

RADIO TEST REPORT

Test Report No. 15047548H-A

Customer	TandD Corporation
Description of EUT	Data Logger
Model Number of EUT	TR71A
FCC ID	SRD50110
Test Regulation	FCC Part 15 Subpart C
Test Result	Complied
Issue Date	November 27, 2023
Remarks	Radiated Spurious Emission and Maximum Peak Output Power tests only

Representative Test Engineer



Daiki Matsui
Engineer

Approved By



Takumi Shimada
Engineer



CERTIFICATE 5107.02

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- The information provided from the customer for this report is identified in Section 1.
- For test report(s) referred in this report, the latest version (including any revisions) is always referred.

REVISION HISTORY

Original Test Report No.: 15047548H-A

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	15047548H-A	November 27, 2023	-

Reference: Abbreviations (Including words undescribed in this report)

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

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SECTION 1: Customer Information

Company Name	TandD Corporation
Address	817-1 Shimadachi, Matsumoto, Nagano, 390-0852 Japan
Telephone Number	+81-263-40-0027
Contact Person	Yuta Sato

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	Data Logger
Model Number	TR71A
Serial Number	Refer to SECTION 4.2
Condition	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	No Modification by the test lab
Receipt Date	September 28, 2023
Test Date	November 15, 2023

2.2 Product Description

General Specification

Rating	DC 2.6 V to 3.0 V (Battery) DC 5.0 V (USB)
Operating temperature	-10 deg. C to 60 deg. C

Radio Specification

WLAN (IEEE802.11b/11g/11n-20)

Equipment Type	Transceiver
Frequency of Operation	2412 MHz to 2462 MHz
Type of Modulation	DSSS, OFDM
Antenna Gain	2.3 dBi

Bluetooth (Low Energy)

Equipment Type	Transceiver
Frequency of Operation	2402 MHz to 2480 MHz
Type of Modulation	GFSK
Antenna Gain	1.6 dBi

2.3 Product Description

Model No. TR71A has variant models: TR72A.

The difference between TR71A and TR72A is only sensor.
(Same radio module is embedded in these models)

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
Maximum Peak Output Power	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02	FCC: Section 15.247(b)(3)	See data.	Complied	Conducted
	ISED: RSS-Gen 6.12	ISED: RSS-247 5.4(d)			
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02	FCC: Section 15.247(d)	7.5 dB 2483.5 dB Horizontal, PK	Complied	Radiated (above 30 MHz) *1)
	ISED: RSS-Gen 6.13	ISED: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10			

Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593.

* In case any questions arise about test procedure, ANSI C63.10: 2013 is also referred.

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

FCC Part 15.31 (e)

This EUT provides the stable voltage constantly to RF part regardless of input voltage. Therefore, this EUT complies with the requirement.

FCC Part 15.203 Antenna requirement

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

3.3 Addition to Standard

No addition, exclusion nor deviation has been made from the standard.

3.4 Uncertainty

Measurement uncertainty is not taken into account when stating conformity with a specified requirement. Note: When margins obtained from test results are less than the measurement uncertainty, the test results may exceed the limit.

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

Radiated emission

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

Antenna Terminal Conducted

Item	Unit	Calculated Uncertainty (+/-)
Antenna terminated conducted emission / Power density / Burst power	dB	3.47
Adjacent channel power (ACP)	dB	2.28
Bandwidth (OBW)	%	0.96
Time readout (time span upto 100 msec)	%	0.11
Time readout (time span upto 1000 msec)	%	0.11
Time readout (time span upto 60 sec)	%	0.02
Power measurement (Power meter < 8 GHz)	dB	1.46
Power measurement (Call box < 6 GHz)	dB	1.69
Frequency readout (Frequency counter)	ppm	0.67
Frequency readout (Spectrum analyzer frequency readout function)	ppm	2.13
Temperature (constant temperature bath)	deg. C	0.69
Humidity (constant temperature bath)	%RH	2.98
Modulation characteristics	%	6.93
Frequency for mobile	ppm	0.08
Contention-based protocol	dB	2.26

3.5 Test Location

UL Japan, Inc. Ise EMC Lab.

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 Japan

Telephone: +81-596-24-8999

A2LA Certificate Number: 5107.02 / FCC Test Firm Registration Number: 884919

ISED Lab Company Number: 2973C / CAB identifier: JP0002

Test site	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms	Maximum measurement distance
No.1 semi-anechoic chamber	19.2 x 11.2 x 7.7	7.0 x 6.0	No.1 Power source room	10 m
No.2 semi-anechoic chamber	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	12.0 x 8.5 x 5.9	6.8 x 5.75	No.3 Preparation room	3 m
No.3 shielded room	4.0 x 6.0 x 2.7	N/A	-	-
No.4 semi-anechoic chamber	12.0 x 8.5 x 5.9	6.8 x 5.75	No.4 Preparation room	3 m
No.4 shielded room	4.0 x 6.0 x 2.7	N/A	-	-
No.5 semi-anechoic chamber	6.0 x 6.0 x 3.9	6.0 x 6.0	-	-
No.5 measurement room	6.4 x 6.4 x 3.0	6.4 x 6.4	-	-
No.6 shielded room	4.0 x 4.5 x 2.7	4.0 x 4.5	-	-
No.6 measurement room	4.75 x 5.4 x 3.0	4.75 x 4.15	-	-
No.7 shielded room	4.7 x 7.5 x 2.7	4.7 x 7.5	-	-
No.8 measurement room	3.1 x 5.0 x 2.7	3.1 x 5.0	-	-
No.9 measurement room	8.8 x 4.6 x 2.8	2.4 x 2.4	-	-
No.10 shielded room	3.8 x 2.8 x 2.8	3.8 x 2.8	-	-
No.11 measurement room	4.0 x 3.4 x 2.5	N/A	-	-
No.12 measurement room	2.6 x 3.4 x 2.5	N/A	-	-
Large Chamber	16.9 x 22.1 x 10.17	16.9 x 22.1	-	10 m
Small Chamber	5.3 x 6.69 x 3.59	5.3 x 6.69	-	-

3.6 Test Data, Test Instruments, and Test Set Up

Refer to APPENDIX.

SECTION 4: Operation of EUT during testing

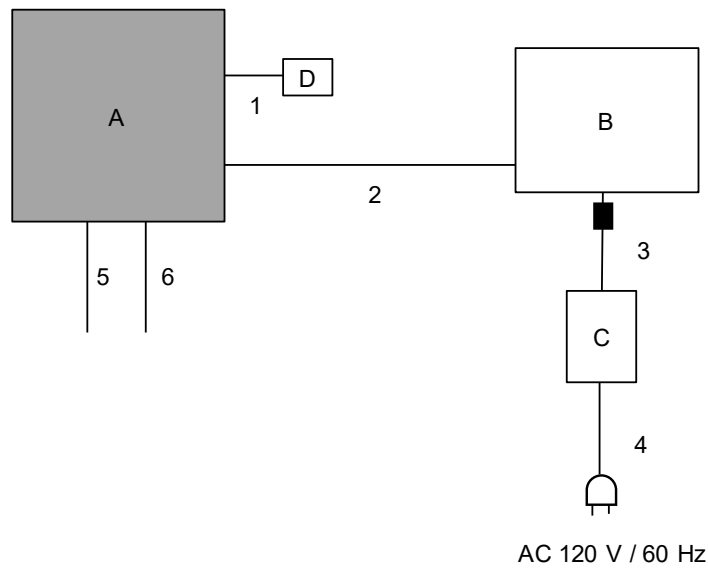
4.1 Operating Mode(s)

Mode	Remarks*
BT LE	Maximum Packet Size, PRBS9
<p>*Power of the EUT was set by the software as follows; Power Setting: 3 dBm Software: PSoC4 BLE Radio Examination Version 1.0.0.0 (Date: August 29, 2022 Storage location: Driven by connected PC)</p> <p>*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.</p>	

*The Details of Operating Mode(s)

Test Item	Operating Mode	Tested Frequency
Radiated Spurious Emission (Below 1 GHz) *1)	Tx BT LE	2402 MHz
Maximum Peak Output Power, Radiated Spurious Emission (Above 1 GHz)	Tx BT LE	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



■: Standard Ferrite Core

* 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	Data Logger	TR71A	5F3AFF0E	TandD Corporation	EUT
B	Laptop PC	NJ3900E	845031007	EPSON	-
C	AC adaptor	ADP-650H CB	671W38G00SD	DELTA ELECTRONICS, INC.	-
D	jig	-	-	-	-

List of Cables Used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Signal Cable	0.2	Unshielded	Unshielded	-
2	USB Cable	1.0	Shielded	Shielded	-
3	DC Cable	1.7	Unshielded	Unshielded	-
4	AC Cable	2.0	Unshielded	Unshielded	-
5	Signal Cable	0.6	Unshielded	Unshielded	-
6	Signal Cable	0.6	Unshielded	Unshielded	-

SECTION 5: Radiated Spurious Emission

Test Procedure

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

[For below 1 GHz]

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

[For above 1 GHz]

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

The height of the measuring antenna varied between 1 m and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.

The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer.

The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear mode).

The test was made with the detector (RBW/VBW) in the following table.

When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

Test Antennas are used as below;

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

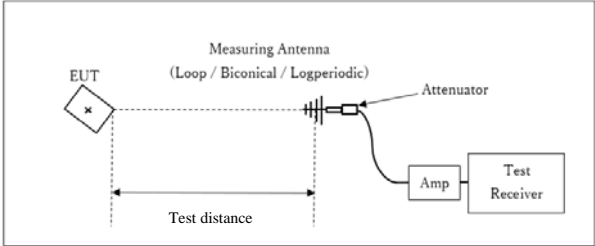
In any 100 kHz bandwidth outside the restricted band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired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

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

Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument Used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	PK	AV	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	<u>11.12.2.5.1</u> RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (RMS) Trace: 100 traces <u>11.12.2.5.2</u> The duty cycle was less than 98% for detected noise, a duty factor was added to the 11.12.2.5.1 results. or The limit for Average detector is applied to the measurement value with Peak detector used Duty cycle correction factor (DCCF).	RBW: 100 kHz VBW: 300 kHz

Figure 2: Test Setup

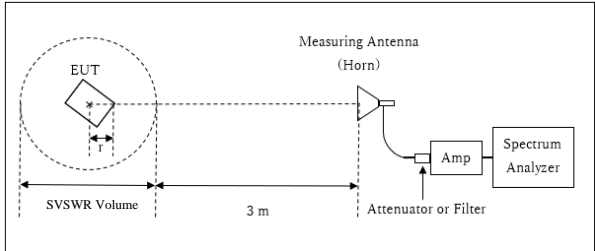
Below 1 GHz



* : Center of turn table

Test Distance: 3 m

1 GHz to 10 GHz



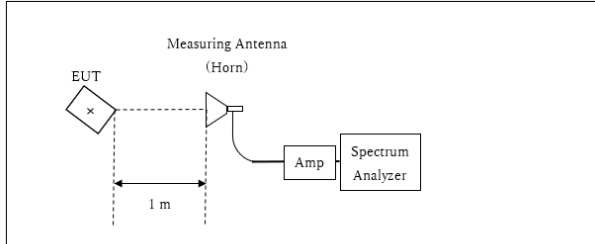
r : Radius of an outer periphery of EUT
 * : Center of turn table

Distance Factor: $20 \times \log(3.75 \text{ m} / 3.0 \text{ m}) = 1.94 \text{ dB}$
 * Test Distance: $(3 + \text{SVSWR Volume} / 2) - r = 3.75 \text{ m}$

SVSWR Volume : 1.5 m
 (SVSWR Volume has been calibrated based on CISPR 16-1-4.)
 r = 0.0 m

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

10 GHz to 26.5 GHz



* : Center of turn table

Distance Factor: $20 \times \log(1.0 \text{ m} / 3.0 \text{ m}) = -9.5 \text{ dB}$
 *Test Distance: 1 m

The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

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
Maximum Peak Output Power	-	-	-	Auto	Peak/ Average *1)	-	Power Meter (Sensor: 50 MHz BW)
*1) Reference data							

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

Maximum Peak Output Power

Test place Ise EMC Lab. No.2 Measurement Room
Date November 15, 2023
Temperature / Humidity 24 deg. C / 44 % RH
Engineer Daiki Matsui
Mode Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Conducted Power					e.i.r.p. for RSS-247					
				Result		Limit		Margin [dB]	Antenna Gain [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]	
2402	-11.42	0.70	10.05	-0.67	0.86	30.00	1000	30.67	1.60	0.93	1.24	36.02	4000	35.09
2440	-11.64	0.70	10.05	-0.89	0.81	30.00	1000	30.89	1.60	0.71	1.18	36.02	4000	35.31
2480	-11.93	0.70	10.05	-1.18	0.76	30.00	1000	31.18	1.60	0.42	1.10	36.02	4000	35.60

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.

Average Output Power (Reference data for RF Exposure)

Test place	Ise EMC Lab. No.2 Measurement Room
Date	November 15, 2023
Temperature / Humidity	24 deg. C / 44 % RH
Engineer	Daiki Matsui
Mode	Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2402	-12.52	0.70	10.05	-1.77	0.67	0.70	-1.07	0.78
2440	-12.77	0.70	10.05	-2.02	0.63	0.70	-1.32	0.74
2480	-13.12	0.70	10.05	-2.37	0.58	0.70	-1.67	0.68

Sample Calculation:

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

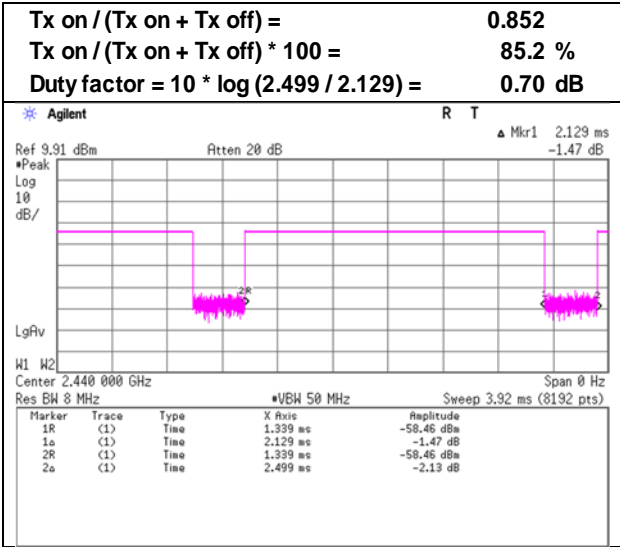
Result (Burst power average) = Time average + Duty factor

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

Burst rate confirmation

Test place Ise EMC Lab. No.2 Semi Anechoic Chamber
 Date November 15, 2023
 Temperature / Humidity 24 deg. C / 44 % RH
 Engineer Daiki Matsui
 Mode Tx

BT LE

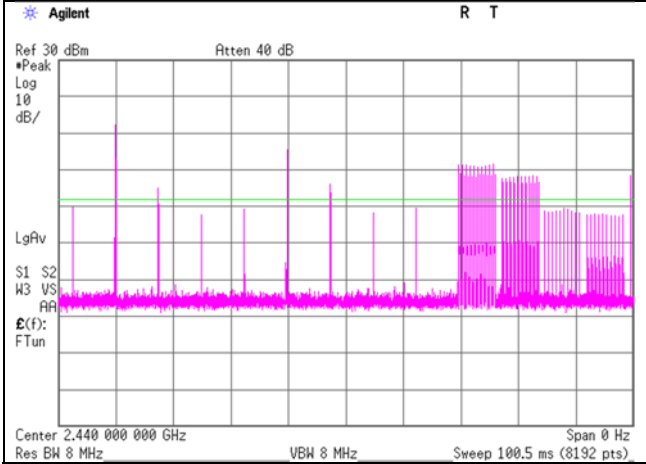


* Since the burst rate is not different between the channels, the data has been obtained on the representative channel.

Duty cycle correction factor

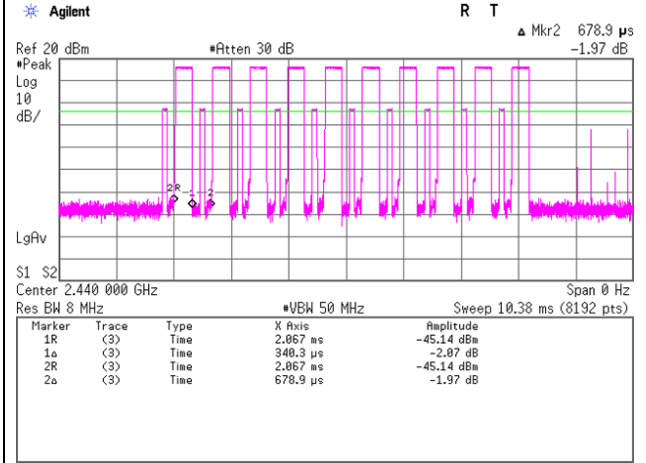
Test place Ise EMC Lab.
Semi Anechoic Chamber No.2
Date November 15, 2023
Temperature / Humidity 24 deg. C / 44 % RH
Engineer Daiki Matsui
Mode Data Communication

Worst Duty in 100 msec



Worst Duty cycle

Averaging factor (Duty factor) =
 $20 \log (20 \times 0.340 / 100) = -23.3 \text{ dB}$



*Since the burst rate is not different between the channels, the data has been obtained on the representative channel.
The ON time (0.340 ms) appears 20 times in 100 ms.
The actual measurement value was applied as Averaging factor (Duty factor).

Radiated Spurious Emission

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	November 15, 2023
Temperature / Humidity	24 deg. C / 44 % RH
Engineer	Daiki Matsui
	(30 MHz to 26.5 GHz)
Mode	Tx BT LE 2402 MHz

Polarity	Frequency	Reading	Reading	Ant.	Loss	Gain	Duty	Result	Result	Limit	Limit	Margin	Margin	Remark
[Hori/Vert]	[MHz]	(QP / PK) [dBuV]	(AV) [dBuV]	Factor [dB/m]	[dB]	[dB]	Factor [dB]	(QP / PK) [dBuV/m]	(AV) [dBuV/m]	(QP / PK) [dBuV/m]	(AV) [dBuV/m]	(QP / PK) [dB]	(AV) [dB]	
Hori.	222.7	24.6		11.6	8.2	27.9		16.6		46.0		29.4		
Hori.	259.3	29.5		12.4	8.5	27.8		22.6		46.0		23.4		
Hori.	299.4	26.7		13.8	8.7	27.8		21.4		46.0		24.6		
Hori.	324.0	36.4		14.6	8.9	27.9		32.0		46.0		14.0		
Hori.	393.1	25.0		15.7	9.3	28.4		21.6		46.0		24.4		
Hori.	453.5	30.3		16.7	9.6	28.9		27.7		46.0		18.3		
Hori.	2390.0	60.7		27.7	4.9	34.9		58.3		73.9		15.6		
Hori.	4804.0	50.8		31.6	7.0	34.1		55.2		73.9		18.7		
Hori.	7206.0	44.0		36.0	8.1	34.0		54.1		73.9		19.8		
Hori.	9608.0	45.4	34.1	38.9	8.7	34.7		58.3	47.0	73.9	53.9	15.6	6.9	Floor noise
Vert.	225.6	24.6		11.7	8.3	27.9		16.6		46.0		29.4		
Vert.	235.8	24.5		11.9	8.3	27.8		16.9		46.0		29.2		
Vert.	259.3	28.5		12.4	8.5	27.8		21.6		46.0		24.4		
Vert.	324.0	28.2		14.6	8.9	27.9		23.8		46.0		22.2		
Vert.	393.2	25.2		15.7	9.3	28.4		21.8		46.0		24.2		
Vert.	453.5	31.2		16.7	9.6	28.9		28.6		46.0		17.4		
Vert.	2390.0	59.5		27.7	4.9	34.9		57.1		73.9		16.8		
Vert.	4804.0	50.6		31.6	6.2	34.1		54.2		73.9		19.7		
Vert.	7206.0	43.8		36.0	7.4	34.0		53.1		73.9		20.8		
Vert.	9608.0	45.3	34.1	38.9	8.2	34.7		57.8	46.5	73.9	53.9	16.2	7.4	Floor noise

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

Peak measurement value with duty cycle correction factor

Frequency	Detector	Reading		Ant	Loss	Gain	DCCF	Result		Limit	Margin		Remark
		Hor	Ver					[dBuV]	[dBuV/m]		[dB]	[dB]	
[MHz]				[dB/m]	[dB]	[dB]	[dB]	Hor	Ver	[dBuV/m]	Hor	Ver	
2390.000	PK	60.7	59.5	27.7	4.9	34.9	-23.3	35.0	33.8	53.9	18.9	20.1	*1)
4804.000	PK	50.8	50.6	31.6	7.0	34.1	-23.3	31.9	31.7	53.9	22.0	22.2	
7206.000	PK	44.0	43.8	36.0	8.1	34.0	-23.3	30.8	30.5	53.9	23.1	23.4	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + DCCF
 *Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

Distance factor: 1 GHz - 10 GHz 20log (3.75 m / 3.0 m) = 1.94 dB
 10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Duty cycle correction factor (DCCF) refer to "Duty cycle correction factor" sheet.
 *1) Not Out of Band emission(Leakage Power)

20dBc Data Sheet

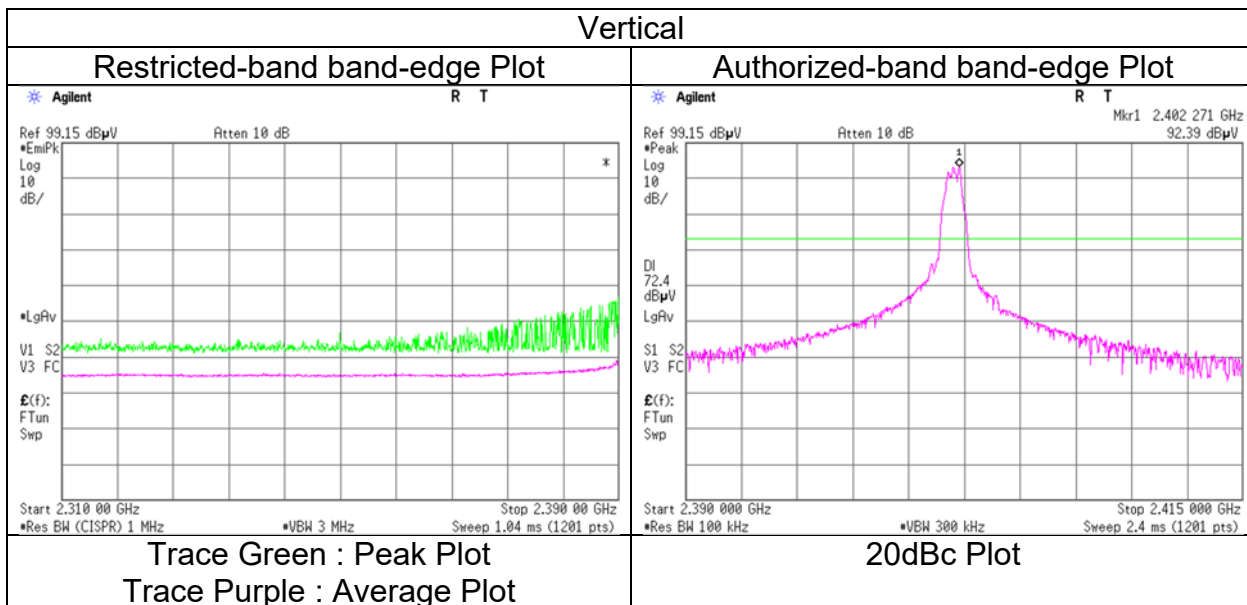
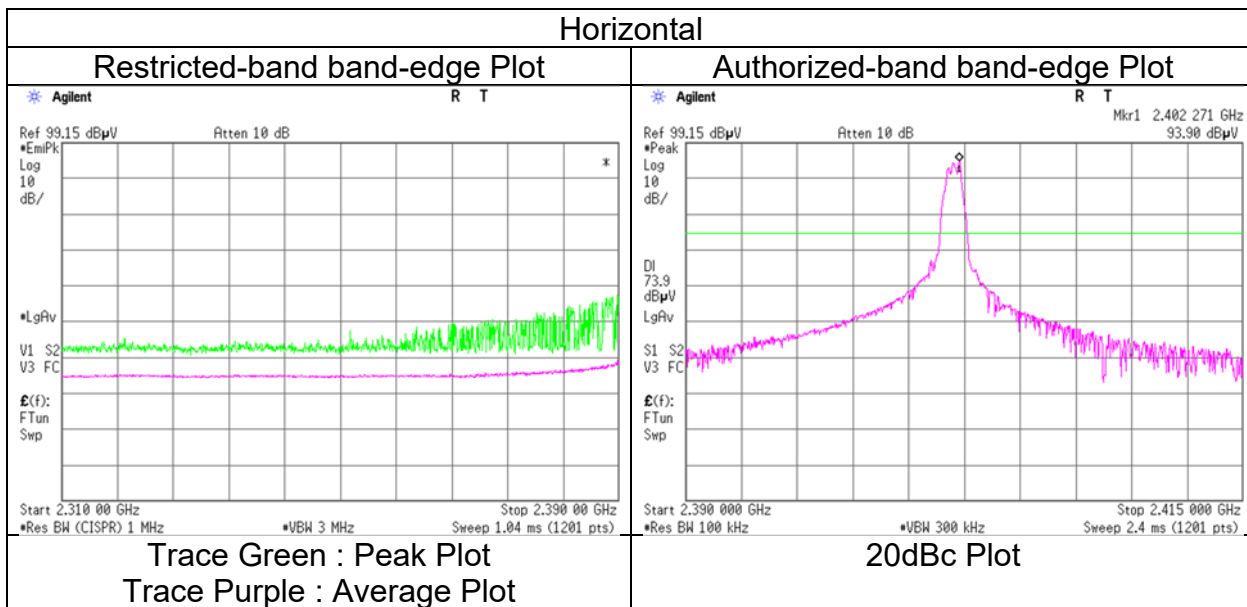
Polarity	Frequency	Reading	Ant	Loss	Gain	Result	Limit	Margin	Remark
[Hori/Vert]	[MHz]	(PK) [dBuV]	Factor [dB/m]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	
Hori.	2402.0	93.9	27.6	4.9	34.9	91.5	-	-	Carrier
Hori.	2400.0	57.6	27.6	4.9	34.9	55.2	71.5	16.3	
Vert.	2402.0	92.4	27.6	4.9	34.9	90.0	-	-	Carrier
Vert.	2400.0	55.1	27.6	4.9	34.9	52.7	70.0	17.3	

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

Distance factor: 1 GHz - 10 GHz 20log (3.75 m / 3.0 m) = 1.94 dB
 10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	November 15, 2023
Temperature / Humidity	24 deg. C / 44 % RH
Engineer	Daiki Matsui
	(1 GHz to 10 GHz)
Mode	Tx BT LE 2402 MHz



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

Radiated Spurious Emission

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	November 15, 2023
Temperature / Humidity	24 deg. C / 44 % RH
Engineer	Daiki Matsui
	(Above 1 GHz)
Mode	Tx BT LE 2440 MHz

Polarity	Frequency	Reading (QP / PK)	Reading (AV)	Ant. Factor	Loss	Gain	Duty Factor	Result (QP / PK)	Result (AV)	Limit (QP / PK)	Limit (AV)	Margin (QP / PK)	Margin (AV)	Remark
[Hori/vert]	[MHz]	[dBuV]	[dBuV]	[dB/m]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dB]	[dB]	
Hori.	4880.0	52.1	-	31.6	7.0	34.2	-	56.6	-	73.9	-	17.3	-	
Hori.	7320.0	43.6	-	36.1	8.1	34.1	-	53.8	-	73.9	-	20.1	-	
Hori.	9760.0	42.5	34.4	39.3	8.7	34.7	-	55.8	47.7	73.9	53.9	18.1	6.2	Floor noise
Vert.	4880.0	52.9	-	31.6	7.0	34.2	-	57.4	-	73.9	-	16.5	-	
Vert.	7320.0	43.0	-	36.1	8.1	34.1	-	53.2	-	73.9	-	20.7	-	
Vert.	9760.0	42.3	34.3	39.3	8.7	34.7	-	55.7	47.6	73.9	53.9	18.3	6.3	Floor noise

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

Distance factor: 1 GHz - 10 GHz 20log (3.75 m / 3.0 m) = 1.94 dB
 10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Peak measurement value with duty cycle correction factor

Frequency	Detector	Reading [dBuV]		Ant Factor [dB/m]	Loss [dB]	Gain [dB]	DCCF [dB]	Result [dBuV/m]		Limit [dBuV/m]	Margin [dB]		Remark
		Hor	Ver					Hor	Ver		Hor	Ver	
4880.000	PK	52.1	52.9	31.6	7.0	34.2	-23.3	33.3	34.1	53.9	20.6	19.8	*1)
7320.000	PK	43.6	43.0	36.1	8.1	34.1	-23.3	30.5	29.9	53.9	23.4	24.0	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + DCCF
 *Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

Distance factor: 1 GHz - 10 GHz 20log (3.75 m / 3.0 m) = 1.94 dB
 10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Duty cycle correction factor (DCCF) refer to "Duty cycle correction factor" sheet.

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

Radiated Spurious Emission

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	November 15, 2023
Temperature / Humidity	24 deg. C / 44 % RH
Engineer	Daiki Matsui
	(Above 1 GHz)
Mode	Tx BT LE 2480 MHz

Polarity	Frequency	Reading (QP / PK)	Reading (AV)	Ant. Factor	Loss	Gain	Duty Factor	Result (QP / PK)	Result (AV)	Limit (QP / PK)	Limit (AV)	Margin (QP / PK)	Margin (AV)	Remark
[Hori/vert]	[MHz]	[dBuV]	[dBuV]	[dB/m]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dB]	[dB]	
Hori.	2483.5	68.9	-	27.5	5.0	34.9	-	66.4	-	73.9	-	7.5	-	
Hori.	4960.0	53.1	-	31.7	7.0	34.2	-	57.7	-	73.9	-	16.2	-	
Hori.	7440.0	42.6	-	36.3	8.1	34.1	-	52.9	-	73.9	-	21.0	-	
Hori.	9920.0	42.6	34.2	39.2	8.8	34.7	-	55.8	47.4	73.9	53.9	18.1	6.5	Floor noise
Vert.	2483.5	67.1	-	27.5	5.0	34.9	-	64.7	-	73.9	-	9.2	-	
Vert.	4960.0	53.3	-	31.7	7.0	34.2	-	57.9	-	73.9	-	16.0	-	
Vert.	7440.0	42.0	-	36.3	8.1	34.1	-	52.4	-	73.9	-	21.5	-	
Vert.	9920.0	42.3	34.2	39.2	8.8	34.7	-	55.6	47.4	73.9	53.9	18.3	6.5	Floor noise

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

Distance factor: 1 GHz - 10 GHz 20log (3.75 m / 3.0 m) = 1.94 dB
 10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Peak measurement value with duty cycle correction factor

Frequency	Detector	Reading		Ant Factor	Loss	Gain	DCCF	Result		Limit	Margin		Remark
		Hor	Ver					[dBuV/m]	[dBuV/m]		[dB]	[dB]	
[MHz]				[dB/m]	[dB]	[dB]	[dB]	Hor	Ver	[dBuV/m]	Hor	Ver	
2483.500	PK	68.9	67.1	27.5	5.0	34.9	-23.3	43.1	41.4	53.9	10.8	12.5	*1)
4960.000	PK	53.1	53.3	31.7	7.0	34.2	-23.3	34.4	34.6	53.9	19.5	19.3	
7440.000	PK	42.6	42.0	36.3	8.1	34.1	-23.3	29.6	29.1	53.9	24.3	24.8	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - Gain(Amplifier) + Duty factor (Refer to Duty factor data sheet)

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

*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

Distance factor: 1 GHz - 10 GHz 20log (3.75 m / 3.0 m) = 1.94 dB
 10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Duty cycle correction factor (DCCF) refer to "Duty cycle correction factor" sheet.

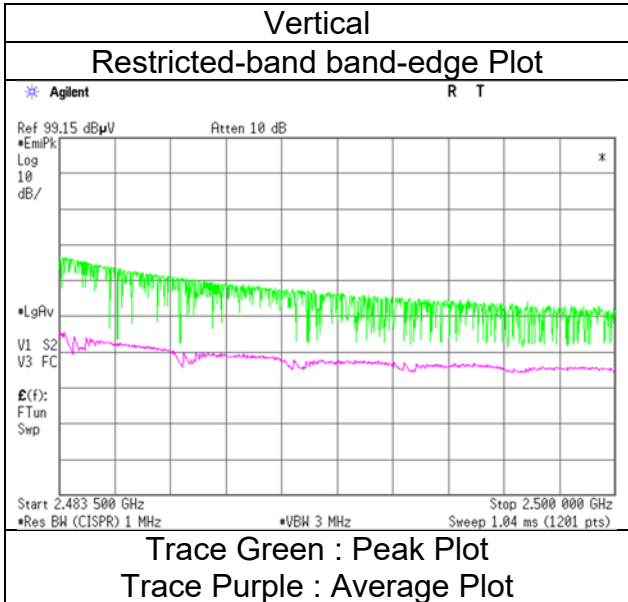
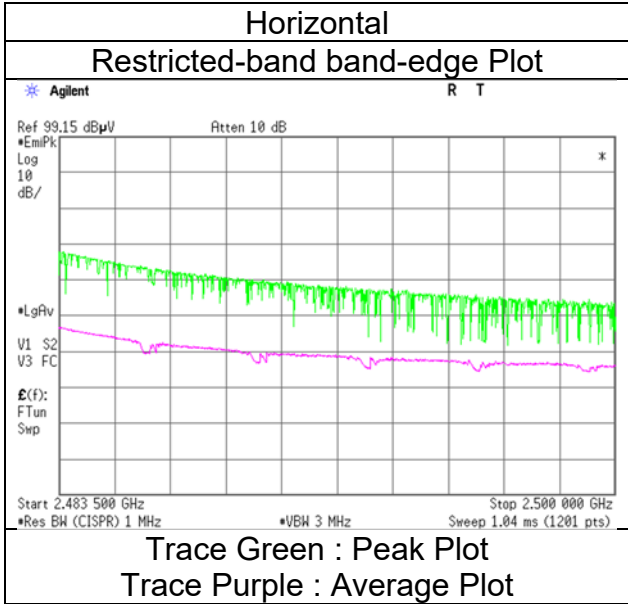
*1) Not Out of Band emission(Leakage Power)

**Radiated Spurious Emission
(Reference Plot for band-edge)**

Test place
Semi Anechoic Chamber
Date
Temperature / Humidity
Engineer

Mode

Ise EMC Lab.
No.2
November 15, 2023
24 deg. C / 44 % RH
Daiki Matsui
(1 GHz to 10 GHz)
Tx BT LE 2480 MHz

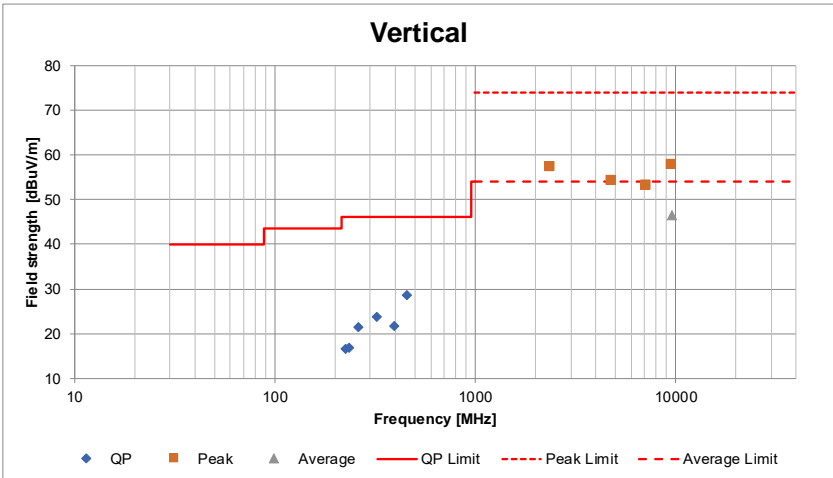
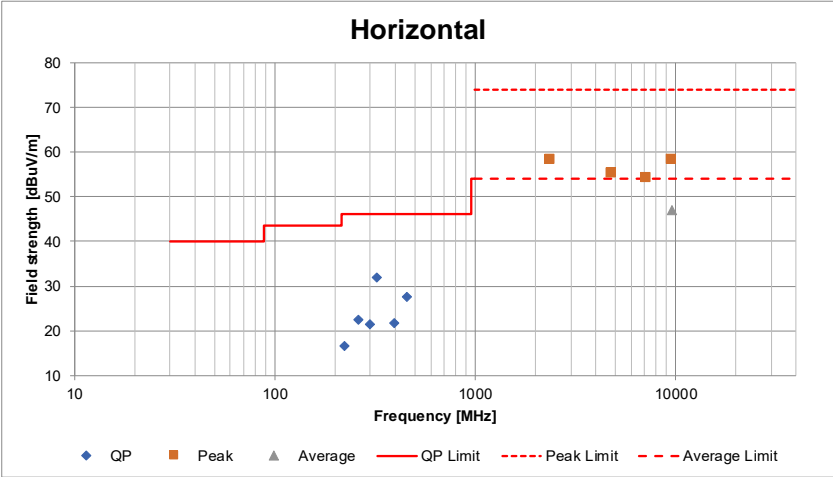


* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

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

Test place
Semi Anechoic Chamber
Date
Temperature / Humidity
Engineer
Mode

Ise EMC Lab.
No.2
November 15, 2023
24 deg. C / 44 % RH
Daiki Matsui
(1 GHz to 10 GHz)
Tx BT LE 2402 MHz



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

APPENDIX 2: Test Instruments

Test Equipment

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	141232	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	001	09/04/2023	12
RE	141265	Logperiodic Antenna(200-1000MHz)	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	9111B-190	07/11/2023	12
RE	141317	Coaxial Cable	UL Japan	-	-	09/12/2023	12
AT	141333	Attenuator(10dB)	Suhner	6810.19.A	-	12/21/2022	12
RE	141427	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	VHA9103B+ BBA9106	08031	07/11/2023	12
RE	141512	Horn Antenna 1-18GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	254	10/17/2023	12
RE	141513	Horn Antenna 15-40GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9170	BBHA9170306	07/19/2023	12
RE	141542	Digital Tester	Fluke Corporation	FLUKE 26-3	78030611	08/01/2023	12
AT	141542	Digital Tester	Fluke Corporation	FLUKE 26-3	78030611	08/01/2023	12
RE	141579	Pre Amplifier	Keysight Technologies Inc	8449B	3008A02142	02/14/2023	12
AT	141590	PowerDivider DC to 26.5GHz	Keysight Technologies Inc	11636B	52258	03/08/2023	12
RE	141594	Pre Amplifier	Keysight Technologies Inc	8447D	2944A10150	02/02/2023	12
AT	141809	Power Meter	Anritsu Corporation	ML2495A	825002	05/26/2023	12
AT	141830	Power sensor	Anritsu Corporation	MA2411B	738285	05/26/2023	12
RE	141884	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY44020357	03/13/2023	12
RE	142004	AC2_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	05/30/2022	24
RE	142228	Measure, Tape, Steel	KOMELON	KMC-36	-	-	-
RE	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	192300	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0013	12/17/2022	12
AT	192300	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0013	12/17/2022	12
RE	220646	Attenuator	Huber+Suhner	6806 N-50-1	-	03/17/2023	12
RE	240023	Microwave Cable	Huber+Suhner	SF126E/11PC35/11 PC35/1000MM, 5000MM	537060/126E / 537075/126E	09/08/2023	12

*Hyphens for Last Calibration Date and Cal Int (month) are instruments that Calibration is not required (e.g. software), or instruments checked in advance before use.

The expiration date of the calibration is the end of the expired month.

As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

Test item:

AT: Antenna Terminal Conducted test

RE: Radiated Emission