TEST REPORT

Issued: 2021-03-01

Name and Address of the Customer:	TOHNICHI MFG. CO., LTD. 2-12, Omori-kita 2-Chome Ota-ku, Tokyo 143-0016, Japan
Test Item:	RF Module
Identification:	FHLSM
Serial No.:	E201023, E201023-1
FCC ID:	UY6-FHLSM
ISED Certification Number:	6561B-FHLSM
Sample No.:	1
Sample Condition:	Good
Sample Receipt Date:	2020-10-23
Test Specification:	☒ Full items with following standard(s) ☐ Limited items with following standard(s) ☐ Requested items by client FCC Part 15 Subpart C RSS-247 Issue 2, RSS-Gen Issue 5
Test Result:	Refer to "2. Summary of Test Results"
Period of Testing:	2020-11-19 to 2021-02-23

Representative Test Personnel:	(Hiroki Onishi)	iNARTE : EMC-003318-NT
Checked by:	(Keisuke Miyaji)	iNARTE : EMC-003627-NE
Approved by:	(Yasuhiro Kawahara)	iNARTE : EMC-002846-NE

Cosmos Corporation
718-1 Katsurase-cho, Matsusaka-shi, Mie 515-1104, JAPAN

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2. 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.
3. The results of this test report validates the test item only specified in "2. Summary of Test Results".
4. This test results in this test report are traceable to the national or international standards.
5. The opinions and the interpretations to the result of the description in this report are outside scope where Cosmos Corp. been accredited.
6. This Test Report is issued by private test house (Cosmos Corporation), therefore this test report must not be used by the customer to claim product certification, approval, or endorsement by A2LA or US government

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1. Description of the Tested Sample

1.1 Product Description

Product	RF Module
Model (referred to as the EUT)	FHLSM
Manufacturer	TOHNICHI MFG. CO., LTD.
Hardware Version	Ver.02
Software Version	Ver.44_06
Type of the Equipment	☐ Stand-alone ☐ Combined Equipment ☒ Plug-in Radio Device ☐ Other ( )
Transmitter Type	☐ WLAN ( ) ☐ Bluetooth ( ) ☐ ZigBee ☐ RFID ( ) ☒ Other
Antenna Type	☒ Integral Antenna ☐ Dedicated External Antenna
Number of Antenna	1 Antenna
Operating Frequency Range	2402 MHz to 2479 MHz
Number of Channel	78 ch
Type of Modulation	☒ FHSS (GFSK) ☐ Other than FHSS
Emission Designator	W7D
Type of Power Source	☐ AC Mains ☐ Dedicated AC Adaptor ☒ DC Voltage ☐ Battery
Input Power Rating	DC 3 V
Type of Battery (if applicable)	N/A
Thermal Limitation	0 °C to 50 °C

1.2 Antenna Description

Model	Gain	Antenna Type
Un-specified *	0 dBi	Pattern Antenna

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

1.3 EUT Description

Equipment under test is as follow:

Equipment	Model	Serial No.
RF Module (EUT1) *1	FHLSM	E201023
RF Module (EUT2) *2	FHLSM	E201023-1

Note:

*1: This equipment was used during the following tests;
20 dB Bandwidth, Carrier Frequency Separation, Number of Hopping Channels, Time of Occupancy, Maximum Peak Conducted Output Power, Band Edge Measurement, Conducted Spurious Emission and Occupied Bandwidth.

*2: This equipment was used during the following tests;
Transmitter Spurious Emissions (Radiated) and Band Edge Measurement.

2. Summary of Test Results

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

FCC Section	ISED Section	Test Description	FCC Result	ISED Result
15.207	RSS-Gen, 8.8	AC Power Line Conducted Emission	N/A *1	N/A *1
15.209	RSS-Gen, 8.9	Transmitter Spurious Emission (Radiated)	PASS	PASS
15.215(c)	RSS-247, 5.1	20 dB Bandwidth	PASS	PASS
15.247(a)	RSS-247, 5.1	Carrier Frequency Separation	PASS	PASS
15.247(a)	RSS-247, 5.1	Number of Hopping Channels	PASS	PASS
15.247(a)	RSS-247, 5.1	Time of Occupancy	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, 5.5	Conducted Spurious Emission	PASS	PASS
15.247(d)	---	Band Edge Measurement	PASS	---
15.247(e)	RSS-247 5.2	Power Spectral Density	N/A *2	N/A *2
---	RSS-Gen, Annex A	Occupied Bandwidth	---	PASS
---	RSS-Gen, 7.3	Receiver Spurious Emission (Radiated)	---	N/A *3

Note:
*1: The EUT is battery-operated equipment.
*2: This item does not apply because it is not required for FHSS equipment.
*3: This item does not apply because it is required only for stand-alone receiver operating in the 30 MHz to 960 MHz and scanner receiver.

3. Test Condition

3.1 Mode of Operation

Mode A: 2.4 GHz Band Transmission

Note:
The EUT makes communication emission with the maximum RF power by a special test program.
Cycle: 2.04 ms, on-time: 0.22 ms

3.2 Additional Equipment

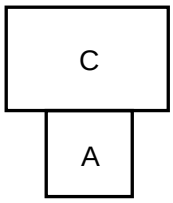
The equipment was tested together with additional peripherals.
The following peripherals were used during the tests:

Equipment	Model	Serial No.	Manufacturer
Electric Board Equipped Module	T-FHLSM-Sub Board	E201023	TOHNICHI MFG. CO., LTD.
Electric Board Equipped Module	T-FHLSM-Sub Board	E201023-1	TOHNICHI MFG. CO., LTD.

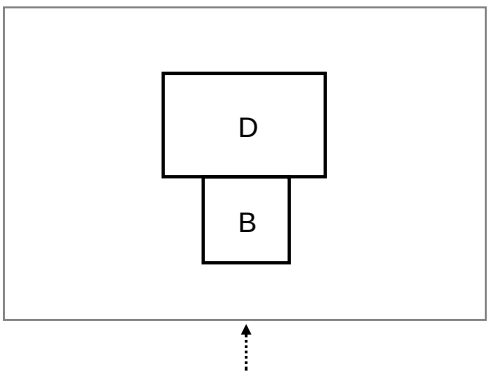
3.3 Configuration

	Equipment	Model
A	EUT1	FHLSM (Serial No.: E201023)
B	EUT2	FHLSM (Serial No.: E201023-1)
C	Electric Board Equipped Module	T-FHLSM-Sub Board (Serial No.: E201023)
D	Electric Board Equipped Module	T-FHLSM-Sub Board (Serial No.: E201023-1)

20 dB Bandwidth / Carrier Frequency Separation / Number of Hopping Channels / Time of Occupancy / Maximum Peak Conducted Output Power / Band Edge Measurement / Conducted Spurious Emission / Occupied Bandwidth

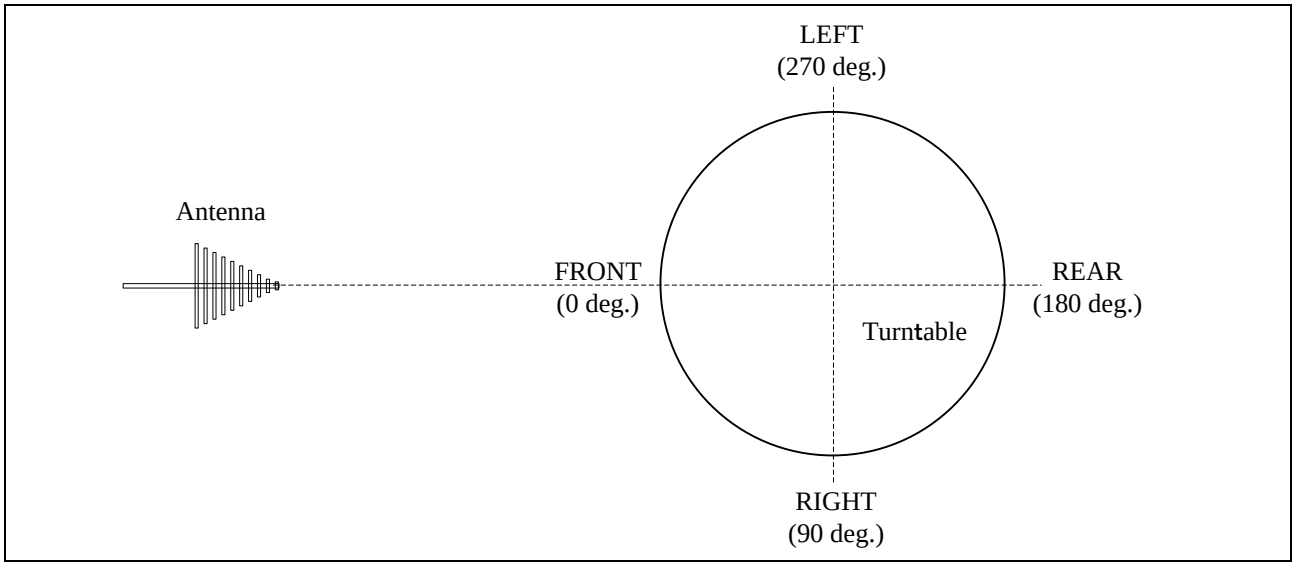


Transmitter Spurious Emissions (Radiated) /
Band Edge Measurement



Non-conductive table, 0.8 m high (Below 1 GHz)
Non-conductive table, 1.5 m high (Above 1 GHz)

3.4 EUT Angle


LEFT
(270 deg.)
Antenna
FRONT
(0 deg.)
REAR
(180 deg.)
Turntable
RIGHT
(90 deg.)

4. General Information

4.1 Test Methodology

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

4.2 Test Facility

The measurement was carried out at the following facility.

Cosmos Corporation EMC Lab. Oonoki
3571-2 Oonoki, Watarai-cho, Watarai-gun, Mie 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: VLAC Accredited Laboratory No. VLAC-039-2
FCC Designation No. JP5182

Recognition: ISED Canada CAB ID. JP0007

4.3 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.

5. Test Result

5.1 Transmitter Spurious Emission (Radiated) (15.209, RSS-Gen 8.9)

5.1.1 Setting Remarks

The test was performed in accordance with ANSI C63.10 clause 6.5 and 6.6.
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 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 25 GHz	Peak	1 MHz
	Average	1 MHz

5.1.2 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)

5.1.3 Test Detail

Result: PASS

Measurement instrumentation uncertainty	:	±4.56 dB (Below 1 GHz)	
	:	±4.50 dB (1 GHz to 18 GHz)	
	:	±4.43 dB (Above 18 GHz)	
Test operator	:	Masahiro Hirohara	
Date of testing	:	2020-11-27	2020-11-30
Room temperature	:	19 °C	20 °C
Relative humidity	:	41 %	45 %

Date of testing	:	2020-12-01
Room temperature	:	15 °C
Relative humidity	:	51 %

Sample Calculation
Result = Reading + c.f
= 21.3 + (−12.9)
= 8.4

Margin = Limit − Result
= 40.0 – 8.4
= 31.6

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

5.1.3 Test Detail (Continued)

<30 MHz to 1 GHz>

Worst Test Data (Tx 2402 MHz)

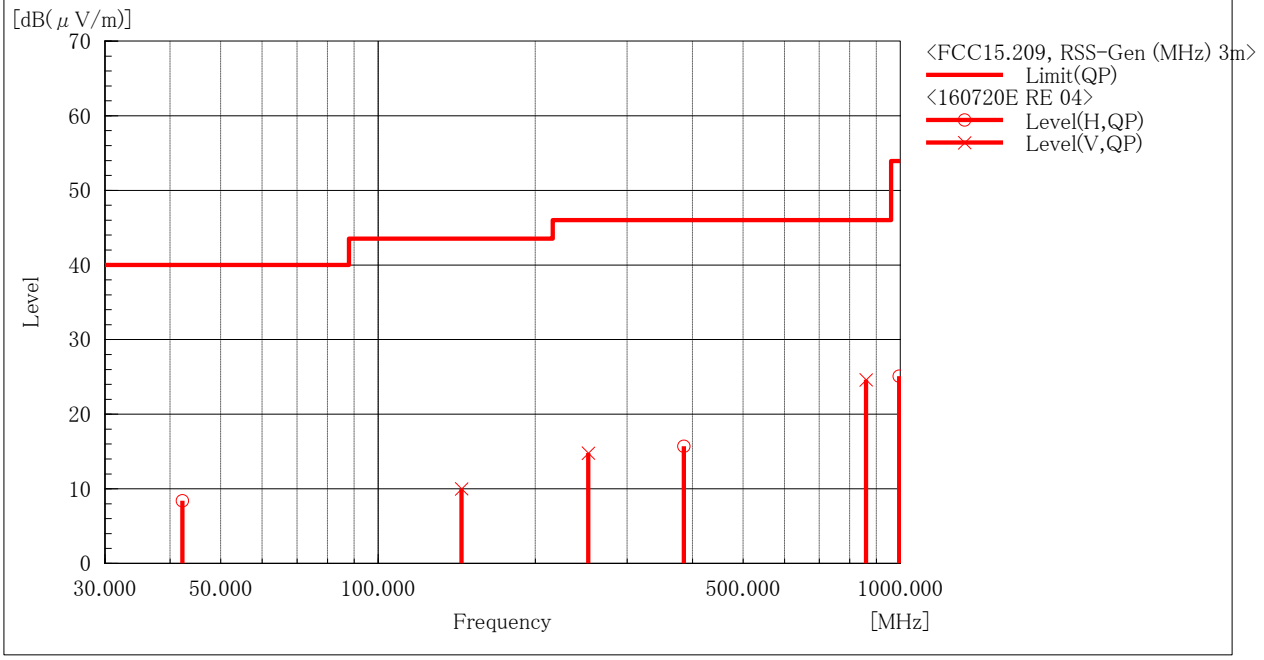
Cosmos Corporation
Oonoki Lab.

<<Radiated Emission EP5/RE Ver 5.7.1>>

1 December,2020 13:26
160720E RE 04.dat

Model : FHLSM
Serial : E201023
Operator : M. Hirohara
Power : DC 3V
Environment : 15℃, 51%, 1025hPa

Limit : FCC15.209, RSS-Gen (MHz) 3m
Mode : 2402MHz TX
Remark : X-axis
Remark :
Remark : RBW:120kHz



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	42.218	21.3	-12.9	8.4	40.0	31.6	400.0	244.2
2	384.963	20.5	-4.8	15.7	46.0	30.3	200.0	313.9
3	994.750	19.2	5.9	25.1	53.9	28.8	269.0	203.3

--- 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	144.514	20.7	-10.7	10.0	43.5	33.5	100.0	152.5
2	252.615	20.0	-5.2	14.8	46.0	31.2	100.0	324.8
3	860.525	20.9	3.7	24.6	46.0	21.4	200.0	4.6

5.1.3 Test Detail (Continued)

<30 MHz to 1 GHz>

Worst Test Data (Tx 2440 MHz)

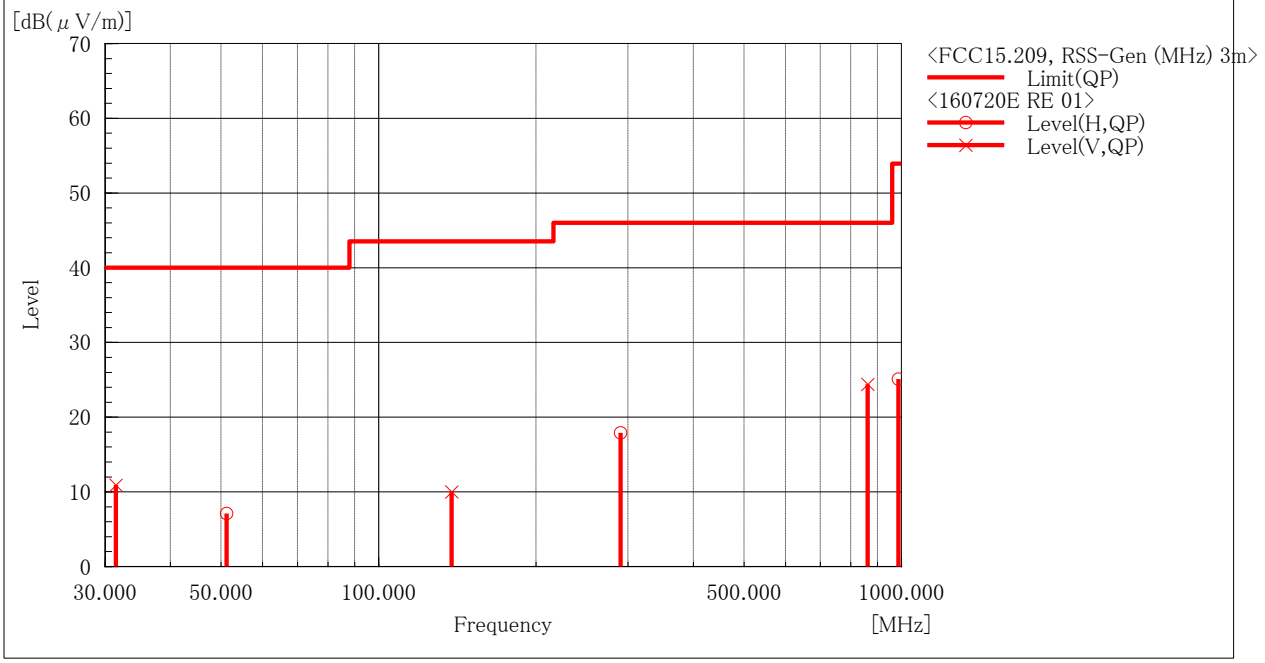
Cosmos Corporation
Oonoki Lab.

<<Radiated Emission EP5/RE Ver 5.7.1>>

1 December,2020 10:56
160720E RE 01.dat

Model : FHLSM
Serial : E201023
Operator : M. Hirohara
Power : DC 3V
Environment : 15℃, 51%, 1025hPa

Limit : FCC15.209, RSS-Gen (MHz) 3m
Mode : 2440MHz TX
Remark : X-axis
Remark :
Remark : RBW:120kHz



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	51.263	21.0	-13.9	7.1	40.0	32.9	100.0	310.6
2	290.348	20.3	-2.4	17.9	46.0	28.1	100.0	153.0
3	987.050	19.4	5.7	25.1	53.9	28.8	183.0	352.1

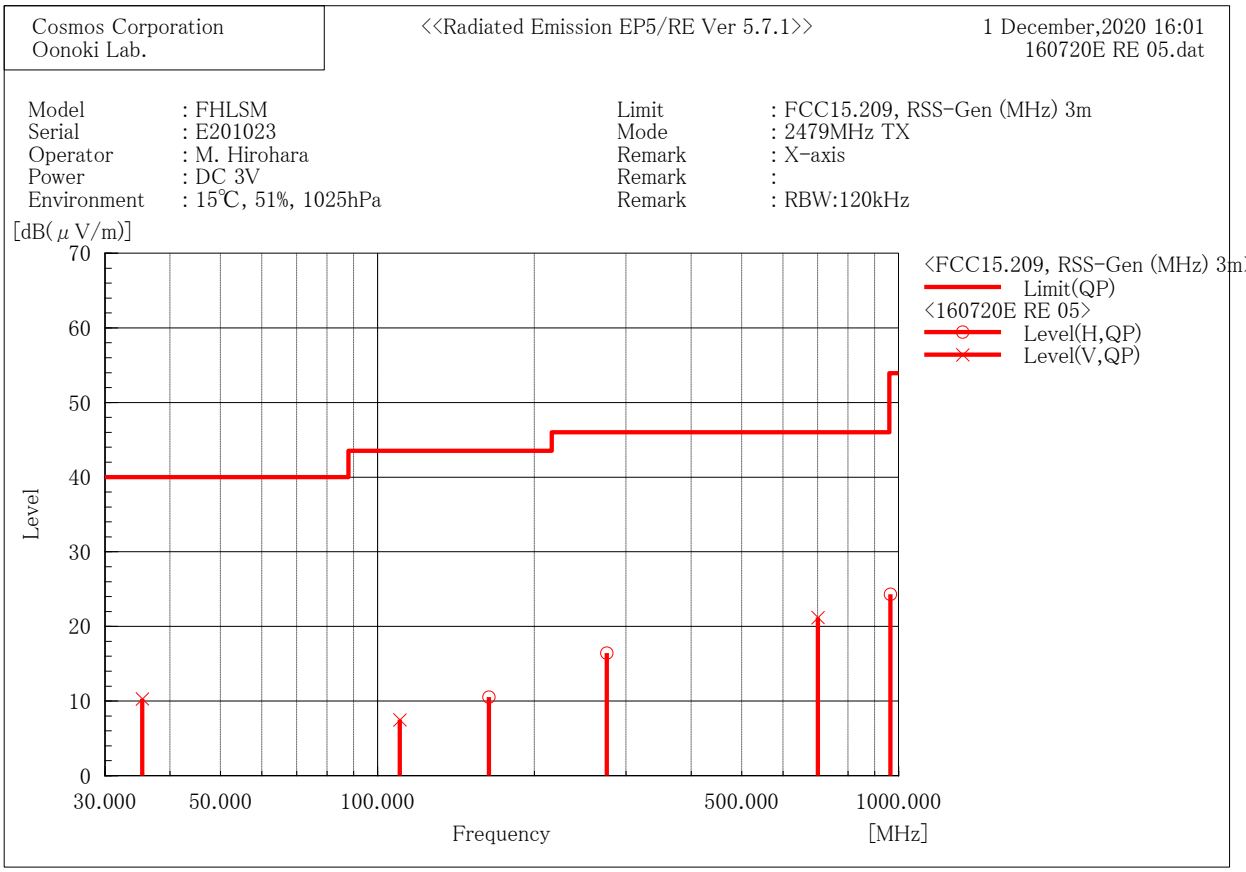
--- Vertical Polarization (QP)---

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	31.451	21.6	-10.7	10.9	40.0	29.1	100.0	180.1
2	138.034	21.0	-11.0	10.0	43.5	33.5	100.0	238.6
3	861.665	20.7	3.7	24.4	46.0	21.6	175.0	230.3

5.1.3 Test Detail (Continued)

<30 MHz to 1 GHz>

Worst Test Data (Tx 2479 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	163.616	20.4	-9.9	10.5	43.5	33.0	200.0	312.7
2	275.565	20.0	-3.6	16.4	46.0	29.6	200.0	312.7
3	964.475	19.2	5.1	24.3	53.9	29.6	100.0	237.4

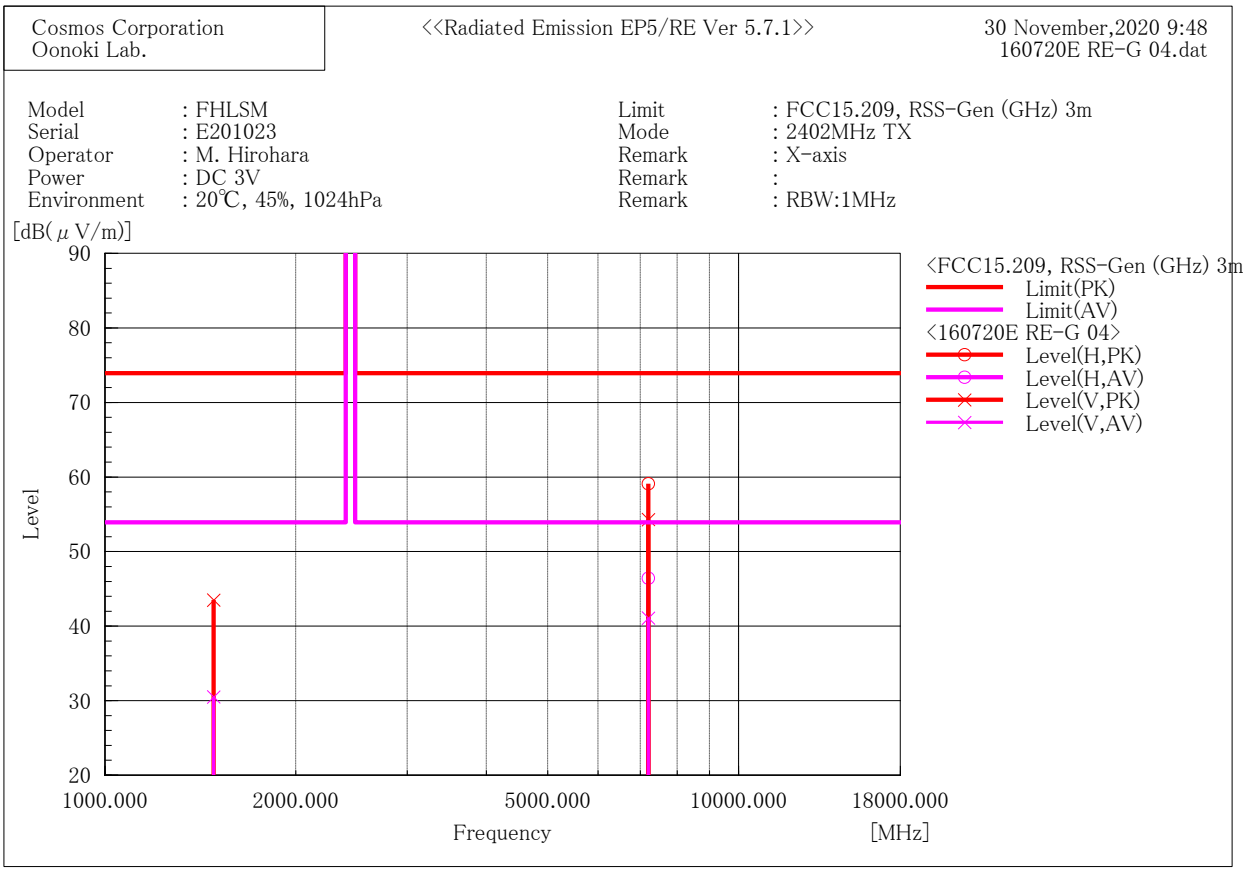
--- Vertical Polarization (QP)---

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	35.400	22.0	-11.7	10.3	40.0	29.7	200.0	310.8
2	110.426	20.3	-12.8	7.5	43.5	36.0	100.0	224.4
3	700.313	20.4	0.8	21.2	46.0	24.8	100.0	247.5

5.1.3 Test Detail (Continued)

<1 GHz to 18 GHz>

Worst Test Data (Tx 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	7206.784	48.8	10.3	59.1	73.9	14.8	100.0	16.0

--- 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	7206.784	36.1	10.3	46.4	53.9	7.5	100.0	16.0

--- 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	1485.167	49.0	-5.5	43.5	73.9	30.4	100.0	2.0
2	7206.400	44.0	10.3	54.3	73.9	19.6	102.0	359.0

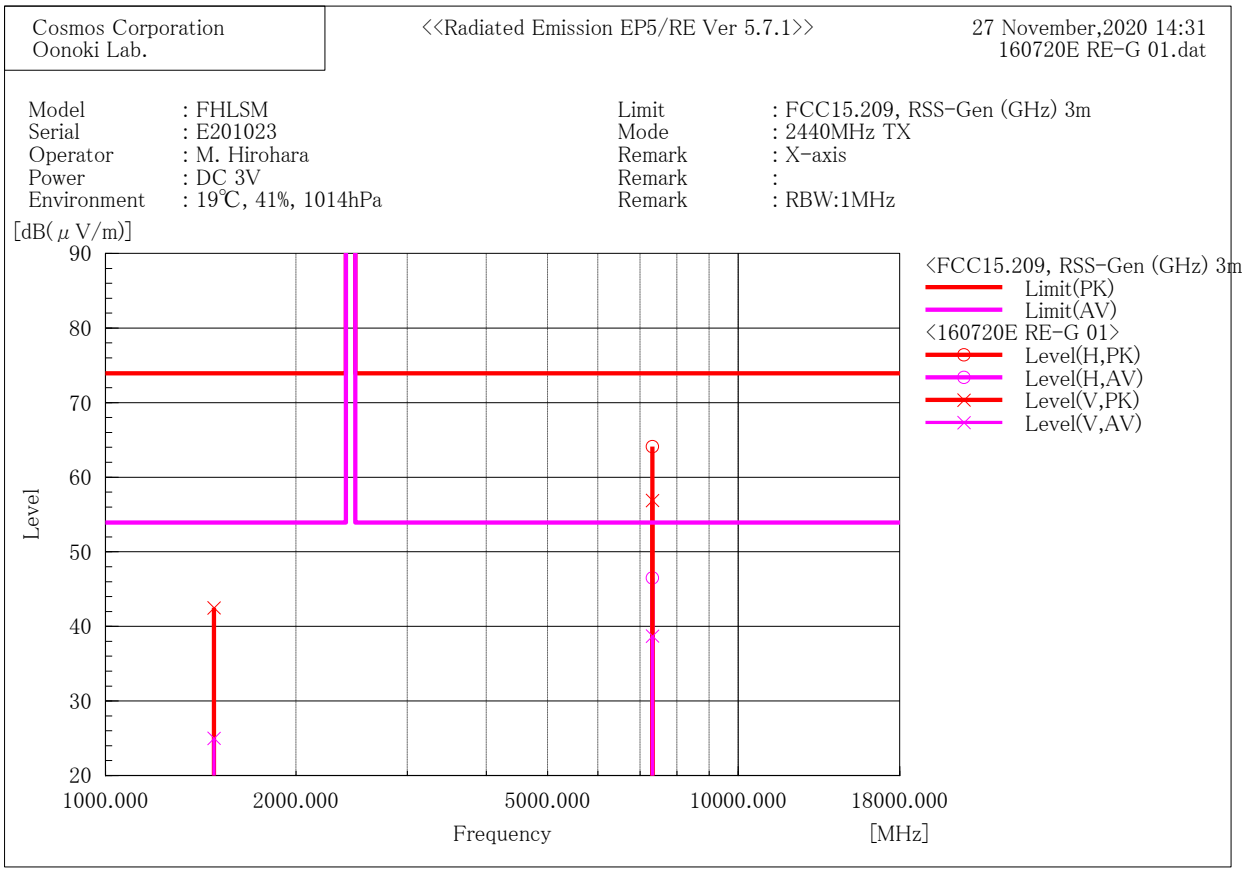
--- Vertical Polarization (AV)---

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	1485.167	36.0	-5.5	30.5	53.9	23.4	100.0	2.0
2	7206.400	30.8	10.3	41.1	53.9	12.8	102.0	359.0

5.1.3 Test Detail (Continued)

<1 GHz to 18 GHz>

Worst Test Data (Tx 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	7320.000	53.6	10.5	64.1	73.9	9.8	100.0	6.0

--- 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	7320.000	36.0	10.5	46.5	53.9	7.4	100.0	6.0

--- 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	1484.917	48.0	-5.5	42.5	73.9	31.4	100.0	14.0
2	7320.634	46.4	10.5	56.9	73.9	17.0	100.0	14.0

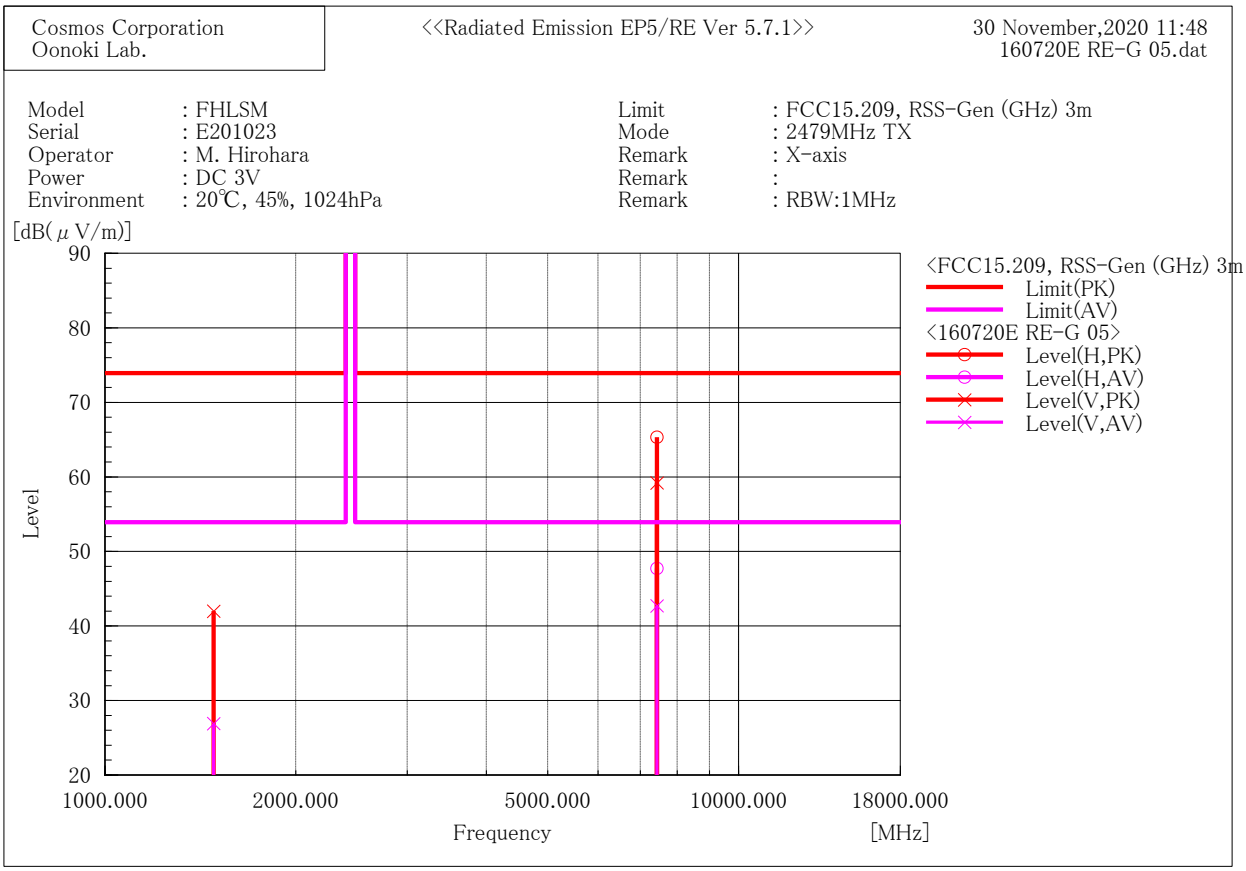
--- Vertical Polarization (AV)---

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	1484.917	30.5	-5.5	25.0	53.9	28.9	100.0	14.0
2	7320.634	28.2	10.5	38.7	53.9	15.2	100.0	14.0

5.1.3 Test Detail (Continued)

<1 GHz to 18 GHz>

Worst Test Data (Tx 2479 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	7437.550	54.8	10.5	65.3	73.9	8.6	100.0	178.0

--- 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	7437.550	37.2	10.5	47.7	53.9	6.2	100.0	178.0

--- 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	1484.833	47.5	-5.5	42.0	73.9	31.9	100.0	218.0
2	7437.934	48.7	10.5	59.2	73.9	14.7	100.0	288.0

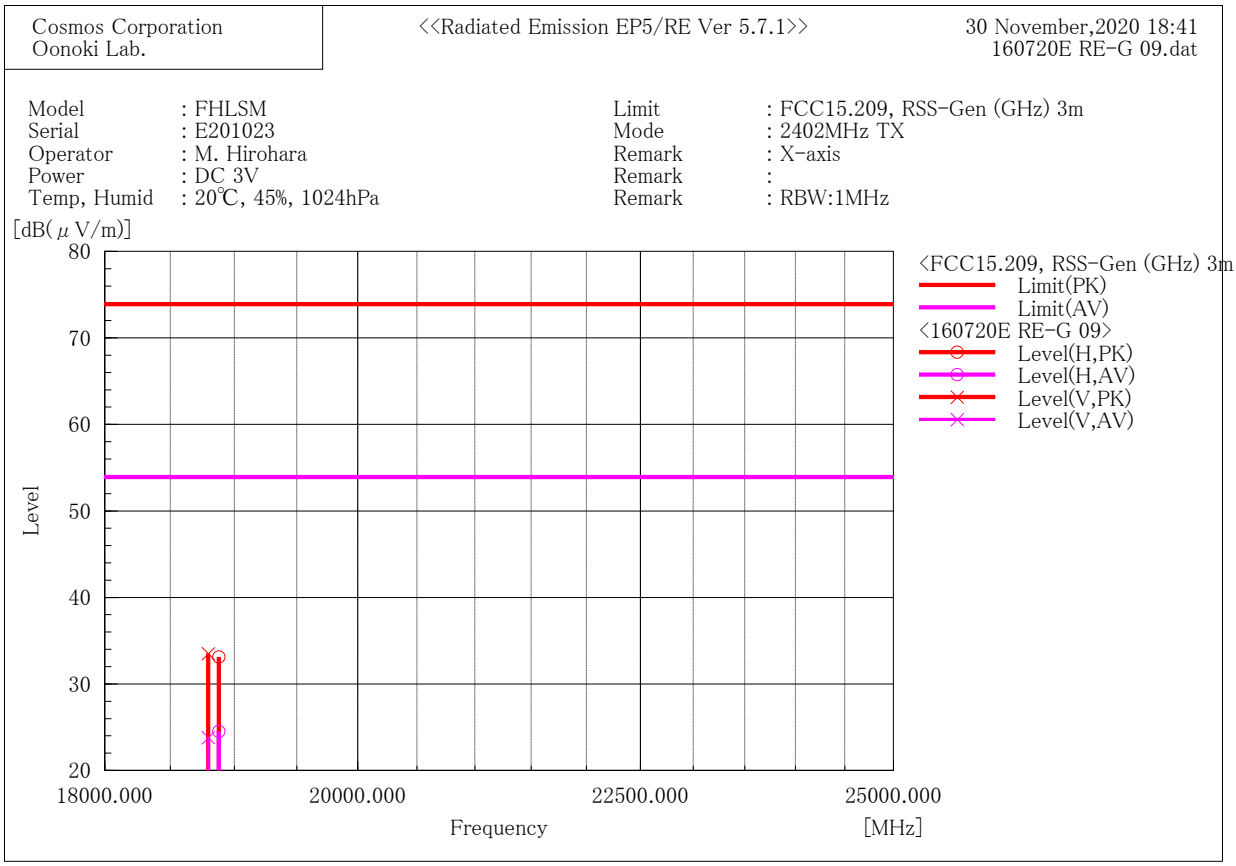
--- Vertical Polarization (AV)---

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	1484.833	32.4	-5.5	26.9	53.9	27.0	100.0	218.0
2	7437.934	32.2	10.5	42.7	53.9	11.2	100.0	288.0

5.1.3 Test Detail (Continued)

<18 GHz to 25 GHz>

Worst Test Data (Tx 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	18877.590	40.7	-7.6	33.1	73.9	40.8	254.0	75.7

--- 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	18877.590	32.1	-7.6	24.5	53.9	29.4	254.0	75.7

--- 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	18794.370	41.2	-7.7	33.5	73.9	40.4	101.3	149.4

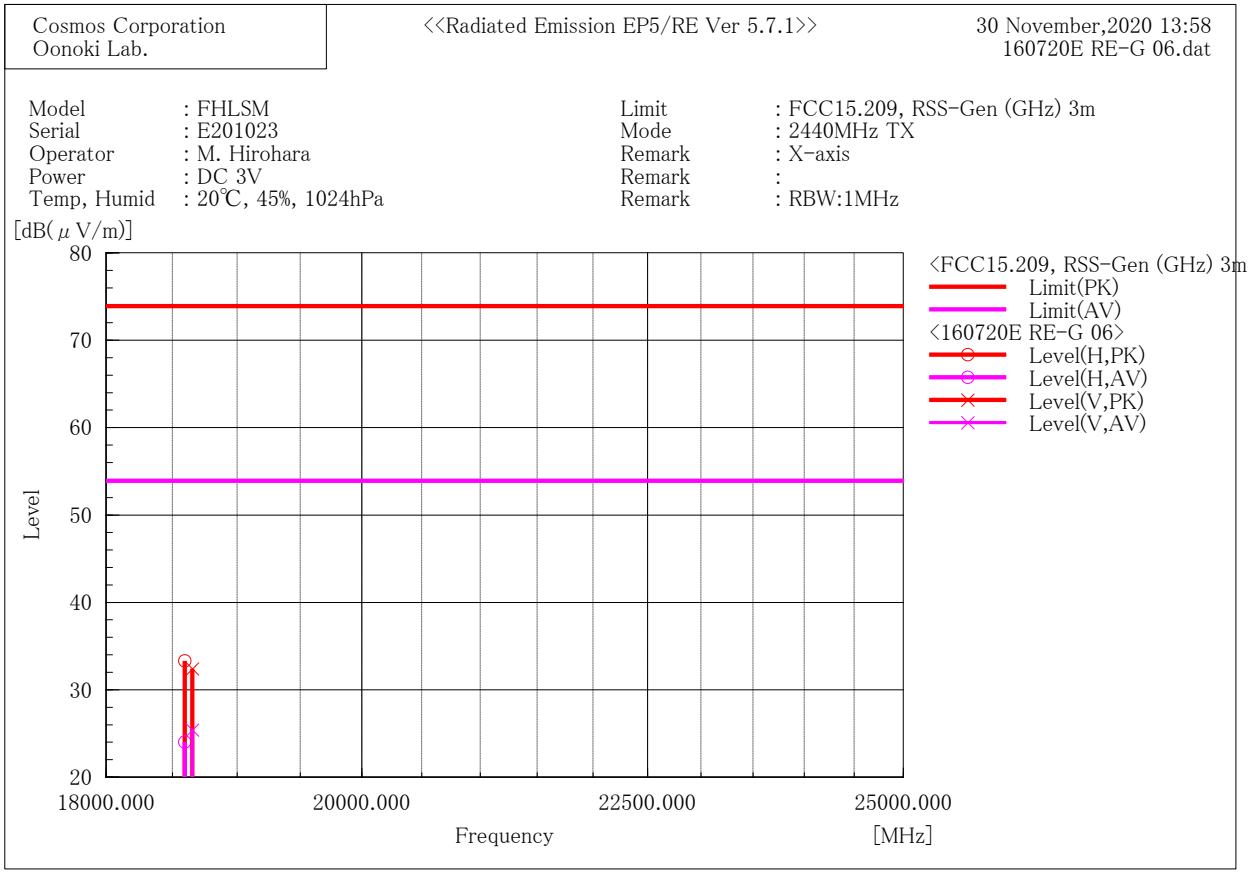
--- Vertical Polarization (AV)---

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	18794.370	31.5	-7.7	23.8	53.9	30.1	101.3	149.4

5.1.3 Test Detail (Continued)

<18 GHz to 25 GHz>

Worst Test Data (Tx 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	18594.740	41.2	-7.9	33.3	73.9	40.6	252.0	94.0

--- 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	18594.740	31.9	-7.9	24.0	53.9	29.9	252.0	94.0

--- 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	18652.810	40.2	-7.8	32.4	73.9	41.5	100.0	346.0

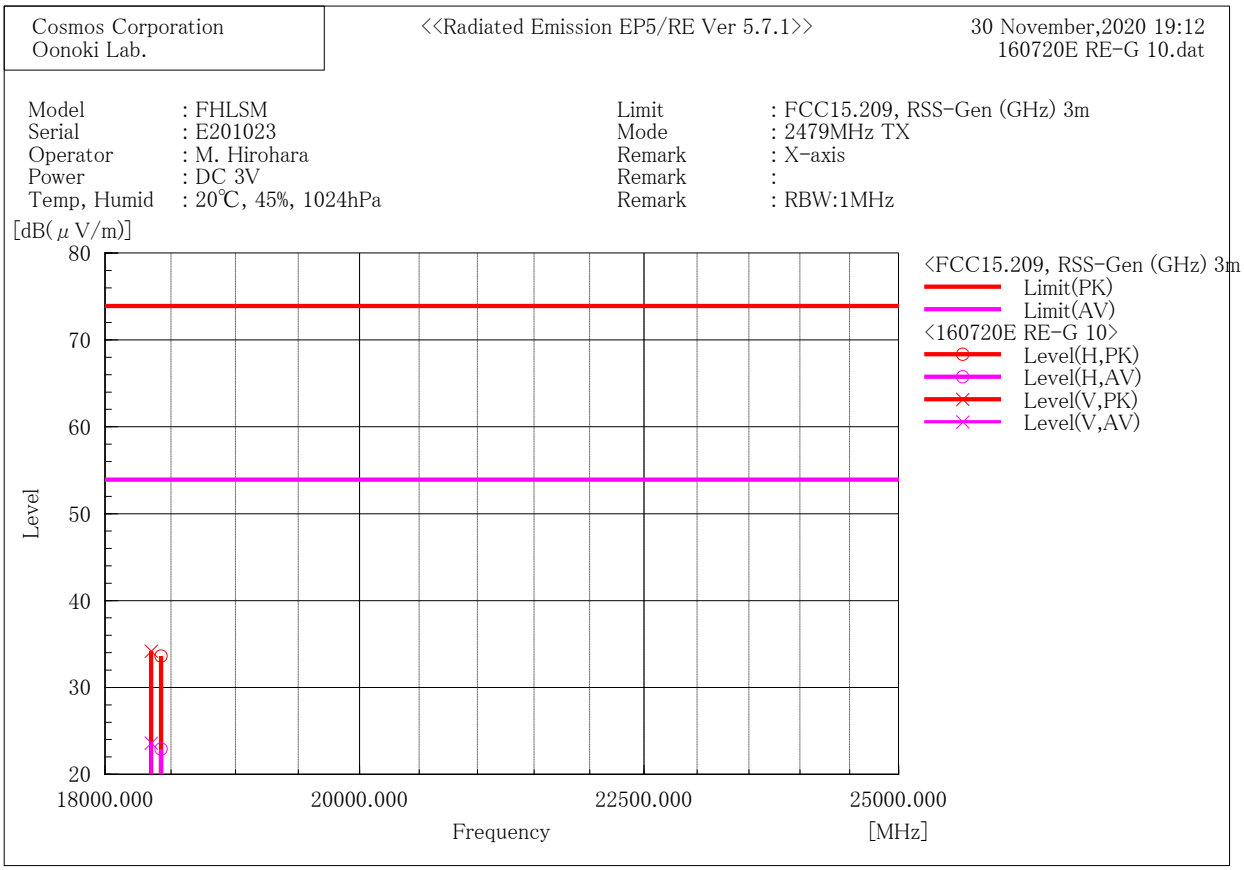
--- Vertical Polarization (AV)---

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	18652.810	33.2	-7.8	25.4	53.9	28.5	100.0	346.0

5.1.3 Test Detail (Continued)

<18 GHz to 25 GHz>

Worst Test Data (Tx 2479 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	18422.850	41.5	-7.9	33.6	73.9	40.3	250.0	287.3

--- 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	18422.850	30.8	-7.9	22.9	53.9	31.0	250.0	287.3

--- 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	18346.890	42.1	-7.9	34.2	73.9	39.7	100.0	163.0

--- 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	18346.890	31.5	-7.9	23.6	53.9	30.3	100.0	163.0

5.2 20 dB Bandwidth (15.215(c), RSS-247 5.1)

5.2.1 Setting Remarks

The both side of 20 dB down value from peak power were measured by spectrum analyzer in accordance with ANSI C63.10 clause 6.9.2.
The spectrum analyzer is set as following:

・Frequency Span	: 3 MHz
・Resolution Bandwidth	: 15 kHz
・Video Bandwidth	: 47 kHz
・Detector Mode	: Peak
・Trace Mode	: Max Hold

5.2.2 Limit

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

5.2.3 Test Detail

Result: PASS

Measurement instrumentation uncertainty	:	±0.080 %
Test operator	:	Keisuke Miyaji
Date of testing	:	2020-11-19
Room temperature	:	26 °C
Relative humidity	:	52 %

5.2.3 Test Detail (Continued)

Test Data

Frequency	Measured Bandwidth [kHz]
2402 MHz	531
2440 MHz	603
2479 MHz	456

Representative Test Data

5.3 Carrier Frequency Separation (15.247(a), RSS-247 5.1)

5.3.1 Setting Remarks

The test was performed in accordance with ANSI C63.10 clause 7.8.2.
The spectrum analyzer is set as following:

・Frequency Span	: 4.122 MHz
・Resolution Bandwidth	: 30 kHz
・Video Bandwidth	: 300 kHz
・Detector Mode	: Peak
・Trace Mode	: Max Hold

5.3.2 Limit

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

5.3.3 Test Detail

Result: PASS

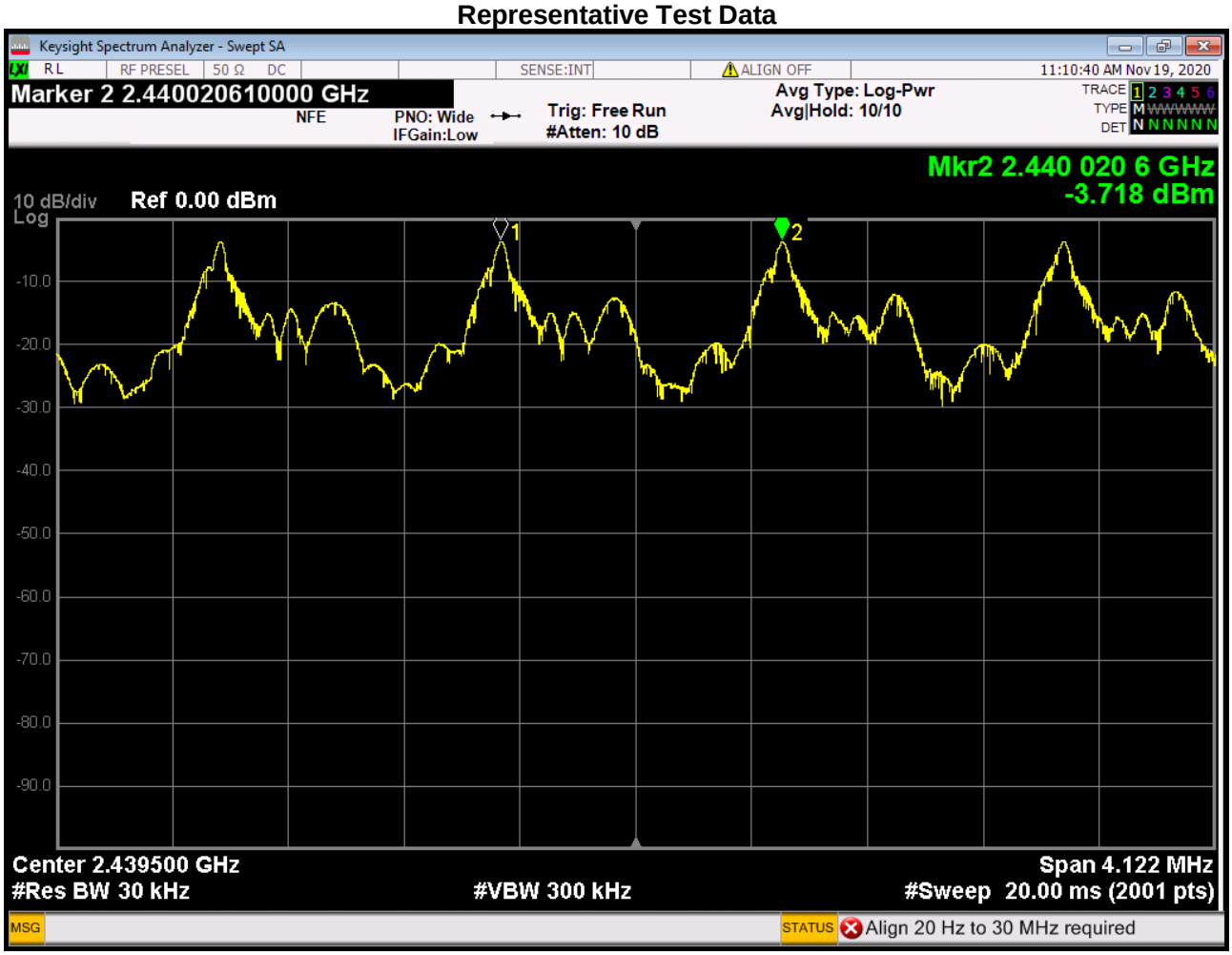
Measurement instrumentation uncertainty	:	±0.080 %
Test operator	:	Keisuke Miyaji
Date of testing	:	2020-11-19
Room temperature	:	23 °C
Relative humidity	:	58 %

5.3.3 Test Detail (Continued)

Test Data

Carrier Frequency Separation [kHz]	Limit [kHz]
1000	>603 (>20 dB BW)

Representative Test Data



5.4 Number of Hopping Channels (15.247(a), RSS-247 5.1)

5.4.1 Setting Remarks

The test was performed in accordance with ANSI C63.10 clause 7.8.3.
The spectrum analyzer is set as following:

・Frequency Span	: 83.5 MHz
・Resolution Bandwidth	: 100 kHz
・Detector Mode	: Peak
・Trace Mode	: Max Hold

5.4.2 Limit

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

5.4.3 Test Detail

Result: PASS

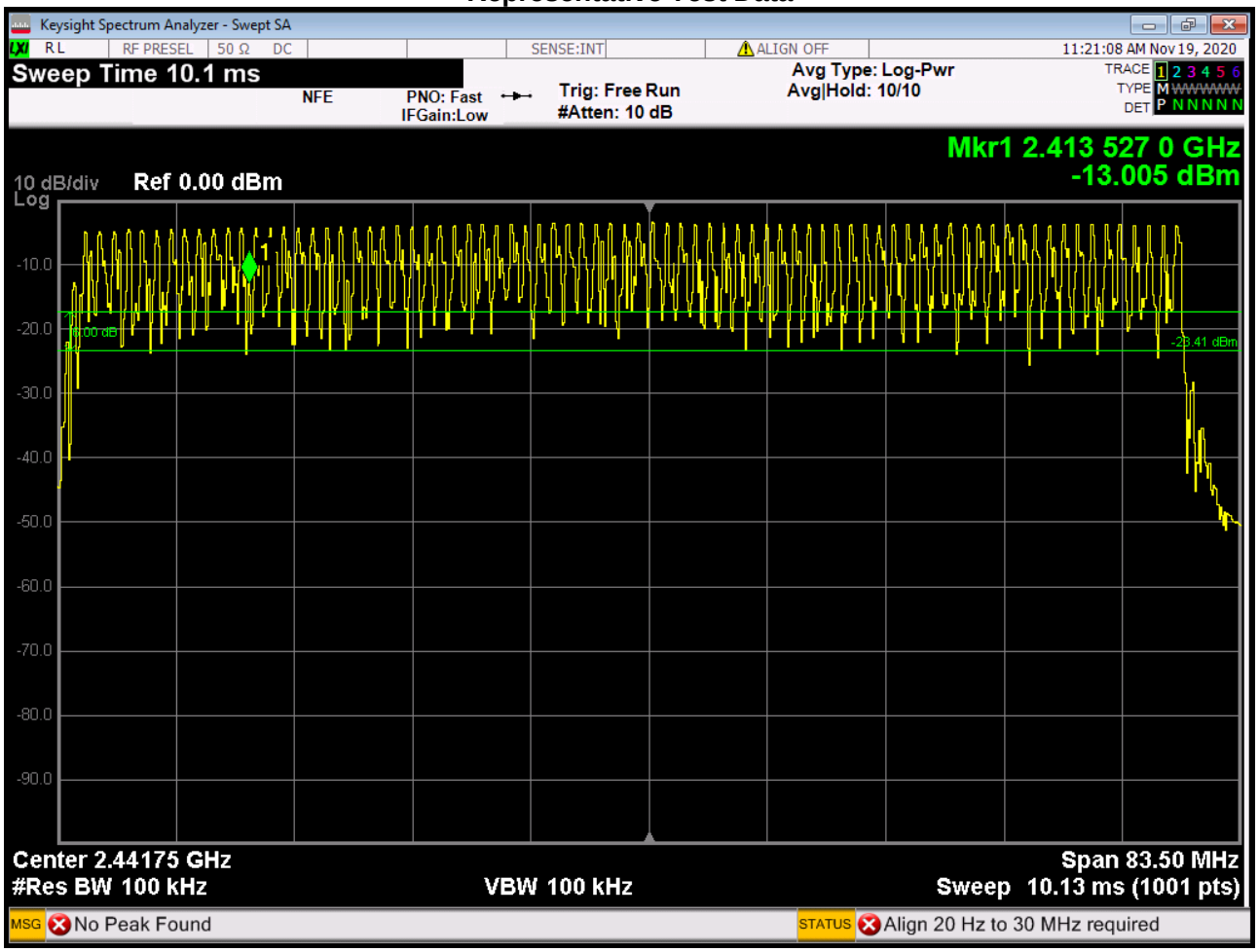
Test operator	:	Keisuke Miyaji
Date of testing	:	2020-11-19
Room temperature	:	23 °C
Relative humidity	:	58 %

5.4.3 Test Detail (Continued)

Test Data

Number of Channels	Limit
78	>15

Representative Test Data



5.5 Time of Occupancy (15.247(a), RSS-247 5.1)

5.5.1 Setting Remarks

The test was performed in accordance with ANSI C63.10 clause 7.8.4.
The spectrum analyzer is set as following:

・Span	: 0 Hz
・Sweep Time	: 3.12 s

5.5.2 Limit

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

5.5.3 Test Detail

Result: PASS

Measurement instrumentation uncertainty	:	±0.012 %
Test operator	:	Junya Takashiba
Date of testing	:	2021-02-23
Room temperature	:	20 °C
Relative humidity	:	54 %

5.5.3 Test Detail (Continued)

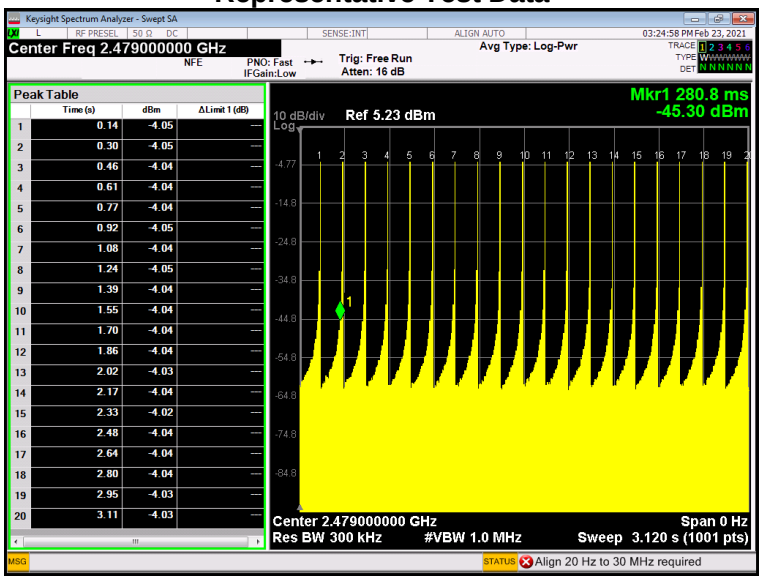
Measurement Period (31.2 S) = Sweep Time (3.12 s) × 10

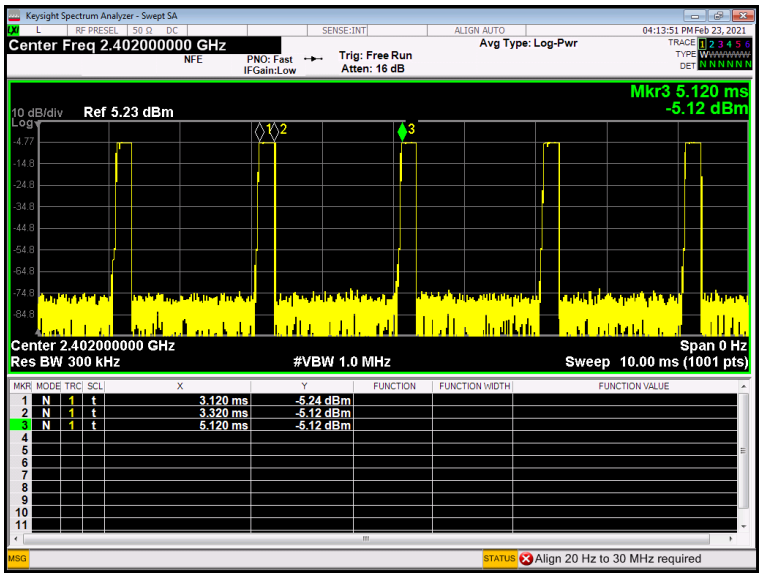
Number of pulse: 20 pulse × 10 = 200 pulse

Test Data

Dwell Time of Each Pulse [ms]	Number of Pulse	Time of Occupancy [ms]	Limit [ms]
0.20	200	40	400

Representative Test Data





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

5.6.1 Setting Remarks

The test was performed in accordance with ANSI C63.10 clause 7.8.5.
The spectrum analyzer is set as following:

・Resolution Bandwidth	: 3 MHz (Greater than 20 dB Bandwidth)
・Video Bandwidth	: 8 MHz
・Detector Mode	: Peak
・Trace Mode	: Max Hold

5.6.2 Limit

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels: 1 watt.
For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

5.6.3 Test Detail

Result: PASS

Measurement instrumentation uncertainty	:	±2.45 dB
Test operator	:	Keisuke Miyaji
Date of testing	:	2020-11-19
Room temperature	:	23 °C
Relative humidity	:	58 %

5.6.3 Test Detail (Continued)

Sample Calculation

Margin = Limit − Peak Power
= 30 − (−2.01)
≒ 32.0

Conducted Output Power Data

Frequency	Peak Power [dBm]	Limit [dBm]	Margin [dB]
2402 MHz	-2.01	30	32.0
2440 MHz	-0.83	30	30.8
2479 MHz	-1.28	30	31.3

E.I.R.P. Data

Frequency	E.I.R.P [dBm]	Limit [dBm]	Margin [dB]
2402 MHz	-2.01	36	38.01
2440 MHz	-0.83	36	36.83
2479 MHz	-1.28	36	37.28

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

5.7.1 Setting Remarks

The test was performed in accordance with ANSI C63.10 clause 6.7 and 7.8.8.
The Spectrums are scanned from 30 MHz 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

5.7.2 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.

5.7.3 Test Detail

Result: PASS

Measurement instrumentation uncertainty	:	±2.45 dB
Test operator	:	Keisuke Miyaji
Date of testing	:	2020-11-19
Room temperature	:	23 °C
Relative humidity	:	58 %

5.7.3 Test Detail (Continued)

Test Data

Fundamental Frequency	Measurement Frequency	Reading [dBm]	Fundamental Level [dBm]	Correction Factor [dB]	Relative Value [dBc]	Limit [dB]	Margin [dB]
2402 MHz	1201 MHz	-49.055	-4.18	-1.030	-45.91	-20	25.9
	7206 MHz	-47.595		2.098	-41.32	-20	21.3

Fundamental Frequency	Measurement Frequency	Reading [dBm]	Fundamental Level [dBm]	Correction Factor [dB]	Relative Value [dBc]	Limit [dB]	Margin [dB]
2440 MHz	1220 MHz	-48.415	-3.08	-0.967	-46.30	-20	26.3
	7320 MHz	-47.851		2.239	-42.53	-20	22.5

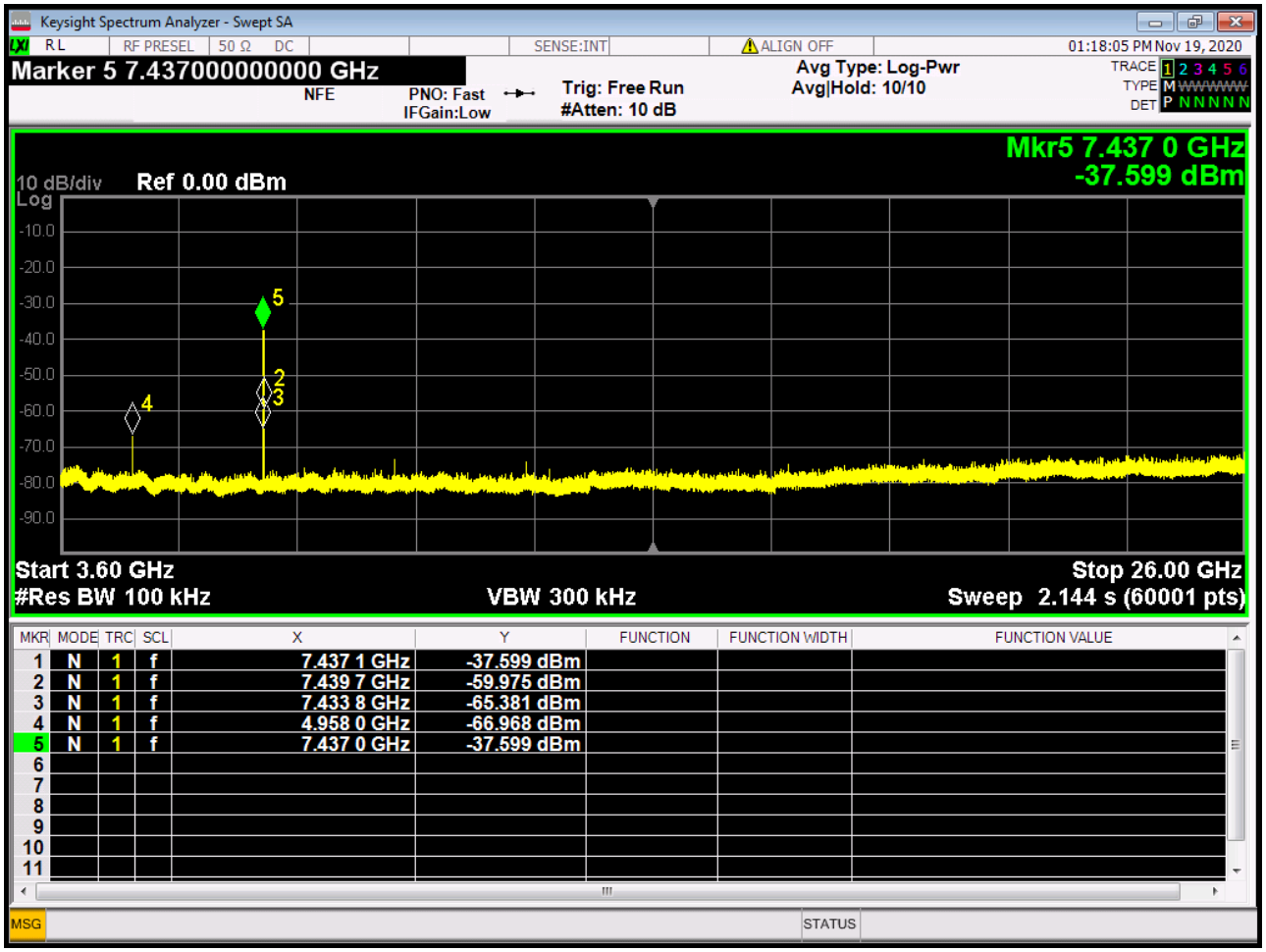
Fundamental Frequency	Measurement Frequency	Reading [dBm]	Fundamental Level [dBm]	Correction Factor [dB]	Relative Value [dBc]	Limit [dB]	Margin [dB]
2479 MHz	1239.5 MHz	-50.819	-3.64	-0.924	-48.10	-20	28.1
	7437 MHz	-37.599		2.402	-31.56	-20	11.6

Note:
Correction Factor is the difference in the cable loss of Measurement Frequency and the cable loss of Fundamental Frequency.

5.7.3 Test Detail (Continued)

Worst Test Data

<3.6 GHz to 26 GHz TX 2402 MHz>



5.8 Band Edge Measurement (15.247(d))

5.8.1 Setting Remarks

The test was performed in accordance with ANSI C63.10 clause 6.10.
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, 1.5 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

5.8.2 Test Detail

Result: PASS

Conducted Measurement

Measurement instrumentation uncertainty	:	±2.45 dB	
Test operator	:	Junya Takashiba	
Date of testing	:	2020-12-18	2021-02-23
Room temperature	:	21 °C	20 °C
Relative humidity	:	48 %	54 %

Radiated Measurement

Measurement instrumentation uncertainty	:	±4.50 dB
Test operator	:	Junya Takashiba
Date of testing	:	2020-12-16
Room temperature	:	16 °C
Relative humidity	:	56 %

5.8.2 Test Detail (Continued)

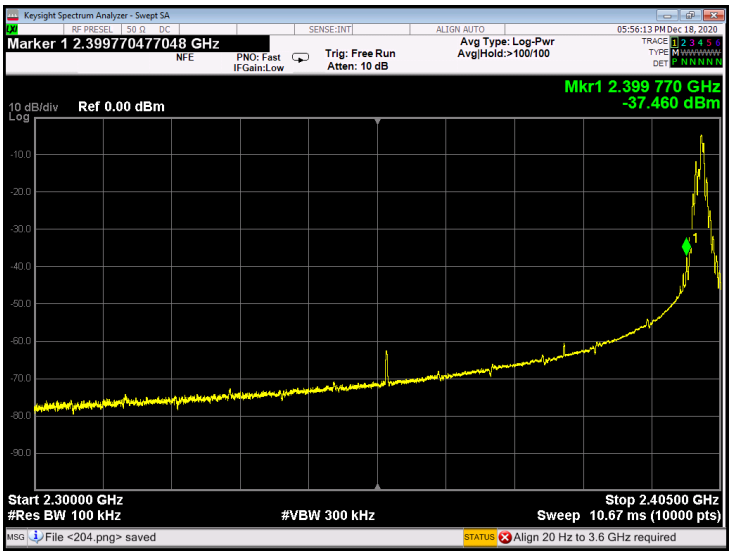
Conducted Measurement

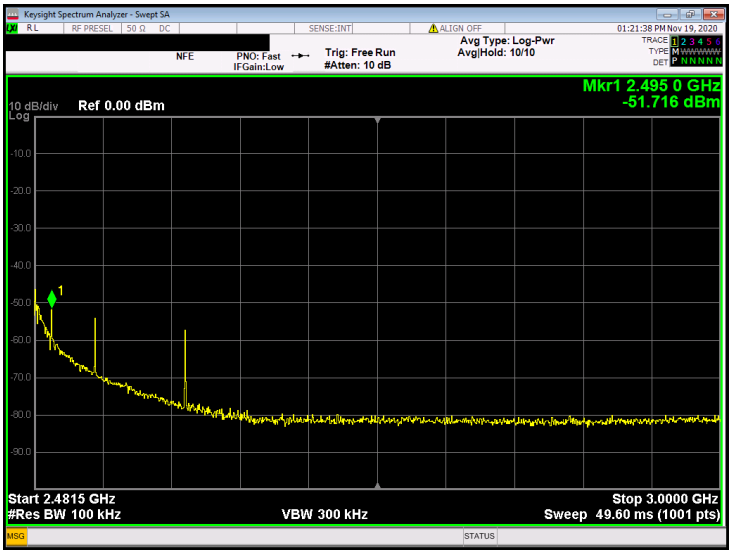
Sample Calculation

Relative Value = Band Edge(Reading) – Fundamental(Reading)
= −37.460 – (−4.782)
= −32.678

Test Data (Single Channel)

Operating Frequency [MHz]	Measurement Frequency [MHz]	Fundamental (Reading) [dBm]	Band Edge (Reading) [dBm]	Relative Value [dBc]	Limit [dBc]
2402.00	2399.77	-4.782	-37.460	-32.678	-20
2479.00	2495.00	-3.676	-51.716	-48.040	-20

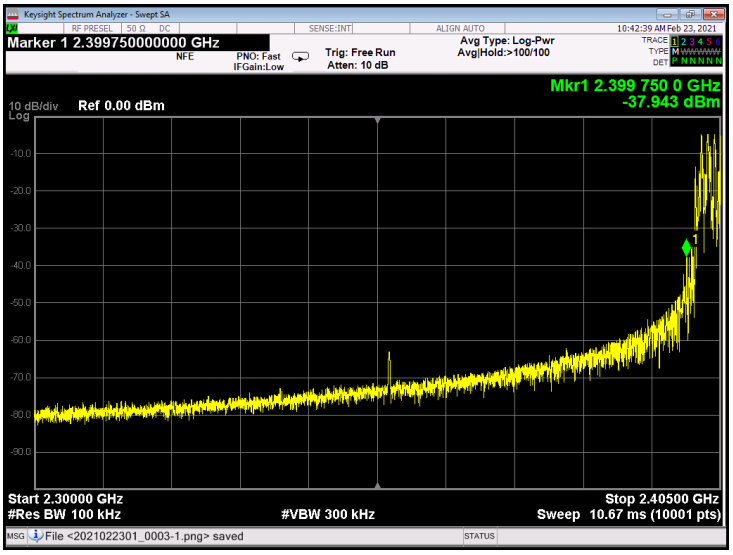


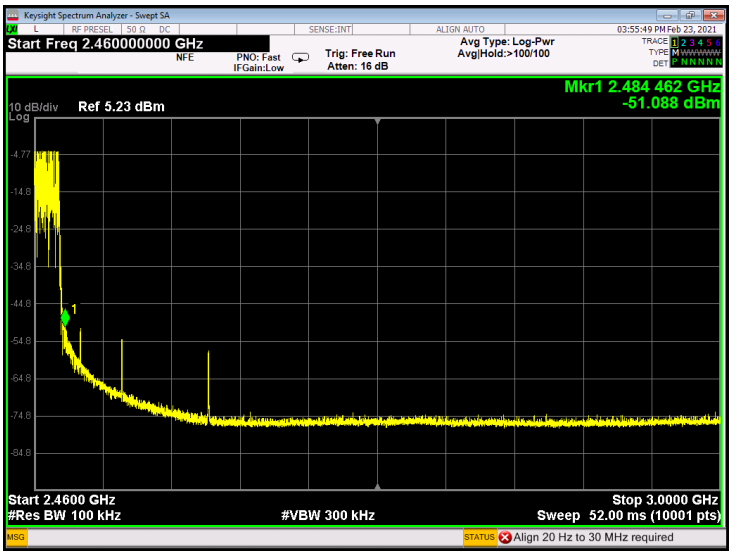


5.8.2 Test Detail (Continued)

Test Data (Hopping)

Operating Frequency [MHz]	Measurement Frequency [MHz]	Fundamental (Reading) [dBm]	Band Edge (Reading) [dBm]	Relative Value [dBc]	Limit [dBc]
2402.00	2399.75	-4.782	-37.943	-33.161	-20
2479.00	2484.46	-3.676	-51.088	-47.412	-20





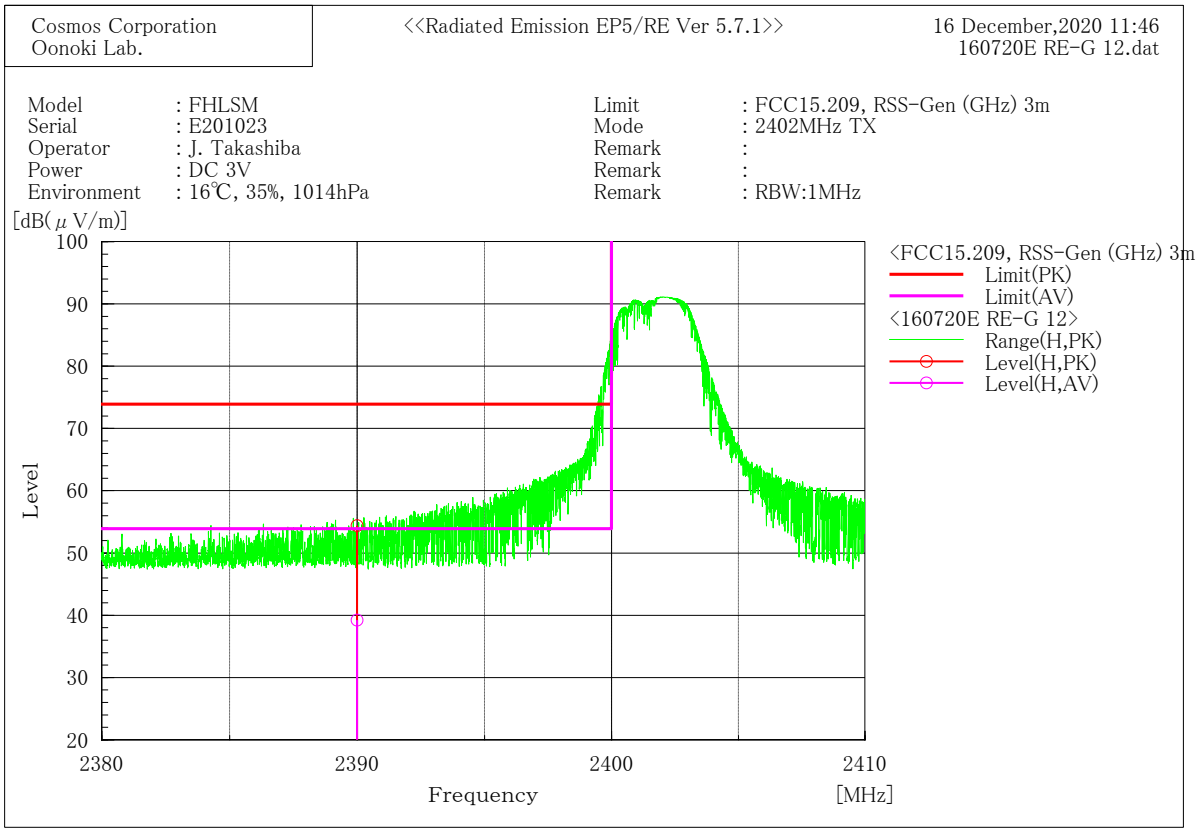
5.8.2 Test Detail (Continued)

Radiated Measurement

Sample Calculation

Result = Reading + c.f
= 44.7 + 9.7
= 54.4

Margin = Limit − Result
= 73.9 – 54.4
= 19.5



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	44.7	9.7	54.4	73.9	19.5	117.0	115.0

--- 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	29.5	9.7	39.2	53.9	14.7	117.0	115.0

5.8.2 Test Detail (Continued)

Test Data

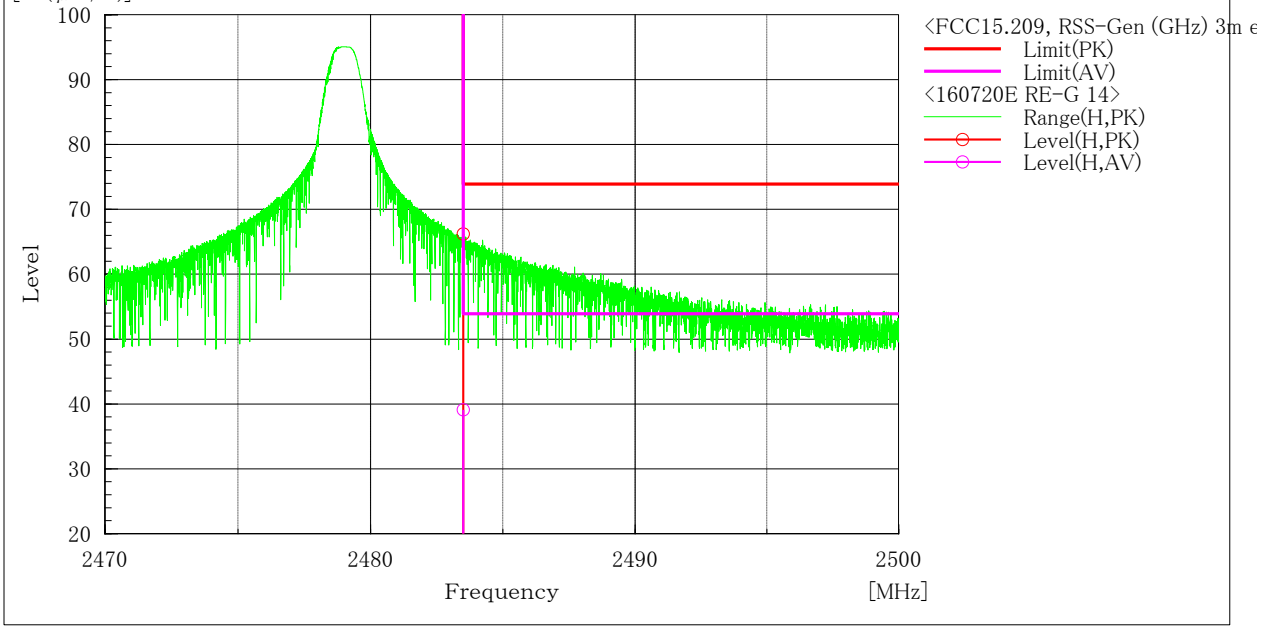
Cosmos Corporation
Oonoki Lab.

<<Radiated Emission EP5/RE Ver 5.7.1>>

16 December,2020 14:00
160720E RE-G 14.dat

Model : FHLSM
Serial : E201023
Operator : J. Takashiba
Power : DC 3V
Environment : 16℃, 35%, 1014hPa

Limit : FCC15.209, RSS-Gen (GHz) 3m
Mode : 2479MHz TX
Remark :
Remark :
Remark : RBW:1MHz



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	56.6	9.6	66.2	73.9	7.7	111.0	304.0

--- 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	29.5	9.6	39.1	53.9	14.8	111.0	304.0

5.9 Occupied Bandwidth (RSS-Gen Annex A)

5.9.1 Setting Remarks

The test was performed in accordance with ANSI C63.10 clause 6.9.3.
Occupied Bandwidth is measured by using 99% Bandwidth measurement function.
The spectrum analyzer is set as following:

- ・Resolution Bandwidth : 15 kHz
- ・Video Bandwidth : 47 kHz
- ・Detector Mode : Peak
- ・Trace Mode : Max Hold

5.9.2 Test Detail

Result: PASS

Measurement instrumentation uncertainty	:	±0.080 %
Test operator	:	Keisuke Miyaji
Date of testing	:	2020-11-19
Room temperature	:	26 °C
Relative humidity	:	52 %

Test Data

Frequency	Measured Bandwidth [kHz]
2402 MHz	1836
2440 MHz	2172
2479 MHz	1758

Representative Test Data

6. Test Instrument List

Transmitter Spurious Emissions (Radiated) (Below 1 GHz)

Instruments	Manufacturer	Model	Serial No.	Calibrated Date/Until
EMI Test Receiver	ROHDE & SCHWARZ	ESCI	100413	2020-03-31 2021-03-30
Pre-Amplifier (30 MHz to 1 GHz)	HEWLETT PACKARD	8447D OPT 010	2944A 07891	2020-05-18 2021-05-17
Biconical Antenna (30 MHz to 300 MHz)	SCHWARZBECK	VHBB9124 / BBA9106	9124-311	2020-11-10 2021-11-09
Log-Periodic Antenna (300 MHz to 1 GHz)	SCHWARZBECK	UHALP9108-A	0645	2020-11-10 2021-11-09
Anechoic Chamber 3 m	JSE	COAC3M-01	---	2020-02-04 2021-02-03
Attenuator 3 dB	JFW	50FP-003-H2	---	2020-05-13 2021-05-12
RF Cable RF Selector (30 MHz to 1 GHz)	Fujikura	8D-2W	OC14	2020-03-16 2021-03-15
	SUHNER	RG223/U	OC11	
		RG214/U	OC15 OC16	
		RG400/U	OC17	
	TSJ	RFM-E121	03149	
Software	TOYO	EP5/RE (ver 5.7.1)	---	---
Digital midi Thermometer Hygrometer	EMPEX	TD-8316	OE00520	2020-07-28 2021-07-27
Barometer	SATO	BAROMEX	04574	2019-08-09 2022-08-08

718-1 Katsurase-cho, Matsusaka-shi, Mie 515-1104, Japan Tel:+81-598-60-1827 Fax:+81-598-60-0300

6. Test Instrument List (Continued)

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

Instruments	Manufacturer	Model	Serial No.	Calibrated Date/Until
EMI Test Receiver	Agilent Technologies	N9038A	MY54130015	2020-06-08 2021-06-07
Pre-Amplifier	TSJ	MLA-0120AML -34	---	2020-09-15 2021-09-14
Double Ridged Broadband Horn Antenna (1 GHz to 18 GHz)	SCHWARZBECK	BBHA9120D	443	2020-11-10 2021-11-09
Standard Gain Horn Antenna (8.2 GHz to 12.4 GHz)	MI Technologies	12-8.2 093290	22856NL	2020-12-17 2021-12-16
Standard Gain Horn Antenna (12.4 GHz to 18 GHz)	MI Technologies	12-12 093275	22857NL	2020-12-17 2021-12-16
Standard Gain Horn Antenna (18 GHz to 26.5 GHz)	TOYO	HAP18-26N	00000013	2020-01-30 2021-01-29
Anechoic Chamber 3 m	JSE	COAC3M-01	---	2020-02-04 2021-02-03
Attenuator 6 dB	JFW INDUSTRIES	50HF-006 N	1306	2020-03-05 2021-03-04
Attenuator 10 dB	JFW INDUSTRIES	50HF-010N	1324	2020-10-01 2021-09-30
RF Cable (1 GHz to 18 GHz)	HUBER + SUHNER	SUCOFLEX 104A	MY1044/4A	2020-03-18 2021-03-17
	STORM	TRUE BLUE 290	OC20 OC49	
RF Cable (18 GHz to 40 GHz)	SUHNER	SUCOFLEX 102A	MY025/2A	2020-11-20 2021-11-19
Notch Filter	MICRO -TRONICS	BRM50702	027	2020-08-17 2021-08-16
Software	TOYO	EP5/RE (ver 5.7.1)	---	---
Digital midi Thermometer Hygrometer	EMPEX	TD-8316	OE00520	2020-07-28 2021-07-27
Barometer	SATO	BAROMEX	04574	2019-08-09 2022-08-08

6. Test Instrument List (Continued)

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

Instruments	Manufacturer	Model	Serial No.	Calibrated Date/Until
EMI Test Receiver	Agilent Technologies	N9038A	MY54130015	2020-06-08 2021-06-07
RF TEST SET	Agilent Technologies (MORITA TECH Co., Ltd.)	MT-747	13326	2020-11-04 2021-11-03
RF Cable	HUBER + SUHNER	SUCOFLEX 102	MY094/2 MY098/2	
Software	KEYSIGHT TECHNOLOGIES	JPJ5A1NN14100 (Ver 1.63)	---	---
Electric Thermometer/ Hygrometer	A & D	AD-5682	OE00533S	2020-07-28 2021-07-27
Barometer	SATO	BAROMEX	04574	2019-08-09 2022-08-08

7. Appendix

Refer to separated files for the following appendixes.
Appendix 1: Photographs of the Test Setup
Appendix 2: External Photographs

Revision History

Revision	Issue Date	Description	Effect Page	Revised By
00	2021-01-15	Initial Issue	-	-
01	2021-02-18	Addition of the clause No. in the standard	10, 21, 23, 25, 27, 29, 31, 34, 38	Hiroki Onishi
02	2021-03-01	Re-measurement for Time of Occupancy	27, 28	Hiroki Onishi
		Additional measurement of Conducted Band Edge	34, 35, 36	

---------- End of Report ----------

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