Audix Technology Corp.
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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	**:**	**T32MZ**
Brand		**Futaba**
FCC ID	**:**	**AZP-T32MZ-24G**
IC	**:**	**2914D-T32MZ**

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

Testing Laboratory
1724

TESTING
NVLAP LAB CODE 200077-0

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 B TEST PHOTOGRAPHS

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TEST REPORT CERTIFICATION

Applicant	:	FUTABA Corporation
Manufacture	:	FUTABA Corporation
EUT Description		
(1) Product	:	Radio Control
(2) Model	:	T32MZ
(3) Brand	:	Futaba
(4) Power Rating	:	(1)DC 5V (USB) (2)DC 3.6 ~ 4.2V (Battery)

Applicable Standards:

47 CFR FCC 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: 2019. 08. 19

Reviewed by: (Tina Huang/Administrator)

Approved by: (Ben Cheng/Manager)

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1. REVISION RECORD OF TEST REPORT

Edition No	Issued Date	Revision Summary	Report Number
0	2019. 08. 19	Original Report	EM-F190261

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2. SUMMARY OF TEST RESULTS

Rule		Description	Results
FCC	IC		
15.207	RSS-Gen §8.8	Conducted Emission	**PASS**
15.247(d)/15.205	RSS-Gen §8.9 RSS-247 §5.5	Radiated Band Edge and Radiated Spurious Emission	**PASS**
15.247(a)(1)	RSS-247 §5.1(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	RSS-Gen §6.8	Antenna Requirement	**Compliance**
Note: The uncertainties value is not used in determining the result.			

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3. GENERAL INFORMATION

3.1. Description of Application

Applicant	FUTABA Corporation 1080 Yabutsuka Chosei-mura Chosei-gun Chiba-ken, 299-4395 Japan.
Manufacturer	FUTABA Corporation 1080 Yabutsuka Chosei-mura Chosei-gun Chiba-ken, 299-4395 Japan.
Product	Radio Control
Model	T32MZ
Brand	Futaba

3.2. Description of EUT

Test Model	T32MZ
Serial Number	N/A
Power Rating	(1)DC 5V (USB) (2)DC 3.6 ~ 4.2V (Battery)
Firmware Version	N/A
RF Features	DSSS: FASSTest, FASST FHSS: S-FHSS, T-FHSS, BT
Transmit Type	1T1R
Sample Status	Production
Date of Receipt	2019. 06. 04
Date of Test	2019. 07. 30 ~ 08. 16
Interface Ports of EUT	• Connector for trainer function (TRAINER) x1 • S.BUS Connector (S.I/F) x2 • Connector for Battery Charger (CHG) x1 • Audio Plug (PHONE) x1 • Micro SD Card Slot x1
Accessories Supplied	AC Adapter (Wall-mount, 2C)

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3.3. Antenna Information

No.	Antenna Part Number	Manufacture/Brand	Antenna Type	Frequency	Max Gain
For FASSTest, FASST, S-FHSS, T-FHSS Mode					
1	ANTB24-094A0	SANSEI ELECTRIC CO., LTD	1/2λ Pencil type antenna	2400 ~ 2500MHz	1.48dBi
For BT Mode					
2.	ANT016008LCD2 442MA1	TDK	built-in chip	2400 ~ 2484MHz	2.3dBi

3.4. EUT Specifications Assessed in Current Report

Mode	Fundamental Range (MHz)	Channel Number	Modulation	Data Rate (Mbps)
Bluetooth	2402-2480	79	FHSS (GFSK, π/4 DQPSK, 8-DPSK)	1/2/3

Channel List							
Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)
00	2402	20	2422	40	2442	60	2462
01	2403	21	2423	41	2443	61	2463
02	2404	22	2424	42	2444	62	2464
03	2405	23	2425	43	2445	63	2465
04	2406	24	2426	44	2446	64	2466
05	2407	25	2427	45	2447	65	2467
06	2408	26	2428	46	2448	66	2468
07	2409	27	2429	47	2449	67	2469
08	2410	28	2430	48	2450	68	2470
09	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473
12	2414	32	2434	52	2454	72	2474
13	2415	33	2435	53	2455	73	2475
14	2416	34	2436	54	2456	74	2476
15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	38	2440	58	2460	78	2480
19	2421	39	2441	59	2461		

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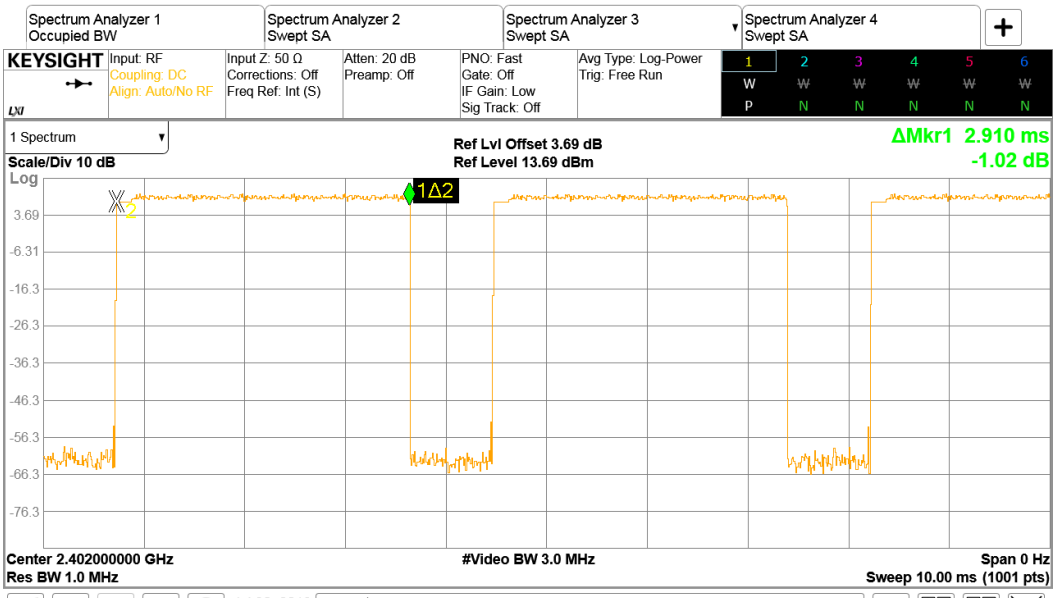
3.5. Description of Key Components

Item	Supplier/Brand	Model	Specification
GPS Module	Position	GPS-86A-093	GPS
Wireless Module	Texas Instruments	WL18MODGB	BT FCC ID: Z64-WL18SBMOD IC: 451I-WL18SBMOD
Wireless Module	Futaba	TC23A	FASSTest, FASST, S-FHSS, T-FHSS
Lithium-polymer Battery	Futaba	LT1F6600B	DC 3.8A, 6600mA, 25.08Wh
AC Adapter (Wall-mount, 2C)	APD	WB-10G05R	I/P: 100-240Vac, 50-60Hz, 0.4A Max. O/P: 5Vdc, 2A DC(USB) Cable: Shielded, Detachable, 1.1m

3.6. Test Configuration

Mode	TX_{on} (ms)	TX_{on+off} (ms)	1/ TX_{on} (kHz)	Duty Cycle Correction Factor (DCCF) (dB)
8-DPSK	2.910	100	0.34	N/A

Note: Duty Cycle Correction Factor (DCCF)= 20log (TX_{on}/100ms)
"TX_{on+off}" means the period of the pulse train or 100ms if the pulse train length is greater than 100ms

Mode	TX_{on}
8-DPSK	

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AC Conduction	
Test Case	Charge Mode

Item		Modulation/ Mode	Data Rate	Test Channel
Radiated Test Case	Radiated Spurious Emission	Charge	---	---
	Radiated Band Edge Note1	GFSK	1Mbps	00/78
		8-DPSK	3Mbps	00/78
	Radiated Spurious Emission Note1	GFSK	1Mbps	00/39/78
		8-DPSK	3Mbps	00/78
Conducted Test Case Note2	20dB Bandwidth	GFSK	1Mbps	00/39/78
		8-DPSK	3Mbps	00/39/78
	Carrier Frequency Separation	GFSK	1Mbps	00/39/78
		8-DPSK	3Mbps	00/39/78
	Time of Occupancy	GFSK	1Mbps	00/39/78
		8-DPSK	3Mbps	00/39/78
	Number of Hopping Channels	GFSK	1Mbps	39
		8-DPSK	3Mbps	39
	Maximum Peak Output Power	GFSK	1Mbps	00/39/78
		8-DPSK	3Mbps	00/39/78
	Band Edges	GFSK	1Mbps	00/78
		8-DPSK	3Mbps	00/78
	Spurious Emission	GFSK	1Mbps	00/39/78
		8-DPSK	3Mbps	00/39/78

Note 1: ☐Mobile Device

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

Note 2: We performed testing of the highest and lowest data rate.

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3.8. Tested Supporting System List

3.8.1. Support Peripheral Unit

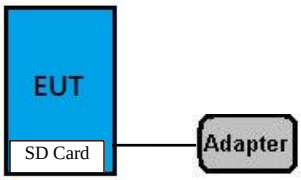
No.	Product	Brand	Model No.	Serial No.	Approval
1.	Micro SD Card (4GB)	Transcend	N/A	N/A	N/A
2.	Power Socket	N/A	N/A	N/A	N/A

3.8.2. Cable Lists

No.	Cable Description Of The Above Support Units
1.	----
2	AC Power Cord: Unshielded, Detachable, 1.0m

3.9. Setup Configuration

3.9.1. EUT Configuration for Power Line & Radiated Emission (Charge mode)



3.9.2. EUT Configuration for Radiated Emission (TX 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: Test program “CMD” is used for enabling EUT BT function under continues transmitting and choosing data rate/ channel.

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3.12.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.7 Shielded Room (2) No.1 3m Semi Anechoic Chamber

3.13.Measurement Uncertainty

Test Item	Frequency Range	Uncertainty
Conduction Test	150kHz~30MHz	±3.50dB
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

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4. MEASUREMENT EQUIPMENT LIST

4.1. Conducted Emission Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Test Receiver	R&S	ESR	101774	2019. 01. 23	1 Year
2.	A.M.N.	R&S	ENV4200	100169	2018. 11. 14	1 Year
3.	Pulse Limiter	R&S	ESH3-Z2	100354	2019. 01. 12	1 Year
4.	Digital Thermo-Hygro Meter	iMax	HTC-1	No.8 S/R	2019. 04. 20	1 Year
5.	Test Software	Audix	e3	V6.120619c	N.C.R.	N.C.R.

4.2. Radiated Emission Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	N9010A-526	MY53400071	2018. 09. 12	1 Year
2.	Test Receiver	R & S	ESCS30	100338	2019. 06. 12	1 Year
3.	Amplifier	HP	8447D	2944A06305	2019. 01. 30	1 Year
4.	Amplifier	HP	8449B	3008A00529	2019. 01. 23	1 Year
5.	Bilog Antenna	CHASE	CBL6112D	33821	2019. 01. 19	1 Year
6.	Horn Antenna	EMCO	3115	9609-4927	2019. 06. 24	1 Year
7.	Horn Antenna	COM-POWER	AH-840	101092	2019. 05. 14	1 Year
8.	Notch Filter	K&L	7NSL10-2441.5/E130.5-O/O	1	2019. 07. 24	1 Year
9.	High-Pass Filter	Microwave	H3G018G1	484796	2018. 08. 22	1 Year
10.	Coaxial Cable	MIYAZAKI	5D2W	RE-11	2019. 02. 01	1 Year
11.	Coaxial Cable	HUBER+SUHNER	SUCOFLEX 106	54602/6	2019. 02. 01	1 Year
12.	Digital Thermo-Hygro Meter	IMax	HTC-1	No.1 3m A/C	2019. 04. 20	1 Year
13.	Test Software	Audix	e3	V6.120619c	N.C.R.	N.C.R.

4.3. RF Conducted Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Keysight	N9010B-544	MY55460198	2019. 05. 06	1 Year
2.	Digital Thermo-Hygro Meter	Shenzhen Datronn Electronics	KT-905	RF	2019. 04. 20	1 Year

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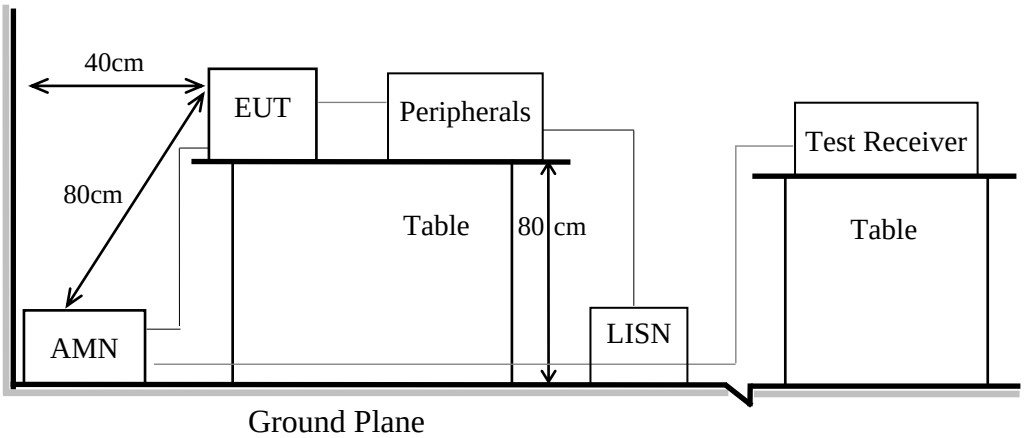
5. CONDUCTED EMISSION

5.1. Block Diagram of Test Setup

5.1.1. Block Diagram of EUT

Indicated as section 3.8

5.1.2. Shielded Room Setup Diagram



5.2. Conducted Emission Limit

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

Remark 1.: 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 C 63.10. 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 150 kHz to 30 MHz and record the emission which does not have 20 dB below limit.

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5.4. Test Results

Please refer to Appendix A.

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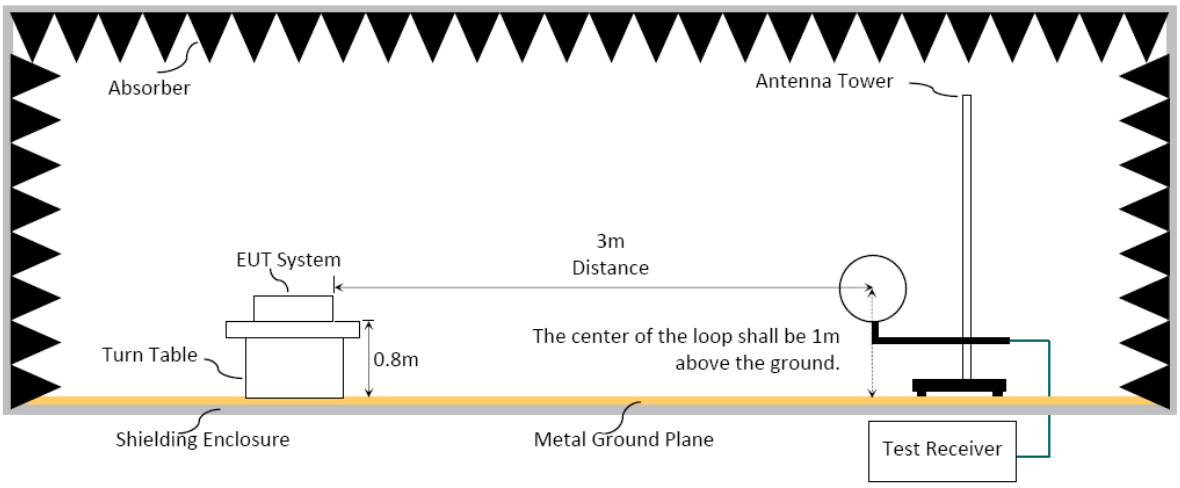
6. RADIATED EMISSION

6.1. Block Diagram of Test Setup

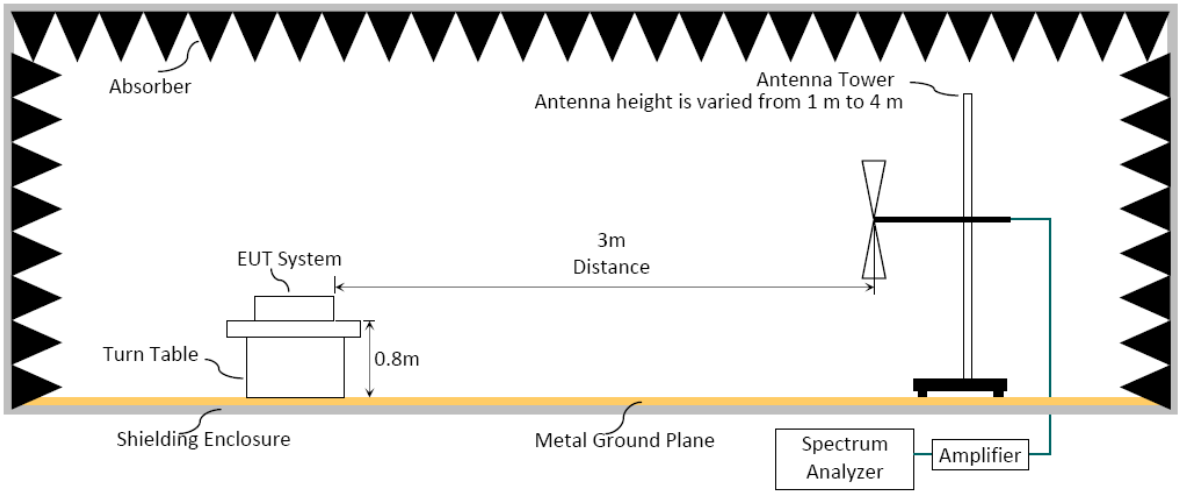
6.1.1. Block Diagram of EUT

Indicated as section 3.8

6.1.2. Setup Diagram for 9kHz-30MHz



6.1.3. Setup Diagram for 30-1000 MHz



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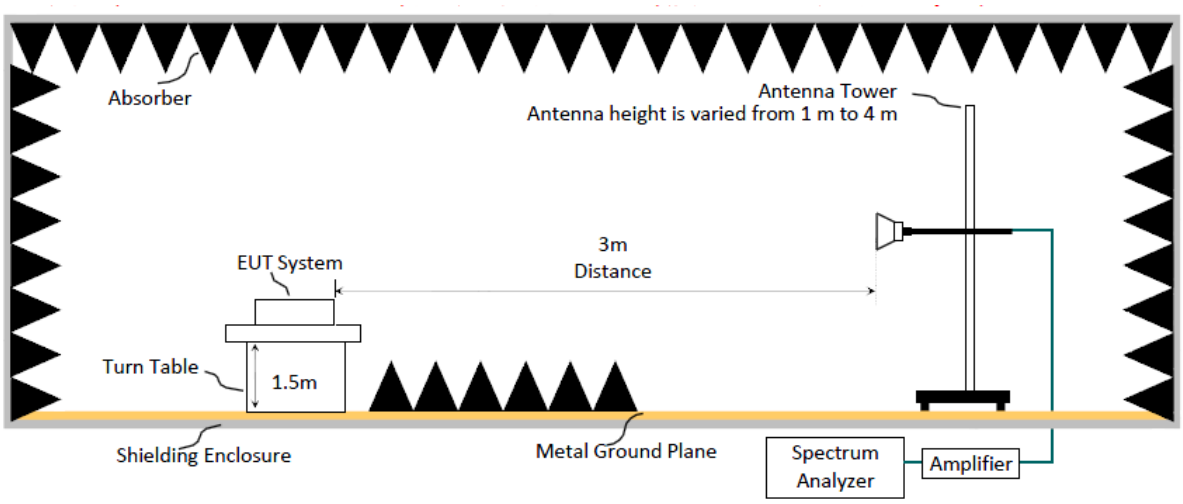
6.1.4. Setup Diagram for above 1GHz



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

Remark：(1) dBμV/m = 20 log (μV/m)
(2) The tighter limit applies to the edge between two frequency bands.
(3) Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.
(4) Fundamental and emission fall within operation band are exempted from this section.
(5) Pursuant to ANSI C63.10: 6.6.4.3, if the maximized peak measured value complies with the average limit, then it is unnecessary to perform an average measurement.

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6.3. Test Procedure

Frequency Range 9kHz~30MHz:
The EUT setup on the 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 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 1 GHz:
Spectrum Analyzer is used for pre-testing with following setting:
(1)RBW = 120KHz
(2)VBW ≥ 3 x RBW.
(3)Detector = Peak.
(4)Sweep time = auto.
(5)Trace mode = max hold.
(6)Allow sweeps to continue until the trace stabilizes.
Note 1: When peak-detected value is lower than limit that the measurement using 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 ≥ 3 x RBW.
(3)Detector = Peak.
(4)Sweep time = auto.
(5)Trace mode = max hold.
(6)Allow sweeps to continue until the trace stabilizes.
Note: When peak-detected value is lower than limit that the measurement using the average detector is not required, otherwise using average detector for final measurement.

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Average Detector:

■**Option 1:**

(1)RBW = 1MHz
(2)VBW ≥ 1/ T.
(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 l=Antenna Factor + Cable Loss + Meter Reading
□Average Emission Level= Peak Emission Level+ DCCF
Duty Cycle Correction Factor (DCCF)= 20log (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.

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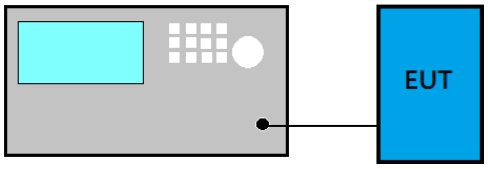
7. 20dB BANDWIDTH

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:

(1) Set RBW close to1% to 5% of OBW.
(2) Set VBW≥3xRBW.
(3) Detector = Peak.
(4) Trace mode = Max hold.
(5) Sweep = Auto couple.
(6) Allow the trace to stabilize.
(7) Setting channel bandwidth function x dB to -20 dB to record the final bandwidth.

7.4. Test Results

Please refer to Appendix A

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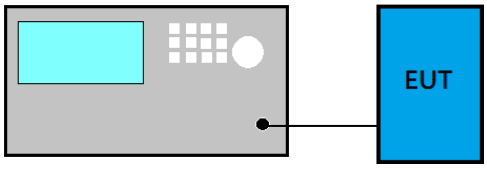
8. CARRIER FREQUENCY SEPARATION

8.1. Block Diagram of Test Setup



8.2. Specification Limits

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

8.3. Test Procedure

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

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

8.4. Test Results

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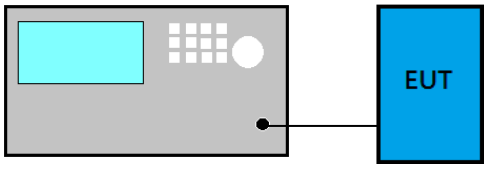
9. TIME OF OCCUPANCY

9.1. Block Diagram of Test Setup



9.2. Specification Limits

Frequency hopping systems in the 2400-2483.5MHz shall use at least 15 non-overlapping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by number of hopping channels employed.

9.3. Test Procedure

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

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

9.4. Test Results

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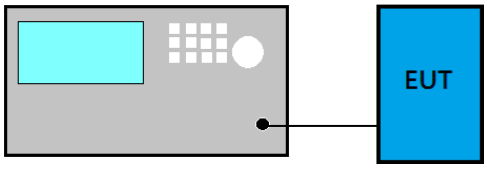
10. NUMBER OF HOPPING CHANNELS

10.1. Block Diagram of Test Setup



10.2. Specification Limits

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

10.3. Test Procedure

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

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

10.4. Test Results

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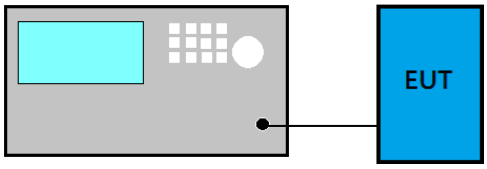
11. MAXIMUM PEAK OUTPUT POWER

11.1. Block Diagram of Test Setup



11.2. Specification Limits

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

11.3. Test Procedure

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

(a) Use the following spectrum analyzer settings

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

(b) Allow trace to stabilize.

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

11.4. Test Results

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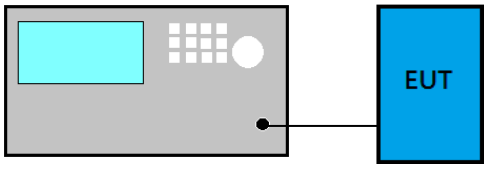
12. EMISSION LIMITATIONS

12.1. Block Diagram of Test Setup



12.2. Specification Limits

In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, that the required attenuation shall be 30 dB instead of 20 dB.

Attenuation below the general limits specified in Section 15.209(a)/RSS-Gen Section 8.9 table 4 is not required. In addition, radiated emissions which fall in restricted bands, as defined in Section 15.205(a)/RSS-Gen Section 8.10 table 6,, must also comply with the radiated emission limits specified in Section 15.209(a)/RSS-Gen Section 8.9 table 4 (See Section 15.205(c)).

12.3. Test Procedure

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

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

12.4. Test Results

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13. DEVIATION TO TEST SPECIFICATIONS

【NONE】

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APPENDIX A

TEST DATA AND PLOTS

(Model: T32MZ)

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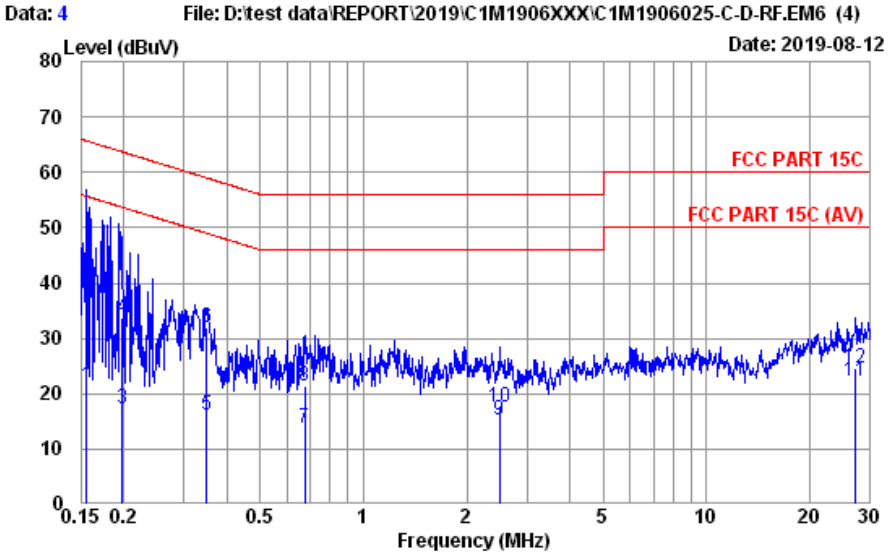
A.1 CONDUCTED EMISSION

Test Date	2019/08/12	Temp./Hum.	26℃/62%
Test Voltage	AC 120V 60Hz (Via AC Adapter)	Mode	Charge



Site no. : No.8 Shielded Room
Condition : ENV4200 100169
Limit : FCC PART 15C
Env. / Ins. : 26*C / 62% ESR3 (1774)
EUT : T32MZ
Power Rating : 120Vac/60Hz
Test Mode : Charge

Data no. : 4
LISN Phase : NEUTRAL
Engineer : Chucky Chiu

	Freq. (MHz)	AMN Factor (dB)	Cable Loss (dB)	Pulse Att. (dB)	Reading (dBμV)	Emission Level (dBμV)	Limits (dBμV)	Margin (dB)	Remark
1	0.156	10.69	0.03	9.86	0.84	21.42	55.69	34.27	Average
2	0.156	10.69	0.03	9.86	20.53	41.11	65.69	24.58	QP
3	0.198	10.62	0.03	9.86	-3.10	17.41	53.71	36.30	Average
4	0.198	10.62	0.03	9.86	13.32	33.83	63.71	29.88	QP
5	0.348	10.52	0.04	9.86	-4.30	16.12	49.00	32.88	Average
6	0.348	10.52	0.04	9.86	11.43	31.85	59.00	27.15	QP
7	0.675	10.48	0.05	9.86	-6.49	13.90	46.00	32.10	Average
8	0.675	10.48	0.05	9.86	0.98	21.37	56.00	34.63	QP
9	2.487	10.55	0.09	9.87	-5.29	15.22	46.00	30.78	Average
10	2.487	10.55	0.09	9.87	-2.81	17.70	56.00	38.30	QP
11	27.127	15.58	0.32	9.99	-3.58	22.31	50.00	27.69	Average
12	27.127	15.58	0.32	9.99	-1.25	24.64	60.00	35.36	QP

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

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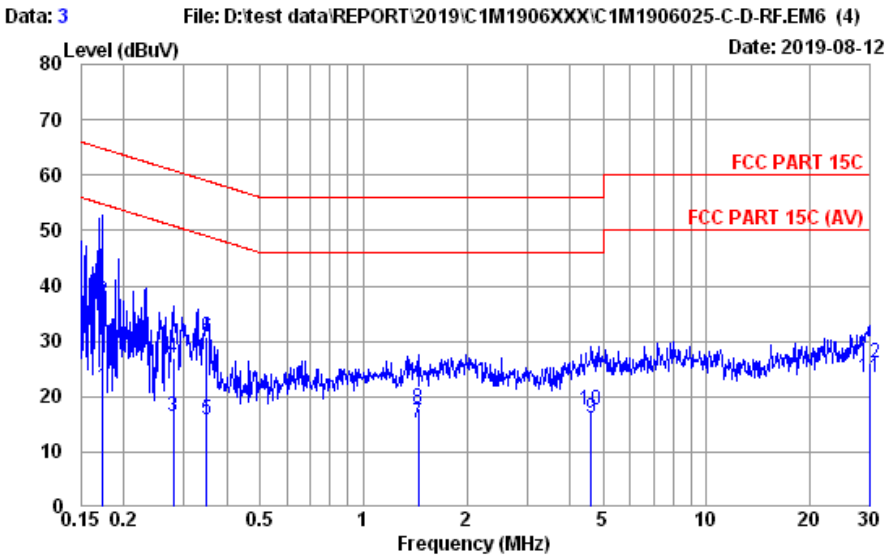
Test Date	2019/08/12	Temp./Hum.	26℃/62%
Test Voltage	AC 120V 60Hz (Via AC Adapter)	Mode	Charge



Site no. : No.8 Shielded Room
Condition : ENV4200 100169
Limit : FCC PART 15C
Env. / Ins. : 26°C / 62% ESR3 (1774)
EUT : T32MZ
Power Rating : 120Vac/60Hz
Test Mode : Charge

Data no. : 3
LISN Phase : LINE
Engineer : Chucky Chiu

	Freq. (MHz)	AMN Factor (dB)	Cable Loss (dB)	Pulse Att. (dB)	Reading (dBμV)	Emission Level (dBμV)	Limits (dBμV)	Margin (dB)	Remark
1	0.174	10.58	0.03	9.86	1.12	21.59	54.77	33.18	Average
2	0.174	10.58	0.03	9.86	16.72	37.19	64.77	27.58	QP
3	0.279	10.50	0.03	9.86	-4.00	16.39	50.85	34.46	Average
4	0.279	10.50	0.03	9.86	6.60	26.99	60.85	33.86	QP
5	0.348	10.47	0.04	9.86	-4.51	15.86	49.00	33.14	Average
6	0.348	10.47	0.04	9.86	10.26	30.63	59.00	28.37	QP
7	1.449	10.44	0.06	9.86	-5.10	15.26	46.00	30.74	Average
8	1.449	10.44	0.06	9.86	-2.40	17.96	56.00	38.04	QP
9	4.598	10.64	0.12	9.87	-4.45	16.18	46.00	29.82	Average
10	4.598	10.64	0.12	9.87	-3.17	17.46	56.00	38.54	QP
11	29.841	15.74	0.34	10.01	-2.67	23.42	50.00	26.58	Average
12	29.841	15.74	0.34	10.01	0.07	26.16	60.00	33.84	QP

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

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A.2 RADIATED EMISSION

Test Date	2019/08/01~05	Temp./Hum.	22~24℃/50~54%
Test Voltage	(1) Charge Mode: AC 120V 60Hz (Via AC Adapter) (2) TX Mode: DC 3.8V (Via Battery)		

A.2.1 Emissions within Restricted Frequency Bands

A.2.1.1 Frequency 9kHz~30MHz

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

A.2.1.2 Frequency Below 1 GHz

Mode	Charge	Frequency	----

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
71.71	12.67	1.91	20.72	35.30	40.00	4.70	Peak
127.00	18.24	2.62	17.49	38.35	43.50	5.15	Peak
163.86	16.27	3.05	18.24	37.56	43.50	5.94	QP
391.81	22.20	5.77	6.63	34.60	46.00	11.40	Peak
521.79	23.94	6.78	2.56	33.28	46.00	12.72	Peak
984.48	27.97	8.95	1.00	37.92	54.00	16.08	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
58.13	12.87	1.70	18.67	33.24	40.00	6.76	Peak
127.97	18.19	2.63	18.89	39.71	43.50	3.79	QP
185.20	15.63	3.28	20.34	39.25	43.50	4.25	QP
195.87	16.10	3.38	20.38	39.86	43.50	3.64	QP
818.61	26.65	8.01	3.31	37.97	46.00	8.03	Peak
971.87	27.87	8.88	1.73	38.48	54.00	15.52	Peak

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Mode	GFSK	Frequency	TX 2402MHz

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
59.10	12.69	1.71	15.39	29.79	40.00	10.21	Peak
131.85	17.99	2.67	8.89	29.55	43.50	13.95	Peak
405.39	22.48	5.92	5.49	33.89	46.00	12.11	Peak
561.56	24.37	6.83	3.95	35.15	46.00	10.85	Peak
945.68	27.66	8.72	2.49	38.87	46.00	7.13	Peak
998.06	28.04	9.03	1.00	38.07	54.00	15.93.	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
41.64	18.75	1.43	5.10	25.28	40.00	14.72	Peak
202.66	16.43	3.45	8.56	28.44	43.50	15.06	Peak
405.39	22.48	5.92	4.94	33.34	46.00	12.66	Peak
762.35	26.12	7.70	2.56	36.38	46.00	9.62	Peak
912.70	27.41	8.52	2.03	37.96	46.00	8.04	Peak
969.93	27.84	8.86	1.92	38.62	54.00	15.38	Peak

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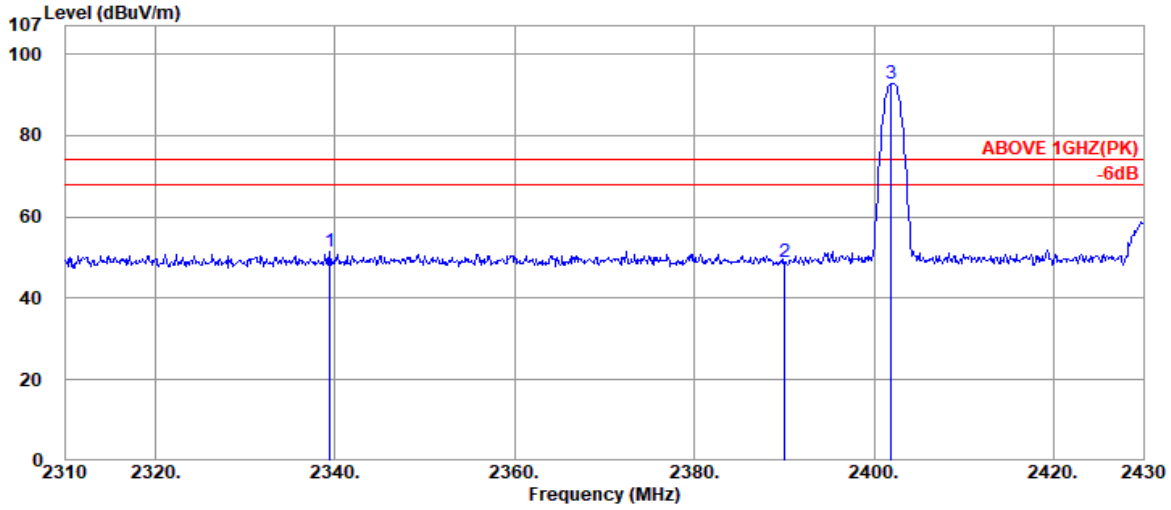
A.2.1.3 Frequency Above 1 GHz to 10th harmonics

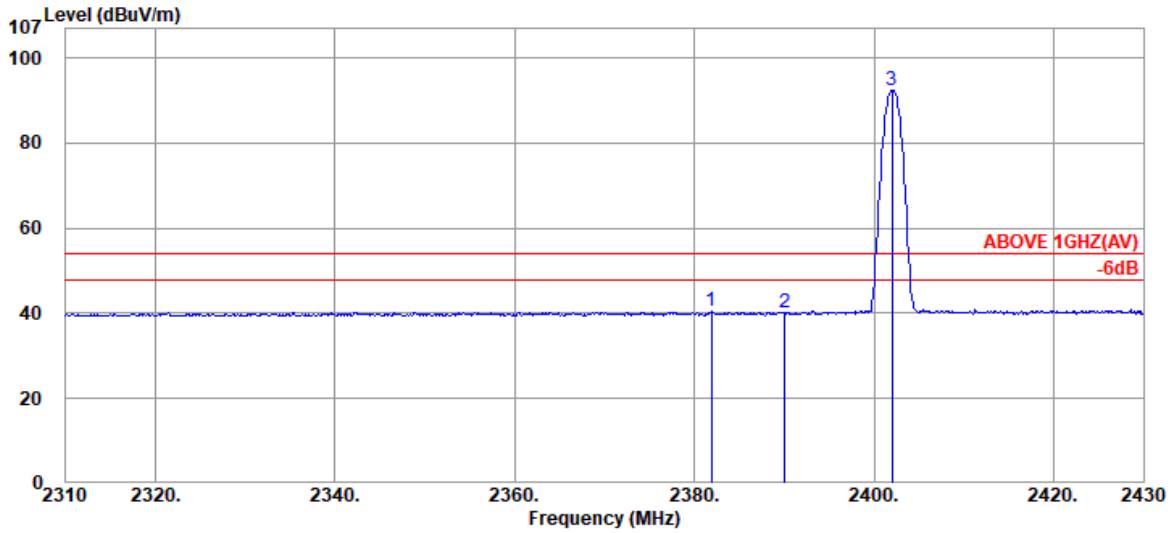
Band Edge:

Mode	GFSK	Frequency	TX 2402MHz



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
2339.40	28.22	5.97	17.21	51.40	74.00	22.60	Peak
2390.04	28.28	6.03	14.48	48.79	74.00	25.21	Peak
2401.92	28.29	6.04	58.41	92.74	---	---	Peak



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
2381.88	28.27	6.02	6.14	40.43	54.00	13.57	Average
2390.04	28.28	6.03	5.81	40.12	54.00	13.88	Average
2402.04	28.29	6.04	58.23	92.56	---	---	Average

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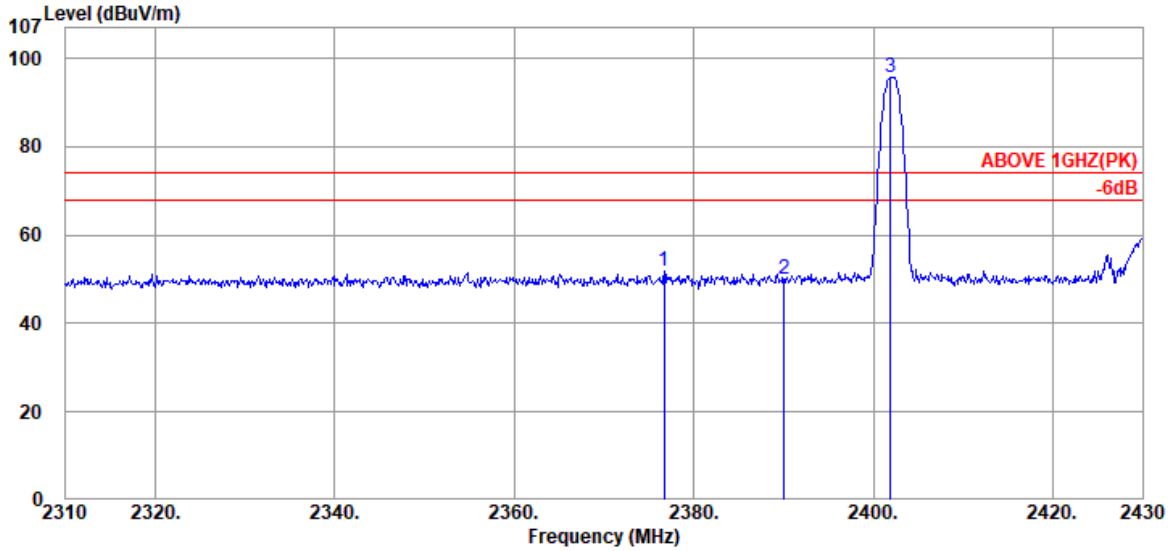
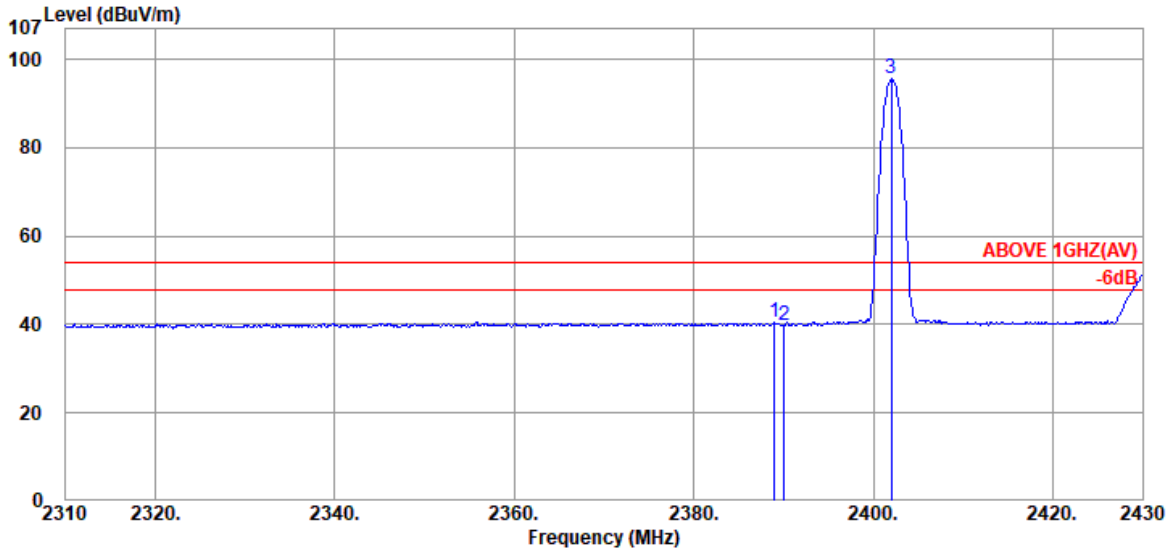
Mode	GFSK	Frequency	TX 2402MHz



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
2376.72	28.27	6.01	17.72	52.00	74.00	22.00	Peak
2390.04	28.28	6.03	15.87	50.18	74.00	23.82	Peak
2401.92	28.29	6.04	61.36	95.69	---	---	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
2388.96	28.28	6.02	6.16	40.46	54.00	13.54	Average
2390.04	28.28	6.03	5.66	39.97	54.00	14.03	Average
2402.04	28.29	6.04	61.19	95.52	---	---	Average

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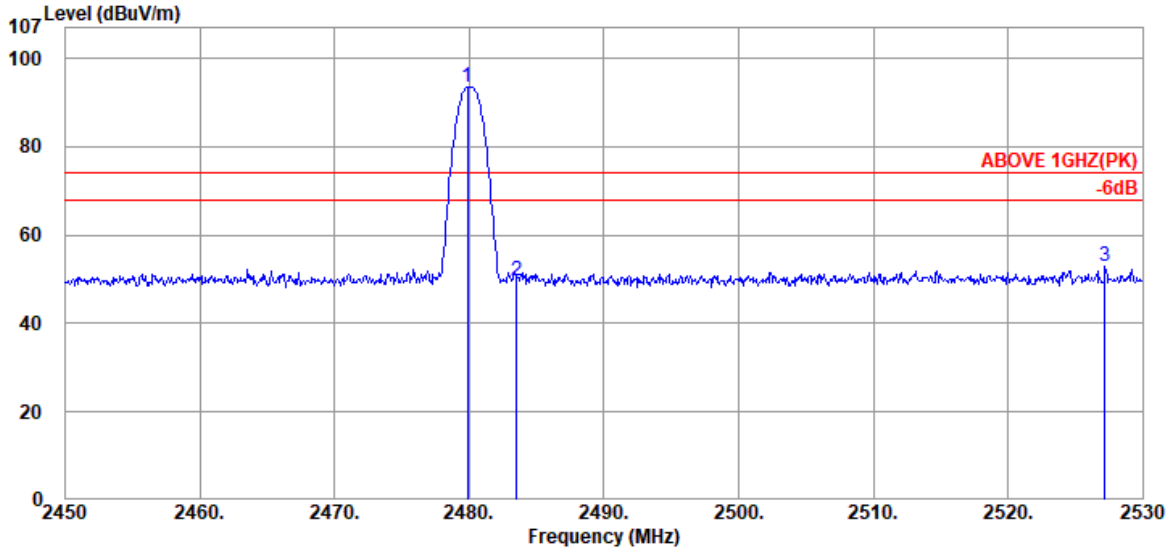
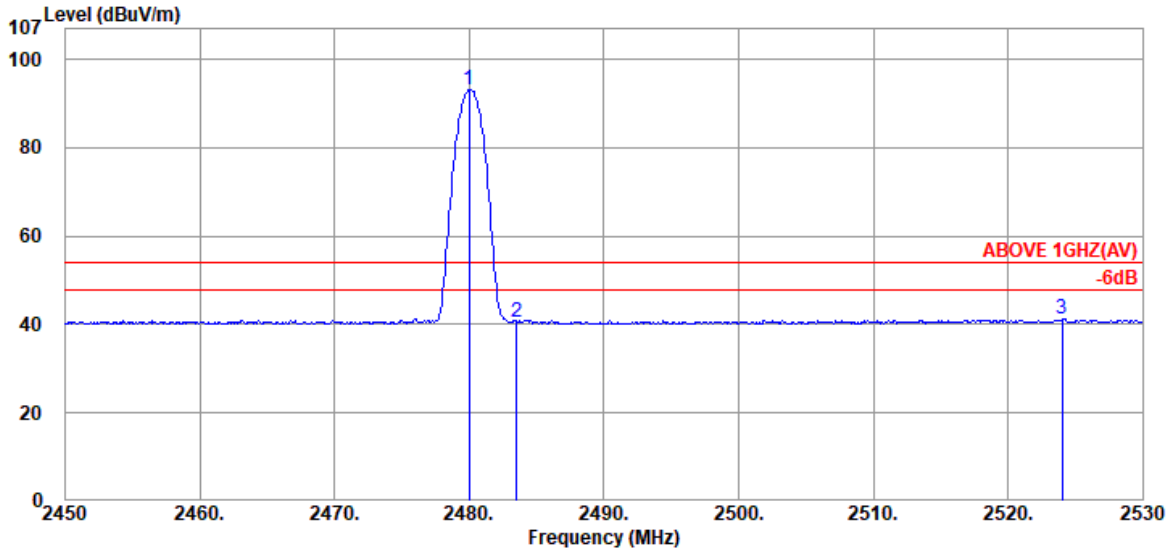
Mode	GFSK	Frequency	TX 2480MHz



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
2479.84	28.38	6.13	58.86	93.37	---	---	Peak
2483.52	28.38	6.13	14.97	49.48	74.00	24.52	Peak
2527.20	28.51	6.19	18.17	52.87	74.00	21.13	Peak



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
2480.00	28.38	6.13	58.69	93.20	---	---	Average
2483.52	28.38	6.13	6.02	40.53	54.00	13.47	Average
2524.00	28.48	6.18	6.53	41.19	54.00	12.81	Average

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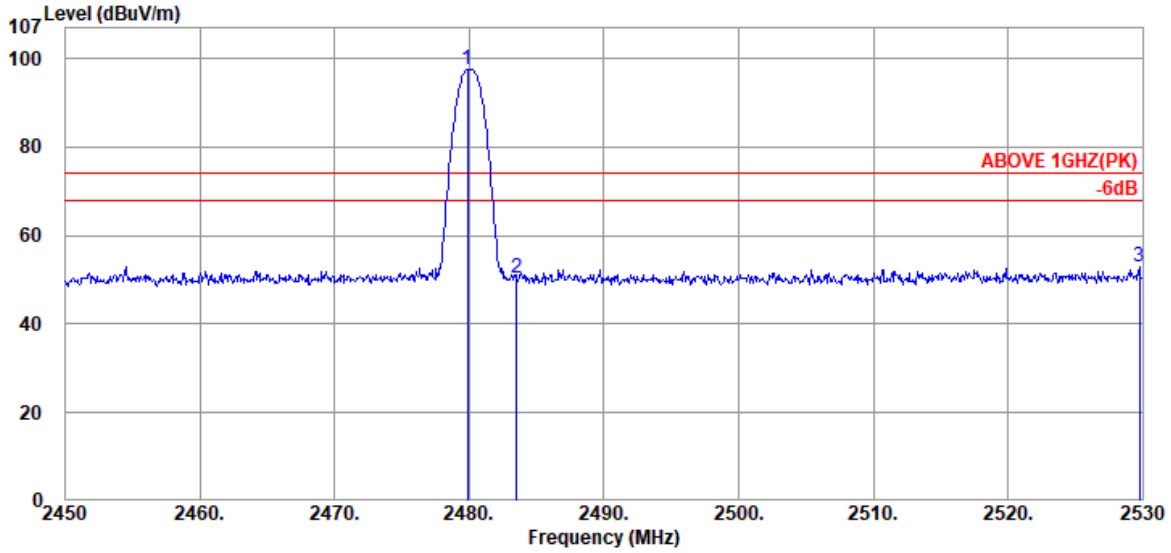
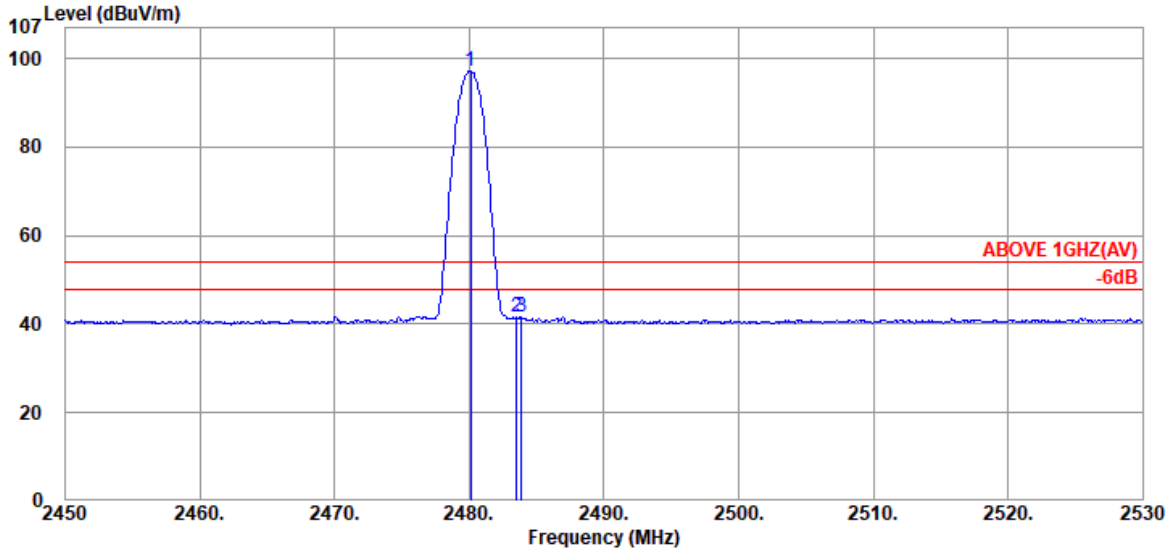
Mode	GFSK	Frequency	TX 2480MHz



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
2479.84	28.38	6.13	62.90	97.41	---	---	Peak
2483.52	28.38	6.13	15.94	50.45	74.00	23.55	Peak
2529.76	28.51	6.19	18.12	52.82	74.00	21.18	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
2480.08	28.38	6.13	62.72	97.23	---	---	Average
2483.52	28.38	6.13	6.96	41.47	54.00	12.53	Average
2483.84	28.38	6.13	7.00	41.51	54.00	12.49	Average

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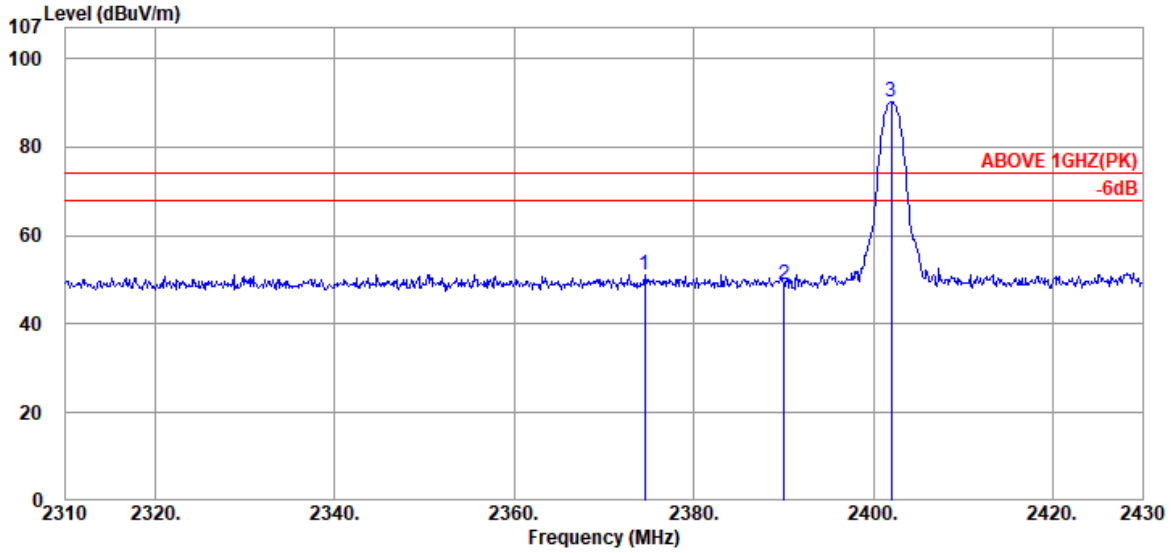
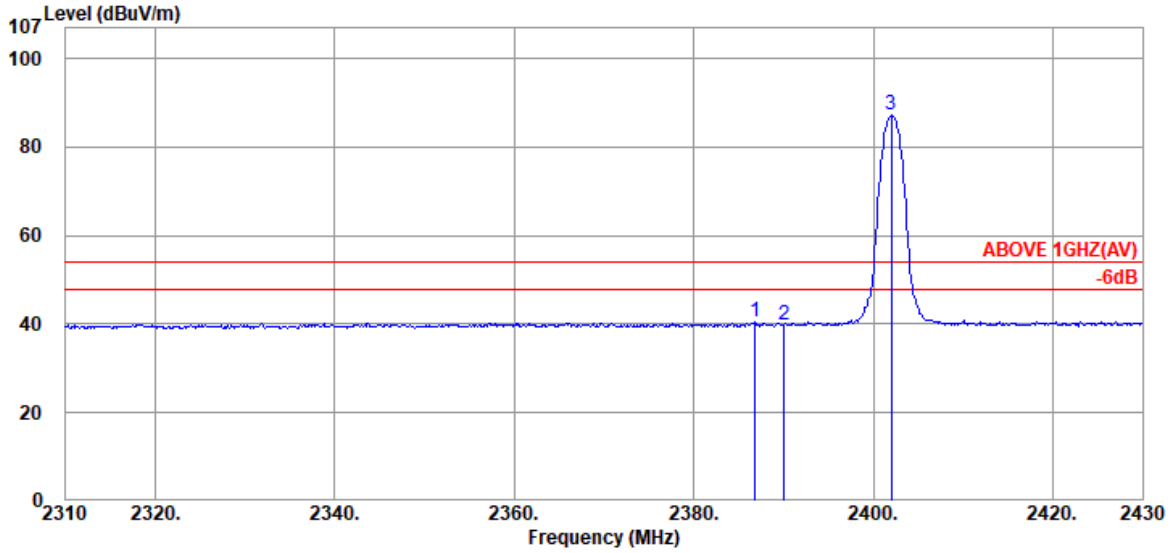
Mode	8-DPSK	Frequency	TX 2402MHz



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
2374.56	28.26	6.01	16.99	51.26	74.00	22.74	Peak
2390.04	28.28	6.03	14.72	49.03	74.00	24.97	Peak
2402.04	28.29	6.04	56.01	90.34	---	---	Peak



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
2386.80	28.28	6.02	6.07	40.37	54.00	13.63	Average
2390.04	28.28	6.03	5.45	39.76	54.00	14.24	Average
2402.04	28.29	6.04	52.80	87.13	---	---	Average

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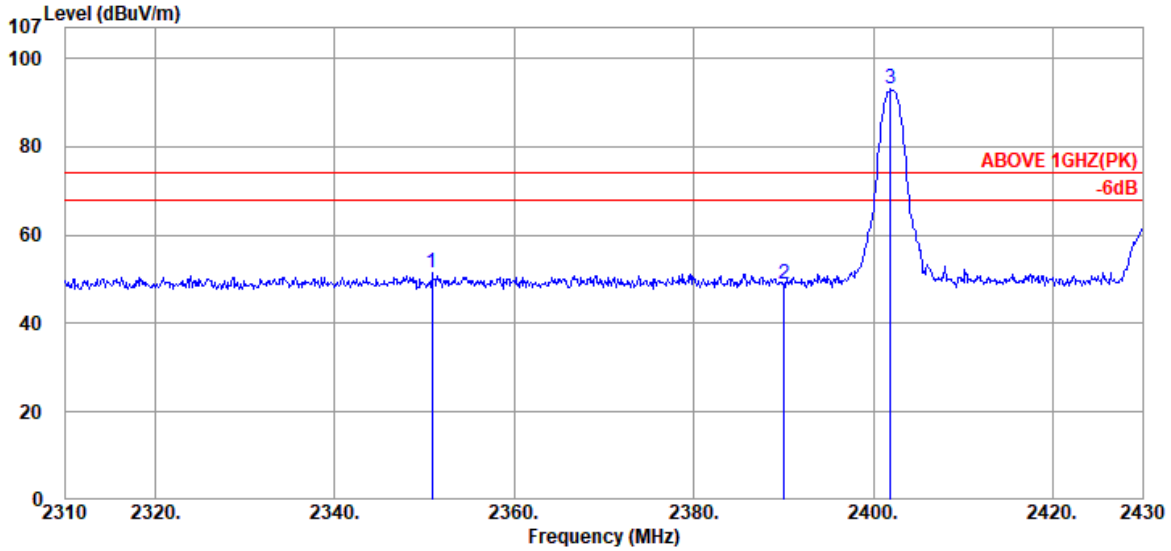
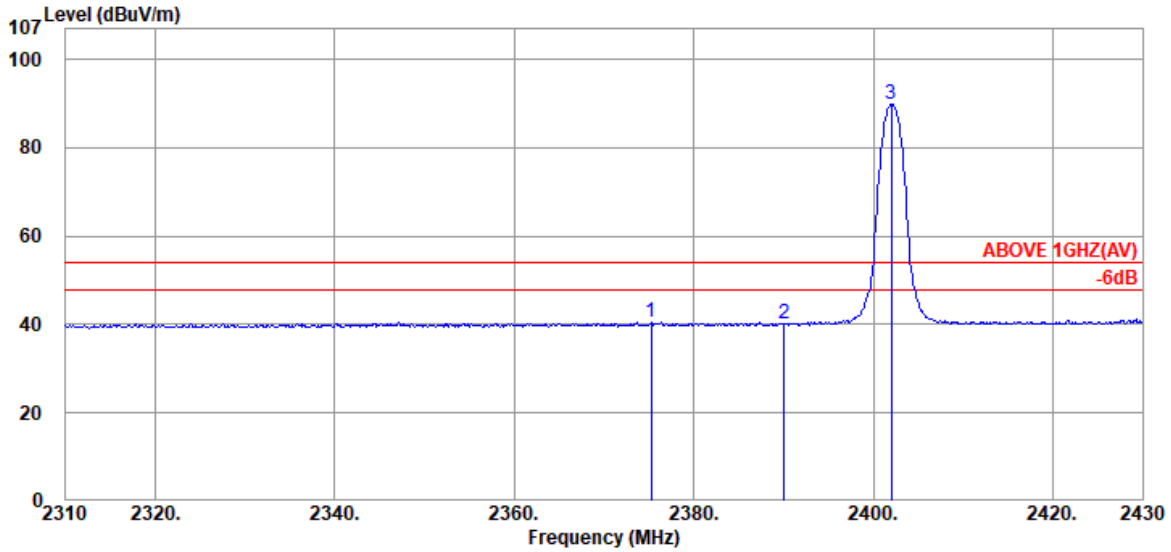
Mode	8-DPSK	Frequency	TX 2402MHz



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
2350.80	28.24	5.98	17.21	51.43	74.00	22.57	Peak
2390.04	28.28	6.03	14.52	48.83	74.00	25.17	Peak
2401.92	28.29	6.04	58.67	93.00	---	---	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
2375.28	28.26	6.01	6.28	40.55	54.00	13.45	Average
2390.04	28.28	6.03	5.68	39.99	54.00	14.01	Average
2402.04	28.29	6.04	55.54	89.87	---	---	Average

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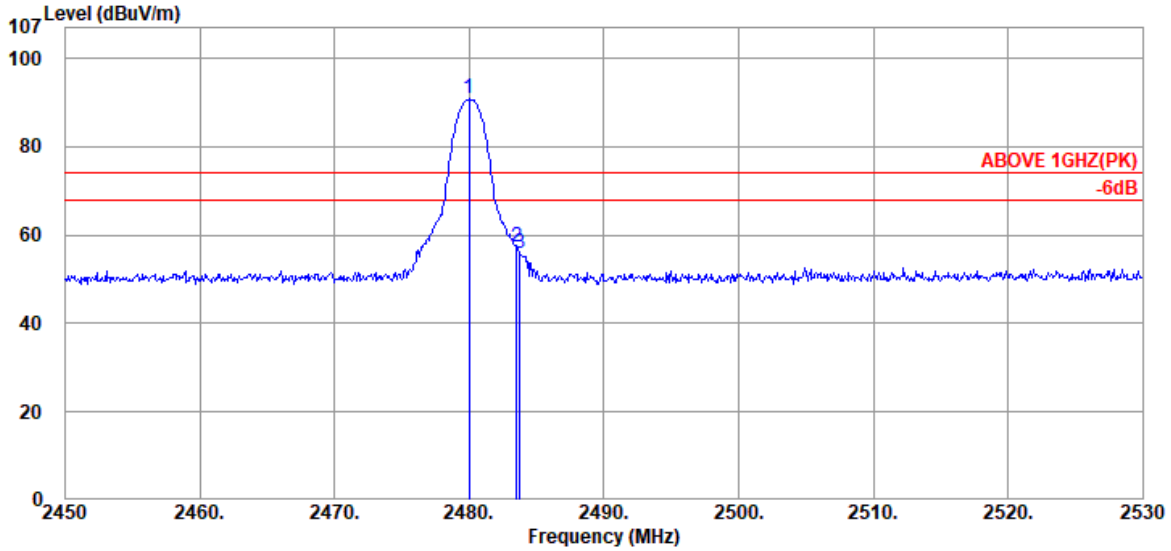
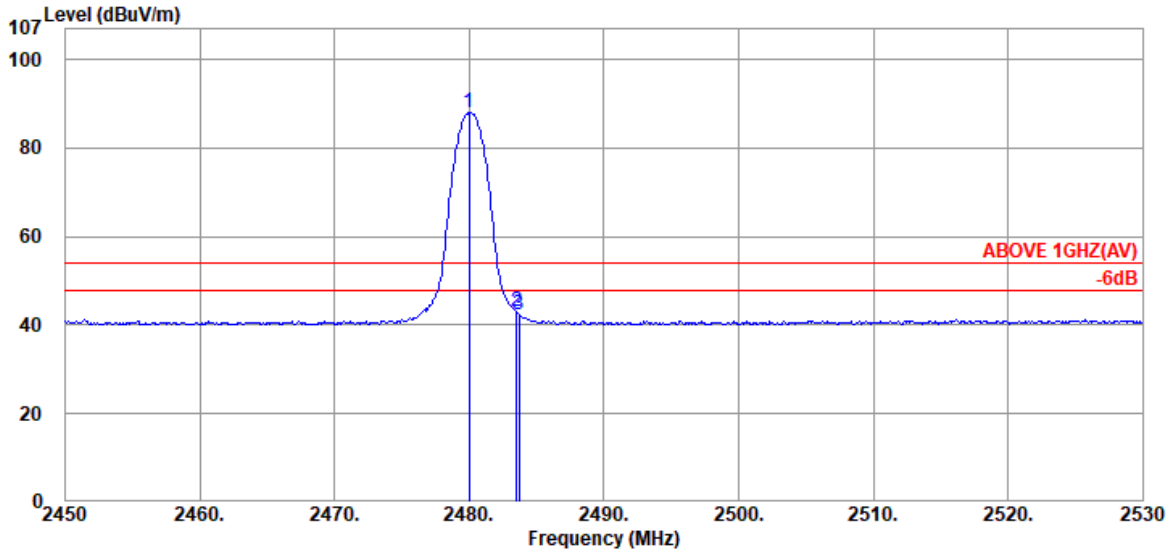
Mode	8-DPSK	Frequency	TX 2480MHz



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
2480.00	28.38	6.13	56.27	90.78	---	---	Peak
2483.52	28.38	6.13	22.78	57.29	74.00	16.71	Peak
2483.76	28.38	6.13	21.44	55.95	74.00	18.05	Peak



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
2480.00	28.38	6.13	53.47	87.98	---	---	Average
2483.52	28.38	6.13	8.58	43.09	54.00	10.91	Average
2483.68	28.38	6.13	7.98	42.49	54.00	11.51	Average

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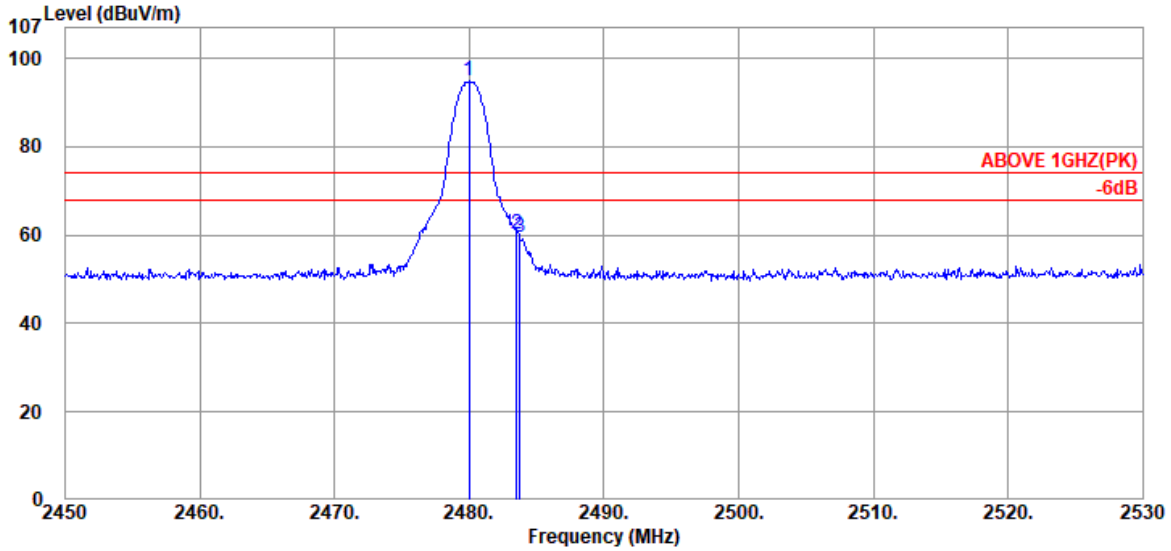
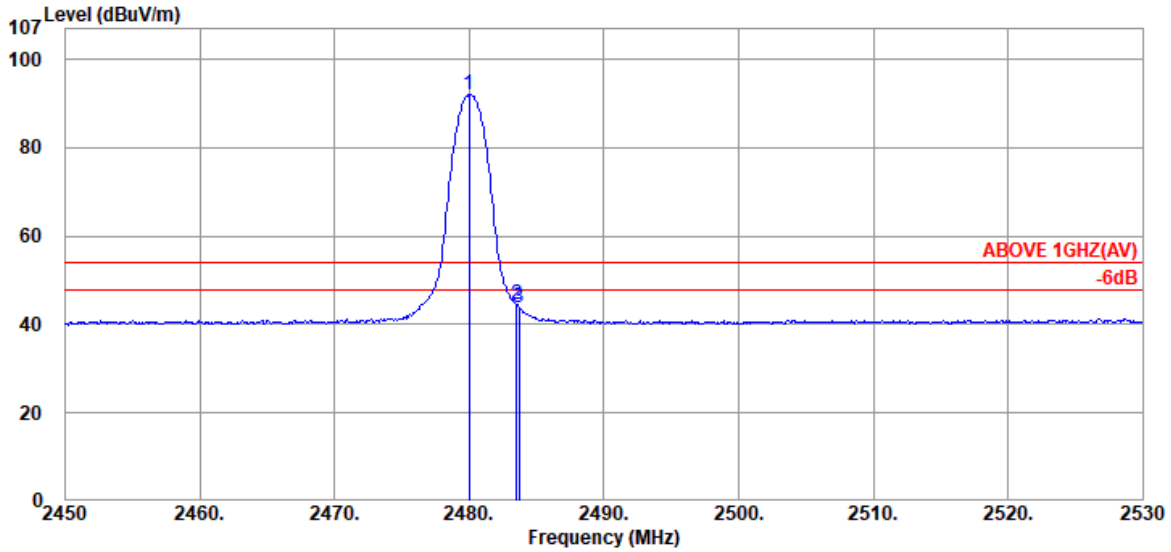
Mode	8-DPSK	Frequency	TX 2480MHz



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
2480.00	28.38	6.13	60.28	94.79	---	---	Peak
2483.52	28.38	6.13	25.87	60.38	74.00	13.62	Peak
2483.76	28.38	6.13	24.97	59.48	74.00	14.52	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
2480.00	28.38	6.13	57.47	91.98	---	---	Average
2483.52	28.38	6.13	10.04	44.55	54.00	9.45	Average
2483.68	28.38	6.13	9.45	43.96	54.00	10.04	Average

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A.2.2 Emissions outside the frequency band:

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

Mode	GFSK	Frequency	TX 2402MHz

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
4804.00	32.82	8.44	4.03	45.29	54.00	8.71	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
4804.00	32.82	8.44	6.55	47.81	54.00	6.19	Peak

Mode	GFSK	Frequency	TX 2441MHz

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
4882.00	32.98	8.52	8.21	49.71	54.00	4.29	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
4882.00	32.98	8.52	10.86	52.36	54.00	1.64	Peak

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Mode	GFSK	Frequency	TX 2480MHz

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
4960.00	33.12	8.60	6.49	48.21	54.00	5.79	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
4960.00	33.12	8.60	8.50	50.22	54.00	3.78	Peak

A.2.3 Emissions in Non-restricted Frequency Bands:

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

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A.3 20dB BANDWIDTH

Test Date	2019/07/30	Temp./Hum.	23℃/55%
Cable Loss	3.69dB	Test Voltage	DC 3.8V (Via Battery)

A.3.1 6dB Bandwidth Result

Mode	Centre Frequency (MHz)	20dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz) (Reference only)	2/3 (20dB Bandwidth)
GFSK	2402	0.9176	0.83369	0.612
	2441	0.9183	0.84058	0.612
	2480	0.9172	0.83294	0.611
8-DPSK	2402	1.264	1.1880	0.843
	2441	1.264	1.1886	0.843
	2480	1.265	1.1857	0.843

Remark: The maximum two-thirds of the 20dB bandwidth is the limit for carrier frequency separation presented.

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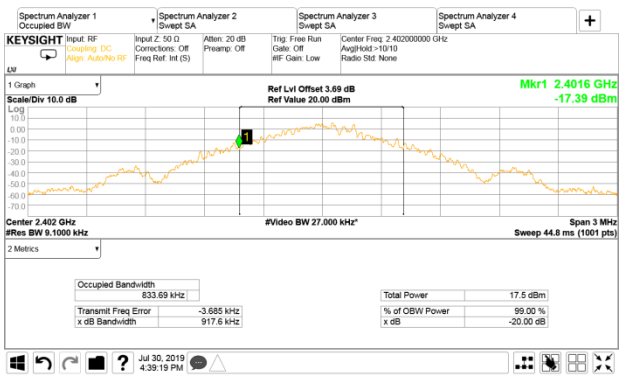
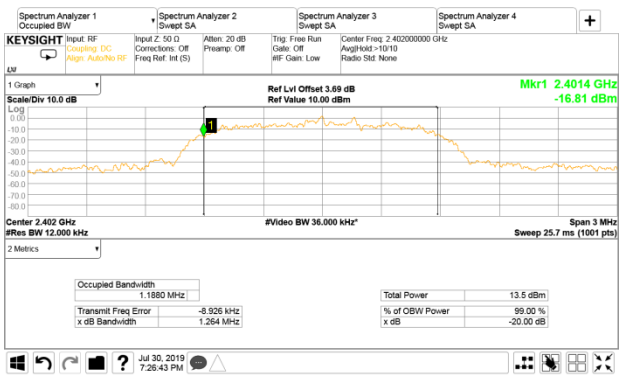
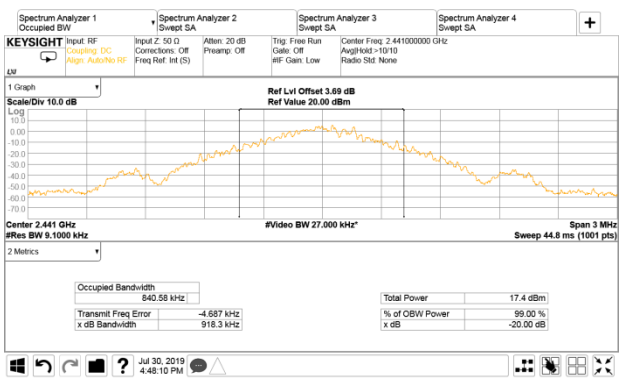
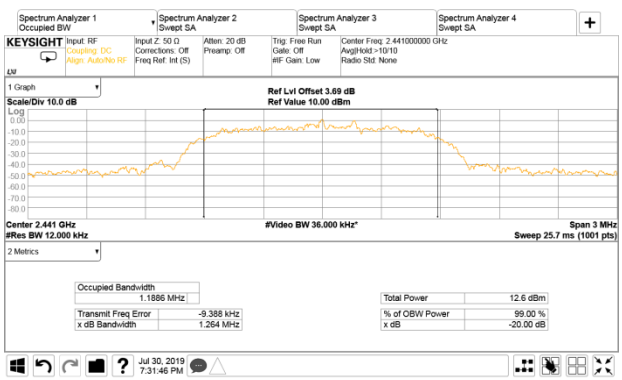
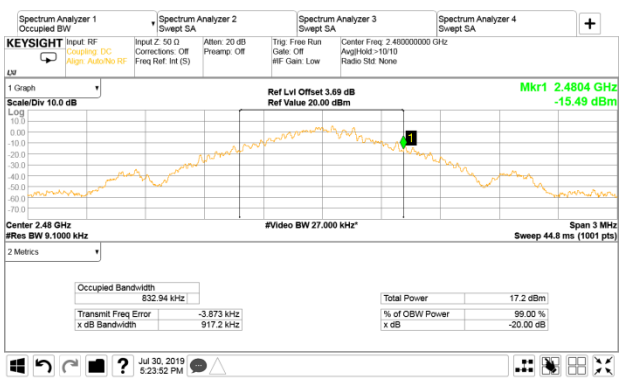
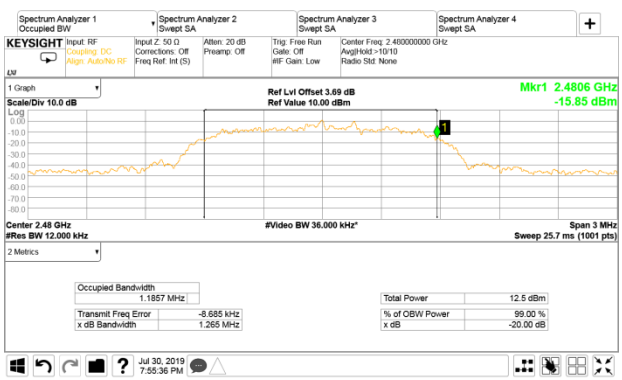
A.3.2 Measurement Plots

Mode: GFSK	Mode: 8-DPSK
	
	
	

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A.4 CARRIER FREQUENCY SEPARATION

Test Date	2019/07/30	Temp./Hum.	23℃/55%
Cable Loss	3.69dB	Test Voltage	DC 3.8V (Via Battery)

A.4.1 Carrier Frequency Separation Result

Mode	Centre Frequency (MHz)		Carrier Frequency Separation (MHz)	Limit (MHz) 2/3 (20dB Bandwidth)
GFSK	2402		0.999	＞0.612
	2441	adjacent channel of right carrier frequency	1.002	
	2441	adjacent channel of left carrier frequency	1.008	
	2480		0.996	

Mode	Centre Frequency (MHz)		Carrier Frequency Separation (MHz)	Limit (MHz) 2/3 (20dB Bandwidth)
8-DPSK	2402		1.017	＞0.843
	2441	adjacent channel of right carrier frequency	0.993	
	2441	adjacent channel of left carrier frequency	1.002	
	2480		1.008	

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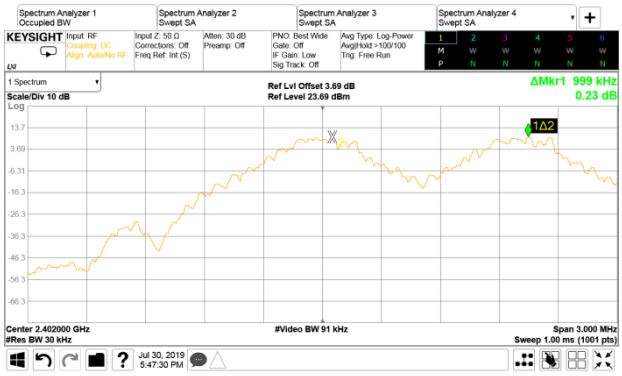
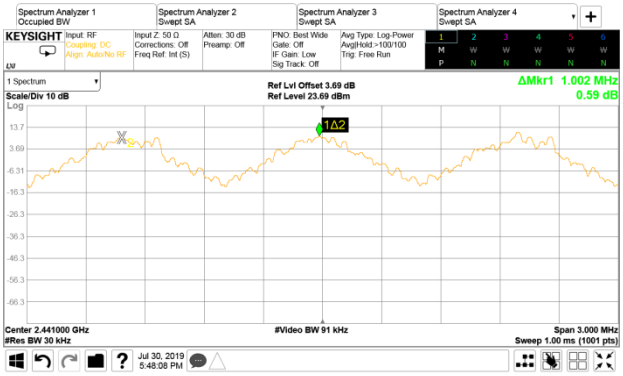
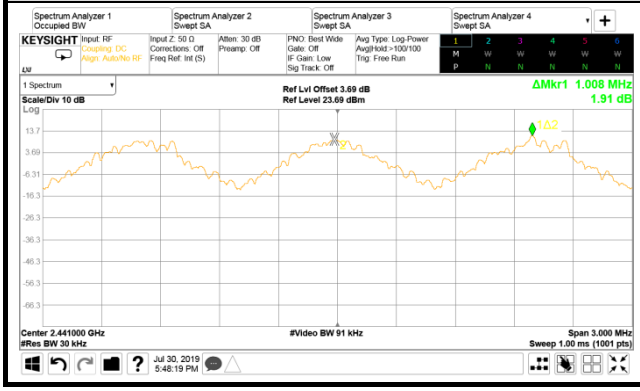
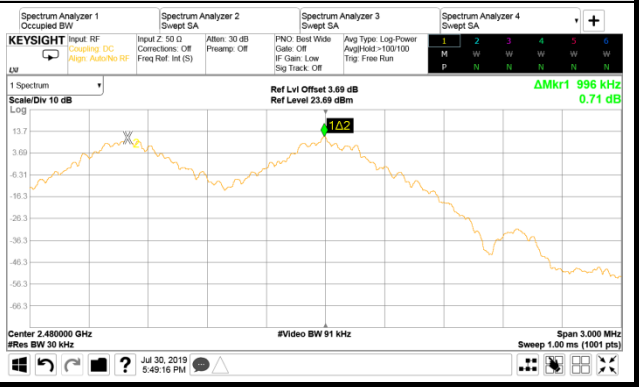
A.4.2 Measurement Plots

Mode: GFSK	
2402MHz	2441MHz adjacent channel of left carrier frequency
	
2441MHz adjacent channel of right carrier frequency	2480MHz
	

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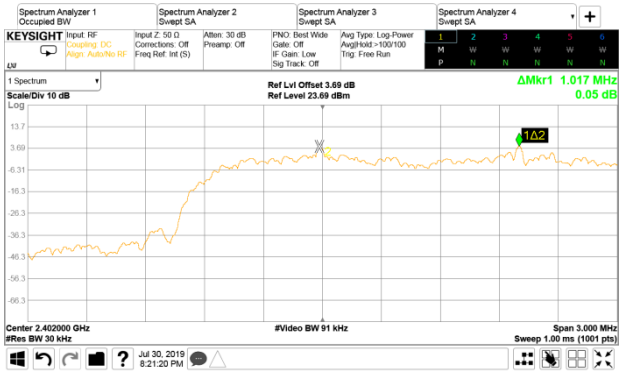
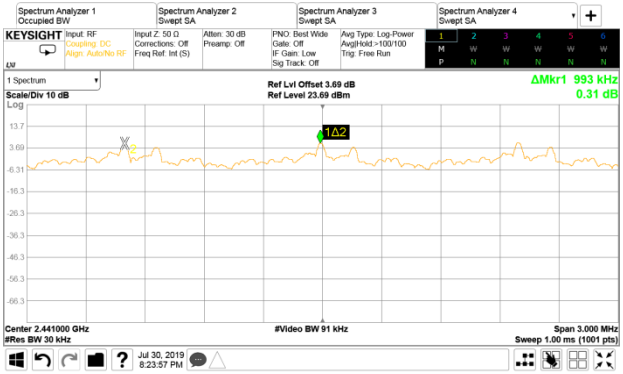
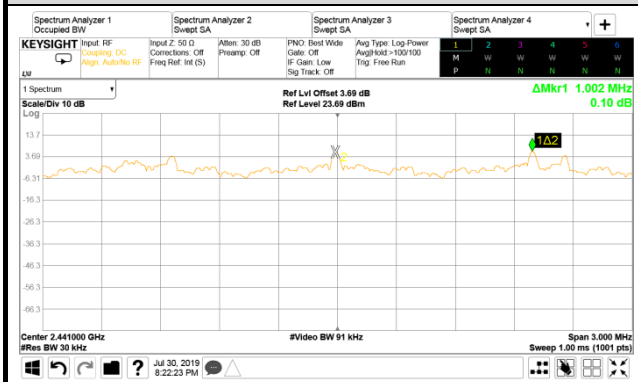
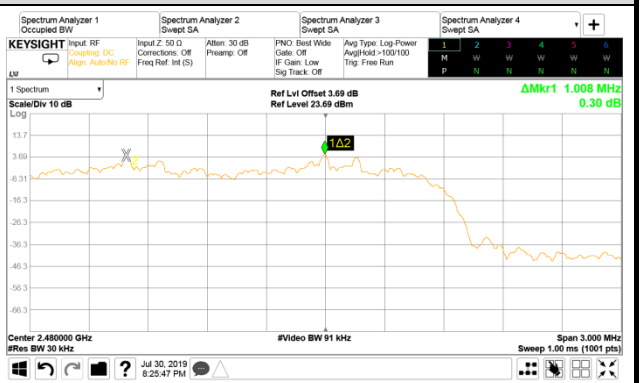
Mode: 8-DPSK	
2402MHz	2441MHz adjacent channel of left carrier frequency
	
2441MHz adjacent channel of right carrier frequency	2480MHz
	

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