

RADIO TEST REPORT

(for Bluetooth Low Energy)

Project No. : JB-Z0328

Client : Sony Corporation

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

Type of Equipment : Digital Music Player

Model No. : NW-ZX300

FCC ID : AK8NWZX300

Regulation Applied : 47 CFR Part 15 Subpart C

Final Judgment : Passed

Sample Receipt : May 25, 2017

Testing : May 30, 2017 - June 26, 2017

Reported : June 27, 2017

Reported by :



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TESTING CERT #3203.01

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A2LA Cert. #3203.01

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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. EUT Modifications	8
2.4. Configuration of Tested System	9
3. Test Data.....	11
3.1. AC Power-line Conducted Emissions	11
3.2. 6dB Bandwidth.....	12
3.3. Maximum Peak Conducted Output Power.....	13
3.4. Power Spectral Density	14
3.5. Radiated Spurious Emissions.....	15
3.6. Conducted Spurious Emissions for Band Edge.....	40
4. Method of Calculation	41
5. List of Test Equipment.....	43
5.1. AC Power-line Conducted Emissions	43
5.2. Antenna-port Conducted Measurements.....	43
5.3. Radiated Spurious Emissions.....	44
6. Photographs of test setup.....	45
6.1. AC Conducted Emission Measurements Photo(s)	45
6.2. Antenna-port Conducted Measurements Photo(s)	45
6.3. Radiated Spurious Emissions Measurement Photo(s).....	46

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 : Digital Music Player
 Trade Name : SONY
 Model No. : NW-ZX300
 Serial No. : 03, 05
 Power Rating : DC 3.7 V(The EUT was supplied with the power from built-in battery)

Similar model (to be covered by this Report)

Model No. : None

Radio specification

Function of the Equipment : Transceiver
 Operating Frequency : 2402 - 2480 MHz
 Modulation Type : GFSK
 Channel Spacing : 2 MHz
 Channel Bandwidth : 2 MHz
 Number of channels : 40
 Antenna Type : Reverse F antenna
 Antenna connector Type : None
 Antenna Gain : -1.9 dBi
 Operating Temperature : +5 to +35 deg.C

1.2. Summary of Test Result

Test Item	Worst Margin	Test Frequency band	Results
AC Power-line Conducted Emissions	11.9 dB (QP) 0.153 MHz N	150 kHz - 30 MHz	Complied
6dB Bandwidth	Refer to the test data	Carrier	Complied
Maximum Peak Conducted Output Power	22.98 dB	Carrier	Complied
Power Spectral Density	16.95 dB	Carrier	Complied
Radiated Spurious Emissions	13.6 dB (AV) 2483.500 MHz Horizontal	9 kHz - 25 GHz (excluding carrier and band edge)	Complied
Conducted Spurious Emissions for Band Edge *1	33.41 dB 2399.91 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 was tested with a new battery)
 Part 15.203 / 212 Antenna requirement
 : Complied (The EUT has an internal antenna which cannot be replaced by users)

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 v04

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 1 GHz) or 1.5m (above 1 GHz) 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 Measurements

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 Measurements were measured with power meter or spectrum analyzer.

Test Item	Detector	RBW
* Antenna-port Conducted Measurements		
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)

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 were compensated the distance factor with follows:
 9 kHz - 490 kHz [Limit at 3m] = [Limit at 300 m] + 40log (300[m] / 3[m])
 490 kHz - 30 MHz [Limit at 3m] = [Limit at 30 m] + 40log (30[m] / 3[m])
5. Find the worst arrangement of the EUT according to follows;
 - Rotating the turntable and/or scanning the antenna.
 - On every condition, exploring 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 of all test operating modes carried out on these emissions as follows;

The test antenna and the turntable were performed with follows;

	9 kHz - 30 MHz	30 MHz - 1000 MHz	above 1 GHz
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

*: 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 1 GHz
Detector	Peak / Average	Quasi-peak	Quasi-peak	Peak / Average
RBW	9 kHz (6 dB) *1	9 kHz (6 dB) *1	120 kHz (6 dB)	1 MHz (6 dB)
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(FCC 15.209(a)) in non-restricted band(excluding carrier band edges), the measurement is carried out additionally and compared with the limit (-20dBc) 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 - 30 MHz	above 30 MHz
Detector	Peak	Peak	Peak
RBW	6 dB RBW: 300 Hz *	6 dB RBW: 10 kHz *	6 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. 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 414788 D01.

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

- 6 dB 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 - 6 GHz	± 0.84 dB
Conducted Spurious Emissions	below 6 GHz	± 0.89 dB

Test Item	Frequency	Distance	4th Site	EMC Site
AC Power-line Conducted Emissions	150 kHz - 30 MHz	-	± 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	2402 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.

The Software for Operating Mode

Name: Diagnosis

Version: 1.02.10

Special accessories needed for connecting the EUT to achieve compliance:

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

2.3. 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 :

2.4. Configuration of Tested System

Antenna-port Conducted Measurements

The equipment under test (EUT)

Symbol	Item	Manufacturer	Model No.	Serial No.
A-1	Digital Music Player	SONY	NW-ZX300	03

Support equipment for operation

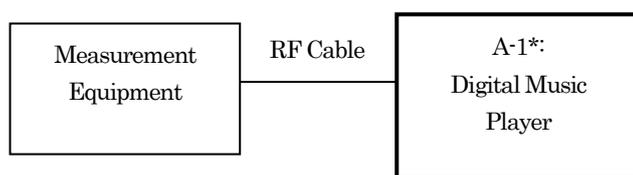
Symbol	Item	Manufacturer	Model No.	Serial No.
-	-	-	-	-

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-2	Digital Music Player	SONY	NW-ZX300	05

Support equipment for operation

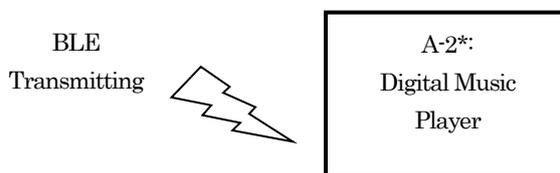
Symbol	Item	Manufacturer	Model No.	Serial No.
-	-	-	-	-

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-2	Digital Music Player	SONY	NW-ZX300	05

Support equipment for operation

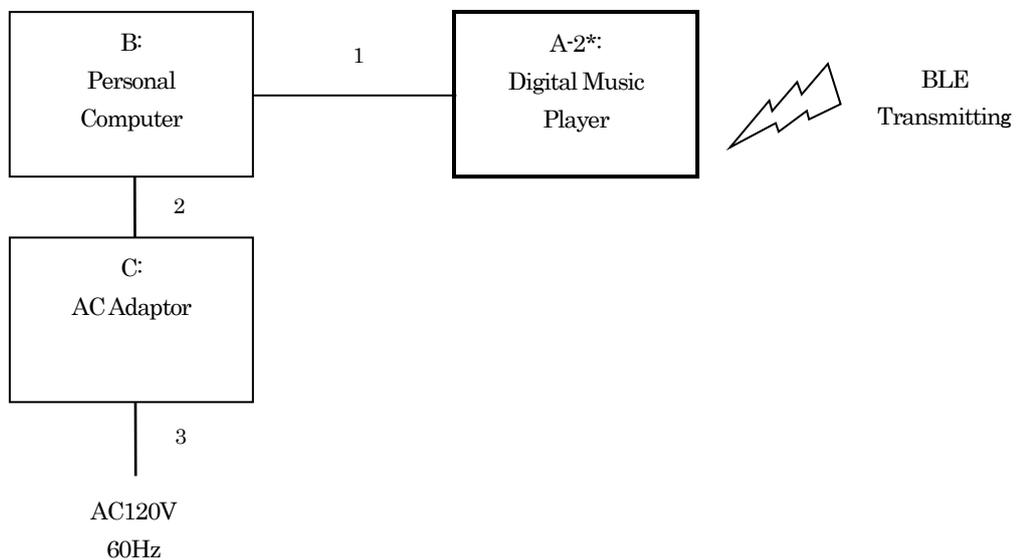
Symbol	Item	Manufacturer	Model No.	Serial No.
B	Personal Computer	HP	HSTNN-I42C	JPH6308MMN
C	AC Adaptor	HP	HSTNN-CA41	WDVTN0CGC9X3WG 0C

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	1.8	Bundled
3	AC Cable	-	NO	NO	0.9	-

System configuration

*: EUT



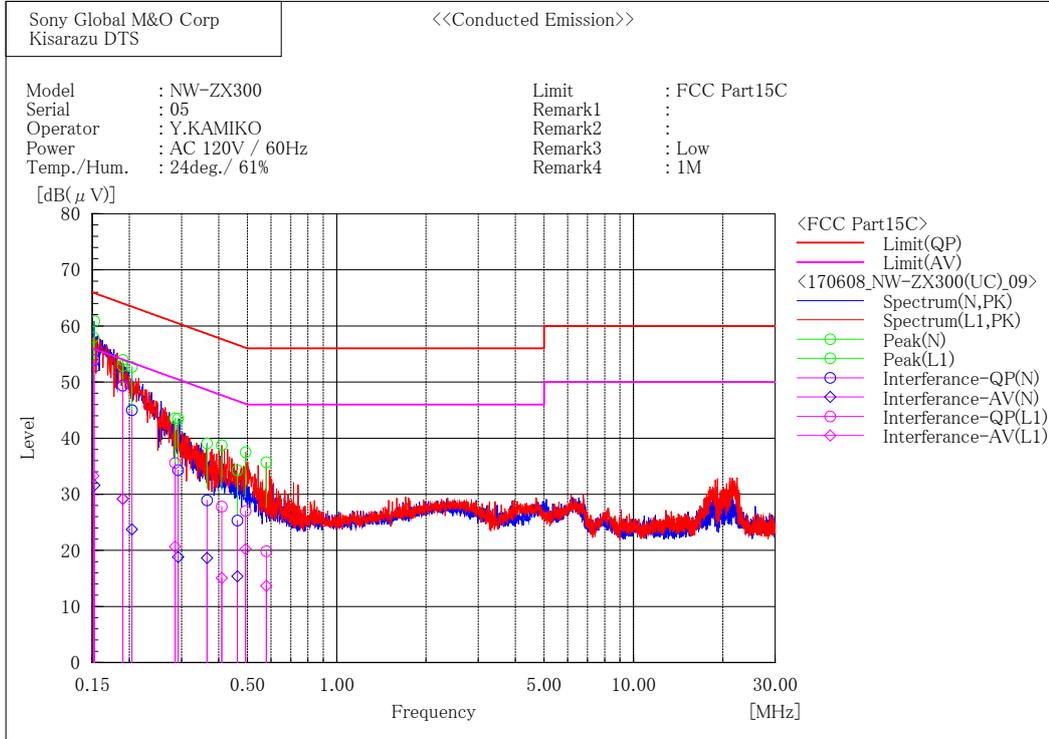
3. Test Data

3.1. AC Power-line Conducted Emissions

150 kHz -30 MHz

1) Date of measurement : June 08, 2017

[Bluetooth Low Energy / 2402 MHz]



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	0.153	37.9	15.5	16.1	54.0	31.6	65.9	55.9	11.9	24.3
2	0.190	33.2	13.0	16.2	49.4	29.2	64.0	54.0	14.6	24.8
3	0.204	29.0	7.7	16.0	45.0	23.7	63.4	53.4	18.4	29.7
4	0.292	18.4	2.9	15.9	34.3	18.8	60.5	50.5	26.2	31.7
5	0.366	12.8	2.6	16.1	28.9	18.7	58.6	48.6	29.7	29.9
6	0.463	9.2	-0.7	16.1	25.3	15.4	56.6	46.6	31.3	31.2

--- 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	0.152	38.0	17.3	16.0	54.0	33.3	65.9	55.9	11.9	22.6
2	0.190	33.1	12.9	16.2	49.3	29.1	64.0	54.0	14.7	24.9
3	0.286	19.8	4.9	15.8	35.6	20.7	60.7	50.7	25.1	30.0
4	0.410	11.7	-1.0	16.1	27.8	15.1	57.6	47.6	29.8	32.5
5	0.493	10.9	4.1	16.1	27.0	20.2	56.1	46.1	29.1	25.9
6	0.579	3.8	-2.4	16.1	19.9	13.7	56.0	46.0	36.1	32.3

3.2. 6dB Bandwidth

- 1) Ambient temperature : 24.0 deg.C
- 2) Relative humidity : 55.3 %
- 3) Date of measurement : June 07, 2017
- 4) Measured by : M. KOUGA
- 5) Operating mode : Transmitting mode

Mode	Rate [Mbps]	Channel [MHz]	Result [MHz]	Limit [MHz]
BLE	1	2402	0.693	0.5
		2440	0.698	0.5
		2480	0.704	0.5

[Bluetooth Low Energy / 2402 MHz]



[Bluetooth Low Energy / 2440 MHz]



[Bluetooth Low Energy / 2480 MHz]



3.3. Maximum Peak Conducted Output Power

- 1) Ambient temperature : 22.5 deg.C
- 2) Relative humidity : 52.6 %
- 3) Date of measurement : May 30, 2017
- 4) Measured by : M. KOUGA
- 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	-4.03	10.53	6.50	0.00447	30.0	23.50
		2440	-3.69	10.53	6.84	0.00483	30.0	23.16
		2480	-3.51	10.53	7.02	0.00504	30.0	22.98

Maximum Average Conducted Output Power (for SAR measurement)

Mode	Rate [Mbps]	Channel [MHz]	Reading(AV) [dBm]	C.F. [dB]	Duty Factor [dB]	Result(AV) [dBm]	Result(AV) [W]
BLE	1	2402	-6.44	10.53	2.15	6.24	0.00421
		2440	-6.07	10.53	2.15	6.61	0.00458
		2480	-5.91	10.53	2.15	6.77	0.00475

Duty Cycle

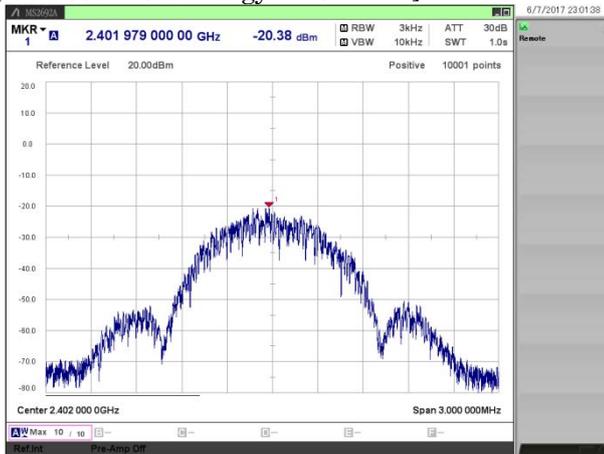
Mode	Rate [Mbps]	Channel [MHz]	T (on+off) [msec]	T (on) [msec]	Duty Factor [dB]	Duty Cycle [%]
BLE	1	2402	0.626	0.382	2.15	61.0

3.4. Power Spectral Density

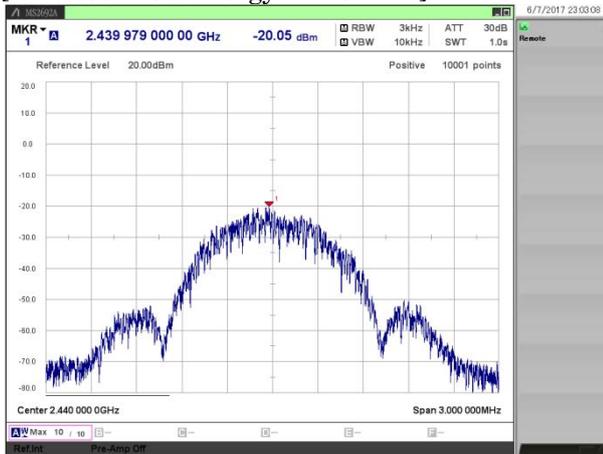
- 1) Ambient temperature : 24.0 deg.C
- 2) Relative humidity : 55.3 %
- 3) Date of measurement : June 07, 2017
- 4) Measured by : M. KOUGA
- 5) Operating mode : Transmitting mode

Mode	Rate [Mbps]	Channel [MHz]	Reading(PK) [dBm]	C.F. [dB]	Result(PK) [dBm]	Limit [dBm]	Margin [dB]
BLE	1	2402	-20.38	10.91	-9.47	≤ 8.0	17.47
		2440	-20.05	10.91	-9.14	≤ 8.0	17.14
		2480	-19.86	10.91	-8.95	≤ 8.0	16.95

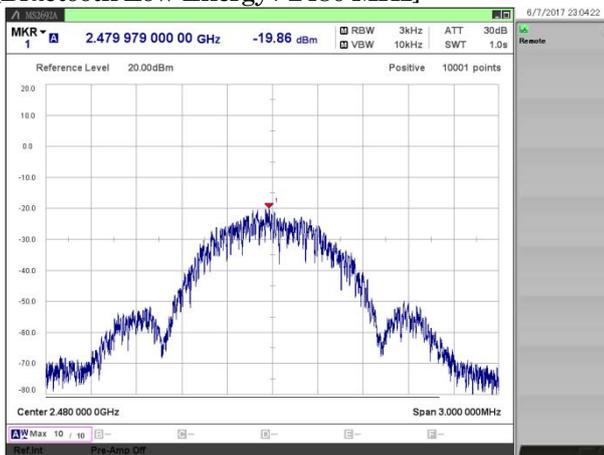
[Bluetooth Low Energy / 2402 MHz]



[Bluetooth Low Energy / 2440 MHz]



[Bluetooth Low Energy / 2480 MHz]



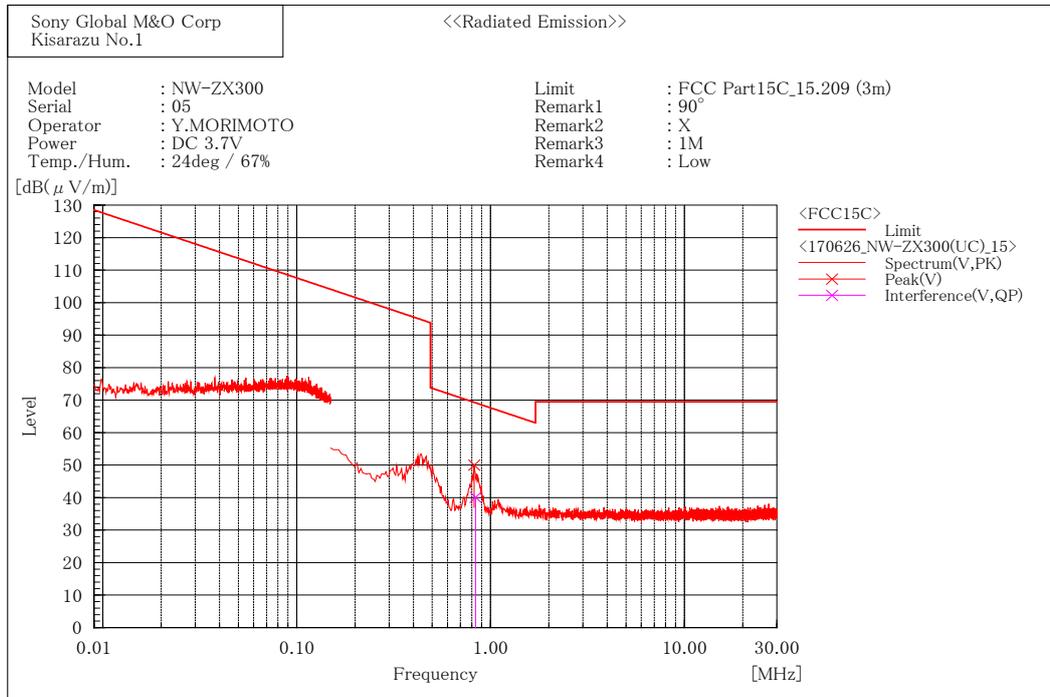
3.5. Radiated Spurious Emissions

1) Date of measurement

9 kHz -30 MHz : June 26, 2017 (all mode)
 30 MHz - 1000 MHz : May 31, 2017 (all mode)
 1 GHz -6 GHz : June 02, 2017 (all mode)
 6 GHz - 18 GHz : June 07, 2017 (all mode)
 18 GHz - 24.835 GHz : June 08, 2017 (all mode)

9 kHz - 30 MHz

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

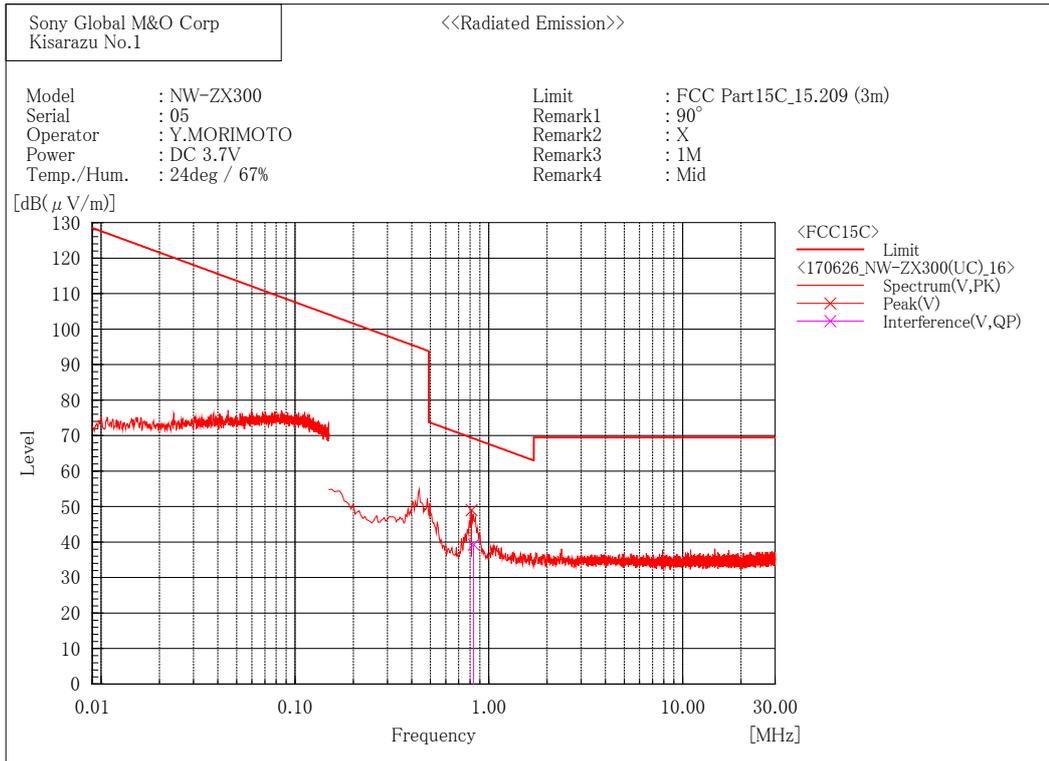


Final Result

--- 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	0.836	20.8	19.4	40.2	69.2	29.0	100.0	128.0

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

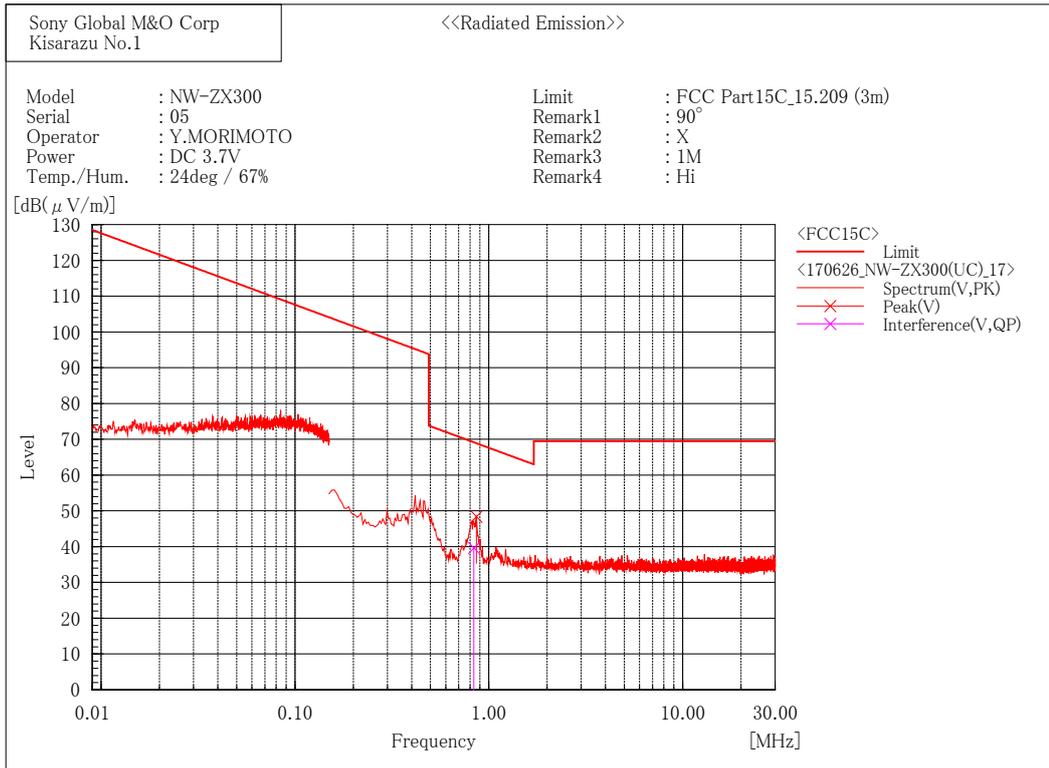


Final Result

--- 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	0.835	19.9	19.4	39.3	69.2	29.9	100.0	136.4

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



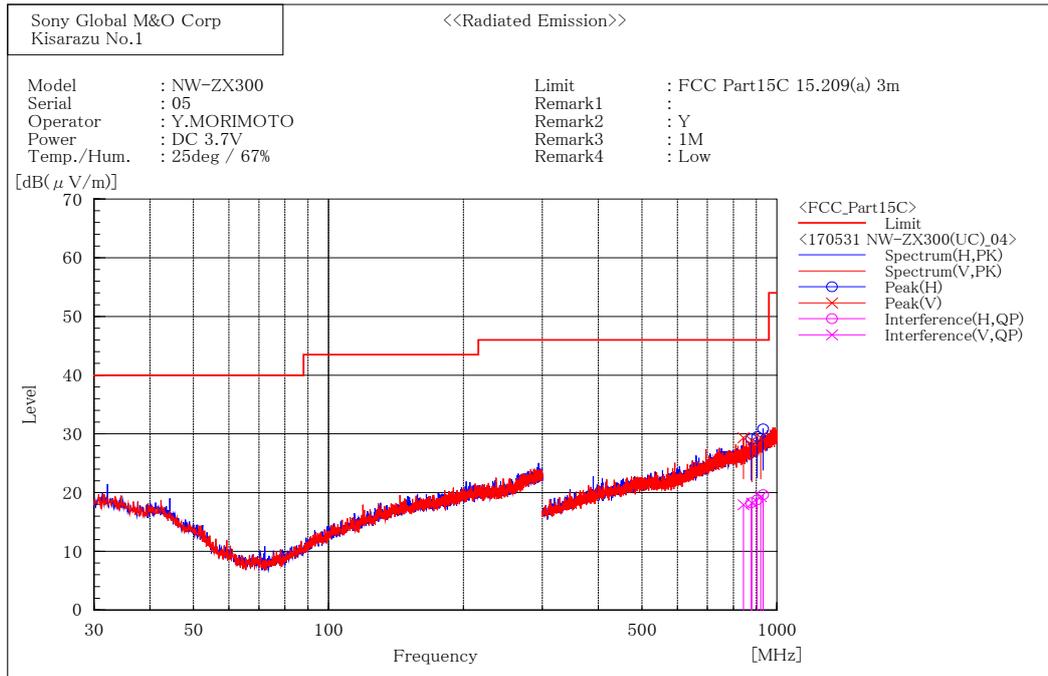
Final Result

--- 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	0.837	20.3	19.4	39.7	69.2	29.5	100.0	129.9

30 MHz - 1000 MHz

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



Final Result

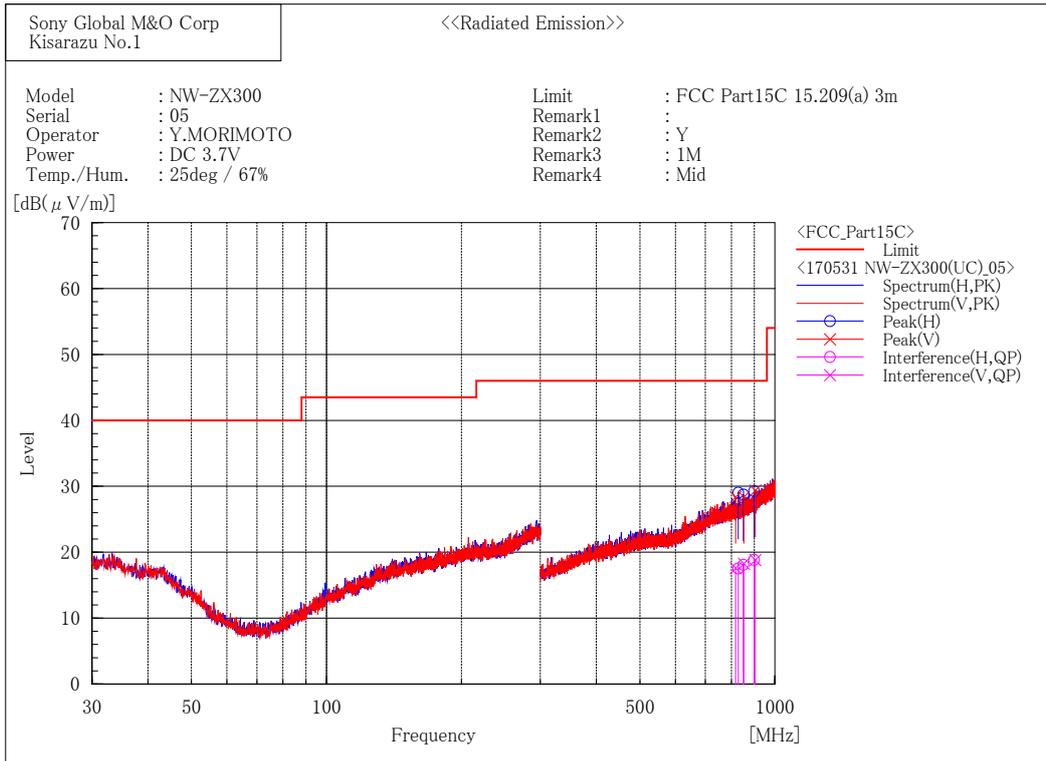
--- Horizontal Polarization (QP)---

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	876.333	19.1	-0.8	18.3	46.0	27.7	257.9	61.6
2	903.867	19.0	-0.2	18.8	46.0	27.2	187.5	10.6
3	932.100	19.0	0.7	19.7	46.0	26.3	360.8	65.3

--- 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	842.733	19.3	-1.4	17.9	46.0	28.1	288.0	270.4
2	879.833	19.1	-0.8	18.3	46.0	27.7	146.7	189.6
3	920.900	19.0	0.3	19.3	46.0	26.7	100.0	281.8

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



Final Result

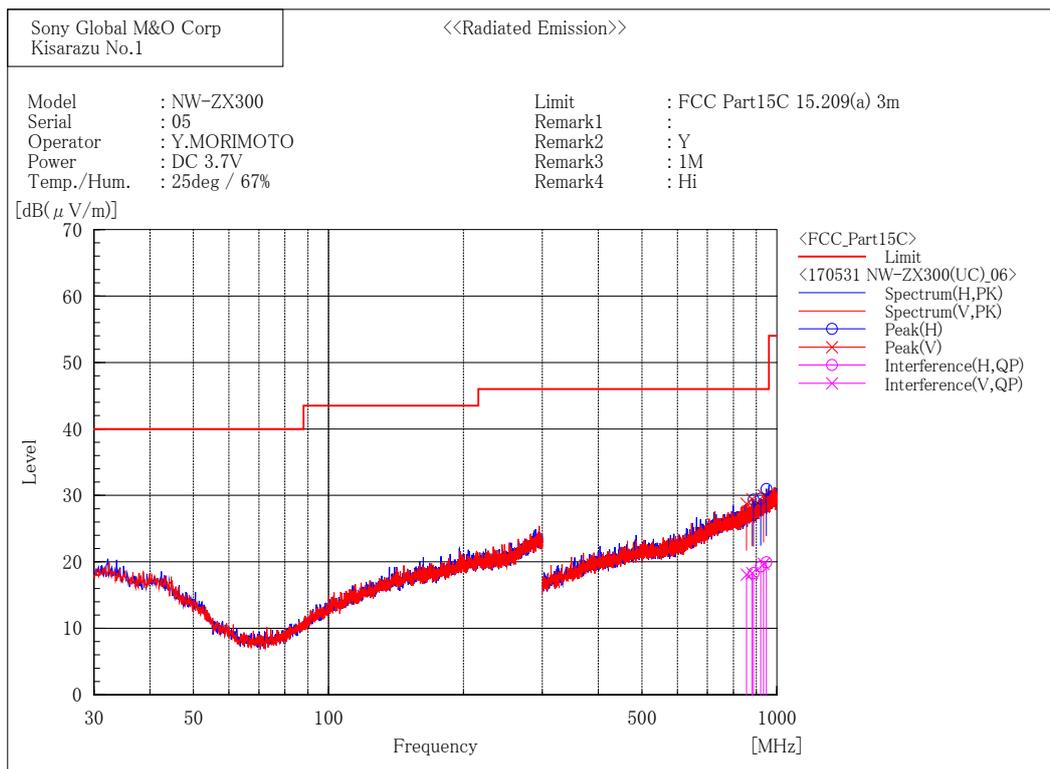
--- Horizontal Polarization (QP)---

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	828.267	19.0	-1.5	17.5	46.0	28.5	237.1	134.9
2	850.433	19.4	-1.3	18.1	46.0	27.9	400.0	68.0
3	898.500	19.1	-0.3	18.8	46.0	27.2	333.9	13.1

--- 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	817.533	19.2	-1.6	17.6	46.0	28.4	210.8	290.1
2	853.000	19.5	-1.2	18.3	46.0	27.7	235.3	343.9
3	904.100	19.0	-0.2	18.8	46.0	27.2	373.0	53.8

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



Final Result

--- Horizontal Polarization (QP)---

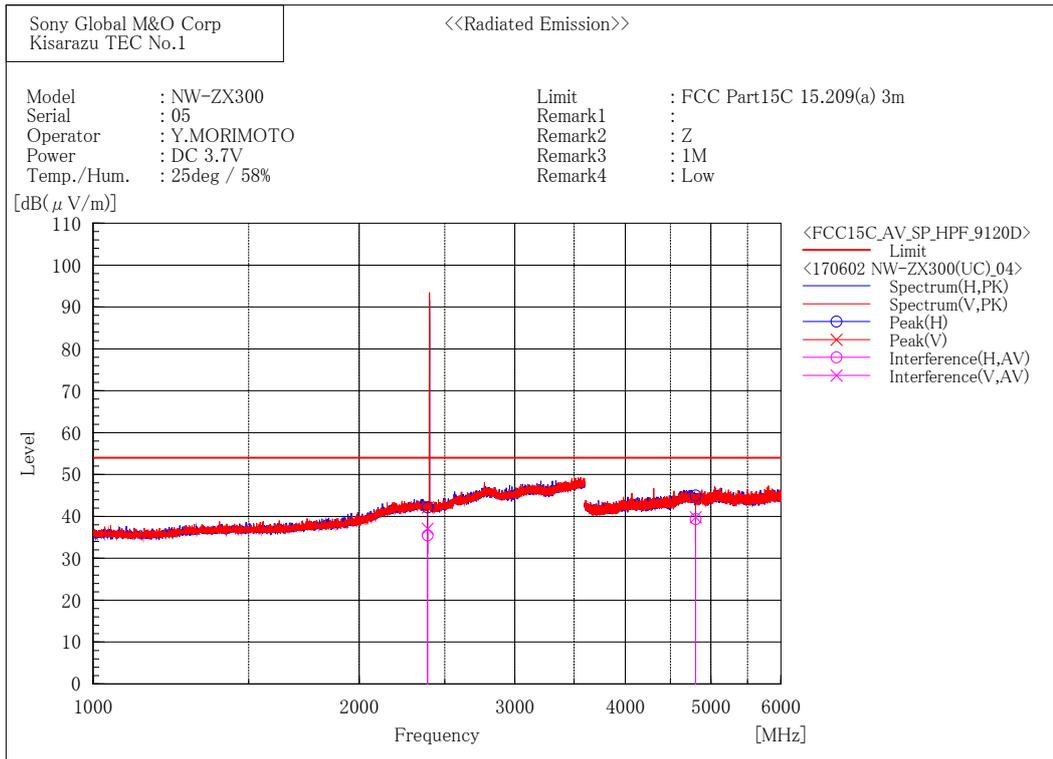
No.	Frequency [MHz]	Reading [dB(μV)]	c. f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	886.600	18.9	-0.6	18.3	46.0	27.7	342.6	310.5
2	920.667	19.0	0.3	19.3	46.0	26.7	147.2	347.2
3	947.967	18.7	1.2	19.9	46.0	26.1	164.2	163.1

--- 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	855.567	19.3	-1.2	18.1	46.0	27.9	278.8	291.3
2	881.233	19.0	-0.7	18.3	46.0	27.7	383.0	136.3
3	933.967	19.0	0.7	19.7	46.0	26.3	119.0	194.9

1GHz - 6 GHz

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



Final Result

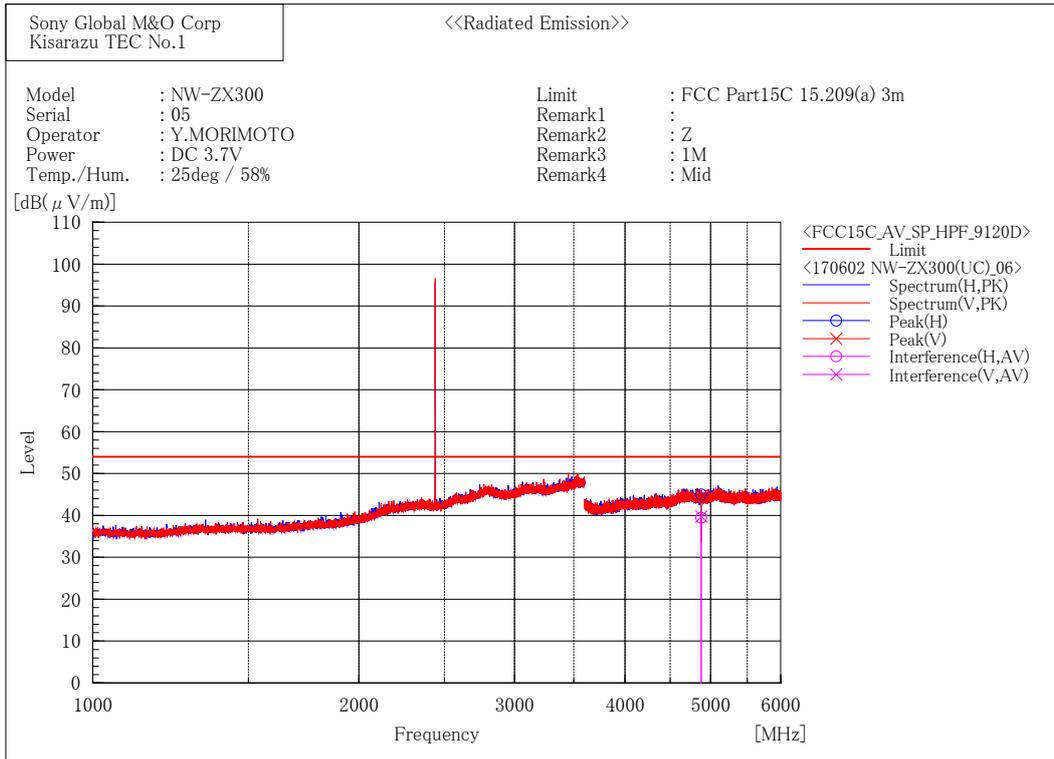
--- Horizontal Polarization (AV) ---

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	2390.000	34.2	1.3	35.5	54.0	18.5	214.2	282.9
2	4803.755	30.1	9.3	39.4	54.0	14.6	400.3	108.2

--- 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	2390.000	35.8	1.3	37.1	54.0	16.9	111.9	90.1
2	4803.656	30.5	9.3	39.8	54.0	14.2	361.3	242.5

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



Final Result

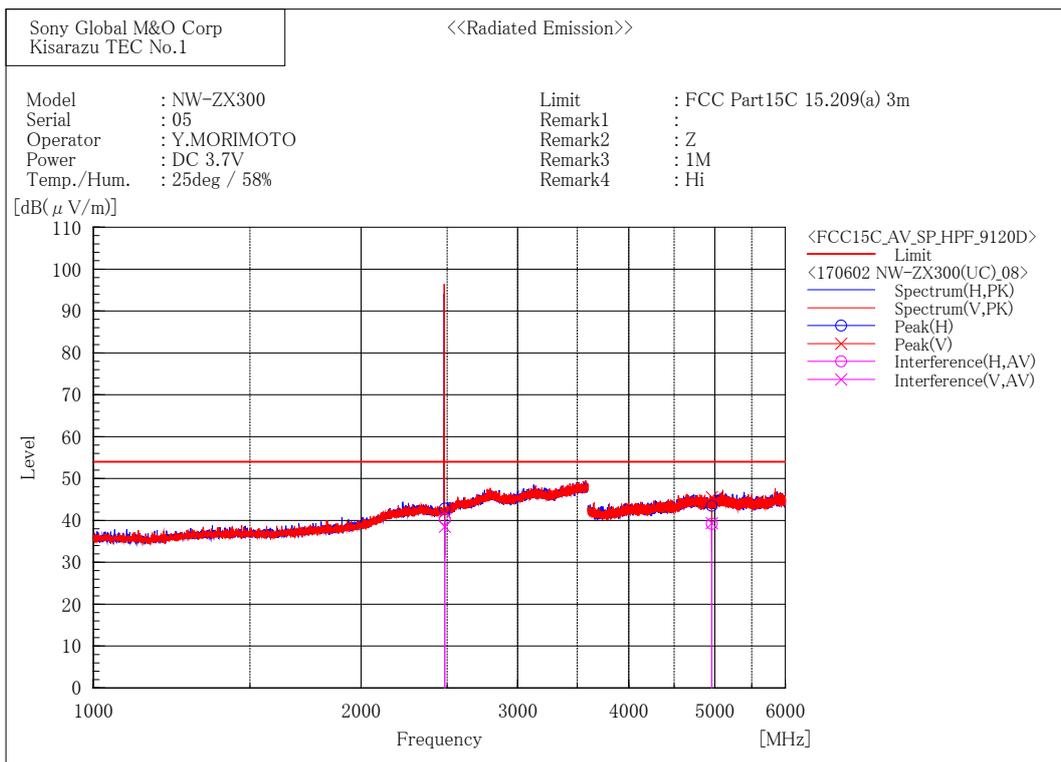
--- Horizontal Polarization (AV)---

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	4879.309	30.1	9.4	39.5	54.0	14.5	100.0	96.7

--- 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	4879.036	30.4	9.4	39.8	54.0	14.2	167.1	228.4

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



Final Result

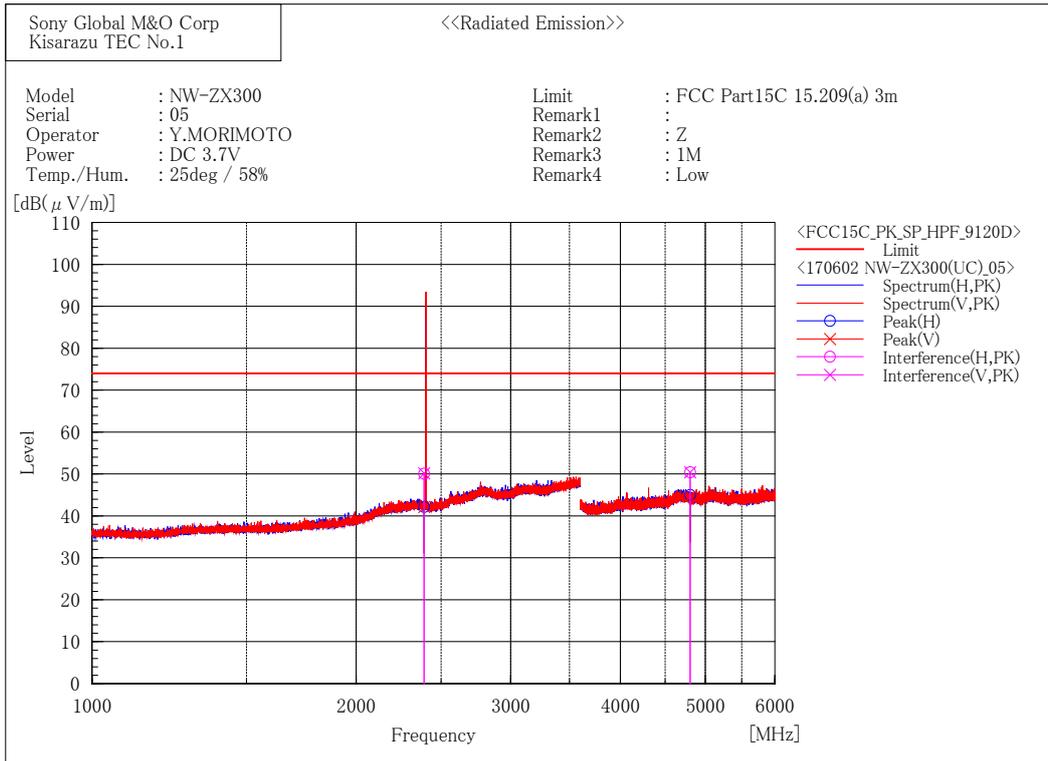
--- Horizontal Polarization (AV) ---

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	2483.500	38.8	1.6	40.4	54.0	13.6	163.4	49.4
2	4959.370	29.7	9.5	39.2	54.0	14.8	225.7	211.2

--- 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	2483.500	36.9	1.6	38.5	54.0	15.5	193.4	174.2
2	4960.029	29.9	9.5	39.4	54.0	14.6	161.4	264.1

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



Final Result

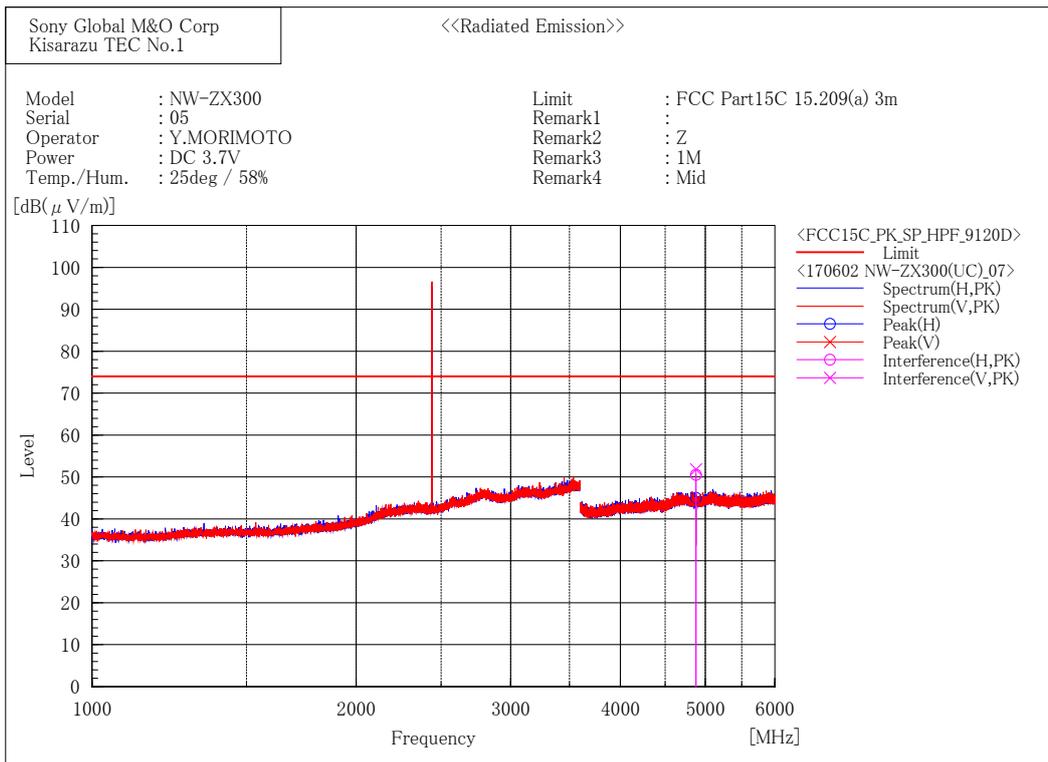
--- Horizontal Polarization (PK)---

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	2390.000	48.8	1.3	50.1	74.0	23.9	214.2	281.0
2	4804.517	41.1	9.3	50.4	74.0	23.6	400.3	108.2

--- 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	2390.000	48.9	1.3	50.2	74.0	23.8	111.9	88.1
2	4803.134	41.1	9.3	50.4	74.0	23.6	361.3	242.3

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



Final Result

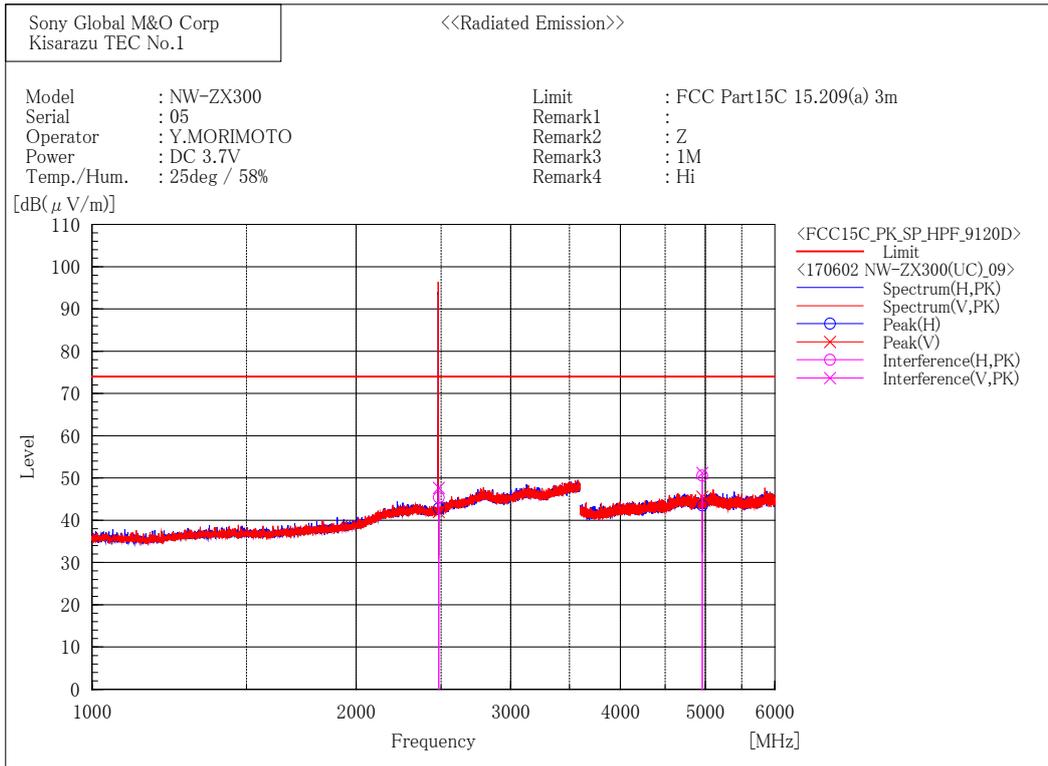
--- Horizontal Polarization (PK)---

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	4877.426	41.1	9.4	50.5	74.0	23.5	100.0	98.8

--- 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	4878.120	42.4	9.4	51.8	74.0	22.2	167.1	228.4

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



Final Result

--- Horizontal Polarization (PK)---

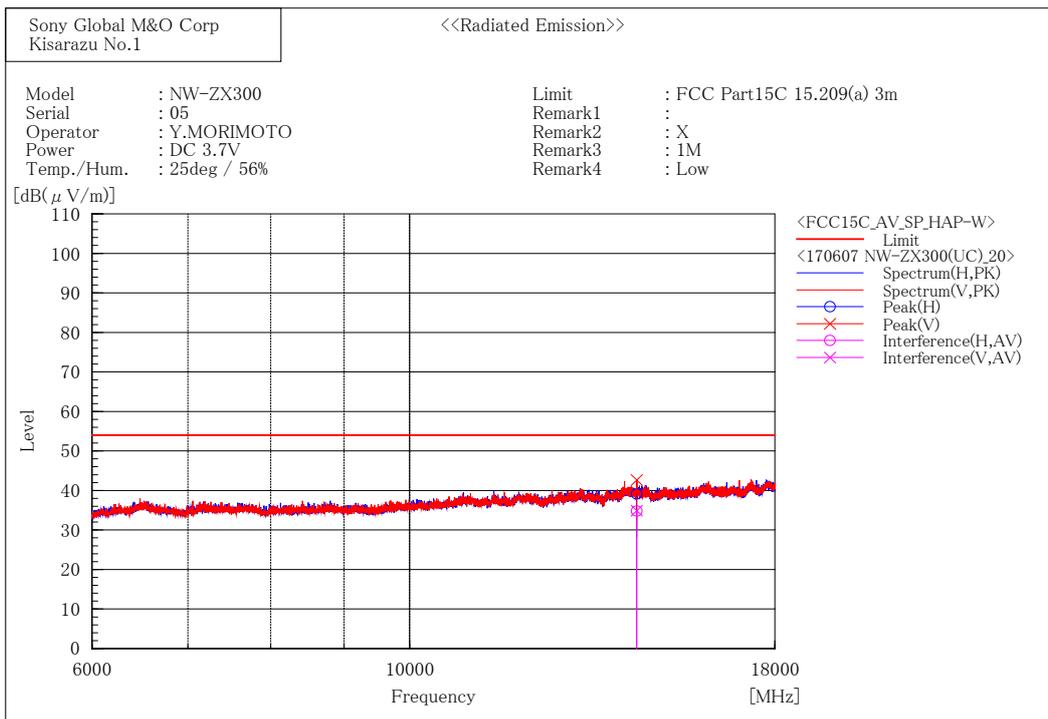
No.	Frequency [MHz]	Reading [dB(μV)]	c. f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	2483.500	43.8	1.6	45.4	74.0	28.6	163.4	51.4
2	4958.701	41.1	9.5	50.6	74.0	23.4	225.7	211.2

--- 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	2483.500	46.1	1.6	47.7	74.0	26.3	193.4	172.2
2	4959.802	41.7	9.5	51.2	74.0	22.8	161.4	262.0

6 GHz - 18 GHz

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



Final Result

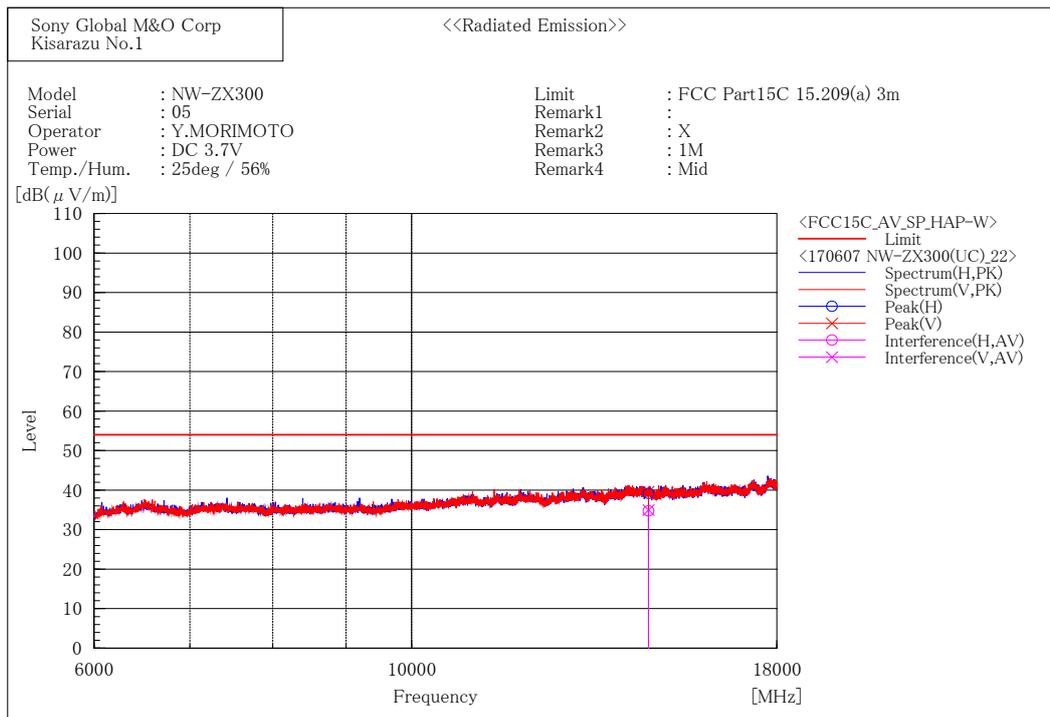
--- Horizontal Polarization (AV)---

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	14414.227	37.2	-2.4	34.8	54.0	19.2	150.4	213.5

--- 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	14414.133	37.3	-2.4	34.9	54.0	19.1	218.3	132.5

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



Final Result

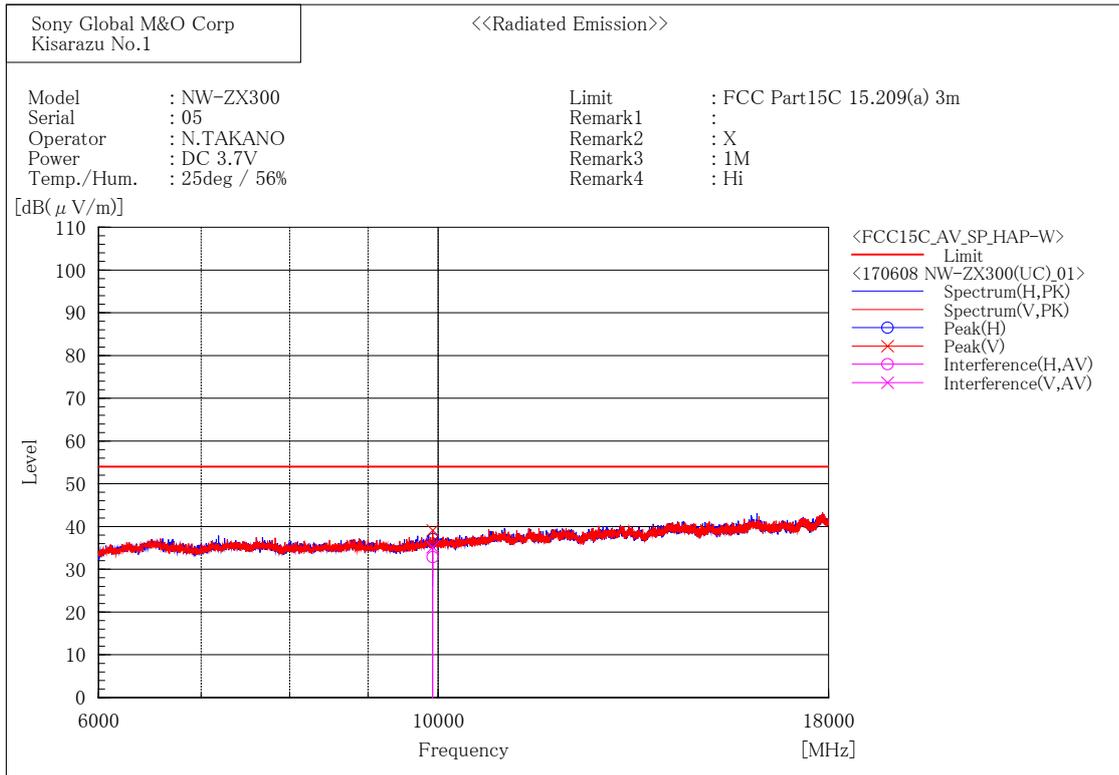
--- Horizontal Polarization (AV)---

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	14640.615	37.3	-2.5	34.8	54.0	19.2	110.5	179.4

--- 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	14640.633	37.5	-2.5	35.0	54.0	19.0	139.4	165.4

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



Final Result

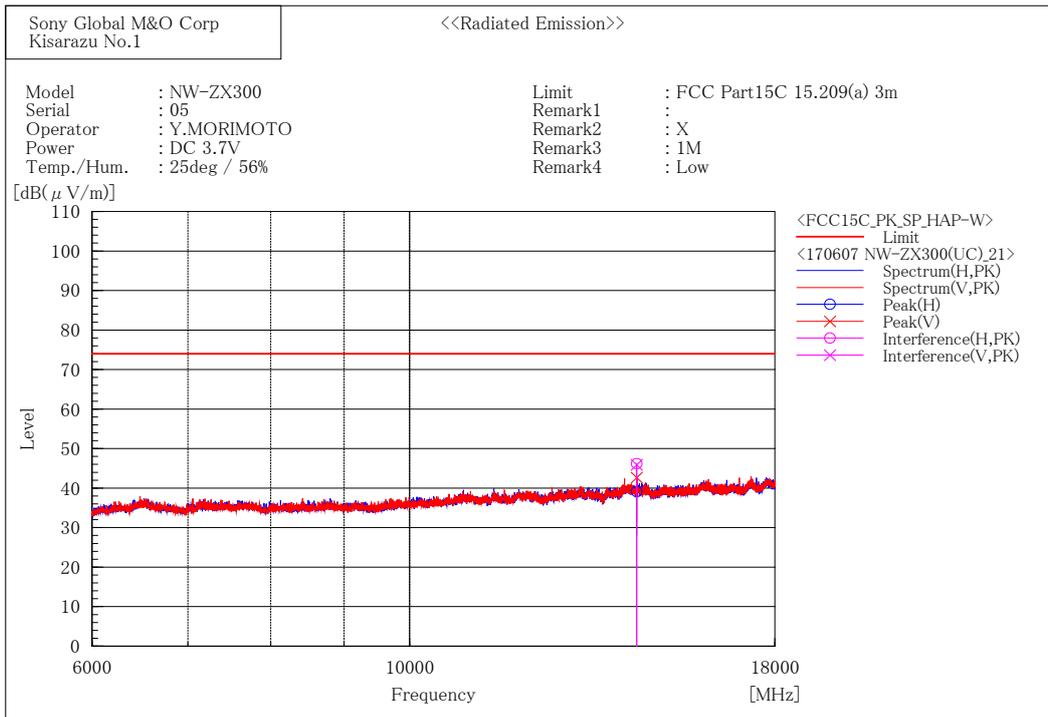
--- Horizontal Polarization (AV)---

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	9920.035	39.6	-6.7	32.9	54.0	21.1	432.0	62.3

--- 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	9920.125	41.9	-6.7	35.2	54.0	18.8	100.0	6.0

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



Final Result

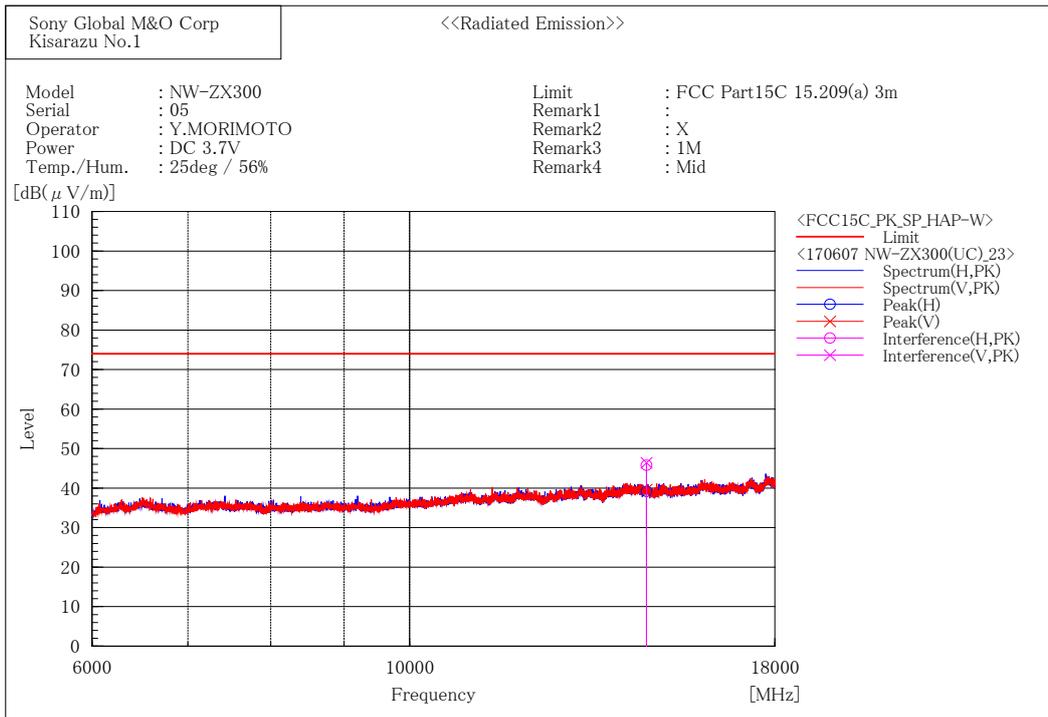
--- Horizontal Polarization (PK)---

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	14413.704	48.6	-2.4	46.2	74.0	27.8	150.4	211.4

--- 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	14414.257	48.3	-2.4	45.9	74.0	28.1	218.3	132.5

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



Final Result

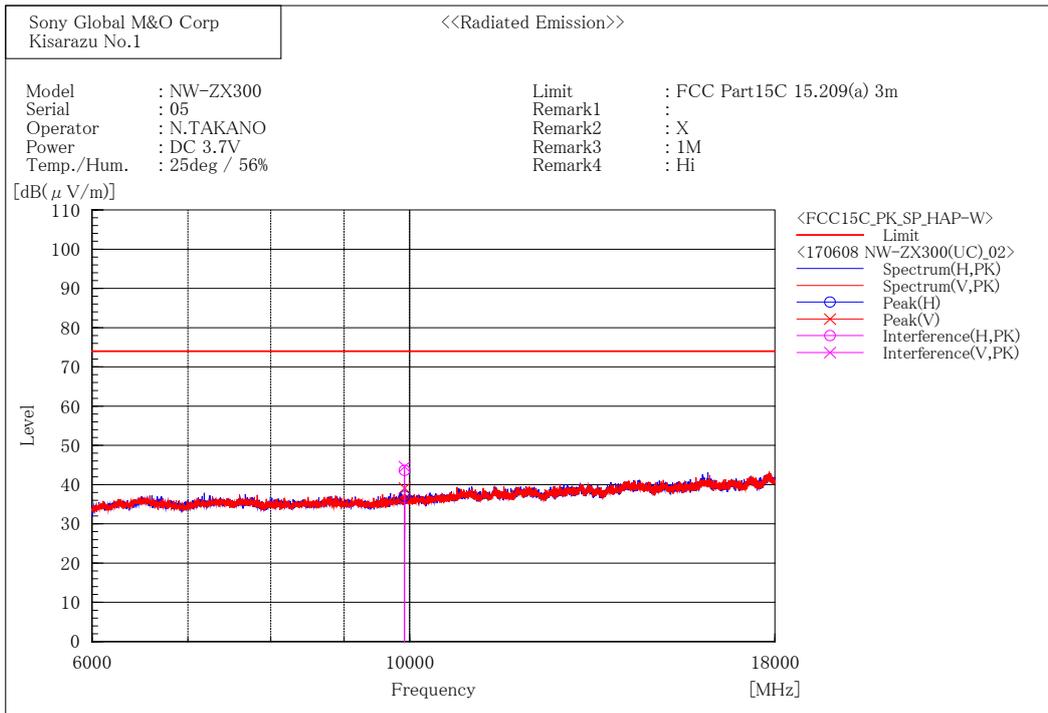
--- Horizontal Polarization (PK)---

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	14640.667	48.3	-2.5	45.8	74.0	28.2	139.4	165.4

--- 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	14640.854	48.9	-2.5	46.4	74.0	27.6	139.4	165.4

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



Final Result

--- Horizontal Polarization (PK)---

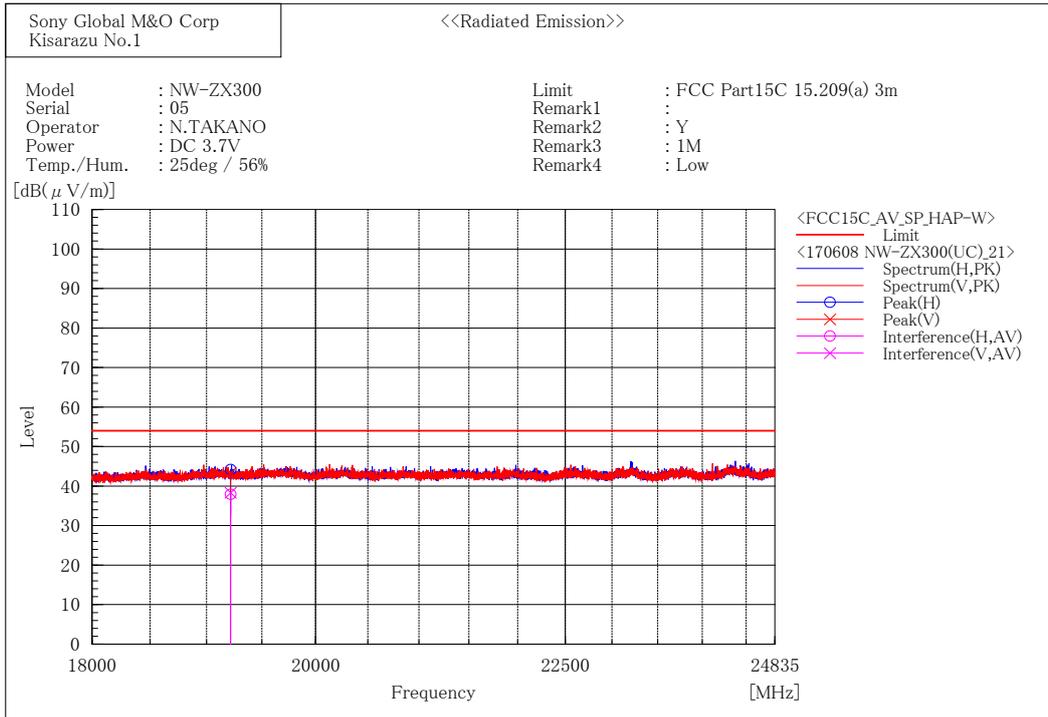
No.	Frequency [MHz]	Reading [dB(μV)]	c. f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	9920.205	50.4	-6.7	43.7	74.0	30.3	432.0	62.3

--- 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	9919.832	51.3	-6.7	44.6	74.0	29.4	100.0	7.9

18 GHz - 24.835 GHz

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



Final Result

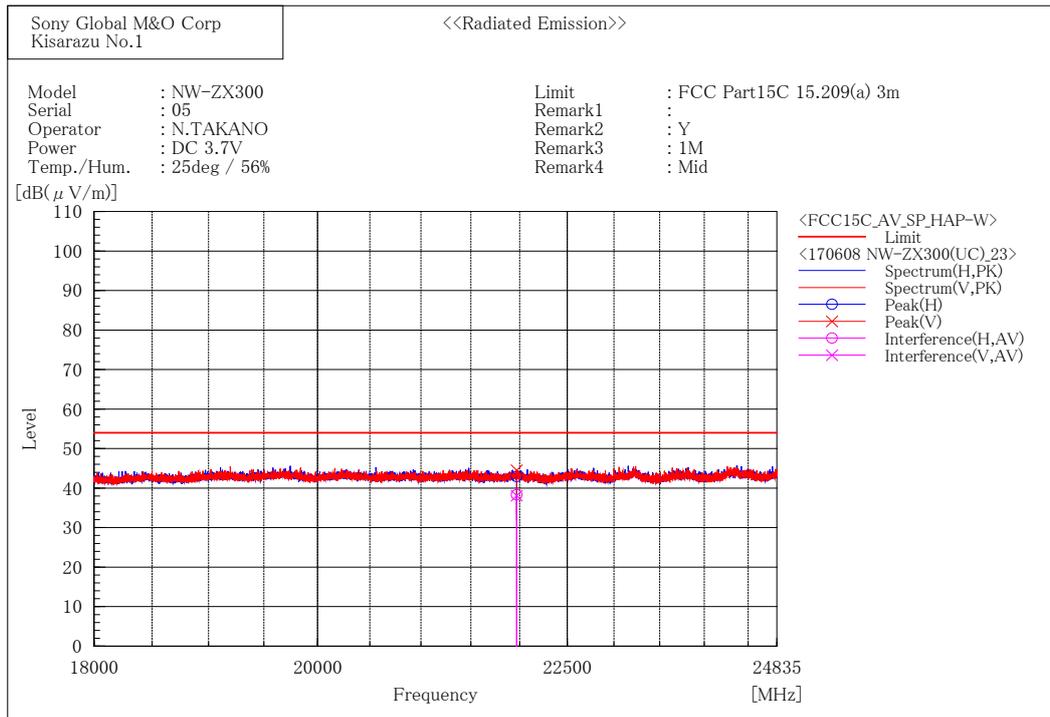
--- Horizontal Polarization (AV)---

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	19215.244	34.5	3.5	38.0	54.0	16.0	103.5	187.9

--- 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	19216.466	34.8	3.5	38.3	54.0	15.7	212.7	184.8

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



Final Result

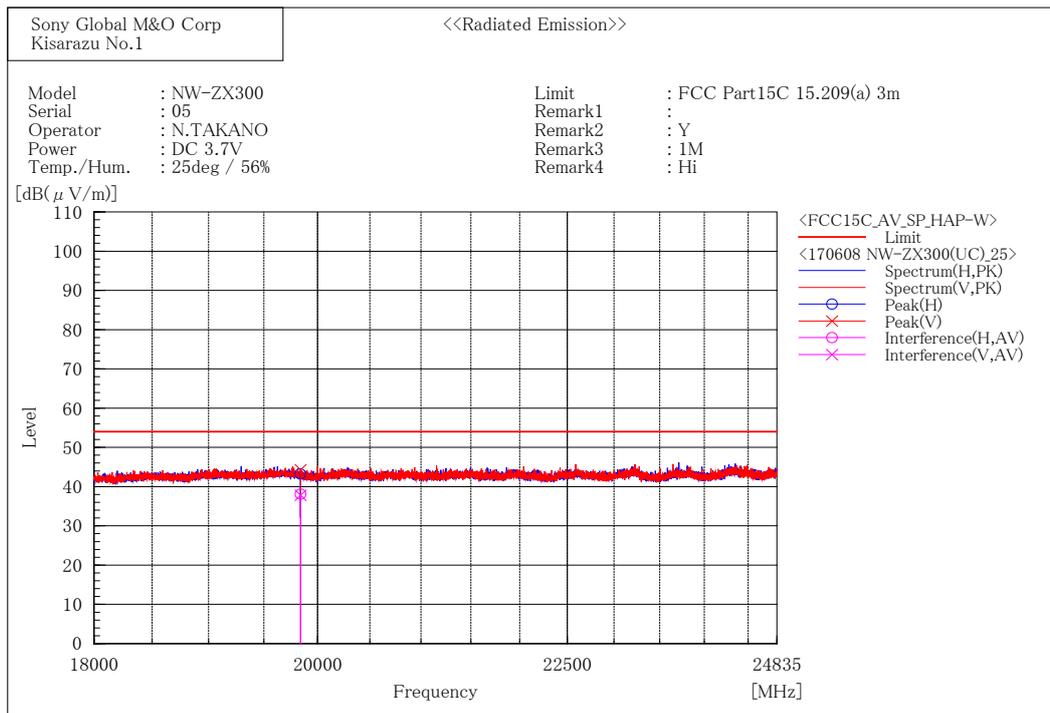
--- Horizontal Polarization (AV)---

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	21967.550	35.4	2.9	38.3	54.0	15.7	199.3	166.0

--- 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	21968.898	35.2	2.9	38.1	54.0	15.9	375.2	193.3

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



Final Result

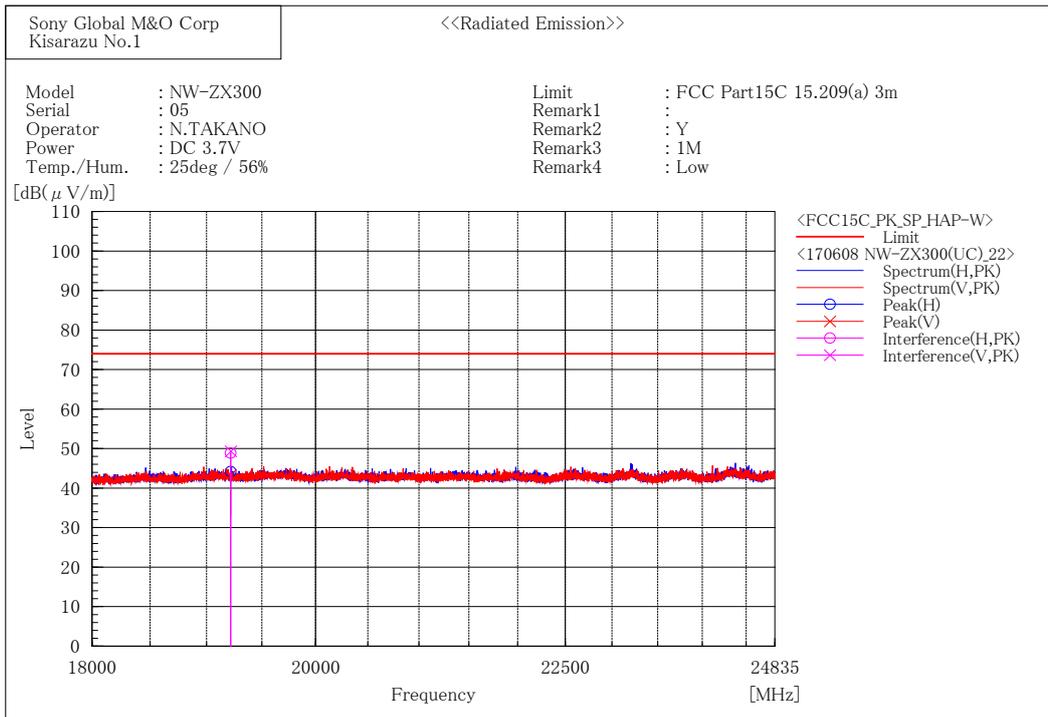
--- Horizontal Polarization (AV)---

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	19840.294	34.5	3.6	38.1	54.0	15.9	381.6	39.5

--- 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	19839.512	34.2	3.6	37.8	54.0	16.2	100.0	39.5

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



Final Result

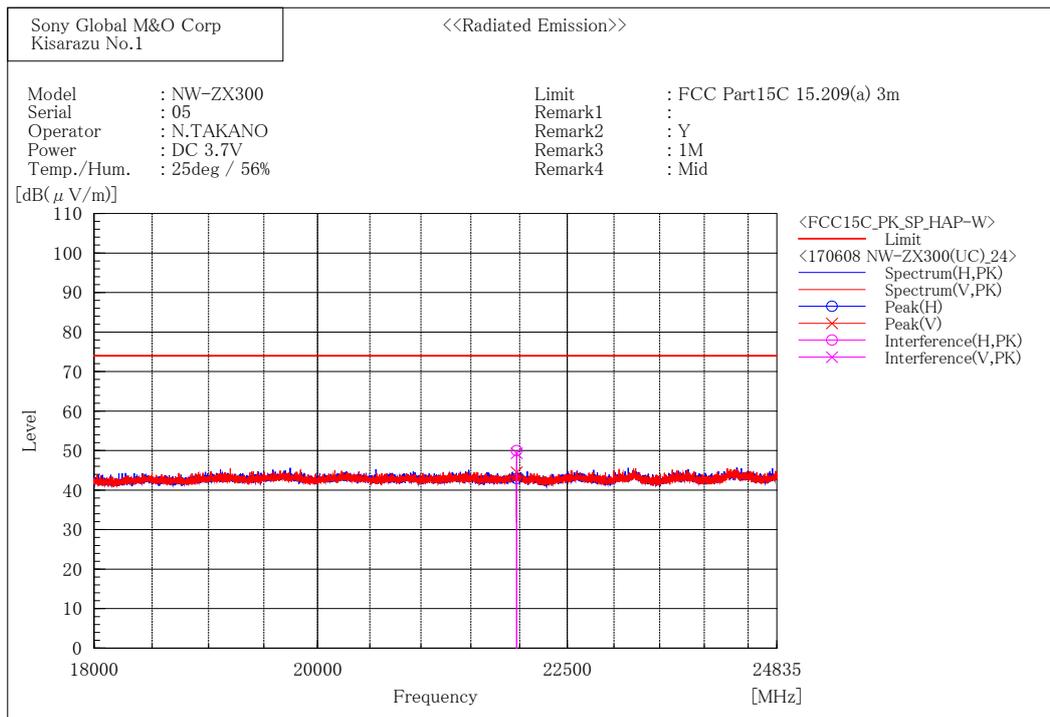
--- Horizontal Polarization (PK)---

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	19215.410	45.4	3.5	48.9	74.0	25.1	103.5	187.9

--- 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	19217.242	45.8	3.5	49.3	74.0	24.7	212.7	186.1

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



Final Result

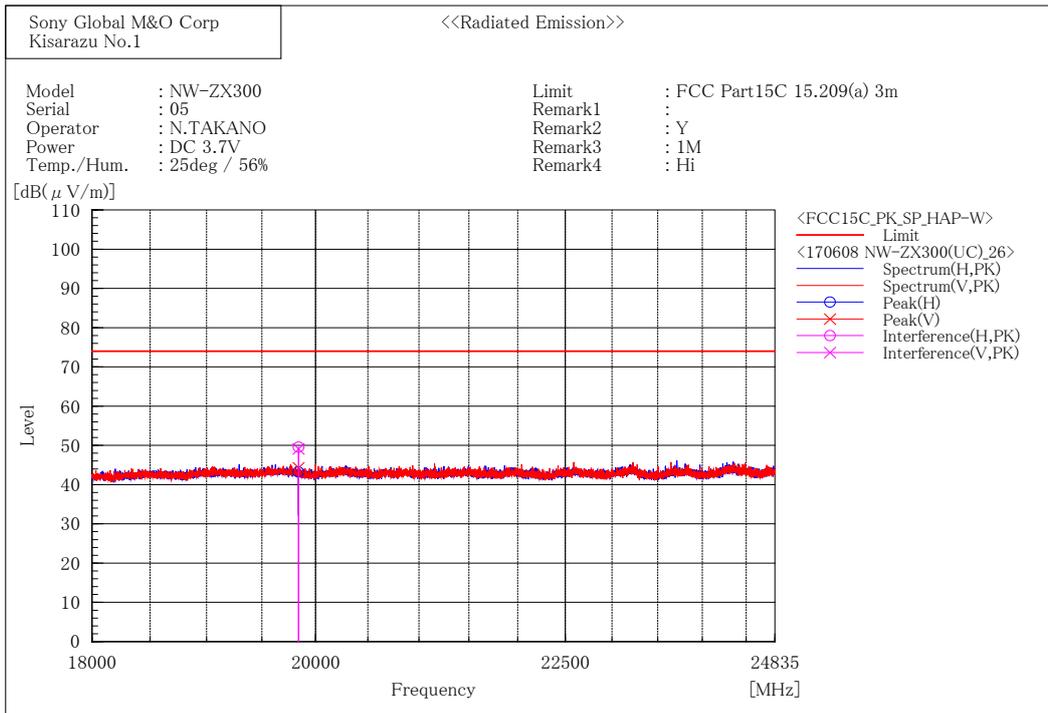
--- Horizontal Polarization (PK)---

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	21967.650	47.1	2.9	50.0	74.0	24.0	199.3	166.0

--- 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	21968.196	46.4	2.9	49.3	74.0	24.7	375.2	191.3

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



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	19840.368	46.0	3.6	49.6	74.0	24.4	381.6	39.5

--- Vertical Polarization (PK)---

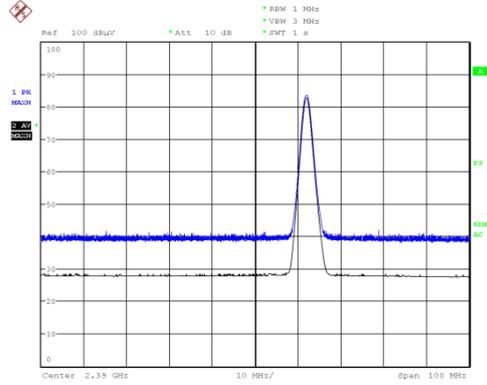
No.	Frequency [MHz]	Reading [dB(μV)]	c. f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	19840.038	45.5	3.6	49.1	74.0	24.9	100.0	39.5

2.4GHz Restricted-Band Edge (Plot data)

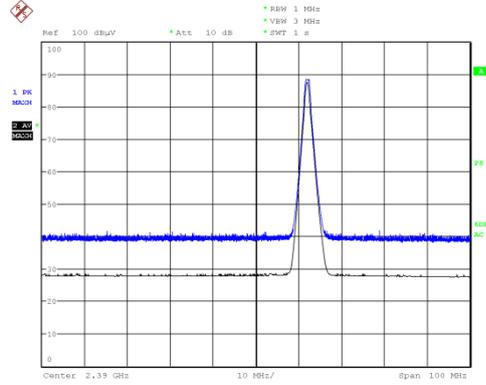
These plot data show peak (trace blue) and average (trace black) spectrum for worst case emissions in the restricted-band edges. (Restricted band edges: below 2390 MHz and above 2483.5 MHz)
The result of the final radiated emissions measurement refers in previous pages.

[Bluetooth Low Energy / 2402 MHz]

Horizontal



Vertical

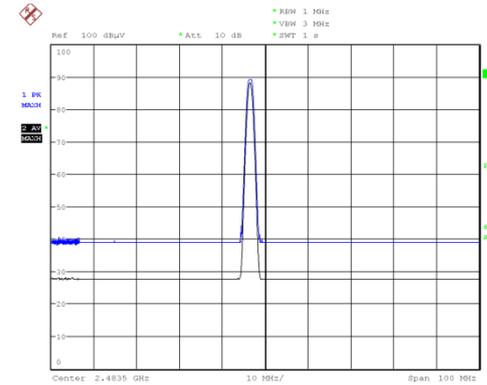


Date: 2.JUN.2017 17:13:12

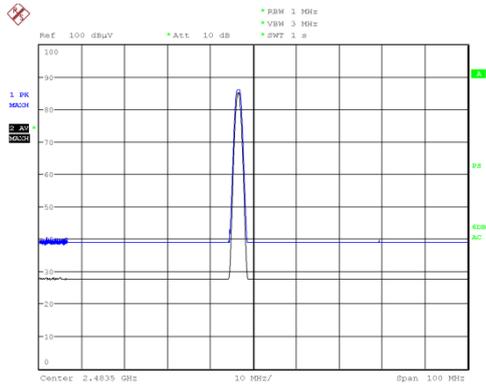
Date: 2.JUN.2017 17:08:14

[Bluetooth Low Energy / 2480 MHz]

Horizontal



Vertical



Date: 2.JUN.2017 21:44:05

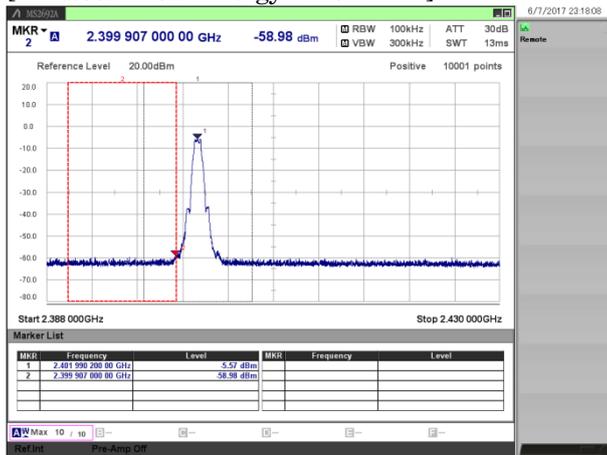
Date: 2.JUN.2017 21:40:19

3.6. Conducted Spurious Emissions for Band Edge

- 1) Ambient temperature : 24.0 deg.C
- 2) Relative humidity : 55.3 %
- 3) Date of measurement : June 07, 2017
- 4) Measured by : M. KOUGA
- 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	2399.91	-58.98	10.91	-48.07	-14.7	33.41
			2401.99	-5.57	10.91	5.34	-	-

[Bluetooth Low Energy / 2402 MHz]



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. 1.3

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

$$\text{Duty Cycle [\%]} = \text{Tx ON Time} / (\text{Tx ON Time} + \text{Tx OFF Time}) * 100$$

Notes :

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

4.3. Power Density Measurement

Method of calculation : Software
 The Software for Calculation Name : SW-316
 Version : Ver.1.3

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

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. 1.3

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

Notes :

- (a) Meter Reading : Reading of the spectrum analyzer.
(b) C.F. : System Cable Loss + 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 1

	Ctrl#	Equipment	Model No.	Serial No.	Manufacturer	Cal.Int.	Last Cal.
x	-	Shield Room	-	-	TDK	-	N/A
x	M515	EMI Receiver	ESCI	100606	Rohde & Schwarz	12	16.08.04
x	CS043	4th Site CE Cable SYSTEM	-	-	EMC/RF Test Lab.	12	17.01.16
x	M664	6dB Attenuator	6806.01A	N/A	HUBER+SUHNER AG	12	17.01.16
x	M619	HIGH FREQUENCY FUSE	MP612A	N/A	Anritsu	12	17.01.16
-	M026	LISN	KNW-407	8-541-1	Kyoritsu	12	17.02.16
-	M116	LISN	KNW-242	8-888-6	Kyoritsu	12	16.07.16
-	M505	LISN	ENV216	100425	Rohde & Schwarz	12	17.06.19
x	M514	LISN (for EUT)	ENV216	100424	Rohde & Schwarz	12	17.05.09
-	M833	AMN	ENV216	100293	Rohde & Schwarz	12	17.01.11
-	M152	50 ohm Terminator	CT-01	N/A	TME	12	17.01.15
-	M153	50 ohm Terminator	CT-01	N/A	TME	12	17.06.19
-	M159	50 ohm Terminator	T1302	N/A	Stack	12	16.07.16
-	M165	50 ohm Terminator	T1302	N/A	Stack	12	17.02.16
x	M690	Thermo Meter	AD-5640A	201304	A&D	12	16.11.07

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	-	N/A
x	W100	Spectrum Analyzer	MS2692A	6201338954	Anritsu	12	17.04.14
x	W006	Power Meter	N1911A	MY50000295	Keysight Technologies	12	16.10.03
x	W007	Power Sensor	N1922A	MY50180022	Keysight Technologies	12	16.10.03
x	W029	10dB Attenuator	8493C	76549	Keysight Technologies	12	16.08.01
x	WC05	RF Cable	SUCOFLEX 102	34287	HUBER + SUHNER	12	16.11.04
x	M720	Thermometer	TH-321	140044	AS ONE	12	17.06.09
x	M719	Thermometer	TH-321	140053	AS ONE	12	17.04.28

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	17.05.13
x	M686	EMI Receiver	N9038A	MY52260113	Keysight Technologies	12	16.12.08
-	M959	EMI Receiver	ESU40	100041	Rohde & Schwarz	12	16.11.01
x	A073	Loop Antenna	HFH2-Z2	100171	Rohde & Schwarz	12	16.10.04
x	A089	Biconical Antenna	BBA9106	VHA91032835	Schwarzbeck	12	17.01.15
x	A088	Log periodic Antenna	UHALP9108A1	0643	Schwarzbeck	12	17.01.15
x	A064	Horn Antenna	BBHA9120D	746	Schwarzbeck	12	17.01.14
x	A078	Horn Antenna	HAP06-18W	00000070	TOYO Corporation	12	17.02.20
x	A058	Horn Antenna	HAP18-26W	00000016	TOYO Corporation	12	17.02.13
x	CS017	N-RE Cable SYSTEM 1	-	-	EMC/RF Test Lab.	12	17.01.13
x	CS018	N-RE Cable SYSTEM 2	-	-	EMC/RF Test Lab.	12	17.01.13
x	CS045	N-3m EMF Cable SYSTEM	-	-	EMC/RF Test Lab.	12	17.01.13
x	CS074/075	N-RE Cable SYSTEM 4	-	-	EMC/RF Test Lab.	12	17.01.13
x	M126	Step Attenuator	8494H	3837M01144	Keysight Technologies	12	17.01.13
x	M752	Pre Amplifier	310N	320621	SONOMA INSTRUMENT	12	17.01.13
x	M128	Attenuator (3dB)	8491A	53541	Keysight Technologies	12	17.01.13
x	M609	Attenuator (3dB)	8491B	MY39265960	Keysight Technologies	12	17.01.13
x	M737	GHz Filter Box	FB-G1	001	Sony Global M&O	12	17.01.13
x	M687	Thermo Meter	AD-5640A	201301	A&D	12	16.10.06
x	M486	EMI Receiver	ESU40	100050	Rohde & Schwarz	12	17.05.15

About calibration interval

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