RADIO TEST REPORT

Test Report No. 15028994H-A

Customer	**DENSO TEN Limited**
Description of EUT	**Car Audio**
Model Number of EUT	**TN0023A**
FCC ID	**BABTN0023A**
Test Regulation	**FCC Part 15 Subpart C**
Test Result	**Complied**
Issue Date	**December 25, 2023**
Remarks	**Wireless LAN (2.4 GHz band) and Bluetooth Low Energy part(s)** **Radiated Spurious Emission test only** *** For Permissive Change**

Representative Test Engineer	**Approved By**
Tomoya Sone Engineer	Ryota Yamanaka Engineer

CERTIFICATE 5107.02

☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan, Inc.

☒ There is no testing item of "Non-accreditation".

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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.: 15028994H-A

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	15028994H-A	December 25, 2023	-

Reference: Abbreviations (Including words undescribed in this report)

A2LA	The American Association for Laboratory Accreditation	ICES	Interference-Causing Equipment Standard
AC	Alternating Current	IEC	International Electrotechnical Commission
AFH	Adaptive Frequency Hopping	IEEE	Institute of Electrical and Electronics Engineers
AM	Amplitude Modulation	IF	Intermediate Frequency
Amp, AMP	Amplifier	ILAC	International Laboratory Accreditation Conference
ANSI	American National Standards Institute	ISED	Innovation, Science and Economic Development Canada
Ant, ANT	Antenna	ISO	International Organization for Standardization
AP	Access Point	JAB	Japan Accreditation Board
ASK	Amplitude Shift Keying	LAN	Local Area Network
Atten., ATT	Attenuator	LIMS	Laboratory Information Management System
AV	Average	MCS	Modulation and Coding Scheme
BPSK	Binary Phase-Shift Keying	MRA	Mutual Recognition Arrangement
BR	Bluetooth Basic Rate	N/A	Not Applicable
BT	Bluetooth	NIST	National Institute of Standards and Technology
BT LE	Bluetooth Low Energy	NS	No signal detect.
BW	BandWidth	NSA	Normalized Site Attenuation
Cal Int	Calibration Interval	NVLAP	National Voluntary Laboratory Accreditation Program
CCK	Complementary Code Keying	OBW	Occupied Band Width
Ch., CH	Channel	OFDM	Orthogonal Frequency Division Multiplexing
CISPR	Comite International Special des Perturbations Radioelectriques	P/M	Power meter
CW	Continuous Wave	PCB	Printed Circuit Board
DBPSK	Differential BPSK	PER	Packet Error Rate
DC	Direct Current	PHY	Physical Layer
D-factor	Distance factor	PK	Peak
DFS	Dynamic Frequency Selection	PN	Pseudo random Noise
DQPSK	Differential QPSK	PRBS	Pseudo-Random Bit Sequence
DSSS	Direct Sequence Spread Spectrum	PSD	Power Spectral Density
EDR	Enhanced Data Rate	QAM	Quadrature Amplitude Modulation
EIRP, e.i.r.p.	Equivalent Isotropically Radiated Power	QP	Quasi-Peak
EMC	ElectroMagnetic Compatibility	QPSK	Quadri-Phase Shift Keying
EMI	ElectroMagnetic Interference	RBW	Resolution Band Width
EN	European Norm	RDS	Radio Data System
ERP, e.r.p.	Effective Radiated Power	RE	Radio Equipment
EU	European Union	RF	Radio Frequency
EUT	Equipment Under Test	RMS	Root Mean Square
Fac.	Factor	RSS	Radio Standards Specifications
FCC	Federal Communications Commission	Rx	Receiving
FHSS	Frequency Hopping Spread Spectrum	SA, S/A	Spectrum Analyzer
FM	Frequency Modulation	SG	Signal Generator
Freq.	Frequency	SVSWR	Site-Voltage Standing Wave Ratio
FSK	Frequency Shift Keying	TR	Test Receiver
GFSK	Gaussian Frequency-Shift Keying	Tx	Transmitting
GNSS	Global Navigation Satellite System	VBW	Video BandWidth
GPS	Global Positioning System	Vert.	Vertical
Hori.	Horizontal	WLAN	Wireless LAN

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SECTION 1: Customer Information

Company Name	DENSO TEN Limited
Address	2-28, Gosho-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 Audio
Model Number	TN0023A
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	November 10, 2023
Test Date	November 13 to 29, 2023

2.2 Product Description

General Specification

Rating	DC 12 V
Operating temperature	-30 deg. C to 65 deg. C

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	0.28 dBi (Peak)

Bluetooth (BR / EDR / Low Energy)

Equipment Type	Transceiver
Frequency of Operation	2402 MHz to 2480 MHz
Type of Modulation	BT: FHSS (GFSK, π/4 DQPSK, 8 DPSK) BT LE: GFSK
Antenna Gain	0.08 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	3.67 dBi (Peak) (ANT 1) / 3.37 dBi (Peak) (ANT 2)	

[AM, HD_AM / FM, 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

SECTION 3: Test Specification, Procedures & Results

3.1 Test Specification

Test Specification	FCC Part 15 Subpart C The latest version on the first day of the testing period
Title	FCC 47 CFR Part 15 Radio Frequency Device Subpart C Intentional Radiators Section 15.207 Conducted limits Section 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

3.2 Procedures and Results

Item	Test Procedure	Specification	Worst Margin	Results	Remarks
Spurious Emission Restricted Band Edges	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section15.247(d)	8.4 dB 5000.00 MHz, AV, Vertical	Complied	Radiated (above 30 MHz) *1)
	ISED: RSS-Gen 6.13	**ISED:** RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10			
Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593. * In case any questions arise about test procedure, ANSI C63.10: 2013 is also referred. *1) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 15.247 Meas Guidance v05r02 8.5 and 8.6.					

FCC Part 15.31 (e)
This EUT provides the stable voltage constantly to RF Module regardless of input voltage.
Therefore, this EUT complies with the requirement.

FCC Part 15.203 Antenna requirement
It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT.
Therefore, the equipment complies with the antenna requirement of Section 15.203.

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		Unit	Calculated Uncertainty (+/-)
3 m	9 kHz to 30 MHz		dB	3.3
10 m			dB	3.1
3 m	30 MHz to 200 MHz	Horizontal	dB	4.8
		Vertical	dB	5.0
	200 MHz to 1000 MHz	Horizontal	dB	5.1
		Vertical	dB	6.2
10 m	30 MHz to 200 MHz	Horizontal	dB	4.8
		Vertical	dB	4.8
	200 MHz to 1000 MHz	Horizontal	dB	4.9
		Vertical	dB	5.0
3 m	1 GHz to 6 GHz	Test Receiver	dB	5.1
		Spectrum Analyzer	dB	4.9
	6 GHz to 18 GHz	Test Receiver	dB	5.4
		Spectrum Analyzer	dB	5.2
1 m	10 GHz to 18 GHz	Spectrum analyzer	dB	5.0
	18 GHz to 26.5 GHz	Spectrum analyzer	dB	5.6
	26.5 GHz to 40 GHz	Spectrum analyzer	dB	4.9
0.5 m	26.5 GHz to 40 GHz	Spectrum analyzer	dB	4.9
10 m	1 GHz to 18 GHz	Test Receiver	dB	5.4

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	Remarks*
IEEE 802.11b (11b)	5.5 Mbps, PN9
IEEE 802.11n MIMO 20 MHz BW (11n-20)	MCS 7(Short 3), PN9
*The worst condition was determined based on the test result of Maximum Peak Output Power (Mid Channel)	
*Power of the EUT was set by the software as follows; Power Setting: 11b : 14 dBm 11n : 6 dBm Software: QCA RCT Ver 3.0.144.0 (Date: October 9, 2017, Storage location: Driven by connected PC) *This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product. Test operating mode was determined as follows according to “Section 1 of 6 802.11 a/b/g/n testing - Managing Complex Regulatory Approvals - ” of TCB Council Workshop October 2009 .	

*The Details of Operating Mode(s)

Test Item	Operating Mode	Tested Frequency
Radiated Spurious Emission (Below 1 GHz)	11n-20 Tx	2437 MHz *1)
Radiated Spurious Emission (Above 1 GHz)	11b Tx 11n-20 Tx*2)	2412 MHz 2437 MHz 2462 MHz
*1) The mode was tested as a representative, because it had the highest power at antenna terminal test. *2) Since 11g and 11n-20 have the same modulation method and no differences in transmitting specification, test was performed on the representative mode that had the highest peak output power.		

Mode	Remarks*
Bluetooth Low Energy (BT LE)	Maximum Packet Size, PRBS9
*Power of the EUT was set by the software as follows; Power Setting: 0 dBm Software: BSDT Ver 5.2.0 (Date: October 9, 2019, Storage location: Driven by connected PC) *This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.	

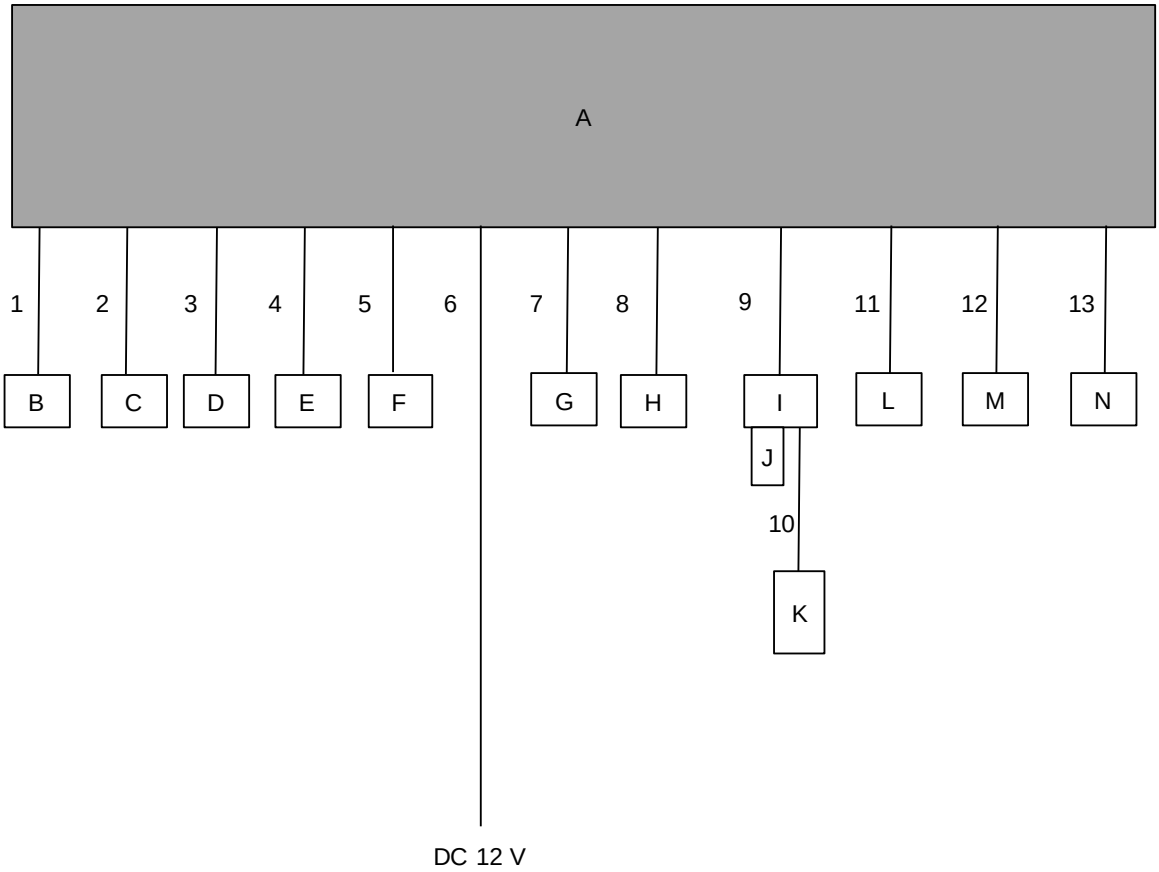
*The Details of Operating Mode(s)

Test Item	Operating Mode	Tested Frequency
Radiated Spurious Emission (Below 1 GHz)	Tx BT LE	2440 MHz *1)
Radiated Spurious Emission (Above 1 GHz)	Tx BT LE	2402 MHz 2440 MHz 2480 MHz

Simultaneous transmission

Test Item	Mode *1)	Tested Antenna
Radiated Spurious Emission	Tx BT LE 2402 MHz + Tx 11a 5180 MHz Tx BT LE 2440 MHz + Tx 11a 5180 MHz Tx BT LE 2480 MHz + Tx 11a 5180 MHz	Bluetooth LE (Antenna 2) + 11a (Antenna 2)
*1) The test was performed on the mode as a representative, because it had the highest power (11a mode /Antenna 2) of 5 GHz band at antenna terminal test.		

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 Audio	TN0023A	100262165-0006	DENSO TEN Limited	EUT
B	Switch	-	-	-	-
C	DCM	19MC_DCM	E-033720026/015	DENSO TEN Limited	-
D	Steering Switch	84250-33500	033722021/015	TOYOTA	-
E	Low noise Amplifier	ZX60-242GLN-S+	S 2036302044	Mini-Circuits	-
F	GPS Antenna	29020043	033722058/002	DENSO TEN Limited	-
G	FM/AM Antenna	86300-30C30	PS600103	DENSO TEN Limited	-
H	Back Camera	86790-33260	033721012/001	Panasonic	-
I	USB/AUX socket	86190-12040	No.39	Kojima Industries Corporation	-
J	USB Memory	RUF3-K16GB	P10416	Buffalo Inc.	-
K	iPod touch	A1367	CCQ50WDDCPC	Apple	-
L	Mic	86730-11010	E-033720014/016	Panasonic	-
M	Mic	86730-11010	No.11	Panasonic	-
N	Speaker Dummy	-	-	-	-

List of Cables Used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Signal Cable	2.4	Unshielded	Unshielded	-
2	Signal Cable	2.6	Unshielded	Unshielded	-
3	Signal Cable	2.4	Unshielded	Unshielded	-
4	Signal Cable	1.0	Unshielded	Unshielded	-
5	GNSS Antenna Cable	8.0	Shielded	Shielded	-
6	DC Cable	5.4	Unshielded	Unshielded	-
7	Antenna Cable	2.5	Shielded	Shielded	-
8	Signal Cable	6.8	Unshielded	Unshielded	-
9	USB Cable	2.5	Shielded	Shielded	-
10	Audio Cable	1.5	Shielded	Shielded	-
11	MIC Cable	2.4	Unshielded	Unshielded	-
12	MIC Cable	2.4	Unshielded	Unshielded	-
13	Speaker Cable	3.2	Unshielded	Unshielded	-

SECTION 5: Radiated Spurious Emission

Test Procedure

It was measured based on "8.5 and 8.6 of KDB 558074 D01 15.247 Meas Guidance v05r02".

[For below 1 GHz]
EUT was placed on a urethane platform of nominal size, 0.5 m by 1.0 m, raised 0.8 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1 GHz]
EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with absorbent materials lined on a ground plane. Test antenna was aimed at the EUT for receiving the maximum signal and always kept within the illumination area of the 3 dB beamwidth of the antenna.

The height of the measuring antenna 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 strength.
The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer.
The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear mode).
The test was made with the detector (RBW/VBW) in the following table.
When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

Test Antennas are used as below;

Frequency	30 MHz to 200 MHz	200 MHz to 1 GHz	Above 1 GHz
Antenna Type	Biconical	Logperiodic	Horn

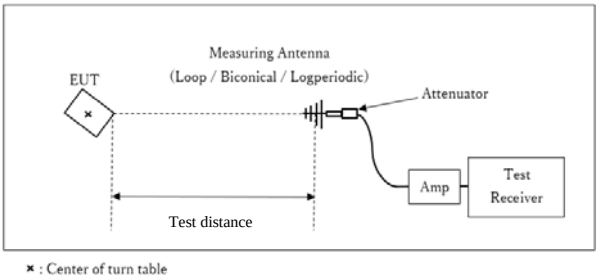
In any 100 kHz bandwidth outside the restricted band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on a radiated measurement.

20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9(ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).

Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument Used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	PK	AV	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	11.12.2.5.1 RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (RMS) Trace: 100 traces 11.12.2.5.2 The duty cycle was less than 98% for detected noise, a duty factor was added to the 11.12.2.5.1 results.	RBW: 100 kHz VBW: 300 kHz

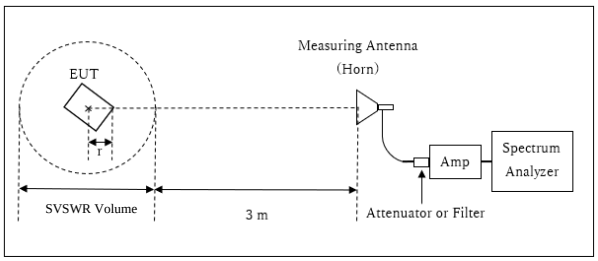
Figure 2: Test Setup

Below 1 GHz



Test Distance: 3 m

1 GHz to 10 GHz

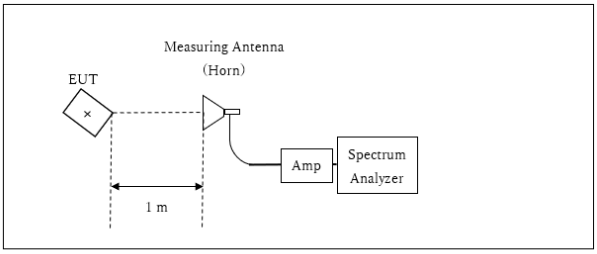


r : Radius of an outer periphery of EUT
× : Center of turn table

Distance Factor: 20 x log (3.6 m / 3.0 m) = 1.59 dB
* Test Distance: (3 + SVSWR Volume /2) - r = 3.6 m

SVSWR Volume : 1.5 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
r = 0.15 m

10 GHz to 26.5 GHz



× : Center of turn table

Distance Factor: 20 x log (1.0 m / 3.0 m) = -9.5 dB
*Test Distance: 1 m

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

The test results and limit are rounded off to one decimal place, so some differences might be observed.

Measurement Range : 30 MHz to 26.5 GHz
Test Data : APPENDIX
Test Result : Pass

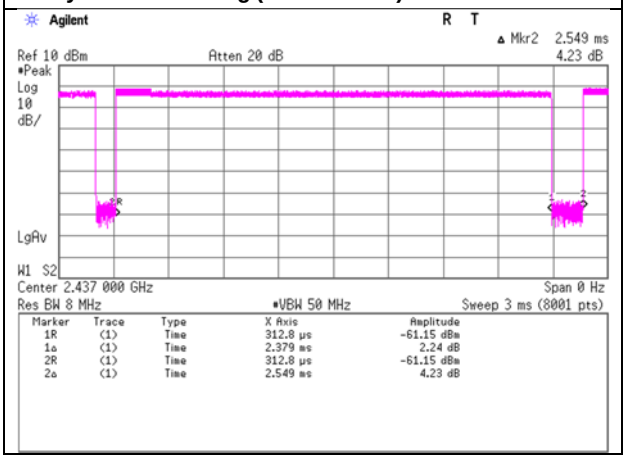
APPENDIX 1: Test Data

Burst rate confirmation

Test place	Ise EMC Lab. No.2 Semi Anechoic Chamber
Date	November 13, 2023
Temperature / Humidity	22 deg. C / 39 % RH
Engineer	Tomoya Sone
Mode	Tx

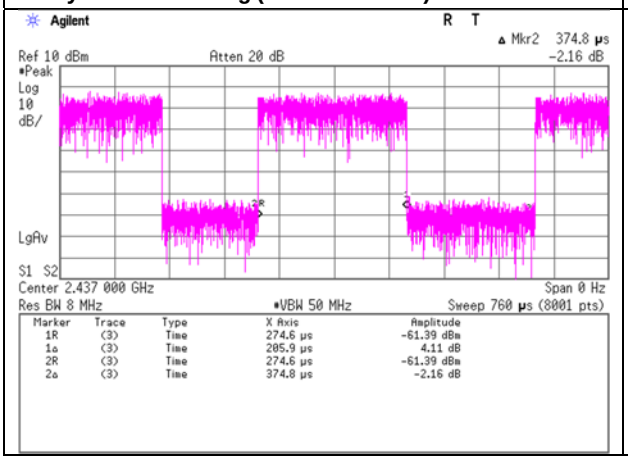
11b 5.5 Mbps

Tx on / (Tx on + Tx off) =	0.933
Tx on / (Tx on + Tx off) * 100 =	93.3 %
Duty factor = 10 * log (2.549 / 2.379) =	0.30 dB



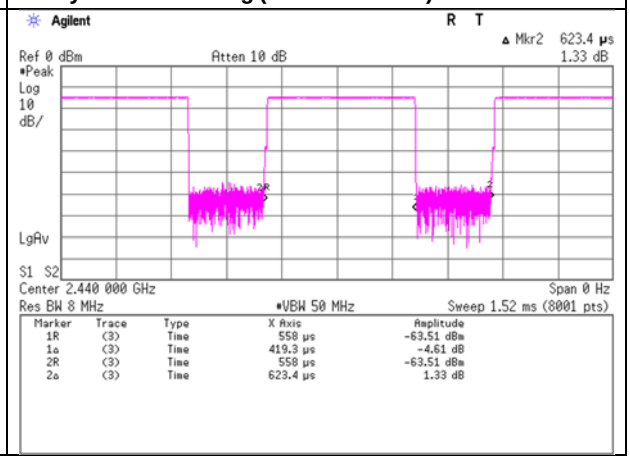
11n-20 MCS 7

Tx on / (Tx on + Tx off) =	0.549
Tx on / (Tx on + Tx off) * 100 =	54.9 %
Duty factor = 10 * log (0.3748 / 0.2059) =	2.60 dB



BT LE

Tx on / (Tx on + Tx off) =	0.673
Tx on / (Tx on + Tx off) * 100 =	67.3 %
Duty factor = 10 * log (0.6234 / 0.4193) =	1.72 dB



* Since the burst rate is not different between the channels, the data has been obtained on the representative channel.

Radiated Spurious Emission

Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.2	No.2	No.2
Date	November 13, 2023	November 16, 2023	November 16, 2023
Temperature / Humidity	22 deg. C / 39 % RH	23 deg. C / 46 % RH	21 deg. C / 40 % RH
Engineer	Tomoya Sone	Junya Okuno	Daiki Matsui
	(1 GHz to 10 GHz)	(10 GHz to 18 GHz)	(18 GHz to 26.5 GHz)
Mode	Tx 11b 2412 MHz		

Polarity [Hori/Vert]	Frequency [MHz]	Reading (QP / PK) [dBuV]	Reading (AV) [dBuV]	Ant. Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (QP / PK) [dBuV/m]	Result (AV) [dBuV/m]	Limit (QP / PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (QP / PK) [dB]	Margin (AV) [dB]	Remark
Hori.	1580.0	46.5	37.8	25.3	4.0	35.5	-	40.3	31.6	73.9	53.9	33.6	22.3	
Hori.	2390.0	47.9	37.0	27.7	4.6	34.9	0.3	45.2	34.6	73.9	53.9	28.7	19.3	*1)
Hori.	4824.0	42.2	34.0	31.6	6.6	34.1	-	46.3	38.0	73.9	53.9	27.6	15.9	Floor noise
Hori.	5000.0	45.4	40.3	31.8	6.7	34.2	-	49.7	44.6	73.9	53.9	24.2	9.3	
Hori.	7236.0	42.2	34.8	36.0	7.8	34.0	-	51.9	44.5	73.9	53.9	22.0	9.4	Floor noise
Hori.	9648.0	42.9	33.5	39.0	8.4	34.7	-	55.6	46.1	73.9	53.9	18.3	7.8	Floor noise
Hori.	10000.0	46.3	40.1	39.6	-2.7	34.7	-	48.4	42.3	73.9	53.9	25.5	11.7	
Hori.	11250.0	43.2	38.0	40.1	-2.2	33.9	-	47.2	41.9	73.9	53.9	26.7	12.0	
Hori.	12500.0	46.8	41.0	39.2	-1.8	33.5	-	50.8	45.0	73.9	53.9	23.1	8.9	
Vert.	1580.0	46.3	38.8	25.3	4.0	35.5	-	40.0	32.5	73.9	53.9	33.9	21.4	
Vert.	2390.0	48.3	37.4	27.7	4.6	34.9	0.3	45.6	34.9	73.9	53.9	28.4	19.0	*1)
Vert.	4824.0	41.4	32.0	31.6	6.6	34.1	-	45.5	36.1	73.9	53.9	28.4	17.8	Floor noise
Vert.	5000.0	46.0	41.1	31.8	6.7	34.2	-	50.3	45.4	73.9	53.9	23.6	8.5	
Vert.	7236.0	43.5	32.8	36.0	7.8	34.0	-	53.2	42.5	73.9	53.9	20.7	11.4	Floor noise
Vert.	9648.0	43.5	33.2	39.0	8.4	34.7	-	56.2	45.9	73.9	53.9	17.7	8.1	Floor noise
Vert.	10000.0	45.8	39.2	39.6	-2.7	34.7	-	47.9	41.4	73.9	53.9	26.0	12.5	
Vert.	11250.0	43.9	37.0	40.1	-2.2	33.9	-	47.9	41.0	73.9	53.9	26.1	12.9	
Vert.	12500.0	45.4	39.1	39.2	-1.8	33.5	-	49.4	43.0	73.9	53.9	24.5	10.9	

Result (QP / PK) = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)
Result (AV)= Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).
*QP detector was used up to 1GHz.
*1) Not Out of Band emission(Leakage Power)

20dBc Data Sheet

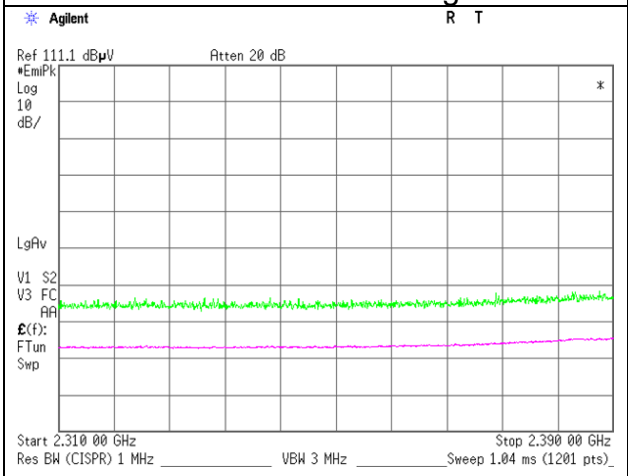
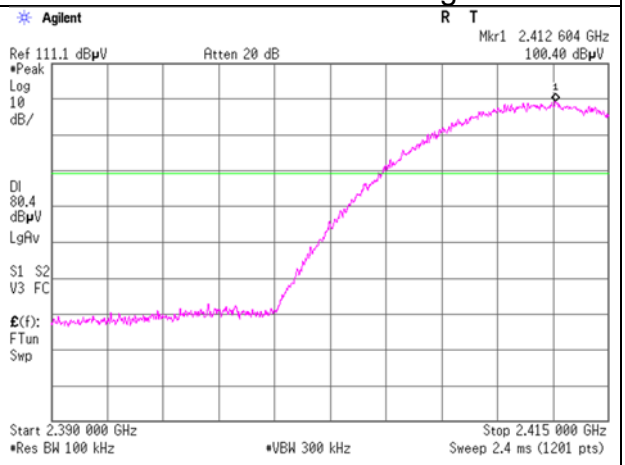
Polarity [Hori/Vert]	Frequency [MHz]	Reading (PK) [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2412.0	100.4	27.6	4.6	34.9	97.7	-	-	Carrier
Hori.	2400.0	41.0	27.6	4.6	34.9	38.3	77.7	39.3	
Vert.	2412.0	101.1	27.6	4.6	34.9	98.3	-	-	Carrier
Vert.	2400.0	43.6	27.6	4.6	34.9	40.9	78.3	37.5	

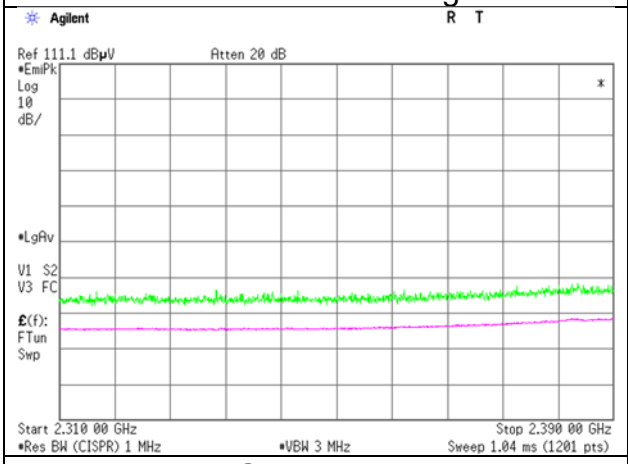
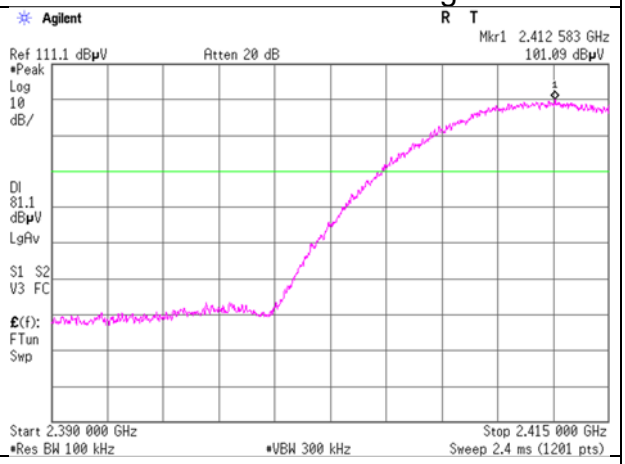
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amprifier)

Distance factor: 1 GHz - 10 GHz 20log (3.6 m / 3.0 m) = 1.59 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	November 13, 2023
Temperature / Humidity	22 deg. C / 39 % RH
Engineer	Tomoya Sone (1 GHz to 10 GHz)
Mode	Tx 11b 2412 MHz

Horizontal	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

Vertical	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge and authorized band edge were shown in tabular data.

Radiated Spurious Emission

Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.2	No.2	No.2
Date	November 13, 2023	November 16, 2023	November 16, 2023
Temperature / Humidity	22 deg. C / 39 % RH	23 deg. C / 46 % RH	21 deg. C / 40 % RH
Engineer	Tomoya Sone	Junya Okuno	Daiki Matsui
	(1 GHz to 10 GHz)	(10 GHz to 18 GHz)	(18 GHz to 26.5 GHz)
Mode	Tx 11b 2437 MHz		

Polarity [Hori/Vert]	Frequency [MHz]	Reading (QP / PK) [dBuV]	Reading (AV) [dBuV]	Ant. Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (QP / PK) [dBuV/m]	Result (AV) [dBuV/m]	Limit (QP / PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (QP / PK) [dB]	Margin (AV) [dB]	Remark
Hori.	1580.0	46.5	37.7	25.3	4.0	35.5	-	40.2	31.5	73.9	53.9	33.7	22.4	
Hori.	4874.0	41.4	32.0	31.6	6.6	34.2	-	45.6	36.1	73.9	53.9	28.4	17.8	Floor noise
Hori.	5000.0	45.4	40.1	31.8	6.7	34.2	-	49.7	44.4	73.9	53.9	24.2	9.5	
Hori.	7311.0	43.5	32.8	36.1	7.8	34.1	-	53.3	42.6	73.9	53.9	20.6	11.3	Floor noise
Hori.	9748.0	43.5	33.2	39.3	8.4	34.7	-	56.5	46.1	73.9	53.9	17.5	7.8	Floor noise
Hori.	10000.0	46.5	40.1	39.6	-2.7	34.7	-	48.6	42.3	73.9	53.9	25.3	11.6	
Hori.	11250.0	43.4	38.2	40.1	-2.2	33.9	-	47.4	42.1	73.9	53.9	26.5	11.8	
Hori.	12500.0	46.5	41.1	39.2	-1.8	33.5	-	50.5	45.1	73.9	53.9	23.5	8.8	
Vert.	1580.0	46.3	38.8	25.3	4.0	35.5	-	40.0	32.5	73.9	53.9	33.9	21.4	
Vert.	4874.0	41.3	34.4	31.6	6.6	34.2	-	45.4	38.5	73.9	53.9	28.5	15.4	Floor noise
Vert.	5000.0	46.0	41.1	31.8	6.7	34.2	-	50.3	45.4	73.9	53.9	23.6	8.5	
Vert.	7311.0	42.0	34.4	36.1	7.8	34.1	-	51.9	44.3	73.9	53.9	22.0	9.6	Floor noise
Vert.	9748.0	43.1	33.8	39.3	8.4	34.7	-	56.0	46.8	73.9	53.9	17.9	7.1	Floor noise
Vert.	10000.0	45.6	39.0	39.6	-2.7	34.7	-	47.8	41.2	73.9	53.9	26.1	12.8	
Vert.	11250.0	43.6	37.0	40.1	-2.2	33.9	-	47.5	41.0	73.9	53.9	26.4	13.0	
Vert.	12500.0	45.1	38.9	39.2	-1.8	33.5	-	49.1	42.9	73.9	53.9	24.8	11.0	

Result (QP / PK) = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)
Result (AV)= Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).
*QP detector was used up to 1GHz.

Distance factor:	1 GHz - 10 GHz	20log (3.6 m / 3.0 m) = 1.59 dB
	10 GHz - 26.5 GHz	20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission

Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.2	No.2	No.2
Date	November 13, 2023	November 16, 2023	November 16, 2023
Temperature / Humidity	22 deg. C / 39 % RH	23 deg. C / 46 % RH	21 deg. C / 40 % RH
Engineer	Tomoya Sone	Junya Okuno	Daiki Matsui
	(1 GHz to 10 GHz)	(10 GHz to 18 GHz)	(18 GHz to 26.5 GHz)
Mode	Tx 11b 2462 MHz		

Polarity [Hori/Vert]	Frequency [MHz]	Reading (QP / PK) [dBuV]	Reading (AV) [dBuV]	Ant. Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (QP / PK) [dBuV/m]	Result (AV) [dBuV/m]	Limit (QP / PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (QP / PK) [dB]	Margin (AV) [dB]	Remark
Hori.	1580.0	46.6	37.8	25.3	4.0	35.5	-	40.3	31.6	73.9	53.9	33.6	22.3	
Hori.	2483.5	52.1	43.8	27.5	4.6	34.9	0.3	49.3	41.3	73.9	53.9	24.6	12.6	*1)
Hori.	4924.0	41.4	34.5	31.7	6.7	34.2	-	45.5	38.6	73.9	53.9	28.4	15.3	Floor noise
Hori.	5000.0	45.4	40.2	31.8	6.7	34.2	-	49.7	44.5	73.9	53.9	24.2	9.4	
Hori.	7386.0	41.7	34.2	36.3	7.8	34.1	-	51.6	44.2	73.9	53.9	22.3	9.7	Floor noise
Hori.	9848.0	42.7	33.7	39.3	8.4	34.7	-	55.7	46.7	73.9	53.9	18.2	7.2	Floor noise
Hori.	10000.0	46.4	40.3	39.6	-2.7	34.7	-	48.5	42.4	73.9	53.9	25.4	11.5	
Hori.	11250.0	43.6	37.9	40.1	-2.2	33.9	-	47.6	41.9	73.9	53.9	26.3	12.0	
Hori.	12500.0	46.8	41.1	39.2	-1.8	33.5	-	50.8	45.1	73.9	53.9	23.1	8.8	
Vert.	1580.0	46.4	38.9	25.3	4.0	35.5	-	40.1	32.6	73.9	53.9	33.8	21.3	
Vert.	2483.5	53.9	41.8	27.5	4.6	34.9	0.3	51.1	39.3	73.9	53.9	22.8	14.6	*1)
Vert.	4924.0	41.8	34.3	31.7	6.7	34.2	-	46.0	38.4	73.9	53.9	27.9	15.5	Floor noise
Vert.	5000.0	46.2	41.2	31.8	6.7	34.2	-	50.5	45.5	73.9	53.9	23.4	8.4	
Vert.	7386.0	42.3	34.3	36.3	7.8	34.1	-	52.3	44.2	73.9	53.9	21.7	9.7	Floor noise
Vert.	9848.0	42.8	33.4	39.3	8.4	34.7	-	55.8	46.4	73.9	53.9	18.1	7.5	Floor noise
Vert.	10000.0	45.8	39.2	39.6	-2.7	34.7	-	48.0	41.4	73.9	53.9	25.9	12.5	
Vert.	11250.0	43.9	37.1	40.1	-2.2	33.9	-	47.9	41.1	73.9	53.9	26.0	12.8	
Vert.	12500.0	45.5	38.9	39.2	-1.8	33.5	-	49.4	42.8	73.9	53.9	24.5	11.1	

Result (QP / PK) = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)
Result (AV)= Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).
*QP detector was used up to 1GHz.
*1) Not Out of Band emission(Leakage Power)

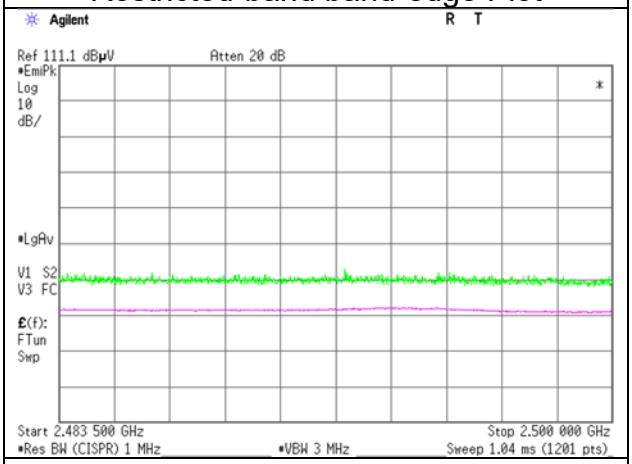
Distance factor:	1 GHz - 10 GHz	20log (3.6 m / 3.0 m) = 1.59 dB
	10 GHz - 26.5 GHz	20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	November 13, 2023
Temperature / Humidity	22 deg. C / 39 % RH
Engineer	Tomoya Sone (1 GHz to 10 GHz)
Mode	Tx 11b 2462 MHz

Horizontal

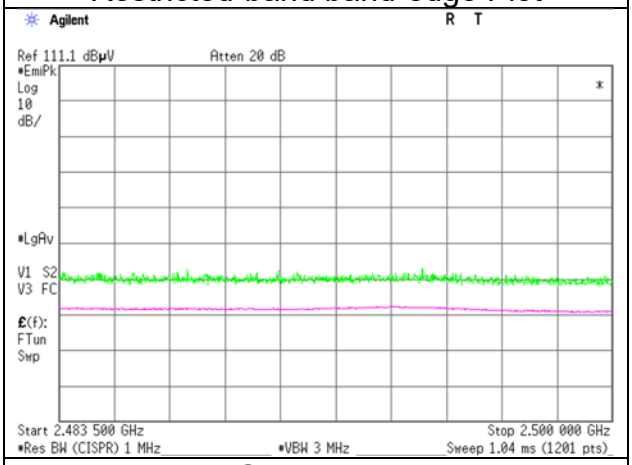
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission

Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.2	No.2	No.2
Date	November 14, 2023	November 16, 2023	November 16, 2023
Temperature / Humidity	23 deg. C / 44 % RH	23 deg. C / 46 % RH	21 deg. C / 40 % RH
Engineer	Tomoya Sone	Junya Okuno	Daiki Matsui
	(1 GHz to 10 GHz)	(10 GHz to 18 GHz)	(18 GHz to 26.5 GHz)
Mode	Tx 11n-20 2412 MHz		

Polarity [Hori/Vert]	Frequency [MHz]	Reading (QP / PK) [dBuV]	Reading (AV) [dBuV]	Ant. Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (QP / PK) [dBuV/m]	Result (AV) [dBuV/m]	Limit (QP / PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (QP / PK) [dB]	Margin (AV) [dB]	Remark
Hori.	1580.0	48.6	42.1	25.3	4.0	35.5	-	42.4	35.9	73.9	53.9	31.5	18.0	
Hori.	2390.0	45.0	34.2	27.7	4.6	34.9	2.6	42.3	34.1	73.9	53.9	31.6	19.9	*1)
Hori.	4824.0	42.5	31.9	31.6	6.6	34.1	-	46.6	36.0	73.9	53.9	27.3	17.9	Floor noise
Hori.	5000.0	44.6	38.5	31.8	6.7	34.2	-	48.9	42.8	73.9	53.9	25.0	11.1	
Hori.	7236.0	42.3	32.6	36.0	7.8	34.0	-	52.1	42.3	73.9	53.9	21.8	11.6	Floor noise
Hori.	9648.0	43.3	33.4	39.0	8.4	34.7	-	55.9	46.1	73.9	53.9	18.0	7.8	Floor noise
Hori.	10000.0	46.4	40.1	39.6	-2.7	34.7	-	48.6	42.3	73.9	53.9	25.3	11.6	
Hori.	11250.0	43.4	37.9	40.1	-2.2	33.9	-	47.4	41.9	73.9	53.9	26.5	12.0	
Hori.	12500.0	46.9	41.2	39.2	-1.8	33.5	-	50.8	45.1	73.9	53.9	23.1	8.8	
Vert.	1580.0	48.1	43.5	25.3	4.0	35.5	-	41.9	37.2	73.9	53.9	32.0	16.7	
Vert.	2390.0	44.7	33.7	27.7	4.6	34.9	2.6	42.0	33.5	73.9	53.9	31.9	20.4	*1)
Vert.	4824.0	41.7	33.7	31.6	6.6	34.1	-	45.8	37.8	73.9	53.9	28.1	16.1	Floor noise
Vert.	5000.0	45.4	40.6	31.8	6.7	34.2	-	49.7	44.9	73.9	53.9	24.2	9.0	
Vert.	7236.0	43.3	34.6	36.0	7.8	34.0	-	53.0	44.3	73.9	53.9	20.9	9.6	Floor noise
Vert.	9648.0	43.6	33.4	39.0	8.4	34.7	-	56.3	46.1	73.9	53.9	17.6	7.8	Floor noise
Vert.	10000.0	45.5	39.4	39.6	-2.7	34.7	-	47.7	41.6	73.9	53.9	26.3	12.3	
Vert.	11250.0	43.7	37.2	40.1	-2.2	33.9	-	47.7	41.2	73.9	53.9	26.2	12.7	
Vert.	12500.0	45.5	39.2	39.2	-1.8	33.5	-	49.5	43.2	73.9	53.9	24.4	10.8	

Result (QP / PK) = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)
Result (AV)= Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).
*QP detector was used up to 1GHz.
*1) Not Out of Band emission(Leakage Power)

20dBc Data Sheet

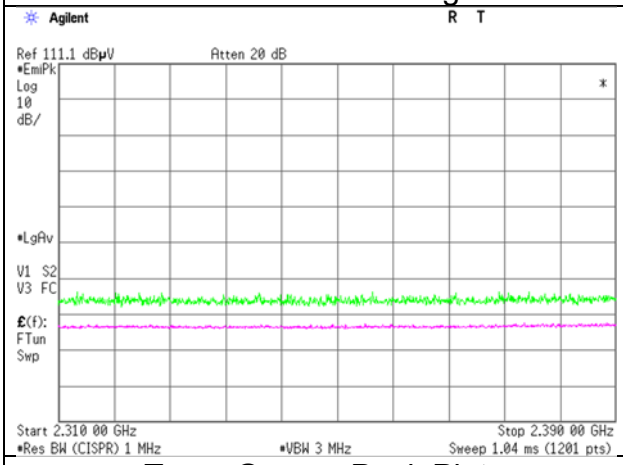
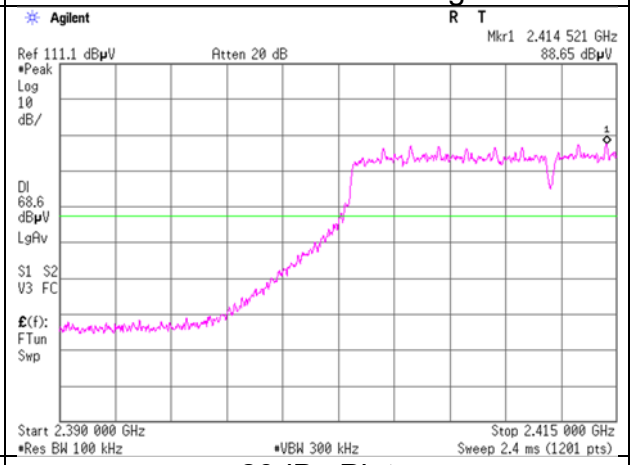
Polarity [Hori/Vert]	Frequency [MHz]	Reading (PK) [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2412.0	88.7	27.6	4.6	34.9	85.9	-	-	Carrier
Hori.	2400.0	52.5	27.6	4.6	34.9	49.7	65.9	16.2	
Vert.	2412.0	88.4	27.6	4.6	34.9	85.7	-	-	Carrier
Vert.	2400.0	52.1	27.6	4.6	34.9	49.3	65.7	16.3	

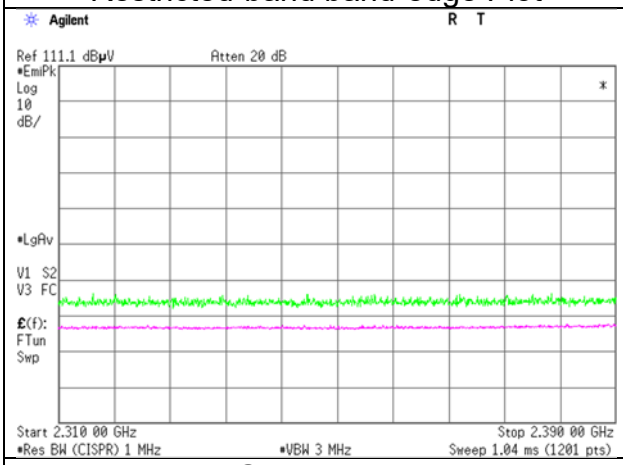
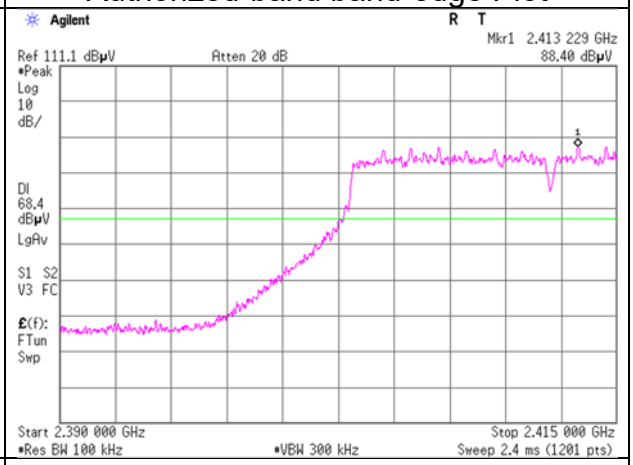
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amprifier)

Distance factor: 1 GHz - 10 GHz 20log (3.6 m / 3.0 m) = 1.59 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	November 14, 2023
Temperature / Humidity	23 deg. C / 44 % RH
Engineer	Tomoya Sone (1 GHz to 10 GHz)
Mode	Tx 11n-20 2412 MHz

Horizontal	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

Vertical	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge and authorized band edge were shown in tabular data.

Radiated Spurious Emission

Test place	Ise EMC Lab.			
Semi Anechoic Chamber	No.2	No.2	No.2	No.2
Date	November 14, 2023	November 16, 2023	November 16, 2023	November 20, 2023
Temperature / Humidity	23 deg. C / 44 % RH	23 deg. C / 46 % RH	21 deg. C / 40 % RH	21 deg. C / 40 % RH
Engineer	Tomoya Sone (1 GHz to 10 GHz)	Junya Okuno (10 GHz to 18 GHz)	Daiki Matsui (18 GHz to 26.5 GHz)	Kiyoshiro Okazaki (Below 1 GHz)
Mode	Tx 11n-20 2437 MHz			

Polarity [Hori/Vert]	Frequency [MHz]	Reading (QP / PK) [dBuV]	Reading (AV) [dBuV]	Ant. Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (QP / PK) [dBuV/m]	Result (AV) [dBuV/m]	Limit (QP / PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (QP / PK) [dB]	Margin (AV) [dB]	Remark
Hori.	44.5	22.0	-	13.1	6.8	28.6	-	13.4	-	40.0	-	26.6	-	
Hori.	52.4	21.6	-	10.2	6.9	28.6	-	10.2	-	40.0	-	29.8	-	
Hori.	61.5	28.7	-	7.5	7.0	28.5	-	14.6	-	40.0	-	25.4	-	
Hori.	97.8	22.3	-	9.8	7.4	28.4	-	11.0	-	43.5	-	32.5	-	
Hori.	108.0	32.5	-	11.4	7.4	28.4	-	22.9	-	43.5	-	20.6	-	
Hori.	272.8	27.1	-	13.4	8.6	27.8	-	21.3	-	46.0	-	24.7	-	
Hori.	1580.0	48.5	42.1	25.3	4.0	35.5	-	42.3	35.8	73.9	53.9	31.6	18.1	
Hori.	4874.0	42.1	34.1	31.6	6.6	34.2	-	46.2	38.2	73.9	53.9	27.7	15.7	Floor noise
Hori.	5000.0	44.4	38.3	31.8	6.7	34.2	-	48.7	42.6	73.9	53.9	25.2	11.3	
Hori.	7311.0	43.0	34.4	36.1	7.8	34.1	-	52.9	44.3	73.9	53.9	21.0	9.6	Floor noise
Hori.	9748.0	43.1	34.0	39.3	8.4	34.7	-	56.1	47.0	73.9	53.9	17.8	6.9	Floor noise
Hori.	10000.0	46.3	40.2	39.6	-2.7	34.7	-	48.5	42.3	73.9	53.9	25.4	11.6	
Hori.	11250.0	43.0	38.1	40.1	-2.2	33.9	-	47.0	42.0	73.9	53.9	26.9	11.9	
Hori.	12500.0	47.1	41.1	39.2	-1.8	33.5	-	51.1	45.0	73.9	53.9	22.8	8.9	
Vert.	44.5	29.1	-	13.1	6.8	28.6	-	20.5	-	40.0	-	19.5	-	
Vert.	52.4	28.1	-	10.2	6.9	28.6	-	16.7	-	40.0	-	23.3	-	
Vert.	61.5	32.5	-	7.5	7.0	28.5	-	18.4	-	40.0	-	21.6	-	
Vert.	97.8	26.6	-	9.8	7.4	28.4	-	15.3	-	43.5	-	28.2	-	
Vert.	108.0	29.5	-	11.4	7.4	28.4	-	19.9	-	43.5	-	23.6	-	
Vert.	272.8	24.6	-	13.4	8.6	27.8	-	18.8	-	46.0	-	27.2	-	
Vert.	1580.0	48.1	43.4	25.3	4.0	35.5	-	41.8	37.1	73.9	53.9	32.1	16.8	
Vert.	4874.0	43.1	34.1	31.6	6.6	34.2	-	47.2	38.2	73.9	53.9	26.7	15.7	Floor noise
Vert.	5000.0	45.2	40.6	31.8	6.7	34.2	-	49.5	44.9	73.9	53.9	24.4	9.1	
Vert.	7311.0	43.0	34.5	36.1	7.8	34.1	-	52.8	44.3	73.9	53.9	21.1	9.6	Floor noise
Vert.	9748.0	42.8	34.2	39.3	8.4	34.7	-	55.7	47.1	73.9	53.9	18.2	6.8	Floor noise
Vert.	10000.0	45.6	39.3	39.6	-2.7	34.7	-	47.8	41.4	73.9	53.9	26.2	12.5	
Vert.	11250.0	44.0	37.0	40.1	-2.2	33.9	-	48.0	40.9	73.9	53.9	26.0	13.0	
Vert.	12500.0	45.3	39.1	39.2	-1.8	33.5	-	49.3	43.1	73.9	53.9	24.6	10.8	

Result (QP / PK) = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)
Result (AV)= Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).
*QP detector was used up to 1GHz

Distance factor:	1 GHz - 10 GHz	20log (3.6 m / 3.0 m) = 1.59 dB
	10 GHz - 26.5 GHz	20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission

Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.2	No.2	No.2
Date	November 14, 2023	November 16, 2023	November 16, 2023
Temperature / Humidity	23 deg. C / 44 % RH	23 deg. C / 46 % RH	21 deg. C / 40 % RH
Engineer	Tomoya Sone	Junya Okuno	Daiki Matsui
	(1 GHz to 10 GHz)	(10 GHz to 18 GHz)	(18 GHz to 26.5 GHz)
Mode	Tx 11n-20 2462 MHz		

Polarity [Hori/Vert]	Frequency [MHz]	Reading (QP / PK) [dBuV]	Reading (AV) [dBuV]	Ant. Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (QP / PK) [dBuV/m]	Result (AV) [dBuV/m]	Limit (QP / PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (QP / PK) [dB]	Margin (AV) [dB]	Remark
Hori.	1580.0	48.7	42.1	25.3	4.0	35.5	-	42.4	35.9	73.9	53.9	31.5	18.0	
Hori.	2483.5	47.3	35.5	27.5	4.6	34.9	2.6	44.5	35.3	73.9	53.9	29.4	18.6	*1)
Hori.	4924.0	42.4	34.0	31.7	6.7	34.2	-	46.5	38.2	73.9	53.9	27.4	15.7	Floor noise
Hori.	5000.0	44.5	38.4	31.8	6.7	34.2	-	48.8	42.7	73.9	53.9	25.1	11.2	
Hori.	7386.0	42.3	34.0	36.3	7.8	34.1	-	52.3	44.0	73.9	53.9	21.6	9.9	Floor noise
Hori.	9848.0	42.3	34.4	39.3	8.4	34.7	-	55.2	47.4	73.9	53.9	18.7	6.5	Floor noise
Hori.	10000.0	46.0	40.2	39.6	-2.7	34.7	-	48.2	42.4	73.9	53.9	25.8	11.5	
Hori.	11250.0	43.1	37.9	40.1	-2.2	33.9	-	47.0	41.9	73.9	53.9	26.9	12.1	
Hori.	12500.0	46.6	41.1	39.2	-1.8	33.5	-	50.6	45.1	73.9	53.9	23.3	8.8	
Vert.	1580.0	48.2	43.5	25.3	4.0	35.5	-	41.9	37.2	73.9	53.9	32.0	16.7	
Vert.	2483.5	46.7	35.1	27.5	4.6	34.9	2.6	43.9	35.0	73.9	53.9	30.0	19.0	*1)
Vert.	4924.0	41.4	34.2	31.7	6.7	34.2	-	45.5	38.4	73.9	53.9	28.4	15.5	Floor noise
Vert.	5000.0	45.3	40.6	31.8	6.7	34.2	-	49.6	44.9	73.9	53.9	24.3	9.0	
Vert.	7386.0	42.2	34.3	36.3	7.8	34.1	-	52.2	44.2	73.9	53.9	21.7	9.7	Floor noise
Vert.	9848.0	42.4	34.5	39.3	8.4	34.7	-	55.4	47.5	73.9	53.9	18.5	6.4	Floor noise
Vert.	10000.0	45.7	39.4	39.6	-2.7	34.7	-	47.9	41.6	73.9	53.9	26.1	12.3	
Vert.	11250.0	44.0	37.1	40.1	-2.2	33.9	-	48.0	41.1	73.9	53.9	25.9	12.8	
Vert.	12500.0	45.7	39.2	39.2	-1.8	33.5	-	49.7	43.2	73.9	53.9	24.2	10.7	

Result (QP / PK) = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)
Result (AV)= Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).
*QP detector was used up to 1GHz.
*1) Not Out of Band emission(Leakage Power)

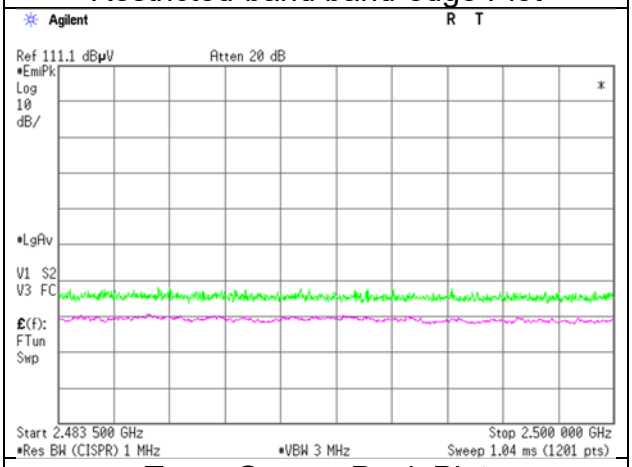
Distance factor:	1 GHz - 10 GHz	20log (3.6 m / 3.0 m) = 1.59 dB
	10 GHz - 26.5 GHz	20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	November 14, 2023
Temperature / Humidity	23 deg. C / 44 % RH
Engineer	Tomoya Sone (1 GHz to 10 GHz)
Mode	Tx 11n-20 2462 MHz

Horizontal

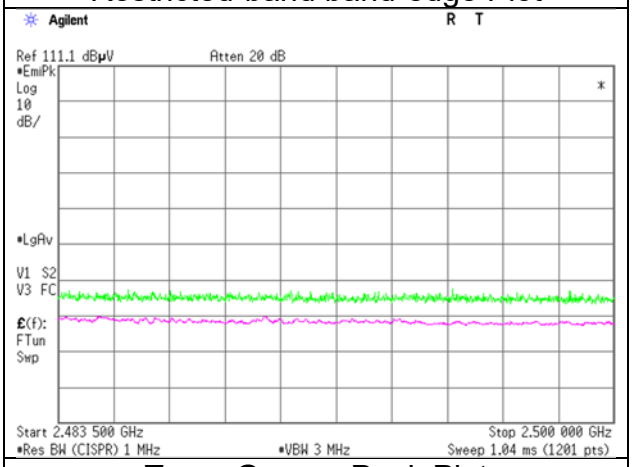
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission

Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.2	No.2	No.2
Date	November 14, 2023	November 19, 2023	November 16, 2023
Temperature / Humidity	23 deg. C / 44 % RH	20 deg. C / 40 % RH	21 deg. C / 40 % RH
Engineer	Tomoya Sone	Junya Okuno	Daiki Matsui
	(1 GHz to 10 GHz)	(10 GHz to 18 GHz)	(18 GHz to 26.5 GHz)
Mode	Tx BT LE 2402 MHz		

Polarity [Hori/Vert]	Frequency [MHz]	Reading (QP / PK) [dBuV]	Reading (AV) [dBuV]	Ant. Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (QP / PK) [dBuV/m]	Result (AV) [dBuV/m]	Limit (QP / PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (QP / PK) [dB]	Margin (AV) [dB]	Remark
Hori.	1580.0	48.7	42.2	25.3	4.0	35.5	-	42.5	35.9	73.9	53.9	31.4	18.0	
Hori.	2390.0	44.9	33.2	27.7	4.6	34.9	1.7	42.2	32.2	73.9	53.9	31.7	21.7	*1)
Hori.	4804.0	42.2	31.7	31.6	6.6	34.1	-	46.2	35.7	73.9	53.9	27.7	18.2	Floor noise
Hori.	5000.0	44.6	38.5	31.8	6.7	34.2	-	48.9	42.8	73.9	53.9	25.0	11.1	
Hori.	7206.0	43.3	32.7	36.0	7.8	34.0	-	53.0	42.4	73.9	53.9	20.9	11.5	Floor noise
Hori.	9608.0	43.4	33.2	38.9	8.3	34.7	-	55.9	45.7	73.9	53.9	18.0	8.2	Floor noise
Hori.	10000.0	45.3	40.0	39.6	-2.7	34.7	-	47.4	42.2	73.9	53.9	26.5	11.8	
Hori.	11250.0	44.0	38.0	40.1	-2.2	33.9	-	48.0	42.0	73.9	53.9	25.9	11.9	
Hori.	12500.0	45.5	40.4	39.2	-1.8	33.5	-	49.5	44.3	73.9	53.9	24.4	9.6	
Vert.	1580.0	48.1	43.5	25.3	4.0	35.5	-	41.9	37.2	73.9	53.9	32.0	16.7	
Vert.	2390.0	44.1	33.6	27.7	4.6	34.9	1.7	41.3	32.6	73.9	53.9	32.6	21.3	*1)
Vert.	4804.0	41.9	31.8	31.6	6.6	34.1	-	46.0	35.9	73.9	53.9	27.9	18.0	Floor noise
Vert.	5000.0	45.4	40.7	31.8	6.7	34.2	-	49.7	45.0	73.9	53.9	24.2	8.9	
Vert.	7206.0	43.2	32.8	36.0	7.8	34.0	-	52.9	42.5	73.9	53.9	21.0	11.4	Floor noise
Vert.	9608.0	43.3	33.6	38.9	8.3	34.7	-	55.9	46.1	73.9	53.9	18.0	7.8	Floor noise
Vert.	10000.0	45.4	39.4	39.6	-2.7	34.7	-	47.5	41.6	73.9	53.9	26.4	12.4	
Vert.	11250.0	44.4	37.5	40.1	-2.2	33.9	-	48.4	41.4	73.9	53.9	25.5	12.5	
Vert.	12500.0	45.2	39.4	39.2	-1.8	33.5	-	49.1	43.4	73.9	53.9	24.8	10.6	

Result (QP / PK) = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)
Result (AV)= Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).
*QP detector was used up to 1GHz.
*1) Not Out of Band emission(Leakage Power)

20dBc Data Sheet

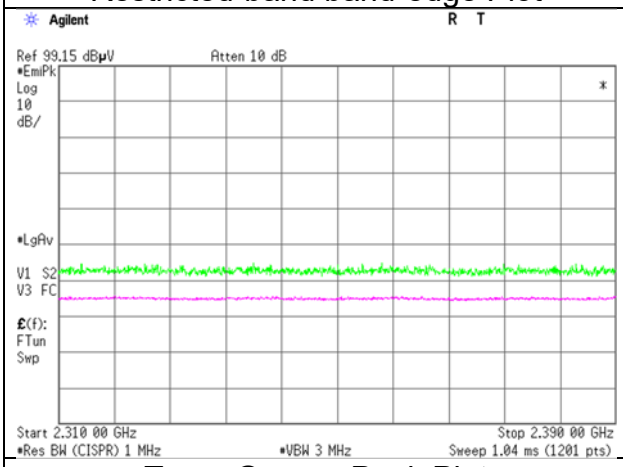
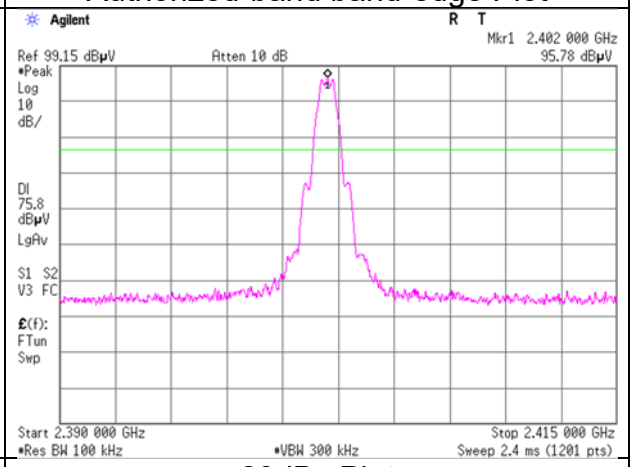
Polarity [Hori/Vert]	Frequency [MHz]	Reading (PK) [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.0	95.8	27.6	4.6	34.9	93.1	-	-	Carrier
Hori.	2400.0	39.9	27.6	4.6	34.9	37.2	73.1	35.9	
Vert.	2402.0	92.4	27.6	4.6	34.9	89.7	-	-	Carrier
Vert.	2400.0	37.3	27.6	4.6	34.9	34.5	69.7	35.2	

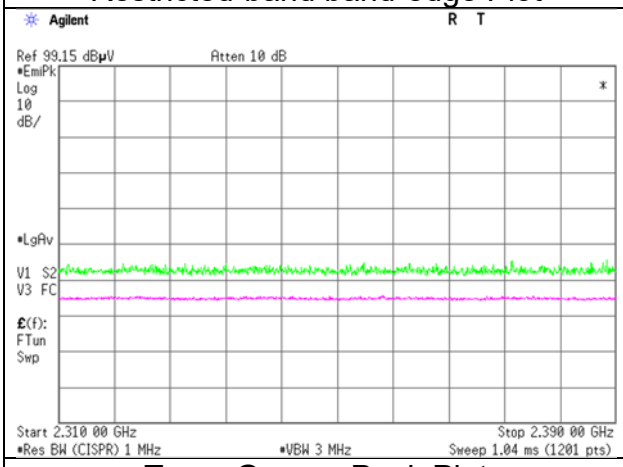
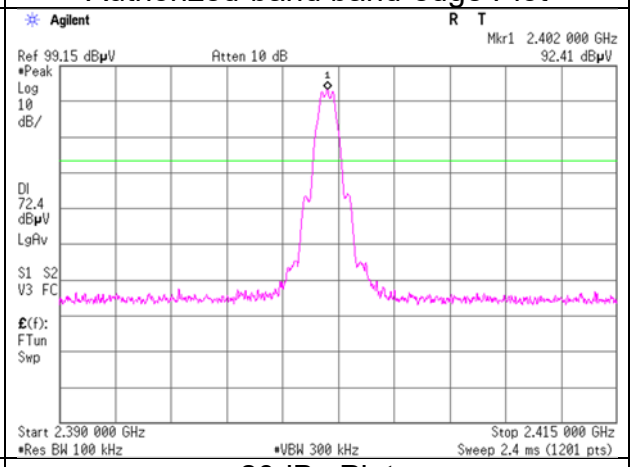
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amprifier)

Distance factor: 1 GHz - 10 GHz 20log (3.6 m / 3.0 m) = 1.59 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	November 14, 2023
Temperature / Humidity	23 deg. C / 44 % RH
Engineer	Tomoya Sone (1 GHz to 10 GHz)
Mode	Tx BT LE 2402 MHz

Horizontal	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

Vertical	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge and authorized band edge were shown in tabular data.

Radiated Spurious Emission

Test place	Ise EMC Lab.			
Semi Anechoic Chamber	No.2	No.2	No.2	No.2
Date	November 14, 2023	November 19, 2023	November 16, 2023	November 20, 2023
Temperature / Humidity	23 deg. C / 44 % RH	20 deg. C / 40 % RH	21 deg. C / 40 % RH	21 deg. C / 40 % RH
Engineer	Tomoya Sone (1 GHz to 10 GHz)	Junya Okuno (10 GHz to 18 GHz)	Daiki Matsui (18 GHz to 26.5 GHz)	Kiyoshiro Okazaki (Below 1 GHz)
Mode	Tx BT LE 2440 MHz			

Polarity [Hori/Vert]	Frequency [MHz]	Reading (QP / PK) [dBuV]	Reading (AV) [dBuV]	Ant. Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (QP / PK) [dBuV/m]	Result (AV) [dBuV/m]	Limit (QP / PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (QP / PK) [dB]	Margin (AV) [dB]	Remark
Hori.	44.3	21.7	-	13.2	6.8	28.6	-	13.1	-	40.0	-	26.9	-	
Hori.	52.8	21.7	-	10.1	6.9	28.6	-	10.2	-	40.0	-	29.8	-	
Hori.	61.4	29.1	-	7.5	7.0	28.5	-	15.0	-	40.0	-	25.0	-	
Hori.	97.3	22.5	-	9.7	7.4	28.4	-	11.1	-	43.5	-	32.4	-	
Hori.	108.0	32.7	-	11.4	7.4	28.4	-	23.1	-	43.5	-	20.4	-	
Hori.	272.8	27.3	-	13.4	8.6	27.8	-	21.5	-	46.0	-	24.5	-	
Hori.	1580.0	48.7	42.0	25.3	4.0	35.5	-	42.4	35.8	73.9	53.9	31.5	18.1	
Hori.	4880.0	42.1	33.9	31.6	6.6	34.2	-	46.2	38.0	73.9	53.9	27.7	15.9	Floor noise
Hori.	5000.0	44.5	38.3	31.8	6.7	34.2	-	48.8	42.6	73.9	53.9	25.1	11.3	
Hori.	7320.0	43.5	34.2	36.1	7.8	34.1	-	53.3	44.1	73.9	53.9	20.6	9.8	Floor noise
Hori.	9760.0	42.7	34.1	39.3	8.4	34.7	-	55.6	47.1	73.9	53.9	18.3	6.8	Floor noise
Hori.	10000.0	45.9	40.1	39.6	-2.7	34.7	-	48.1	42.3	73.9	53.9	25.9	11.6	
Hori.	11250.0	43.8	37.8	40.1	-2.2	33.9	-	47.8	41.8	73.9	53.9	26.1	12.1	
Hori.	12500.0	45.7	40.1	39.2	-1.8	33.5	-	49.6	44.0	73.9	53.9	24.3	9.9	
Vert.	44.3	29.3	-	13.2	6.8	28.6	-	20.7	-	40.0	-	19.3	-	
Vert.	52.8	28.5	-	10.1	6.9	28.6	-	17.0	-	40.0	-	23.0	-	
Vert.	61.4	32.8	-	7.5	7.0	28.5	-	18.7	-	40.0	-	21.3	-	
Vert.	97.3	26.3	-	9.7	7.4	28.4	-	14.9	-	43.5	-	28.6	-	
Vert.	108.0	29.4	-	11.4	7.4	28.4	-	19.8	-	43.5	-	23.7	-	
Vert.	272.8	24.5	-	13.4	8.6	27.8	-	18.7	-	46.0	-	27.3	-	
Vert.	1580.0	48.1	43.4	25.3	4.0	35.5	-	41.8	37.1	73.9	53.9	32.1	16.8	
Vert.	4880.0	41.5	34.0	31.6	6.6	34.2	-	45.6	38.1	73.9	53.9	28.3	15.8	Floor noise
Vert.	5000.0	45.2	40.6	31.8	6.7	34.2	-	49.5	44.9	73.9	53.9	24.4	9.0	
Vert.	7320.0	42.7	34.3	36.1	7.8	34.1	-	52.6	44.2	73.9	53.9	21.4	9.7	Floor noise
Vert.	9760.0	42.4	34.3	39.3	8.4	34.7	-	55.4	47.3	73.9	53.9	18.5	6.6	Floor noise
Vert.	10000.0	45.1	39.3	39.6	-2.7	34.7	-	47.2	41.4	73.9	53.9	26.7	12.5	
Vert.	11250.0	44.5	37.3	40.1	-2.2	33.9	-	48.5	41.3	73.9	53.9	25.4	12.6	
Vert.	12500.0	45.4	39.5	39.2	-1.8	33.5	-	49.4	43.5	73.9	53.9	24.6	10.4	

Result (QP / PK) = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)
Result (AV)= Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).
*QP detector was used up to 1GHz.

Distance factor:	1 GHz - 10 GHz	20log (3.6 m / 3.0 m) = 1.59 dB
	10 GHz - 26.5 GHz	20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission

Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.2	No.2	No.2
Date	November 14, 2023	November 19, 2023	November 16, 2023
Temperature / Humidity	23 deg. C / 44 % RH	20 deg. C / 40 % RH	21 deg. C / 40 % RH
Engineer	Tomoya Sone	Junya Okuno	Daiki Matsui
	(1 GHz to 10 GHz)	(10 GHz to 18 GHz)	(18 GHz to 26.5 GHz)
Mode	Tx BT LE 2480 MHz		

Polarity [Hori/Vert]	Frequency [MHz]	Reading (QP / PK) [dBuV]	Reading (AV) [dBuV]	Ant. Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (QP / PK) [dBuV/m]	Result (AV) [dBuV/m]	Limit (QP / PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (QP / PK) [dB]	Margin (AV) [dB]	Remark
Hori.	1580.0	48.5	41.9	25.3	4.0	35.5	-	42.3	35.7	73.9	53.9	31.7	18.2	
Hori.	2483.5	50.0	33.8	27.5	4.6	34.9	1.7	47.2	32.7	73.9	53.9	26.7	21.2	*1)
Hori.	4960.0	41.4	31.7	31.7	6.7	34.2	-	45.6	35.9	73.9	53.9	28.3	18.0	Floor noise
Hori.	5000.0	44.3	38.3	31.8	6.7	34.2	-	48.6	42.6	73.9	53.9	25.3	11.3	
Hori.	7440.0	42.7	32.3	36.3	7.8	34.1	-	52.7	42.3	73.9	53.9	21.2	11.6	Floor noise
Hori.	9920.0	42.6	32.3	39.2	8.4	34.7	-	55.5	45.1	73.9	53.9	18.4	8.8	Floor noise
Hori.	10000.0	45.6	40.1	39.6	-2.7	34.7	-	47.7	42.2	73.9	53.9	26.2	11.7	
Hori.	11250.0	43.7	37.8	40.1	-2.2	33.9	-	47.7	41.8	73.9	53.9	26.2	12.2	
Hori.	12500.0	45.8	40.4	39.2	-1.8	33.5	-	49.7	44.4	73.9	53.9	24.2	9.5	
Vert.	1580.0	48.0	43.3	25.3	4.0	35.5	-	41.7	37.0	73.9	53.9	32.2	16.9	
Vert.	2483.5	47.6	33.4	27.5	4.6	34.9	1.7	44.9	32.4	73.9	53.9	29.0	21.5	*1)
Vert.	4960.0	43.4	32.0	31.7	6.7	34.2	-	47.6	36.2	73.9	53.9	26.3	17.7	Floor noise
Vert.	5000.0	45.2	40.4	31.8	6.7	34.2	-	49.5	44.7	73.9	53.9	24.4	9.2	
Vert.	7440.0	42.4	32.1	36.3	7.8	34.1	-	52.4	42.1	73.9	53.9	21.5	11.8	Floor noise
Vert.	9920.0	42.0	32.3	39.2	8.4	34.7	-	54.9	45.2	73.9	53.9	19.1	8.7	Floor noise
Vert.	10000.0	45.6	39.3	39.6	-2.7	34.7	-	47.7	41.4	73.9	53.9	26.2	12.5	
Vert.	11250.0	44.4	37.5	40.1	-2.2	33.9	-	48.4	41.4	73.9	53.9	25.6	12.5	
Vert.	12500.0	45.1	39.5	39.2	-1.8	33.5	-	49.1	43.5	73.9	53.9	24.8	10.5	

Result (QP / PK) = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)
Result (AV)= Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).
*QP detector was used up to 1GHz.
*1) Not Out of Band emission(Leakage Power)

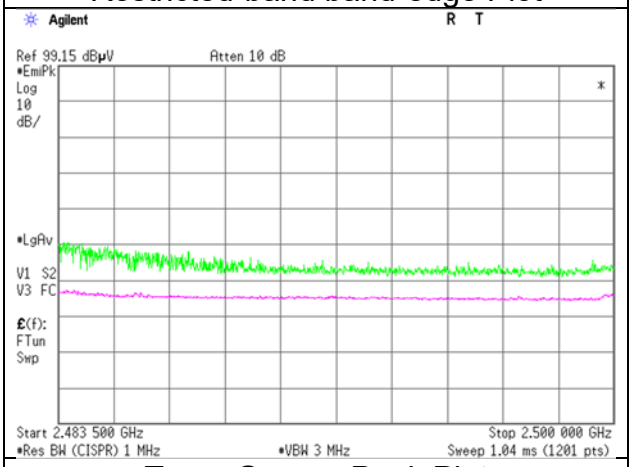
Distance factor:	1 GHz - 10 GHz	20log (3.6 m / 3.0 m) = 1.59 dB
	10 GHz - 26.5 GHz	20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	November 14, 2023
Temperature / Humidity	23 deg. C / 44 % RH
Engineer	Tomoya Sone (1 GHz to 10 GHz)
Mode	Tx BT LE 2480 MHz

Horizontal

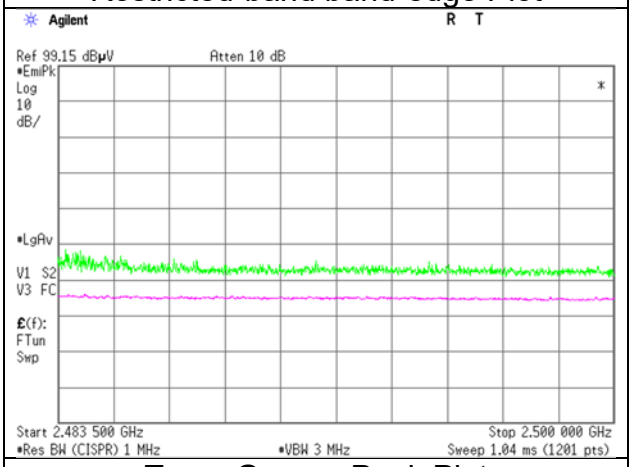
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	November 29, 2023	November 29, 2023
Temperature / Humidity	23 deg. C / 44 % RH	22 deg. C / 42 % RH
Engineer	Shousei Hamaguchi	Daiki Matsui
	(1 GHz to 18 GHz)	(Above 18 GHz)
Mode	Tx BT LE 2402 MHz + 11a 5180 MHz	

Polarity [Hori/Vert]	Frequency [MHz]	Reading (QP / PK) [dBuV]	Reading (AV) [dBuV]	Ant. Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (QP / PK) [dBuV/m]	Result (AV) [dBuV/m]	Limit (QP / PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (QP / PK) [dB]	Margin (AV) [dB]	Remark
Hori.	1580.0	48.5	42.0	25.3	4.0	35.5	-	42.3	35.8	73.9	53.9	31.6	18.1	
Hori.	2390.0	44.0	36.0	27.7	4.6	34.9	1.7	41.3	35.0	73.9	53.9	32.6	18.9	*1)
Hori.	4804.0	42.5	34.7	31.6	6.7	34.1	-	46.7	38.8	73.9	53.9	27.3	15.1	Floor noise
Hori.	5000.0	45.9	39.9	31.8	6.8	34.2	-	50.3	44.4	73.9	53.9	23.6	9.6	
Hori.	7206.0	45.0	35.0	36.0	7.9	34.0	-	54.9	44.8	73.9	53.9	19.1	9.1	Floor noise
Hori.	9608.0	43.7	34.9	38.9	8.7	34.7	-	56.6	47.8	73.9	53.9	17.3	6.1	Floor noise
Hori.	10000.0	47.9	43.4	39.6	-2.9	34.7	-	49.9	45.4	73.9	53.9	24.0	8.5	
Hori.	11250.0	45.3	37.8	40.1	-2.4	33.9	-	49.0	41.5	73.9	53.9	24.9	12.4	
Hori.	12500.0	46.1	40.9	39.2	-2.0	33.5	-	49.8	44.6	73.9	53.9	24.1	9.3	
Vert.	1580.0	43.2	34.8	25.3	4.0	35.5	-	37.0	28.6	73.9	53.9	36.9	25.3	
Vert.	2390.0	43.8	35.6	27.7	4.6	34.9	1.7	41.2	34.6	73.9	53.9	32.8	19.3	*1)
Vert.	4804.0	42.5	34.7	31.6	6.7	34.1	-	46.7	38.8	73.9	53.9	27.3	15.1	Floor noise
Vert.	5000.0	46.5	41.3	31.8	6.8	34.2	-	50.9	45.7	73.9	53.9	23.0	8.2	
Vert.	7206.0	45.0	35.0	36.0	7.9	34.0	-	54.9	44.8	73.9	53.9	19.1	9.1	Floor noise
Vert.	9608.0	43.7	34.9	38.9	8.7	34.7	-	56.6	47.8	73.9	53.9	17.3	6.1	Floor noise
Vert.	10000.0	45.8	39.7	39.6	-2.9	34.7	-	47.8	41.7	73.9	53.9	26.1	12.2	
Vert.	11250.0	45.2	38.1	40.1	-2.4	33.9	-	48.9	41.8	73.9	53.9	25.0	12.1	
Vert.	12500.0	45.7	40.0	39.2	-2.0	33.5	-	49.4	43.7	73.9	53.9	24.5	10.2	

Result (QP / PK) = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)
Result (AV)= Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).
*QP detector was used up to 1GHz.
*1) Not Out of Band emission(Leakage Power)

20dBc Data Sheet

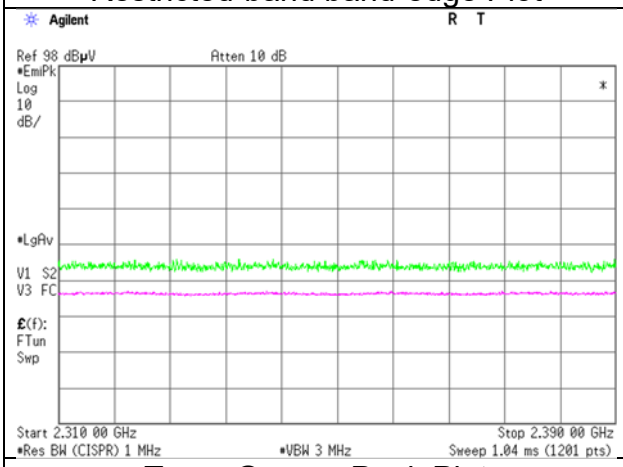
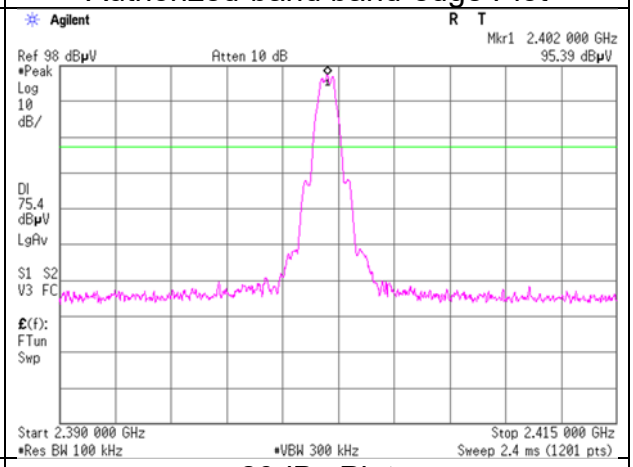
Polarity [Hori/Vert]	Frequency [MHz]	Reading (PK) [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.0	95.4	27.6	4.6	34.9	92.7	-	-	Carrier
Hori.	2400.0	40.3	27.6	4.6	34.9	37.6	72.7	35.1	
Vert.	2402.0	91.5	27.6	4.6	34.9	88.9	-	-	Carrier
Vert.	2400.0	38.0	27.6	4.6	34.9	35.3	68.9	33.6	

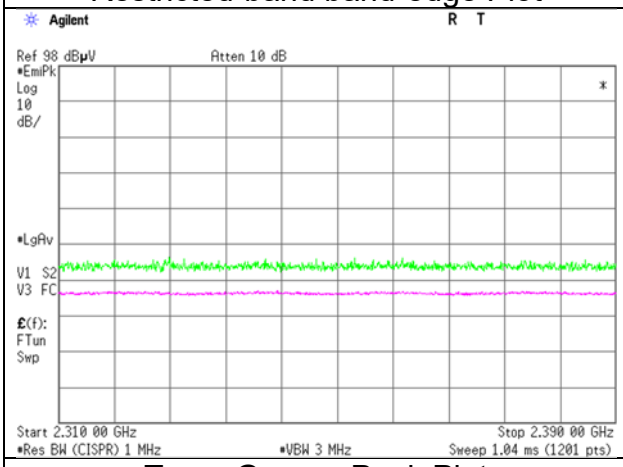
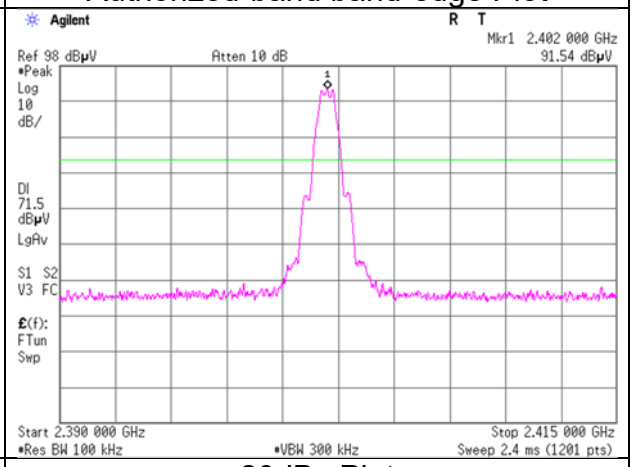
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amprifier)

Distance factor: 1 GHz - 10 GHz 20log (3.6 m / 3.0 m) = 1.59 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	November 29, 2023
Temperature / Humidity	23 deg. C / 44 % RH
Engineer	Shousei Hamaguchi (1 GHz to 10 GHz)
Mode	Tx BT LE 2402 MHz + 11a 5180 MHz

Horizontal	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

Vertical	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge and authorized band edge were shown in tabular data.

Radiated Spurious Emission

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	November 29, 2023	November 29, 2023
Temperature / Humidity	23 deg. C / 44 % RH	22 deg. C / 42 % RH
Engineer	Shousei Hamaguchi	Daiki Matsui
	(1 GHz to 18 GHz)	(18 GHz to 40 GHz, Below 1 GHz)
Mode	Tx BT LE 2440 MHz + 11a 5180 MHz	

Polarity [Hori/Vert]	Frequency [MHz]	Reading (QP / PK) [dBuV]	Reading (AV) [dBuV]	Ant. Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (QP / PK) [dBuV/m]	Result (AV) [dBuV/m]	Limit (QP / PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (QP / PK) [dB]	Margin (AV) [dB]	Remark
Hori.	68.8	23.5	-	6.4	7.1	28.5	-	8.5	-	40.0	-	31.5	-	
Hori.	85.8	23.8	-	7.7	7.2	28.5	-	10.3	-	40.0	-	29.7	-	
Hori.	96.0	22.5	-	9.5	7.3	28.4	-	10.9	-	43.5	-	32.6	-	
Hori.	108.0	24.2	-	11.4	7.4	28.4	-	14.6	-	43.5	-	28.9	-	
Hori.	137.6	22.1	-	14.2	7.7	28.3	-	15.7	-	43.5	-	27.8	-	
Hori.	270.0	26.6	-	13.2	8.5	27.8	-	20.6	-	46.0	-	25.4	-	
Hori.	1580.0	48.7	42.1	25.3	4.0	35.5	-	42.5	35.9	73.9	53.9	31.4	18.0	
Hori.	4880.0	43.1	34.6	31.6	6.8	34.2	-	47.3	38.9	73.9	53.9	26.6	15.0	Floor noise
Hori.	5000.0	45.6	39.9	31.8	6.8	34.2	-	50.0	44.3	73.9	53.9	23.9	9.6	
Hori.	7320.0	43.3	34.6	36.2	7.9	34.1	-	53.3	44.6	73.9	53.9	20.6	9.3	Floor noise
Hori.	9760.0	43.0	34.1	39.3	8.8	34.7	-	56.3	47.4	73.9	53.9	17.6	6.5	Floor noise
Hori.	10000.0	48.0	43.5	39.6	-2.9	34.7	-	50.0	45.4	73.9	53.9	23.9	8.5	
Hori.	11250.0	45.4	37.8	40.1	-2.4	33.9	-	49.0	41.5	73.9	53.9	24.9	12.4	
Hori.	12500.0	46.2	41.0	39.2	-2.0	33.5	-	49.9	44.7	73.9	53.9	24.0	9.2	
Vert.	61.4	26.9	-	7.5	7.0	28.5	-	12.8	-	40.0	-	27.2	-	
Vert.	86.0	25.0	-	7.7	7.2	28.5	-	11.5	-	40.0	-	28.5	-	
Vert.	98.3	28.2	-	9.9	7.4	28.4	-	17.0	-	43.5	-	26.5	-	
Vert.	108.0	28.1	-	11.4	7.4	28.4	-	18.5	-	43.5	-	25.0	-	
Vert.	110.0	25.8	-	11.6	7.5	28.4	-	16.4	-	43.5	-	27.1	-	
Vert.	270.0	26.8	-	13.2	8.5	27.8	-	20.8	-	46.0	-	25.2	-	
Vert.	1580.0	43.2	34.9	25.3	4.0	35.5	-	37.0	28.7	73.9	53.9	36.9	25.3	
Vert.	4880.0	43.1	34.6	31.6	6.8	34.2	-	47.3	38.9	73.9	53.9	26.6	15.0	Floor noise
Vert.	5000.0	46.7	41.3	31.8	6.8	34.2	-	51.1	45.7	73.9	53.9	22.8	8.2	
Vert.	7320.0	43.3	34.6	36.2	7.9	34.1	-	53.3	44.6	73.9	53.9	20.6	9.3	Floor noise
Vert.	9760.0	43.0	34.1	39.3	8.8	34.7	-	56.3	47.4	73.9	53.9	17.6	6.5	Floor noise
Vert.	10000.0	45.7	39.7	39.6	-2.9	34.7	-	47.7	41.7	73.9	53.9	26.2	12.2	
Vert.	11250.0	45.3	38.0	40.1	-2.4	33.9	-	49.0	41.7	73.9	53.9	24.9	12.2	
Vert.	12500.0	45.8	40.1	39.2	-2.0	33.5	-	49.5	43.8	73.9	53.9	24.4	10.2	

Result (QP / PK) = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)
Result (AV)= Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).
*QP detector was used up to 1GHz.

Distance factor:	1 GHz - 10 GHz	20log (3.6 m / 3.0 m) = 1.59 dB
	10 GHz - 26.5 GHz	20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	November 29, 2023	November 29, 2023
Temperature / Humidity	23 deg. C / 44 % RH	22 deg. C / 42 % RH
Engineer	Shousei Hamaguchi (1 GHz to 18 GHz)	Daiki Matsui (Above 18 GHz)
Mode	Tx BT LE 2480 MHz + 11a 5180 MHz	

Polarity [Hori/Vert]	Frequency [MHz]	Reading (QP / PK) [dBuV]	Reading (AV) [dBuV]	Ant. Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (QP / PK) [dBuV/m]	Result (AV) [dBuV/m]	Limit (QP / PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (QP / PK) [dB]	Margin (AV) [dB]	Remark
Hori.	1580.0	48.7	42.1	25.3	4.0	35.5	-	42.5	35.9	73.9	53.9	31.4	18.0	
Hori.	2483.5	51.0	38.3	27.5	4.7	34.9	1.7	48.3	37.3	73.9	53.9	25.6	16.6	*1)
Hori.	2700.0	47.2	38.1	28.1	4.8	34.8	-	45.3	36.2	73.9	53.9	28.6	17.7	
Hori.	4960.0	42.7	34.4	31.7	6.8	34.2	-	47.0	38.7	73.9	53.9	26.9	15.2	Floor noise
Hori.	5000.0	45.7	39.9	31.8	6.8	34.2	-	50.1	44.3	73.9	53.9	23.8	9.6	
Hori.	7440.0	43.3	35.1	36.3	8.0	34.1	-	53.6	45.4	73.9	53.9	20.4	8.5	Floor noise
Hori.	9920.0	41.7	34.3	39.2	8.9	34.7	-	55.0	47.7	73.9	53.9	18.9	6.2	Floor noise
Hori.	10000.0	48.0	43.5	39.6	-2.9	34.7	-	50.0	45.4	73.9	53.9	23.9	8.5	
Hori.	11250.0	45.4	37.8	40.1	-2.4	33.9	-	49.0	41.5	73.9	53.9	24.9	12.4	
Hori.	12500.0	46.2	41.0	39.2	-2.0	33.5	-	49.9	44.7	73.9	53.9	24.0	9.2	
Vert.	1580.0	43.3	34.9	25.3	4.0	35.5	-	37.1	28.7	73.9	53.9	36.8	25.2	
Vert.	2483.5	46.7	36.1	27.5	4.7	34.9	1.7	44.0	35.1	73.9	53.9	29.9	18.9	*1)
Vert.	2700.0	50.3	41.6	28.1	4.8	34.8	-	48.4	39.7	73.9	53.9	25.6	14.2	
Vert.	4960.0	42.7	34.4	31.7	6.8	34.2	-	47.0	38.7	73.9	53.9	26.9	15.2	Floor noise
Vert.	5000.0	46.7	41.3	31.8	6.8	34.2	-	51.1	45.7	73.9	53.9	22.8	8.2	
Vert.	7440.0	43.3	35.1	36.3	8.0	34.1	-	53.6	45.4	73.9	53.9	20.4	8.5	Floor noise
Vert.	9920.0	41.7	34.3	39.2	8.9	34.7	-	55.0	47.7	73.9	53.9	18.9	6.2	Floor noise
Vert.	10000.0	45.7	39.7	39.6	-2.9	34.7	-	47.7	41.7	73.9	53.9	26.2	12.2	
Vert.	11250.0	45.3	38.0	40.1	-2.4	33.9	-	49.0	41.7	73.9	53.9	24.9	12.2	
Vert.	12500.0	45.8	40.1	39.2	-2.0	33.5	-	49.5	43.8	73.9	53.9	24.4	10.2	

Result (QP / PK) = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)
Result (AV)= Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).
*QP detector was used up to 1GHz.
*1) Not Out of Band emission(Leakage Power)

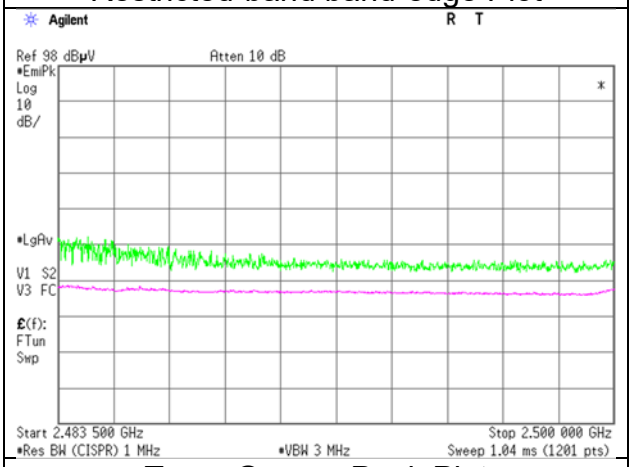
Distance factor:	1 GHz - 10 GHz	20log (3.6 m / 3.0 m) = 1.59 dB
	10 GHz - 26.5 GHz	20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	November 29, 2023
Temperature / Humidity	23 deg. C / 44 % RH
Engineer	Shousei Hamaguchi (1 GHz to 10 GHz)
Mode	Tx BT LE 2480 MHz + 11a 5180 MHz

Horizontal

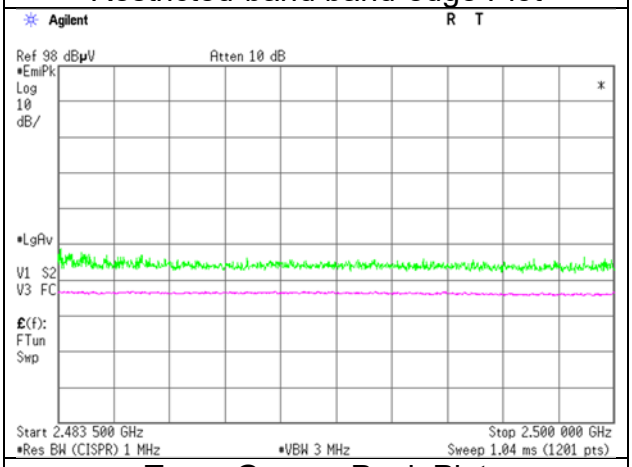
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot

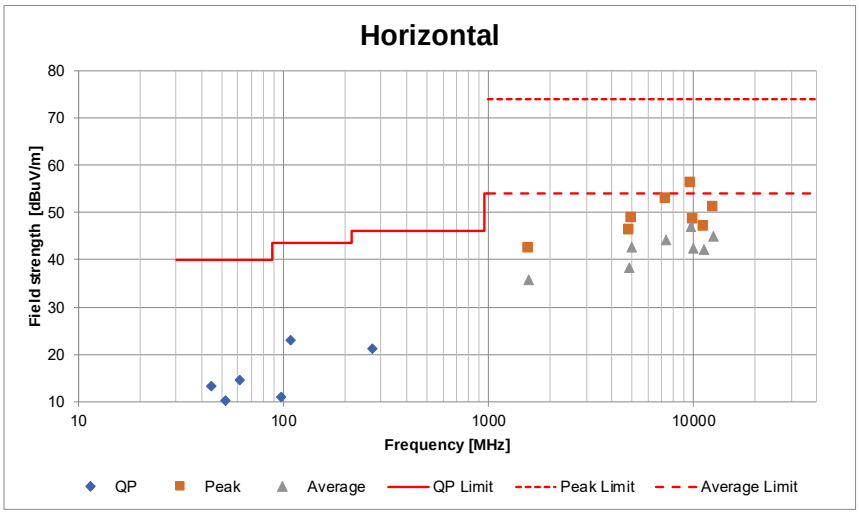


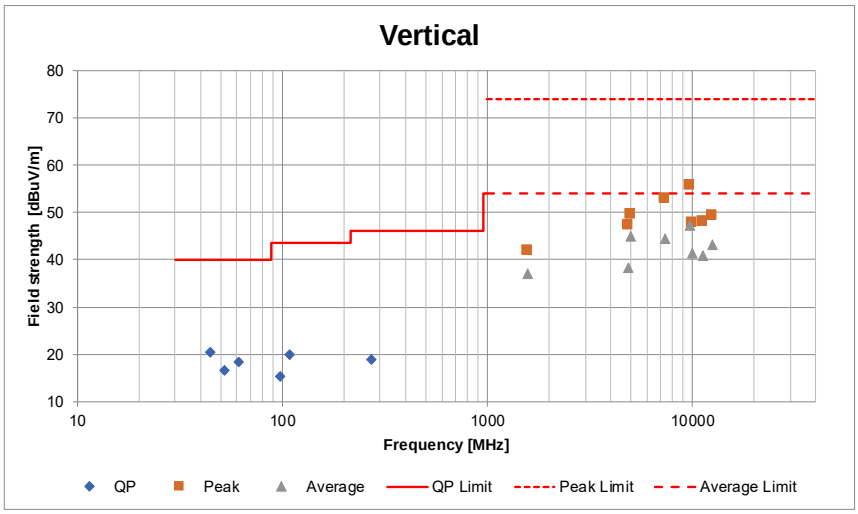
Trace Green : Peak Plot
Trace Purple : Average Plot

* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission
(Plot data, Worst case mode for Maximum Peak Output Power)

Test place	Ise EMC Lab.			
Semi Anechoic Chamber	No.2	No.2	No.2	No.2
Date	November 14, 2023	November 16, 2023	November 16, 2023	November 20, 2023
Temperature / Humidity	23 deg. C / 44 % RH	23 deg. C / 46 % RH	21 deg. C / 40 % RH	21 deg. C / 40 % RH
Engineer	Tomoya Sone (1 GHz to 10 GHz)	Junya Okuno (10 GHz to 18 GHz)	Daiki Matsui (18 GHz to 26.5 GHz)	Kiyoshiro Okazaki (Below 1 GHz)
Mode	Tx 11n-20 2437 MHz			

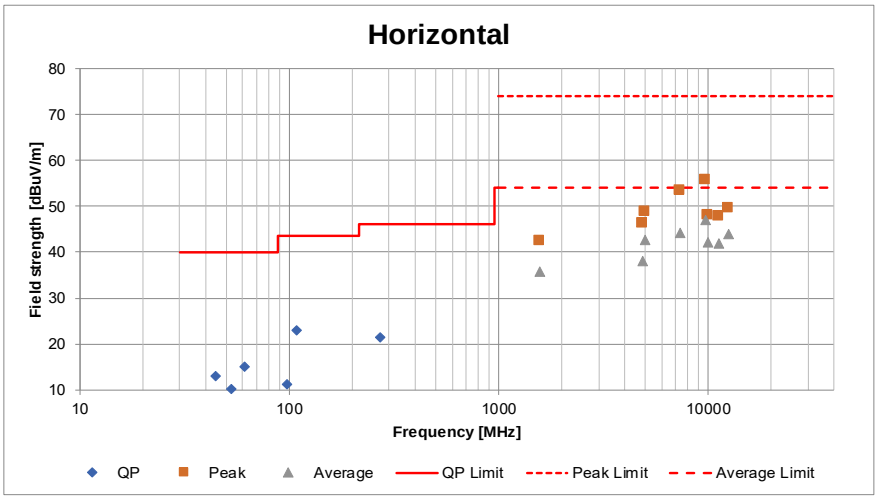


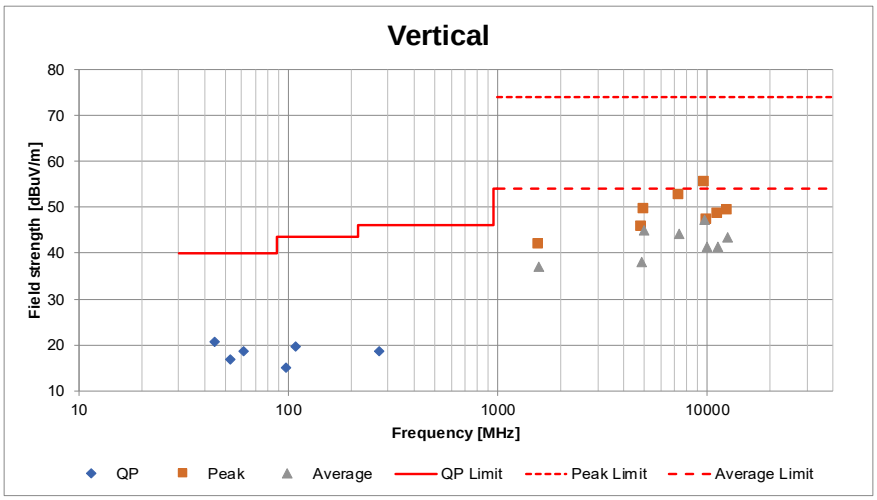


*These plots data contain sufficient number to show the trend of characteristic features for EUT.

Radiated Spurious Emission
(Plot data, Worst case mode for Maximum Peak Output Power)

Test place	Ise EMC Lab.			
Semi Anechoic Chamber	No.2	No.2	No.2	No.2
Date	November 14, 2023	November 19, 2023	November 16, 2023	November 20, 2023
Temperature / Humidity	23 deg. C / 44 % RH	20 deg. C / 40 % RH	21 deg. C / 40 % RH	21 deg. C / 40 % RH
Engineer	Tomoya Sone (1 GHz to 10 GHz)	Junya Okuno (10 GHz to 18 GHz)	Daiki Matsui (18 GHz to 26.5 GHz)	Kiyoshiro Okazaki (Below 1 GHz)
Mode	Tx BT LE 2440 MHz			





*These plots data contain sufficient number to show the trend of characteristic features for EUT.

APPENDIX 2: Test Instruments

Test Equipment

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	141232	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	001	09/04/2023	12
RE	141265	Logperiodic Antenna (200-1000MHz)	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	9111B-190	07/11/2023	12
RE	141317	Coaxial Cable	UL Japan	-	-	09/12/2023	12
RE	141427	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	VHA9103B+BBA9106	08031	07/11/2023	12
RE	141503	Horn Antenna 18-26.5GHz	EMCO	3160-09	1265	06/23/2023	12
RE	141512	Horn Antenna 1-18GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	254	10/17/2023	12
RE	141513	Horn Antenna 15-40GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9170	BBHA9170306	07/19/2023	12
RE	141542	Digital Tester	Fluke Corporation	FLUKE 26-3	78030611	08/01/2023	12
RE	141579	Pre Amplifier	Keysight Technologies Inc	8449B	3008A02142	02/14/2023	12
RE	141594	Pre Amplifier	Keysight Technologies Inc	8447D	2944A10150	02/02/2023	12
RE	141884	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY44020357	03/13/2023	12
RE	142004	AC2_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	05/30/2022	24
RE	142006	AC2_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-06902	10/20/2023	12
RE	142228	Measure, Tape, Steel	KOMELON	KMC-36	-	-	-
RE	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	192300	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0013	12/17/2022	12
RE	213780	EMI Test Receiver	Rohde & Schwarz	ESW8	103079	12/07/2022	12
RE	220646	Attenuator	Huber+Suhner	6806_N-50-1	-	03/17/2023	12
RE	240023	Microwave Cable	Huber+Suhner	SF126E/11PC35/11PC35/ 1000MM,5000MM	537060/126E / 537075/126E	09/08/2023	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