

EMI TEST REPORT

Test Report No. 14814707H-D

Customer	DENSO TEN Limited
Description of EUT	Car Navigation
Model Number of EUT	TN0022A
FCC ID	BABTN0022A
Test Regulation	FCC Part 15 Subpart B
Test Result	Complied
Issue Date	July 31, 2023
Remarks	-

Representative test engineer

Takafumi Noguchi
Engineer

Approved by

Ryota Yamanaka
Engineer

CERTIFICATE 5107.02

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- The information provided from the customer for this report is identified in SECTION 1.
- For test report(s) referred in this report, the latest version (including any revisions) is always referred.

REVISION HISTORY

Original Test Report No. 14814707H-D

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	14814707H-D	July 31, 2023	-

Reference: Abbreviations (Including words undescribed in this report)

A2LA	The American Association for Laboratory Accreditation	GPS	Global Positioning System
AAN	Asymmetric Artificial Network	Hori.	Horizontal
AC	Alternating Current	ICES	Interference-Causing Equipment Standard
AM	Amplitude Modulation	I/O	Input/Output
AMN	Artificial Mains Network	IEC	International Electrotechnical Commission
Amp, AMP	Amplifier	IEEE	Institute of Electrical and Electronics Engineers
ANSI	American National Standards Institute	IF	Intermediate Frequency
Ant, ANT	Antenna	ILAC	International Laboratory Accreditation Conference
AP	Access Point	ISED	Innovation, Science and Economic Development Canada
ASK	Amplitude Shift Keying	ISN	Impedance Stabilization Network
Atten., ATT	Attenuator	ISO	International Organization for Standardization
AV	Average	JAB	Japan Accreditation Board
BPSK	Binary Phase-Shift Keying	LAN	Local Area Network
BR	Bluetooth Basic Rate	LCL	Longitudinal Conversion Loss
BT	Bluetooth	LIMS	Laboratory Information Management System
BT LE	Bluetooth Low Energy	LISN	Line Impedance Stabilization Network
BW	BandWidth	MRA	Mutual Recognition Arrangement
C.F	Correction Factor	N/A	Not Applicable
Cal Int	Calibration Interval	NIST	National Institute of Standards and Technology
CAV	CISPR AV	NS	No signal detect.
CCK	Complementary Code Keying	NSA	Normalized Site Attenuation
CDN	Coupling Decoupling Network	OBW	Occupied BandWidth
Ch., CH	Channel	OFDM	Orthogonal Frequency Division Multiplexing
CISPR	Comite International Special des Perturbations Radioelectriques	PER	Packet Error Rate
Corr.	Correction	PK	Peak
CPE	Customer premise equipment	P _{LT}	long-term flicker severity
CW	Continuous Wave	POHC(A)	Partial Odd Harmonic Current
DBPSK	Differential BPSK	Pol., Pola.	Polarization
DC	Direct Current	PR-ASK	Phase Reversal ASK
DET	Detector	P _{ST}	short-term flicker severity
D-factor	Distance factor	QAM	Quadrature Amplitude Modulation
Dmax	maximum absolute voltage change during an observation period	QP	Quasi-Peak
DQPSK	Differential QPSK	QPSK	Quadrature Phase Shift Keying
DSSS	Direct Sequence Spread Spectrum	r.m.s., RMS	Root Mean Square
DUT	Device Under Test	RBW	Resolution BandWidth
EDR	Enhanced Data Rate	RE	Radio Equipment
e.i.r.p., EIRP	Equivalent Isotropically Radiated Power	REV	Reverse
EM clamp	Electromagnetic clamp	RF	Radio Frequency
EMC	ElectroMagnetic Compatibility	RFID	Radio Frequency Identifier
EMI	ElectroMagnetic Interference	RNSS	Radio Navigation Satellite Service
EMS	ElectroMagnetic Susceptibility	RSS	Radio Standards Specifications
EN	European Norm	Rx	Receiving
e.r.p., ERP	Effective Radiated Power	SINAD	Ratio of (Signal + Noise + Distortion) to (Noise + Distortion)
ETSI	European Telecommunications Standards Institute	S/N	Signal to Noise ratio
EU	European Union	SA, S/A	Spectrum Analyzer
EUT	Equipment Under Test	SG	Signal Generator
Fac.	Factor	SVSWR	Site-Voltage Standing Wave Ratio
FCC	Federal Communications Commission	THC(A)	Total Harmonic Current
FHSS	Frequency Hopping Spread Spectrum	THD(%)	Total Harmonic Distortion
FM	Frequency Modulation	TR, T/R	Test Receiver
Freq.	Frequency	Tx	Transmitting
FSK	Frequency Shift Keying	VBW	Video BandWidth
Fund	Fundamental	Vert.	Vertical
FWD	Forward	WLAN	Wireless LAN
GFSK	Gaussian Frequency-Shift Keying	xDSL	Generic term for all types of DSL technology
GNSS	Global Navigation Satellite System		(DSL: Digital Subscriber Line)

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SECTION 1: Customer information

Company Name	DENSO TEN Limited
Address	2-28, Goshō-dori 1-Chome, Hyogo-ku, Kobe, 652-8510 Japan
Telephone Number	+81-78-682-2159
Contact Person	Kaoru Abe

The information provided from the customer is as follows;

- Customer, Description of EUT, Model Number of EUT, FCC ID 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 the Receipt Date and Test 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 (EUT)

2.1 Identification of EUT

Description	Car Navigation
Model Number	TN0022A
Serial Number	Refer to SECTION 4.2
Condition	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	No Modification by the test lab
Receipt Date	June 16, 2023
Test Date	June 29 and 30, 2023

2.2 Product Description

General Specification

Rating	DC 12 V
Clock frequency (ies) in the system	7.3333333 GHz (max)

Radio Specification

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

Equipment Type	Transceiver
Frequency of Operation	2412 MHz to 2462 MHz
Type of Modulation	DSSS, OFDM
Antenna Gain	-1.25 dBi (Peak)

Bluetooth (BR / EDR/ Low Energy)

Equipment Type	Transceiver
Frequency of Operation	2402 MHz to 2480 MHz
Type of Modulation	BT: FHSS (GFSK, $\pi/4$ DQPSK, 8 DPSK) BT LE: GFSK
Antenna Gain	-1.74 dBi (Peak)

WLAN (IEEE802.11a/11n-20/11ac-20/11n-40/11ac-40/11ac-80)

Equipment Type	Transceiver	
Frequency of Operation	20 MHz Band	5180 MHz to 5240 MHz 5745 MHz to 5825 MHz
	40 MHz Band	5190 MHz to 5230 MHz 5755 MHz to 5795 MHz
	80 MHz Band	5210 MHz 5775 MHz
Type of Modulation	OFDM	
Antenna Gain	3.09 dBi (Peak) (ANT 1) / 2.08 dBi (Peak) (ANT 2)	

AM (incl. HD_AM)/FM (incl. RBDS/HD_FM)/SDARS

Equipment Type	Receiver
Frequency of Operation	AM, HD_AM: 530 kHz to 1710 kHz FM, RBDS/HD_FM: 87.75 MHz to 107.9 MHz SDARS: 2320 MHz to 2345 MHz
Type of Modulation	AM FM SDARS: QPSK(Sat)/COFDM(Terr)
Antenna Connector Type	HFC IV

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification	FCC Part 15 Subpart B The latest version on the first day of the testing period
Title	FCC 47CFR Part15 Radio Frequency Device Subpart B Unintentional Radiators

3.2 Procedures and results

Item	Test Procedure	Limits	Worst margin	Result	Remarks
Conducted emission	ANSI C63.4: 2014 7. AC power - line conducted emission measurements IEEE 187:2003	Part 15 Subpart B 15.107(a)	-	N/A	*1)
Radiated emission	ANSI C63.4: 2014 8. Radiated emission measurements IEEE 187:2003	Part 15 Subpart B 15.109(a)	7.37 dB 4999.950 MHz, Horizontal, Mode 1 (Other)	Complied	-
Antenna Terminal	ANSI C63.4: 2014 12. Measurement of unintentional radiators other than ITE IEEE 187:2003	Part 15 Subpart B 15.111(a)	24.70 dB 499.193 MHz, PK, Mode 3	Complied	-

* Note: UL Japan, Inc.'s EMI Work Procedure: Work Instructions-ULID-003591.

*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.

3.3 Addition to standard

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

3.4 Uncertainty

Measurement uncertainty is not taken into account when stating conformity with a specified requirement.
Note: When margins obtained from test results are less than the measurement uncertainty, the test results may exceed the limit.

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

Radiated emission

Measurement distance	Frequency range		Uncertainty (+/-)
3 m	30 MHz to 200 MHz	Horizontal	4.8 dB
		Vertical	5.0 dB
	200 MHz to 1000 MHz	Horizontal	5.1 dB
		Vertical	6.2 dB
10 m	30 MHz to 200 MHz	Horizontal	4.8 dB
		Vertical	4.8 dB
	200 MHz to 1000 MHz	Horizontal	4.9 dB
		Vertical	5.0 dB
3 m	1 GHz to 6 GHz	Test Receiver	5.0 dB
		Spectrum analyzer	4.9 dB
	6 GHz to 18 GHz	Test Receiver	5.3 dB
		Spectrum analyzer	5.2 dB
1 m	10 GHz to 26.5 GHz	Spectrum analyzer	5.5 dB
	26.5 GHz to 40 GHz	Spectrum analyzer	5.4 dB
0.5 m	26.5 GHz to 40 GHz	Spectrum analyzer	5.4 dB
10 m	1 GHz to 18 GHz	Test Receiver	5.3 dB

Antenna Terminal test

Test Item	Uncertainty (+/-)
Antenna terminal conducted emission	3.3 dB

3.5 Test Location

UL Japan, Inc. Ise EMC Lab.

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 Japan

Telephone: +81-596-24-8999

A2LA Certificate Number: 5107.02 / FCC Test Firm Registration Number: 884919

ISED Lab Company Number: 2973C / CAB identifier: JP0002

Test site	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms	Maximum measurement distance
No.1 semi-anechoic chamber	19.2 x 11.2 x 7.7	7.0 x 6.0	No.1 Power source room	10 m
No.2 semi-anechoic chamber	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	12.0 x 8.5 x 5.9	6.8 x 5.75	No.3 Preparation room	3 m
No.3 shielded room	4.0 x 6.0 x 2.7	N/A	-	-
No.4 semi-anechoic chamber	12.0 x 8.5 x 5.9	6.8 x 5.75	No.4 Preparation room	3 m
No.4 shielded room	4.0 x 6.0 x 2.7	N/A	-	-
No.5 semi-anechoic chamber	6.0 x 6.0 x 3.9	6.0 x 6.0	-	-
No.5 measurement room	6.4 x 6.4 x 3.0	6.4 x 6.4	-	-
No.6 shielded room	4.0 x 4.5 x 2.7	4.0 x 4.5	-	-
No.6 measurement room	4.75 x 5.4 x 3.0	4.75 x 4.15	-	-
No.7 shielded room	4.7 x 7.5 x 2.7	4.7 x 7.5	-	-
No.8 measurement room	3.1 x 5.0 x 2.7	3.1 x 5.0	-	-
No.9 measurement room	8.8 x 4.6 x 2.8	2.4 x 2.4	-	-
No.10 shielded room	3.8 x 2.8 x 2.8	3.8 x 2.8	-	-
No.11 measurement room	4.0 x 3.4 x 2.5	N/A	-	-
No.12 measurement room	2.6 x 3.4 x 2.5	N/A	-	-
Large Chamber	16.9 x 22.1 x 10.17	16.9 x 22.1	-	10 m
Small Chamber	5.3 x 6.69 x 3.59	5.3 x 6.69	-	-

3.6 Test data, Test instruments, and Test set up

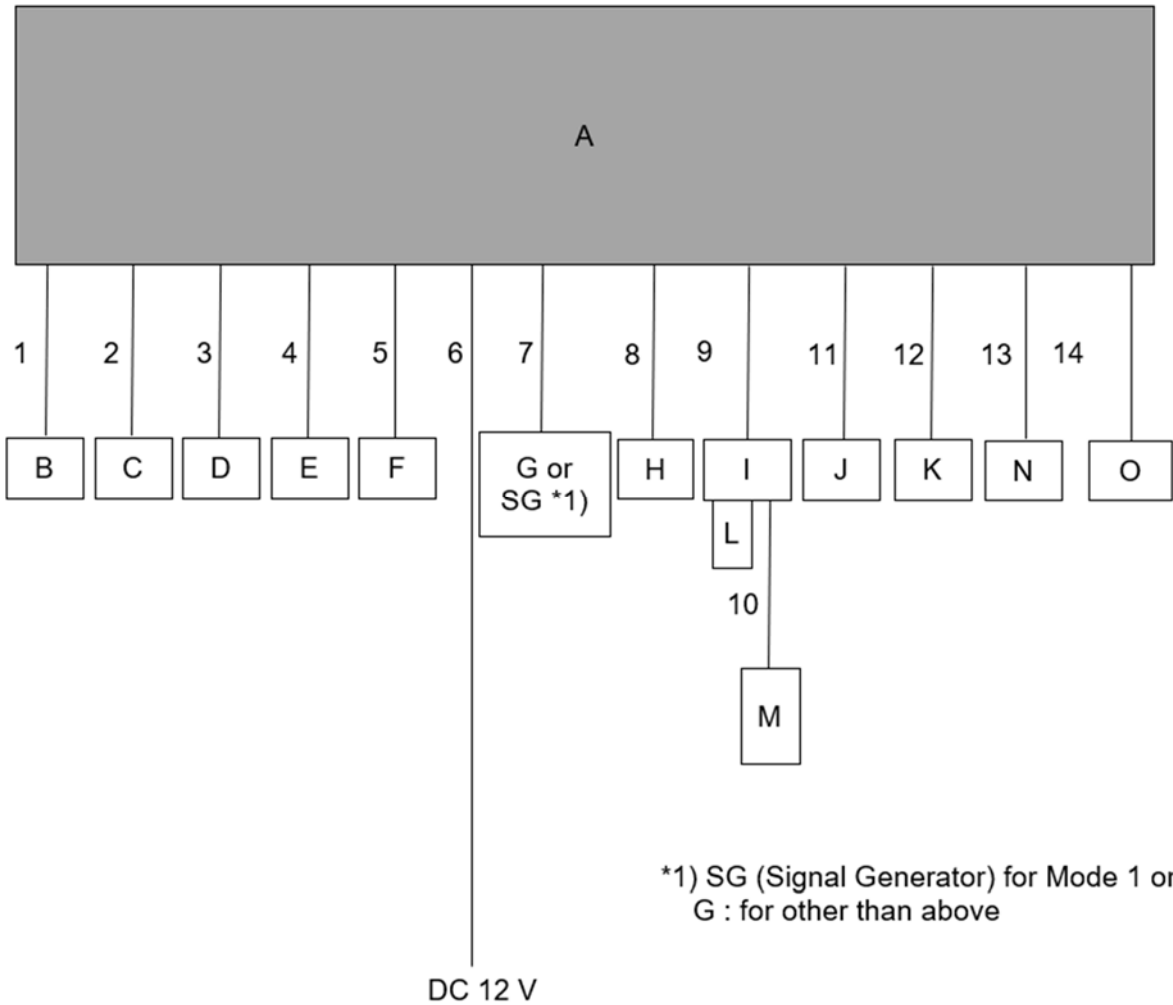
Refer to APPENDIX.

SECTION 4: Operation of EUT during testing

4.1 Operating Mode(s)

Mode	1. FM Main Port Receiving mode (Local / Other) (Radiated Emission test) 2. USB Memory Play mode (Radiated Emission test) 3. FM Main Port Tuning mode (Antenna Terminal test)
Software(s)	NANP04.056561C

4.2 Configuration and peripherals



* Cabling and setup(s) 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	Car Navigation	TN0022A	MUC00025	DENSO TEN Limited	EUT
B	Switch	-	-	-	-
C	DCM	19MC_DCM	E-033720026/004	DENSO Corporation	-
D	Steering Switch	PA6-GF30	No.55	TOYOTA	-
E	Low noise Amp	ZX60-242GLN-S+	S 2036302044	Mini-Circuits	-
F	GNSS Antenna	033722058/002	29020043	DENSO TEN Limited	-
G	FM/AM connector (Main)	86300-30C30	PTA00490	DENSO TEN Limited	-
H	Digital BGM Camera	867B0-78080	07SD00016	KYOCERA Corporation	-
I	USB/AUX socket	-	No.39	-	-
J	Mic	SDA3510A	0DC040829	-	-
K	Mic	SDA3510A	0DC040805	-	-
L	USB Memory	RYF3-K16GB	P10416	Buffalo Inc.	-
M	iPod touch	A1367	CCQ50WDDCPC	Apple	-
N	Speaker Dummy	-	-	-	-
O	Satellite Switch	86170-AK010	-	-	-

List of Cables Used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Signal Cable	3.5	Unshielded	Unshielded	-
2	Signal Cable	2.4	Unshielded	Unshielded	-
3	Signal Cable	2.4	Unshielded	Unshielded	-
4	Signal Cable	0.9	Unshielded	Unshielded	-
5	GNSS Antenna Cable	8.0	Shielded	Shielded	-
6	DC Cable	4.5	Unshielded	Unshielded	-
7	Signal Cable	2.6	Unshielded	Unshielded	-
8	Signal Cable	3.2	Unshielded	Unshielded	-
9	USB Cable	1.9	Shielded	Shielded	-
10	Audio Cable	1.0	Shielded	Shielded	-
11	Signal Cable	2.7	Unshielded	Unshielded	-
12	Signal Cable	2.7	Unshielded	Unshielded	-
13	Speaker Cable	5.2	Shielded	Shielded	-
14	Signal Cable	5.0	Unshielded	Unshielded	-

SECTION 5: Radiated Emission

5.1 Operating environment

Date : See data
Test place : See data
Temperature : See data
Humidity : See data
Test engineer : See data

5.2 Test configuration

EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane.

The EUT was set on the center of the tabletop.

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 3.

6.3 Test conditions

Frequency range : 30 MHz to 200 MHz (Biconical antenna)
200 MHz to 1000 MHz (Logperiodic antenna)
1000 MHz to 40000 MHz (Horn antenna)
Test distance : 3 m
EUT position : Table top
EUT operation mode : See Clause 4.1

6.4 Test procedure

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

The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer.

The radiated emission measurements were made with the following detector function of the Test Receiver and the Spectrum Analyzer.

The test of Local oscillator spurious has been measured up to appropriate frequency based on the result of the antenna terminal test.

Test antenna was aimed at the emission source for receiving the maximum signal and always kept. (Above 1 GHz)

Frequency	Below 1 GHz	Above 1 GHz *1)
Instrument used	Test Receiver	Test Receiver
IF Bandwidth	QP: BW 120 kHz	PK: BW 1 MHz, CAV: BW 1 MHz

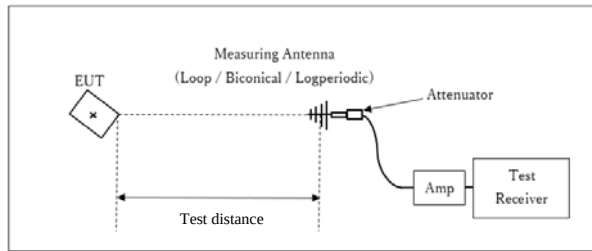
*1) The measurement data was adjusted to a 3 m distance using the following Distance Factor.

Distance Factor: See Figure 1

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

Figure 1: Test Setup

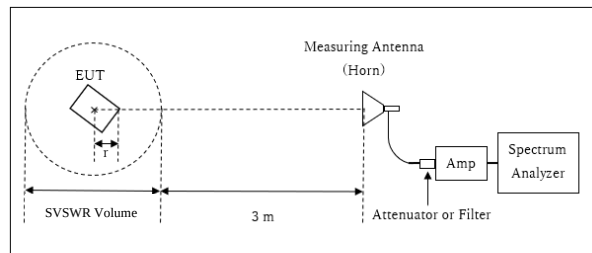
Below 1 GHz



x : Center of turn table

Test Distance: 3 m

1 GHz to 10 GHz



r : Radius of an outer periphery of EUT

x : Center of turn table

Distance Factor: $20 \times \log (3.10 \text{ m}^* / 3.0 \text{ m}) = 0.28 \text{ dB}$

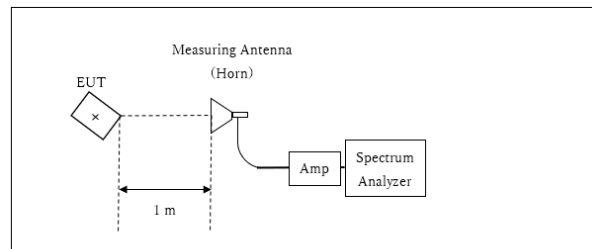
* Test Distance: $(3 + \text{SVSWR Volume} / 2) - r = 3.10 \text{ m}$

SVSWR Volume: 2 m

(SVSWR Volume has been calibrated based on CISPR 16-1-4.)

$r = 0.9 \text{ m}$

10 GHz to 40 GHz



x : Center of turn table

Distance Factor: $20 \times \log (1.0 \text{ m}^* / 3.0 \text{ m}) = -9.54 \text{ dB}$

*Test Distance: 1 m

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

6.5 Test result

Summary of the test results: Pass

The limit is rounded down to one decimal place.

The test result is rounded off to one or two decimal places, so some differences might be observed.

SECTION 6: Antenna Terminal

6.1 Operating environment

Date : See data
Test place : See data
Temperature : See data
Humidity : See data
Test engineer : See 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. Photographs of the set up are shown in APPENDIX 3.

6.3 Test conditions

Frequency range : 30 MHz to 1000 MHz / 1000 MHz to 40000 MHz
Test distance : N/A
EUT position : Table top
EUT operation mode : See Clause 4.1

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 Test result

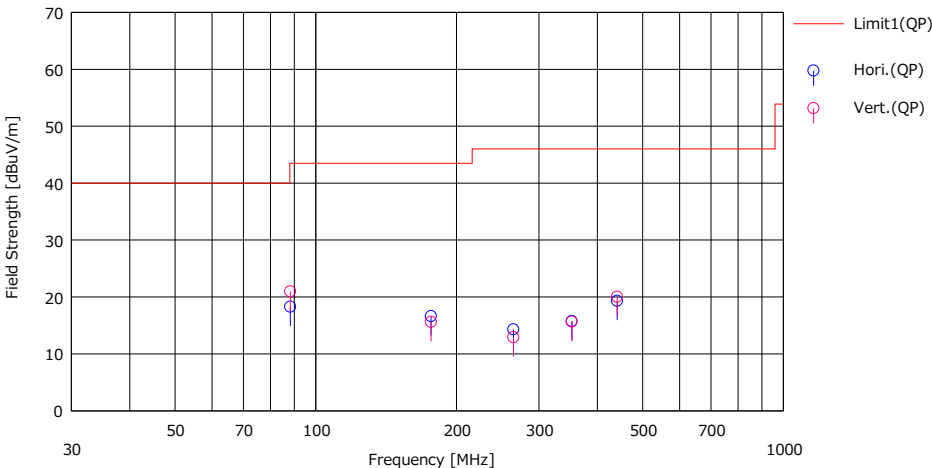
Summary of the test results: Pass

APPENDIX 1: Test data

Radiated Emission

Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date June 29, 2023
Temperature / Humidity 21 deg. C / 44 % RH
Engineer Takafumi Noguchi
 (Below 1 GHz)
Mode Mode 1 Local 87.75 MHz

Limit : FCC_Part 15 Subpart B(15.109)_Class B



No.	Freq. [MHz]	Reading (QP)	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result (QP)	Limit (QP)	Margn (QP)	Pola. [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
		[dBuV]				[dBuV/m]	[dBuV/m]	[dB]					
1	88.207	34.30	8.26	7.77	32.06	18.27	43.50	25.23	Hori.	256	56	BA	
2	176.414	24.00	16.07	8.57	32.02	16.62	43.50	26.88	Hori.	192	108	BA	
3	264.621	24.40	12.56	9.35	32.01	14.30	46.00	31.70	Hori.	100	244	LA23	
4	352.828	22.70	15.19	9.92	32.06	15.75	46.00	30.25	Hori.	100	0	LA23	
5	441.035	24.60	16.43	10.42	32.14	19.31	46.00	26.69	Hori.	100	188	LA23	
6	88.207	37.00	8.26	7.77	32.06	20.97	43.50	22.53	Vert.	100	103	BA	
7	176.414	23.00	16.07	8.57	32.02	15.62	43.50	27.88	Vert.	100	98	BA	
8	264.621	23.00	12.56	9.35	32.01	12.90	46.00	33.10	Vert.	166	0	LA23	
9	352.828	22.60	15.19	9.92	32.06	15.65	46.00	30.35	Vert.	100	0	LA23	
10	441.035	25.30	16.43	10.42	32.14	20.01	46.00	25.99	Vert.	100	131	LA23	

CHART: WITH FACTOR
ANT TYPE: - 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN
CALCULATION: RESULT = READING + ANT FACTOR + LOSS(CABLE + ATT) - GAIN(AMP)
Except for the above table: adequate margin data below the limits.

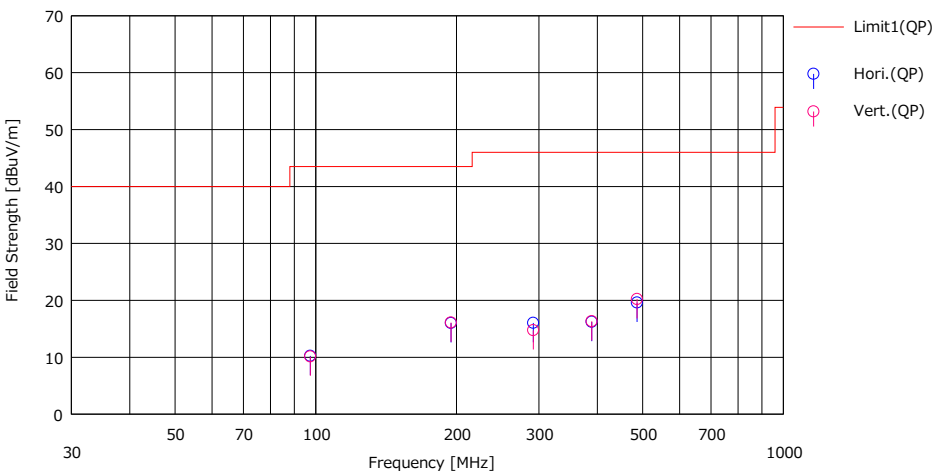
Radiated Emission

Test place
Semi Anechoic Chamber
Date
Temperature / Humidity
Engineer

Mode

Ise EMC Lab.
No.4
June 29, 2023
21 deg. C / 44 % RH
Takafumi Noguchi
(Below 1 GHz)
Mode 1 Local 97.7 MHz

Limit : FCC_Part 15 Subpart B(15.109)_Class B



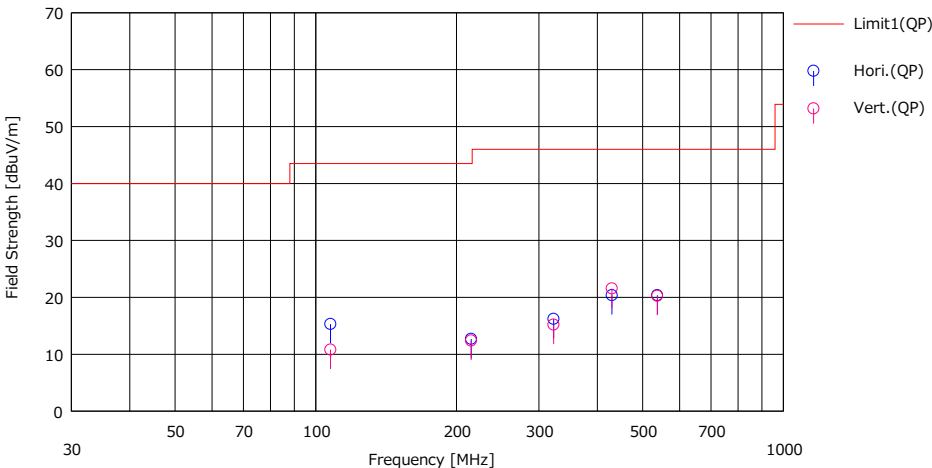
No.	Freq. [MHz]	Reading (QP)	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result (QP)	Limit (QP)	Margin (QP)	Pola [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
		[dBuV]				[dBuV/m]	[dBuV/m]	[dB]					
1	97.297	24.60	9.82	7.86	32.05	10.23	43.50	33.27	Hori.	317	72	BA	
2	194.594	22.80	16.48	8.72	32.01	15.99	43.50	27.51	Hori.	177	0	BA	
3	291.891	24.70	13.73	9.61	32.01	16.03	46.00	29.97	Hori.	100	295	LA23	
4	389.188	22.60	15.59	10.11	32.09	16.21	46.00	29.79	Hori.	100	293	LA23	
5	486.485	23.50	17.58	10.70	32.18	19.60	46.00	26.40	Hori.	100	314	LA23	
6	97.297	24.50	9.82	7.86	32.05	10.13	43.50	33.37	Vert.	100	36	BA	
7	194.594	22.90	16.48	8.72	32.01	16.09	43.50	27.41	Vert.	100	151	BA	
8	291.891	23.40	13.73	9.61	32.01	14.73	46.00	31.27	Vert.	155	353	LA23	
9	389.188	22.70	15.59	10.11	32.09	16.31	46.00	29.69	Vert.	139	142	LA23	
10	486.485	24.10	17.58	10.70	32.18	20.20	46.00	25.80	Vert.	100	58	LA23	

CHART: WITH FACTOR
ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN
CALCULATION: RESULT = READING + ANT FACTOR + LOSS(CABLE + ATT) - GAIN(AMP)
Except for the above table: adequate margin data below the limits.

Radiated Emission

Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date June 29, 2023
Temperature / Humidity 21 deg. C / 44 % RH
Engineer Takafumi Noguchi
(Below 1 GHz)
Mode Mode 1 Local 107.9 MHz

Limit : FCC_Part 15 Subpart B(15.109)_Class B



No.	Freq. [MHz]	Reading (QP)	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result (QP)	Limit (QP)	Margn (QP)	Pola [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
		[dBuV]				[dBuV/m]	[dBuV/m]	[dB]					
1	107.496	28.00	11.37	7.96	32.04	15.29	43.50	28.21	Hori.	167	279	BA	
2	214.992	24.70	11.09	8.91	32.01	12.69	43.50	30.81	Hori.	100	69	LA23	
3	322.488	24.10	14.35	9.78	32.03	16.20	46.00	29.80	Hori.	100	279	LA23	
4	429.984	25.90	16.23	10.35	32.13	20.35	46.00	25.65	Hori.	100	173	LA23	
5	537.480	23.80	17.75	11.01	32.21	20.35	46.00	25.65	Hori.	124	63	LA23	
6	107.496	23.50	11.37	7.96	32.04	10.79	43.50	32.71	Vert.	100	301	BA	
7	214.992	24.40	11.09	8.91	32.01	12.39	43.50	31.11	Vert.	100	138	LA23	
8	322.488	23.10	14.35	9.78	32.03	15.20	46.00	30.80	Vert.	100	204	LA23	
9	429.984	27.10	16.23	10.35	32.13	21.55	46.00	24.45	Vert.	126	122	LA23	
10	537.480	23.70	17.75	11.01	32.21	20.25	46.00	25.75	Vert.	188	195	LA23	

CHART: WITH FACTOR
ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN
CALCULATION: RESULT = READING + ANT FACTOR + LOSS(CABLE + ATT) - GAIN(AMP)
Except for the above table: adequate margin data below the limits

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	June 29, 2023
Temperature / Humidity	20 deg. C / 42 % RH
Engineer	Masaya Minami (Above 1 GHz)
Mode	Mode 1 Local 87.75 MHz

[illegible]

Radiated Emission

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	June 29, 2023
Temperature / Humidity	20 deg. C / 42 % RH
Engineer	Masaya Minami (Above 1 GHz)
Mode	Mode 1 Local 97.7 MHz

Limit : FCC_Part 15 Subpart B(15.109)_Class B

<< AV/PK DATA >>

No.	Freq. (MHz)	Reading		Ant Foc (dB/m)	Loss (dB)	Gain (dB)	Result		Limit		Margin		Pola (H/V)	Height (cm)	Angle (deg)	Ant. Type	Comment
		(AV)	(PK)				(AV)	(PK)	(AV)	(PK)	(AV)	(PK)					
		(dBuV)	(dBuV)				(dBuV/m)	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)					
1	1070.267	32.30	45.20	24.40	1.83	34.68	23.85	36.75	53.90	73.90	30.05	37.15	Horl	100	0	H2.1	
2	1070.267	32.10	45.10	24.40	1.83	34.68	23.65	36.65	53.90	73.90	30.25	37.25	Vert.	100	0	H2.1	

CHART: WITH FACTOR
ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN
CALCULATION: RESULT = READING + ANT FACTOR + LOSS(CABLE + D-factor) - GAIN(AMP)
Except for the above table: adequate margin data below the limits

Radiated Emission

Limit : FCC_Part 15 Subpart B(15.109)_Class B

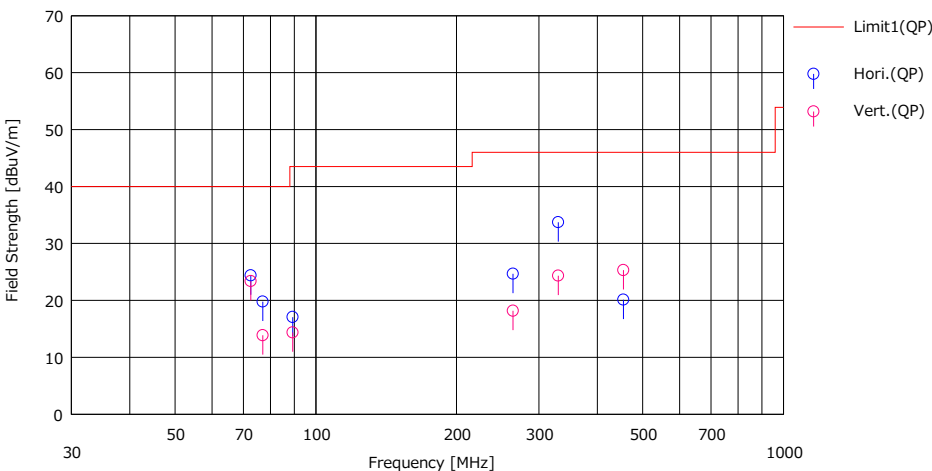
No.	Freq.	Reading		Ant.Fac	Loss	Gain	Result		Limit		Margin		Pola	Height	Angle	Ant. Type	Comment
		(AV)	(PK)				(AV)	(PK)	(AV)	(PK)	(AV)	(PK)					

CHART: WITH FACTOR

Radiated Emission

Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date June 29, 2023
Temperature / Humidity 21 deg. C / 44 % RH
Engineer Takafumi Noguchi
Mode (Below 1 GHz)
Mode 1 Other

Limit : FCC_Part 15 Subpart B(15.109)_Class B



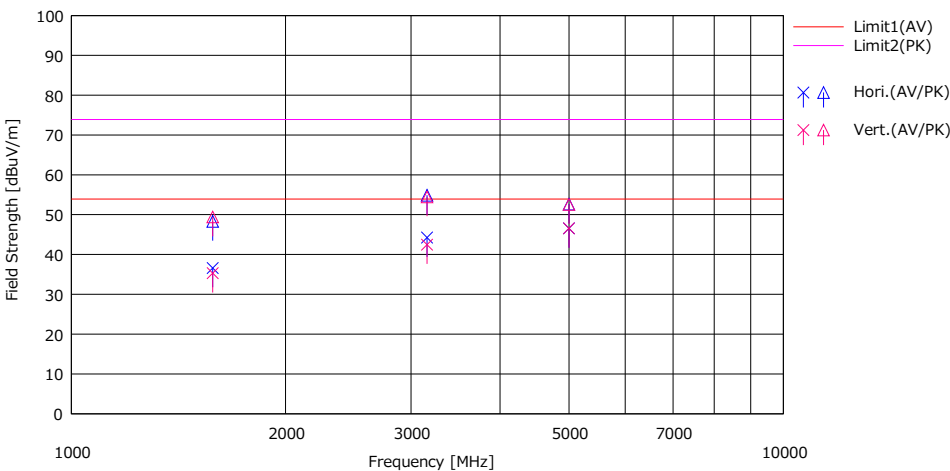
No.	Freq. [MHz]	Reading (QP)	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result (QP)	Limit (QP)	Margn (QP)	Pola [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
		[dBuV]				[dBuV/m]	[dBuV/m]	[dB]					
1	72.580	42.50	6.34	7.61	32.08	24.37	40.00	15.63	Hori.	236	306	BA	
2	77.006	37.60	6.58	7.66	32.08	19.76	40.00	20.24	Hori.	219	332	BA	
3	89.228	32.90	8.43	7.78	32.06	17.05	43.50	26.45	Hori.	194	266	BA	
4	263.999	34.80	12.52	9.35	32.01	24.66	46.00	21.34	Hori.	100	259	LA23	
5	329.995	41.30	14.64	9.82	32.04	33.72	46.00	12.28	Hori.	100	294	LA23	
6	454.721	25.00	16.75	10.50	32.15	20.10	46.00	25.90	Hori.	100	191	LA23	
7	72.580	41.50	6.34	7.61	32.08	23.37	40.00	16.63	Vert.	100	359	BA	
8	77.006	31.70	6.58	7.66	32.08	13.86	40.00	26.14	Vert.	100	247	BA	
9	89.228	30.20	8.43	7.78	32.06	14.35	43.50	29.15	Vert.	125	47	BA	
10	263.999	28.30	12.52	9.35	32.01	18.16	46.00	27.84	Vert.	100	0	LA23	
11	329.995	31.90	14.64	9.82	32.04	24.32	46.00	21.68	Vert.	131	272	LA23	
12	454.721	30.20	16.75	10.50	32.15	25.30	46.00	20.70	Vert.	100	125	LA23	

CHART: WITH FACTOR
ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN
CALCULATION: RESULT = READING + ANT FACTOR + LOSS(CABLE + ATT) - GAIN(AMP)
Except for the above table: adequate margin data below the limits

Radiated Emission

Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date June 29, 2023
Temperature / Humidity 20 deg. C / 42 % RH
Engineer Masaya Minami
Mode (1 GHz - 10 GHz)
Mode 1 Other

Limit : FCC_Part 15 Subpart B(15.109)_Class B



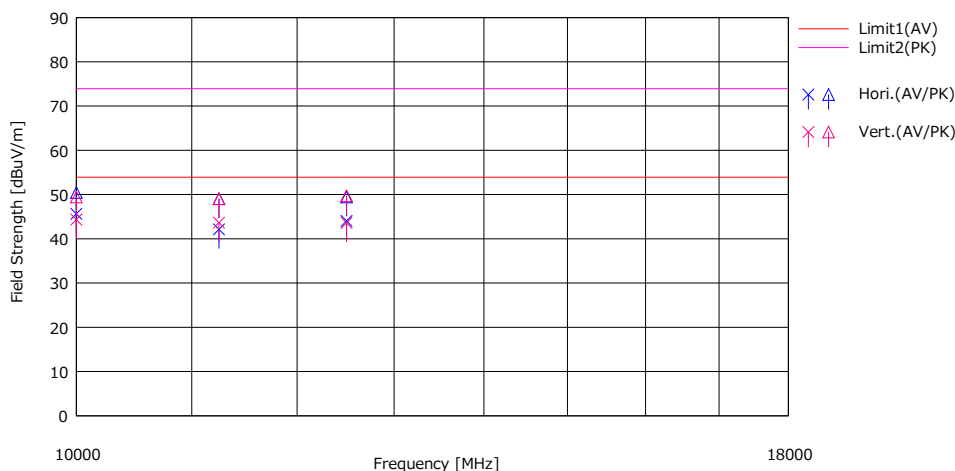
No.	Freq. [MHz]	Reading		Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result		Limit		Margin		Pda. [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
		(AV) [dBuV]	(PK) [dBuV]				(AV) [dBuV/m]	(PK) [dBuV/m]	(AV) [dBuV/m]	(PK) [dBuV/m]	(AV) [dB]	(PK) [dB]					
1	1579.953	42.80	54.50	24.98	2.16	33.34	36.60	48.30	53.90	73.90	17.30	25.60	Hori.	100	191	H21	
2	3159.989	44.00	54.60	28.87	3.00	31.62	44.25	54.85	53.90	73.90	9.65	19.05	Hori.	207	245	H21	
3	4999.950	42.10	48.20	31.75	3.78	31.10	46.53	52.63	53.90	73.90	7.37	21.27	Hori.	202	110	H21	
4	1579.953	41.50	55.60	24.98	2.16	33.34	35.30	49.40	53.90	73.90	18.60	24.50	Vert.	100	186	H21	
5	3159.989	42.20	54.20	28.87	3.00	31.62	42.45	54.45	53.90	73.90	11.45	19.45	Vert.	183	133	H21	
6	4999.950	42.10	48.10	31.75	3.78	31.10	46.53	52.53	53.90	73.90	7.37	21.37	Vert.	100	212	H21	

CHART: WITH FACTOR
ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN
CALCULATION: RESULT = READING + ANT FACTOR + LOSS(CABLE + D-factor) - GAIN(AMP)
Except for the above table: adequate margin data below the limits

Radiated Emission

Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date June 29, 2023
Temperature / Humidity 20 deg. C / 42 % RH
Engineer Masaya Minami
(10 GHz - 40 GHz)
Mode Mode 1 Other

Limit : FCC_Part 15 Subpart B(15.109)_Class B



No.	Freq. [MHz]	Reading		Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result		Limit		Margin		Pda. [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
		(AV) [dBuV]	(PK) [dBuV]				(AV) [dBuV/m]	(PK) [dBuV/m]	(AV) [dBuV/m]	(PK) [dBuV/m]	(AV) [dB]	(PK) [dB]					
1	10000000	43.89	48.71	38.97	-4.52	32.71	45.63	50.45	53.90	73.90	8.27	23.45	Hori.	150	131	H21	
2	11249900	39.75	46.68	39.53	-4.19	32.97	42.12	49.05	53.90	73.90	11.78	24.85	Hori.	112	87	H21	
3	12499880	41.75	47.15	38.82	-3.92	32.61	44.04	49.44	53.90	73.90	9.86	24.46	Hori.	114	187	H21	
4	10000000	42.61	47.67	38.97	-4.52	32.71	44.35	49.41	53.90	73.90	9.55	24.49	Vert.	108	146	H21	
5	11249900	41.25	46.66	39.53	-4.19	32.97	43.62	49.03	53.90	73.90	10.28	24.87	Vert.	114	134	H21	
6	12499880	41.29	47.44	38.82	-3.92	32.61	43.58	49.73	53.90	73.90	10.32	24.17	Vert.	100	162	H21	

CHART: WITH FACTOR

ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN

CALCULATION: RESULT = READING + ANT FACTOR + LOSS(CABLE + D-factor) - GAIN(AMP)

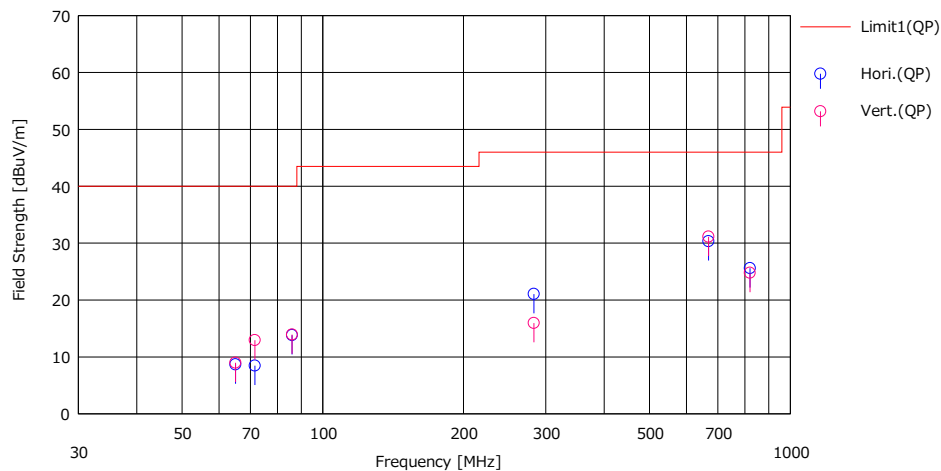
Except for the above table: adequate margin data below the limits

* No signal was detected above 18 GHz.

Radiated Emission

Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date June 29, 2023
Temperature / Humidity 21 deg. C / 44 % RH
Engineer Takafumi Noguchi
(Below 1 GHz)
Mode Mode 2

Limit : FCC_Part 15 Subpart B(15.109)_Class B



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	65.073	26.50	6.74	7.52	32.08	8.48	40.00	31.32	Hori.	285	73	BA	
2	71.573	26.60	6.33	7.60	32.08	8.45	40.00	31.55	Hori.	216	114	BA	
3	85.998	30.30	7.85	7.75	32.07	13.83	40.00	26.17	Hori.	256	64	BA	
4	282.885	30.00	13.54	9.52	32.01	21.05	46.00	24.95	Hori.	100	206	LA23	
5	668.681	31.60	19.46	11.54	32.27	30.33	46.00	15.67	Hori.	125	355	LA23	
6	820.489	24.10	21.00	12.06	31.58	25.58	46.00	20.42	Hori.	100	153	LA23	
7	65.073	26.80	6.74	7.52	32.08	8.98	40.00	31.02	Vert.	100	0	BA	
8	71.573	31.10	6.33	7.60	32.08	12.95	40.00	27.05	Vert.	100	239	BA	
9	85.998	30.40	7.85	7.75	32.07	13.93	40.00	26.07	Vert.	100	25	BA	
10	282.885	24.90	13.54	9.52	32.01	15.95	46.00	30.05	Vert.	100	175	LA23	
11	668.846	32.40	19.46	11.54	32.27	31.13	46.00	14.87	Vert.	100	47	LA23	
12	820.104	23.30	21.00	12.06	31.59	24.77	46.00	21.23	Vert.	100	151	LA23	

CHART: WITH FACTOR

ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN

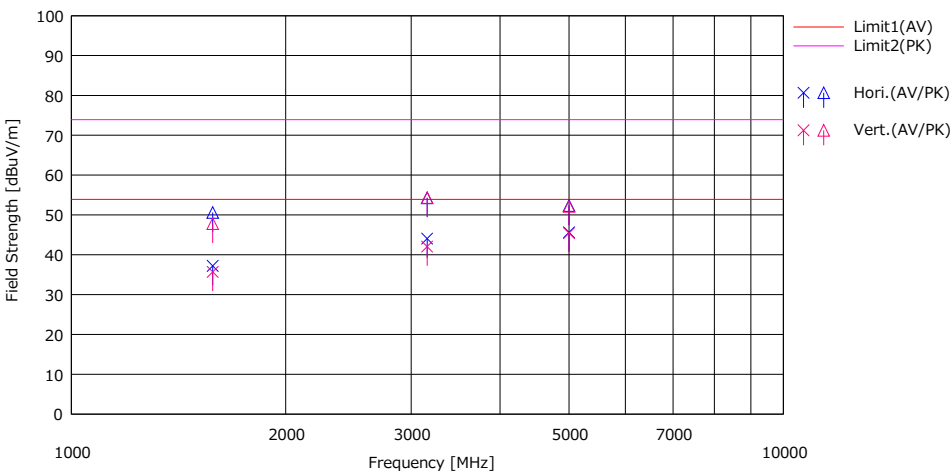
CALCULATION: RESULT = READING + ANT FACTOR + LOSS(CABLE + ATT) - GAIN(AMP)

Except for the above table: adequate margin data below the limits

Radiated Emission

Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date June 29, 2023
Temperature / Humidity 20 deg. C / 42 % RH
Engineer Masaya Minami
Mode (1 GHz - 10 GHz)
Mode 2

Limit : FCC_Part 15 Subpart B(15.109)_Class B



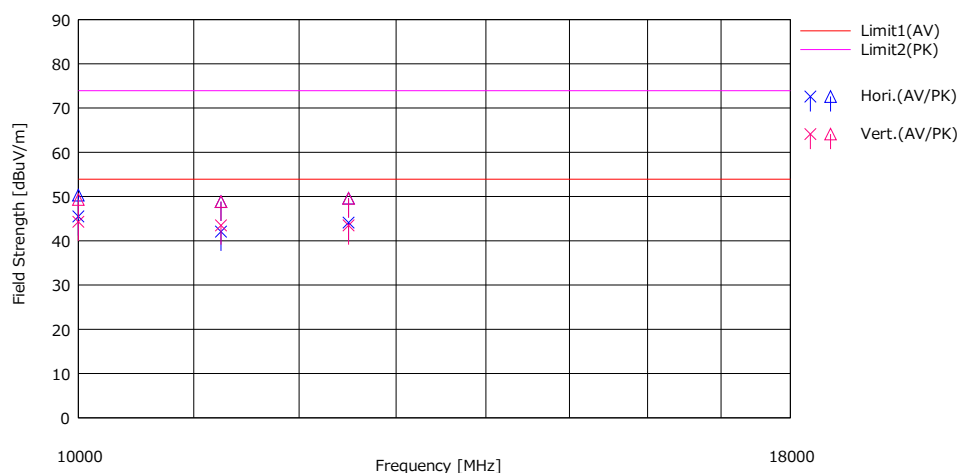
No.	Freq. [MHz]	Reading		Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result		Limit		Margin		Pola. [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
		(AV) [dBuV]	(PK) [dBuV]				(AV) [dBuV/m]	(PK) [dBuV/m]	(AV) [dBuV/m]	(PK) [dBuV/m]	(AV) [dB]	(PK) [dB]					
1	1579.953	43.40	56.80	24.98	2.16	33.34	37.20	50.60	53.90	73.90	16.70	23.30	Hori.	100	200	H21	
2	3159.989	43.80	54.00	28.87	3.00	31.62	44.05	54.25	53.90	73.90	9.85	19.65	Hori.	209	245	H21	
3	4999.950	41.20	47.90	31.75	3.78	31.10	45.63	52.33	53.90	73.90	8.27	21.57	Hori.	165	111	H21	
4	1579.953	41.90	54.00	24.98	2.16	33.34	35.70	47.80	53.90	73.90	18.20	26.10	Vert.	100	180	H21	
5	3159.989	41.80	54.10	28.87	3.00	31.62	42.05	54.35	53.90	73.90	11.85	19.55	Vert.	182	132	H21	
6	4999.950	41.00	47.70	31.75	3.78	31.10	45.43	52.13	53.90	73.90	8.47	21.77	Vert.	110	165	H21	

CHART: WITH FACTOR
ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN
CALCULATION: RESULT = READING + ANT FACTOR + LOSS(CABLE + D-factor) - GAIN(AMP)
Except for the above table: adequate margin data below the limits

Radiated Emission

Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date June 29, 2023
Temperature / Humidity 20 deg. C / 42 % RH
Engineer Masaya Minami
(10 GHz - 40 GHz)
Mode Mode 2

Limit : FCC_Part 15 Subpart B(15.109)_Class B



No.	Freq. [MHz]	Reading		Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result		Limit		Margin		Pda. [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
		(AV) [dBuV]	(PK) [dBuV]				(AV) [dBuV/m]	(PK) [dBuV/m]	(AV) [dBuV/m]	(PK) [dBuV/m]	(AV) [dB]	(PK) [dB]					
1	10000.000	43.77	48.56	38.97	-4.52	32.71	45.51	50.30	53.90	73.90	8.39	23.60	Hori.	150	132	H21	
2	11249.900	39.69	46.45	39.53	-4.19	32.97	42.06	48.82	53.90	73.90	11.84	25.08	Hori.	112	88	H21	
3	12499.880	41.82	47.32	38.82	-3.92	32.61	44.11	49.61	53.90	73.90	9.79	24.29	Hori.	113	186	H21	
4	10000.000	42.57	47.58	38.97	-4.52	32.71	44.31	49.32	53.90	73.90	9.59	24.58	Vert.	107	146	H21	
5	11249.900	41.11	46.48	39.53	-4.19	32.97	43.48	48.85	53.90	73.90	10.42	25.06	Vert.	113	133	H21	
6	12499.880	41.18	47.27	38.82	-3.92	32.61	43.47	49.56	53.90	73.90	10.43	24.34	Vert.	100	161	H21	

CHART: WITH FACTOR

ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN

CALCULATION: RESULT = READING + ANT FACTOR + LOSS(CABLE + D-factor) - GAIN(AMP)

Except for the above table: adequate margin data below the limits

* No signal was detected above 18 GHz.

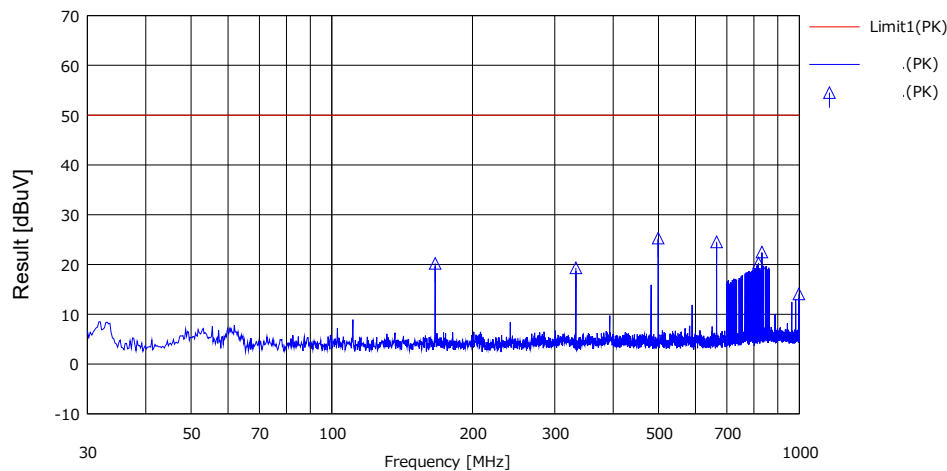
Antenna Terminal Conducted Emission

Test place
Semi Anechoic Chamber
Date
Temperature / Humidity
Engineer

Mode

Ise EMC Lab.
No.4
June 30, 2023
20 deg. C / 42 % RH
Takafumi Noguchi
(Below 1 GHz)
Mode 3

Limit : FCC15.111 Antenna terminal measurement



No.	Freq. [MHz]	Reading (PK)	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result (PK)	Limit *1) (PK)	Margn (PK)	Pola [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
		[dBuV]				[dBuV]	[dBuV]	[dB]					
1	166.402	44.07	0.00	8.16	32.02	20.21	50.00	29.79					
2	332.796	42.95	0.00	8.42	32.04	19.33	50.00	30.67					
3	499.193	48.93	0.00	8.56	32.19	25.30	50.00	24.70					
4	665.592	48.21	0.00	8.61	32.27	24.55	50.00	25.45					
5	818.372	43.21	0.00	8.71	31.60	20.32	50.00	29.68					Local 90.5 MHz
6	831.983	45.30	0.00	8.72	31.52	22.50	50.00	27.50					
7	998.383	35.75	0.00	8.86	30.54	14.07	50.00	35.93					

* 2 nW = -57 dBm = 50 dBuV
CHART: WITH FACTOR
CALCULATION: RESULT = READING + LOSS (CABLE + Matching Pad) – GAIN (AMP)
Except for the above table: adequate margin data below the limits.

APPENDIX 2: Test instruments

Test equipment (1/2)

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	COTS-MEMI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	MAEC-04	142011	AC4_Semi Anechoic Chamber (NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	05/22/2022	24
RE	MAEC-04-SVSWR	142017	AC4_Semi Anechoic Chamber (SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-10005	04/14/2023	24
RE	MAT-34	141331	Attenuator(6dB)	TME	UFA-01	-	02/01/2023	12
RE	MBA-05	141425	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	VHA9103+BBA9106	VHA 91031302	08/26/2022	12
RE	MCC-224	160324	Coaxial Cable	Huber+Suhner	SUCOFLEX 102A	MY009/2A	10/19/2022	12
RE	MCC-265	234602	Microwave Cable	Huber+Suhner	SF126E/11PC35/11PC35/1000M,5000M	537063/126E / 537074/126E	03/16/2023	-
RE	MCC-50	141397	Coaxial Cable	UL Japan	-	-	11/18/2022	12
RE	MHA-17	141506	Horn Antenna 15-40GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9170	BBHA9170307	07/22/2022	12
RE	MHA-21	141508	Horn Antenna 1-18GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	557	05/17/2023	12
RE	MHA-29	141517	Horn Antenna 26.5-40GHz	ETS-Lindgren	3160-10	152399	11/14/2022	12
RE	MJM-29	142230	Measure, Tape, Steel	KOMELON	KMC-36	-	-	-
RE	MLA-23	141267	Logperiodic Antenna (200-1000MHz)	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	9111B-192	09/21/2022	12
RE	MMM-10	141545	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	51201148	01/18/2023	12
RE	MOS-15	141562	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0010	01/13/2023	12
RE	MPA-12	141581	MicroWave System Amplifier	Keysight Technologies Inc	83017A	00650	10/05/2022	12
RE	MPA-14	141583	Pre Amplifier	SONOMA INSTRUMENT	310	260833	04/05/2023	12
RE	MPA-22	141588	Pre Amplifier	L3 Narda-MITEQ	AMF-6F-2600400-33-8P / AMF-4F-2600400-33-8P	1871355 / 1871328	01/24/2023	12
RE	MSA-10	141899	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY46180655	02/20/2023	12
RE	MSG-14	141894	Signal Generator	Rohde & Schwarz	SMC100A	103408	10/19/2022	12
RE	MTR-09	141950	EMI Test Receiver	Rohde & Schwarz	ESU26	100412	10/11/2022	12

Test equipment (2/2)

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
AT	COTS-MEMI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
AT	MAT-86	141366	Attenuator	Weinschel Associates	WA56-20	56200213	05/18/2023	12
AT	MCC-265	234602	Microwave Cable	Huber+Suhner	SF126E/11PC35/ 11PC35/1000M,5000M	537063/126E / 537074/126E	03/16/2023	-
AT	MCC-64	141327	Coaxial Cable	UL Japan	-	-	02/01/2023	12
AT	MMM-10	141545	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	51201148	01/18/2023	12
AT	MMP-01	141550	Matching Pad Anritsu	Anritsu Corporation	MB-009	40063	07/28/2022	12
AT	MOS-15	141562	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0010	01/13/2023	12
AT	MPA-12	141581	MicroWave System Amplifier	Keysight Technologies Inc	83017A	00650	10/05/2022	12
AT	MPA-14	141583	Pre Amplifier	SONOMA INSTRUMENT	310	260833	04/05/2023	12
AT	MSA-22	141978	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY46180899	03/06/2023	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

AT: Antenna Terminal Conducted