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FCC 15.247 & RSS-247
2.4 GHz Test Report

for

FUTABA Corporation

1080 YabutsukaChosei-son Chosei-gun, Chiba, 299-4395 Japan.

Product Name	**:**	**Radio Control Module**
Model Name	**:**	**FEX01TB-1**
Brand		**Futaba**
FCC ID	**:**	**AZP-FEX01T1**
IC	**:**	**2914D-FEX01T1**

Prepared by: : AUDIX Technology Corporation, EMC Department

Testing Laboratory
1724

The test report is based on a single evaluation of one sample of the above-mentioned products. It does not imply an assessment of the whole production and does not permit the use of the test lab logo.

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TEST REPORT

Applicant	:	FUTABA Corporation
Manufacturer	:	FUTABA Corporation
EUT Description		
(1) Product	:	Radio Control Module
(2) Model	:	FEX01TB-1
(3) Brand	:	Futaba
(4) Power Supply	:	DC 3.8 ~ 8.5V

Applicable Standards:

Title 47 CFR FCC Part 15 Subpart C
RSS-Gen (Issue 5), Amendment 2, February 2021
RSS-247 (Issue 2), February 2017
ANSI C63.10:2013

Audix Technology Corp. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.
Audix Technology Corp. does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens and samples.

Date of Report: 2022. 07. 15

Reviewed by:  (Annie Yu/Administrator)

Approved by:  (Johnny Hsueh/Section Manager)

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1. REVISION RECORD OF TEST REPORT

Edition No	Issued Date	Revision Summary	Report Number
0	2022. 07. 15	Original Report	EM-F220445

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2. SUMMARY OF TEST RESULTS

Rule		Description	Results
FCC	IC		
15.207	RSS-Gen §8.8	Conducted Emission	**PASS**
15.247(d)/15.205	RSS-Gen §8.9 RSS-247 §5.5	Radiated Band Edge and Radiated Spurious Emission	**PASS**
15.247(a)(1)	RSS-247 §5.1(2)	20dB Bandwidth	**PASS**
15.247(a)(1)	RSS-247 §5.1(2)	Carrier Frequency Separation	**PASS**
15.247(a)(1)(iii)	RSS-247 §5.1(4)	Time of Occupancy	**PASS**
15.247(a)(1)(iii)	RSS-247 §5.1(4)	Number of Hopping Channels	**PASS**
15.247(b)(1)	RSS-247 §5.1(2)	Maximum Peak Output Power	**PASS**
15.247(d)	RSS-247 §5.5	Conducted Band Edges and Conducted Spurious Emission	**PASS**
15.203	---	Antenna Requirement	**Compliance**
Note: The uncertainties value is not used in determining the result.			

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3. GENERAL INFORMATION

3.1. Description of Application

Applicant	FUTABA Corporation 1080 Yabutsuka Chosei-mura Chosei-gun Chiba-ken, 299-4395 Japan.
Manufacturer	FUTABA Corporation 1080 Yabutsuka Chosei-mura Chosei-gun Chiba-ken, 299-4395 Japan.
Product	Radio Control Module
Model	FEX01TB-1
Brand	Futaba

3.2. Description of EUT

Test Model	FEX01TB-1
Serial Number	N/A
Power Rating	DC 3.8 ~ 8.5V
Software Version	Version 1.100
RF Features	FHSS
Transmit Type	1T1R
Test Sample	Sample No. / Test Item / Firmware: 01 / AC Conduction, RSE, RF Conducted / N/A
Sample Status	Trial sample
Date of Receipt	2022. 05. 18
Date of Test	2022. 06. 01 ~ 21
Interface Ports of EUT	None
Accessories Supplied	• Antenna x4 (Please refer to section 3.3)

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3.3. Antenna Information

No.	Antenna Type	Manufacture	Antenna Part Number	Connector Type	Frequency (MHz)	Max Gain (dBi)
1.	Omnidirectional Antenna	SANSEI ELECTRIC CO., LTD	ANTB24-073A0	MHF (I-PEX)	2400-2484	2.14

3.4. EUT Specifications Assessed in Current Report

Fundamental Range (MHz)	Channel Number	Modulation	Data Rate (kbps)
2407.500 to 2467.500	31	FHSS	128.143

Channel List			
Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)
1	2407.5	17	2439.5
2	2409.5	18	2441.5
3	2411.5	19	2443.5
4	2413.5	20	2445.5
5	2415.5	21	2447.5
6	2417.5	22	2449.5
7	2419.5	23	2451.5
8	2421.5	24	2453.5
9	2423.5	25	2455.5
10	2425.5	26	2457.5
11	2427.5	27	2459.5
12	2429.5	28	2461.5
13	2431.5	29	2463.5
14	2433.5	30	2465.5
15	2435.5	31	2467.5
16	2437.5		

3.5. Description of Key Components

None

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3.6. Test Configuration

Mode	Duty Cycle (x)	T (ms)	Duty Cycle Correction Factor (dB)
FHSS	N/A	1.50	N/A

Item		Test Voltage	Antenna Port	Modulation	Test Channel
Radiated Test Case	Radiated Band Edge Note1	DC 5V (Via DC Power Supply)	Ant B	FHSS	1/31
	Radiated Spurious Emission Note1			FHSS	1/16/31
Conducted Test Case	20dB Bandwidth		Ant B	FHSS	1/16/31
	Carrier Frequency Separation		Ant B	FHSS	1/16/31
	Time of Occupancy		Ant B	FHSS	1/16/31
	Number of Hopping Channels		Ant B	FHSS	1/16/31
	Maximum Peak Output Power		Ant B	FHSS	1/16/31
			Ant A	FHSS	1/16/31
	Band Edges		Ant B	FHSS	1/31
	Spurious Emission		Ant B	FHSS	1/16/31

Note : 1. ■Mobile Device □Portable Device
and 3 axis were assessed. The worst scenario for Radiated Spurious Emission as follow: ■Lie □Side □Stand
2. We presented worst case (Ant B) in the report.

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3.7. Output Power Setting

Centre Frequency (MHz)	Power Setting	
	ANT A	ANT B
2407.5	Default	Default
2437.5	Default	Default
2467.5	Default	Default

3.8. Tested Supporting System List

3.8.1. Support Peripheral Unit

No.	Product	Brand	Model No.	Serial No.	Approval
1.	Notebook PC	IBM	2652	99NXMML	ANOVNCBDC80211B
2.	Test Jig	N/A	N/A	N/A	N/A
3.	DC Power Supply	TOP WARD	3303A	721773	N/A

3.8.2. Cable Lists

No.	Cable Description Of The Above Support Units
1.	USB Cable: Unshielded, Detachable, 1.0m
2.	Data Cable: Unshielded, Detachable, 0.7m
3.	DC Power Cord*2: Unshielded, Detachable, 0.7m AC Power Cord: Unshielded, Undetachable, 1.8m

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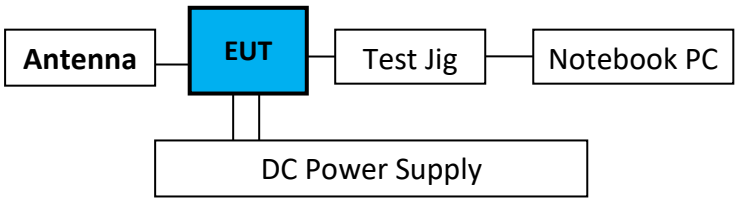
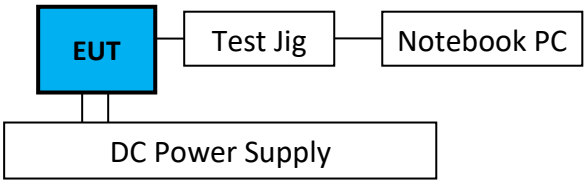
3.9. Setup Configuration

3.9.1. EUT Configuration for Power Line & Radiated Emission



3.9.2. EUT Configuration for RF Conducted Test Items



3.10. Operating Condition of EUT

Test program “Futaba Term” is used for enabling EUT RF function under continues transmitting and choosing data rate/ channel.

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3.11.Description of Test Facility

Name of Test Firm	Audix Technology Corporation / EMC Department No. 491, Zhongfu Rd., Linkou Dist., New Taipei City 244, Taiwan Tel: +886-2-26092133 Fax: +886-2-26099303 Website : www.audixtech.com Contact e-mail: attemc_report@audixtech.com
Accreditations	The laboratory is accredited by following organizations under ISO/IEC 17025:2017 (1) NVLAP(USA) NVLAP Lab Code 200077-0 (2) TAF(Taiwan) No. 1724
Test Facilities	FCC OET Designation Number under APEC MRA by NCC is : TW1724 ISED CAB Identifier Number under APEC TEL MRA by NCC is TW1724 (1) No.8 Shielded Room (2) No.1 3m Semi Anechoic Chamber

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3.12.Measurement Uncertainty

Test Items/Facilities			Frequency Range	Uncertainty
Conduction Test			9kHz-150kHz	±3.7dB
			150kHz-30MHz	±3.4dB
Radiation Test	☒	No.1 3m Semi Anechoic Chamber	30MHz-200MHz, 3m, Horizontal	±3.8dB
			200MHz-1000MHz, 3m, Horizontal	±4.1dB
			30MHz-200MHz, 3m, Vertical	±4.5dB
			200MHz-1000MHz, 3m, Vertical	±4.5dB
			1GHz-6GHz, 3m	±4.7dB
			6GHz-18GHz, 3m	±4.1dB
			18GHz-40GHz, 3m	±3.52dB
	☐	No.3 3m Semi Anechoic Chamber	30MHz-200MHz, 3m, Horizontal	±3.9dB
			200MHz-1000MHz, 3m, Horizontal	±4.2dB
			30MHz-200MHz, 3m, Vertical	±4.3dB
			200MHz-1000MHz, 3m, Vertical	±4.5dB
	☐	No.4 3m Semi Anechoic Chamber	30MHz-200MHz, 3m, Horizontal	±4.1dB
			200MHz-1000MHz, 3m, Horizontal	±4.5dB
			30MHz-200MHz, 3m, Vertical	±4.4dB
			200MHz-1000MHz, 3m, Vertical	±4.8dB
			1GHz-6GHz, 3m	±5.0dB
			6GHz-18GHz, 3m	±4.7dB
	☐	No.5 3m Semi Anechoic Chamber	30MHz-200MHz, 3m, Horizontal	±4.2dB
			200MHz-1000MHz, 3m, Horizontal	±4.3dB
			30MHz-200MHz, 3m, Vertical	±4.3dB
			200MHz-1000MHz, 3m, Vertical	±4.7dB
			1GHz-6GHz, 3m	±4.8dB
			6GHz-18GHz, 3m	±4.5dB

Remark：Uncertainty = $ku_c(y)$

Test Item	Uncertainty
20dB Bandwidth	±0.2kHz
99% Occupied Bandwidth	±0.38%
Carrier Frequency Separation	±0.2kHz
Time of Occupancy	±0.03sec
Maximum peak Output power	± 0.52dB
Conducted Emission Limitations	± 0.13dB

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4. MEASUREMENT EQUIPMENTLIST

4.1. Conducted Emission Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Test Receiver	R&S	ESR3	101774	2022. 01. 11	1 Year
2.	A.M.N.	R&S	ENV432	101567	2022. 05. 26	1 Year
3.	L.I.S.N.	Kyoritsu	KNW-407	8-855-9	2021. 12. 19	1 Year
4.	Pulse Limiter	R&S	ESH3-Z2	100354	2021. 12. 13	1 Year
5.	Digital Thermo-Hygro Meter	iMax	HTC-1	No.8 S/R	2022. 04. 14	1 Year
6.	Coaxial Cable	Yeida	RG/58AU	CE-08	2021. 09. 13	1 Year
7.	Test Software	Audix	e3	V6.120619c	N.C.R.	N.C.R.

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4.2. Radiated Emission Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	N9010A-526	MY53400071	2021. 09. 09	1 Year
2.	Spectrum Analyzer	Agilent	N9030A-526	MY53310269	2022. 02. 21	1 Year
3.	Test Receiver	R&S	ESCS30	100039	2022. 04. 08	1 Year
4.	Amplifier	HP	8447D	2944A06305	2022. 01. 05	1 Year
5.	Microwave Preamplifier	Agilent	8449B	3008A02678	2022. 02. 22	1 Year
6.	Microwave Amplifier	Keysight	83051A	MY53010042	2021. 07. 30	1 Year
7.	Loop Antenna	ETS・LINDGREN	6512	00035867	2021. 09. 29	1 Year
8.	Bilog Antenna	TESEQ	CBL6112D	33821	2021. 07. 16	1 Year
9.	Double-Ridged Waveguide Horn	ETS-Lindgren	3115	00114104	2022. 04. 27	1 Year
10.	Horn Antenna	COM-POWER	AH-840	101092	2022. 01. 06	1 Year
11.	2.4GHz Notch Filter	K&L Microwave	7NSL10-2441.5/E130.5-O/O	2	2021 .07. 24	1 Year
12.	3GHz Notch Filter	Microwave	H3G018G1	484796	2021 .07. 24	1 Year
13.	Coaxial Cable	MIYAZAKI	5D2W	RE-11	2022. 01. 20	1 Year
14.	Coaxial Cable	HUBER+SUHNER	SUCOFLEX 106	RE-14	2022. 01. 20	1 Year
15.	Coaxial Cable	HUBER+SUHNER	SUCOFLEX 102	RE-30	2021. 08. 25	1 Year
16.	Digital Thermo-Hygro Meter	iMax	HTC-1	No.1 3m A/C	2022. 04. 14	1 Year
17.	Test Software	Audix	e3	V6.120619c	N.C.R.	N.C.R.

4.3. RF Conducted Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Keysight	N9030B	MY61330403	2021. 12. 21	1 Year
2.	Digital Thermo-Hygro Meter	iMax	HTC-1	RF-03	2022. 04. 14	1 Year

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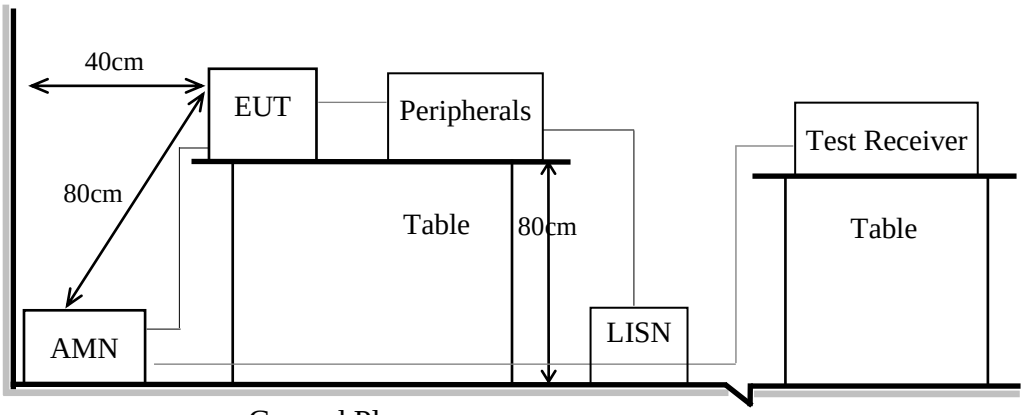
5. CONDUCTED EMISSION

5.1. Block Diagram of Test Setup

5.1.1. Block Diagram of EUT

Indicated as section 3.9

5.1.2. Shielded Room Setup Diagram



5.2. Conducted Emission Limit

Frequency	Conducted Limit	
	Quasi-Peak Level	Average Level
150kHz ~ 500kHz	66 ~ 56 dBμV	56 ~ 46 dBμV
500kHz ~ 5MHz	56 dBμV	46 dBμV
5MHz ~ 30MHz	60 dBμV	50 dBμV

Remark1.: If the average limit is met when using a Quasi-Peak detector, the measurement using the average detector is not required.
2.: The lower limit applies to the band edges.

5.3. Test Procedure

5.3.1. To set up the EUT as indicated in ANSI C63.10. The EUT was placed on the table which has 80 cm height to the ground and 40 cm distance to the conducting wall.

5.3.2. Power supplier of the EUT was connected to the AC mains through an Artificial Mains Network (A.M.N.).

5.3.3. The AC power supplies to all peripheral devices must be provided through line impedance stabilization network (L.I.S.N.)

5.3.4. Checking frequency range from 150kHz to 30 MHz and record the emission which does not have 20 dB below limit.

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5.4. Test Results

Please refer to Appendix A.

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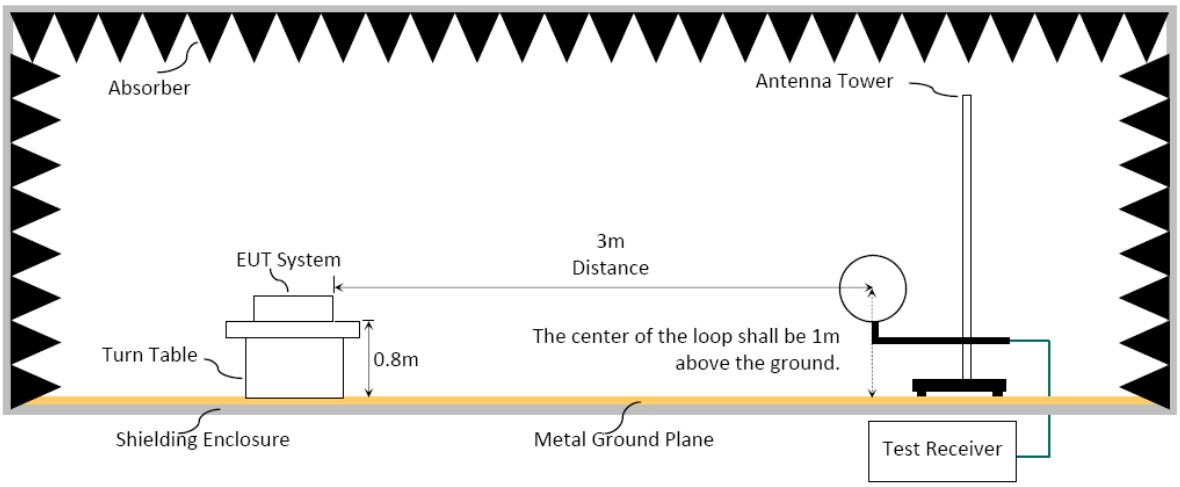
6. RADIATED EMISSION

6.1. Block Diagram of Test Setup

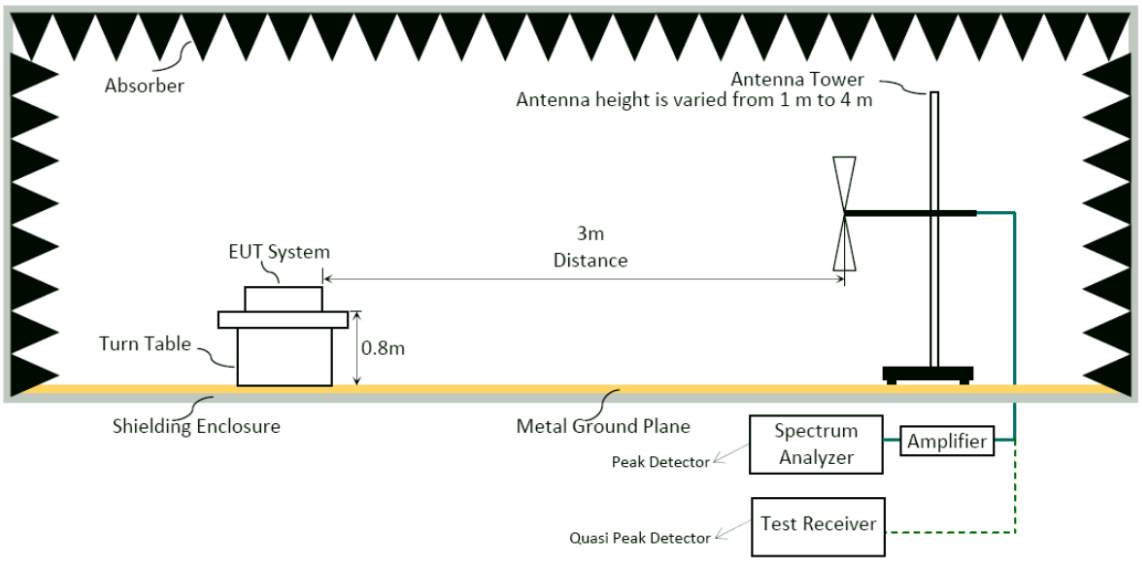
6.1.1. Block Diagram of EUT

Indicated as section 3.9

6.1.2. Setup Diagram for 9kHz-30MHz



6.1.3. Setup Diagram for 30-1000MHz



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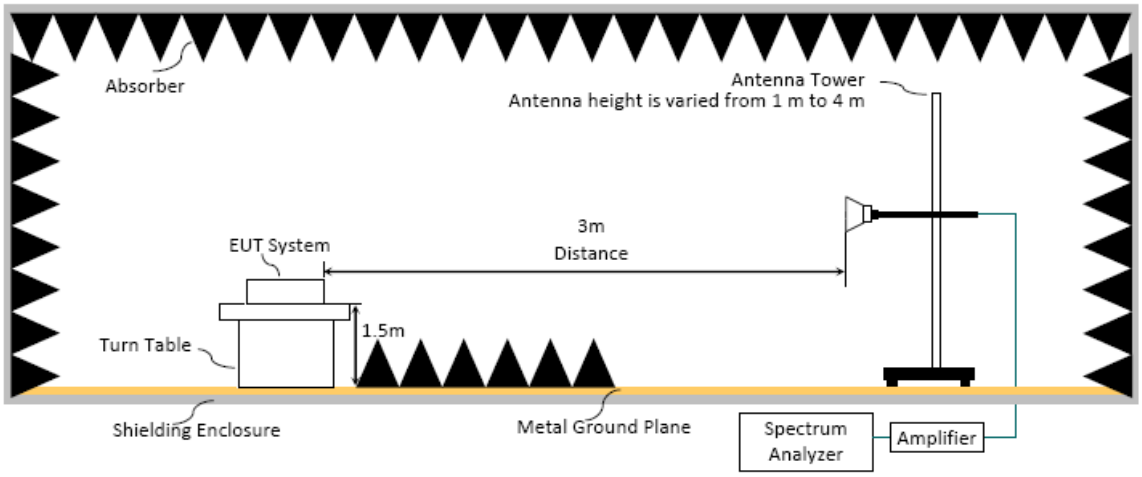
6.1.4. Setup Diagram for above 1GHz



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6.2. Radiated Emission Limits

In any 100kHz bandwidth outside the frequency band, the radio frequency power produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level. In addition, radiated emissions which fall in restricted bands, as defined in Section 15.205/ RSS-Gen Section 8.10 table 6, must also comply with the radiated emission limits specified as below.

Frequency (MHz)	Distance(m)	Limits	
		dBμV/m	μV/m
0.009 - 0.490	300	67.6-20 log f(kHz)	2400/f kHz
0.490 - 1.705	30	87.6-20 log f(kHz)	24000/f kHz
1.705 - 30	30	29.5	30
30 - 88	3	40.0	100
88- 216	3	43.5	150
216- 960	3	46.0	200
Above 960	3	54.0	500
Above 1000	3	74.0 dBμV/m (Peak) 54.0 dBμV/m (Average)	

Remark：(1) dBμV/m = 20 log (μV/m)

(2) The tighter limit applies to the edge between two frequency bands.

(3) Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.

(4) Fundamental and emission fall within operation band are exempted from this section.

(5) Pursuant to ANSI C63.10: 6.6.4.3, if the maximized peak measured value complies with the average limit, then it is unnecessary to perform an average measurement.

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6.3. Test Procedure

Frequency Range 9kHz~30MHz:
The EUT setup on the turntable which has 0.8 m height to the ground. The turn table rotated 360 degrees and antenna fixed to 1 m to find the maximum emission level.
In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10-2013 regulation.

(1) RBW = 9kHz with peak and average detector.

(2) Detector: average and peak (9kHz-490kHz)
Q.P. (490kHz-30MHz)

Frequency Range 30MHz ~ 25GHz:
The EUT setup on the turn table which has 80cm (for 30-1000MHz) and 1.5m (for above 1GHz) height to the ground. The turn table rotated 360 degrees and antenna varied from 1 m to 4 m to find the maximum emission level. Both horizontal and vertical polarization are required. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10-2013 regulation.

Frequency below 1GHz:
Spectrum Analyzer is used for pre-testing with following setting:

(1)RBW = 120KHz

(2)VBW ≥ 3 x RBW.

(3)Detector = Peak.

(4)Sweep time = auto.

(5)Trace mode = max hold.

(6)Allow sweeps to continue until the trace stabilizes.

Note 1: When peak-detected value is lower than limit that the measurement using theQ.P. detector is not required, otherwise using Q.P. for final measurement.

Note 2: When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds.

Frequency above 1GHz to 10th harmonic(up to 25 GHz):
Peak Detector:

(1)RBW = 1MHz

(2)VBW ≥ 3 x RBW.

(3)Detector = Peak.

(4)Sweep time = auto.

(5)Trace mode = max hold.

(6)Allow sweeps to continue until the trace stabilizes.

Note: When peak-detected value is lower than limit that the measurement using the average detector is not required, otherwise using average detector for final measurement.

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Average Detector:

■**Option 1:**

(1)RBW = 1MHz

(2)VBW ≥ 1/ T

Mode	TX_{on} (ms)	1/ TX_{on} (kHz)	VBW(>1/ TX_{on}) (kHz)
FHSS	1.50	0.666	3

(3)Detector = Peak.

(4)Sweep time = auto.

(5)Trace mode = max hold.

(6)Allow sweeps to continue until the trace stabilizes.

□**Option 2:**

Average Emission Level= Peak Emission Level+ D.C.C.F.

6.4. Measurement Result Explanation

■Peak Emission Level(dBμV/m)=Antenna Factor(dB/m) + Cable Loss (dB)– Preamp Gain (dB)+ Reading(dBμV).

■Average Emission Level(dBμV/m)= Antenna Factor(dB/m) + Cable Loss (dB)– Preamp Gain (dB)+ Reading(dBμV).

□Average Emission Level(dBμV/m)= Peak Emission Level(dBμV/m)+ DCCF(dB)
Duty Cycle Correction Factor (DCCF)(dB)= 20log(TX_{on}/TX_{on+off}) presented in section 3.7.

□ERP(dBm)= Peak Emission Level(dBμV/m) -95.2dB-2.14dB

6.5. Test Results

Please refer to Appendix A.

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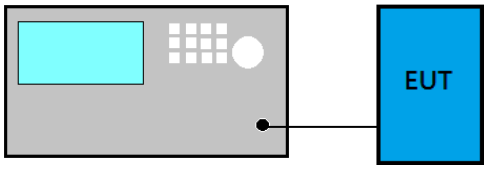
7. 20dB/OCCUPIED BANDWIDTH

7.1. Block Diagram of Test Setup



7.2. Specification Limits

Alternatively, frequency hopping systems operating in the 2400-2483.5MHz band may have hopping channel carrier frequencies that are separated by 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater.

7.3. Test Procedure

Following measurement procedure is reference to ANSI C63.10:2013:

For 20dB Bandwidth

(1) Set Span range 2~5 times the OBW
(2) Set VBW≥3xRBW.
(3) Detector = Peak.
(4) Trace mode = Max hold.
(5) Sweep = Auto couple.
(6) Allow the trace to stabilize.
(7) Setting channel bandwidth function x dB to -20 dB to record the final bandwidth.

For 99% Occupied Bandwidth

(8) Set Span range 1.5~5 times the OBW
(9) Set RBW close to1% to 5% of OBW.
(10) Set VBW≥3xRBW.
(11) Detector = Peak.
(12) Trace mode = Max hold
(13) Sweep = Auto couple.
(14) Allow the trace to stabilize.

7.4. Test Results

Please refer to Appendix A

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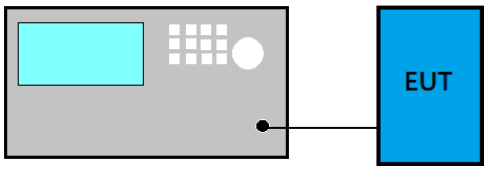
8. CARRIER FREQUENCY SEPARATION

8.1. Block Diagram of Test Setup



8.2. Specification Limits

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

8.3. Test Procedure

Following measurement procedure is reference to ANSI C63.10:2013:

(1) Span = Wide enough to capture the peaks of two adjacent channels
(2) RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
(3) VBW≥ RBW
(4) Sweep = Auto
(5) Detector function = Peak
(6) Trace = Max hold
(7) Allow the trace to stabilize.

8.4. Test Results

Please refer to Appendix A

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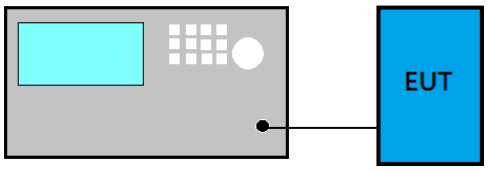
9. TIME OF OCCUPANCY

9.1. Block Diagram of Test Setup



9.2. Specification Limits

Frequency hopping systems in the 2400-2483.5MHz shall use at least 15 non-overlapping channels. 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 number of hopping channels employed.

9.3. Test Procedure

Following measurement procedure is reference to ANSI C63.10:2013:

(1) Span: Zero span, centered on a hopping channel.
(2) RBW shall be ≤ channel spacing and where possible RBW should be set >> 1/T, where T is the expected dwell time per channel.
(3) Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
(4) Detector function = Peak
(5) Trace = Max hold

9.4. Test Results

Please refer to Appendix A

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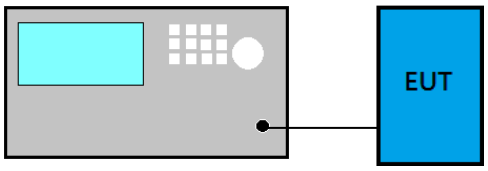
10. NUMBER OF HOPPING CHANNELS

10.1. Block Diagram of Test Setup



10.2. Specification Limits

Frequency hopping systems which use fewer than 20 hopping frequencies may employ intelligent hopping techniques to avoid interference to other transmissions. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 non-overlapping channels.

10.3. Test Procedure

Following measurement procedure is reference to ANSI C63.10:2013:

(1) Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
(2) RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
(3) VBW ≥ RBW
(4) Sweep = Auto
(5) Detector function = Peak
(6) Trace = m=Max hold
(7) Allow the trace to stabilize.

10.4. Test Results

Please refer to Appendix A

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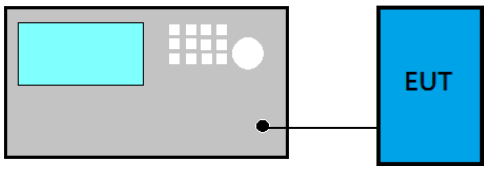
11. MAXIMUM PEAK OUTPUT POWER

11.1. Block Diagram of Test Setup



11.2. Specification Limits

The Limits of maximum Peak Output Power for frequency hopping systems in 2400-2483.5MHz is: 0.125Watt. (21dBm)

11.3. Test Procedure

Following measurement procedure is reference to ANSI C63.10:2013:

(a) Use the following spectrum analyzer settings

(1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
(2) RBW > 20 dB bandwidth of the emission being measured.
(3) VBW ≥ RBW
(4) Sweep: Auto
(5) Detector function: Peak
(6) Trace: Max hold

(b) Allow trace to stabilize.

(c) Use the marker-to-peak function to set the marker to the peak of the emission.

11.4. Test Results

Please refer to Appendix A

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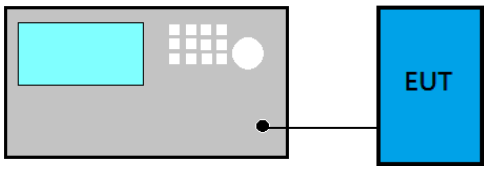
12. EMISSION LIMITATIONS

12.1. Block Diagram of Test Setup



12.2. Specification Limits

In any 100kHz 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, that the required attenuation shall be 30 dB instead of 20 dB.
Attenuation below the general limits specified in Section 15.209(a)/ RSS-Gen Section 8.9 table 4 is not required. In addition, radiated emissions which fall in restricted bands, as defined in Section 15.205(a)/RSS-Gen Section 8.10 table 6, must also comply with the radiated emission limits specified in Section 15.209(a)/RSS-Gen Section 8.9 table 4. (See Section 15.205(c)).

12.3. Test Procedure

Following measurement procedure is reference to ANSI C63.10:2013:

(1) Set span wide enough to capture the peak level of the in-band emission and all spurious emissions; up to 10^{th} harmonic.
(2) RBW = 100 kHz
(3) VBW ≥ RBW
(4) Sweep = Auto
(5) Detector function = Peak
(6) Trace = Max hold

12.4. Test Results

Please refer to Appendix A

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13. DEVIATION TO TEST SPECIFICATIONS

【NONE】

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APPDNDIX A

TEST DATA AND PLOTS

(Model: FEX01TB-1)

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Audix Technology Corp.
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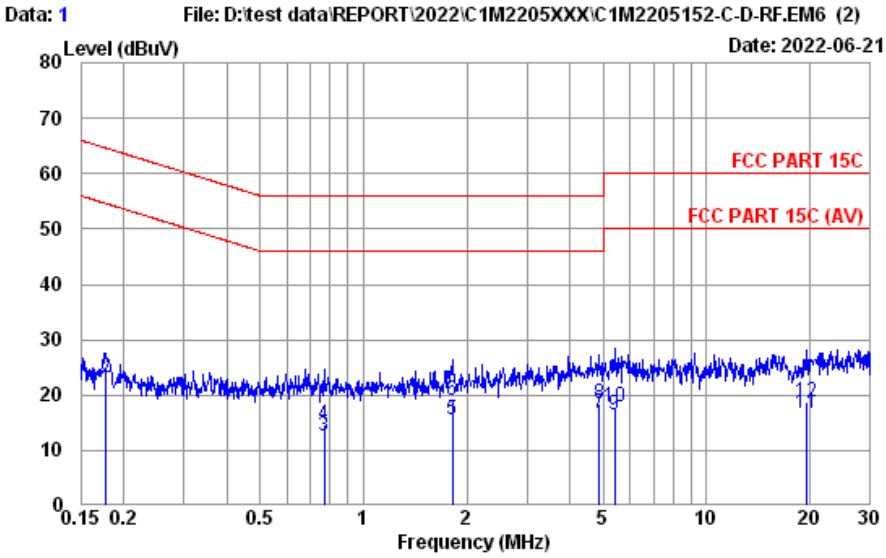
A.1 CONDUCTED EMISSION

Test Date	2022/06/21	Temp./Hum.	26℃/49%
Test Voltage	DC 5V (Via DC Power Supply)	Tested By	Roy Hung
		Test Model	FEX01TB-1



Site No. : No.8 Shielded Room Data No. : 1
Instrument 1 : Receiver ESR3(774)
Instrument 2 : ENV432 (567)(A)|CE-08|ESH3-Z2 (354)
Limit : FCC PART 15C Phase : NEUTRAL
Environment : 26°C / 49% Engineer : Roy Hung
EUT Model : FEX01TB Test Rating : DC 5V
Test Mode : Operating

	Freq. (MHz)	AMN Factor (dB)	Cable Loss (dB)	Pulse Att. (dB)	Reading (dBµV)	Emission Level (dBµV)	Limits (dBµV)	Margin (dB)	Remark
1	0.178	10.33	0.03	9.85	0.87	21.08	54.59	33.51	Average
2	0.178	10.33	0.03	9.85	2.92	23.13	64.59	41.46	QP
3	0.767	10.33	0.04	9.85	-7.49	12.73	46.00	33.27	Average
4	0.767	10.33	0.04	9.85	-5.69	14.53	56.00	41.47	QP
5	1.819	10.36	0.06	9.86	-4.71	15.57	46.00	30.43	Average
6	1.819	10.36	0.06	9.86	-1.25	19.03	56.00	36.97	QP
7	4.874	10.45	0.10	9.87	-3.76	16.66	46.00	29.34	Average
8	4.874	10.45	0.10	9.87	-1.89	18.53	56.00	37.47	QP
9	5.390	10.47	0.10	9.87	-4.09	16.35	50.00	33.65	Average
10	5.390	10.47	0.10	9.87	-2.59	17.85	60.00	42.15	QP
11	19.635	11.04	0.19	9.94	-4.57	16.60	50.00	33.40	Average
12	19.635	11.04	0.19	9.94	-2.39	18.78	60.00	41.22	QP

Remarks: 1. Emission Level= AMN Factor + Cable Loss + Pulse Att. + Reading.
2. If the average limit is met when using a quasi-peak detector, the EUT shall be deemed to meet both limits and measurement with average detector is unnecessary.

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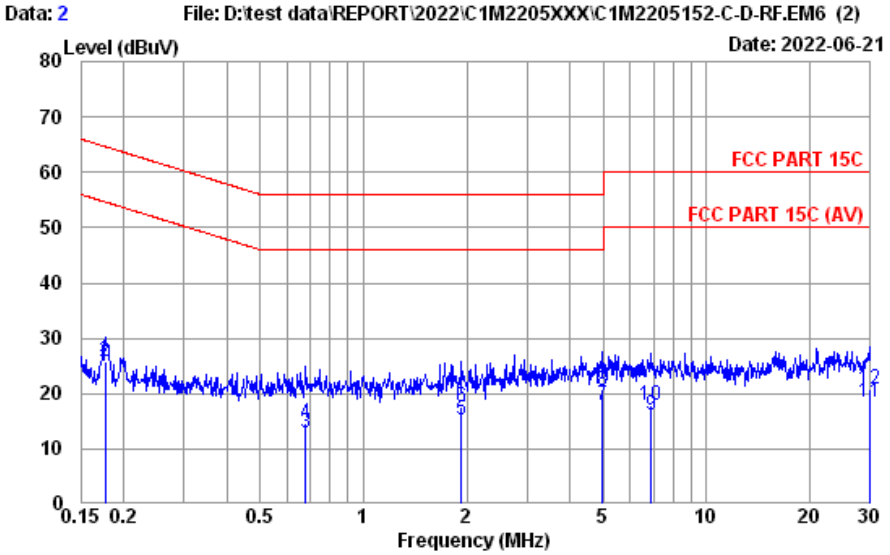
Test Date	2022/06/21	Temp./Hum.	26℃/49%
Test Voltage	DC 5V (Via DC Power Supply)	Tested By	Roy Hung
		Test Model	FEX01TB-1



Site No. : No.8 Shielded Room Data No. : 2
Instrument 1 : Receiver ESR3(774)
Instrument 2 : ENV432 (567)(A)|CE-08|ESH3-Z2 (354)
Limit : FCC PART 15C Phase : LINE
Environment : 26°C / 49% Engineer : Roy Hung
EUT Model : FEX01TB Test Rating : DC 5V
Test Mode : Operating

	Freq. (MHz)	AMN Factor (dB)	Cable Loss (dB)	Pulse Att. (dB)	Reading (dBµV)	Emission Level (dBµV)	Limits (dBµV)	Margin (dB)	Remark
1	0.177	10.22	0.03	9.85	4.91	25.01	54.64	29.63	Average
2	0.177	10.22	0.03	9.85	5.78	25.88	64.64	38.76	QP
3	0.679	10.23	0.04	9.85	-7.12	13.00	46.00	33.00	Average
4	0.679	10.23	0.04	9.85	-5.36	14.76	56.00	41.24	QP
5	1.928	10.25	0.06	9.86	-5.02	15.15	46.00	30.85	Average
6	1.928	10.25	0.06	9.86	-2.51	17.66	56.00	38.34	QP
7	4.978	10.31	0.10	9.87	-2.34	17.94	46.00	28.06	Average
8	4.978	10.31	0.10	9.87	0.14	20.42	56.00	35.58	QP
9	6.878	10.36	0.11	9.87	-4.27	16.07	50.00	33.93	Average
10	6.878	10.36	0.11	9.87	-2.52	17.82	60.00	42.18	QP
11	29.841	10.73	0.24	10.01	-2.40	18.58	50.00	31.42	Average
12	29.841	10.73	0.24	10.01	-0.15	20.83	60.00	39.17	QP

Remarks: 1. Emission Level= AMN Factor + Cable Loss + Pulse Att. + Reading.
2. If the average limit is met when using a quasi-peak detector, the EUT shall be deemed to meet both limits and measurement with average detector is unnecessary.

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A.2 RADIATED EMISSION

Test Date	2022/06/07 ~ 13	Temp./Hum.	23~24℃/60~62%
Test Voltage	DC 5V (Via DC Power Supply)	Tested By	Martin Chen
		Test Model	FEX01TB-1

A.2.1 Emissions within Restricted Frequency Bands

A.2.1.1 Frequency 9kHz~30MHz

The emissions (9kHz~30MHz) not reported for there is no emission be found.

A.2.1.2 Frequency Below 1 GHz

Mode	FHSS	Frequency	TX 2407.5MHz

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
35.820	21.22	1.55	26.48	29.17	25.46	40.00	14.54	Peak
101.780	16.65	2.63	26.28	31.70	24.70	43.50	18.80	Peak
392.780	21.23	5.84	26.39	28.60	29.28	46.00	16.72	Peak
734.220	25.21	7.84	27.37	28.93	34.61	46.00	11.39	Peak
813.760	25.99	8.28	27.22	28.06	35.11	46.00	10.89	Peak
997.090	27.10	9.27	26.66	27.29	37.00	54.00	17.00	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
35.820	21.22	1.55	26.48	38.38	34.67	40.00	5.33	Peak
159.010	15.73	3.29	25.95	31.43	24.50	43.50	19.00	Peak
485.900	22.89	6.65	27.04	30.86	33.36	46.00	12.64	Peak
735.190	25.21	7.84	27.37	28.73	34.41	46.00	11.59	Peak
901.060	26.30	8.76	26.99	29.03	37.10	46.00	8.90	Peak
985.450	27.02	9.22	26.69	28.45	38.00	54.00	16.00	Peak

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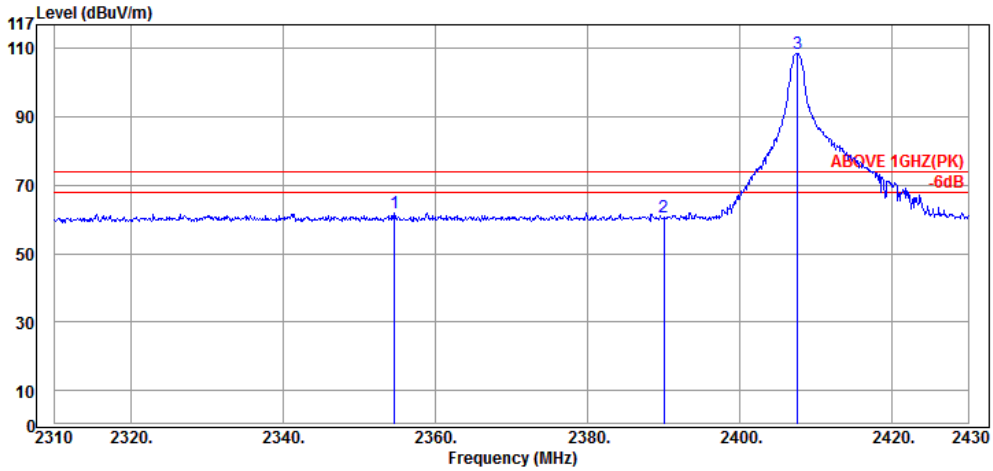
A.2.1.3 Frequency Above 1 GHz to 10th harmonics

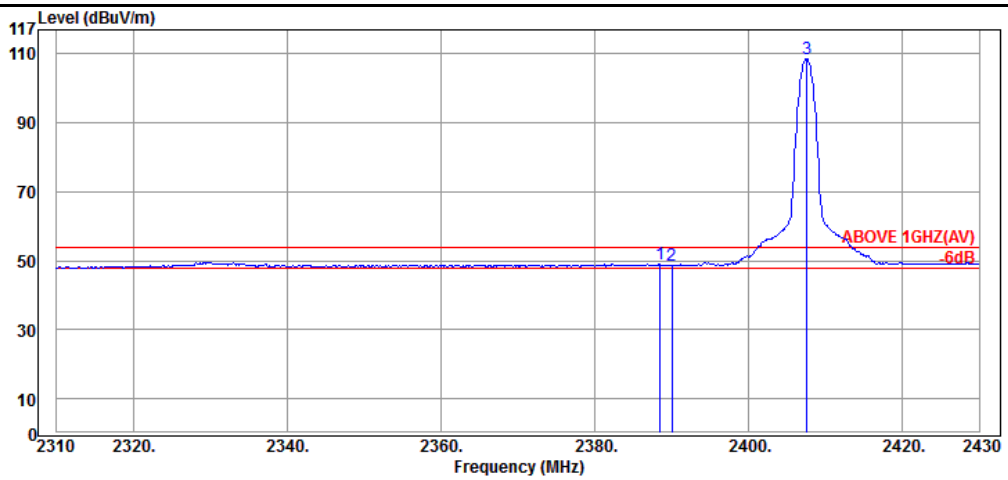
Band Edge:

Mode	FHSS	Frequency	TX 2407.5MHz



Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2354.640	27.50	5.66	34.50	63.44	62.10	74.00	11.90	Peak
2390.040	27.57	5.72	34.51	61.75	60.53	74.00	13.47	Peak
@2407.560	27.59	5.75	34.51	109.72	108.55	---	---	Peak



Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2388.480	27.57	5.72	34.51	50.29	49.07	54.00	4.93	Average
2390.040	27.57	5.72	34.51	49.81	48.59	54.00	5.41	Average
@2407.560	27.59	5.75	34.51	109.66	108.49	---	---	Average

Remark: The "@" means fundamental frequency, it is ignored in this section.

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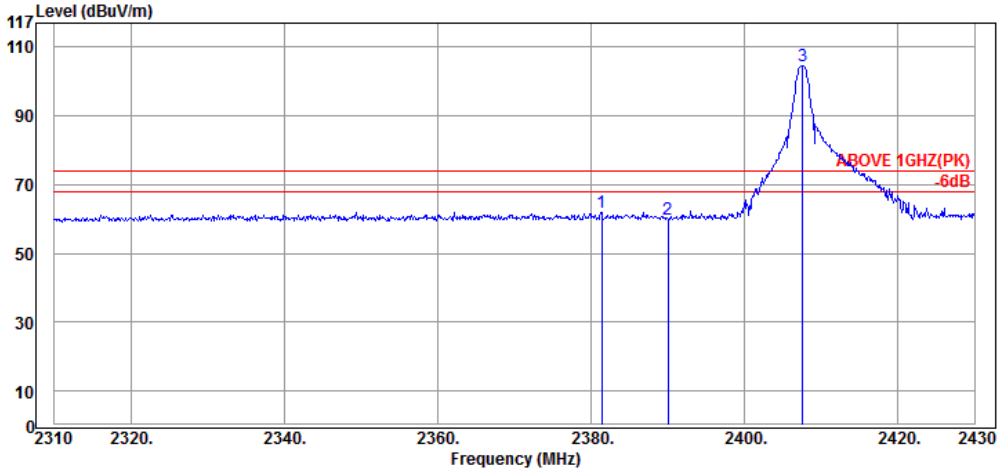
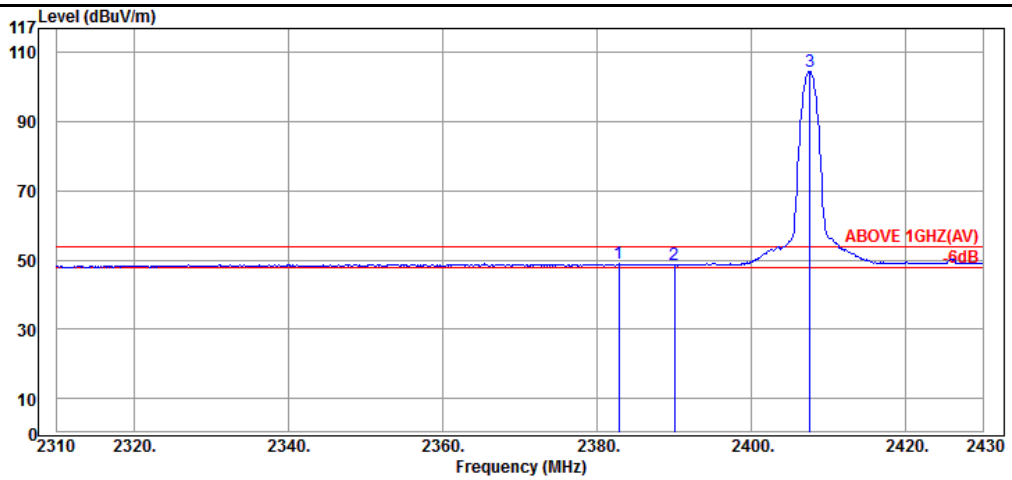
Mode	FHSS	Frequency	TX 2407.5MHz



Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2381.400	27.56	5.71	34.51	63.13	61.89	74.00	12.11	Peak
2390.040	27.57	5.72	34.51	61.30	60.08	74.00	13.92	Peak
@2407.560	27.59	5.75	34.51	105.84	104.67	---	---	Peak



Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2382.840	27.56	5.71	34.51	50.15	48.91	54.00	5.09	Average
2390.040	27.57	5.72	34.51	49.93	48.71	54.00	5.29	Average
@2407.560	27.59	5.75	34.51	105.76	104.59	---	---	Average

Remark: The "@" means fundamental frequency, it is ignored in this section.

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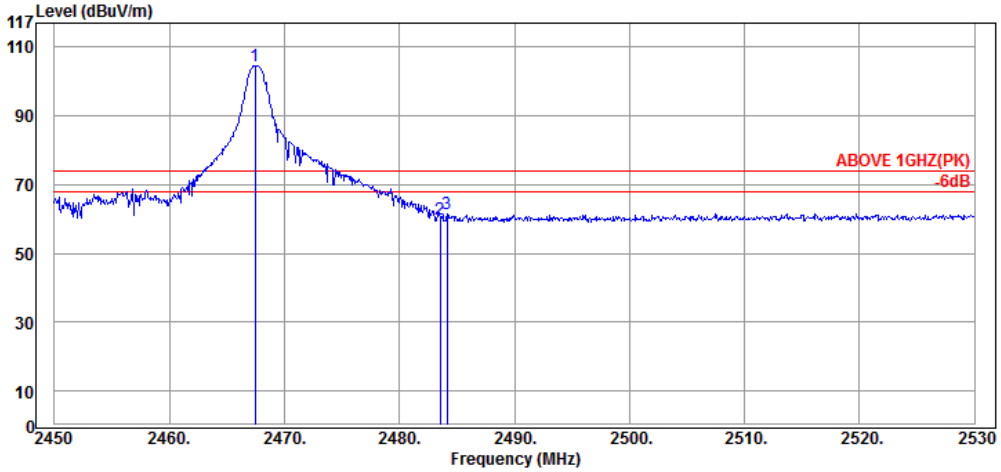
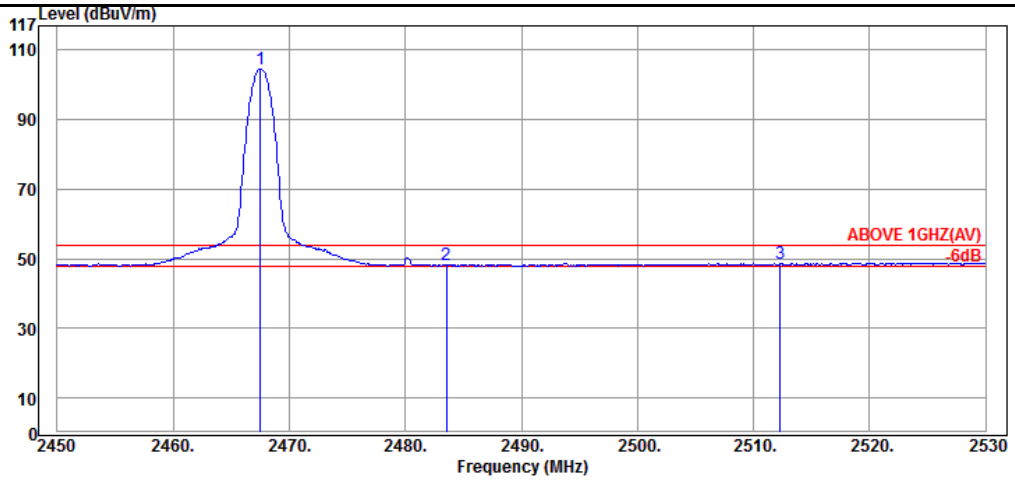
Mode	FHSS	Frequency	TX 2467.5MHz



Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
@2467.440	27.64	5.84	34.52	105.77	104.73	---	---	Peak
2483.520	27.86	5.87	34.53	60.68	59.88	74.00	14.12	Peak
2484.160	27.86	5.87	34.53	62.24	61.44	74.00	12.56	Peak



Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
@2467.520	27.64	5.84	34.52	105.69	104.65	---	---	Average
2483.520	27.86	5.87	34.53	48.90	48.10	54.00	5.90	Average
2512.320	28.06	5.93	34.53	49.25	48.71	54.00	5.29	Average

Remark: The "@" means fundamental frequency, it is ignored in this section.

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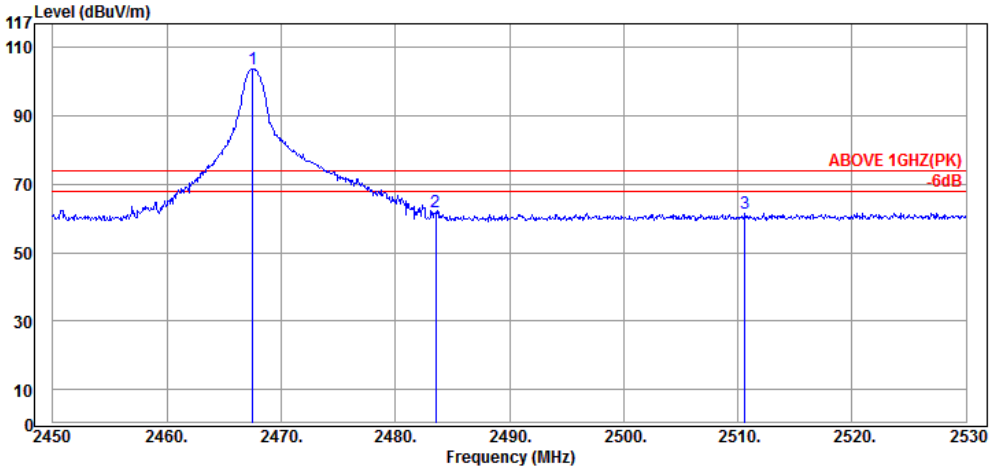
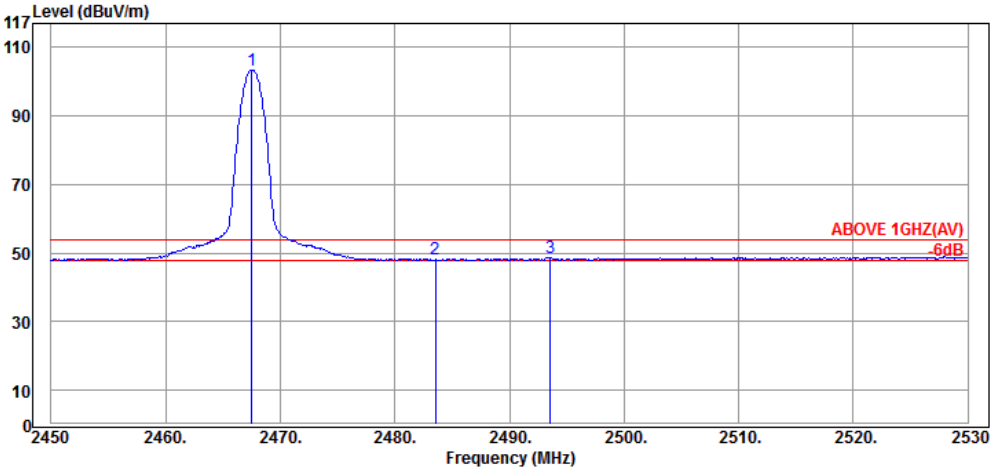
Mode	FHSS	Frequency	TX 2467.5MHz



Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
@2467.520	27.64	5.84	34.52	104.63	103.59	---	---	Peak
2483.520	27.86	5.87	34.53	62.58	61.78	74.00	12.22	Peak
2510.640	28.03	5.91	34.53	62.22	61.63	74.00	12.37	Peak



Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
@2467.520	27.64	5.84	34.52	104.54	103.50	---	---	Average
2483.520	27.86	5.87	34.53	48.93	48.13	54.00	5.87	Average
2493.600	27.93	5.88	34.53	49.41	48.69	54.00	5.31	Average

Remark: The "@" means fundamental frequency, it is ignored in this section.

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A.2.2 Emissions outside the frequency band:

The emissions (up to 25GHz) not reported for there is no emission be found.

Mode	FHSS	Frequency	TX 2407.5MHz

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4815.000	32.60	8.55	34.43	41.13	47.85	54.00	6.15	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4815.000	32.60	8.55	34.43	46.83	53.55	54.00	0.45	Peak

Mode	FHSS	Frequency	TX 2437.5MHz

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4875.000	32.90	8.62	34.42	42.05	49.15	54.00	4.85	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4875.000	32.90	8.62	34.42	46.27	53.37	54.00	0.63	Peak

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Mode	FHSS	Frequency	TX 2467.5MHz

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4935.000	33.00	8.70	34.41	40.96	48.25	54.00	5.75	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4935.000	33.00	8.70	34.41	44.51	51.80	54.00	2.20	Peak

A.2.3 Emissions in Non-restricted Frequency Bands:

All emission levels below the FCC 15.209(a)/RSS-Gen Section 8.9 table 4 general radiated emissions limits is not required.

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A.3 20dB/OCCUPIED BANDWIDTH

Test Date	2022/06/01	Temp./Hum.	23℃/59%
Cable Loss	0.50dB	Tested By	Martin Chen
Test Voltage	DC 5V (Via DC Power Supply)	Test Model	FEX01TB-1

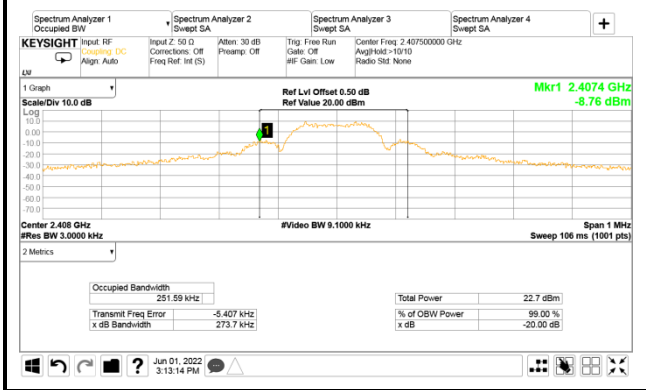
A.3.1 Emission Bandwidth Result

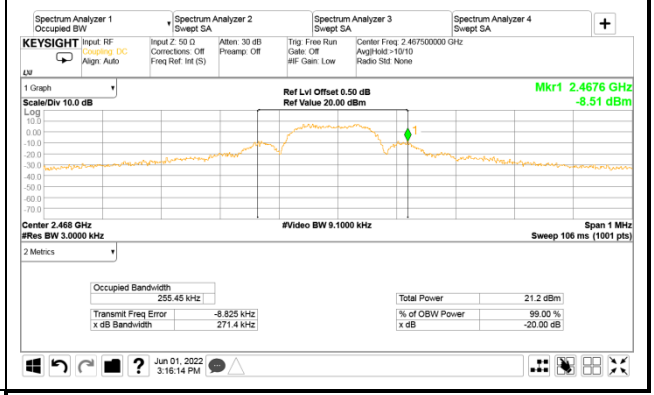
Mode	Centre Frequency (MHz)	20 dB Bandwidth (MHz)	99% Bandwidth (MHz)	Limit 2/3 (20dB Bandwidth)
FHSS	2407.5	0.2737	0.25159	0.182
	2437.5	0.2714	0.25545	0.181
	2467.5	0.2717	0.27042	0.181

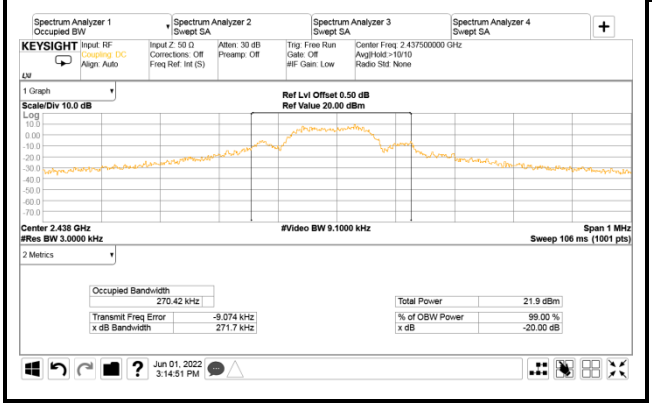
Remark: The maximum two-thirds of the 20dB bandwidth shall be at maximum 0.182MHz.

A.3.2 Measurement Plots

FHSS







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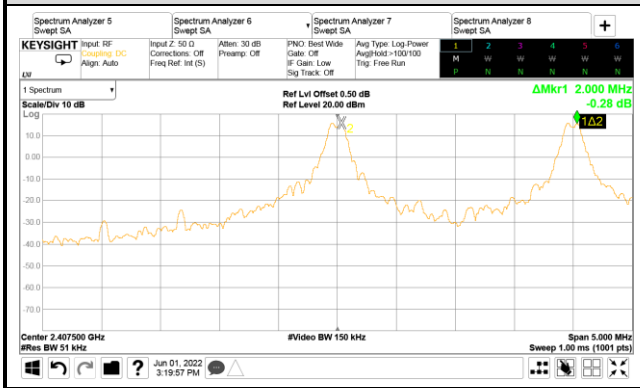
A.4 CARRIER FREQUENCY SEPARATION

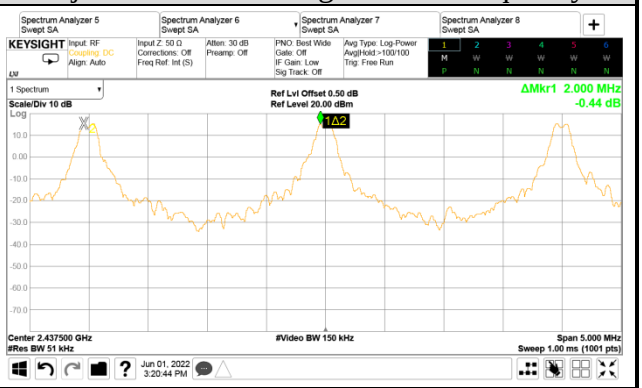
Test Date	2022/06/01	Temp./Hum.	23℃/59%
Cable Loss	0.50dB	Tested By	Martin Chen
Test Voltage	DC 5V (Via DC Power Supply)	Test Model	FEX01TB-1

FHSS

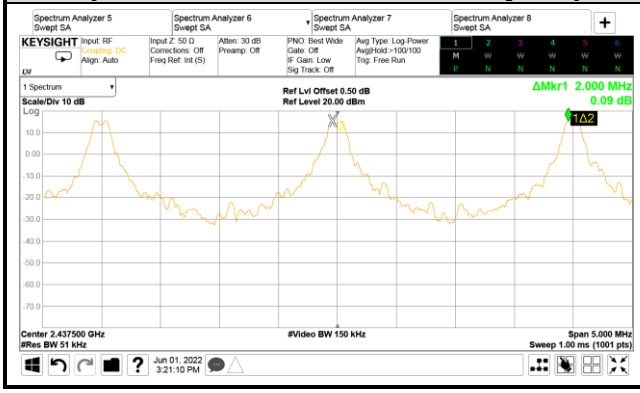
2407.5MHz



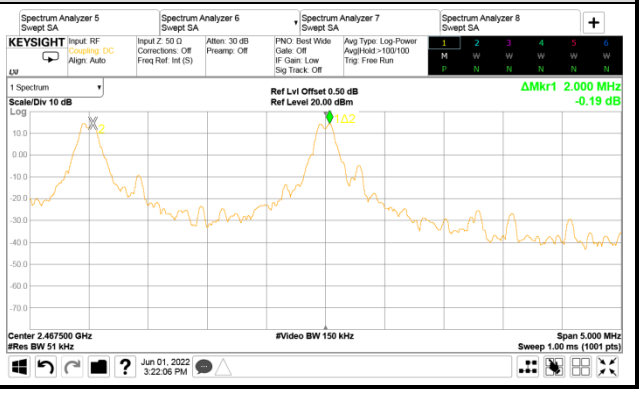
2437.5MHz
adjacent channel of right carrier frequency



2437.5MHz
adjacent channel of left carrier frequency



2467.5MHz



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A.5 TIME OF OCCUPANCY

Test Date	2022/06/01	Temp./Hum.	23℃/59%
Cable Loss	0.50dB	Tested By	Martin Chen
Test Voltage	DC 5V (Via DC Power Supply)	Test Model	FEX01TB-1

A.5.1 Time of Occupancy

Mode	Centre Frequency (MHz)	Each obervation period appearance transmission	Time of Occupancy (ms)	Maximum accumulated Time of Occupancy (ms)	Limit (ms)
FHSS	2407.5	8	1.50	12.00	<400
	2437.5	8	1.50	12.00	<400
	2467.5	8	1.50	12.00	<400

Observation Period:
31 channels* **0.4** seconds= **12.4** seconds
Centre Frequency: 2407.5MHz
For each obervation period of **8** transmission appearance,the longest time of occupancy is
8 channels* **12.4** **/12.4*** **1.50** ms= **12.00** ms (<400ms)
Centre Frequency: 2437.5MHz
For each obervation period of **8** transmission appearance,the longest time of occupancy is
8 channels* **12.4** **/12.4*** **1.50** ms= **12.00** ms (<400ms)
Centre Frequency: 2467.5MHz
For each obervation period of **8** transmission appearance,the longest time of occupancy is
8 channels* **12.4** **/12.4*** **1.50** ms= **12.00** ms (<400ms)

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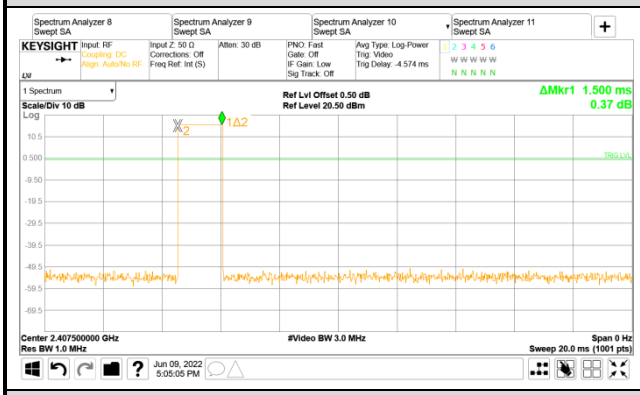
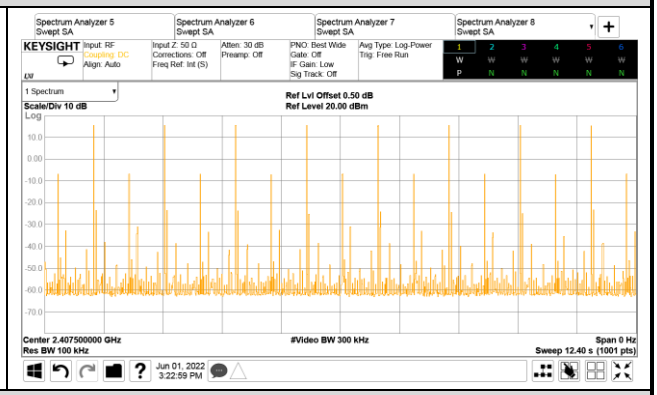
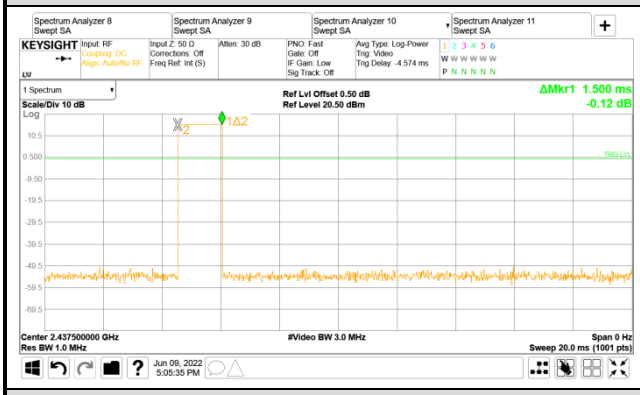
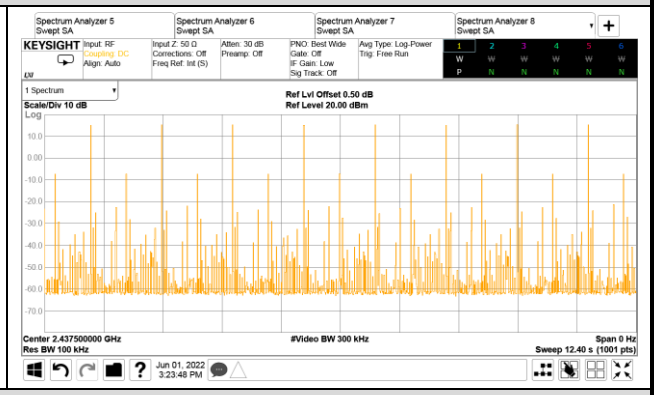
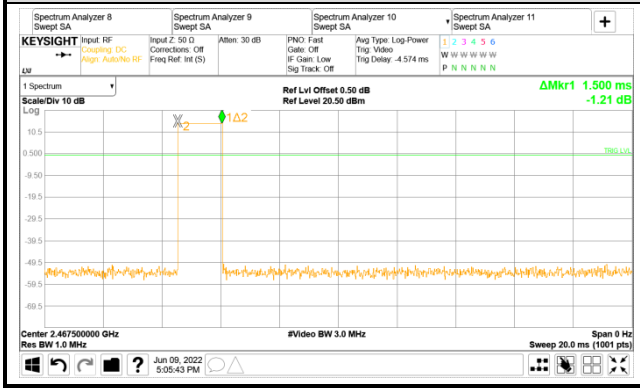
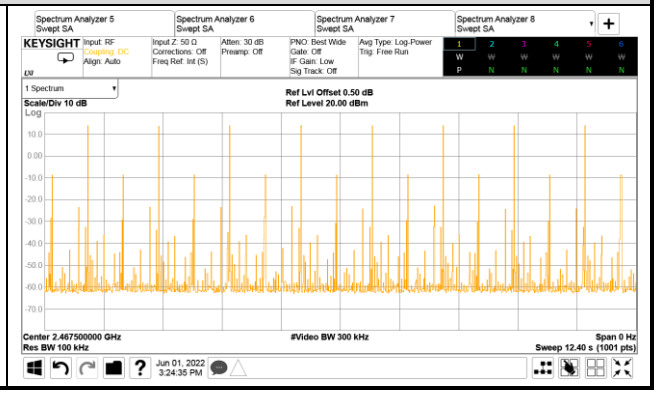
A.5.2 Measurement Plots

FHSS	
2407.5MHz	
	
2437.5MHz	
	
2467.5MHz	
	

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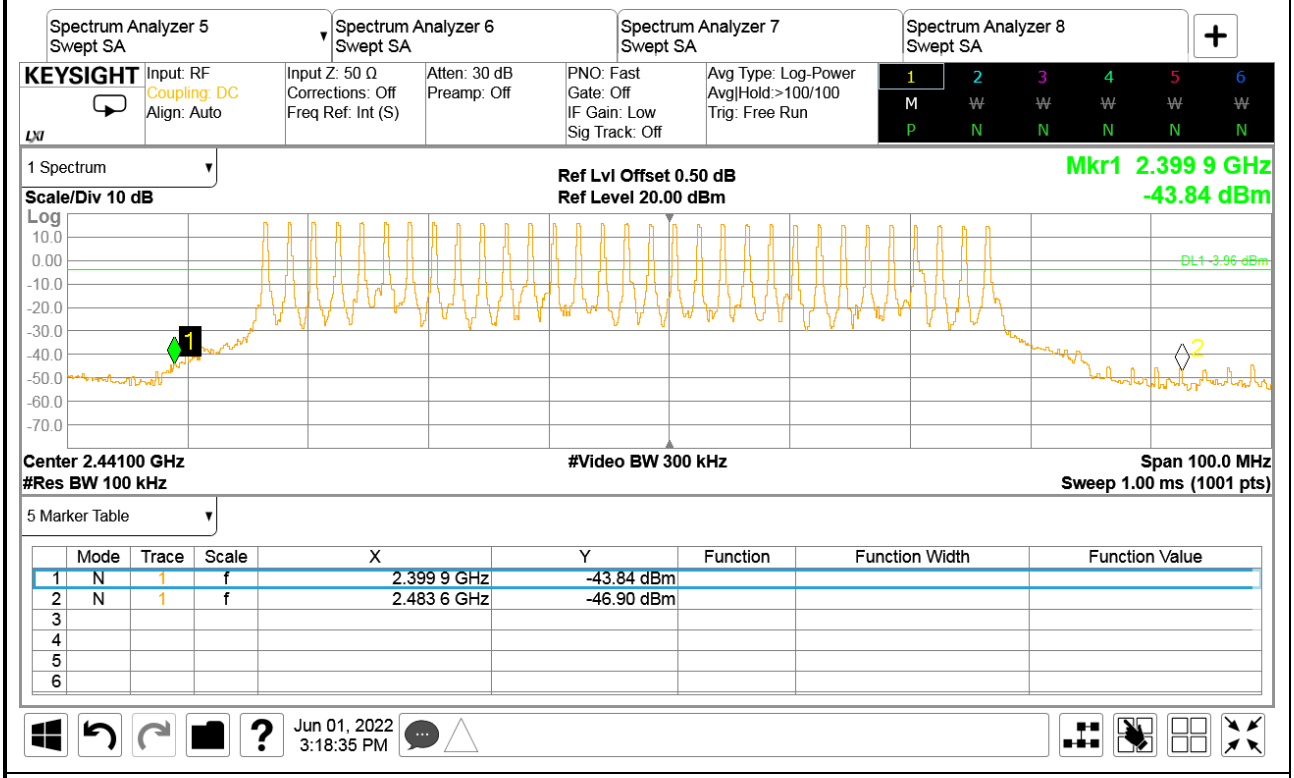
A.6 NUMBER OF HOPPING CHANNELS

Test Date	2022/06/01	Temp./Hum.	23℃/59%
Cable Loss	0.50dB	Tested By	Martin Chen
Test Voltage	DC 5V (Via DC Power Supply)	Test Model	FEX01TB-1

FHSS



The number hopping channel is 31.

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A.7 MAXIMUM PEAK OUTPUT POWER

Test Date	2022/06/21	Temp./Hum.	25℃/53%
Cable Loss	0.70dB	Tested By	Martin Chen
Test Voltage	DC 5V (Via DC Power Supply)	Test Model	FEX01TB-1

A.7.1 Maximum Peak Output Power

Mode	Antenna	Centre Frequency (MHz)	Peak Output Power		Limit
			dBm	W	
FHSS	ANT A	2407.50	14.59	0.028774	21dBm (0.125W)
		2437.50	14.40	0.027542	
		2467.50	13.71	0.023496	

Mode	Antenna	Centre Frequency (MHz)	Peak Output Power		Limit
			dBm	W	
FHSS	ANT B	2407.50	14.62	0.028973	21dBm (0.125W)
		2437.50	14.31	0.026977	
		2467.50	13.64	0.023121	

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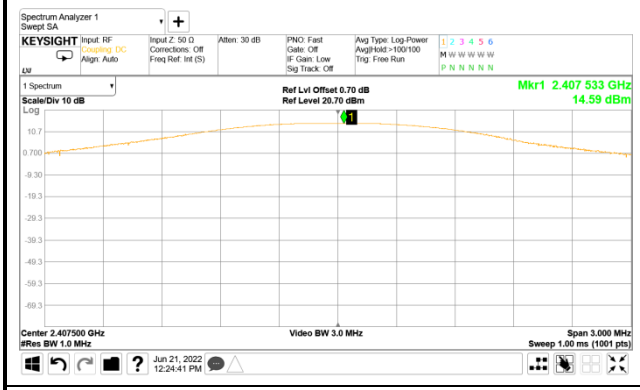
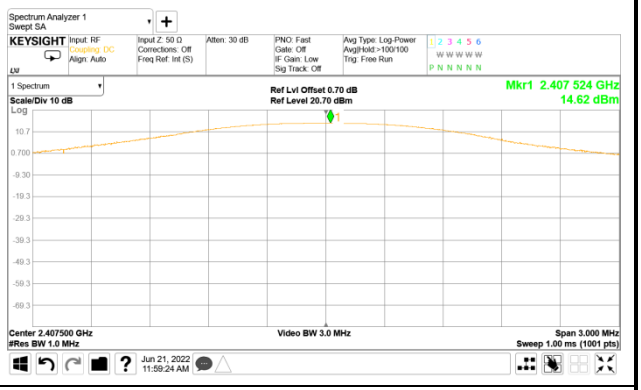
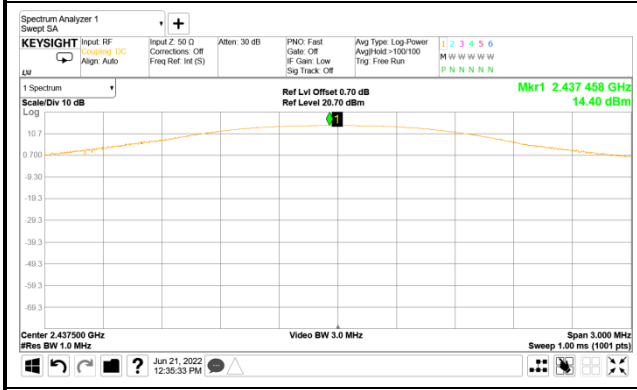
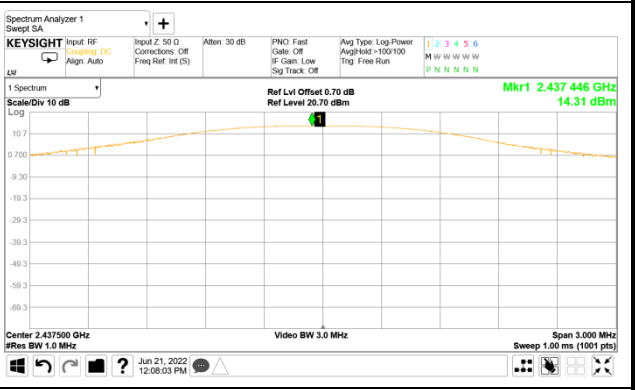
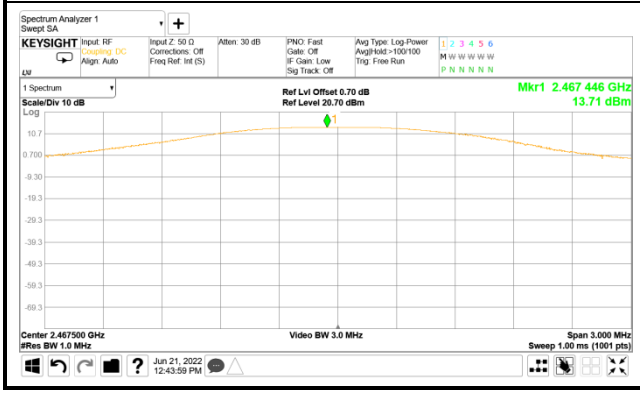
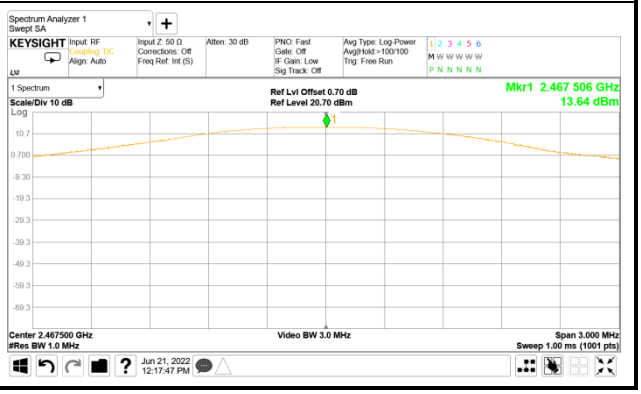
A.7.2 Measurement Plots

FHSS	
ANT A	ANT B
	
	
	

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A.8 EMISSION LIMITATIONS MEASUREMENT

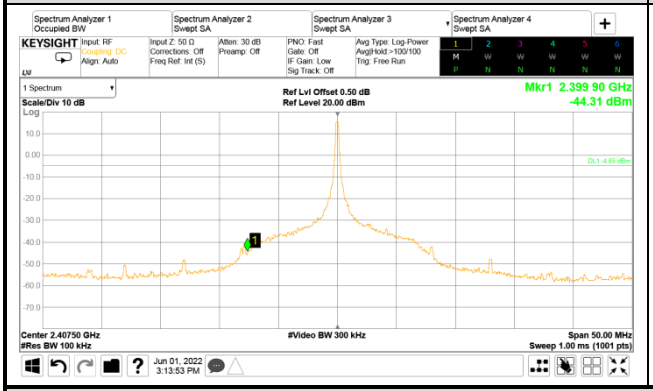
A.8.1 Band Edge

Test Date	2022/06/01	Temp./Hum.	23℃/59%
Cable Loss	0.50dB	Tested By	Martin Chen
Test Voltage	DC 5V (Via DC Power Supply)	Test Model	FEX01TB-1

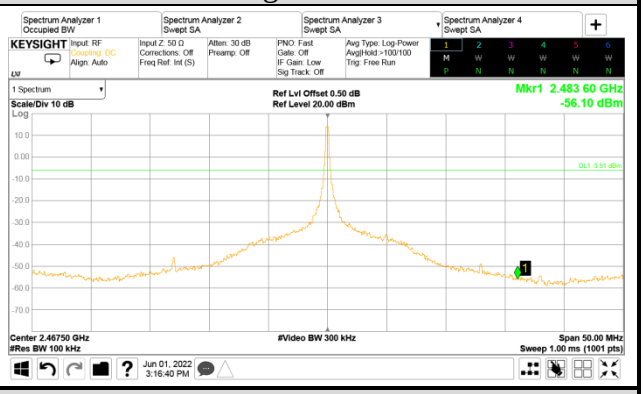
FHSS

Single Channel

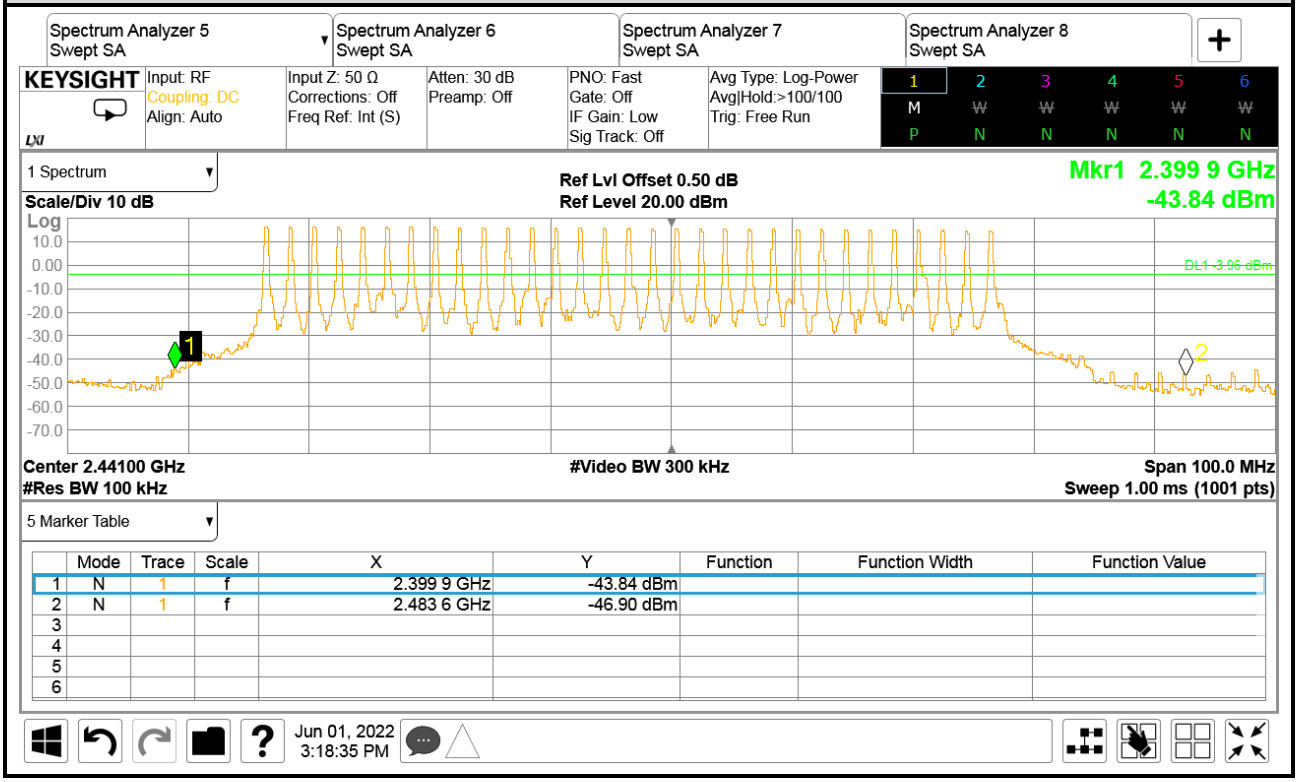
Low channel



High channel



Hopping Mode



	Mode	Trace	Scale	X	Y	Function	Function Width	Function Value
1	N	1	f	2.399 9 GHz	-43.84 dBm			
2	N	1	f	2.483 6 GHz	-46.90 dBm			
3								
4								
5								
6								

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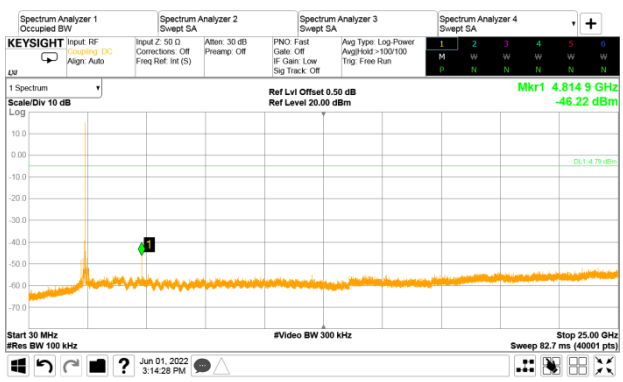
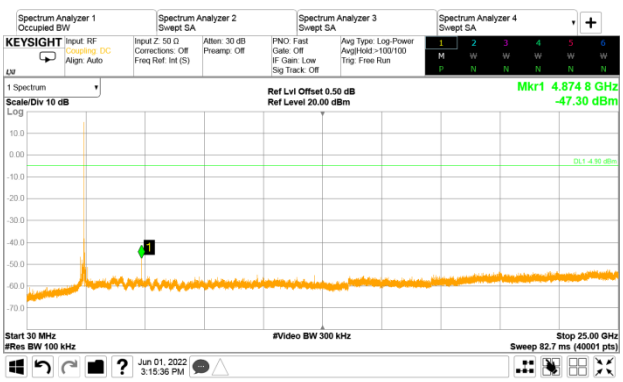
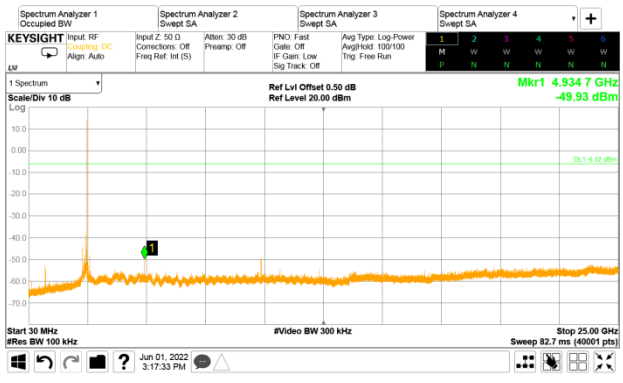
A.8.2 Spurious Emission

Test Date	2022/06/01	Temp./Hum.	23℃/59%
Cable Loss	0.50dB	Tested By	Martin Chen
Test Voltage	DC 5V (Via DC Power Supply)	Test Model	FEX01TB-1

FHSS	
2407.5MHz	2437.5MHz
	

FHSS
2467.5MHz


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APPDNDIX B

TEST PHOTOGRAPHS

(Model: FEX01TB-1)