

FCC 15.247 & RSS-247 2.4GHz Test Report

for

FUTABA Corporation

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

Brand : Futaba
Product Name : Radio Control
Model Name : R3004SB
FCC ID : AZPR3004SB-24G
IC : 2914D-R3004SB

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



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TEST REPORT CERTIFICATION

Applicant : FUTABA Corporation
Manufacture : FUTABA Corporation
EUT Description
(1) Product : Radio Control
(2) Model : R3004SB
(3) Brand : Futaba
(4) Power Rating : DC 3.5-8.4V

Applicable Standards:

47 CFR FCC Part 15 Subpart C
RSS-Gen (Issue 4), November 2014
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: 2017. 12. 14

Reviewed by:

Annie Yu

(Annie Yu/Administrator)

Approved by:

Ben Cheng

(Ben Cheng/Manager)

1. REVISION RECORD OF TEST REPORT

Edition No	Issued Data	Revision Summary	Report Number
0	2017. 12. 14	Original Report.	EM-F170783

2. SUMMARY OF TEST RESULTS

Rule		Description	Results
FCC	IC		
15.207	RSS-Gen §8.8	Conducted Emission	N/A, NOTE
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(a)	20dB Bandwidth	PASS
15.247(a)(1)	RSS-247 §5.1(B)	Carrier Frequency Separation	PASS
15.247(a)(1)(iii)	RSS-247 §5.1(d)	Time of Occupancy	PASS
15.247(a)(1)(iii)	RSS-247 §5.1(d)	Number of Hopping Channels	PASS
15.247(b)(1)	RSS-247 §5.1(b)	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 EUT only employs battery power for operation, so it is unnecessary to test.

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	R3004SB
Brand	Futaba

3.2. Description of Application

Test Model	R3004SB
Serial Number	N/A
Power Rating	DC 3.5-8.4V
Firmware Version	N/A
RF Features	FHSS (T-FHSS)
Transmit Type	1T1R
Sample Status	Production
Date of Receipt	2017. 11. 21
Date of Test	2017. 12. 04 ~ 14
I/O Ports List	None
Accessories Supplied	None

3.3. Antenna Information

No.	Antenna Part Number	Manufacture	Antenna Type	Frequency	Max Gain (dBi)
1	JA1R0277A	WAN SHIH ELECTRONIC (H.K) CO.,LTD	mono-pole type	2.4GHz	ANT A: -5.16 ANT B: -5.16

We performed conducted tests for both antennas and submit test data measured on antenna A as worse performance.

3.4. EUT Specifications Assessed in Current Report

Mode	Fundamental Range (MHz)	Channel Number	Modulation	Data Rate (kbps)
FHSS	2407.500 to 2467.500	31	T-FHSS	128

Modulation: T-FHSS			
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. Test Configuration

Modulation	T _{on} (ms)	Duty Cycle Correction Factor (dB)
T-FHSS	1.57	-36.08

Note: Duty Cycle Correction Factor (DCCF) = 20log (TX_{on}/100ms)

Item		Modulation	Test Channel
Radiated Test Case	Radiated Band Edge ^{Note1}	T-FHSS	1/31
	Radiated Spurious Emission ^{Note1}	T-FHSS	1/16/31
Conducted Test Case	20dB Bandwidth	T-FHSS	1/16/31
	Carrier Frequency Separation	T-FHSS	1/16/31
	Time of Occupancy	T-FHSS	1/16/31
	Number of Hopping Channels	T-FHSS	1/16/31
	Maximum Peak Output Power	T-FHSS	1/16/31
	Band Edges	T-FHSS	1/31
	Spurious Emission	T-FHSS	1/16/31

Note 1:

- Mobile Device, and 3 axis were assessed. The worst scenario for Radiated Spurious Emission as follow:
 - Lie
 - Side
 - Stand
- Portable Device, and 3 axis were assessed. The worst scenario for Radiated Spurious Emission as follow:
 - Lie
 - Side
 - Stand

3.6. Tested Supporting System List

3.6.1. Support Peripheral Unit

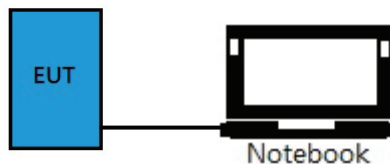
No.	Product	Brand	Model No.	Serial No.	FCC ID
1.	Notebook PC	acer	Acer Aspire 4755G	N/A	N/A
2.	DC Power Supply	TOP WARD	3303A	N/A	N/A
3.	Servo*3	Futaba	S3004	N/A	N/A
4.	Notebook PC	ASUS	X5502E	N/A	N/A
5.	DC Power Supply	TOP WARD	6303A	N/A	N/A

3.6.2. Cable Lists

No.	Cable Description Of The Above Support Units
1.	USB Cable: Unshielded, Detachable, 1.5m Adapter: DELTA, M/N ADP-90CDDDB AC Power Cord: Shielded, Detachable, 1.8m DC Power Cord: Undshielded, Undetachable, 1.8m
2.	DC Power Cord*2: Unshielded, Detachable, 0.1m
3.	Cable*3: Unshielded, Detachable, 0.15m
4.	USB Cable: Unshielded, Detachable, 1.5m Adapter: Enerironix, M/N EXA1208UH AC Power Cord: Shielded, Detachable, 1.8m DC Power Cord: Undshielded, Undetachable, 1.8m
5.	DC Power Cord*2: Unshielded, Detachable, 0.1m

3.7. Setup Configuration

3.7.1. EUT Configuration for Radiated Emission



3.7.2. EUT Configuration for RF Conducted Test Items



3.8. Operating Condition of EUT

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

3.9. 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: sales@audixtech.com
Accreditations	The laboratory is accredited by following organizations under ISO/IEC 17025:2005 (1) NVLAP(USA) NVLAP Lab Code 200077-0 (2) TAF(Taiwan) No. 1724 (3) FCC OET Designation No. TW1004 & TW1090 & TW1724
Test Facilities	(1) Semi-Anechoic Chamber (IC Test Site Registration No.: 5183B-1) (2) Fully Anechoic Chamber (IC Test Site Registration No.: 5183B-4)

3.10. Measurement Uncertainty

Test Item	Frequency Range	Uncertainty
Radiation Test (Distance: 3m)	30MHz~1000MHz	± 3.68dB
	Above 1GHz	± 5.82dB

Remark : Uncertainty = $ku_c(y)$

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

4. MEASUREMENT EQUIPMENT LIST

4.1. Radiated Emission Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	N9010A-526	MY53400071	2017. 09. 13	1 Year
2.	Spectrum Analyzer	Agilent	N9030A-526	MY53310269	2017. 01. 02	1 Year
3.	Test Receiver	R & S	ESCS30	100338	2017. 06. 19	1 Year
4.	Amplifier	HP	8447D	2944A06305	2017. 02. 16	1 Year
5.	Amplifier	HP	8449B	3008A00529	2017. 02. 08	1 Year
6.	Bilog Antenna	CHASE	CBL6112D	33821	2017. 01. 21	1 Year
7.	Horn Antenna	ETS-Lindgren	3117	00135902	2017. 03. 08	1 Year
8.	Horn Antenna	COM-POWER	AH-840	101092	2017. 05. 04	1 Year
9.	2.4GHz Notch Filter	K&L	7NSL10-2441 .5E130.5-0/0	1	2017. 07. 28	1 Year
10.	3GHz Notch Filter	Microwave	H3G018G1	484798	2017. 08. 25	1 Year
11.	Digital Thermo-Hygro Meter	IMax	HTC-1	No.1 3m A/C	N.C.R.	N.C.R.
12.	Test Software	Audix	e3	V.6.1206197	N.C.R.	N.C.R.
13.	Test Software	Audix	e3	V.6.110601	N.C.R.	N.C.R.

4.2. RF Conducted Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Keysight	N9010B-544	MY55460198	2017. 04. 18	1 Year
2.	Digital Thermo-Hygro Meter	Shenzhen Datronn Electronics	KT-905	RF	N.C.R.	N.C.R.

5. CONDUCTED EMISSION MEASUREMENT

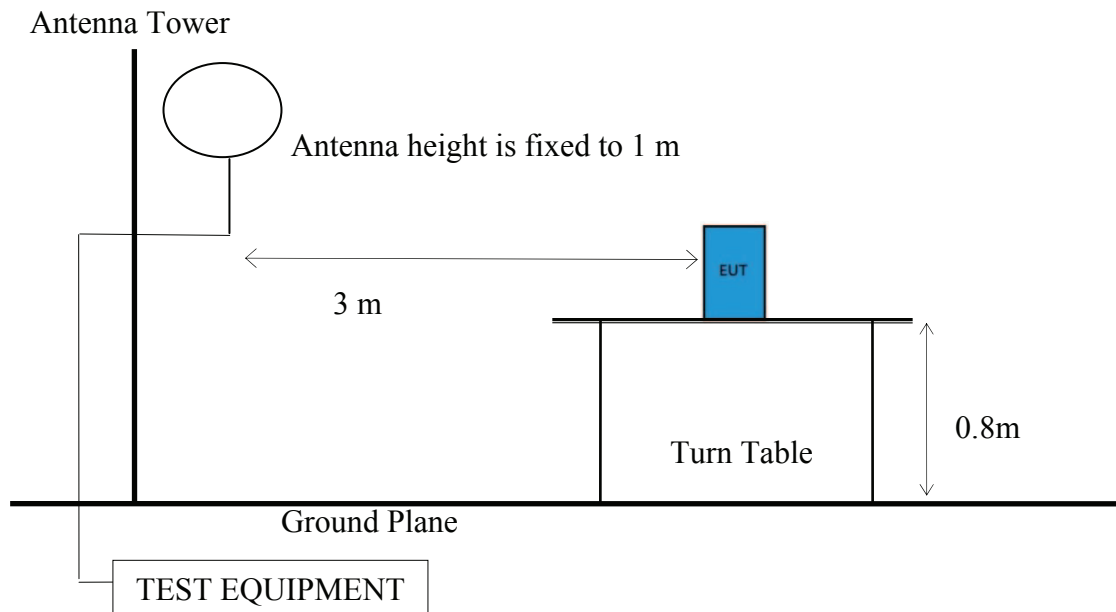
【The EUT only employs battery power for operation, no conductive emission limits are required according to FCC 15.207 and RSS-Gen §8.8】

6. RADIATED EMISSION MEASUREMENT

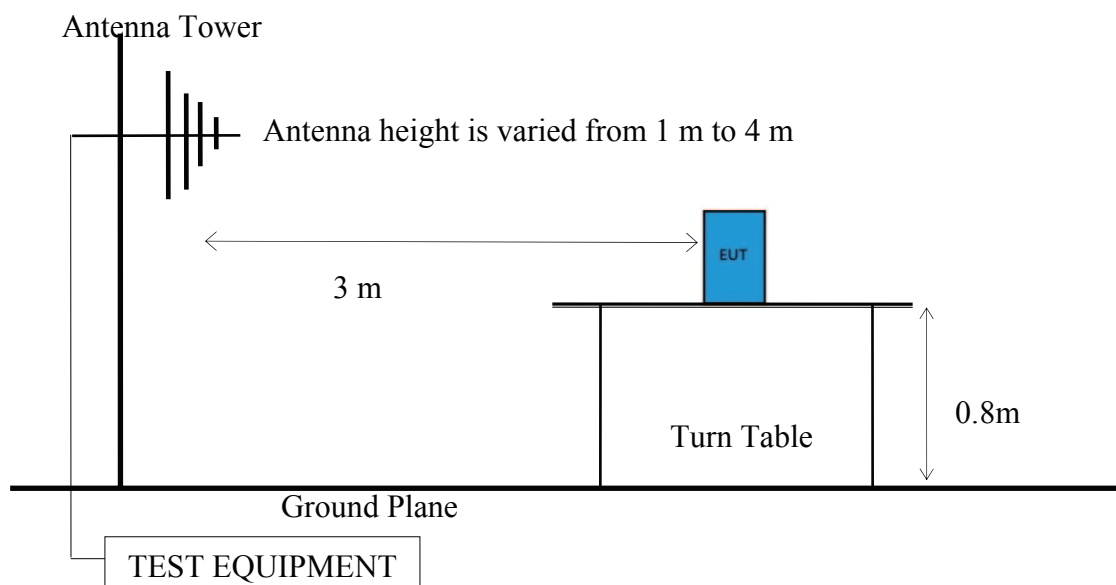
6.1. Block Diagram of Test Setup

6.1.1. Block Diagram of connection between EUT and simulators
Indicated as section 3.7

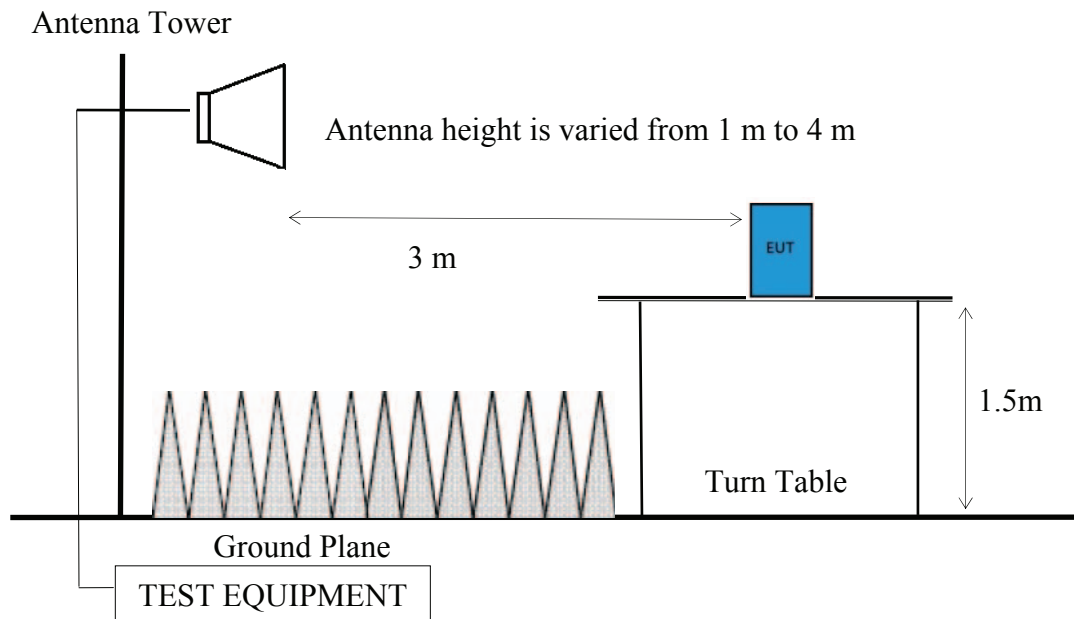
6.1.2. Setup Diagram for 9kHz-30MHz



6.1.3. Setup Diagram for 30-1000 MHz



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 μ V/m	μ V/m
0.009 - 0.490	300	67.6	2400/kHz
0.490 - 1.705	30	87.6	24000/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 μ V/m (Peak) 54.0 dB μ V/m (Average)	

- Remark :
- (1) dB μ V/m = 20 log (μ 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 turn table 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 find table which has 80 cm (for 30-1000 MHz) 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 $\geq 3 \times$ RBW.
- (3) Detector = Peak.
- (4) Sweep time = auto.
- (5) Trace mode = max hold.
- (6) Allow sweeps to continue until the trace stabilizes.
- (7) When peak-detected value is lower than limit that the measurement using the Q.P. detector is not required. Otherwise using Q.P. for finally measurement.

Frequency above 1GHz to 10th harmonic:

Peak Measurement:

- (1) RBW = 1 MHz
- (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.
- (7) When peak-detected value is lower than limit that the measurement using the average detector is not required. Otherwise using average for finally measurement.

Average Measurement: **Option 1:**

- (1) RBW = 1 MHz
- (2) VBW = 1/T, where T is Tx-on presented in Appendix A.4.
- (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

Average Emission Level = Antenna Factor + Cable Loss + Meter Reading

Average Emission Level = Peak Emission Level + DCCF

Duty Cycle Correction Factor (DCCF) = $20 \log (TX_{on}/100ms)$ presented in section 3.5

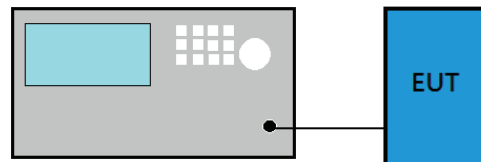
ERP = Peak Emission Level - 95.2 dB - 2.14 dB

6.5. Test Results

Please refer to Appendix A.

7. 20dB BANDWIDTH MEASUREMENT

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:

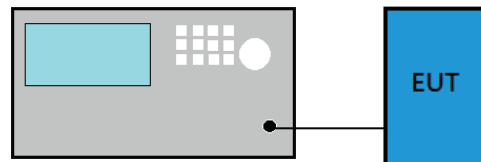
- (1) Set RBW close to 1 ~ 5% of OBW.
- (2) Set VBW= three times RBW.
- (3) Detector = Peak.
- (4) Trace mode = max hold.
- (5) Sweep = auto couple.
- (6) Allow the trace to stabilize.
- (7) Setting channel bandwidth function x dB to -20 dB to record the final bandwidth.

7.4. Test Results

Please refer to Appendix A

8. CARRIER FREQUENCY SEPARATION MEASUREMENT

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 power no greater than 125mW.

8.3. Test Procedure

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

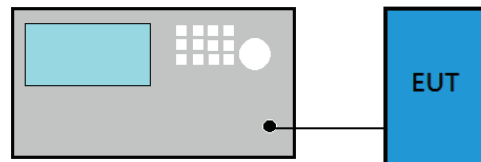
- (1) Span = Wide enough to capture the peaks of two adjacent channels.
- (2) RBW = Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
- (3) VBW \geq RBW
- (4) Sweep = Auto
- (5) Detector function = peak
- (6)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

8.4. Test Results

Please refer to Appendix A

9. TIME OF OCCUPANCY MEASUREMENT

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:

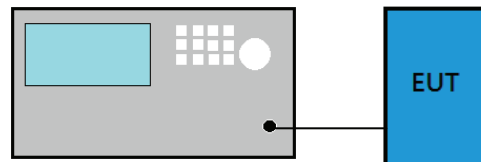
- (1) Span = Zero span, centered on a hopping channel.
- (2) RBW shall be \leq channel spacing and where possible RBW should be set $> 1/T$, where T is the expected dwell time per channel.
- (3) Sweep= As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger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

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:

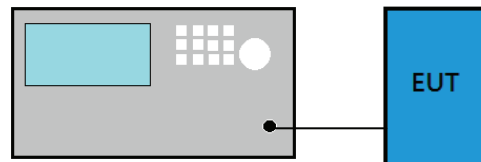
- (1) Span = The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
- (2) RBW = To identify clearly the individual channels, set 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 = max hold
- (7) Allow the trace to stabilize.

10.4. Test Results

Please refer to Appendix A

11. MAXIMUM PEAK OUTPUT POWER MEASUREMENT

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:

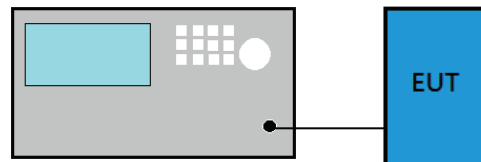
- (1) Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
- (2) RBW \geq 1% of the span
- (3) VBW \geq RBW
- (4) Sweep = auto
- (5) Detector function = peak
- (6) Trace = max hold

11.4. Test Results

Please refer to Appendix A

12. EMISSION LIMITATIONS MEASUREMENT

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 FCC Section 15.209(a) and 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) and RSS-Gen Section 8.10 table 6, must also comply with the radiated emission limits specified in Section 15.209(a) and 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 10th 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

13.DEVIATION TO TEST SPECIFICATIONS

【NONE】



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APPENDIX A

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APPDNDIX A

TEST DATA AND PLOTS

(Model: R3004SB)

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A.1 RADIATED EMISSION

Test Date	2017/12/11	Temp./Hum.	23°C/53%
Test Voltage	DC 6V (Via DC Power Supply)		

A.1.1 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	T-FHSS	Frequency	TX 2407.500MHz
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Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
69.77	12.77	1.88	18.17	32.82	40.00	7.18	Peak
216.24	16.92	3.50	12.61	33.03	46.00	12.97	Peak
359.80	21.09	5.09	5.48	31.66	46.00	14.34	Peak
515.97	23.40	6.48	11.08	40.96	46.00	5.04	Peak
769.14	25.61	7.45	5.38	38.44	46.00	7.56	Peak
960.23	27.42	8.57	5.20	41.19	54.00	12.81	Peak

Antenna at Vertical Polarization

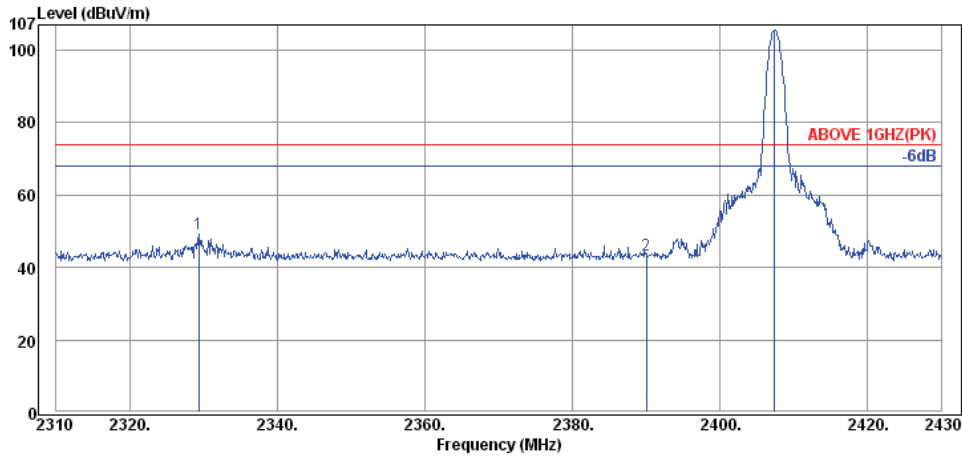
Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
33.88	22.81	1.29	14.58	38.68	40.00	1.32	Peak
120.21	18.80	2.51	13.07	34.38	43.50	9.12	Peak
256.01	19.20	3.87	8.54	31.61	46.00	14.39	Peak
491.72	23.07	6.37	8.79	38.23	46.00	7.77	Peak
735.19	25.25	7.27	2.72	35.24	46.00	10.76	Peak
982.54	27.66	8.72	1.68	38.06	54.00	15.94	Peak

Remark: The TX 2407.5MHz is a worst mode for T-FHSS modulation.

A.2.1.3 Frequency Above 1 GHz to 10th harmonics

Band Edge:

Mode	T-FHSS	Frequency	TX 2407.500MHz
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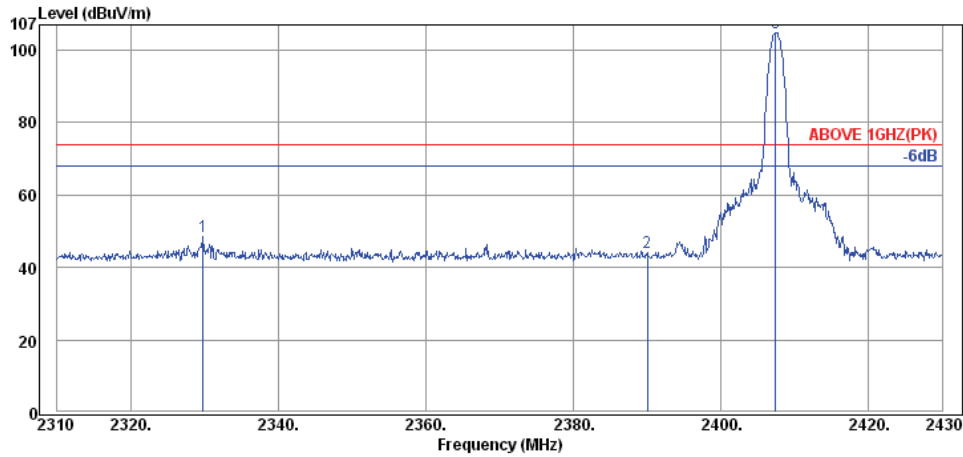


Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2329.32	32.06	6.49	10.76	49.31	74.00	24.69	Peak
2390.04	32.16	6.57	4.70	43.43	74.00	30.57	Peak
2407.44	32.18	6.59	66.76	105.53	---	---	Peak

Emission Frequency (MHz)	Peak Emission Level (dBμV/m)	DCCF (dB)	Average Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Remark
2329.32	49.31	-36.08	13.23	54.00	40.77	Average
2390.04	43.43	-36.08	7.35	54.00	46.65	Average

Mode	T-FHSS	Frequency	TX 2407.500MHz
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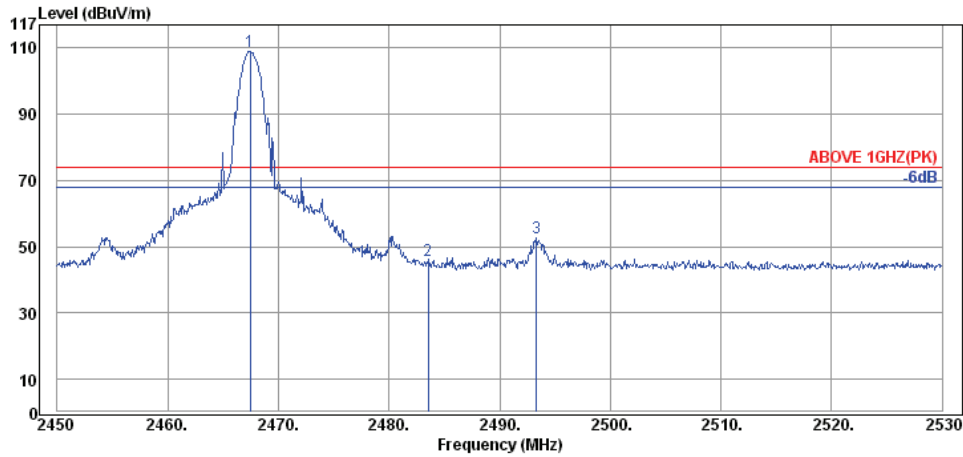


Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2329.80	32.06	6.49	9.86	48.41	74.00	25.59	Peak
2390.04	32.16	6.57	5.35	44.08	74.00	29.92	Peak
2407.44	32.18	6.59	66.11	104.88	---	---	Peak

Emission Frequency (MHz)	Peak Emission Level (dBμV/m)	DCCF (dB)	Average Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Remark
2329.80	48.41	-36.08	12.33	54.00	41.67	Average
2390.04	44.08	-36.08	8.00	54.00	46.00	Average

Mode	T-FHSS	Frequency	TX 2467.500MHz
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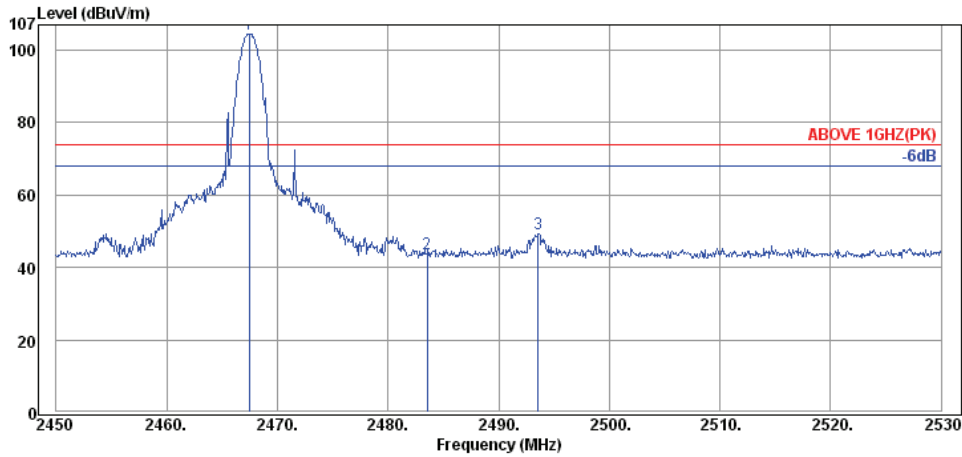


Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2467.44	32.25	6.65	70.04	108.94	---	---	Peak
2483.52	32.28	6.67	7.03	45.98	74.00	28.02	Peak
2493.36	32.30	6.69	13.68	52.67	74.00	21.33	Peak

Emission Frequency (MHz)	Peak Emission Level (dBμV/m)	DCCF (dB)	Average Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Remark
2483.52	45.98	-36.08	9.90	54.00	44.10	Average
2493.36	52.67	-36.08	16.59	54.00	37.41	Average

Mode	T-FHSS	Frequency	TX 2467.500MHz
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Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
2467.44	32.25	6.65	65.56	104.46	---	---	Peak
2483.52	32.28	6.67	4.79	43.74	74.00	30.26	Peak
2493.60	32.30	6.69	10.36	49.35	74.00	24.65	Peak

Emission Frequency (MHz)	Peak Emission Level (dBμV/m)	DCCF (dB)	Average Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Remark
2483.52	43.74	-36.08	7.66	54.00	46.34	Average
2493.60	49.35	-36.08	13.27	54.00	40.73	Average

A.1.2 Emissions outside the frequency band:

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

Mode	T-FHSS	Frequency	TX 2407.500MHz
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Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dB μ V)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector
4815.00	34.22	9.54	14.44	58.20	74.00	15.80	Peak
7225.00	35.80	11.82	19.08	66.70	74.00	7.30	Peak
9630.00	36.87	15.30	2.86	55.03	74.00	18.97	Peak

Emission Frequency (MHz)	Peak Emission Level (dB μ V/m)	DCCF (dB)	Average Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Remark
4815.00	58.20	-36.08	22.12	54.00	31.88	Average
7225.00	66.70	-36.08	30.62	54.00	23.38	Average
9630.00	55.03	-36.08	18.95	54.00	35.05	Average

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dB μ V)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector
4815.00	34.22	9.54	11.17	54.93	74.00	19.07	Peak
7220.00	35.80	11.82	16.12	63.74	74.00	10.26	Peak
9630.00	36.87	15.30	-2.04	50.13	74.00	23.87	Peak
12040.00	38.92	16.58	-0.92	54.58	74.00	19.42	Peak

Emission Frequency (MHz)	Peak Emission Level (dB μ V/m)	DCCF (dB)	Average Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Remark
4815.00	54.93	-36.08	18.85	54.00	35.15	Average
7220.00	63.74	-36.08	27.66	54.00	26.34	Average
9630.00	50.13	-36.08	14.05	54.00	39.95	Average
12040.00	54.58	-36.08	18.50	54.00	35.50	Average

Mode	T-FHSS	Frequency	TX 2437.500MHz
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Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dB μ V)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector
4870.00	34.25	9.56	11.48	55.29	74.00	18.71	Peak
7305.00	35.80	11.90	13.79	61.49	74.00	12.51	Peak
9740.00	36.99	15.45	4.90	57.34	74.00	16.66	Peak

Emission Frequency (MHz)	Peak Emission Level (dB μ V/m)	DCCF (dB)	Average Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Remark
4870.00	55.29	-36.08	19.21	54.00	34.79	Average
7305.00	61.49	-36.08	25.41	54.00	28.59	Average
9740.00	57.34	-36.08	21.26	54.00	32.74	Average

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dB μ V)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector
4870.00	34.25	9.56	13.66	57.47	74.00	16.53	Peak
7305.00	35.80	11.90	16.61	64.31	74.00	9.69	Peak
9740.00	36.99	15.45	0.01	52.45	74.00	21.55	Peak
12180.00	39.01	16.65	-0.64	55.02	74.00	18.98	Peak

Emission Frequency (MHz)	Peak Emission Level (dB μ V/m)	DCCF (dB)	Average Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Remark
4870.00	57.47	-36.08	21.39	54.00	32.61	Average
7305.00	64.31	-36.08	28.23	54.00	25.77	Average
9740.00	52.45	-36.08	16.37	54.00	37.63	Average
12180.00	55.02	-36.08	18.94	54.00	35.06	Average

Mode	T-FHSS	Frequency	TX 2467.500MHz
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Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4935.00	34.27	9.58	10.70	54.55	74.00	19.45	Peak
7400.00	35.80	11.99	13.21	61.00	74.00	13.00	Peak
9870.00	37.16	15.64	5.86	58.66	74.00	15.34	Peak

Emission Frequency (MHz)	Peak Emission Level (dBμV/m)	DCCF (dB)	Average Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Remark
4935.00	54.55	-36.08	18.47	54.00	35.53	Average
7400.00	61.00	-36.08	24.92	54.00	29.08	Average
9870.00	58.66	-36.08	22.58	54.00	31.42	Average

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
4935.00	34.27	9.58	10.80	54.65	74.00	19.35	Peak
7400.00	35.80	11.99	13.11	60.90	74.00	13.10	Peak
9870.00	37.16	15.64	2.39	55.19	74.00	18.81	Peak

Emission Frequency (MHz)	Peak Emission Level (dBμV/m)	DCCF (dB)	Average Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Remark
4935.00	54.65	-36.08	18.57	54.00	35.43	Average
7400.00	60.90	-36.08	24.82	54.00	29.18	Average
9870.00	55.19	-36.08	19.11	54.00	34.89	Average

A.1.3 Emissions in Non-restricted Frequency Bands:

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

A.2 20dB BANDWIDTH MEASUREMENT

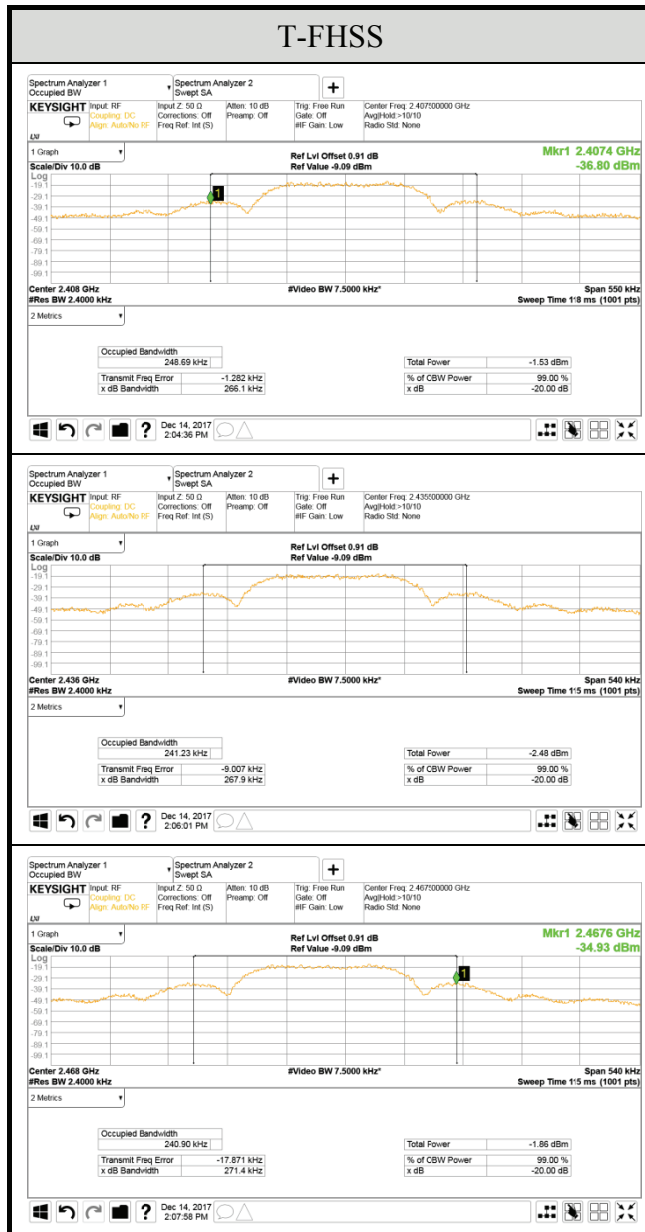
Test Date	2017/12/14	Temp./Hum.	23°C/55%
Cable Loss	0.4dB	Test Voltage	DC 6V (Via DC Power Supply)

A.2.1 20dB Bandwidth Result

Modulation	Centre Frequency (MHz)	20 dB Bandwidth (MHz)	99% Bandwidth (MHz)	Limit 2/3 (20dB Bandwidth)
T-FHSS	2407.5	0.2661	0.24869	0.177
	2437.5	0.2679	0.24123	0.179
	2467.5	0.2714	0.24090	0.181

Remark: The maximum two-thirds of the 20dB bandwidth shall be at maximum 0.181MHz.

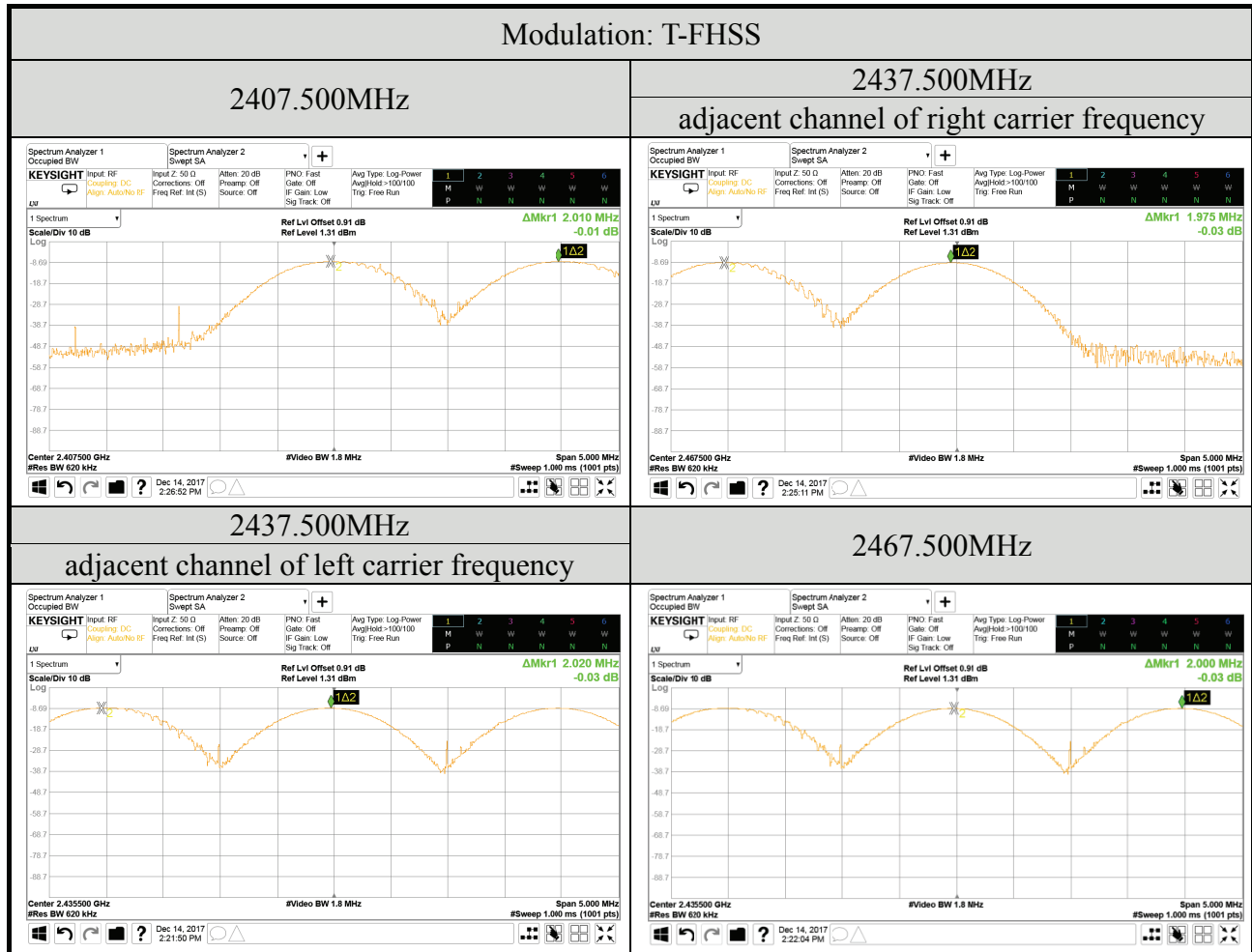
A.2.2 Measurement Plots



A.3 CARRIER FREQUENCY SEPARATION MEASUREMENT

Test Date	2017/12/14	Temp./Hum.	23°C/55%
Cable Loss	0.4dB	Test Voltage	DC 6V (Via DC Power Supply)

A.3.1 Measurement Plots



A.4 TIME OF OCCUPANCY MEASUREMENT

Test Date	2017/12/04 ~ 12	Temp./Hum.	24°C/55%
Cable Loss	1.0dB	Test Voltage	DC 6V (Via DC Power Supply)

A.4.1 Time of Occupancy

Modulation	Centre Frequency (MHz)	Time of Occupancy (ms)	Maximum accumulated Time of Occupancy (ms)	Limit (ms)
T-FHSS	2407.500	1.560	19.344	<400
	2437.500	1.570	19.468	<400
	2467.500	1.570	19.468	<400

Duty cycle: 31 channels*0.4 seconds = 12.4 seconds

Test Frequency: 2407.500MHz

For each 1 second of 1 channel appearance, the longest time of occupancy for each of 12.4 seconds is:

$$1 \text{ channel} * 12.4 \text{ seconds} / 1 * 1.560 \text{ms} = 19.344 \text{ms}$$

Test Frequency: 2437.500MHz

For each 1 second of 1 channel appearance, the longest time of occupancy for each of 12.4 seconds is:

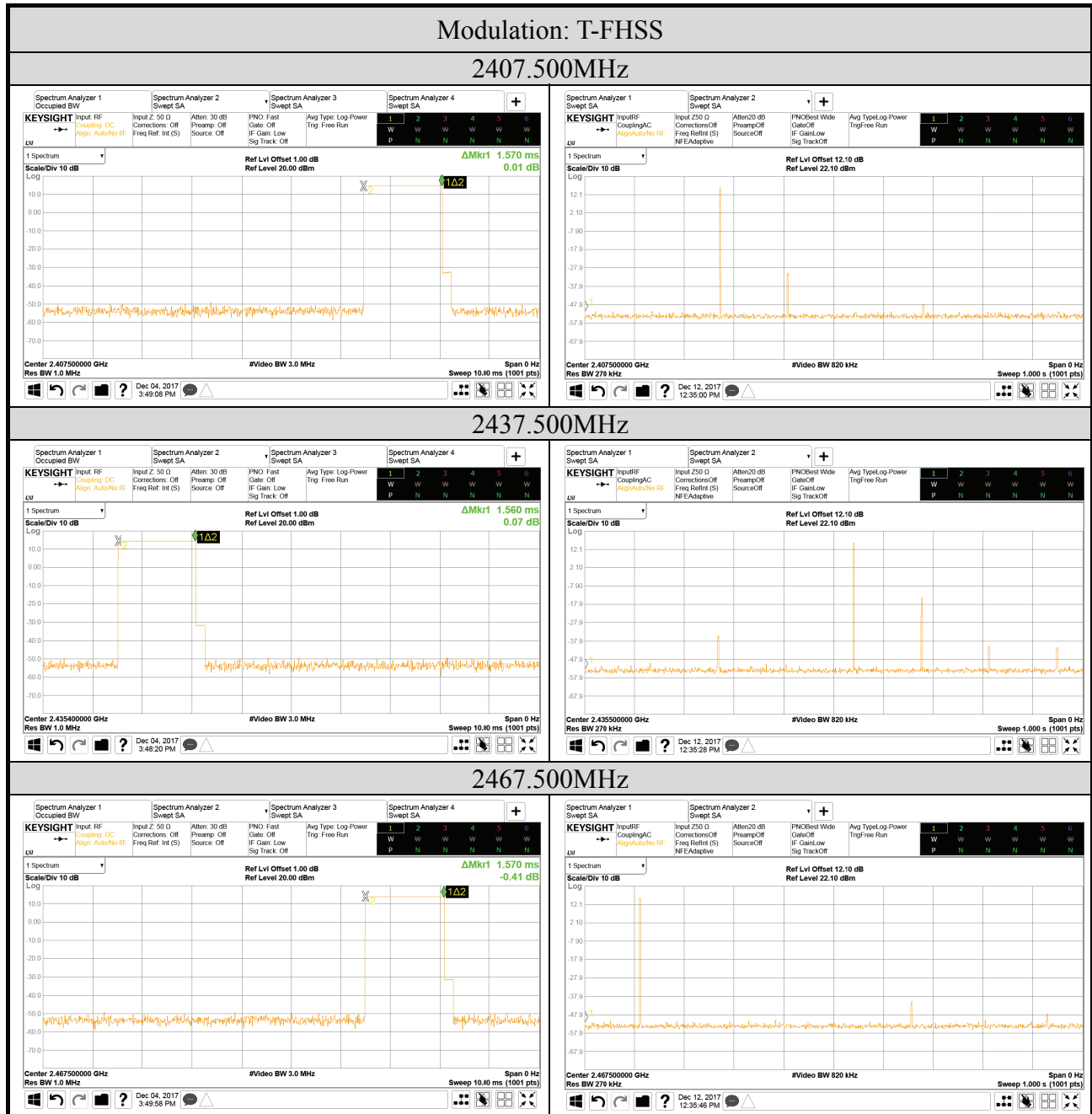
$$1 \text{ channel} * 12.4 \text{ seconds} / 1 * 1.570 \text{ms} = 19.468 \text{ms}$$

Test Frequency: 2467.500MHz

For each 1 second of 1 channel appearance, the longest time of occupancy for each of 12.4 seconds is:

$$1 \text{ channel} * 12.4 \text{ seconds} / 1 * 1.570 \text{ms} = 19.468 \text{ms}$$

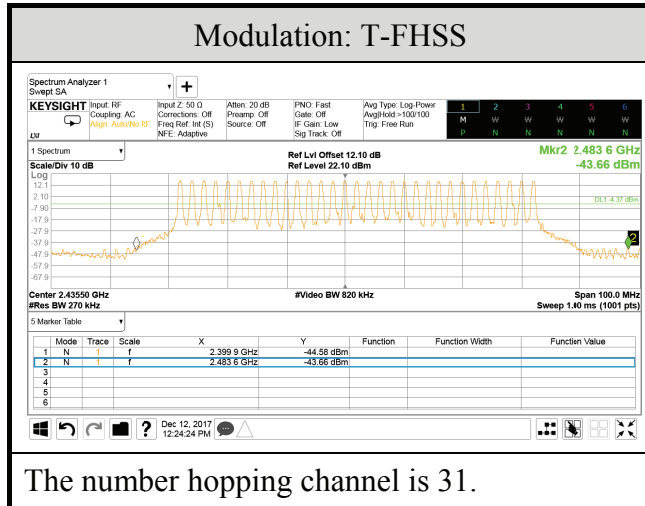
● Measurement Plots



A.5 NUMBER OF HOPPING CHANNELS MEASUREMENT

Test Date	2017/12/12	Temp./Hum.	24°C/55%
Cable Loss	1.0dB	Test Voltage	DC 6V (Via DC Power Supply)

A.5.1 Measurement Plots



A.6 MAXIMUM PEAK OUTPUT POWER MEASUREMENT

Test Date	2017/12/11	Temp./Hum.	25°C/55%
Cable Loss	0.4dB	Test Voltage	DC 6V (Via DC Power Supply)

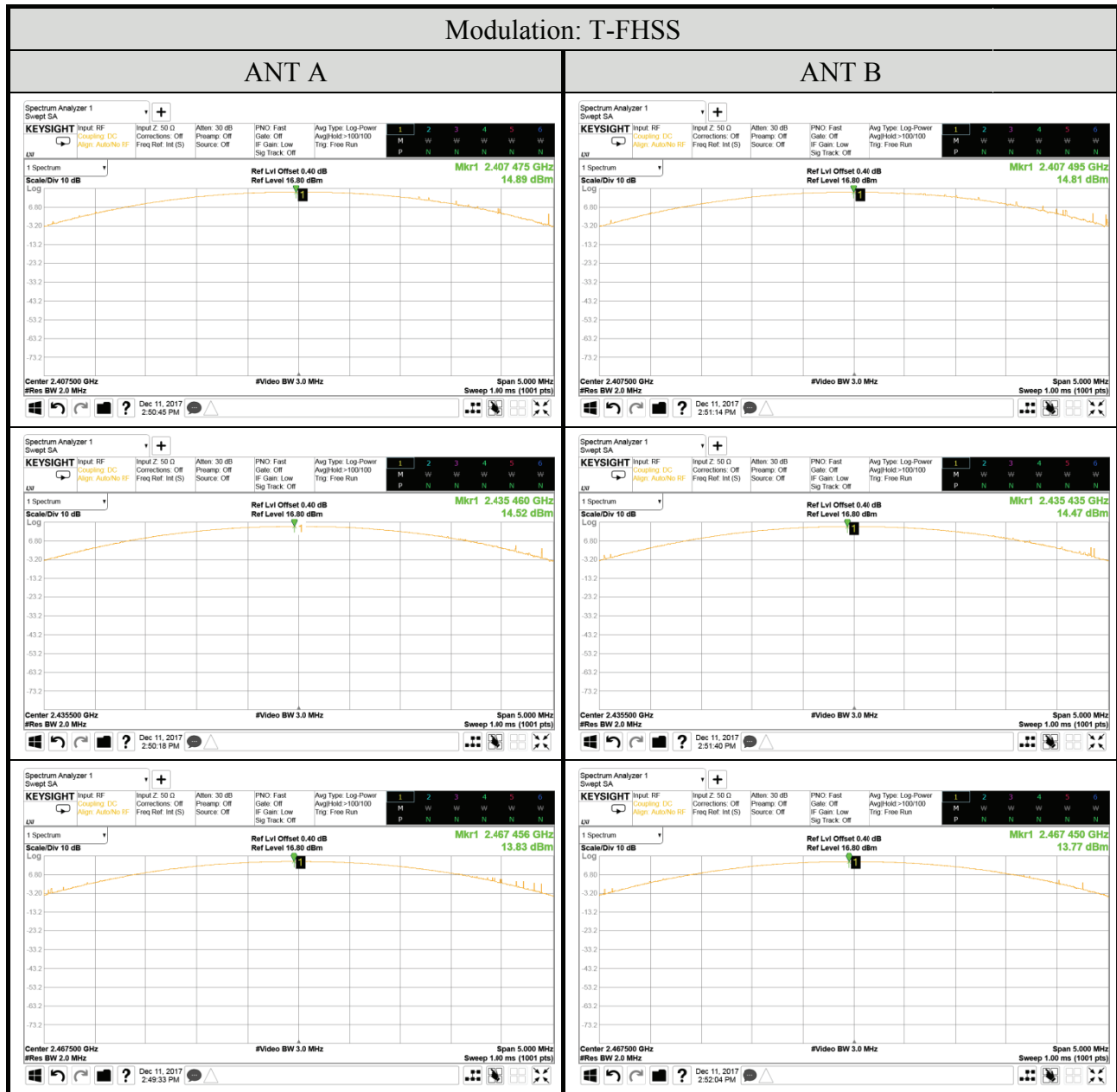
ANT A

Modulation	Centre Frequency (MHz)	Peak Output Power		Limit
		dBm	W	
T-FHSS	2407.50	14.89	0.030832	21dBm (0.125W)
	2437.50	14.52	0.028314	
	2467.50	13.83	0.024155	

ANT B

Modulation	Centre Frequency (MHz)	Peak Output Power		Limit
		dBm	W	
T-FHSS	2407.50	14.81	0.030269	21dBm (0.125W)
	2437.50	14.47	0.027990	
	2467.50	13.77	0.023823	

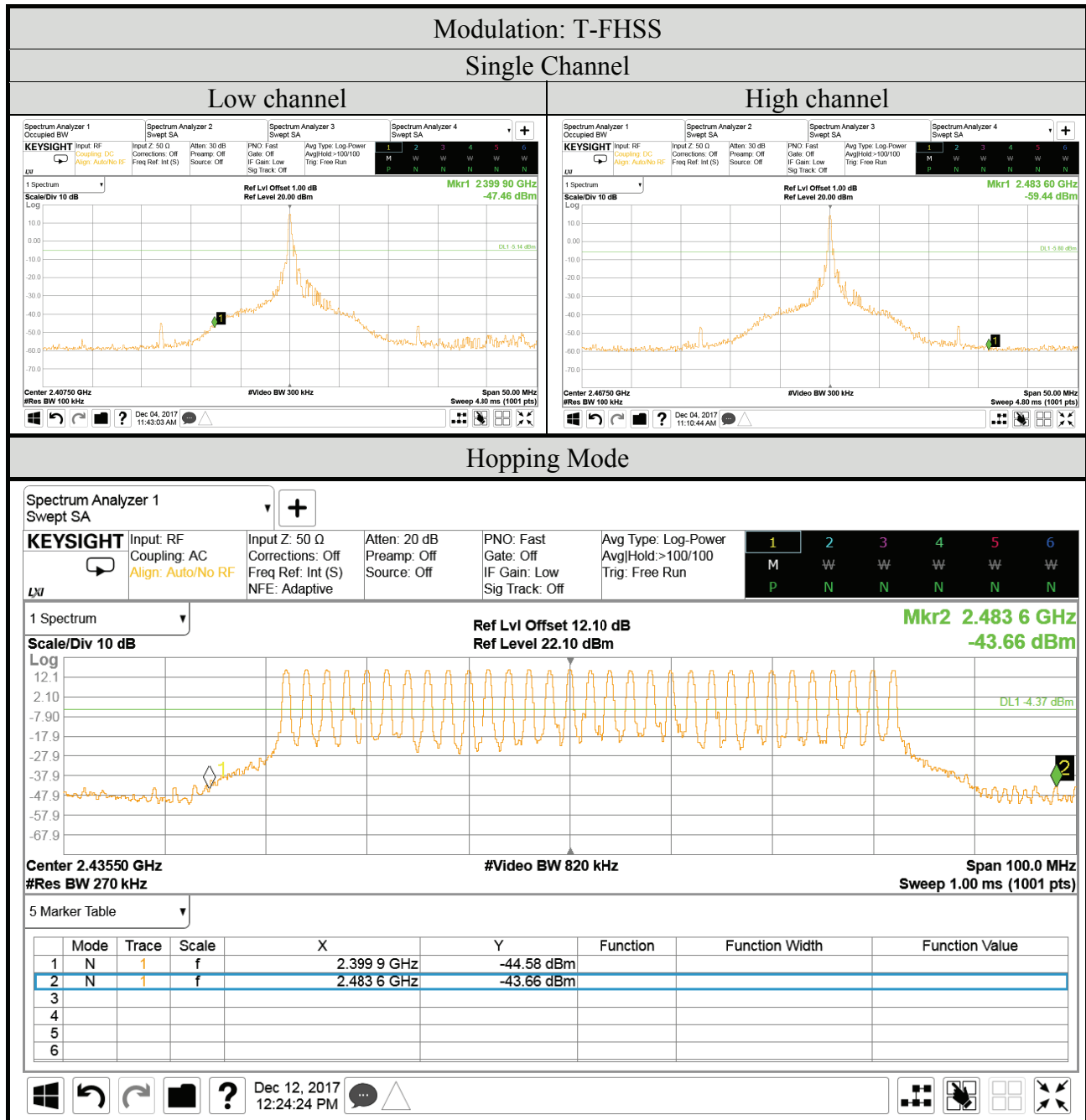
A.6.1 Measurement Plots



A.7 EMISSION LIMITATIONS MEASUREMENT

A.7.1 Band Edge

Test Date	2017/12/04 ~ 12	Temp./Hum.	24°C/55%
Cable Loss	1.0dB	Test Voltage	DC 6V (Via DC Power Supply)



A.7.2 Spurious Emission

Test Date	2017/12/04	Temp./Hum.	24°C/55%
Mode	TX	Modulation	T-FHSS
		Frequency	2407.500MHz
Cable Loss	1.0dB	Test Voltage	DC 6V (Via DC Power Supply)



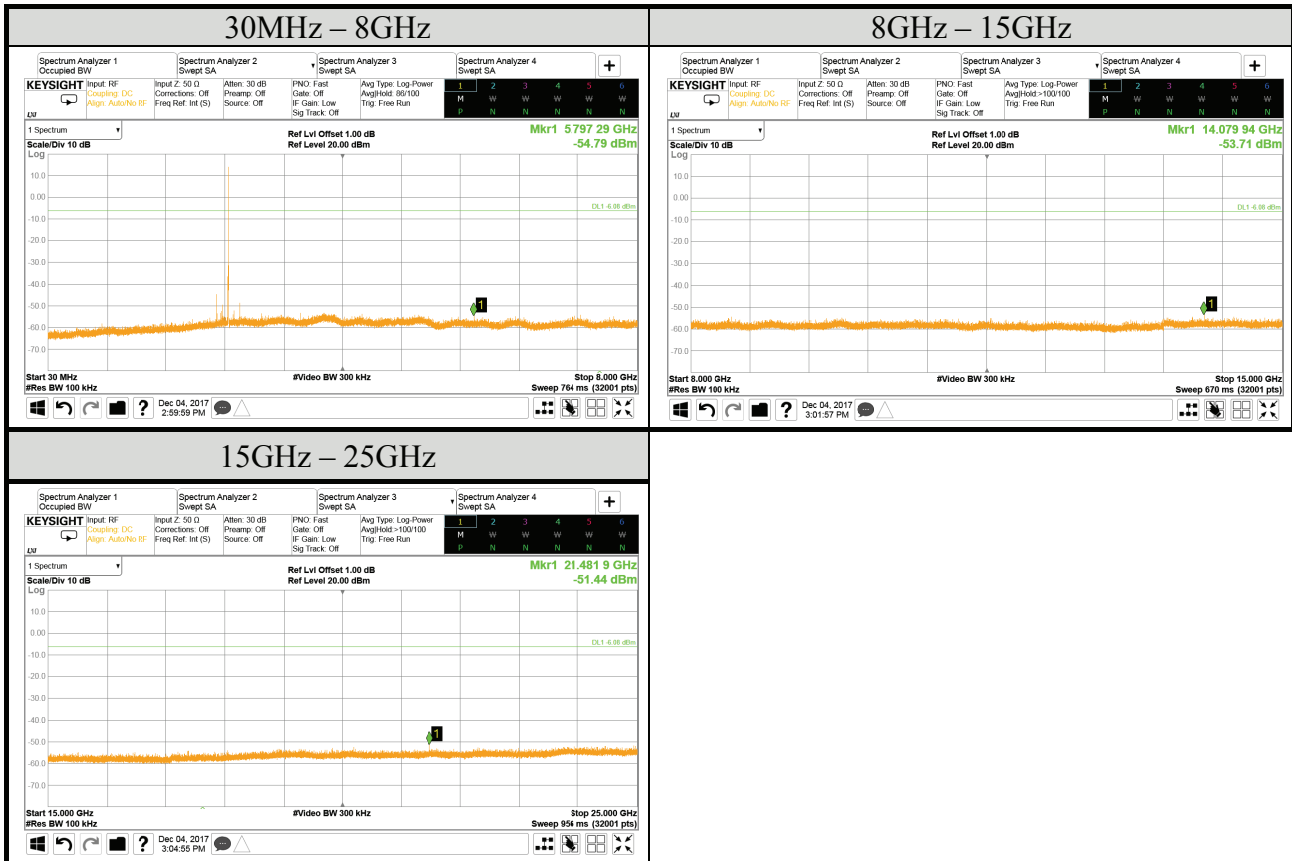
Note: All results have been included cable loss and simultaneous factor.

Test Date	2017/12/04	Temp./Hum.	24°C/55%
Mode	TX	Modulation	T-FHSS
		Frequency	2437.500MHz
Cable Loss	1.0dB	Test Voltage	DC 6V (Via DC Power Supply)



Note: All results have been included cable loss and simultaneous factor.

Test Date	2017/12/04	Temp./Hum.	24°C/55%
Mode	TX	Modulation	T-FHSS
		Frequency	2467.500MHz
Cable Loss	1.0dB	Test Voltage	DC 6V (Via DC Power Supply)



Note: All results have been included cable loss and simultaneous factor.



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APPENDIX B

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APPDNDIX B

TEST PHOTOGRAPHS

(Model: R3004SB)