



RADIO TEST REPORT

Test Report No. : 13204004M-C-R1

Applicant : **DENSO CORPORATION**
Type of EUT : **Cockpit Control Unit**
Model Number of EUT : **DNNS114**
FCC ID : **HYQDNNS114**
Test regulation : **FCC Part 15 Subpart C: 2019**
***Bluetooth BDR/EDR 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 limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by any agency of the Federal Government.
6. This test report covers Radio technical requirements.
It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
7. The all test items in this test report are conducted by UL Japan, Inc. Kashima EMC Lab.
8. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
9. The information provided from the customer for this report is identified in SECTION 1.
10. This report is a revised version of 13204004M-C. 13204004M-C is replaced with this report.

Date of test: January 14 to February 28, 2020

Representative test engineer:

K. Ando

Kazuhiro Ando
Engineer
Consumer Technology Division

Approved by:

T. Yamashita

Tomoyuki Yamashita
Leader
Consumer Technology Division



CERTIFICATE 1266.01

- ☐ 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.

Kashima EMC Lab.

1614, Mushihata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

REVISION HISTORY

Original Test Report No.: 13204004M-C

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13204004M-C	April 17, 2020	-	-
1	13204004M-C-R1	May 18, 2020	P.6	Modify The maximum clock frequencies used in the EUT from 1.8 GHz to 40 MHz (Radio part).
1	13204004M-C-R1	May 18, 2020	P.10	Modify The WLAN Power Setting from 3 dBm to 0 dBm.
1	13204004M-C-R1	May 18, 2020	P.10	Add the following comment to the table; (The setting value might be different from the product specification value.)
1	13204004M-C-R1	May 18, 2020	P.10	Modify the Date of the software from March 8, 2020 to January 10, 2020
1	13204004M-C-R1	May 18, 2020	P.11	Add A' and A'' in a figure. Also connect the antenna to the BT/WiFi cables.
1	13204004M-C-R1	May 18, 2020	P.11	Add A' and A'' (the WiFi/ASSEMBLY Bluetooth antenna) in the table of "Description of EUT and Support equipment".
1	13204004M-C-R1	May 18, 2020	P.12	Missing cable number 11 in the "List of cables used". Add the cable number 11 and modify the number after 11 in the list.

UL Japan, Inc.

Kashima EMC Lab.

1614, Mushihata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

Reference: Abbreviations (Including words undescribed in this report)

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

UL Japan, Inc.

Kashima EMC Lab.

1614, Mushiata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

CONTENTS	PAGE
SECTION 1: Customer information.....	5
SECTION 2: Equipment under test (EUT).....	5
SECTION 3: Test specification, procedures & results.....	7
SECTION 4: Operation of EUT during testing.....	10
SECTION 5: Radiated Spurious Emission	13
SECTION 6: Antenna Terminal Conducted Tests.....	15
APPENDIX 1: Test data	16
20dB Bandwidth, 99%Occupied Bandwidth and Carrier Frequency Separation.....	16
Number of Hopping Frequency	20
Dwell time.....	22
Maximum Peak Output Power	25
Average Output Power.....	26
Radiated Spurious Emission	28
Conducted Spurious Emission	39
Conducted Emission Band Edge compliance	45
APPENDIX 2: Test instruments	47
APPENDIX 3: Photographs of test setup	48
Radiated Spurious Emission	48

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

The information provided from the customer is as follows;

- Applicant, Type of EUT, Model Number of EUT, FCC ID on the cover and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- SECTION 1: Customer information
- SECTION 2: Equipment under test (EUT) other than Receipt Date
- SECTION 4: Operation of EUT during testing

* The laboratory is exempted from liability of any test results affected from the above information in SECTION 2 and 4.

SECTION 2: Equipment under test (EUT)

2.1 Identification of EUT

Type	:	Cockpit Control Unit
Model Number	:	DNNS114
Serial Number	:	Refer to SECTION 4.2
Rating	:	DC 13.2 V
Receipt Date	:	January 8, 2020
Country of Mass-production	:	JAPAN
Condition	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	:	No Modification by the test lab.

2.2 Product Description

Model: DNNS114 (referred to as the EUT in this report) is a Cockpit Control Unit.

General Specification

The maximum clock frequencies used in the EUT: 40 MHz (Radio part)

Radio Specification

*Wireless LAN and Bluetooth do not transmit simultaneously.

*This test report applies to Bluetooth (2.4 GHz band).

[WLAN (IEEE802.11b/g/n-20)]

	IEEE802.11b	IEEE802.11g/n (20 M band)
Radio Type	Transceiver	
Frequency of operation	2412 MHz - 2462 MHz	
Type of modulation	DSSS (CCK, DQPSK, DBPSK)	OFDM (64QAM, 16QAM, QPSK, BPSK)
Channel spacing	5 MHz	
Antenna type	ASSEMBLY WiFi Antenna	
Antenna Connector type	MHF PLUG	
Antenna Gain	-6.40 dBi (max)	

[Bluetooth (BDR / EDR function)]

	Bluetooth Ver.4.2 with EDR function
Radio Type	Transceiver
Frequency of operation	2402 MHz - 2480 MHz
Type of modulation	FHSS (GFSK, $\pi/4$ -DQPSK, 8-DPSK)
Channel spacing	1 MHz
Antenna type	ASSEMBLY BT Antenna
Antenna Connector type	MHF PLUG
Antenna Gain	-4.52 dBi (max)

[Broadcast]

	AM	FM	XM	RBDS
Radio Type	Receiver			
Frequency of operation	522 kHz – 1629 kHz	87.5 MHz – 108.0 MHz	2333.465 MHz – 2344.045 MHz	87.5 MHz – 108.0 MHz
Antenna Connector type	GT13	GT13	GT13	GT13

UL Japan, Inc.

Kashima EMC Lab.

1614, Mushihata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

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

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

3.2 Procedures and results

Item	Test Procedure	Specification	Worst Margin	Results	Remarks
Conducted Emission	FCC: ANSI C63.10-2013 6. Standard test methods ISED: RSS-Gen 8.8	FCC: Section 15.207 ISED: RSS-Gen 8.8	-	N/A	*1)
Carrier Frequency Separation	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: -	FCC: Section 15.247(a)(1) ISED: RSS-247 5.1 (b)	See data.	Complied a)	Conducted
20dB Bandwidth	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: -	FCC: Section 15.247(a)(1) ISED: RSS-247 5.1 (a)		Complied a)	Conducted
Number of Hopping Frequency	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: -	FCC: Section 15.247(a)(1)(iii) ISED: RSS-247 5.1 (d)		Complied b)	Conducted
Dwell time	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: -	FCC: Section 15.247(a)(1)(iii) ISED: RSS-247 5.1 (d)		Complied c)	Conducted
Maximum Peak Output Power	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: RSS-Gen 6.12	FCC: Section 15.247(a)(b)(1) ISED: RSS-247 5.4 (b)		Complied d)	Conducted
Spurious Emission & Band Edge Compliance	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02 ISED: RSS-Gen 6.13	FCC: Section 15.247(d) ISED: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	1.0 dB 7206.00 MHz, AV, Vert.	Complied# e) /f)	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).

a) Refer to APPENDIX 1 (data of 20dB Bandwidth, 99% Occupied Bandwidth and Carrier Frequency Separation)

b) Refer to APPENDIX 1 (data of Number of Hopping Frequency)

c) Refer to APPENDIX 1 (data of Dwell time)

d) Refer to APPENDIX 1 (data of Maximum Peak Output Power)

e) Refer to APPENDIX 1 (data of Conducted Spurious Emission)

f) Refer to APPENDIX 1 (data of Radiated Spurious Emission)

Symbols:

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

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

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

FCC Part 15.31 (e)

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.

Kashima EMC Lab.

1614, Mushiata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99% Occupied Bandwidth	ISED: RSS-Gen 6.7	ISED: -	N/A	- a)	Conducted
a) Refer to APPENDIX 1 (data of 20dB Bandwidth, 99%Occupied Bandwidth and Carrier Frequency Separation)					

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 laboratory uncertainty is applied.

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

Conducted emission

Frequency range	Required Uncertainty (+/-)	Uncertainty (+/-)
0.15 MHz to 30 MHz	3.4 dB	3.3 dB

Radiated emission

Measurement distance	Frequency range	Required Uncertainty (+/-)	Uncertainty (+/-)
3 m	9 kHz to 30 MHz	Not Defined	2.9 dB
	30 MHz to 200 MHz	6.3 dB	6.1 dB
	200 MHz to 1000 MHz		6.2 dB
	1 GHz to 6 GHz	5.2 dB	5.0 dB
	6 GHz to 18 GHz	5.5 dB	5.4 dB
	18 GHz to 40 GHz	Not Defined	5.5 dB
1 m	1 GHz to 18 GHz	Not Defined	5.4 dB
	18 GHz to 40 GHz		5.6 dB

Antenna Terminal test

Test Item	Required Uncertainty (+/-)	Uncertainty (+/-)
20 dB Bandwidth / 99 % Occupied Bandwidth	Not Defined	1.6 %
Maximum Peak Output Power	0.75 dB	0.73 dB
Carrier Frequency Separation	Not Defined	2.1×10^{-7}
Dwell time / Burst Rate	Not Defined	0.256 %
Conducted Spurious Emission (below 6 GHz)	4 dB	2.2 dB
Conducted Spurious Emission (6 GHz to 18 GHz)		2.2 dB
Conducted Spurious Emission (18 GHz to 26.5 GHz)		2.4 dB
Conducted Spurious Emission (26.5 GHz to 40 GHz)		2.7 dB

3.5 Test Location

UL Japan, Inc. Kashima EMC Lab.

1614 Mushihata, Katori-shi, Chiba-ken, 289-0341 JAPAN

Telephone: +81 478 88 6500, Facsimile: +81 478 82 3373

A2LA Certificate Number: 1266.01/FCC Test Firm Registration Number: 910230 / ISED Lab Company Number: 4659A

Test site	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Open site	6.0 x 5.5 x 2.5	20 x 40	10 m
No.5 Open site	8.6 x 7.1 x 2.4	18 x 23	10 m
No.1 Shielded room	5.4 x 4.5 x 2.3	-	-
No.5 Shielded Room	4.2 x 3.1 x 2.5	-	-
No.9 Shielded Room	6.1 x 3.6 x 2.8	-	-
No.6 Semi-anechoic Chamber	8.5 x 5.5 x 5.2	-	3 m
No.10 Semi-anechoic Chamber	18.4 x 9.9 x 7.7	-	10 m
No.11 Semi-anechoic Chamber	9.0 x 6.5 x 5.2	-	3 m
No.1 Measurement room	5.0 x 3.7 x 2.6	-	-
No.2 Measurement room	4.3 x 4.4 x 2.7	-	-
No.3 Measurement room	4.5 x 5.3 x 2.7	-	-

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

UL Japan, Inc.

Kashima EMC Lab.

1614, Mushihata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

SECTION 4: Operation of EUT during testing

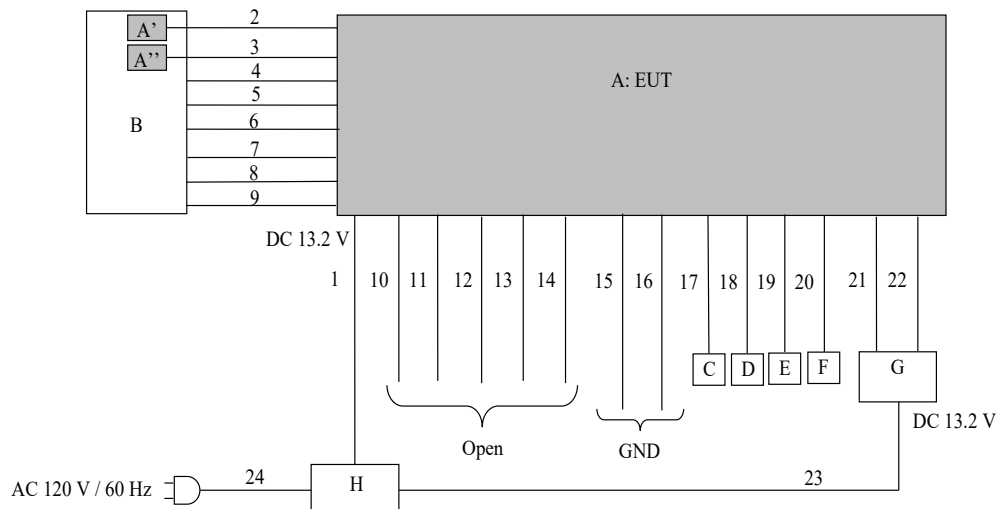
4.1 Operating Mode(s)

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 On) -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 (Hopping On) -DH5 -3DH5	-
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 (Hopping On / Hopping Off) -DH5 -3DH5	2402 MHz 2480 MHz
99% Occupied Bandwidth	Tx (Hopping On / Hopping Off) -DH5 -3DH5	2402 MHz 2441 MHz 2480 MHz
*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 the items based on Bluetooth Core specification. *EUT has the power settings by the software as follows; Power settings : 0 dBm Software : MSoC F41CMM006-007 (Date: January 10, 2020, Storage: EUT Memory) *This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product. (The setting value might be different from the product specification value.)		

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	DNNS114	4687263540001933 5909016010000000	DENSO CORPORATION	EUT
A'	WiFi Antenna	2314128-2	*1)	TE Connectivity Ltd.	EUT
A''	ASSEMBLY Bluetooth Antenna	2462810-0140	*1)	TE Connectivity Ltd.	EUT
B	Center Information Display	DNNS105	1911290020	DENSO CORPORATION	
C	8 Ω Speaker	K50	17	VISATON	-
D	8 Ω Speaker	K50	18	VISATON	-
E	8 Ω Speaker	K50	19	VISATON	-
F	8 Ω Speaker	K50	20	VISATON	-
G	Meter	TN257550-6773	12C19	DENSO CORPORATION	*3)
H	DC Power Supply	GSV3000	1708192900 *2) 60646742 *3)	DIAMOND ANTENNA	-

*1) The number is under the control of the equipment B.

*2) Used for Antenna Terminal conducted test

*3) Used for Radiated Emission test

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	1.7	Unshielded	Unshielded	-
2	WiFi Cable	0.2	Shielded	Shielded	-
3	BT Cable	0.2	Shielded	Shielded	-
4	DC + Signal Cable	0.2	Unshielded	Unshielded	-
5	LVDS Cable	0.2	Shielded	Shielded	-
6	FG Cable	0.1	Unshielded	Unshielded	-
7	FG Cable	0.1	Unshielded	Unshielded	-
8	FG Cable	0.1	Unshielded	Unshielded	-
9	FG Cable	0.1	Unshielded	Unshielded	-
10	AM/FM Cable	2.0	Shielded	Shielded	-
11	USB Cable	0.9	Shielded	Shielded	-
12	XM Cable	1.6	Unshielded	Unshielded	-
13	Mic Cable	1.6	Shielded	Shielded	-
14	AUX Box Cable	1.0	Shielded	Shielded	-
15	GND Cable	1.6	Unshielded	Unshielded	-
16	GND Cable	1.6	Unshielded	Unshielded	-
17	Speaker Cable	1.9	Unshielded	Unshielded	-
18	Speaker Cable	1.9	Unshielded	Unshielded	-
19	Speaker Cable	1.9	Unshielded	Unshielded	-
20	Speaker Cable	1.9	Unshielded	Unshielded	-
21	Meter Cable	3.0	Shielded	Shielded	-
22	Meter Cable	1.6	Unshielded	Unshielded	-
23	DC Cable	1.5	Unshielded	Unshielded	-
24	AC Cable	1.7	Unshielded	Unshielded	-

UL Japan, Inc.

Kashima EMC Lab.

1614, Mushihata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

SECTION 5: Radiated Spurious Emission

Test Procedure

[For below 1 GHz]

EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1 GHz]

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

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

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

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

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

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

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

Test Antennas are used as below;

Frequency	Below 1 GHz	Above 1 GHz
Antenna Type	Hybrid	Horn

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

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

Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	PK	AV *1)	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	RBW: 1 MHz VBW: 1/T (T: burst length, refer to Burst rate confirmation sheet) Detector: Peak	RBW: 100 kHz VBW: 300 kHz

*1) Average Power Measurement was performed based on KDB 558074 D01 15.247 Meas Guidance v05r02.

UL Japan, Inc.

Kashima EMC Lab.

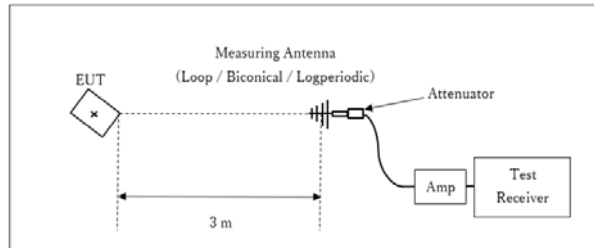
1614, Mushiata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

Figure 2: Test Setup

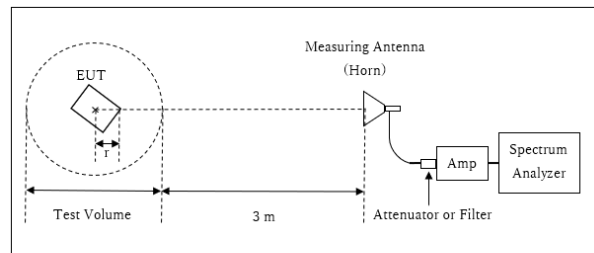
Below 1 GHz



x : Center of turn table

Test Distance: 3 m

1 GHz - 10 GHz



r : Radius of an outer periphery of EUT

x : Center of turn table

Distance Factor: $20 \times \log (3.85 \text{ m} / 3.0 \text{ m}) = 2.17 \text{ dB}$

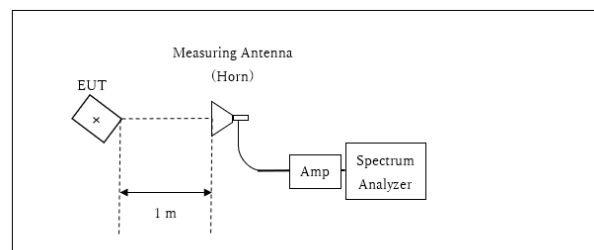
*Test Distance: $(3 + \text{Test Volume} / 2) - r = 3.85 \text{ m}$

Test Volume : 2.0 m

(Test Volume has been calibrated based on CISPR 16-1-4.)

$r = 0.15 \text{ m}$

10 GHz - 26.5 GHz



x : Center of turn table

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

*Test Distance: 1 m

The test was made on EUT at the normal use position.

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

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

SECTION 6: Antenna Terminal Conducted Tests

Test Procedure

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

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument used
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:160MHzBW)
Carrier Frequency Separation	3 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
Number of Hopping Frequency	30 MHz	100 kHz	300 kHz	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), *4)	9 kHz to 150 kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150 kHz to 30 MHz	10 kHz	30 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.

(9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 10 kHz).

*4) The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377 Ohms. For example, the measurement at frequency 9 kHz resulted in a level of 45.5 dBuV/m, which is equivalent to $45.5 - 51.5 = -6.0$ dBuA/m, which has the same margin, 3 dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

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

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

Test data : APPENDIX

Test result : Pass

UL Japan, Inc.

Kashima EMC Lab.

1614, Mushiata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

APPENDIX 1: Test data

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

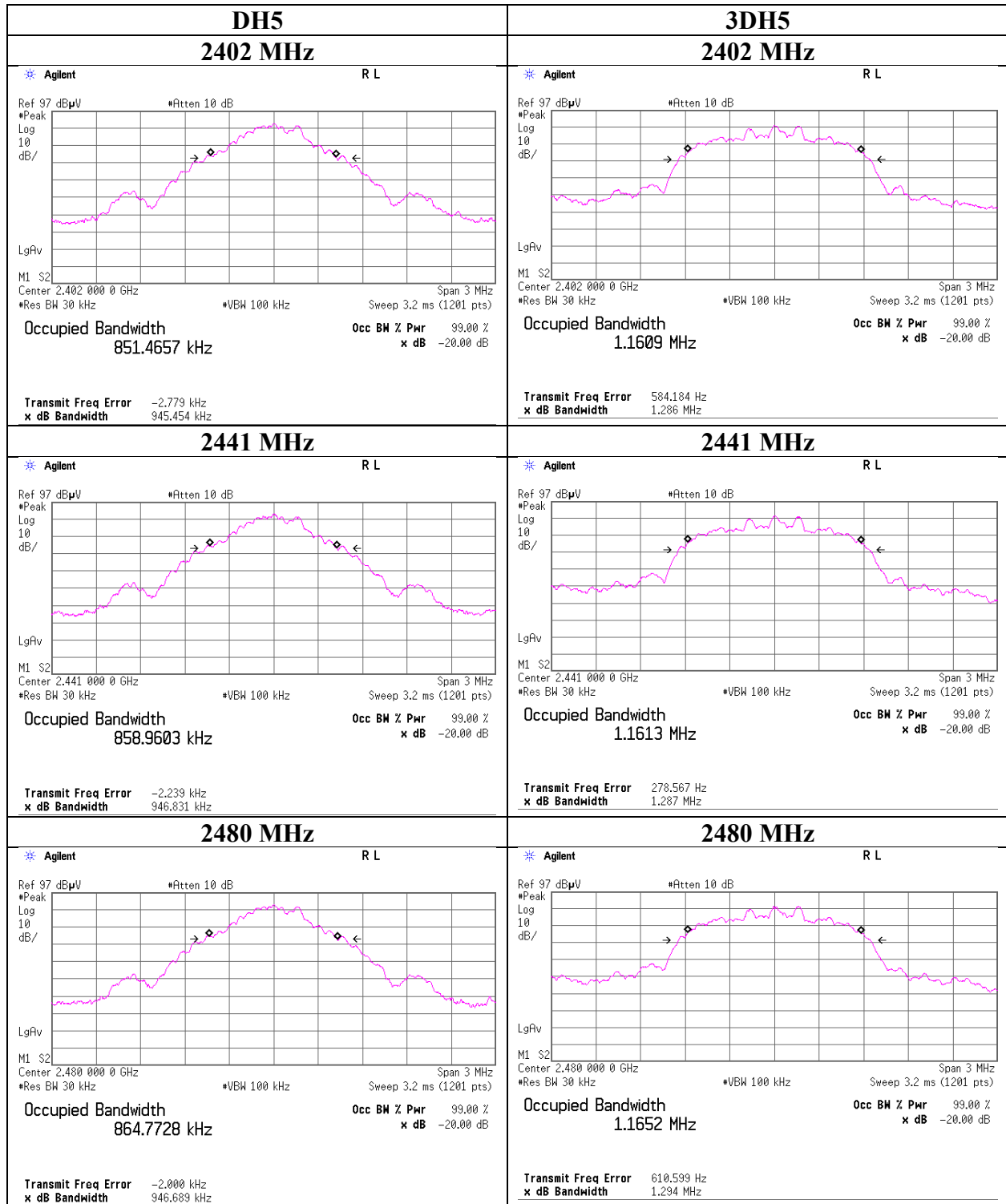
Report No.	13204004M-C-R1	
Test place	Kashima EMC Lab. No.2 Measurement Room	
Date	January 15, 2020	January 21, 2020
Temperature / Humidity	20 deg. C / 45 % RH	20 deg. C / 45 % RH
Engineer	Kazuhiro Ando	Kazuhiro Ando
Mode	Tx, Hopping Off, Tx, Hopping On	

Mode	Freq. [MHz]	20dB Bandwidth [MHz]	99% Occupied Bandwidth [kHz]	Carrier Frequency Separation [MHz]	Limit for Carrier Frequency separation [MHz]
DH5	2402.0	0.945	851.466	1.000	>= 0.630
DH5	2441.0	0.947	858.960	1.000	>= 0.631
DH5	2480.0	0.947	864.773	1.000	>= 0.631
DH5	Hopping On	-	78648.1	-	-
3DH5	2402.0	1.286	1160.9	1.000	>= 0.858
3DH5	2441.0	1.287	1161.3	1.000	>= 0.858
3DH5	2480.0	1.294	1165.2	1.000	>= 0.863
3DH5	Hopping On	-	78710.4	-	-

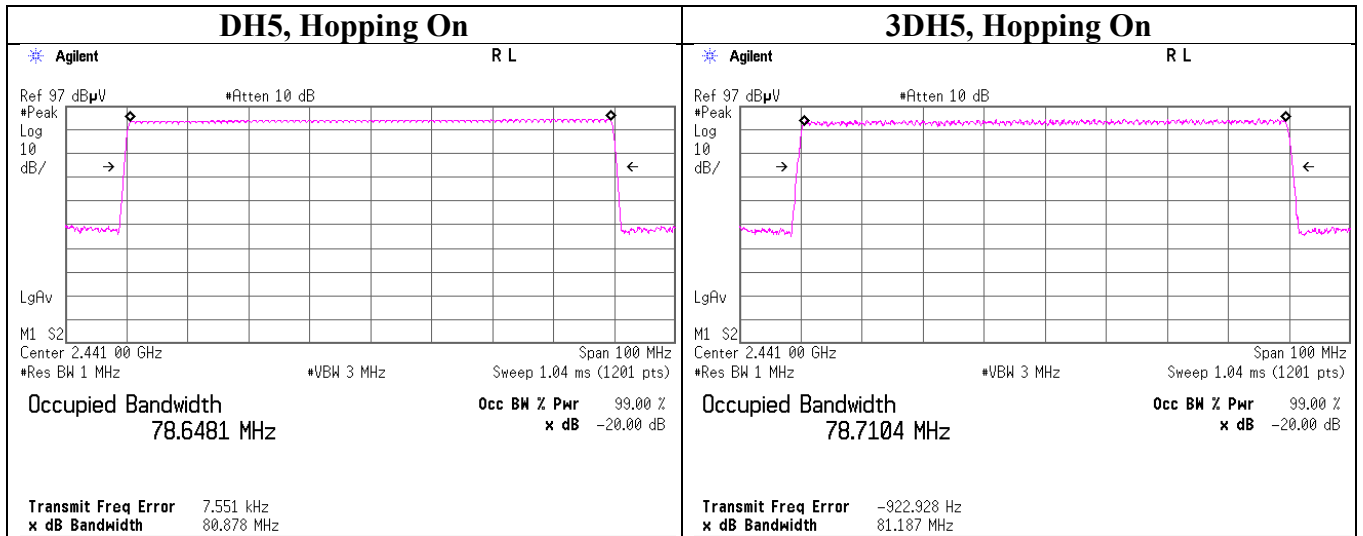
Limit: Two-thirds of 20dB Bandwidth or 25kHz (whichever is greater).

No limit applies to 20dB Bandwidth.

20dB Bandwidth and 99% Occupied Bandwidth



20dB Bandwidth and 99% Occupied Bandwidth



UL Japan, Inc.

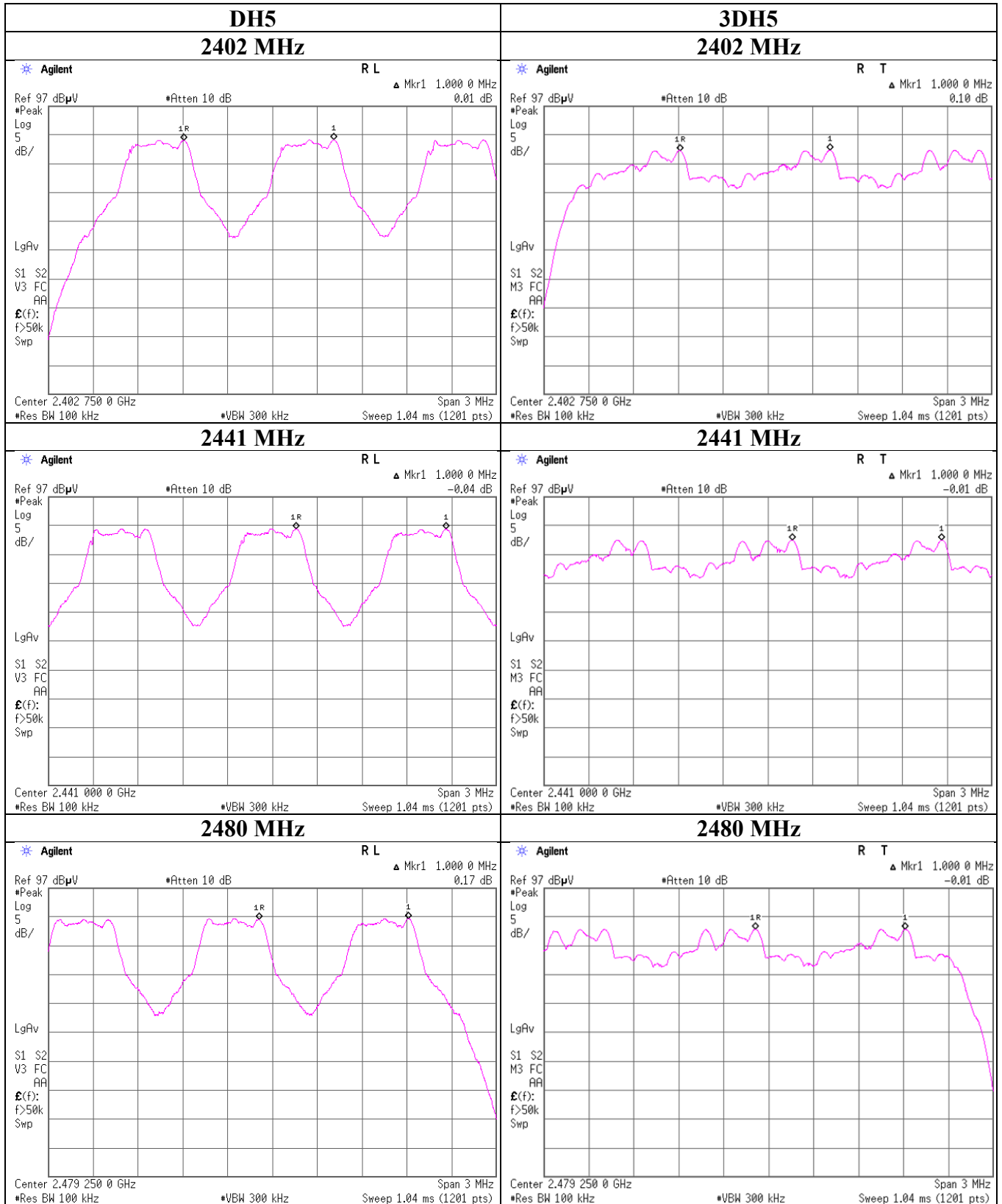
Kashima EMC Lab.

1614, Mushihata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

Carrier Frequency Separation



UL Japan, Inc.

Kashima EMC Lab.

1614, Mushihata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

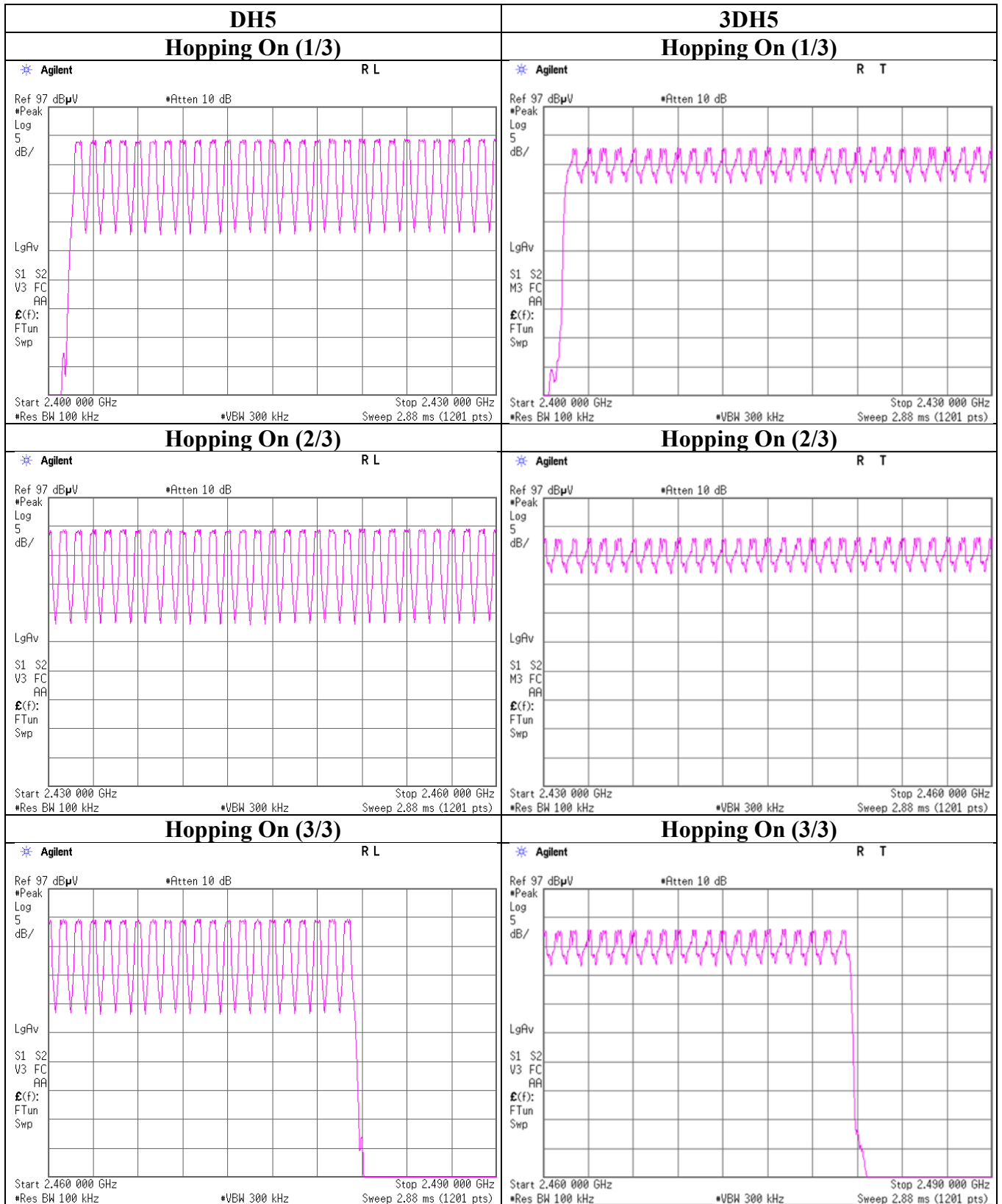
Number of Hopping Frequency

Report No. 13204004M-C-R1
Test place Kashima EMC Lab. No.2 Measurement Room
Date January 15, 2020
Temperature / Humidity 20 deg. C / 45 % RH
Engineer Kazuhiro Ando
Mode 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



Dwell time

Report No. 13204004M-C-R1
Test place Kashima EMC Lab. No.2 Measurement Room
Date January 15, 2020 January 21, 2020
Temperature / Humidity 20 deg. C / 45 % RH 20 deg. C / 45 % RH
Engineer Kazuhiro Ando Kazuhiro Ando
Mode 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	17.0 times	/	5 sec.	x 31.6 sec. = 108 times	0.409	44	400
DH3	17.0 times	/	5 sec.	x 31.6 sec. = 108 times	1.665	180	400
DH5	17.0 times	/	5 sec.	x 31.6 sec. = 108 times	2.914	315	400
3DH1	17.0 times	/	5 sec.	x 31.6 sec. = 108 times	0.421	45	400
3DH3	17.0 times	/	5 sec.	x 31.6 sec. = 108 times	1.670	180	400
3DH5	17.0 times	/	5 sec.	x 31.6 sec. = 108 times	2.922	316	400

Sample Calculation

Result = Number of transmission x Length of transmission

*Average data of 5 tests.(except Inquiry)

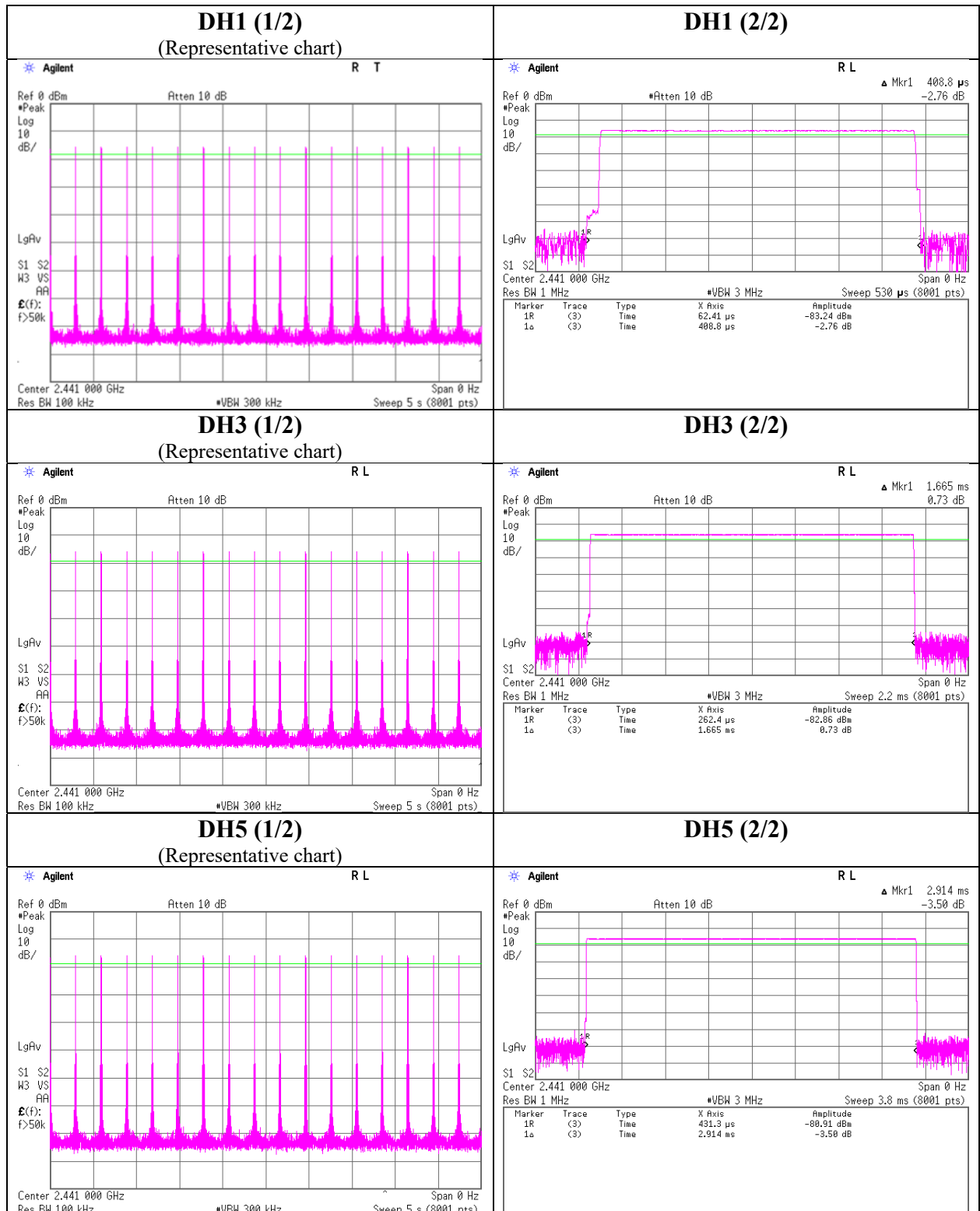
Mode	Sampling [times]					Average [times]
	1	2	3	4	5	
DH1	17	17	17	17	17	17
DH3	17	17	17	17	17	17
DH5	17	17	17	17	17	17
3DH1	17	17	17	17	17	17
3DH3	17	17	17	17	17	17
3DH5	17	17	17	17	17	17

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.

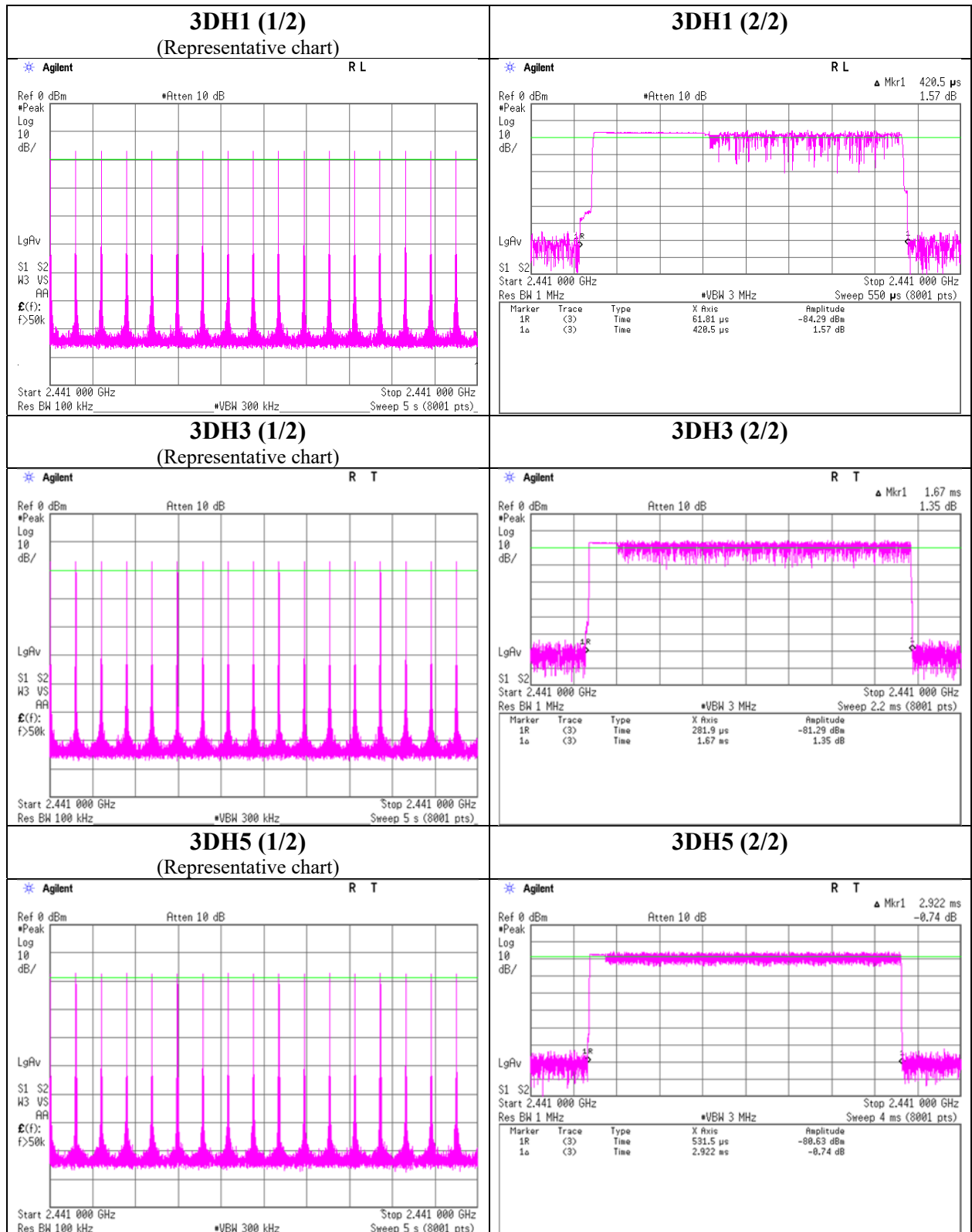
Kashima EMC Lab.

1614, Mushiata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

Dwell time



UL Japan, Inc.

Kashima EMC Lab.

1614, Mushiata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

Maximum Peak Output Power

Report No. 13204004M-C-R1
Test place Kashima EMC Lab. No.2 Measurement Room
Date January 14, 2020
Temperature / Humidity 20 deg. C / 45 % RH
Engineer Kazuhiro Ando
Mode Tx, Hopping Off

Mode	Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Conducted Power					e.i.r.p. for RSS-247					
					Result		Limit		Margin	Antenna Gain [dBi]	Result		Limit		Margin
					[dBm]	[mW]	[dBm]	[mW]			[dBm]	[mW]	[dBm]	[mW]	
DH5	2402.0	-5.54	2.13	0.00	-3.41	0.46	20.96	125	24.37	-4.52	-7.93	0.16	36.02	4000	43.95
DH5	2441.0	-5.24	1.74	0.00	-3.50	0.45	20.96	125	24.46	-4.52	-8.02	0.16	36.02	4000	44.04
DH5	2480.0	-5.01	1.87	0.00	-3.14	0.49	20.96	125	24.10	-4.52	-7.66	0.17	36.02	4000	43.68
2DH5	2402.0	-5.75	2.13	0.00	-3.62	0.43	20.96	125	24.58	-4.52	-8.14	0.15	36.02	4000	44.16
2DH5	2441.0	-5.37	1.74	0.00	-3.63	0.43	20.96	125	24.59	-4.52	-8.15	0.15	36.02	4000	44.17
2DH5	2480.0	-5.08	1.87	0.00	-3.21	0.48	20.96	125	24.17	-4.52	-7.73	0.17	36.02	4000	43.75
3DH5	2402.0	-5.04	2.13	0.00	-2.91	0.51	20.96	125	23.87	-4.52	-7.43	0.18	36.02	4000	43.45
3DH5	2441.0	-4.82	1.74	0.00	-3.08	0.49	20.96	125	24.04	-4.52	-7.60	0.17	36.02	4000	43.62
3DH5	2480.0	-4.59	1.87	0.00	-2.72	0.53	20.96	125	23.68	-4.52	-7.24	0.19	36.02	4000	43.26

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.

UL Japan, Inc.

Kashima EMC Lab.

1614, Mushihata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

Average Output Power (Reference data for RF Exposure)

Report No.	13204004M-C-R1
Test place	Kashima EMC Lab. No.2 Measurement Room
Date	January 14, 2020
Temperature / Humidity	20 deg. C / 45 % RH
Engineer	Kazuhiro Ando
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	-6.91	2.13	0.00	-4.78	0.33	1.10	-3.68	0.43
DH5	2441.0	-6.60	1.74	0.00	-4.86	0.33	1.10	-3.76	0.42
DH5	2480.0	-6.35	1.87	0.00	-4.48	0.36	1.10	-3.38	0.46
2DH5	2402.0	-9.66	2.13	0.00	-7.53	0.18	1.09	-6.44	0.23
2DH5	2441.0	-9.24	1.74	0.00	-7.50	0.18	1.09	-6.41	0.23
2DH5	2480.0	-8.91	1.87	0.00	-7.04	0.20	1.09	-5.95	0.25
3DH5	2402.0	-9.66	2.13	0.00	-7.53	0.18	1.08	-6.45	0.23
3DH5	2441.0	-9.39	1.74	0.00	-7.65	0.17	1.08	-6.57	0.22
3DH5	2480.0	-9.09	1.87	0.00	-7.22	0.19	1.08	-6.14	0.24

Sample Calculation:

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

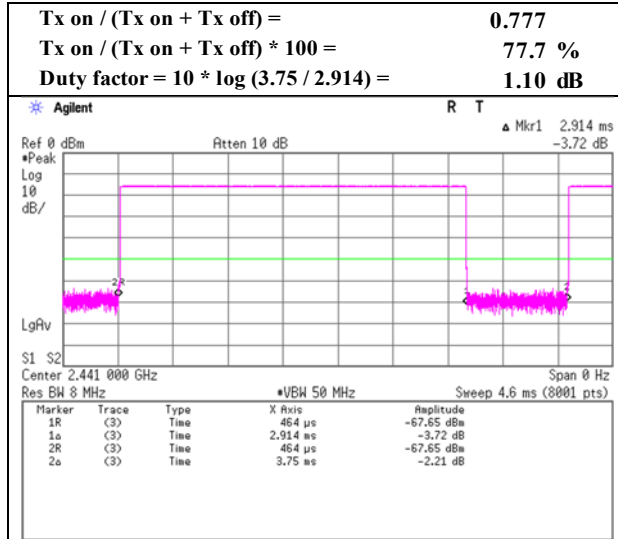
Result (Burst power average) = Time average + Duty factor

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

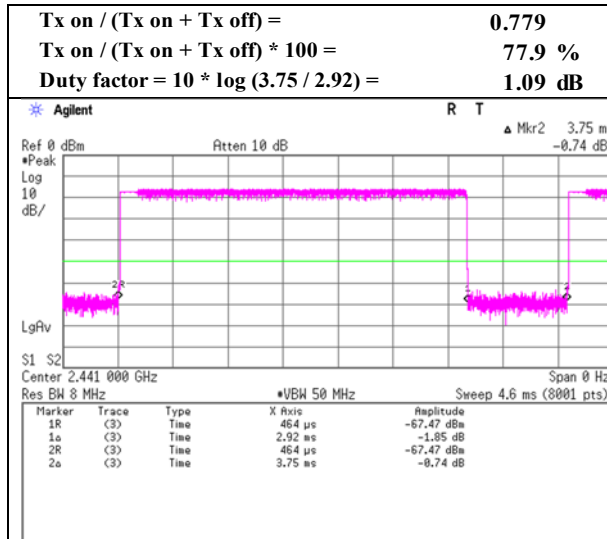
Burst Rate Confirmation

Report No. 13204004M-C-R1
Test place Kashima EMC Lab. No.2 Measurement Room
Date January 21, 2020
Temperature / Humidity 20 deg. C / 45 % RH
Engineer Kazuhiro Ando
Mode Tx, Hopping Off

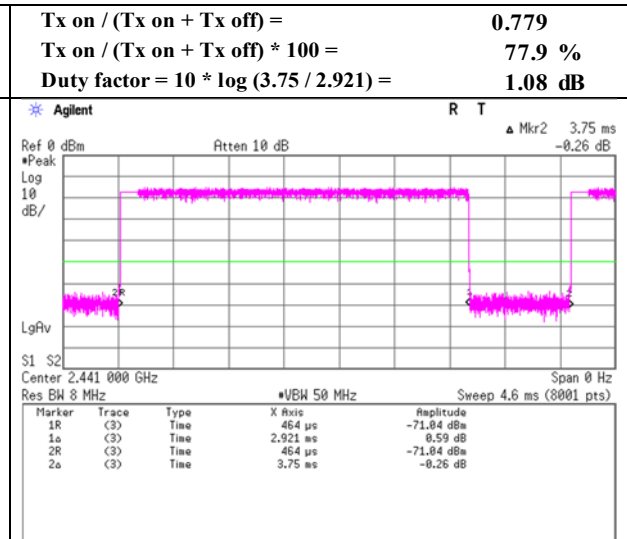
DH5



2DH5



3DH5



Radiated Spurious Emission

Report No.	13204004M-C-R1		
Test place	Kashima EMC Lab.		
Semi Anechoic Chamber	No.11	No.11	No.11
Date	February 27, 2020	February 27, 2020	February 28, 2020
Temperature / Humidity	21 deg. C / 43 % RH	21 deg. C / 43 % RH	21 deg. C / 36 % RH
Engineer	Hiromitsu Tanabe	Hiromitsu Tanabe	Kazuhiro Ando
	(30 MHz -1000 MHz)	(1 GHz -10 GHz)	(10 GHz -26.5 GHz)
Mode	Tx, Hopping Off, DH5 2402 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	200.000	QP	48.00	9.92	6.97	32.09	0.00	32.80	43.5	10.7	191	204	
Hori.	203.686	QP	44.00	9.88	6.99	32.09	0.00	28.78	43.5	14.7	188	72	
Hori.	411.324	QP	42.50	15.79	8.10	32.00	0.00	34.39	46.0	11.6	100	155	
Hori.	2322.000	PK	51.50	27.55	13.63	43.92	2.17	50.93	73.9	22.9	161	0	
Hori.	2390.000	PK	50.30	27.60	13.69	43.90	2.17	49.86	73.9	24.0	161	0	
Hori.	2880.000	PK	57.80	28.80	5.39	43.82	2.17	50.34	73.9	23.5	147	230	
Hori.	3394.833	PK	55.30	30.14	5.38	44.04	2.17	48.95	73.9	24.9	150	145	
Hori.	3650.000	PK	57.00	30.78	5.35	44.14	2.17	51.16	73.9	22.7	160	265	
Hori.	4804.000	PK	54.60	32.65	5.79	45.21	2.17	50.00	73.9	23.9	161	0	
Hori.	7206.000	PK	56.50	37.21	7.13	44.08	2.17	58.93	73.9	14.9	150	240	
Hori.	9608.000	PK	47.70	38.11	7.96	41.88	2.17	54.06	73.9	19.8	150	0	Floor noise
Hori.	2322.000	AV	42.40	27.55	13.63	43.92	2.17	41.83	53.9	12.0	161	0	VBW: 360 Hz
Hori.	2390.000	AV	38.50	27.60	13.69	43.90	2.17	38.06	53.9	15.8	161	0	VBW: 360 Hz
Hori.	2880.000	AV	53.30	28.80	5.39	43.82	2.17	45.84	53.9	8.0	147	230	VBW: 10 Hz
Hori.	3394.833	AV	50.00	30.14	5.38	44.04	2.17	43.65	53.9	10.2	150	145	VBW: 10 Hz
Hori.	3650.000	AV	52.10	30.78	5.35	44.14	2.17	46.26	53.9	7.6	160	265	VBW: 10 Hz
Hori.	4804.000	AV	41.50	32.65	5.79	45.21	2.17	36.90	53.9	17.0	161	0	VBW: 360 Hz
Hori.	7206.000	AV	49.80	37.21	7.13	44.08	2.17	52.23	53.9	1.6	150	240	VBW: 360 Hz
Hori.	9608.000	AV	35.70	38.11	7.96	41.88	2.17	42.06	53.9	11.8	150	0	Floor noise
Vert.	75.399	QP	40.00	10.33	6.09	32.19	0.00	24.23	40.0	15.7	100	250	
Vert.	180.602	QP	45.00	11.58	6.85	32.11	0.00	31.32	43.5	12.1	100	150	
Vert.	200.000	QP	52.30	9.92	6.97	32.09	0.00	37.10	43.5	6.4	100	0	
Vert.	203.655	QP	47.50	9.88	6.99	32.09	0.00	32.28	43.5	11.2	100	41	
Vert.	320.000	QP	46.30	14.04	7.62	32.02	0.00	35.94	46.0	10.0	100	20	
Vert.	536.000	QP	39.30	18.31	8.62	32.03	0.00	34.20	46.0	11.8	100	181	
Vert.	2322.000	PK	51.40	27.55	13.63	43.92	2.17	50.83	73.9	23.0	206	152	
Vert.	2390.000	PK	50.00	27.60	13.69	43.90	2.17	49.56	73.9	24.3	206	152	
Vert.	2880.000	PK	58.40	28.80	5.39	43.82	2.17	50.94	73.9	22.9	130	225	
Vert.	3437.617	PK	59.10	30.31	5.38	44.05	2.17	52.91	73.9	20.9	155	145	
Vert.	3650.000	PK	58.80	30.78	5.35	44.14	2.17	52.96	73.9	20.9	130	190	
Vert.	4804.000	PK	54.40	32.65	5.79	45.21	2.17	49.80	73.9	24.1	150	185	
Vert.	7206.000	PK	56.40	37.21	7.13	44.08	2.17	58.83	73.9	15.0	150	195	
Vert.	9608.000	PK	48.10	38.11	7.96	41.88	2.17	54.46	73.9	19.4	150	0	Floor noise
Vert.	2322.000	AV	40.80	27.55	13.63	43.92	2.17	40.23	53.9	13.6	206	152	VBW: 360 Hz
Vert.	2390.000	AV	38.50	27.60	13.69	43.90	2.17	38.06	53.9	15.8	206	152	VBW: 360 Hz
Vert.	2880.000	AV	54.50	28.80	5.39	43.82	2.17	47.04	53.9	6.8	130	225	VBW: 10 Hz
Vert.	3437.617	AV	54.90	30.31	5.38	44.05	2.17	48.71	53.9	5.1	155	145	VBW: 10 Hz
Vert.	3650.000	AV	54.60	30.78	5.35	44.14	2.17	48.76	53.9	5.1	130	190	VBW: 10 Hz
Vert.	4804.000	AV	41.50	32.65	5.79	45.21	2.17	36.90	53.9	17.0	150	185	VBW: 360 Hz
Vert.	7206.000	AV	50.40	37.21	7.13	44.08	2.17	52.83	53.9	1.0	150	195	VBW: 360 Hz
Vert.	9608.000	AV	35.60	38.11	7.96	41.88	2.17	41.96	53.9	11.9	150	0	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log (3.85 m / 3.0 m) = 2.17 dB

10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

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

20 dBc Data Sheet (RBW 100 kHz, VBW 300 kHz)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	92.30	27.62	13.70	43.89	2.17	91.90	-	-	Carrier
Hori.	2400.000	PK	40.80	27.61	13.70	43.89	2.17	40.39	71.9	31.5	
Vert.	2402.000	PK	88.70	27.62	13.70	43.89	2.17	88.30	-	-	Carrier
Vert.	2400.000	PK	40.50	27.61	13.70	43.89	2.17	40.09	68.3	28.2	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log (3.85 m / 3.0 m) = 2.17 dB

10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

UL Japan, Inc.

Kashima EMC Lab.

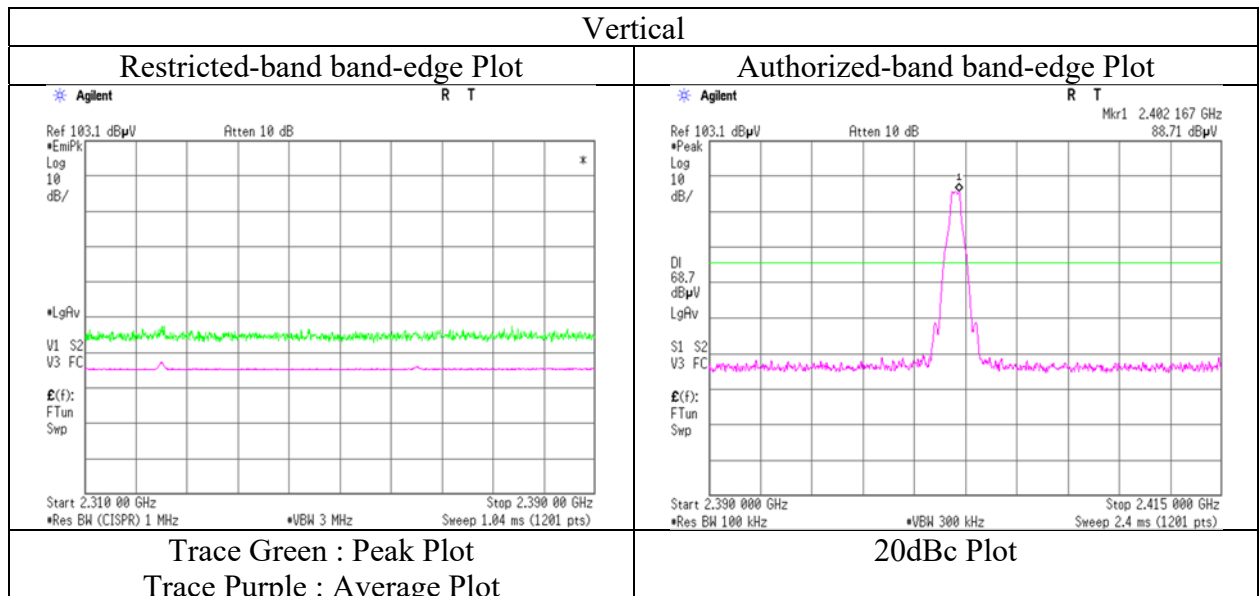
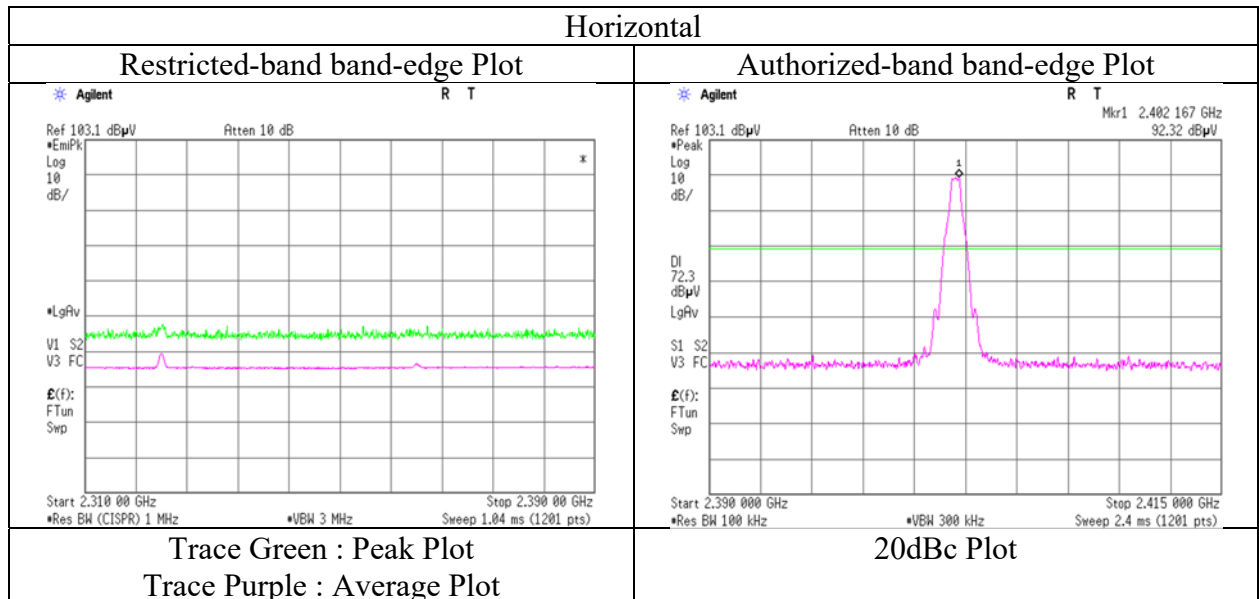
1614, Mushihata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	13204004M-C-R1	No.11	No.11
Test place	Kashima EMC Lab.	February 27, 2020	February 28, 2020
Semi Anechoic Chamber	No.11	February 27, 2020	February 28, 2020
Date	February 27, 2020	21 deg. C / 43 % RH	21 deg. C / 36 % RH
Temperature / Humidity	21 deg. C / 43 % RH	Hiromitsu Tanabe	Kazuhiro Ando
Engineer	Hiromitsu Tanabe	(1 GHz -10 GHz)	(10 GHz -26.5 GHz)
Mode	Tx, Hopping Off, DH5 2402 MHz		



* 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.	13204004M-C-R1		
Test place	Kashima EMC Lab.		
Semi Anechoic Chamber	No.11	No.11	No.11
Date	February 27, 2020	February 27, 2020	February 28, 2020
Temperature / Humidity	21 deg. C / 43 % RH	21 deg. C / 43 % RH	21 deg. C / 36 % RH
Engineer	Hiromitsu Tanabe	Hiromitsu Tanabe	Kazuhiro Ando
	(30 MHz -1000 MHz)	(1 GHz -10 GHz)	(10 GHz -26.5 GHz)
Mode	Tx, Hopping Off, DH5 2441 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	200.000	QP	48.00	9.92	6.97	32.09	0.00	32.80	43.5	10.7	194	143	
Hori.	203.214	QP	43.50	9.89	6.99	32.09	0.00	28.29	43.5	15.2	167	67	
Hori.	408.612	QP	41.70	15.72	8.09	32.00	0.00	33.51	46.0	12.4	100	157	
Hori.	2361.000	PK	53.60	27.57	13.66	43.91	2.17	53.09	73.9	20.8	160	0	
Hori.	2521.000	PK	53.20	28.11	13.78	43.85	2.17	53.41	73.9	20.4	160	0	
Hori.	2880.000	PK	57.20	28.80	5.39	43.82	2.17	49.74	73.9	24.1	140	225	
Hori.	3343.783	PK	56.70	29.99	5.35	44.04	2.17	50.17	73.9	23.7	150	145	
Hori.	3650.000	PK	57.80	30.78	5.35	44.14	2.17	51.96	73.9	21.9	160	265	
Hori.	4882.000	PK	52.70	32.67	5.84	45.25	2.17	48.13	73.9	25.7	150	180	
Hori.	7323.000	PK	53.20	37.41	7.17	43.81	2.17	56.14	73.9	17.7	175	130	
Hori.	9764.000	PK	48.20	38.14	8.03	41.77	2.17	54.77	73.9	19.1	150	0	Floor noise
Hori.	2361.000	AV	43.00	27.57	13.66	43.91	2.17	42.49	53.9	11.4	160	0	VBW: 360 Hz
Hori.	2521.000	AV	42.00	28.11	13.78	43.85	2.17	42.21	53.9	11.6	160	0	VBW: 360 Hz
Hori.	2880.000	AV	52.70	28.80	5.39	43.82	2.17	45.24	53.9	8.6	140	225	VBW: 10 Hz
Hori.	3343.783	AV	51.40	29.99	5.35	44.04	2.17	44.87	53.9	9.0	150	145	VBW: 10 Hz
Hori.	3650.000	AV	53.50	30.78	5.35	44.14	2.17	47.66	53.9	6.2	160	265	VBW: 10 Hz
Hori.	4882.000	AV	39.90	32.67	5.84	45.25	2.17	35.33	53.9	18.5	150	180	VBW: 360 Hz
Hori.	7323.000	AV	44.60	37.41	7.17	43.81	2.17	47.54	53.9	6.3	175	130	VBW: 360 Hz
Hori.	9764.000	AV	35.60	38.14	8.03	41.77	2.17	42.17	53.9	11.7	150	0	Floor noise
Vert.	74.784	QP	40.30	10.46	6.07	32.19	0.00	24.64	40.0	15.3	100	261	
Vert.	180.243	QP	44.70	11.63	6.85	32.11	0.00	31.07	43.5	12.4	100	163	
Vert.	200.000	QP	51.50	9.92	6.97	32.09	0.00	36.30	43.5	7.2	100	180	
Vert.	203.222	QP	47.70	9.89	6.99	32.09	0.00	32.49	43.5	11.0	100	161	
Vert.	320.000	QP	45.30	14.04	7.62	32.02	0.00	34.94	46.0	11.0	100	20	
Vert.	536.000	QP	37.30	18.31	8.62	32.03	0.00	32.20	46.0	13.8	100	181	
Vert.	2361.000	PK	53.00	27.57	13.66	43.91	2.17	52.49	73.9	21.4	195	155	
Vert.	2521.000	PK	52.70	28.11	13.78	43.85	2.17	52.91	73.9	20.9	195	155	
Vert.	2880.000	PK	58.00	28.80	5.39	43.82	2.17	50.54	73.9	23.3	130	215	
Vert.	3446.133	PK	58.90	30.34	5.37	44.05	2.17	52.73	73.9	21.1	195	155	
Vert.	3650.000	PK	57.70	30.78	5.35	44.14	2.17	51.86	73.9	22.0	130	220	
Vert.	4882.000	PK	52.40	32.67	5.84	45.25	2.17	47.83	73.9	26.0	150	165	
Vert.	7323.000	PK	55.20	37.41	7.17	43.81	2.17	58.14	73.9	15.7	150	190	
Vert.	9764.000	PK	48.00	38.14	8.03	41.77	2.17	54.57	73.9	19.3	150	0	Floor noise
Vert.	2361.000	AV	40.90	27.57	13.66	43.91	2.17	40.39	53.9	13.5	195	155	VBW: 360 Hz
Vert.	2521.000	AV	39.60	28.11	13.78	43.85	2.17	39.81	53.9	14.0	195	155	VBW: 360 Hz
Vert.	2880.000	AV	53.70	28.80	5.39	43.82	2.17	46.24	53.9	7.6	130	215	VBW: 10 Hz
Vert.	3446.133	AV	55.80	30.34	5.37	44.05	2.17	49.63	53.9	4.2	195	155	VBW: 10 Hz
Vert.	3650.000	AV	53.10	30.78	5.35	44.14	2.17	47.26	53.9	6.6	130	220	VBW: 10 Hz
Vert.	4882.000	AV	40.00	32.67	5.84	45.25	2.17	35.43	53.9	18.4	150	165	VBW: 360 Hz
Vert.	7323.000	AV	48.60	37.41	7.17	43.81	2.17	51.54	53.9	2.3	150	190	VBW: 360 Hz
Vert.	9764.000	AV	35.60	38.14	8.03	41.77	2.17	42.17	53.9	11.7	150	0	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log (3.85 m / 3.0 m) = 2.17 dB

10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

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

UL Japan, Inc.

Kashima EMC Lab.

1614, Mushihata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

Radiated Spurious Emission

Report No.	13204004M-C-R1		
Test place	Kashima EMC Lab.		
Semi Anechoic Chamber	No.11	No.11	No.11
Date	February 27, 2020	February 27, 2020	February 28, 2020
Temperature / Humidity	21 deg. C / 43 % RH	21 deg. C / 43 % RH	21 deg. C / 36 % RH
Engineer	Hiromitsu Tanabe	Hiromitsu Tanabe	Kazuhiro Ando
	(30 MHz -1000 MHz)	(1 GHz -10 GHz)	(10 GHz -26.5 GHz)
Mode	Tx, Hopping Off, DH5 2480 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	200.000	QP	48.30	9.92	6.97	32.09	0.00	33.10	43.5	10.4	187	136	
Hori.	202.982	QP	43.50	9.89	6.99	32.09	0.00	28.29	43.5	15.2	158	74	
Hori.	408.612	QP	41.90	15.72	8.09	32.00	0.00	33.71	46.0	12.2	100	157	
Hori.	2483.500	PK	50.30	27.93	13.75	43.87	2.17	50.28	73.9	23.6	211	0	
Hori.	2560.000	PK	50.80	28.32	13.82	43.82	2.17	51.29	73.9	22.6	211	0	
Hori.	2880.000	PK	57.60	28.80	5.39	43.82	2.17	50.14	73.9	23.7	211	0	
Hori.	3375.667	PK	56.20	30.08	5.36	44.04	2.17	49.77	73.9	24.1	150	215	
Hori.	3650.000	PK	58.20	30.78	5.35	44.14	2.17	52.36	73.9	21.5	160	265	
Hori.	4960.000	PK	52.30	32.70	5.90	45.32	2.17	47.75	73.9	26.1	211	0	
Hori.	7440.000	PK	52.80	37.47	7.20	43.49	2.17	56.15	73.9	17.7	130	240	
Hori.	9920.000	PK	48.20	38.29	8.09	41.76	2.17	54.99	73.9	18.9	150	0	Floor noise
Hori.	2483.500	AV	38.50	27.93	13.75	43.87	2.17	38.48	53.9	15.4	211	0	VBW: 360 Hz
Hori.	2560.000	AV	40.50	28.32	13.82	43.82	2.17	40.99	53.9	12.9	211	0	VBW: 360 Hz
Hori.	2880.000	AV	53.60	28.80	5.39	43.82	2.17	46.14	53.9	7.7	211	0	VBW: 10 Hz
Hori.	3375.667	AV	51.30	30.08	5.36	44.04	2.17	44.87	53.9	9.0	150	215	VBW: 10 Hz
Hori.	3650.000	AV	53.70	30.78	5.35	44.14	2.17	47.86	53.9	6.0	160	265	VBW: 10 Hz
Hori.	4960.000	AV	40.30	32.70	5.90	45.32	2.17	35.75	53.9	18.1	211	0	VBW: 360 Hz
Hori.	7440.000	AV	44.80	37.47	7.20	43.49	2.17	48.15	53.9	5.7	130	240	VBW: 360 Hz
Hori.	9920.000	AV	35.40	38.29	8.09	41.76	2.17	42.19	53.9	11.7	150	0	Floor noise
Vert.	74.009	QP	41.30	10.59	6.07	32.19	0.00	25.77	40.0	14.2	100	258	
Vert.	180.728	QP	44.20	11.56	6.85	32.11	0.00	30.50	43.5	13.0	100	173	
Vert.	200.000	QP	51.00	9.92	6.97	32.09	0.00	35.80	43.5	7.7	100	0	
Vert.	202.987	QP	47.00	9.89	6.99	32.09	0.00	31.79	43.5	11.7	100	158	
Vert.	320.000	QP	45.30	14.04	7.62	32.02	0.00	34.94	46.0	11.0	100	23	
Vert.	536.000	QP	37.00	18.31	8.62	32.03	0.00	31.90	46.0	14.1	100	166	
Vert.	2483.500	PK	50.00	27.93	13.75	43.87	2.17	49.98	73.9	23.9	115	37	
Vert.	2560.000	PK	50.30	28.32	13.82	43.82	2.17	50.79	73.9	23.1	115	37	
Vert.	2880.000	PK	58.10	28.80	5.39	43.82	2.17	50.64	73.9	23.2	130	220	
Vert.	3460.917	PK	58.10	30.34	5.38	44.05	2.17	51.94	73.9	21.9	150	145	
Vert.	3650.000	PK	58.00	30.78	5.35	44.14	2.17	52.16	73.9	21.7	130	225	
Vert.	4960.000	PK	52.70	32.70	5.90	45.32	2.17	48.15	73.9	25.7	150	180	
Vert.	7440.000	PK	54.00	37.47	7.20	43.49	2.17	57.35	73.9	16.5	130	190	
Vert.	9920.000	PK	48.90	38.29	8.09	41.76	2.17	55.69	73.9	18.2	150	0	Floor noise
Vert.	2483.500	AV	38.60	27.93	13.75	43.87	2.17	38.58	53.9	15.3	115	37	VBW: 360 Hz
Vert.	2560.000	AV	39.20	28.32	13.82	43.82	2.17	39.69	53.9	14.2	115	37	VBW: 360 Hz
Vert.	2880.000	AV	54.00	28.80	5.39	43.82	2.17	46.54	53.9	7.3	130	220	VBW: 10 Hz
Vert.	3460.917	AV	53.20	30.34	5.38	44.05	2.17	47.04	53.9	6.8	150	145	VBW: 10 Hz
Vert.	3650.000	AV	53.60	30.78	5.35	44.14	2.17	47.76	53.9	6.1	130	225	VBW: 10 Hz
Vert.	4960.000	AV	40.30	32.70	5.90	45.32	2.17	35.75	53.9	18.1	150	180	VBW: 360 Hz
Vert.	7440.000	AV	46.40	37.47	7.20	43.49	2.17	49.75	53.9	4.1	130	190	VBW: 360 Hz
Vert.	9920.000	AV	35.30	38.29	8.09	41.76	2.17	42.09	53.9	11.8	150	0	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log (3.85 m / 3.0 m) = 2.17 dB

10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

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

UL Japan, Inc.

Kashima EMC Lab.

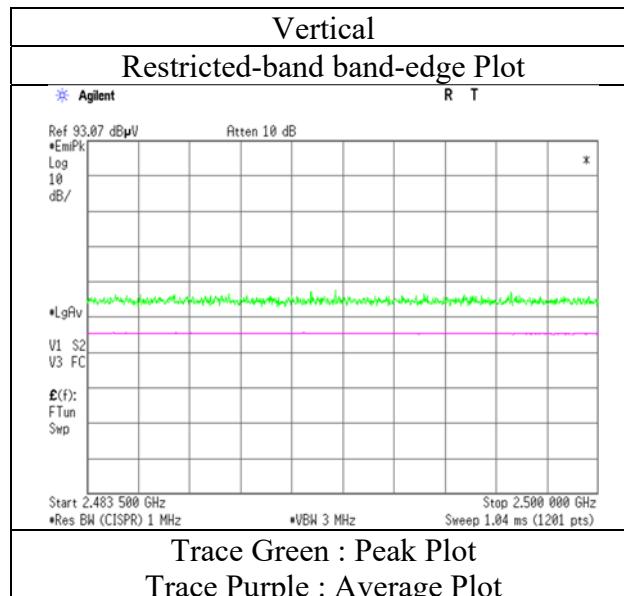
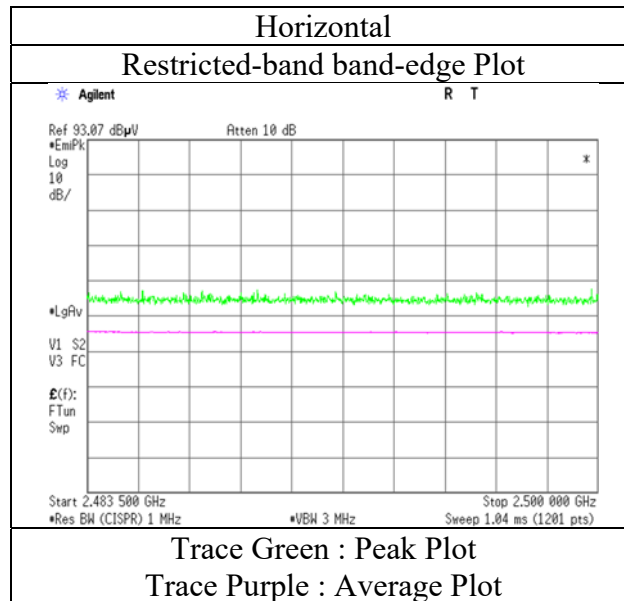
1614, Mushihata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	13204004M-C-R1		
Test place	Kashima EMC Lab.		
Semi Anechoic Chamber	No.11	No.11	No.11
Date	February 27, 2020	February 27, 2020	February 28, 2020
Temperature / Humidity	21 deg. C / 43 % RH	21 deg. C / 43 % RH	21 deg. C / 36 % RH
Engineer	Hiromitsu Tanabe	Hiromitsu Tanabe	Kazuhiro Ando
	(30 MHz -1000 MHz)	(1 GHz -10 GHz)	(10 GHz -26.5 GHz)
Mode	Tx, Hopping Off, DH5 2480 MHz		



* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.

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

UL Japan, Inc.

Kashima EMC Lab.

1614, Mushihata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

Radiated Spurious Emission

Report No.	13204004M-C-R1		
Test place	Kashima EMC Lab.		
Semi Anechoic Chamber	No.11	No.11	No.11
Date	February 27, 2020	February 27, 2020	February 28, 2020
Temperature / Humidity	21 deg. C / 43 % RH	21 deg. C / 43 % RH	21 deg. C / 36 % RH
Engineer	Hiromitsu Tanabe	Hiromitsu Tanabe	Kazuhiro Ando
	(30 MHz -1000 MHz)	(1 GHz -10 GHz)	(10 GHz -26.5 GHz)
Mode	Tx, Hopping Off, 3DH5 2402 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	200.000	QP	48.00	9.92	6.97	32.09	0.00	32.80	43.5	10.7	190	140	
Hori.	202.851	QP	43.70	9.89	6.99	32.09	0.00	28.49	43.5	15.0	190	70	
Hori.	408.612	QP	42.30	15.72	8.09	32.00	0.00	34.11	46.0	11.8	100	160	
Hori.	2322.000	PK	51.50	27.55	13.63	43.92	2.17	50.93	73.9	22.9	155	0	
Hori.	2390.000	PK	49.70	27.60	13.69	43.90	2.17	49.26	73.9	24.6	155	0	
Hori.	2880.000	PK	55.90	28.80	5.39	43.82	2.17	48.44	73.9	25.4	150	230	
Hori.	3401.717	PK	55.80	30.16	5.38	44.04	2.17	49.47	73.9	24.4	150	160	
Hori.	3650.000	PK	57.10	30.78	5.35	44.14	2.17	51.26	73.9	22.6	155	265	
Hori.	4804.000	PK	51.60	32.65	5.79	45.21	2.17	47.00	73.9	26.9	155	175	
Hori.	7206.000	PK	54.00	37.21	7.13	44.08	2.17	56.43	73.9	17.4	145	240	
Hori.	9608.000	PK	46.30	38.11	7.96	41.88	2.17	52.66	73.9	21.2	150	0	Floor noise
Hori.	2322.000	AV	40.30	27.55	13.63	43.92	2.17	39.73	53.9	14.1	155	0	VBW: 360 Hz
Hori.	2390.000	AV	38.30	27.60	13.69	43.90	2.17	37.86	53.9	16.0	155	0	VBW: 360 Hz
Hori.	2880.000	AV	51.90	28.80	5.39	43.82	2.17	44.44	53.9	9.4	150	230	VBW: 10 Hz
Hori.	3401.717	AV	51.40	30.16	5.38	44.04	2.17	45.07	53.9	8.8	150	160	VBW: 10 Hz
Hori.	3650.000	AV	54.00	30.78	5.35	44.14	2.17	48.16	53.9	5.7	155	265	VBW: 10 Hz
Hori.	4804.000	AV	41.20	32.65	5.79	45.21	2.17	36.60	53.9	17.3	155	175	VBW: 360 Hz
Hori.	7206.000	AV	45.50	37.21	7.13	44.08	2.17	47.93	53.9	5.9	145	240	VBW: 360 Hz
Hori.	9608.000	AV	35.10	38.11	7.96	41.88	2.17	41.46	53.9	12.4	150	0	Floor noise
Vert.	74.032	QP	41.30	10.58	6.07	32.19	0.00	25.76	40.0	14.2	100	270	
Vert.	180.566	QP	44.00	11.59	6.85	32.11	0.00	30.33	43.5	13.1	100	168	
Vert.	200.000	QP	50.70	9.92	6.97	32.09	0.00	35.50	43.5	8.0	100	255	
Vert.	203.498	QP	47.00	9.89	6.99	32.09	0.00	31.79	43.5	11.7	100	38	
Vert.	320.000	QP	45.00	14.04	7.62	32.02	0.00	34.64	46.0	11.3	100	23	
Vert.	536.000	QP	37.00	18.31	8.62	32.03	0.00	31.90	46.0	14.1	100	200	
Vert.	2322.000	PK	50.40	27.55	13.63	43.92	2.17	49.83	73.9	24.0	163	320	
Vert.	2390.000	PK	49.50	27.60	13.69	43.90	2.17	49.06	73.9	24.8	163	320	
Vert.	2880.000	PK	56.50	28.80	5.39	43.82	2.17	49.04	73.9	24.8	145	210	
Vert.	3445.950	PK	57.80	30.34	5.37	44.05	2.17	51.63	73.9	22.2	150	145	
Vert.	3650.000	PK	56.70	30.78	5.35	44.14	2.17	50.86	73.9	23.0	150	140	
Vert.	4804.000	PK	51.80	32.65	5.79	45.21	2.17	47.20	73.9	26.7	160	180	
Vert.	7206.000	PK	54.40	37.21	7.13	44.08	2.17	56.83	73.9	17.0	150	195	
Vert.	9608.000	PK	46.30	38.11	7.96	41.88	2.17	52.66	73.9	21.2	150	0	Floor noise
Vert.	2322.000	AV	37.80	27.55	13.63	43.92	2.17	37.23	53.9	16.6	163	320	VBW: 360 Hz
Vert.	2390.000	AV	38.30	27.60	13.69	43.90	2.17	37.86	53.9	16.0	163	320	VBW: 360 Hz
Vert.	2880.000	AV	53.10	28.80	5.39	43.82	2.17	45.64	53.9	8.2	145	210	VBW: 10 Hz
Vert.	3445.950	AV	52.70	30.34	5.37	44.05	2.17	46.53	53.9	7.3	150	145	VBW: 10 Hz
Vert.	3650.000	AV	53.00	30.78	5.35	44.14	2.17	47.16	53.9	6.7	150	140	VBW: 10 Hz
Vert.	4804.000	AV	41.50	32.65	5.79	45.21	2.17	36.90	53.9	17.0	160	180	VBW: 360 Hz
Vert.	7206.000	AV	46.30	37.21	7.13	44.08	2.17	48.73	53.9	5.1	150	195	VBW: 360 Hz
Vert.	9608.000	AV	35.00	38.11	7.96	41.88	2.17	41.36	53.9	12.5	150	0	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log (3.85 m / 3.0 m) = 2.17 dB

10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

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

20 dBc Data Sheet (RBW 100 kHz, VBW 300 kHz)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	89.60	27.62	13.70	43.89	2.17	89.20	-	-	Carrier
Hori.	2400.000	PK	42.60	27.61	13.70	43.89	2.17	42.19	69.2	27.0	
Vert.	2402.000	PK	84.50	27.62	13.70	43.89	2.17	84.10	-	-	Carrier
Vert.	2400.000	PK	40.50	27.61	13.70	43.89	2.17	40.09	64.1	24.0	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log (3.85 m / 3.0 m) = 2.17 dB

10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

UL Japan, Inc.

Kashima EMC Lab.

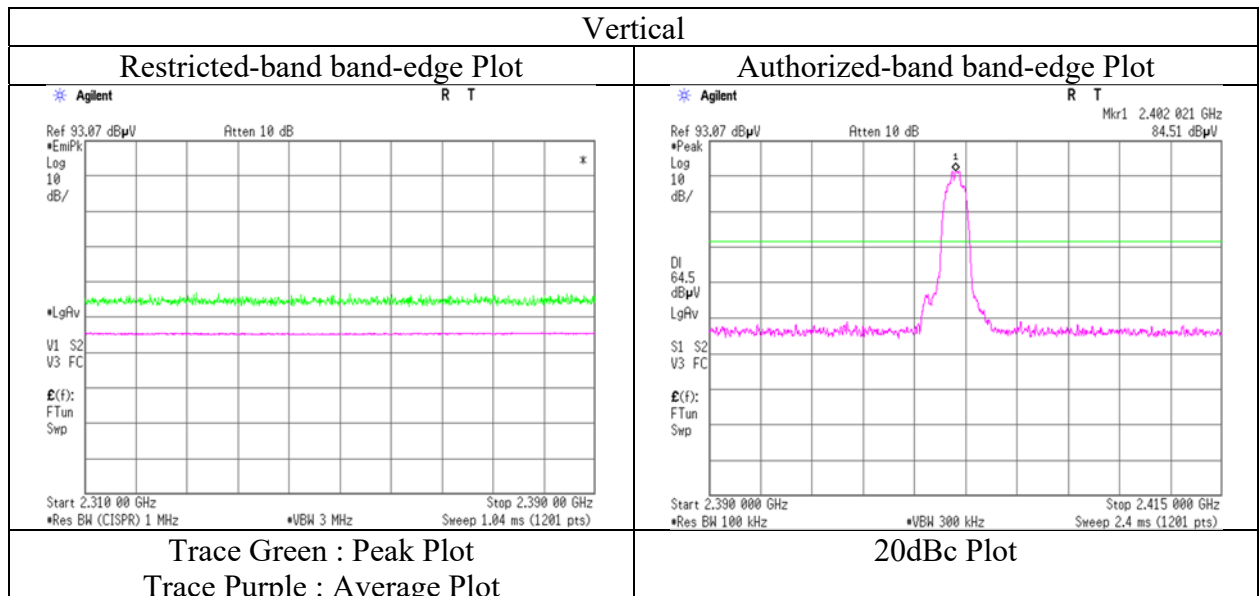
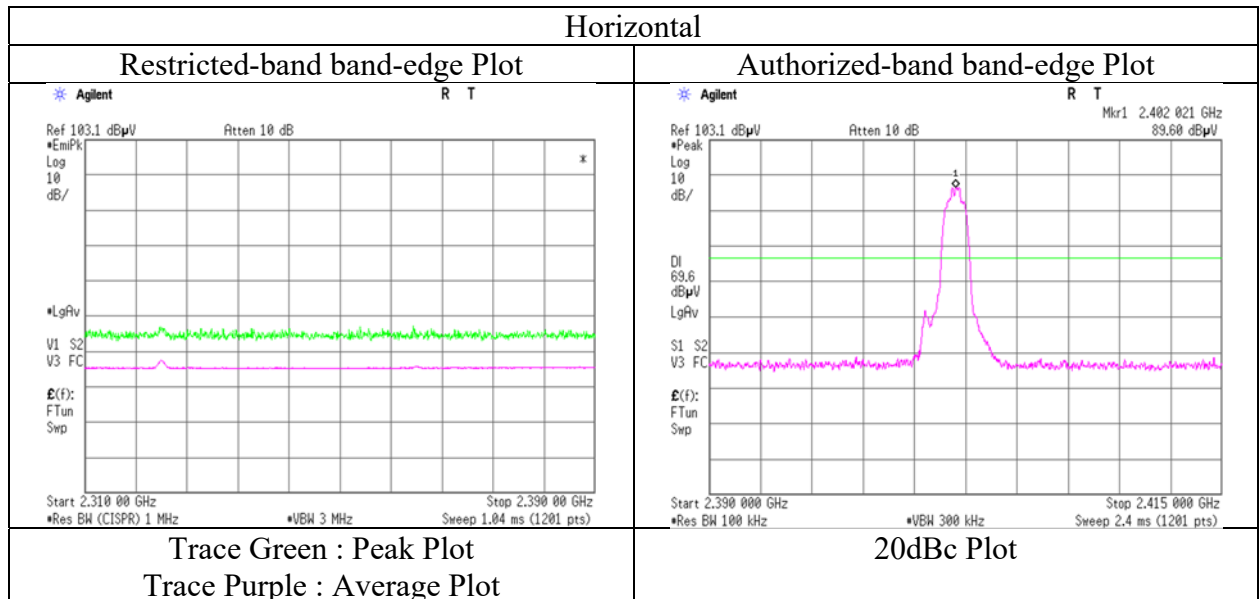
1614, Mushihata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	13204004M-C-R1	No.11	No.11
Test place	Kashima EMC Lab.	February 27, 2020	February 28, 2020
Semi Anechoic Chamber	No.11	February 27, 2020	February 28, 2020
Date	February 27, 2020	21 deg. C / 43 % RH	21 deg. C / 36 % RH
Temperature / Humidity	21 deg. C / 43 % RH	Hiromitsu Tanabe	Kazuhiro Ando
Engineer	Hiromitsu Tanabe	(1 GHz -10 GHz)	(10 GHz -26.5 GHz)
Mode	Tx, Hopping Off, 3DH5 2402 MHz		



* 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.	13204004M-C-R1		
Test place	Kashima EMC Lab.		
Semi Anechoic Chamber	No.11	No.11	No.11
Date	February 27, 2020	February 27, 2020	February 28, 2020
Temperature / Humidity	21 deg. C / 43 % RH	21 deg. C / 43 % RH	21 deg. C / 36 % RH
Engineer	Hiromitsu Tanabe	Hiromitsu Tanabe	Kazuhiro Ando
	(30 MHz -1000 MHz)	(1 GHz -10 GHz)	(10 GHz -26.5 GHz)
Mode	Tx, Hopping Off, 3DH5 2441 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	200.000	QP	49.00	9.92	6.97	32.09	0.00	33.80	43.5	9.7	186	145	
Hori.	203.436	QP	43.00	9.89	6.99	32.09	0.00	27.79	43.5	15.7	160	60	
Hori.	407.966	QP	42.30	15.70	8.09	32.00	0.00	34.09	46.0	11.9	100	160	
Hori.	2361.000	PK	52.90	27.57	13.66	43.91	2.17	52.39	73.9	21.5	155	0	
Hori.	2521.000	PK	53.00	28.11	13.78	43.85	2.17	53.21	73.9	20.6	155	0	
Hori.	2880.000	PK	55.90	28.80	5.39	43.82	2.17	48.44	73.9	25.4	170	140	
Hori.	3369.275	PK	55.90	30.06	5.36	44.04	2.17	49.45	73.9	24.4	150	215	
Hori.	3650.000	PK	57.80	30.78	5.35	44.14	2.17	51.96	73.9	21.9	155	265	
Hori.	4882.000	PK	52.90	32.67	5.84	45.25	2.17	48.33	73.9	25.5	160	165	
Hori.	7323.000	PK	52.60	37.41	7.17	43.81	2.17	55.54	73.9	18.3	150	170	
Hori.	9764.000	PK	48.30	38.14	8.03	41.77	2.17	54.87	73.9	19.0	150	0	Floor noise
Hori.	2361.000	AV	40.80	27.57	13.66	43.91	2.17	40.29	53.9	13.6	155	0	VBW: 360 Hz
Hori.	2521.000	AV	40.90	28.11	13.78	43.85	2.17	41.11	53.9	12.7	155	0	VBW: 360 Hz
Hori.	2880.000	AV	50.80	28.80	5.39	43.82	2.17	43.34	53.9	10.5	170	140	VBW: 10 Hz
Hori.	3369.275	AV	50.30	30.06	5.36	44.04	2.17	43.85	53.9	10.0	150	215	VBW: 10 Hz
Hori.	3650.000	AV	53.60	30.78	5.35	44.14	2.17	47.76	53.9	6.1	155	265	VBW: 10 Hz
Hori.	4882.000	AV	39.50	32.67	5.84	45.25	2.17	34.93	53.9	18.9	160	165	VBW: 360 Hz
Hori.	7323.000	AV	41.90	37.41	7.17	43.81	2.17	44.84	53.9	9.0	150	170	VBW: 360 Hz
Hori.	9764.000	AV	34.70	38.14	8.03	41.77	2.17	41.27	53.9	12.6	150	0	Floor noise
Vert.	73.976	QP	40.00	10.60	6.07	32.19	0.00	24.48	40.0	15.5	100	290	
Vert.	180.840	QP	45.00	11.54	6.86	32.11	0.00	31.29	43.5	12.2	100	176	
Vert.	200.000	QP	52.00	9.92	6.97	32.09	0.00	36.80	43.5	6.7	100	24	
Vert.	203.449	QP	47.70	9.89	6.99	32.09	0.00	32.49	43.5	11.0	100	161	
Vert.	320.000	QP	45.00	14.04	7.62	32.02	0.00	34.64	46.0	11.3	100	23	
Vert.	536.000	QP	37.00	18.31	8.62	32.03	0.00	31.90	46.0	14.1	100	200	
Vert.	2361.000	PK	52.30	27.57	13.66	43.91	2.17	51.79	73.9	22.1	195	160	
Vert.	2521.000	PK	51.40	28.11	13.78	43.85	2.17	51.61	73.9	22.2	195	160	
Vert.	2880.000	PK	57.30	28.80	5.39	43.82	2.17	49.84	73.9	24.0	145	205	
Vert.	3420.483	PK	57.30	30.24	5.37	44.04	2.17	51.04	73.9	22.8	150	220	
Vert.	3650.000	PK	58.20	30.78	5.35	44.14	2.17	52.36	73.9	21.5	150	138	
Vert.	4882.000	PK	52.30	32.67	5.84	45.25	2.17	47.73	73.9	26.1	155	185	
Vert.	7323.000	PK	54.90	37.41	7.17	43.81	2.17	57.84	73.9	16.0	160	190	
Vert.	9764.000	PK	47.30	38.14	8.03	41.77	2.17	53.87	73.9	20.0	150	0	Floor noise
Vert.	2361.000	AV	39.70	27.57	13.66	43.91	2.17	39.19	53.9	14.7	195	160	VBW: 360 Hz
Vert.	2521.000	AV	38.70	28.11	13.78	43.85	2.17	38.91	53.9	14.9	195	160	VBW: 360 Hz
Vert.	2880.000	AV	52.40	28.80	5.39	43.82	2.17	44.94	53.9	8.9	145	205	VBW: 10 Hz
Vert.	3420.483	AV	53.30	30.24	5.37	44.04	2.17	47.04	53.9	6.8	150	220	VBW: 10 Hz
Vert.	3650.000	AV	53.20	30.78	5.35	44.14	2.17	47.36	53.9	6.5	150	138	VBW: 10 Hz
Vert.	4882.000	AV	39.40	32.67	5.84	45.25	2.17	34.83	53.9	19.0	155	185	VBW: 360 Hz
Vert.	7323.000	AV	44.70	37.41	7.17	43.81	2.17	47.64	53.9	6.2	160	190	VBW: 360 Hz
Vert.	9764.000	AV	35.00	38.14	8.03	41.77	2.17	41.57	53.9	12.3	150	0	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log (3.85 m / 3.0 m) = 2.17 dB

10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

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

UL Japan, Inc.

Kashima EMC Lab.

1614, Mushihata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

Radiated Spurious Emission

Report No.	13204004M-C-R1		
Test place	Kashima EMC Lab.		
Semi Anechoic Chamber	No.11	No.11	No.11
Date	February 27, 2020	February 27, 2020	February 28, 2020
Temperature / Humidity	21 deg. C / 43 % RH	21 deg. C / 43 % RH	21 deg. C / 36 % RH
Engineer	Hiromitsu Tanabe	Hiromitsu Tanabe	Kazuhiro Ando
	(30 MHz -1000 MHz)	(1 GHz -10 GHz)	(10 GHz -26.5 GHz)
Mode	Tx, Hopping Off, 3DH5 2480 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	200.000	QP	49.00	9.92	6.97	32.09	0.00	33.80	43.5	9.7	195	141	
Hori.	202.528	QP	44.00	9.89	6.99	32.09	0.00	28.79	43.5	14.7	185	56	
Hori.	408.548	QP	42.50	15.72	8.09	32.00	0.00	34.31	46.0	11.6	100	159	
Hori.	2483.500	PK	49.50	27.93	13.75	43.87	2.17	49.48	73.9	24.4	185	0	
Hori.	2560.000	PK	50.00	28.32	13.82	43.82	2.17	50.49	73.9	23.4	185	0	
Hori.	2880.000	PK	57.20	28.80	5.39	43.82	2.17	49.74	73.9	24.1	140	230	
Hori.	3387.117	PK	56.00	30.11	5.37	44.04	2.17	49.61	73.9	24.2	150	220	
Hori.	3650.000	PK	57.70	30.78	5.35	44.14	2.17	51.86	73.9	22.0	160	270	
Hori.	4960.000	PK	52.70	32.70	5.90	45.32	2.17	48.15	73.9	25.7	160	185	
Hori.	7440.000	PK	52.30	37.47	7.20	43.49	2.17	55.65	73.9	18.2	155	205	
Hori.	9920.000	PK	48.20	38.29	8.09	41.76	2.17	54.99	73.9	18.9	150	0	Floor noise
Hori.	2483.500	AV	38.50	27.93	13.75	43.87	2.17	38.48	53.9	15.4	185	0	VBW: 360 Hz
Hori.	2560.000	AV	39.60	28.32	13.82	43.82	2.17	40.09	53.9	13.8	185	0	VBW: 360 Hz
Hori.	2880.000	AV	52.10	28.80	5.39	43.82	2.17	44.64	53.9	9.2	140	230	VBW: 10 Hz
Hori.	3387.117	AV	50.50	30.11	5.37	44.04	2.17	44.11	53.9	9.7	150	220	VBW: 10 Hz
Hori.	3650.000	AV	53.20	30.78	5.35	44.14	2.17	47.36	53.9	6.5	160	270	VBW: 10 Hz
Hori.	4960.000	AV	40.30	32.70	5.90	45.32	2.17	35.75	53.9	18.1	160	185	VBW: 360 Hz
Hori.	7440.000	AV	41.40	37.47	7.20	43.49	2.17	44.75	53.9	9.1	155	205	VBW: 360 Hz
Hori.	9920.000	AV	35.30	38.29	8.09	41.76	2.17	42.09	53.9	11.8	150	0	Floor noise
Vert.	75.083	QP	40.00	10.40	6.09	32.19	0.00	24.30	40.0	15.7	100	242	
Vert.	180.399	QP	44.00	11.61	6.85	32.11	0.00	30.35	43.5	13.1	100	176	
Vert.	200.000	QP	51.30	9.92	6.97	32.09	0.00	36.10	43.5	7.4	100	0	
Vert.	202.994	QP	46.70	9.89	6.99	32.09	0.00	31.49	43.5	12.0	100	158	
Vert.	320.000	QP	44.00	14.04	7.62	32.02	0.00	33.64	46.0	12.3	100	23	
Vert.	536.000	QP	37.00	18.31	8.62	32.03	0.00	31.90	46.0	14.1	100	200	
Vert.	2483.500	PK	49.70	27.93	13.75	43.87	2.17	49.68	73.9	24.2	174	144	
Vert.	2560.000	PK	49.70	28.32	13.82	43.82	2.17	50.19	73.9	23.7	174	144	
Vert.	2880.000	PK	58.10	28.80	5.39	43.82	2.17	50.64	73.9	23.2	125	220	
Vert.	3415.750	PK	58.40	30.22	5.38	44.04	2.17	52.13	73.9	21.7	174	144	
Vert.	3650.000	PK	57.80	30.78	5.35	44.14	2.17	51.96	73.9	21.9	130	225	
Vert.	4960.000	PK	52.70	32.70	5.90	45.32	2.17	48.15	73.9	25.7	150	185	
Vert.	7440.000	PK	53.30	37.47	7.20	43.49	2.17	56.65	73.9	17.2	160	190	
Vert.	9920.000	PK	47.70	38.29	8.09	41.76	2.17	54.49	73.9	19.4	150	0	Floor noise
Vert.	2483.500	AV	38.50	27.93	13.75	43.87	2.17	38.48	53.9	15.4	174	144	VBW: 360 Hz
Vert.	2560.000	AV	38.90	28.32	13.82	43.82	2.17	39.39	53.9	14.5	174	144	VBW: 360 Hz
Vert.	2880.000	AV	53.90	28.80	5.39	43.82	2.17	46.44	53.9	7.4	125	220	VBW: 10 Hz
Vert.	3415.750	AV	54.20	30.22	5.38	44.04	2.17	47.93	53.9	5.9	174	144	VBW: 10 Hz
Vert.	3650.000	AV	53.80	30.78	5.35	44.14	2.17	47.96	53.9	5.9	130	225	VBW: 10 Hz
Vert.	4960.000	AV	40.30	32.70	5.90	45.32	2.17	35.75	53.9	18.1	150	185	VBW: 360 Hz
Vert.	7440.000	AV	43.10	37.47	7.20	43.49	2.17	46.45	53.9	7.4	160	190	VBW: 360 Hz
Vert.	9920.000	AV	35.30	38.29	8.09	41.76	2.17	42.09	53.9	11.8	150	0	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log (3.85 m / 3.0 m) = 2.17 dB

10 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

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

UL Japan, Inc.

Kashima EMC Lab.

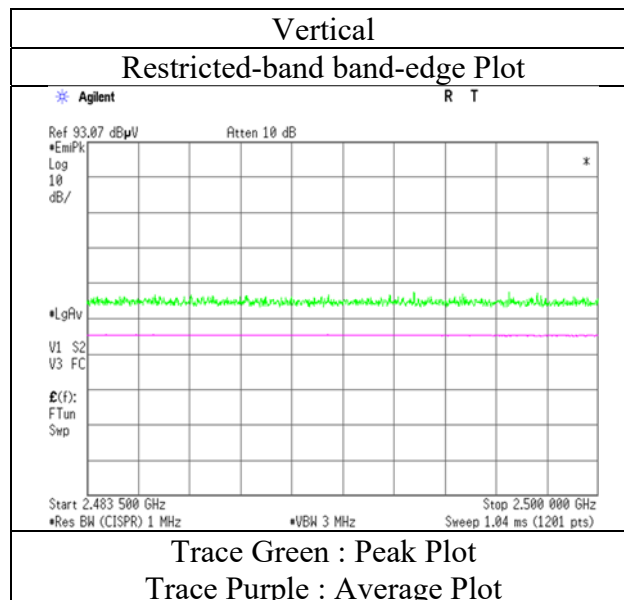
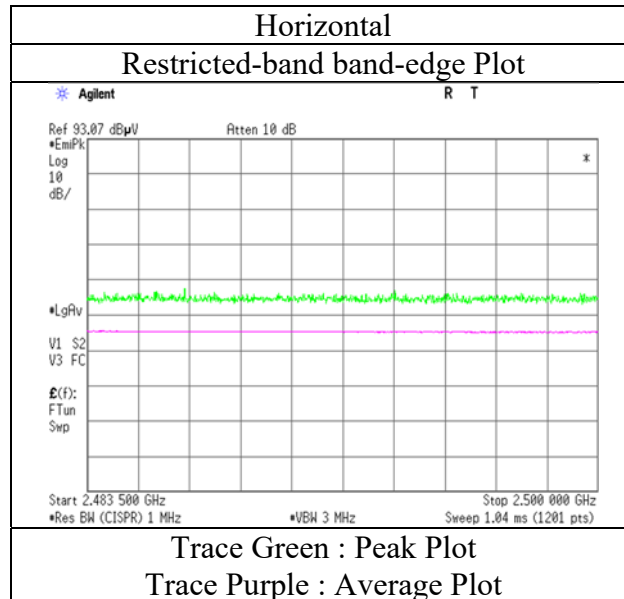
1614, Mushihata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

Radiated Spurious Emission (Reference Plot for band-edge)

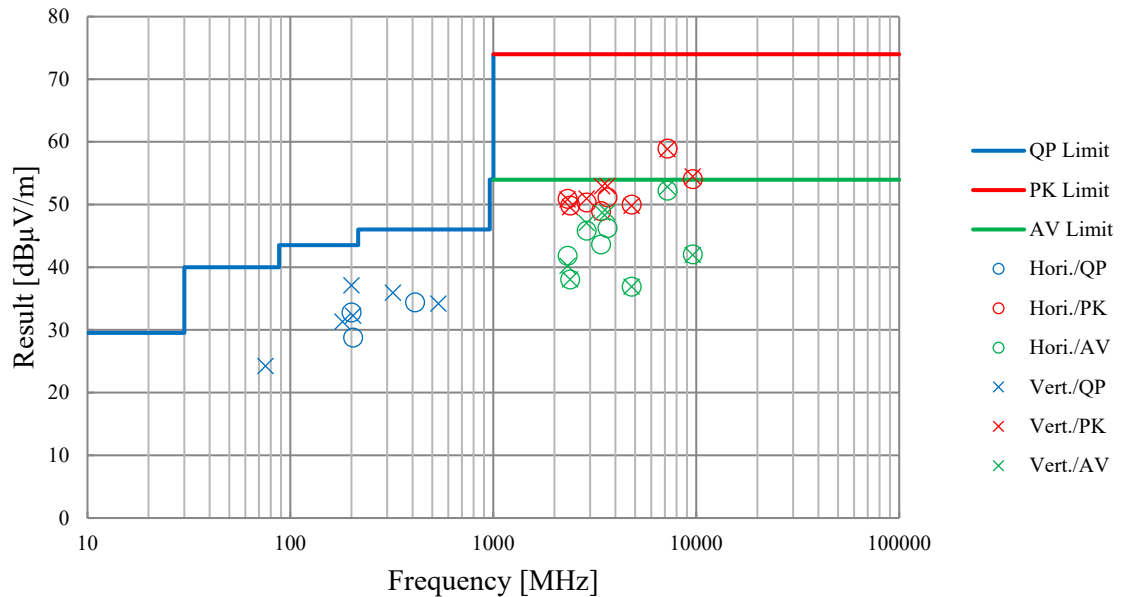
Report No.	13204004M-C-R1		
Test place	Kashima EMC Lab.		
Semi Anechoic Chamber	No.11	No.11	No.11
Date	February 27, 2020	February 27, 2020	February 28, 2020
Temperature / Humidity	21 deg. C / 43 % RH	21 deg. C / 43 % RH	21 deg. C / 36 % RH
Engineer	Hiromitsu Tanabe	Hiromitsu Tanabe	Kazuhiro Ando
	(30 MHz -1000 MHz)	(1 GHz -10 GHz)	(10 GHz -26.5 GHz)
Mode	Tx, Hopping Off, 3DH5 2480 MHz		



* 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.	13204004M-C-R1		
Test place	Kashima EMC Lab.		
Semi Anechoic Chamber	No.11	No.11	No.11
Date	February 27, 2020	February 27, 2020	February 28, 2020
Temperature / Humidity	21 deg. C / 43 % RH	21 deg. C / 43 % RH	21 deg. C / 36 % RH
Engineer	Hiromitsu Tanabe	Hiromitsu Tanabe	Kazuhiro Ando
	(30 MHz -1000 MHz)	(1 GHz -10 GHz)	(10 GHz -26.5 GHz)
Mode	Tx, Hopping Off, DH5	2402 MHz	

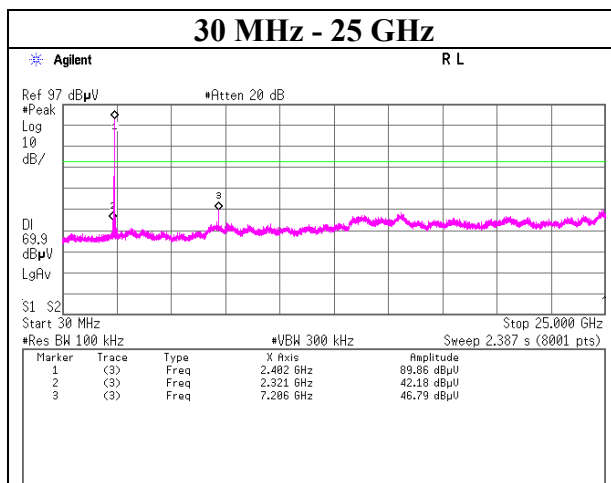
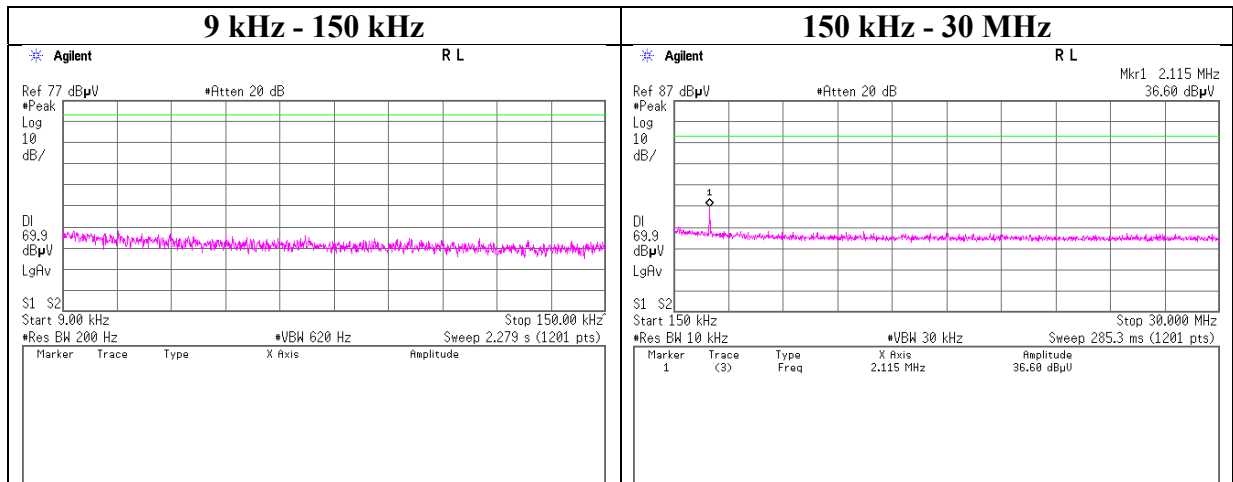


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

Conducted Spurious Emission

Report No.	13204004M-C-R1
Test place	Kashima EMC Lab. No.2 Measurement Room
Date	January 15, 2020
Temperature / Humidity	20 deg. C / 45 % RH
Engineer	Kazuhiro Ando
Mode	Tx, Hopping Off, DH5

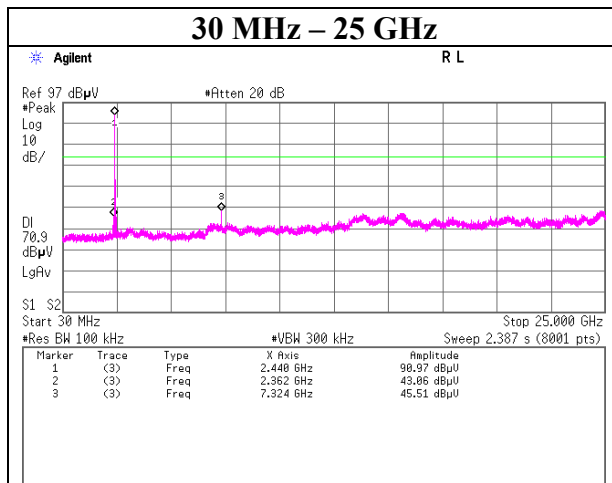
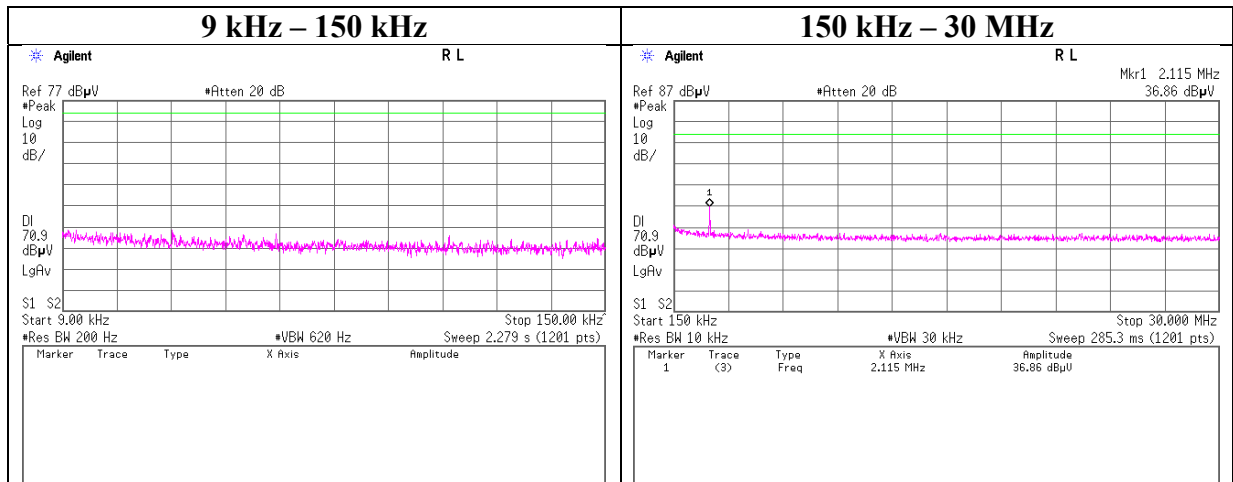
2402 MHz



Conducted Spurious Emission

Report No.	13204004M-C-R1
Test place	Kashima EMC Lab. No.2 Measurement Room
Date	January 15, 2020
Temperature / Humidity	20 deg. C / 45 % RH
Engineer	Kazuhiro Ando
Mode	Tx, Hopping Off, DH5

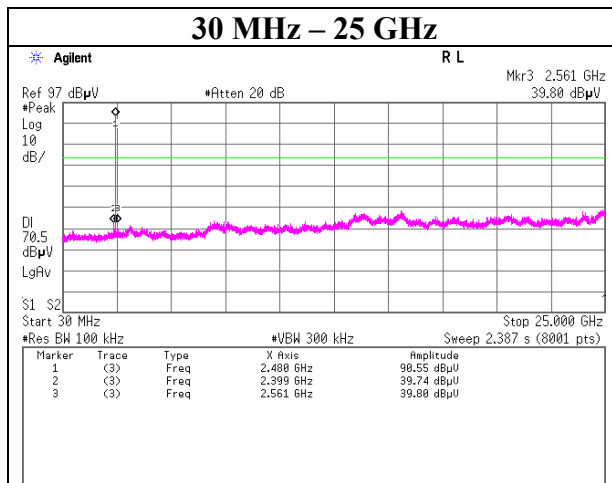
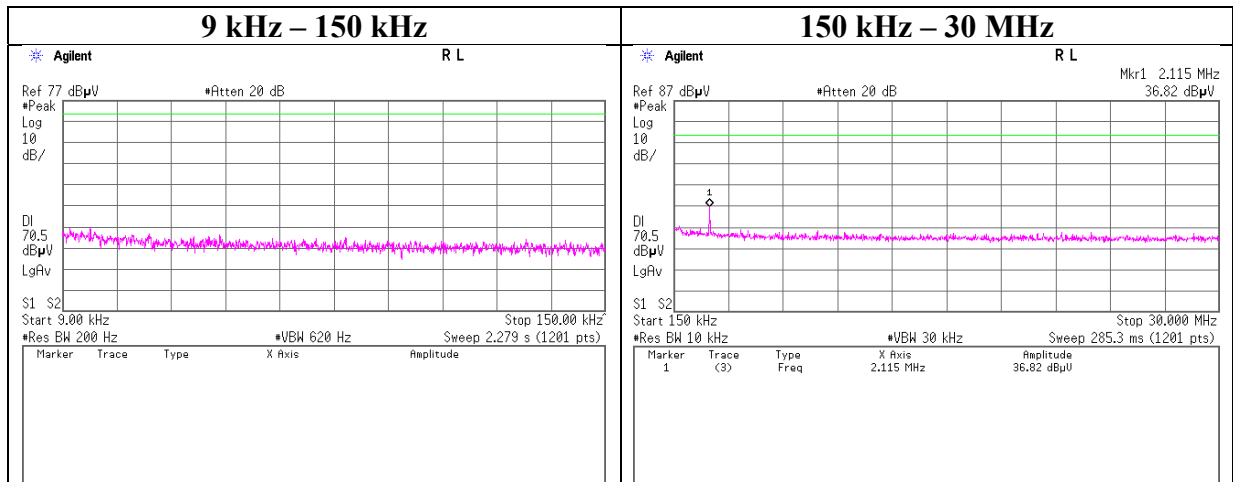
2441 MHz



Conducted Spurious Emission

Report No.	13204004M-C-R1
Test place	Kashima EMC Lab. No.2 Measurement Room
Date	January 15, 2020
Temperature / Humidity	20 deg. C / 45 % RH
Engineer	Kazuhiro Ando
Mode	Tx, Hopping Off, DH5

2480 MHz



UL Japan, Inc.

Kashima EMC Lab.

1614, Mushiata, Katori-shi, Chiba-ken, 289-0341 Japan

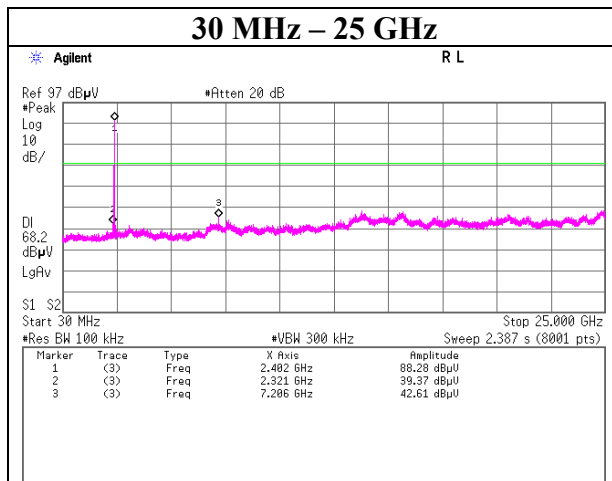
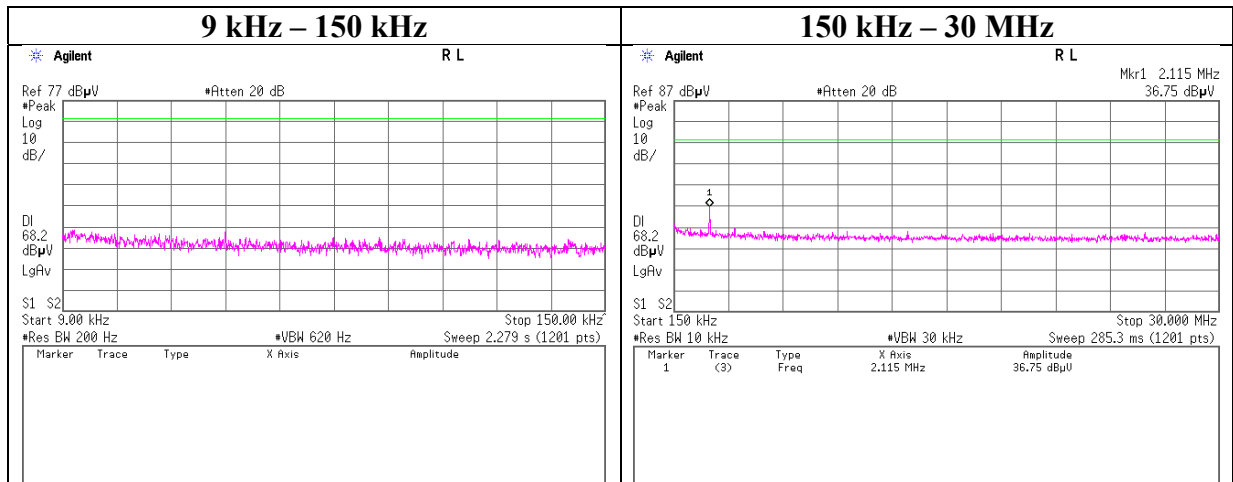
Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

Conducted Spurious Emission

Report No.	13204004M-C-R1
Test place	Kashima EMC Lab. No.2 Measurement Room
Date	January 15, 2020
Temperature / Humidity	20 deg. C / 45 % RH
Engineer	Kazuhiro Ando
Mode	Tx, Hopping Off, 3DH5

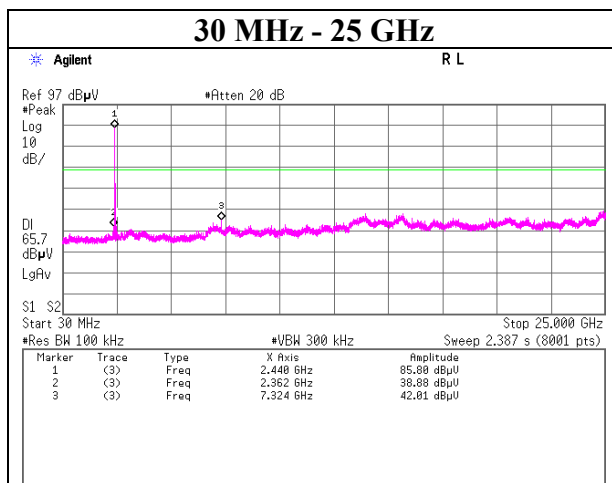
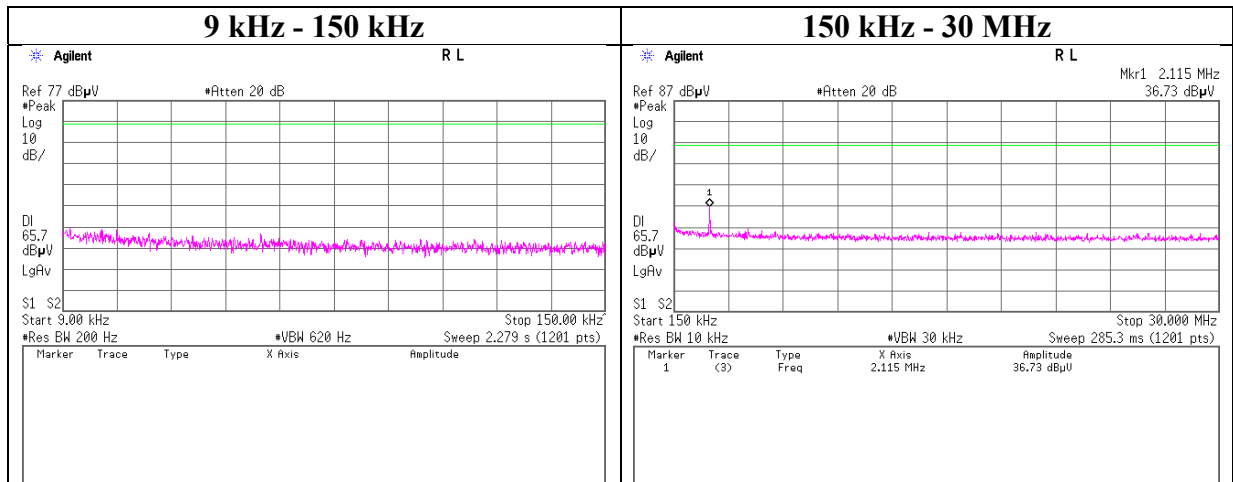
2402 MHz



Conducted Spurious Emission

Report No.	13204004M-C-R1
Test place	Kashima EMC Lab. No.2 Measurement Room
Date	January 15, 2020
Temperature / Humidity	20 deg. C / 45 % RH
Engineer	Kazuhiro Ando
Mode	Tx, Hopping Off, 3DH5

2441 MHz



UL Japan, Inc.

Kashima EMC Lab.

1614, Mushihata, Katori-shi, Chiba-ken, 289-0341 Japan

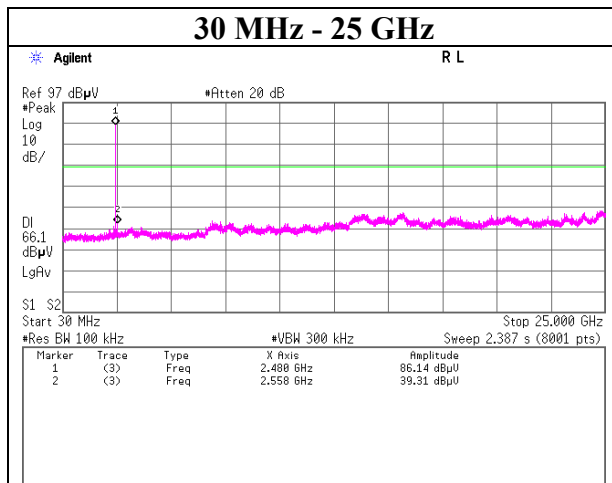
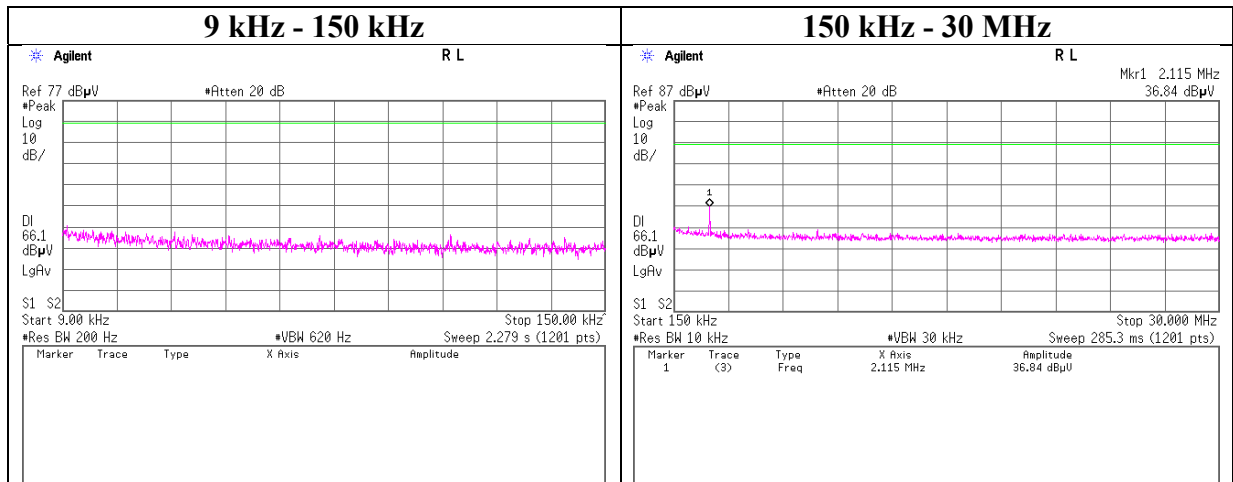
Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

Conducted Spurious Emission

Report No.	13204004M-C-R1
Test place	Kashima EMC Lab. No.2 Measurement Room
Date	January 15, 2020
Temperature / Humidity	20 deg. C / 45 % RH
Engineer	Kazuhiro Ando
Mode	Tx, Hopping Off, 3DH5

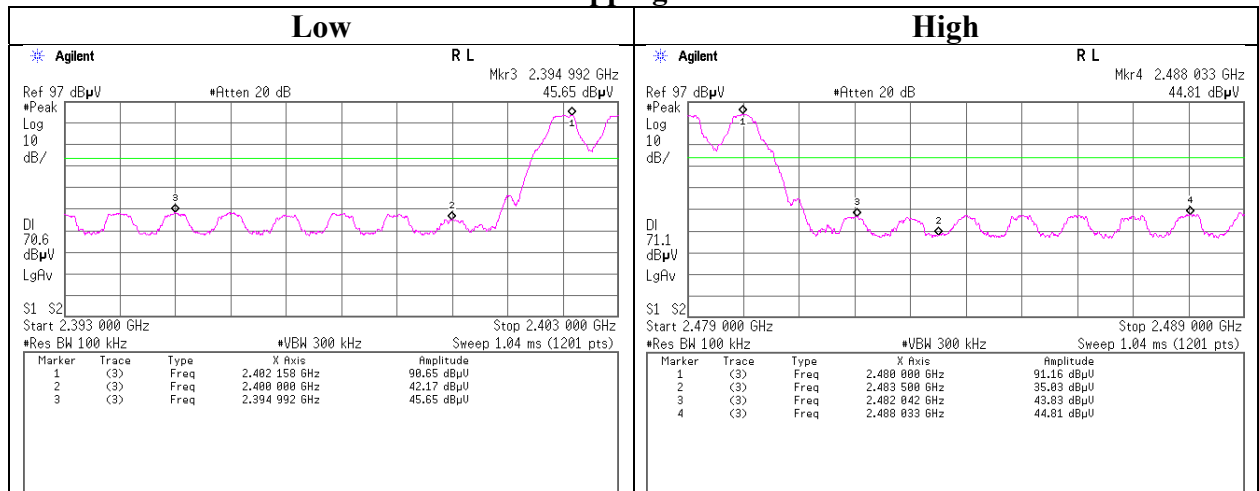
2480 MHz



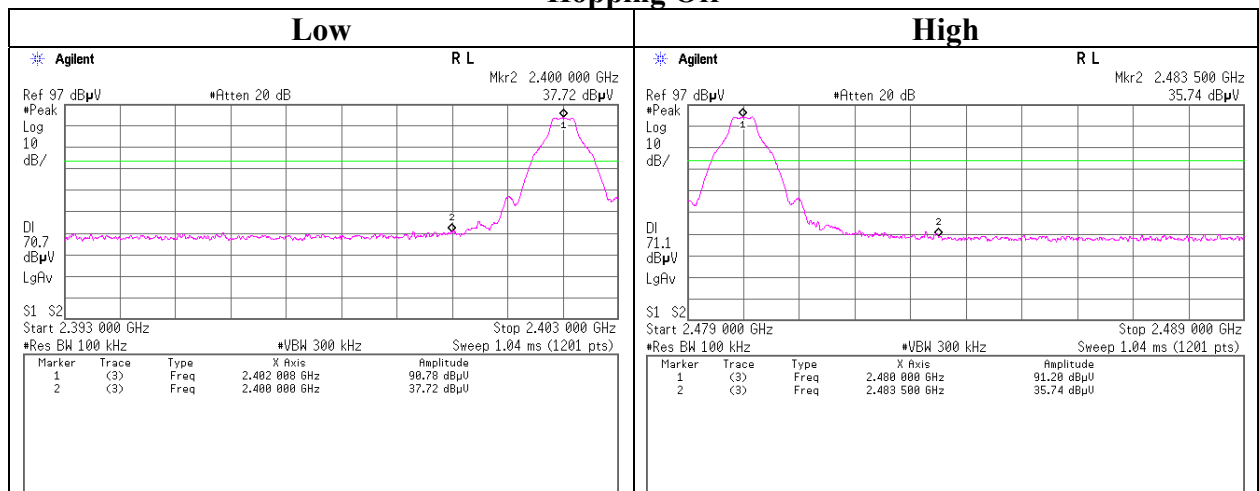
Conducted Emission Band Edge compliance

Report No. 13204004M-C-R1
Test place Kashima EMC Lab. No.2 Measurement Room
Date January 15, 2020
Temperature / Humidity 20 deg. C / 45 % RH
Engineer Kazuhiro Ando
Mode Tx DH5

Hopping On



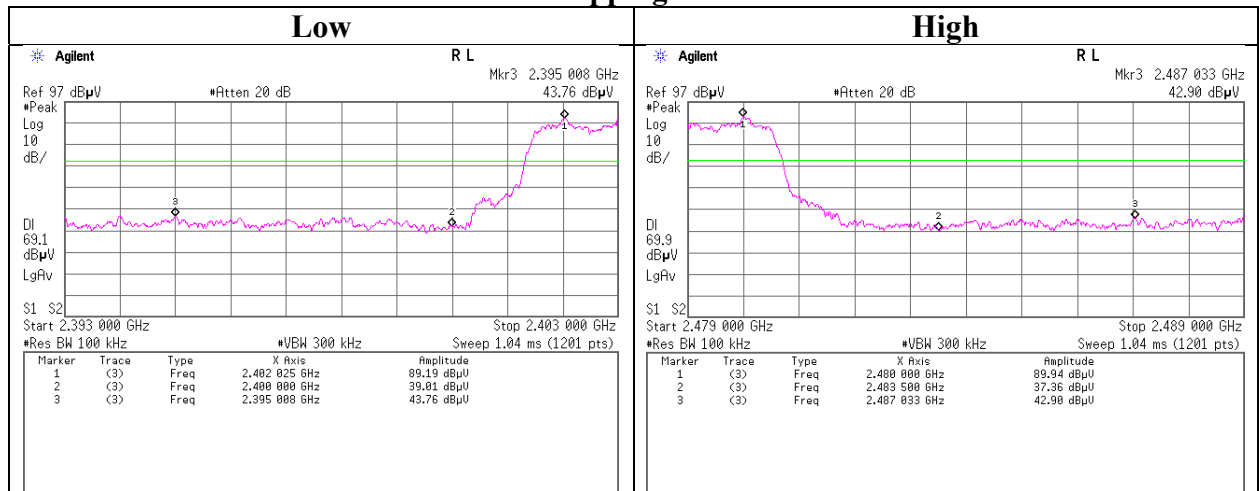
Hopping Off



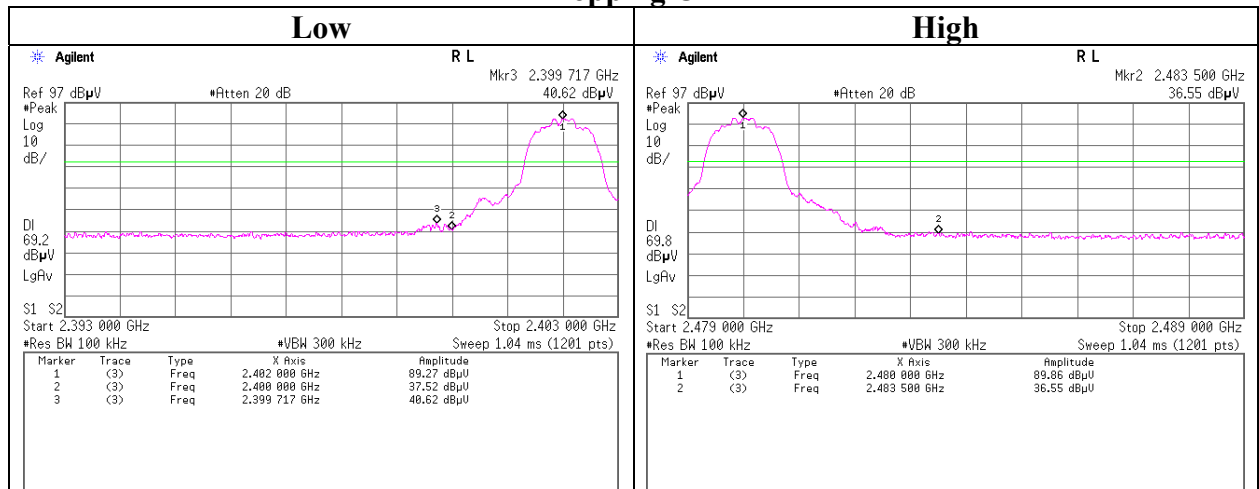
Conducted Emission Band Edge compliance

Report No. 13204004M-C-R1
Test place Kashima EMC Lab. No.2 Measurement Room
Date January 15, 2020
Temperature / Humidity 20 deg. C / 45 % RH
Engineer Kazuhiro Ando
Mode Tx 3DH5

Hopping On



Hopping Off



APPENDIX 2: Test instruments

Test equipment

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE(GHz)	TSA-01	143642	Spectrum Analyzer	Keysight Technologies Inc	N9030A	MY53310670 Version A.13.12	2019/05/27	12
RE(GHz)	CCC-W05	142990	Micro Wave Cable	Shuner	SUCOFLEX104A	MY1477/4A	2019/05/23	12
RE(GHz)	CCC-W07	143111	Micro Wave Cable	Junkosha	MWX221	MRA-12-14-148	2019/05/23	12
RE(GHz)	CAT10-17	143023	10dB Fixed Atten.	Weinschel - API Technologies Corp	54A-10	56251	2019/05/23	12
RE(GHz)	CHF-04	143442	HPF	MICRO-TRONICS	HPM50111-02	009	2019/05/23	12
RE(GHz)	CAF-22	142940	Pre-Amplifier	Micro Wave Factory	MPR-1G26.5-35	161399	2019/06/10	12
RE(GHz)	CHA-25	143456	Double Ridged Wave Guide	ETS-Lindgren	3115	00204573	2019/02/04	12
RE(GHz)	CHA-07	143438	Double Ridged Horn	ETS-Lindgren	3160-09	0166043	2019/06/08	12
RE(GHz)	CAF-19	142937	Pre-Amplifier	TOYO	HAP18-26W	00000035	2019/06/12	12
RE(GHz)	CCC-W09	143113	Micro Wave Cable	Suhner	SUCOFLEX104	MY588/4	2019/07/12	12
RE	CCC-S11-R	143169	Coaxial Cable	Fujikura,Suhner,Suhner,Agilent,Suhner,-,Suhner	5D-2W,SF106,SF104,8496B+8494B,SF106,-,SF106	MY42143380,US00431042(Step Att)	2019/11/19	12
RE	CBL-09	143122	LOGBICON	Schwarzbeck	VULB 9168	508	2019/04/03	12
RE	CAT5-04	178807	5dB Fixed Atten.	PASTERNAK	PE7047-5	none	2019/04/03	12
RE	CAF-16	142936	Pre-Amplifier	SONOMA INSTRUMENT	310N	325015	2019/05/30	12
RE	CTR-01	144193	Test Receiver	Rohde & Schwarz	ESU40	100426	2019/04/19	12
RE	CSCL-16	143655	Ruler	TAJIMA	G3 gold	none	-	-
RE	COS-11	143543	Temperature, Humidity & Atmospheric Logger	T&D	TR-73U	F8060468	2019/06/25	12
RE	CTS-13	144215	Digital Multimeter	Fluke Corporation	FLK-83-V	14610320	2019/10/27	12
RE	COTS-CE MI-03	178804	EMI Software	TSJ	TEPTO-DV3 (RE,CE,ME,PE)	-	-	-
AT	CSA-07	143643	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY52490024	2019/06/01	12
AT	CAT10-17	143023	10dB Fixed Atten.	Weinschel - API Technologies Corp	54A-10	56251	2019/05/23	12
AT	CCC-W01	143109	Micro Wave Cable	Suhner	SUCOFLEX102	MY3662/2	2019/05/23	12
AT	CPM-16	143588	Peak Power Analyzer	Keysight Technologies Inc	8990B	MY51000276	2019/06/21	12
AT	CPSO-24	143606	Power Sensor	Keysight Technologies Inc	N1923A	MY54070024	2019/06/21	12
AT	CTS-18	144220	Digital Multimeter	Fluke Corporation	87-3	85220051	-	-
AT	COS-02	143534	Temperature & Humidity Indicator	A&D	AD-5681	6878345	2019/07/24	12

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

The expiration date of the calibration is the end of the expired month.

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

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

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

UL Japan, Inc.

Kashima EMC Lab.

1614, Mushiata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373