RADIO TEST REPORT

Test Report No. 15512884S-A-R1

Customer	**CASIO COMPUTER CO., LTD.**
Description of EUT	**Watch**
Model Number of EUT	**GST-B1000** (Bluetooth Module: CW5748 is contained.)
FCC ID	**BBQS62W**
Test Regulation	**FCC Part 15 Subpart C**
Test Result	**Complied**
Issue Date	**August 1, 2025**
Remarks	**-**

Representative Test Engineer	**Approved By**
Yuta Shiba Engineer	Shunsaku Yumi Engineer

CERTIFICATE 1266.03

☐ 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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REVISION HISTORY

Original Test Report No. 15512884S-A

This report is a revised version of 15512884S-A. 15512884S-A is replaced with this report.

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	15512884S-A	January 6, 2025	-
R1	15512884S-A-R1	August 1, 2025	Page 24, Corrected plot data.

Reference: Abbreviations (Including words undescribed in this report)

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

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SECTION 1: Customer Information

Company Name	CASIO COMPUTER CO., LTD.
Address	2-1, Sakaecho 3 chome, Hamura-shi, Tokyo 205-8555 Japan
Telephone Number	+81-42-579-7282
Contact Person	Shuji Yamashita

The information provided by 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

SECTION 2: Equipment Under Test (EUT)

2.1 Identification of EUT

Description	Watch
Model Number	GST-B1000 (Bluetooth Module: CW5748 is contained.)
Alternative Number	R072
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 21, 2024
Test Date	November 25 to December 2, 2024

2.2 Product Description

General Specification

Rating	Typical: DC 2.5 V, Min.: DC 1.9 V, Max.: DC 2.7 V
Operating temperature	-10 deg. C to 60 deg. C

Radio Specification

This report contains data provided by the customer which can impact the validity of results. UL Japan, Inc. is only responsible for the validity of results after the integration of the data provided by the customer.
The data provided by the customer is marked “a)” in the table below.

Bluetooth (Low Energy)

Equipment Type	Transceiver
Frequency of Operation	2402 MHz to 2480 MHz
Type of Modulation	GFSK
Antenna Gain[a)]	-2.0 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

* Also the EUT complies with FCC Part 15 Subpart B.

3.2 Procedures and Results

Item	Test Procedure	Specification	Worst Margin	Results	Remarks
Conducted Emission	**FCC:** ANSI C63.10-2013 6. Standard test methods	**FCC:** Section 15.207	-	N/A	*1)
	ISED: RSS-Gen 8.8	**ISED:** RSS-Gen 8.8			
6 dB Bandwidth	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section 15.247(a)(2)	See data.	Complied	Conducted
	ISED: -	**ISED:** RSS-247 5.2(a)			
Maximum Peak Output Power	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section 15.247(b)(3)		Complied	Conducted
	ISED: RSS-Gen 6.12	**ISED:** RSS-247 5.4(d)			
Power Density	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section 15.247(e)		Complied	Conducted
	ISED: -	**ISED:** RSS-247 5.2(b)			
Spurious Emission Restricted Band Edges	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section15.247(d)	11.7 dB 2483.500 MHz, AV, Horizontal Mode: Tx BT LE 2480 MHz	Complied	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *2)
	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) The test is not applicable since the EUT does not have AC mains.
*2) 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 EUT provides stable voltage constantly to the RF part regardless of input voltage.
Instead of a new battery, DC power supply was used for the test. That does not affect the test result.
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

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.

Item	Frequency range	Uncertainty (+/-)
Conducted Emission (AC Mains) LISN	150 kHz to 30 MHz	3.0 dB
Radiated Emission (Measurement distance: 3 m)	9 kHz to 30 MHz	3.3 dB
	30 MHz to 200 MHz	4.8 dB
	200 MHz to 1 GHz	6.1 dB
	1 GHz to 6 GHz	4.7 dB
	6 GHz to 18 GHz	5.3 dB
	18 GHz to 40 GHz	5.5 dB
Radiated Emission (Measurement distance: 1 m)	1 GHz to 18 GHz	5.6 dB
	18 GHz to 40 GHz	5.8 dB

Antenna terminal test	Uncertainty (+/-)
Power Measurement above 1 GHz (Average Detector)	1.3 dB
Power Measurement above 1 GHz (Peak Detector)	1.5 dB
Spurious Emission (Conducted) below 1 GHz	0.93 dB
Conducted Emissions Power Density Measurement 1 GHz to 3 GHz	0.93 dB
Conducted Emissions Power Density Measurement 3 GHz to 18 GHz	3.0 dB
Spurious Emission (Conducted) 18 GHz to 26.5 GHz	2.8 dB
Spurious Emission (Conducted) 26.5 GHz to 40 GHz	2.3 dB
Bandwidth Measurement	0.012 %
Duty Cycle and Time Measurement	0.27 %
Temperature	2.2 deg.C.
Humidity	3.4 %
Voltage	0.92 %

3.5 Test Location

UL Japan, Inc. Shonan EMC Lab.
1-22-3, Megumigaoka, Hiratsuka-shi, Kanagawa-ken 259-1220 Japan
Telephone: +81-463-50-6400
A2LA Certificate Number: 1266.03
(FCC test firm registration number: 626366, ISED lab company number: 2973D / CAB identifier: JP0001)

Test room	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Semi-anechoic chamber (SAC1)	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.2 Semi-anechoic chamber (SAC2)	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.3 Semi-anechoic chamber (SAC3)	12.7 x 7.7 x 5.35	12.7 x 7.7	5 m
No.4 Semi-anechoic chamber (SAC4)	8.1 x 5.1 x 3.55	8.1 x 5.1	-
Wireless anechoic chamber 1 (WAC1)	9.5 x 6.0 x 5.4	9.5 x 6.0	3 m
Wireless anechoic chamber 2 (WAC2)	9.5 x 6.0 x 5.4	9.5 x 6.0	3 m
No.1 Shielded room	6.8 x 4.1 x 2.7	6.8 x 4.1	-
No.2 Shielded room	6.8 x 4.1 x 2.7	6.8 x 4.1	-
No.3 Shielded room	6.3 x 4.7 x 2.7	6.3 x 4.7	-
No.4 Shielded room	4.4 x 4.7 x 2.7	4.4 x 4.7	-
No.5 Shielded room	7.8 x 6.4 x 2.7	7.8 x 6.4	-
No.6 Shielded room	7.8 x 6.4 x 2.7	7.8 x 6.4	-
No.8 Shielded room	3.45 x 5.5 x 2.4	3.45 x 5.5	-
No.1 Measurement room	2.55 x 4.1 x 2.5	-	-
No.2 Measurement room	4.5 x 3.5 x 2.5	-	-
Wireless shielded room 1	3.0 x 4.5 x 2.7	3.0 x 4.5	-
Wireless shielded room 2	3.0 x 4.5 x 2.7	3.0 x 4.5	-

3.6 Test Data, Test Instruments, and Test Set Up

Refer to APPENDIX.

SECTION 4: Operation of EUT during testing

[BT LE]

Mode	Remarks*
Bluetooth Low Energy (BT LE)	Uncoded 1M-PHY (1M), Maximum Packet Size, PRBS9

*Power of the EUT was set by the software as follows;
Power Setting: Fixed
Software: BLE RF Test Version: 9.9
(Date: 2024.11.25, Storage location: EUT memory)

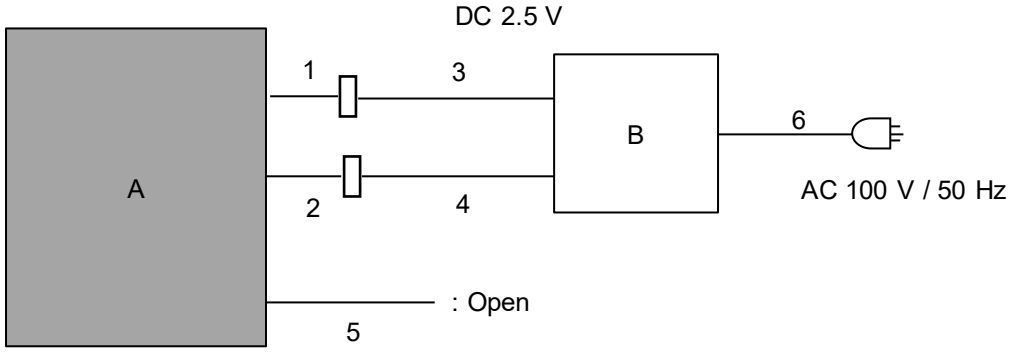
*This setting of software is the worst case.
Any conditions under the normal use do not exceed the condition of setting.
In addition, end users cannot change the settings of the output power of the product.

*The Details of Operating Mode(s)

Test Item	Operating Mode	Tested Frequency
Radiated Spurious Emission (Below 1 GHz) Conducted Spurious Emission	Tx BT LE 1M-PHY *1)	2440 MHz
Radiated Spurious Emission (Above 1 GHz), Maximum Peak Output Power, Power Density, 6 dB Bandwidth, 99 % Occupied Bandwidth	Tx BT LE 1M-PHY	2402 MHz 2440 MHz 2480 MHz

*1) Radiated 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.

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	Watch	GST-B1000	05 *1) 01 *2)	CASIO COMPUTER CO., LTD.	EUT
B	Power Supply (DC)	PAN35-10A	NA000955	KIKUSUI	*1)
		PW16-5ADP	19100034	GW Instek	*2)

List of Cables Used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC (+)	0.14	Unshielded	Unshielded	*3)
2	DC (-)	0.14	Unshielded	Unshielded	*3)
3	DC (+)	0.50 + 2.00 *1) 1.00 *2)	Unshielded	Unshielded	-
4	DC (-)	0.50 + 2.00 *1) 1.00 *2)	Unshielded	Unshielded	-
5	Signal	0.16	Unshielded	Unshielded	*4)
6	AC	2.00	Unshielded	Unshielded	-

*1) Used for Radiated Emission test.
*2) Used for Antenna Terminal conducted test.
*3) Used for test operation.
*4) Cable is for system reset during the development, not used for the product.

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

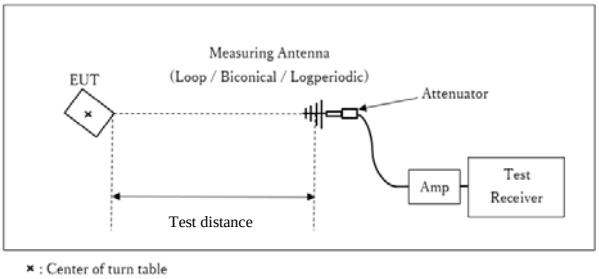
In any 100 kHz bandwidth outside the restricted band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired 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	RBW: 100 kHz VBW: 300 kHz

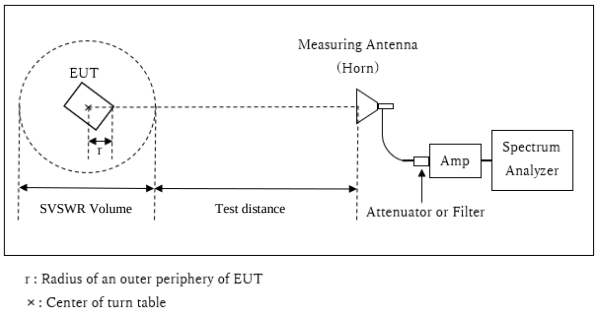
Figure 1: Test Setup

Below 1 GHz



Test Distance: 3 m

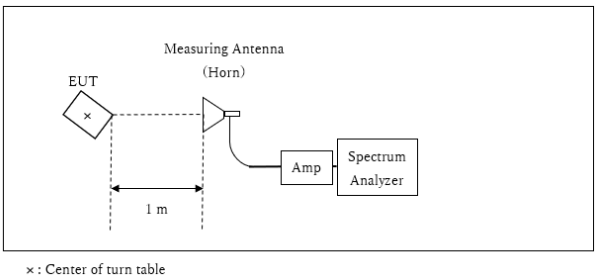
1 GHz to 10 GHz



Distance Factor: 20 x log (3.97 m* / 3.0 m) = 2.44 dB
*(Test Distance + SVSWR Volume /2) - r = 3.97 m

Test Distance: 3 m
SVSWR Volume: 2 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
r: 0.03 m

10 GHz to 26.5 GHz



Distance Factor: 20 x log (1.0 m / 3.0 m) = -9.54 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.

Antenna polarization	Carrier	Spurious (30 MHz - 1 GHz)	Spurious (1 GHz - 2.8 GHz)	Spurious (2.8 GHz - 10 GHz)	Spurious (10 GHz - 18 GHz)	Spurious (18 GHz - 26.5 GHz)
Horizontal	X	X	X	Y	X	X
Vertical	Y	X	Y	Y	X	X

Test results are rounded off and limit are rounded down, so some differences might be observed.

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

SECTION 6: 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
6 dB 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: 160 MHz BW)
Peak Power Density	1.5 times the 6 dB Bandwidth	3 kHz	9.1 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	10 kHz	30 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 low enough 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 Ohmes. 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.

Test results are rounded off and limit are rounded down, 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

99 % Occupied Bandwidth and 6 dB Bandwidth

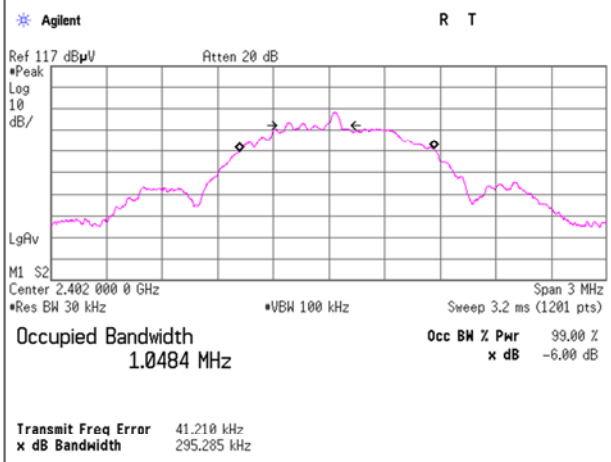
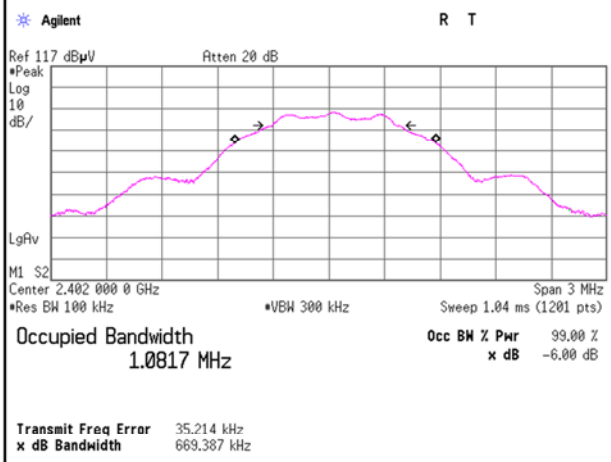
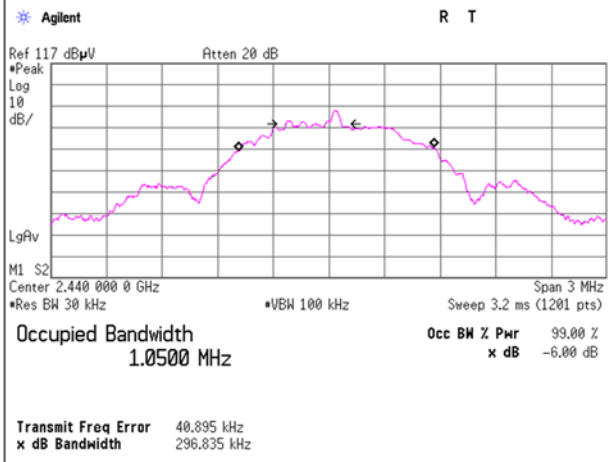
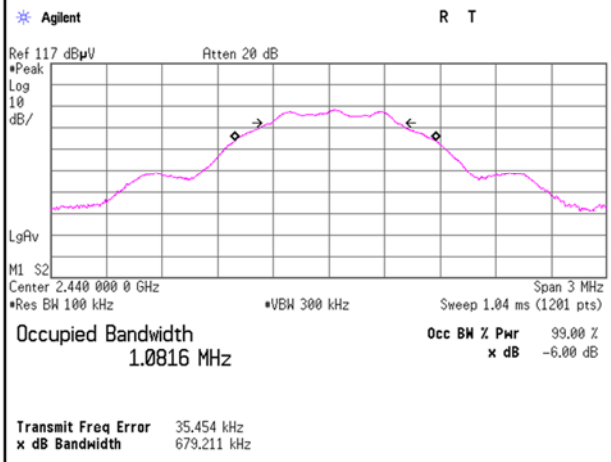
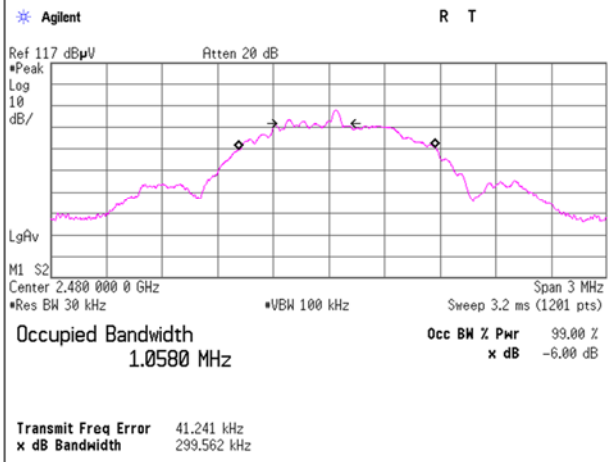
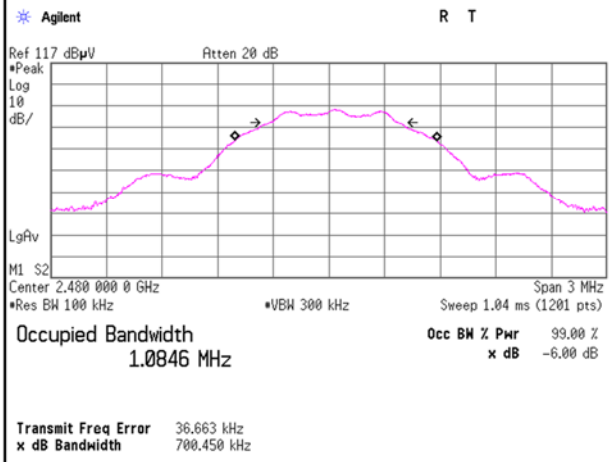
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	December 2, 2024
Temperature / Humidity	22 deg. C / 30 % RH
Engineer	Makoto Hosaka
Mode	Tx

BT LE 1M-PHY

Frequency [MHz]	99 % Occupied Bandwidth [kHz]	6 dB Bandwidth [MHz]	Limit for 6 dB Bandwidth [MHz]
2402	1048.4	0.669	> 0.5000
2440	1050.0	0.679	> 0.5000
2480	1058.0	0.700	> 0.5000

99 % Occupied Bandwidth and 6 dB Bandwidth

BT LE 1M-PHY

99 % Occupied Bandwidth	6 dB Bandwidth
2402 MHz	**2402 MHz**
	
2440 MHz	**2440 MHz**
	
2480 MHz	**2480 MHz**
	

Maximum Peak Output Power

Test place	Shonan EMC Lab. No.5 Shielded Room
Date	November 26, 2024
Temperature / Humidity	21 deg. C / 32 % RH
Engineer	Yuta Shiba
Mode	Tx

BT LE 1M-PHY

Maximum peak output power

				Conducted Power					e.i.r.p. for RSS-247					
Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2402	-11.25	0.88	9.63	-0.74	0.84	30.00	1000	30.74	-2.00	-2.74	0.53	36.02	4000	38.76
2440	-11.26	0.89	9.64	-0.73	0.85	30.00	1000	30.73	-2.00	-2.73	0.53	36.02	4000	38.75
2480	-11.41	0.89	9.64	-0.88	0.82	30.00	1000	30.88	-2.00	-2.88	0.52	36.02	4000	38.90

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	Shonan EMC Lab. No.5 Shielded Room
Date	November 26, 2024
Temperature / Humidity	21 deg. C / 32 % RH
Engineer	Yuta Shiba
Mode	Tx

BT LE 1M-PHY

Average power

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2402	-13.41	0.88	9.63	-2.90	0.51	1.64	-1.26	0.75
2440	-13.47	0.89	9.64	-2.94	0.51	1.64	-1.30	0.74
2480	-13.56	0.89	9.64	-3.03	0.50	1.64	-1.39	0.73

Sample Calculation:

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

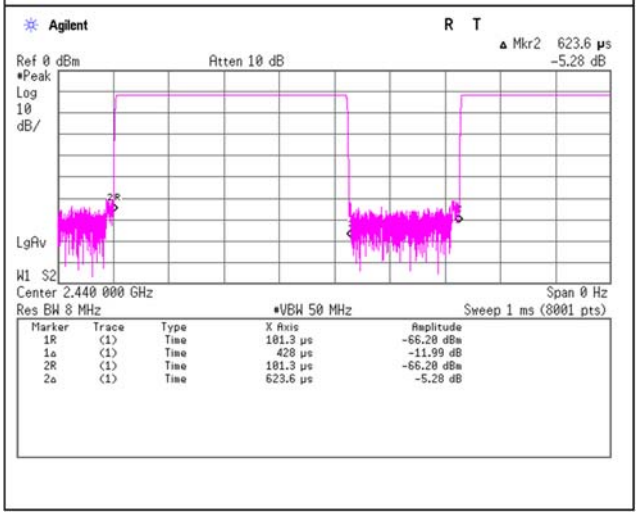
Result (Burst power average) = Result (Time average) + Duty factor

Burst rate confirmation

Test place	Shonan EMC Lab. No.5 Shielded Room
Date	November 26, 2024
Temperature / Humidity	21 deg. C / 32 % RH
Engineer	Yuta Shiba
Mode	Tx

BT LE 1M-PHY

Tx on / (Tx on + Tx off) =	0.686
Tx on / (Tx on + Tx off) * 100 =	68.6 %
Duty factor = 10 * log (0.624 / 0.428) =	1.64 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	Shonan EMC Lab.	
Semi Anechoic Chamber	SAC3	SAC3
Date	November 26, 2024	November 25, 2024
Temperature / Humidity	24 deg. C / 24 % RH	22 deg. C / 25 % RH
Engineer	Yuta Shiba (1 GHz to 10 GHz) (18 GHz to 26.5 GHz)	Yuta Shiba (10 GHz to 18 GHz)
Mode	Tx BT LE 2402 MHz	

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Fac. [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg.]	Remark
Hori.	2390.000	PK	47.73	27.79	14.57	41.55	2.44	50.98	73.9	22.9	125	24	-
Hori.	4804.000	PK	49.36	31.26	7.33	42.82	2.44	47.57	73.9	26.3	154	46	-
Hori.	7206.000	PK	48.19	36.91	8.89	43.26	2.44	53.17	73.9	20.7	150	0	Floor Noise
Hori.	7206.000	AV	37.57	36.91	8.89	43.26	2.44	42.55	53.9	11.3	150	0	Floor Noise
Vert.	2390.000	PK	47.83	27.79	14.57	41.55	2.44	51.08	73.9	22.8	185	32	-
Vert.	4804.000	PK	49.20	31.26	7.33	42.82	2.44	47.41	73.9	26.4	124	344	-
Vert.	7206.000	PK	48.46	36.91	8.89	43.26	2.44	53.44	73.9	20.4	150	0	Floor Noise
Vert.	7206.000	AV	37.69	36.91	8.89	43.26	2.44	42.67	53.9	**11.2**	150	0	Floor Noise

Result = Reading + Ant.Fac. + Loss (Cable + (Atten or Filter)(below 18 GHz)) - Gain(Amp) + Distance Fac.
*Other frequency noises omitted in this report were not seen or have enough margin (more than 20 dB).
Distance Fac. : 1 GHz to 10 GHz : 20log (3.97 [m] / 3.0 [m]) = 2.44 [dB]
10 GHz to 40 GHz : 20log (1.00 [m] / 3.0 [m]) = -9.54 [dB]

Average measurement value with Duty Factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Fac. [dB]	Distance Fac. [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2390.000	AV	36.42	27.79	14.57	41.55	1.64	2.44	41.31	53.9	12.5	*1)
Hori.	4804.000	AV	40.13	31.26	7.33	42.82	1.64	2.44	39.98	53.9	13.9	-
Vert.	2390.000	AV	37.30	27.79	14.57	41.55	1.64	2.44	42.19	53.9	11.7	*1)
Vert.	4804.000	AV	39.90	31.26	7.33	42.82	1.64	2.44	39.75	53.9	14.1	-

Result = Reading + Ant.Fac. + Loss (Cable + (Atten or Filter)(below 18 GHz)) - Gain(Amp) + Duty Fac. + Distance Fac.
Distance Fac. : 1 GHz to 10 GHz : 20log (3.97 [m] / 3.0 [m]) = 2.44 [dB]
10 GHz to 40 GHz : 20log (1.00 [m] / 3.0 [m]) = -9.54 [dB]
Duty factor refer to "Burst rate confirmation" sheet.
*1) Not out of band emission (Leakage Power)

20 dBc Data Sheet

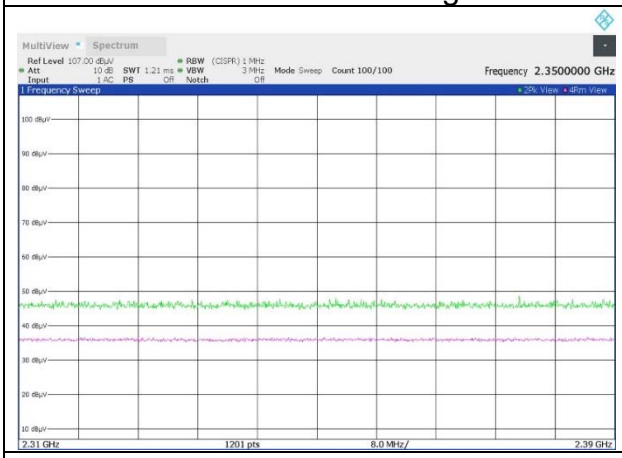
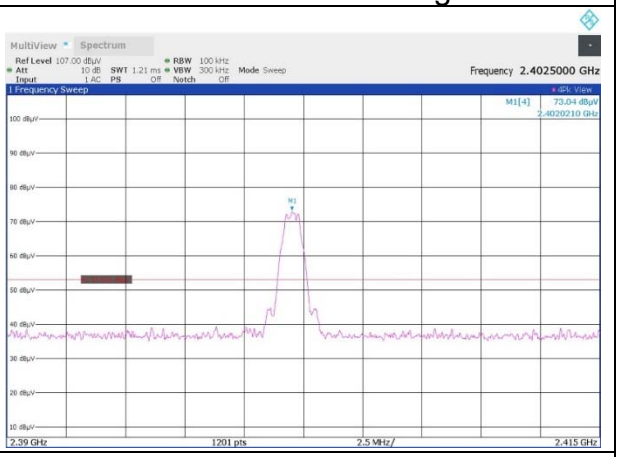
(RBW 100 kHz, VBW 300 kHz)

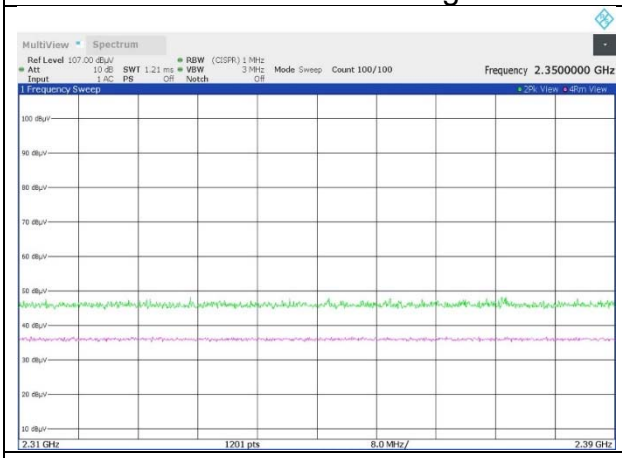
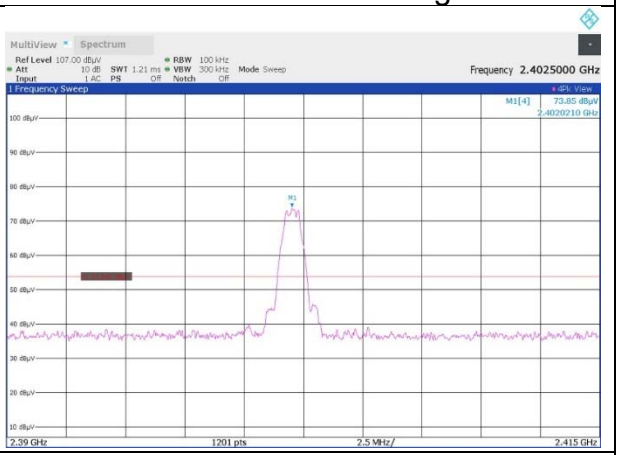
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Fac. [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	73.04	27.77	14.59	41.56	2.44	76.28	-	-	Carrier
Hori.	2400.000	PK	40.53	27.77	14.59	41.56	2.44	43.77	56.2	12.4	-
Vert.	2402.000	PK	73.85	27.77	14.59	41.56	2.44	77.09	-	-	Carrier
Vert.	2400.000	PK	39.96	27.77	14.59	41.56	2.44	43.20	57.0	13.8	-

Result = Reading + Ant.Fac. + Loss (Cable + (Atten or Filter)(below 18 GHz)) - Gain(Amp) + Distance Fac.
Distance Fac. : 1 GHz to 10 GHz : 20log (3.97 [m] / 3.0 [m]) = 2.44 [dB]
10 GHz to 40 GHz : 20log (1.00 [m] / 3.0 [m]) = -9.54 [dB]

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Shonan EMC Lab.
Semi Anechoic Chamber	SAC3
Date	November 26, 2024
Temperature / Humidity	24 deg. C / 24 % RH
Engineer	Yuta Shiba (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	Shonan EMC Lab.		
Semi Anechoic Chamber	SAC3	SAC3	SAC3
Date	November 27, 2024	November 26, 2024	November 25, 2024
Temperature / Humidity	23 deg. C / 30 % RH	24 deg. C / 24 % RH	22 deg. C / 25 % RH
Engineer	Yuta Shiba (Below 1 GHz)	Yuta Shiba (1 GHz to 10 GHz) (18 GHz to 26.5 GHz)	Yuta Shiba (10 GHz to 18 GHz)
Mode	Tx BT LE 2440 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Fac. [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg.]	Remark
Hori.	129.427	QP	21.40	13.80	7.46	32.09	0.00	10.57	43.5	32.9	200	0	-
Hori.	632.513	QP	21.00	19.18	10.37	31.87	0.00	18.68	46.0	27.3	100	0	-
Hori.	756.205	QP	20.80	20.55	10.88	31.66	0.00	20.57	46.0	25.4	100	0	-
Hori.	863.727	QP	20.60	22.02	11.25	31.19	0.00	22.68	46.0	23.3	100	0	-
Hori.	4880.000	PK	48.76	31.35	7.38	42.82	2.44	47.11	73.9	26.7	160	175	-
Hori.	7320.000	PK	47.63	37.03	8.99	43.34	2.44	52.75	73.9	21.1	150	0	Floor Noise
Hori.	7320.000	AV	38.71	37.03	8.99	43.34	2.44	43.83	53.9	10.0	150	0	Floor Noise
Vert.	44.068	QP	22.00	13.31	6.70	32.15	0.00	9.86	40.0	30.1	100	0	-
Vert.	172.759	QP	21.10	15.70	7.96	32.05	0.00	12.71	43.5	30.7	100	0	-
Vert.	680.419	QP	20.90	20.05	10.59	31.84	0.00	19.70	46.0	26.3	100	0	-
Vert.	891.245	QP	20.30	22.15	11.33	31.02	0.00	22.76	46.0	23.2	150	0	-
Vert.	4880.000	PK	49.89	31.35	7.38	42.82	2.44	48.24	73.9	25.6	144	24	-
Vert.	7320.000	PK	48.28	37.03	8.99	43.34	2.44	53.40	73.9	20.5	150	0	Floor Noise
Vert.	7320.000	AV	39.02	37.03	8.99	43.34	2.44	44.14	53.9	**9.7**	150	0	Floor Noise

Result = Reading + Ant.Fac. + Loss (Cable + (Atten or Filter)(below 18 GHz)) - Gain(Amp) + Distance Fac.
*Other frequency noises omitted in this report were not seen or have enough margin (more than 20 dB).
Distance Fac. : 1 GHz to 10 GHz : 20log (3.97 [m] / 3.0 [m]) = 2.44 [dB]
10 GHz to 40 GHz : 20log (1.00 [m] / 3.0 [m]) = -9.54 [dB]

Average measurement value with Duty Factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Fac. [dB]	Distance Fac. [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	4880.000	AV	39.87	31.35	7.38	42.82	1.64	2.44	39.86	53.9	14.0	-
Vert.	4880.000	AV	40.08	31.35	7.38	42.82	1.64	2.44	40.07	53.9	13.8	-

Result = Reading + Ant.Fac. + Loss (Cable + (Atten or Filter)(below 18 GHz)) - Gain(Amp) + Duty Fac. + Distance Fac.
Distance Fac. : 1 GHz to 10 GHz : 20log (3.97 [m] / 3.0 [m]) = 2.44 [dB]
10 GHz to 40 GHz : 20log (1.00 [m] / 3.0 [m]) = -9.54 [dB]
Duty factor refer to "Burst rate confirmation" sheet.

Radiated Spurious Emission

Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	SAC3	SAC3
Date	November 26, 2024	November 25, 2024
Temperature / Humidity	24 deg. C / 24 % RH	22 deg. C / 25 % RH
Engineer	Yuta Shiba (1 GHz to 10 GHz) (18 GHz to 26.5 GHz)	Yuta Shiba (10 GHz to 18 GHz)
Mode	Tx BT LE 2480 MHz	

(* PK: Peak, AV: Average, QP. Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Fac. [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg.]	Remark
Hori.	2483.500	PK	47.49	27.67	14.68	41.58	2.44	50.70	73.9	23.2	132	29	-
Hori.	4960.000	PK	48.56	31.54	7.43	42.82	2.44	47.15	73.9	26.7	155	182	-
Hori.	7440.000	PK	47.60	37.14	9.07	43.43	2.44	52.82	73.9	21.0	150	0	Floor Noise
Hori.	7440.000	AV	39.08	37.14	9.07	43.43	2.44	44.30	53.9	9.6	150	0	Floor Noise
Vert.	2483.500	PK	47.89	27.67	14.68	41.58	2.44	51.10	73.9	22.8	113	357	-
Vert.	4960.000	PK	49.15	31.54	7.43	42.82	2.44	47.74	73.9	26.1	133	349	-
Vert.	7440.000	PK	47.85	37.14	9.07	43.43	2.44	53.07	73.9	20.8	150	0	Floor Noise
Vert.	7440.000	AV	39.23	37.14	9.07	43.43	2.44	44.45	53.9	**9.4**	150	0	Floor Noise

Result = Reading + Ant.Fac. + Loss (Cable + (Atten or Filter)(below 18 GHz)) - Gain(Amp) + Distance Fac.
*Other frequency noises omitted in this report were not seen or have enough margin (more than 20 dB).
Distance Fac. : 1 GHz to 10 GHz : 20log (3.97 [m] / 3.0 [m]) = 2.44 [dB]
10 GHz to 40 GHz : 20log (1.00 [m] / 3.0 [m]) = -9.54 [dB]

Average measurement value with Duty Factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Fac. [dB]	Distance Fac. [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2483.500	AV	37.35	27.67	14.68	41.58	1.64	2.44	42.20	53.9	11.7	*1)
Hori.	4960.000	AV	39.94	31.54	7.43	42.82	1.64	2.44	40.17	53.9	13.7	-
Vert.	2483.500	AV	37.17	27.67	14.68	41.58	1.64	2.44	42.02	53.9	11.8	*1)
Vert.	4960.000	AV	40.09	31.54	7.43	42.82	1.64	2.44	40.32	53.9	13.5	-

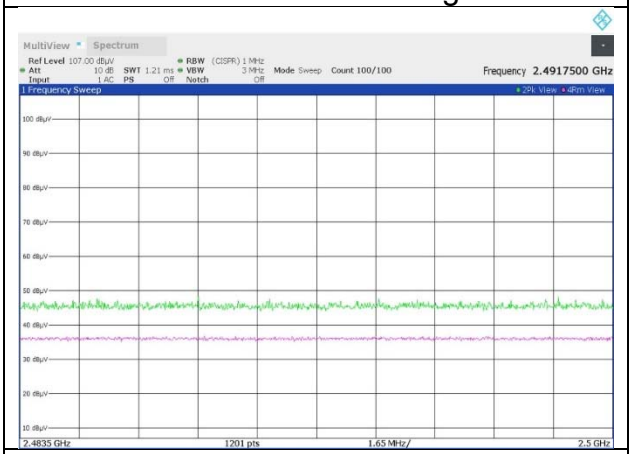
Result = Reading + Ant.Fac. + Loss (Cable + (Atten or Filter)(below 18 GHz)) - Gain(Amp) + Duty Fac. + Distance Fac.
Distance Fac. : 1 GHz to 10 GHz : 20log (3.97 [m] / 3.0 [m]) = 2.44 [dB]
10 GHz to 40 GHz : 20log (1.00 [m] / 3.0 [m]) = -9.54 [dB]
Duty factor refer to "Burst rate confirmation" sheet.
*1) Not out of band emission (Leakage Power)

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Shonan EMC Lab.
Semi Anechoic Chamber	SAC3
Date	November 26, 2024
Temperature / Humidity	24 deg. C / 24 % RH
Engineer	Yuta Shiba (1 GHz to 10 GHz) (18 GHz to 26.5 GHz)
Mode	Tx BT LE 2480 MHz

Horizontal

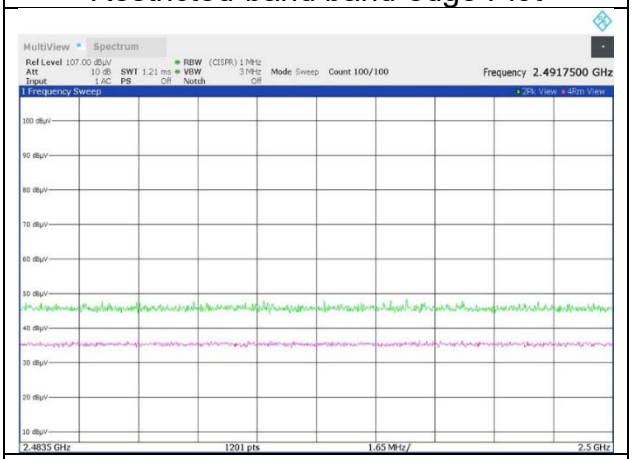
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot

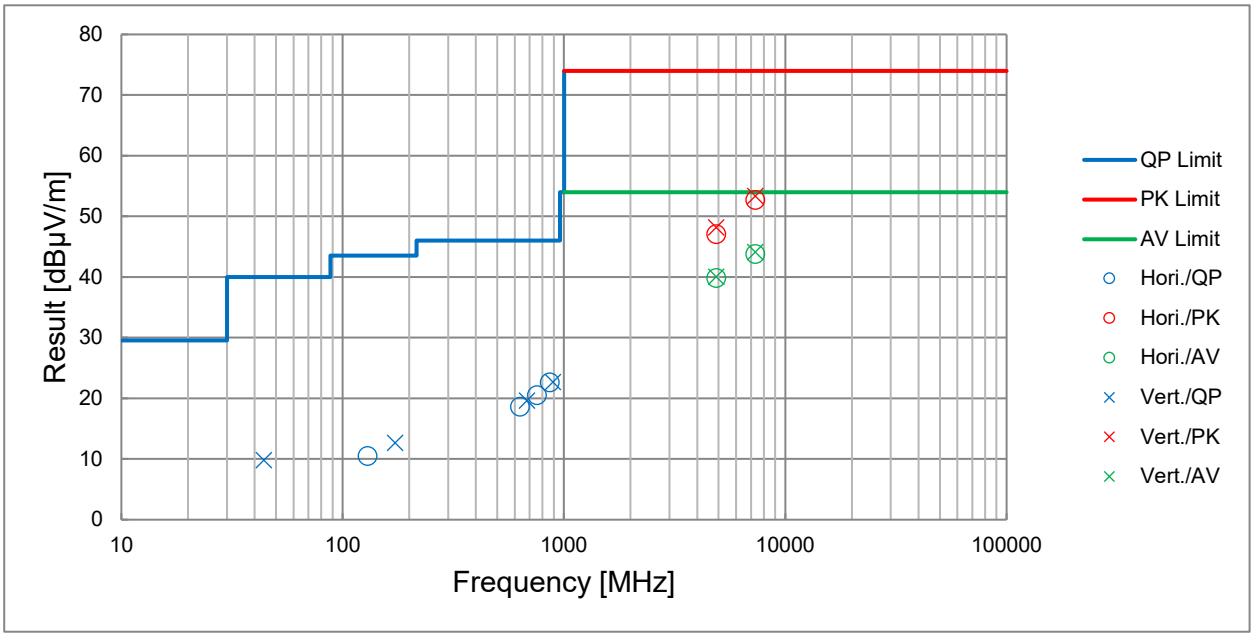


Trace Green : Peak Plot
Trace Purple : Average Plot

* 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
(Plot data, Worst case mode for Maximum Peak Output Power)

Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	SAC3	SAC3	SAC3
Date	November 27, 2024	November 26, 2024	November 25, 2024
Temperature / Humidity	23 deg. C / 30 % RH	24 deg. C / 24 % RH	22 deg. C / 25 % RH
Engineer	Yuta Shiba (Below 1 GHz)	Yuta Shiba (1 GHz to 10 GHz) (18 GHz to 26.5 GHz)	Yuta Shiba (10 GHz to 18 GHz)
Mode	Tx BT LE 2440 MHz		



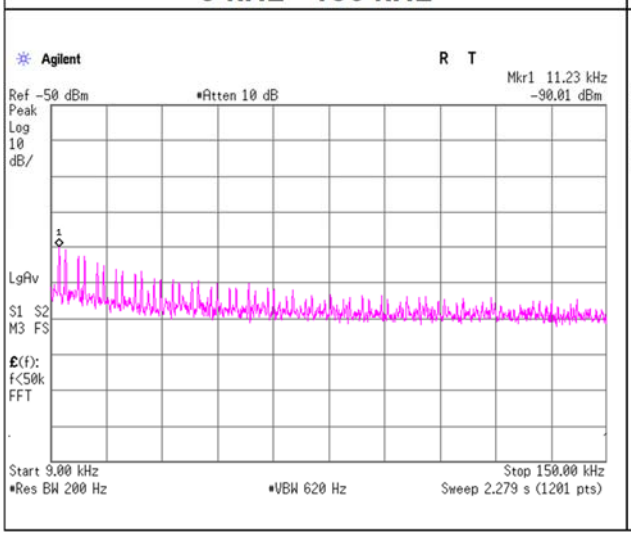
*These plots data contain sufficient number to show the trend of characteristic features for EUT.

Conducted Spurious Emission

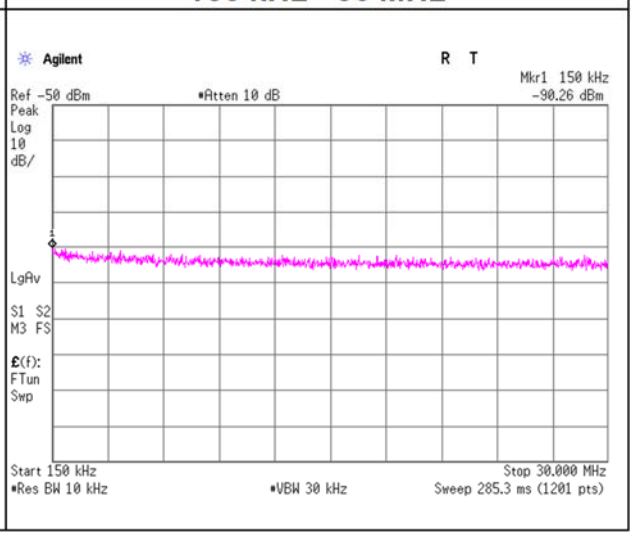
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	December 2, 2024
Temperature / Humidity	22 deg. C / 30 % RH
Engineer	Makoto Hosaka
Mode	Tx

BT LE 1M-PHY, 2440 MHz

9 kHz - 150 kHz



150 kHz - 30 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain * [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
11.23	-90.0	0.5	9.5	2.0	1.0	-78.0	300	6.0	-16.7	46.5	63.2	-
150.00	-90.3	0.5	9.5	2.0	1.0	-78.2	300	6.0	-17.0	24.0	41.0	-

E [dBuV/m] = EIRP [dBm] - 20 log (Distance [m]) + Ground bounce [dB] + 104.8 [dBuV/m]

EIRP[dBm] = Reading [dBm] + Cable loss [dB] + Attenuator Loss [dB] + 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	Shonan EMC Lab. No.5 Shielded Room
Date	December 2, 2024
Temperature / Humidity	22 deg. C / 30 % RH
Engineer	Makoto Hosaka
Mode	Tx

BT LE 1M-PHY

Frequency [MHz]	Measured Frequency [MHz]	Reading [dBm/3 kHz]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm/3 kHz]	Limit [dBm/3 kHz]	Margin [dB]
2402	2402.034	-25.39	0.88	9.63	-14.88	8.00	22.88
2440	2440.035	-25.32	0.89	9.64	-14.79	8.00	22.79
2480	2480.035	-25.26	0.89	9.64	-14.73	8.00	22.73

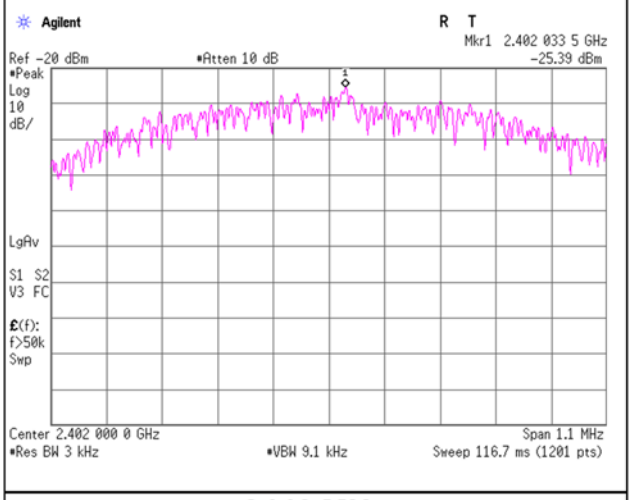
Sample Calculation:

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

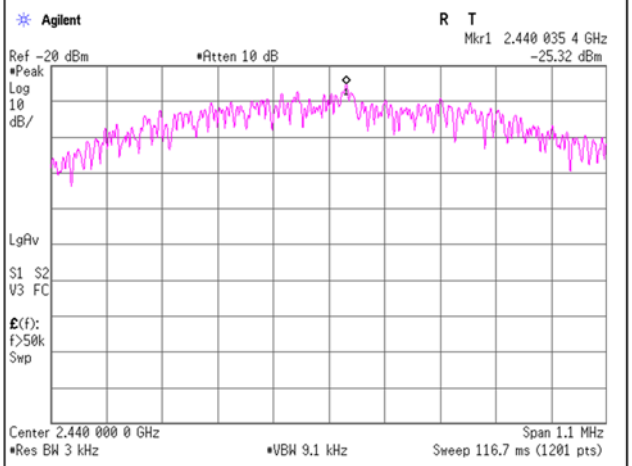
Power Density

BT LE 1M-PHY

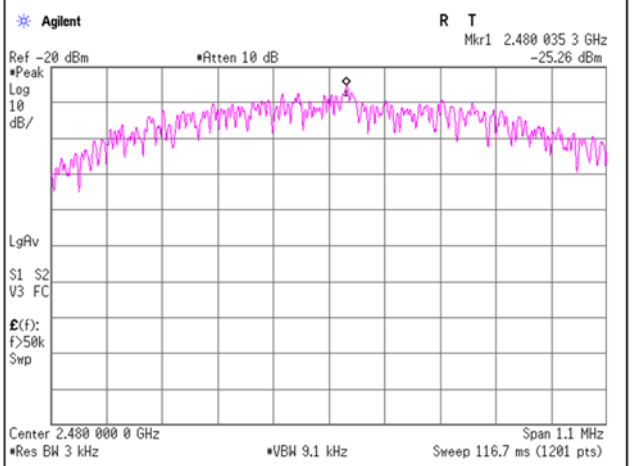
2402 MHz



2440 MHz



2480 MHz



APPENDIX 2: Test Instruments

Test Equipment

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
AT	145089	Spectrum Analyzer	Keysight Technologies Inc	E4446A	MY46180525	2024/08/19	12
AT	145132	Attenuator	Weinschel Corp.	54A-10	W5692	2024/10/10	12
AT	145174	Coaxial Cable	Suhner	SUCOFLEX 102	31595/2	2024/03/07	12
AT	146212	Digital Hitester	HIOKI E.E. CORPORATION	3805-50	80997828	2024/09/24	12
AT	146247	Power Meter	Keysight Technologies Inc	8990B	MY51000272	2024/05/14	12
AT	146310	Power sensor	Keysight Technologies Inc	N1923A	MY5326009	2024/05/14	12
AT	175822	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	-	2024/08/11	12
RE	145005	Pre Amplifier	Toyo Corporation	TPA0118-36	2046104	2024/02/16	12
RE	145007	Pre Amplifier	Toyo Corporation	HAP18-26W	19	2024/08/21	12
RE	145023	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	BBA9106	91032666	2024/05/10	12
RE	145126	Pre Amplifier	SONOMA	310N	290213	2024/02/07	12
RE	145136	Attenuator	Keysight Technologies Inc	8493C-010	74864	2024/10/10	12
RE	145176	Coaxial Cable	Suhner	SUCOFLEX 102	32703/2	2024/08/21	12
RE	145301	Highpass Filter	Micro-Tronics	HPM50111	51	2024/10/10	12
RE	145501	Horn Antenna	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	9120D-739	2024/03/20	12
RE	145512	Horn Antenna	ETS-Lindgren	3160-09	00094868	2024/06/20	12
RE	145529	Logperiodic Antenna	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	196	2024/05/10	12
RE	145565	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	2024/04/03	12
RE	145566	Semi-Anechoic Chamber	TDK	SAEC-03(SVSWR)	3	2024/05/23	12
RE	146210	Digital Hitester	HIOKI E.E. CORPORATION	3805-50	80997823	2024/09/24	12
RE	146432	Tape Measure	TAJIMA	GL19-55	-	-	-
RE	156380	Coaxial Cable	Huber+Suhner	SUCOFLEX_104_E	SN MY 13406/4E	2024/05/09	12
RE	170932	EMI Software	TSJ (Techno Science Japan)	TEPTO-DV3(RE,CE,ME,PE)	Ver 3.1.0546	-	-
RE	179540	Coaxial Cable	Huber+Suhner	SUCOFLEX 102	802815/2	2024/03/05	12
RE	191840	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	-	2024/08/12	12
RE	194685	Horn Antenna	Schwarzbeck Mess-Elektronik OHG	BBHA 9120 C	711	2024/03/20	12
RE	200010	Coaxial Cable	Huber+Suhner	SUCOFLEX 104	575618/4	2024/06/05	12
RE	213530	Test Receiver	Rohde & Schwarz	ESW44	103068	2024/02/22	12
RE	243217	Coaxial Cable	Hayashi-Repic co., Ltd.	SMS13-13A26-NMS13-9.0m	49306-01-04	2023/12/20	12
RE	248303	Attenuator	JFW	50HFFA-006-2/18N	-	2024/05/06	12
RE	253628	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/Suhner/TOYO	5D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-271(RF Selector)	2024/10/16	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:

AT: Antenna Terminal Conducted test
RE: Radiated Emission