
For the operating (powered) tests, the DUT shall be monitored during operation. There shall be no lockups of the DUT requiring power off reset and Group C and D functions of the DUT shall not be affected by the ESD (Status I), Group A and B functions are allowed Status II (DUT could move to the failsafe mode during the test or discharging. It shall recover automatically to its normal mode after the test or discharging). Refer to the table below.

**ESD Immunity Requirements – Operating Test**

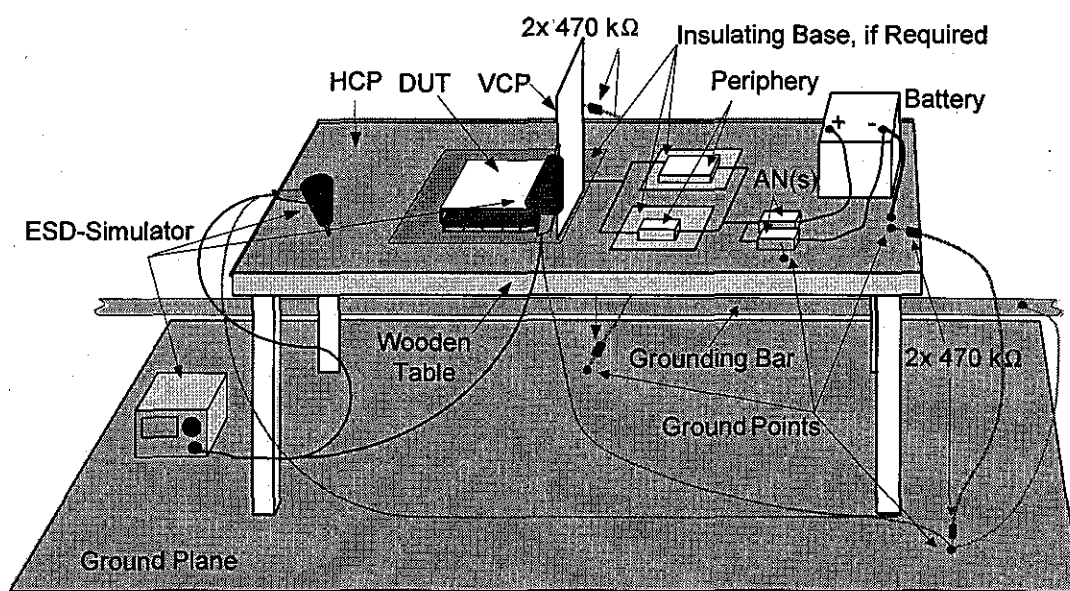
Test Voltage		Group A Status (Parts for comfort)	Group B Status (Critical parts but not for vehicle control)	Group C Status (For vehicle control)	Group D Status (Explosive device like SRS)
Air	Contact				
± 25 kV	No Test	No Test		No Test	I
± 20 kV				II	I
± 15 kV	± 8 kV	II	II	I	I
± 8 kV	± 4 kV	II	I	I	I
± 4 kV	± 3 kV	II	I	I	I

**② Operating test setup**

For a schematic diagram of the test setup during the performance of direct and indirect discharges refer to the figures below.



**ESD Operating Test - Direct Discharge**



**ESD Operating Test - Indirect Discharge**

- An ESD simulator and discharge electrode according to IEC 61000-4-2 shall be used.
- DUT with metal enclosures shall be placed directly on the HCP and conductively connected with it; all other devices shall be placed on a 50 mm thick nonconductive spacer centered on the HCP.
- The ground connection of the DUT shall be connected as intended in the vehicle - directly via the vehicle body (i.e. the HCP) or via the wiring harness.
- The battery ground shall be electrically connected to the HCP.
- Any peripheral support equipment shall be separated from the DUT by at least 200 mm.
- Wherever possible, the production intent wiring harness shall be used.

### ③ Operating test conditions

- Before testing commences, the discharge voltage of the ESD simulator shall be verified.
- Discharge points: Potentially all points which can be touched by the user after installation, including any DUT switches, displays, cables, plugs etc, and the HCP as well as the VCP. The individual discharge points shall be discussed with related engineers including the electronics testing section.
- For discharges at points which can be touched by a person remaining inside the vehicle, a discharge capacity of 330 pF shall be used, otherwise use 150 pF. For indirect discharges to the HCP and VCP, 330 pF shall be used. The discharge capacity shall be specified in the test plan.
- For indirect discharges into the HCP and VCP, the distance to the DUT shall be 100 mm and the air discharges may be omitted.
- For each polarity and voltage, 10 contact discharges shall be carried out at each of the specified discharge points. In this process, the ESD simulator with the contact discharge electrode shall be positioned on the device and then discharged.
- For each polarity and voltage, 10 air discharges shall be carried out at each of the specified discharge points. In this process, the ESD simulator with the air discharge electrode shall be moved towards the discharge point as quickly as possible until discharge occurs.
- Between two individual discharges, the charge applied shall be removed via a grounded discharge resistor with approximately 1 megohm resistance (e.g.  $2 \times 470$  kohm resistors in series) by touching the discharge point and the housing. Alternatively, at least 1 s can be allowed to pass between two discharges.

## 4.9 Electromagnetic Interference Test

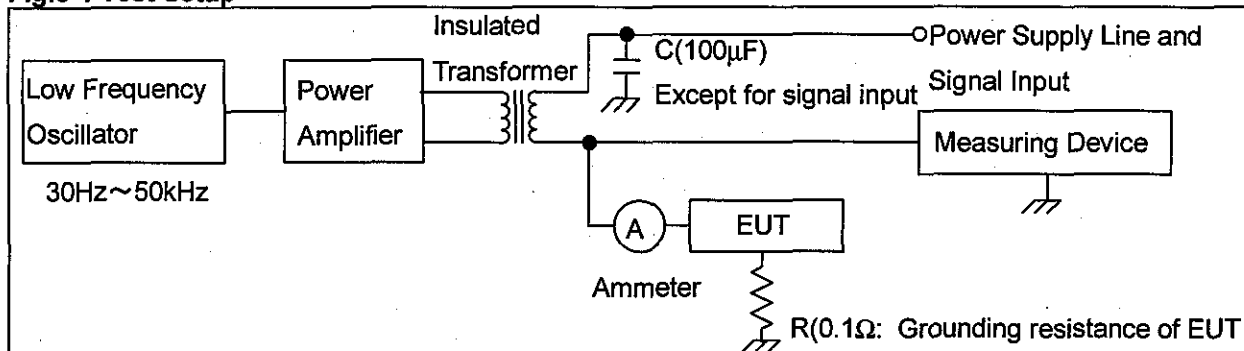
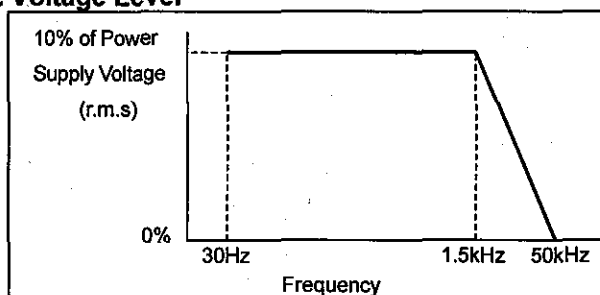
### 4.9.1 Conducted Electromagnetic Test

#### 1) Electromagnetic Disturbance Test

When an interference electromagnetic voltage shown in Fig.6-2 is applied to a power supply line and a signal input<sup>\*2</sup> in a test arrangement<sup>\*1</sup> as shown in Fig.6-1, an EUT shall be free from malfunction. An interference electromagnetic current shall be limited at 3 amperes as an upper limit.

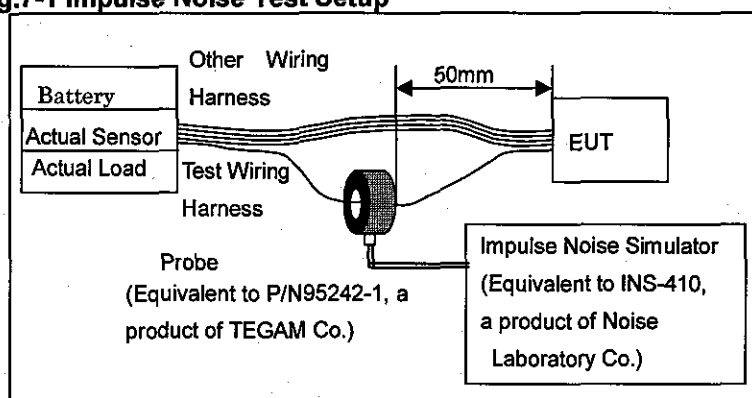
\*1: It is permitted to apply the voltage shown in Fig.6-2 to a power supply line directly by using programmable power supply etc..

\*2: A portion of very weak input and output signals may be omitted by an agreement of the parties concerned.

**Fig.6-1 Test Setup****Fig.6-2 Voltage Level****2) Impulse Noise Test**

In a test setup shown in Fig.7-1, each wiring harness shall be injected respectively with an output voltage of a noise simulator being increased gradually.

All deviation from normal operation shall be recorded and an evaluation shall be made by the standard shown in Table 6-1. This test may be omitted or alternative tests may be allowed with the discussion among related engineers including the electronics testing section.

**Fig.7-1 Impulse Noise Test Setup****Table 6-1 Impulse Noise Test Condition**

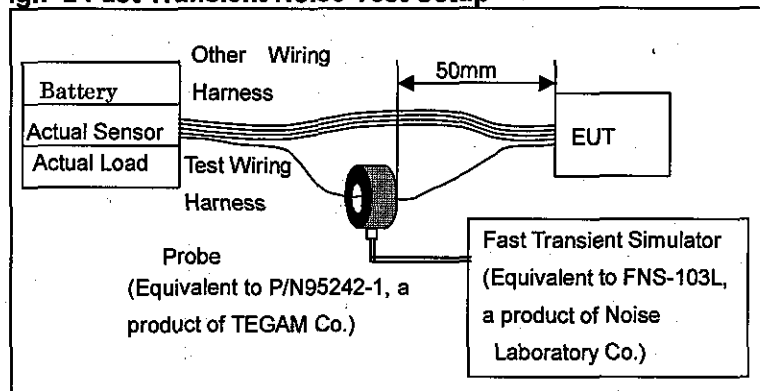
Pulse Width	1μsec	
Injection Period	10msec	
Test Time	10min	
Evaluation Standard	≤±500V	To be free from a malfunction
	±500V~2kV	In case of a malfunction, necessity of countermeasures shall be determined according to fault contents

### 3) Fast Transient Noise Test


In a test setup shown in Fig.7-2, each wiring harness shall be injected respectively with an output voltage of a noise simulator being increased gradually.

All deviation from normal operation shall be recorded and an evaluation shall be made by the standard shown in Table 6-2. This test may be omitted or alternative tests may be allowed with the discussion among related engineers including the electronics testing section.

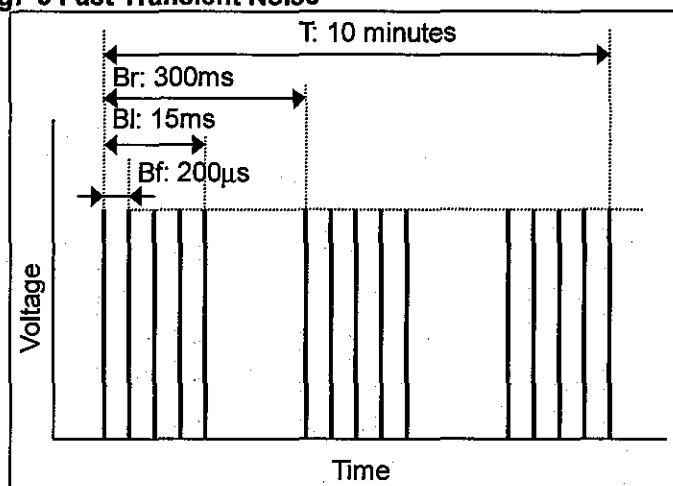
**Fig.7-2 Fast Transient Noise Test Setup**



**Table6-2 Fast Transient Noise Condition**

Injection Period(Bf)	200 $\mu$ sec	
Burst Length(Bl)	15ms	
Burst repetition time(Br)	300ms	
Test Time(T)	10min	
Evaluation Standard 	$\leq +2$ kV	To be free from a malfunction
	$\pm 2$ kV-4kV	In case of a malfunction, necessity of countermeasures shall be determined according to fault contents

**Fig7-3 Fast Transient Noise**





#### 4.9.2 Radiated Electromagnetic Test

##### 1) Electromagnetic Immunity Test

Immunity of EUT to electromagnetic radiation shall be tested by the method stipulated by ANNEX 9 of EC Commission Directive 95/54/EC. A unit shall keep immunity in field strength levels shown in Table 7 when a range of frequency between 10KHz and 18GHz is applied to it in a radio wave irradiation method, TEM cell method, BCI method or stripline method. A test shall be performed by both unmodulation and modulation (1KHz/80%/AM). The field strength level shown in Table 7 is for unmodulation. In the test with amplitude modulated wave, the maximum envelope excursion of the test signal shall equal the maximum envelope excursion of an unmodulated sine wave.

Table 7

Free Field Method	100V/m
TEM Cell Method	100V/m
BCI Method	107mA
Stripline Method	100V/m

Example

10kHz~40MHz: Stripline Method

40MHz~200MHz: TEM Cell Method

200MHz~18GHz: Free Field Method

##### 2) Electromagnetic Immunity Test (Handy Transceiver Method)

A handy transceiver of a specification as shown below shall be held above an EUT in a way as shown in Fig.8 and moved along wiring harness for 30cm while radio wave is being transmitted. The unit shall suffice the following condition in this instance. The antenna of transceiver shall be pointed in 3 directions namely, (1) parallel with wiring harness, (2) at right angle to wiring harness and (3) front tip of antenna pointed to wiring harness.

Distance between Wiring Harness and Antenna	Evaluation Standard (Please see Table 8.)
0cm <sup>*1</sup>	To be free from a malfunction of Rank I.
3cm	To be free from malfunction of Rank I and II.
8cm	To be free from malfunction operation Rank I, II and III.

\*1: An electronic equipment to be installed in engine compartment or truck space, or to be shielded by a protection cover or trim cover shall be subjected to an irradiation of radio wave transmitted in 3cm distance.

##### ○ Applicable Handy Transceiver

(An output is a nominal value set by a manufacturer.)

144MHz 5W(CW, FM)

430MHz 5W(CW, FM)

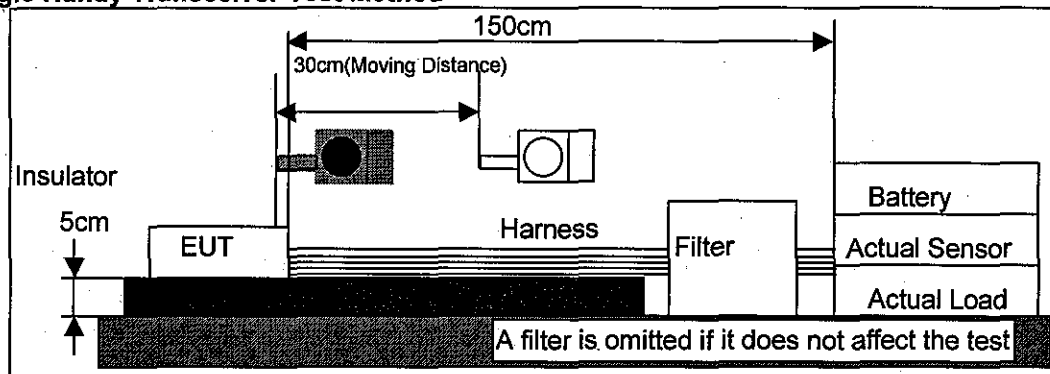
900MHz 5W(CW, FM): When a handy type transceiver is not available, a car mounting type personal radio unit may be used.

1200MHz 1W(CW, FM)

##### ○ Portable telephone(digital)

PDC(925-960MHz, 1420-1460MHz)

PHS(1890-1920MHz)

**Fig.8 Handy Transceiver Test Method****Table 8 Classification of Malfunctions**

Classification		Example
Rank I	Malfunction or breakdown which would impair a vehicle safety or bring forth a difficulty to a cruising function.	<ul style="list-style-type: none"> <li>Engine stall</li> <li>Uncontrollable run</li> <li>Brake malfunction</li> <li>Headlamp off</li> <li>Faulty explosion and non operation of air bag</li> </ul>
Rank II	Malfunction or breakdown which would bring forth a difficulty to cruising function except for rank I.	<ul style="list-style-type: none"> <li>Stop of turn signal lamp flashing</li> <li>Erasure of memory</li> <li>Malfunction of fail-safe mechanism</li> </ul>
Rank III*	Malfunction or breakdown which will not be directly associated with vehicle's function.	<ul style="list-style-type: none"> <li>Swinging of tachometer pointer</li> <li>Malfunction of transitory nature</li> </ul>

\*: A need for a remedial action for rank III failure will be discussed in each occasion and an action shall be taken by weighing a nature and also considering a level of action taken in the competitive models.

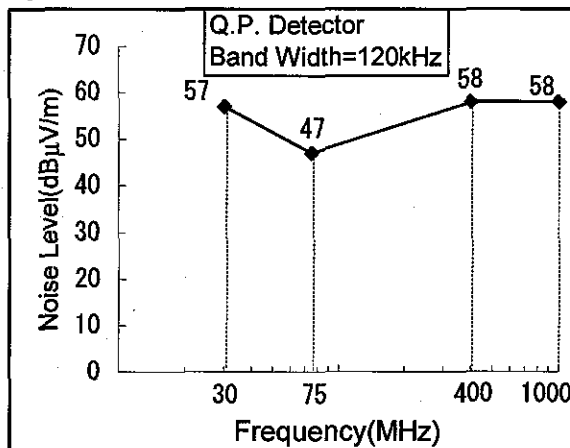
### 3) Helmholtz Coil Test

Magnetic field ranging from 160dB (60Hz) to 52dB (30kHz) [12dB/OCT] shall be applied to an EUT at a unit of 1 picotesla in a frequency between 60Hz and 30kHz by using a Helmholtz tester. It is given in 5.10 of JASO D001-94 "General Rules for Environmental Testing Methods of Automotive Electronic Equipment". The unit shall be free from malfunction.

### 4.9.3 Broadband Emissions Measurement

#### 1) Broadband Emissions Measurement(This test shall also apply to EUTs that radiate narrow band noise.)

Broadband Emissions from electronic parts, motor, electromagnetic solenoid, etc. shall be measured by the method specified by ANNEX 7 of EC Commission Directive 95/54/EC and their values shall not exceed the value shown in Fig.9.

**Fig.9 Broadband Emissions Limit****2) Magnetic Emissions Measurement**

Magnetic Emissions which will be radiated from a magnetic field generating part shall be measured in a point 25cm apart from it and the value shall not be larger than 160dBpT (60Hz) to 62dBpT (30kHz) in a frequency between 60Hz and 30KHz.

**3) Conducted Noise Measurement**

This is the test for active devices and electronically controlled motors (categories A and ECM?). Both CISPR 25 voltage on supply lines and CISPR 25 current measurement on all lines shall be performed in the frequency range from 150 kHz to 110 MHz.

Brush commutated electric motors (category BCM) and pulsed inductive devices (category IP) shall be tested for RF broadband emissions (no narrowband) over the frequency range from 150 kHz to 200 MHz using the CISPR 25 voltage method.

Passive devices (category P) are not tested for RF emissions.

For narrowband emissions both peak (P) and average (AV) detectors are allowed, unless specified otherwise. For broadband emissions both peak and quasi-peak (QP) detectors are allowed to 200 MHz, unless specified otherwise. When a spectrum analyzer is used for peak or quasi-peak detector measurements, the video bandwidth shall be at least three times the resolution bandwidth. For receivers, frequency step sizes shall be  $\leq 50\%$  of the measurement bandwidth unless otherwise specified in the product specification and/or test plan. If a spectrum analyzer is used the sweep rate shall be 1 MHz per second or slower for 9/10 kHz resolution bandwidth (RBW) and 10 MHz per second or slower for 100/120 kHz RBW. For QP, these sweep rates become 1 kHz or slower for 9/10 kHz RBW and 10 kHz or slower for 100/120 kHz RBW. Minimum receiver measurement times are in the table below.

**Minimum Receiver Measurement Time**

Detector Type	Minimum Measurement Time (ms)
Peak (P)	50
Average (AV)	9/10kHz: 50
	100/120kHz: 100
Quasi-peak (QP)	1000

Limits are given for the continuous frequency ranges (150 kHz to 110/200 MHz) and for the specified frequency ranges where protection for onboard receivers is required. At transition frequencies where the limit changes, the lower level will apply. Consideration will be given to emissions at frequencies between 5% below the lower frequency and 5% above the upper frequency for each onboard receiver band.

#### ① CISPR 25 Conducted RF Emissions - (Voltage on Supply Lines) \*\*\*

Radio disturbance emissions conducted along supply lines shall be measured in accordance with CISPR 25 within the frequency range of 150 kHz to 110/200 MHz (see Figure 1) using one or several artificial networks allowing the decoupling of the disturbance voltage. Artificial network(s) in accordance with CISPR shall be used. The test setups for devices under test with several supply voltage connections shall be implemented using the appropriate number of ANs.

#### > Requirement

The measurements shall be made in the frequency range from 150 kHz to 30 MHz with a measuring bandwidth of 9 or 10 kHz. The measurements shall be made in the frequency range from 30 MHz to 110/200 MHz with a measurement bandwidth of 100 or 120 kHz except where additional narrowband measurements with 9/10 kHz bandwidth are specified. The measured values shall be below the limit values indicated in Tables 9. (the limit values indicated on the tables below are selectable)

**CISPR 25 Conducted RF Emissions Basic Limit Levels on Power Lines**

Frequency Range	NB Limit (dB $\mu$ V) P or AV	BB Limit (dB $\mu$ V) P or QP
150 to 500 kHz	94 to 70	104 to 80
500 kHz to 6.3 MHz	70	80
6.3 to 30 MHz	60	70
30 to 110/200 MHz	50	60

**CISPR 25 Measurement Settings and Narrowband CE Limit Levels on Power Lines for Specified Frequency Bands**

Test No.	Usage	Frequency Range (MHz)	Measuring Instrument Bandwidth (kHz)	Limit Value (dB $\mu$ V) P or AV
Global Requirements				
G1	LW AM (EU)	0.15 – 0.28	9/10	50
G2	MW AM	0.53 – 1.7	9/10	34
G3	SW AM (EU)	5.8 – 6.3	9/10	33
G4	Communications (NA)	30 – 54	9/10	24
G5	Communications/TV (EU)	65 – 87.5	100/120	24
G6	VHF	87.5 – 108	100/120	24
Optional Requirements for Europe				

Test No.	Usage	Frequency Range (MHz)	Measuring Instrument Bandwidth (kHz)	Limit Value (dB $\mu$ V) P or AV
OEU1	Fleet	7.1 – 7.6 9.3 – 10.0 11.5 – 12.1 13.6 – 13.8 15.0 – 15.7	9/10	33
OEU2	Communications	25 – 30	9/10	24
OEU3	TV I	41 – 65	100/120	24
OEU4	Fleet	84.015 – 87.255	9/10	12
Optional Requirements for North America				
ONA1	Fleet	30 – 54	9/10	12

**CISPR 25 Measurement Settings and Broadband CE Limit Levels on Power Lines for Specified Frequency Bands**

Test No.	Usage	Frequency Range (MHz)	Limit Value (dB $\mu$ V) P or QP
Global Requirements			
G1	LW AM (EU)	0.15 – 0.28	60
G2	MW AM	0.53 – 1.7	50
G3	SW AM (EU)	5.8 – 6.3	40
G4	Communications (NA)	30 – 54	24
G5	Communications/TV (EU)	65 – 87.5	24
G6	VHF	87.5 – 108	24
G7	Communications	140 – 180	24
Optional Requirements for Europe			
OEU1	SW AM Fleet	7.1 – 7.6 9.3 – 10.0 11.5 – 12.1 13.6 – 13.8 15.0 – 15.7	40
OEU2	Communications	25 – 30	24
OEU3	TV I TV III	41 – 65 180 – 200	24

### ➤ Test setup

Test setup is described in detail in CISPR 25. The test setup for devices under test with several supply voltage connections shall be implemented accordingly. Action shall be taken to ensure that the DUT emits its maximum disturbance power (occurring during normal operation) during the measurement.

### ② CISPR 25 Conducted RF Emissions - (Current on all Lines in Harness) \*\*\*

The emitted radio disturbance currents shall be measured on the wiring harness in accordance with CISPR 25 using a current probe within the frequency range of 150 kHz to 110 MHz including the power leads in the current probe. The power supply shall be connected via an artificial network (AN) in accordance with CISPR 25.

### ➤ Requirements

The measurements shall be made in the frequency range from 150 kHz to 30 MHz with a measuring bandwidth of 9 or 10 kHz. The measurements shall be made in the frequency range from 30 MHz to 110/200 MHz with a measurement bandwidth of 100 or 120 kHz except where additional narrowband measurements with 9/10 kHz bandwidth are specified. All measured values shall be below the limit values in Tables. (the limit values indicated on Tables are selectable)

**CISPR 25 Conducted RF Emissions Basic Limit Levels on All Lines**

Frequency Range	NB Limit (dB $\mu$ A) P or AV	BB Limit (dB $\mu$ A) P or QP
150 to 500 kHz	68 to 44	78 to 54
500 kHz to 6.3 MHz	38	48
6.3 to 30 MHz	26	36
30 to 110/200 MHz	16	26

**CISPR 25 Measurement Settings and Narrowband CE Limit Levels on All Lines for Specified Frequency Bands**

Test No.	Usage	Frequency Range (MHz)	Measuring Instrument Bandwidth (kHz)	Limit Value (dB $\mu$ A) P or AV
<b>Global Requirements</b>				
G1	LW AM (EU)	0.15 – 0.28	9/10	30
G2	MW AM	0.53 – 1.7	9/10	6
G3	SW AM (EU)	5.8 – 6.3	9/10	-1
G4	Communications (NA)	30 – 54	9/10	-6
G5	Communications/TV (EU)	65 – 87.5	100/120	-10
G6	VHF	87.5 – 108	100/120	-10
<b>Optional Requirements for Europe</b>				

Test No.	Usage	Frequency Range (MHz)	Measuring Instrument Bandwidth (kHz)	Limit Value (dBμA) P or AV
OEU1	Fleet	7.1 – 7.6 9.3 – 10.0 11.5 – 12.1 13.6 – 13.8 15.0 – 15.7	9/10	-1
OEU2	Communications	25 – 30	9/10	-6
OEU3	TV I	41 – 65	100/120	-10
OEU5	Fleet	84.015 – 87.255	9/10	-16
Optional Requirements for North America				
DNA1	Fleet	30 – 54	9/10	-6

**CISPR 25 Measurement Settings and Broadband CE Limit Levels on All Lines for Specified Frequency Bands**

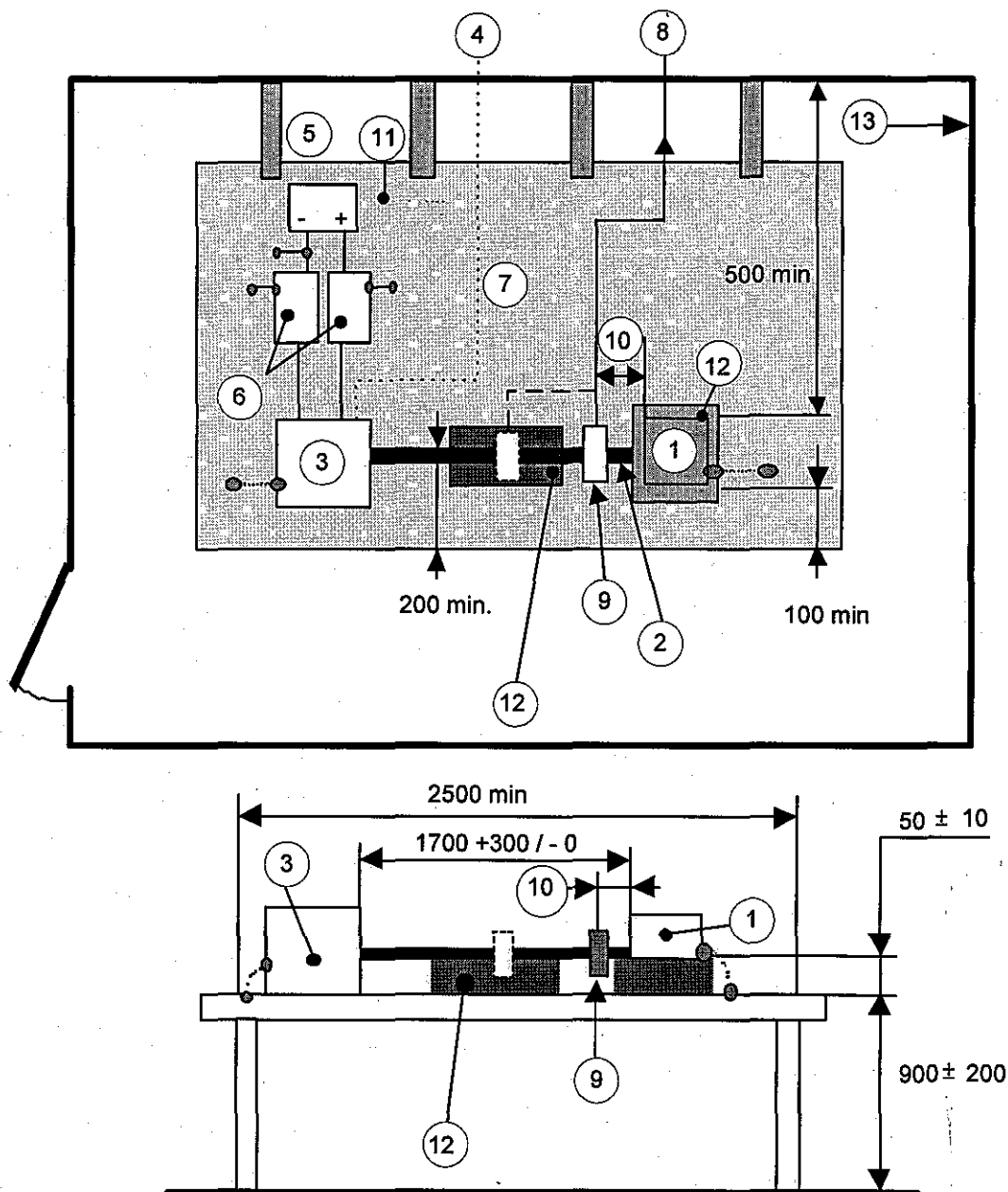
Test No.	Usage	Frequency Range (MHz)	Limit Value (dBμA) P or QP
Global Requirements			
G1	LW AM	0.15 – 0.28	40
G2	MW AM	0.53 – 1.7	22
G3	SW AM	5.8 – 6.3	6
G4	Communications (NA)	30 – 54	6
G5	Communications/TV (EU)	65 – 87.5	-10
G6	VHF	87.5 – 108	-10
G7	Communications	140 – 180	-10
Optional Requirements for Europe			
OEU1	SW AM Fleet	7.1 – 7.6 9.3 – 10.0 11.5 – 12.1 13.6 – 13.8 15.0 – 15.7	6
OEU2	Communications	25 – 30	6
OEU3	TV I TV III	41 – 65 180 – 200	-10

### ➤ Test setup

CISPR 25 applies with the following exceptions:

- The test harness shall be 1700 (+ 300, - 0) mm long and routed 50 mm above the ground plane
- Measurements shall be taken at the following one or two points:
  - at a distance of  $50 \pm 10$  mm from the DUT connector or case over all frequencies;
  - at a distance of  $750 \pm 50$  mm from the DUT connector or case for frequencies above 30 MHz;

For a schematic diagram of the measuring setup, refer to the figure below.





**Key:**

- |   |   |    |   |
|---|---|----|---|
| 1 | Device under test (connected to ground if specified in the test plan)     | 7  | Optical fibers  |
| 2 | Wiring harness  | 8  | Measurement equipment                                   |
| 3 | Load simulator (placement and ground connection according to ISO 11452-4) | 9  | Current probe (represented at 2 positions)              |
| 4 | Stimulation and monitoring system   | 10 | The distance from the DUT to the closest probe position |
| 5 | Power supply  | 11 | Ground plane (connected to the shielded room)           |
| 6 | AN or 50 ohm BAN  | 12 | Insulating support                                      |
|   |   | 13 | Shielded room   |

This figure is adapted from ISO WD 11452-4.

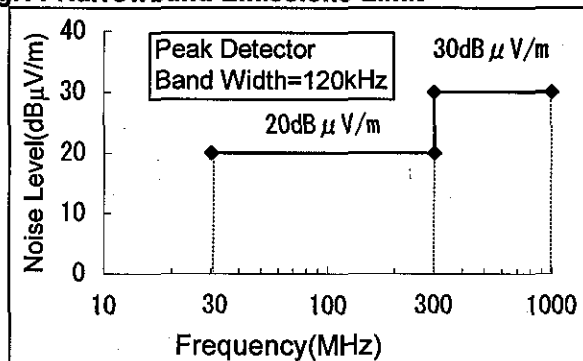
Figure 3: Measurement of Radio Disturbance Currents Conducted along the Wiring Harness

#### 4.9.4 Narrowband Emissions Measurement

##### 1) Spectrum Analysis Method

Narrowband radiation electromagnetic Emission shall be tested by the method specified by ANNEX 8 of EC Commission Directive 95/54/EC and its value shall not exceed the standard shown in Fig.11. If a noise emitted from a communication line between parts becomes a problem, another method of test shall be worked out by a negotiation among the parties concerned.

Fig.11 Narrowband Emissions Limit



##### 2) Handy Transceiver Method

When the antenna of a transceiver is touched directly to a case or a wiring harness of a control unit and the frequency of the transceiver shall be set to 145.00MHz and 433.00MHz respectively, no noise from the unit shall interfere in the transceiver.. (A test shall be performed with an amateur radio band frequency generally applied in a country other than Japan.)

#### 4.9.5 Vehicle Test

An EUT shall be free from the following problems in an actual vehicle test.

- An electric noise generated by the unit shall not cause a wrong effect to a radio, stereo unit, and other vehicle mounted equipment. It shall also be free from deterioration of S/N and a misstop while seeking broadcasting station. (An evaluation standard shall be not larger than 8dBuV measured by the method given in CISPR25 "Measurement of Radiation Noise Received by Antenna Mounted on Same Vehicle" with frequency at 70MHz to 110MHz.)
- When the unit suffices this specification and yet a malfunction may be caused by electric noises emitted from other units mounted on a same vehicle, a remedial action shall be worked out jointly by a supplier and MMC.

Example: Transition voltage generated by motor, relay, and solenoid, etc.

Electronic devices (Key-less entry and GPS, etc.) which use radio wave

- c. The unit shall be free from malfunction under the field strength radiated by on-board transmitters(100W), cellular phones(20W), and external antennas(100V/m, substitution method).
- d. The unit shall be free from malfunction during and after an electrostatic discharge test.
- e. The unit shall be free from malfunction during and after a fast Transient and an impulse noise test.
- f. The supplier must offer the reason which requires the vehicle test when the vehicle test is necessary.

#### 4.10 Low Temperature Shelf Test

When an EUT is left in an ambience at -40°C for 70 hours and then at a room temperature for 2 hours, it shall still fulfill the characteristics and performance stipulated in a relative part specification. A test shall be performed by the method given in 5.12 of JASO D001-94 "General Rules for Environmental Testing of Automotive Electronic Equipment".

#### 4.11 Low Temperature Operating Test

When an EUT is left in an ambience at -30°C for 1 hour and, then, operated for 70 hours, it shall be free from irregular action. A power shall always be supplied to +B and ON for 30min. and OFF for 2 hours shall be repeated to Acc and IG power supply lines.

#### 4.12 High Temperature Shelf Test

When an EUT is left in an ambience at a temperature shown in Table 9 for 94 hours and, then, at a room temperature for longer than 2 hours, it shall suffice the characteristics and performance stipulated in a relative part specification and in 4.1 through 4.9 above.

**Table 9 Temperature for Exposure**

Classification of Equipment		Temperature for Exposure(°C)
Group 1	For installation in a vehicle room or trunk space	85
Group 2	An equipment set up at the upper part of instrument panel and rear deck, and position where direct sunshine is received.	105
Group 3	An equipment other than group 4 for installation in an engine compartment	125, 135*
Group 4	For installation in a proximity of scorching section or a special section	To be determined separately from this specification

\*: An execution of test at 135°C will be stipulated in a relative drawing and part specification.

A test shall be performed by the method given in 5.14. of JASO D001-94 "General Rules for Environmental Testing of Automotive Electronic Equipment".

#### 4.13 High Temperature Operating Test

An EUT shall be operated under a temperature shown in Table 10 for 118 hours. It shall be operated normally throughout the test. A test sample shall not be exposed from a current of air in the constant temperature chamber.

**Table 10 Temperature for Exposure**

Classification of Function	Temperature for Exposure (°C)
Group 1	75
Group 2	95
Group 3	100, 115*, 125*
Group 4	To be specified separately

Remarks:

Classification of equipment is as shown in Table 9.

\*: An execution of test at 115 and 125 °C will be stipulated in a relative drawing and part specification.

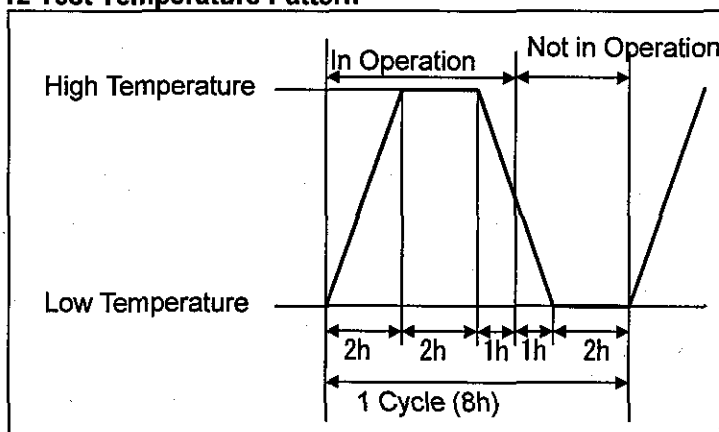
When the parts equipped in an engine compartment are to be tested at other temperatures they will be stipulated in a relative drawing and a part specification.

A test shall be performed by the method given in 5.15. of JASO D001-94 "General Rules for Environmental Testing of Automotive Electronic Equipment".

#### 4.14 Temperature Cycle Test

After an EUT is left in an ambience at -30°C, it shall be subjected to temperature in a pattern as shown in Fig.12 which shall be repeated for 30 cycles. The unit shall operate normally throughout the test and suffice the characteristics and performance stipulated in a relative part specification after it is left in a room temperature for longer than 2 hours.

**Fig.12 Test Temperature Pattern**



**Table 11 Temperature in Pattern**

Classification of Function	Temperature for Exposure	
	High Temperature(°C)	Low Temperature(°C)
Group 1	75	-30
Group 2	95	
Group 3	100,115*, 125*	
Group 4	To be specified separately	

\*: An execution of a test at 115 and 125°C will be specified in a relative part specification.

A test shall be performed by the method given in 5.16. of JASO D001-94 "General Rules for

Environmental Testing of Automotive Electronic Equipment”.

When the parts equipped in an engine compartment are to be tested at other temperatures they will be stipulated in a relative drawing and a part specification.

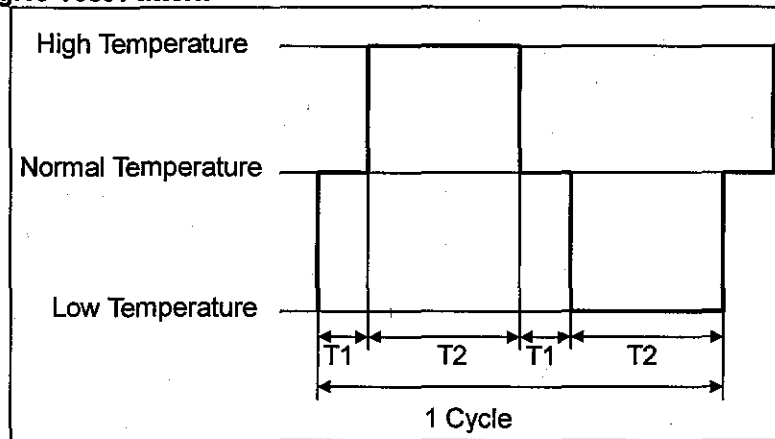
#### 4.15 Thermal Shock Test

After an EUT is left in an ambience at  $-40^{\circ}\text{C}$  for 2 hours, a thermal impact in a pattern as shown in Fig.13 shall be applied to it repetitively for a number of cycles shown in the following. After it is left in a room temperature for longer than 2 hours, it shall remain intact without a crack formed on a solder and electronic part and a peel of printed substrate and further suffice the characteristics and performance stipulated in a relative part specification.

Electronic part for installation in engine compartment: 500 cycles

Electronic part for installation in a vehicle room: 100 cycles

**Fig.13 Test Pattern**



**Table 12 Temperature in Pattern**

Classification of Function	Temperature for Exposure	
	High Temperature( $^{\circ}\text{C}$ )	Low Temperature( $^{\circ}\text{C}$ )
Group 1	85	-40
Group 2	105	
Group 3	125	
Group 4	To be specified separately	

<Remarks> Classification of equipment is as shown in Table 9.

**Table 13 Exposure Time in Each Temperature**

Equipment Weight (kg)	T1	T2
Less than 0.2	Not longer 1min.	1h+15min 0
Not less than 0.2 and less than 0.8		2h+15min 0
Not less than 0.8 and less than 1.5		3h+15min 0
Not less than 1.5		4h+15min 0

(Note) A time for transfer of EUT T1 is shown for a reference and it would be preferable the time will be shortened as much as possible.

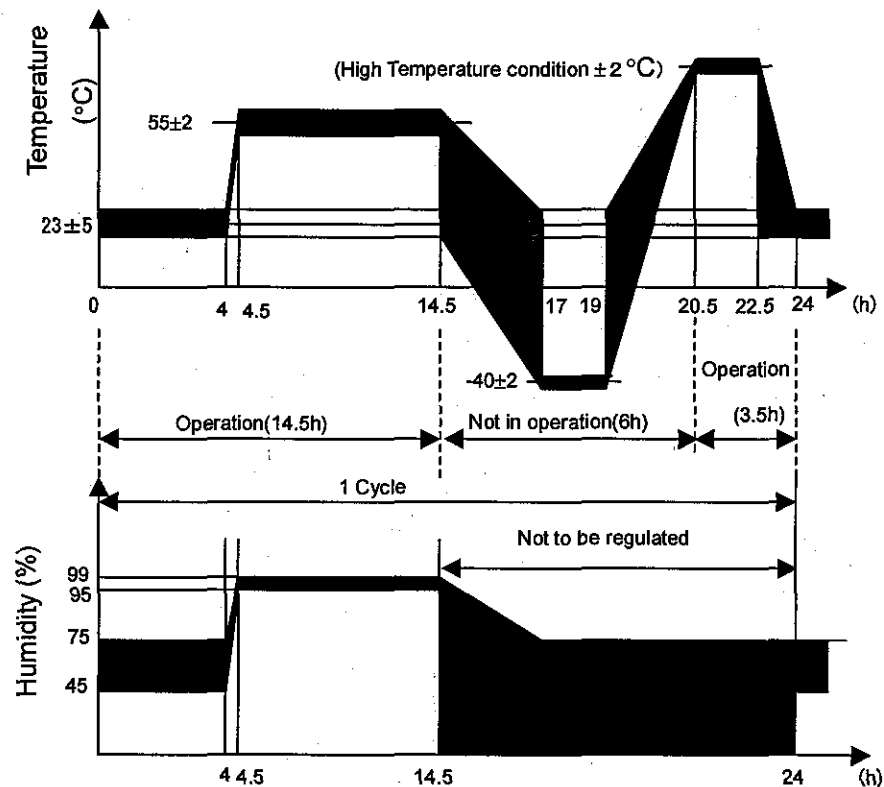
A test shall be performed by the method given in 5.17 of JASO D001-94: "General Rules for Environmental Testing of Automotive Electronic Equipment".

When the parts equipped in an engine compartment are to be tested at other temperatures they will be stipulated in a relative drawing and a part specification.

#### 4.16 Thermal and Humidity Cycle Test

After an EUT is exposed to an ambience with a temperature and humidity respectively at  $25 \pm 5^\circ\text{C}$  and  $60 \pm 15\%$  for 2.5 hours, it shall be subjected to the following pattern of temperature and humidity cycle which shall be repeated for 10 times. The unit shall operate normally throughout the test and suffice the characteristics and performance stipulated in a relative part specification after the test. A test shall be performed by the method given in 5.18 of JASO D001-94 "General Rules for Environmental Testing of Automotive Electronic Equipment".

Fig.14 Test Pattern



#### 4.17 Steady Humidity Test

After an EUT is placed in a chamber where an ambience condition is maintained with a temperature and relative humidity respectively at  $55 \pm 2^\circ\text{C}$  and  $95 \pm 5\%$  for 1 hour and, then, operated in it for 94 hours. It shall operate normally throughout the test and when it is removed from the chamber after the test and wiped off water droplets, it shall suffice the characteristics and performance stipulated in a relative specification. A test shall be performed by the method given in 5.19 of JASO D001-94 "General Rules for Environmental Testing of Automotive Electronic Equipment".

#### 4.18 Dew Formation Test

After a EUT is left in a constant temperature chamber regulated at  $-5^\circ\text{C}$  for 2 hours, it shall be removed from it and immediately put in another constant temperature chamber regulated at  $35 \pm 2^\circ\text{C}$  and  $85 \pm 5\%$  humidity for 10min. During this time, a test sample shall not be exposed from a current of air in the constant temperature chamber. It shall be removed from the chamber and operated by supplying an electric power to it without wiping off water droplets deposited on it. It

shall operate normally. Such a test shall be performed once in a day for 5 days. The unit shall be supplied with an electric power except the time when it is kept in a constant temperature chamber. Water droplets are not wiped off

#### 4.19 Dust Test

A test on an EUT shall be carried out for 8 hours by the condition stipulated in Type F, Section 3 of JIS D0207. (Dust density not smaller than  $100\text{mg/m}^3$ , agitation and stop times in a cycle respectively for 5sec and 10min.) And the unit shall suffice the characteristics and performance stipulated in a relative part specification after the test.

#### 4.20 Vibration Test (A test on a part to be fitted to an engine will be specified separately.)

##### 1) Vibration Test (Operating)

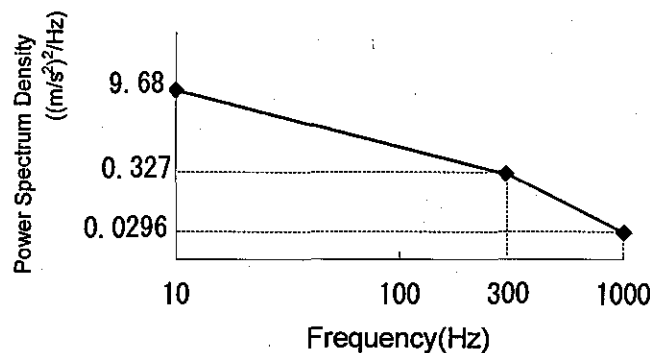
When a test is performed on an EUT by the following condition, it shall operate normally throughout the test and suffice the characteristics and performance stipulated in a relative part specification after the test.

Frequency spectrum: Please see Fig.15.

Acceleration:  $20\text{m/s}^2$  (r.m.s.)

Test time: 8 hours in each axis

**Fig.15 Random Vibration Spectrum**



##### 2) Vibration Test (Not Operating)

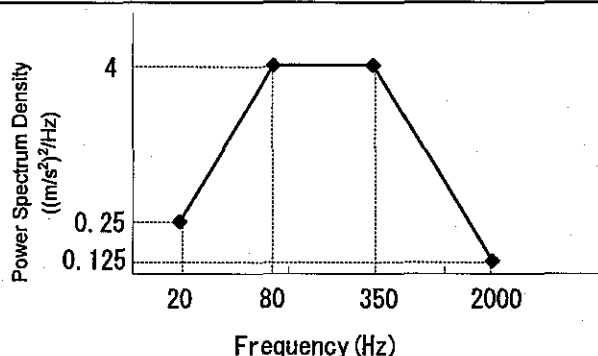
After an EUT is tested by the following condition, it shall suffice the characteristics and performance stipulated in a relative part specification.

Frequency spectrum: Please see Fig.16.

Acceleration:  $60\text{m/s}^2$  (r.m.s.)

Test time: 5min. in each axis

**Fig.16 Random Vibration Spectrum**



#### 4.21 Shock Test (on independent EUT)

A half sine impact of peak value at  $500\text{m/s}^2$  and a time width at 11msec. Shall be applied 3 times on each side of an EUT (normally 6 sides). The unit, then, shall suffice the characteristics and performance stipulated in a relative part specification.

#### 4.22 Drop Test (on an independent EUT)

After an EUT is dropped freely onto a concrete floor from 1.0m height twice, it shall suffice the characteristics and performance stipulated in a relative part specification.

#### 4.23 Endurance Test

An EUT shall be operated in an ambience at  $75^\circ\text{C}$  incessantly for 1000 hours. It shall operate normally throughout the test and suffice the characteristics and performance stipulated in a relative part specification.

#### 4.24 Thermal Characteristic Test

After an EUT is kept in a constant temperature chamber regulated at each of the following temperature for 1 hour, it shall suffice the characteristics and performance stipulated in a relative part specification. A test shall be performed by the method stipulated in 5.11 of JASO D001-94 "General Rules for Environmental Testing of Automotive Electronic Equipment".

Classification of Equipment*1	Set Temperature( $^\circ\text{C}$ )
Group 1	-30, -5, 25, 65, 80
Group 2	-30, -5, 25, 65, 95
Group 3	-30, -5, 25, 65, 95, 100, 115 <sup>*2</sup> , 125 <sup>*2</sup>
Group 4	To be determined by a negotiation among parties relative to the delivery and reception of a unit

\*1: Equipment shall be classified into the following 4 categories.

Group 1: Units to be installed in a vehicle room or trunk space but except for units belonging to group 4.

Group 2: Units set up at the upper part of instrument panel and rear deck, and position where direct sunshine is received.

Group 3: Units to be installed in an engine compartment but except for units belonging to group 4.

Group 4: Units to be installed in a scorching section and its proximity or in a special position.

\*2: A test with a temperature at 115 and 125°C for a unit of group 3 shall be performed when it is required.

When the parts equipped in an engine compartment are to be tested at other temperatures they will be stipulated in a relative drawing and a part specification.

#### 4.25 Water Resistance Test

1) An EUT shall be installed in test equipment as specified in JIS D203 in a posture almost equal to that in a vehicle and the tests shown in Table 14 shall be performed on it while an electric power is supplied to the unit. The unit shall operate normally throughout the test. It shall be exposed to an ambience with a temperature and humidity respectively at 40°C and 93% for 7 days after the test. It shall remain free from a trace of water infiltration to the inside and corrosion and suffice the characteristics and performance stipulated in a relative part specification.

**Table 14 Water Resistance Test Condition**

Classification of Equipment	Type of Test
Group 1 (inside of vehicle room and trunk space)	R1
Group 2 (upper position in an engine compartment)	S2
Group 3 (outside of vehicle and in lower position of engine compartment)	R2 and S2
Group 4 (to be determined separately)	To be determined separately

**Table 15 Type of Water Resistance Test**

	Water Pressure in Sprinkle Port (kgf/cm <sup>2</sup> )	Sprinkle Port Dimension (mm)	Number of Sprinkle Port	Total Water Flow (l/min.)	Water Temperature (°C)	Test Time	Distance (mm)
R1	0.1	See JIS D0203	2	1.9	Normal Temp.	10min	400
R2	0.3	See JIS D0203	2	3.2	Normal Temp.	10min	400
S2	3	φ1.2	40	39.2	Normal Temp.	1h	400

#### 2) Liquid dropping test

The part shall be free from malfunction for 8 hours after dropping water and kerosene (100CC) from the upper side with a syringe.

#### 4.26 Salt Water Spray Test

##### 1) Operation under Salt Water Spray Test

A test shall be performed on an EUT by the method given in JIS C0024 with a severity at 1 while an electric power is supplied to the unit. The unit shall operate normally during the test and suffice, after the test, the characteristics and performance stipulated in a relative part specification.



**2) Salt Water Spray Endurance Test**

After a test by the method given in JIS C0023 is performed on a EUT for 96 hours, it shall remain free from brown rusting and suffice the characteristics and performance stipulated in a relative part specification.

**4.27 Ozone Resistance Test**

After a test is performed on an EUT for 72 hours by the method given in 16 of JIS K6301, it shall suffice the characteristics and performance stipulated in a relative part specification.

**4.28 Fluid Resistance Test****1) Coating Test**

Fluids shown in the following shall be coated on an EUT and left in the air for 24 hours. After this operation is repeated for 5 times, the unit shall suffice the characteristics and performance stipulated in a relative part specification.

- [1] Gasoline
- [2] Engine Oil
- [3] Torque Converter Fluid
- [4] 30% Solution of Long Life Coolant
- [5] Brake Fluid
- [6] Washer Fluid

**2) Immersion Test**

An EUT\* connected with a connector and a wiring harness shall be completely immersed into the above fluids for 1min. and, then, left in the air for 24 hours while an electric power is supplied to it. It shall suffice the characteristics and performance stipulated in a relative part specification.

\*EUT:electronic equipment to be subjected to this test will be stipulated in a relative part specification and drawing.