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

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

Telephone: +86 (0) 20 82155555
Fax: +86 (0) 20 82075059
Email: ee.guangzhou@sgs.com

TEST REPORT

Application No.:	GZEM1811002327CR
Applicant:	FOCAL JMLab
Address of Applicant:	108 Avenue de l'Avenir ZI Molina La Chazotte 42350 La Talaudière FRANCE
Manufacturer:	The same as Applicant
Address of Manufacturer:	The same as Applicant
Factory:	Minami Acoustics Limited
Address of Factory:	Shangou Industrial Park GongJiang Town, Yudu County Ganzhou City Jiangxi 342300 China
Equipment Under Test (EUT):	
FCC ID:	OV3-SPHEAR
EUT Name:	Bluetooth Headphones
Model No.:	Focal Sphear Wireless , Focal Sphear Wireless/Black, Focal Sphear Wireless/Blue, Focal Sphear Wireless/Olive, Focal Sphear Wireless/Purple, Focal Sphear Wireless/XX, [XX=AA to ZZ (for different color)]. ¤
¤	Please refer to section 2 of this report which indicates which model was actually tested and which were electrically identical.
Trade Mark:	FOCAL
Standard(s) :	47 CFR Part 15, Subpart C 15.247
Date of Receipt:	2018-11-02
Date of Test:	2018-11-02 to 2018-11-20
Date of Issue:	2018-12-12
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.

Revision Record				
Version	**Chapter**	**Date**	**Modifier**	**Remark**
01		2018-12-12		Original

Authorized for issue by:				
Tested By		 **Jackson_Yuan /Project Engineer**		2018-11-02 to 2018-11-20 **Date**
Checked By		 **Ricky Liu /Reviewer**		2018-12-12 **Date**

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

¤ Declaration of EUT Family Grouping:

Model No.: Focal Sphear Wireless , Focal Sphear Wireless/Black, Focal Sphear Wireless/Blue, Focal Sphear Wireless/Olive, Focal Sphear Wireless/Purple, Focal Sphear Wireless/XX, [XX=AA to ZZ (for different color)].

According to the declaration from the applicant, the electrical circuit design, layout, components used and internal wiring were identical for all models, with only differences on the item's no and outer color.

Therefore only one model **Focal Sphear Wireless/Black** was tested in this report.

3 Contents

4 General Information

4.1 Details of E.U.T.

Power Supply:	DC 5 V for charging by AC/DC adapter Powered by Built-in battery as below: Model No.: 401230 Rated: 3.7V, 120mAh, 0.44Wh
Test Voltage:	AC 120V, 60Hz with AC/DC adapter referred to section 4.3 for charging DC 3.7V for earphone working
Cable:	Micro USB charging ports (unshielded, <3m)
Antenna Gain	0.8 dBi
Antenna Type	Integrated Antenna
Channel Spacing	1MHz
Modulation Type	GFSK, π/4DQPSK, 8DPSK
Number of Channels	79
Operation Frequency	2402MHz to 2480MHz
Software	CSR
Spectrum Spread Technology	Frequency Hopping Spread Spectrum(FHSS)

4.2 Environment parameter

Environment Parameter	Selected Values During Tests	
Relative Humidity	Ambient	
Value	Temperature(℃)	Voltage(V)
TNVN	25	3.7
TLVN	-20	3.7
THVN	55	3.7

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

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

4.3 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
AC/DC Adapter	SGS	DC 5V	REF. No.SEA0500
Laptop	Lenovo	T430u	REF. No.SEA1800

4.4 Measurement Uncertainty

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

4.5 Test Location

All tests were performed at:

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

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

Tel: +86 20 82155555 Fax: +86 20 82075059

No tests were sub-contracted.

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-1)

The 3m/10m Alternate Semi-anechoic chamber of SGS-CSTC Standards Technical Services Co., Ltd., has been registered by Certification and Engineering of Industry Canada for radio equipment testing with Registration No. 4620B-1.

● VCCI (Registration No.: R-2460, C-2584, G-449 and T-1179)

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-2460, C-2584，G-449 and T-1179 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, IECEE 01 and Rules of procedure IECEE 02, and the relevant IECEE CB-Scheme Operational documents.

4.7 Deviation from Standards

None

4.8 Abnormalities from Standard Conditions

The EUT passed: Radiated Spurious Emissions test after modification.

5 Equipment List

Conducted Emissions at AC Power Line (150kHz-30MHz)					
Equipment	**Manufacturer**	**Model No**	**Inventory No**	**Cal Date**	**Cal Due Date**
Shielding Room	Zhong Yu	8m x 3m x 3.8m	EMC0306	N/A	N/A
Two-Line V-Netwok	R&S	ENV216	EMC0118	2018-01-19	2019-01-18
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

Conducted Peak Output Power					
Equipment	**Manufacturer**	**Model No**	**Inventory No**	**Cal Date**	**Cal Due Date**
EXA Signal Analzer	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

20dB Bandwidth					
Equipment	**Manufacturer**	**Model No**	**Inventory No**	**Cal Date**	**Cal Due Date**
EXA Signal Analzer	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

Carrier Frequencies Separation					
Equipment	**Manufacturer**	**Model No**	**Inventory No**	**Cal Date**	**Cal Due Date**
EXA Signal Analzer	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

Hopping Channel Number					
Equipment	**Manufacturer**	**Model No**	**Inventory No**	**Cal Date**	**Cal Due Date**
EXA Signal Analzer	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

Dwell Time					
Equipment	**Manufacturer**	**Model No**	**Inventory No**	**Cal Date**	**Cal Due Date**
EXA Signal Analzer	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

Conducted Band Edges Measurement					
Equipment	**Manufacturer**	**Model No**	**Inventory No**	**Cal Date**	**Cal Due Date**
MXA Signal Analyzer	AgilentTechnologies	N9020A	SEM004-10	2018-03-10	2019-03-09
ESG Vector Signal Generator	Keysight	E4438C	SEM006-03	2018-04-10	2019-04-10
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 Analzer	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

Conducted Spurious Emissions					
Equipment	**Manufacturer**	**Model No**	**Inventory No**	**Cal Date**	**Cal Due Date**
EXA Signal Analzer	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

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	2018-01-19	2019-01-18
EMI Test Receiver	Rohde & Schwarz	ESCI	EMC0056	2018-01-19	2019-01-18
Chamber cable	HangTianXing	N/A	EMC0542	2017-06-30	2019-06-30
Trilog Broadband Antenna 30MHz-1GHz	SCHWARZBECKMESS-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	2018-01-08	2019-01-07
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	2018-02-24	2019-02-23
High Pass Filter(915MHz)	FSY MICROWAVE	HM1465-9SS	EMC2079	2018-01-19	2019-01-18
2.4GHz Filter	Micro-Tronics	BRM 50702	EMC2069	2018-01-08	2019-01-07
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	2017-11-29	2018-11-28
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	SCHWARZBECKMESS-ELEKTRONIK	VULB 9168	SEM003-18	2016-06-29	2019-06-28
Test Software E3	Audix	Ver.6.120110a	GZE100-61	N/A	N/A

Radiated Spurious Emissions					
Equipment	**Manufacturer**	**Model No**	**Inventory No**	**Cal Date**	**Cal Due Date**
EMI Test Receiver	Rohde & Schwarz	ESIB26	EMC0522	2018-01-19	2019-01-18
EMI Test Receiver	Rohde & Schwarz	ESCI	EMC0056	2018-01-19	2019-01-18
Chamber cable	HangTianXing	N/A	EMC0542	2017-06-30	2019-06-30
Trilog Broadband Antenna 30MHz-1GHz	SCHWARZBECKMESS-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	2018-01-08	2019-01-07
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	2018-02-24	2019-02-23
High Pass Filter(915MHz)	FSY MICROWAVE	HM1465-9SS	EMC2079	2018-01-19	2019-01-18
2.4GHz Filter	Micro-Tronics	BRM 50702	EMC2069	2018-01-08	2019-01-07
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	2017-11-29	2018-11-28
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	SCHWARZBECKMESS-ELEKTRONIK	VULB 9168	SEM003-18	2016-06-29	2019-06-28
Test Software E3	Audix	Ver.6.120110a	GZE100-61	N/A	N/A

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

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:

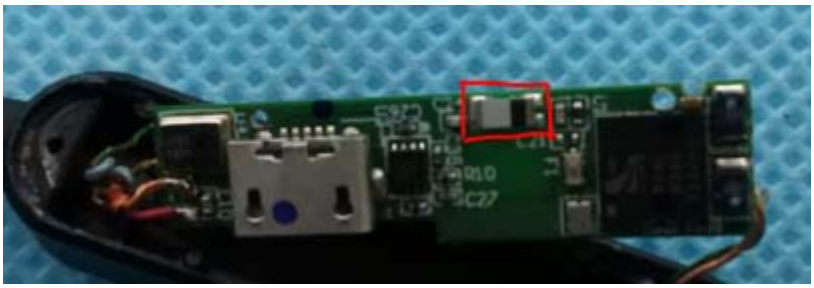
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit 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 0.8 dBi.



Test result: The unit does meet the FCC requirements.

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: 29 -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

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(dBμV)	
	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.		

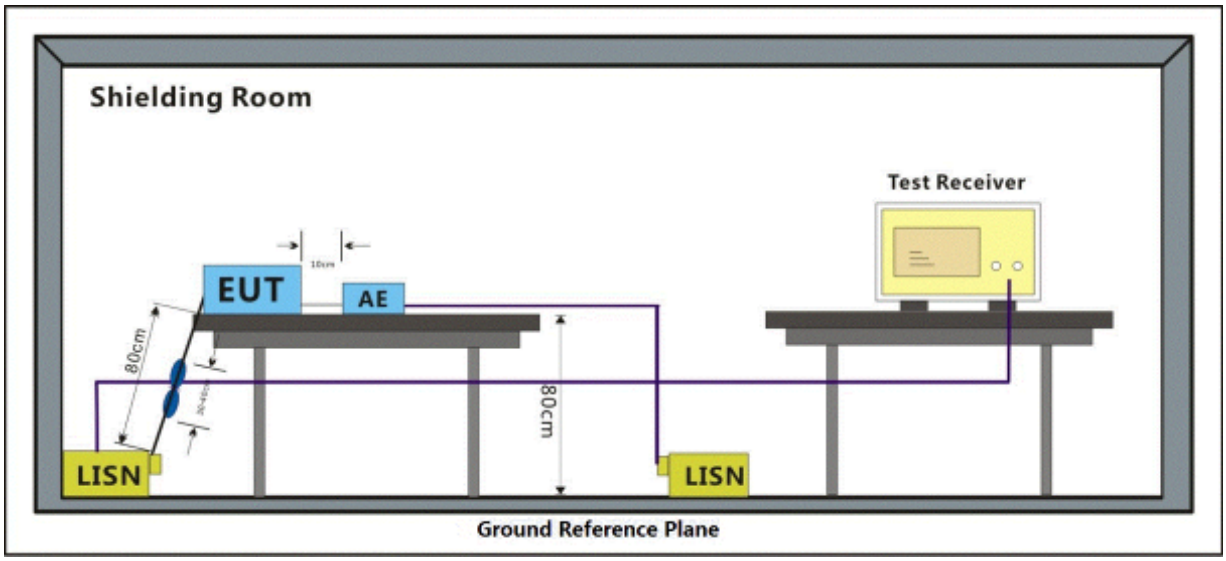
7.1.1 E.U.T. Operation

Operating Environment:

Temperature: 26.1 °C Humidity: 52 % RH Atmospheric Pressure: 1020 mbar

Test mode c: Charging.

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/50μH + 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.

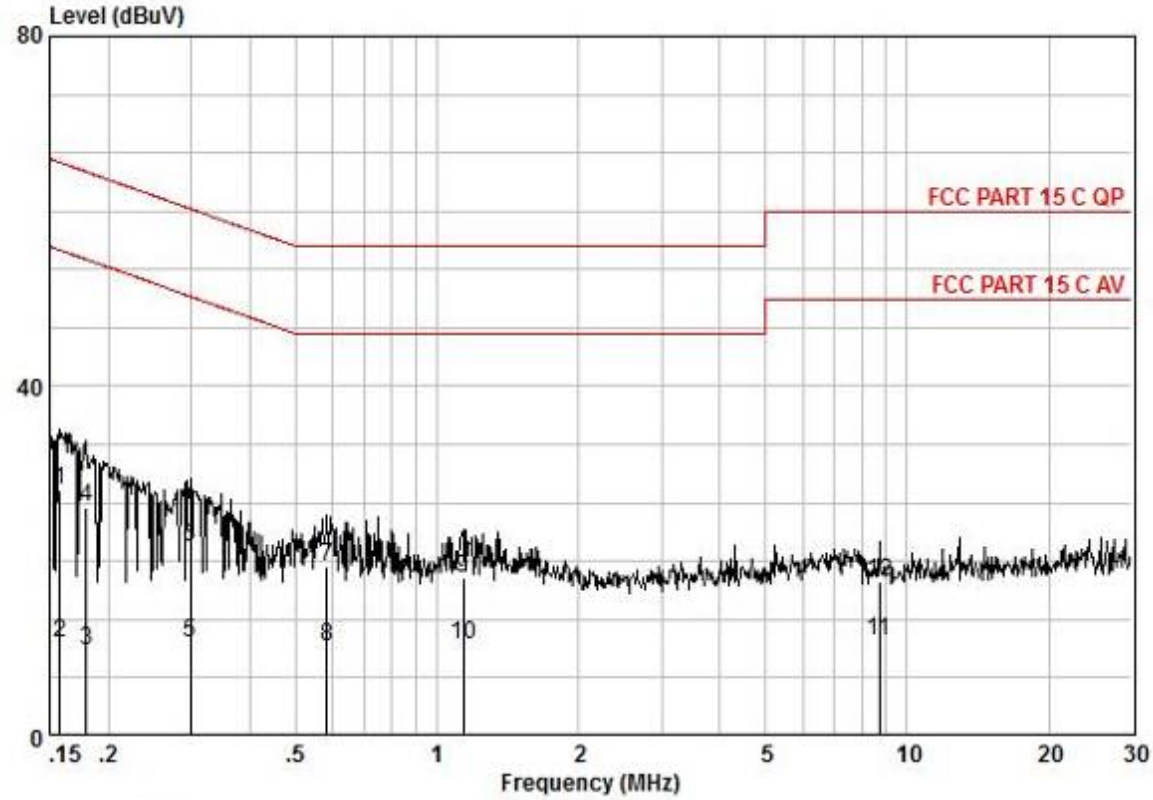
3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane,

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

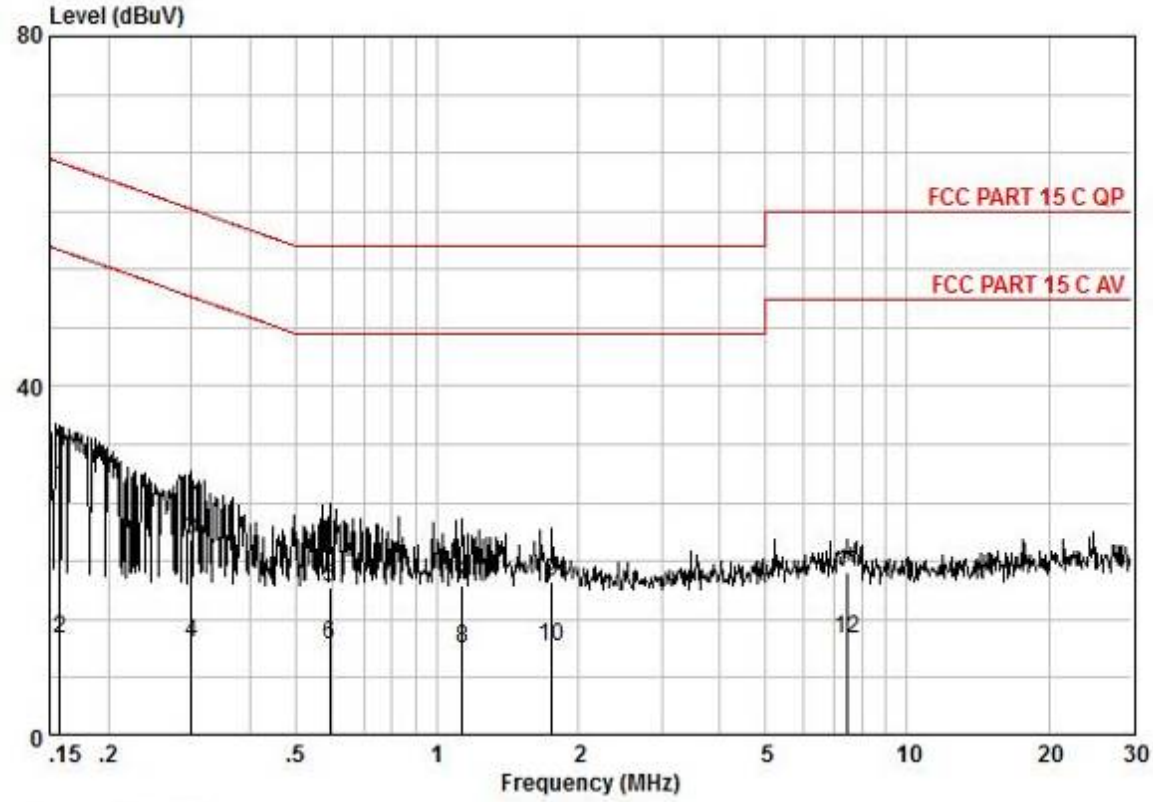
Mode:c; Line:Live Line



Pol :LIVE
No :
Model :

Frequency MHz	read level dBuV	Cable Loss dB	LISN Factor dB	Measured level dBuV	Limit Line dBuV	Over limit dB	Remark
0,16	18,27	0,10	9,65	28,02	65,60	-37,59	QP
0,16	1,00	0,10	9,65	10,75	55,60	-44,86	AVERAGE
0,18	0,03	0,10	9,65	9,78	54,50	-44,72	AVERAGE
0,18	16,36	0,10	9,65	26,11	64,50	-38,39	QP
0,30	0,85	0,14	9,64	10,63	50,28	-39,65	AVERAGE
0,30	11,79	0,14	9,64	21,57	60,28	-38,71	QP
0,58	9,51	0,22	9,64	19,37	56,00	-36,63	QP
0,58	0,45	0,22	9,64	10,31	46,00	-35,69	AVERAGE
1,14	8,13	0,30	9,66	18,09	56,00	-37,91	QP
1,14	0,46	0,30	9,66	10,42	46,00	-35,58	AVERAGE
8,73	0,56	0,62	9,78	10,96	50,00	-39,04	AVERAGE
8,73	7,33	0,62	9,78	17,73	60,00	-42,27	QP

Mode:c; Line:Neutral Line



Pol :NEUTRAL
No :
Model :

Frequency MHz	read level dBuV	Cable Loss dB	LISN Factor dB	Measured level dBuV	Limit Line dBuV	Over limit dB	Remark
0,16	18,84	0,10	9,67	28,61	65,60	-37,00	QP
0,16	1,33	0,10	9,67	11,10	55,60	-44,51	AVERAGE
0,30	12,68	0,14	9,66	22,48	60,24	-37,75	QP
0,30	0,89	0,14	9,66	10,69	50,24	-39,54	AVERAGE
0,59	7,05	0,22	9,67	16,95	56,00	-39,05	QP
0,59	0,55	0,22	9,67	10,45	46,00	-35,55	AVERAGE
1,13	7,25	0,30	9,68	17,23	56,00	-38,77	QP
1,13	0,07	0,30	9,68	10,05	46,00	-35,95	AVERAGE
1,75	7,53	0,35	9,68	17,57	56,00	-38,43	QP
1,75	0,26	0,35	9,68	10,30	46,00	-35,70	AVERAGE
7,49	8,39	0,64	9,78	18,82	60,00	-41,18	QP
7,49	0,59	0,64	9,78	11,02	50,00	-38,98	AVERAGE

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 ≥50 hopping channels
	0.25 for 25≤ hopping channels <50
	1 for digital modulation
2400-2483.5	1 for ≥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

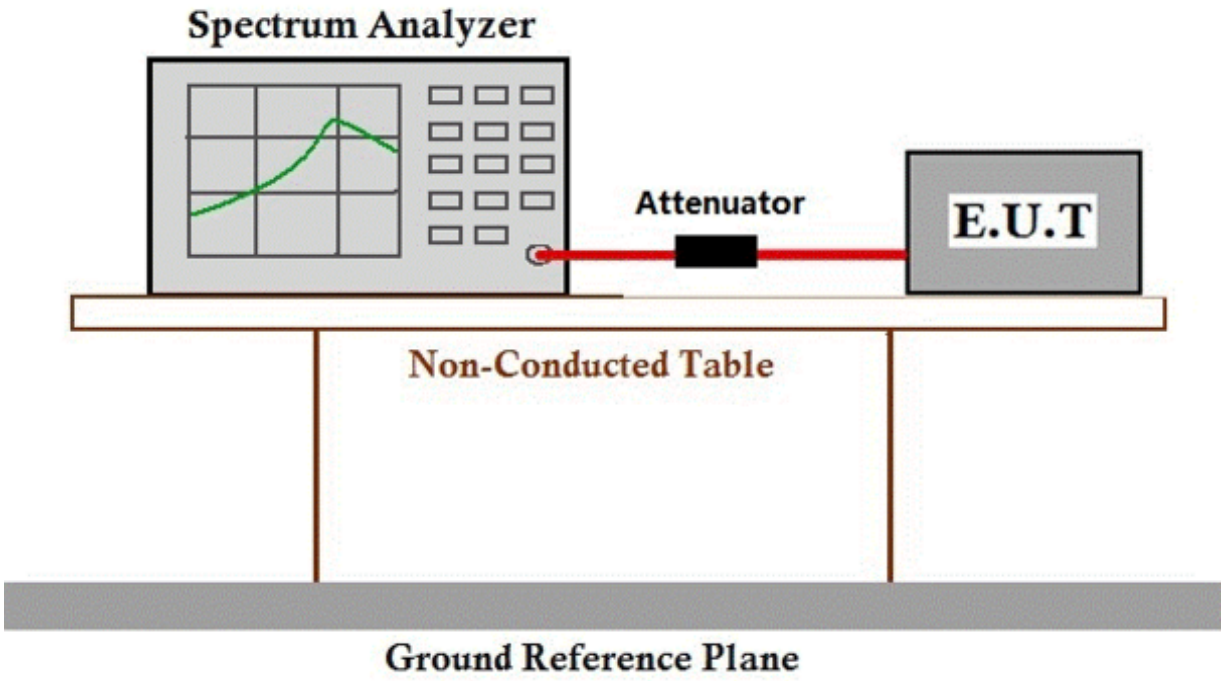
7.2.1 E.U.T. Operation

Operating Environment:

Temperature: 25.5 °C Humidity: 55.4 % RH Atmospheric Pressure: 1020 mbar

Test mode 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.

7.2.2 Test Setup Diagram



7.2.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247

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

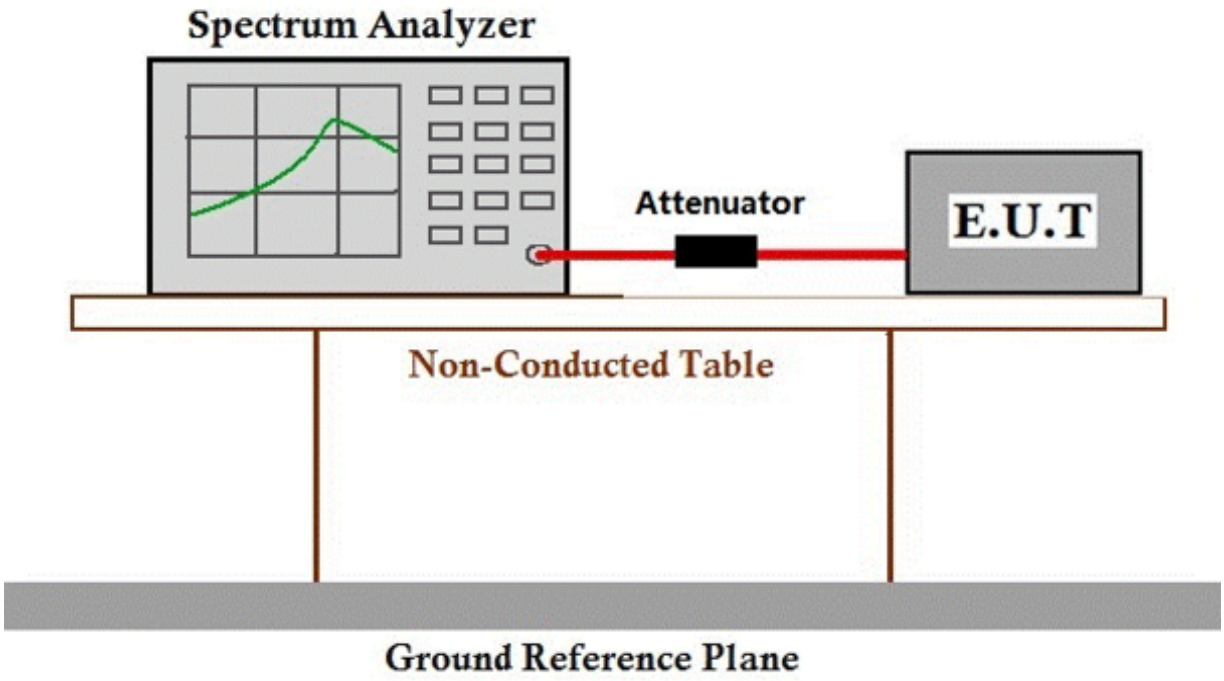
7.3.1 E.U.T. Operation

Operating Environment:

Temperature: 25.5 °C Humidity: 55.4 % RH Atmospheric Pressure: 1020 mbar

Test mode 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.

7.3.2 Test Setup Diagram



7.3.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247

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

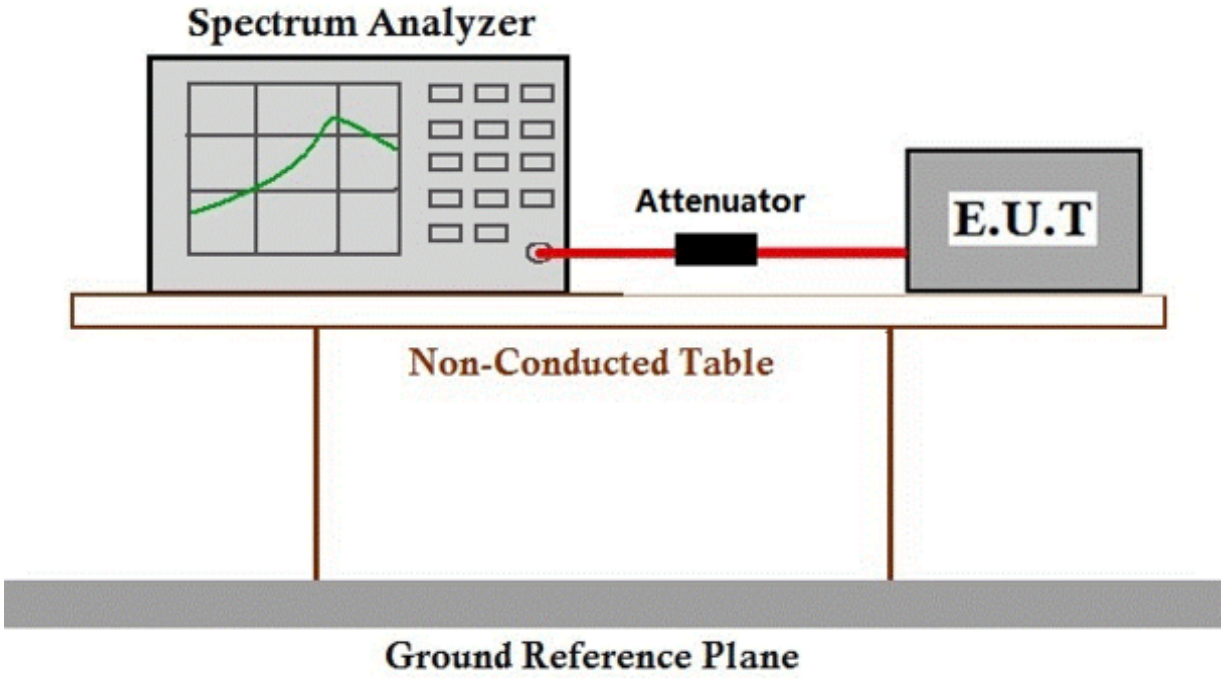
7.4.1 E.U.T. Operation

Operating Environment:

Temperature: 25.5 °C Humidity: 55.5 % 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

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 ≥250kHz
2400-2483.5	15
5725-5850	75

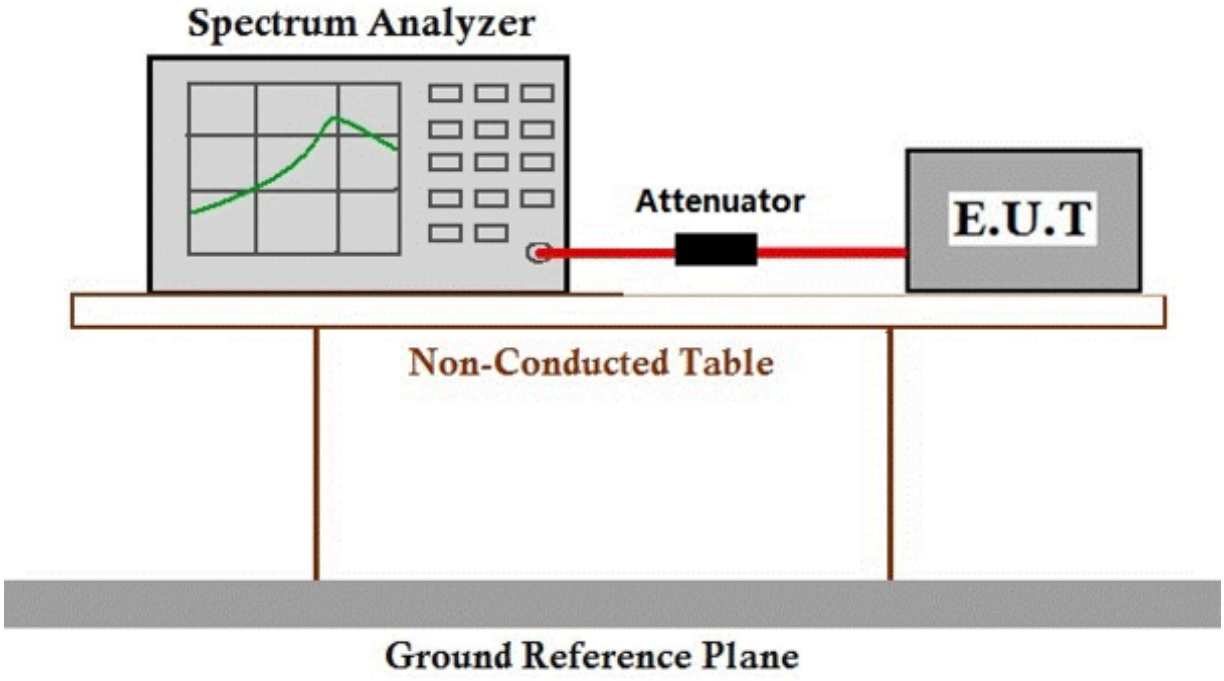
7.5.1 E.U.T. Operation

Operating Environment:

Temperature: 25.5 °C Humidity: 55.5 % 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.

7.5.2 Test Setup Diagram



7.5.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247

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

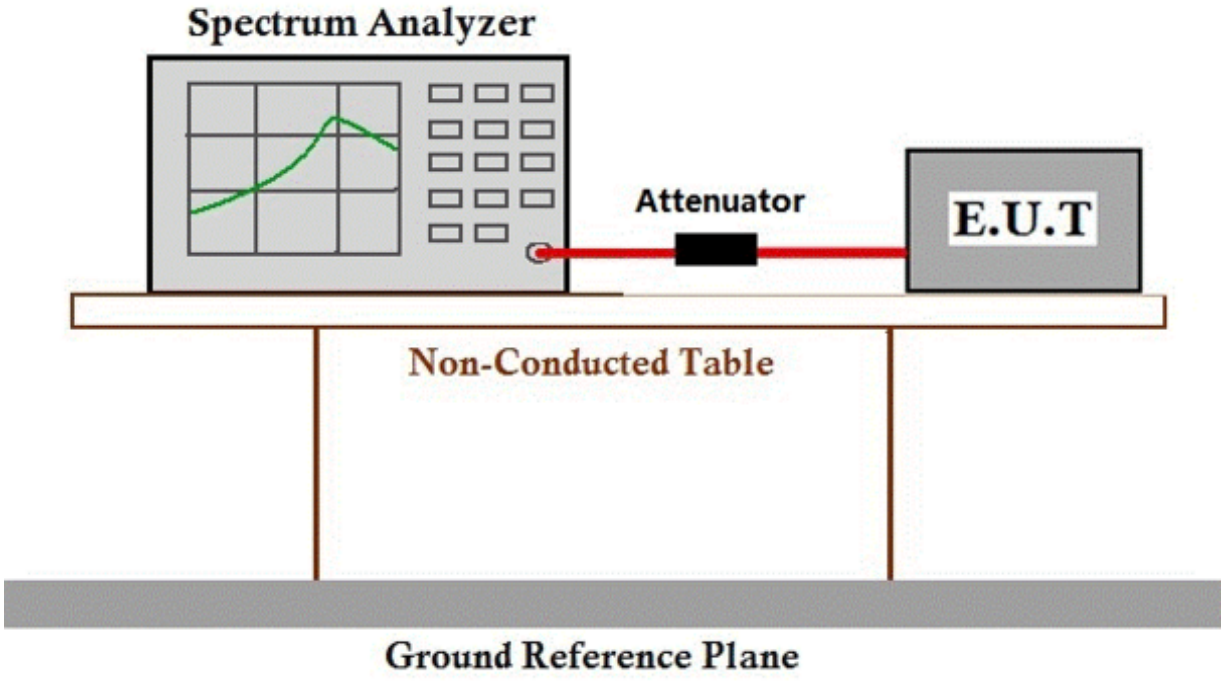
7.6.1 E.U.T. Operation

Operating Environment:

Temperature: 25.5 °C Humidity: 55.4 % 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

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)

7.7.1 E.U.T. Operation

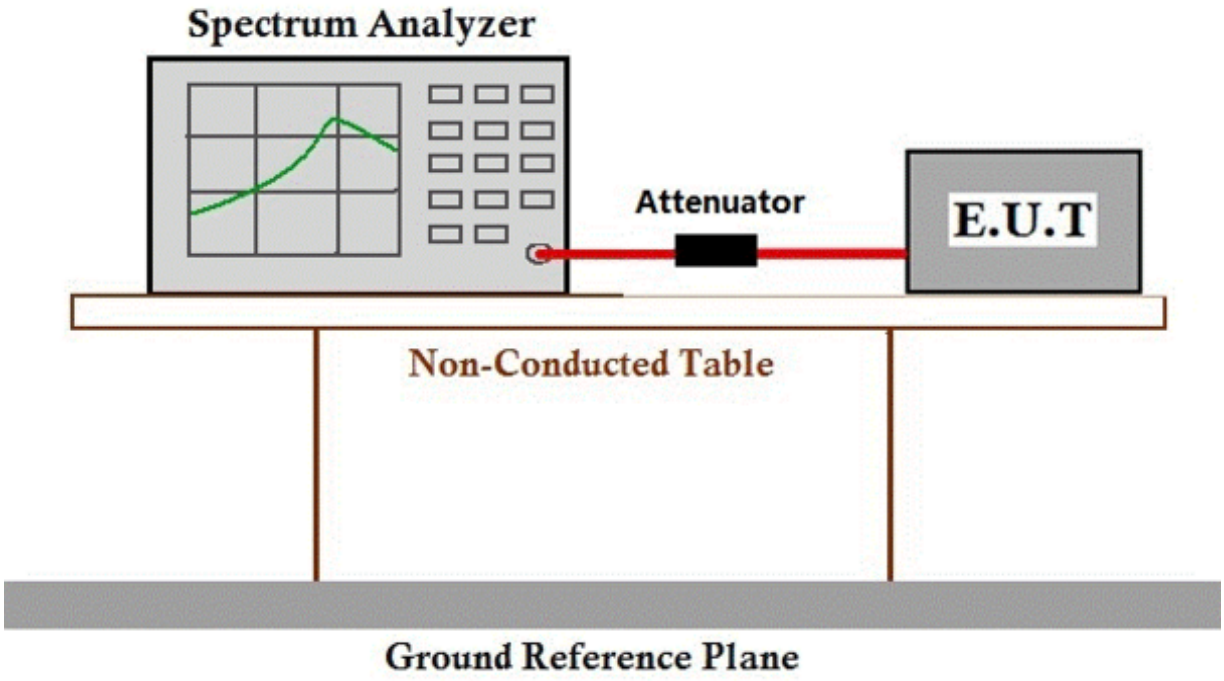
Operating Environment:

Temperature: 25.5 °C Humidity: 55.4 % 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

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)

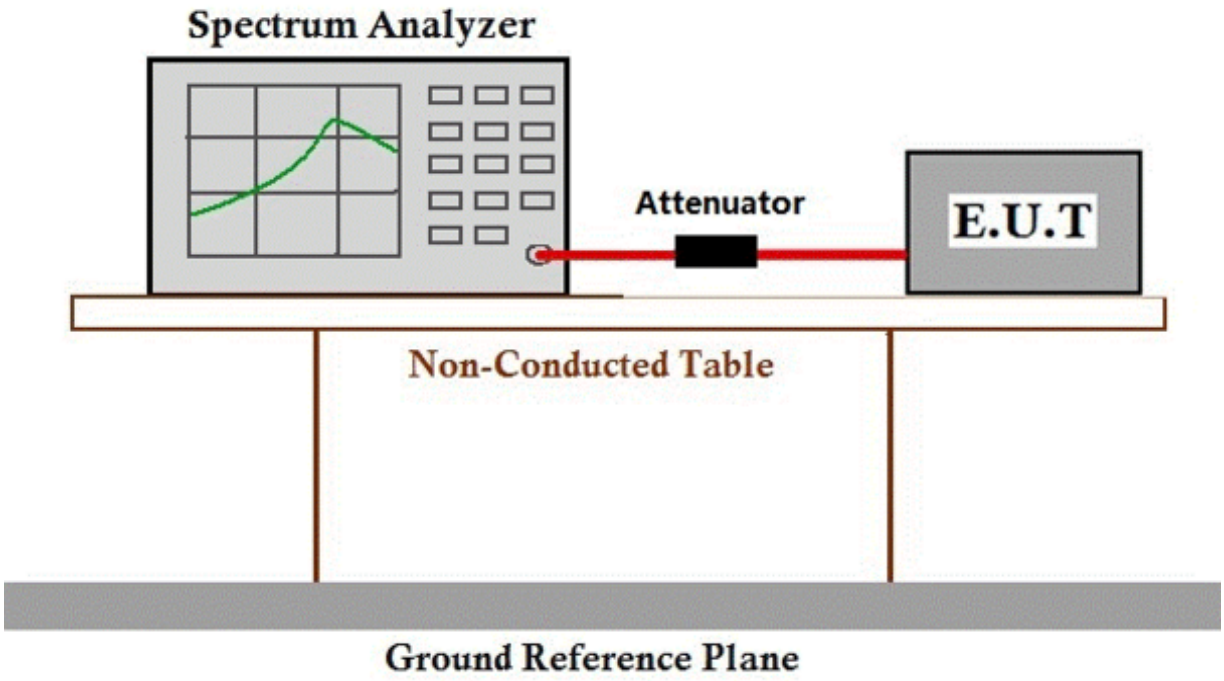
7.8.1 E.U.T. Operation

Operating Environment:

Temperature: 25.5 °C Humidity: 55.4 % RH Atmospheric Pressure: 1020 mbar

Test mode: 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.

7.8.2 Test Setup Diagram



7.8.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247

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: 24.9 °C Humidity: 65.4 % RH Atmospheric Pressure: 1020 mbar

Test mode 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.

7.9.2 Test Setup Diagram

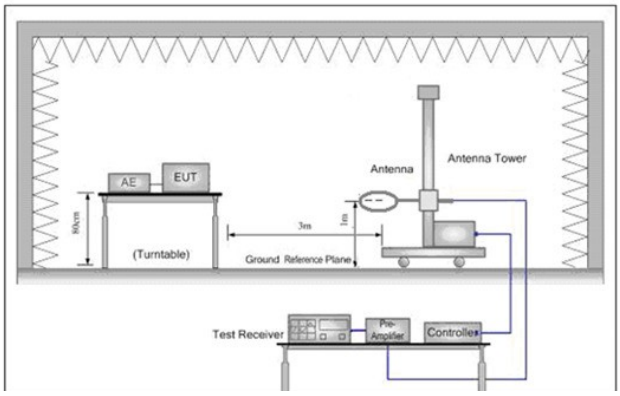


Figure 1. Below 30MHz

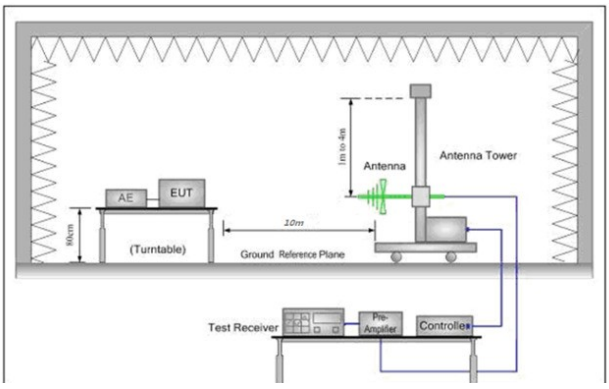


Figure 2. 30MHz to 1GHz

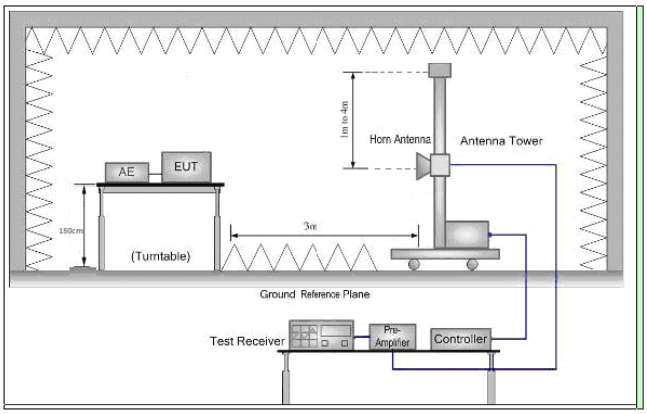


Figure 3. Above 1 GHz

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

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

	Freq	ReadAntenna Level	Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	2310.000	32.26	26.25	5.03	37.44	26.10	54.00	-27.90	HORIZONTAL	Average
2	2310.000	45.47	26.25	5.03	37.44	39.31	74.00	-34.69	HORIZONTAL	Peak
3	2390.000	31.98	26.43	4.88	37.42	25.87	54.00	-28.13	HORIZONTAL	Average
4	2390.000	44.37	26.43	4.88	37.42	38.26	74.00	-35.74	HORIZONTAL	Peak
5	2483.500	31.54	26.58	5.23	37.40	25.95	54.00	-28.05	HORIZONTAL	Average
6	2483.500	44.01	26.58	5.23	37.40	38.42	74.00	-35.58	HORIZONTAL	Peak
7	2500.000	30.11	26.60	4.95	37.39	24.27	54.00	-29.73	HORIZONTAL	Average
8	2500.000	45.70	26.60	4.95	37.39	39.86	74.00	-34.14	HORIZONTAL	Peak

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

	Freq	ReadAntenna Level	Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	2310.000	31.41	26.25	5.03	37.44	25.25	54.00	-28.75	VERTICAL	Average
2	2310.000	45.07	26.25	5.03	37.44	38.91	74.00	-35.09	VERTICAL	Peak
3	2390.000	32.14	26.43	4.88	37.42	26.03	54.00	-27.97	VERTICAL	Average
4	2390.000	44.97	26.43	4.88	37.42	38.86	74.00	-35.14	VERTICAL	Peak
5	2483.500	30.98	26.58	5.23	37.40	25.39	54.00	-28.61	VERTICAL	Average
6	2483.500	45.67	26.58	5.23	37.40	40.08	74.00	-33.92	VERTICAL	Peak
7	2500.000	31.70	26.60	4.95	37.39	25.86	54.00	-28.14	VERTICAL	Average
8	2500.000	46.10	26.60	4.95	37.39	40.26	74.00	-33.74	VERTICAL	Peak

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

	Freq	ReadAntenna Level	Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	2310.000	30.05	26.25	5.03	37.44	23.89	54.00	-30.11	HORIZONTAL	Average
2	2310.000	45.70	26.25	5.03	37.44	39.54	74.00	-34.46	HORIZONTAL	Peak
3	2390.000	32.45	26.43	4.88	37.42	26.34	54.00	-27.66	HORIZONTAL	Average
4	2390.000	44.46	26.43	4.88	37.42	38.35	74.00	-35.65	HORIZONTAL	Peak
5	2483.500	32.65	26.58	5.23	37.40	27.06	54.00	-26.94	HORIZONTAL	Average
6	2483.500	48.53	26.58	5.23	37.40	42.94	74.00	-31.06	HORIZONTAL	Peak
7	2500.000	34.12	26.60	4.95	37.39	28.28	54.00	-25.72	HORIZONTAL	Average
8	2500.000	48.43	26.60	4.95	37.39	42.59	74.00	-31.41	HORIZONTAL	Peak

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

	Freq	ReadAntenna Level	Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	2310.000	32.29	26.25	5.03	37.44	26.13	54.00	-27.87	VERTICAL	Average
2	2310.000	46.04	26.25	5.03	37.44	39.88	74.00	-34.12	VERTICAL	Peak
3	2390.000	31.82	26.43	4.88	37.42	25.71	54.00	-28.29	VERTICAL	Average
4	2390.000	46.86	26.43	4.88	37.42	40.75	74.00	-33.25	VERTICAL	Peak
5	2483.500	32.15	26.58	5.23	37.40	26.56	54.00	-27.44	VERTICAL	Average
6	2483.500	46.15	26.58	5.23	37.40	40.56	74.00	-33.44	VERTICAL	Peak
7	2500.000	30.83	26.60	4.95	37.39	24.99	54.00	-29.01	VERTICAL	Average
8	2500.000	46.98	26.60	4.95	37.39	41.14	74.00	-32.86	VERTICAL	Peak

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.		

7.10.1 E.U.T. Operation

Operating Environment:

Temperature: 24.9 °C Humidity: 65.4 % RH Atmospheric Pressure: 1020 mbar

Test mode 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.

7.10.2Test Setup Diagram

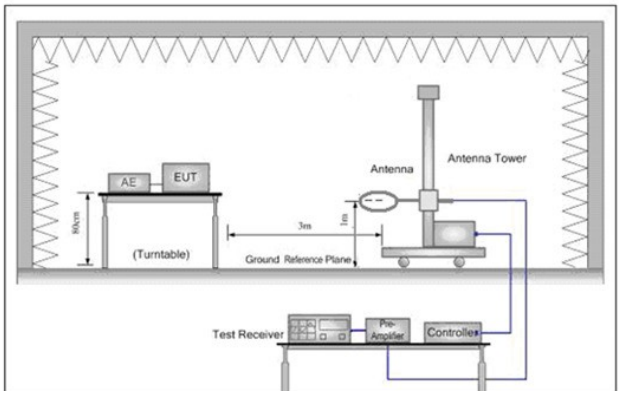


Figure 1. Below 30MHz

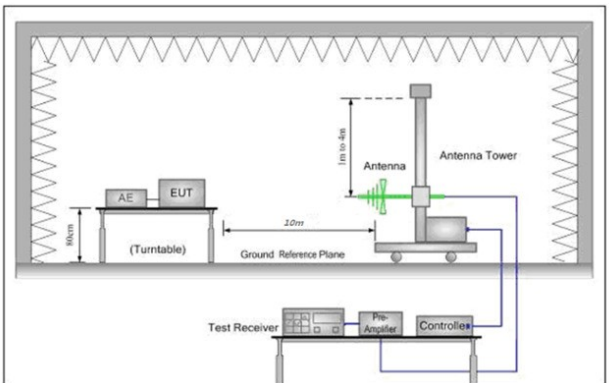


Figure 2. 30MHz to 1GHz

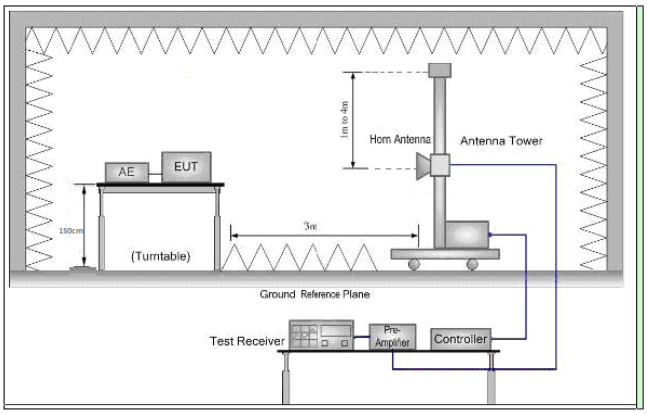


Figure 3. Above 1 GHz

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

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

	Freq	ReadAntenna Level	Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	31.955	21.51	12.25	0.11	21.90	11.97	40.00	-28.03	HORIZONTAL	QP
2	55.221	24.39	12.54	0.59	25.08	12.44	40.00	-27.56	HORIZONTAL	QP
3	71.832	25.61	10.50	0.73	25.58	11.26	40.00	-28.74	HORIZONTAL	QP
4	107.510	28.30	10.25	0.87	27.49	11.93	43.50	-31.57	HORIZONTAL	QP
5	159.784	27.26	13.40	1.26	28.10	13.82	43.50	-29.68	HORIZONTAL	QP
6	872.183	35.20	23.73	2.93	28.29	33.57	46.00	-12.43	HORIZONTAL	QP

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

	Freq	ReadAntenna Level	Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	4804.110	53.06	30.79	5.87	36.94	52.78	54.00	-1.22	HORIZONTAL	Average
2	4804.110	53.39	30.79	5.87	36.94	53.11	74.00	-20.89	HORIZONTAL	Peak
3	5830.640	32.99	32.19	7.45	37.00	35.63	54.00	-18.37	HORIZONTAL	Average
4	5830.640	44.41	32.19	7.45	37.00	47.05	74.00	-26.95	HORIZONTAL	Peak
5	7206.309	30.05	35.45	7.34	36.93	35.91	54.00	-18.09	HORIZONTAL	Average
6	7206.309	43.68	35.45	7.34	36.93	49.54	74.00	-24.46	HORIZONTAL	Peak
7	8440.945	29.21	36.13	8.06	36.93	36.47	54.00	-17.53	HORIZONTAL	Average
8	8440.945	43.35	36.13	8.06	36.93	50.61	74.00	-23.39	HORIZONTAL	Peak
9	9608.221	31.73	37.51	8.15	37.08	40.31	54.00	-13.69	HORIZONTAL	Average
10	9608.221	44.52	37.51	8.15	37.08	53.10	74.00	-20.90	HORIZONTAL	Peak
11	12010.760	28.00	39.50	10.67	37.20	40.97	54.00	-13.03	HORIZONTAL	Average
12	12010.760	41.47	39.50	10.67	37.20	54.44	74.00	-19.56	HORIZONTAL	Peak

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

	Freq	ReadAntenna Level	Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	45.855	22.32	12.87	0.70	24.53	11.36	40.00	-28.64	VERTICAL	QP
2	60.069	23.11	12.20	0.58	25.23	10.66	40.00	-29.34	VERTICAL	QP
3	70.832	25.29	10.68	0.73	25.55	11.15	40.00	-28.85	VERTICAL	QP
4	107.510	28.84	10.25	0.87	27.49	12.47	43.50	-31.03	VERTICAL	QP
5	169.005	25.33	13.08	1.31	28.09	11.63	43.50	-31.87	VERTICAL	QP
6	872.183	33.65	23.73	2.93	28.29	32.02	46.00	-13.98	VERTICAL	QP

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

	Freq	ReadAntenna Level	Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	4804.110	43.60	30.79	5.87	36.94	43.32	54.00	-10.68	VERTICAL	Average
2	4804.110	48.41	30.79	5.87	36.94	48.13	74.00	-25.87	VERTICAL	Peak
3	5763.617	32.34	32.12	7.10	37.00	34.56	54.00	-19.44	VERTICAL	Average
4	5763.617	44.56	32.12	7.10	37.00	46.78	74.00	-27.22	VERTICAL	Peak
5	7206.982	27.82	35.45	7.34	36.93	33.68	54.00	-20.32	VERTICAL	Average
6	7206.982	43.36	35.45	7.34	36.93	49.22	74.00	-24.78	VERTICAL	Peak
7	8995.123	29.06	36.50	8.24	37.01	36.79	54.00	-17.21	VERTICAL	Average
8	8995.123	44.46	36.50	8.24	37.01	52.19	74.00	-21.81	VERTICAL	Peak
9	9608.916	30.42	37.51	8.15	37.08	39.00	54.00	-15.00	VERTICAL	Average
10	9608.916	43.08	37.51	8.15	37.08	51.66	74.00	-22.34	VERTICAL	Peak
11	12010.540	28.94	39.50	10.67	37.20	41.91	54.00	-12.09	VERTICAL	Average
12	12010.540	42.29	39.50	10.67	37.20	55.26	74.00	-18.74	VERTICAL	Peak

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

	Freq	ReadAntenna Level	Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	3834.438	31.23	29.12	7.80	36.91	31.24	54.00	-22.76	HORIZONTAL	Average
2	3834.438	44.20	29.12	7.80	36.91	44.21	74.00	-29.79	HORIZONTAL	Peak
3	4882.000	52.84	30.95	6.86	36.95	53.70	54.00	-0.30	HORIZONTAL	Average
4	4882.000	54.33	30.95	6.86	36.95	55.19	74.00	-18.81	HORIZONTAL	Peak
5	6432.732	32.46	34.09	7.02	36.99	36.58	54.00	-17.42	HORIZONTAL	Average
6	6432.732	43.70	34.09	7.02	36.99	47.82	74.00	-26.18	HORIZONTAL	Peak
7	7323.267	44.70	35.74	7.39	36.92	50.91	54.00	-3.09	HORIZONTAL	Average
8	7323.267	47.39	35.74	7.39	36.92	53.60	74.00	-20.40	HORIZONTAL	Peak
9	9764.717	29.94	37.70	8.33	37.09	38.88	54.00	-15.12	HORIZONTAL	Average
10	9764.717	43.59	37.70	8.33	37.09	52.53	74.00	-21.47	HORIZONTAL	Peak
11	12205.100	28.67	39.21	10.98	37.06	41.80	54.00	-12.20	HORIZONTAL	Average
12	12205.100	40.16	39.21	10.98	37.06	53.29	74.00	-20.71	HORIZONTAL	Peak

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

	Freq	ReadAntenna Level	Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	4039.212	31.11	29.53	7.13	36.90	30.87	54.00	-23.13	VERTICAL	Average
2	4039.212	44.55	29.53	7.13	36.90	44.31	74.00	-29.69	VERTICAL	Peak
3	4882.043	43.03	30.95	6.86	36.95	43.89	54.00	-10.11	VERTICAL	Average
4	4882.043	48.58	30.95	6.86	36.95	49.44	74.00	-24.56	VERTICAL	Peak
5	7323.542	31.48	35.74	7.39	36.92	37.69	54.00	-16.31	VERTICAL	Average
6	7323.542	43.68	35.74	7.39	36.92	49.89	74.00	-24.11	VERTICAL	Peak
7	8368.069	28.20	36.18	8.11	36.93	35.56	54.00	-18.44	VERTICAL	Average
8	8368.069	44.88	36.18	8.11	36.93	52.24	74.00	-21.76	VERTICAL	Peak
9	9764.164	28.34	37.70	8.33	37.09	37.28	54.00	-16.72	VERTICAL	Average
10	9764.164	41.87	37.70	8.33	37.09	50.81	74.00	-23.19	VERTICAL	Peak
11	12205.740	27.48	39.21	10.98	37.06	40.61	54.00	-13.39	VERTICAL	Average
12	12205.740	40.34	39.21	10.98	37.06	53.47	74.00	-20.53	VERTICAL	Peak

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

	Freq	ReadAntenna Level	Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	3757.637	32.08	28.82	7.65	36.92	31.63	54.00	-22.37	HORIZONTAL	Average
2	3757.637	44.42	28.82	7.65	36.92	43.97	74.00	-30.03	HORIZONTAL	Peak
3	4959.970	50.42	31.05	7.84	36.96	52.35	54.00	-1.65	HORIZONTAL	Average
4	4959.970	51.16	31.05	7.84	36.96	53.09	74.00	-20.91	HORIZONTAL	Peak
5	7440.914	33.30	35.92	7.43	36.92	39.73	54.00	-14.27	HORIZONTAL	Average
6	7440.914	46.60	35.92	7.43	36.92	53.03	74.00	-20.97	HORIZONTAL	Peak
7	8638.399	29.73	36.20	7.96	36.95	36.94	54.00	-17.06	HORIZONTAL	Average
8	8638.399	44.86	36.20	7.96	36.95	52.07	74.00	-21.93	HORIZONTAL	Peak
9	9920.140	29.10	37.92	8.63	37.10	38.55	54.00	-15.45	HORIZONTAL	Average
10	9920.140	42.40	37.92	8.63	37.10	51.85	74.00	-22.15	HORIZONTAL	Peak
11	12400.950	26.79	38.93	11.17	36.90	39.99	54.00	-14.01	HORIZONTAL	Average
12	12400.950	41.09	38.93	11.17	36.90	54.29	74.00	-19.71	HORIZONTAL	Peak

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

	Freq	ReadAntenna Level	Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	3867.831	31.32	29.22	7.69	36.91	31.32	54.00	-22.68	VERTICAL	Average
2	3867.831	42.63	29.22	7.69	36.91	42.63	74.00	-31.37	VERTICAL	Peak
3	4960.307	48.29	31.05	7.84	36.96	50.22	54.00	-3.78	VERTICAL	Average
4	4960.307	49.69	31.05	7.84	36.96	51.62	74.00	-22.38	VERTICAL	Peak
5	7440.727	28.10	35.92	7.43	36.92	34.53	54.00	-19.47	VERTICAL	Average
6	7440.727	41.79	35.92	7.43	36.92	48.22	74.00	-25.78	VERTICAL	Peak
7	8764.146	29.10	36.33	8.00	36.97	36.46	54.00	-17.54	VERTICAL	Average
8	8764.146	42.37	36.33	8.00	36.97	49.73	74.00	-24.27	VERTICAL	Peak
9	9920.525	30.88	37.92	8.63	37.10	40.33	54.00	-13.67	VERTICAL	Average
10	9920.525	43.47	37.92	8.63	37.10	52.92	74.00	-21.08	VERTICAL	Peak
11	12400.070	28.53	38.93	11.17	36.90	41.73	54.00	-12.27	VERTICAL	Average
12	12400.070	42.50	38.93	11.17	36.90	55.70	74.00	-18.30	VERTICAL	Peak

8 Appendix

8.1 Appendix 15.247

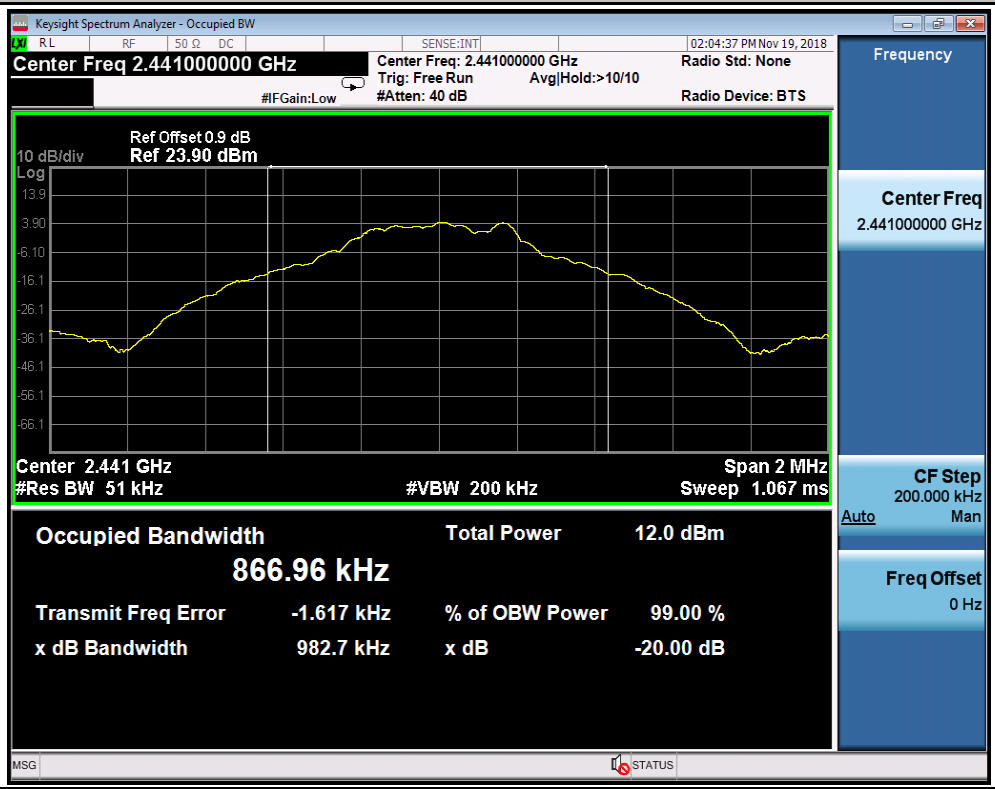
1.20 dB Bandwidth

Test Mode	Test Channel	EBW[MHz]	2/3 Bandwidth [MHz]	Limit[MHz]	Verdict
DH5	2402	1.111	0.741	---	PASS
DH5	2441	0.9827	0.655	---	PASS
DH5	2480	0.9893	0.660	---	PASS
2DH5	2402	1.284	0.856	---	PASS
2DH5	2441	1.300	0.867	---	PASS
2DH5	2480	1.297	0.865	---	PASS
3DH5	2402	1.305	0.870	---	PASS
3DH5	2441	1.313	0.875	---	PASS
3DH5	2480	1.309	0.873	---	PASS

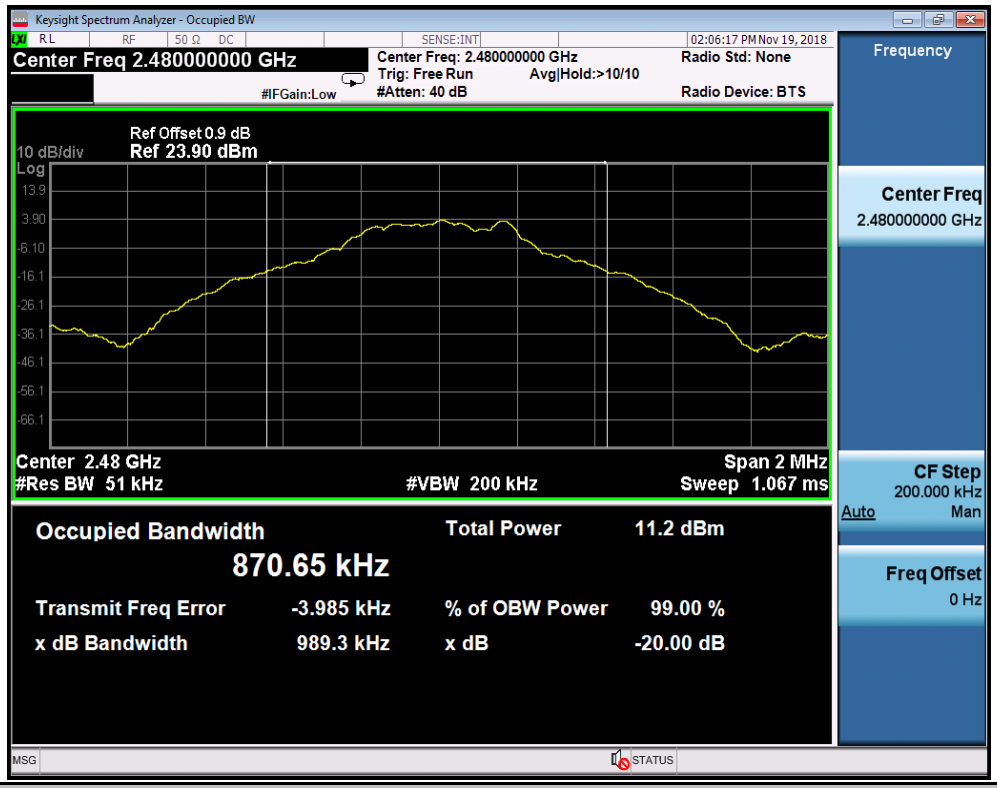
TEST PLOT

20 dB Bandwidth_DH5_2402

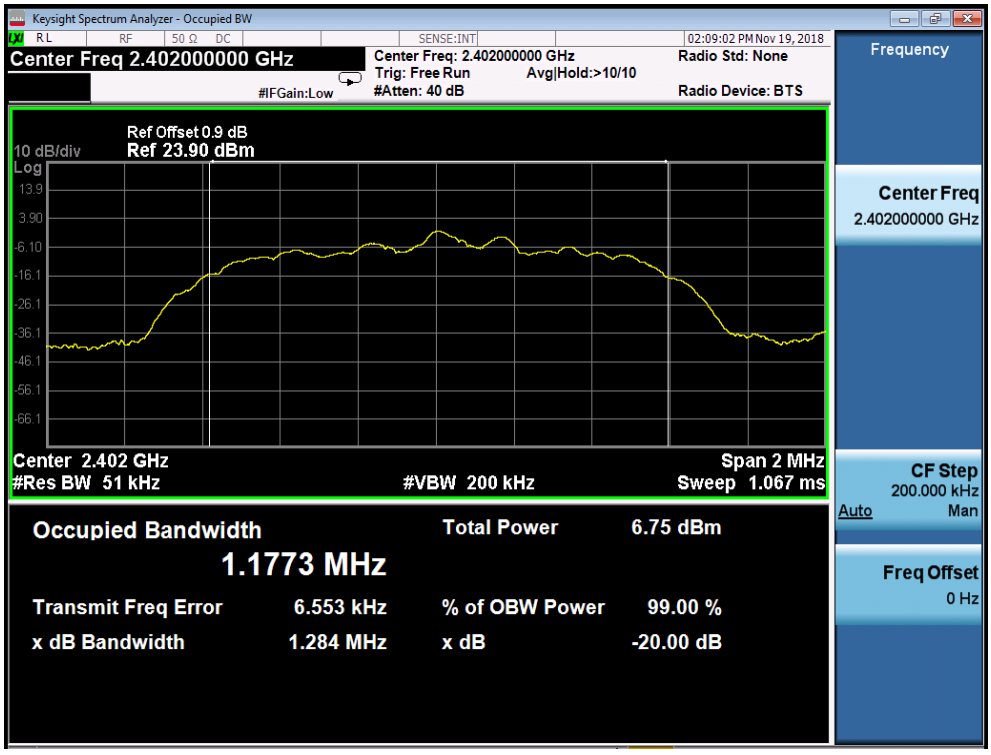
20 dB Bandwidth_DH5_2441



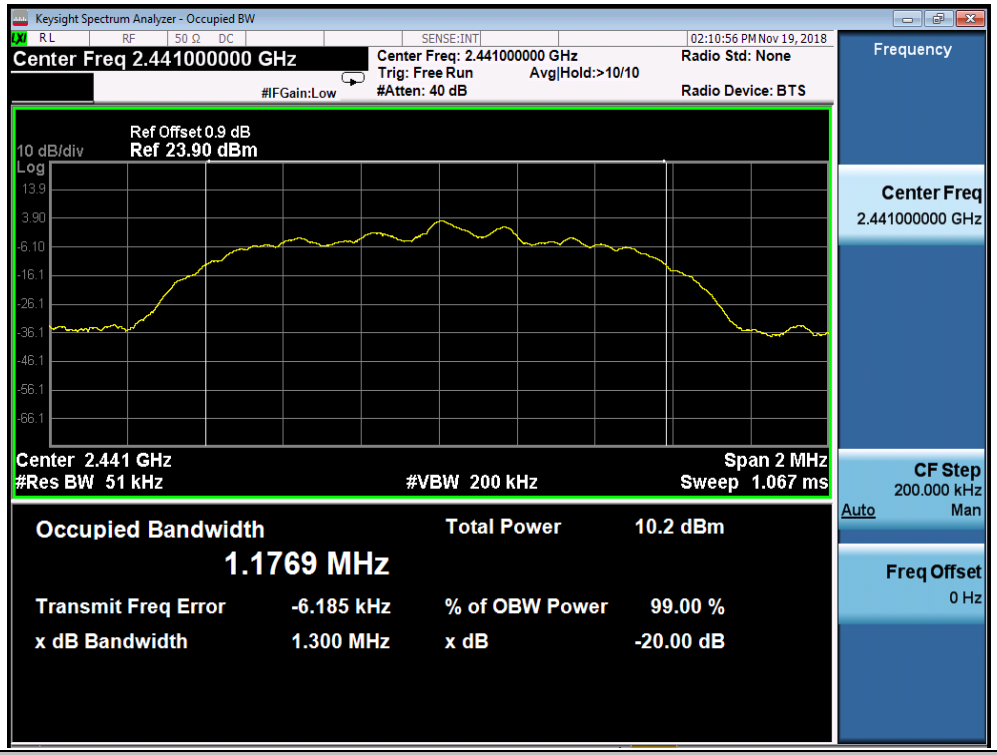
20 dB Bandwidth_DH5_2480



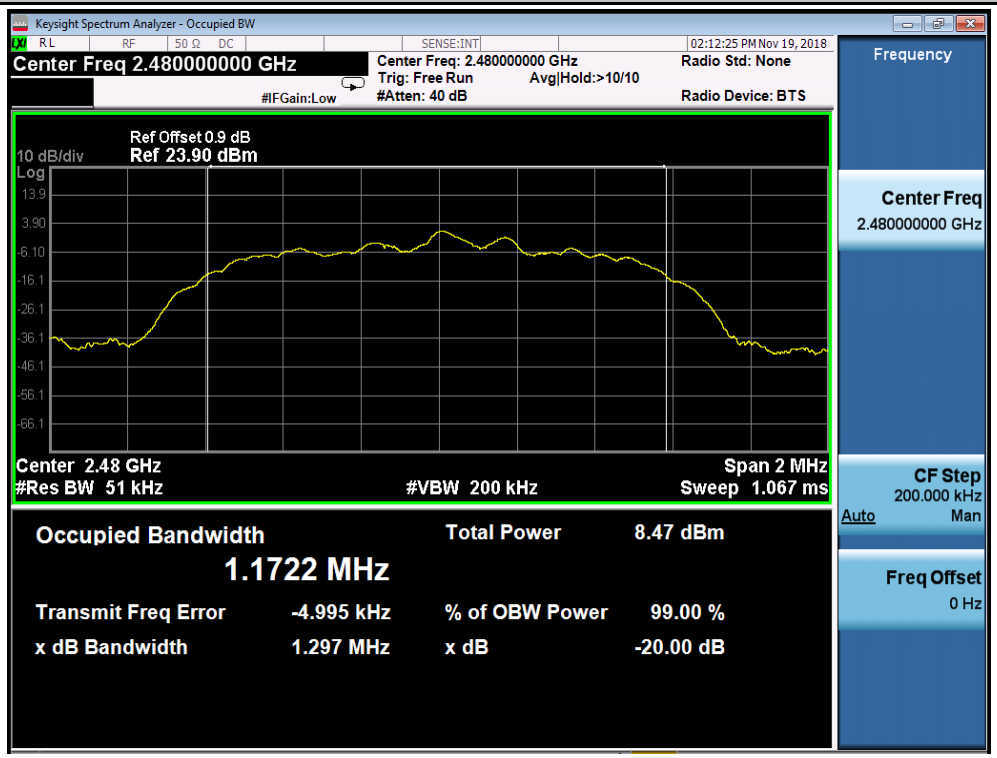
20 dB Bandwidth_2DH5_2402



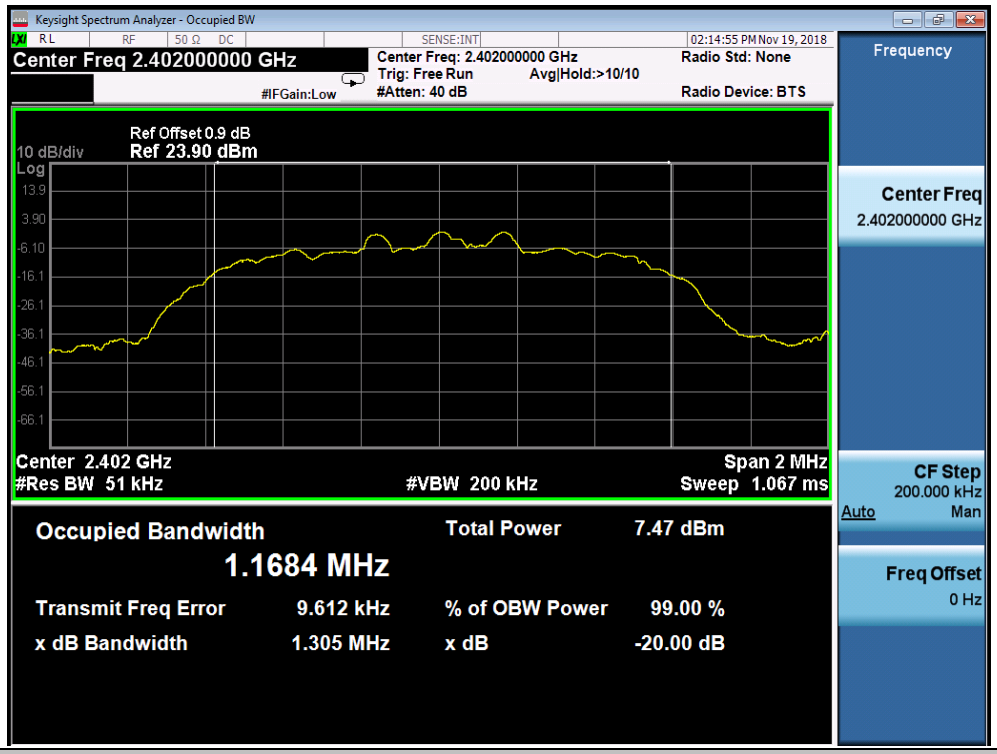
20 dB Bandwidth_2DH5_2441



20 dB Bandwidth_2DH5_2480

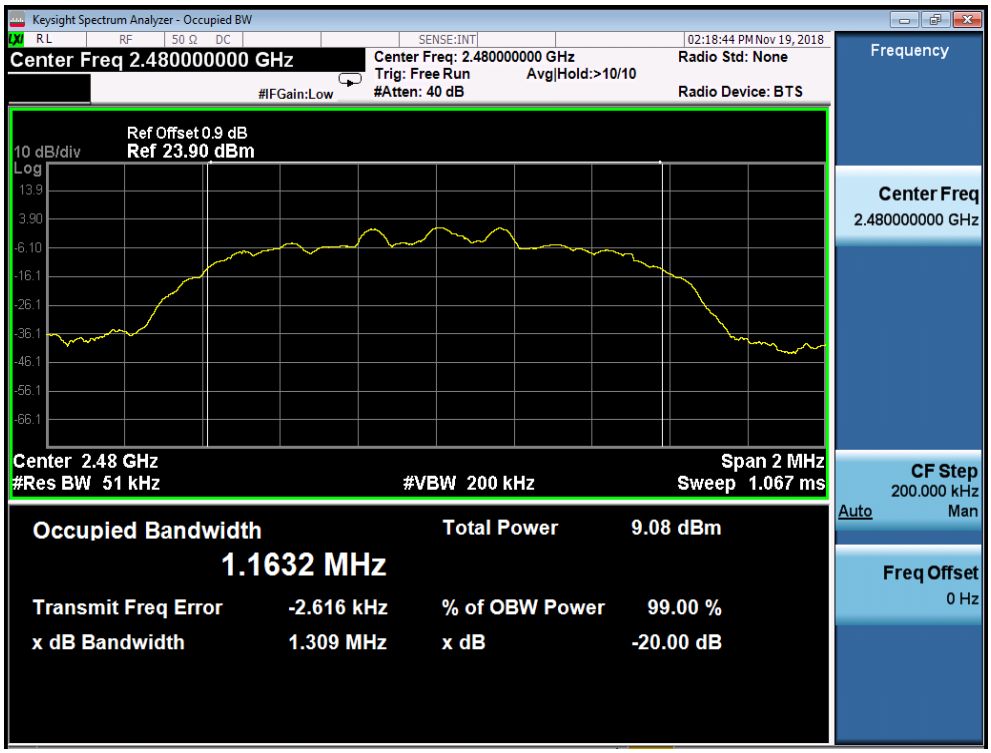


20 dB Bandwidth_3DH5_2402



20 dB Bandwidth_3DH5_2441

20 dB Bandwidth_3DH5_2480

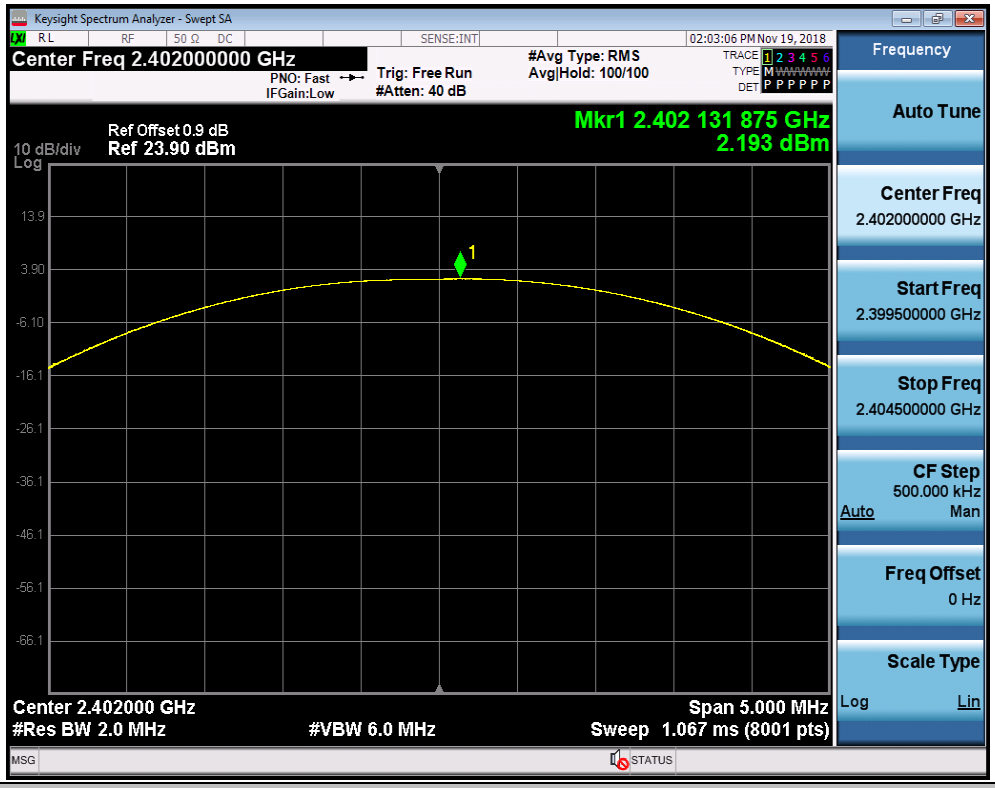


2.Conducted Peak Output Power

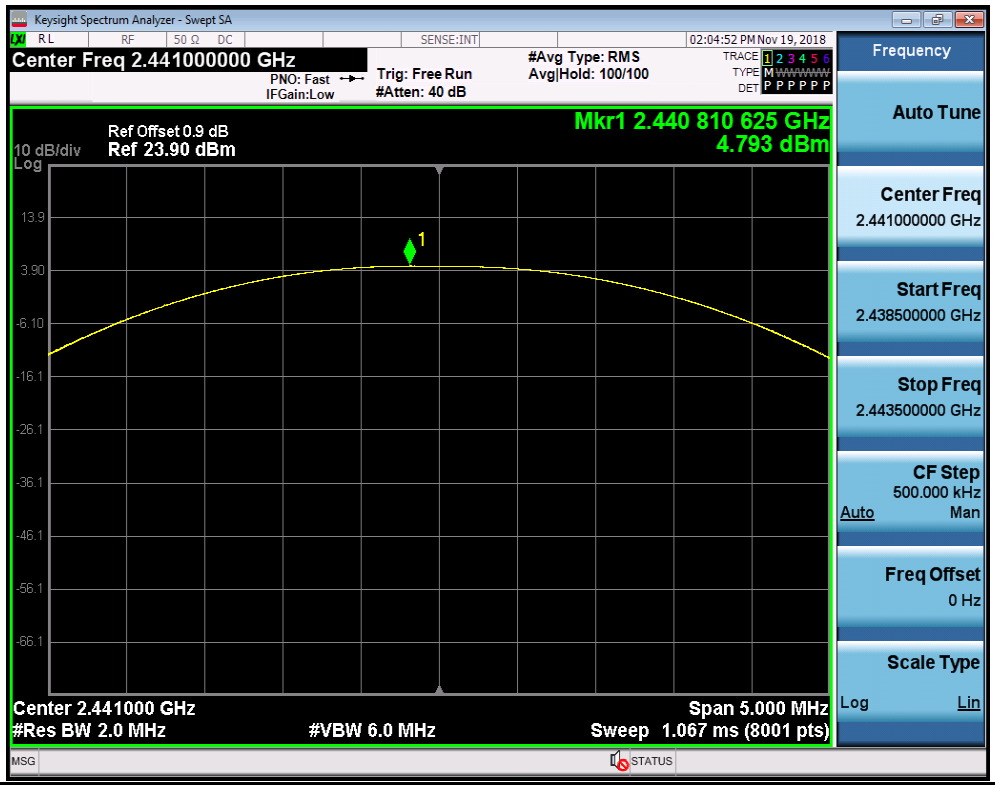
Test Mode	Test Channel	Power[dBm]	Limit[dBm]	Verdict
DH5	2402	2.193	21	PASS
DH5	2441	4.793	21	PASS
DH5	2480	4.015	21	PASS
2DH5	2402	0.78	21	PASS
2DH5	2441	3.863	21	PASS
2DH5	2480	2.495	21	PASS
3DH5	2402	1.093	21	PASS
3DH5	2441	3.928	21	PASS
3DH5	2480	2.465	21	PASS

TEST PLOT

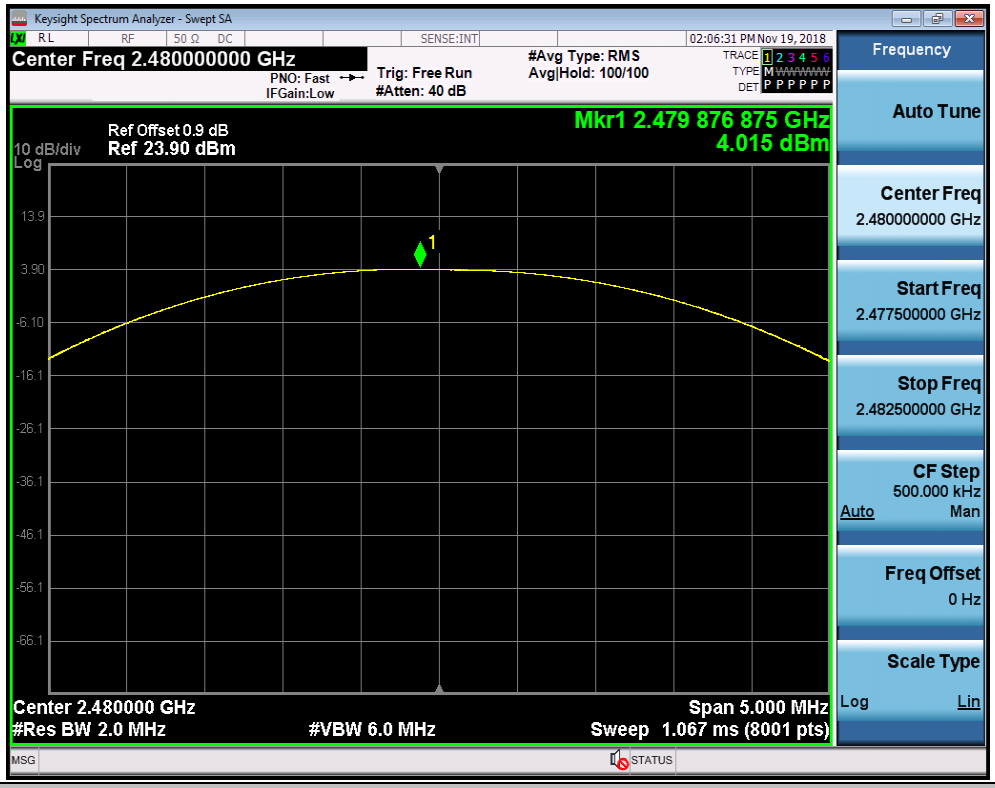
Conducted Peak Output Power_DH5_2402



Conducted Peak Output Power_DH5_2441



Conducted Peak Output Power_DH5_2480

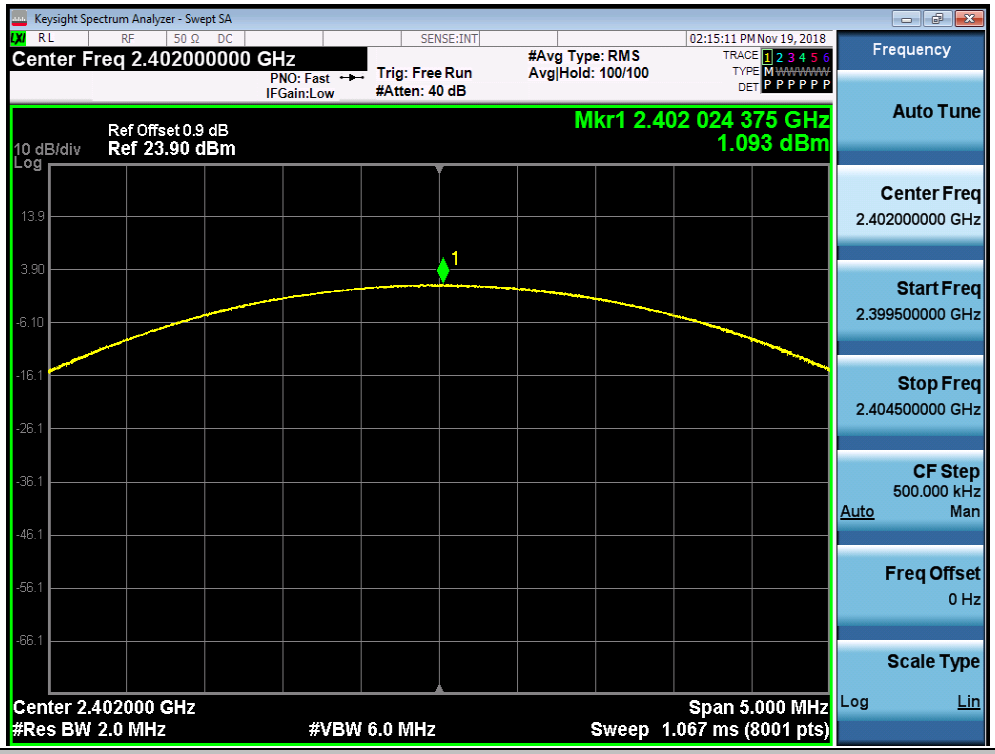


Conducted Peak Output Power_2DH5_2402

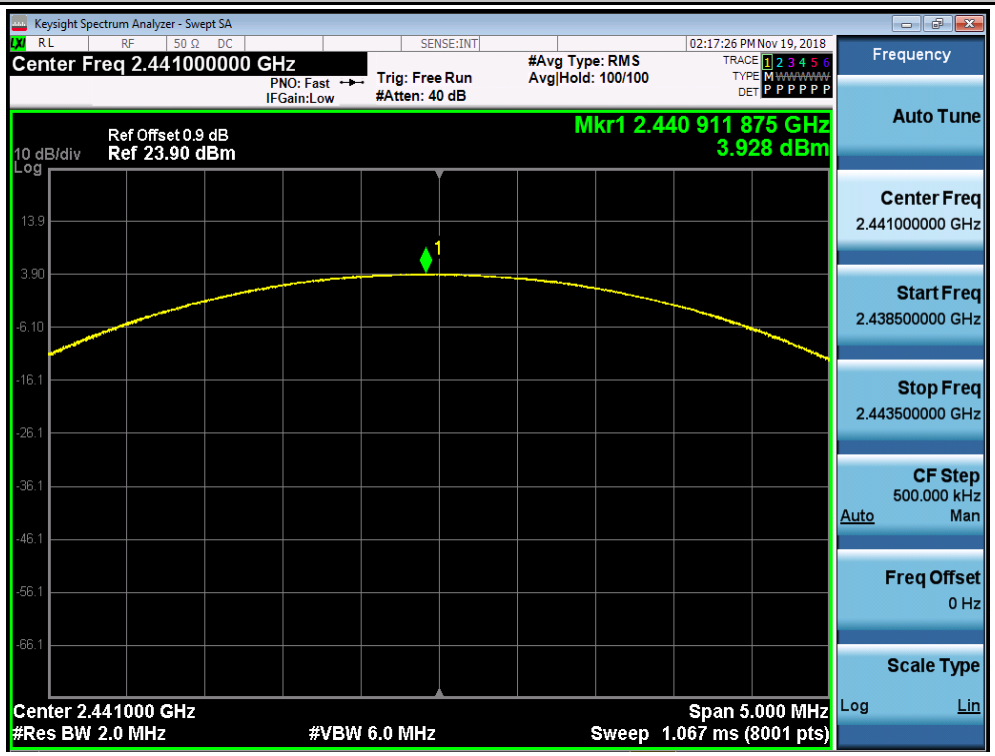
Conducted Peak Output Power_2DH5_2441

Conducted Peak Output Power_2DH5_2480

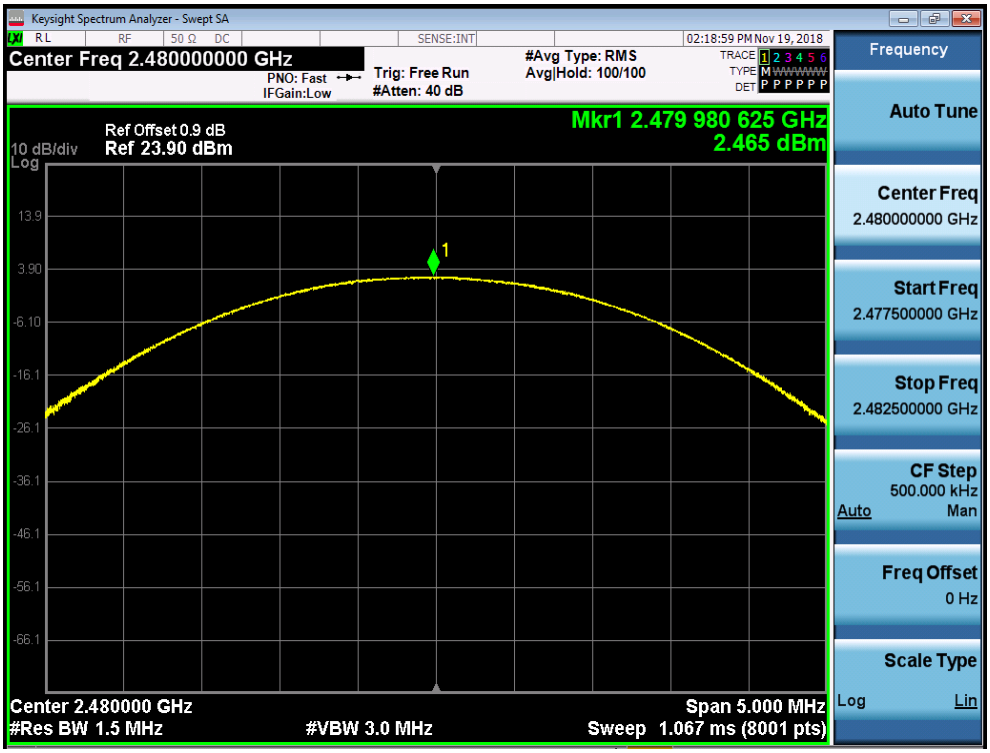
Conducted Peak Output Power_3DH5_2402



Conducted Peak Output Power_3DH5_2441



Conducted Peak Output Power_3DH5_2480



3.Carrier Frequency Separation

Test Mode	Test Channel	Result[MHz]	Limit[MHz]	Verdict
DH5	2402	1.055	0.741	PASS
DH5	2441	0.861	0.655	PASS
DH5	2480	1.14	0.660	PASS

TEST PLOT

Carrier Frequency Separation_DH5_2402

Carrier Frequency Separation_DH5_2441

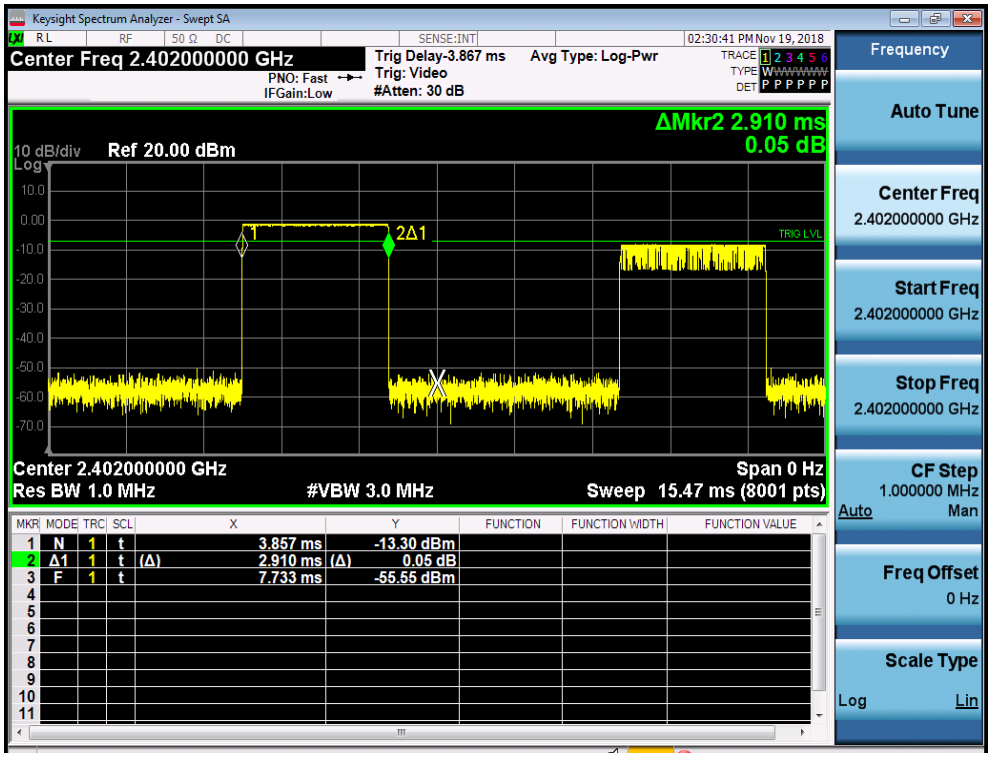
Carrier Frequency Separation_DH5_2480

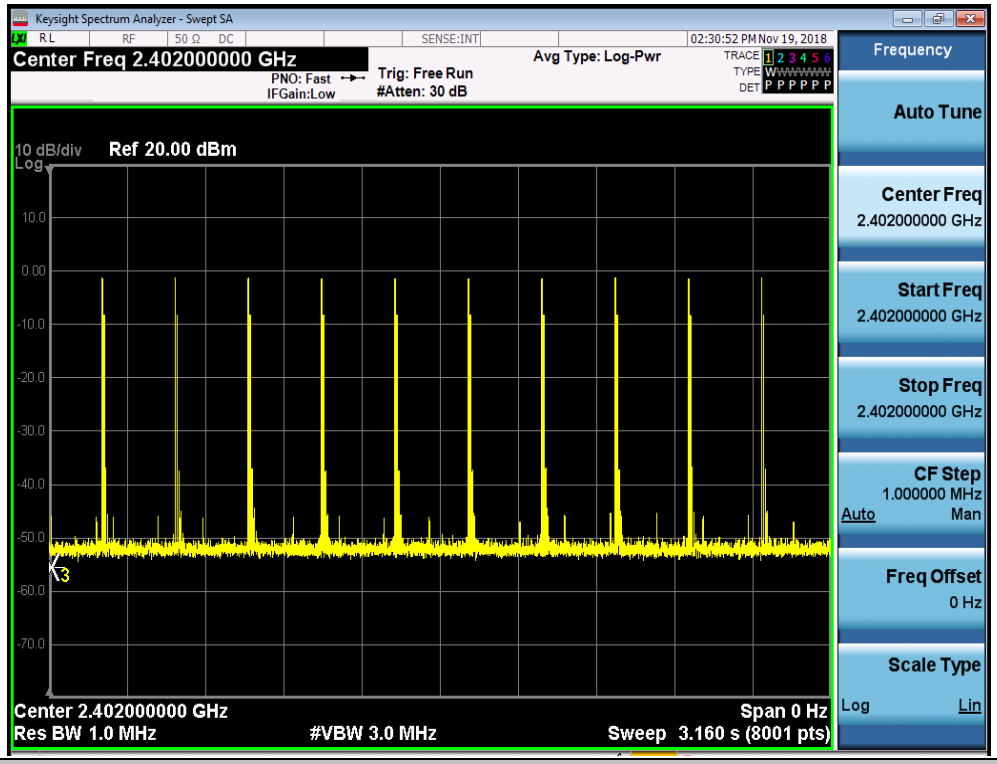
4.Dwell Time

Test Mode	Test Channel	Burst Width[ms/hop/ch]	Total Hops[hop*ch]	Dwell Time[s]	Limit[s]	Verdict
DH5	2402	2.91	100	0.29	0.4	PASS
DH5	2441	2.91	110	0.32	0.4	PASS
DH5	2480	2.91	110	0.32	0.4	PASS
2DH5	2402	1.72	160	0.28	0.4	PASS
2DH5	2441	1.72	160	0.28	0.4	PASS
2DH5	2480	1.72	160	0.28	0.4	PASS
3DH5	2402	2.92	110	0.32	0.4	PASS
3DH5	2441	2.92	110	0.32	0.4	PASS
3DH5	2480	2.92	110	0.32	0.4	PASS

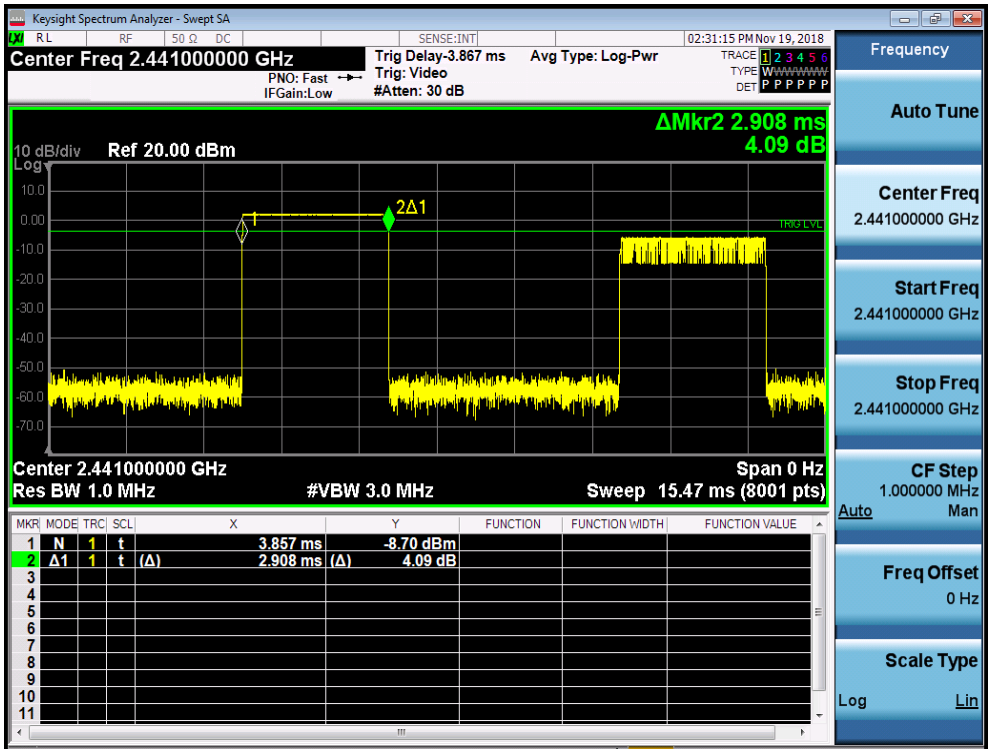
TEST PLOT

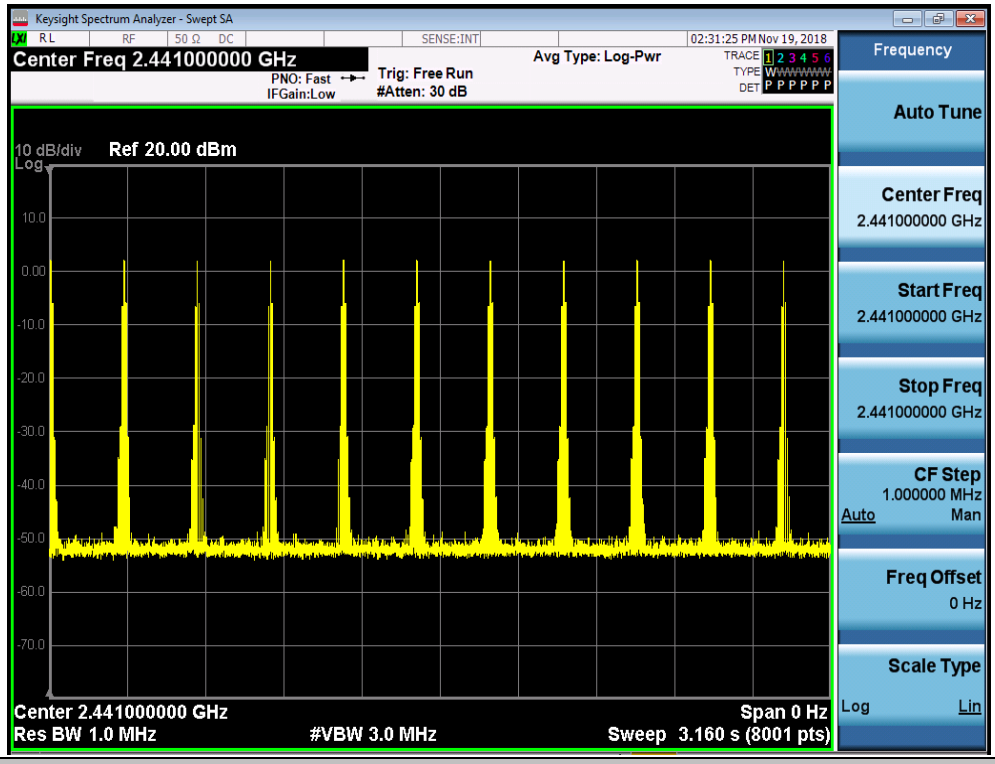
Dwell Time_DH5_2402



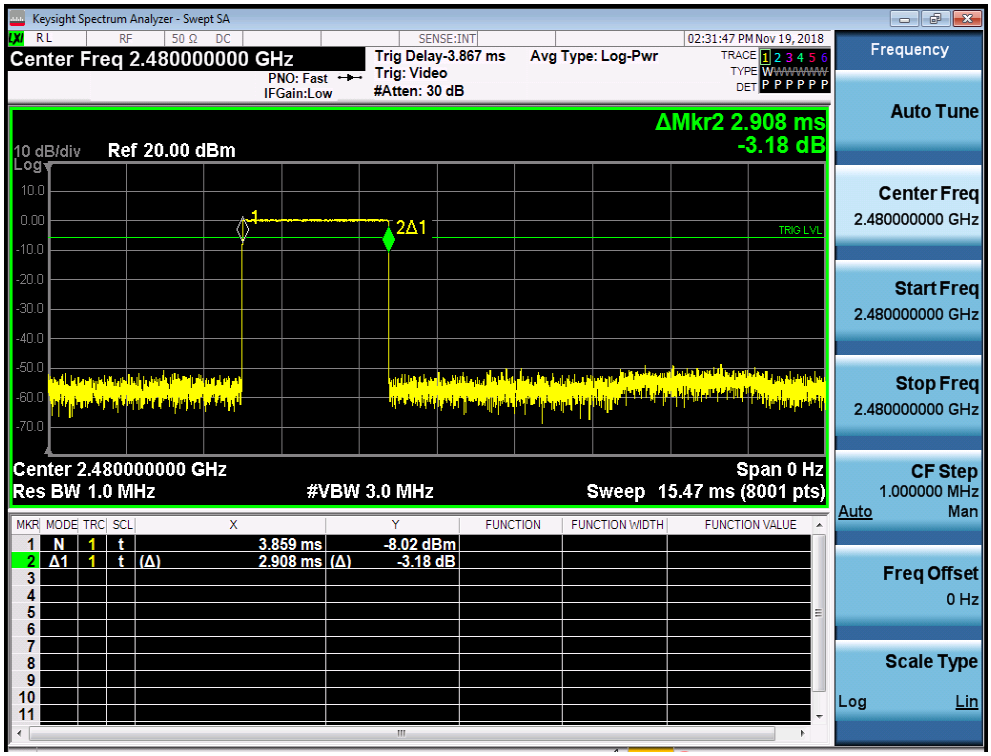


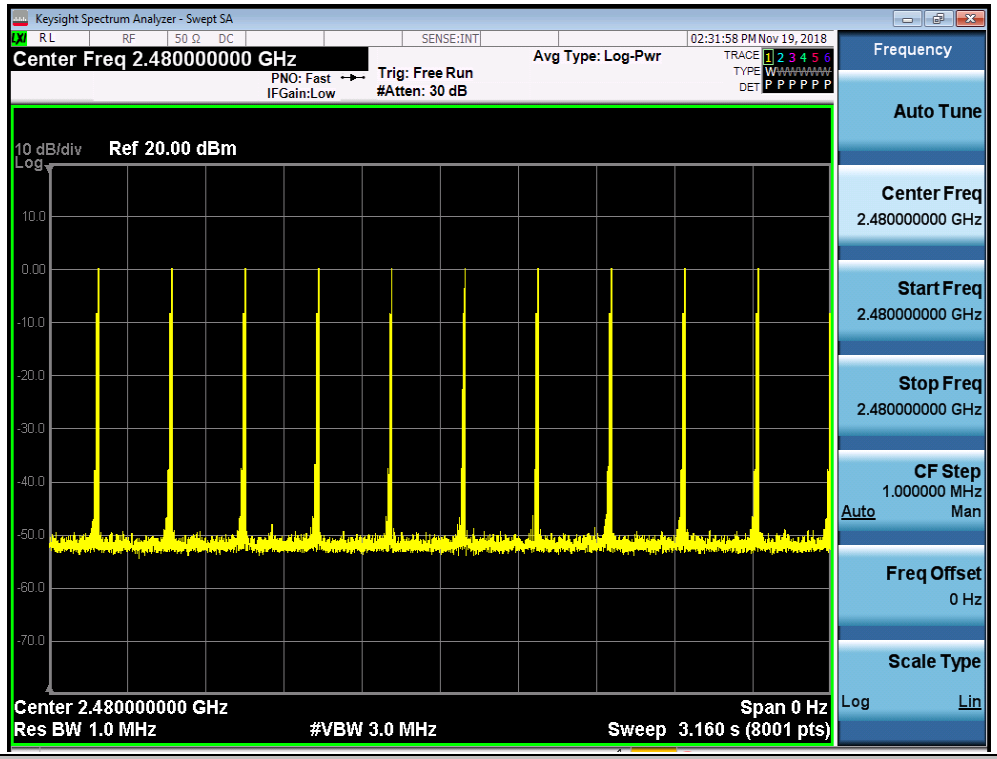
Dwell Time_DH5_2441



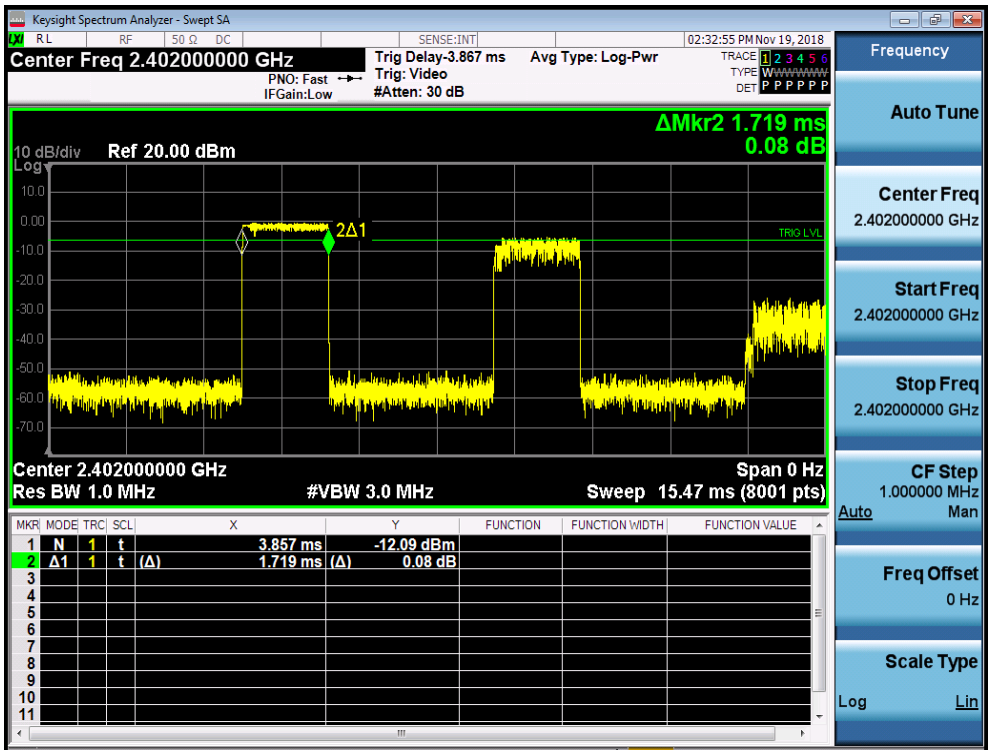


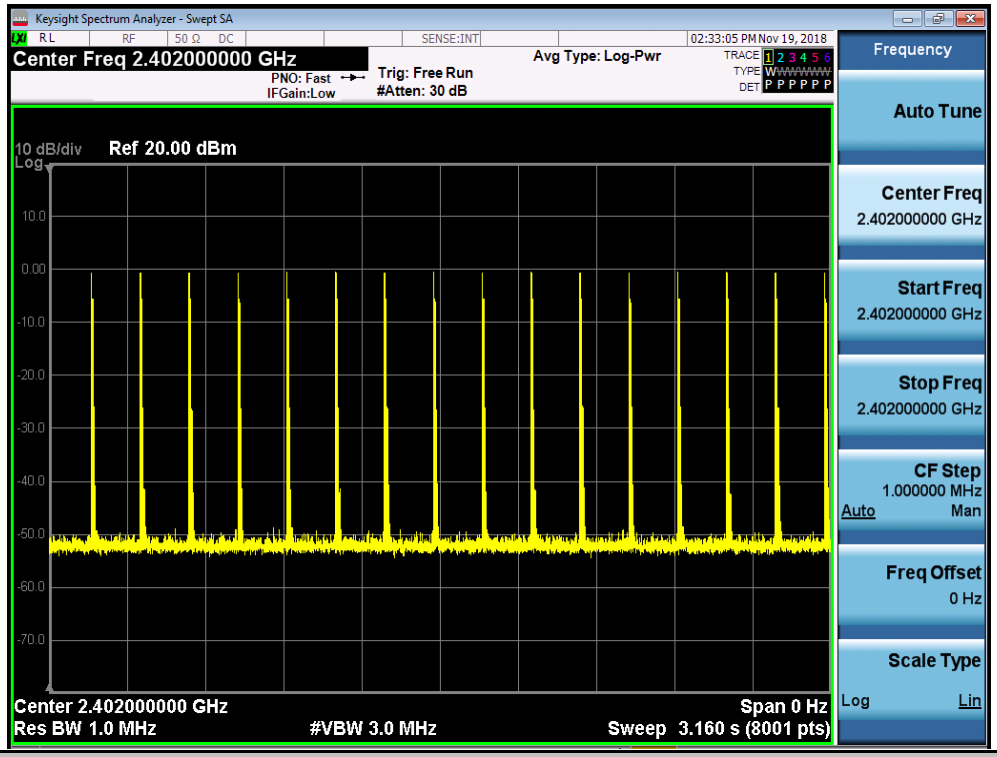
Dwell Time_DH5_2480



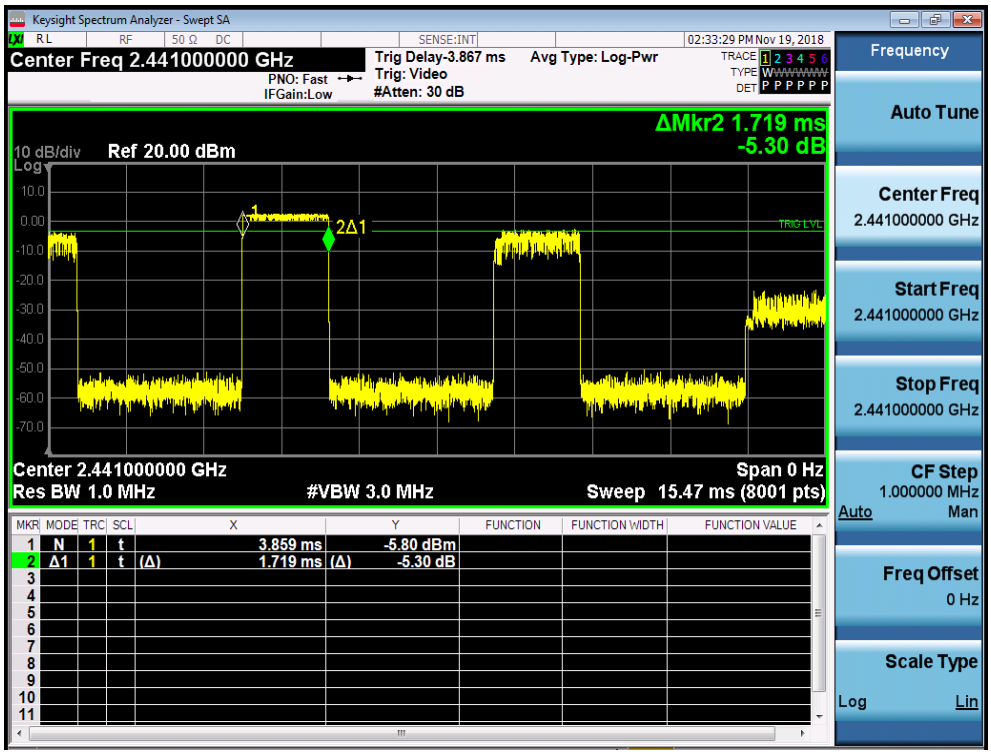


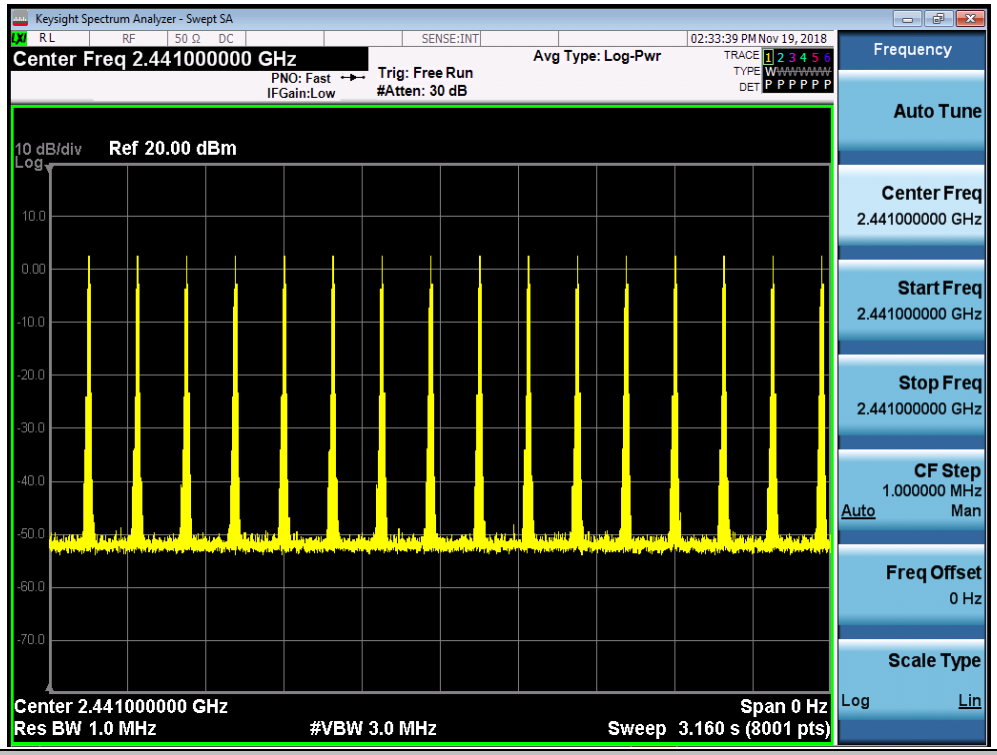
Dwell Time_2DH5_2402



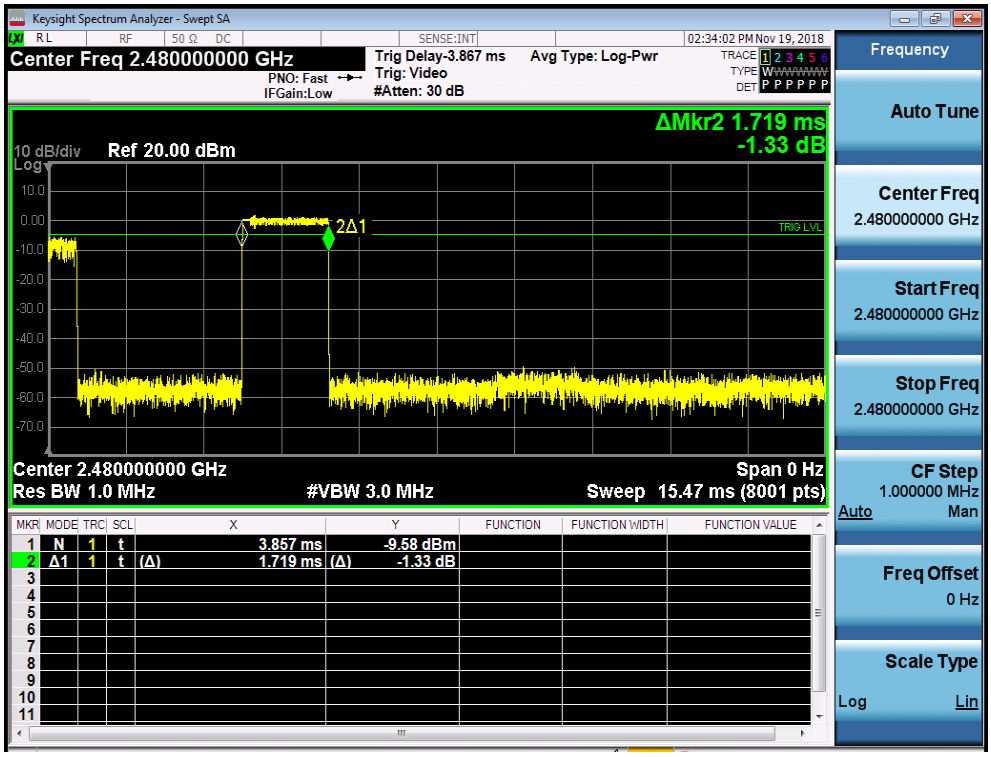


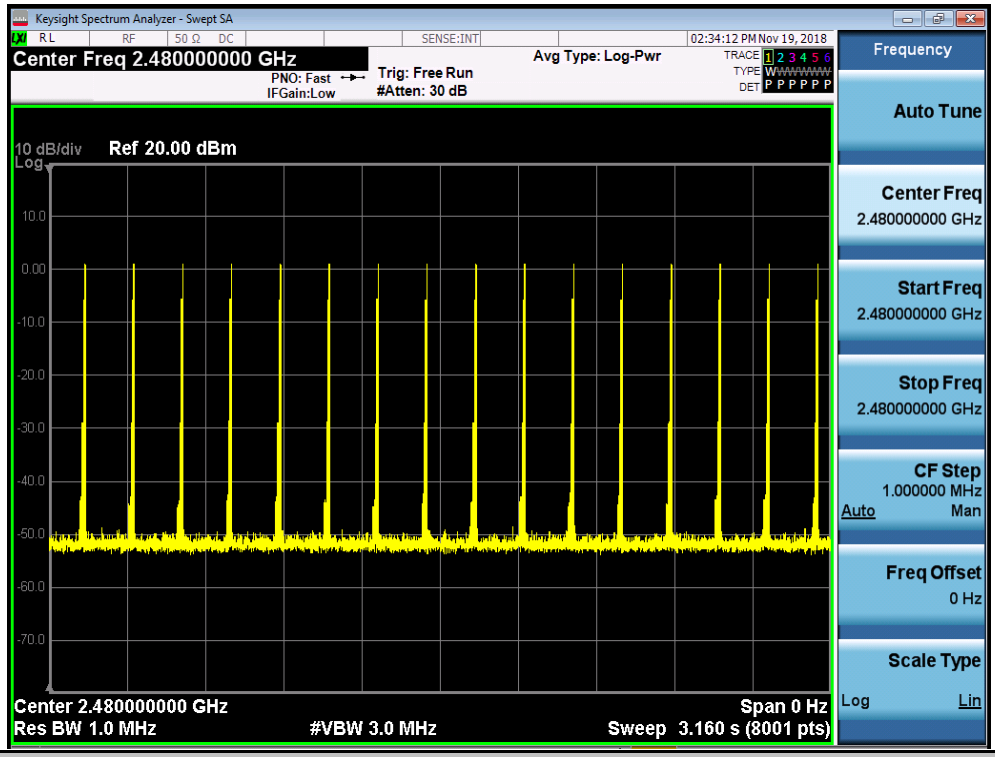
Dwell Time_2DH5_2441



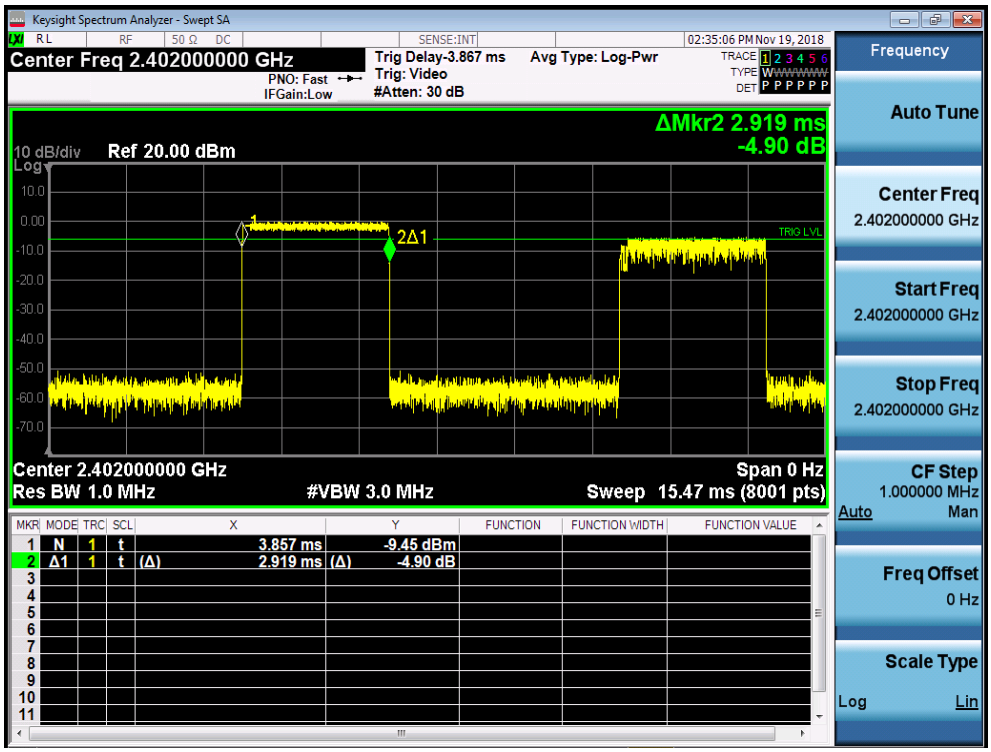


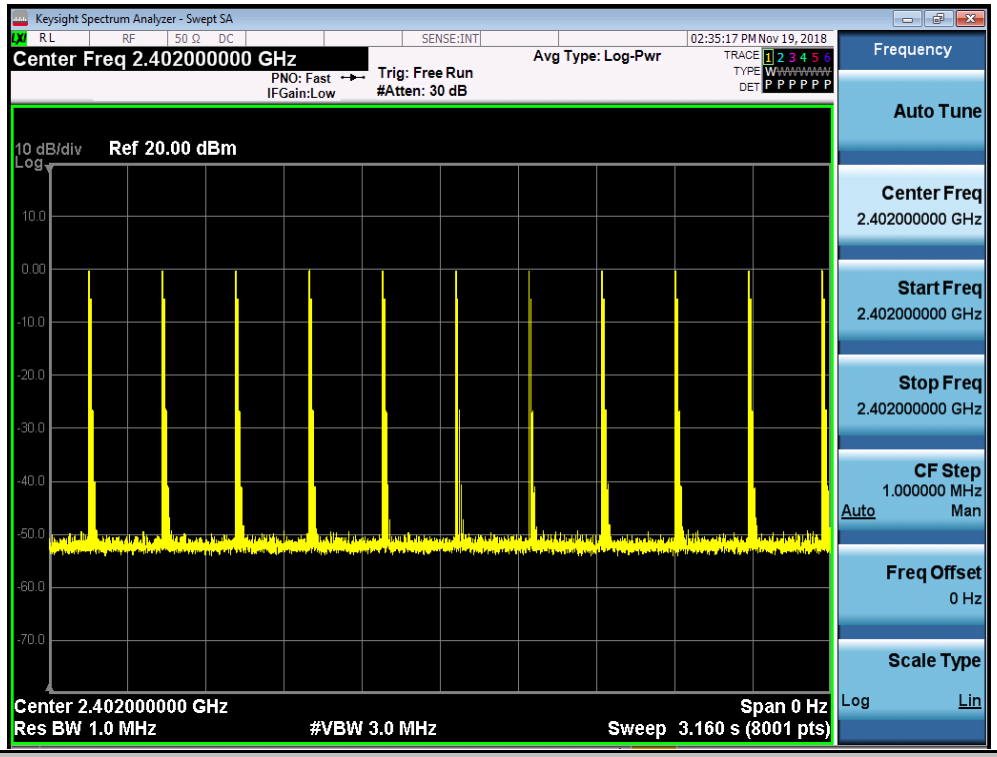
Dwell Time_2DH5_2480



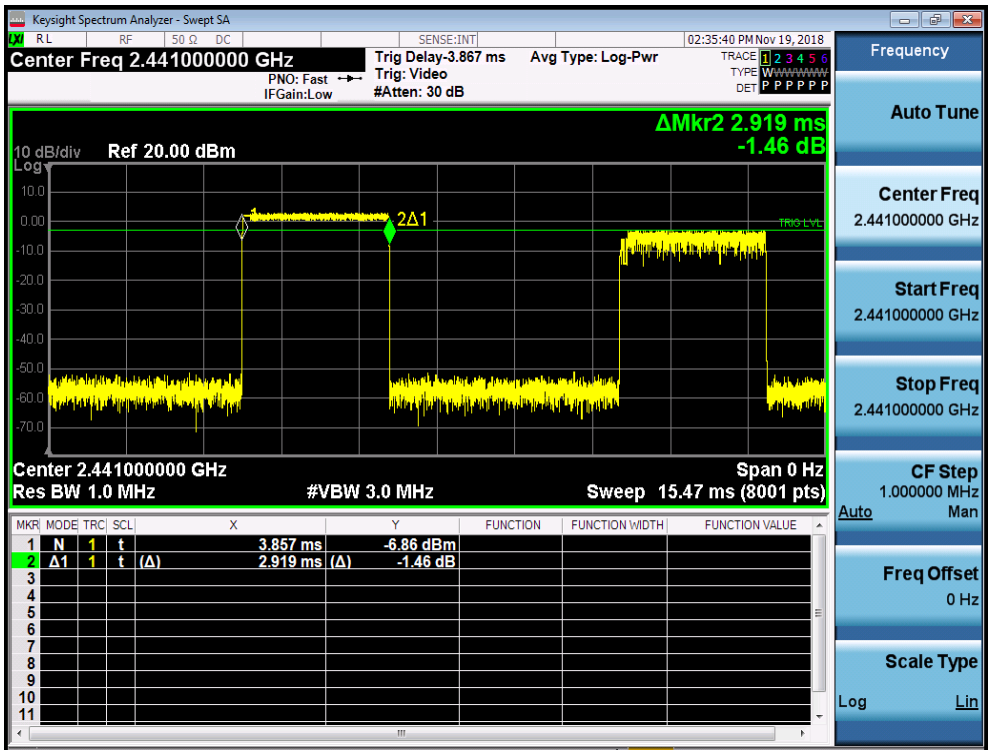


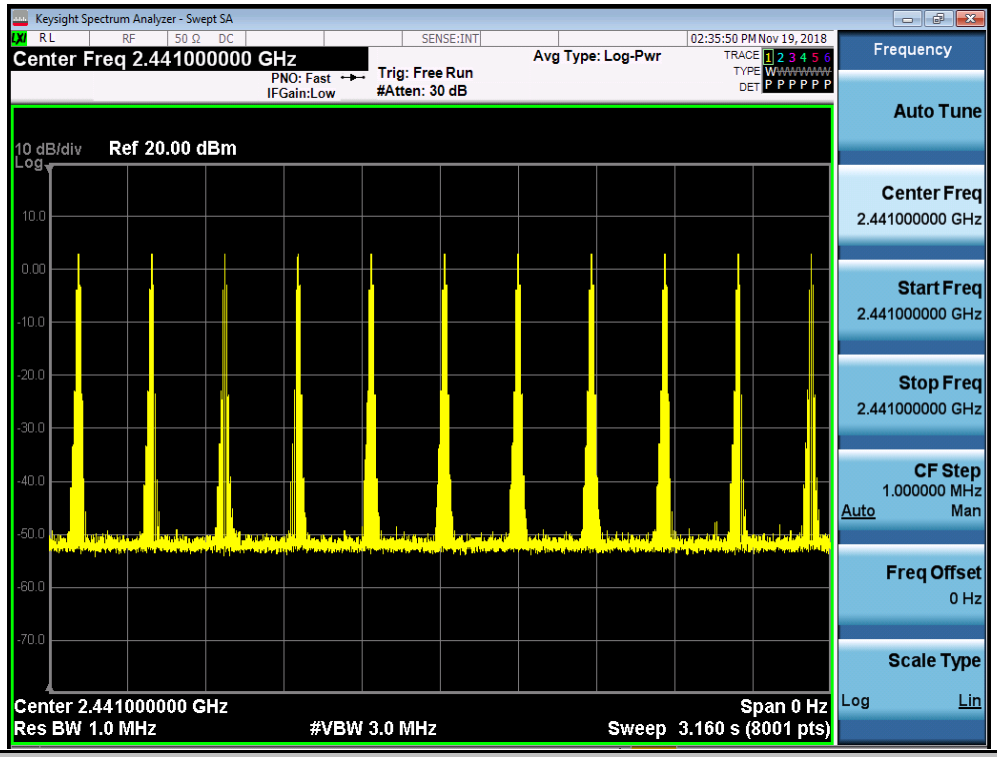
Dwell Time_3DH5_2402



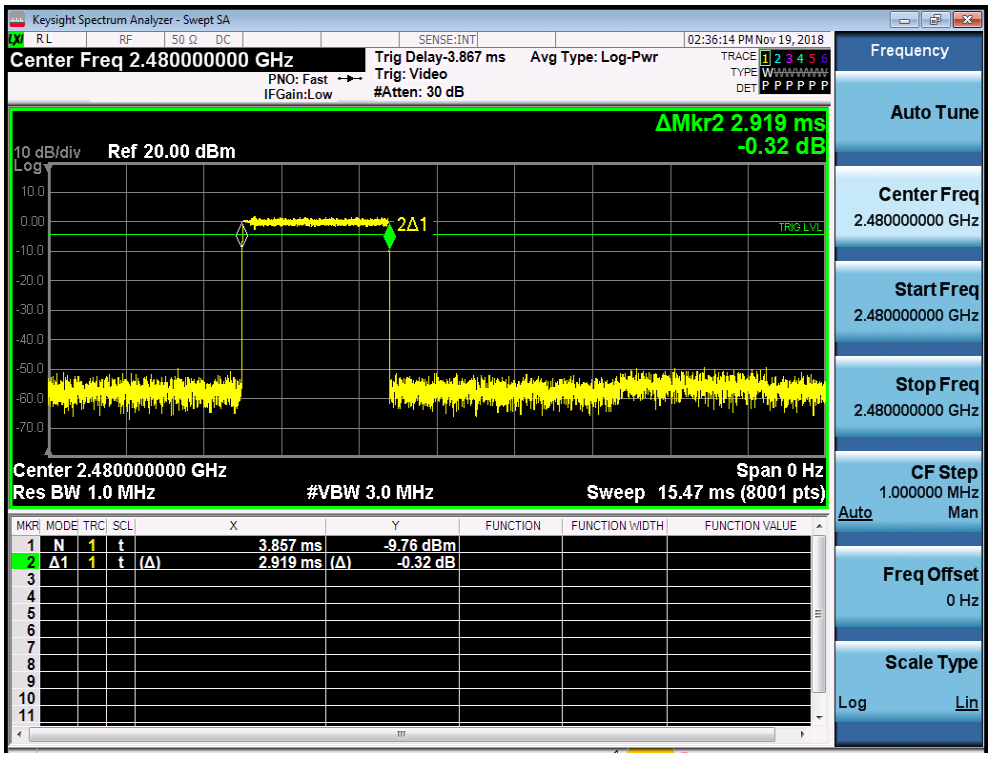


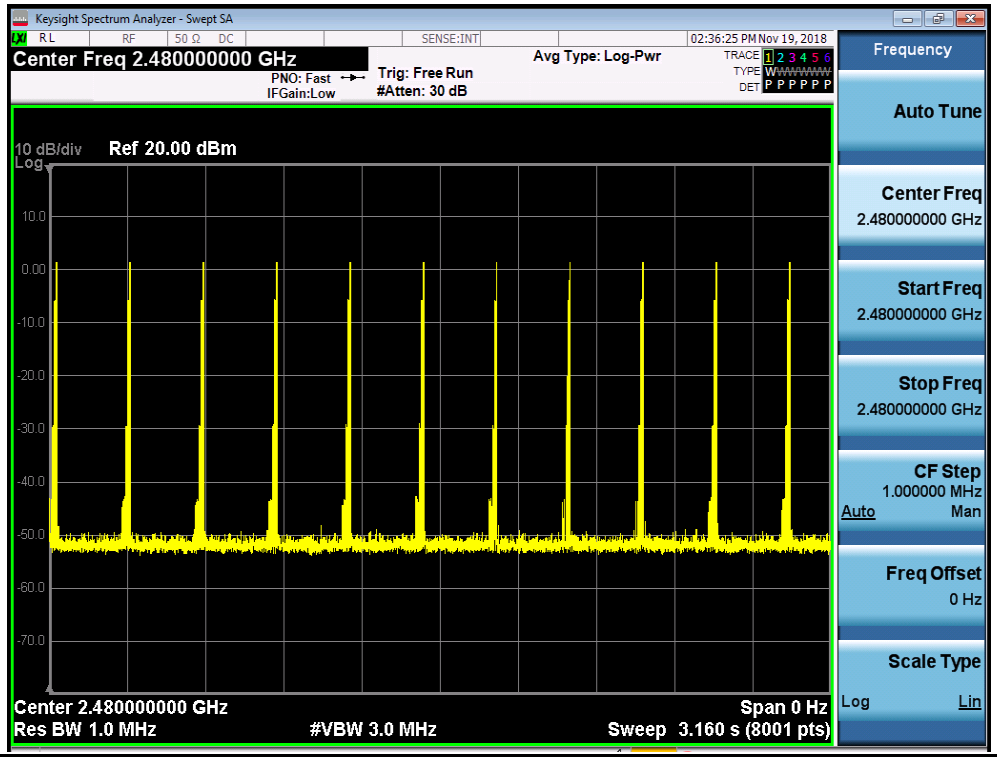
Dwell Time_3DH5_2441





Dwell Time_3DH5_2480



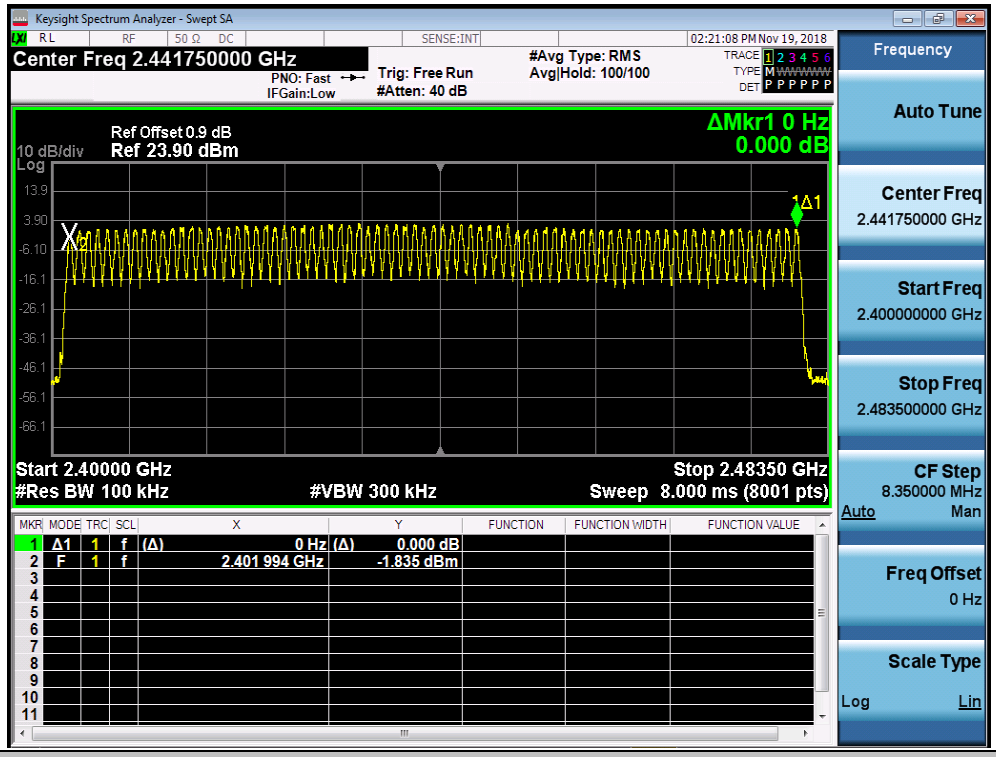


5.Hopping Channel Number

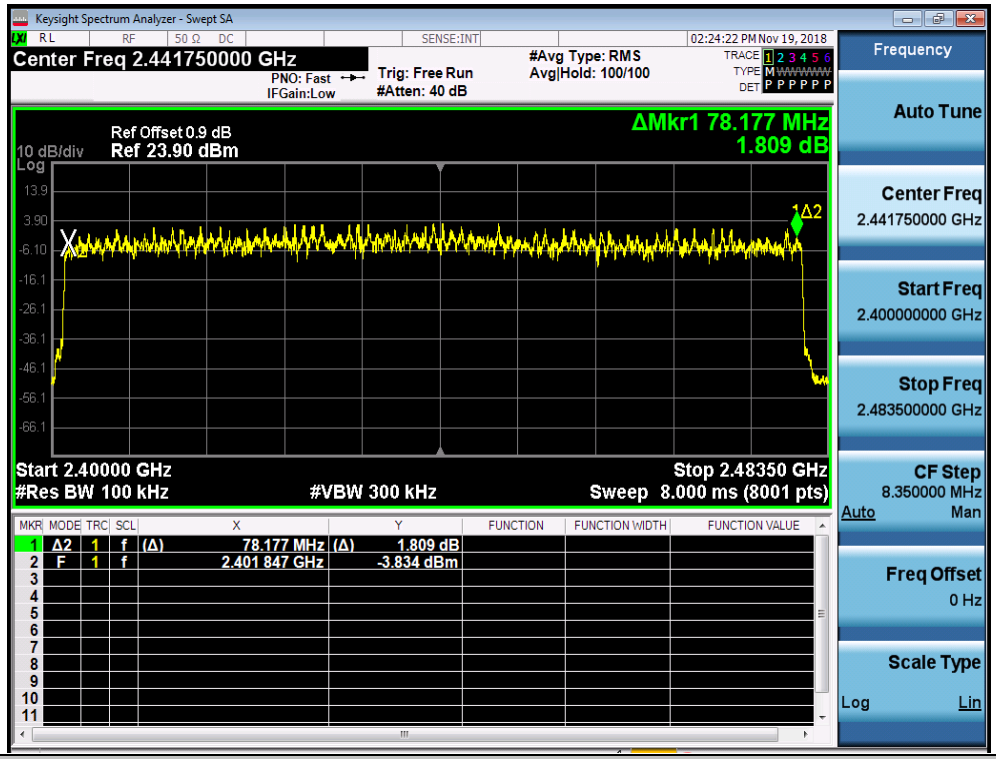
Test Mode	Test Channel	Number of Hopping Channel[N]	Limit[N]	Verdict
DH5	All the hopping channel	79	>=15	PASS
2DH5		79	>=15	PASS
3DH5		79	>=15	PASS

TEST PLOT

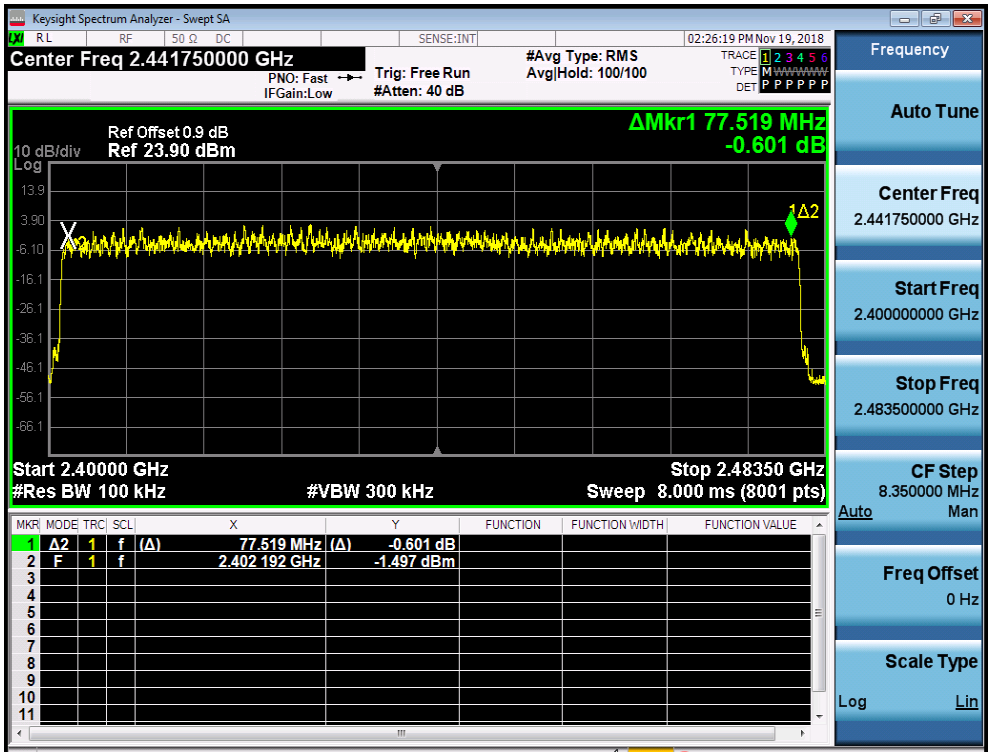
Hopping Channel Number_DH5



Hopping Channel Number_2DH5



Hopping Channel Number_3DH5

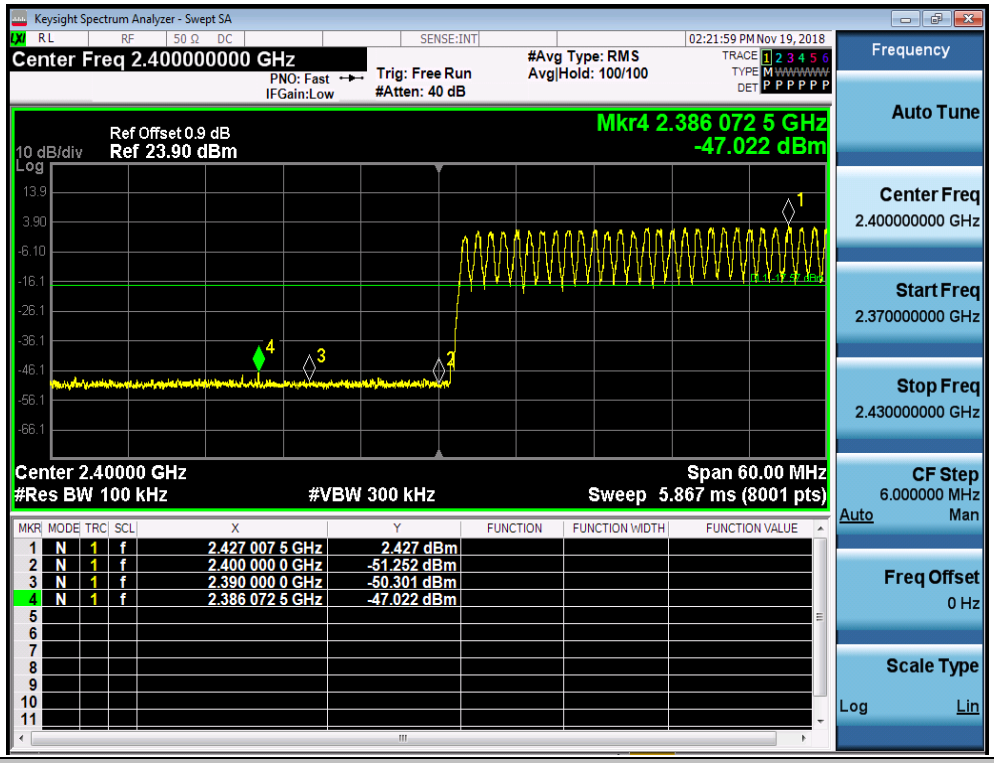


6.Band-edge for RF Conducted Emissions

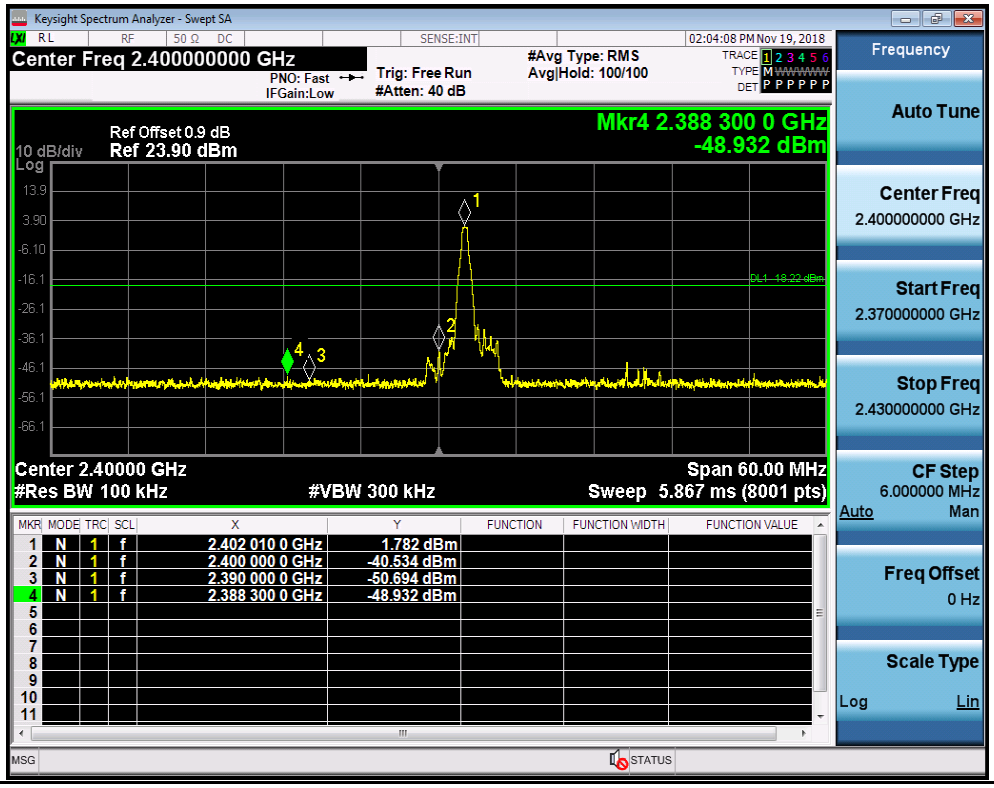
Test Mode	Test Channel	Hopping	Carrier Power[dBm]	Max. Spurious Level [dBm]	Limit[dBm]	Verdict
DH5	2402	On	2.427	-47.022	-17.57	PASS
DH5	2402	Off	1.782	-48.932	-18.22	PASS
DH5	2480	On	1.337	-48.539	-18.66	PASS
DH5	2480	Off	3.655	-48.615	-16.35	PASS
2DH5	2402	On	2.474	-48.303	-17.53	PASS
2DH5	2402	Off	-0.623	-49.239	-20.62	PASS
2DH5	2480	On	1.300	-48.302	-18.7	PASS
2DH5	2480	Off	1.164	-48.300	-18.84	PASS
3DH5	2402	On	2.276	-48.513	-17.72	PASS
3DH5	2402	Off	-0.445	-49.141	-20.45	PASS
3DH5	2480	On	1.509	-48.361	-18.49	PASS
3DH5	2480	Off	0.960	-48.742	-19.04	PASS

TEST PLOT

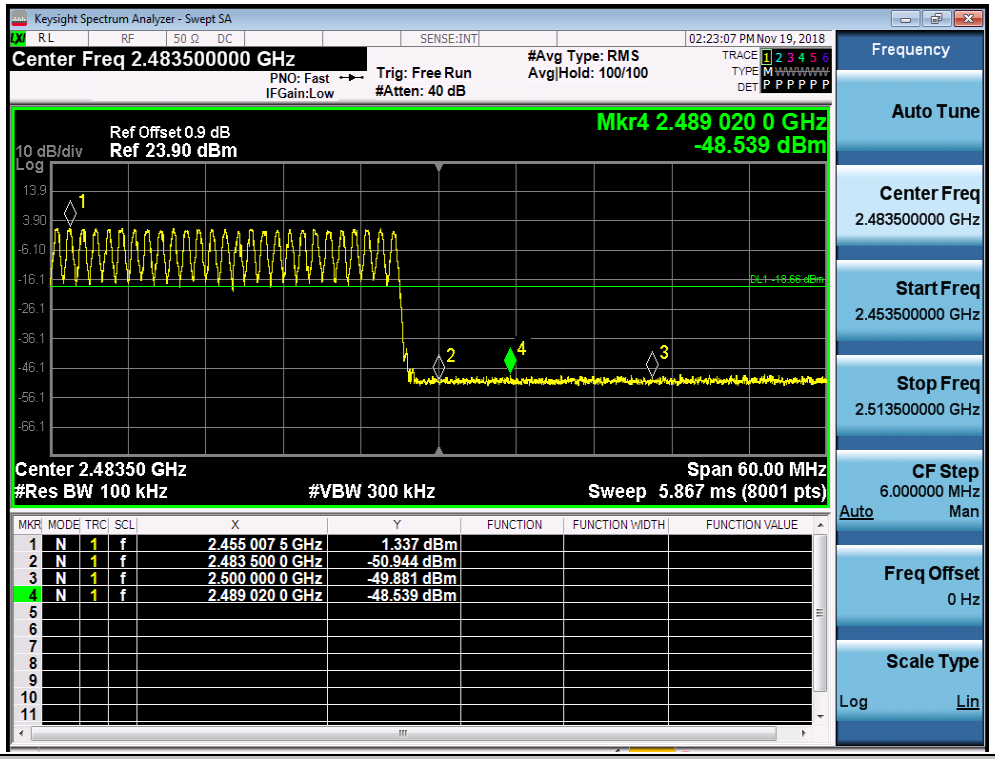
Band-edge for RF Conducted Emissions_DH5_2402_Hopping On



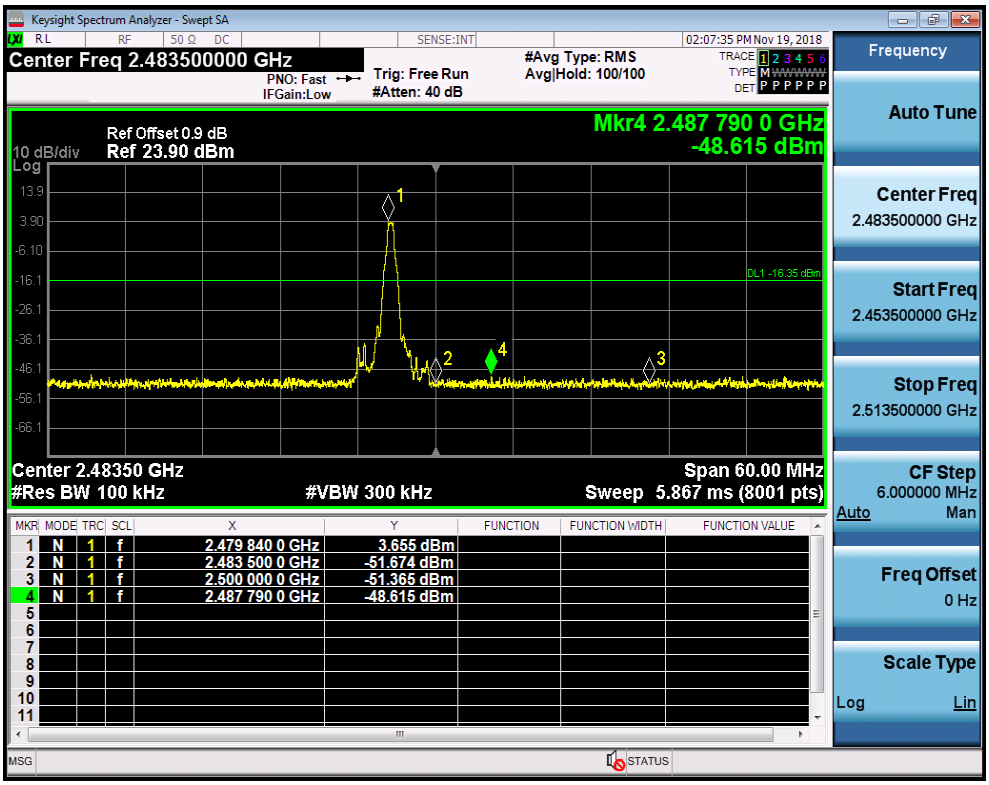
Band-edge for RF Conducted Emissions_DH5_2402_Hopping Off



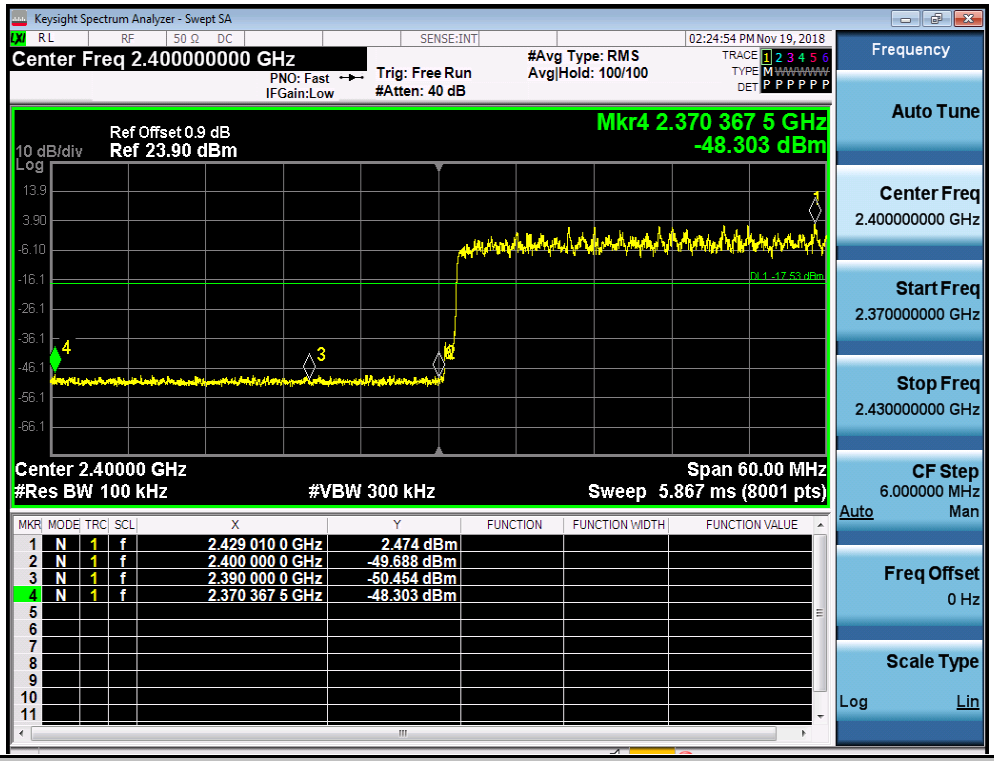
Band-edge for RF Conducted Emissions_DH5_2480_Hopping On



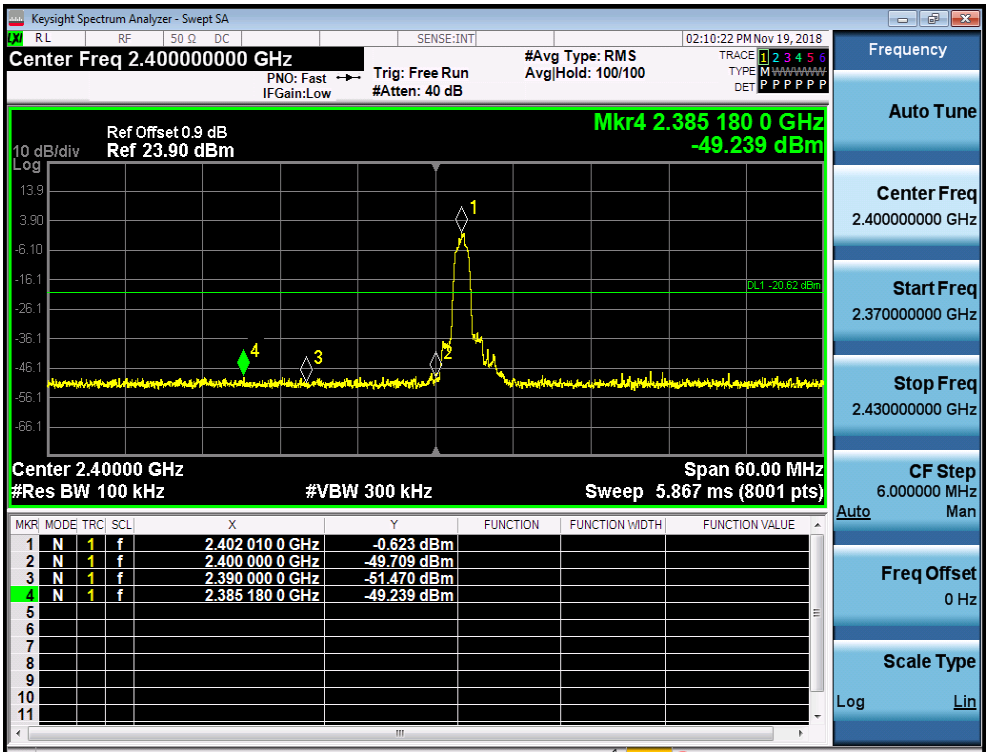
Band-edge for RF Conducted Emissions_DH5_2480_Hopping Off



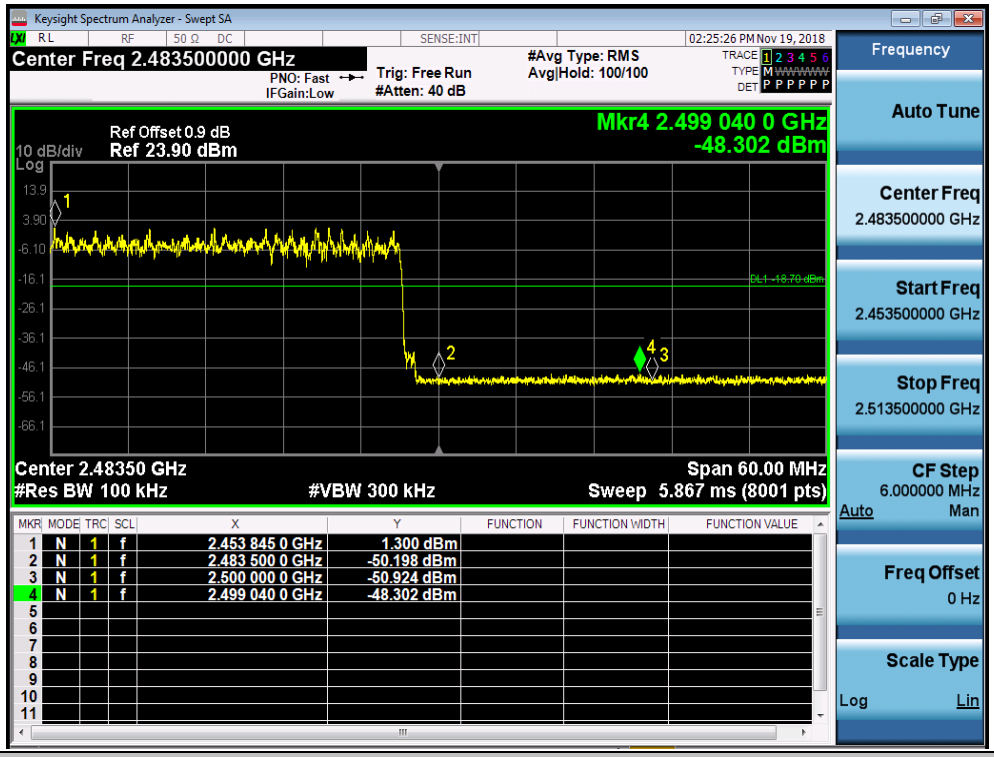
Band-edge for RF Conducted Emissions_2DH5_2402_Hopping On



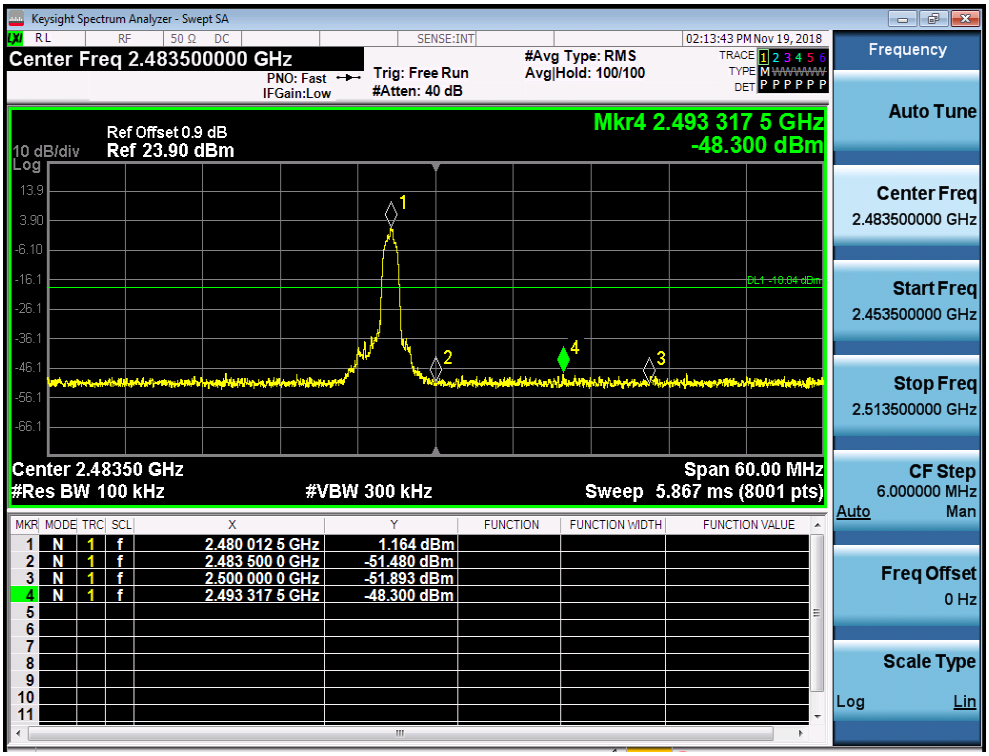
Band-edge for RF Conducted Emissions_2DH5_2402_Hopping Off



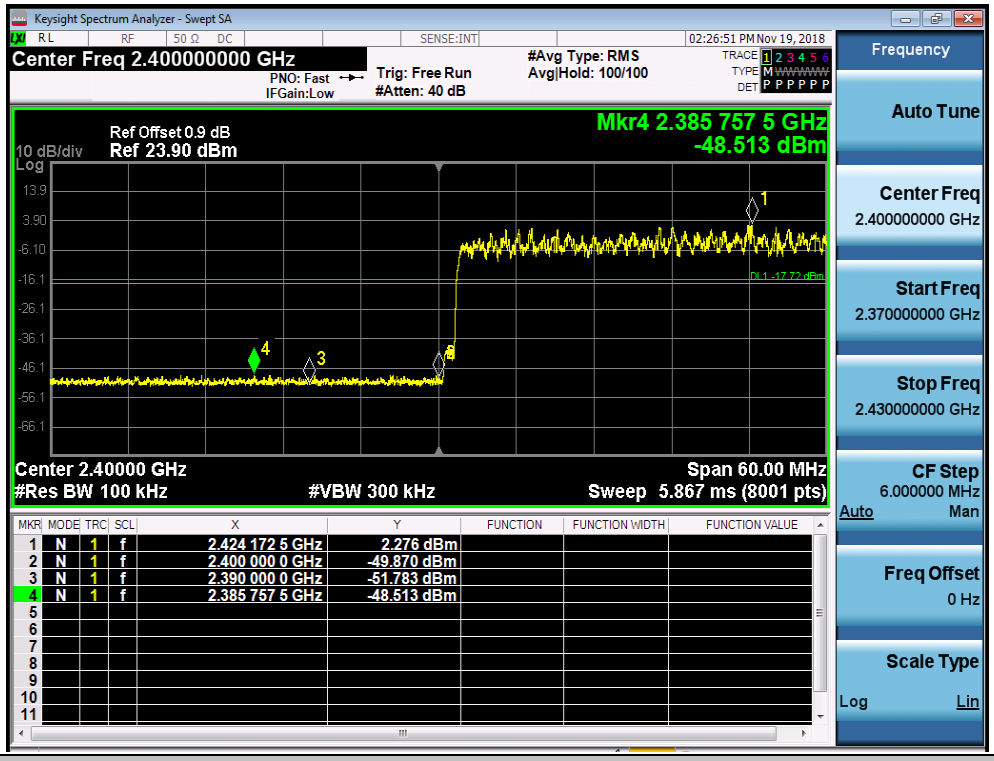
Band-edge for RF Conducted Emissions_2DH5_2480_Hopping On



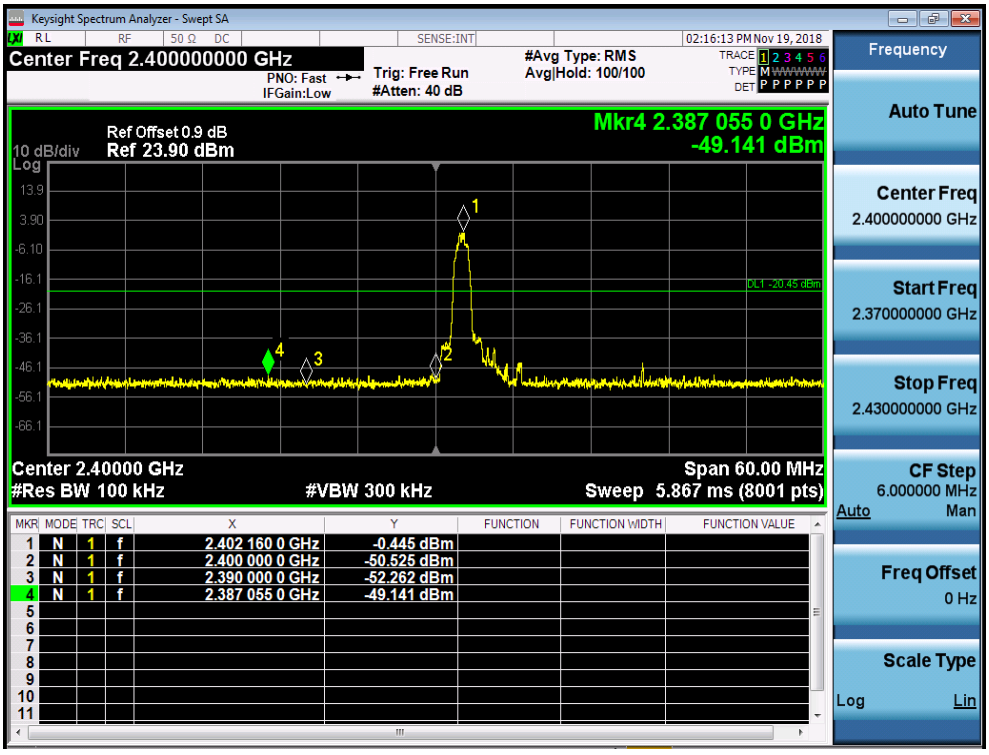
Band-edge for RF Conducted Emissions_2DH5_2480_Hopping Off



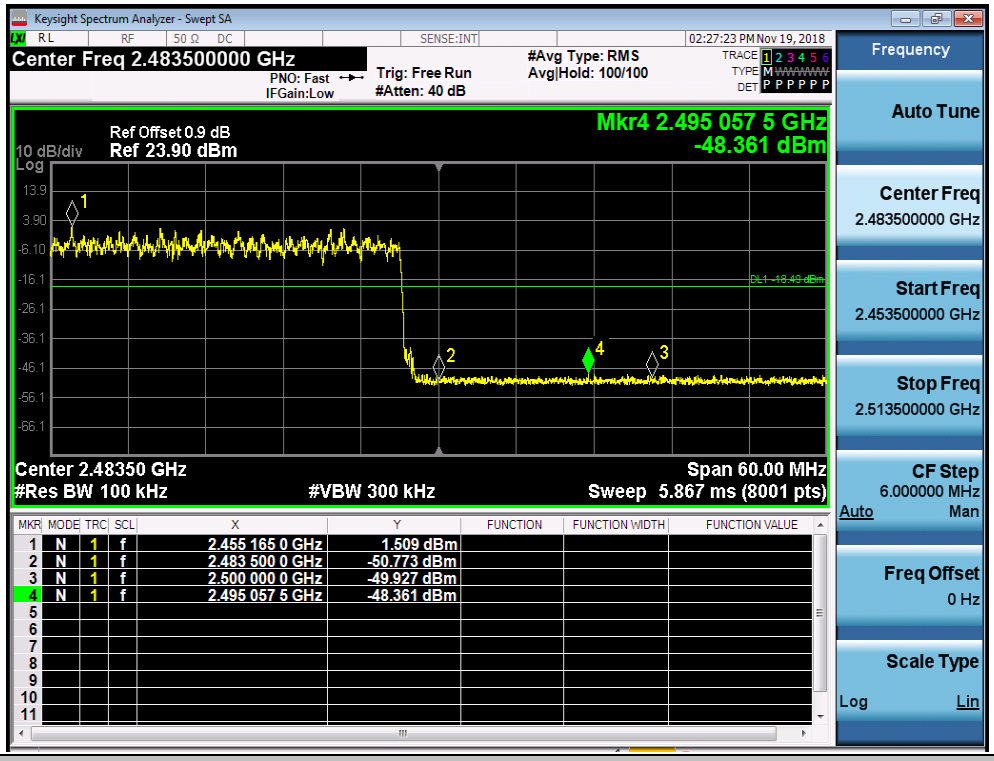
Band-edge for RF Conducted Emissions_3DH5_2402_Hopping On



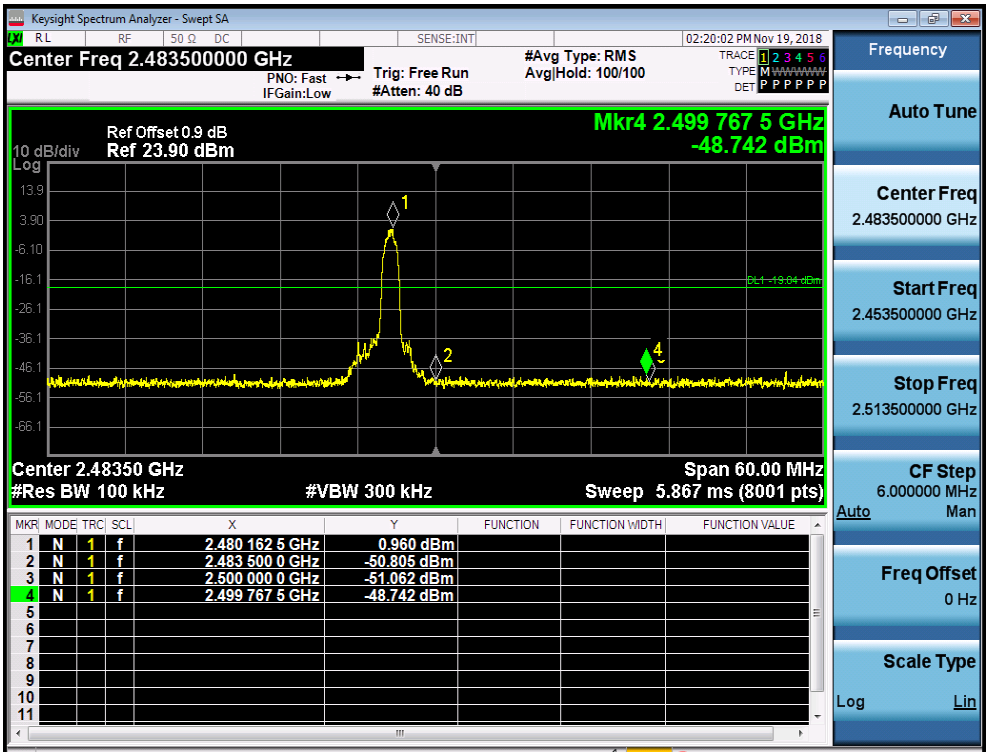
Band-edge for RF Conducted Emissions_3DH5_2402_Hopping Off



Band-edge for RF Conducted Emissions_3DH5_2480_Hopping On

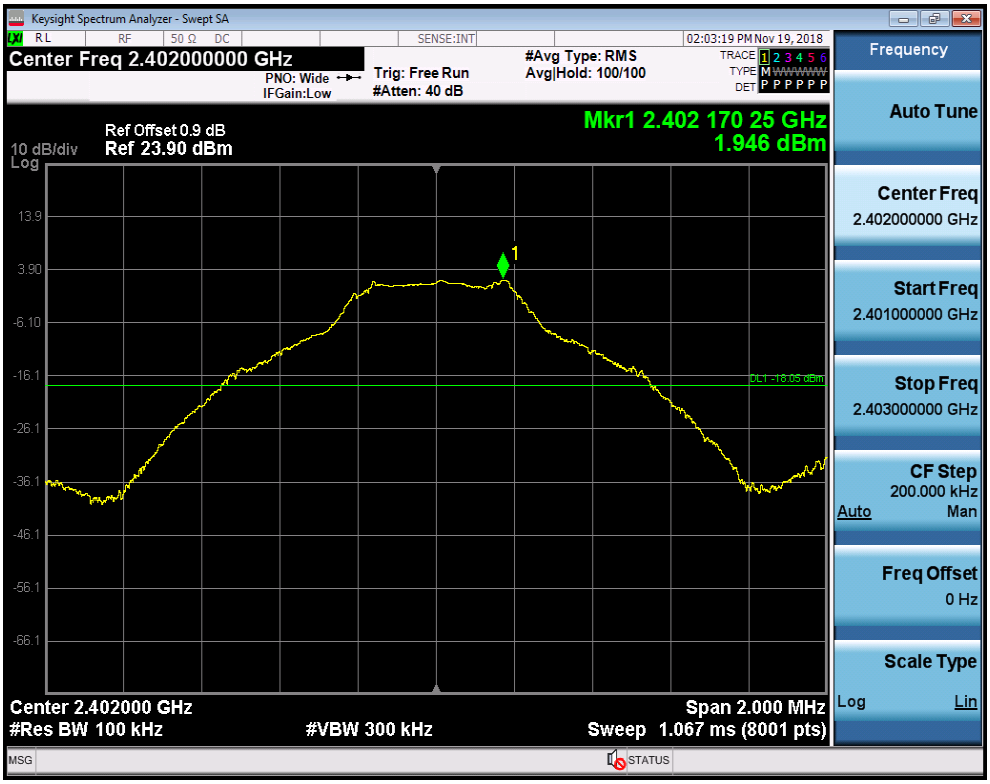
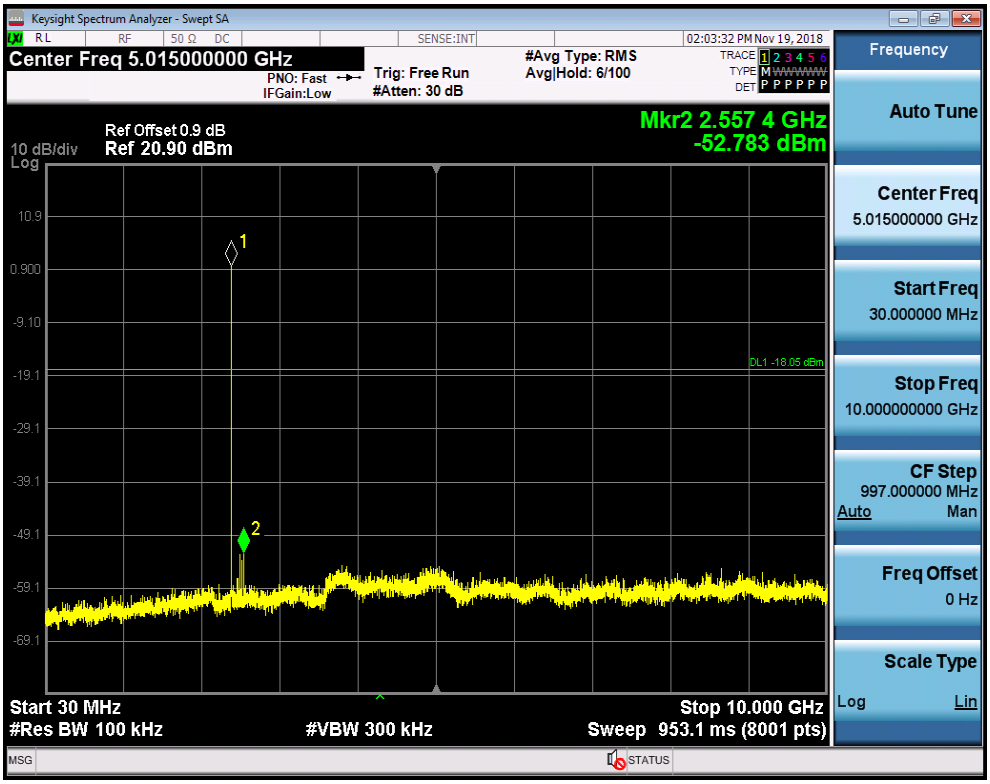


Band-edge for RF Conducted Emissions_3DH5_2480_Hopping Off

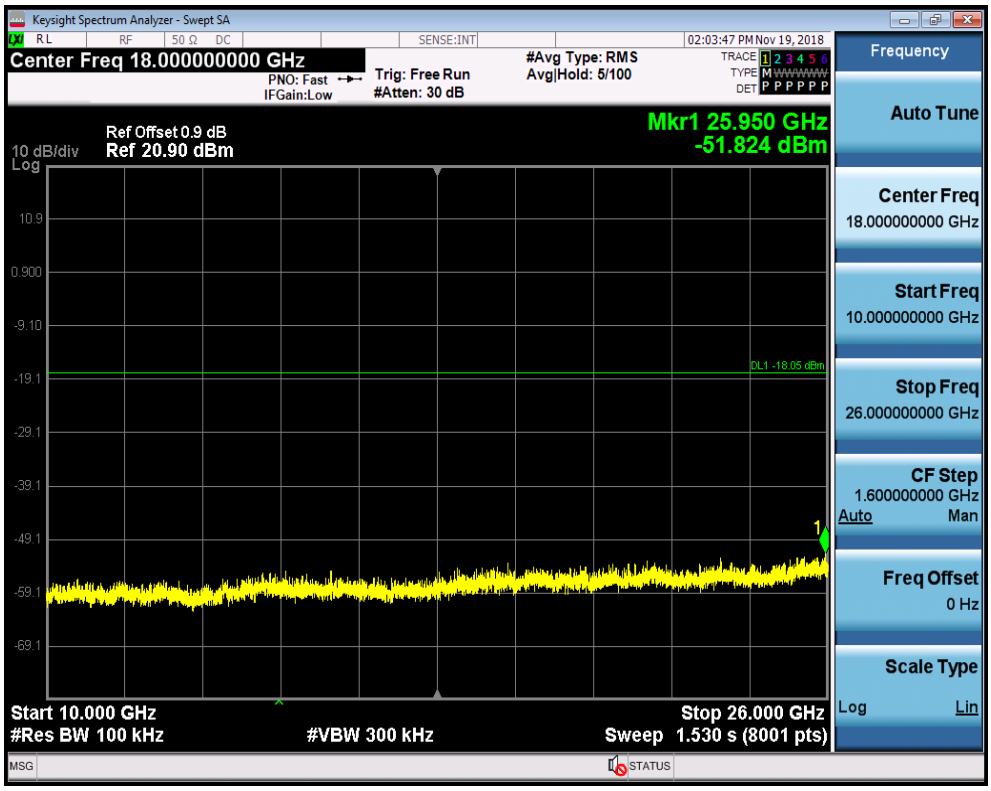


7.RF Conducted Spurious Emissions

Test Mode	Test Channel	StartFre [MHz]	StopFre [MHz]	RBW [kHz]	VBW [kHz]	Pref[dBm]	Max. Level [dBm]	Limit [dBm]	Verdict
DH5	2402	30	10000	100	300	1.946	-52.783	<-18.054	PASS
DH5	2402	10000	26000	100	300	1.946	-51.824	<-18.054	PASS
DH5	2441	30	10000	100	300	4.53	-53.350	<-15.47	PASS
DH5	2441	10000	26000	100	300	4.53	-51.791	<-15.47	PASS
DH5	2480	30	10000	100	300	3.631	-53.429	<-16.369	PASS
DH5	2480	10000	26000	100	300	3.631	-51.438	<-16.369	PASS
2DH5	2402	30	10000	100	300	-0.646	-54.809	<-20.646	PASS
2DH5	2402	10000	26000	100	300	-0.646	-51.418	<-20.646	PASS
2DH5	2441	30	10000	100	300	2.792	-54.502	<-17.208	PASS
2DH5	2441	10000	26000	100	300	2.792	-51.915	<-17.208	PASS
2DH5	2480	30	10000	100	300	0.8	-54.639	<-19.2	PASS
2DH5	2480	10000	26000	100	300	0.8	-50.997	<-19.2	PASS
3DH5	2402	30	10000	100	300	-0.446	-54.300	<-20.446	PASS
3DH5	2402	10000	26000	100	300	-0.446	-50.948	<-20.446	PASS
3DH5	2441	30	10000	100	300	2.86	-54.249	<-17.14	PASS
3DH5	2441	10000	26000	100	300	2.86	-51.188	<-17.14	PASS
3DH5	2480	30	10000	100	300	0.954	-54.629	<-19.046	PASS
3DH5	2480	10000	26000	100	300	0.954	-51.780	<-19.046	PASS

TEST PLOT	
RF Conducted Spurious Emissions_DH5_2402	
Pref	
CSE_1	

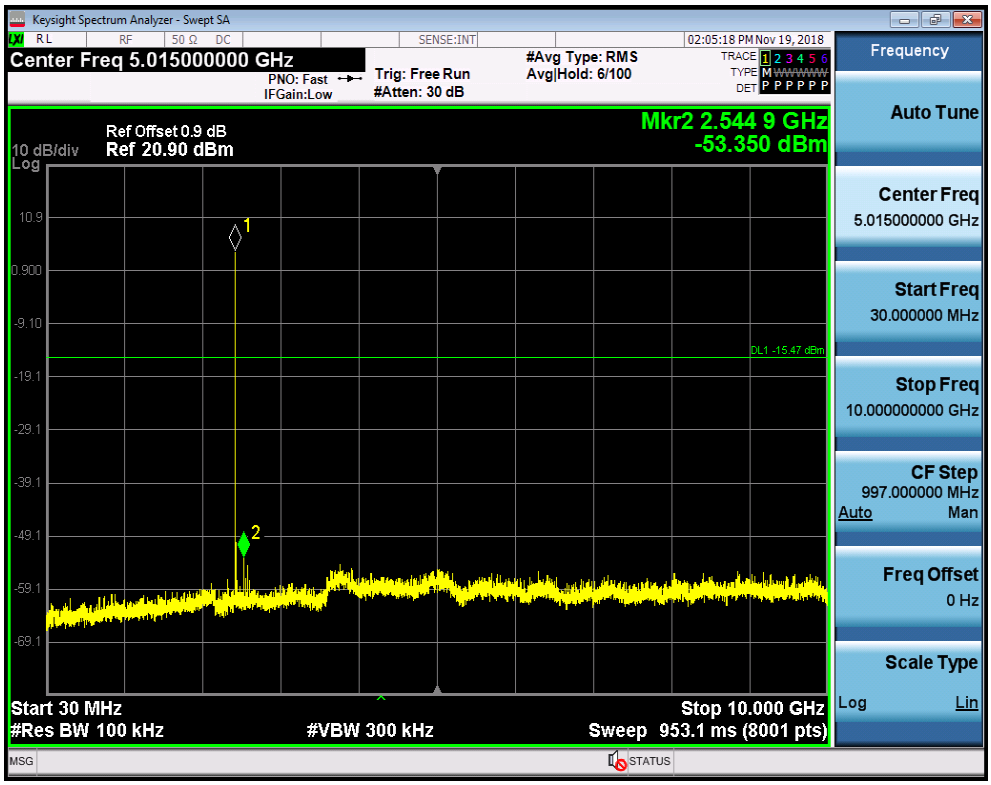
CSE_2



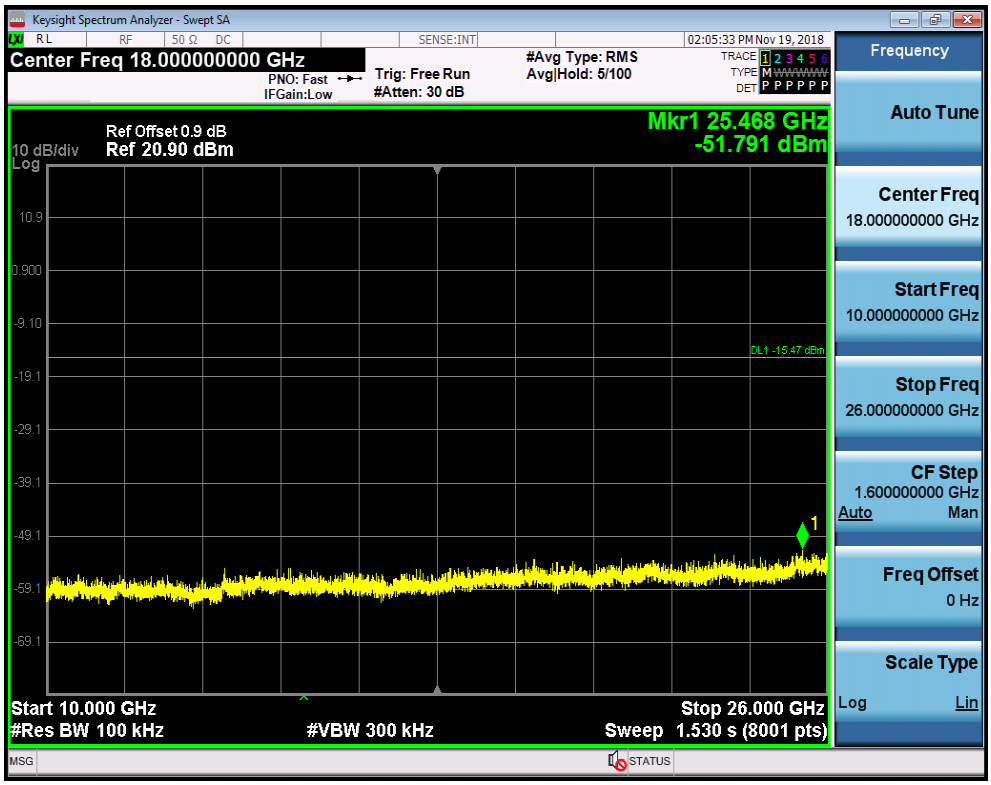
RF Conducted Spurious Emissions_DH5_2441

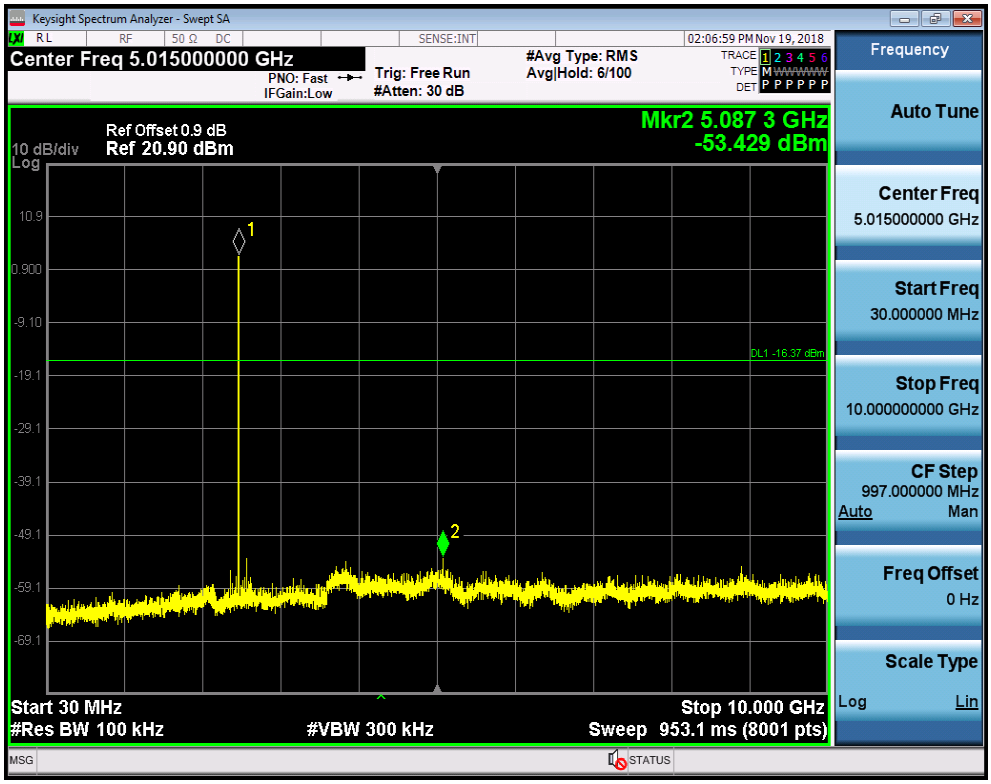
Pref

CSE_1

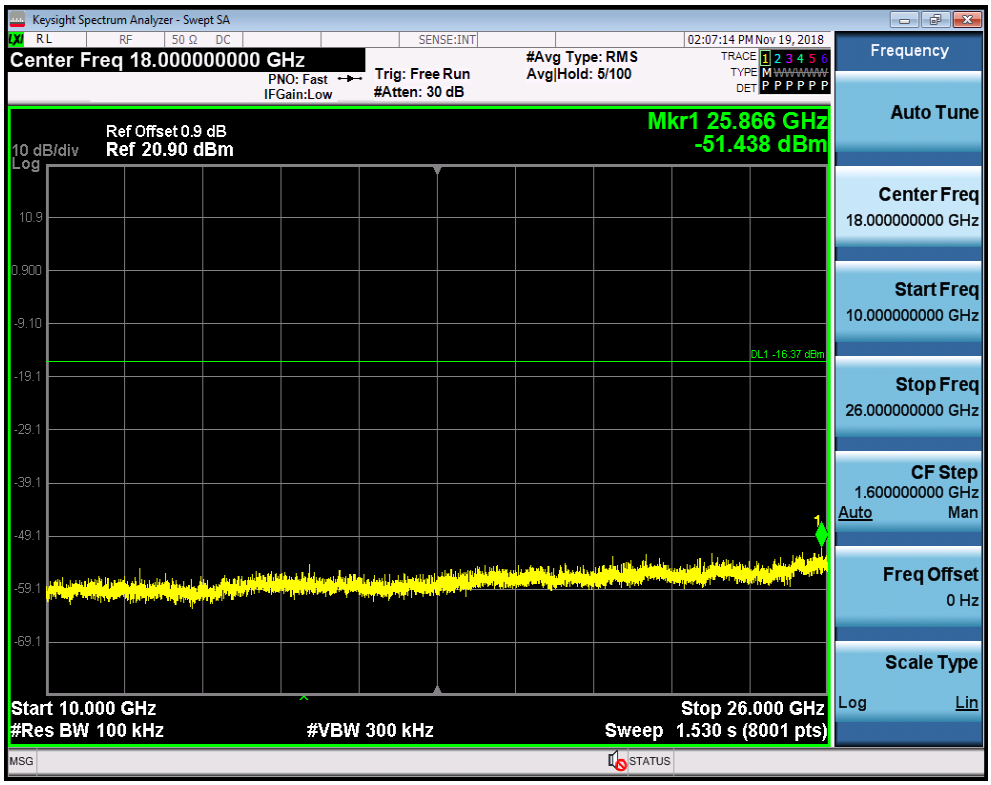


CSE_2



RF Conducted Spurious Emissions_DH5_2480	
Pref	
CSE_1	

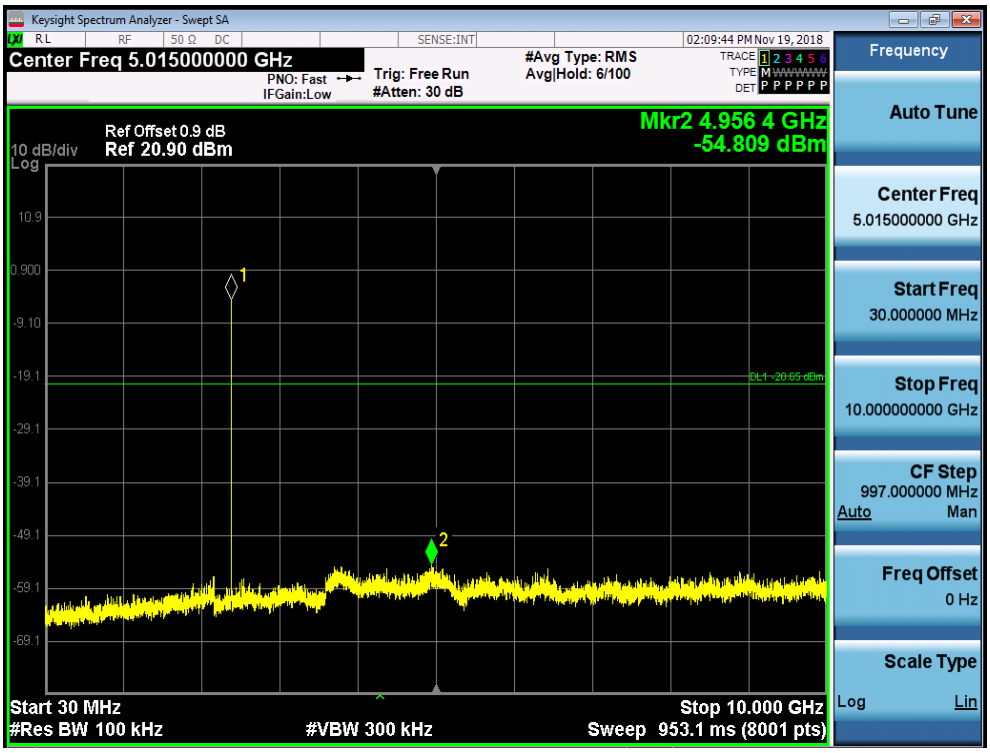
CSE_2



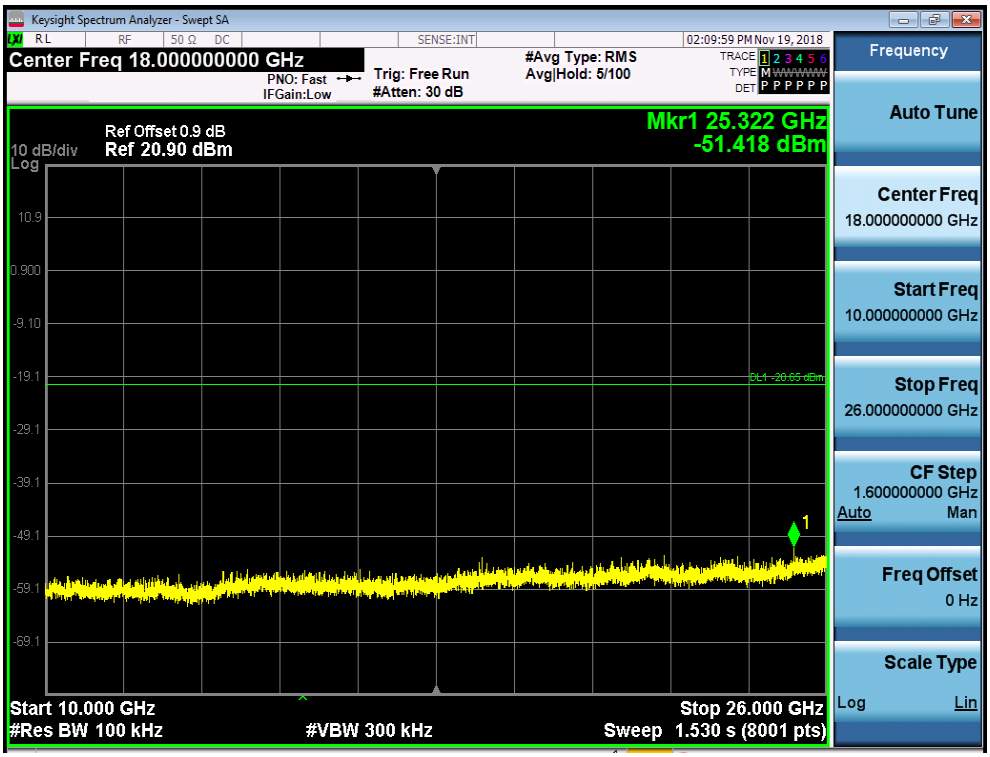
RF Conducted Spurious Emissions_2DH5_2402

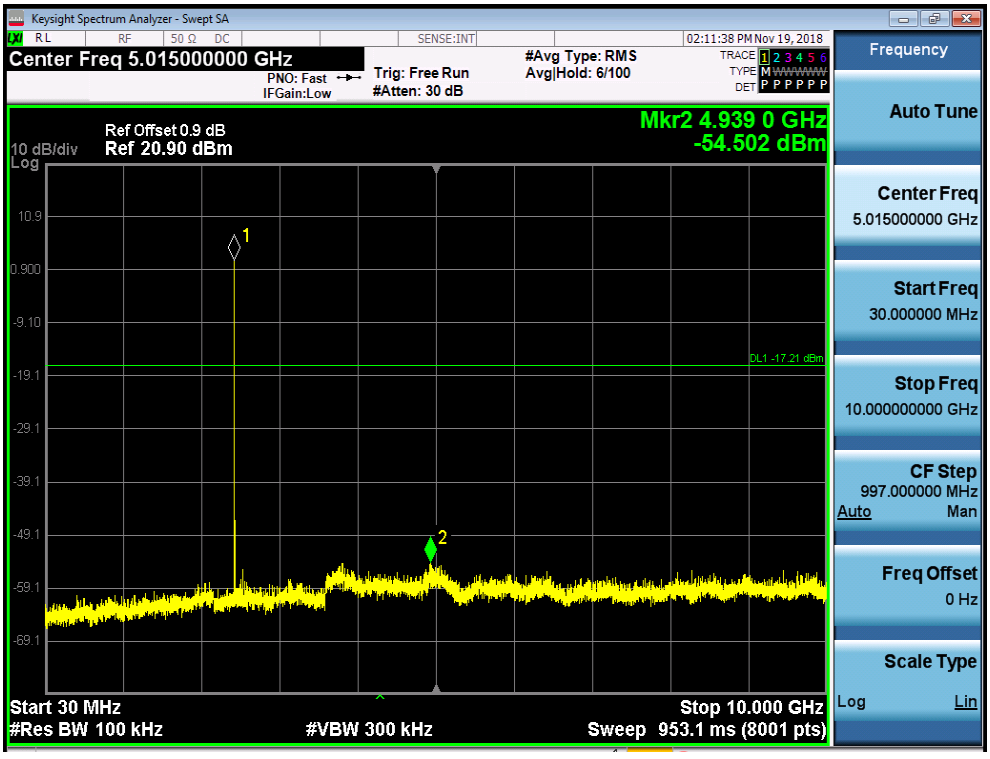
Pref

CSE_1

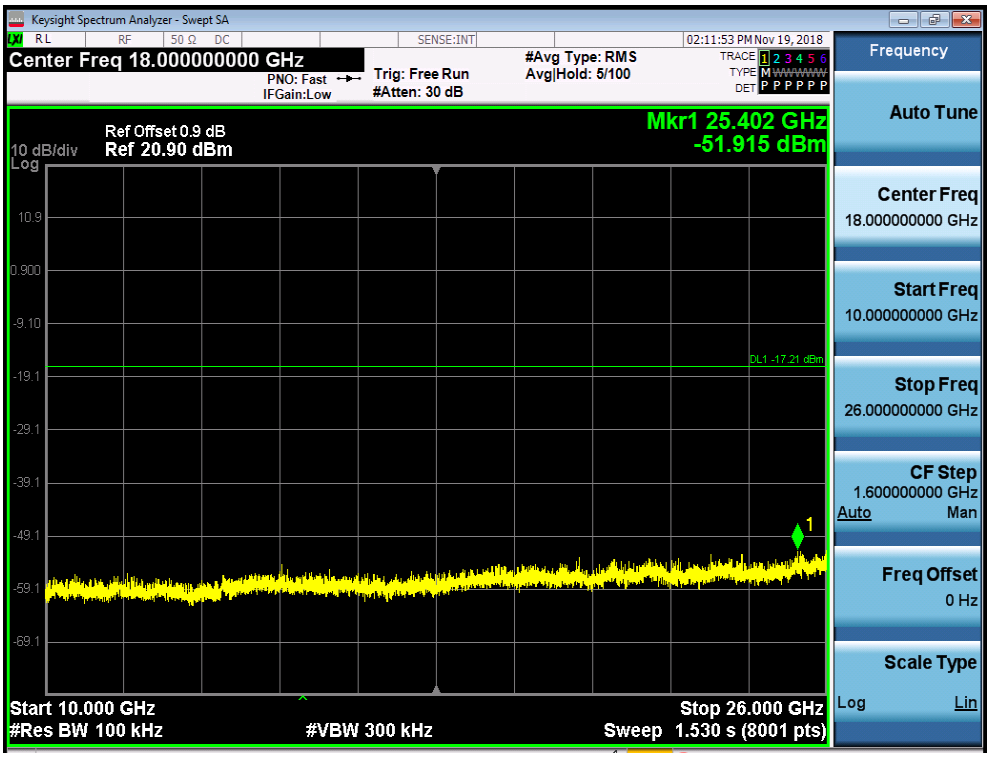


CSE_2



RF Conducted Spurious Emissions_2DH5_2441	
Pref	
CSE_1	

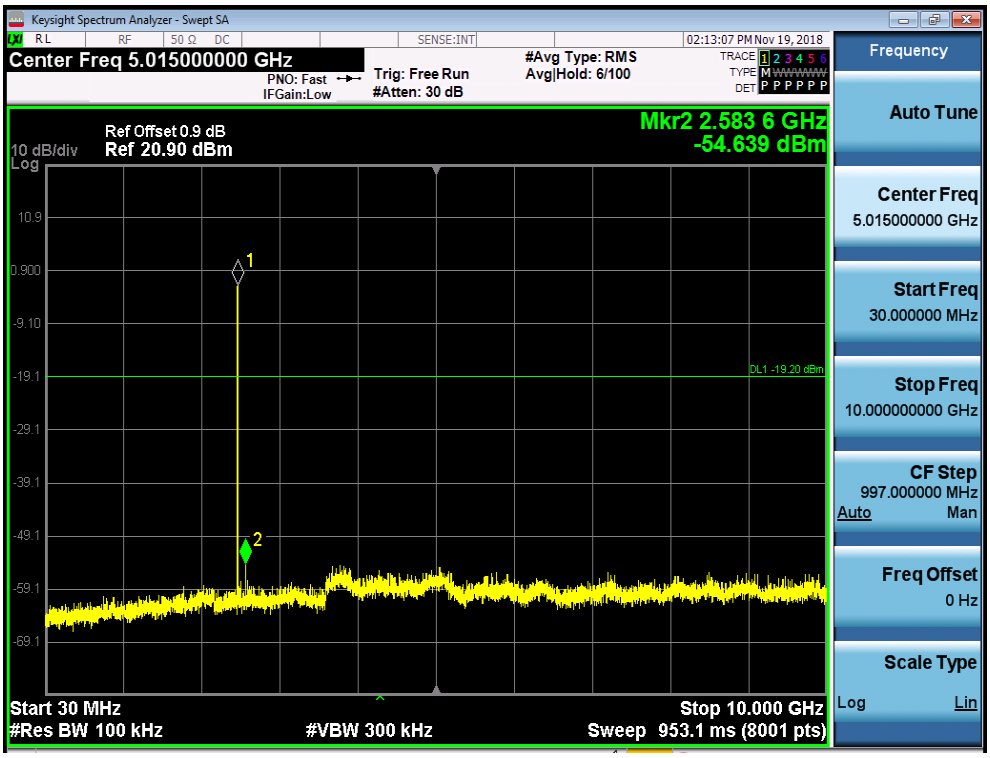
CSE_2



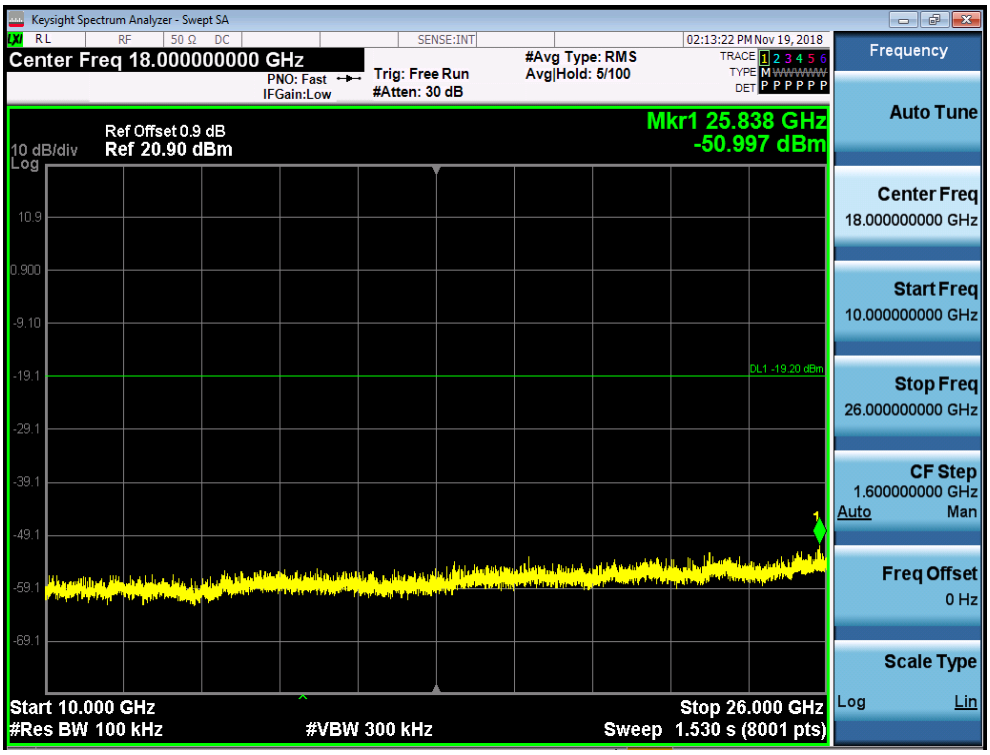
RF Conducted Spurious Emissions_2DH5_2480

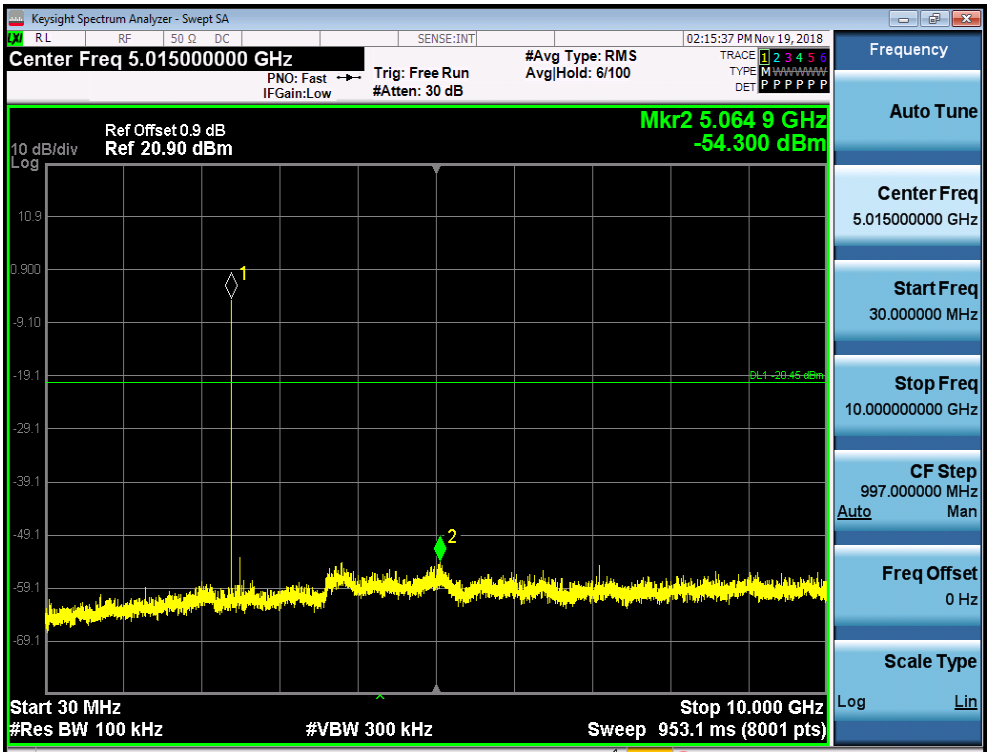
Pref

CSE_1

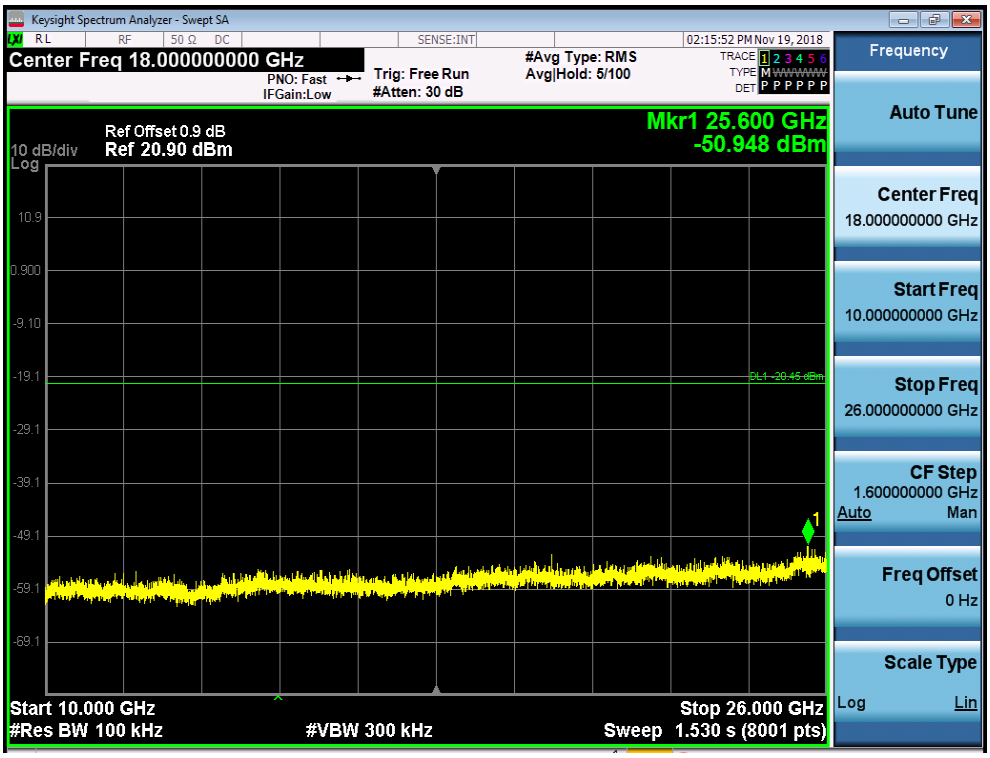


CSE_2



RF Conducted Spurious Emissions_3DH5_2402	
Pref	
CSE_1	

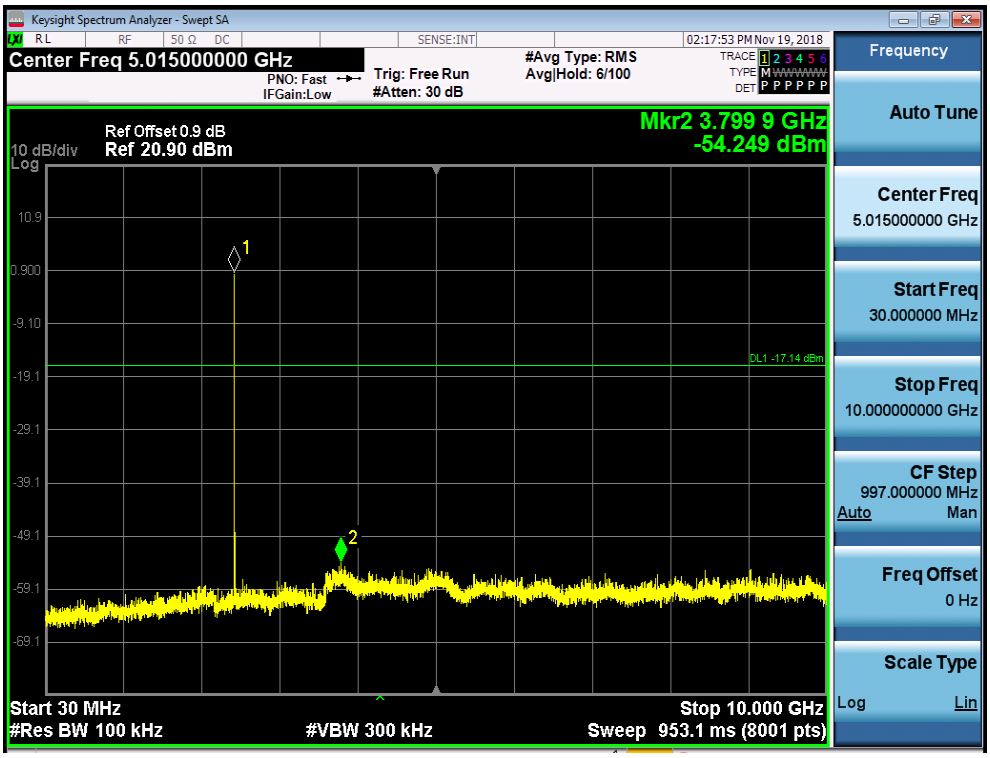
CSE_2



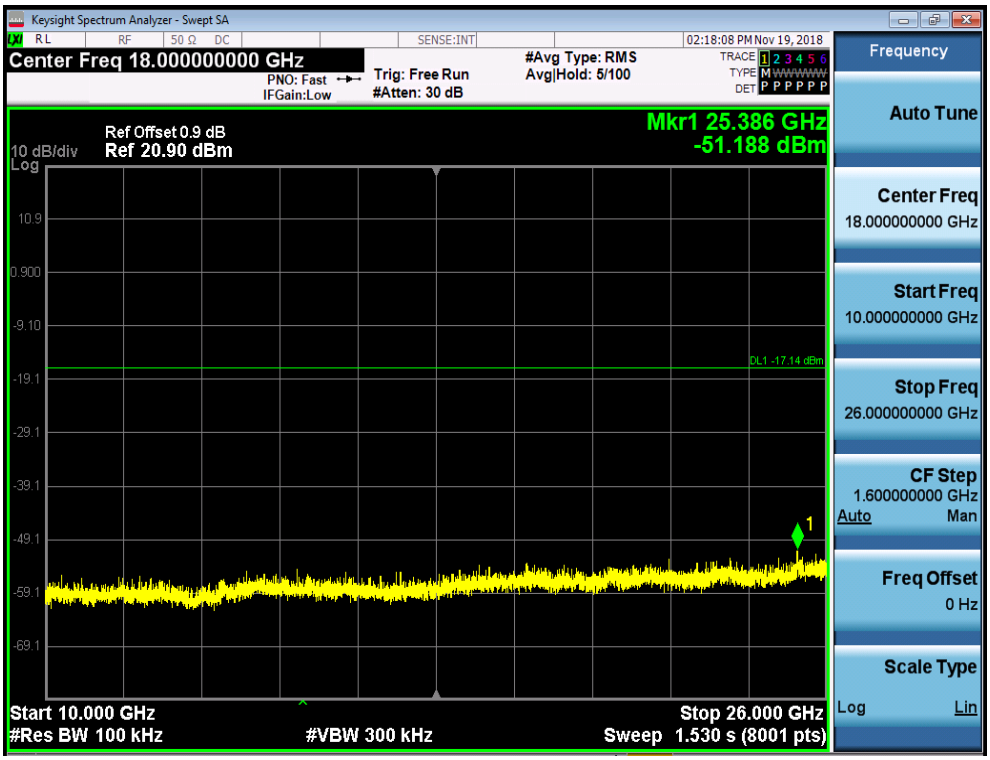
RF Conducted Spurious Emissions_3DH5_2441

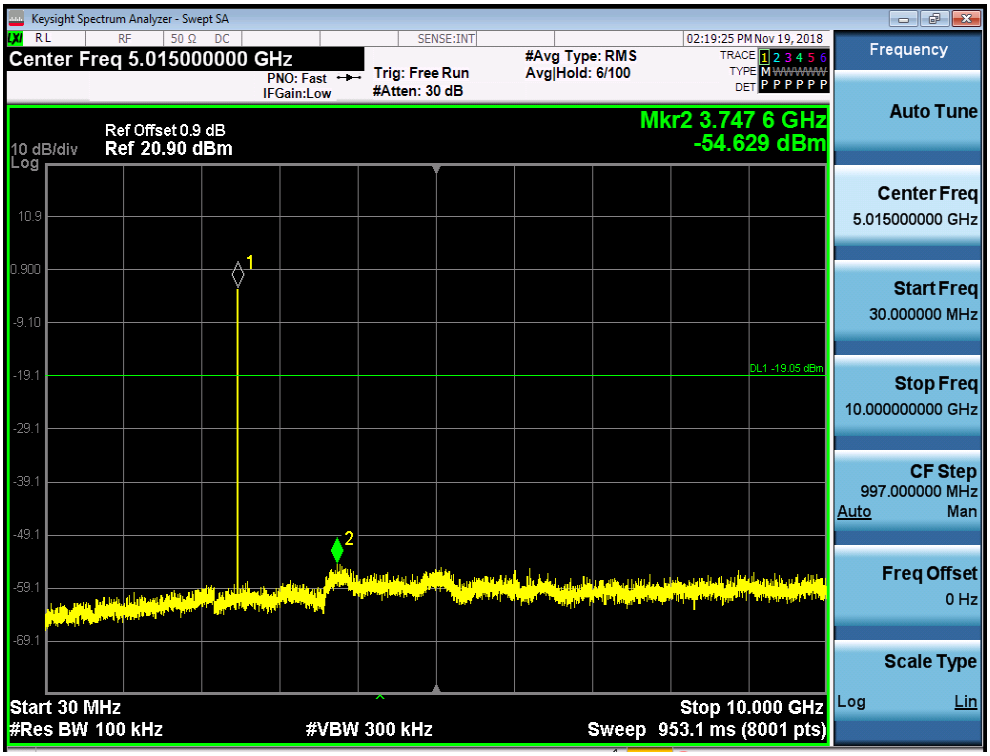
Pref

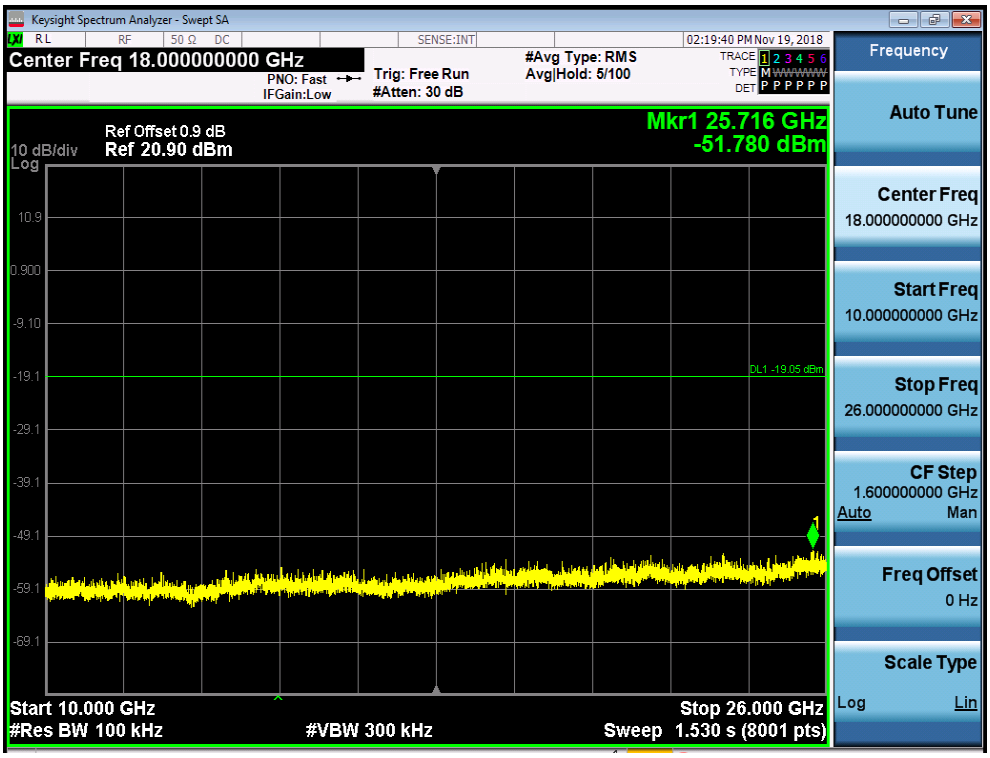
CSE_1



CSE_2



RF Conducted Spurious Emissions_3DH5_2480	
Pref	
CSE_1	

CSE_2	

--End of Report—