

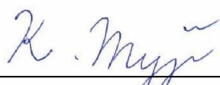


TEST REPORT

Issued: January 21, 2016

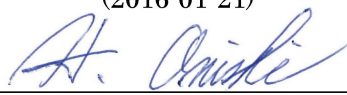
Name and Address of the Customer:	USHIO INC. 6409 Moto-Ishikawa-cho, Aoba-ku, Yokohama-shi, Kanagawa 225-0004
Test Item:	PiCOEXPLORER
Identification:	PAS-110
Serial No.:	1508013, 1508047
FCC ID:	2AF33USHIO-PAS
IC Certification Number:	20775-USHIOPAS
Sample No.:	1
Sample Receipt Date:	October 26, 2015
Test Specification:	47 CFR Part 15 Subpart C RSS-Gen Issue 4, RSS-247 Issue 1
Period of Testing:	November 16, 2015 – January 12, 2016
Test Result:	PASS

Representative
Test Personnel:


(2016-01-21)

K. Miyaji (EMC Dept.)
iNARTE : EMC-003627-NE

Reviewed by:


(2016-01-21)

H. Onishi (EMC Dept.)
iNARTE : EMC-003318-NT

Other Aspects:

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

Note:

This Test Report should not be reproduced except in full, without the written approval of Cosmos Corporation.
The test result of this Test Report is based on the tests made for sample provided, and it is not applicable to individual product identical to the sample or similar product.
The judgment of this test report validates the test item only specified in "4. Summary of Test Results".



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1. General Information

1.1 Test Methodology

All measurement subject to the present test report is carried out according to the procedures in ANSI C63.10-2013.

1.2 Test Facility

The measurement was carried out at the following facility.

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

- ☒ Semi anechoic Chamber 3 m (COAC3M-01)
- ☒ Shielded Room (COSR-01)
- ☒ Measurement Room

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

Accreditation: A2LA Accredited Laboratory No. 2900.01
VLAC Accredited Laboratory No. VLAC-039-2
FCC Designation No. JP5182

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

1.3 Traceability

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



2. Description of the Tested Sample

2.1 Product Description

Manufacturer	USHIO INC.
Model (referred to as the EUT)	PAS-110
Hardware Version	A
Software Version	1.0.0 1.0.1 (the special test mode for compliance test)
Type of the Equipment	☐ Stand-alone ☒ Combined Equipment ☐ Plug-in Radio Device ☐ Other ()
Transmitter Type	☐ WLAN ☒ Bluetooth (Low Energy) ☐ ZigBee ☐ RFID ☐ Other ()
Nominal Voltage	DC 4.5 V (Battery) / 5 V (DC-powered)
Type of Modulation	FHSS (GFSK)
Emission Designator	1M16F1D
Antenna Type	☒ Integral Antenna ☐ Dedicated External Antenna
Operating Frequency	2402 MHz to 2480 MHz
Type of Power Source	☐ AC Mains ☐ Dedicated AC Adaptor ☒ DC Voltage ☒ Battery
Type of Battery (if applicable)	Dry-Cell Battery (AAA Type)
Thermal Limitation	5°C to 35°C

2.2 Antenna Description

Model	Gain	Antenna Type	Remarks
Un-specified *	2.41 dBi	Print Pattern Antenna	---

Note:

*: The antenna does not have model name, because the antenna is a part of RF Module.

Module Model: TM41B1412



2.3 EUT Description

Equipment under test is as follow:

Instrument	Model	Serial No.	Rating
PiCOEXPLORER (EUT1)	PAS-110	1508013 * ¹	DC 4.5 V (Battery) DC 5 V (DC-powered) MAX. 1 A
PiCOEXPLORER (EUT2)	PAS-110	1508047 * ²	DC 4.5 V (Battery) DC 5 V (DC-powered) MAX. 1 A

Note:

*¹: This equipment was used during the following tests;

6 dB Bandwidth, Maximum Peak Conducted Output Power and E.I.R.P.,
Conducted Spurious Emission, Power Spectral Density and Occupied Bandwidth.

*²: This equipment was used during the following tests;

AC Power Line Conducted Emission, Transmitter Spurious Emissions (Radiated),
Band Edge Measurement and Receiver Spurious Emissions (Radiated).



3. Test Condition (Manufacturer's Specification)

3.1 Mode of Operation

Mode of operation : Bluetooth LE Operating

Note:

The EUT makes communication emission with the maximum RF power by a special test program. The test of Maximum Peak Conducted Output Power and E.I.R.P. was performed under the following condition:

Voltage: Nominal DC Voltage $\pm 15\%$

3.2 Additional Equipment

The equipment was tested together with additional peripherals.
The following peripherals were used during the tests:

Instrument	Model	Serial No.	Manufacturer	FCC ID
Personal Computer	PP17L	CN-0N8719-48643-57F-1500	DELL	DoC
AC Adapter	HP-OQ065B83	CN-0N2765-47890-47D-8266	DELL	DoC
USB Mouse	M-BJ58	LNA30910367	Logitec	DoC
Access Point	FXA2000-G	CJRKL77000593	CONTEC	PQRFXA2000-G
AC Adapter	SA115B-05U	0613C	SINO-AMERICAN	DoC

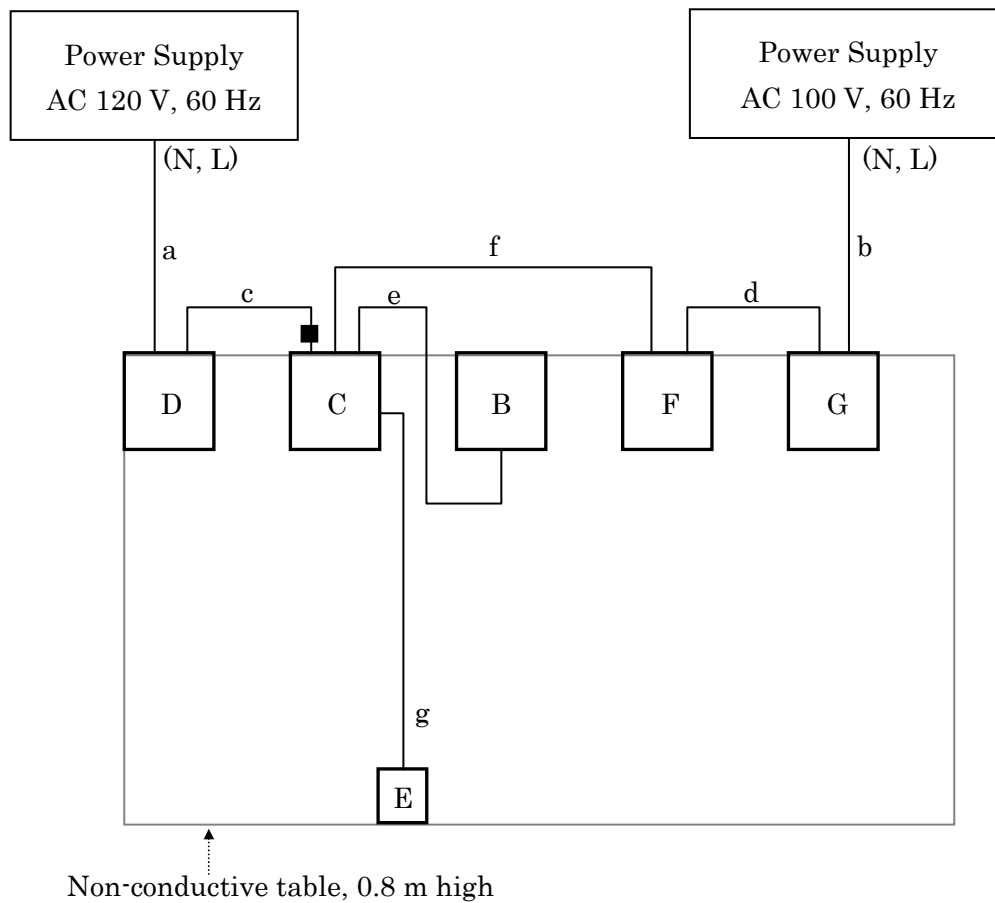


3.3 Configuration

	Instrument	Model		Cable	Length	Shield
A	EUT 1 (PiCOEXPLORER)	PAS-110 (S/N:1508013)	a	AC Power Cord	0.9 m	×
			b	AC Power Cord	1.8 m	×
B	EUT 2 (PiCOEXPLORER)	PAS-110 (S/N:1508047)	c	DC Power Cord	1.9 m	○
			d	DC Power Cord	1.9 m	×
C	Personal Computer	PP17L	e	USB Cable	0.9 m	○
D	AC Adapter	HP-OQ065B83	f	LAN Cable	2.0 m	×
E	USB Mouse	M-BJ58	g	USB Mouse Cable	1.8 m	○
F	Access Point	FXA2000-G				
G	AC Adapter	SA115B-05U				

3.3 Configuration (Continued)

AC Power Line Conducted Emission



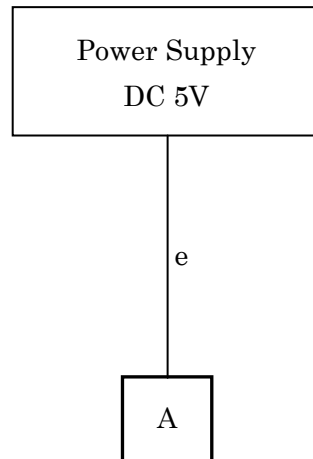
Excess cable arrangement

AC Power Line Conducted Emission

Symbol	Length	Position	Setting
b	0.3 m	Center	Bundle
c, d, f	0.4 m	Center	Bundle and Hung
g	0.4 m	Center	Bundle

3.3 Configuration (Continued)

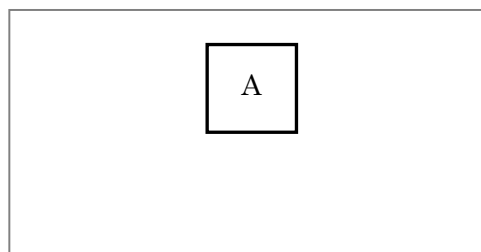
6 dB Bandwidth / Maximum Peak Conducted Output Power and E.I.R.P. (DC-powered)
Conducted Spurious Emission / Power Spectral Density / Occupied Bandwidth



Maximum Peak Conducted Output Power and E.I.R.P. (Battery-powered)

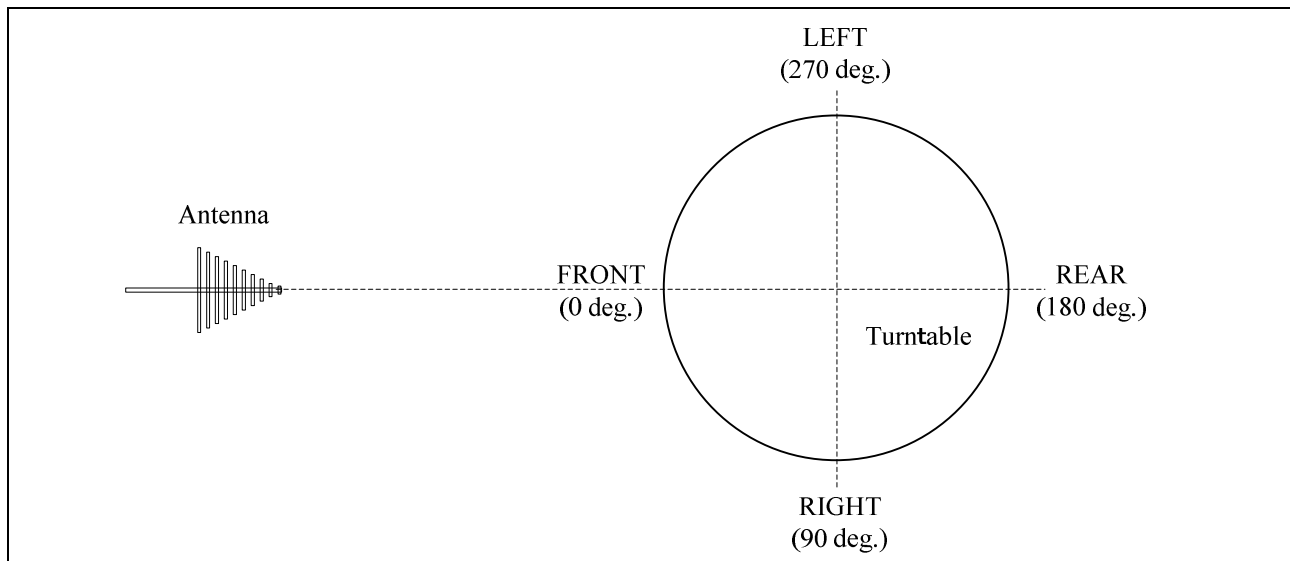


Transmitter Spurious Emissions (Radiated) / Band Edge Measurement
Receiver Spurious Emissions (Radiated)



Non-conductive table, 0.8 m high

3.4 EUT Angle



4. Summary of Test Results

These test results are the test results of the condition specified with “3. Test Condition”.

FCC Section	IC Section	Test Item	FCC Result	IC Result
15.207	RSS-Gen 8.8	AC Power Line Conducted Emission	PASS	PASS
15.209	RSS-Gen 8.9	Transmitter Spurious Emissions (Radiated)	PASS	PASS
15.247(a)	RSS-247 5.2(1)	6 dB Bandwidth	PASS	PASS
15.247(b)	RSS-247 5.4	Maximum Peak Conducted Output Power and E.I.R.P.	PASS	PASS
15.247(d)	RSS-247	Conducted Spurious Emission	PASS	PASS
15.247(d)	---	Band Edge Measurement	PASS	---
15.247(e)	RSS-247 5.2(2)	Power Spectral Density	PASS	PASS
---	RSS-Gen Annex A	Occupied Bandwidth	---	PASS
---	RSS-Gen 7.1	Receiver Spurious Emissions (Radiated)	---	PASS



5. Test Result

5.1 AC Power Line Conducted Emission (15.207, RSS-Gen 8.8)

Result: **PASS**

5.1.1 Setting Remarks

The conducted disturbance voltage of AC power line in the frequency range from 150 kHz to 30 MHz was measured in accordance with ANSI C63.10-2013.

The test setup was made in accordance with ANSI C63.10-2013 on the table installed in a shielded room. The non-conductive table, 0.8 m high, was placed on the reference ground plane, and the EUT was put on the non-conductive table. The used Line Impedance Stabilizing Network (LISN) has a rated impedance of 50 Ω /50 μ H as specified in CISPR16-1-2. The test receiver with Quasi Peak and Average detector is in accordance with CISPR 16-1-1.

The conducted emission level is calculated by adding Cable Attenuation Factor and Insertion Loss of LISN.

Activate the EUT System and run the software prepared for the test.

Setting Condition of Test receiver

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

5.1.2 Limit

Frequency range	Conducted Limit [dB μ V]	
	Quasi Peak	Average
150 kHz to 500 kHz	66 to 56 *	56 to 46 *
500 kHz to 5 MHz	56	46
5 MHz to 30 MHz	60	50

Note:

*: Decrease with the logarithm of the frequency.



5.1.3 Test Detail

Uncertainty of measurement result : ± 3.45 dB
Date of testing : December 2, 2015
Room temperature : 23°C
Relative humidity : 41%

Sample Calculation

Result = Reading + c.f
= 36.6 + 10.4
= 47.0

Margin = Limit - Result
= 65.2 - 47.0
= 18.2

Note:

c.f (Correction Factor) = Cable Attenuation Factor + LISN Factor

Worst Test Data (Tx 0ch)

***** Cosmos Corporation *****
<<Conducted Emission EP5/CE Ver 5.3.20>>
2 December, 2015 22:43
133358E FCC CE 01.dat

Limit : FCC 15.207
Model : PAS-110
Serial : 1508047
Operator : K. Miyaji
Power : DC 5V
Temp., Humi. : 23deg., 41%
Mode : Bluetooth LE Tx 0ch
Remark : PC Power:AC 120V, 60Hz
Remark :
Remark : RBW:9kHz

Final Result

--- L1 Phase ---

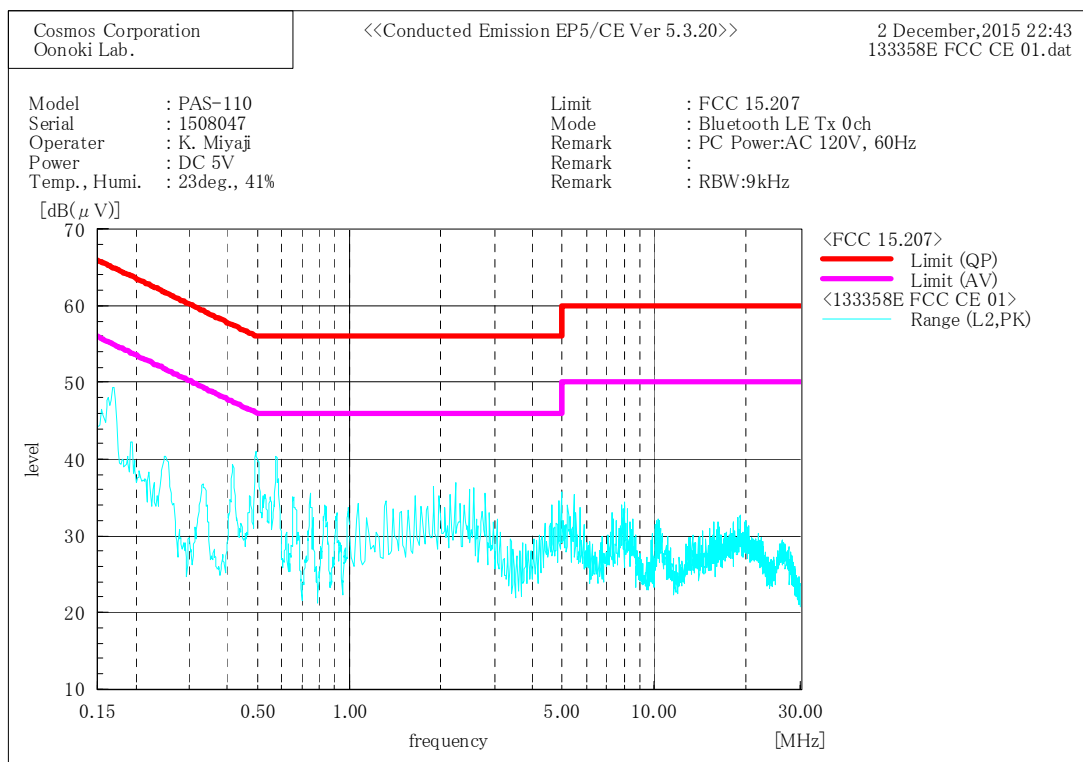
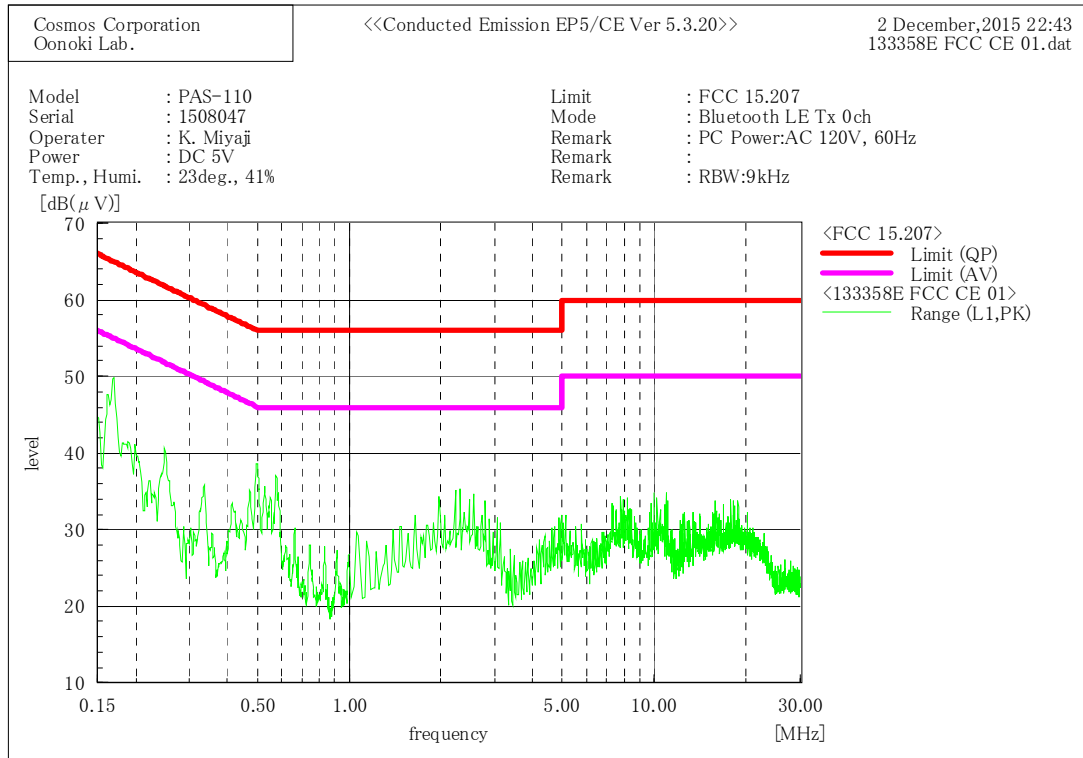
No.	Frequency	Reading QP	Reading AV	c.f	Result QP	Result AV	Limit QP	Limit AV	Margin QP	Margin AV
	[MHz]	[dB(μV)]	[dB(μV)]	[dB]	[dB(μV)]	[dB(μV)]	[dB(μV)]	[dB(μV)]	[dB]	[dB]
1	0.16605	36.6	31.9	10.4	47.0	42.3	65.2	55.2	18.2	12.9
2	0.49738	28.3	22.2	10.2	38.5	32.4	56.0	46.0	17.5	13.6
3	0.5793	25.7	19.4	10.2	35.9	29.6	56.0	46.0	20.1	16.4
4	2.2471	16.7	10.2	10.3	27.0	20.5	56.0	46.0	29.0	25.5
5	4.8216	14.4	4.5	10.5	24.9	15.0	56.0	46.0	31.1	31.0
6	10.2966	18.4	5.8	10.7	29.1	16.5	60.0	50.0	30.9	33.5

--- L2 Phase ---

No.	Frequency	Reading QP	Reading AV	c.f	Result QP	Result AV	Limit QP	Limit AV	Margin QP	Margin AV
	[MHz]	[dB(μV)]	[dB(μV)]	[dB]	[dB(μV)]	[dB(μV)]	[dB(μV)]	[dB(μV)]	[dB]	[dB]
1	0.16617	37.7	33.2	10.4	48.1	43.6	65.1	55.1	17.0	11.5
2	0.49756	27.3	22.2	10.2	37.5	32.4	56.0	46.0	18.5	13.6
3	0.57636	29.7	24.5	10.2	39.9	34.7	56.0	46.0	16.1	11.3
4	2.2455	20.8	9.6	10.3	31.1	19.9	56.0	46.0	24.9	26.1
5	4.9018	19.1	6.9	10.5	29.6	17.4	56.0	46.0	26.4	28.6
6	10.2966	16.3	3.8	10.6	26.9	14.4	60.0	50.0	33.1	35.6

5.1.3 Test Detail (Continued)

Worst Test Data (Tx 0ch)





5.2 Transmitter Spurious Emissions (Radiated) (15.209, RSS-Gen 8.9)

Result:

PASS

5.2.1 Setting Remarks

In the frequency range from 30 MHz to 25 GHz (as 10th harmonics), the electric field strength was measured in accordance with ANSI C63.10-2013.

The test setup was made in accordance with ANSI C63.10-2013 on the table installed in a semi-anechoic chamber. The non-conductive table, 0.8 m high, was placed on the turntable, and the EUT was put on the non-conductive table. The EUT was measured at 1 m to 4 m height of the antenna above 30 MHz. The turntable was fully rotated. The highest radiation from the equipment was recorded. The measurement above 30 MHz was carried out with both horizontal and vertical antenna polarization. The test receiver with Peak, Quasi Peak and Average detector is in accordance with CISPR 16-1-1. The measurement was carried out with the measuring distance of 3 m. Then the limit of 30 m distance below 30 MHz was converted to the limit of 3 m distance with the $40\log(30\text{ m}/3\text{ m})$.

Setting Condition of Test receiver

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

5.2.2 Limit

Frequency range	Field Strength (Distance)			
	[μV/m]		[dBμV/m]	
30 MHz to 88 MHz	100	(3 m)	40.0	(3 m)
88 MHz to 216 MHz	150	(3 m)	43.5	(3 m)
216 MHz to 960 MHz	200	(3 m)	46.0	(3 m)
Above 960 MHz	500	(3 m)	53.9	(3 m)



5.2.3 Test Detail

Uncertainty of measurement result	: ± 5.08 dB	
Date of testing	: November 16, 2015	November 17, 2015
Room temperature	: 22°C	20°C
Relative humidity	: 56%	56%
Date of testing	: November 19, 2015	December 8, 2015
Room temperature	: 24°C	21°C
Relative humidity	: 45%	42%
Date of testing	: December 9, 2015	
Room temperature	: 24°C	
Relative humidity	: 33%	

Sample Calculation

$$\begin{aligned}\text{Result} &= \text{Reading} + \text{c.f} \\ &= 33.5 + (-2.8) \\ &= 30.7\end{aligned}$$

$$\begin{aligned}\text{Margin} &= \text{Limit} - \text{Result} \\ &= 46.0 - 30.7 \\ &= 15.3\end{aligned}$$

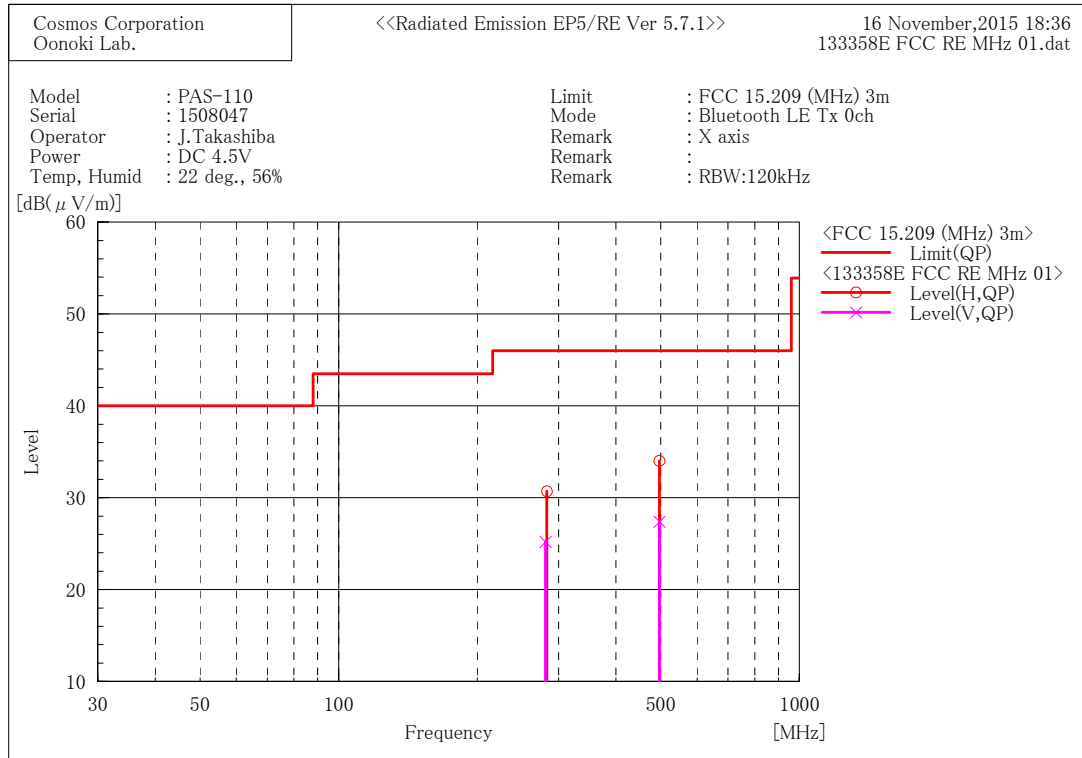
Note:

$$\text{c.f (Correction Factor)} = \text{Cable Attenuation Factor} + \text{Antenna Factor} + \text{Amplifier Gain}$$



5.2.3 Test Detail (Continued)

<30 MHz to 1 GHz> Worst Test Data (Tx 0ch)



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	283.098	33.5	-2.8	30.7	46.0	15.3	101.0	90.0
2	496.593	36.9	-2.9	34.0	46.0	12.0	184.0	71.0

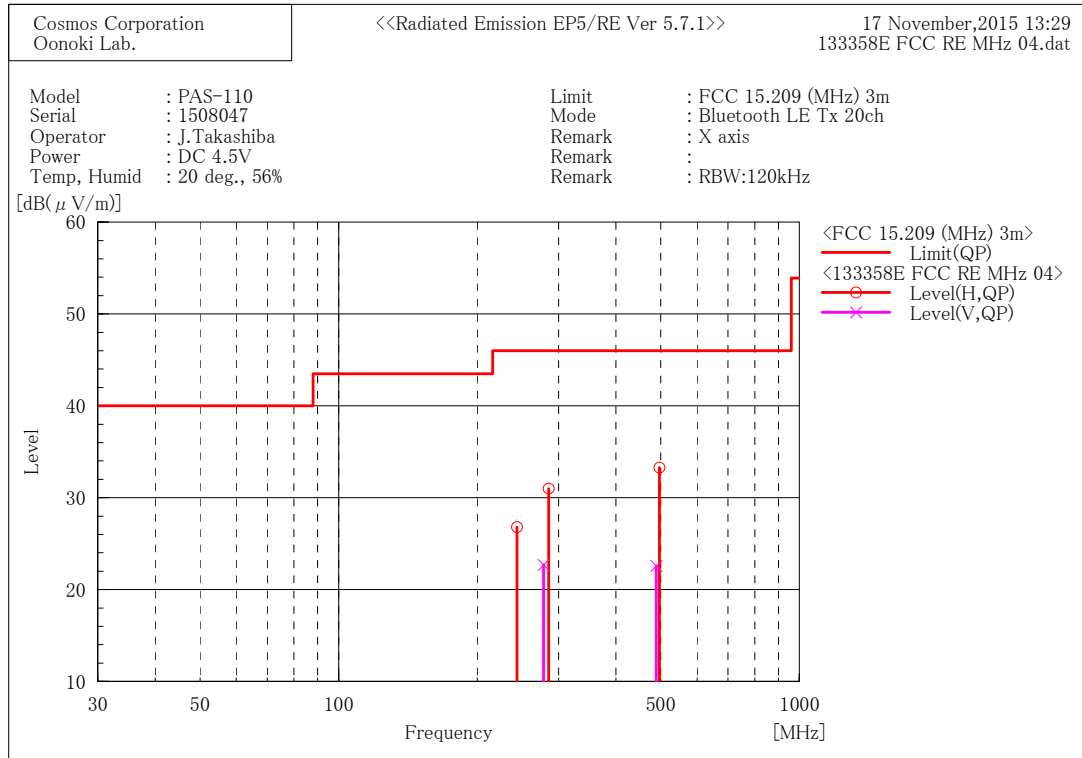
--- Vertical Polarization (QP)---

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	281.162	28.1	-2.9	25.2	46.0	20.8	101.0	201.0
2	496.593	30.3	-2.9	27.4	46.0	18.6	199.0	144.0



5.2.3 Test Detail (Continued)

<30 MHz to 1 GHz> Worst Test Data (Tx 20ch)



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	243.657	32.1	-5.3	26.8	46.0	19.2	103.0	65.0
2	285.343	33.6	-2.6	31.0	46.0	15.0	111.0	70.0
3	496.563	36.2	-2.9	33.3	46.0	12.7	198.0	269.0

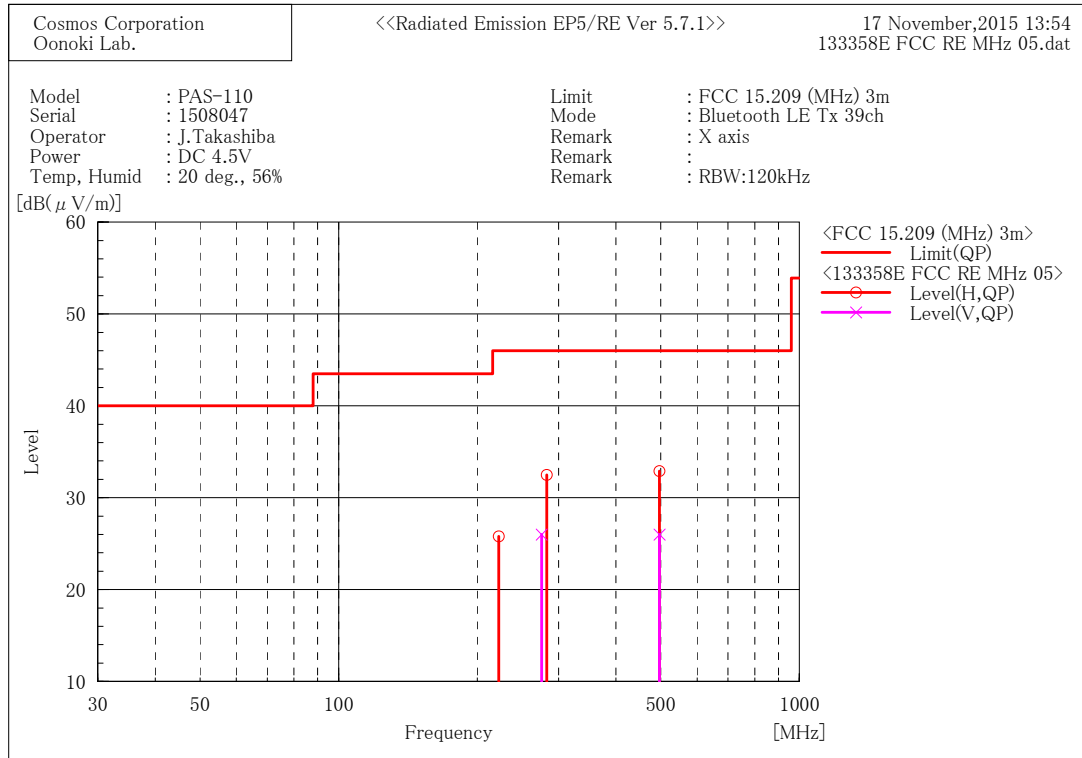
--- Vertical Polarization (QP)---

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	278.360	25.8	-3.1	22.7	46.0	23.3	153.0	343.0
2	489.163	25.6	-3.0	22.6	46.0	23.4	216.0	160.0



5.2.3 Test Detail (Continued)

<30 MHz to 1 GHz> Worst Test Data (Tx 39ch)



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	222.654	32.1	-6.3	25.8	46.0	20.2	101.0	95.0
2	282.863	35.3	-2.8	32.5	46.0	13.5	120.0	59.0
3	496.577	35.8	-2.9	32.9	46.0	13.1	205.0	69.0

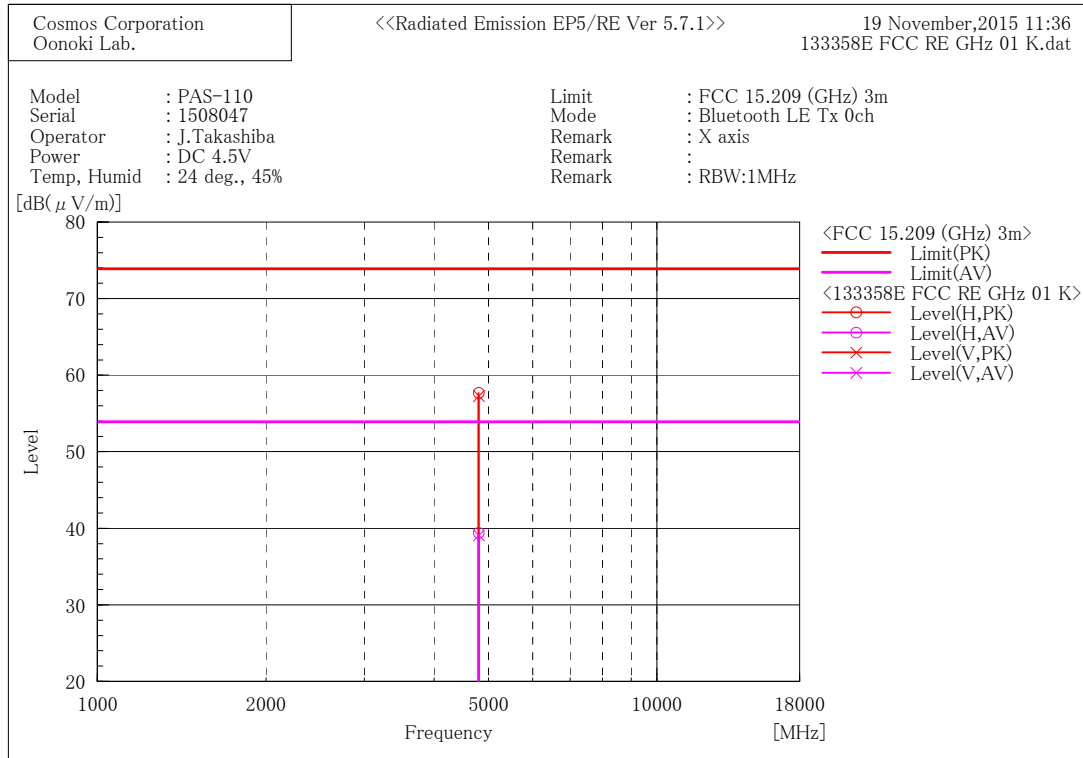
--- Vertical Polarization (QP)---

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	275.678	29.3	-3.3	26.0	46.0	20.0	111.0	169.0
2	496.577	28.9	-2.9	26.0	46.0	20.0	222.0	147.0



5.2.3 Test Detail (Continued)

<1 GHz to 18 GHz> Worst Test Data (Tx 0ch)



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	4804.215	56.9	0.8	57.7	73.9	16.2	372.0	11.0

--- Horizontal Polarization (AV)---

No.	Frequency [MHz]	Reading [dB(μV)]	c. f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	4804.215	38.6	0.8	39.4	53.9	14.5	372.0	11.0

--- 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	4804.462	56.5	0.8	57.3	73.9	16.6	377.0	337.0

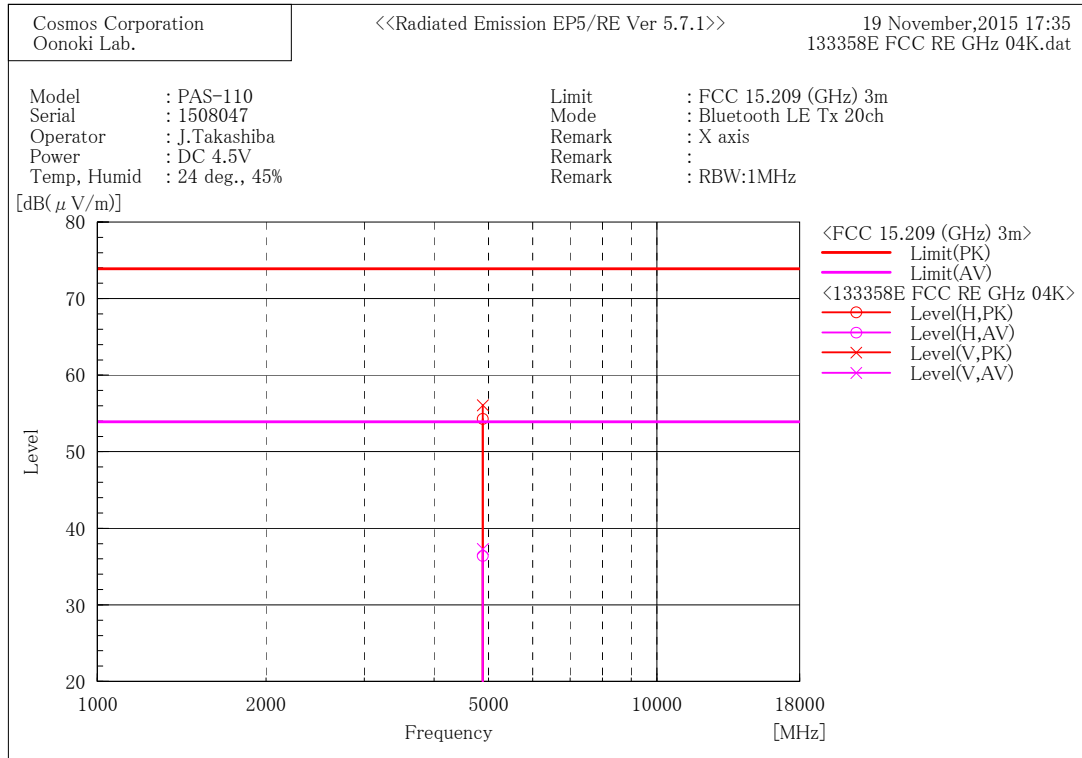
--- Vertical Polarization (AV)---

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	4804.462	38.3	0.8	39.1	53.9	14.8	377.0	337.0



5.2.3 Test Detail (Continued)

<1 GHz to 18 GHz> Worst Test Data (Tx 20ch)



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	4883.539	53.3	1.0	54.3	73.9	19.6	363.0	3.0

--- Horizontal Polarization (AV)---

No.	Frequency [MHz]	Reading [dB(μV)]	c.f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	4883.539	35.4	1.0	36.4	53.9	17.5	363.0	3.0

--- 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	4883.893	55.1	1.0	56.1	73.9	17.8	100.0	347.0

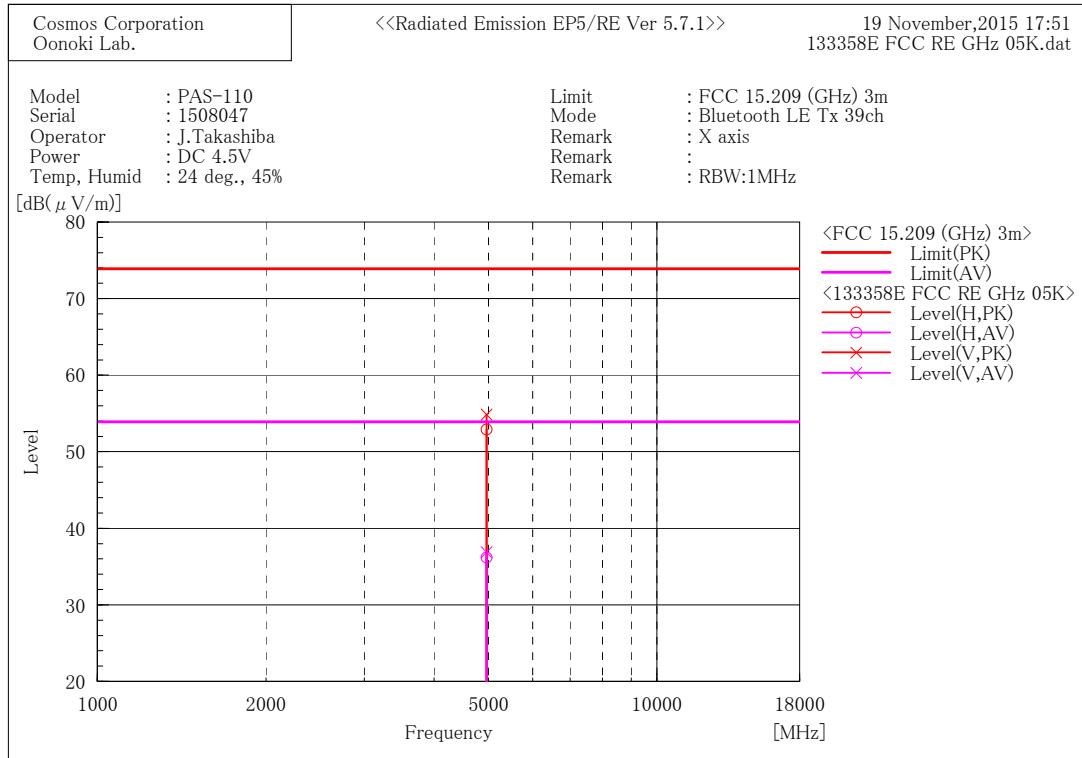
--- Vertical Polarization (AV)---

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	4883.893	36.3	1.0	37.3	53.9	16.6	100.0	347.0



5.2.3 Test Detail (Continued)

<1 GHz to 18 GHz> Worst Test Data (Tx 39ch)



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	4959.465	51.6	1.3	52.9	73.9	21.0	358.0	11.0

--- Horizontal Polarization (AV)---

No.	Frequency [MHz]	Reading [dB(μV)]	c.f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	4959.465	34.9	1.3	36.2	53.9	17.7	358.0	11.0

--- 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	4959.841	53.6	1.3	54.9	73.9	19.0	256.0	344.0

--- 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	4959.841	35.6	1.3	36.9	53.9	17.0	256.0	344.0

<18 GHz to 25 GHz>

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



5.3 6 dB Bandwidth (15.247(a), RSS-247 5.2(1))

Result: PASS

5.3.1 Setting Remarks

The both side of 6 dB down value from peak power were measured by using 6 dB bandwidth measurement function.

The spectrum analyzer is set as following:

·Frequency Span	: 1.6 MHz
·Resolution Bandwidth	: 100 kHz
·Video Bandwidth	: 300 kHz
·Detector Mode	: Peak
·Trace Mode	: Max Hold

5.3.2 Limit

Systems using digital modulation techniques may operate in the 902 MHz to 928 MHz, 2400 MHz to 2483.5 MHz, and 5725 MHz to 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

5.3.3 Test Detail

Uncertainty of measurement result	: $\pm 0.011\%$
Date of testing	: January 12, 2016
Room temperature	: 26°C
Relative humidity	: 32%

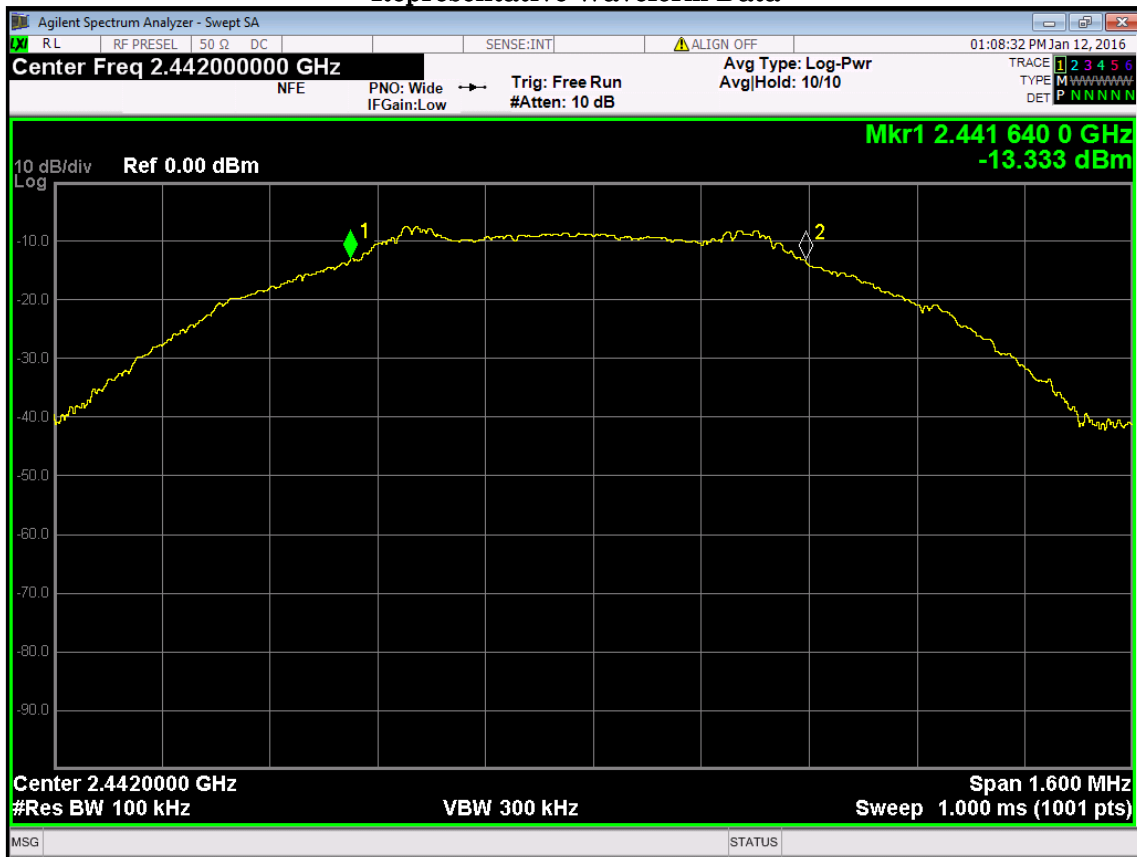


5.3.3 Test Detail (Continued)

Test Data

Frequency	Measured Bandwidth [kHz]
2402 (0ch)	659
2442 (20ch)	675
2480 (39ch)	664

Representative Waveform Data





5.4 Maximum Peak Conducted Output Power and E.I.R.P. (15.247(b), RSS-247 5.4)

Result: **PASS**

5.4.1 Setting Remarks

The spectrum analyzer is set as following:

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

5.4.2 Limit

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

5.4.3 Test Detail

Uncertainty of measurement result	: ± 1.31 dB
Date of testing	: December 1, 2015
Room temperature	: 20°C
Relative humidity	: 51%



5.4.3 Test Detail (Continued)

Sample Calculation

$$\begin{aligned}\text{Margin} &= \text{Limit} - \text{Peak Power} \\ &= 30 - (-3.56) \\ &= 33.56\end{aligned}$$

Conducted Output Power (DC-powered)

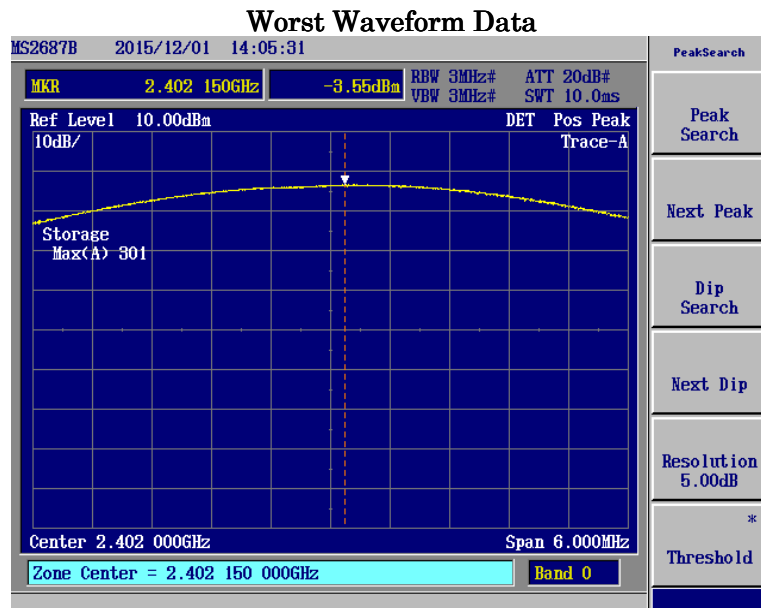
Frequency [MHz]	Power Supply Voltage [V]	Peak Power [dBm]	Limit [dBm]	Margin [dB]
2402	4.25	-3.56	30	33.56
	5.00	-3.58	30	33.58
	5.75	-3.58	30	33.58
2442	4.25	-4.39	30	34.39
	5.00	-4.39	30	34.39
	5.75	-4.37	30	34.37
2480	4.25	-5.21	30	35.21
	5.00	-5.20	30	35.20
	5.75	-5.20	30	35.20

Conducted Output Power (Battery-powered)

Frequency [MHz]	Peak Power [dBm]	Limit [dBm]	Margin [dB]
2402	-3.55	30	33.55
2442	-4.36	30	34.36
2480	-5.20	30	35.20



5.4.3 Test Detail (Continued)



E.I.R.P. (Worst Data : Battery-powered)

Frequency [MHz]	E.I.R.P. [dBm]	Limit [dBm]	Margin [dB]
2402	-1.14	36	37.14
2442	-1.95	36	37.95
2480	-2.79	36	38.79



5.5 Conducted Spurious Emission (15.247(d), RSS-247 5.5)

Result: **PASS**

5.5.1 Setting Remarks

The Spectrums are scanned from the lowest generated frequency of EUT up to the 10th harmonics by using the spectrum analyzer.

The spectrum analyzer is set as following:

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

5.5.2 Limit

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

5.5.3 Test Detail

Uncertainty of measurement result	: ± 1.58 dB
Date of testing	: December 2, 2015
Room temperature	: 25°C
Relative humidity	: 36%

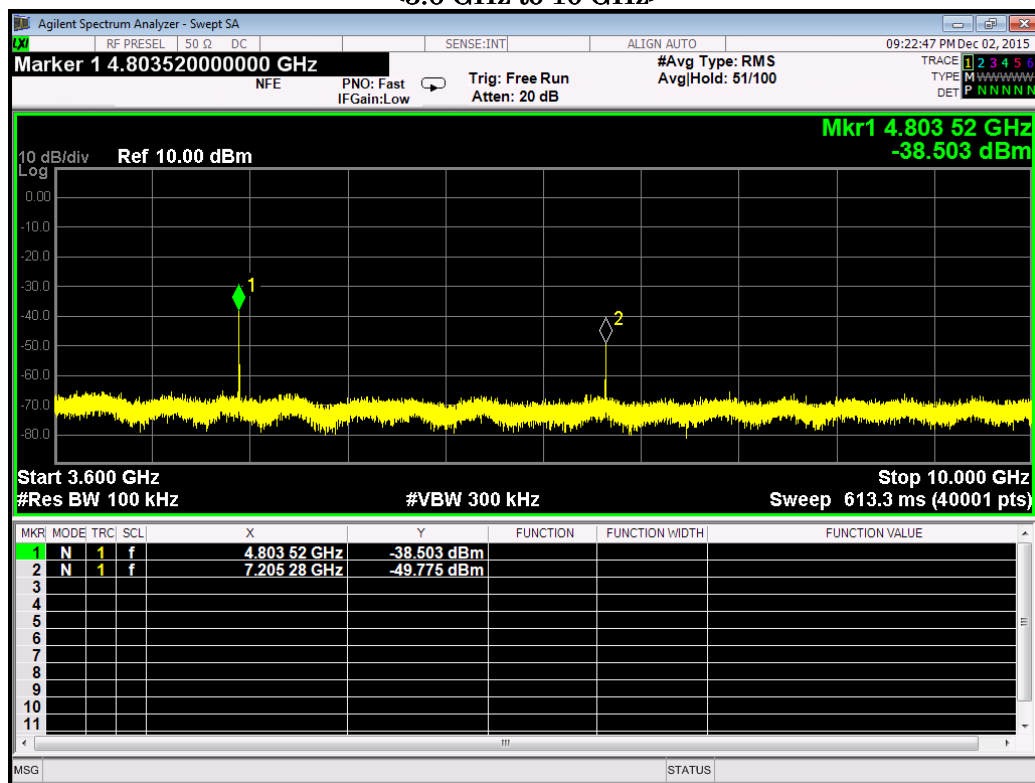


5.5.3 Test Detail (Continued)

Worst Test Data (Limit Level)

Fundamental Level (Reading) [dBm]	Spurious Limit [dBm]
-5.035	-25.035

Worst Test Data <3.6 GHz to 10 GHz>

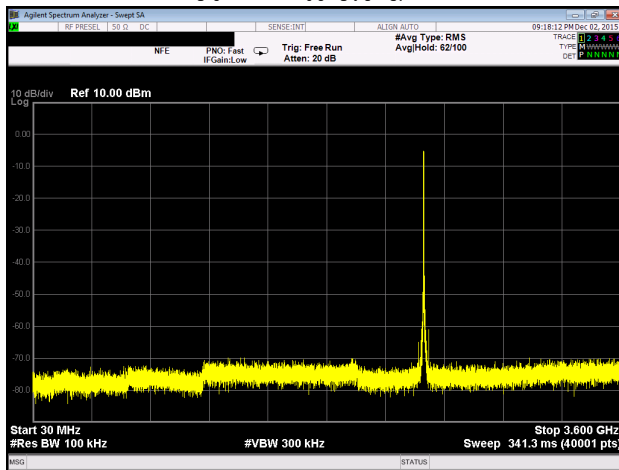




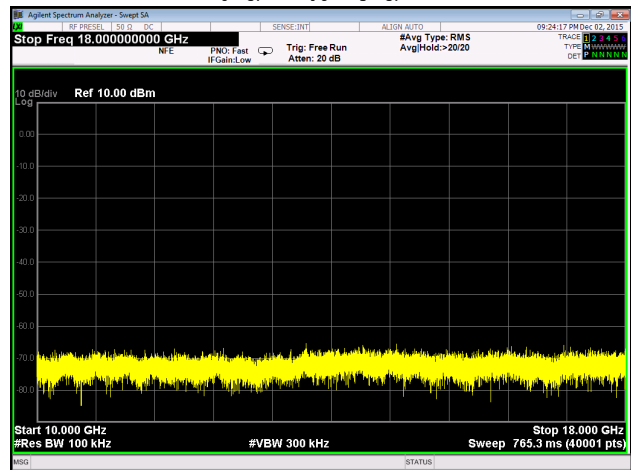
5.5.3 Test Detail (Continued)

Worst Test Data

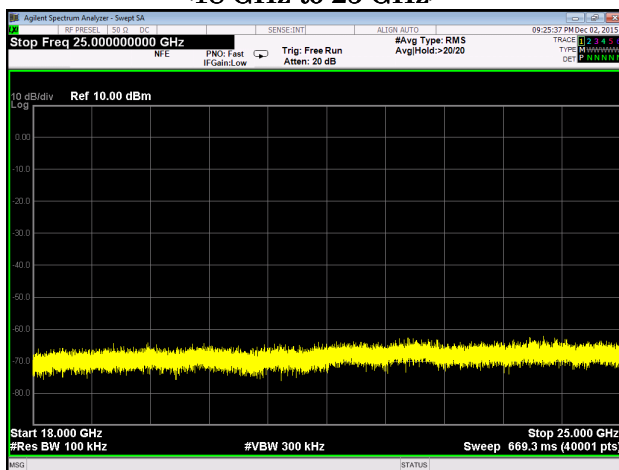
<30 MHz to 3.6 GHz>



<10 GHz to 18 GHz>



<18 GHz to 25 GHz>





5.6 Band Edge Measurement (15.247(d))

Result:

PASS

5.6.1 Setting Remarks

The test setup was made in accordance with ANSI C63.10-2013 on the table installed in a semi-anechoic chamber. The non-conductive table, 0.8 m high, was placed on the turntable, and the EUT was put on the non-conductive table. The EUT was measured at 1 m to 4 m height of the antenna. The turntable was fully rotated. The highest radiation from the equipment was recorded. The measurement was carried out with both horizontal and vertical antenna polarization. This measurement is repeated in both side of the spectrum. The test receiver with Peak, Quasi Peak and Average detector is in accordance with CISPR 16-1-1. The measurement was carried out with the measuring distance of 3 m.

Setting Condition of Analyzer

Detector	RBW
Peak	1 MHz
Average	1 MHz

5.6.2 Test Detail

Uncertainty of measurement result : ± 4.72 dB
Date of testing : December 8, 2015
Room temperature : 21°C
Relative humidity : 42%

Sample Calculation

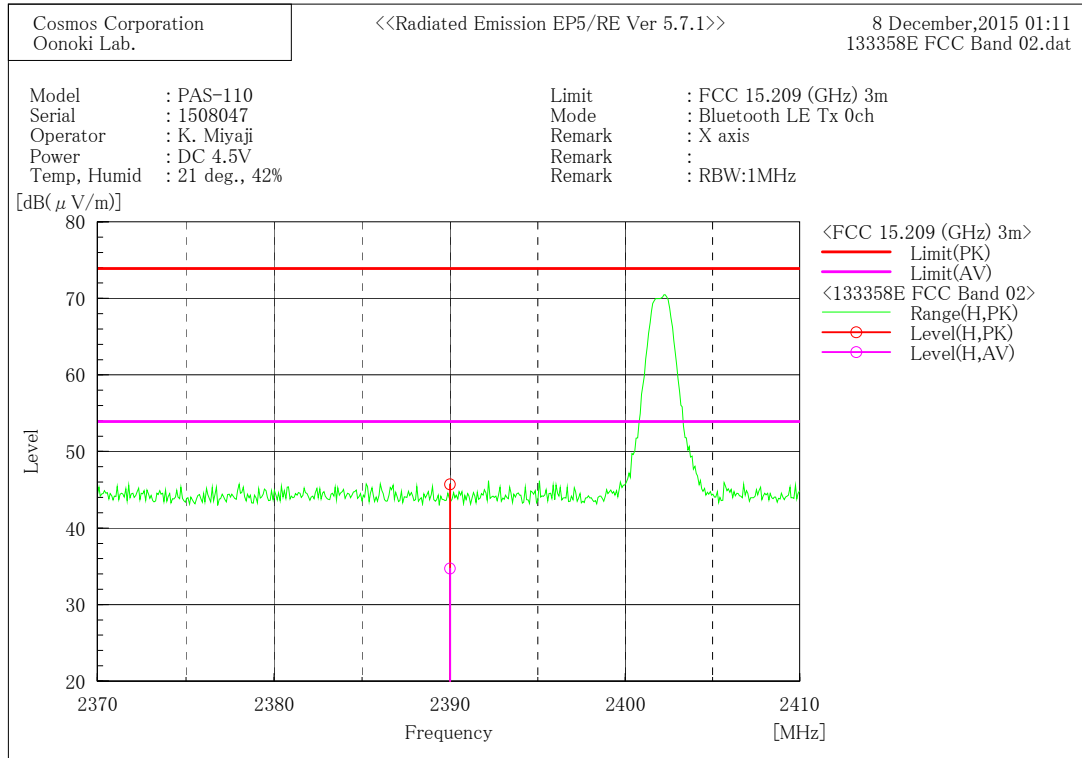
Result = Reading + c.f
= $40.3 + 5.4$
= 45.7

Margin = Limit – Result
= $73.9 - 45.7$
= 28.2



5.6.2 Test Detail (Continued)

Test Data



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	40.3	5.4	45.7	73.9	28.2	322.0	36.0

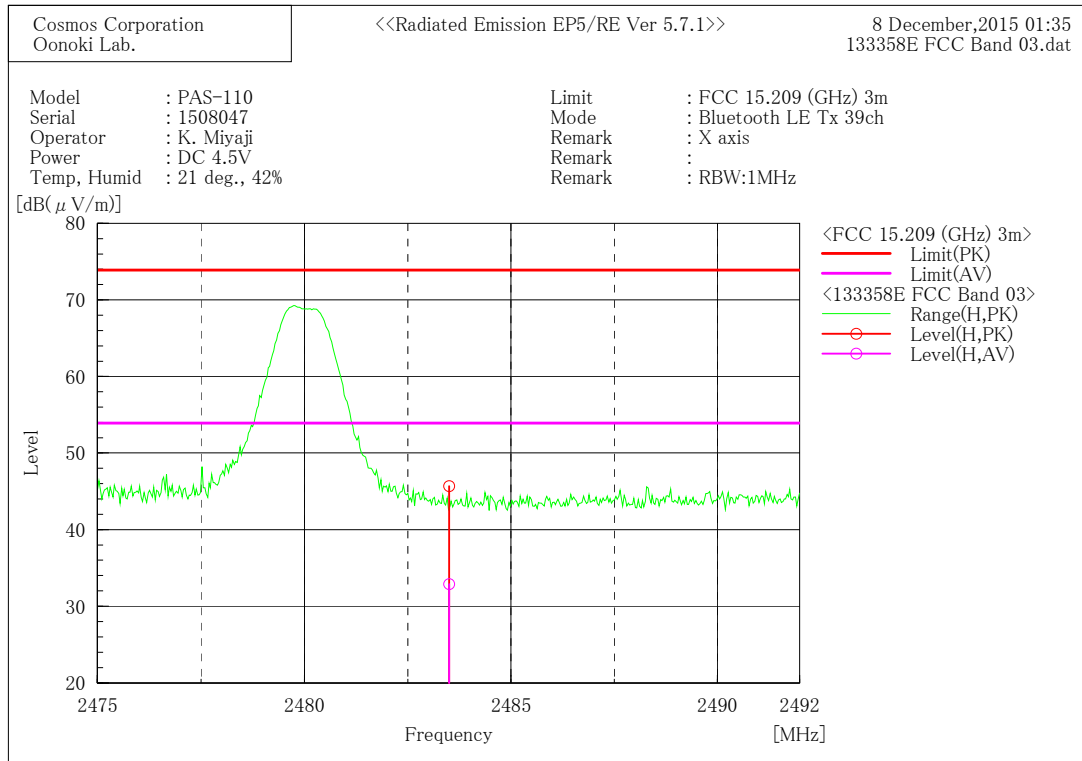
--- Horizontal Polarization (AV)---

No.	Frequency [MHz]	Reading [dB(μV)]	c.f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	2390.000	29.3	5.4	34.7	53.9	19.2	322.0	36.0



5.6.2 Test Detail (Continued)

Test Data



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	40.4	5.3	45.7	73.9	28.2	303.0	36.0

--- Horizontal Polarization (AV)---

No.	Frequency [MHz]	Reading [dB(μV)]	c.f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	2483.500	27.6	5.3	32.9	53.9	21.0	303.0	36.0



5.7 Power Spectral Density (15.247(e), RSS-247 5.2(2))

Result: **PASS**

5.7.1 Setting Remarks

The spectrum analyzer is set as following:

· Frequency Span	: Approx. 1.5 × 6 dB Bandwidth
· Resolution Bandwidth	: 3 kHz
· Video Bandwidth	: 10 kHz
· Detector Mode	: Peak
· Trace Mode	: Max Hold

5.7.2 Limit

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

5.7.3 Test Detail

Uncertainty of measurement result	: ±1.31 dB
Date of testing	: January 12, 2016
Room temperature	: 26°C
Relative humidity	: 32%

Sample Calculation

$$\begin{aligned}\text{Margin} &= \text{Limit} - \text{Peak Power} \\ &= 8 - (-16.40) \\ &= 24.40\end{aligned}$$

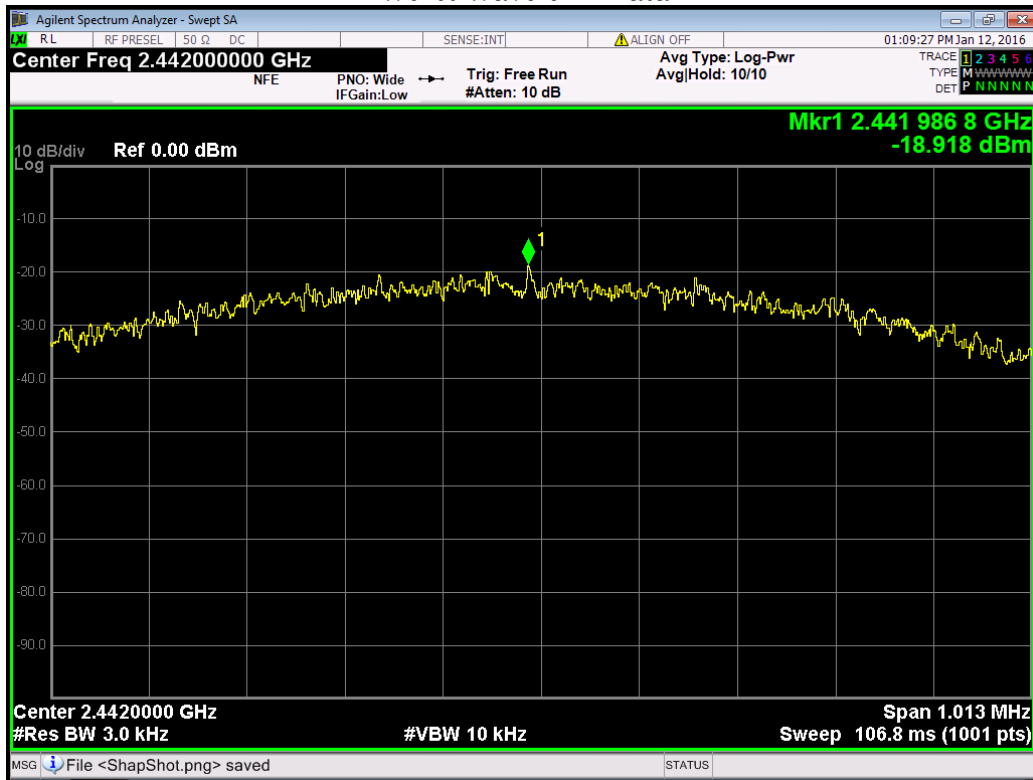
Test Data

Frequency [MHz]	Power Spectral Density [dBm]	Limit [dBm]	Margin [dB]
2402	-16.40	8	24.40
2442	-16.21	8	24.21
2480	-16.95	8	24.95



5.7.3 Test Detail (Continued)

Worst Waveform Data





5.8 Occupied Bandwidth (RSS-Gen Annex A)

Result: **PASS**

5.8.1 Setting Remarks

Occupied Bandwidth is measured by using 99% Bandwidth measurement function of the spectrum analyzer.

The spectrum analyzer is set as following:

·Frequency Span	: 5 MHz
·Resolution Bandwidth	: 30 kHz
·Video Bandwidth	: 1 MHz
·Detector Mode	: Peak
·Trace Mode	: Max Hold

5.8.2 Test Detail

Uncertainty of measurement result	: $\pm 0.011\%$
Date of testing	: December 1, 2015
Room temperature	: 20°C
Relative humidity	: 51%

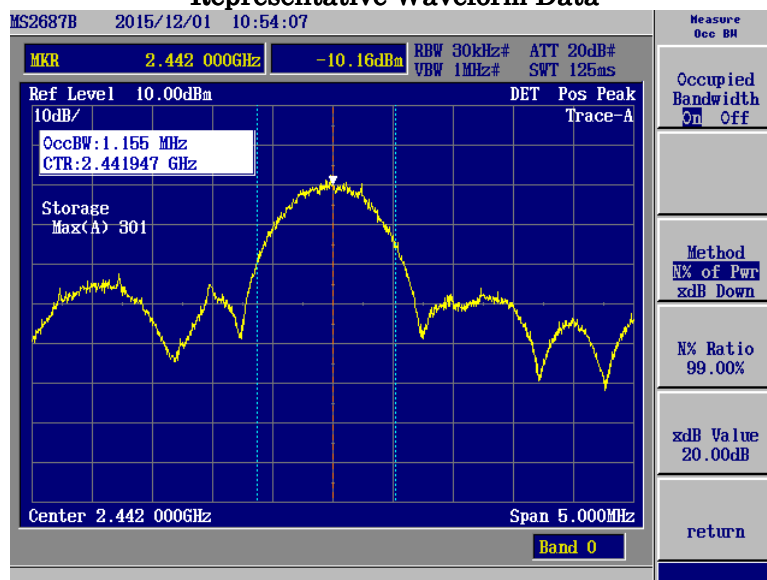


5.8.3 Test Detail (Continued)

Test Data

Frequency	Measured Bandwidth [kHz]
2402 (0ch)	1110
2442 (20ch)	1155
2480 (39ch)	1125

Representative Waveform Data





5.9 Receiver Spurious Emissions (Radiated) (RSS-Gen 7.1)

Result:

PASS

5.9.1 Setting Remarks

In the frequency range from 30 MHz to 12.5 GHz (as 5th harmonics), the electric field strength was measured in accordance with ANSI C63.10-2013.

The test setup was made in accordance with ANSI C63.10-2013 on the table installed in a semi-anechoic chamber. The non-conductive table, 0.8 m high, was placed on the turntable, and the EUT was put on the non-conductive table. The EUT was measured at 1 m to 4 m height of the antenna. The turntable was fully rotated. The highest radiation from the equipment was recorded. The measurement was carried out with both horizontal and vertical antenna polarization. The test receiver with Peak, Quasi Peak and Average detector is in accordance with CISPR 16-1-1. The measurement was carried out with the measuring distance of 3 m.

Setting Condition of Test receiver

Frequency range	Detector	RBW
30 MHz to 1 GHz	Quasi peak	120 kHz
1 GHz to 12.5 GHz	Peak	1 MHz
	Average	1 MHz

5.9.2 Limit

Frequency range	Field Strength (Distance)	
	[μ V/m]	[dB μ V/m]
30 MHz to 88 MHz	100 (3 m)	40.0 (3 m)
88 MHz to 216 MHz	150 (3 m)	43.5 (3 m)
216 MHz to 960 MHz	200 (3 m)	46.0 (3 m)
Above 960 MHz	500 (3 m)	53.9 (3 m)



5.9.3 Test Detail

Uncertainty of measurement result	:	±5.08 dB	
Date of testing	:	November 17, 2015	November 20, 2015
Room temperature	:	20°C	22°C
Relative humidity	:	56%	52%
Date of testing	:	December 8, 2015	
Room temperature	:	21 – 24°C	
Relative humidity	:	33 – 42%	

Sample Calculation

Result = Reading + c.f
= 28.9 + (-7.0)
= 21.9

Margin = Limit – Result
= 43.5 – 21.9
= 21.6

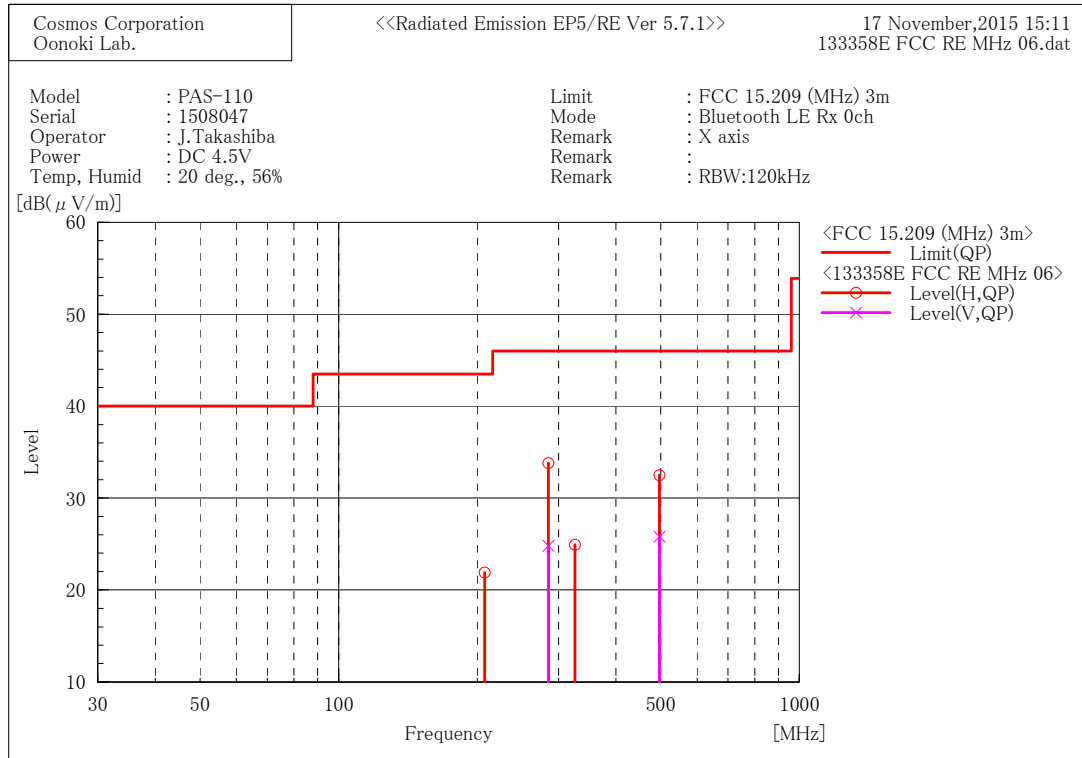
Note:

c.f (Correction Factor) = Cable Attenuation Factor + Antenna Factor + Amplifier Gain



5.9.3 Test Detail (Continued)

<30 MHz to 1 GHz> Worst Test Data (Rx 0ch)



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	207.357	28.9	-7.0	21.9	43.5	21.6	199.0	63.0
2	284.977	36.5	-2.7	33.8	46.0	12.2	116.0	93.0
3	325.679	31.1	-6.2	24.9	46.0	21.1	103.0	65.0
4	496.627	35.4	-2.9	32.5	46.0	13.5	205.0	164.0

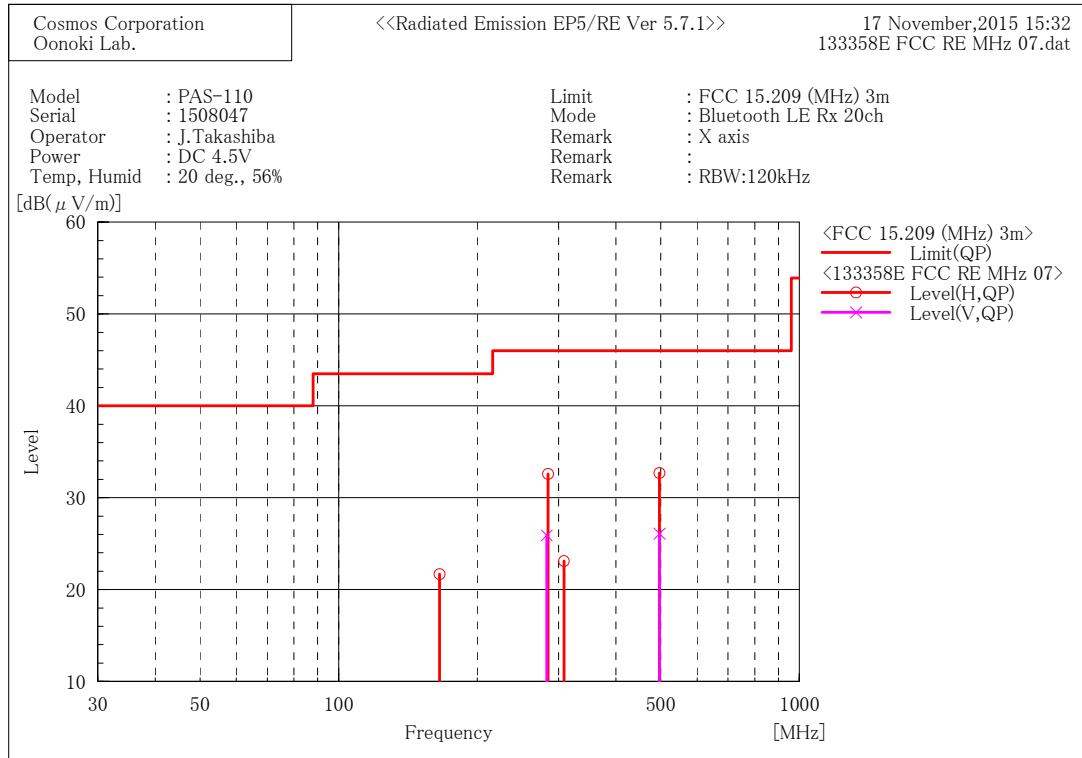
--- Vertical Polarization (QP)---

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	284.986	27.5	-2.7	24.8	46.0	21.2	109.0	121.0
2	496.644	28.7	-2.9	25.8	46.0	20.2	220.0	166.0



5.9.3 Test Detail (Continued)

<30 MHz to 1 GHz> Worst Test Data (Rx 20ch)



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	165.574	31.3	-9.6	21.7	43.5	21.8	199.0	84.0
2	284.942	35.3	-2.7	32.6	46.0	13.4	119.0	241.0
3	308.183	29.4	-6.3	23.1	46.0	22.9	101.0	99.0
4	496.629	35.6	-2.9	32.7	46.0	13.3	185.0	89.0

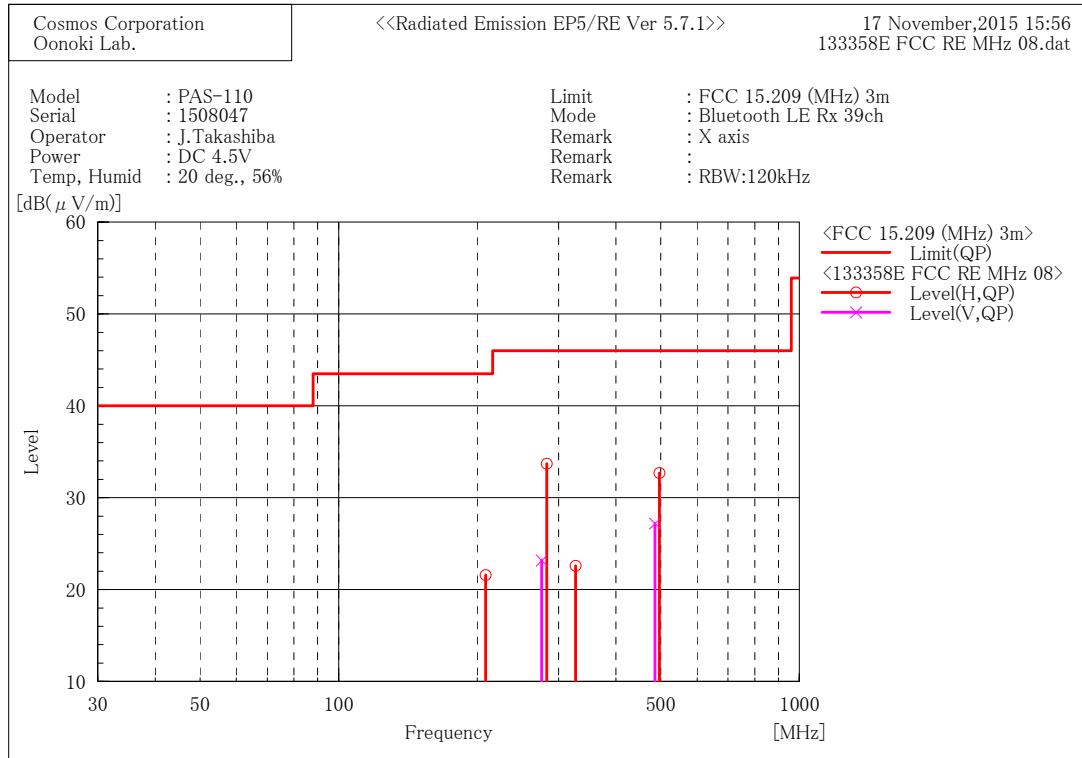
--- Vertical Polarization (QP)---

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	282.644	28.7	-2.8	25.9	46.0	20.1	171.0	137.0
2	496.756	29.0	-2.9	26.1	46.0	19.9	204.0	162.0



5.9.3 Test Detail (Continued)

<30 MHz to 1 GHz> Worst Test Data (Rx 39ch)



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	208.516	28.5	-6.9	21.6	43.5	21.9	101.0	240.0
2	282.660	36.5	-2.8	33.7	46.0	12.3	119.0	248.0
3	326.714	28.8	-6.2	22.6	46.0	23.4	101.0	278.0
4	496.656	35.6	-2.9	32.7	46.0	13.3	177.0	278.0

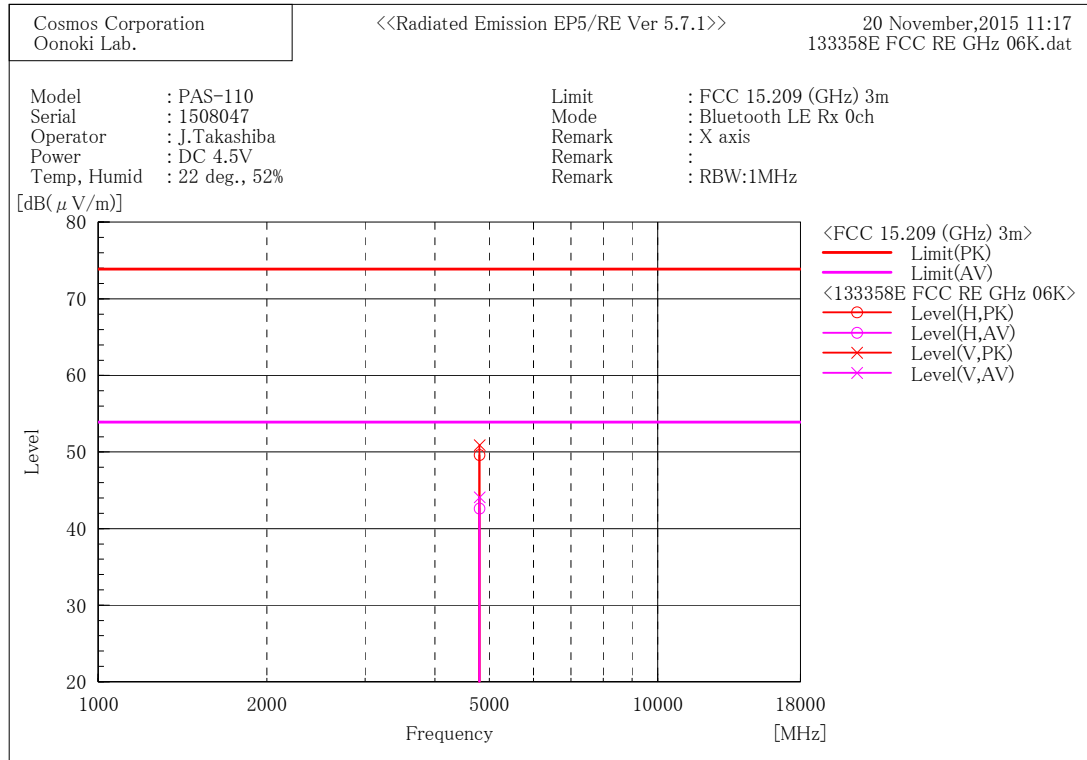
--- Vertical Polarization (QP)---

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	275.714	26.5	-3.3	23.2	46.0	22.8	104.0	317.0
2	485.578	30.3	-3.1	27.2	46.0	18.8	198.0	4.0



5.9.3 Test Detail (Continued)

<1 GHz to 18 GHz> Worst Test Data (Rx 0ch)



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	4806.268	48.8	0.8	49.6	73.9	24.3	190.0	9.0

--- Horizontal Polarization (AV) ---

No.	Frequency [MHz]	Reading [dB(μV)]	c.f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	4806.268	41.8	0.8	42.6	53.9	11.3	190.0	9.0

--- 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	4805.882	50.1	0.8	50.9	73.9	23.0	239.0	340.0

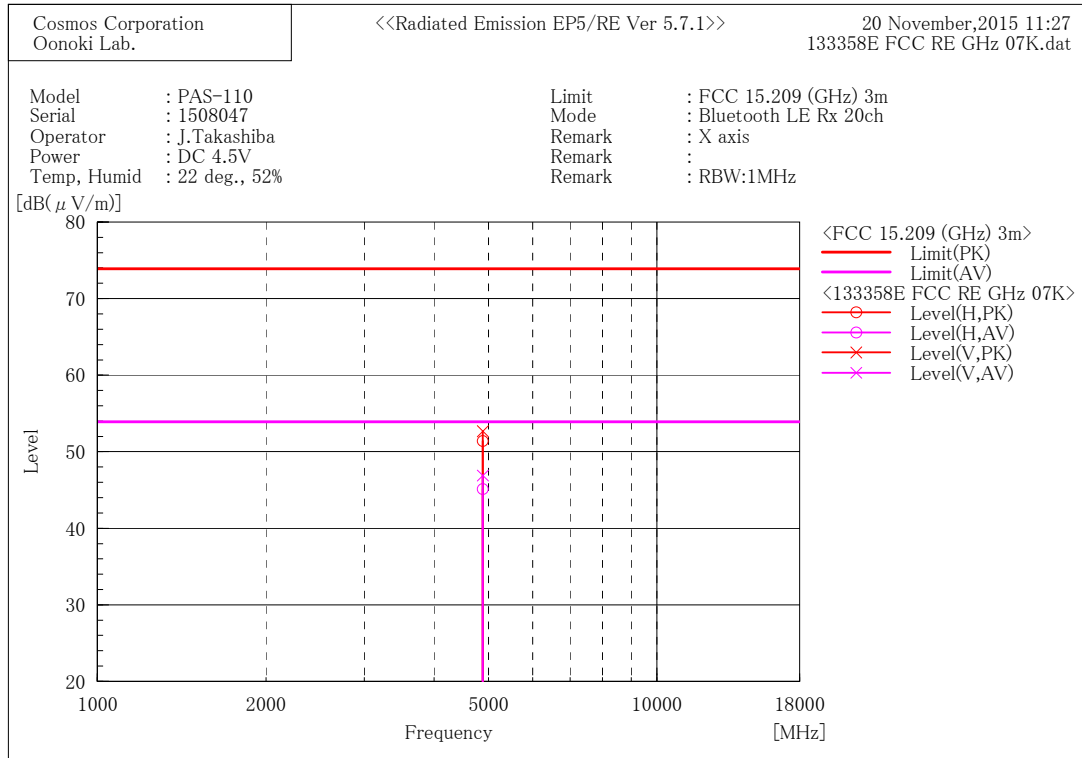
--- Vertical Polarization (AV) ---

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	4805.882	43.3	0.8	44.1	53.9	9.8	239.0	340.0



5.9.3 Test Detail (Continued)

<1 GHz to 18 GHz> Worst Test Data (Rx 20ch)



Final Result

--- Horizontal Polarization (PK)---

No.	Frequency [MHz]	Reading [dB(μ V)]	c. f [dB(1/m)]	Result [dB(μ V/m)]	Limit [dB(μ V/m)]	Margin [dB]	Height [cm]	Angle [°]
1	4882.250	50.4	1.0	51.4	73.9	22.5	187.0	28.0

--- Horizontal Polarization (AV)---

No.	Frequency [MHz]	Reading [dB(μ V)]	c. f [dB(1/m)]	Result [dB(μ V/m)]	Limit [dB(μ V/m)]	Margin [dB]	Height [cm]	Angle [°]
1	4882.250	44.1	1.0	45.1	53.9	8.8	187.0	28.0

--- Vertical Polarization (PK)---

No.	Frequency [MHz]	Reading [dB(μ V)]	c. f [dB(1/m)]	Result [dB(μ V/m)]	Limit [dB(μ V/m)]	Margin [dB]	Height [cm]	Angle [°]
1	4882.007	51.7	1.0	52.7	73.9	21.2	250.0	206.0

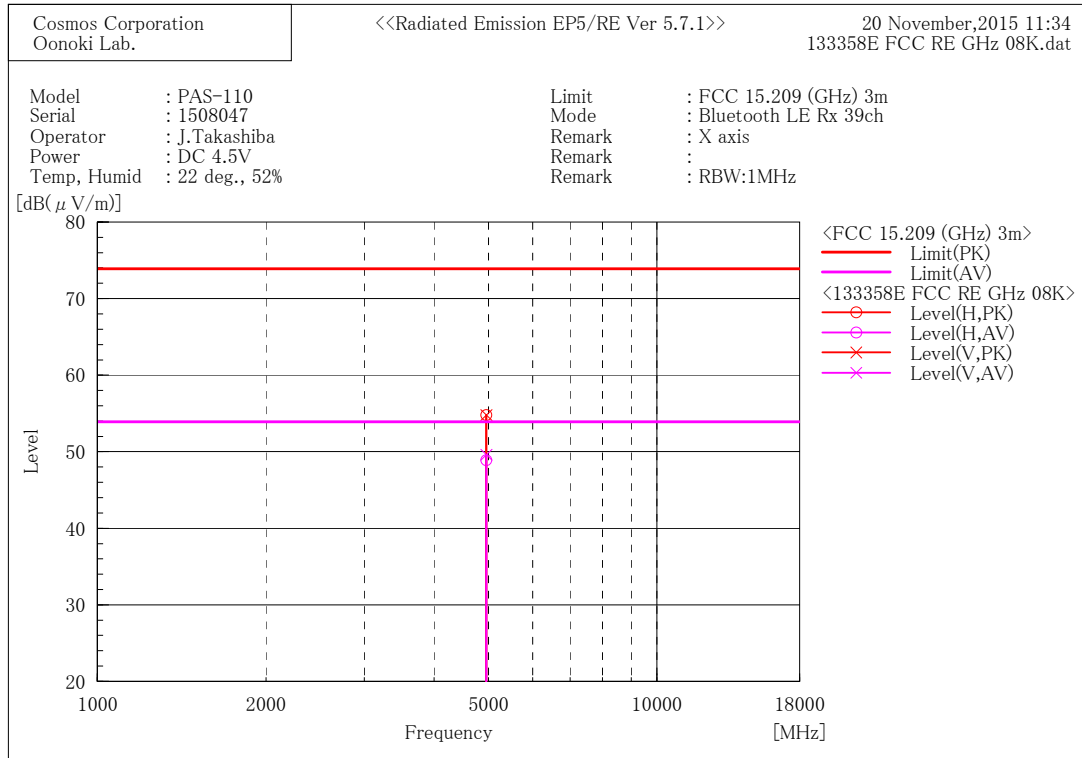
--- Vertical Polarization (AV)---

No.	Frequency [MHz]	Reading [dB(μ V)]	c. f [dB(1/m)]	Result [dB(μ V/m)]	Limit [dB(μ V/m)]	Margin [dB]	Height [cm]	Angle [°]
1	4882.007	45.9	1.0	46.9	53.9	7.0	250.0	206.0



5.9.3 Test Detail (Continued)

<1 GHz to 18 GHz> Worst Test Data (Rx 39ch)



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	4957.889	53.5	1.3	54.8	73.9	19.1	171.0	38.0

--- Horizontal Polarization (AV)---

No.	Frequency [MHz]	Reading [dB(μV)]	c.f [dB(1/m)]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Height [cm]	Angle [°]
1	4957.889	47.6	1.3	48.9	53.9	5.0	171.0	38.0

--- 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	4957.889	53.5	1.3	54.8	73.9	19.1	200.0	352.0

--- 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	4957.889	48.3	1.3	49.6	53.9	4.3	200.0	352.0



6. List of Test and Measurement Instruments

AC Power Line Conducted Emission

Instruments	Manufacturer	Model	Serial No.	Calibrated Date/Until
EMI Test Receiver	ROHDE & SCHWARZ	ESIB40	100211	2015/03/12 2016/03/11
Artificial-Mains Network (for EUT) /Highpass Filter /Attenuator 10 dB	Kyoritsu /Kyoritsu /TAMAGAWA	KNW-341C (F) /KFL-007 /CFA-03	8-1659-1 /8-1708-10 /---	2015/01/27 2016/01/26
Artificial-Mains Network (for peripheral) /Highpass Filter /Attenuator 10 dB	Kyoritsu /Kyoritsu /JFW	KNW-341 (F) /KFL-007 /50FP-010-H2	8S-2996-1 /8-1741-2 /---	2015/06/25 2016/06/24
Shielded Room	JSE	COSR-01	---	---
RF Cable RF Selector	Fujikura	3D-2W	OC01	2015/04/06 2016/04/05
	SUHNER	RG223/U	OC02 OC04	
	TSJ	RFM-E221	3148	
50 Ω Terminator	RES-NET MICROWAVE	RCX6BM	---	2015/05/28 2016/05/27
Software	TOYO	EP5/RE (ver 5.7.1)	---	---



6. List of Test and Measurement Instruments (Continued)

Transmitter Spurious Emissions (Radiated) (Below 1 GHz)

Receiver Spurious Emissions (Radiated) (Below 1 GHz)

Instruments	Manufacturer	Model	Serial No.	Calibrated Date/Until
EMI Test Receiver	ROHDE & SCHWARZ	ESIB40	100211	2015/03/12 2016/03/11
Pre-Amplifier (30 MHz to 1 GHz)	HEWLETT PACKARD	8447D OPT 010	2944A 07891	2015/03/13 2016/03/12
Biconical Antenna (30 MHz to 300 MHz)	SCHWARZBECK	VHBB9124 / BBA9106	9124-311	2015/08/31 2016/08/30
Log-Periodic Antenna (300 MHz to 1 GHz)	SCHWARZBECK	UHALP9108-A	0645	2015/08/31 2016/08/30
Anechoic Chamber 3 m	JSE	COAC3M-01	---	2015/05/07 2016/05/06
Attenuator 3 dB	JFW	50FP-003-H2	---	2015/03/13 2016/03/12
RF Cable RF Selector (30 MHz to 1 GHz)	Fujikura	8D-2W	OC14	2015/05/11 2016/05/10
	SUHNER	RG223/U	OC11	
		RG214/U	OC15 OC16	
		RG400/U	OC17	
	TSJ	RFM-E121	03149	
Software	TOYO	EP5/RE (ver 5.7.1)	---	---



6. List of Test and Measurement Instruments (Continued)

Transmitter Spurious Emissions (Radiated) (Above 1 GHz) / Band Edge Measurement Receiver Spurious Emissions (Radiated) (Above 1 GHz)

Instruments	Manufacturer	Model	Serial No.	Calibrated Date/Until
EMI Test Receiver	Agilent Technologies	N9038A	MY54130015	2015/10/14 2016/10/13
Pre-Amplifier	TSJ	MLA-0120AML -34	---	2015/11/13 2016/11/12
Double Ridged Broadband Horn Antenna (1 GHz to 18 GHz)	SCHWARZBECK	BBHA9120D	443	2015/11/02 2016/11/01
Standard Gain Horn Antenna (8.2 GHz to 12.4 GHz)	MI Technologies	12-8.2 093290	22856NL	2015/10/21 2016/10/20
Standard Gain Horn Antenna (12.4 GHz to 18 GHz)	MI Technologies	12-12 093275	22857NL	2015/10/21 2016/10/20
Standard Gain Horn Antenna (18 GHz to 26.5 GHz)	ETS LINDGREN / TSJ	3160-09 / MLA- 1826POM-30	00034723 / ---	2015/11/05 2016/11/04
Anechoic Chamber 3 m	JSE	COAC3M-01	---	2015/05/07 2016/05/06
RF Cable (1 GHz to 18 GHz)	STORM	TRUE BLUE 290	OC18 OC19 OC20	2015/05/11 2016/05/10
RF Cable (18 GHz to 40 GHz)	SUHNER	SUCOFLEX 102A	OC39	2015/12/17 2016/12/16
Attenuator 10 dB	JFW INDUSTRIES	50HF-010 N	1324	2015/07/24 2016/07/23
Notch Filter	MICRO -TRONICS	BRM50702	027	2015/02/03 2016/02/29
Software	TOYO	EP5/RE (ver 5.7.1)	---	---



6. List of Test and Measurement Instruments (Continued)

Maximum Peak Conducted Output Power and E.I.R.P. / Occupied Bandwidth

Instruments	Manufacturer	Model	Serial No.	Calibrated Date/Until
Spectrum Analyzer	ANRITSU CORP.	MS2687B	6200162706	2015/07/22 2016/07/31

6 dB Bandwidth / Conducted Spurious Emission / Power Spectral Density

Instruments	Manufacturer	Model	Serial No.	Calibrated Date/Until
EMI Test Receiver	Agilent Technologies	N9038A	MY54130015	2015/10/14 2016/10/13
Software	KEYSIGHT TECHNOLOGIES	JPJ5A1NN14100 (Ver 1.60)	---	---

7. Appendix

Refer to separated files for the following appendixes.

Appendix 1: Angle of EUT

Appendix 2: Photographs of the Test Setup

Appendix 3: Photographs of EUT