




RADIO TEST REPORT


Test Report No. : 12344074H-B-R1

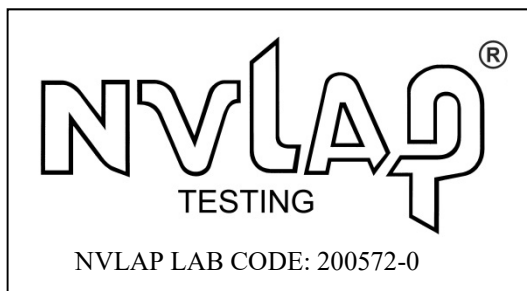
Applicant : DENSO CORPORATION
Type of Equipment : Cockpit Control Unit (CCU)
Model No. : DNNS091
FCC ID : HYQDNNS091
Test regulation : FCC Part 15 Subpart C: 2018
(Bluetooth part)
Test Result : Complied

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the 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. This report is a revised version of 12344074H-B. 12344074H-B is replaced with this report.

Date of test: June 4 to 17, 2018

Representative test engineer: 
Takafumi Noguchi
Engineer
Consumer Technology Division

Approved by: 
Satofumi Matsuyama
Engineer
Consumer Technology Division



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. *As for the range of Accreditation in NVLAP, you may refer to the WEB address, http://japan.ul.com/resources/emc_accredited/

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

UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

13-EM-F0429

CONTENTS	PAGE
SECTION 1: Customer information.....	4
SECTION 2: Equipment under test (E.U.T.).....	4
SECTION 3: Test specification, procedures & results.....	6
SECTION 4: Operation of E.U.T. during testing.....	9
SECTION 5: Radiated Spurious Emission	12
SECTION 6: Antenna Terminal Conducted Tests.....	13
APPENDIX 1: Test data	14
20dB Bandwidth, 99%Occupied Bandwidth and Carrier Frequency Separation.....	14
Number of Hopping Frequency	18
Dwell time.....	20
Maximum Peak Output Power	23
Average Output Power.....	24
Radiated Spurious Emission	26
Conducted Spurious Emission	37
Conducted Emission Band Edge compliance	43
APPENDIX 2: Test instruments	45
APPENDIX 3: Photographs of test setup	46
Radiated Spurious Emission	46
Worst Case Position (Horizontal: 0 degrees / Vertical:0 degrees).....	47

SECTION 1: Customer information

Company Name : DENSO CORPORATION
Address : 1-1 Showa-cho, Kariya-shi, Aichi ken, 448-8661 Japan
Telephone Number : +81-566-20-3304
Facsimile Number : +81-566-25-4920
Contact Person : Naoto Makino

SECTION 2: Equipment under test (E.U.T.)

2.1 Identification of E.U.T.

Type of Equipment : Cockpit Control Unit (CCU)
Model No. : DNNS091
Serial No. : Refer to Section 4, Clause 4.2
Rating : DC 13.2 V
Receipt Date of Sample : June 3, 2018
Country of Mass-production : the 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: DNNS091 (referred to as the EUT in this report) is a Cockpit Control Unit (CCU).

Radio Specification

Feature of EUT:

Clock frequency(ies) in the system : 2.0 GHz (max.)
Operating Temperature : -30 deg. C to 65 deg. C

[AM/FM/HD/XM Radio]

	AM	FM	HD	XM
Equipment type	Receiver			
Frequency of operation	531 kHz to 1602 kHz	87.5 MHz to 108.0 MHz	AM: 531 kHz to 1602 kHz FM: 87.5 MHz to 108.0 MHz	2333.465 MHz to 2344.045 MHz
Channel spacing	9 kHz	50 kHz	AM: 9 kHz FM: 50 kHz	-
Antenna connector type	Receptacle Connector			High Frequency Connector

[WLAN (IEEE802.11b/g/n-20) / Bluetooth (Ver4.2 BDR/EDR)]

	IEEE802.11b	IEEE802.11g/n (20 M band)	Bluetooth *1)
Equipment type	Transceiver		
Frequency of operation	2412 MHz to 2462 MHz	2412 MHz to 2462 MHz	2402 MHz to 2480 MHz
Type of modulation	DSSS (CCK, DQPSK, DBPSK)	OFDM-CCK (64QAM, 16QAM, QPSK, BPSK)	FHSS (GFSK, $\pi/4$ -DQPSK, 8-DPSK)
Channel spacing	5MHz		1 MHz
Antenna type	ASSEMBLY Bluetooth/WiFi Antenna		
Antenna Connector type	MHF PLUG		
Antenna Gain	-4.15 dBi		1.35 dBi

Variant models

The EUT has two type: High model and Mid model.

Differences between High model and Mid model are Navigation and OTA.

Test was only performed to High model according to the customer's request.

* This test report applied to Bluetooth.

UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on March 12, 2018 and effective April 11, 2018

Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted limits
Section 15.247 Operation within the bands 902-928MHz,
2400-2483.5MHz, and 5725-5850MHz

* Also the EUT complies with FCC Part 15 Subpart B.

3.2 Procedures and results

Item	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)
Carrier Frequency Separation	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section15.247(a)(1) IC: RSS-247 5.1 (b)	See data.	Complied	Conducted
20dB Bandwidth	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section15.247(a)(1) IC: RSS-247 5.1 (a)		Complied	Conducted
Number of Hopping Frequency	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section15.247(a)(1)(iii) IC: RSS-247 5.1 (d)		Complied	Conducted
Dwell time	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section15.247(a)(1)(iii) IC: RSS-247 5.1 (d)		Complied	Conducted
Maximum Peak Output Power	FCC: FCC Public Notice DA 00-705 IC: RSS-Gen 6.12	FCC: Section15.247(a)(b)(1) IC: RSS-247 5.4 (b)		Complied	Conducted
Spurious Emission & Band Edge Compliance	FCC: FCC Public Notice DA 00-705 IC: RSS-Gen 6.13	FCC: Section15.247(d) IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	1.3 dB 7206.000 MHz, AV, Vert.	Complied#	Conducted/ 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).

Symbols:

Complied The data of this test item has enough margin, more than the measurement uncertainty.

Complied# The data of this test item meets the limits unless the measurement uncertainty is taken into consideration.

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

FCC Part 15.31 (e)

The 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.

UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99% Occupied Bandwidth	IC: RSS-Gen 6.6	IC: -	N/A	Complied	Conducted
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.				

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

3.4 Uncertainty

EMI

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

Antenna Terminal test

Test Item	Uncertainty (+/-)
RF output power	1.3 dB
Antenna terminal conducted emission / Power density / Burst power	
Below 3GHz	2.0 dB
Adjacent channel power / Channel power	
Below 3GHz	1.9 dB

Radiated emission

Measurement distance	Frequency range	Uncertainty (+/-)
3 m	9 kHz to 30 MHz	3.3 dB
10 m		3.2 dB
3 m	30 MHz to 200 MHz (Horizontal)	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

UL Japan, Inc. Ise EMC Lab.
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone: +81 596 24 8999, Facsimile: +81 596 24 8124
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	N/A	-	-
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 2.0 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 E.U.T. during testing

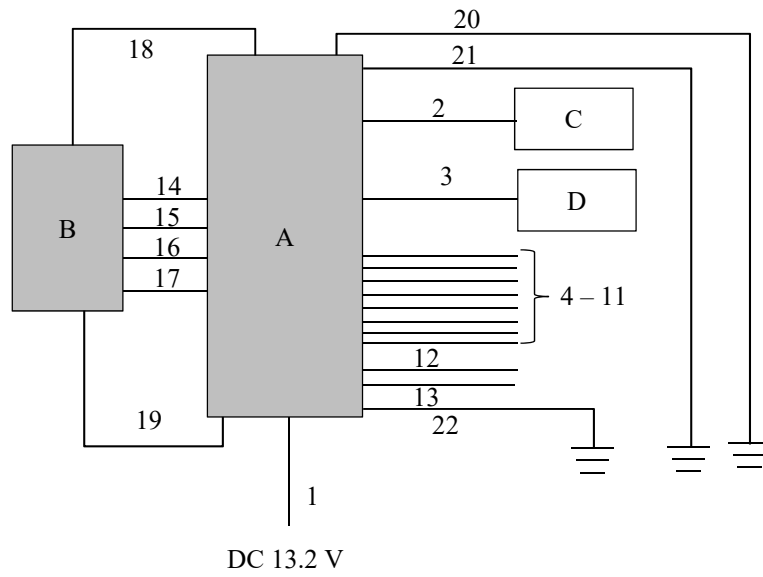
4.1 Operating Mode(s)

Bluetooth (BT): Transmitting (Tx), Payload: PRBS9

Details of Operating Mode(s)

Test Item	Mode	Tested frequency
Spurious Emission (Conducted/Radiated)	Tx (Hopping Off) DH5, 3DH5	2402 MHz 2441 MHz 2480 MHz
Carrier Frequency Separation	Tx (Hopping Off) DH5, 3DH5	2402 MHz 2441 MHz 2480 MHz
20dB Bandwidth	Tx (Hopping Off) DH5, 3DH5	2402 MHz 2441 MHz 2480 MHz
Number of Hopping Frequency	Tx DH5, 3DH5 -Hopping On -Hopping Off	-
Dwell time	Tx (Hopping On), -DH1, DH3, DH5 -3DH1, 3DH3, 3DH5	-
Maximum Peak Output Power	Tx (Hopping Off) DH5, 2DH5, 3DH5	2402 MHz 2441 MHz 2480 MHz
Band Edge Compliance (Conducted)	Tx DH5, 3DH5 -Hopping On -Hopping Off	2402 MHz 2480 MHz
99% Occupied Bandwidth	Tx DH5, 3DH5 -Hopping On -Hopping Off	2402 MHz 2441 MHz 2480 MHz
<p>*As a result of preliminary test, the formal test was performed with the above modes, which had the maximum payload length (except Dwell time test) *2DH mode (2Mb/s EDR: pi/4DQPSK) was excluded for other tests than power measurement by using 3DH mode (3 Mb/s EDR: 8DPSK) as a representative. * It is considered that the non-tested packet type (e.g. inquiry) can be omitted as it is complied with above all test items based on Bluetooth Core specification.</p> <p>*EUT has the power settings by the software as follows; Power settings: BDR / EDR: 3 dBm Software: MSoC Ver: F11GHMO11-O14</p> <p>*This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.</p>		

4.2 Configuration and peripherals



* 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	Cockpit Control Unit (CCU)	DNNS091	468726300000833	DENSO CORPORATION	EUT
B	CID	86213AAN65A	ASSY-K3-HiMid-089	DENSO CORPORATION	EUT
C	Speaker	-	-	-	-
D	Speaker	-	-	-	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	2.5	Unshielded	Unshielded	-
2	Speaker Cable	1.0	Unshielded	Unshielded	-
3	Speaker Cable	1.0	Unshielded	Unshielded	-
4	Signal Cable	1.8	Unshielded	Unshielded	-
5	Mater Cable	1.7	Shielded	Shielded	-
6	USB Cable	2.0	Shielded	Shielded	-
7	USB Cable	2.0	Shielded	Shielded	-
8	USB Cable	2.0	Shielded	Shielded	-
9	XM Cable	1.0	Shielded	Shielded	-
10	Signal Cable	2.0	Unshielded	Unshielded	-
11	GPS Cable	1.0	Shielded	Shielded	-
12	AM/FM Cable (Main)	1.0	Shielded	Shielded	-
13	AM/FM Cable (Sub)	1.0	Shielded	Shielded	-
14	DC Cable	0.2	Unshielded	Unshielded	-
15	Signal Cable	0.2	Shielded	Shielded	-
16	BT Cable	0.2	Shielded	Shielded	-
17	WiFi Cable	0.2	Shielded	Shielded	-
18	FG Cable	0.1	Unshielded	Unshielded	-
19	FG Cable	0.1	Unshielded	Unshielded	-
20	FG Cable	3.0	Unshielded	Unshielded	-
21	FG Cable	3.0	Unshielded	Unshielded	-
22	FG Cable	3.0	Unshielded	Unshielded	-

UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

SECTION 5: Radiated Spurious Emission

Test Procedure

[For below 1 GHz]

EUT was placed on a urethane platform of nominal size, 1.5 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	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	RBW: 1 MHz VBW: 10 Hz *1)	RBW: 100 kHz VBW: 300 kHz
Test Distance	3 m	4.0 m*2) (1 GHz - 10 GHz), 1.0 m*3) (10 GHz - 26.5 GHz)		4.0 m*2) (1 GHz - 10 GHz), 1 m*3) (10 GHz - 26.5 GHz)

*1) Although DA 00-705 accepts VBW = 10 Hz for AV measurements, it was confirmed that superfluous smoothing was not performed.

*2) Distance Factor: $20 \times \log(4.0 \text{ m}/3.0 \text{ m}) = 2.5 \text{ dB}$

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

- The carrier level and noise levels were confirmed at each position of 0 degree and 30 degree as tilt angle 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

UL Japan, Inc.

Ise EMC Lab.

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone : +81 596 24 8999
Facsimile : +81 596 24 8124

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
20dB Bandwidth	3 MHz	30 kHz	100 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99% Occupied Bandwidth *1)	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak Average *2)	-	Power Meter (Sensor: 50MHz BW)
Carrier Frequency Separation	3 MHz	30 kHz	100 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
Number of Hopping Frequency	30 MHz	300 kHz	1 MHz	Auto	Peak	Max Hold	Spectrum Analyzer
Dwell Time	Zero Span	100 kHz, 1 MHz	300 kHz, 3 MHz	As necessary capture the entire dwell time per hopping channel	Peak	Clear Write	Spectrum Analyzer
Conducted Spurious Emission *3)	9 kHz to 150 kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150 kHz to 30 MHz	9.1 kHz	27 kHz				
	30 MHz to 25 GHz	100 kHz	300 kHz				
Conducted Spurious Emission Band Edge compliance	10 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer

*1) Peak hold was applied as Worst-case measurement.

*2) Reference data

*3) 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.

Test data : APPENDIX

Test result : Pass

APPENDIX 1: Test data

20dB Bandwidth, 99%Occupied Bandwidth and Carrier Frequency Separation

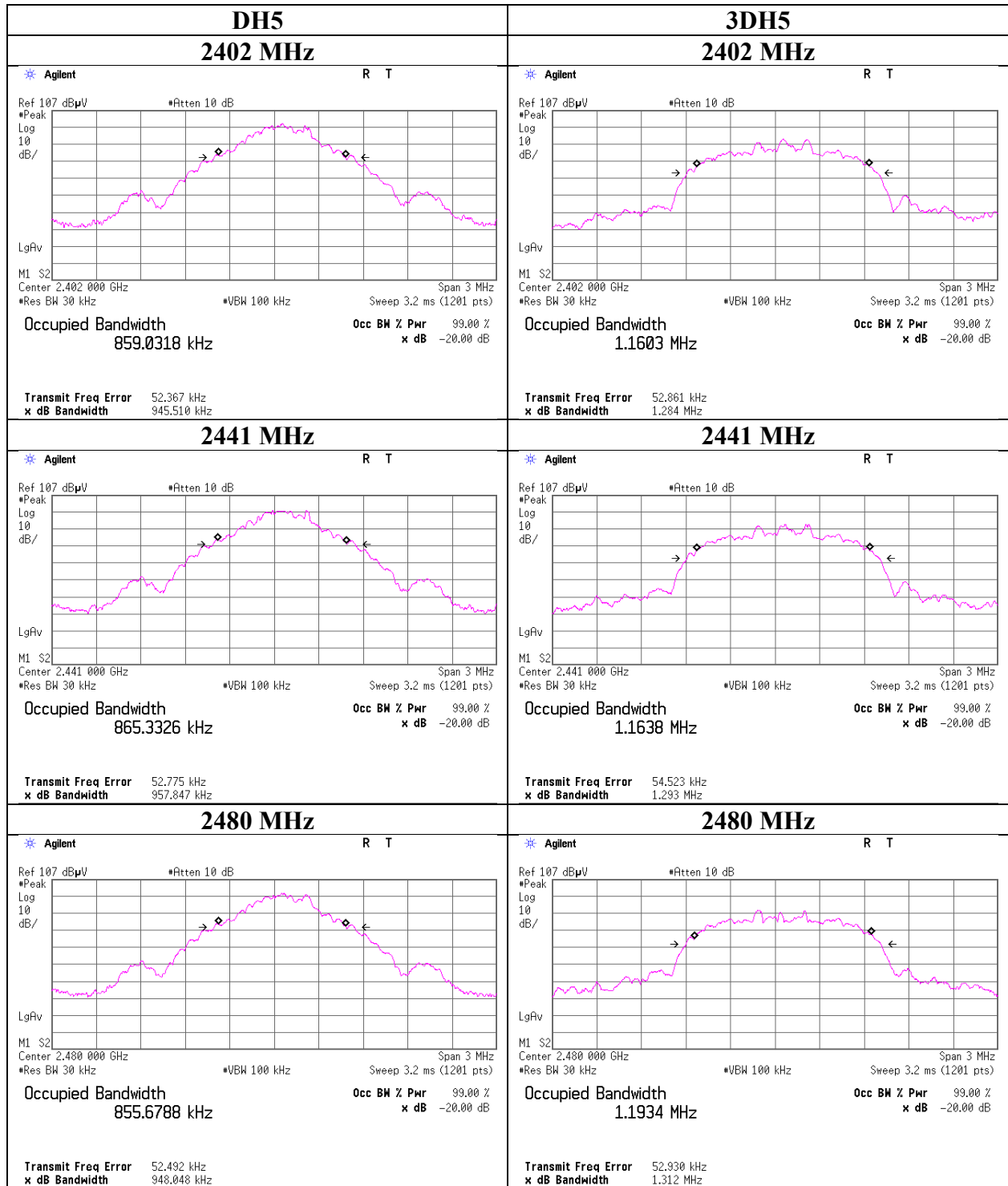
Report No.	12344074H	
Test place	Ise EMC Lab.	
Measurement Room	No.6	No.11
Date	June 4, 2018	June 17, 2018
Temperature / Humidity	22 deg. C / 45 % RH	23 deg. C / 57 % RH
Engineer	Ryota Yamanaka	Takafumi Noguchi
Mode	Tx, Hopping Off, Tx, Hopping On	

Mode	Freq. [MHz]	20dB Bandwidth [MHz]	99% Occupied Bandwidth [kHz]	Carrier Frequency Separation [MHz]	Limit for Carrier Frequency separation [MHz]
DH5	2402.0	0.946	859.032	1.000	≥ 0.631
DH5	2441.0	0.958	865.333	1.000	≥ 0.639
DH5	2480.0	0.948	855.679	1.000	≥ 0.632
DH5	Hopping On	-	78661.600	-	-
3DH5	2402.0	1.284	1160.300	1.000	≥ 0.856
3DH5	2441.0	1.293	1163.800	1.000	≥ 0.862
3DH5	2480.0	1.312	1193.400	1.000	≥ 0.875
3DH5	Hopping On	-	78715.100	-	-

Limit: Two-thirds of 20dB Bandwidth or 25kHz (whichever is greater).

No limit applies to 20dB Bandwidth.

20dB Bandwidth and 99% Occupied Bandwidth



UL Japan, Inc.

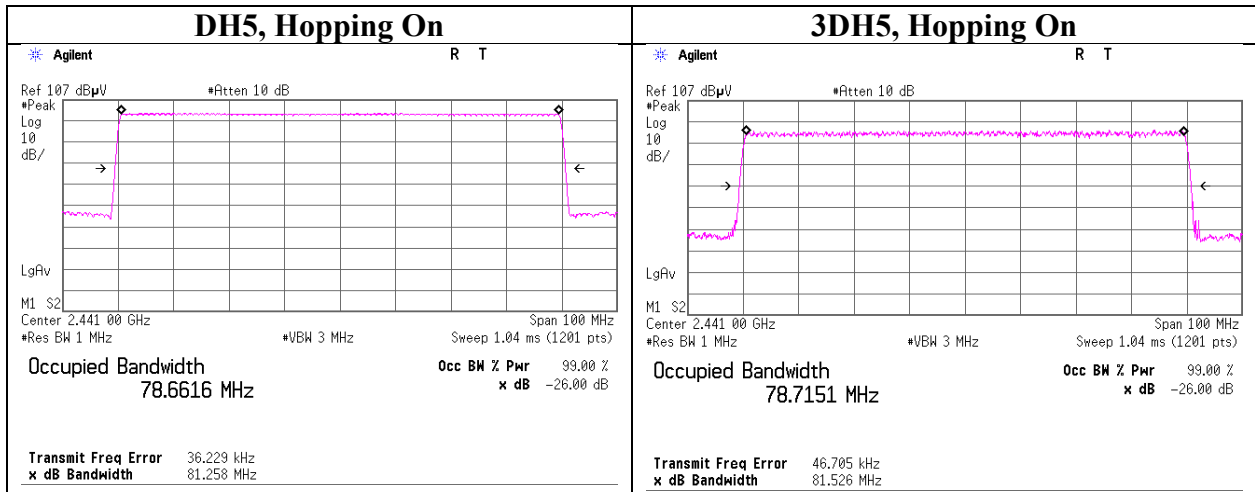
Ise EMC Lab.

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

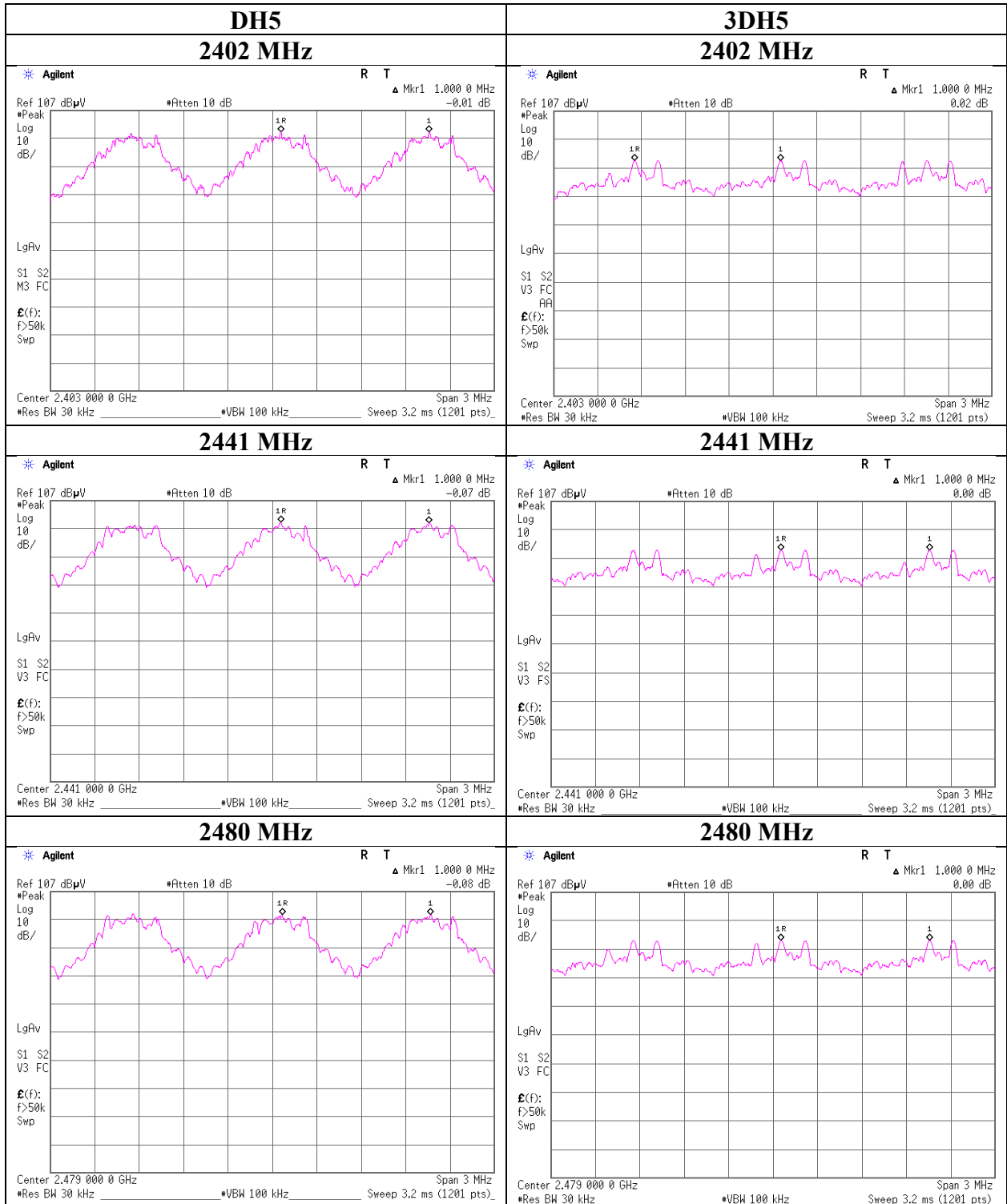
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

20dB Bandwidth and 99% Occupied Bandwidth



Carrier Frequency Separation



UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

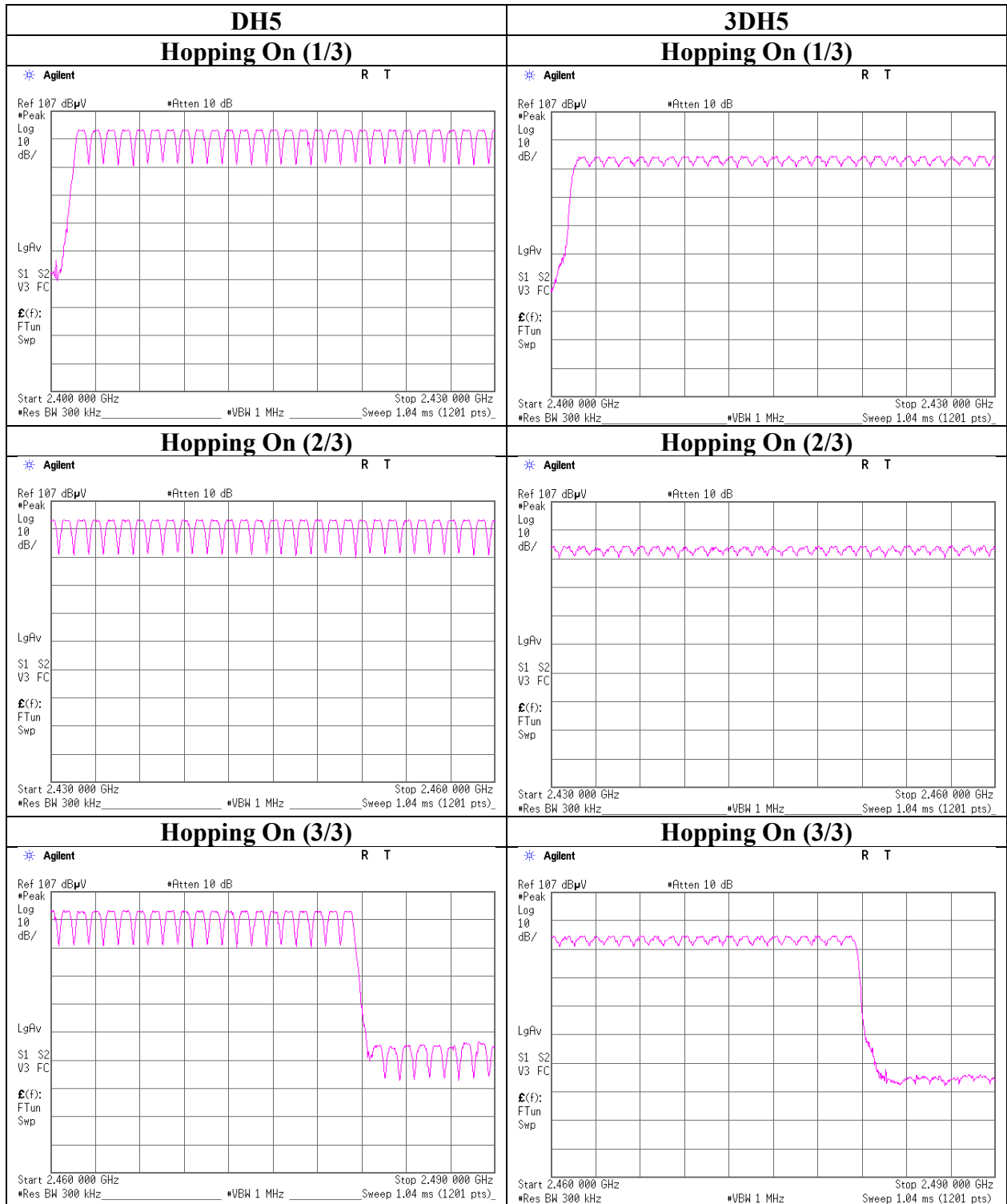
Number of Hopping Frequency

Report No. 12344074H
Test place Ise EMC Lab.
Measurement Room No.6 No.11
Date June 4, 2018 June 17, 2018
Temperature / Humidity 22 deg. C / 45 % RH 23 deg. C / 57 % RH
Engineer Ryota Yamanaka Takafumi Noguchi
Mode Tx, Hopping Off, Tx, Hopping On

Mode	Number of channel [channels]	Limit [channels]
DH5	79	>= 15
3DH5	79	>= 15

Test was not performed at AFH mode whose number of hopping channel is 20 channels because this Bluetooth radio is in compliance of Bluetooth Specification.

Number of Hopping Frequency



UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Dwell time

Report No.	12344074H	
Test place	Ise EMC Lab.	
Measurement Room	No.6	No.11
Date	June 4, 2018	June 17, 2018
Temperature / Humidity	22 deg. C / 45 % RH	23 deg. C / 57 % RH
Engineer	Ryota Yamanaka	Takafumi Noguchi
Mode	Tx, Hopping Off, Tx, Hopping On	

Mode	Number of transmission in a 31.6(79 Hopping x 0.4) / 12.8 (32 Hopping x 0.4) second period	Length of transmission [msec]	Result [msec]	Limit [msec]
DH1	47.4 times / 5 sec. x 31.6 sec. = 300 times	0.410	123	400
DH3	24.2 times / 5 sec. x 31.6 sec. = 153 times	1.672	256	400
DH5	17.4 times / 5 sec. x 31.6 sec. = 110 times	2.920	321	400
3DH1	47.4 times / 5 sec. x 31.6 sec. = 300 times	0.420	126	400
3DH3	25.4 times / 5 sec. x 31.6 sec. = 161 times	1.682	271	400
3DH5	18.2 times / 5 sec. x 31.6 sec. = 116 times	2.934	340	400

Sample Calculation

Result = Number of transmission x Length of transmission

*Average data of 5 tests.(except Inquiry)

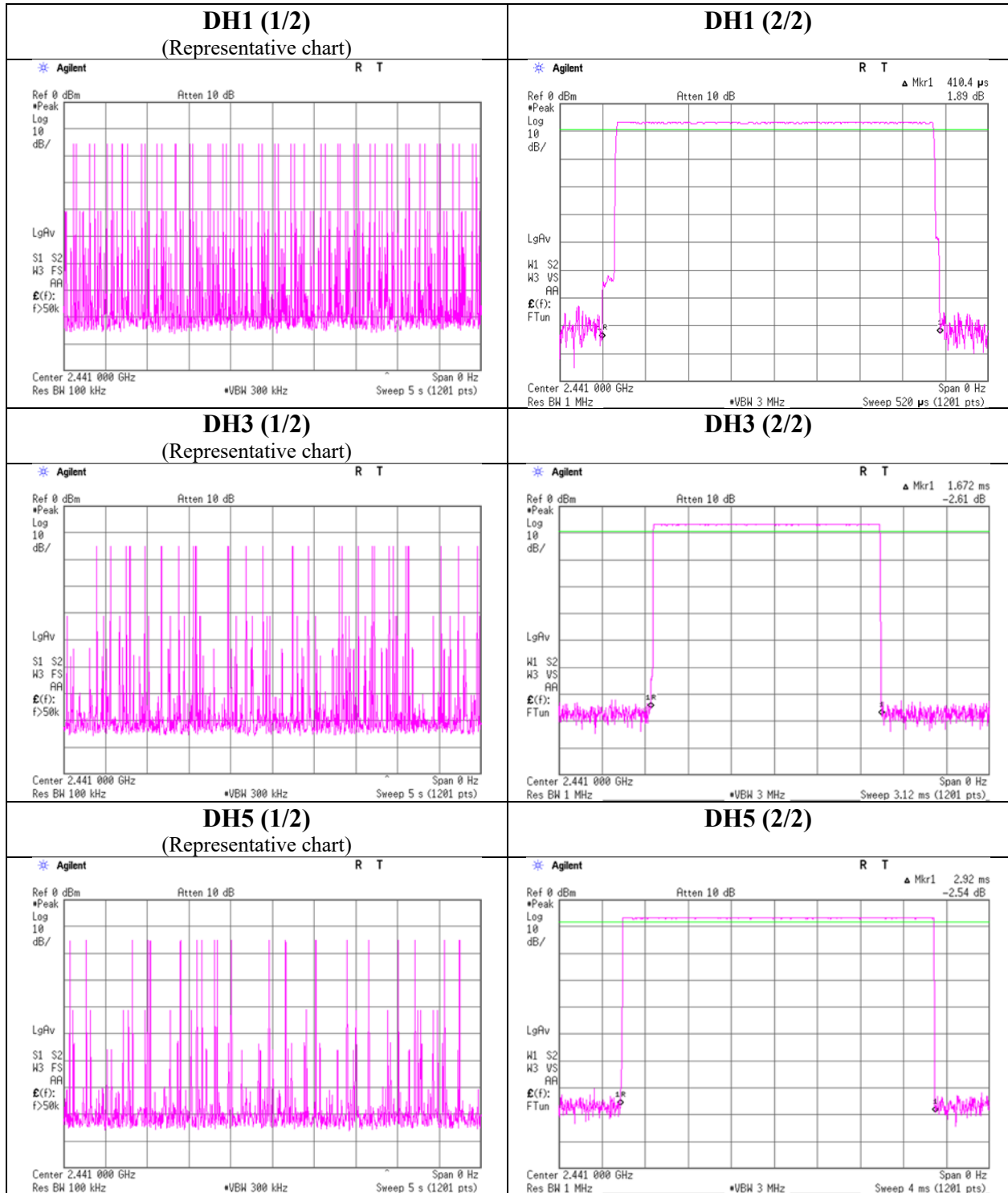
Mode	Sampling [times]					Average [times]
	1	2	3	4	5	
DH1	48	48	47	47	47	47.4
DH3	23	23	24	26	25	24.2
DH5	17	17	17	20	16	17.4
3DH1	49	47	47	48	46	47.4
3DH3	28	23	25	28	23	25.4
3DH5	16	19	18	19	19	18.2

Sample Calculation

Average = Summation (Sampling 1 to 5) / 5

This device complies with the Bluetooth protocol for FHSS operation, employing a pseudo random channel selection and hopping rate to ensure that the occupancy time in $N \times 0.4s$, where N is the number of channels being used in the hopping sequence ($20 \leq N \leq 79$), is always less than $0.4s$ regardless of packet size. This is confirmed in the test report for $N = 79$.

Dwell time



UL Japan, Inc.

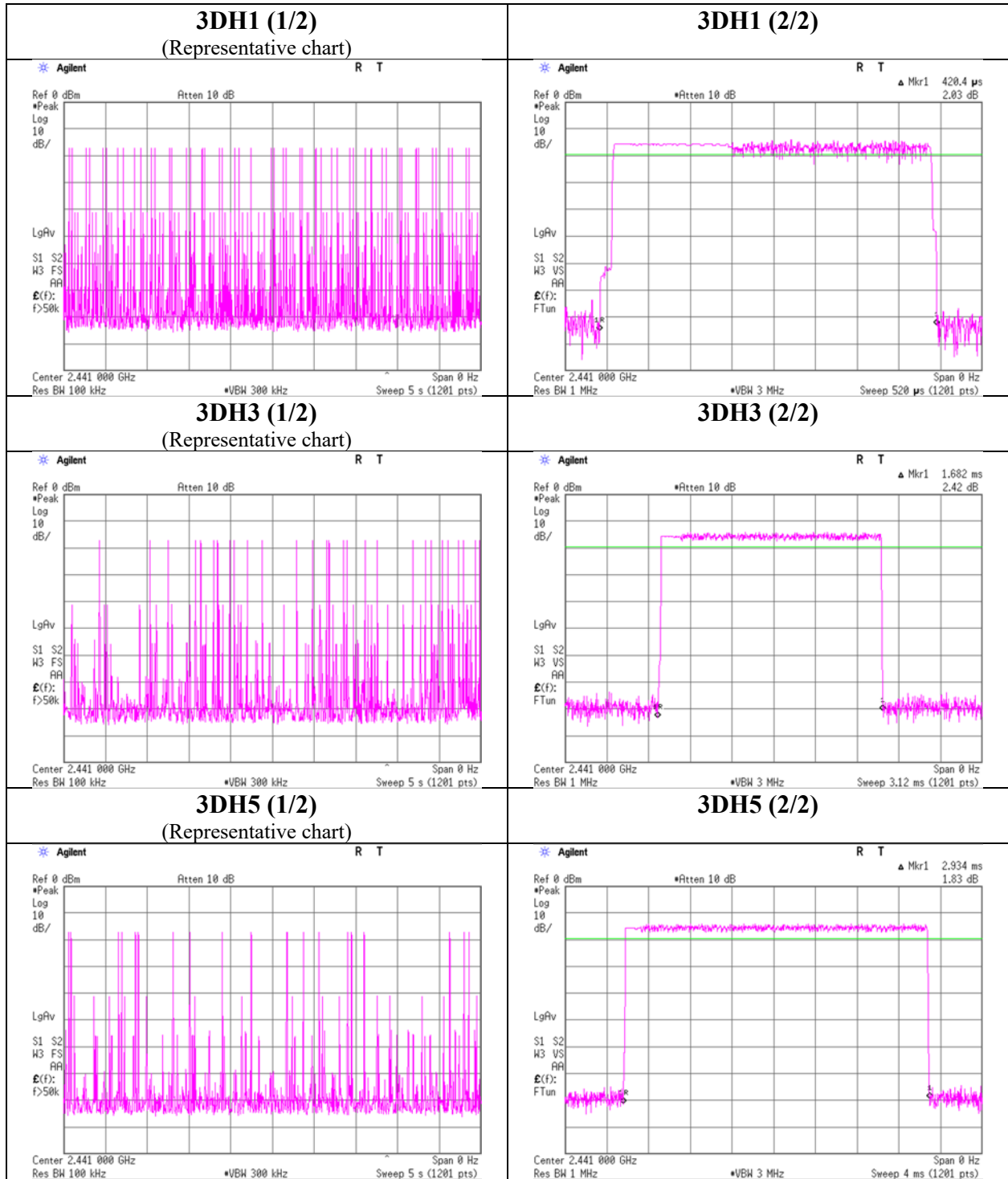
Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Dwell time



UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Maximum Peak Output Power

Report No. 12344074H
Test place Ise EMC Lab. No.11 Measurement Room
Date June 17, 2018
Temperature / Humidity 23 deg. C / 57 % RH
Engineer Takafumi Noguchi
Mode Tx, Hopping Off

Mode	Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
					[dBm]	[mW]	[dBm]	[mW]	
DH5	2402.0	-13.42	1.78	9.96	-1.68	0.68	20.96	125	22.64
DH5	2441.0	-13.19	1.40	9.96	-1.83	0.66	20.96	125	22.79
DH5	2480.0	-13.07	1.52	9.96	-1.59	0.69	20.96	125	22.55
2DH5	2402.0	-13.83	1.78	9.96	-2.09	0.62	20.96	125	23.05
2DH5	2441.0	-13.79	1.40	9.96	-2.43	0.57	20.96	125	23.39
2DH5	2480.0	-13.37	1.52	9.96	-1.89	0.65	20.96	125	22.85
3DH5	2402.0	-13.25	1.78	9.96	-1.51	0.71	20.96	125	22.47
3DH5	2441.0	-13.00	1.40	9.96	-1.64	0.69	20.96	125	22.60
3DH5	2480.0	-12.84	1.52	9.96	-1.36	0.73	20.96	125	22.32

Sample Calculation:

Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
e.i.r.p. Result = Conducted Power Result + Antenna Gain

Test was not performed at AFH mode, because the decrease of number of channel (min: 20ch) at AFH mode does not influence on the output power and bandwidth of the EUT.

As this device had AFH mode and frequency separation could not meet the requirement of over 20dB BW without 2/3 relaxation, 125mW power limit was applied to it.

Average Output Power
(Reference data for RF Exposure)

Report No. 12344074H
Test place Ise EMC Lab. No.11 Measurement Room
Date June 17, 2018
Temperature / Humidity 23 deg. C / 57 % RH
Engineer Takafumi Noguchi
Mode Tx, Hopping Off

Mode	Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
					[dBm]	[mW]		[dBm]	[mW]
DH5	2402.0	-15.35	1.78	9.96	-3.61	0.44	1.10	-2.51	0.56
DH5	2441.0	-15.01	1.40	9.96	-3.65	0.43	1.10	-2.55	0.56
DH5	2480.0	-14.82	1.52	9.96	-3.34	0.46	1.10	-2.24	0.60
2DH5	2402.0	-18.06	1.78	9.96	-6.32	0.23	1.09	-5.23	0.30
2DH5	2441.0	-17.98	1.40	9.96	-6.62	0.22	1.09	-5.53	0.28
2DH5	2480.0	-17.56	1.52	9.96	-6.08	0.25	1.09	-4.99	0.32
3DH5	2402.0	-18.02	1.78	9.96	-6.28	0.24	1.09	-5.19	0.30
3DH5	2441.0	-17.77	1.40	9.96	-6.41	0.23	1.09	-5.32	0.29
3DH5	2480.0	-17.52	1.52	9.96	-6.04	0.25	1.09	-4.95	0.32

Sample Calculation:

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

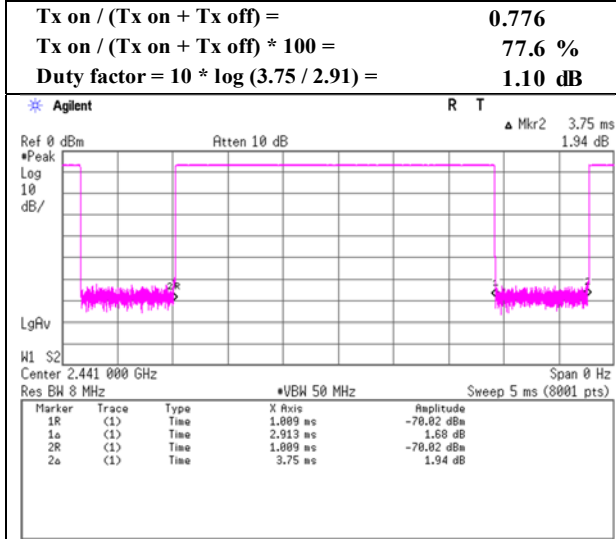
Result (Burst power average) = Time average + Duty factor

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

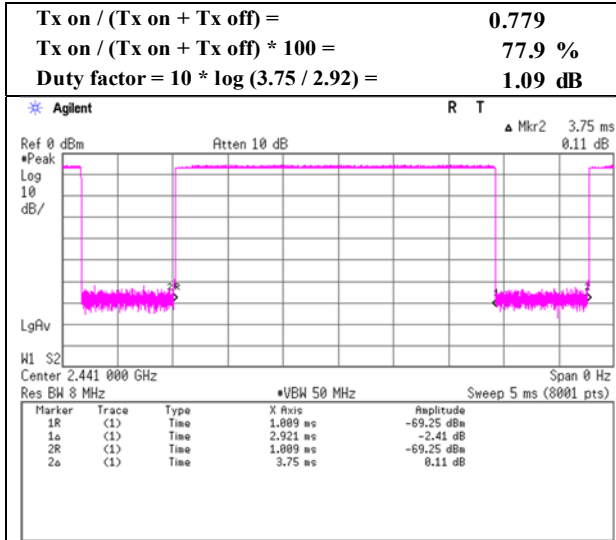
Burst Rate Confirmation

Report No. 12344074H
 Test place Ise EMC Lab. No.6 Measurement Room / Shielded Room
 Date June 4, 2018
 Temperature / Humidity 22 deg. C / 45 % RH
 Engineer Ryota Yamanaka
 Mode Tx, Hopping Off

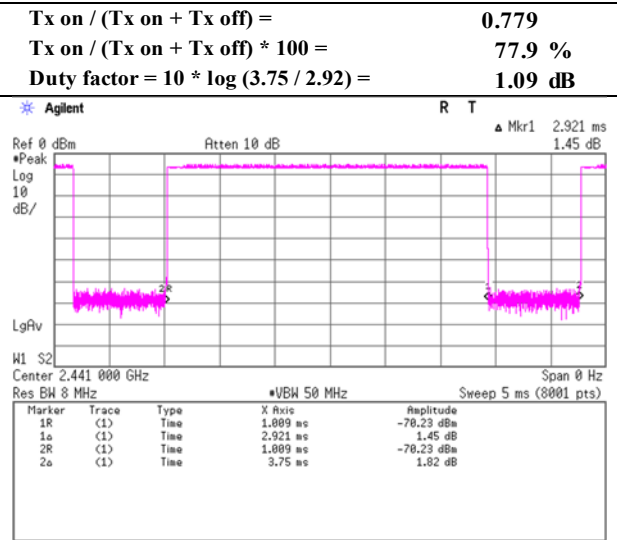
DH5



2DH5



3DH5



UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Radiated Spurious Emission

Report No. 12344074H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4 No.4
Date June 11, 2018 (Day) June 11, 2018 (Night)
Temperature / Humidity 22 deg. C / 71 % RH 23 deg. C / 69 % RH
Engineer Takafumi Noguchi Takumi Shimada
(1 GHz -10 GHz) (Above 10 GHz , Below 1 GHz)
Mode Tx, Hopping Off, DH5 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	176.000	QP	30.4	16.2	8.9	32.0	-	23.5	43.5	20.0	
Hori	208.000	QP	40.4	11.5	9.2	32.0	-	29.1	43.5	14.4	
Hori	224.000	QP	40.2	11.6	9.3	32.0	-	29.1	46.0	16.9	
Hori	232.000	QP	40.0	11.7	9.3	32.0	-	29.0	46.0	17.0	
Hori	240.000	QP	41.9	11.7	9.5	32.0	-	31.1	46.0	14.9	
Hori	264.000	QP	37.4	12.3	9.7	32.0	-	27.4	46.0	18.6	
Hori	2390.000	PK	41.9	27.4	5.9	32.1	-	43.1	73.9	30.8	
Hori	4804.000	PK	40.8	31.7	8.1	31.3	-	49.3	73.9	24.6	Floor noise
Hori	7206.000	PK	47.2	36.4	9.5	32.4	-	60.7	73.9	13.2	
Hori	9608.000	PK	43.6	38.0	10.2	32.6	-	59.2	73.9	14.7	Floor noise
Hori	2390.000	AV	29.8	27.4	5.9	32.1	-	31.0	53.9	22.9	
Hori	4804.000	AV	28.7	31.7	8.1	31.3	-	37.2	53.9	16.7	Floor noise
Hori	7206.000	AV	37.7	36.4	9.5	32.4	-	51.2	53.9	2.7	
Hori	9608.000	AV	31.8	38.0	10.2	32.6	-	47.4	53.9	6.5	Floor noise
Vert	176.000	QP	28.9	16.2	8.9	32.0	-	22.0	43.5	21.5	
Vert	208.000	QP	38.0	11.5	9.2	32.0	-	26.7	43.5	16.8	
Vert	224.000	QP	36.6	11.6	9.3	32.0	-	25.5	46.0	20.5	
Vert	232.000	QP	40.6	11.7	9.4	32.0	-	29.7	46.0	16.3	
Vert	240.000	QP	43.0	11.7	9.5	32.0	-	32.2	46.0	13.8	
Vert	264.000	QP	38.3	12.3	9.7	32.0	-	28.3	46.0	17.7	
Vert	2390.000	PK	40.8	27.4	5.9	32.1	-	42.0	73.9	31.9	
Vert	4804.000	PK	41.8	31.7	8.1	31.3	-	50.3	73.9	23.6	Floor noise
Vert	7206.000	PK	48.2	36.4	9.5	32.4	-	61.7	73.9	12.2	
Vert	9608.000	PK	44.5	38.0	10.2	32.6	-	60.1	73.9	13.8	Floor noise
Vert	2390.000	AV	29.6	27.4	5.9	32.1	-	30.8	53.9	23.1	
Vert	4804.000	AV	28.7	31.7	8.1	31.3	-	37.2	53.9	16.7	Floor noise
Vert	7206.000	AV	39.1	36.4	9.5	32.4	-	52.6	53.9	1.3	
Vert	9608.000	AV	31.9	38.0	10.2	32.6	-	47.5	53.9	6.4	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(4.0 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	2402.000	PK	83.3	27.4	5.9	32.1	84.5	-	-	Carrier
Hori	2400.000	PK	34.8	27.4	5.9	32.1	36.0	64.5	28.5	
Vert	2402.000	PK	88.3	27.4	5.9	32.1	89.5	-	-	Carrier
Vert	2400.000	PK	34.2	27.4	5.9	32.1	35.4	69.5	34.1	

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

Distance factor: 1 GHz - 10 GHz 20log(4.0 m / 3.0 m) = 2.5 dB

***These results have sufficient margin without taking account Dwell time factor.**

UL Japan, Inc.

Ise EMC Lab.

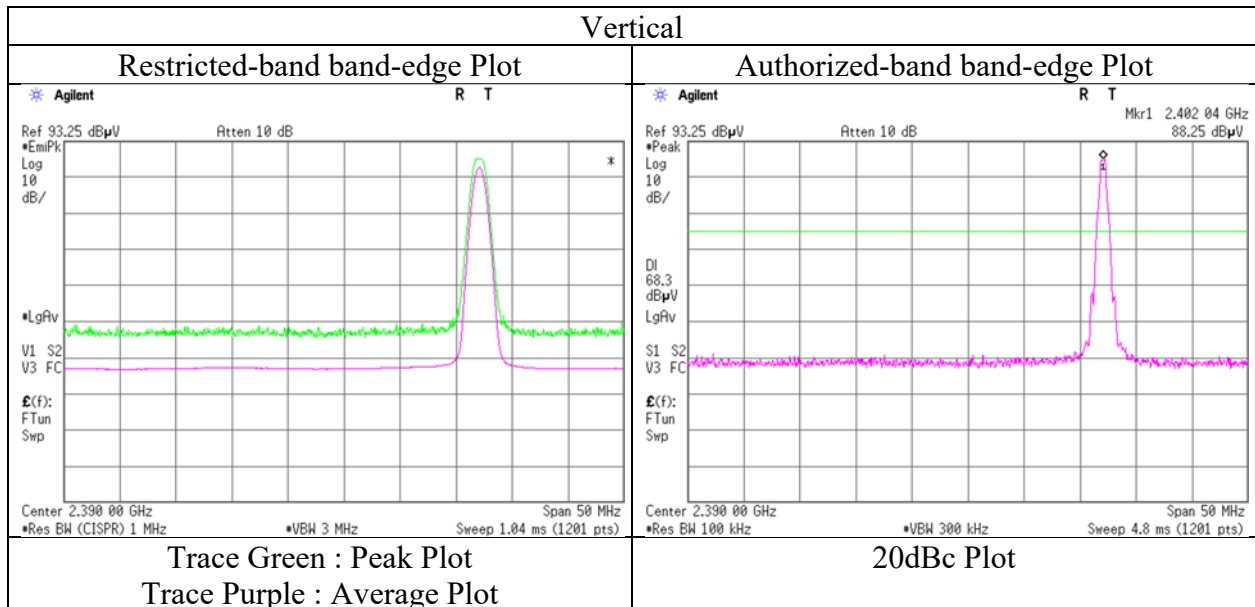
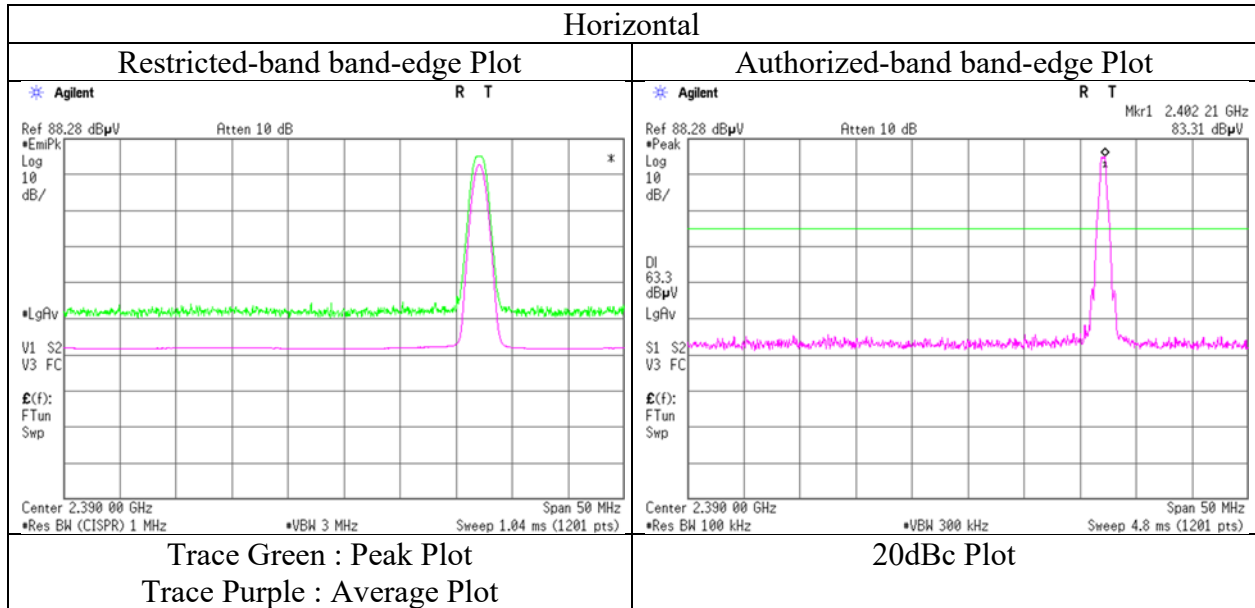
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12344074H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	June 11, 2018
Temperature / Humidity	22 deg. C / 71 % RH
Engineer	Takafumi Noguchi
	(1 GHz -10 GHz)
Mode	Tx, Hopping Off, DH5 2402 MHz



* Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission

Report No. 12344074H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4 No.4
Date June 11, 2018 (Day) June 11, 2018 (Night)
Temperature / Humidity 22 deg. C / 71 % RH 23 deg. C / 69 % RH
Engineer Takafumi Noguchi Takumi Shimada
(1 GHz -10 GHz) (Above 10 GHz , Below 1 GHz)
Mode Tx, Hopping Off, DH5 2441 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	176.000	QP	30.3	16.2	8.9	32.0	-	23.4	43.5	20.1	
Hori	208.000	QP	40.2	11.5	9.2	32.0	-	28.9	43.5	14.6	
Hori	224.000	QP	40.1	11.6	9.3	32.0	-	29.0	46.0	17.0	
Hori	232.000	QP	40.0	11.7	9.3	32.0	-	29.0	46.0	17.0	
Hori	240.000	QP	42.2	11.7	9.5	32.0	-	31.4	46.0	14.6	
Hori	264.000	QP	37.5	12.3	9.7	32.0	-	27.5	46.0	18.5	
Hori	4882.000	PK	40.9	31.9	8.2	31.2	-	49.8	73.9	24.1	Floor noise
Hori	7323.000	PK	45.2	36.6	9.5	32.4	-	58.9	73.9	15.0	
Hori	9764.000	PK	44.2	38.1	10.2	32.7	-	59.8	73.9	14.1	Floor noise
Hori	4882.000	AV	28.8	31.9	8.2	31.2	-	37.7	53.9	16.2	Floor noise
Hori	7323.000	AV	34.9	36.6	9.5	32.4	-	48.6	53.9	5.3	
Hori	9764.000	AV	31.6	38.1	10.2	32.7	-	47.2	53.9	6.7	Floor noise
Vert	176.000	QP	29.0	16.2	8.9	32.0	-	22.1	43.5	21.4	
Vert	208.000	QP	38.3	11.5	9.2	32.0	-	27.0	43.5	16.5	
Vert	224.000	QP	36.7	11.6	9.3	32.0	-	25.6	46.0	20.4	
Vert	232.000	QP	40.7	11.7	9.4	32.0	-	29.8	46.0	16.2	
Vert	240.000	QP	43.2	11.7	9.5	32.0	-	32.4	46.0	13.6	
Vert	264.000	QP	38.2	12.3	9.7	32.0	-	28.2	46.0	17.8	
Vert	4882.000	PK	42.6	31.9	8.2	31.2	-	51.5	73.9	22.4	Floor noise
Vert	7323.000	PK	45.7	36.6	9.5	32.4	-	59.4	73.9	14.5	
Vert	9764.000	PK	43.9	38.1	10.2	32.7	-	59.5	73.9	14.4	Floor noise
Vert	4882.000	AV	30.9	31.9	8.2	31.2	-	39.8	53.9	14.1	Floor noise
Vert	7323.000	AV	36.3	36.6	9.5	32.4	-	50.0	53.9	3.9	
Vert	9764.000	AV	31.6	38.1	10.2	32.7	-	47.2	53.9	6.7	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(4.0 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. 12344074H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4 No.4
Date June 11, 2018 (Day) June 11, 2018 (Night)
Temperature / Humidity 22 deg. C / 71 % RH 23 deg. C / 69 % RH
Engineer Takafumi Noguchi Takumi Shimada
(1 GHz -10 GHz) (Above 10 GHz , Below 1 GHz)
Mode Tx, Hopping Off, DH5 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	176.000	QP	30.1	16.2	8.9	32.0	-	23.2	43.5	20.3	
Hori	208.000	QP	40.4	11.5	9.2	32.0	-	29.1	43.5	14.4	
Hori	224.000	QP	40.0	11.6	9.3	32.0	-	28.9	46.0	17.1	
Hori	232.000	QP	40.3	11.7	9.3	32.0	-	29.3	46.0	16.7	
Hori	240.000	QP	42.8	11.7	9.5	32.0	-	32.0	46.0	14.0	
Hori	264.000	QP	37.3	12.3	9.7	32.0	-	27.3	46.0	18.7	
Hori	2483.500	PK	42.7	27.5	5.9	32.0	-	44.1	73.9	29.8	
Hori	4960.000	PK	41.9	32.2	8.2	31.2	-	51.1	73.9	22.8	Floor noise
Hori	7440.000	PK	42.8	36.8	9.5	32.5	-	56.6	73.9	17.3	
Hori	9920.000	PK	43.0	38.2	10.2	32.8	-	58.6	73.9	15.3	Floor noise
Hori	2483.500	AV	30.0	27.5	5.9	32.0	-	31.4	53.9	22.5	
Hori	4960.000	AV	29.0	32.2	8.2	31.2	-	38.2	53.9	15.7	Floor noise
Hori	7440.000	AV	31.7	36.8	9.5	32.5	-	45.5	53.9	8.4	
Hori	9920.000	AV	31.4	38.2	10.2	32.8	-	47.0	53.9	6.9	Floor noise
Vert	176.000	QP	29.2	16.2	8.9	32.0	-	22.3	43.5	21.2	
Vert	208.000	QP	38.1	11.5	9.2	32.0	-	26.8	43.5	16.7	
Vert	224.000	QP	36.9	11.6	9.3	32.0	-	25.8	46.0	20.2	
Vert	232.000	QP	40.6	11.7	9.4	32.0	-	29.7	46.0	16.3	
Vert	240.000	QP	43.4	11.7	9.5	32.0	-	32.6	46.0	13.4	
Vert	264.000	QP	38.5	12.3	9.7	32.0	-	28.5	46.0	17.5	
Vert	2483.500	PK	41.9	27.5	5.9	32.0	-	43.3	73.9	30.6	
Vert	4960.000	PK	40.8	32.2	8.2	31.2	-	50.0	73.9	23.9	Floor noise
Vert	7440.000	PK	45.2	36.8	9.5	32.5	-	59.0	73.9	14.9	
Vert	9920.000	PK	43.4	38.2	10.2	32.8	-	59.0	73.9	14.9	Floor noise
Vert	2483.500	AV	29.6	27.5	5.9	32.0	-	31.0	53.9	22.9	
Vert	4960.000	AV	29.0	32.2	8.2	31.2	-	38.2	53.9	15.7	Floor noise
Vert	7440.000	AV	35.3	36.8	9.5	32.5	-	49.1	53.9	4.8	
Vert	9920.000	AV	31.4	38.2	10.2	32.8	-	47.0	53.9	6.9	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(4.0 m / 3.0 m) = 2.5 dB
10 GHz - 26.5 GHz 20log(1.0 m / 3.0 m) = -9.5 dB

UL Japan, Inc.

Ise EMC Lab.

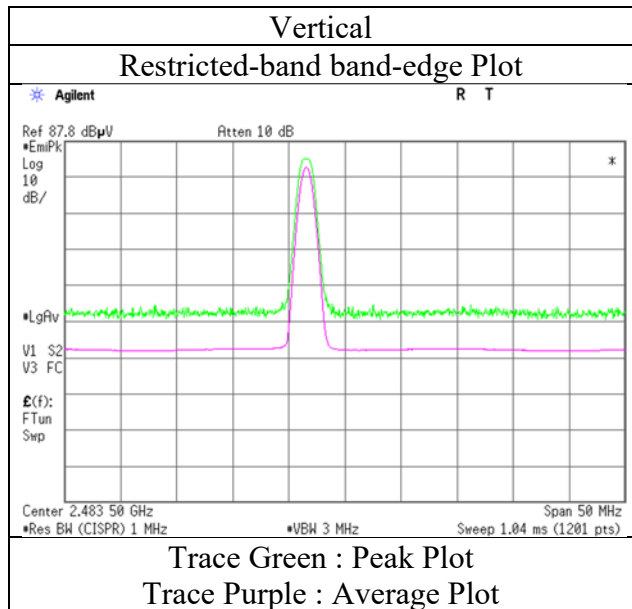
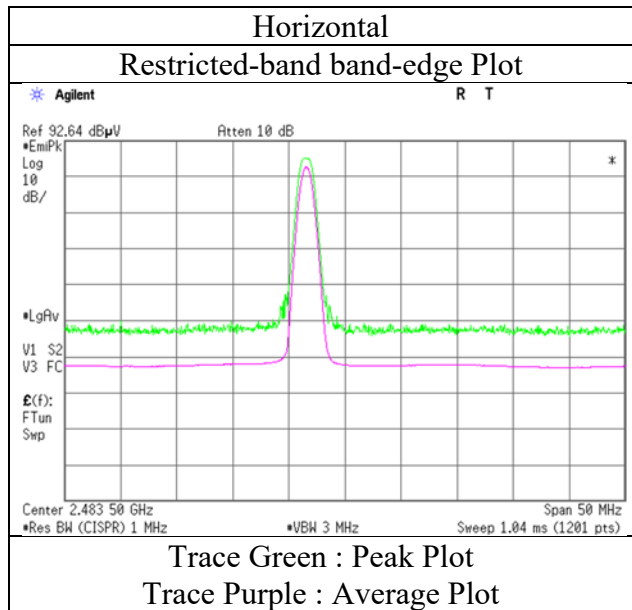
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No. 12344074H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date June 11, 2018
Temperature / Humidity 22 deg. C / 71 % RH
Engineer Takafumi Noguchi
(1 GHz -10 GHz)
Mode Tx, Hopping Off, DH5 2480 MHz



* Final result of restricted band edge was shown in tabular data.

UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Radiated Spurious Emission

Report No.	12344074H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	June 11, 2018	June 11, 2018 (Night)	June 12, 2018 (Night)
Temperature / Humidity	22 deg. C / 71 % RH	23 deg. C / 69 % RH	21 deg. C / 57 % RH
Engineer	Takafumi Noguchi	Takumi Shimada	Takumi Shimada
	(1 GHz -10 GHz)	(Above 10 GHz)	(Below 1 GHz)
Mode	Tx, Hopping Off, 3DH5 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	176.000	QP	30.5	16.2	8.9	32.0	-	23.6	43.5	19.9	
Hori	208.000	QP	40.2	11.5	9.2	32.0	-	28.9	43.5	14.6	
Hori	224.000	QP	40.1	11.6	9.3	32.0	-	29.0	46.0	17.0	
Hori	232.000	QP	40.3	11.7	9.4	32.0	-	29.4	46.0	16.6	
Hori	240.000	QP	42.5	11.7	9.5	32.0	-	31.7	46.0	14.3	
Hori	264.000	QP	37.6	12.3	9.7	32.0	-	27.6	46.0	18.4	
Hori	2390.000	PK	41.7	27.4	5.9	32.1	-	42.9	73.9	31.0	
Hori	4804.000	PK	40.4	31.7	8.1	31.3	-	48.9	73.9	25.0	Floor noise
Hori	7206.000	PK	45.9	36.4	9.5	32.4	-	59.4	73.9	14.5	
Hori	9608.000	PK	43.4	38.0	10.2	32.6	-	59.0	73.9	14.9	Floor noise
Hori	2390.000	AV	29.8	27.4	5.9	32.1	-	31.0	53.9	22.9	
Hori	4804.000	AV	28.7	31.7	8.1	31.3	-	37.2	53.9	16.7	Floor noise
Hori	7206.000	AV	35.5	36.4	9.5	32.4	-	49.0	53.9	4.9	
Hori	9608.000	AV	31.7	38.0	10.2	32.6	-	47.3	53.9	6.6	Floor noise
Vert	176.000	QP	29.4	16.2	8.9	32.0	-	22.5	43.5	21.0	
Vert	208.000	QP	38.5	11.5	9.2	32.0	-	27.2	43.5	16.3	
Vert	224.000	QP	36.7	11.6	9.3	32.0	-	25.6	46.0	20.4	
Vert	232.000	QP	40.5	11.7	9.4	32.0	-	29.6	46.0	16.4	
Vert	240.000	QP	43.0	11.7	9.5	32.0	-	32.2	46.0	13.8	
Vert	264.000	QP	38.5	12.3	9.7	32.0	-	28.5	46.0	17.5	
Vert	2390.000	PK	41.8	27.4	5.9	32.1	-	43.0	73.9	30.9	
Vert	4804.000	PK	40.8	31.7	8.1	31.3	-	49.3	73.9	24.6	Floor noise
Vert	7206.000	PK	47.3	36.4	9.5	32.4	-	60.8	73.9	13.1	
Vert	9608.000	PK	43.8	38.0	10.2	32.6	-	59.4	73.9	14.5	Floor noise
Vert	2390.000	AV	29.5	27.4	5.9	32.1	-	30.7	53.9	23.2	
Vert	4804.000	AV	28.8	31.7	8.1	31.3	-	37.3	53.9	16.6	Floor noise
Vert	7206.000	AV	36.8	36.4	9.5	32.4	-	50.3	53.9	3.6	
Vert	9608.000	AV	32.0	38.0	10.2	32.6	-	47.6	53.9	6.3	Floor noise

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

*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(4.0 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	2402.000	PK	89.1	27.4	5.9	32.1	90.3	-	-	Carrier
Hori	2400.000	PK	39.3	27.4	5.9	32.1	40.5	70.3	29.8	
Vert	2402.000	PK	81.9	27.4	5.9	32.1	83.1	-	-	Carrier
Vert	2400.000	PK	35.3	27.4	5.9	32.1	36.5	63.1	26.6	

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

Distance factor: 1 GHz - 10 GHz 20log(4.0 m / 3.0 m) = 2.5 dB

***These results have sufficient margin without taking account Dwell time factor.**

UL Japan, Inc.

Ise EMC Lab.

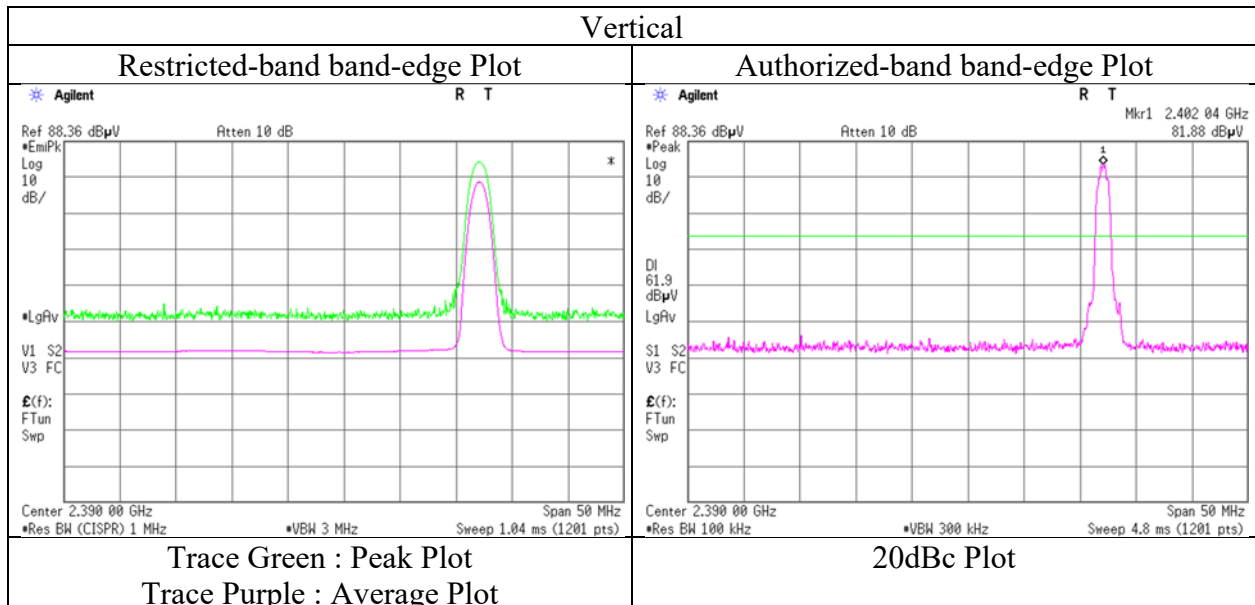
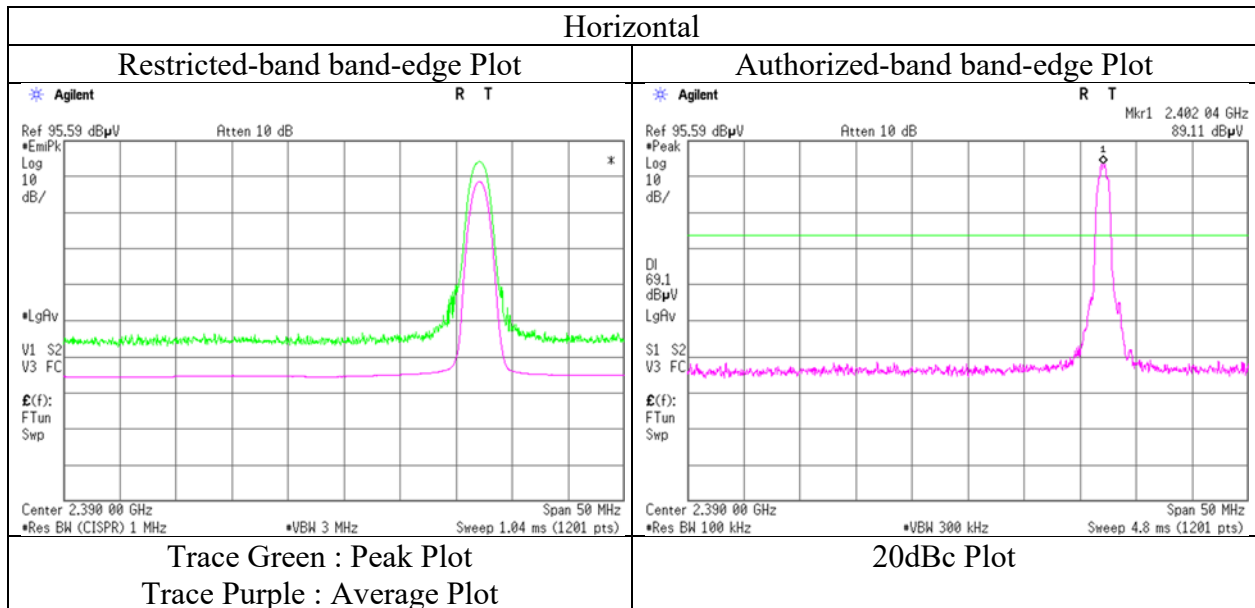
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12344074H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	June 11, 2018
Temperature / Humidity	22 deg. C / 71 % RH
Engineer	Takafumi Noguchi
	(1 GHz -10 GHz)
Mode	Tx, Hopping Off, 3DH5 2402 MHz



* Final result of restricted band edge was shown in tabular data.

UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Radiated Spurious Emission

Report No.	12344074H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	June 11, 2018	June 11, 2018 (Night)	June 12, 2018 (Night)
Temperature / Humidity	22 deg. C / 71 % RH	23 deg. C / 69 % RH	21 deg. C / 57 % RH
Engineer	Takafumi Noguchi	Takumi Shimada	Takumi Shimada
	(1 GHz -10 GHz)	(Above 10 GHz)	(Below 1 GHz)
Mode	Tx, Hopping Off, 3DH5 2441 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	176.000	QP	30.8	16.2	8.9	32.0	-	23.9	43.5	19.6	
Hori	208.000	QP	40.1	11.5	9.2	32.0	-	28.8	43.5	14.7	
Hori	224.000	QP	40.3	11.6	9.3	32.0	-	29.2	46.0	16.8	
Hori	232.000	QP	40.4	11.7	9.4	32.0	-	29.5	46.0	16.5	
Hori	240.000	QP	42.4	11.7	9.5	32.0	-	31.6	46.0	14.4	
Hori	264.000	QP	37.4	12.3	9.7	32.0	-	27.4	46.0	18.6	
Hori	4882.000	PK	41.0	31.9	8.2	31.2	-	49.9	73.9	24.0	Floor noise
Hori	7323.000	PK	44.6	36.6	9.5	32.4	-	58.3	73.9	15.6	
Hori	9764.000	PK	43.7	38.1	10.2	32.7	-	59.3	73.9	14.6	Floor noise
Hori	4882.000	AV	28.8	31.9	8.2	31.2	-	37.7	53.9	16.2	Floor noise
Hori	7323.000	AV	33.1	36.6	9.5	32.4	-	46.8	53.9	7.1	
Hori	9764.000	AV	31.5	38.1	10.2	32.7	-	47.1	53.9	6.8	Floor noise
Vert	176.000	QP	29.9	16.2	8.9	32.0	-	23.0	43.5	20.5	
Vert	208.000	QP	38.4	11.5	9.2	32.0	-	27.1	43.5	16.4	
Vert	224.000	QP	36.9	11.6	9.3	32.0	-	25.8	46.0	20.2	
Vert	232.000	QP	40.5	11.7	9.4	32.0	-	29.6	46.0	16.4	
Vert	240.000	QP	44.1	11.7	9.5	32.0	-	33.3	46.0	12.7	
Vert	264.000	QP	38.2	12.3	9.7	32.0	-	28.2	46.0	17.8	
Vert	4882.000	PK	40.8	31.9	8.2	31.2	-	49.7	73.9	24.2	Floor noise
Vert	7323.000	PK	46.2	36.6	9.5	32.4	-	59.9	73.9	14.0	
Vert	9764.000	PK	43.0	38.1	10.2	32.7	-	58.6	73.9	15.3	Floor noise
Vert	4882.000	AV	28.7	31.9	8.2	31.2	-	37.6	53.9	16.3	Floor noise
Vert	7323.000	AV	34.7	36.6	9.5	32.4	-	48.4	53.9	5.5	
Vert	9764.000	AV	31.6	38.1	10.2	32.7	-	47.2	53.9	6.7	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(4.0 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.	12344074H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	June 11, 2018	June 11, 2018 (Night)	June 12, 2018 (Night)
Temperature / Humidity	22 deg. C / 71 % RH	23 deg. C / 69 % RH	21 deg. C / 57 % RH
Engineer	Takafumi Noguchi	Takumi Shimada	Takumi Shimada
	(1 GHz -10 GHz)	(Above 10 GHz)	(Below 1 GHz)
Mode	Tx, Hopping Off, 3DH5 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	176.000	QP	30.9	16.2	8.9	32.0	-	24.0	43.5	19.5	
Hori	208.000	QP	40.2	11.5	9.2	32.0	-	28.9	43.5	14.6	
Hori	224.000	QP	40.2	11.6	9.3	32.0	-	29.1	46.0	16.9	
Hori	232.000	QP	40.2	11.7	9.4	32.0	-	29.3	46.0	16.7	
Hori	240.000	QP	42.6	11.7	9.5	32.0	-	31.8	46.0	14.2	
Hori	264.000	QP	37.3	12.3	9.7	32.0	-	27.3	46.0	18.7	
Hori	2483.500	PK	43.0	27.5	5.9	32.0	-	44.4	73.9	29.5	
Hori	4960.000	PK	41.8	32.2	8.2	31.2	-	51.0	73.9	22.9	Floor noise
Hori	7440.000	PK	43.1	36.8	9.5	32.5	-	56.9	73.9	17.0	
Hori	9920.000	PK	42.9	38.2	10.2	32.8	-	58.5	73.9	15.4	Floor noise
Hori	2483.500	AV	30.1	27.5	5.9	32.0	-	31.5	53.9	22.4	
Hori	4960.000	AV	27.5	32.2	8.2	31.2	-	36.7	53.9	17.2	Floor noise
Hori	7440.000	AV	30.3	36.8	9.5	32.5	-	44.1	53.9	9.8	
Hori	9920.000	AV	30.0	38.2	10.2	32.8	-	45.6	53.9	8.3	Floor noise
Vert	176.000	QP	30.1	16.2	8.9	32.0	-	23.2	43.5	20.3	
Vert	208.000	QP	38.7	11.5	9.2	32.0	-	27.4	43.5	16.1	
Vert	224.000	QP	36.6	11.6	9.3	32.0	-	25.5	46.0	20.5	
Vert	232.000	QP	40.4	11.7	9.4	32.0	-	29.5	46.0	16.5	
Vert	240.000	QP	44.3	11.7	9.5	32.0	-	33.5	46.0	12.5	
Vert	264.000	QP	38.7	12.3	9.7	32.0	-	28.7	46.0	17.3	
Vert	2483.500	PK	43.0	27.5	5.9	32.0	-	44.4	73.9	29.5	
Vert	4960.000	PK	40.6	32.2	8.2	31.2	-	49.8	73.9	24.1	Floor noise
Vert	7440.000	PK	45.2	36.8	9.5	32.5	-	59.0	73.9	14.9	
Vert	9920.000	PK	43.4	38.2	10.2	32.8	-	59.0	73.9	14.9	Floor noise
Vert	2483.500	AV	29.7	27.5	5.9	32.0	-	31.1	53.9	22.8	
Vert	4960.000	AV	29.0	32.2	8.2	31.2	-	38.2	53.9	15.7	Floor noise
Vert	7440.000	AV	33.4	36.8	9.5	32.5	-	47.2	53.9	6.7	
Vert	9920.000	AV	31.4	38.2	10.2	32.8	-	47.0	53.9	6.9	Floor noise

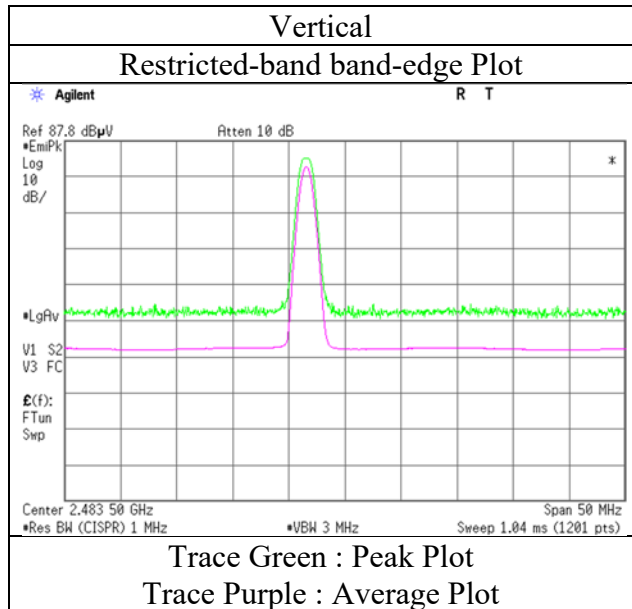
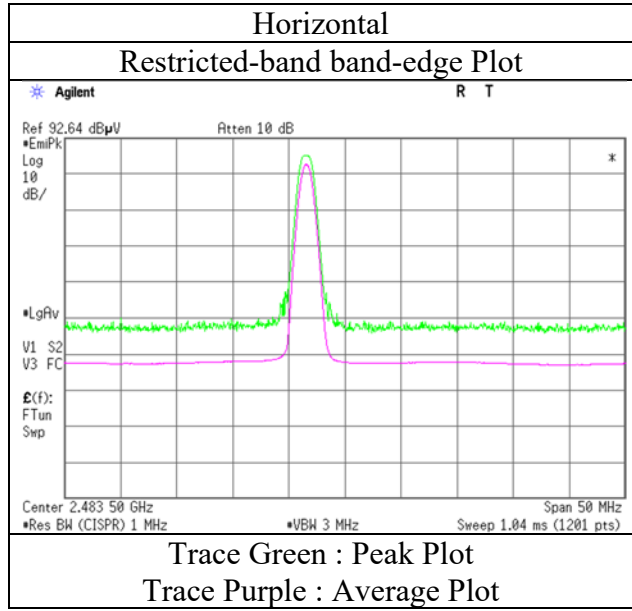
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)

*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(4.0 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)

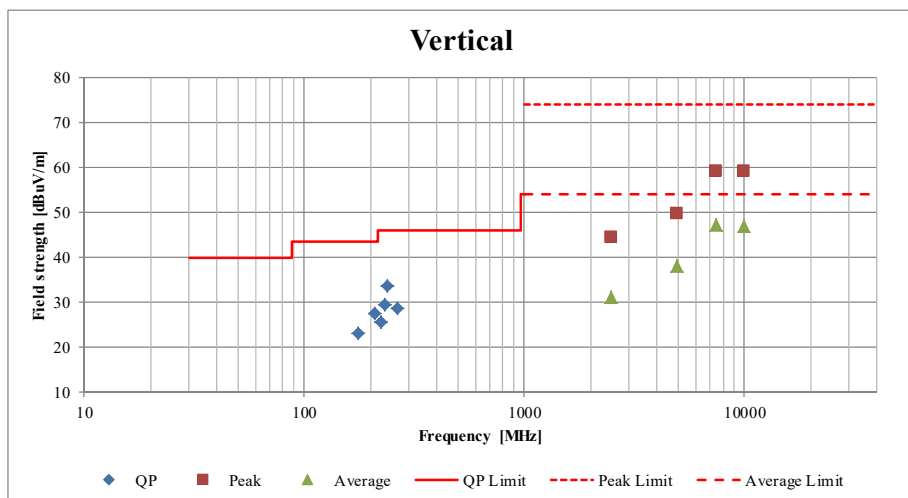
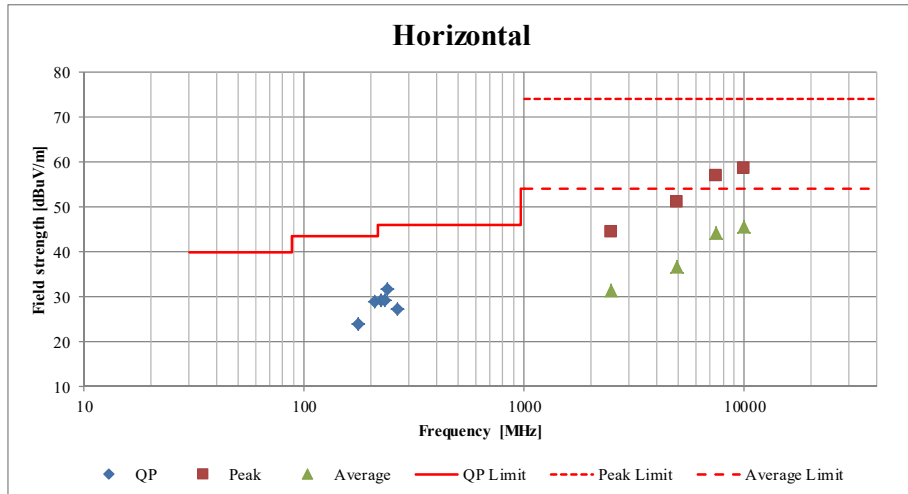
Report No. 12344074H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date June 11, 2018
Temperature / Humidity 22 deg. C / 71 % RH
Engineer Takafumi Noguchi
(1 GHz -10 GHz)
Mode Tx, Hopping Off, 3DH5 2480 MHz



* Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission (Plot data, Worst case)

Report No.	12344074H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	June 11, 2018	June 11, 2018 (Night)	June 12, 2018 (Night)
Temperature / Humidity	22 deg. C / 71 % RH	23 deg. C / 69 % RH	21 deg. C / 57 % RH
Engineer	Takafumi Noguchi (1 GHz -10 GHz)	Takumi Shimada (Above 10 GHz)	Takumi Shimada (Below 1 GHz)
Mode	Tx, Hopping Off, 3DH5 2480 MHz		

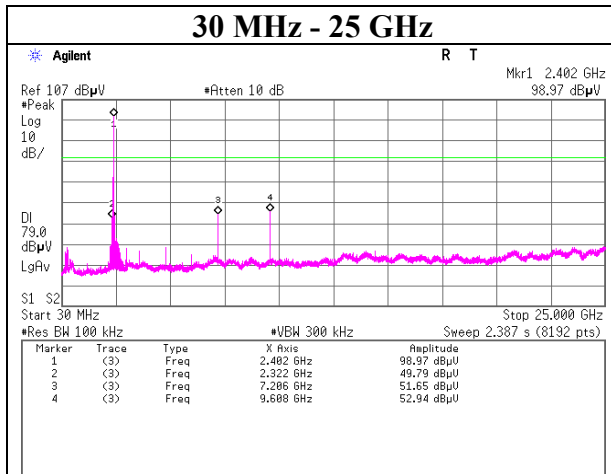
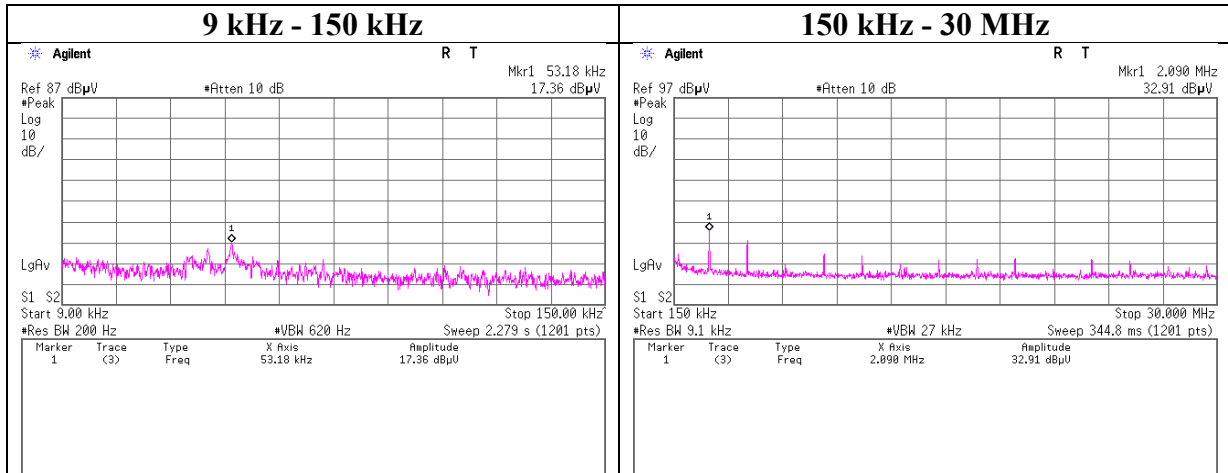


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

Conducted Spurious Emission

Report No. 12344074H
 Test place Ise EMC Lab. No.6 Measurement Room / Shielded Room
 Date June 4, 2018
 Temperature / Humidity 22 deg. C / 45 % RH
 Engineer Ryota Yamanaka
 Mode Tx, Hopping Off, DH5

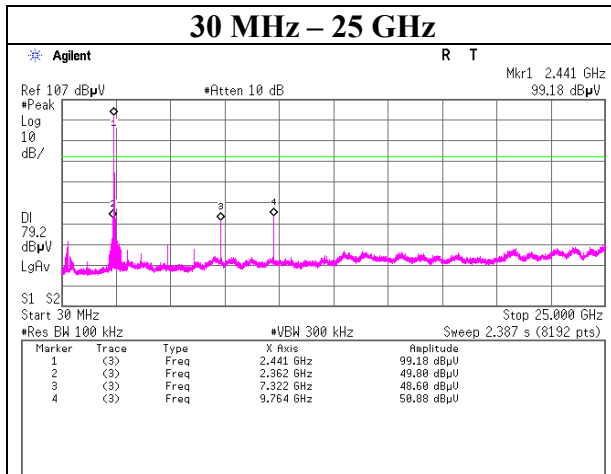
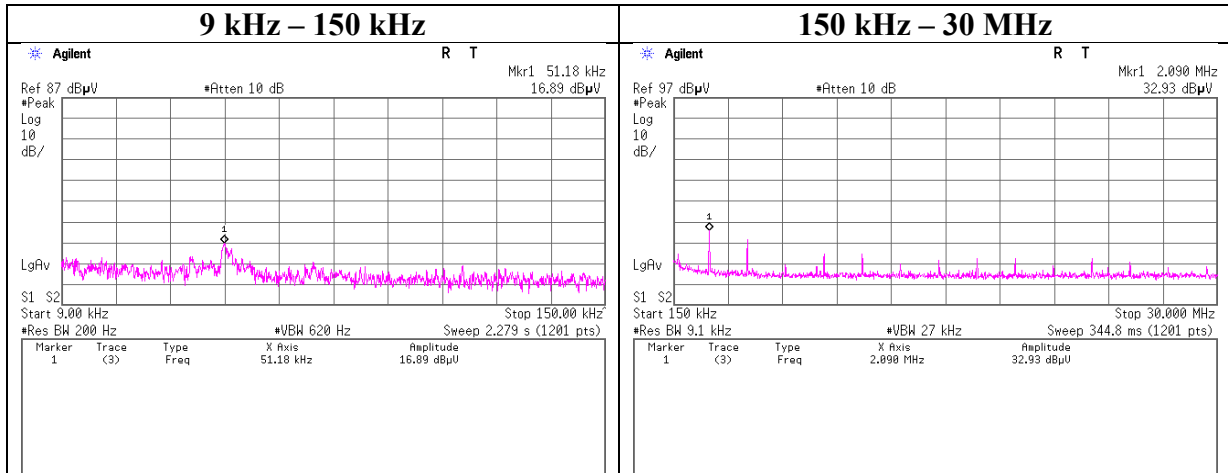
2402 MHz



Conducted Spurious Emission

Report No. 12344074H
 Test place Ise EMC Lab. No.6 Measurement Room / Shielded Room
 Date June 4, 2018
 Temperature / Humidity 22 deg. C / 45 % RH
 Engineer Ryota Yamanaka
 Mode Tx, Hopping Off, DH5

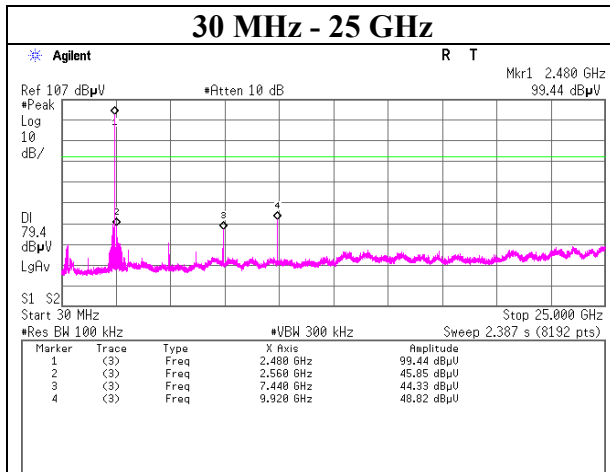
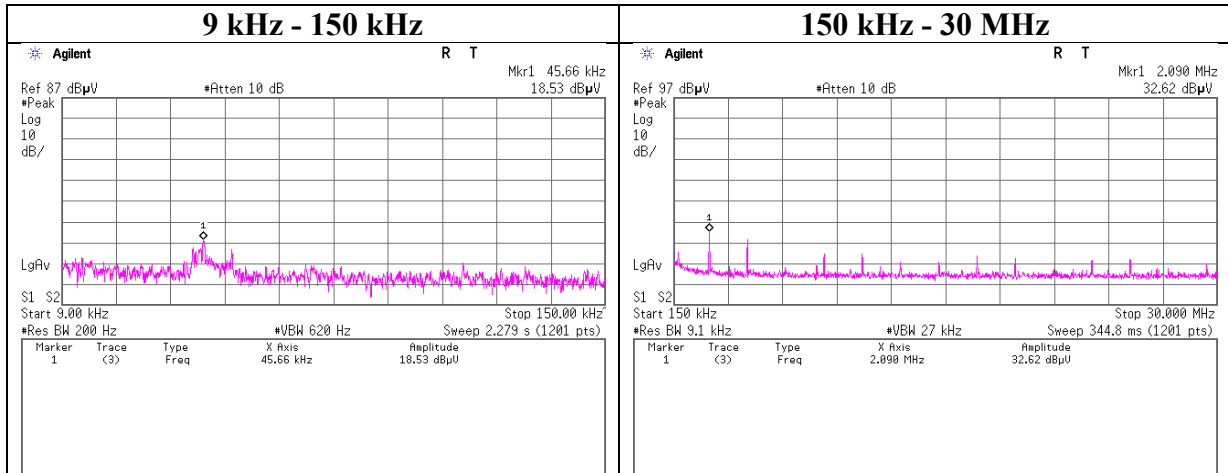
2441 MHz



Conducted Spurious Emission

Report No. 12344074H
 Test place Ise EMC Lab. No.6 Measurement Room / Shielded Room
 Date June 4, 2018
 Temperature / Humidity 22 deg. C / 45 % RH
 Engineer Ryota Yamanaka
 Mode Tx, Hopping Off, DH5

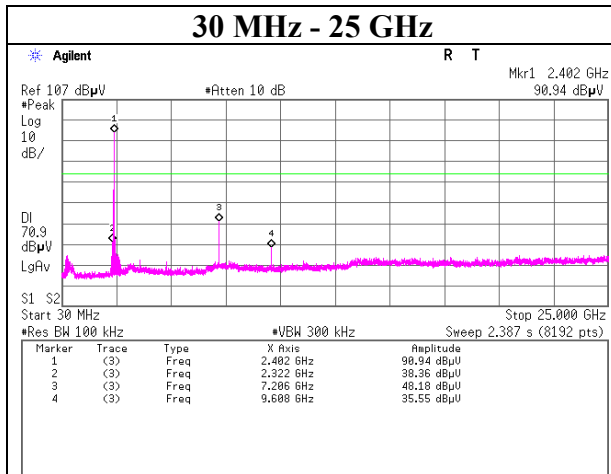
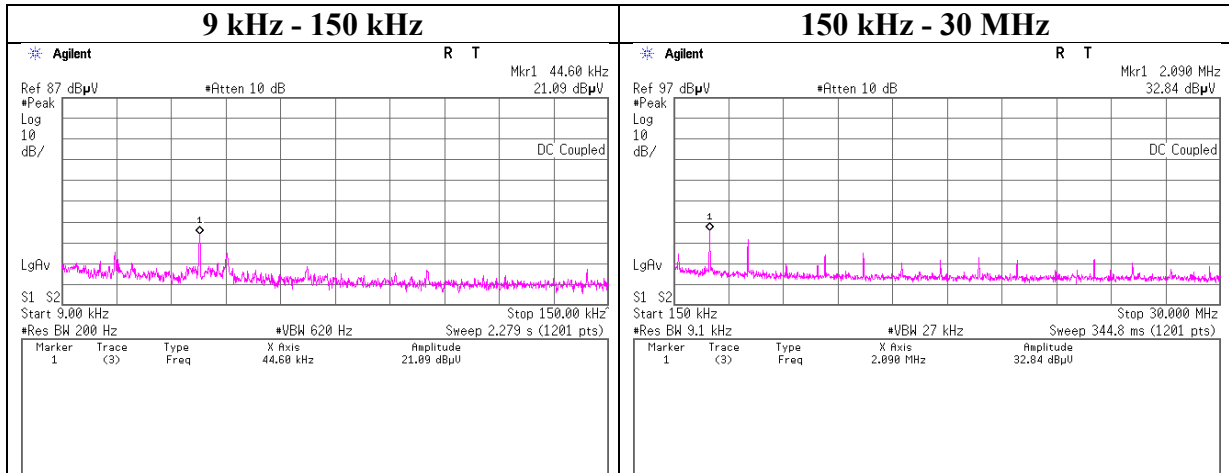
2480 MHz



Conducted Spurious Emission

Report No. 12344074H
 Test place Ise EMC Lab. No.11 Measurement Room
 Date June 17, 2018
 Temperature / Humidity 23 deg. C / 57 % RH
 Engineer Takafumi Noguchi
 Mode Tx, Hopping Off, 3DH5

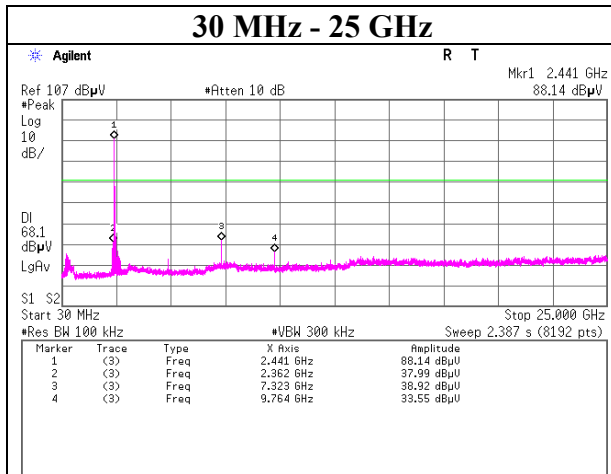
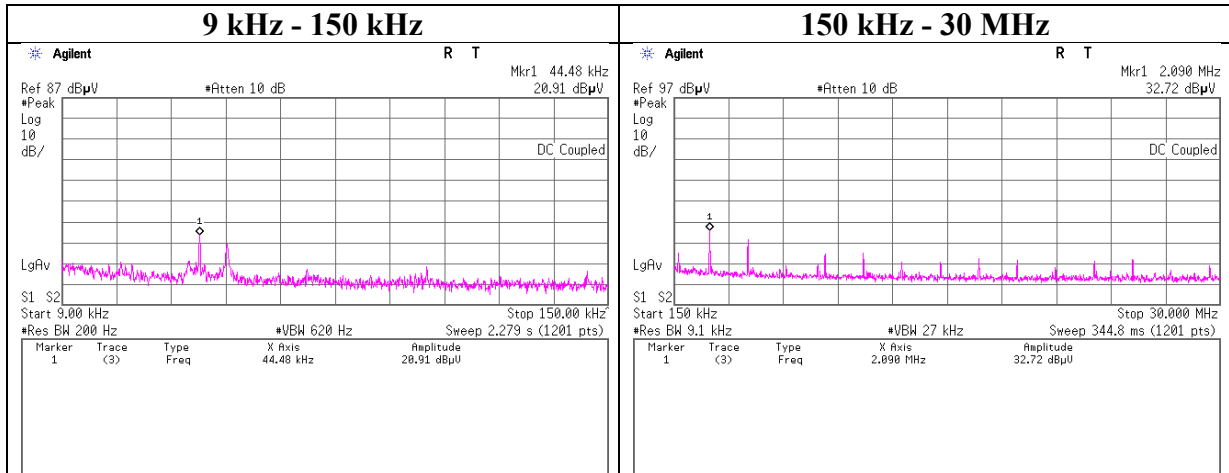
2402 MHz



Conducted Spurious Emission

Report No. 12344074H
 Test place Ise EMC Lab. No.11 Measurement Room
 Date June 17, 2018
 Temperature / Humidity 23 deg. C / 57 % RH
 Engineer Takafumi Noguchi
 Mode Tx, Hopping Off, 3DH5

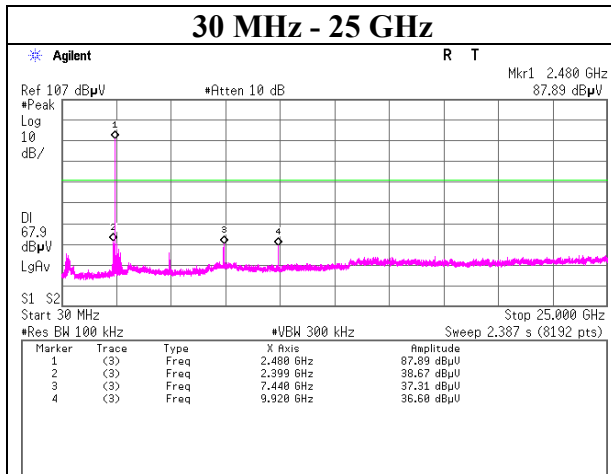
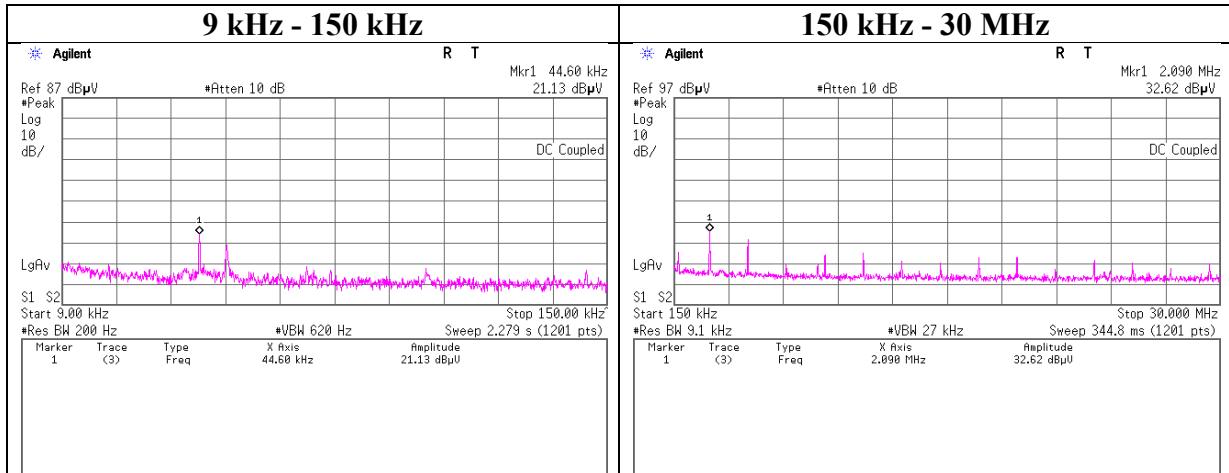
2441 MHz



Conducted Spurious Emission

Report No. 12344074H
 Test place Ise EMC Lab. No.11 Measurement Room
 Date June 17, 2018
 Temperature / Humidity 23 deg. C / 57 % RH
 Engineer Takafumi Noguchi
 Mode Tx, Hopping Off, 3DH5

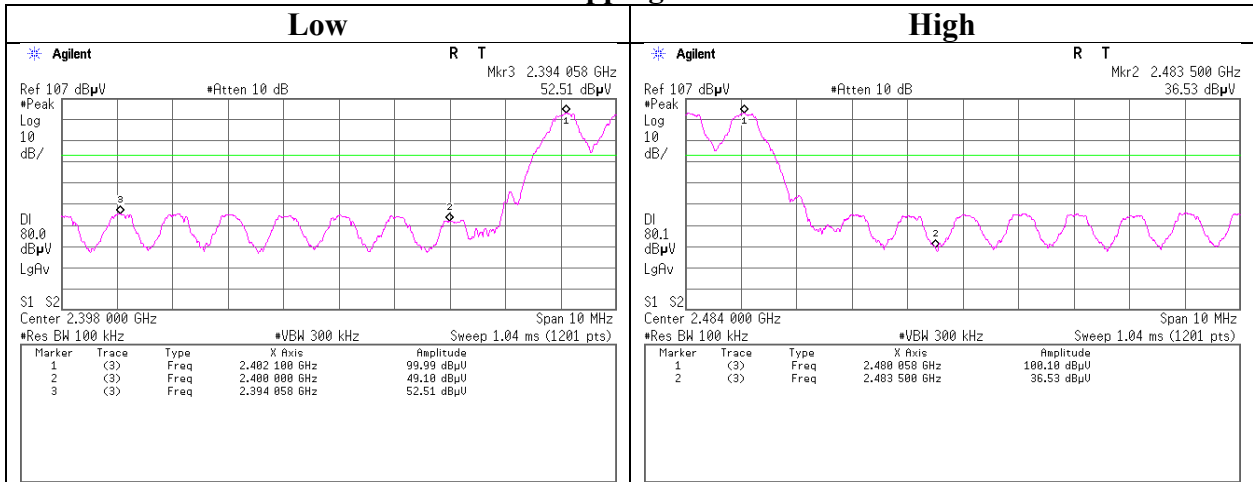
2480 MHz



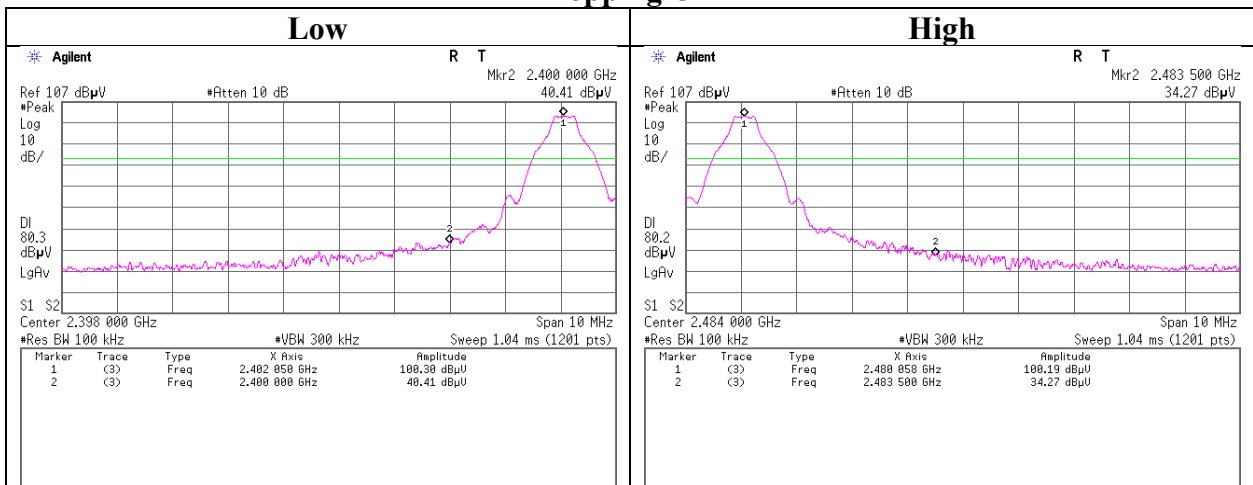
Conducted Emission Band Edge compliance

Report No. 12344074H
 Test place Ise EMC Lab. No.6 Measurement Room / Shielded Room
 Date June 4, 2018
 Temperature / Humidity 22 deg. C / 45 % RH
 Engineer Ryota Yamanaka
 Mode Tx DH5

Hopping On



Hopping Off



UL Japan, Inc.

Ise EMC Lab.

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

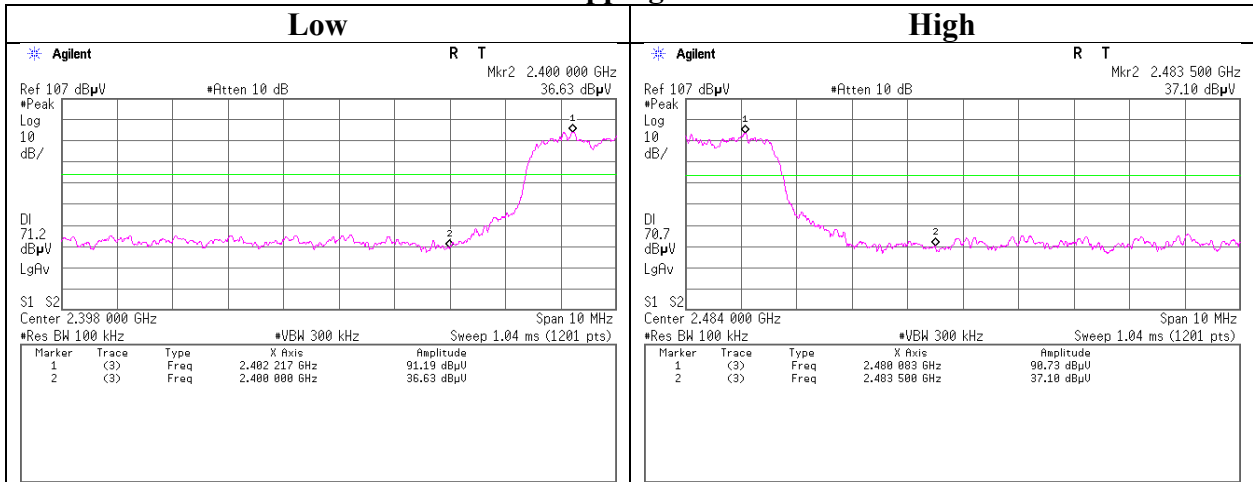
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

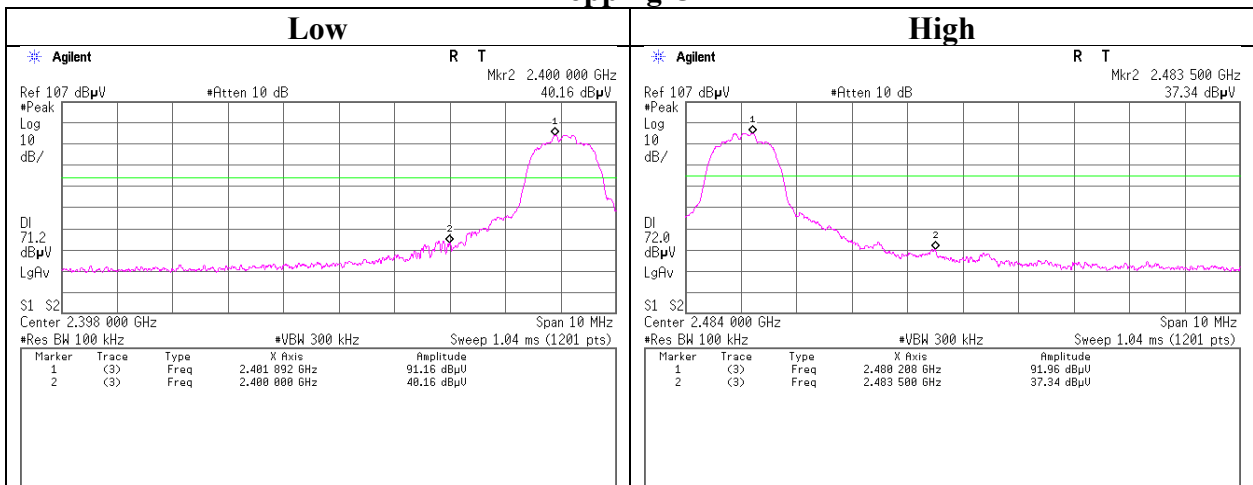
Conducted Emission Band Edge compliance

Report No. 12344074H
 Test place Ise EMC Lab. No.11 Measurement Room
 Date June 17, 2018
 Temperature / Humidity 23 deg. C / 57 % RH
 Engineer Takafumi Noguchi
 Mode Tx 3DH5

Hopping On



Hopping Off



UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

APPENDIX 2: Test instruments

Test Instruments

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Cal Int
RE	141296	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	002	9/11/2017	9/30/2018	12
RE	141545	DIGITAL HiTESTER	HIOKI	3805	51201148	1/9/2018	1/31/2019	12
RE	141412	Microwave Cable	Junkosha	MWX221	1305S002R(1m) / 1405S146(5m)	6/14/2018	6/30/2019	12
RE	141581	MicroWave System Amplifier	AGILENT	83017A	650	10/6/2017	10/31/2018	12
RE	141512	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	254	2/25/2018	2/28/2019	12
RE	141152	EMI measurement program	TSJ	TEPTO-DV	-	-	-	-
RE	142227	Measure	KOMELON	KMC-36	-	-	-	-
RE	141562	Thermo-Hygrometer	CUSTOM	CTH-180	1501	1/24/2018	1/31/2019	12
RE	142011	AC4 Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	10/30/2017	10/31/2018	12
RE, AT	141885	Spectrum Analyzer	AGILENT	E4448A	US44300523	11/14/2017	11/30/2018	12
RE	141951	EMI Test Receiver	Rohde & Schwarz	ESR26	101408	1/30/2018	1/31/2019	12
RE	141425	Biconical Antenna	Schwarzbeck	BBA9106	1302	11/23/2017	11/30/2018	12
RE	141267	Logperiodic Antenna (200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-192	12/10/2017	12/31/2018	12
RE	148898	Attenuator	KEYSIGHT	8491A	MY52462282	10/12/2017	10/31/2018	12
RE	141397	Coaxial Cable	UL Japan	-	-	6/13/2018	6/30/2019	12
RE	141506	Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170	BBHA9170307	6/29/2017	6/30/2018	12
RE	141583	Pre Amplifier	SONOMA INSTRUMENT	11/5/1900	260833	2/27/2018	2/28/2019	12
AT	141835	Power sensor	AGILENT	N1923A	MY54070004	4/19/2018	4/30/2019	12
AT	141812	Power Meter	AGILENT	8990B	MY51000271	4/19/2018	4/30/2019	12
AT	141903	Spectrum Analyzer	AGILENT	E4440A	MY46186390	9/20/2017	9/30/2018	12
AT	141156	Attenuator(10dB)	Weinschel Corp	2	BL1173	11/14/2017	11/30/2018	12
AT	141226	Microwave Cable	Junkosha	MMX221-00500DMSDMS	1502S304	3/12/2018	3/31/2019	12
AT	141535	Thermo-Hygrometer	CUSTOM	CTH-201	0001	12/21/2017	12/31/2018	12
AT	141561	Thermo-Hygrometer	CUSTOM	CTH-201	1401	1/24/2018	1/31/2019	12
AT	141328	Microwave Cable 1G-40GHz	Suhner	SUCOFLEX102	28636/2	4/24/2018	4/30/2019	12
AT	141361	Attenuator(10dB) 1-18GHz	Orient Microwave	BX10-0476-00	-	3/12/2018	3/31/2019	12
AT	141547	DIGITAL HiTESTER	HIOKI	3805	60500120	2/7/2018	2/28/2019	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

UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124