

## **FCC 15.247 & RSS-247 2.4 GHz Test Report**

**for**

**FUTABA Corporation**

**1080 Yabutsuka Chosei-mura Chosei-gun Chiba-ken  
299-4395 JAPAN**

**Product Name : Radio Control**  
**Model Name : T16IZ**  
**Brand : Futaba**  
**FCC ID : AZP-T16IZ-24G**  
**IC : 2914D-T16IZ**

**Prepared by: : AUDIX Technology Corporation,  
EMC Department**



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.  
The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

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APPENDIX A TEST DATA AND PLOTS

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## TEST REPORT

Applicant : FUTABA Corporation  
Manufacturer : FUTABA Corporation  
EUT Description  
(1) Product : Radio Control  
(2) Model : T16IZ  
(3) Brand : Futaba  
(4) Power Supply : (1)DC 5V (USB)  
(2)DC7.4V (Battery)

### Applicable Standards:

Title 47 FCC CFR, Part 15, Subpart C  
RSS-Gen (Issue 5), April 2018  
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: 2020. 12. 14

Reviewed by:

Sabrina Wang

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Approved by:

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## 1. REVISION RECORD OF TEST REPORT

Edition No	Issued Date	Revision Summary	Report Number
0	2020. 12. 14	Original Report	EM-F200597

## 2. SUMMARY OF TEST RESULTS

Rule		Description	Results
FCC	IC		
15.207	RSS-Gen §8.8	Conducted Emission	<b>PASS</b>
15.247(d)/15.205	RSS-Gen §8.9 RSS-247 §5.5	Radiated Band Edge and Radiated Spurious Emission	<b>PASS</b>
15.247(a)(1)	RSS-247 §5.1(2)	20dB/Occupied Bandwidth	<b>PASS</b>
15.247(a)(1)	RSS-247 §5.1(2)	Carrier Frequency Separation	<b>PASS</b>
15.247(a)(1)(iii)	RSS-247 §5.1(4)	Time of Occupancy	<b>PASS</b>
15.247(a)(1)(iii)	RSS-247 §5.1(4)	Number of Hopping Channels	<b>PASS</b>
15.247(b)(1)	RSS-247 §5.1(2)	Maximum Peak Output Power	<b>PASS</b>
15.247(d)	RSS-247 §5.5	Conducted Band Edges and Conducted Spurious Emission	<b>PASS</b>
15.203	RSS-Gen §6.8	Antenna Requirement	<b>Compliance</b>

Note: The uncertainties value is not used in determining the result.

### 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
Model	T16IZ
Brand	Futaba

#### 3.2. Description of EUT

Test Model	T16IZ		
Serial Number	N/A		
Power Rating	(1)DC 5V (USB) (2)DC7.4V (Battery)		
RF Features	DSSS: FASSTest, FASST FHSS: S-FHSS, T-FHSS		
Test Sample	Sample No.	Test Item	Firmware
	-01	AC Conduction, RSE, Output Power	N/A
Sample Status	Production		
Date of Receipt	2020. 09. 10		
Date of Test	2020. 09. 15~ 12. 11		
Interface Ports of EUT	<ul style="list-style-type: none"> <li>• Micro SD Card Slot x 1</li> <li>• PC Port (Type C) x 1</li> <li>• S.BUS (S.I/F) Connector x 1</li> <li>• Trainer Connector x 1</li> <li>• Charging Port (Type C) x 1</li> <li>• Earphone Plug x 1</li> <li>• Battery Connector x 1</li> </ul>		
Accessories Supplied	<ul style="list-style-type: none"> <li>• Type C Cable</li> </ul>		

#### 3.3. Reference Test Guidance

None

### 3.4. Antenna Information

No.	Antenna Type	Manufacture	Antenna Part Number	Frequency (MHz)	Max Gain (dBi)
1.	1/2λ Sleeve antenna	SANSEI	ANTB24	2400 - 2500	1.48

### 3.5. EUT Specifications Assessed in Current Report

Mode	Fundamental Range (MHz)	Channel Number	Modulation	Data Rate (kbps)
S-FHSS	2403.25 - 2447.50	60	FHSS	128
T-FHSS	2407.50 - 2467.50	31	FHSS	128

S-FHSS							
Channel List							
Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)
1	2403.25	16	2414.50	31	2425.75	46	2437.00
2	2404.00	17	2415.25	32	2426.50	47	2437.75
3	2404.75	18	2416.00	33	2427.25	48	2438.50
4	2405.50	19	2416.75	34	2428.00	49	2439.25
5	2406.25	20	2417.50	35	2428.75	50	2440.00
6	2407.00	21	2418.25	36	2429.50	51	2440.75
7	2407.75	22	2419.00	37	2430.25	52	2441.50
8	2408.50	23	2419.75	38	2431.00	53	2442.25
9	2409.25	24	2420.50	39	2431.75	54	2443.00
10	2410.00	25	2421.25	40	2432.50	55	2443.75
11	2410.75	26	2422.00	41	2433.25	56	2444.50
12	2411.50	27	2422.75	42	2434.00	57	2445.25
13	2412.25	28	2423.50	43	2434.75	58	2446.00
14	2413.00	29	2424.25	44	2435.50	59	2446.75
15	2413.75	30	2425.00	45	2436.25	60	2447.50

T-FHSS							
Channel List							
Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)
1	2407.50	9	2423.50	17	2439.50	25	2455.50
2	2409.50	10	2425.50	18	2441.50	26	2457.50
3	2411.50	11	2427.50	19	2443.50	27	2459.50
4	2413.50	12	2429.50	20	2445.50	28	2461.50
5	2415.50	13	2431.50	21	2447.50	29	2463.50
6	2417.50	14	2433.50	22	2449.50	30	2465.50
7	2419.50	15	2435.50	23	2451.50	31	2467.50
8	2421.50	16	2437.50	24	2453.50		



### 3.6. Description of Key Components

Item	Supplier/Brand	Model	Specification
Wireless Module	Futaba	TC23B	DSSS: FASSTest, FASST FHSS: S-FHSS, T-FHSS
Lithium-ion polymer battery	Futaba	LT2F2000B	DC 7.4A, 2000mA, 14.8Wh
Type C Cable	Futaba	KH7674-011	USB AM-TYPE C 22AWG*2C+28AWG*2C L=1000mm

### 3.7. Test Configuration

Mode	Duty Cycle (x)	T (ms)	Duty Cycle Correction Factor (dB)
S-FHSS	N/A	1.450	N/A
T-FHSS	N/A	1.440	N/A



AC Conduction	
Test Case	Charge Mode

	Item	Modulation	Test Channel
Radiated Test Case	Radiated Spurious Emission	Charge	---
	Radiated Band Edge <sup>Note1</sup>	S-FHSS	1/60
		T-FHSS	1/31
	Radiated Spurious Emission <sup>Note1</sup>	S-FHSS	1/30/60
T-FHSS		1/16/31	
Conducted Test Case	20dB Bandwidth	S-FHSS	1/30/60
		T-FHSS	1/16/31
	Carrier Frequency Separation	S-FHSS	1/30/60
		T-FHSS	1/16/31
	Time of Occupancy	S-FHSS	1/30/60
		T-FHSS	1/16/31
	Number of Hopping Channels	S-FHSS	1/30/60
		T-FHSS	1/16/31
	Maximum Peak Output Power	S-FHSS	1/30/60
		T-FHSS	1/16/31
	Band Edges	S-FHSS	1/60
		T-FHSS	1/31
	Spurious Emission	S-FHSS	1/30/60
		T-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

### 3.8. Tested Supporting System List

#### 3.8.1. Support Peripheral Unit

No.	Product	Brand	Model No.	Serial No.	Approval
1.	AC Adapter Wall-mount, 2C (DC 5V)	APD	WB-10G05R	N/A	N/A
2.	Power Socket	N/A	N/A	N/A	N/A
3.	Micro SD Card (4GB)	Transcend	N/A	N/A	N/A

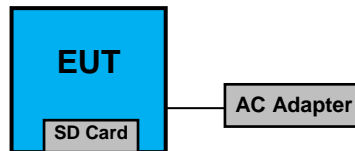
#### 3.8.2. Cable Lists

No.	Cable Description Of The Above Support Units
1.	Type C Cable: Shielded, Detachable, 1.0m
2.	AC Power Cable: Unshielded, Undetachable, 1.8m

### 3.9. Setup Configuration

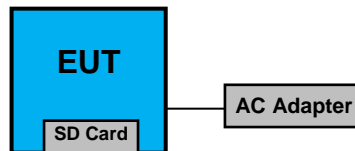
#### 3.9.1. EUT Configuration for Power Line Emission

- Charge mode

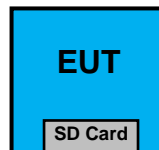


#### 3.9.2. EUT Configuration for Radiated Emission

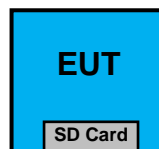
- Charge mode



- Transmit Mode



#### 3.9.3. EUT Configuration for RF Conducted Test Items



### 3.10. Operating Condition of EUT

- Charge Mode: The EUT connects the AC adapter on charge mode.
- Transmit Mode: Press the button of the EUT is used for enabling EUT RF function under continues transmitting and choosing mode/channel. (The test program was installed in SD card)

### 3.11. Description of Test Facility

Name of Test Firm	Audix Technology Corporation / EMC Department No. 53-11, Dingfu, 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 (3) Fully Anechoic Chamber

### 3.12.Measurement Uncertainty

Test Items/Facilities		Frequency Range	Uncertainty	
Conduction Test		9kHz-150kHz	±3.7dB	
		150kHz-30MHz	±3.5dB	
Radiation Test	<input checked="" type="checkbox"/>	No.1 3m Semi Anechoic Chamber	30MHz-200MHz, 3m, Horizontal	±4.1dB
			200MHz-1000MHz, 3m, Horizontal	±3.9dB
			30MHz-200MHz, 3m, Vertical	±4.2dB
			200MHz-1000MHz, 3m, Vertical	±4.1dB
			1GHz-6GHz, 3m	±4.2dB
			6GHz-18GHz, 3m	±4.6dB
	<input type="checkbox"/>	No.3 3m Semi Anechoic Chamber	30MHz-200MHz, 3m, Horizontal	±3.9dB
			200MHz-1000MHz, 3m, Horizontal	±3.9dB
			30MHz-200MHz, 3m, Vertical	±4.4dB
			200MHz-1000MHz, 3m, Vertical	±4.1dB
	<input type="checkbox"/>	No.4 3m Semi Anechoic Chamber	30MHz-200MHz, 3m, Horizontal	±4.3dB
			200MHz-1000MHz, 3m, Horizontal	±4.0dB
			30MHz-200MHz, 3m, Vertical	±4.3dB
			200MHz-1000MHz, 3m, Vertical	±4.4dB
			1GHz-6GHz, 3m	±4.5dB
			6GHz-18GHz, 3m	±4.6dB
	<input type="checkbox"/>	No.5 3m Semi Anechoic Chamber	30MHz-200MHz, 3m, Horizontal	±4.0dB
			200MHz-1000MHz, 3m, Horizontal	±3.9dB
			30MHz-200MHz, 3m, Vertical	±4.2dB
			200MHz-1000MHz, 3m, Vertical	±4.3dB
			1GHz-6GHz, 3m	±4.3dB
			6GHz-18GHz, 3m	±4.7dB
	<input checked="" type="checkbox"/>	Fully Anechoic Chamber	30MHz~1000MHz	±4.7dB
			1GHz~18GHz	±5.3dB
18GHz~40GHz			±3.52dB	
40GHz~260GHz			±3.56dB	

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

## 4. MEASUREMENT EQUIPMENTLIST

### 4.1. Conducted Emission Measurement

Item	Type	Brand	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Test Receiver	R&S	ESR3	101774	2020.02.04	1 Year
2.	A.M.N.	R&S	ENV432	101567	2020.04.20	1 Year
3.	L.I.S.N.	Kyoritsu	KNW-407	8-855-9	2020.12.10	1 Year
4.	Pulse Limiter	R&S	ESH3-Z2	100354	2020.01.05	1 Year
5.	Digital Thermo-Hygro Meter	iMax	HTC-1	No.8 S/R	2020.04.17	1 Year
6.	Coaxial Cable	Yeida	RG/58AU	CE-08	2020.09.19	1 Year
7.	Test Software	Audix	e3	V6.120619c	N.C.R.	N.C.R.

### 4.2. Radiated Emission Measurement

Item	Type	Brand	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	N9030A-526	MY53400071	2020.01.16	1 Year
2.	Spectrum Analyzer	Keysight	N9010B-544	MY55460198	2020.04.29	1 Year
3.	Test Receiver	R&S	ESCS30	100039	2020.06.05	1 Year
4.	Amplifier	HP	8447D	2944A06305	2020.01.16	1 Year
5.	Amplifier	HP	8449B	3008A02678	2020.02.27	1 Year
6.	Amplifier	Keysight	83051A	MY53010042	2020.08.05	1 Year
7.	Loop Antenna	R&S	HFH2-Z2	891847/27	2019.12.26	2 Years
8.	Bilog Antenna	TESEQ	CBL6112D	33821	2020.01.17	1 Year
9.	Horn Antenna	EMCO	3117	00135902	2020.03.20	1 Year
10.	Horn Antenna	COM-POWER	AH-840	101092	2020.05.08	1 Year
11.	2.4GHz Notch Filter	K&L	7NSL10-2441.5/E 130.5-O/O	1	2020.07.24	1 Year
12.	High-Pass Filter	Microwave	H3G018G1	484796	2020.08.20	1 Year
13.	Coaxial Cable	MIYAZAKI	5D2W	CLAMP-01	2020.09.19	1 Year
14.	Coaxial Cable	MIYAZAKI	5D2W	RE-11	2020.01.31	1 Year
15.	Coaxial Cable	HUBER+SUHNER	SUCOFLEX 104	RE-29	2020.09.19	1 Year
16.	Coaxial Cable	HUBER+SUHNER	SUCOFLEX 102	RE-30	2020.09.19	1 Year
17.	Digital Thermo-Hygro Meter	iMax	HTC-1	No.1 3m A/C	2020.04.17	1 Year
18.	Digital Thermo-Hygro Meter	EVERY DAY	E-512	RF-02	2020.04.17	1 Year
19.	Test Software	Audix	e3	V6.120619c	N.C.R.	N.C.R.
20.	Test Software	Audix	e3	V6.110601	N.C.R.	N.C.R.

### 4.3. RF Conducted Measurement

Item	Type	Brand	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Keysight	N9020B-544	MY57120357	2020.01.10	1 Year
2.	Digital Thermo-Hygro Meter	Datronn	KT-905	RF	2020.04.17	1 Year

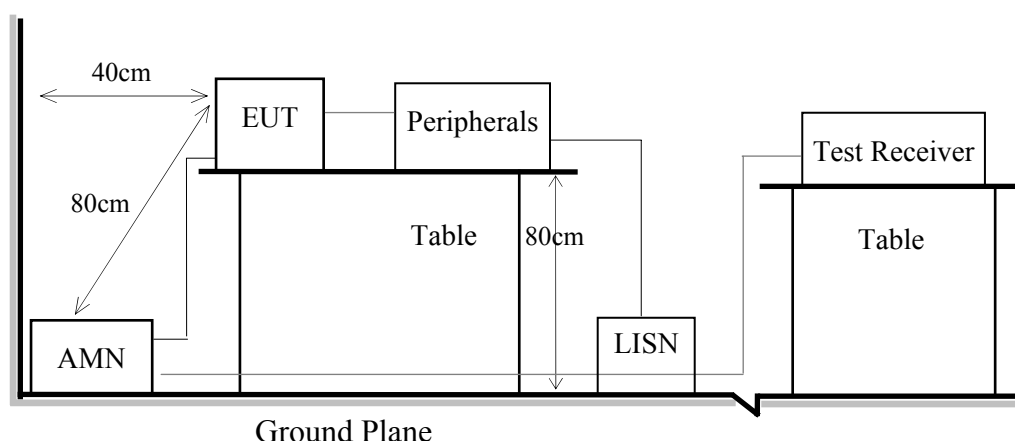
## 5. CONDUCTED EMISSION

### 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 dB $\mu$ V	56 ~ 46 dB $\mu$ V
500kHz ~ 5MHz	56 dB $\mu$ V	46 dB $\mu$ V
5MHz ~ 30MHz	60 dB $\mu$ V	50 dB $\mu$ V

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.

### 5.4. Test Results

Please refer to Appendix A.



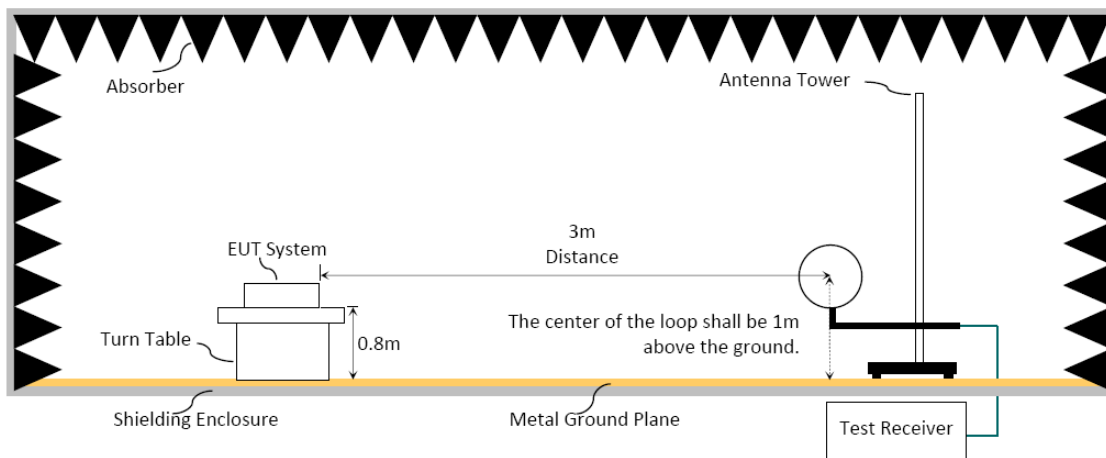
## 6. RADIATED EMISSION

### 6.1. Block Diagram of Test Setup

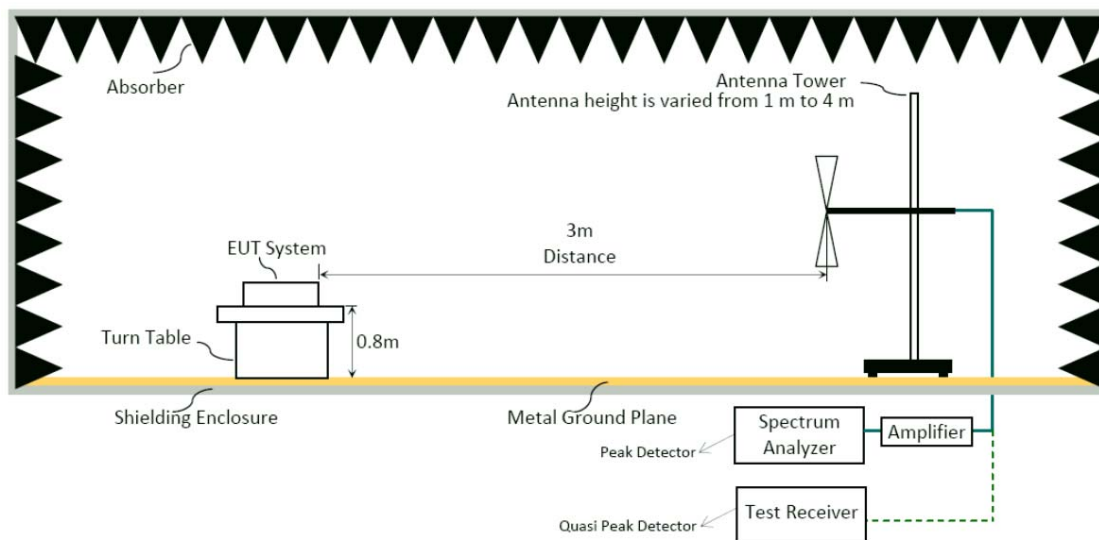
#### 6.1.1. Block Diagram of EUT

Indicated as section 3.9

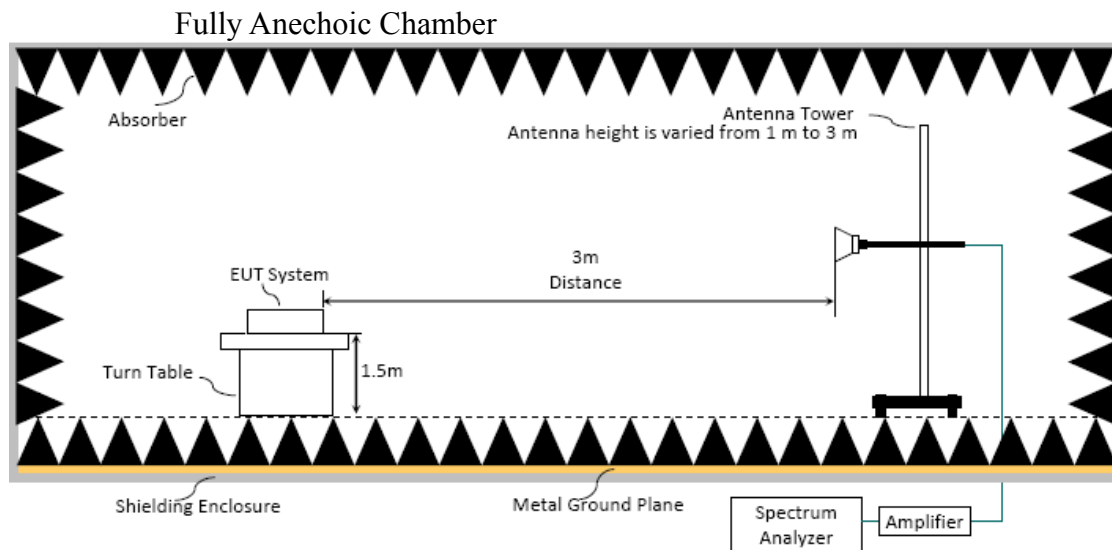
#### 6.1.2. Setup Diagram for 9kHz-30MHz



#### 6.1.3. Setup Diagram for 30-1000MHz



### 6.1.4. Setup Diagram for above 1GHz



## 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	
		dB $\mu$ V/m	$\mu$ V/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 dB $\mu$ V/m (Peak) 54.0 dB $\mu$ V/m (Average)	

Remark : (1) dB $\mu$ V/m = 20 log ( $\mu$ V/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.

### 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 (for 30-1000MHz) and from 1m to 3m (for above 1GHz at fully Anechoic Chamber) or from 1 m to 4 m (for above 1GHz at Semi Anechoic Chamber) 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  $\geq 3 \times$  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 the Q.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  $\geq 3 \times$  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.

**Average Detector:** **Option 1:**

(1) RBW = 1MHz

(2) VBW  $\geq$  1/ T.

Modulation Type	TX <sub>on</sub> (ms)	1/ TX <sub>on</sub> (kHz)	VBW Setting (kHz)
FASSTest	1.450	0.690	3
FASST	1.440	0.694	3

N/A: 1/ T is not implemented when duty cycle presented in section 3.7 is  $\geq$ 98%.

(3) Detector = Peak.

(4) Sweep time = auto.

(5) Trace mode = max hold.

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

 **Option 2:**

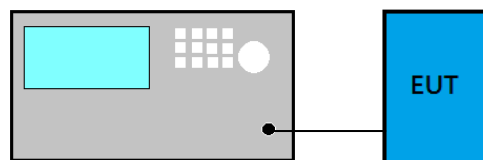
Average Emission Level = Peak Emission Level + D.C.C.F.

**6.4. Measurement Result Explanation** Peak Emission Level = Antenna Factor + Cable Loss + Meter Reading (including Preamp factor if test used) Average Emission Level = Antenna Factor + Cable Loss + Meter Reading (including Preamp factor if test used) Average Emission Level = Peak Emission Level + DCCFDuty Cycle Correction Factor (DCCF) =  $20\log(TX_{on}/TX_{on+off})$  presented in section 3.6 ERP = Peak Emission Level - 95.2dB - 2.14dB**6.5. Test Results**

Please refer to Appendix A.

## 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 $\geq$ 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

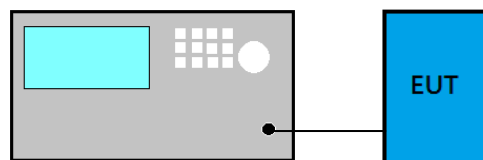
- (8) Set Span range 1.5~5 times the OBW
- (9) Set RBW close to 1% to 5% of OBW.
- (10) Set VBW $\geq$ 3xRBW.
- (11) Detector = Peak.
- (12) Trace mode = Max hold
- (13) Sweep = Auto couple.
- (14) Allow the trace to stabilize.

### 7.4. Test Results

Please refer to Appendix A

## 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:

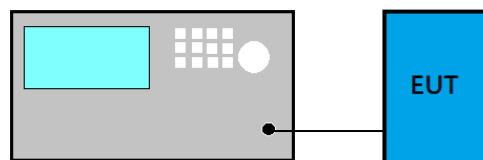
- (1) Span = Wide enough to capture the peaks of two adjacent channels
- (2) RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
- (3)  $VBW \geq RBW$
- (4) Sweep = Auto
- (5) Detector function = Peak
- (6)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

### 8.4. Test Results

Please refer to Appendix A

## 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:

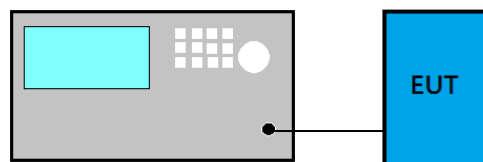
- (1) Span: Zero span, centered on a hopping channel.
- (2) RBW shall be  $\leq$  channel spacing and where possible RBW should be set  $\gg 1/T$ , where T is the expected dwell time per channel.
- (3) Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video 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

## 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  $\geq$  RBW
- (4) Sweep = Auto
- (5) Detector function = Peak
- (6) Trace = m=Max hold
- (7) Allow the trace to stabilize.

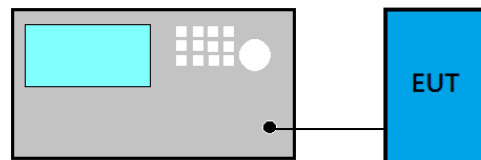
### 10.4. Test Results

Please refer to Appendix A



## 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:

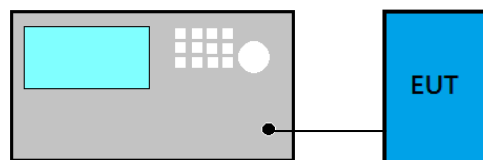
- (a) Use the following spectrum analyzer settings
  - (1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
  - (2) RBW > 20 dB bandwidth of the emission being measured.
  - (3) VBW  $\geq$  RBW
  - (4) Sweep: Auto
  - (5) Detector function: Peak
  - (6) Trace: Max hold
- (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

## 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<sup>th</sup> harmonic.
- (2) RBW = 100 kHz
- (3) VBW  $\geq$  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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**APPENDIX A**

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# APPDNDIX A

## TEST DATA AND PLOTS

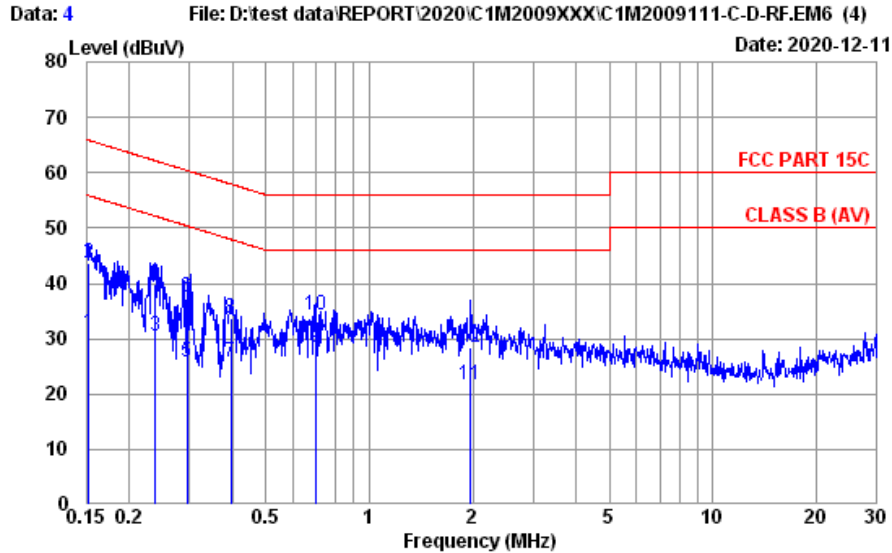
(Model: T16IZ)

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## A.1 CONDUCTED EMISSION

Test Date	2020/12/11	Temp./Hum.	25°C/66%
Test Voltage	AC 120V 60Hz (Via AC Adapter)	Tested By	Chucky Chiu



Site No.	: No.8 Shielded Room	Data No.	: 4
Instrument 1	: Receiver ESR(774)		
Instrument 2	: EIV432 (567)(A) CE-08 ESH3-Z2 (354)		
Limit	: FCC PART 15C	Phase	: NEUTRAL
Environment	: 25°C / 66%	Engineer	: Chucky Chiu
EUT Model	: T161Z	Test Rating	: 120Vac / 60Hz
Test Mode	: Charge		

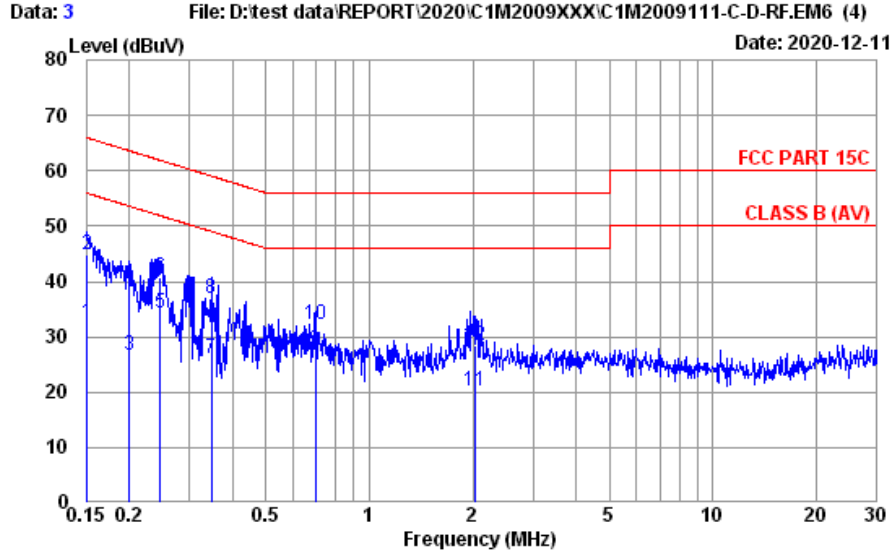
	Freq. (MHz)	AMI Factor (dB)	Cable Loss (dB)	Pulse Att. (dB)	Reading (dBµV)	Emission Level (dBµV)	Limits (dBµV)	Margin (dB)	Remark
1	0.152	10.20	0.03	9.85	11.02	31.10	55.87	24.77	Average
2	0.152	10.20	0.03	9.85	23.63	43.71	65.87	22.16	QP
3	0.238	10.20	0.03	9.85	10.36	30.44	52.17	21.73	Average
4	0.238	10.20	0.03	9.85	19.90	39.98	62.17	22.19	QP
5	0.294	10.20	0.03	9.85	5.84	25.92	50.41	24.49	Average
6	0.294	10.20	0.03	9.85	17.29	37.37	60.41	23.04	QP
7	0.396	10.20	0.03	9.85	5.66	25.74	47.95	22.21	Average
8	0.396	10.20	0.03	9.85	13.61	33.69	57.95	24.26	QP
9	0.697	10.20	0.04	9.85	8.41	28.50	46.00	17.50	Average
10	0.697	10.20	0.04	9.85	14.07	34.16	56.00	21.84	QP
11	1.970	10.30	0.06	9.86	1.53	21.75	46.00	24.25	Average
12	1.970	10.30	0.06	9.86	8.15	28.37	56.00	27.63	QP

Remarks: 1. Emission Level= AMI Factor + Cable Loss + Pulse Att. + Reading.

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Test Date	2020/12/11	Temp./Hum.	25°C/66%
Test Voltage	AC 120V 60Hz (Via AC Adapter)	Tested By	Chucky Chiu



Site No.	: No.8 Shielded Room	Data No.	: 3
Instrument 1	: Receiver ESR(774)		
Instrument 2	: EHV432 (567)(A) CE-08 ESH3-22 (354)		
Limit	: FCC PART 15C	Phase	: LINE
Environment	: 25°C / 66%	Engineer	: Chucky Chiu
EUT Model	: T161Z	Test Rating	: 120Vac / 60Hz
Test Mode	: Charge		

	Freq. (MHz)	AMI Factor (dB)	Cable Loss (dB)	Pulse Att. (dB)	Reading (dBµV)	Emission Level (dBµV)	Limits (dBµV)	Margin (dB)	Remark
1	0.151	10.20	0.03	9.85	12.46	32.54	55.96	23.42	Average
2	0.151	10.20	0.03	9.85	24.70	44.78	65.96	21.18	QP
3	0.201	10.20	0.03	9.85	6.68	26.76	53.58	26.82	Average
4	0.201	10.20	0.03	9.85	19.37	39.45	63.58	24.13	QP
5	0.247	10.20	0.03	9.85	14.30	34.38	51.86	17.48	Average
6	0.247	10.20	0.03	9.85	20.60	40.68	61.86	21.18	QP
7	0.346	10.20	0.03	9.85	6.03	26.11	49.05	22.94	Average
8	0.346	10.20	0.03	9.85	16.88	36.96	59.05	22.09	QP
9	0.696	10.20	0.04	9.85	7.32	27.41	46.00	18.59	Average
10	0.696	10.20	0.04	9.85	12.21	32.30	56.00	23.70	QP
11	2.033	10.30	0.06	9.86	-0.13	20.09	46.00	25.91	Average
12	2.033	10.30	0.06	9.86	8.31	28.53	56.00	27.47	QP

Remarks: 1. Emission Level= AMI Factor + Cable Loss + Pulse Att. + Reading.

## A.2 RADIATED EMISSION

Test Date	2020/11/30~12/01	Temp./Hum.	22°C/62~67%
Test Voltage	(1)AC 120V 60Hz (Via AC Adapter) (2)DC 7.4V (Via Battery)	Tested By	Kuper Hsu

### 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 1GHz

Mode	Charge Mode	Frequency	---
------	-------------	-----------	-----

#### Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
76.560	12.92	2.12	26.39	42.81	31.46	40.00	8.54	Peak
204.600	15.70	3.60	25.86	45.35	38.79	43.50	4.71	Peak
296.750	19.24	4.52	0.00	18.90	42.66	46.00	3.34	QP
774.960	25.83	8.00	27.44	29.41	35.80	46.00	10.20	Peak
920.460	26.94	8.81	27.07	29.09	37.77	46.00	8.23	Peak
971.870	27.25	9.04	26.92	28.83	38.20	54.00	15.80	Peak

#### Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
34.850	22.18	1.35	0.00	14.50	38.03	40.00	1.97	QP
49.400	14.82	1.64	0.00	23.30	39.76	40.00	0.24	QP
74.620	12.80	2.09	0.00	19.60	34.49	40.00	5.51	QP
202.660	15.54	3.58	25.86	39.36	32.62	43.50	10.88	Peak
285.110	19.11	4.39	25.72	42.25	40.03	46.00	5.97	Peak
980.600	27.28	9.07	26.90	28.93	38.38	54.00	15.62	Peak



Mode	S-FHSS	Frequency	TX 2403.25MHz
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**Antenna at Horizontal Polarization**

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
35.820	21.56	1.38	26.52	28.12	24.54	40.00	15.46	Peak
152.220	17.10	3.08	26.04	37.91	32.05	43.50	11.45	Peak
210.420	16.12	3.65	25.85	39.79	33.71	43.50	9.79	Peak
412.180	22.06	6.13	26.64	35.28	36.83	46.00	9.17	Peak
790.480	26.01	8.08	27.42	29.67	36.34	46.00	9.66	Peak
972.840	27.25	9.04	26.92	28.85	38.22	54.00	15.78	Peak

**Antenna at Vertical Polarization**

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
31.940	23.35	1.26	26.53	28.07	26.15	40.00	13.85	Peak
137.670	18.14	2.91	26.11	44.13	39.07	43.50	4.43	Peak
210.420	16.12	3.65	25.85	36.40	30.32	43.50	13.18	Peak
403.450	21.90	6.05	26.55	29.64	31.04	46.00	14.96	Peak
651.770	24.90	7.33	27.49	29.31	34.05	46.00	11.95	Peak
983.510	27.30	9.09	26.87	29.04	38.56	54.00	15.44	Peak

Mode	T-FHSS	Frequency	TX 2407.50MHz
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**Antenna at Horizontal Polarization**

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
32.910	22.98	1.29	26.53	27.70	25.44	40.00	14.56	Peak
150.280	17.22	3.06	26.05	36.48	30.71	43.50	12.79	Peak
210.420	16.12	3.65	25.85	39.47	33.39	43.50	10.11	Peak
412.180	22.06	6.13	26.64	34.54	36.09	46.00	9.91	Peak
860.320	26.54	8.49	27.26	29.64	37.41	46.00	8.59	Peak
983.510	27.30	9.09	26.87	28.82	38.34	54.00	15.66	Peak

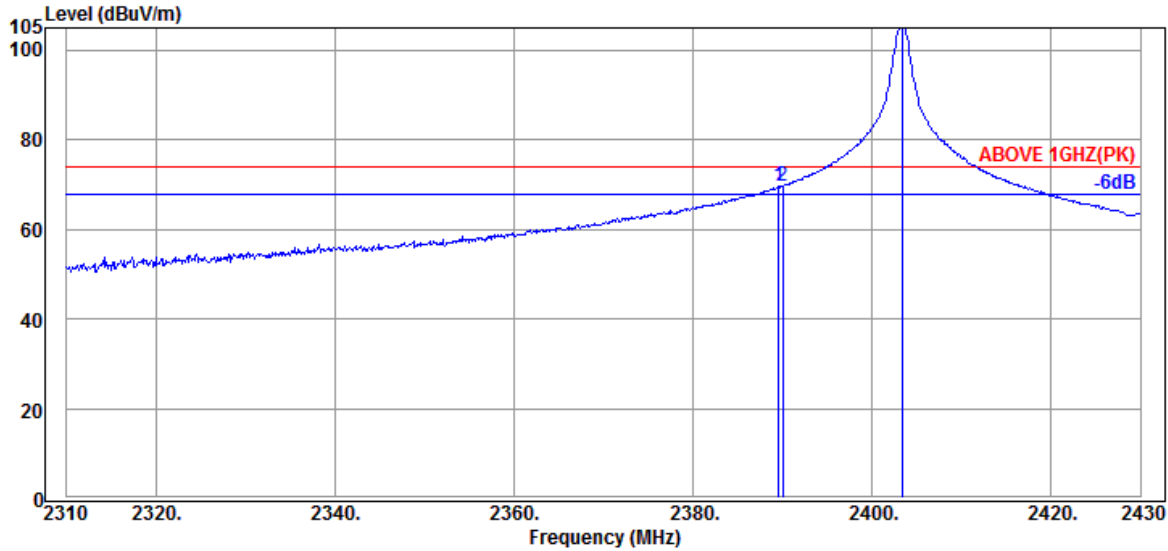
**Antenna at Vertical Polarization**

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
32.910	22.98	1.29	26.53	27.80	25.54	40.00	14.46	Peak
147.370	17.47	3.03	26.07	44.33	38.76	43.50	4.74	Peak
210.420	16.12	3.65	25.85	36.44	30.36	43.50	13.14	Peak
539.250	24.04	6.97	27.33	28.94	32.62	46.00	13.38	Peak
746.830	25.54	7.86	27.46	29.95	35.89	46.00	10.11	Peak
976.720	27.26	9.06	26.90	29.53	38.95	54.00	15.05	Peak

A.2.1.3 Frequency Above 1 GHz to 10<sup>th</sup> harmonics

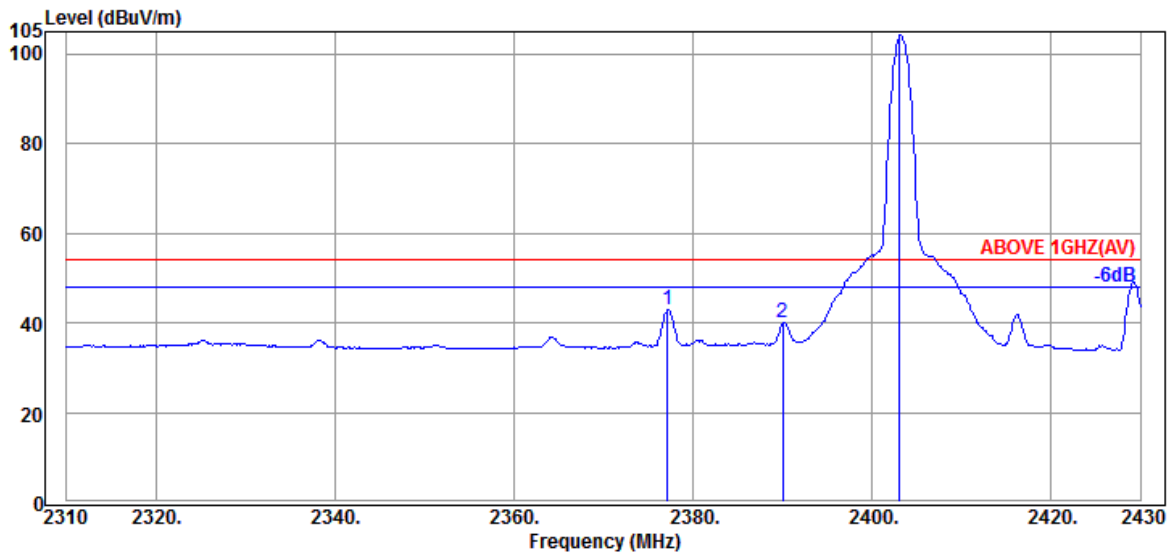
**Band Edge:**

Mode	S-FHSS	Frequency	TX 2403.25MHz
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Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2389.560	32.44	7.95	34.58	63.72	69.53	74.00	4.47	Peak
2390.040	32.44	7.95	34.58	63.87	69.68	74.00	4.32	Peak
@ 2403.480	32.50	7.95	34.59	99.23	105.09	---	---	Peak

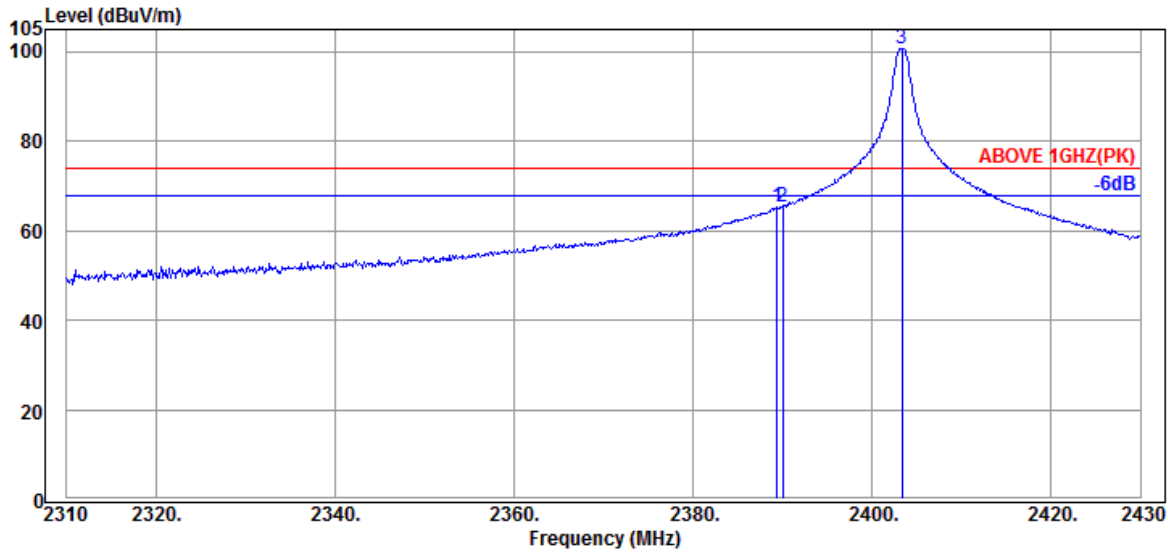


Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2377.200	32.41	7.95	34.58	37.12	42.90	54.00	11.10	Average
2390.040	32.44	7.95	34.58	34.09	39.90	54.00	14.10	Average
@ 2403.120	32.50	7.95	34.59	98.27	104.13	---	---	Average

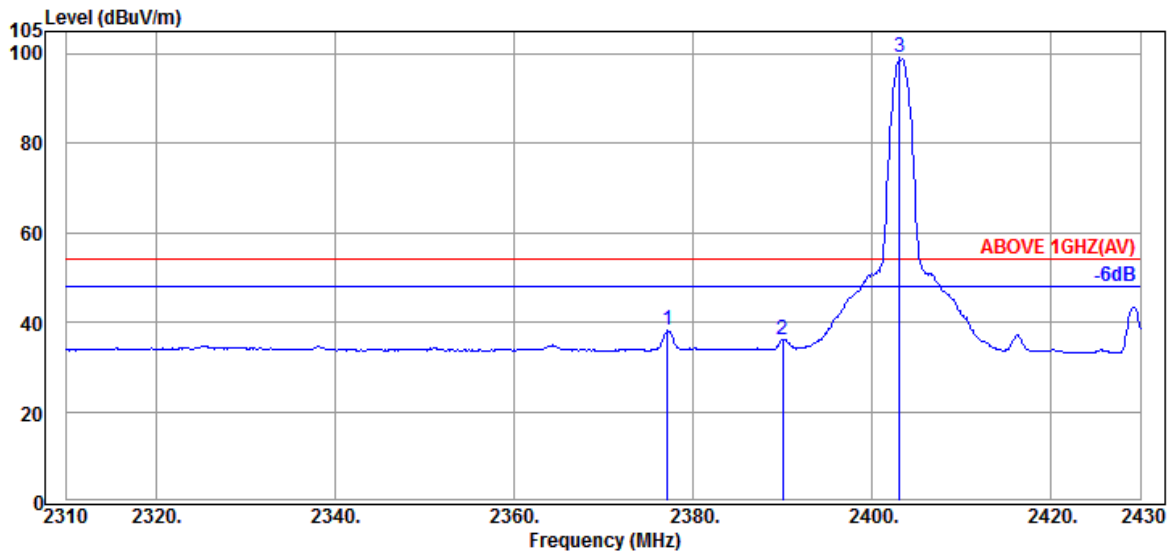
Remark: The “@” means fundamental frequency, it is ignored in this section.

Mode	S-FHSS	Frequency	TX 2403.25MHz
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Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2389.440	32.44	7.95	34.58	59.60	65.41	74.00	8.59	Peak
2390.040	32.44	7.95	34.58	59.48	65.29	74.00	8.71	Peak
@ 2403.360	32.50	7.95	34.59	94.99	100.85	---	---	Peak

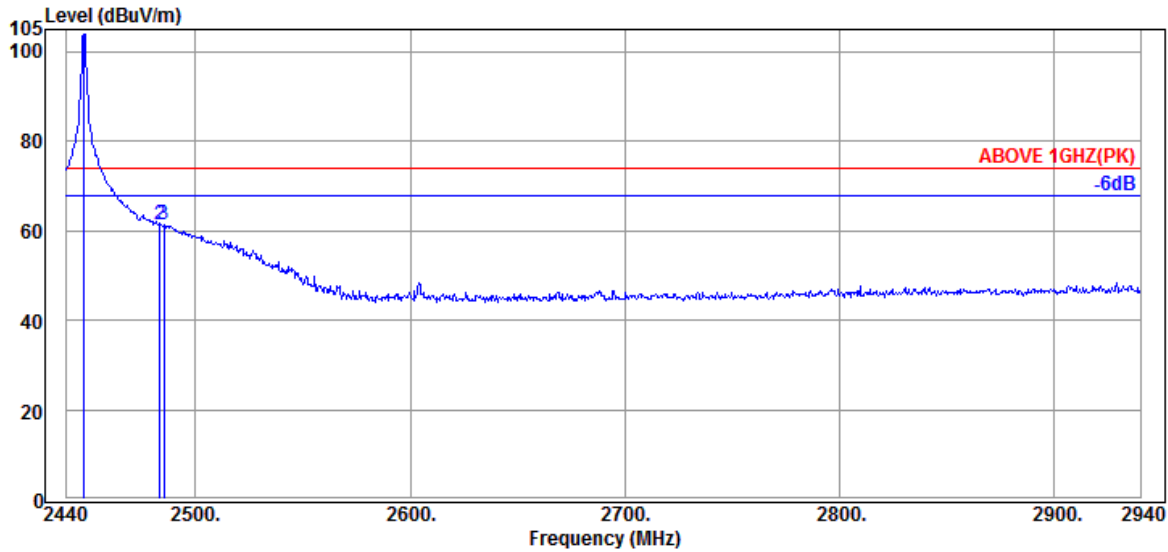


Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2377.200	32.41	7.95	34.58	32.43	38.21	54.00	15.79	Average
2390.040	32.44	7.95	34.58	30.26	36.07	54.00	17.93	Average
@ 2403.120	32.50	7.95	34.59	93.29	99.15	---	---	Average

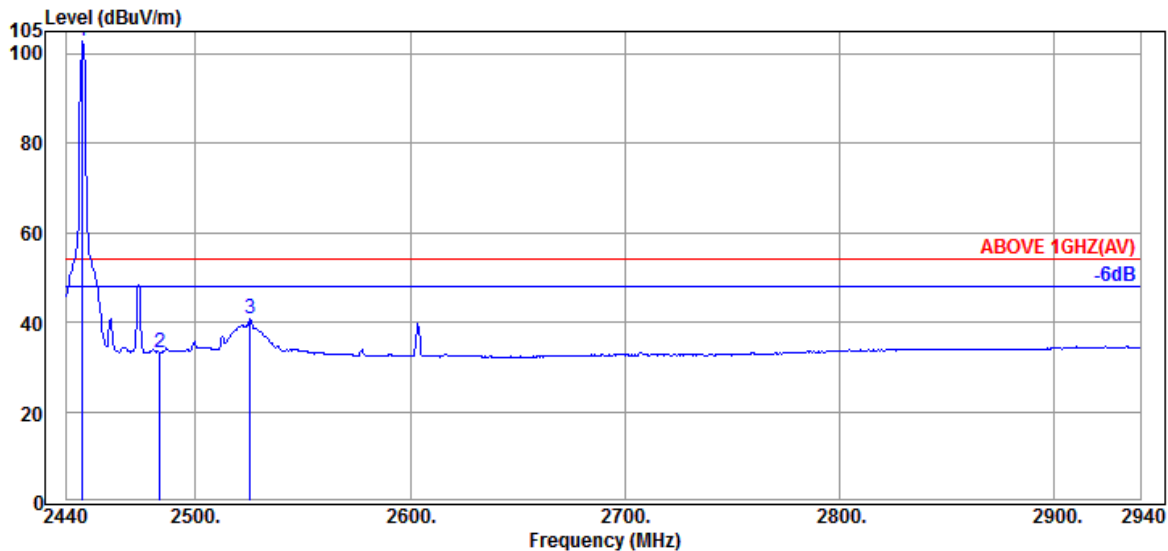
Remark: The “@” means fundamental frequency, it is ignored in this section.

Mode	S-FHSS	Frequency	TX 2447.50MHz
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Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
@ 2448.000	32.00	7.98	34.60	98.54	103.92	---	---	Peak
2483.500	32.14	7.99	34.61	55.92	61.44	74.00	12.56	Peak
2485.500	32.14	7.99	34.61	55.70	61.22	74.00	12.78	Peak

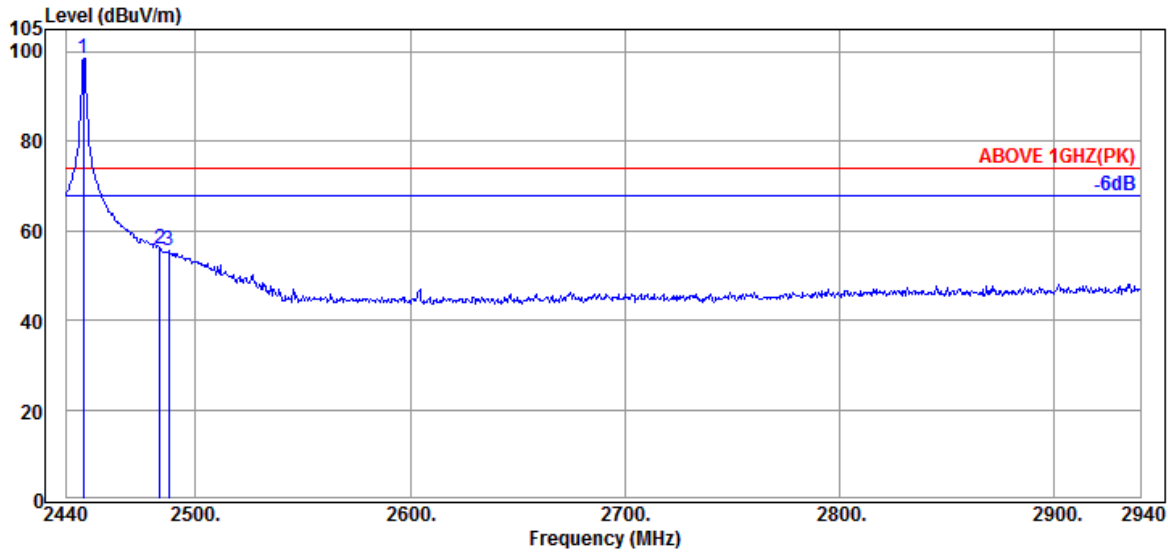


Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
@ 2447.500	32.00	7.98	34.60	97.33	102.71	---	---	Average
2483.500	32.14	7.99	34.61	27.76	33.28	54.00	20.72	Average
2525.500	32.26	8.02	34.61	35.11	40.78	54.00	13.22	Average

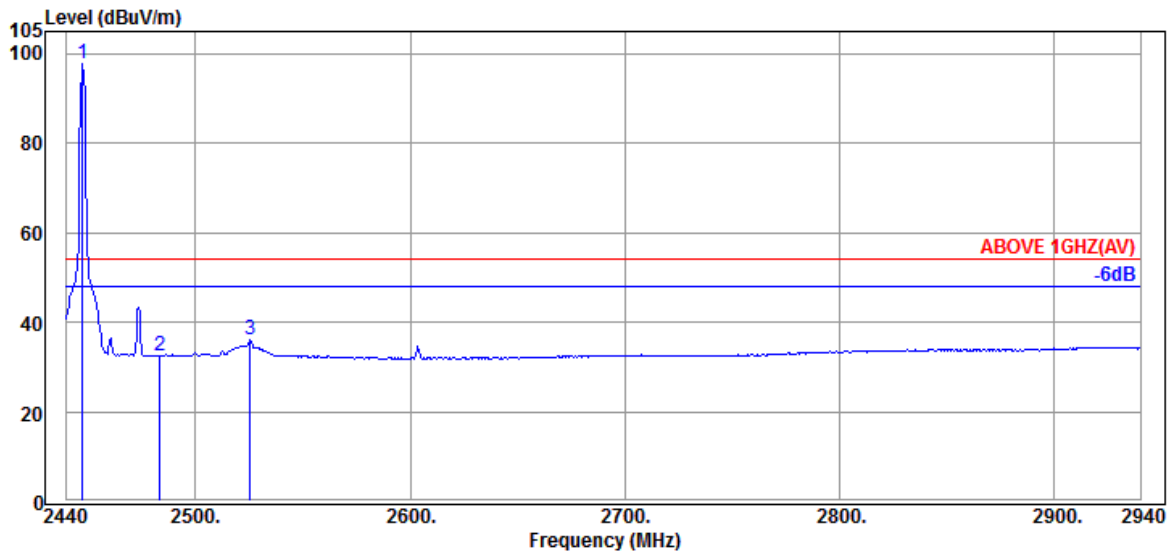
Remark: The “@” means fundamental frequency, it is ignored in this section.

Mode	S-FHSS	Frequency	TX 2447.50MHz
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Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
@ 2448.000	32.00	7.98	34.60	93.15	98.53	---	---	Peak
2483.500	32.14	7.99	34.61	50.28	55.80	74.00	18.20	Peak
2487.500	32.14	8.00	34.61	49.96	55.49	74.00	18.51	Peak

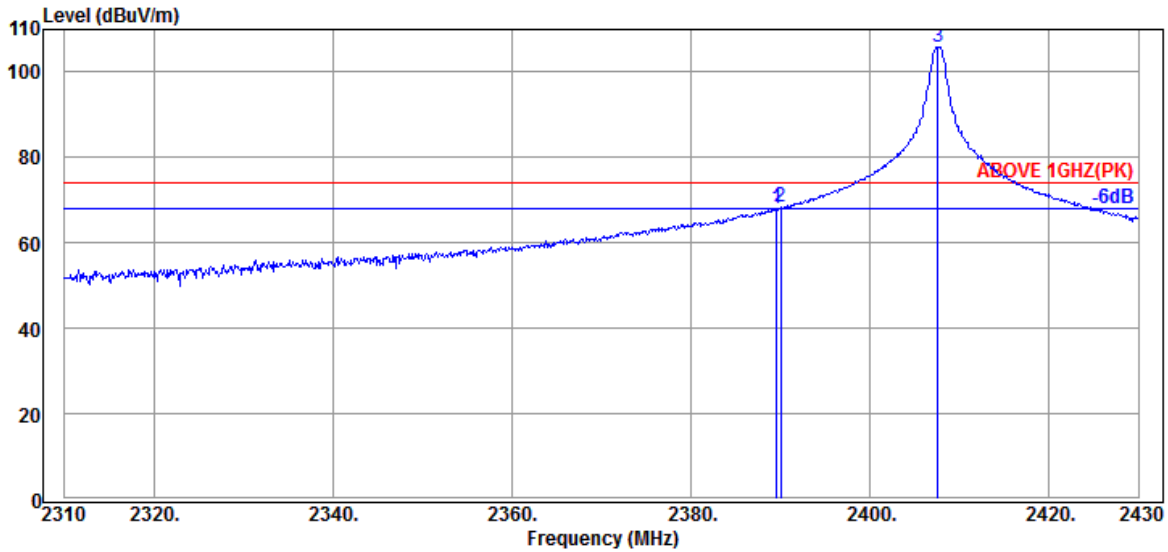


Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
@ 2447.500	32.00	7.98	34.60	92.30	97.68	---	---	Average
2483.500	32.14	7.99	34.61	27.02	32.54	54.00	21.46	Average
2525.500	32.26	8.02	34.61	30.39	36.06	54.00	17.94	Average

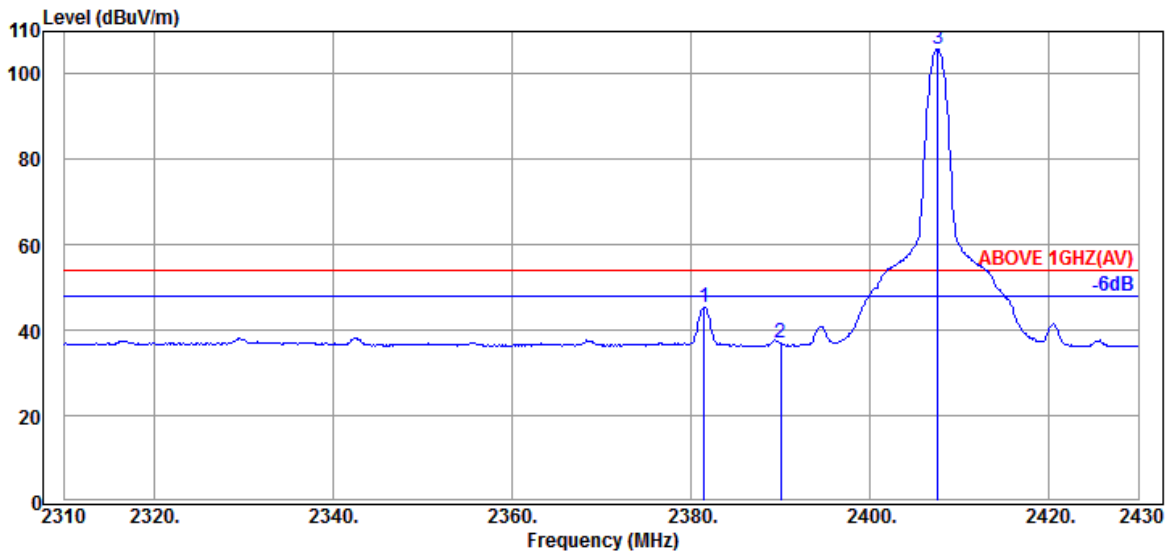
Remark: The “@” means fundamental frequency, it is ignored in this section.

Mode	T-FHSS	Frequency	TX 2407.50MHz
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Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2389.560	32.44	7.95	34.58	62.14	67.95	74.00	6.05	Peak
2390.040	32.44	7.95	34.58	62.47	68.28	74.00	5.72	Peak
@ 2407.560	32.43	7.96	34.59	100.14	105.94	---	---	Peak

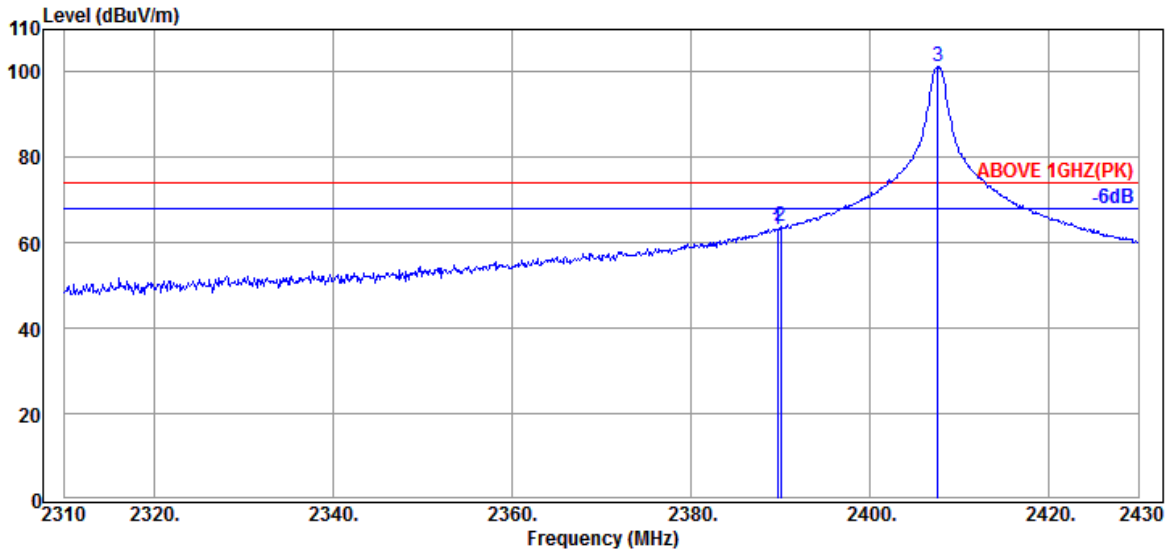


Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2381.520	32.41	7.95	34.58	39.68	45.46	54.00	8.54	Average
2390.040	32.44	7.95	34.58	31.24	37.05	54.00	16.95	Average
@ 2407.560	32.43	7.96	34.59	100.14	105.94	---	---	Average

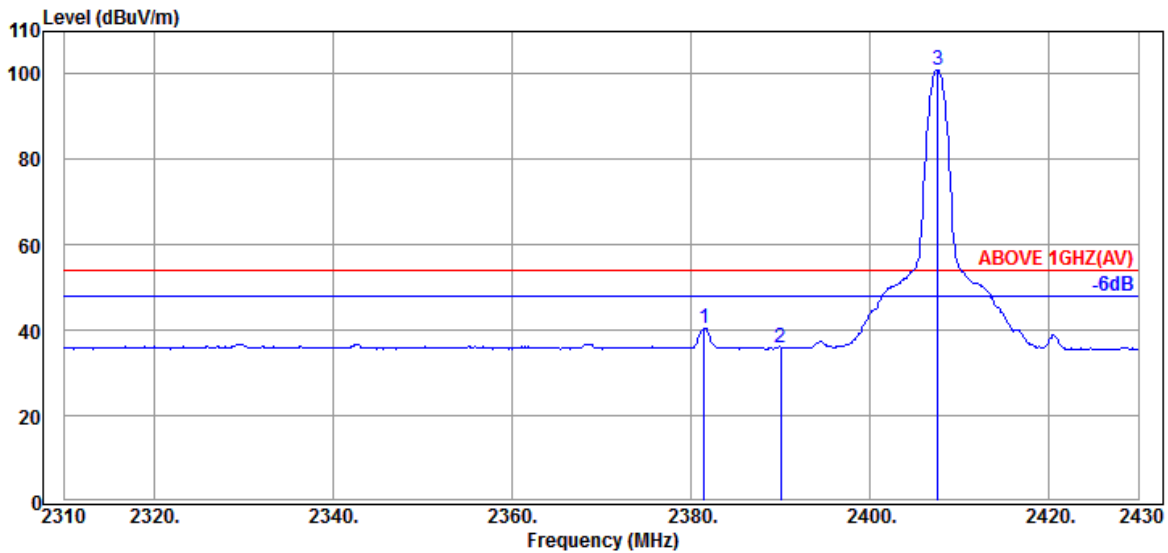
Remark: The "@" means fundamental frequency, it is ignored in this section.

Mode	T-FHSS	Frequency	TX 2407.50MHz
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Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2389.680	32.44	7.95	34.58	57.48	63.29	74.00	10.71	Peak
2390.040	32.44	7.95	34.58	57.97	63.78	74.00	10.22	Peak
@ 2407.560	32.43	7.96	34.59	95.33	101.13	---	---	Peak

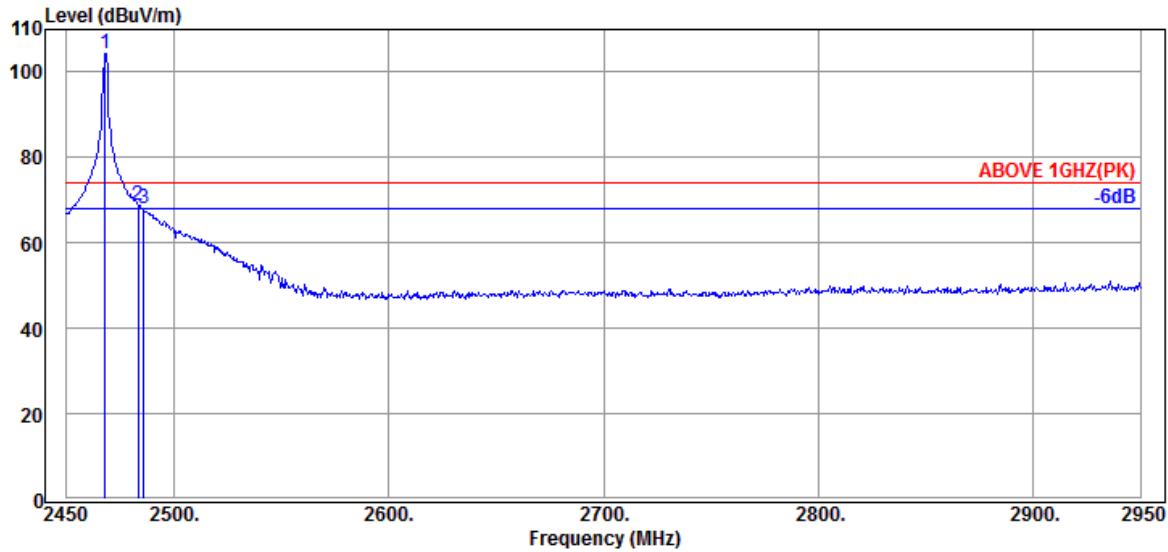


Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2381.520	32.41	7.95	34.58	34.77	40.55	54.00	13.45	Average
2390.040	32.44	7.95	34.58	29.99	35.80	54.00	18.20	Average
@ 2407.560	32.43	7.96	34.59	95.28	101.08	---	---	Average

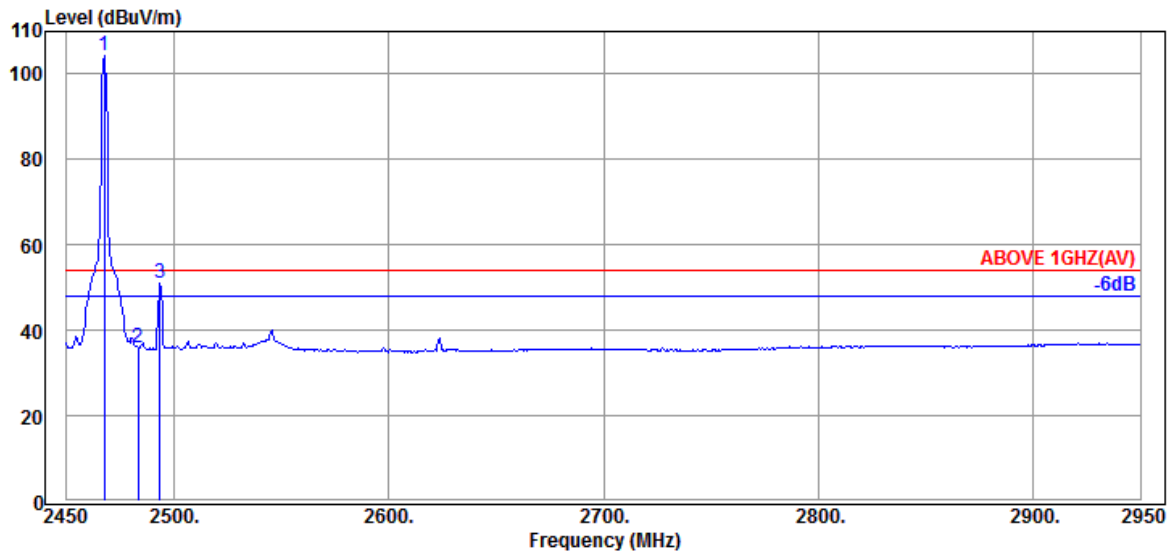
Remark: The “@” means fundamental frequency, it is ignored in this section.

Mode	T-FHSS	Frequency	TX 2467.50MHz
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Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
@ 2468.000	32.09	7.98	34.60	98.92	104.39	---	---	Peak
2483.500	32.14	7.99	34.61	63.45	68.97	74.00	5.03	Peak
2486.000	32.14	8.00	34.61	62.70	68.23	74.00	5.77	Peak



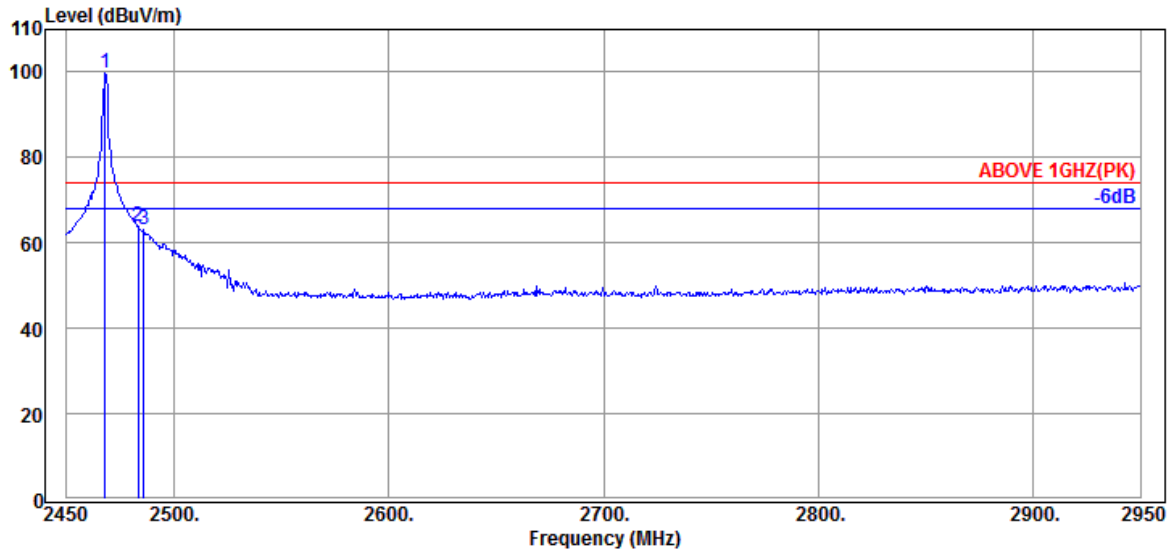
Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
@ 2467.500	32.06	7.98	34.60	98.73	104.17	---	---	Average
2483.500	32.14	7.99	34.61	30.30	35.82	54.00	18.18	Average
2493.500	32.17	8.00	34.61	45.34	50.90	54.00	3.10	Average

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

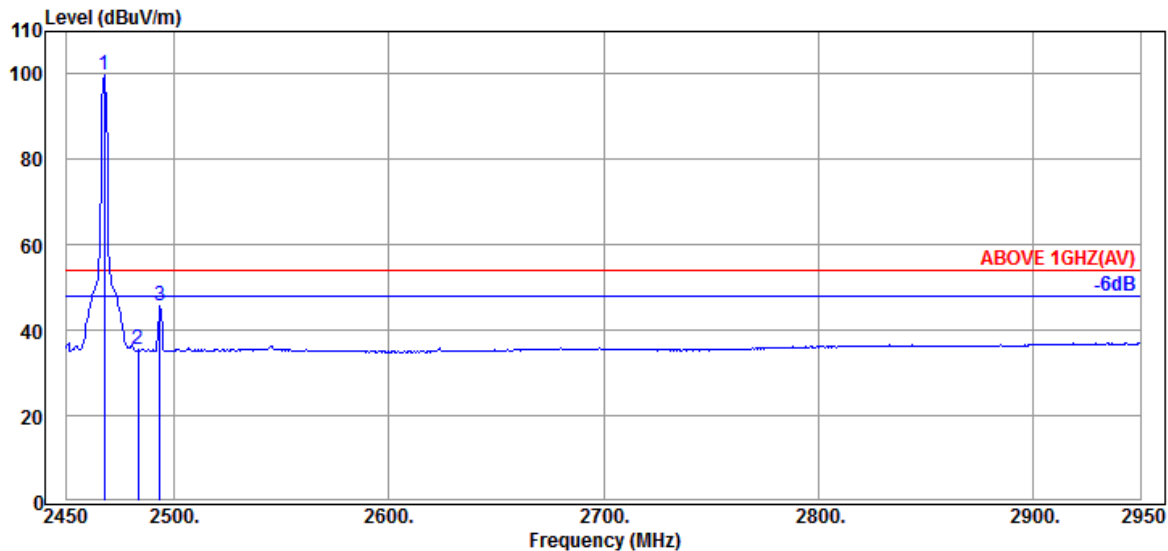


Mode	T-FHSS	Frequency	TX 2467.50MHz
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Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
@ 2468.000	32.09	7.98	34.60	94.18	99.65	---	---	Peak
2483.500	32.14	7.99	34.61	58.23	63.75	74.00	10.25	Peak
2486.000	32.14	8.00	34.61	57.56	63.09	74.00	10.91	Peak



Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
@ 2467.500	32.06	7.98	34.60	94.17	99.61	---	---	Average
2483.500	32.14	7.99	34.61	29.90	35.42	54.00	18.58	Average
2493.500	32.17	8.00	34.61	40.04	45.60	54.00	8.40	Average

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

**A.2.2 Emissions outside the frequency band:**

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

Mode	S-FHSS	Frequency	TX 2403.25MHz
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**Antenna at Horizontal Polarization**

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4807.000	34.10	10.49	34.47	42.12	52.24	54.00	1.76	Peak
7209.000	35.60	12.25	34.60	35.10	48.35	54.00	5.65	Peak

**Antenna at Vertical Polarization**

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4807.000	34.10	10.49	34.47	42.22	52.34	54.00	1.66	Peak
7210.000	35.60	12.25	34.60	34.20	47.45	54.00	6.55	Peak

Mode	S-FHSS	Frequency	TX 2425.0MHz
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**Antenna at Horizontal Polarization**

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4850.000	34.10	10.51	34.46	41.26	51.41	54.00	2.59	Peak
7274.000	35.60	12.27	34.64	34.25	47.48	54.00	6.52	Peak

**Antenna at Vertical Polarization**

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4850.000	34.10	10.51	34.46	41.49	51.64	54.00	2.36	Peak
7274.000	35.60	12.27	34.64	33.27	46.50	54.00	7.50	Peak

Mode	S-FHSS	Frequency	TX 2447.5MHz
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**Antenna at Horizontal Polarization**

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4896.000	34.00	10.54	34.45	40.29	50.38	54.00	3.62	Peak
7343.000	35.60	12.31	34.70	33.33	46.54	54.00	7.46	Peak

**Antenna at Vertical Polarization**

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4896.000	34.00	10.54	34.45	41.46	51.55	54.00	2.45	Peak
7343.000	35.60	12.31	34.70	32.78	45.99	54.00	8.01	Peak

Mode	T-FHSS	Frequency	TX 2407.5MHz
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**Antenna at Horizontal Polarization**

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4815.000	34.10	10.49	34.47	41.98	52.10	54.00	1.90	Peak
7223.000	35.60	12.25	34.60	34.08	47.33	54.00	6.67	Peak

**Antenna at Vertical Polarization**

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4815.000	34.10	10.49	34.47	43.39	53.51	54.00	0.49	Peak
7223.000	35.60	12.25	34.60	33.33	46.58	54.00	7.42	Peak

Mode	T-FHSS	Frequency	TX 2437.5MHz
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**Antenna at Horizontal Polarization**

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4876.000	34.05	10.54	34.46	41.70	51.83	54.00	2.17	Peak
7403.000	35.67	12.34	34.76	32.80	46.05	54.00	7.95	Peak

**Antenna at Vertical Polarization**

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4876.000	34.05	10.54	34.46	42.63	52.76	54.00	1.24	Peak
7313.000	35.60	12.29	34.68	32.17	45.38	54.00	8.62	Peak

Mode	T-FHSS	Frequency	TX 2467.5MHz
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**Antenna at Horizontal Polarization**

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4936.000	34.07	10.58	34.44	40.01	50.22	54.00	3.78	Peak
7403.000	35.67	12.34	34.76	33.90	47.15	54.00	6.85	Peak

**Antenna at Vertical Polarization**

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4936.000	34.07	10.58	34.44	41.29	51.50	54.00	2.50	Peak
7403.000	35.67	12.34	34.76	32.17	45.42	54.00	8.58	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.

### A.3 20dB BANDWIDTH

Test Date	2020/09/15~16	Temp./Hum.	24~25°C/49~52%
Cable Loss	0.80dB	Tested By	Kuper Hsu
Test Voltage	DC 7.4V (Via Battery)		

#### A.3.1 20dB Bandwidth Result

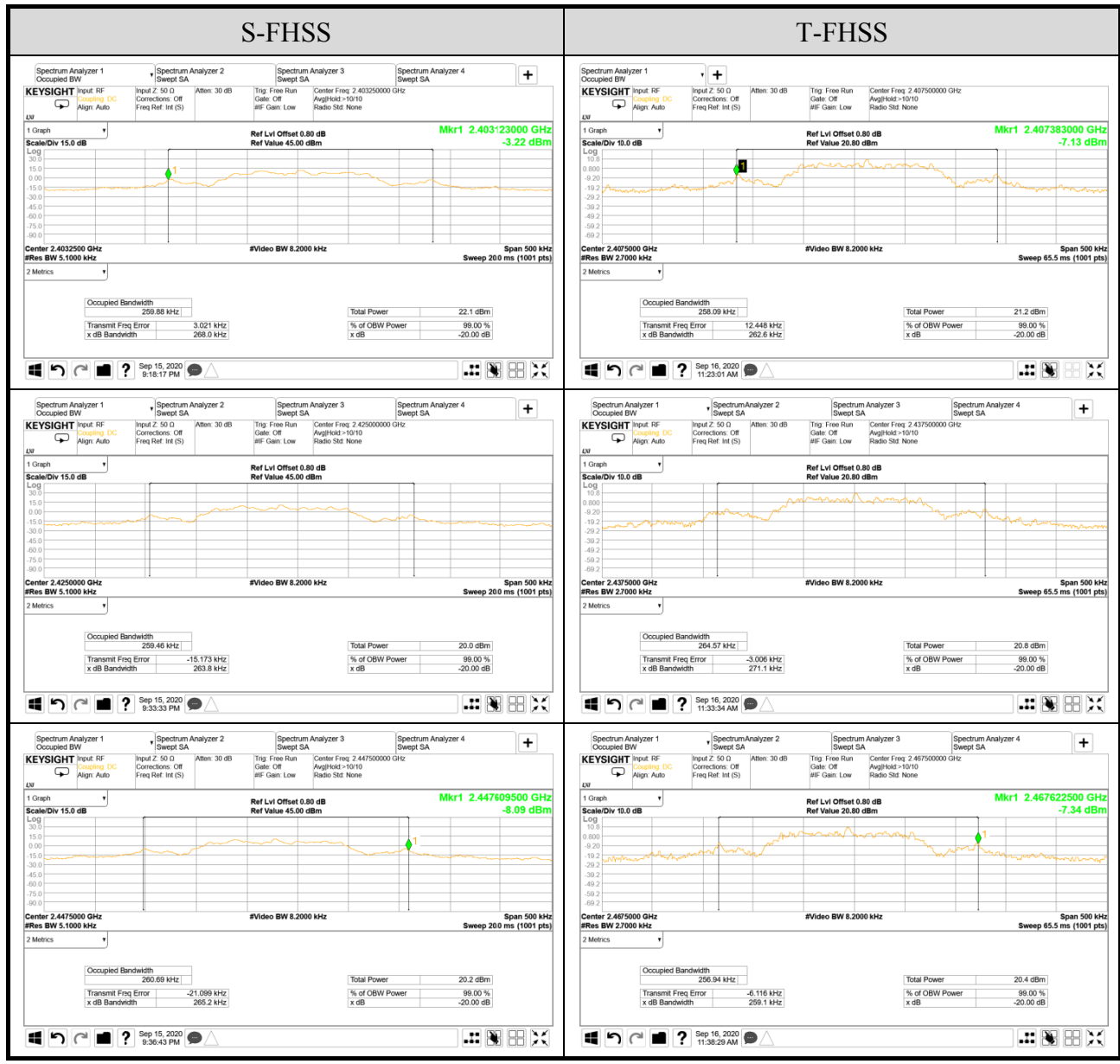
Mode	Centre Frequency (MHz)	20dB Bandwidth (MHz)	99%Occupied Bandwidth (MHz) (Reference only)	2/3 (20dB Bandwidth)
S-FHSS	2403.25	0.2680	0.25988	0.179
	2425.00	0.2638	0.25946	0.176
	2447.50	0.2652	0.26069	0.177
T-FHSS	2407.50	0.2626	0.25809	0.175
	2437.50	0.2711	0.26457	0.181
	2467.50	0.2591	0.25694	0.173

Remark:

S-FHSS Mode the maximum two-thirds of the 20dB bandwidth shall be at maximum 0.179MHz.

T-FHSS Mode the maximum two-thirds of the 20dB bandwidth shall be at maximum 0.181MHz.

A.3.2 Measurement Plots



## A.4 CARRIER FREQUENCY SEPARATION MEASUREMENT

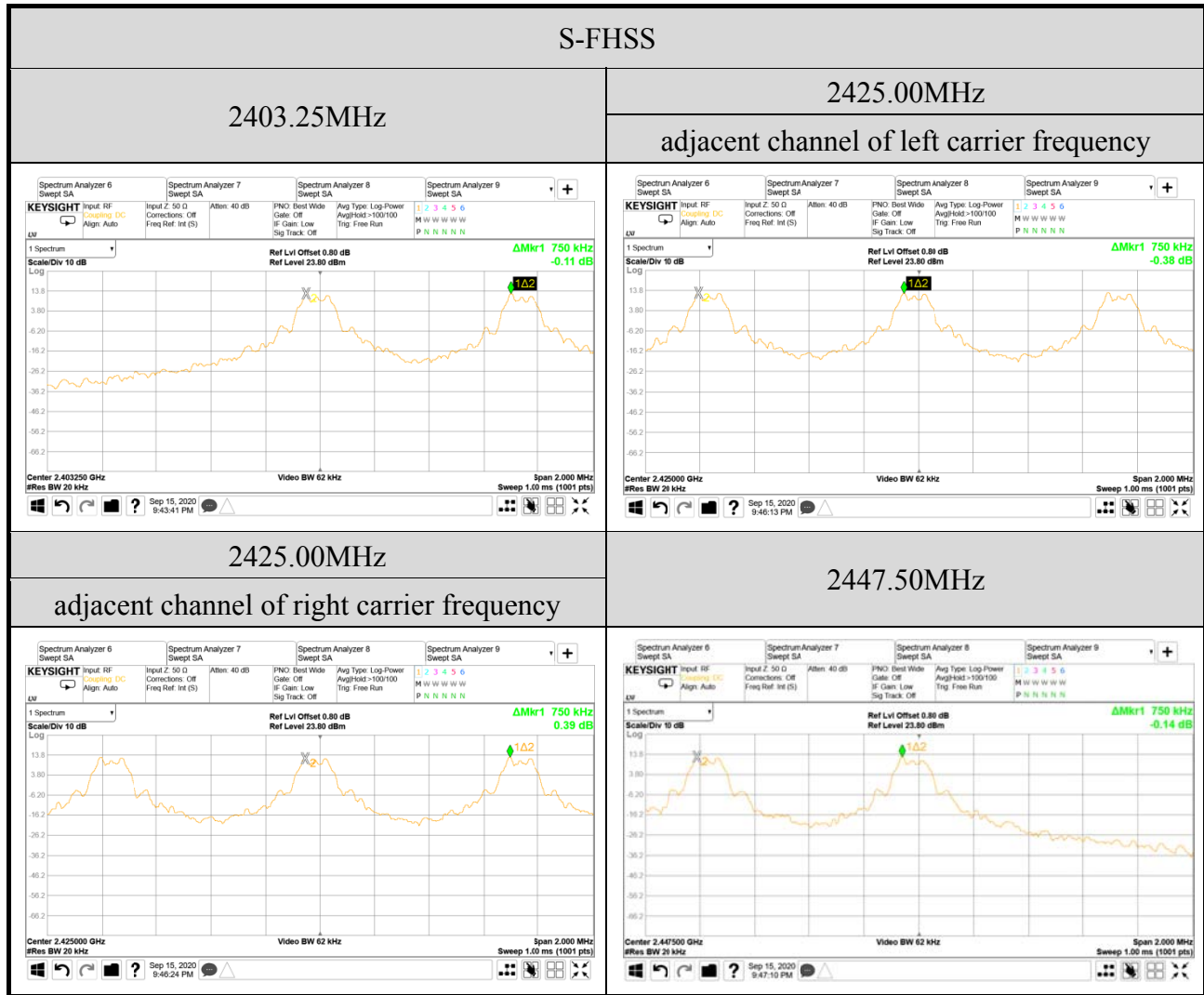
Test Date	2020/09/15~16	Temp./Hum.	24~25°C/49~52%
Cable Loss	0.80dB	Tested By	Kuper Hsu
Test Voltage	DC 7.4V (Via Battery)		

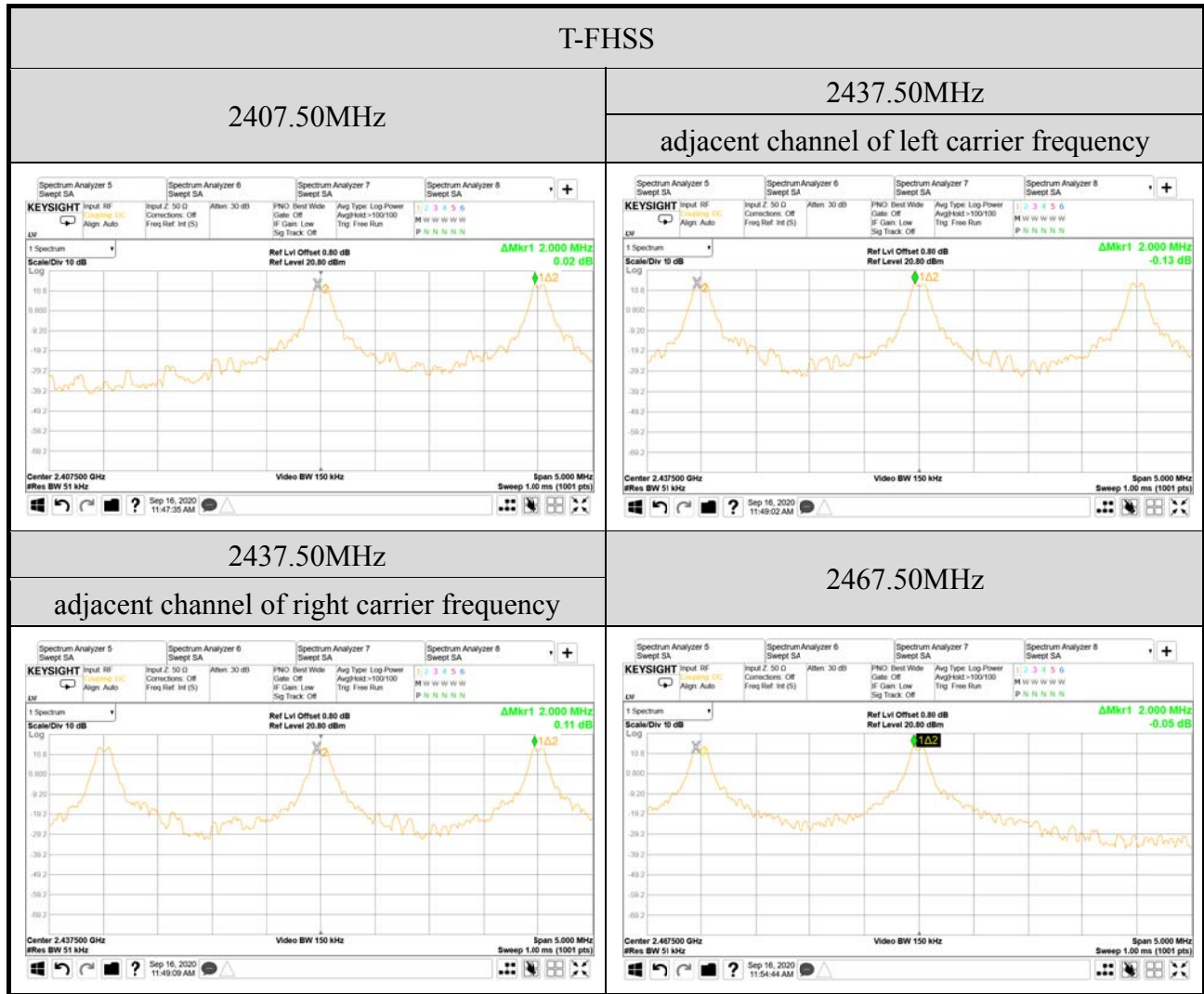
### A.4.1 Carrier Frequency Separation Result

Mode	Centre Frequency (MHz)		Carrier Frequency Separation (MHz)	Limit (MHz) 2/3 (20dB Bandwidth)
S-FHSS	2403.25		0.750	> 0.179
	2425.00	adjacent channel of right carrier frequency	0.750	
	2425.00	adjacent channel of left carrier frequency	0.750	
	2447.50		0.750	

Mode	Centre Frequency (MHz)		Carrier Frequency Separation (MHz)	Limit (MHz) 2/3 (20dB Bandwidth)
T-FHSS	2407.50		2.000	> 0.181
	2437.50	adjacent channel of right carrier frequency	2.000	
	2437.50	adjacent channel of left carrier frequency	2.000	
	2467.50		2.000	

A.4.2 Measurement Plots







## A.5 TIME OF OCCUPANCY MEASUREMENT

Test Date	2020/09/15~16	Temp./Hum.	24~25°C/49~52%
Cable Loss	0.80dB	Tested By	Kuper Hsu
Test Voltage	DC 7.4V (Via Battery)		

### A.5.1 Time of Occupancy

Mode	Centre Frequency (MHz)	Each second appearance transmission	Time of Occupancy (ms)	Maximum accumulated Time of Occupancy (ms)	Limit (ms)
S-FHSS	2403.25	5	1.440	172.800	<400
	2425.00	5	1.450	174.000	<400
	2447.50	5	1.450	174.000	<400

Observation Period:

**60** channels\* **0.4** seconds= **24.0** seconds

**Centre Frequency: 2403.25MHz**

For each second of **5** transmission appearance, the longest time of occupancy is  
**5** channels\* **24.0** /1\* **1.440** ms= **172.800** ms (<400ms)

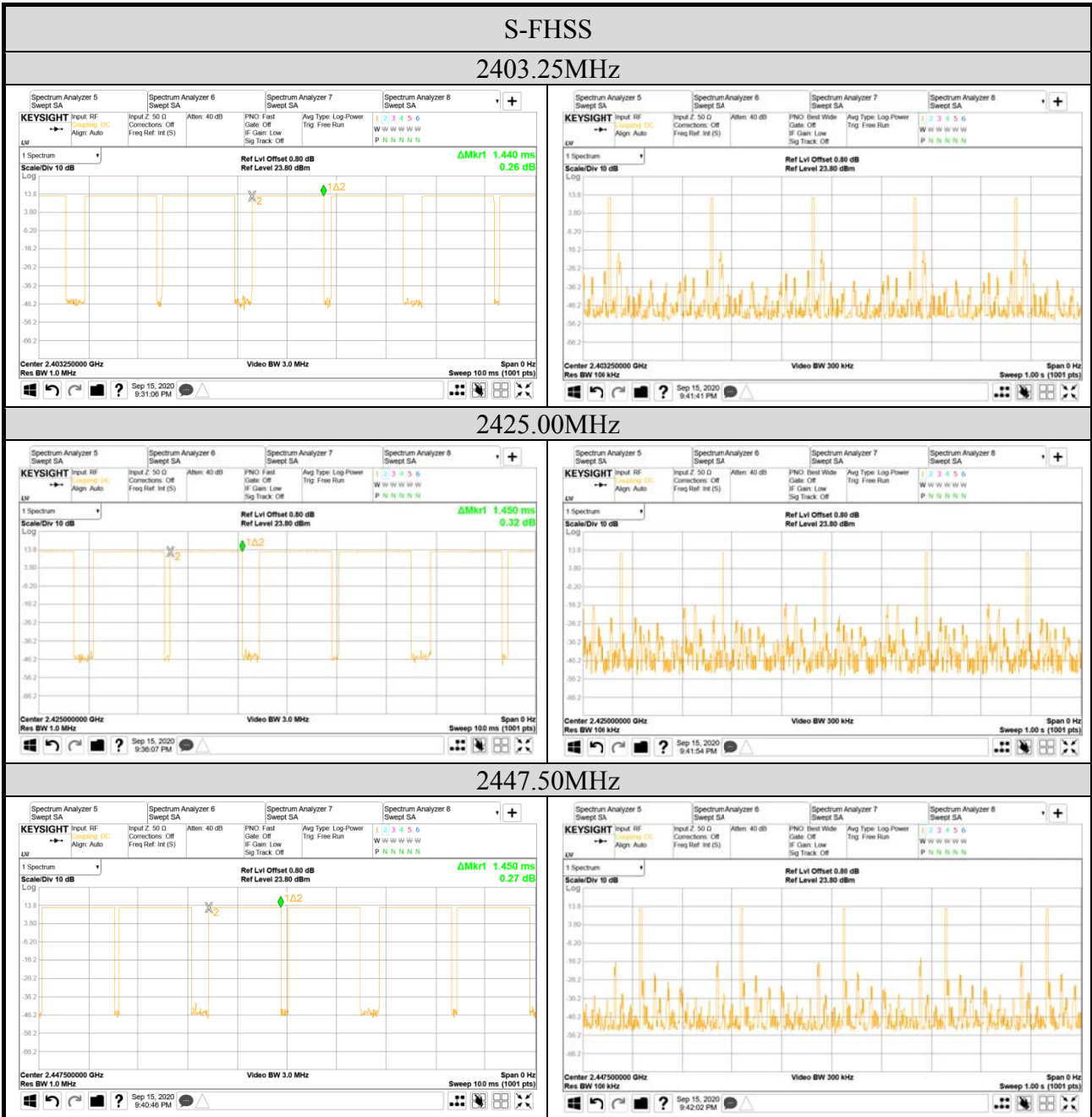
**Centre Frequency: 2425.00MHz**

For each second of **5** transmission appearance, the longest time of occupancy is  
**5** channels\* **24.0** /1\* **1.450** ms= **174.000** ms (<400ms)

**Centre Frequency: 2447.50MHz**

For each second of **5** transmission appearance, the longest time of occupancy is  
**5** channels\* **24.0** /1\* **1.450** ms= **174.000** ms (<400ms)

● Measurement Plots



Mode	Centre Frequency (MHz)	Each second appearance transmission	Time of Occupancy (ms)	Maximum accumulated Time of Occupancy (ms)	Limit (ms)
T-FHSS	2407.50	2	1.440	35.7120	<400
	2437.50	2	1.440	35.7120	<400
	2467.50	2	1.440	35.7120	<400

Observation Period:

**31** channels\* **0.4** seconds= **12.4** seconds

**Centre Frequency: 2407.50MHz**

For each second of **2** transmission appearance,the longest time of occupancy is  
**2** channels\* **12.4** /1\* **1.4400** ms= **35.7120** ms (<400ms)

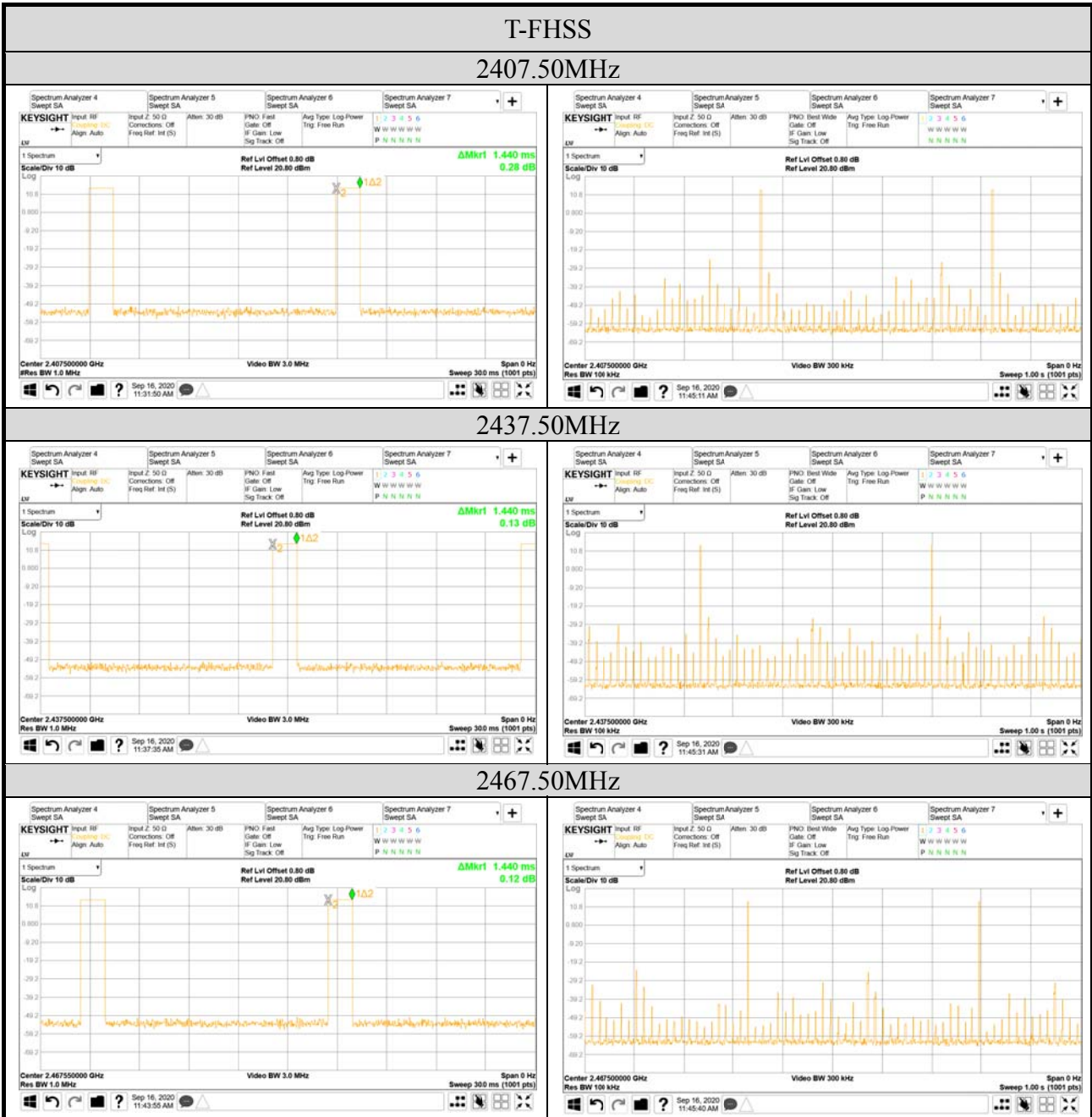
**Centre Frequency: 2437.50MHz**

For each second of **2** transmission appearance,the longest time of occupancy is  
**2** channels\* **12.4** /1\* **1.4400** ms= **35.7120** ms (<400ms)

**Centre Frequency: 2467.50MHz**

For each second of **2** transmission appearance,the longest time of occupancy is  
**2** channels\* **12.4** /1\* **1.4400** ms= **35.7120** ms (<400ms)

● Measurement Plots



## A.6 NUMBER OF HOPPING CHANNELS

Test Date	2020/09/15~16	Temp./Hum.	24~25°C/49~52%
Cable Loss	0.80dB	Tested By	Kuper Hsu
Test Voltage	DC 7.4V (Via Battery)		

Mode: S-FHSS	Mode: T-FHSS																																																																																																																
<p>Mode: S-FHSS</p> <p>Center: 2.44000 GHz Span: 100.0 MHz</p> <p>Mkr2: 2.4836 GHz -48.58 dBm</p> <table border="1"> <thead> <tr> <th>Mode</th> <th>Trace</th> <th>Scale</th> <th>X</th> <th>Y</th> <th>Function</th> <th>Function Width</th> <th>Function Value</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>N</td> <td>f</td> <td>2.3999 GHz</td> <td>-32.35 dBm</td> <td></td> <td></td> <td></td> </tr> <tr> <td>2</td> <td>N</td> <td>f</td> <td>2.4836 GHz</td> <td>-48.58 dBm</td> <td></td> <td></td> <td></td> </tr> <tr> <td>3</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>4</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>5</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>6</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Mode	Trace	Scale	X	Y	Function	Function Width	Function Value	1	N	f	2.3999 GHz	-32.35 dBm				2	N	f	2.4836 GHz	-48.58 dBm				3								4								5								6								<p>Mode: T-FHSS</p> <p>Center: 2.44100 GHz Span: 100.0 MHz</p> <p>Mkr2: 2.4836 GHz -43.30 dBm</p> <table border="1"> <thead> <tr> <th>Mode</th> <th>Trace</th> <th>Scale</th> <th>X</th> <th>Y</th> <th>Function</th> <th>Function Width</th> <th>Function Value</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>N</td> <td>f</td> <td>2.3999 GHz</td> <td>-41.47 dBm</td> <td></td> <td></td> <td></td> </tr> <tr> <td>2</td> <td>N</td> <td>f</td> <td>2.4836 GHz</td> <td>-43.30 dBm</td> <td></td> <td></td> <td></td> </tr> <tr> <td>3</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>4</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>5</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>6</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Mode	Trace	Scale	X	Y	Function	Function Width	Function Value	1	N	f	2.3999 GHz	-41.47 dBm				2	N	f	2.4836 GHz	-43.30 dBm				3								4								5								6							
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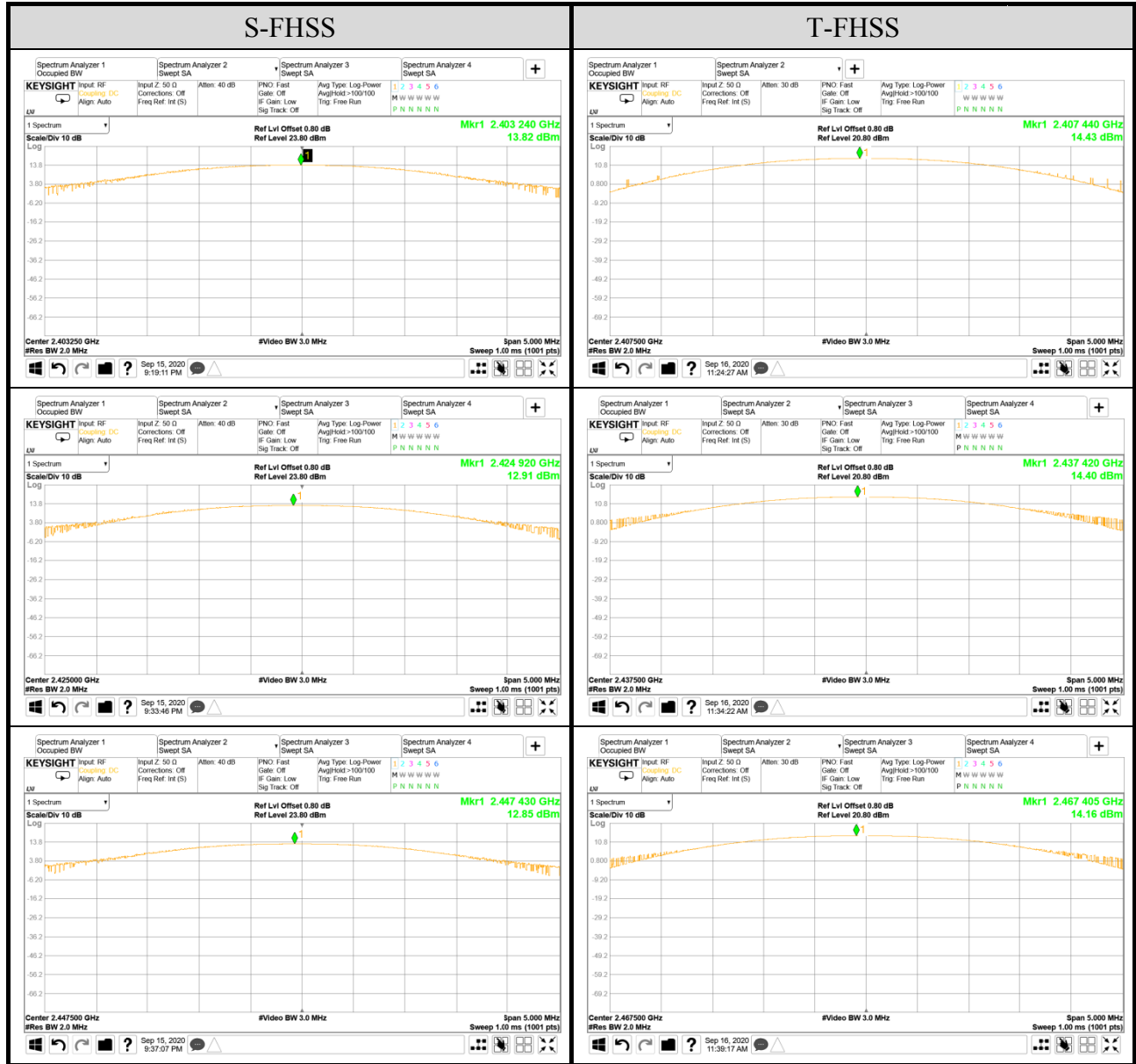
## A.7 MAXIMUM PEAK OUTPUT POWER

Test Date	2020/09/15~16	Temp./Hum.	24~25°C/49~52%
Cable Loss	0.80dB	Tested By	Kuper Hsu
Test Voltage	DC 7.4V (Via Battery)		

### A.7.1 Maximum Peak Output Power

Mode	Centre Frequency (MHz)	Maximum Peak Output Power		Limit
		dBm	W	
S-FHSS	2403.25	13.82	0.0241	21dBm (0.125W)
	2425.00	12.91	0.0195	
	2447.50	12.85	0.0193	
T-FHSS	2407.50	14.43	0.0277	
	2437.50	14.40	0.0275	
	2467.50	14.16	0.0261	

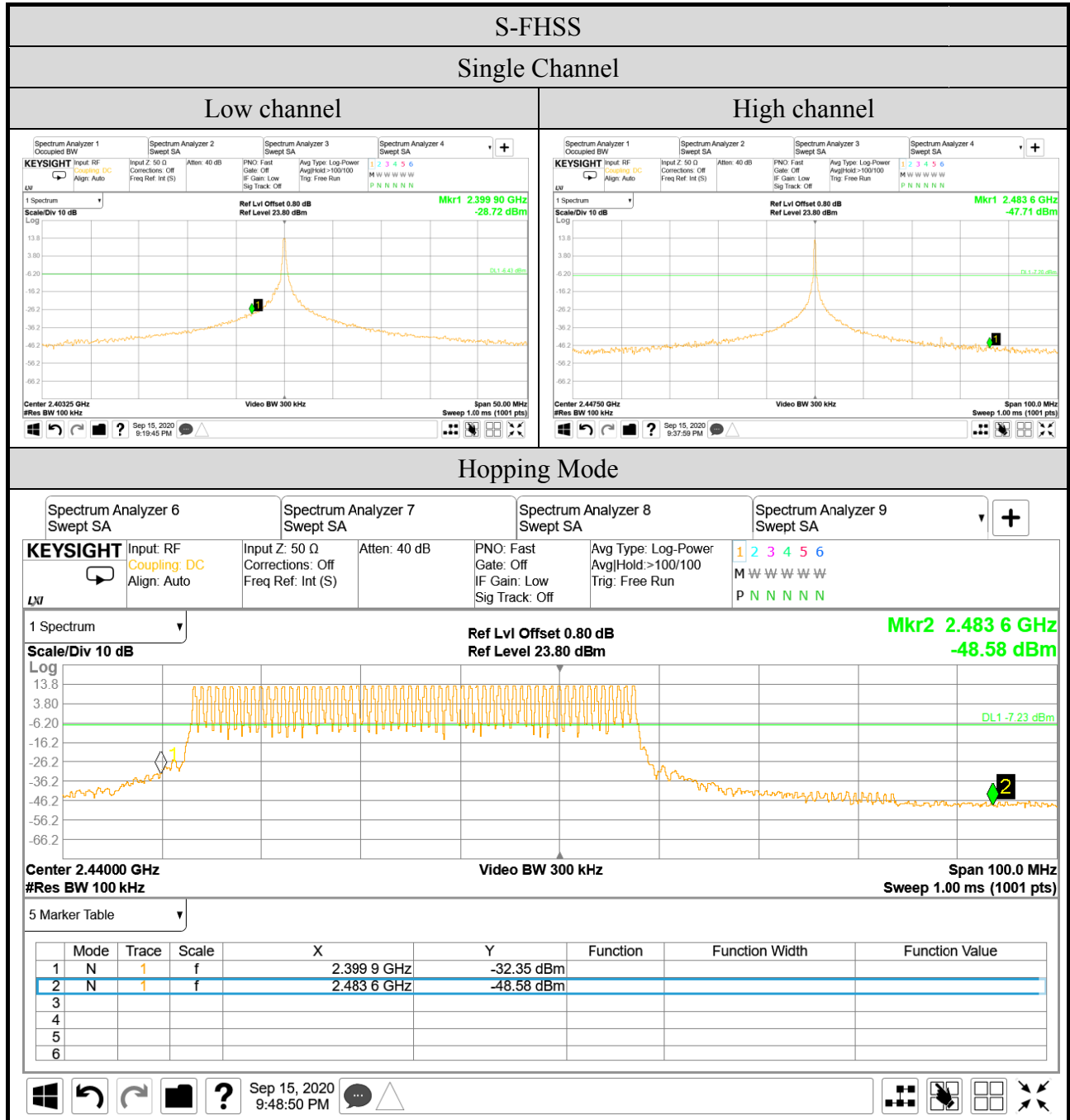
A.7.2 Measurement Plots



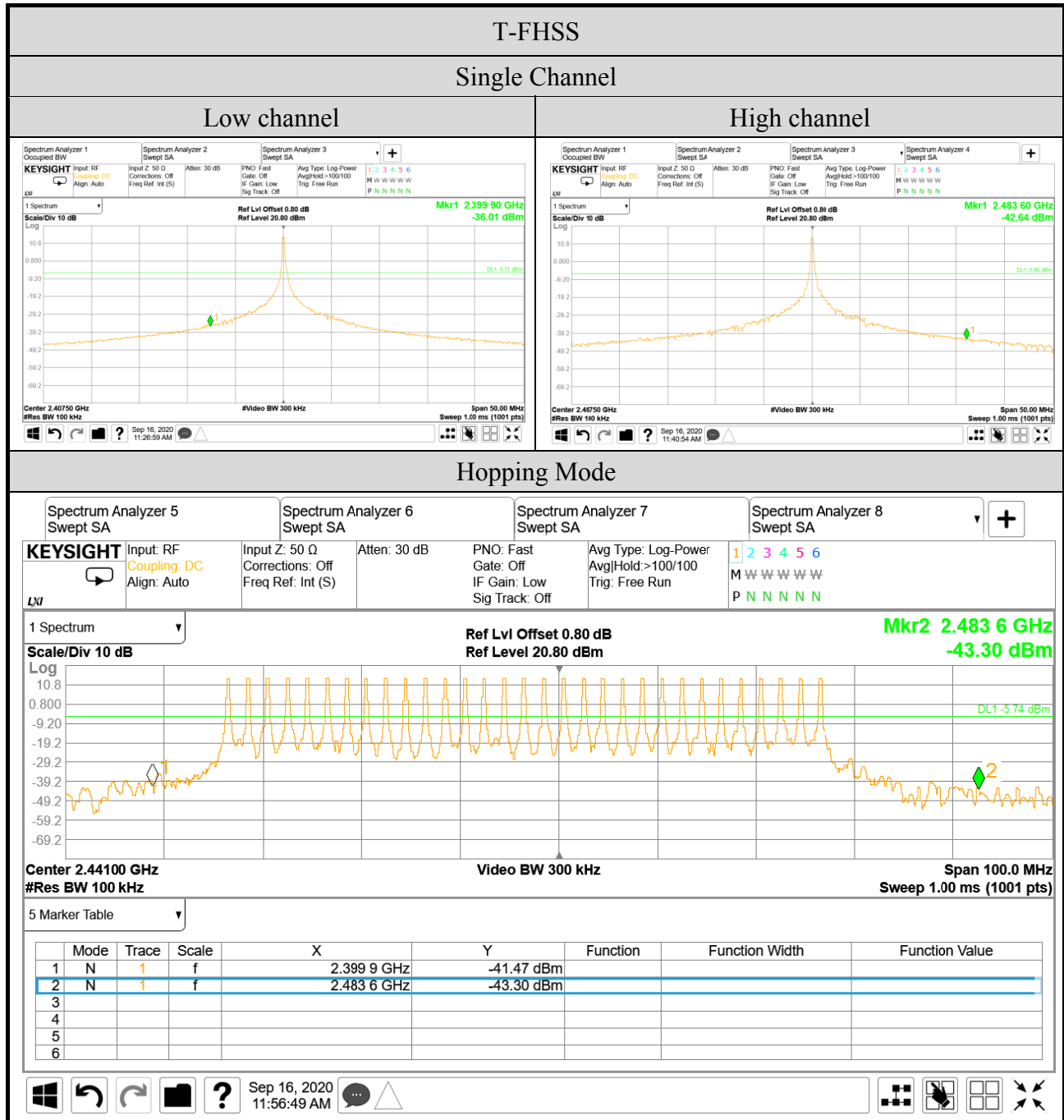
## A.8 EMISSION LIMITATIONS MEASUREMENT

Test Date	2020/09/15~16	Temp./Hum.	24~25°C/49~52%
Cable Loss	0.80dB	Tested By	Kuper Hsu
Test Voltage	DC 7.4V (Via Battery)		

### A.8.1 Band Edge



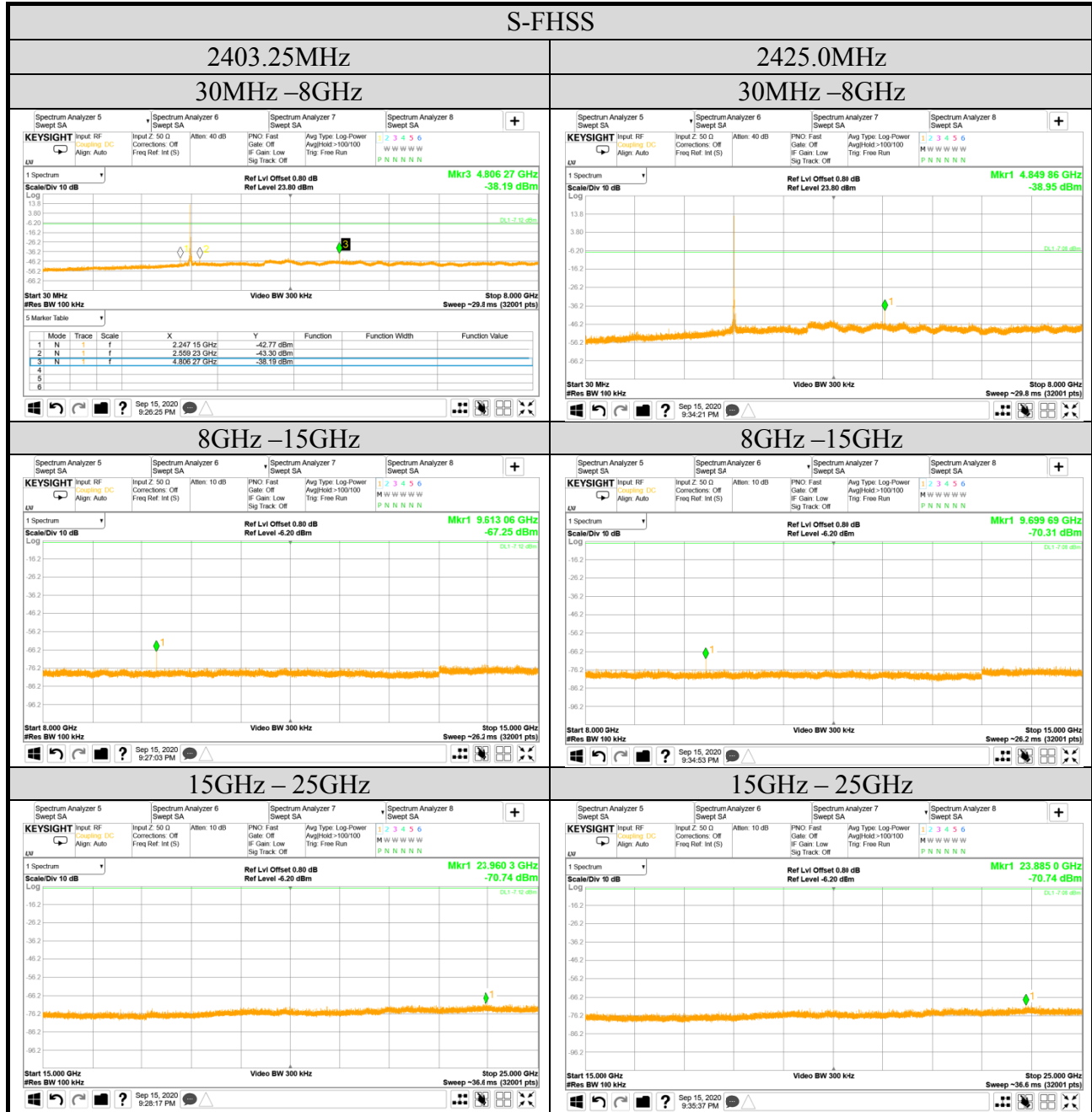




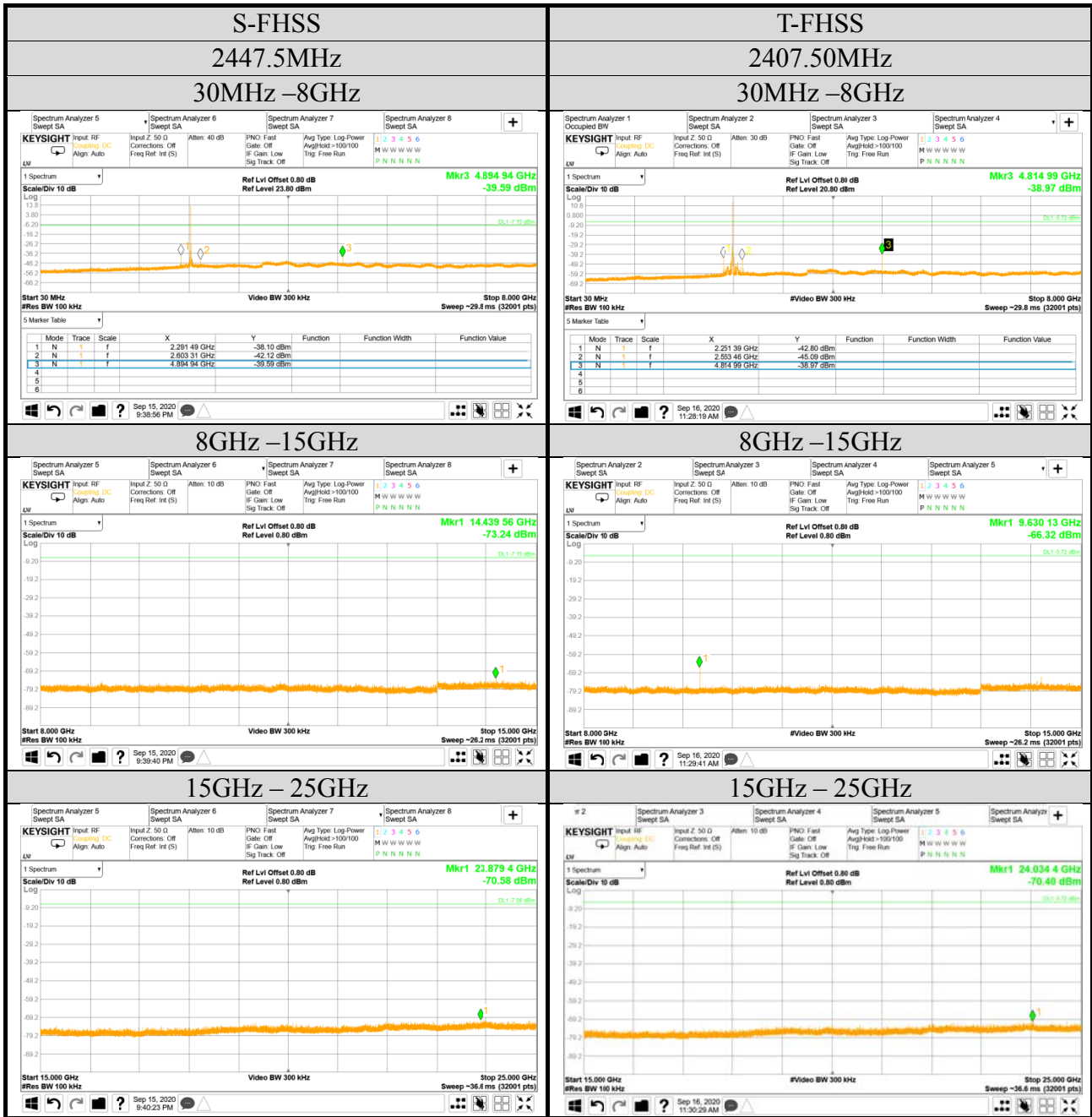
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 New Taipei City 244, Taiwan

**Tel: +886 2 26099301**  
**Fax: +886 2 26099303**

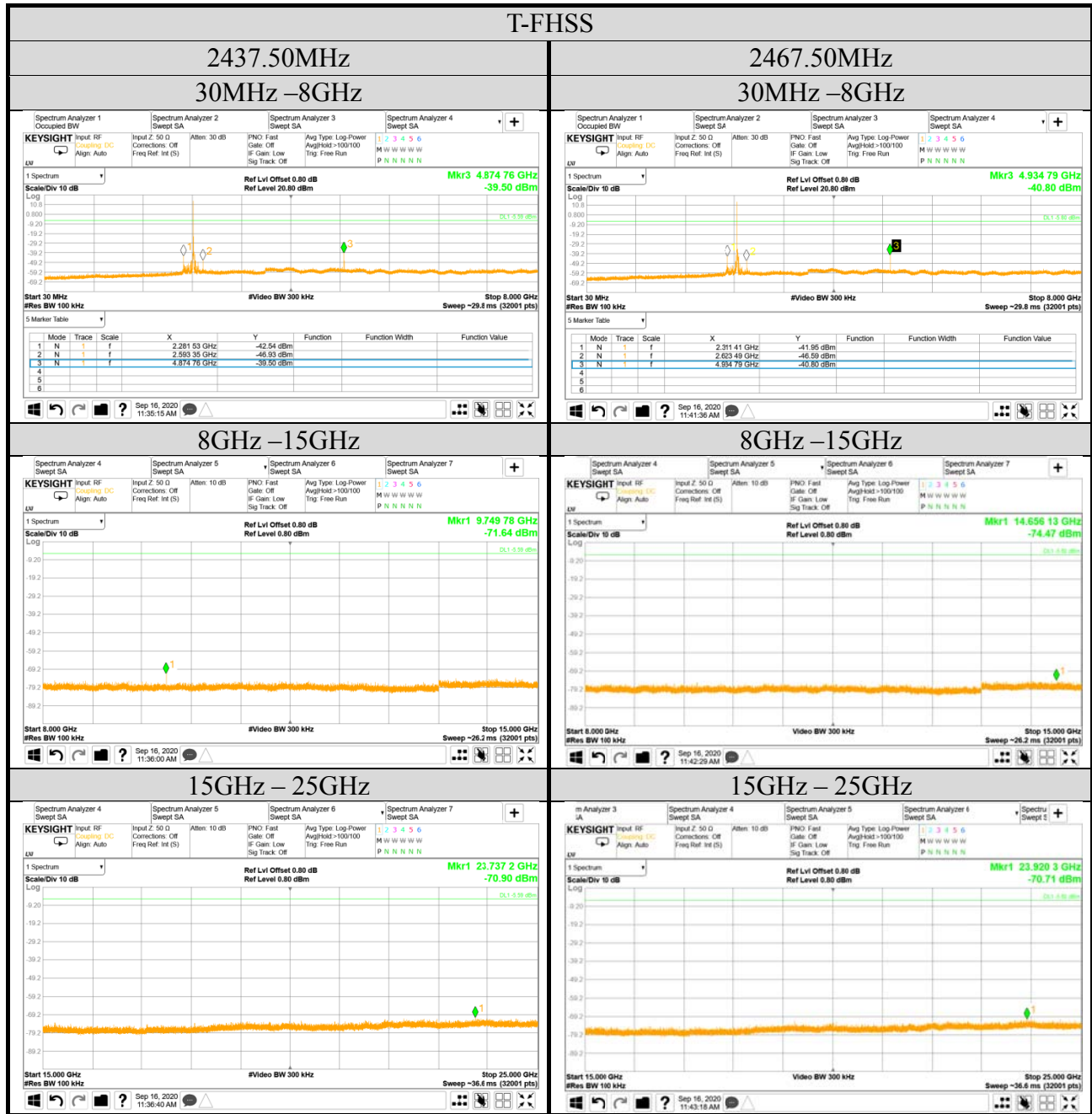
**A.8.2 Spurious Emission**



Note: All results have been included cable loss.



Note: All results have been included cable loss.



Note: All results have been included cable loss.



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*APPENDIX B*

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# APPDNDIX B

## TEST PHOTOGRAPHS

(Model: T16IZ)