



# SGS-CSTC Standards Technical Services Co., Ltd. Guangzhou Branch

198 Kezhu Road, Scientech Park, Guangzhou Economic & Technological Development District, Guangzhou, China 510663

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Report No.: GZEM190301160201  
Page: 1 of 135  
FCC ID: 2AR2SHTL1520BSW

## TEST REPORT

**Application No.:**

GZEM1903011602CR

**Applicant:**

MMD Hong Kong Holding Limited

**Address of Applicant:**

Units 1006-1007, 10th Floor, C-Bons International Center, 108 Wai Yip Street, Kwun Tong, Kowloon, Hong Kong

**Manufacturer:**

MMD Hong Kong Holding Limited

**Address of Manufacturer:**

Units 1006-1007, 10th Floor, C-Bons International Center, 108 Wai Yip Street, Kwun Tong, Kowloon, Hong Kong

**Factory:**

Guangzhou Panyu Juda Car Audio Equipment Co., Ltd.

**Address of Factory:**

Vtrek Dewei Industrial Garden, Shibei Industrial Road, Dashi Town, Panyu Borough, Guangzhou City, Guangdong Province, China

**Equipment Under Test (EUT):**

**FCC ID:** 2AR2SHTL1520BSW

**EUT Name:** Subwoofer

**Model No.:** HTL1520BSW/37

**Trade Mark:** PHILIPS

**Standard(s) :** 47 CFR Part 15, Subpart C 15.247

**Date of Receipt:** 2019-03-27

**Date of Test:** 2019-03-28 to 2019-04-17

**Date of Issue:** 2019-05-15

**Test Result:**

Pass\*

\* In the configuration tested, the EUT complied with the standards specified above.



Kobe Jian

Lab Manager

The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or testing done by SGS International Electrical Approvals in connection with, distribution or use of the product described in this report must be approved by SGS International Electrical Approvals in writing.

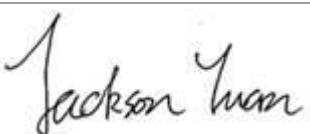


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Revision Record				
Version	Chapter	Date	Modifier	Remark
01		2019-05-15		Original

Authorized for issue by:			
Tested By		 Jackson Yuan	2019-03-28 to 2019-04-17
		Jackson_Yuan /Project Engineer	Date
Checked By		 Ricky Liu	2019-04-25
		Ricky_Liu /Reviewer	Date

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## 2 Test Summary

Radio Spectrum Technical Requirement				
Item	Standard	Method	Requirement	Result
Antenna Requirement	47 CFR Part 15, Subpart C 15.247	N/A	47 CFR Part 15, Subpart C 15.203 & 15.247(c)	Pass
Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence	47 CFR Part 15, Subpart C 15.247	N/A	47 CFR Part 15, Subpart C 15.247(a)(1),(g),(h)	Pass

Radio Spectrum Matter Part				
Item	Standard	Method	Requirement	Result
Conducted Emissions at AC Power Line (150kHz-30MHz)	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 6.2	47 CFR Part 15, Subpart C 15.207	Pass
Conducted Peak Output Power	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.5	47 CFR Part 15, Subpart C 15.247(b)(1)	Pass
20dB Bandwidth	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.7	47 CFR Part 15, Subpart C 15.247(a)(1)	Pass
Carrier Frequencies Separation	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.2	47 CFR Part 15, Subpart C 15.247a(1)	Pass
Hopping Channel Number	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.3	47 CFR Part 15, Subpart C 15.247a(1)(iii)	Pass
Dwell Time	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.4	47 CFR Part 15, Subpart C 15.247a(1)(iii)	Pass**
Conducted Band Edges Measurement	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.6	47 CFR Part 15, Subpart C 15.247(d)	Pass
Conducted Spurious Emissions	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.8	47 CFR Part 15, Subpart C 15.247(d)	Pass
Radiated Emissions which fall in the restricted bands	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 6.10.5	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass
Radiated Spurious Emissions	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 6.4,6.5,6.6	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass

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## 4 General Information

### 4.1 Details of E.U.T.

Power Supply:	AC 100-240V, 50/60Hz
Test Voltage:	AC 120 V, 60 Hz
Cable:	AC mains (unshielded, 1.5m)
Antenna Gain	0 dBi
Antenna Type	PCB Antenna
Channel Spacing	1MHz
Modulation Type	GFSK, π/4DQPSK, 8DPSK
Number of Channels	79
Operation Frequency	2402MHz to 2480MHz
Spectrum Spread Technology	Frequency Hopping Spread Spectrum(FHSS)
Software	BT FCC TOOL V2.00

### 4.2 Environment Parameter

Environment Parameter	Selected Values During Tests	
Relative Humidity	Ambient	
Value	Temperature(°C)	Voltage(V)
TNVN	25	120
TLVN	-20	120
THVN	55	120

Note:

VN: Normal Voltage  
TN: Normal Temperature  
TL: Low Extreme  
Test Temperature  
TH: High Extreme  
Test Temperature

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Operation Frequency each of channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
0	2402MHz	20	2422MHz	40	2442MHz	60	2462MHz
1	2403MHz	21	2423MHz	41	2443MHz	61	2463MHz
2	2404MHz	22	2424MHz	42	2444MHz	62	2464MHz
3	2405MHz	23	2425MHz	43	2445MHz	63	2465MHz
4	2406MHz	24	2426MHz	44	2446MHz	64	2466MHz
5	2407MHz	25	2427MHz	45	2447MHz	65	2467MHz
6	2408MHz	26	2428MHz	46	2448MHz	66	2468MHz
7	2409MHz	27	2429MHz	47	2449MHz	67	2469MHz
8	2410MHz	28	2430MHz	48	2450MHz	68	2470MHz
9	2411MHz	29	2431MHz	49	2451MHz	69	2471MHz
10	2412MHz	30	2432MHz	50	2452MHz	70	2472MHz
11	2413MHz	31	2433MHz	51	2453MHz	71	2473MHz
12	2414MHz	32	2434MHz	52	2454MHz	72	2474MHz
13	2415MHz	33	2435MHz	53	2455MHz	73	2475MHz
14	2416MHz	34	2436MHz	54	2456MHz	74	2476MHz
15	2417MHz	35	2437MHz	55	2457MHz	75	2477MHz
16	2418MHz	36	2438MHz	56	2458MHz	76	2478MHz
17	2419MHz	37	2439MHz	57	2459MHz	77	2479MHz
18	2420MHz	38	2440MHz	58	2460MHz	78	2480MHz
19	2421MHz	39	2441MHz	59	2461MHz		

Using test software was control EUT work in continuous transmitter and receiver mode.and select test channel as below:

Channel	Frequency
The lowest channel (CH0)	2402MHz
The middle channel (CH39)	2441MHz
The highest channel (CH78)	2480MHz

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#### 4.3 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
Laptop	Lenovo	T430u	REF. No. SEA1800
BT test board	SGS EMC	RF 07	RF 07

#### 4.4 Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	Radio Frequency	$\pm 5.5 \times 10^{-8}$
2	Duty cycle	$\pm 0.57\%$
3	Occupied Bandwidth	$\pm 3\%$
4	RF Conducted power	$\pm 0.68\text{dB}$
5	RF Power Density	$\pm 1.50\text{dB}$
6	Conducted Spurious Emissions	$\pm 1.04\text{dB}$
7	RF Radiated Power	$\pm 4.5\text{dB}$ (below 1GHz)
		$\pm 4.8\text{dB}$ (above 1GHz)
8	Radiated Spurious Emission Test	$\pm 4.5\text{dB}$ (30MHz-1GHz)
		$\pm 4.8\text{dB}$ (1GHz-18GHz)
9	Temperature	$\pm 0.4^\circ\text{C}$
10	Humidity	$\pm 1.3\%$
11	Supply Voltages	$\pm 1.5\%$
12	Time	$\pm 3\%$

#### 4.5 Test Location

All tests were performed at:

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198 Kezhu Road, Scientech Park, Guangzhou Economic & Technology Development District,  
Guangzhou, China 510663

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No tests were sub-contracted.

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## 4.6 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

● **NVLAP (Lab Code: 200611-0)**

SGS-CSTC Standards Technical Services Co., Ltd., Guangzhou EMC Laboratory is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP/NIST). NVLAP Code: 200611-0.

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

● **ACMA**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory can also perform testing for the Australian C-Tick mark as a result of our NVLAP accreditation.

● **SGS UK(Certificate No.: 32), SGS-TUV SAARLAND and SGS-FIMKO**

Have approved SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory as a supplier of EMC TESTING SERVICES and SAFETY TESTING SERVICES.

● **CNAS (Lab Code: L0167)**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory has been assessed and in compliance with CNAS-CL01:2006 accreditation criteria for testing laboratories (identical to

ISO/IEC 17025:2005 General Requirements) for the Competence of Testing Laboratories.

● **FCC Recognized 2.948 Listed Test Firm(Registration No.: 282399)**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 282399, May 31, 2002.

● **FCC Recognized Accredited Test Firm(Registration No.: 486818)**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory has been accredited and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Designation Number: CN5016, Test Firm Registration Number: 486818, Jul 13, 2017.

● **Industry Canada (Registration No.: 4620B, CAB identifier: CN0052)**

SGS-CSTC Standards Technical Services Co., Ltd., has been registered by Innovation Science and Economic Development Canada for Wireless Device Testing laboratories to test to Canadian radio equipment requirements. Registration No. 4620B, CAB identifier: CN0052.

● **VCCI (Registration No.: R-12460, C-12584, G-10449 and T-11179)**

The 10m Semi-anechoic chamber and Shielded Room of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-12460, C-12584, G-10449 and T-11179 respectively.

● **CBTL (Lab Code: TL129)**

SGS-CSTC Standards Technical Services Co., Ltd., E&E Laboratory has been assessed and fully comply with the requirements of ISO/IEC 17025:2005, the Basic Rules, IEC60068-2-27 and Rules of procedure IEC60068-2-27, and the relevant IEC60068-2-27 CB-Scheme Operational documents.



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#### **4.7 Deviation from Standards**

None

#### **4.8 Abnormalities from Standard Conditions**

The EUT passed: Dwell Time test after modification.



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## 5 Equipment List

<b>Conducted Emissions at AC Power Line (150kHz-30MHz)</b>					
<b>Equipment</b>	<b>Manufacturer</b>	<b>Model No</b>	<b>Inventory No</b>	<b>Cal Date</b>	<b>Cal Due Date</b>
Shielding Room	Zhong Yu	8m x 3m x 3.8m	EMC0306	N/A	N/A
Two-Line V-Netwok	R&S	ENV216	EMC0118	2019-01-11	2020-01-10
LISN	R&S	ENV216	EMC2135	2018-09-21	2019-09-20
EMI Test Receiver	Rohde & Schwarz	ESCS30	EMC0506	2018-11-19	2019-11-18
Coaxial Cable	HangTianXing	2m	EMC0107	2017-07-23	2019-07-22
Voltage Probe	SGS	N/A	EMC0106	2018-04-04	2020-04-03
Conical Metal Housing	SGS-EMC	N/A	EMC0167	2018-04-19	2020-04-18
Test Software E3c	Audix	Ver. 5.4.1221b	GZE100-62	N/A	N/A

<b>Conducted Peak Output Power</b>					
<b>Equipment</b>	<b>Manufacturer</b>	<b>Model No</b>	<b>Inventory No</b>	<b>Cal Date</b>	<b>Cal Due Date</b>
EXA Signal Analyzer	AgilentTechnologies	N9010A	EMC2138	2018-11-19	2019-11-18
6dB Attenuator	HP	8491A	EMC2062	2018-04-04	2020-04-03
Test Software JS1120-3	HangTianXing	V2.6	GZE100-69	N/A	N/A

<b>20dB Bandwidth</b>					
<b>Equipment</b>	<b>Manufacturer</b>	<b>Model No</b>	<b>Inventory No</b>	<b>Cal Date</b>	<b>Cal Due Date</b>
EXA Signal Analyzer	AgilentTechnologies	N9010A	EMC2138	2018-11-19	2019-11-18
6dB Attenuator	HP	8491A	EMC2062	2018-04-04	2020-04-03
Test Software JS1120-3	HangTianXing	V2.6	GZE100-69	N/A	N/A

<b>Carrier Frequencies Separation</b>					
<b>Equipment</b>	<b>Manufacturer</b>	<b>Model No</b>	<b>Inventory No</b>	<b>Cal Date</b>	<b>Cal Due Date</b>
EXA Signal Analyzer	AgilentTechnologies	N9010A	EMC2138	2018-11-19	2019-11-18
6dB Attenuator	HP	8491A	EMC2062	2018-04-04	2020-04-03
Test Software JS1120-3	HangTianXing	V2.6	GZE100-69	N/A	N/A

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<b>Hopping Channel Number</b>					
<b>Equipment</b>	<b>Manufacturer</b>	<b>Model No</b>	<b>Inventory No</b>	<b>Cal Date</b>	<b>Cal Due Date</b>
EXA Signal Analyzer	AgilentTechnologies	N9010A	EMC2138	2018-11-19	2019-11-18
6dB Attenuator	HP	8491A	EMC2062	2018-04-04	2020-04-03
Test Software JS1120-3	HangTianXing	V2.6	GZE100-69	N/A	N/A

<b>Dwell Time</b>					
<b>Equipment</b>	<b>Manufacturer</b>	<b>Model No</b>	<b>Inventory No</b>	<b>Cal Date</b>	<b>Cal Due Date</b>
EXA Signal Analyzer	AgilentTechnologies	N9010A	EMC2138	2018-11-19	2019-11-18
6dB Attenuator	HP	8491A	EMC2062	2018-04-04	2020-04-03
Test Software JS1120-3	HangTianXing	V2.6	GZE100-69	N/A	N/A

<b>Conducted Band Edges Measurement</b>					
<b>Equipment</b>	<b>Manufacturer</b>	<b>Model No</b>	<b>Inventory No</b>	<b>Cal Date</b>	<b>Cal Due Date</b>
MXA Signal Analyzer	AgilentTechnologies	N9020A	SEM004-10	2019-02-24	2020-02-23
ESG Vector Signal Generator	Keysight	E4438C	SEM006-03	2019-04-05	2020-04-04
EXG Analog Signal Generator	AgilentTechnologies	N5171B	SEM006-04	2017-07-26	2020-07-25
Power Meter	AgilentTechnologies	U2021XA_Ch2	SEM009-02	2018-09-20	2019-09-19
Power Meter	AgilentTechnologies	U2021XA_Ch3	SEM009-03	2018-09-20	2019-09-19
EXA Signal Analyzer	AgilentTechnologies	N9010A	EMC2138	2018-11-19	2019-11-18
6dB Attenuator	HP	8491A	EMC2062	2018-04-04	2020-04-03
Test Software JS1120-3	HangTianXing	V2.6	GZE100-69	N/A	N/A

<b>Conducted Spurious Emissions</b>					
<b>Equipment</b>	<b>Manufacturer</b>	<b>Model No</b>	<b>Inventory No</b>	<b>Cal Date</b>	<b>Cal Due Date</b>
EXA Signal Analyzer	AgilentTechnologies	N9010A	EMC2138	2018-11-19	2019-11-18
6dB Attenuator	HP	8491A	EMC2062	2018-04-04	2020-04-03
Test Software JS1120-3	HangTianXing	V2.6	GZE100-69	N/A	N/A

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Radiated Emissions which fall in the restricted bands					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EMI Test Receiver	Rohde & Schwarz	ESIB26	EMC0522	2019-01-20	2020-01-19
EMI Test Receiver	Rohde & Schwarz	ESCI	EMC0056	2019-01-20	2020-01-19
Chamber cable	HangTianXing	N/A	EMC0542	2017-06-30	2019-06-30
Trilog Broadband Antenna 30MHz-1GHz	SCHWARZBECKME SS-ELEKTRONIK	VULB 9160	EMC2025	2016-09-08	2019-09-07
Bi-log Type Antenna	Schaffner -Chase	CBL6112B	EMC0524	2016-09-08	2019-09-07
Bi-log Type Antenna	Schaffner -Chase	CBL6143	EMC0519	2017-05-04	2020-05-03
Horn Antenna 1GHz-18GHz	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120D	EMC2026	2016-09-09	2019-09-08
1GHz-26.5 GHz Pre-Amplifier	Agilent	8449B	EMC0521	2019-01-07	2020-01-08
Amplifier	HP	8447F	EMC2065	2018-06-01	2019-05-31
Pre-Amplifier MH648A	ANRITSU CORP	MH648A	EMC2086	2018-11-19	2019-11-18
Active Loop Antenna	EMCO	6502	EMC0523	2018-03-05	2020-03-04
High Pass Filter(915MHz)	FSY MICROWAVE	HM1465-9SS	EMC2079	2019-01-11	2020-01-10
2.4GHz Filter	Micro-Tronics	BRM 50702	EMC2069	2019-01-11	2020-01-10
10m Semi-Anechoic Chamber	ETS	N/A	EMC0530	2017-06-18	2019-06-18
966 Anechoic Chamber	C.R.T	9m x 6m x 6m	EMC2142	2017-12-19	2019-12-18
MXE EMI Receiver	Keysight	N9038A	EMC2139	2018-11-19	2019-11-18
EXA Signal Analyzer	Keysight	N9010A	EMC2138	2018-11-19	2019-11-18
Trilog Broadband Antenna 30MHz-1GHz	SCHWARZBECKME SS-ELEKTRONIK	VULB 9168	SEM003-18	2016-06-29	2019-06-28
Test Software E3	Audix	Ver.6.120110a	GZE100-61	N/A	N/A

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<b>Radiated Spurious Emissions</b>					
<b>Equipment</b>	<b>Manufacturer</b>	<b>Model No</b>	<b>Inventory No</b>	<b>Cal Date</b>	<b>Cal Due Date</b>
EMI Test Receiver	Rohde & Schwarz	ESIB26	EMC0522	2019-01-20	2020-01-19
EMI Test Receiver	Rohde & Schwarz	ESCI	EMC0056	2019-01-20	2020-01-19
Chamber cable	HangTianXing	N/A	EMC0542	2017-06-30	2019-06-30
Trilog Broadband Antenna 30MHz-1GHz	SCHWARZBECKME SS-ELEKTRONIK	VULB 9160	EMC2025	2016-09-08	2019-09-07
Bi-log Type Antenna	Schaffner -Chase	CBL6112B	EMC0524	2016-09-08	2019-09-07
Bi-log Type Antenna	Schaffner -Chase	CBL6143	EMC0519	2017-05-04	2020-05-03
Horn Antenna 1GHz-18GHz	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120D	EMC2026	2016-09-09	2019-09-08
1GHz-26.5 GHz Pre-Amplifier	Agilent	8449B	EMC0521	2019-01-07	2020-01-08
Amplifier	HP	8447F	EMC2065	2018-06-01	2019-05-31
Pre-Amplifier MH648A	ANRITSU CORP	MH648A	EMC2086	2018-11-19	2019-11-18
Active Loop Antenna	EMCO	6502	EMC0523	2018-03-05	2020-03-04
High Pass Filter(915MHz)	FSY MICROWAVE	HM1465-9SS	EMC2079	2019-01-11	2020-01-10
2.4GHz Filter	Micro-Tronics	BRM 50702	EMC2069	2019-01-11	2020-01-10
10m Semi-Anechoic Chamber	ETS	N/A	EMC0530	2017-06-18	2019-06-18
966 Anechoic Chamber	C.R.T	9m x 6m x 6m	EMC2142	2017-12-19	2019-12-18
MXE EMI Receiver	Keysight	N9038A	EMC2139	2018-11-19	2019-11-18
EXA Signal Analyzer	Keysight	N9010A	EMC2138	2018-11-19	2019-11-18
Trilog Broadband Antenna 30MHz-1GHz	SCHWARZBECKME SS-ELEKTRONIK	VULB 9168	SEM003-18	2016-06-29	2019-06-28
Test Software E3	Audix	Ver.6.120110a	GZE100-61	N/A	N/A

<b>General used equipment</b>					
<b>Equipment</b>	<b>Manufacturer</b>	<b>Model No</b>	<b>Inventory No</b>	<b>Cal Date</b>	<b>Cal Due Date</b>
DMM	Fluke	73	EMC0006	2018-07-20	2019-07-19
DMM	Fluke	73	EMC0007	2018-07-19	2019-07-18

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## 6 Radio Spectrum Technical Requirement

### 6.1 Antenna Requirement

#### 6.1.1 Test Requirement:

47 CFR Part 15, Subpart C 15.203 & 15.247(c)

#### 6.1.2 Conclusion

Standard 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, 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.

15.247(b) (4) requirement:

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

EUT Antenna:

The antenna is integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is 0dBi.



**Test result: The unit does meet the FCC requirements.**



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## **6.2 Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence**

### **6.2.1 Test Requirement:**

47 CFR Part 15, Subpart C 15.247(a)(1),(g),(h)

### **6.2.2 Conclusion**

Standard Requirement:

The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

Compliance for section 15.247(a)(1):

According to Technical Specification, the pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONEs; i.e. the shift register is initialized with nine ones.

> Number of shift register stages: 9

> Length of pseudo-random sequence:  $2^9 - 1 = 511$  bits

> Longest sequence of zeros: 8 (non-inverted signal)

Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:

Each frequency used equally on the average by each transmitter.

According to Technical Specification, the receivers are designed to have input and IF bandwidths that match the hopping channel bandwidths of any transmitters and shift frequencies in synchronization with the transmitted signals.

Compliance for section 15.247(g):

According to Technical Specification, the system transmits the packet with the pseudorandom hopping frequency with a continuous data and the short burst transmission from the Bluetooth system is also transmitted under the frequency hopping system with the pseudorandom hopping frequency system.

Compliance for section 15.247(h):

According to Technical specification, the system incorporates with an adaptive system to detect other user within the spectrum bands



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## 7 Radio Spectrum Matter Test Results

### 7.1 Conducted Emissions at AC Power Line (150kHz-30MHz)

Test Requirement 47 CFR Part 15, Subpart C 15.207

Test Method: ANSI C63.10 (2013) Section 6.2

Limit:

Frequency of emission(MHz)	Conducted limit(dB $\mu$ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

\*Decreases with the logarithm of the frequency.



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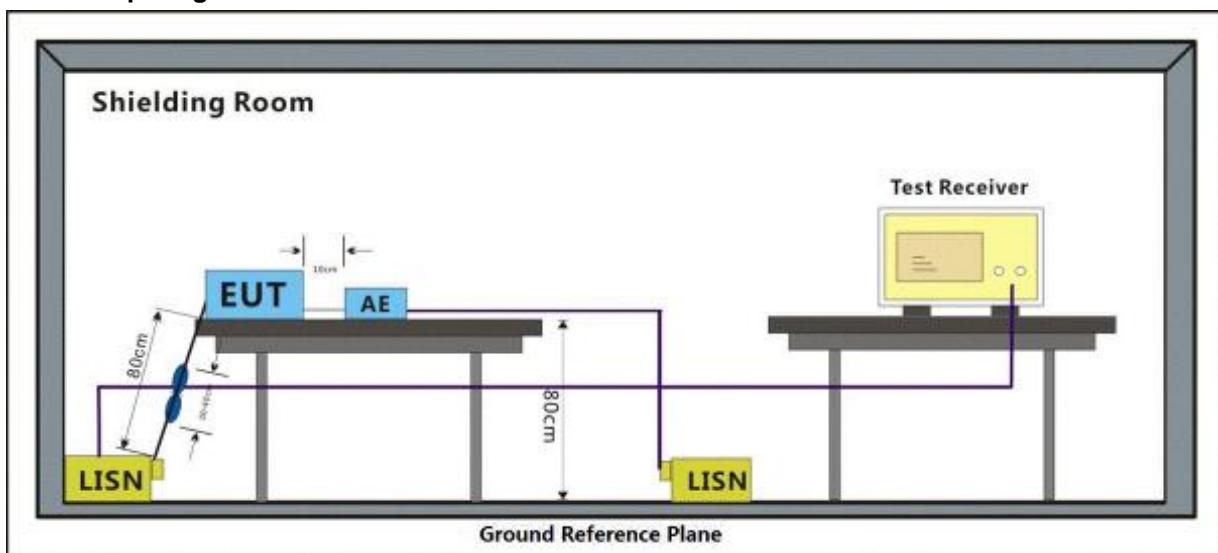
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### 7.1.1 E.U.T. Operation

Operating Environment:

Temperature: 25.8 °C      Humidity: 52 % RH      Atmospheric Pressure: 1020 mbar  
 Test mode      b:TX\_non-Hop mode\_Keep the EUT in continuously transmitting mode with GFSK modulation,  $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

### 7.1.2 Test Setup Diagram



### 7.1.3 Measurement Procedure and Data

- 1) The mains terminal disturbance voltage test was conducted in a shielded room.
- 2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50ohm/50 $\mu$ H + 5ohm linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
- 3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane,
- 4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.
- 5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.

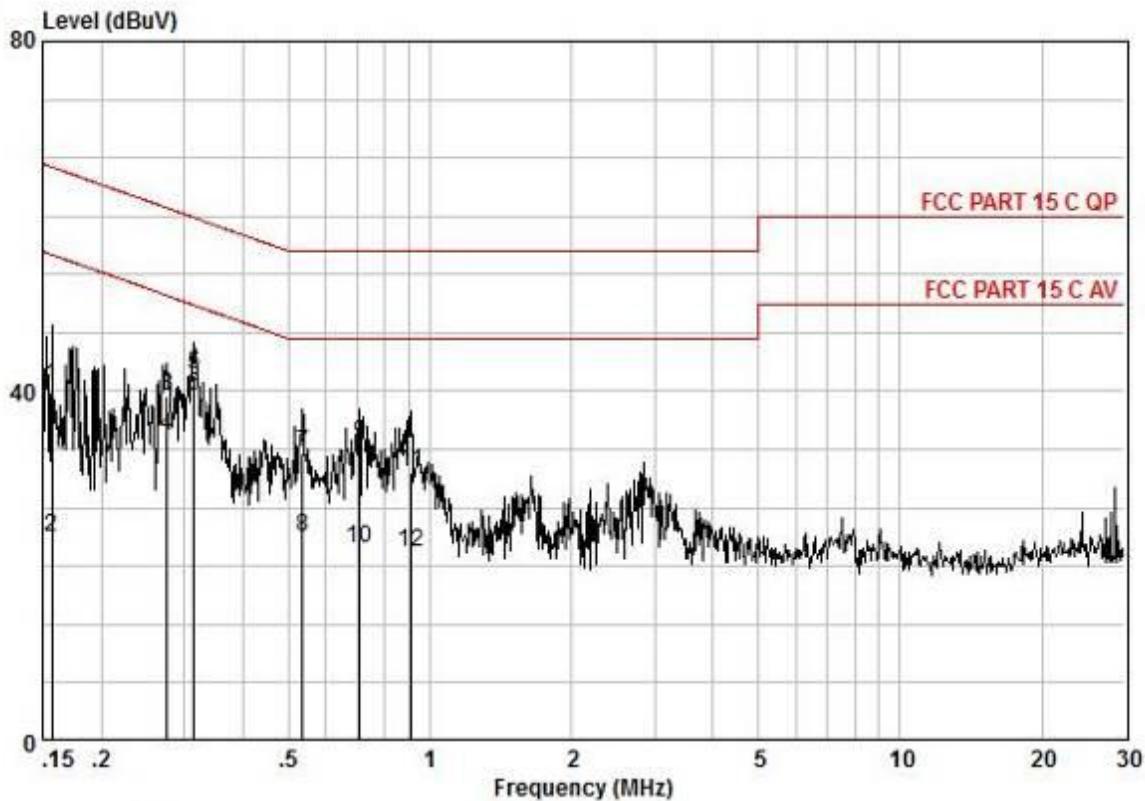
Remark: LISN=Read Level+ Cable Loss+ LISN Factor



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Mode:b; Line:Live Line



Pol :LIVE  
No :SUBWOOFER  
Model :

Frequency MHz	read level dBuV	Cable Loss dB	LISN Factor dB	Measured level dBuV	Limit Line dBuV	Over limit dB	Remark
0.16	30.73	0.10	9.67	40.50	65.65	-25.15	QP
0.16	13.46	0.10	9.67	23.23	55.65	-32.42	AVERAGE
0.28	29.62	0.10	9.67	39.39	60.94	-21.55	QP
0.28	25.17	0.10	9.67	34.94	50.94	-16.00	AVERAGE
0.31	32.08	0.10	9.67	41.85	59.84	-17.99	QP
0.31	29.66	0.10	9.67	39.43	49.84	-10.41	AVERAGE
0.53	23.24	0.10	9.67	33.01	56.00	-22.99	QP
0.53	13.56	0.10	9.67	23.33	46.00	-22.67	AVERAGE
0.71	24.26	0.10	9.67	34.03	56.00	-21.97	QP
0.71	12.33	0.10	9.67	22.10	46.00	-23.90	AVERAGE
0.91	20.91	0.10	9.67	30.68	56.00	-25.32	QP
0.91	11.87	0.10	9.67	21.64	46.00	-24.36	AVERAGE

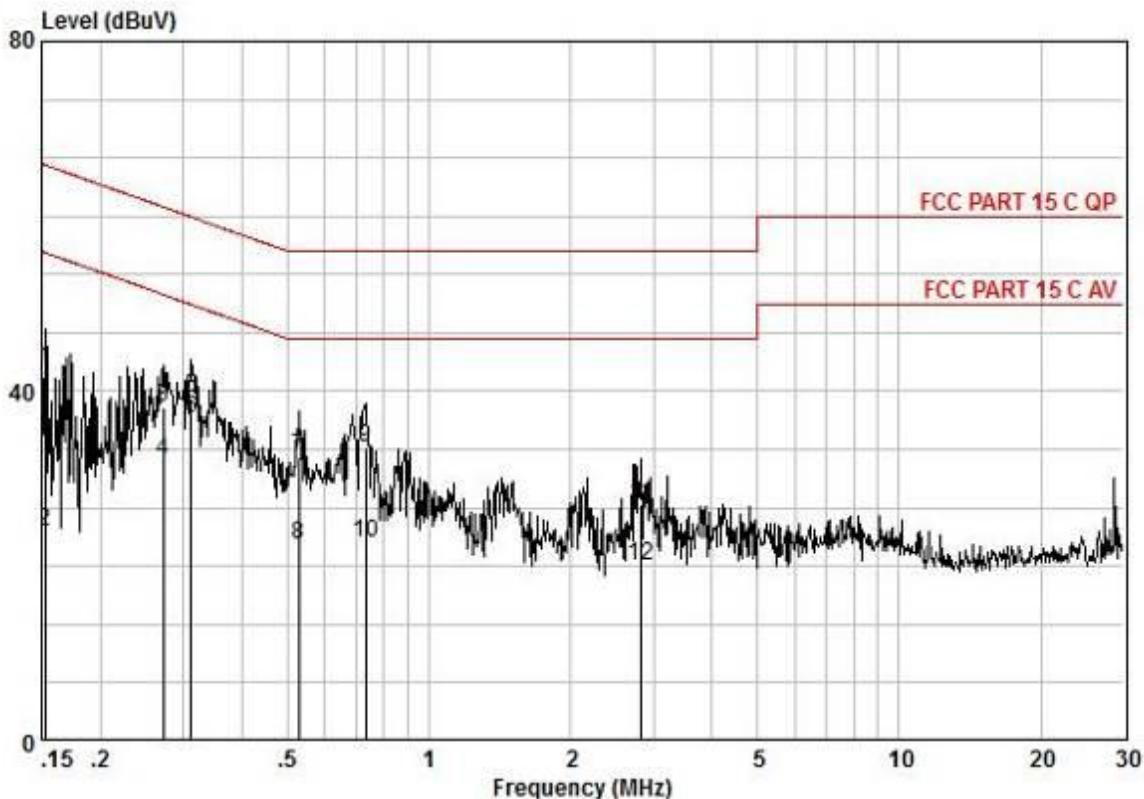
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Mode:b; Line:Neutral Line



Pol : NEUTRAL  
No : SUBWOOFER  
Model :

Frequency MHz	read level dBuV	Cable Loss dB	LISN Factor dB	Measured level dBuV	Limit Line dBuV	Over limit dB	Remark
0.15	32.80	0.10	9.58	42.48	65.87	-23.39	QP
0.15	14.22	0.10	9.58	23.90	55.87	-31.97	AVERAGE
0.27	28.48	0.10	9.59	38.17	61.07	-22.90	QP
0.27	22.29	0.10	9.59	31.98	51.07	-19.09	AVERAGE
0.31	29.56	0.10	9.59	39.25	59.93	-20.68	QP
0.31	27.24	0.10	9.59	36.93	49.93	-13.00	AVERAGE
0.53	22.87	0.10	9.60	32.57	56.00	-23.43	QP
0.53	12.86	0.10	9.60	22.56	46.00	-23.44	AVERAGE
0.73	23.89	0.10	9.60	33.59	56.00	-22.41	QP
0.73	13.00	0.10	9.60	22.70	46.00	-23.30	AVERAGE
2.82	17.82	0.19	9.62	27.13	56.00	-28.87	QP
2.82	10.15	0.19	9.62	19.96	46.00	-26.04	AVERAGE

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## 7.2 Conducted Peak Output Power

Test Requirement 47 CFR Part 15, Subpart C 15.247(b)(1)

Test Method: ANSI C63.10 (2013) Section 7.8.5

Limit:

Frequency range(MHz)	Output power of the intentional radiator(watt)
902-928	1 for $\geq 50$ hopping channels
	0.25 for $25 \leq$ hopping channels $< 50$
	1 for digital modulation
2400-2483.5	1 for $\geq 75$ non-overlapping hopping channels
	0.125 for all other frequency hopping systems
	1 for digital modulation
5725-5850	1 for frequency hopping systems and digital modulation



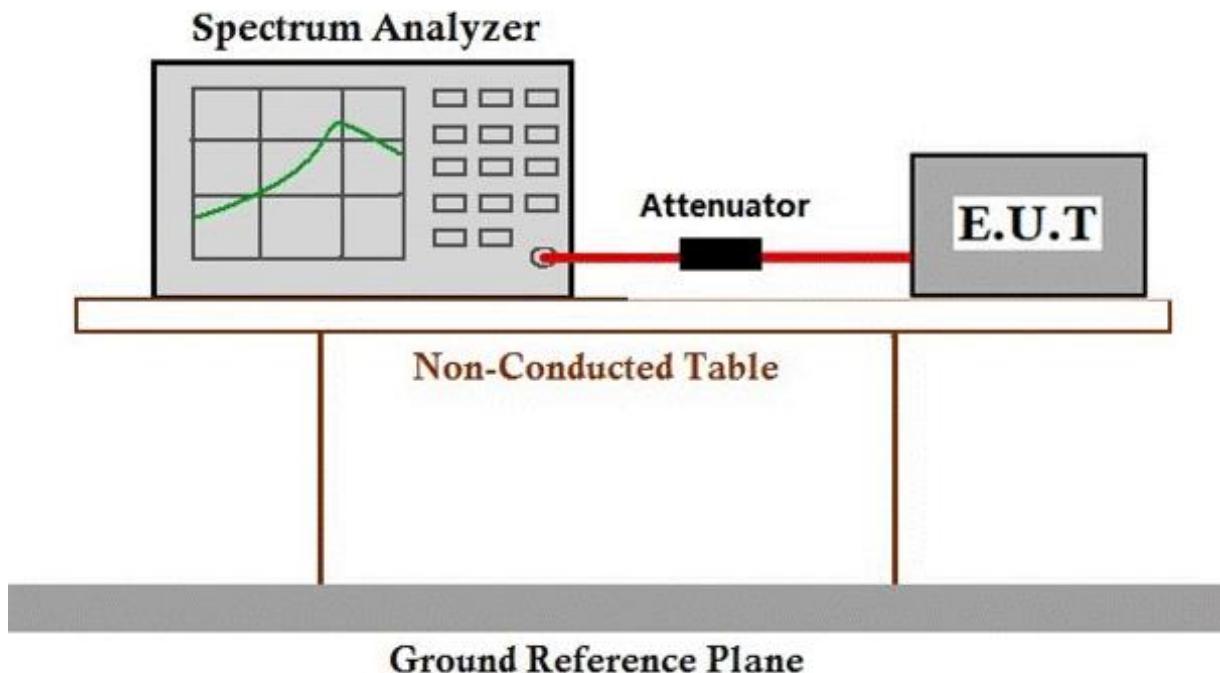
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**7.2.1 E.U.T. Operation**

Operating Environment:

Temperature: 25.2 °C      Humidity: 71.2 % RH      Atmospheric Pressure: 1020 mbar  
Test mode b:TX\_non-Hop mode\_Keep the EUT in continuously transmitting mode with GFSK modulation,  $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

**7.2.2 Test Setup Diagram****7.2.3 Measurement Procedure and Data**

The detailed test data see: Appendix 15.247

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### 7.3 20dB Bandwidth

Test Requirement 47 CFR Part 15, Subpart C 15.247(a)(1)

Test Method: ANSI C63.10 (2013) Section 7.8.7

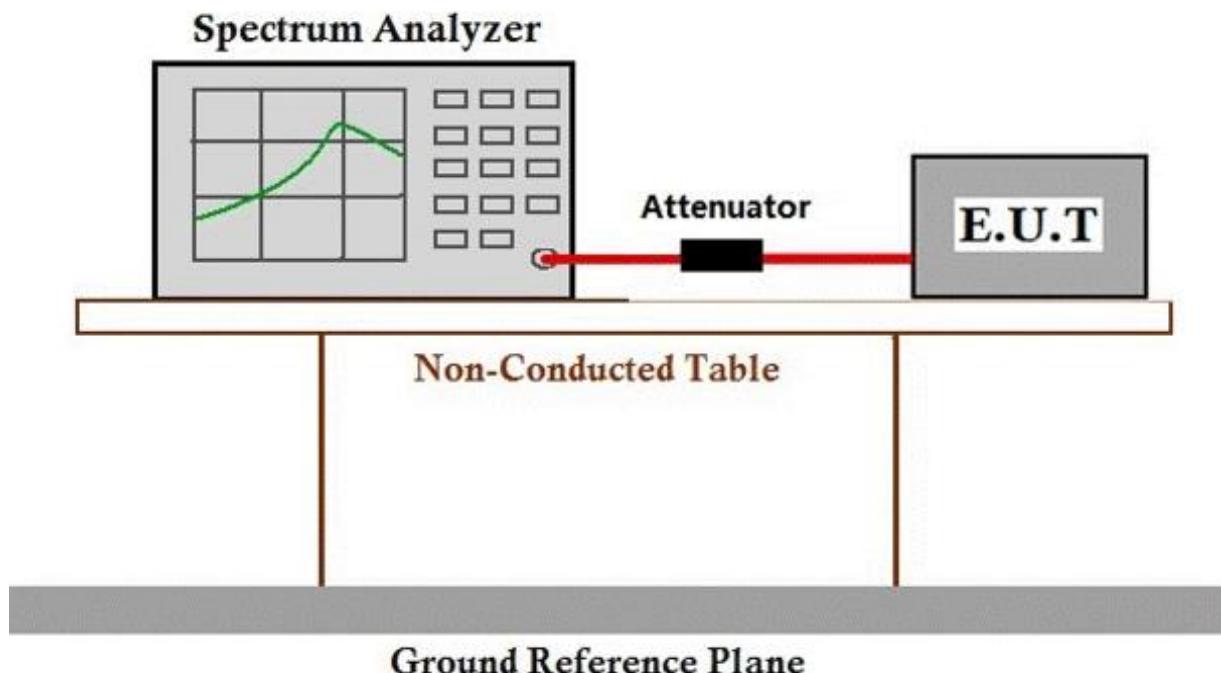
#### 7.3.1 E.U.T. Operation

Operating Environment:

Temperature: 25.2 °C Humidity: 71.2 % RH Atmospheric Pressure: 1020 mbar

Test mode b:TX\_non-Hop mode\_Keep the EUT in continuously transmitting mode with GFSK modulation,  $\pi/4$ DDQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

#### 7.3.2 Test Setup Diagram



#### 7.3.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247



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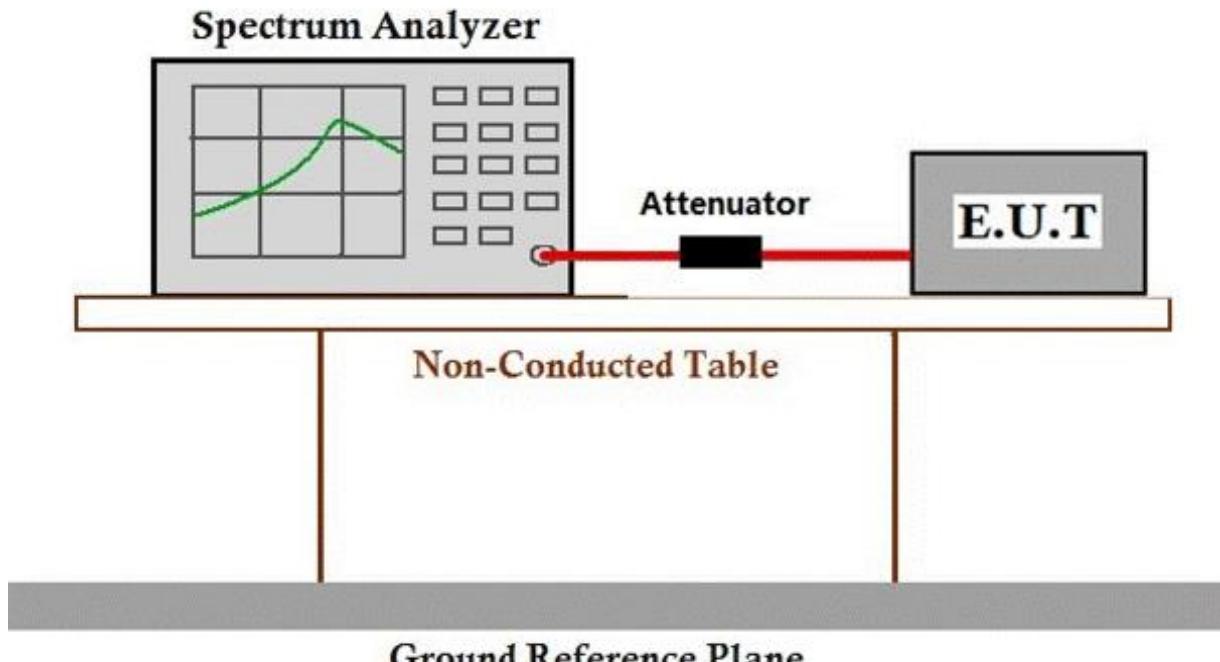
## 7.4 Carrier Frequencies Separation

Test Requirement 47 CFR Part 15, Subpart C 15.247a(1)  
Test Method: ANSI C63.10 (2013) Section 7.8.2  
Limit: 2/3 of the 20dB bandwidth base on the transmission power is less than 0.125W

### 7.4.1 E.U.T. Operation

Operating Environment:  
Temperature: 25.2 °C Humidity: 71.2 % RH Atmospheric Pressure: 1020 mbar  
Test mode a:TX\_Hop mode\_Keep the EUT in frequency hopping mode with GFSK modulation, π/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

### 7.4.2 Test Setup Diagram



### 7.4.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247



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## 7.5 Hopping Channel Number

Test Requirement 47 CFR Part 15, Subpart C 15.247a(1)(iii)

Test Method: ANSI C63.10 (2013) Section 7.8.3

Limit:

Frequency range(MHz)	Number of hopping channels (minimum)
902-928	50 for 20dB bandwidth <250kHz
	25 for 20dB bandwidth $\geq$ 250kHz
2400-2483.5	15
5725-5850	75

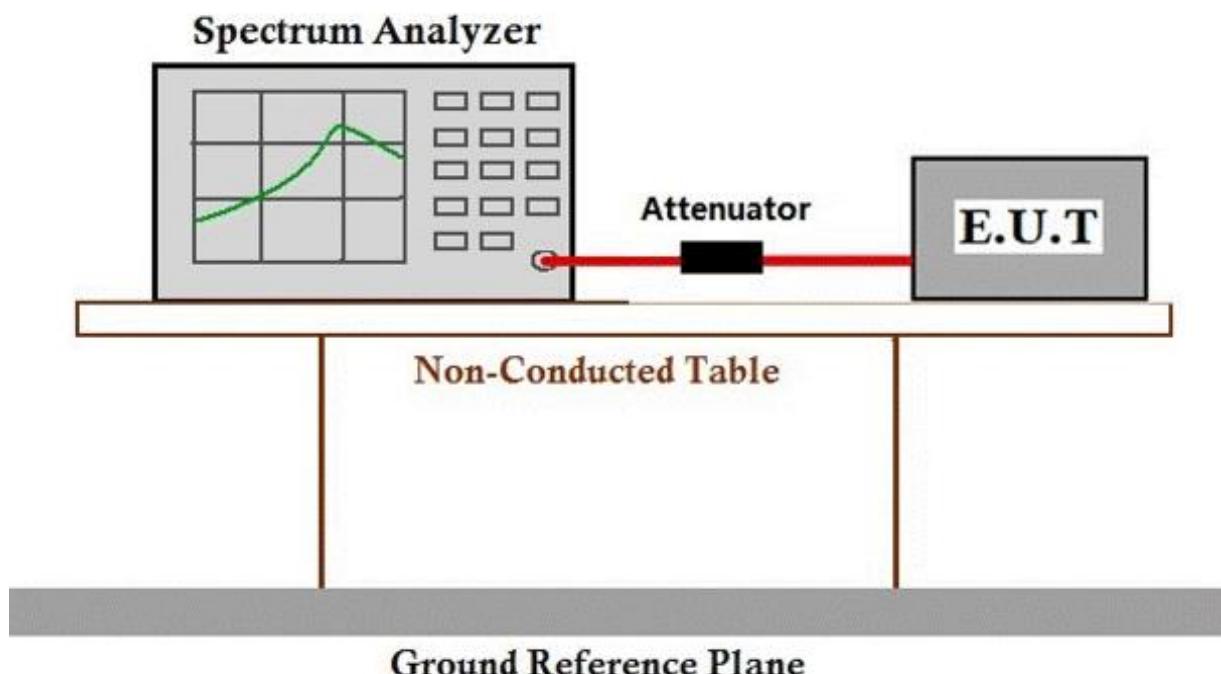
### 7.5.1 E.U.T. Operation

Operating Environment:

Temperature: 25.2 °C Humidity: 71.2 % RH Atmospheric Pressure: 1020 mbar

Test mode a:TX\_Hop mode\_Keep the EUT in frequency hopping mode with GFSK modulation,  $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

### 7.5.2 Test Setup Diagram



### 7.5.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247



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## 7.6 Dwell Time

Test Requirement 47 CFR Part 15, Subpart C 15.247a(1)(iii)

Test Method: ANSI C63.10 (2013) Section 7.8.4

Limit:

Frequency(MHz)	Limit
902-928	0.4S within a 20S period(20dB bandwidth<250kHz)
	0.4S within a 10S period(20dB bandwidth≥250kHz)
2400-2483.5	0.4S within a period of 0.4S multiplied by the number of hopping channels
5725-5850	0.4S within a 30S period



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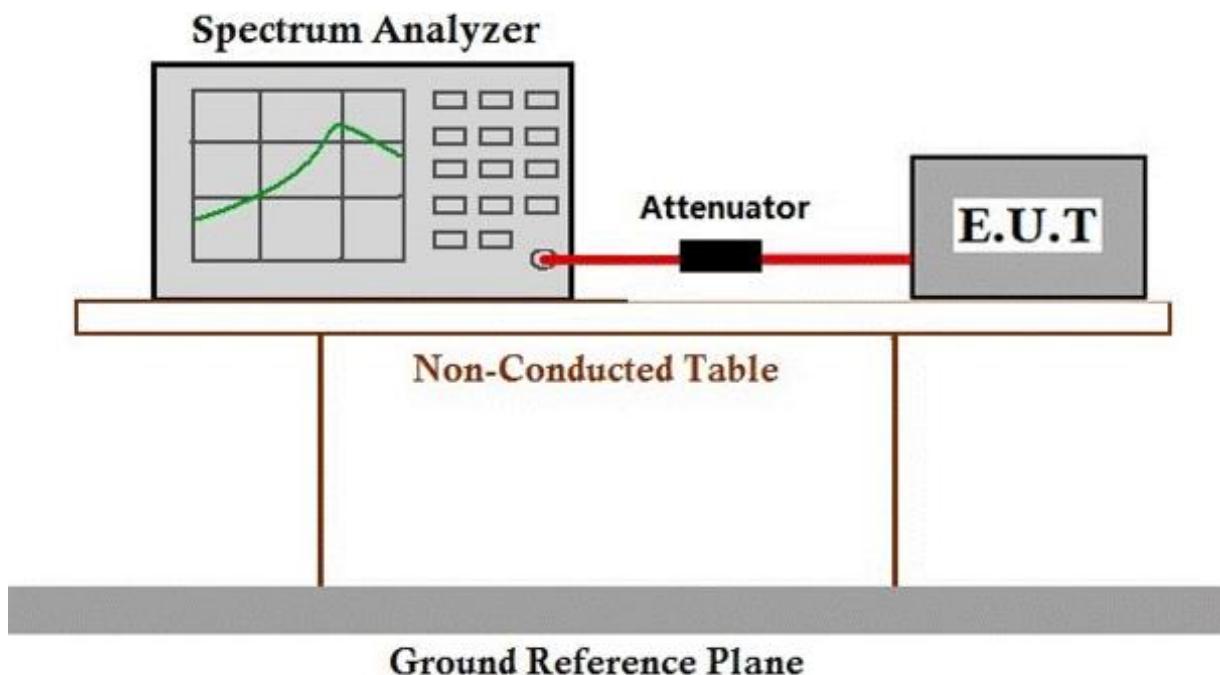
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**7.6.1 E.U.T. Operation**

Operating Environment:

Temperature: 25.2 °C      Humidity: 71.1 % RH      Atmospheric Pressure: 1020 mbar  
Test mode a:TX\_Hop mode\_Keep the EUT in frequency hopping mode with GFSK modulation, π/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

**7.6.2 Test Setup Diagram****7.6.3 Measurement Procedure and Data**

The detailed test data see: Appendix 15.247

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## 7.7 Conducted Band Edges Measurement

Test Requirement	47 CFR Part 15, Subpart C 15.247(d)
Test Method:	ANSI C63.10 (2013) Section 7.8.6
Limit:	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))



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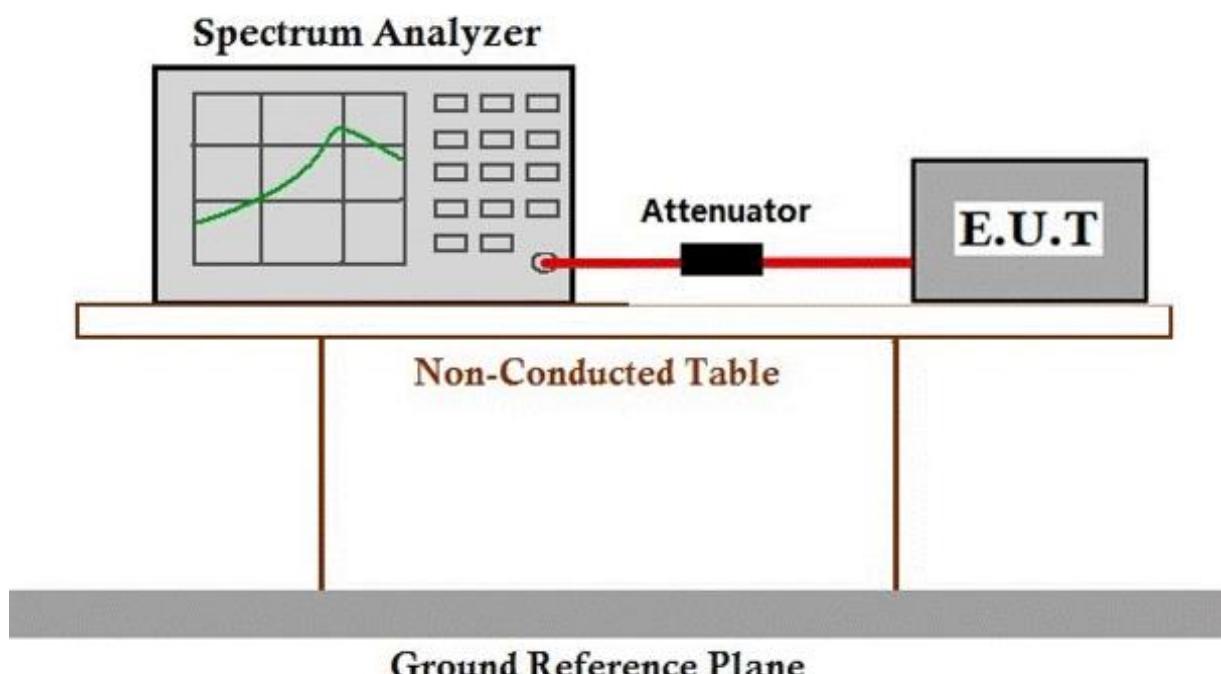
**7.7.1 E.U.T. Operation**

## Operating Environment:

Temperature: 25.2 °C Humidity: 70.7 % RH Atmospheric Pressure: 1020 mbar

Test mode: a:TX\_Hop mode\_Keep the EUT in frequency hopping mode with GFSK modulation, π/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

b:TX\_non-Hop mode\_Keep the EUT in continuously transmitting mode with GFSK modulation, π/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

**7.7.2 Test Setup Diagram****7.7.3 Measurement Procedure and Data**

The detailed test data see: Appendix 15.247

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## **7.8 Conducted Spurious Emissions**

Test Requirement	47 CFR Part 15, Subpart C 15.247(d)
Test Method:	ANSI C63.10 (2013) Section 7.8.8
Limit:	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))



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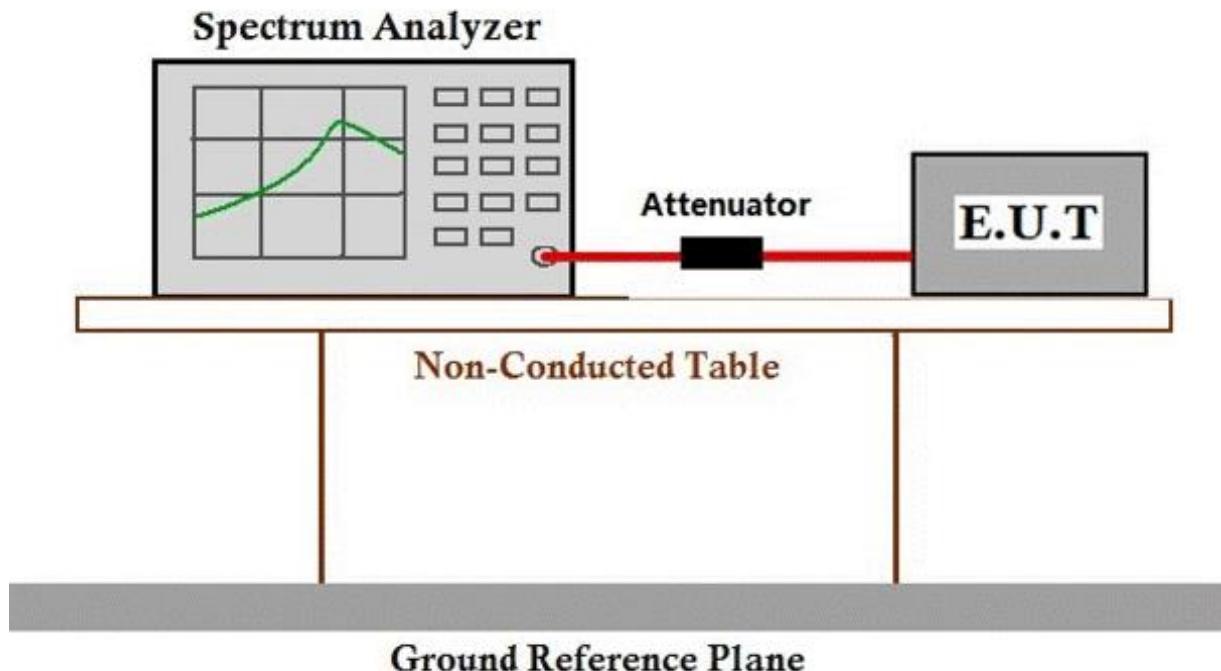
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**7.8.1 E.U.T. Operation**

## Operating Environment:

Temperature: 25.2 °C      Humidity: 71.1 % RH      Atmospheric Pressure: 1020 mbar  
Test mode b:TX\_non-Hop mode\_Keep the EUT in continuously transmitting mode with GFSK modulation,  $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

**7.8.2 Test Setup Diagram****7.8.3 Measurement Procedure and Data**

The detailed test data see: Appendix 15.247

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## 7.9 Radiated Emissions which fall in the restricted bands

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209  
Test Method: ANSI C63.10 (2013) Section 6.10.5  
Measurement Distance: 3m  
Limit:

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

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

### 7.9.1 E.U.T. Operation

Operating Environment:

Temperature: 24.3 °C Humidity: 57.9 % RH Atmospheric Pressure: 1020 mbar

Test mode b:TX\_non-Hop mode\_Keep the EUT in continuously transmitting mode with GFSK modulation,  $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.



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## 7.9.2 Test Setup Diagram

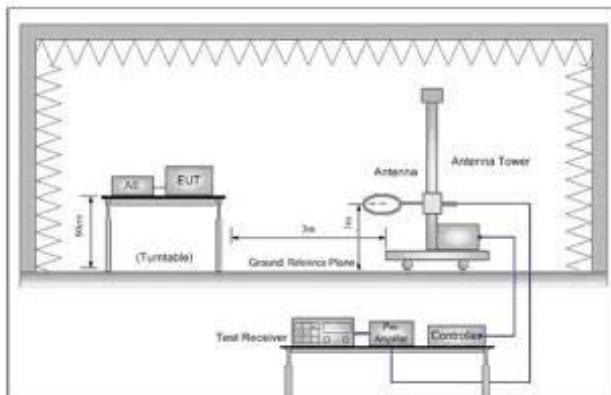


Figure 1. Below 30MHz

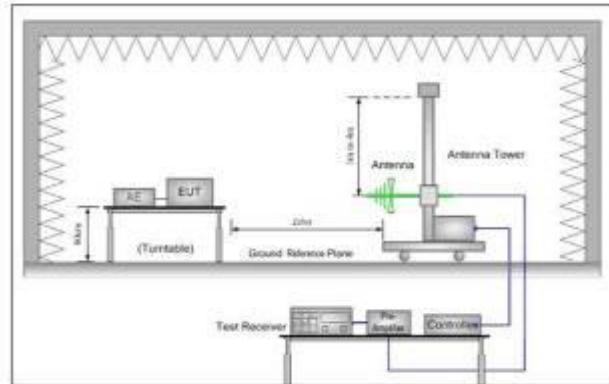


Figure 2. 30MHz to 1GHz

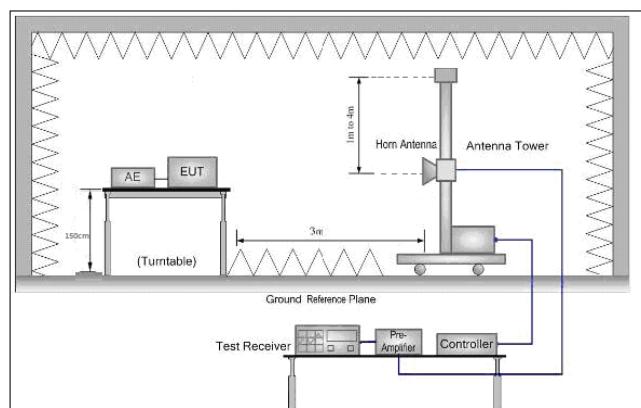


Figure 3. Above 1 GHz

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### 7.9.3 Measurement Procedure and Data

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

Remark 1: Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor

Remark 2: For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

Level=Read Level + Antenna Factor + Cable Loss - Preamp Factor

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Mode:b; Polarization:Horizontal; Modulation:GFSK; ; Channel:Low

Freq	ReadAntenna		Cable Preamp		Limit Line	Over Limit	Pol/Phase	Remark
	Level	Factor	Loss	Factor				
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB
1	2310.000	34.82	26.25	5.03	37.44	28.66	54.00	-25.34 HORIZONTAL Average
2	2310.000	48.62	26.25	5.03	37.44	42.46	74.00	-31.54 HORIZONTAL Peak
3	2390.000	34.88	26.43	4.88	37.42	28.77	54.00	-25.23 HORIZONTAL Average
4	2390.000	48.32	26.43	4.88	37.42	42.21	74.00	-31.79 HORIZONTAL Peak
5	2483.500	31.23	26.58	5.23	37.40	25.64	54.00	-28.36 HORIZONTAL Average
6	2483.500	46.65	26.58	5.23	37.40	41.06	74.00	-32.94 HORIZONTAL Peak
7	2500.000	31.76	26.60	4.95	37.39	25.92	54.00	-28.08 HORIZONTAL Average
8	2500.000	46.88	26.60	4.95	37.39	41.04	74.00	-32.96 HORIZONTAL Peak

Mode:b; Polarization:Vertical; Modulation:GFSK; ; Channel:Low

Freq	ReadAntenna		Cable Preamp		Limit Line	Over Limit	Pol/Phase	Remark
	Level	Factor	Loss	Factor				
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB
1	2310.000	32.36	26.25	5.03	37.44	26.20	54.00	-27.80 VERTICAL Average
2	2310.000	45.49	26.25	5.03	37.44	39.33	74.00	-34.67 VERTICAL Peak
3	2390.000	33.26	26.43	4.88	37.42	27.15	54.00	-26.85 VERTICAL Average
4	2390.000	46.01	26.43	4.88	37.42	39.90	74.00	-34.10 VERTICAL Peak
5	2483.500	30.55	26.58	5.23	37.40	24.96	54.00	-29.04 VERTICAL Average
6	2483.500	45.72	26.58	5.23	37.40	40.13	74.00	-33.87 VERTICAL Peak
7	2500.000	30.33	26.60	4.95	37.39	24.49	54.00	-29.51 VERTICAL Average
8	2500.000	46.76	26.60	4.95	37.39	40.92	74.00	-33.08 VERTICAL Peak

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Mode:b; Polarization:Horizontal; Modulation:GFSK; ; Channel:High

Freq	ReadAntenna		Cable Preamp		Limit Line	Over Limit	Pol/Phase	Remark
	Level	Factor	Loss	Factor				
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB
1	2310.000	34.23	26.25	5.03	37.44	28.07	54.00	-25.93 HORIZONTAL Average
2	2310.000	47.65	26.25	5.03	37.44	41.49	74.00	-32.51 HORIZONTAL Peak
3	2390.000	33.09	26.43	4.88	37.42	26.98	54.00	-27.02 HORIZONTAL Average
4	2390.000	47.27	26.43	4.88	37.42	41.16	74.00	-32.84 HORIZONTAL Peak
5	2483.500	38.00	26.58	5.23	37.40	32.41	54.00	-21.59 HORIZONTAL Average
6	2483.500	52.41	26.58	5.23	37.40	46.82	74.00	-27.18 HORIZONTAL Peak
7	2500.000	32.65	26.60	4.95	37.39	26.81	54.00	-27.19 HORIZONTAL Average
8	2500.000	47.23	26.60	4.95	37.39	41.39	74.00	-32.61 HORIZONTAL Peak

Mode:b; Polarization:Vertical; Modulation:GFSK; ; Channel:High

Freq	ReadAntenna		Cable Preamp		Limit Line	Over Limit	Pol/Phase	Remark
	Level	Factor	Loss	Factor				
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB
1	2310.000	33.44	26.25	5.03	37.44	27.28	54.00	-26.72 VERTICAL Average
2	2310.000	47.62	26.25	5.03	37.44	41.46	74.00	-32.54 VERTICAL Peak
3	2390.000	33.17	26.43	4.88	37.42	27.06	54.00	-26.94 VERTICAL Average
4	2390.000	47.20	26.43	4.88	37.42	41.09	74.00	-32.91 VERTICAL Peak
5	2483.500	40.93	26.58	5.23	37.40	35.34	54.00	-18.66 VERTICAL Average
6	2483.500	52.19	26.58	5.23	37.40	46.60	74.00	-27.40 VERTICAL Peak
7	2500.000	32.10	26.60	4.95	37.39	26.26	54.00	-27.74 VERTICAL Average
8	2500.000	46.89	26.60	4.95	37.39	41.05	74.00	-32.95 VERTICAL Peak

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## 7.10 Radiated Spurious Emissions

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209

Test Method: ANSI C63.10 (2013) Section 6.4,6.5,6.6

Measurement Distance: 3m

Limit:

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

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.



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**7.10.1 E.U.T. Operation**

Operating Environment:

Temperature: 24.3 °C      Humidity: 57.9 % RH      Atmospheric Pressure: 1020 mbar  
Test mode b:TX\_non-Hop mode\_Keep the EUT in continuously transmitting mode with GFSK modulation,  $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

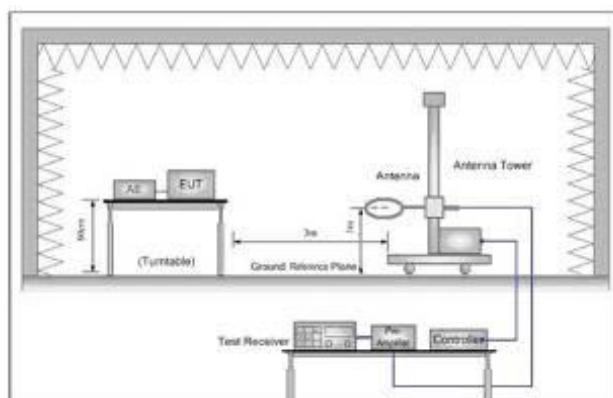
**7.10.2 Test Setup Diagram**

Figure 1. Below 30MHz

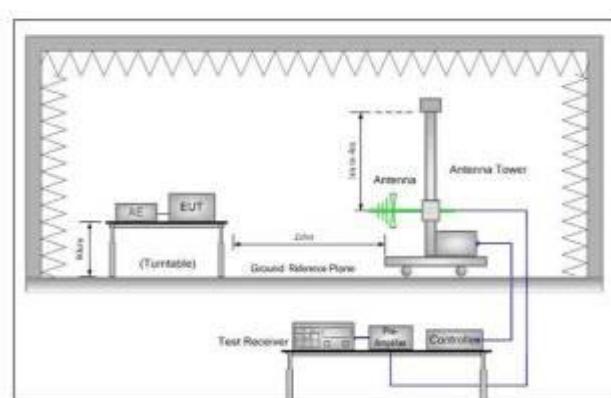


Figure 2. 30MHz to 1GHz

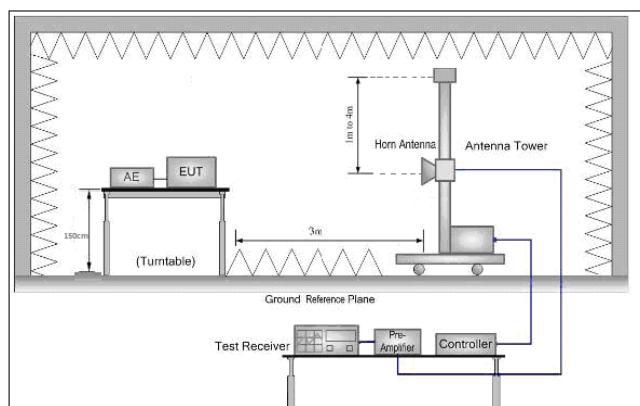


Figure 3. Above 1 GHz

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### **7.10.3 Measurement Procedure and Data**

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

Remark:

- 1) For emission below 1GHz, through pre-scan found the worst case is the lowest channel. Only the worst case is recorded in the report.
- 2) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

Final Test Level = Receiver Reading + Antenna Factor + Cable Factor - Preamplifier Factor

- 3) Scan from 9kHz to 25GHz, the disturbance above 18GHz and below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.

- 4) For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown



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Mode:b; Polarization:Horizontal; Modulation:GFSK; ; Channel:Low

Freq	ReadAntenna		Cable Preamp		Limit Level	Line	Over Limit	Pol/Phase	Remark
	Level	Factor	Loss	Factor					
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	50.409	35.25	12.98	0.60	29.50	19.33	40.00	-20.67	HORIZONTAL QP
2	72.592	31.97	10.34	0.74	29.41	13.64	40.00	-26.36	HORIZONTAL QP
3	147.404	29.17	13.20	1.14	29.40	14.11	43.50	-29.39	HORIZONTAL QP
4	535.707	29.71	18.96	2.23	29.57	21.33	46.00	-24.67	HORIZONTAL QP
5	656.530	29.62	21.12	2.12	29.48	23.38	46.00	-22.62	HORIZONTAL QP
6	912.862	28.55	24.10	3.45	28.50	27.60	46.00	-18.40	HORIZONTAL QP

Mode:b; Polarization:Horizontal; Modulation:GFSK; ; Channel:Low

Freq	ReadAntenna		Cable Preamp		Limit Level	Line	Over Limit	Pol/Phase	Remark
	Level	Factor	Loss	Factor					
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	4804.760	32.90	30.79	5.87	36.94	32.62	54.00	-21.38	HORIZONTAL Average
2	4804.760	46.28	30.79	5.87	36.94	46.00	74.00	-28.00	HORIZONTAL Peak
3	6285.695	29.15	33.51	6.95	36.99	32.62	54.00	-21.38	HORIZONTAL Average
4	6285.695	44.06	33.51	6.95	36.99	47.53	74.00	-26.47	HORIZONTAL Peak
5	7206.309	28.45	35.45	7.34	36.93	34.31	54.00	-19.69	HORIZONTAL Average
6	7206.309	44.72	35.45	7.34	36.93	50.58	74.00	-23.42	HORIZONTAL Peak
7	8248.005	29.33	36.30	8.21	36.92	36.92	54.00	-17.08	HORIZONTAL Average
8	8248.005	44.29	36.30	8.21	36.92	51.88	74.00	-22.12	HORIZONTAL Peak
9	9608.710	31.94	37.51	8.15	37.08	40.52	54.00	-13.48	HORIZONTAL Average
10	9608.710	46.04	37.51	8.15	37.08	54.62	74.00	-19.38	HORIZONTAL Peak
11	12010.070	27.55	39.50	10.67	37.20	40.52	54.00	-13.48	HORIZONTAL Average
12	12010.070	40.99	39.50	10.67	37.20	53.96	74.00	-20.04	HORIZONTAL Peak

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Mode:b; Polarization:Vertical; Modulation:GFSK; ; Channel:Low

Freq	ReadAntenna		Cable Preamp		Limit Level	Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	Level Factor	Loss Factor					
1	31.955	30.88	12.25	0.11	29.81	13.43	40.00	-26.57	VERTICAL QP
2	120.277	30.94	11.52	0.92	29.40	13.98	43.50	-29.52	VERTICAL QP
3	159.784	28.18	13.40	1.26	29.40	13.44	43.50	-30.06	VERTICAL QP
4	570.610	29.37	20.14	1.94	29.53	21.92	46.00	-24.08	VERTICAL QP
5	848.056	27.99	23.35	2.92	29.16	25.10	46.00	-20.90	VERTICAL QP
6	935.546	28.31	24.35	3.64	28.30	28.00	46.00	-18.00	VERTICAL QP

Mode:b; Polarization:Vertical; Modulation:GFSK; ; Channel:Low

Freq	ReadAntenna		Cable Preamp		Limit Level	Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	Level Factor	Loss Factor					
1	3823.371	30.44	29.08	7.83	36.91	30.44	54.00	-23.56	VERTICAL Average
2	3823.371	45.08	29.08	7.83	36.91	45.08	74.00	-28.92	VERTICAL Peak
3	4804.993	31.42	30.79	5.87	36.94	31.14	54.00	-22.86	VERTICAL Average
4	4804.993	46.60	30.79	5.87	36.94	46.32	74.00	-27.68	VERTICAL Peak
5	7206.092	29.27	35.45	7.34	36.93	35.13	54.00	-18.87	VERTICAL Average
6	7206.092	44.41	35.45	7.34	36.93	50.27	74.00	-23.73	VERTICAL Peak
7	8224.200	26.91	36.33	8.23	36.92	34.55	54.00	-19.45	VERTICAL Average
8	8224.200	44.52	36.33	8.23	36.92	52.16	74.00	-21.84	VERTICAL Peak
9	9608.689	29.61	37.51	8.15	37.08	38.19	54.00	-15.81	VERTICAL Average
10	9608.689	45.15	37.51	8.15	37.08	53.73	74.00	-20.27	VERTICAL Peak
11	12010.280	25.89	39.50	10.67	37.20	38.86	54.00	-15.14	VERTICAL Average
12	12010.280	41.65	39.50	10.67	37.20	54.62	74.00	-19.38	VERTICAL Peak

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Mode:b; Polarization:Horizontal; Modulation:GFSK; ; Channel:middle

Freq	ReadAntenna		Cable Preamp		Limit Level	Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB					
1	3757.637	30.92	28.82	7.65	36.92	30.47	54.00	-23.53	HORIZONTAL Average
2	3757.637	45.49	28.82	7.65	36.92	45.04	74.00	-28.96	HORIZONTAL Peak
3	4884.151	30.86	30.95	6.86	36.95	31.72	54.00	-22.28	HORIZONTAL Average
4	4884.151	45.81	30.95	6.86	36.95	46.67	74.00	-27.33	HORIZONTAL Peak
5	7323.999	28.55	35.74	7.39	36.92	34.76	54.00	-19.24	HORIZONTAL Average
6	7323.999	43.36	35.74	7.39	36.92	49.57	74.00	-24.43	HORIZONTAL Peak
7	8271.880	28.45	36.27	8.19	36.92	35.99	54.00	-18.01	HORIZONTAL Average
8	8271.880	44.24	36.27	8.19	36.92	51.78	74.00	-22.22	HORIZONTAL Peak
9	9764.257	29.42	37.70	8.33	37.09	38.36	54.00	-15.64	HORIZONTAL Average
10	9764.257	45.04	37.70	8.33	37.09	53.98	74.00	-20.02	HORIZONTAL Peak
11	12205.450	25.90	39.21	10.98	37.06	39.03	54.00	-14.97	HORIZONTAL Average
12	12205.450	41.06	39.21	10.98	37.06	54.19	74.00	-19.81	HORIZONTAL Peak

Mode:b; Polarization:Vertical; Modulation:GFSK; ; Channel:middle

Freq	ReadAntenna		Cable Preamp		Limit Level	Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB					
1	3890.255	31.75	29.27	7.61	36.91	31.72	54.00	-22.28	VERTICAL Average
2	3890.255	45.38	29.27	7.61	36.91	45.35	74.00	-28.65	VERTICAL Peak
3	4882.490	28.17	30.95	6.86	36.95	29.03	54.00	-24.97	VERTICAL Average
4	4882.490	44.97	30.95	6.86	36.95	45.83	74.00	-28.17	VERTICAL Peak
5	7323.806	29.15	35.74	7.39	36.92	35.36	54.00	-18.64	VERTICAL Average
6	7323.806	44.86	35.74	7.39	36.92	51.07	74.00	-22.93	VERTICAL Peak
7	8200.463	27.71	36.35	8.25	36.91	35.40	54.00	-18.60	VERTICAL Average
8	8200.463	44.27	36.35	8.25	36.91	51.96	74.00	-22.04	VERTICAL Peak
9	9764.540	29.58	37.70	8.33	37.09	38.52	54.00	-15.48	VERTICAL Average
10	9764.540	44.21	37.70	8.33	37.09	53.15	74.00	-20.85	VERTICAL Peak
11	12205.210	26.50	39.21	10.98	37.06	39.63	54.00	-14.37	VERTICAL Average
12	12205.210	41.34	39.21	10.98	37.06	54.47	74.00	-19.53	VERTICAL Peak

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Mode:b; Polarization:Horizontal; Modulation:GFSK; ; Channel:High

Freq	ReadAntenna		Cable Preamp		Limit Line	Over Limit	Pol/Phase	Remark
	Level	Factor	Loss	Factor				
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB
1	3856.668	30.42	29.19	7.73	36.91	30.43	54.00	-23.57 HORIZONTAL Average
2	3856.668	44.82	29.19	7.73	36.91	44.83	74.00	-29.17 HORIZONTAL Peak
3	4960.993	31.35	31.05	7.84	36.96	33.28	54.00	-20.72 HORIZONTAL Average
4	4960.993	46.57	31.05	7.84	36.96	48.50	74.00	-25.50 HORIZONTAL Peak
5	6894.806	28.98	34.98	7.24	36.95	34.25	54.00	-19.75 HORIZONTAL Average
6	6894.806	44.32	34.98	7.24	36.95	49.59	74.00	-24.41 HORIZONTAL Peak
7	7440.005	29.59	35.92	7.43	36.92	36.02	54.00	-17.98 HORIZONTAL Average
8	7440.005	44.32	35.92	7.43	36.92	50.75	74.00	-23.25 HORIZONTAL Peak
9	9920.710	29.09	37.92	8.63	37.10	38.54	54.00	-15.46 HORIZONTAL Average
10	9920.710	43.84	37.92	8.63	37.10	53.29	74.00	-20.71 HORIZONTAL Peak
11	12400.580	27.62	38.93	11.17	36.90	40.82	54.00	-13.18 HORIZONTAL Average
12	12400.580	41.29	38.93	11.17	36.90	54.49	74.00	-19.51 HORIZONTAL Peak

Mode:b; Polarization:Vertical; Modulation:GFSK; ; Channel:High

Freq	ReadAntenna		Cable Preamp		Limit Line	Over Limit	Pol/Phase	Remark
	Level	Factor	Loss	Factor				
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB
1	4267.237	32.49	29.85	6.46	36.91	31.89	54.00	-22.11 VERTICAL Average
2	4267.237	45.11	29.85	6.46	36.91	44.51	74.00	-29.49 VERTICAL Peak
3	4960.436	29.26	31.05	7.84	36.96	31.19	54.00	-22.81 VERTICAL Average
4	4960.436	44.97	31.05	7.84	36.96	46.90	74.00	-27.10 VERTICAL Peak
5	7440.006	28.58	35.92	7.43	36.92	35.01	54.00	-18.99 VERTICAL Average
6	7440.006	44.55	35.92	7.43	36.92	50.98	74.00	-23.02 VERTICAL Peak
7	8840.473	29.15	36.40	8.06	36.98	36.63	54.00	-17.37 VERTICAL Average
8	8840.473	44.78	36.40	8.06	36.98	52.26	74.00	-21.74 VERTICAL Peak
9	9920.018	29.05	37.92	8.63	37.10	38.50	54.00	-15.50 VERTICAL Average
10	9920.018	44.44	37.92	8.63	37.10	53.89	74.00	-20.11 VERTICAL Peak
11	12400.610	28.01	38.93	11.17	36.90	41.21	54.00	-12.79 VERTICAL Average
12	12400.610	42.20	38.93	11.17	36.90	55.40	74.00	-18.60 VERTICAL Peak

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## 8 Appendix

### 8.1 Appendix 15.247

#### 1.20 dB Bandwidth

Test Mode	Test Channel	20 dB Bandwidth [MHz]	2/3 20 dB Bandwidth [MHz]	Verdict
DH5	2402	0.9509	0.634	PASS
DH5	2441	0.9499	0.633	PASS
DH5	2480	0.9494	0.633	PASS
2DH5	2402	1.320	0.880	PASS
2DH5	2441	1.320	0.880	PASS
2DH5	2480	1.318	0.879	PASS
3DH5	2402	1.303	0.869	PASS
3DH5	2441	1.301	0.867	PASS
3DH5	2480	1.303	0.869	PASS

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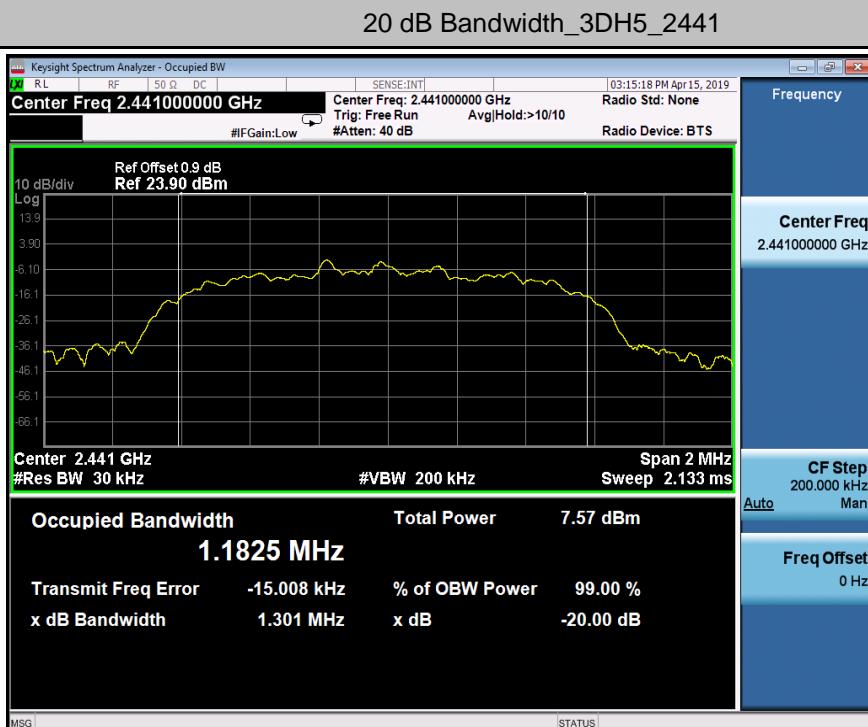
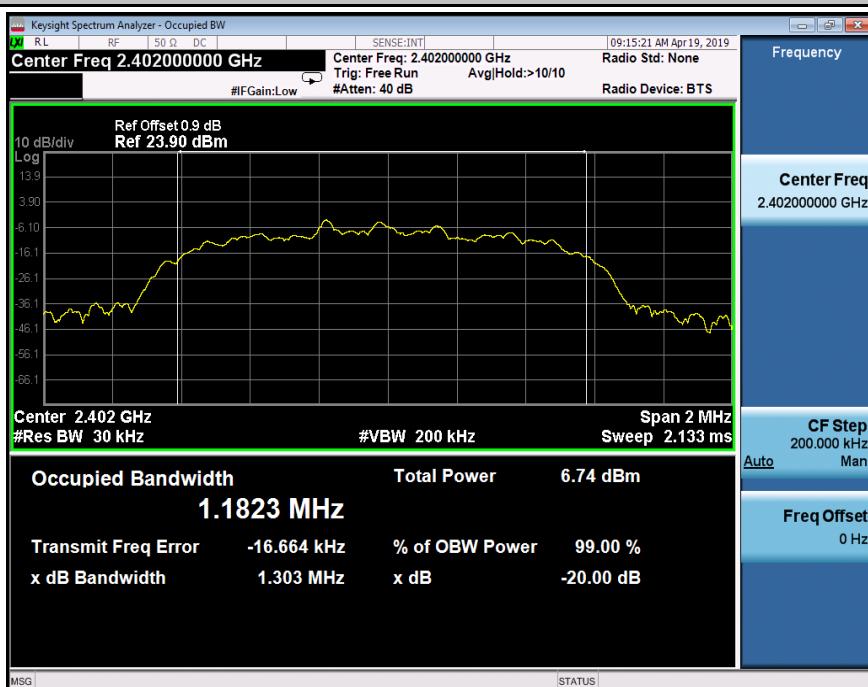


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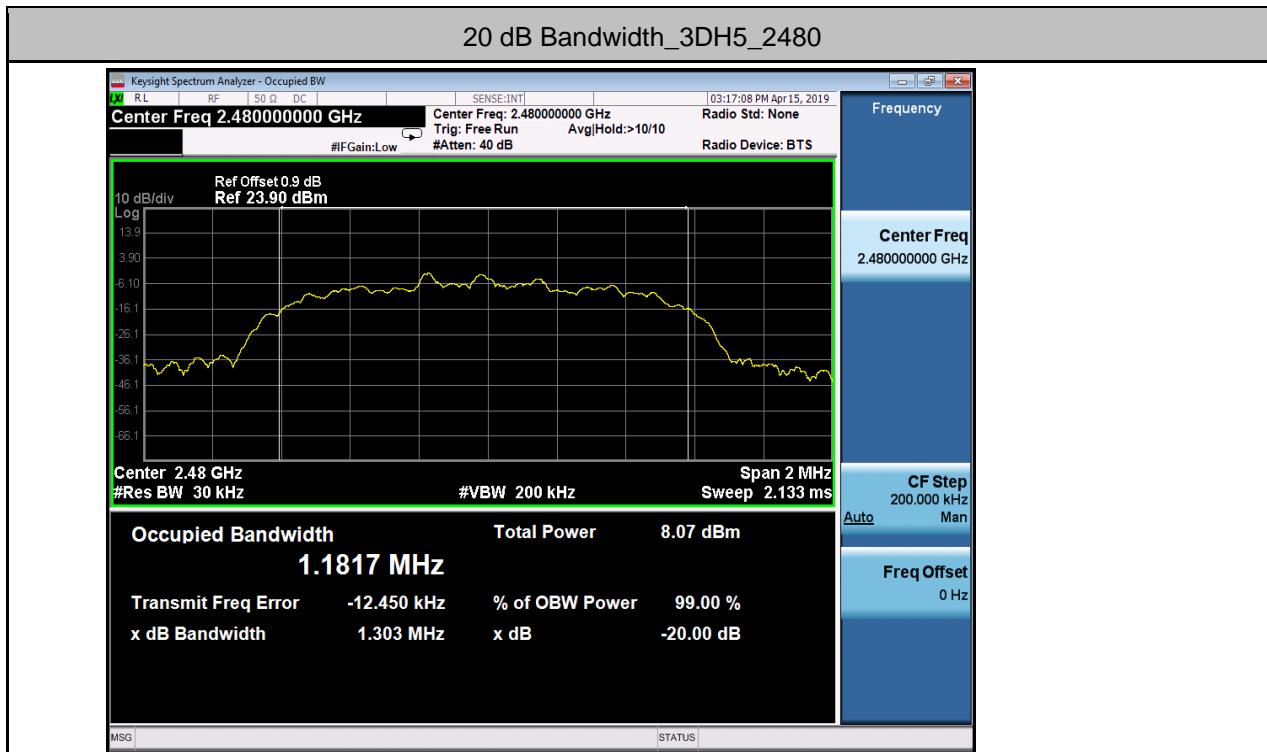
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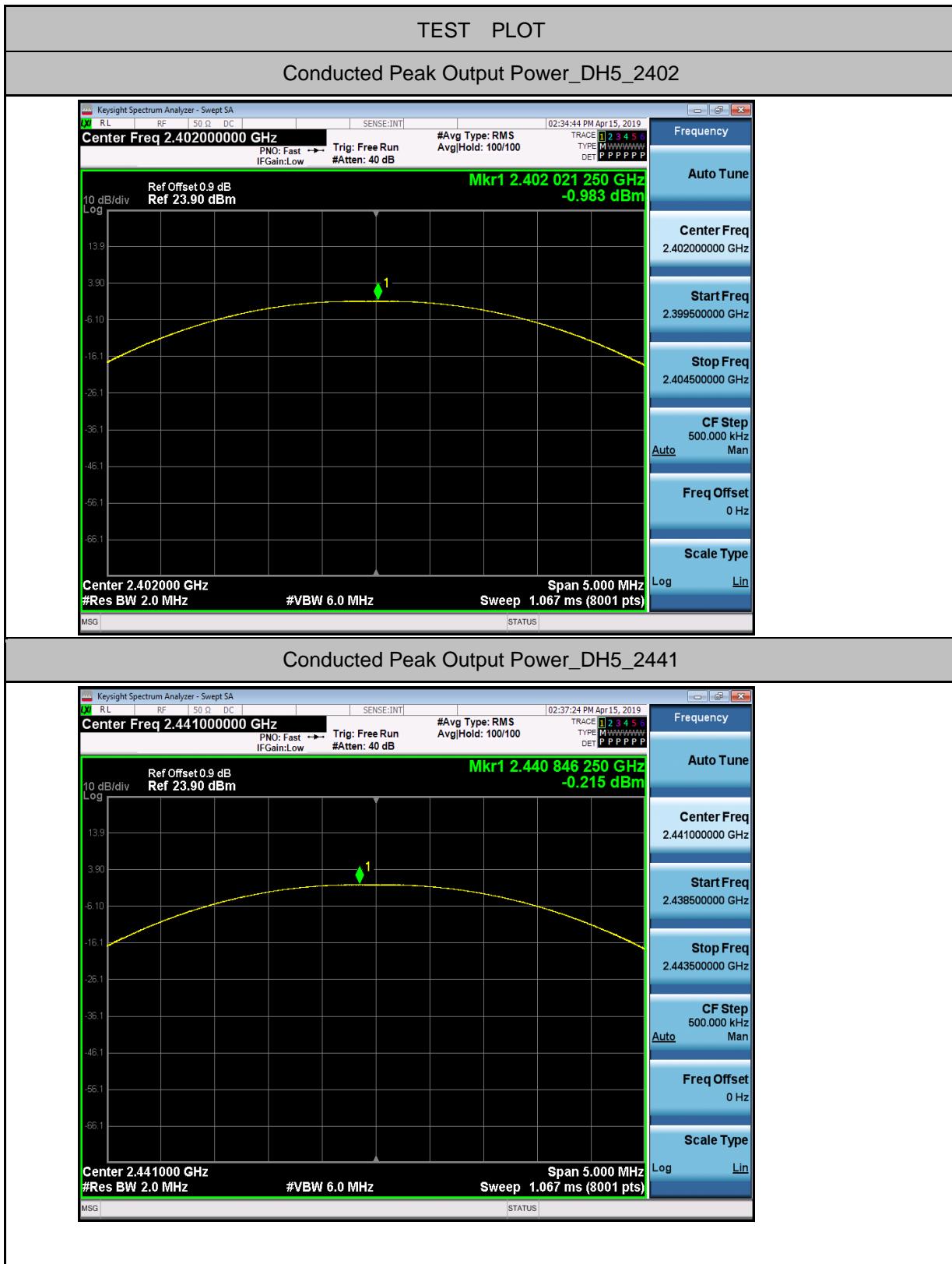
## 2. Conducted Peak Output Power

Test Mode	Test Channel	Power[dBm]	Limit[dBm]	Verdict
DH5	2402	-0.983	21	PASS
DH5	2441	-0.215	21	PASS
DH5	2480	0.195	21	PASS
2DH5	2402	0.977	21	PASS
2DH5	2441	2.245	21	PASS
2DH5	2480	2.811	21	PASS
3DH5	2402	1.504	21	PASS
3DH5	2441	2.764	21	PASS
3DH5	2480	3.211	21	PASS

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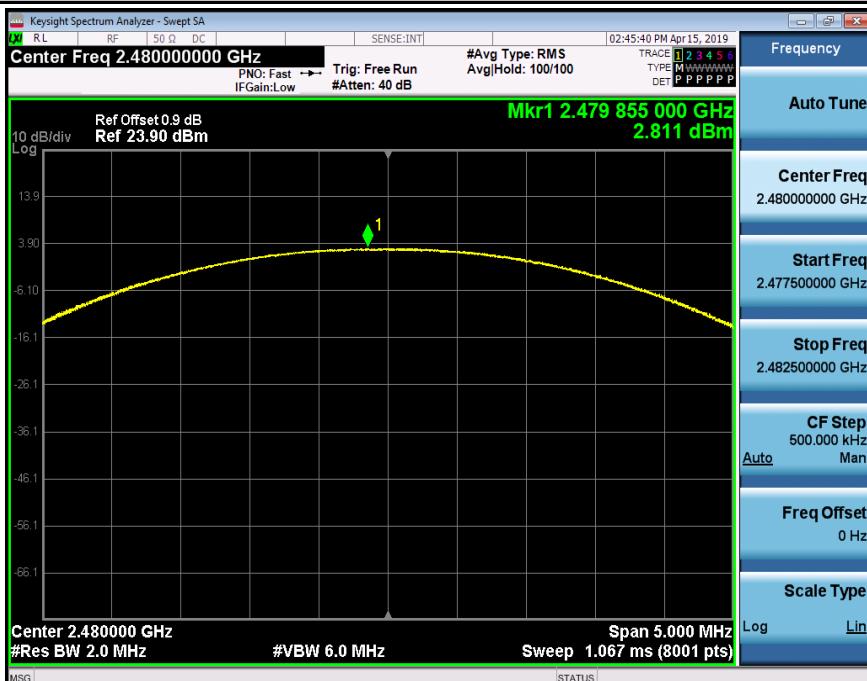


**Conducted Peak Output Power\_DH5\_2480****Conducted Peak Output Power\_2DH5\_2402**

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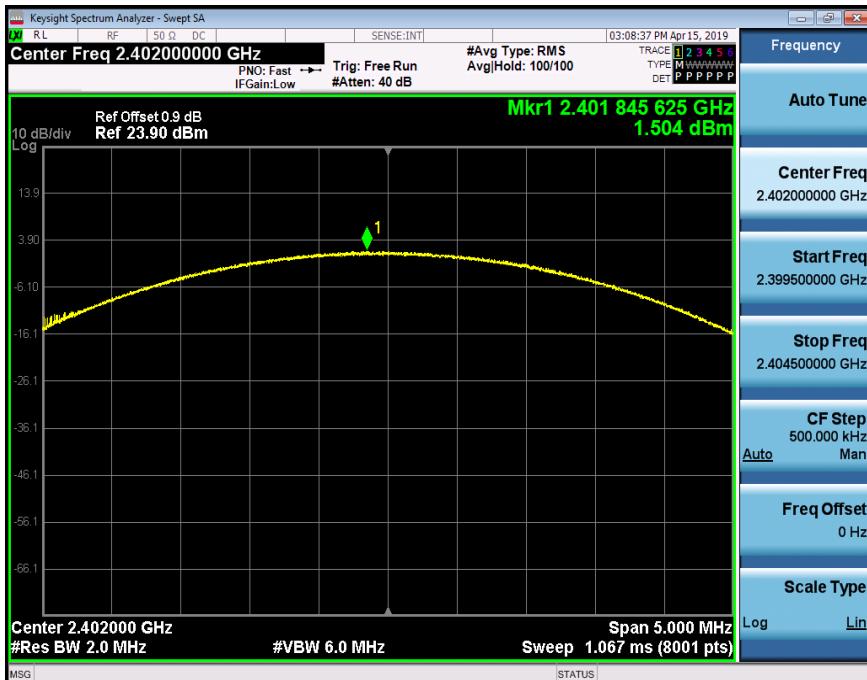
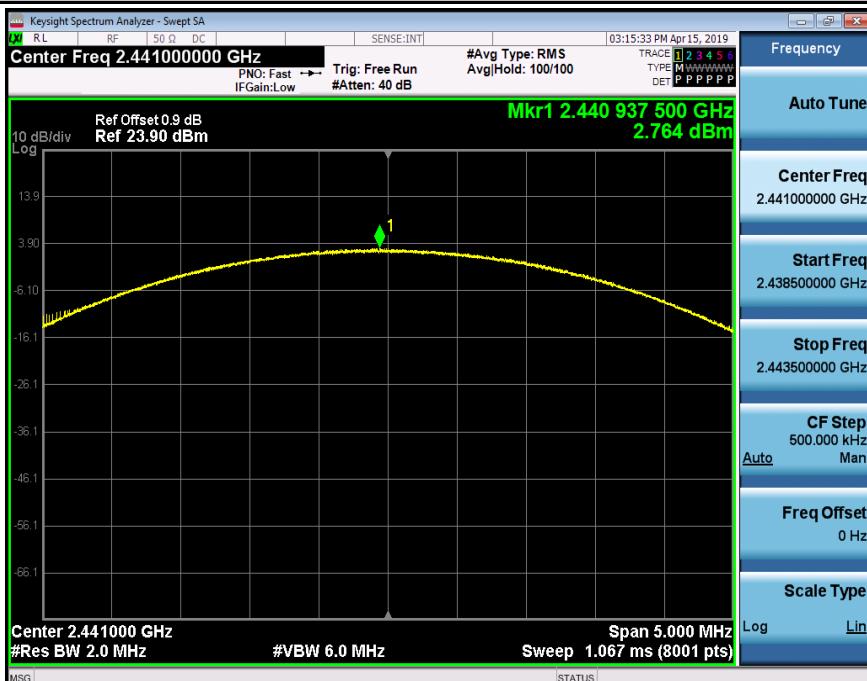
**Conducted Peak Output Power\_2DH5\_2441****Conducted Peak Output Power\_2DH5\_2480**

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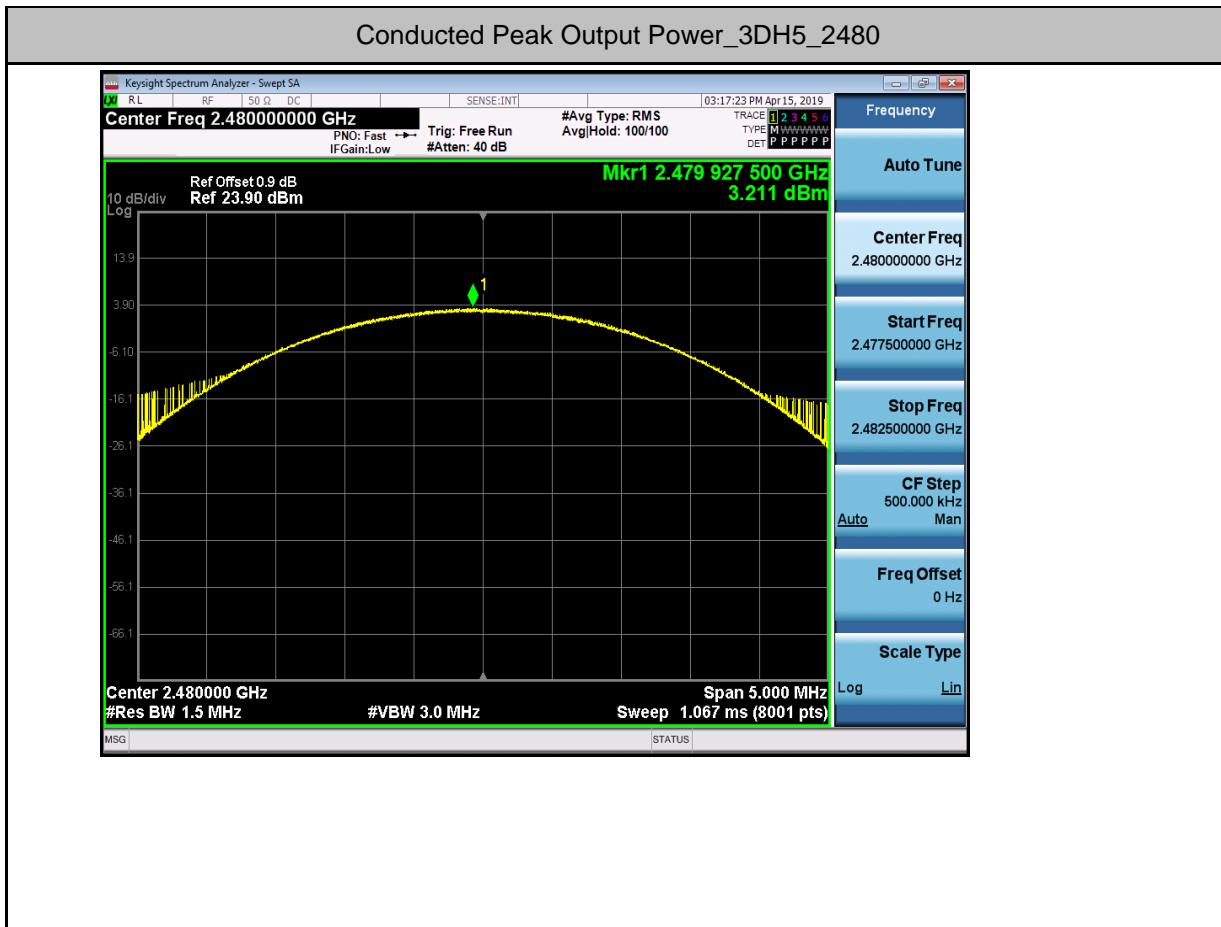


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**Conducted Peak Output Power\_3DH5\_2402****Conducted Peak Output Power\_3DH5\_2441**

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### 3. Carrier Frequency Separation

Test Mode	Test Channel	Result[MHz]	Limit[MHz]	Verdict
DH5	2402	0.947	0.634	PASS
DH5	2441	0.91	0.633	PASS
DH5	2480	0.984	0.633	PASS

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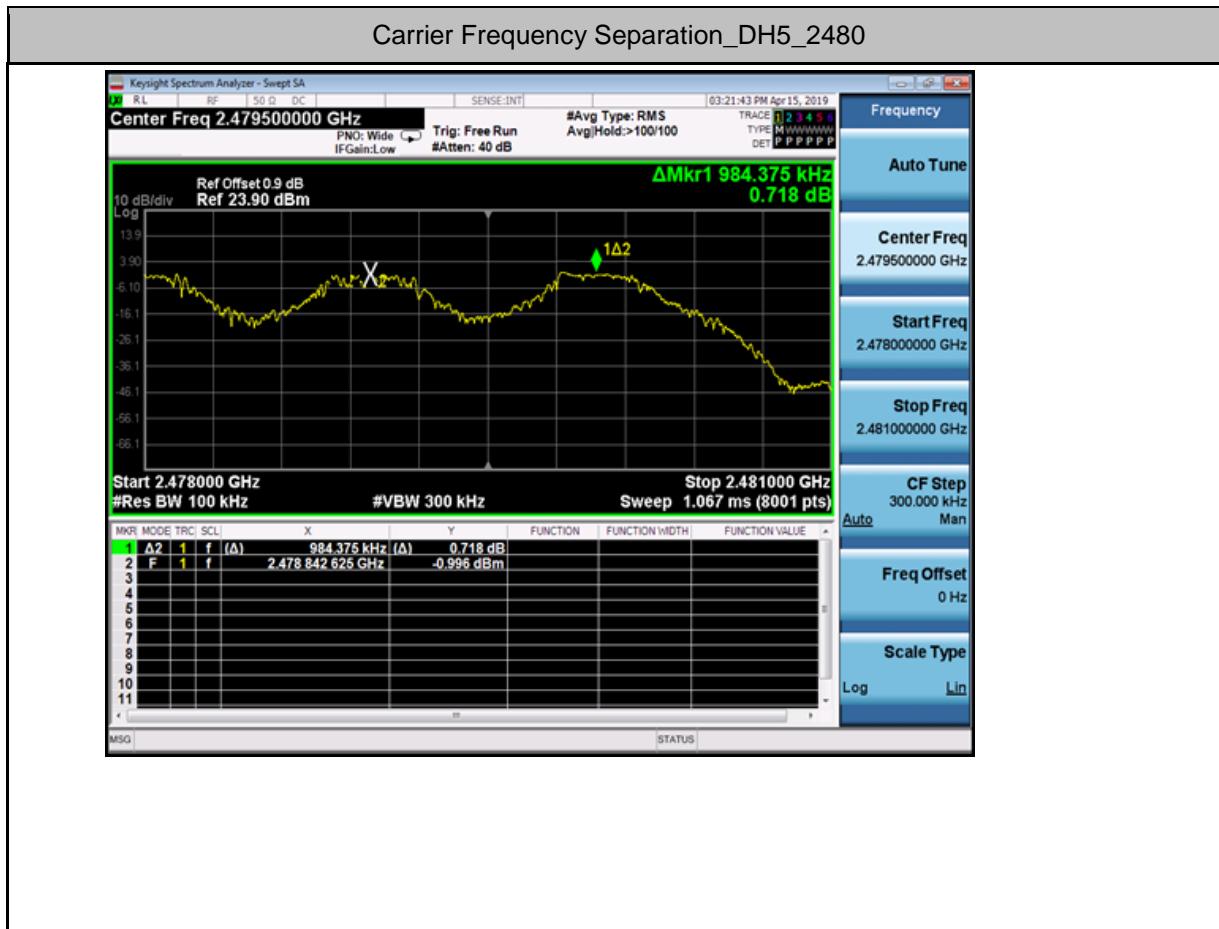




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## 4.Dwell Time

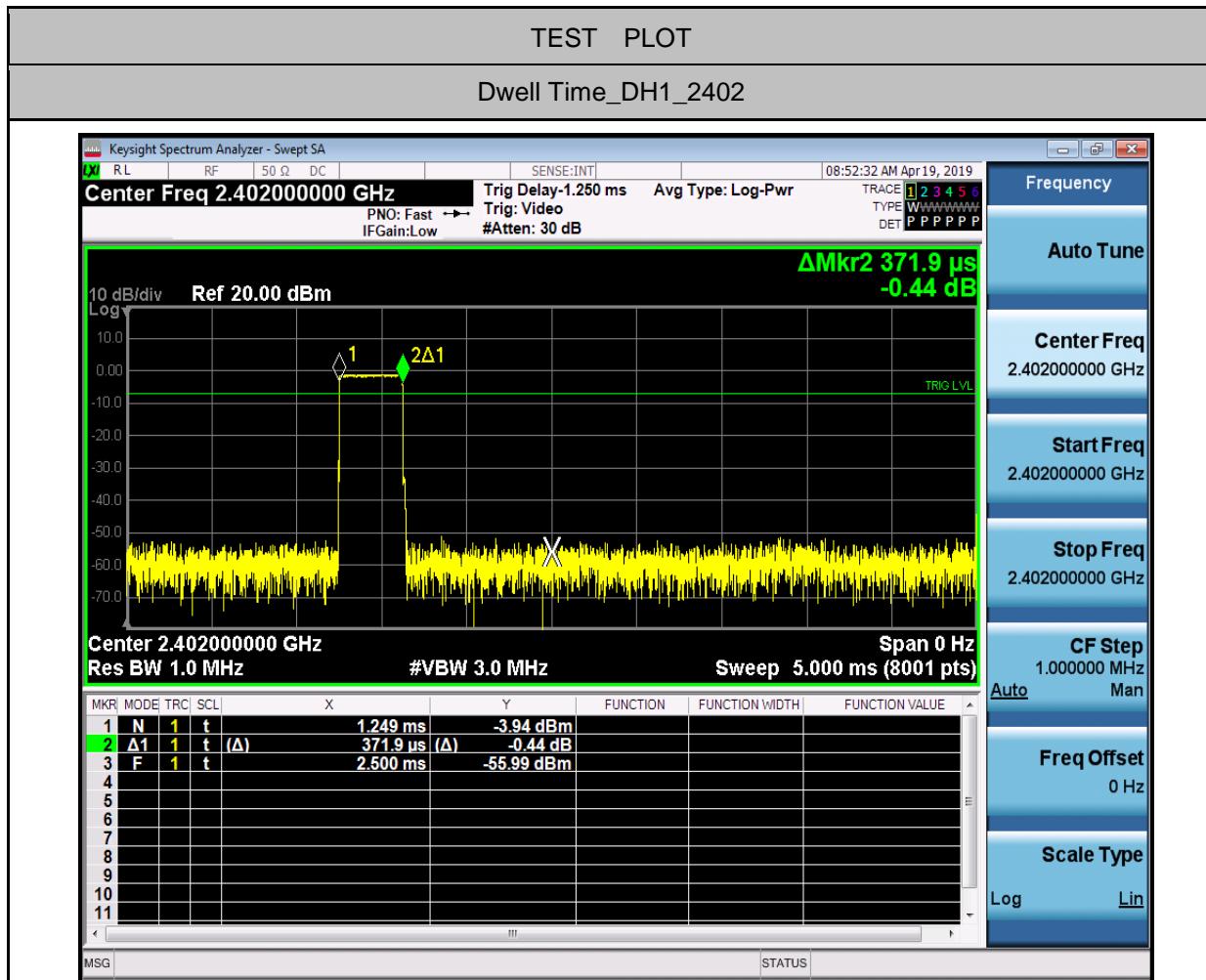
Test Mode	Test Channel	Burst Width[ms/hop/ch]	Total Hops[hop*ch]	Dwell Time[s]	Limit[s]	Verdict
DH1	2402	0.37	320	0.12	0.4	PASS
DH1	2441	0.37	320	0.12	0.4	PASS
DH1	2480	0.37	320	0.12	0.4	PASS
DH3	2402	1.63	160	0.26	0.4	PASS
DH3	2441	1.63	160	0.26	0.4	PASS
DH3	2480	1.63	160	0.26	0.4	PASS
DH5	2402	2.87	110	0.32	0.4	PASS
DH5	2441	2.87	110	0.32	0.4	PASS
DH5	2480	2.87	110	0.32	0.4	PASS
2DH1	2402	0.38	320	0.12	0.4	PASS
2DH1	2441	0.38	310	0.12	0.4	PASS
2DH1	2480	0.38	320	0.12	0.4	PASS
2DH3	2402	1.63	160	0.26	0.4	PASS
2DH3	2441	1.63	160	0.26	0.4	PASS
2DH3	2480	1.63	160	0.26	0.4	PASS
2DH5	2402	2.88	110	0.32	0.4	PASS
2DH5	2441	2.88	110	0.32	0.4	PASS
2DH5	2480	2.88	100	0.29	0.4	PASS
3DH1	2402	0.39	320	0.12	0.4	PASS
3DH1	2441	0.39	320	0.12	0.4	PASS
3DH1	2480	0.39	330	0.13	0.4	PASS
3DH3	2402	1.63	160	0.26	0.4	PASS
3DH3	2441	1.63	160	0.26	0.4	PASS
3DH3	2480	1.63	170	0.28	0.4	PASS
3DH5	2402	2.89	100	0.29	0.4	PASS
3DH5	2441	2.89	120	0.35	0.4	PASS
3DH5	2480	2.89	110	0.32	0.4	PASS

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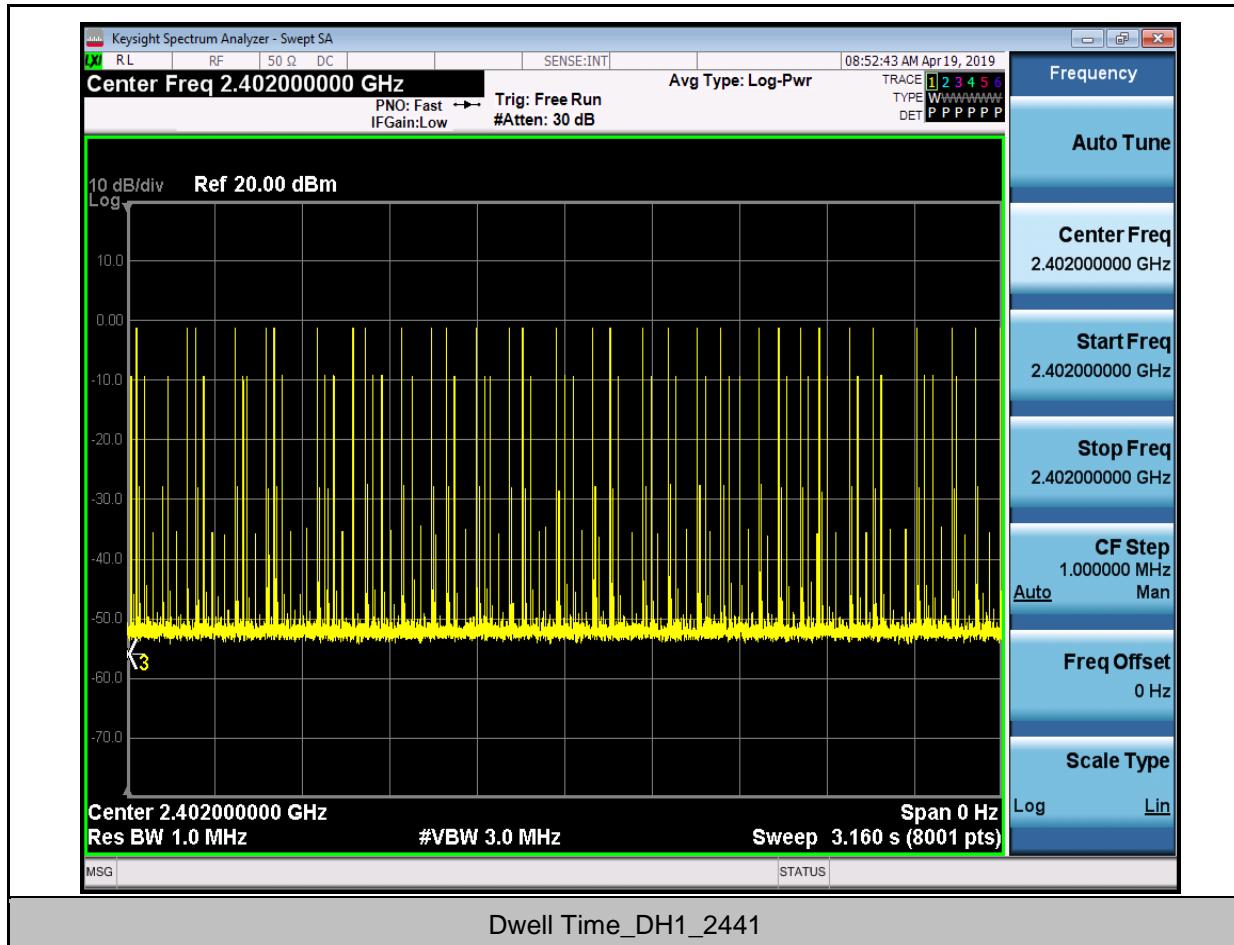


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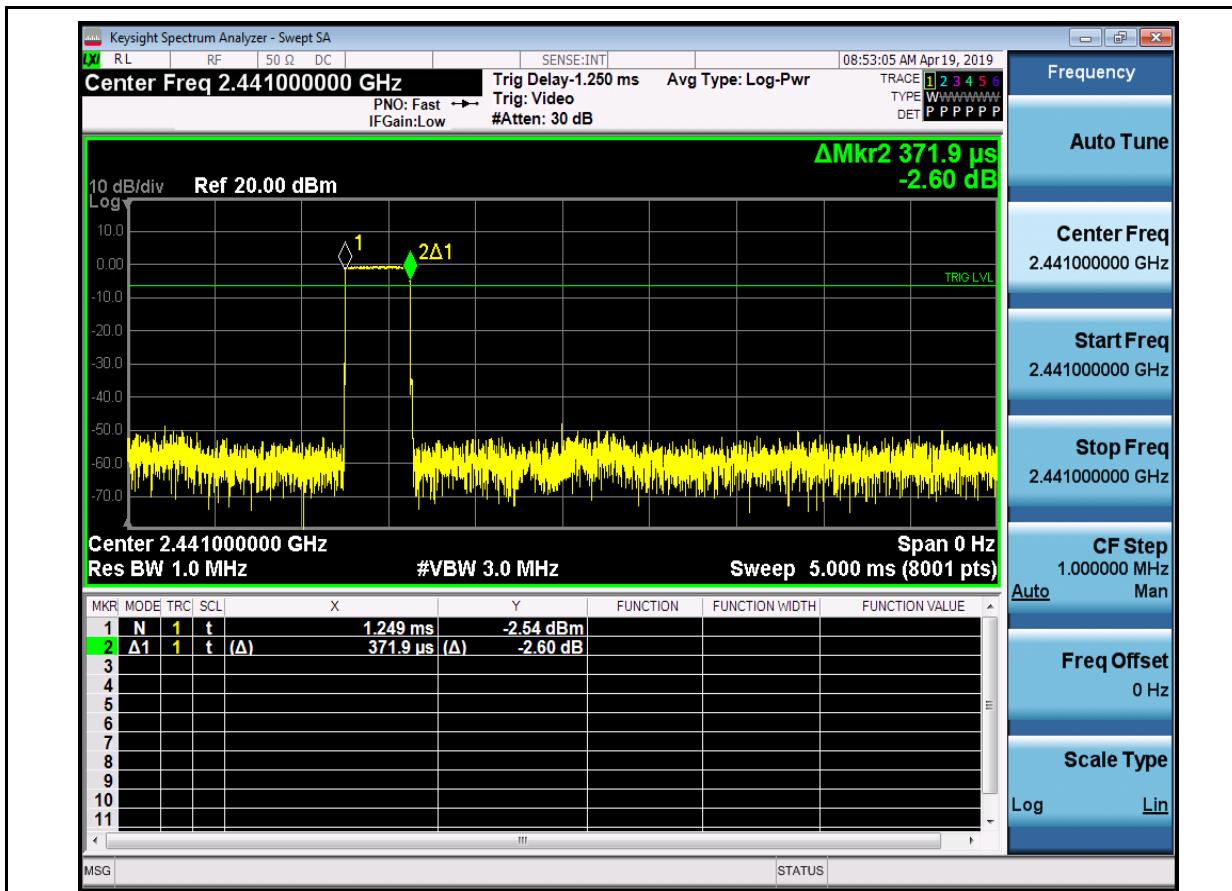


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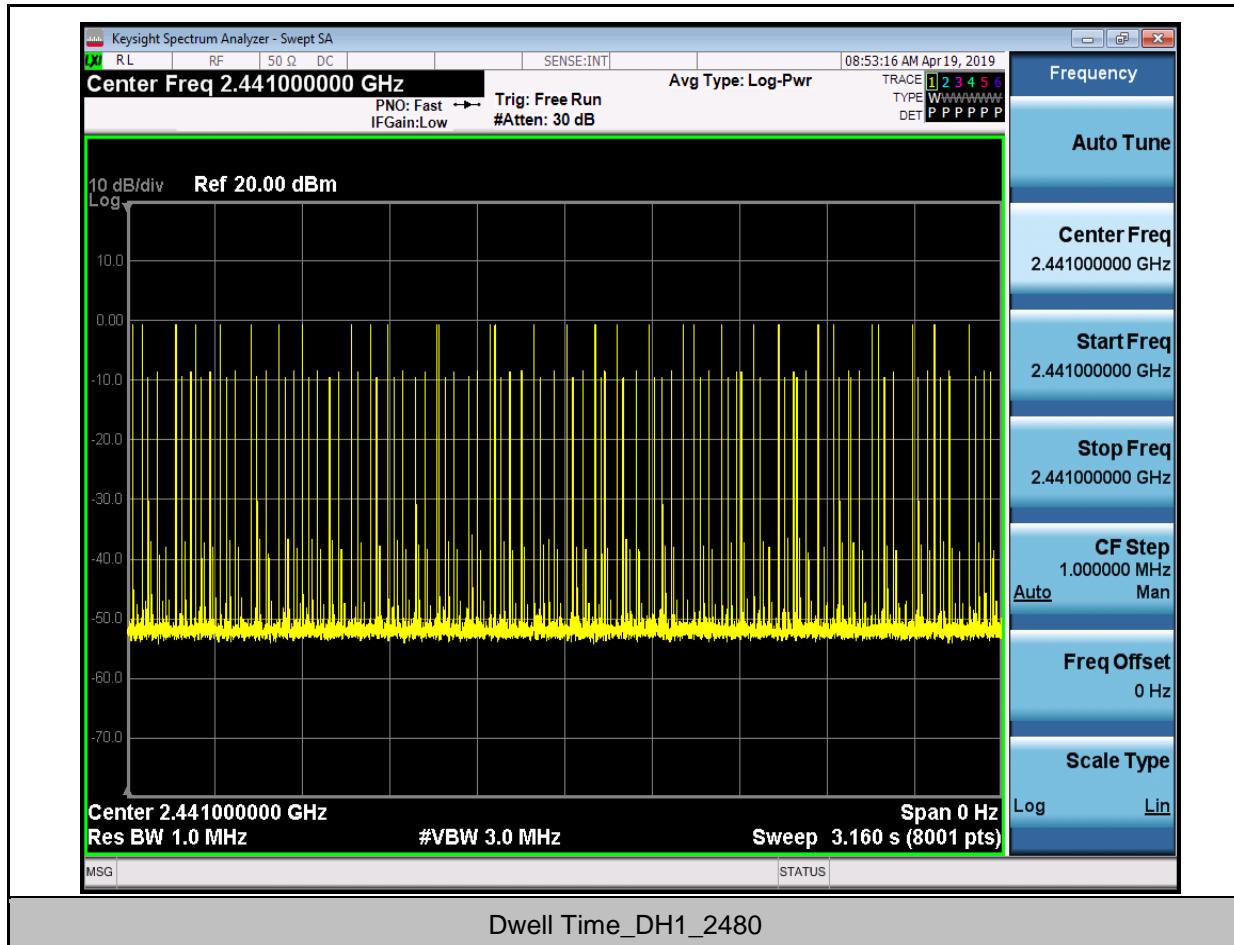
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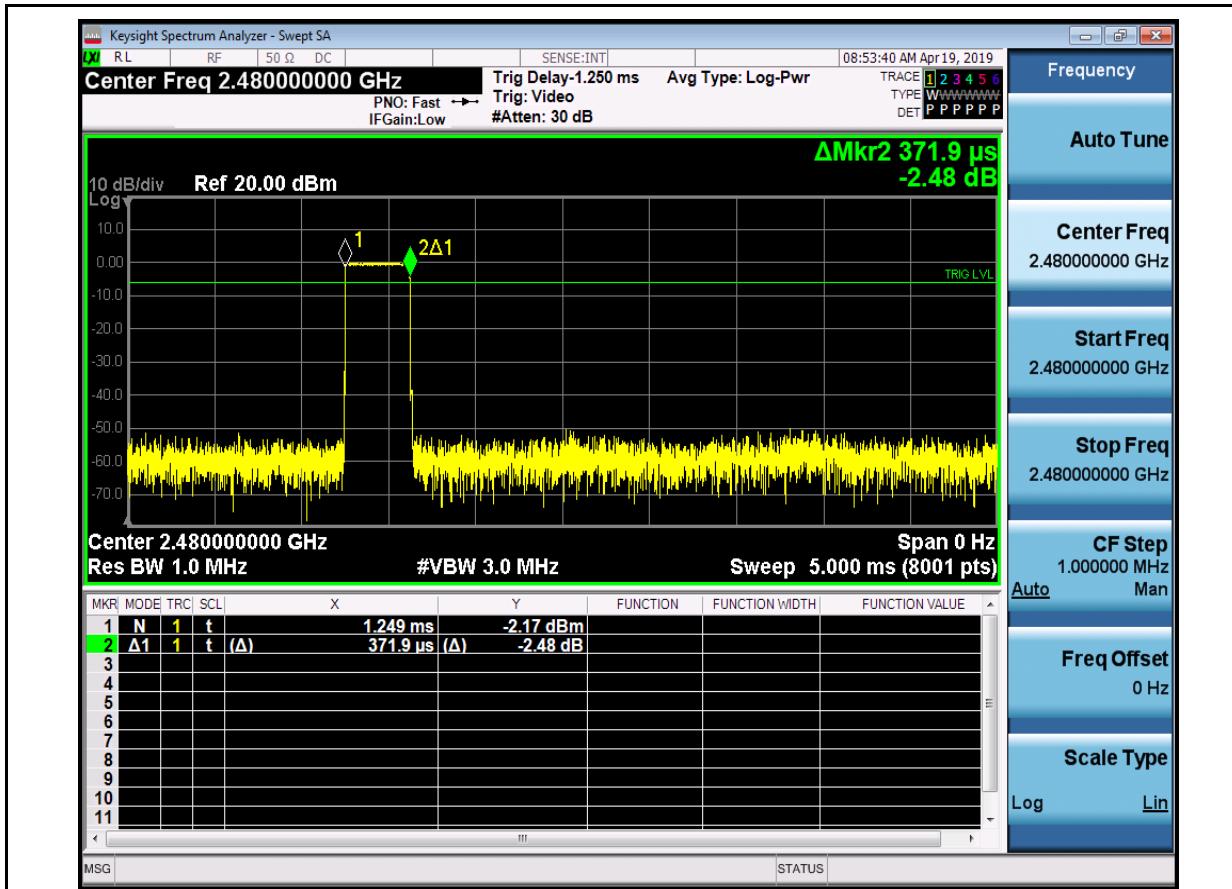


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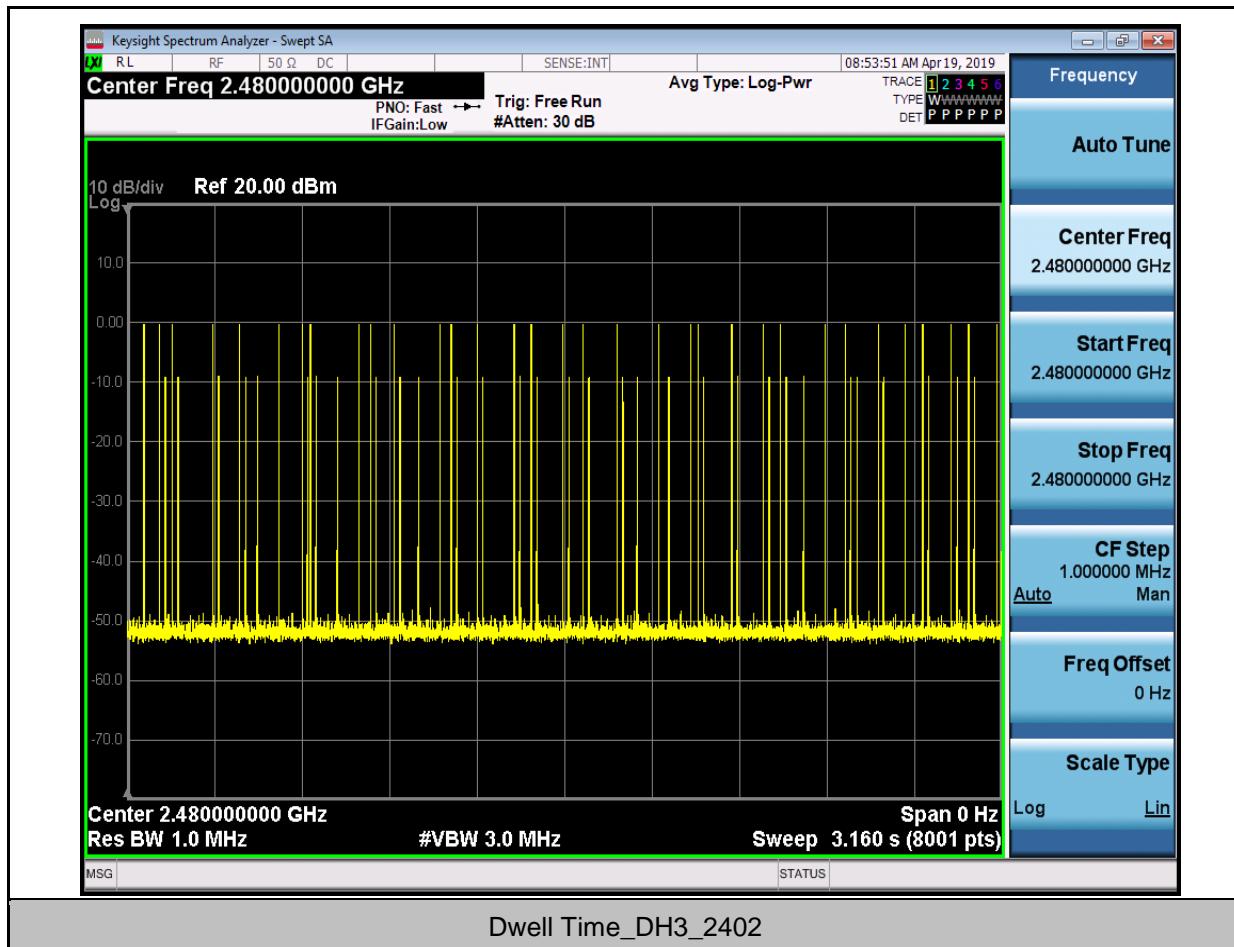
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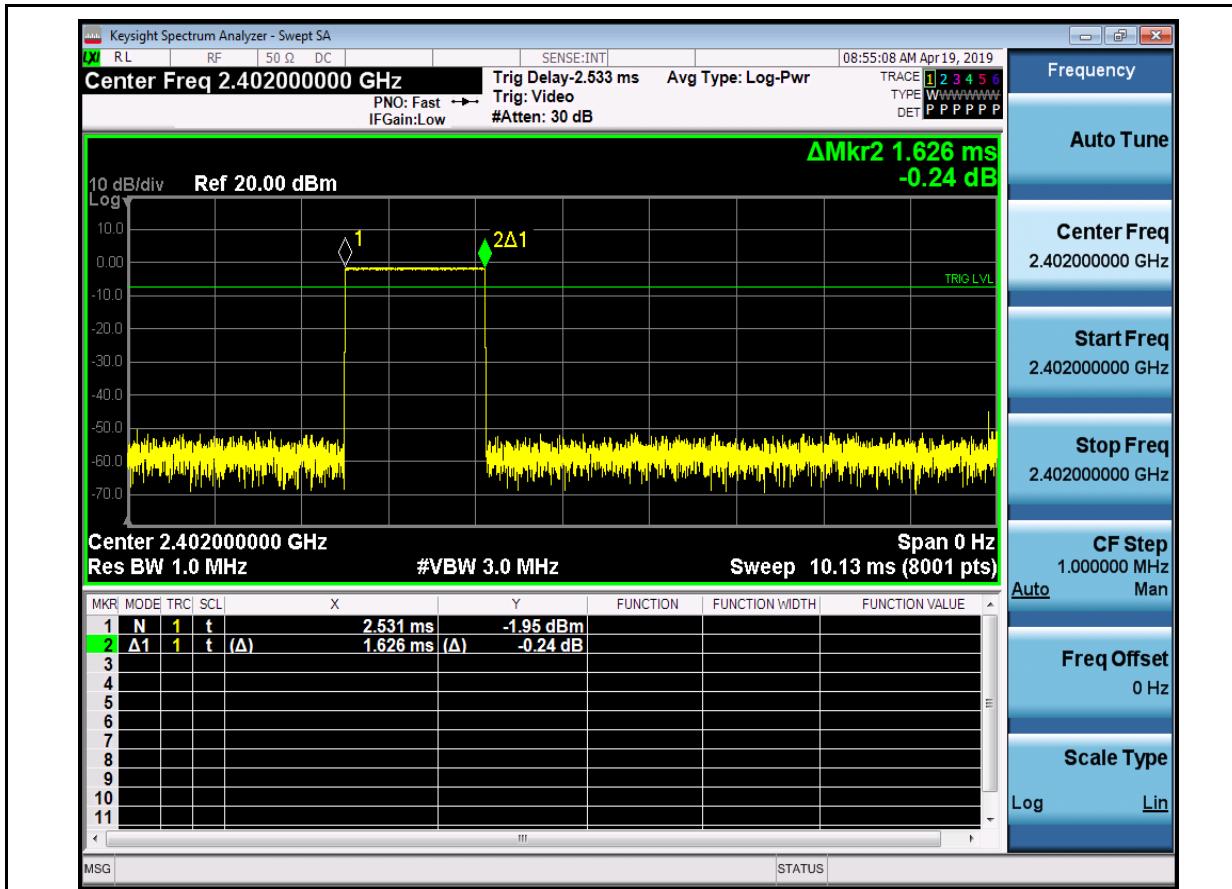


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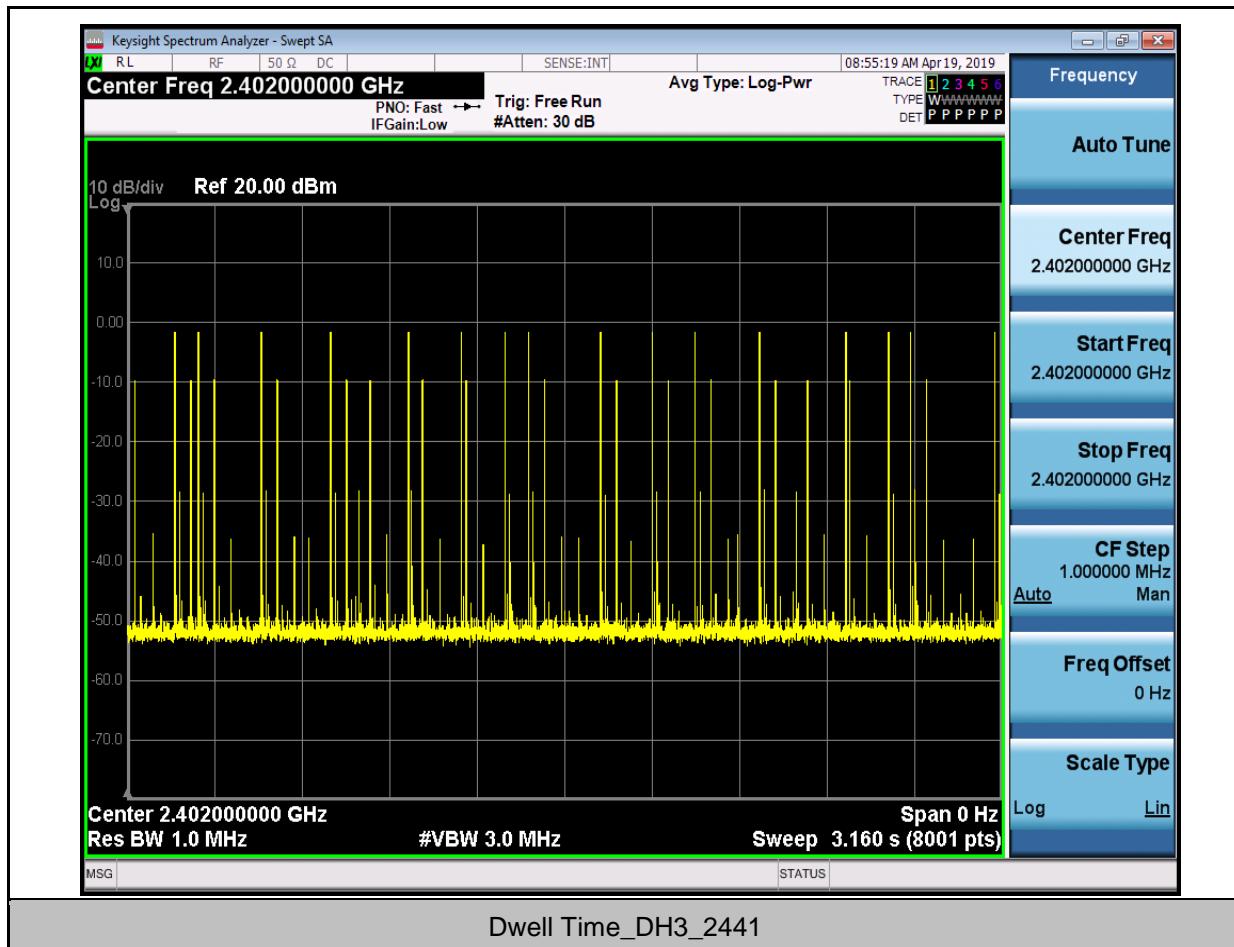
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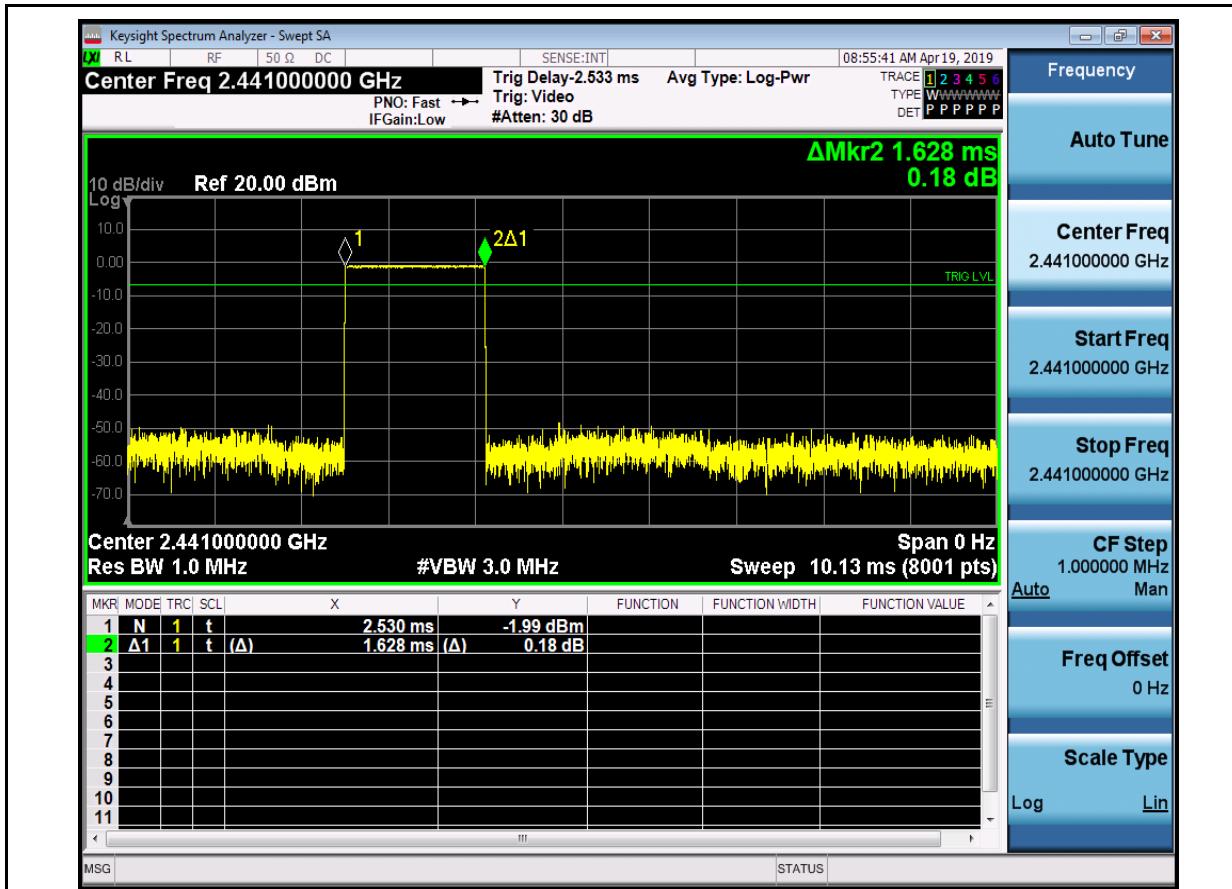
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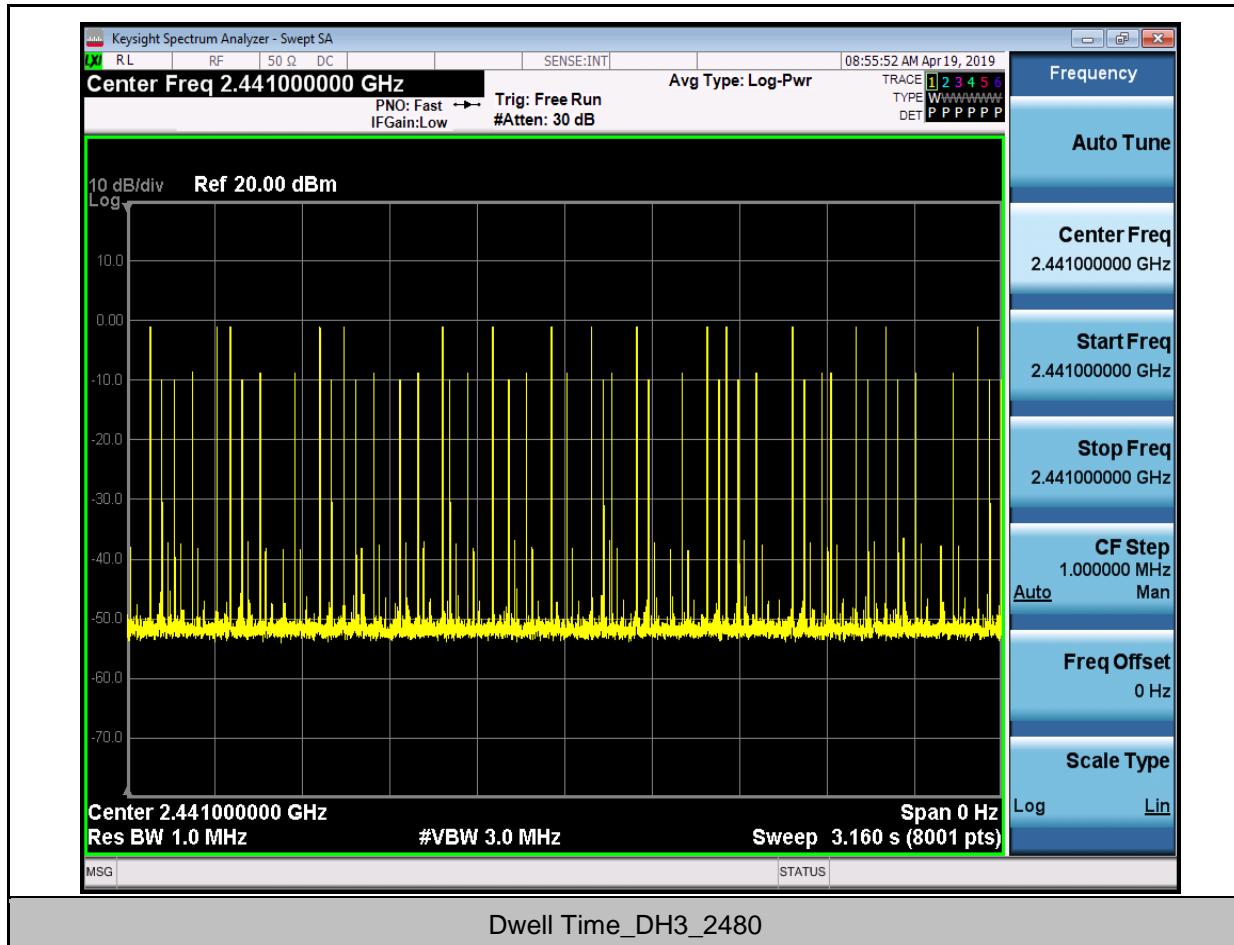
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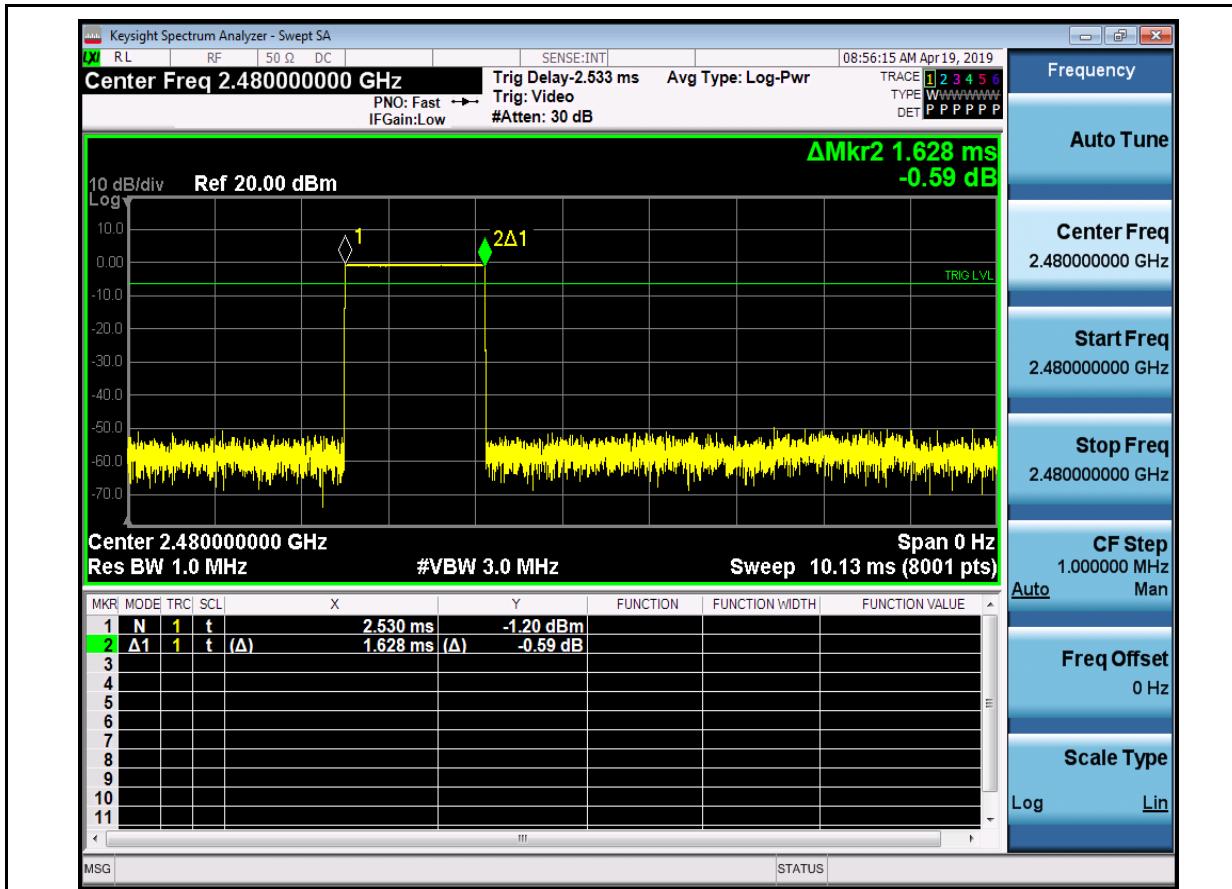
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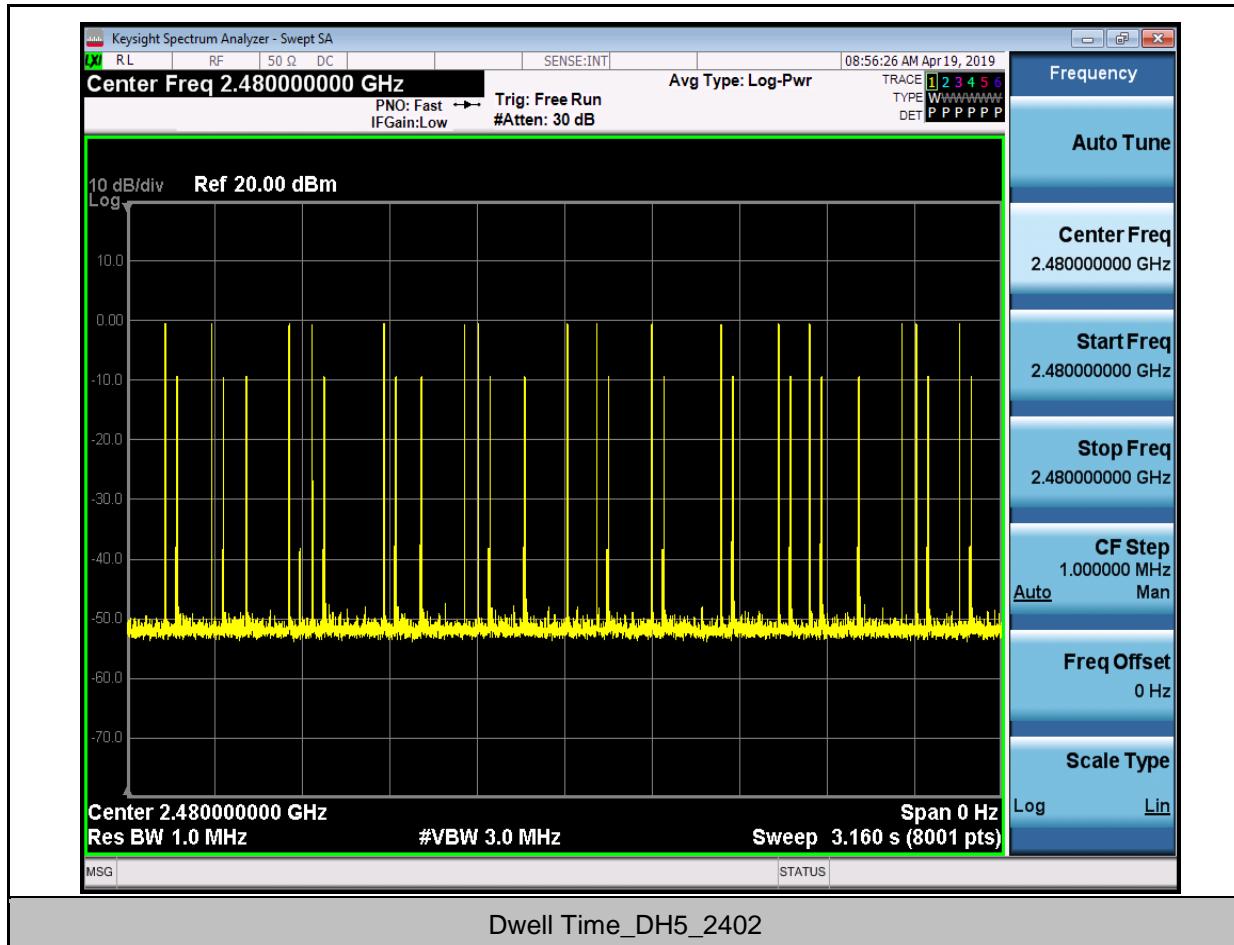
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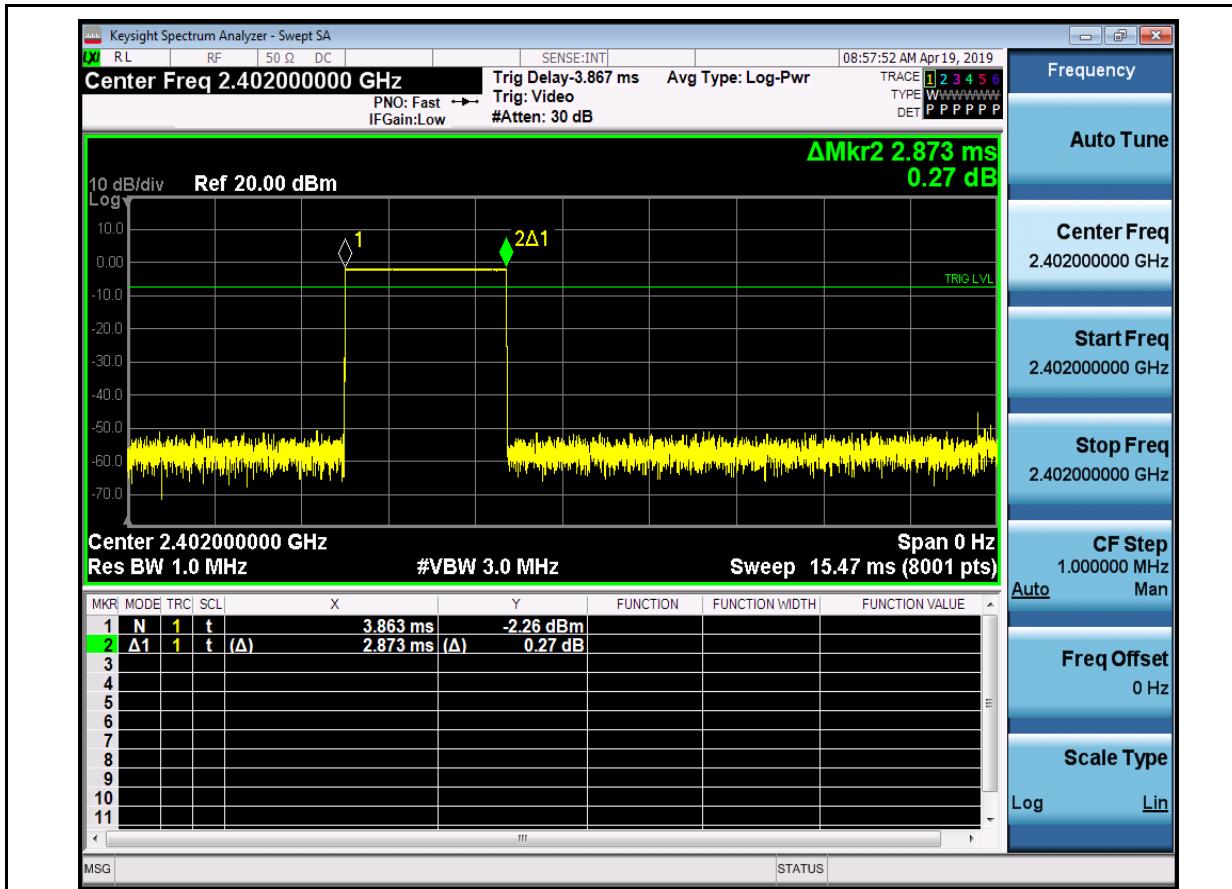
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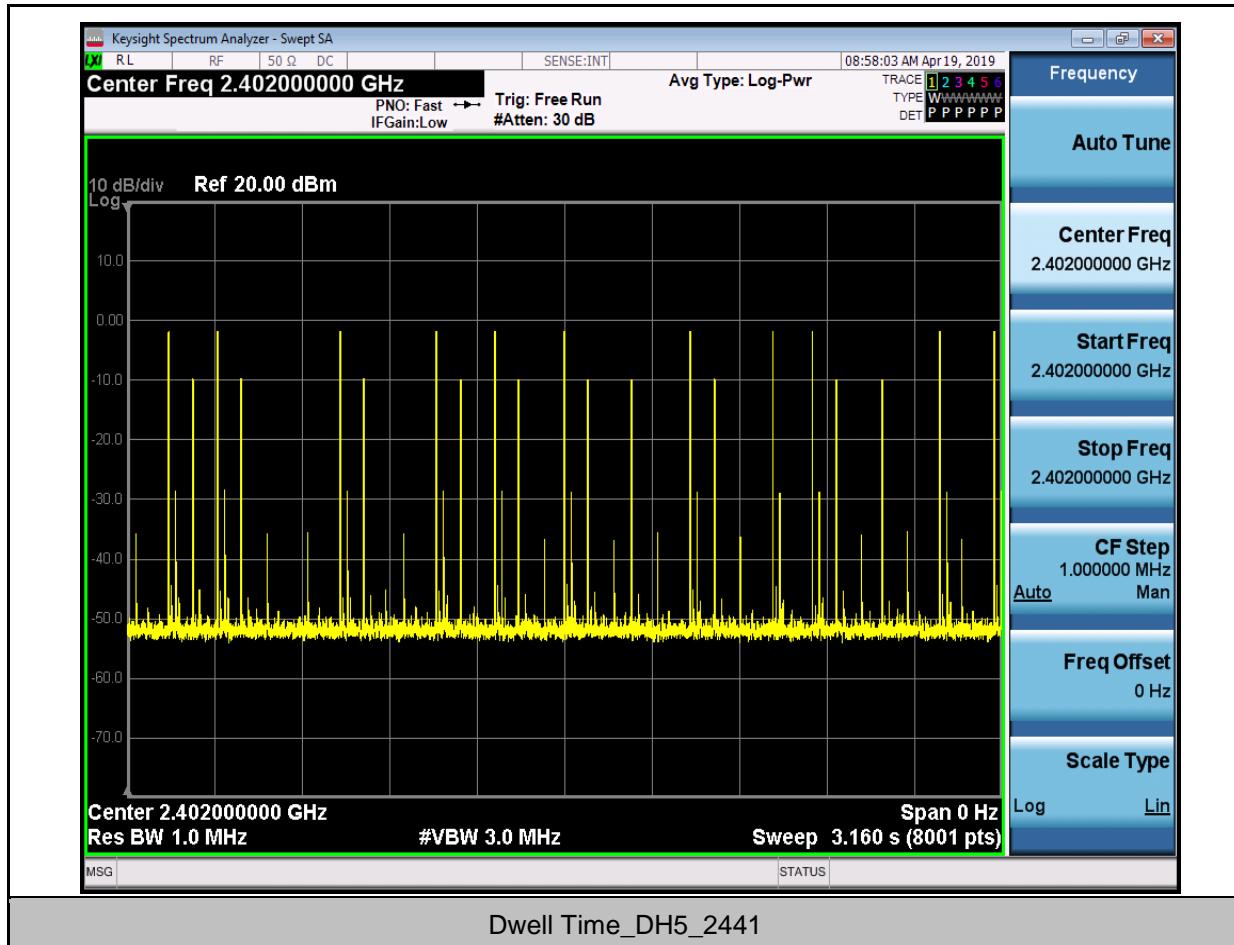
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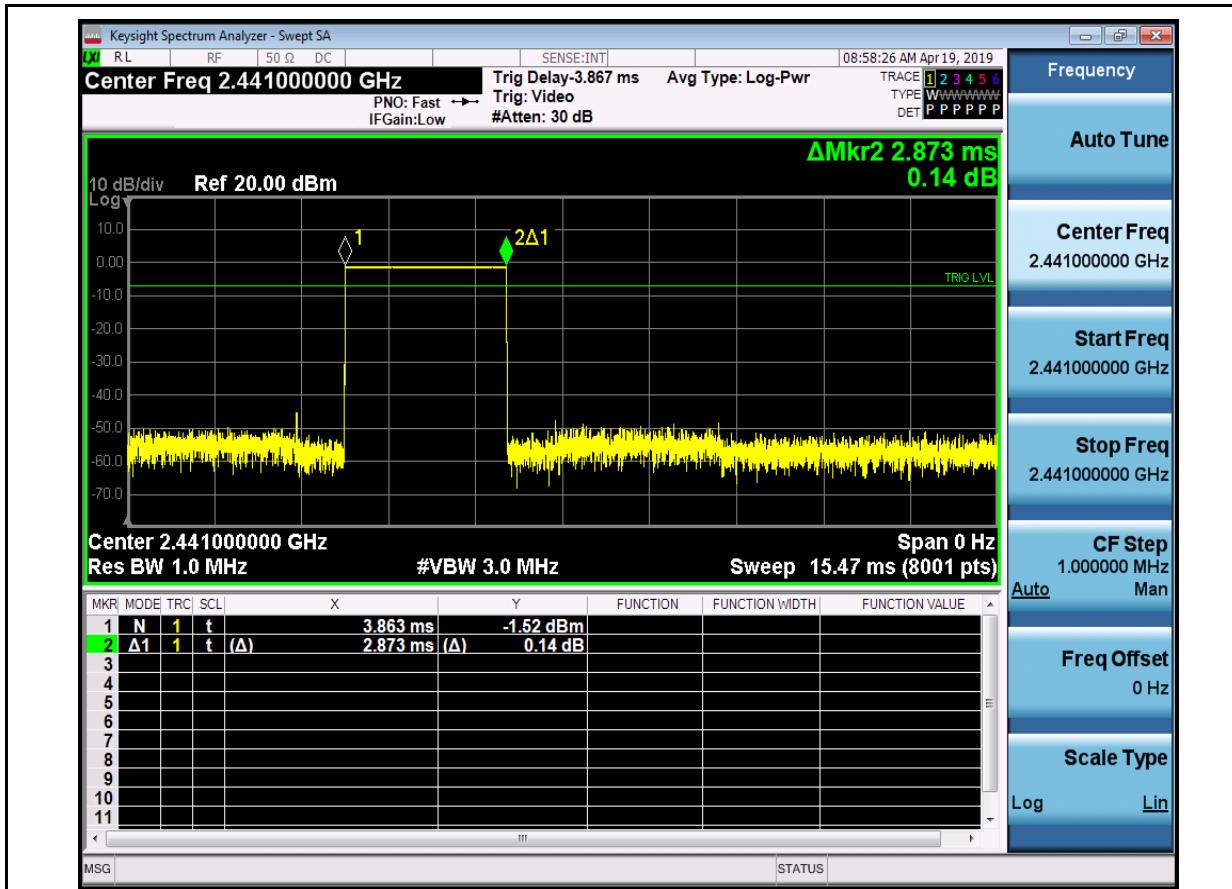
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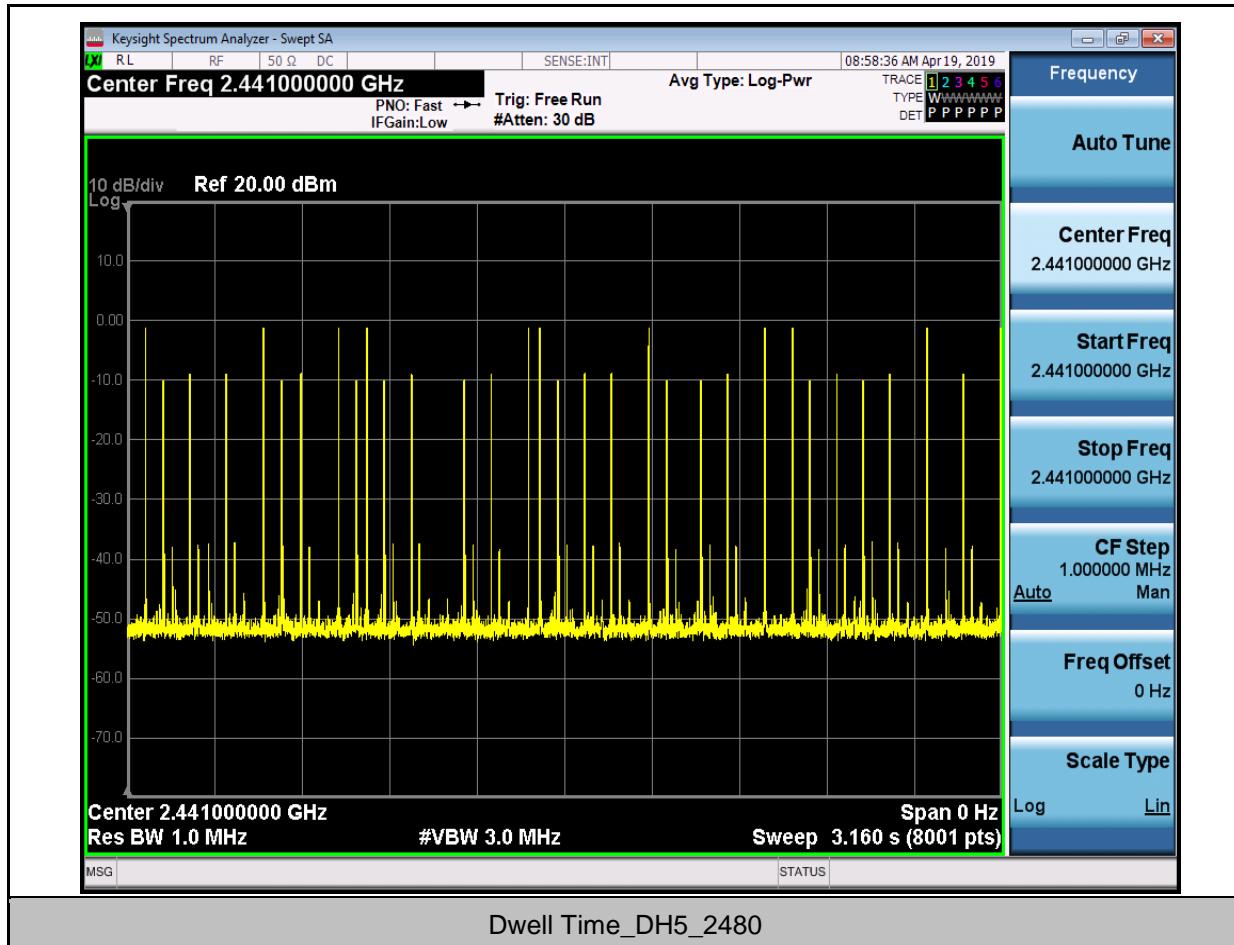




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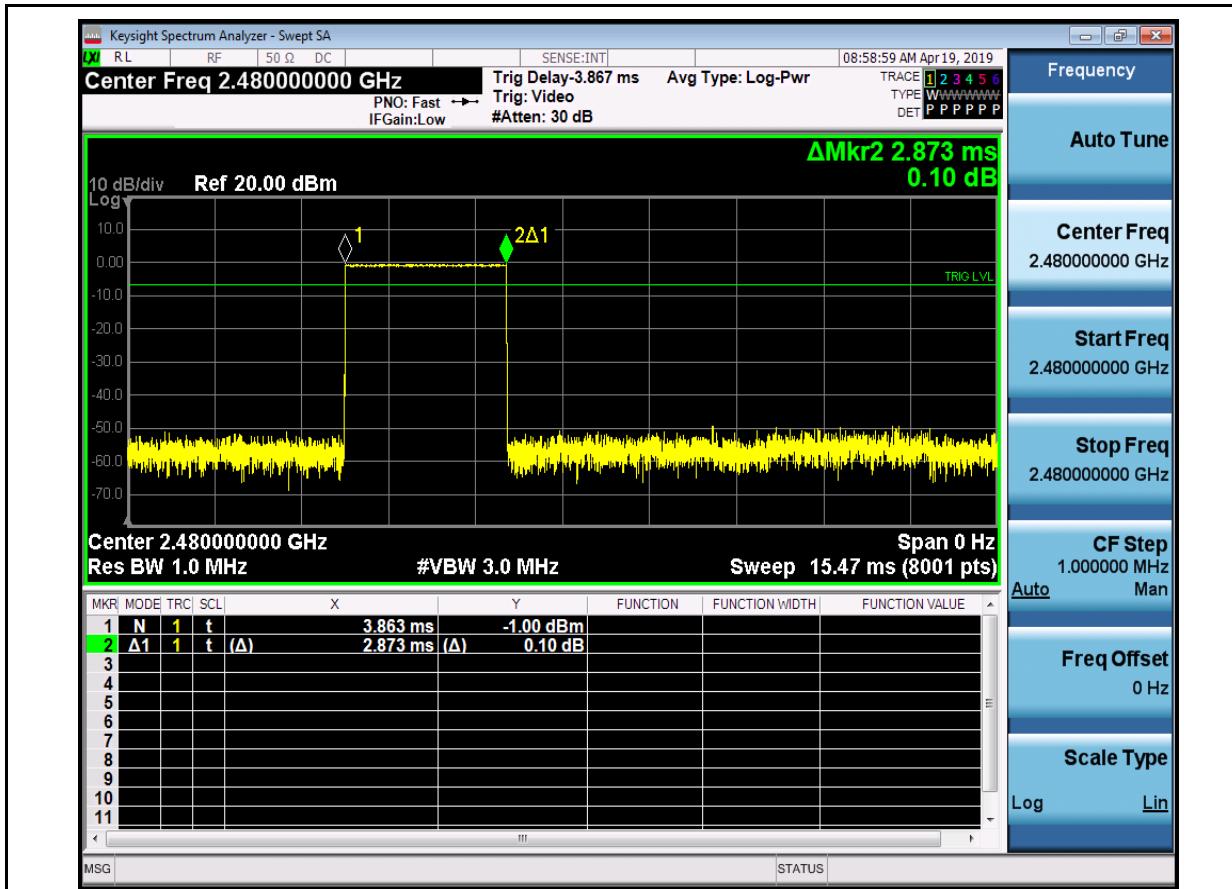
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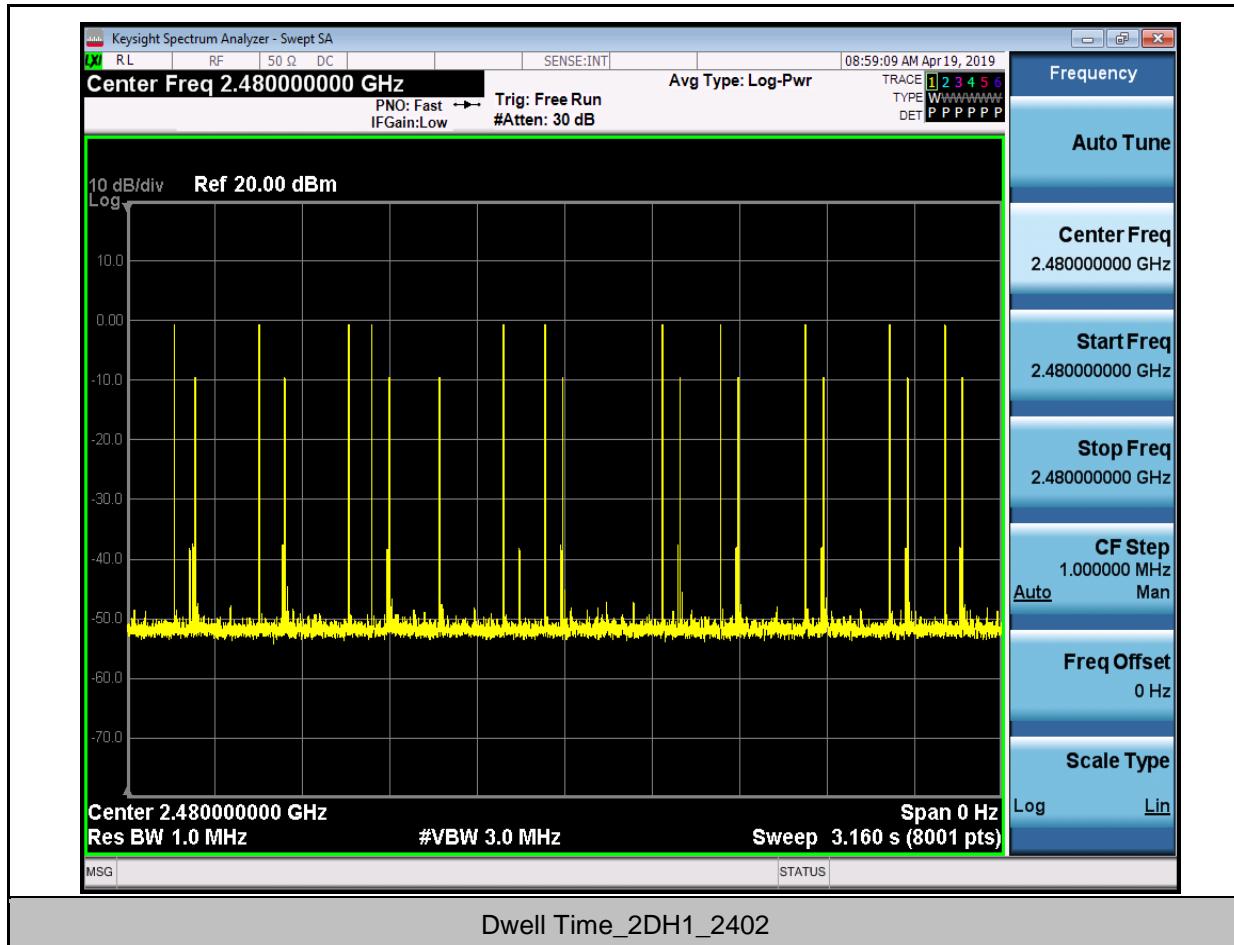
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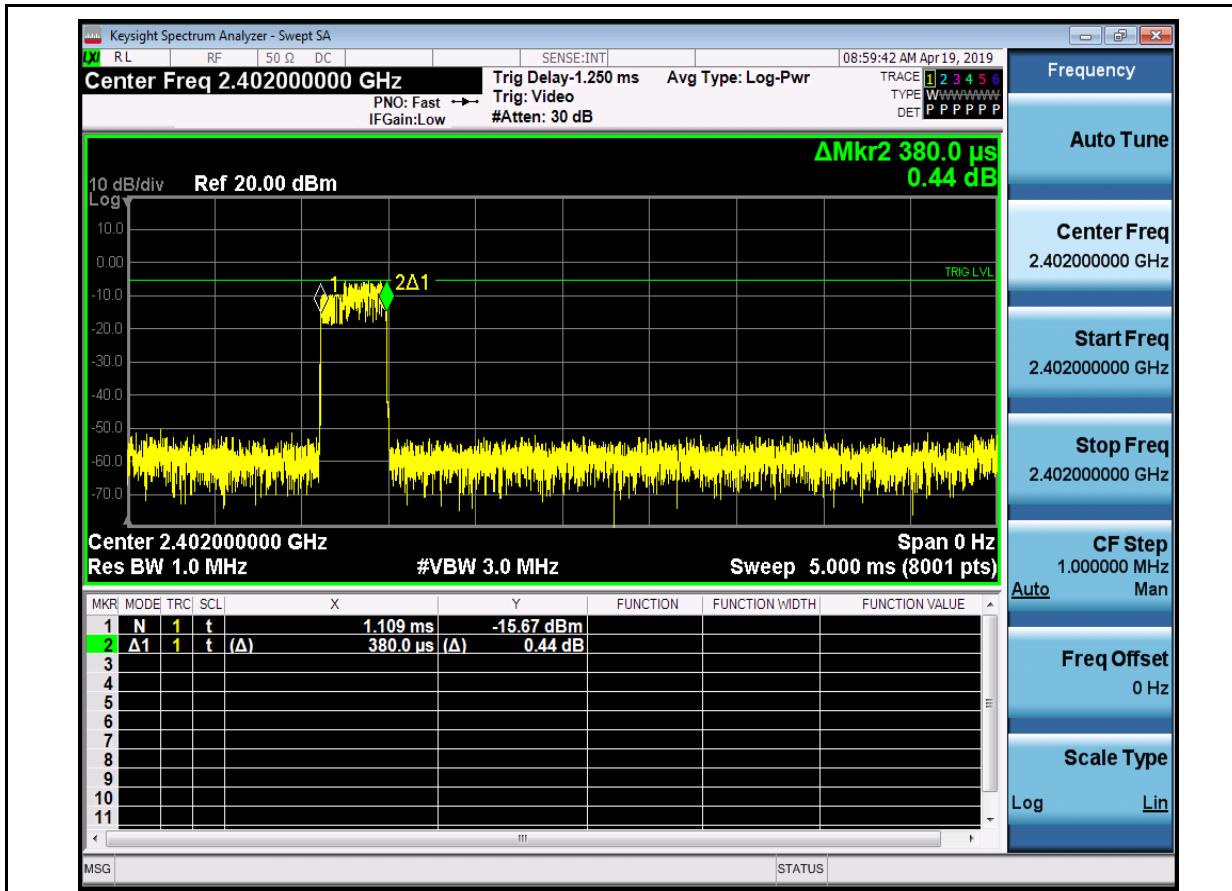
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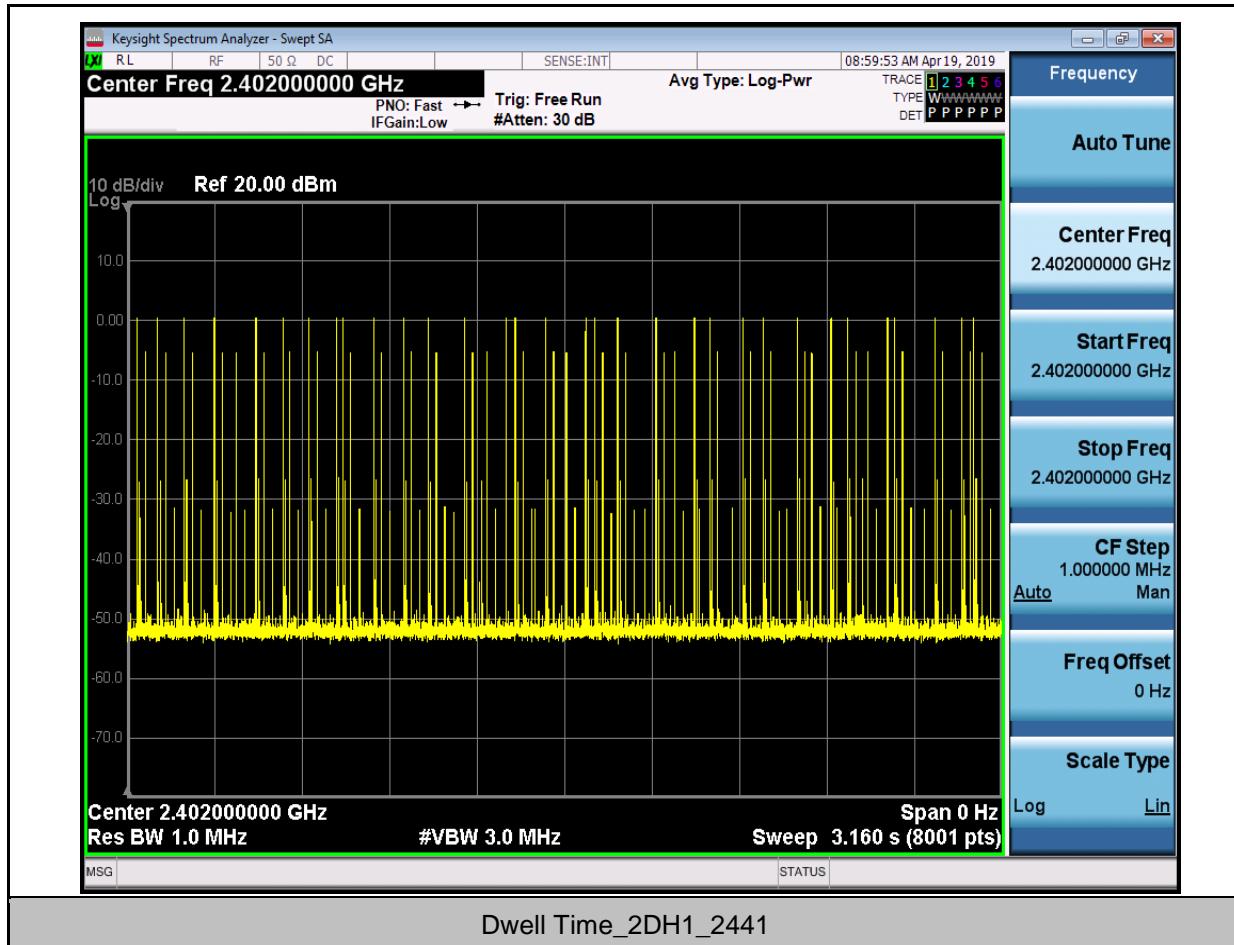
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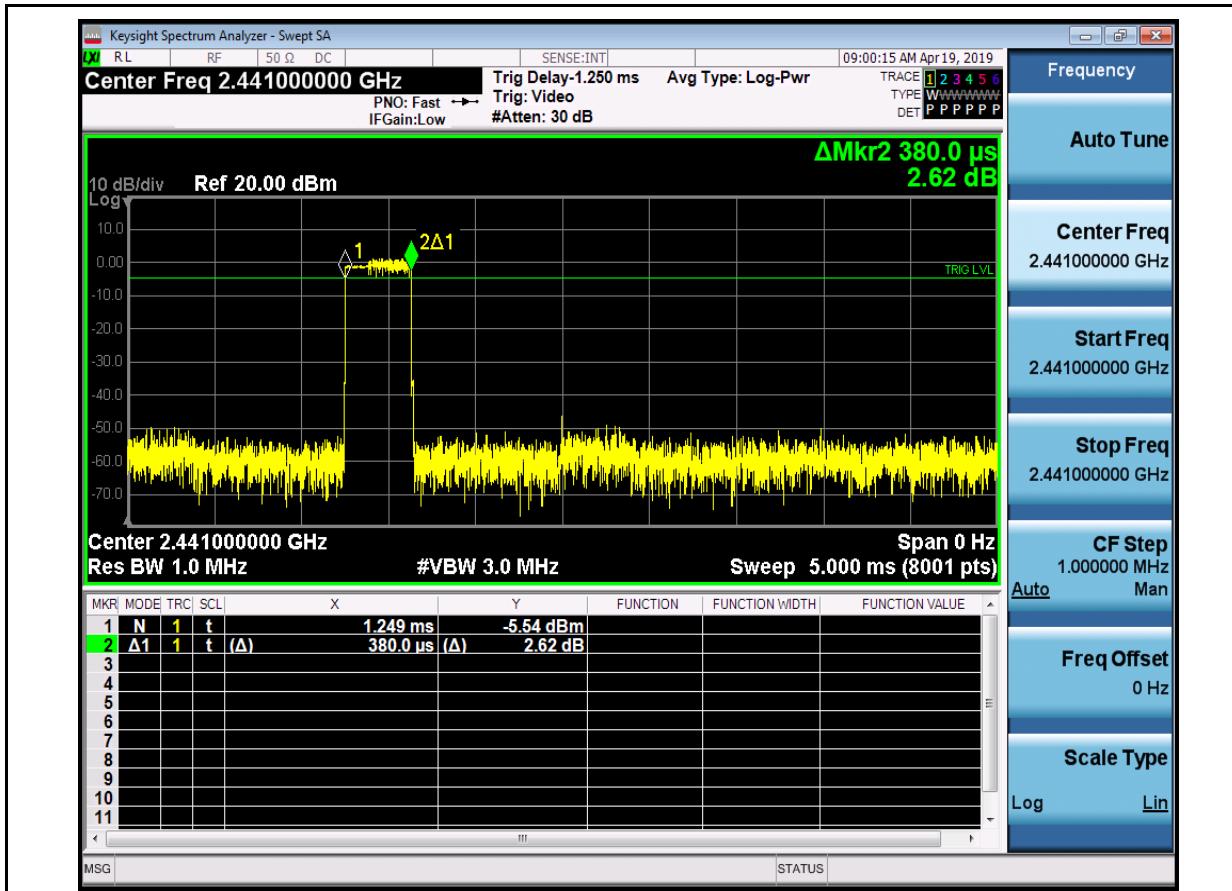
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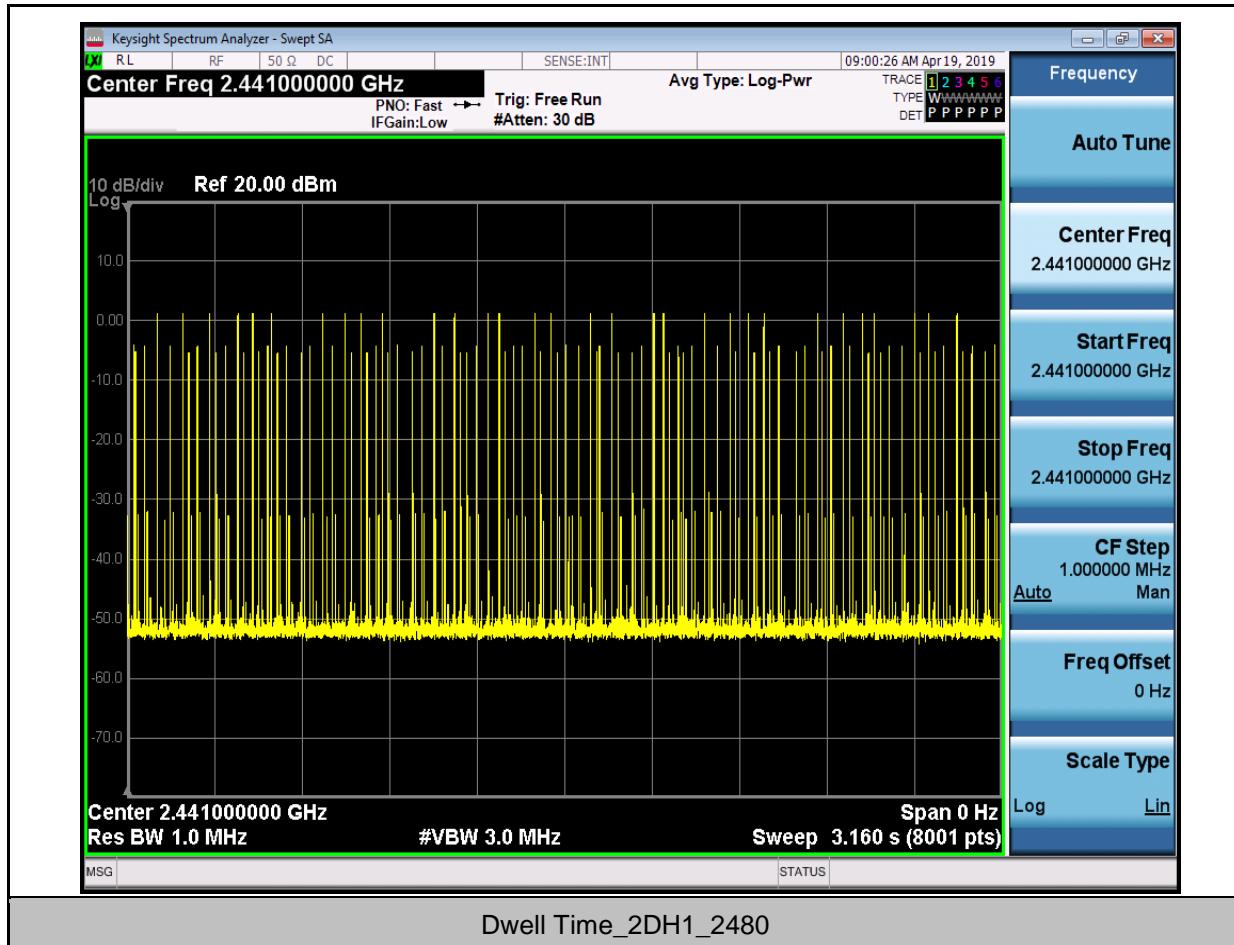
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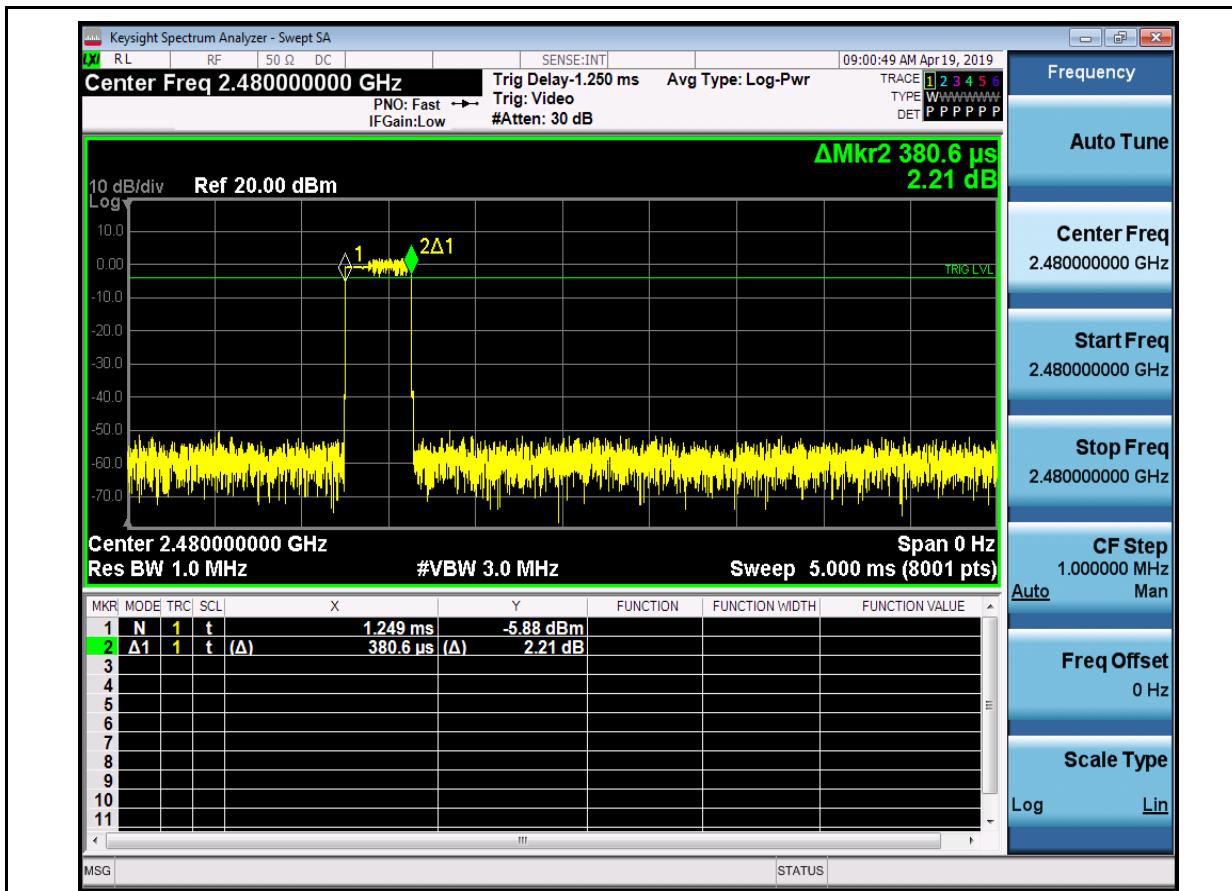


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