



EMI TEST REPORT

Test Report No.: 14691361H-A-R2

Customer	DENSO CORPORATION
Description of EUT	Remote Keyless Entry System and TPMS (Receiver)
Model Number of EUT	23ABY
FCC ID	HYQ23ABY
Test Regulation	FCC Part 15 Subpart B
Test Result	Complied (Refer to SECTION 3)
Issue Date	April 24, 2023
Remarks	-

Representative test engineer

Tetsuro Yoshida
Engineer

Approved by

Tsubasa Takayama
Leader



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.: 14691361H-A

This report is a revised version of 14691361H-A-R1. 14691361H-A-R1 is replaced with this report.

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	14691361H-A	April 17, 2023	-
1	14691361H-A-R1	April 18, 2023	Correction of the Variation information in Clause 2.2; - Change the number of Variations: from 15 variations to 18 variations - Change the number of Inverse Antenna: from 5 types to 6 types - Change the Inverse L Antenna Variation: from 1 type to 2 types - Change the Antenna Switching TYPE: from TYPE 1) to TYPE 2) - Changed the Variation No. as follows; - from No.2 to No.3 - from No.4 to No.6 - from No.6 to No.9 - from No.8 to No.12 - from No.10 to No.15 - from No.12 to No.18
2	14691361H-A-R2	April 24, 2023	Correction of the Serial number of EUT in Clause 4.2.

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 CORPORATION
Address	1-1, Showa-cho, Kariya-shi, Aichi-ken, 448-8661, Japan
Telephone Number	+81-566-63-7723
Contact Person	Takamasa Makida

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	Remote Keyless Entry System and TPMS (Receiver)
Model Number	23ABY
Serial Number	Refer to SECTION 4.2
Condition	Engineering prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	No Modification by the test lab
Receipt Date	February 19, 2023
Test Date	March 30 to April 10, 2023

2.2 Product Description**General Specification**

Rating	DC 12.0 V
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Radio Specification

Type of receiving system	Super-heterodyne
Frequency of Operation	RKES* (CH1): 314.35 MHz RKES* (CH2): 312.10 MHz TPMS*: 314.98 MHz
Oscillator Frequency	30.265 MHz Crystal
Type of Modulation	RKES*: FSK (F1D) TPMS*: FSK (F1D)
Antenna Type	Antenna 1: Internal antenna (Inverse F antenna / Inverse L antenna) Antenna 2: External antenna (Connector)
Voltage Controlled Oscillator	RKES* (CH1): 1256.28 MHz RKES* (CH2): 1247.28 MHz TPMS*: 1258.8 MHz
Mixer Input frequency	RKES* (CH1): 314.07 MHz RKES* (CH2): 311.82 MHz TPMS*: 314.7 MHz

- * RKES: Remote Keyless Entry System
- TPMS: Tire Pressure Monitoring System

23ABY has 18 variations. For details of the variations are the following combinations.

- Inverse Antenna is 6 types. (4 types of Inverse F antenna and 2 types of Inverse L antenna)
- External Antenna is 2 types. (with or without External Antenna for each Inverse Antenna)
- Antenna Switching is 2 types. (for with External Antenna)

This report presents the test results for Variation No. 3 (Inverse F Antenna: TYPE 1, External Antenna: TYPE 2, Antenna Switching: TYPE 2). *1)

*1) For Radiated Emission test, the tests were performed only with variation No.3 which was the worst variation, after the test results were compared among Variation No.3, 6, 9, 12, 15 and 18 at pre-check.

For Antenna Terminal Conducted Emission test, the tests were performed only with variation No.3 (for Below 1 GHz test), No.15 (for Above 1 GHz test) which was the worst variation, after the test results were compared among Variation No.3, 6, 9, 12, 15 and 18 at pre-check.

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	Deviation	Worst margin	Result	Remarks
Conducted emission	FCC: ANSI C63.4: 2014 7. AC power - line conducted emission measurements	FCC:Part 15 Subpart B 15.107(a)	N/A	-	N/A	*1)
	ISED: RSS-Gen 7.1	ISED: RSS-Gen 7.2				
Radiated emission	FCC: ANSI C63.4: 2014 8. Radiated emission measurements	FCC: Part 15 Subpart B 15.109(a)	N/A	25.78 dB 34.332 MHz, Horizontal / Vertical (Mode 1, Mode 2, Mode 3)	Complied a)	-
	ISED: RSS-Gen 7.1	ISED: RSS-Gen 7.3				
Antenna Terminal	FCC: ANSI C63.4: 2014 12. Measurement of unintentional radiators other than ITE	FCC: Part 15 Subpart B 15.111(a)	N/A	20.31 dB 1888.200 MHz (Mode 3)	Complied b)	-
	ISED: RSS-Gen 7.1	ISED: RSS-Gen 7.4				
<p>* Note: UL Japan, Inc.'s EMI Work Procedure: Work Instructions-ULID-003591.</p> <p>*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.</p> <p>a) Refer to APPENDIX 1 (data of Radiated Emission)</p> <p>b) Refer to APPENDIX 1 (data of Antenna Terminal)</p>						

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.

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

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

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

Telephone: +81-596-24-8999

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

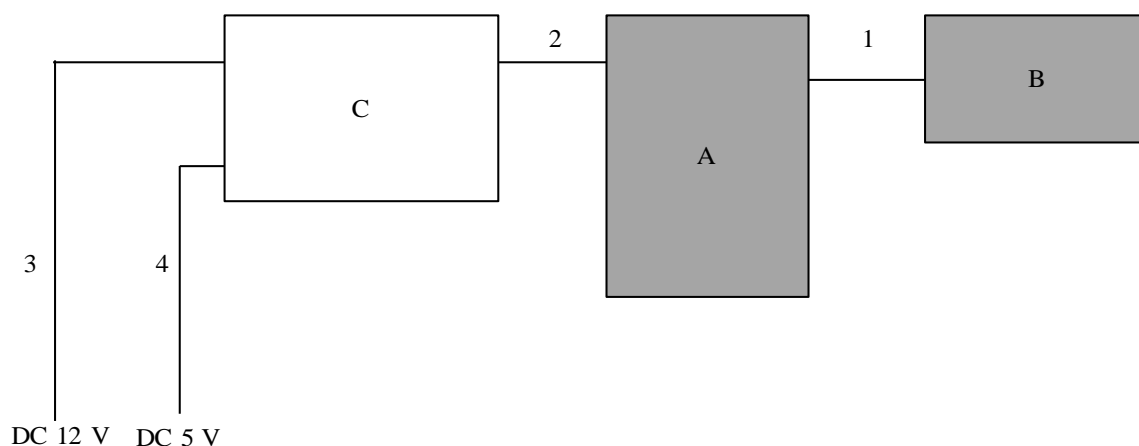
4.1 Operating Mode(s)

Mode	1. RKES Receiving mode (314.35 MHz) 2. RKES Receiving mode (312.10 MHz) 3. TPMS Receiving mode (314.98 MHz)
Software(s)	DN-2585002190-02.hex

*The test signal level was confirmed to be sufficient to stabilize the local oscillator of the EUT.

*Tuning was confirmed to be locked on each mode by checking local oscillator frequency to be stable using a search-coil.

4.2 Configuration and peripherals



* Cabling and setup(s) were taken into consideration and test data was taken under worse case conditions.
* Item No. A includes Receiver Antenna.

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Remote Keyless Entry System and TPMS (Receiver)	23ABY	No.2 *1) No.10 *2)	DENSO CORPORATION	EUT
B	External Antenna	300M_External Ant	No.1	DENSO CORPORATION	EUT
C	Check Bench	TPMS-RKE/ SMART check bench	No.1	DENSO CORPORATION	-

*1) Used for Radiated emission and Antenna Terminal (Below 1 GHz).

*2) Used for Antenna Terminal (Above 1 GHz).

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Antenna Cable	1.5	Shielded	Shielded	-
2	Signal & DC Cable	1.8	Unshielded	Unshielded	-
3	DC Cable	2.0	Unshielded	Unshielded	-
4	DC Cable	1.0	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

5.3 Test conditions

Frequency range : 30 MHz to 200 MHz (Biconical antenna)
200 MHz to 1000 MHz (Logperiodic antenna)
1000 MHz to 7000 MHz (Horn antenna)
Test distance : 3 m
EUT position : Table top
EUT operation mode : See Clause 4.1

5.4 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.

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

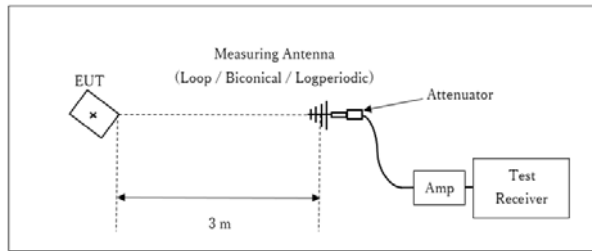
Test antenna was aimed at the emission source for receiving the maximum signal and always kept. (above 1 GHz)

Frequency	Below 1GHz	Above 1GHz *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.

Figure 1: Test Setup

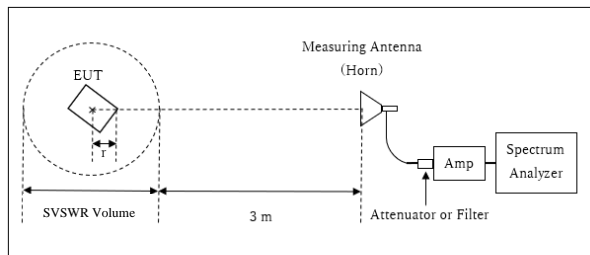
Below 1 GHz



x : Center of turn table

Test Distance: 3 m

1 GHz to 7 GHz



r : Radius of an outer periphery of EUT

x : Center of turn table

Distance Factor: $20 \times \log(3.50 \text{ m}^*/3.0 \text{ m}) = 1.34 \text{ dB}$
* Test Distance: $(3 + \text{SVSWR Volume} / 2) - r = 3.50 \text{ m}$

SVSWR Volume: 2m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
 $r = 0.5 \text{ m}$

The noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at representative X-axis since no difference was found among each position.

5.5 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 7000 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: 300 kHz	PK: RBW: 1 MHz / VBW: 3 MHz

*1) The Spectrum Analyzer was used in 6 dB resolution bandwidth.

6.5 Test result

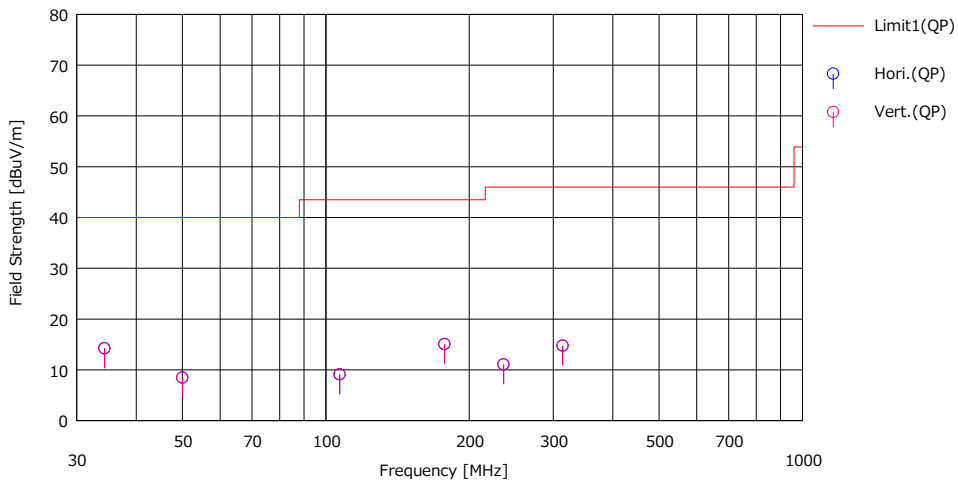
Summary of the test results: Pass

APPENDIX 1: Test data

Radiated Emission

Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date March 31, 2023
Temperature / Humidity 20 deg. C / 34 % RH
Engineer Tetsuro Yoshida
 (Below 1 GHz)
Mode Mode 1

Limit : FCC_Part 15 Subpart B(15.109)_Class B



No.	Freq. [MHz]	Reading	Ant.Fac	Loss	Gain	Result	Limit	Margin	Pola.	Height	Angle	Arr. Type	Comment
		(QP)				(QP)							
		[dBuV]	[dB/m]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[H/V]	[cm]	[deg]		
1	34.332	22.20	17.02	7.10	32.10	14.22	40.00	25.78	Hor.	100	0	BA	
2	50.015	22.00	11.20	7.33	32.09	8.44	40.00	31.56	Hor.	100	0	BA	
3	106.945	21.90	11.30	7.95	32.06	9.09	43.50	34.41	Hor.	100	0	BA	
4	177.485	22.40	16.08	8.58	32.01	15.05	43.50	28.45	Hor.	100	0	BA	
5	236.013	22.40	11.55	9.10	32.01	11.04	46.00	34.96	Hor.	100	0	LA23	
6	314.070	23.00	14.04	9.74	32.05	14.73	46.00	31.27	Hor.	100	0	LA23	
7	34.332	22.20	17.02	7.10	32.10	14.22	40.00	25.78	Vert.	100	0	BA	
8	50.015	22.00	11.20	7.33	32.09	8.44	40.00	31.56	Vert.	100	0	BA	
9	106.945	21.90	11.30	7.95	32.06	9.09	43.50	34.41	Vert.	100	0	BA	
10	177.485	22.40	16.08	8.58	32.01	15.05	43.50	28.45	Vert.	100	0	BA	
11	236.013	22.40	11.55	9.10	32.01	11.04	46.00	34.96	Vert.	100	0	LA23	
12	314.070	23.00	14.04	9.74	32.05	14.73	46.00	31.27	Vert.	100	0	LA23	

CHART: WITH FACTOR

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

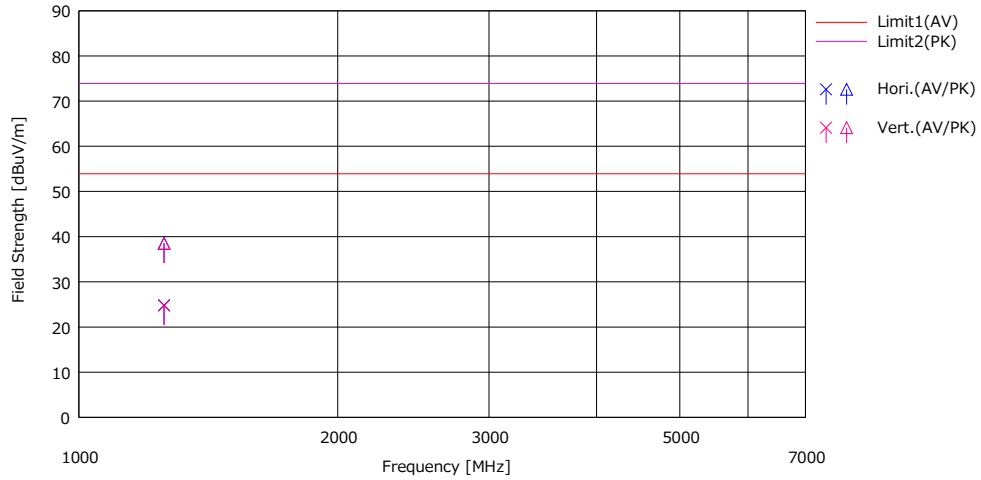
CALCULATION: RESULT = READING + ANT FACTOR + LOSS(CABLE + ATT) - GAIN(AMP)

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

Radiated Emission

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	March 30, 2023
Temperature / Humidity	22 deg. C / 29 % RH
Engineer	Kiyoshiro Okazaki (Above 1 GHz)
Mode	Mode 1

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) [dB]	(PK) [dB]	(AV) [dB]	(PK) [dB]					
1	1256.280	30.30	44.00	25.73	3.00	34.19	24.84	38.54	53.90	73.90	29.06	35.36	Hori.	100	359	HA30	
2	1256.280	30.20	43.90	25.73	3.00	34.19	24.74	38.44	53.90	73.90	29.16	35.46	Vert.	100	359	HA30	

CHART: WITH FACTOR

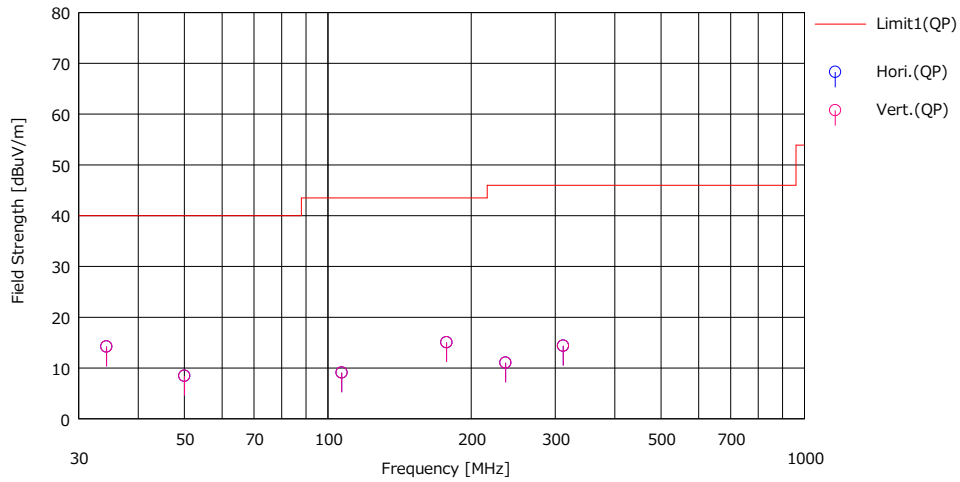
ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN
 CALCULATION: RESULT = READING + ANT FACTOR + LOSS(CABLE + D-factor) - GAIN(AMP)

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

Radiated Emission

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	March 31, 2023
Temperature / Humidity	20 deg. C / 34 % RH
Engineer	Tetsuro Yoshida
	(Below 1 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	Pola. [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
		[dBuV]				[dBuV/m]	[dB]	[dB]					
1	34.332	22.20	17.02	7.10	32.10	14.22	40.00	25.78	Hori.	100	0	BA	
2	50.015	22.00	11.20	7.33	32.09	8.44	40.00	31.56	Hori.	100	0	BA	
3	106.945	21.90	11.30	7.95	32.06	9.09	43.50	34.41	Hori.	100	0	BA	
4	177.485	22.40	16.08	8.58	32.01	15.05	43.50	28.45	Hori.	100	0	BA	
5	236.013	22.40	11.55	9.10	32.01	11.04	46.00	34.96	Hori.	100	0	LA23	
6	311.820	22.70	13.97	9.73	32.04	14.36	46.00	31.64	Hori.	100	0	LA23	
7	34.332	22.20	17.02	7.10	32.10	14.22	40.00	25.78	Vert.	100	0	BA	
8	50.015	22.00	11.20	7.33	32.09	8.44	40.00	31.56	Vert.	100	0	BA	
9	106.945	21.90	11.30	7.95	32.06	9.09	43.50	34.41	Vert.	100	0	BA	
10	177.485	22.40	16.08	8.58	32.01	15.05	43.50	28.45	Vert.	100	0	BA	
11	236.013	22.40	11.55	9.10	32.01	11.04	46.00	34.96	Vert.	100	0	LA23	
12	311.820	22.70	13.97	9.73	32.04	14.36	46.00	31.64	Vert.	100	0	LA23	

CHART: WITH FACTOR

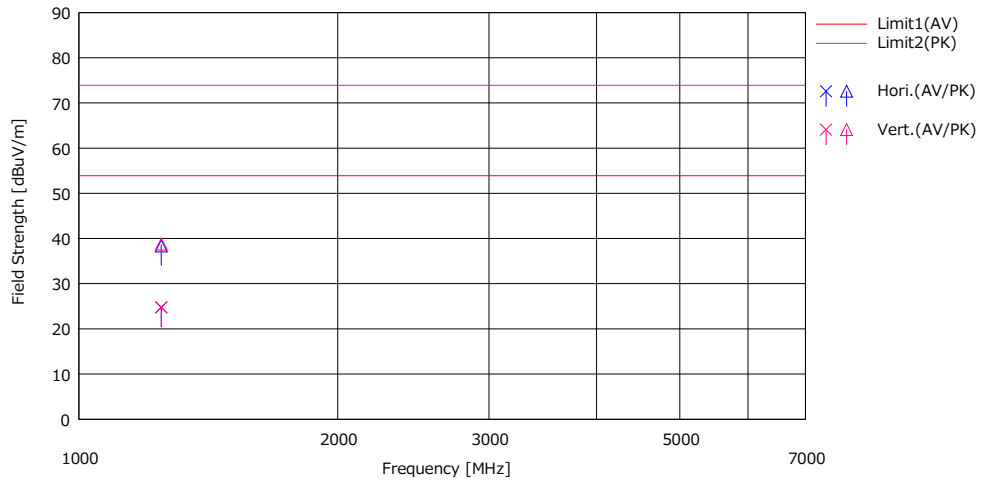
ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN
CALCULATION: RESULT = READING + ANT FACTOR + LOSS(CABLE + ATT) - GAIN(AMP)

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

Radiated Emission

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	March 30, 2023
Temperature / Humidity	22 deg. C / 29 % RH
Engineer	Kiyoshiro Okazaki
	(Above 1 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		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	1247.280	30.30	43.90	25.68	2.99	34.22	24.75	38.35	53.90	73.90	29.15	35.55	Hori.	100	359	HA30	
2	1247.280	30.30	44.30	25.68	2.99	34.22	24.75	38.75	53.90	73.90	29.15	35.15	Vert.	100	359	HA30	

CHART: WITH FACTOR

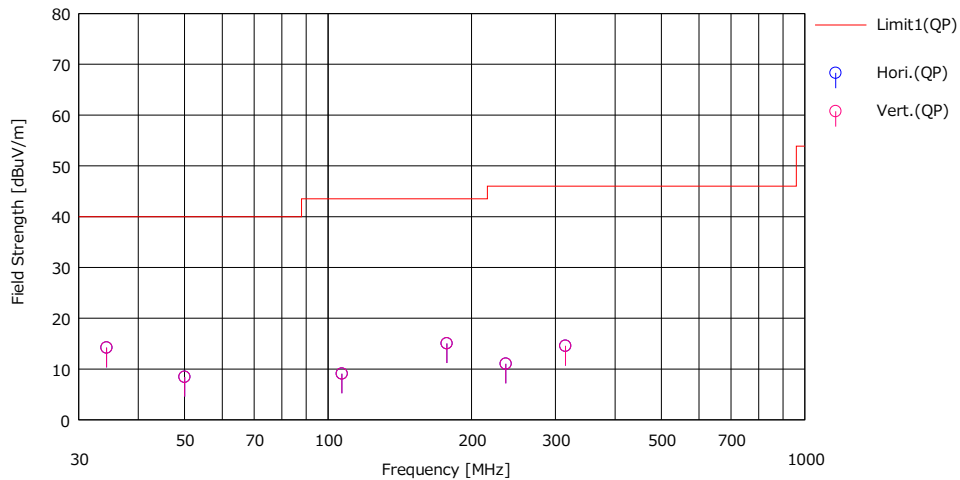
ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN
CALCULATION: RESULT = READING + ANT FACTOR + LOSS(CABLE + D-factor) - GAIN(AMP)

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

Radiated Emission

Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date March 31, 2023
Temperature / Humidity 20 deg. C / 34 % RH
Engineer Tetsuro Yoshida
 (Below 1 GHz)
Mode Mode 3

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	Limit	Margin	Pola. [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
						(QP) [dBuV/m]	(QP) [dBuV/m]	(QP) [dB]					
1	34.332	22.20	17.02	7.10	32.10	14.22	40.00	25.78	Hori.	100	0	BA	
2	50.015	22.00	11.20	7.33	32.09	8.44	40.00	31.56	Hori.	100	0	BA	
3	106.945	21.90	11.30	7.95	32.06	9.09	43.50	34.41	Hori.	100	0	BA	
4	177.485	22.40	16.08	8.58	32.01	15.05	43.50	28.45	Hori.	100	0	BA	
5	236.013	22.40	11.55	9.10	32.01	11.04	46.00	34.96	Hori.	100	0	LA23	
6	314.700	22.80	14.06	9.75	32.05	14.56	46.00	31.44	Hori.	100	0	LA23	
7	34.332	22.20	17.02	7.10	32.10	14.22	40.00	25.78	Vert.	100	0	BA	
8	50.015	22.00	11.20	7.33	32.09	8.44	40.00	31.56	Vert.	100	0	BA	
9	106.945	21.90	11.30	7.95	32.06	9.09	43.50	34.41	Vert.	100	0	BA	
10	177.485	22.40	16.08	8.58	32.01	15.05	43.50	28.45	Vert.	100	0	BA	
11	236.013	22.40	11.55	9.10	32.01	11.04	46.00	34.96	Vert.	100	0	LA23	
12	314.700	22.80	14.06	9.75	32.05	14.56	46.00	31.44	Vert.	100	0	LA23	

CHART: WITH FACTOR

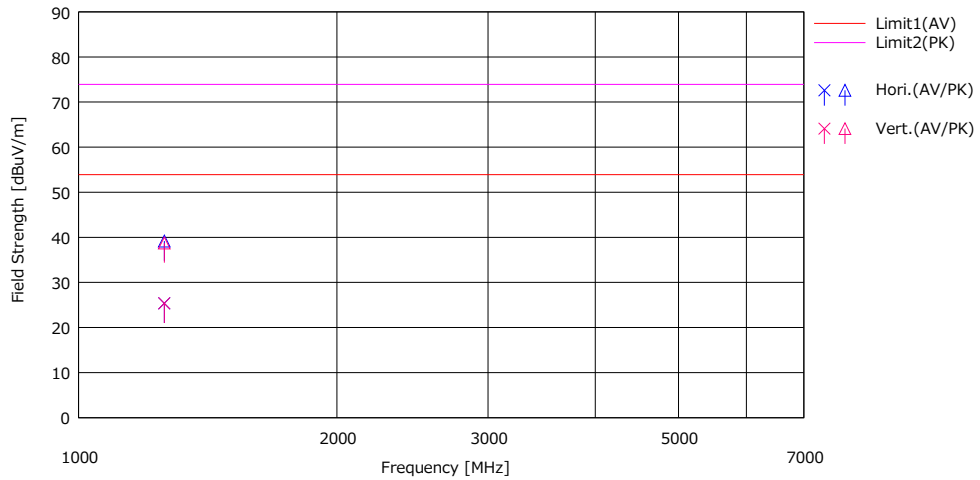
ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN
CALCULATION: RESULT = READING + ANT FACTOR + LOSS(CABLE + ATT) - GAIN(AMP)

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

Radiated Emission

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	March 30, 2023
Temperature / Humidity	22 deg. C / 29 % RH
Engineer	Kiyoshiro Okazaki (Above 1 GHz)
Mode	Mode 3

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	1258.800	30.80	44.60	25.75	3.00	34.19	25.36	39.16	53.90	73.90	28.54	34.74	Hori.	100	359	HA30	
2	1258.800	30.80	44.20	25.75	3.00	34.19	25.36	38.76	53.90	73.90	28.54	35.14	Vert.	100	359	HA30	

CHART: WITH FACTOR

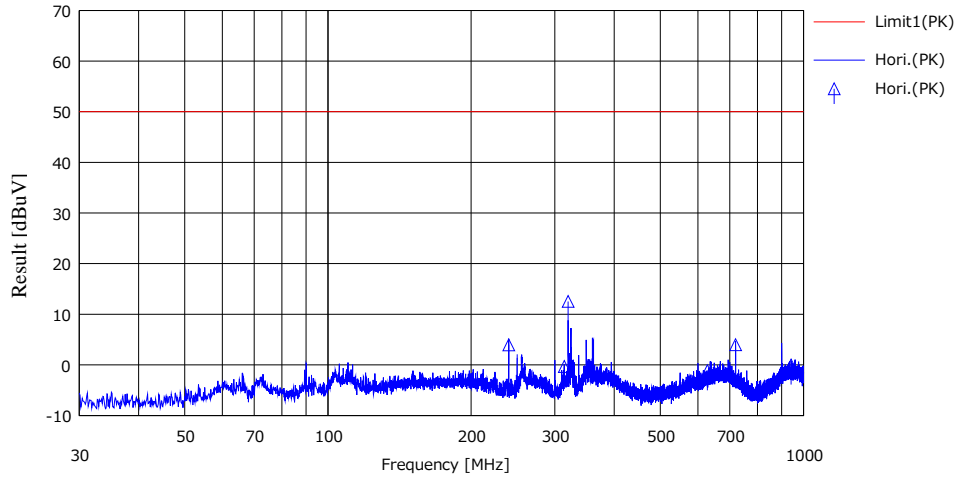
ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN
CALCULATION: RESULT = READING + ANT FACTOR + LOSS(CABLE + D-factor) - GAIN(AMP)

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

Antenna Terminal Conducted Emission

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	April 10, 2023
Temperature / Humidity	23 deg. C / 30 % RH
Engineer	Hiroyuki Furutaka (Below 1 GHz)
Mode	Mode 1

Limit : FCC15.111 Antenna terminal measurement



No.	Freq. [MHz]	Reading	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result	Limit *1)	Margin	Ant. Type	Comment
		(PK) [dBuV]				(PK) [dBuV]	(PK) [dB]			
1	239.993	35.78	0.00	0.18	32.01	3.95	50.00	46.05	---	
2	314.070	31.46	0.00	0.20	31.97	-0.21	50.00	50.31	---	
3	319.922	44.30	0.00	0.20	31.97	12.53	50.00	37.47	---	
4	628.140	30.51	0.00	0.28	31.94	-1.15	50.00	51.15	---	
5	719.995	35.48	0.00	0.31	31.81	3.98	50.00	46.02	---	
6	942.210	30.25	0.00	0.35	30.62	-0.02	50.00	50.02	---	

*1) 2 nW = -57 dBm = 50 dBuV

CHART: WITH FACTOR

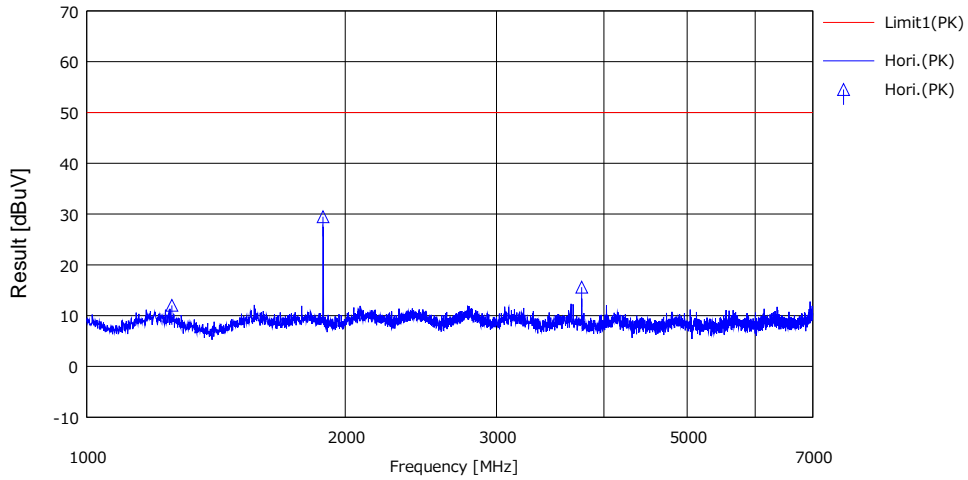
CALCULATION: RESULT = READING + LOSS (CABLE) - GAIN (AMP)

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

Antenna Terminal Conducted Emission

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	April 10, 2023
Temperature / Humidity	23 deg. C / 30 % RH
Engineer	Hiroyuki Furutaka (Above 1 GHz)
Mode	Mode 1

Limit : FCC15.111 Antenna terminal measurement



No.	Freq. [MHz]	Reading	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result	Limit *1)	Margn	Ant. Type	Comment
		(PK) [dBuV]				(PK) [dBuV]	(PK) [dB]			
1	1256.280	48.25	0.00	0.41	36.63	12.03	50.00	37.97	---	
2	1884.032	65.17	0.00	0.48	36.17	29.48	50.00	20.52	---	
3	3768.840	50.76	0.00	0.68	35.83	15.61	50.00	34.39	---	

*1) 2 nW = -57 dBm = 50 dBuV

CHART: WITH FACTOR

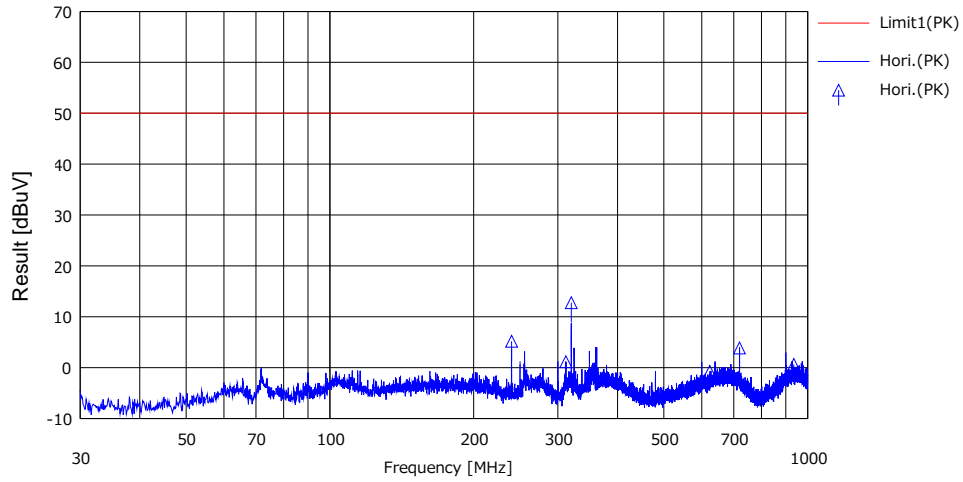
CALCULATION: RESULT = READING + LOSS (CABLE) - GAIN (AMP)

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

Antenna Terminal Conducted Emission

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	April 10, 2023
Temperature / Humidity	23 deg. C / 30 % RH
Engineer	Hiroyuki Furutaka (Below 1 GHz)
Mode	Mode 2

Limit : FCC15.111 Antenna terminal measurement



No.	Freq.	Reading	Ant.Fac.	Loss	Gain	Result	Limit *1)	Margin	Ant. Type	Comment
	[MHz]	[dBuV]	[dB/m]	[dB]	[dB]	[dBuV]	[dBuV]	[dB]		
1	239.993	37.00	0.00	0.18	32.01	5.17	50.00	44.83	---	
2	311.820	32.93	0.00	0.20	31.97	1.16	50.00	48.84	---	
3	320.002	44.53	0.00	0.20	31.97	12.76	50.00	37.24	---	
4	623.640	30.91	0.00	0.28	31.94	-0.75	50.00	50.75	---	
5	719.995	35.37	0.00	0.31	31.81	3.87	50.00	46.13	---	
6	935.460	30.92	0.00	0.35	30.66	0.61	50.00	49.39	---	

*1) 2 nW = -57 dBm = 50 dBuV

CHART: WITH FACTOR

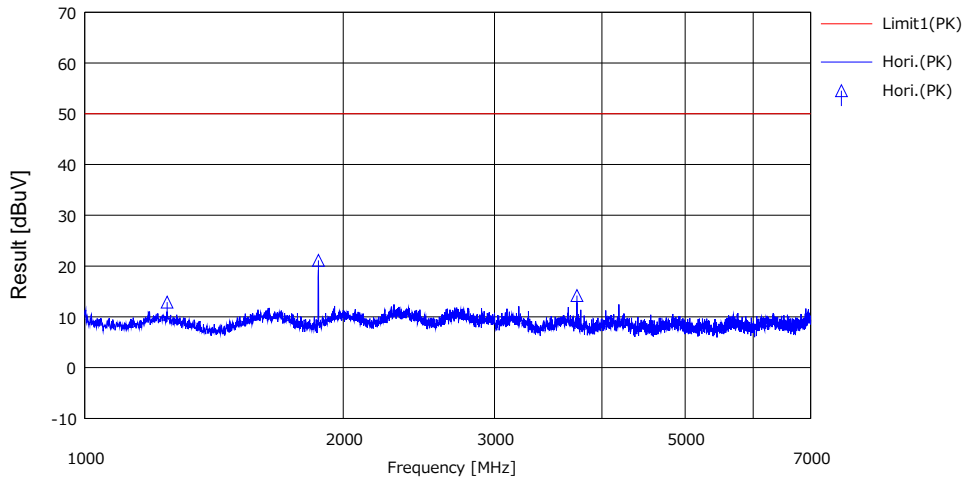
CALCULATION: RESULT = READING + LOSS (CABLE) - GAIN (AMP)

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

Antenna Terminal Conducted Emission

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	April 10, 2023
Temperature / Humidity	23 deg. C / 30 % RH
Engineer	Hiroyuki Furutaka (Above 1 GHz)
Mode	Mode 2

Limit : FCC15.111 Antenna terminal measurement



No.	Freq. [MHz]	Reading (PK)	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result	Limit *1)	Margin	Ant. Type	Comment
		[dBuV]				[dBuV]	[dB]			
1	1247.280	49.14	0.00	0.40	36.64	12.90	50.00	37.10	---	
2	1871.041	56.82	0.00	0.48	36.18	21.12	50.00	28.88	---	
3	3741.840	49.36	0.00	0.68	35.85	14.19	50.00	35.81	---	

*1) 2 nW = -57 dBm = 50 dBuV

CHART: WITH FACTOR

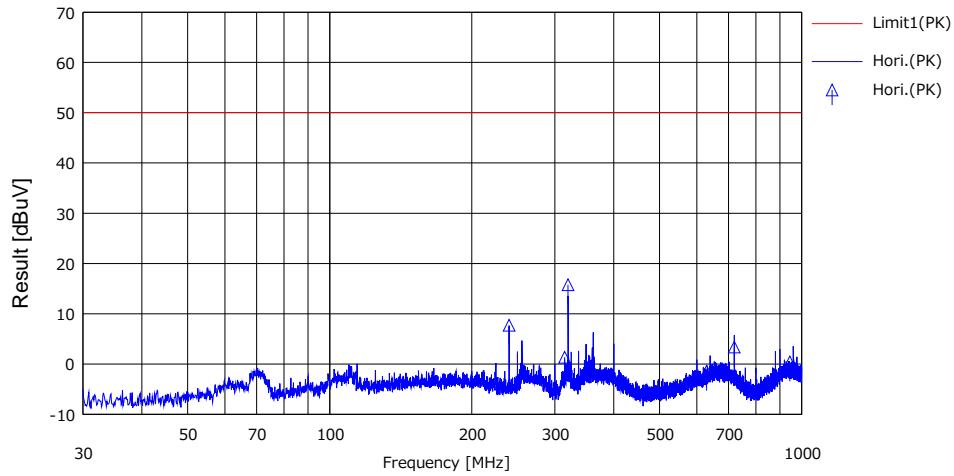
CALCULATION: RESULT = READING + LOSS (CABLE) - GAIN (AMP)

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

Antenna Terminal Conducted Emission

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	April 10, 2023
Temperature / Humidity	23 deg. C / 30 % RH
Engineer	Hiroyuki Furutaka (Below 1 GHz)
Mode	Mode 3

Limit : FCC15.111 Antenna terminal measurement



No.	Freq. [MHz]	Reading	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result	Limit *1)	Margn	Ant. Type	Comment
		(PK) [dBuV]				(PK) [dBuV]	(PK) [dB]			
1	239.993	39.55	0.00	0.18	32.01	7.72	50.00	42.28	---	
2	314.700	33.12	0.00	0.20	31.97	1.35	50.00	48.65	---	
3	320.002	47.54	0.00	0.20	31.97	15.77	50.00	34.23	---	
4	629.400	30.23	0.00	0.28	31.94	-1.43	50.00	51.43	---	
5	719.995	34.85	0.00	0.31	31.81	3.35	50.00	46.65	---	
6	944.100	30.65	0.00	0.35	30.61	0.39	50.00	49.61	---	

*1) 2 nW = -57 dBm = 50 dBuV

CHART: WITH FACTOR

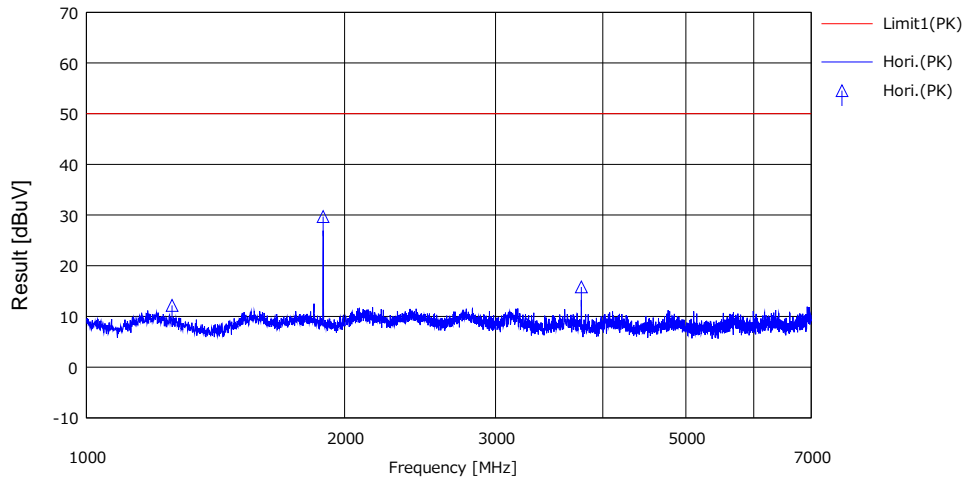
CALCULATION: RESULT = READING + LOSS (CABLE) - GAIN (AMP)

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

Antenna Terminal Conducted Emission

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	April 10, 2023
Temperature / Humidity	23 deg. C / 30 % RH
Engineer	Hiroyuki Furutaka
	(Above 1 GHz)
Mode	Mode 3

Limit : FCC15.111 Antenna terminal measurement



No.	Freq. [MHz]	Reading	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result	Limit *1)	Margin	Ant. Type	Comment
		(PK) [dBuV]				(PK) [dBuV]	(PK) [dB]			
1	1258.800	48.41	0.00	0.41	36.63	12.19	50.00	37.81	---	
2	1888.200	65.37	0.00	0.48	36.16	29.69	50.00	20.31	---	
3	3776.400	50.96	0.00	0.68	35.83	15.81	50.00	34.19	---	

*1) 2 nW = -57 dBm = 50 dBuV

CHART: WITH FACTOR

CALCULATION: RESULT = READING + LOSS (CABLE) – GAIN (AMP)

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

APPENDIX 2: Test instruments

Test equipment

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	04/12/2021	24
RE	MCC-265	234602	Microwave Cable	Huber+Suhner	SF126E/11PC35/11PC35/1000M,5000M	537063/126E / 537074/126E	03/16/2023	-
RE	MHA-30	141514	Horn Antenna 1-18GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	01611	06/22/2022	12
RE	MJM-29	142230	Measure, Tape, Steel	KOMELON	KMC-36	-	-	-
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	MTR-10	141951	EMI Test Receiver	Rohde & Schwarz	ESR26	101408	07/25/2022	12
RE	MBA-05	141425	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	VHA9103+ BBA9106	VHA 91031302	08/26/2022	12
RE	MLA-23	141267	Logperiodic Antenna (200-1000MHz)	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	9111B-192	09/21/2022	12
RE	MAT-34	141331	Attenuator(6dB)	TME	UFA-01	-	02/01/2023	12
RE	MCC-50	141397	Coaxial Cable	UL Japan	-	-	11/18/2022	12
RE	MPA-14	141583	Pre Amplifier	SONOMA INSTRUMENT	310	260833	04/04/2022	12
RE	MTR-03	141942	Test Receiver	Rohde & Schwarz	ESCI	100300	07/29/2022	12
AT	COTS-MEMI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
AT	MAEC-03	142008	AC3_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	05/23/2022	24
AT	MCC-176	141279	Microwave Cable	Junkosha	MMX221-00500DMSDMS	1502S303	03/08/2023	12
AT	MCC-177	141226	Microwave Cable	Junkosha	MMX221-00500DMSDMS	1502S304	03/03/2023	12
AT	MJM-16	142183	Measure	KOMELON	KMC-36	-	10/03/2022	12
AT	MMM-08	141532	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	51201197	01/17/2023	12
AT	MOS-13	141554	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	1301	01/13/2023	12
AT	MPA-11	141580	MicroWave System Amplifier	Keysight Technologies Inc	83017A	MY39500779	03/08/2023	12
AT	MPA-13	141582	Pre Amplifier	SONOMA INSTRUMENT	310	260834	02/07/2023	12
AT	MSA-03	141884	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY44020357	03/13/2023	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