

# RADIO TEST REPORT

(for Bluetooth Low Energy)

Project No. : JB-Z0155-A  
 Client : Sony Corporation  
 Address : 1-7-1 Konan Minato-ku Tokyo, 108-0075 Japan  
 Type of Equipment : Digital Music Player  
 Model No. : NW-WM1Z  
 Serial No. : 2000014, 2000454  
 FCC ID : AK8NWWM1Z  
 Regulation Applied : 47 CFR Part 15 Subpart C  
**Final Judgment** : **Passed**  
 Sample Receipt : May 26, 2016  
 Testing : May 30, 2016 - June 23, 2016  
 Reported : July 11, 2016

Reported by :

Approved Signatory :



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**Notice**

- \* These test results relate only to the items (combination equipment, test configuration, operation condition etc.) tested.
- \* This report shall not be reproduced except in full, without written approval of the laboratory.
- \* 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

## TABLE OF CONTENTS

1. General Information.....	3
1.1. Description of Equipment Under Test (EUT).....	3
1.2. Summary of Test Result.....	3
1.3. Tested Methodology .....	4
1.4. Measurement Procedures .....	4
1.5. Test Facility.....	7
1.6. Uncertainty .....	7
2. System Test Configuration.....	8
2.1. Validation .....	8
2.2. Test Operating Conditions .....	8
2.3. Special Accessories .....	8
2.4. EUT Modifications .....	8
2.5. Configuration of Tested System .....	9
3. Test Data.....	12
3.1. AC Power-line Conducted Emissions .....	12
3.2. 6dB Bandwidth.....	13
3.3. Maximum Peak Conducted Output Power.....	14
3.4. Power Spectral Density .....	15
3.5. Radiated Spurious Emissions.....	16
3.6. Conducted Spurious Emissions for Band Edge.....	41
4. Method of Calculation .....	42
5. List of Test Equipment.....	44
5.1. AC Power-line Conducted Emissions .....	44
5.2. Antenna-port Conducted Measurements.....	44
5.3. Radiated Spurious Emissions.....	45
6. Photographs of test setup.....	46
6.1. AC Power-line Conducted Emissions Measurement Photo(s) .....	46
6.2. Antenna-port Conducted Measurements Photo(s) .....	46
6.3. Radiated Spurious Emissions Measurement Photo(s).....	47

### 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.



### 1.3. Tested Methodology

Test Standard : 47 CFR Part 15 Subpart C Section 15.207 / 15.247  
 Test Method : ANSI C63.10 - 2013  
 KDB 558074 D01 DTS Meas. Guidance v03r05

Test Condition

Radiated Spurious Emissions

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

Dimensions of the EUT table : 0.8m (below 1GHz) or 1.5m (above 1GHz) height, 1.5m width and 1m depth.

AC Power-line Conducted Emissions

Dimensions of the EUT table : 0.8m height, 2m width and 1m depth.

### 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

#### Antenna-port Conducted Measurement

1. Antenna-port of the EUT was connected to the power sensor (Maximum peak conducted output power) or spectrum analyzer. (other test items).
2. For each EUT operation mode, the Antenna-port Conducted Measurement were measured with spectrum analyzer.

Test Item	Detector	RBW
<b>* Antenna-port Conducted Measurements</b>		
6dB Bandwidth	Peak	100 kHz
Maximum Peak Conducted Output Power	Peak	-
Power Spectral Density	Peak	3 kHz
Conducted Spurious Emissions for Band Edge	Peak	100 kHz

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 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.
3. The LISN was placed in 80 cm from the nearest part of the EUT chassis.
4. 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.
5. The connection of the all other equipment to the second LISN was performed. The second LISN was terminated with a 50-ohm terminator.
6. 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.
7. 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)
8. 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)

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 EUT was placed on the center of the tabletop.
3. The test antenna was placed away from the EUT at test distance.
4. 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])
5. Find the worst arrangement of the EUT as follows:
  - 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)

6. 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)

7. 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.

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

8. If the final average measurement result exceeded the limit in the authorized band edge, the integration method is carried out with follows;

	2483.5 - 2485.5MHz
Detector	Peak
RBW	3 dB RBW: 100 kHz
Instrument	Spectrum analyzer
Function	Channel Power (integration BW : 1MHz)

9. Although these tests were performed other than open field area test site, adequate comparison measurements were confirmed against 30 m open field area test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 937606.

## 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  EMC Site

### Radiated Spurious Emission

#### Semi-Anechoic chamber

4th Site  EMC 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	Distance	4th Site	EMC Site
AC Power-line Conducted Emissions	150kHz - 30MHz	-	± 3.34 dB	± 3.35 dB
Radiated Emissions	below 30 MHz	3m	± 2.59 dB	± 3.12 dB
	30 - 300 MHz	3m	± 4.18 dB	± 5.26 dB
	300 - 1000 MHz	3m	± 4.04 dB	± 4.37 dB
	1 - 6 GHz	3m	± 4.63 dB	± 4.90 dB
	6 - 18 GHz	3m	± 5.31 dB	± 5.50 dB
	18 - 26.5 GHz	3m	± 5.78 dB	± 5.63 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	2440 MHz *1
6dB Bandwidth, Maximum Peak Conducted Output Power, Power Spectral Density, Radiated Spurious Emissions	Bluetooth Low Energy	1 Mbps	2402 MHz, 2440 MHz, 2480 MHz
Conducted Spurious Emissions for Band Edge	Bluetooth Low Energy	1 Mbps	2402 MHz

Note:

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

### 2.3. Special Accessories

Special accessories needed for connecting the EUT to achieve compliance:

Item	Manufacturer	Model No.	Serial No.	Remark
-	-	-	-	-

### 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.	Serial No.
A	Digital Music Player	SONY	NW-WM1A	2000014

Support equipment for operation

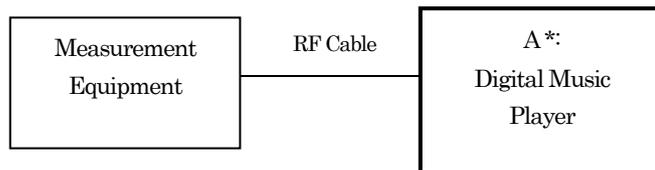
Symbol	Item	Manufacturer	Model No.	Serial No.
-	-	-	-	-

Type of cable

Symbol	Description	Identification (Manufacturer etc.)	Shielded YES / NO	Ferrite Core	Length (m)	Bundled
-	-	-	-	-	-	-

System configuration

\*: EUT



Radiated Spurious Emissions Measurement

The equipment under test (EUT)

Symbol	Item	Manufacturer	Model No.	Serial No.
A	Digital Music Player	SONY	NW-WM1Z	2000454

Support equipment for operation

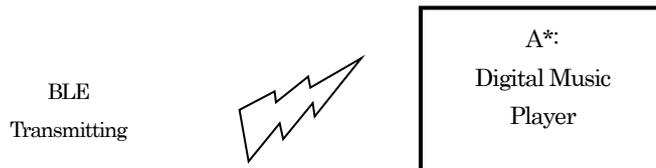
Symbol	Item	Manufacturer	Model No.	Serial No.
-	-	-	-	-

Type of cable

Symbol	Description	Identification (Manufacturer etc.)	Shielded YES / NO	Ferrite Core	Length (m)	Bundled
-	-	-	-	-	-	-

System configuration

\*: EUT



AC Power-line Conducted Emissions Measurement

The equipment under test (EUT)

Symbol	Item	Manufacturer	Model No.	Serial No.
A	Digital Music Player	SONY	NW-WM1Z	2000454

Support equipment for operation

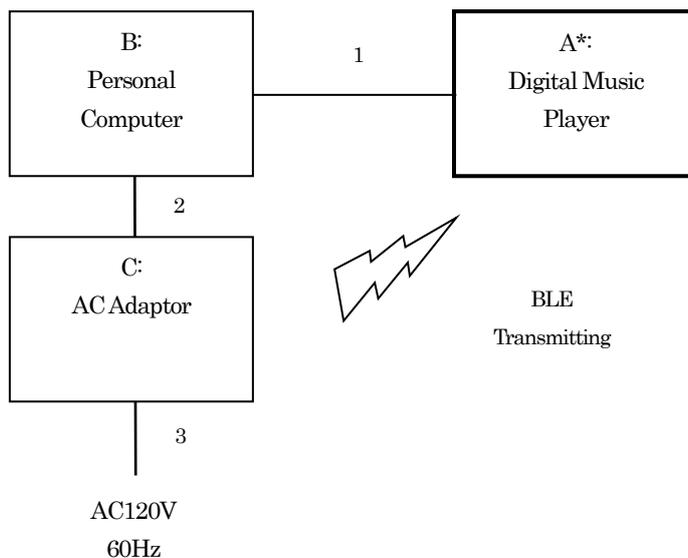
Symbol	Item	Manufacturer	Model No.	Serial No.
B	Personal Computer	HP	K7U44AV-ACJA	JPA55142KP
C	AC Adaptor	HP	HSTNN-CA41	WDVTPOCGC8X1LY

Type of cable

Symbol	Description	Identification (Manufacturer etc.)	Shielded YES / NO	Ferrite Core	Length (m)	Bundled
1	USB cable	SONY	YES	NO	1.0	-
2	DC cable	-	NO	NO	2.0	Bundled
3	AC cable	-	NO	NO	1.0	-

System configuration

\*: EUT

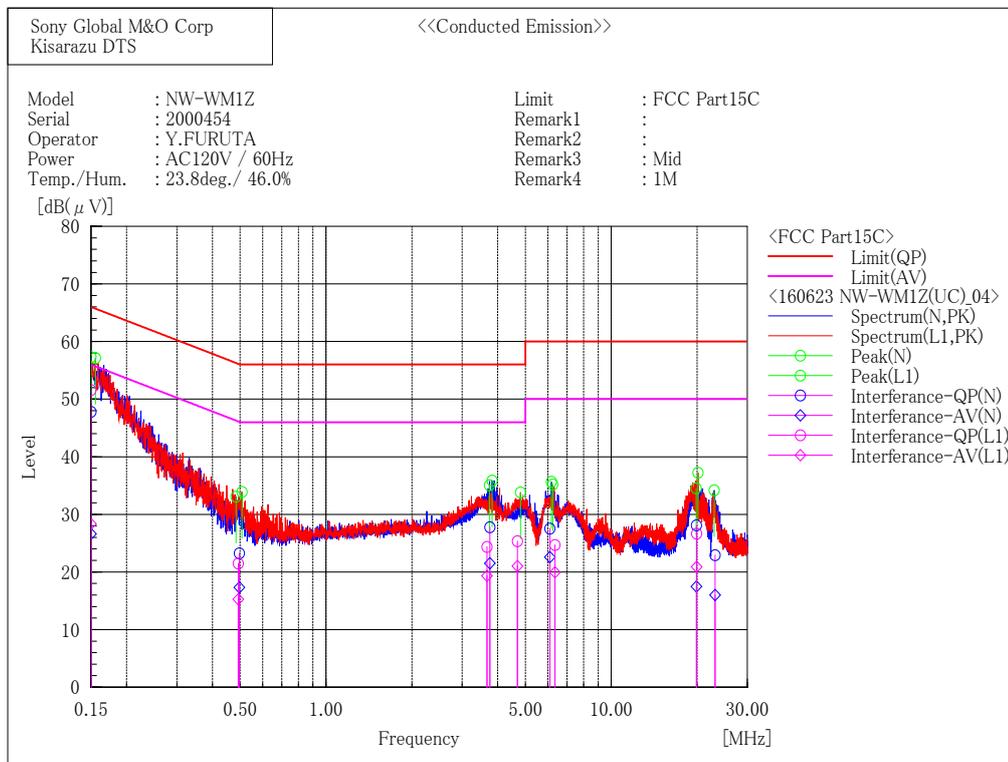


### 3. Test Data

#### 3.1. AC Power-line Conducted Emissions

1) Date of measurement : June 23, 2016

[Bluetooth Low Energy (1 Mbps) / 2440MHz]



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	0.150	31.8	10.6	16.0	47.8	26.6	66.0	56.0	18.2	29.4
2	0.497	7.0	1.1	16.2	23.2	17.3	56.1	46.1	32.9	28.8
3	3.752	11.8	5.5	16.0	27.8	21.5	56.0	46.0	28.2	24.5
4	6.093	11.5	6.6	16.0	27.5	22.6	60.0	50.0	32.5	27.4
5	19.882	11.6	1.0	16.5	28.1	17.5	60.0	50.0	31.9	32.5
6	23.146	6.3	-0.6	16.6	22.9	16.0	60.0	50.0	37.1	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	0.150	35.6	12.3	16.0	51.6	28.3	66.0	56.0	14.4	27.7
2	0.492	5.3	-0.9	16.2	21.5	15.3	56.1	46.1	34.6	30.8
3	3.667	8.3	3.3	16.0	24.3	19.3	56.0	46.0	31.7	26.7
4	4.689	9.3	5.0	16.0	25.3	21.0	56.0	46.0	30.7	25.0
5	6.349	8.6	3.8	16.1	24.7	19.9	60.0	50.0	35.3	30.1
6	19.929	10.2	4.5	16.4	26.6	20.9	60.0	50.0	33.4	29.1

### 3.2. 6dB Bandwidth

- 1) Ambient temperature : 23.8deg.C
- 2) Relative humidity : 75.6 %
- 3) Date of measurement : June 22, 2016
- 4) Measured by : H. Waki
- 5) Operating mode : Transmitting mode

Mode	Rate [Mbps]	Channel [MHz]	Result [MHz]	Limit [MHz]
BLE	1	2402	0.697	0.5
		2440	0.691	0.5
		2480	0.685	0.5

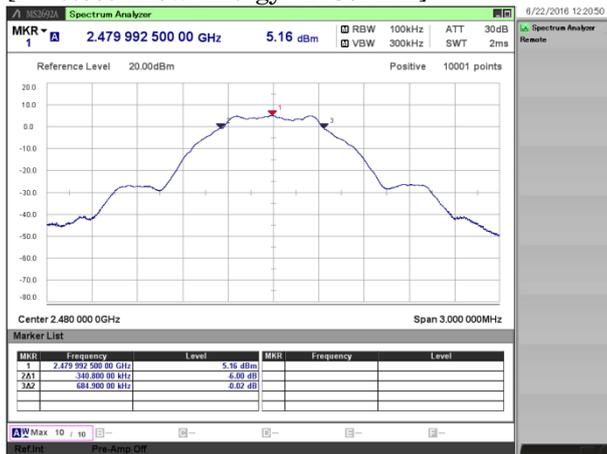
[Bluetooth Low Energy / 2402MHz]



[Bluetooth Low Energy / 2440MHz]



[Bluetooth Low Energy / 2480MHz]



### 3.3. Maximum Peak Conducted Output Power

- 1) Ambient temperature : 21.6deg.C
- 2) Relative humidity : 70.1 %
- 3) Date of measurement : May 30, 2016
- 4) Measured by : H. Waki
- 5) Operating mode : Transmitting mode

#### Maximum Peak Conducted Output Power

Mode	Rate [Mbps]	Channel [MHz]	Reading(PK) [dBm]	C.F. [dB]	Result(PK) [dBm]	Result(PK) [W]	Limit [dBm]	Margin [dB]
BLE	1	2402	-2.92	10.52	7.60	0.00575	30.0	22.40
		2440	-2.93	10.52	7.59	0.00574	30.0	22.41
		2480	-3.08	10.52	7.44	0.00555	30.0	22.56

#### Maximum Average Conducted Output Power (for SAR measurement)

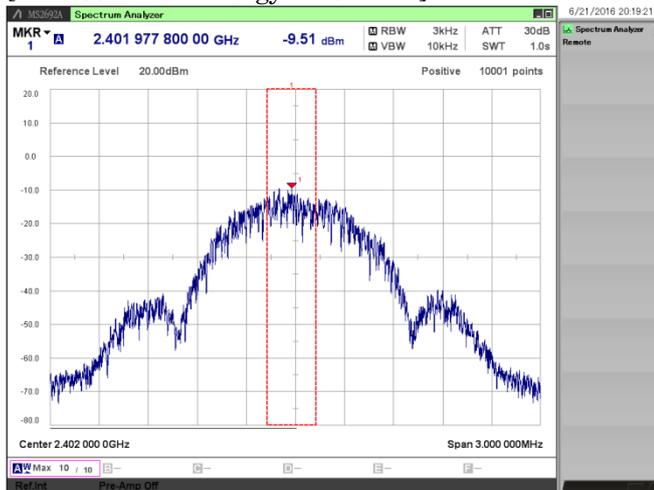
Mode	Rate [Mbps]	Channel [MHz]	Reading(AV) [dBm]	C.F. [dB]	Result(AV) [dBm]	Result(AV) [W]
BLE	1	2402	-3.75	10.52	6.77	0.00475
		2440	-3.62	10.52	6.90	0.00490
		2480	-3.68	10.52	6.84	0.00483

### 3.4. Power Spectral Density

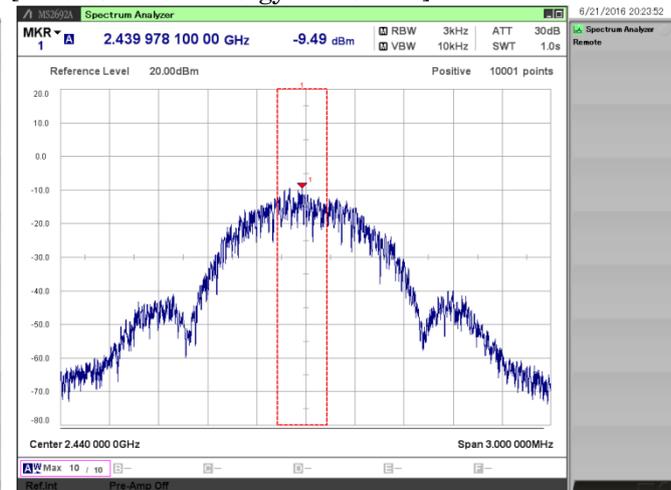
- 1) Ambient temperature : 20.4deg.C
- 2) Relative humidity : 58.7 %
- 3) Date of measurement : June 21, 2016
- 4) Measured by : H. Waki
- 5) Operating mode : Transmitting mode

Mode	Rate [Mbps]	Channel [MHz]	Reading(PK) [dBm]	C.F. [dB]	Result(PK) [dBm]	Limit [dBm]	Margin [dB]
BLE	1	2402	-9.51	0.87	-8.64	8.0	16.64
		2440	-9.49	0.88	-8.61	8.0	16.61
		2480	-9.37	0.88	-8.49	8.0	16.49

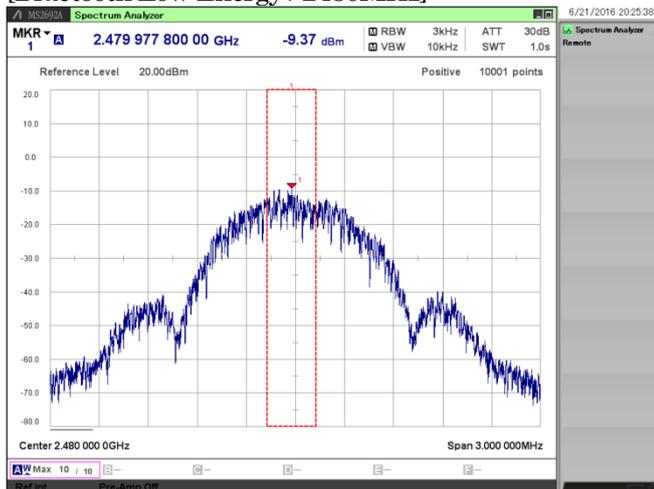
[Bluetooth Low Energy / 2402MHz]



[Bluetooth Low Energy / 2440MHz]



[Bluetooth Low Energy / 2480MHz]



### 3.5. Radiated Spurious Emissions

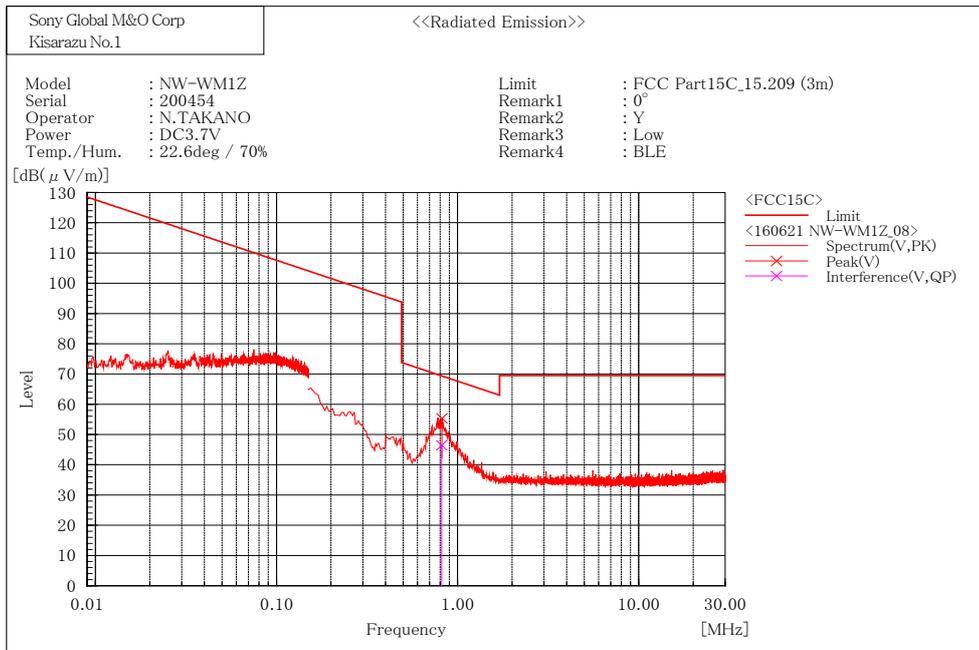
1) Date of measurement

9kHz - 30MHz : June 21, 2016 (all mode)  
 30MHz - 1000MHz : June 21, 2016 (all mode)  
 1GHz - 6GHz : June 16, 2016 (all mode)  
 6GHz - 18GHz : June 17, 2016 (all mode)  
 18GHz - 24.835GHz : June 16, 2016 (all mode)

June 16, 2016 (band edge plot data)

9 kHz - 30 MHz

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

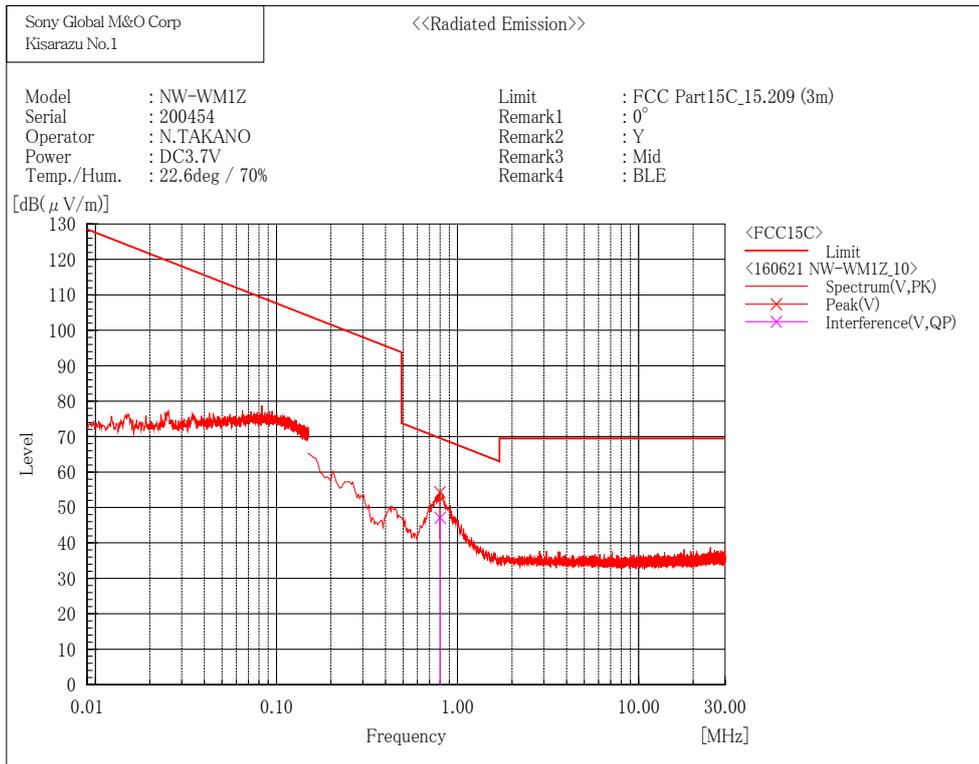


Final Result

--- 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	0.817	27.0	19.4	46.4	69.4	23.0	100.0	32.8

[Bluetooth Low Energy (1 Mbps) / 2440MHz]

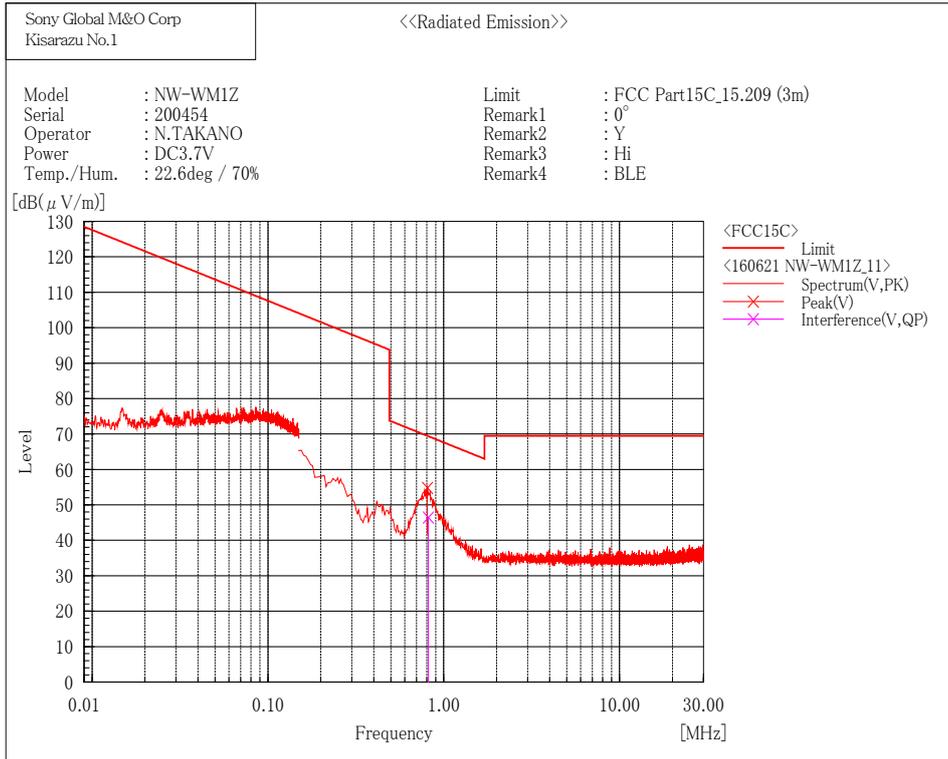


Final Result

--- 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	0.801	27.7	19.4	47.1	69.5	22.4	100.0	50.2

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

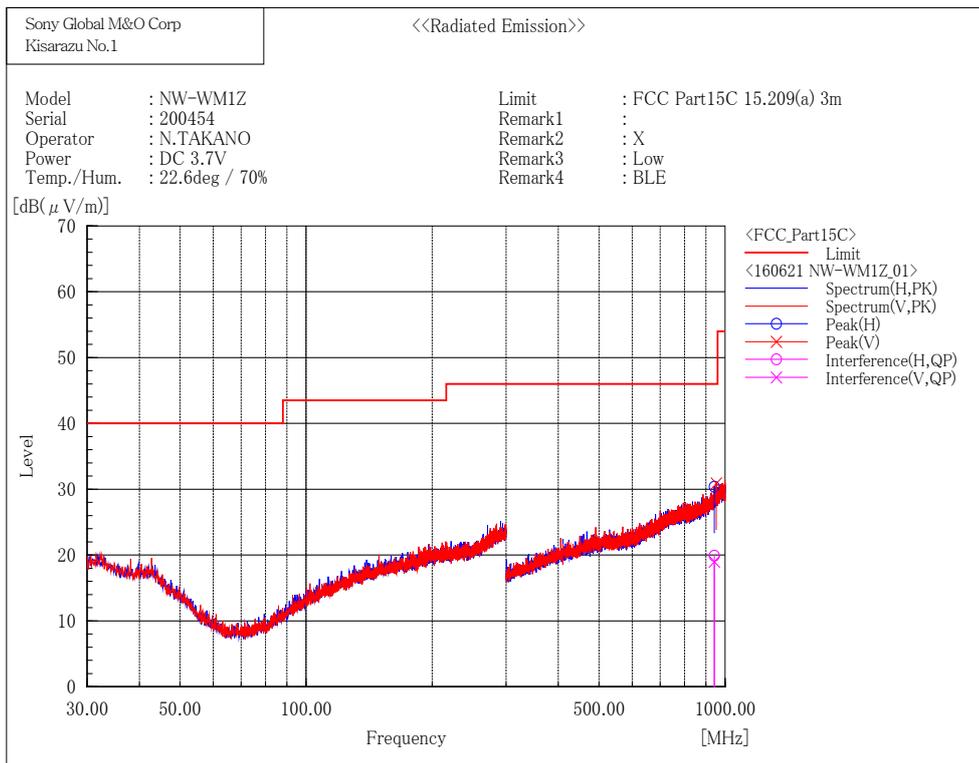


Final Result

--- 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	0.816	27.1	19.4	46.5	69.4	22.9	100.0	15.9

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



Final Result

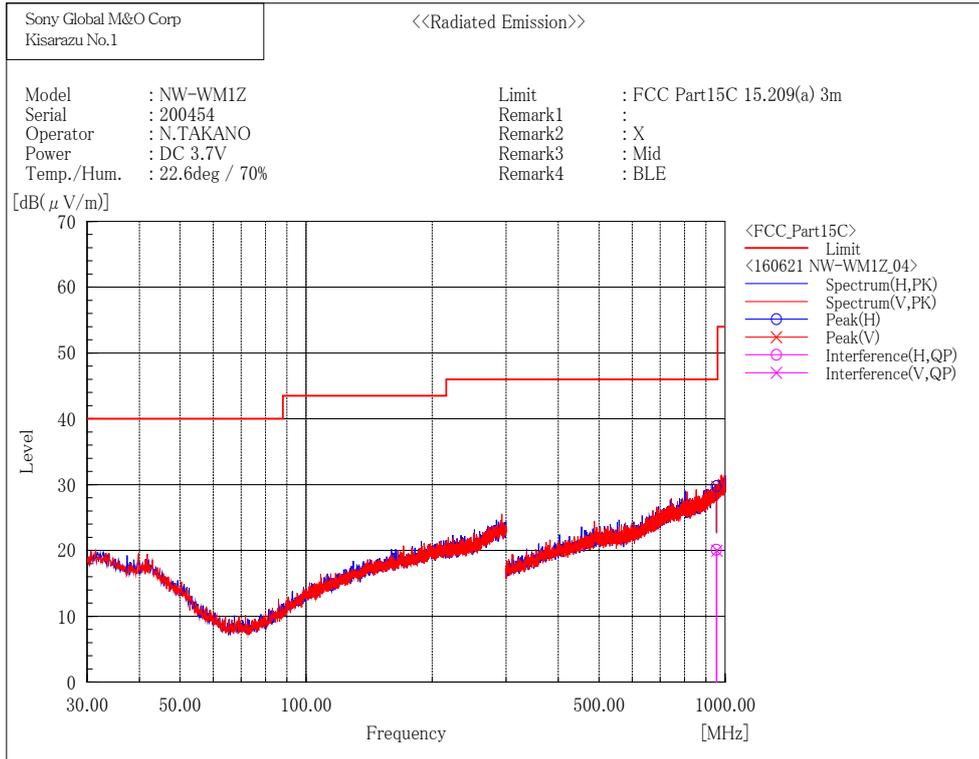
--- Horizontal Polarization (QP)---

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	942.507	18.9	1.0	19.9	46.0	26.1	100.0	56.2

--- 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	942.507	18.0	1.0	19.0	46.0	27.0	100.0	69.0

[Bluetooth Low Energy (1 Mbps) / 2440MHz]



Final Result

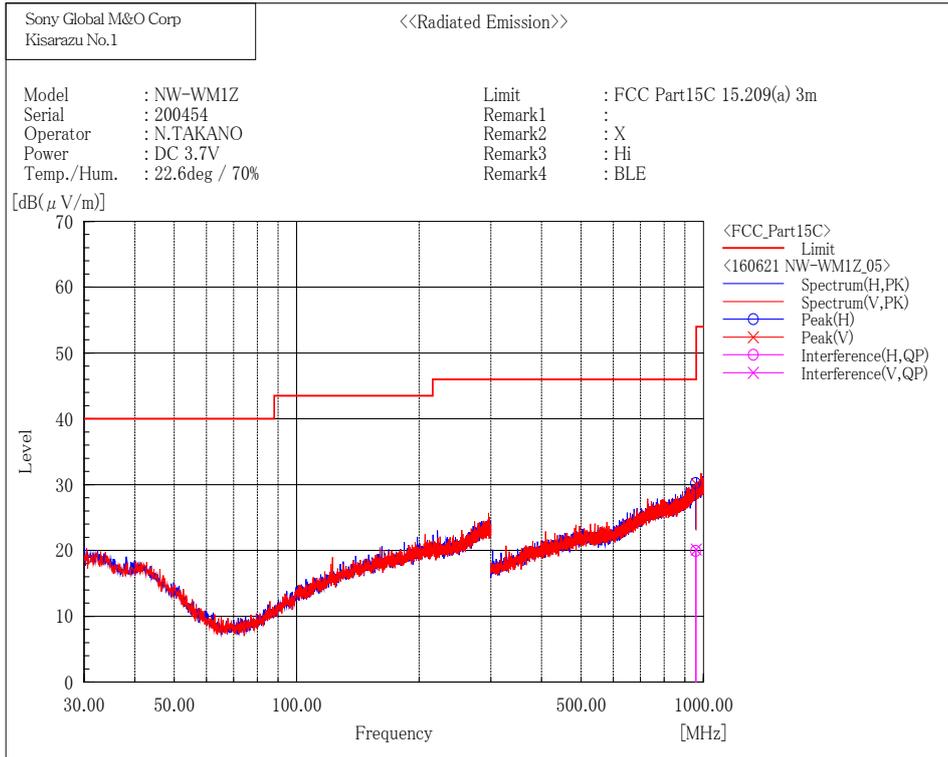
--- Horizontal Polarization (QP)---

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	953.235	18.7	1.4	20.1	46.0	25.9	100.0	329.8

--- 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	955.795	18.6	1.4	20.0	46.0	26.0	124.2	314.1

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



Final Result

--- Horizontal Polarization (QP)---

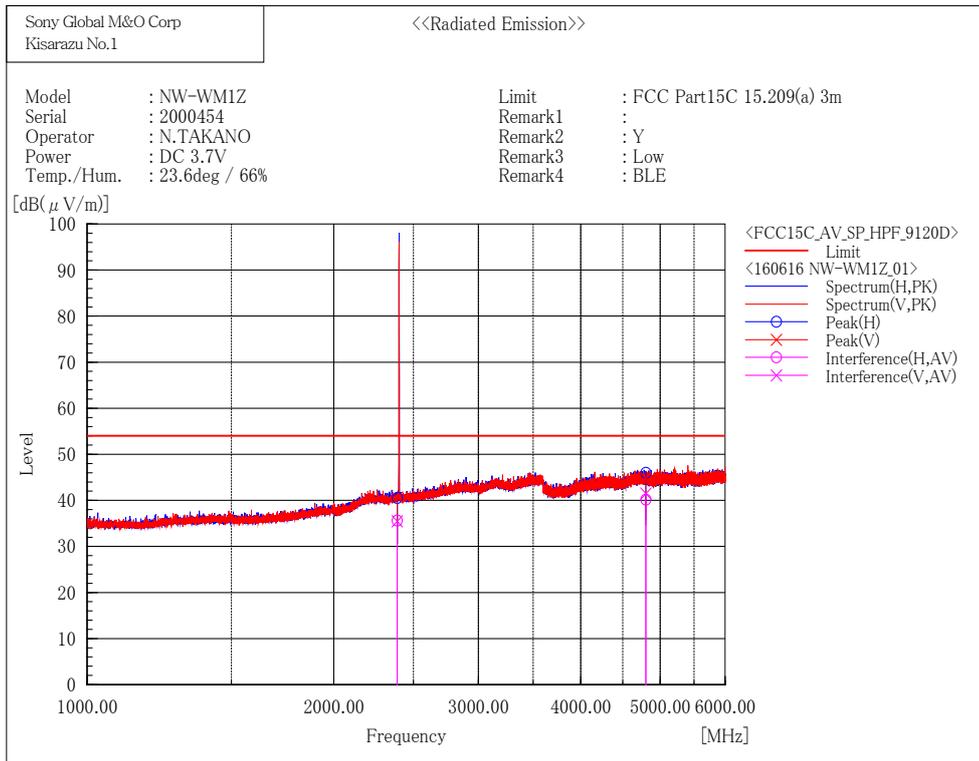
No.	Frequency [MHz]	Reading [dB(μV)]	c. f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	956.075	18.5	1.4	19.9	46.0	26.1	154.5	163.9

--- 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	959.322	18.7	1.5	20.2	46.0	25.8	100.0	165.6

1GHz - 6 GHz

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



Final Result

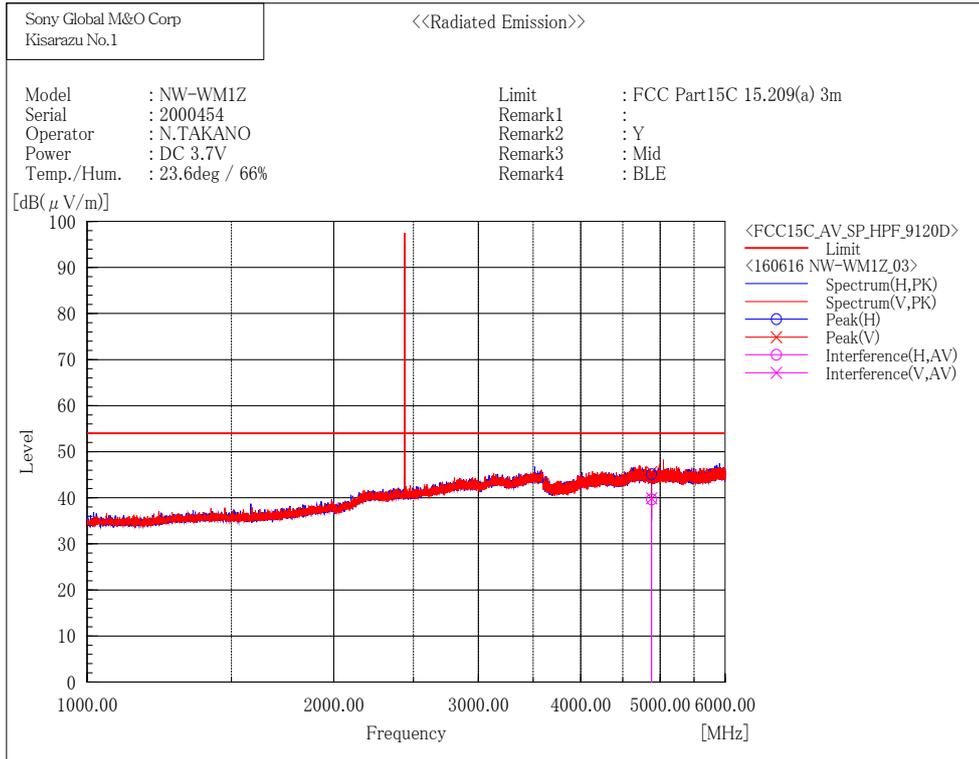
--- Horizontal Polarization (AV)---

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	2389.177	34.0	1.6	35.6	54.0	18.4	139.5	285.0
2	4803.454	30.5	9.6	40.1	54.0	13.9	109.0	203.1

--- 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	2388.694	33.9	1.6	35.5	54.0	18.5	120.3	227.1
2	4803.799	31.9	9.6	41.5	54.0	12.5	161.4	233.1

[Bluetooth Low Energy (1 Mbps) / 2440MHz]



Final Result

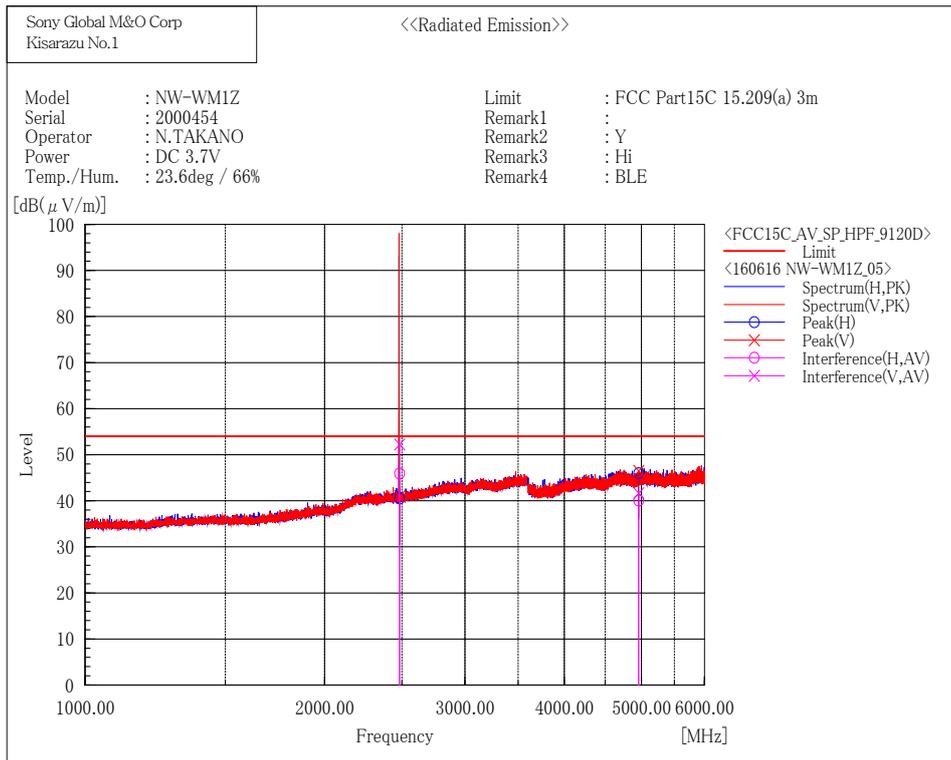
--- Horizontal Polarization (AV)---

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	4880.265	30.1	9.5	39.6	54.0	14.4	163.0	134.3

--- 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	4879.733	30.4	9.5	39.9	54.0	14.1	128.6	81.6

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



Final Result

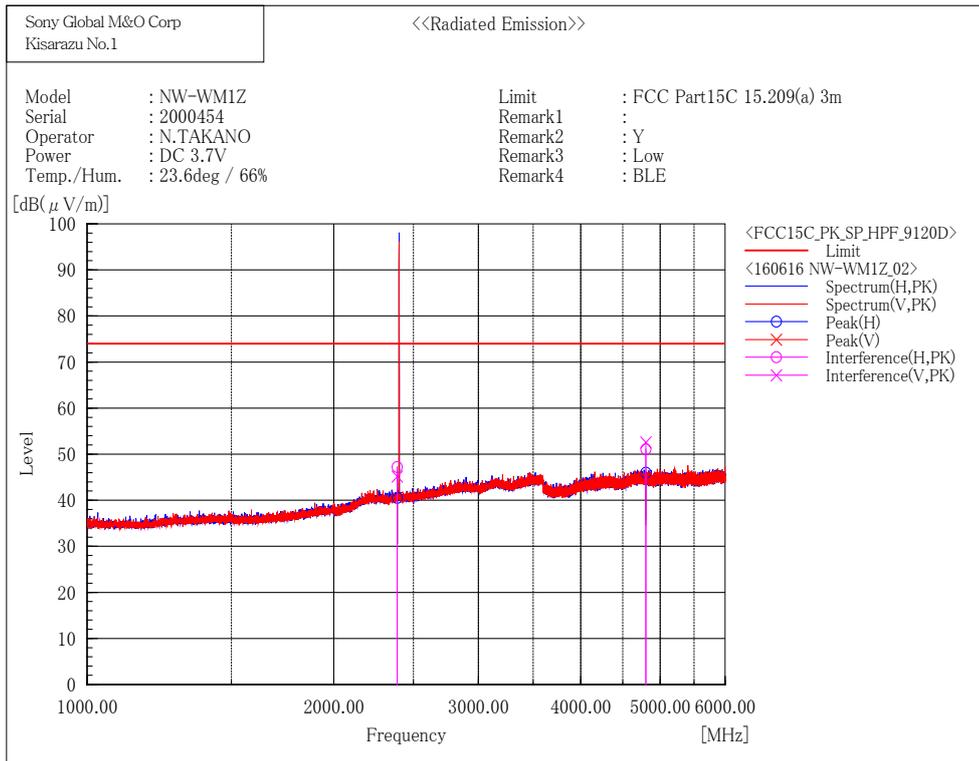
--- Horizontal Polarization (AV)---

No.	Frequency [MHz]	Reading [dB( $\mu$ V)]	c. f [dB(1/m)]	Result [dB( $\mu$ V/m)]	Limit [dB( $\mu$ V/m)]	Margin [dB]	Height [cm]	Angle [°]
1	2483.500	44.0	1.9	45.9	54.0	8.1	240.7	288.2
2	4960.202	30.2	9.8	40.0	54.0	14.0	198.4	198.9

--- Vertical Polarization (AV)---

No.	Frequency [MHz]	Reading [dB( $\mu$ V)]	c. f [dB(1/m)]	Result [dB( $\mu$ V/m)]	Limit [dB( $\mu$ V/m)]	Margin [dB]	Height [cm]	Angle [°]
1	2483.500	50.4	1.9	52.3	54.0	1.7	168.5	260.9
2	4959.443	31.8	9.8	41.6	54.0	12.4	166.1	260.9

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



Final Result

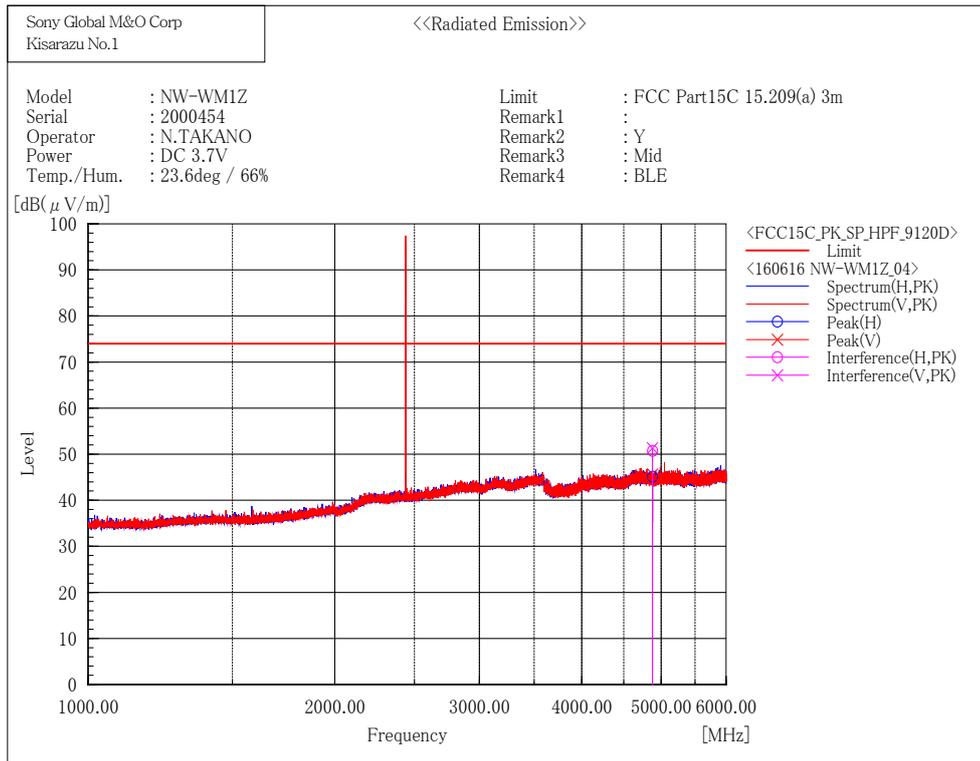
--- Horizontal Polarization (PK)---

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	2389.425	45.6	1.6	47.2	74.0	26.8	127.6	285.2
2	4802.814	41.5	9.6	51.1	74.0	22.9	109.0	226.8

--- 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	2388.395	43.6	1.6	45.2	74.0	28.8	120.3	227.1
2	4803.732	43.0	9.6	52.6	74.0	21.4	164.0	233.6

[Bluetooth Low Energy (1 Mbps) / 2440MHz]



Final Result

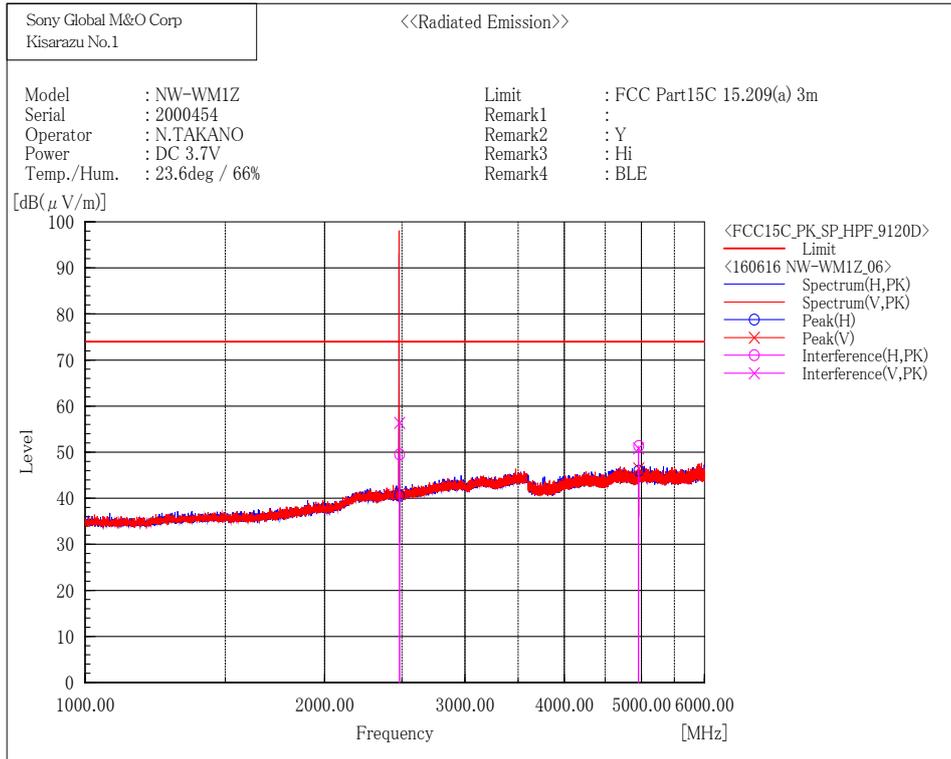
--- Horizontal Polarization (PK)---

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	4880.484	41.2	9.5	50.7	74.0	23.3	163.0	134.3

--- 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	4879.241	41.8	9.5	51.3	74.0	22.7	128.6	81.5

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



Final Result

--- Horizontal Polarization (PK)---

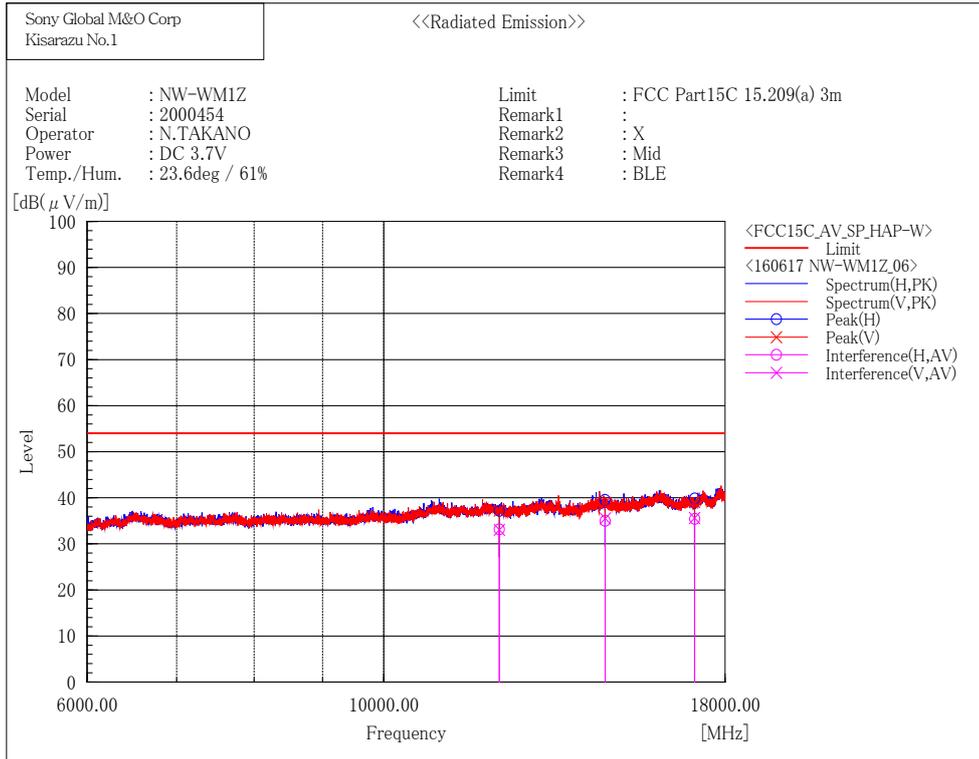
No.	Frequency [MHz]	Reading [dB(μV)]	c. f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	2483.510	47.7	1.9	49.6	74.0	24.4	240.7	288.2
2	4959.545	41.5	9.8	51.3	74.0	22.7	198.4	198.9

--- 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	2483.504	54.5	1.9	56.4	74.0	17.6	168.5	260.9
2	4958.057	41.1	9.7	50.8	74.0	23.2	166.1	260.9



[Bluetooth Low Energy (1 Mbps) / 2440MHz]



Final Result

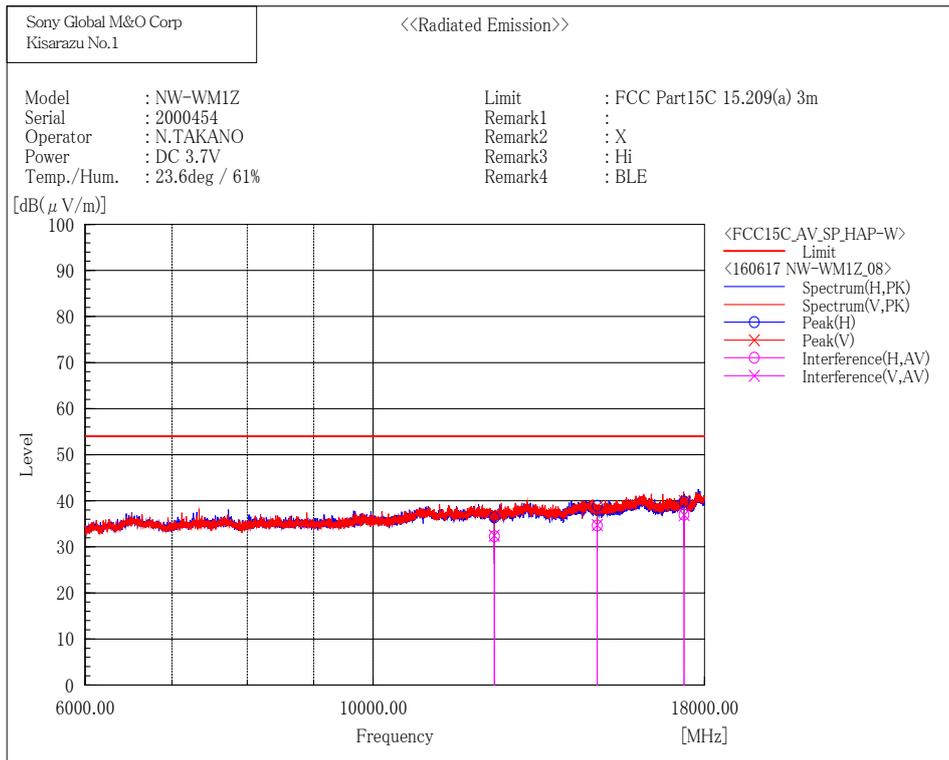
--- Horizontal Polarization (AV)---

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	12200.051	37.7	-4.5	33.2	54.0	20.8	347.5	321.1
2	14638.621	37.7	-2.7	35.0	54.0	19.0	366.6	333.4
3	17081.900	35.4	0.0	35.4	54.0	18.6	150.1	47.0

--- 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	12201.045	37.6	-4.5	33.1	54.0	20.9	126.0	177.3
2	14641.172	38.2	-2.7	35.5	54.0	18.5	323.0	18.3
3	17078.792	35.7	-0.1	35.6	54.0	18.4	307.0	245.2

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



Final Result

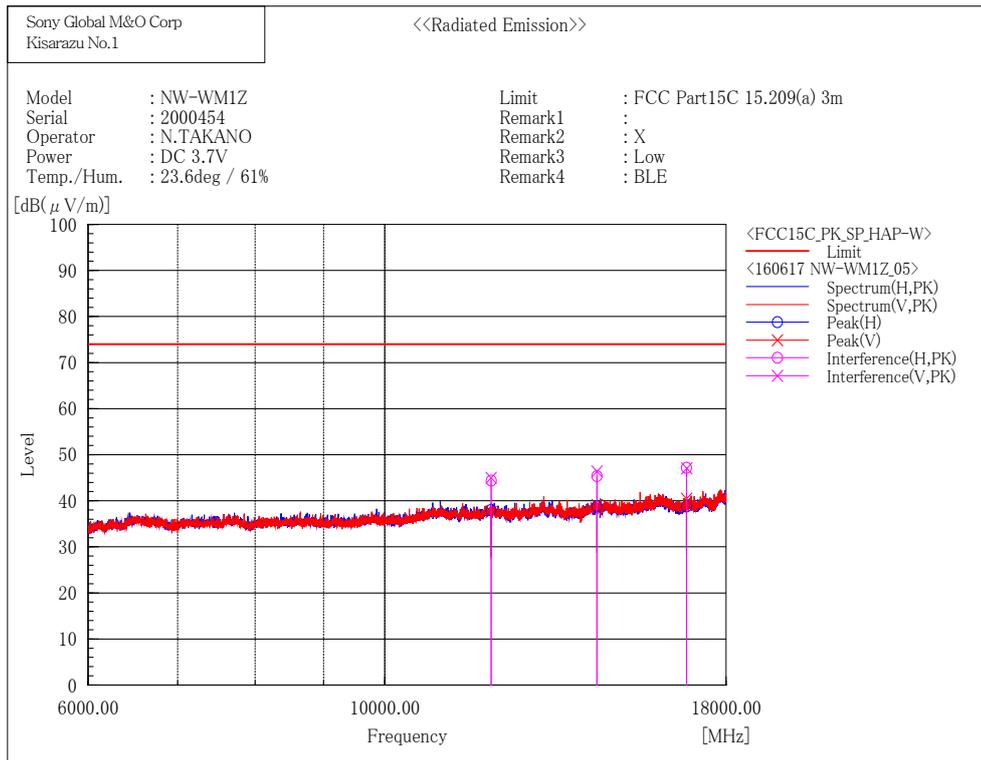
--- Horizontal Polarization (AV)---

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	12400.660	37.0	-4.7	32.3	54.0	21.7	344.1	201.1
2	14883.393	37.4	-2.7	34.7	54.0	19.3	348.1	43.1
3	17359.106	36.8	0.2	37.0	54.0	17.0	163.1	40.7

--- 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	12397.428	37.2	-4.7	32.5	54.0	21.5	295.6	262.2
2	14880.214	37.4	-2.7	34.7	54.0	19.3	339.6	262.0
3	17362.122	36.7	0.2	36.9	54.0	17.1	171.9	299.9

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



Final Result

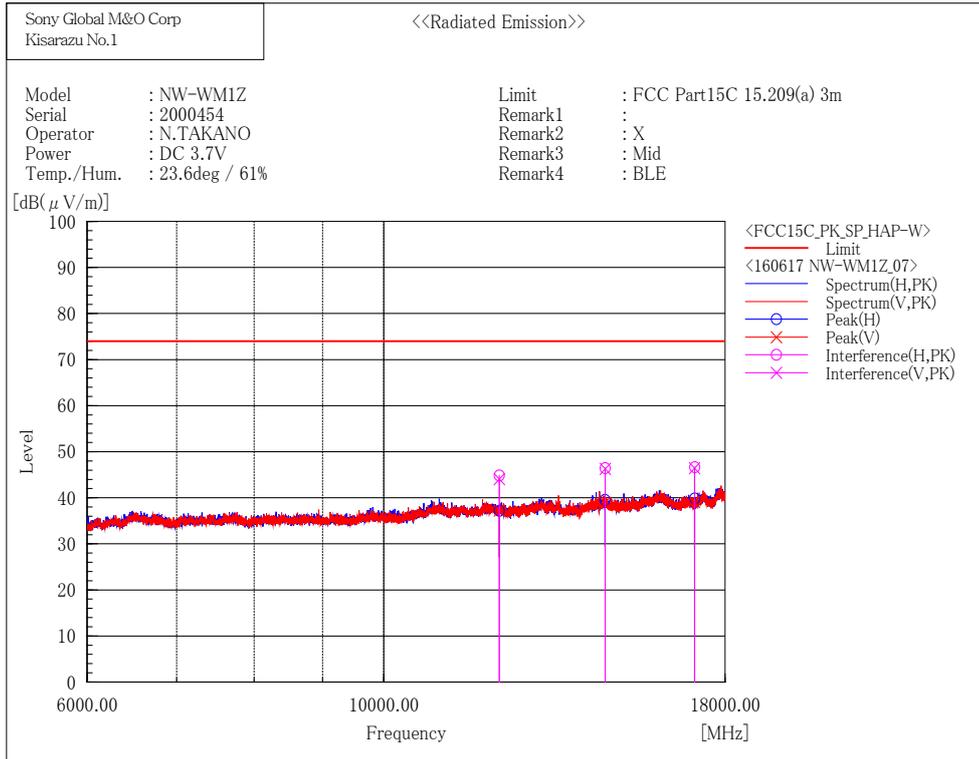
--- Horizontal Polarization (PK)---

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	12011.841	48.6	-4.2	44.4	74.0	29.6	143.2	16.8
2	14410.395	48.3	-3.0	45.3	74.0	28.7	223.4	5.4
3	16813.998	48.0	-0.8	47.2	74.0	26.8	197.1	350.0

--- 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	12009.874	49.2	-4.2	45.0	74.0	29.0	135.0	226.8
2	14411.774	49.4	-3.0	46.4	74.0	27.6	304.3	171.3
3	16817.390	47.9	-0.8	47.1	74.0	26.9	178.4	24.7

[Bluetooth Low Energy (1 Mbps) / 2440MHz]



Final Result

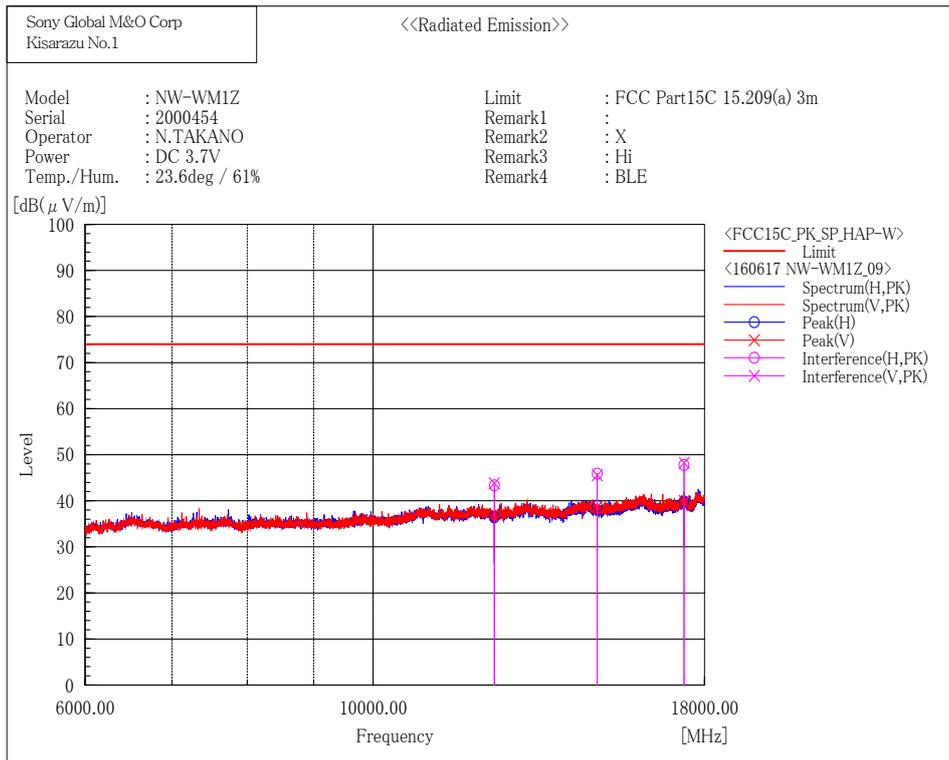
--- Horizontal Polarization (PK)---

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	12201.039	49.3	-4.5	44.8	74.0	29.2	347.6	321.2
2	14638.583	49.2	-2.7	46.5	74.0	27.5	366.7	333.5
3	17081.364	46.7	0.0	46.7	74.0	27.3	150.1	47.0

--- 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	12201.682	48.6	-4.5	44.1	74.0	29.9	126.0	177.4
2	14640.433	49.0	-2.7	46.3	74.0	27.7	323.1	18.3
3	17077.616	46.6	-0.1	46.5	74.0	27.5	307.1	245.3

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



Final Result

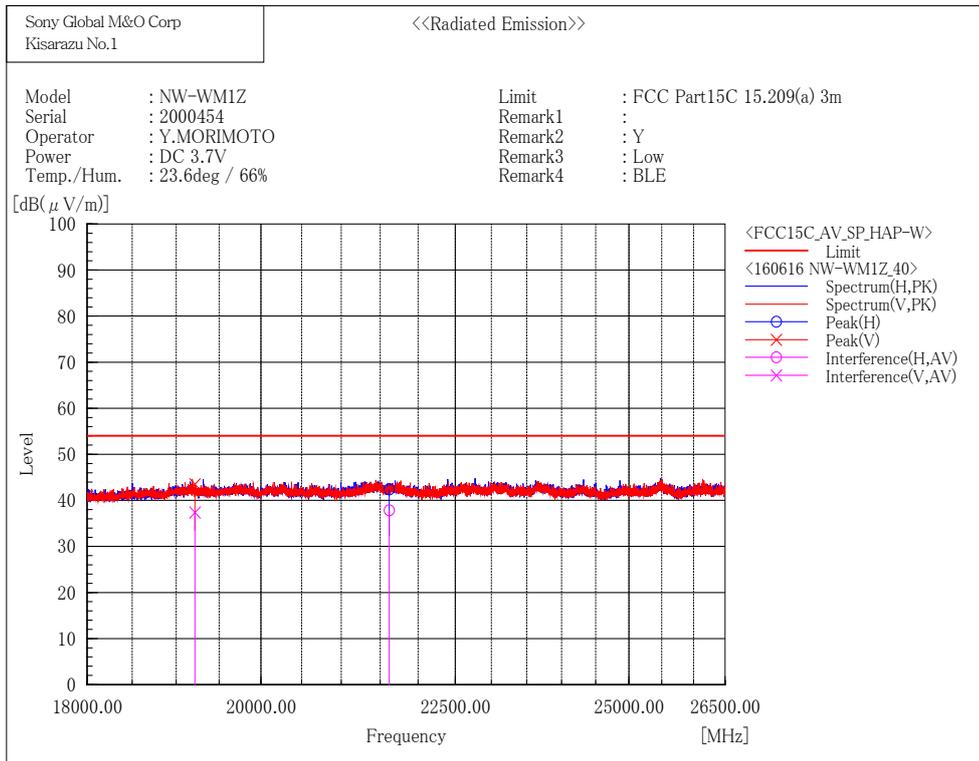
--- Horizontal Polarization (PK)---

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	12401.894	48.0	-4.7	43.3	74.0	30.7	344.2	201.2
2	14883.250	48.6	-2.7	45.9	74.0	28.1	348.2	43.1
3	17358.790	47.6	0.2	47.8	74.0	26.2	163.1	40.7

--- 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	12397.804	48.5	-4.7	43.8	74.0	30.2	295.7	262.3
2	14880.730	48.3	-2.7	45.6	74.0	28.4	295.7	262.3
3	17361.556	48.1	0.2	48.3	74.0	25.7	171.9	300.0

18 GHz – 24.835 GHz  
 [Bluetooth Low Energy (1 Mbps) / 2402MHz]



Final Result

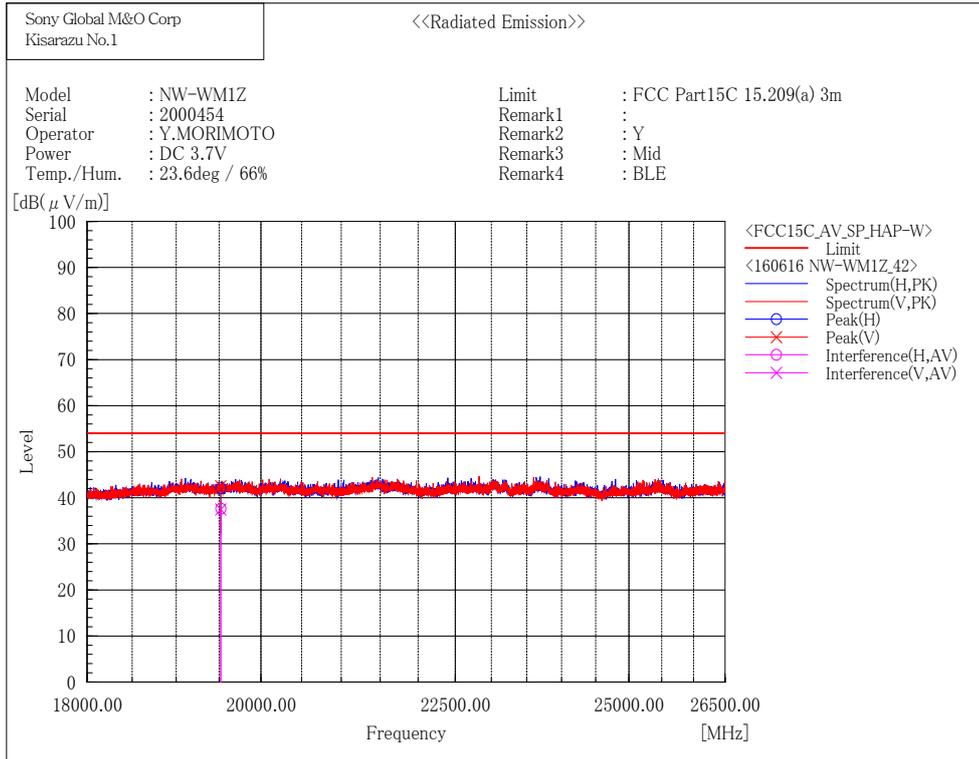
--- Horizontal Polarization (AV)---

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	21617.578	38.6	-0.8	37.8	54.0	16.2	140.0	81.4

--- 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	19216.466	37.8	-0.4	37.4	54.0	16.6	209.7	12.7

[Bluetooth Low Energy (1 Mbps) / 2440MHz]



Final Result

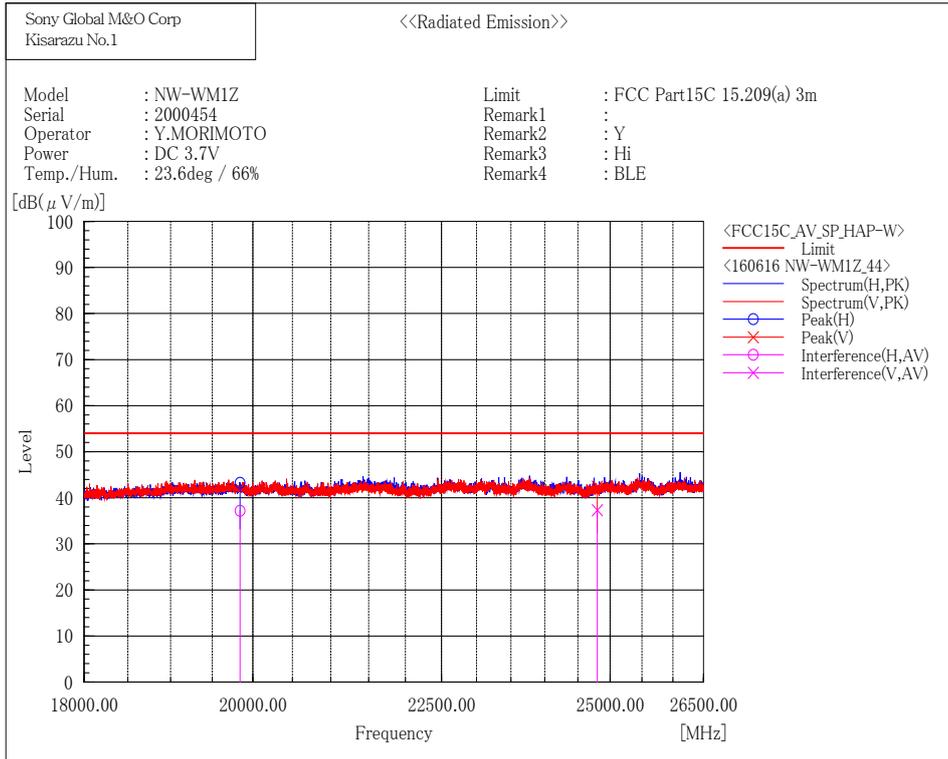
--- Horizontal Polarization (AV)---

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	19520.544	38.2	-0.5	37.7	54.0	16.3	374.6	19.9

--- 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	19518.990	38.0	-0.5	37.5	54.0	16.5	101.5	165.8

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



Final Result

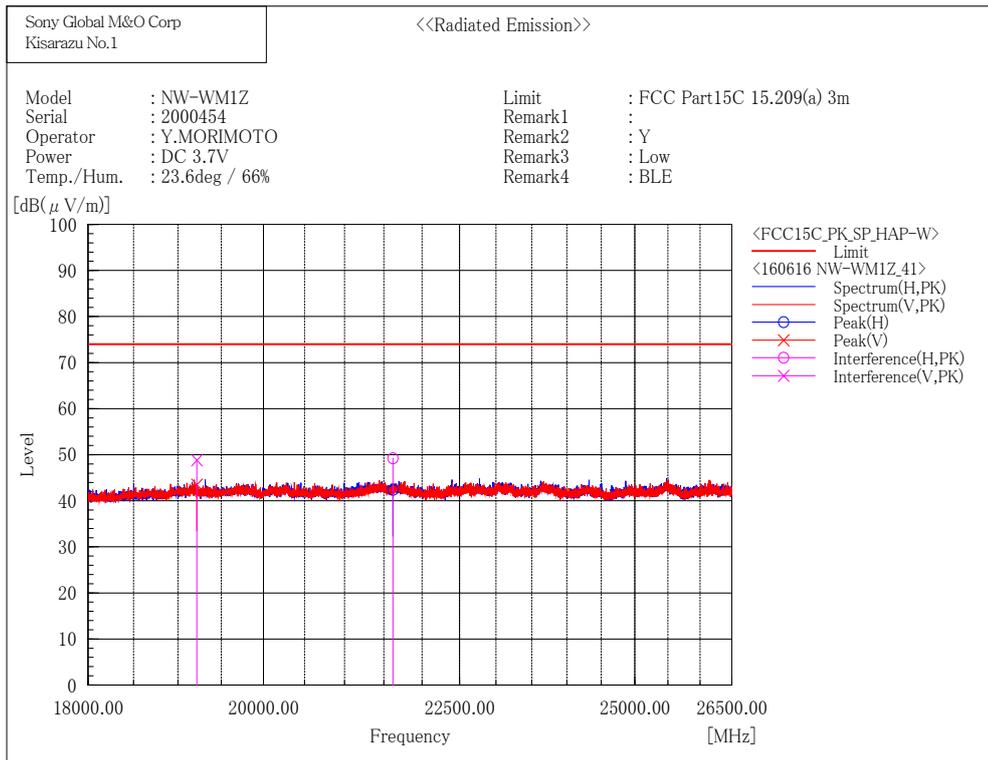
--- Horizontal Polarization (AV)---

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	19841.140	37.7	-0.5	37.2	54.0	16.8	385.4	99.9

--- 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	24800.764	39.4	-2.1	37.3	54.0	16.7	171.1	251.8

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



Final Result

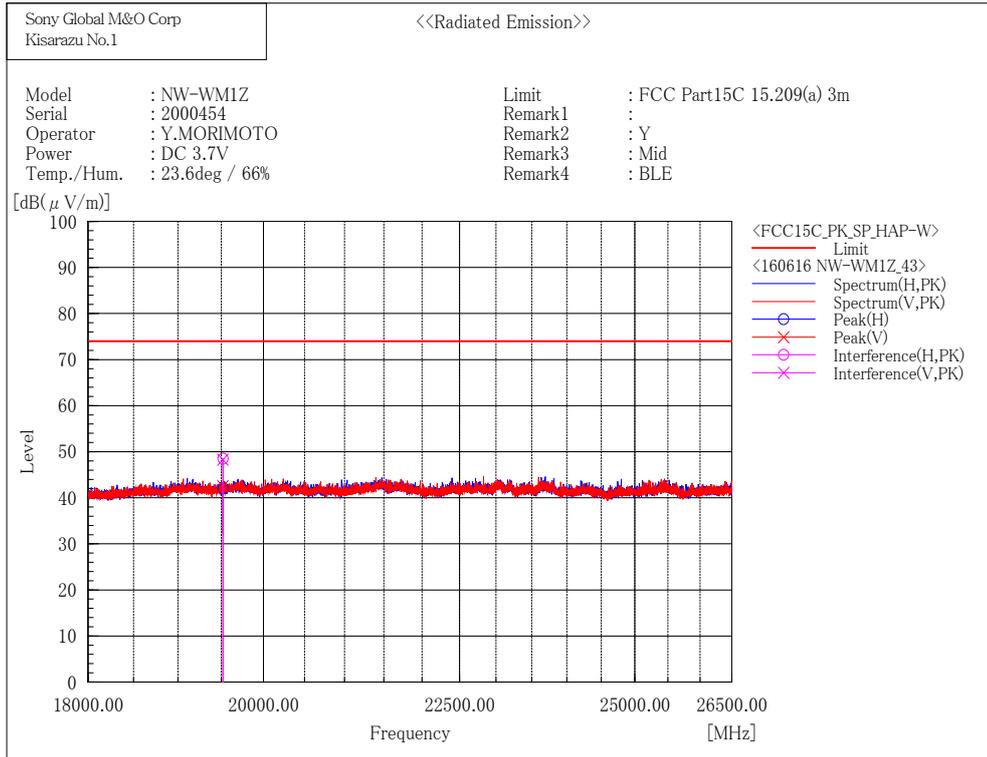
--- Horizontal Polarization (PK)---

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	21617.420	50.0	-0.8	49.2	74.0	24.8	140.0	81.4

--- 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	19217.262	49.2	-0.4	48.8	74.0	25.2	209.7	12.7

[Bluetooth Low Energy (1 Mbps) / 2440MHz]



Final Result

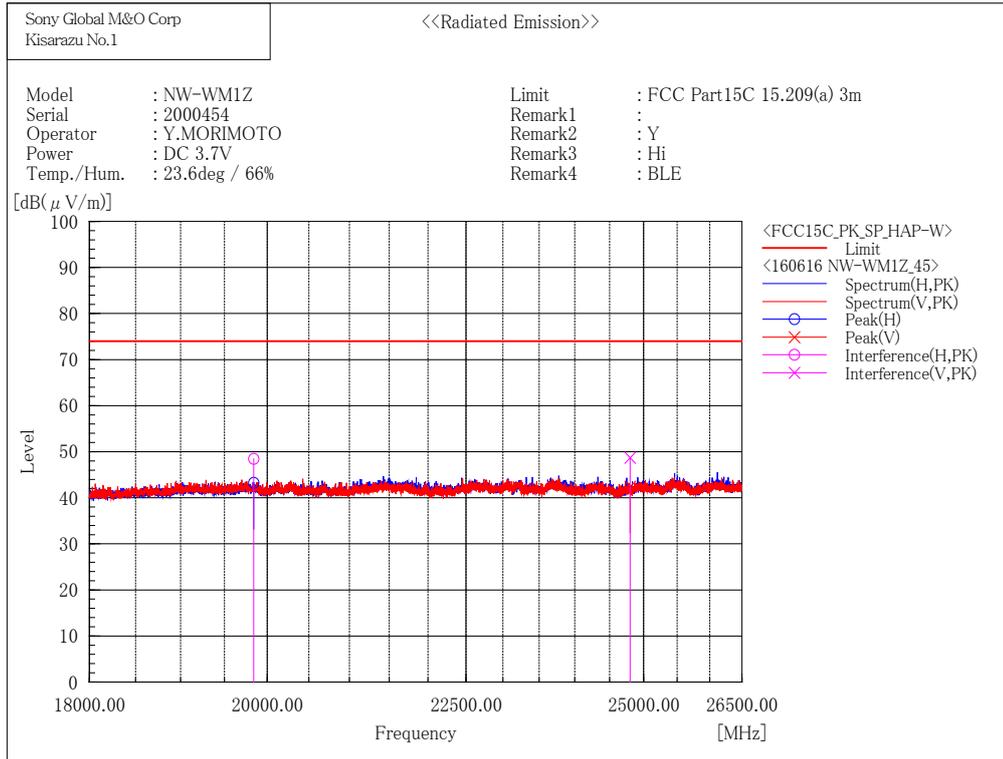
--- Horizontal Polarization (PK)---

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	19520.218	49.0	-0.5	48.5	74.0	25.5	374.6	19.9

--- 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	19518.104	48.8	-0.5	48.3	74.0	25.7	101.5	165.9

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



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	19840.252	49.0	-0.5	48.5	74.0	25.5	385.5	99.9

--- Vertical Polarization (PK)---

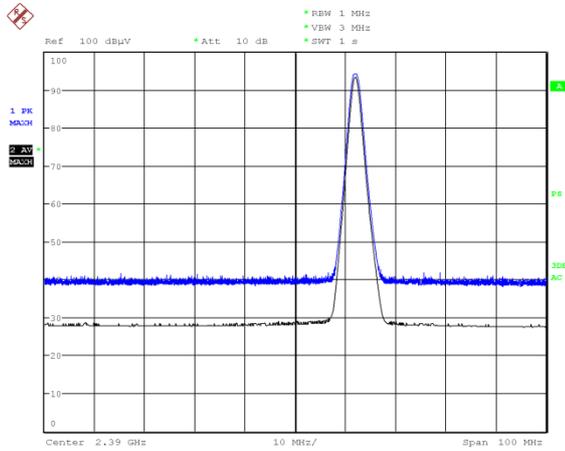
No.	Frequency [MHz]	Reading [dB(μV)]	c. f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	24800.776	50.8	-2.1	48.7	74.0	25.3	171.1	251.8

2.4GHz Restricted-Band Edge (Plot data)

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

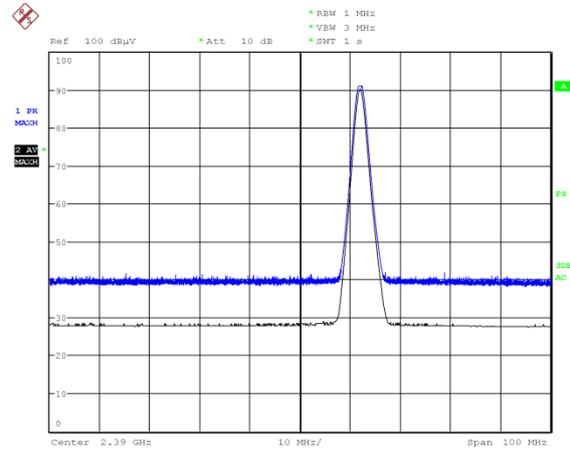
The result of the final radiated emissions measurement refers in previous pages.

[Bluetooth Low Energy / 2402MHz]  
Horizontal



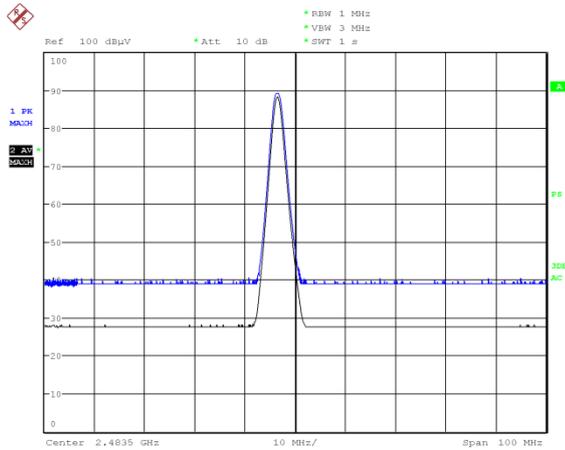
Date: 16.JUN.2016 10:52:41

Vertical



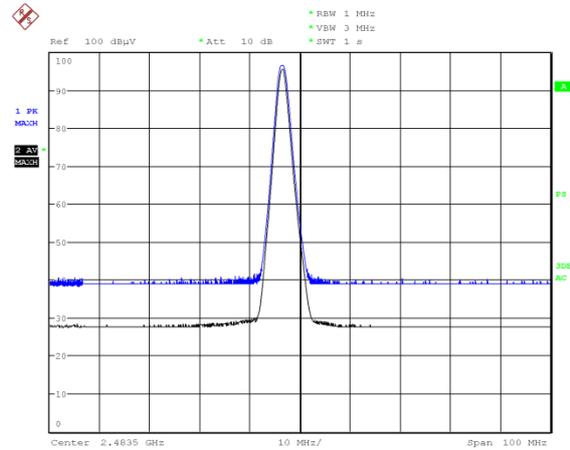
Date: 16.JUN.2016 10:58:54

[Bluetooth Low Energy / 2480MHz]  
Horizontal



Date: 16.JUN.2016 12:24:11

Vertical



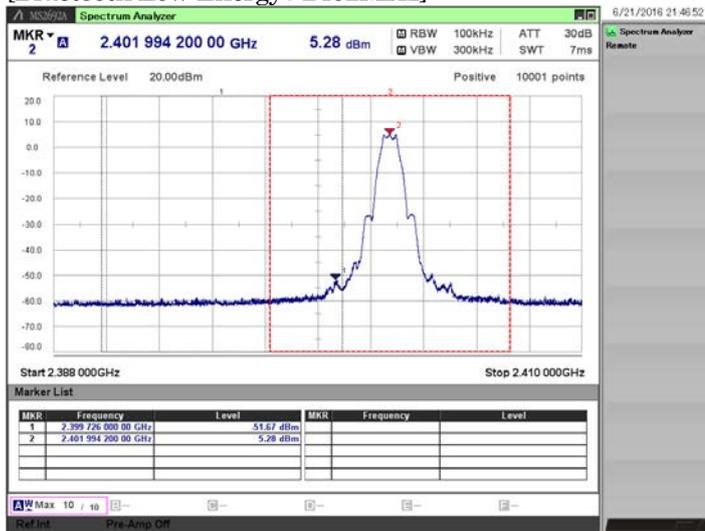
Date: 16.JUN.2016 12:42:47

### 3.6. Conducted Spurious Emissions for Band Edge

- 1) Ambient temperature : 20.4deg.C
- 2) Relative humidity : 58.7 %
- 3) Date of measurement : June 21, 2016
- 4) Measured by : H. Waki
- 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	2399.73	-51.67	0.87	-50.80	-13.9	36.95
			2401.99	5.28	0.87	6.15	-	-

[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
x	M514	LISN (for EUT)	ENV216	100424	Rohde & Schwarz	12	16.05.25
-	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

### 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 Projects	-	-
-	W003	Spectrum Analyzer	E4440A	US42511926	Keysight Technologies	12	15.06.02
x	W006	Power meter	N1911A	MY50000295	Keysight Technologies	12	15.09.02
x	W007	Power Sensor	N1922A	MY50180022	Keysight Technologies	12	15.09.09
-	W104	Power Sensor	U2021XA	MY54040006	Keysight Technologies	12	15.12.14
-	W105	Power Sensor	U2021XA	MY54080005	Keysight Technologies	12	15.12.14
x	W029	10dB Attenuator	8493C	76549	Keysight Technologies	12	15.09.24
-	W110	10dB Attenuator	6610-SK-50-1	2	HUBER + SUHNER	12	15.06.08
-	WC02	RF Cable	SUCOFLEX102	34124/2	HUBER + SUHNER	12	15.10.16
-	WC03	RF Cable	SUCOFLEX102	34127/2	HUBER + SUHNER	12	15.10.08
x	WC05	RF Cable	SUCOFLEX102	34287/2	HUBER + SUHNER	12	15.10.16
-	WC06	RF Cable	SUCOFLEX102	34289/2	HUBER + SUHNER	12	15.10.08
x	M719	Thermo Meter	TH-321	140053	ASONE	12	15.06.10
x	W100	Signal Analyzer	MS2692A	6201338954	Anritsu	12	16.04.15

## 5.3. Radiated Spurious Emissions

## EMC Site 3m Semi-Anechoic Chamber:

	Ctrl#	Equipment	Model No.	Serial No.	Manufacturer	Cal.Int.	Last Cal.
x	M115	Semi-Anechoic Chamber	-	7D1-8A11	Otsuka Science	12	16.06.03
x	M486	EMI Receiver	ESU40	100050	Rohde & Schwarz	12	16.02.23
x	M686	EMI Receiver	N9038A	MY52260113	Keysight Technologies	12	15.11.11
x	A073	Loop Antenna	HFH2-Z2	100171	Rohde & Schwarz	12	15.10.12
x	A089	Biconical Antenna	BBA9106	VHA91032835	Schwarzbeck	12	16.01.27
x	A088	Logperiodic Antenna	UHALP9108A1	0649	Schwarzbeck	12	16.01.27
x	A064	Horn Antenna	BBHA9120D	746	Schwarzbeck	12	16.01.27
x	A078	Horn Antenna	HAP06-18W	00000070	Toyo Corporation	12	16.02.04
x	A058	Horn Antenna	HAP18-26W	00000016	Toyo Corporation	12	16.01.26
x	CS017	N-RE Cable SYS1	-	-	EMC/RF Test Lab.	12	16.06.03
x	CS018	N-RE Cable SYS2	-	-	EMC/RF Test Lab.	12	16.06.03
x	CS045	N-3m EMF Cable SYS	-	-	EMC/RF Test Lab.	12	16.06.03
x	CS074	N-RE Cable SYS4	-	-	EMC/RF Test Lab.	12	16.06.03
x	CS075	N-RE Cable SYS4	-	-	EMC/RF Test Lab.	12	16.06.03
x	M126	Step Attenuator	8494H	3837M01144	Agilent Technologies	12	16.06.03
x	M609	3dB Attenuator	8491B	MY39265960	Agilent Technologies	12	16.06.03
x	M752	RF Pre-Amp	310N	320621	Sonoma Instrument	12	16.06.03
x	M128	3dB Attenuator	8491A	53451	Agilent Technologies	12	16.06.03
x	M737	GHz Filter Box	FB-G1	001	Sony Global M&O	12	16.06.03
-	M485	EMI Receiver	ESCI	100626	Rohde & Schwarz	12	16.04.18
x	M687	Thermo Meter	AD-5640A	201301	AND	12	15.10.15

## About calibration interval

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