RADIO TEST REPORT

Test Report No. : 12069761H-A-R1

Applicant	:	**Komatsu Ltd.**
Type of Equipment	:	**KOMTRAX terminal**
Model No.	:	**KDTG105**
FCC ID	:	**X4QKDTG105**
Test regulation	:	**FCC Part 15 Subpart C: 2018**
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 covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
6. The all test items in this test report are conducted by UL Japan, Inc. Ise EMC Lab.
7. This test report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.
8. This report is a revised version of 12069761H-A. 12069761H-A is replaced with this report.

Date of test: July 11 to 18, 2018

Representative test engineer:
Tomoki Matsui
Engineer
Consumer Technology Division

Approved by:
Takayuki Shimada
Leader
Consumer Technology Division

NVLAP TESTING
NVLAP LAB CODE: 200572-0

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REVISION HISTORY

Original Test Report No.: 12069761H-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	12069761H-A	August 29, 2018	-	-
1	12069761H-A-R1	October 16, 2018	P 9	Correction of unit in Clause 4.2 From 60 MHz to 60 Hz
1	12069761H-A-R1	October 16, 2018	P 27	Correction of test data

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SECTION 1: Customer information

Company Name	:	Komatsu Ltd.
Address	:	3-25-1 Shinomiya, Hiratsuka-Shi, Kanagawa-Ken, 254-8555 Japan
Telephone Number	:	+81-463-22-8758
Facsimile Number	:	+81-463-22-8586
Contact Person	:	Onagi Miku

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

2.1 Identification of E.U.T.

Type of Equipment	:	KOMTRAX terminal
Model No.	:	KDTG105
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 10 V to 30 V
Receipt Date of Sample	:	July 10, 2018
Country of Mass-production	:	Japan
Condition of EUT	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT	:	No Modification by the test lab

2.2 Product Description

Model: KDTG105 (referred to as the EUT in this report) is a KOMTRAX terminal.

Radio Specification

Specification of Wireless LAN (IEEE802.11b/g/a/n-20)

Type of radio	IEEE802.11b	IEEE802.11g/n (20 M band)
Radio Type	Transceiver	
Frequency of operation	2412 MHz - 2462 MHz	2412 MHz - 2462 MHz
Type of modulation	DSSS (CCK, DQPSK, DBPSK)	OFDM-CCK (64QAM, 16QAM, QPSK, BPSK)
Channel spacing	5 MHz	
Antenna type	Pattern Antenna	
Antenna Gain	4.08 dBi	
Clock frequency(ies) in the system	26 MHz	

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification	:	FCC Part 15 Subpart C
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	N/A *1)	N/A	-
6dB Bandwidth	**FCC:** KDB 558074 D01 DTS Meas Guidance v04 **IC:** -	**FCC:** Section 15.247(a)(2) **IC:** RSS-247 5.2(a)	See data.	Complied	Conducted
Maximum Peak Output Power	**FCC:** KDB 558074 D01 DTS Meas Guidance v04 **IC:** RSS-Gen 6.12	**FCC:** Section 15.247(b)(3) **IC:** RSS-247 5.4(d)		Complied	Conducted
Power Density	**FCC:** KDB 558074 D01 DTS Meas Guidance v04 **IC:** -	**FCC:** Section 15.247(e) **IC:** RSS-247 5.2(b)		Complied	Conducted
Spurious Emission Restricted Band Edges	**FCC:** KDB 558074 D01 DTS Meas Guidance v04 **IC:** RSS-Gen 6.13	**FCC:** Section15.247(d) **IC:** RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	3.0 dB 749.982 MHz, QP, Hori/ 4824.000 MHz, AV, Vert.	Complied	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *2)

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.
*1) The test is not applicable since the EUT does not have AC ports.
*2) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 DTS Meas Guidance v04 12.2.7.

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

FCC Part 15.31 (e)
This EUT provides stable voltage constantly to RF Module regardless of input voltage. 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.

3.3 Addition to standard

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

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.

Ise EMC Lab.
Radiated emission

Measurement distance	Frequency range	Uncertainty (+/-)
3 m	9 kHz to 30 MHz	3.3 dB
10 m		3.2 dB
3 m	30 MHz to 200 MHz (Horizontal)	4.8 dB
	(Vertical)	5.0 dB
	200 MHz to 1000 MHz (Horizontal)	5.2 dB
	(Vertical)	6.3 dB
10 m	30 MHz to 200 MHz (Horizontal)	4.8 dB
	(Vertical)	4.9 dB
	200 MHz to 1000 MHz (Horizontal)	5.0 dB
	(Vertical)	5.0 dB
3 m	1 GHz to 6 GHz	5.0 dB
	6 GHz to 18 GHz	5.3 dB
1 m	10 GHz to 26.5 GHz	5.8 dB
	26.5 GHz to 40 GHz	5.8 dB
10 m	1 GHz to 18 GHz	5.2 dB

Radiated emission test
The data listed in this report meets the limits unless the uncertainty is taken into consideration.

3.5 Test Location

UL Japan, Inc. Ise EMC Lab.
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone: +81 596 24 8999, Facsimile: +81 596 24 8124
NVLAP Lab. code: 200572-0 / FCC Test Firm Registration Number: 199967

Test site	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms	Maximum measurement distance
No.1 semi-anechoic chamber	2973C-1	19.2 x 11.2 x 7.7	7.0 x 6.0	No.1 Power source room	10 m
No.2 semi-anechoic chamber	2973C-2	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	2973C-3	12.0 x 8.5 x 5.9	6.8 x 5.75	No.3 Preparation room	3 m
No.3 shielded room	-	4.0 x 6.0 x 2.7	N/A	-	-
No.4 semi-anechoic chamber	2973C-4	12.0 x 8.5 x 5.9	6.8 x 5.75	No.4 Preparation room	3 m
No.4 shielded room	-	4.0 x 6.0 x 2.7	N/A	-	-
No.5 semi-anechoic chamber	-	6.0 x 6.0 x 3.9	6.0 x 6.0	-	-
No.6 shielded room	-	4.0 x 4.5 x 2.7	4.0 x 4.5	-	-
No.6 measurement room	-	4.75 x 5.4 x 3.0	4.75 x 4.15	-	-
No.7 shielded room	-	4.7 x 7.5 x 2.7	4.7 x 7.5	-	-
No.8 measurement room	-	3.1 x 5.0 x 2.7	N/A	-	-
No.9 measurement room	-	8.8 x 4.6 x 2.8	2.4 x 2.4	-	-
No.11 measurement room	-	6.2 x 4.7 x 3.0	4.8 x 4.6	-	-

* Size of vertical conducting plane (for Conducted Emission test) : 2.0 m x 2.0m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

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

4.1 Operating Mode(s)

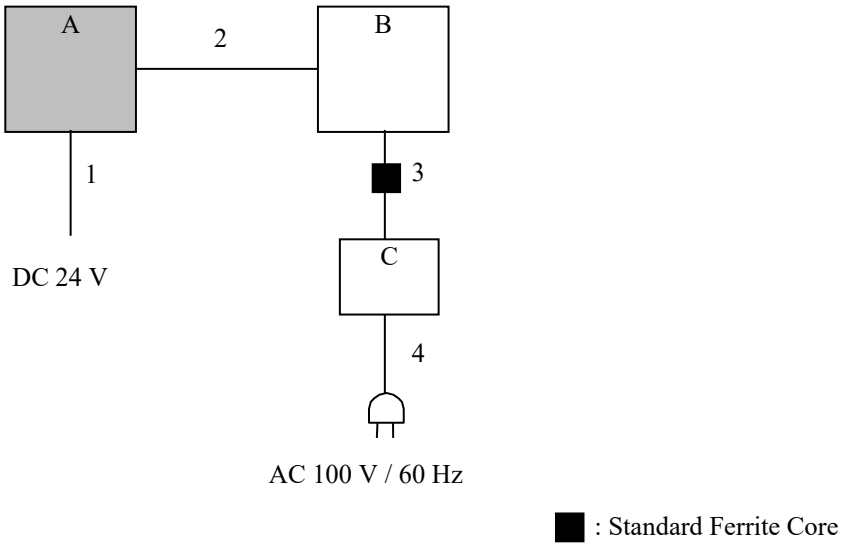
Test operating mode was determined as follows according to "Section 1 of 6 802.11 a/b/g/n testing - Managing Complex Regulatory Approvals - " of TCB Council Workshop October 2009

Mode	Remarks*
IEEE 802.11b (11b)	11 Mbps, PN9
IEEE 802.11g (11g)	12 Mbps, PN9
IEEE 802.11n 20 MHz BW (11n-20)	MCS 0, PN9
*The worst condition was determined based on the test result of Maximum Peak Output Power (Mid Channel)	
*Power of the EUT was set by the software as follows (setting value might be different from product specification value); Power settings: WLAN: 11b: 17 dBm, 11g: 15 dBm, 11n: 15 dBm Software: Tera Term Ver 4.9.2 *This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.	

*The details of Operating mode(s)

Test Item	Operating Mode	Tested frequency
Radiated Spurious Emission (Above 1 GHz)	11b Tx 11g Tx *1)	2412 MHz 2437 MHz 2462 MHz
	11n-20 Tx *2)	2412 MHz 2462 MHz
Radiated Spurious Emission (Below 1 GHz)	11g Tx *3)	2437 MHz
6dB Bandwidth Maximum Peak Output Power Power Density 99% Occupied Bandwidth	11b Tx 11g Tx 11n-20 Tx	2412 MHz 2437 MHz 2462 MHz
*1) Since 11g and 11n-20 have the same modulation method and no differences in transmitting specification, test was performed on the representative mode that had the highest output power. *2) Only band edge test was tested on this mode, because the 11g Tx mode had the higher power at antenna terminal test. *3) The mode was tested as a representative, because it had the highest power at antenna terminal test.		

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	KOMTRAX terminal	KDTG105	782626310A00001006 *1) 782626310A00001003 *2)	Komatsu Ltd.	EUT
B	Laptop PC	CF-N8HWCDPS	9LKSA04258 *1) 10CKSA09265 *2)	Panasonic	-
C	AC Adapter	CF-AA6372B M4 *1) CF-AA6372B M6 *2)	6372BM409X14190B *1) 6372BM610X10953E *2)	Panasonic	-

*1) Used for Antenna Terminal conducted test
*2) Used for Radiated Emission test

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	3.3	Unshielded	Unshielded	-
2	Signal Cable	3.3	Unshielded	Unshielded	-
3	DC Cable	1.1	Unshielded	Unshielded	-
4	AC Cable	0.9	Unshielded	Unshielded	-

SECTION 5: Radiated Spurious Emission

Test Procedure

It was measured based on "11.0 Emissions in non-restricted frequency bands" of "KDB 558074 D01 DTS Meas Guidance v04".

[For below 1 GHz]
EUT was placed on a urethane platform of nominal size, 0.5 m by 1.0 m, raised 0.8 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

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

The height of the measuring antenna varied between 1 and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.
The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer.
The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear mode).
The test was made with the detector (RBW/VBW) in the following table.
When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

Test Antennas are used as below;

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

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

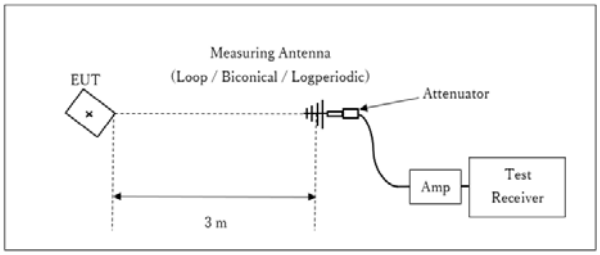
20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9(IC) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (IC).

Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	PK	AV *1)	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	Average Power Method: RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (RMS) Trace: 100 traces If duty cycle was less than 98%, a duty factor was added to the results.	RBW: 100 kHz VBW: 300kHz

*1) Average Power Measurement was performed based on 6. 0 & 12.2.5 of "KDB 558074 D01 DTS Meas Guidance v04".

Figure 1: Test Setup

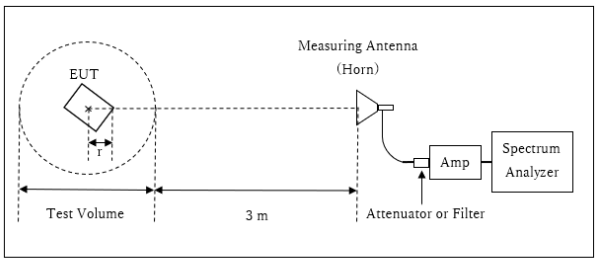
Below 1 GHz



× : Center of turn table

Test Distance: 3 m

1 GHz - 10 GHz



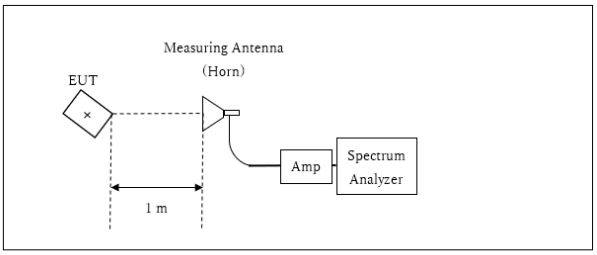
r : Radius of an outer periphery of EUT
× : Center of turn table

Distance Factor: 20 x log (3.75 m / 3.0 m) = 1.94 dB
* Test Distance: (3 + Test Volume /2) - r = 3.75 m

Test Volume : 1.5 m
(Test Volume has been calibrated based on CISPR 16-1-4.)
r = 0.0 m

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

10 GHz – 26.5 GHz



× : Center of turn table

Distance Factor: 20 x log (1.0 m / 3.0 m) = -9.5 dB
*Test Distance: 1 m

- The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

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

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

SECTION 6: Antenna Terminal Conducted Tests

Test Procedure

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

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument used
6dB Bandwidth	20 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99% Occupied Bandwidth *1)	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak/ Average *2)	-	Power Meter (Sensor: 50 MHz BW)
Peak Power Density	1.5 times the 6dB Bandwidth	3 kHz	10 kHz	Auto	Peak	Max Hold	Spectrum Analyzer *3)
Conducted Spurious Emission *4)	9kHz to 150kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150kHz to 30MHz	9.1 kHz	27 kHz				

*1) Peak hold was applied as Worst-case measurement.
*2) Reference data
*3) Section 10.2 Method PKPSD (peak PSD) of "KDB 558074 D01 DTS Meas Guidance v04".
*4) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents.
Then, wide-band noise near the limit was checked separately, however the noise was low enough as shown in the chart.
(9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 9.1 kHz).

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

Test data : APPENDIX
Test result : Pass

APPENDIX 1: Test data

6 dB Bandwidth and 99 % Occupied Bandwidth

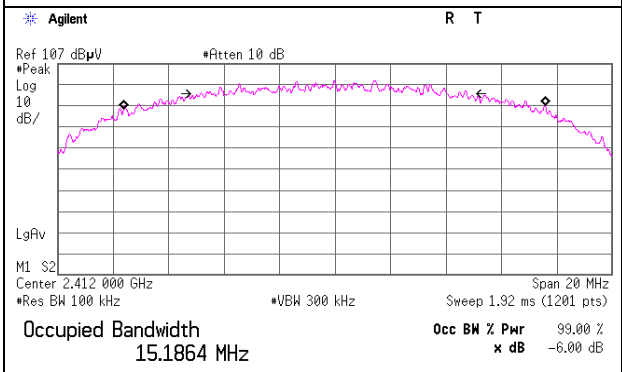
Report No.	12069761H
Test place	Ise EMC Lab. No.6 Shielded Room
Date	July 11, 2018
Temperature / Humidity	25.5 deg. C / 57 % RH
Engineer	Tomoki Matsui
Mode	Tx

Mode	Frequency [MHz]	99% Occupied Bandwidth [kHz]	6dB Bandwidth [MHz]	Limit for 6dB Bandwidth [MHz]
11b	2412	15340.0	9.606	> 0.5000
	2437	15301.7	9.596	> 0.5000
	2462	15312.4	9.601	> 0.5000
11g	2412	16790.0	16.324	> 0.5000
	2437	16816.1	16.309	> 0.5000
	2462	16810.3	16.305	> 0.5000
11n-20	2412	17869.7	16.992	> 0.5000
	2437	17865.2	16.911	> 0.5000
	2462	17858.0	17.040	> 0.5000

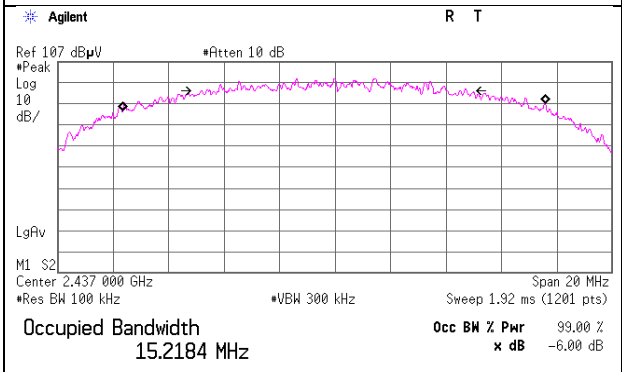
6dB Bandwidth

11b

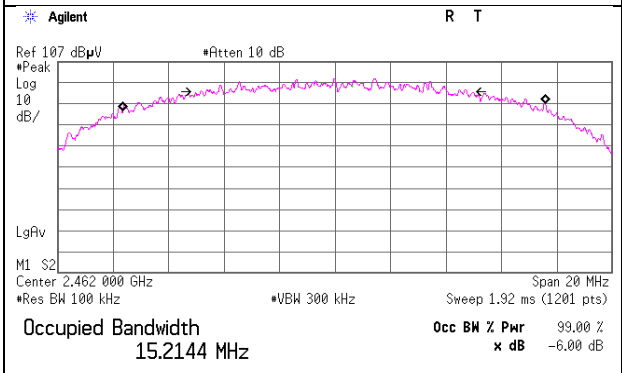
2412 MHz



2437 MHz

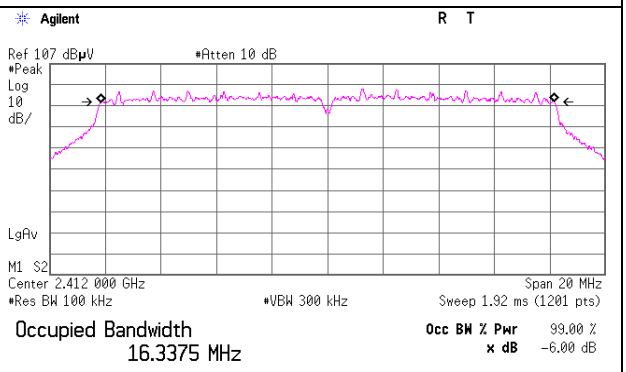


2462 MHz

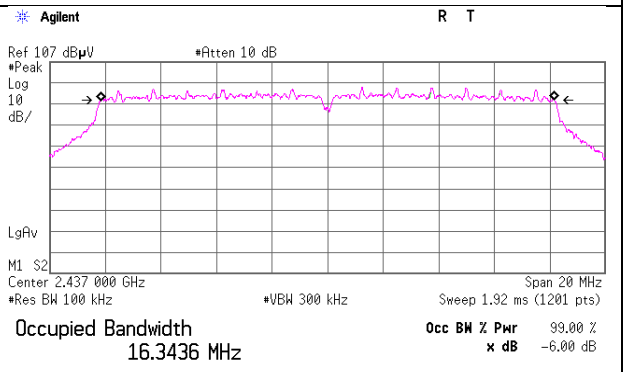


11g

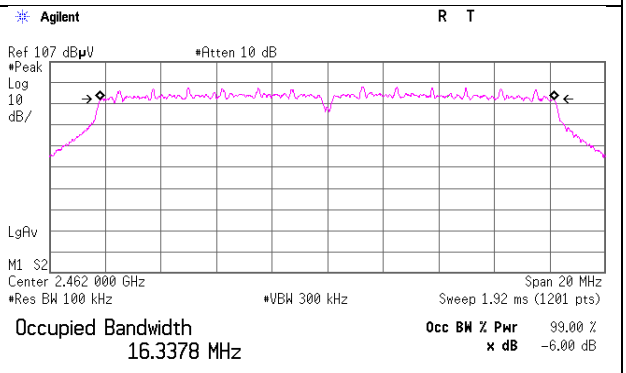
2412 MHz



2437 MHz



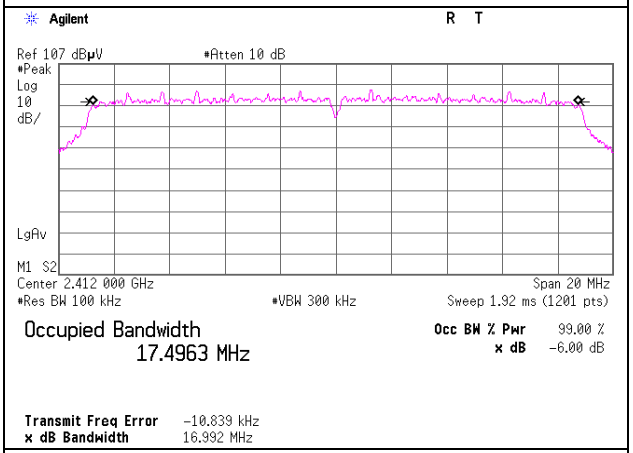
2462 MHz



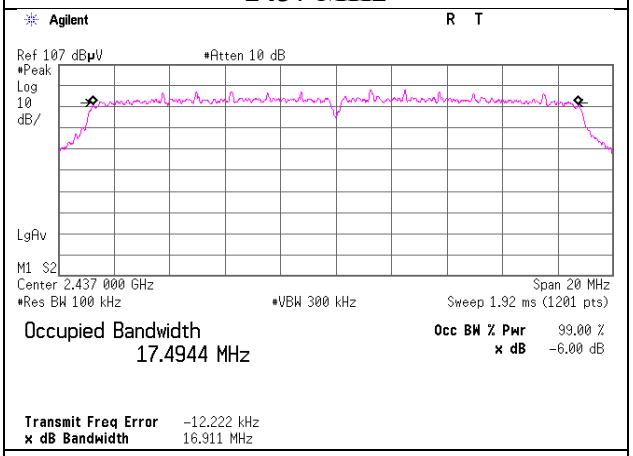
6dB Bandwidth

11n-20

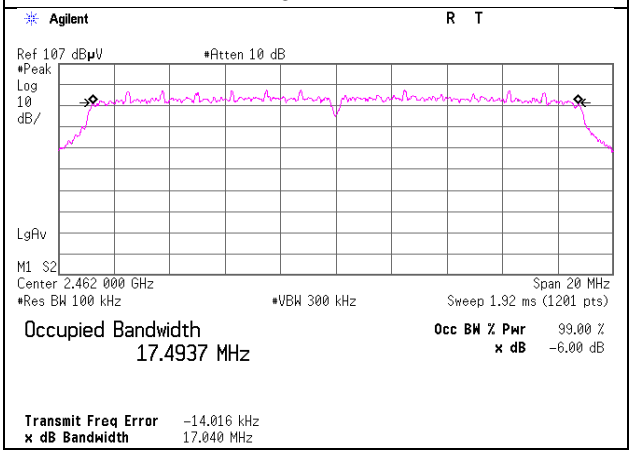
2412 MHz



2437 MHz



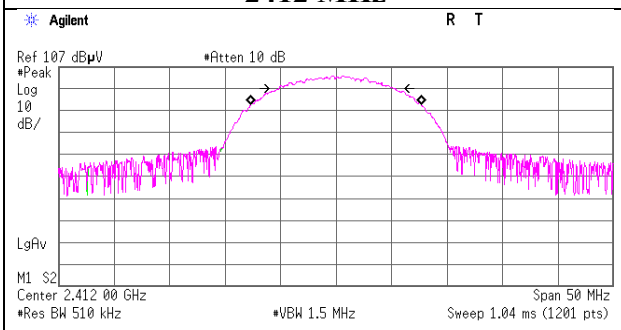
2462 MHz



99 % Occupied Bandwidth

11b

2412 MHz

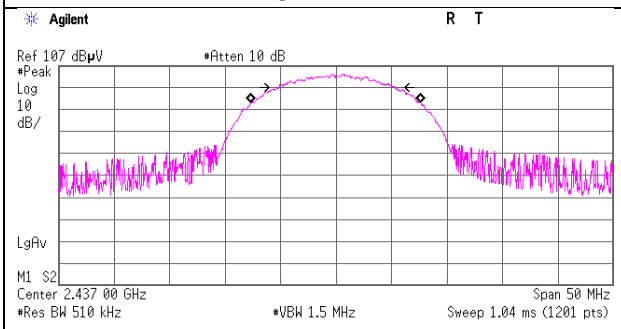


Occupied Bandwidth
15.3400 MHz

Occ BW % Pwr 99.00 %
x dB -6.00 dB

Transmit Freq Error -844.923 Hz
x dB Bandwidth 10.529 MHz

2437 MHz

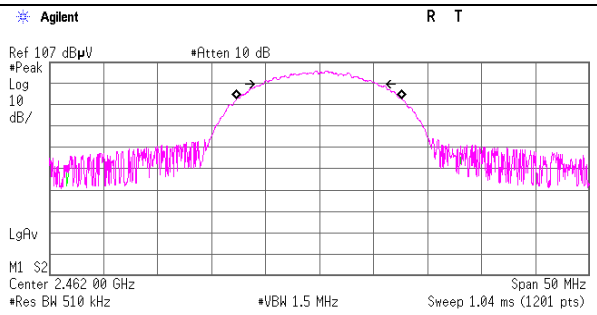


Occupied Bandwidth
15.3017 MHz

Occ BW % Pwr 99.00 %
x dB -6.00 dB

Transmit Freq Error -10.988 kHz
x dB Bandwidth 10.503 MHz

2462 MHz



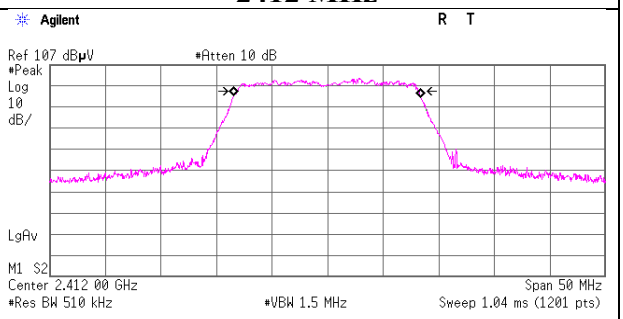
Occupied Bandwidth
15.3124 MHz

Occ BW % Pwr 99.00 %
x dB -6.00 dB

Transmit Freq Error -14.655 kHz
x dB Bandwidth 10.538 MHz

11g

2412 MHz

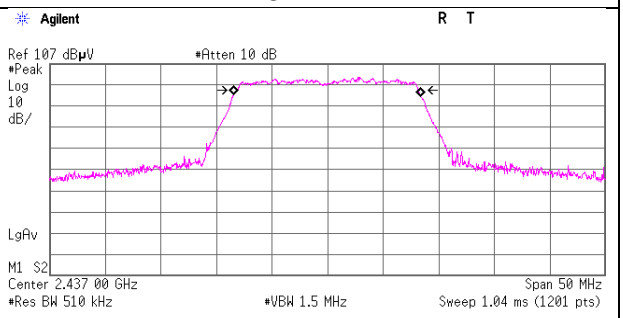


Occupied Bandwidth
16.7900 MHz

Occ BW % Pwr 99.00 %
x dB -6.00 dB

Transmit Freq Error -28.085 kHz
x dB Bandwidth 16.256 MHz

2437 MHz

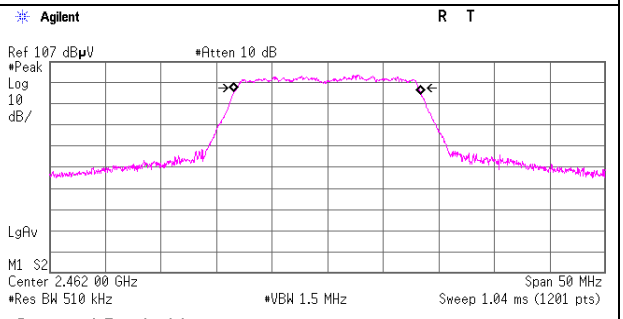


Occupied Bandwidth
16.8161 MHz

Occ BW % Pwr 99.00 %
x dB -6.00 dB

Transmit Freq Error -19.543 kHz
x dB Bandwidth 16.324 MHz

2462 MHz



Occupied Bandwidth
16.8103 MHz

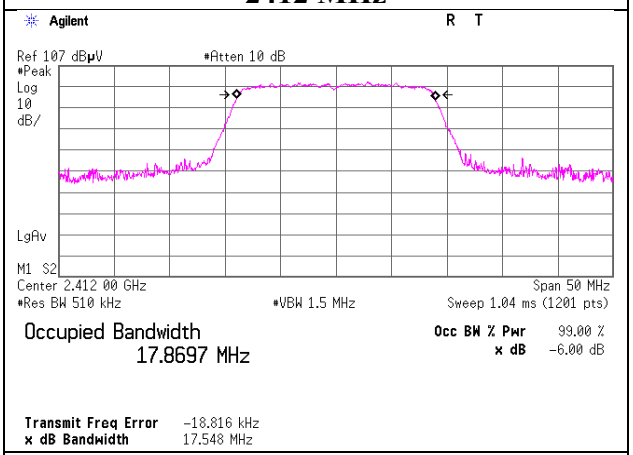
Occ BW % Pwr 99.00 %
x dB -6.00 dB

Transmit Freq Error -23.430 kHz
x dB Bandwidth 16.214 MHz

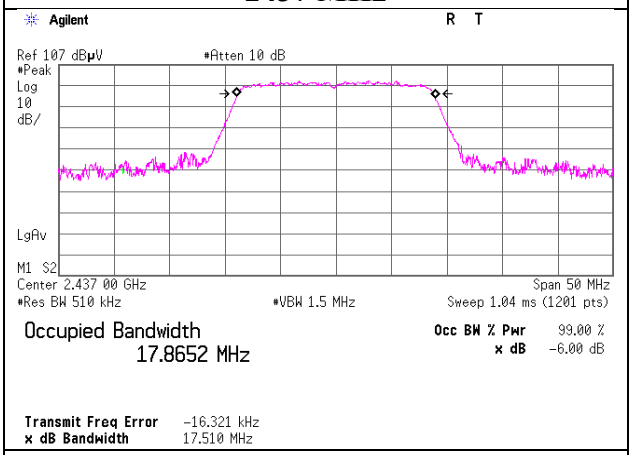
99 % Occupied Bandwidth

11n-20

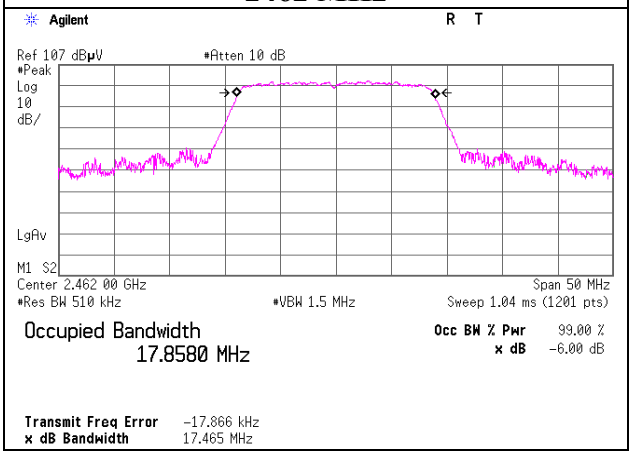
2412 MHz



2437 MHz



2462 MHz



Maximum Peak Output Power

Report No.	12069761H
Test place	Ise EMC Lab. No.6 Shielded Room
Date	July 11, 2017
Temperature / Humidity	25.5 deg. C / 57 % RH
Engineer	Tomoki Matsui
Mode	Tx 11b

				Conducted Power					e.i.r.p. for RSS-247					
Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2412	2.90	1.43	10.04	14.37	27.35	30.00	1000	15.63	4.08	18.45	69.98	36.02	4000	17.57
2437	2.94	1.43	10.04	14.41	27.61	30.00	1000	15.59	4.08	18.49	70.63	36.02	4000	17.53
2462	2.87	1.44	10.04	14.35	27.23	30.00	1000	15.65	4.08	18.43	69.66	36.02	4000	17.59

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

2437MHz

Rate [Mbps]	Reading [dBm]	Remark
1	2.70	
2	2.75	
5.5	2.73	
11	2.78	*

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

Maximum Peak Output Power

Report No.	12069761H
Test place	Ise EMC Lab. No.6 Shielded Room
Date	July 11, 2018
Temperature / Humidity	25.5 deg. C / 57 % RH
Engineer	Tomoki Matsui
Mode	Tx 11g

				Conducted Power					e.i.r.p. for RSS-247					
Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2412	8.99	1.43	10.04	20.46	111.17	30.00	1000	9.54	4.08	24.54	284.45	36.02	4000	11.48
2437	9.23	1.43	10.04	20.70	117.49	30.00	1000	9.30	4.08	24.78	300.61	36.02	4000	11.24
2462	8.76	1.44	10.04	20.24	105.68	30.00	1000	9.76	4.08	24.32	270.40	36.02	4000	11.70

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

2437 MHz

Rate [Mbps]	Reading [dBm]	Remark
6	8.35	
9	8.28	
12	8.54	*
18	8.19	
24	8.41	
36	8.29	
48	8.28	
54	8.25	

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

Maximum Peak Output Power

Report No.	12069761H
Test place	Ise EMC Lab. No.6 Shielded Room
Date	July 11, 2018
Temperature / Humidity	25.5 deg. C / 57 % RH
Engineer	Tomoki Matsui
Mode	Tx 11n-20

				Conducted Power					e.i.r.p. for RSS-247					
Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2412	8.87	1.43	10.04	20.34	108.14	30.00	1000	9.66	4.08	24.42	276.69	36.02	4000	11.60
2437	8.56	1.43	10.04	20.03	100.69	30.00	1000	9.97	4.08	24.11	257.63	36.02	4000	11.91
2462	8.35	1.44	10.04	19.83	96.16	30.00	1000	10.17	4.08	23.91	246.04	36.02	4000	12.11

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

2437 MHz

MCS Number	Reading [dBm]	Remark
0	8.69	*
1	8.38	
2	8.46	
3	8.31	
4	8.06	
5	6.58	
6	7.17	
7	6.57	

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

Average Output Power
(Reference data for RF Exposure)

Report No.	12069761H
Test place	Ise EMC Lab. No.6 Shielded Room
Date	July 11, 2018
Temperature / Humidity	25.5 deg. C / 57 % RH
Engineer	Tomoki Matsui
Mode	Tx

11b **1 Mbps**

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2412	0.71	1.43	10.04	12.18	16.52	0.00	12.18	16.52
2437	0.80	1.43	10.04	12.27	16.87	0.00	12.27	16.87
2462	0.90	1.44	10.04	12.38	17.30	0.00	12.38	17.30

11g **6 Mbps**

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2412	-1.06	1.43	10.04	10.41	10.99	0.04	10.45	11.09
2437	-0.99	1.43	10.04	10.48	11.17	0.04	10.52	11.27
2462	-0.93	1.44	10.04	10.55	11.35	0.04	10.59	11.46

11n-20 **MCS 0**

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2412	-1.16	1.43	10.04	10.31	10.74	0.04	10.35	10.84
2437	-1.16	1.43	10.04	10.31	10.74	0.04	10.35	10.84
2462	-1.02	1.44	10.04	10.46	11.12	0.04	10.50	11.22

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

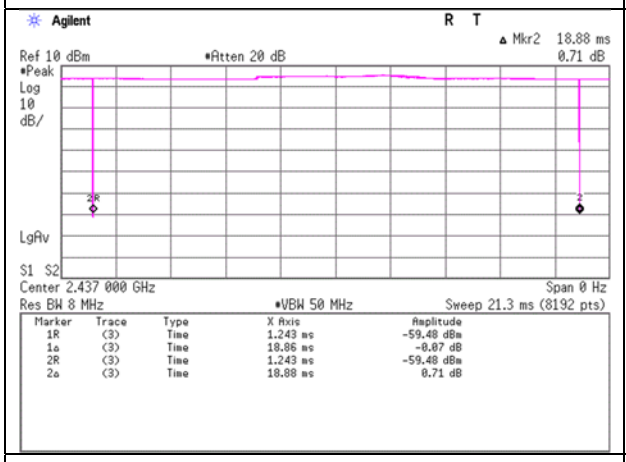
The average output power was measured with the lowest order modulation and lowest data rate configuration in each IEEE 802.11 mode based on KDB 248227 D01.

Burst rate confirmation

Report No.	12069761H
Test place	Ise EMC Lab. No.6 Shielded Room
Date	July 12, 2018
Temperature / Humidity	25.5 deg. C / 57 % RH
Engineer	Tomoki Matsui
Mode	Tx

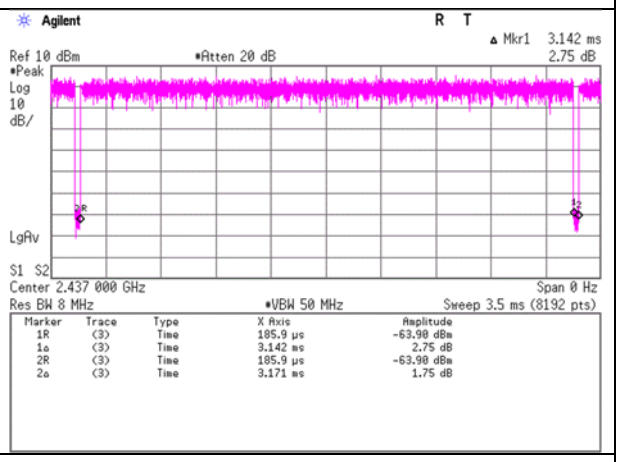
11b 1 Mbps

Tx on / (Tx on + Tx off) =	0.999
Tx on / (Tx on + Tx off) * 100 =	99.9 %
Duty factor = 10 * log (18.88 / 18.86) =	0.00 dB



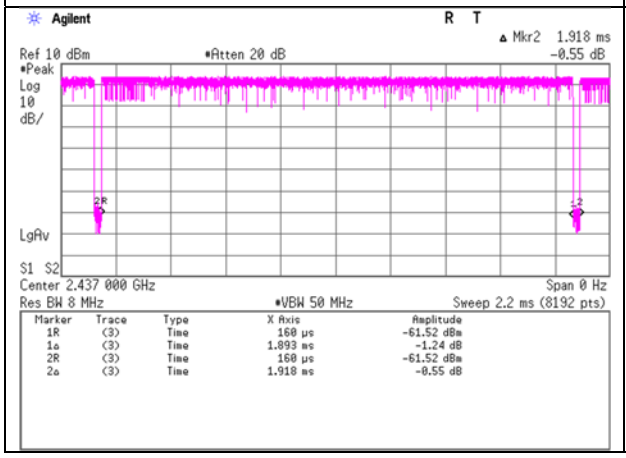
11g 6 Mbps

Tx on / (Tx on + Tx off) =	0.991
Tx on / (Tx on + Tx off) * 100 =	99.1 %
Duty factor = 10 * log (3.171 / 3.142) =	0.04 dB



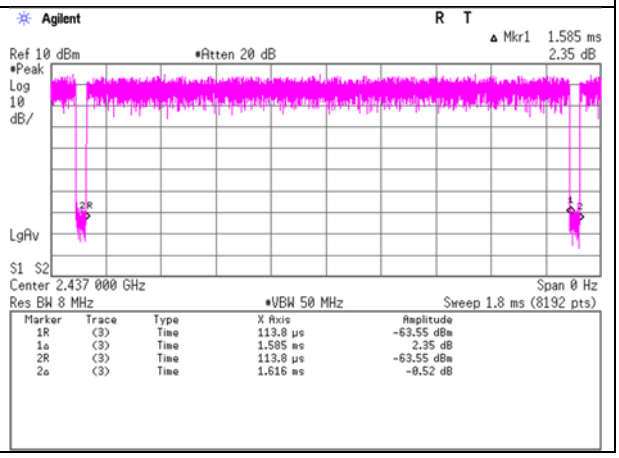
11b 11 Mbps

Tx on / (Tx on + Tx off) =	0.987
Tx on / (Tx on + Tx off) * 100 =	98.7 %
Duty factor = 10 * log (1.918 / 1.893) =	0.06 dB



11g 12 Mbps

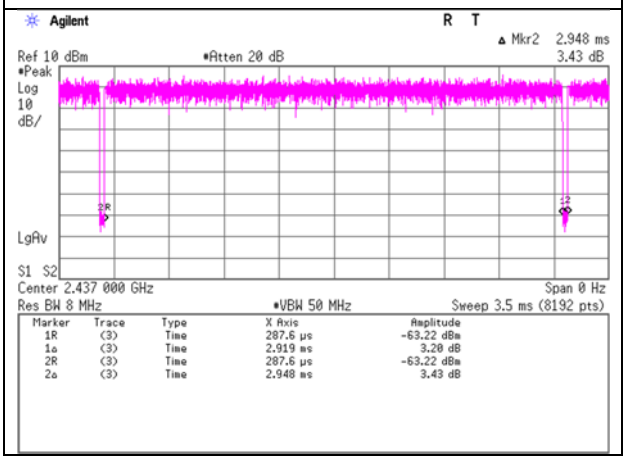
Tx on / (Tx on + Tx off) =	0.981
Tx on / (Tx on + Tx off) * 100 =	98.1 %
Duty factor = 10 * log (1.616 / 1.585) =	0.08 dB



Burst rate confirmation

11n-20 MCS 0

Tx on / (Tx on + Tx off) =	0.990
Tx on / (Tx on + Tx off) * 100 =	99.0 %
Duty factor = 10 * log (2.948 / 2.919) =	0.04 dB



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

Radiated Spurious Emission

Report No.	12069761H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	July 18, 2018	July 18, 2018
Temperature / Humidity	23 deg. C / 49 % RH	23 deg. C / 49 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)	Takumi Shimada (10 GHz - 26.5 GHz)
Mode	Tx 11b 2412 MHz	

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	1499.998	PK	57.7	26.0	4.5	35.0	-	53.2	73.9	20.7	
Hori	2281.430	PK	52.4	27.6	5.0	34.5	-	50.5	73.9	23.4	
Hori	2390.000	PK	66.6	27.7	5.0	34.4	-	64.9	73.9	9.0	
Hori	2690.000	PK	53.7	28.3	5.2	34.4	-	52.8	73.9	21.1	
Hori	4824.000	PK	53.4	31.3	7.3	33.7	-	58.3	73.9	15.6	
Hori	7236.000	PK	48.4	35.6	8.7	33.6	-	59.1	73.9	14.8	Floor noise
Hori	1499.998	AV	54.9	26.0	4.5	35.0	-	50.4	53.9	3.5	
Hori	2281.430	AV	44.2	27.6	5.0	34.5	-	42.3	53.9	11.6	
Hori	2390.000	AV	47.2	27.7	5.0	34.4	-	45.5	53.9	8.4	
Hori	2690.000	AV	45.1	28.3	5.2	34.4	-	44.2	53.9	9.7	
Hori	4824.000	AV	45.6	31.3	7.3	33.7	-	50.5	53.9	3.4	
Hori	7236.000	AV	35.2	35.6	8.7	33.6	-	45.9	53.9	8.0	Floor noise
Vert	1499.998	PK	55.0	26.0	4.5	35.0	-	50.5	73.9	23.4	
Vert	2281.430	PK	50.3	27.6	5.0	34.5	-	48.4	73.9	25.5	
Vert	2390.000	PK	65.8	27.7	5.0	34.4	-	64.1	73.9	9.8	
Vert	2690.000	PK	52.8	28.3	5.2	34.4	-	51.9	73.9	22.0	
Vert	4824.000	PK	53.1	31.3	7.3	33.7	-	58.0	73.9	15.9	
Vert	7236.000	PK	43.3	35.6	8.7	33.6	-	54.0	73.9	19.9	Floor noise
Vert	1499.998	AV	51.8	26.0	4.5	35.0	-	47.3	53.9	6.6	
Vert	2281.430	AV	42.1	27.6	5.0	34.5	-	40.2	53.9	13.7	
Vert	2390.000	AV	46.6	27.7	5.0	34.4	-	44.9	53.9	9.0	
Vert	2690.000	AV	44.2	28.3	5.2	34.4	-	43.3	53.9	10.6	
Vert	4824.000	AV	46.0	31.3	7.3	33.7	-	50.9	53.9	3.0	
Vert	7236.000	AV	35.1	35.6	8.7	33.6	-	45.8	53.9	8.1	Floor noise

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

Distance factor: 1 GHz - 10 GHz 20log (3.75 m / 3.0 m) = 1.94 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

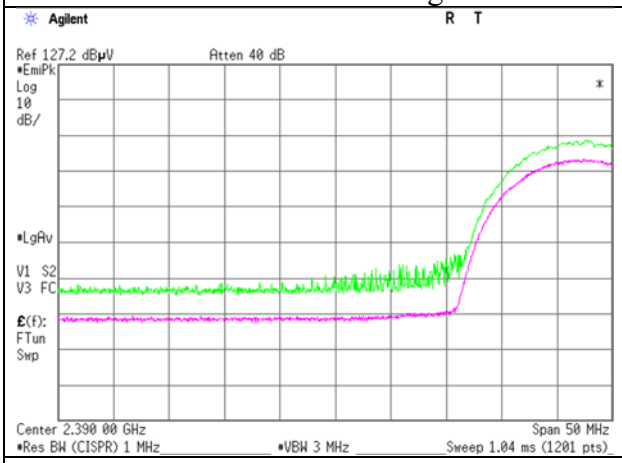
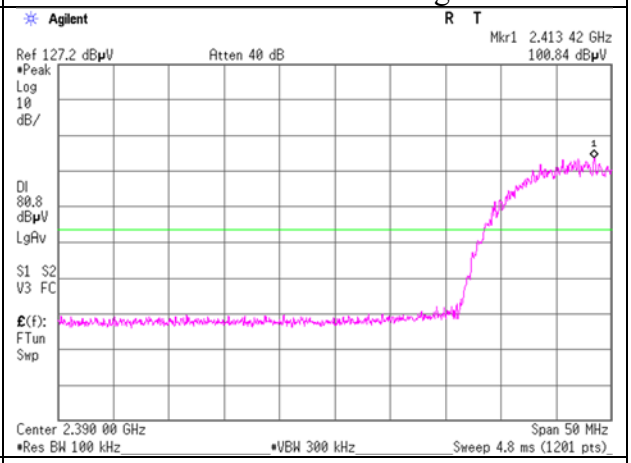
20dBc Data Sheet

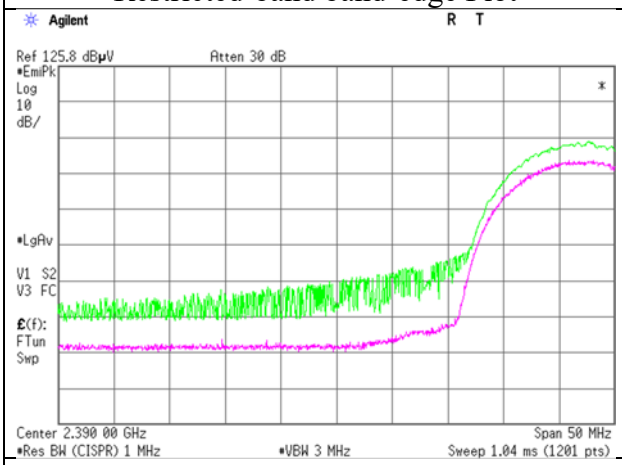
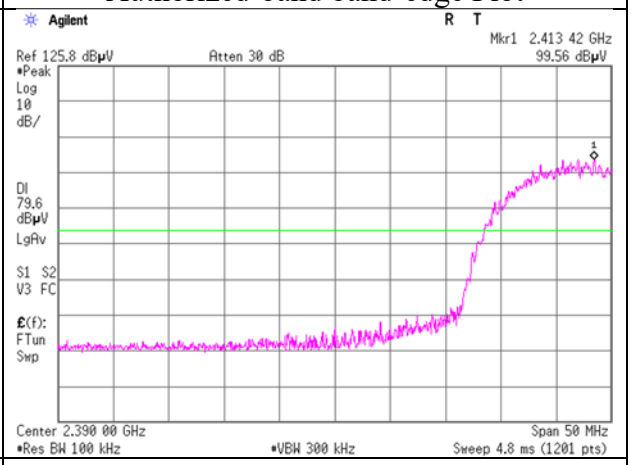
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2412.000	PK	100.8	27.6	5.0	34.4	99.0	-	-	Carrier
Hori	2400.000	PK	55.3	27.8	5.0	34.4	53.7	79.0	25.3	
Hori	9648.000	PK	37.7	38.4	8.6	33.9	50.8	79.0	28.2	
Vert	2412.000	PK	99.6	27.6	5.0	34.4	97.8	-	-	Carrier
Vert	2400.000	PK	54.3	27.8	5.0	34.4	52.7	77.8	25.1	
Vert	9648.000	PK	39.4	38.4	8.6	33.9	52.5	77.8	25.3	

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

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	July 18, 2018
Temperature / Humidity	23 deg. C / 49 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)
Mode	Tx 11b 2412 MHz

Horizontal	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

Vertical	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

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

Radiated Spurious Emission

Report No.	12069761H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	July 18, 2018	July 18, 2018
Temperature / Humidity	23 deg. C / 49 % RH	23 deg. C / 49 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)	Takumi Shimada (10 GHz - 26.5 GHz)
Mode	Tx 11b 2437 MHz	

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	1499.998	PK	56.9	26.0	4.5	35.0	-	52.4	73.9	21.5	
Hori	2281.021	PK	51.2	27.6	5.0	34.5	-	49.3	73.9	24.6	
Hori	2690.000	PK	54.2	28.3	5.2	34.4	-	53.3	73.9	20.6	
Hori	4874.000	PK	52.2	31.5	7.3	33.7	-	57.3	73.9	16.6	
Hori	7311.000	PK	43.8	35.9	8.7	33.6	-	54.8	73.9	19.1	Floor noise
Hori	1499.998	AV	54.8	26.0	4.5	35.0	-	50.3	53.9	3.6	
Hori	2281.021	AV	41.7	27.6	5.0	34.5	-	39.8	53.9	14.1	
Hori	2690.000	AV	45.3	28.3	5.2	34.4	-	44.4	53.9	9.5	
Hori	4874.000	AV	43.5	31.5	7.3	33.7	-	48.6	53.9	5.3	
Hori	7311.000	AV	34.7	35.9	8.7	33.6	-	45.7	53.9	8.2	Floor noise
Vert	1499.998	PK	54.9	26.0	4.5	35.0	-	50.4	73.9	23.5	
Vert	2281.021	PK	50.5	27.6	5.0	34.5	-	48.6	73.9	25.3	
Vert	2690.000	PK	53.9	28.3	5.2	34.4	-	53.0	73.9	20.9	
Vert	4874.000	PK	52.3	31.5	7.3	33.7	-	57.4	73.9	16.5	
Vert	7311.000	PK	43.7	35.9	8.7	33.6	-	54.7	73.9	19.2	Floor noise
Vert	1499.998	AV	52.4	26.0	4.5	35.0	-	47.9	53.9	6.0	
Vert	2281.021	AV	42.3	27.6	5.0	34.5	-	40.4	53.9	13.5	
Vert	2690.000	AV	44.6	28.3	5.2	34.4	-	43.7	53.9	10.2	
Vert	4874.000	AV	43.5	31.5	7.3	33.7	-	48.6	53.9	5.3	
Vert	7311.000	AV	34.8	35.9	8.7	33.6	-	45.8	53.9	8.1	Floor noise

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

Distance factor: 1 GHz - 10 GHz 20log (3.75 m / 3.0 m) = 1.94 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

20dBc Data Sheet

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2437.000	PK	100.4	27.4	5.1	34.4	98.5	-	-	Carrier
Hori	9748.000	PK	37.8	38.6	8.6	34.0	51.0	78.5	27.5	
Vert	2437.000	PK	99.7	27.4	5.1	34.4	97.8	-	-	Carrier
Vert	9748.000	PK	40.4	38.6	8.6	34.0	53.6	77.8	24.2	

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

Radiated Spurious Emission

Report No.	12069761H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	July 18, 2018	July 18, 2018
Temperature / Humidity	23 deg. C / 49 % RH	23 deg. C / 49 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)	Takumi Shimada (10 GHz - 26.5 GHz)
Mode	Tx 11b 2462 MHz	

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	1499.998	PK	58.2	26.0	4.5	35.0	-	53.7	73.9	20.2	
Hori	2281.301	PK	51.0	27.6	5.0	34.5	-	49.1	73.9	24.8	
Hori	2483.500	PK	69.0	27.5	5.1	34.4	-	67.2	73.9	6.7	
Hori	2690.000	PK	53.3	28.3	5.2	34.4	-	52.4	73.9	21.5	
Hori	4924.000	PK	49.8	31.6	7.4	33.7	-	55.1	73.9	18.8	
Hori	7386.000	PK	47.0	36.1	8.7	33.6	-	58.2	73.9	15.7	Floor noise
Hori	1499.998	AV	54.8	26.0	4.5	35.0	-	50.3	53.9	3.6	
Hori	2281.301	AV	41.3	27.6	5.0	34.5	-	39.4	53.9	14.5	
Hori	2483.500	AV	48.7	27.5	5.1	34.4	-	46.9	53.9	7.0	
Hori	2690.000	AV	45.1	28.3	5.2	34.4	-	44.2	53.9	9.7	
Hori	4924.000	AV	37.7	31.6	7.4	33.7	-	43.0	53.9	10.9	
Hori	7386.000	AV	36.1	36.1	8.7	33.6	-	47.3	53.9	6.6	Floor noise
Vert	1499.998	PK	55.3	26.0	4.5	35.0	-	50.8	73.9	23.1	
Vert	2281.301	PK	52.1	27.6	5.0	34.5	-	50.2	73.9	23.7	
Vert	2483.500	PK	69.0	27.5	5.1	34.4	-	67.2	73.9	6.7	
Vert	2690.000	PK	53.6	28.3	5.2	34.4	-	52.7	73.9	21.2	
Vert	4924.000	PK	44.6	31.6	7.4	33.7	-	49.9	73.9	24.0	
Vert	7386.000	PK	42.6	36.1	8.7	33.6	-	53.8	73.9	20.1	Floor noise
Vert	1499.998	AV	52.8	26.0	4.5	35.0	-	48.3	53.9	5.6	
Vert	2281.301	AV	42.0	27.6	5.0	34.5	-	40.1	53.9	13.8	
Vert	2483.500	AV	48.9	27.5	5.1	34.4	-	47.1	53.9	6.8	
Vert	2690.000	AV	44.6	28.3	5.2	34.4	-	43.7	53.9	10.2	
Vert	4924.000	AV	34.7	31.6	7.4	33.7	-	40.0	53.9	13.9	
Vert	7386.000	AV	32.3	36.1	8.7	33.6	-	43.5	53.9	10.4	Floor noise

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

Distance factor: 1 GHz - 10 GHz 20log (3.75 m / 3.0 m) = 1.94 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

20dBc Data Sheet

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2462.000	PK	100.3	27.3	5.1	34.4	98.3	-	-	Carrier
Hori	9848.000	PK	38.3	38.6	8.6	34.0	51.5	78.3	26.8	
Vert	2462.000	PK	100.3	27.3	5.1	34.4	98.3	-	-	Carrier
Vert	9848.000	PK	40.5	38.6	8.6	34.0	53.7	78.3	24.6	

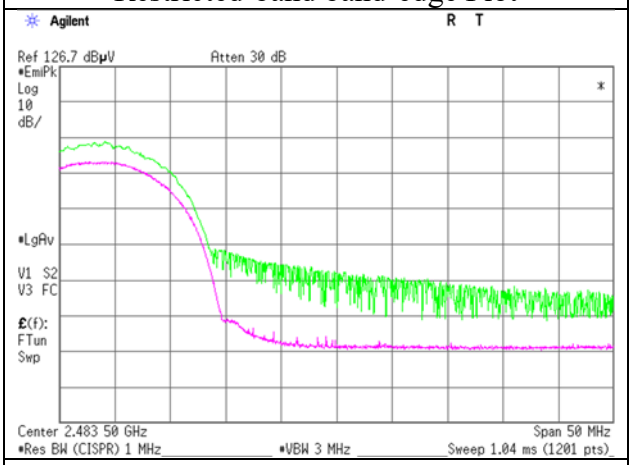
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amprifier)

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	12069761H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	July 18, 2018
Temperature / Humidity	23 deg. C / 49 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)
Mode	Tx 11b 2462 MHz

Horizontal

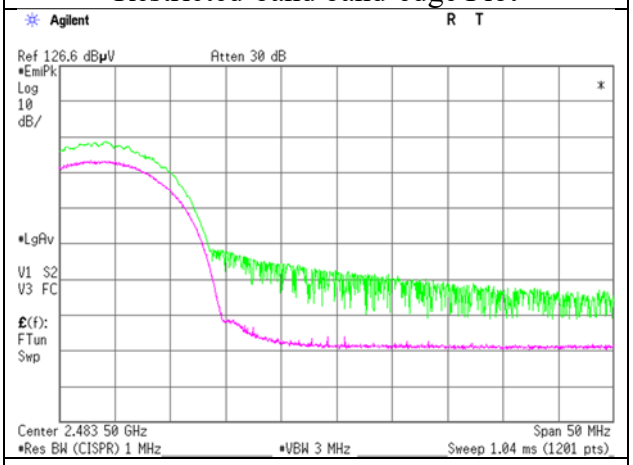
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

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

Radiated Spurious Emission

Report No.	12069761H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	July 18, 2018	July 18, 2018
Temperature / Humidity	23 deg. C / 49 % RH	23 deg. C / 49 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)	Takumi Shimada (10 GHz - 26.5 GHz)
Mode	Tx 11g 2412 MHz	

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	1499.998	PK	56.7	26.0	4.5	35.0	-	52.2	73.9	21.7	
Hori	2282.763	PK	53.6	27.6	5.0	34.5	-	51.7	73.9	22.2	
Hori	2390.000	PK	58.1	27.7	5.0	34.4	-	56.4	73.9	17.5	
Hori	2690.000	PK	55.0	28.3	5.2	34.4	-	54.1	73.9	19.8	
Hori	4824.000	PK	48.4	31.3	7.3	33.7	-	53.3	73.9	20.6	
Hori	7236.000	PK	41.7	35.6	8.7	33.6	-	52.4	73.9	21.5	Floor noise
Hori	1499.998	AV	54.5	26.0	4.5	35.0	-	50.0	53.9	3.9	
Hori	2282.763	AV	45.6	27.6	5.0	34.5	-	43.7	53.9	10.2	
Hori	2390.000	AV	45.7	27.7	5.0	34.4	-	44.0	53.9	9.9	
Hori	2690.000	AV	46.4	28.3	5.2	34.4	-	45.5	53.9	8.4	
Hori	4824.000	AV	38.6	31.3	7.3	33.7	-	43.5	53.9	10.4	
Hori	7236.000	AV	33.1	35.6	8.7	33.6	-	43.8	53.9	10.1	Floor noise
Vert	1499.998	PK	56.0	26.0	4.5	35.0	-	51.5	73.9	22.4	
Vert	2282.763	PK	51.6	27.6	5.0	34.5	-	49.7	73.9	24.2	
Vert	2390.000	PK	58.2	27.7	5.0	34.4	-	56.5	73.9	17.4	
Vert	2690.000	PK	54.6	28.3	5.2	34.4	-	53.7	73.9	20.2	
Vert	4824.000	PK	47.9	31.3	7.3	33.7	-	52.8	73.9	21.1	
Vert	7236.000	PK	46.2	35.6	8.7	33.6	-	56.9	73.9	17.0	Floor noise
Vert	1499.998	AV	52.7	26.0	4.5	35.0	-	48.2	53.9	5.7	
Vert	2282.763	AV	43.1	27.6	5.0	34.5	-	41.2	53.9	12.7	
Vert	2390.000	AV	47.7	27.7	5.0	34.4	-	46.0	53.9	7.9	
Vert	2690.000	AV	45.6	28.3	5.2	34.4	-	44.7	53.9	9.2	
Vert	4824.000	AV	40.8	31.3	7.3	33.7	-	45.7	53.9	8.2	
Vert	7236.000	AV	34.9	35.6	8.7	33.6	-	45.6	53.9	8.3	Floor noise

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

Distance factor: 1 GHz - 10 GHz 20log (3.75 m / 3.0 m) = 1.94 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

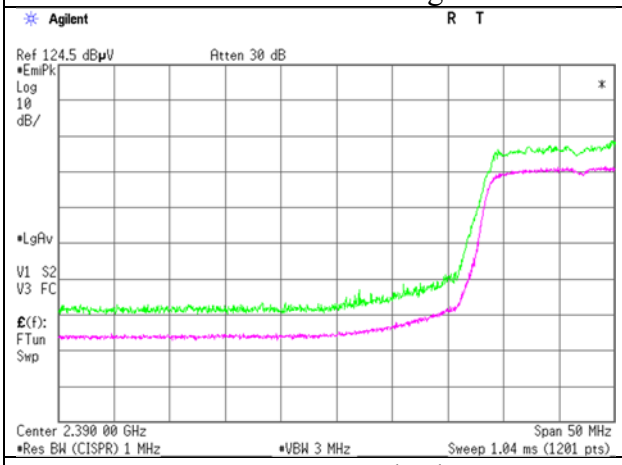
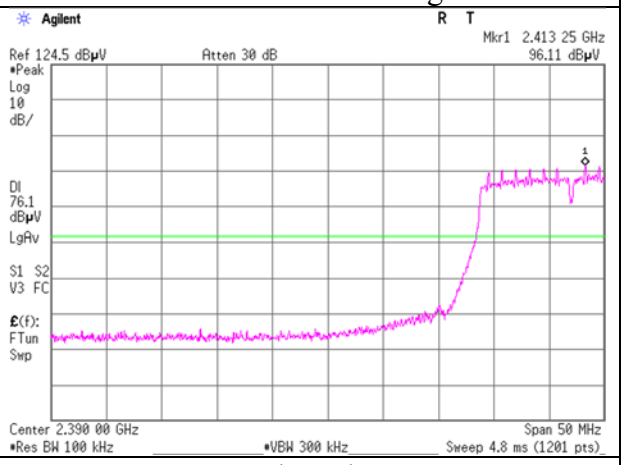
20dBc Data Sheet

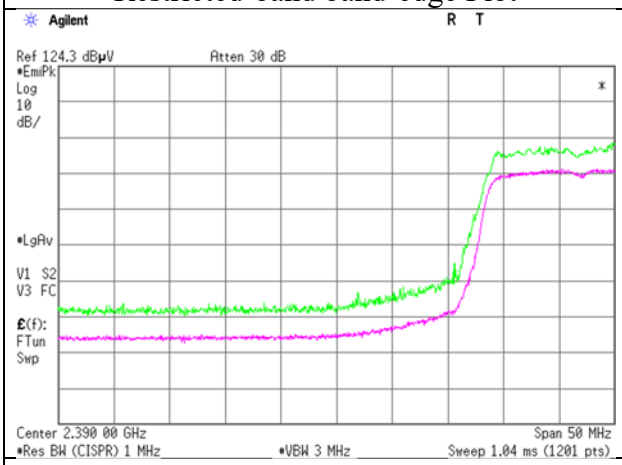
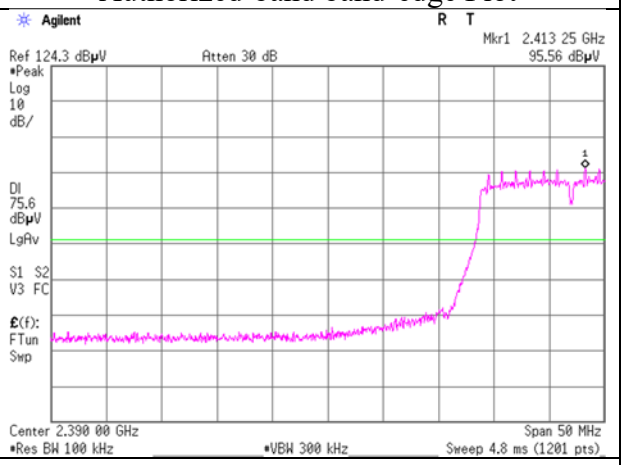
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2412.000	PK	96.1	27.6	5.0	34.4	94.3	-	-	Carrier
Hori	2400.000	PK	56.1	27.8	5.0	34.4	54.5	74.3	19.8	
Hori	9648.000	PK	37.7	38.4	8.6	33.9	50.8	74.3	23.5	
Vert	2412.000	PK	95.6	27.6	5.0	34.4	93.8	-	-	Carrier
Vert	2400.000	PK	55.2	27.8	5.0	34.4	53.6	73.8	20.2	
Vert	9648.000	PK	39.4	38.4	8.6	33.9	52.5	73.8	21.3	

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

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	12069761H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	July 18, 2018
Temperature / Humidity	23 deg. C / 49 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)
Mode	Tx 11g 2412 MHz

Horizontal	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

Vertical	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

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

Radiated Spurious Emission

Report No.	12069761H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.2	No.2	No.2
Date	July 18, 2018	July 18, 2018	July 18, 2018
Temperature / Humidity	23 deg. C / 49 % RH	23 deg. C / 49 % RH	23 deg. C / 61 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)	Takumi Shimada (10 GHz - 26.5 GHz)	Junki Nagatomi (Below 1 GHz)
Mode	Tx 11g 2437 MHz		

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	69.121	QP	55.6	6.6	7.8	38.9	-	31.1	40.0	8.9	
Hori	85.509	QP	44.9	7.2	8.0	38.9	-	21.2	40.0	18.8	
Hori	148.122	QP	44.6	14.8	8.7	39.0	-	29.1	43.5	14.4	
Hori	250.001	QP	49.3	11.8	9.6	38.9	-	31.8	46.0	14.2	
Hori	349.890	QP	40.3	15.0	10.3	38.7	-	26.9	46.0	19.1	
Hori	749.982	QP	48.5	20.2	12.5	38.2	-	43.0	46.0	3.0	
Hori	767.992	QP	42.1	20.4	12.6	38.2	-	36.9	46.0	9.1	
Hori	1499.998	PK	57.2	26.0	4.5	35.0	-	52.7	73.9	21.2	
Hori	2281.733	PK	53.5	27.6	5.0	34.5	-	51.6	73.9	22.3	
Hori	2690.000	PK	54.3	28.3	5.2	34.4	-	53.4	73.9	20.5	
Hori	4874.000	PK	47.3	31.5	7.3	33.7	-	52.4	73.9	21.5	
Hori	7311.000	PK	43.8	35.9	8.7	33.6	-	54.8	73.9	19.1	Floor noise
Hori	1499.998	AV	54.9	26.0	4.5	35.0	-	50.4	53.9	3.5	
Hori	2281.733	AV	45.2	27.6	5.0	34.5	-	43.3	53.9	10.6	
Hori	2690.000	AV	46.3	28.3	5.2	34.4	-	45.4	53.9	8.5	
Hori	4874.000	AV	39.1	31.5	7.3	33.7	-	44.2	53.9	9.7	
Hori	7311.000	AV	34.9	35.9	8.7	33.6	-	45.9	53.9	8.0	Floor noise
Vert	69.120	QP	59.4	6.6	7.8	38.9	-	34.9	40.0	5.1	
Vert	85.499	QP	57.8	7.2	8.0	38.9	-	34.1	40.0	5.9	
Vert	149.000	QP	48.8	14.9	8.7	39.0	-	33.4	43.5	10.1	
Vert	250.001	QP	49.2	11.8	9.6	38.9	-	31.7	46.0	14.3	
Vert	294.310	QP	43.8	13.4	9.9	38.8	-	28.3	46.0	17.7	
Vert	749.982	QP	46.0	20.2	12.5	38.2	-	40.5	46.0	5.5	
Vert	767.992	QP	41.7	20.4	12.6	38.2	-	36.5	46.0	9.5	
Vert	1499.998	PK	54.7	26.0	4.5	35.0	-	50.2	73.9	23.7	
Vert	2281.733	PK	53.6	27.6	5.0	34.5	-	51.7	73.9	22.2	
Vert	2690.000	PK	55.5	28.3	5.2	34.4	-	54.6	73.9	19.3	
Vert	4874.000	PK	47.7	31.5	7.3	33.7	-	52.8	73.9	21.1	
Vert	7311.000	PK	43.3	35.9	8.7	33.6	-	54.3	73.9	19.6	Floor noise
Vert	1499.998	AV	52.2	26.0	4.5	35.0	-	47.7	53.9	6.2	
Vert	2281.733	AV	45.4	27.6	5.0	34.5	-	43.5	53.9	10.4	
Vert	2690.000	AV	45.5	28.3	5.2	34.4	-	44.6	53.9	9.3	
Vert	4874.000	AV	39.5	31.5	7.3	33.7	-	44.6	53.9	9.3	
Vert	7311.000	AV	34.6	35.9	8.7	33.6	-	45.6	53.9	8.3	Floor noise

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

Distance factor: 1 GHz - 10 GHz 20log (3.75 m / 3.0 m) = 1.94 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

20dBc Data Sheet

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2437.000	PK	95.1	27.4	5.1	34.4	93.2	-	-	Carrier
Hori	9748.000	PK	37.3	38.6	8.6	34.0	50.5	73.2	22.7	
Vert	2437.000	PK	96.0	27.4	5.1	34.4	94.1	-	-	Carrier
Vert	9748.000	PK	40.0	38.6	8.6	34.0	53.2	74.1	20.9	

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

Radiated Spurious Emission

Report No.	12069761H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	July 18, 2018	July 18, 2018
Temperature / Humidity	23 deg. C / 49 % RH	23 deg. C / 49 % RH
Engineer	Takumi Shimada	Takumi Shimada
	(1 GHz - 10 GHz)	(10 GHz - 26.5 GHz)
Mode	Tx 11g 2462 MHz	

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	1499.998	PK	57.7	26.0	4.5	35.0	-	53.2	73.9	20.7	
Hori	2299.920	PK	50.6	27.6	5.0	34.4	-	48.8	73.9	25.1	
Hori	2483.500	PK	65.9	27.5	5.1	34.4	-	64.1	73.9	9.8	
Hori	2690.000	PK	54.7	28.3	5.2	34.4	-	53.8	73.9	20.1	
Hori	4924.000	PK	43.4	31.6	6.6	33.7	-	47.9	73.9	26.0	
Hori	7386.000	PK	42.3	36.1	7.8	33.6	-	52.6	73.9	21.3	Floor noise
Hori	1499.998	AV	54.6	26.0	4.5	35.0	-	50.1	53.9	3.8	
Hori	2299.920	AV	41.1	27.6	5.0	34.4	-	39.3	53.9	14.6	
Hori	2483.500	AV	45.2	27.5	5.1	34.4	-	43.4	53.9	10.5	
Hori	2690.000	AV	41.5	28.3	5.2	34.4	-	40.6	53.9	13.3	
Hori	4924.000	AV	31.1	31.6	6.6	33.7	-	35.6	53.9	18.3	
Hori	7386.000	AV	29.6	36.1	7.8	33.6	-	39.9	53.9	14.0	Floor noise
Vert	1499.998	PK	54.8	26.0	4.5	35.0	-	50.3	73.9	23.6	
Vert	2299.920	PK	49.8	27.6	5.0	34.4	-	48.0	73.9	25.9	
Vert	2483.500	PK	66.7	27.5	5.1	34.4	-	64.9	73.9	9.0	
Vert	2690.000	PK	52.1	28.3	5.2	34.4	-	51.2	73.9	22.7	
Vert	4924.000	PK	44.4	31.6	6.6	33.7	-	48.9	73.9	25.0	
Vert	7386.000	PK	42.6	36.1	8.7	33.6	-	53.8	73.9	20.1	Floor noise
Vert	1499.998	AV	52.5	26.0	4.5	35.0	-	48.0	53.9	5.9	
Vert	2299.920	AV	40.5	27.6	5.0	34.4	-	38.7	53.9	15.2	
Vert	2483.500	AV	48.5	27.5	5.1	34.4	-	46.7	53.9	7.2	
Vert	2690.000	AV	42.5	28.3	5.2	34.4	-	41.6	53.9	12.3	
Vert	4924.000	AV	33.6	31.6	6.6	33.7	-	38.1	53.9	15.8	
Vert	7386.000	AV	32.1	36.1	7.8	33.6	-	42.4	53.9	11.5	Floor noise

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

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

Distance factor: 1 GHz - 10 GHz 20log (3.75 m / 3.0 m) = 1.94 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

20dBc Data Sheet

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2462.000	PK	92.5	27.3	5.1	34.4	90.5	-	-	Carrier
Hori	9848.000	PK	37.4	38.6	8.6	34.0	50.6	70.5	19.9	
Vert	2462.000	PK	93.1	27.3	5.1	34.4	91.1	-	-	Carrier
Vert	9848.000	PK	39.0	38.6	8.6	34.0	52.2	71.1	18.9	

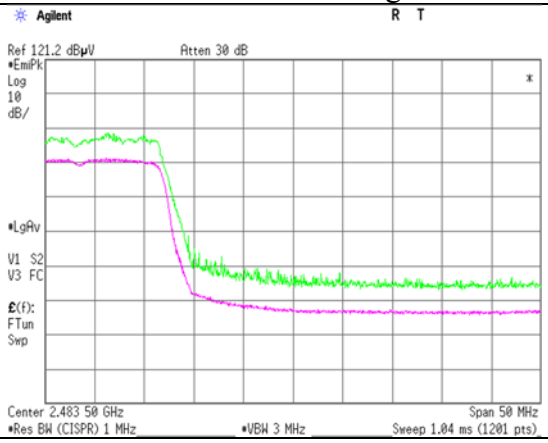
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amprifier)

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	12069761H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	July 18, 2018
Temperature / Humidity	23 deg. C / 49 % RH
Engineer	Takumi Shimada (1 GHz - 10 GHz)
Mode	Tx 11g 2462 MHz

Horizontal

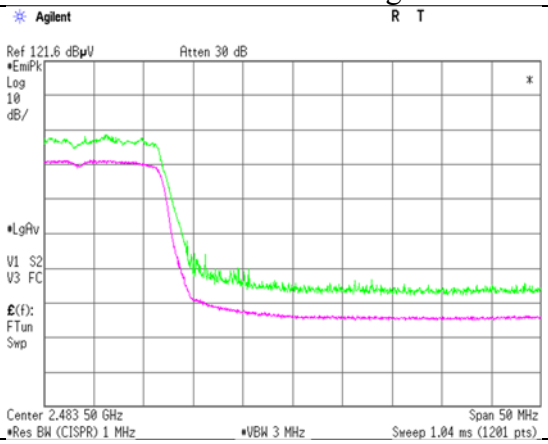
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

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

Radiated Spurious Emission

Report No.	12069761H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	July 18, 2018
Temperature / Humidity	23 deg. C / 49 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)
Mode	Tx 11n-20 2412 MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2390.000	PK	57.8	27.7	5.0	34.4	-	56.1	73.9	17.8	
Hori	2390.000	AV	45.3	27.7	5.0	34.4	-	43.6	53.9	10.3	
Vert	2390.000	PK	58.0	27.7	5.0	34.4	-	56.3	73.9	17.6	
Vert	2390.000	AV	47.2	27.7	5.0	34.4	-	45.5	53.9	8.4	

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 20log (3.75 m / 3.0 m) = 1.94 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

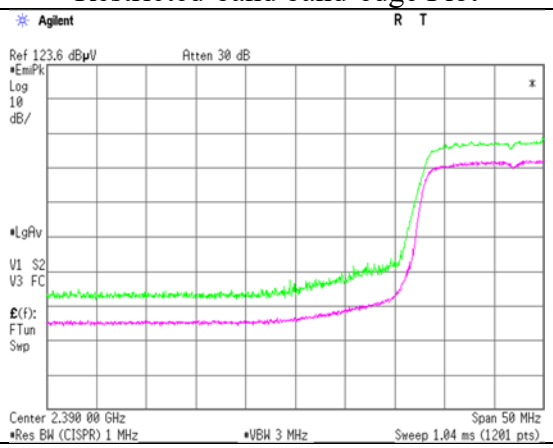
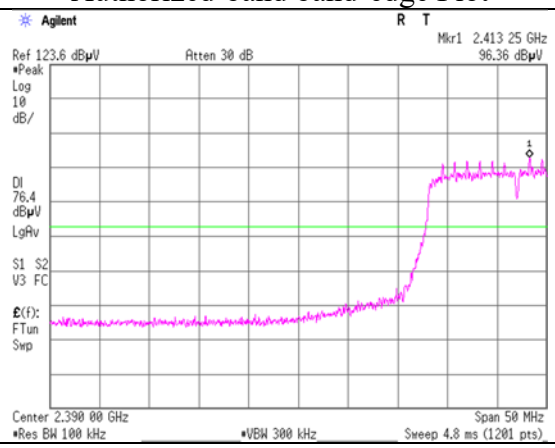
20dBc Data Sheet

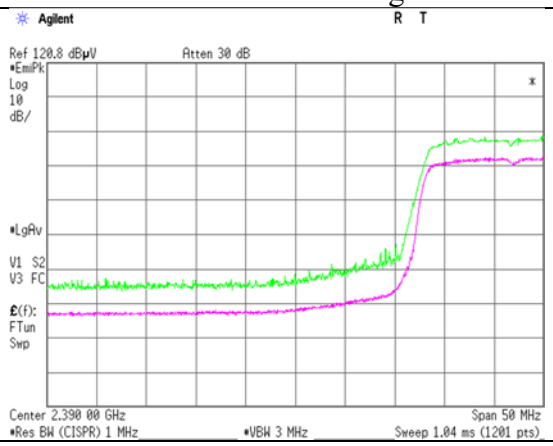
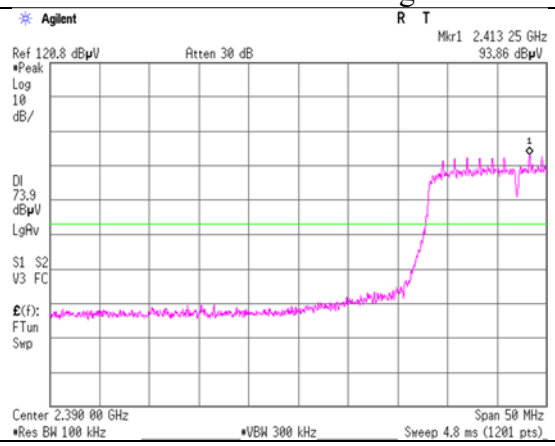
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2412.000	PK	96.4	27.6	5.0	34.4	94.6	-	-	Carrier
Hori	2400.000	PK	56.0	27.8	5.0	34.4	54.4	74.6	20.2	
Vert	2412.000	PK	93.9	27.6	5.0	34.4	92.1	-	-	Carrier
Vert	2400.000	PK	55.3	27.8	5.0	34.4	53.7	72.1	18.4	

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

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	12069761H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	July 18, 2018
Temperature / Humidity	23 deg. C / 49 % RH
Engineer	Takumi Shimada (1 GHz - 10 GHz)
Mode	Tx 11n-20 2412 MHz

Horizontal	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

Vertical	
Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

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

Radiated Spurious Emission

Report No.	12069761H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	July 18, 2018
Temperature / Humidity	23 deg. C / 49 % RH
Engineer	Takumi Shimada (1 GHz - 10 GHz)
Mode	Tx 11n-20 2462 MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2483.500	PK	66.3	27.5	5.1	34.4	-	64.5	73.9	9.4	
Hori	2483.500	AV	45.1	27.5	5.1	34.4	-	43.3	53.9	10.6	
Vert	2483.500	PK	66.3	27.5	5.1	34.4	-	64.5	73.9	9.4	
Vert	2483.500	AV	48.3	27.5	5.1	34.4	-	46.5	53.9	7.4	

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).

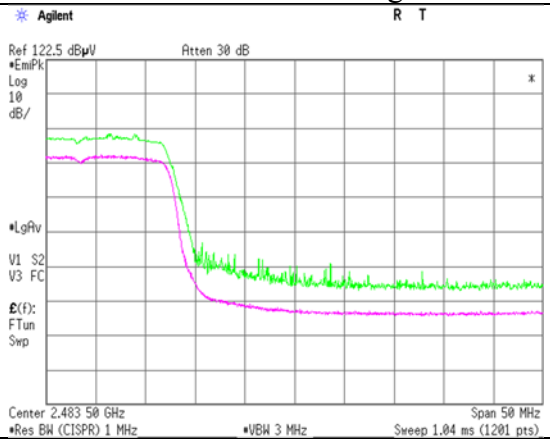
Distance factor: 1 GHz - 10 GHz 20log (3.75 m / 3.0 m) = 1.94 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	12069761H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	July 18, 2018
Temperature / Humidity	23 deg. C / 49 % RH
Engineer	Takumi Shimada (1 GHz - 10 GHz)
Mode	Tx 11n-20 2462 MHz

Horizontal

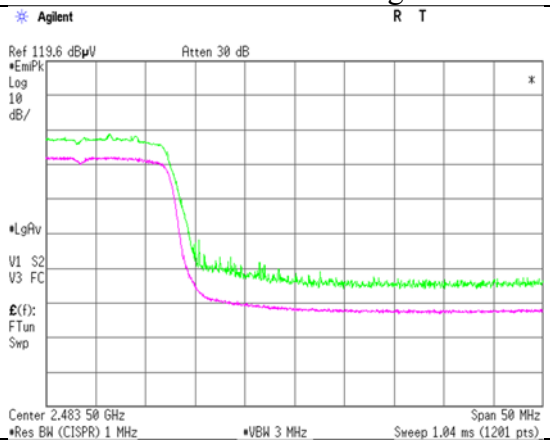
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot

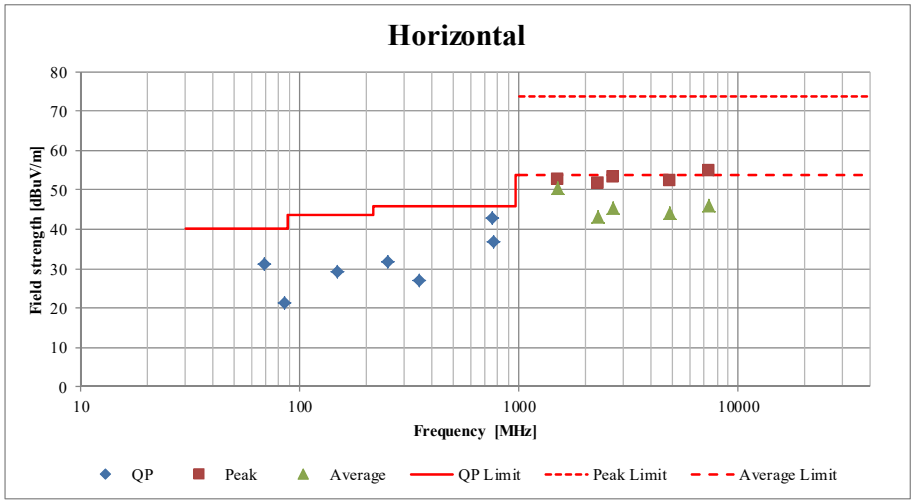


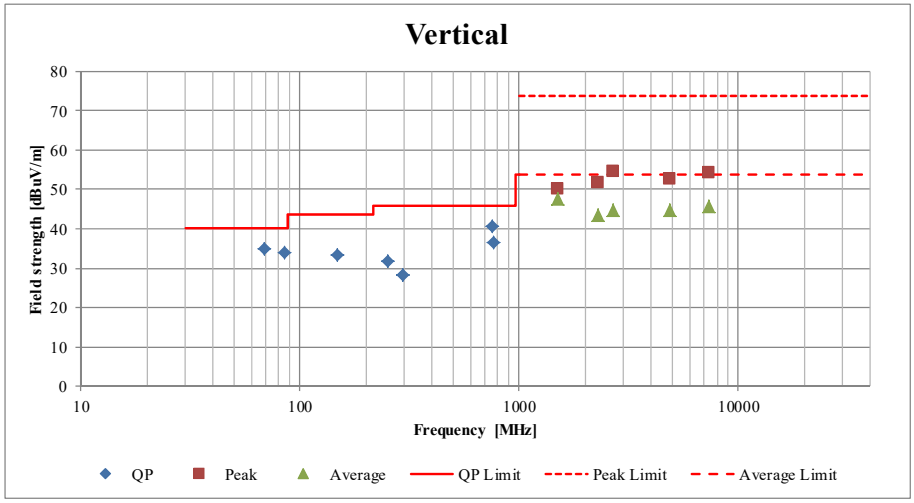
Trace Green : Peak Plot
Trace Purple : Average Plot

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

Radiated Spurious Emission
(Plot data, Worst case)

Report No.	12069761H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.2	No.2	No.2
Date	July 18, 2018	July 18, 2018	July 18, 2018
Temperature / Humidity	23 deg. C / 49 % RH	23 deg. C / 49 % RH	23 deg. C / 61 % RH
Engineer	Junki Nagatomi (1 GHz - 10 GHz)	Takumi Shimada (10 GHz - 26.5 GHz)	Junki Nagatomi (Below 1 GHz)
Mode	Tx 11g 2437 MHz		



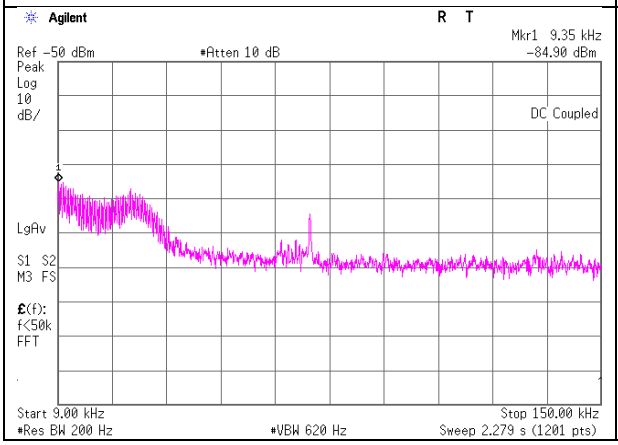


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

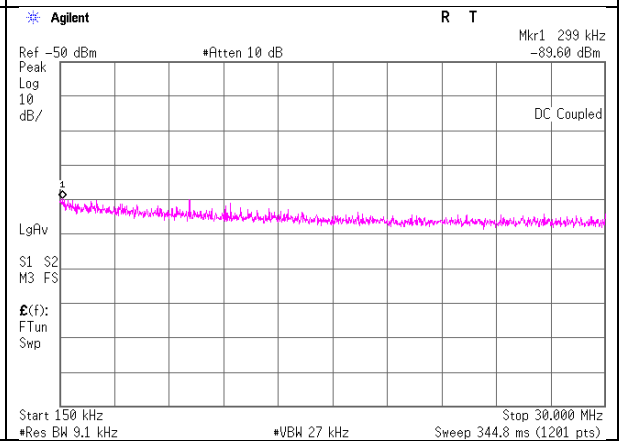
Conducted Spurious Emission

Report No.	12069761H
Test place	Ise EMC Lab. No.6 Shielded Room
Date	July 12, 2018
Temperature / Humidity	25.5 deg. C / 57 % RH
Engineer	Tomoki Matsui
Mode	Tx 11g 2437 MHz

9 kHz - 150 kHz



150 kHz - 30 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
9.35	-84.9	0.10	9.9	4.08	1	-70.8	300	6.0	-9.6	48.1	57.7	
299.00	-89.6	0.10	9.9	4.08	1	-75.5	300	6.0	-14.3	18.0	32.3	

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

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

N: Number of output

Power Density

Report No.	12069761H
Test place	Ise EMC Lab. No.6 Shielded Room
Date	July 12, 2018
Temperature / Humidity	25.5 deg. C / 57 % RH
Engineer	Tomoki Matsui
Mode	Tx

11b

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2412.00	-8.69	1.43	10.04	2.78	8.00	5.22
2437.00	-8.24	1.43	10.04	3.23	8.00	4.77
2462.00	-8.49	1.44	10.04	2.99	8.00	5.01

11g

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2412.00	-27.61	1.43	10.04	-16.14	8.00	24.14
2437.00	-27.89	1.43	10.04	-16.42	8.00	24.42
2462.00	-27.16	1.44	10.04	-15.68	8.00	23.68

11n-20

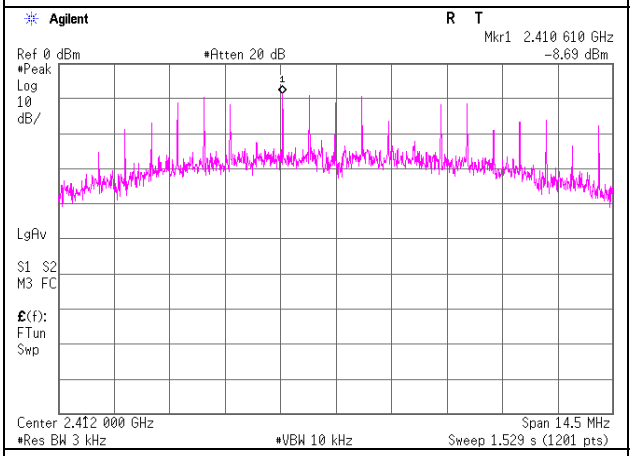
Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2412.00	-28.49	1.43	10.04	-17.02	8.00	25.02
2437.00	-26.49	1.43	10.04	-15.02	8.00	23.02
2462.00	-26.76	1.44	10.04	-15.28	8.00	23.28

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

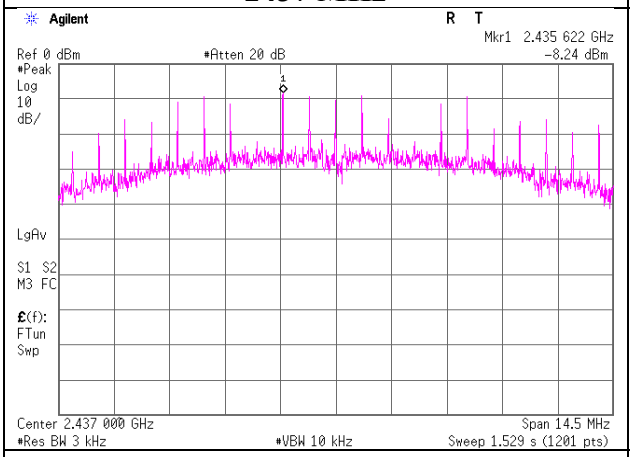
Power Density

11b

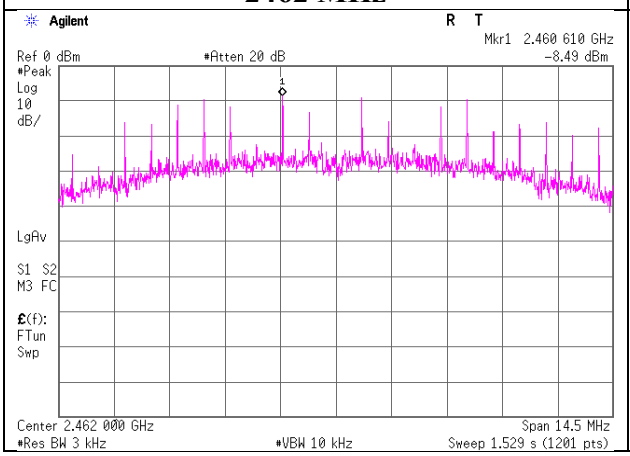
2412 MHz



2437 MHz

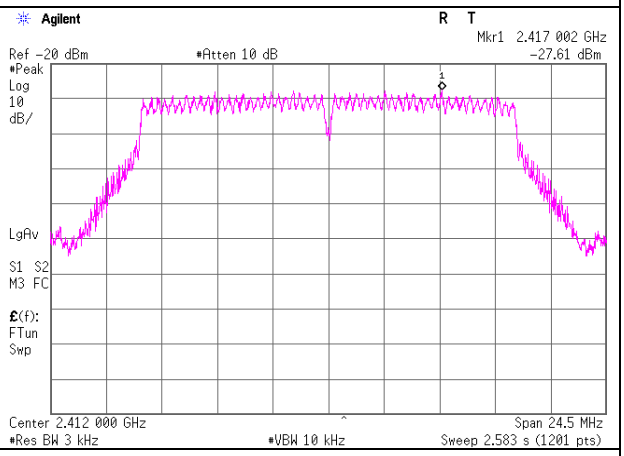


2462 MHz

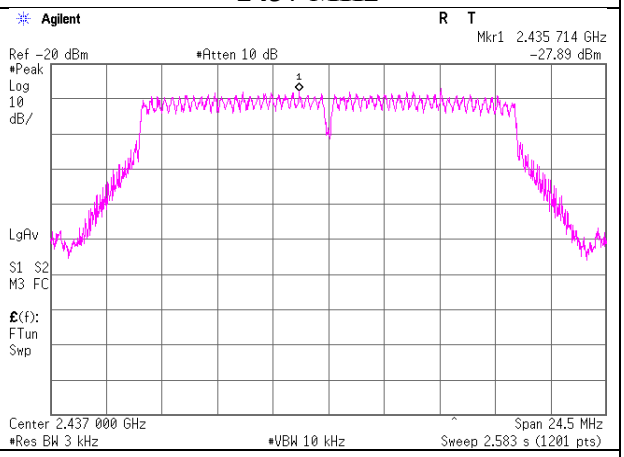


11g

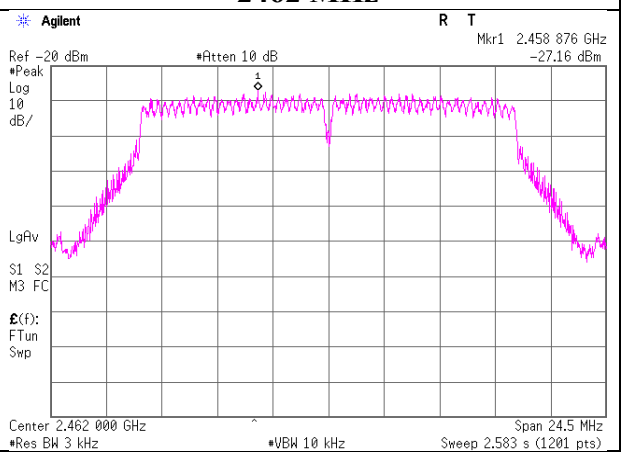
2412 MHz



2437 MHz



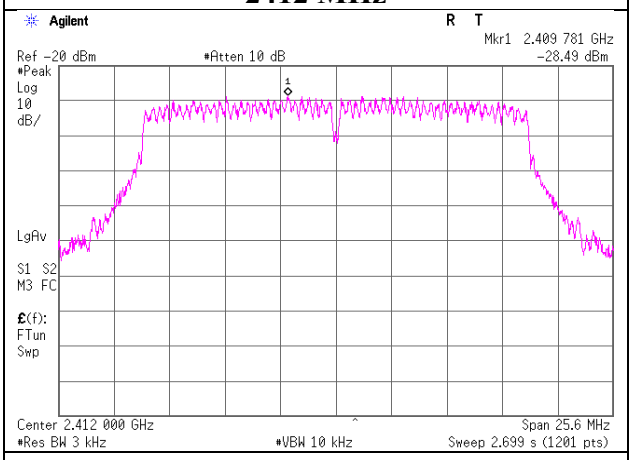
2462 MHz



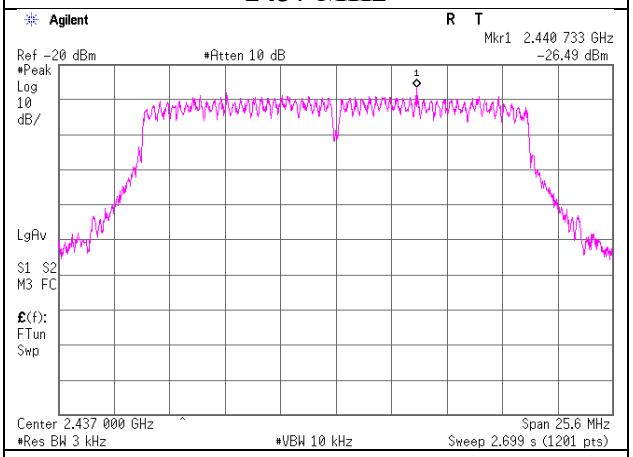
Power Density

11n-20

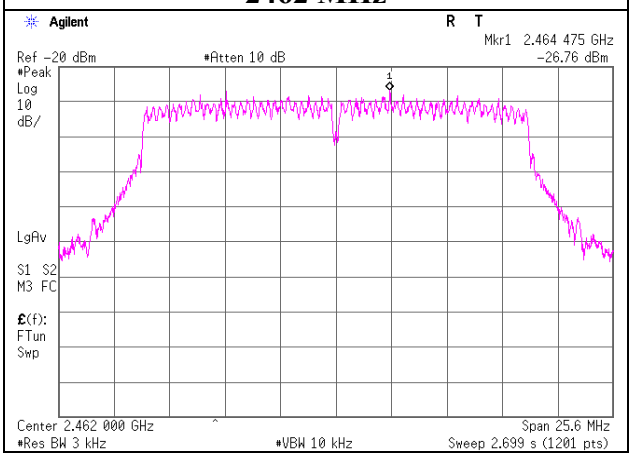
2412 MHz



2437 MHz



2462 MHz



APPENDIX 2: Test instruments

Test Instruments

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Cal Int
AT	141809	Power Meter	ANRITSU	ML2495A	825002	5/21/2018	5/31/2019	12
AT	141830	Power sensor	ANRITSU	MA2411B	738285	5/21/2018	5/31/2019	12
AT	160318	REGULATED DC POWER SUPPLY	TEXIO	PW16-2ATP	GJR810407	-	-	-
AT	141156	Attenuator(10dB)	Weinschel Corp	2	BL1173	11/14/2017	11/30/2018	12
AT	141547	DIGITAL HiTESTER	HIOKI	3805	60500120	2/7/2018	2/28/2019	12
AT	90289	Thermo-Hygrometer	CUSTOM	CTH-201	5	1/24/2018	1/31/2019	12
AT	141903	Spectrum Analyzer	AGILENT	E4440A	MY46186390	9/20/2017	9/30/2018	12
AT	141269	Attenuator(10dB) 1-18GHz	Orient Microwave	BX10-0476-00	-	3/12/2018	3/31/2019	12
AT	141328	Microwave Cable 1G-40GHz	Suhner	SUCOFLEX102	28636/2	4/24/2018	4/30/2019	12
RE	141232	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	001	9/22/2017	9/30/2018	12
RE	141152	EMI measurement program	TSJ	TEPTO-DV	-	-	-	-
RE	141542	Digital Tester	Fluke Corporation	FLUKE 26-3	78030611	8/7/2017	8/31/2018	12
RE	141579	Pre Amplifier	AGILENT	8449B	3008A02142	1/23/2018	1/31/2019	12
RE	141392	Microwave Cable	Junkosha	MWX221	1604S253(1 m) / 1608S087(5 m)	8/4/2017	8/31/2018	12
RE	141512	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	254	6/6/2018	6/30/2019	12
RE	141884	Spectrum Analyzer	AGILENT	E4448A	MY44020357	11/7/2017	11/30/2018	12
RE	142182	Measure	KOMELON	KMC-36	-	-	-	-
RE	142004	AC2_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	-	8/31/2018	12
RE	141556	Thermo-Hygrometer	CUSTOM	CTH-201	0003	12/21/2017	12/31/2018	12
RE	148898	Attenuator	KEYSIGHT	8491A	MY52462282	10/12/2017	10/31/2018	12
RE	141503	Horn Antenna 18-26.5GHz	EMCO	Sep-60	1265	6/6/2018	6/30/2019	12
RE	141267	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-192	6/1/2018	6/30/2019	12
RE	141425	Biconical Antenna	Schwarzbeck	BBA9106	1302	6/1/2018	6/30/2019	12
RE	141397	Coaxial Cable	UL Japan	-	-	6/13/2018	6/30/2019	12
RE	142227	Measure	KOMELON	KMC-36	-	-	-	-
RE	141562	Thermo-Hygrometer	CUSTOM	CTH-180	1501	1/24/2018	1/31/2019	12
RE	142011	AC4_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	6/28/2018	6/30/2020	24
RE	141152	EMI measurement program	TSJ	TEPTO-DV	-	-	-	-
RE	141951	EMI Test Receiver	Rohde & Schwarz	ESR26	101408	1/30/2018	1/31/2019	12

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

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

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