EMI TEST REPORT

Test report No. 13204004M-E-R2

Applicant	:	**DENSO CORPORATION**
Type of EUT	:	**Cockpit Control Unit**
Model Number of EUT	:	**DNNS114**
FCC ID	:	**HYQDNNS114**
Test standard	:	**FCC Part15 Subpart B:2019, FM Broadcast Receiver ICES-003 Issue 6:2016 (SMSE-005-19), FM Broadcast Receiver**
Test result	:	**Complied (Refer to Section 3.2)**

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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. Kashima 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. The test was performed in accordance with FCC regulation, as an alternative arrangement of ICES-003.
11. This report is a revised version of 13204004M-E-R1. 13204004M-E-R1 is replaced with this report.

Date of test: January 31 and February 28, 2020

Representative test operator:

Kazuhiro Ando
Engineer
Consumer Technology Division

Approved by :

Tomoyuki Yamashita
Leader
Consumer Technology Division

ilac-MRA
LAB
JAB Testing
RTL02610

☐ 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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REVISION HISTORY

Original Test Report No.: 13204004M-E

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13204004M-E	April 17, 2020	-	-
1	13204004M-E-R1	May 18, 2020	P.6	Modify The maximum clock frequencies used in the EUT from 1.8 GHz to 3.1 GHz.
1	13204004M-E-R1	May 18, 2020	P.10	Add A' and A" in a figure. Also connect the antenna to the BT/WiFi cables.
1	13204004M-E-R1	May 18, 2020	P.11	Add A' and A" (the WiFi/ASSEMBLY Bluetooth antenna) in the table of "Description of EUT and Support equipment".
2	13204004M-E-R2	May 22, 2020	P.1, P.7	Modify description from Class B to FM Broadcast Receiver

Reference: Abbreviations (Including words undescribed in this report)

AAN	Asymmetric Artificial Network
AC	Alternating Current
AM	Amplitude Modulation
AMN	Artificial Mains Network
Amp, AMP	Amplifier
ANSI	American National Standards Institute
Ant, ANT	Antenna
AP	Access Point
ASK	Amplitude Shift Keying
Atten., ATT	Attenuator
AV	Average
BPSK	Binary Phase-Shift Keying
BR	Bluetooth Basic Rate
BT	Bluetooth
BT LE	Bluetooth Low Energy
BW	BandWidth
C.F	Correction Factor
Cal Int	Calibration Interval
CAV	CISPR AV
CCK	Complementary Code Keying
CDN	Coupling Decoupling Network
Ch., CH	Channel
CISPR	Comite International Special des Perturbations Radioelectriques
Corr.	Correction
CPE	Customer premise equipment
CW	Continuous Wave
DBPSK	Differential BPSK
DC	Direct Current
DET	Detector
Dmax	maximum absolute voltage change during an observation period
DQPSK	Differential QPSK
DSSS	Direct Sequence Spread Spectrum
EDR	Enhanced Data Rate
e.i.r.p., EIRP	Equivalent Isotropically Radiated Power
EM clamp	Electromagnetic clamp
EMC	ElectroMagnetic Compatibility
EMI	ElectroMagnetic Interference
EMS	ElectroMagnetic Susceptibility
EN	European Norm
e.r.p., ERP	Effective Radiated Power
EU	European Union
EUT	Equipment Under Test
Fac.	Factor
FCC	Federal Communications Commission
FHSS	Frequency Hopping Spread Spectrum
FM	Frequency Modulation
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
ILAC	International Laboratory Accreditation Conference
ISED	Innovation, Science and Economic Development Canada
ISN	Impedance Stabilization Network
ISO	International Organization for Standardization
JAB	Japan Accreditation Board
LAN	Local Area Network
LCL	Longitudinal Conversion Loss
LIMS	Laboratory Information Management System
LISN	Line Impedance Stabilization Network
MRA	Mutual Recognition Arrangement
NIST	National Institute of Standards and Technology
NS	No signal detect.
NSA	Normalized Site Attenuation
NVLAP	National Voluntary Laboratory Accreditation Program
OBW	Occupied Band Width
OFDM	Orthogonal Frequency Division Multiplexing
PK	Peak
P_{LT}	long-term flicker severity
POHC(A)	Partial Odd Harmonic Current
Pol., Pola.	Polarization
PR-ASK	Phase Reversal ASK
P_{ST}	short-term flicker severity
QAM	Quadrature Amplitude Modulation
QP	Quasi-Peak
QPSK	Quadri-Phase Shift Keying
r.m.s., RMS	Root Mean Square
RBW	Resolution Band Width
RE	Radio Equipment
REV	Reverse
RF	Radio Frequency
RFID	Radio Frequency Identifier
RSS	Radio Standards Specifications
Rx	Receiving
SINAD	Ratio of (Signal + Noise + Distortion) to (Noise + Distortion)
S/N	Signal to Noise ratio
SA, S/A	Spectrum Analyzer
SG	Signal Generator
SVSWR	Site-Voltage Standing Wave Ratio
THC(A)	Total Harmonic Current
THD(%)	Total Harmonic Distortion
TR	Test Receiver
Tx	Transmitting
VBW	Video BandWidth
Vert.	Vertical
WLAN	Wireless LAN
xDSL	Generic term for all types of DSL technology (DSL: Digital Subscriber Line)

CONTENTS **PAGE**

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 EUT, Model Number of EUT, 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 (EUT) other than Receipt Date
- SECTION 4: Operation of EUT during testing

* The laboratory is exempted from liability of any test results affected from the above 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	:	DNNS114
Serial Number	:	Refer to Section 4, Clause 4.2
Rating	:	DC 13.2 V
Receipt Date	:	January 8, 2020
Country of Mass-production	:	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 DNNS114 (referred to as the EUT in this report) is a Cockpit Control Unit.

General Specificaion

The maximum clock frequencies used in the EUT.: 3.1 GHz

Radio Specification

*Wireless LAN and Bluetooth do not transmit simultaneously.

[WLAN (IEEE802.11b/g/n-20)]

	IEEE802.11b	IEEE802.11g/n (20 M band)
Radio Type	Transceiver	
Frequency of operation	2412 MHz - 2462 MHz	
Type of modulation	DSSS (CCK, DQPSK, DBPSK)	OFDM (64QAM, 16QAM, QPSK, BPSK)
Channel spacing	5 MHz	
Antenna type	ASSEMBLY WiFi Antenna	
Antenna Connector type	MHF PLUG	
Antenna Gain	-6.40 dBi (max)	

[Bluetooth (BDR / EDR function)]

	Bluetooth Ver.4.2 with EDR function
Radio Type	Transceiver
Frequency of operation	2402 MHz - 2480 MHz
Type of modulation	FHSS (GFSK, π/4-DQPSK, 8-DPSK)
Channel spacing	1 MHz
Antenna type	ASSEMBLY BT Antenna
Antenna Connector type	MHF PLUG
Antenna Gain	-4.52 dBi (max)

[Broadcast]

	AM	FM	XM	RBDS
Radio Type	Receiver			
Frequency of operation	522 kHz – 1629 kHz	87.5 MHz – 108.0 MHz	2333.465 MHz – 2344.045 MHz	87.5 MHz – 108.0 MHz
Antenna Connector type	GT13	GT13	GT13	GT13

Section 3: Test specifications, procedures and results

3.1 Test specification

Test Specifications	:	FCC Part 15 Subpart B FCC Part 15 final revised on July 19, 2019 and effective August 19, 2019 except 15.258
Title	:	FCC 47CFR Part15 Radio Frequency Device Subpart B Unintentional Radiators
Test Specification	:	ICES-003 Issue 6:2016 (SMSE-005-19)
Title	:	Spectrum Management and Telecommunications Interference-Causing Equipment Standard Information Technology Equipment (Including Digital Apparatus) -Limits and Methods of Measurement

3.2 Procedures & results

Item	Test Procedure	Limits	Deviation	Worst margin	Result	Remarks
Conducted emission	ANSI C63.4: 2014 7. AC power - line conducted emission measurements	**FCC:**Part 15 Subpart B 15.107(a) **ISED:** ICES-003 Issue 6, 6.1	N/A	N/A	N/A	*1)
Radiated emission	ANSI C63.4: 2014 8. Radiated emission measurements, IEEE187:2003	**FCC:** Part 15 Subpart B 15.109(a) **ISED:** ICES-003 Issue 6, 6.2	N/A	1.7 dB 3459.890 MHz Average Horizontal	Complied # a)	-
Antenna Terminal	**FCC:** ANSI C63.4: 2014 12. Measurement of unintentional radiators other than ITE, IEEE187:2003 **ISED: -**	**FCC:** Part 15 Subpart B 15.111(a) **ISED: -**	N/A	11.8 dB 1727.723 MHz Peak	Complied b)	-

Note: UL Japan, Inc's EMI Work Procedure 13-EM-W0420.
*1) The test is not applicable since the EUT is not the device that is designed to be connected to the public utility (AC) power line.

a) Refer to APPENDIX 1 (data of Radiated Emission)
b) Refer to APPENDIX 1 (data of Antenna Terminal Conducted Emission)

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 Addition to standards

No addition, exclusion nor deviation has been made from the standards.

3.4 Confirmation

UL Japan, Inc. hereby confirm that EUT, in the configuration tested, complies with the specification(s) FCC Part15 Subpart B:2019 FM Broadcast Receiver and ICES-003 Issue 6:2016 (SMSE-005-19), FM Broadcast Receiver.

3.5 Uncertainty

EMI
There is no applicable rule of uncertainty in this applied standard. Therefore, the results are derived depending on whether laboratory uncertainty is applied.

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

Conducted emission

Frequency range	Required Uncertainty (+/-)	Uncertainty (+/-)
0.15 MHz to 30 MHz	3.4 dB	3.3 dB

Radiated emission

Measurement distance	Frequency range	Required Uncertainty (+/-)	Uncertainty (+/-)
3 m	9 kHz to 30 MHz	Not Defined	2.9 dB
	30 MHz to 200 MHz	6.3 dB	6.1 dB
	200 MHz to 1000 MHz		6.2 dB
	1 GHz to 6 GHz	5.2 dB	5.0 dB
	6 GHz to 18 GHz	5.5 dB	5.4 dB
	18 GHz to 40 GHz	Not Defined	5.5 dB
1 m	1 GHz to 18 GHz	Not Defined	5.4 dB
	18 GHz to 40 GHz		5.6 dB

Antenna Terminal test

Test Item	Required Uncertainty (+/-)	Uncertainty (+/-)
6 dB Bandwidth / 99 % Occupied Bandwidth	Not Defined	1.6 %
Maximum Output Power	0.75 dB	0.73 dB
Burst Rate	Not Defined	0.256 %
Power Density	4 dB	2.2 dB
Conducted Spurious Emission (9 kHz to 30 MHz)	4 dB	2.2 dB

3.6 Test Location

UL Japan, Inc. Kashima EMC Lab.
1614 Mushihata, Katori-shi, Chiba-ken, 289-0341 JAPAN
Telephone: +81 478 88 6500, Facsimile: +81 478 82 3373
JAB Accreditation No.:RTL02610 / FCC Test Firm Registration Number: 910230 / ISED Lab Company Number: 4659A

Test site	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Open site	6.0 x 5.5 x 2.5	20 x 40	10 m
No.5 Open site	8.6 x 7.1 x 2.4	18 x 23	10 m
No.1 Shielded room	5.4 x 4.5 x 2.3	-	-
No.5 Shielded Room	4.2 x 3.1 x 2.5	-	-
No.9 Shielded Room	6.1 x 3.6 x 2.8	-	-
No.6 Semi-anechoic Chamber	8.5 x 5.5 x 5.2	-	3 m
No.10 Semi-anechoic Chamber	18.4 x 9.9 x 7.7	-	10 m
No.11 Semi-anechoic Chamber	9.0 x 6.5 x 5.2	-	3 m
No.1 Measurement room	5.0 x 3.7 x 2.6	-	-
No.2 Measurement room	4.3 x 4.4 x 2.7	-	-
No.3 Measurement room	4.5 x 5.3 x 2.7	-	-

3.7 Test setup, Test Data & Test instruments

Refer to Appendix 1 to 3.

Section 4: Operation of EUT during testing

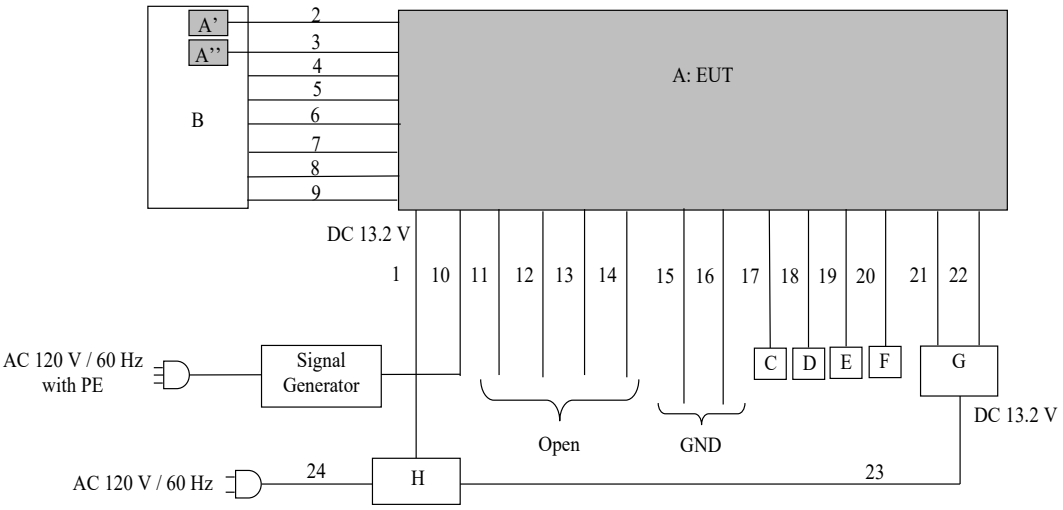
4.1 Operating mode

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

The mode(s) : 1. FM Receiving mode (Radiated emission test)
2. FM Tuning mode (Antenna terminal test)

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

4.2 Configuration and peripherals



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

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	**Cockpit Control Unit**	**DNNS114**	**46872635400019335 909016010000000**	**DENSO CORPORATION**	**EUT *1)**
			A973Q2PCD4Z0000		**EUT *2)**
A'	**WiFi Antenna**	**2314128-2**	***3)**	**TE Connectivity Ltd.**	**EUT**
A''	**ASSEMBLY Bluetooth Antenna**	**2462810-0140**	***3)**	**TE Connectivity Ltd.**	**EUT**
B	Center Information Display	DNNS105	1911290020	DENSO CORPORATION	-
C	8 Ω Speaker	K50	17	VISATON	-
D	8 Ω Speaker	K50	18	VISATON	-
E	8 Ω Speaker	K50	19	VISATON	-
F	8 Ω Speaker	K50	20	VISATON	-
G	Meter	TN257550-6773	12C19	DENSO CORPORATION	-
H	DC Power Supply	GSV3000	1708192900 *2) 60646742 *1)	DIAMOND ANTENNA	-

*1) Used for the Radiated emission test
*2) Used for the Antenna terminal test
*3) The number is under the control of the equipment B.

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	1.7	Unshielded	Unshielded	-
2	WiFi Cable	0.2	Shielded	Shielded	-
3	BT Cable	0.2	Shielded	Shielded	-
4	DC + Signal Cable	0.2	Unshielded	Unshielded	-
5	LVDS Cable	0.2	Shielded	Shielded	-
6	FG Cable	0.1	Unshielded	Unshielded	-
7	FG Cable	0.1	Unshielded	Unshielded	-
8	FG Cable	0.1	Unshielded	Unshielded	-
9	FG Cable	0.1	Unshielded	Unshielded	-
10	AM/FM Cable	2.0	Shielded	Shielded	-
11	USB Cable	0.9	Shielded	Shielded	-
12	XM Cable	1.6	Unshielded	Unshielded	-
13	Mic Cable	1.6	Shielded	Shielded	-
14	AUX Box Cable	1.0	Shielded	Shielded	-
15	GND Cable	1.6	Unshielded	Unshielded	-
16	GND Cable	1.6	Unshielded	Unshielded	-
17	Speaker Cable	1.9	Unshielded	Unshielded	-
18	Speaker Cable	1.9	Unshielded	Unshielded	-
19	Speaker Cable	1.9	Unshielded	Unshielded	-
20	Speaker Cable	1.9	Unshielded	Unshielded	-
21	Meter Cable	3.0	Shielded	Shielded	-
22	Meter Cable	1.6	Unshielded	Unshielded	-
23	DC Cable	1.5	Unshielded	Unshielded	-
24	AC Cable	1.7	Unshielded	Unshielded	-

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 1.5 m, raised 0.8 m above the conducting ground plane. The table is made of polystyrene foam. 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 for the forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane.
Test was made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna was varied in height above the conducting ground plane to obtain the maximum signal strength.
Photographs of the set up are shown in Appendix 1.

5.3 Test conditions

Frequency range : 30 MHz - 20000 MHz
Test distance : 3 m
EUT position : Table top

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 straight-line periphery describing a simple geometric configuration encompassing the EUT.

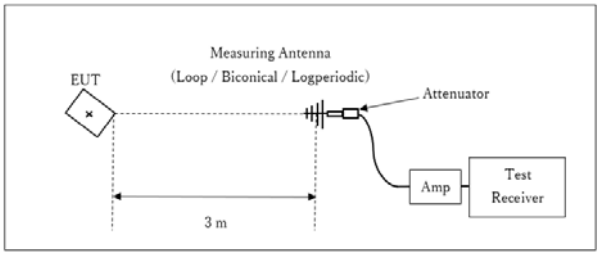
The measuring antenna height was varied between 1 m and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.
Test antenna was aimed at the EUT for receiving the maximum signal and always kept within the illumination area of the 3 dB beam width 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.

Frequency	30 MHz - 1000 MHz	1000 MHz - 20000 MHz	
Instrument used	Test receiver	Spectrum analyzer	
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.

Figure 1: Test Setup

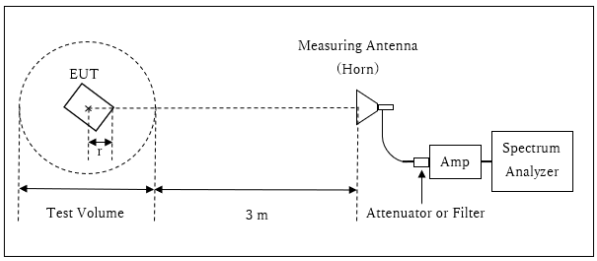
Below 1 GHz



× : Center of turn table

Test Distance: 3 m

1 GHz - 13 GHz

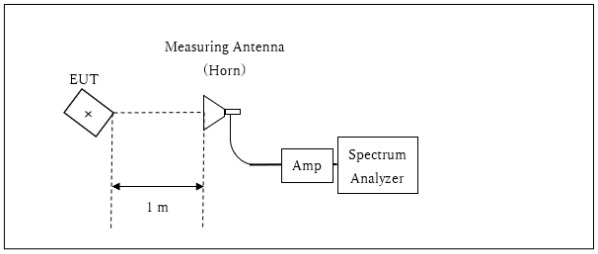


r : Radius of an outer periphery of EUT
× : Center of turn table

Distance Factor: 20 x log (3.25 m*/3.0 m) = 0.695 dB
* Test Distance: (3 + Test Volume /2) - r = 3.25 m

Test Volume: 2 m
(Test Volume has been calibrated based on CISPR 16-1-4.)
r = 0.75 m

13 GHz - 26.5 GHz



× : Center of turn table

Distance Factor: 20 x log (1.0 m* / 3.0 m) = -9.54 dB
*Test Distance: 1 m

The test was made on EUT at the normal use position.

5.5 Results

Summary of the test results: Pass

Section 6: Antenna Terminal

6.1 Operating environment

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

6.2 Test configuration

EUT was placed on a wooden table of nominal size, 1.0 m by 1.5 m, raised 0.8 m from the ground.

6.3 Test conditions

Frequency range : 30 MHz - 2000 MHz
Test distance : N/A
EUT position : Table top

6.4 Test procedure

The Antenna Terminal was measured with a spectrum analyzer connected to the antenna port.

Frequency	Below 1 GHz	Above 1 GHz
Instrument used	Spectrum Analyzer	Spectrum Analyzer *1)
IF Bandwidth	PK: RBW: 100 kHz / VBW: 100 kHz	PK: RBW: 1 MHz / VBW: 3 MHz

*1) The Spectrum Analyzer was used in 3 dB resolution bandwidth.

6.5 Results

Summary of the test results: Pass

Appendix 1: Test data

Radiated emission

DATA OF RADIATED EMISSION TEST

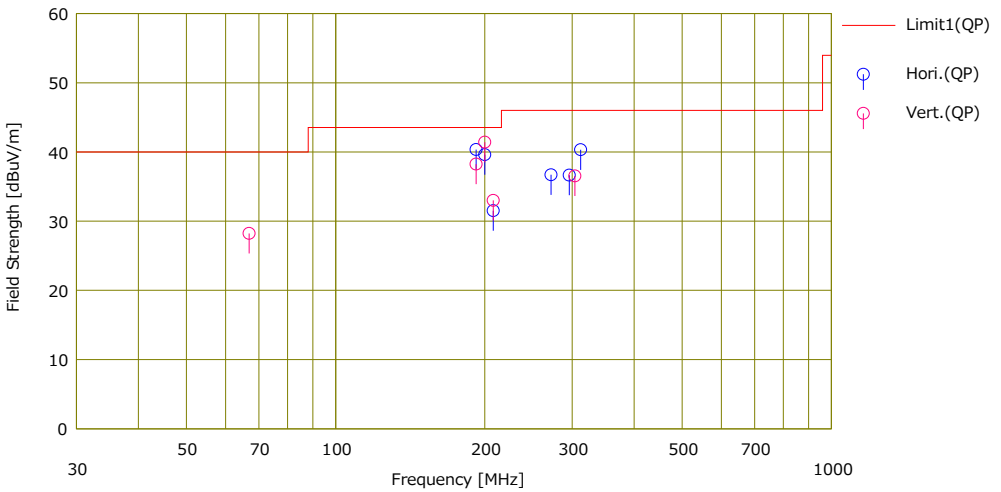
UL Japan, Inc. Kashima EMC Lab. No.11 Semi-Anechoic Chamber
Date : 2020/02/28

Mode : FM Receiving mode (106.1MHz)
Order No. : 13204004M
Power : DC 13.2V
Temp./Humi. : 21deg.C / 36%RH

Remarks : Antenna Port A

Limit : FCC_Part 15 Subpart B(15.109)_Class B

Tested by : Kazuhiro Ando



No.	Freq. [MHz]	Reading (QP) [dBuV]	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result (QP) [dBuV/m]	Limit (QP) [dBuV/m]	Margin (QP) [dB]	Pola. [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
1	192.000	55.20	10.32	6.92	32.10	40.34	43.52	3.1	Hori.	208	172	HB	
2	200.000	54.80	9.92	6.97	32.09	39.60	43.52	3.9	Hori.	191	198	HB	
3	208.000	46.70	9.88	7.02	32.09	31.51	43.52	12.0	Hori.	173	296	HB	
4	272.000	48.60	12.79	7.37	32.05	36.71	46.02	9.3	Hori.	161	171	HB	
5	296.000	47.80	13.37	7.50	32.03	36.64	46.02	9.3	Hori.	137	168	HB	
6	312.040	50.90	13.85	7.58	32.02	40.31	46.02	5.7	Hori.	181	139	HB	
7	66.916	42.30	12.12	6.00	32.19	28.23	40.00	11.7	Vert.	100	96	HB	
8	192.000	53.10	10.32	6.92	32.10	38.24	43.52	5.2	Vert.	100	0	HB	
9	200.000	56.60	9.92	6.97	32.09	41.40	43.52	2.1	Vert.	100	0	HB	
10	208.000	48.20	9.88	7.02	32.09	33.01	43.52	10.5	Vert.	100	0	HB	
11	304.000	47.40	13.62	7.54	32.03	36.53	46.02	9.4	Vert.	179	216	HB	

Calculation:Result[dBuV/m]=Reading[dBuV]+Ant.Fac[dB/m]+Loss(Cable+ATT)[dB]-Gain(AMP)[dB]
Ant.Type=HB:Hybrid Antenna

Radiated emission

DATA OF RADIATED EMISSION TEST

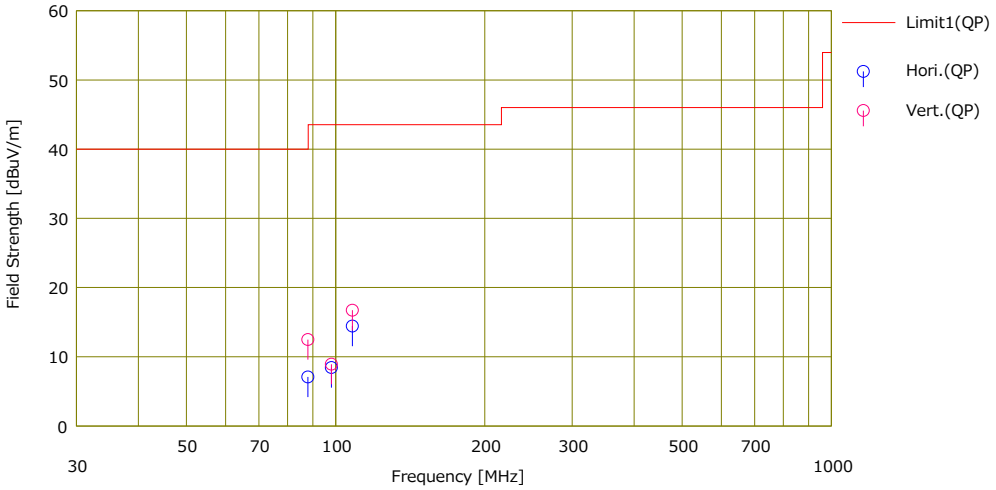
UL Japan, Inc. Kashima EMC Lab. No.11 Semi-Anechoic Chamber
Date : 2020/02/28

Mode : FM Receiving mode
Order No. : 13204004M
Power : DC 13.2V
Temp./Humi. : 21deg.C / 36%RH

Remarks : Antenna Port A

Limit : FCC_Part 15 Subpart B(15.109)_Class B

Tested by : Kazuhiro Ando



No.	Freq. [MHz]	Reading <QP> [dBuV]	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result <QP> [dBuV/m]	Limit <QP> [dBuV/m]	Margin <QP> [dB]	Pola. [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
1	87.920	25.10	7.96	6.19	32.18	7.07	40.00	32.9	Hori.	211	184	HB	FM 87.7MHz Local
2	98.120	25.70	8.62	6.27	32.17	8.42	43.52	35.1	Hori.	268	170	HB	FM 97.9MHz Local
3	108.120	30.10	10.14	6.35	32.16	14.43	43.52	29.0	Hori.	298	181	HB	FM 107.9MHz Local
4	87.920	30.50	7.96	6.19	32.18	12.47	40.00	27.5	Vert.	100	108	HB	FM 87.7MHz Local
5	98.120	26.20	8.62	6.27	32.17	8.92	43.52	34.6	Vert.	100	258	HB	FM 97.9MHz Local
6	108.120	32.40	10.14	6.35	32.16	16.73	43.52	26.7	Vert.	100	115	HB	FM 107.9MHz Local

Calculation:Result[dBuV/m]=Reading[dBuV]+Ant.Fac[dB/m]+Loss(Cable+ATT)[dB]-Gain(AMP)[dB]
Ant.Type=HB:Hybrid Antenna

Radiated emission

DATA OF RADIATED EMISSION TEST

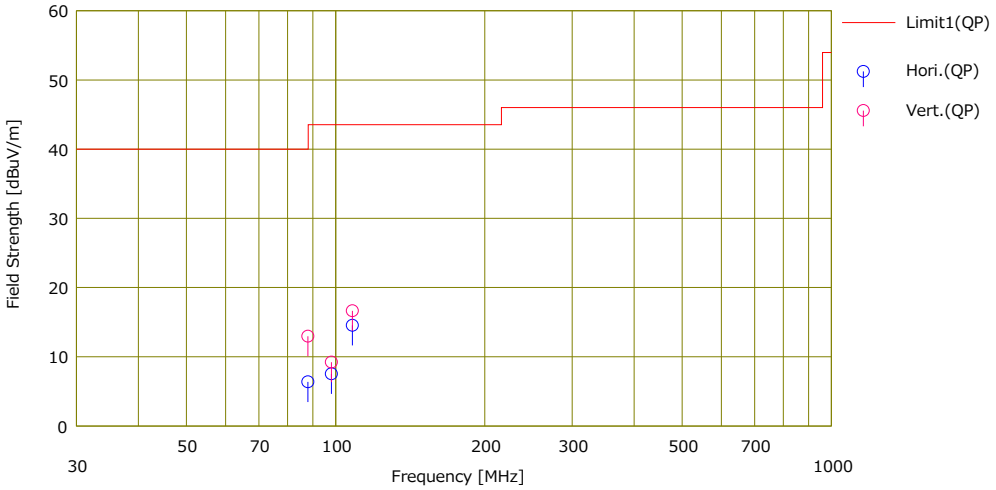
UL Japan, Inc. Kashima EMC Lab. No.11 Semi-Anechoic Chamber
Date : 2020/02/28

Mode : FM Receiving mode
Order No. : 13204004M
Power : DC 13.2V
Temp./Humi. : 21deg.C / 36%RH

Remarks : Antenna Port B

Limit : FCC_Part 15 Subpart B(15.109)_Class B

Tested by : Kazuhiro Ando



No.	Freq. [MHz]	Reading <QP> [dBuV]	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result <QP> [dBuV/m]	Limit <QP> [dBuV/m]	Margin <QP> [dB]	Pola. [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
1	87.920	24.40	7.96	6.19	32.18	6.37	40.00	33.6	Hori.	220	178	HB	FM 87.7MHz Local
2	98.120	24.80	8.62	6.27	32.17	7.52	43.52	36.0	Hori.	239	178	HB	FM 97.9MHz Local
3	108.120	30.20	10.14	6.35	32.16	14.53	43.52	28.9	Hori.	300	176	HB	FM 107.9MHz Local
4	87.920	31.00	7.96	6.19	32.18	12.97	40.00	27.0	Vert.	100	110	HB	FM 87.7MHz Local
5	98.120	26.50	8.62	6.27	32.17	9.22	43.52	34.3	Vert.	100	261	HB	FM 97.9MHz Local
6	108.120	32.30	10.14	6.35	32.16	16.63	43.52	26.8	Vert.	100	113	HB	FM 107.9MHz Local

Calculation:Result[dBuV/m]=Reading[dBuV]+Ant.Fac[dB/m]+Loss(Cable+ATT)[dB]-Gain(AMP)[dB]
Ant.Type=HB:Hybrid Antenna

Radiated emission

DATA OF RADIATED EMISSION TEST

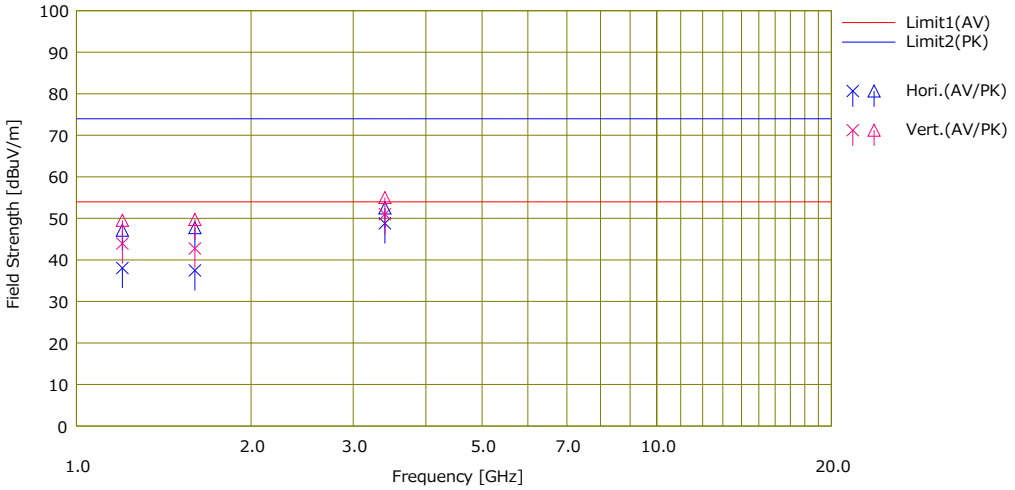
UL Japan, Inc. Kashima EMC Lab. No.11 Semi-Anechoic Chamber
Date : 2020/02/28

Mode : FM Receiving mode (106.1MHz)
Order No. : 13204004M
Power : DC 13.2V
Temp./Humi. : 21deg.C / 36%RH

Remarks : Test Distance=3.25m, Antenna Port A

Limit : FCC_Part 15 Subpart B(15.109)_Class B

Tested by : Kazuhiro Ando



No.	Freq.	Reading		Ant.Fac	Loss	Gain	D.Fac	Result		Limit		Margin		Pola.	Height	Angle	Ant. Type	Comment
		<AV>	<PK>					<AV>	<PK>	<AV>	<PK>	<AV>	<PK>					
	[MHz]	[dBuV]	[dBuV]	[dB/m]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dB]	[dB]	[H/V]	[cm]	[deg]		
1	1200.000	43.60	52.70	24.53	12.60	43.41	0.70	38.02	47.12	53.97	73.97	15.9	26.8	Hori.	269	230	Horn	
2	1600.000	42.20	52.50	25.49	13.00	43.95	0.70	37.44	47.74	53.97	73.97	16.5	26.2	Hori.	185	329	Horn	
3	3401.960	56.60	60.30	30.16	5.38	44.04	0.70	48.80	52.50	53.97	73.97	5.1	21.4	Hori.	100	190	Horn	Local
4	1200.000	49.50	55.10	24.53	12.60	43.41	0.70	43.92	49.52	53.97	73.97	10.0	24.4	Vert.	185	26	Horn	
5	1600.000	47.50	54.50	25.49	13.00	43.95	0.70	42.74	49.74	53.97	73.97	11.2	24.2	Vert.	127	2	Horn	
6	3401.960	58.80	62.80	30.16	5.38	44.04	0.70	51.00	55.00	53.97	73.97	2.9	18.9	Vert.	100	209	Horn	Local

Calculation:Result[dBuV/m]=Reading[dBuV]+Ant.Fac[dB/m]+Loss(Cable+ATTorHPF)[dB]+D.Fac[dB]-Gain(AMP)[dB]
Ant.Type=Horn:Horn Antenna

Radiated emission

DATA OF RADIATED EMISSION TEST

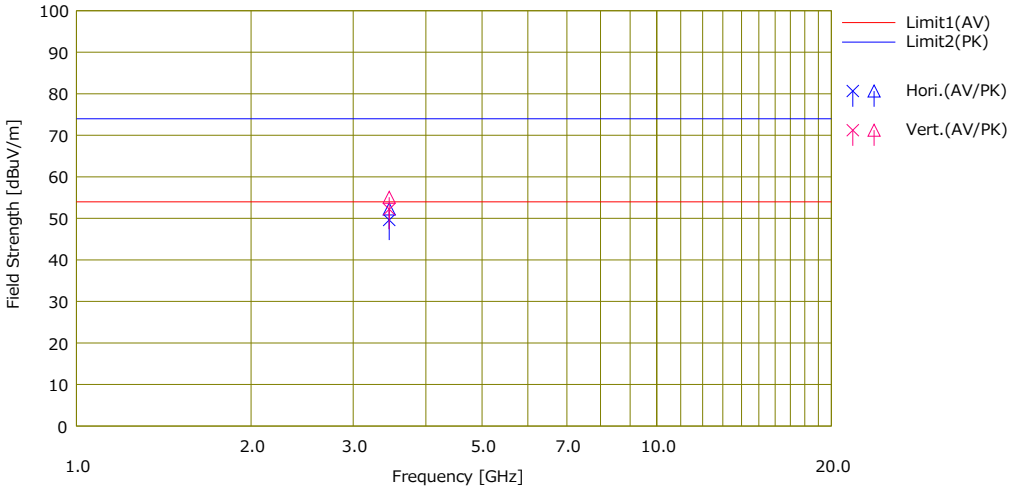
UL Japan, Inc. Kashima EMC Lab. No.11 Semi-Anechoic Chamber
Date : 2020/02/28

Mode : FM Receiving mode (107.9MHz)
Order No. : 13204004M
Power : DC 13.2V
Temp./Humi. : 21deg.C / 36%RH

Remarks : Test Distance=3.25m, Antenna Port B

Limit : FCC_Part 15 Subpart B(15.109)_Class B

Tested by : Kazuhiro Ando



No.	Freq.	Reading		Ant.Fac	Loss	Gain	D.Fac	Result		Limit		Margin		Pola.	Height	Angle	Ant. Type	Comment
		<AV>	<PK>					<AV>	<PK>	<AV>	<PK>	<AV>	<PK>					
	[MHz]	[dBuV]	[dBuV]	[dB/m]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dB]	[dB]	[H/V]	[cm]	[deg]		
1	3459.890	57.20	59.90	30.35	5.38	44.05	0.70	49.58	52.28	53.97	73.97	4.3	21.6	Hori.	100	169	Horn	Local
2	3459.890	59.80	62.70	30.35	5.38	44.05	0.70	52.18	55.08	53.97	73.97	1.7	18.8	Vert.	100	144	Horn	Local

Calculation:Result[dBuV/m]=Reading[dBuV]+Ant.Fac[dB/m]+Loss(Cable+ATTorHPF)[dB]+D.Fac[dB]-Gain(AMP)[dB]
Ant.Type=Horn:Horn Antenna

Antenna Terminal Conducted Emission

DATA OF ANTENNA TERMINAL TEST

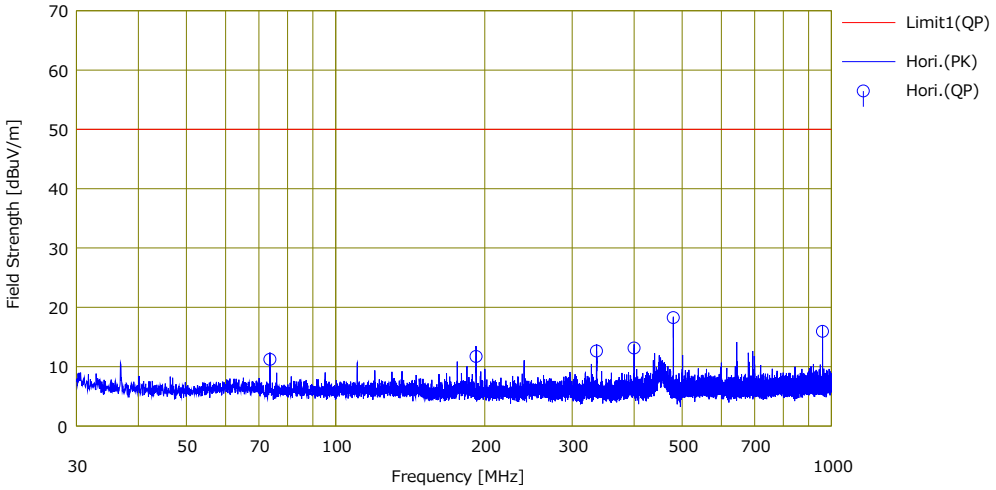
UL Japan, Inc. Kashima EMC Lab. No.2 Measurement Room
Date : 2020/01/31

Mode : FM Tuning mode
Order No. : 13204004M
Power : DC 13.2V
Temp./Humi. : 22deg.C / 41%RH

Remarks : Port A

Limit : FCC15.111 Antenna terminal measurement

Tested by : Kazuhiro Ando



No.	Freq. [MHz]	Reading <QP> [dBuV]	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result <QP> [dBuV/m]	Limit <QP> [dBuV/m]	Margin <QP> [dB]	Pola. [H/V]	Ant. Type	Comment
1	73.726	29.20	0.00	8.46	26.44	11.22	50.00	38.7		-	
2	192.000	28.70	0.00	8.90	25.89	11.71	50.00	38.2		-	
3	336.001	29.20	0.00	9.28	25.86	12.62	50.00	37.3		-	
4	400.000	30.10	0.00	9.44	26.42	13.12	50.00	36.8		-	
5	480.000	35.60	0.00	9.62	26.96	18.26	50.00	31.7		-	
6	960.072	31.90	0.00	10.52	26.49	15.93	50.00	34.0		-	

Calculation:Result[dBuV/m]=Reading[dBuV]+Loss(Cable+ATT)[dB]-Gain(AMP)[dB]

Antenna Terminal Conducted Emission

DATA OF ANTENNA TERMINAL TEST

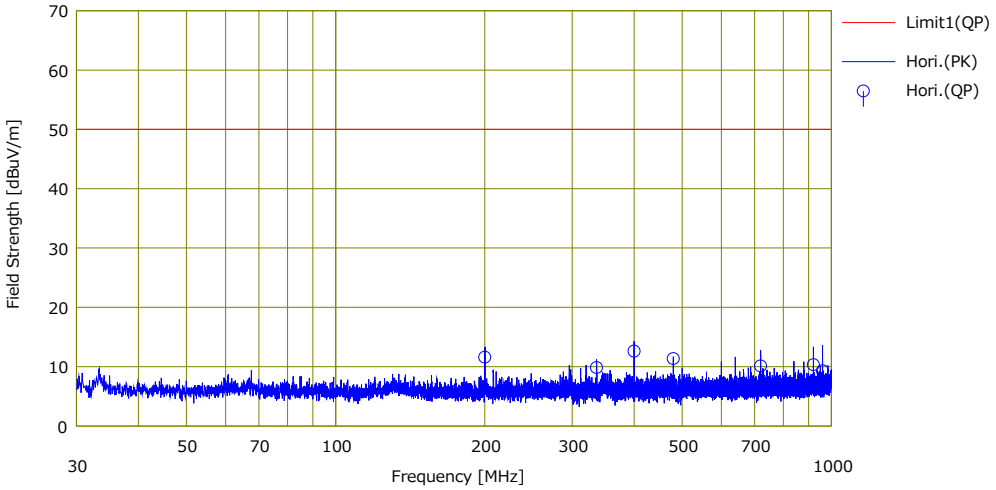
UL Japan, Inc. Kashima EMC Lab. No.2 Measurement Room
Date : 2020/01/31

Mode : FM Tuning mode
Order No. : 13204004M
Power : DC 13.2V
Temp./Humi. : 22deg.C / 41%RH

Remarks : Port B

Limit : FCC15.111 Antenna terminal measurement

Tested by : Kazuhiro Ando



No.	Freq. [MHz]	Reading (QP) [dBuV]	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result (QP) [dBuV]	Limit (QP) [dBuV]	Margin (QP) [dB]	Pola. [H/V]	Ant. Type	Comment
1	200.000	28.50	0.00	8.93	25.85	11.58	50.00	38.4		-	
2	336.000	26.40	0.00	9.28	25.86	9.82	50.00	40.1		-	
3	400.000	29.60	0.00	9.43	26.42	12.61	50.00	37.3		-	
4	480.000	28.70	0.00	9.61	26.96	11.35	50.00	38.6		-	
5	720.000	27.20	0.00	10.08	27.17	10.11	50.00	39.8		-	
6	920.000	26.50	0.00	10.43	26.62	10.31	50.00	39.6		-	
7	960.000	25.30	0.00	10.49	26.49	9.30	50.00	40.7		-	

Calculation:Result[dBuV/m]=Reading[dBuV]+Loss(Cable+ATT)[dB]-Gain(AMP)[dB]

Antenna Terminal Conducted Emission

DATA OF ANTENNA TERMINAL TEST

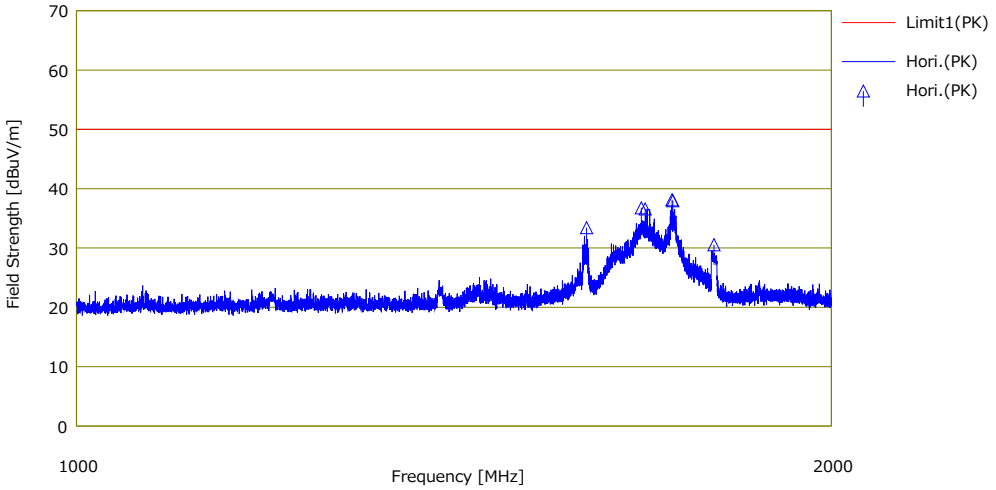
UL Japan, Inc. Kashima EMC Lab. No.2 Measurement Room
Date : 2020/01/31

Mode : FM Tuning mode
Order No. : 13204004M
Power : DC 13.2V
Temp./Humi. : 22deg.C / 41%RH

Remarks : Port A

Limit : FCC15.111 Antenna terminal measurement

Tested by : Kazuhiro Ando



No.	Freq. [MHz]	Reading <PK> [dBuV]	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result <PK> [dBuV]	Limit <PK> [dBuV]	Margin <PK> [dB]	Pola. [H/V]	Ant. Type	Comment
1	1597.437	61.99	0.00	15.38	43.95	33.42	50.00	16.5		-	
2	1679.739	65.20	0.00	15.51	43.94	36.77	50.00	13.2		-	
3	1685.715	65.01	0.00	15.51	43.94	36.58	50.00	13.4		-	
4	1727.723	66.49	0.00	15.56	43.91	38.14	50.00	11.8		-	
5	1729.177	66.31	0.00	15.56	43.91	37.96	50.00	12.0		-	
6	1795.575	58.78	0.00	15.63	43.87	30.54	50.00	19.4		-	

Calculation:Result[dBuV/m]=Reading[dBuV]+Loss(Cable+ATT)[dB]-Gain(AMP)[dB]

Antenna Terminal Conducted Emission

DATA OF ANTENNA TERMINAL TEST

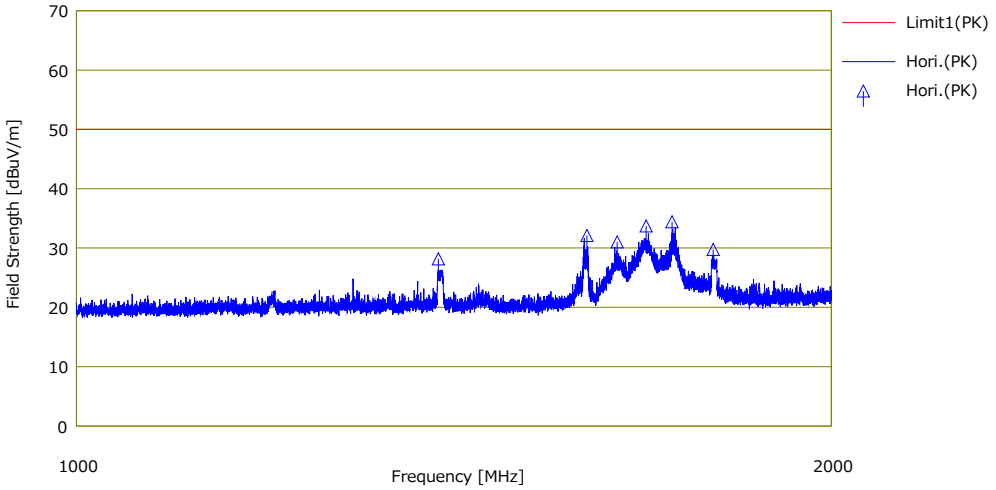
UL Japan, Inc. Kashima EMC Lab. No.2 Measurement Room
Date : 2020/01/31

Mode : FM Tuning mode
Order No. : 13204004M
Power : DC 13.2V
Temp./Humi. : 22deg.C / 41%RH

Remarks : Port B

Limit : FCC15.111 Antenna terminal measurement

Tested by : Kazuhiro Ando



No.	Freq. [MHz]	Reading 〈PK〉 [dBuV]	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result 〈PK〉 [dBuV]	Limit 〈PK〉 [dBuV]	Margin 〈PK〉 [dB]	Pola. [H/V]	Ant. Type	Comment
1	1394.042	56.76	0.00	15.09	43.67	28.18	50.00	21.8	Hori.		
2	1597.827	60.67	0.00	15.38	43.95	32.10	50.00	17.9	Hori.		
3	1642.892	59.53	0.00	15.45	43.95	31.03	50.00	18.9	Hori.		
4	1687.231	62.16	0.00	15.51	43.94	33.73	50.00	16.2	Hori.		
5	1727.805	62.77	0.00	15.56	43.91	34.42	50.00	15.5	Hori.		
6	1794.275	58.00	0.00	15.63	43.87	29.76	50.00	20.2	Hori.		

Calculation:Result[dBuV/m]=Reading[dBuV]+Loss(Cable+ATT)[dB]-Gain(AMP)[dB]

Appendix 2: Test instruments

Test equipment

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE(GHz)	TSA-01	143642	Spectrum Analyzer	Keysight Technologies Inc	N9030A	MY53310670 Version A.13.12	2019/05/27	12
RE(GHz)	CCC-W05	142990	Micro Wave Cable	Shuner	SUCOFLEX104A	MY1477/4A	2019/05/23	12
RE(GHz)	CCC-W07	143111	Micro Wave Cable	Junkosha	MWX221	MRA-12-14-148	2019/05/23	12
RE(GHz)	CAT10-17	143023	10dB Fixed Atten.	Weinschel - API Technologies Corp	54A-10	56251	2019/05/23	12
RE(GHz)	CHF-04	143442	HPF	MICRO-TRONICS	HPM50111-02	009	2019/05/23	12
RE(GHz)	CAF-22	142940	Pre-Amplifier	Micro Wave Factory	MPR-1G26.5-35	161399	2019/06/10	12
RE(GHz)	CHA-25	143456	Double Ridged Wave Guide	ETS-Lindgren	3115	00204573	2019/02/04	12
RE(GHz)	CHA-07	143438	Double Ridged Horn	ETS-Lindgren	3160-09	0166043	2019/06/08	12
RE(GHz)	CAF-19	142937	Pre-Amplifier	TOYO	HAP18-26W	00000035	2019/06/12	12
RE(GHz)	CCC-W09	143113	Micro Wave Cable	Suhner	SUCOFLEX104	MY588/4	2019/07/12	12
RE	CCC-S11-R	143169	Coaxial Cable	Fujikura,Suhner,Suhner ,Agilent,Suhner,- ,Suhner	5D-2W,SF106, SF104,8496B+8494B ,SF106,-,SF106	MY42143380, US00431042 (Step Att)	2019/11/19	12
RE	CBL-09	143122	LOGBICON	Schwarzbeck	VULB 9168	508	2019/04/03	12
RE	CAT5-04	178807	5dB Fixed Atten.	PASTERNACK	PE7047-5	none	2019/04/03	12
RE	CAF-16	142936	Pre-Amplifier	SONOMA INSTRUMENT	310N	325015	2019/05/30	12
RE	CTR-01	144193	Test Receiver	Rohde & Schwarz	ESU40	100426	2019/04/19	12
RE	CSCL-16	143655	Ruler	TAJIMA	G3 gold	none	-	-
RE	COS-11	143543	Temperature, Humidity & Atmospheric Logger	T&D	TR-73U	F8060468	2019/06/25	12
RE	CTS-13	144215	Digital Multimeter	Fluke Corporation	FLK-83- V	14610320	2019/10/27	12
RE	COTS-CEMI-03	178804	EMI Software	TSJ	TEPTO-DV3 (RE,CE,ME,PE)	-	-	-
AT	CTS-18	144220	Digital Multimeter	Fluke Corporation	87-3	85220051	-	-
AT	COS-02	143534	Temperature & Humidity Indicator	A&D	AD-5681	6878345	2019/07/24	12
AT	CTR-05	144196	Test Receiver	Rohde & Schwarz	ESCI	100608	2019/09/05	12
AT	CAF-02	142925	Pre-Amplifier	Hewlett Packard	8447D	2944A07219	2019/07/11	12
AT	CAF-22	142940	Pre-Amplifier	Micro Wave Factory	MPR-1G26.5-35	161399	2019/06/10	12
AT	CIMT-02	144831	Impedance Transformer	TAMAGAWA	ZT-130	1011101	2020/01/10	12
AT	CCC-W02	143110	Micro Wave Cable	Suhner	SUCOFLEX102	MY3773/2	2019/05/23	12
AT	CAT10-40	192240	10dB Fixed Attenuator	Weinschel Associates	54A-10	101826	2020/01/08	12

***Hyphens for Last Calibration Date and Cal Int (month) are instruments that Calibration is not required (e.g. software), or instruments checked in advance before use.**

The expiration date of the calibration is the end of the expired month.
As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.
Test item: RE: Radiated Emission test
AT: Antenna Terminal Conducted test