RADIO TEST REPORT

Test Report No. 14568555S-A-R2

Customer	**TDK Corporation**
Description of EUT	**Network Controller**
Model Number of EUT	**Network Controller**
FCC ID	**2ADLX-NC0110013M**
Test Regulation	**FCC Part 15 Subpart C**
Test Result	**Complied (Refer to SECTION 3)**
Issue Date	**November 13, 2023**
Remarks	**-**

Representative Test Engineer	**Approved By**
Y. Tanikawara	K. Takeyama
Yusuke Tanikawara Engineer	Kazutaka Takeyama Leader

CERTIFICATE 1266.03

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

UL Japan, Inc. Shonan EMC Lab.
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 Japan / +81-463-50-6400

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REVISION HISTORY

Original Test Report No.: 14568555S-A

This report is a revised version of 14568555S-A-R1. 14568555S-A-R1 is replaced with this report.

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	14568555S-A	February 28, 2023	-
1	14568555S-A-R1	September 21, 2023	Page 5 ・ Corrected Description of EUT from “Equipment” to “Network Controller”. ・ Added “and September 1, 2023” to Receipt Date. ・ Corrected testing end date from “February 14, 2023” to “September 1, 2023”.
			Page 10 Corrected note about supply voltage during Conducted Emission test from “AC 120 V of the worst voltage” to “AC 240 V of the worst voltage”.
			Page 11 Added note *3) about antenna.
			Pages 5, 24, 40 to 45 Corrected antenna gain from 2.0 dBi to 2.33 dBi.
			Page 27 Corrected DCCF waveforms.
2	14568555S-A-R2	November 13, 2023	Page 11 Added detailed description of differences between W1010 and W1030 to note *3).

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	TDK Corporation
Address	2-15-7 Higashiohwada Ichikawa-shi Chiba, Japan
Telephone Number	+81-70-2260-5879
Contact Person	Michihiro Muramoto

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	Network Controller
Model Number	Network Controller
Serial Number	Refer to SECTION 4.2
Condition	Engineering prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	No Modification by the test lab
Receipt Date	December 19, 2022 and September 1, 2023
Test Date	December 19, 2022 to September 1, 2023

2.2 Product Description

General Specification

Rating	DC 4.75 V to 5.25 V
Operating temperature	-10 deg. C to 60 deg. C

Radio Specification

IEEE 802.15.4

Equipment Type	Transceiver
Frequency of Operation	2405 MHz to 2480 MHz
Type of Modulation	O-QPSK
Antenna Gain	2.33 dBi

Bluetooth (Low Energy)

Equipment Type	Transceiver
Frequency of Operation	2402 MHz to 2480 MHz
Type of Modulation	GFSK
Antenna Gain	2.33 dBi

* IEEE 802.15.4 and Bluetooth do not transmit simultaneously.

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	12.4 dB, 0.50018 MHz, L1 Mode : Tx IEEE 802.15.4, 2405 MHz	Complied a)	-
	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 b)	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 c)	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 d)	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)	5.4 dB 4960.000 MHz, PK, Hori. Mode : Tx BT LE 2M-PHY, 2480 MHz	Complied e), f)	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *1)
	ISED: RSS-Gen 6.13	**ISED:** RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10			

Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593.
* In case any questions arise about test procedure, ANSI C63.10: 2013 is also referred.

*1) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 15.247 Meas Guidance v05r02 8.5 and 8.6.

a) Refer to APPENDIX 1 (data of Conducted Emission)
b) Refer to APPENDIX 1 (data of 6 dB Bandwidth and 99 % Occupied Bandwidth)
c) Refer to APPENDIX 1 (data of Maximum Peak Output Power)
d) Refer to APPENDIX 1 (data of Power Density)
e) Refer to APPENDIX 1 (data of Conducted Spurious Emission)
f) Refer to APPENDIX 1 (data of Radiated Spurious Emission)

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

FCC Part 15.203 Antenna requirement
The EUT has a unique coupling/antenna connector (RP SMA).
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	- a)	Conducted
a) Refer to APPENDIX 1 (data of 6 dB Bandwidth and 99 % Occupied Bandwidth)					

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-30 MHz	3.1 dB
Radiated emission	9 kHz-30 MHz	3.3 dB
(Measurement distance: 3 m)	30 MHz-200 MHz	4.8 dB
	200 MHz-1 GHz	6.1 dB
	1 GHz-6 GHz	4.7 dB
	6 GHz-18 GHz	5.3 dB
	18 GHz-40 GHz	5.5 dB
Radiated emission	1 GHz-18 GHz	5.6 dB
(Measurement distance: 1 m)	18 GHz-40 GHz	5.8 dB

Antenna terminal test	Uncertainty (+/-)
Power Measurement above 1 GHz (Average Detector)_SPM-06	1.3 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-06	2.1 dB
Power Measurement above 1 GHz (Average Detector)_SPM-07	1.1 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-07	1.2 dB
Power Measurement above 1 GHz (Average Detector)_SPM-13	1.1 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-13	1.4 dB
Spurious emission (Conducted) below 1 GHz	0.84 dB
Conducted emissions Power Density Measurement 1 GHz-3 GHz	0.86 dB
Conducted emissions Power Density Measurement 3 GHz-18 GHz	2.4 dB
Spurious emission (Conducted) 18 GHz-26.5 GHz	2.4 dB
Spurious emission (Conducted) 26.5 GHz-40 GHz	2.2 dB
Bandwidth Measurement	0.012 %
Duty cycle and Time Measurement	0.27 %
Temperature_SCH-01	0.87 deg.C.
Humidity_SCH-01	3.5 %
Temperature_SCH-02	2.0 deg.C.
Humidity_SCH-02	6.7 %
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 site	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Semi-anechoic chamber	2973D-1	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.2 Semi-anechoic chamber	2973D-2	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.3 Semi-anechoic chamber	2973D-3	12.7 x 7.7 x 5.35	12.7 x 7.7	5 m
No.4 Semi-anechoic chamber	-	8.1 x 5.1 x 3.55	8.1 x 5.1	-
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	-	-

3.6 Test Data, Test Instruments, and Test Set Up

Refer to APPENDIX.

SECTION 4: Operation of EUT during testing

4.1 Operating Mode(s)

Mode	Remarks*
IEEE 802.15.4	Maximum Packet Size, PRBS9
Bluetooth Low Energy (BLE) 2M-PHY Uncoded PHY (2M-PHY)	Maximum Packet Size, PRBS9
*Power of the EUT was set by the software as follows; Power Setting: 5 dBm Software: SmartRF Studio 7 Version: 2.27.0 (Date: 2022.10 07, Storage location: Driven by connected PC) *This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.	

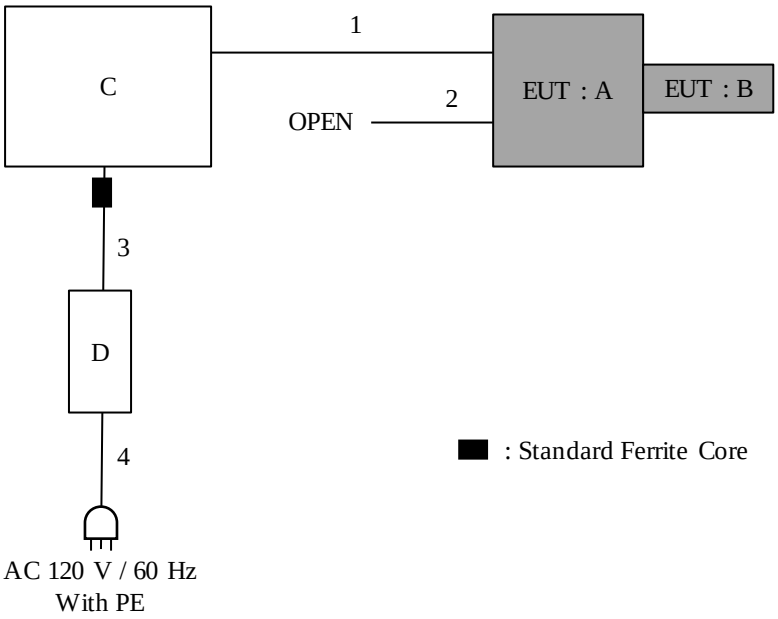
*The Details of Operating Mode(s)

Test Item	Operating Mode	Tested frequency
Conducted Emission, Radiated Spurious Emission (Below 1 GHz)	Tx IEEE 802.15.4 *1)	2405 MHz
	Tx BLE, 2M-PHY *1)	2402 MHz
Radiated Spurious Emission (Above 1 GHz), Maximum Peak Output Power, Power Density, 6 dB Bandwidth, 99 % Occupied Bandwidth, Conducted Spurious Emission	Tx IEEE 802.15.4	2405 MHz 2440 MHz 2480 MHz
	Tx BLE, 2M-PHY	2402 MHz 2440 MHz 2480 MHz

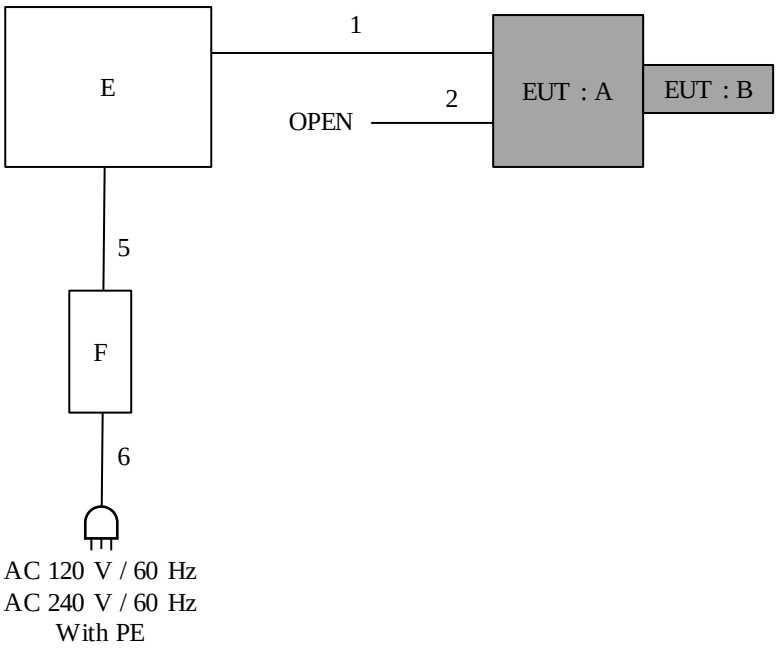
*1) The mode was tested as a representative, because it had the highest power at antenna terminal test.

4.2 Configuration and Peripherals

Other than Conducted Emission test



Conducted Emission test



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

*As a result of comparing AC 120 V and AC 240 V at pre-check, conducted emission test was performed with AC 240 V of the worst voltage as representative.

Description of EUT and Support Equipment

No.	Item	Model number	Serial Number	Manufacturer	Remarks
A	Network Controller	Network Controller	NC 001 *1) NC 003 *2)	TDK Corporation	EUT
B	Antenna	W1010	WK282022	Pulse Electronics	EUT *3)
C	Laptop PC	DX-C3	723450-25086	THIRDWAVE	-
D	AC Adapter	A18-045N2A	CNYAAG19023C 169014T00829	Chiconya POWER TECHNOLOGY	-
E	Laptop PC	E1Q57PA#ABJ	5CB3310KHW	HP	-
F	AC Adapter	PPP009L-E	3453442403	HP	-

*1) Used for Antenna Terminal conducted test, Conducted Emission test and Radiated Emission test.
*2) Used for Duty cycle correction factor test.
*3) W1010 (used only for the tests) is the same as W1030 (to be used for the production model) except for the antenna connector part: W1010 is the SMA-type model and W1030 is the reverse SMA-type model.

List of Cables Used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	USB	1.0 + 2.0 1.0 *3)	Shielded	Shielded	-
2	Signal	0.2	Unshielded	Unshielded	-
3	DC	1.5	Unshielded	Unshielded	-
4	AC	0.9	Unshielded	Unshielded	-
5	DC	1.7	Unshielded	Unshielded	-
6	AC	1.0	Unshielded	Unshielded	-

*3) Used for Conducted Emission test.

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 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).

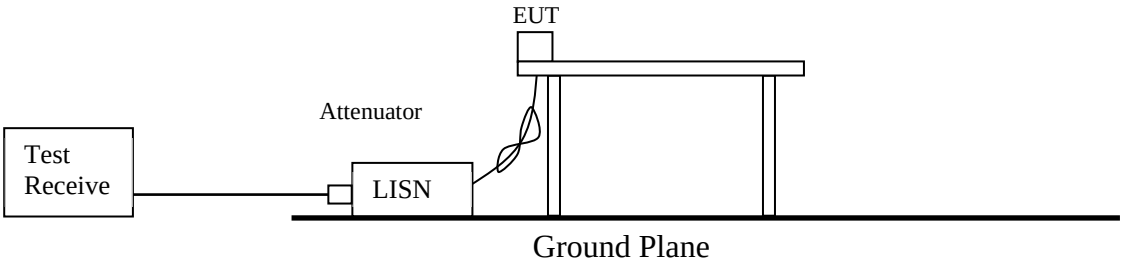
For the tests on EUT with other peripherals (as a whole system)
I/O cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane. All unused 50ohm connectors of the LISN (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 Shielded Room.
The EUT was connected to a LISN (AMN).
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	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.

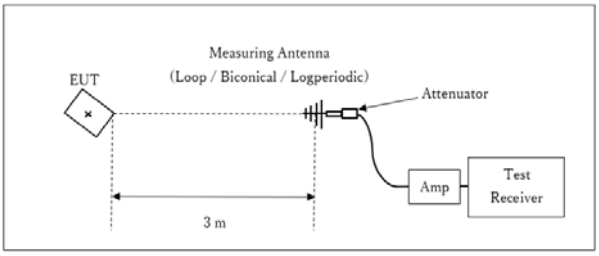
20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9(ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).

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	*1)	RBW: 100 kHz VBW: 300 kHz

*1) Measurement with Average detector was not performed. The limit for Average detector is applied to the measurement value with Peak detector used Duty cycle correction factor (DCCF).

Figure 2: Test Setup

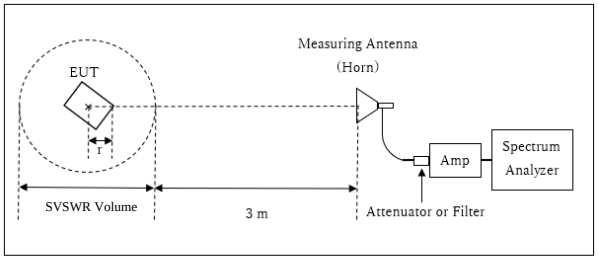
Below 1 GHz



× : Center of turn table

Test Distance: 3 m

1 GHz to 10 GHz

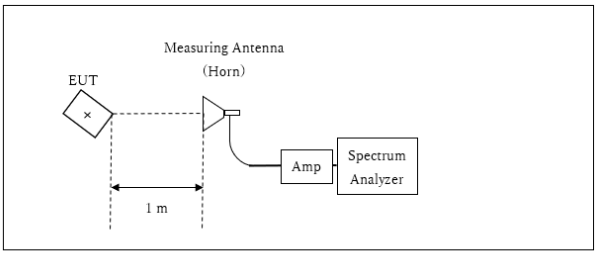


r : Radius of an outer periphery of EUT
× : Center of turn table

Distance Factor: 20 x log (3.93 m / 3.0 m) = 2.35 dB
* Test Distance: (3 + SVSWR Volume /2) - r = 3.93 m

SVSWR Volume : 2.0 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
r = 0.07 m

10 GHz to 26.5 GHz



× : Center of turn table

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, 0 deg and 90 deg of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

IEEE 802.15.4

	Horizontal	Vertical
Below 1 GHz	Axis Y / 0 deg	Axis Y / 0 deg
1 GHz - 10 GHz	Axis Y / 0 deg	Axis Z / 0 deg
Above 10 GHz	Axis X / 0 deg	Axis X / 0 deg

BT LE

	Horizontal	Vertical
Below 1 GHz	Axis Y / 0 deg	Axis Y / 0 deg
1 GHz - 2.8 GHz	Axis Y / 0 deg	Axis Z / 0 deg
2.8 GHz - 10 GHz	Axis X / 0 deg	Axis Z / 0 deg
Above 10 GHz	Axis X / 0 deg	Axis X / 0 deg

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
6 dB Bandwidth	5 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 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 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.

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

DATA OF CONDUCTED EMISSION TEST

UL Japan,Inc. Shonan EMC Lab. No.2 Shielded Room
Date : 2023/02/14

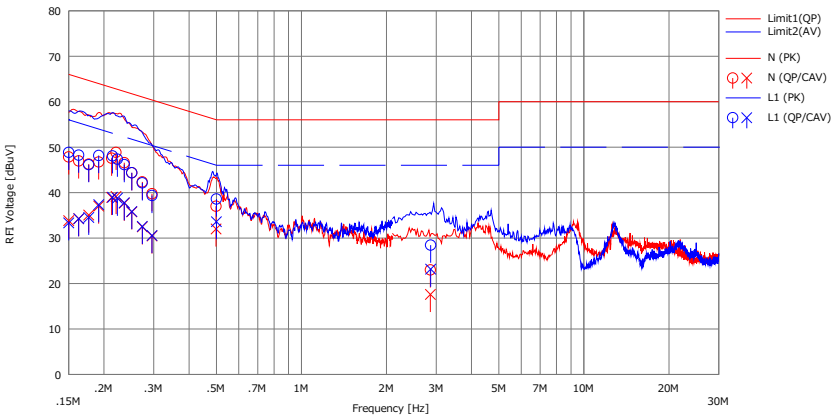
Mode : Tx IEEE 802.15.4, 2405 MHz

Power : AC 240 V / 60 Hz (AC Adapter)
Temp./Humi. : 25 deg.C / 26 %RH

Remarks : -

Limit : FCC_Part 15 Subpart C(15.207)

Engineer : Yusuke Tanikawara



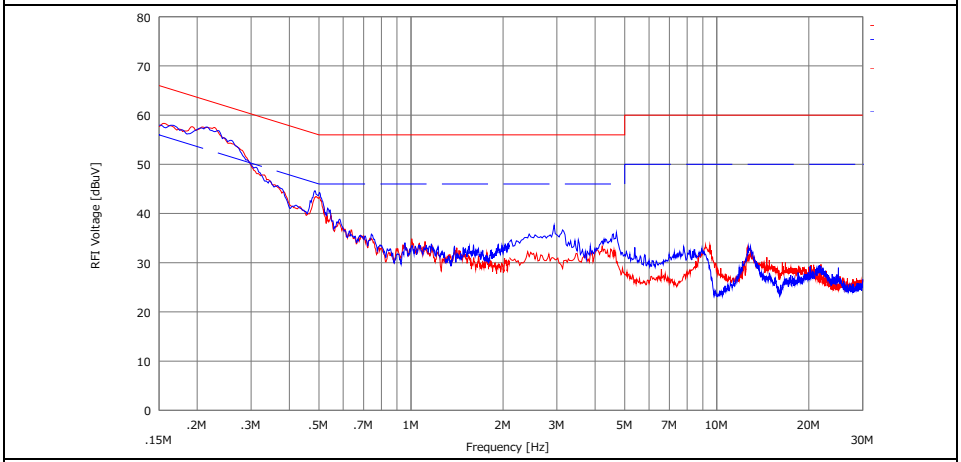
No.	Freq.	Reading ⟨QP⟩	Reading ⟨CAV⟩	C.Fac	Results ⟨QP⟩	Results ⟨CAV⟩	Limit ⟨QP⟩	Limit ⟨AV⟩	Margin ⟨QP⟩	Margin ⟨AV⟩	Phase	Comment
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.15000	35.40	21.40	12.43	47.83	33.83	66.00	56.00	18.1	22.1	N	
2	0.16278	34.50	21.80	12.44	46.94	34.24	65.32	55.32	18.3	21.0	N	
3	0.17673	33.80	22.60	12.44	46.24	35.04	64.64	54.64	18.4	19.6	N	
4	0.19168	34.30	24.60	12.43	46.73	37.03	63.96	53.96	17.2	16.9	N	
5	0.21291	35.10	26.50	12.44	47.54	38.94	63.09	53.09	15.5	14.1	N	
6	0.22070	36.40	26.70	12.44	48.84	39.14	62.79	52.79	13.9	13.6	N	
7	0.23602	34.10	25.20	12.45	46.55	37.65	62.24	52.24	15.6	14.5	N	
8	0.25091	31.90	23.30	12.45	44.35	35.75	61.73	51.73	17.3	15.9	N	
9	0.27338	29.90	20.00	12.45	42.35	32.45	61.01	51.01	18.6	18.5	N	
10	0.29591	27.30	18.00	12.45	39.75	30.45	60.36	50.36	20.6	19.9	N	
11	0.49862	24.50	19.50	12.49	36.99	31.99	56.02	46.02	19.0	14.0	N	
12	2.86035	10.30	4.90	12.67	22.97	17.57	56.00	46.00	33.0	28.4	N	
13	0.15000	36.40	20.90	12.45	48.85	33.35	66.00	56.00	17.1	22.6	L1	
14	0.16278	35.80	21.80	12.44	48.24	34.24	65.32	55.32	17.0	21.0	L1	
15	0.17673	33.70	22.10	12.44	46.14	34.54	64.64	54.64	18.5	20.1	L1	
16	0.19168	35.70	24.90	12.45	48.15	37.35	63.96	53.96	15.8	16.6	L1	
17	0.21433	35.60	26.50	12.46	48.06	38.96	63.04	53.04	14.9	14.0	L1	
18	0.22305	34.90	26.30	12.46	47.36	38.76	62.70	52.70	15.3	13.9	L1	
19	0.23602	33.70	25.30	12.45	46.15	37.75	62.24	52.24	16.0	14.4	L1	
20	0.25091	31.90	23.40	12.45	44.35	35.85	61.73	51.73	17.3	15.8	L1	
21	0.27338	29.70	20.10	12.45	42.15	32.55	61.01	51.01	18.8	18.4	L1	
22	0.29591	26.90	18.10	12.46	39.36	30.56	60.36	50.36	21.0	19.8	L1	
23	0.50018	26.10	21.10	12.49	38.59	33.59	56.00	46.00	17.4	12.4	L1	
24	2.86750	15.80	10.50	12.64	28.44	23.14	56.00	46.00	27.5	22.8	L1	

Calculation:Result[dBuV]=Reading[dBuV]+C.Fac(LISN(AMN)+Cable+ATT)[dB]
LISN(AMN)=SLS-03

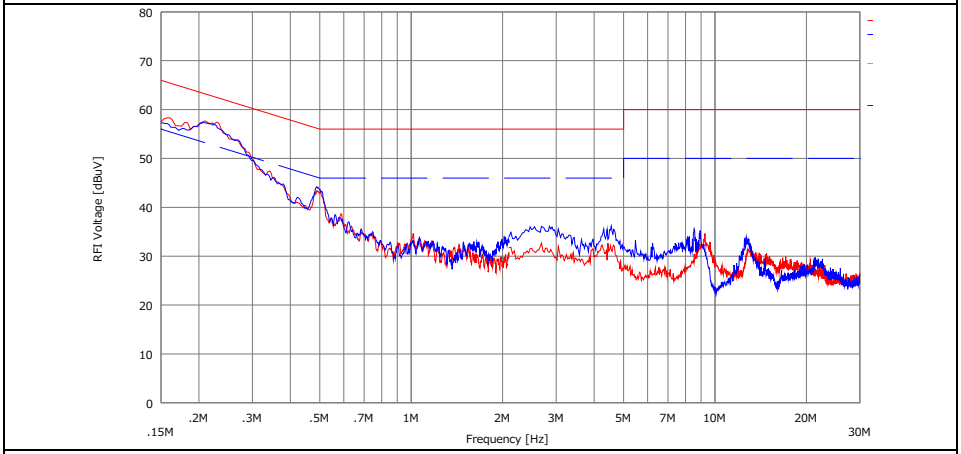
Conducted Emission

Test place	Shonan EMC Lab. No.2 Shielded Room
Date	February 13, 2023
Temperature / Humidity	25 deg. C / 26 % RH
Engineer	Yusuke Tanikawara
Mode	Tx IEEE 802.15.4

2405 MHz



2440 MHz



2480 MHz

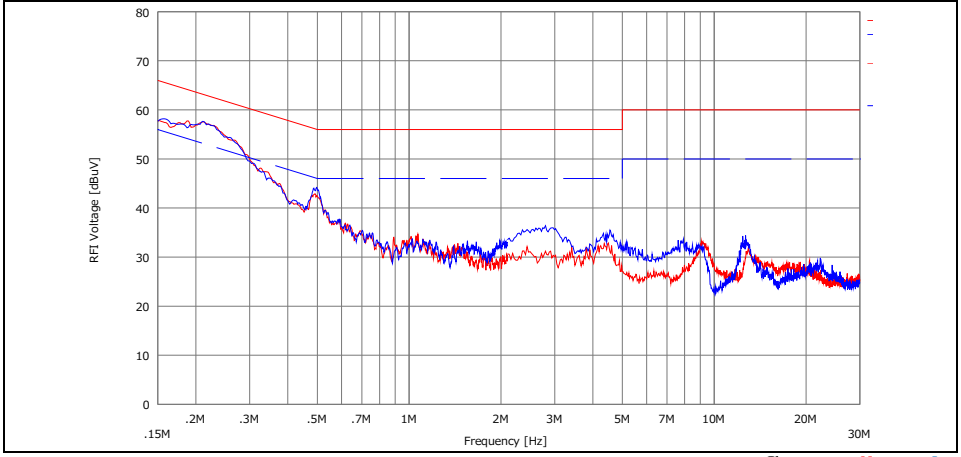


Chart — N — L

Conducted Emission

DATA OF CONDUCTED EMISSION TEST

UL Japan,Inc. Shonan EMC Lab. No.2 Shielded Room
Date : 2023/02/13

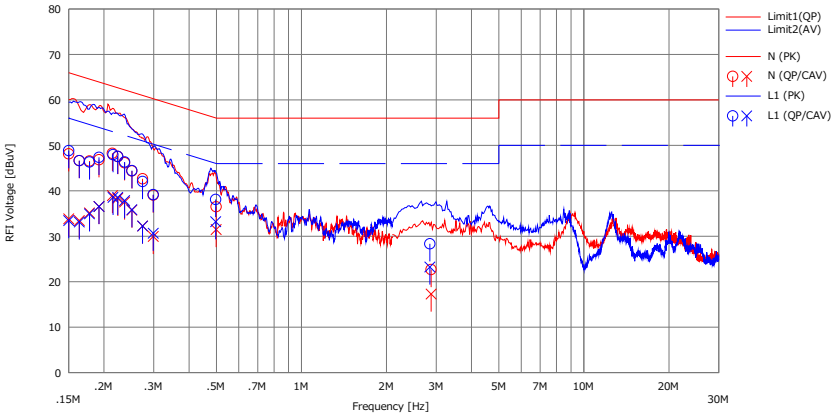
Mode : Tx BT LE 2M-PHY, 2402 MHz

Power : AC 240 V / 60 Hz (AC Adapter)
Temp./Humi. : 25 deg.C / 26 %RH

Remarks : -

Limit : FCC_Part 15 Subpart C(15.207)

Engineer : Yusuke Tanikawara



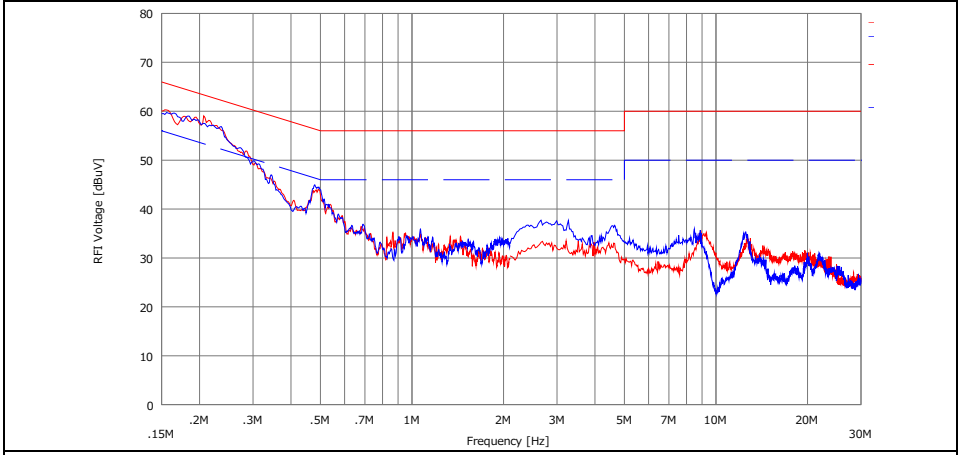
No.	Freq.	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		(QP)	(CAV)		(QP)	(CAV)	(QP)	(AV)	(QP)	(AV)		
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.15000	35.70	21.40	12.43	48.13	33.83	66.00	56.00	17.8	22.1	N	
2	0.16353	34.20	21.00	12.44	46.64	33.44	65.28	55.28	18.6	21.8	N	
3	0.17772	34.10	22.70	12.44	46.54	35.14	64.59	54.59	18.0	19.4	N	
4	0.19207	34.40	24.10	12.43	46.83	36.53	63.95	53.95	17.1	17.4	N	
5	0.21416	35.80	26.50	12.44	48.24	38.94	63.04	53.04	14.8	14.1	N	
6	0.22380	35.10	25.90	12.44	47.54	38.34	62.68	52.68	15.1	14.3	N	
7	0.23664	33.70	25.10	12.45	46.15	37.55	62.21	52.21	16.0	14.6	N	
8	0.25102	31.90	23.30	12.45	44.35	35.75	61.72	51.72	17.3	15.9	N	
9	0.27400	30.20	19.80	12.45	42.65	32.25	61.00	51.00	18.3	18.7	N	
10	0.29889	26.60	17.50	12.45	39.05	29.95	60.27	50.27	21.2	20.3	N	
11	0.49888	24.00	19.00	12.49	36.49	31.49	56.02	46.02	19.5	14.5	N	
12	2.87771	10.00	4.60	12.68	22.68	17.28	56.00	46.00	33.3	28.7	N	
13	0.15000	36.40	21.00	12.45	48.85	33.45	66.00	56.00	17.1	22.5	L1	
14	0.16353	34.20	20.70	12.44	46.64	33.14	65.28	55.28	18.6	22.1	L1	
15	0.17772	33.90	22.50	12.44	46.34	34.94	64.59	54.59	18.2	19.6	L1	
16	0.19207	34.90	24.10	12.45	47.35	36.55	63.95	53.95	16.6	17.4	L1	
17	0.21521	35.50	26.10	12.46	47.96	38.56	63.00	53.00	15.0	14.4	L1	
18	0.22365	35.10	26.10	12.46	47.56	38.56	62.68	52.68	15.1	14.1	L1	
19	0.23664	33.90	25.40	12.45	46.35	37.85	62.21	52.21	15.8	14.3	L1	
20	0.25102	32.00	23.40	12.45	44.45	35.85	61.72	51.72	17.2	15.8	L1	
21	0.27400	29.60	19.80	12.45	42.05	32.25	61.00	51.00	18.9	18.7	L1	
22	0.29889	26.70	18.20	12.46	39.16	30.66	60.27	50.27	21.1	19.6	L1	
23	0.49718	25.60	20.70	12.49	38.09	33.19	56.05	46.05	17.9	12.8	L1	
24	2.84920	15.70	10.60	12.64	28.34	23.24	56.00	46.00	27.6	22.7	L1	

Calculation:Result[dBuV]=Reading[dBuV]+C.Fac(LISN(AMN)+Cable+ATT)[dB]
LISN(AMN)=SLS-03

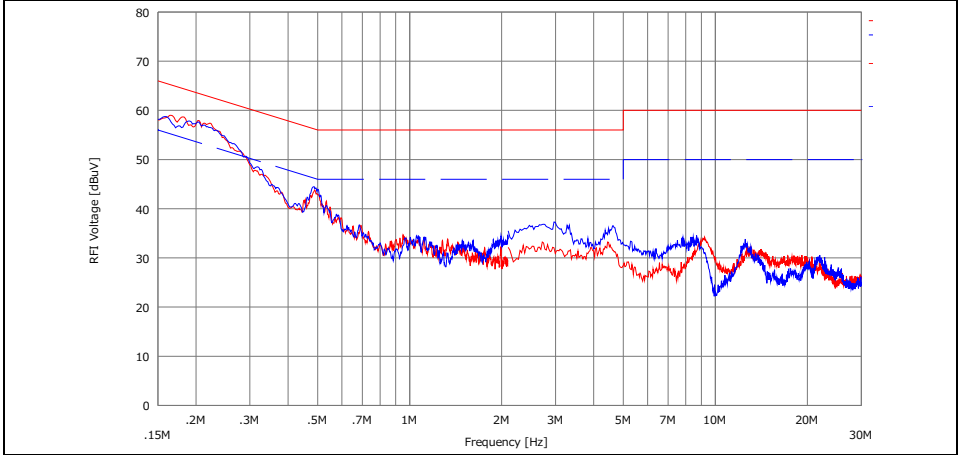
Conducted Emission

Test place	Shonan EMC Lab. No.2 Shielded Room
Date	February 13, 2023
Temperature / Humidity	25 deg. C / 26 % RH
Engineer	Yusuke Tanikawara
Mode	Tx BT LE

2402 MHz



2440 MHz



2480 MHz

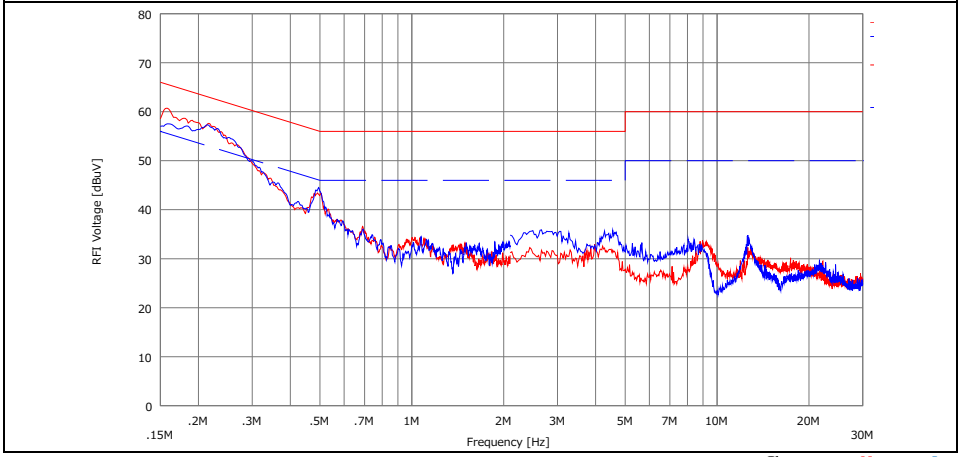


Chart — N — L

99 % Occupied Bandwidth and 6 dB Bandwidth

Test place	Shonan EMC Lab. No.5 Shielded Room
Date	December 21, 2022
Temperature / Humidity	23 deg. C / 34 % RH
Engineer	Yosuke Murakami
Mode	Tx

IEEE 802.15.4

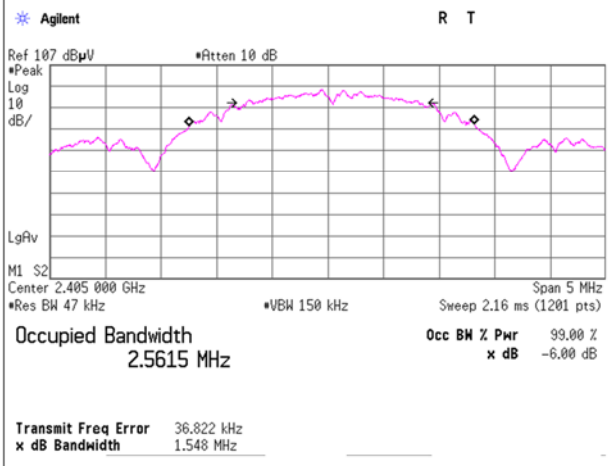
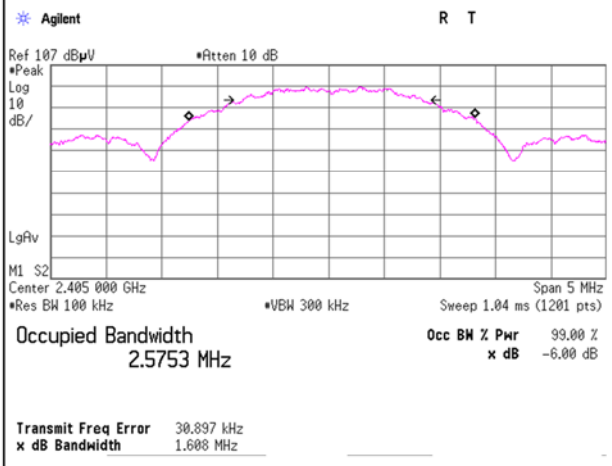
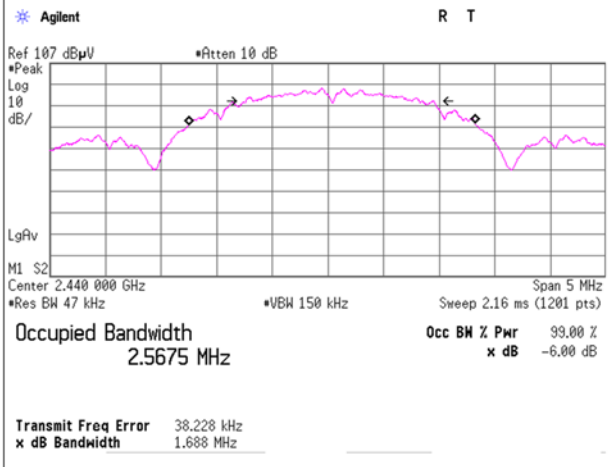
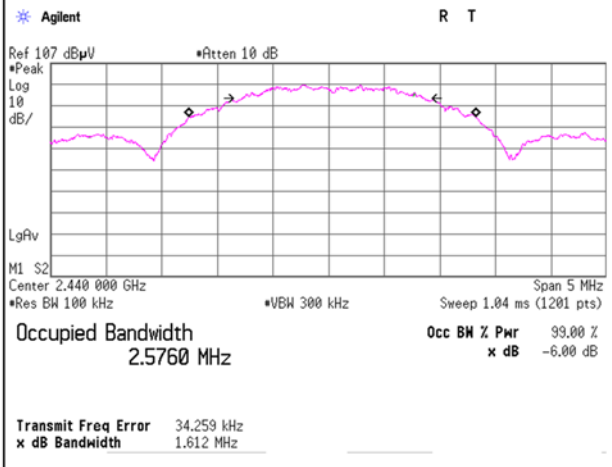
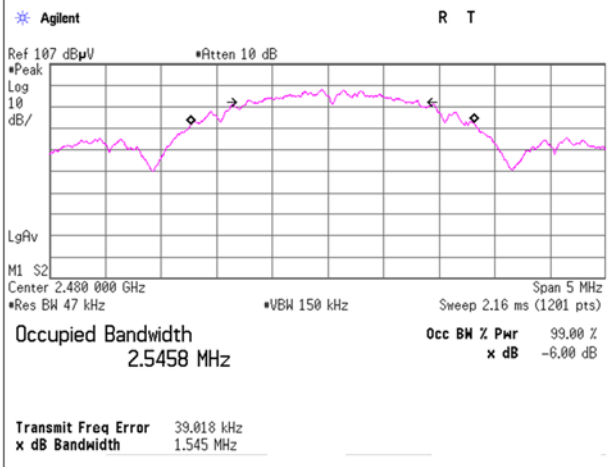
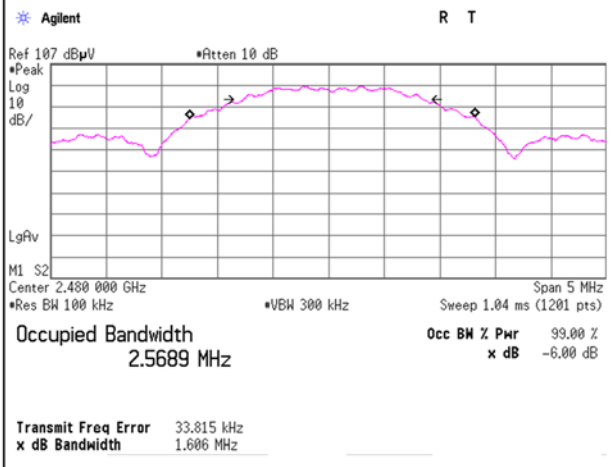
Frequency [MHz]	99 % Occupied Bandwidth [kHz]	6 dB Bandwidth [MHz]	Limit for 6 dB Bandwidth [MHz]
2405	2561.5	1.608	> 0.5000
2440	2567.5	1.612	> 0.5000
2480	2545.8	1.606	> 0.5000

BT LE 2 M-PHY

Frequency [MHz]	99 % Occupied Bandwidth [kHz]	6 dB Bandwidth [MHz]	Limit for 6 dB Bandwidth [MHz]
2402	2054.7	1.381	> 0.5000
2440	2071.3	1.383	> 0.5000
2480	2067.2	1.316	> 0.5000

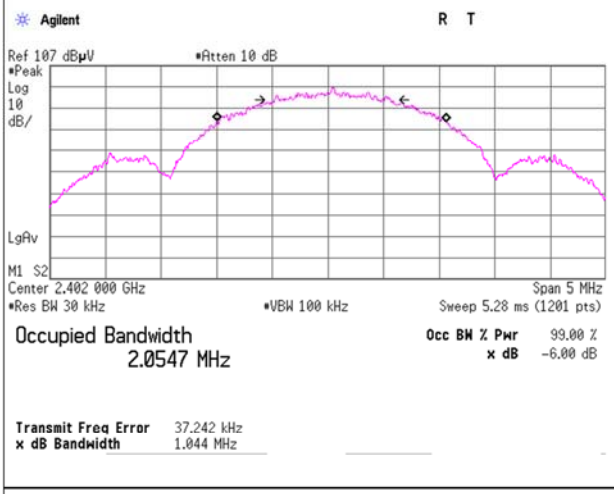
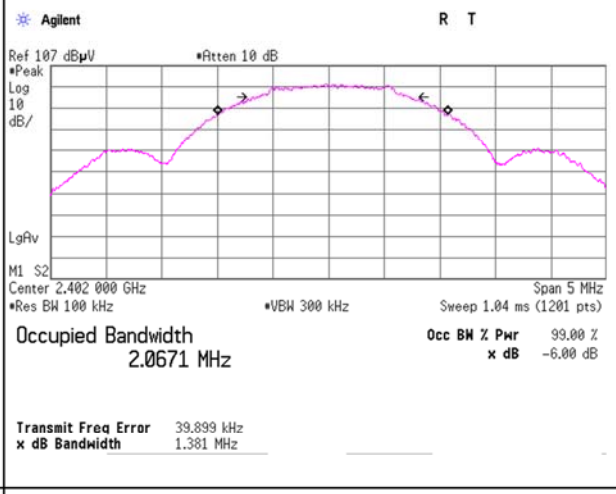
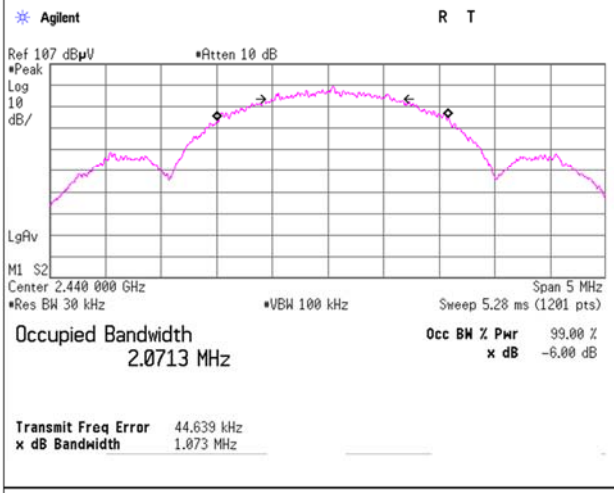
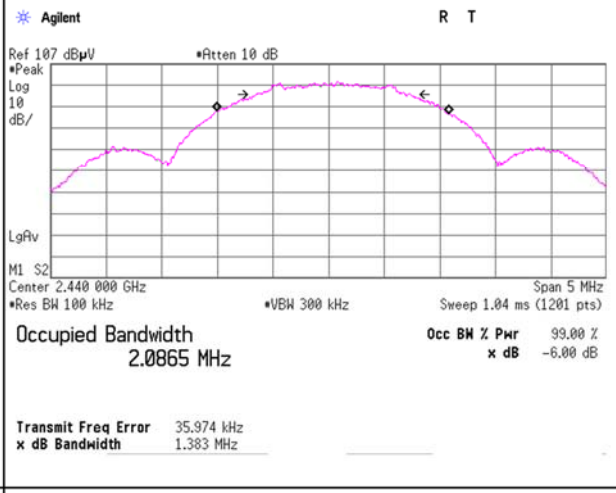
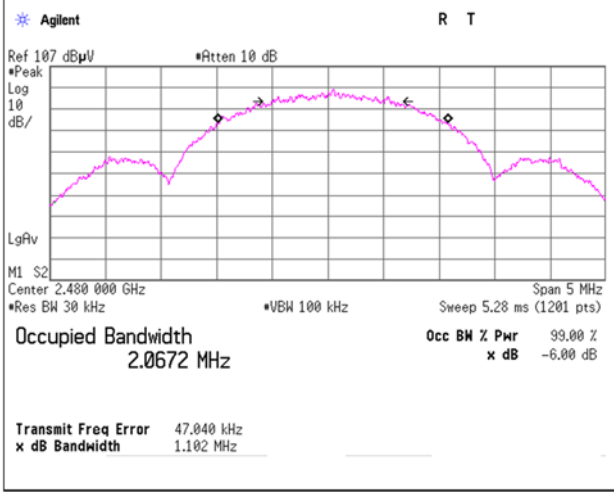
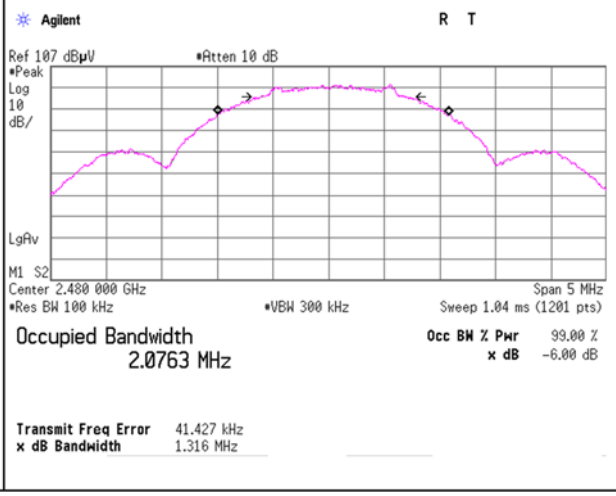
99 % Occupied Bandwidth and 6 dB Bandwidth

IEEE 802.15.4

99 % Occupied Bandwidth	6 dB Bandwidth
2405 MHz	2405 MHz
	
2440 MHz	2440 MHz
	
2480 MHz	2480 MHz
	

99 % Occupied Bandwidth and 6 dB Bandwidth

BT LE 2 M-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.1 Shielded Room
Date	December 19, 2022
Temperature / Humidity	25 deg. C / 46 % RH
Engineer	Yosuke Murakami
Mode	Tx

IEEE 802.15.4

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]
2405	-6.61	1.34	9.64	4.37	2.74	30.00	1000	25.63	2.33	6.70	4.68	36.02	4000	29.32
2440	-6.65	1.35	9.64	4.34	2.72	30.00	1000	25.66	2.33	6.67	4.65	36.02	4000	29.35
2480	-6.79	1.36	9.64	4.21	2.64	30.00	1000	25.79	2.33	6.54	4.51	36.02	4000	29.48

Sample Calculation:

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

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

*The equipment and cables were not used for factor 0 dB of the data sheets.

All comparison were carried out on same frequency and measurement factors.

BT LE 2 M-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	-6.61	1.34	9.64	4.37	2.74	30.00	1000	25.63	2.33	6.70	4.68	36.02	4000	29.32
2440	-6.74	1.35	9.64	4.25	2.66	30.00	1000	25.75	2.33	6.58	4.55	36.02	4000	29.44
2480	-6.83	1.36	9.64	4.17	2.61	30.00	1000	25.83	2.33	6.50	4.47	36.02	4000	29.52

Sample Calculation:

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

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

*The equipment and cables were not used for factor 0 dB of the data sheets.

All comparison were carried out on same frequency and measurement factors.

Average Output Power
(Reference data for RF Exposure)

Test place	Shonan EMC Lab. No.1 Shielded Room
Date	December 19, 2022
Temperature / Humidity	25 deg. C / 46 % RH
Engineer	Yosuke Murakami
Mode	Tx

IEEE 802.15.4

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]
2405	-6.82	1.34	9.64	4.16	2.61	0.00	4.16	2.61
2440	-6.86	1.35	9.64	4.13	2.59	0.00	4.13	2.59
2480	-6.96	1.36	9.64	4.04	2.54	0.00	4.04	2.54

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

BT LE 2 M-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	-6.89	1.34	9.64	4.09	2.56	0.00	4.09	2.56
2440	-6.85	1.35	9.64	4.14	2.59	0.00	4.14	2.59
2480	-6.95	1.36	9.64	4.05	2.54	0.00	4.05	2.54

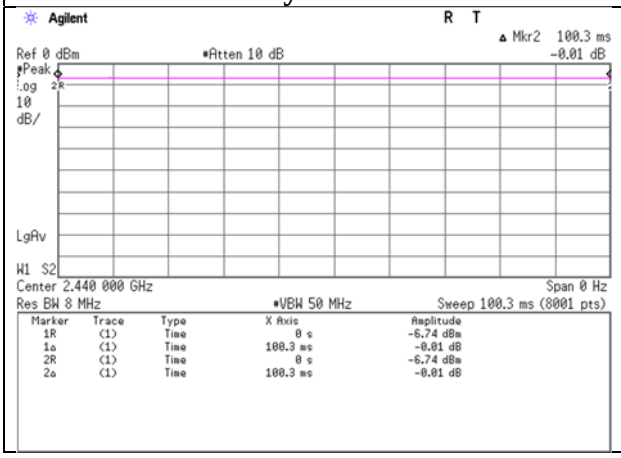
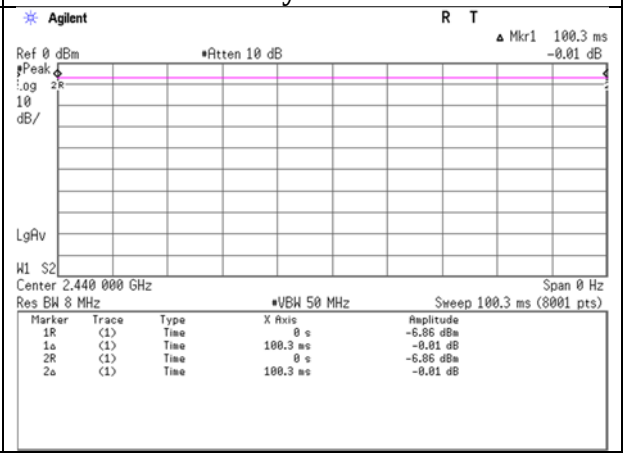
Sample Calculation:

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	December 21, 2022
Temperature / Humidity	23 deg. C / 34 % RH
Engineer	Yosuke Murakami
Mode	Tx

IEEE 802.15.4	BT LE 2 M - PHY
Duty 100 %	Duty 100 %
	

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

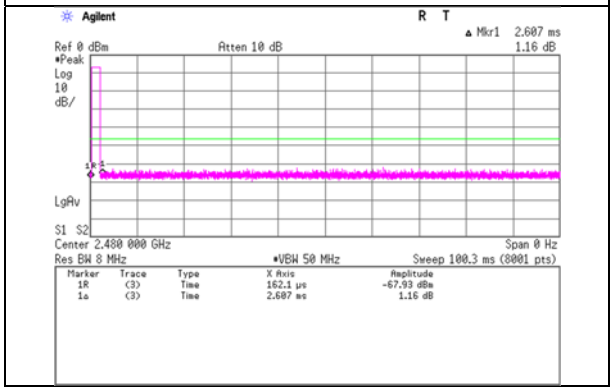
Duty cycle correction factor

(for Spurious emissions)

Test place	Shonan EMC Lab. No.5 Shielded Room
Date	September 1, 2023
Temperature / Humidity	26 deg. C / 44 % RH
Engineer	Kouki Yamada
Mode	Tx

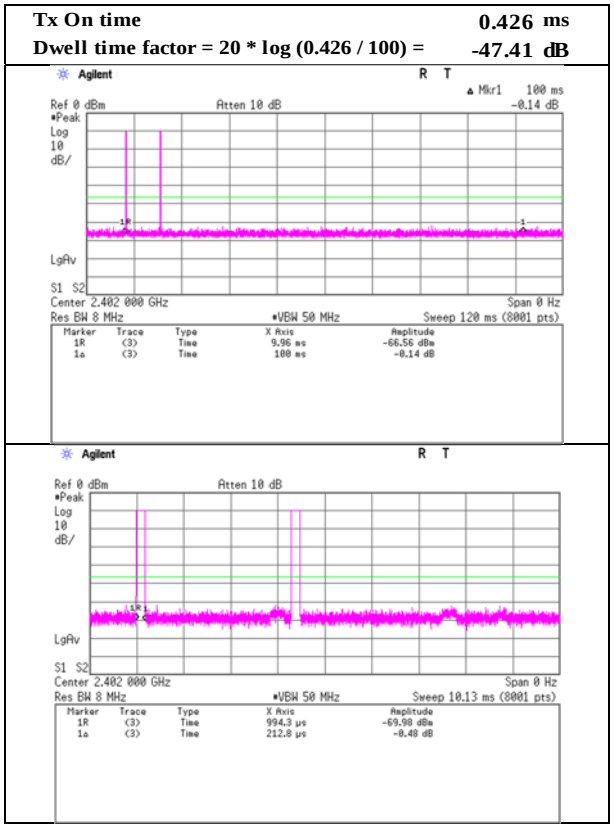
Worst 100 ms (reference chart)
IEEE 802.15.4

Tx On time **2.607 ms**
Dwell time factor = 20 * log (2.607 / 100) = **-31.67 dB**



Worst 100 ms (reference chart)
BT LE 2M-PHY

Tx On time **0.426 ms**
Dwell time factor = 20 * log (0.426 / 100) = **-47.41 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	No.3	No.3	No.2	No.3
Date	February 9, 2023	February 8, 2023	December 24, 2022	February 8, 2023
Temperature / Humidity	21 deg. C / 26 % RH	22 deg. C / 25 % RH	25 deg. C / 28 % RH	24 deg. C / 25 % RH
Engineer	Kouki Yamada	Kouki Yamada	Miku Ikudome	Shiro Kobayashi
	(Below 1 GHz)	(1 GHz - 2.8 GHz)	(2.8 GHz - 10 GHz)	(10 GHz - 26.5 GHz)
Mode	Tx IEEE 802.15.4 2405 MHz			

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	31.985	QP	22.00	17.95	6.50	32.17	0.00	14.28	40.0	25.7	100	351	-
Hori.	372.697	QP	32.30	15.11	8.96	31.91	0.00	24.46	46.0	21.5	100	100	-
Hori.	880.425	QP	20.30	22.05	10.90	31.09	0.00	22.16	46.0	23.8	100	2	-
Hori.	2390.000	PK	49.12	28.18	14.71	41.63	2.35	52.73	73.9	21.1	140	80	-
Hori.	4810.000	PK	57.47	31.91	6.55	38.64	2.35	59.64	73.9	14.2	193	266	-
Hori.	7215.000	PK	57.15	37.58	8.03	39.24	2.35	65.87	73.9	**8.0**	165	90	-
Vert.	58.598	QP	38.30	8.58	6.61	32.14	0.00	21.35	40.0	18.6	100	189	-
Vert.	364.244	QP	32.80	15.13	8.92	31.91	0.00	24.94	46.0	21.0	165	301	-
Vert.	368.478	QP	34.30	15.11	8.94	31.91	0.00	26.44	46.0	19.5	164	294	-
Vert.	372.716	QP	35.40	15.11	8.96	31.91	0.00	27.56	46.0	18.4	165	205	-
Vert.	375.539	QP	34.10	15.13	8.97	31.91	0.00	26.29	46.0	19.7	160	203	-
Vert.	376.952	QP	35.20	15.13	8.98	31.91	0.00	27.40	46.0	18.6	159	210	-
Vert.	379.774	QP	34.70	15.18	8.99	31.91	0.00	26.96	46.0	19.0	159	207	-
Vert.	384.010	QP	34.40	15.26	9.01	31.91	0.00	26.76	46.0	19.2	162	270	-
Vert.	957.088	QP	20.00	22.02	11.14	30.59	0.00	22.57	46.0	23.4	100	355	-
Vert.	2390.000	PK	48.00	28.18	14.71	41.63	2.35	51.61	73.9	22.2	342	354	-
Vert.	4810.000	PK	57.70	31.91	6.55	38.64	2.35	59.87	73.9	14.0	276	145	-
Vert.	7215.000	PK	56.52	37.58	8.03	39.24	2.35	65.24	73.9	8.6	148	65	-

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.93 m / 3.0 m) = 2.35 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

Peak measurement value with Duty cycle correction factor (DCCF)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	DCCF [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2390.000	PK	49.12	28.18	14.71	41.63	-31.67	2.35	21.06	53.9	32.8	*1)
Hori.	4810.000	PK	57.47	31.91	6.55	38.64	-31.67	2.35	27.97	53.9	25.9	-
Hori.	7215.000	PK	57.15	37.58	8.03	39.24	-31.67	2.35	34.20	53.9	19.7	-
Vert.	2390.000	PK	48.00	28.18	14.71	41.63	-31.67	2.35	19.94	53.9	33.9	*1)
Vert.	4810.000	PK	57.70	31.91	6.55	38.64	-31.67	2.35	28.20	53.9	25.7	-
Vert.	7215.000	PK	56.52	37.58	8.03	39.24	-31.67	2.35	33.57	53.9	20.3	-

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + DCCF + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.93 m / 3.0 m) = 2.35 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB
Duty cycle correction factor (DCCF) refer to "Duty cycle correction factor" sheet.
*1) Not out of band emission (Leakage Power)

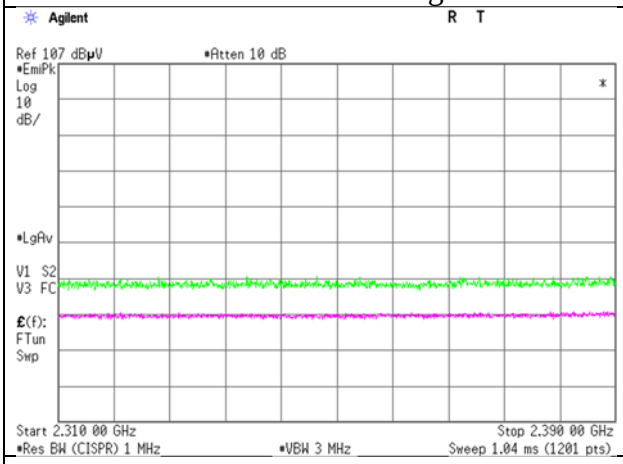
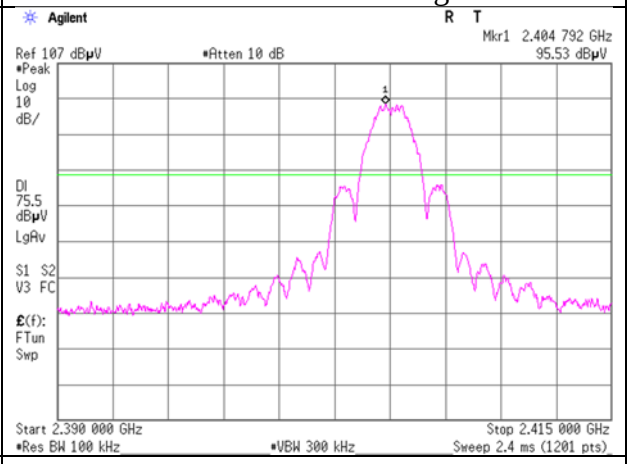
20 dBc Data Sheet **(RBW 100 kHz, VBW 300 kHz)**

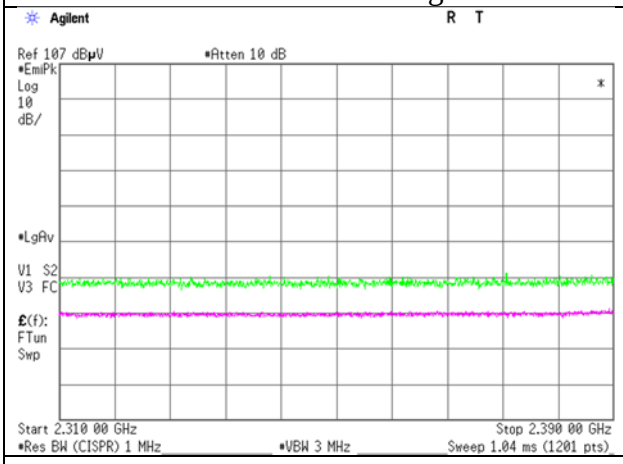
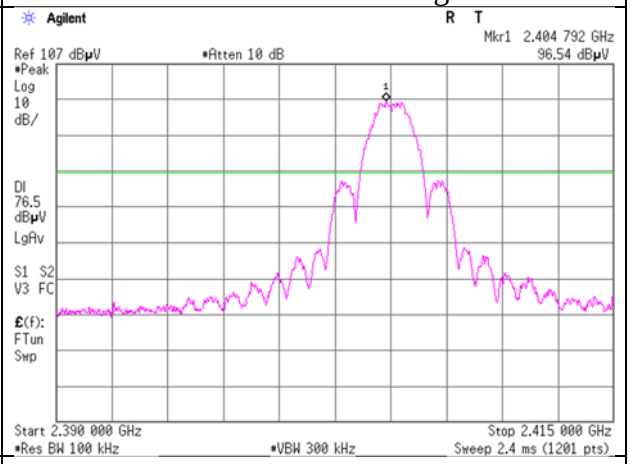
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2405.000	PK	94.77	28.17	14.73	41.64	2.35	98.38	-	-	Carrier
Hori.	2400.000	PK	46.81	28.17	14.72	41.64	2.35	50.41	78.3	27.8	-
Vert.	2405.000	PK	95.73	28.17	14.73	41.64	2.35	99.34	-	-	Carrier
Vert.	2400.000	PK	47.72	28.17	14.72	41.64	2.35	51.32	79.3	27.9	-

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.93 m / 3.0 m) = 2.35 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.3
Date	February 8, 2023
Temperature / Humidity	22 deg. C / 25 % RH
Engineer	Kouki Yamada
	(1 GHz - 2.8 GHz)
Mode	Tx IEEE 802.15.4 2405 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 was shown in tabular data.

Radiated Spurious Emission

Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No.3	No.2	No.3
Date	February 8, 2023	December 24, 2022	February 8, 2023
Temperature / Humidity	22 deg. C / 25 % RH	25 deg. C / 28 % RH	24 deg. C / 25 % RH
Engineer	Kouki Yamada	Miku Ikudome	Shiro Kobayashi
	(1 GHz - 2.8 GHz)	(2.8 GHz - 10 GHz)	(10 GHz - 26.5 GHz)
Mode	Tx IEEE 802.15.4 2440 MHz		

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	4880.000	PK	60.25	31.92	6.60	38.68	2.35	62.44	73.9	11.4	143	297	-
Hori.	7320.000	PK	54.21	37.66	8.09	39.28	2.35	63.03	73.9	**10.8**	107	91	-
Vert.	4880.000	PK	60.05	31.92	6.60	38.68	2.35	62.24	73.9	11.6	220	295	-
Vert.	7320.000	PK	53.38	37.66	8.09	39.28	2.35	62.20	73.9	11.7	187	130	-

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.93 m / 3.0 m) = 2.35 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

Peak measurement value with Duty cycle correction factor (DCCF)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	DCCF [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	4880.000	PK	60.25	31.92	6.60	38.68	-31.67	2.35	30.77	53.9	23.1	-
Hori.	7320.000	PK	54.21	37.66	8.09	39.28	-31.67	2.35	31.36	53.9	22.5	-
Vert.	4880.000	PK	60.05	31.92	6.60	38.68	-31.67	2.35	30.57	53.9	23.3	-
Vert.	7320.000	PK	53.38	37.66	8.09	39.28	-31.67	2.35	30.53	53.9	23.3	-

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + DCCF + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.93 m / 3.0 m) = 2.35 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB
Duty cycle correction factor (DCCF) refer to "Duty cycle correction factor" sheet.

Radiated Spurious Emission

Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No.3	No.2	No.3
Date	February 8, 2023	December 24, 2022	February 8, 2023
Temperature / Humidity	22 deg. C / 25 % RH	25 deg. C / 28 % RH	24 deg. C / 25 % RH
Engineer	Kouki Yamada	Miku Ikudome	Shiro Kobayashi
	(1 GHz - 2.8 GHz)	(2.8 GHz - 10 GHz)	(10 GHz - 26.5 GHz)
Mode	Tx IEEE 802.15.4 2480 MHz		

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	2483.500	PK	60.59	28.08	14.83	41.68	2.35	64.17	73.9	9.7	157	64	-
Hori.	4960.000	PK	66.00	32.10	6.65	38.72	2.35	68.38	73.9	**5.5**	388	283	-
Hori.	7440.000	PK	53.25	37.82	8.15	39.33	2.35	62.24	73.9	11.6	124	93	-
Vert.	2483.500	PK	60.74	28.08	14.83	41.68	2.35	64.32	73.9	9.5	139	319	-
Vert.	4960.000	PK	65.43	32.10	6.65	38.72	2.35	67.81	73.9	6.0	199	299	-
Vert.	7440.000	PK	52.50	37.82	8.15	39.33	2.35	61.49	73.9	12.4	185	106	-

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.93 m / 3.0 m) = 2.35 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

Peak measurement value with Duty cycle correction factor (DCCF)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	DCCF [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2483.500	PK	60.59	28.08	14.83	41.68	-31.67	2.35	32.50	53.9	21.4	*1)
Hori.	4960.000	PK	66.00	32.10	6.65	38.72	-31.67	2.35	36.71	53.9	17.1	-
Hori.	7440.000	PK	53.25	37.82	8.15	39.33	-31.67	2.35	30.57	53.9	23.3	-
Vert.	2483.500	PK	60.74	28.08	14.83	41.68	-31.67	2.35	32.65	53.9	21.2	*1)
Vert.	4960.000	PK	65.43	32.10	6.65	38.72	-31.67	2.35	36.14	53.9	17.7	-
Vert.	7440.000	PK	52.50	37.82	8.15	39.33	-31.67	2.35	29.82	53.9	24.0	-

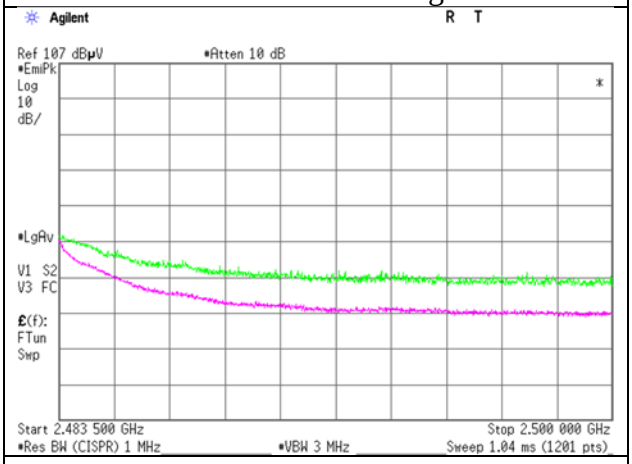
Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + DCCF + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.93 m / 3.0 m) = 2.35 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB
Duty cycle correction factor (DCCF) refer to "Duty cycle correction factor" 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	No.3
Date	February 8, 2023
Temperature / Humidity	22 deg. C / 25 % RH
Engineer	Kouki Yamada
	(1 GHz - 2.8 GHz)
Mode	Tx IEEE 802.15.4 2480 MHz

Horizontal

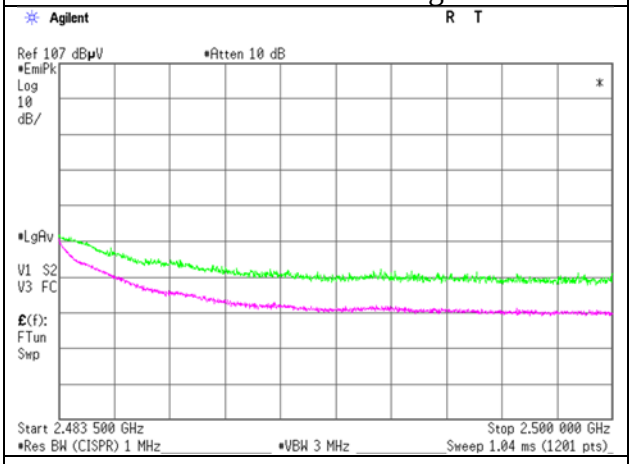
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot

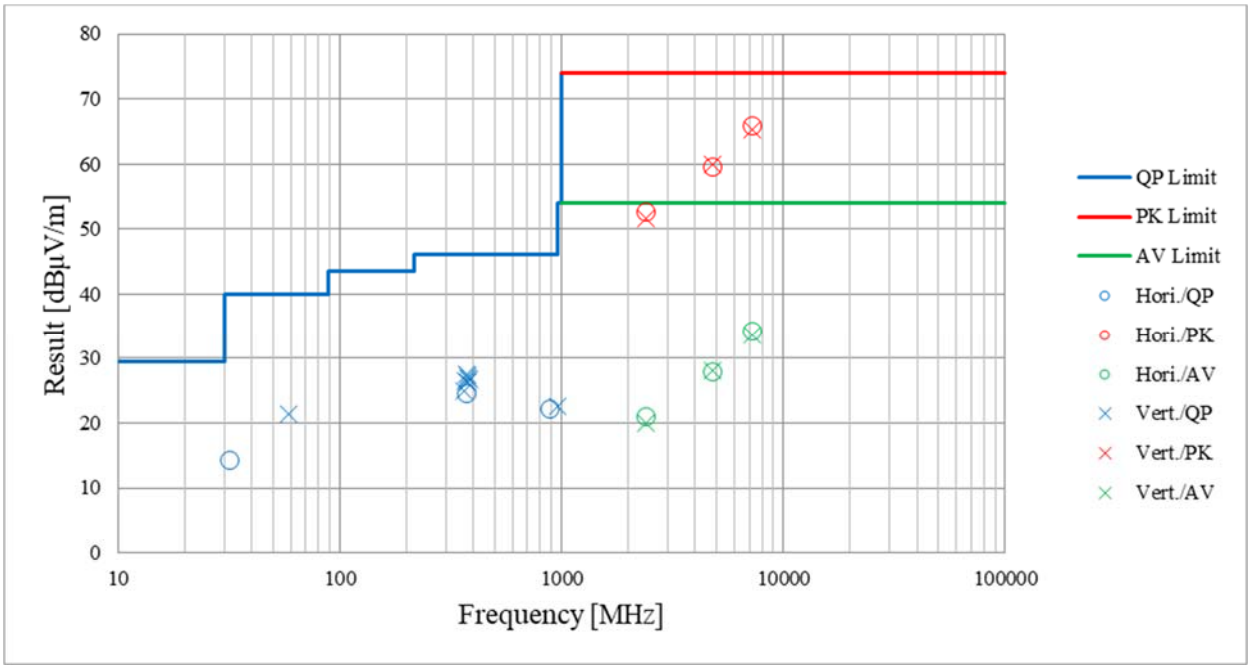


Trace Green : Peak Plot
Trace Purple : Average Plot

* 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	No.3	No.3	No.2	No.3
Date	February 9, 2023	February 8, 2023	December 24, 2022	February 8, 2023
Temperature / Humidity	21 deg. C / 26 % RH	22 deg. C / 25 % RH	25 deg. C / 28 % RH	24 deg. C / 25 % RH
Engineer	Kouki Yamada	Kouki Yamada	Miku Ikudome	Shiro Kobayashi
	(Below 1 GHz)	(1 GHz - 2.8 GHz)	(2.8 GHz - 10 GHz)	(10 GHz - 26.5 GHz)
Mode	Tx IEEE 802.15.4 2405 MHz			



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

Radiated Spurious Emission

Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No.3	No.2	No.3
Date	February 9, 2023	December 24, 2022	February 8, 2023
Temperature / Humidity	21 deg. C / 26 % RH	25 deg. C / 28 % RH	24 deg. C / 25 % RH
Engineer	Kouki Yamada	Miku Ikudome	Shiro Kobayashi
	(30 MHz - 1 GHz)	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)
Mode	Tx BT LE 2M-PHY 2402 MHz		

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	31.127	QP	22.20	18.29	6.48	32.17	0.00	14.80	40.0	25.2	100	23	-
Hori.	372.711	QP	35.50	15.11	8.96	31.91	0.00	27.66	46.0	18.3	100	79	-
Hori.	922.506	QP	19.80	22.00	11.03	30.83	0.00	22.00	46.0	24.0	100	321	-
Hori.	2390.000	PK	45.77	28.57	14.14	38.81	2.35	52.02	73.9	21.8	147	72	-
Hori.	4804.000	PK	58.31	31.90	6.55	38.64	2.35	60.47	73.9	13.4	149	110	-
Hori.	7206.000	PK	55.03	37.57	8.02	39.24	2.35	63.73	73.9	10.1	144	275	-
Vert.	31.786	QP	22.00	18.03	6.49	32.17	0.00	14.35	40.0	25.6	100	35	-
Vert.	364.246	QP	30.40	15.13	8.92	31.91	0.00	22.54	46.0	23.4	173	307	-
Vert.	368.481	QP	31.80	15.11	8.94	31.91	0.00	23.94	46.0	22.0	175	164	-
Vert.	372.716	QP	33.10	15.11	8.96	31.91	0.00	25.26	46.0	20.7	171	199	-
Vert.	375.541	QP	32.20	15.13	8.97	31.91	0.00	24.39	46.0	21.6	173	199	-
Vert.	376.951	QP	33.60	15.13	8.98	31.91	0.00	25.80	46.0	20.2	168	194	-
Vert.	379.775	QP	33.70	15.18	8.99	31.91	0.00	25.96	46.0	20.0	171	198	-
Vert.	381.185	QP	32.40	15.20	9.00	31.91	0.00	24.69	46.0	21.3	154	180	-
Vert.	384.008	QP	34.40	15.26	9.01	31.91	0.00	26.76	46.0	19.2	154	326	-
Vert.	907.723	QP	20.30	22.07	10.98	30.92	0.00	22.43	46.0	23.5	100	71	-
Vert.	2390.000	PK	45.38	28.57	14.14	38.81	2.35	51.63	73.9	22.2	220	304	-
Vert.	4804.000	PK	58.41	31.90	6.55	38.64	2.35	60.57	73.9	13.3	327	180	-
Vert.	7206.000	PK	55.67	37.57	8.02	39.24	2.35	64.37	73.9	**9.5**	166	94	-

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.93 m / 3.0 m) = 2.35 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

Peak measurement value with Duty cycle correction factor (DCCF)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	DCCF [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2390.000	PK	45.77	28.57	14.14	38.81	-47.41	2.35	4.61	53.9	49.2	*1)
Hori.	4804.000	PK	58.31	31.90	6.55	38.64	-47.41	2.35	13.06	53.9	40.8	-
Hori.	7206.000	PK	55.03	37.57	8.02	39.24	-47.41	2.35	16.32	53.9	37.5	-
Vert.	2390.000	PK	45.38	28.57	14.14	38.81	-47.41	2.35	4.22	53.9	49.6	*1)
Vert.	4804.000	PK	58.41	31.90	6.55	38.64	-47.41	2.35	13.16	53.9	40.7	-
Vert.	7206.000	PK	55.67	37.57	8.02	39.24	-47.41	2.35	16.96	53.9	36.9	-

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + DCCF + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.93 m / 3.0 m) = 2.35 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB
Duty cycle correction factor (DCCF) refer to "Duty cycle correction factor" sheet.
*1) Not out of band emission (Leakage Power)

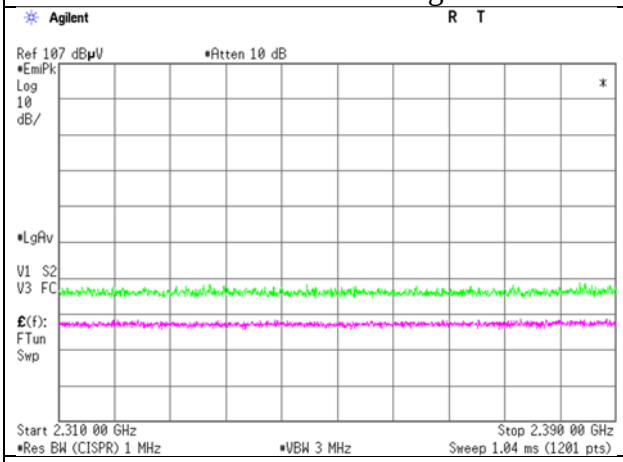
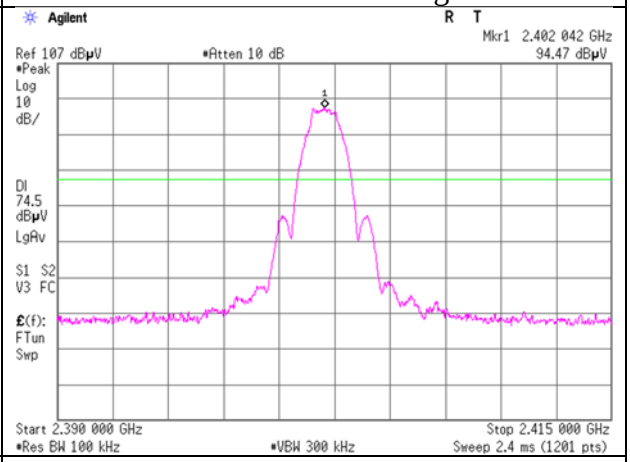
20 dBc Data Sheet **(RBW 100 kHz, VBW 300 kHz)**

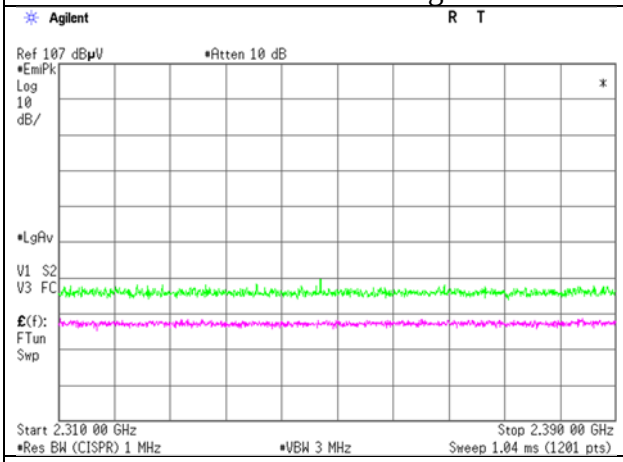
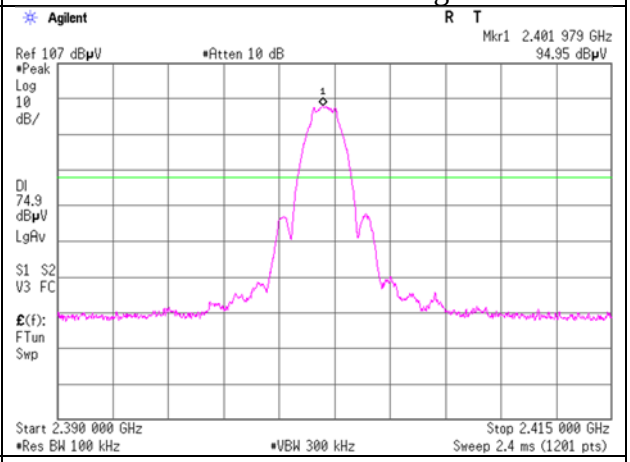
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	95.37	28.55	14.16	38.80	2.35	101.63	-	-	Carrier
Hori.	2400.000	PK	63.41	28.55	14.15	38.81	2.35	69.65	81.6	11.9	-
Vert.	2402.000	PK	92.22	28.55	14.16	38.80	2.35	98.48	-	-	Carrier
Vert.	2400.000	PK	62.27	28.55	14.15	38.81	2.35	68.51	78.4	9.8	-

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.93 m / 3.0 m) = 2.35 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.2
Date	December 24, 2022
Temperature / Humidity	25 deg. C / 28 % RH
Engineer	Miku Ikudome
	(1 GHz - 10 GHz)
Mode	Tx BT LE 2M-PHY 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 was shown in tabular data.

Radiated Spurious Emission

Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.2	No.3
Date	December 24, 2022	February 8, 2023
Temperature / Humidity	25 deg. C / 28 % RH	24 deg. C / 25 % RH
Engineer	Miku Ikudome	Shiro Kobayashi
	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)
Mode	Tx BT LE 2M-PHY 2440 MHz	

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	4880.000	PK	60.46	31.92	6.60	38.68	2.35	62.65	73.9	11.2	193	289	-
Hori.	7320.000	PK	52.46	37.66	8.09	39.28	2.35	61.28	73.9	12.6	223	302	-
Vert.	4880.000	PK	60.31	31.92	6.60	38.68	2.35	62.50	73.9	11.4	198	230	-
Vert.	7320.000	PK	53.94	37.66	8.09	39.28	2.35	62.76	73.9	**11.1**	172	107	-

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.93 m / 3.0 m) = 2.35 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

Peak measurement value with Duty cycle correction factor (DCCF)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	DCCF [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	4880.000	PK	60.46	31.92	6.60	38.68	-47.41	2.35	15.24	53.9	38.6	-
Hori.	7320.000	PK	52.46	37.66	8.09	39.28	-47.41	2.35	13.87	53.9	40.0	-
Vert.	4880.000	PK	60.31	31.92	6.60	38.68	-47.41	2.35	15.09	53.9	38.8	-
Vert.	7320.000	PK	53.94	37.66	8.09	39.28	-47.41	2.35	15.35	53.9	38.5	-

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + DCCF + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.93 m / 3.0 m) = 2.35 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB
Duty cycle correction factor (DCCF) refer to "Duty cycle correction factor" sheet.

Radiated Spurious Emission

Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.2	No.3
Date	December 24, 2022	February 8, 2023
Temperature / Humidity	25 deg. C / 28 % RH	24 deg. C / 25 % RH
Engineer	Miku Ikudome	Shiro Kobayashi
	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)
Mode	Tx BT LE 2M-PHY 2480 MHz	

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	2483.500	PK	52.17	28.44	14.24	38.76	2.35	58.44	73.9	15.4	302	76	-
Hori.	4960.000	PK	66.10	32.10	6.65	38.72	2.35	68.48	73.9	**5.4**	143	278	-
Hori.	7440.000	PK	52.64	37.82	8.15	39.33	2.35	61.63	73.9	12.2	137	138	-
Vert.	2483.500	PK	52.96	28.44	14.24	38.76	2.35	59.23	73.9	14.6	148	315	-
Vert.	4960.000	PK	65.21	32.10	6.65	38.72	2.35	67.59	73.9	6.3	191	49	-
Vert.	7440.000	PK	51.94	37.82	8.15	39.33	2.35	60.93	73.9	12.9	195	118	-

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.93 m / 3.0 m) = 2.35 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

Peak measurement value with Duty cycle correction factor (DCCF)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	DCCF [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2483.500	PK	52.17	28.44	14.24	38.76	-47.41	2.35	11.03	53.9	42.8	*1)
Hori.	4960.000	PK	66.10	32.10	6.65	38.72	-47.41	2.35	21.07	53.9	32.8	-
Hori.	7440.000	PK	52.64	37.82	8.15	39.33	-47.41	2.35	14.22	53.9	39.6	-
Vert.	2483.500	PK	52.96	28.44	14.24	38.76	-47.41	2.35	11.82	53.9	42.0	*1)
Vert.	4960.000	PK	65.21	32.10	6.65	38.72	-47.41	2.35	20.18	53.9	33.7	-
Vert.	7440.000	PK	51.94	37.82	8.15	39.33	-47.41	2.35	13.52	53.9	40.3	-

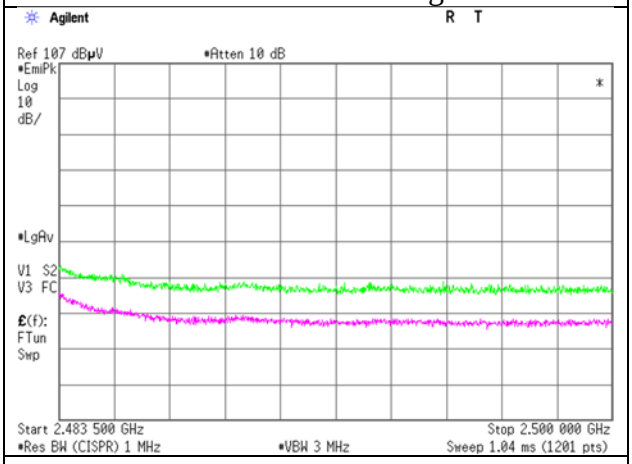
Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + DCCF + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.93 m / 3.0 m) = 2.35 dB
10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB
Duty cycle correction factor (DCCF) refer to "Duty cycle correction factor" 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	No.2
Date	December 24, 2022
Temperature / Humidity	25 deg. C / 28 % RH
Engineer	Miku Ikudome
	(1 GHz - 10 GHz)
Mode	Tx BT LE 2M-PHY 2480 MHz

Horizontal

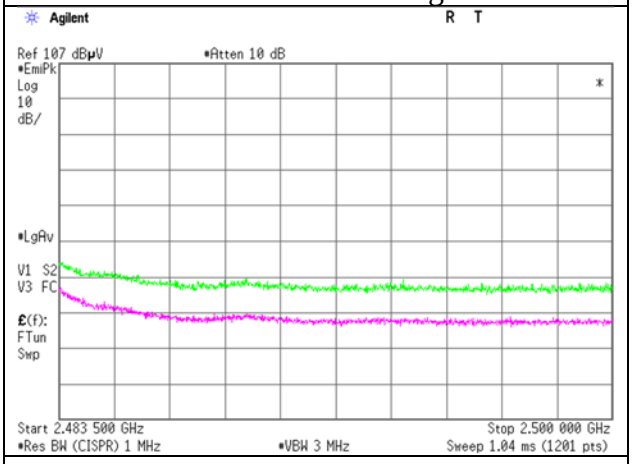
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot

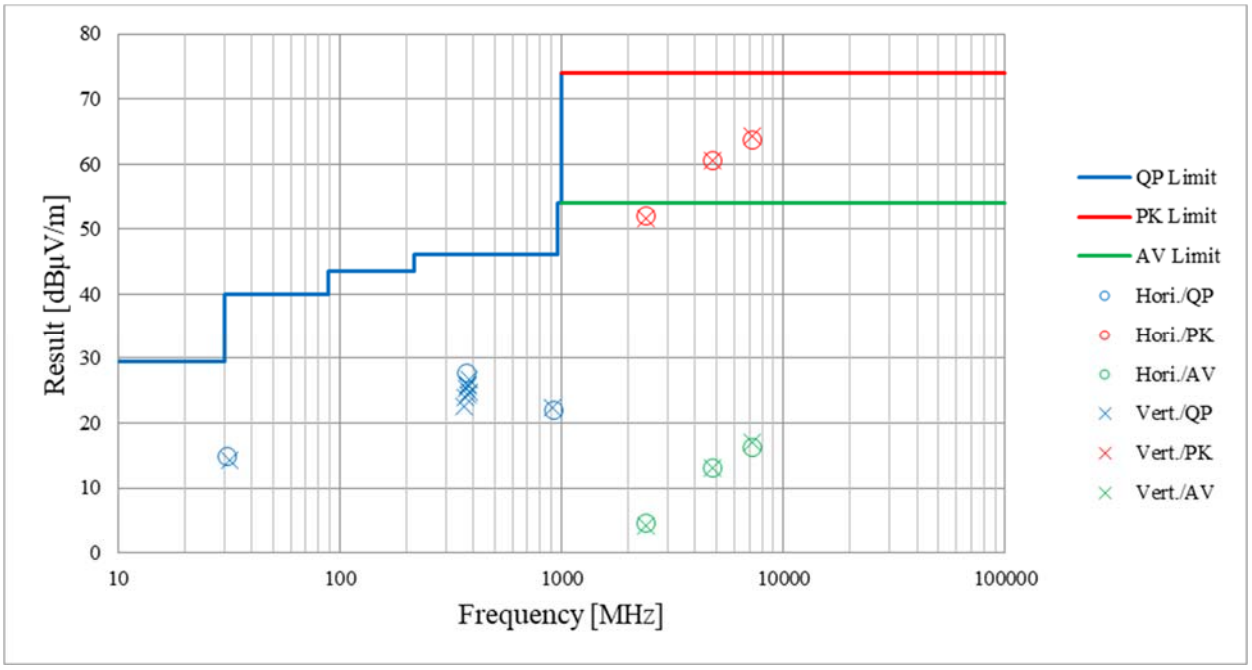


Trace Green : Peak Plot
Trace Purple : Average Plot

* 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	No.3	No.2	No.3
Date	February 9, 2023	December 24, 2022	February 8, 2023
Temperature / Humidity	21 deg. C / 26 % RH	25 deg. C / 28 % RH	24 deg. C / 25 % RH
Engineer	Kouki Yamada	Miku Ikudome	Shiro Kobayashi
	(30 MHz - 1 GHz)	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)
Mode	Tx BT LE 2M-PHY 2402 MHz		



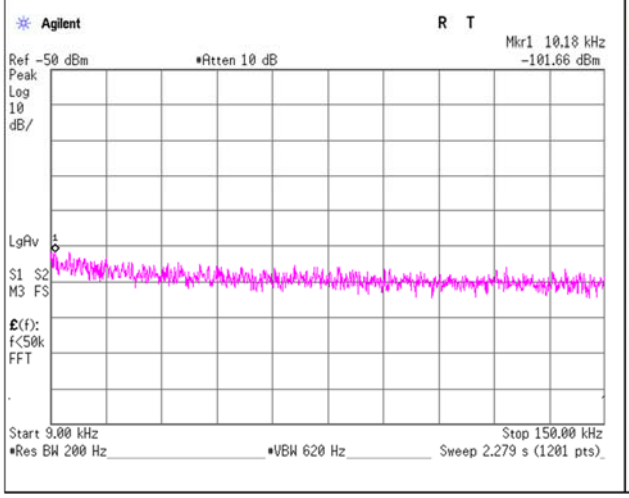
*These plots data contains sufficient number to show the trend of characteristic features for EUT.

Conducted Spurious Emission

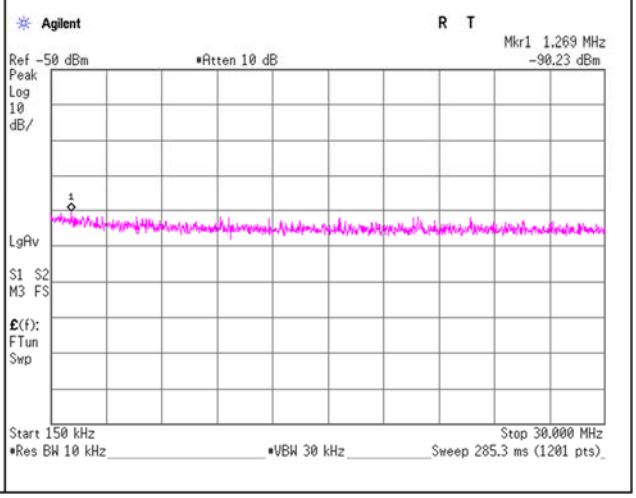
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	December 21, 2022
Temperature / Humidity	23 deg. C / 34 % RH
Engineer	Yosuke Murakami
Mode	Tx IEEE 802.15.4 2405 MHz

Tx, 2405 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
10.18	-101.66	0.01	9.74	2.33	1	-89.6	300	6.0	-28.3	47.4	75.7	-
1269.00	-90.23	0.02	9.74	2.33	1	-78.1	30	6.0	3.1	25.5	22.4	-

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)

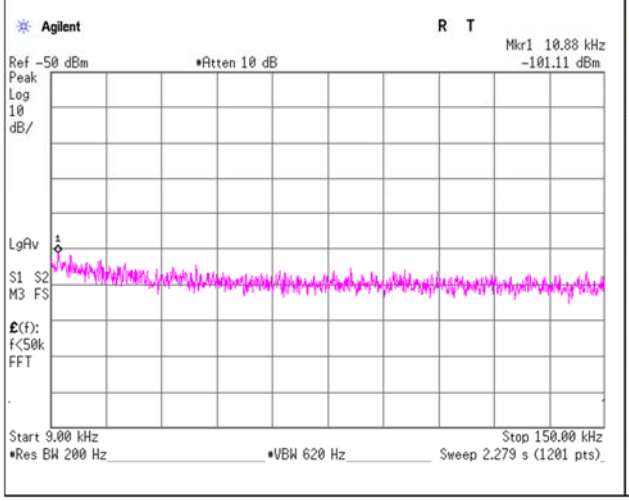
N: Number of output

Conducted Spurious Emission

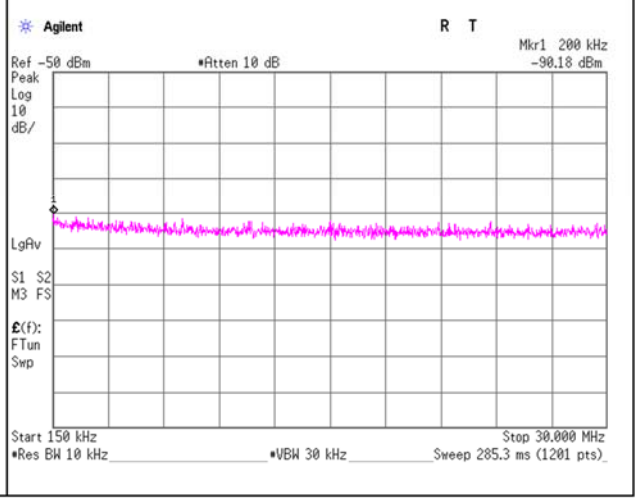
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	December 21, 2022
Temperature / Humidity	23 deg. C / 34 % RH
Engineer	Yosuke Murakami
Mode	Tx IEEE 802.15.4 2440 MHz

Tx, 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
10.88	-101.11	0.01	9.74	2.33	1	-89.0	300	6.0	-27.8	46.8	74.6	-
200.00	-90.18	0.02	9.74	2.33	1	-78.1	300	6.0	-16.8	21.5	38.3	-

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)

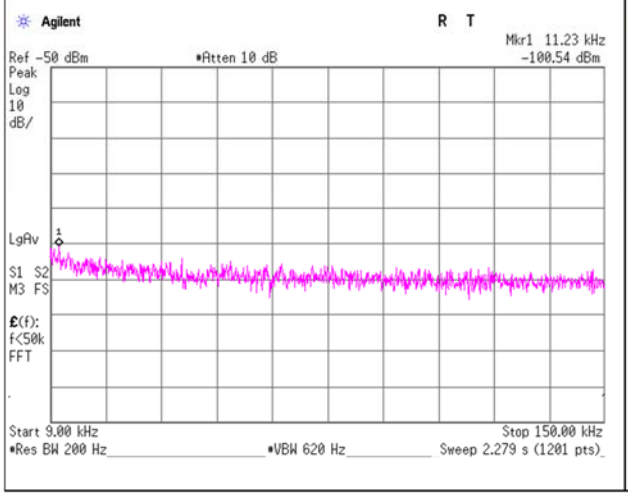
N: Number of output

Conducted Spurious Emission

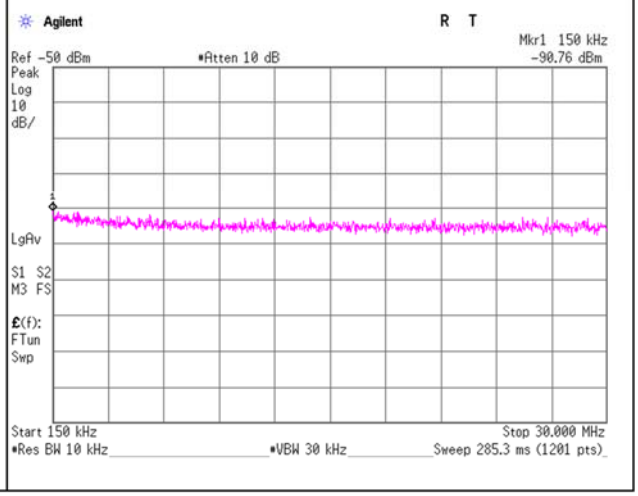
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	December 21, 2022
Temperature / Humidity	23 deg. C / 34 % RH
Engineer	Yosuke Murakami
Mode	Tx IEEE 802.15.4 2480 MHz

Tx, 2480 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	-100.54	0.01	9.74	2.33	1	-88.5	300	6.0	-27.2	46.5	73.7	-
150.00	-90.77	0.01	9.74	2.33	1	-78.7	300	6.0	-17.4	24.0	41.4	-

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)

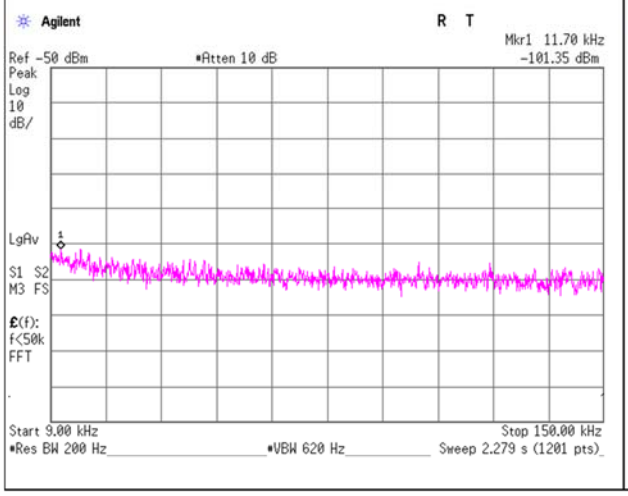
N: Number of output

Conducted Spurious Emission

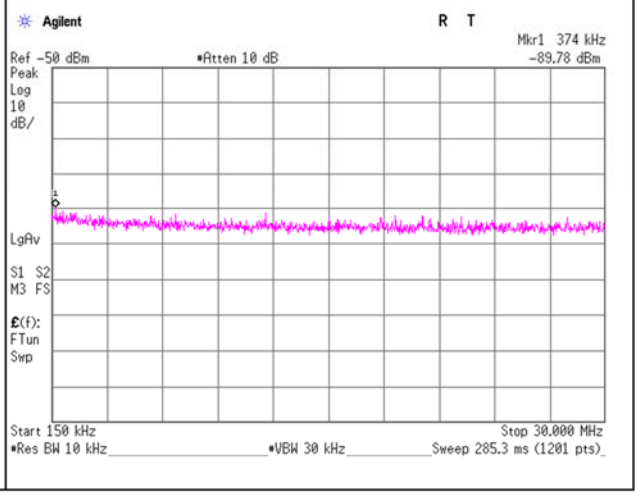
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	December 21, 2022
Temperature / Humidity	23 deg. C / 34 % RH
Engineer	Yosuke Murakami
Mode	Tx BT LE 2 M - PHY 2402 MHz

Tx, 2402 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
11.70	-101.35	0.01	9.74	2.33	1	-89.3	300	6.0	-28.0	46.2	74.2	-
374.00	-89.78	0.02	9.74	2.33	1	-77.7	300	6.0	-16.4	16.1	32.5	-

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)

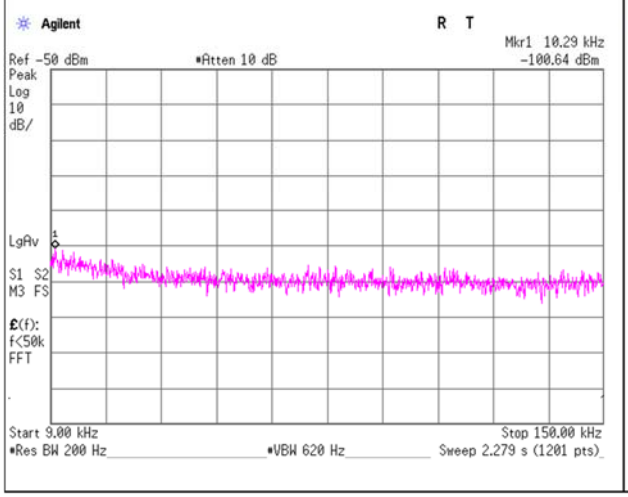
N: Number of output

Conducted Spurious Emission

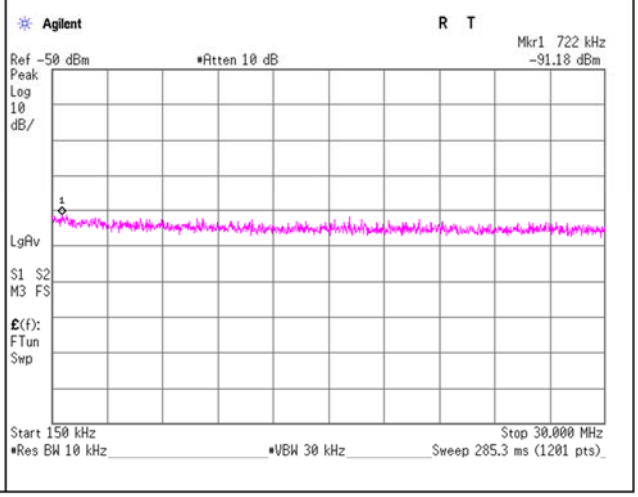
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	December 21, 2022
Temperature / Humidity	23 deg. C / 34 % RH
Engineer	Yosuke Murakami
Mode	Tx BT LE 2 M - PHY 2440 MHz

Tx, 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
10.29	-100.64	0.01	9.74	2.33	1	-88.6	300	6.0	-27.3	47.3	74.6	-
722.00	-91.18	0.02	9.74	2.33	1	-79.1	30	6.0	2.2	30.4	28.2	-

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)

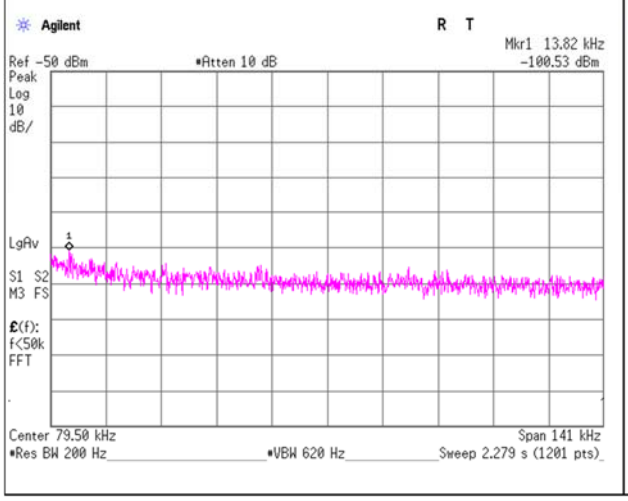
N: Number of output

Conducted Spurious Emission

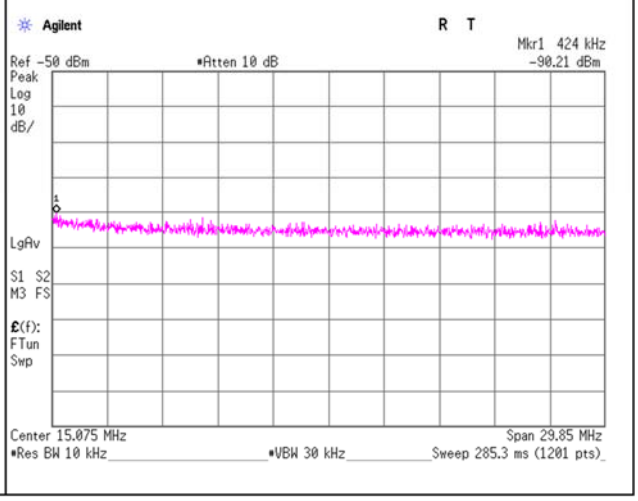
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	December 21, 2022
Temperature / Humidity	23 deg. C / 34 % RH
Engineer	Yosuke Murakami
Mode	Tx BT LE 2 M - PHY 2480 MHz

Tx, 2480 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
13.82	-100.53	0.01	9.74	2.33	1	-88.5	300	6.0	-27.2	44.7	71.9	-
424.00	-90.21	0.02	9.74	2.33	1	-78.1	300	6.0	-16.9	15.0	31.9	-

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

Power Density

Test place	Shonan EMC Lab. No.5 Shielded Room
Date	December 21, 2022
Temperature / Humidity	23 deg. C / 34 % RH
Engineer	Yosuke Murakami
Mode	Tx

IEEE 802.15.4

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]
2405	2404.794	-20.96	1.34	9.64	-9.98	8.00	17.98
2440	2439.792	-20.76	1.35	9.64	-9.77	8.00	17.77
2480	2479.979	-21.16	1.36	9.64	-10.16	8.00	18.16

Sample Calculation:

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

BT LE 2 M-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	2402.042	-19.62	1.34	9.64	-8.64	8.00	16.64
2440	2440.046	-18.72	1.35	9.64	-7.73	8.00	15.73
2480	2480.044	-18.67	1.36	9.64	-7.67	8.00	15.67

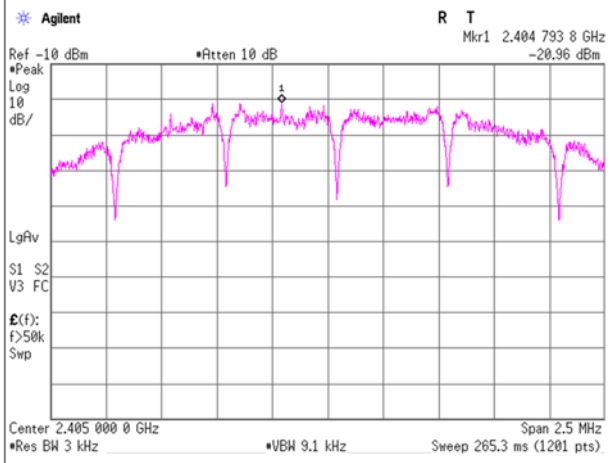
Sample Calculation:

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

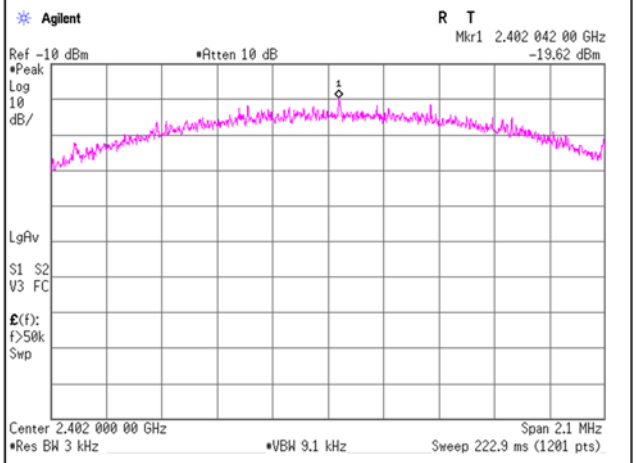
Power Density

IEEE 802.15.4 **BT LE 2 M-PHY**

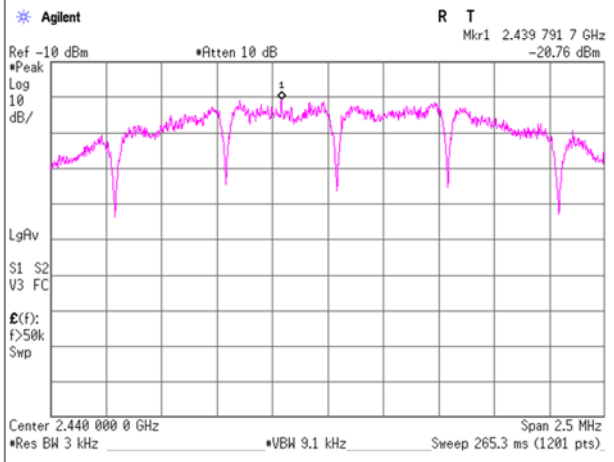
2405 MHz



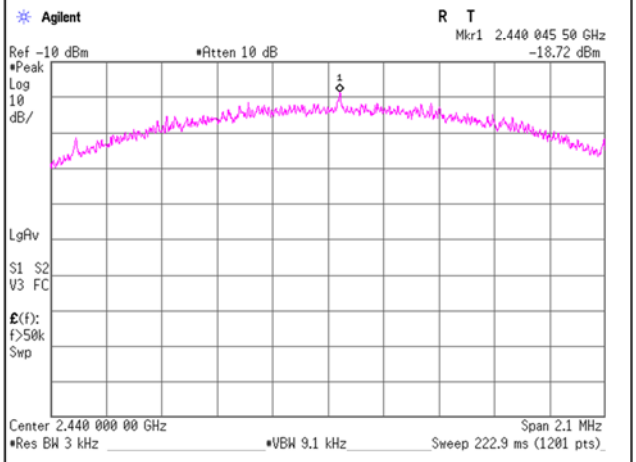
2402 MHz



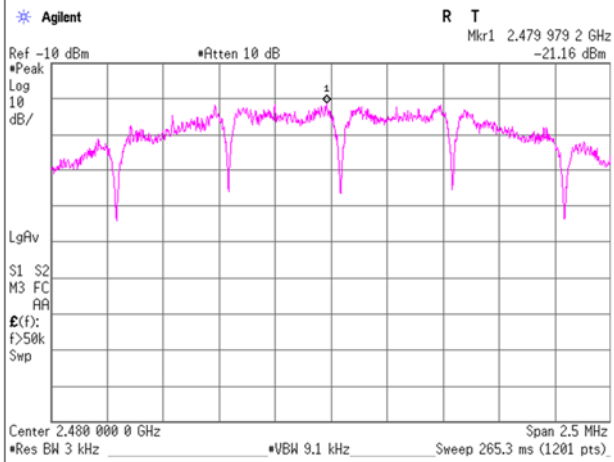
2440 MHz



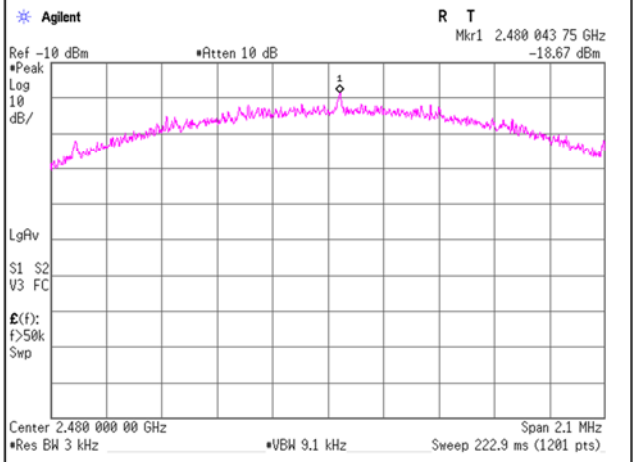
2440 MHz



2480 MHz



2480 MHz



APPENDIX 2: Test Instruments

Test Equipment(1/2)

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
AT	KTS-07	145111	Digital Tester	SANWA	PC500	7019232	2022/09/20	12
AT	SAT10-09	145132	Attenuator	Weinschel Corp.	54A-10	W5692	2022/10/20	12
AT	SAT10-14	154591	Attenuator	Weinschel Corp.	54A-10	81595	2022/04/01	12
AT	SAT10-24	204928	Attenuator	Weinschel Corp.	54A-10	109973	2022/02/21	12
AT	SCC-G13	145166	Coaxial Cable	Suhner	SUCOFLEX 102	31599/2	2022/12/01	12
AT	SCC-G53	179107	Coaxial Cable	Junkosha	MWX241-01000KMSKMS/B	1901Q062-R	2022/04/01	12
AT	SCC-G67	196949	Coaxial Cable	Huber+Suhner	SUCOFLEX 102	803480/2	2022/03/02	12
AT	SOS-16	167990	Thermo-Hygrometer	CUSTOM. Inc	CTH-202	708Q08R	2022/10/18	12
AT	SOS-27	191845	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	-	2022/08/08	12
AT	SPM-13	169910	Power Meter	Keysight Technologies Inc	8990B	MY51000448	2022/11/08	12
AT	SPSS-06	169911	Power sensor	Keysight Technologies Inc	N1923A	MY57270004	2022/11/08	12
AT	STS-01	145792	Digital Hitester	HIOKI E.E. CORPORATION	3805-50	80997812	2022/09/20	12
AT,RE	KSA-08	145089	Spectrum Analyzer	Keysight Technologies Inc	E4446A	MY46180525	2022/11/01	12
CE	KAT3-12	144896	Attenuator	JFW IND. INC.	50HF-003N	-	2022/07/14	12
CE	SCC-B12/B13/SRSE-02	144969	Coaxial Cable&RF Selector	Suhner/Suhner/TOYO	RG223U/141PE/NS4906	-/0901-270(RF Selector)	2022/04/20	12
CE	SLS-03	145540	LISN	Rohde & Schwarz	ENV216	100513	2022/02/23	12
CE	SOS-22	191839	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	-	2022/10/18	12
CE,RE	COTS-SEMI-5	170932	EMI Software	TSJ (Techno Science Japan)	TEPTO-DV3(RE,CE,ME,PE)	-	-	-
CE,RE	SJM-20	207277	Measuring	ASKUL	-	-	-	-
CE,RE	STR-08	150463	Test Receiver	Rohde & Schwarz	ESW44	101581	2022/03/02	12
CE,RE	STS-02	145793	Digital Hitester	HIOKI E.E. CORPORATION	3805-50	80997819	2022/04/07	12
RE	KAT10-S2	144892	Attenuator	Keysight Technologies Inc	8490D 010	6036	2022/10/20	12
RE	KJM-02	146432	Measure	TAJIMA	GL19-55	-	-	-
RE	SAEC-02(SVSWR)	145598	Semi-Anechoic Chamber	TDK	SAEC-02(SVSWR)	2	2022/05/16	12
RE	SAEC-03(NSA)	145565	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	2022/04/15	12
RE	SAEC-03(SVSWR)	145566	Semi-Anechoic Chamber	TDK	SAEC-03(SVSWR)	3	2022/05/18	12
RE	SAF-03	145126	Pre Amplifier	SONOMA	310N	290213	2022/02/24	12
RE	SAF-05	145128	Pre Amplifier	Toyo Corporation	TPA0118-36	1440490	2022/05/12	12
RE	SAF-06	145005	Pre Amplifier	Toyo Corporation	TPA0118-36	1440491	2022/02/04	12
RE	SAF-09	145008	Pre Amplifier	Toyo Corporation	HAP18-26W	18	2022/09/01	12
RE	SAT10-06	145137	Attenuator	Keysight Technologies Inc	8493C-010	74865	2022/10/20	12
RE	SAT6-13	167094	Attenuator	JFW	50HF-006N	-	2022/02/21	12
RE	SBA-03	145023	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	BBA9106	91032666	2022/05/14	12

Test Equipment(2/2)

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	SCC-C1/C2/C3/C4/C5/C10/SRSE-03	145171	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-271(RF Selector)	2022/04/20	12
RE	SCC-G15	145176	Coaxial Cable	Suhner	SUCOFLEX 102	32703/2	2022/03/03	12
RE	SCC-G40	166491	Coaxial Cable	Junkosha	MWX221-01000NFSNMS/B	1612S005	2023/01/12	12
RE	SCC-G43	156380	Coaxial Cable	Huber+Suhner	SUCOFLEX_104_E	SN MY 13406/4E	2022/05/20	12
RE	SCC-G50	178573	Coaxial Cable	Huber+Suhner	SUCOFLEX_104_E	MY13407/4E	2022/03/03	12
RE	SCC-G51	178572	Coaxial Cable	Huber+Suhner	SUCOFLEX 104	800288 /4A	2022/03/03	12
RE	SCC-G57	179540	Coaxial Cable	Huber+Suhner	SUCOFLEX 102	802815/2	2022/05/12	12
RE	SCC-G58	183047	Coaxial Cable	Huber+Suhner	SUCOFLEX 104	800287/4A	-	-
RE	SCC-G70	200010	Coaxial Cable	Huber+Suhner	SUCOFLEX 104	575618/4	2022/07/22	12
RE	SFL-02	145301	Highpass Filter	MICRO-TRONICS	HPM50111	51	2022/10/20	12
RE	SFL-18	145305	Highpass Filter	MICRO-TRONICS	HPM50111	119	2022/03/02	12
RE	SHA-02	145384	Horn Antenna	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	9120D-726	2022/03/10	12
RE	SHA-03	145501	Horn Antenna	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	9120D-739	2022/03/16	12
RE	SHA-05	145513	Horn Antenna	ETS-Lindgren	3160-09	00094867	2022/06/06	12
RE	SHA-10	194685	Horn Antenna	Schwarzbeck Mess-Elektronik OHG	BBHA 9120 C	711	2022/03/16	12
RE	SLA-07	145529	Logperiodic Antenna	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	196	2022/05/14	12
RE	SOS-21	191838	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	-	2022/08/08	12
RE	SOS-23	191840	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	-	2022/08/08	12
RE	STS-03	146210	Digital Hitester	HIOKI E.E. CORPORATION	3805-50	80997823	2022/09/20	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