

RADIO TEST REPORT

Test Report No. 14964542H-A-R2

Customer	Fujitsu Component Limited
Description of EUT	Bluetooth Low Energy Enable Module
Model Number of EUT	FWM7BLZ23
FCC ID	SQK-7BLZ23
Test Regulation	FCC Part 15 Subpart C
Test Result	Complied
Issue Date	October 19, 2023
Remarks	-

Representative Test EngineerShousei Hamaguchi
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".

Report Cover Page - Form-ULID-003532 (DCS:13-EM-F0429) Issue# 22.0

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- The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan, Inc. has been accredited.
- 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.: 14964542H-A

This report is a revised version of 14964542H-A-R1. 14964542H-A-R1 is replaced with this report.

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	14964542H-A	October 6, 2023	-
1	14964542H-A-R1	October 18, 2023	Correction of Section 2.2 test date due to additional test From September 14 to 20, 2023 To September 14 to October 17, 2023
1	14964542H-A-R1	October 18, 2023	Deletion of the following sentence from clause 3.1; * Also the EUT complies with FCC Part 15 Subpart B.
1	14964542H-A-R1	October 18, 2023	Correction of the "FCC Part 15.31 (e)" and "FCC Part 15.203/212 Antenna requirement" in Clause 3.2
1	14964542H-A-R1	October 18, 2023	The following changes in Section 4.1 - Power setting value correction and *a) addition - the description of Maximum Peak Output Power correction and note *1) addition
1	14964542H-A-R1	October 18, 2023	Addition of the data for Power setting value: -20 dBm to "Maximum Peak Output Power" and "Average Output Power" tests
1	14964542H-A-R1	October 18, 2023	Addition of the Test Equipment due to additional test MCC-67, MPM-12, MPM-17
2	14964542H-A-R2	October 19, 2023	Addition of the reason for omitting 2 Mbps in Section 4.1. (for Conducted Emission, Radiated Spurious Emission (Below 1 GHz), and Conducted Spurious Emission tests)
2	14964542H-A-R2	October 19, 2023	Correction of the display digit number for Power setting value: -20dBm data of "Maximum Peak Output Power" and "Average Output Power" tests.

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	Fujitsu Component Limited
Address	Shinagawa Seaside Park Tower, 12-4, Higashi-shinagawa 4-chome, Shinagawa-ku, Tokyo, 140-8586, Japan
Telephone Number	+81-3-3450-1639
Contact Person	Koichi Nishizawa

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	Bluetooth Low Energy Enable Module
Model Number	FWM7BLZ23
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	September 8, 2023
Test Date	September 14 to October 17, 2023

2.2 Product Description

General Specification

Rating	DC 3.0 V (DC 1.7 V to DC 3.6 V)
Operating temperature	-40 deg. C to +85 deg. C

Radio Specification

Bluetooth (Low Energy)

Equipment Type	Transceiver
Frequency of Operation	2402 MHz to 2480 MHz
Type of Modulation	GFSK
Antenna Gain	-0.7 dBi

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
Conducted Emission	FCC: ANSI C63.10-2013 6. Standard test methods ISED: RSS-Gen 8.8	FCC: Section 15.207 ISED: RSS-Gen 8.8	12.33 dB, 3.73400 MHz, AV Phase N	Complied	-
6dB Bandwidth	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: -	FCC: Section 15.247(a)(2) ISED: RSS-247 5.2(a)	See data.	Complied	Conducted
Maximum Peak Output Power	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: RSS-Gen 6.12	FCC: Section 15.247(b)(3) ISED: RSS-247 5.4(d)		Complied	Conducted
Power Density	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: -	FCC: Section 15.247(e) ISED: RSS-247 5.2(b)		Complied	Conducted
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: RSS-Gen 6.13	FCC: Section 15.247(d) ISED: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	0.4 dB 7206.0 MHz, AV	Complied	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *1)
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)

The RF Module has its own regulator.

The RF Module is constantly provided with voltage through the regulator regardless of input voltage.
Therefore, this EUT complies with the requirement.

FCC Part 15.203/212 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

Item	Test Procedure	Specification	Worst Margin	Results	Remarks
99% Occupied Bandwidth	ISED: RSS-Gen 6.7	ISED: -	N/A	-	Conducted

Other than above, 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 $k = 2$.

Conducted emission

Item	Frequency Range	Unit	Calculated Uncertainty (+/-)
AMN (LISN)	0.009 MHz to 0.15 MHz	dB	3.7
	0.15 MHz to 30 MHz	dB	3.3

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		dB	4.9
	6 GHz to 18 GHz		dB	5.2
1 m	10 GHz to 26.5 GHz		dB	5.5
	26.5 GHz to 40 GHz		dB	5.4
10 m	1 GHz to 18 GHz		dB	5.3

Antenna Terminal Conducted Tests

Item	Unit	Calculated Uncertainty (+/-)
Antenna Terminated Conducted Emission / Power Density / Burst Power	dB	3.28
Adjacent Channel Power (ACP)	dB	2.27
Bandwidth (OBW)	%	0.96
Time Readout (Time span upto 100 msec)	%	0.11
Time Readout (Time span upto 1000 msec)	%	0.11
Time Readout (Time span upto 60 sec)	%	0.02
Power Measurement (Power meter)	dB	1.50
Frequency Readout (Frequency counter)	ppm	0.67
Frequency Readout (Spectrum analyzer frequency readout function)	ppm	1.61
Temperature (Constant temperature bath)	deg. C	0.78
Humidity (Constant temperature bath)	%RH	2.80
Modulation Characteristics	%	6.93
Frequency for Mobile	ppm	0.08

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	-	-

* Size of vertical conducting plane (for Conducted Emission test): 2.0 x 3.0 m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

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 (BT LE) Low Energy (LE) 1M-PHY - Uncoded PHY (1 Mbps) - Coded PHY (500 kbps) - Coded PHY (125 kbps)	Maximum Packet Size, PRBS9
Bluetooth (BT) Low Energy (LE) 2M-PHY - Uncoded PHY (2 Mbps)	Maximum Packet Size, PRBS9
*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: 8 dBm (all tests), -20 dBm (Maximum Peak Output Power test only) ^{*a)} Software: Direct Test Mode Version: 2.1.0 (Date: 2023.06.15, 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.	

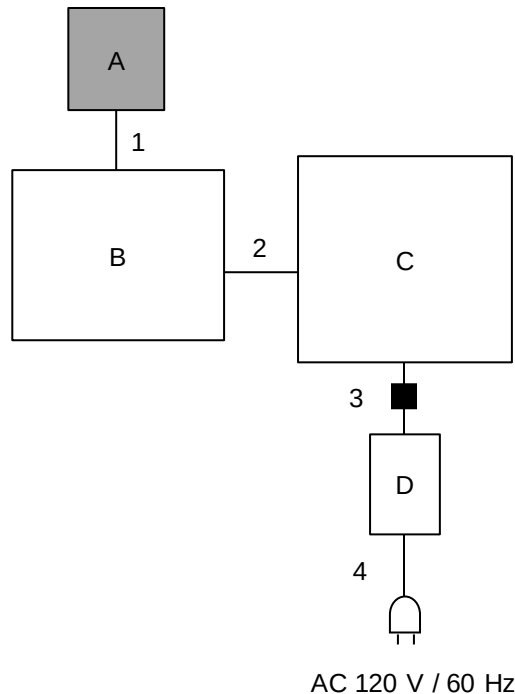
*a) All tests were performed with 8 dBm power setting as a representative which was the worst condition after having compared with other power settings.

*The Details of Operating Mode(s)

Test Item	Operating Mode	Tested Frequency
Maximum Peak Output Power	Tx BT LE 1M-PHY Uncoded PHY (1 Mbps) / 2M-PHY Uncoded PHY (2 Mbps)	2402 MHz 2440 MHz 2480 MHz
	1M-PHY Coded PHY (500 kbps) / 1M-PHY Coded PHY (125 kbps) /	2402 MHz*1)
Conducted Emission, Radiated Spurious Emission (Below 1 GHz), Conducted Spurious Emission	Tx BT LE 1M-PHY Uncoded PHY (1 Mbps) *2), *3)	2440 MHz
Radiated Spurious Emission (Above 1 GHz), 6dB Bandwidth, Power Density, 99% Occupied Bandwidth	Tx BT LE 1M-PHY Uncoded PHY (1 Mbps) *4) 2M-PHY Uncoded PHY (2 Mbps)	2402 MHz 2440 MHz 2480 MHz
*1) For comparison with Uncoded PHY (1 Mbps), Coded PHY (500 kbps) and Coded PHY (125 kbps) were tested only with the channel of 2402 MHz as representative. *2) Conducted emissions, Spurious emissions for frequencies below 1 GHz, and Conducted Spurious Emission 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. *3) After the comparison between 1M-PHY Uncoded PHY (1 Mbps), Coded PHY (125 kbps), Coded PHY (500 kbps) and 2M-PHY Uncoded PHY (2 Mbps) all tests were performed with the 1M-PHY Uncoded PHY (1 Mbps) that had higher power as a representative. *4) After the comparison between 1M-PHY Uncoded PHY (1 Mbps), Coded PHY (125 kbps) and Coded PHY (500 kbps) all tests were performed with the 1M-PHY Uncoded PHY (1 Mbps) that had higher power as a representative.		

4.2 Configuration and Peripherals

Conducted Spurious Emission / Radiated Spurious Emission tests



■ : Standard Ferrite Core (detachable)

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

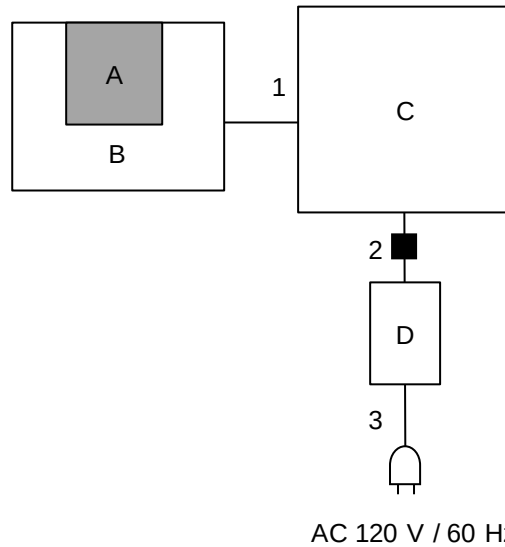
Description of EUT and Support Equipment

No.	Item	Model number	Serial Number	Manufacturer	Remarks
A	Bluetooth Low Energy Enable Module	FWM7BLZ23	8	Fujitsu Component Limited	EUT
B	Jig	-	-	Fujitsu Component Limited	-
C	Laptop PC	X1 Carbon	R9-OH8OBW 15/9	LENOVO	-
D	AC Adapter	ADXL45NCC2A	11S45N0299Z1ZS9 44B6KBR	LENOVO	-

List of Cables Used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Signal Cable	0.2	Unshielded	Unshielded	-
2	USB Cable	1.0	Shielded	Shielded	-
3	DC Cable	1.7	Unshielded	Unshielded	-
4	AC Cable	1.0	Unshielded	Unshielded	-

Antenna Terminal Conducted Tests



■ : Standard Ferrite Core (detachable)

* 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	Bluetooth Low Energy Enable Module	FWM7BLZ23	2	Fujitsu Component Limited	EUT
B	Jig	-	-	Fujitsu Component Limited	-
C	Laptop PC	X1 Carbon	R9-OH8OBW 15/9	LENOVO	-
D	AC Adapter	ADXL45NCC2A	11S45N0299Z1ZS9 44B6KBR	LENOVO	-

List of Cables Used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	USB Cable	1.0	Shielded	Shielded	-
2	DC Cable	1.7	Unshielded	Unshielded	-
3	AC Cable	1.0	Unshielded	Unshielded	-

SECTION 5: Conducted Emission

Test Procedure and Conditions

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

The rear of tabletop was located 40 cm to the vertical conducting plane. The rear of EUT, including peripherals was aligned and flushed with rear of tabletop. All other surfaces of tabletop were at least 80cm from any other grounded conducting surface. EUT was located 80 cm from a Line Impedance Stabilization Network (LISN) / Artificial mains Network (AMN) and excess AC cable was bundled in center.

For the tests on EUT with other peripherals (as a whole system)

I/O cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane. All unused 50ohm connectors of the LISN (AMN) were resistivity terminated in 50 ohm when not connected to the measuring equipment.

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a Semi Anechoic Chamber.

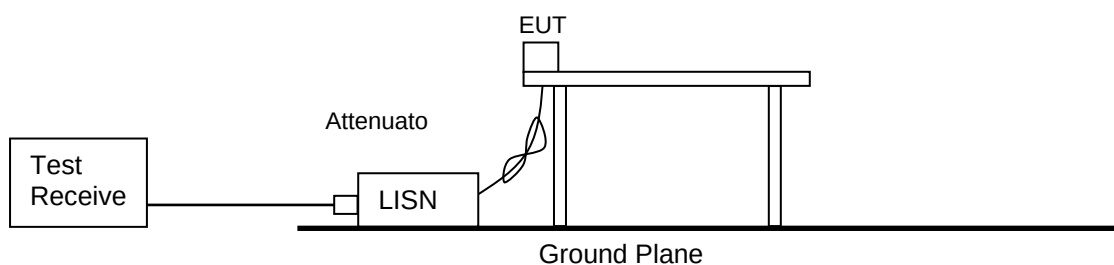
The EUT was connected to a LISN (Via AC adapter).

An overview sweep with peak detection has been performed.

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

Detector	: QP and CISPR AV
Measurement Range	: 0.15 MHz to 30 MHz
Test Data	: APPENDIX
Test Result	: Pass

Figure 1: Test Setup



SECTION 6: 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, 1.0 m by 1.5 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	Below 30 MHz	30 MHz to 200 MHz	200 MHz to 1 GHz	Above 1 GHz
Antenna Type	Loop	Biconical	Logperiodic	Horn

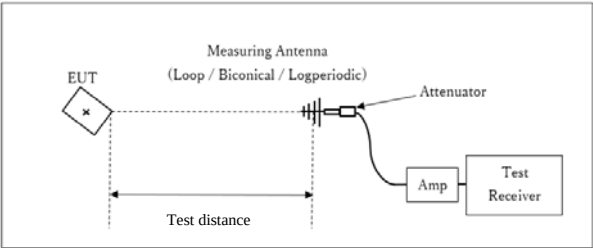
In any 100 kHz bandwidth outside the restricted band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired 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	<u>11.12.2.5.1</u> RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (RMS) Trace: 100 traces <u>11.12.2.5.2</u> 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

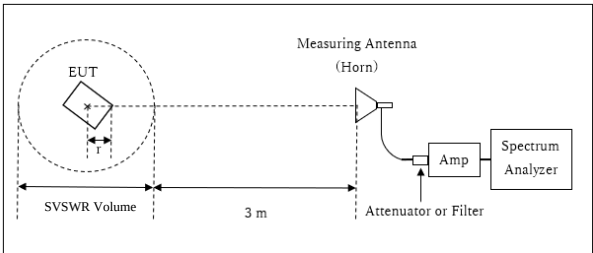
Below 1 GHz



x : Center of turn table

Test Distance: 3 m

1 GHz to 10 GHz



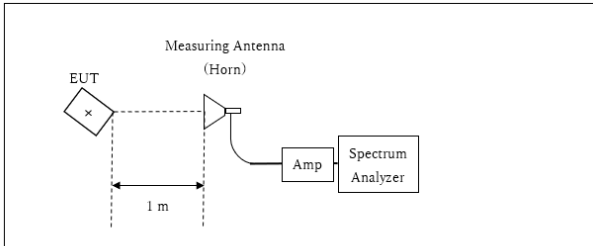
r : Radius of an outer periphery of EUT
x : Center of turn table

Distance Factor: $20 \times \log (4.0 \text{ m} / 3.0 \text{ m}) = 2.50 \text{ dB}$
* Test Distance: $(3 + \text{SVSWR Volume} / 2) - r = 4.0 \text{ m}$

SVSWR Volume : 2.0 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
 $r = 0.0 \text{ m}$

* The test was performed with $r = 0.0 \text{ m}$ since EUT is small and it was the rather conservative condition.

10 GHz to 26.5 GHz



x : Center of turn table

Distance Factor: $20 \times \log (1.0 \text{ m} / 3.0 \text{ m}) = -9.5 \text{ dB}$
*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

SECTION 7: Antenna Terminal Conducted Tests

Test Procedure

The tests were made with below setting connected to the antenna port.

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument Used
6dB Bandwidth	3 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99% Occupied Bandwidth *1)	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak/ Average *2)	-	Power Meter (Sensor: 50 MHz BW)
Peak Power Density	1.5 times the 6dB Bandwidth	3 kHz	10 kHz	Auto	Peak	Max Hold	Spectrum Analyzer *3)
Conducted Spurious Emission *4) *5)	9 kHz to 150 kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150 kHz to 30 MHz	9.1 kHz	27 kHz				

*1) Peak hold was applied as Worst-case measurement.

*2) Reference data

*3) Section 11.10.2 Method PKPSD (peak PSD) of "ANSI C63.10-2013".

*4) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents.

Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart.

(9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 10 kHz)

*5) The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377 Ohms. For example, the measurement at frequency 9 kHz resulted in a level of 45.5 dBuV/m, which is equivalent to $45.5 - 51.5 = -6.0$ dBuA/m, which has the same margin, 3 dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

The test results and limit are rounded off to two decimals place, so some differences might be observed.
The equipment and cables were not used for factor 0 dB of the data sheets.

Test Data : APPENDIX

Test Result : Pass

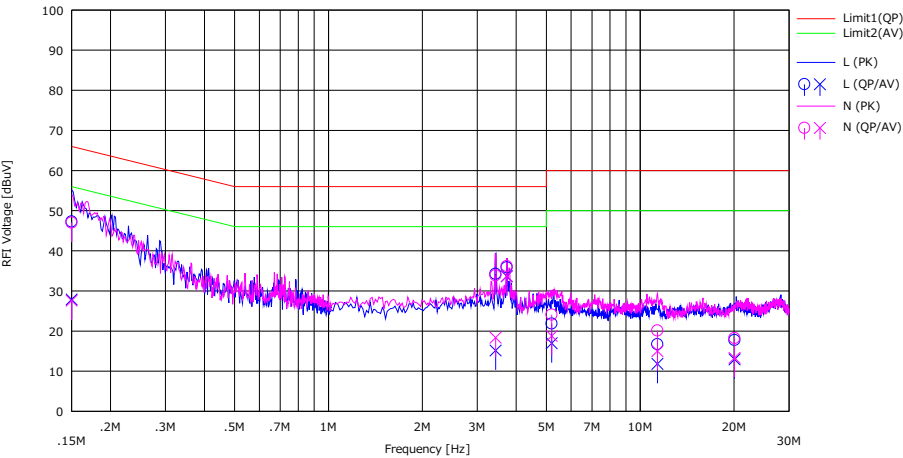
APPENDIX 1: Test Data

Conducted Emission

Test place
Date
Temperature / Humidity
Engineer
Mode

Ise EMC Lab. No.3 Semi Anechoic Chamber
September 20, 2023
23 deg. C / 65 % RH
Takafumi Noguchi
Tx BT LE 1M-PHY 2440 MHz

Limit : FCC_Part 15 Subpart C(15.207)

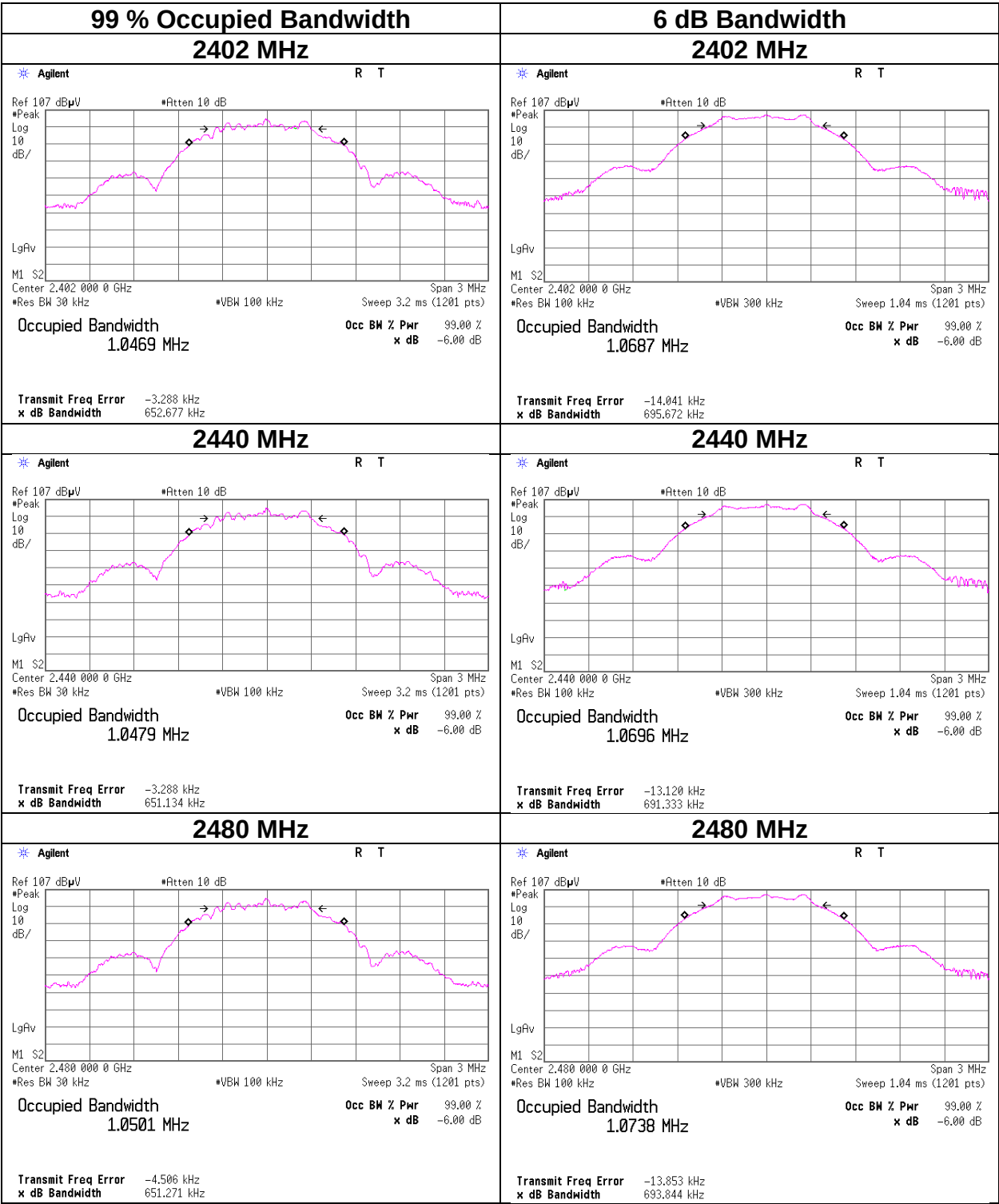


No.	Freq. [MHz]	Reading		LISN	LOSS	Results		Limit		Margin		Phase	Comment
		(QP)	(AV)			(QP)	(AV)	(QP)	(AV)	(QP)	(AV)		
		[dBuV]	[dBuV]			[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.15000	34.10	14.70	0.03	13.13	47.26	27.86	66.00	56.00	18.74	28.14	L	
2	3.43760	20.80	1.70	0.09	13.35	34.24	15.14	56.00	46.00	21.76	30.86	L	
3	3.73400	22.40	20.20	0.10	13.36	35.86	33.66	56.00	46.00	20.14	12.34	L	
4	5.20100	8.30	3.40	0.13	13.43	21.86	16.96	60.00	50.00	38.14	33.04	L	
5	11.35740	2.80	-2.10	0.29	13.62	16.71	11.81	60.00	50.00	43.29	38.19	L	
6	20.07800	3.50	-1.30	0.42	13.83	17.75	12.95	60.00	50.00	42.25	37.05	L	
7	0.15000	33.80	14.40	0.06	13.13	46.99	27.59	66.00	56.00	19.01	28.41	N	
8	3.43760	20.40	4.90	0.11	13.35	33.86	18.36	56.00	46.00	22.14	27.64	N	
9	3.73400	22.70	20.20	0.11	13.36	36.17	33.67	56.00	46.00	19.83	12.33	N	
10	5.20012	10.50	5.20	0.14	13.43	24.07	18.77	60.00	50.00	35.93	31.23	N	
11	11.35728	6.20	1.10	0.29	13.62	20.11	15.01	60.00	50.00	39.89	34.99	N	
12	20.07916	4.00	-0.90	0.39	13.83	18.22	13.32	60.00	50.00	41.78	36.68	N	

CHART: WITH FACTOR Peak hold data. CALCULATION : RESULT = READING + LISN + LOSS (CABLE + ATT)
Except for the above table: adequate margin data below the limits.

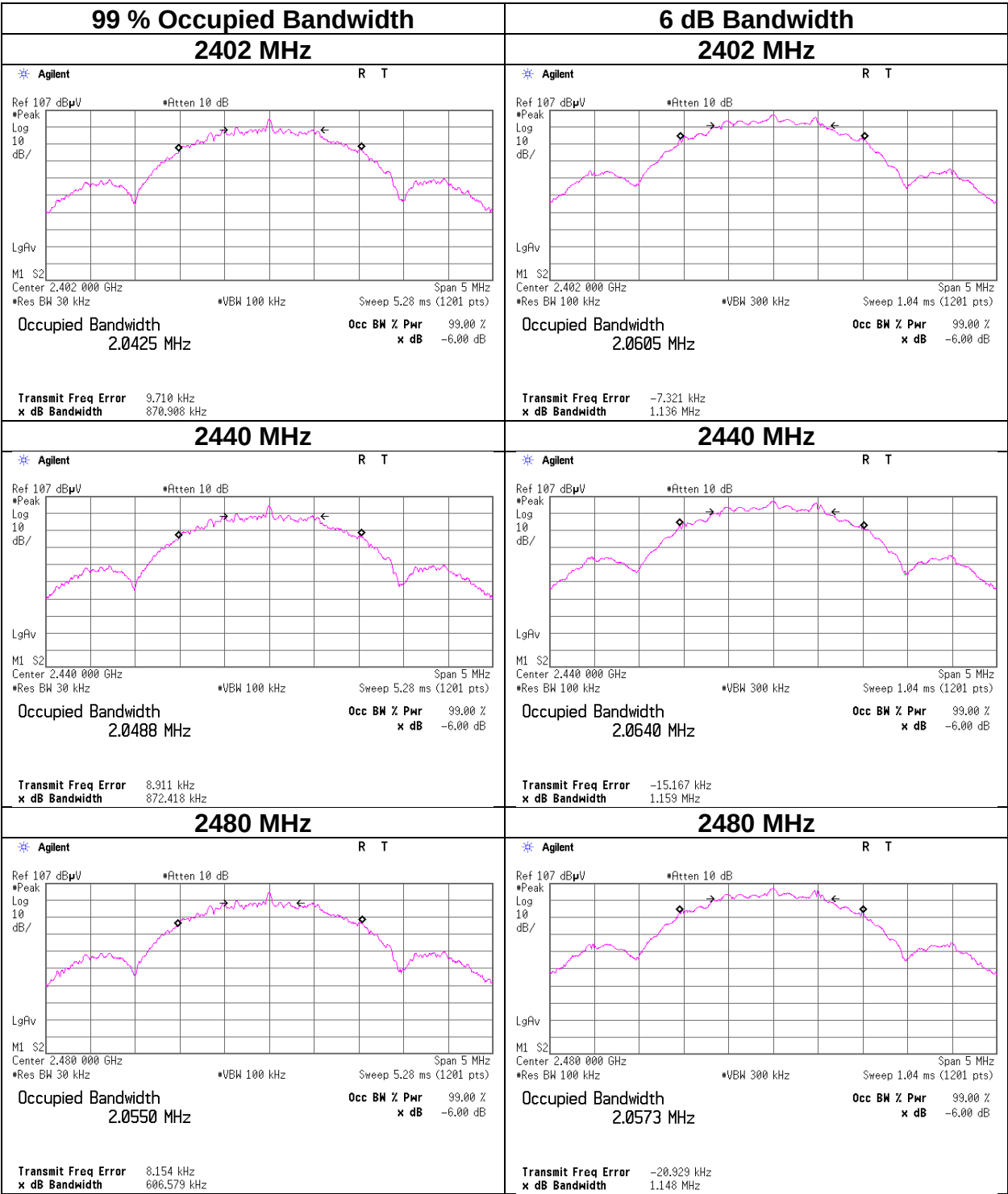
99 % Occupied Bandwidth and 6 dB Bandwidth

1M-PHY



99 % Occupied Bandwidth and 6 dB Bandwidth

2M-PHY



Maximum Peak Output Power

Test place
Date
Temperature / Humidity
Engineer
Mode

Ise EMC Lab. No.6 Measurement Room
September 14, 2023
23 deg. C / 47 % RH
Shousei Hamaguchi
Tx BT LE

October 17, 2023
23 deg. C / 51 % RH
Nachi Konegawa

Setting value 8 dBm

1M-PHY Uncoded PHY (1 Mbps)				Conducted Power					e.i.r.p. for RSS-247				
Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]	Antenna Gain [dBi]	Result		Limit	
				[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]
2402	-3.02	1.18	9.74	7.90	6.17	30.00	1000	22.10	-0.70	7.20	5.25	36.02	4000
2440	-3.03	1.19	9.75	7.91	6.18	30.00	1000	22.09	-0.70	7.21	5.26	36.02	4000
2480	-3.07	1.20	9.75	7.88	6.14	30.00	1000	22.12	-0.70	7.18	5.22	36.02	4000

1M-PHY Coded PHY (500 kbps)				Conducted Power					e.i.r.p. for RSS-247				
Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]	Antenna Gain [dBi]	Result		Limit	
				[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]
2402	-3.03	1.18	9.74	7.89	6.15	30.00	1000	22.11	-0.70	7.19	5.24	36.02	4000

1M-PHY Coded PHY (125 kbps)				Conducted Power					e.i.r.p. for RSS-247				
Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]	Antenna Gain [dBi]	Result		Limit	
				[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]
2402	-3.03	1.18	9.74	7.89	6.15	30.00	1000	22.11	-0.70	7.19	5.24	36.02	4000

2M-PHY Uncoded PHY (2 Mbps)				Conducted Power					e.i.r.p. for RSS-247				
Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]	Antenna Gain [dBi]	Result		Limit	
				[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]
2402	-3.03	1.18	9.74	7.89	6.15	30.00	1000	22.11	-0.70	7.19	5.24	36.02	4000
2440	-3.04	1.19	9.75	7.90	6.17	30.00	1000	22.10	-0.70	7.20	5.25	36.02	4000
2480	-3.08	1.20	9.75	7.87	6.12	30.00	1000	22.13	-0.70	7.17	5.21	36.02	4000

Sample Calculation:

Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

e.i.r.p. Result = Conducted Power Result + Antenna Gain

Setting value -20 dBm

1M-PHY Uncoded PHY (1 Mbps)				Conducted Power					e.i.r.p. for RSS-247				
Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]	Antenna Gain [dBi]	Result		Limit	
				[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]
2402	-18.54	1.65	0.00	-16.89	0.020	30.00	1000	46.89	-0.70	-17.59	0.017	36.02	4000
2440	-18.83	1.66	0.00	-17.17	0.019	30.00	1000	47.17	-0.70	-17.87	0.016	36.02	4000
2480	-18.90	1.67	0.00	-17.23	0.019	30.00	1000	47.23	-0.70	-17.93	0.016	36.02	4000

1M-PHY Coded PHY (500 kbps)				Conducted Power					e.i.r.p. for RSS-247				
Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]	Antenna Gain [dBi]	Result		Limit	
				[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]
2402	-18.63	1.65	0.00	-16.98	0.020	30.00	1000	46.98	-0.70	-17.68	0.017	36.02	4000

1M-PHY Coded PHY (125 kbps)				Conducted Power					e.i.r.p. for RSS-247				
Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]	Antenna Gain [dBi]	Result		Limit	
				[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]
2402	-18.65	1.65	0.00	-17.00	0.020	30.00	1000	47.00	-0.70	-17.70	0.017	36.02	4000

2M-PHY Uncoded PHY (2 Mbps)				Conducted Power					e.i.r.p. for RSS-247				
Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]	Antenna Gain [dBi]	Result		Limit	
				[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]
2402	-18.63	1.65	0.00	-16.98	0.020	30.00	1000	46.98	-0.70	-17.68	0.017	36.02	4000
2440	-18.82	1.66	0.00	-17.16	0.019	30.00	1000	47.16	-0.70	-17.86	0.016	36.02	4000
2480	-19.01	1.67	0.00	-17.34	0.018	30.00	1000	47.34	-0.70	-18.04	0.016	36.02	4000

Sample Calculation:

Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

e.i.r.p. Result = Conducted Power Result + Antenna Gain

Average Output Power (Reference data for RF Exposure)

Test place	Ise EMC Lab. No.6 Measurement Room	
Date	September 14, 2023	October 17, 2023
Temperature / Humidity	23 deg. C / 47 % RH	23 deg. C / 51 % RH
Engineer	Shousei Hamaguchi	Nachi Konegawa
Mode	Tx BT LE	

Setting value 8 dBm

1M-PHY

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2402	-3.82	1.18	9.74	7.10	5.13	0.67	7.77	5.98
2440	-3.83	1.19	9.75	7.11	5.14	0.67	7.78	6.00
2480	-3.90	1.20	9.75	7.05	5.07	0.67	7.72	5.92

2M-PHY

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2402	-5.55	1.18	9.74	5.37	3.44	2.39	7.76	5.97
2440	-5.56	1.19	9.75	5.38	3.45	2.39	7.77	5.98
2480	-5.60	1.20	9.75	5.35	3.43	2.39	7.74	5.94

Sample Calculation:

Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

Result (Burst power average) = Time average + Duty factor

Setting value -20 dBm

1M-PHY

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2402	-22.22	1.65	0.00	-20.57	0.009	0.67	-19.90	0.010
2440	-23.64	1.66	0.00	-21.98	0.006	0.67	-21.31	0.007
2480	-23.94	1.67	0.00	-22.27	0.006	0.67	-21.60	0.007

2M-PHY

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2402	-26.01	1.65	0.00	-24.36	0.004	2.39	-21.97	0.006
2440	-26.44	1.66	0.00	-24.78	0.003	2.39	-22.39	0.006
2480	-26.74	1.67	0.00	-25.07	0.003	2.39	-22.68	0.005

Sample Calculation:

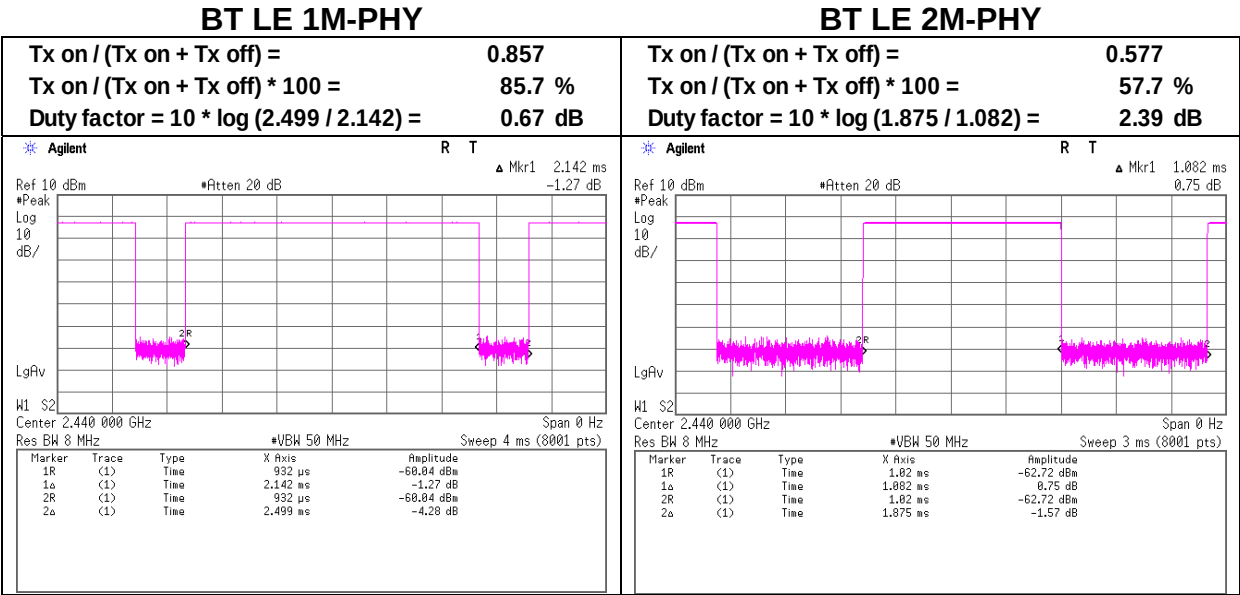
Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

Result (Burst power average) = Time average + Duty factor

Burst rate confirmation

Test place
Date
Temperature / Humidity
Engineer
Mode

Ise EMC Lab. No.6 Measurement Room
September 14, 2023
23 deg. C / 47 % RH
Shousei Hamaguchi
Tx BT LE



* 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.3	No.3
Date	September 19, 2023	September 19, 2023
Temperature / Humidity	23 deg. C / 60 % RH	23 deg. C / 60 % RH
Engineer	Nachi Konegawa	Takafumi Noguchi
	(1 GHz to 10 GHz)	(Above 10 GHz)
Mode	Tx BT LE 1M-PHY 2402 MHz	

Polarity	Frequency	Reading (QP / PK)	Reading (AV)	Ant. Factor	Loss	Gain	Duty Factor	Result (QP / PK)	Result (AV)	Limit (QP / PK)	Limit (AV)	Margin (QP / PK)	Margin (AV)	Remark
[Hori/Vert]	[MHz]	[dBuV]	[dBuV]	[dB/m]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dB]	[dB]	
Hori.	2338.0	53.0	49.5	27.9	5.4	32.4	0.7	53.8	51.1	73.9	53.9	20.1	2.8	
Hori.	2390.0	43.9	35.2	27.7	5.5	32.4	0.7	44.6	36.6	73.9	53.9	29.3	17.3	
Hori.	4804.0	43.9	35.2	31.5	7.6	31.4	0.7	51.5	43.5	73.9	53.9	22.4	10.4	
Hori.	7206.0	46.6	39.9	35.8	8.8	32.3	0.7	58.9	52.9	73.9	53.9	15.0	1.0	
Hori.	9608.0	43.1	32.8	38.8	9.3	32.9	-	58.2	47.9	73.9	53.9	15.7	6.0	
Vert.	2338.0	51.6	48.4	27.9	5.4	32.4	0.7	52.5	50.0	73.9	53.9	21.4	3.9	
Vert.	2390.0	44.1	35.6	27.7	5.5	32.4	0.7	44.8	37.0	73.9	53.9	29.1	16.9	
Vert.	4804.0	44.8	37.2	31.5	7.6	31.4	0.7	52.5	45.5	73.9	53.9	21.4	8.4	
Vert.	7206.0	47.8	40.5	35.8	8.8	32.3	0.7	60.1	53.5	73.9	53.9	13.8	0.4	
Vert.	9608.0	43.1	32.8	38.8	9.3	32.9	-	58.2	47.9	73.9	53.9	15.7	6.0	

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.

*1) Not Out of Band emission(Leakage Power)

20dBc Data Sheet

Polarity	Frequency	Reading (PK)	Ant Factor	Loss	Gain	Result	Limit	Margin	Remark
[Hori/Vert]	[MHz]	[dBuV]	[dB/m]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	
Hori.	2402.0	101.3	27.6	5.5	32.4	102.0	-	-	Carrier
Hori.	2400.0	49.8	27.6	5.5	32.4	50.5	82.0	31.5	
Vert.	2402.0	100.7	27.6	5.5	32.4	101.4	-	-	Carrier
Vert.	2400.0	49.4	27.6	5.5	32.4	50.1	81.4	31.3	

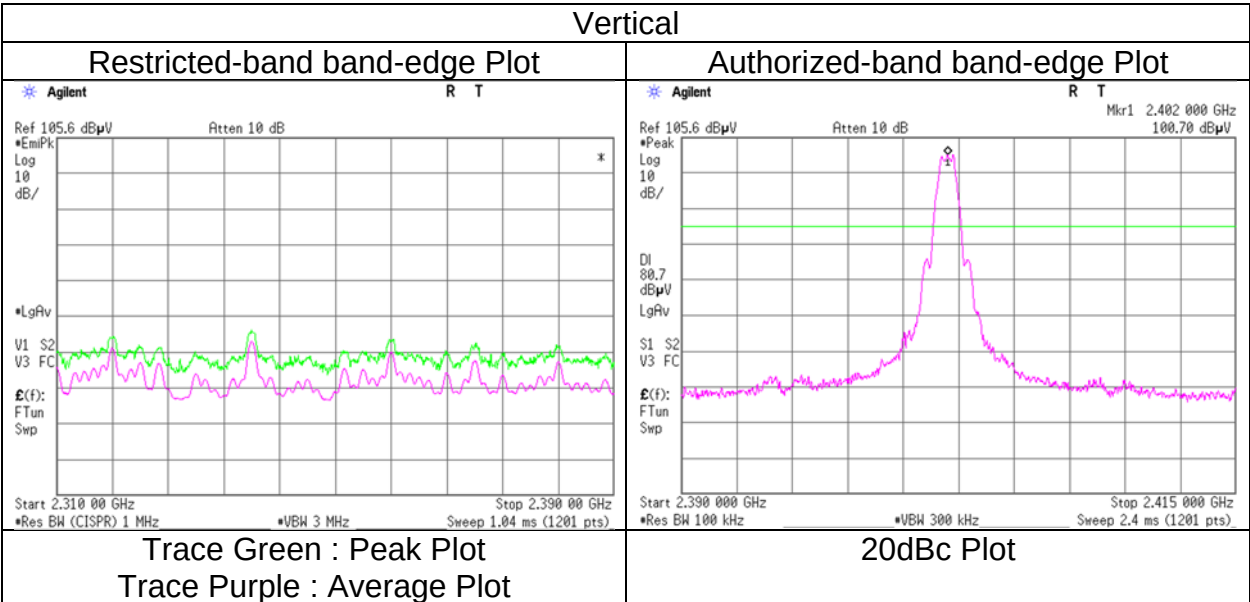
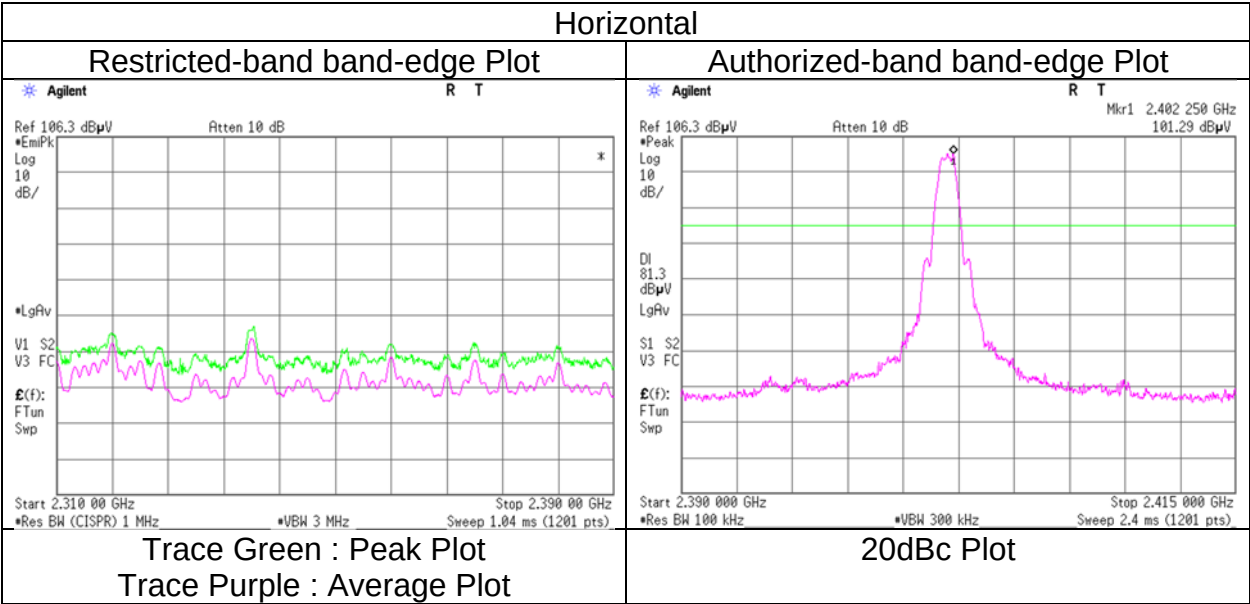
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)

Distance factor: 1 GHz - 10 GHz 20log (4 m / 3.0 m) = 2.5 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.3
Date	September 19, 2023
Temperature / Humidity	23 deg. C / 60 % RH
Engineer	Nachi Konegawa
	(1 GHz to 10 GHz)
Mode	Tx BT LE 1M-PHY 2402 MHz



* 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.3	No.3	No.3
Date	September 19, 2023	September 19, 2023	September 20, 2023
Temperature / Humidity	23 deg. C / 60 % RH	23 deg. C / 60 % RH	23 deg. C / 65 % RH
Engineer	Nachi Konegawa	Takafumi Noguchi	Nachi Konegawa
	(1 GHz to 10 GHz)	(Above 10 GHz)	(Below 1 GHz)
Mode	Tx BT LE 1M-PHY 2440 MHz		

Polarity	Frequency	Reading (QP / PK)	Reading (AV)	Ant. Factor	Loss	Gain	Duty Factor	Result (QP / PK)	Result (AV)	Limit (QP / PK)	Limit (AV)	Margin (QP / PK)	Margin (AV)	Remark
[Hori/Vert]	[MHz]	[dBuV]	[dBuV]	[dB/m]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dB]	[dB]	
Hori.	45.0	36.8	-	13.0	7.2	32.2	-	24.8	-	40.0	-	15.2	-	
Hori.	69.7	43.6	-	6.4	7.5	32.2	-	25.4	-	40.0	-	14.6	-	
Hori.	120.0	47.4	-	12.9	8.1	32.1	-	36.3	-	43.5	-	7.2	-	
Hori.	144.0	41.7	-	14.7	8.4	32.1	-	32.7	-	43.5	-	10.9	-	
Hori.	300.0	43.1	-	13.5	9.7	32.0	-	34.3	-	46.0	-	11.7	-	
Hori.	456.0	37.0	-	16.7	10.7	32.0	-	32.4	-	46.0	-	13.6	-	
Hori.	2375.8	53.8	50.4	27.7	5.5	32.4	0.7	54.6	51.9	73.9	53.9	19.3	2.0	
Hori.	4880.0	42.3	34.2	31.5	7.6	31.4	0.7	50.0	42.6	73.9	53.9	23.9	11.3	
Hori.	7320.0	46.7	39.8	36.0	8.8	32.3	0.7	59.2	52.9	73.9	53.9	14.7	1.0	
Hori.	9760.0	42.9	32.4	39.1	9.3	33.0	-	58.3	47.8	73.9	53.9	15.6	6.1	Floor noise
Vert.	45.0	46.8	-	13.0	7.2	32.2	-	34.8	-	40.0	-	5.2	-	
Vert.	69.7	48.8	-	6.4	7.5	32.2	-	30.6	-	40.0	-	9.4	-	
Vert.	120.0	42.4	-	12.9	8.1	32.1	-	31.3	-	43.5	-	12.2	-	
Vert.	144.0	31.8	-	14.7	8.4	32.1	-	22.8	-	43.5	-	20.8	-	
Vert.	300.0	33.4	-	13.5	9.7	32.0	-	24.6	-	46.0	-	21.4	-	
Vert.	444.0	35.0	-	16.4	10.6	32.0	-	30.0	-	46.0	-	16.0	-	
Vert.	2375.8	52.3	48.4	27.7	5.5	32.4	0.7	53.1	49.8	73.9	53.9	20.8	4.1	
Vert.	4880.0	42.1	34.5	31.5	7.6	31.4	0.7	49.8	42.8	73.9	53.9	24.1	11.1	
Vert.	7320.0	46.9	40.0	36.0	8.8	32.3	0.7	59.4	53.1	73.9	53.9	14.5	0.8	
Vert.	9760.0	42.9	32.4	39.1	9.3	33.0	-	58.3	47.8	73.9	53.9	15.6	6.1	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 (4 m / 3.0 m) = 2.5 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.3	No.3
Date	September 19, 2023	September 19, 2023
Temperature / Humidity	23 deg. C / 60 % RH	23 deg. C / 60 % RH
Engineer	Nachi Konegawa	Takafumi Noguchi
	(1 GHz to 10 GHz)	(Above 10 GHz)
Mode	Tx BT LE 1M-PHY 2480 MHz	

Polarity	Frequency	Reading (QP / PK)	Reading (AV)	Ant. Factor	Loss	Gain	Duty Factor	Result (QP / PK)	Result (AV)	Limit (QP / PK)	Limit (AV)	Margin (QP / PK)	Margin (AV)	Remark
[Hori/Vert]	[MHz]	[dBuV]	[dBuV]	[dB/m]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dB]	[dB]	
Hori.	2372.0	54.1	50.8	27.7	5.5	32.4	0.7	54.9	52.3	73.9	53.9	19.0	1.7	*1)
Hori.	2483.5	49.5	37.4	27.5	5.5	32.4	0.7	50.2	38.7	73.9	53.9	23.7	15.2	
Hori.	4960.0	44.0	36.3	31.6	7.6	31.4	0.7	51.8	44.8	73.9	53.9	22.1	9.1	
Hori.	7440.0	46.5	39.2	36.2	8.8	32.4	0.7	59.1	52.5	73.9	53.9	14.8	1.4	
Hori.	9920.0	43.6	35.1	39.1	9.3	33.1	0.7	59.0	51.2	73.9	53.9	14.9	2.7	
Vert.	2372.0	53.3	47.7	27.7	5.5	32.4	0.7	54.0	49.1	73.9	53.9	19.9	4.8	*1)
Vert.	2483.5	48.4	36.5	27.5	5.5	32.4	0.7	49.1	37.9	73.9	53.9	24.8	16.0	
Vert.	4960.0	43.6	35.5	31.6	7.6	31.4	0.7	51.4	44.0	73.9	53.9	22.5	9.9	
Vert.	7440.0	47.0	39.6	36.2	8.8	32.4	0.7	59.6	52.9	73.9	53.9	14.3	1.0	
Vert.	9920.0	44.4	36.8	39.1	9.3	33.1	0.7	59.8	52.8	73.9	53.9	14.2	1.1	

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)

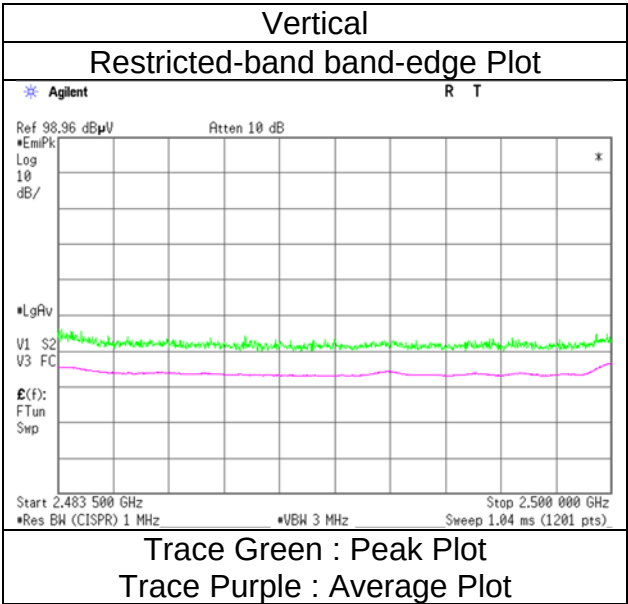
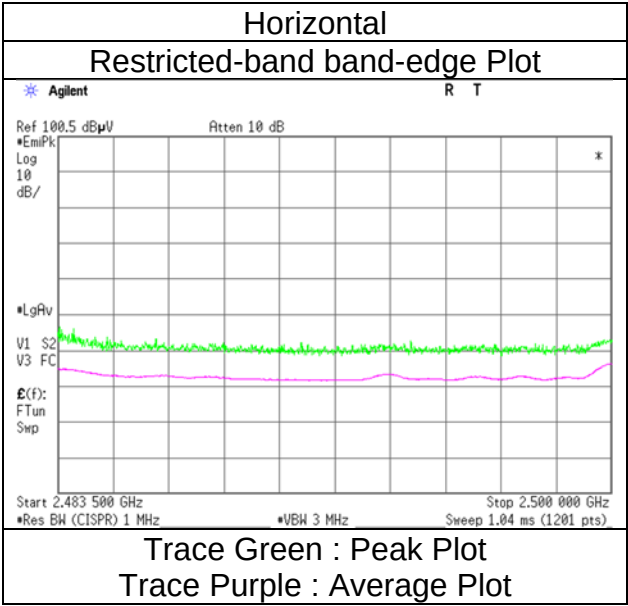
Distance factor:	1 GHz - 10 GHz	20log (4 m / 3.0 m) = 2.5 dB
	10 GHz - 26.5 GHz	20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place
Semi Anechoic Chamber
Date
Temperature / Humidity
Engineer

Mode

Ise EMC Lab.
No.3
September 19, 2023
23 deg. C / 60 % RH
Nachi Konegawa
(1 GHz to 10 GHz)
Tx BT LE 1M-PHY 2480 MHz



* 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.3	No.3
Date	September 19, 2023	September 19, 2023
Temperature / Humidity	23 deg. C / 60 % RH	23 deg. C / 60 % RH
Engineer	Nachi Konegawa	Takafumi Noguchi
	(1 GHz to 10 GHz)	(Above 10 GHz)
Mode	Tx BT LE 2M-PHY 2402 MHz	

Polarity	Frequency	Reading (QP / PK)	Reading (AV)	Ant. Factor	Loss	Gain	Duty Factor	Result (QP / PK)	Result (AV)	Limit (QP / PK)	Limit (AV)	Margin (QP / PK)	Margin (AV)	Remark
[Hori/Vert]	[MHz]	[dBuV]	[dBuV]	[dB/m]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dB]	[dB]	
Hori.	2338.0	51.7	46.7	27.9	5.4	32.4	2.4	52.5	50.0	73.9	53.9	21.4	3.9	
Hori.	2390.0	45.8	36.4	27.7	5.5	32.4	2.4	46.5	39.5	73.9	53.9	27.4	14.4	
Hori.	4804.0	42.3	33.9	31.5	7.6	31.4	2.4	49.9	44.0	73.9	53.9	24.0	10.0	
Hori.	7206.0	46.4	38.4	35.8	8.8	32.3	2.4	58.8	53.1	73.9	53.9	15.2	0.8	
Hori.	9608.0	43.1	32.8	38.8	9.3	32.9	-	58.2	47.9	73.9	53.9	15.7	6.0	
Vert.	2338.0	51.6	45.7	27.9	5.4	32.4	2.4	52.5	49.0	73.9	53.9	21.4	4.9	
Vert.	2390.0	45.6	36.2	27.7	5.5	32.4	2.4	46.3	39.3	73.9	53.9	27.6	14.6	
Vert.	4804.0	43.0	35.0	31.5	7.6	31.4	2.4	50.6	45.0	73.9	53.9	23.3	8.9	
Vert.	7206.0	46.5	38.4	35.8	8.8	32.3	2.4	58.8	53.2	73.9	53.9	15.1	0.7	
Vert.	9608.0	43.1	32.8	38.8	9.3	32.9	-	58.2	47.9	73.9	53.9	15.7	6.0	

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.

*1) Not Out of Band emission(Leakage Power)

20dBc Data Sheet

Polarity	Frequency	Reading (PK)	Ant Factor	Loss	Gain	Result	Limit	Margin	Remark
[Hori/Vert]	[MHz]	[dBuV]	[dB/m]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	
Hori.	2402.0	100.8	27.6	5.5	32.4	101.5	-	-	Carrier
Hori.	2400.0	68.4	27.6	5.5	32.4	69.1	81.5	12.4	
Vert.	2402.0	100.5	27.6	5.5	32.4	101.2	-	-	Carrier
Vert.	2400.0	68.4	27.6	5.5	32.4	69.1	81.2	12.1	

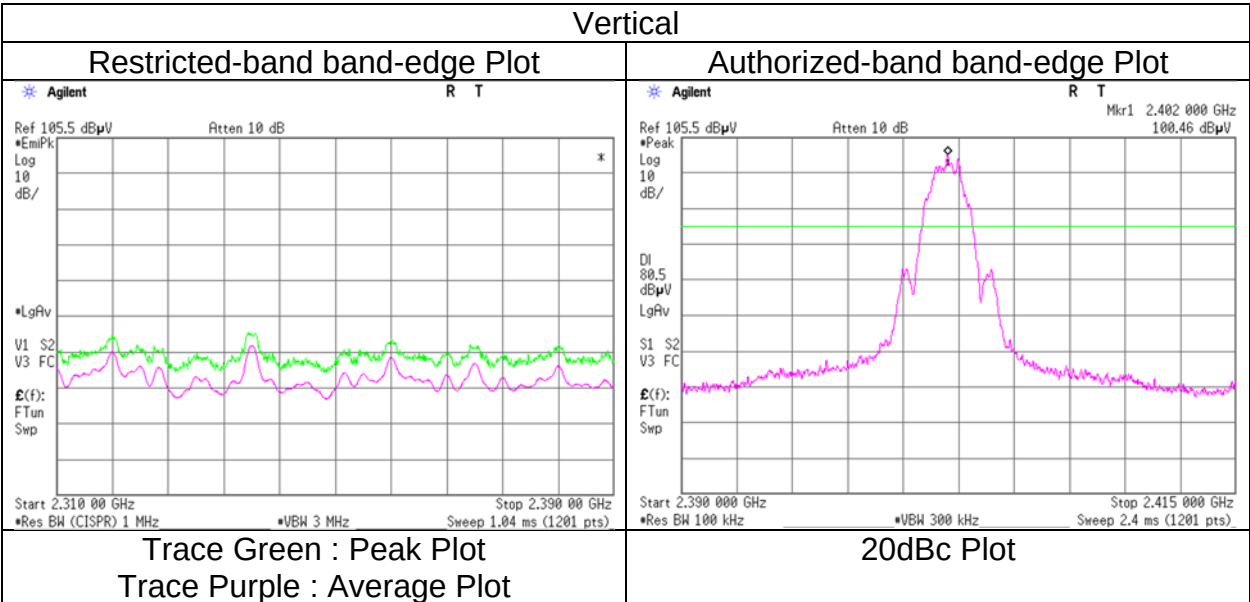
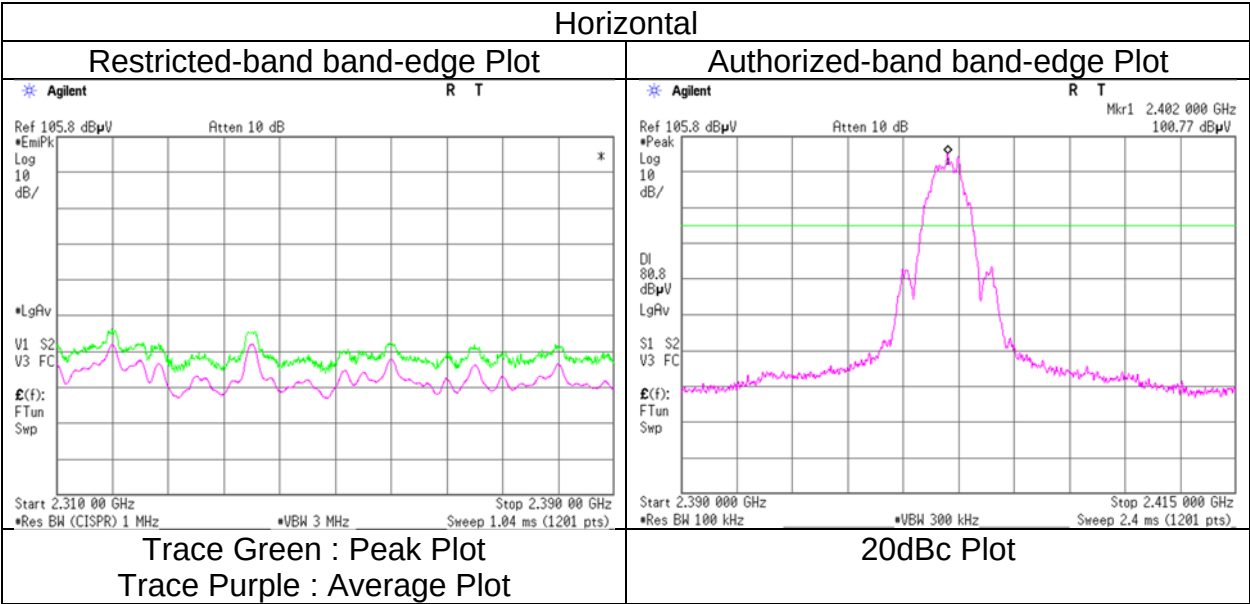
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)

Distance factor: 1 GHz - 10 GHz 20log (4 m / 3.0 m) = 2.5 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.3
Date	September 19, 2023
Temperature / Humidity	23 deg. C / 60 % RH
Engineer	Nachi Konegawa
	(1 GHz to 10 GHz)
Mode	Tx BT LE 2M-PHY 2402 MHz



* 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.3	No.3
Date	September 19, 2023	September 19, 2023
Temperature / Humidity	23 deg. C / 60 % RH	23 deg. C / 60 % RH
Engineer	Nachi Konegawa	Takafumi Noguchi
	(1 GHz to 10 GHz)	(Above 10 GHz)
Mode	Tx BT LE 2M-PHY 2440 MHz	

Polarity	Frequency	Reading (QP / PK)	Reading (AV)	Ant. Factor	Loss	Gain	Duty Factor	Result (QP / PK)	Result (AV)	Limit (QP / PK)	Limit (AV)	Margin (QP / PK)	Margin (AV)	Remark
[Hori/Vert]	[MHz]	[dBuV]	[dBuV]	[dB/m]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dB]	[dB]	
Hori.	2375.8	52.7	48.0	27.7	5.5	32.4	2.4	53.4	51.2	73.9	53.9	20.5	2.7	
Hori.	4880.0	41.0	32.9	31.5	7.6	31.4	2.4	48.7	43.0	73.9	53.9	25.2	10.9	
Hori.	7320.0	45.1	37.3	36.0	8.8	32.3	2.4	57.6	52.1	73.9	53.9	16.3	1.8	
Hori.	9760.0	42.9	32.4	39.1	9.3	33.0	-	58.3	47.8	73.9	53.9	15.6	6.1	Floor noise
Vert.	2375.8	53.6	48.9	27.7	5.5	32.4	2.4	54.4	52.0	73.9	53.9	19.5	1.9	
Vert.	4880.0	41.8	33.3	31.5	7.6	31.4	2.4	49.5	43.4	73.9	53.9	24.4	10.5	
Vert.	7320.0	46.8	37.9	36.0	8.8	32.3	2.4	59.2	52.7	73.9	53.9	14.7	1.2	
Vert.	9760.0	42.9	32.4	39.1	9.3	33.0	-	58.3	47.8	73.9	53.9	15.6	6.1	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 (4 m / 3.0 m) = 2.5 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.3	No.3
Date	September 19, 2023	September 19, 2023
Temperature / Humidity	23 deg. C / 60 % RH	23 deg. C / 60 % RH
Engineer	Nachi Konegawa	Takafumi Noguchi
	(1 GHz to 10 GHz)	(Above 10 GHz)
Mode	Tx BT LE 2M-PHY 2480 MHz	

Polarity	Frequency	Reading (QP / PK)	Reading (AV)	Ant. Factor	Loss	Gain	Duty Factor	Result (QP / PK)	Result (AV)	Limit (QP / PK)	Limit (AV)	Margin (QP / PK)	Margin (AV)	Remark
[Hori/Vert]	[MHz]	[dBuV]	[dBuV]	[dB/m]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dB]	[dB]	
Hori.	2372.0	54.5	49.3	27.7	5.5	32.4	2.4	55.3	52.4	73.9	53.9	18.6	1.5	*1)
Hori.	2483.5	50.4	40.6	27.5	5.5	32.4	2.4	51.1	43.7	73.9	53.9	22.8	10.2	
Hori.	4960.0	42.5	35.0	31.6	7.6	31.4	2.4	50.4	45.3	73.9	53.9	23.5	8.6	
Hori.	7440.0	46.0	37.7	36.2	8.8	32.4	2.4	58.6	52.8	73.9	53.9	15.3	1.2	
Hori.	9920.0	43.6	34.5	39.1	9.3	33.1	2.4	59.0	52.3	73.9	53.9	14.9	1.6	
Vert.	2372.0	54.0	49.4	27.7	5.5	32.4	2.4	54.8	52.6	73.9	53.9	19.1	1.3	*1)
Vert.	2483.5	49.7	39.6	27.5	5.5	32.4	2.4	50.4	42.7	73.9	53.9	23.5	11.2	
Vert.	4960.0	42.8	34.1	31.6	7.6	31.4	2.4	50.6	44.3	73.9	53.9	23.3	9.6	
Vert.	7440.0	45.6	37.2	36.2	8.8	32.4	2.4	58.2	52.2	73.9	53.9	15.7	1.7	
Vert.	9920.0	44.1	35.5	39.1	9.3	33.1	2.4	59.5	53.3	73.9	53.9	14.4	0.6	

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).

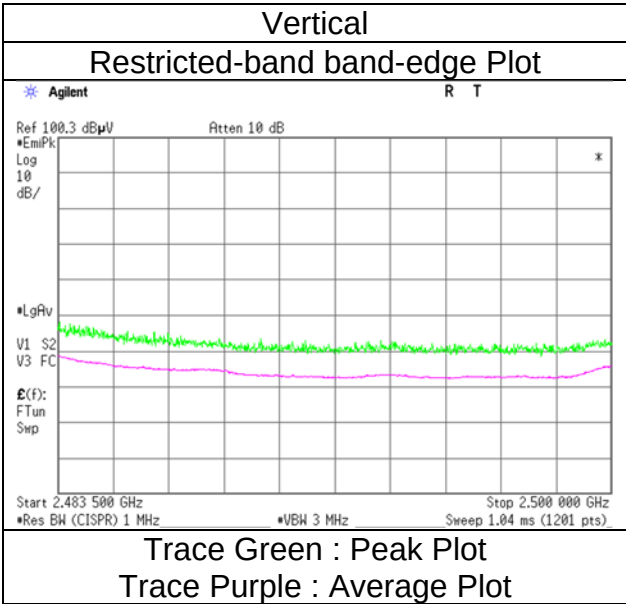
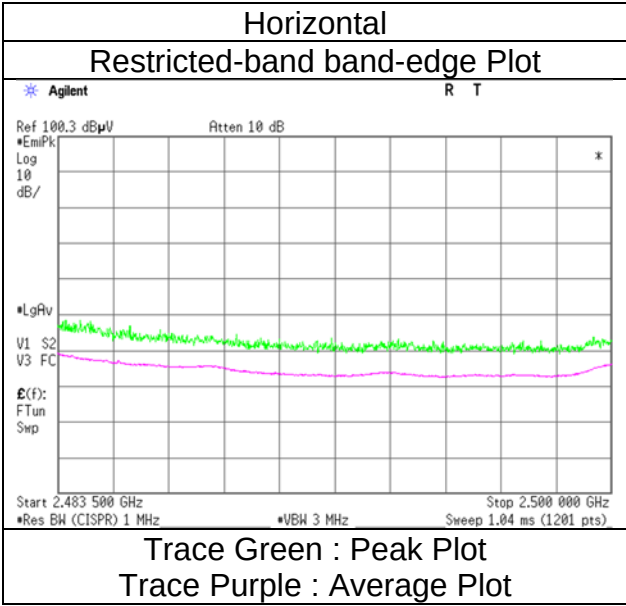
*QP detector was used up to 1GHz.

*1) Not Out of Band emission(Leakage Power)

Distance factor: 1 GHz - 10 GHz $20\log(4\text{ m} / 3.0\text{ m}) = 2.5\text{ dB}$
 10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

Radiated Spurious Emission
(Reference Plot for band-edge)

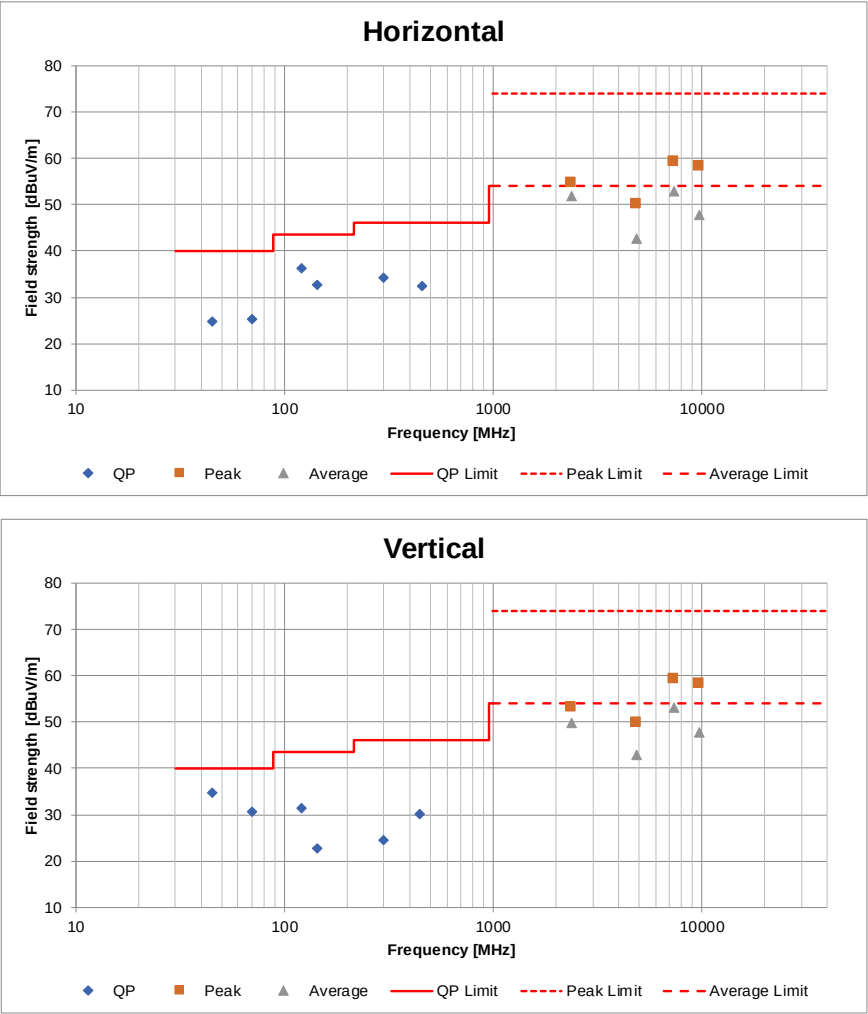
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	September 19, 2023
Temperature / Humidity	23 deg. C / 60 % RH
Engineer	Nachi Konegawa
	(1 GHz to 10 GHz)
Mode	Tx BT LE 2M-PHY 2480 MHz



* 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.	No.3	No.3
Semi Anechoic Chamber	No.3	September 19, 2023	September 20, 2023
Date	September 19, 2023	23 deg. C / 60 % RH	23 deg. C / 65 % RH
Temperature / Humidity	23 deg. C / 60 % RH	Takafumi Noguchi	Nachi Konegawa
Engineer	Nachi Konegawa	(Above 10 GHz)	(Below 1 GHz)
Mode	(1 GHz to 10 GHz)		
	Tx BT LE 1M-PHY 2440 MHz		

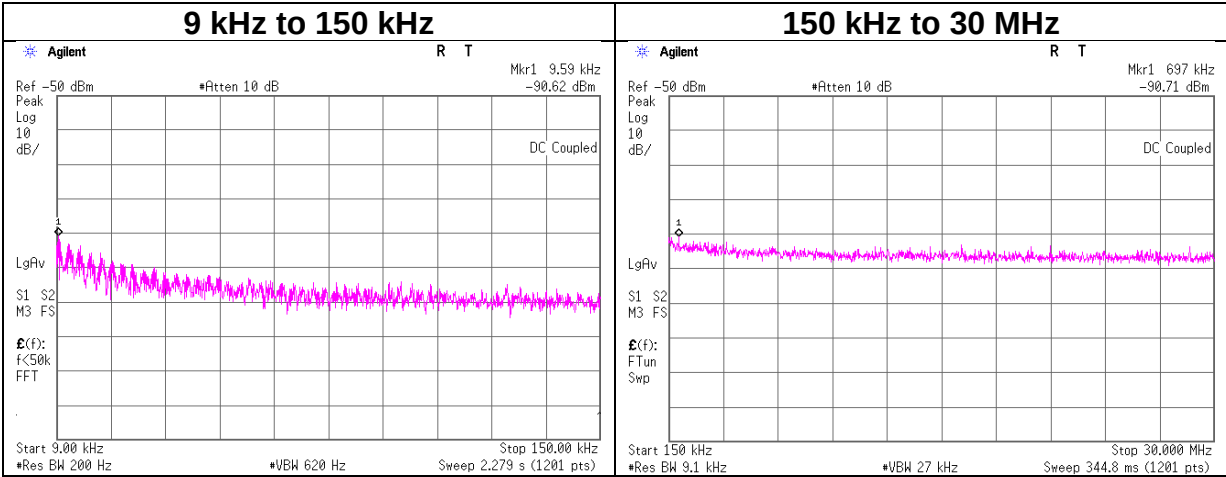


*These plots data contain sufficient number to show the trend of characteristic features for EUT.

Conducted Spurious Emission

Test place
Date
Temperature / Humidity
Engineer
Mode

Ise EMC Lab. No.6 Measurement Room
September 14, 2023
23 deg. C / 47 % RH
Shousei Hamaguchi
Tx BT LE 1M-PHY 2440MHz



Frequency	Reading	Cable Loss	Attenuator Loss	Antenna Gain*	N	EIRP	Distance	Ground bounce	E	Limit	Margin	Remark
[kHz]	[dBm]	[dB]	[dB]	[dBi]	(Number of Output)	[dBm]	[m]	[dB]	(field strength) [dBuV/m]	[dBuV/m]	[dB]	
9.59	-90.6	0.30	9.7	2.0	1	-78.7	300	6.0	-17.4	47.9	65.3	
697.00	-90.7	0.31	9.7	2.0	1	-78.7	30	6.0	2.5	30.7	28.2	

$E\text{ [dBuV/m]} = EIRP\text{ [dBm]} - 20\log(\text{Distance [m]}) + \text{Ground bounce [dB]} + 104.8\text{ [dBuV/m]}$
 $EIRP\text{ [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log(N)$
N: Number of output
*2.0 dBi was applied to the test result based on ANSI C63.10 since antenna gain was less than 2.0 dBi.

Power Density

Test place Ise EMC Lab. No.6 Measurement Room
Date September 14, 2023
Temperature / Humidity 23 deg. C / 47 % RH
Engineer Shousei Hamaguchi
Mode Tx BT LE

1M-PHY

Freq. [MHz]	Reading [dBm / 3 kHz]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm / 3 kHz]	Limit [dBm / 3 kHz]	Margin [dB]
2402	-18.40	1.18	9.74	-7.48	8.00	15.48
2440	-18.38	1.19	9.75	-7.44	8.00	15.44
2480	-18.50	1.20	9.75	-7.55	8.00	15.55

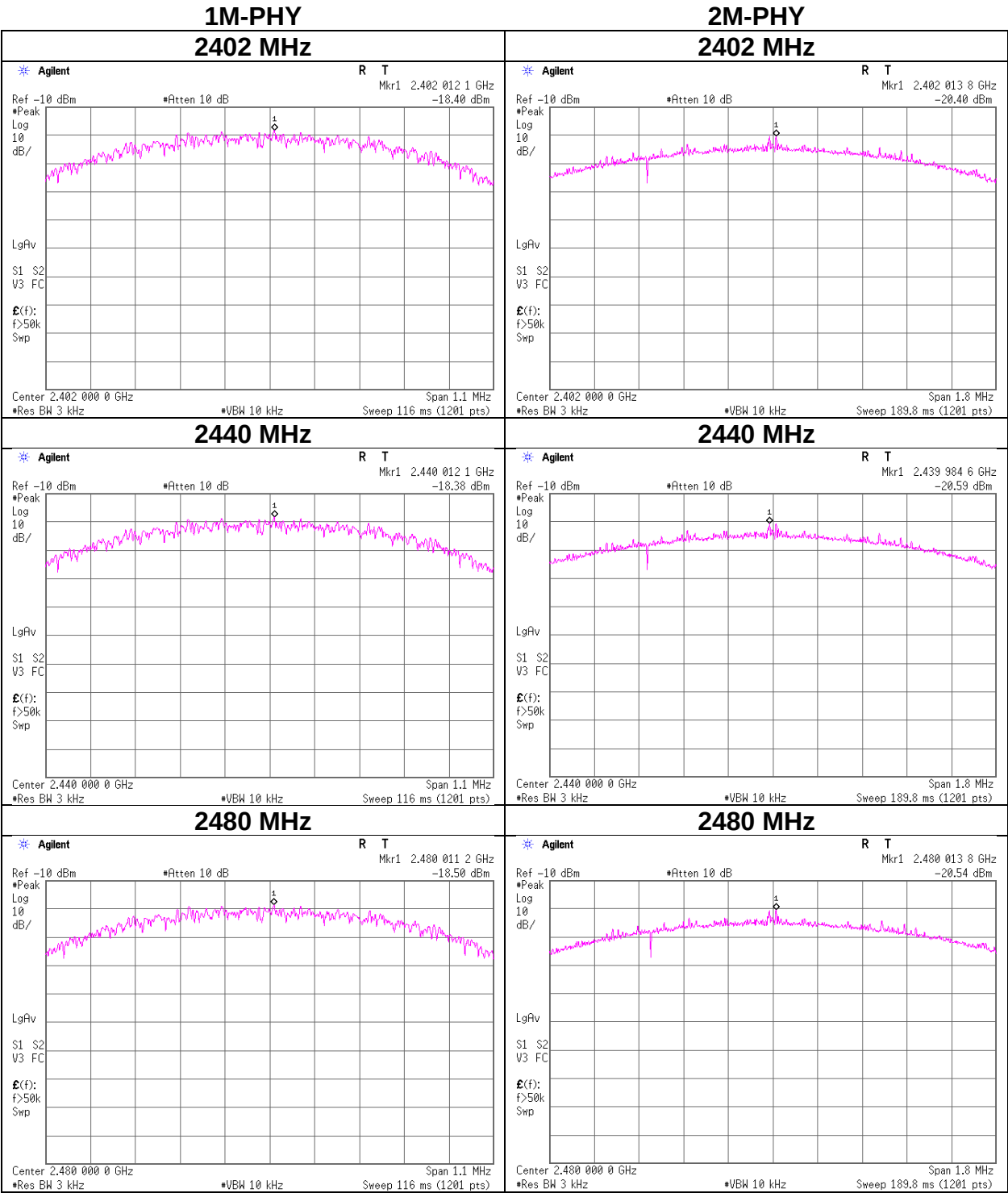
2M-PHY

Freq. [MHz]	Reading [dBm / 3 kHz]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm / 3 kHz]	Limit [dBm / 3 kHz]	Margin [dB]
2402	-20.40	1.18	9.74	-9.48	8.00	17.48
2440	-20.59	1.19	9.75	-9.65	8.00	17.65
2480	-20.54	1.20	9.75	-9.59	8.00	17.59

Sample Calculation:

Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

Power Density



APPENDIX 2: Test Instruments

Test Equipment

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
CE	COTS-MEMI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
CE	MAEC-03	142008	AC3_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	05/23/2022	24
CE	MAT-67	141248	Attenuator	JFW Industries, Inc.	50FP-013H2 N	-	12/22/2022	12
CE	MCC-112	141216	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W/SFM14/sucoform141-PE/421-010/RFM-E321(SW)	-/00640	07/25/2023	12
CE	MJM-16	142183	Measure	KOMELON	KMC-36	-	10/03/2022	12
CE	MLS-24	141358	LISN(AMN)	Schwarzbeck Mess-Elektronik OHG	NSLK8127	8127-730	07/13/2023	12
CE	MMM-08	141532	DIGITAL HITESTER	HIOKI E.E. CORPORATION	3805	51201197	01/17/2023	12
CE	MOS-13	141554	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	1301	01/13/2023	12
CE	MTR-08	141949	Test Receiver	Rohde & Schwarz	ESCI	100767	05/17/2023	12
RE	COTS-MEMI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	MAEC-03	142008	AC3_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	05/23/2022	24
RE	MAEC-03-SVSWR	142013	AC3_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-10005	04/12/2023	24
RE	MAT-95	142314	Attenuator	Pasternack Enterprises	PE7390-6	D/C 1504	06/23/2023	12
RE	MBA-05	141425	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	VHA9103+ BBA9106	VHA 91031302	08/10/2023	12
RE	MCC-265	234602	Microwave Cable	Huber+Suhner	SF126E/11PC35/11PC35/1000M,5000M	537063/126E / 537074/126E	03/16/2023	12
RE	MCC-51	141323	Coaxial cable	UL Japan	-	-	09/10/2023	12
RE	MHA-16	141513	Horn Antenna 15-40GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9170	BBHA9170306	07/19/2023	12
RE	MHA-20	141507	Horn Antenna 1-18GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	258	11/14/2022	12
RE	MHF-25	141232	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	001	09/04/2023	12
RE	MJM-16	142183	Measure	KOMELON	KMC-36	-	10/03/2022	12
RE	MLA-22	141266	Logperiodic Antenna (200-1000MHz)	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	9111B-191	08/10/2023	12
RE	MMM-08	141532	DIGITAL HITESTER	HIOKI E.E. CORPORATION	3805	51201197	01/17/2023	12
RE	MOS-13	141554	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	1301	01/13/2023	12
RE	MPA-11	141580	MicroWave System Amplifier	Keysight Technologies Inc	83017A	MY39500779	03/08/2023	12
RE	MPA-13	141582	Pre Amplifier	SONOMA INSTRUMENT	310	260834	02/07/2023	12
RE	MSA-03	141884	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY44020357	03/13/2023	12
RE	MTR-08	141949	Test Receiver	Rohde & Schwarz	ESCI	100767	05/17/2023	12
AT	MAT-26	141244	Attenuator(10dB)	Weinschel - API Technologies Corp	WA8-10-34	A198	02/01/2023	12
AT	MAT-89	141419	Attenuator	Weinschel Associates	WA56-10	56100305	05/18/2023	12
AT	MCC-245	197220	Microwave cable	Huber+Suhner	SF126E/11PC35/11PC35/2000MM	537003/126E	03/08/2023	12
AT	MCC-64	141327	Coaxial Cable	UL Japan	-	-	02/01/2023	12
AT	MOS-14	141561	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	1401	01/13/2023	12
AT	MPM-13	141810	Power Meter	Anritsu Corporation	ML2495A	824014	12/26/2022	12
AT	MPSE-18	141832	Power sensor	Anritsu Corporation	MA2411B	738174	12/26/2022	12
AT	MSA-14	141901	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY48250080	01/16/2023	12
AT	MCC-67	141329	Microwave Cable 1G-40GHz	Suhner	SUCOFLEX102	28635/2	04/10/2023	12
AT	MPM-12	141809	Power Meter	Anritsu Corporation	ML2495A	825002	05/26/2023	12
AT	MPM-17	141813	Power Meter	Raditeq (Formerly DARE!! Instruments)	RPR3006W	14100048SNO 081	10/04/2023	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:

CE: Conducted Emission

RE: Radiated Emission

AT: Antenna Terminal Conducted test