

TEST REPORT

Report number: Z071C-13092

Issue Date: March 27, 2013

The device, as described herewith, was tested pursuant to applicable test procedure indicated below and complies with the requirements of;

FCC Part15 Subpart C

The test results are traceable to the international or national standards.

Applicant	: KYOCERA Corporation
Equipment under test (EUT)	: Mobile Phone
FCC ID	: JOYKCMH01
Model Number	: KCMH01

Test procedure	: ANSI C63.4-2003
Date of test	: March 15, 18, 20, 21, 2013
Test place	: ZACTA Technology Corporation Yonezawa Testing Center 4149-7 Hachimanpara 5-chome Yonezawa-shi Yamagata 991-1128 Japan Phone: +81-238-28-2880 Fax: +81-238-28-2888
Test results	: Complied

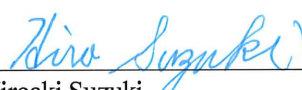
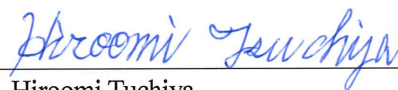
Zacta Technology Corporation certifies that no party to the application is subject to a denial of federal benefits that include FCC benefits, pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 853(a).

The results in this report are applicable only to the samples tested.

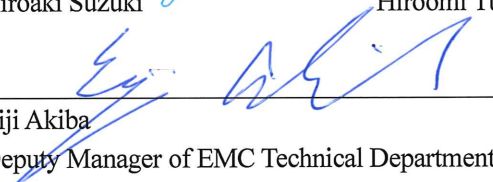
This report shall not be re-produced except in full without the written approval of ZACTA Technology Corporation.

This test report must not be used by client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

Tested by:


Hiroaki Suzuki
Hiroomi Tuchiya

Authorized by:


Eiji Akiba

Deputy Manager of EMC Technical Department



NVLAP LAB CODE 200306-0

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1. Summary of Test

1.1 Purpose of test

It is the original test in order to verify conformance to standards listed in section 1.2.

1.2 Standards

CFR47 FCC Part 15 Subpart C

1.3 Summary of test results

Table-A presents the list of the measurement items for Spread Spectrum, Frequency hopping devices under FCC Part 15 Subpart C.

Table-A: List of the measurements

Test Items Section	Test Items	Condition	Result
	Transmit mode [Tx]:		
15.247(a)(1)	20dB Bandwidth	Conducted	Pass
15.247(a)(1)	Carrier Frequency Separation	Conducted	Pass
15.247(a)(1)(iii)	Number of Hopping Frequencies	Conducted	Pass
15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Conducted	Pass
15.247(b)(1) 15.31(e)	Maximum Peak Output Power - Conducted -	Conducted	Pass
15.247(d)	Band Edge Compliance of RF Conducted Emissions	Conducted	Pass
15.247(d) 15.205 15.209	Spurious Emissions	Conducted Radiated	Pass
15.247(d) 15.205 15.209	Restricted Bands of Operation	Radiated	Pass
15.207	AC Power Line Conducted Emissions 150kHz – 30MHz	Conducted	Pass

1.4 Deviation from the standard

None

1.5 Modification to the EUT by laboratory

None

2. Equipment description

2.1 General Description of equipment

EUT is the Mobile Phone.

2.2 EUT information

Applicant	: KYOCERA Corporation Yokohama Office 2-1-1 Kagahara, Tsuzuki-ku Yokohama-shi, Kanagawa, Japan Phone: +81-45-943-6253 Fax: +81-45-943-6314
Equipment under test (EUT)	: Mobile Phone
Trade name	: Kyocera
Model number	: KCMH01
Serial number	: 31 (Antenna port Conducted Test) 25 (Radiated Emission, Conducted Emission Test)
EUT condition	: Production
Max. frequency	: 96MHz
Power ratings	: DC 3.7V
Size	: (W) 89 x (D) 48 x (H) 17 mm
Environment	: Indoor and Outdoor use
Thermal limitation	: -20°C to 60°C
Operating mode	: Tx mode / Rx mode
Variation of model(s)	: N/A
[RF Specification]	
Protocol	: Bluetooth 2.1+EDR
Spread method	: Frequency hopping spread spectrum (FHSS)
Communication method	: TDD
Frequency Range	: 2402MHz - 2480MHz
Number of FR Channels	: 79 Channels
Modulation Method/Data rate	: GFSK (1Mbps), $\pi/4$ -DQPSK (2Mbps), 8-DPSK (3Mbps)
Nominal Bit Rates	: 1600hops/s
Channel Separation	: 1MHz
Output power	: 0.807mW
Antenna (Rx and Tx)	: Internal Antenna
Antenna gain	: 0dBi
RF type	: Transceiver
Intended use	: Data transmission

2.3 Operating channels and frequencies

Channel	Frequency [MHz]	Channel	Frequency [MHz]	Channel	Frequency [MHz]
0	2402	27	2429	54	2456
1	2403	28	2430	55	2457
2	2404	29	2431	56	2458
3	2405	30	2432	57	2459
4	2406	31	2433	58	2460
5	2407	32	2434	59	2461
6	2408	33	2435	60	2462
7	2409	34	2436	61	2463
8	2410	35	2437	62	2464
9	2411	36	2438	63	2465
10	2412	37	2439	64	2466
11	2413	38	2440	65	2467
12	2414	39	2441	66	2468
13	2415	40	2442	67	2469
14	2416	41	2443	68	2470
15	2417	42	2444	69	2471
16	2418	43	2445	70	2472
17	2419	44	2446	71	2473
18	2420	45	2447	72	2474
19	2421	46	2448	73	2475
20	2422	47	2449	74	2476
21	2423	48	2450	75	2477
22	2424	49	2451	76	2478
23	2425	50	2452	77	2479
24	2426	51	2453	78	2480
25	2427	52	2454		
26	2428	53	2455		

2.4 Description of Test modes

The EUT had been tested under operating condition.
There are three channels have been tested as following;

Tested Channel	Frequency
Low	2402MHz
Middle	2441MHz
High	2480MHz

The pre-test has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates.

Following channel(s) was (were) selected for the final test as listed below;

Tested Channel	Modulation Technology	Modulation Type	Packet Type
Low, Middle, High	FHSS	GFSK	DH5
Low, Middle, High	FHSS	8-DPSK	3-DH5

The field strength of spurious emission was measured at each position of all three axis X,Y and Z to compare the level, and the maximum noise.

The worst emission was found in X axis and the worst case recorded.

2.5 Operating mode

【Tx mode】

- i) Bluetooth test program set up to the DM tool
- ii) Select a test mode
Operating frequency: No hopping (Channel Low, Channel Middle, Channel High), Hopping
Packet type: DH5, 3-DH5
- iii) Start test mode

【Rx mode】

- i) Bluetooth test program set up to the DM tool
- ii) Select a test mode
Operating frequency: Channel Low, Channel Middle, Channel High
- iii) Start test mode

3. Configuration information

3.1 EUT and Peripheral(s) used

No.	Equipment	Company	Model No.	Serial No.	FCC ID/DoC	Comment
1	Mobile Phone	KYOCERA	KCMH01	31, 25	FCC ID: JOYKCMH01	EUT
2	Note PC	FUJISTU	FMVNC4DC4	R7101676	DoC	*
3	AC adapter for PC	FUJITSU	FMV-AC320A	06837981A	-	*
4	Modem	US. Robotics	Sport_Ster33.6kbps	000839032B K6YV4J	DoC	*
5	AC adapter for Modem	US. Robotics	N/A	N/A	-	*
6	Printer	SII	DPU-414	1000169C	Doc	*
7	AC adapter for Printer	SII	PW-4007-JU1-E	0948	-	*

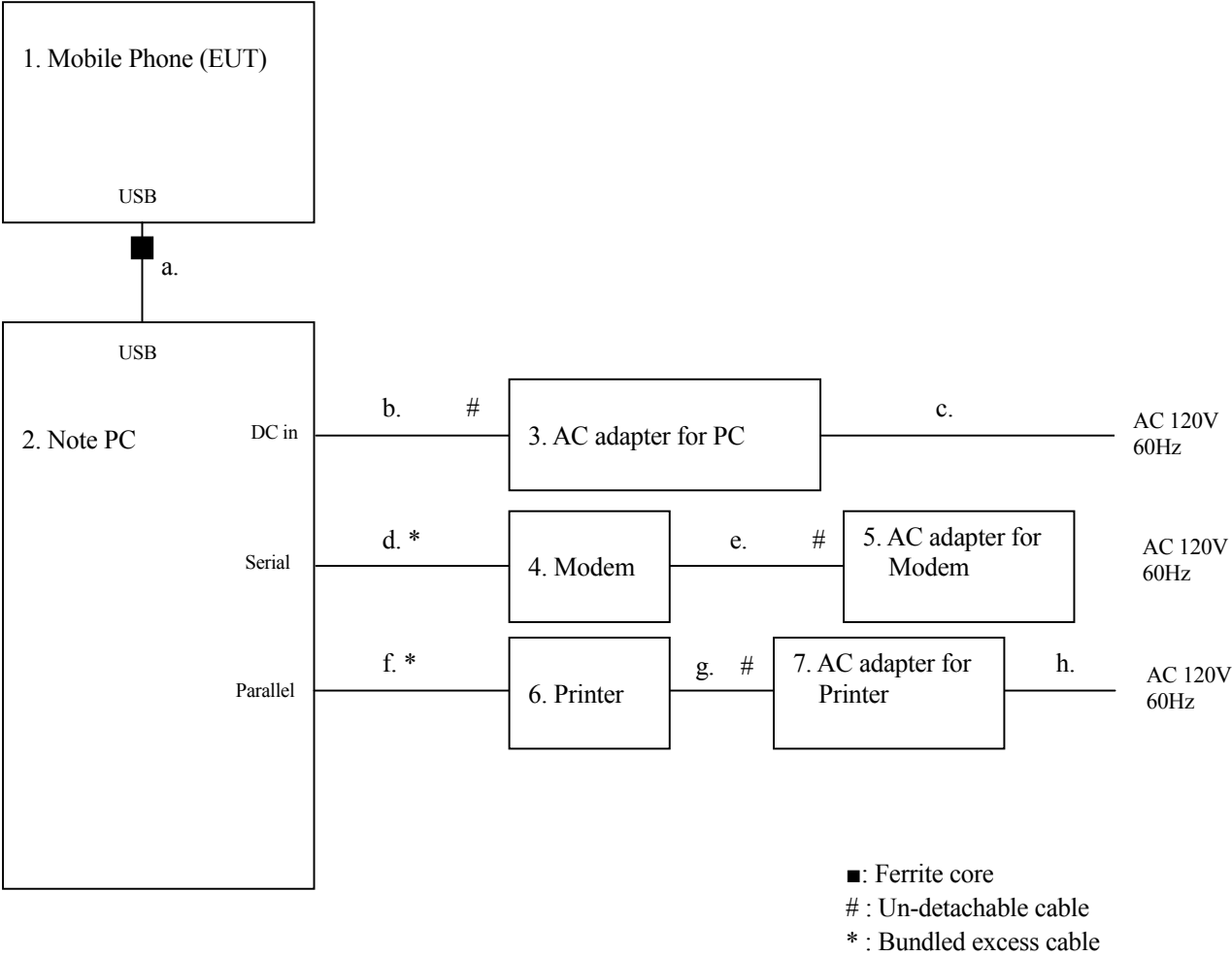
*: AC power line Conducted Emission test.

3.2 Cable(s) information

No.	Cable	Length[m]	Shield	Connector	Comment
a	USB cable	0.8	Yes	Metal	Accessory *
b	DC cable	1.8	No	Plastic	*
c	AC power cord for PC AC adapter	1.9	No	Plastic	*
d	Serial cable	2.0	Yes	Metal	*
e	DC cable for Modem AC adapter	1.7	No	Plastic	*
f	Parallel cable	2.1	Yes	Metal	*
g	DC cable	1.9	No	Plastic	*
h	AC power cord for Printer	2.0	No	Plastic	*

*: AC power line Conducted Emission test.

3.3 System configuration



Note 1: Numbers assigned to equipment or cables on this diagram are corresponded to the list in “3.1 EUT and Peripheral(s) used”, “3.2 Cable(s) information”.

Note 2: USB cable (No.a) with one ferrite core is supplied with EUT.

4. Test Type and Results

4.1 20dB Bandwidth

4.1.1 Test Procedure [FCC 15.247(a)(1)]

The bandwidth at 20 dB down from the highest inband spectral density is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

The spectrum analyzer is set to:

- RBW=30kHz, VBW=100kHz, Span=3MHz, Sweep=auto

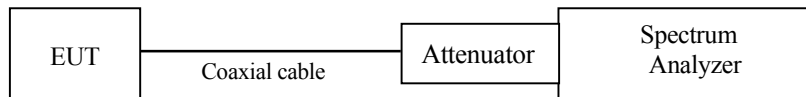
The EUT was set to operate with following conditions.

- No hopping [Channel Low: 2402MHz, Channel Middle: 2441MHz, Channel High: 2480MHz]

The test mode of EUT is as follows.

- Tx mode

4.1.2 Measurement Setup



4.1.3 Limit of Bandwidth at 20 dB below

None

4.1.4 Measurement Result

Channel	Center Frequency (MHz)	Packet type	20dB Bandwidth (MHz)
Low	2402	DH5	0.923
		3-DH5	1.273
Middle	2441	DH5	0.932
		3-DH5	1.257
High	2480	DH5	0.928
		3-DH5	1.260

4.1.5 Trace Data

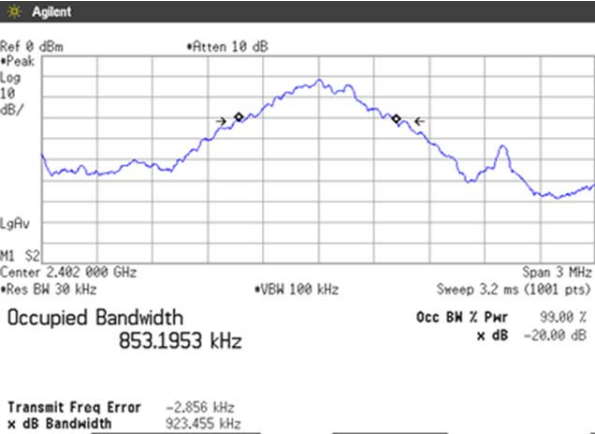
Test Personnel:

Tested by: Hiroaki Suzuki

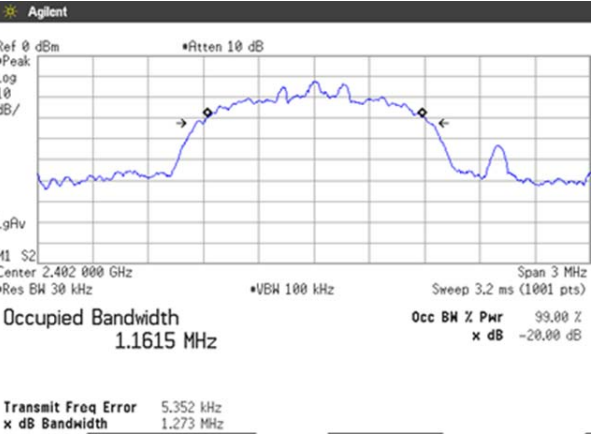
Date : Mar. 20, 2013
Temperature : 20.0 [°C]
Humidity : 45.0 [%]
Test place : Shielded room

20dB Bandwidth

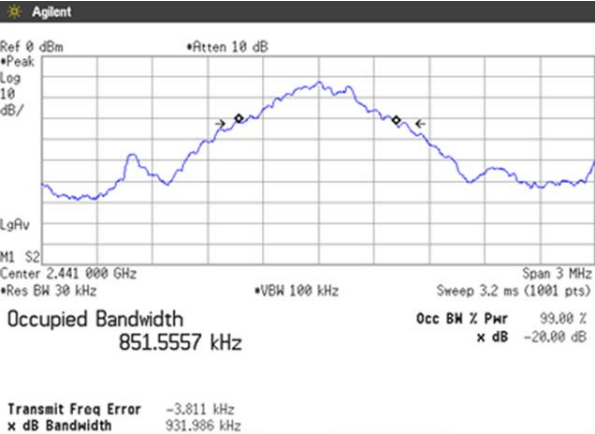
Channel Low: 2402MHz
DH5



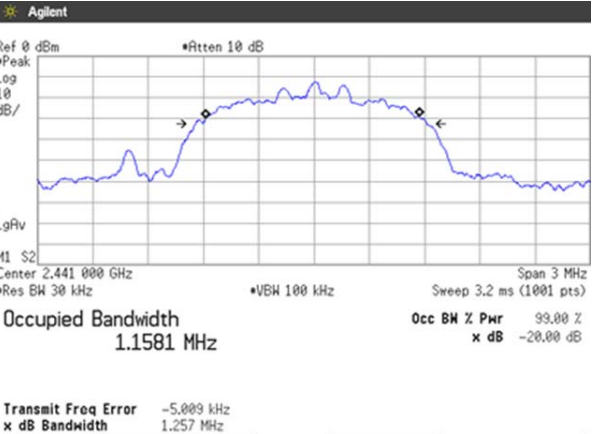
3-DH5



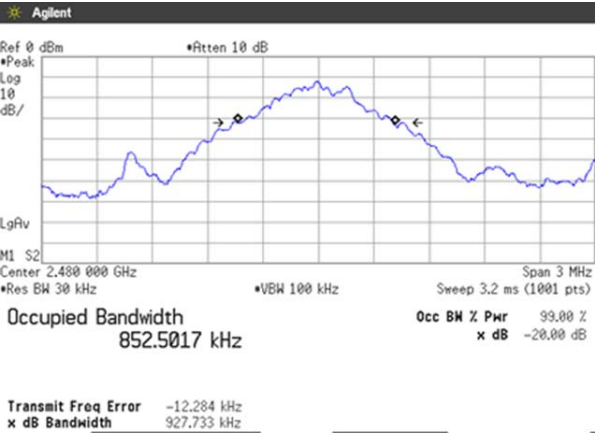
Channel Middle: 2441MHz
DH5



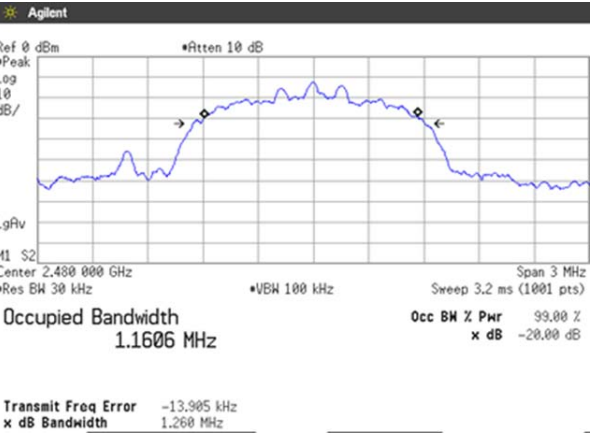
3-DH5



Channel High: 2480MHz
DH5



3-DH5



4.2 Carrier Frequency Separation

4.2.1 Test Procedure [FCC 15.247(a)(1)]

The adjacent channel interval is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

The spectrum analyzer is set to:

- RBW=30kHz, VBW=30kHz, Span=3MHz, Sweep=auto

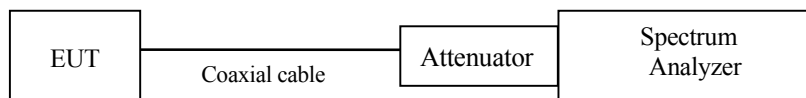
The EUT was set to operate with following conditions.

- Hopping [Channel Middle: 2441MHz]

The test mode of EUT is as follows.

- Tx mode

4.2.2 Measurement Setup



4.2.3 Limit of Carrier Frequency Separation

Systems shall have hopping channel carrier frequencies separated by a minimum of; 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater.

4.2.4 Measurement Result

Packet type	Channel separation (MHz)	Limit (MHz)	Result
DH5	1.02	>two-thirds of the 20dB Bandwidth = 621 kHz	PASS
3-DH5	1.02	>two-thirds of the 20dB Bandwidth =849kHz	PASS

4.2.5 Trace Data

Test Personnel:

Tested by:

Hiroaki Suzuki

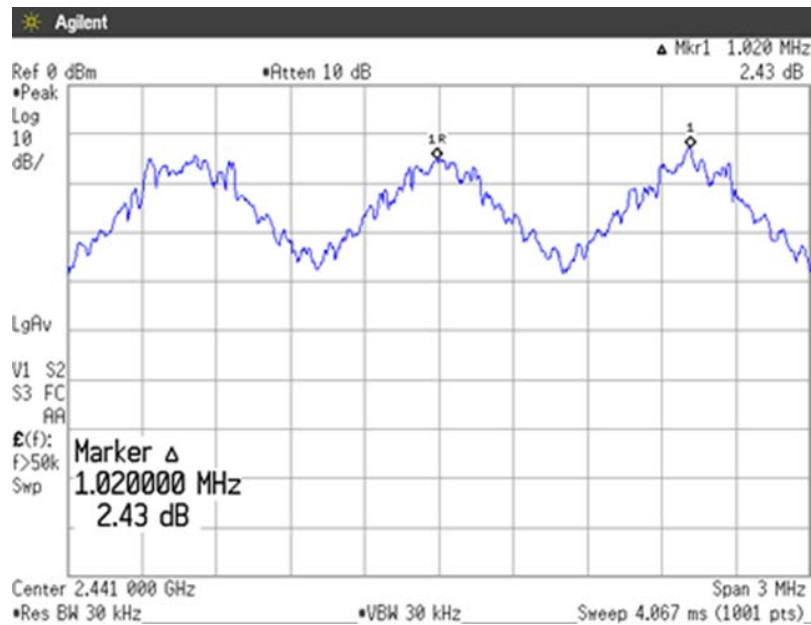
Date : Mar. 20, 2013

Temperature : 20.0 [°C]

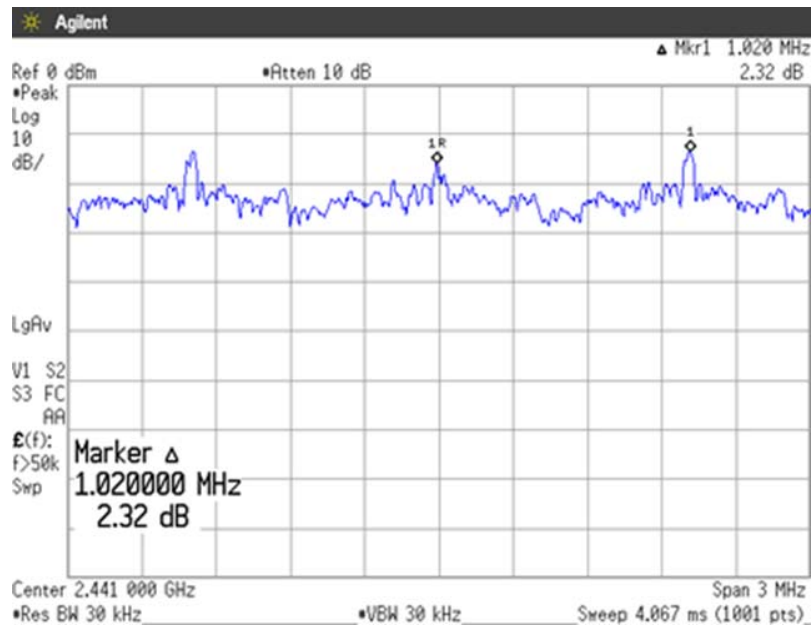
Humidity : 45.0 [%]

Test place : Shielded room

Carrier Frequency Separation
Channel Middle: 2441MHz
DH5



3-DH5



4.3 Number of Hopping Frequencies

4.3.1 Test Procedure [FCC 15.247(a)(1)(iii)]

The number of hopping channels is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

The spectrum analyzer is set to:

- RBW=510kHz, VBW=510kHz, Span=Arbitrary setting, Sweep=auto

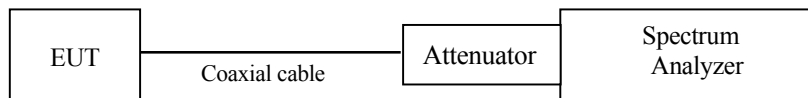
The EUT was set to operate with following conditions.

- Hopping

The test mode of EUT is as follows.

- Tx mode

4.3.2 Measurement Setup



4.3.3 Limit of Number of Hopping Frequencies

Shall have more than 15 channels.

4.3.4 Measurement Result

Number of channels	Limit	Result
79	≥15 channel	PASS

4.3.5 Trace Data

Test Personnel:

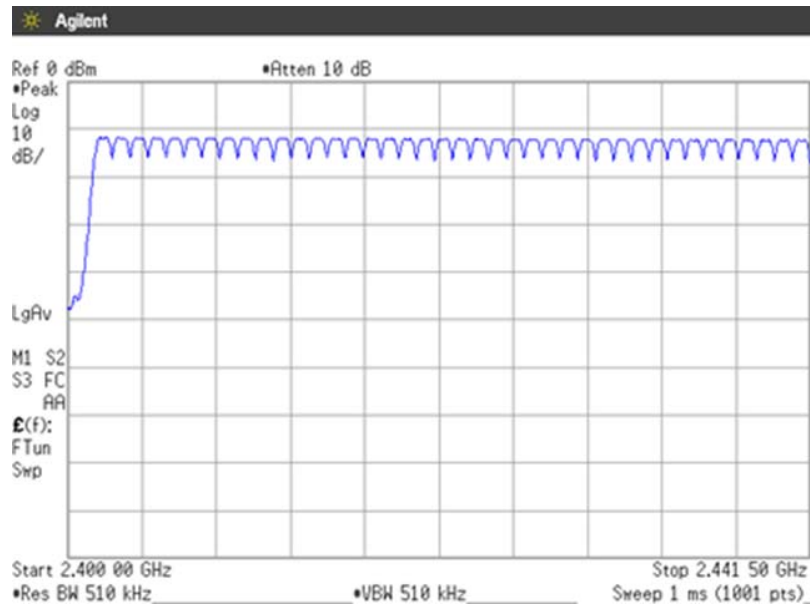
Tested by: Hiroaki Suzuki

Date : Mar. 20, 2013
Temperature : 20.0 [°C]
Humidity : 45.0 [%]
Test place : Shielded room

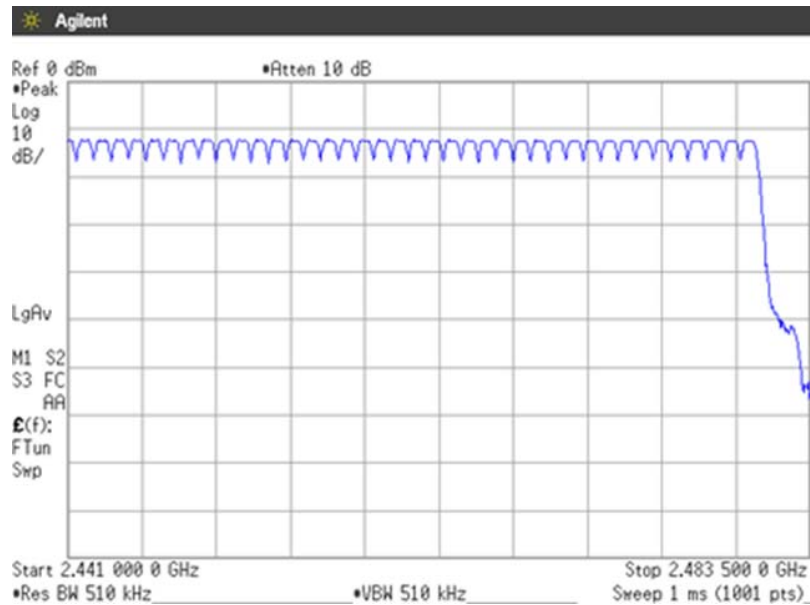
Number of Hopping Frequencies

DH5

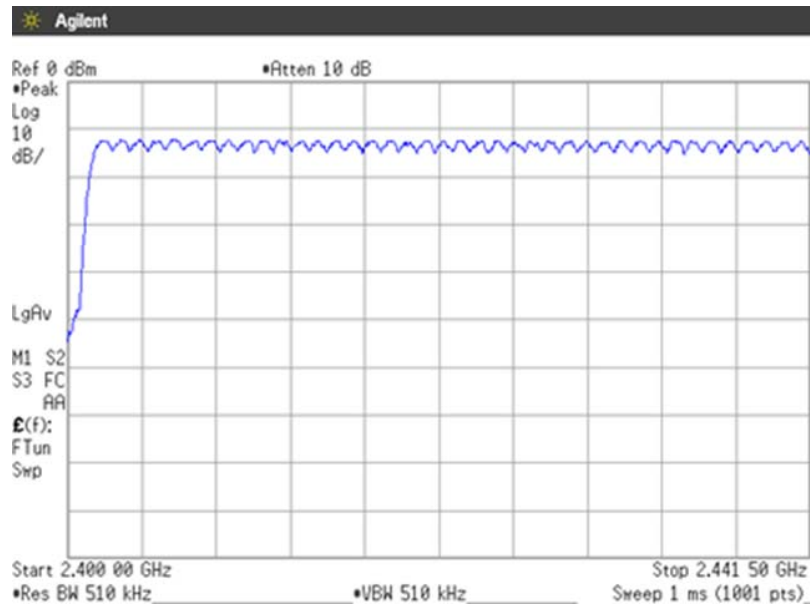
Low



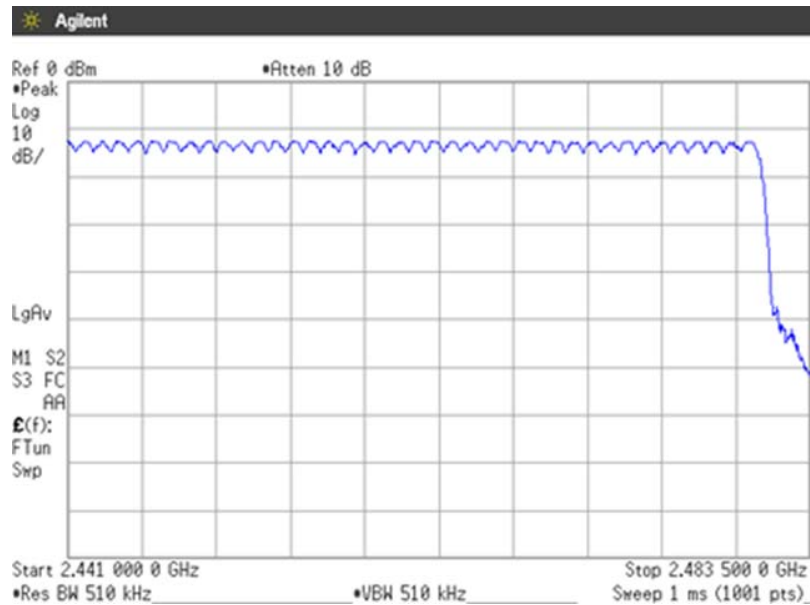
High



3-DH5
Low



High



4.4 Time of Occupancy (Dwell Time)

4.4.1 Test Procedure [FCC 15.247(a)(1)(iii)]

The time occupancy of hopping channel is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

The spectrum analyzer is set to:

- RBW=1MHz, VBW=1MHz, Span=0MHz, Sweep=10ms

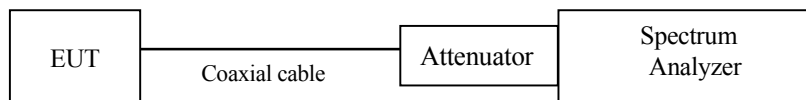
The EUT was set to operate with following conditions.

- Hopping

The test mode of EUT is as follows.

- Tx mode

4.4.2 Measurement Setup



4.4.3 Limit of Time of Occupancy (Dwell Time)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

4.4.4 Measurement Result

DH5

Channel	Frequency (MHz)	Packet type	Dwell time (ms)	Occupancy time of 31.6 seconds (s)	Limit	Result
Low	2402	DH5	2.900	0.309	<0.4s	PASS
Middle	2441	DH5	2.920	0.311	<0.4s	PASS
High	2480	DH5	2.920	0.311	<0.4s	PASS

$$DH5 = \text{Dwell time(ms)} \times 1600 / 6 / 79 \times 31.6$$

The hopping rates of Bluetooth devices change with different types of payload. The longer the payload is, the slower the hopping rate. The hopping rate scenario is defined in Bluetooth core specification.

Calculation:

Occupancy time of 31.6 seconds * = time domain slot length x hop rate / number of hopper channel / 79 x 31.6

EX.) For Channel Middle, DH5 = 2.920 ms x 1600 / 6 / 79 x 31.6 = 311 ms

3-DH5

Channel	Frequency (MHz)	Packet type	Dwell time (ms)	Occupancy time of 31.6 seconds (s)	Limit	Result
Low	2402	3-DH5	2.920	0.311	<0.4s	PASS
Middle	2441	3-DH5	2.920	0.311	<0.4s	PASS
High	2480	3-DH5	2.920	0.311	<0.4s	PASS

$$3\text{-DH5} = \text{Dwell time(ms)} \times 1600 / 6 / 79 \times 31.6$$

The hopping rates of Bluetooth devices change with different types of payload. The longer the payload is, the slower the hopping rate. The hopping rate scenario is defined in Bluetooth core specification.

Calculation:

Occupancy time of 31.6 seconds * = time domain slot length x hop rate / number of hopper channel / 79 x 31.6
EX.) For Channel Middle, 3- DH5 = 2.920 ms x 1600 / 6 / 79 x 31.6 = 311 ms

4.4.5 Trace Data

Test Personnel:

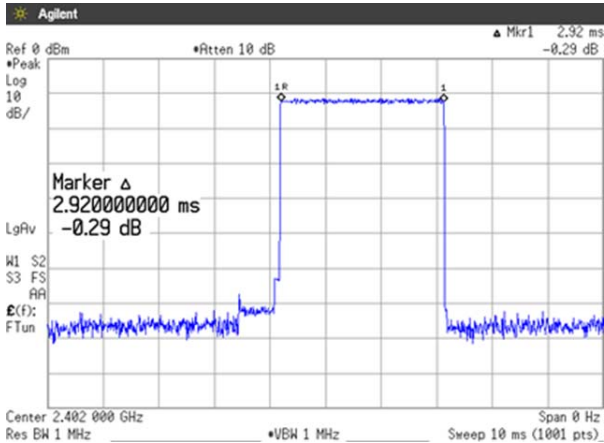
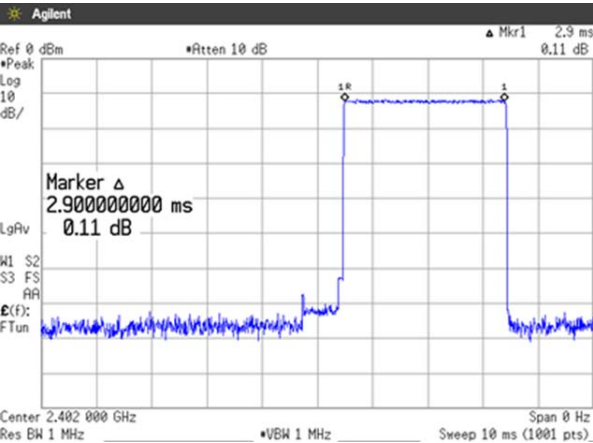
Tested by: Hiroaki Suzuki

Date : Mar. 20, 2013
Temperature : 20.0 [°C]
Humidity : 45.0 [%]
Test place : Shielded room

Dwell Time

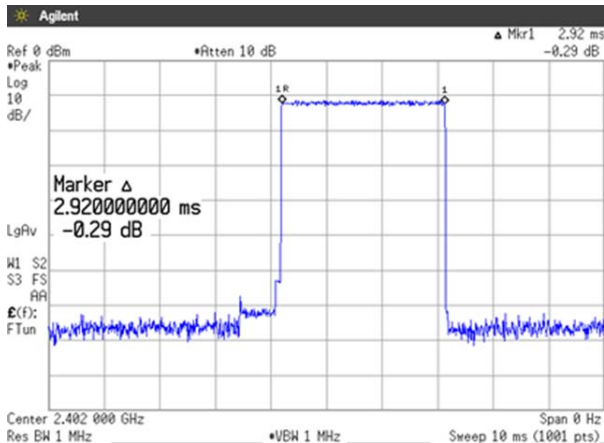
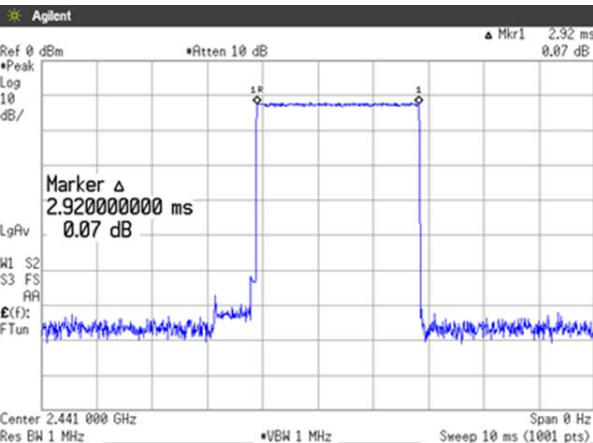
Channel Low: 2402MHz
DH5

3-DH5



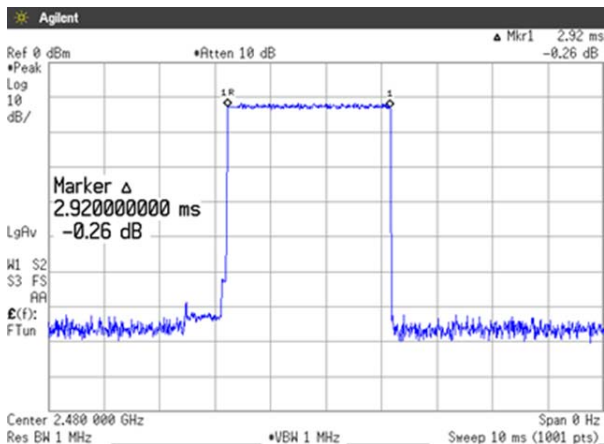
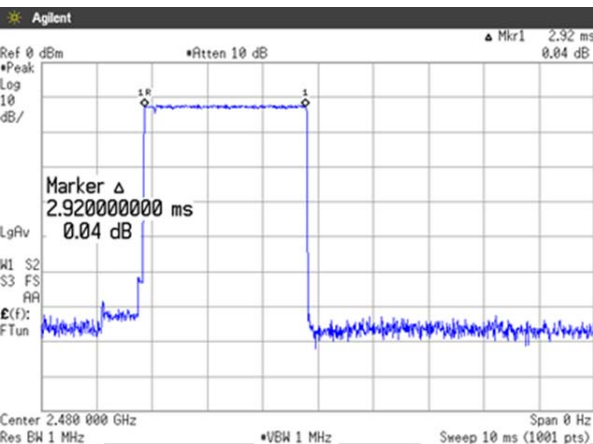
Channel Middle: 2441MHz
DH5

3-DH5



Channel High: 2480MHz
DH5

3-DH5



4.5 Maximum Peak Output Power - Conducted -

4.5.1 Test Procedure [FCC 15.247(b)(1), 15.31(e)]

The peak power is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

The spectrum analyzer is set to:

- RBW=3MHz, VBW=3MHz, Span=10MHz, Sweep=auto

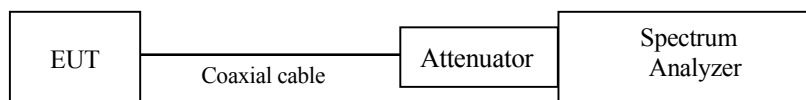
The EUT was set to operate with following conditions.

- No hopping [Channel Low: 2402MHz, Channel Middle: 2441MHz, Channel High: 2480MHz]

The test mode of EUT is as follows.

- Tx mode

4.5.2 Test Instruments and Measurement Setup



4.5.3 Limit of Maximum Peak Output Power

0.125 watt or less.

4.5.4 Measurement Result

Channel	Center Frequency (MHz)	Packet type	Reading (dBm)	Factor (dB)	Level (dBm)	Peak Output Power (mW)	Limit (mW)	Result
Low	2402	DH5	-12.21	10.37	-1.84	0.655	≤125	PASS
		3-DH5	-11.30	10.37	-0.93	0.807	≤125	PASS
Middle	2441	DH5	-12.51	10.37	-2.14	0.611	≤125	PASS
		3-DH5	-11.47	10.37	-1.10	0.776	≤125	PASS
High	2480	DH5	-12.49	10.37	-2.12	0.614	≤125	PASS
		3-DH5	-11.40	10.37	-1.03	0.789	≤125	PASS

Calculation:

Reading (dBm) + Factor (dB) = Level (dBm)

$10\log P = \text{Level (dBm)}$

$P = 10^{(\text{Maximum Peak Output Power (dBm)} / 10)} \text{ (mW)}$

4.5.5 Trace Data

Test Personnel:

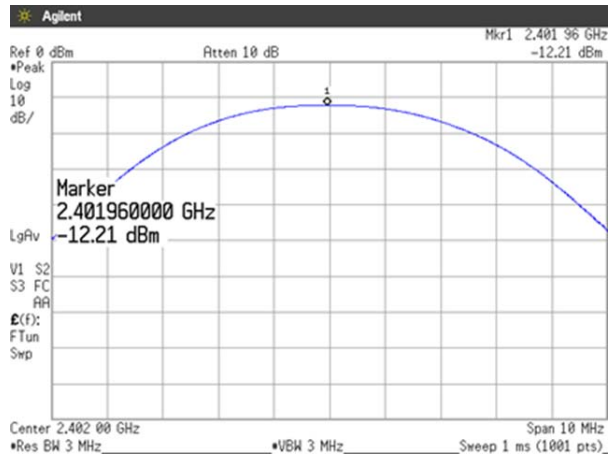
Tested by: Hiroaki Suzuki

Date : Mar. 20, 2013
Temperature : 20.0 [°C]
Humidity : 45.0 [%]
Test place : Shielded room

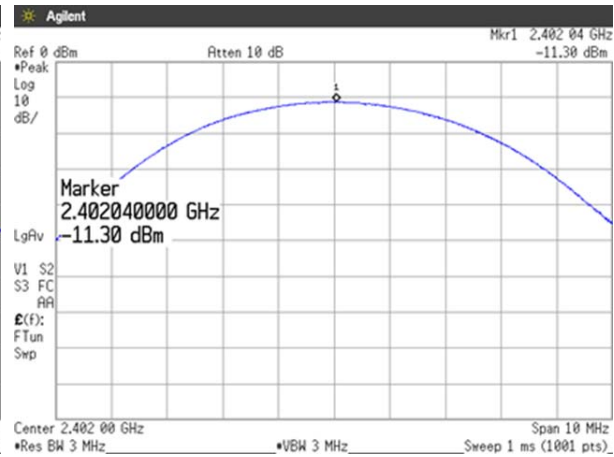
Maximum Peak Output Power - Conducted -

Channel Low: 2402MHz

DH5

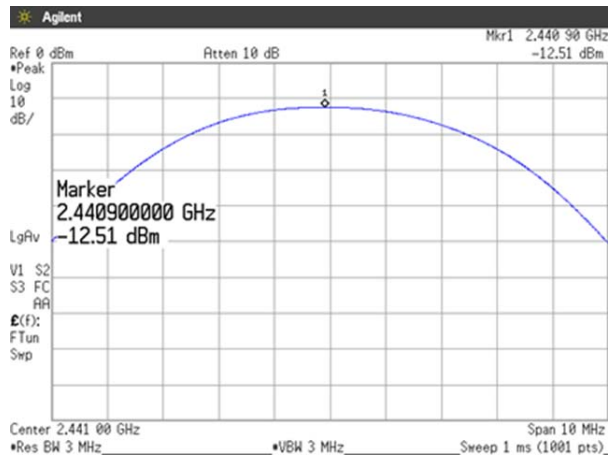


3-DH5

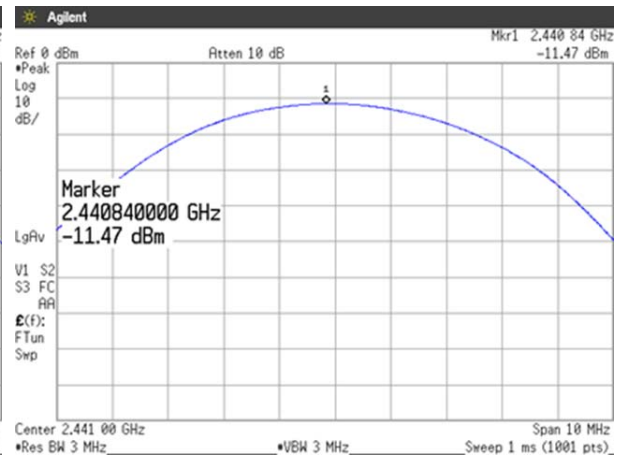


Channel Middle: 2441MHz

DH5

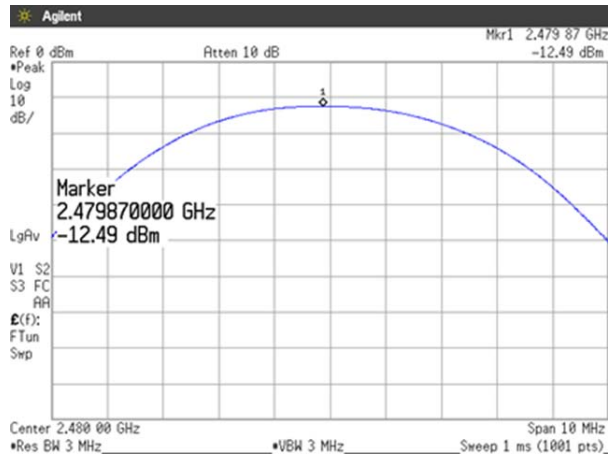


3-DH5

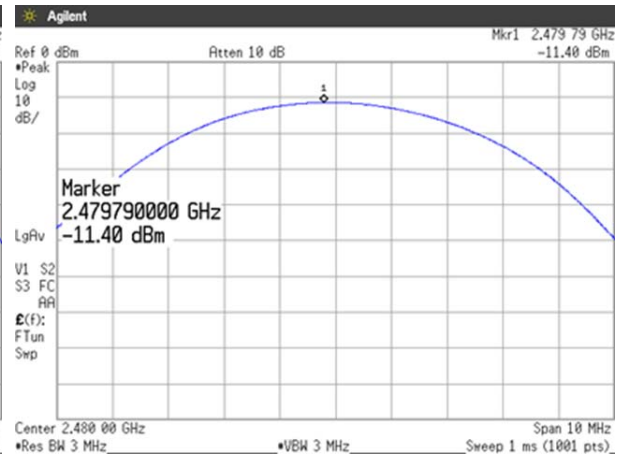


Channel High: 2480MHz

DH5



3-DH5



4.6 Band Edge Compliance of RF Conducted Emissions

4.6.1 Test Procedure [FCC 15.247 (d)]

The Band Edge is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

The spectrum analyzer is set to :

- RBW=100kHz, VBW=100kHz, Span= Arbitrary setting , Sweep=Auto

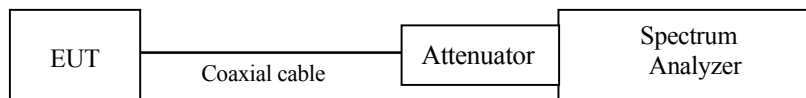
The EUT was set to operate with following conditions.

- No hopping [Channel Low: 2402MHz, Channel High: 2480MHz]

The test mode of EUT is as follows.

- Tx mode (Hopping)
- Tx mode (No hopping)

4.6.2 Test Instruments and Measurement Setup



4.6.3 Limit of Band-edge Compliance of RF Conducted Emissions

In any 100KHz bandwidth outside the frequency band the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100KHz bandwidth within the band that contains the highest level of the desired power.

4.6.4 Measurement Results of Band-edge

[Tx mode (Hopping)]

Channel	Frequency (MHz)	Packet type	RF Power Level (dBm)	Band-edge Frequency (MHz)	Band-edge Level (dBm)	Difference Level (dBm)	Limit (dBm)	Result
Low	2402	DH5	-11.86	2399.51	-50.42	38.56	At least 20dB below from peak of RF	PASS
		3-DH5	-14.20	2399.54	-60.57	46.37		PASS
High	2480	DH5	-12.30	2483.50	-69.09	56.79		PASS
		3-DH5	-12.72	2483.50	-68.03	55.31		PASS

[Tx mode (No hopping)]

Channel	Frequency (MHz)	Packet type	RF Power Level (dBm)	Band-edge Frequency (MHz)	Band-edge Level (dBm)	Difference Level (dBm)	Limit (dBm)	Result
Low	2402	DH5	-11.72	2399.49	-48.87	37.15	At least 20dB below from peak of RF	PASS
		3-DH5	-12.16	2399.71	-59.53	47.37		PASS
High	2480	DH5	-12.26	2483.65	-69.63	57.37		PASS
		3-DH5	-12.47	2483.46	-70.99	58.52		PASS

4.6.5 Trace Data

Test Personnel:

Tested by: Hiroaki Suzuki

Date : Mar. 20, 2013
Temperature : 20.0 [°C]
Humidity : 45.0 [%]
Test place : Shielded room

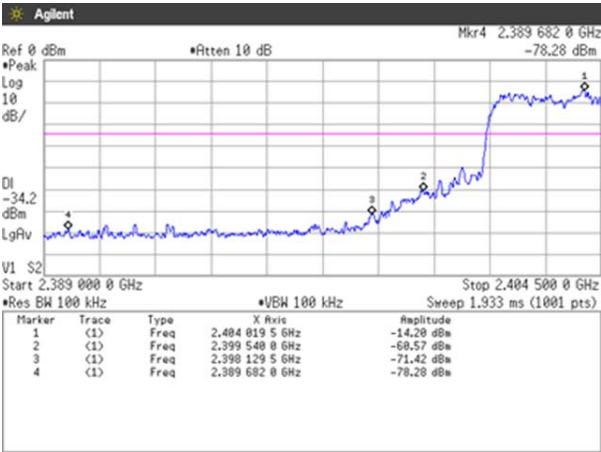
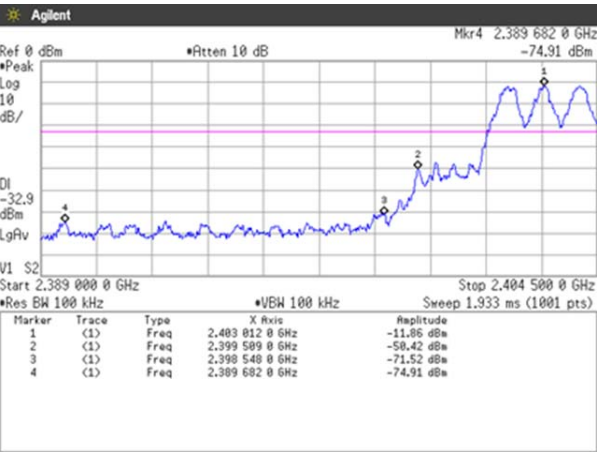
Band Edge Compliance of RF Conducted Emissions

[Tx mode (Hopping)]

Channel Low: 2402MHz

DH5

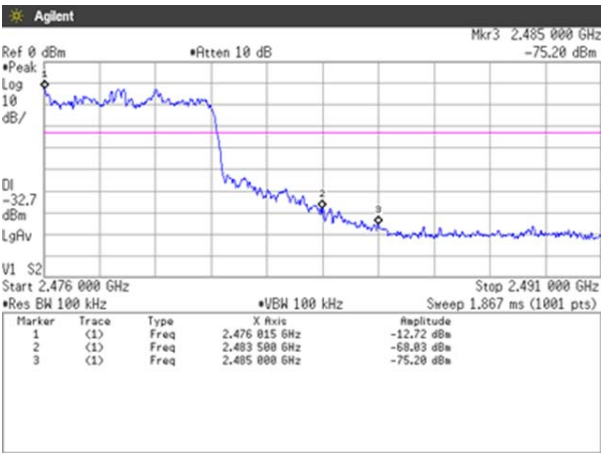
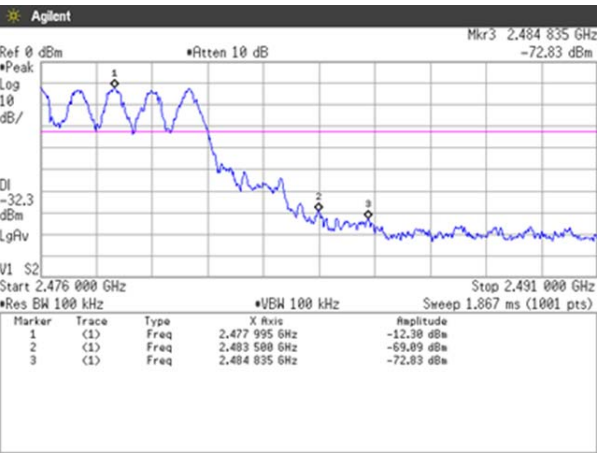
3-DH5



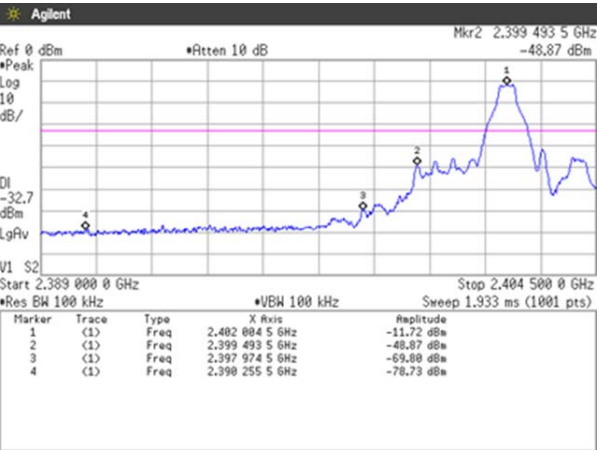
Channel High: 2480MHz

DH5

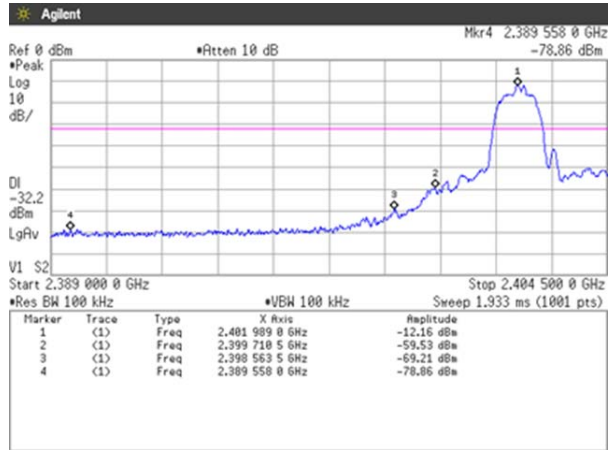
3-DH5



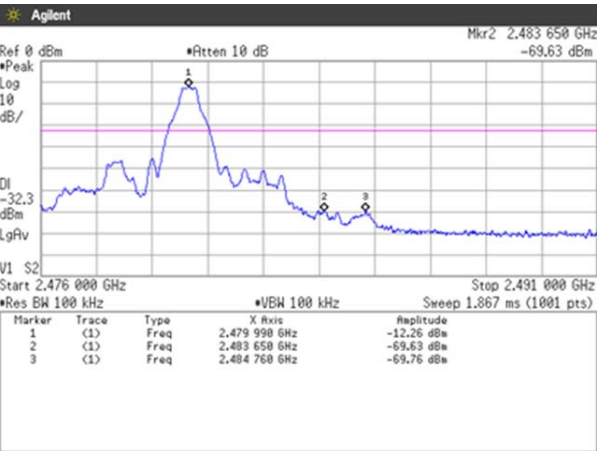
[Tx mode (No hopping)]
Channel Low: 2402MHz
DH5



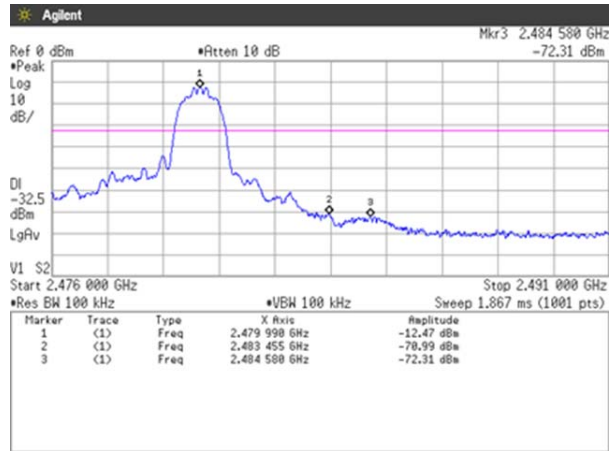
3-DH5



Channel High: 2480MHz
DH5



3-DH5



4.7 Spurious Emissions - Conducted -

4.7.1 Test Procedure [FCC 15.247(d)]

The spurious emissions (Conducted) are measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

The spectrum analyzer is set to:

- RBW=100kHz, VBW=300kHz, Span=Arbitrary setting, Sweep=Auto

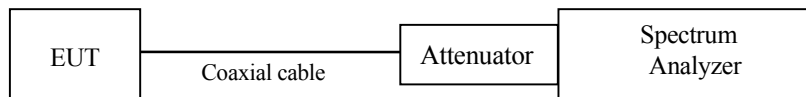
The EUT was set to operate with following conditions.

- No hopping [Channel Low: 2402MHz, Channel Middle: 2441MHz, Channel High: 2480MHz]

The test mode of EUT is as follows.

- Tx mode

4.7.2 Measurement Setup



4.7.3 Limit of Spurious Emissions - Conducted -

In any 100KHz bandwidth outside the frequency band the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100KHz bandwidth within the band that contains the highest level of the desired power.

4.7.4 Measurement Results of Spurious Emissions - Conducted -

Channel	Frequency [MHz]	Limit [dBm]	Results Chart	PASS / FAIL
Low	2402	At least 20dB below from peak of RF.	See the Trace Data	PASS
Middle	2441	At least 20dB below from peak of RF.	See the Trace Data	PASS
High	2480	At least 20dB below from peak of RF.	See the Trace Data	PASS

4.7.5 Trace Data

Test Personnel:

Tested by: Hiroaki Suzuki

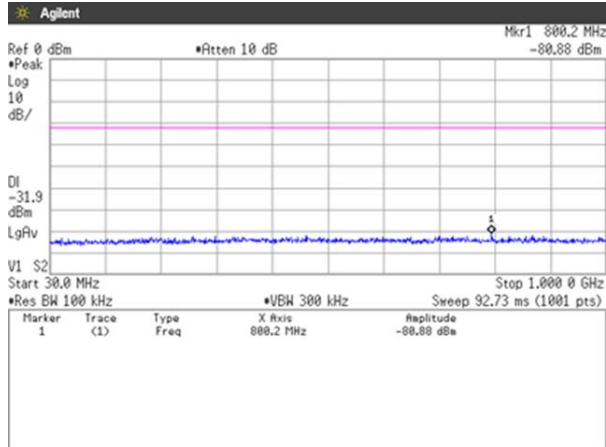
Date : Mar. 20, 2013
 Temperature : 20.0 [°C]
 Humidity : 45.0 [%]
 Test place : Shielded room

Spurious Emissions - Conducted -

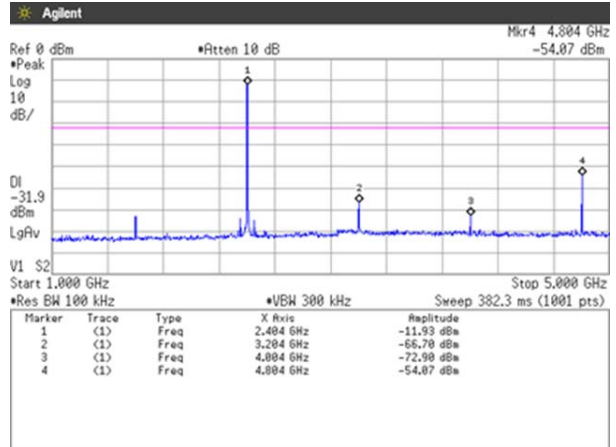
DH5

Channel Low: 2402MHz

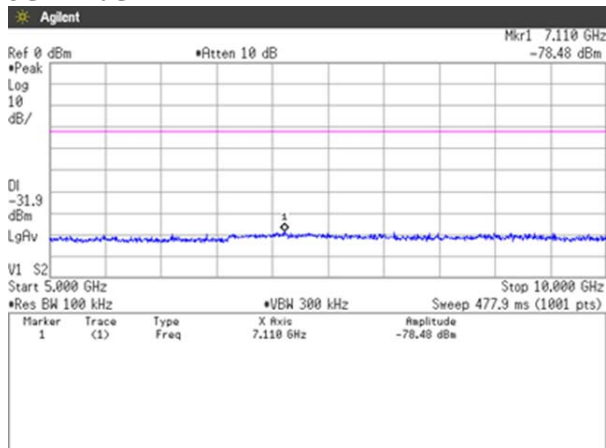
30MHz-1GHz



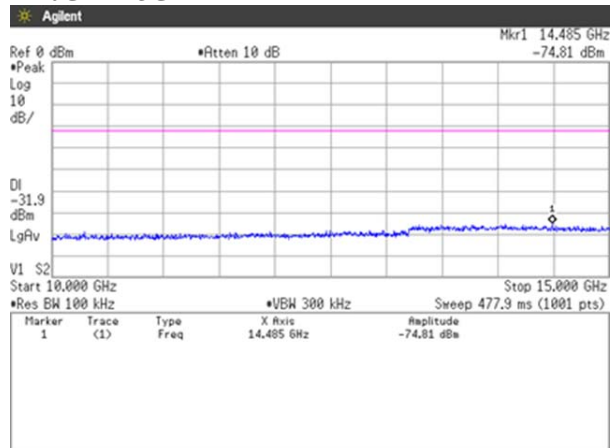
1GHz-5GHz



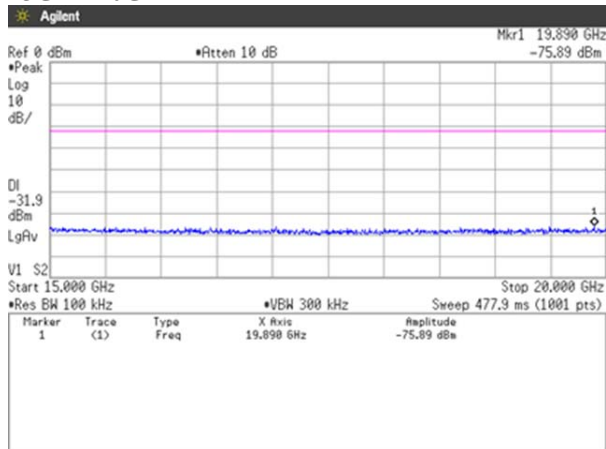
5GHz-10GHz



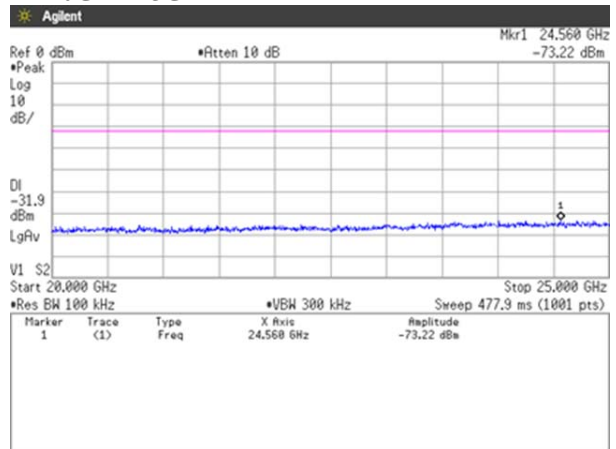
10GHz-15GHz



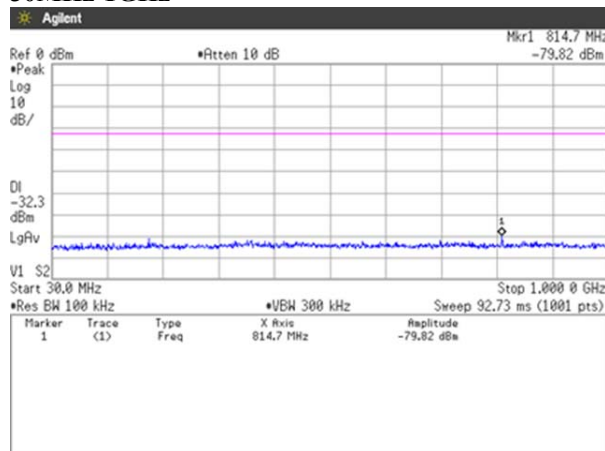
15GHz-20GHz



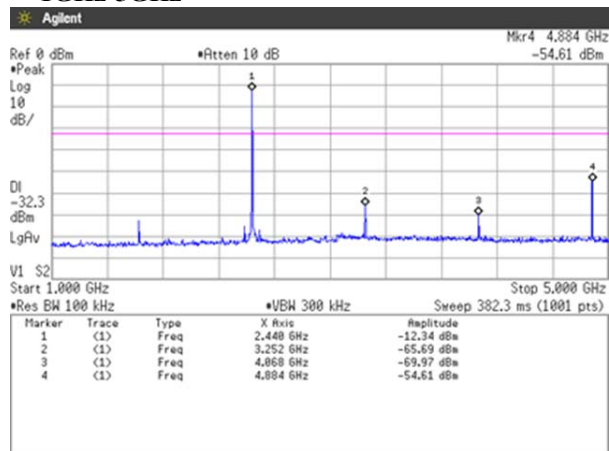
20GHz-25GHz



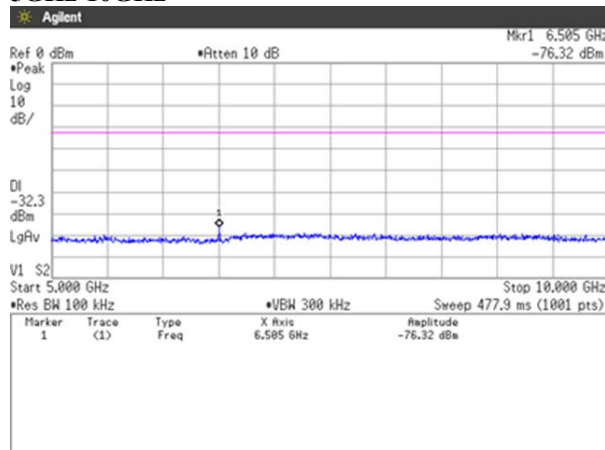
Channel Middle: 2441MHz 30MHz-1GHz



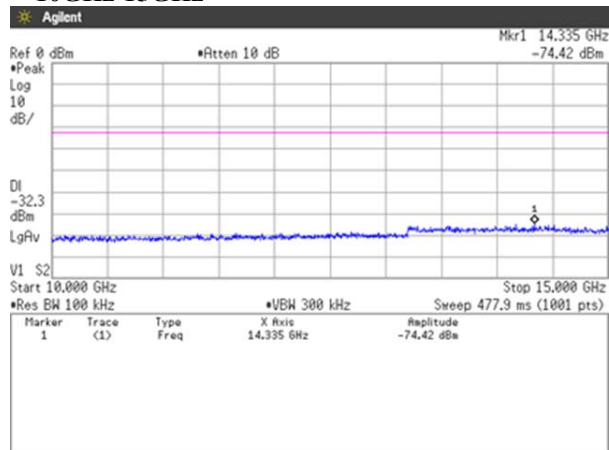
1GHz-5GHz



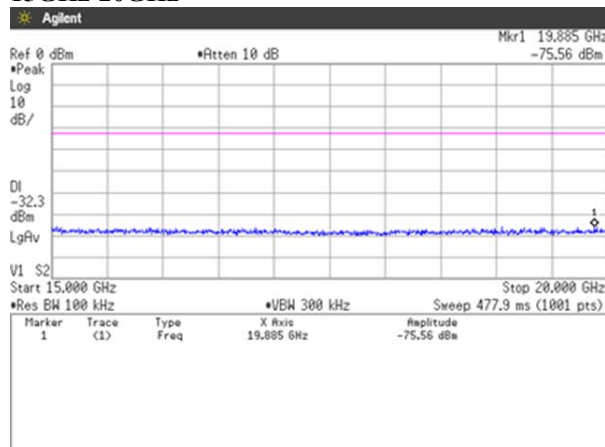
5GHz-10GHz



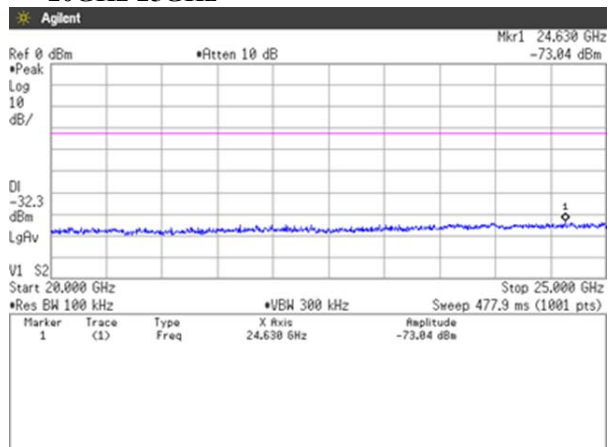
10GHz-15GHz



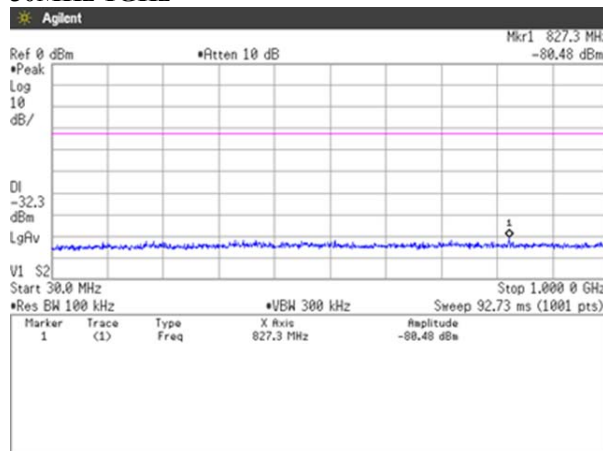
15GHz-20GHz



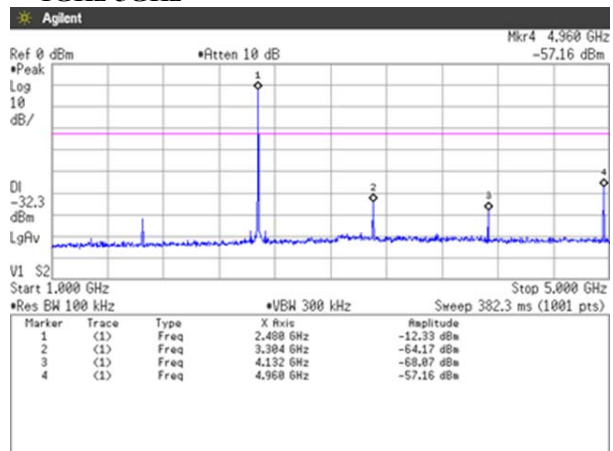
20GHz-25GHz



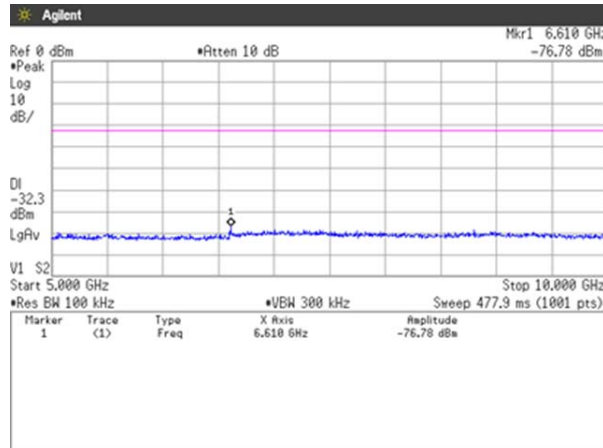
Channel High: 2480MHz 30MHz-1GHz



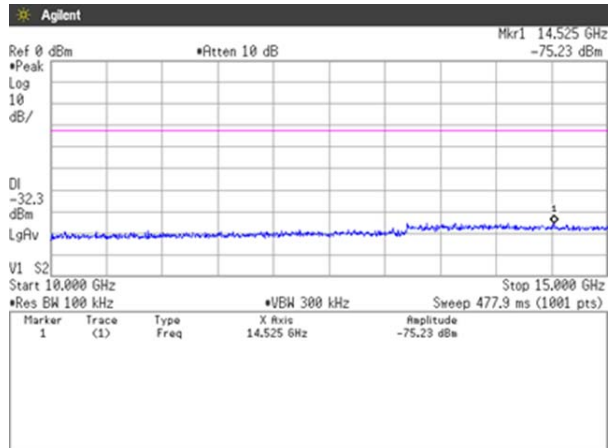
1GHz-5GHz



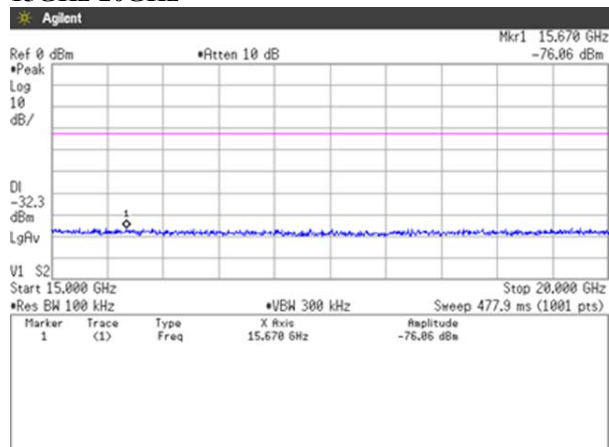
5GHz-10GHz



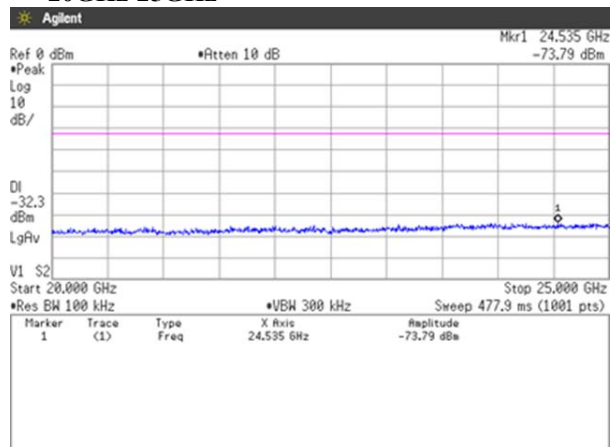
10GHz-15GHz



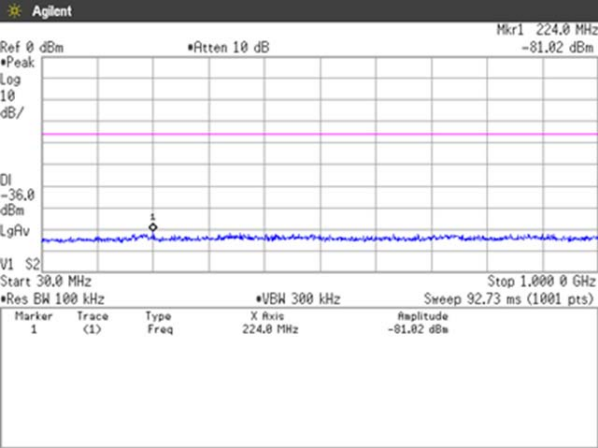
15GHz-20GHz



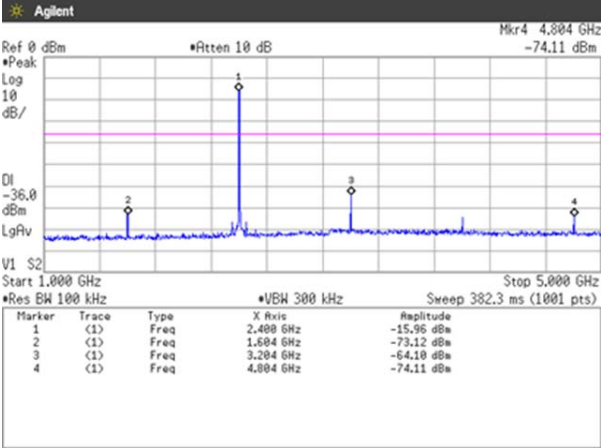
20GHz-25GHz



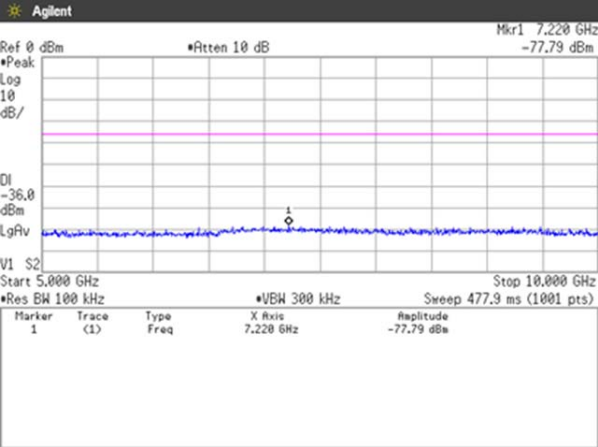
3-DH5
Channel Low: 2402MHz
30MHz-1GHz



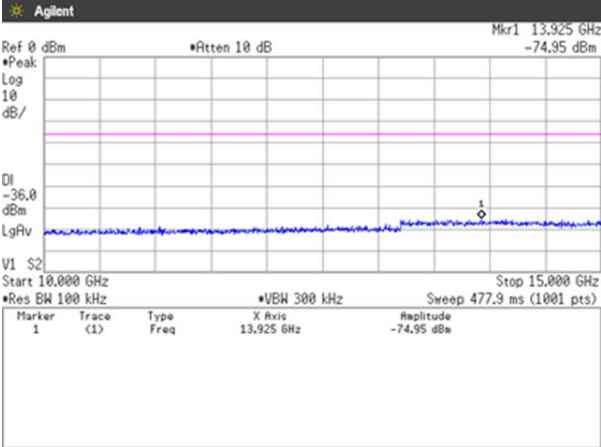
1GHz-5GHz



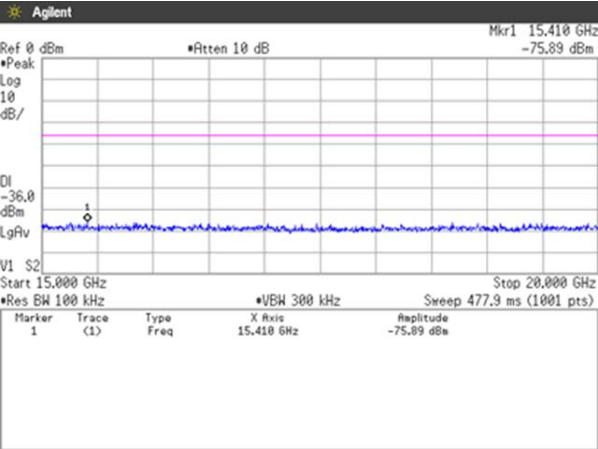
5GHz-10GHz



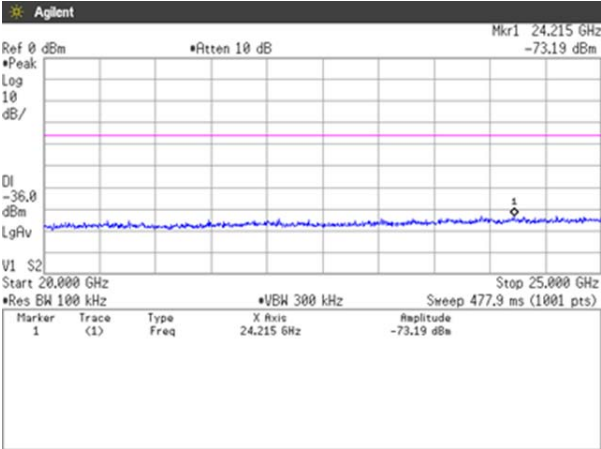
10GHz-15GHz



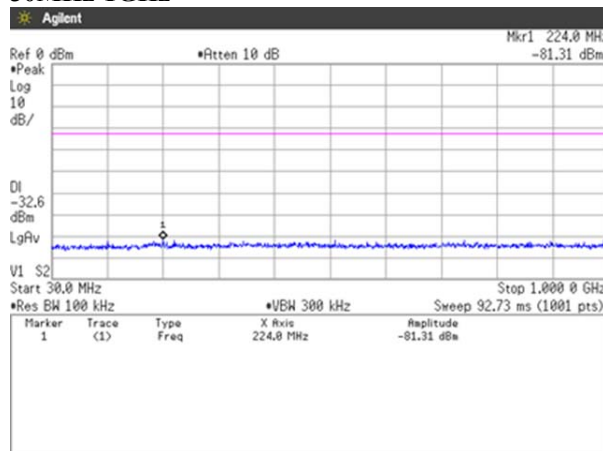
15GHz-20GHz



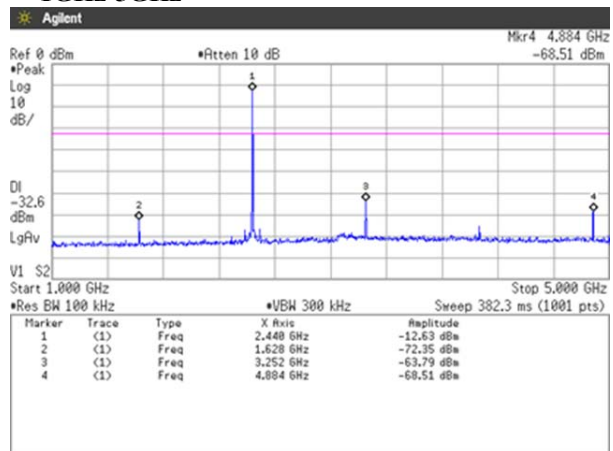
20GHz-25GHz



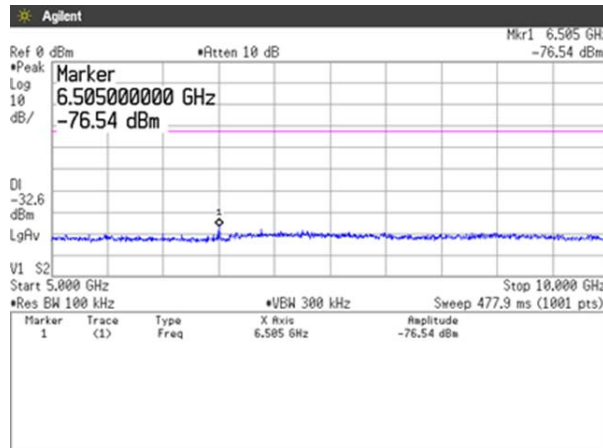
Channel Middle: 2441MHz 30MHz-1GHz



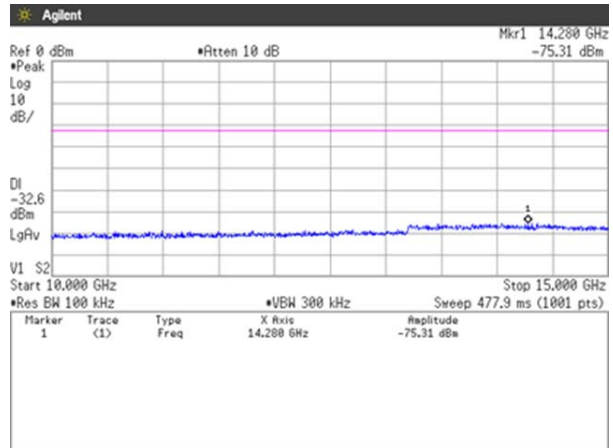
1GHz-5GHz



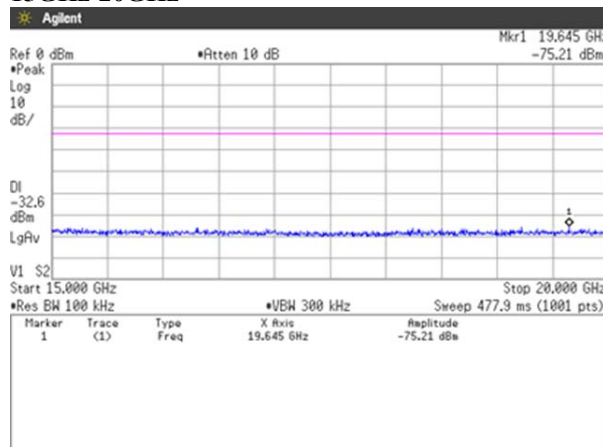
5GHz-10GHz



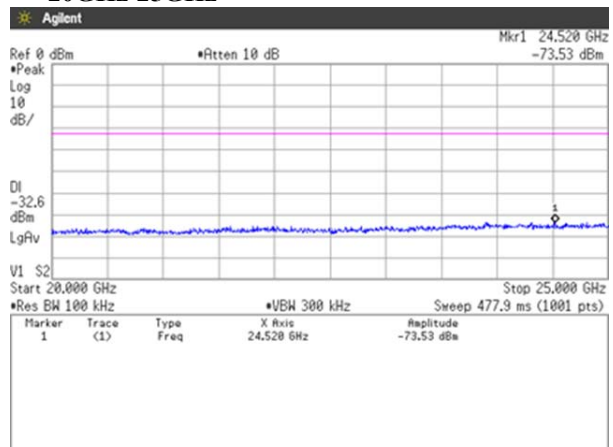
10GHz-15GHz



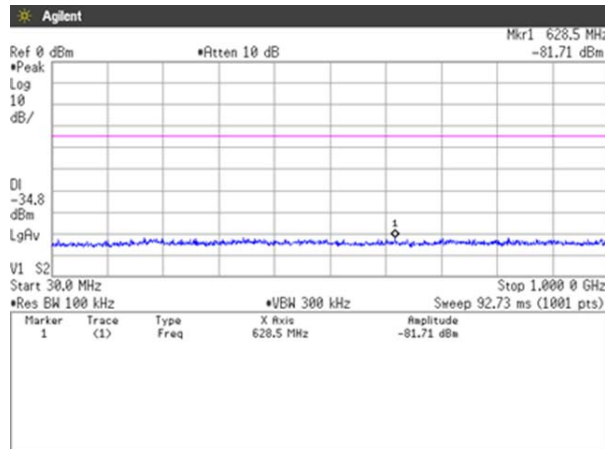
15GHz-20GHz



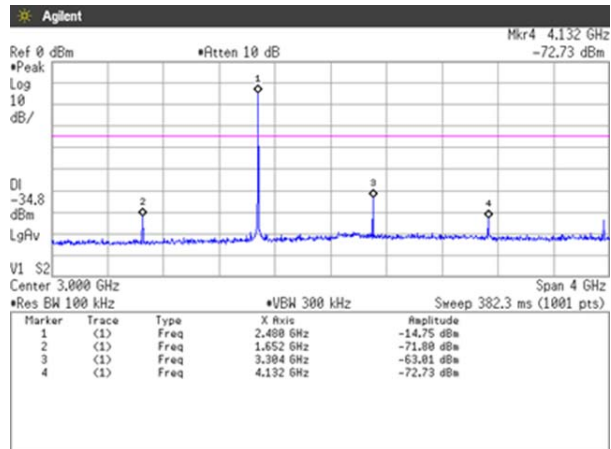
20GHz-25GHz



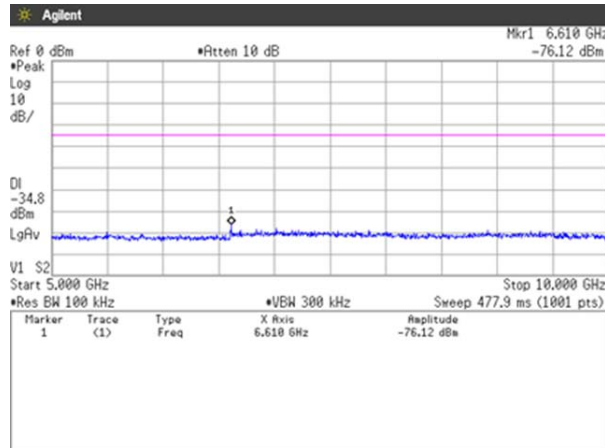
Channel High: 2480MHz 30MHz-1GHz



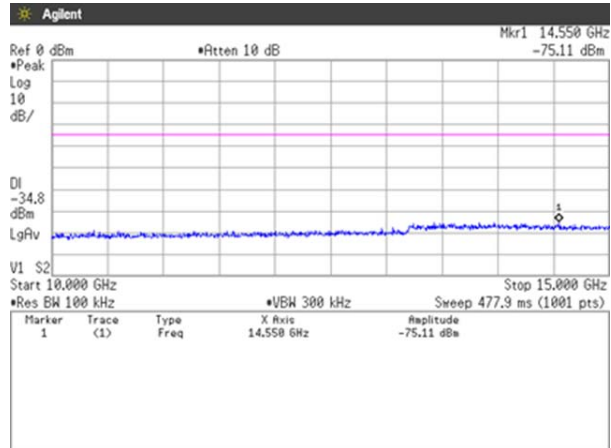
1GHz-5GHz



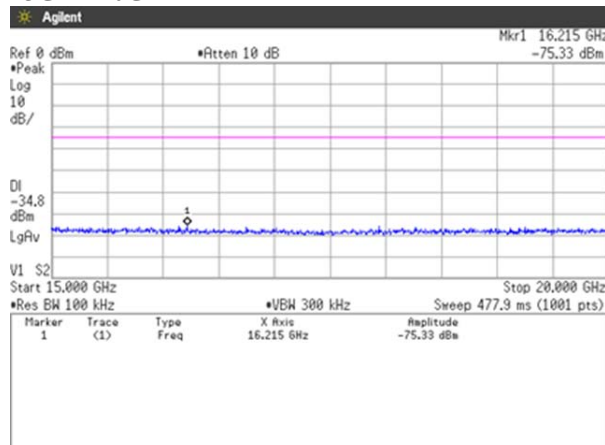
5GHz-10GHz



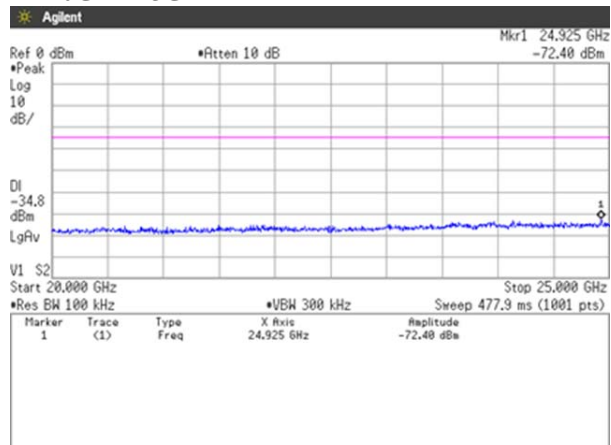
10GHz-15GHz



15GHz-20GHz



20GHz-25GHz



4.8 Spurious Emissions - Radiated - (9kHz - 25GHz)

4.8.1 Test Procedure [FCC 15.205, 15.209, 15.247(d)]

Radiated emission measurements are performed at 3m distance with the broadband antenna (Loop antenna, TRILOG antenna, and double-ridged guide antenna). The antenna is positioned both the horizontal and vertical planes of polarization and height is varied 1 to 4 meters and stopped at height producing the maximum emission. As for the Loop antenna, it is positioned with its plane vertical, and the center of the Loop is 1.0meter above the ground plane. Frequency Range: 9kHz –1GHz is scanned and investigated with the test receiver, and above 1GHz, with the spectrum analyzer. The detector function of the test receiver is set to CISPR Quasi-peak mode and the bandwidth is set to 120kHz. Peak and average detectors are used for measurements above 1GHz. The bandwidth of the spectrum analyzer is set to 1MHz.

The EUT and support equipment are placed on a 1meter x 2meter surface, 0.8meter height FRP table. The turntable is rotated by 360 degrees and stopped at azimuth of producing the maximum emission.

Interconnecting cables, which hanging closer than 40cm to the horizontal metal ground plane are bundled its excess in center. The highest fundamental frequency generated in the EUT is 2402-2480MHz, therefore the frequency was investigated up to 25GHz, as specified in CFR section 15.33, and at least six highest emissions are reported. The test results represent the worst-case emission for each emission with manipulating the EUT, support equipment, interconnecting cables and varying the mode of operation.

Sufficient time for the EUT, support equipment, and test equipment are allowed in order for them to warm up to their normal operating condition.

The spectrum analyzer is set to:

- Peak: RBW=1MHz, VBW=1MHz, Span=0Hz, Sweep=auto
- Average: RBW=1MHz, VBW=10Hz, Span=0Hz, Sweep=auto

The EUT was set to operate with following conditions.

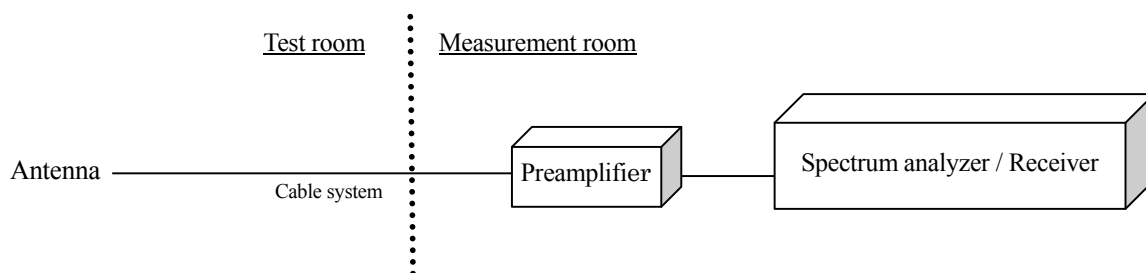
- No hopping [Channel Low: 2402MHz, Channel Middle: 2441MHz, Channel High: 2480MHz]

The test mode of EUT is as follows.

- Tx mode
- Rx mode

4.8.2 Measurement Setup

Test configuration for Spurious emissions



4.8.3 Limit of Spurious Emission Measurement

Frequency [MHz]	Field Strength	
	[uV/m]	[dBuV/m]
0.009 – 0.490	2400 / F [kHz]	20logE [uV/m]
0.490 – 1.705	24000 / F [kHz]	20logE [uV/m]
1.705-30	30	29.5
30 – 88	100	40.0
88 – 216	150	43.5
216 – 960	200	46.0
Above 960	500	54.0

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level [dBuV/m] = 20 log Emission [uV/m]
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

4.8.4 Measurement Results

Test Personnel:

Tested by: Hiroaki Suzuki

Date : Mar. 15, 2013
Temperature : 18.8 [°C]
Humidity : 23.6 [%]
Test place : 3m Semi-anechoic chamber

Test Personnel:

Tested by: Hiroaki Suzuki

Date : Mar. 18, 2013
Temperature : 20.7 [°C]
Humidity : 24.7 [%]
Test place : 3m Semi-anechoic chamber

Spurious Emissions - Radiated- **DH5**

Tx Channel Low: 2402MHz

No.	Frequency	(P)	Reading PK	Reading CAV	c. f	Result PK	Result CAV	Limit PK	Limit AV	Margin PK	Margin CAV	Height	Angle
	[MHz]		[dB(μV)]	[dB(μV)]	[dB(1/m)]	[dB(μV/m)]	[dB(μV/m)]	[dB(μV/m)]	[dB(μV/m)]	[dB]	[dB]	[cm]	[°]
1	4803.940	H	48.1	40.1	8.6	56.7	48.7	74.0	54.0	17.3	5.3	120.0	15.0
2	4804.380	V	49.6	41.6	8.6	58.2	50.2	74.0	54.0	15.8	3.8	100.0	104.0

Tx Channel Middle: 2441MHz

No.	Frequency	(P)	Reading PK	Reading CAV	c. f	Result PK	Result CAV	Limit PK	Limit AV	Margin PK	Margin CAV	Height	Angle
	[MHz]		[dB(μV)]	[dB(μV)]	[dB(1/m)]	[dB(μV/m)]	[dB(μV/m)]	[dB(μV/m)]	[dB(μV/m)]	[dB]	[dB]	[cm]	[°]
1	4881.880	H	47.2	38.5	9.0	56.2	47.5	74.0	54.0	17.8	6.5	117.0	35.0
2	4882.130	V	48.1	40.0	9.0	57.1	49.0	74.0	54.0	16.9	5.0	100.0	105.0

Tx Channel High: 2480MHz

No.	Frequency	(P)	Reading PK	Reading CAV	c. f	Result PK	Result CAV	Limit PK	Limit AV	Margin PK	Margin CAV	Height	Angle
	[MHz]		[dB(μV)]	[dB(μV)]	[dB(1/m)]	[dB(μV/m)]	[dB(μV/m)]	[dB(μV/m)]	[dB(μV/m)]	[dB]	[dB]	[cm]	[°]
1	4960.380	H	46.3	36.7	9.3	55.6	46.0	74.0	54.0	18.4	8.0	128.0	28.0
2	4959.880	V	48.3	40.3	9.3	57.6	49.6	74.0	54.0	16.4	4.4	100.0	104.0

Note1: Emission Level (Margin) = Limit – [Reading + Factor (Antenna + Cable - Amp)]

Note 2: No emissions were detected in frequency range 9kHz to 1000MHz at the 3 meters distance.

3-DH5

Tx Channel Low: 2402MHz

No.	Frequency	(P)	Reading PK	Reading CAV	c. f	Result PK	Result CAV	Limit PK	Limit AV	Margin PK	Margin CAV	Height	Angle
	[MHz]		[dB(μV)]	[dB(μV)]	[dB(1/m)]	[dB(μV/m)]	[dB(μV/m)]	[dB(μV/m)]	[dB(μV/m)]	[dB]	[dB]	[cm]	[°]
1	4804.080	H	43.9	31.1	8.6	52.5	39.7	74.0	54.0	21.5	14.3	118.0	11.0
2	4804.080	V	44.0	31.6	8.6	52.6	40.2	74.0	54.0	21.4	13.8	103.0	104.0

Tx Channel Middle: 2441MHz

No.	Frequency	(P)	Reading PK	Reading CAV	c. f	Result PK	Result CAV	Limit PK	Limit AV	Margin PK	Margin CAV	Height	Angle
	[MHz]		[dB(μV)]	[dB(μV)]	[dB(1/m)]	[dB(μV/m)]	[dB(μV/m)]	[dB(μV/m)]	[dB(μV/m)]	[dB]	[dB]	[cm]	[°]
1	4882.000	H	43.3	30.7	9.0	52.3	39.7	74.0	54.0	21.7	14.3	119.0	16.0
2	4882.000	V	43.5	30.8	9.0	52.5	39.8	74.0	54.0	21.5	14.2	100.0	106.0

Tx Channel High: 2480MHz

No.	Frequency	(P)	Reading PK	Reading CAV	c. f	Result PK	Result CAV	Limit PK	Limit AV	Margin PK	Margin CAV	Height	Angle
	[MHz]		[dB(μV)]	[dB(μV)]	[dB(1/m)]	[dB(μV/m)]	[dB(μV/m)]	[dB(μV/m)]	[dB(μV/m)]	[dB]	[dB]	[cm]	[°]
1	4960.020	H	43.2	30.2	9.3	52.5	39.5	74.0	54.0	21.5	14.5	117.0	20.0
2	4960.000	V	43.4	30.9	9.3	52.7	40.2	74.0	54.0	21.3	13.8	100.0	104.0

Note1: Emission Level (Margin) = Limit – [Reading + Factor (Antenna + Cable - Amp)]

Note 2: No emissions were detected in frequency range 9kHz to 1000MHz at the 3 meters distance.

Rx Channel Low: 2402MHz

No.	Frequency [MHz]	(P)	Reading PK [dB(μV)]	Reading CAV [dB(μV)]	c. f [dB(1/m)]	Result PK [dB(μV/m)]	Result CAV [dB(μV/m)]	Limit PK [dB(μV/m)]	Limit AV [dB(μV/m)]	Margin PK [dB]	Margin CAV [dB]	Height [cm]	Angle [°]
1	2403.500	H	50.5	45.1	0.9	51.4	46.0	74.0	54.0	22.6	8.0	100.0	14.0
2	2403.500	V	47.2	38.0	0.9	48.1	38.9	74.0	54.0	25.9	15.1	114.0	176.0

Rx Channel Middle: 2441MHz

No.	Frequency [MHz]	(P)	Reading PK [dB(μV)]	Reading CAV [dB(μV)]	c. f [dB(1/m)]	Result PK [dB(μV/m)]	Result CAV [dB(μV/m)]	Limit PK [dB(μV/m)]	Limit AV [dB(μV/m)]	Margin PK [dB]	Margin CAV [dB]	Height [cm]	Angle [°]
1	2439.540	H	49.9	44.3	1.0	50.9	45.3	74.0	54.0	23.1	8.7	100.0	14.0
2	2439.540	V	47.0	36.0	1.0	48.0	37.0	74.0	54.0	26.0	17.0	114.0	174.0

Rx Channel High: 2480MHz

No.	Frequency [MHz]	(P)	Reading PK [dB(μV)]	Reading CAV [dB(μV)]	c. f [dB(1/m)]	Result PK [dB(μV/m)]	Result CAV [dB(μV/m)]	Limit PK [dB(μV/m)]	Limit AV [dB(μV/m)]	Margin PK [dB]	Margin CAV [dB]	Height [cm]	Angle [°]
1	2478.550	H	49.6	43.0	1.1	50.7	44.1	74.0	54.0	23.3	9.9	100.0	15.0
2	2478.550	V	46.4	36.0	1.1	47.5	37.1	74.0	54.0	26.5	16.9	110.0	169.0

Note1: Emission Level (Margin) = Limit – [Reading + Factor (Antenna + Cable - Amp)]

Note 2: No emissions were detected in frequency range 9kHz to 1000MHz at the 3 meters distance.

4.9 Restricted Band of Operation

4.9.1 Test Procedure [FCC 15.205, 15.209, 15.247(d)]

The peak power is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

The spectrum analyzer is set to:

- Peak: RBW=1MHz, VBW=1MHz, Span=40MHz, Sweep=auto
- Average: RBW=1MHz, VBW=10kHz, Span=40MHz, Sweep=auto

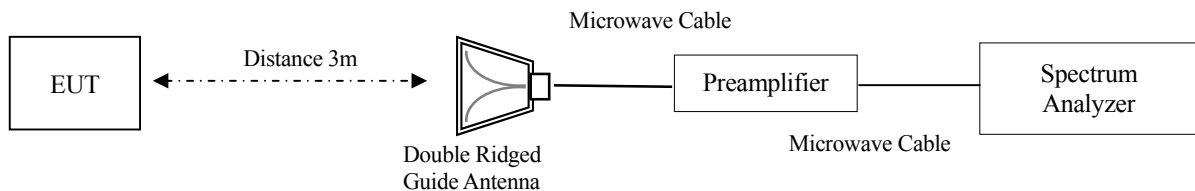
The EUT was set to operate with following conditions.

- No hopping [Channel Low: 2402MHz, Channel High: 2480MHz]

The test mode of EUT is as follows.

- Tx mode

4.9.2 Measurement Setup



4.9.3 Limit of Restricted Band of Operation

Emission at the boundary of the restricted band provided by 15.205 shall be lower than 15.209 limit.

4.9.4 Measurement Result

Packet type	Channel	Frequency[MHz]	Results Chart	PASS / FAIL
DH5	Low	2402	See the Trace Data	PASS
	High	2480	See the Trace Data	PASS
3-DH5	Low	2402	See the Trace Data	PASS
	High	2480	See the Trace Data	PASS

4.9.5 Trace Data

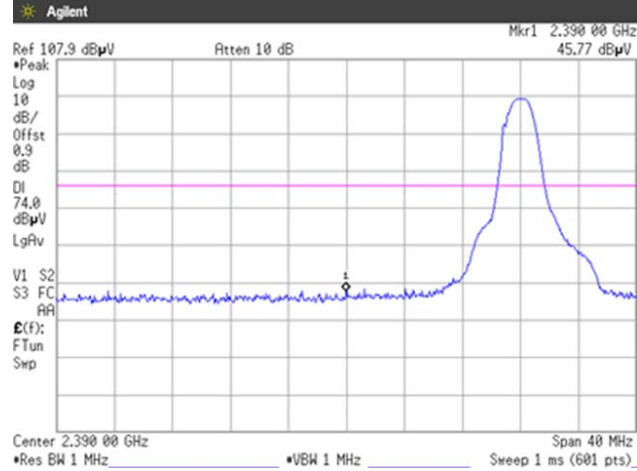
Test Personnel:

Tested by: Hiroaki Suzuki

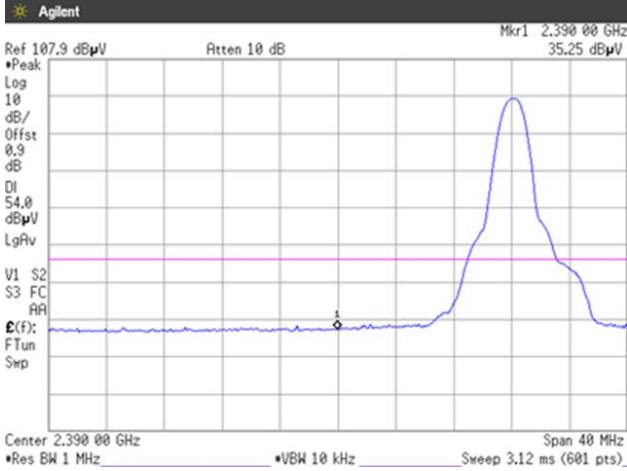
Date : Mar. 18, 2013
 Temperature : 20.7 [°C]
 Humidity : 24.7 [%]
 Test place : 3m Semi-anechoic chamber

Restricted Band of Operation

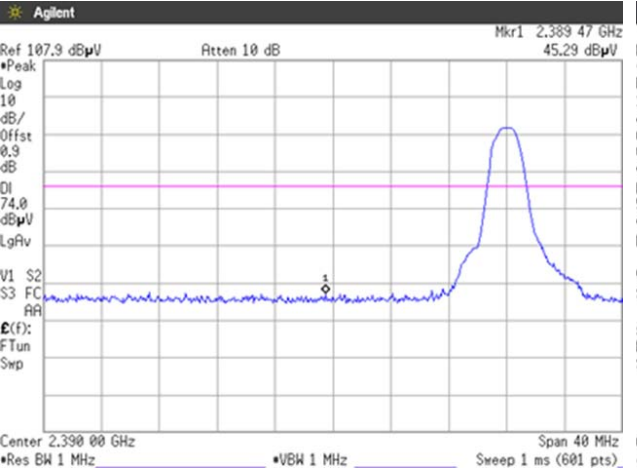
Frequency: 2390.0MHz -Horizontal- [DH5]
Peak



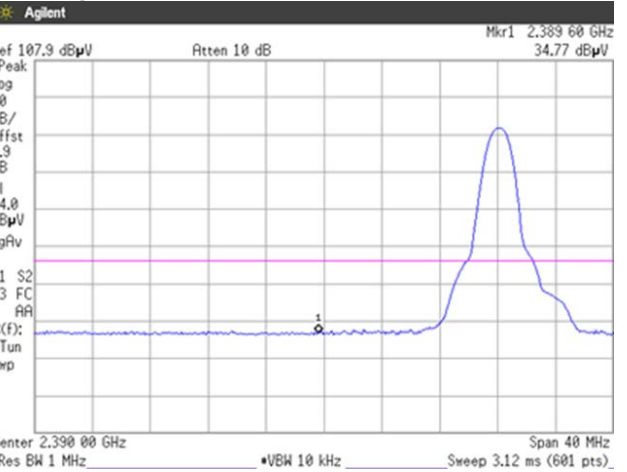
Average



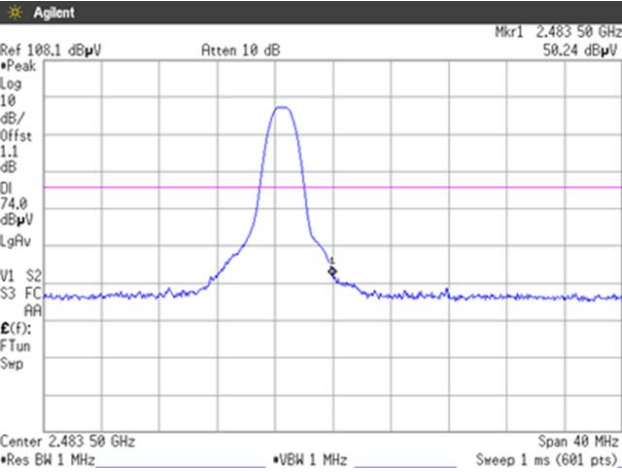
Frequency: 2390.0MHz -Vertical- [DH5]
Peak



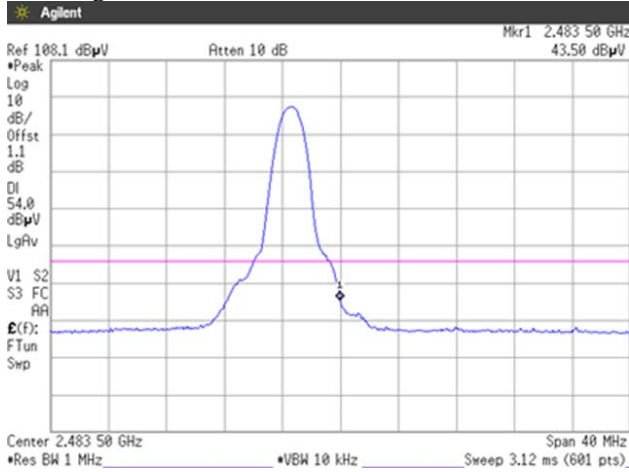
Average



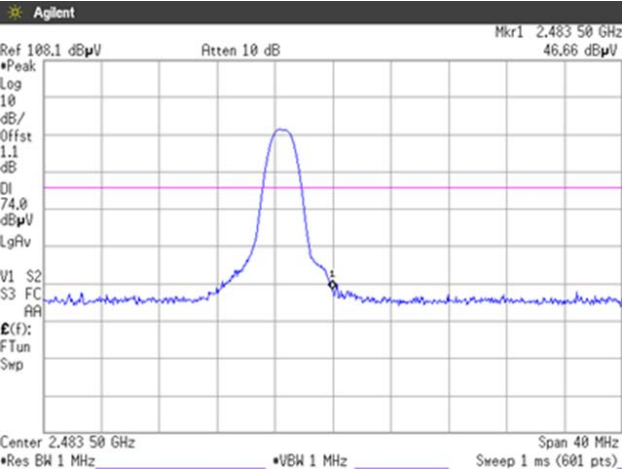
Frequency: 2483.5MHz -Horizontal- [DH5]
Peak



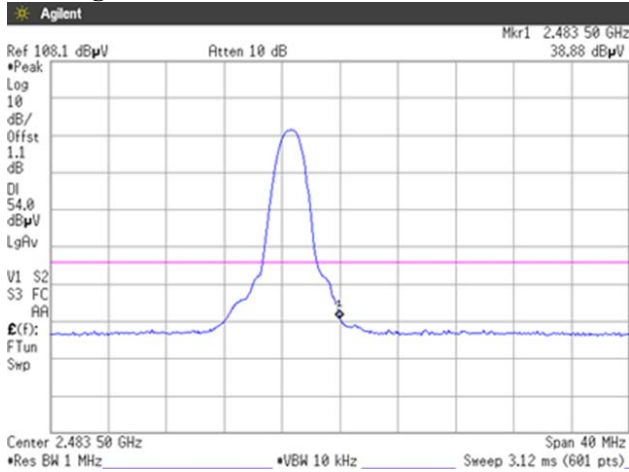
Average



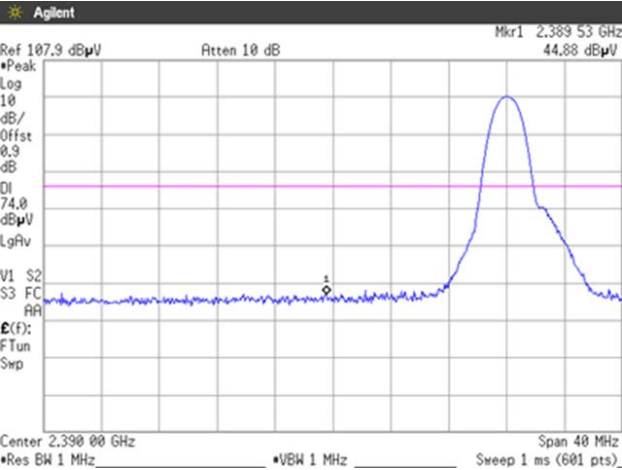
Frequency: 2483.5MHz -Vertical- [DH5]
Peak



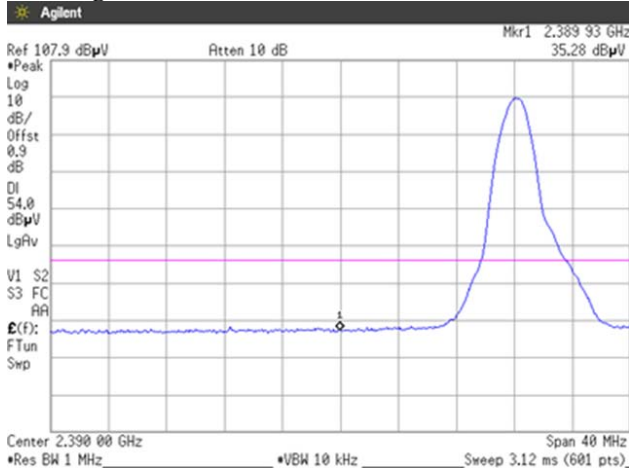
Average



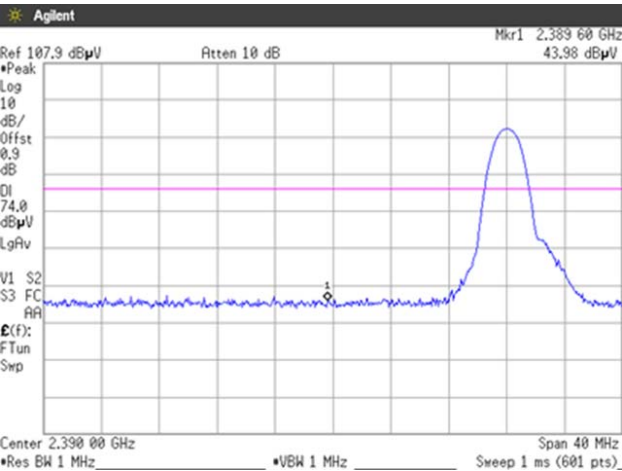
Frequency: 2390.0MHz -Horizontal- [3-DH5]
Peak



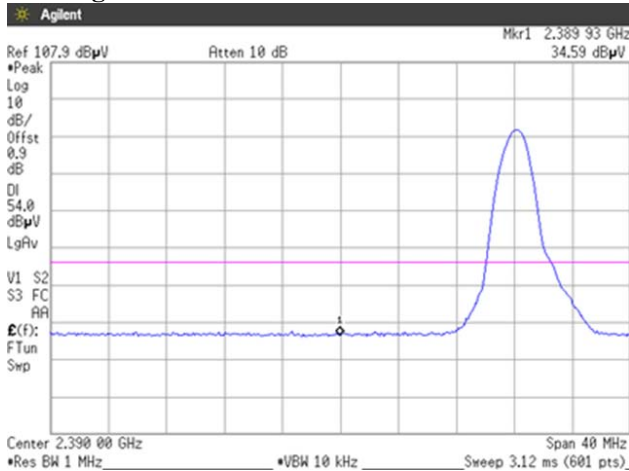
Average



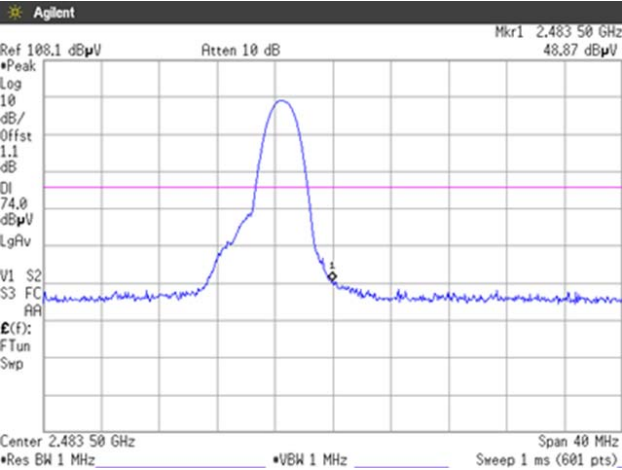
Frequency: 2390.0MHz -Vertical- [3-DH5]
Peak



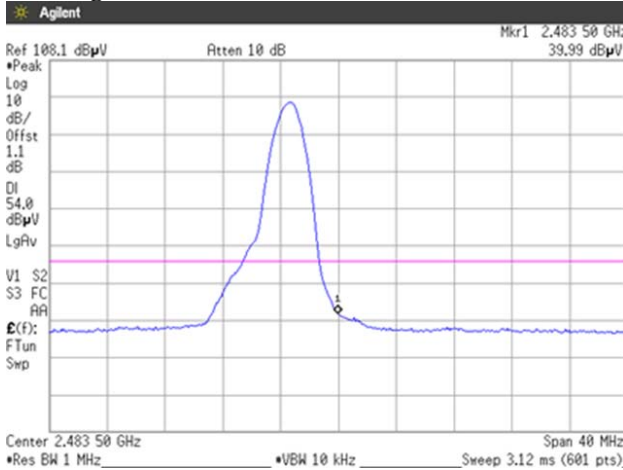
Average



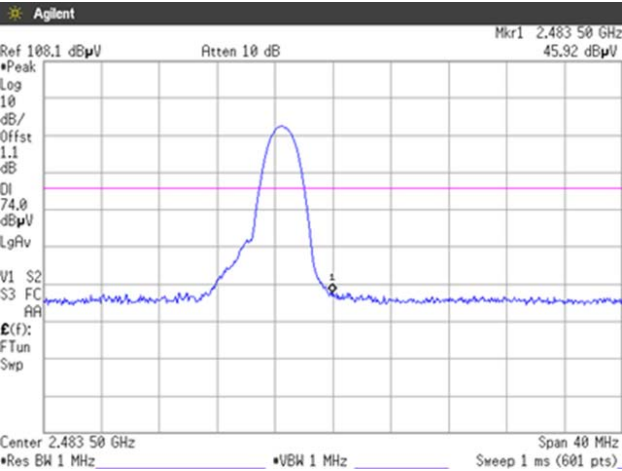
Frequency: 2483.5MHz -Horizontal- [3-DH5]
Peak



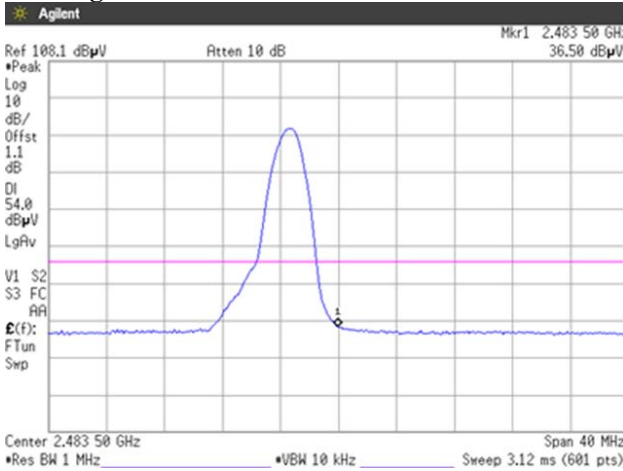
Average



Frequency: 2483.5MHz -Vertical- [3-DH5]
Peak



Average



4.10 AC power line Conducted Emissions

4.10.1 Test Procedure [FCC 15.207]

Conducted emission at AC mains port measurements are performed at 3m Semi-anechoic chamber according to ANSI C63.4 section 7.

EUT and support equipment are placed on FRP table of 2.0m(W) × 1.0m(D) × 0.8m(H) in size. EUT is connected to 50Ω/50μH Line impedance Stabilization network (LISN) which is placed on reference ground plane, and was placed 80cm away from EUT. Excess of AC power cable is bundled in center. Vertical Metal Reference Plane 2.0m (W) × 2.0m (H) in size is placed 0.4m away from EUT. LISN for peripheral is terminated in 50Ω.

EUT operating mode is selected to emit the maximum noise. Overall frequency range is investigated with spectrum analyzer using peak detector. Maximum emission configuration is determined by manipulating the EUT, support equipment, interconnecting cables. Then, emission measurements are performed with test receiver in above setting to each current-carrying conductor of the mains port. Sufficient time for EUT, support equipment and test equipment are provided in order for them to warm up to their normal operating condition.

Frequency range:

- 0.15MHz to 30MHz

The Test receiver is set to:

Detector: Quasi-peak, Average

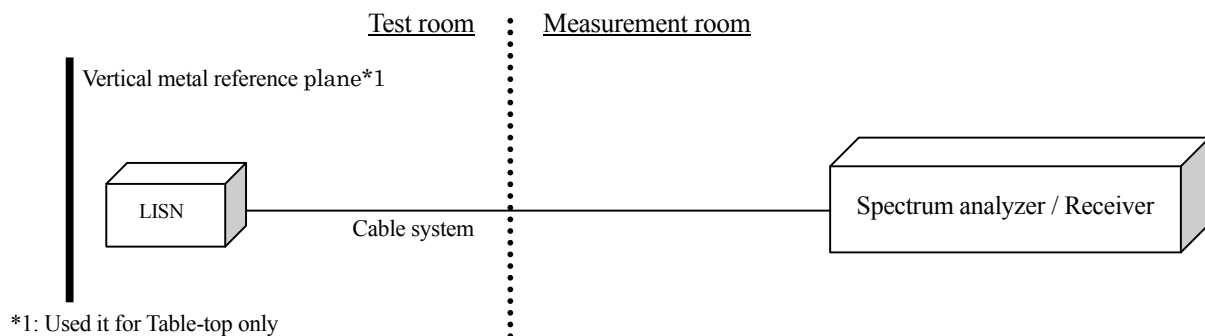
Bandwidth: 9kHz

Test condition:

- Tx mode (Hopping)

4.10.2 Measurement Setup

Test configuration for AC power line Conducted Emissions



4.10.3 Limit of AC power line Conducted Emissions Measurement

Frequency	Limit	
	QP(dBμV)	AV(dBμV)
0.15MHz to 0.5MHz	66 to 56*	56 to 46*
0.5MHz to 5MHz	56	46
5MHz to 30MHz	60	50

*: The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz.

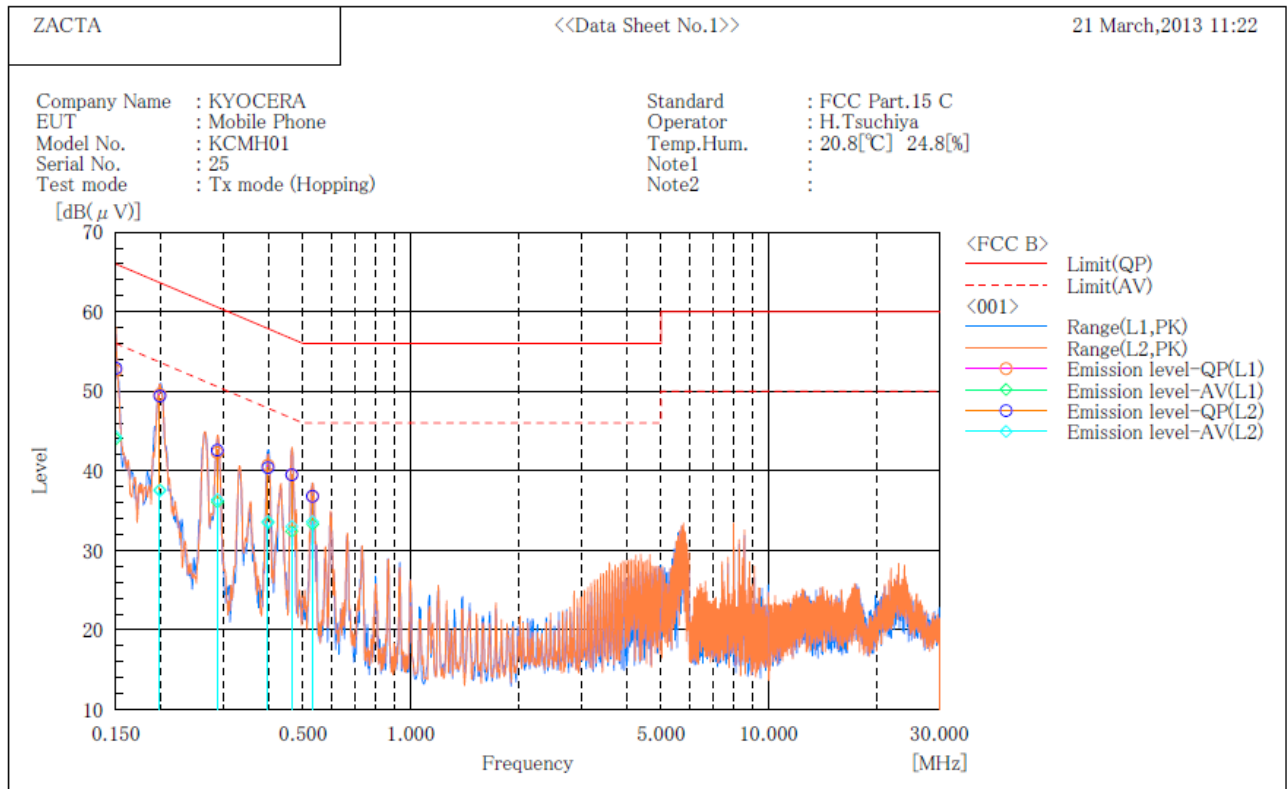
4.10.4 Calculation method

Emission level = Reading + (LISN. factor + Cable system loss)

Margin = Limit – Emission level

4.10.5 Measurement Result

***** CONDUCTED EMISSION at MAINS PORT *****
 << 3m Semi-anechoic chamber >>



Final Result

--- L1 Phase ---

No.	Frequency [MHz]	Reading QP [dB(μV)]	Reading AV [dB(μV)]	c. f [dB]	Result QP [dB(μV)]	Result AV [dB(μV)]	Limit QP [dB(μV)]	Limit AV [dB(μV)]	Margin QP [dB]	Margin AV [dB]
1	0.150	42.1	33.5	10.5	52.6	44.0	66.0	56.0	13.4	12.0
2	0.199	39.2	27.2	10.4	49.6	37.6	63.7	53.7	14.1	16.1
3	0.288	32.0	25.8	10.3	42.3	36.1	60.6	50.6	18.3	14.5
4	0.399	30.4	23.2	10.3	40.7	33.5	57.9	47.9	17.2	14.4
5	0.465	29.2	22.1	10.3	39.5	32.4	56.6	46.6	17.1	14.2
6	0.532	26.5	23.0	10.3	36.8	33.3	56.0	46.0	19.2	12.7

--- L2 Phase ---

No.	Frequency [MHz]	Reading QP [dB(μV)]	Reading AV [dB(μV)]	c. f [dB]	Result QP [dB(μV)]	Result AV [dB(μV)]	Limit QP [dB(μV)]	Limit AV [dB(μV)]	Margin QP [dB]	Margin AV [dB]
1	0.150	42.3	33.7	10.6	52.9	44.3	66.0	56.0	13.1	11.7
2	0.199	38.9	27.0	10.5	49.4	37.5	63.7	53.7	14.3	16.2
3	0.288	32.2	26.0	10.4	42.6	36.4	60.6	50.6	18.0	14.2
4	0.399	30.0	23.2	10.4	40.4	33.6	57.9	47.9	17.5	14.3
5	0.465	29.1	22.6	10.4	39.5	33.0	56.6	46.6	17.1	13.6
6	0.531	26.4	23.2	10.4	36.8	33.6	56.0	46.0	19.2	12.4

4.11 Antenna requirement

According to FCC section 15.203., an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

The antenna is a special antenna mounted inside of the EUT. Therefore, the EUT complies with the antenna requirement of FCC section 15.203.

5. Uncertainty of measurement

Expanded uncertainties stated were calculated with a coverage Factor $k=2$.

Please note that these results are not taken into account when determining compliance or non-compliance with test result.

Test item	Measurement uncertainty
Conducted emission at mains port	$\pm 3.0\text{dB}$
Radiated emission (9kHz - 30MHz)	$\pm 4.4\text{dB}$
Radiated emission (30MHz – 1000MHz)	$\pm 4.5\text{dB}$
Radiated emission (1000MHz – 26GHz)	$\pm 3.9\text{dB}$

6. Laboratory description

1. Location: ZACTA Technology Corporation Yonezawa Testing Center
4149-7 Hachimanpara 5-chome Yonezawa-shi Yamagata 992-1128 Japan
Phone: +81-238-28-2880 Fax: +81-238-28-2888

2. Facility filing information:

1) NVLAP accreditation: NVLAP Lab. code: 200306-0

2)VLAC accreditation: Lab. code: VLAC-013

Site name	Radiated emission	Conducted emission for mains port	Conducted emission for telecom port	Radiated emission (CMAD)	Expiry Date
10m Semi-anechoic chamber	VLAC-013			VLAC-013	Jul. 3, 2013
3m Semi-anechoic chamber				-	
Shielded room No.1	-	VLAC-013		-	

3) FCC filing:

Site name	Registration Number	Expiry Date
Site 2	91065	Oct.31, 2014
Site 3		
10m Semi-anechoic chamber	540072	Jan. 9, 2016
3m Semi-anechoic chamber		
Shielded room No.1		
Techno-Park Takatsu Anechoic Chamber	872753	Jun. 8, 2014

4) Industry Canada Oats site filing:

Site name	Sites on file: Oats 3m/10m	Expiry Date
Site 2	4224A-2	Jan. 23, 2015
Site 3	4224A-3	
3m Semi-anechoic chamber	4224A-4	
10m Semi-anechoic chamber	4224A-5	
Techno-Park Takatsu Anechoic Chamber	4224B-1	Feb. 2, 2015

5) VCCI site filing:

Site name	Radiated emission	Conducted emission for mains port	Expiry Date	Conducted emission for telecom port	Expiry Date
Site 2	R-137	C-133	Nov. 16, 2014	T-1221	Nov. 28, 2014
Site 3	R-138	C-134		T-1222	
10m Semi-anechoic chamber	R-2480	C-2722	Jul. 3, 2013	T-1474	Jul. 3, 2013
	G-81	-		-	-
3m Semi-anechoic chamber	R-2481	C-2723		T-1475	Jul. 3, 2013
	G-82	-		-	-
Shielded room No.1	-	C-2724	Mar. 24, 2016	T-1476	Jul. 3, 2013
Techno-Park Takatsu Anechoic Chamber	R-1509	C-1590		T-1795	Mar. 24, 2016
	G-263	-		-	-

- 6) TÜV SÜD PS authorization:
Authorized as an EMC test laboratory
- 7) Intertek authorization:
Authorized as an EMC test laboratory
- 8) TÜV Rheinland authorization:
Authorized as an EMC test laboratory
- 9) BUREAU VERITAS certification:
Certified as an EMC test laboratory

Appendix A: Test equipment

Antenna port Conducted Test

Equipment	Company	Model No.	Serial No.	Cal. due	Cal. date
Spectrum Analyzer	Agilent Technologies	E4440A	US40420937	Oct. 2013	Oct. 19, 2012
Microwave cable	SUHNER	SUCOFLEX104	199511/4	Nov. 2013	Nov. 12, 2012
Attenuator	Weinschel	56-10	J4180	Nov. 2013	Nov. 12, 2012

*The calibrations of the above equipment are traceable to NIST or equivalent standards of the reference organizations.

Radiated Emission

Equipment	Company	Model No.	Serial No.	Cal. due	Cal. date
Spectrum Analyzer	Agilent Technologies	E4447A	MY46180188	Mar. 2014	Mar. 8, 2013
Preamplifier	ANRITSU	MH648A	M96057	Jun. 2013	Jun. 12, 2012
Preamplifier	Agilent Technologies	8449B	3008A01008	Dec. 2013	Dec. 9, 2012
Preamplifier	TSJ	MLA-1840-B03-35	1040332	Apr. 2013	Apr. 20, 2010
EMI Receiver	ROHDE&SCHWARZ	ESCI	100764	Jul. 2013	Jul. 6, 2012
Loop antenna	ROHDE&SCHWARZ	HFH2-Z2	891847/010	Sep.2013	Sep. 14, 2012
TRILOG Antenna	Schwarzbeck	VULB9160	9160-3218	May 2014	May 2, 2012
Attenuator(6dB)	TME	CFA-01NPJ-6	N/A (S274)	Jun. 2013	Jun. 12, 2012
Double Ridged Guide Antenna	EMCO	3115	4328	Jan. 2014	Jan. 21, 2013
Broad-Band Horn Antenna	Schwarzbeck	BBHA9170	BBHA9170189	Apr. 2013	Apr. 20, 2010
Microwave cable	SUHNER	SUCOFLEX104/9m	346314/4	Oct. 2013	Oct. 6, 2012
		SUCOFLEX104/1m	322084/4	Oct. 2013	Oct. 6, 2012
		SUCOFLEX104/1.5m	317226/4	Oct. 2013	Oct. 6, 2012
		SUCOFLEX106/7m	41625/6	Oct. 2013	Oct. 6, 2012
Notch Filter	Micro-Tronics	BRM50702	045	Nov. 2013	Nov. 12, 2012
PC	DELL	DIMENSION E521	75465BX	N/A	N/A
Software	TOYO Corporation	EP5/RE-AJ	0611193/V5.3.61	N/A	N/A
3m Semi-anechoic chamber	TOKIN	N/A	N/A (9002-NSA)	May 2013	May 19, 2012

*The calibrations of the above equipment are traceable to NIST or equivalent standards of the reference organizations.

Conducted Emission

Equipment	Company	Model No.	Serial No.	Cal. due	Cal. date
EMI Receiver	ROHDE&SCHWARZ	ESCI	100764	Jul. 2013	Jul. 6, 2012
Coaxial cable	FUJIKURA	5D-2W/4m	N/A (S350)	Feb. 2014	Feb. 4, 2013
	FUJIKURA	5D-2W/1m	N/A (S193)	Feb. 2014	Feb. 4, 2013
	SUHNER	RG214/U/10m	N/A (S194)	Feb. 2014	Feb. 4, 2013
Line impedance Stabilization network for EUT	Kyoritsu Electrical Works, Ltd.	KNW-407F	8-2003-1	Mar. 2014	Mar. 13, 2013
Line impedance Stabilization network for EUT	Kyoritsu Electrical Works, Ltd.	KNW-242F	8-1973-1	Jun. 2013	Jun. 12, 2012
Attenuator	HUBER+SUHNER	6810.01.A	N/A (S411)	Jun. 2013	Jun. 25, 2012
50Ω terminator	HRS	UG-88/U	N/A (S068)	Nov. 2013	Nov. 29, 2012
PC	DELL	DIMENSION E521	75465BX	N/A	N/A
Software	TOYO Corporation	EP5/CE-AJ	0611193/V5.2.41	N/A	N/A

*The calibrations of the above equipment are traceable to NIST or equivalent standards of the reference organizations.