

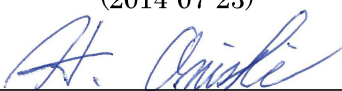


TEST REPORT

Issued: July 23, 2014

Name and Address of the Applicant:	SATO Corporation 1-7-1, Shimomeguro, Meguro-ku, Tokyo 153-0064 Japan
Test Item:	Bluetooth Module
Identification:	BT301(VRB4123-0102E)
Serial No.:	KFCY0012, KFCY0017
FCC ID:	MMFS8486EX-BT
Sample No.:	1
Sample Receipt Date:	March 7, 2014
Test Specification:	47 CFR Part 15 Subpart C
Date of Testing:	March 11, 12, 13, 17, 20, 21, 24, 26 and 27, 2014
Test Result:	PASS

Report Prepared by:	Cosmos Corporation 3571-2 Oonoki, Watarai-cho, Watarai-gun, Mie-ken 516-2102, Japan Phone: +81-596-63-0707 Fax: +81-596-63-0777
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Representative Test Personnel:	 (2014-07-23)	T. Nakai (EMC Dept.)
Reviewed by:	 (2014-07-23)	H. Onishi (EMC Dept.) iNARTE : EMC-003318-NT

Other Aspects:

Abbreviations:	PASS	=	passed
	FAIL	=	failed
	N/A	=	not applicable

Note:

1. This Test Report should not be reproduced except in full, without the written approval of Cosmos Corporation.
2. All measurement data contained in this Test Report may have uncertainty. A judgment for the limitation should be taken into the count.
3. The test result of this Test Report is based on the tests made for sample provided, and it is not applicable to individual product identical to the sample or similar product.
4. The judgment of this test report validates the test item only specified in "3. Summary of Test Results".



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1. General Information

1.1 Product Description

SATO Corporation, Model BT301(VRB4123-0102E) (referred to as the EUT in this report) is Bluetooth Module.

Manufacturer	SATO Corporation
Model (referred to as the EUT)	BT301(VRB4123-0102E)
Transmitter Type	☐ WLAN ☐ Bluetooth ☐ Zigbee ☐ RFID ☐ Other ()
Nominal Voltage	DC 5 V
Type of Modulation	FSK, PSK (FHSS)
Mode of Operation	☐ Simplex ☐ Duplex ☐ Other
Type of the Equipment	☐ Stand-alone ☐ Combined Equipment ☐ Plug-In Card ☐ Other (Module unit)
Type of the Antenna	☐ Integral ☐ External ☐ Other
Type of Power Source	☐ AC mains ☐ Dedicated AC adapter (V) ☐ DC Voltage ☐ Battery
Type of Battery (if applicable)	None
Type of Operation	☐ Continuous ☐ Burst ☐ Intermittent
Frequency Band Lower limit	2400 MHz
Upper limit	2483.5 MHz
Frequency of Operation	2402 MHz to 2480 MHz
Thermal Limitation	5°C to 40°C

1.2 Antenna Description

It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT.

Therefore, the equipment complies with the antenna requirement of Section 15.203.

No.	Model	Gain	Antenna Type	Remarks
1	ANT8030-01A	2.0 dBi	Multilayer Chip Antenna	Integral



1.3 Tested System Details

Instrument	Model	Serial No.	FCC ID	Rating
EUT1 (Bluetooth Module)	BT301(VRB4123-0102E)	KFCY0012 * ¹	---	DC 5 V
EUT2 (Bluetooth Module)	BT301(VRB4123-0102E)	KFCY0017 * ²	---	DC 5 V
Barcode Printer	S84-ex (203dpi, RH) * ³ * ⁵	3K-002	---	AC 100-240 V, 50-60 Hz, 7 A
Barcode Printer	S84-ex (203dpi, LH) * ⁴ * ⁵	3K-009	---	AC 100-240 V, 50-60 Hz, 7 A
Personal Computer	0DW634	CN-0DW634-70166-9B8-G08U-A04	DoC	DC 19.5 V, 4.62 A
AC Adapter	LA90PE0-01	CN-03T6XF-71615-05B-223A-A01	---	AC 100-240 V, 50-60 Hz, 1.5 A
USB Mouse	AMU1402JP	0605000678	DoC	DC 5 V

Note:

*¹:This instrument was used during the test of AC Power Line Conducted Emission, Radiated Spurious Emission and Band Edge Measurement.

*²:This instrument was used during the test of 20 dB Bandwidth, Maximum Peak Conducted Output Power, Carrier Frequency Separation, Number of Channels, Time of Occupancy and Conducted Spurious Emission.

*³:This instrument was used during the test of Radiated Spurious Emission and Band Edge Measurement.

*⁴:This instrument was used during the test of AC Power Line Conducted Emission.

*⁵:The difference between "S84-ex(203dpi, RH)" and "S84-ex(203dpi, LH)" is the position of communication ports:USB, RS-232C etc.
The position of RF module is the same.



1.4 Test Methodology

All measurement subject to the present test report is carried out according to the procedures in ANSI C63.4:2003.

1.5 Test Facility

The measurement was carried out at the following facility.

Cosmos Corporation EMC Lab. Oonoki
3571-2 Oonoki, Watarai-cho, Watarai-gun, Mie-ken 516-2102, Japan

☐ Semi anechoic Chamber 3 m (COAC3M-01)

☐ Shielded Room (COSR-01)

☐ Measurement Room

Cosmos Corporation EMC Lab. Oonoki is accredited in accordance with the International Standard ISO/IEC 17025 by the following accreditation bodies and the test facility is registered by the following bodies.

Accreditation: A2LA Accredited Laboratory. No. 2900.01
FCC Designation No. JP5182

Registration: Industry Canada Registration No. 3958B
Nemko Laboratory Authorisation. No. ELA 621

1.6 Traceability

The calibration of measurement equipment used in the test subject to the present report is designed and operated to ensure that the measurement is traceable to national standards of measurement or equivalent abroad.

2. Test Condition (Manufacturer's Specification)

2.1 Mode of Operation

Mode of operation: Bluetooth Continuous Transmit mode (DH5 / 2-DH5 / 3-DH5)

Note:

EUT makes communication emission with the maximum RF power by a special test program.

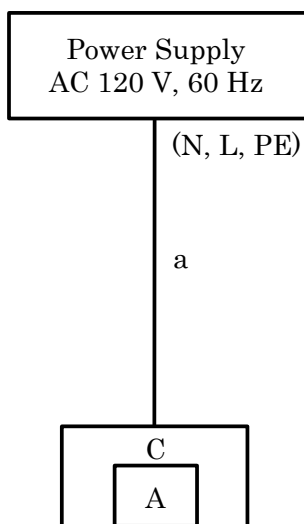
2.2 Test Configuration

	Instrument	Model		Cable	Length	Shield
A	EUT1 (Bluetooth Module)	BT301(VRB4123-0102E) (Serial No.: KFCY0012)	a	AC Power Cord	3.0 m	×
			b	AC Power Cord	0.9 m	×
			c	DC Power Cord	1.8 m	○
			d	DC Power Cord	1.5 m	×
B	EUT2 (Bluetooth Module)	BT301(VRB4123-0102E) (Serial No.: KFCY0017)	e	RS-232C Cable *	1.8 m	○
			f	LAN Cable (Cat. 5e)	1.8 m	×
			g	IEEE1284 Cable	1.9 m	○
			h	USB Cable	1.9 m	○
C	Barcode Printer	S84-ex (203dpi, RH)	i	USB Mouse Cable	1.6 m	○
D	Barcode Printer	S84-ex (203dpi, LH)	j	RS-232C Cable	0.2 m	×
E	Personal Computer	0DW634				
F	AC Adapter	LA90PE0-01				
G	USB Mouse	AMU1402JP				

Note:

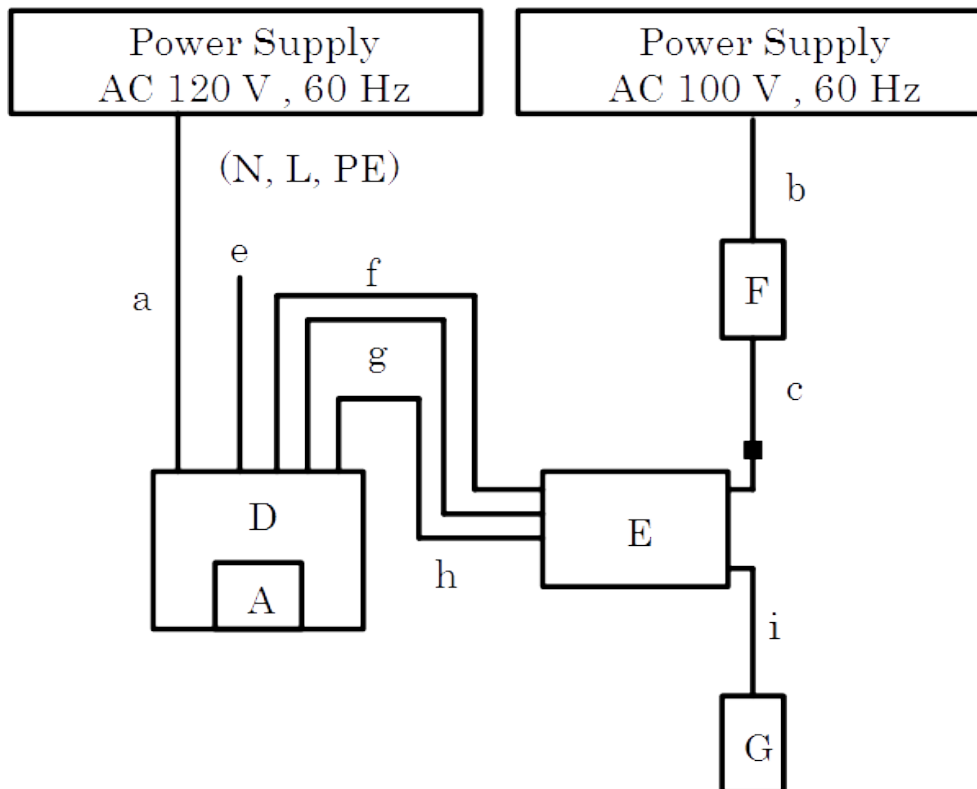
*: This cable was not terminated.

Block diagram of the tested system
(Radiated Spurious Emission and Band Edge Measurement)



2.2 Test Configuration (Continued)

Block diagram of the tested system (AC Power Line Conducted Emission)



■ Integrated Ferrite Core

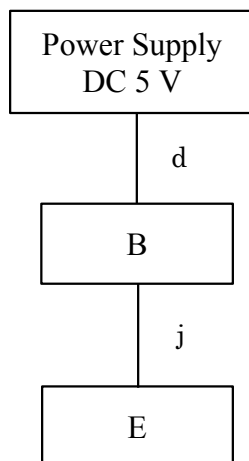
Excess cable arrangement

Symbol	Length	Position	Setting
a	0.3 m	Center	Bundle
c	0.35 m	Center	Bundle
e	0.3 m	End	Bundle and Hung
f, h	0.3 m	Center	Bundle and Hung
g	0.35 m	Center	Bundle and Hung



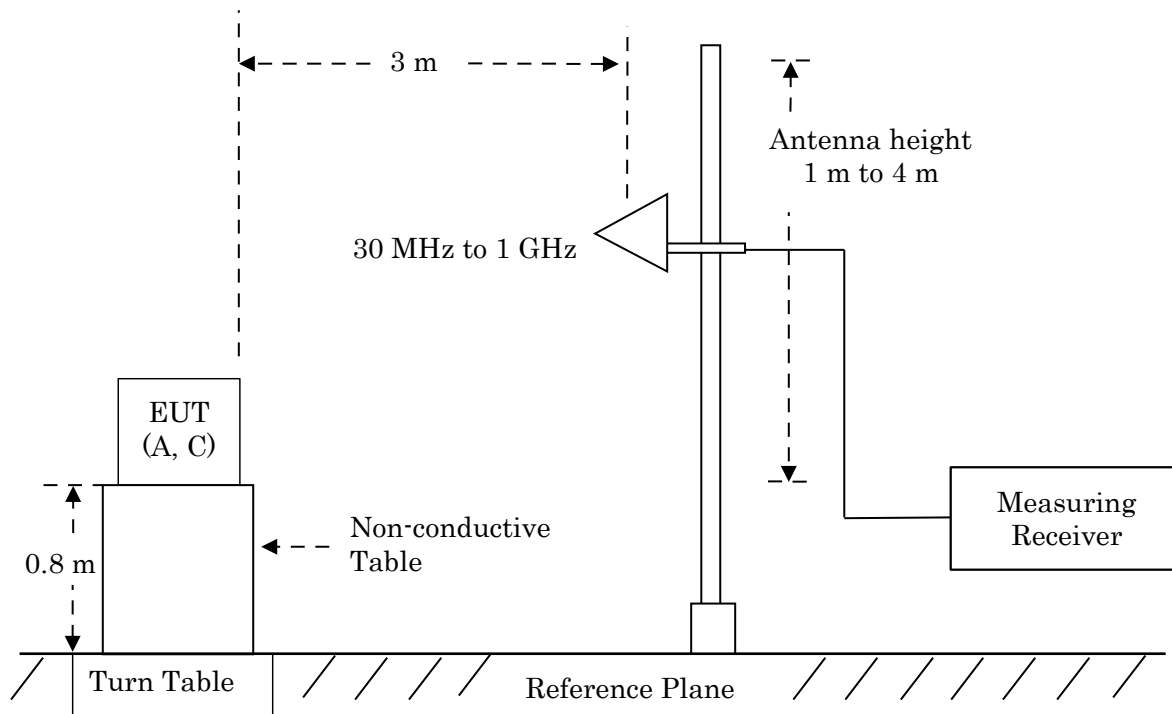
2.2 Test Configuration (Continued)

Block diagram of the tested system
(20 dB Bandwidth / Maximum Peak Conducted Output Power /
Carrier Frequency Separation / Number of Channels / Time of Occupancy /
Conducted Spurious Emission)

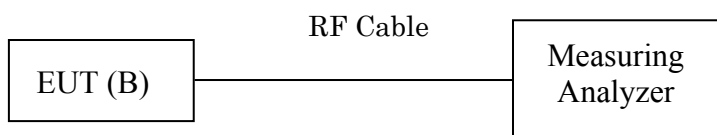


2.2 Test Configuration (Continued)

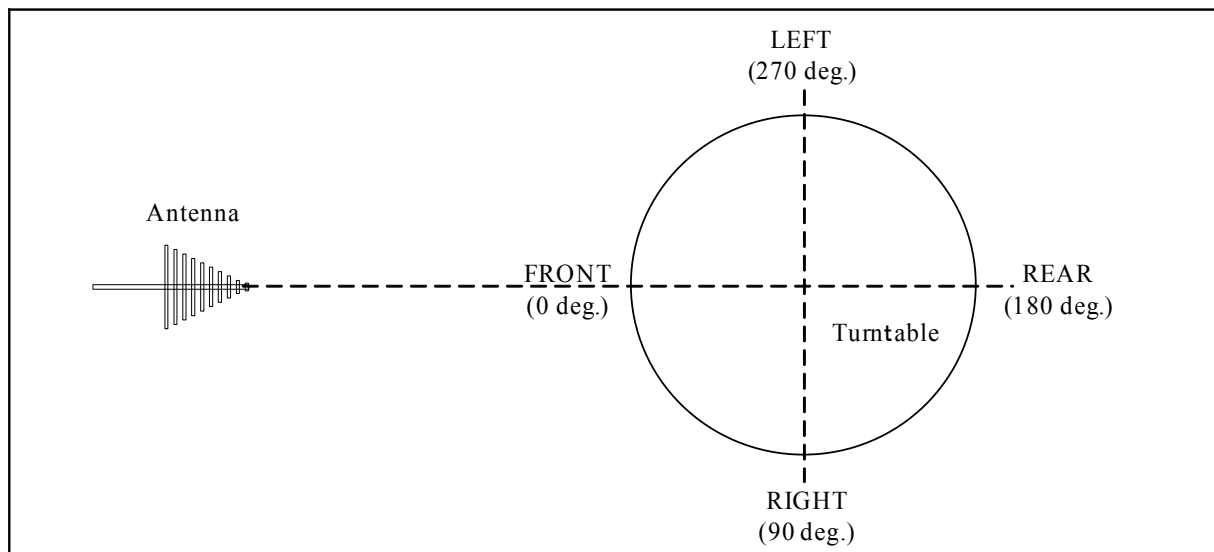
Radiated Spurious Emission / Band Edge Measurement



20 dB Bandwidth / Maximum Peak Conducted Output Power / Carrier Frequency Separation / Number of Channels / Time of Occupancy / Conducted Spurious Emission



2.3 EUT Angle



Note:
Refer to Appendix 1.

3. Summary of Test Results

These test results are the test results of the condition specified with “2. Test Condition”.

Section	Test Item	Result
15.207	AC Power Line Conducted Emission	Pass
15.209	Radiated Spurious Emission	Pass
15.215(c)	20 dB Bandwidth	Pass
15.247(b)	Maximum Peak Conducted Output Power	Pass
15.247(a)	Carrier Frequency Separation	Pass
15.247(a)	Number of Channels	Pass
15.247(a)	Time of Occupancy	Pass
15.247(d)	Conducted Spurious Emission	Pass
15.247(d)	Band Edge Measurement	Pass

4. Measurement Result

4.1 15.207 AC Power Line Conducted Emission

4.1.1 Setting Remarks

- The conducted disturbance voltage of AC power line in the frequency range from 0.15 MHz to 30 MHz was measured in accordance with ANSI C63.4:2003.
- The test setup was made in accordance with ANSI C63.4:2003 on the table installed in a shielded room.
- The non-conductive table, 0.8 m high, was placed on the reference ground plane, and the EUT was put on the non-conductive table.
- The used Line Impedance Stabilizing Network (LISN) has a rated impedance of 50 Ω /50 μ H as specified in CISPR16-1-2.
- The test receiver with Quasi Peak and Average detector is in accordance with CISPR 16-1-1.
- The conducted emission level is calculated by adding Cable Attenuation Factor and Insertion Loss of LISN.
- Activate the EUT System and run the software prepared for the test.
- Refer to the figure of 2.2 Test Configuration.

Setting Condition of Test receiver

Frequency range	Detector	RBW
150 kHz to 30 MHz	Quasi-peak	9 kHz
	Average	9 kHz

4.1.2 Limit

Frequency (MHz)	Conducted Limit (dB μ V)	
	QP	AV
0.15 to 0.5	66 to 56 *	56 to 46 *
0.5 to 5	56	46
5 to 30	60	50

* Decrease with the logarithm of the frequency.

4.1.3 Result

EUT complies with the requirement.

Uncertainty of measurement result : ± 2.26 dB
Date of testing : March 26, 2014
Temperature : 22°C
Humidity : 35%



4.1.4 Measured Data

Sample Calculation

Result = Reading + c.f. (Correction Factor)
= 36.9 + 11.7
= 48.6
Margin = Limit - Result
= 63.7 - 48.6
= 15.1

c.f. = LISN Factor + Cable Attenuation Factor

Mode: Bluetooth DH5 39ch

***** Cosmos Corporation *****
<<Conducted Emission EP5/CE Ver 5.3.20>>

26 March, 2014 17:08
121647E FCC CE Result02.dat

Limit : FCC 15.207
Model : BT301(VRB4123-0102E)
Model : S84-ex (203dpi, LH)
Serial : KFCY0012 / 3K-009
Operator : T.Ezaki
Temp., Humi. : 22 deg., 35%
Power : DC 5V / AC 120V, 60Hz
Mode : Bluetooth DH5 39ch
Remark1 :
Remark2 : RBW:9kHz

Final Result

--- L1 Phase ---

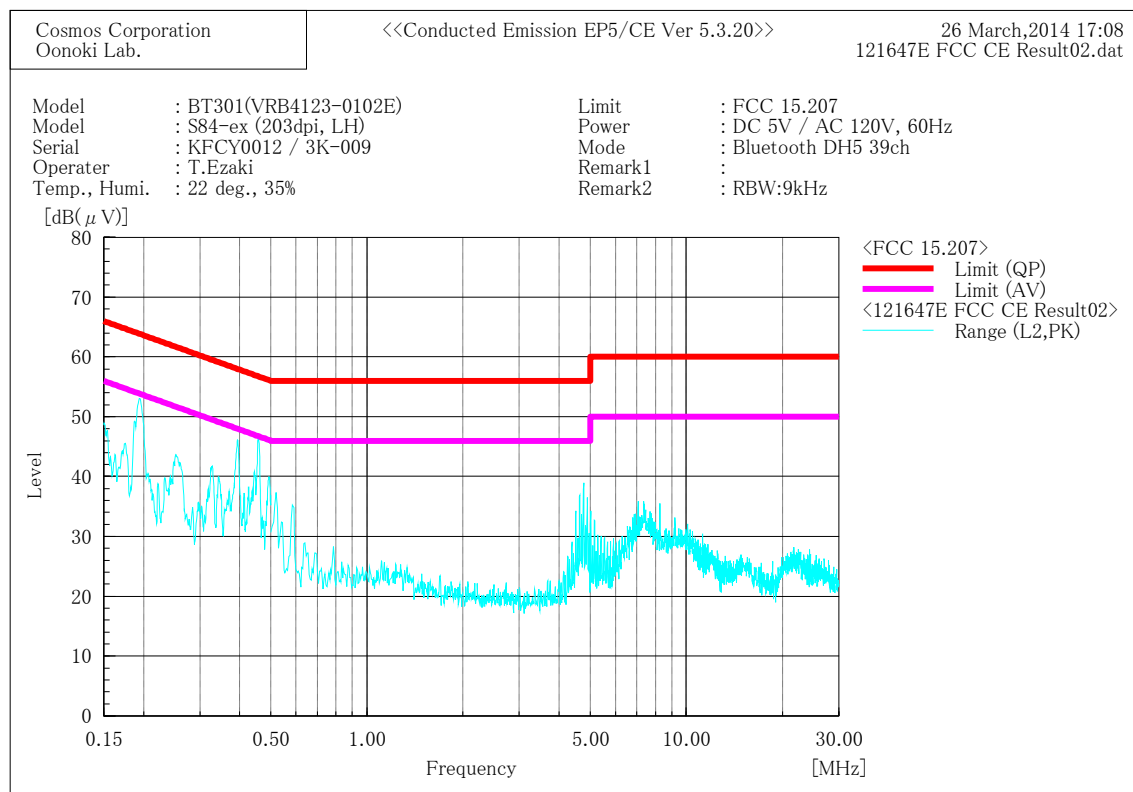
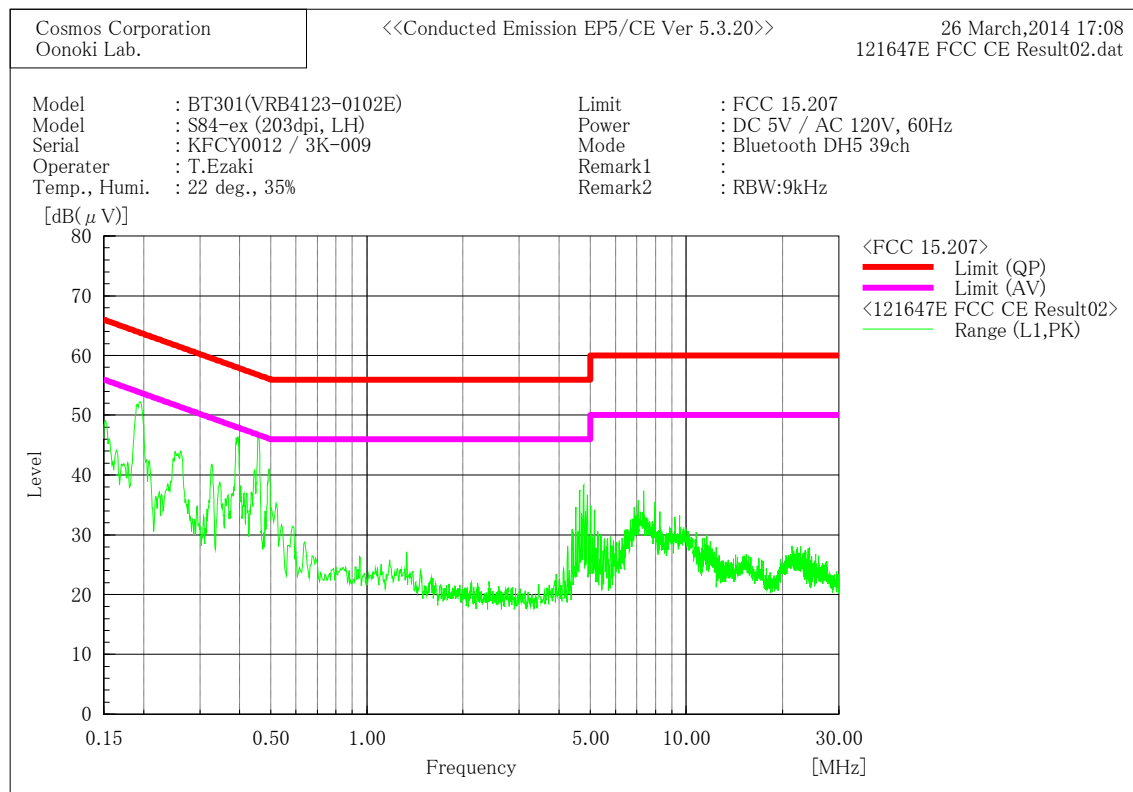
No.	Frequency	Reading QP	Reading AV	c.f	Result QP	Result AV	Limit QP	Limit AV	Margin QP	Margin AV
	[MHz]	[dB(μV)]	[dB(μV)]	[dB]	[dB(μV)]	[dB(μV)]	[dB(μV)]	[dB(μV)]	[dB]	[dB]
1	0.19795	36.9	34.5	11.7	48.6	46.2	63.7	53.7	15.1	7.5
2	0.39745	27.6	23.6	11.6	39.2	35.2	57.9	47.9	18.7	12.7
3	0.45905	31.5	25.8	11.6	43.1	37.4	56.7	46.7	13.6	9.3
4	1.3385	-3.3	-7.6	11.6	8.3	4.0	56.0	46.0	47.7	42.0
5	4.7749	12.7	5.3	11.6	24.3	16.9	56.0	46.0	31.7	29.1
6	21.3777	12.4	7.3	12.1	24.5	19.4	60.0	50.0	35.5	30.6

--- L2 Phase ---

No.	Frequency	Reading QP	Reading AV	c.f	Result QP	Result AV	Limit QP	Limit AV	Margin QP	Margin AV
	[MHz]	[dB(μV)]	[dB(μV)]	[dB]	[dB(μV)]	[dB(μV)]	[dB(μV)]	[dB(μV)]	[dB]	[dB]
1	0.19585	38.5	35.9	11.7	50.2	47.6	63.8	53.8	13.6	6.2
2	0.39605	29.9	25.5	11.6	41.5	37.1	57.9	47.9	16.4	10.8
3	0.45905	31.7	26.1	11.6	43.3	37.7	56.7	46.7	13.4	9.0
4	1.10575	-3.8	-9.0	11.7	7.9	2.7	56.0	46.0	48.1	43.3
5	4.7655	26.5	20.6	11.6	38.1	32.2	56.0	46.0	17.9	13.8
6	21.7791	9.1	2.9	12.4	21.5	15.3	60.0	50.0	38.5	34.7

4.1.4 Measured Data (Continued)

Mode: Bluetooth DH5 39ch





4.1.4 Measured Data (Continued)

Mode: Bluetooth 2-DH5 39ch

***** Cosmos Corporation *****
<<Conducted Emission EP5/CE Ver 5.3.20>>

26 March, 2014 17:38
121647E FCC CE Result03.dat

Limit : FCC 15.207
Model : BT301 (VRB4123-0102E)
Model : S84-ex (203dpi, LH)
Serial : KFCY0012 / 3K-009
Operator : T. Ezaki
Temp., Humi. : 22 deg., 35%
Power : DC 5V / AC 120V, 60Hz
Mode : Bluetooth 2-DH5 39ch
Remark1 :
Remark2 : RBW:9kHz

Final Result

--- L1 Phase ---

No.	Frequency	Reading QP	Reading AV	c. f	Result QP	Result AV	Limit QP	Limit AV	Margin QP	Margin AV
	[MHz]	[dB(μV)]	[dB(μV)]	[dB]	[dB(μV)]	[dB(μV)]	[dB(μV)]	[dB(μV)]	[dB]	[dB]
1	0.19725	37.5	35.2	11.7	49.2	46.9	63.7	53.7	14.5	6.8
2	0.39535	31.3	26.5	11.6	42.9	38.1	58.0	48.0	15.1	9.9
3	0.45975	30.2	24.4	11.6	41.8	36.0	56.7	46.7	14.9	10.7
4	1.1658	-4.0	-9.2	11.7	7.7	2.5	56.0	46.0	48.3	43.5
5	4.7431	11.9	4.9	11.6	23.5	16.5	56.0	46.0	32.5	29.5
6	20.6397	9.0	3.4	11.9	20.9	15.3	60.0	50.0	39.1	34.7

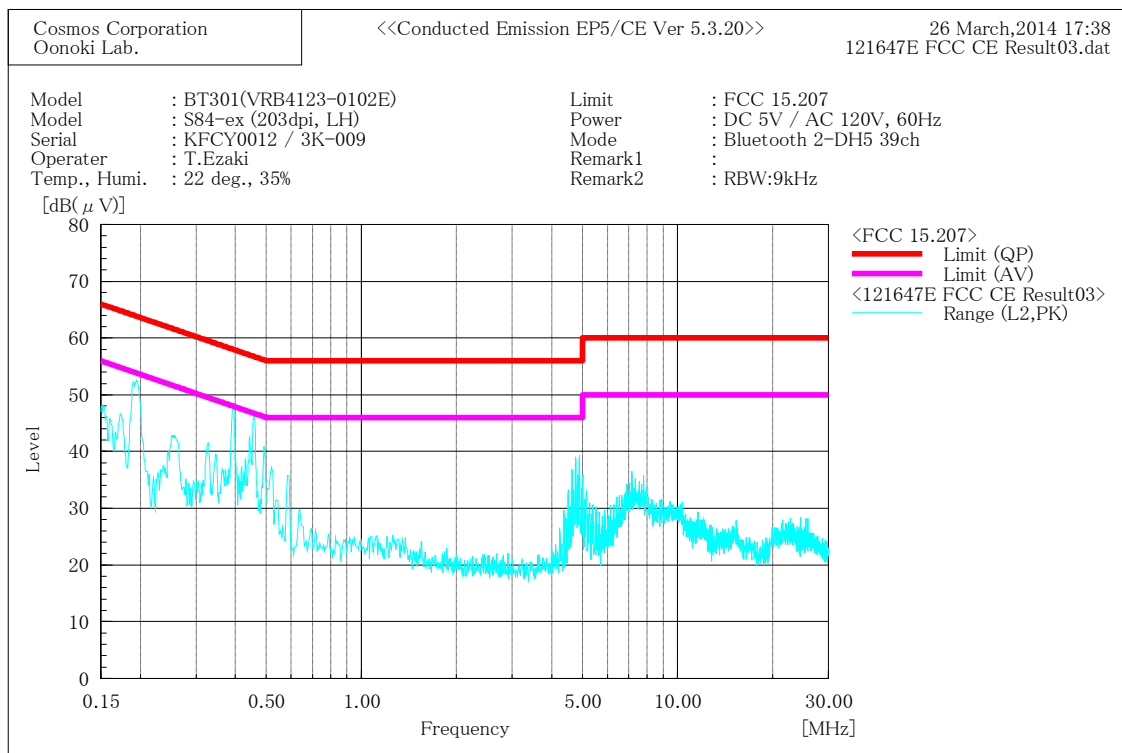
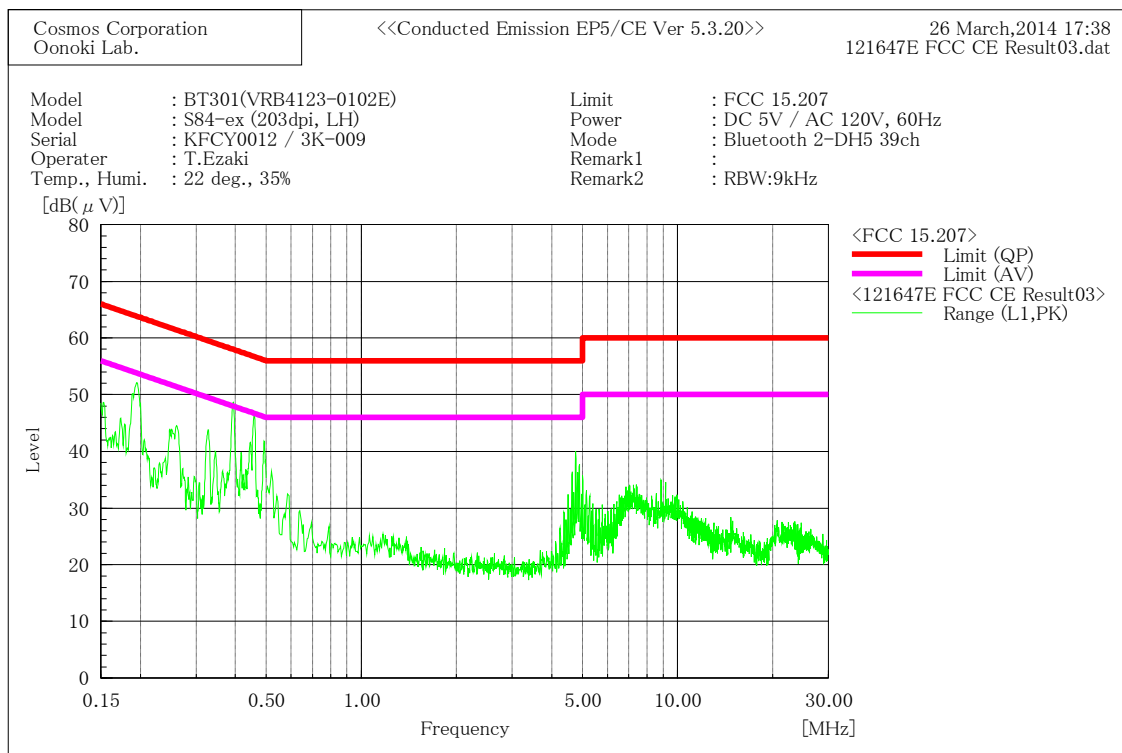
--- L2 Phase ---

No.	Frequency	Reading QP	Reading AV	c. f	Result QP	Result AV	Limit QP	Limit AV	Margin QP	Margin AV
	[MHz]	[dB(μV)]	[dB(μV)]	[dB]	[dB(μV)]	[dB(μV)]	[dB(μV)]	[dB(μV)]	[dB]	[dB]
1	0.19655	38.3	35.6	11.7	50.0	47.3	63.8	53.8	13.8	6.5
2	0.39465	31.6	26.5	11.6	43.2	38.1	58.0	48.0	14.8	9.9
3	0.45905	31.4	25.8	11.6	43.0	37.4	56.7	46.7	13.7	9.3
4	1.2653	-3.3	-8.3	11.7	8.4	3.4	56.0	46.0	47.6	42.6
5	4.8962	20.2	14.8	11.6	31.8	26.4	56.0	46.0	24.2	19.6
6	24.5697	3.9	-1.6	13.0	16.9	11.4	60.0	50.0	43.1	38.6



4.1.4 Measured Data (Continued)

Mode: Bluetooth 2-DH5 39ch





4.1.4 Measured Data (Continued)

Mode: Bluetooth 3-DH5 39ch

***** Cosmos Corporation *****
<<Conducted Emission EP5/CE Ver 5.3.20>>

26 March, 2014 17:55
121647E FCC CE Result04. dat

Limit : FCC 15.207
Model : BT301 (VRB4123-0102E)
Model : S84-ex (203dpi, LH)
Serial : KFCY0012 / 3K-009
Operator : T. Ezaki
Temp., Humi. : 22 deg., 35%
Power : DC 5V / AC 120V, 60Hz
Mode : Bluetooth 3-DH5 39ch
Remark1 :
Remark2 : RBW:9kHz

Final Result

--- L1 Phase ---

No.	Frequency	Reading QP	Reading AV	c. f	Result QP	Result AV	Limit QP	Limit AV	Margin QP	Margin AV
	[MHz]	[dB(μV)]	[dB(μV)]	[dB]	[dB(μV)]	[dB(μV)]	[dB(μV)]	[dB(μV)]	[dB]	[dB]
1	0.19725	37.5	35.1	11.7	49.2	46.8	63.7	53.7	14.5	6.9
2	0.39255	33.4	27.2	11.6	45.0	38.8	58.0	48.0	13.0	9.2
3	0.45905	30.8	25.0	11.6	42.4	36.6	56.7	46.7	14.3	10.1
4	1.28025	-3.6	-8.8	11.7	8.1	2.9	56.0	46.0	47.9	43.1
5	4.7624	22.7	16.4	11.6	34.3	28.0	56.0	46.0	21.7	18.0
6	21.8454	8.6	3.1	12.2	20.8	15.3	60.0	50.0	39.2	34.7

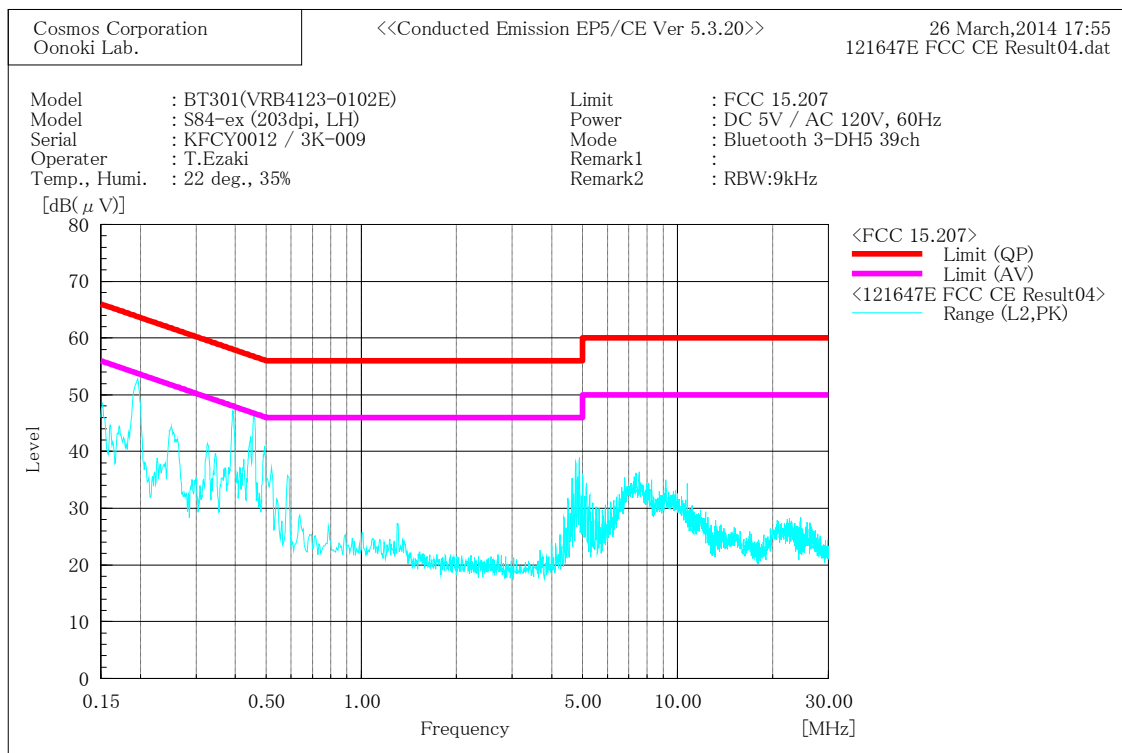
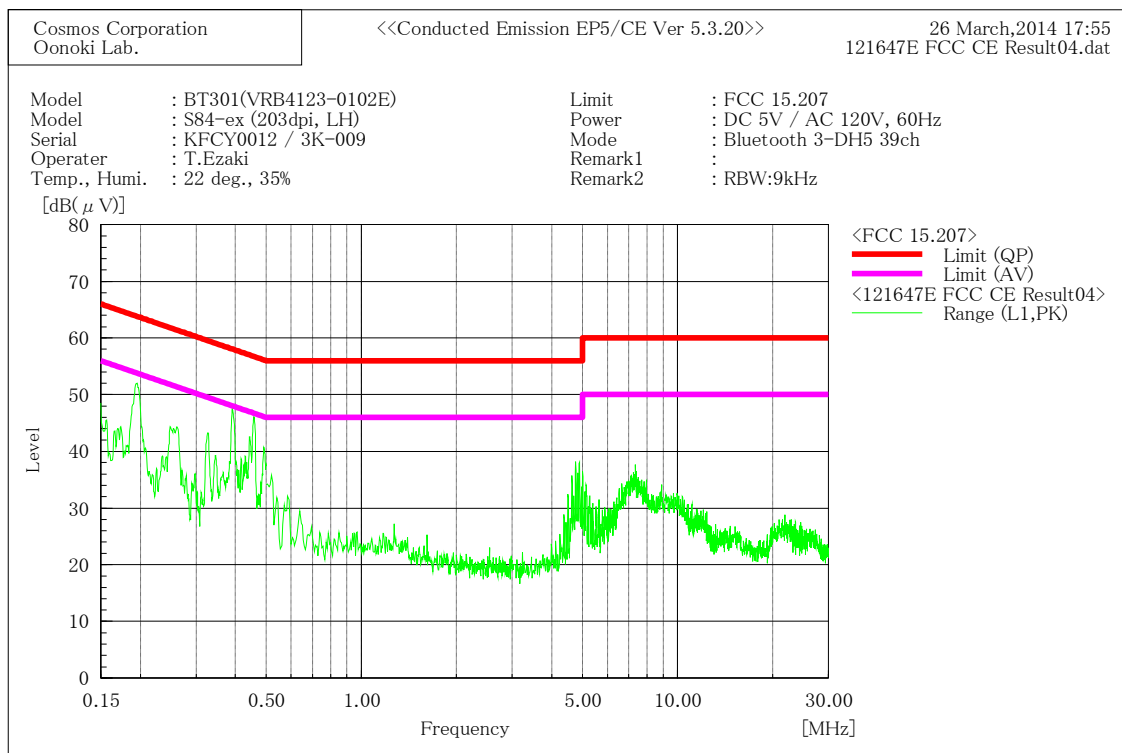
--- L2 Phase ---

No.	Frequency	Reading QP	Reading AV	c. f	Result QP	Result AV	Limit QP	Limit AV	Margin QP	Margin AV
	[MHz]	[dB(μV)]	[dB(μV)]	[dB]	[dB(μV)]	[dB(μV)]	[dB(μV)]	[dB(μV)]	[dB]	[dB]
1	0.19795	36.9	34.1	11.7	48.6	45.8	63.7	53.7	15.1	7.9
2	0.39465	30.8	26.3	11.6	42.4	37.9	58.0	48.0	15.6	10.1
3	0.45905	31.0	25.3	11.6	42.6	36.9	56.7	46.7	14.1	9.8
4	1.28975	-4.5	-9.7	11.7	7.2	2.0	56.0	46.0	48.8	44.0
5	4.9013	13.8	5.6	11.5	25.3	17.1	56.0	46.0	30.7	28.9
6	24.5004	3.4	-2.3	13.0	16.4	10.7	60.0	50.0	43.6	39.3



4.1.4 Measured Data (Continued)

Mode: Bluetooth 3-DH5 39ch



4.2 15.209 Radiated Spurious Emission

4.2.1 Setting Remarks

- In the frequency range from 30 MHz to 25 GHz (as 10th harmonics), the electric field strength was measured in accordance with ANSI C63.4:2003.
- The test setup was made in accordance with ANSI C63.4:2003 on the table installed in a semi-anechoic chamber.
- The non-conductive table, 0.8 m high, was placed on the turntable, and the EUT was put on the non-conductive table.
- The EUT was measured at 1 m to 4 m height of the antenna.
- The turntable was fully rotated. The highest radiation from the equipment was recorded.
- The measurement was carried out with both horizontal and vertical antenna polarization.
- The test receiver with Peak, Quasi Peak and Average detector is in accordance with CISPR 16-1-1.
- The measurement was carried out with the measuring distance of 3 m.
- Refer to the figure of 2.2 Test Configuration.

Frequency range	Detector	RBW
30 MHz to 1 GHz	Quasi-peak	120 kHz
1 GHz to 25 GHz	Peak	1 MHz
	Average	1 MHz

4.2.2 Limit

Frequency [MHz]	Field Strength (Distance)	
	[μV/m]	[dBμV/m]
0.009 to 0.49	2400/F(kHz) (300 m) 266.6 to 4.89	128.5 to 93.8 (3 m)
0.49 to 1.705	24000/F(kHz) (30 m) 48.9 to 14.0	73.8 to 62.9 (3 m)
1.705 to 30	30 (30 m)	69.5 (3 m)
30 to 88	100 (3 m)	40.0 (3 m)
88 to 216	150 (3 m)	43.5 (3 m)
216 to 960	200 (3 m)	46.0 (3 m)
Above 960	500 (3 m)	53.9 (3 m)



4.2.3 Result

EUT complies with the requirement.

Uncertainty of measurement result	:	±3.64 dB		
Date of testing	:	March 20, 2014	March 21, 2014	March 24, 2014
Room temperature	:	20°C	20°C	20°C
Relative humidity	:	41%	41%	33%

4.2.4 Measured Data

Sample Calculation

Result = Reading + c.f. (Correction Factor)
= 41.8 - 15.0
= 26.8

Margin = Limit - Result
= 40.0 - 26.8
= 13.2

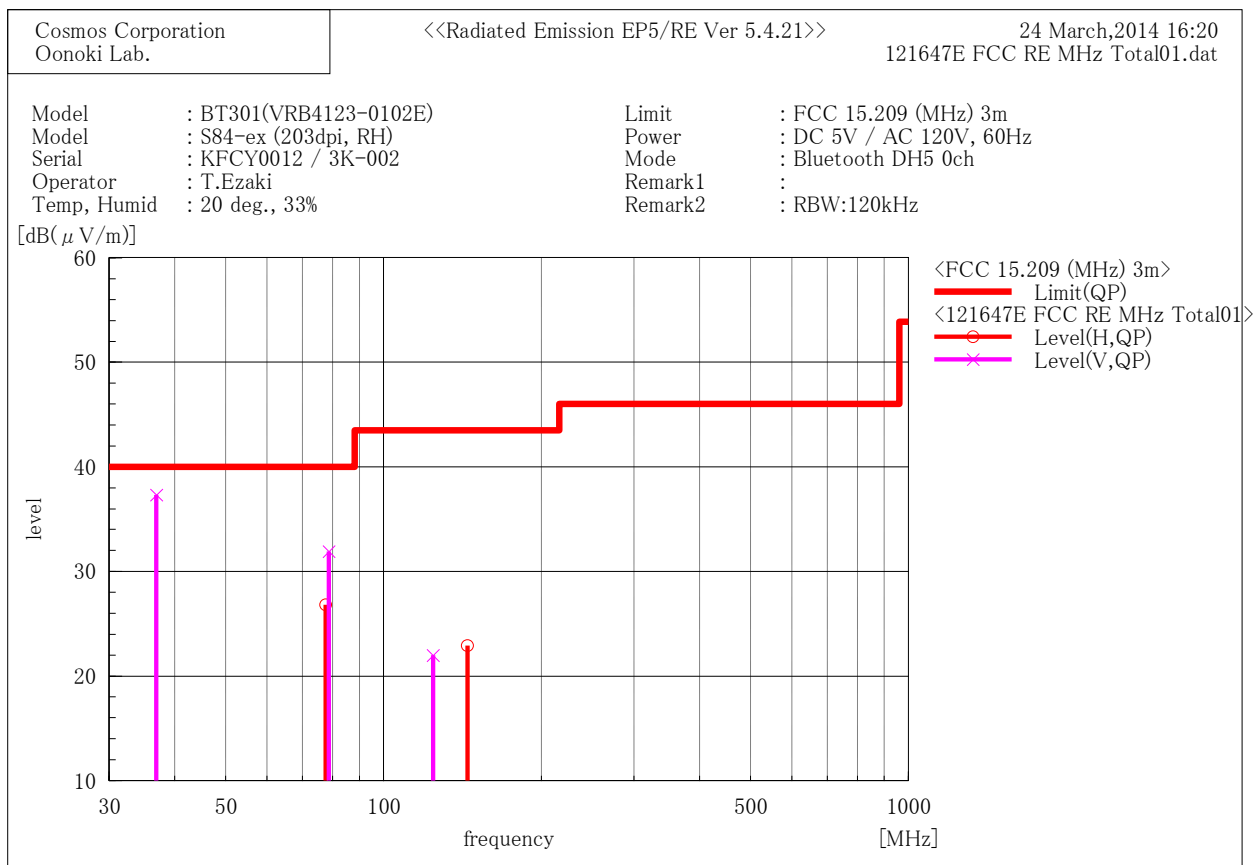
c.f. = Cable Attenuation Factor + Pre-Amplifier Gain + Antenna Factor

No spurious emission for RF module was found in 18 GHz to 25 GHz



4.2.4 Measured Data (Continued) (Worst Test Data)

Mode: Bluetooth DH5 0ch 30 MHz to 1 GHz



Final Result

--- Horizontal Polarization (QP)---

No.	Frequency [MHz]	Reading [dB(μV)]	c.f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	77.580	41.8	-15.0	26.8	40.0	13.2	260.0	111.0
2	144.620	33.7	-10.8	22.9	43.5	20.6	133.0	263.0

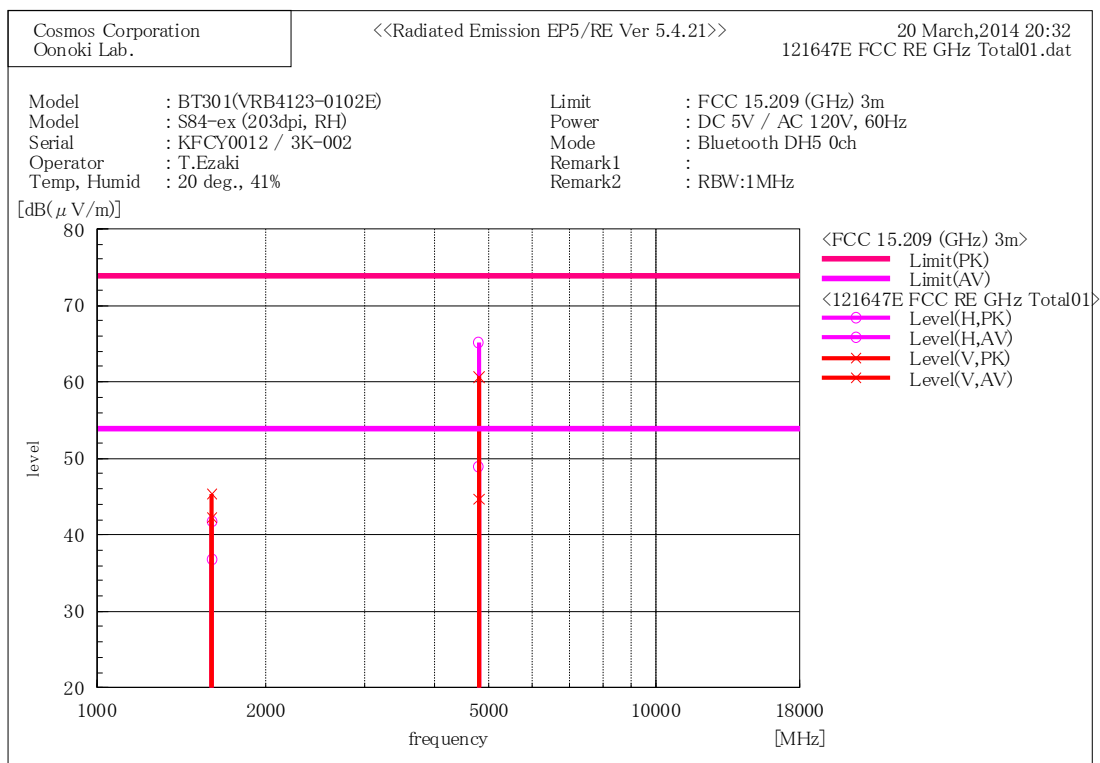
--- Vertical Polarization (QP)---

No.	Frequency [MHz]	Reading [dB(μV)]	c.f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	36.880	49.8	-12.5	37.3	40.0	2.7	100.0	13.0
2	78.560	46.9	-15.0	31.9	40.0	8.1	100.0	144.0
3	124.300	34.0	-12.0	22.0	43.5	21.5	100.0	161.0



4.2.4 Measured Data (Continued) (Worst Test Data)

Mode: Bluetooth DH5 0ch 1 GHz to 18 GHz



Final Result

— Horizontal Polarization (PK) —

No.	Frequency [MHz]	Reading [dB(μV)]	c. f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	1602.034	48.0	-6.2	41.8	73.9	32.1	100.0	9.0
2	4803.668	63.4	1.8	65.2	73.9	8.7	173.0	84.0

— Horizontal Polarization (AV) —

No.	Frequency [MHz]	Reading [dB(μV)]	c. f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	1602.034	43.0	-6.2	36.8	53.9	17.1	100.0	9.0
2	4803.668	47.1	1.8	48.9	53.9	5.0	173.0	84.0

— Vertical Polarization (PK) —

No.	Frequency [MHz]	Reading [dB(μV)]	c. f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	1602.014	51.6	-6.2	45.4	73.9	28.5	149.0	34.0
2	4804.348	58.8	1.8	60.6	73.9	13.3	139.0	0.0

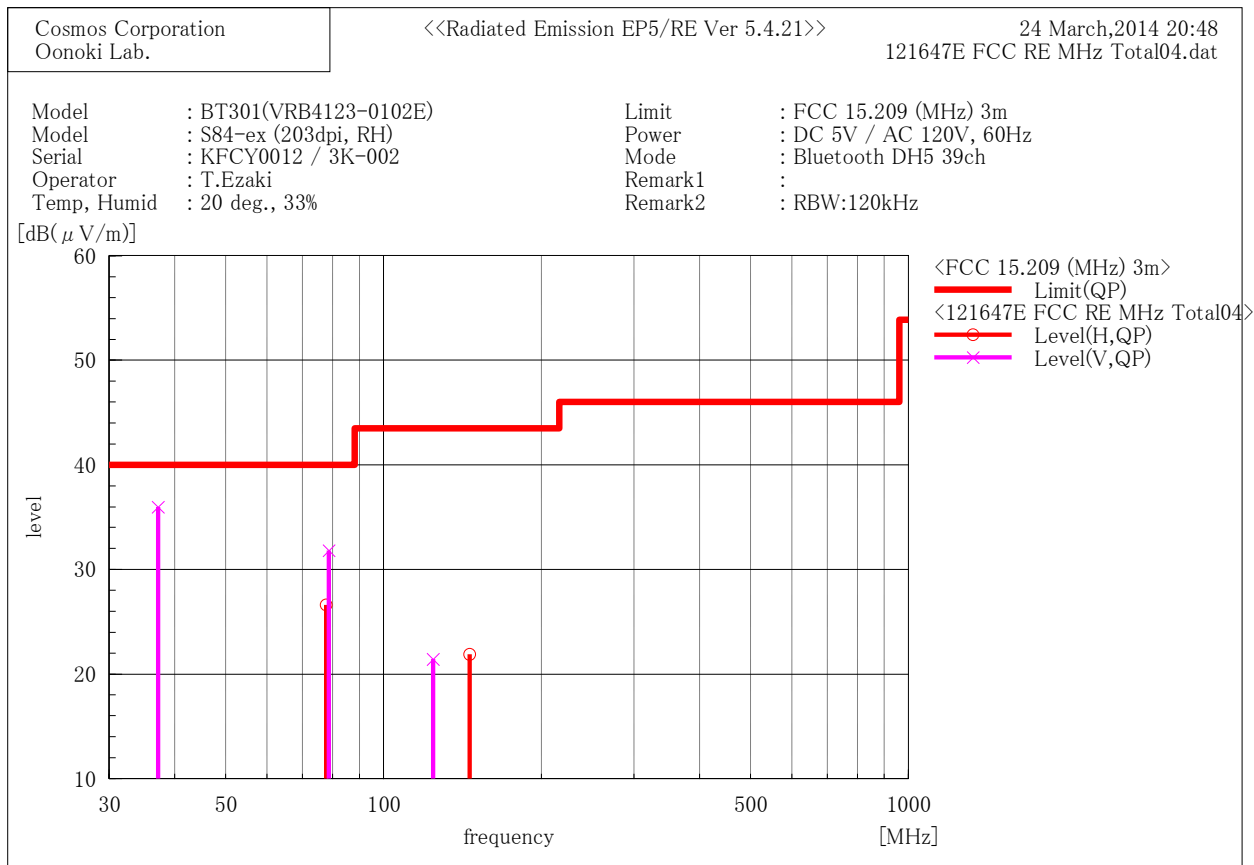
— Vertical Polarization (AV) —

No.	Frequency [MHz]	Reading [dB(μV)]	c. f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	1602.014	48.4	-6.2	42.2	53.9	11.7	149.0	34.0
2	4804.348	42.8	1.8	44.6	53.9	9.3	139.0	0.0



4.2.4 Measured Data (Continued) (Worst Test Data)

Mode: Bluetooth DH5 39ch 30 MHz to 1 GHz



Final Result

--- Horizontal Polarization (QP)---

No.	Frequency [MHz]	Reading [dB(μV)]	c.f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	77.780	41.6	-15.0	26.6	40.0	13.4	268.0	97.0
2	146.000	32.6	-10.7	21.9	43.5	21.6	225.0	278.0

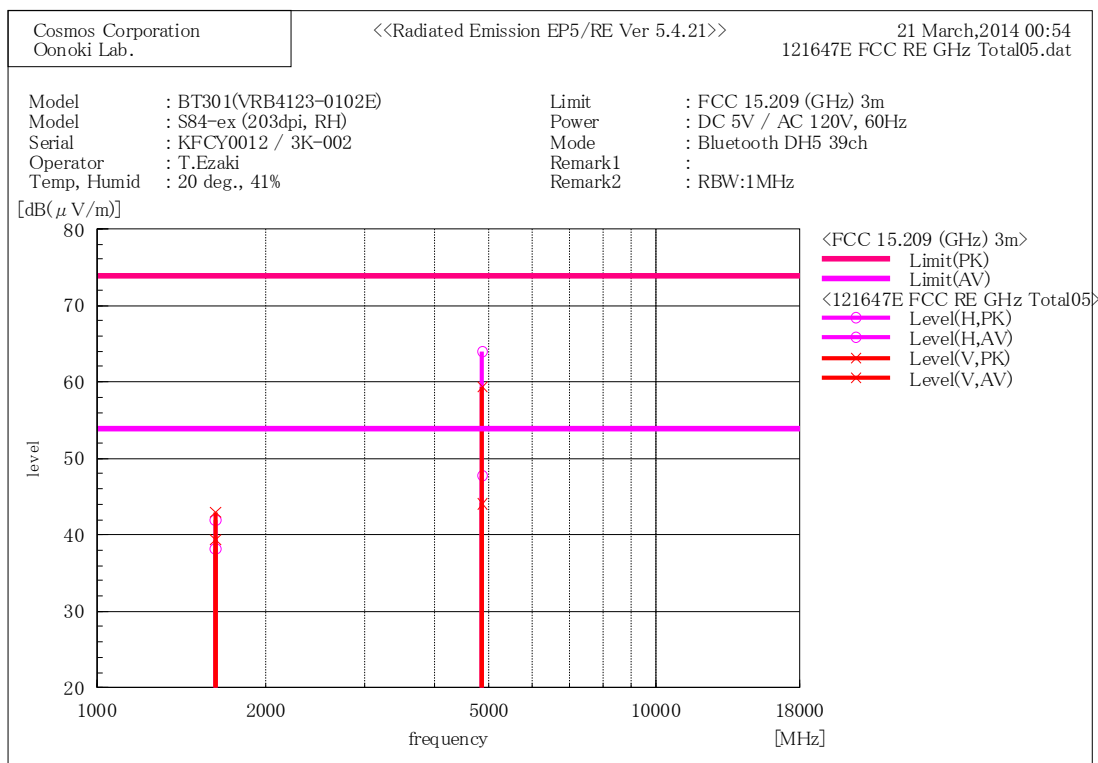
--- Vertical Polarization (QP)---

No.	Frequency [MHz]	Reading [dB(μV)]	c.f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	37.180	48.6	-12.6	36.0	40.0	4.0	100.0	9.0
2	78.620	46.8	-15.0	31.8	40.0	8.2	100.0	179.0
3	124.280	33.4	-12.0	21.4	43.5	22.1	100.0	198.0



4.2.4 Measured Data (Continued) (Worst Test Data)

Mode: Bluetooth DH5 39ch 1 GHz to 18 GHz



Final Result

— Horizontal Polarization (PK) —

No.	Frequency [MHz]	Reading [dB(μV)]	c.f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	1628.007	48.1	-6.1	42.0	73.9	31.9	131.0	327.0
2	4881.989	61.9	2.1	64.0	73.9	9.9	153.0	330.0

— Horizontal Polarization (AV) —

No.	Frequency [MHz]	Reading [dB(μV)]	c.f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	1628.007	44.2	-6.1	38.1	53.9	15.8	131.0	327.0
2	4881.989	45.6	2.1	47.7	53.9	6.2	153.0	330.0

— Vertical Polarization (PK) —

No.	Frequency [MHz]	Reading [dB(μV)]	c.f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	1628.000	49.0	-6.1	42.9	73.9	31.0	255.0	84.0
2	4881.759	57.2	2.1	59.3	73.9	14.6	129.0	38.0

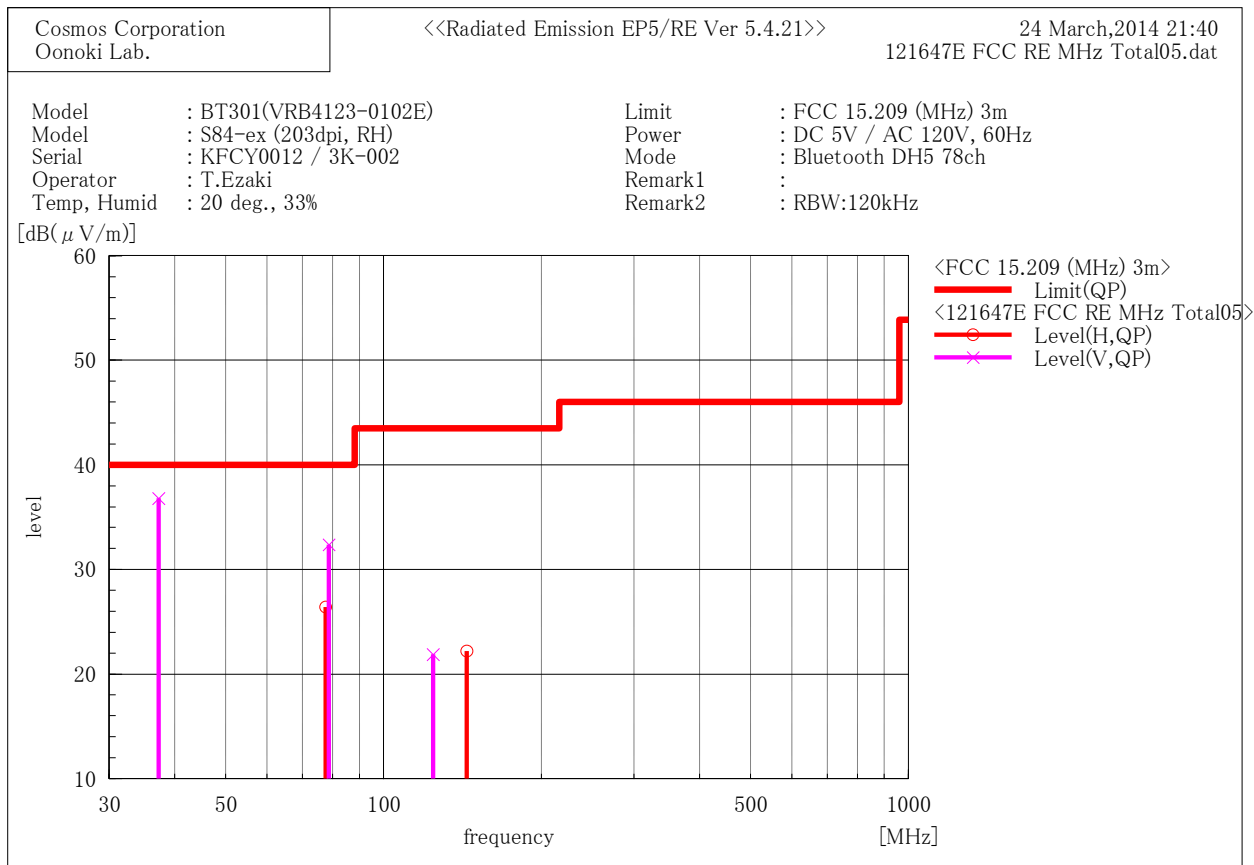
— Vertical Polarization (AV) —

No.	Frequency [MHz]	Reading [dB(μV)]	c.f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	1628.000	45.4	-6.1	39.3	53.9	14.6	255.0	84.0
2	4881.759	42.0	2.1	44.1	53.9	9.8	129.0	38.0



4.2.4 Measured Data (Continued) (Worst Test Data)

Mode: Bluetooth DH5 78ch 30 MHz to 1 GHz



Final Result

--- Horizontal Polarization (QP)---

No.	Frequency [MHz]	Reading [dB(μV)]	c.f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	77.520	41.4	-15.0	26.4	40.0	13.6	257.0	271.0
2	144.000	33.0	-10.8	22.2	43.5	21.3	131.0	278.0

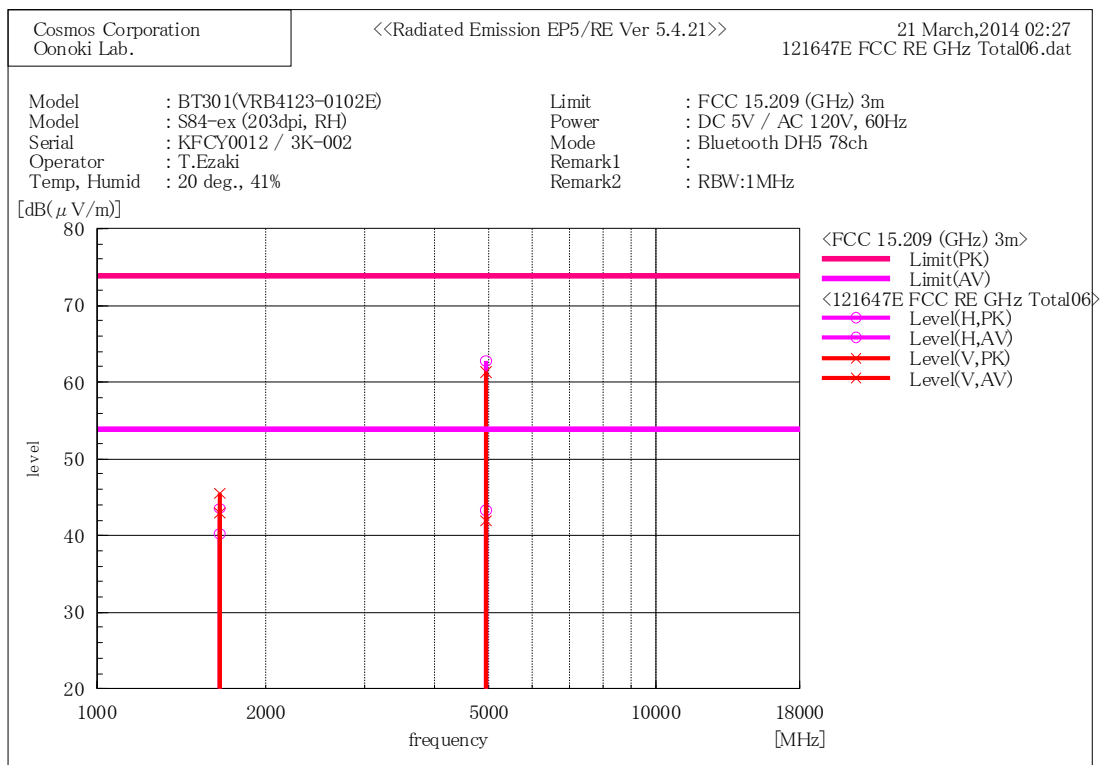
--- Vertical Polarization (QP)---

No.	Frequency [MHz]	Reading [dB(μV)]	c.f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	37.220	49.4	-12.6	36.8	40.0	3.2	100.0	31.0
2	78.640	47.4	-15.0	32.4	40.0	7.6	100.0	208.0
3	124.120	33.9	-12.0	21.9	43.5	21.6	100.0	193.0



4.2.4 Measured Data (Continued) (Worst Test Data)

Mode: Bluetooth DH5 78ch 1 GHz to 18 GHz



Final Result

— Horizontal Polarization (PK) —

No.	Frequency [MHz]	Reading [dB(μ V)]	c.f [dB(1/m)]	Result [dB(μ V/m)]	Limit [dB(μ V/m)]	Margin [dB]	Height [cm]	Angle [°]
1	1654.018	49.6	-6.1	43.5	73.9	30.4	127.0	325.0
2	4959.978	60.3	2.4	62.7	73.9	11.2	100.0	8.0

— Horizontal Polarization (AV) —

No.	Frequency [MHz]	Reading [dB(μ V)]	c.f [dB(1/m)]	Result [dB(μ V/m)]	Limit [dB(μ V/m)]	Margin [dB]	Height [cm]	Angle [°]
1	1654.018	46.2	-6.1	40.1	53.9	13.8	127.0	325.0
2	4959.978	40.9	2.4	43.3	53.9	10.6	100.0	8.0

— Vertical Polarization (PK) —

No.	Frequency [MHz]	Reading [dB(μ V)]	c.f [dB(1/m)]	Result [dB(μ V/m)]	Limit [dB(μ V/m)]	Margin [dB]	Height [cm]	Angle [°]
1	1654.013	51.6	-6.1	45.5	73.9	28.4	109.0	34.0
2	4959.990	58.9	2.4	61.3	73.9	12.6	236.0	44.0

— Vertical Polarization (AV) —

No.	Frequency [MHz]	Reading [dB(μ V)]	c.f [dB(1/m)]	Result [dB(μ V/m)]	Limit [dB(μ V/m)]	Margin [dB]	Height [cm]	Angle [°]
1	1654.013	49.0	-6.1	42.9	53.9	11.0	109.0	34.0
2	4959.990	39.5	2.4	41.9	53.9	12.0	236.0	44.0

4.3 15.215(c) 20 dB bandwidth

4.3.1 Setting Remarks

- The both side of 20 dB down value from peak power were measured by using 20 dB bandwidth measurement function of the spectrum analyzer.
- The spectrum analyzer is set as following;

Frequency Span	: 3 MHz
Resolution Bandwidth	: 100 kHz
Video Bandwidth	: 300 kHz
Detector Mode	: Peak
Trace Mode	: Max Hold

- Refer to the figure of 2.2 Test Configuration.

4.3.2 Limit

Intentional radiators must be designed to ensure that the 20 dB bandwidth of the emission is contained within the frequency band designated in the rule section under which the equipment is operated.

4.3.3 Result

EUT complies with the requirement.

Uncertainty of measurement result	: ±0.8 dB
Date of testing	: March 11, 2014
Room temperature	: 24°C
Relative humidity	: 23%

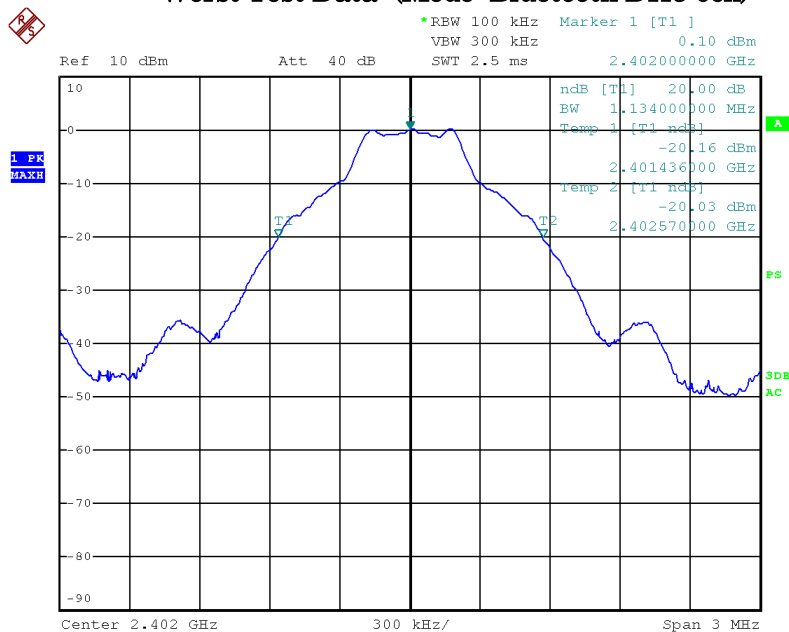


4.3.4 Measured Data

Frequency	Measured Bandwidth [kHz]
DH5	
2402 (0ch)	1134
2441 (39ch)	1134
2480 (78ch)	1128
2-DH5	
2402 (0ch)	1374
2441 (39ch)	1374
2480 (78ch)	1374
3-DH5	
2402 (0ch)	1386
2441 (39ch)	1380
2480 (78ch)	1380

Edge of Bandwidth [MHz]	Limit [MHz]	Margin [MHz]
DH5		
2401.436	2400	1.436
2480.564	2483.5	2.936
2-DH5		
2401.304	2400	1.304
2480.678	2483.5	2.822
3-DH5		
2401.310	2400	1.310
2480.690	2483.5	2.810

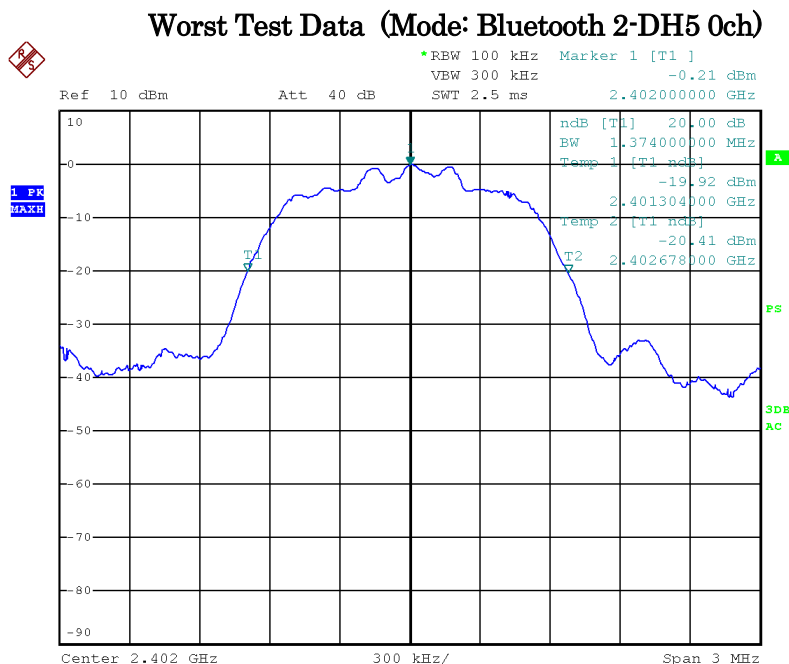
Worst Test Data (Mode: Bluetooth DH5 0ch)



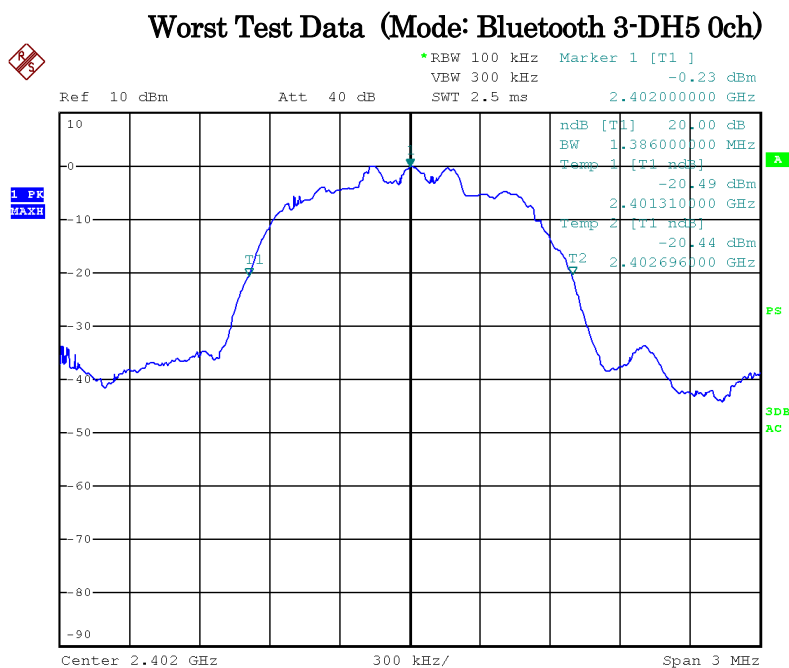
Date: 11.MAR.2014 20:50:26



4.3.4 Measured Data (Continued)



Date: 11.MAR.2014 20:58:05



Date: 11.MAR.2014 21:01:52



4.4 15.247(b) Maximum Peak Conducted Output Power

4.4.1 Setting Remarks

·The spectrum analyzer is set as following;

Frequency Span	: 6 MHz
Resolution Bandwidth	: 3 MHz
Video Bandwidth	: 10 MHz
Detector Mode	: Peak
Trace Mode	: Max Hold

·Refer to the figure of 2.2 Test configuration.

4.4.2 Limit

The maximum peak conducted output power of the intentional radiator shall not exceed the following: For frequency hopping systems operating in the 2400 MHz to 2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725 MHz to 5850 MHz band : 1 watt. For all other frequency hopping systems in the 2400 MHz to 2483.5 MHz band : 0.125 watts.

4.4.3 Result

EUT complies with the requirement.

Uncertainty of measurement result	: ± 3.64 dB
Date of testing	: March 11, 2014
Temperature	: 24°C
Humidity	: 23%



4.4.4 Measured Data

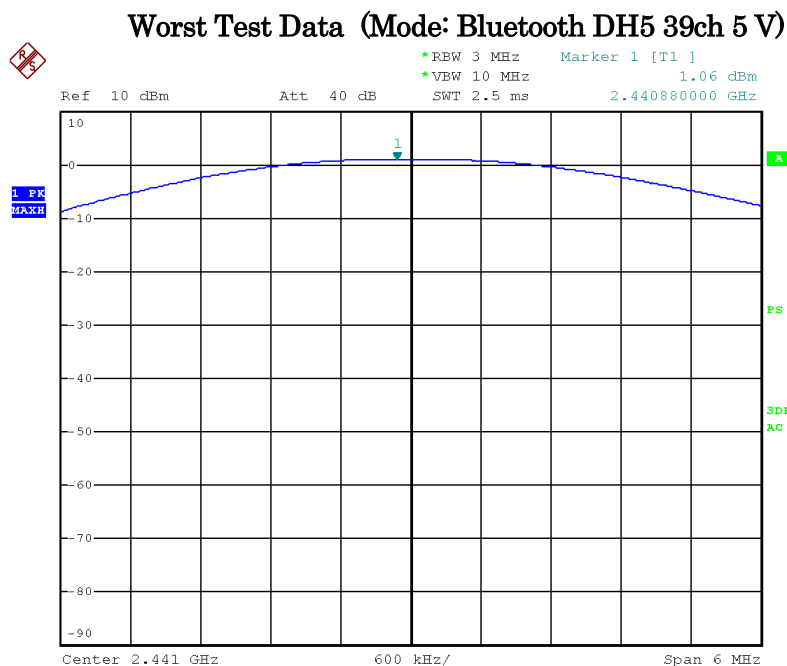
Sample Calculation

$$\begin{aligned}\text{Margin} &= \text{Limit} - \text{Result} \\ &= 30 - 0.30 \\ &= 29.70\end{aligned}$$

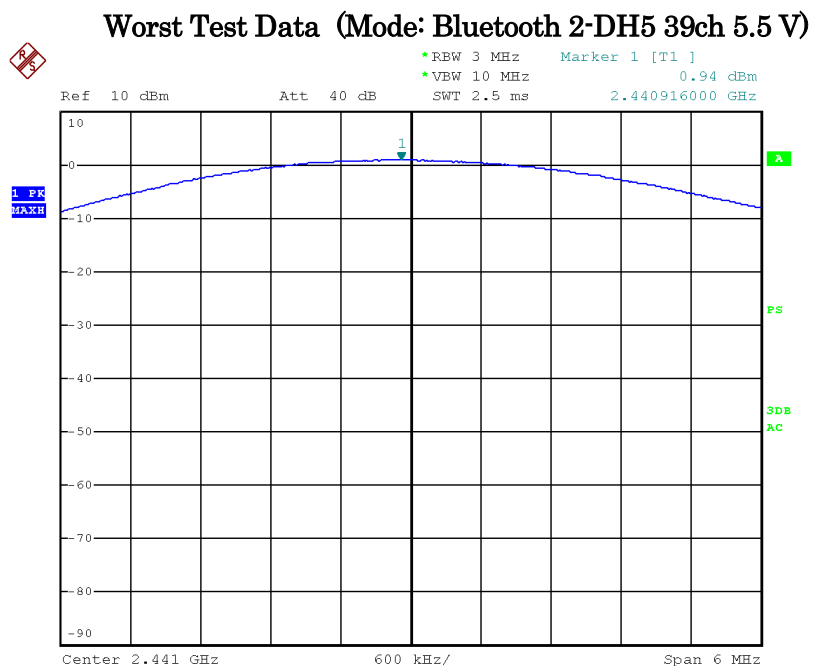
Frequency [MHz]	Power Supply Voltage [V]	Peak Power [dBm]	Limit [dBm]	Margin [dB]
DH5				
2402 (0 ch)	4.25	0.30	30	29.70
	5.00	0.24	30	29.76
	5.75	0.48	30	29.52
2441 (39 ch)	4.25	1.06	30	28.94
	5.00	1.06	30	28.94
	5.75	0.91	30	29.09
2480 (78 ch)	4.25	0.39	30	29.61
	5.00	0.55	30	29.45
	5.75	0.55	30	29.45
2-DH5				
2402 (0 ch)	4.25	0.64	30	29.36
	5.00	0.61	30	29.39
	5.75	0.67	30	29.33
2441 (39 ch)	4.25	0.85	30	29.15
	5.00	0.85	30	29.15
	5.75	0.94	30	29.06
2480 (78 ch)	4.25	-0.03	30	30.03
	5.00	-0.13	30	30.13
	5.75	0.03	30	29.97
3-DH5				
2402 (0 ch)	4.25	0.91	30	29.09
	5.00	0.79	30	29.21
	5.75	0.94	30	29.06
2441 (39 ch)	4.25	1.16	30	28.84
	5.00	1.03	30	28.97
	5.75	1.13	30	28.87
2480 (78 ch)	4.25	0.15	30	29.85
	5.00	0.18	30	29.82
	5.75	0.24	30	29.76



4.4.4 Measured Data (Continued)



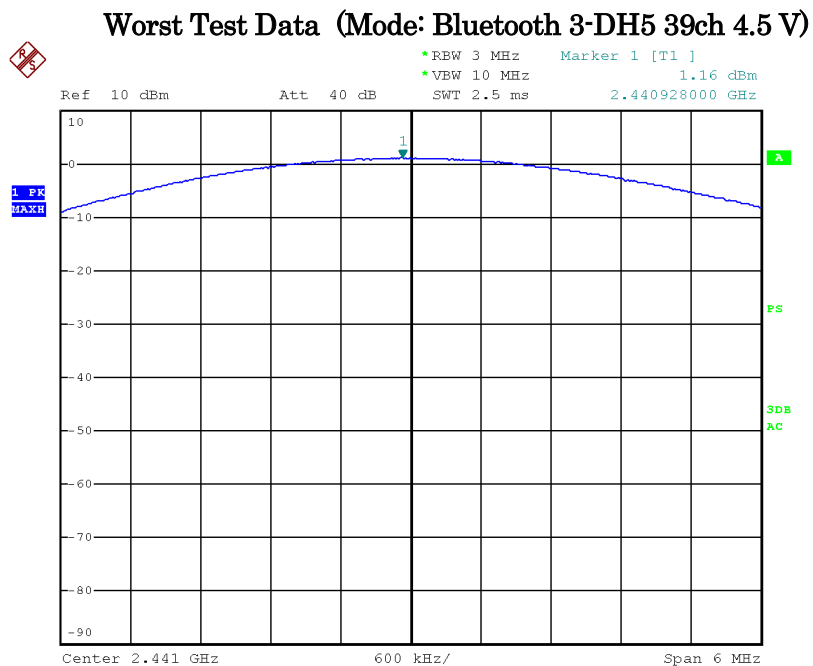
Date: 11.MAR.2014 21:52:02



Date: 11.MAR.2014 22:46:19



4.4.4 Measured Data (Continued)



Date: 11.MAR.2014 22:36:06



4.5 15.247(a) Carrier Frequency Separation

4.5.1 Setting Remarks

·The spectrum analyzer is set as following;

Frequency Span	: 10 MHz
Resolution Bandwidth	: 1 MHz
Video Bandwidth	: 3 MHz
Detector Mode	: RMS
Trace Mode	: Max Hold

·Refer to the figure of 2.2 Test configuration.

4.5.2 Limit

Frequency hopping systems operating in the 2400 MHz to 2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

4.5.3 Result

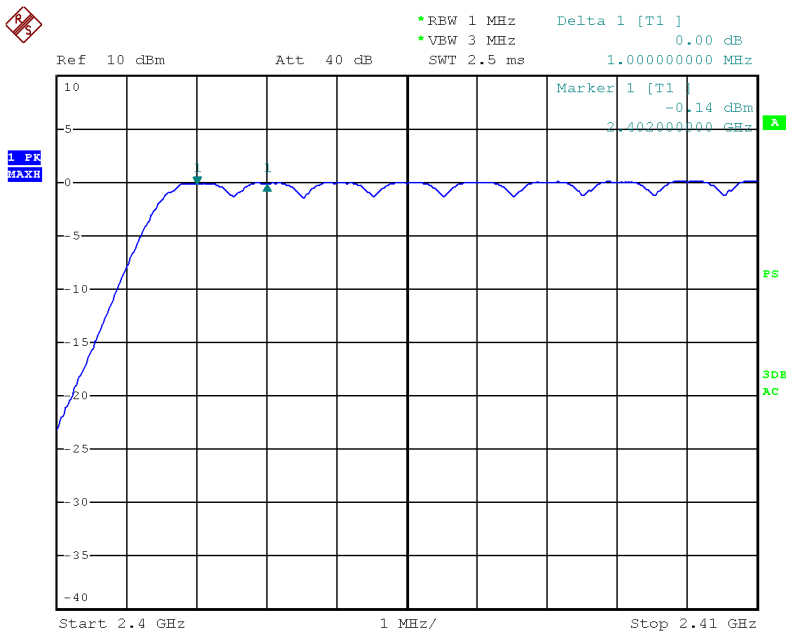
EUT complies with the requirement.

Uncertainty of measurement result	: ± 1 Hz
Date of testing	: March 12, 2014
Temperature	: 25°C
Humidity	: 24%



4.5.4 Measured Data

Carrier Frequency Separation [kHz]	Limit [kHz]
1000	Two-thirds of the 20dB BW (> 924 = 1386 * 2/3)



Date: 12.MAR.2014 20:44:01



4.6 15.247(a) Number of Channels

4.6.1 Setting Remarks

·The spectrum analyzer is set as following;

Frequency Span	: 83.5 MHz
Resolution Bandwidth	: 1 MHz
Detector Mode	: Peak
Trace Mode	: Max Hold

·Refer to the figure of 2.2 Test configuration.

4.6.2 Limit

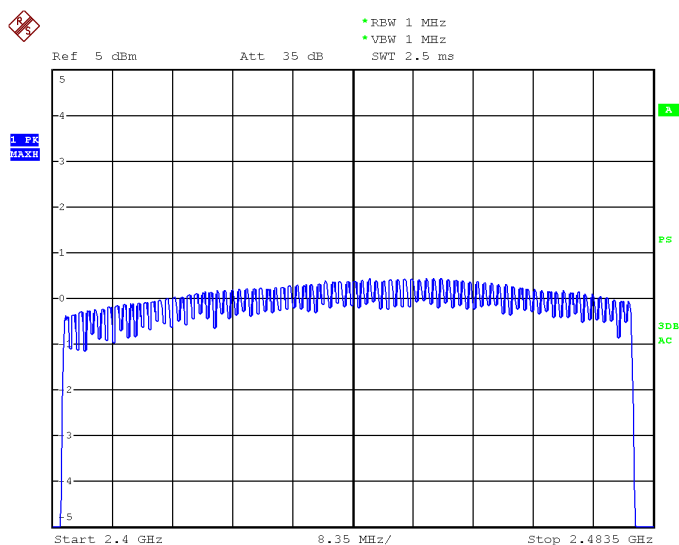
Frequency hopping systems in the 2400 MHz to 2483.5 MHz band shall use at least 15 channels.

4.6.3 Result

EUT complies with the requirement.

Date of testing	: March 12, 2014
Temperature	: 25°C
Humidity	: 24%

4.6.4 Measured Data



Date: 12.MAR.2014 21:29:20



4.7 15.247(a) Time of Occupancy

4.7.1 Setting Remarks

- Time of Occupancy is determined by using the marker-data function of spectrum analyzer.
- The spectrum analyzer is set as following to measure Time of Occupancy;

Span	: 0 Hz
Resolution Bandwidth	: 1 MHz
Video Bandwidth	: 3 MHz
Detector Mode	: Peak

- Refer to the figure of 2.2 Test configuration.

4.7.2 Limit

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.

4.7.3 Result

EUT complies with the requirement.

Uncertainty of measurement result	: $\pm 1 \mu\text{s}$
Date of testing	: March 12, 2014
Temperature	: 25°C
Humidity	: 24%



4.7.3 Measured Data

Mode: Bluetooth DH5

Frequency [MHz]	Cycle [ms]	ON Time [ms]	Duty cycle	Dwell Time [s]	Limit [s]	Margin [s]
2441 (39 ch)	12.52	2.92	0.23	0.09	0.40	0.31

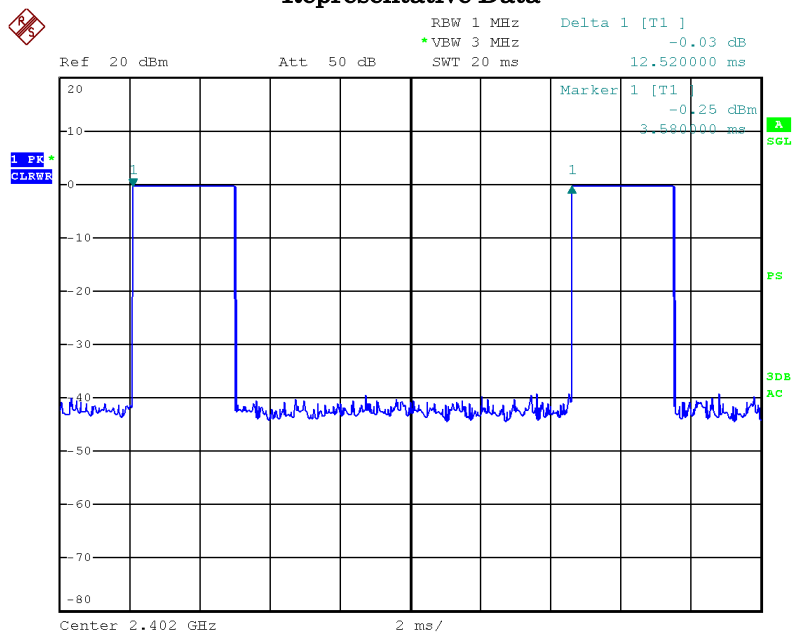
Mode: Bluetooth 2-DH5

Frequency [MHz]	Cycle [ms]	ON Time [ms]	Duty cycle	Dwell Time [s]	Limit [s]	Margin [s]
2441 (39 ch)	12.52	2.92	0.23	0.09	0.40	0.31

Mode: Bluetooth 3-DH5

Frequency [MHz]	Cycle [ms]	ON Time [ms]	Duty cycle	Dwell Time [s]	Limit [s]	Margin [s]
2441 (39 ch)	12.52	2.92	0.23	0.09	0.40	0.31

Representative Data



Date: 12.MAR.2014 22:04:52



4.8 15.247(d) Conducted Spurious Emission

4.8.1 Setting Remarks

- The Spectrums are scanned from the lowest generated frequency of EUT up to the 10th harmonics by using the spectrum analyzer.
- The spectrum analyzer is set as following;

Resolution Bandwidth	: 100 kHz
Video Bandwidth	: 300 kHz
Detector Mode	: Peak
Trace Mode	: Max Hold

- Refer to the figure of 2.2 Test configuration.

4.8.2 Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

4.8.3 Result

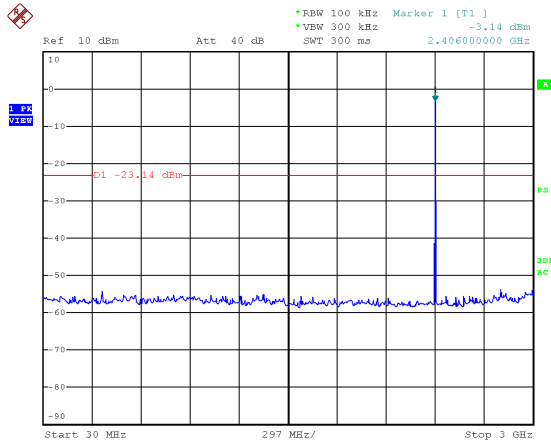
EUT complies with the requirement.

Uncertainty of measurement result	: ±0.8 dB	
Date of testing	: March 13, 2014	March 17, 2014
Temperature	: 25°C	22°C
Humidity	: 33%	42%

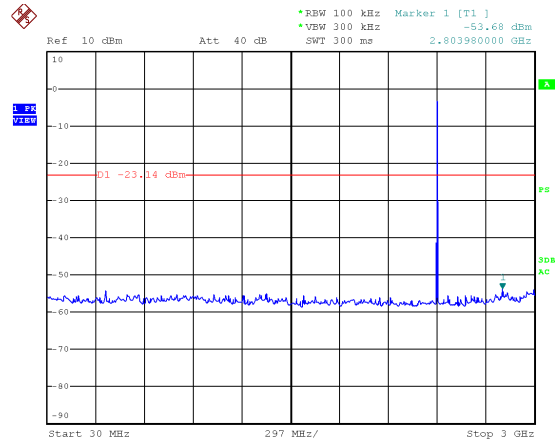


4.8.3 Measured Data

Worst Test Data (Mode: Bluetooth DH5 0ch) 30 MHz to 3 GHz



Date: 13.MAR.2014 14:40:25



Date: 13.MAR.2014 14:40:42

2 GHz to 13 GHz



12 GHz to 25 GHz





4.9 15.247(d) Band Edge Measurement

4.9.1 Setting Remarks

- The test setup was made in accordance with ANSI C63.4:2003 on the table installed in a semi-anechoic chamber.
- The non-conductive table, 0.8 m high, was placed on the turntable, and the EUT was put on the non-conductive table.
- The EUT was measured at 1 m to 4 m height of the antenna.
- The turntable was fully rotated. The highest radiation from the equipment was recorded.
- The measurement was carried out with both horizontal and vertical antenna polarization.
- This measurement is repeated in both side of the spectrum.
- The test receiver with Peak, Quasi Peak and Average detector is in accordance with CISPR 16-1-1.
- The measurement was carried out with the measuring distance of 3 m.
- Refer to the figure of 2.2 Test Configuration.

Setting Condition of Analyzer

Detector	RBW
Peak	1 MHz
Average	1 MHz

- Refer to the figure of 3.2 Test configuration.

4.9.2 Result

EUT complies with the requirement.

Uncertainty of measurement result : ± 3.64 dB
Date of testing : March 27, 2014
Temperature : 19°C
Humidity : 47%

4.9.3 Measured Data

Mode: Bluetooth DH5

Frequency	CH	Detector	Reading	c.f.	Result	Limit	Margin
			dB μ V	dB/m	dB μ V/m	dB μ V/m	dB
Below 2390 MHz	0ch	PK	41.14	6.1	47.3	73.9	26.6
		AV	26.00	6.1	32.1	53.9	21.8
Above 2483.5 MHz	78ch	PK	53.13	6.3	59.5	73.9	14.4
		AV	32.14	6.3	38.5	53.9	15.4

Mode: Bluetooth 2-DH5

Frequency	CH	Detector	Reading	c.f.	Result	Limit	Margin
			dB μ V	dB/m	dB μ V/m	dB μ V/m	dB
Below 2390 MHz	0 ch	PK	43.31	6.1	49.5	73.9	24.4
		AV	26.22	6.1	32.4	53.9	21.5
Above 2483.5 MHz	78 ch	PK	57.95	6.3	64.3	73.9	9.6
		AV	33.87	6.3	40.2	53.9	13.7

Mode: Bluetooth 3-DH5

Frequency	CH	Detector	Reading	c.f.	Result	Limit	Margin
			dB μ V	dB/m	dB μ V/m	dB μ V/m	dB
Below 2390 MHz	0 ch	PK	42.32	6.1	48.5	73.9	25.4
		AV	27.04	6.1	33.2	53.9	20.7
Above 2483.5 MHz	78 ch	PK	59.66	6.3	66.0	73.9	7.9
		AV	33.90	6.3	40.2	53.9	13.7



5. List of Test Measurement Instruments

AC Power Line Conducted Emission

Instruments	Manufacturer	Model	Serial No.	Calibrated Date/Until
EMI Test Receiver	ROHDE& SCHWARZ	ESCI	100413	2013/11/23 2014/11/22
Artificial-Mains Network (for EUT)	Kyoritsu	KNW-341C (F)	8-1659-1	2014/01/14 2015/01/13
Artificial-Mains Network (for peripheral)	Kyoritsu	KNW-244C (F)	8-1657-1	2013/06/25 2014/06/24
RF Cable	Fujikura	3D-2W	OC01	2013/05/10 2014/05/09
RF Cable	SUHNER	RG223/U	OC02 OC04	2013/05/10 2014/05/09
RF Selector	TSJ	RFM-E221	3148	2013/05/10 2014/05/09
RF Selector	TSJ	RFM-E121	03149	2013/09/23 2014/09/22
Terminator	RES-NET MICROWAVE	RCX6BM	---	2013/07/11 2014/07/10
Software	TOYO	EP5/CE (ver5.3.20)	---	---



5. List of Test Measurement Instruments (Continued)

Radiated Spurious Emission (30 MHz to 1 GHz)

Band Edge Measurement

Instruments	Manufacturer	Model	Serial No.	Calibrated Date/Until
EMI Test Receiver	ROHDE& SCHWARZ	ESCI	100413	2013/11/23 2014/11/22
Pre-Amplifier (30 MHz to 1 GHz)	HEWLETT PACKARD	8447D OPT 010	2944A 07891	2013/04/15 2014/04/14
Biconical Antenna (30 MHz to 300 MHz)	SCHWARZBECK	VHBB9124 / BBA9106	9124-311	2013/10/12 2014/10/11
Log-Periodic Antenna (300 MHz to 1 GHz)	SCHWARZBECK	UHALP9108- A	0645	2013/10/12 2014/10/11
Anechoic Chamber 3 m	JSE	COAC3M-01	---	2013/07/19 2014/07/18
Attenuator	JFW	50FP-003-H2	---	2013/05/16 2014/05/15
RF Cable (30 MHz to 1 GHz)	SUHNER	RG223/U	OC11	2013/04/23 2014/04/22
RF Cable (30 MHz to 1 GHz)	Fujikura	8D-2W	OC14	2013/04/23 2014/04/22
RF Cable (30 MHz to 1 GHz)	SUHNER	RG214/U	OC15 OC16	2013/04/23 2014/04/22
RF Cable (30 MHz to 1 GHz)	SUHNER	RG400/U	OC17	2013/04/23 2014/04/22
RF Selector	TSJ	RFM-E121	03149	2013/09/23 2014/09/22
Software	TOYO	EP5/RE (ver 5.4.21)	---	---



5. List of Test Measurement Instruments (Continued)

Radiated Spurious Emission (1 GHz to 18 GHz)

Instruments	Manufacturer	Model	Serial No.	Calibrated Date/Until
EMI Test Receiver	ROHDE & SCHWARZ	ESIB40	100211	2013/03/30 2014/03/29
Pre-Amplifier	TSJ	MLA-0120AML -34	---	2013/11/13 2014/11/12
Horn Antenna (1 GHz to 18 GHz)	SCHWARZBECK	BBHA9120D	443	2013/12/05 2014/12/04
Horn Antenna (12.5 GHz to 18 GHz)	ETS LINDGREN	3160-08	00033778	2013/12/14 2014/12/13
Horn Antenna (18 GHz to 26.5 GHz)	ETS LINDGREN / TSJ	3160-09 / MLA-1826POM- 30	00034723 / ---	2013/10/19 2014/10/18
Anechoic Chamber 3 m	JSE	COAC3M-01	---	2013/07/19 2014/07/18
RF Cable (1 GHz to 18 GHz)	STORM	TRUE BLUE 290	OC18 OC19 OC20	2013/06/11 2014/06/10
RF Cable (1 GHz to 13 GHz)	STORM	TRUE BLUE 125	OC22	2013/05/20 2014/05/19
Notch Filter	MICRO -TRONICS	BRM50702	027	2013/02/25 2014/02/24
Software	TOYO	EP5/RE (ver 5.4.21)	---	---

20 dB Bandwidth / Maximum Peak Conducted Output Power / Number of Channels Time of Occupancy / Conducted Spurious Emission

Instruments	Manufacturer	Model	Serial No.	Calibrated Date/Until
EMI Test Receiver	ROHDE & SCHWARZ	ESCI	100413	2013/11/23 2014/11/22
Thermostatic Chamber	ESPEC	PU-2KP	14010422	2013/08/22 2014/08/21

6. Appendix

Refer to separated files for the following appendixes.

Appendix 1 : EUT Angle

Appendix 2 : External Photos

Appendix 3 : Setup Photos