RADIO TEST REPORT

Test Report No. 14202139H-A-R1

Customer	**Murata Manufacturing Co., Ltd.**
Description of EUT	**Communication Module**
Model Number of EUT	**2TY**
FCC ID	**VPYLBCA2HN2AY**
Test Regulation	**FCC Part 15 Subpart C: 2022**
Test Result	**Complied (Refer to SECTION 3)**
Issue Date	**April 11, 2022**
Remarks	**Radiated Spurious Emission only** ***For Permissive Change**

Representative Test Engineer

Yuta Moriya
Engineer

Approved By

Takumi Shimada
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 applicant 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.: 14202139H-A

This report is a revised version of 14202139H-A. 14202139H-A is replaced with this report.

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	14202139H-A	March 16, 2022	-
1	14202139H-A-R1	April 11, 2022	Test Regulation update FCC Part 15 Subpart C: 2021 → FCC Part 15 Subpart C: 2022
1	14202139H-A-R1	April 11, 2022	Addition of below explanatory note in Section 3.1. FCC Part 15 final revised on April 1, 2022 and effective May 2, 2022. * The revision does not affect the test result conducted before its effective date.
1	14202139H-A-R1	April 11, 2022	Deletion of below explanatory note in SECTION 5 Figure 2: Test Setup. * The test was performed with r = 0.0 m since EUT is small and it was the rather conservative condition.
1	14202139H-A-R1	April 11, 2022	Correction of Test Date in SECTION 2: Equipment Under Test (EUT) February 20, 2022 → February 20 and April 10, 2022
1	14202139H-A-R1	April 11, 2022	P 15 and 18 Replacement of chart image for Restricted-band band-edge Plot (Hori / Vert).
1	14202139H-A-R1	April 11, 2022	Addition of below test equipment in APPENDIX 2: Test Instruments. Local ID: MOS-15, MMM-10, MJM-29, MAEC-04-SVSWR, MHA-21, MPA-12, MCC-257, MSA-22

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	Murata Manufacturing Co., Ltd.
Address	1-10-1 Higashikotari, Nagaokakyo-shi, Kyoto 617-8555 Japan
Telephone Number	+81-75-955-6736
Contact Person	Motoo Hayashi

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	Communication Module
Model Number	2TY
Serial Number	Refer to SECTION 4.2
Condition	Production model
Modification	No Modification by the test lab
Receipt Date	February 15, 2022
Test Date	February 20 and April 10, 2022

2.2 Product Description

General Specification

Rating	Typ. DC 3.0 V / Min. DC 1.8 V / Max. DC 3.3 V

Radio Specification

Bluetooth (Low Energy)

Equipment Type	Transceiver
Frequency of Operation	2402 MHz to 2480 MHz
Type of Modulation	GFSK
Antenna Gain	1.0 dBi

SECTION 3: Test Specification, Procedures & Results

3.1 Test Specification

Test Specification	FCC Part 15 Subpart C FCC Part 15 final revised on April 1, 2022 and effective May 2, 2022
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

* The revision does not affect the test result conducted before its effective date.

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)	11.9 dB 2483.5 MHz, AV, Hori	Complied a)	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. a) Refer to APPENDIX 1 (data of Radiated Spurious Emission)					
Symbols: Complied The data of this test item has enough margin, more than the measurement uncertainty. Complied# The data of this test item meets the limits unless the measurement uncertainty is taken into consideration					

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
The antenna is not removable from 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

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

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

Radiated emission

Measurement distance	Frequency range		Uncertainty (+/-)
3 m	9 kHz to 30 MHz		3.2 dB
10 m			3.0 dB
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	5.0 dB
		Vertical	5.0 dB
3 m	1 GHz to 6 GHz		4.9 dB
	6 GHz to 18 GHz		5.2 dB
1 m	10 GHz to 26.5 GHz		5.4 dB
	26.5 GHz to 40 GHz		5.4 dB
10 m	1 GHz to 18 GHz		5.4 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, Facsimile: +81 596 24 8124

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*
Bluetooth Low Energy (BLE) 1M-PHY Uncoded PHY (1M-PHY)	Maximum Packet Size, PRBS9

*Power of the EUT was set by the software as follows;
Power Setting: 2.5 dBm
Software: prodtest_2AY.exe
(Date: 2022.2.18 Storage location: Driven by connected PC)

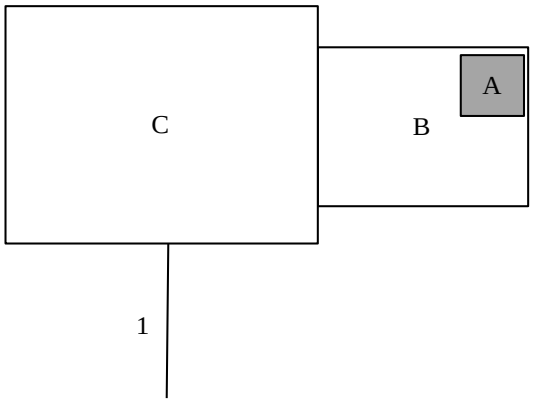
*This setting of software is the worst case.
Any conditions under the normal use do not exceed the condition of setting.
In addition, end users cannot change the settings of the output power of the product.

*The Details of Operating Mode(s)

Test Item	Operating Mode	Tested frequency
Radiated Spurious Emission (Below 1 GHz)	Tx BT LE (Uncoded 1M-PHY)	2402 MHz *1)
Radiated Spurious Emission (Above 1 GHz)	Tx BT LE (Uncoded 1M-PHY)	2402 MHz 2440 MHz 2480 MHz

*1) Spurious emissions for frequencies below 1 GHz were limited to the channel that had the highest power during the antenna terminal test, as preliminary testing indicated that changing the operating frequency had no significant impact on the emissions in those frequency bands.

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	Communication Module	2TY	2	Murata Manufacturing Co.,Ltd	EUT
B	Jig	P2ML9415	2	Murata Manufacturing Co.,Ltd	-
C	Jig	P2ML3656	1	Murata Manufacturing Co.,Ltd	-

List of Cables Used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	1	DC Cable	3.6	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.

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.
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 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.

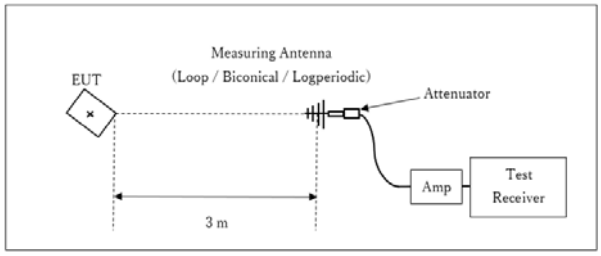
20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9(ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).

Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument Used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	PK	AV *1)	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

*1) Average Power Measurement was performed based on ANSI C63.10-2013.

Figure 2: Test Setup

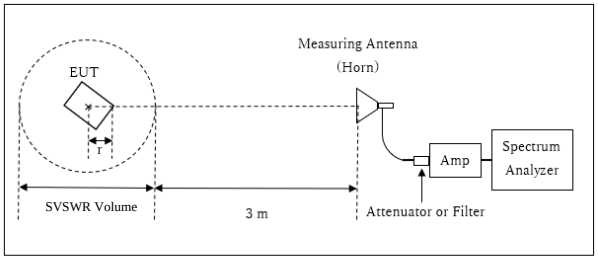
Below 1 GHz



× : Center of turn table

Test Distance: 3 m

1 GHz to 10 GHz

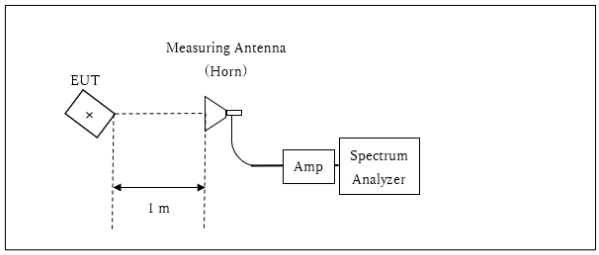


r : Radius of an outer periphery of EUT
× : Center of turn table

Distance Factor: 20 x log (3.7 m / 3.0 m) = 1.83 dB
* Test Distance: (3 + SVSWR Volume /2) - r = 3.7 m

SVSWR Volume : 1.5 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
r = 0.05 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 carrier level and 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 the position that has the maximum noise.

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**

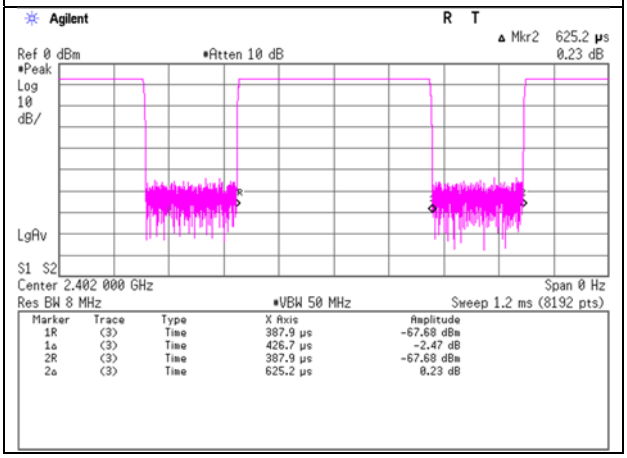
APPENDIX 1: Test data

Burst rate confirmation

Test place	Ise EMC Lab. No.2 Semi Anechoic Chamber
Date	February 20, 2022
Temperature / Humidity	16 deg. C / 39 % RH
Engineer	Yuta Moriya
Mode	Tx BT LE Uncoded 1M-PHY

BT LE

Tx on / (Tx on + Tx off) = 0.683
Tx on / (Tx on + Tx off) * 100 = 68.3 %
Duty factor = 10 * log (0.000625 / 0.000427) = 1.65 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
Date	February 20, 2022
Temperature / Humidity	16 deg. C / 39 % RH
Engineer	Yuta Moriya
	(Above 1 GHz)
	(Below 1 GHz)
Mode	Tx BT LE 2402 MHz Uncoded 1M-PHY

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.	89.6	21.6	-	8.5	7.4	28.3	-	9.1	-	43.5	-	34.4	-	
Hori.	168.0	21.1	-	15.8	8.0	28.1	-	16.8	-	43.5	-	26.8	-	
Hori.	256.0	20.7	-	12.5	8.5	27.7	-	14.0	-	46.0	-	32.0	-	
Hori.	315.2	20.7	-	14.6	8.9	27.7	-	16.5	-	46.0	-	29.6	-	
Hori.	403.2	21.2	-	16.4	9.6	28.5	-	18.8	-	46.0	-	27.3	-	
Hori.	491.3	21.5	-	18.0	9.7	29.0	-	20.3	-	46.0	-	25.8	-	
Hori.	2390.0	52.7	37.1	27.6	4.3	35.1	1.7	49.5	35.5	73.9	53.9	24.4	18.4	*1)
Hori.	4804.0	43.8	33.2	31.5	6.2	34.4	-	47.2	36.6	73.9	53.9	26.7	17.3	Floor noise
Hori.	7206.0	43.7	33.6	35.9	7.1	34.4	-	52.3	42.3	73.9	53.9	21.6	11.6	Floor noise
Hori.	9608.0	43.9	33.7	38.7	8.0	35.0	-	55.7	45.5	73.9	53.9	18.2	8.4	Floor noise
Vert.	89.6	21.8	-	8.5	7.4	28.3	-	9.3	-	43.5	-	34.2	-	
Vert.	168.0	21.2	-	15.8	8.0	28.1	-	16.9	-	43.5	-	26.7	-	
Vert.	256.0	20.8	-	12.5	8.5	27.7	-	14.1	-	46.0	-	31.9	-	
Vert.	315.2	20.8	-	14.6	8.9	27.7	-	16.6	-	46.0	-	29.5	-	
Vert.	403.2	21.1	-	16.4	9.6	28.5	-	18.7	-	46.0	-	27.4	-	
Vert.	491.3	21.6	-	18.0	9.7	29.0	-	20.4	-	46.0	-	25.7	-	
Vert.	2390.0	51.9	36.5	27.6	4.3	35.1	1.7	48.7	35.0	73.9	53.9	25.2	18.9	*1)
Vert.	4804.0	43.7	33.2	31.5	6.2	34.4	-	47.1	36.6	73.9	53.9	26.9	17.3	Floor noise
Vert.	7206.0	44.2	33.6	35.9	7.1	34.4	-	52.8	42.3	73.9	53.9	21.1	11.7	Floor noise
Vert.	9608.0	43.6	33.7	38.7	8.0	35.0	-	55.4	45.5	73.9	53.9	18.6	8.4	Floor noise

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	100.4	27.6	4.3	35.1	97.2	-	-	Carrier
Hori.	2400.0	58.2	27.6	4.3	35.1	54.9	77.2	22.2	
Vert.	2402.0	99.8	27.6	4.3	35.1	96.6	-	-	Carrier
Vert.	2400.0	57.5	27.6	4.3	35.1	54.3	76.6	22.2	

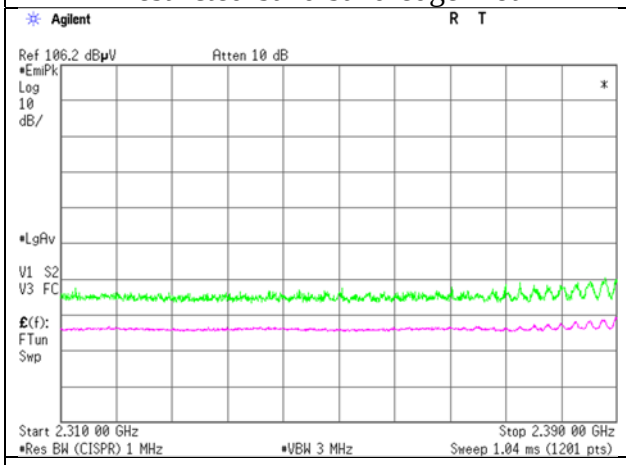
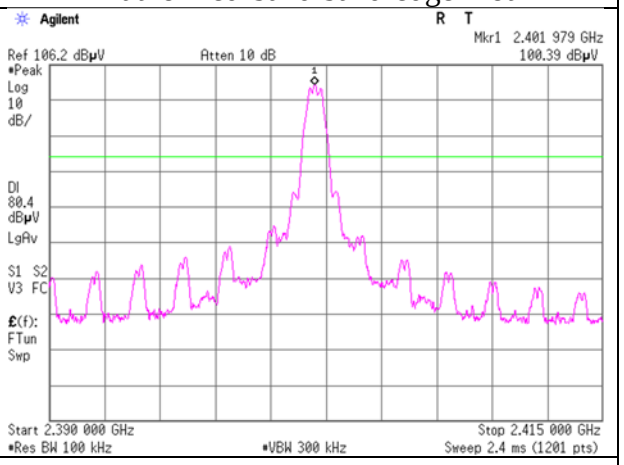
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amprifier)

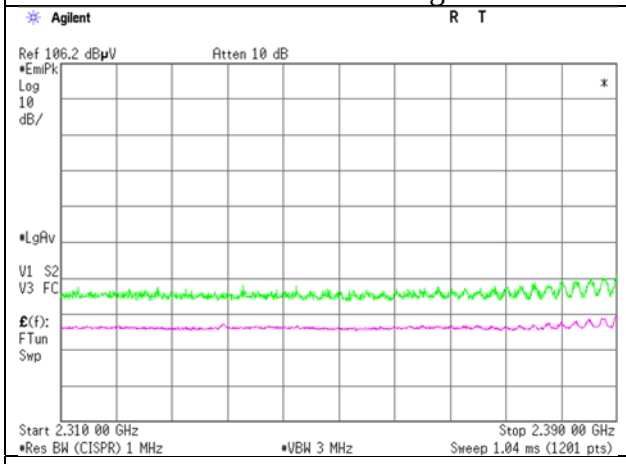
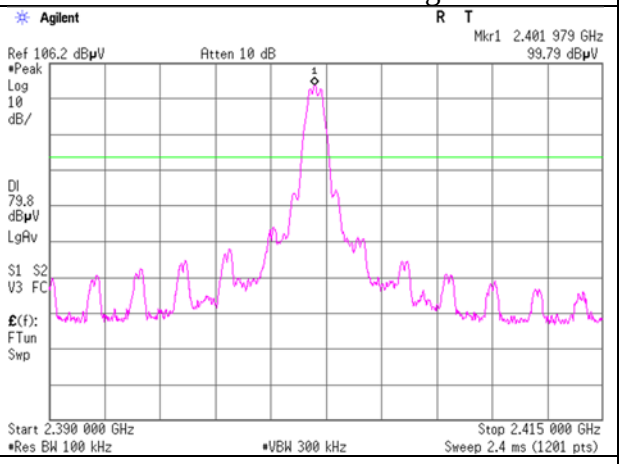
Distance factor: 1 GHz - 10 GHz 20log (3.7 m / 3.0 m) = 1.83 dB

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	No.4
Date	February 20, 2022	April 10, 2022
Temperature / Humidity	16 deg. C / 39 % RH	23 deg. C / 33 % RH
Engineer	Yuta Moriya	Sayaka Hara
	Authorized-band	Restricted-band
Mode	Tx BT LE 2402 MHz Uncoded 1M-PHY	

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 was shown in tabular data.

Radiated Spurious Emission

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	February 20, 2022
Temperature / Humidity	16 deg. C / 39 % RH
Engineer	Yuta Moriya
	(Above 1 GHz)
Mode	Tx BT LE 2440 MHz Uncoded 1M-PHY

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.	4880.0	43.8	33.2	31.5	6.2	34.4	-	47.1	36.6	73.9	53.9	26.8	17.3	Floor noise
Hori.	7320.0	43.7	33.6	36.0	7.2	34.4	-	52.5	42.4	73.9	53.9	21.4	11.5	Floor noise
Hori.	9760.0	44.0	33.7	39.1	8.0	35.0	-	56.0	45.8	73.9	53.9	17.9	8.1	Floor noise
Vert.	4880.0	43.7	33.2	31.5	6.2	34.4	-	47.0	36.6	73.9	53.9	26.9	17.4	Floor noise
Vert.	7320.0	44.0	33.6	36.0	7.2	34.4	-	52.8	42.4	73.9	53.9	21.1	11.5	Floor noise
Vert.	9760.0	43.7	33.7	39.1	8.0	35.0	-	55.7	45.8	73.9	53.9	18.2	8.1	Floor noise

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 (3.7 m / 3.0 m) = 1.83 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
Date	February 20, 2022
Temperature / Humidity	16 deg. C / 39 % RH
Engineer	Yuta Moriya
	(Above 1 GHz)
Mode	Tx BT LE 2480 MHz Uncoded 1M-PHY

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.	2483.5	52.6	43.6	27.5	4.3	35.0	1.7	49.4	42.0	73.9	53.9	24.6	11.9	*1)
Hori.	2484.0	55.7	41.4	27.5	4.3	35.0	1.7	52.5	39.8	73.9	53.9	21.4	14.1	
Hori.	4960.0	43.8	33.2	31.6	6.2	34.4	-	47.2	36.7	73.9	53.9	26.7	17.2	Floor noise
Hori.	7440.0	43.7	33.6	36.2	7.2	34.4	-	52.7	42.6	73.9	53.9	21.2	11.3	Floor noise
Hori.	9920.0	44.0	33.7	39.0	8.1	35.1	-	56.0	45.8	73.9	53.9	17.9	8.1	Floor noise
Vert.	2483.5	47.3	42.0	27.5	4.3	35.0	1.7	44.1	40.4	73.9	53.9	29.8	13.5	*1)
Vert.	2484.0	54.9	40.9	27.5	4.3	35.0	1.7	51.6	39.3	73.9	53.9	22.3	14.6	
Vert.	4960.0	43.7	33.2	31.6	6.2	34.4	-	47.1	36.6	73.9	53.9	26.8	17.3	Floor noise
Vert.	7440.0	43.8	33.6	36.2	7.2	34.4	-	52.8	42.6	73.9	53.9	21.1	11.3	Floor noise
Vert.	9920.0	43.9	33.7	39.0	8.1	35.1	-	55.9	45.8	73.9	53.9	18.0	8.1	Floor noise

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)

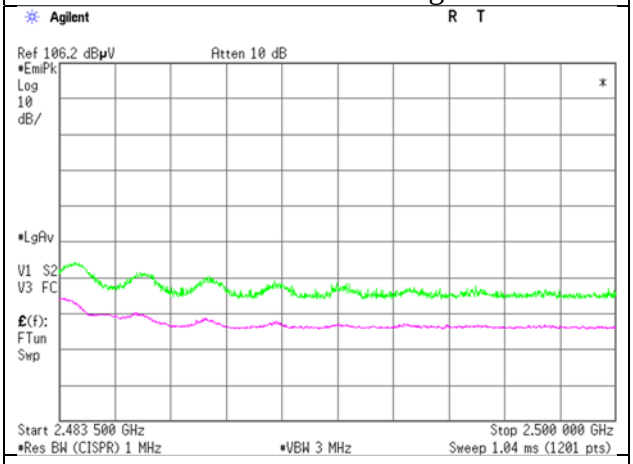
Distance factor:	1 GHz - 10 GHz	20log (3.7 m / 3.0 m) = 1.83 dB
	10 GHz - 26.5 GHz	20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	April 10, 2022
Temperature / Humidity	23 deg. C / 33 % RH
Engineer	Sayaka Hara
Mode	Tx BT LE 2480 MHz Uncoded 1M-PHY

Horizontal

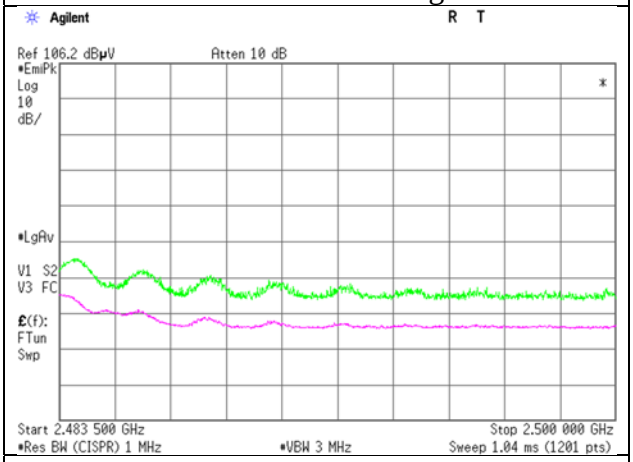
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot

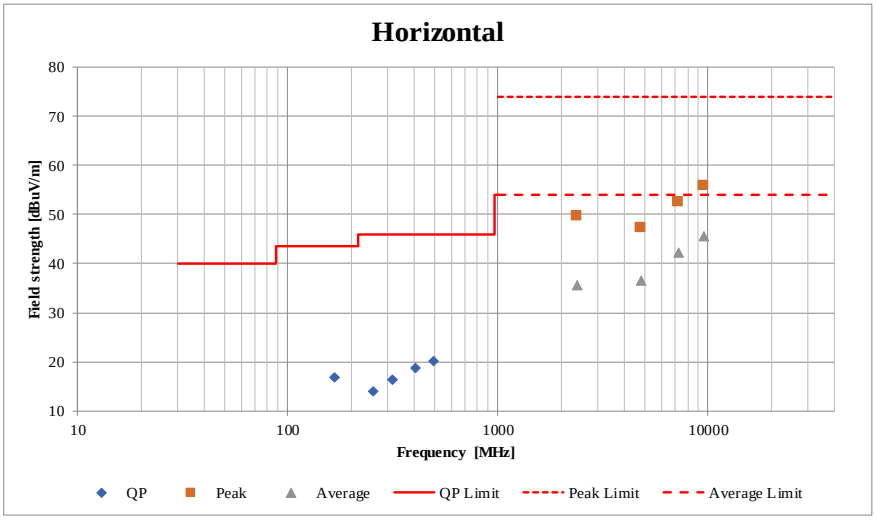


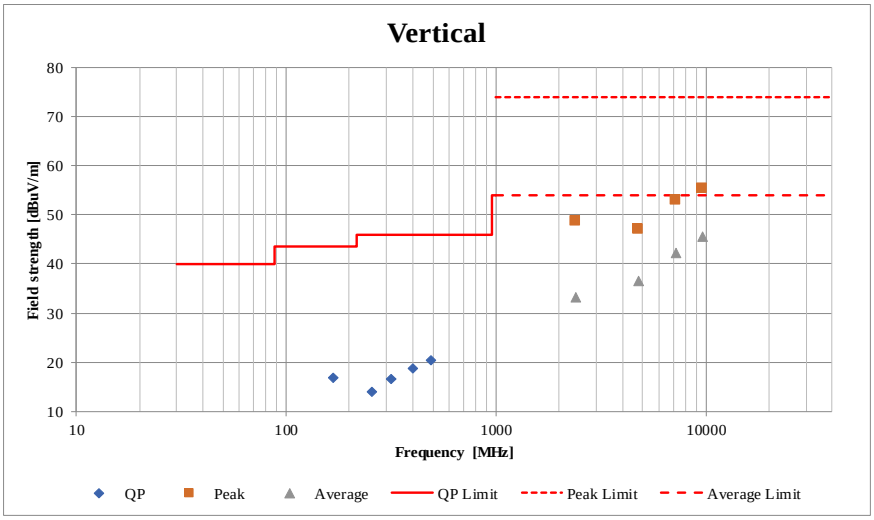
Trace Green : Peak Plot
Trace Purple : Average Plot

* 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
Date	February 20, 2022
Temperature / Humidity	16 deg. C / 39 % RH
Engineer	Yuta Moriya
Mode	Tx BT LE 2402 MHz Uncoded 1M-PHY





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

APPENDIX 2: Test Instruments

Test Equipment

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	MOS-41	192300	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0013	12/19/2021	12
RE	MMM-01	141542	Digital Tester	Fluke Corporation	FLUKE 26-3	78030611	08/10/2021	12
RE	MJM-27	142228	Measure	KOMELON	KMC-36	-	-	-
RE	COTS-MEMI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	MAEC-02-SVSWR	142006	AC2_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-06902	04/09/2021	24
RE	MAT-07	141203	Attenuator(6dB)	Weinschel Corp	2	BK7970	11/09/2021	12
RE	MBA-08	141427	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	VHA9103B+ BBA9106	08031	07/10/2021	12
RE	MCC-12	141317	Coaxial Cable	UL Japan, Inc.	-	-	09/06/2021	12
RE	MLA-21	141265	Logperiodic Antenna (200-1000MHz)	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	9111B-190	07/10/2021	12
RE	MPA-24	141594	Pre Amplifier	Keysight Technologies Inc	8447D	2944A10150	02/18/2021	12
RE	MTR-08	141949	Test Receiver	Rohde & Schwarz	ESCI	100767	08/05/2021	12
RE	MHA-06	141512	Horn Antenna 1-18GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	254	10/21/2021	12
RE	MCC-218	141394	Microwave Cable	Junkosha	MWX221	1607S141(1 m) / 1608S264(5 m)	09/30/2021	12
RE	MPA-10	141579	Pre Amplifier	Keysight Technologies Inc	8449B	3008A02142	02/18/2021	12
RE	MHF-06	141404	High Pass Filter 3.5-24GHz	TOKIMEC	TF323DCA	601	05/18/2021	12
RE	MOS-15	141562	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0010	01/10/2022	12
RE	MMM-10	141545	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	51201148	01/16/2022	12
RE	MJM-29	142230	Measure	KOMELON	KMC-36	-	-	-
RE	MAEC-04-SVSWR	142017	AC4_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-10005	04/12/2021	24
RE	MHA-21	141508	Horn Antenna 1-18GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	557	05/10/2021	12
RE	MPA-12	141581	MicroWave System Amplifier	Keysight Technologies Inc	83017A	00650	10/07/2021	12
RE	MCC-257	208936	Microwave Cable	Huber+Suhner	SF126E/11PC35/11PC35/1000M,5000M	537061/126E / 537076/126E	07/18/2021	12
RE	MSA-22	141978	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY46180899	03/24/2022	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