



RADIO TEST REPORT

Test Report No. : 11201777H-B-R1

Applicant : KEYENCE CORPORATION

Type of Equipment : Handheld Mobile Computer

Model No. : BT-W100GA

FCC ID : RF41395C

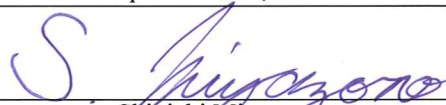
**Test regulation : FCC Part 15 Subpart C: 2016
* Bluetooth part**

Test Result : Complied

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the above regulation.
4. The test results in this report are traceable to the national or international standards.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or 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. This report is a revised version of 11201777H-B. 11201777H-B is replaced with this report.

Date of test: April 11 to 25, 2016

Representative test engineer:


Shinichi Miyazono
Engineer
Consumer Technology Division

Approved by:


Takahiro Hatakeda
Leader
Consumer Technology Division



NVLAP LAB CODE: 200572-0

This laboratory is accredited by the NVLAP LAB CODE 200572-0, U.S.A. The tests reported herein have been performed in accordance with its terms of accreditation.
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13-EM-F0429

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SECTION 1: Customer information

Company Name	:	KEYENCE CORPORATION
Address	:	1-3-14, Higashinakajima Higashiyodogwa-ku Osaka 533-8555 Japan
Telephone Number	:	+81-6-6379-1111
Facsimile Number	:	+81-6-6325-6818
Contact Person	:	Tsuyoshi Aoyama

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

2.1 Identification of E.U.T.

Type of Equipment	:	Handheld Mobile Computer
Model No.	:	BT-W100GA
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 2.8 V – 4.2 V (Battery) DC 5.3 V (Cradle)
Receipt Date of Sample	:	April 11, 2016
Country of Mass-production	:	Japan
Condition of EUT	:	Engineering 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: BT-W100GA (referred to as the EUT in this report) is a Handheld Mobile Computer.

General Specification

Clock frequency(ies) in the system	:	38.4 MHz (X'tal)
Operating Temperature	:	-20 deg. C - +50 deg. C

Radio Specification

Radio Type : Transceiver
Power Supply (inner) : DC 1.8 V / DC 3.3 V

	IEEE802.11b *1)	IEEE802.11g/n (20 M band) *1)	IEEE802.11a/n (20 M band)	IEEE802.11n (40 M band)
Frequency of operation	2412 MHz - 2462 MHz	2412 MHz - 2462 MHz	5180 MHz - 5240 MHz 5280 MHz - 5320 MHz 5500 MHz - 5580 MHz 5660 MHz - 5700 MHz 5745 MHz - 5825 MHz	5190 MHz - 5230 MHz 5310 MHz 5510 MHz - 5550 MHz 5670 MHz 5755 MHz - 5795 MHz
Type of modulation	DSSS (CCK, DQPSK, DBPSK)	OFDM-CCK (64QAM, 16QAM, QPSK, BPSK)	OFDM (64QAM, 16QAM, QPSK, BPSK)	
Channel spacing	5MHz		20MHz	40MHz
Antenna type	Multilayer Monopole Antenna			
Antenna Connector type	Soldering			
Antenna Gain	2.1 dBi (2.4 GHz)		2.4 dBi (5 GHz)	

	Bluetooth Ver.2.1 with EDR function
Frequency of operation	2402 MHz - 2480 MHz
Type of modulation	FHSS (GFSK, $\pi/4$ -DQPSK, 8-DPSK)
Channel spacing	1 MHz
Antenna type	Multilayer Monopole Antenna
Antenna Connector type	Soldering
Antenna Gain	2.1 dBi

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

Variant model

This model has a variant model: BT-W155GA.

BT-W100GA is a Laser-type handy scanner. BT-W155GA is a Camera-type handy scanner.

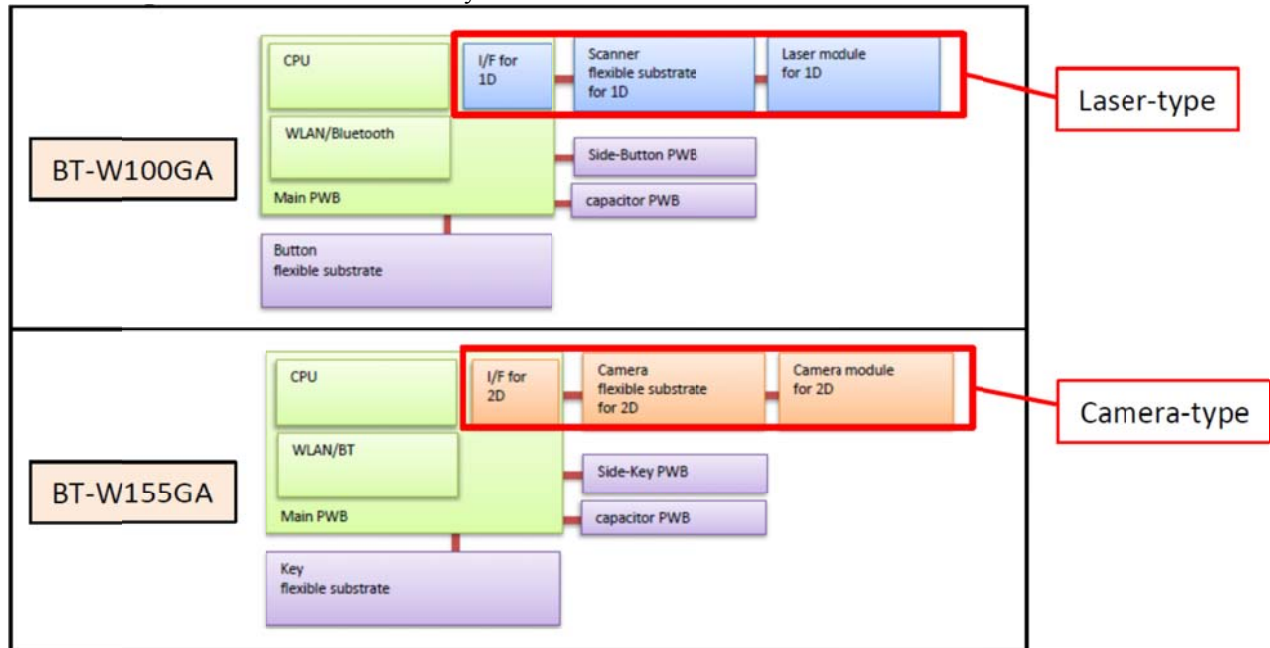
The schematic differences between BT-W100GA and BT-W155GA are the following diagrams.

Circuit design related with WLAN/Bluetooth is same between 2 models.

These difference cause no influence to radio specification.

There was no degradation of EMC characteristic.

Therefore we can consider them electrically identical.



SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC part 15 final revised on April 6, 2016.

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

3.2 Procedures and results

Item	Test Procedure	Specification	Worst Margin	Results	Remarks
Conducted Emission	FCC: ANSI C63.10-2013 6. Standard test methods IC: RSS-Gen 8.8	FCC: Section 15.207 IC: RSS-Gen 8.8	QP 19.8 dB, 0.65800 MHz, L AV 16.0 dB, 0.65865 MHz, N	Complied	-
Carrier Frequency Separation	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section15.247(a)(1) IC: RSS-247 5.1 (2)	See data.	Complied	Conducted
20dB Bandwidth	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section15.247(a)(1) IC: RSS-247 5.1 (1)		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 (4)		Complied	Conducted
Dwell time	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section15.247(a)(1)(iii) IC: RSS-247 5.1 (4)		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 (2)		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	5.1 dB 85.490 MHz, QP, Vertical	Complied	Conducted/ Radiated (above 30 MHz) *1)
Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422. *1) Radiated test was selected over 30 MHz based on section 15.247(d).					

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

FCC Part 15.31 (e)

The test was performed with the New Battery (DC 4.2 V) and the EUT constantly provides the stable voltage to RF part through the regulator regardless of input voltage from New Battery. Therefore, this EUT complies with the requirement.

FCC Part 15.203 Antenna requirement

It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT. Therefore, the equipment complies with the antenna requirement of Section 15.203.

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3.3 Addition to standard

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

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 $k = 2$.
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Antenna terminal test Uncertainty (+/-)							
Power meter		Conducted emission and Power density			Conducted emission		Channel power
Below 1 GHz	Above 1 GHz	Below 1 GHz	1 GHz - 3 GHz	3 GHz - 18 GHz	18 GHz - 26.5 GHz	26.5 GHz - 40 GHz	
0.9 dB	1.0 dB	1.4 dB	1.7 dB	2.8 dB	2.8 dB	2.9 dB	

Frequency range	Conducted emission using AMN(LISN) (+dB)
0.009 – 0.15MHz	3.5 dB
0.15 – 30MHz	2.9 dB

Test distance	Radiated emission (+dB) 9 kHz - 30 MHz
3m	3.8 dB
10m	3.7 dB

Polarity	Radiated emission (Below 1GHz)			
	(3 m*)(+dB)		(10 m*)(+dB)	
	30 – 200 MHz	200 – 1000MHz	30 – 200 MHz	200 – 1000MHz
Horizontal	4.9 dB	5.2 dB	4.9 dB	5.0 dB
Vertical	4.6 dB	5.9 dB	5.0 dB	5.0 dB

Radiated emission				
(3 m*)(+dB)		(1 m*)(+dB)	(0.5 m*)(+dB)	(10 m*)(+dB)
1 – 6GHz	6 – 18GHz	10 – 26.5 GHz	26.5 – 40GHz	1 -18 GHz
5.1 dB	5.3 dB	5.1 dB	5.1 dB	5.3 dB

*Measurement distance

Conducted Emission test

The data listed in this test report has enough margin, more than the site margin.

Radiated emission test

The data listed in this test report has enough margin, more than the site margin.

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3.5 Test Location

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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	-	-

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

SECTION 4: Operation of E.U.T. during testing

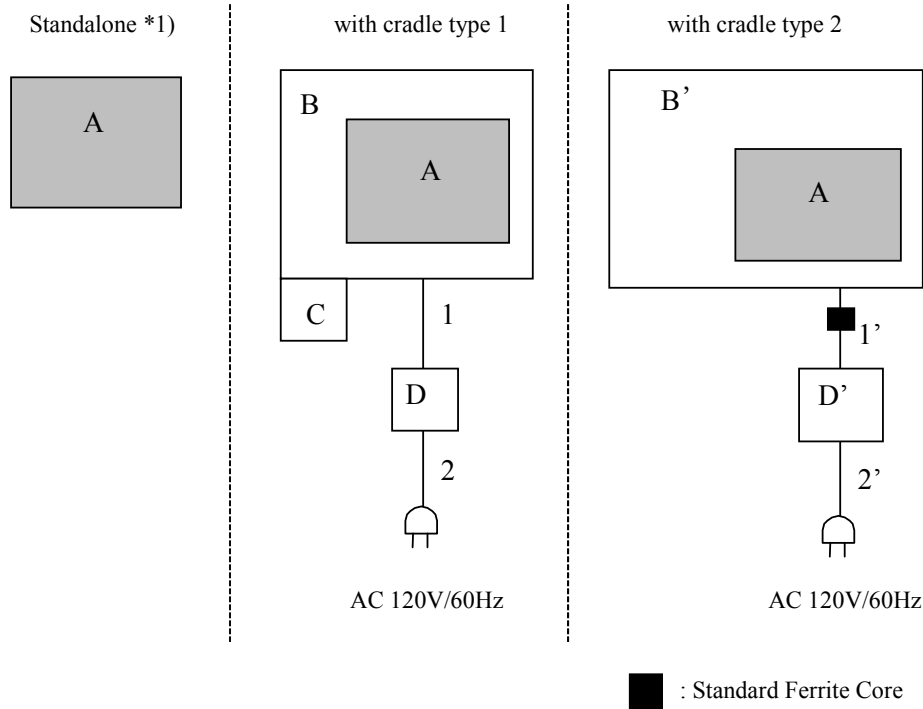
4.1 Operating Mode(s)

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

Details of Operating Mode(s)

Test Item	Mode	Tested frequency
Conducted Emission, 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 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
*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. *EUT has the power settings by the software as follows; Power settings: Same as production model Software: calibrateG *This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.		

4.2 Configuration and peripherals



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

Description of EUT

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Handheld Mobile Computer	BT-W100GA	#2A610011 *1) #2A610012 *2)	KEYENCE CORPORATION	EUT
B	Cradle	BT-WUC1U	#2A610250	KEYENCE CORPORATION	*3)
B'	Cradle	BT-WUC14	-	KEYENCE CORPORATION	-
C	USB Memory	OP-87502	-	KEYENCE CORPORATION	-
D	AC Adaptor	OP-88020	-	KEYENCE CORPORATION	-
D'	AC Adaptor	SEE60N2-16-0	ES057	Sanken Electric Co., Ltd.	-

*1) Used for antenna terminal conducted tests

*2) Used for all tests except for Antenna terminal conducted tests

*3) Used for Conducted emission test as a representative

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	1.8	Unshielded	Unshielded	-
1'	DC Cable	1.3	Unshielded	Unshielded	-
2	AC Cable	2.0	Unshielded	Unshielded	-
2'	AC Cable	2.0	Unshielded	Unshielded	-

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SECTION 5: Conducted Emission

Test Procedure and conditions

EUT was placed on a urethane platform of nominal size, 0.5 m by 1.0 m, raised 0.8m above the conducting ground plane.

The rear of tabletop was located 40 cm to the vertical conducting plane. The rear of EUT, including peripherals aligned and flushed with rear of tabletop. All other surfaces of tabletop were at least 80 cm from any other grounded conducting surface. EUT was located 80 cm from a Line Impedance Stabilization Network (LISN) / Artificial mains Network (AMN) and excess AC cable was bundled in center.

For the tests on EUT with other peripherals (as a whole system)

I/O cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane. All unused 50 ohm connectors of the LISN (AMN) were resistivity terminated in 50 ohm when not connected to the measuring equipment.

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a Semi Anechoic Chamber.

The EUT was connected to a LISN (AMN).

An overview sweep with peak detection has been performed.

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

Detector	: QP and CISPR AV
Measurement range	: 0.15 MHz - 30 MHz
Test data	: APPENDIX
Test result	: Pass

SECTION 6: Radiated Spurious Emission

Test Procedure

[For below 1GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 1.0 m, raised 0.8 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1GHz]

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	4.5 m*2) (1 GHz - 10 GHz), 1 m*3) (10 GHz - 26.5 GHz),		4.5 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: $20 \times \log(4.5 \text{ m}/3.0 \text{ m}) = 3.53 \text{ dB}$

*2) 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 X, Y and Z axes of EUT, EUT on the cradle Type1 and Type2 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 M - 26.5 GHz
Test data	: APPENDIX
Test result	: Pass

SECTION 7: 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 *1)	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak Average *3)	-	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 *2)	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) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents. Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart. (9 kHz -150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 9.1 kHz)

*3) Reference data

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

Test data : APPENDIX
Test result : Pass

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APPENDIX 1: Test data

Conducted Emission

DATA OF CONDUCTED EMISSION TEST

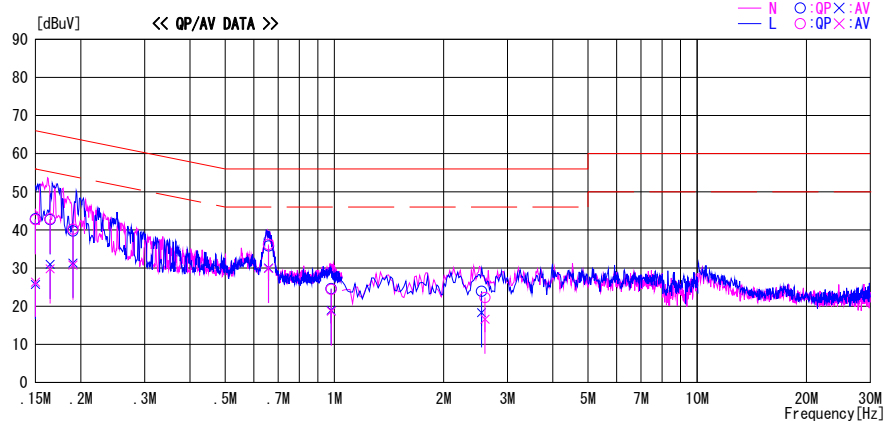
UL Japan, Inc. Ise EMC Lab. No.1 Semi Anechoic Chamber
Date : 04/15/2016

Report No. : 11201777H

Temp./Humi. : 23deg. C / 43% RH
Engineer : Hiroyuki Furutaka

Mode / Remarks : Tx BT DH5 2441 MHz

LIMIT : FCC15.207 QP
FCC15.207 AV

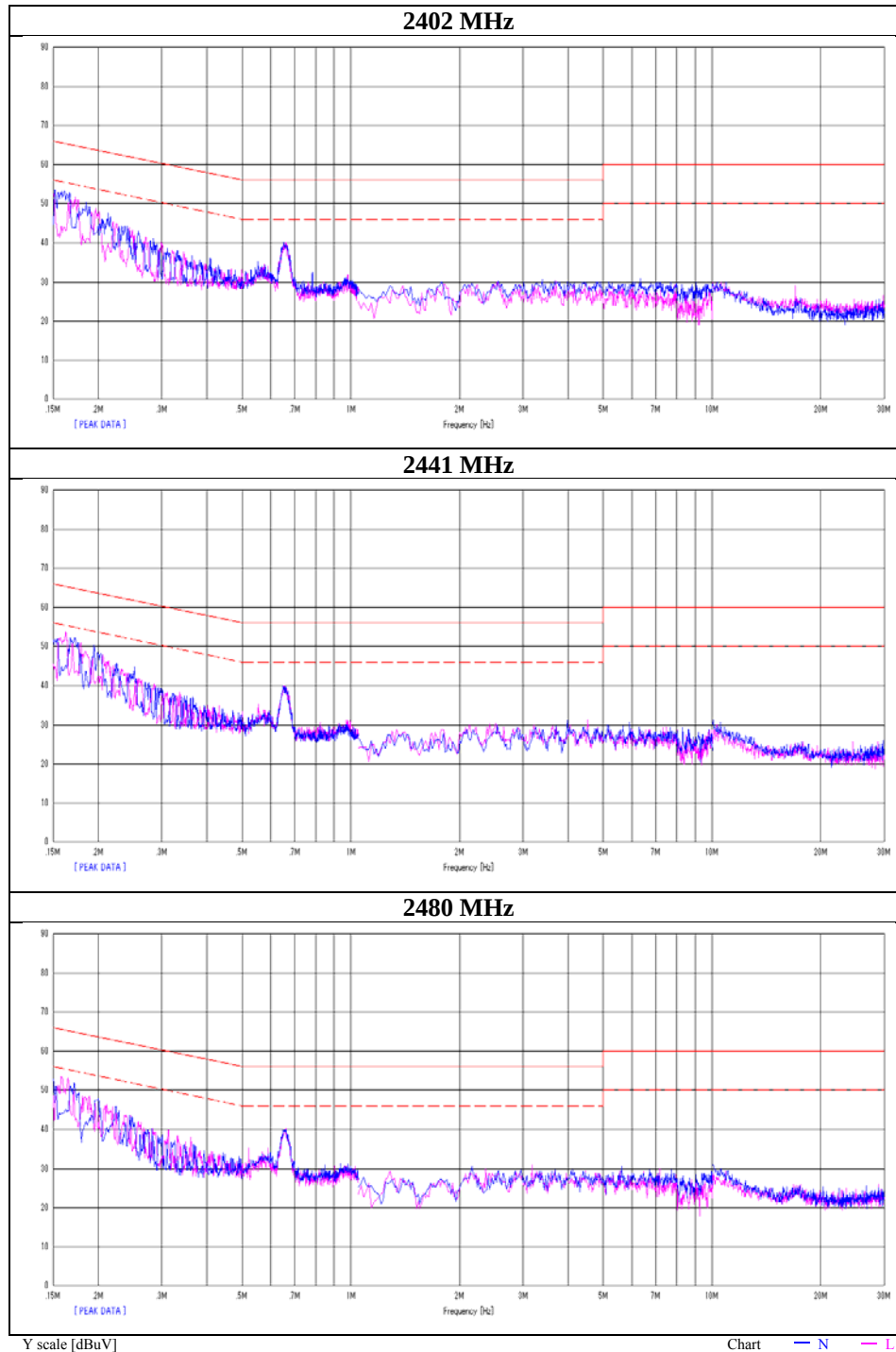


Frequency [MHz]	Reading Level		Corr. Factor [dB]	Results		Limit		Margin		Phase	Comment
	QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dB]	AV [dB]		
0.15000	29.7	12.5	13.2	42.9	25.7	66.0	56.0	23.1	30.3	N	
0.16461	29.5	17.8	13.2	42.7	31.0	65.2	55.2	22.5	24.2	N	
0.19024	26.5	18.1	13.2	39.7	31.3	64.0	54.0	24.3	22.7	N	
0.65865	22.4	16.6	13.4	35.8	30.0	56.0	46.0	20.2	16.0	N	
0.97900	11.2	5.5	13.4	24.6	18.9	56.0	46.0	31.4	27.1	N	
2.54400	10.2	4.6	13.7	23.9	18.3	56.0	46.0	32.1	27.7	N	
0.15000	29.5	13.1	13.2	42.7	26.3	66.0	56.0	23.3	29.7	L	
0.16460	29.7	16.6	13.2	42.9	29.8	65.2	55.2	22.3	25.4	L	
0.19023	27.0	17.6	13.2	40.2	30.8	64.0	54.0	23.8	23.2	L	
0.65800	22.8	16.5	13.4	36.2	29.9	56.0	46.0	19.8	16.1	L	
0.98000	11.0	5.3	13.4	24.4	18.7	56.0	46.0	31.6	27.3	L	
2.60000	8.6	2.9	13.7	22.3	16.6	56.0	46.0	33.7	29.4	L	

CHART : WITH FACTOR. Peak hold data. CALCULATION : RESULT = READING + C.F (LISN + ATTEN + CABLE)
Except for the above table : adequate margin data below the limits.

Conducted Emission

Test place	Ise EMC Lab. No.1 Semi Anechoic Chamber
Report No.	11201777H
Date	April 15, 2016
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx, Hopping Off, DH5



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Conducted Emission

DATA OF CONDUCTED EMISSION TEST

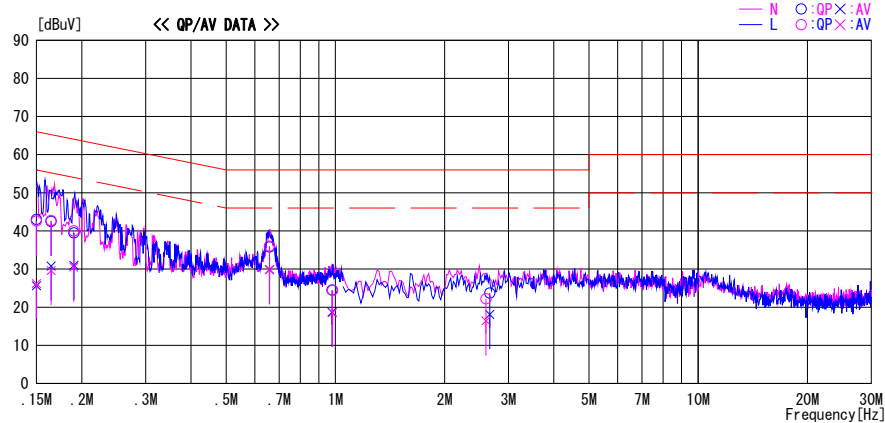
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Date : 04/15/2016

Report No. : 11201777H

Temp./Humi. : 23deg. C / 43% RH
Engineer : Hiroyuki Furutaka

Mode / Remarks : Tx BT 3DH5 2441 MHz

LIMIT : FCC15.207 QP
FCC15.207 AV

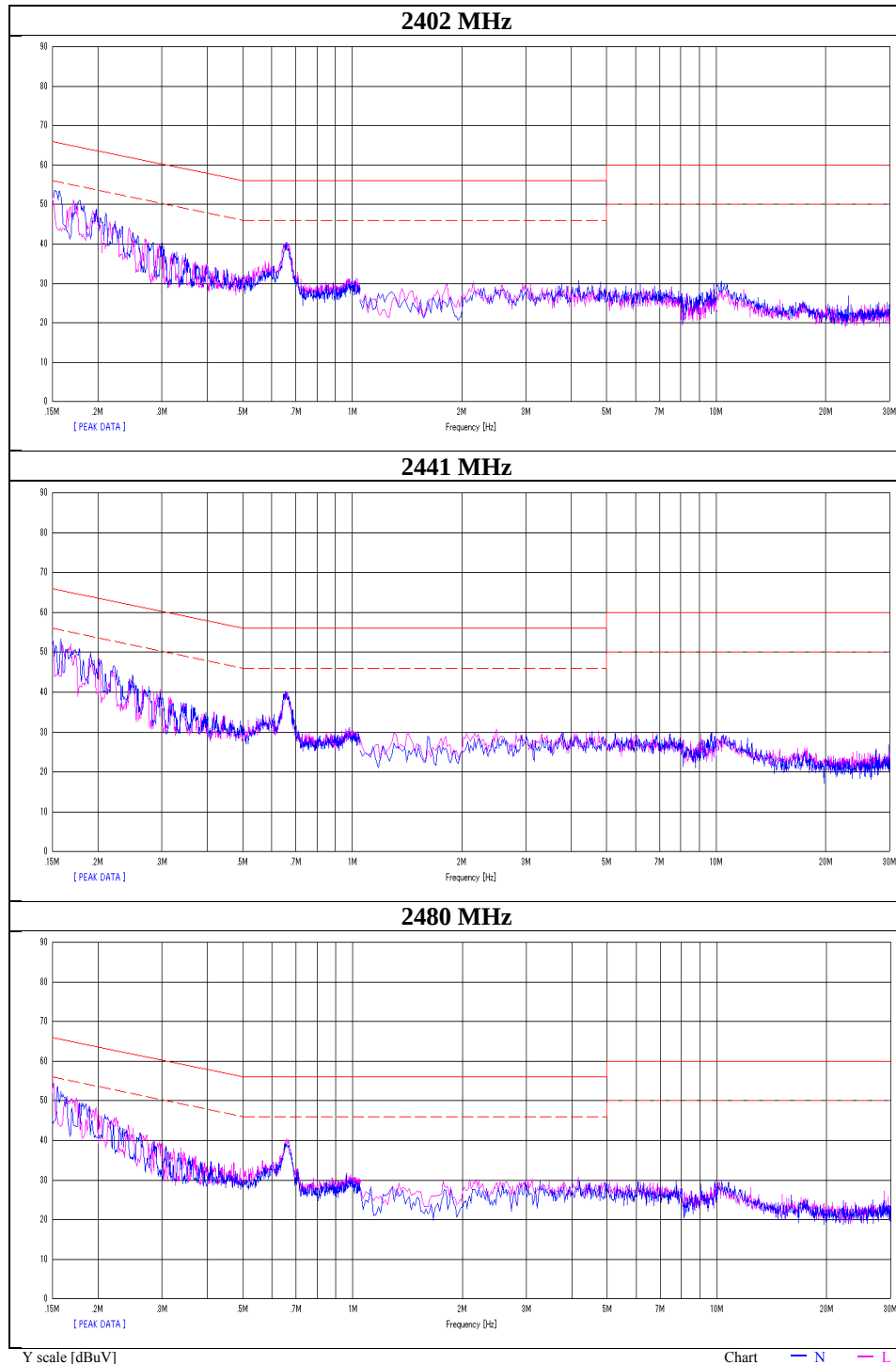


Frequency [MHz]	Reading Level		Corr. Factor	Results		Limit		Margin		Phase	Comment
	QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dB]	AV [dB]		
0.15000	29.8	12.4	13.2	43.0	25.6	66.0	56.0	23.0	30.4	N	
0.15000	29.4	13.0	13.2	42.6	26.2	66.0	56.0	23.4	29.8	L	
0.16456	29.5	16.4	13.2	42.7	29.6	65.2	55.2	22.5	25.6	L	
0.16460	29.3	17.6	13.2	42.5	30.8	65.2	55.2	22.7	24.4	N	
0.19000	26.8	17.3	13.2	40.0	30.5	64.0	54.0	24.0	23.5	L	
0.19023	26.3	17.8	13.2	39.5	31.0	64.0	54.0	24.5	23.0	N	
0.65790	22.6	16.4	13.4	36.0	29.8	56.0	46.0	20.0	16.2	L	
0.65865	22.4	16.5	13.4	35.8	29.9	56.0	46.0	20.2	16.1	N	
0.97860	11.1	5.3	13.4	24.5	18.7	56.0	46.0	31.5	27.3	N	
0.98210	11.0	5.2	13.4	24.4	18.6	56.0	46.0	31.6	27.4	L	
2.60000	8.5	2.7	13.7	22.2	16.4	56.0	46.0	33.8	29.6	L	
2.66410	10.0	4.4	13.7	23.7	18.1	56.0	46.0	32.3	27.9	N	

CHART : WITH FACTOR. Peak hold data. CALCULATION : RESULT = READING + C.F (LISN + ATTN + CABLE)
Except for the above table : adequate margin data below the limits.

Conducted Emission

Test place	Ise EMC Lab. No.1 Semi Anechoic Chamber
Report No.	11201777H
Date	April 15, 2016
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx, Hopping Off, 3DH5



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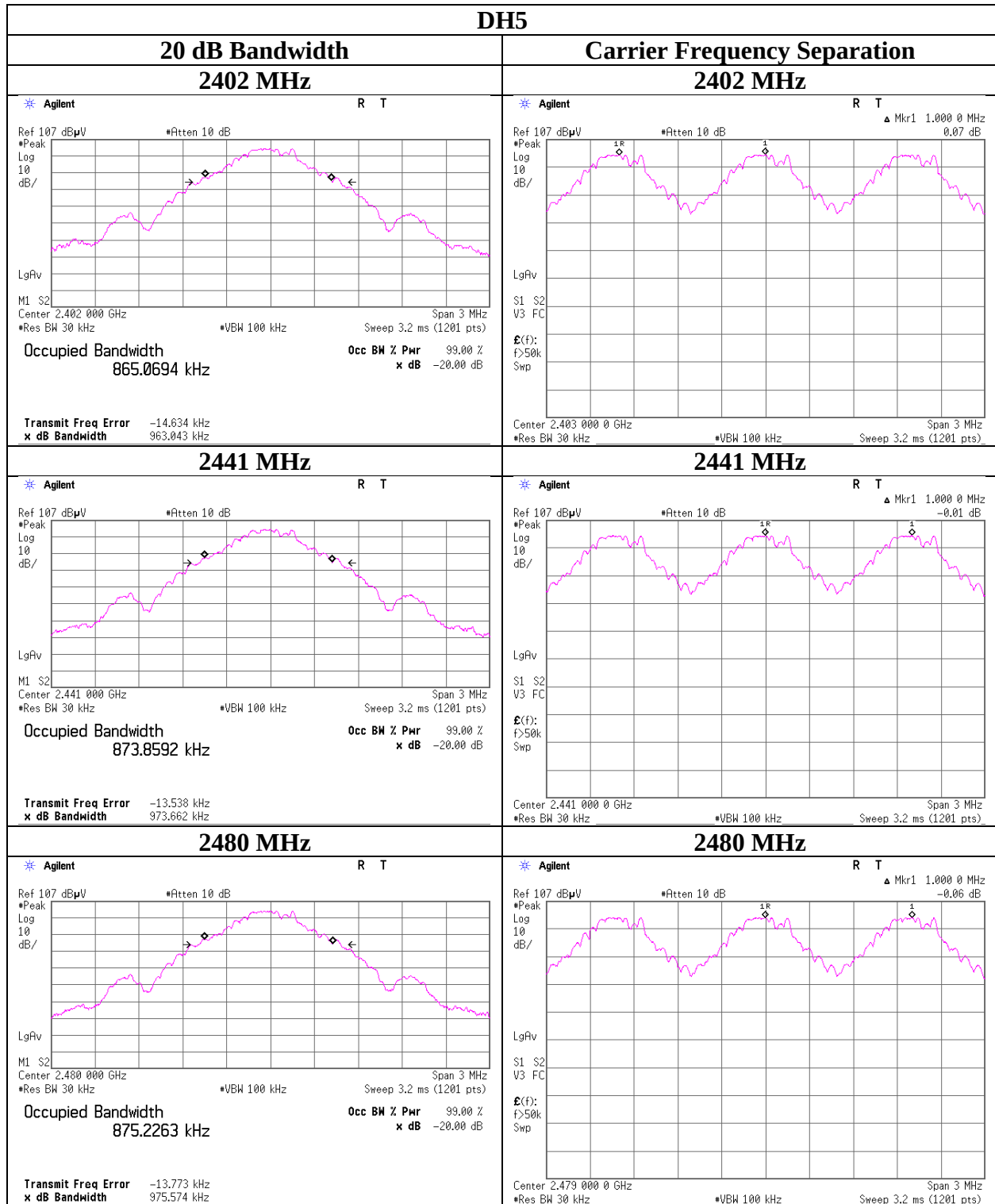
20dB Bandwidth and Carrier Frequency Separation

Test place : Ise EMC Lab. No.6 Measurement Room
Report No. : 11201777H
Date : April 14, 2016
Temperature / Humidity : 26 deg. C / 51 % RH
Engineer : Masafumi Niwa
Mode : Tx, Hopping Off/On

Mode	Freq. [MHz]	20dB Bandwidth [MHz]	Carrier Frequency Separation [MHz]	Limit for Carrier Frequency separation [MHz]
DH5	2402.0	0.963	1.000	≥ 0.642
DH5	2441.0	0.974	1.000	≥ 0.649
DH5	2480.0	0.976	1.000	≥ 0.651
3DH5	2402.0	1.311	1.000	≥ 0.874
3DH5	2441.0	1.312	1.000	≥ 0.875
3DH5	2480.0	1.311	1.000	≥ 0.874

Limit: Two-thirds of 20dB Bandwidth or 25kHz (whichever is greater).
No limit applies to 20dB Bandwidth.

20dB Bandwidth and Carrier Frequency Separation



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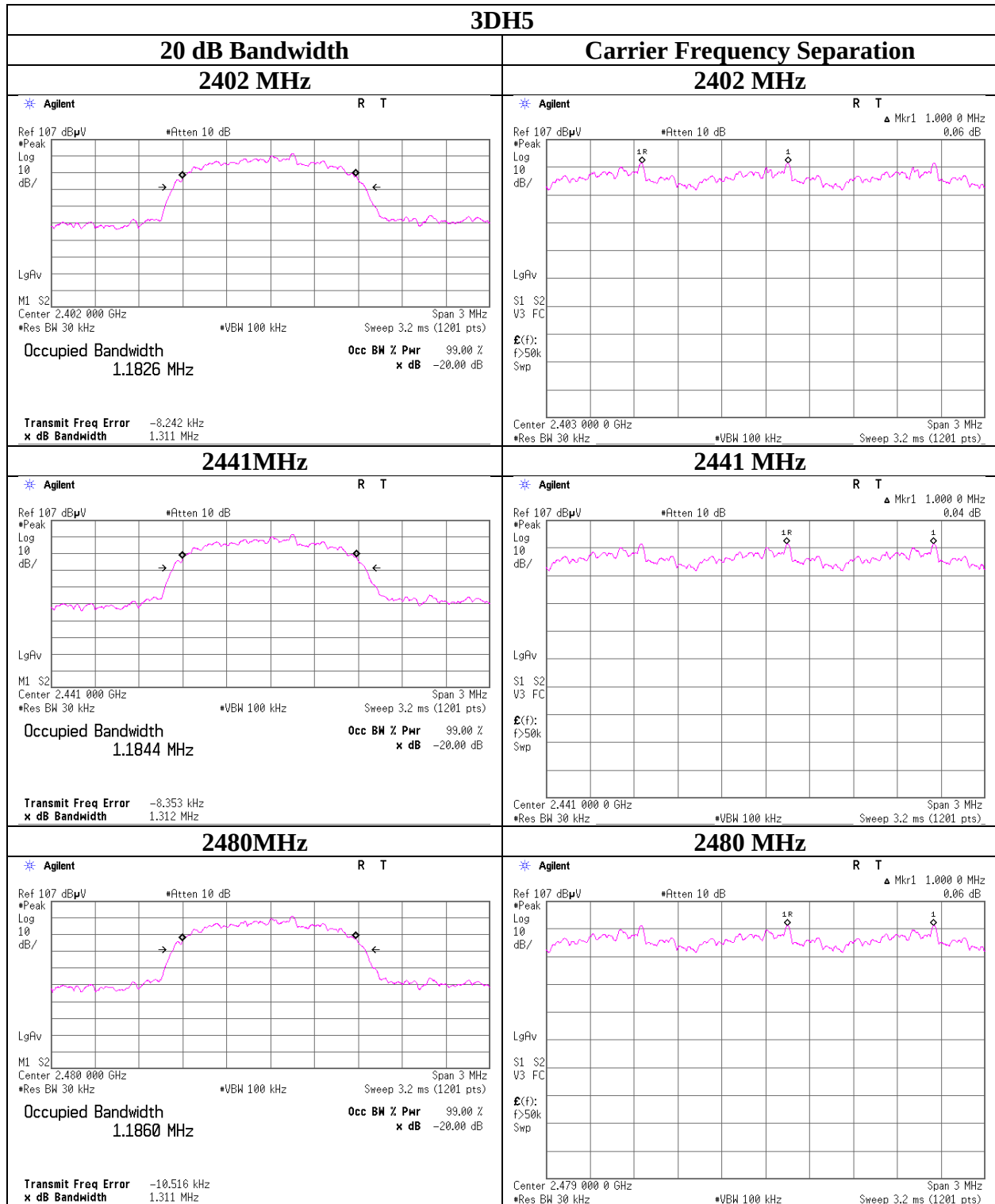
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20dB Bandwidth and Carrier Frequency Separation



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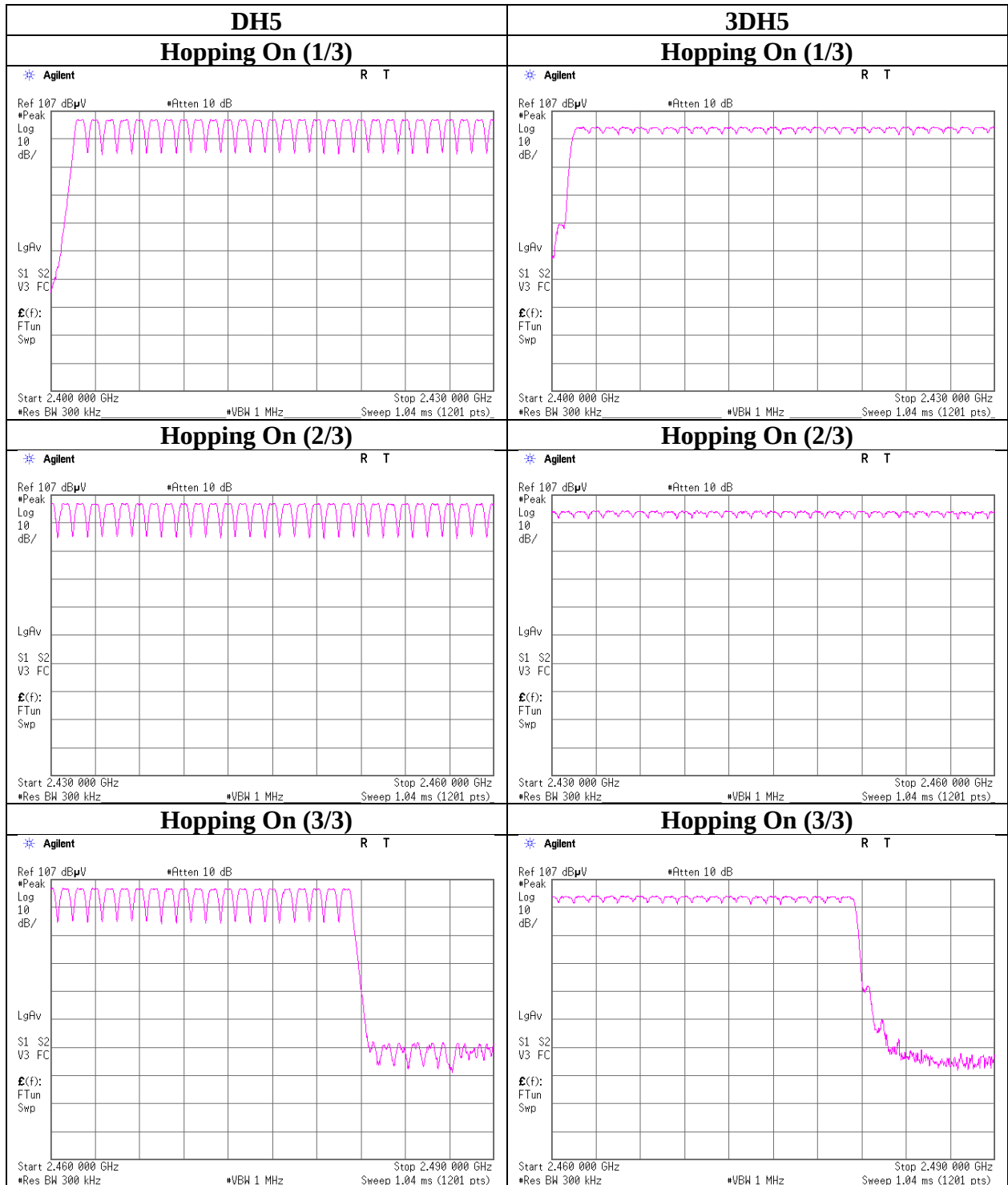
Number of Hopping Frequency

Test place Ise EMC Lab. No.6 Measurement Room
Report No. 11201777H
Date April 14, 2016
Temperature / Humidity 26 deg. C / 51 % RH
Engineer Masafumi Niwa
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



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Dwell time

Test place : Ise EMC Lab. No.6 Measurement Room
Report No. : 11201777H
Date : April 14, 2016
Temperature / Humidity : 26 deg. C / 51 % RH
Engineer : Masafumi Niwa
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	49.2 times / 5 sec. x 31.6 sec. = 311 times	0.395	123	400
DH3	26.8 times / 5 sec. x 31.6 sec. = 170 times	1.657	282	400
DH5	19.8 times / 5 sec. x 31.6 sec. = 126 times	2.920	368	400
3DH1	49.4 times / 5 sec. x 31.6 sec. = 313 times	0.399	125	400
3DH3	26.2 times / 5 sec. x 31.6 sec. = 166 times	1.661	276	400
3DH5	19.4 times / 5 sec. x 31.6 sec. = 123 times	2.907	358	400

Sample Calculation

Result = Number of transmission x Length of transmission

*Average data of 5 tests.(except Inquiry)

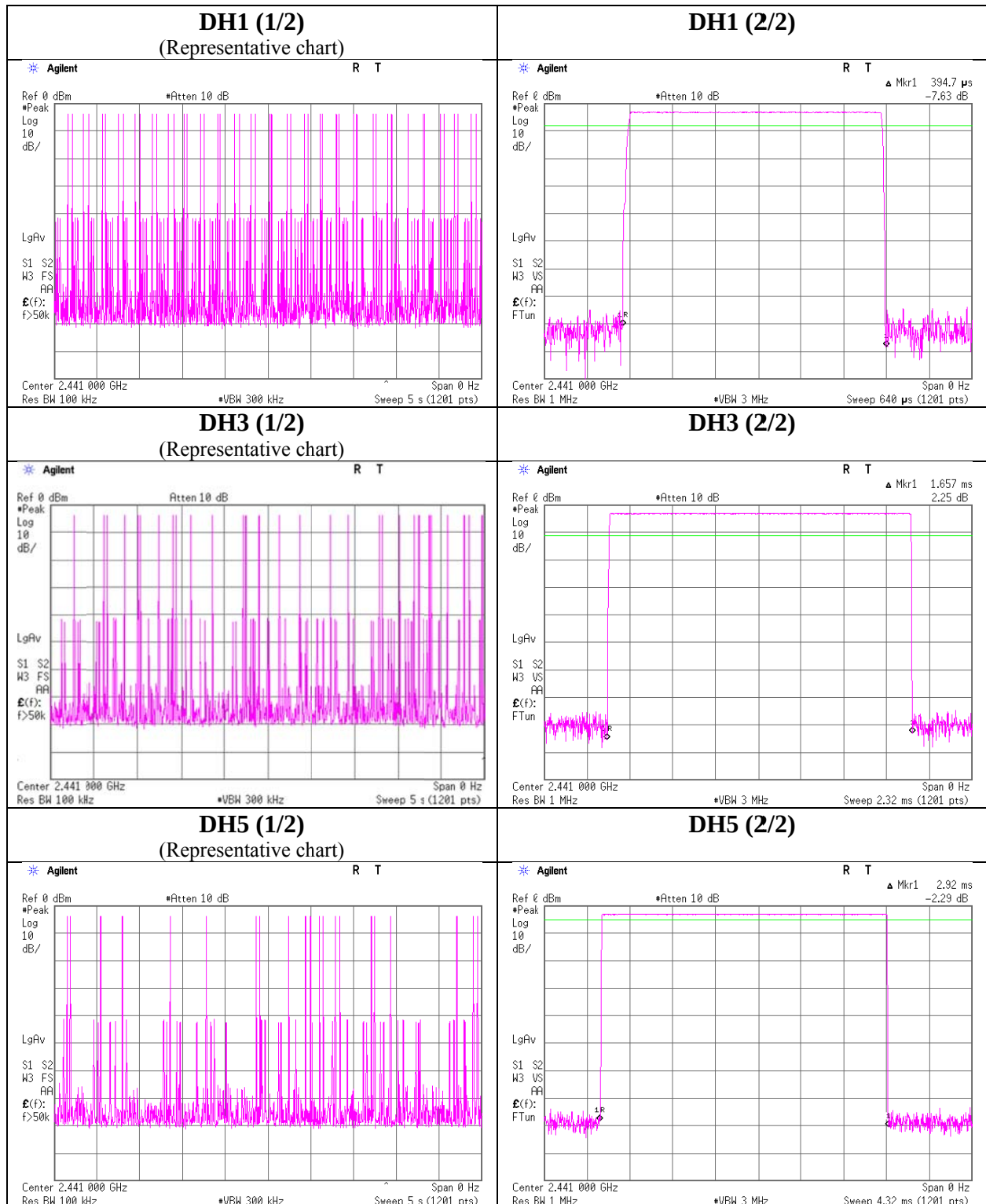
Mode	Sampling [times]					Average [times]
	1	2	3	4	5	
DH1	49	49	49	50	49	49.2
DH3	29	25	28	29	23	26.8
DH5	21	21	21	20	16	19.8
3DH1	50	49	50	48	50	49.4
3DH3	22	29	28	25	27	26.2
3DH5	19	21	19	19	19	19.4

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



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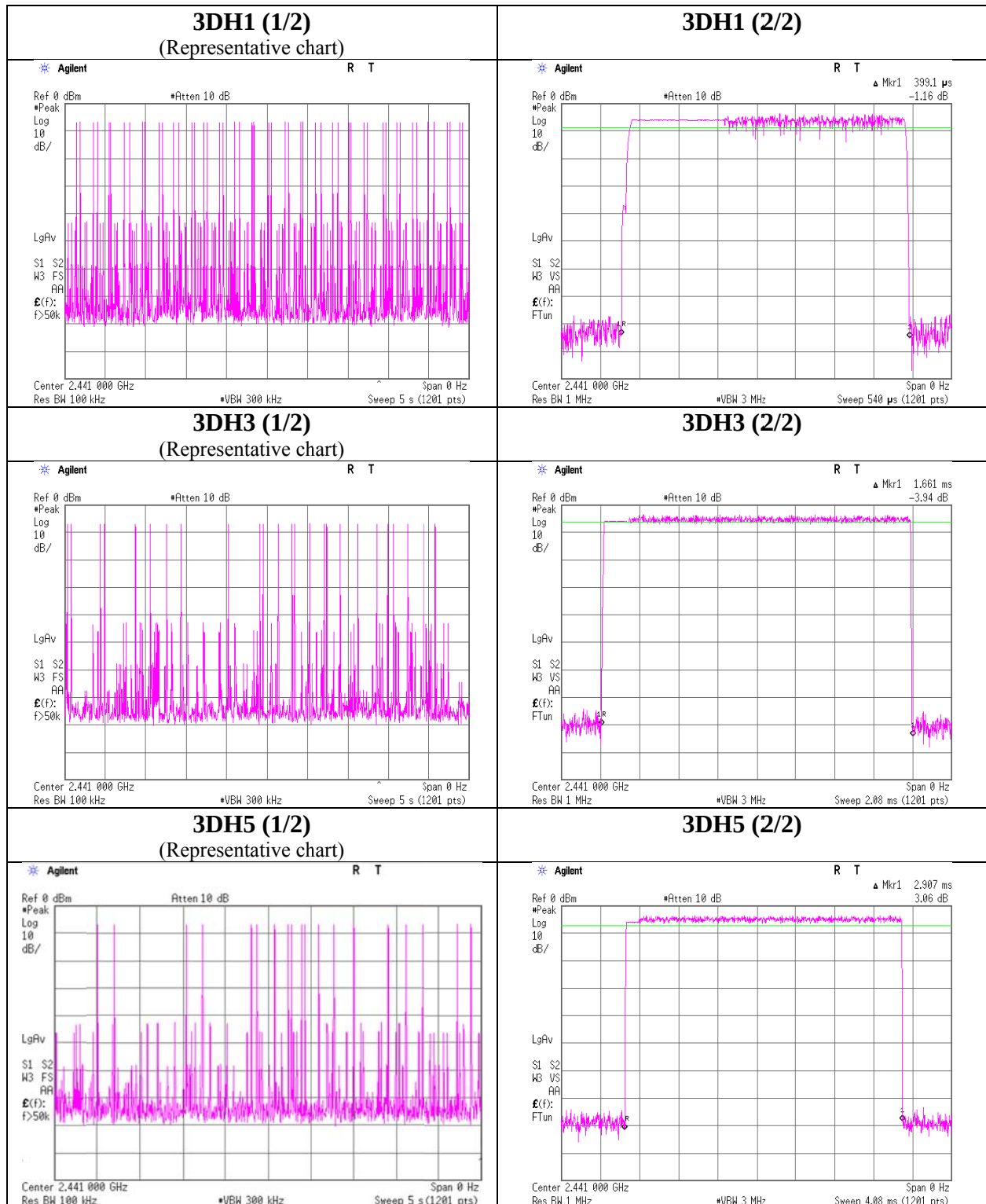
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Dwell time



Maximum Peak Output Power

Test place : Ise EMC Lab. No.6 Measurement Room
Report No. : 11201777H
Date : April 14, 2016
Temperature / Humidity : 26 deg. C / 51 % RH
Engineer : Masafumi Niwa
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	-3.15	0.97	10.03	7.85	6.10	20.96	125	13.11
DH5	2441.0	-3.12	0.99	10.03	7.90	6.17	20.96	125	13.06
DH5	2480.0	-3.41	1.00	10.03	7.62	5.78	20.96	125	13.34
2DH5	2402.0	-3.71	0.97	10.03	7.29	5.36	20.96	125	13.67
2DH5	2441.0	-3.67	0.99	10.03	7.35	5.43	20.96	125	13.61
2DH5	2480.0	-3.94	1.00	10.03	7.09	5.12	20.96	125	13.87
3DH5	2402.0	-3.25	0.97	10.03	7.75	5.96	20.96	125	13.21
3DH5	2441.0	-3.23	0.99	10.03	7.79	6.01	20.96	125	13.17
3DH5	2480.0	-3.49	1.00	10.03	7.54	5.68	20.96	125	13.42

Sample Calculation:

Result = Reading + Cable Loss + Attenuator Loss

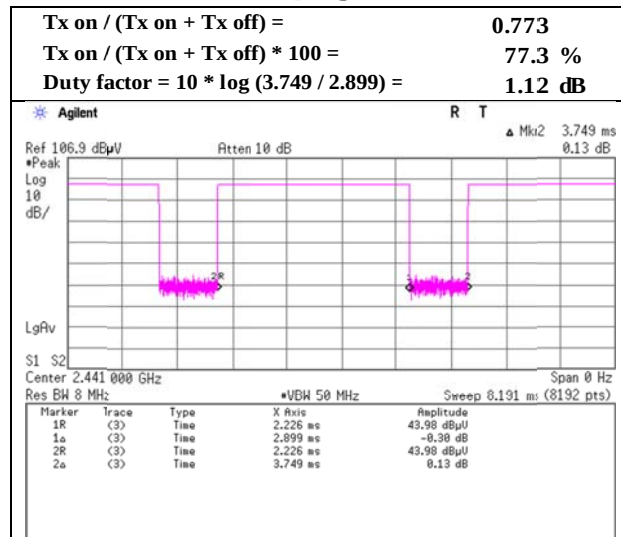
Test was not performed at AFH mode, because the decrease of number of channel (min: 20ch) at AFH mode does not influence on the output power and bandwidth of the EUT.

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.

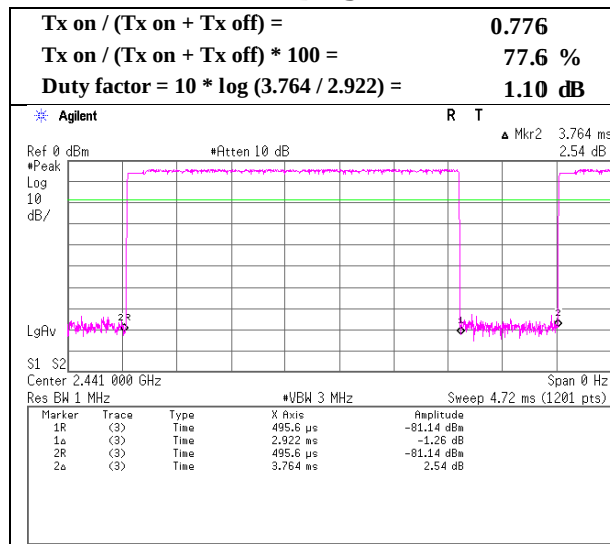
Burst Rate Confirmation

Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber and No.6 Measurement Room	
Report No.	11201777H	
Date	April 11, 2016	April 14, 2016
Temperature / Humidity	23 deg. C / 35 % RH	26 deg. C / 51 % RH
Engineer	Shinichi Miyazono	Masafumi Niwa
Mode	Tx, Hopping Off	

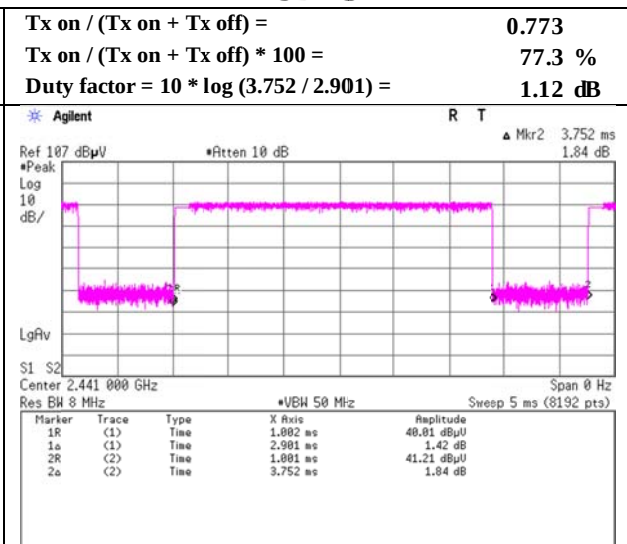
DH5



2DH5

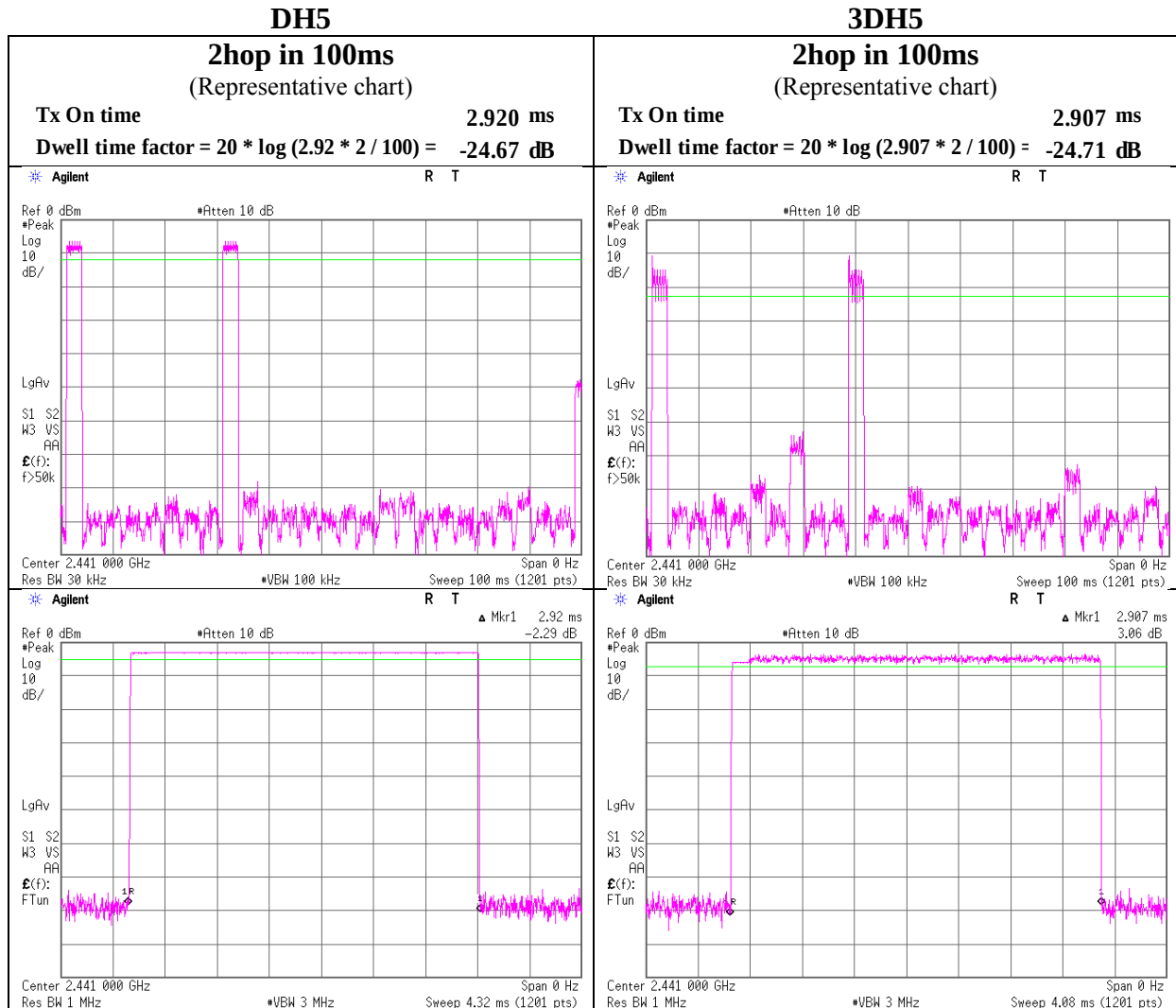


3DH5



Dwell time factor

Test place	Ise EMC Lab. No.6 Measurement Room
Report No.	11201777H
Date	April 14, 2016
Temperature / Humidity	26 deg. C / 51 % RH
Engineer	Masafumi Niwa
Mode	Tx, Hopping On



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Radiated Spurious Emission

Test place : Ise EMC Lab. No.4 Semi Anechoic Chamber
Report No. : 11201777H
Date : April 11, 2016 April 20, 2016 April 22, 2016 April 25, 2016
Temperature / Humidity : 23 deg. C / 35 % RH 20deg. C / 33 % RH 22deg. C / 51 % RH 25deg. C / 43 % RH
Engineer : Shinichi Miyazono Tomoki Matsui Kazuya Yoshioka Takafumi Noguchi
 (1 GHz - 10 GHz) (10 GHz - 18 GHz) (Below 1GHz) (18 GHz - 26.5 GHz)
Mode : Tx, Hopping Off, DH5 2402 MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	77.436	QP	32.9	6.5	7.8	32.1	15.1	40.0	24.9	
Hori	85.499	QP	40.4	7.6	7.9	32.1	23.8	40.0	16.2	
Hori	142.492	QP	36.1	14.6	8.6	32.0	27.3	43.5	16.2	
Hori	161.490	QP	38.5	15.3	8.8	32.0	30.6	43.5	12.9	
Hori	180.500	QP	36.8	16.1	8.9	32.0	29.8	43.5	13.7	
Hori	273.368	QP	30.4	12.9	9.7	31.8	21.2	46.0	24.8	
Hori	2390.000	PK	41.3	27.9	6.8	32.1	43.9	73.9	30.0	
Hori	4804.000	PK	45.6	32.8	9.2	31.3	56.3	73.9	17.6	
Hori	7206.000	PK	42.3	36.8	10.4	32.6	56.9	73.9	17.0	Floor Noise
Hori	9608.000	PK	43.0	38.1	11.1	32.6	59.6	73.9	14.3	Floor Noise
Hori	12010.000	PK	48.1	39.9	-1.1	33.2	53.7	73.9	20.2	
Hori	2390.000	AV	29.8	27.9	6.8	32.1	32.4	53.9	21.5	
Hori	7206.000	AV	31.8	36.8	10.4	32.6	46.4	53.9	7.5	Floor Noise
Hori	9608.000	AV	30.7	38.1	11.1	32.6	47.3	53.9	6.6	Floor Noise
Vert	77.536	QP	46.6	6.5	7.8	32.1	28.8	40.0	11.2	
Vert	85.501	QP	51.3	7.6	7.9	32.1	34.7	40.0	5.3	
Vert	142.494	QP	42.0	14.6	8.6	32.0	33.2	43.5	10.3	
Vert	161.498	QP	42.9	15.4	8.8	32.0	35.1	43.5	8.4	
Vert	180.488	QP	41.3	16.1	8.9	32.0	34.3	43.5	9.2	
Vert	265.978	QP	37.2	12.7	9.6	31.9	27.6	46.0	18.4	
Vert	2390.000	PK	41.9	27.9	6.8	32.1	44.5	73.9	29.4	
Vert	4804.000	PK	45.2	32.8	9.2	31.3	55.9	73.9	18.0	
Vert	7206.000	PK	45.8	36.8	10.4	32.6	60.4	73.9	13.5	
Vert	9608.000	PK	43.0	38.1	11.1	32.6	59.6	73.9	14.3	Floor Noise
Vert	12010.000	PK	49.0	39.9	-1.1	33.2	54.6	73.9	19.3	
Vert	2390.000	AV	29.6	27.9	6.8	32.1	32.2	53.9	21.7	
Vert	9608.000	AV	30.6	38.1	11.1	32.6	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 $20\log(4.5\text{ m} / 3.0\text{ m}) = 3.53\text{ dB}$
 10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

Dwell time factor relaxation

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Dwell Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	4804.000	AV	37.5	32.8	9.2	31.3	-24.7	23.5	53.9	30.4	*
Hori	12010.000	AV	40.5	39.9	-1.1	33.2	-24.7	21.4	53.9	32.5	*
Vert	4804.000	AV	37.3	32.8	9.2	31.3	-24.7	23.3	53.9	30.6	*
Vert	7206.000	AV	35.5	36.8	10.4	32.6	-24.7	25.4	53.9	28.5	*
Vert	12010.000	AV	41.9	39.9	-1.1	33.2	-24.7	22.8	53.9	31.1	*

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

- Gain(Amplifier) + Dwell time factor (Refer to dwell time data sheet)

*Above noise was synchronized with carrier frequency.

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	97.6	28.0	6.8	32.1	100.3	-	-	Carrier
Hori	2400.000	PK	37.9	28.0	6.8	32.1	40.6	80.3	39.7	
Vert	2402.000	PK	95.3	28.0	6.8	32.1	98.0	-	-	Carrier
Vert	2400.000	PK	36.8	28.0	6.8	32.1	39.5	78.0	38.5	

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

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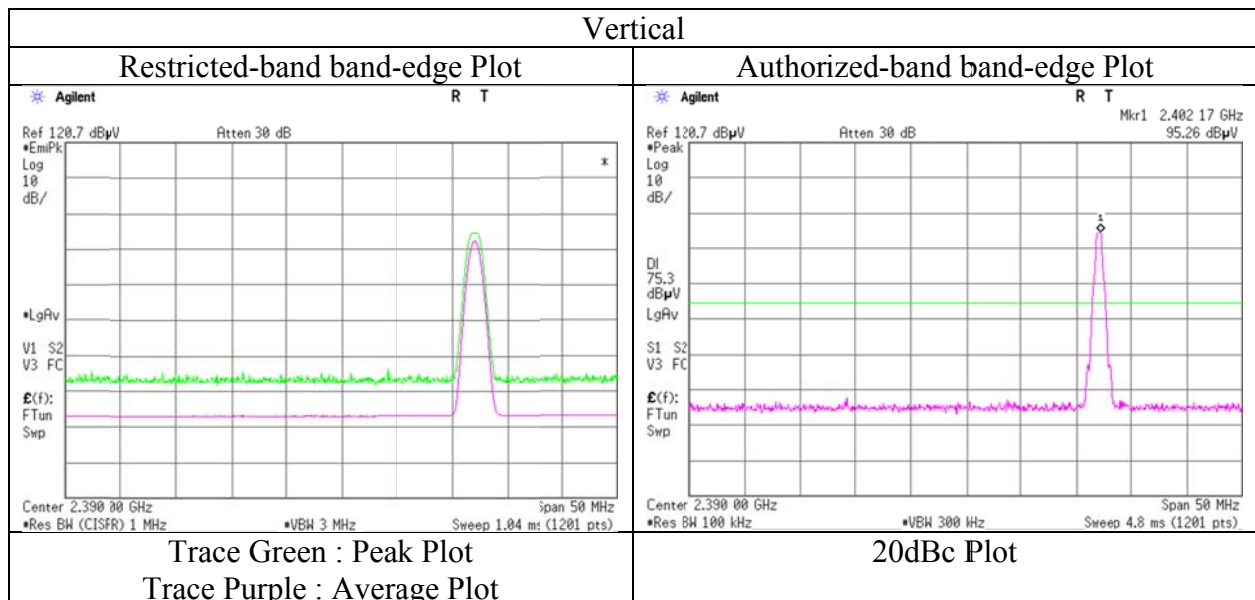
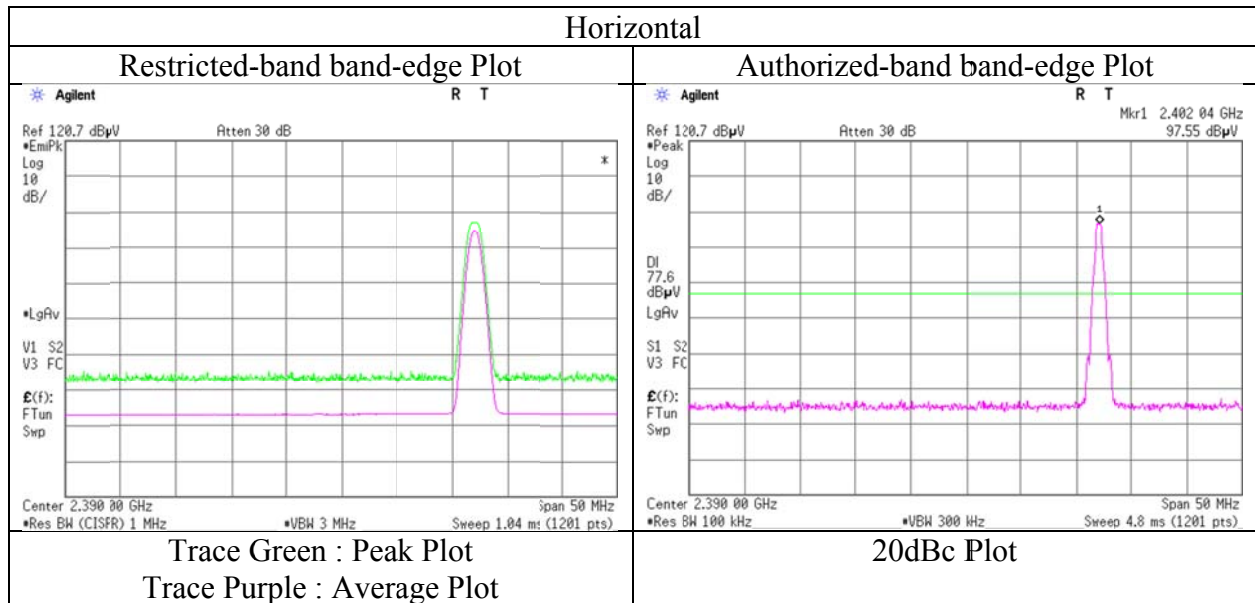
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Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber
Report No.	11201777H
Date	April 11, 2016
Temperature / Humidity	23 deg. C / 35 % RH
Engineer	Shinichi Miyazono (1 GHz - 10 GHz)
Mode	Tx, Hopping Off, DH5 2402 MHz



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

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Radiated Spurious Emission

Test place : Ise EMC Lab. No.4 Semi Anechoic Chamber
Report No. : 11201777H
Date : April 11, 2016 April 20, 2016 April 22, 2016 April 25, 2016
Temperature / Humidity : 23 deg. C / 35 % RH 20deg. C / 33 % RH 22deg. C / 51 % RH 25deg. C / 43 % RH
Engineer : Shinichi Miyazono Tomoki Matsui Kazuya Yoshioka Takafumi Noguchi
(1 GHz - 10 GHz) (10 GHz - 18 GHz) (Below 1GHz) (18 GHz - 26.5 GHz)
Mode : Tx, Hopping Off, DH5 2441 MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	77.500	QP	34.2	6.5	7.8	32.1	16.4	40.0	23.6	
Hori	85.500	QP	40.0	7.6	7.9	32.1	23.4	40.0	16.6	
Hori	104.510	QP	37.4	10.6	8.2	32.1	24.1	43.5	19.4	
Hori	142.492	QP	36.3	14.6	8.6	32.0	27.5	43.5	16.0	
Hori	161.500	QP	38.7	15.4	8.8	32.0	30.9	43.5	12.6	
Hori	265.975	QP	32.0	12.7	9.6	31.9	22.4	46.0	23.6	
Hori	4882.000	PK	45.8	33.1	9.3	31.3	56.9	73.9	17.0	
Hori	7323.000	PK	43.2	36.8	10.4	32.6	57.8	73.9	16.1	
Hori	9764.000	PK	43.0	38.2	10.5	32.7	59.0	73.9	14.9	
Hori	12205.000	PK	46.1	39.9	-1.0	33.0	52.0	73.9	21.9	
Hori	7323.000	AV	31.6	36.8	10.4	32.6	46.2	53.9	7.7	Floor Noise
Hori	9764.000	AV	30.6	38.2	11.2	32.7	47.3	53.9	6.6	Floor Noise
Vert	78.019	QP	46.7	6.5	7.9	32.1	29.0	40.0	11.0	
Vert	85.506	QP	51.0	7.6	7.9	32.1	34.4	40.0	5.6	
Vert	104.504	QP	43.0	10.6	8.2	32.1	29.7	43.5	13.8	
Vert	142.490	QP	42.6	14.6	8.6	32.0	33.8	43.5	9.7	
Vert	161.500	QP	44.3	15.4	8.8	32.0	36.5	43.5	7.0	
Vert	265.932	QP	36.0	12.7	9.6	31.9	26.4	46.0	19.6	
Vert	4882.000	PK	45.9	33.1	9.3	31.3	57.0	73.9	16.9	
Vert	7323.000	PK	46.5	36.8	10.4	32.6	61.1	73.9	12.8	
Vert	9764.000	PK	43.1	38.2	11.2	32.7	59.8	73.9	14.1	
Vert	12205.000	PK	46.0	39.9	-1.0	33.0	51.9	73.9	22.0	
Vert	9764.000	AV	30.7	38.2	11.2	32.7	47.4	53.9	6.5	Floor Noise

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

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

Distance factor: 1 GHz - 10 GHz $20\log(4.5\text{ m} / 3.0\text{ m}) = 3.53\text{ dB}$
10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

Dwell time factor relaxation

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Dwell Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	4882.000	AV	37.9	33.1	9.3	31.3	-24.7	24.3	53.9	29.6	*
Hori	12205.000	AV	35.8	39.9	-1.0	33.0	-24.7	17.0	53.9	36.9	*
Vert	4882.000	AV	38.3	33.1	9.3	31.3	-24.7	24.7	53.9	29.2	*
Vert	7323.000	AV	36.6	36.8	10.4	32.6	-24.7	26.5	53.9	27.4	*
Vert	12205.000	AV	35.4	39.9	-1.0	33.0	-24.7	16.6	53.9	37.3	*

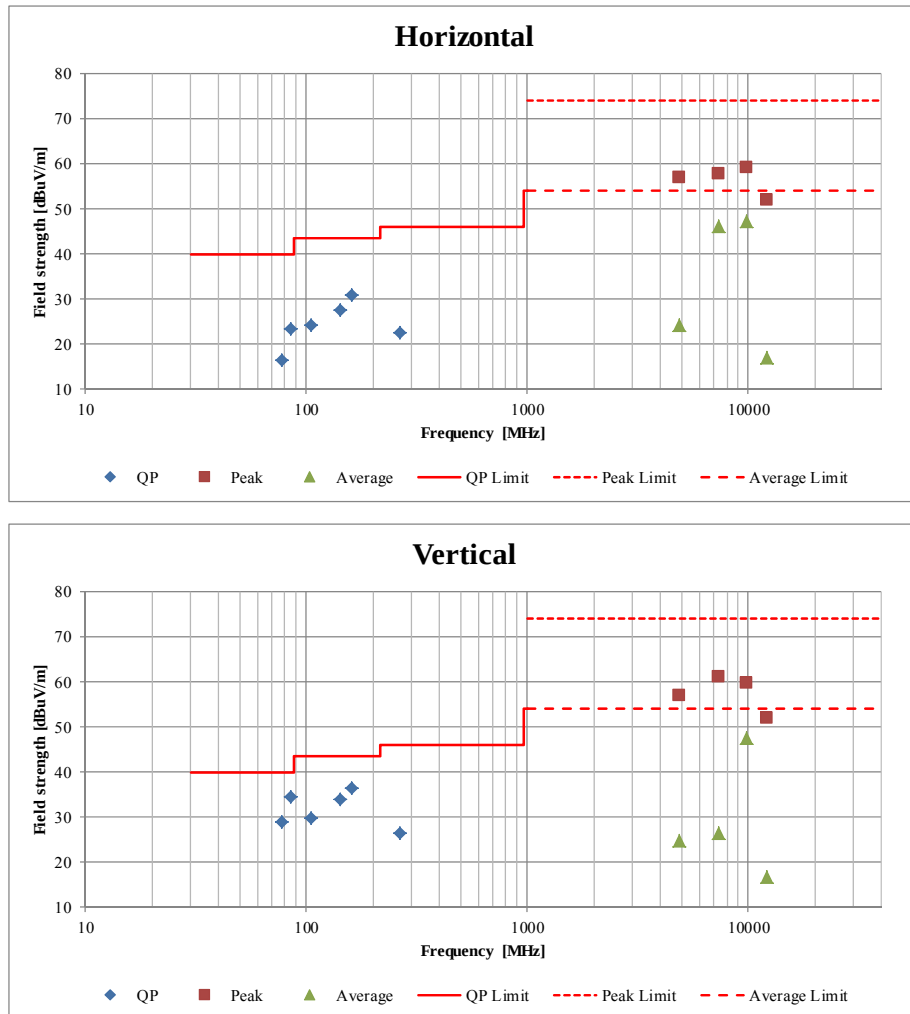
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz))

- Gain(Amplifier) + Dwell time factor (Refer to dwell time data sheet)

*Above noise was synchronized with carrier frequency.

Radiated Spurious Emission (Plot data, Worst case)

Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber			
Report No.	11201777H			
Date	April 11, 2016	April 20, 2016	April 22, 2016	April 25, 2016
Temperature / Humidity	23 deg. C / 35 % RH	20deg. C / 33 % RH	22deg. C / 51 % RH	25deg. C / 43 % RH
Engineer	Shinichi Miyazono	Tomoki Matsui	Kazuya Yoshioka	Takafumi Noguchi
	(1 GHz - 10 GHz)	(10 GHz - 18 GHz)	(Below 1GHz)	(18 GHz - 26.5 GHz)
Mode	Tx, Hopping Off, DH5 2441 MHz			



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

Radiated Spurious Emission

Test place : Ise EMC Lab. No.4 Semi Anechoic Chamber
Report No. : 11201777H
Date : April 11, 2016 April 20, 2016 April 22, 2016 April 25, 2016
Temperature / Humidity : 23 deg. C / 35 % RH 20deg. C / 33 % RH 22deg. C / 51 % RH 25deg. C / 43 % RH
Engineer : Shinichi Miyazono Tomoki Matsui Kazuya Yoshioka Takafumi Noguchi
(1 GHz - 10 GHz) (10 GHz - 18 GHz) (Below 1GHz) (18 GHz - 26.5 GHz)
Mode : Tx, Hopping Off, DH5 2480 MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	76.559	QP	34.1	6.4	7.8	32.1	16.2	40.0	23.8	
Hori	85.510	QP	39.6	7.6	7.9	32.1	23.0	40.0	17.0	
Hori	142.494	QP	36.2	14.6	8.6	32.0	27.4	43.5	16.1	
Hori	161.504	QP	38.6	15.4	8.8	32.0	30.8	43.5	12.7	
Hori	180.499	QP	37.0	16.1	8.9	32.0	30.0	43.5	13.5	
Hori	550.980	QP	24.3	18.3	11.5	32.2	21.9	46.0	24.1	
Hori	2483.500	PK	43.4	28.1	6.9	32.1	46.3	73.9	27.6	
Hori	4960.000	PK	47.2	33.4	9.3	31.2	58.7	73.9	15.2	
Hori	7440.000	PK	42.8	36.8	10.4	32.7	57.3	73.9	16.6	Floor Noise
Hori	9920.000	PK	43.0	38.3	10.6	32.8	59.1	73.9	14.8	Floor Noise
Hori	12400.000	PK	46.4	39.8	-0.9	32.9	52.4	73.9	21.5	
Hori	2483.500	AV	30.5	28.1	6.9	32.1	33.4	53.9	20.5	
Hori	7440.000	AV	30.3	36.8	10.4	32.7	44.8	53.9	9.1	Floor Noise
Hori	9920.000	AV	30.6	38.3	10.6	32.8	46.7	53.9	7.2	Floor Noise
Vert	78.036	QP	46.8	6.5	7.9	32.1	29.1	40.0	10.9	
Vert	85.507	QP	51.0	7.6	7.9	32.1	34.4	40.0	5.6	
Vert	142.494	QP	41.7	14.6	8.6	32.0	32.9	43.5	10.6	
Vert	161.490	QP	44.0	15.3	8.8	32.0	36.1	43.5	7.4	
Vert	180.509	QP	42.2	16.1	8.9	32.0	35.2	43.5	8.3	
Vert	550.983	QP	31.7	18.3	11.5	32.2	29.3	46.0	16.7	
Vert	2483.500	PK	43.4	28.1	6.9	32.1	46.3	73.9	27.6	
Vert	4960.000	PK	47.4	33.4	9.3	31.2	58.9	73.9	15.0	
Vert	7440.000	PK	46.8	36.8	10.4	32.7	61.3	73.9	12.6	
Vert	9920.000	PK	43.1	38.3	11.2	32.8	59.8	73.9	14.1	Floor Noise
Vert	12400.000	PK	46.2	39.8	-0.9	32.9	52.2	73.9	21.7	
Vert	2483.500	AV	29.9	28.1	6.9	32.1	32.8	53.9	21.1	
Vert	9920.000	AV	30.7	38.3	11.2	32.8	47.4	53.9	6.5	Floor Noise

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

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

Distance factor: 1 GHz - 10 GHz $20\log(4.5\text{ m} / 3.0\text{ m}) = 3.53\text{ dB}$
10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

Dwell time factor relaxation

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Dwell Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	4960.000	AV	40.2	33.4	9.3	31.2	-24.7	27.0	53.9	26.9	*
Hori	12400.000	AV	35.9	39.8	-0.9	32.9	-24.7	17.2	53.9	36.7	*
Vert	4960.000	AV	40.7	33.4	9.3	31.2	-24.7	27.5	53.9	26.4	*
Vert	7440.000	AV	37.3	36.8	10.4	32.7	-24.7	27.1	53.9	26.8	*
Vert	12400.000	AV	36.0	39.8	-0.9	32.9	-24.7	17.3	53.9	36.6	*

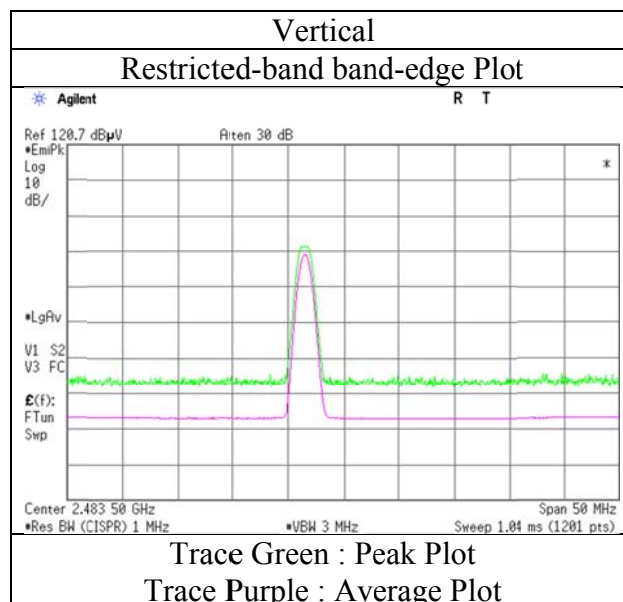
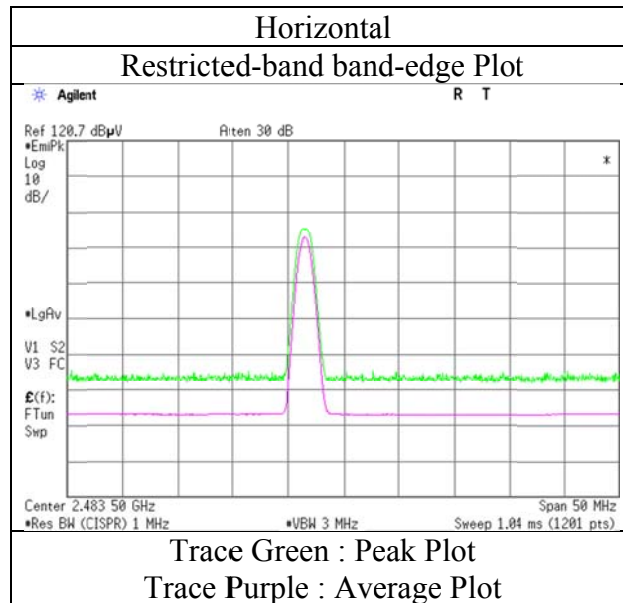
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz))

- Gain(Amplifier) + Dwell time factor (Refer to dwell time data sheet)

*Above noise was synchronized with carrier frequency.

Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber
Report No.	11201777H
Date	April 11, 2016
Temperature / Humidity	23 deg. C / 35 % RH
Engineer	Shinichi Miyazono
	(1 GHz - 10 GHz)
Mode	Tx, Hopping Off, DH5 2480 MHz



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

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Radiated Spurious Emission

Test place : Ise EMC Lab. No.4 Semi Anechoic Chamber
Report No. : 11201777H
Date : April 12, 2016 April 20, 2016 April 22, 2016 April 25, 2016
Temperature / Humidity : 20 deg. C / 40 % RH 20deg. C / 33 % RH 22deg. C / 51 % RH 25deg. C / 43 % RH
Engineer : Shinichi Miyazono Tomoki Matsui Kazuya Yoshioka Takafumi Noguchi
Mode : (1 GHz - 10GHz) (10 GHz - 18 GHz) (Below 1GHz) (18 GHz - 26.5 GHz)
Tx, Hopping Off, 3DH5 2402 MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	77.034	QP	34.3	6.4	7.8	32.1	16.4	40.0	23.6	
Hori	85.491	QP	40.2	7.6	7.9	32.1	23.6	40.0	16.4	
Hori	142.507	QP	36.5	14.6	8.6	32.0	27.7	43.5	15.8	
Hori	161.504	QP	38.7	15.4	8.8	32.0	30.9	43.5	12.6	
Hori	180.512	QP	35.1	16.1	8.9	32.0	28.1	43.5	15.4	
Hori	294.500	QP	34.0	13.3	9.9	31.8	25.4	46.0	20.6	
Hori	2390.000	PK	42.4	27.9	6.8	32.1	45.0	73.9	28.9	
Hori	4804.000	PK	40.5	32.8	9.2	31.3	51.2	73.9	22.7	
Hori	7206.000	PK	41.1	36.8	10.4	32.6	55.7	73.9	18.2	Floor Noise
Hori	9608.000	PK	41.3	38.1	11.1	32.6	57.9	73.9	16.0	Floor Noise
Hori	12010.000	PK	45.8	39.9	-1.1	33.2	51.4	73.9	22.5	
Hori	2390.000	AV	28.6	27.9	6.8	32.1	31.2	53.9	22.7	
Hori	4804.000	AV	31.1	32.8	9.2	31.3	41.8	53.9	12.1	
Hori	7206.000	AV	29.2	36.8	10.4	32.6	43.8	53.9	10.1	Floor Noise
Hori	9608.000	AV	28.8	38.1	11.1	32.6	45.4	53.9	8.5	Floor Noise
Hori	12010.000	AV	33.4	39.9	-1.1	33.2	39.0	53.9	14.9	
Vert	77.054	QP	47.2	6.4	7.8	32.1	29.3	40.0	10.7	
Vert	85.531	QP	50.2	7.6	7.9	32.1	33.6	40.0	6.4	
Vert	142.507	QP	41.2	14.6	8.6	32.0	32.4	43.5	11.1	
Vert	161.505	QP	44.4	15.4	8.8	32.0	36.6	43.5	6.9	
Vert	180.504	QP	42.8	16.1	8.9	32.0	35.8	43.5	7.7	
Vert	256.471	QP	39.0	12.5	9.6	31.9	29.2	46.0	16.8	
Vert	2390.000	PK	42.1	27.9	6.8	32.1	44.7	73.9	29.2	
Vert	4804.000	PK	40.6	32.8	9.2	31.3	51.3	73.9	22.6	
Vert	7206.000	PK	32.1	36.8	10.4	32.6	46.7	73.9	27.2	
Vert	9608.000	PK	41.3	38.1	11.1	32.6	57.9	73.9	16.0	Floor Noise
Vert	12010.000	PK	45.7	39.9	-1.1	33.2	51.3	73.9	22.6	
Vert	2390.000	AV	30.5	27.9	6.8	32.1	33.1	53.9	20.8	
Vert	4804.000	AV	30.2	32.8	9.2	31.3	40.9	53.9	13.1	
Vert	7206.000	AV	31.7	36.8	10.4	32.6	46.3	53.9	7.6	
Vert	9608.000	AV	27.4	38.1	11.1	32.6	44.0	53.9	9.9	Floor Noise
Vert	12010.000	AV	33.9	39.9	-1.1	33.2	39.5	53.9	14.4	

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 $20\log(4.5\text{ m} / 3.0\text{ m}) = 3.53\text{ dB}$
10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

Dwell time factor relaxation

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Dwell Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	4804.000	AV	31.1	32.8	9.2	31.3	-24.7	17.1	53.9	36.8	*
Hori	12010.000	AV	33.4	39.9	-1.1	33.2	-24.7	14.3	53.9	39.6	*
Vert	4804.000	AV	30.2	32.8	9.2	31.3	-24.7	16.2	53.9	37.7	*
Vert	7206.000	AV	31.7	36.8	10.4	32.6	-24.7	21.6	53.9	32.3	*
Vert	12010.000	AV	33.9	39.9	-1.1	33.2	-24.7	14.8	53.9	39.1	*

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

- Gain(Amplifier) + Dwell time factor (Refer to dwell time data sheet)

*Above noise was synchronized with carrier frequency.

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	90.5	28.0	6.8	32.1	93.2	-	-	Carrier
Hori	2400.000	PK	42.8	28.0	6.8	32.1	45.5	73.2	27.7	
Vert	2402.000	PK	84.1	28.0	6.8	32.1	86.8	-	-	Carrier
Vert	2400.000	PK	42.9	28.0	6.8	32.1	45.6	66.8	21.2	

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

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Ise EMC Lab.

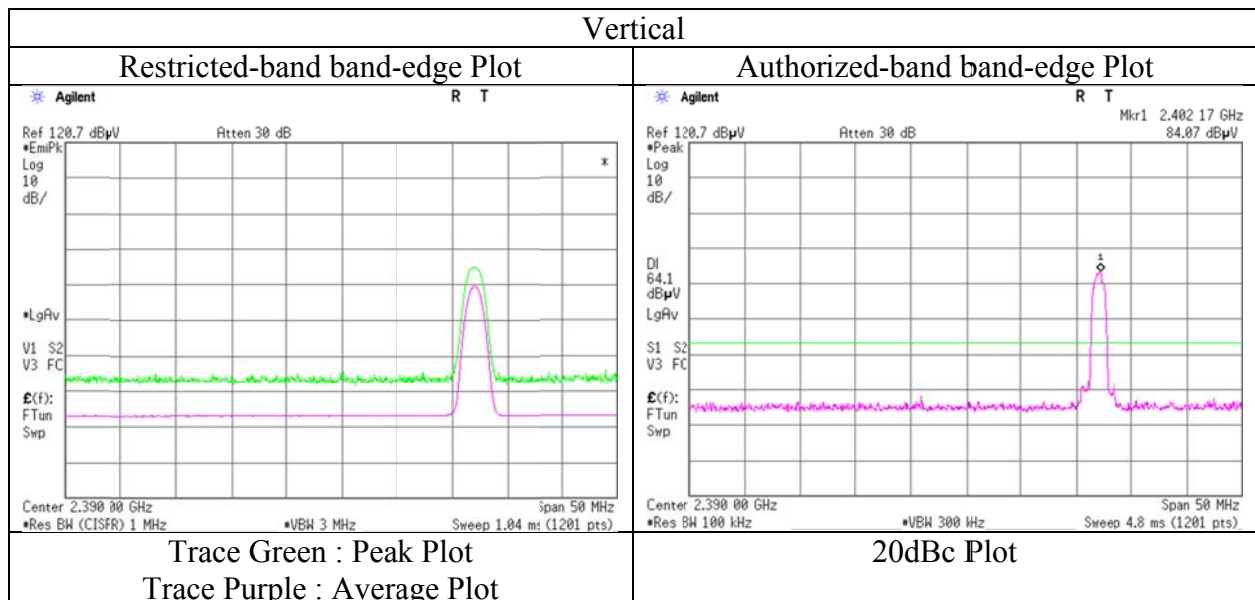
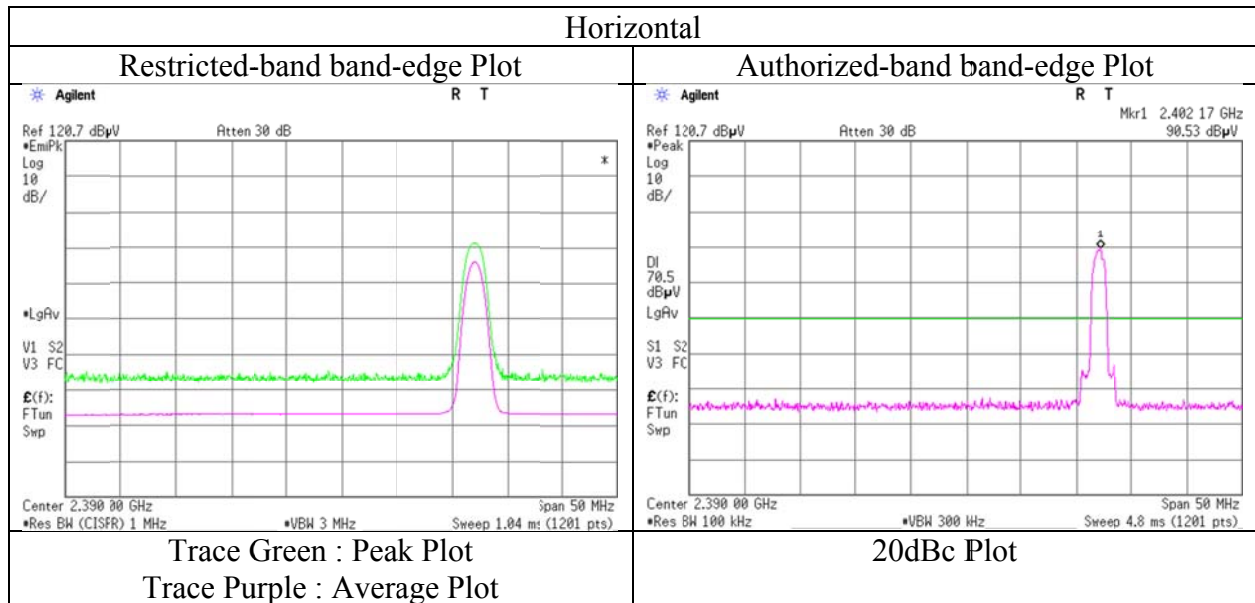
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

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Facsimile : +81 596 24 8124

Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber		
Report No.	11201777H		
Date	April 12, 2016	April 20, 2016	
Temperature / Humidity	20 deg. C / 40 % RH	20deg. C / 33 % RH	
Engineer	Shinichi Miyazono	Tomoki Matsui	
	(1-10GHz)	(10 GHz-18 GHz)	
Mode	Tx, Hopping Off, 3DH5 2402 MHz		



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

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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

Test place : Ise EMC Lab. No.4 Semi Anechoic Chamber
Report No. : 11201777H
Date : April 12, 2016 April 20, 2016 April 22, 2016 April 25, 2016
Temperature / Humidity : 20 deg. C / 40 % RH 20deg. C / 33 % RH 22deg. C / 51 % RH 25deg. C / 43 % RH
Engineer : Shinichi Miyazono Tomoki Matsui Kazuya Yoshioka Takafumi Noguchi
(1GHz - 10 GHz) (10 GHz - 18 GHz) (Below 1GHz) (18 GHz - 26.5 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	78.032	QP	34.4	6.5	7.9	32.1	-	16.7	40.0	23.3	
Hori	85.502	QP	39.9	7.6	7.9	32.1	-	23.3	40.0	16.7	
Hori	142.512	QP	36.7	14.6	8.6	32.0	-	27.9	43.5	15.6	
Hori	161.504	QP	39.3	15.4	8.8	32.0	-	31.5	43.5	12.0	
Hori	180.500	QP	35.5	16.1	8.9	32.0	-	28.5	43.5	15.0	
Hori	294.510	QP	34.2	13.3	9.9	31.8	-	25.6	46.0	20.4	
Hori	4882.000	PK	43.1	33.1	9.3	31.3	-	54.2	73.9	19.7	
Hori	7323.000	PK	43.1	36.8	10.4	32.6	-	57.7	73.9	16.2	
Hori	9764.000	PK	42.3	38.2	11.2	32.7	-	59.0	73.9	14.9	Floor Noise
Hori	12205.000	PK	43.5	39.9	-1.0	33.0	-	49.4	73.9	24.5	
Hori	9764.000	AV	30.5	38.2	11.2	32.7	-	47.2	53.9	6.7	Floor Noise
Vert	77.054	QP	47.2	6.4	7.8	32.1	-	29.3	40.0	10.7	
Vert	85.490	QP	51.5	7.6	7.9	32.1	-	34.9	40.0	5.1	
Vert	142.492	QP	41.4	14.6	8.6	32.0	-	32.6	43.5	10.9	
Vert	161.492	QP	44.6	15.3	8.8	32.0	-	36.7	43.5	6.8	
Vert	180.504	QP	42.9	16.1	8.9	32.0	-	35.9	43.5	7.6	
Vert	256.495	QP	39.6	12.5	9.6	31.9	-	29.8	46.0	16.2	
Vert	4882.000	PK	43.5	33.1	9.3	31.3	-	54.6	73.9	19.3	
Vert	7323.000	PK	43.5	36.8	10.4	32.6	-	58.1	73.9	15.8	
Vert	9764.000	PK	41.6	38.2	11.2	32.7	-	58.3	73.9	15.6	Floor Noise
Vert	12205.000	PK	44.7	39.9	-1.0	33.0	-	50.6	73.9	23.3	
Vert	9764.000	AV	30.6	38.2	11.2	32.7	-	47.3	53.9	6.6	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 $20\log(4.5\text{ m} / 3.0\text{ m}) = 3.53\text{ dB}$
10 GHz - 26.5 GHz $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

Dwell time factor relaxation

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Dwell Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	4882.000	AV	33.9	33.1	9.3	31.3	-24.7	20.3	53.9	33.6	*
Hori	7323.000	AV	31.4	36.8	10.4	32.6	-24.7	21.3	53.9	32.6	*
Hori	12205.000	AV	31.9	39.9	-1.0	33.0	-24.7	13.1	53.9	40.8	*
Vert	4882.000	AV	33.5	33.1	9.3	31.3	-24.7	19.9	53.9	34.0	*
Vert	7323.000	AV	31.3	36.8	10.4	32.6	-24.7	21.2	53.9	32.7	*
Vert	12205.000	AV	32.1	39.9	-1.0	33.0	-24.7	13.3	53.9	40.6	*

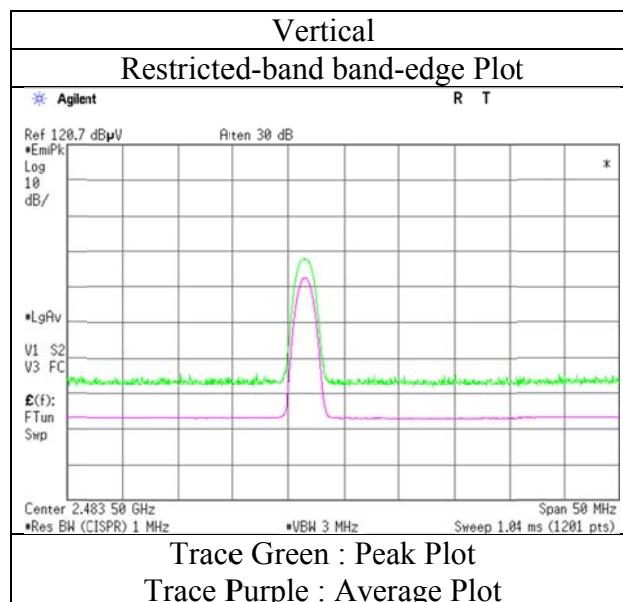
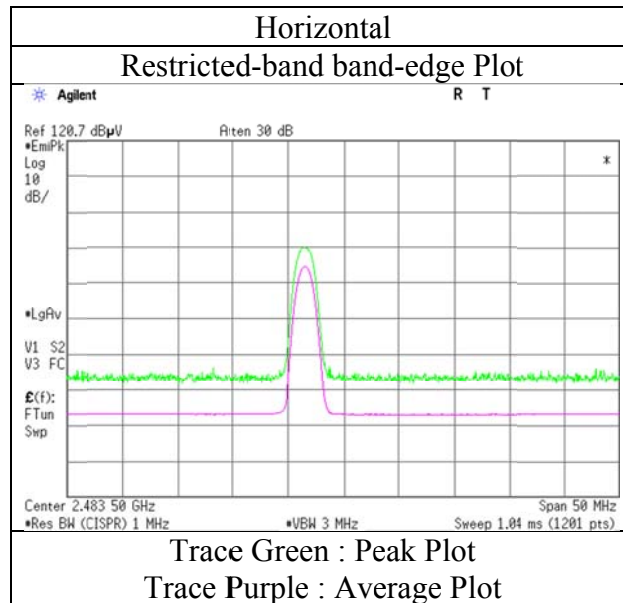
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz))

- Gain(Amplifier) + Dwell time factor (Refer to dwell time data sheet)

*Above noise was synchronized with carrier frequency.

Radiated Spurious Emission **(Reference Plot for band-edge)**

Test place : Ise EMC Lab. No.4 Semi Anechoic Chamber
Report No. : 11201777H
Date : April 12, 2016
Temperature / Humidity : 20 deg. C / 40 % RH
Engineer : Shinichi Miyazono
(1GHz - 10GHz)
Mode : Tx, Hopping Off, 3DH5 2480 MHz



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

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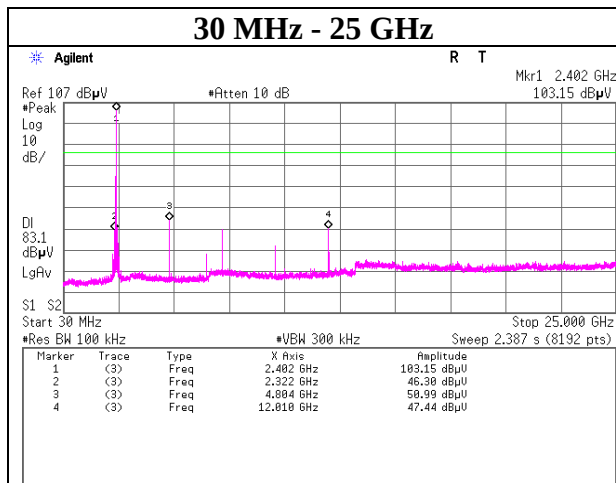
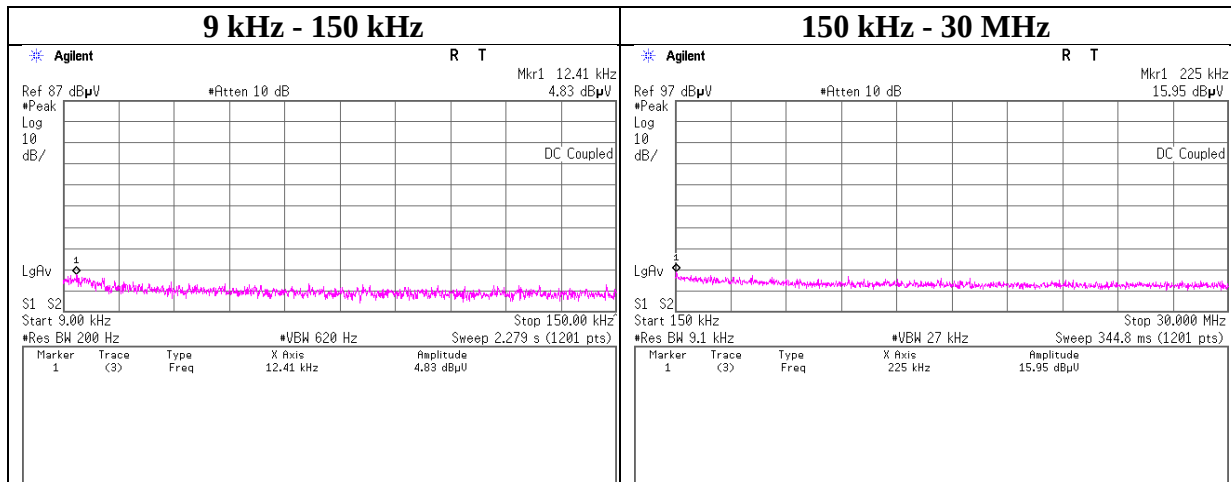
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Test place Ise EMC Lab. No.6 Measurement Room
Report No. 11201777H
Date April 14, 2016
Temperature / Humidity 26 deg. C / 51 % RH
Engineer Masafumi Niwa
Mode Tx, Hopping Off, DH5

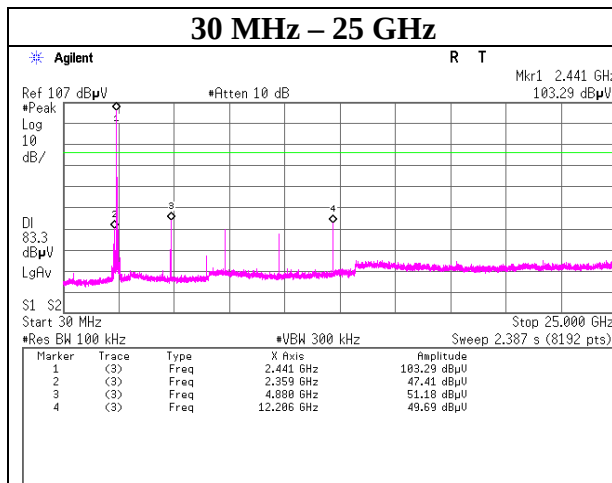
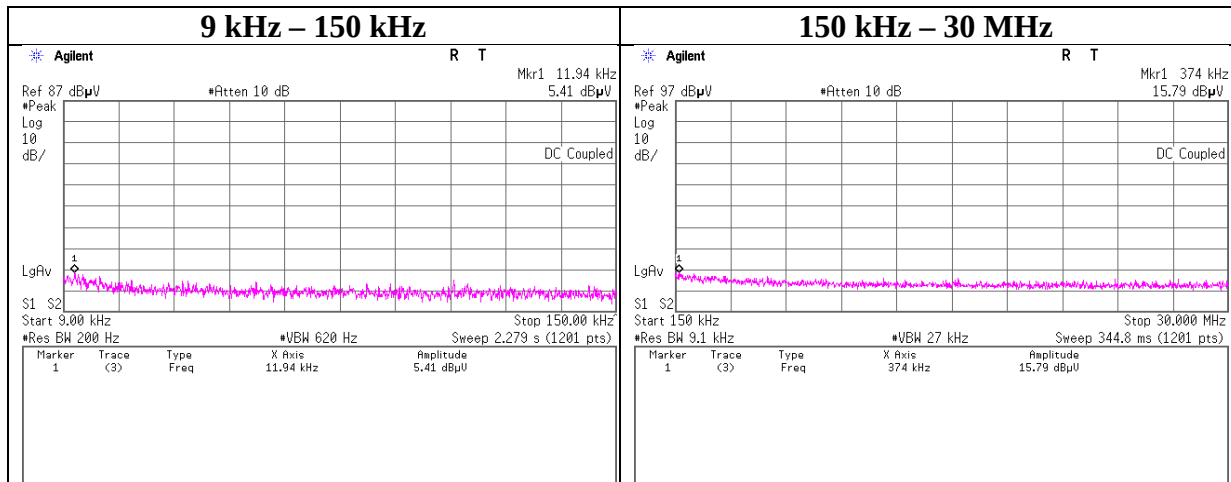
2402 MHz



Conducted Spurious Emission

Test place : Ise EMC Lab. No.6 Measurement Room
Report No. : 11201777H
Date : April 14, 2016
Temperature / Humidity : 26 deg. C / 51 % RH
Engineer : Masafumi Niwa
Mode : Tx, Hopping Off, DH5

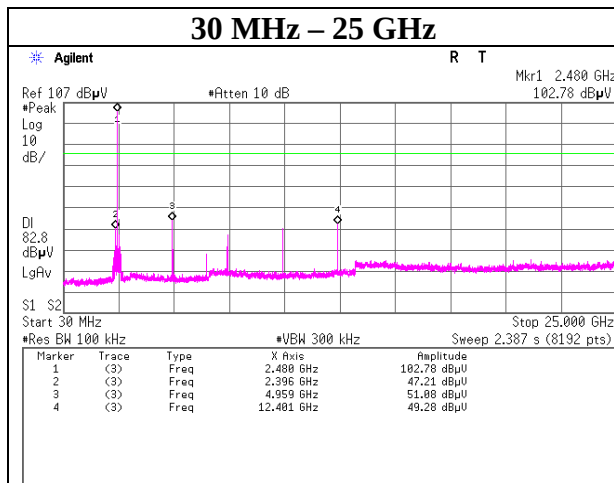
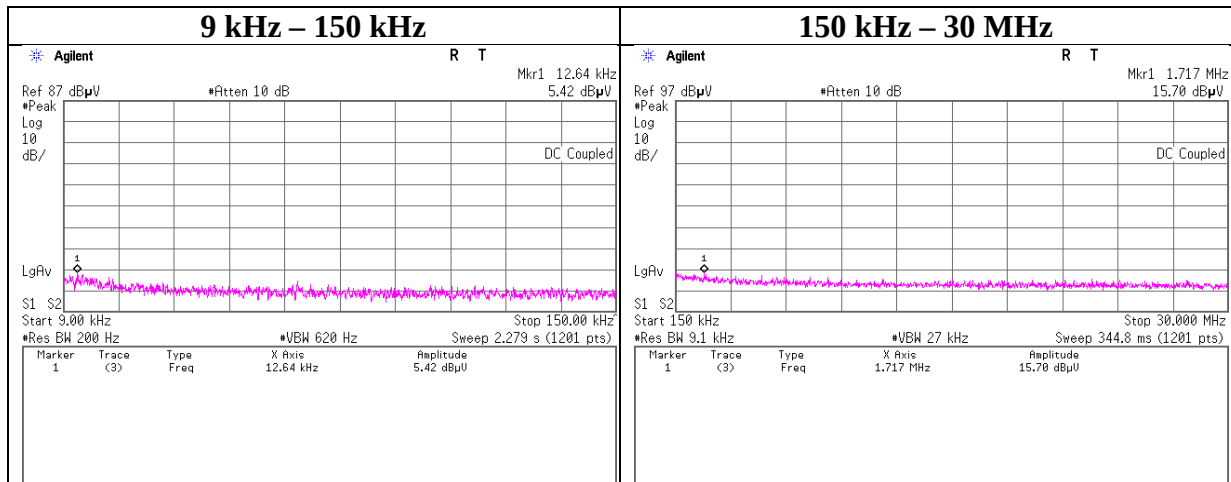
2441 MHz



Conducted Spurious Emission

Test place : Ise EMC Lab. No.6 Measurement Room
Report No. : 11201777H
Date : April 14, 2016
Temperature / Humidity : 26 deg. C / 51 % RH
Engineer : Masafumi Niwa
Mode : Tx, Hopping Off, DH5

2480 MHz



UL Japan, Inc.

Ise EMC Lab.

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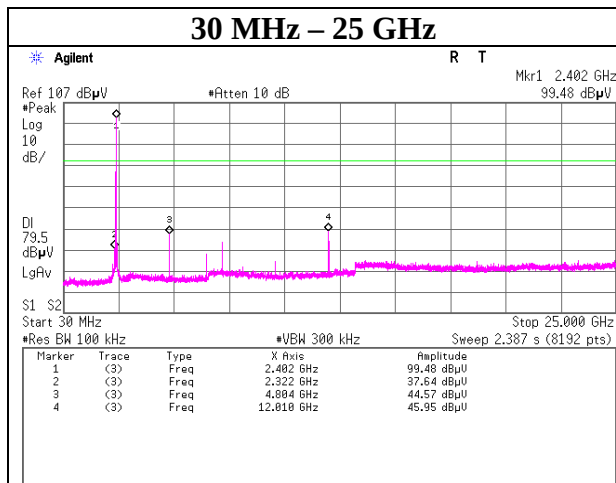
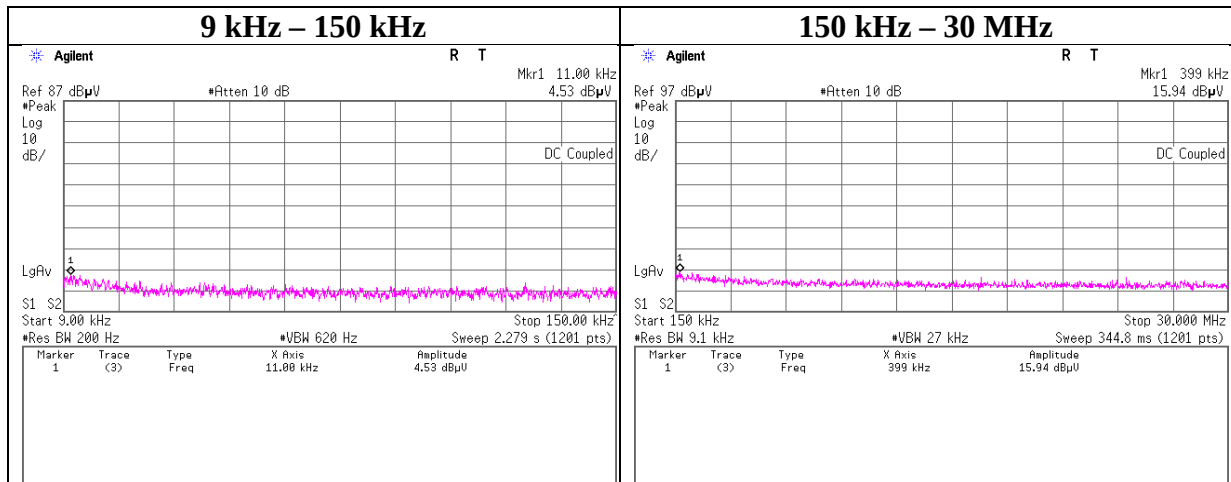
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Test place	Ise EMC Lab. No.6 Measurement Room
Report No.	11201777H
Date	April 14, 2016
Temperature / Humidity	26 deg. C / 51 % RH
Engineer	Masafumi Niwa
Mode	Tx, Hopping Off, 3DH5

2402 MHz



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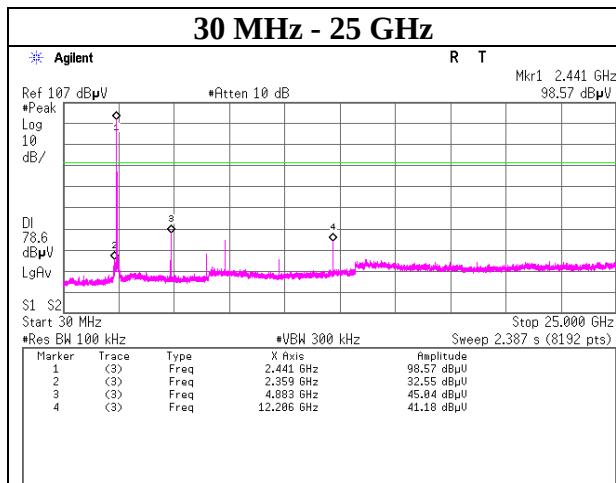
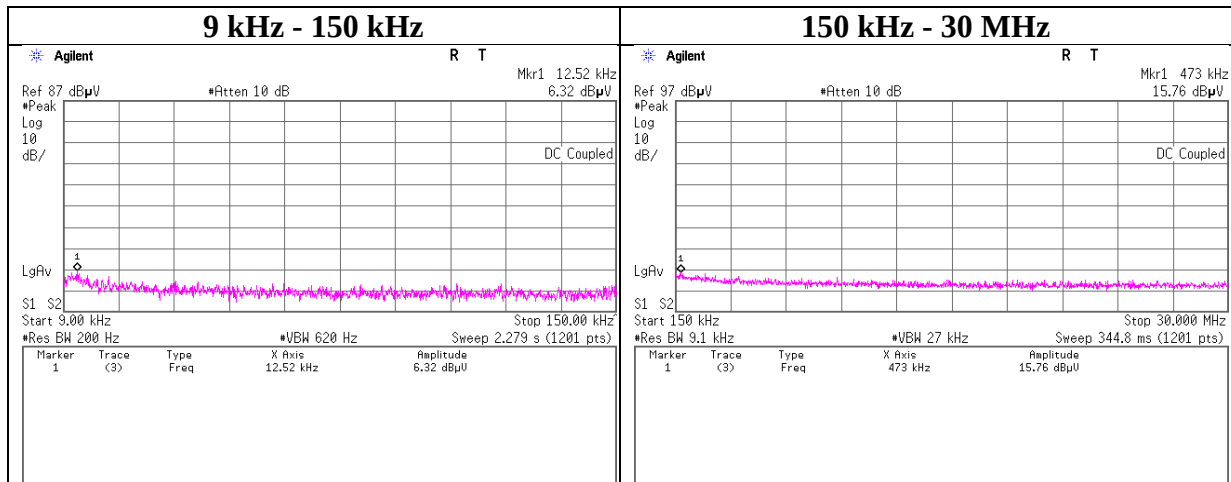
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Test place	Ise EMC Lab. No.6 Measurement Room
Report No.	11201777H
Date	April 14, 2016
Temperature / Humidity	26 deg. C / 51 % RH
Engineer	Masafumi Niwa
Mode	Tx, Hopping Off, 3DH5

2441 MHz



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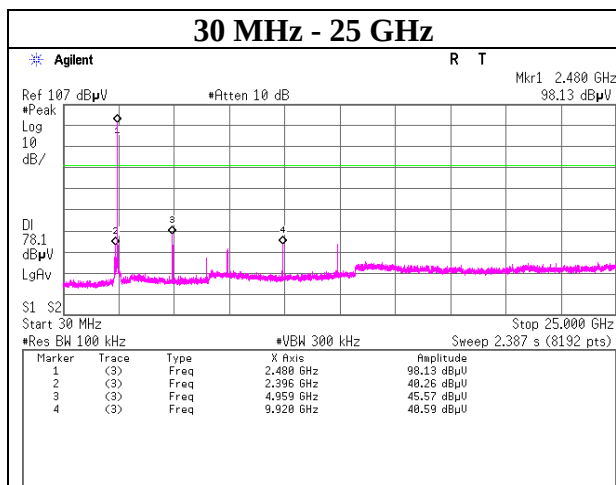
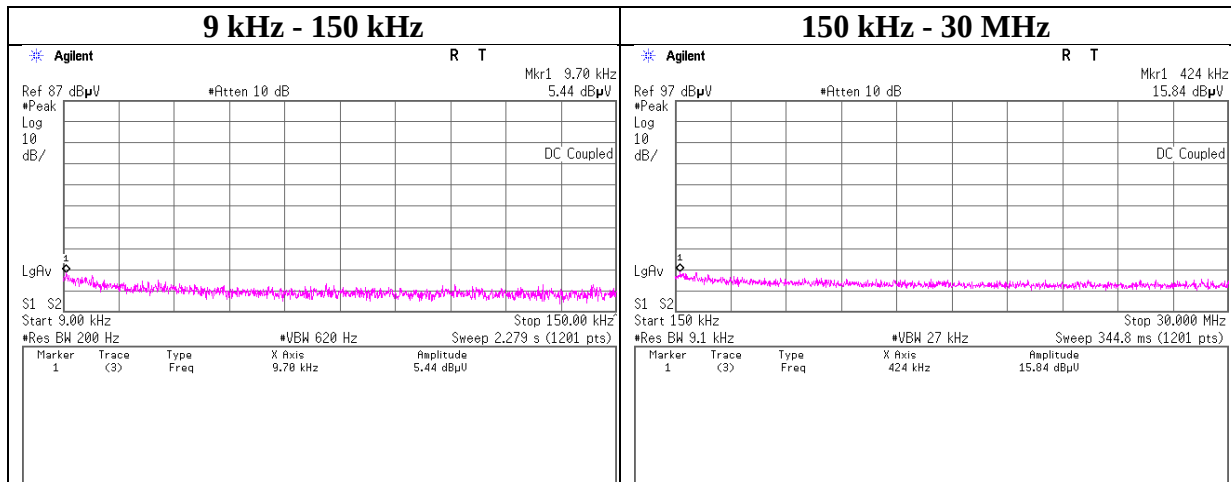
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Test place : Ise EMC Lab. No.6 Measurement Room
Report No. : 11201777H
Date : April 14, 2016
Temperature / Humidity : 26 deg. C / 51 % RH
Engineer : Masafumi Niwa
Mode : Tx, Hopping Off, 3DH5

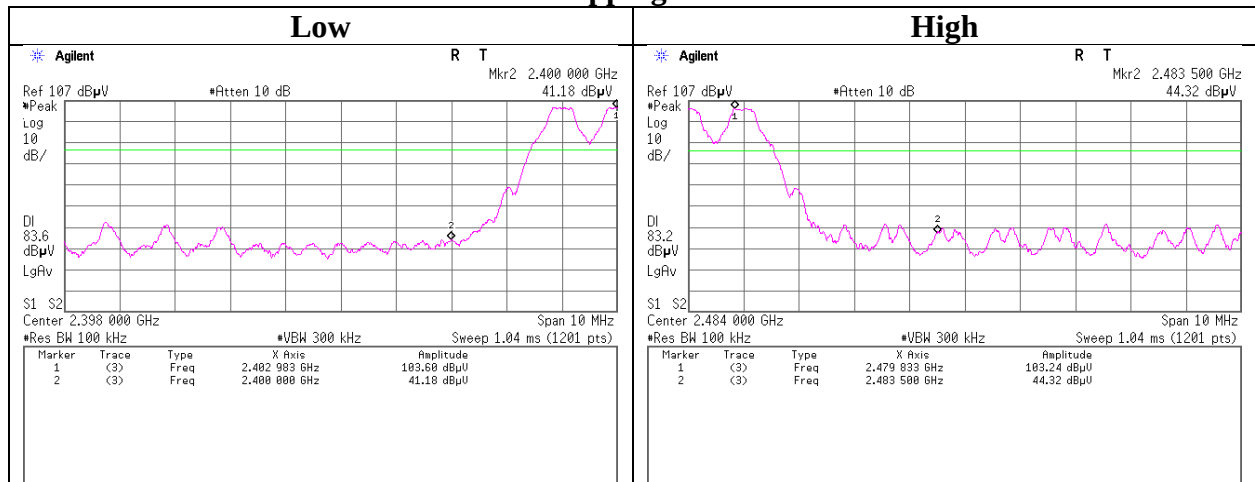
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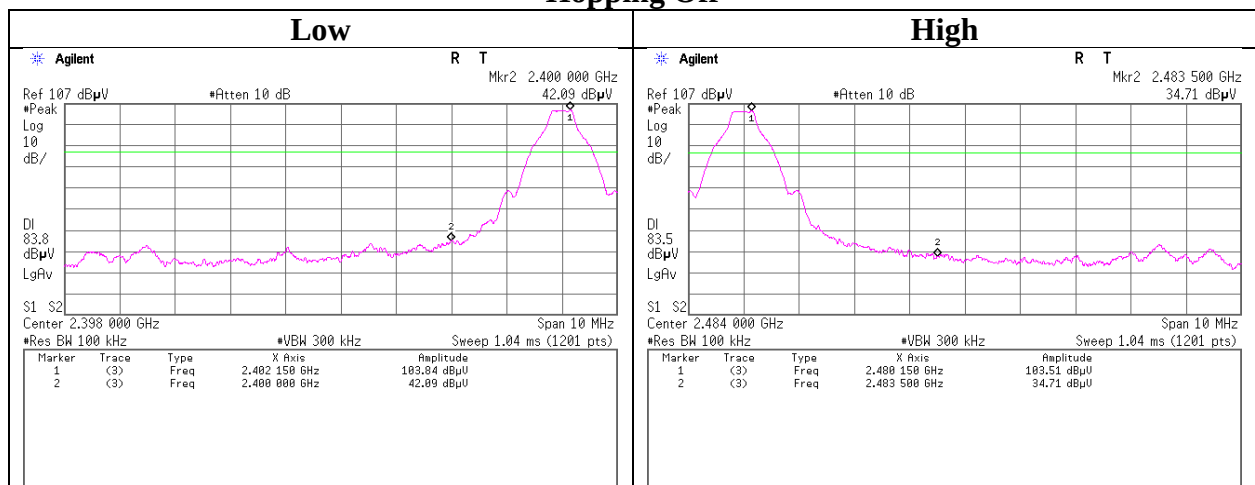
Conducted Emission Band Edge compliance

Test place : Ise EMC Lab. No.6 Measurement Room
Report No. : 11201777H
Date : April 14, 2016
Temperature / Humidity : 26 deg. C / 51 % RH
Engineer : Masafumi Niwa
Mode : Tx DH5

Hopping On



Hopping Off



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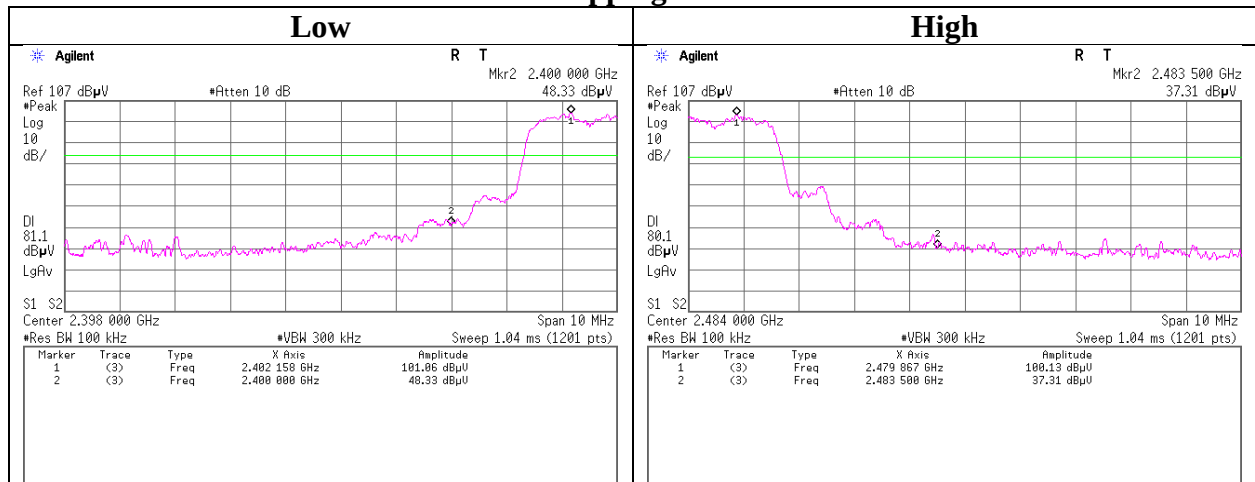
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

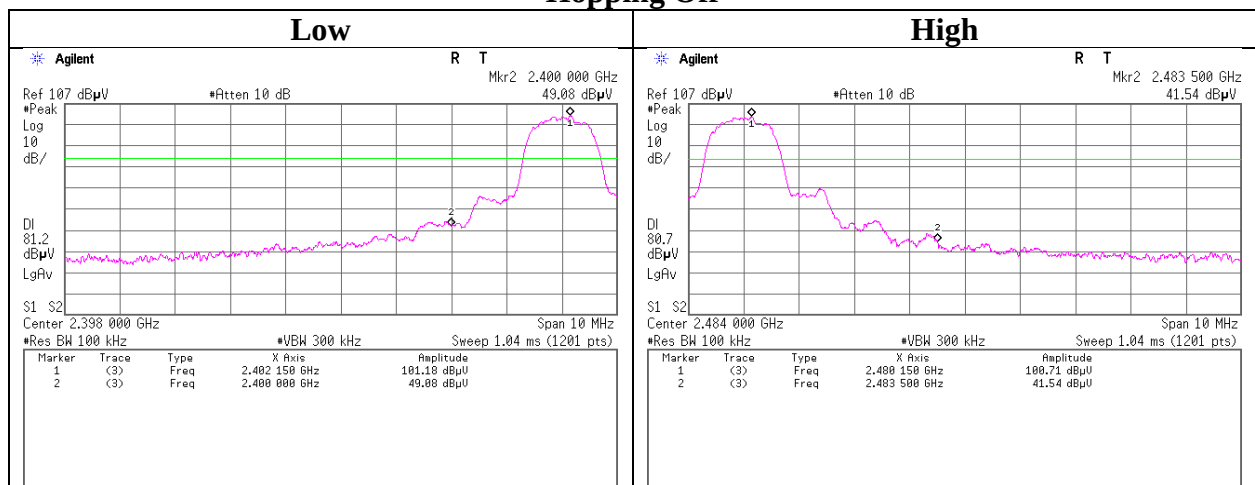
Conducted Emission Band Edge compliance

Test place : Ise EMC Lab. No.6 Measurement Room
Report No. : 11201777H
Date : April 14, 2016
Temperature / Humidity : 26 deg. C / 51 % RH
Engineer : Masafumi Niwa
Mode : Tx 3DH5

Hopping On



Hopping Off



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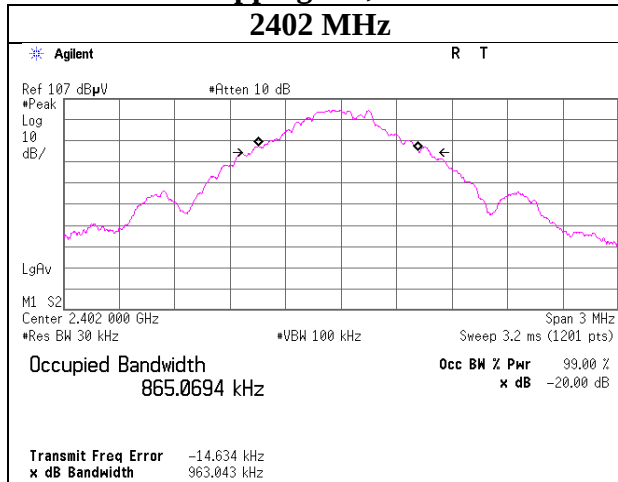
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

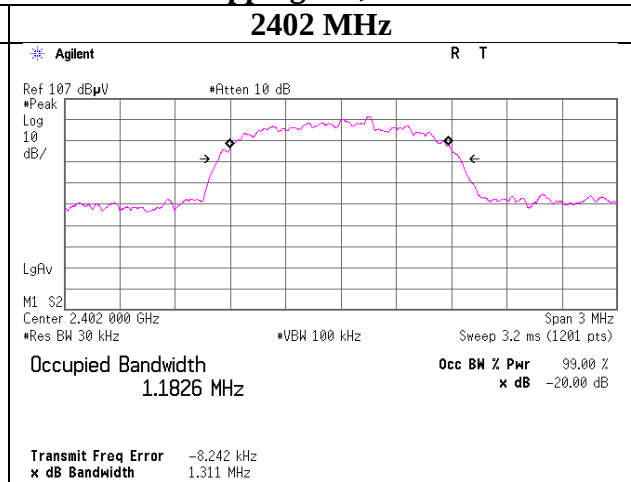
99% Occupied Bandwidth

Test place	Ise EMC Lab. No.6 Measurement Room
Report No.	11201777H
Date	April 14, 2016
Temperature / Humidity	26 deg. C / 51 % RH
Engineer	Masafumi Niwa
Mode	Tx Hopping Off

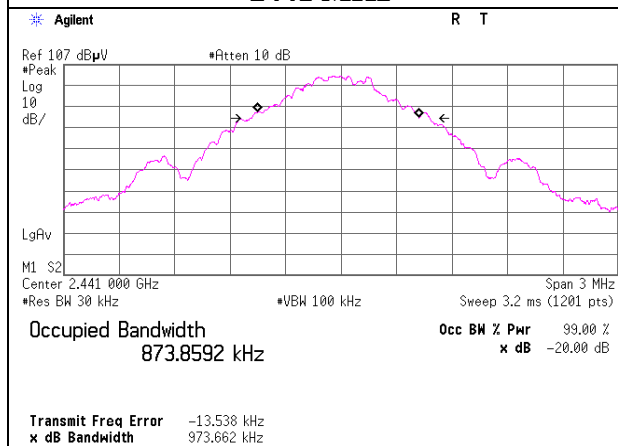
Hopping Off, DH5



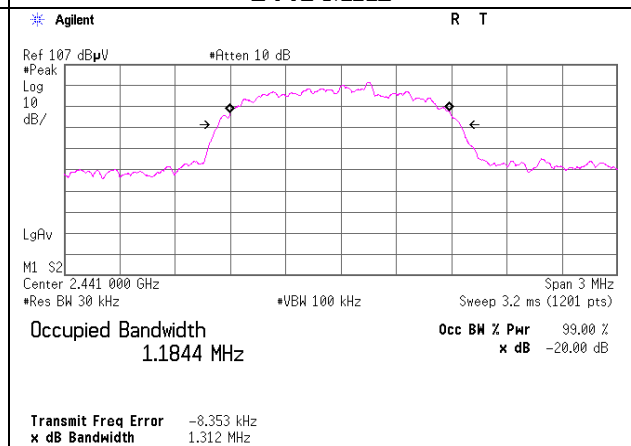
Hopping Off, 3DH5



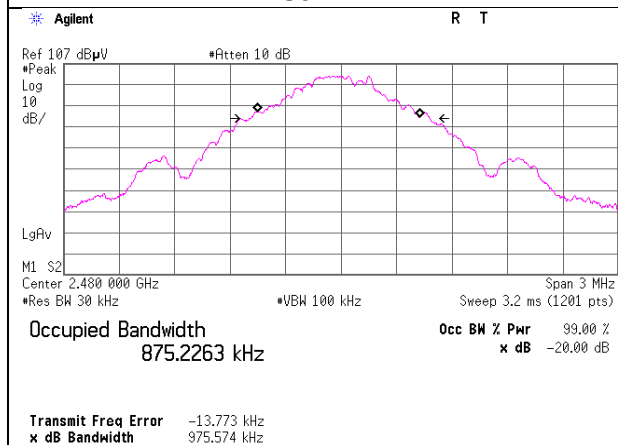
2441 MHz



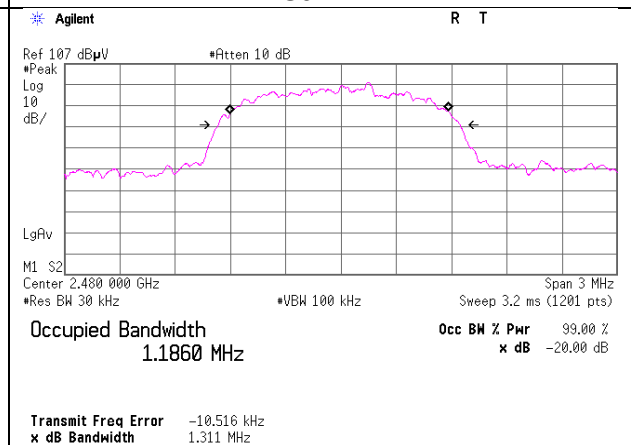
2441 MHz



2480 MHz



2480 MHz



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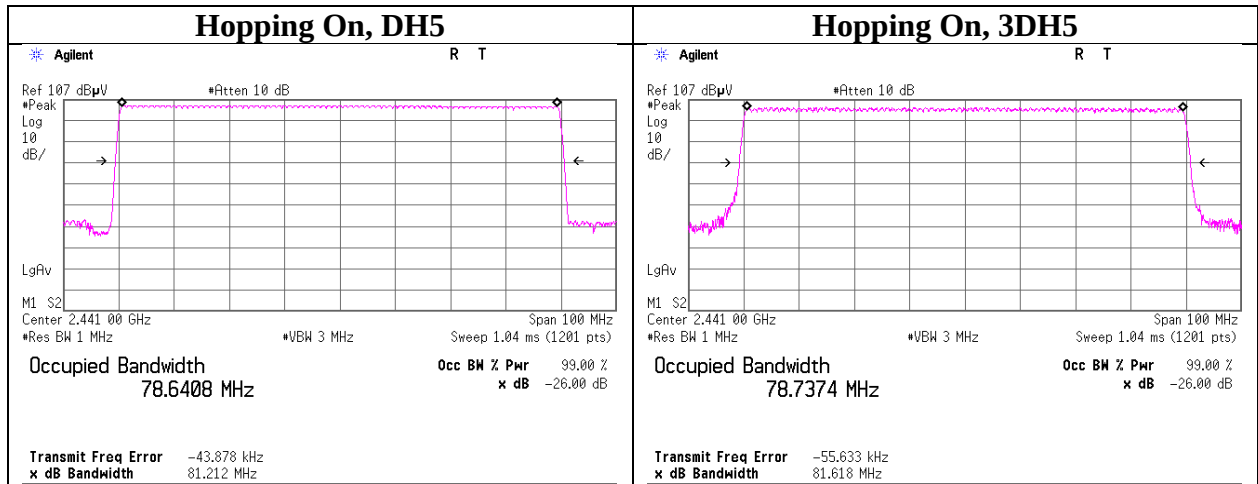
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99% Occupied Bandwidth

Test place	Ise EMC Lab. No.6 Measurement Room
Report No.	11201777H
Date	April 14, 2016
Temperature / Humidity	26 deg. C / 51 % RH
Engineer	Masafumi Niwa
Mode	Tx Hopping On



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APPENDIX 2: Test instruments

Test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MAEC-04	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE	2015/10/02 * 12
MOS-15	Thermo-Hygrometer	Custom	CTH-180	1501	RE	2016/01/21 * 12
MJM-26	Measure	KOMELON	KMC-36	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE/CE	-
MSA-04	Spectrum Analyzer	Agilent	E4448A	US44300523	RE	2015/11/06 * 12
MHA-21	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	9120D-557	RE	2015/08/10 * 12
MCC-141	Microwave Cable	Junkosha	MWX221	1305S002R(1m) / 1405S146(5m)	RE	2015/06/22 * 12
MPA-12	MicroWave System Amplifier	Agilent	83017A	00650	RE	2015/10/01 * 12
MMM-10	DIGITAL HiTESTER	Hioki	3805	051201148	RE	2016/01/18 * 12
MHF-26	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	002	RE	2015/09/17 * 12
MOS-14	Thermo-Hygrometer	Custom	CTH-201	1401	AT	2016/01/21 * 12
MPM-09	Power Meter	Anritsu	ML2495A	6K00003348	AT	2015/10/19 * 12
MPSE-12	Power sensor	Anritsu	MA2411B	011598	AT	2015/10/19 * 12
MSA-14	Spectrum Analyzer	Agilent	E4440A	MY48250080	AT	2015/10/07 * 12
MCC-163	Microwave Cable	Murata	MXGS83RK3000	-	AT	2015/11/10 * 12
MAT-23	Attenuator(10dB) 1-18GHz	Orient Microwave	BX10-0476-00	-	AT	2016/03/18 * 12
MAEC-01	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 10m	DA-06881	CE	2015/09/19 * 12
MOS-27	Thermo-Hygrometer	CUSTOM	CTH-201	A08Q26	CE	2016/01/21 * 12
MJM-25	Measure	KOMELON	KMC-36	-	CE	-
MTR-09	EMI Test Receiver	Rohde & Schwarz	ESU26	100412	CE	2015/06/08 * 12
MLS-25	LISN(AMN)	Schwarzbeck	NSLK8127	8127-731	CE	2015/07/17 * 12
MCC-03	Coaxial Cable	Fujikura/Suhner/TSJ	5D-2W(20m)/ 3D-2W(7.5m)/ RG400u(1.5m)/ RFM-E421(Switcher)	-/01068 (Switcher)	CE	2015/09/29 * 12
MAT-64	Attenuator(13dB)	JFW Industries, Inc.	50FP-013H2 N	-	CE	2016/01/14 * 12
MMM-03	Digital Tester	Fluke	FLUKE 26-3	78030621	CE	2015/08/19 * 12
MSA-03	Spectrum Analyzer	Agilent	E4448A	MY44020357	RE	2015/05/18 * 12
MTR-10	EMI Test Receiver	Rohde & Schwarz	ESR26	101408	RE	2016/01/29 * 12
MBA-05	Biconical Antenna	Schwarzbeck	BBA9106	1302	RE	2015/11/02 * 12
MLA-23	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-192	RE	2016/01/30 * 12
MCC-50	Coaxial Cable	UL Japan	-	-	RE	2015/06/19 * 12
MAT-68	Attenuator	Anritsu	MP721B	6200961025	RE	2015/11/12 * 12
MPA-14	Pre Amplifier	SONOMA INSTRUMENT	310	260833	RE	2016/03/18 * 12
MHA-17	Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170	BBHA9170307	RE	2015/06/06 * 12

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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: CE: Conducted Emission test
 RE: Radiated Emission test
 AT: Antenna Terminal Conducted test