RADIO TEST REPORT

Test Report No. : 13454495H-A-R1

Applicant	:	**DENSO CORPORATION**
Type of EUT	:	**Control Box**
Model Number of EUT	:	**DNNS087**
FCC ID	:	**HYQDNNS087**
Test regulation	:	**FCC Part 15 Subpart C: 2020** **For Permissive Change** *** Bluetooth Low Energy parts**
Test Result	:	**Complied (Refer to SECTION 3.2)**

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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.
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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 information provided from the customer for this report is identified in SECTION 1.
9. This report is a revised version of 13454495H-A. 13454495H-A is replaced with this report.

Date of test: August 18 to 20, 2020

Representative test engineer:
Yuichiro Yamazaki
Engineer
Consumer Technology Division

Approved by:
Tsubasa Takayama
Leader
Consumer Technology Division

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This laboratory is accredited by the NVLAP LAB CODE 200572-0, U.S.A. The tests reported herein have been performed in accordance with its terms of accreditation.
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☐ This report contains data that are not covered by the NVLAP accreditation.
☒ There is no testing item of "Non-accreditation".

REVISION HISTORY

Original Test Report No.: 13454495H-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13454495H-A	August 26, 2020	-	-
1	13454495H-A-R1	October 16, 2020	P. 1	Change of A2LA logo to NVLAP combined ILAC MRK mark
1	13454495H-A-R1	October 16, 2020	P. 1	Change the sentence No.5 due to the logo change Delete the sentence No.8 (original report)
1	13454495H-A-R1	October 16, 2020	P. 7	Correction of Test Specification
1	13454495H-A-R1	October 16, 2020	P. 8	Correction of sentence for FCC Part 15.203 Antenna requirement
1	13454495H-A-R1	October 16, 2020	P. 10	Change the test location's information due to the logo change
1	13454495H-A-R1	October 16, 2020	P. 11	Addition of Software information
1	13454495H-A-R1	October 16, 2020	P. 25, 28	Correction of font color of Duty Factor cells
1	13454495H-A-R1	October 16, 2020	P. 36	Addition of Test equipment: Local ID: MTR-10 and MHA-17

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 Showa-cho, Kariya-shi, Aichi-ken, 448-8661 Japan
Telephone Number	:	+81-566-26-5919
Facsimile Number	:	+81-566-25-4920
Contact Person	:	Isamu Suzuki

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	:	Control Box
Model Number	:	DNNS087
Serial Number	:	Refer to SECTION 4.2
Rating	:	DC 12 V
Receipt Date	:	August 7, 2020
Country of Mass-production	:	United States of America
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: DNNS087 (referred to as the EUT in this report) is a Control Box.

General Specification

Clock frequency(ies) in the system : 533 MHz
32.768 kHz, 37.4 MHz (Crystal)
Operating Temperature : -30 deg. C - +70 deg. C

Radio Specification

Radio Type : Transceiver

	IEEE802.11b *1)	IEEE802.11g/n *1) (20 M band)	IEEE802.11a/n/ac (20 M band)	IEEE802.11n/ac (40 M band)	IEEE802.11ac (80 M band)
Frequency of operation	2412 MHz - 2462 MHz	2412 MHz - 2462 MHz	5180 MHz - 5240 MHz 5260 MHz - 5320 MHz 5500 MHz - 5720 MHz 5745 MHz - 5825 MHz	5190 MHz - 5230 MHz 5270 MHz - 5310 MHz 5510 MHz - 5710 MHz 5755 MHz - 5795 MHz	5210 MHz 5290 MHz 5530 MHz - 5690 MHz 5775 MHz
Type of modulation	DSSS (CCK, DQPSK, DBPSK)	OFDM-CCK (64QAM, 16QAM, QPSK, BPSK)	OFDM (64QAM, 16QAM, QPSK, BPSK, 256QAM(IEEE802.11ac only))		
Channel spacing	5MHz		20MHz	40MHz	80MHz
Antenna type	ASSEMBLY WiFi Antenna				
Antenna Connector type	MHF PLUG				
Antenna Gain	-3.2 dBi				

	GPS	Bluetooth Ver.4.1 with EDR function *1)
Frequency of operation	1575.42 MHz	2402 MHz - 2480 MHz
Type of modulation	BPSK	BT: FHSS (GFSK, π/4-DQPSK, 8-DPSK) LE: GFSK
Channel spacing	-	BT: 1 MHz LE: 2 MHz
Antenna type	ANTENNA ASSY, GPS	ASSEMBLY WiFi Antenna
Antenna Connector type	FAKRA	MHF PLUG
Antenna Gain	26.5 dBi	-3.2 dBi

*1) This test report applies to Bluetooth Low Energy.
*Wireless LAN and Bluetooth do not transmit simultaneously.

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification	:	FCC Part 15 Subpart C FCC Part 15 final revised on June 26, 2020 and effective July 27, 2020
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

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)	5.5 dB 233.129 MHz, QP, 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 15.31 (e)
The EUT provides stable voltage constantly to the wireless transmitter regardless of input voltage.
Instead of a new battery, DC power supply was used for the test.
That does not affect the test result, therefore the 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	- 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.
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
0.5 m	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.
*NVLAP Lab. code: 200572-0 / FCC Test Firm Registration Number: 199967 / ISED Lab Company Number: 2973C
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

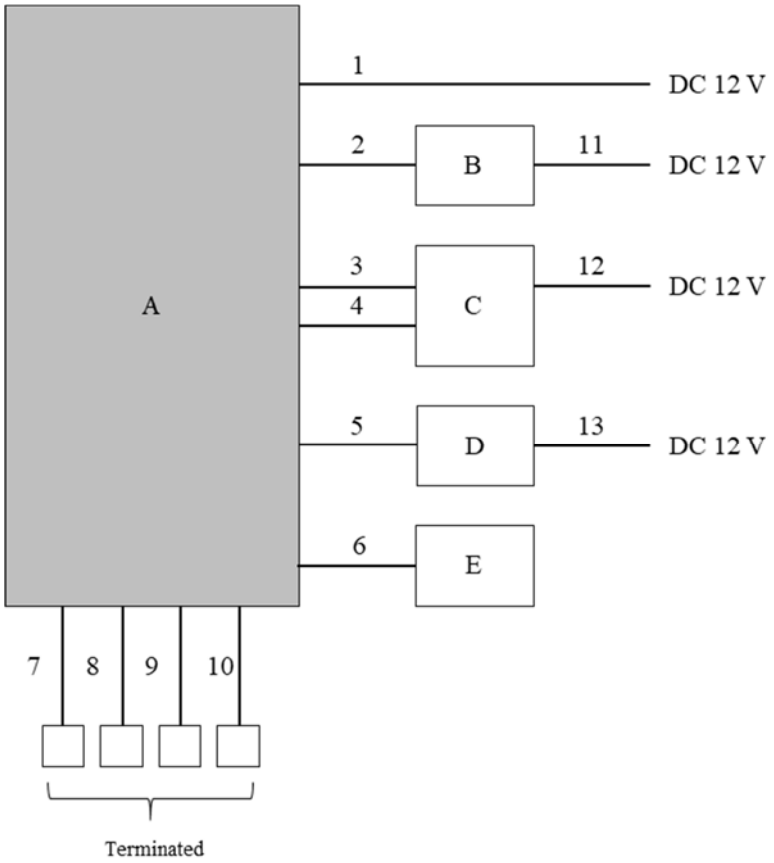
4.1 Operating Mode(s)

Mode	Remarks*
Bluetooth Low Energy (BT LE)	Maximum Packet Size, PN9

*Power of the EUT was set by the software as follows;
Power settings: 10 dBm
Software: BT Validation.exe Ver.1.0.0.0
BT Chip vendor: Software file No. XXX.0728.hcd
(Date: December 1, 2019, 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.

4.2 Configuration and peripherals

For Radiated Spurious Emission test



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

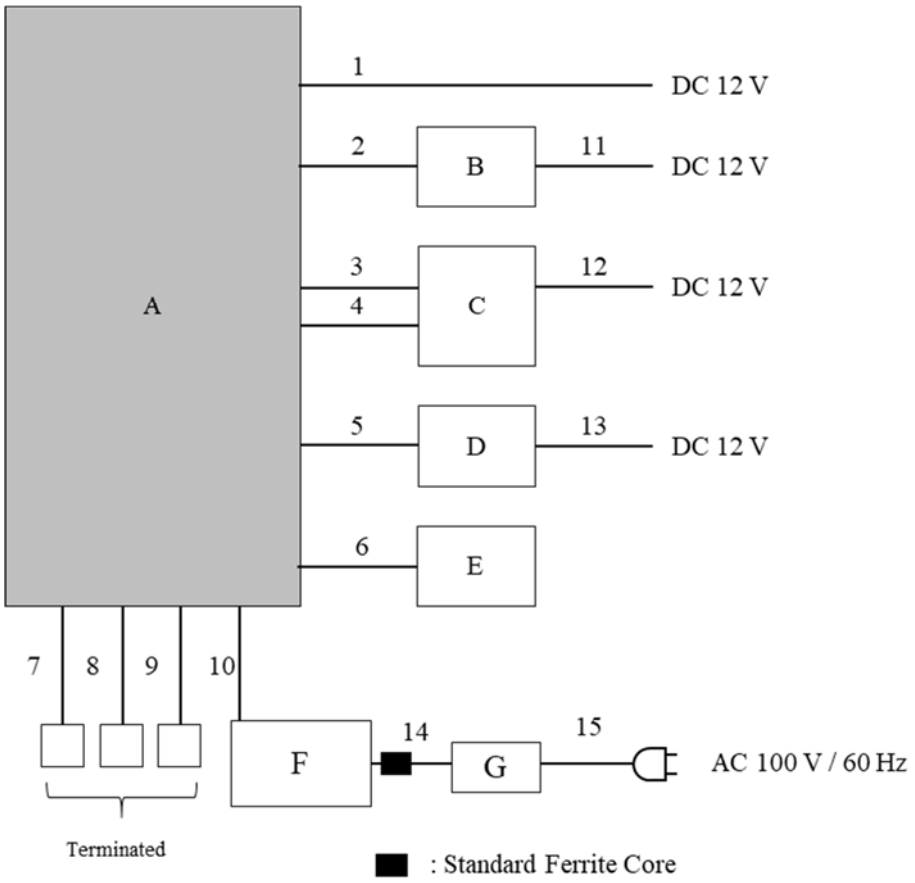
Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Control Box	DNNS087	00000028	DENSO CORPORATION	EUT
B	Touch Pad	39060-TJB-3030-DAN0-1-0013	6	VISTEON CORPORATION	-
C	Jig (cPhy)	cPhy	No.1	MICROCHIP	-
D	Display	39710-TJBA-A1	16150222	Panasonic Automotive Systems	-
E	GPS Antenna	39835-THRA-A112-M1 26050003	31	Yokowo Co.,Ltd	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	2.0	Unshielded	Unshielded	-
2	Signal and DC Cable	2.2	Unshielded	Unshielded	-
3	MOST Cable (Red)	1.8	Shielded	Shielded	-
4	MOST Cable (Green)	1.8	Shielded	Shielded	-
5	LVDS Cable	1.3	Shielded	Shielded	-
6	GNSS Antenna Cable	0.4	Shielded	Shielded	-
7	Camera Cable	2.0	Unshielded	Unshielded	-
8	USB Cable	2.0	Shielded	Shielded	-
9	USB Cable	2.0	Shielded	Shielded	-
10	USB Cable	0.2	Shielded	Shielded	-
11	DC Cable	1.4	Unshielded	Unshielded	-
12	DC Cable	0.9	Unshielded	Unshielded	-
13	DC Cable	2.0	Unshielded	Unshielded	-

For 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	Control Box	DNNS087	00000298	DENSO CORPORATION	EUT
B	Touch Pad	39060-TJB-3030	2	CISTEON CORPORATION	-
C	Jig (cPhy)	cPhy	No.5	MICROCHIP	-
D	Display	-	RDX T2-89	Panasonic Automotive Systems	-
E	GPS Antenna	39835-THRA-A112-M1 26050003	31	Yokowo Co.,Ltd	-
F	Laptop PC	CF-N8HWCDPS	0BKSA08723	Panasonic	-
G	AC Adapter	CF-AA6372B	6372BM409X18054B	Panasonic	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	2.0	Unshielded	Unshielded	-
2	Signal and DC Cable	2.6	Unshielded	Unshielded	-
3	MOST Cable (Red)	0.8	Shielded	Shielded	-
4	MOST Cable (Green)	0.8	Shielded	Shielded	-
5	LVDS Cable	2.0	Shielded	Shielded	-
6	GNSS Antenna Cable	0.4	Shielded	Shielded	-
7	Camera Cable	2.0	Unshielded	Unshielded	-
8	USB Cable	2.0	Shielded	Shielded	-
9	USB Cable	2.0	Shielded	Shielded	-
10	USB Cable	2.8	Shielded	Shielded	-
11	DC Cable	2.0	Unshielded	Unshielded	-
12	DC Cable	0.9	Unshielded	Unshielded	-
13	DC Cable	2.0	Unshielded	Unshielded	-
14	DC Cable	1.0	Unshielded	Unshielded	-
15	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, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane.
The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1 GHz]
EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane.
The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with absorbent materials lined on a ground plane.

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.

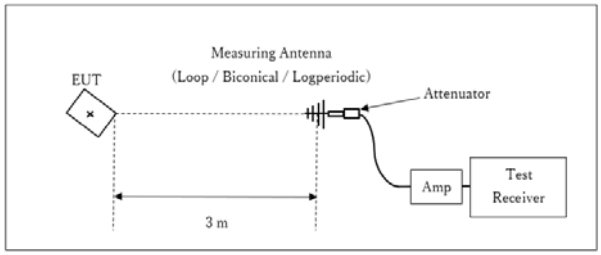
20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9(ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).

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

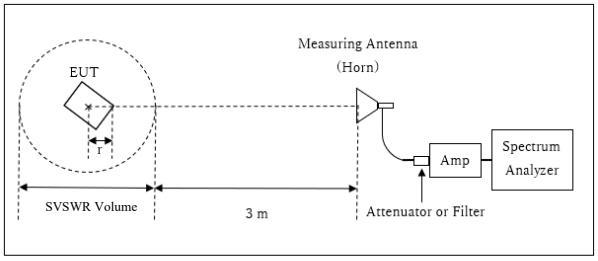
Below 1 GHz



× : Center of turn table

Test Distance: 3 m

1 GHz - 10 GHz

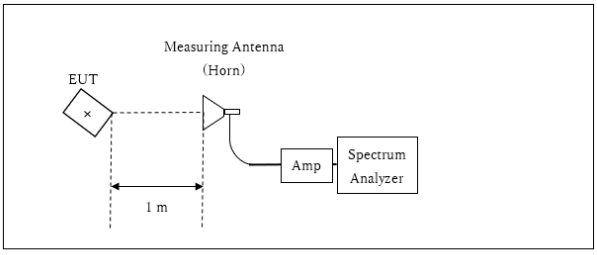


r : Radius of an outer periphery of EUT
× : Center of turn table

Distance Factor: 20 x log (3.9 m / 3.0 m) = 2.28 dB
* Test Distance: (3 + (SVSWR Volume /2)) - r = 3.9 m

SVSWR Volume : 2.0 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
r = 0.1 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 test was made on EUT at the normal use position.

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	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)
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 low enough as shown in the chart.
(9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 9.1 kHz).In the frequency range below 30MHz, RBW was narrowed to separate the noise contents.
*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 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

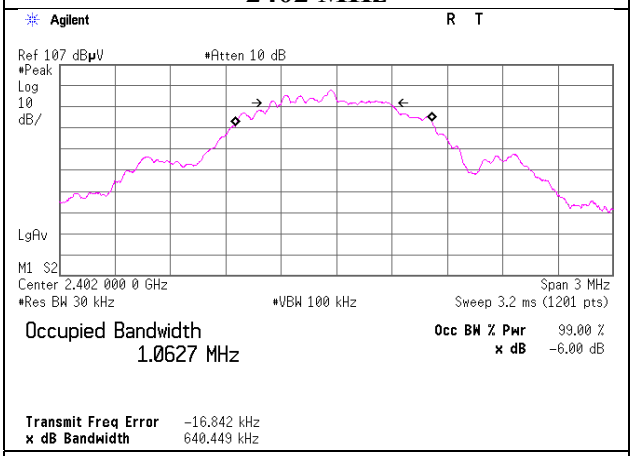
Report No.	13454495H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	August 20, 2020
Temperature / Humidity	24 deg. C / 55 % RH
Engineer	Yuta Moriya
Mode	Tx BT LE

Frequency [MHz]	99% Occupied Bandwidth [kHz]	6dB Bandwidth [MHz]	Limit for 6dB Bandwidth [MHz]
2402	1062.7	0.712	> 0.5000
2440	1062.2	0.716	> 0.5000
2480	1061.1	0.720	> 0.5000

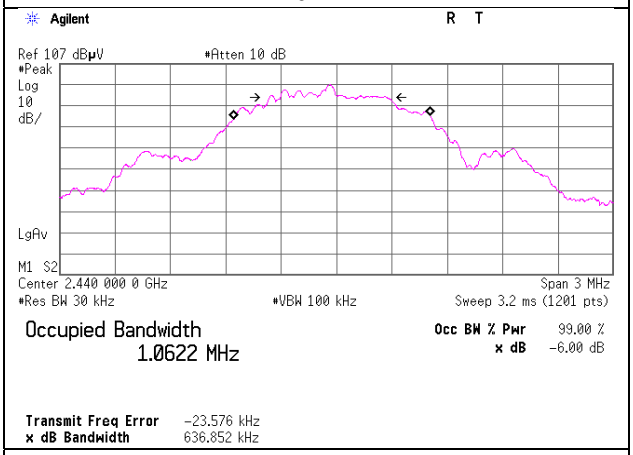
99%Occupied Bandwidth

BT LE

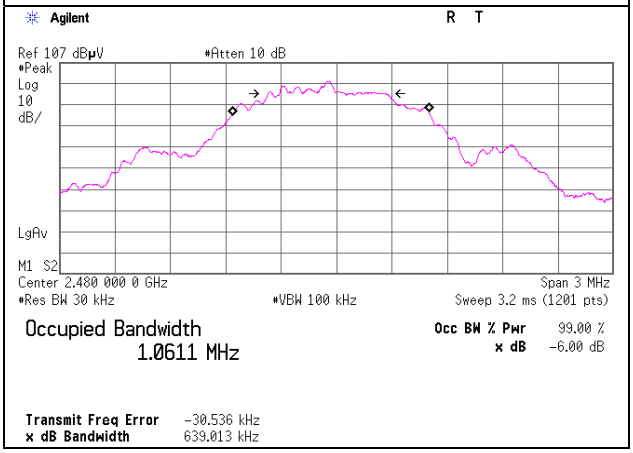
2402 MHz



2440 MHz



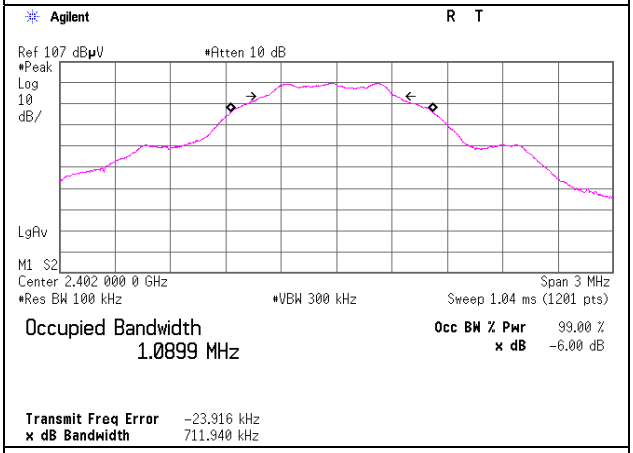
2480 MHz



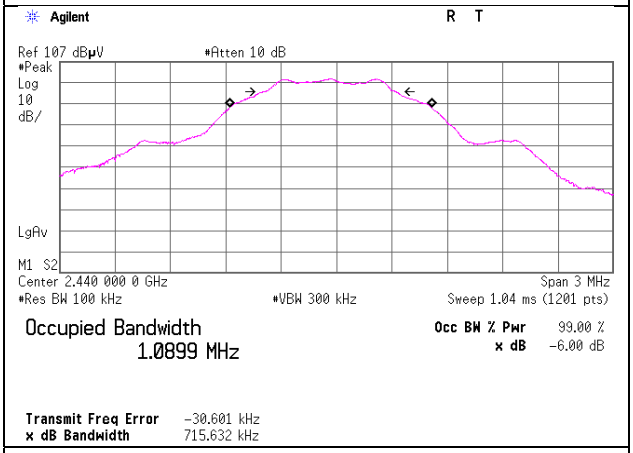
6dB Bandwidth

BT LE

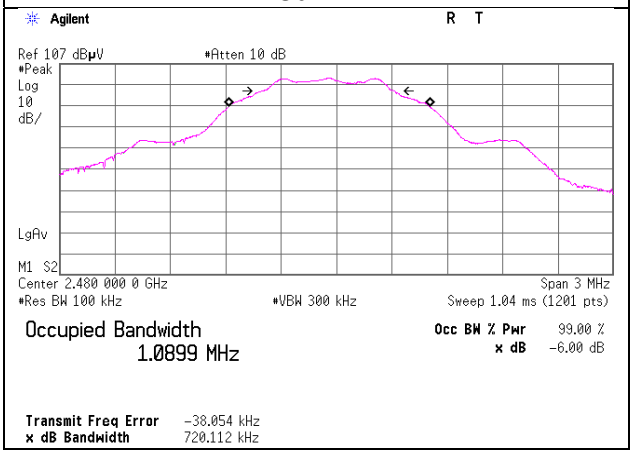
2402 MHz



2440 MHz



2480 MHz



Maximum Peak Output Power

Report No.	13454495H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	August 18, 2020
Temperature / Humidity	26 deg. C / 32 % RH
Engineer	Yuta Moriya
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	-9.09	2.07	9.73	2.71	1.87	30.00	1000	27.29	-3.20	-0.49	0.89	36.02	4000	36.51
2440	-7.20	2.16	9.73	4.69	2.94	30.00	1000	25.31	-3.20	1.49	1.41	36.02	4000	34.53
2480	-5.85	2.19	9.73	6.07	4.05	30.00	1000	23.93	-3.20	2.87	1.94	36.02	4000	33.15

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.	13454495H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	August 18, 2020
Temperature / Humidity	26 deg. C / 32 % RH
Engineer	Yuta Moriya
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	-11.67	2.07	9.73	0.13	1.03	1.98	2.11	1.63
2440	-9.72	2.16	9.73	2.17	1.65	1.98	4.15	2.60
2480	-8.25	2.19	9.73	3.67	2.33	1.98	5.65	3.67

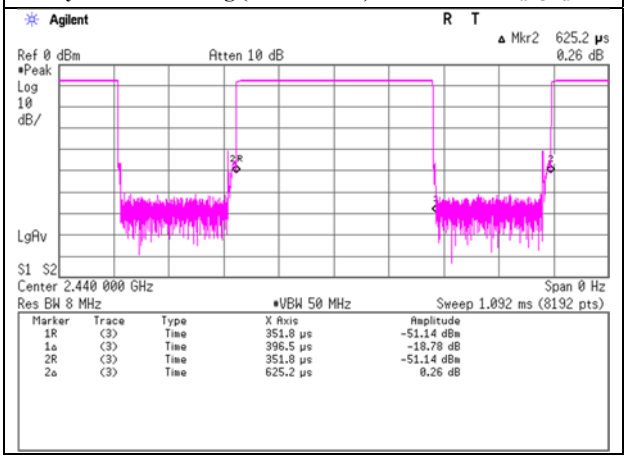
Sample Calculation:
Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
Result (Burst power average) = Time average + Duty factor

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

Burst rate confirmation

Report No.	13454495H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	August 18, 2020
Temperature / Humidity	26 deg. C / 32 % RH
Engineer	Yuta Moriya
Mode	Tx BT LE

Tx on / (Tx on + Tx off) =	**0.634**
Tx on / (Tx on + Tx off) * 100 =	**63.4 %**
Duty factor = 10 * log (625.2 / 396.5) =	**1.98 dB**



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

Radiated Spurious Emission

Report No.	13454495H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	August 18, 2020 (Day)	August 18, 2020 (Night)	August 19, 2020
Temperature / Humidity	22 deg. C / 47 % RH	22 deg. C / 62 % RH	23 deg. C / 63 % RH
Engineer	Yuichiro Yamazaki (1 GHz -10 GHz)	Junki Nagatomi (Above 10 GHz)	Yuichiro Yamazaki (Below 1 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.	233.129	QP	51.6	11.4	9.3	31.8	-	40.5	46.0	5.5	
Hori.	356.353	QP	46.1	15.1	10.1	31.8	-	39.5	46.0	6.5	
Hori.	577.542	QP	35.3	18.6	11.3	32.0	-	33.3	46.0	12.7	
Hori.	610.154	QP	39.1	19.5	11.5	32.0	-	38.2	46.0	7.8	
Hori.	797.930	QP	36.4	20.8	12.4	31.6	-	38.0	46.0	8.0	
Hori.	906.832	QP	35.9	22.0	12.9	31.1	-	39.8	46.0	6.2	
Hori.	1071.251	PK	53.4	24.3	4.3	34.5	-	47.5	73.9	26.4	
Hori.	2390.000	PK	43.2	27.8	5.3	31.9	-	44.5	73.9	29.4	
Hori.	4804.000	PK	42.0	31.6	7.5	31.3	-	49.9	73.9	24.0	Floor noise
Hori.	7206.000	PK	42.7	36.5	8.8	32.4	-	55.6	73.9	18.3	Floor noise
Hori.	9608.000	PK	43.0	38.0	9.5	32.8	-	57.8	73.9	16.2	Floor noise
Hori.	1071.251	AV	48.2	24.3	4.3	34.5	-	42.4	53.9	11.5	
Hori.	2390.000	AV	33.8	27.8	5.3	31.9	2.0	37.0	53.9	16.9	*1)
Hori.	4804.000	AV	31.2	31.6	7.5	31.3	-	39.1	53.9	14.8	Floor noise
Hori.	7206.000	AV	33.0	36.5	8.8	32.4	-	45.9	53.9	8.0	Floor noise
Hori.	9608.000	AV	32.7	38.0	9.5	32.8	-	47.4	53.9	6.5	Floor noise
Vert.	233.129	QP	47.2	11.4	9.3	31.8	-	36.1	46.0	9.9	
Vert.	356.353	QP	39.1	15.1	10.1	31.8	-	32.5	46.0	13.5	
Vert.	577.542	QP	38.1	18.6	11.3	32.0	-	36.1	46.0	9.9	
Vert.	610.154	QP	36.3	19.5	11.5	32.0	-	35.4	46.0	10.7	
Vert.	797.930	QP	35.6	20.8	12.4	31.6	-	37.2	46.0	8.8	
Vert.	906.832	QP	33.7	22.0	12.9	31.1	-	37.6	46.0	8.4	
Vert.	1071.251	PK	54.3	24.3	4.3	34.5	-	48.5	73.9	25.4	
Vert.	2390.000	PK	43.0	27.8	5.3	31.9	-	44.3	73.9	29.6	
Vert.	4804.000	PK	41.8	31.6	7.5	31.3	-	49.6	73.9	24.3	Floor noise
Vert.	7206.000	PK	42.2	36.5	8.8	32.4	-	55.1	73.9	18.8	Floor noise
Vert.	9608.000	PK	43.2	38.0	9.5	32.8	-	57.9	73.9	16.0	Floor noise
Vert.	1071.251	AV	49.0	24.3	4.3	34.5	-	43.2	53.9	10.7	
Vert.	2390.000	AV	33.7	27.8	5.3	31.9	2.0	36.9	53.9	17.0	*1)
Vert.	4804.000	AV	31.3	31.6	7.5	31.3	-	39.2	53.9	14.7	Floor noise
Vert.	7206.000	AV	32.7	36.5	8.8	32.4	-	45.6	53.9	8.3	Floor noise
Vert.	9608.000	AV	32.8	38.0	9.5	32.8	-	47.5	53.9	6.4	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 (3.9 m / 3.0 m) = 2.28 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB
*1) Not Out of Band emission(Leakage Power)

20dBc Data Sheet

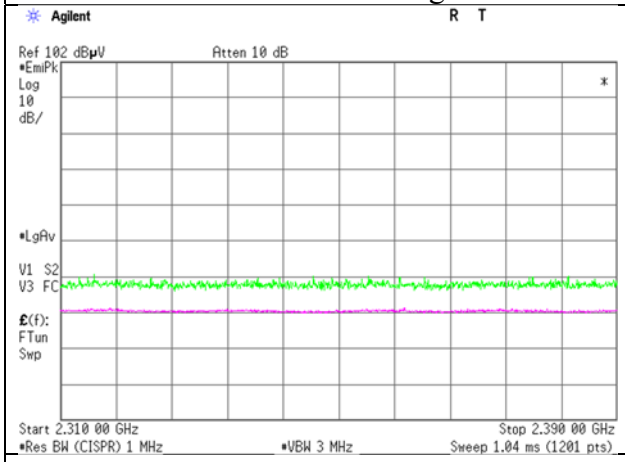
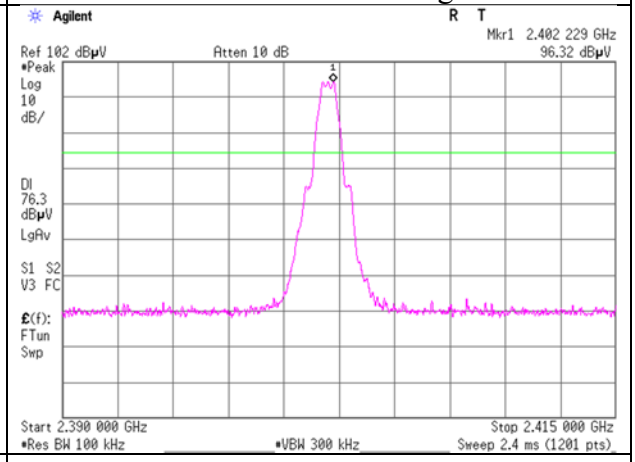
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	96.3	27.8	5.3	31.9	97.6	-	-	Carrier
Hori.	2400.000	PK	39.0	27.8	5.3	31.9	40.3	77.6	37.3	
Vert.	2402.000	PK	98.6	27.8	5.3	31.9	99.9	-	-	Carrier
Vert.	2400.000	PK	40.9	27.8	5.3	31.9	42.2	79.9	37.7	

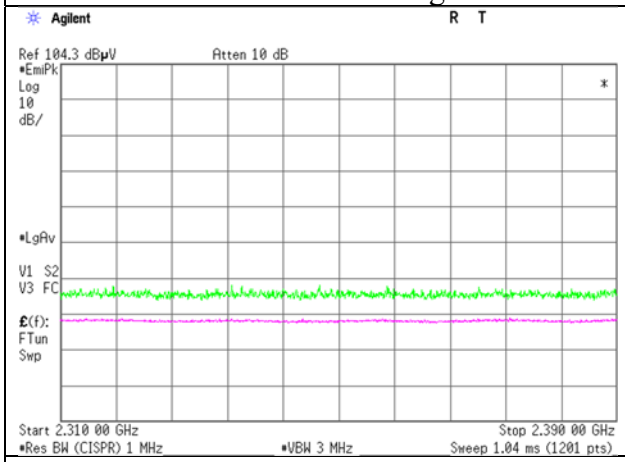
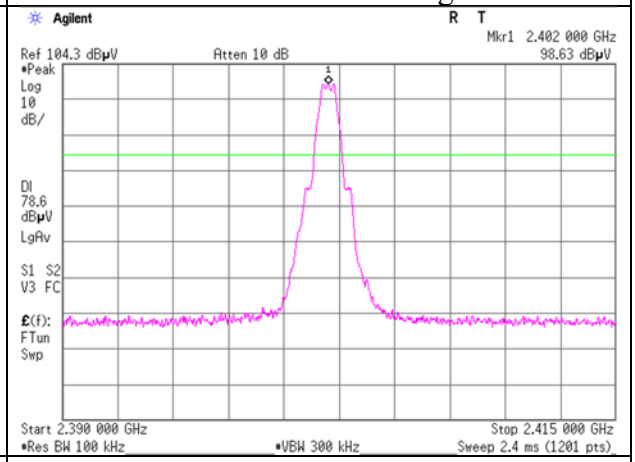
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amprifier)

Distance factor: 1 GHz - 10 GHz 20log (3.9 m / 3.0 m) = 2.28 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	13454495H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	August 18, 2020 (Day)
Temperature / Humidity	22 deg. C / 47 % RH
Engineer	Yuichiro Yamazaki (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

Report No.	13454495H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	August 18, 2020 (Night)	August 19, 2020
Temperature / Humidity	22 deg. C / 62 % RH	23 deg. C / 63 % RH
Engineer	Junki Nagatomi (Above 1 GHz)	Yuichiro Yamazaki (Below 1 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.	231.666	QP	33.0	11.4	9.2	31.8	-	21.8	46.0	24.2	
Hori.	356.362	QP	46.2	15.1	10.1	31.8	-	39.6	46.0	6.4	
Hori.	577.530	QP	41.0	18.6	11.3	32.0	-	39.0	46.0	7.0	
Hori.	618.977	QP	39.5	19.5	11.6	32.0	-	38.5	46.0	7.5	
Hori.	798.256	QP	35.6	20.8	12.4	31.6	-	37.2	46.0	8.8	
Hori.	905.983	QP	32.1	22.0	12.9	31.1	-	36.0	46.0	10.0	
Hori.	1071.251	PK	51.6	24.3	4.3	34.5	-	45.8	73.9	28.1	
Hori.	4880.000	PK	40.9	31.6	7.5	31.2	-	48.7	73.9	25.2	Floor noise
Hori.	7320.000	PK	42.8	36.6	8.8	32.5	-	55.7	73.9	18.2	Floor noise
Hori.	9760.000	PK	42.7	38.4	9.6	32.9	-	57.8	73.9	16.1	Floor noise
Hori.	1071.251	AV	44.8	24.3	4.3	34.5	-	39.0	53.9	14.9	
Hori.	4880.000	AV	31.4	31.6	7.5	31.2	-	39.3	53.9	14.7	Floor noise
Hori.	7320.000	AV	33.1	36.6	8.8	32.5	-	46.0	53.9	7.9	Floor noise
Hori.	9760.000	AV	32.7	38.4	9.6	32.9	-	47.8	53.9	6.1	Floor noise
Vert.	231.666	QP	33.8	11.4	9.2	31.8	-	22.6	46.0	23.4	
Vert.	356.362	QP	39.0	15.1	10.1	31.8	-	32.4	46.0	13.6	
Vert.	577.530	QP	38.5	18.6	11.3	32.0	-	36.5	46.0	9.5	
Vert.	618.977	QP	39.3	19.5	11.6	32.0	-	38.3	46.0	7.7	
Vert.	798.256	QP	34.4	20.8	12.4	31.6	-	36.0	46.0	10.0	
Vert.	906.699	QP	34.3	22.0	12.9	31.1	-	38.2	46.0	7.8	
Vert.	1071.251	PK	55.3	24.3	4.3	34.5	-	49.5	73.9	24.5	
Vert.	4880.000	PK	41.0	31.6	7.5	31.2	-	48.9	73.9	25.0	Floor noise
Vert.	7320.000	PK	42.5	36.6	8.8	32.5	-	55.4	73.9	18.5	Floor noise
Vert.	9760.000	PK	42.5	38.4	9.6	32.9	-	57.6	73.9	16.3	Floor noise
Vert.	1071.251	AV	50.4	24.3	4.3	34.5	-	44.6	53.9	9.3	
Vert.	4880.000	AV	31.4	31.6	7.5	31.2	-	39.3	53.9	14.7	Floor noise
Vert.	7320.000	AV	33.1	36.6	8.8	32.5	-	46.0	53.9	7.9	Floor noise
Vert.	9760.000	AV	32.7	38.4	9.6	32.9	-	47.8	53.9	6.1	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 20log (3.9 m / 3.0 m) = 2.28 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission

Report No.	13454495H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	August 18, 2020 (Night)	August 19, 2020
Temperature / Humidity	22 deg. C / 62 % RH	23 deg. C / 63 % RH
Engineer	Junki Nagatomi (Above 1 GHz)	Yuichiro Yamazaki (Below 1 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.	231.666	QP	33.0	11.4	9.2	31.8	-	21.8	46.0	24.2	
Hori.	356.362	QP	46.2	15.1	10.1	31.8	-	39.6	46.0	6.4	
Hori.	577.530	QP	41.0	18.6	11.3	32.0	-	39.0	46.0	7.0	
Hori.	618.977	QP	39.5	19.5	11.6	32.0	-	38.5	46.0	7.5	
Hori.	798.256	QP	35.6	20.8	12.4	31.6	-	37.2	46.0	8.8	
Hori.	905.983	QP	32.1	22.0	12.9	31.1	-	36.0	46.0	10.0	
Hori.	1071.251	PK	52.2	24.3	4.3	34.5	-	46.4	73.9	27.5	
Hori.	2483.500	PK	43.2	27.7	5.4	31.8	-	44.4	73.9	29.5	
Hori.	4960.000	PK	40.3	31.6	7.5	31.2	-	48.2	73.9	25.7	Floor noise
Hori.	7440.000	PK	42.4	36.7	8.8	32.5	-	55.4	73.9	18.6	Floor noise
Hori.	9920.000	PK	42.1	38.6	7.3	33.0	-	55.0	73.9	18.9	Floor noise
Hori.	1071.251	AV	47.0	24.3	4.3	34.5	-	41.2	53.9	12.7	
Hori.	2483.500	AV	34.3	27.7	5.4	31.8	2.0	37.5	53.9	16.4	*1)
Hori.	4960.000	AV	32.5	31.6	7.5	31.2	-	40.4	53.9	13.5	Floor noise
Hori.	7440.000	AV	33.5	36.7	8.8	32.5	-	46.5	53.9	7.4	Floor noise
Hori.	9920.000	AV	33.4	38.6	7.3	33.0	-	46.3	53.9	7.6	Floor noise
Vert.	231.666	QP	33.8	11.4	9.2	31.8	-	22.6	46.0	23.4	
Vert.	356.362	QP	39.0	15.1	10.1	31.8	-	32.4	46.0	13.6	
Vert.	577.530	QP	38.5	18.6	11.3	32.0	-	36.5	46.0	9.5	
Vert.	618.977	QP	39.3	19.5	11.6	32.0	-	38.3	46.0	7.7	
Vert.	798.256	QP	34.4	20.8	12.4	31.6	-	36.0	46.0	10.0	
Vert.	906.699	QP	34.3	22.0	12.9	31.1	-	38.2	46.0	7.8	
Vert.	1071.251	PK	55.7	24.3	4.3	34.5	-	49.8	73.9	24.1	
Vert.	2483.500	PK	45.8	27.7	5.4	31.8	-	47.1	73.9	26.8	
Vert.	4960.000	PK	41.0	31.6	7.5	31.2	-	48.9	73.9	25.0	Floor noise
Vert.	7440.000	PK	41.8	36.7	8.8	32.5	-	54.8	73.9	19.1	Floor noise
Vert.	9920.000	PK	42.6	38.6	7.3	33.0	-	55.5	73.9	18.4	Floor noise
Vert.	1071.251	AV	51.1	24.3	4.3	34.5	-	45.2	53.9	8.7	
Vert.	2483.500	AV	35.4	27.7	5.4	31.8	2.0	38.6	53.9	15.3	*1)
Vert.	4960.000	AV	32.5	31.6	7.5	31.2	-	40.4	53.9	13.5	Floor noise
Vert.	7440.000	AV	33.5	36.7	8.8	32.5	-	46.5	53.9	7.4	Floor noise
Vert.	9920.000	AV	33.4	38.6	7.3	33.0	-	46.3	53.9	7.6	Floor noise

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

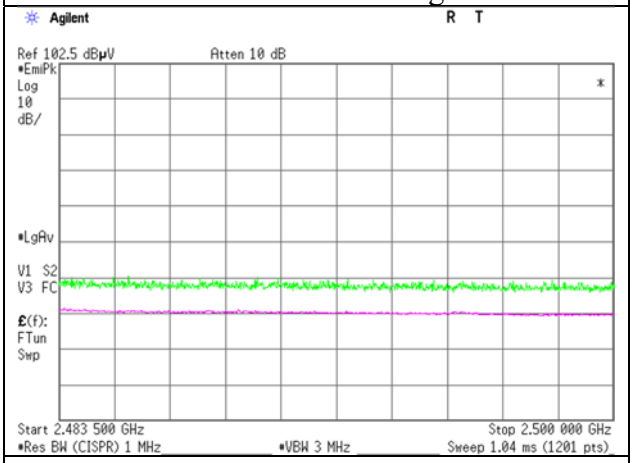
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

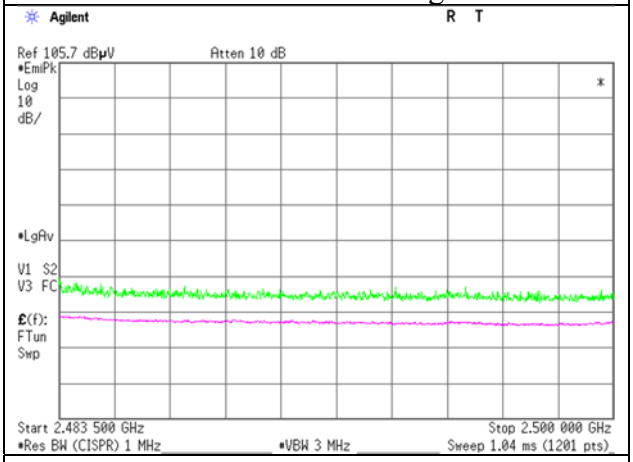
Distance factor: 1 GHz - 10 GHz 20log (3.9 m / 3.0 m) = 2.28 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

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

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	13454495H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	August 18, 2020
Temperature / Humidity	22 deg. C / 62 % RH
Engineer	Junki Nagatomi
Mode	Tx BT LE 2480 MHz

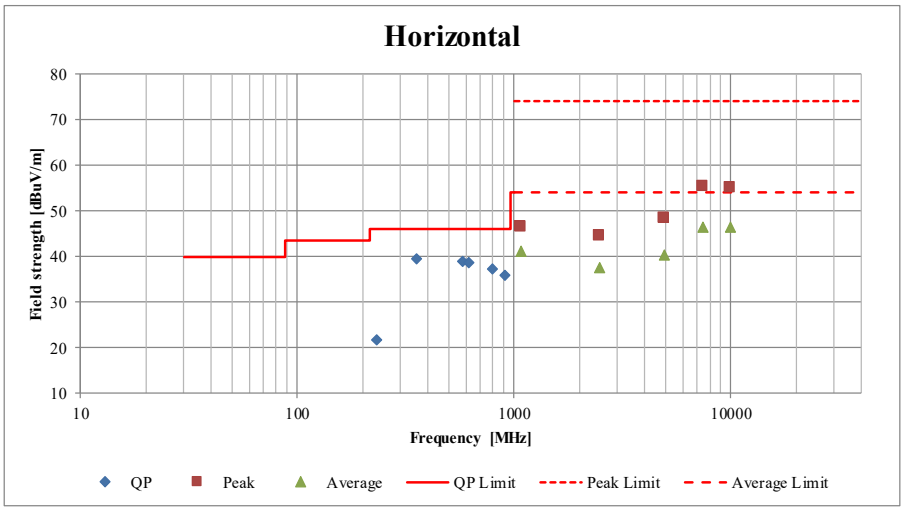
Horizontal
Restricted-band band-edge Plot

Trace Green : Peak Plot Trace Purple : Average Plot

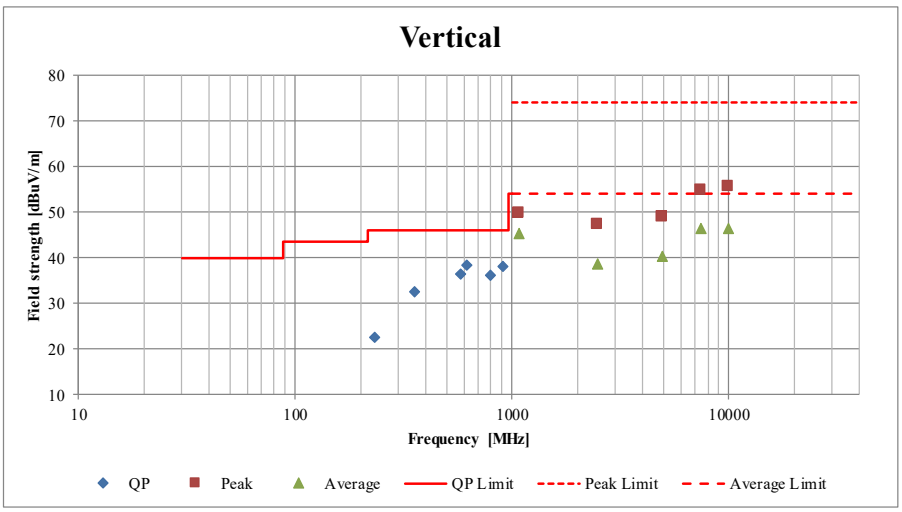
Vertical
Restricted-band band-edge Plot

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)

Report No.	13454495H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	August 18, 2020 (Night)	August 19, 2020
Temperature / Humidity	22 deg. C / 62 % RH	23 deg. C / 63 % RH
Engineer	Junki Nagatomi (Above 1 GHz)	Yuichiro Yamazaki (Below 1 GHz)
Mode	Tx BT LE 2480 MHz	



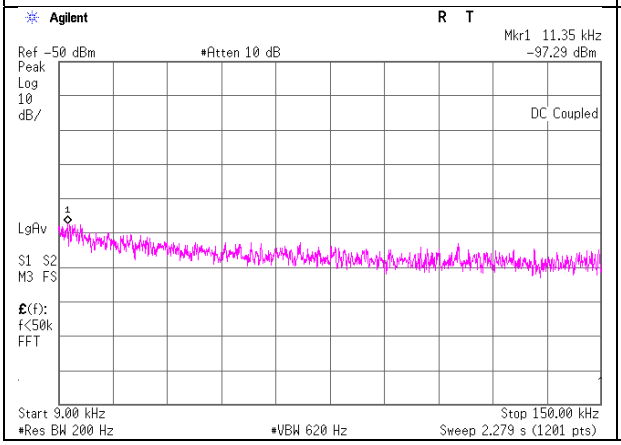


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

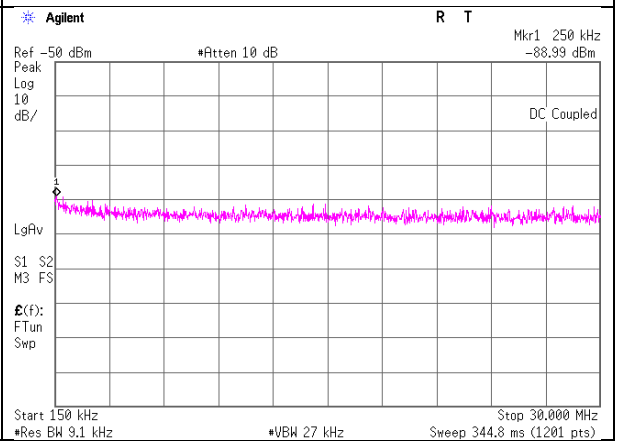
Conducted Spurious Emission

Report No.	13454495H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	August 20, 2020
Temperature / Humidity	24 deg. C / 55 % RH
Engineer	Yuta Moriya
Mode	Tx BT LE 2402 MHz

9 kHz - 150 kHz



150 kHz - 30 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
11.35	-97.3	2.07	9.7	2.0	1	-83.5	300	6.0	-22.2	46.5	68.7	
250.00	-89.0	2.07	9.7	2.0	1	-75.2	300	6.0	-13.9	19.6	33.5	

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

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

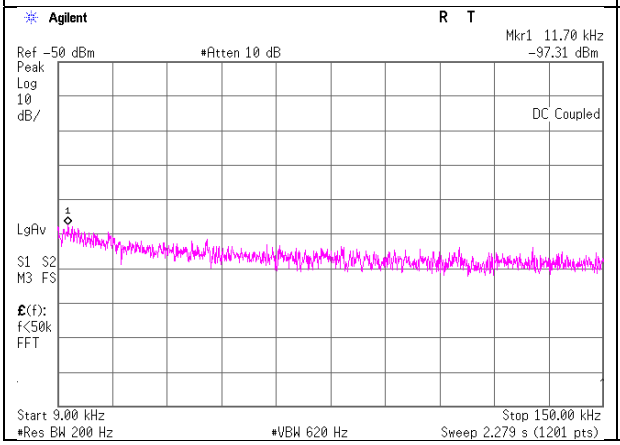
N: Number of output

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

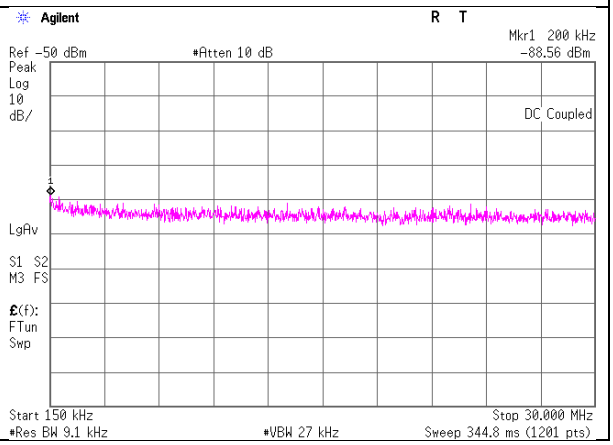
Conducted Spurious Emission

Report No.	13454495H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	August 20, 2020
Temperature / Humidity	24 deg. C / 55 % RH
Engineer	Yuta Moriya
Mode	Tx BT LE 2440 MHz

9 kHz - 150 kHz



150 kHz - 30 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
11.70	-97.3	2.16	9.7	2.0	1	-83.4	300	6.0	-22.2	46.2	68.4	
200.00	-88.6	2.16	9.7	2.0	1	-74.7	300	6.0	-13.4	21.5	34.9	

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)

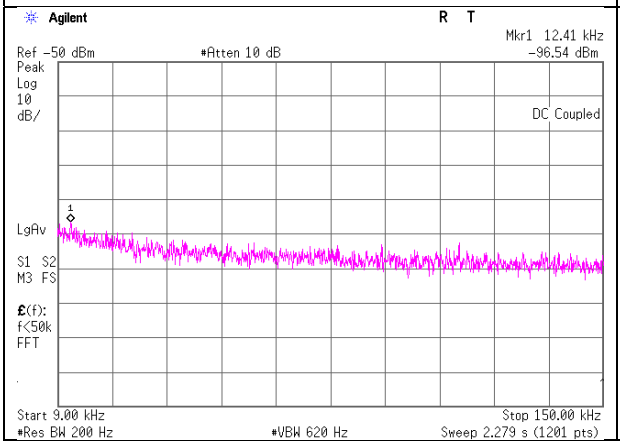
N: Number of output

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

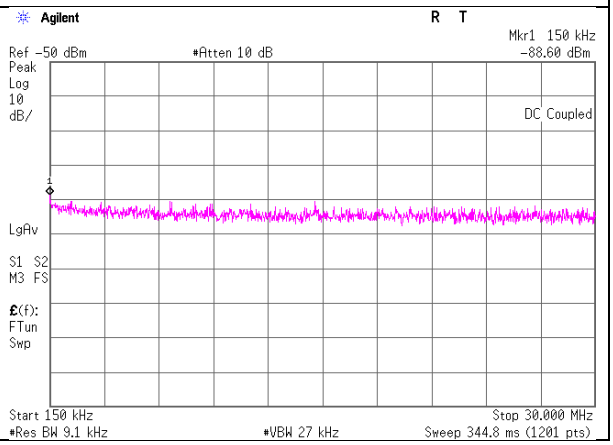
Conducted Spurious Emission

Report No.	13454495H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	August 20, 2020
Temperature / Humidity	24 deg. C / 55 % RH
Engineer	Yuta Moriya
Mode	Tx BT LE 2480 MHz

9 kHz - 150 kHz



150 kHz - 30 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
12.41	-96.5	2.19	9.7	2.0	1	-82.6	300	6.0	-21.4	45.7	67.1	
150.00	-88.6	2.19	9.7	2.0	1	-74.7	300	6.0	-13.4	24.0	37.4	

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

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

Power Density

Report No.	13454495H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	August 20, 2020
Temperature / Humidity	24 deg. C / 55 % RH
Engineer	Yuta Moriya
Mode	Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402	-23.78	2.07	9.73	-11.98	8.00	19.98
2440	-21.58	2.16	9.73	-9.69	8.00	17.69
2480	-20.34	2.19	9.73	-8.42	8.00	16.42

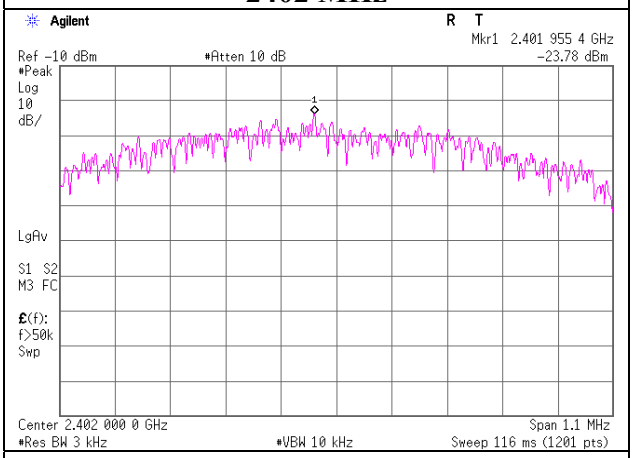
Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

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

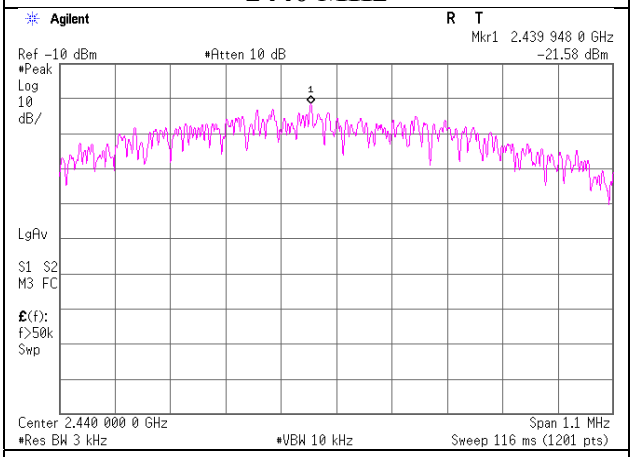
Power Density

BT LE

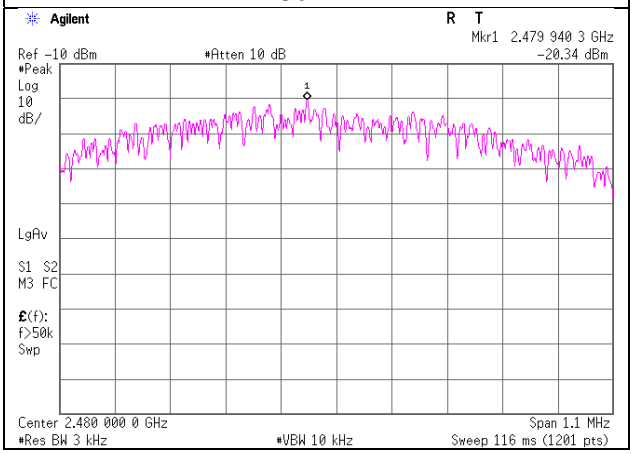
2402 MHz



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
AT	MSA-15	141902	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY46187105	10/09/2019	12
AT	MPM-12	141809	Power Meter	ANRITSU	ML2495A	825002	05/07/2020	12
AT	MPSE-17	141830	Power sensor	ANRITSU	MA2411B	738285	05/07/2020	12
AT	MAT-88	141312	Attenuator	Weinschel Associates	WA56-10	56100304	05/27/2020	12
AT	MOS-14	141561	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	1401	01/07/2020	12
RE	MAEC-04	142011	AC4_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	05/25/2020	24
RE	MOS-15	141562	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0010	01/07/2020	12
RE	MMM-10	141545	DIGITAL HiTESTER	Hioki	3805	51201148	01/06/2020	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	AC4_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-10005	04/04/2019	24
RE	MHA-21	141508	Horn Antenna 1-18GHz	Schwarzbeck Mess - Elektronik	BBHA9120D	557	05/22/2020	12
RE	MPA-12	141581	MicroWave System Amplifier	Keysight Technologies Inc	83017A	650	10/16/2019	12
RE	MCC-246	199563	Microwave Cable	HUBER+SUNER	SF126E/11PC35/ 11PC35/1000M,5000M	537061/126E / 537072/126E	06/11/2020	12
RE	MHF-26	141296	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	002	09/11/2019	12
RE	MSA-03	141884	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY44020357	03/04/2020	12
RE	MBA-05	141425	Biconical Antenna	Schwarzbeck Mess - Elektronik	VHA9103+BBA9106	1302	08/24/2019	12
RE	MLA-23	141267	Logperiodic Antenna (200-1000MHz)	Schwarzbeck Mess - Elektronik	VUSLP9111B	9111B-192	08/24/2019	12
RE	MPA-14	141583	Pre Amplifier	SONOMA INSTRUMENT	310	260833	02/18/2020	12
RE	MCC-50	141397	Coaxial Cable	UL Japan	-	-	03/24/2020	12
RE	MAT-34	141331	Attenuator(6dB)	TME	UFA-01	-	02/05/2020	12
RE	MTR-10	141951	EMI Test Receiver	Rohde & Schwarz	ESR26	101408	2020/03/10	12
RE	MHA-17	141506	Horn Antenna 15-40GHz	Schwarzbeck Mess - Elektronik	BBHA9170	BBHA9170307	2020/07/16	12

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

The expiration date of the calibration is the end of the expired month.
As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

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

Test item:

RE: Radiated Emission test
AT: Antenna Terminal Conducted test