

Test Report

Report No.: MTi230306012-02E1

Date of issue: 2023-03-23

Applicant: Shen Zhen Shi Mi Ya Xin Xi Ji Shu You Xian Gong Si

Product: Wireless Earphones

Model(s): Miatone London, JS-U-21, JS-U-21A, JS-U-21B

FCC ID: 2AWG3-JSU21

Shenzhen Microtest Co., Ltd.

<http://www.mtitest.com>

Instructions

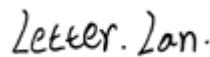
1. This test report shall not be partially reproduced without the written consent of the laboratory.
2. The test results in this test report are only responsible for the samples submitted
3. This test report is invalid without the seal and signature of the laboratory.
4. This test report is invalid if transferred, altered, or tampered with in any form without authorization.
5. Any objection to this test report shall be submitted to the laboratory within 15 days from the date of receipt of the report.

Table of contents

1	General Description	5
1.1	Description of the EUT	5
1.2	Description of test modes	5
1.3	Test conditions	7
1.4	Description of support units	7
2	Measurement uncertainty	8
3	Summary of Test Result.....	9
4	Test Laboratory	10
5	Equipment List	11
6	Test Result	12
6.1	Antenna requirement	12
6.2	AC power line conducted emissions.....	13
6.3	Radiated spurious emission	14
6.4	20dB emission bandwidth	28
6.5	Maximum conducted output power	29
6.6	Carrier frequency separation.....	30
6.7	Time of occupancy.....	31
6.8	Number of hopping channels	32
6.9	Band edge (Conducted)	33
6.10	Conducted spurious emissions	34
	Appendix A: 20dB Emission Bandwidth	35
	Appendix B: Maximum conducted output power.....	40
	Appendix C: Carrier frequency separation	45
	Appendix D: Time of occupancy	48
	Appendix E: Number of hopping channels.....	57
	Appendix F: Band edge measurements.....	60
	Appendix G: Conducted Spurious Emission.....	66
	Photographs of the Test Setup.....	79
	Photographs of the EUT.....	80

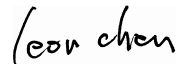
Test Result Certification	
Applicant:	Shen Zhen Shi Mi Ya Xin Xi Ji Shu You Xian Gong Si
Address:	Room 2212 Building A, Huihai Square Chuangye RD, Long Hua New District, Shenzhen, Guangdong Province, China
Manufacturer:	Shenzhen Jsound Technologies Co., Limited
Address:	RM 601, Building 9, No.19, Guanlan Avenue, Xikeng Community, Fucheng Street, Longhua Shenzhen
Factory:	Shenzhen Jsound Technologies Co., Limited
Address:	RM 601, Building 9, No.19, Guanlan Avenue, Xikeng Community, Fucheng Street, Longhua Shenzhen
Product description	
Product name:	Wireless Earphones
Trademark:	MIATONE
Model name:	Miatone London
Series Model:	JS-U-21, JS-U-21A, JS-U-21B
Standards:	FCC 47 CFR Part 15 Subpart C
Test method:	ANSI C63.10-2013
Date of Test	
Date of test:	2023-03-15 ~ 2023-03-23
Test result:	Pass

Test Engineer :



(Letter Lan)

Reviewed By :



(Leon Chen)

Approved By :



(Tom Xue)

1 General Description

1.1 Description of the EUT

Product name:	Wireless Earphones
Model name:	Miatone London
Series Model:	JS-U-21, JS-U-21A, JS-U-21B
Model difference:	All the models are the same circuit and module, except the model name.
Electrical rating:	Input: DC 5V/500mA Battery: Bluetooth earphone: DC 3.7V 40mAh 0.148Wh
Hardware version:	JS-U-21 H.W.V5
Software version:	JS-U-21 S.W.V1.1
Accessories:	N/A
Test sample(s) number:	MTi230306012-02S1001
RF specification:	
Bluetooth version:	V5.3
Operation frequency:	2402 MHz ~ 2480 MHz
Modulation type:	GFSK, $\pi/4$ -DQPSK
Antenna(s) information:	Antenna type: Ceramic antenna Antenna gain: 2.25 dBi
Maximum conducted output power:	5.52 dBm

1.2 Description of test modes

1.2.1 Operation channel list

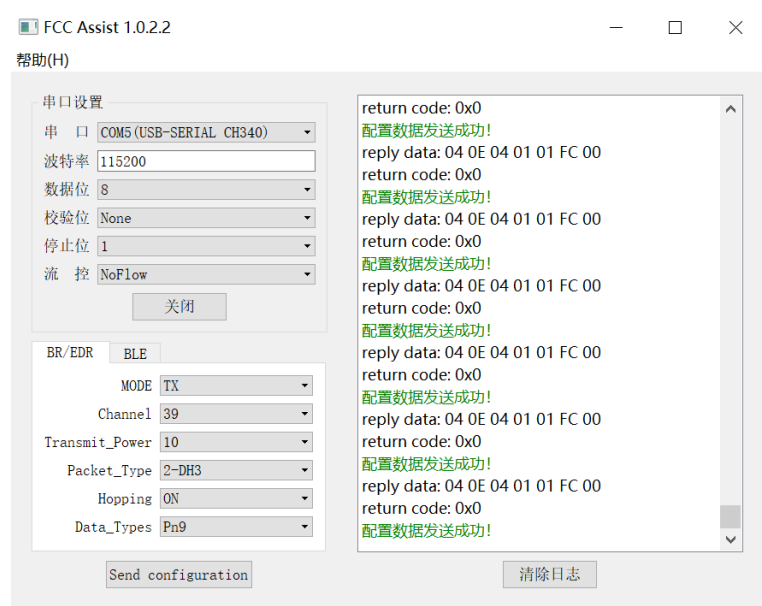
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2422	40	2442	60	2462
1	2403	21	2423	41	2443	61	2463
2	2404	22	2424	42	2444	62	2464
3	2405	23	2425	43	2445	63	2465
4	2406	24	2426	44	2446	64	2466
5	2407	25	2427	45	2447	65	2467
6	2408	26	2428	46	2448	66	2468
7	2409	27	2429	47	2449	67	2469
8	2410	28	2430	48	2450	68	2470
9	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
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	-	-

Note: The test software provided by manufacturer is used to control EUT for working in engineering mode, that enables selectable channel, and capable of continuous transmitting mode.

Mode	Test Software	Antenna	FCC Assist1.0.2.2		
	Channel		2402MHz	2441MHz	2480MHz
GFSK	Power setting	Right/Left	10	10	10
$\pi/4$ -DQPSK		Right/Left	10	10	10

The test software:



1.3 Test conditions

Environment of test site:

Temperature:	15°C~35°C
Humidity:	20 % RH ~ 75 % RH

1.4 Description of support units

Support equipment list			
Description	Model	Serial No.	Manufacturer
/	/	/	/
Support cable list			
Description	Length (m)	From	To
/	/	/	/

2 Measurement uncertainty

Parameter	Measurement uncertainty
AC power line conducted emission (9 kHz~30 MHz)	± 2.5 dB
Occupied Bandwidth	± 3 %
Conducted RF output power	± 0.16 dB
Conducted spurious emissions	± 0.21 dB
Radiated emission (9 kHz ~ 30 MHz)	± 4.0 dB
Radiated emission (30 MHz~1 GHz)	± 4.2 dB
Radiated emission (above 1 GHz)	± 4.3 dB

Note: the measurement uncertainty is calculated and correspond to a factor $k = 2$ (which provide confidence levels of 95.45 %)

3 Summary of Test Result

No.	FCC reference	Description of test	Result
1	§ 15.203	Antenna requirement	Pass
2	§ 15.207	AC power line conducted emissions	N/A
3	§ 15.247(d), 15.209, 15.205	Radiated spurious emissions	Pass
4	§ 15.247(a)(1)	20dB emission bandwidth	Pass
5	§ 15.247(b)(1)	Maximum conducted output power	Pass
6	§ 15.247(a)(1)	Carrier Frequencies Separation	Pass
7	§ 15.247(a)(1)	Time of occupancy	Pass
8	§ 15.247(a)(1)	Number of hopping channels	Pass
9	§ 15.247(d)	Band edge (Conducted)	Pass
10	§ 15.247(d)	Conducted spurious emissions	Pass

Notes:

N/A means not applicable.

Since the EUT cannot be operating while charging, therefore AC power line conducted emissions test is not required.

4 Test Laboratory

Test laboratory:	Shenzhen Microtest Co., Ltd.
Test site location:	101, No.7, Zone 2, Xinxing Industrial Park, Fuhai Avenue, Xinhe Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China
Telephone:	(86-755)88850135
Fax:	(86-755)88850136
CNAS Registration No.:	CNAS L5868
FCC Registration No.:	448573

5 Equipment List

No.	Equipment	Manufacturer	Model	Serial No.	Cal. date	Cal. Due
MTi-E002	EMI Test Receiver	R&S	ESCI3	101368	2022/05/05	2023/05/04
MTi-E023	Artificial power network	Schwarzbeck	NSLK8127	NSLK8127#841	2022/05/05	2023/05/04
MTi-E025	Artificial power network	Schwarzbeck	NSLK8127	8127183	2022/05/05	2023/05/04
MTi-E043	EMI test receiver	R&S	ESCI7	101166	2022/05/05	2023/05/04
MTi-E046	Active Loop Antenna	Schwarzbeck	FMZB 1519 B	00044	2021/05/30	2023/05/29
MTi-E044	Broadband antenna	Schwarzbeck	VULB9163	9163-1338	2021/05/30	2023/05/29
MTi-E045	Horn antenna	Schwarzbeck	BBHA9120D	9120D-2278	2021/05/30	2023/05/29
MTi-E047	Pre-amplifier	Hewlett-Packard	8447F	3113A06184	2022/05/05	2023/05/04
MTi-E048	Pre-amplifier	Agilent	8449B	3008A01120	2022/05/05	2023/05/04
MTi-E120	Broadband antenna	Schwarzbeck	VULB9163	9163-1419	2021/05/30	2023/05/29
MTi-E121	Pre-amplifier	Hewlett-Packard	8447D	2944A09365	2022/04/15	2023/04/14
MTi-E123	Pre-amplifier	Agilent	8449B	3008A04723	2022/05/05	2023/05/04
MTi-E135	Horn antenna	Schwarzbeck	BBHA 9170	00987	2021/05/30	2023/05/29
MTi-E136	Pre-amplifier	Space-Dtronics	EWLAN1840G-G45	210405001	2022/05/05	2023/05/04
MTi-E062	PXA Signal Analyzer	Agilent	N9030A	MY51350296	2022/05/05	2023/05/04
MTi-E067	RF Control Unit	Tonscend	JS0806-1	19D8060152	2022/05/05	2023/05/04
MTi-E068	RF Control Unit	Tonscend	JS0806-2	19D8060153	2022/05/05	2023/05/04
MTi-E069	Band Reject Filter Group	Tonscend	JS0806-F	19D8060160	2022/05/05	2023/05/04
MTi-E010S	EMI Measurement Software	Farad	EZ-EMC Ver. EMEC-3A1	/	/	/
MTi-E014S	RF Test System	Tonscend	TS®JS1120 V2.6.88.0330	/	/	/

Note: the calibration interval of the test equipment is 12 or 24 months and the calibrations are traceable to international system unit(SI)

6 Test Result

6.1 Antenna requirement

§ 15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§15.211, 15.213, 15.217, 15.219, 15.221, or §15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

Description of the antenna of EUT

The antenna of the EUT is permanently attached.

Conclusion:

The EUT complies with the requirement of § 15.203.

6.2 AC power line conducted emissions

6.2.1 Limits

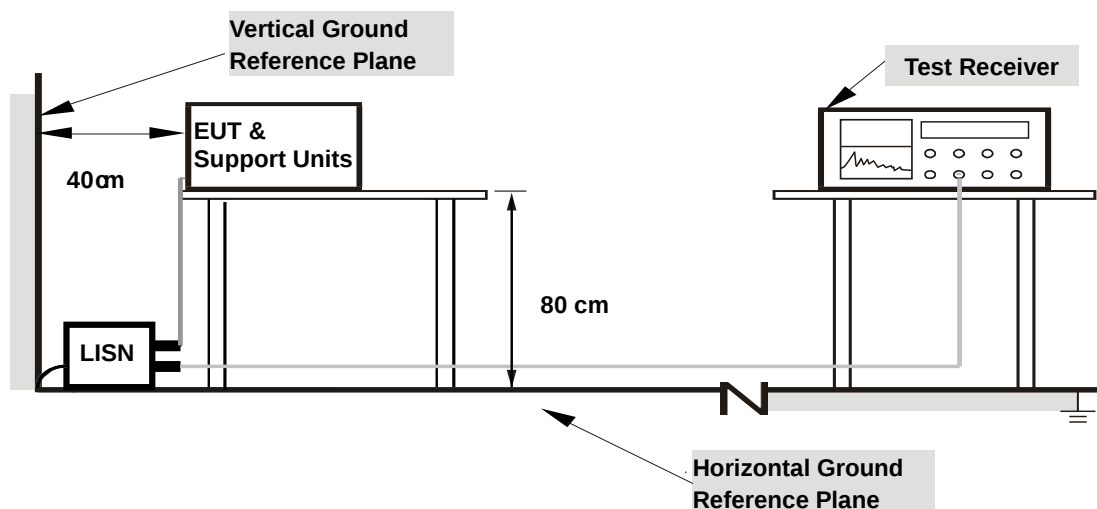
Frequency (MHz)	Detector type / Bandwidth	Limit-Quasi-peak dB μ V	Limit-Average dB μ V
0.15 -0.5	Average / 9 kHz	66 to 56	56 to 46
0.5 -5		56	46
5 -30		60	50

Note 1: the limit decreases with the logarithm of the frequency in the range of 0.15 MHz to 0.5 MHz.

6.2.2 Test Procedures

- Test method: ANSI C63.10-2013 Section 6.2.
- The EUT is connected to the main power through a line impedance stabilization network (LISN). All support equipment is powered from additional LISN(s).
- Emissions were measured on each current carrying line of the EUT using an EMI test receiver connected to the LISN powering the EUT.
- The test receiver scanned from 150 kHz to 30 MHz for emissions in each of the test modes described in Item 1.2.
- The test data of the worst-case condition(s) was recorded.

6.2.3 Test setup



For the actual test configuration, please refer to the related item – Photographs of the test setup.

6.2.4 Test Result

Notes:

Since the EUT cannot be operating while charging, therefore AC power line conducted emissions test is not required.

All modes of operation of the EUT were investigated, and only the worst-case results are reported.

Calculation formula:

Measurement (dB μ V) = Reading Level (dB μ V) + Correct Factor (dB)

Over (dB) = Measurement (dB μ V) – Limit (dB μ V)

6.3 Radiated spurious emission

6.3.1 Limits

§ 15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

§ 15.209 Radiated emission limits; general requirements.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Note 1: the tighter limit applies at the band edges.

Note 2: the emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector

§ 15.35 (b) requirements:

When average radiated emission measurements are specified in this part, including average emission measurements below 1000 MHz, there also is a limit on the peak level of the radio frequency emissions. Unless otherwise specified, e.g., see §§ 15.250, 15.252, 15.253(d), 15.255, 15.256, and 15.509 through 15.519, the limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test.

According to ANSI C63.10-2013, the tests shall be performed in the frequency range shown in the following table:

Frequency range of measurements for unlicensed wireless device

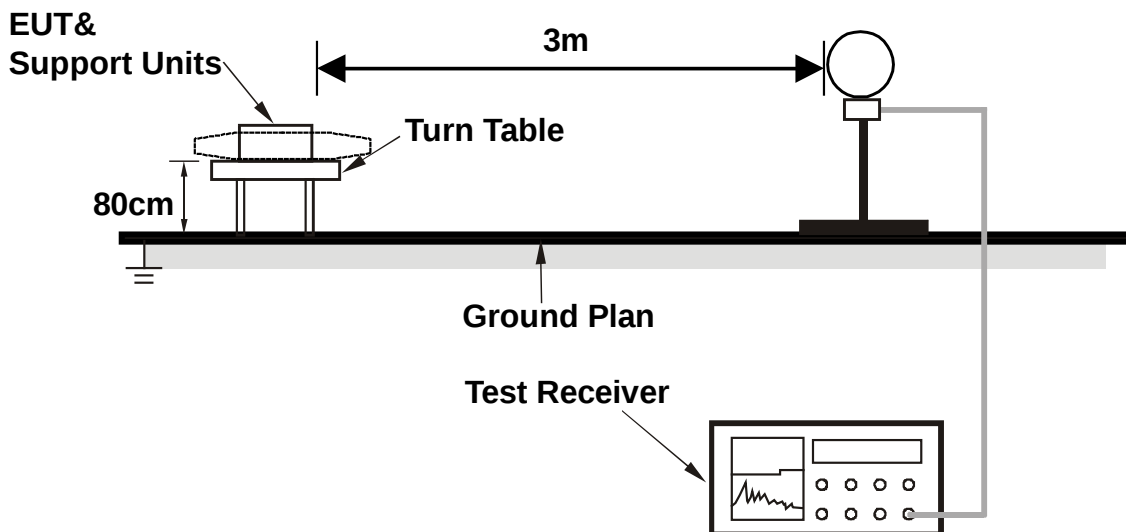
Lowest frequency generated in the device	Upper frequency range of measurement
9 kHz to below 10 GHz	10th harmonic of highest fundamental frequency or to 40 GHz, whichever is lower
At or above 10 GHz to below 30 GHz	5th harmonic of highest fundamental frequency or to 100 GHz, whichever is lower
At or above 30 GHz	5th harmonic of highest fundamental frequency or to 200 GHz, whichever is lower, unless otherwise specified

Frequency range of measurements for unlicensed wireless device with digital device

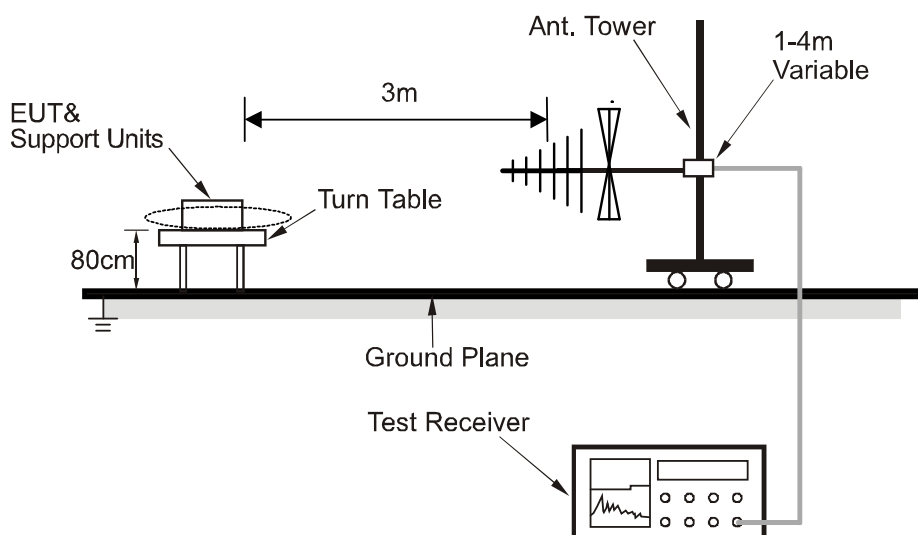
Highest frequency generated or used in the device or on which the device operates or tunes	Upper frequency range of measurement
Below 1.705 MHz	30 MHz
1.705 MHz to 108 MHz	1000 MHz
108 MHz to 500 MHz	2000 MHz
500 MHz to 1000 MHz	5000 MHz
Above 1000 MHz	5th harmonic of the highest frequency or 40 GHz, whichever is lower

6.3.2 Test setup

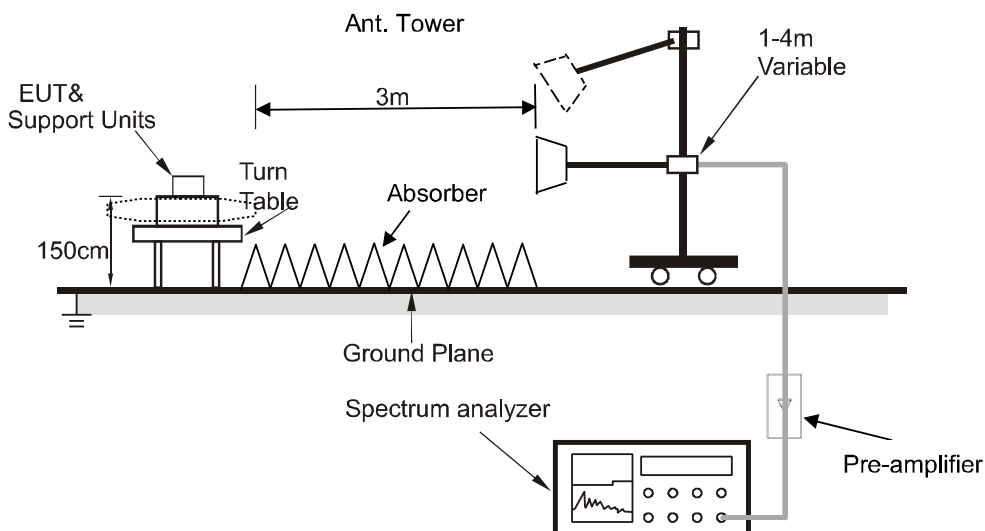
Below 30MHz



30MHz~1GHz



Above 1GHz



For the actual test configuration, please refer to the related item – Photographs of the test setup.

6.3.3 Test procedure

- a) Test method: ANSI C63.10-2013 Section 6.3, 6.4, 6.5, 6.6, 6.10.
- b) The EUT is placed on an on-conducting table 0.8 meters above the ground plane for measurement below 1GHz, 1.5 meters above the ground plane for measurement above 1GHz.
- c) Emission below 18 GHz were measured at a 3 meters test distance, above 18 GHz were measured at 1-meter test distance with the application of a distance correction factor
- d) The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

KDB 558074 D01 15.247 Meas Guidance v05r02

The use of a duty cycle correction factor (DCCF) is permitted for calculating average radiated field strength emission levels for an FHSS device in 15.247. This DCCF can be applied when the unwanted emission limit is subject to an average field strength limit (e.g., within a Government Restricted band) and the conditions specified in Section 15.35(c) can be satisfied. The average radiated field strength is calculated by subtracting the DCCF from the maximum radiated field strength level as determined through measurement. The maximum radiated field strength level represents the worst-case (maximum amplitude) RMS measurement of the emission(s) during continuous transmission (i.e., not including any time intervals during which the transmitter is off or is transmitting at a reduced power level). It is also acceptable to apply the DCCF to a measurement performed with a peak detector instead of the specified RMS power averaging detector. Note that Section 15.35(c) specifies that the DCCF shall represent the worst-case (greatest duty cycle) over any 100 msec transmission period.

Test instrument setup

Frequency	Test receiver / Spectrum analyzer setting
9 kHz ~ 150 kHz	Quasi Peak / RBW: 200 Hz
150 kHz ~ 30 MHz	Quasi Peak / RBW: 9 kHz
30 MHz ~ 1 GHz	Quasi Peak / RBW: 120 kHz
Above 1 GHz	Peak / RBW: 1 MHz, VBW: 3MHz, Peak detector AVG / RBW: 1 MHz, VBW: 1/T, Peak detector

6.3.4 Test results

Notes:

The amplitude of spurious emissions which are attenuated more than 20 dB below the limits are not reported.

All modes of operation of the EUT were investigated, and only the worst-case results are reported.

There were no emissions found below 30MHz within 20dB of the limit.

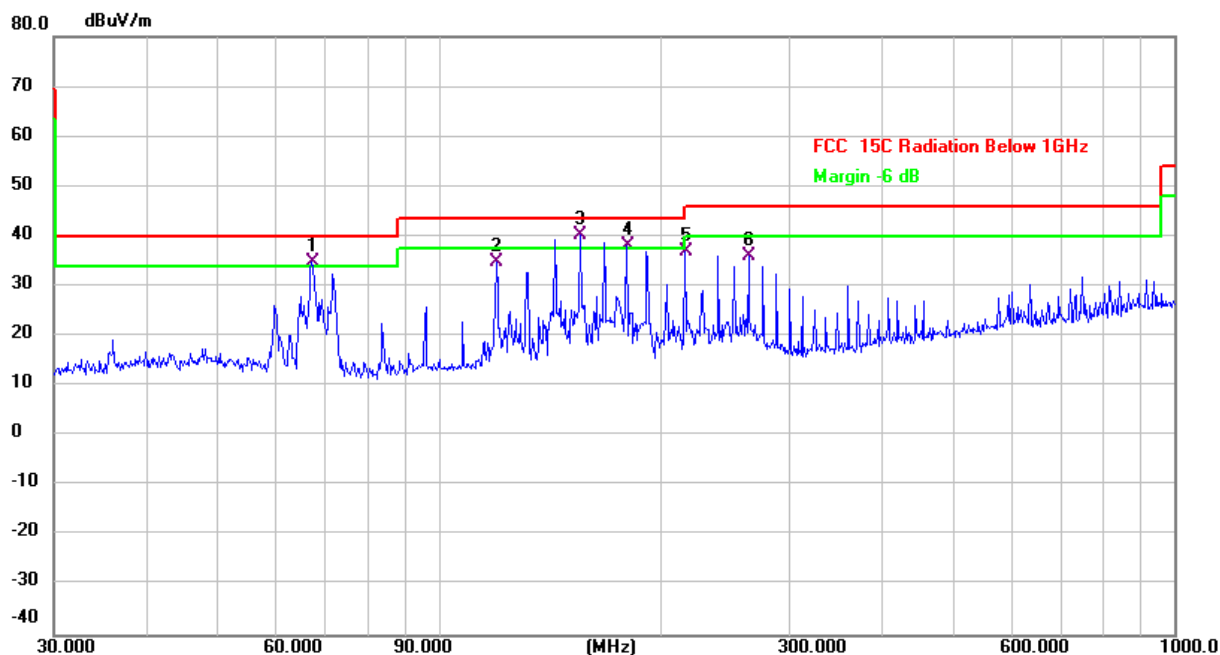
Calculation formula:

Measurement (dB μ V/m) = Reading Level (dB μ V) + Correct Factor (dB/m)

Over (dB) = Measurement (dB μ V/m) – Limit (dB μ V/m)

Radiated emissions between 30MHz – 1GHz
Right earphone:

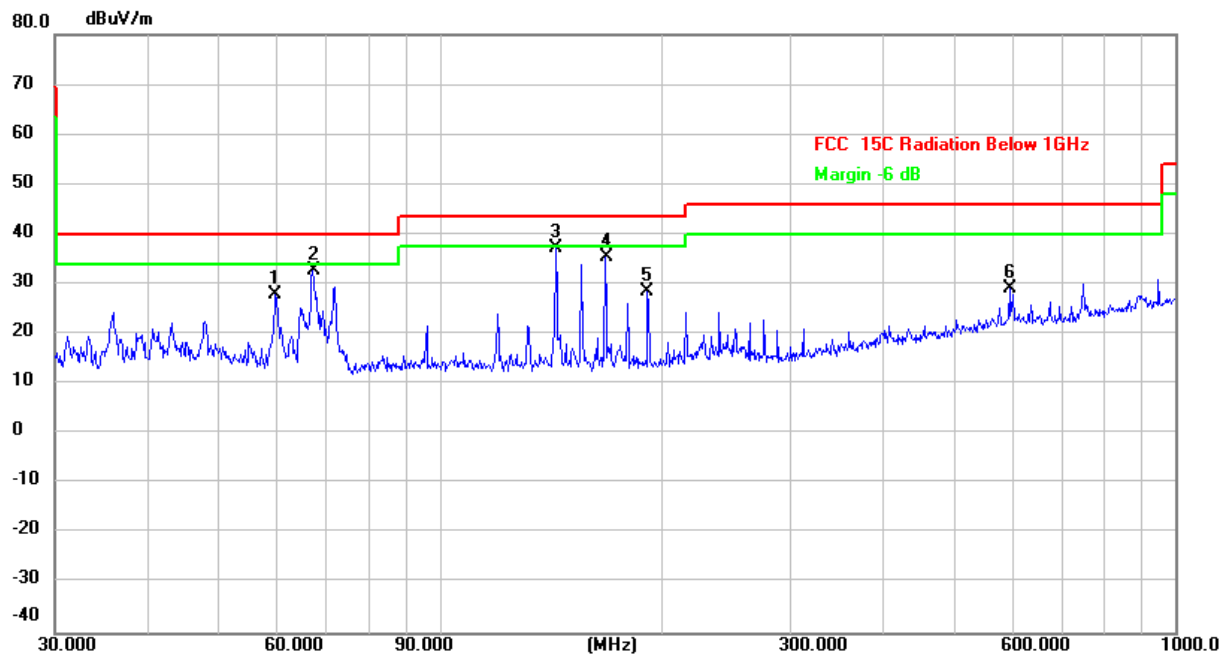
Test mode:	TX DH5-2480	Polarization:	Horizontal
Power supply:	DC 3.7V	Test site:	RE chamber 2



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1	!	67.2022	46.40	-11.51	34.89	40.00	-5.11	QP
2		119.8556	47.15	-12.20	34.95	43.50	-8.55	QP
3	*	155.9101	52.38	-12.09	40.29	43.50	-3.21	QP
4	!	180.0165	49.14	-10.98	38.16	43.50	-5.34	QP
5		216.0240	46.36	-9.40	36.96	46.00	-9.04	QP
6		263.8190	44.17	-8.00	36.17	46.00	-9.83	QP

Radiated emissions between 30MHz – 1GHz

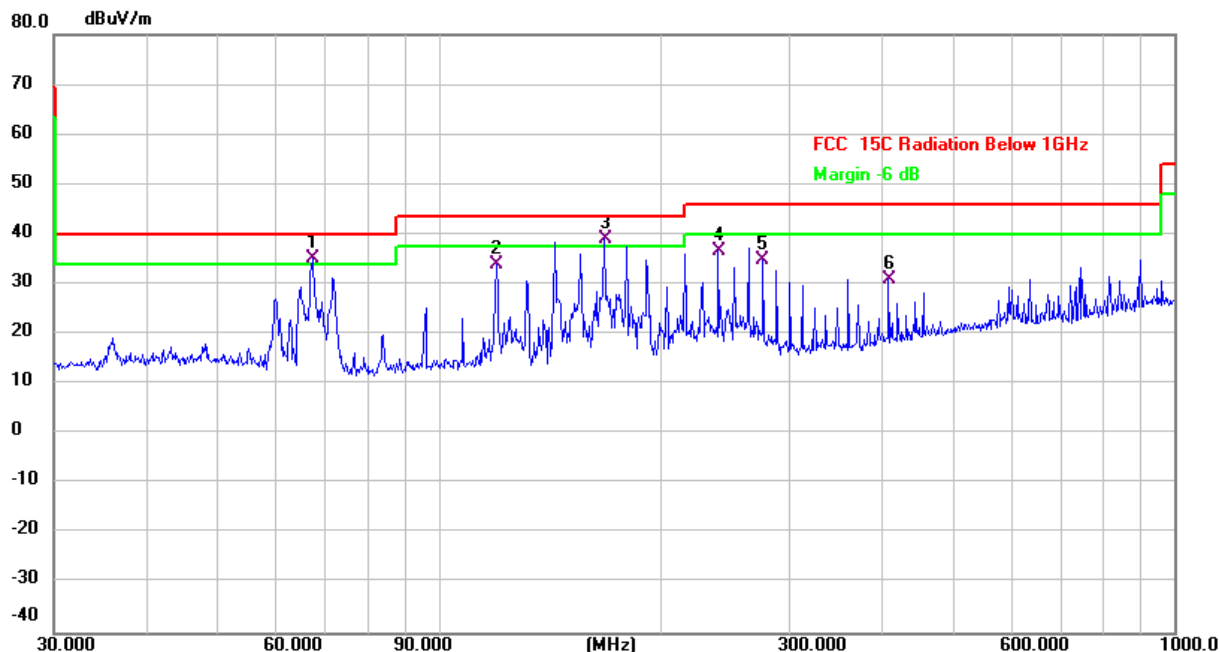
Test mode:	TX DH5-2480	Polarization:	Vertical
Power supply:	DC 3.7V	Test site:	RE chamber



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		59.8588	39.21	-11.19	28.02	40.00	-11.98	QP
2		67.2022	44.37	-11.51	32.86	40.00	-7.14	QP
3	*	143.8295	50.04	-12.71	37.33	43.50	-6.17	QP
4		167.8243	47.11	-11.72	35.39	43.50	-8.11	QP
5		191.7450	39.05	-10.52	28.53	43.50	-14.97	QP
6		595.1329	31.85	-2.72	29.13	46.00	-16.87	QP

Left earphone:

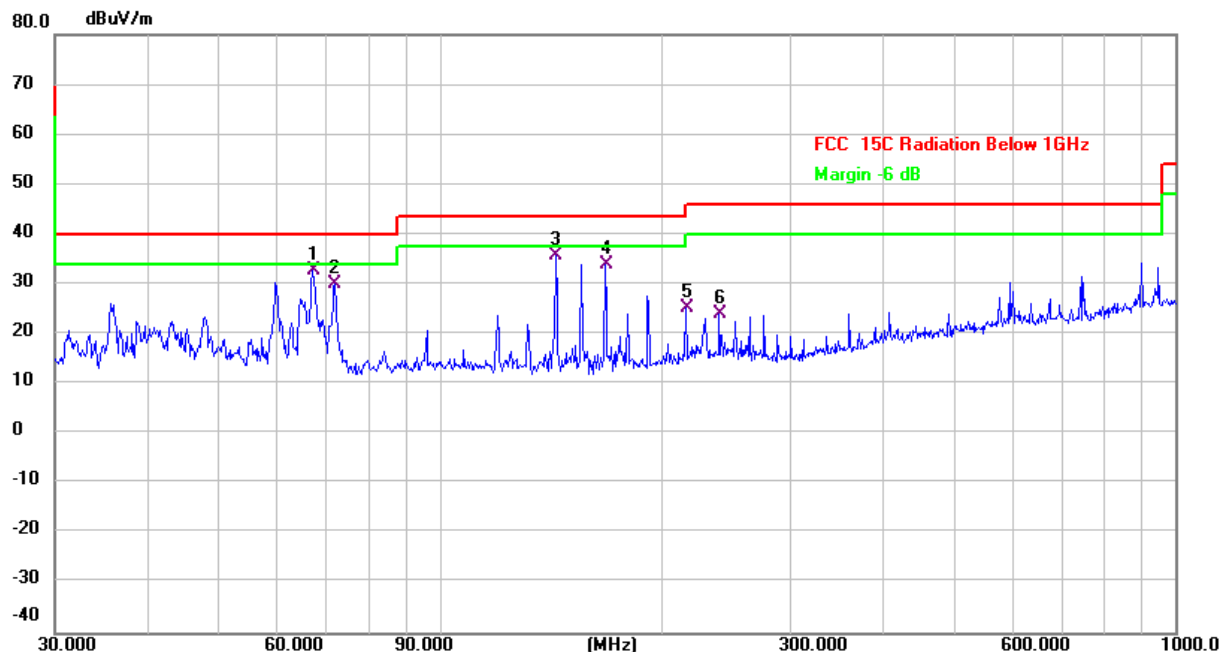
Test mode:	TX DH5-2480	Polarization:	Horizontal
Power supply:	DC 3.7V	Test site:	RE chamber 2



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1	!	67.4382	46.56	-11.51	35.05	40.00	-4.95	QP
2		119.8556	46.13	-12.20	33.93	43.50	-9.57	QP
3	*	167.8243	50.89	-11.72	39.17	43.50	-4.33	QP
4		239.9874	45.23	-8.53	36.70	46.00	-9.30	QP
5		276.1235	42.64	-7.92	34.72	46.00	-11.28	QP
6		408.9460	37.54	-6.54	31.00	46.00	-15.00	QP

Radiated emissions between 30MHz – 1GHz

Test mode:	TX DH5-2480	Polarization:	Vertical
Power supply:	DC 3.7V	Test site:	RE chamber



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1	*	67.2022	44.29	-11.51	32.78	40.00	-7.22	QP
2		72.0843	41.57	-11.64	29.93	40.00	-10.07	QP
3		143.8295	48.54	-12.71	35.83	43.50	-7.67	QP
4		167.8243	45.63	-11.72	33.91	43.50	-9.59	QP
5		216.0240	34.79	-9.40	25.39	46.00	-20.61	QP
6		239.9874	32.44	-8.53	23.91	46.00	-22.09	QP

Right earphone:
Radiated emissions 1 GHz ~ 25 GHz

Frequency	Reading Level	Correct Factor	Measurement	Limits	Over	Detector	Polarization
(MHz)	(dBμV)	(dB/m)	(dBμV/m)	(dBμV/m)	(dB)	Peak/AVG	H/V
GFSK - 2402 MHz TX mode							
4804.000	42.63	0.74	43.37	74.00	-30.63	Peak	V
4804.000	35.05	0.74	35.79	54.00	-18.21	AVG	V
7206.000	41.06	6.02	47.08	74.00	-26.92	Peak	V
7206.000	34.83	6.02	40.85	54.00	-13.15	AVG	V
9608.000	41.29	5.88	47.17	74.00	-26.83	Peak	V
9608.000	35.13	5.88	41.01	54.00	-12.99	AVG	V
4804.000	53.23	0.74	53.97	74.00	-20.03	Peak	H
4804.000	43.25	0.74	43.99	54.00	-10.01	AVG	H
7206.000	40.47	6.02	46.49	74.00	-27.51	Peak	H
7206.000	34.36	6.02	40.38	54.00	-13.62	AVG	H
9608.000	41.95	5.88	47.83	74.00	-26.17	Peak	H
9608.000	35.86	5.88	41.74	54.00	-12.26	AVG	H
GFSK - 2441 MHz TX mode							
4882.000	44.32	1.05	45.37	74.00	-28.63	Peak	V
4882.000	36.97	1.05	38.02	54.00	-15.98	AVG	V
7323.000	40.55	5.94	46.49	74.00	-27.51	Peak	V
7323.000	34.23	5.94	40.17	54.00	-13.83	AVG	V
9764.000	41.39	6.55	47.94	74.00	-26.06	Peak	V
9764.000	35.12	6.55	41.67	54.00	-12.33	AVG	V
4882.000	53.72	1.05	54.77	74.00	-19.23	Peak	H
4882.000	44.39	1.05	45.44	54.00	-8.56	AVG	H
7323.000	40.36	5.94	46.30	74.00	-27.70	Peak	H
7323.000	34.07	5.94	40.01	54.00	-13.99	AVG	H
9764.000	41.54	6.55	48.09	74.00	-25.91	Peak	H
9764.000	35.21	6.55	41.76	54.00	-12.24	AVG	H

Frequency	Reading Level	Correct Factor	Measurement	Limits	Over	Detector	Polarization
(MHz)	(dBμV)	(dB/m)	(dBμV/m)	(dBμV/m)	(dB)	Peak/AVG	H/V
GFSK - 2480 MHz TX mode							
4960.000	53.40	1.50	54.90	74.00	-19.10	Peak	V
4960.000	43.66	1.50	45.16	54.00	-8.84	AVG	V
7440.000	41.48	5.61	47.09	74.00	-26.91	Peak	V
7440.000	36.21	5.61	41.82	54.00	-12.18	AVG	V
9920.000	42.85	6.10	48.95	74.00	-25.05	Peak	V
9920.000	36.48	6.10	42.58	54.00	-11.42	AVG	V
4960.000	43.52	1.50	45.02	74.00	-28.98	Peak	H
4960.000	37.26	1.50	38.76	54.00	-15.24	AVG	H
7440.000	40.03	5.61	45.64	74.00	-28.36	Peak	H
7440.000	33.74	5.61	39.35	54.00	-14.65	AVG	H
9920.000	42.72	6.10	48.82	74.00	-25.18	Peak	H
9920.000	36.44	6.10	42.54	54.00	-11.46	AVG	H

Left earphone:
Radiated emissions 1 GHz ~ 25 GHz

Frequency	Reading Level	Correct Factor	Measurement	Limits	Over	Detector	Polarization
(MHz)	(dBμV)	(dB/m)	(dBμV/m)	(dBμV/m)	(dB)	Peak/AVG	H/V
GFSK - 2402 MHz TX mode							
4804.000	41.65	0.74	42.39	74.00	-31.61	Peak	V
4804.000	35.34	0.74	36.08	54.00	-17.92	AVG	V
7206.000	40.66	6.02	46.68	74.00	-27.32	Peak	V
7206.000	34.15	6.02	40.17	54.00	-13.83	AVG	V
9608.000	40.96	5.88	46.84	74.00	-27.16	Peak	V
9608.000	34.50	5.88	40.38	54.00	-13.62	AVG	V
4804.000	51.07	0.74	51.81	74.00	-22.19	Peak	H
4804.000	42.67	0.74	43.41	54.00	-10.59	AVG	H
7206.000	40.61	6.02	46.63	74.00	-27.37	Peak	H
7206.000	34.27	6.02	40.29	54.00	-13.71	AVG	H
9608.000	41.42	5.88	47.30	74.00	-26.70	Peak	H
9608.000	35.34	5.88	41.22	54.00	-12.78	AVG	H
GFSK - 2441 MHz TX mode							
4882.000	41.12	1.05	42.17	74.00	-31.83	Peak	V
4882.000	34.97	1.05	36.02	54.00	-17.98	AVG	V
7323.000	40.29	5.94	46.23	74.00	-27.77	Peak	V
7323.000	34.17	5.94	40.11	54.00	-13.89	AVG	V
9764.000	41.25	6.55	47.80	74.00	-26.20	Peak	V
9764.000	35.03	6.55	41.58	54.00	-12.42	AVG	V
4882.000	54.81	1.05	55.86	74.00	-18.14	Peak	H
4882.000	44.55	1.05	45.60	54.00	-8.40	AVG	H
7323.000	40.84	5.94	46.78	74.00	-27.22	Peak	H
7323.000	34.22	5.94	40.16	54.00	-13.84	AVG	H
9764.000	41.65	6.55	48.20	74.00	-25.80	Peak	H
9764.000	35.31	6.55	41.86	54.00	-12.14	AVG	H

Frequency	Reading Level	Correct Factor	Measurement	Limits	Over	Detector	Polarization
(MHz)	(dBμV)	(dB/m)	(dBμV/m)	(dBμV/m)	(dB)	Peak/AVG	H/V
GFSK - 2480 MHz TX mode							
4960.000	42.57	1.50	44.07	74.00	-29.93	Peak	V
4960.000	36.50	1.50	38.00	54.00	-16.00	AVG	V
7440.000	40.78	5.61	46.39	74.00	-27.61	Peak	V
7440.000	34.48	5.61	40.09	54.00	-13.91	AVG	V
9920.000	42.21	6.10	48.31	74.00	-25.69	Peak	V
9920.000	36.11	6.10	42.21	54.00	-11.79	AVG	V
4960.000	51.39	1.50	52.89	74.00	-21.11	Peak	H
4960.000	47.17	1.50	48.67	54.00	-5.33	AVG	H
7440.000	40.22	5.61	45.83	74.00	-28.17	Peak	H
7440.000	33.83	5.61	39.44	54.00	-14.56	AVG	H
9920.000	41.53	6.10	47.63	74.00	-26.37	Peak	H
9920.000	34.95	6.10	41.05	54.00	-12.95	AVG	H

Right earphone:

Radiated emissions at band edge

Frequency	Reading Level	Correct Factor	Measurement	Limits	Over	Detector	Polarization
(MHz)	(dBμV)	(dB/m)	(dBμV/m)	(dBμV/m)	(dB)	Peak/AVG	H/V
GFSK – Low band-edge							
(MHz)	(dBμV)	(dB/m)	(dBμV/m)	(dBμV/m)	(dB)	Peak/AVG	H/V
2310.000	46.91	-8.08	38.83	74.00	-35.17	Peak	V
2310.000	37.36	-8.08	29.28	54.00	-24.72	AVG	V
2390.000	54.43	-7.71	46.72	74.00	-27.28	Peak	V
2390.000	44.66	-7.71	36.95	54.00	-17.05	AVG	V
2310.000	46.73	-8.08	38.65	74.00	-35.35	Peak	H
2310.000	37.33	-8.08	29.25	54.00	-24.75	AVG	H
2390.000	55.53	-7.71	47.82	74.00	-26.18	Peak	H
2390.000	45.35	-7.71	37.64	54.00	-16.36	AVG	H
GFSK – High band-edge							
2483.500	58.93	-7.24	51.69	74.00	-22.31	Peak	V
2483.500	42.85	-7.24	35.61	54.00	-18.39	AVG	V
2500.000	57.60	-7.17	50.43	74.00	-23.57	Peak	V
2500.000	48.50	-7.17	41.33	54.00	-12.67	AVG	V
2483.500	54.69	-7.24	47.45	74.00	-26.55	Peak	H
2483.500	42.99	-7.24	35.75	54.00	-18.25	AVG	H
2500.000	57.77	-7.17	50.60	74.00	-23.40	Peak	H
2500.000	48.64	-7.17	41.47	54.00	-12.53	AVG	H

Left earphone:
Radiated emissions at band edge

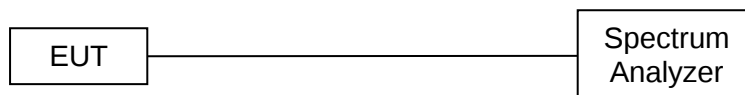
Frequency	Reading Level	Correct Factor	Measurement	Limits	Over	Detector	Polarization
(MHz)	(dB μ V)	(dB/m)	(dB μ V/m)	(dB μ V/m)	(dB)	Peak/AVG	H/V
GFSK – Low band-edge							
(MHz)	(dB μ V)	(dB/m)	(dB μ V/m)	(dB μ V/m)	(dB)	Peak/AVG	H/V
2310.000	47.59	-8.08	39.51	74.00	-34.49	Peak	V
2310.000	37.31	-8.08	29.23	54.00	-24.77	AVG	V
2390.000	50.07	-7.71	42.36	74.00	-31.64	Peak	V
2390.000	40.23	-7.71	32.52	54.00	-21.48	AVG	V
2310.000	47.11	-8.08	39.03	74.00	-34.97	Peak	H
2310.000	37.49	-8.08	29.41	54.00	-24.59	AVG	H
2390.000	57.56	-7.71	49.85	74.00	-24.15	Peak	H
2390.000	48.39	-7.71	40.68	54.00	-13.32	AVG	H
GFSK – High band-edge							
2483.500	55.05	-7.24	47.81	74.00	-26.19	Peak	V
2483.500	39.19	-7.24	31.95	54.00	-22.05	AVG	V
2500.000	51.16	-7.17	43.99	74.00	-30.01	Peak	V
2500.000	41.44	-7.17	34.27	54.00	-19.73	AVG	V
2483.500	64.73	-7.24	57.49	74.00	-16.51	Peak	H
2483.500	45.32	-7.24	38.08	54.00	-15.92	AVG	H
2500.000	60.63	-7.17	53.46	74.00	-20.54	Peak	H
2500.000	50.81	-7.17	43.64	54.00	-10.36	AVG	H

6.4 20dB emission bandwidth

6.4.1 Limits

None, for reporting purposes only.

6.4.2 Test setup



6.4.3 Test procedures

Test method: ANSI C63.10-2013 Section 6.9.2

6.4.4 Test results

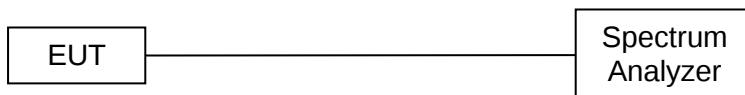
Note: See the Appendix A

6.5 Maximum conducted output power

6.5.1 Limits

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

6.5.2 Test setup



6.5.3 Test procedure

Test method: ANSI C63.10-2013 Section 7.8.5

6.5.4 Test results

Note: see the Appendix B

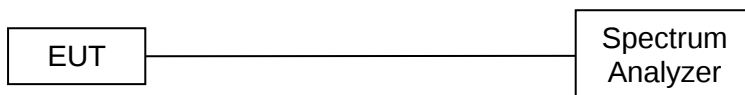
6.6 Carrier frequency separation

6.6.1 Limits

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

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

6.6.2 Test setup



6.6.3 Test procedure

Test method: ANSI C63.10-2013 Section 7.8.2

6.6.4 Test results

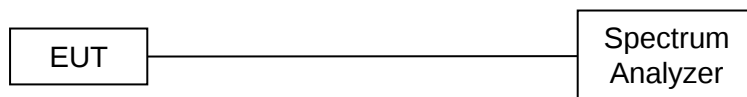
Note: see the Appendix C

6.7 Time of occupancy

6.7.1 Limits

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

6.7.2 Test setup



6.7.3 Test procedure

Test method: ANSI C63.10-2013 Section 7.8.4

6.7.4 Test results

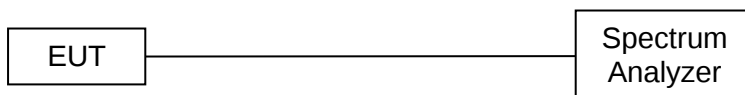
Note: see the Appendix D

6.8 Number of hopping channels

6.8.1 Limit

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

6.8.2 Test setup



6.8.3 Test procedure

Test method: ANSI C63.10-2013 Section 7.8.3

6.8.4 Test results

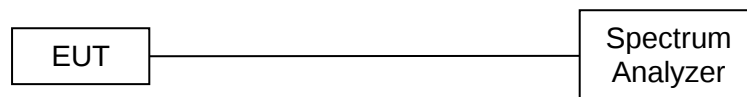
Note: see the Appendix E

6.9 Band edge (Conducted)

6.9.1 Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

6.9.2 Test setup



6.9.3 Test procedure

Test method: ANSI C63.10-2013 Section 6.10.4

6.9.4 Test results

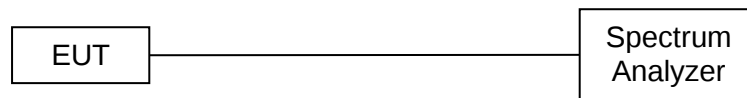
Note: see the Appendix F

6.10 Conducted spurious emissions

6.10.1 Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

6.10.2 Test setup



6.10.3 Test procedure

Test method: ANSI C63.10-2013 Section 7.8.8

6.10.4 Test results

Note: See the Appendix G

APPENDIX A: 20DB EMISSION BANDWIDTH

Test Result

Test Mode	Antenna	Frequency [MHz]	20db EBW [MHz]
DH5	Right	2402	1.032
		2441	1.029
		2480	1.047
	Left	2402	1.011
		2441	1.029
		2480	1.038
2DH5	Right	2402	1.287
		2441	1.326
		2480	1.335
	Left	2402	1.320
		2441	1.359
		2480	1.320

Test Graphs

DH5 Right 2402



DH5 Right 2441



DH5 Right 2480



DH5 Left 2402



DH5 Left 2441



DH5 Left 2480



2DH5 Right 2402



2DH5_Right 2441



2DH5_Right 2480



2DH5_Left 2402



2DH5 Left 2441



2DH5 Left 2480



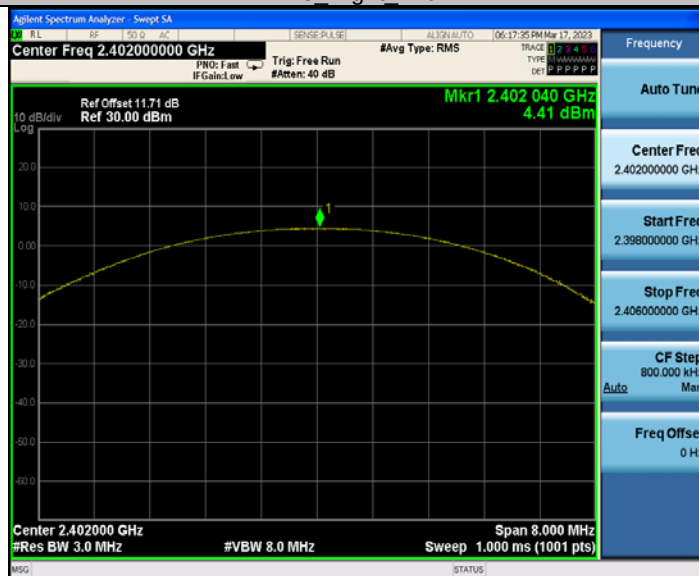
APPENDIX B: MAXIMUM CONDUCTED OUTPUT POWER

Test Result Peak

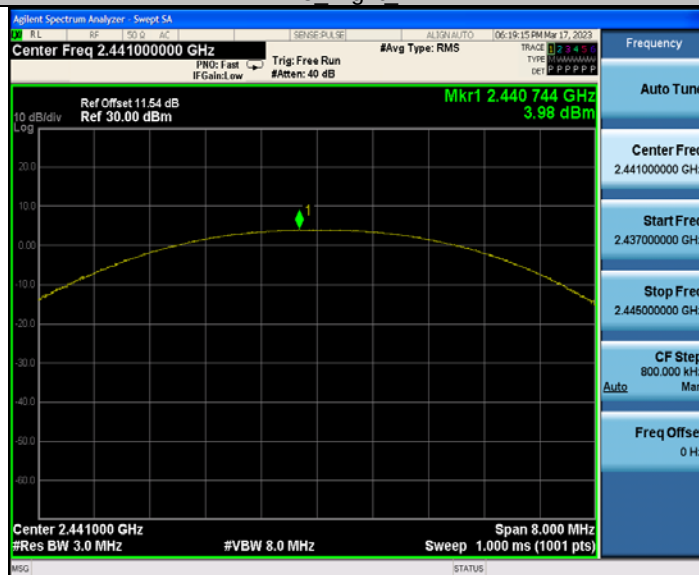
Test Mode	Antenna	Frequency [MHz]	Conducted Peak Power [dBm]	Limit [dBm]	Verdict
DH5	Right	2402	4.41	≤30	PASS
		2441	3.98	≤30	PASS
		2480	4.73	≤30	PASS
	Left	2402	3.51	≤30	PASS
		2441	3.25	≤30	PASS
		2480	4.20	≤30	PASS
2DH5	Right	2402	5.17	≤20.97	PASS
		2441	4.7	≤20.97	PASS
		2480	5.52	≤20.97	PASS
	Left	2402	4.29	≤20.97	PASS
		2441	4.03	≤20.97	PASS
		2480	5.00	≤20.97	PASS

Test Graphs

DH5_Right_2402



DH5_Right_2441



DH5_Right_2480



DH5_Left_2402



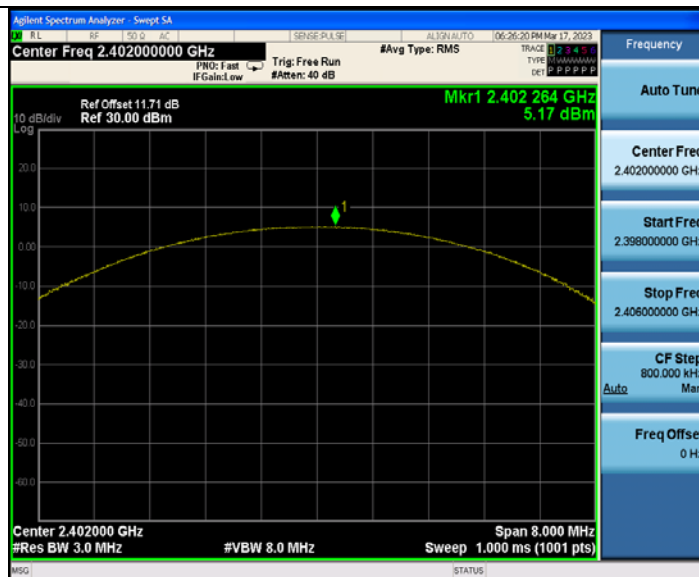
DH5 Left 2441



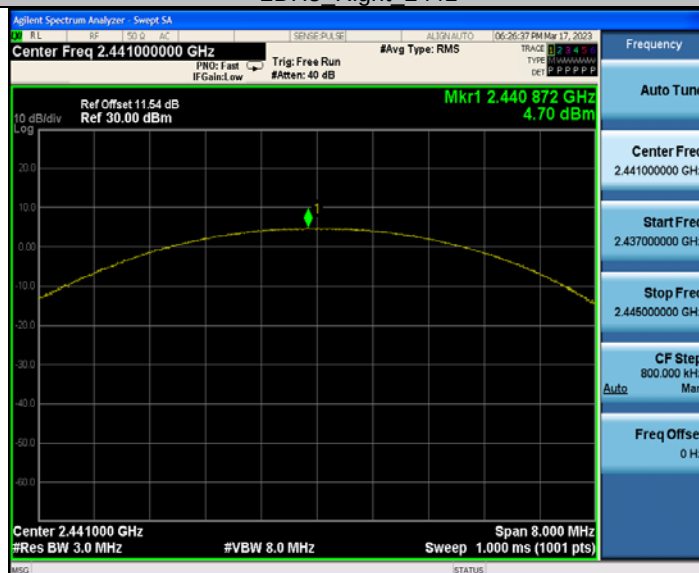
DH5 Left 2480



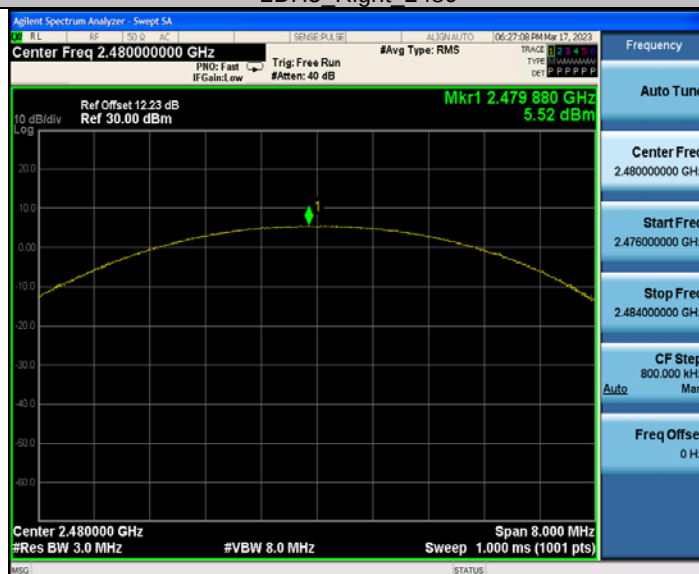
2DH5 Right 2402



2DH5_Right 2441



2DH5_Right 2480



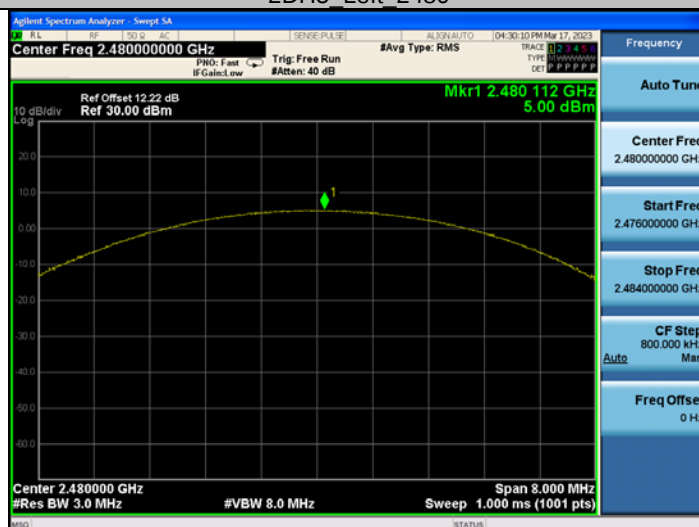
2DH5_Left 2402



2DH5 Left 2441



2DH5 Left 2480



APPENDIX C: CARRIER FREQUENCY SEPARATION

Test Result

Test Mode	Antenna	Frequency [MHz]	Result [MHz]	Limit [MHz]	Verdict
DH5	Right	Hop	1	≥ 0.698	PASS
	Left	Hop	0.994	≥ 0.698	PASS
2DH5	Right	Hop	1	≥ 0.890	PASS
	Left	Hop	0.998	≥ 0.890	PASS

Test Graphs

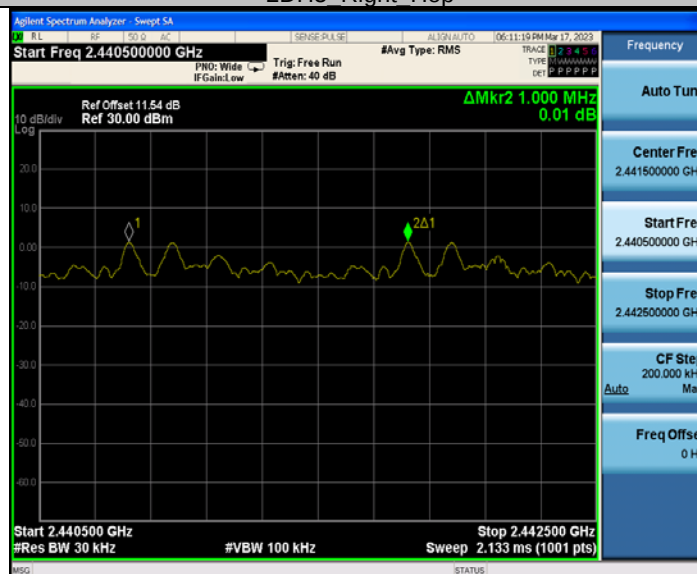
DH5_Right_Hop



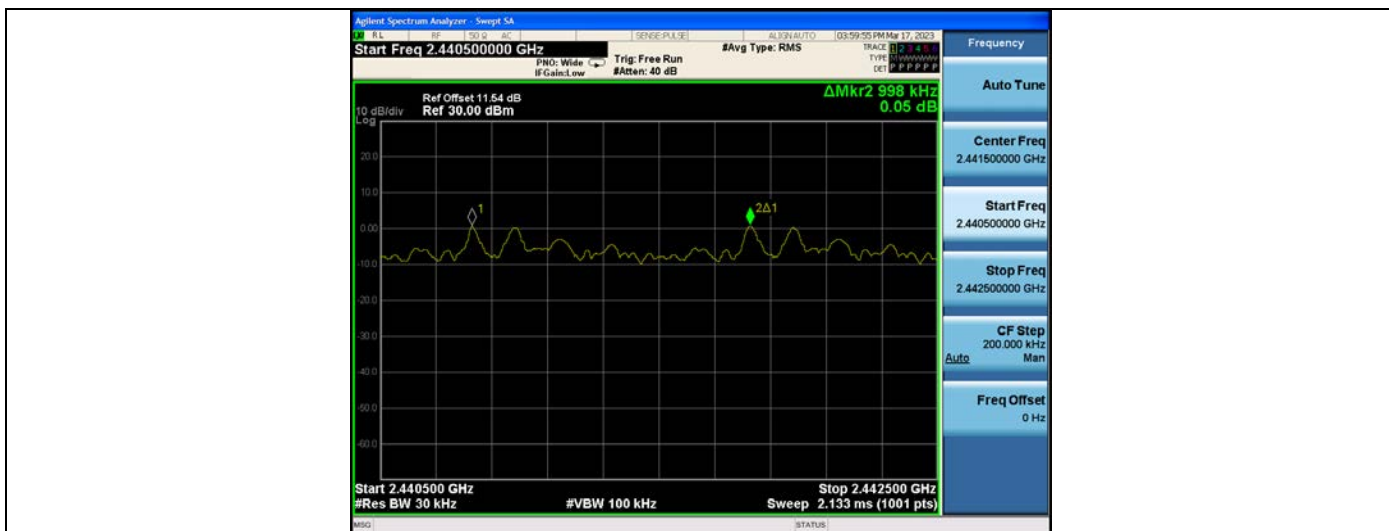
DH5_Left_Hop



2DH5_Right_Hop



2DH5_Left_Hop



APPENDIX D: TIME OF OCCUPANCY

Test Result

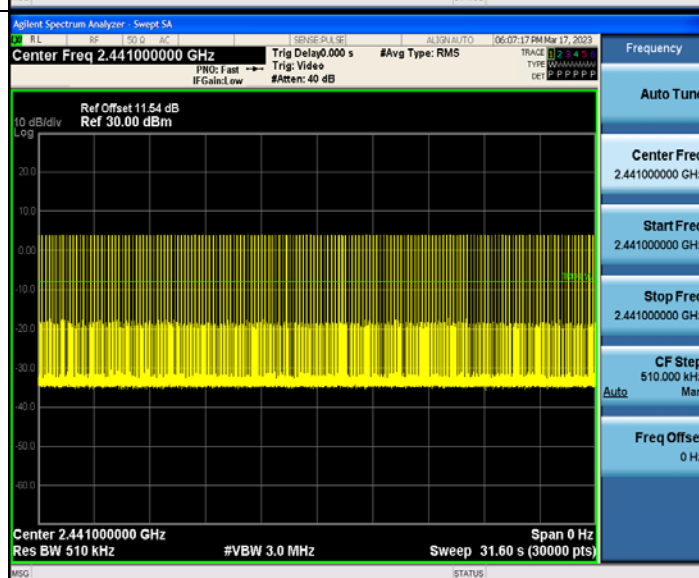
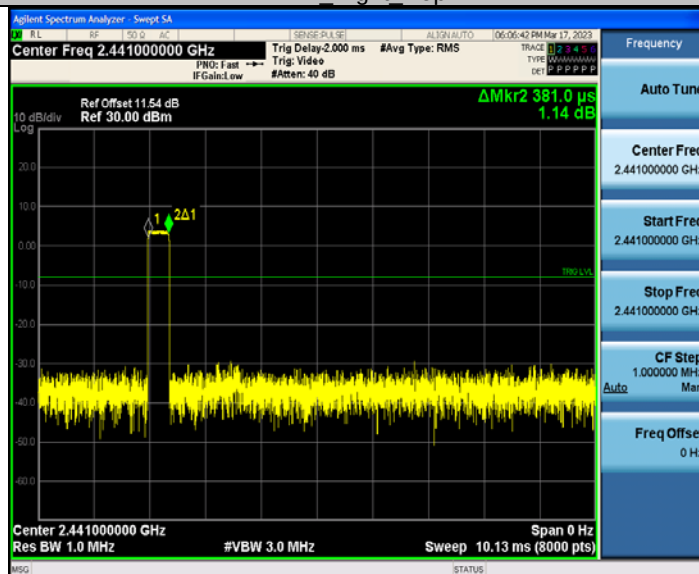
Test Mode	Antenna	Frequency [MHz]	BurstWidth [ms]	Hops in 31.6s [Num]	Result [s]	Limit [s]	Verdict
DH1	Right	Hop	0.381	318	0.121	≤0.4	PASS
DH3	Right	Hop	1.637	152	0.249	≤0.4	PASS
DH5	Right	Hop	2.885	104	0.3	≤0.4	PASS
DH1	Left	Hop	0.381	318	0.121	≤0.4	PASS
DH3	Left	Hop	1.637	152	0.249	≤0.4	PASS
DH5	Left	Hop	2.885	104	0.3	≤0.4	PASS
2DH1	Right	Hop	0.390	319	0.124	≤0.4	PASS
2DH3	Right	Hop	1.643	160	0.263	≤0.4	PASS
2DH5	Right	Hop	2.891	99	0.286	≤0.4	PASS
2DH1	Left	Hop	0.390	319	0.124	≤0.4	PASS
2DH3	Left	Hop	1.643	160	0.263	≤0.4	PASS
2DH5	Left	Hop	2.891	99	0.286	≤0.4	PASS

Notes:

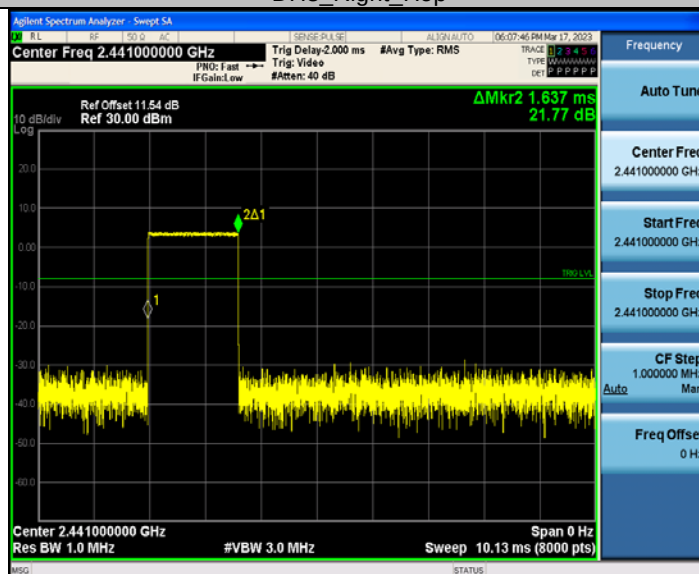
1. Period time = $0.4s * 79 = 31.6s$
2. Result (Time of occupancy) = BurstWidth[ms] * Hops in 31.6s [Num]

Test Graphs

DH1_Right_Hop

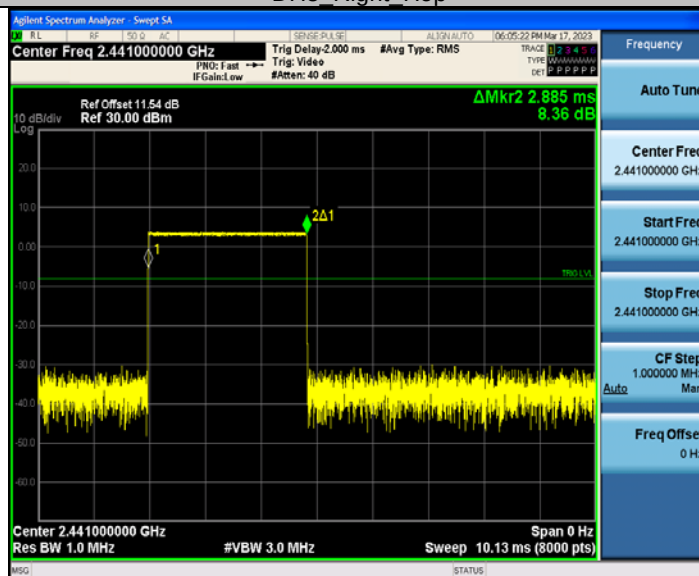


DH3_Right_Hop

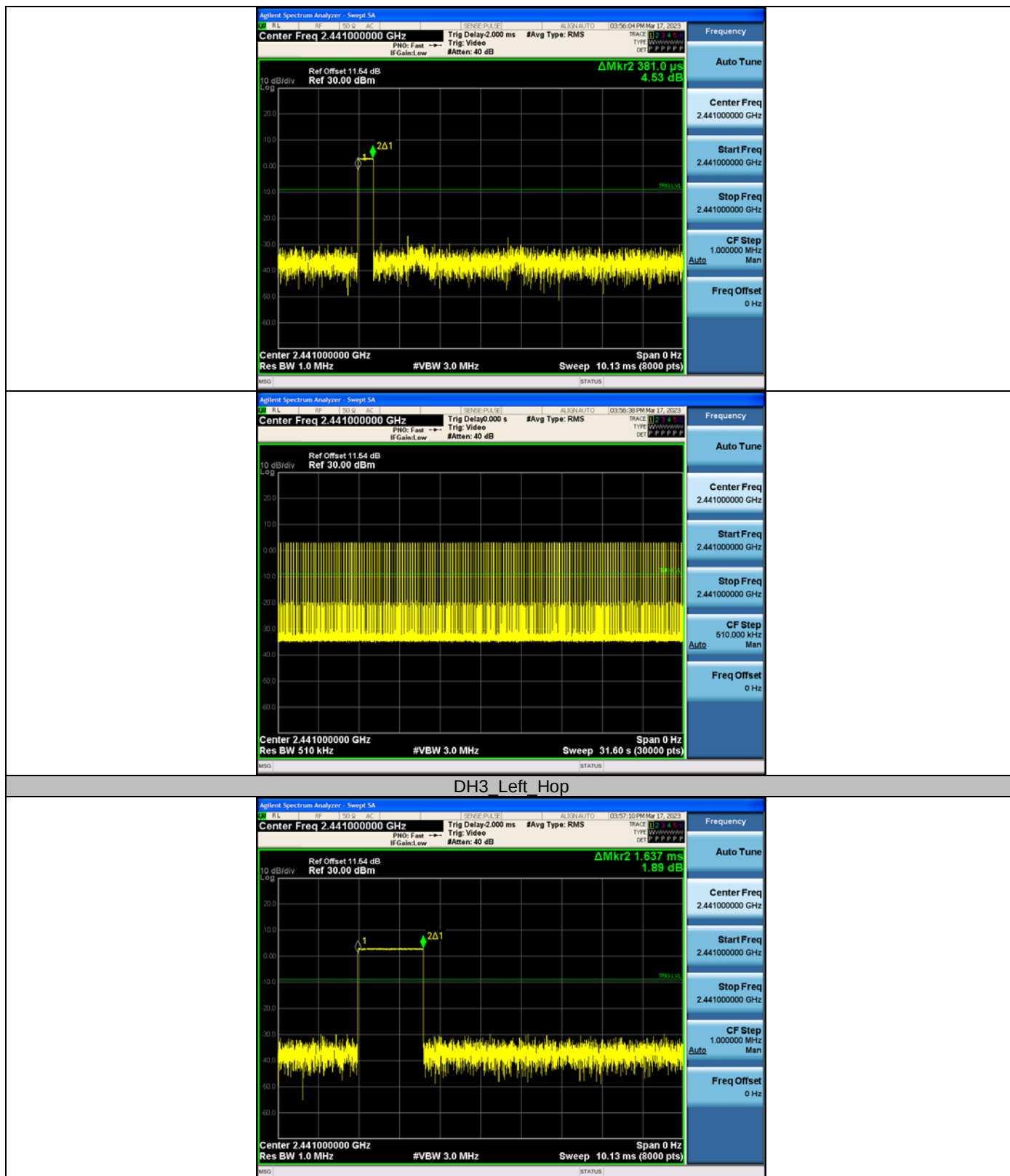


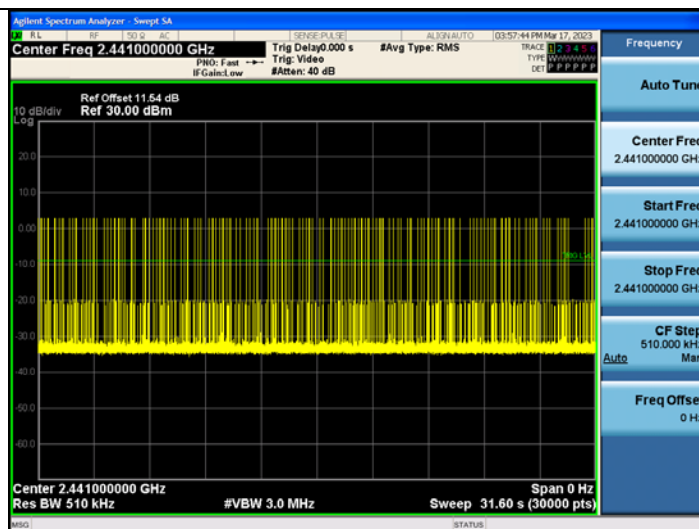


DH5 Right Hop

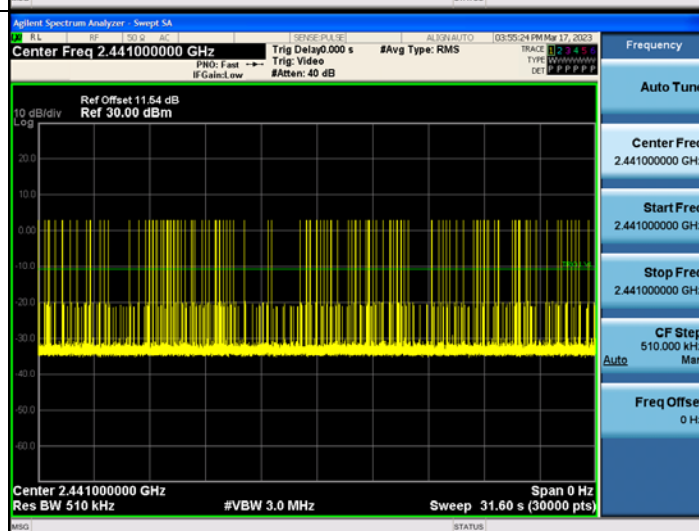
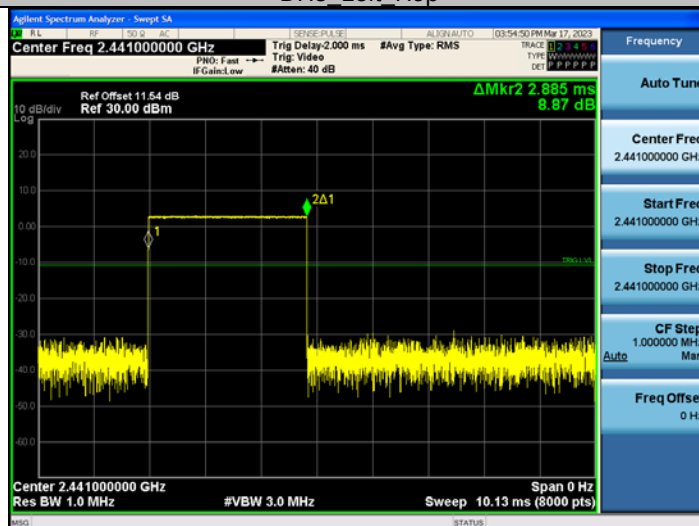


DH1 Left Hop

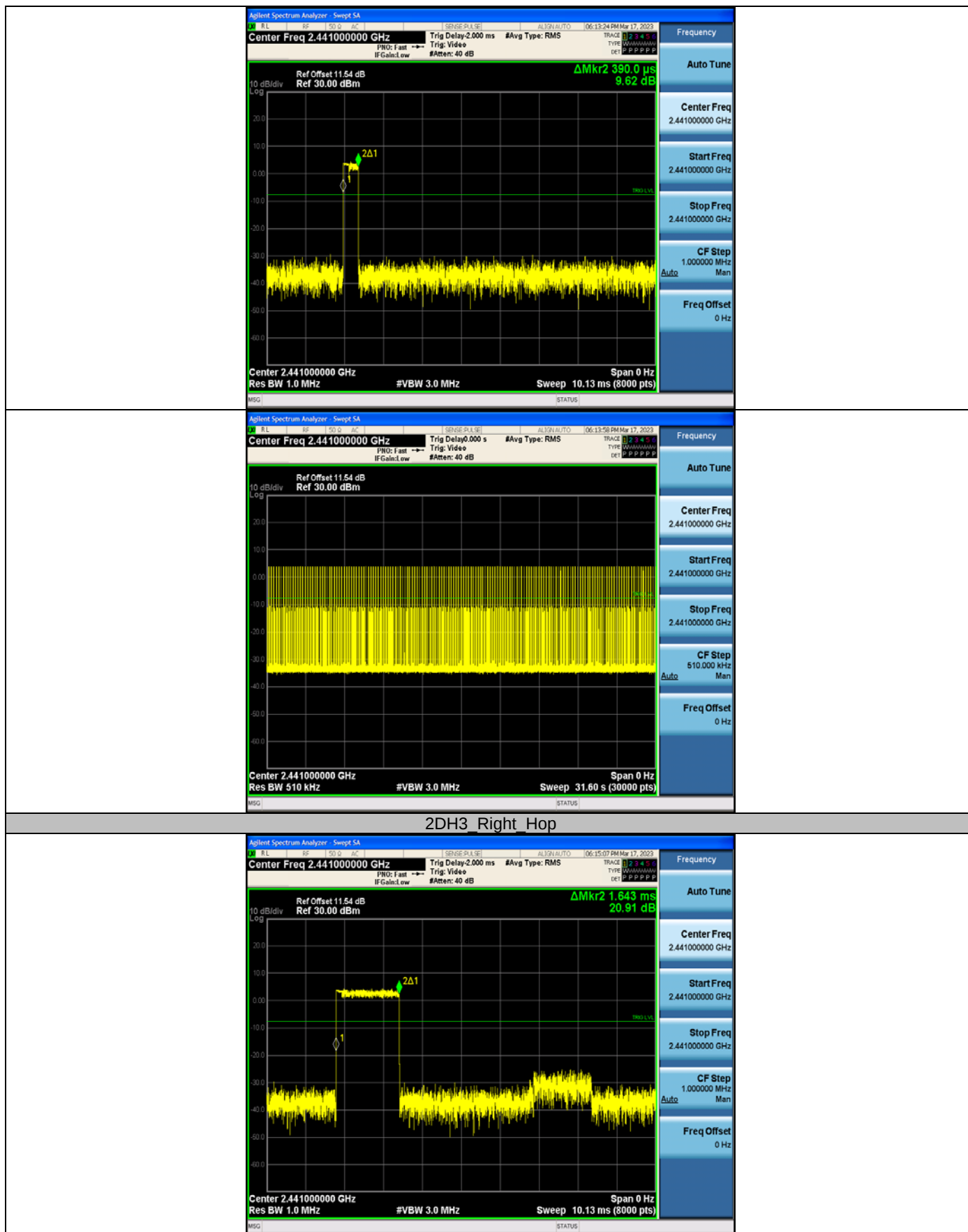


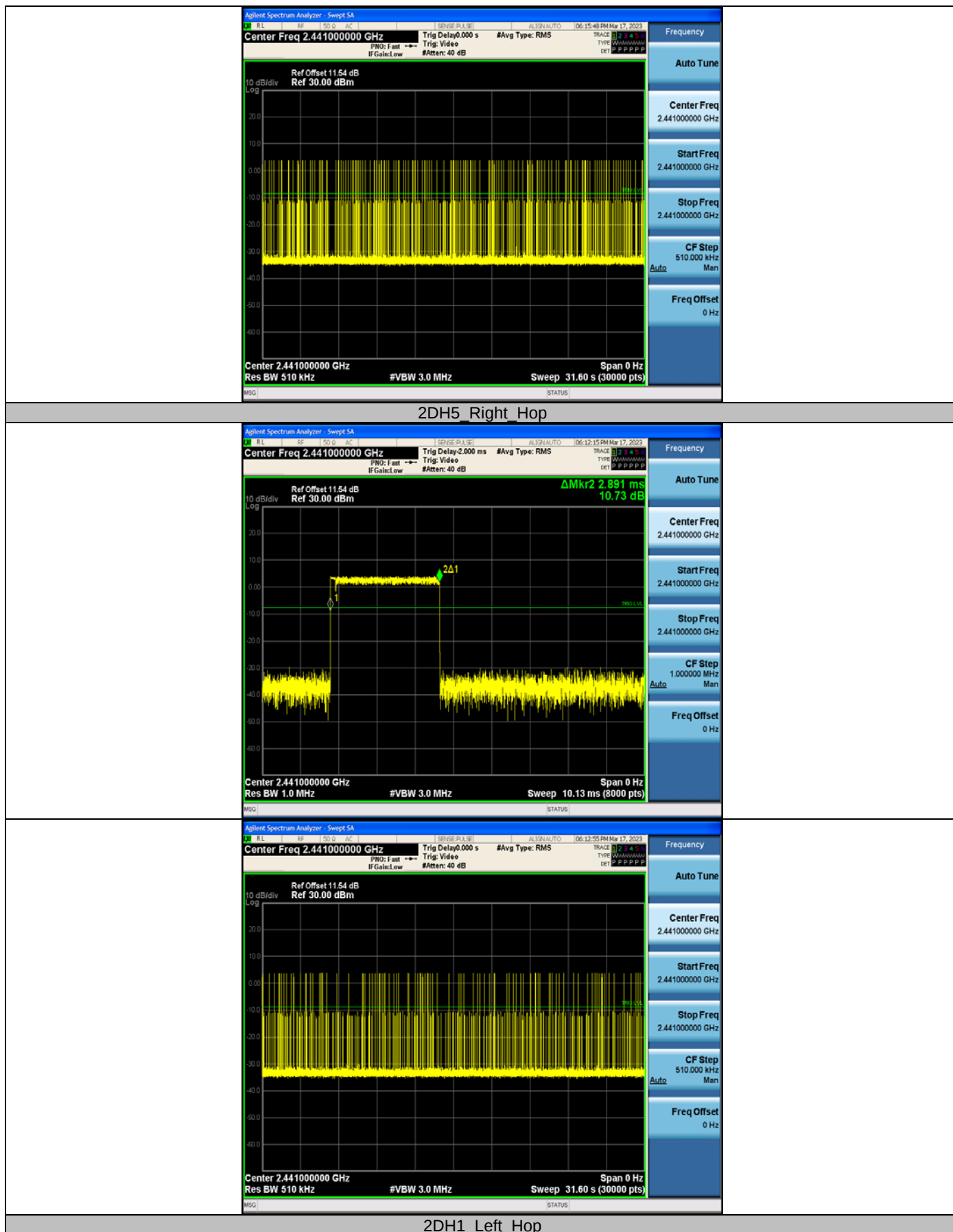


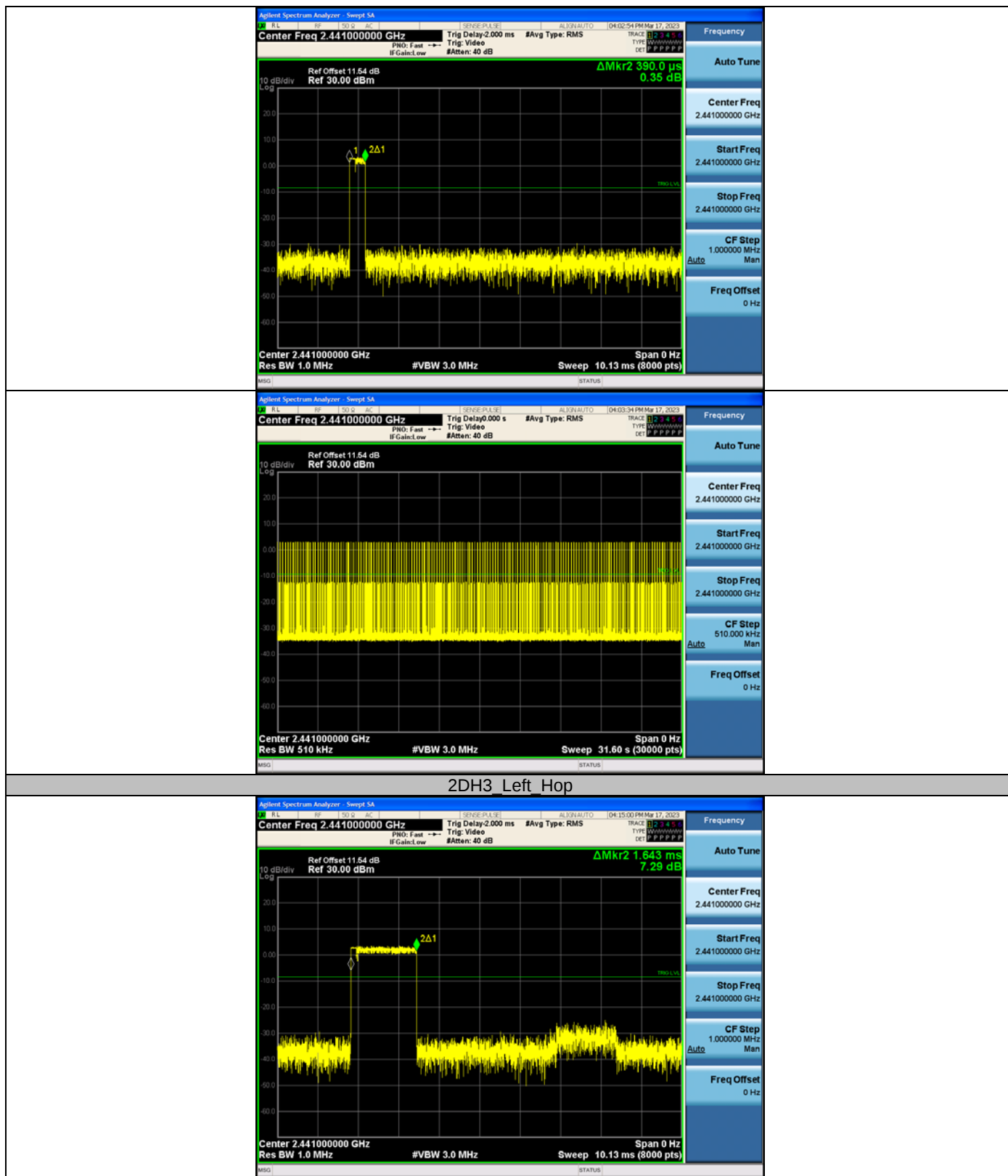
DH5 Left Hop

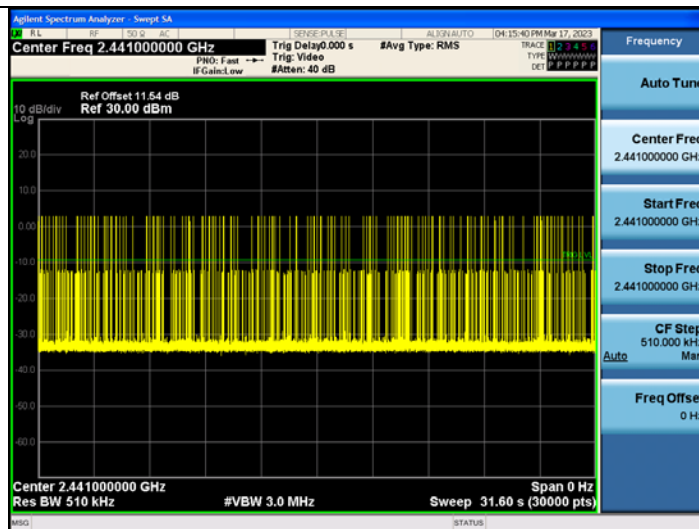


2DH1 Right Hop

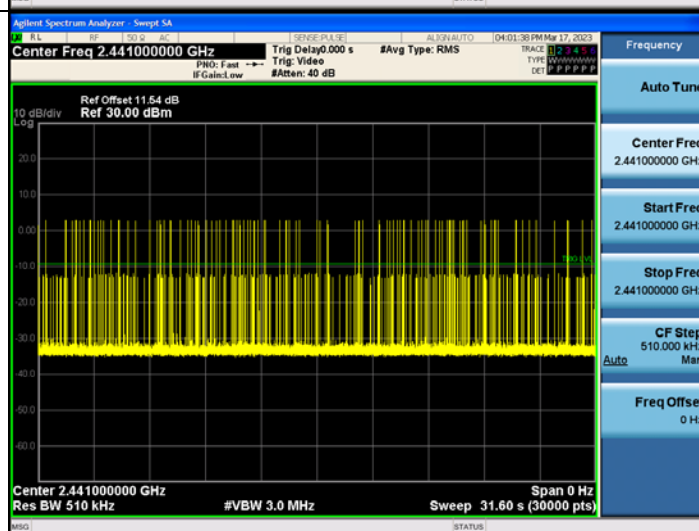
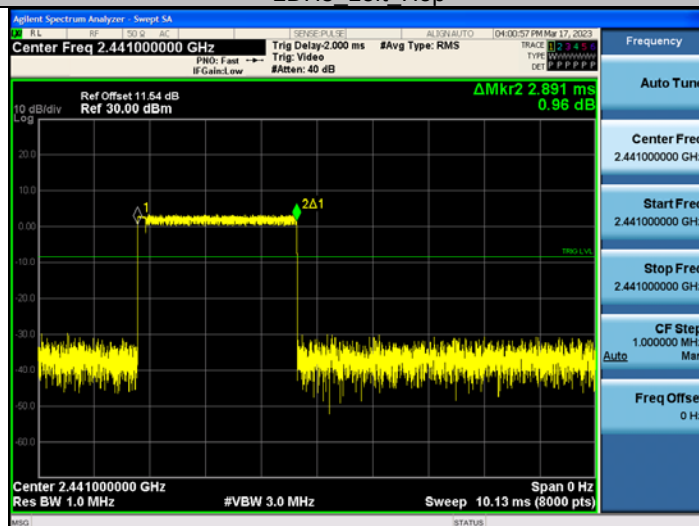








2DH5 Left Hop



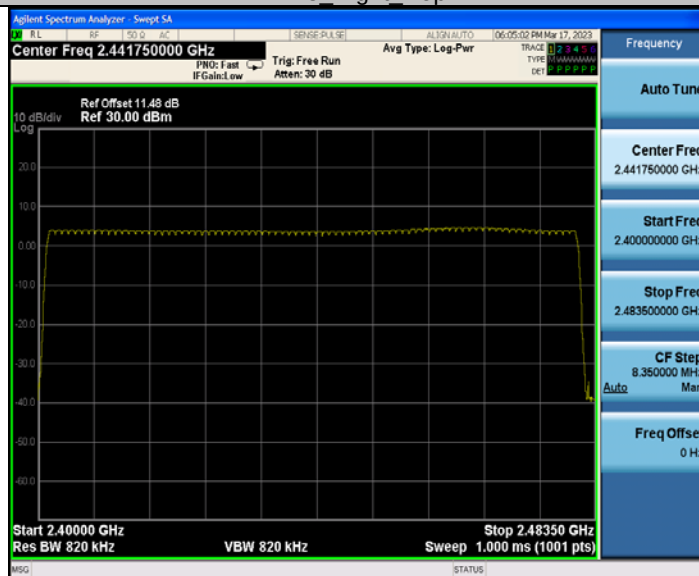
APPENDIX E: NUMBER OF HOPPING CHANNELS

Test Result

Test Mode	Antenna	Frequency [MHz]	Result [Num]	Limit [Num]	Verdict
DH5	Right	Hop	79	≥15	PASS
DH5	Left	Hop	79	≥15	PASS
2DH5	Right	Hop	79	≥15	PASS
2DH5	Left	Hop	79	≥15	PASS

Test Graphs

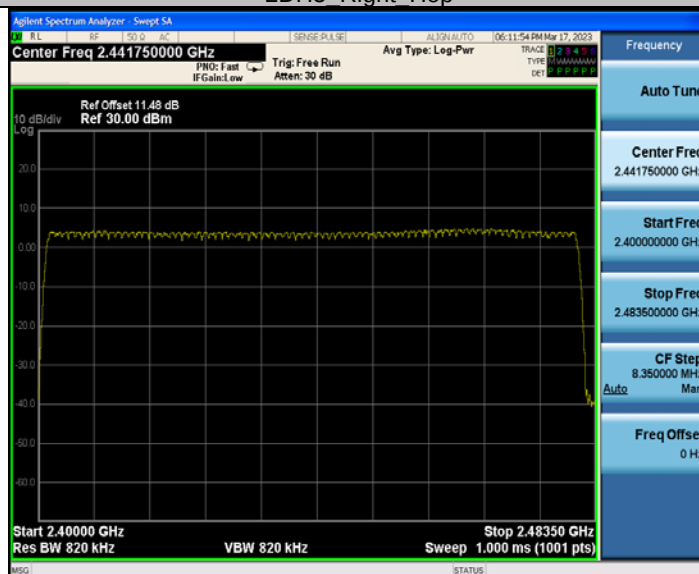
DH5_Right_Hop



DH5_Left_Hop



2DH5_Right_Hop



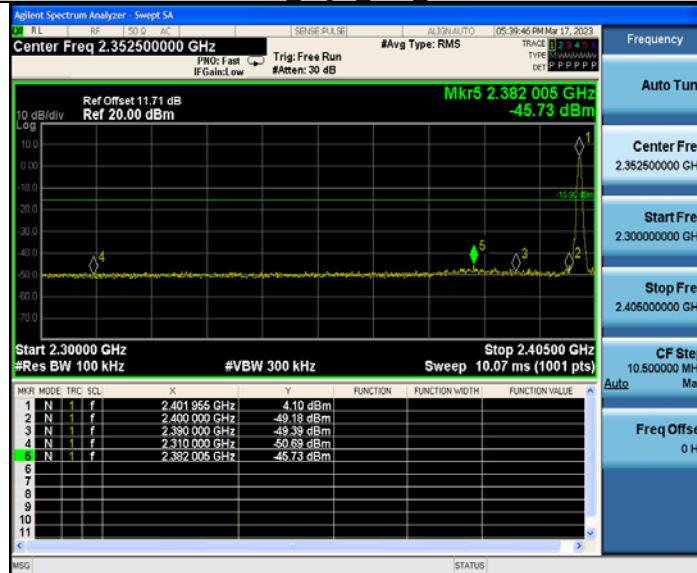
2DH5_Left_Hop



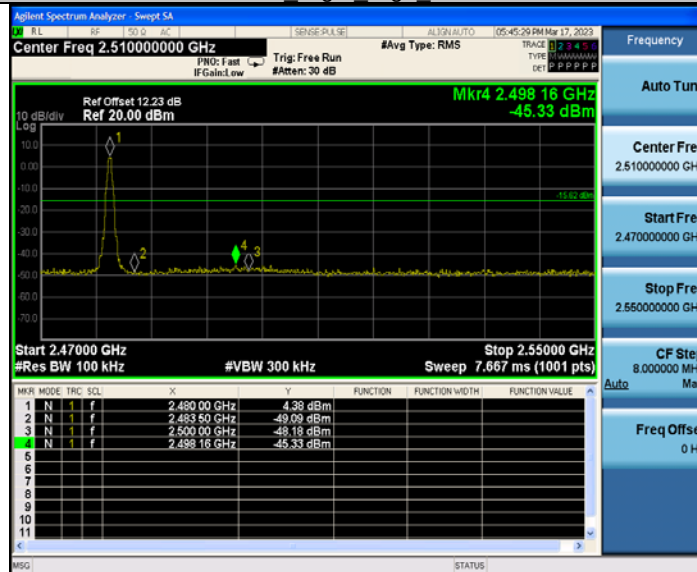
APPENDIX F: BAND EDGE MEASUREMENTS

Test Graphs

DH5 Right Low 2402



DH5 Right High 2480



DH5 Left Low 2402

