

RADIO TEST REPORT

(for Bluetooth Low Energy)

Project No. : JB-Z0127-E

Client : Sony Corporation

Address : 1-7-1 Konan Minato-ku Tokyo, 108-0075, Japan

Type of Equipment : WiFi / Bluetooth Module

Model No. : FL-N01-WBM

Serial No. : c62e

FCC ID : AK8FLN01WBM

Regulation Applied : 47 CFR Part 15 Subpart C

Final Judgment : Passed

Sample Receipt : February 18, 2016

Original Testing : February 25, 2016 - March 25, 2016

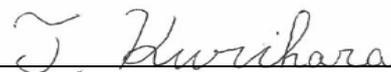
Amend Testing : May 23, 2016 - May 24, 2016

Original Reported : April 06, 2016

Amend Reported : June 27, 2016

Reported by :

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Notice

* These test results relate only to the items (combination equipment, test configuration, operation condition etc.) tested.

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* This report must not be used by the client to claim product endorsement by A2LA or any agency of the U.S. Government.

* All test results are traceable to the national and / or international standards.

The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in Sony Global Manufacturing & Operations Corporation EMC/RF Test Laboratory.



TESTING CERT #3203.01

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Note

- indicates that the listed condition, standard or equipment is applicable for this report.
-indicates that the listed condition, standard or equipment is not applicable for this report.

1. General Information

1.1. Description of Equipment Under Test (EUT)

General specification

Test Sample Condition : Prototype Pre-production Mass-production
 Type of Equipment : WiFi/Bluetooth Module
 Trade Name : SONY
 Model No. : FL-N01-WBM
 Serial No. : c62e
 Power Rating : DC 3.3V (The EUT was supplied with the power from the host device)
 Software Ver. : develop #158

Radio specification

Function of the Equipment : Transceiver
 Operating Frequency : 2402 - 2480MHz
 Modulation Type : GFSK
 Channel Spacing : 2MHz
 Channel Bandwidth : 2MHz
 Number of channels : 39
 Antenna Type : Dipole Antenna
 Antenna connector Type : X.FL
 Antenna Gain : -1.40 dBi
 Operating Temperature : +5 to +35 deg.C

1.2. Summary of Test Result

47 CFR Part 15 Subpart C § 15.247 [DTS]

Test Item	Worst Margin	Test Frequency band	Results
AC Power-line Conducted Emissions	15.7 dB (QP) 0.548 MHz L1	150 kHz - 30 MHz	Complied
6dB Bandwidth	Refer to the test data	Carrier	Complied
Maximum Peak Conducted Output Power	30.21 dB	Carrier	Complied
Power Spectral Density	24.11 dB	Carrier	Complied
Radiated Spurious Emissions	0.1 dB (QP) 156.0 MHz Horizontal	9 kHz - 25 GHz (excluding carrier and band edge)	Complied
Conducted Spurious Emissions for Band Edge *1	28.28 dB 2399.79 MHz	Carrier band edge	Complied

*1: Conducted Spurious Emission was tested for the only frequencies in the non-restricted carrier band edges, since the spurious emissions in other non-restricted band were complied with Radiated Spurious Emission measurement.

Other requirements

Part 15.31(e) Supply voltage requirement
 : Complied (The EUT is provided with stable DC 3.3V from the host device)
 Part 15.203 / 212 Antenna requirement
 : Complied (Users cannot replace the external antenna, since it is mounted to the EUT inside)

1.3. Tested Methodology

Test Standard : 47 CFR Part15 Subpart C Section 15.207 / 15.247
 Test Method : ANSI C63.10 - 2013
 KDB 558074 D01 DTS Meas. Guidance v03r04

Test Distance for Radiated Spurious Emissions : 3 m 10m (9kHz - 30 MHz)
 3 m 10m (30 - 1000 MHz)
 3 m (1 - 25 GHz)

1.4. Measurement Procedures

We performed the measurements in accordance with NV3-06, available upon the request.

- No deviation
 Deviation from the above procedure

The summary of the above procedure is mentioned below

AC Power-line Conducted Emissions

1. The non-conductive table (EUT table) made of (FRP, wood, other non-conductive material) was placed 0.4 m from its rear to the vertical reference ground plane.
2. The dimensions of the EUT table were 0.8 m height, 2.0m width and 1.0 m depth.
3. The EUT was placed on the center of tabletop and its rear was flush with the rear of the table, connected through a LISN to the input power mains.
4. The LISN was placed in 80 cm from the nearest part of the EUT chassis.
5. The excess length of the AC cable between the EUT and the LISN receptacle, or an adaptor or extension cable connected to and measured with LISN, was folded back and forth at the center of the lead to form a bundle not exceeding 40 cm in length.
6. The connection of the all other equipment to the second LISN was performed. The second LISN was terminated with a 50-ohm terminator.
7. Interconnecting cables that hang closer than 40 cm to the horizontal reference ground plane was folded back and forth forming a bundle 30 to 40 cm long, hanging approximately in the middle between the horizontal reference ground plane and the tabletop.
8. Find the worst mode and arrangement of the EUT according to the follows:
 - Connecting all peripherals and change the position of peripherals and cables.
 - Changing the all test operation modes of the EUT.
 - On every condition, exploring the highest emissions with the spectrum analyzer. (150kHz - 30MHz, peak detector, RBW: 10 kHz)
9. On the worst condition of the EUT found in above, choose the 6 highest emissions on the spectrum data. The final measurements carried out on these emissions with EMI test receiver. (quasi-peak and average detector, RBW: 9 kHz)

6dB Bandwidth

1. Antenna-port of the EUT was connected to the spectrum analyzer.
2. On every test operating mode of the EUT, the 6dB Bandwidth was measured with spectrum analyzer.
 - Detector type : Peak
 - RBW : 100kHz

Maximum Peak Conducted Output Power

1. Antenna-port of the EUT was connected to the peak power meter and sensor.
2. On every test operating mode of the EUT, the Maximum Peak Conducted Output Power was measured with peak power meter and sensor.
 - Detector type : Peak
 - VBW : 30MHz

Power Spectral Density

1. Antenna-port of the EUT was connected to the spectrum analyzer.
2. On every test operating mode of the EUT, the Power Density was measured with a spectrum analyzer.
 - Detector type : Peak
 - RBW : 3kHz

Radiated Spurious Emissions

1. The non-conductive table (EUT table) made of (FRP, Styrene Foam, other non-conductive material) was placed in the center of the turntable.
2. The dimensions of the EUT table were 0.8 m (for MHz), 1.5m (for GHz) height, 2.0 m width and 1.0 m depth.
3. The EUT was placed on the center of the tabletop.
4. The test antenna was placed away from the EUT at 3m distance.
5. The limits compensated the distance factor with follows:
 - 9 kHz - 490 kHz [Limit at 3m] = [Limit at 300m] + 40log (300[m] / 3[m])
 - 490 kHz - 30 MHz [Limit at 3m] = [Limit at 30m] + 40log (30[m] / 3[m])
6. Find the worst arrangement of the EUT as follows;
 - Connect all peripherals and change the position of EUT, peripherals and cables.
 - Rotate the turntable and/or scanning the antenna.
 - On every condition, explore the highest emissions with the spectrum analyzer. (9 kHz - 25 GHz, peak detector)

7. On the worst arrangement of the EUT found in above, choose the three highest harmonics or spurious emissions on the spectrum data.(*excluding carrier band edges)

The final measurements are performed with all test operating modes for these emissions as follows;

The test antenna and the turntable were performed with follows;

	9kHz - 30MHz	30MHz - 1000MHz	above 1GHz
Antenna	Loop Antenna	Bi-conical Antenna, Log-periodic Antenna	Horn Antenna
Antenna scanning range	1m, Vertical, 360 degrees	1 - 4m, Horizontal and Vertical	1 - 4m *, Horizontal and Vertical
Turntable rotating range	360 degrees	360 degrees	360 degrees

*: When the measurement frequencies above 1GHz, final measurements are performed keeping the antenna in the "cone of radiation" from EUT area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.

Instruments settings were carried out with follows;

	9 kHz - 90 kHz 110 kHz - 490 kHz	90 kHz- 110 kHz 490 kHz - 30 MHz	30 MHz - 1000 MHz	above 1GHz
Detector	Peak / Average	Quasi-peak	Quasi-peak	Peak / Average
RBW	200 Hz (6dB) or 9 kHz (6dB) *1	200 Hz (6dB) or 9 kHz (6dB) *1	120 kHz (6dB)	1 MHz (3dB)
VBW	N/A	N/A	N/A	3 MHz (for peak) 10 kHz (for average) *2
Instrument	EMI test receiver	EMI test receiver	EMI test receiver	Spectrum analyzer

*1: When the measurement frequencies below 150 kHz, RBW: 200 Hz was used.

*2: VBW setting (for average) was higher than 1/T. (T is the minimum transmission duration)

8. If the final measurement result exceeded the limit in non-restricted band(excluding carrier band edges), the measurement is carried out additionally with follows;

Measurement points

- Fundamental Frequency
- Frequency that exceeded the limit in non-restricted band (excluding carrier band edges)

	9 kHz - 150 kHz	150 kHz - 30MHz	above 30MHz
Detector	Peak	Peak	Peak
RBW	3 dB RBW: 300 Hz *	3 dB RBW: 10 kHz *	3 dB RBW: 100 kHz
Instrument	Spectrum analyzer	Spectrum analyzer	Spectrum analyzer

*: Correction factor of RBW was compensated to a measurement result by the following formula.

$$C.F. \text{ of RBW [dB]} = 10 * \log (100\text{kHz} / \text{used RBW})$$

9. These tests were performed in semi anechoic chamber. Therefore the measured level of emissions may be higher than if measurements were made without a ground plane. However test results were confirmed to pass against standard limit.

Conducted Spurious Emissions for Band Edge

1. Antenna-port of the EUT was connected to the spectrum analyzer.
2. On every test operation modes of the EUT, the Conducted Spurious Emissions for Band Edge was measured with a spectrum analyzer.
 - Detector type : Peak
 - RBW : 100kHz

1.5. Test Facility

Address of Test Facility

Test Facility Name : Sony Global Manufacturing & Operations Corporation
EMC/ RF Test Laboratory, Main Lab.
Address : Kisarazu Site 8-4 Shiomi Kisarazu-shi, Chiba, 292-0834 Japan
Phone : +81 438 37 2750

AC Power-line Conducted Emissions

Shielded Room
 4th Site

Radiated Spurious Emission

Semi-Anechoic chamber
 4th Site

Antenna-port Conducted Measurements *

Shielded Room
 4th Site SR1

*Note: This item contains the following

- 6dB Bandwidth
- Maximum Peak Conducted Output Power
- Power Spectral Density
- Conducted Spurious Emissions for Band Edge

A2LA Accreditation for Test Facility

The above test facility has been fully reported to A2LA and accepted as follows:
Effective dates: 2015-09-15 through 2017-10-31

1.6. Uncertainty

Test Item	Frequency	4th Site SR1
Conducted Output Power	1 - 6GHz	± 0.84 dB
Power Spectral Density, Conducted Spurious Emissions	below 6GHz	± 0.89 dB

Test Item	Frequency	4th Site	
AC Power-line Conducted Emissions	150kHz - 30MHz	± 3.34 dB	
Radiated Emissions	below 30 MHz	3m	± 2.59 dB
	30 - 300 MHz	3m	± 4.18 dB
	300 - 1000 MHz	3m	± 4.04 dB
	1 - 6 GHz	3m	± 4.63 dB
	6 - 18 GHz	3m	± 5.31 dB
	18 - 26.5 GHz	3m	± 5.78 dB

2. System Test Configuration

2.1. Validation

The system was configured for testing in a typical (as a customer would normally use it).
The tests were conducted with the worst case modes as follows.

2.2. Test Operating Conditions

The tests have been carried out the following conditions.

Test Items	Operating Mode	Data Rate	Test Channels
AC Power-line Conducted Emissions	Bluetooth Low Energy	1 Mbps	2402 MHz *1
6dB Bandwidth, Maximum Peak Conducted Output Power, Power Spectral Density, Radiated Spurious Emissions	Bluetooth Low Energy	1 Mbps	2402 MHz, 2442 MHz, 2480 MHz
Conducted Spurious Emissions for Band Edge	Bluetooth Low Energy	1 Mbps	2402 MHz

Note:

*1: The final test was performed with the representative mode that had been found as the worst emission mode while exploratory testing.

2.3. Special Accessories

Special accessories needed for connecting the EUT to achieve compliance:

Item	Manufacturer	Model No.	Serial No.	Remark
Personal Computer	SONY	VPCZ21ADZ	1009099	-
AC Adaptor	SONY	VGP-AC19V25	148013121 0212911	-

2.4. EUT Modifications

- No equipment modification to achieve compliance to the standard levels was done during the tests.
 Equipment was modified to achieve compliance to the standard level as below.

Responsible Party Signature

Typed/ Print Name :
Responsible Party :
Position :
Date :

2.5. Configuration of Tested System

Antenna-port Conducted Measurements

The equipment under test (EUT)

Symbol	Item	Manufacturer	Model No.	FCC ID	Serial No.
A	WiFi / Bluetooth Module	SONY	FL-N01-WBM	AK8FLN01WBM	c62e

Support equipment for operation

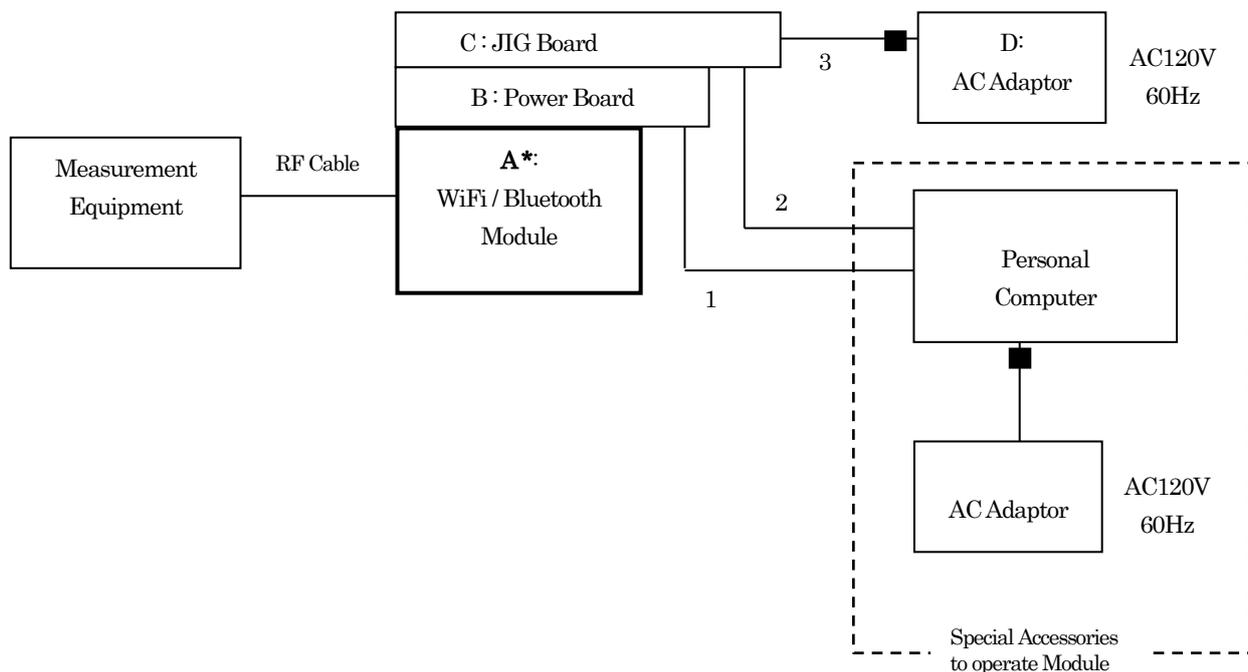
Symbol	Item	Manufacturer	Model No.	FCC ID	Serial No.
B	Power Board	-	-	N/A	-
C	JIG Board	-	-	N/A	-
D	AC Adaptor	GO FORWARD ENTERPRISE	GF12-US0520	N/A	1410-08

Type of cable

Symbol	Description	Identification (Manufacturer etc.)	Shielded YES / NO	Ferrite Core	Length (m)	Bundled
1	USB Cable	-	YES	NO	1.2	-
2	USB Cable	-	YES	NO	0.9	-
3	AC Adaptor Cable	-	NO	NO	1.5	-

System configuration

*: EUT ■ : Ferrite core



Radiated Spurious Emissions

The equipment under test (EUT)

Symbol	Item	Manufacturer	Model No.	FCC ID	Serial No.
A-1	WiFi / Bluetooth Module	SONY	FL-N01-WBM	AK8FLN01WBM	c62e
A-2	Antenna	SONY	FPC-ANT-B	N/A	-

Support equipment for operation

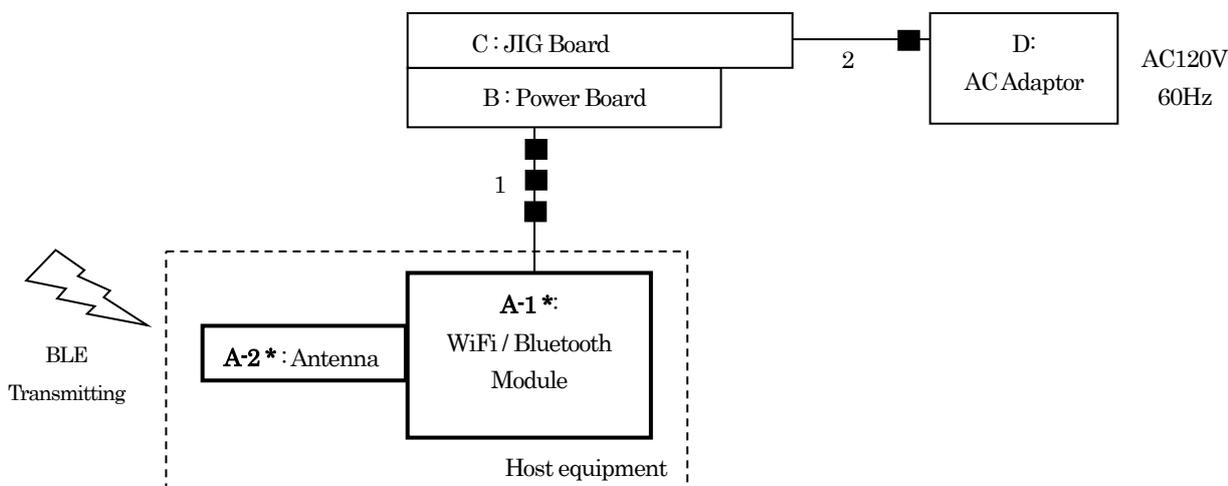
Symbol	Item	Manufacturer	Model No.	FCC ID	Serial No.
B	Power Board	-	-	N/A	-
C	JIG Board	-	-	N/A	-
D	AC Adaptor	GO FORWARD ENTERPRISE	GF12-US0520	N/A	1410-08

Type of Cable

Symbol	Description	Identification (Manufacturer etc.)	Shielded YES / NO	Ferrite Core	Length (m)	Bundled
1	B to B Extended Cable	-	NO	YES (x3)	0.1	-
2	AC Adaptor Cable	-	NO	YES (x1)	1.5	-

System configuration

*: EUT ■ : Ferrite core



EUT was tested under the same conditions as mounted in the host equipment. (See Note)

- Note:
- The radio specifications (e.g. Tx power, channel) of this host equipment (refers to Clause 6.3 "Setup 2: Module product") is same as final product (refers to Clause 6.3 "Setup 1: Final product") specifications.
 - Module product setup was confirmed by comparing with final product setup with normal communicating mode, since final product cannot operate with continuous transmission.
 - Hereby, module product which confirmed worst condition was measured with continuous transmission.

AC Power-line Conducted Emissions

The equipment under test (EUT)

Symbol	Item	Manufacturer	Model No.	FCC ID	Serial No.
A-1	WiFi / Bluetooth Module	SONY	FL-N01-WBM	AK8FLN01WBM	c62e
A-2	Antenna	SONY	FPC-ANT-B	N/A	-

Support equipment for operation

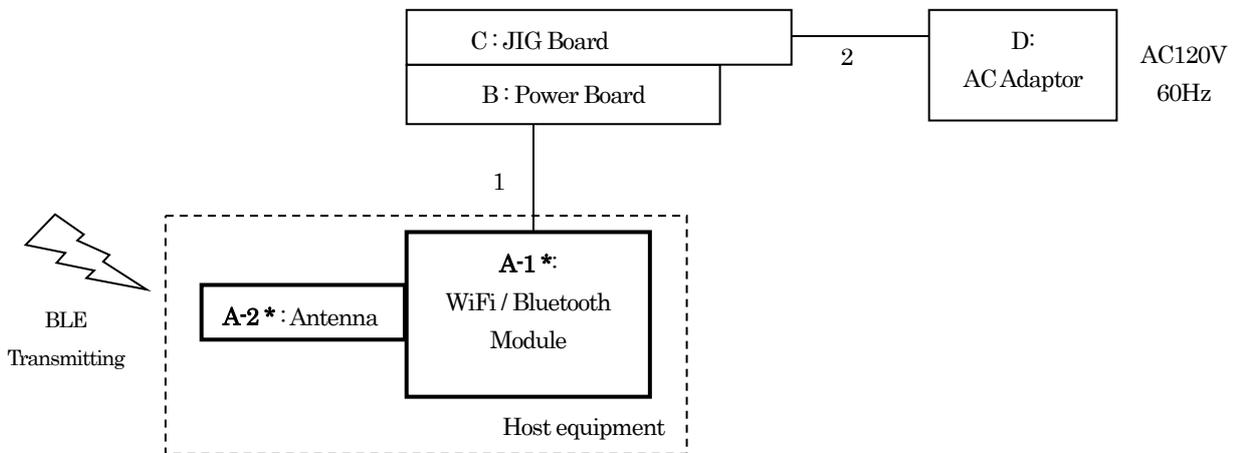
Symbol	Item	Manufacturer	Model No.	FCC ID	Serial No.
B	Power Board	-	-	N/A	-
C	JIG Board	-	-	N/A	-
D	AC Adaptor	GO FORWARD ENTERPRISE	GF12-US0520	N/A	1410-08

Type of Cable

Symbol	Description	Identification (Manufacturer etc.)	Shielded YES / NO	Ferrite Core	Length (m)	Bundled
1	B to B Extended Cable	-	NO	NO	0.1	-
2	AC Adaptor Cable	-	NO	NO	1.5	Bundled

System configuration

*: EUT



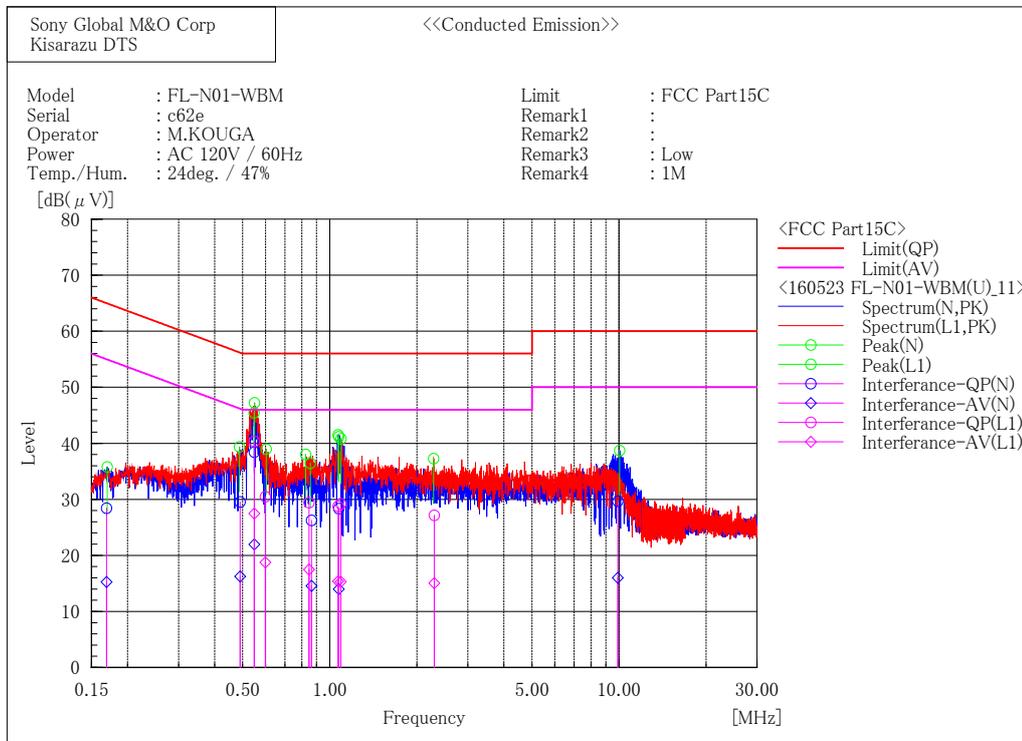
EUT was tested under the same conditions as mounted in the host equipment.

3. Test Data

3.1. AC Power-line Conducted Emissions

1) Date of measurement : May 23, 2016

[Bluetooth Low Energy (1 Mbps) / 2402MHz]



Final Result

--- N 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	0.169	12.4	-0.8	16.0	28.4	15.2	65.0	55.0	36.6	39.8
2	0.490	13.4	0.2	16.1	29.5	16.3	56.2	46.2	26.7	29.9
3	0.549	22.3	5.8	16.1	38.4	21.9	56.0	46.0	17.6	24.1
4	0.865	10.3	-1.5	16.0	26.3	14.5	56.0	46.0	29.7	31.5
5	1.074	12.3	-2.0	16.0	28.3	14.0	56.0	46.0	27.7	32.0
6	9.912	13.5	-0.2	16.2	29.7	16.0	60.0	50.0	30.3	34.0

--- L1 Phase ---

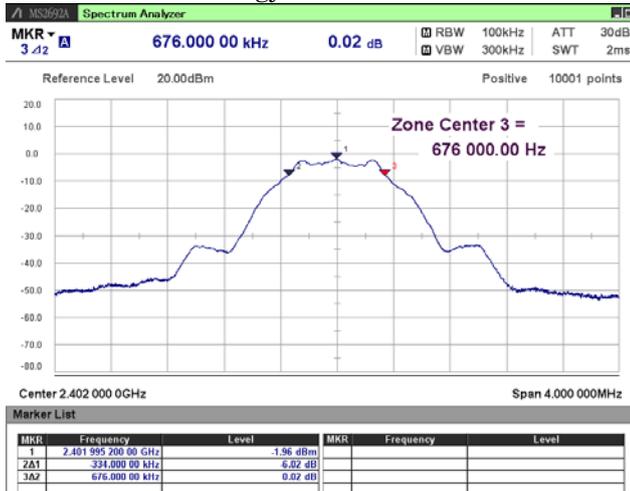
No.	Frequency [MHz]	Reading QP [dB(μV)]	Reading AV [dB(μV)]	c. f [dB]	Result QP [dB(μV)]	Result AV [dB(μV)]	Limit QP [dB(μV)]	Limit AV [dB(μV)]	Margin QP [dB]	Margin AV [dB]
1	0.548	24.2	11.4	16.1	40.3	27.5	56.0	46.0	15.7	18.5
2	0.599	14.4	2.6	16.1	30.5	18.7	56.0	46.0	25.5	27.3
3	0.848	13.4	1.5	16.0	29.4	17.5	56.0	46.0	26.6	28.5
4	1.068	12.8	-0.6	16.0	28.8	15.4	56.0	46.0	27.2	30.6
5	1.092	13.2	-0.7	16.0	29.2	15.3	56.0	46.0	26.8	30.7
6	2.296	11.3	-0.8	15.9	27.2	15.1	56.0	46.0	28.8	30.9

3.2. 6dB Bandwidth

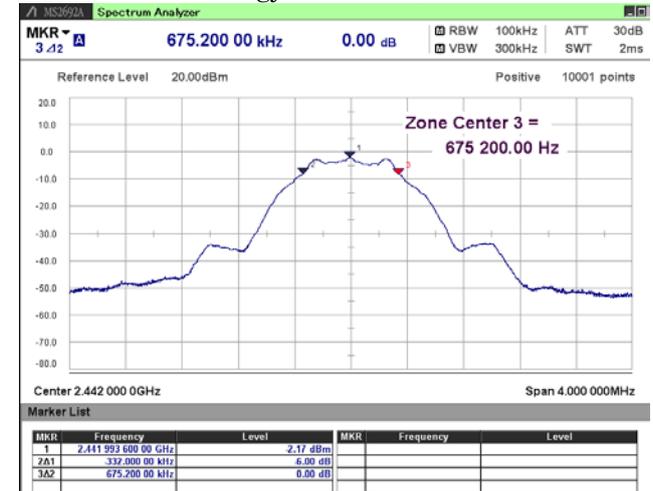
- 1) Ambient temperature : 25.8deg.C
- 2) Relative humidity : 46.5 %
- 3) Date of measurement : March 02, 2016
- 4) Measured by : Y.AOYAMA
- 5) Operating mode : Transmitting mode

Mode	Rate [Mbps]	Channel [MHz]	Result [MHz]	Limit [MHz]
BLE	1	2402	0.676	0.5
		2442	0.675	0.5
		2480	0.676	0.5

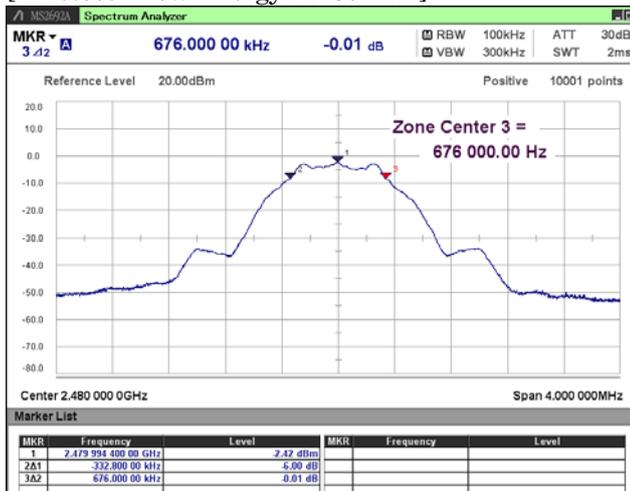
[Bluetooth Low Energy / 2402MHz]



[Bluetooth Low Energy / 2442MHz]



[Bluetooth Low Energy / 2480MHz]



3.3. Maximum Peak Conducted Output Power

- 1) Ambient temperature : 25.8deg.C
- 2) Relative humidity : 46.5 %
- 3) Date of measurement : March 02, 2016
- 4) Measured by : Y.AOYAMA
- 5) Operating mode : Transmitting mode

Maximum Peak Conducted Output Power

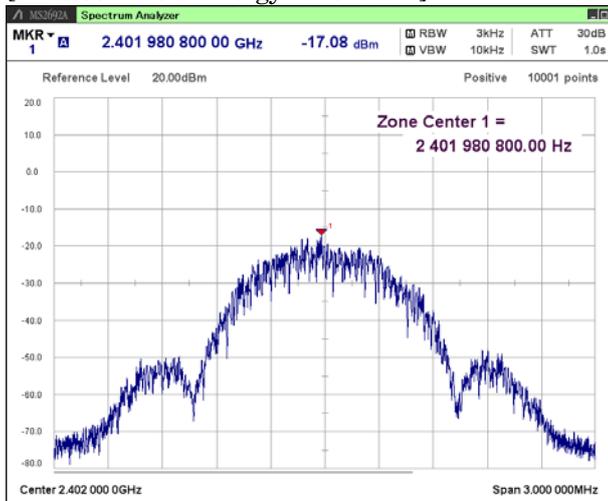
Mode	Rate [Mbps]	Channel [MHz]	Reading(PK) [dBm]	C.F. [dB]	Result(PK) [dBm]	Limit [dBm]	Margin [dB]
BLE	1	2402	-0.81	0.60	-0.21	30.0	30.21
		2442	-0.92	0.60	-0.32	30.0	30.32
		2480	-1.06	0.60	-0.46	30.0	30.46

3.4. Power Spectral Density

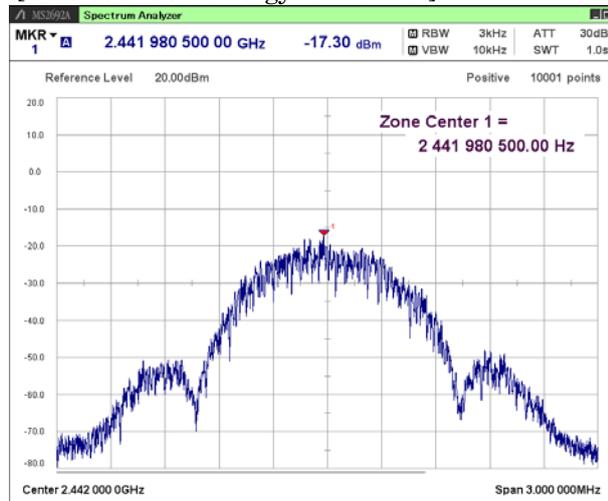
- 1) Ambient temperature : 25.8deg.C
- 2) Relative humidity : 46.5 %
- 3) Date of measurement : March 02, 2016
- 4) Measured by : Y.AOYAMA
- 5) Operating mode : Transmitting mode

Mode	Rate [Mbps]	Channel [MHz]	Reading(PK) [dBm]	C.F. [dB]	Result(PK) [dBm]	Limit [dBm]	Margin [dB]
BLE	1	2402	-17.08	0.97	-16.11	8.0	24.11
		2442	-17.30	0.98	-16.32	8.0	24.32
		2480	-17.52	0.98	-16.54	8.0	24.54

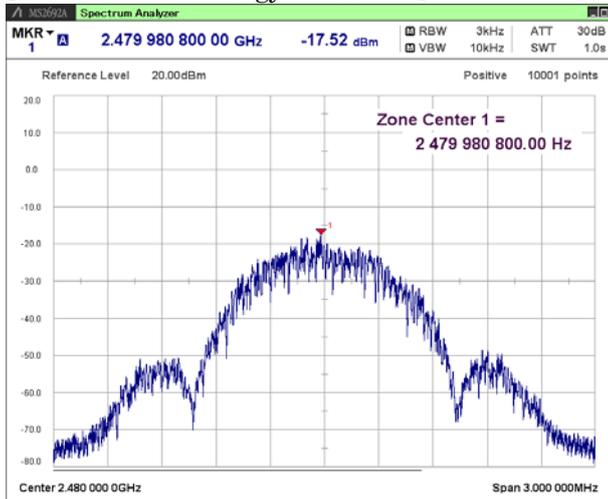
[Bluetooth Low Energy / 2402MHz]



[Bluetooth Low Energy / 2442MHz]



[Bluetooth Low Energy / 2480MHz]



3.5. Radiated Spurious Emissions

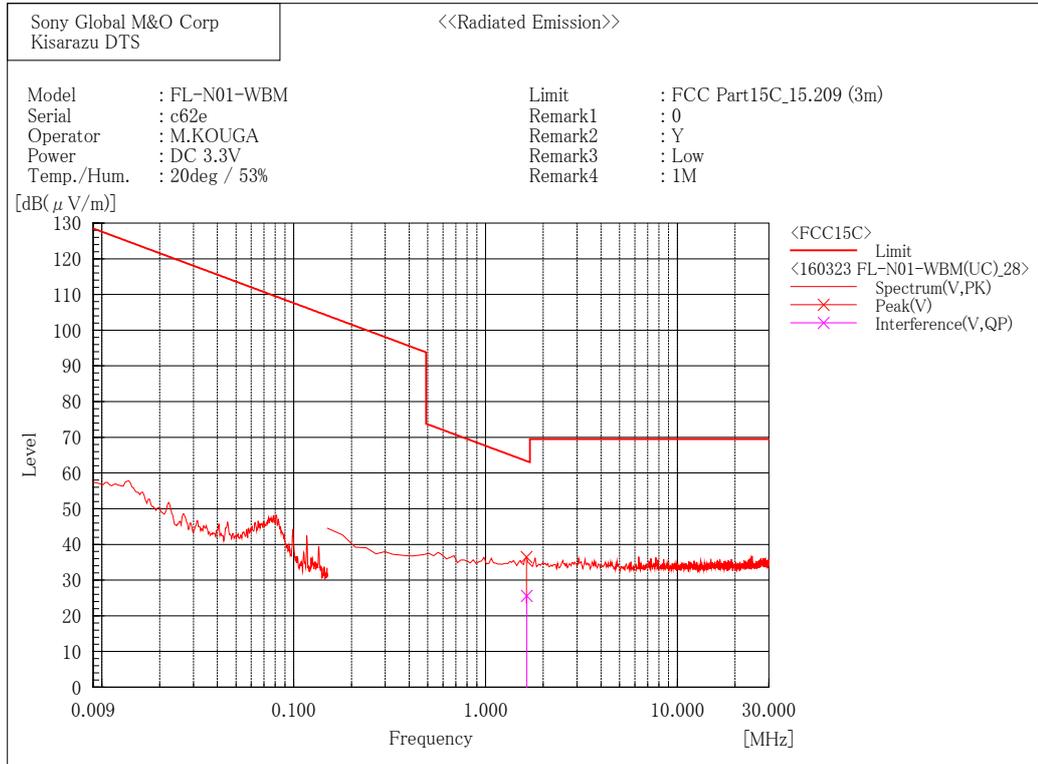
1) Date of measurement

9kHz - 30MHz : March 23, 2016 (all mode)
 30MHz - 1000MHz : March 10, 2016 (all mode)
 1GHz - 6GHz : March 11, 2016 (all mode)
 6GHz - 18GHz : March 18, 2016 (all mode)
 18GHz - 24.835GHz : March 17, 2016 (all mode)

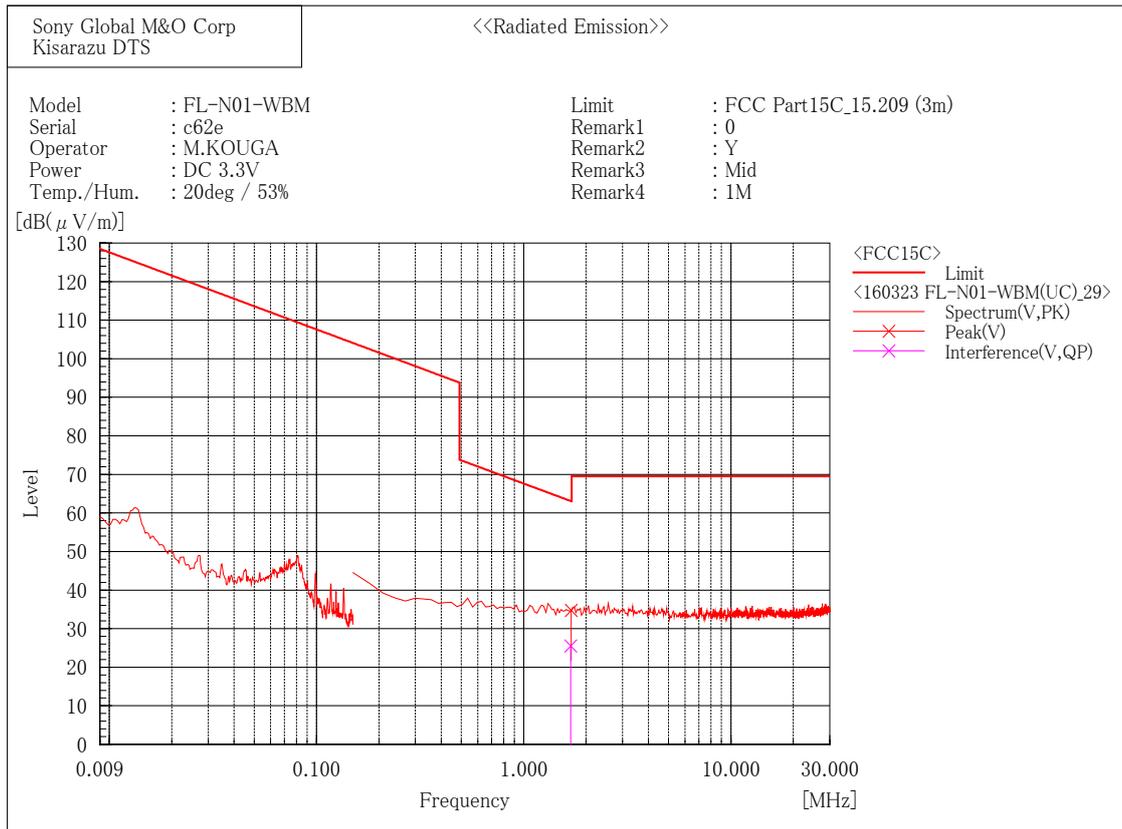
May 24, 2016 (band edge plot data)

9 kHz - 30 MHz

[Bluetooth Low Energy (1 Mbps) / 2402MHz]



[Bluetooth Low Energy (1 Mbps) / 2442MHz]

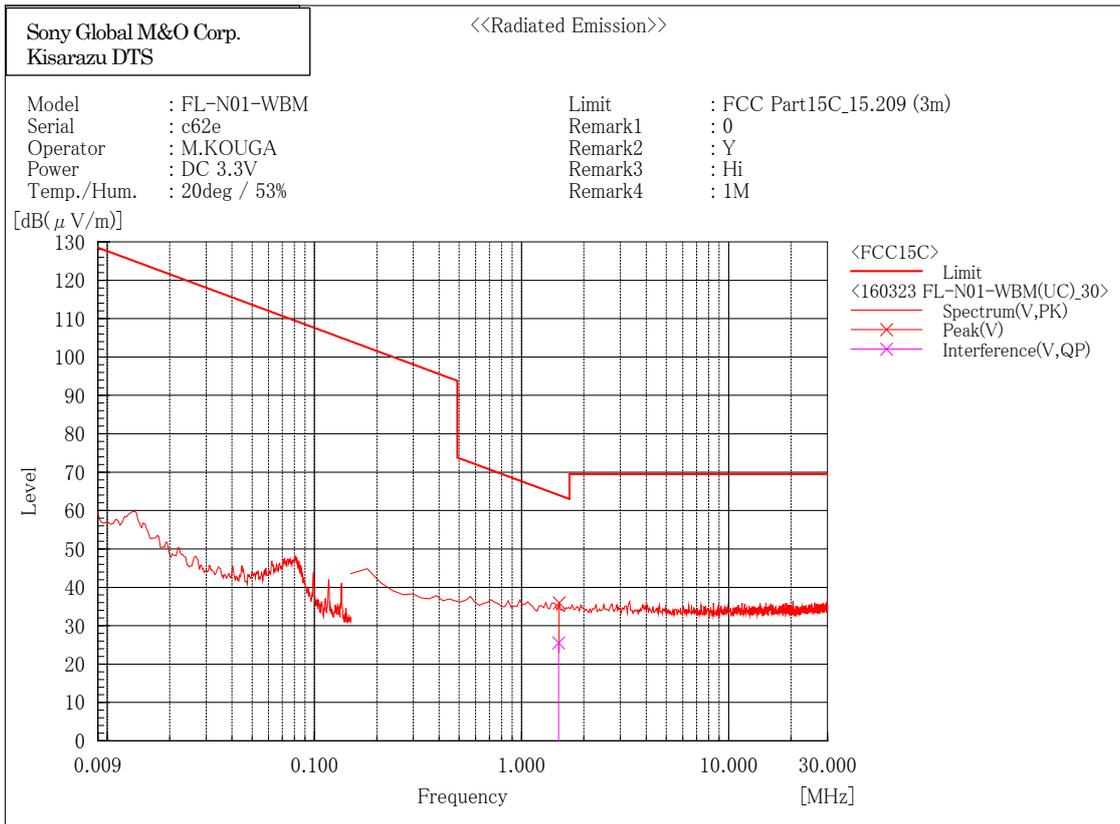


Final Result

--- 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	1.683	5.6	19.9	25.5	63.1	37.6	100.0	87.0

[Bluetooth Low Energy (1 Mbps) / 2480MHz]

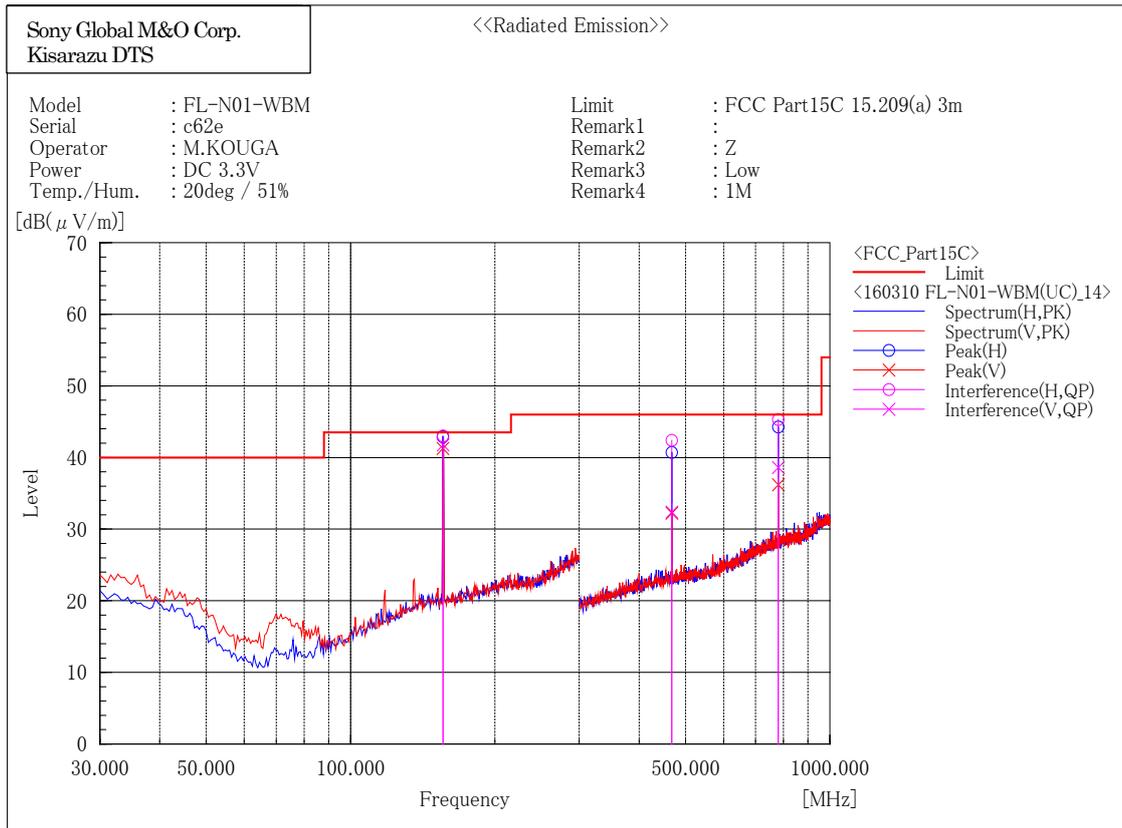


Final Result

--- 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	1.511	5.7	19.8	25.5	64.0	38.5	100.0	83.0

30 MHz - 1000 MHz
 [Bluetooth Low Energy (1 Mbps) / 2402MHz]



Final Result

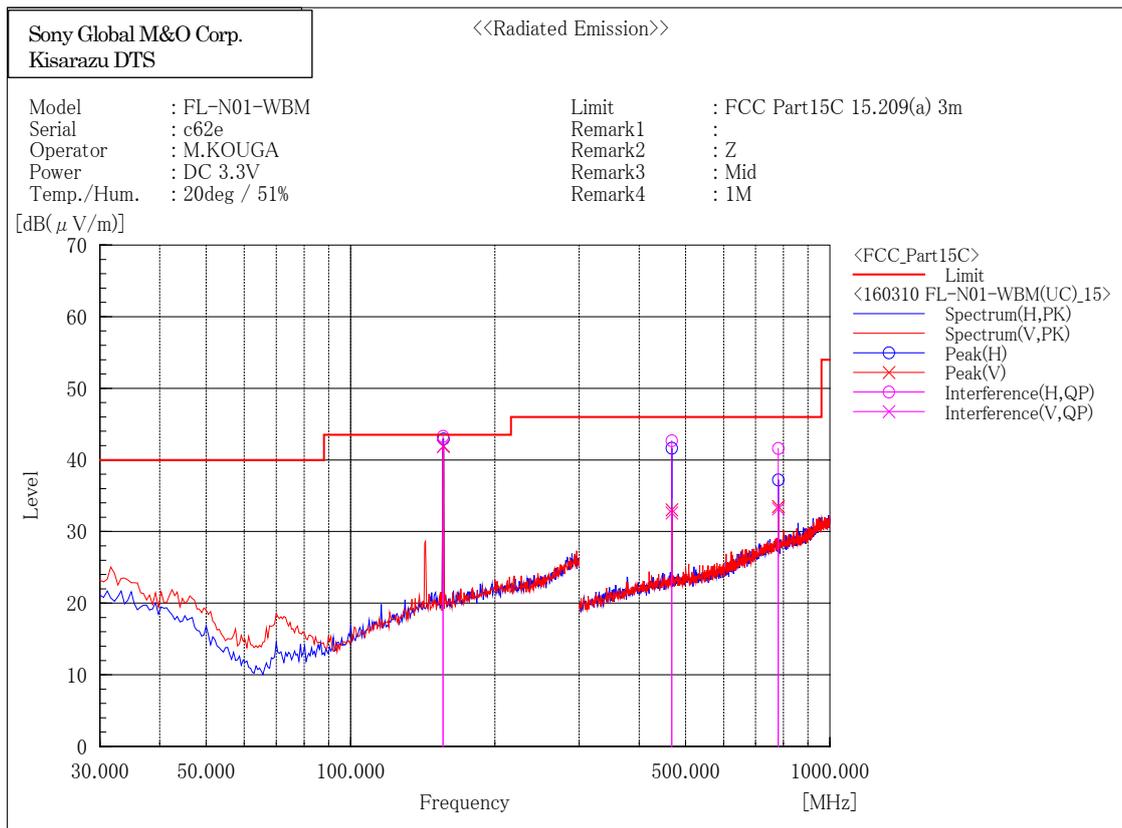
--- Horizontal Polarization (QP) ---

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	156.000	54.8	-11.8	43.0	43.5	0.5	184.0	88.0
2	467.998	51.6	-9.2	42.4	46.0	3.6	203.0	71.0
3	780.001	49.2	-3.9	45.3	46.0	0.7	100.0	184.0

--- 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	156.001	53.6	-11.8	41.8	43.5	1.7	100.6	236.0
2	467.998	41.6	-9.2	32.4	46.0	13.6	100.0	188.0
3	780.004	42.5	-3.9	38.6	46.0	7.4	142.7	226.4

[Bluetooth Low Energy (1 Mbps) / 2442MHz]



Final Result

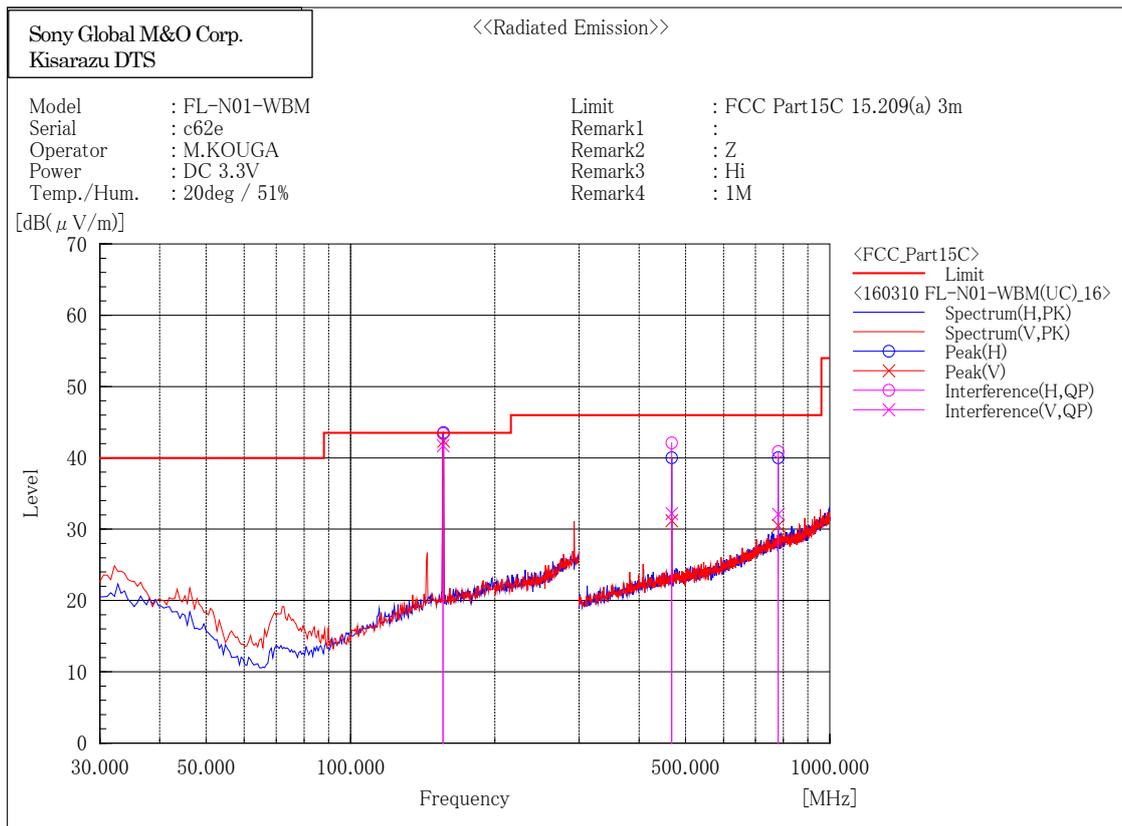
--- Horizontal Polarization (QP)---

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	156.001	55.1	-11.8	43.3	43.5	0.2	192.8	85.0
2	468.000	51.9	-9.2	42.7	46.0	3.3	216.6	73.0
3	780.000	45.5	-3.9	41.6	46.0	4.4	100.0	41.0

--- 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	155.999	53.7	-11.8	41.9	43.5	1.6	100.0	236.0
2	468.000	41.8	-9.2	32.6	46.0	13.4	115.0	184.0
3	780.002	37.1	-3.9	33.2	46.0	12.8	185.0	95.9

[Bluetooth Low Energy (1 Mbps) / 2480MHz]



Final Result

--- Horizontal Polarization (QP)---

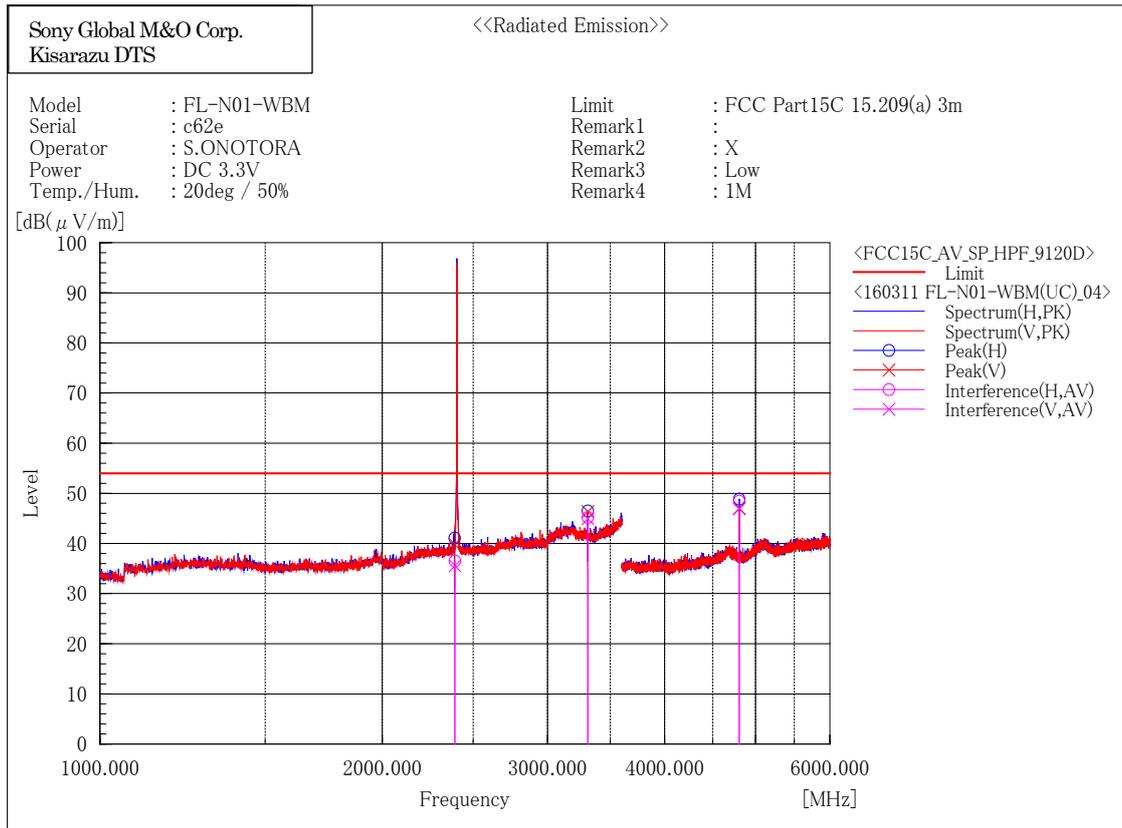
No.	Frequency [MHz]	Reading [dB(μ V)]	c. f [dB(1/m)]	Result [dB(μ V/m)]	Limit [dB(μ V/m)]	Margin [dB]	Height [cm]	Angle [°]
1	156.000	55.2	-11.8	43.4	43.5	0.1	187.6	97.0
2	468.000	51.3	-9.2	42.1	46.0	3.9	194.8	79.0
3	780.000	44.8	-3.9	40.9	46.0	5.1	106.0	43.0

--- Vertical Polarization (QP)---

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	156.000	53.5	-11.8	41.7	43.5	1.8	100.0	100.0
2	467.998	41.4	-9.2	32.2	46.0	13.8	100.0	170.0
3	780.000	36.0	-3.9	32.1	46.0	13.9	184.1	113.4

1GHz - 6 GHz

[Bluetooth Low Energy (1 Mbps) / 2402MHz]



Final Result

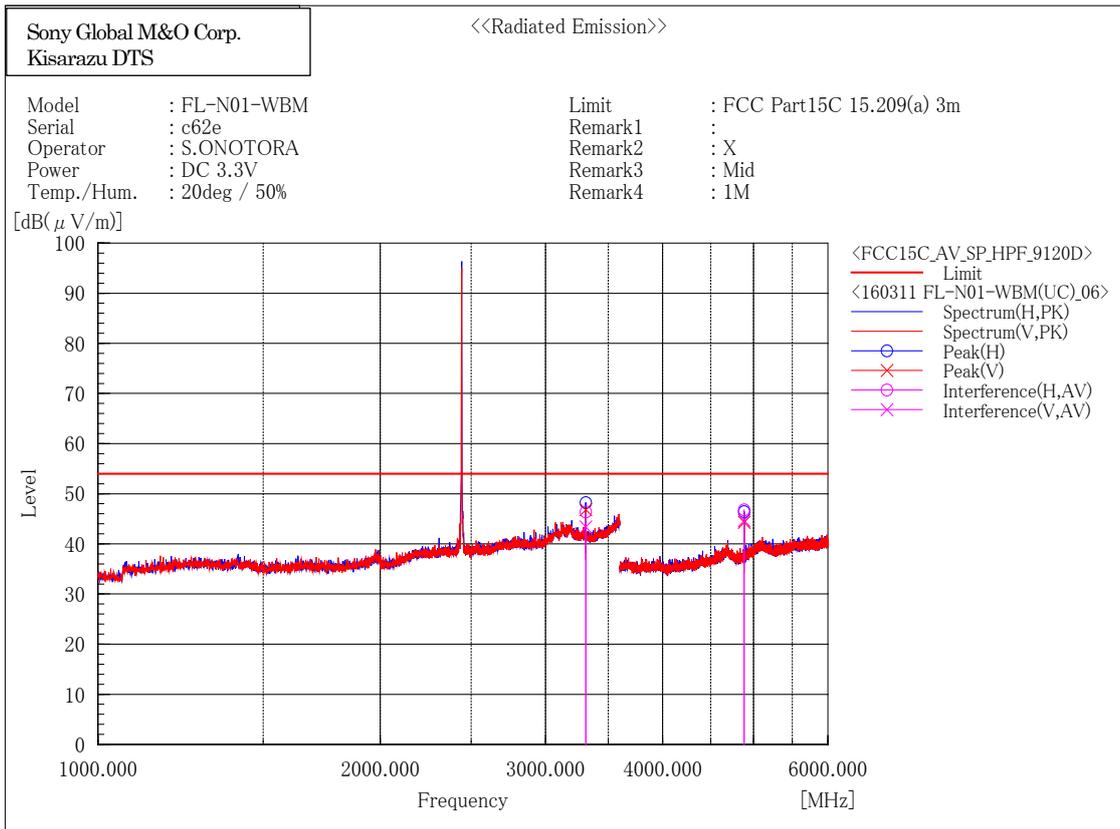
--- Horizontal Polarization (AV)---

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	2389.646	37.9	-1.4	36.5	54.0	17.5	100.0	195.7
2	3311.981	44.9	0.3	45.2	54.0	8.8	380.5	170.0
3	4803.913	45.3	3.1	48.4	54.0	5.6	151.3	332.3

--- 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	2389.790	37.0	-1.4	35.6	54.0	18.4	100.0	169.4
2	3311.958	44.7	0.3	45.0	54.0	9.0	365.9	83.4
3	4803.731	43.8	3.1	46.9	54.0	7.1	358.4	286.0

[Bluetooth Low Energy (1 Mbps) / 2442MHz]



Final Result

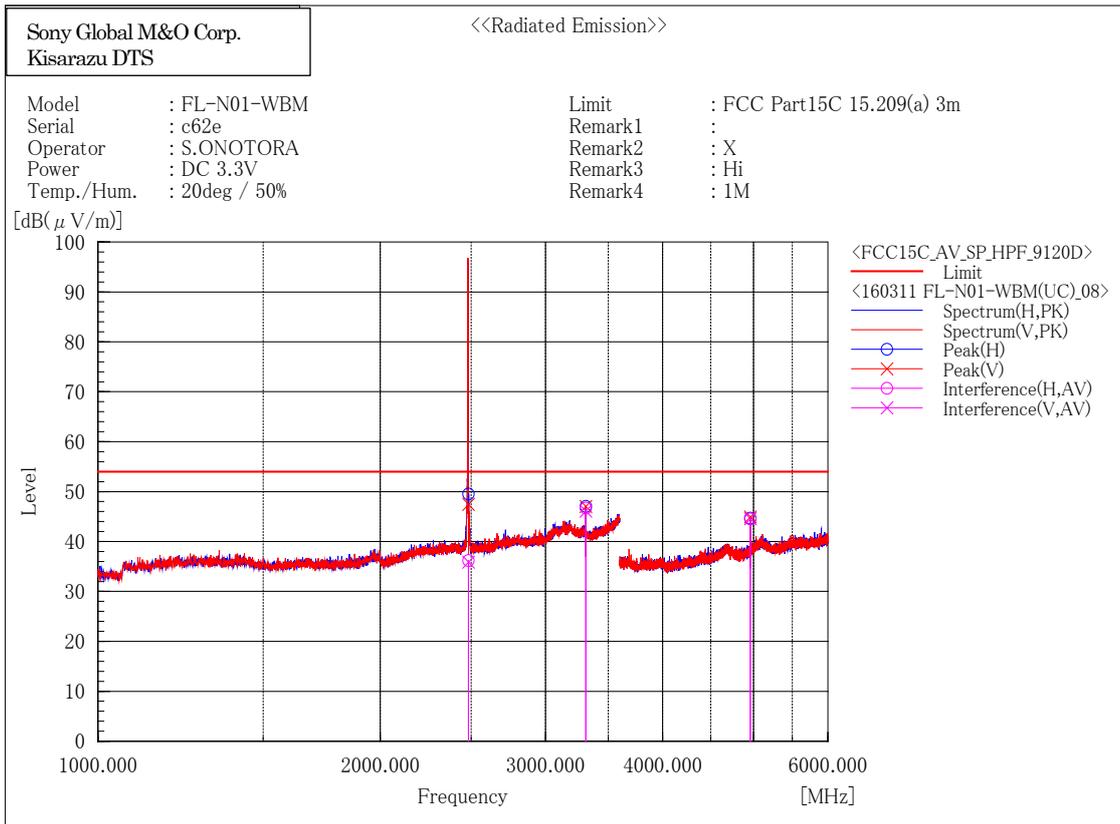
--- Horizontal Polarization (AV)---

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	3312.001	46.1	0.3	46.4	54.0	7.6	380.6	158.4
2	4883.955	43.9	2.9	46.8	54.0	7.2	124.9	336.9

--- 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	3311.987	43.1	0.3	43.4	54.0	10.6	368.0	92.0
2	4883.892	41.8	2.9	44.7	54.0	9.3	365.0	289.4

[Bluetooth Low Energy (1 Mbps) / 2480MHz]



Final Result

--- Horizontal Polarization (AV)---

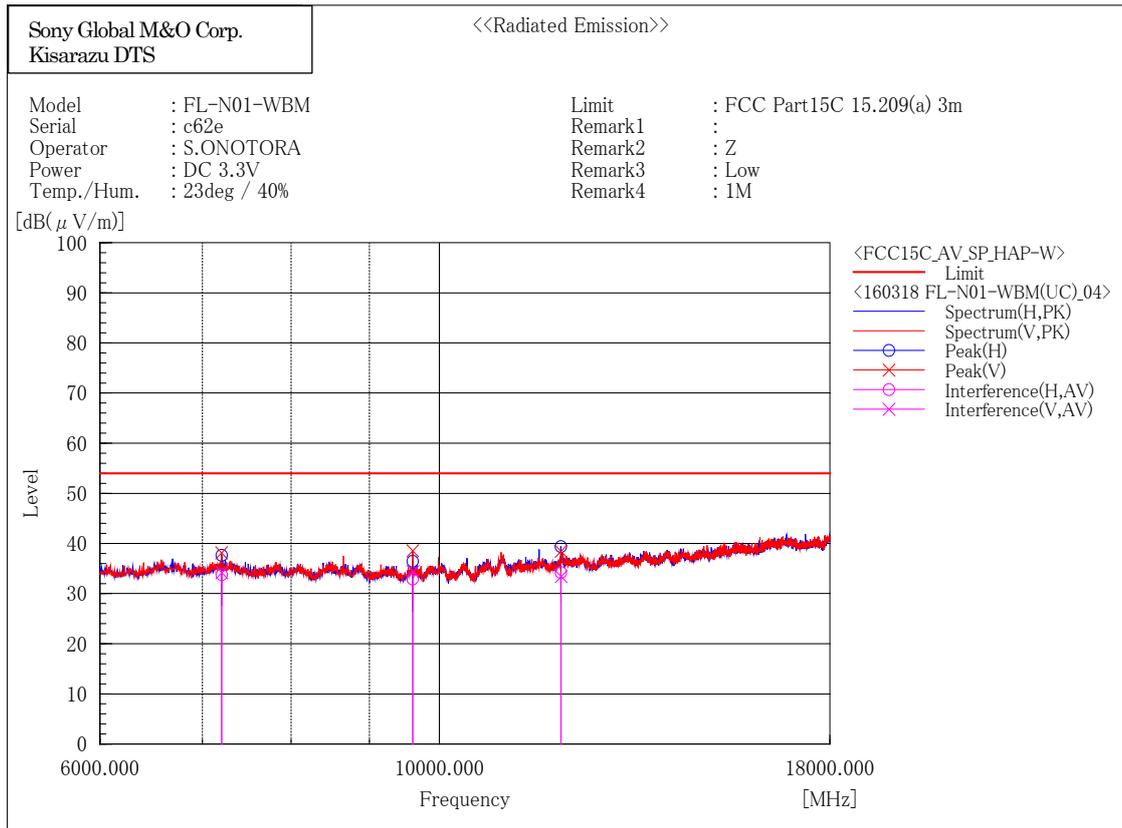
No.	Frequency [MHz]	Reading [dB(μV)]	c. f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	2483.526	37.5	-1.3	36.2	54.0	17.8	391.5	6.4
2	3311.928	46.4	0.3	46.7	54.0	7.3	373.7	168.0
3	4959.716	41.4	3.1	44.5	54.0	9.5	130.0	337.1

--- 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	2483.532	37.2	-1.3	35.9	54.0	18.1	380.6	310.0
2	3311.989	45.8	0.3	46.1	54.0	7.9	360.0	84.2
3	4959.754	41.5	3.1	44.6	54.0	9.4	355.0	301.9

6 GHz - 18 GHz

[Bluetooth Low Energy (1 Mbps) / 2402MHz]



Final Result

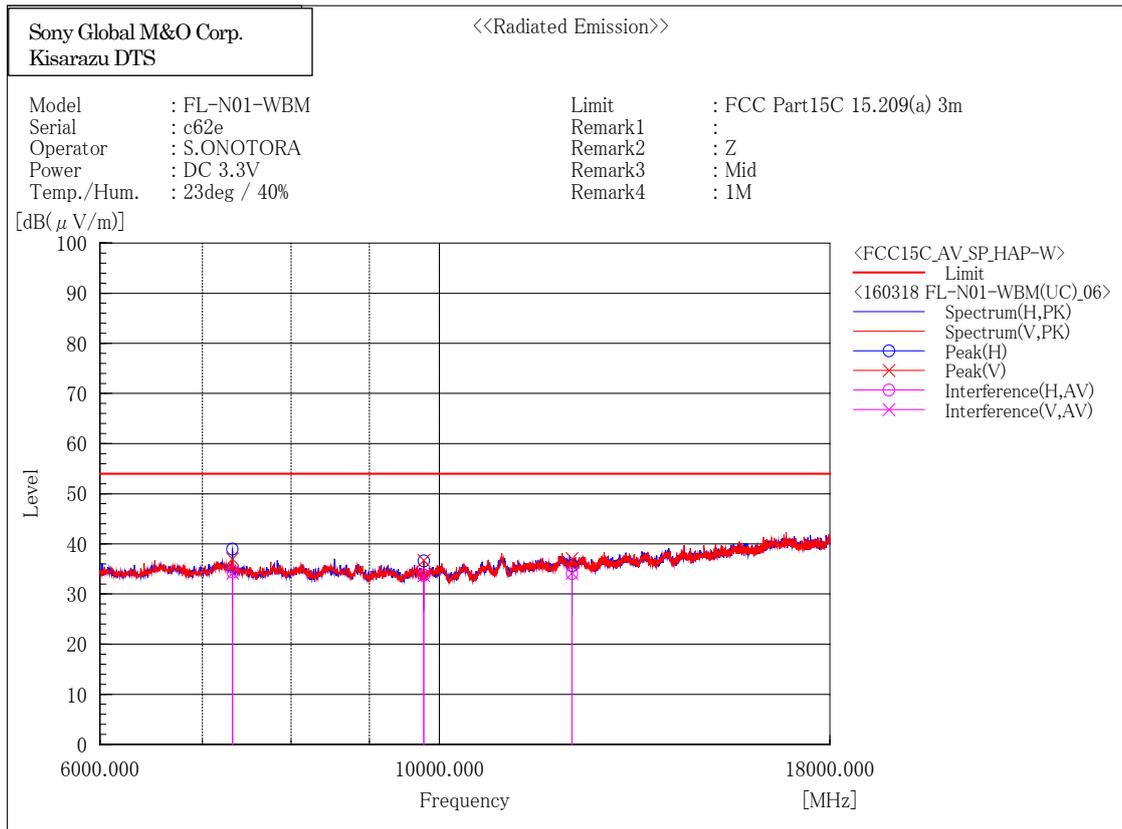
--- Horizontal Polarization (AV)---

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	7205.843	41.9	-8.1	33.8	54.0	20.2	100.0	263.6
2	9607.303	39.3	-6.4	32.9	54.0	21.1	321.5	78.0
3	12008.947	39.3	-5.1	34.2	54.0	19.8	144.2	135.9

--- 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	7205.668	42.3	-8.1	34.2	54.0	19.8	364.0	122.6
2	9608.750	40.8	-6.4	34.4	54.0	19.6	234.6	303.7
3	12011.054	38.5	-5.1	33.4	54.0	20.6	153.0	286.7

[Bluetooth Low Energy (1 Mbps) / 2442MHz]



Final Result

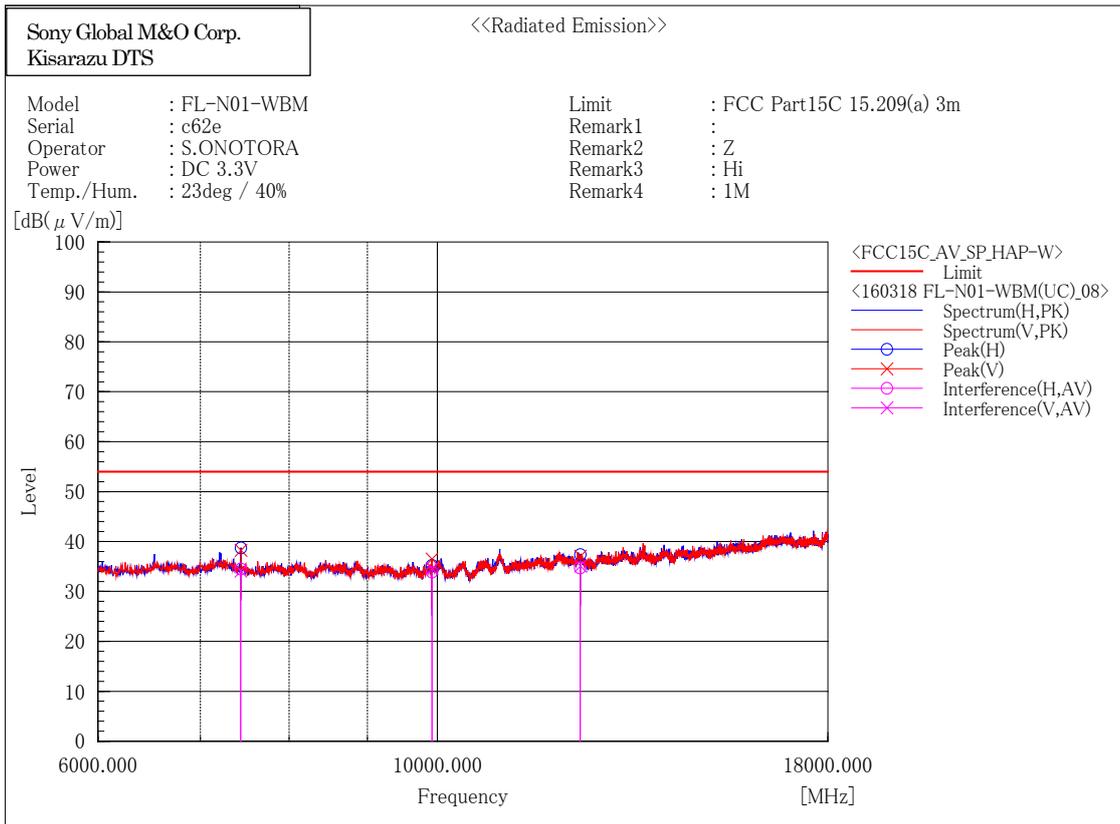
--- Horizontal Polarization (AV)---

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	7325.887	42.8	-8.4	34.4	54.0	19.6	289.0	42.5
2	9767.287	39.9	-6.1	33.8	54.0	20.2	308.0	80.9
3	12211.187	39.3	-5.2	34.1	54.0	19.9	305.7	45.4

--- 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	7325.617	42.6	-8.4	34.2	54.0	19.8	384.0	141.8
2	9767.774	39.8	-6.1	33.7	54.0	20.3	350.4	137.7
3	12209.953	39.4	-5.2	34.2	54.0	19.8	372.0	80.3

[Bluetooth Low Energy (1 Mbps) / 2480MHz]



Final Result

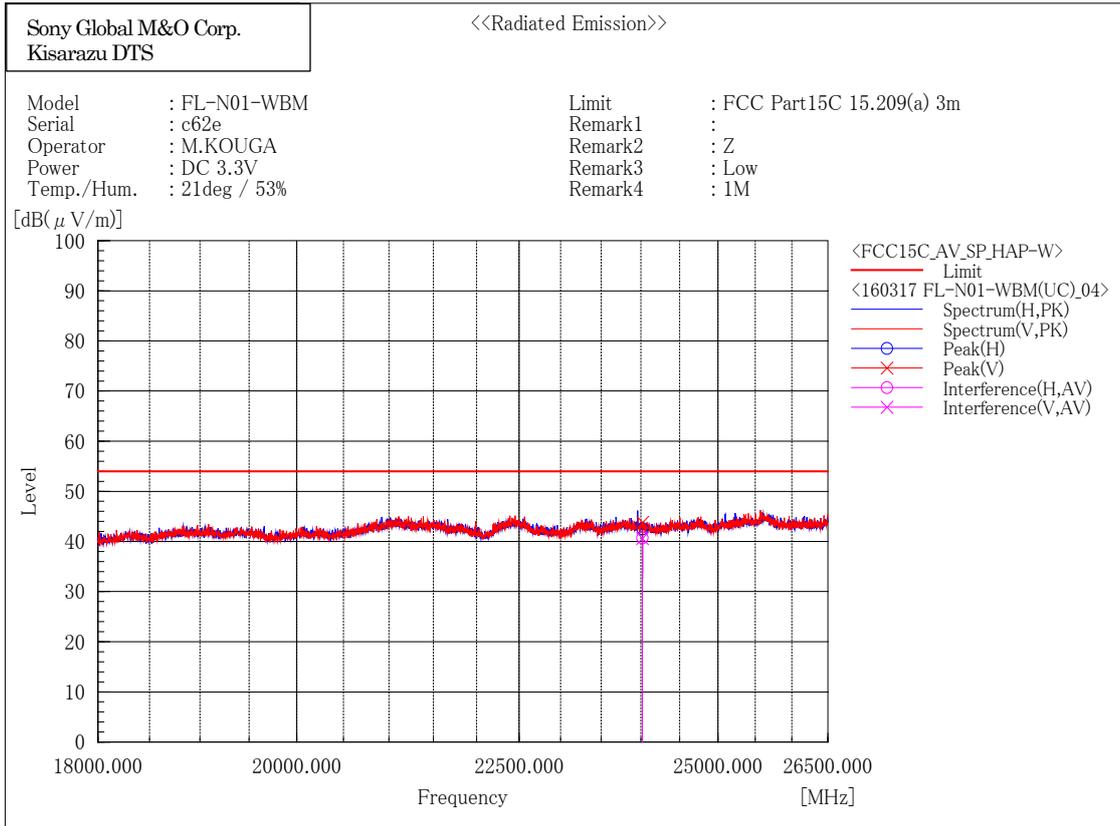
--- Horizontal Polarization (AV)---

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	7439.698	43.2	-8.7	34.5	54.0	19.5	167.0	16.9
2	9919.310	39.5	-5.6	33.9	54.0	20.1	207.0	41.9
3	12398.998	40.7	-6.0	34.7	54.0	19.3	100.0	130.9

--- 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	7439.519	42.8	-8.7	34.1	54.0	19.9	376.0	112.1
2	9920.924	40.2	-5.6	34.6	54.0	19.4	179.1	337.6
3	12401.208	41.1	-6.0	35.1	54.0	18.9	356.1	122.8

18 GHz - 26 GHz
 [Bluetooth Low Energy (1 Mbps) / 2402MHz]



Final Result

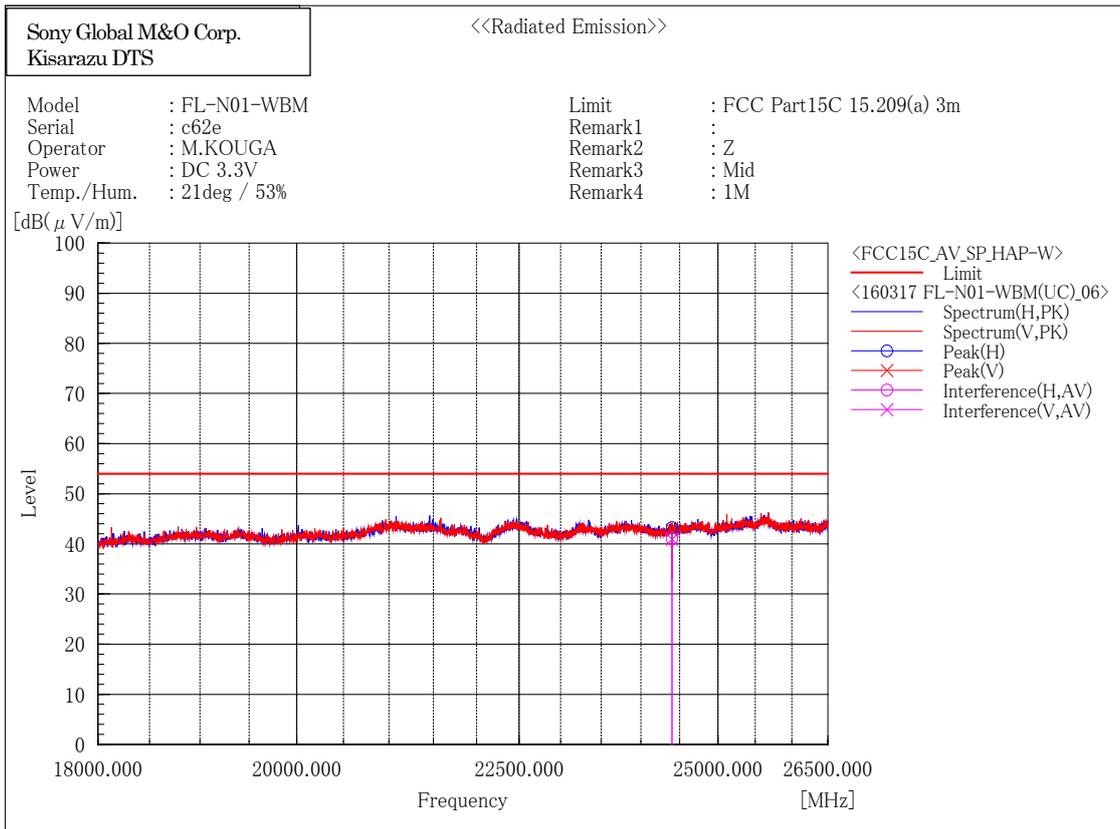
--- Horizontal Polarization (AV) ---

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	24019.066	42.8	-2.1	40.7	54.0	13.3	134.0	54.0

--- 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	24020.606	42.7	-2.1	40.6	54.0	13.4	100.0	345.0

[Bluetooth Low Energy (1 Mbps) / 2442MHz]



Final Result

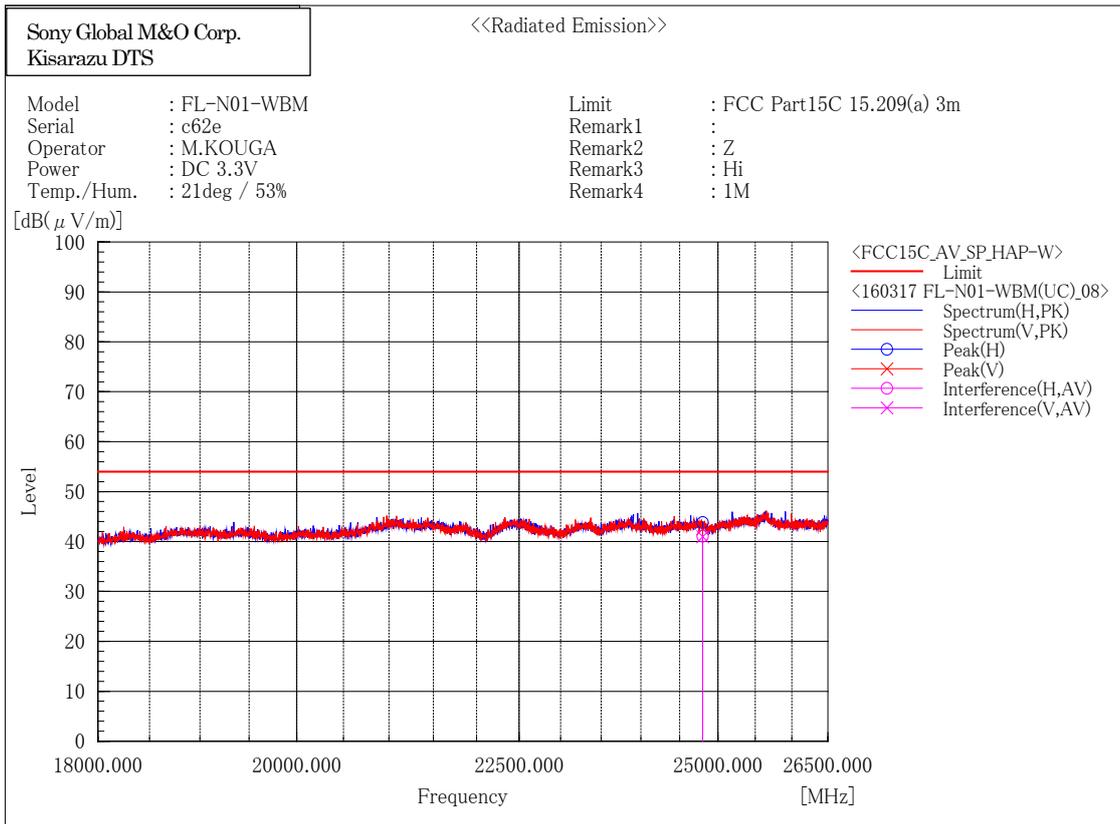
--- Horizontal Polarization (AV)---

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	24399.512	43.2	-2.2	41.0	54.0	13.0	125.0	200.7

--- 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	24400.094	43.1	-2.2	40.9	54.0	13.1	212.0	225.4

[Bluetooth Low Energy (1 Mbps) / 2480MHz]



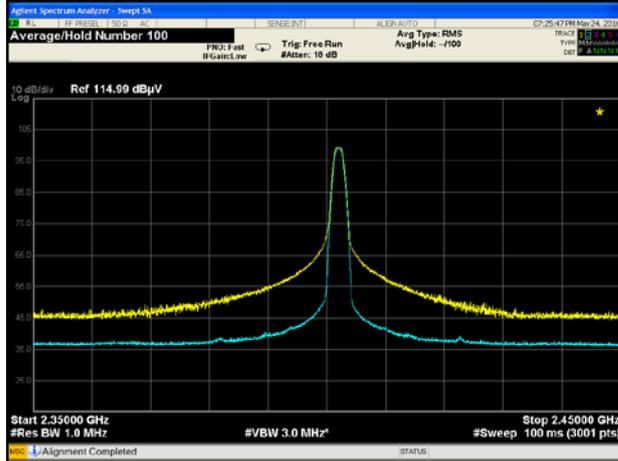
2.4GHz Restricted-Band Edge (Plot data)

These plot data show peak (trace yellow) and average (trace blue) spectrum for worst case emissions in the restricted-band edges. (Restricted band edges: below 2390MHz and above 2483.5MHz)

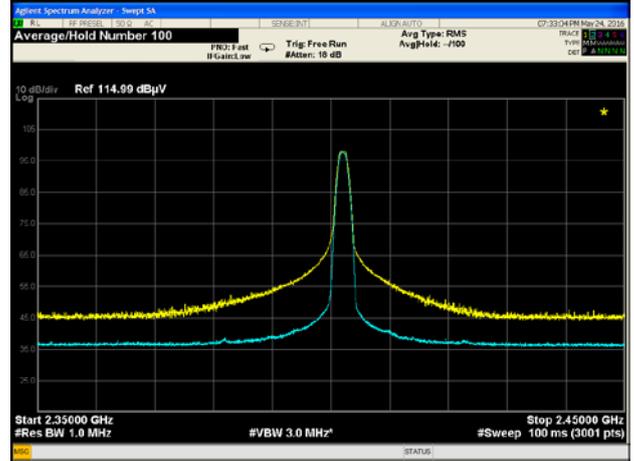
The result of the final radiated emissions measurement refers in previous pages.

[Bluetooth Low Energy / 2402MHz]

Horizontal

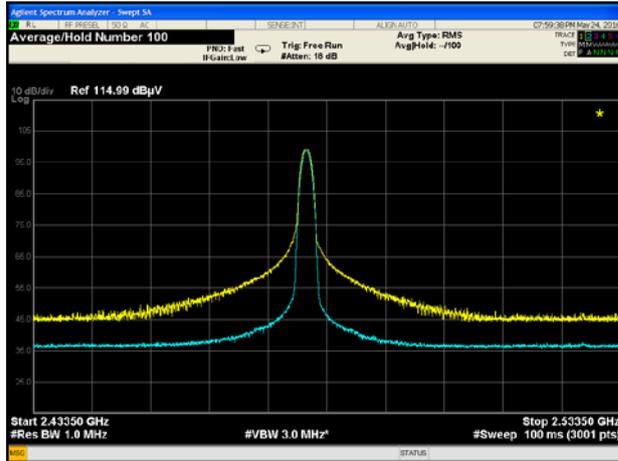


Vertical

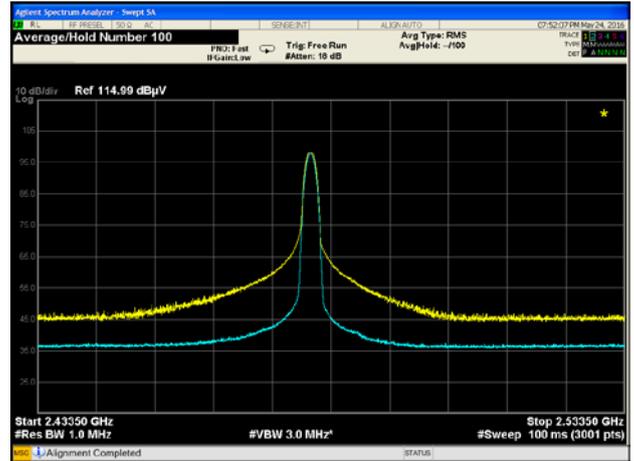


[Bluetooth Low Energy / 2480MHz]

Horizontal



Vertical

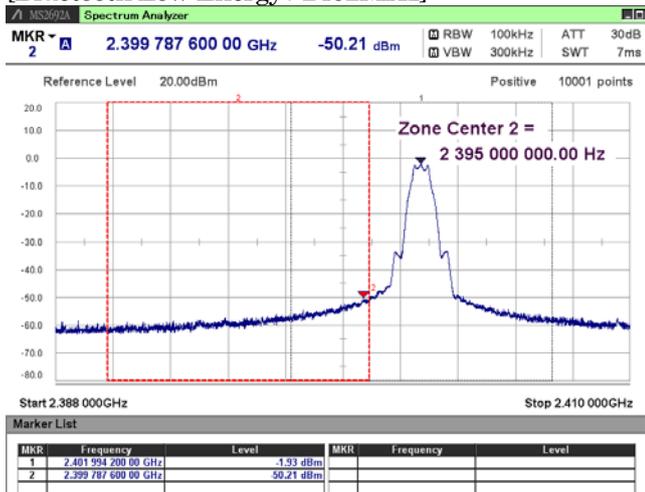


3.6. Conducted Spurious Emissions for Band Edge

- 1) Ambient temperature : 25.8deg.C
- 2) Relative humidity : 46.5 %
- 3) Date of measurement : March 02, 2016
- 4) Measured by : Y.AOYAMA
- 5) Operating mode : Transmitting mode

Mode	Rate [Mbps]	Channel [MHz]	Frequency [MHz]	Reading(PK) [dBm]	C.F. [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
BLE	1	2402	2399.79	-50.21	0.97	-49.24	-21.0	28.28
			2401.99	-1.93	0.97	-0.96	-	-

[Bluetooth Low Energy / 2402MHz]



4. Method of Calculation

4.1. AC Power-line Conducted Emissions Measurement

Method of calculation : Software
 The Software for Calculation Name : EP5/ CE
 Version : Ver5.0.0

$$\text{Test Result [dBuV]} = \text{Meter Reading [dBuV]} + \text{C.F. [dB]}$$

Notes :

- (a) Meter Reading : Reading of the EMI test receiver or spectrum analyzer.
- (b) C.F. : System Loss + Correction Factor of LISN.

4.2. Maximum Peak Conducted Output Power Measurement

Method of calculation : Software
 The Software for Calculation Name : SW-316
 Version : Ver.1.0

$$\text{Test Result (PK) [dBm]} = \text{Meter Reading [dBm]} + \text{C.F. [dB]}$$

$$\text{Test Result (AV) [dBm]} = \text{Meter Reading [dBm]} + \text{C.F. [dB]} + \text{Duty Factor [dB]}$$

Notes :

- (a) Meter Reading : Reading of the power meter.
- (b) C.F. : Attenuator Loss + EUT Cable Loss
- (c) Duty Factor : $10\log \{(\text{Tx ON Time} + \text{Tx OFF Time}) / (\text{Tx ON Time})\}$

4.3. Power Density Measurement

Method of calculation : Software
 The Software for Calculation Name : SW-316
 Version : Ver.1.0

$$\text{Test Result [dBm]} = \text{Meter Reading [dBm]} + \text{C.F. [dB]}$$

Notes :

- (a) Meter Reading : Reading of the spectrum analyzer.
- (b) C.F. : System Cable Loss + Attenuator Loss + EUT Cable Loss

4.4. Radiated Spurious Emission Measurement

Method of calculation : Software
The Software for Calculation Name : V-Scan
Version : Ver. 4.0.30

$$\text{Test Result [dBuV/m]} = \text{Meter Reading [dBuV]} + \text{C.F. [dB/m]}$$

Notes :

- (a) Meter Reading : Reading of the EMI test receiver or spectrum analyzer.
- (b) C.F. : Antenna Factor (including Balun Loss) + System GainLoss
: Antenna Factor (including Balun Loss) + System GainLoss + 20 log (3 m/ 10 m)

4.5. Conducted Spurious Emission for Band Edge Measurement

Method of calculation : Software
The Software for Calculation Name : SW-316
Version : Ver.1.0

$$\text{Test Result [dBm]} = \text{Meter Reading [dBm]} + \text{C.F. [dB]}$$

Notes :

- (a) Meter Reading : Reading of the spectrum analyzer.
- (b) C.F. : System Cable Loss + Attenuator Loss + EUT Cable Loss

5. List of Test Equipment

All test results are traceable to the national and/or international standards.

5.1. AC Power-line Conducted Emissions

4th Site Shielded Room

	Ctrl.#	Equipment	Model No.	Serial No.	Manufacturer	Cal.Int.	Last Cal.
x	-	Shield Room	-	-	TDK	-	-
x	M515	EMI Receiver	ESCI	100606	Rohde & Schwarz	12	15.07.07
-	M109	EMI Receiver	ESI7	100051	Rohde & Schwarz	12	16.03.15
x	CS043	4th Site CE Cable SYSTEM	-	-	EMC/RF Test Lab.	12	15.10.28
x	M664	6dB Attenuator	6806.01A	N/A	HUBER+SUHNER AG	12	15.10.28
x	M619	HIGH FREQUENCY FUSE	MP612A	N/A	Anritsu	12	15.10.28
-	M026	LISN	KNW-407	8-541-1	Kyoritsu	12	15.12.10
-	M420	LISN	ESH3-Z5	829996/008	Rohde & Schwarz	12	16.01.09
-	M514	LISN (for EUT)	ENV216	100424	Rohde & Schwarz	12	15.04.07
-	M152	50 ohm Terminator	CT-01	N/A	TME	12	15.10.28
-	M158	50 ohm Terminator	T1302	N/A	Stack	12	16.01.27
x	M690	Thermometer	AD-5640A	201304	AND	12	15.11.15
x	M832	LISN (for EUT)	ENV216	100281	Rohde & Schwarz	12	15.12.01

5.2. Antenna-port Conducted Measurements

4th Site Shielded Room 1

	Ctrl.#	Equipment	Model No.	Serial No.	Manufacturer	Cal.Int.	Last Cal.
x	-	Shield Room	B83117-B2432-T161	P26428	Albatross Project	-	-
x	W100	Spectrum Analyzer	MS2692A	6201338954	Anritsu	12	16.04.15
x	W006	Power Meter	N1911A	MY50000295	Keysight Technologies	12	15.09.28
x	W007	Power Sensor	N1922A	MY50180022	Keysight Technologies	12	15.09.28
-	W029	10dB Attenuator	8493C	76549	Keysight Technologies	12	15.09.24
x	WC05	RF Cable	SUCOFLEX 102	34287	HUBER + SUHNER	12	15.10.16
x	M719	Thermometer	TH-321	140053	AS ONE	12	15.06.10

5.3. Radiated Spurious Emissions

4th Site 10m Semi-Anechoic Chamber

	Ctrl.#	Equipment	Model No.	Serial No.	Manufacturer	Cal.Int.	Last Cal.
x	M506	EMC Chamber	None	-	TDK	12	15.08.03
x	M575	EMI Receiver	ESCI	100161	Rohde&Schwarz	12	15.11.09
x	M669	EMI Receiver	N9038A	MY51210223	Keysight Technologies	12	15.05.19
x	A043	Biconical Antenna	BBA9106	V5(91032598)	Schwarzbeck	12	15.08.04
x	A046	Log periodic Antenna	UHALP9108A1	0830	Schwarzbeck	12	15.08.06
x	A056	Horn Antenna	BBHA9120D	670	Schwarzbeck	12	16.01.27
x	A057	Horn Antenna	HAP06-18W	00000037	TOYO Corporation	12	15.08.04
x	A058	Horn Antenna	HAP18-26W	00000016	TOYO Corporation	12	16.01.26
-	CS037	Fourth Site RE Cable SYS1	-	-	EMC/RF Test Lab.	12	15.10.28
x	CS039	Fourth Site RE Cable SYS3	-	-	EMC/RF Test Lab.	12	15.10.28
x	CS054	Fourth Site RE Cable SYS	-	-	EMC/RF Test Lab.	12	15.10.28
x	CS064/065	Fourth Site RE Cable SYS8	-	-	EMC/RF Test Lab.	12	15.10.28
x	M510	RF Selector	NS4900	0802-226	TOYO Corporation	12	15.10.28
x	M620	RF Pre-Amp	8447D	2944A10720	Keysight Technologies	12	15.10.28
x	M706	3dB Attenuator	8491A	MY39267782	Keysight Technologies	12	15.10.28
x	M831	GHz Filter Box	FB-G1	002	Sony EMCS	12	15.10.28
x	M689	Thermometer	AD-5640A	201303	AND	12	15.11.05

About calibration interval

Valid until the end of the month listed in "Cal. Int." column.