



Zacta

TEST REPORT

Report number : Z071C-13470

Issue date : December 27, 2013

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

FCC Part15 Subpart C

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

Applicant	: MITSUMI ELECTRIC CO., LTD.
Equipment under test (EUT)	: Bluetooth LE Module
Model number	: WML-C75
FCC ID	: POO-WC75

Date of test : November 28, December 24, 25, 26, 2013
 Test place : TÜV SÜD Zacta Ltd. Yonezawa Testing Center
 4149-7 Hachimanpara 5-chome
 Yonezawa-shi Yamagata 992-1128 Japan
 Phone: +81-238-28-2880 Fax: +81-238-28-2888
 Test results : Complied

The results in this report are applicable only to the equipment tested.
 This report shall not be re-produced except in full without the written approval of TÜV SÜD Zacta Ltd.
 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 : Chiaki Kanno N. Toda
 Chiaki Kanno Nobuyuki Toda

Tested by : Taiki Watanabe
 Taiki Watanabe

Authorized by : Hiroaki Suzuki
 Hiroaki Suzuki
 Manager of EMC Technical Department

NVLAP[®]
 NVLAP LAB CODE 200306-0



Table of contents

	Page
1. Summary of Test	4
1.1 Purpose of test	4
1.2 Standards	4
1.3 List of applied test to the EUT	4
1.4 Modification to the EUT by laboratory	4
2. Equipment Under Test	5
2.1 General Description of equipment	5
2.2 EUT information	5
2.3 Variation of the family model(s)	6
2.4 Operating channels and frequencies	6
2.5 Operating mode	6
2.6 Operating mode	7
3. Configuration of equipment	8
3.1 Equipment(s) used	8
3.2 Cable(s) used	8
3.3 System configuration	8
4. 6dB Bandwidth	9
4.1 Measurement procedure	9
4.2 Limit	9
4.3 Measurement result	9
4.4 Trace data	10
5. Maximum Peak Output Power	11
5.1 Measurement procedure	11
5.2 Limit	11
5.3 Measurement result	12
5.4 Trace data	13
6. Band Edge Compliance of RF Conducted Emissions	16
6.1 Measurement procedure	16
6.2 Limit	16
6.3 Measurement result	16
6.4 Trace data	17
7. Spurious emissions - Conducted -	18
7.1 Measurement procedure	18
7.2 Limit	18
7.3 Measurement result	18
7.4 Trace data	19
8. Spurious Emissions - Radiated -	22
8.1 Measurement procedure	22
8.2 Calculation method	23
8.3 Limit	23
8.4 Test data	24
9. Restricted Band of Operation	26
9.1 Measurement procedure	26



Zacta

9.2 Limit..... 26

9.3 Measurement Result..... 27

9.4 Test data..... 27

10. Transmitter Power Spectral Density..... 29

10.1 Measurement procedure..... 29

10.2 Limit..... 29

10.3 Measurement result..... 29

10.4 Trace data 30

11.1 Measurement procedure 31

11.2 Calculation method..... 31

11.3 Limit..... 31

11.4 Test data..... 32

12. Antenna requirement 33

13. Uncertainty of measurement..... 34

14. Laboratory description 35

Appendix A. Test equipment 36

Appendix B. Duty Cycle..... 37

1. Summary of Test

1.1 Purpose of test

It is the original test in order to verify conformance to FCC Part 15 Subpart C.

1.2 Standards

CFR47 FCC Part 15 Subpart C

1.2.1 Test Methods

ANSI C63.4-2003, KDB558074

1.2.2 Deviation from standards

None

1.3 List of applied test to the EUT

Test items Section	Test items	Condition	Result
15.247(a)(2)	6dB Bandwidth	Conducted	PASS
15.247(b)(3)	Maximum Peak Output Power	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
15.247(e)	Transmitter Power Spectral Density	Conducted	PASS
15.207	AC Power Line Conducted Emissions	Conducted	PASS

1.3.1 Test set up

Table-Top

1.4 Modification to the EUT by laboratory

None



2. Equipment Under Test

2.1 General Description of equipment

EUT is the Bluetooth LE Module.

2.2 EUT information

Applicant	:	MITSUMI ELECTRIC CO., LTD. 2-11-2, TSURUMAKI, TAMA-SHI, TOKYO, JAPAN 206-8567 Phone: +81-42-310-4823 Fax: +81-42-310-5582
Equipment under test	:	Bluetooth LE Module
Trade name	:	MITSUMI
Model number	:	WML-C75
Serial number	:	1 (Antenna port Conducted Test) 3 (Radiated Emission, Conducted Emission Test)
EUT condition	:	Pre-Production
Max. frequency	:	16MHz
Power ratings	:	DC 3.0V
Size	:	(W) 13.0 x (H) 19.0 x (D) 2.3 mm
Environment	:	Indoor and Outdoor use
Terminal limitation	:	-30°C to 85°C
RF Specification Protocol	:	Bluetooth 4.0 LE
Frequency range	:	2402MHz-2480MHz
Number of RF Channels	:	40 Channels
Modulation method/ Data rate	:	GFSK (1Mbps)
Channel separation	:	2MHz
Output power	:	6.577mW
Antenna type	:	PCB antenna
Antenna gain	:	-0.01dBi

2.3 Variation of the family model(s)

N/A

2.4 Operating channels and frequencies

Channel	Frequency [MHz]	Channel	Frequency [MHz]
0	2402	20	2442
1	2404	21	2444
2	2406	22	2446
3	2408	23	2448
4	2410	24	2450
5	2412	25	2452
6	2414	26	2454
7	2416	27	2456
8	2418	28	2458
9	2420	29	2460
10	2422	30	2462
11	2424	31	2464
12	2426	32	2466
13	2428	33	2468
14	2430	34	2470
15	2432	35	2472
16	2434	36	2474
17	2436	37	2476
18	2438	38	2478
19	2440	39	2480

2.5 Operating mode

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

Tested Channel	Frequency [MHz]
Low	2402
Middle	2440
High	2480

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

Tested Channel	Modulation Type	Data Rate
Low, Middle, High	GFSK	1Mbps

The field strength of spurious emissions 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.

2.6 Operating mode

Software : uEnergy_Tools-2.1.0.163

[Tx mode]

- i) RF test program set up
- ii) Select a PACKET TRANSMIT
Operating frequency: Channel Low: 2402MHz, Channel Middle: 2440MHz, Channel High: 2480MHz
- iii) Start test mode

[Rx mode]

- i) RF test program set up
- ii) Select a RECEIVE
Operating frequency: Channel Low: 2402MHz, Channel Middle: 2440MHz, Channel High: 2480MHz
- iii) Start test mode

3. Configuration of equipment

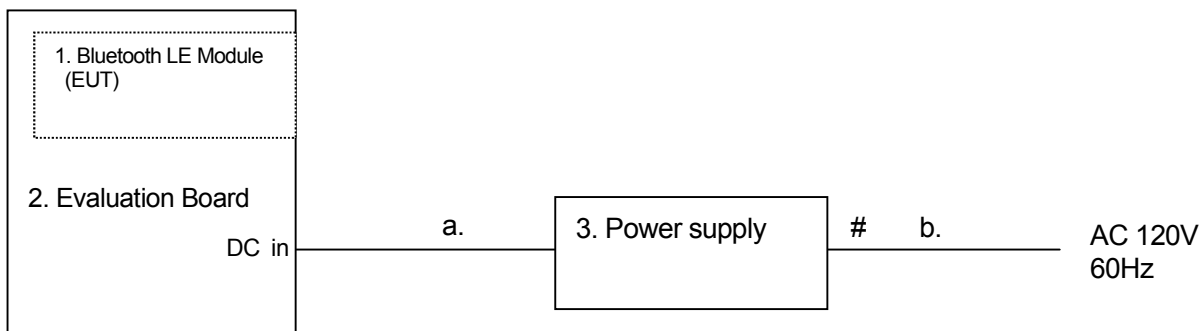
3.1 Equipment(s) used

No.	Equipment	Company	Model No.	Serial No.	FCC ID / DoC	Comment
1	Bluetooth LE Module	MITSUMI	WML-C75	1,3	FCC ID:POO-WC75	EUT
2	Evaluation Board	MITSUMI	N/A	N/A	-	Test jig
3	Power supply	KIKUSUI	PAB	N/A	-	-

3.2 Cable(s) used

No.	Cable	Length[m]	Shield	Connector	Comment
a	DC cable	1.5	No	-	-
b	AC power cord for Power supply	2.0	No	Plastic	-

3.3 System configuration



Note1: Numbers assigned to equipment or cables on this diagram correspond to the list in "3.1 Equipment(s) used" and "3.2 Cable(s) used".

4. 6dB Bandwidth

4.1 Measurement procedure

[FCC 15.247(a)(2), KDB558074]

The bandwidth at 6dB 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=100kHz, VBW=300kHz, Span=3MHz, Sweep=auto, Detector=Peak, Trace mode=Max hold

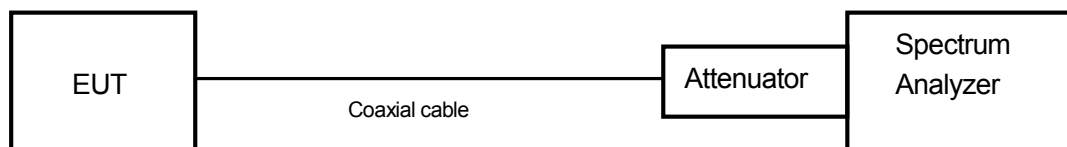
The EUT was set to operate with following conditions.

- Channel Low: 2402MHz, Channel Middle: 2440MHz, Channel High: 2480MHz

The test mode of EUT is as follows.

- Tx mode

- Test configuration



4.2 Limit

The minimum permissible 6dB bandwidth is 500kHz.

4.3 Measurement result

Date : Nov. 28, 2013
 Temperature : 20.0 [°C]
 Humidity : 46.0 [%]
 Test place : Shielded room

Test personnel :

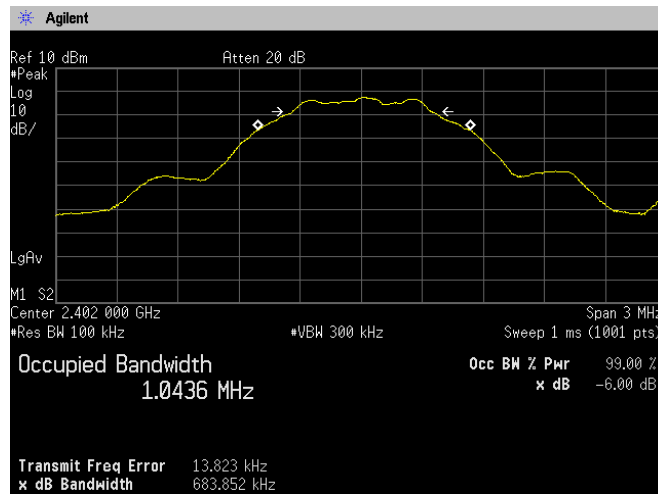
Tested by :

Nobuyuki Toda

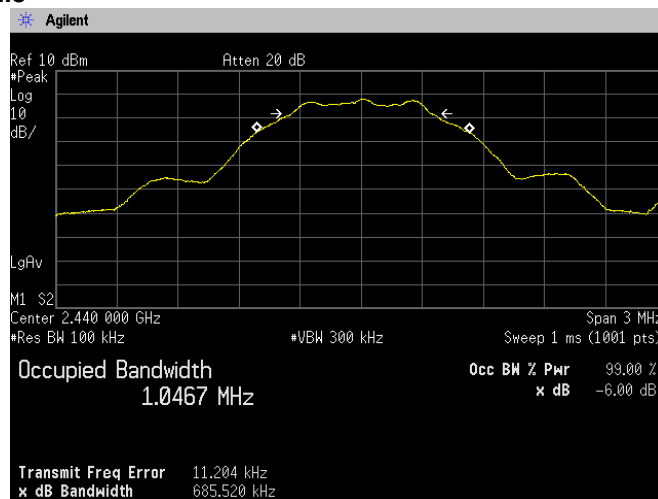
Channel	Frequency [MHz]	6dB bandwidth [MHz]
Low	2402	0.6839
Middle	2440	0.6855
High	2480	0.6934

4.4 Trace data

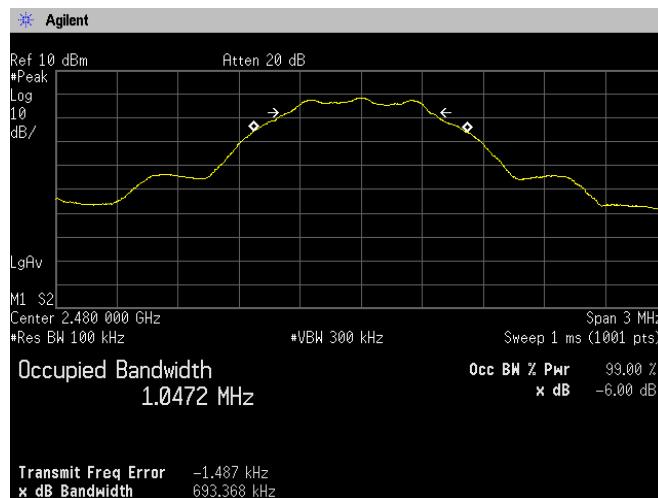
Channel Low



Channel Middle



Channel High



5. Maximum Peak Output Power

5.1 Measurement procedure

[FCC 15.247(b)(3), 15.31(e), KDB558074]

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=1MHz, VBW=8MHz, Span=3MHz, Sweep=auto, Detector=Peak, Trace mode=Max hold

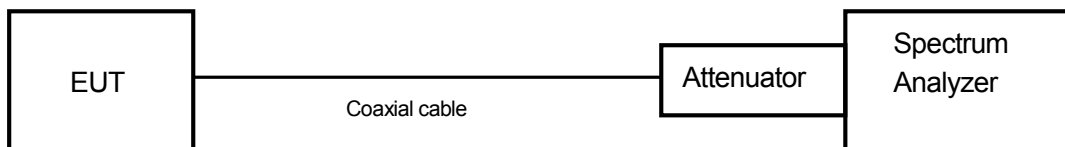
The EUT was set to operate with following conditions.

- Channel Low: 2402MHz, Channel Middle: 2440MHz, Channel High: 2480MHz

The test mode of EUT is as follows.

- Tx mode

- Test configuration



5.2 Limit

1W (1000mW) or less



Zacta

5.3 Measurement result

Date : Nov. 28, 2013
 Temperature : 20.0 [°C]
 Humidity : 46.0 [%]
 Test place : Shielded room

Test personnel :

Tested by :

Nobuyuki Toda

[2.55V]

Channel	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Peak Output Power (mW)	Limit (mW)	Result
Low	2402	-2.47	9.81	7.34	5.420	≤1000	PASS
Middle	2440	-2.02	9.81	7.79	6.012	≤1000	PASS
High	2480	-1.65	9.81	8.16	6.546	≤1000	PASS

[3.0V]

Channel	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Peak Output Power (mW)	Limit (mW)	Result
Low	2402	-2.50	9.81	7.31	5.383	≤1000	PASS
Middle	2440	-2.06	9.81	7.75	5.957	≤1000	PASS
High	2480	-1.63	9.81	8.18	6.577	≤1000	PASS

[3.45V]

Channel	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Peak Output Power (mW)	Limit (mW)	Result
Low	2402	-2.49	9.81	7.32	5.395	≤1000	PASS
Middle	2440	-2.00	9.81	7.81	6.039	≤1000	PASS
High	2480	-1.93	9.81	7.88	6.138	≤1000	PASS

Calculation;

$$\text{Reading (dBm)} + \text{Factor (dB)} = \text{Level (dBm)}$$

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

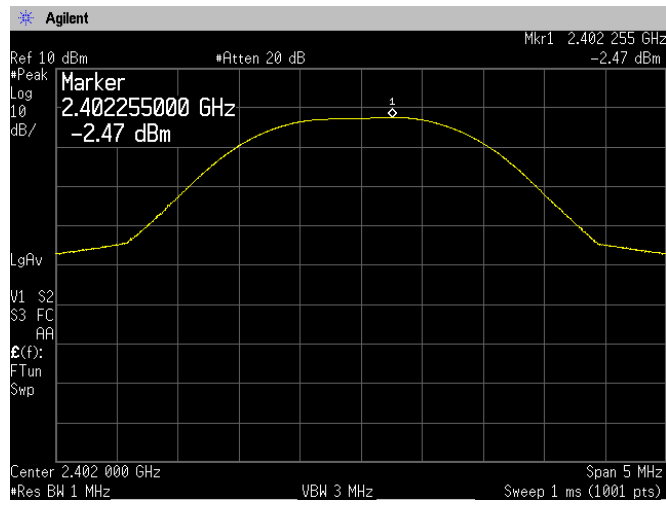
$$P = 10^{(\text{Maximum Peak Output Power} / 10)} \text{ (mW)}$$



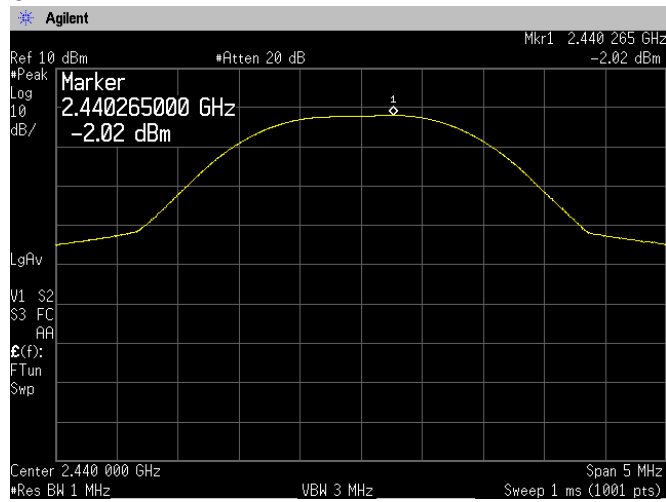
Zacta

5.4 Trace data

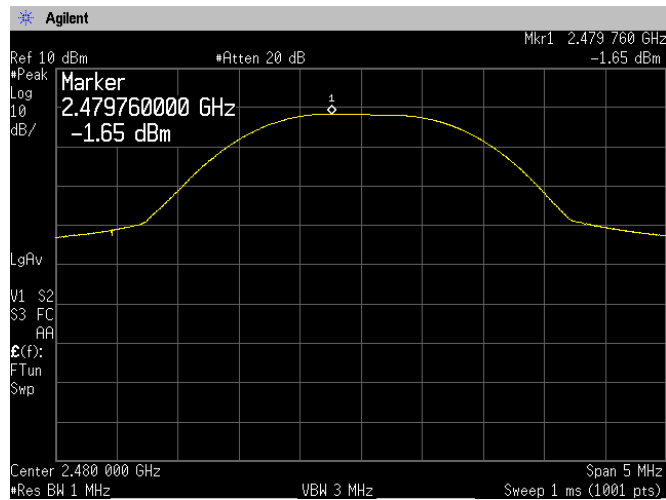
[2.55V]
Channel Low



Channel Middle



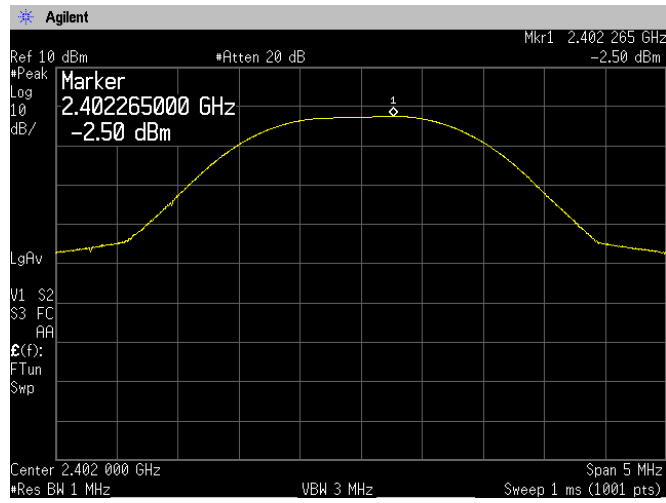
Channel High



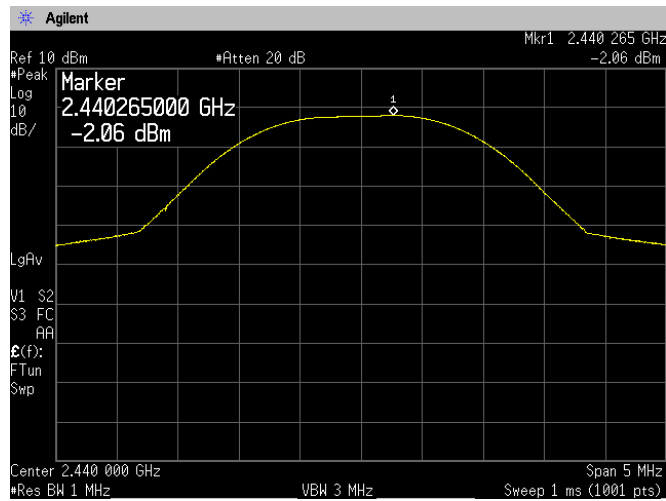


Zacta

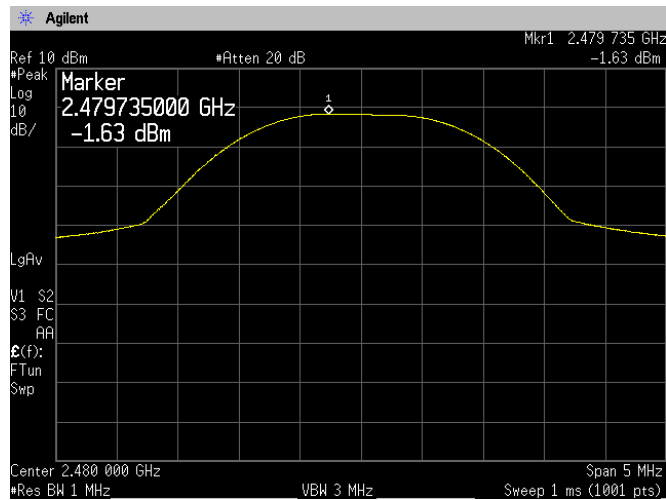
[3.0V]
Channel Low



Channel Middle



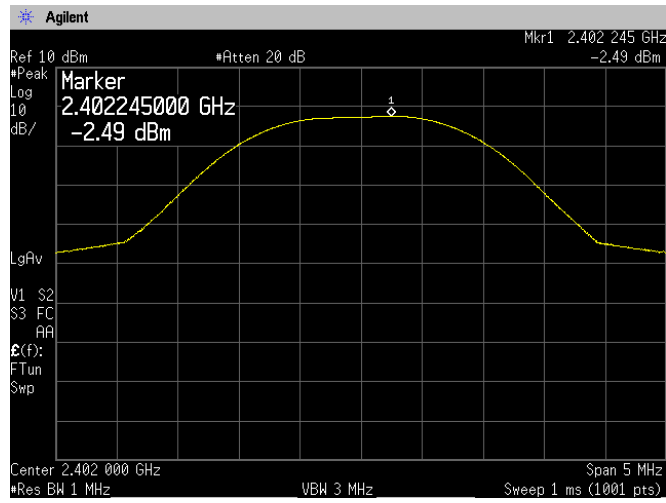
Channel High



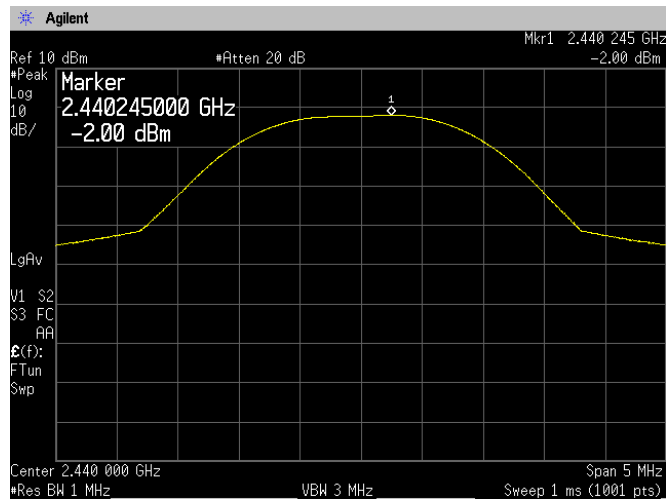


Zacta

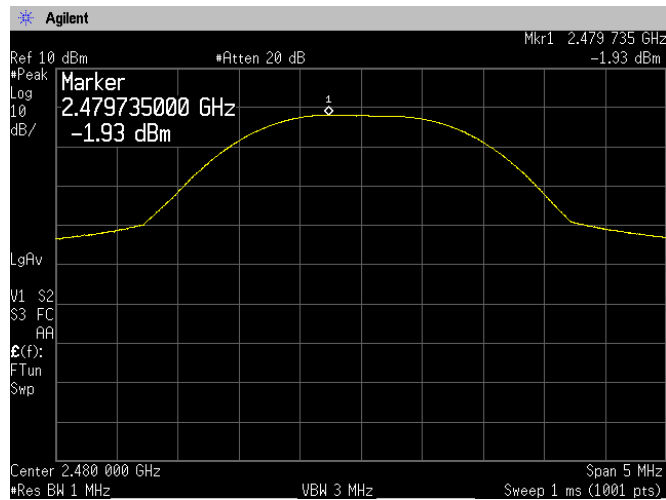
[3.45V] Channel Low



Channel Middle



Channel High



6. Band Edge Compliance of RF Conducted Emissions

6.1 Measurement procedure [FCC 15.247(d), KDB558074]

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, Detector=Peak, Trace mode=Max hold

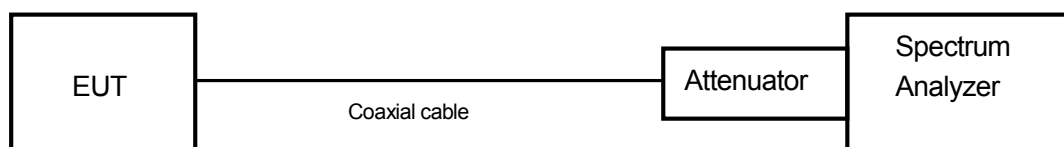
The EUT was set to operate with following conditions.

- Channel Low: 2402MHz, Channel High: 2480MHz

The test mode of EUT is as follows.

- Tx mode

- Test configuration



6.2 Limit

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.

6.3 Measurement result

Date : Nov. 28, 2013
 Temperature : 20.0 [°C]
 Humidity : 46.0 [%]
 Test place : Shielded room

Test personnel :

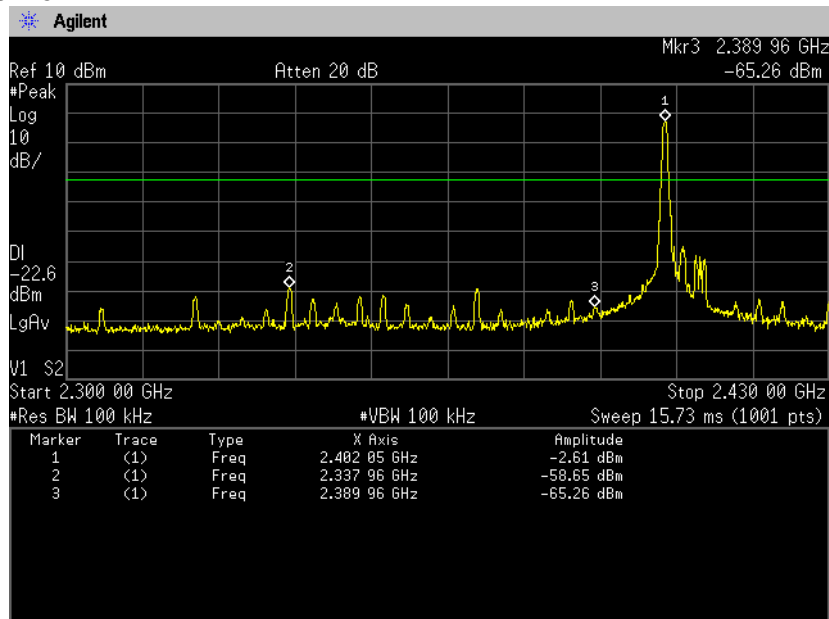
Tested by :

Nobuyuki Toda

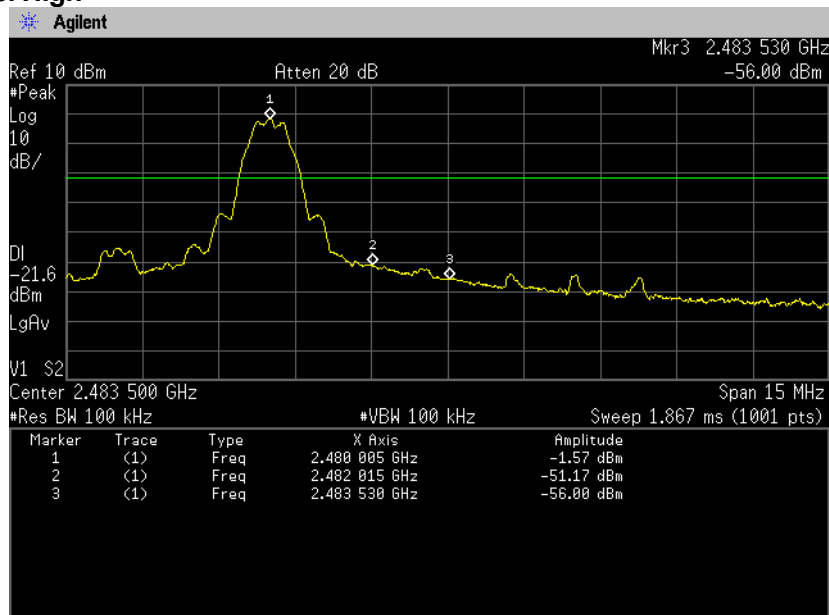
Channel	Frequency (MHz)	RF Power Level (dBm)	Band-edge Frequency (MHz)	Band-edge Level (dBm)	Difference Level (dBm)	Limit (dBm)	Result
Low	2402	-2.61	2337.96	-58.65	56.04	At least 20dB below from peak of RF	PASS
High	2480	-1.57	2483.53	-56.00	54.43	At least 20dB below from peak of RF	PASS

6.4 Trace data

Channel Low



Channel High



7. Spurious emissions - Conducted -

7.1 Measurement procedure [FCC 15.247(d), KDB558074]

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, Detector=Peak, Trace mode=Max hold

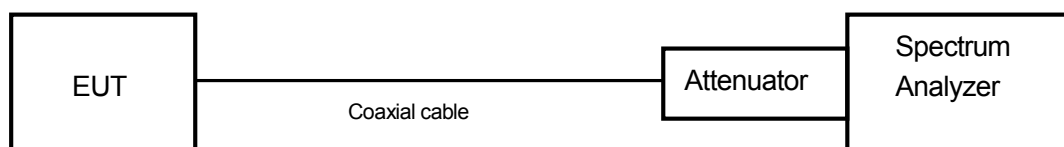
The EUT was set to operate with following conditions.

- Channel Low: 2402MHz, Channel Middle: 2440MHz, Channel High: 2480MHz

The test mode of EUT is as follows.

- Tx mode

- Test configuration



7.2 Limit

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.

7.3 Measurement result

Date : Nov. 28, 2013
 Temperature : 20.0 [°C]
 Humidity : 46.0 [%]
 Test place : Shielded room

Test personnel :

Tested by :

Nobuyuki Toda

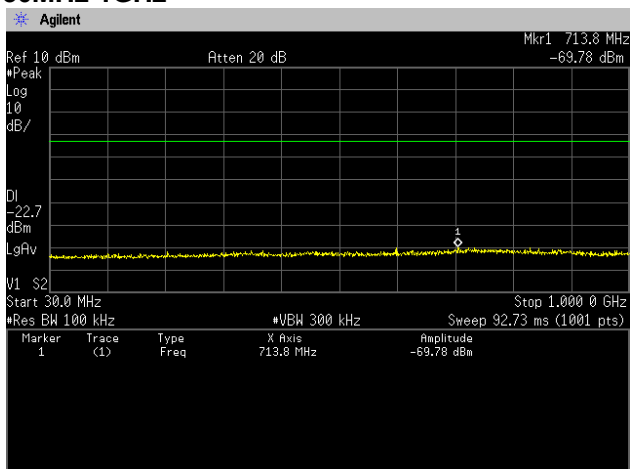
Channel	Frequency [MHz]	Limit [dB]	Results Chart	Result
Low	2402	At least 20dB below from peak of RF	See the trace Data	PASS
Middle	2440	At least 20dB below from peak of RF	See the trace Data	PASS
High	2480	At least 20dB below from peak of RF	See the trace Data	PASS



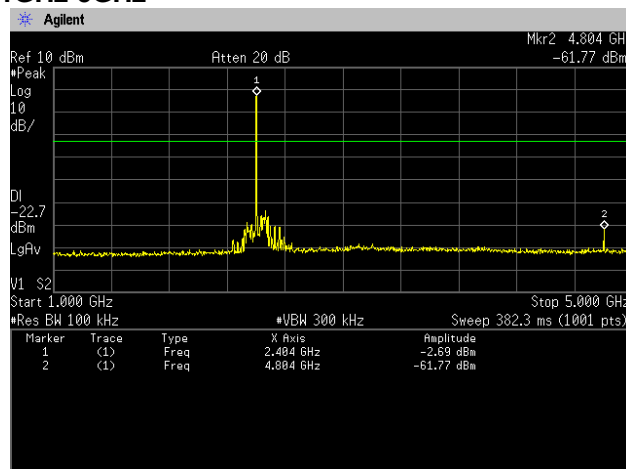
Zacta

7.4 Trace data

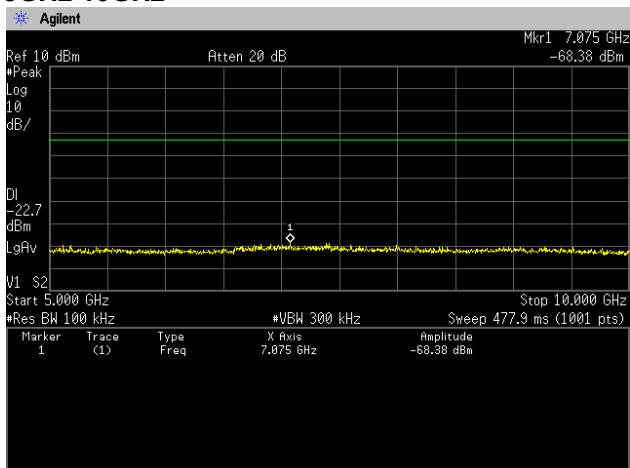
Channel Low 30MHz-1GHz



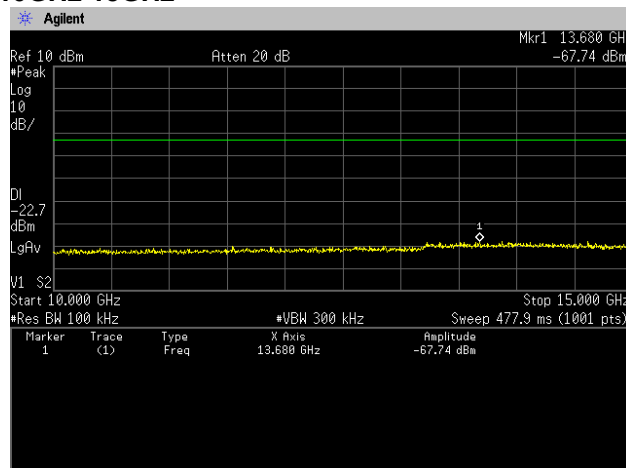
1GHz-5GHz



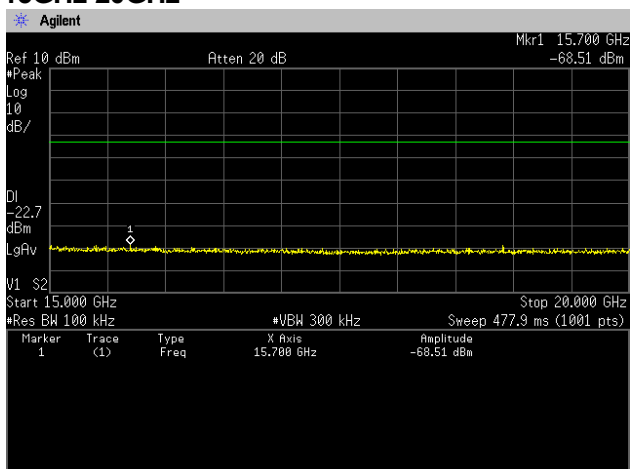
5GHz-10GHz



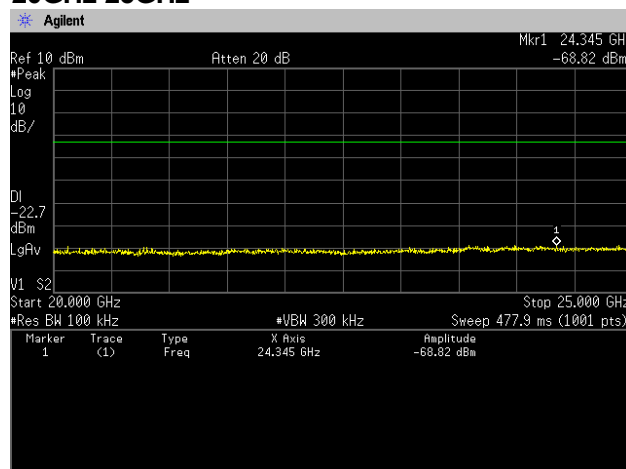
10GHz-15GHz



15GHz-20GHz



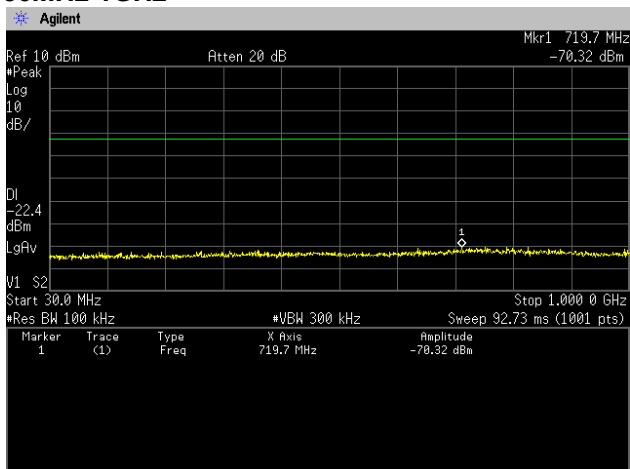
20GHz-25GHz



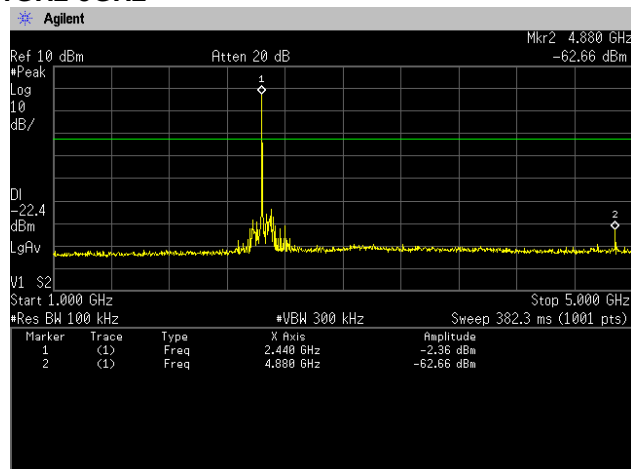


Zacta

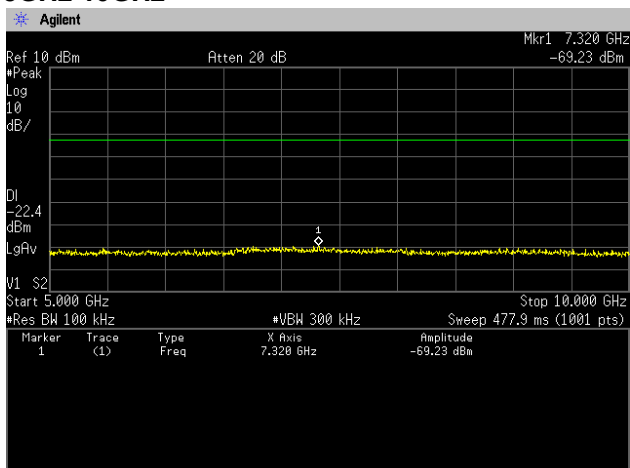
Channel Middle 30MHz-1GHz



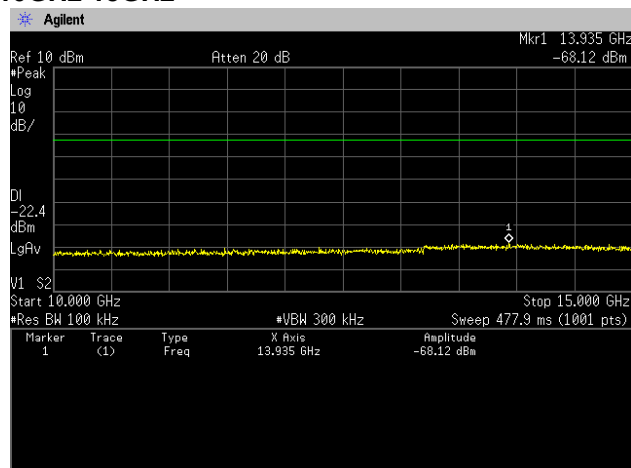
1GHz-5GHz



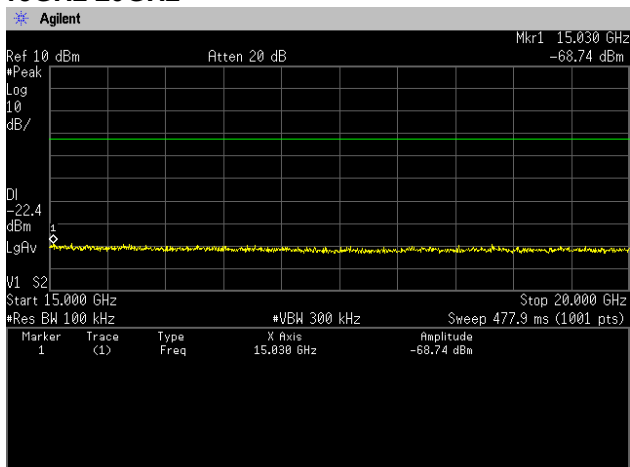
5GHz-10GHz



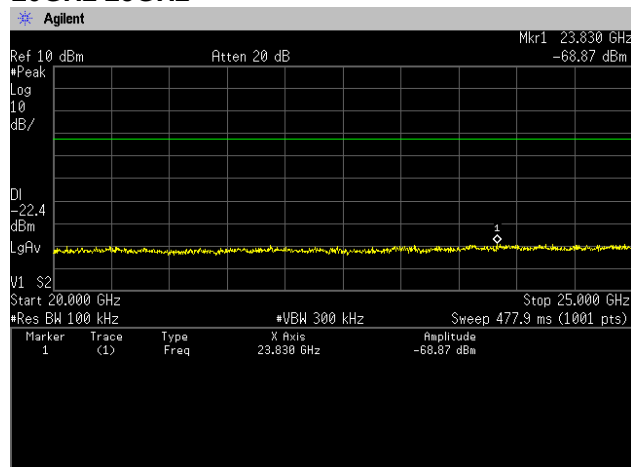
10GHz-15GHz



15GHz-20GHz



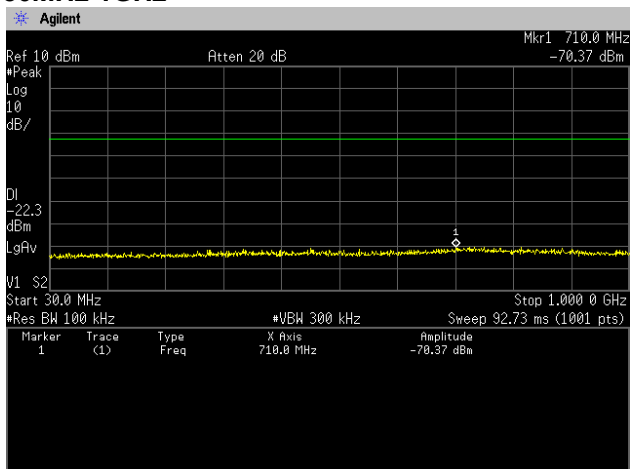
20GHz-25GHz



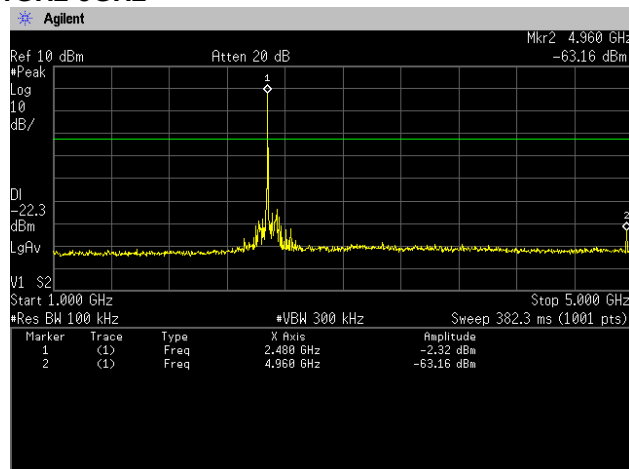


Zacta

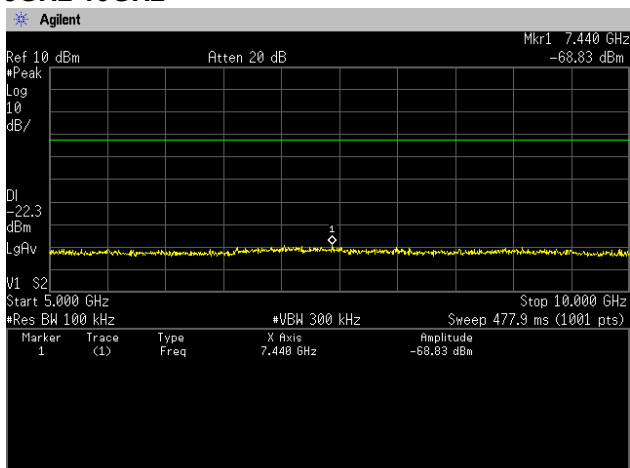
Channel High 30MHz-1GHz



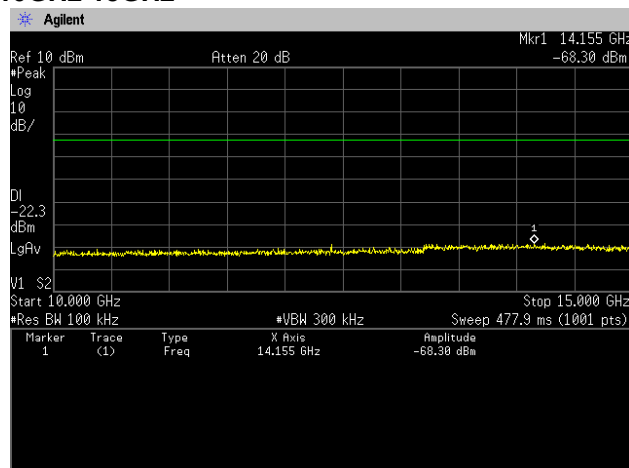
1GHz-5GHz



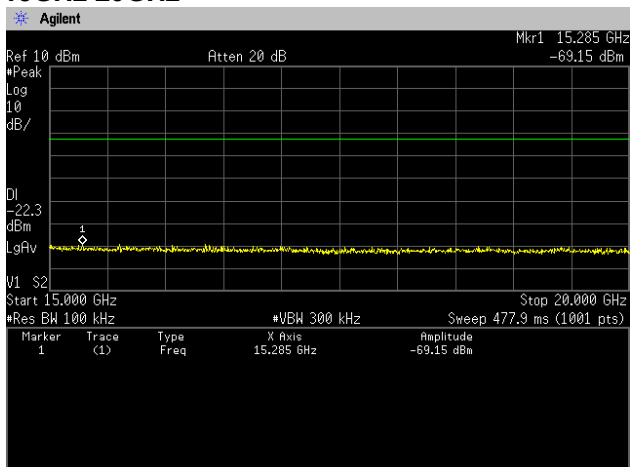
5GHz-10GHz



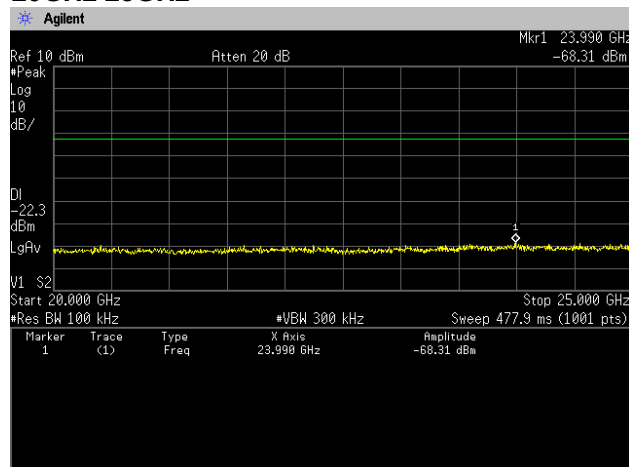
10GHz-15GHz



15GHz-20GHz



20GHz-25GHz



8. Spurious Emissions - Radiated -

8.1 Measurement procedure [FCC 247(d), 15.205, 15.209]

Test was applied by following conditions.

Test method	:	ANSI C63.4
Frequency range	:	9kHz to 25GHz
Test place	:	3m Semi-anechoic chamber
EUT was placed on	:	FRP table / (W)2.0m × (D)1.0m × (H)0.8m
Antenna distance	:	3m
Test receiver setting	:	Below 1GHz
- Detector	:	Average (9kHz-90kHz, 110kHz-490kHz), Quasi-peak
- Bandwidth	:	200Hz, 120kHz
Spectrum analyzer setting	:	Above 1GHz
- Peak	:	RBW=1MHz, VBW=3MHz, Span=0Hz, Sweep=auto
- Average	:	RBW=1MHz, VBW=3kHz, Span=0Hz, Sweep=auto
	:	Display mode=Linear

Average Measurement Setting [VBW]

Mode	Duty Cycle (%)	T _{on} (us)	T _{off} (us)	1/T _{on} (kHz)	Determined VBW Setting
Bluetooth 4.0 LE	64.22	402.0	224.0	2.5	3kHz

Radiated emission measurements are performed at 3m distance with the broadband antenna (Loop antenna, Biconical antenna, Log periodic antenna and Double ridged guide antenna). The antenna is positioned both the horizontal and vertical planes of polarization and height is varied 1m to 4m 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 antenna is 1m above the ground plane.

The EUT is Placed on a turntable, which is 0.8m above ground plane. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level. 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.

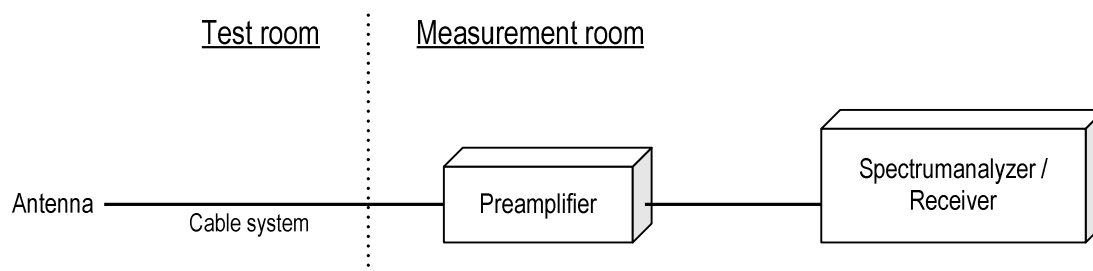
The EUT was set to operate with following conditions.

- Channel Low: 2402MHz, Channel Middle: 2440MHz, Channel High: 2480MHz

The test mode of EUT is as follows.

- Tx mode, Rx mode

- Test configuration



8.2 Calculation method

[9kHz to 150kHz]

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

Margin = Limit – Emission level

[150kHz to 25GHz]

Emission level = Reading + (Ant. factor + Cable system loss – Amp. Gain)

Margin = Limit – Emission level

8.3 Limit

Frequency [MHz]	Field strength		Distance [m]
	[uV/m]	[dBuV/m]	
0.009-0.490	2400 / F [kHz]	20logE [uV/m]	300
0.490-1.705	24000 / F [kHz]	20logE [uV/m]	30
1.705-30	30	29.5	30
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	300	54.0	3

Note:

1. The lower limit shall apply at the transition frequencies.
2. Emission level [dBuV/m] = 20log 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 modulation.

8.4 Test data

Date : Dec. 24, 2013 Test personnel :
 Temperature : 18.1 [°C]
 Humidity : 33.6 [%] Tested by :
 Test place : 3m Semi-anechoic chamber Chiaki Kanno

Date : Dec. 25, 2013 Test personnel :
 Temperature : 19.7 [°C]
 Humidity : 23.8 [%] Tested by :
 Test place : 3m Semi-anechoic chamber Taiki Watanabe

[Transmit mode] Channel Low

No.	Frequency [MHz]	(P)	Reading QP [dB(μV)]	c. f [dB(1/m)]	Result QP [dB(μV/m)]	Limit QP [dB(μV/m)]	Margin QP [dB]	Height [cm]	Angle [°]
1	35.999	V	35.3	-6.6	28.7	40.0	11.3	100.0	118.0
2	119.991	V	34.1	-8.8	25.3	43.5	18.2	100.0	107.0
3	191.984	V	31.9	-4.7	27.2	43.5	16.3	100.0	119.0
4	276.521	H	22.8	-2.5	20.3	46.0	25.7	100.0	0.0
5	359.994	H	48.5	-8.9	39.6	46.0	6.4	100.0	49.0
6	431.998	H	46.2	-6.9	39.3	46.0	6.7	100.0	116.0

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	1089.000	H	50.4	37.3	-5.1	45.3	32.2	74.0	54.0	28.7	21.8	100.0	315.0
2	2338.010	H	55.6	50.4	2.1	57.7	52.5	74.0	54.0	16.3	1.5	100.0	301.0
3	2498.018	H	52.6	43.7	2.7	55.3	46.4	74.0	54.0	18.7	7.6	100.0	265.0
4	4804.000	H	46.7	35.3	11.2	57.9	46.5	74.0	54.0	16.1	7.5	100.0	273.0
5	7206.000	H	43.9	32.1	16.0	59.9	48.1	74.0	54.0	14.1	5.9	100.0	297.0

Channel Middle

No.	Frequency [MHz]	(P)	Reading QP [dB(μV)]	c. f [dB(1/m)]	Result QP [dB(μV/m)]	Limit QP [dB(μV/m)]	Margin QP [dB]	Height [cm]	Angle [°]
1	359.999	H	48.6	-8.9	39.7	46.0	6.3	100.0	43.0
2	431.997	H	46.7	-6.9	39.8	46.0	6.2	100.0	118.0
3	797.600	V	24.9	-0.9	24.0	46.0	22.0	106.0	329.0

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	1065.000	H	49.3	37.4	-5.3	44.0	32.1	74.0	54.0	30.0	21.9	100.0	226.0
2	2376.025	H	54.7	48.1	2.3	57.0	50.4	74.0	54.0	17.0	3.6	100.0	279.0
3	2503.640	H	51.7	44.9	2.7	54.4	47.6	74.0	54.0	19.6	6.4	100.0	278.0
4	4880.000	H	46.8	40.3	11.4	58.2	51.7	74.0	54.0	15.8	2.3	100.0	302.0
5	7320.000	H	42.7	32.7	16.7	59.4	49.4	74.0	54.0	14.6	4.6	100.0	302.0

Channel High

No.	Frequency [MHz]	(P)	Reading QP [dB(μV)]	c. f [dB(1/m)]	Result QP [dB(μV/m)]	Limit QP [dB(μV/m)]	Margin QP [dB]	Height [cm]	Angle [°]
1	312.000	H	48.5	-10.0	38.5	46.0	7.5	100.0	290.0
2	359.998	H	48.8	-8.9	39.9	46.0	6.1	100.0	277.0
3	432.010	H	45.1	-6.9	38.2	46.0	7.8	100.0	129.0

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	1089.000	H	49.6	36.7	-5.1	44.5	31.6	74.0	54.0	29.5	22.4	100.0	306.0
2	2254.000	H	51.3	34.3	1.4	52.7	35.7	74.0	54.0	21.3	18.3	100.0	299.0
3	2543.930	H	59.0	48.9	3.0	62.0	51.9	74.0	54.0	12.0	2.1	100.0	48.0
4	4960.000	H	46.4	37.3	11.8	58.2	49.1	74.0	54.0	15.8	4.9	100.0	4.0
5	7440.000	H	44.6	32.9	16.8	61.4	49.7	74.0	54.0	12.6	4.3	100.0	278.0

Note:

- Emission Level (Margin) = Limit - [Reading + Factor (Antenna + Cable - Amp)]
- No emission were detected in frequency range 9kHz to 30MHz at the 3 meters distance.



Zacta

[Receive mode]**Channel Low**

No.	Frequency [MHz]	(P)	Reading QP [dB(μ V)]	c. f [dB(1/m)]	Result QP [dB(μ V/m)]	Limit QP [dB(μ V/m)]	Margin QP [dB]	Height [cm]	Angle [$^{\circ}$]
1	30.574	V	35.0	-4.7	30.3	40.0	9.7	100.0	210.0
2	312.000	H	42.6	-10.0	32.6	46.0	13.4	100.0	127.0
3	432.000	H	39.9	-6.9	33.0	46.0	13.0	100.0	308.0

Channel Middle

No.	Frequency [MHz]	(P)	Reading QP [dB(μ V)]	c. f [dB(1/m)]	Result QP [dB(μ V/m)]	Limit QP [dB(μ V/m)]	Margin QP [dB]	Height [cm]	Angle [$^{\circ}$]
1	312.000	H	42.2	-10.0	32.2	46.0	13.8	100.0	232.0
2	448.000	H	39.0	-6.5	32.5	46.0	13.5	237.0	189.0

Channel High

No.	Frequency [MHz]	(P)	Reading QP [dB(μ V)]	c. f [dB(1/m)]	Result QP [dB(μ V/m)]	Limit QP [dB(μ V/m)]	Margin QP [dB]	Height [cm]	Angle [$^{\circ}$]
1	312.001	H	42.4	-10.0	32.4	46.0	13.6	100.0	236.0
2	440.000	H	39.5	-6.8	32.7	46.0	13.3	230.0	186.0

9. Restricted Band of Operation

9.1 Measurement procedure [FCC 247(d), 15.205, 15.209]

Test was applied by following conditions.

Test method : ANSI C63.4
 Test place : 3m Semi-anechoic chamber
 EUT was placed on : FRP table / (W)2.0m × (D)1.0m × (H)0.8m
 Antenna distance : 3m

Spectrum analyzer setting
 - Peak : RBW=1MHz, VBW=3MHz, Span=Arbitrary setting, Sweep=auto
 - Average : RBW=1MHz, VBW=3kHz, Span=Arbitrary setting, Sweep=auto
 Display mode=Linear

Average Measurement Setting [VBW]

Mode	Duty Cycle (%)	T _{on} (us)	T _{off} (us)	1/T _{on} (kHz)	Determined VBW Setting
Bluetooth 4.0 LE	64.22	402.0	224.0	2.5	3kHz

Radiated emission measurements are performed at 3m distance with the broadband antenna (Double ridged guide antenna). The antenna is positioned both the horizontal and vertical planes of polarization and height is varied 1m to 4m and stopped at height producing the maximum emission.

The EUT is Placed on a turntable, which is 0.8m above ground plane. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level. 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.

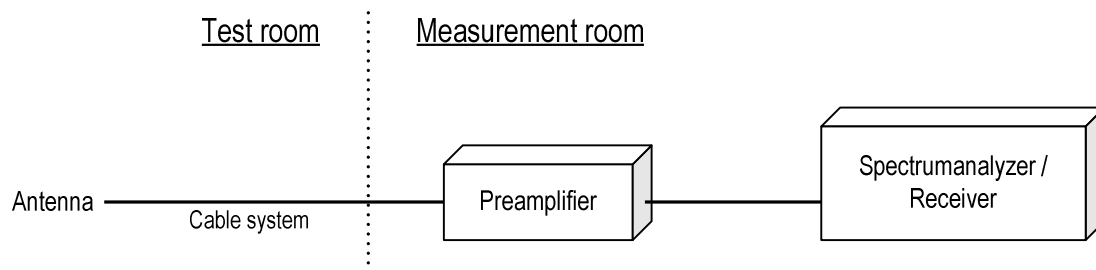
The EUT was set to operate with following conditions.

- Channel Low: 2402MHz, Channel High: 2480MHz

The test mode of EUT is as follows.

- Tx mode

- Test configuration



9.2 Limit

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

9.3 Measurement Result

Channel	Frequency [MHz]	Results Chart	Result
Low	2402	See the Trace Data	Pass
High	2480	See the Trace Data	Pass

9.4 Test data

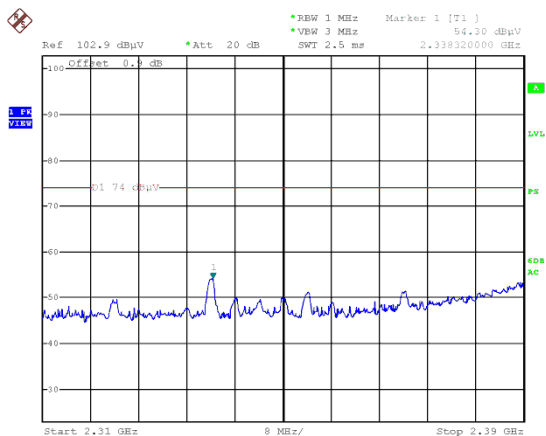
Date : Dec. 26, 2013
 Temperature : 21.4 [°C]
 Humidity : 23.3 [%]
 Test place : 3m Semi-anechoic chamber

Test personnel :

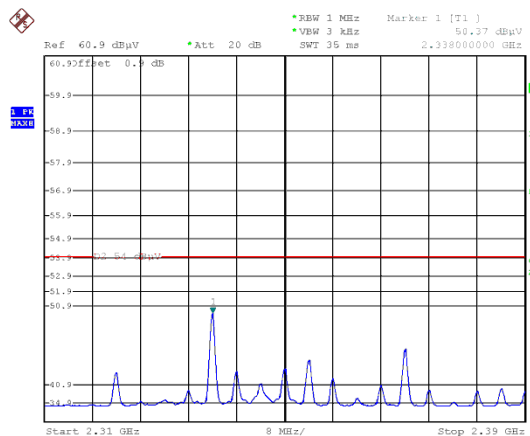
Tested by :

Taiki Watanabe

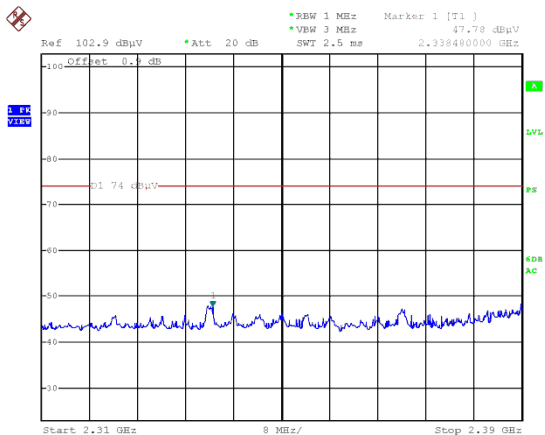
Channel Low Horizontal Peak



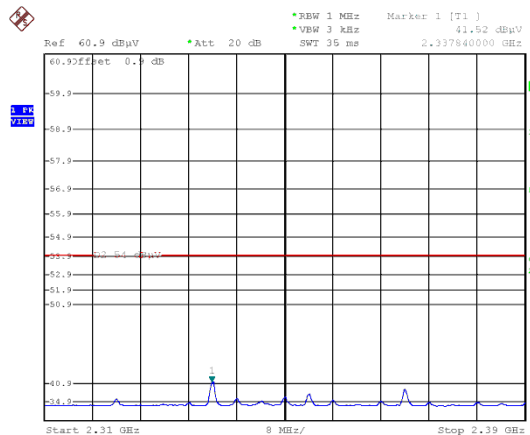
Average



Vertical Peak



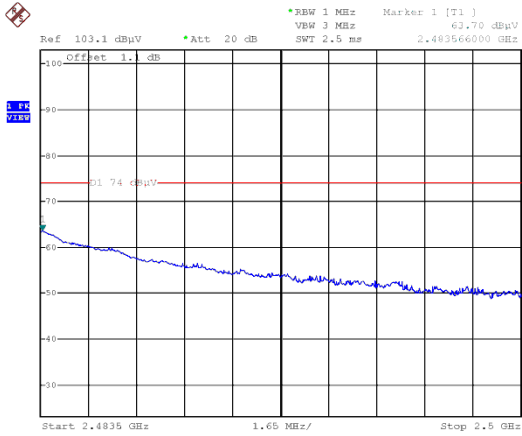
Average



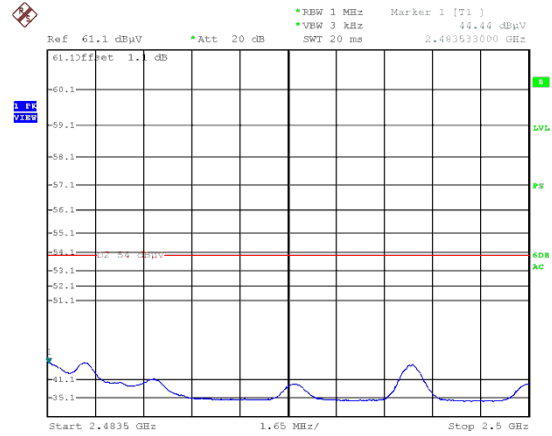


Zacta

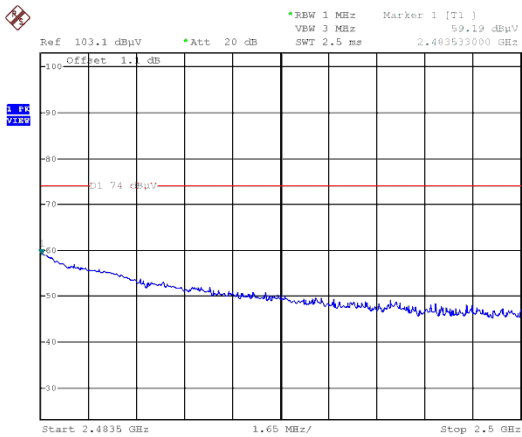
Channel High Horizontal Peak



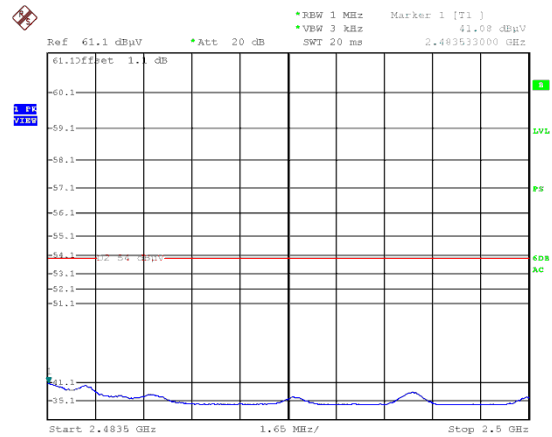
Average



Vertical Peak



Average



10. Transmitter Power Spectral Density

10.1 Measurement procedure [FCC 15.247(d), KDB558074]

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=3kHz, VBW=10kHz, Span=1MHz, Sweep=Auto, Detector=Peak, Trace mode=Max hold

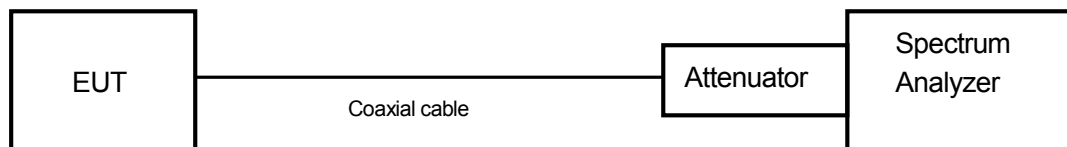
The EUT was set to operate with following conditions.

- Channel Low: 2402MHz, Channel Middle: 2440MHz, Channel High: 2480MHz

The test mode of EUT is as follows.

- Tx mode

- Test configuration



10.2 Limit

The peak power spectral density shall not be greater than 8dBm in any 3kHz band.

10.3 Measurement result

Date : Nov. 28, 2013
 Temperature : 20.0 [°C]
 Humidity : 46.0 [%]
 Test place : Shielded room

Test personnel :

Tested by :

Nobuyuki Toda

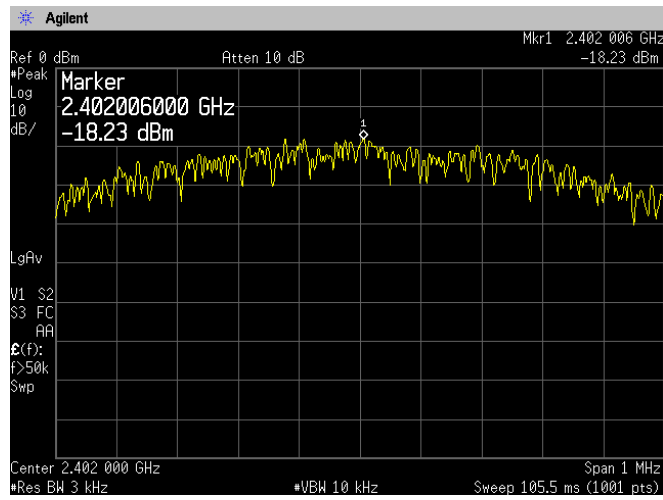
Channel	Frequency (MHz)	Reading (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dBm)	Result
Low	2402	-18.23	9.81	-8.42	8.00	16.42	PASS
Middle	2440	-17.63	9.81	-7.82	8.00	15.82	PASS
High	2480	-15.18	9.81	-5.37	8.00	13.37	PASS

Calculation;

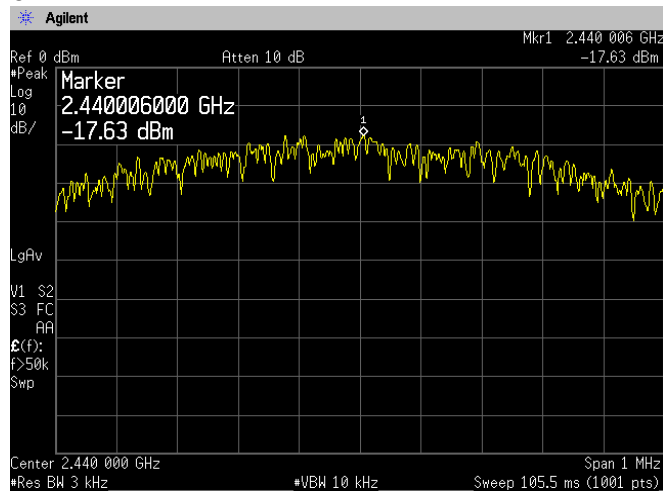
Transmitter Power Spectral Density Level (Margin) = Limit – (Reading + Factor)

10.4 Trace data

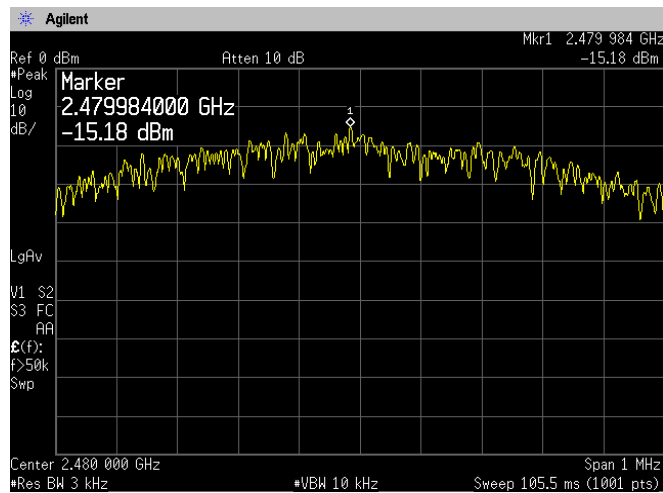
Channel Low



Channel Middle



Channel High



11. AC Power Line Conducted Emissions

11.1 Measurement procedure [FCC 15.207]

Test was applied by following conditions.

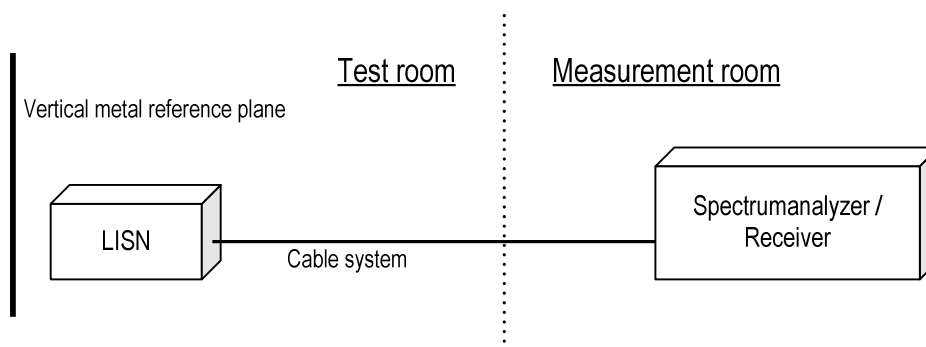
Test method	: ANSI C63.4
Frequency range	: 0.15MHz to 30MHz
Test place	: 10m Semi-anechoic chamber
EUT was placed on	: FRP table / (W)2.0m × (D)1.0m × (H)0.8m
Vertical Metal Reference Plane	: (W)2.0m × (H)2.0m 0.4m away from EUT
Test receiver setting	
- Detector	: Quasi-peak, Average
- Bandwidth	: 9kHz

EUT and peripherals are connected to 50Ω/50μH Line Impedance Stabilization Network (LISN) which are connected to reference ground plane, and are placed 80cm away from EUT. Excess of AC power cable is bundled in center.

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, peripherals, 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, peripherals and test equipment is provided in order for them to warm up to their normal operating condition. If the average limit is met when using a quasi-peak detector receiver, the EUT shall be deemed to meet both limits.

- Test configuration



11.2 Calculation method

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

Margin = Limit – Emission level

11.3 Limit

Frequency [MHz]	Limit	
	QP [dBuV]	AV [dBuV]
0.15-0.5	66-56*	56-46*
0.5-5	56	46
5-30	60	50

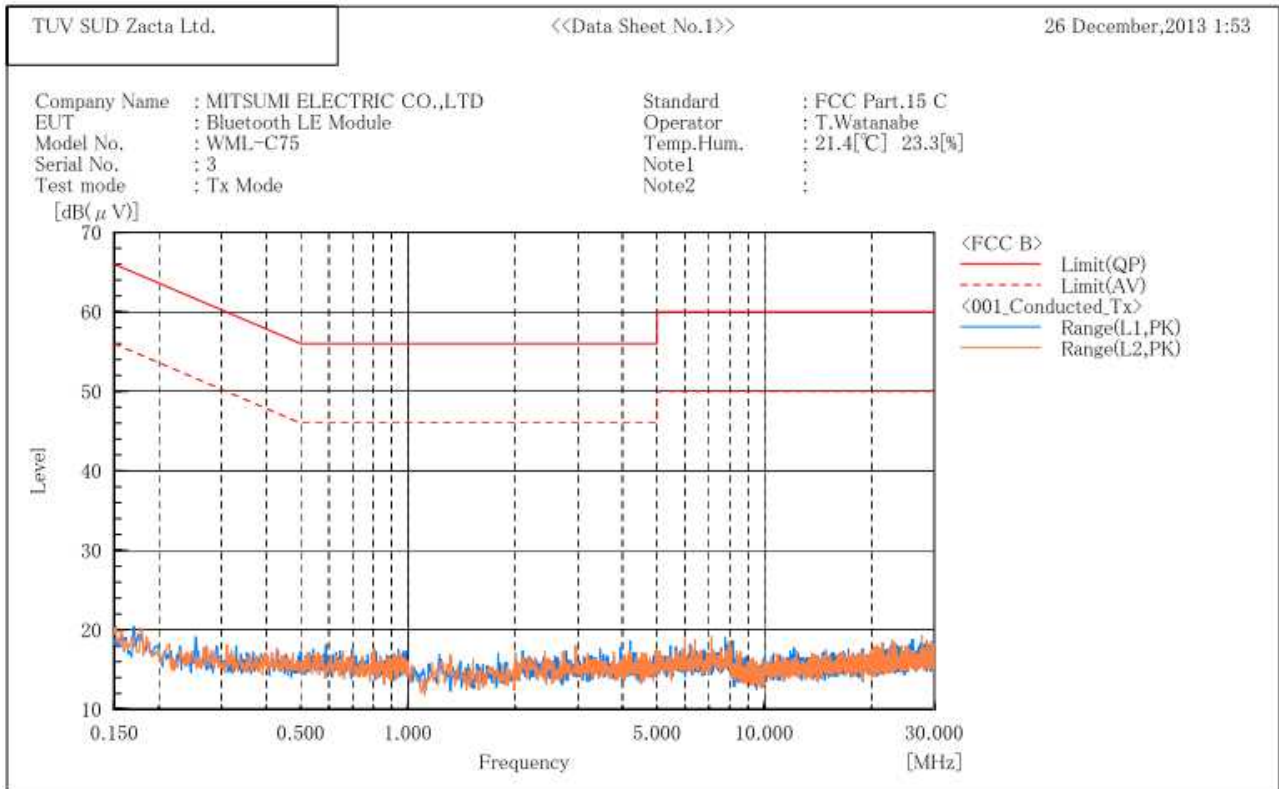
*: The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz.



Zacta

11.4 Test data

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



Note: No emissions were observed during Conducted Emission testing.

12. 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.

13. Uncertainty of measurement

Expanded uncertainties stated are 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)	$\pm 3.9\text{dB}$



Zacta

14. Laboratory description

1. Location:

TÜV SÜD Zacta Ltd. 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
3m Semi-anechoic chamber	VLAC-013	-	-	-	Jul. 3, 2015
10m Semi-anechoic chamber				VLAC-013	
Shielded room No.1	-	VLAC-013	-	-	

3) FCC filing:

Site name	Registration Number	Expiry Date
Site 2	91065	Oct.31, 2014
Site 3		
3m Semi-anechoic chamber	540072	Jan. 9, 2016
10m Semi-anechoic chamber		
Shielded room No.1		

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	

5) VCCI site filing:

Site name	Radiated emission	Conducted emission for mains port	Conducted emission for telecom port	Expiry Date
Site 2	R-137	C-133	T-1221	Nov. 16, 2014 Nov. 28, 2014* (*:Telecom port)
Site 3	R-138	C-134	T-1222	
3m Semi-anechoic chamber	-	A-0166	-	Jul. 3, 2015
10m Semi-anechoic chamber				
Shielded room No.1	-	A-0166	-	

6) TÜV SÜD PS authorization:

Authorized as an EMC test laboratory

7) TÜV Rheinland authorization:

Authorized 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	US4432655	May 2014	May 14, 2013
Microwave cable	RS	YH_13S5	N/A (S403)	May 2014	May 10, 2013
Attenuator	Weinschel	56-10	J4180	Nov. 2014	Nov. 12, 2013

Radiated emission

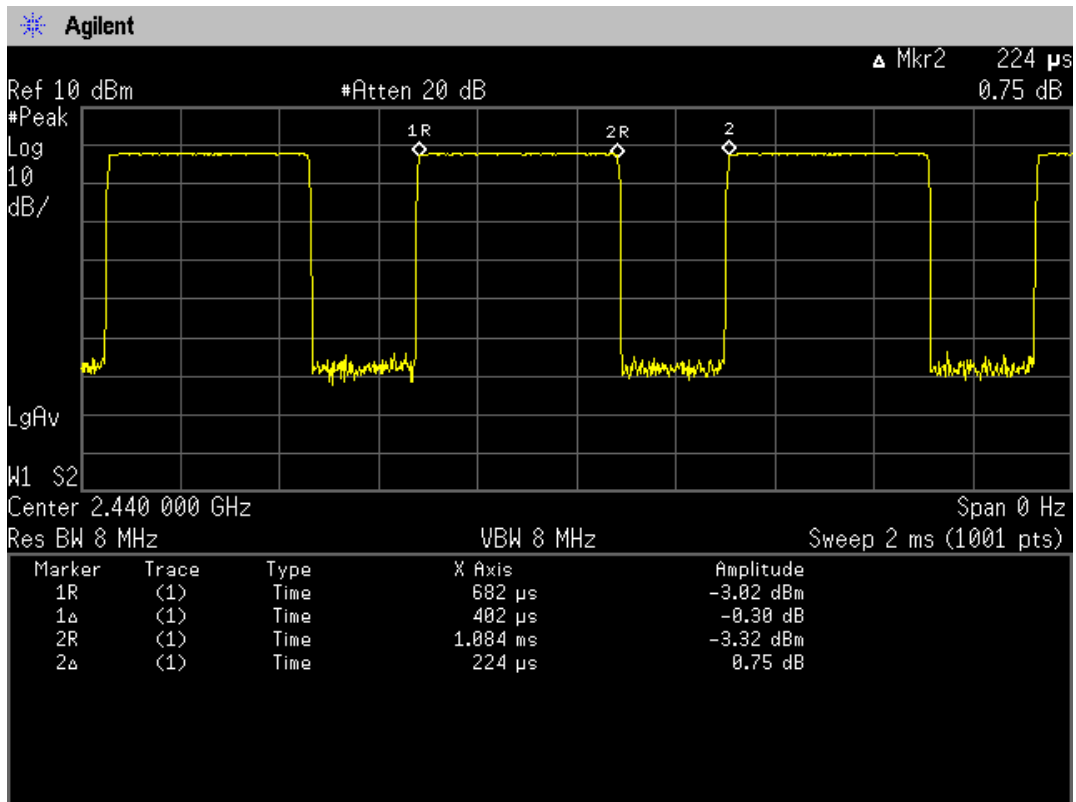
Equipment	Company	Model No.	Serial No.	Cal. Due	Cal. Date
EMI Receiver	ROHDE&SCHWARZ	ECSI	100451	Nov. 2014	Nov. 16, 2013
Preamplifier	ANRITSU	MH648A	M96057	Jun. 2014	Jun. 12, 2013
Loop antenna	ROHDE&SCHWARZ	HFH2-Z2	892246/010	Oct. 2014	Oct. 5, 2013
Biconical Antenna	Schwarzbeck	VHA9103/BBA9106	2155	May 2014	May 1, 2013
Log periodic Antenna	Schwarzbeck	UHALP9108A	0560	May 2014	May 1, 2013
Attenuator	TME	CFA-01NPJ-6	N/A (S275)	Jun. 2014	Jun. 6, 2013
Attenuator	TME	CFA-01NPJ-3	N/A (S272)	Jun. 2014	Jun. 6, 2013
Spectrum analyzer	Agilent Technologies	E4447A	MY46180188	Mar. 2014	Mar. 8, 2013
Preamplifier	Agilent Technologies	8449B	3008A1008	Dec. 2014	Dec. 9, 2013
Double ridged guide antenna	EMCO	3115	4328	Jan. 2014	Jan. 21, 2013
Attenuator	AEROFLEX	40A-03	081217-20	Feb. 2014	Feb. 23, 2013
Broad-Band Horn Antenna	Schwarzbeck	BBHA9170	BBHA9170189	May 2015	May 2, 2013
Preamplifier	TSJ	MLA-1840-B03-35	1240332	May 2015	May 2, 2013
Microwave cable	SUHNER	SUCOFLEX104/9m	346316/4	Oct. 2014	Oct. 6, 2013
		SUCOFLEX104/1m	322084/4	Oct. 2014	Oct. 6, 2013
		SUCOFLEX104/1.5m	317226/4	Oct. 2014	Oct. 6, 2013
		SUCOFLEX104/7m	41625/6	Oct. 2014	Oct. 6, 2013
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 2014	May 19, 2013
3m Semi-anechoic chamber	TOKIN	N/A	N/A (9002-SVSWR)	May 2014	May 19, 2013

Conducted emission at mains port

Equipment	Company	Model No.	Serial No.	Cal. due	Cal. date
EMI Receiver	ROHDE&SCHWARZ	ECSI	100451	Nov. 2014	Nov. 16, 2013
Attenuator	HUBER+SUHNER	6810.01.A	N/A (S411)	Feb. 2014	Feb. 28, 2013
Line impedance stabilization network for EUT	Kyoritsu Electrical Works, Ltd.	KNW-407F	8-2003-1	Mar. 2014	Mar. 12, 2013
Coaxial cable	FUJIKURA	5D-2W/4m	N/A (S350)	Feb. 2014	Feb. 4, 2013
Coaxial cable	FUJIKURA	5D-2W/1m	N/A (S193)	Feb. 2014	Feb. 4, 2013
Coaxial cable	SUHNER	RG214/U/10m	N/A (S194)	Feb. 2014	Feb. 4, 2013
PC	DELL	DIMENSION	75465BX	N/A	N/A

Appendix B. Duty Cycle

[Plot & Calculation]



$$\text{Duty Cycle} = T_{\text{on}} / (T_{\text{on}} + T_{\text{off}}) = 402[\mu\text{s}] / (402[\mu\text{s}] + 224[\mu\text{s}]) = 64.22\%$$