



EMI TEST REPORT

Test Report No.: 13692701S-G-R2

Applicant : DENSO CORPORATION
Type of EUT : Cockpit Control Unit
Model Number of EUT : DNNS122
FCC ID : HYQDNNS122
Test regulation : FCC Part 15 Subpart B: 2021
Test Result : Complied (Refer to Section 3)

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
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6. This test report covers EMC technical requirements.
It does not cover administrative issues such as Manual or non-EMC test related Requirements. (if applicable)
7. The all test items in this test report are conducted by UL Japan, Inc. Shonan EMC Lab.
8. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
9. The information provided from the customer for this report is identified in SECTION 1
10. This report is a revised version of 13692701S-G-R1. 13692701S-G-R1 is replaced with this report.

Date of test: January 30 to February 3, 2021

Representative test engineer:


Yohsuke Matsuzawa
Engineer

Approved by :


Kazutaka Takeyama
Leader



- ☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan.
☒ There is no testing item of "Non-accreditation".

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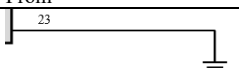
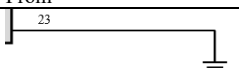
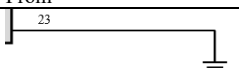
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REVISION HISTORY

Original Test Report No.: 13692701S-G

Revision	Test report No.	Date	Page revised	Contents				
- (Original)	13692701S-G	March 26, 2021	-	-				
1	13692701S-G-R1	June 25, 2021	1	Removal of the division name “Consumer Technology Division”				
			1,7	Fixed the Class B notation.				
			5	Correction of clock frequency: 2 GHz → 3.1 GHz				
			7	Update of Test Specification: From “FCC Part 15 final revised on January 12, 2021 and effective February 11, 2021” To “FCC Part 15 final revised on May 3, 2021 and effective July 2, 2021 *The revision does not affect the test result conducted before its effective date.”				
			10,11	Modification of 4.2 Configuration and peripherals: <table border="1"><thead><tr><th>From</th><th>To</th></tr></thead><tbody><tr><td></td><td></td></tr></tbody></table>	From	To		
				From	To			
								
Correction of 4.2 Configuration and peripherals: Cable No.23 “GND” <table border="1"><thead><tr><th>From</th><th>To</th></tr></thead><tbody><tr><td></td><td></td></tr></tbody></table>	From	To						
From	To							
								
Added explanation of Terminated								
Added the description of "open" to the open port.								
18	Addition of zoom up photo for each test mode.							
2	13692701S-G-R2	July 5, 2021	14	Correction of value: From “r = 0.03 m” to “r = 0.93 m”				

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Reference: Abbreviations (Including words undescribed in this report)

AAN	Asymmetric Artificial Network	ILAC	International Laboratory Accreditation Conference
AC	Alternating Current	ISED	Innovation, Science and Economic Development Canada
AM	Amplitude Modulation	ISN	Impedance Stabilization Network
AMN	Artificial Mains Network	ISO	International Organization for Standardization
Amp, AMP	Amplifier	JAB	Japan Accreditation Board
ANSI	American National Standards Institute	LAN	Local Area Network
Ant, ANT	Antenna	LCL	Longitudinal Conversion Loss
AP	Access Point	LIMS	Laboratory Information Management System
ASK	Amplitude Shift Keying	LISN	Line Impedance Stabilization Network
Atten., ATT	Attenuator	MRA	Mutual Recognition Arrangement
AV	Average	N/A	Not Applicable
BPSK	Binary Phase-Shift Keying	NIST	National Institute of Standards and Technology
BR	Bluetooth Basic Rate	NS	No signal detect.
BT	Bluetooth	NSA	Normalized Site Attenuation
BT LE	Bluetooth Low Energy	NVLAP	National Voluntary Laboratory Accreditation Program
BW	BandWidth	OBW	Occupied Band Width
C.F	Correction Factor	OFDM	Orthogonal Frequency Division Multiplexing
Cal Int	Calibration Interval	PK	Peak
CAV	CISPR AV	P _{LT}	long-term flicker severity
CCK	Complementary Code Keying	POHC(A)	Partial Odd Harmonic Current
CDN	Coupling Decoupling Network	Pol., Pola.	Polarization
Ch., CH	Channel	PR-ASK	Phase Reversal ASK
CISPR	Comite International Special des Perturbations Radioelectriques	P _{ST}	short-term flicker severity
Corr.	Correction	QAM	Quadrature Amplitude Modulation
CPE	Customer premise equipment	QP	Quasi-Peak
CW	Continuous Wave	QPSK	Quadri-Phase Shift Keying
DBPSK	Differential BPSK	r.m.s., RMS	Root Mean Square
DC	Direct Current	RBW	Resolution Band Width
DET	Detector	RE	Radio Equipment
D-factor	Distance factor	REV	Reverse
Dmax	maximum absolute voltage change during an observation period	RF	Radio Frequency
DQPSK	Differential QPSK	RFID	Radio Frequency Identifier
DSSS	Direct Sequence Spread Spectrum	RSS	Radio Standards Specifications
EDR	Enhanced Data Rate	Rx	Receiving
e.i.r.p., EIRP	Equivalent Isotropically Radiated Power	SINAD	Ratio of (Signal + Noise + Distortion) to (Noise + Distortion)
EM clamp	Electromagnetic clamp	S/N	Signal to Noise ratio
EMC	ElectroMagnetic Compatibility	SA, S/A	Spectrum Analyzer
EMI	ElectroMagnetic Interference	SG	Signal Generator
EMS	ElectroMagnetic Susceptibility	SVSWR	Site-Voltage Standing Wave Ratio
EN	European Norm	THC(A)	Total Harmonic Current
e.r.p., ERP	Effective Radiated Power	THD(%)	Total Harmonic Distortion
EU	European Union	TR	Test Receiver
EUT	Equipment Under Test	Tx	Transmitting
Fac.	Factor	VBW	Video BandWidth
FCC	Federal Communications Commission	Vert.	Vertical
FHSS	Frequency Hopping Spread Spectrum	WLAN	Wireless LAN
FM	Frequency Modulation	xDSL	Generic term for all types of DSL technology (DSL: Digital Subscriber Line)
Freq.	Frequency		
FSK	Frequency Shift Keying		
Fund	Fundamental		
FWD	Forward		
GFSK	Gaussian Frequency-Shift Keying		
GNSS	Global Navigation Satellite System		
GPS	Global Positioning System		
Hori.	Horizontal		
ICES	Interference-Causing Equipment Standard		
I/O	Input/Output		
IEC	International Electrotechnical Commission		
IEEE	Institute of Electrical and Electronics Engineers		
IF	Intermediate Frequency		

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SECTION 1: Customer information

Company Name : DENSO CORPORATION
Address : 1-1 Showa-cho, Kariya-shi, Aichi ken, 448-8661 Japan
Telephone Number : +81-566-20-3304
Facsimile Number : +81-566-25-4920
Contact Person : Naoto Makino

The information provided from the customer is as follows;

- Applicant, Type of Equipment, Model No. on the cover and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- SECTION 1: Customer information
- SECTION 2: Equipment under test (E.U.T.) other than the Receipt Date
- SECTION 4: Operation of E.U.T. during testing

* The laboratory is exempted from liability of any test results affected from the information in SECTION 2 and 4.

SECTION 2: Equipment under test (E.U.T.)

2.1 Identification of E.U.T.

Type : Cockpit Control Unit
Model Number : DNNS122
Serial Number : Refer to SECTION 4.2
Rating : DC 13.2 V
Receipt Date : January 29, 2021
Country of Mass-production : USA, JAPAN
Condition : Production prototype
(Not for Sale: This sample is equivalent to mass-produced items.)
Modification : No Modification by the test lab.

2.2 Product description

Model: DNNS122 (referred to as the EUT in this report) is a Cockpit Control Unit.

General Specification

Clock frequency(ies) in the system : 3.1 GHz

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Radio Specification

Bluetooth (BR/EDR)	
Frequency of operation	2402 MHz - 2480 MHz
Channel spacing	1 MHz
Modulation	FHSS (GFSK, $\pi/4$ -DQPSK, 8DPSK)
Antenna type	External Antenna
Antenna Gain	2.55 dBi (Max)

	IEEE802.11b	IEEE802.11g	IEEE802.11n (20 MHz band)	IEEE802.11n (40 MHz band)
Frequency of operation	2412 MHz - 2462 MHz	2412 MHz - 2462 MHz	2412 MHz - 2462 MHz 5180 MHz - 5240 MHz 5745 MHz - 5825 MHz	5190 MHz - 5230 MHz 5755 MHz - 5795 MHz
Channel spacing	5 MHz		2.4 GHz band 5 MHz 5 GHz band 20 MHz	5 GHz band 40 MHz
Modulation	DSSS: DBPSK, DQPSK, CCK	OFDM: BPSK, QPSK, 16QAM, 64QAM		
	IEEE802.11a	IEEE802.11ac (20 MHz band)	IEEE802.11ac (40 MHz band)	IEEE802.11ac (80 MHz band)
Frequency of operation	5180 MHz - 5240 MHz 5745 MHz - 5825 MHz	5180 MHz - 5240 MHz 5745 MHz - 5825 MHz	5190 MHz - 5230 MHz 5755 MHz - 5795 MHz	5210 MHz 5775 MHz
Channel spacing	20 MHz		40 MHz	80 MHz
Modulation	OFDM BPSK, QPSK, 16QAM, 64QAM, 256QAM (*256QAM is only for IEEE802.11ac 80 MHz band)			
Antenna type	External Antenna			
Antenna Gain	Main Antenna: Chain0 : 2.55 dBi (2.4 GHz), 0.02 dBi (5 GHz) Sub Antenna: Chain1 : -2.10 dBi (2.4 GHz), -5.26 dBi (5 GHz)			

[AM/FM (incl.RBDS)/XM Radio]

	AM	FM (incl. RBDS)	XM
Equipment type	Receiver		
Frequency of operation	530 kHz to 1710 kHz	87.75 MHz to 107.9 MHz	2333.465 MHz to 2344.045 MHz

FM tuner specification

Intermediate frequency: 220 kHz

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SECTION 3: Test specification, procedures & results**3.1 Test specification**

Test Specification : FCC Part 15 Subpart B
 FCC Part 15 final revised on May 3, 2021 and effective July 2, 2021
 *The revision does not affect the test result conducted before its effective date.

Title : FCC 47CFR Part15 Radio Frequency Device
 Subpart B Unintentional Radiators

3.2 Procedures & Results**< FCC Part 15 Subpart B, FM receiver >**

Item	Test Procedure	Limits	Deviation	Worst margin	Result
Conducted emission	ANSI C 63.4:2014 +C 63.4a:2017 7. AC powerline conducted emission measurements IEEE 187:2003	FCC 15.107 (a)	N/A *1)	N/A	N/A
Radiated emission	ANSI C 63.4:2014 +C 63.4a:2017 8. Radiated emission measurements IEEE 187:2003	FCC 15.109 (a)	N/A *2)	0.7 dB Freq.: 3518.800 MHz Polarization: Vertical Detection: Average Mode: FM Reception Analog (87.75 MHz), Local, Port A	Complied# a)
Antenna power conduction for receivers	ANSI C 63.4:2014 +C 63.4a:2017 12.1.5 Antenna-conducted power measurements IEEE 187:2003	FCC 15.111 (a)	N/A	24.4 dB Freq.: 1722.880 MHz Detection: Peak Mode: FM Reception Digital (107.9 MHz), Local, Port A	Complied b)

Note: UL Japan's EMI Work Procedures No.13-EM-W0420

*1) The test is not applicable since the EUT does not have AC Mains.

*2) Measurements have been performed up to 30 GHz since the highest frequency of internal source of the EUT is 5825 MHz.

a) Refer to Appendix 2 (data of Radiated emission)

b) Refer to Appendix 2 (data of Antenna power conduction for receivers)

Symbols:

Complied The data of this test item has enough margin, more than the measurement uncertainty.

Complied# The data of this test item meets the limits unless the measurement uncertainty is taken into consideration.

3.3 Additions to standards

No addition, deviation or exclusion has been made from standards.

3.4 Confirmation

**UL Japan, Inc. hereby confirms the E.U.T., in the configuration tested, complies with the specifications
 FCC Part 15 Subpart B: 2021.**

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3.5 Uncertainty

There is no applicable rule of uncertainty in this applied standard. Therefore, the results are derived depending on whether or not laboratory uncertainty is applied.

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor $k=2$.

Item	Frequency range	No.1 SAC ^{*1} /SR ^{*2} (±)	No.2 SAC/SR (±)	No.3 SAC/SR (±)	No.4 SAC/SR (±)
Radiated emission (Measurement distance: 3 m)	30 MHz-200 MHz	4.6 dB	4.6 dB	4.6 dB	-
	200 MHz-1 GHz	6.0 dB	6.0 dB	6.0 dB	-
	1 GHz-6 GHz	4.8 dB	4.8 dB	4.8 dB	-
	6 GHz-13 GHz	5.4 dB	5.4 dB	5.4 dB	-
Radiated emission (Measurement distance: 1 m)	13 GHz-40 GHz	5.3 dB	5.3 dB	5.3 dB	-
Antenna Terminal Voltage ^{*3}	30 MHz-1000 MHz	2.7 dB			
	1 GHz-2.15 GHz	2.7 dB			

*1: SAC=Semi-Anechoic Chamber

*2: SR= Shielded Room is applied besides radiated emission

*3: Value of Antenna Terminal Voltage measurement is also applies to the No.5 and No.6 Shielded Room.

3.6 Test location

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JAB Accreditation No. : RTL02610

(FCC Test Firm Registration Number: 839876, ISED Lab Company Number: 2973D)

	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Semi-anechoic chamber	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.2 Semi-anechoic chamber	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.3 Semi-anechoic chamber	12.7 x 7.7 x 5.35	12.7 x 7.7	5 m
No.4 Semi-anechoic chamber	8.1 x 5.1 x 3.55	8.1 x 5.1	-
No.1 Shielded room	6.8 x 4.1 x 2.7	6.8 x 4.1	-
No.2 Shielded room	6.8 x 4.1 x 2.7	6.8 x 4.1	-
No.3 Shielded room	6.3 x 4.7 x 2.7	6.3 x 4.7	-
No.4 Shielded room	4.4 x 4.7 x 2.7	4.4 x 4.7	-
No.5 Shielded room	7.8 x 6.4 x 2.7	7.8 x 6.4	-
No.6 Shielded room	7.8 x 6.4 x 2.7	7.8 x 6.4	-
No.7 Shielded room	2.76 x 3.76 x 2.4	2.76 x 3.76	-
No.8 Shielded room	3.45 x 5.5 x 2.4	3.45 x 5.5	-
No.1 Measurement room	2.55 x 4.1 x 2.5	2.55 x 4.1	-

3.7 Test Setup, Data of EMI & Test instruments

Refer to Appendix 1 to 3.

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SECTION 4: Operation of E.U.T. during testing

4.1 Operating mode

The EUT exercise program used during testing was designed to exercise the various system components in a manner similar to typical use.

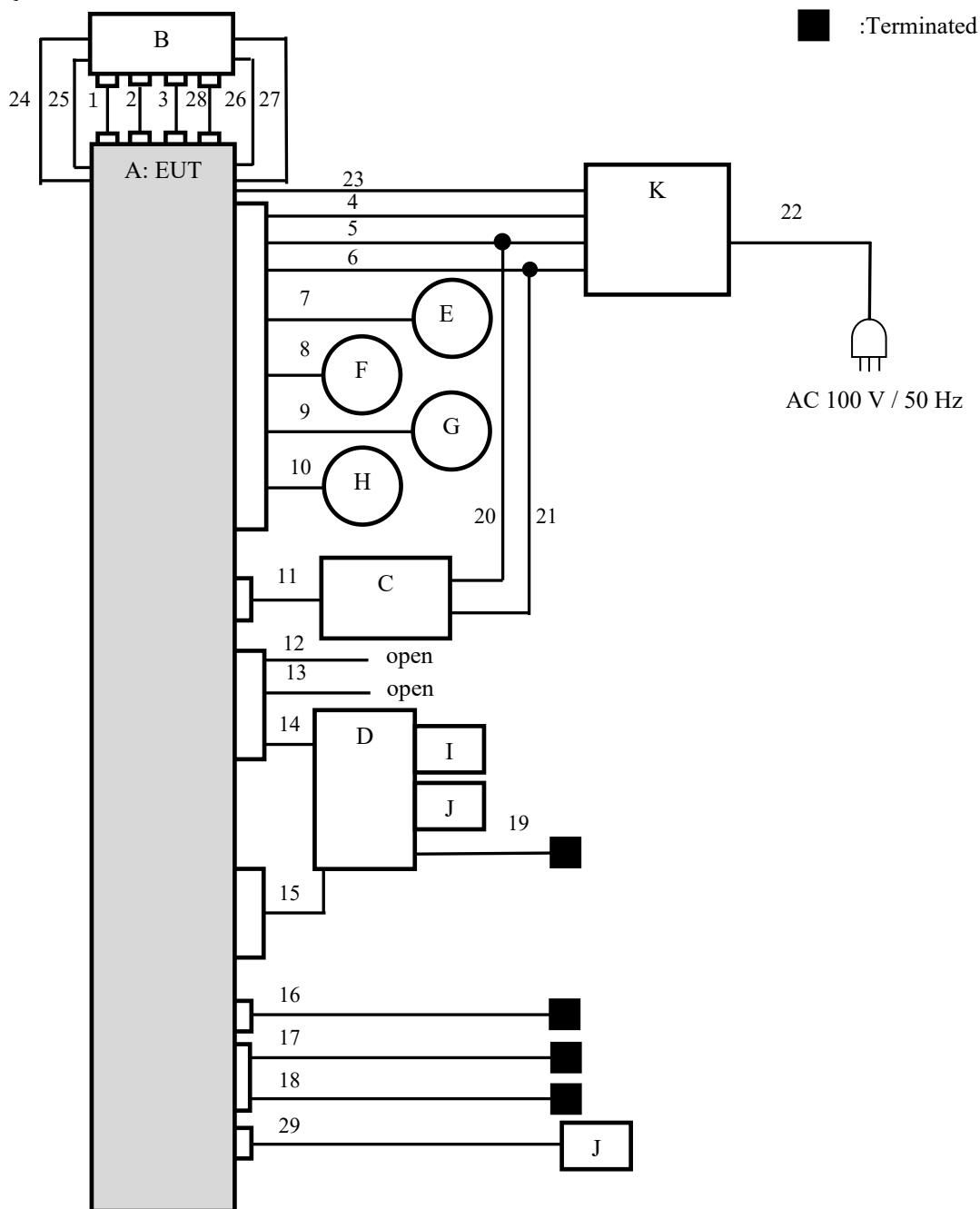
Test sequence is used : 1. FM Reception Digital (87.75 MHz, 97.7 MHz, 107.9 MHz) * Port A
2. FM Reception Analog (87.75 MHz, 97.7 MHz, 107.9 MHz) * Port A / B

Software (Version) : MSoC Ver.F61WHM010-708(Date:2020.Nov-12th)
(Storage location: EUT memory)

Justification: The system was configured in typical fashion (as a customer would normally use it) for testing.

4.2 Configuration and peripherals

[RE: Radiated emission]



* Cabling and setup(s) were taken into consideration and test data was taken under worse case conditions.

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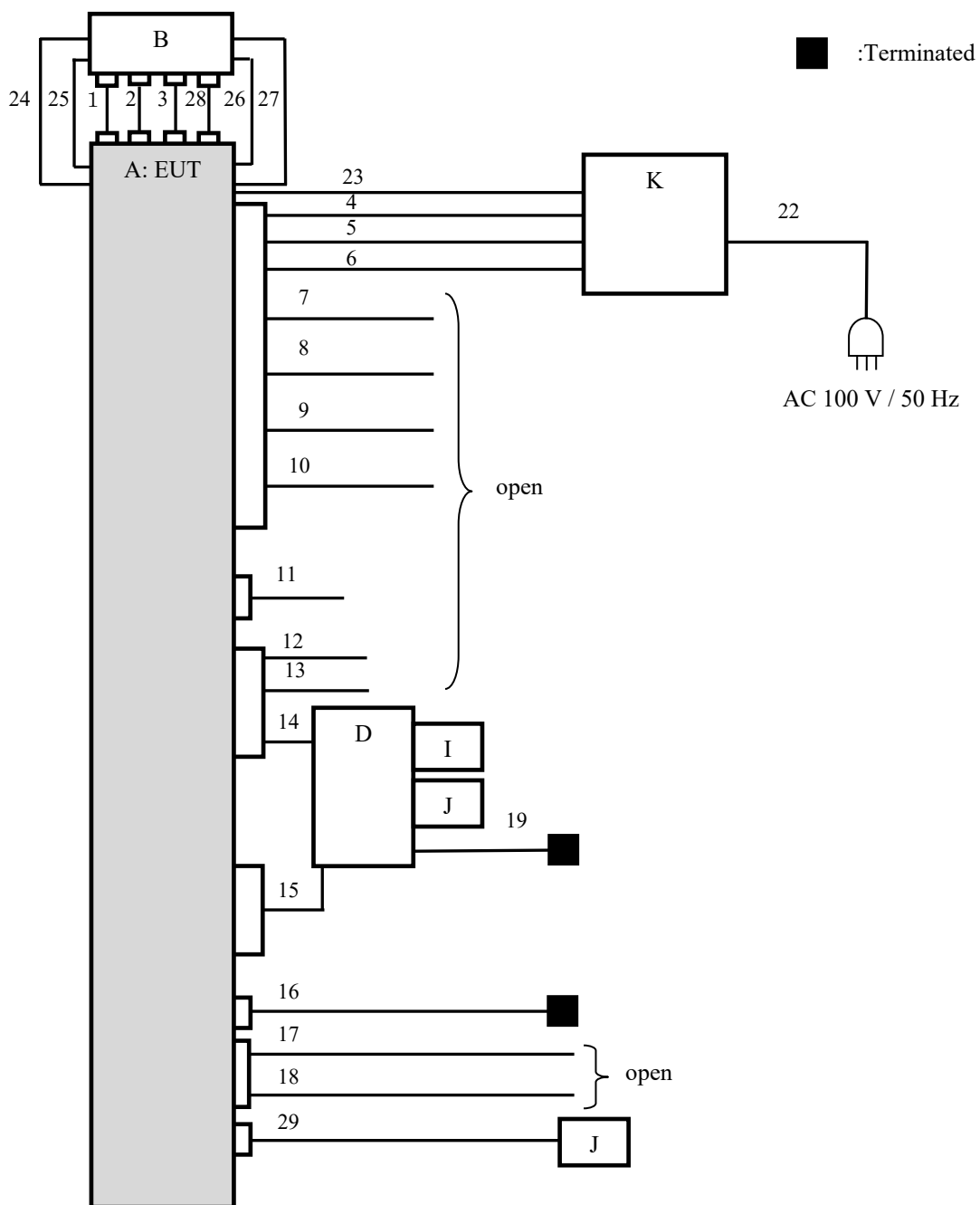
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[AT: Antenna power conduction]



Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Cockpit Control Unit	DNNS122	CP1.5-K3-GZ1-US-High-064	DENSO CORPORATION	EUT
B	Center Information Display	DNNS132	GZ1-SD-HM LHD-077	DENSO CORPORATION	-
C	Meter	85002AN02A	-	DENSO CORPORATION	-
D	AUX-BOX	86257 AN00A	No.5	HOSIDEN	-
E	Speaker L	20FHI-SPRE-03	-	DENSO CORPORATION	-
F	Speaker R	20FHI-SPRE-03	-	DENSO CORPORATION	-
G	Speaker Rear L	20FHI-SPRE-03	-	DENSO CORPORATION	-
H	Speaker Rear R	20FHI-SPRE-03	-	DENSO CORPORATION	-
I	USB Memory	USM4GL-W	-	SONY	-
J	USB Memory	USM4GU	-	SONY	-
K	DC Power supply	PAN60-10A	NL002383	KIKUSUI	-
L	GPS Antenna	86277AL150	03590033	SUBARU	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	CCU-CID-POW	0.2	Unshielded	Unshielded	-
2	CCU-CID-LVDS	0.2	Unshielded	Unshielded	-
3	CCU-CID-BT	0.2	Unshielded	Unshielded	-
4	DC power(+B)	1.8	Unshielded	Unshielded	-
5	DC power(+IG)	1.8	Unshielded	Unshielded	-
6	DC power(GND)	1.8	Unshielded	Unshielded	-
7	Speaker L	1.8	Unshielded	Unshielded	-
8	Speaker R	1.8	Unshielded	Unshielded	-
9	Speaker Rear L	1.8	Unshielded	Unshielded	-
10	Speaker Rear R	1.8	Unshielded	Unshielded	-
11	Meter	1.8	Unshielded	Unshielded	-
12	USB(Blue)	1.5	Shielded	Shielded	-
13	USB(Brown)	0.15	Shielded	Shielded	-
14	USB(Green)	0.5	Shielded	Shielded	-
15	Power Supply	1.0	Unshielded	Unshielded	-
16	XM	1.0	Shielded	Shielded	-
17	FM	2.0	Shielded	Shielded	-
18	FM	2.0	Shielded	Shielded	-
19	Mini Jack	2.0	Unshielded	Unshielded	-
20	DC power(+IG)	1.2	Unshielded	Unshielded	-
21	DC power(GND)	1.2	Unshielded	Unshielded	-
22	AC	3.0	Unshielded	Unshielded	-
23	GND	2.4	Unshielded	Unshielded	-
24	GND	0.2	Unshielded	Unshielded	-
25	GND	0.2	Unshielded	Unshielded	-
26	GND	0.2	Unshielded	Unshielded	-
27	GND	0.2	Unshielded	Unshielded	-
28	CCU-CID-Wifi	0.2	Unshielded	Unshielded	-
29	GPS	0.8	Shielded	Shielded	-

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SECTION 5: Radiated emission

5.1 Operating environment

Test room : Refer to data
Temperature : Refer to data
Humidity : Refer to data

5.2 Test configuration

The EUT was placed on a platform of nominal size, 1.0 m by 2.0 m, raised 0.8 m above the conducting ground plane. The table is made of expanded polystyrol and expanded polypropylene and the table top is covered with polycarbonate. That has very low permittivity. The rear of EUT, including its peripherals was aligned and flushed with rear of tabletop. I/O cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane. Photographs of the set up are shown in Appendix 1.

5.3 Test conditions

Frequency range : 30 MHz –30 GHz
EUT position : Table top
Test distance : 3 m

5.4 Test procedure

The Radiated Electric Field Strength intensity has been measured on a Semi-Anechoic Chamber with a ground plane at a distance of 3 m*.

* Measuring distance

The boundary of the EUT is defined by an imaginary circular periphery.

The measuring antenna height was varied between 1 m and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.

For above 1 GHz, test antenna was aimed at the EUT for receiving the maximum signal and always kept within the illumination area of the 3 dB beam width of the antenna.

The measurements were performed for vertical or horizontal antenna polarization or both as necessary.

The radiated emission measurements were made with the following detector function of the test receiver and spectrum analyzer.

	<u>30 MHz -1000 MHz (Test receiver)</u>	<u>1 GHz – 30 GHz (Spectrum analyzer)</u>
Detector Type	: QP	AV *1) PK
IF Band width	: 120 kHz	RBW 1 MHz/ VBW 10 Hz RBW 1 MHz/ VBW 3 MHz

*1) When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

5.5 Results

Summary of the test results: Pass

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Figure 1. Antenna angle

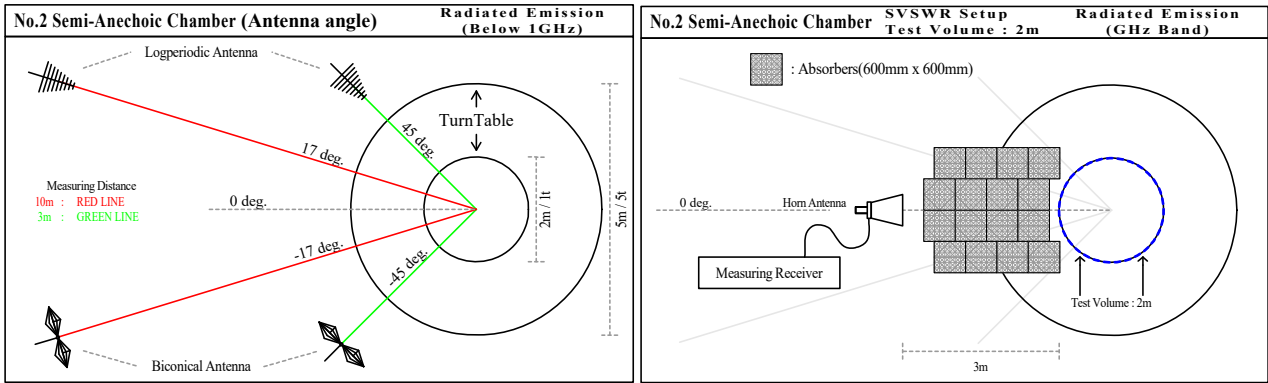
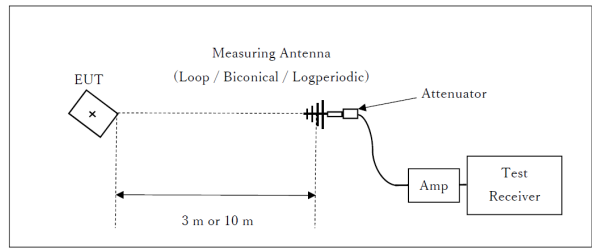


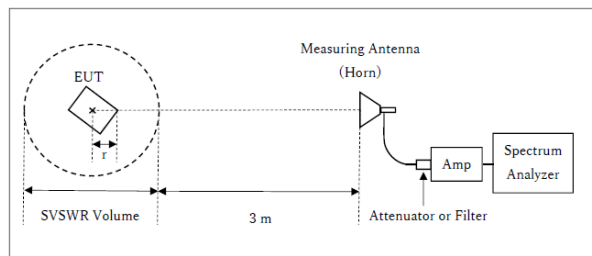
Figure 2: Test Setup
Below 1 GHz



× : Center of turn table

Test Distance: 3 m

1 GHz - 13 GHz



r : Radius of an outer periphery of EUT
× : Center of turn table

Distance Factor: $20 \times \log (3.07 \text{ m}^*/3.0 \text{ m}) = 0.21 \text{ dB}$
* Test Distance: $(3 + \text{SVSWR Volume} / 2) - r = 3.07 \text{ m}$

SVSWR Volume: 2 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
 $r = 0.93 \text{ m}$

SECTION 6: Antenna power conduction for receivers**6.1 Operating environment**

Test room : Refer to data
Temperature : Refer to data
Humidity : Refer to data

6.2 Test configuration

The EUT was placed on a non-metallic table height of 0.8 m above the reference ground plane.
Photographs of the set up are shown in Appendix 1.

6.3 Test conditions

Frequency range : 30 MHz – 2 GHz
EUT position : Table top

6.4 Test procedure

The antenna power conduction for receivers was made with the following detector function of the test receiver.

	<u>30 MHz -1000 MHz (Test receiver)</u>	<u>1 GHz – 2 GHz</u>
Detector Type	: QP	Peak
IF Band width	: 120 kHz	RBW: 1 MHz/ VBW: 3 MHz

6.5 Results

Summary of the test results : Pass