RADIO TEST REPORT

Test Report No. : 12804674H-A-R2

Applicant	:	**DENSO Corporation**
Type of Equipment	:	**Control Box**
Model No.	:	**DNNS097**
FCC ID	:	**HYQDNNS097**
Test regulation	:	**FCC Part 15 Subpart C: 2019** ***WLAN and Bluetooth Low Energy Part**
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 above regulation.
4. The test results in this report are traceable to the national or international standards.
5. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
6. The all test items in this test report are conducted by UL Japan, Inc. Ise EMC Lab.
7. This test report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.
8. The information provided from the customer for this report is identified in SECTION 1.
9. This report is a revised version of 12804674H-A-R1. 12804674H-A-R1 is replaced with this report.

Date of test: July 30 to August 10, 2019

Representative test engineer:
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Engineer
Consumer Technology Division

Approved by:
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Engineer
Consumer Technology Division

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REVISION HISTORY

Original Test Report No.: 12804674H-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	12804674H-A	October 10, 2019	-	-
1	12804674H-A-R1	November 19, 2019	P.6	- Deletion of Clock frequency(ies) in the system - Addition of Clock frequency (maximum) in Radio Specification
1	12804674H-A-R1	November 19, 2019	P.12	Correction of Cable No. 5 and 12 information: - Cable's shield: from Shielded to Unshielded
1	12804674H-A-R1	November 19, 2019	P.11	Addition of test operating mode: Tx BT LE on Conducted Spurious Emission
1	12804674H-A-R1	November 19, 2019	P.49 - 51	Addition of the Conducted Spurious Emission data on Tx BT LE mode
1	12804674H-A-R2	November 28, 2019	P.12	Correction of Name of Cable No.12 from Signal Cable to Signal and DC Cable

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

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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 Equipment, Model No., FCC ID on the cover and other relevant pages
- SECTION 1: Customer information
- SECTION 2: Equipment under test (E.U.T.)
- SECTION 4: Operation of E.U.T. 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 (E.U.T.)

2.1 Identification of E.U.T.

Type of Equipment	:	Control Box
Model No.	:	DNNS097
Serial No.	:	Refer to SECTION 4.2
Rating	:	DC 12 V
Receipt Date of Sample (Information from test lab.)	:	July 24, 2019
Country of Mass-production	:	United States of America
Condition of EUT	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT	:	No Modification by the test lab

2.2 Product Description

Model: DNNS097 (referred to as the EUT in this report) is a Control Box.

Feature of EUT:
Operating Temperature : -30 deg. C to +70 deg. C

Radio Specification

Clock frequency (Maximum) : 37.4 MHz (Bluetooth and Wi-Fi Module IC)

	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	(USA) 5180 MHz - 5825 MHz (CANADA) 5280 MHz - 5580 MHz 5660 MHz - 5825 MHz	(USA) 5190 MHz - 5795 MHz (CANADA) 5310 MHz - 5550 MHz 5670 MHz - 5795 MHz	(USA) 5210 MHz - 5775 MHz (CANADA) 5530 MHz 5690 MHz - 5775 MHz
Type of modulation	DSSS/CCK (DQPSK, DBPSK)	OFDM (64QAM, 16QAM, QPSK, BPSK)	OFDM (64QAM, 16QAM, QPSK, BPSK, 256QAM(IEEE802.11ac only))		
Channel spacing	5 MHz		20 MHz	40 MHz	80 MHz
Antenna type	ASSEMBLY WiFi Antenna				
Antenna Connector type	MHF PLUG				
Antenna Gain	-2.9 dBi (max.)				

	GPS/GLONASS	Bluetooth Ver.4.2 with EDR function *1)
Frequency of operation	GPS: 1575.42 MHz GLONASS: 1598.0625 MHz - 1605.375 MHz	2402 MHz - 2480 MHz
Type of modulation	GPS: BPSK GLONASS: FDMA	BT: FHSS (GFSK, π/4-DQPSK, 8-DPSK) LE: GFSK
Channel spacing	-	BT: 1 MHz LE: 2 MHz
Antenna type	External Antenna	ASSEMBLY BT Antenna
Antenna Connector type	FAKRA	MHF PLUG
Antenna Gain	26.5 dBic	-2.9 dBi (max.)

*1) This test report applies to WLAN (2.4 GHz band) and Bluetooth Low Energy.

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on July 19, 2019 and effective August 19, 2019 except 15.258

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 revisions made after testing date do not affect the test specification applied to the EUT.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	**FCC:** ANSI C63.10-2013 6. Standard test methods **IC:** RSS-Gen 8.8	**FCC:** Section 15.207 **IC:** RSS-Gen 8.8	N/A	N/A	*1)
6dB Bandwidth	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 **IC:** -	**FCC:** Section 15.247(a)(2) **IC:** RSS-247 5.2(a)	See data.	Complied a)	Conducted
Maximum Peak Output Power	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 **IC:** RSS-Gen 6.12	**FCC:** Section 15.247(b)(3) **IC:** RSS-247 5.4(d)		Complied b)	Conducted
Power Density	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 **IC:** -	**FCC:** Section 15.247(e) **IC:** RSS-247 5.2(b)		Complied c)	Conducted
Spurious Emission Restricted Band Edges	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 **IC:** RSS-Gen 6.13	**FCC:** Section15.247(d) **IC:** RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	3.2 dB 2390.000 MHz, AV, Vert.	Complied# d), e)	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *2)

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 vehicle. 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	RSS-Gen 6.7	IC: -	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	1.3 dB
Carrier Frequency Separation	0.42 %
Dwell time / Burst rate	0.10 %
Conducted Spurious Emission	2.7 dB

Conducted emission

using Item	Frequency range	Uncertainty (+/-)
AMN (LISN)	0.009 MHz to 0.15 MHz	3.8 dB
	0.15 MHz to 30 MHz	3.4 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)	4.9 dB
	200 MHz to 1000 MHz (Horizontal)	5.0 dB
	(Vertical)	5.0 dB
3 m	1 GHz to 6 GHz	5.0 dB
	6 GHz to 18 GHz	5.3 dB
1 m	10 GHz to 26.5 GHz	5.8 dB
	26.5 GHz to 40 GHz	5.8 dB
10 m	1 GHz to 18 GHz	5.2 dB

3.5 Test Location

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NVLAP Lab. code: 200572-0 / FCC Test Firm Registration Number: 199967

Test site	IC Registration Number	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	2973C-1	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	2973C-2	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	2973C-3	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	2973C-4	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.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 m x 2.0m 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 E.U.T. during testing

4.1 Operating Mode(s)

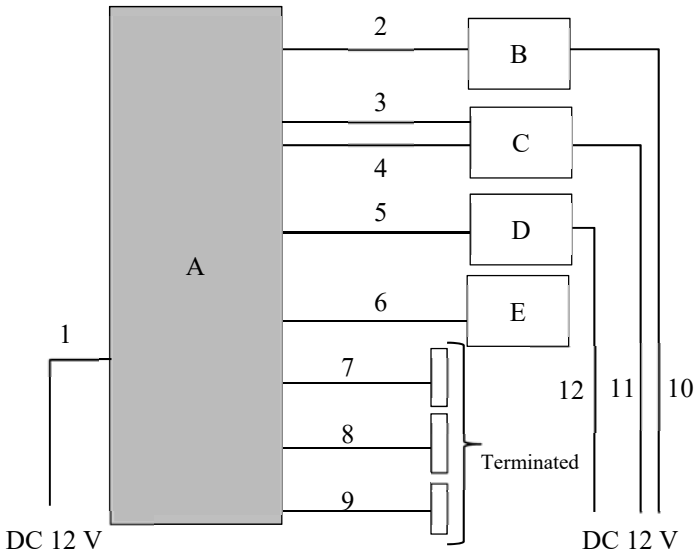
Test operating mode was determined as follows according to "Section 1 of 6 802.11 a/b/g/n testing - Managing Complex Regulatory Approvals - " of TCB Council Workshop October 2009.

Mode	Remarks*
IEEE 802.11b (11b)	11 Mbps, PN9
IEEE 802.11g (11g)	48 Mbps, PN9
IEEE 802.11n 20 MHz BW (11n-20)	MCS 7, PN9
Bluetooth Low Energy (BT LE)	Maximum Packet Size, PN9
*The worst condition was determined based on the test result of Maximum Peak Output Power (Mid Channel)	
*Power of the EUT was set by the software as follows; [WLAN] Power settings: 11b: 15 dBm 11g: 12 dBm 11n-20: 11 dBm Software: TYAA WiFi Validation V1.1.2.67 [BT LE] Power settings: 0 dBm Software: TYAA BT Validation V1.0.0.0 *This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.	

*The details of Operating mode(s)

Test Item	Operating Mode	Tested frequency
Radiated Spurious Emission	Tx 11b Tx 11g	2412 MHz 2437 MHz 2462 MHz
	Tx 11n-20	2412 MHz 2437 MHz 2462 MHz
	Tx BT LE	2402 MHz 2440 MHz 2480 MHz
Conducted Spurious Emission	Tx 11g	2437 MHz
	Tx BT LE	2402 MHz 2440 MHz 2480 MHz
6dB Bandwidth Maximum Peak Output Power Power Density 99% Occupied Bandwidth	Tx 11b Tx 11g	2412 MHz 2437 MHz 2462 MHz
	Tx 11n-20	2412 MHz 2437 MHz 2462 MHz
	Tx BT LE	2402 MHz 2440 MHz 2480 MHz

4.2 Configuration and peripherals



*Cabling and setup 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	DNNS097	No.2 for RE* No.1 for AT*	DENSO CORPORATION	EUT
B	Display	39710-TYAA-A010-M1	M17007A-ES1	Panasonic Corporation	-
C	Jig	cPhy	No.6	MICROCHIP	-
D	Touch Pad	-	-	VISTEON CORPORATION	-
E	GPS Antenna	V3-000624	No.6	Yokowo Co.,Ltd	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	2.0	Unshielded	Unshielded	-
2	Display Cable	1.0	Shielded	Shielded	-
3	Signal Cable	1.0	Shielded	Shielded	-
4	Signal Cable	1.0	Shielded	Shielded	-
5	Signal Cable	2.0	Unshielded	Unshielded	-
6	GPS Antenna Cable	2.0	Shielded	Shielded	-
7	USB Cable	1.0	Shielded	Shielded	-
8	USB Cable	1.0	Shielded	Shielded	-
9	USB Cable	1.0	Shielded	Shielded	-
10	DC Cable	2.0	Unshielded	Unshielded	-
11	DC Cable	2.0	Unshielded	Unshielded	-
12	Signal and DC Cable	2.0	Unshielded	Unshielded	

* RE: Radiated Spurious Emission, AT; Antenna Terminal Conducted test

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 and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.
The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer.
The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear mode).
The test was made with the detector (RBW/VBW) in the following table.
When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

Test Antennas are used as below;

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

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

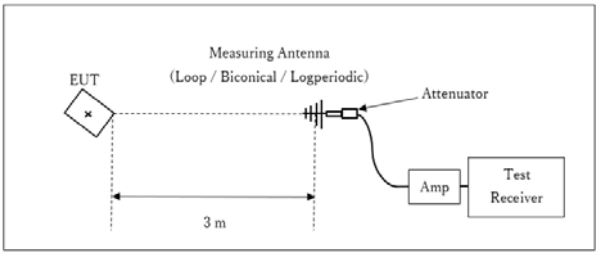
20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9(IC) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (IC).

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

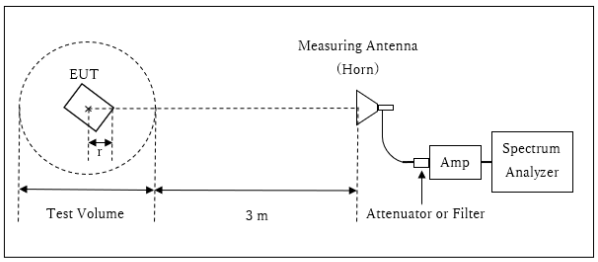
Below 1 GHz



× : Center of turn table

Test Distance: 3 m

1 GHz - 10 GHz



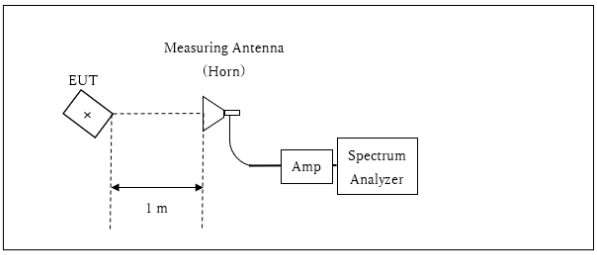
r : Radius of an outer periphery of EUT
× : Center of turn table

Distance Factor: 20 x log (4.0 m / 3.0 m) = 2.50 dB
* Test Distance: (3 + Test Volume /2) - r = 4.0 m

Test Volume : 2.0 m
(Test Volume has been calibrated based on CISPR 16-1-4.)
r = 0.0m

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

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	20 MHz (11b, 11g, 11n-20) 3 MHz (BT LE)	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)	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.

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

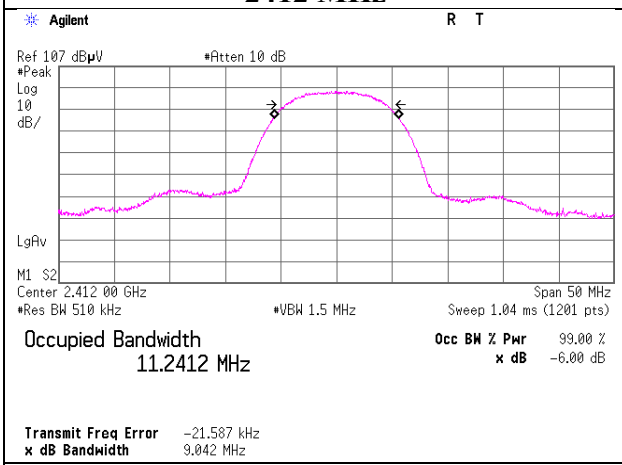
Report No.	12804674H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	August 9, 2019
Temperature / Humidity	24 deg. C / 68 % RH
Engineer	Junya Okuno
Mode	Tx

Mode	Frequency [MHz]	99% Occupied Bandwidth [kHz]	6dB Bandwidth [MHz]	Limit for 6dB Bandwidth [MHz]
11b	2412	11241.2	8.502	> 0.5000
	2437	11239.0	8.627	> 0.5000
	2462	11205.6	8.479	> 0.5000
11g	2412	17326.6	16.451	> 0.5000
	2437	17339.6	16.451	> 0.5000
	2462	17340.6	16.455	> 0.5000
11n-20	2412	18355.1	17.749	> 0.5000
	2437	18373.8	17.740	> 0.5000
	2462	18327.4	17.704	> 0.5000
BTLE	2402	1062.2	0.710	> 0.5000
	2440	1061.8	0.707	> 0.5000
	2480	1062.4	0.710	> 0.5000

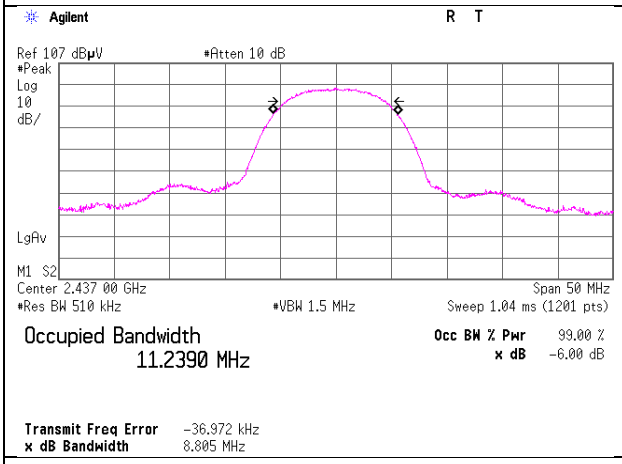
99%Occupied Bandwidth

11b

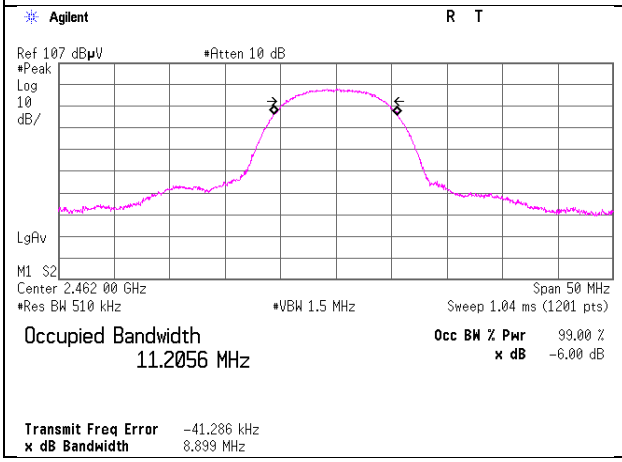
2412 MHz



2437 MHz

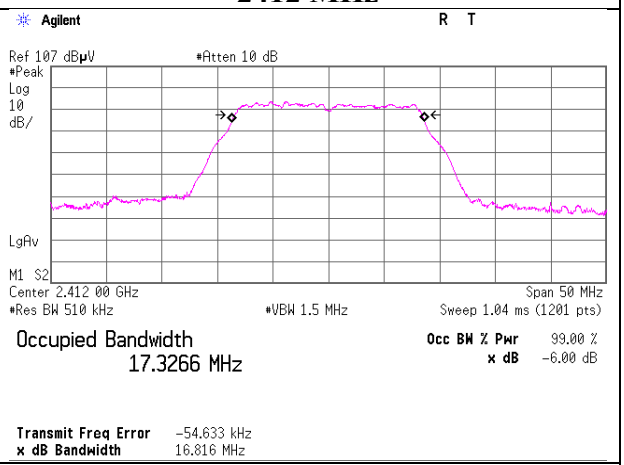


2462 MHz

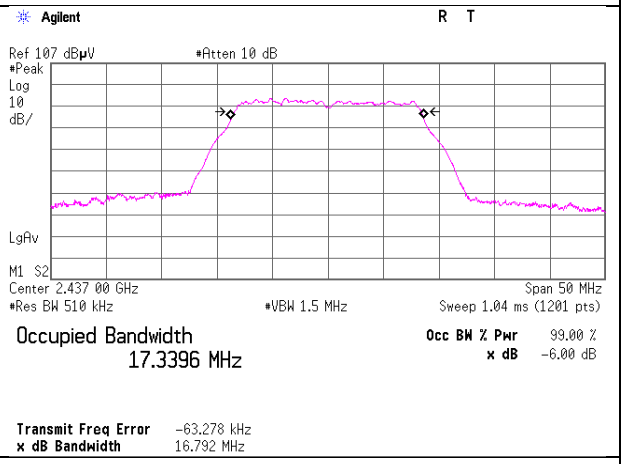


11g

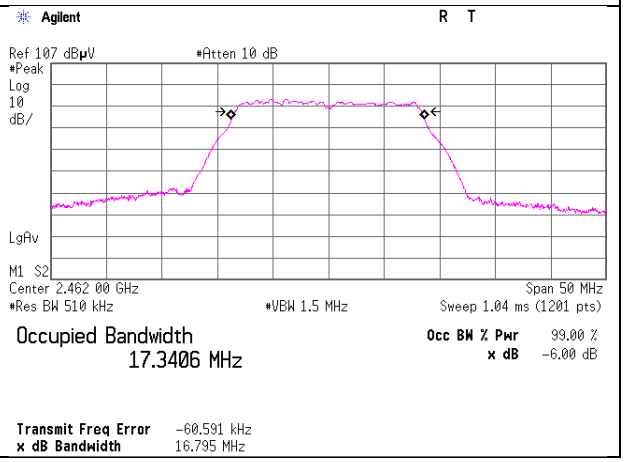
2412 MHz



2437 MHz



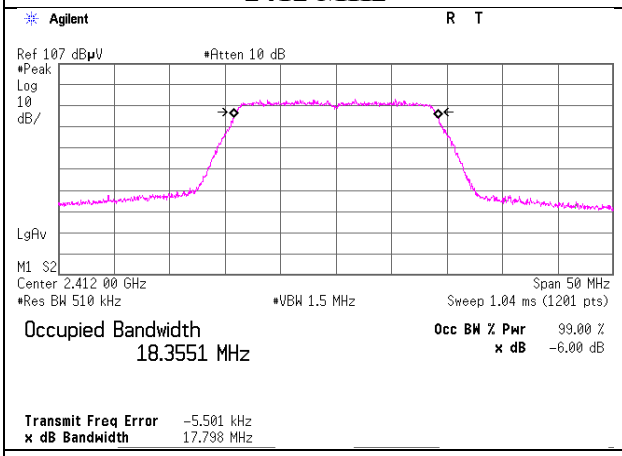
2462 MHz



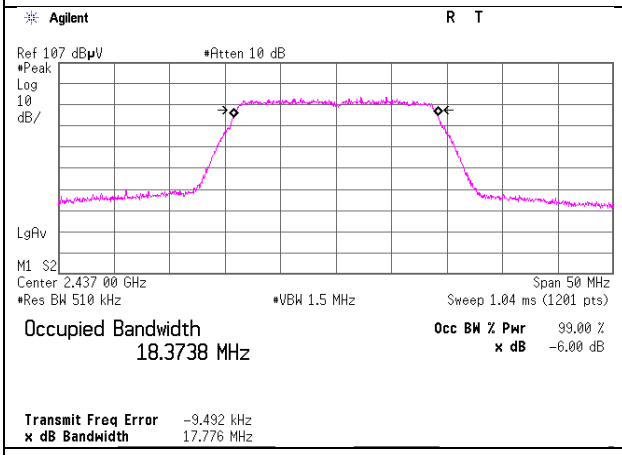
99% Occupied Bandwidth

11n-20

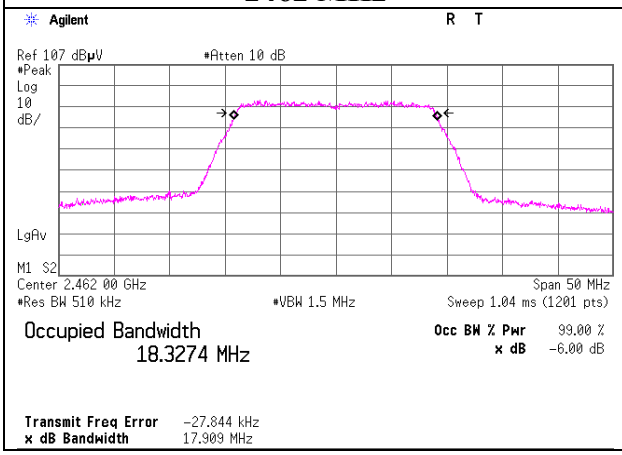
2412 MHz



2437 MHz

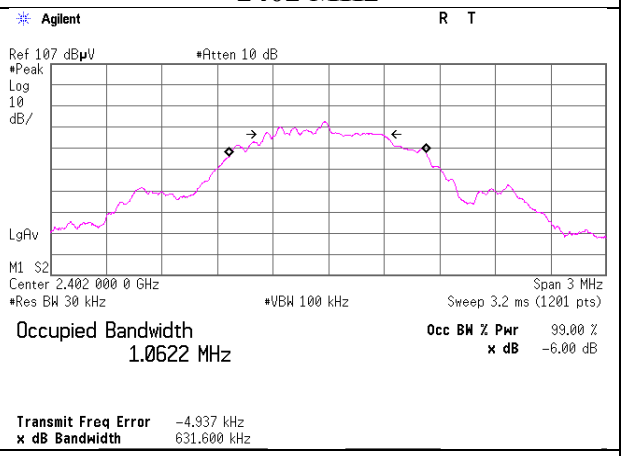


2462 MHz

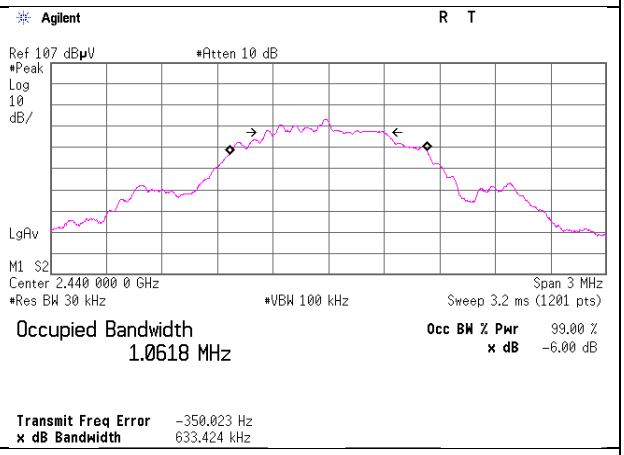


BTLE

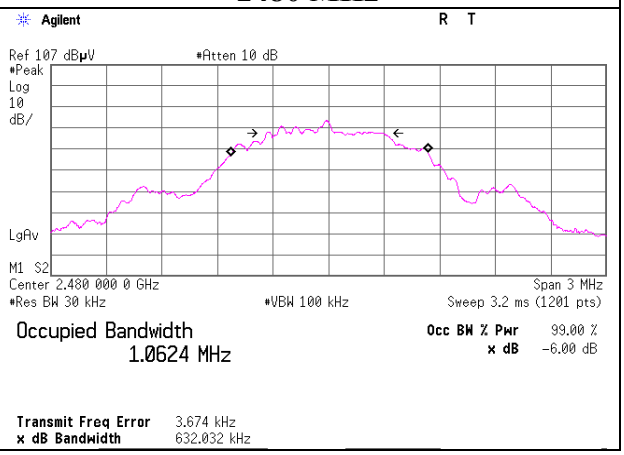
2402 MHz



2440 MHz



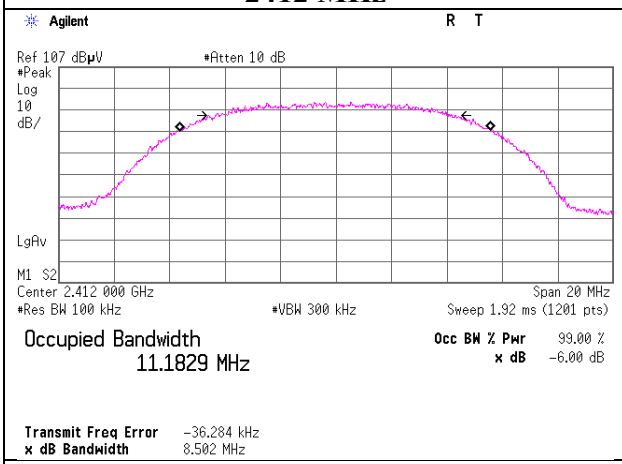
2480 MHz



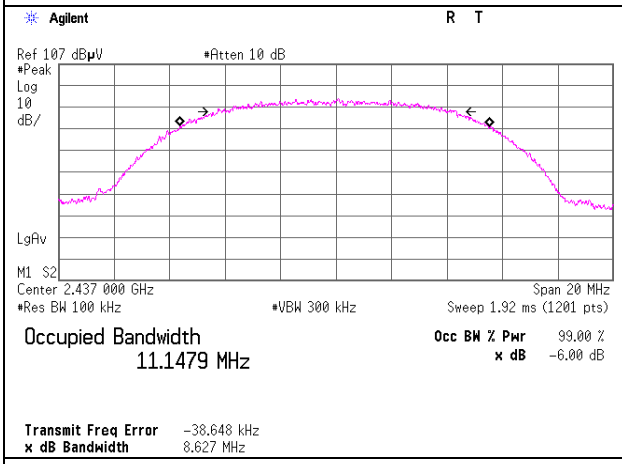
6dB Bandwidth

11b

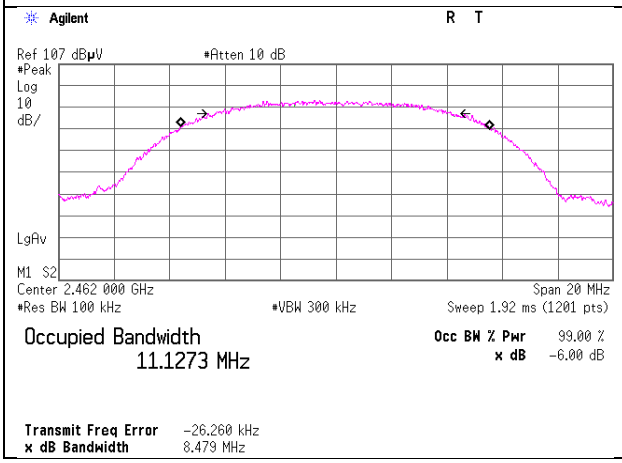
2412 MHz



2437 MHz

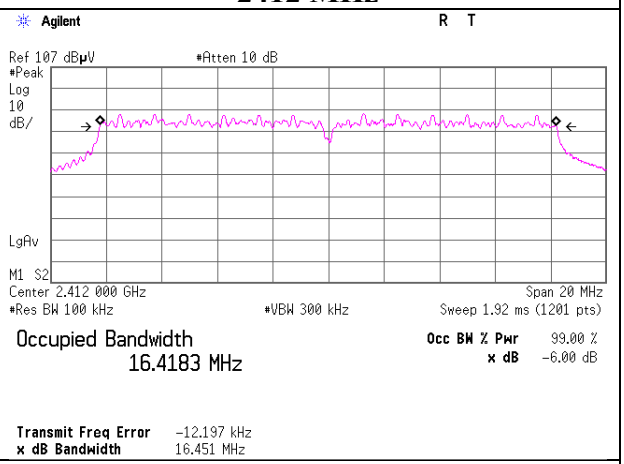


2462 MHz

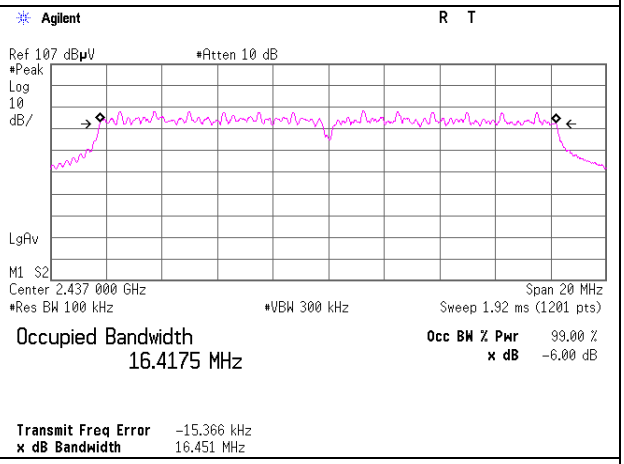


11g

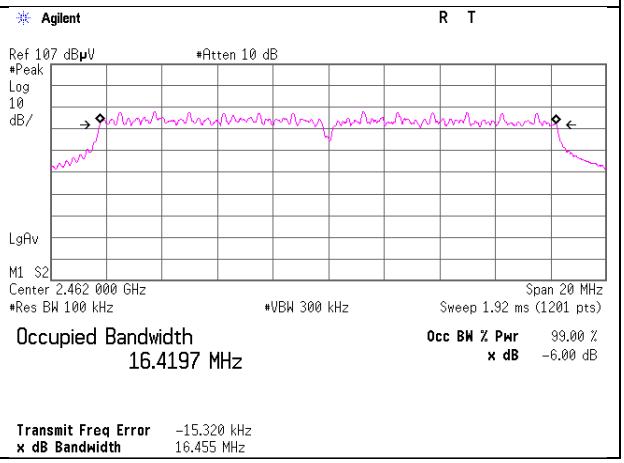
2412 MHz



2437 MHz



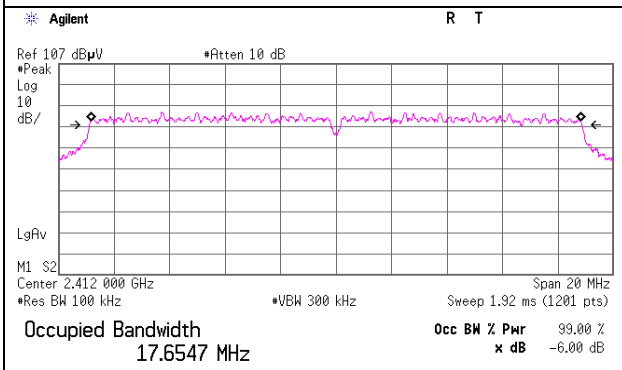
2462 MHz



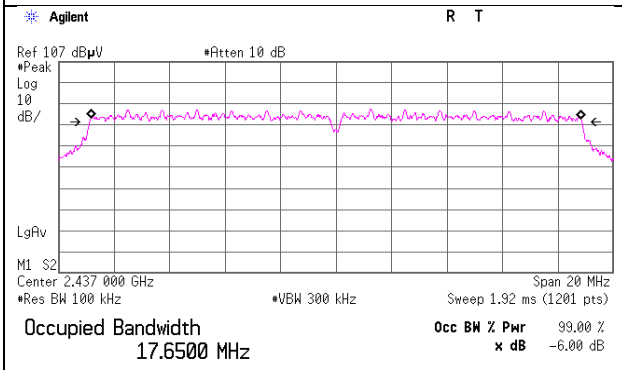
6dB Bandwidth

11n-20

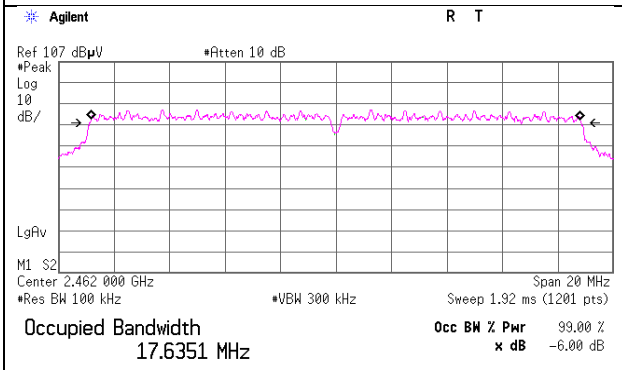
2412 MHz



2437 MHz

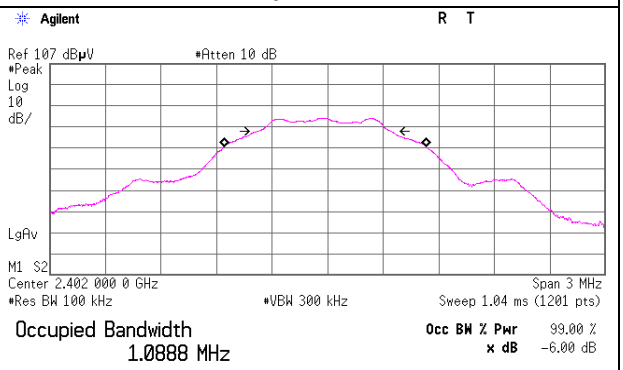


2462 MHz

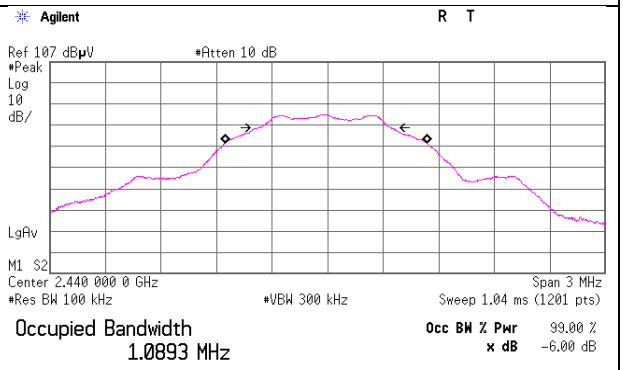


BT LE

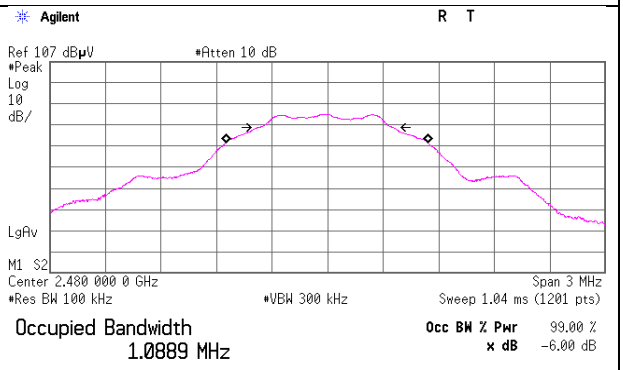
2402 MHz



2440 MHz



2480 MHz



Maximum Peak Output Power

Report No.	12804674H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	July 30, 2019
Temperature / Humidity	23 deg. C / 62 % RH
Engineer	Junki Nagatomi
Mode	Tx 11b

				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]
2412	5.17	3.91	10.09	19.17	82.60	30.00	1000	10.83	-2.9	16.27	42.36	36.02	4000	19.75
2437	5.45	3.91	10.09	19.45	88.10	30.00	1000	10.55	-2.9	16.55	45.19	36.02	4000	19.47
2462	5.30	3.91	10.09	19.30	85.11	30.00	1000	10.70	-2.9	16.40	43.65	36.02	4000	19.62

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.

2437MHz

Rate [Mbps]	Result [dBm]	Remark
1	16.42	
2	16.07	
5.5	16.25	
11	16.73	*

*: Worst Rate
All comparison were carried out on same frequency and measurement factors.

Maximum Peak Output Power

Report No.	12804674H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	July 30, 2019
Temperature / Humidity	23 deg. C / 62 % RH
Engineer	Junki Nagatomi
Mode	Tx 11g

				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]
2412	10.06	3.91	10.09	24.06	254.68	30.00	1000	5.94	-2.9	21.16	130.62	36.02	4000	14.86
2437	10.12	3.91	10.09	24.12	258.23	30.00	1000	5.88	-2.9	21.22	132.43	36.02	4000	14.80
2462	9.80	3.91	10.09	23.80	239.88	30.00	1000	6.20	-2.9	20.90	123.03	36.02	4000	15.12

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.

2437 MHz

Rate [Mbps]	Result [dBm]	Remark
6	20.58	
9	20.23	
12	20.24	
18	20.56	
24	20.47	
36	21.00	
48	22.46	*
54	21.17	

*: Worst Rate
All comparison were carried out on same frequency and measurement factors.

Maximum Peak Output Power

Report No.	12804674H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	July 30, 2019
Temperature / Humidity	23 deg. C / 62 % RH
Engineer	Junki Nagatomi
Mode	Tx 11n-20

				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]
2412	8.56	3.91	10.09	22.56	180.30	30.00	1000	7.44	-2.9	19.66	92.47	36.02	4000	16.36
2437	9.19	3.91	10.09	23.19	208.45	30.00	1000	6.81	-2.9	20.29	106.91	36.02	4000	15.73
2462	8.90	3.91	10.09	22.90	194.98	30.00	1000	7.10	-2.9	20.00	100.00	36.02	4000	16.02

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.

2437 MHz

MCS Number	Result [dBm]	Remark
0	20.72	
1	20.59	
2	21.10	
3	21.69	
4	21.52	
5	22.28	
6	22.10	
7	22.29	*

*: Worst Rate
All comparison were carried out on same frequency and measurement factors.

Maximum Peak Output Power

Report No.	12804674H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	August 10, 2019
Temperature / Humidity	23 deg. C / 62 % 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	-15.03	3.90	10.10	-1.03	0.79	30.00	1000	31.03	-2.9	-3.93	0.40	36.02	4000	39.95
2440	-14.36	3.91	10.10	-0.35	0.92	30.00	1000	30.35	-2.9	-3.25	0.47	36.02	4000	39.27
2480	-14.06	3.91	10.10	-0.05	0.99	30.00	1000	30.05	-2.9	-2.95	0.51	36.02	4000	38.97

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 / SAR testing)

Report No.	12804674H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	August 10, 2019
Temperature / Humidity	23 deg. C / 68 % RH
Engineer	Yuta Moriya
Mode	Tx

11b **1 Mbps**

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2412	1.67	3.90	10.10	15.67	36.90	0.04	15.71	37.24
2437	1.66	3.91	10.10	15.67	36.90	0.04	15.71	37.24
2462	1.51	3.91	10.10	15.52	35.65	0.04	15.56	35.97

11g **6 Mbps**

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2412	-1.39	3.90	10.10	12.61	18.24	0.29	12.90	19.50
2437	-1.31	3.91	10.10	12.70	18.62	0.29	12.99	19.91
2462	-1.31	3.91	10.10	12.70	18.62	0.29	12.99	19.91

11n-20 **MCS 0**

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2412	-2.31	3.90	10.10	11.69	14.76	0.31	12.00	15.85
2437	-2.30	3.91	10.10	11.71	14.83	0.31	12.02	15.92
2462	-2.37	3.91	10.10	11.64	14.59	0.31	11.95	15.67

BTLE

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	-17.85	3.90	10.10	-3.85	0.41	1.84	-2.01	0.63
2440	-16.99	3.91	10.10	-2.98	0.50	1.84	-1.14	0.77
2480	-16.74	3.91	10.10	-2.73	0.53	1.84	-0.89	0.81

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.

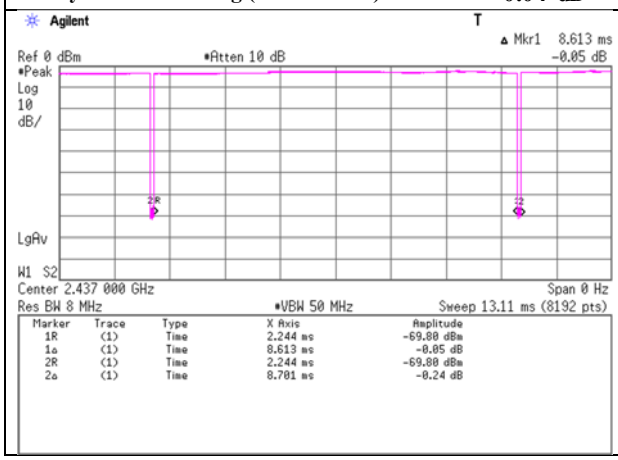
The average output power was measured with the lowest order modulation and lowest data rate configuration in each IEEE 802.11 mode based on KDB 248227 D01.

Burst rate confirmation

Report No.	12804674H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	August 9, 2019
Temperature / Humidity	24 deg. C / 68 % RH
Engineer	Junya Okuno
Mode	Tx

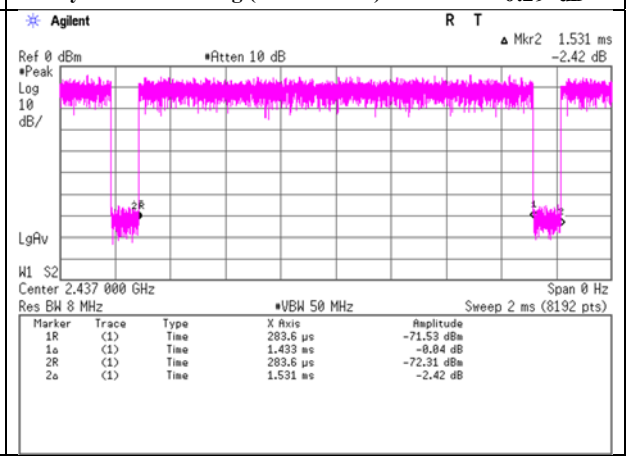
11b 1 Mbps

Tx on / (Tx on + Tx off) =	0.990
Tx on / (Tx on + Tx off) * 100 =	99.0 %
Duty factor = 10 * log (8.701 / 8.613) =	0.04 dB



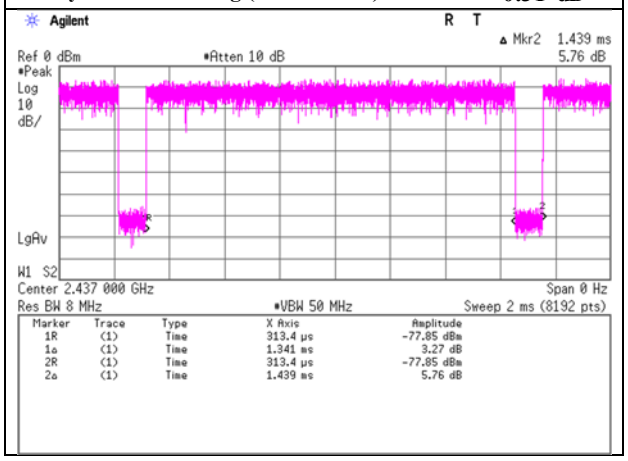
11g 6 Mbps

Tx on / (Tx on + Tx off) =	0.936
Tx on / (Tx on + Tx off) * 100 =	93.6 %
Duty factor = 10 * log (1.531 / 1.433) =	0.29 dB



11n-20 MCS 0

Tx on / (Tx on + Tx off) =	0.932
Tx on / (Tx on + Tx off) * 100 =	93.2 %
Duty factor = 10 * log (1.439 / 1.341) =	0.31 dB



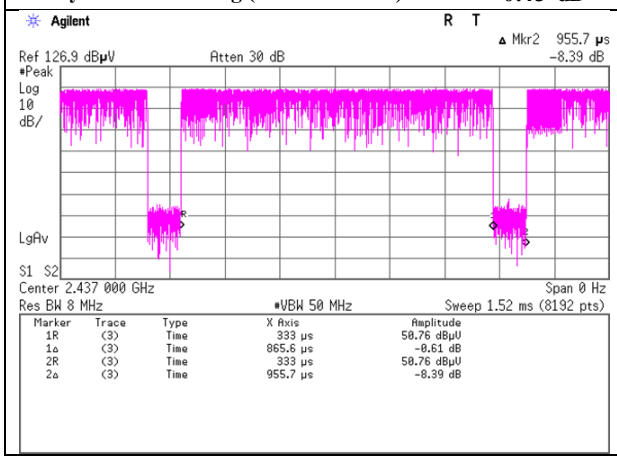
* Since the burst rate is not different between the channels, the data has been obtained on the representative channel.

Burst rate confirmation

Report No.	12804674H
Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Date	August 4, 2019
Temperature / Humidity	23 deg. C / 65 % RH
Engineer	Junki Nagatomi
Mode	Tx

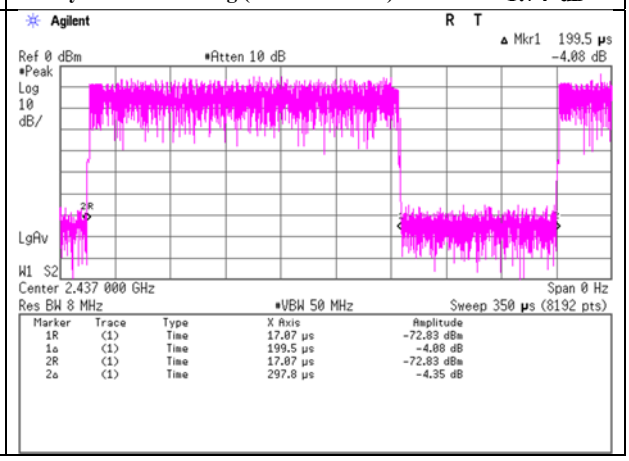
11b 11 Mbps

Tx on / (Tx on + Tx off) =	0.906
Tx on / (Tx on + Tx off) * 100 =	90.6 %
Duty factor = 10 * log (0.9557 / 0.8656) =	0.43 dB



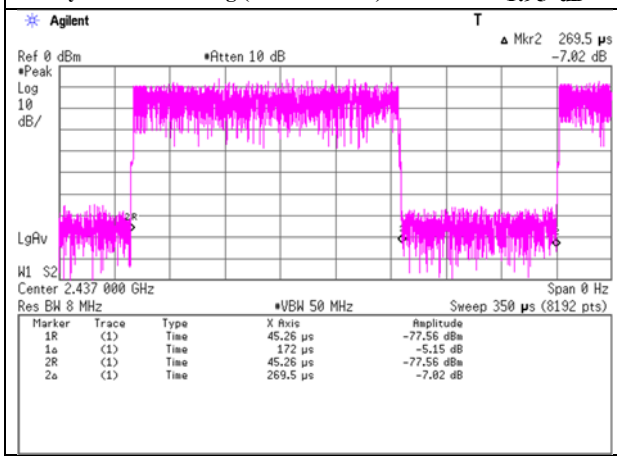
11g 48 Mbps

Tx on / (Tx on + Tx off) =	0.670
Tx on / (Tx on + Tx off) * 100 =	67.0 %
Duty factor = 10 * log (0.2978 / 0.1995) =	1.74 dB



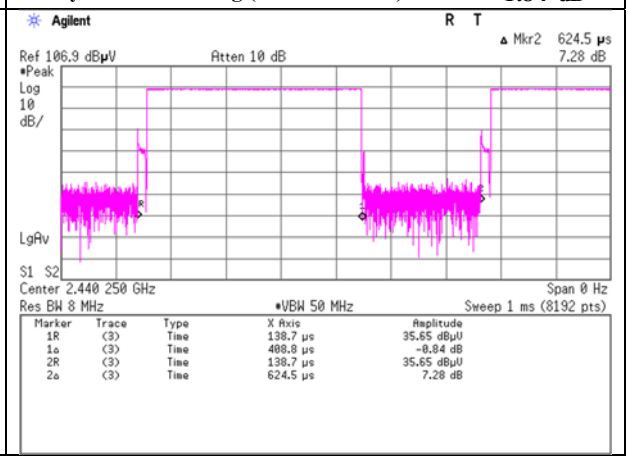
11n-20 MCS 7

Tx on / (Tx on + Tx off) =	0.638
Tx on / (Tx on + Tx off) * 100 =	63.8 %
Duty factor = 10 * log (0.2695 / 0.172) =	1.95 dB



BT LE

Tx on / (Tx on + Tx off) =	0.655
Tx on / (Tx on + Tx off) * 100 =	65.5 %
Duty factor = 10 * log (0.6245 / 0.4088) =	1.84 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.	12804674H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.3	No.3
Date	August 4, 2019	August 6, 2019
Temperature / Humidity	23 deg. C / 65 % RH	22 deg. C / 66 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)	Junki Nagatomi (Above 10 GHz)
Mode	Tx 11b 2412 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.	2386.943	PK	59.6	27.3	5.5	36.7	-	55.9	73.9	18.1	
Hori.	2390.000	PK	61.7	27.3	5.5	36.7	-	57.9	73.9	16.0	
Hori.	4824.000	PK	44.2	31.7	7.7	36.2	-	47.4	73.9	26.5	Floor noise
Hori.	7236.000	PK	44.4	36.1	8.9	36.3	-	53.1	73.9	20.8	Floor noise
Hori.	9648.000	PK	45.2	38.6	9.4	36.8	-	56.4	73.9	17.5	Floor noise
Hori.	2386.943	AV	51.2	27.3	5.5	36.7	0.4	47.9	53.9	6.0	
Hori.	2390.000	AV	52.1	27.3	5.5	36.7	0.4	48.7	53.9	5.2	*1)
Hori.	4824.000	AV	35.3	31.7	7.7	36.2	-	38.5	53.9	15.4	Floor noise
Hori.	7236.000	AV	35.9	36.1	8.9	36.3	-	44.7	53.9	9.3	Floor noise
Hori.	9648.000	AV	36.6	38.6	9.4	36.8	-	47.9	53.9	6.0	Floor noise
Vert.	2386.943	PK	59.1	27.3	5.5	36.7	-	55.3	73.9	18.6	
Vert.	2390.000	PK	61.2	27.3	5.5	36.7	-	57.4	73.9	16.5	
Vert.	4824.000	PK	43.8	31.7	7.7	36.2	-	47.0	73.9	26.9	Floor noise
Vert.	7236.000	PK	44.0	36.1	8.9	36.3	-	52.7	73.9	21.2	Floor noise
Vert.	9648.000	PK	45.6	38.6	9.4	36.8	-	56.8	73.9	17.1	Floor noise
Vert.	2386.943	AV	50.9	27.3	5.5	36.7	0.4	47.6	53.9	6.3	
Vert.	2390.000	AV	52.1	27.3	5.5	36.7	0.4	48.7	53.9	5.2	*1)
Vert.	4824.000	AV	35.3	31.7	7.7	36.2	-	38.5	53.9	15.4	Floor noise
Vert.	7236.000	AV	35.9	36.1	8.9	36.3	-	44.7	53.9	9.3	Floor noise
Vert.	9648.000	AV	36.6	38.6	9.4	36.8	-	47.9	53.9	6.0	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 (4 m / 3.0 m) = 2.5 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB
*1) Not Out of Band emission(Leakage Power)

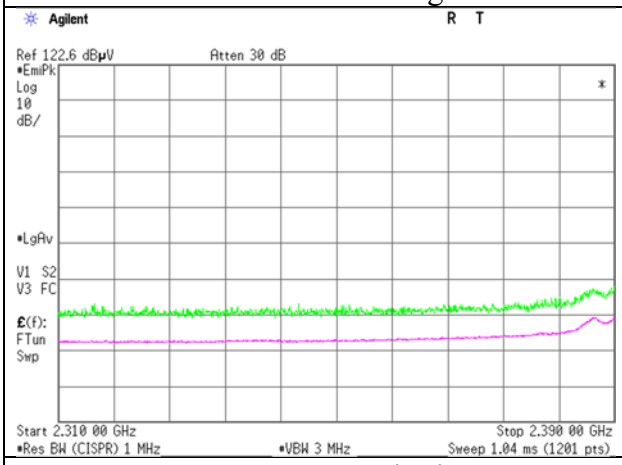
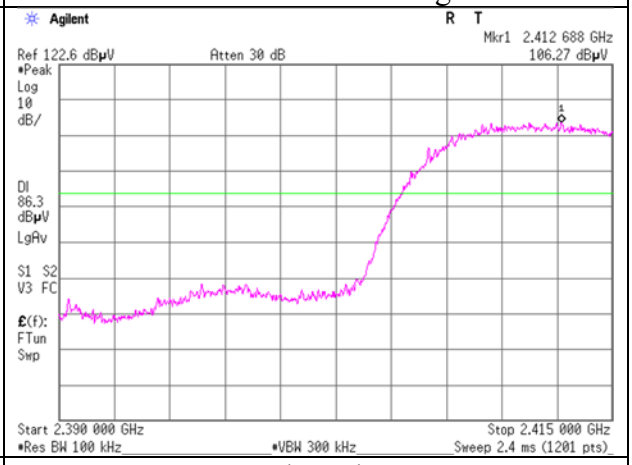
20dBc Data Sheet

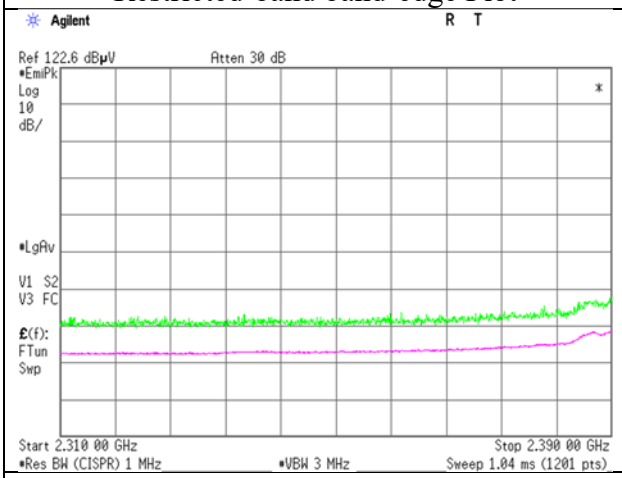
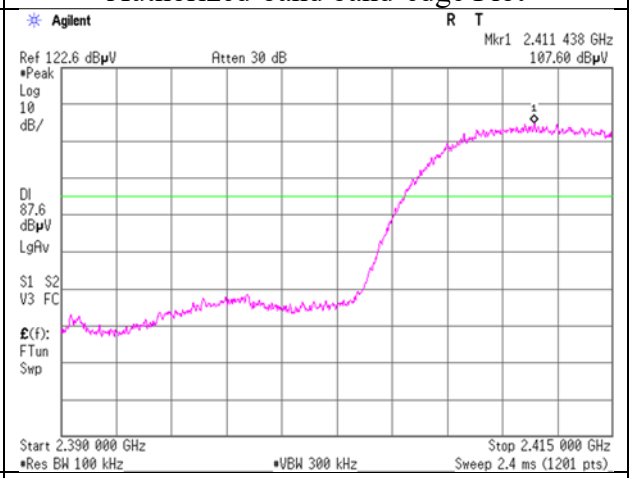
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2412.000	PK	106.3	27.4	5.6	36.7	102.5	-	-	Carrier
Hori.	2400.000	PK	56.5	27.2	5.6	36.7	52.6	82.5	30.0	
Hori.	2397.467	PK	61.6	27.2	5.6	36.7	57.7	82.5	24.9	
Vert.	2412.000	PK	107.6	27.4	5.6	36.7	103.9	-	-	Carrier
Vert.	2400.000	PK	57.9	27.2	5.6	36.7	53.9	83.9	30.0	
Vert.	2397.467	PK	60.7	27.2	5.6	36.7	56.8	83.9	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.	12804674H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	August 4, 2019
Temperature / Humidity	23 deg. C / 65 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)
Mode	Tx 11b 2412 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.	12804674H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.3	No.3
Date	August 4, 2019	August 6, 2019
Temperature / Humidity	23 deg. C / 65 % RH	22 deg. C / 66 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)	Junki Nagatomi (Above 10 GHz)
Mode	Tx 11b 2437 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.	4874.000	PK	43.1	31.7	7.7	36.2	-	46.3	73.9	27.6	Floor noise
Hori.	7311.000	PK	44.3	35.9	8.9	36.3	-	52.8	73.9	21.1	Floor noise
Hori.	9748.000	PK	45.0	38.7	9.4	36.9	-	56.3	73.9	17.6	Floor noise
Hori.	4874.000	AV	35.0	31.7	7.7	36.2	-	38.3	53.9	15.6	Floor noise
Hori.	7311.000	AV	35.3	35.9	8.9	36.3	-	43.8	53.9	10.1	Floor noise
Hori.	9748.000	AV	36.1	38.7	9.4	36.9	-	47.4	53.9	6.5	Floor noise
Vert.	4874.000	PK	43.6	31.7	7.7	36.2	-	46.8	73.9	27.1	Floor noise
Vert.	7311.000	PK	44.0	35.9	8.9	36.3	-	52.6	73.9	21.3	Floor noise
Vert.	9748.000	PK	44.3	38.7	9.4	36.9	-	55.6	73.9	18.3	Floor noise
Vert.	4874.000	AV	35.0	31.7	7.7	36.2	-	38.3	53.9	15.6	Floor noise
Vert.	7311.000	AV	35.3	35.9	8.9	36.3	-	43.8	53.9	10.1	Floor noise
Vert.	9748.000	AV	36.1	38.7	9.4	36.9	-	47.4	53.9	6.5	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 (4 m / 3.0 m) = 2.5 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission

Report No.	12804674H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.3	No.3
Date	August 4, 2019	August 6, 2019
Temperature / Humidity	23 deg. C / 65 % RH	22 deg. C / 66 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)	Junki Nagatomi (Above 10 GHz)
Mode	Tx 11b 2462 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.	2483.500	PK	51.6	27.9	5.6	36.7	-	48.4	73.9	25.5	
Hori.	4924.000	PK	43.5	31.9	7.7	36.2	-	46.9	73.9	27.0	Floor noise
Hori.	7386.000	PK	44.4	36.3	8.9	36.3	-	53.4	73.9	20.5	Floor noise
Hori.	9848.000	PK	44.1	38.8	9.4	36.9	-	55.4	73.9	18.5	Floor noise
Hori.	2483.500	AV	44.1	27.9	5.6	36.7	0.4	41.3	53.9	12.6	*1)
Hori.	4924.000	AV	35.2	31.9	7.7	36.2	-	38.6	53.9	15.3	Floor noise
Hori.	7386.000	AV	35.3	36.3	8.9	36.3	-	44.3	53.9	9.6	Floor noise
Hori.	9848.000	AV	35.5	38.8	9.4	36.9	-	46.8	53.9	7.1	Floor noise
Vert.	2483.500	PK	55.6	27.9	5.6	36.7	-	52.4	73.9	21.5	
Vert.	4924.000	PK	43.7	31.9	7.7	36.2	-	47.1	73.9	26.8	Floor noise
Vert.	7386.000	PK	43.9	36.3	8.9	36.3	-	52.8	73.9	21.1	Floor noise
Vert.	9848.000	PK	43.7	38.8	9.4	36.9	-	55.0	73.9	18.9	Floor noise
Vert.	2483.500	AV	46.9	27.9	5.6	36.7	0.4	44.1	53.9	9.8	*1)
Vert.	4924.000	AV	35.2	31.9	7.7	36.2	-	38.6	53.9	15.3	Floor noise
Vert.	7386.000	AV	35.3	36.3	8.9	36.3	-	44.3	53.9	9.6	Floor noise
Vert.	9848.000	AV	35.5	38.8	9.4	36.9	-	46.8	53.9	7.1	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 (4 m / 3.0 m) = 2.5 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

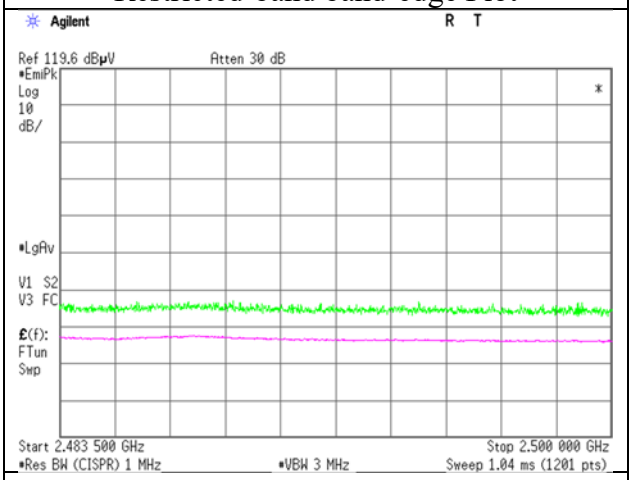
*1) Not Out of Band emission(Leakage Power)

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	12804674H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	August 4, 2019
Temperature / Humidity	23 deg. C / 65 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)
Mode	Tx 11b 2462 MHz

Horizontal

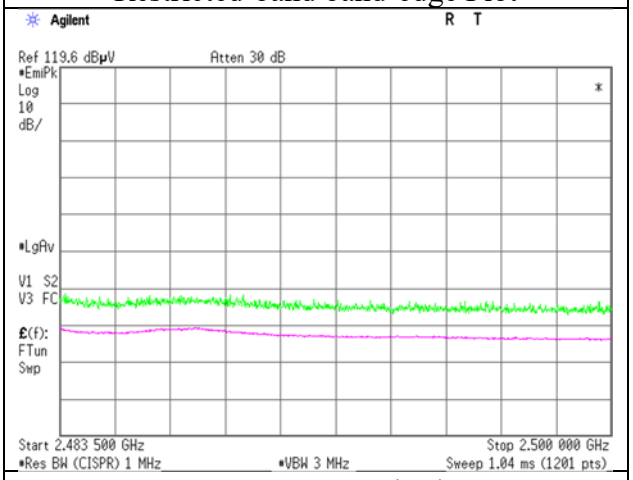
Restricted-band band-edge Plot



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

Report No.	12804674H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.3	No.3
Date	August 4, 2019	August 6, 2019
Temperature / Humidity	23 deg. C / 65 % RH	22 deg. C / 66 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)	Junki Nagatomi (Above 10 GHz)
Mode	Tx 11g 2412 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.	2390.000	PK	58.7	27.3	5.5	36.7	-	54.9	73.9	19.1	
Hori.	4824.000	PK	43.4	31.7	7.7	36.2	-	46.6	73.9	27.4	Floor noise
Hori.	7236.000	PK	44.7	36.1	8.9	36.3	-	53.5	73.9	20.4	Floor noise
Hori.	9648.000	PK	45.3	38.6	9.4	36.8	-	56.6	73.9	17.3	Floor noise
Hori.	2390.000	AV	49.5	27.3	5.5	36.7	1.7	47.4	53.9	6.5	*1)
Hori.	4824.000	AV	34.9	31.7	7.7	36.2	-	38.1	53.9	15.8	Floor noise
Hori.	7236.000	AV	35.2	36.1	8.9	36.3	-	43.9	53.9	10.0	Floor noise
Hori.	9648.000	AV	36.3	38.6	9.4	36.8	-	47.5	53.9	6.4	Floor noise
Vert.	2390.000	PK	61.6	27.3	5.5	36.7	-	57.8	73.9	16.1	
Vert.	4824.000	PK	44.3	31.7	7.7	36.2	-	47.5	73.9	26.4	Floor noise
Vert.	7236.000	PK	43.5	36.1	8.9	36.3	-	52.3	73.9	21.7	Floor noise
Vert.	9648.000	PK	44.8	38.6	9.4	36.8	-	56.1	73.9	17.8	Floor noise
Vert.	2390.000	AV	52.7	27.3	5.5	36.7	1.7	50.7	53.9	3.2	*1)
Vert.	4824.000	AV	34.9	31.7	7.7	36.2	-	38.1	53.9	15.8	Floor noise
Vert.	7236.000	AV	35.2	36.1	8.9	36.3	-	43.9	53.9	10.0	Floor noise
Vert.	9648.000	AV	36.3	38.6	9.4	36.8	-	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 (4 m / 3.0 m) = 2.5 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

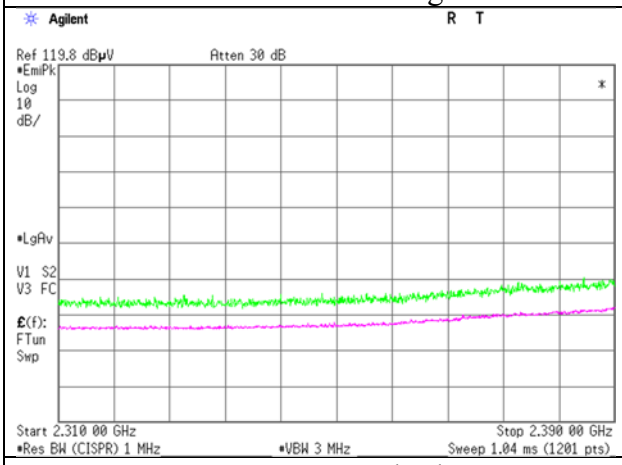
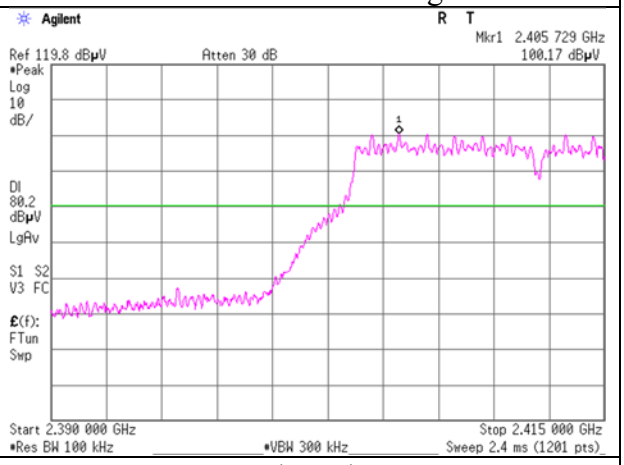
20dBc Data Sheet

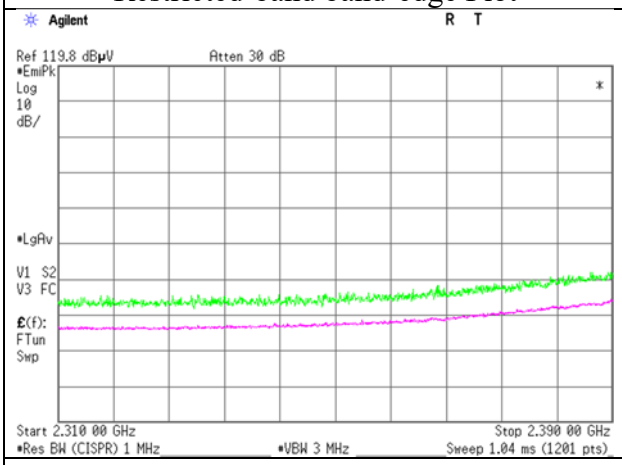
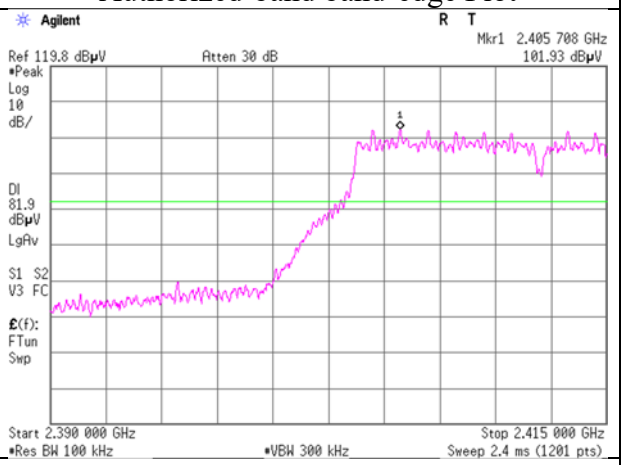
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2412.000	PK	100.2	27.4	5.6	36.7	96.4	-	-	Carrier
Hori.	2400.000	PK	56.9	27.2	5.6	36.7	53.0	76.4	23.5	
Vert.	2412.000	PK	101.9	27.4	5.6	36.7	98.2	-	-	Carrier
Vert.	2400.000	PK	59.1	27.2	5.6	36.7	55.2	78.2	23.0	

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.	12804674H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	August 4, 2019
Temperature / Humidity	23 deg. C / 65 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)
Mode	Tx 11g 2412 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.	12804674H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.3	No.3	No.3
Date	August 5, 2019	August 6, 2019	August 7, 2019
Temperature / Humidity	22 deg. C / 58 % RH	22 deg. C / 66 % RH	25 deg. C / 63 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)	Junki Nagatomi (Above 10 GHz)	Akihiko Maeda (Below 1 GHz)
Mode	Tx 11g 2437 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.	54.715	QP	47.1	9.2	7.5	32.2	-	31.5	40.0	8.5	
Hori.	157.455	QP	36.1	15.3	8.7	32.1	-	28.1	43.5	15.4	
Hori.	168.984	QP	35.5	16.0	8.8	32.1	-	28.3	43.5	15.2	
Hori.	231.083	QP	42.6	11.4	9.4	32.0	-	31.4	46.0	14.7	
Hori.	344.076	QP	41.1	14.9	10.3	31.9	-	34.4	46.0	11.6	
Hori.	849.936	QP	25.6	21.6	13.3	31.2	-	29.3	46.0	16.7	
Hori.	4874.000	PK	43.8	31.7	7.7	36.2	-	47.0	73.9	26.9	Floor noise
Hori.	7311.000	PK	43.8	35.9	8.9	36.3	-	52.3	73.9	21.6	Floor noise
Hori.	9748.000	PK	44.2	38.7	9.4	36.9	-	55.5	73.9	18.4	Floor noise
Hori.	4874.000	AV	34.8	31.7	7.7	36.2	-	38.1	53.9	15.8	Floor noise
Hori.	7311.000	AV	35.0	35.9	8.9	36.3	-	43.6	53.9	10.3	Floor noise
Hori.	9748.000	AV	35.8	38.7	9.4	36.9	-	47.1	53.9	6.8	Floor noise
Vert.	54.733	QP	47.5	9.2	7.5	32.2	-	31.9	40.0	8.1	
Vert.	159.514	QP	32.4	15.5	8.7	32.1	-	24.5	43.5	19.0	
Vert.	167.942	QP	36.6	15.9	8.8	32.1	-	29.2	43.5	14.3	
Vert.	229.485	QP	38.8	11.3	9.4	32.0	-	27.5	46.0	18.5	
Vert.	344.067	QP	32.8	14.9	10.3	31.9	-	26.1	46.0	19.9	
Vert.	849.936	QP	32.9	21.6	13.3	31.2	-	36.6	46.0	9.4	
Vert.	4874.000	PK	42.9	31.7	7.7	36.2	-	46.1	73.9	27.8	Floor noise
Vert.	7311.000	PK	43.1	35.9	8.9	36.3	-	51.6	73.9	22.3	Floor noise
Vert.	9748.000	PK	44.4	38.7	9.4	36.9	-	55.7	73.9	18.2	Floor noise
Vert.	4874.000	AV	34.8	31.7	7.7	36.2	-	38.1	53.9	15.8	Floor noise
Vert.	7311.000	AV	35.0	35.9	8.9	36.3	-	43.6	53.9	10.3	Floor noise
Vert.	9748.000	AV	35.8	38.7	9.4	36.9	-	47.1	53.9	6.8	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 (4 m / 3.0 m) = 2.5 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission

Report No.	12804674H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.3	No.3
Date	August 5, 2019	August 6, 2019
Temperature / Humidity	22 deg. C / 58 % RH	22 deg. C / 66 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)	Junki Nagatomi (Above 10 GHz)
Mode	Tx 11g 2462 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.	2483.500	PK	54.7	27.9	5.6	36.7	-	51.4	73.9	22.5	
Hori.	4924.000	PK	43.8	31.9	7.7	36.2	-	47.2	73.9	26.7	Floor noise
Hori.	7386.000	PK	44.5	36.3	8.9	36.3	-	53.4	73.9	20.5	Floor noise
Hori.	9848.000	PK	43.5	38.8	9.4	36.9	-	54.9	73.9	19.0	Floor noise
Hori.	2483.500	AV	44.6	27.9	5.6	36.7	1.7	43.1	53.9	10.8	*1)
Hori.	4924.000	AV	35.3	31.9	7.7	36.2	-	38.7	53.9	15.2	Floor noise
Hori.	7386.000	AV	35.0	36.3	8.9	36.3	-	43.9	53.9	10.0	Floor noise
Hori.	9848.000	AV	35.4	38.8	9.4	36.9	-	46.7	53.9	7.2	Floor noise
Vert.	2483.500	PK	57.1	27.9	5.6	36.7	-	53.9	73.9	20.0	
Vert.	4924.000	PK	47.3	31.9	7.7	36.2	-	50.7	73.9	23.2	Floor noise
Vert.	7386.000	PK	43.7	36.3	8.9	36.3	-	52.6	73.9	21.3	Floor noise
Vert.	9848.000	PK	43.7	38.8	9.4	36.9	-	55.1	73.9	18.8	Floor noise
Vert.	2483.500	AV	47.4	27.9	5.6	36.7	1.7	45.9	53.9	8.0	*1)
Vert.	4924.000	AV	35.3	31.9	7.7	36.2	-	38.7	53.9	15.2	Floor noise
Vert.	7386.000	AV	35.0	36.3	8.9	36.3	-	43.9	53.9	10.0	Floor noise
Vert.	9848.000	AV	35.4	38.8	9.4	36.9	-	46.7	53.9	7.2	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).

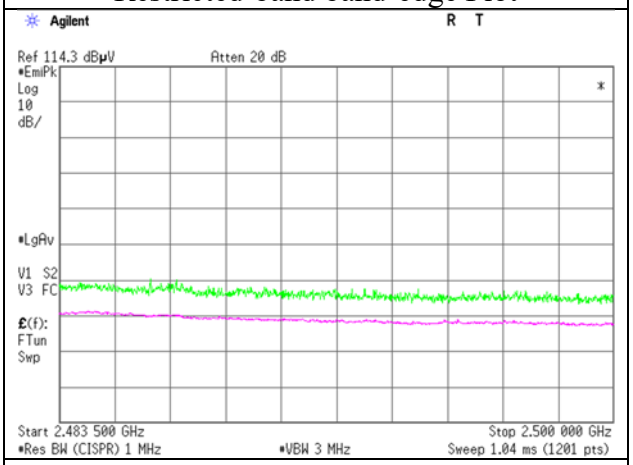
Distance factor: 1 GHz - 10 GHz 20log (4 m / 3.0 m) = 2.5 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	12804674H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	August 5, 2019
Temperature / Humidity	22 deg. C / 58 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)
Mode	Tx 11g 2462 MHz

Horizontal

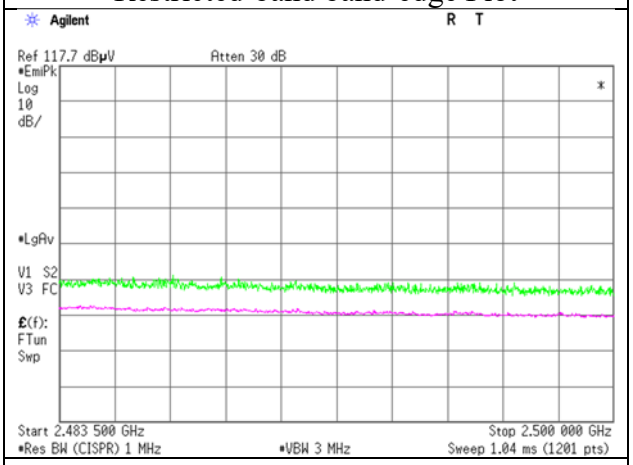
Restricted-band band-edge Plot



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

Report No.	12804674H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	August 4, 2019
Temperature / Humidity	23 deg. C / 65 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)
Mode	Tx 11n-20 2412 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.	2390.000	PK	61.3	27.3	5.5	36.7	-	57.5	73.9	16.4	
Hori.	2390.000	AV	49.8	27.3	5.5	36.7	2.0	47.9	53.9	6.0	*1)
Vert.	2390.000	PK	63.4	27.3	5.5	36.7	-	59.6	73.9	14.3	
Vert.	2390.000	AV	52.3	27.3	5.5	36.7	2.0	50.4	53.9	3.5	*1)

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 (4 m / 3.0 m) = 2.5 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB
*1) Not Out of Band emission(Leakage Power)

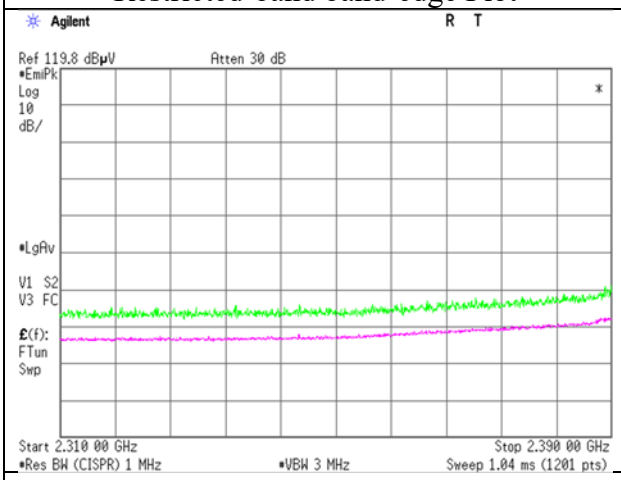
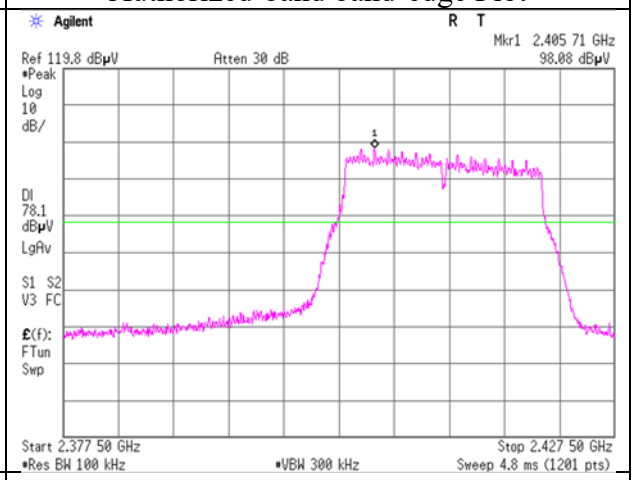
20dBc Data Sheet

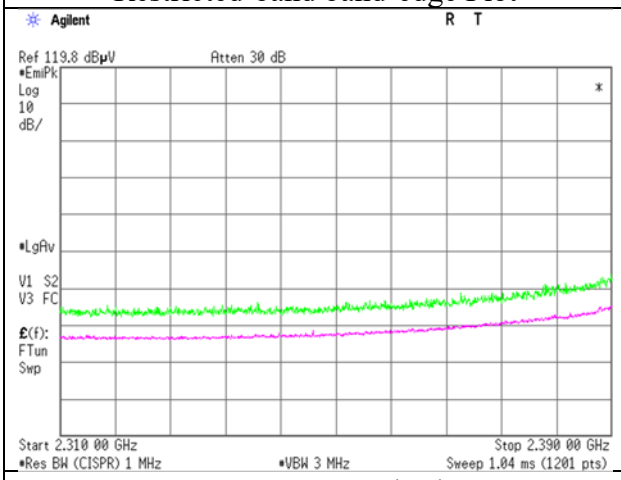
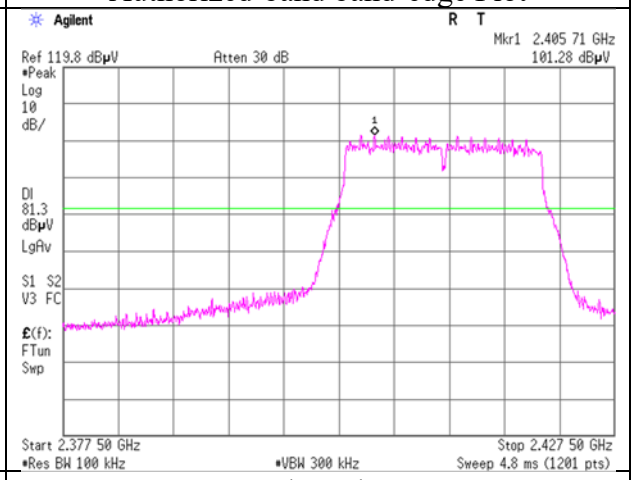
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2412.000	PK	98.1	27.4	5.6	36.7	94.4	-	-	Carrier
Hori.	2400.000	PK	57.5	27.2	5.6	36.7	53.6	74.4	20.8	
Vert.	2412.000	PK	101.3	27.4	5.6	36.7	97.6	-	-	Carrier
Vert.	2400.000	PK	59.2	27.2	5.6	36.7	55.2	77.6	22.3	

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.	12804674H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	August 4, 2019
Temperature / Humidity	23 deg. C / 65 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)
Mode	Tx 11n-20 2412 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.	12804674H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	August 5, 2019
Temperature / Humidity	22 deg. C / 58 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)
Mode	Tx 11n-20 2462 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.	2483.500	PK	56.0	27.9	5.6	36.7	-	52.7	73.9	21.2	
Hori.	2483.500	AV	45.5	27.9	5.6	36.7	2.0	44.3	53.9	9.6	*1)
Vert.	2483.500	PK	56.7	27.9	5.6	36.7	-	53.5	73.9	20.4	
Vert.	2483.500	AV	45.5	27.9	5.6	36.7	2.0	44.2	53.9	9.7	*1)

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).

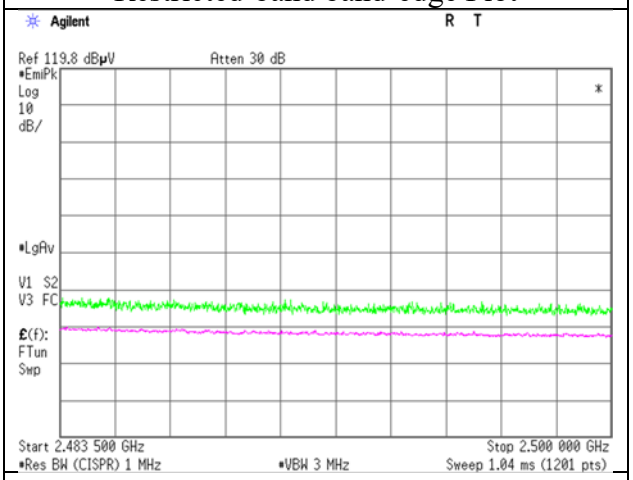
Distance factor: 1 GHz - 10 GHz 20log (4 m / 3.0 m) = 2.5 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	12804674H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	August 5, 2019
Temperature / Humidity	22 deg. C / 58 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)
Mode	Tx 11g 2462 MHz

Horizontal

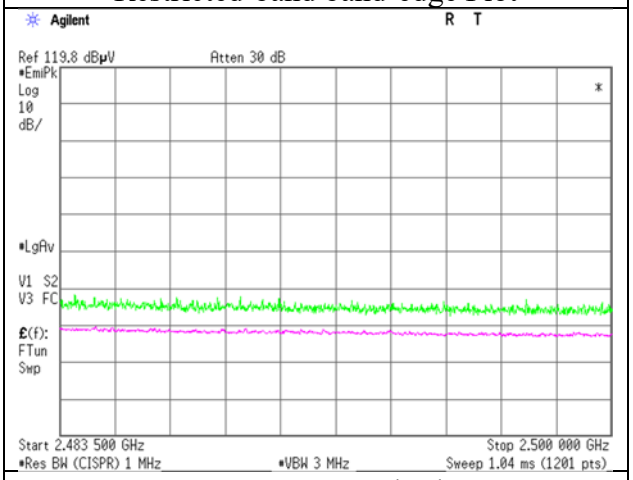
Restricted-band band-edge Plot



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

Report No.	12804674H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.3	No.3	No.3
Date	August 4, 2019	August 6, 2019	August 7, 2019
Temperature / Humidity	23 deg. C / 65 % RH	22 deg. C / 66 % RH	25 deg. C / 63 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)	Junki Nagatomi (Above 10 GHz)	Akihiko Maeda (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.	54.711	QP	46.8	9.2	7.5	32.2	-	31.2	40.0	8.8	
Hori.	156.731	QP	37.9	15.4	8.7	32.1	-	29.9	43.5	13.6	
Hori.	163.846	QP	32.4	15.7	8.8	32.1	-	24.8	43.5	18.7	
Hori.	231.291	QP	42.4	11.4	9.4	32.0	-	31.2	46.0	14.9	
Hori.	344.023	QP	41.2	14.9	10.3	31.9	-	34.5	46.0	11.5	
Hori.	849.943	QP	26.1	21.6	13.3	31.2	-	29.8	46.0	16.2	
Hori.	2390.000	PK	46.1	27.3	5.5	36.7	-	42.3	73.9	31.6	
Hori.	4804.000	PK	43.9	31.7	7.7	36.2	-	47.1	73.9	26.8	Floor noise
Hori.	7206.000	PK	45.0	36.3	8.9	36.3	-	54.0	73.9	19.9	Floor noise
Hori.	9608.000	PK	45.0	38.5	9.4	36.8	-	56.2	73.9	17.7	Floor noise
Hori.	2390.000	AV	36.5	27.3	5.5	36.7	1.8	34.6	53.9	19.3	*1)
Hori.	4804.000	AV	34.9	31.7	7.7	36.2	-	38.2	53.9	15.7	Floor noise
Hori.	7206.000	AV	35.4	36.3	8.9	36.3	-	44.4	53.9	9.5	Floor noise
Hori.	9608.000	AV	36.5	38.5	9.4	36.8	-	47.6	53.9	6.3	Floor noise
Vert.	54.724	QP	47.4	9.2	7.5	32.2	-	31.8	40.0	8.2	
Vert.	157.596	QP	34.4	15.3	8.7	32.1	-	26.4	43.5	17.2	
Vert.	163.856	QP	34.0	15.7	8.8	32.1	-	26.4	43.5	17.1	
Vert.	229.533	QP	38.8	11.3	9.4	32.0	-	27.5	46.0	18.5	
Vert.	344.041	QP	33.1	14.9	10.3	31.9	-	26.4	46.0	19.6	
Vert.	849.930	QP	33.0	21.6	13.3	31.2	-	36.7	46.0	9.3	
Vert.	2390.000	PK	44.9	27.3	5.5	36.7	-	41.1	73.9	32.8	
Vert.	4804.000	PK	43.5	31.7	7.7	36.2	-	46.8	73.9	27.2	Floor noise
Vert.	7206.000	PK	44.2	36.3	8.9	36.3	-	53.2	73.9	20.8	Floor noise
Vert.	9608.000	PK	45.8	38.5	9.4	36.8	-	56.9	73.9	17.0	Floor noise
Vert.	2390.000	AV	36.3	27.3	5.5	36.7	1.8	34.4	53.9	19.5	*1)
Vert.	4804.000	AV	34.9	31.7	7.7	36.2	-	38.2	53.9	15.7	Floor noise
Vert.	7206.000	AV	35.4	36.3	8.9	36.3	-	44.4	53.9	9.5	Floor noise
Vert.	9608.000	AV	36.5	38.5	9.4	36.8	-	47.6	53.9	6.3	Floor noise

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

Distance factor: 1 GHz - 10 GHz 20log (4 m / 3.0 m) = 2.5 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB
*1) Not Out of Band emission(Leakage Power)

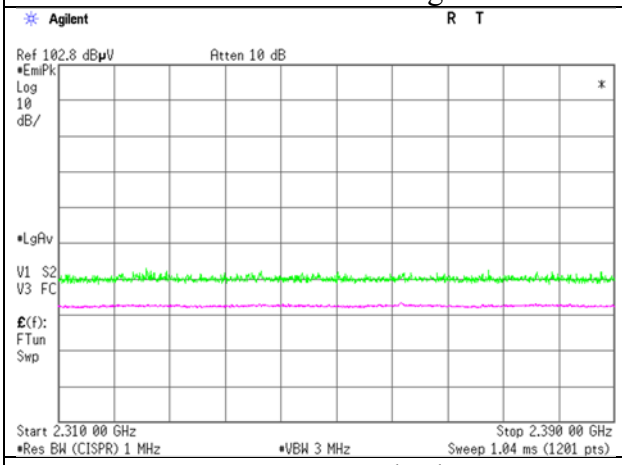
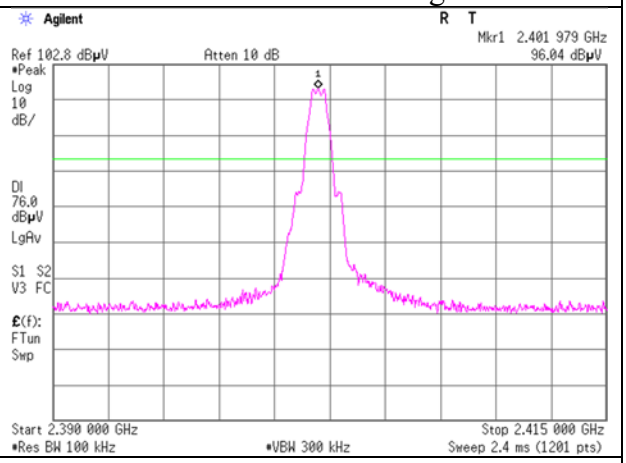
20dBc Data Sheet

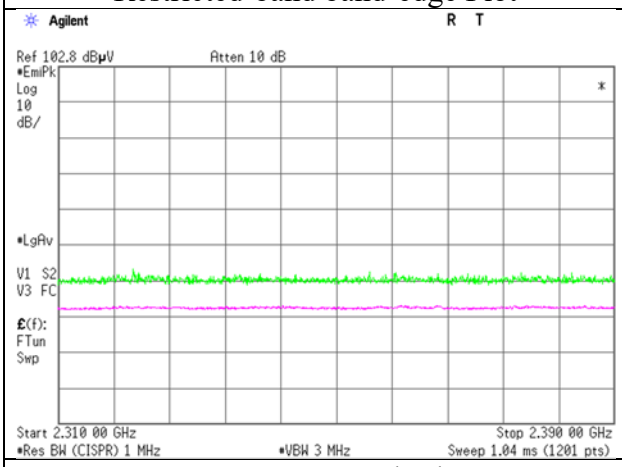
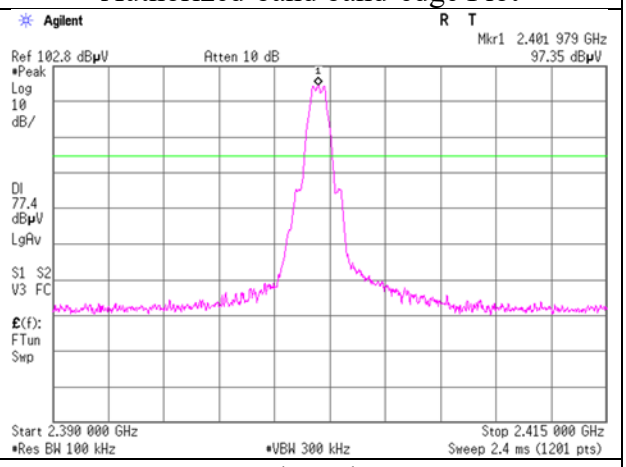
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	96.0	27.2	5.6	36.7	92.1	-	-	Carrier
Hori.	2400.000	PK	41.9	27.2	5.6	36.7	38.0	72.1	34.1	
Vert.	2402.000	PK	97.4	27.2	5.6	36.7	93.4	-	-	Carrier
Vert.	2400.000	PK	42.2	27.2	5.6	36.7	38.2	73.4	35.2	

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.	12804674H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	August 4, 2019
Temperature / Humidity	23 deg. C / 65 % RH
Engineer	Junki Nagatomi (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.	12804674H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.3	No.3	No.3
Date	August 4, 2019	August 6, 2019	August 7, 2019
Temperature / Humidity	23 deg. C / 65 % RH	22 deg. C / 66 % RH	25 deg. C / 63 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)	Junki Nagatomi (Above 10 GHz)	Akihiko Maeda (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.	54.712	QP	46.7	9.2	7.5	32.2	-	31.1	40.0	8.9	
Hori.	156.740	QP	37.4	15.4	8.7	32.1	-	29.4	43.5	14.1	
Hori.	164.011	QP	32.5	15.8	8.8	32.1	-	25.0	43.5	18.6	
Hori.	231.314	QP	42.1	11.4	9.4	32.0	-	30.9	46.0	15.2	
Hori.	344.013	QP	41.5	14.9	10.3	31.9	-	34.8	46.0	11.2	
Hori.	849.921	QP	26.4	21.6	13.3	31.2	-	30.1	46.0	15.9	
Hori.	4880.000	PK	42.6	31.7	7.7	36.2	-	45.9	73.9	28.0	Floor noise
Hori.	7320.000	PK	42.9	36.0	8.9	36.3	-	51.6	73.9	22.4	Floor noise
Hori.	9760.000	PK	44.9	38.8	9.4	36.9	-	56.2	73.9	17.7	Floor noise
Hori.	4880.000	AV	34.6	31.7	7.7	36.2	-	37.8	53.9	16.1	Floor noise
Hori.	7320.000	AV	35.2	36.0	8.9	36.3	-	43.9	53.9	10.1	Floor noise
Hori.	9760.000	AV	35.6	38.8	9.4	36.9	-	47.0	53.9	7.0	Floor noise
Vert.	54.801	QP	47.3	9.1	7.5	32.2	-	31.7	40.0	8.3	
Vert.	157.543	QP	35.0	15.3	8.7	32.1	-	27.0	43.5	16.6	
Vert.	164.003	QP	33.8	15.8	8.8	32.1	-	26.3	43.5	17.3	
Vert.	229.621	QP	38.9	11.3	9.4	32.0	-	27.6	46.0	18.4	
Vert.	344.025	QP	33.4	14.9	10.3	31.9	-	26.7	46.0	19.3	
Vert.	849.913	QP	32.8	21.6	13.3	31.2	-	36.5	46.0	9.5	
Vert.	4880.000	PK	43.3	31.7	7.7	36.2	-	46.5	73.9	27.4	Floor noise
Vert.	7320.000	PK	43.8	36.0	8.9	36.3	-	52.4	73.9	21.5	Floor noise
Vert.	9760.000	PK	43.9	38.8	9.4	36.9	-	55.3	73.9	18.6	Floor noise
Vert.	4880.000	AV	34.6	31.7	7.7	36.2	-	37.8	53.9	16.1	Floor noise
Vert.	7320.000	AV	35.2	36.0	8.9	36.3	-	43.9	53.9	10.1	Floor noise
Vert.	9760.000	AV	35.6	38.8	9.4	36.9	-	47.0	53.9	7.0	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 (4 m / 3.0 m) = 2.5 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission

Report No.	12804674H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.3	No.3	No.3
Date	August 4, 2019	August 6, 2019	August 7, 2019
Temperature / Humidity	23 deg. C / 65 % RH	22 deg. C / 66 % RH	25 deg. C / 63 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)	Junki Nagatomi (Above 10 GHz)	Akihiko Maeda (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.	54.676	QP	46.8	9.2	7.5	32.2	-	31.3	40.0	8.8	
Hori.	156.941	QP	36.6	15.4	8.7	32.1	-	28.6	43.5	14.9	
Hori.	170.404	QP	38.5	15.8	8.8	32.1	-	31.0	43.5	12.5	
Hori.	230.537	QP	41.9	11.4	9.4	32.0	-	30.6	46.0	15.4	
Hori.	344.002	QP	42.0	14.9	10.3	31.9	-	35.3	46.0	10.7	
Hori.	900.269	QP	24.2	22.1	13.5	30.9	-	28.9	46.0	17.1	
Hori.	2483.500	PK	53.1	27.9	5.6	36.7	-	49.9	73.9	24.0	
Hori.	4960.000	PK	43.2	32.0	7.7	36.2	-	46.7	73.9	27.2	Floor noise
Hori.	7440.000	PK	43.2	36.4	8.9	36.3	-	52.3	73.9	21.6	Floor noise
Hori.	9920.000	PK	44.3	38.7	9.4	36.9	-	55.4	73.9	18.5	Floor noise
Hori.	2483.500	AV	39.0	27.9	5.6	36.7	1.8	37.6	53.9	16.3	*1)
Hori.	4960.000	AV	35.0	32.0	7.7	36.2	-	38.5	53.9	15.4	Floor noise
Hori.	7440.000	AV	34.8	36.4	8.9	36.3	-	43.9	53.9	10.0	Floor noise
Hori.	9920.000	AV	35.4	38.7	9.4	36.9	-	46.5	53.9	7.4	Floor noise
Vert.	54.723	QP	47.4	9.2	7.5	32.2	-	31.8	40.0	8.2	
Vert.	157.221	QP	34.2	15.4	8.7	32.1	-	26.2	43.5	17.3	
Vert.	170.204	QP	37.2	15.8	8.8	32.1	-	29.7	43.5	13.8	
Vert.	230.024	QP	38.9	11.4	9.4	32.0	-	27.6	46.0	18.4	
Vert.	344.054	QP	33.2	14.9	10.3	31.9	-	26.5	46.0	19.5	
Vert.	900.223	QP	30.0	22.1	13.5	30.9	-	34.7	46.0	11.3	
Vert.	2483.500	PK	55.0	27.9	5.6	36.7	-	51.8	73.9	22.2	
Vert.	4960.000	PK	43.3	32.0	7.7	36.2	-	46.8	73.9	27.1	Floor noise
Vert.	7440.000	PK	43.2	36.4	8.9	36.3	-	52.3	73.9	21.6	Floor noise
Vert.	9920.000	PK	44.3	38.7	9.4	36.9	-	55.4	73.9	18.5	Floor noise
Vert.	2483.500	AV	39.7	27.9	5.6	36.7	1.8	38.3	53.9	15.6	*1)
Vert.	4960.000	AV	35.0	32.0	7.7	36.2	-	38.5	53.9	15.4	Floor noise
Vert.	7440.000	AV	34.8	36.4	8.9	36.3	-	43.9	53.9	10.0	Floor noise
Vert.	9920.000	AV	35.4	38.7	9.4	36.9	-	46.5	53.9	7.4	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 (4 m / 3.0 m) = 2.5 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

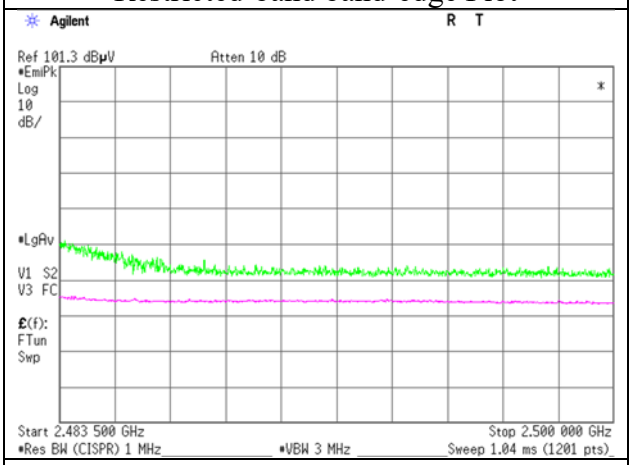
*1) Not Out of Band emission(Leakage Power)

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	12804674H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	August 4, 2019
Temperature / Humidity	23 deg. C / 65 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)
Mode	Tx BT LE 2480 MHz

Horizontal

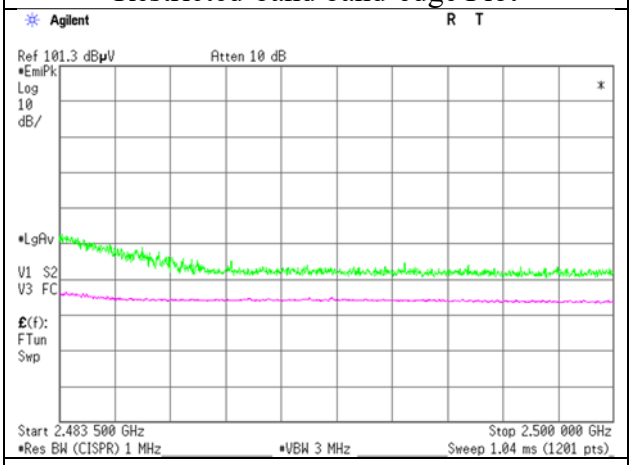
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot

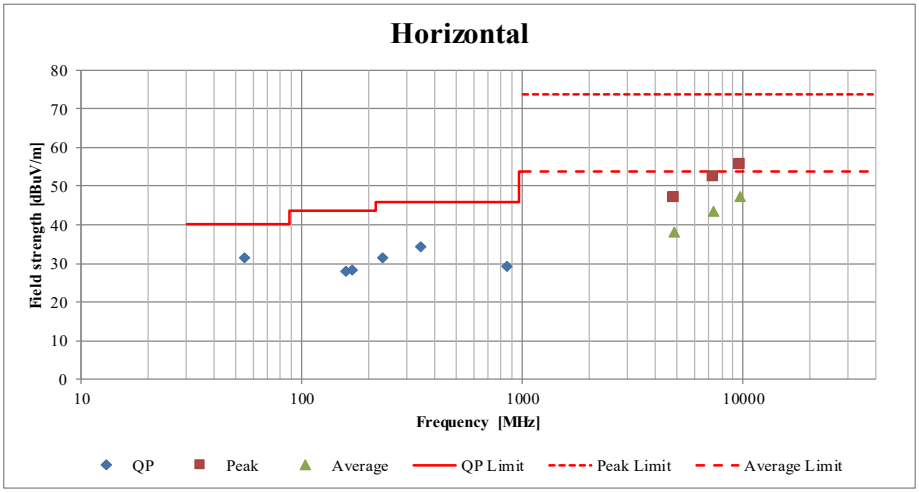


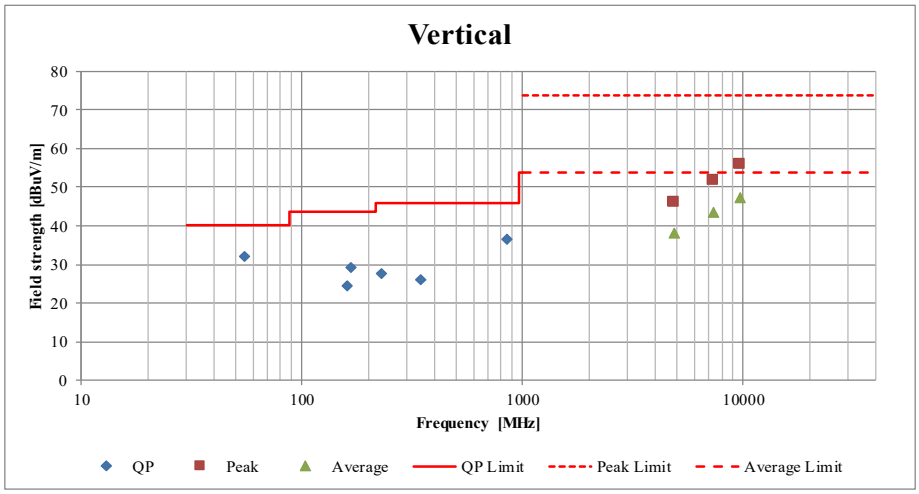
Trace Green : Peak Plot
Trace Purple : Average Plot

* 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)

Report No.	12804674H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.3	No.3	No.3
Date	August 5, 2019	August 6, 2019	August 7, 2019
Temperature / Humidity	22 deg. C / 58 % RH	22 deg. C / 66 % RH	25 deg. C / 63 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)	Junki Nagatomi (Above 10 GHz)	Akihiko Maeda (Below 1 GHz)
Mode	Tx 11g 2437 MHz		

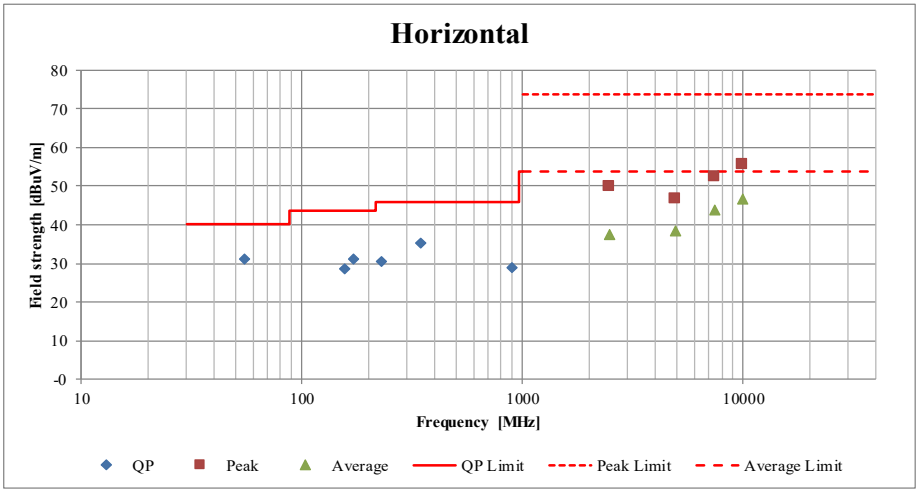


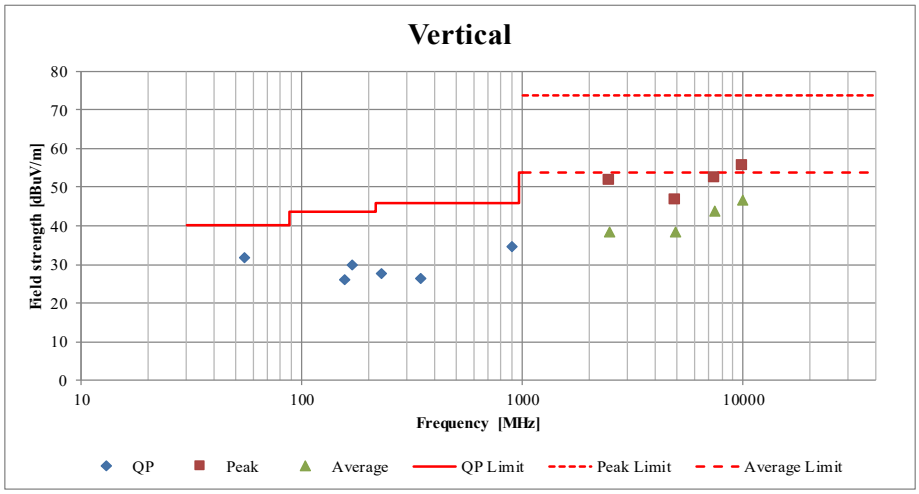


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

Radiated Spurious Emission
(Plot data, Worst case)

Report No.	12804674H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.3	No.3	No.3
Date	August 4, 2019	August 6, 2019	August 7, 2019
Temperature / Humidity	23 deg. C / 65 % RH	22 deg. C / 66 % RH	25 deg. C / 63 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)	Junki Nagatomi (Above 10 GHz)	Akihiko Maeda (Below 1 GHz)
Mode	Tx BT LE 2480 MHz		



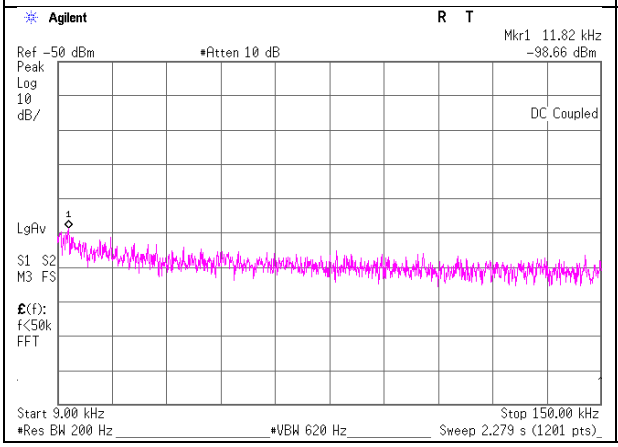


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

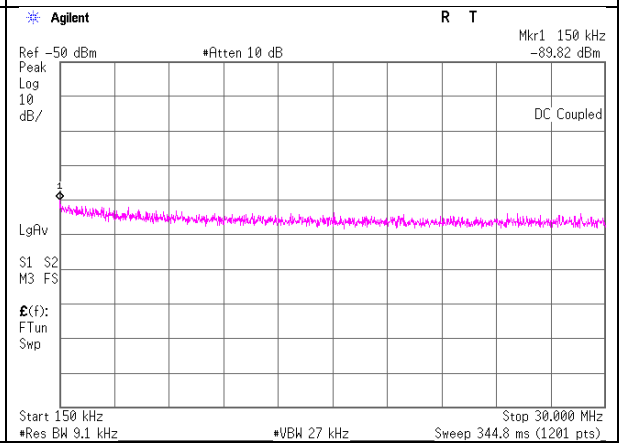
Conducted Spurious Emission

Report No.	12804674H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	August 9, 2019
Temperature / Humidity	24 deg. C / 68 % RH
Engineer	Junya Okuno
Mode	Tx 11g 2437 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
11.82	-98.7	3.91	19.98	2.0	1	-72.8	300	6.0	-11.5	46.1	57.6	
150.00	-89.8	3.91	19.98	2.0	1	-63.9	300	6.0	-2.7	24.0	26.7	

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)

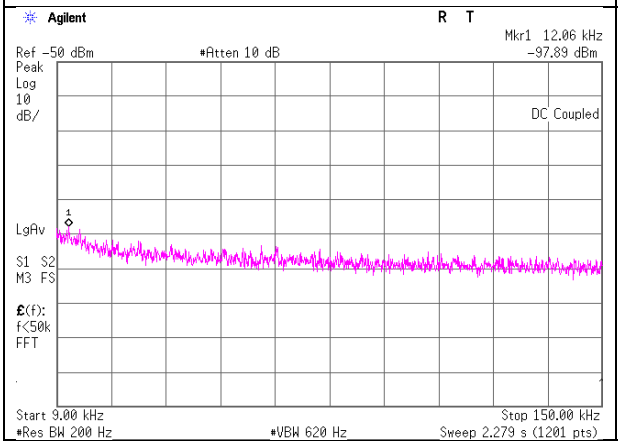
N: Number of output

*2.0 dBi was applied to the test result based on KDB 558074 since antenna gain was less than 2.0 dBi.

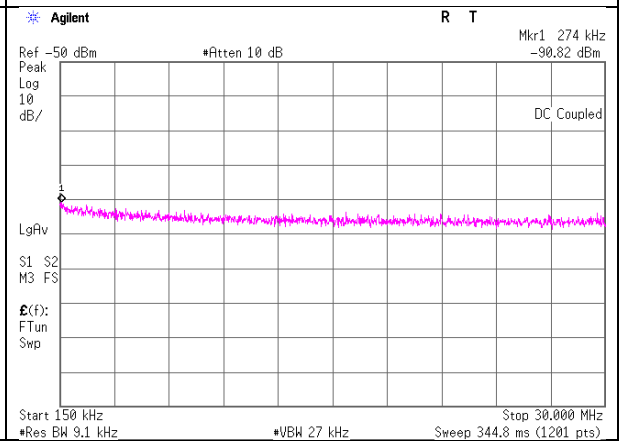
Conducted Spurious Emission

Report No.	12804674H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	August 9, 2019
Temperature / Humidity	24 deg. C / 68 % RH
Engineer	Junya Okuno
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
12.06	-97.9	3.90	19.97	2.0	1	-72.0	300	6.0	-10.8	45.9	56.7	
274.00	-90.8	3.90	19.97	2.0	1	-65.0	300	6.0	-3.7	18.8	22.5	

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)

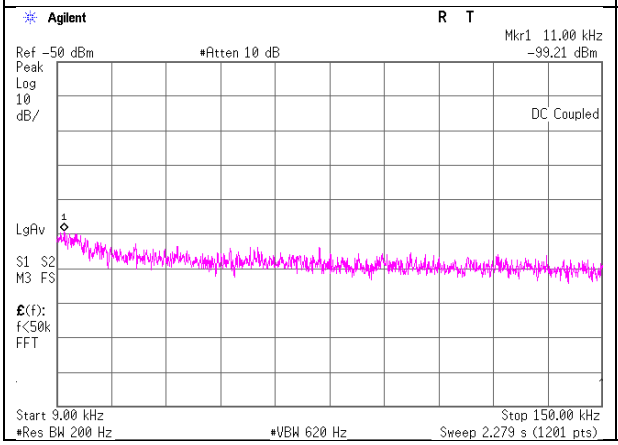
N: Number of output

*2.0 dBi was applied to the test result based on KDB 558074 since antenna gain was less than 2.0 dBi.

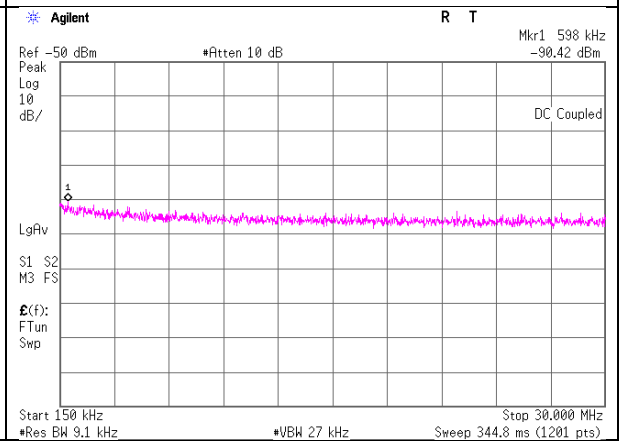
Conducted Spurious Emission

Report No.	12804674H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	August 9, 2019
Temperature / Humidity	24 deg. C / 68 % RH
Engineer	Junya Okuno
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
11.00	-99.2	3.91	19.98	2.0	1	-73.3	300	6.0	-12.1	46.7	58.8	
598.00	-90.4	3.91	19.98	2.0	1	-64.5	30	6.0	16.7	32.0	15.3	

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

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

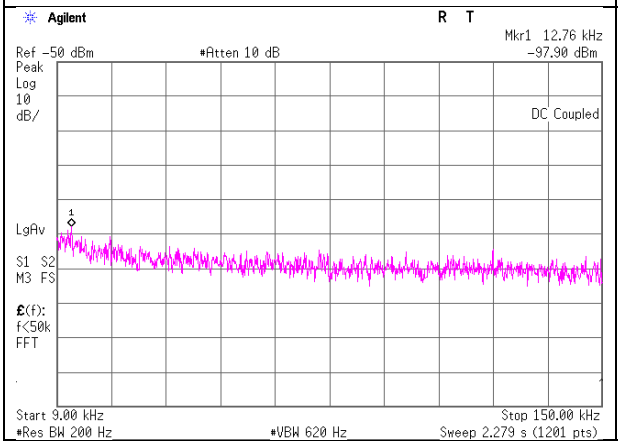
N: Number of output

*2.0 dBi was applied to the test result based on KDB 558074 since antenna gain was less than 2.0 dBi.

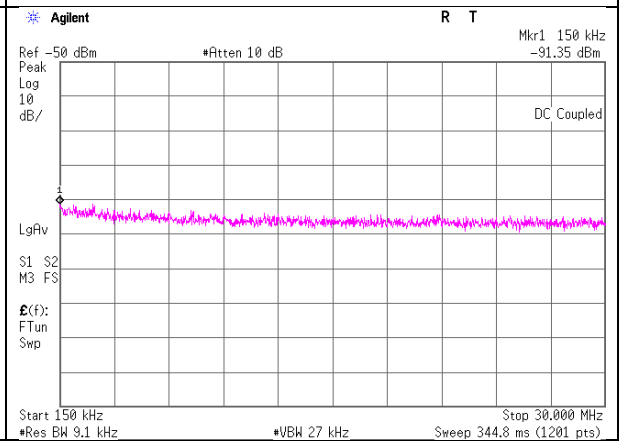
Conducted Spurious Emission

Report No.	12804674H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	August 9, 2019
Temperature / Humidity	24 deg. C / 68 % RH
Engineer	Junya Okuno
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
12.76	-97.9	3.91	19.98	2.0	1	-72.0	300	6.0	-10.8	45.4	56.2	
150.00	-91.4	3.91	19.98	2.0	1	-65.5	300	6.0	-4.2	24.0	28.2	

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

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

N: Number of output

*2.0 dBi was applied to the test result based on KDB 558074 since antenna gain was less than 2.0 dBi.

Power Density

Report No.	12804674H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	August 9, 2019
Temperature / Humidity	24 deg. C / 68 % RH
Engineer	Junya Okuno
Mode	Tx

11b

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2412.00	-31.54	3.90	19.98	-7.66	8.00	15.66
2437.00	-31.07	3.91	19.98	-7.18	8.00	15.18
2462.00	-31.25	3.91	19.98	-7.36	8.00	15.36

11g

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2412.00	-37.74	3.90	19.98	-13.86	8.00	21.86
2437.00	-37.71	3.91	19.98	-13.82	8.00	21.82
2462.00	-37.92	3.91	19.98	-14.03	8.00	22.03

11n-20

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2412.00	-36.44	3.90	19.98	-12.56	8.00	20.56
2437.00	-38.14	3.91	19.98	-14.25	8.00	22.25
2462.00	-37.46	3.91	19.98	-13.57	8.00	21.57

BT LE

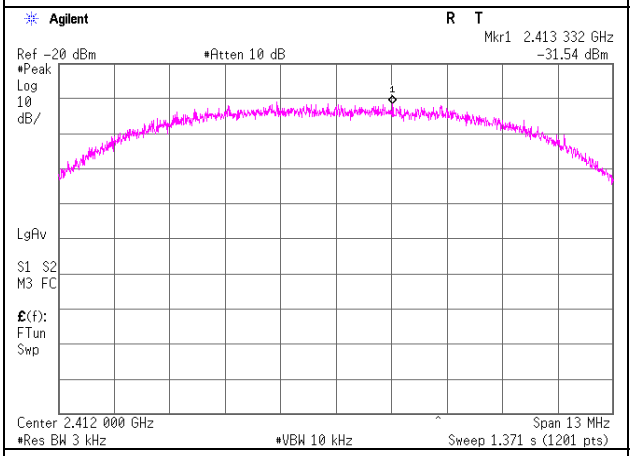
Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2412.00	-39.19	3.90	19.98	-15.31	8.00	23.31
2437.00	-38.31	3.91	19.98	-14.42	8.00	22.42
2462.00	-38.09	3.91	19.98	-14.20	8.00	22.20

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

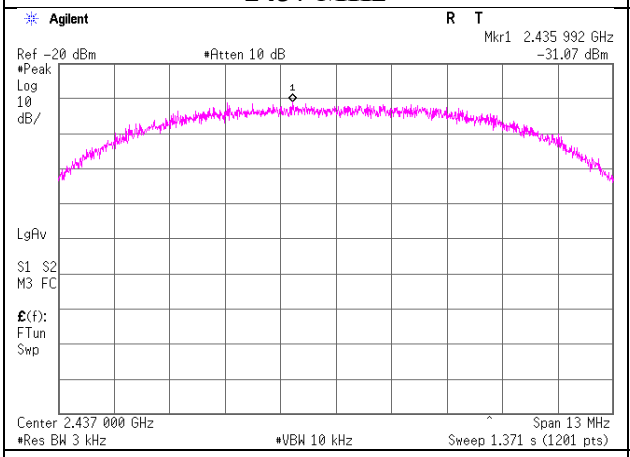
Power Density

11b

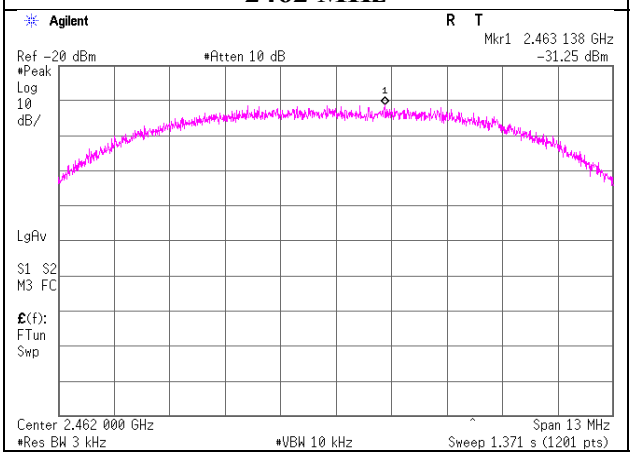
2412 MHz



2437 MHz

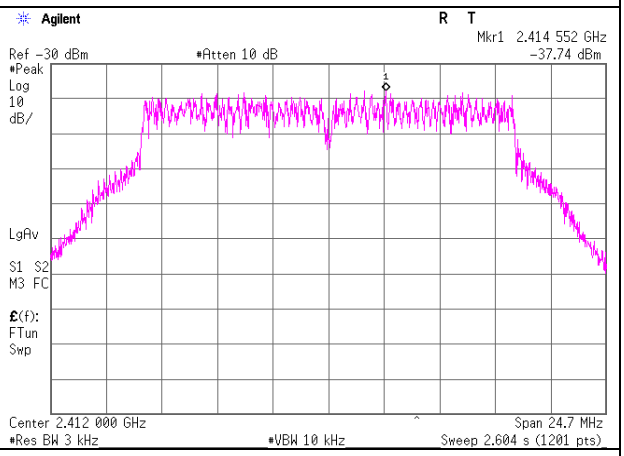


2462 MHz

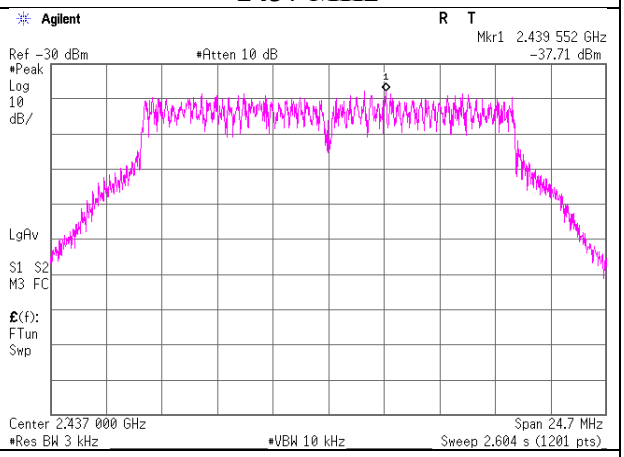


11g

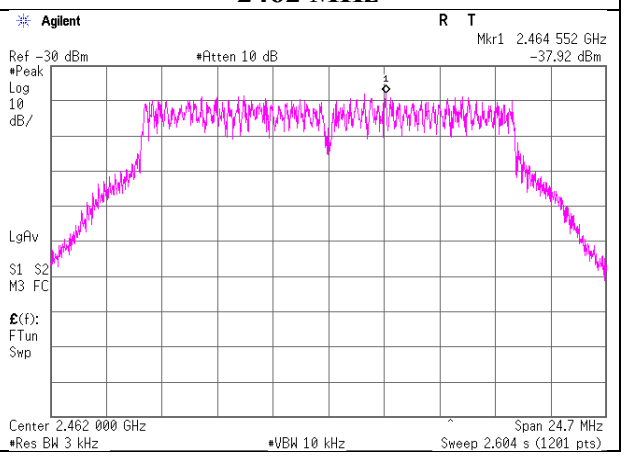
2412 MHz



2437 MHz



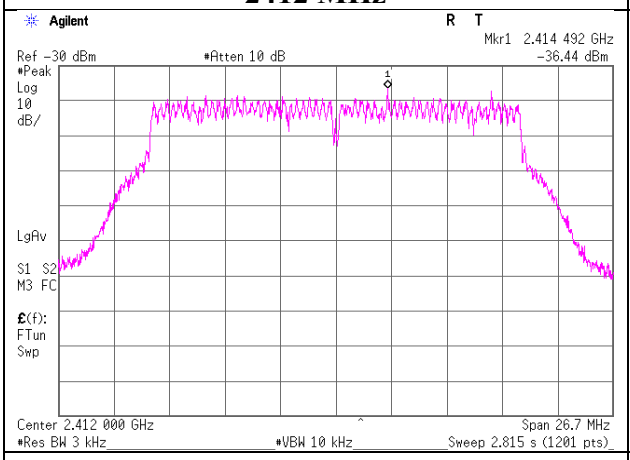
2462 MHz



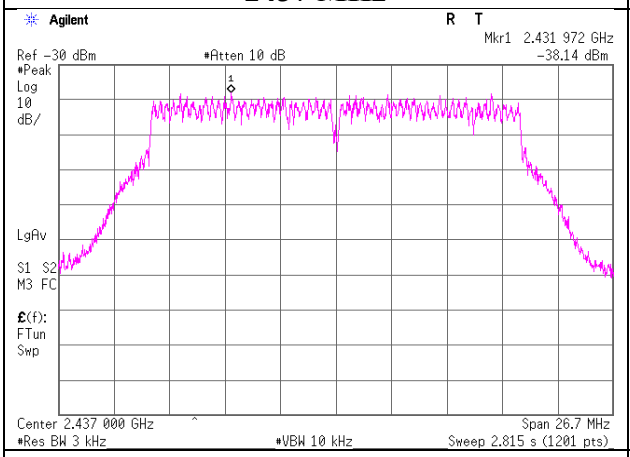
Power Density

11n-20

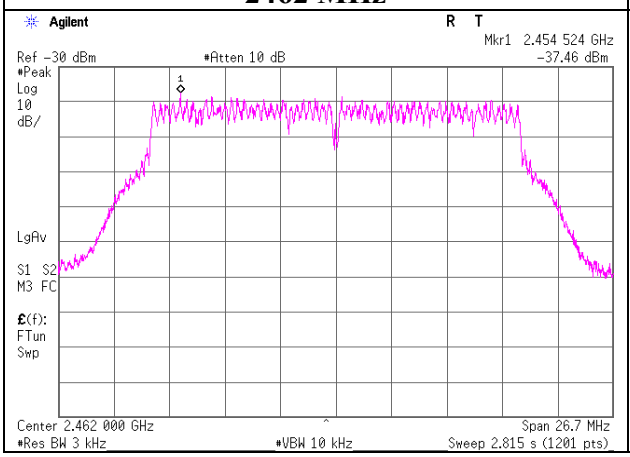
2412 MHz



2437 MHz

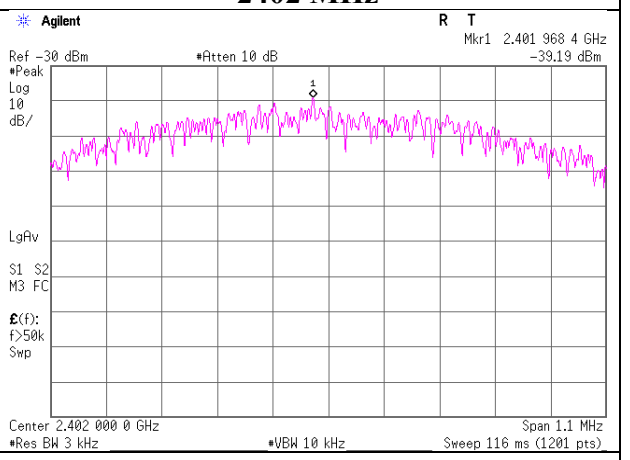


2462 MHz

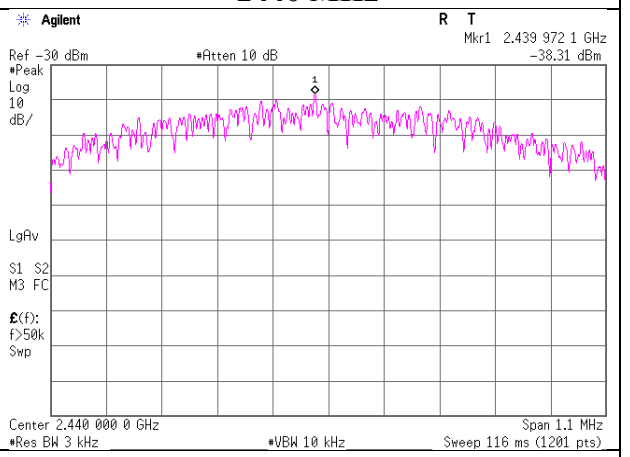


BT LE

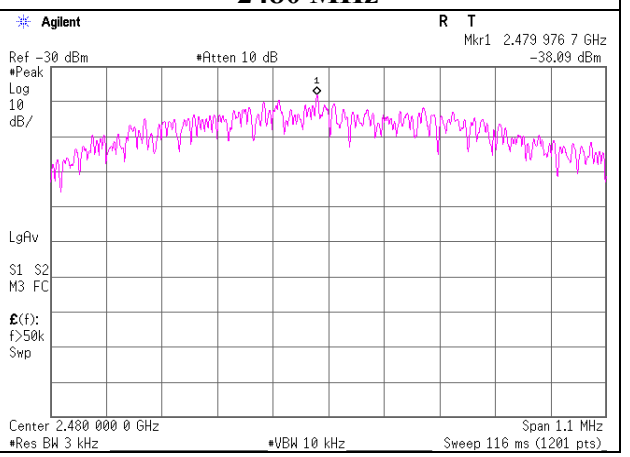
2402 MHz



2440 MHz



2480 MHz



APPENDIX 2: Test instruments

Test Instruments

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Cal Int
AT	141361	Attenuator(10dB) 1-18GHz	Orient Microwave	BX10-0476-00	-	03/04/2019	03/31/2020	12
AT	141830	Power sensor	ANRITSU	MA2411B	738285	05/16/2019	05/31/2020	12
AT	141809	Power Meter	ANRITSU	ML2495A	825002	05/16/2019	05/31/2020	12
AT	141173	Attenuator(10dB) (above1GHz)	HIROSE ELECTRIC CO.,LTD.	AT-110	-	12/17/2018	12/31/2019	12
AT	141547	DIGITAL HiTESTER	HIOKI	3805	60500120	02/25/2019	02/29/2020	12
AT	141414	Microwave Cable	Junkosha	MWX221	1207S407	08/06/2019	08/31/2020	12
AT	141902	Spectrum Analyzer	AGILENT	E4440A	MY46187105	10/04/2018	10/31/2019	12
AT	141561	Thermo-Hygrometer	CUSTOM	CTH-201	1401	01/11/2019	01/31/2020	12
RE	142013	AC3_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-10005	04/08/2019	04/30/2021	24
RE	141588	Pre Amplifier	MITEQ, Inc	AMF-6F-2600400-33-8P / AMF-4F-2600	1871355 /1871328	09/21/2018	09/30/2019	12
RE	142183	Measure	KOMELON	KMC-36	-	-	-	-
RE	141554	Thermo-Hygrometer	CUSTOM	CTH-180	1301	01/11/2019	01/31/2020	12
RE	142008	AC3_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	06/26/2018	06/30/2020	24
RE	177964	Microwave Cable	Junkosha INC.	MMX221	1901S329(1m)/ 1902S579(5m)	03/05/2019	03/31/2020	12
RE	141507	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	258	05/10/2019	05/31/2020	12
RE	141532	DIGITAL HiTESTER	HIOKI	3805	51201197	01/29/2019	01/31/2020	12
RE	141576	Pre Amplifier	AGILENT	8449B	3008A01671	02/08/2019	02/29/2020	12
RE	141884	Spectrum Analyzer	AGILENT	E4448A	MY44020357	03/13/2019	03/31/2020	12
RE	178648	EMI measurement program	TSJ	TEPTO-DV	-	-	-	-
RE	141513	Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170	BBHA9170306	05/10/2019	05/31/2020	12
RE	141580	MicroWave System Amplifier	AGILENT	83017A	MY39500779	03/05/2019	03/31/2020	12
RE	141950	EMI Test Receiver	Rohde & Schwarz	ESU26	100412	06/27/2019	06/30/2020	12
RE	142314	Attenuator	Pasternack	PE7390-6	D/C 1504	06/11/2019	06/30/2020	12
RE	141582	Pre Amplifier	SONOMA INSTRUMENT	310	260834	02/08/2019	02/29/2020	12
RE	141266	Logperiodic Antenna (200-1000MHz)	Schwarzbeck	VUSLP9111B	9111B-191	08/24/2019	08/31/2020	12
RE	141152	EMI measurement program	TSJ	TEPTO-DV	-	-	-	-
RE	141424	Biconical Antenna	Schwarzbeck	VHA9103+BBA9106	1915	08/24/2019	08/31/2020	12
RE	141323	Coaxial cable	UL Japan	-	-	07/02/2019	07/31/2020	12
RE	141296	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	2	09/19/2018	09/30/2019	12
AT	141938	Terminator	TME	CT-01BP	-	12/05/2018	12/31/2019	12
AT	141174	Attenuator(20dB) (above1GHz)	HIROSE ELECTRIC CO.,LTD.	AT-120	901247	01/10/2019	01/31/2020	12
AT	141900	Spectrum Analyzer	AGILENT	E4440A	MY46185823	11/15/2018	11/30/2019	12

***Hyphens for Last Calibration Date, Calibration Due Date and Cal Int 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.
All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

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

Test item: RE: Radiated Emission test
AT: Antenna Terminal Conducted test