RADIO TEST REPORT

Test Report No. : 13414283H-A-R2

Applicant	:	**DENSO CORPORATION**
Type of EUT	:	**BLE ECU**
Model Number of EUT	:	**17EAA**
FCC ID	:	**HYQ17EAA**
Test regulation	:	**FCC Part 15 Subpart C: 2021**
Test Result	:	**Complied (Refer to SECTION 3.2)**

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
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.
10. This report is a revised version of 13414283H-A-R1. 13414283H-A-R1 is replaced with this report.

Date of test: January 13 to February 3, 2021

Representative test engineer:
Hiroyuki Furutaka
Engineer
Consumer Technology Division

Approved by:
Motoya Imura
Leader
Consumer Technology Division

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".

UL Japan, Inc.
Ise EMC Lab.
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone : +81 596 24 8999
Facsimile : +81 596 24 8124

REVISION HISTORY

Original Test Report No.: 13414283H-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13414283H-A	March 11, 2021	-	-
1	13414283H-A-R1	March 16, 2021	P.1	Correction of the Date of test in Cover page; From January 13 and 21, 2021 To January 13 to February 3, 2021
1	13414283H-A-R1	March 16, 2021	P.21, 23, 24, 26, 28 to 32	Correction of the test Date; From January 21, 2021 To February 3, 2021
1	13414283H-A-R1	March 16, 2021	P.29	Deletion of the "Floor noise" notation for the 2rd harmonic (Horizontal) from test data.
1	13414283H-A-R1	March 16, 2021	P.33, 35	Correction of frequency value of conduction spurious; accordingly change of Margin value.
2	13414283H-A-R2	March 18, 2021	P. 6	Correction of the Worst Margin for Spurious Emission Restricted Band Edges in Clause 3.2; From 3.3 dB 9608.000 MHz, AV, Vertical / 9760.000 MHz, AV, Vertical To 3.0 dB 9608.000 MHz, AV, Horizontal
2	13414283H-A-R2	March 18, 2021	P. 29	Addition of the "Floor noise" notation for the 3rd harmonic (Horizontal) from test data.

Reference: Abbreviations (Including words undescribed in this report)

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

CONTENTS **PAGE**

SECTION 1: Customer information

Company Name	:	DENSO CORPORATION
Address	:	1-1, Show a-ch Ka riya-shi, Aio, chi-ken, 448-8661, Japan
Telephone Number	:	+81-566-87-3327
Facsimile Number	:	+81-566-25-4837
Contact Person	:	Shinichiro Kato

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	:	BLE ECU
Model Number	:	17EAA
Serial Number	:	Refer to SECTION 4.2
Rating	:	DC 12.0 V DC 3.3 V (BLE IC)
Receipt Date	:	January 12, 2021
Country of Mass-production	:	Japan
Condition	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	:	No Modification by the test lab.

2.2 Product Description

Model: 17EAA (referred to as the EUT in this report) is a BLE ECU.

Radio Specification

Bluetooth Spec. Ver. 5.0

Equipment Type	:	Transceiver
Frequency of Operation	:	2400 MHz to 2483.5 MHz
Type of Modulation	:	GFSK
Antenna Type	:	Inverted F or Loop Antenna
Antenna Gain	:	5.0 dBi (max)
Clock frequency (Maximum)	:	48 MHz (CPU)

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on January 12, 2021 and effective February 11, 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.
* Also the EUT complies with FCC Part 15 Subpart B.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	**FCC:** ANSI C63.10-2013 6. Standard test methods	**FCC:** Section 15.207	N/A	N/A	*1)
	ISED: RSS-Gen 8.8	**ISED:** RSS-Gen 8.8			
6dB Bandwidth	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section 15.247(a)(2)	See data.	Complied a)	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 b)	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 c)	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)	3.0 dB 9608.000 MHz, AV, Horizontal	Complied# d), e)	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *2)
	ISED: RSS-Gen 6.13	**ISED:** RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10			

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.
*1) The test is not applicable since the EUT is not the device that is designed to be connected to the public utility (AC) power line.
*2) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 15.247 Meas Guidance v05r02 8.5 and 8.6.

a) Refer to APPENDIX 1 (data of 6 dB Bandwidth and 99 % Occupied Bandwidth)
b) Refer to APPENDIX 1 (data of Maximum Peak Output Power)
c) Refer to APPENDIX 1 (data of Power Density)
d) Refer to APPENDIX 1 (data of Conducted Spurious Emission)
e) 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)
The RF Module has its own regulator.
The RF Module is constantly provided voltage through the regulator 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

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

Other than above, no addition, exclusion nor deviation has been made from the standard.

3.4 Uncertainty

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.

Ise EMC Lab.

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

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)	4.8 dB
	(Vertical)	5.0 dB
	200 MHz to 1000 MHz (Horizontal)	5.2 dB
	(Vertical)	6.3 dB
10 m	30 MHz to 200 MHz (Horizontal)	4.8 dB
	(Vertical)	4.8 dB
	200 MHz to 1000 MHz (Horizontal)	5.0 dB
	(Vertical)	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

3.5 Test Location

UL Japan, Inc. Ise EMC Lab.
*A2LA Certificate Number: 5107.02 / FCC Test Firm Registration Number: 199967
ISED Lab Company Number: 2973C / CAB identifier: JP0002
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone: +81 596 24 8999, Facsimile: +81 596 24 8124

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.11 measurement room	6.2 x 4.7 x 3.0	4.8 x 4.6	-	-

* 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.

SECTION 4: Operation of EUT during testing

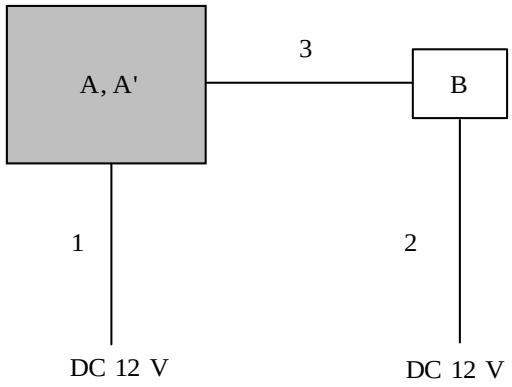
4.1 Operating Mode(s)

Bluetooth (BT) Low Energy (LE): Transmitting mode (Tx)

Test Item	Operating Mode	Tested Frequency
6dB Bandwidth Maximum Peak Output Power 99% Occupied Bandwidth Spurious Emission Power Density	Tx BT LE	2402 MHz 2440 MHz 2480 MHz
*Power of the EUT was set by the software as follows; Power settings: +5dBm Software: AuthTestSndRcv_ECU_CC2642R_20200721.hex (Date: 2020.7.21, Storage location: EUT memory) *This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.		

4.2 Configuration and peripherals

[Radiated emission test]



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

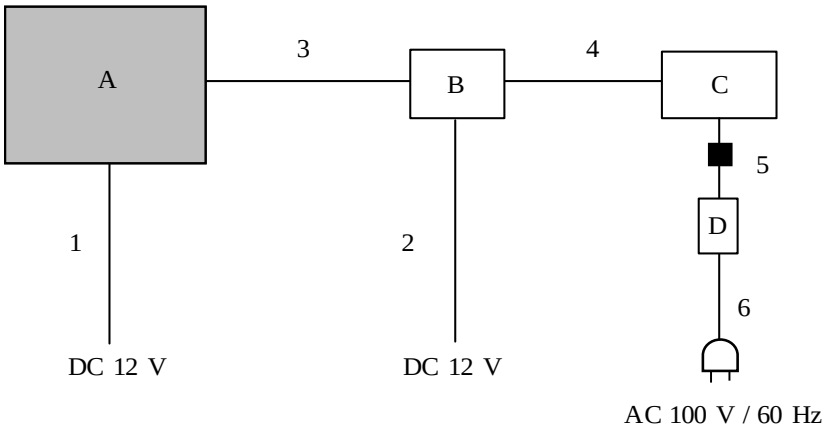
Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	BLE ECU	17EAA	1	DENSO CORPORATION	EUT (Antenna Type: Inverted F)
A'	BLE ECU	17EAA	2	DENSO CORPORATION	EUT (Antenna Type: Loop)
B	MLT Advan	5CF1SD2	5949	PRISM Co.,Ltd.	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	3.0	Unshielded	Unshielded	-
2	DC Cable	1.5	Unshielded	Unshielded	-
3	UART Cable	2.5	Unshielded	Unshielded	-

[Antenna Terminal Conducted Tests]



* 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	BLE ECU	17EAA	3	DENSO CORPORATION	EUT
B	MLT Advan	5CF1SD2	5949	PRISM Co.,Ltd.	-
C	Laptop PC	CF-MX4	5FKSA17992	PANASONIC	-
D	AC Adapter	CF-AA62J2C	62J2CM21522514 38SB	Panasonic	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	3.0	Unshielded	Unshielded	-
2	DC Cable	1.5	Unshielded	Unshielded	-
3	UART Cable	2.5	Unshielded	Unshielded	-
4	USB Cable	1.0	Shielded	Shielded	-
5	DC Cable	1.6	Unshielded	Unshielded	-
6	AC Cable	0.8	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.

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.

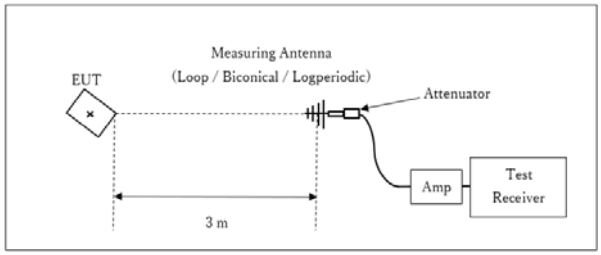
20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9(ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).

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 11.12.2.5.2 The duty cycle was less than 98% for detected noise, a duty factor was added to the 11.12.2.5.1 results.	RBW: 100 kHz VBW: 300 kHz

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

Figure 2: Test Setup

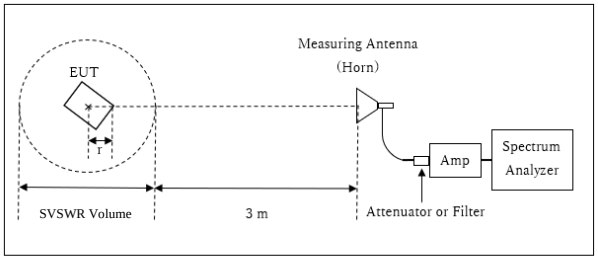
Below 1 GHz



× : Center of turn table

Test Distance: 3 m

1 GHz - 10 GHz

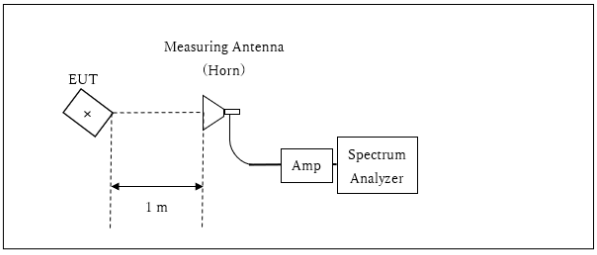


r : Radius of an outer periphery of EUT
× : Center of turn table

Distance Factor: 20 x log (3.95 m / 3.0 m) = 2.39 dB
* Test Distance: (3 + SVSWR Volume /2) - r = 3.95 m

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

10 GHz - 26.5 GHz



× : Center of turn table

Distance Factor: 20 x log (1.0 m / 3.0 m) = -9.5 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 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
6dB Bandwidth	3 MHz	30 kHz	100 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99% Occupied Bandwidth *1)	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak/ Average *2)	-	Power Meter (Sensor: 50 MHz BW)
Peak Power Density	1.5 times the 6dB Bandwidth	3 kHz	10 kHz	Auto	Peak	Max Hold	Spectrum Analyzer *3)
Conducted Spurious Emission *4) *5)	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) 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)
*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

6 dB Bandwidth and 99 % Occupied Bandwidth

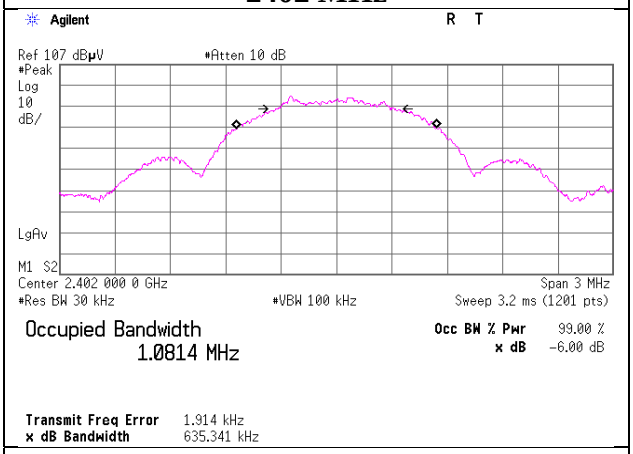
Report No.	13414283H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	January 13, 2021
Temperature / Humidity	20 deg. C / 30 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx BT LE

Mode	Frequency [MHz]	99% Occupied Bandwidth [kHz]	6dB Bandwidth [MHz]	Limit for 6dB Bandwidth [MHz]
BLE	2402	1081.4	0.732	> 0.5000
	2440	1043.1	0.698	> 0.5000
	2480	1055.2	0.734	> 0.5000

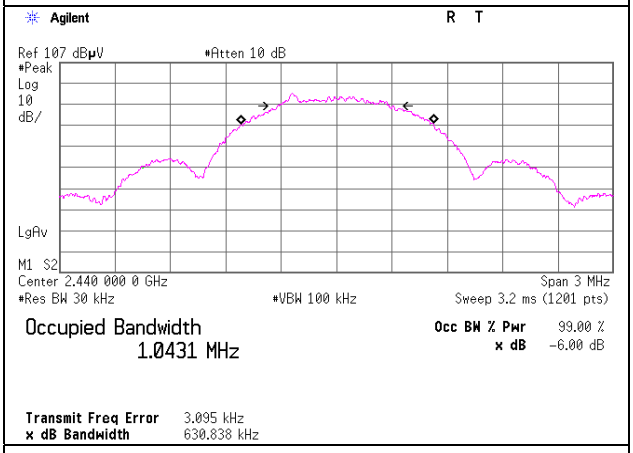
99%Occupied Bandwidth

BT LE

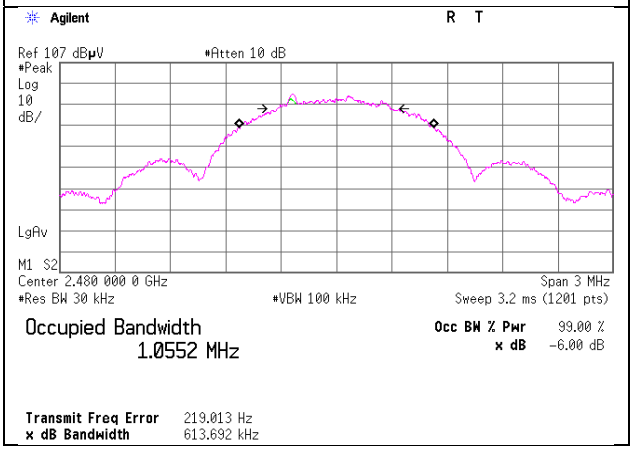
2402 MHz



2440 MHz



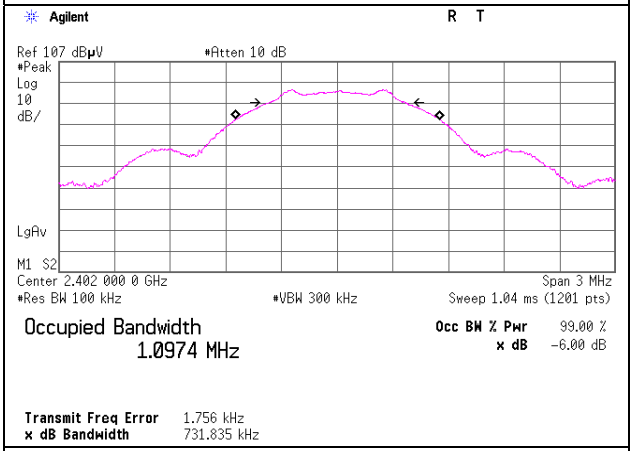
2480 MHz



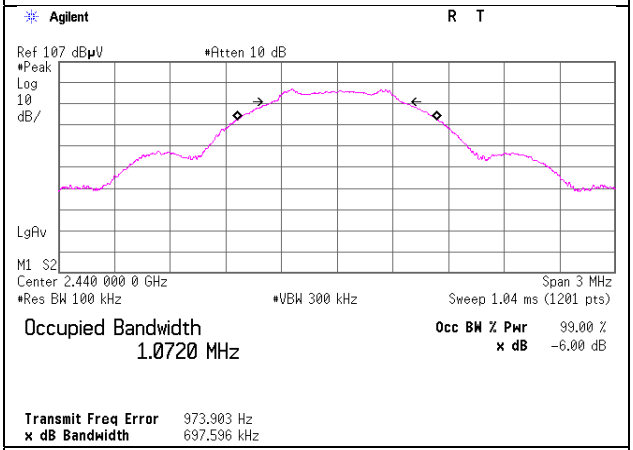
6dB Bandwidth

BT LE

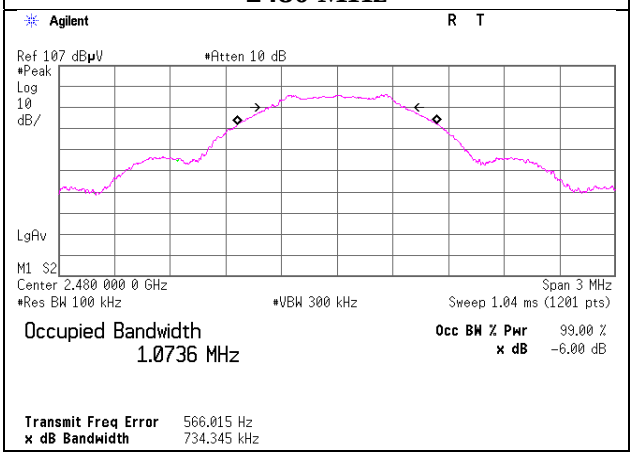
2402 MHz



2440 MHz



2480 MHz



Maximum Peak Output Power

Report No.	13414283H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	January 13, 2021
Temperature / Humidity	20 deg. C / 30 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx BT LE

				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	-12.91	1.61	10.10	-1.20	0.76	30.00	1000	31.20	5.00	3.80	2.40	36.02	4000	32.22
2440	-12.80	1.62	10.10	-1.08	0.78	30.00	1000	31.08	5.00	3.92	2.47	36.02	4000	32.10
2480	-13.14	1.63	10.10	-1.41	0.72	30.00	1000	31.41	5.00	3.59	2.29	36.02	4000	32.43

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.	13414283H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	January 13, 2021
Temperature / Humidity	20 deg. C / 30 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx BT LE

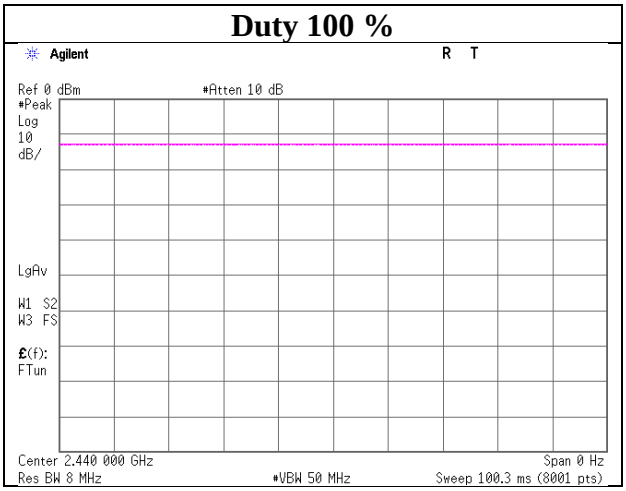
Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2402	-13.61	1.61	10.10	-1.90	0.65	0.00	-1.90	0.65
2440	-13.45	1.62	10.10	-1.73	0.67	0.00	-1.73	0.67
2480	-13.96	1.63	10.10	-2.23	0.60	0.00	-2.23	0.60

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.	13414283H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	January 13, 2021
Temperature / Humidity	20 deg. C / 30 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx BT LE



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

Radiated Spurious Emission

Inverted F ANT

Report No.	13414283H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	January 21, 2021	February 3, 2021
Temperature / Humidity	19 deg. C / 31 % RH	21 deg. C / 37 % RH
Engineer	Hiroyuki Furutaka (1 GHz - 10 GHz)	Junki Nagatomi (Below 1 GHz, Above 10 GHz)
Mode	Tx BT LE 2402 MHz	

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.	30.000	QP	21.8	18.4	7.1	28.6	-	18.7	40.0	21.3	
Hori.	80.345	QP	21.6	6.9	7.8	28.6	-	7.7	40.0	32.4	
Hori.	150.221	QP	21.4	14.9	8.4	28.3	-	16.4	43.5	27.1	
Hori.	299.899	QP	21.7	13.6	9.6	27.8	-	17.1	46.0	28.9	
Hori.	499.898	QP	21.5	17.8	10.7	29.2	-	20.8	46.0	25.2	
Hori.	900.210	QP	21.2	21.9	12.4	29.0	-	26.5	46.0	19.5	
Hori.	2390.000	PK	41.6	27.8	5.4	31.8	-	43.0	73.9	30.9	
Hori.	4804.000	PK	44.4	31.6	7.6	31.2	-	52.4	73.9	21.5	
Hori.	7206.000	PK	42.0	36.5	8.8	32.4	-	54.9	73.9	19.0	
Hori.	9608.000	PK	41.0	38.0	9.5	32.6	-	55.9	73.9	18.0	
Hori.	12010.000	PK	44.7	39.4	-1.8	32.9	-	49.4	73.9	24.5	
Hori.	2390.000	AV	33.5	27.8	5.4	31.8	-	34.9	53.9	19.0	
Hori.	4804.000	AV	38.0	31.6	7.6	31.2	-	46.0	53.9	7.9	
Hori.	7206.000	AV	34.0	36.5	8.8	32.4	-	46.9	53.9	7.0	
Hori.	9608.000	AV	33.2	38.0	9.5	32.6	-	48.1	53.9	5.8	
Hori.	12010.000	AV	36.5	39.4	-1.8	32.9	-	41.2	53.9	12.7	
Vert.	30.000	QP	21.9	18.4	7.1	28.6	-	18.8	40.0	21.2	
Vert.	80.521	QP	21.6	6.9	7.8	28.6	-	7.7	40.0	32.3	
Vert.	150.131	QP	21.4	14.9	8.4	28.3	-	16.5	43.5	27.0	
Vert.	300.211	QP	21.6	13.6	9.6	27.8	-	17.0	46.0	29.0	
Vert.	500.053	QP	21.5	17.8	10.7	29.2	-	20.8	46.0	25.2	
Vert.	899.875	QP	21.2	21.9	12.4	29.0	-	26.5	46.0	19.5	
Vert.	2390.000	PK	41.9	27.8	5.4	31.8	-	43.3	73.9	30.6	
Vert.	4804.000	PK	43.3	31.6	7.6	31.2	-	51.3	73.9	22.6	
Vert.	7206.000	PK	41.6	36.5	8.8	32.4	-	54.5	73.9	19.4	Floor noise
Vert.	9608.000	PK	43.0	38.0	9.5	32.6	-	57.9	73.9	16.0	
Vert.	12010.000	PK	46.4	39.4	-1.8	32.9	-	51.1	73.9	22.9	
Vert.	2390.000	AV	34.0	27.8	5.4	31.8	-	35.4	53.9	18.5	
Vert.	4804.000	AV	35.5	31.6	7.6	31.2	-	43.5	53.9	10.4	
Vert.	7206.000	AV	33.3	36.5	8.8	32.4	-	46.2	53.9	7.7	Floor noise
Vert.	9608.000	AV	35.0	38.0	9.5	32.6	-	49.9	53.9	4.0	
Vert.	12010.000	AV	39.2	39.4	-1.8	32.9	-	43.9	53.9	10.0	

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 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

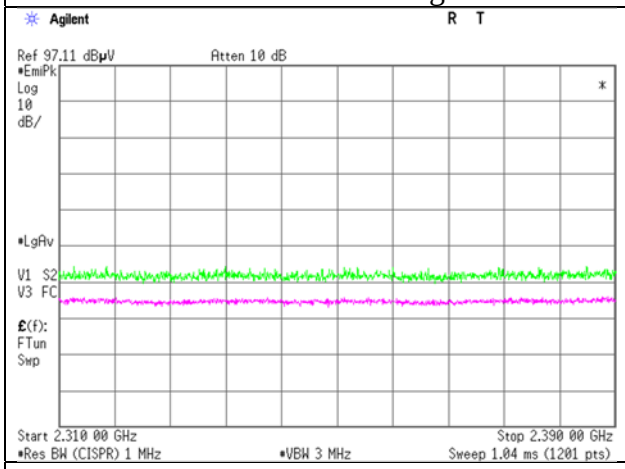
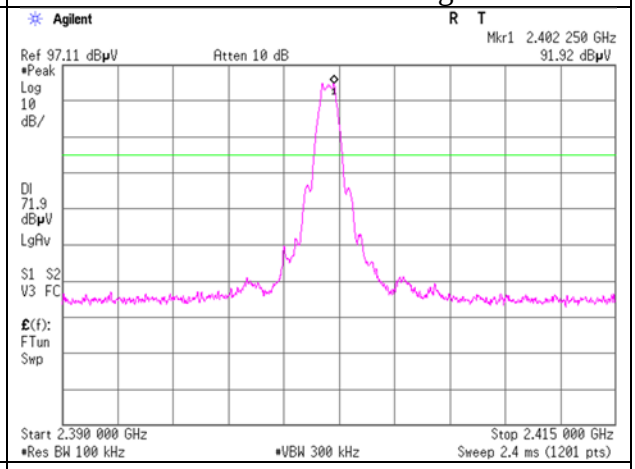
20dBc Data Sheet

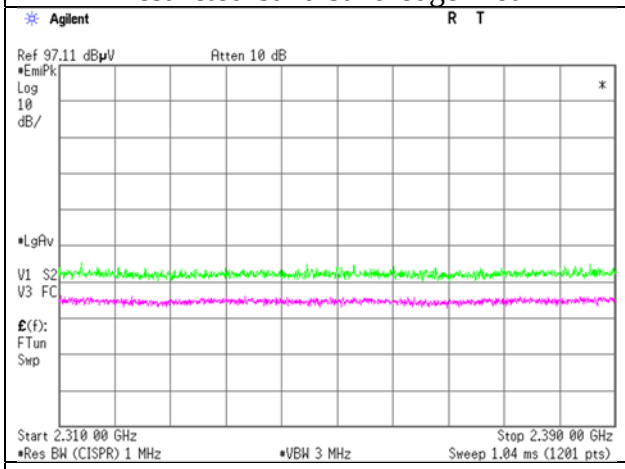
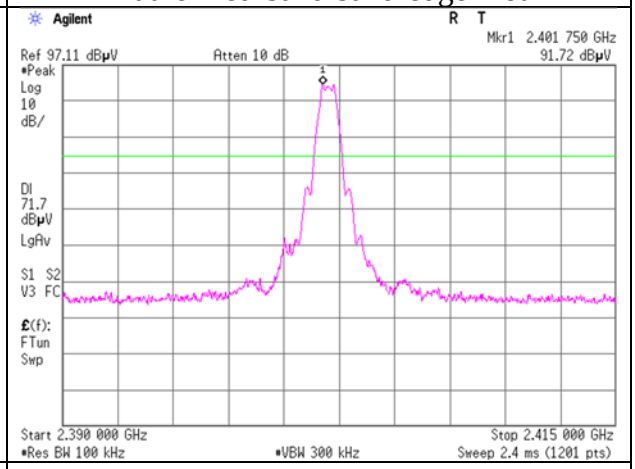
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	91.9	27.8	5.4	31.8	93.3	-	-	Carrier
Hori.	2400.000	PK	46.3	27.8	5.4	31.8	47.7	73.3	25.6	
Vert.	2402.000	PK	91.7	27.8	5.4	31.8	93.1	-	-	Carrier
Vert.	2400.000	PK	47.8	27.8	5.4	31.8	49.2	73.1	23.9	

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

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	13414283H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	January 21, 2021
Temperature / Humidity	19 deg. C / 31 % RH
Engineer	Hiroyuki Furutaka (1 GHz - 10 GHz)
Mode	Tx BT LE 2402 MHz

Horizontal	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

Vertical	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

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

Radiated Spurious Emission

Inverted F ANT

Report No.	13414283H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	January 21, 2021	February 3, 2021
Temperature / Humidity	19 deg. C / 31 % RH	21 deg. C / 37 % RH
Engineer	Hiroyuki Furutaka (1 GHz - 10 GHz)	Junki Nagatomi (Below 1 GHz, Above 10 GHz)
Mode	Tx BT LE 2440 MHz	

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.	30.000	QP	21.7	18.4	7.1	28.6	-	18.7	40.0	21.3	
Hori.	80.452	QP	21.5	6.9	7.8	28.6	-	7.6	40.0	32.4	
Hori.	150.202	QP	21.3	14.9	8.4	28.3	-	16.4	43.5	27.2	
Hori.	300.121	QP	21.7	13.6	9.6	27.8	-	17.1	46.0	28.9	
Hori.	499.889	QP	21.5	17.8	10.7	29.2	-	20.8	46.0	25.2	
Hori.	899.899	QP	21.2	21.9	12.4	29.0	-	26.5	46.0	19.5	
Hori.	4880.000	PK	45.9	31.6	7.6	31.2	-	53.9	73.9	20.0	
Hori.	7320.000	PK	42.7	36.6	8.8	32.4	-	55.7	73.9	18.2	
Hori.	9760.000	PK	40.4	38.4	9.5	32.7	-	55.7	73.9	18.2	
Hori.	12200.000	PK	46.7	39.3	-1.7	32.9	-	51.5	73.9	22.4	
Hori.	4880.000	AV	40.0	31.6	7.6	31.2	-	48.0	53.9	5.9	
Hori.	7320.000	AV	34.5	36.6	8.8	32.4	-	47.5	53.9	6.4	
Hori.	9760.000	AV	33.2	38.4	9.5	32.7	-	48.5	53.9	5.4	
Hori.	12200.000	AV	38.3	39.3	-1.7	32.9	-	43.0	53.9	10.9	
Vert.	30.000	QP	21.8	18.4	7.1	28.6	-	18.7	40.0	21.3	
Vert.	80.521	QP	21.5	6.9	7.8	28.6	-	7.7	40.0	32.3	
Vert.	149.899	QP	21.4	14.9	8.4	28.3	-	16.4	43.5	27.1	
Vert.	300.023	QP	21.6	13.6	9.6	27.8	-	17.0	46.0	29.1	
Vert.	500.110	QP	21.5	17.8	10.7	29.2	-	20.8	46.0	25.2	
Vert.	900.042	QP	21.2	21.9	12.4	29.0	-	26.5	46.0	19.5	
Vert.	4880.000	PK	43.1	31.6	7.6	31.2	-	51.1	73.9	22.8	
Vert.	7320.000	PK	40.8	36.6	8.8	32.4	-	53.8	73.9	20.1	Floor noise
Vert.	9760.000	PK	42.1	38.4	9.5	32.7	-	57.4	73.9	16.5	
Vert.	12200.000	PK	47.3	39.3	-1.7	32.9	-	52.1	73.9	21.9	
Vert.	4880.000	AV	36.0	31.6	7.6	31.2	-	44.0	53.9	9.9	
Vert.	7320.000	AV	33.2	36.6	8.8	32.4	-	46.2	53.9	7.7	Floor noise
Vert.	9760.000	AV	35.0	38.4	9.5	32.7	-	50.3	53.9	3.6	
Vert.	12200.000	AV	39.7	39.3	-1.7	32.9	-	44.4	53.9	9.5	

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 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

Radiated Spurious Emission

Inverted F ANT

Report No.	13414283H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	January 21, 2021	February 3, 2021
Temperature / Humidity	19 deg. C / 31 % RH	21 deg. C / 37 % RH
Engineer	Hiroyuki Furutaka (1 GHz - 10 GHz)	Junki Nagatomi (Below 1 GHz, Above 10 GHz)
Mode	Tx BT LE 2480 MHz	

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.	30.000	QP	21.7	18.4	7.1	28.6	-	18.7	40.0	21.3	
Hori.	80.422	QP	21.6	6.9	7.8	28.6	-	7.7	40.0	32.3	
Hori.	150.020	QP	21.3	14.9	8.4	28.3	-	16.4	43.5	27.2	
Hori.	300.124	QP	21.8	13.6	9.6	27.8	-	17.1	46.0	28.9	
Hori.	500.224	QP	21.6	17.8	10.7	29.2	-	20.9	46.0	25.2	
Hori.	900.063	QP	21.2	21.9	12.4	29.0	-	26.5	46.0	19.5	
Hori.	2483.500	PK	42.8	27.7	5.5	31.8	-	44.1	73.9	29.8	
Hori.	4960.000	PK	43.6	31.6	7.6	31.2	-	51.6	73.9	22.3	
Hori.	7440.000	PK	41.8	36.7	8.8	32.5	-	54.8	73.9	19.1	
Hori.	9920.000	PK	40.6	38.6	9.6	32.7	-	56.0	73.9	17.9	
Hori.	12400.000	PK	47.3	39.0	-1.6	32.8	-	51.9	73.9	22.0	
Hori.	2483.500	AV	35.0	27.7	5.5	31.8	-	36.3	53.9	17.6	
Hori.	4960.000	AV	37.8	31.6	7.6	31.2	-	45.8	53.9	8.1	
Hori.	7440.000	AV	34.1	36.7	8.8	32.5	-	47.1	53.9	6.8	
Hori.	9920.000	AV	33.4	38.6	9.6	32.7	-	48.8	53.9	5.1	
Hori.	12400.000	AV	39.7	39.0	-1.6	32.8	-	44.3	53.9	9.6	
Vert.	30.000	QP	21.8	18.4	7.1	28.6	-	18.7	40.0	21.3	
Vert.	80.452	QP	21.6	6.9	7.8	28.6	-	7.7	40.0	32.3	
Vert.	149.879	QP	21.4	14.9	8.4	28.3	-	16.4	43.5	27.1	
Vert.	300.102	QP	21.6	13.6	9.6	27.8	-	16.9	46.0	29.1	
Vert.	499.890	QP	21.5	17.8	10.7	29.2	-	20.8	46.0	25.2	
Vert.	899.789	QP	21.2	21.9	12.4	29.0	-	26.5	46.0	19.5	
Vert.	2483.500	PK	44.8	27.7	5.5	31.8	-	46.1	73.9	27.8	
Vert.	4960.000	PK	43.8	31.6	7.6	31.2	-	51.8	73.9	22.1	
Vert.	7440.000	PK	41.4	36.7	8.8	32.5	-	54.4	73.9	19.5	Floor noise
Vert.	9920.000	PK	41.1	38.6	9.6	32.7	-	56.5	73.9	17.4	
Vert.	12400.000	PK	47.9	39.0	-1.6	32.8	-	52.5	73.9	21.4	
Vert.	2483.500	AV	35.5	27.7	5.5	31.8	-	36.8	53.9	17.1	
Vert.	4960.000	AV	36.7	31.6	7.6	31.2	-	44.7	53.9	9.2	
Vert.	7440.000	AV	32.5	36.7	8.8	32.5	-	45.5	53.9	8.4	Floor noise
Vert.	9920.000	AV	33.8	38.6	9.6	32.7	-	49.2	53.9	4.7	
Vert.	12400.000	AV	41.3	39.0	-1.6	32.8	-	45.8	53.9	8.1	

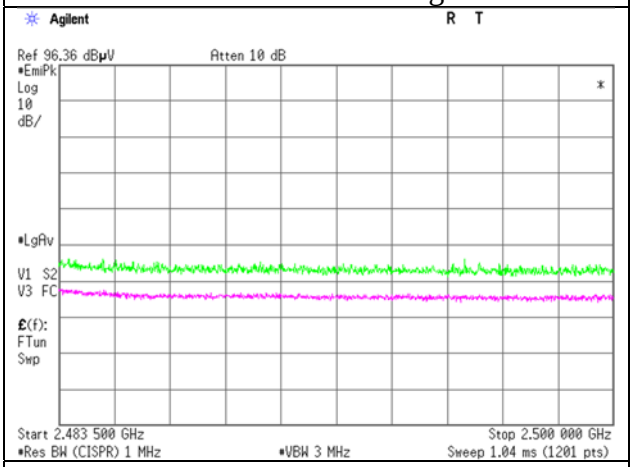
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)

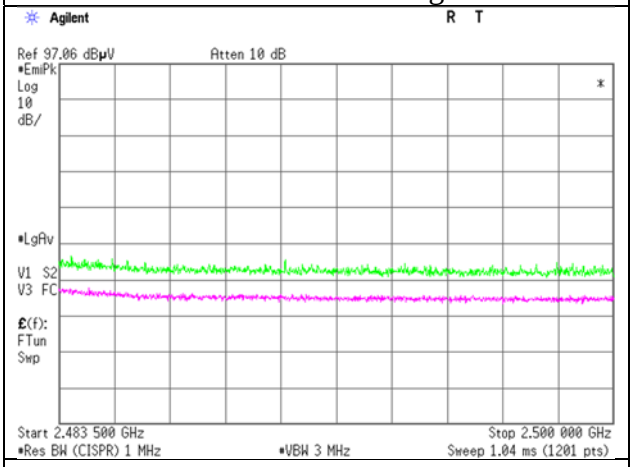
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

Distance factor: 1 GHz - 10 GHz 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

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	13414283H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	January 21, 2021
Temperature / Humidity	19 deg. C / 31 % RH
Engineer	Hiroyuki Furutaka
	(1 GHz - 10 GHz)
Mode	Tx BT LE 2480 MHz

Horizontal
Restricted-band band-edge Plot

Trace Green : Peak Plot Trace Purple : Average Plot

Vertical
Restricted-band band-edge Plot

Trace Green : Peak Plot Trace Purple : Average Plot

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

Radiated Spurious Emission

Loop ANT

Report No.	13414283H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	January 21, 2021	February 3, 2021
Temperature / Humidity	19 deg. C / 31 % RH	21 deg. C / 37 % RH
Engineer	Hiroyuki Furutaka (1 GHz - 10 GHz)	Junki Nagatomi (Below 1 GHz, Above 10 GHz)
Mode	Tx BT LE 2402 MHz	

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.	30.000	QP	21.8	18.4	7.1	28.6	-	18.7	40.0	21.3	
Hori.	80.481	QP	21.5	6.9	7.8	28.6	-	7.7	40.0	32.3	
Hori.	150.102	QP	21.4	14.9	8.4	28.3	-	16.4	43.5	27.1	
Hori.	300.002	QP	21.7	13.6	9.6	27.8	-	17.1	46.0	28.9	
Hori.	500.032	QP	21.5	17.8	10.7	29.2	-	20.8	46.0	25.2	
Hori.	900.202	QP	21.2	21.9	12.4	29.0	-	26.5	46.0	19.6	
Hori.	2390.000	PK	42.0	27.8	5.4	31.8	-	43.4	73.9	30.5	
Hori.	4804.000	PK	45.7	31.6	7.6	31.2	-	53.7	73.9	20.2	
Hori.	7206.000	PK	42.0	36.5	8.8	32.4	-	54.9	73.9	19.0	Floor noise
Hori.	9608.000	PK	42.9	38.0	9.5	32.6	-	57.8	73.9	16.1	
Hori.	12010.000	PK	45.6	39.4	-1.8	32.9	-	50.3	73.9	23.6	
Hori.	2390.000	AV	33.1	27.8	5.4	31.8	-	34.5	53.9	19.4	
Hori.	4804.000	AV	38.3	31.6	7.6	31.2	-	46.3	53.9	7.6	
Hori.	7206.000	AV	33.7	36.5	8.8	32.4	-	46.6	53.9	7.3	Floor noise
Hori.	9608.000	AV	36.0	38.0	9.5	32.6	-	50.9	53.9	3.0	
Hori.	12010.000	AV	38.1	39.4	-1.8	32.9	-	42.8	53.9	11.1	
Vert.	30.000	QP	21.9	18.4	7.1	28.6	-	18.9	40.0	21.2	
Vert.	80.487	QP	21.6	6.9	7.8	28.6	-	7.8	40.0	32.2	
Vert.	150.321	QP	21.4	14.9	8.4	28.3	-	16.4	43.5	27.1	
Vert.	299.978	QP	21.7	13.6	9.6	27.8	-	17.0	46.0	29.0	
Vert.	500.221	QP	21.5	17.8	10.7	29.2	-	20.8	46.0	25.2	
Vert.	900.222	QP	21.2	21.9	12.4	29.0	-	26.5	46.0	19.5	
Vert.	2390.000	PK	41.8	27.8	5.4	31.8	-	43.2	73.9	30.7	
Vert.	4804.000	PK	43.3	31.6	7.6	31.2	-	51.3	73.9	22.6	
Vert.	7206.000	PK	41.8	36.5	8.8	32.4	-	54.7	73.9	19.2	Floor noise
Vert.	9608.000	PK	42.7	38.0	9.5	32.6	-	57.6	73.9	16.3	
Vert.	12010.000	PK	47.2	39.4	-1.8	32.9	-	51.9	73.9	22.0	
Vert.	2390.000	AV	33.5	27.8	5.4	31.8	-	34.9	53.9	19.0	
Vert.	4804.000	AV	37.6	31.6	7.6	31.2	-	45.6	53.9	8.3	
Vert.	7206.000	AV	33.7	36.5	8.8	32.4	-	46.6	53.9	7.3	Floor noise
Vert.	9608.000	AV	35.7	38.0	9.5	32.6	-	50.6	53.9	3.3	
Vert.	12010.000	AV	38.0	39.4	-1.8	32.9	-	42.7	53.9	11.2	

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 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

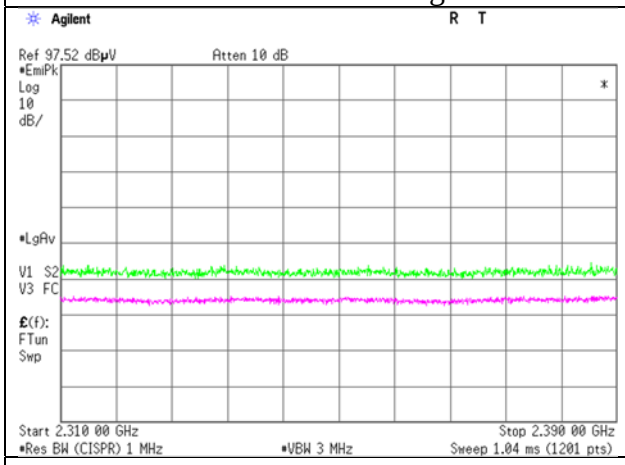
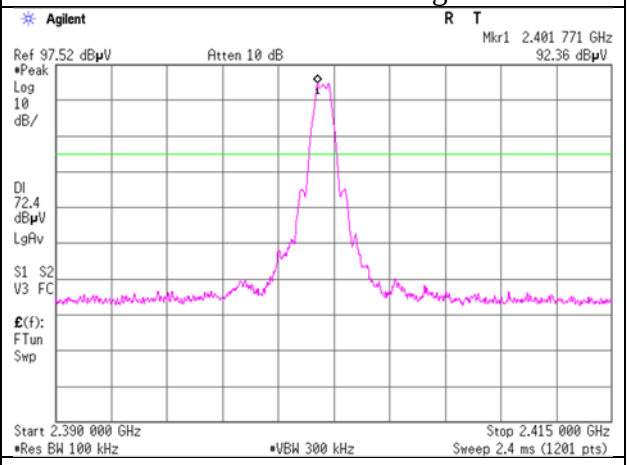
20dBc Data Sheet

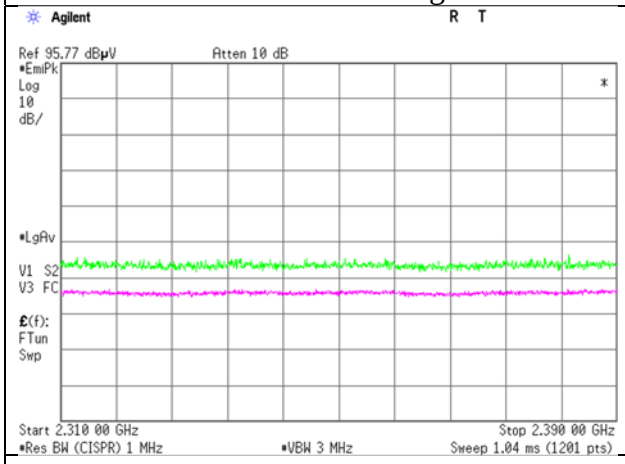
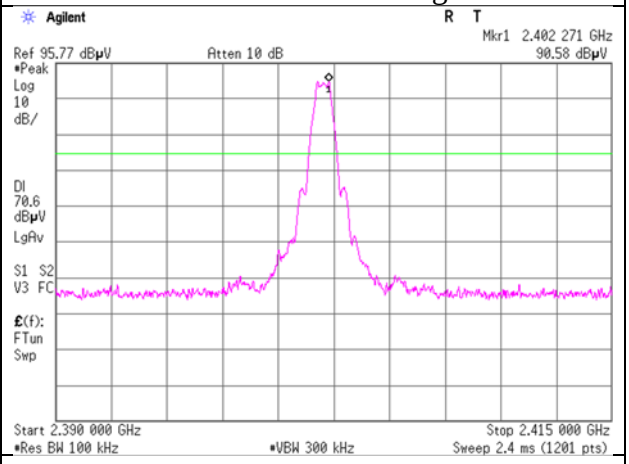
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	92.4	27.8	5.4	31.8	93.8	-	-	Carrier
Hori.	2400.000	PK	44.8	27.8	5.4	31.8	46.2	73.8	27.6	
Vert.	2402.000	PK	90.6	27.8	5.4	31.8	92.0	-	-	Carrier
Vert.	2400.000	PK	43.4	27.8	5.4	31.8	44.8	72.0	27.1	

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

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	13414283H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	January 21, 2021
Temperature / Humidity	19 deg. C / 31 % RH
Engineer	Hiroyuki Furutaka (1 GHz - 10 GHz)
Mode	Tx BT LE 2402 MHz

Horizontal	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

Vertical	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

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

Radiated Spurious Emission

Loop ANT

Report No.	13414283H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	February 3, 2021
Temperature / Humidity	21 deg. C / 37 % RH
Engineer	Junki Nagatomi
	(30 MHz - 26.5 GHz)
Mode	Tx BT LE 2440 MHz

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.	30.000	QP	21.8	18.4	7.1	28.6	-	18.7	40.0	21.3	
Hori.	80.448	QP	21.6	6.9	7.8	28.6	-	7.7	40.0	32.3	
Hori.	150.123	QP	21.4	14.9	8.4	28.3	-	16.4	43.5	27.1	
Hori.	300.232	QP	21.8	13.6	9.6	27.8	-	17.1	46.0	28.9	
Hori.	500.012	QP	21.5	17.8	10.7	29.2	-	20.8	46.0	25.2	
Hori.	900.002	QP	21.2	21.9	12.4	29.0	-	26.5	46.0	19.5	
Hori.	4880.000	PK	44.8	31.6	7.6	31.2	-	52.7	73.9	21.2	
Hori.	7320.000	PK	43.2	36.6	8.8	32.4	-	56.2	73.9	17.7	Floor noise
Hori.	9760.000	PK	43.7	38.4	9.5	32.7	-	59.0	73.9	14.9	
Hori.	12200.000	PK	48.2	39.3	-1.7	32.9	-	52.9	73.9	21.0	
Hori.	4880.000	AV	37.4	31.6	7.6	31.2	-	45.4	53.9	8.5	
Hori.	7320.000	AV	33.7	36.6	8.8	32.4	-	46.7	53.9	7.2	Floor noise
Hori.	9760.000	AV	34.6	38.4	9.5	32.7	-	49.9	53.9	4.0	
Hori.	12200.000	AV	42.5	39.3	-1.7	32.9	-	47.3	53.9	6.7	
Vert.	30.000	QP	21.9	18.4	7.1	28.6	-	18.8	40.0	21.2	
Vert.	80.345	QP	21.6	6.9	7.8	28.6	-	7.7	40.0	32.3	
Vert.	150.123	QP	21.4	14.9	8.4	28.3	-	16.5	43.5	27.1	
Vert.	299.989	QP	21.6	13.6	9.6	27.8	-	17.0	46.0	29.0	
Vert.	500.052	QP	21.5	17.8	10.7	29.2	-	20.8	46.0	25.2	
Vert.	900.200	QP	21.2	21.9	12.4	29.0	-	26.5	46.0	19.5	
Vert.	4880.000	PK	43.0	31.6	7.6	31.2	-	51.0	73.9	22.9	
Vert.	7320.000	PK	42.8	36.6	8.8	32.4	-	55.7	73.9	18.2	Floor noise
Vert.	9760.000	PK	44.0	38.4	9.5	32.7	-	59.3	73.9	14.6	
Vert.	12200.000	PK	47.8	39.3	-1.7	32.9	-	52.6	73.9	21.3	
Vert.	4880.000	AV	37.3	31.6	7.6	31.2	-	45.2	53.9	8.7	
Vert.	7320.000	AV	33.7	36.6	8.8	32.4	-	46.7	53.9	7.2	Floor noise
Vert.	9760.000	AV	35.3	38.4	9.5	32.7	-	50.6	53.9	3.3	
Vert.	12200.000	AV	43.4	39.3	-1.7	32.9	-	48.2	53.9	5.7	

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 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

Radiated Spurious Emission

Loop ANT

Report No.	13414283H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	February 3, 2021
Temperature / Humidity	21 deg. C / 37 % RH
Engineer	Junki Nagatomi
	(30 MHz - 26.5 GHz)
Mode	Tx BT LE 2480 MHz

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.	30.000	QP	21.8	18.4	7.1	28.6	-	18.7	40.0	21.3	
Hori.	80.520	QP	21.6	6.9	7.8	28.6	-	7.7	40.0	32.3	
Hori.	150.023	QP	21.4	14.9	8.4	28.3	-	16.4	43.5	27.1	
Hori.	299.998	QP	21.8	13.6	9.6	27.8	-	17.1	46.0	28.9	
Hori.	500.041	QP	21.5	17.8	10.7	29.2	-	20.8	46.0	25.3	
Hori.	900.199	QP	21.2	21.9	12.4	29.0	-	26.4	46.0	19.6	
Hori.	2483.500	PK	44.4	27.7	5.5	31.8	-	45.7	73.9	28.2	
Hori.	4960.000	PK	44.6	31.6	7.6	31.2	-	52.6	73.9	21.3	
Hori.	7440.000	PK	43.3	36.7	8.8	32.5	-	56.3	73.9	17.6	Floor noise
Hori.	9920.000	PK	43.8	38.6	9.6	32.7	-	59.2	73.9	14.7	
Hori.	12400.000	PK	45.8	39.0	-1.6	32.8	-	50.4	73.9	23.5	
Hori.	2483.500	AV	35.1	27.7	5.5	31.8	-	36.4	53.9	17.5	
Hori.	4960.000	AV	36.3	31.6	7.6	31.2	-	44.3	53.9	9.6	
Hori.	7440.000	AV	33.6	36.7	8.8	32.5	-	46.7	53.9	7.3	Floor noise
Hori.	9920.000	AV	34.5	38.6	9.6	32.7	-	49.9	53.9	4.0	
Hori.	12400.000	AV	38.7	39.0	-1.6	32.8	-	43.3	53.9	10.6	
Vert.	30.000	QP	21.9	18.4	7.1	28.6	-	18.8	40.0	21.2	
Vert.	80.870	QP	21.7	6.9	7.8	28.5	-	7.9	40.0	32.2	
Vert.	150.132	QP	21.4	14.9	8.4	28.3	-	16.4	43.5	27.1	
Vert.	297.686	QP	21.7	13.6	9.6	27.8	-	17.0	46.0	29.0	
Vert.	500.136	QP	21.5	17.8	10.7	29.2	-	20.8	46.0	25.2	
Vert.	900.222	QP	21.2	21.9	12.4	29.0	-	26.4	46.0	19.6	
Vert.	2483.500	PK	44.1	27.7	5.5	31.8	-	45.4	73.9	28.5	
Vert.	4960.000	PK	42.9	31.6	7.6	31.2	-	50.9	73.9	23.0	
Vert.	7440.000	PK	43.3	36.7	8.8	32.5	-	56.4	73.9	17.5	Floor noise
Vert.	9920.000	PK	43.9	38.6	9.6	32.7	-	59.4	73.9	14.5	
Vert.	12400.000	PK	48.3	39.0	-1.6	32.8	-	52.9	73.9	21.0	
Vert.	2483.500	AV	34.6	27.7	5.5	31.8	-	35.9	53.9	18.0	
Vert.	4960.000	AV	33.6	31.6	7.6	31.2	-	41.6	53.9	12.3	
Vert.	7440.000	AV	33.5	36.7	8.8	32.5	-	46.5	53.9	7.4	Floor noise
Vert.	9920.000	AV	34.2	38.6	9.6	32.7	-	49.7	53.9	4.2	
Vert.	12400.000	AV	39.6	39.0	-1.6	32.8	-	44.2	53.9	9.7	

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).

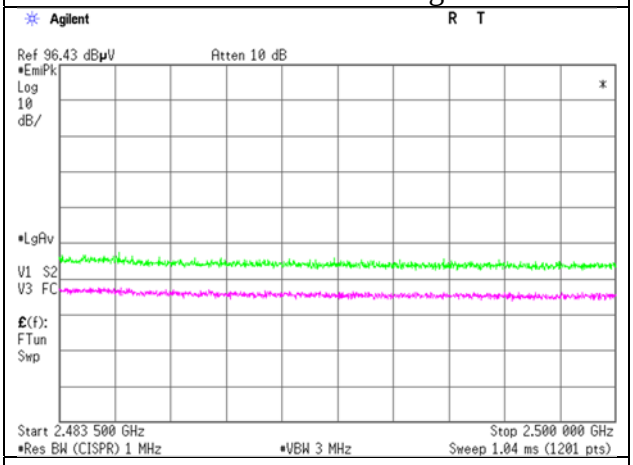
Distance factor: 1 GHz - 10 GHz 20log (3.95 m / 3.0 m) = 2.39 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	13414283H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	February 3, 2021
Temperature / Humidity	21 deg. C / 37 % RH
Engineer	Junki Nagatomi
	(1 GHz - 10 GHz)
Mode	Tx BT LE 2480 MHz

Horizontal

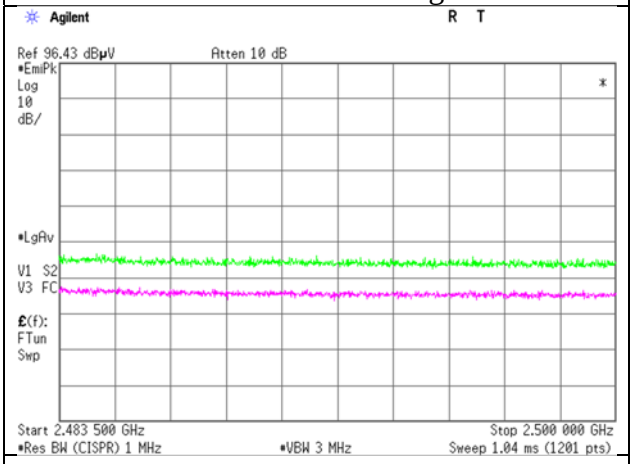
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot

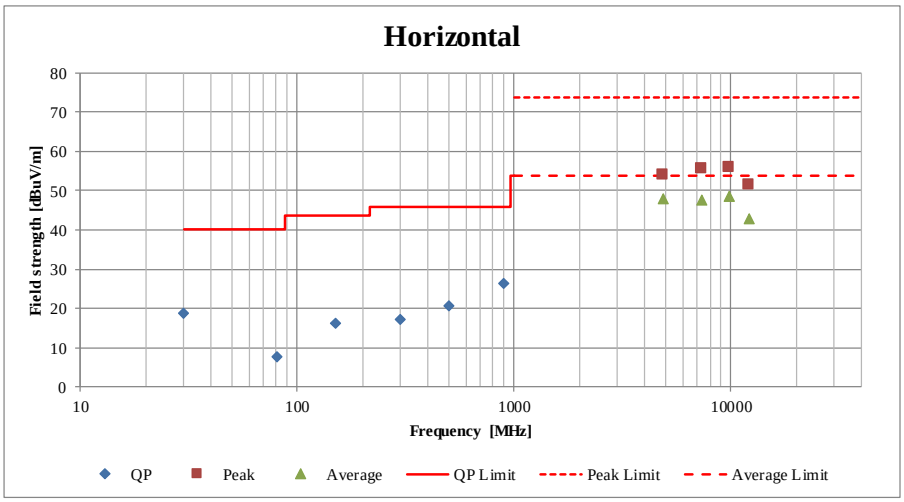


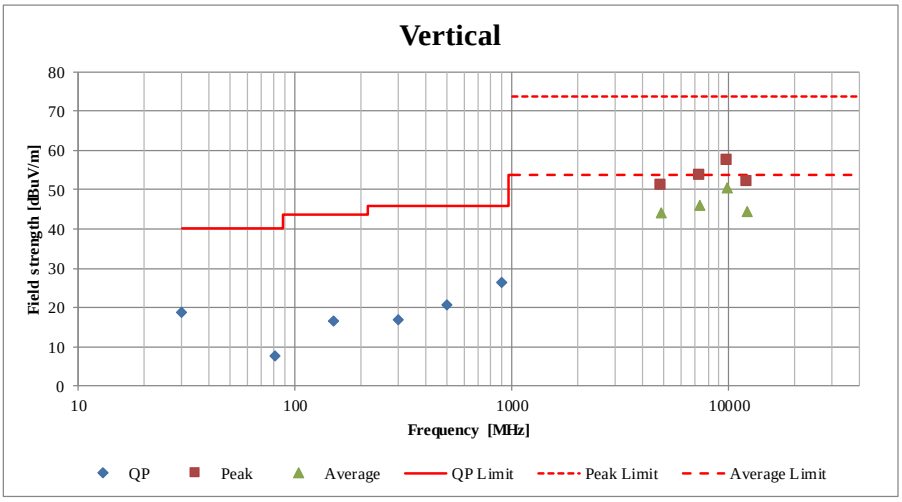
Trace Green : Peak Plot
Trace Purple : Average Plot

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

Radiated Spurious Emission
(Plot data, Worst case)
Inverted F ANT

Report No.	13414283H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	January 21, 2021	February 3, 2021
Temperature / Humidity	19 deg. C / 31 % RH	21 deg. C / 37 % RH
Engineer	Hiroyuki Furutaka (1 GHz - 10 GHz)	Junki Nagatomi (Below 1 GHz, Above 10 GHz)
Mode	Tx BT LE 2440 MHz	

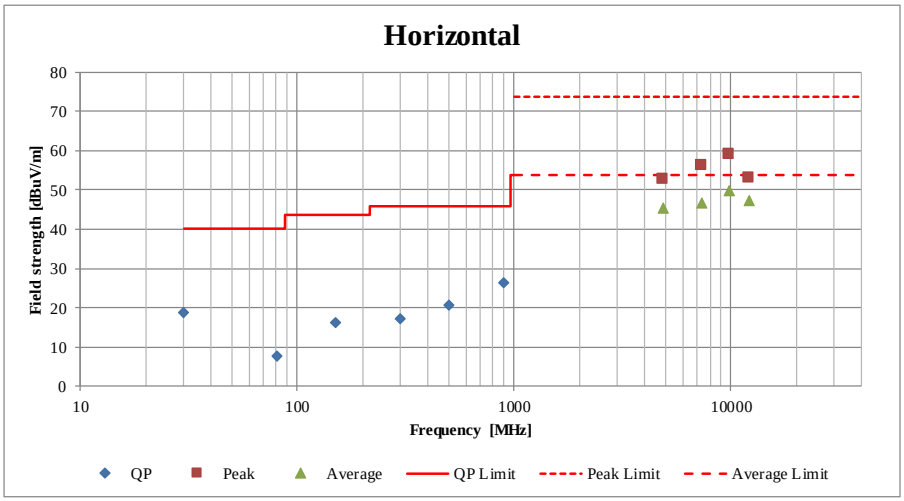


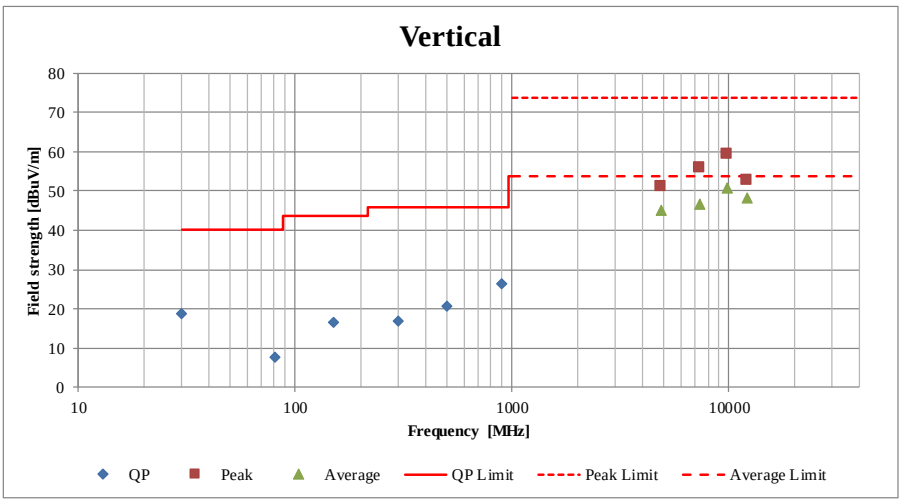


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

Radiated Spurious Emission
(Plot data, Worst case)
Loop ANT

Report No.	13414283H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	February 3, 2021
Temperature / Humidity	21 deg. C / 37 % RH
Engineer	Junki Nagatomi
	(30 MHz – 26.5 GHz)
Mode	Tx BT LE 2440 MHz



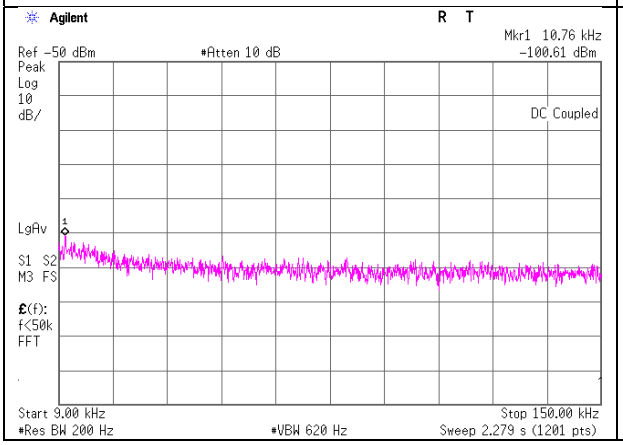


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

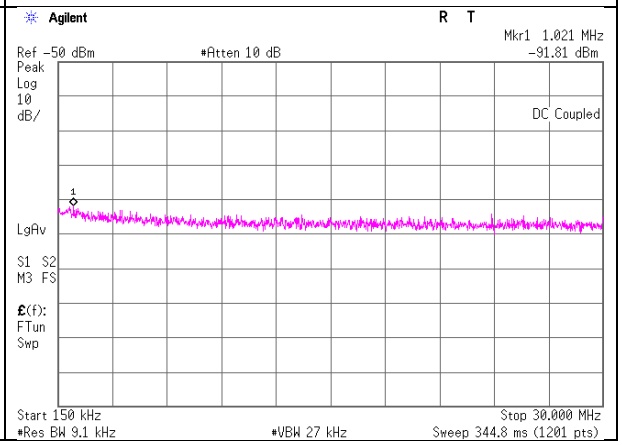
Conducted Spurious Emission

Report No.	13414283H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	January 13, 2021
Temperature / Humidity	20 deg. C / 30 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx BT LE 2402MHz

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
10.76	-100.6	0.00	9.8	5.0	1	-85.8	300	6.0	-24.5	46.9	71.4	
1021.00	-91.8	0.01	9.8	5.0	1	-77.0	30	6.0	4.3	27.4	23.1	

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

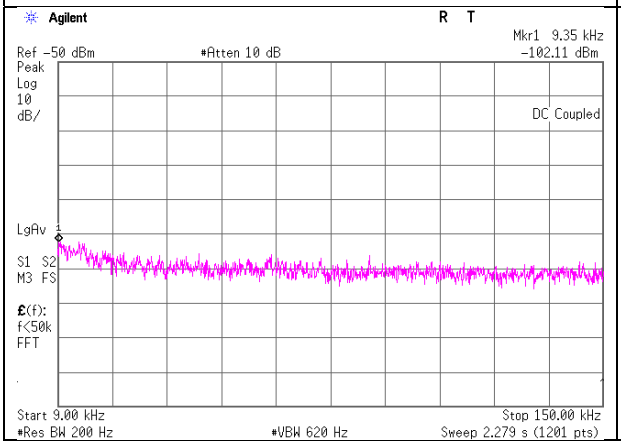
EIRP[dBm] = Reading [dBm] + Cable loss [dB] + Attenuator Loss [dB] + Antenna gain [dBi] + 10 * log (N)

N: Number of output

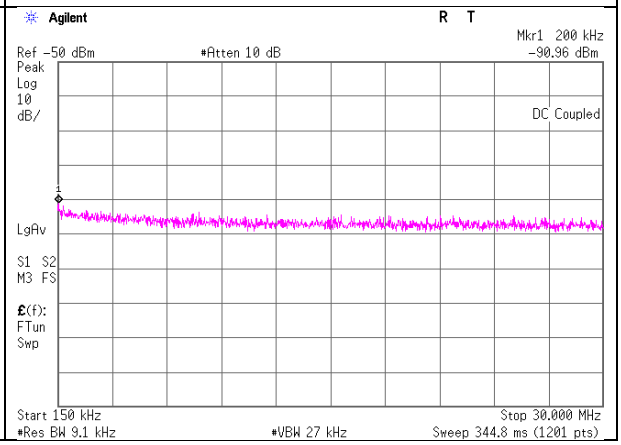
Conducted Spurious Emission

Report No.	13414283H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	January 13, 2021
Temperature / Humidity	20 deg. C / 30 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx BT LE 2440MHz

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
9.35	-102.1	0.00	9.8	5.0	1	-87.3	300	6.0	-26.0	48.1	74.1	
200.00	-91.0	0.01	9.8	5.0	1	-76.1	300	6.0	-14.9	21.5	36.4	

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

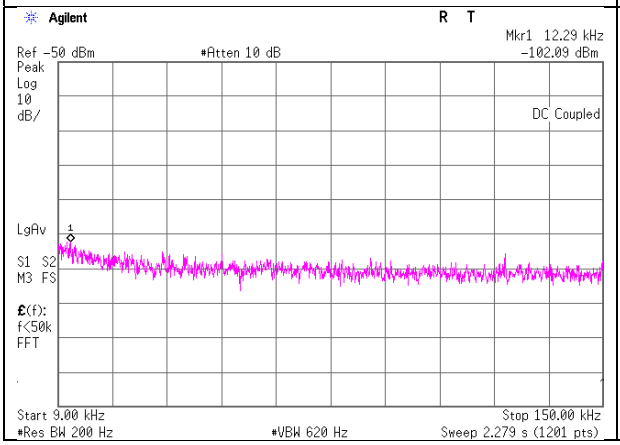
EIRP[dBm] = Reading [dBm] + Cable loss [dB] + Attenuator Loss [dB] + Antenna gain [dBi] + 10 * log (N)

N: Number of output

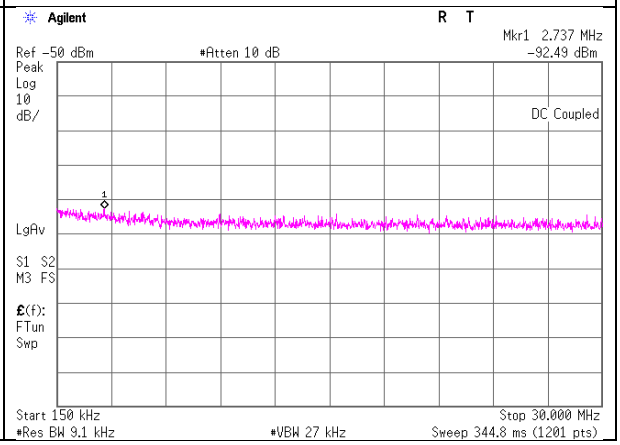
Conducted Spurious Emission

Report No.	13414283H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	January 13, 2021
Temperature / Humidity	20 deg. C / 30 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx BT LE 2480MHz

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
12.29	-102.1	0.00	9.8	5.0	1	-87.3	300	6.0	-26.0	45.8	71.8	
2737.00	-92.5	0.02	9.8	5.0	1	-77.6	30	6.0	3.6	29.5	25.9	

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

Report No.	13414283H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	January 13, 2021
Temperature / Humidity	20 deg. C / 30 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402	-22.44	1.61	10.01	-10.82	8.00	18.82
2440	-23.36	1.62	10.01	-11.73	8.00	19.73
2480	-26.34	1.63	10.01	-14.70	8.00	22.70

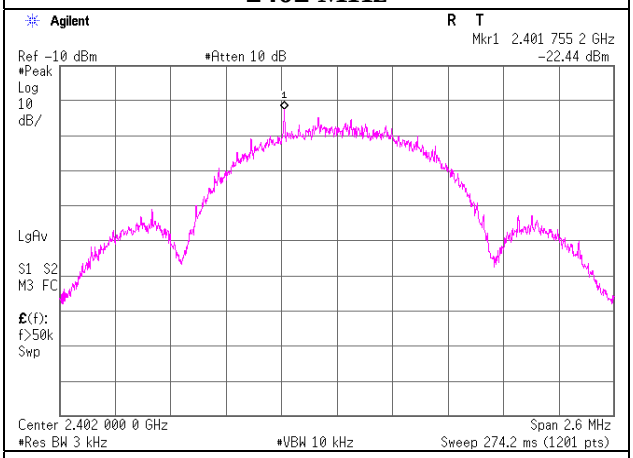
Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

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

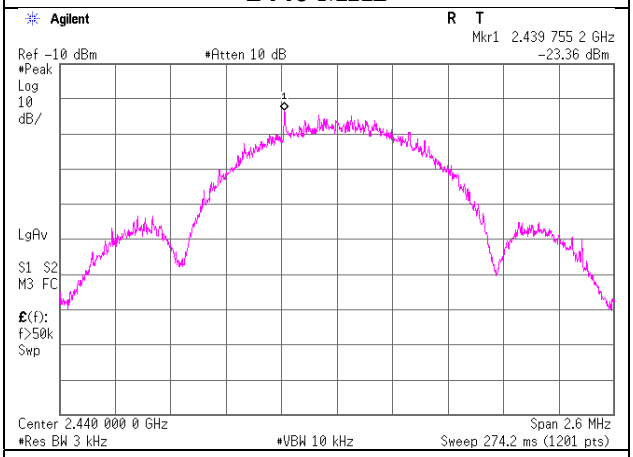
Power Density

BT LE

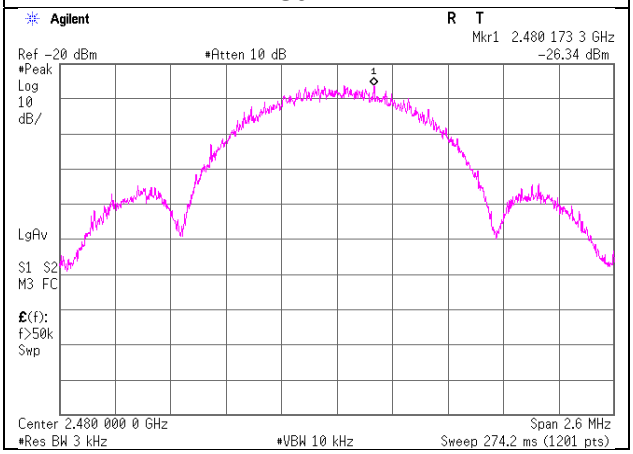
2402 MHz



2440 MHz



2480 MHz



APPENDIX 2: Test instruments

Test equipment

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	MSA-16	141903	Spectrum Analyzer	AGILENT	E4440A	MY46186390	12/18/2020	12
RE	MOS-15	141562	Thermo-Hygrometer	CUSTOM	CTH-180	1501	01/15/2021	12
RE	MMM-10	141545	DIGITAL HiTESTER	HIOKI	3805	51201148	01/07/2021	12
RE	MJM-26	142227	Measure	KOMELON	KMC-36	-	-	-
RE	COTS-MEMI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	MAEC-04-SVSWR	142017	Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-10005	04/04/2019	24
RE	MSA-10	141899	Spectrum Analyzer	AGILENT	E4448A	MY46180655	08/04/2020	12
RE	MTR-08	141949	Test Receiver	Rohde & Schwarz	ESCI	100767	08/18/2020	12
RE	MHA-21	141508	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	9120D-557	05/22/2020	12
RE	MPA-12	141581	MicroWave System Amplifier	AGILENT	83017A	650	10/19/2020	12
RE	MCC-246	199563	Microwave Cable	HUBER+SUNER	SF126E/11PC35/11 PC35/1000M,5000M	537061/126E / 537072/126E	06/11/2020	12
RE	MHA-17	141506	Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170	BBHA9170307	07/16/2020	12
RE	MHF-26	141296	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	2	09/23/2020	12
RE	MAT-34	141331	Attenuator(6dB)	TME	UFA-01	-	02/05/2020	12
RE	MBA-05	141425	Biconical Antenna	Schwarzbeck	BBA9106	1302	08/31/2020	12
RE	MCC-50	141397	Coaxial Cable	UL Japan	-	-	11/06/2020	12
RE	MLA-23	141267	Logperiodic Antenna (200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-192	09/02/2020	12
RE	MPA-24	141594	Pre Amplifier	AGILENT	8447D	2944A10150	02/10/2020	12
RE	MAEC-04	142011	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	05/25/2020	24
AT	MOS-24	90289	Thermo-Hygrometer	CUSTOM	CTH-201	5	01/15/2021	12
AT	MMM-12	141547	DIGITAL HiTESTER	HIOKI	3805	60500120	02/03/2020	12
AT	MAT-23	141361	Attenuator(10dB) 1-18GHz	Orient Microwave	BX10-0476-00	-	04/21/2020	12
AT	MCC-144	141414	Microwave Cable	Junkosha	MWX221	1207S407	08/03/2020	12
AT	MAT-10	141156	Attenuator(10dB)	Weinschel Corp	2	BL1173	11/13/2020	12
AT	MCC-38	141395	Coaxial Cable	UL Japan	-	-	08/20/2020	12
AT	MPSE-22	141842	Power sensor	AGILENT	N1923A	MY54070003	08/20/2020	12
AT	MPM-16	141812	Power Meter	AGILENT	8990B	MY51000271	08/20/2020	12
AT	MSA-14	141901	Spectrum Analyzer	AGILENT	E4440A	MY48250080	12/18/2020	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: RE: Radiated Emission test
AT: Antenna Terminal Conducted test