



RADIO TEST REPORT

Test Report No. : 13809763H-A

Applicant : Murata Manufacturing Co., Ltd.

Type of EUT : Communication Module

Model Number of EUT : 2AY

FCC ID : VPYLBCA2HN2AY

Test regulation : FCC Part 15 Subpart C: 2021

Test Result : Complied (Refer to SECTION 3)

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by the A2LA accreditation body.
6. This test report covers Radio technical requirements.
It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
7. The all test items in this test report are conducted by UL Japan, Inc. Ise EMC Lab.
8. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
9. The information provided from the customer for this report is identified in Section 1.

Date of test: June 1 and 2, 2021

Representative test engineer:


Hiroyuki Furutaka
Engineer

Approved by:


Takayuki Shimada
Leader



CERTIFICATE 5107.02

- ☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan.
- ☒ There is no testing item of "Non-accreditation".

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REVISION HISTORY

Original Test Report No.: 13809763H-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13809763H-A	June 22, 2021	-	-

Reference: Abbreviations (Including words undescribed in this report)

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

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SECTION 1: Customer information

Company Name	:	Murata Manufacturing Co., Ltd.
Address	:	1-10-1 Higashikotari, Nagaokakyo-shi, Kyoto 617-8555 Japan
Telephone Number	:	+81-75-955-6736
Facsimile Number	:	+81-75-955-6634
Contact Person	:	Motoo Hayashi

The information provided from the customer is as follows;

- Applicant, Type 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
- 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

Type	:	Communication Module
Model Number	:	2AY
Serial Number	:	Refer to SECTION 4.2
Rating	:	Typ. DC 3.0 V / Min. DC 1.8 V / Max. DC 3.3 V
Receipt Date	:	May 31, 2021
Country of Mass-production	:	China, Japan
Condition	:	Engineering prototype
	:	(Not for Sale: This sample is equivalent to mass-produced items.)
Modification	:	No Modification by the test lab.

2.2 Product Description

Model: 2AY (referred to as the EUT in this report) is a Communication Module.

Radio Specification

Radio Type	:	Transceiver
Frequency of Operation	:	2402 MHz - 2480MHz
Modulation	:	GFSK
Antenna type	:	Monopole antenna
Antenna Gain	:	0.5 dBi
Clock frequency (Maximum)	:	32 MHz

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on May 3, 2021 and effective July 2, 2021

Title : FCC 47 CFR Part 15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted limits
Section 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz,
and 5725-5850 MHz

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

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	FCC: ANSI C63.10-2013 6. Standard test methods ISED: RSS-Gen 8.8	FCC: Section 15.207 ISED: RSS-Gen 8.8	34.37 dB, 0.15000 MHz, QP, L	Complied a)	-
6dB Bandwidth	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: -	FCC: Section 15.247(a)(2) ISED: RSS-247 5.2(a)	See data.	Complied b)	Conducted
Maximum Peak Output Power	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: RSS-Gen 6.12	FCC: Section 15.247(b)(3) ISED: RSS-247 5.4(d)		Complied c)	Conducted
Power Density	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: -	FCC: Section 15.247(e) ISED: RSS-247 5.2(b)		Complied d)	Conducted
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02	FCC: Section15.247(d)	11.4 dB 2483.500 MHz, AV, Vert.	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 No. 13-EM-W0420 and 13-EM-W0422. *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)					
Symbols: Complied The data of this test item has enough margin, more than the measurement uncertainty. Complied# The data of this test item meets the limits unless the measurement uncertainty is taken into consideration.					

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

FCC Part 15.31 (e)

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

FCC Part 15.203 Antenna requirement

The antenna is not removable from the EUT.
Therefore, the equipment complies with the antenna requirement of Section 15.203.

3.3 Addition to standard

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

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

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

Test Item	Uncertainty (+/-)
20 dB Bandwidth / 99 % Occupied Bandwidth	0.96 %
Maximum Peak Output Power / Average Output Power	1.4 dB
Carrier Frequency Separation	0.42 %
Dwell time / Burst rate	0.10 %
Conducted Spurious Emission	2.6 dB

Conducted emission

using Item	Frequency range	Uncertainty (+/-)
AMN (LISN)	0.009 MHz to 0.15 MHz	3.4 dB
	0.15 MHz to 30 MHz	2.9 dB

Radiated emission

Measurement distance	Frequency range	Uncertainty (+/-)
3 m	9 kHz to 30 MHz	3.3 dB
10 m		3.2 dB
3 m	30 MHz to 200 MHz (Horizontal) (Vertical)	4.8 dB
		5.0 dB
	200 MHz to 1000 MHz (Horizontal) (Vertical)	5.2 dB
		6.3 dB
10 m	30 MHz to 200 MHz (Horizontal) (Vertical)	4.8 dB
		4.8 dB
	200 MHz to 1000 MHz (Horizontal) (Vertical)	5.0 dB
		5.0 dB
3 m	1 GHz to 6 GHz	4.9 dB
	6 GHz to 18 GHz	5.2 dB
1 m	10 GHz to 26.5 GHz	5.5 dB
	26.5 GHz to 40 GHz	5.5 dB
10 m	1 GHz to 18 GHz	5.2 dB

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3.5 Test Location

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*A2LA Certificate Number: 5107.02 / FCC Test Firm Registration Number: 199967

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

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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	-	-

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

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

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SECTION 4: Operation of EUT during testing

4.1 Operating Mode(s)

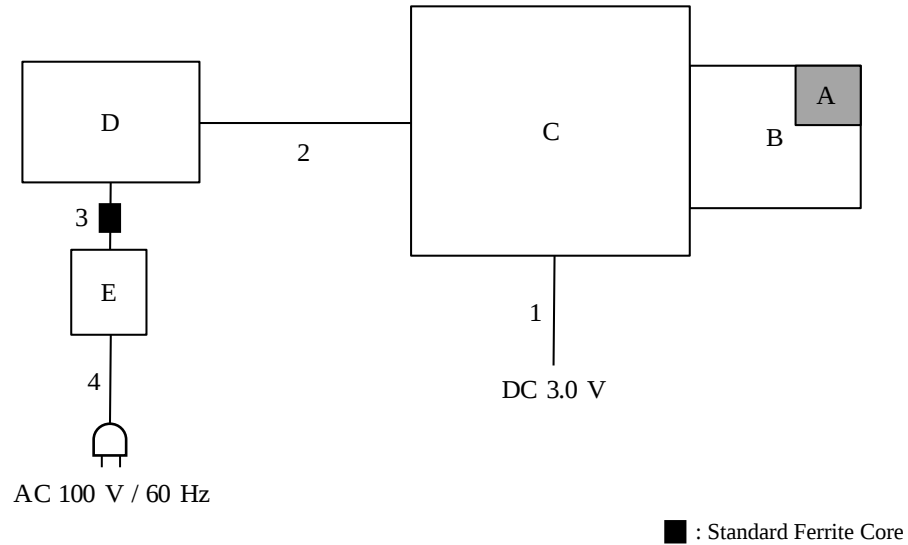
Mode	Remarks*
BT LE	Uncoded 1M-PHY, Maximum Packet Size, PRBS9
*Power of the EUT was set by the software as follows; (setting value might be different from product specification value) Power settings: Max: 2.5dBm (All tests) Min: -19.5dBm (Maximum Peak Output Power and Average Output Power tests only.) Software: prodtest_2AY.exe (Date: 2021.06.01, 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	Tx BT LE (Uncoded 1M-PHY)	2402 MHz
Spurious Emission		2440 MHz
6dB Bandwidth		2480 MHz
Maximum Peak Output Power		
Power Density		
99% Occupied Bandwidth		

4.2 Configuration and peripherals

Antenna Terminal Conducted test



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

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Communication Module	2AY	75	Murata Manufacturing Co.,Ltd	EUT
B	Jig	P2ML9415	-	Murata Manufacturing Co.,Ltd	-
C	Jig	P2ML3656	-	Murata Manufacturing Co.,Ltd	-
D	Laptop PC	CF-N8HWCDPS	0CKSA09265	Panasonic	-
E	AC Adapter	CF-AA6372B	6372BM610X10953E	Panasonic	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	2.0	Unshielded	Unshielded	-
2	USB Cable	1.5	Shielded	Shielded	-
3	DC Cable	1.0	Unshielded	Unshielded	-
4	AC Cable	0.8	Unshielded	Unshielded	-

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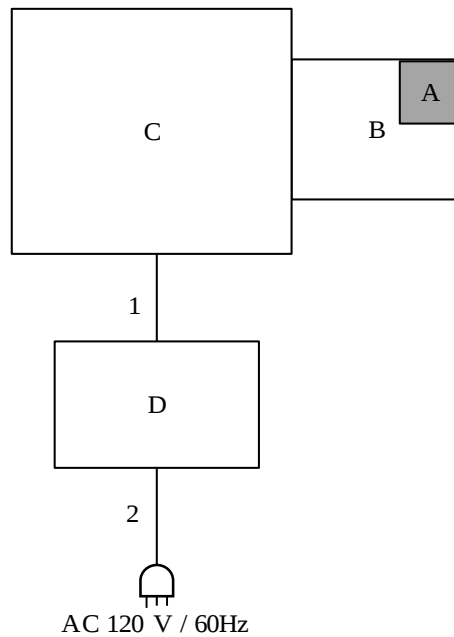
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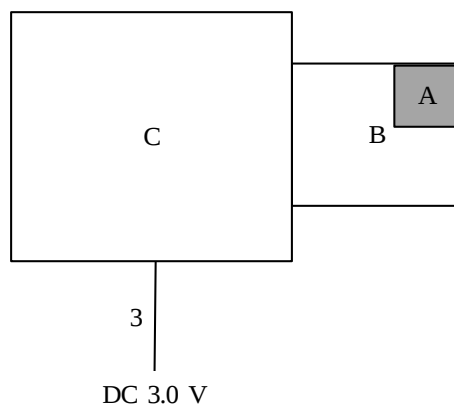
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Conducted emission test



Radiated emission test



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

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Communication Module	2AY	90	Murata Manufacturing Co.,Ltd	EUT
B	Jig	P2ML9415	-	Murata Manufacturing Co.,Ltd	-
C	Jig	P2ML3656	-	Murata Manufacturing Co.,Ltd	-
D	DC Power Supply	PMC35-2A	RM000298	KIKUSUI	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	1.0	Unshielded	Unshielded	-
2	AC Cable	1.2	Unshielded	Unshielded	-
3	DC Cable	2.0	Unshielded	Unshielded	-

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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) and excess AC cable was bundled in center.

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

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

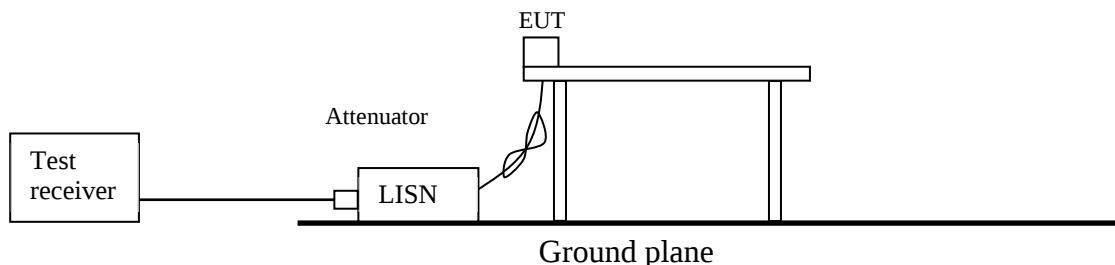
The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a Semi Anechoic Chamber. The EUT was connected to a LISN (AMN).

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 - 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, 0.5 m by 1.0 m, raised 0.8 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1 GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with absorbent materials lined on a ground plane.

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

Test antenna was aimed at the EUT for receiving the maximum signal and always kept within the illumination area of the 3 dB beamwidth of the antenna.

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

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

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

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

Test Antennas are used as below;

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

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

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

Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	PK	AV *1)	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	11.12.2.5.1 RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (RMS) Trace: 100 traces	RBW: 100 kHz VBW: 300 kHz

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

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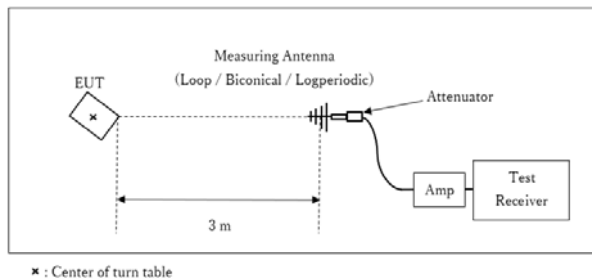
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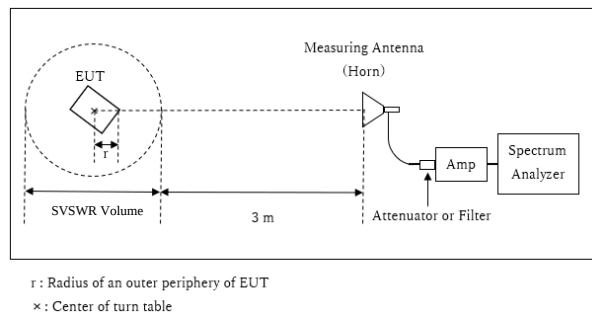
Figure 2: Test Setup

Below 1 GHz



Test Distance: 3 m

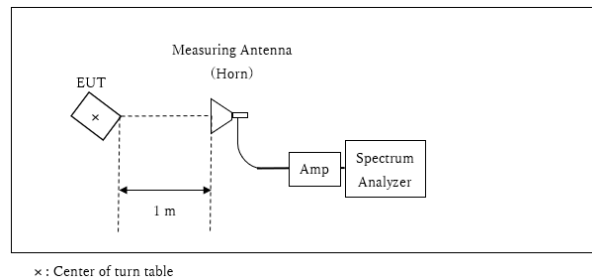
1 GHz - 10 GHz



Distance Factor: $20 \times \log (3.95 \text{ m} / 3.0 \text{ m}) = 2.39 \text{ dB}$
* Test Distance: $(3 + \text{SVSWR Volume} / 2) - r = 3.95 \text{ m}$

SVSWR Volume : 2.0 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
 $r = 0.05 \text{ m}$

10 GHz – 26.5 GHz



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

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

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

Measurement range	: 30 MHz - 26.5 GHz
Test data	: APPENDIX
Test result	: Pass

SECTION 7: Antenna Terminal Conducted Tests

Test Procedure

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

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

*1) Peak hold was applied as Worst-case measurement.
 *2) Reference data
 *3) Section 11.10.2 Method PKPSD (peak PSD) of "ANSI C63.10-2013".
 *4) The test was not performed at RBW:3 kHz however the measurement is to be performed with RBW:3 kHz in the regulation, because, the measurement value with RBW:3 kHz is less than the value of RBW:30 kHz and the test data met the limit with RBW:30 kHz.
 *5) 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 = 9.1 kHz)
 *6) The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377 Ohms. For example, the measurement at frequency 9 kHz resulted in a level of 45.5 dBuV/m, which is equivalent to $45.5 - 51.5 = -6.0$ dBuA/m, which has the same margin, 3 dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

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

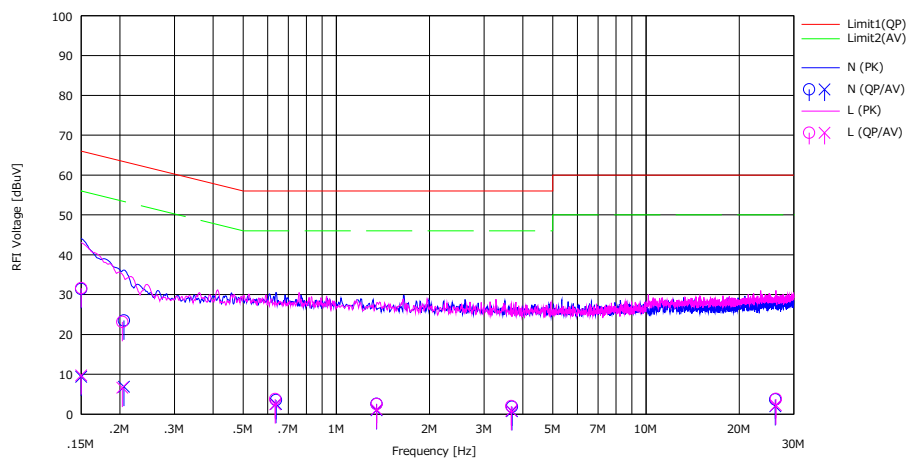
Test data : APPENDIX
Test result : Pass

APPENDIX 1: Test data

Conducted Emission

Report No. 13809763H
Test place Ise EMC Lab. No.3 Semi Anechoic Chamber
Date June 2, 2021
Temperature / Humidity 20 deg. C / 64 % RH
Engineer Junki Nagatomi
Mode Tx BT LE, Uncoded 1M-PHY, 2402MHz

Limit : FCC_Part 15 Subpart C(15.207)



No.	Freq. [MHz]	Reading		USN [dB]	LOSS [dB]	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]			<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]		
1	0.15000	18.10	-3.90	0.07	13.23	31.40	9.40	66.00	56.00	34.60	46.60	N	
2	0.20610	10.20	-6.40	0.06	13.23	23.49	6.89	63.36	53.36	39.87	46.47	N	
3	0.63875	-9.80	-10.80	0.06	13.28	3.54	2.54	56.00	46.00	52.46	43.46	N	
4	1.34800	-10.80	-12.40	0.08	13.33	2.61	1.01	56.00	46.00	53.39	44.99	N	
5	3.69100	-11.70	-12.80	0.11	13.46	1.87	0.77	56.00	46.00	54.13	45.23	N	
6	26.16000	-10.90	-12.60	0.54	14.05	3.69	1.99	60.00	50.00	56.31	48.01	N	
7	0.15000	18.30	-3.60	0.10	13.23	31.63	9.73	66.00	56.00	34.37	46.27	L	
8	0.20355	9.80	-6.70	0.10	13.23	23.13	6.63	63.46	53.46	40.33	46.83	L	
9	0.63450	-9.60	-10.90	0.11	13.28	3.79	2.49	56.00	46.00	52.21	43.51	L	
10	1.34920	-10.90	-12.30	0.12	13.33	2.55	1.15	56.00	46.00	53.45	44.85	L	
11	3.67300	-11.60	-12.80	0.16	13.46	2.02	0.82	56.00	46.00	53.98	45.18	L	
12	26.26000	-10.90	-12.50	0.66	14.05	3.81	2.21	60.00	50.00	56.19	47.79	L	

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

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Ise EMC Lab.

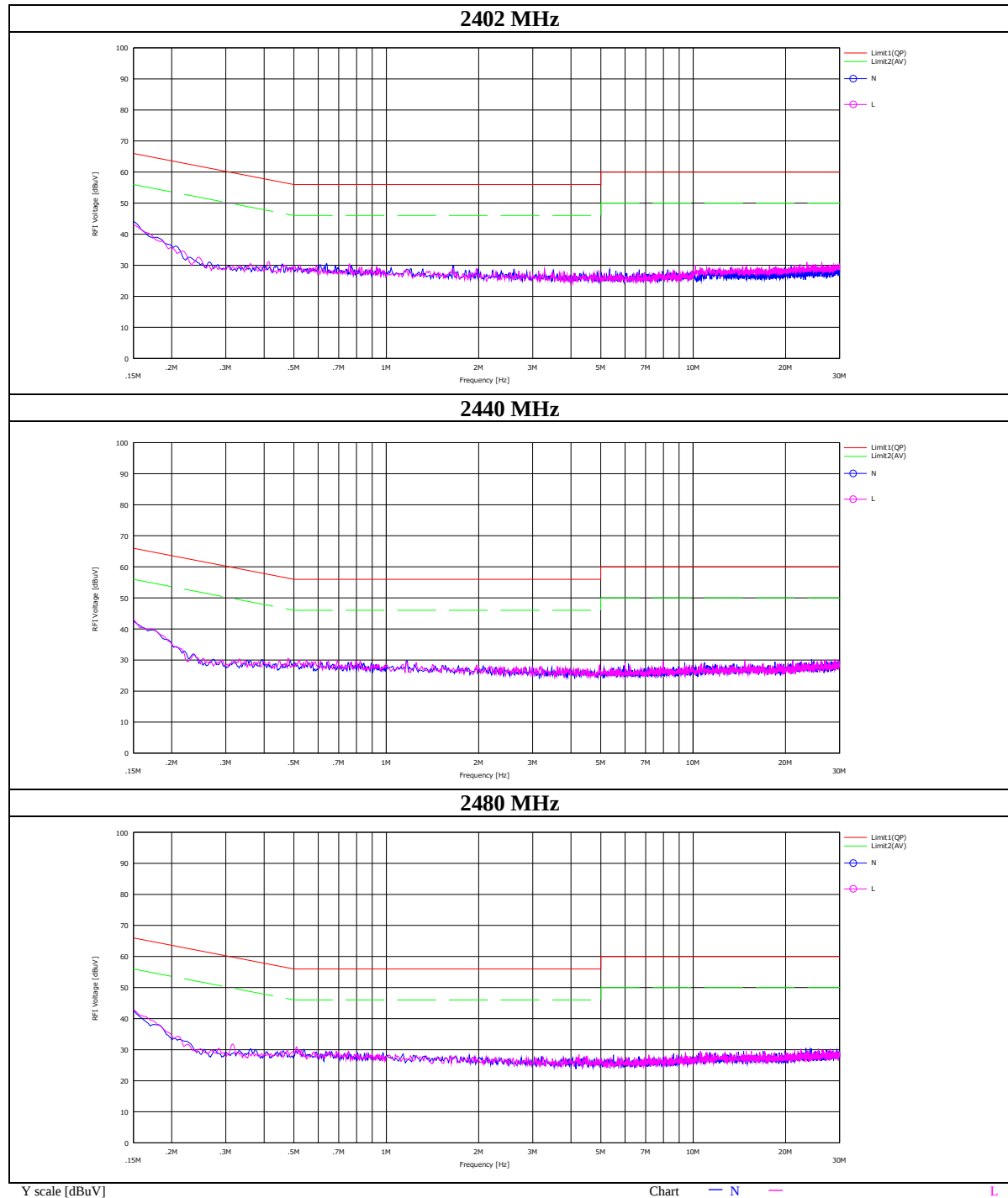
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Emission

Report No. 13809763H
Test place Ise EMC Lab. No.3 Semi Anechoic Chamber
Date June 2, 2021
Temperature / Humidity 23 deg. C / 68 % RH
Engineer Junki Nagatomi
Mode Tx BT LE Uncoded 1M-PHY



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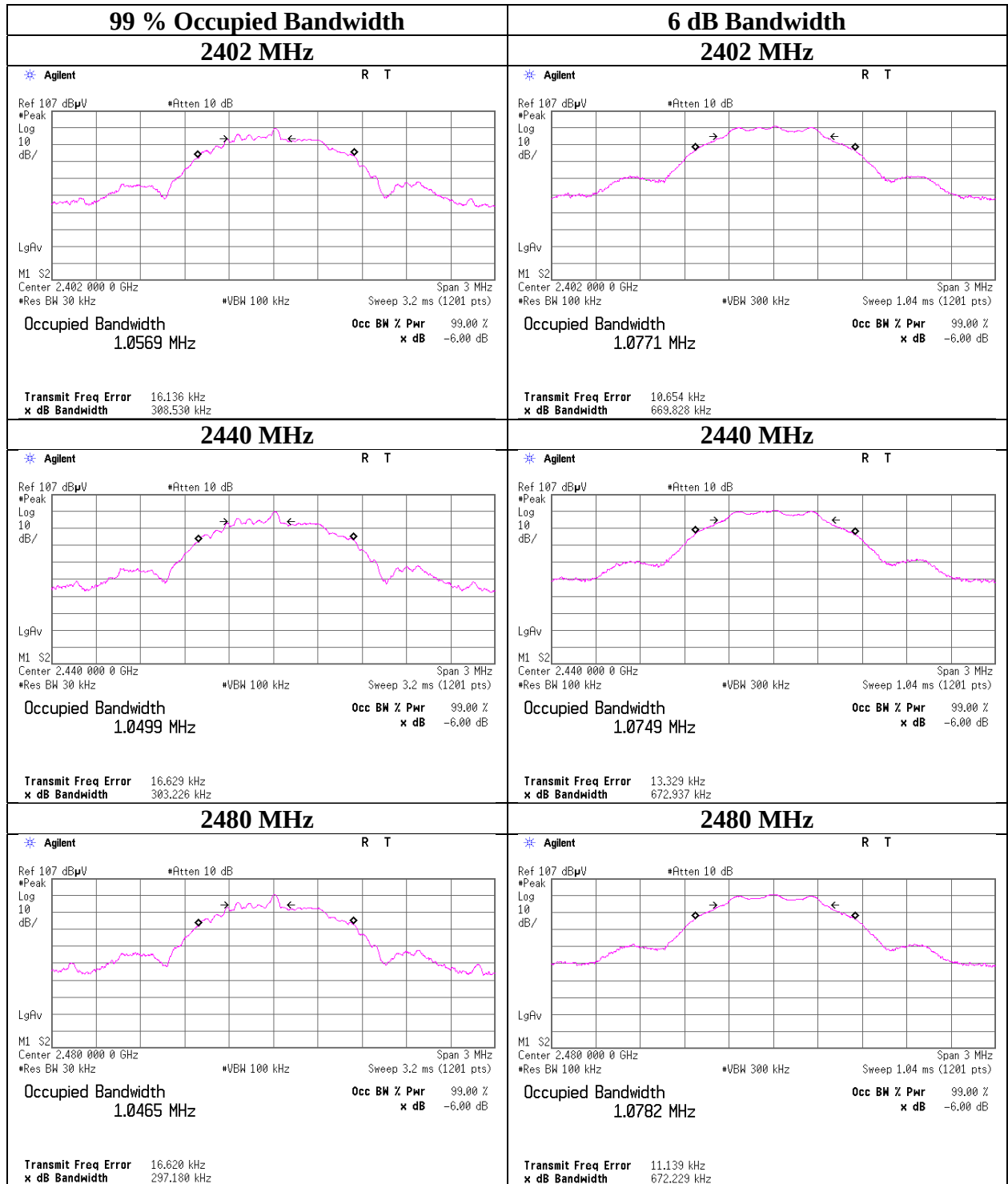
99 % Occupied Bandwidth and 6 dB Bandwidth

Report No. 13809763H
Test place Ise EMC Lab. No.6 Measurement Room
Date June 1, 2021
Temperature / Humidity 24 deg. C / 53 % RH
Engineer Hiroyuki Furutaka
Mode Tx BT LE Uncoded 1M-PHY

Mode	Frequency [MHz]	99 % Occupied Bandwidth [kHz]	6 dB Bandwidth [MHz]	Limit for 6 dB Bandwidth [MHz]
BT LE	2402	1056.9	0.670	> 0.5000
	2440	1049.9	0.673	> 0.5000
	2480	1046.5	0.672	> 0.5000

99 % Occupied Bandwidth and 6 dB Bandwidth

BT LE



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Maximum Peak Output Power

Report No. 13809763H
Test place Ise EMC Lab. No.6 Measurement Room
Date June 1, 2021
Temperature / Humidity 24 deg. C / 53 % RH
Engineer Hiroyuki Furutaka
Mode Tx BT LE Uncoded 1M-PHY

Max Power(2.5dBm)

Freq.	Reading	Cable Loss	Atten. Loss	Conducted Power					e.i.r.p. for RSS-247						
				Result		Limit		Margin	Antenna Gain	Result		Limit		Margin	
				[dBm]	[mW]	[dBm]	[mW]			[dB]	[dBm]	[mW]	[dBm]		[mW]
[MHz]	[dBm]	[dB]	[dB]						[dBi]						
2402	-9.46	1.51	10.07	2.12	1.63	30.00	1000	27.88	0.50	2.62	1.83	36.02	4000	33.40	
2440	-9.60	1.52	10.07	1.99	1.58	30.00	1000	28.01	0.50	2.49	1.77	36.02	4000	33.53	
2480	-9.71	1.53	10.06	1.88	1.54	30.00	1000	28.12	0.50	2.38	1.73	36.02	4000	33.64	

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.

Min Power(-19.5dBm)

				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	-18.11	1.51	0.00	-16.60	0.02	30.00	1000	46.60	0.50	-16.10	0.02	36.02	4000	52.12	
2440	-18.37	1.52	0.00	-16.85	0.02	30.00	1000	46.85	0.50	-16.35	0.02	36.02	4000	52.37	
2480	-18.45	1.53	0.00	-16.92	0.02	30.00	1000	46.92	0.50	-16.42	0.02	36.02	4000	52.44	

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)**

Report No.	13809763H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	June 1, 2021
Temperature / Humidity	24 deg. C / 53 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx BT LE Uncoded 1M-PHY

Max Power(2.5dBm)

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	-11.60	1.51	10.07	-0.02	1.00	1.63	1.61	1.45
2440	-11.69	1.52	10.07	-0.10	0.98	1.63	1.53	1.42
2480	-11.83	1.53	10.06	-0.24	0.95	1.63	1.39	1.38

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.

Min Power(-19.5dBm)

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	-23.34	1.51	0.00	-21.83	0.01	1.63	-20.20	0.01
2440	-23.41	1.52	0.00	-21.89	0.01	1.63	-20.26	0.01
2480	-23.42	1.53	0.00	-21.89	0.01	1.63	-20.26	0.01

Sample Calculation:

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

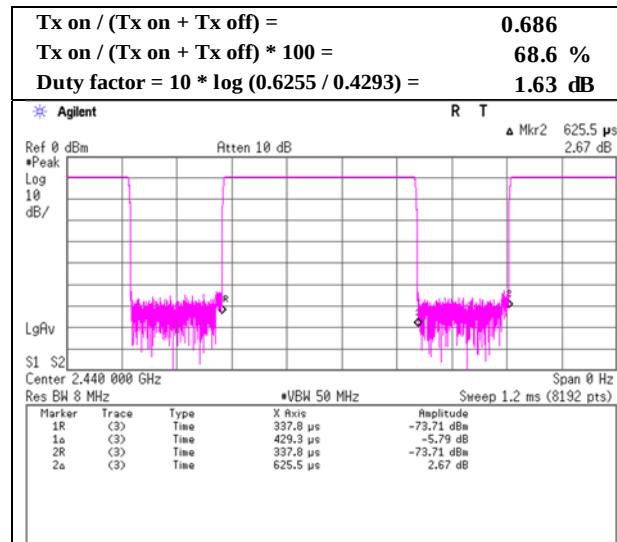
Result (Burst power average) = Time average + Duty factor

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

Burst rate confirmation

Report No.	13809763H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	June 1, 2021
Temperature / Humidity	24 deg. C / 53 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx BT LE Uncoded 1M-PHY

BT LE



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

Radiated Spurious Emission

Report No. 13809763H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4 No.3
Date June 1, 2021 June 2, 2021
Temperature / Humidity 23 deg. C / 52 % RH 20 deg. C / 64 % RH
Engineer Yuichiro Yamazaki Junki Nagatomi
(Above 1GHz) (Below 1GHz)
Mode Tx BT LE 2402 MHz Uncoded 1M-PHY

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	89.591	QP	25.3	8.6	8.1	32.3	-	9.7	43.5	33.9	
Hori.	168.000	QP	28.2	15.7	8.9	32.2	-	20.6	43.5	22.9	
Hori.	256.018	QP	30.1	12.0	9.7	32.1	-	19.7	46.0	26.3	
Hori.	315.220	QP	33.4	13.9	10.2	32.1	-	25.3	46.0	20.7	
Hori.	403.203	QP	29.2	15.7	10.8	32.1	-	23.6	46.0	22.4	
Hori.	491.313	QP	21.5	17.5	11.4	32.1	-	18.3	46.0	27.7	
Hori.	2390.000	PK	50.7	27.8	5.4	31.8	-	52.0	73.9	21.9	
Hori.	4804.000	PK	40.1	31.6	7.6	31.2	-	48.1	73.9	25.9	Floor noise
Hori.	7206.000	PK	42.4	36.2	8.8	32.4	-	55.0	73.9	18.9	Floor noise
Hori.	9608.000	PK	40.9	38.0	9.5	32.6	-	55.8	73.9	18.1	Floor noise
Hori.	2390.000	AV	36.3	27.8	5.4	31.8	1.6	39.3	53.9	14.6	*1)
Hori.	4804.000	AV	32.2	31.6	7.6	31.2	-	40.2	53.9	13.7	Floor noise
Hori.	7206.000	AV	32.6	36.2	8.8	32.4	-	45.1	53.9	8.8	Floor noise
Hori.	9608.000	AV	32.8	38.0	9.5	32.6	-	47.7	53.9	6.2	Floor noise
Vert.	89.591	QP	25.9	8.6	8.1	32.3	-	10.3	43.5	33.3	
Vert.	168.000	QP	28.4	15.7	8.9	32.2	-	20.8	43.5	22.7	
Vert.	256.018	QP	30.4	12.0	9.7	32.1	-	20.0	46.0	26.0	
Vert.	315.220	QP	33.2	13.9	10.2	32.1	-	25.1	46.0	20.9	
Vert.	403.203	QP	30.1	15.7	10.8	32.1	-	24.5	46.0	21.5	
Vert.	491.313	QP	23.1	17.5	11.4	32.1	-	19.9	46.0	26.1	
Vert.	2390.000	PK	50.3	27.8	5.4	31.8	-	51.6	73.9	22.3	
Vert.	4804.000	PK	40.1	31.6	7.6	31.2	-	48.1	73.9	25.8	Floor noise
Vert.	7206.000	PK	42.3	36.2	8.8	32.4	-	54.8	73.9	19.1	Floor noise
Vert.	9608.000	PK	42.6	38.0	9.5	32.6	-	57.5	73.9	16.4	Floor noise
Vert.	2390.000	AV	36.4	27.8	5.4	31.8	1.6	39.4	53.9	14.6	*1)
Vert.	4804.000	AV	32.4	31.6	7.6	31.2	-	40.4	53.9	13.5	Floor noise
Vert.	7206.000	AV	32.7	36.2	8.8	32.4	-	45.2	53.9	8.7	Floor noise
Vert.	9608.000	AV	32.7	38.0	9.5	32.6	-	47.6	53.9	6.3	Floor noise

Result = 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).

Distance factor: 1 GHz - 10 GHz $20\log(3.95\text{ m} / 3.0\text{ m}) = 2.39\text{ dB}$
10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

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

20dBc Data Sheet

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2402.000	PK	96.3	27.8	5.4	31.8	97.6	-	-	Carrier
Hori	2400.000	PK	55.6	27.8	5.4	31.8	56.9	77.6	20.7	
Vert	2402.000	PK	95.7	27.8	5.4	31.8	97.0	-	-	Carrier
Vert	2400.000	PK	55.3	27.8	5.4	31.8	56.6	77.0	20.4	

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

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Ise EMC Lab.

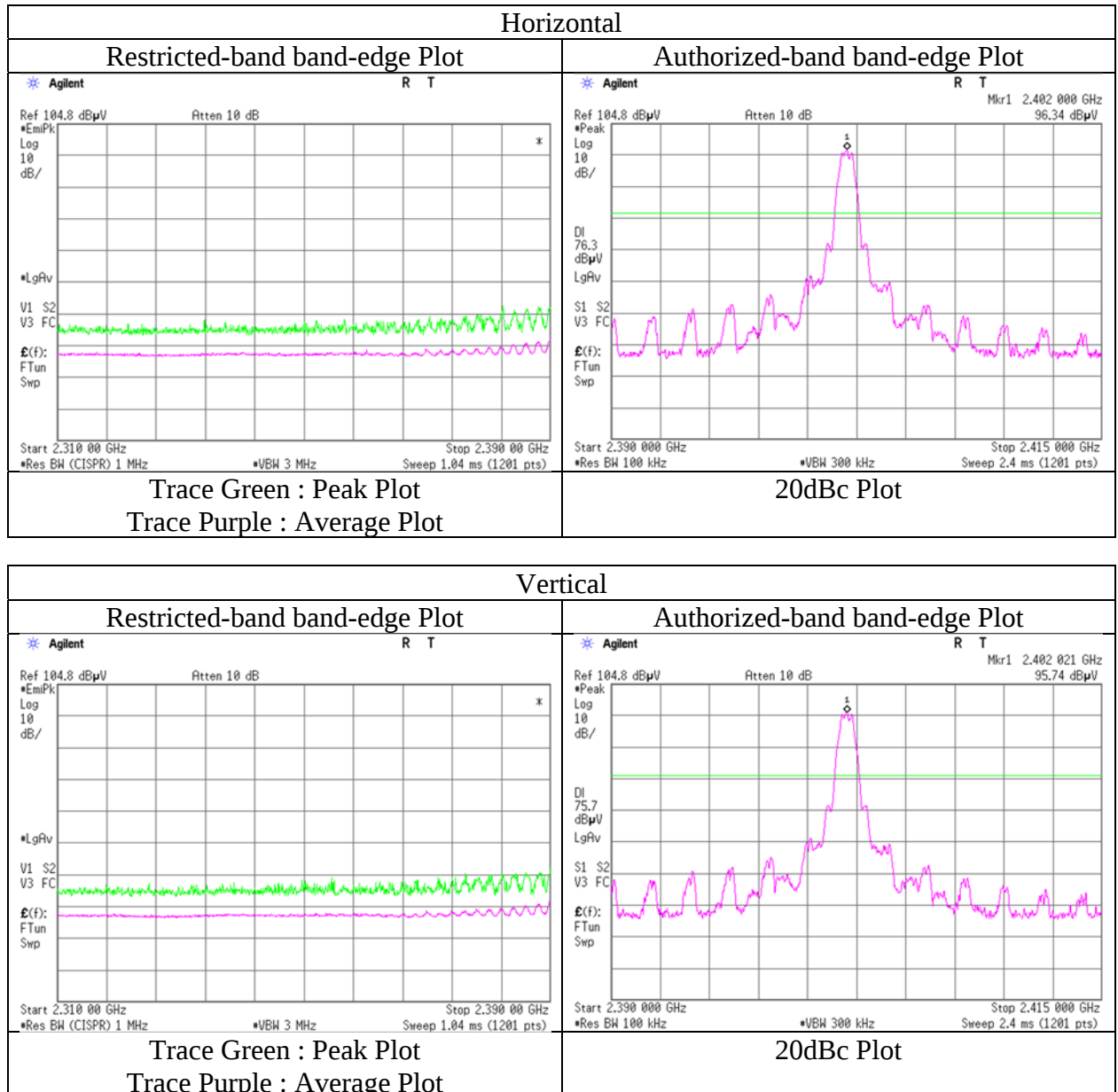
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	13809763H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	June 1, 2021
Temperature / Humidity	23 deg. C / 52 % RH
Engineer	Yuichiro Yamazaki (Above 1GHz)
Mode	Tx BT LE 2402 MHz Uncoded 1M-PHY



* 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.

UL Japan, Inc.

Ise EMC Lab.

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Radiated Spurious Emission

Report No.	13809763H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.3
Date	June 1, 2021	June 2, 2021
Temperature / Humidity	23 deg. C / 52 % RH	20 deg. C / 64 % RH
Engineer	Yuichiro Yamazaki	Junki Nagatomi
	(Above 1GHz)	(Below 1GHz)
Mode	Tx BT LE 2440 MHz Uncoded 1M-PHY	

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	89.591	QP	25.1	8.6	8.1	32.3	-	9.5	43.5	34.1	
Hori.	168.000	QP	28.4	15.7	8.9	32.2	-	20.8	43.5	22.7	
Hori.	256.018	QP	30.2	12.0	9.7	32.1	-	19.8	46.0	26.2	
Hori.	315.220	QP	33.5	13.9	10.2	32.1	-	25.4	46.0	20.6	
Hori.	403.203	QP	29.2	15.7	10.8	32.1	-	23.6	46.0	22.4	
Hori.	491.313	QP	21.1	17.5	11.4	32.1	-	17.9	46.0	28.1	
Hori.	4880.000	PK	41.0	31.6	7.6	31.2	-	49.0	73.9	24.9	Floor noise
Hori.	7320.000	PK	42.2	36.3	8.8	32.4	-	54.9	73.9	19.1	Floor noise
Hori.	9760.000	PK	42.1	38.4	9.5	32.7	-	57.4	73.9	16.5	Floor noise
Hori.	4880.000	AV	32.3	31.6	7.6	31.2	-	40.3	53.9	13.6	Floor noise
Hori.	7320.000	AV	32.5	36.3	8.8	32.4	-	45.1	53.9	8.8	Floor noise
Hori.	9760.000	AV	32.3	38.4	9.5	32.7	-	47.6	53.9	6.3	Floor noise
Vert.	89.591	QP	25.9	8.6	8.1	32.3	-	10.3	43.5	33.3	
Vert.	168.000	QP	28.5	15.7	8.9	32.2	-	20.9	43.5	22.6	
Vert.	256.018	QP	30.4	12.0	9.7	32.1	-	20.0	46.0	26.0	
Vert.	315.220	QP	33.3	13.9	10.2	32.1	-	25.2	46.0	20.8	
Vert.	403.203	QP	30.1	15.7	10.8	32.1	-	24.5	46.0	21.5	
Vert.	491.313	QP	23.2	17.5	11.4	32.1	-	20.0	46.0	26.0	
Vert.	4880.000	PK	40.9	31.6	7.6	31.2	-	48.9	73.9	25.0	Floor noise
Vert.	7320.000	PK	42.1	36.3	8.8	32.4	-	54.7	73.9	19.2	Floor noise
Vert.	9760.000	PK	42.6	38.4	9.5	32.7	-	57.8	73.9	16.1	Floor noise
Vert.	4880.000	AV	32.0	31.6	7.6	31.2	-	40.0	53.9	13.9	Floor noise
Vert.	7320.000	AV	32.4	36.3	8.8	32.4	-	45.0	53.9	8.9	Floor noise
Vert.	9760.000	AV	32.4	38.4	9.5	32.7	-	47.7	53.9	6.2	Floor noise

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

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

Distance factor: 1 GHz - 10 GHz $20\log(3.95\text{ m} / 3.0\text{ m}) = 2.39\text{ dB}$
10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

Radiated Spurious Emission

Report No. 13809763H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4 No.3
Date June 1, 2021 June 2, 2021
Temperature / Humidity 23 deg. C / 52 % RH 20 deg. C / 64 % RH
Engineer Yuichiro Yamazaki Junki Nagatomi
(Above 1GHz) (Below 1GHz)
Mode Tx BT LE 2480 MHz Uncoded 1M-PHY

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	89.591	QP	25.2	8.6	8.1	32.3	-	9.6	43.5	34.0	
Hori.	168.000	QP	28.6	15.7	8.9	32.2	-	21.0	43.5	22.5	
Hori.	256.018	QP	30.0	12.0	9.7	32.1	-	19.6	46.0	26.4	
Hori.	315.220	QP	33.6	13.9	10.2	32.1	-	25.5	46.0	20.5	
Hori.	403.203	QP	29.4	15.7	10.8	32.1	-	23.8	46.0	22.2	
Hori.	491.313	QP	20.9	17.5	11.4	32.1	-	17.7	46.0	28.3	
Hori.	2483.500	PK	48.8	27.7	5.5	31.8	-	50.1	73.9	23.8	
Hori.	4960.000	PK	41.3	31.7	7.6	31.2	-	49.5	73.9	24.4	Floor noise
Hori.	7440.000	PK	42.2	36.5	8.8	32.5	-	55.0	73.9	18.9	Floor noise
Hori.	9920.000	PK	42.3	38.6	9.6	32.7	-	57.7	73.9	16.2	Floor noise
Hori.	2483.500	AV	39.4	27.7	5.5	31.8	1.6	42.3	53.9	11.6	*1)
Hori.	4960.000	AV	32.4	31.7	7.6	31.2	-	40.6	53.9	13.3	Floor noise
Hori.	7440.000	AV	32.5	36.5	8.8	32.5	-	45.3	53.9	8.6	Floor noise
Hori.	9920.000	AV	32.4	38.6	9.6	32.7	-	47.8	53.9	6.1	Floor noise
Vert.	89.591	QP	25.7	8.6	8.1	32.3	-	10.1	43.5	33.5	
Vert.	168.000	QP	28.6	15.7	8.9	32.2	-	21.0	43.5	22.5	
Vert.	256.018	QP	30.4	12.0	9.7	32.1	-	20.0	46.0	26.0	
Vert.	315.220	QP	33.6	13.9	10.2	32.1	-	25.5	46.0	20.5	
Vert.	403.203	QP	30.1	15.7	10.8	32.1	-	24.5	46.0	21.5	
Vert.	491.313	QP	22.9	17.5	11.4	32.1	-	19.7	46.0	26.3	
Vert.	2483.500	PK	48.6	27.7	5.5	31.8	-	50.0	73.9	24.0	
Vert.	4960.000	PK	41.0	31.7	7.6	31.2	-	49.2	73.9	24.7	Floor noise
Vert.	7440.000	PK	42.5	36.5	8.8	32.5	-	55.3	73.9	18.6	Floor noise
Vert.	9920.000	PK	42.4	38.6	9.6	32.7	-	57.8	73.9	16.1	Floor noise
Vert.	2483.500	AV	39.5	27.7	5.5	31.8	1.6	42.5	53.9	11.4	*1)
Vert.	4960.000	AV	32.5	31.7	7.6	31.2	-	40.7	53.9	13.2	Floor noise
Vert.	7440.000	AV	32.8	36.5	8.8	32.5	-	45.6	53.9	8.3	Floor noise
Vert.	9920.000	AV	32.2	38.6	9.6	32.7	-	47.6	53.9	6.3	Floor noise

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

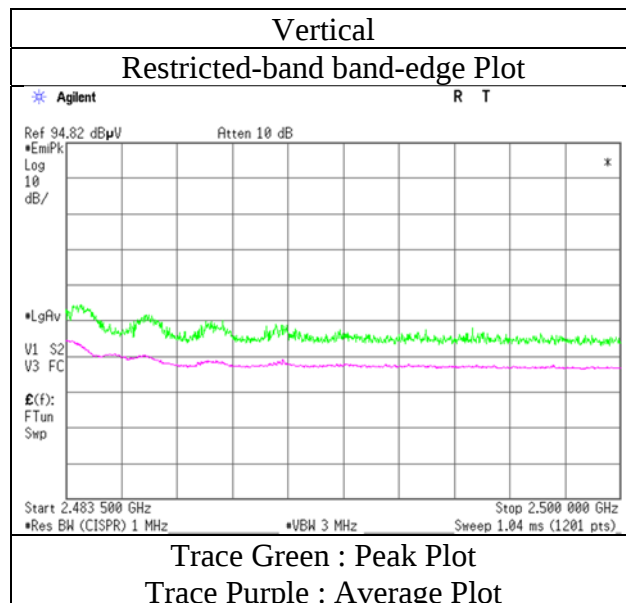
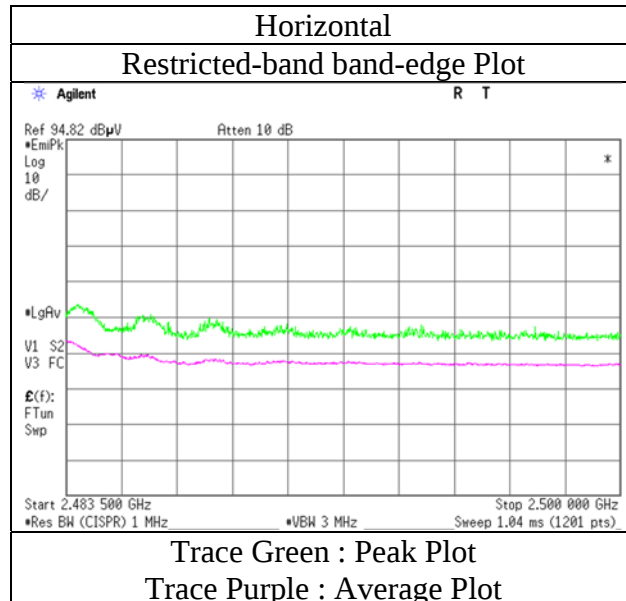
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

Distance factor: 1 GHz - 10 GHz 20log (3.95 m / 3.0 m) = 2.39 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

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

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	13809763H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	June 1, 2021
Temperature / Humidity	23 deg. C / 52 % RH
Engineer	Yuichiro Yamazaki (Above 1GHz)
Mode	Tx BT LE 2480 MHz Uncoded 1M-PHY



* 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.

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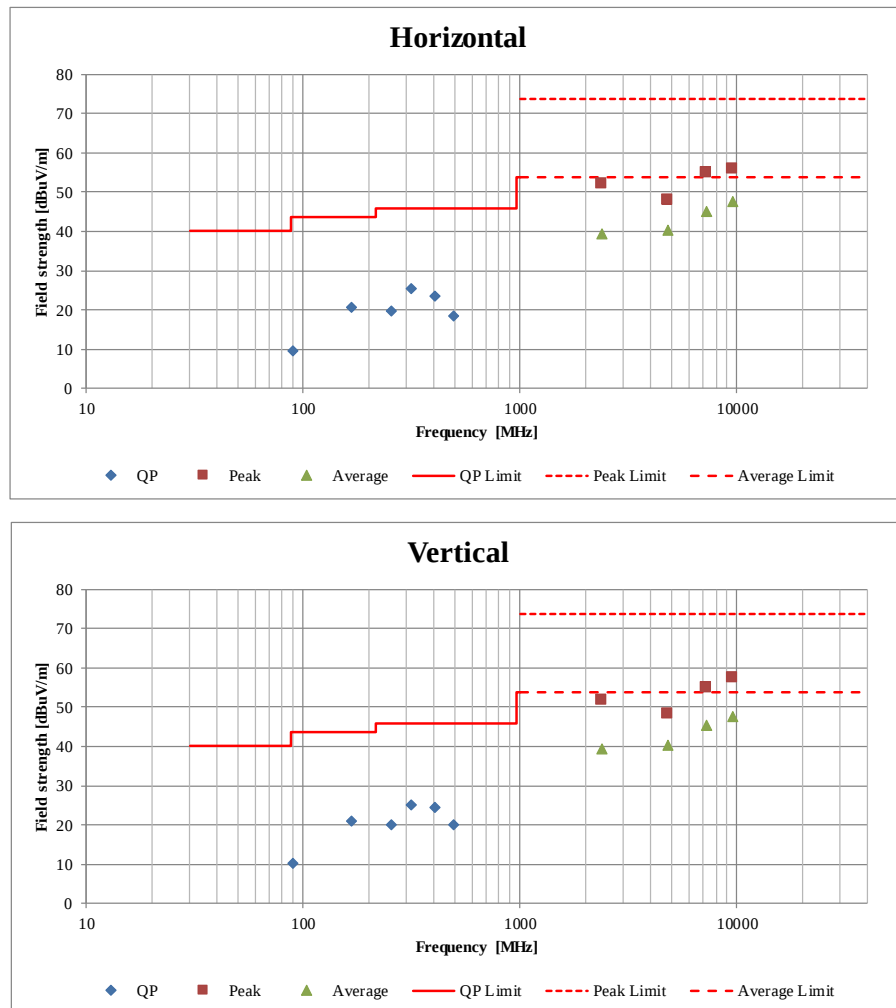
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Radiated Spurious Emission (Plot data, Worst case)

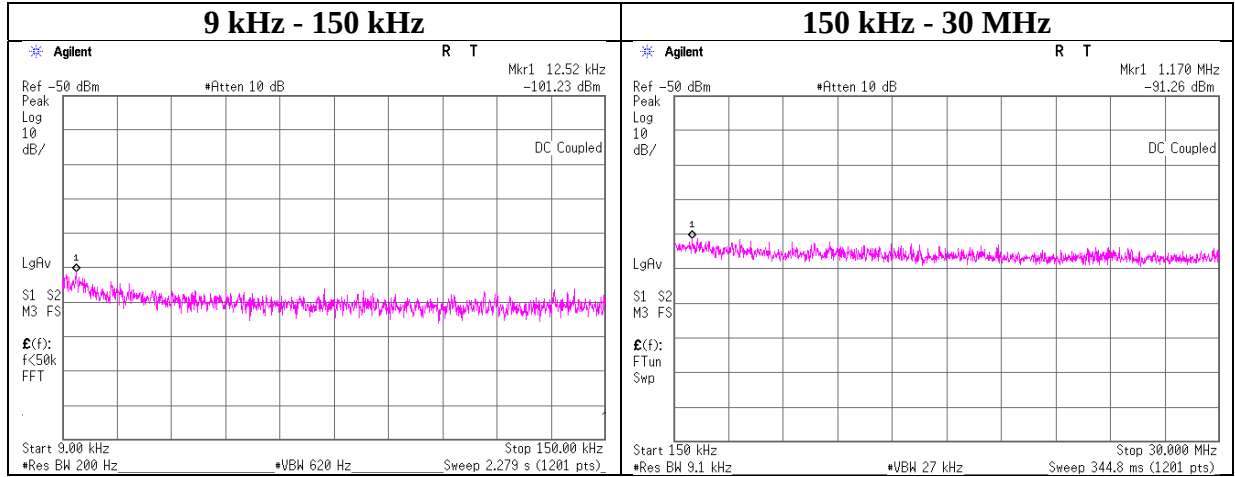
Report No.	13809763H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.3
Date	June 1, 2021	June 2, 2021
Temperature / Humidity	23 deg. C / 52 % RH	20 deg. C / 64 % RH
Engineer	Yuichiro Yamazaki (Above 1GHz)	Junki Nagatomi (Below 1GHz)
Mode	Tx BT LE 2402 MHz Uncoded 1M-PHY	



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

Conducted Spurious Emission

Report No.	13809763H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	June 1, 2021
Temperature / Humidity	24 deg. C / 53 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx BT LE 2402 MHz Uncoded 1M-PHY



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
12.52	-101.2	0.50	9.8	2.0	1	-88.9	300	6.0	-27.6	45.6	73.2	
1170.00	-91.3	0.52	9.8	2.0	1	-78.9	30	6.0	2.4	26.2	23.8	

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

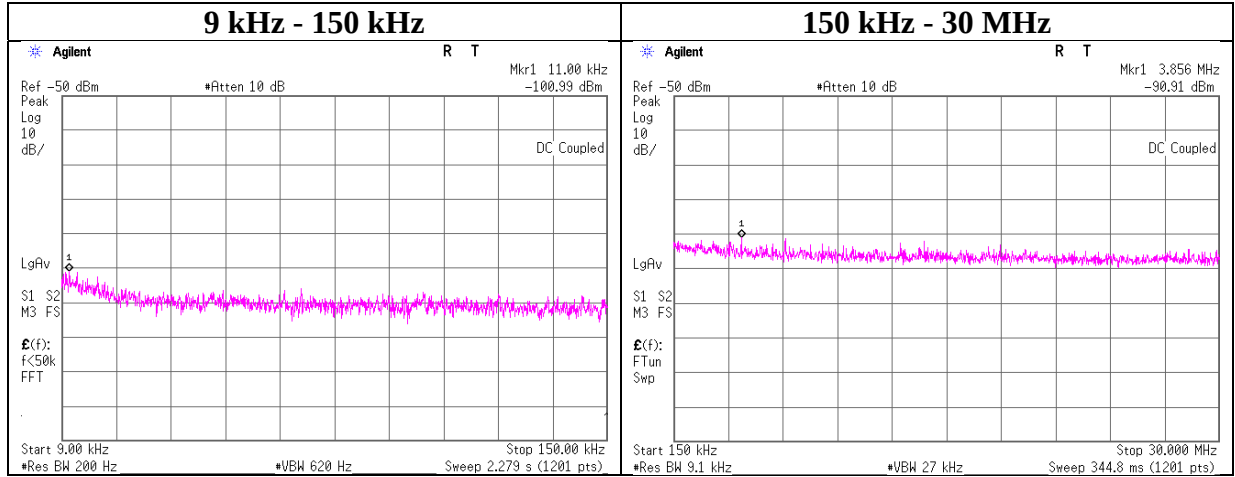
$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log (N)$

N: Number of output

*2.0 dBi was applied to the test result based on ANSI C63.10 since antenna gain was less than 2.0 dBi.

Conducted Spurious Emission

Report No.	13809763H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	June 1, 2021
Temperature / Humidity	24 deg. C / 53 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx BT LE 2440 MHz Uncoded 1M-PHY



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
11.00	-101.0	0.50	9.8	2.0	1	-88.7	300	6.0	-27.4	46.7	74.1	
3856.00	-90.9	0.54	9.8	2.0	1	-78.5	30	6.0	2.7	29.5	26.8	

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

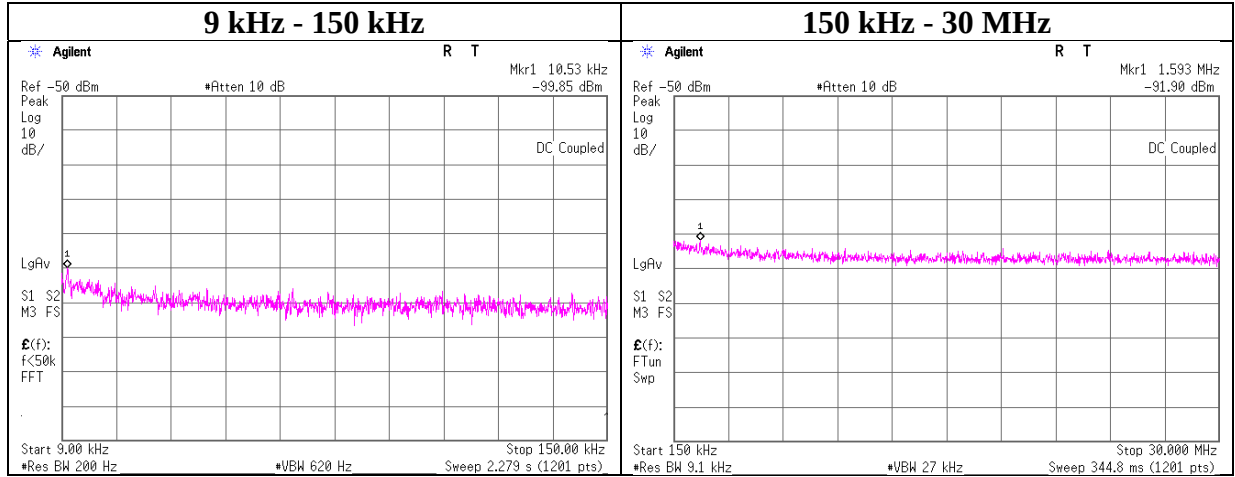
$EIRP [dBm] = Reading [dBm] + Cable\ loss [dB] + Attenuator\ Loss [dB] + Antenna\ gain [dBi] + 10 * \log (N)$

N: Number of output

*2.0 dBi was applied to the test result based on ANSI C63.10 since antenna gain was less than 2.0 dBi.

Conducted Spurious Emission

Report No.	13809763H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	June 1, 2021
Temperature / Humidity	24 deg. C / 53 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx BT LE 2480 MHz Uncoded 1M-PHY



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
10.53	-99.9	0.50	9.8	2.0	1	-87.5	300	6.0	-26.3	47.1	73.4	
1593.00	-91.9	0.52	9.8	2.0	1	-79.5	30	6.0	1.7	23.5	21.8	

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

$EIRP [dBm] = Reading [dBm] + Cable\ loss [dB] + Attenuator\ Loss [dB] + Antenna\ gain [dBi] + 10 * \log (N)$

N: Number of output

*2.0 dBi was applied to the test result based on ANSI C63.10 since antenna gain was less than 2.0 dBi.

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Power Density

Report No. 13809763H
Test place Ise EMC Lab. No.6 Measurement Room
Date June 1, 2021
Temperature / Humidity 24 deg. C / 53 % RH
Engineer Hiroyuki Furutaka
Mode Tx BT LE Uncoded 1M-PHY

Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	dBm / 3 kHz	[dB]	[dB]	[dBm / 3 kHz]	[dBm / 3 kHz]	[dB]
2402	-24.21	1.51	10.07	-12.63	8.00	20.63
2440	-24.19	1.52	10.07	-12.60	8.00	20.60
2480	-23.58	1.53	10.06	-11.99	8.00	19.99

Sample Calculation:

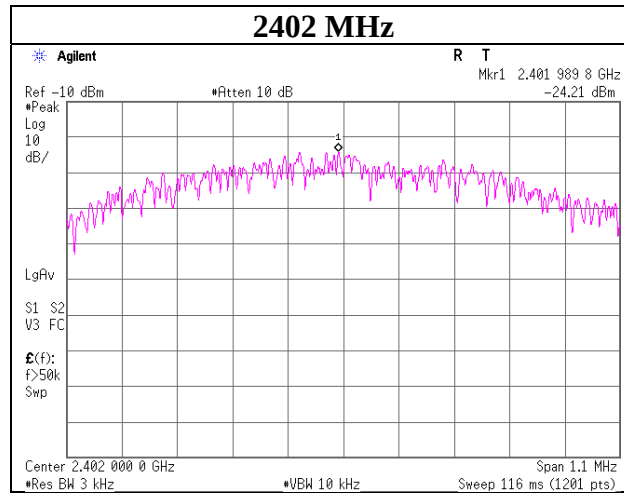
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

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

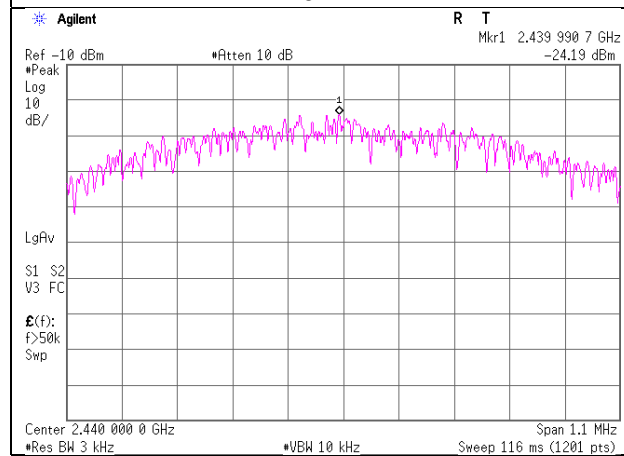
Power Density

BT LE

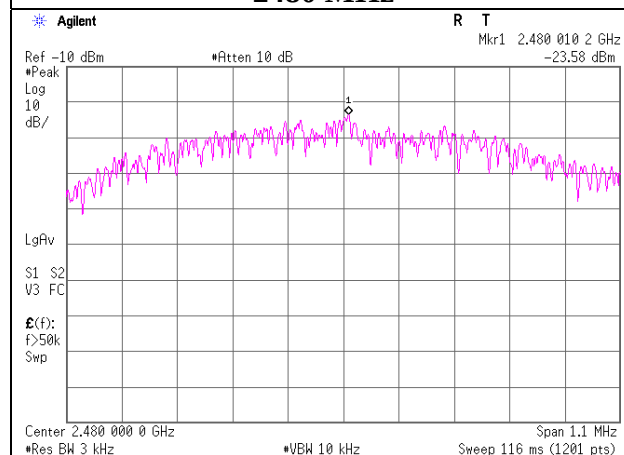
2402 MHz



2440 MHz



2480 MHz



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APPENDIX 2: Test instruments

Test equipment(1/2)

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
CE	MLS-23	141357	LISN(AMN)	Schwarzbeck Mess-Elektronik OHG	NSLK8127	8127-729	2020/07/22	12
CE	MAT-66	141247	Attenuator(13dB)	JFW Industries, Inc.	50FP-013H2 N	-	-	-
CE	MCC-112	141216	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W/SFM14/sucoform141-PE/421-010/RFM-E321(SW)	-/00640	2020/07/06	12
CE	MTR-10	141951	EMI Test Receiver	Rohde & Schwarz	ESR26	101408	2021/03/09	12
CE	MAEC-03	142008	AC3_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	2020/05/22	24
CE	MOS-13	141554	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	1301	2021/01/15	12
CE	MMM-08	141532	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	51201197	2021/01/07	12
CE	MJM-16	142183	Measure	KOMELON	KMC-36	-	-	-
CE	COTS-MEMI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	MHF-26	141296	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	002	2020/09/23	12
RE	MHA-17	141506	Horn Antenna 15-40GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9170	BBHA9170307	2020/07/16	12
RE	MPA-12	141581	MicroWave System Amplifier	Keysight Technologies Inc	83017A	00650	2020/10/19	12
RE	MCC-246	199563	Microwave Cable	Huber+Suhner	SF126E/11PC35/11PC35/1000M,5000M	537061/126E / 537072/126E	2020/06/11	12
RE	MHA-21	141508	Horn Antenna 1-18GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	557	2021/05/10	12
RE	MSA-10	141899	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY46180655	2020/08/04	12
RE	MJM-29	142230	Measure	KOMELON	KMC-36	-	-	-
RE	MAEC-04-SVSWR	142017	AC4_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-10005	2021/04/12	24
RE	MAEC-03	142008	AC3_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	2020/05/22	24
RE	MOS-13	141554	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	1301	2021/01/15	12
RE	MMM-08	141532	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	51201197	2021/01/07	12
RE	MJM-16	142183	Measure	KOMELON	KMC-36	-	-	-
RE	MAT-95	142314	Attenuator	Pasternack Enterprises	PE7390-6	D/C 1504	2021/06/09	12
RE	MBA-03	141424	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	VHA9103+BBA9106	1915	2020/08/13	12
RE	MCC-51	141323	Coaxial cable	UL Japan	-	-	2020/07/06	12
RE	MLA-22	141266	Logperiodic Antenna(200-1000MHz)	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	9111B-191	2020/08/13	12
RE	MPA-13	141582	Pre Amplifier	SONOMA INSTRUMENT	310	260834	2021/02/18	12
RE	MTR-10	141951	EMI Test Receiver	Rohde & Schwarz	ESR26	101408	2021/03/09	12
RE	MAEC-04	142011	AC4_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	2020/05/25	24
RE	MOS-15	141562	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0010	2021/01/15	12
RE	MMM-10	141545	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	51201148	2021/01/07	12

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Test equipment(2/2)

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
AT	MPM-16	141812	Power Meter	Keysight Technologies Inc	8990B	MY51000271	2020/08/20	12
AT	MAT-20	141173	Attenuator(10dB)(above1GHz)	HIROSE ELECTRIC CO.,LTD.	AT-110	-	2020/12/07	12
AT	MCC-144	141414	Microwave Cable	Junkosha	MWX221	1207S407	2020/08/03	12
AT	MPSE-22	141842	Power sensor	Keysight Technologies Inc	N1923A	MY54070003	2020/08/20	12
AT	MOS-14	141561	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	1401	2021/01/15	12
AT	MSA-14	141901	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY48250080	2020/12/18	12
AT	MCC-64	141327	Coaxial Cable	UL Japan	-	-	2021/02/03	12
AT	MAT-10	141156	Attenuator(10dB)	Weinschel Corp	2	BL1173	2020/11/13	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 test
RE: Radiated Emission test
AT: Antenna Terminal Conducted test

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