

TEST REPORT

of

FCC Part 15 Subpart C

☒ New Application; ☐ Class I PC; ☐ Class II PC

Product : VLine
Brand: GROM
Model: VL2
Model Difference: N/A
FCC ID: 2AJFZ-GROMVL
FCC Rule Part: §15.247, Cat: DSS
Applicant: X-Media Tech Inc.
Address: 519 Marine View Ave #H, Belmont, CA,
94002, United States

Test Performed by:
International Standards Laboratory Corp.

<LT Lab.>

*Site Registration No.

BSMI: SL2-IN-E-0013; MRA TW0997; TAF: 0997; IC: IC4067B-4;

*Address:

No. 120, Lane 180, Hsin Ho Rd.,
Lung-Tan Dist., Tao Yuan City 325, Taiwan

*Tel : 886-3-407-1718; Fax: 886-3-407-1738

Report No.: **ISL-19LR322FCDSS**

Issue Date : **2019/12/19**



Test results given in this report apply only to the specific sample(s) tested and are traceable to national or international standard through calibration of the equipment and evaluating measurement uncertainty herein.

This report MUST not be used to claim product endorsement by TAF or any agency of the Government.

This test report shall not be reproduced except in full, without the written approval of International Standards Laboratory Corp.

VERIFICATION OF COMPLIANCE

Applicant: X-Media Tech Inc.
Product Description: VLine
Brand Name: GROM
Model No.: VL2
Model Difference: N/A
FCC ID: 2AJFZ-GROMVL
Date of test: 2019/10/29 ~ 2019/12/18
Date of EUT Received: 2019/10/29

We hereby certify that:

All the tests in this report have been performed and recorded in accordance with the standards described above and performed by an independent electromagnetic compatibility consultant, International Standards Laboratory Corp.

The test results contained in this report accurately represent the measurements of the characteristics and the energy generated by sample equipment under test at the time of the test. The sample equipment tested as described in this report is in compliance with the limits of above standards.

Test By:		Date:	2019/12/19
	<hr/>		<hr/>
	<i>Bill Huang / Engineer</i>		
Prepared By:		Date:	2019/12/19
	<hr/>		<hr/>
	<i>Gigi Yeh / Senior Engineer</i>		
Approved By:		Date:	2019/12/19
	<hr/>		<hr/>
	<i>Jerry Liu / Technical Manager</i>		

Version

Version No.	Date	Description
00	2019/12/19	Initial creation of document

Uncertainty of Measurement

Description Of Test	Uncertainty
Conducted Emission (AC power line)	2.586 dB
Field Strength of Spurious Radiation	$\leq 30\text{MHz}$: 2.96dB 30-1GHz: 4.22 dB 1-40 GHz: 4.08 dB
Conducted Power	2.412 GHz: 1.30 dB 5.805 GHz: 1.55 dB
Power Density	2.412 GHz: 1.30 dB 5.805 GHz: 1.67 dB
Frequency	0.0032%
Time	0.01%
DC Voltage	1%

Table of Contents

1. General Information.....	6
1.1. Product Description	6
1.2. Related Submittal(s) / Grant (s)	7
1.3. Test Methodology	7
1.4. Test Facility.....	7
1.5. Special Accessories.....	7
1.6. Equipment Modifications.....	7
2. System Test Configuration.....	8
2.1 EUT Configuration	8
2.2 EUT Exercise	8
2.3 Test Procedure.....	8
2.4 Configuration of Tested System.....	9
3. Summary of Test Results.....	10
4. Description of Test Modes.....	10
5. Conducted Emission Test	11
5.1 Standard Applicable:	11
5.2 Measurement Equipment Used:	11
5.3 EUT Setup:.....	11
5.4 Measurement Procedure:	12
5.5 Measurement Result:	12
6. Peak Output Power Measurement	13
6.1 Standard Applicable:	13
6.2 Measurement Equipment Used:	13
6.3 Test Set-up:	14
6.4 Measurement Procedure:	14
6.5 Measurement Result:	15
7. Spurious Emission Test	16
7.1 Standard Applicable:	16
7.2 Measurement Equipment Used:	16
7.3 Test SET-UP:.....	17
7.4 Measurement Procedure:	18
7.5 Field Strength Calculation	19
7.6 Measurement Result:	19
8. 100kHz Bandwidth of Band Edges Measurement	26
8.1 Standard Applicable:	26
8.2 Measurement Equipment Used:	26
8.3 Test SET-UP:.....	26
8.4 Measurement Procedure:	26
8.5 Field Strength Calculation	27
8.6 Measurement Result:	27
9. FREQUENCY SEPARATION	52
9.1 Standard Applicable:	52
9.2 Measurement Equipment Used:	52

9.3	Test Set-up:	52
9.4	Measurement Procedure:	52
9.5	Measurement Result:	52
10.	Number of Hopping Frequency	55
10.1	Standard Applicable:	55
10.2	Measurement Equipment Used:	55
10.3	Test Set-up:	55
10.4	Measurement Procedure:	55
10.5	Measurement Result:	55
11.	Time of Occupancy (Dwell Time)	57
11.1	Standard Applicable:	57
11.2	Measurement Equipment Used:	57
11.3	Test Set-up:	57
11.4	Measurement Procedure:	57
11.5	Measurement Result:	58
12.	20dB Bandwidth	64
12.1	Standard Applicable:	64
12.2	Measurement Equipment Used:	64
12.3	Test Set-up:	64
12.4	Measurement Procedure:	64
12.5	Measurement Result:	65
13.	Antenna Requirement	71
13.1	Standard Applicable:	71
13.2	Antenna Connected Construction:	71

1. General Information

1.1. Product Description

General:

Product Name:	VLine
Brand Name:	GROM
Model Name:	VL2
Model Difference:	N/A
Power Supply	12Vdc by DC power supply
micro USB Port	One provided
HDMI port	Two provided
USB port	Two provided
Micphone port	One provided
Camera AV1(16pin) port	One provided
12pin port	One provided
20pin port	One provided
Lithium battery	3Vdc by CR1216 Battery

Bluetooth:

Frequency Range:	2402 – 2480MHz
Bluetooth Version:	V2.1 + EDR
Channel number:	79 channels
Modulation type	GFSK $+\pi$ / 4DQPSK + 8DPSK
Tune up power:	-1.00 dBm Peak, +/- 1 dB
Dwell Time:	$\leq 0.4s$
Antenna Designation:	Antenna Type: Dipole, Gain: 3dBi

This report applies for BT V2.1 + EDR

Remark: The above DUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

1.2. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID: 2AJFZ-GROMVL** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

1.3. Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.10: 2013. Radiated testing was performed at an antenna to EUT distance 3 meters.

KDB Document: 558074 D01 15.247 Meas Guidance v05r02

1.4. Test Facility

The measurement facilities used to collect the 3m Radiated Emission and AC power line conducted data are located on the address of International Standards Laboratory Corp. <LT Lab.> No. 120, Lane 180, Hsin Ho Rd., Lung-Tan Dist., Tao Yuan City 325, Taiwan which are constructed and calibrated to meet the FCC requirements in documents . FCC Registration Number is: 487532; Designation Number is: TW0997, Canada Registration Number: 4067B-4.

1.5. Special Accessories

Not available for this EUT intended for grant.

1.6. Equipment Modifications

Not available for this EUT intended for grant.

2. System Test Configuration

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

The EUT (Transmitter) was tested with a test program to fix the TX/RX frequency that was for the purpose of the measurements. For more information please see test data and APPENDIX 1 for set-up photographs.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is placed on a turn table which is 0.8 m above ground plane. According to the requirements in Section 6 of ANSI C63.10: 2013. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR 16-1-1 Quasi-Peak and Average detector mode.

2.3.2 Radiated Emissions

The EUT is placed on a turn table which is 0.8 m/1.5m (frequency above 1GHz) above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter(EUT) was rotated through three orthogonal axes according to the requirements in Section 6 and 11 of ANSI C63.10: 2013.

2.4 Configuration of Tested System

Fig. 2-1 Configuration of Tested System (Fixed channel)

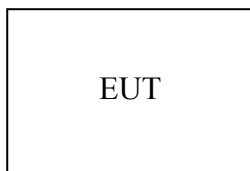


Table 1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/ Type No.	Series No.	Data Cable	Power Cord
1	N/A					

3. Summary of Test Results

FCC Rules	Description Of Test	Result
§15.207(a)	AC Power line Conducted Emission	Compliant
§15.247(b)(1)	Peak Output Power	Compliant
§15.247(d)	100 kHz Bandwidth Of Frequency Band Edges	Compliant
§15.247(c)	Spurious Emission	Compliant
§15.247(a)(1)	Frequency Separation	Compliant
§15.247(a)(1)(iii)	Number of hopping frequency	Compliant
§15.247(a)(1)(ii)	Time of Occupancy	Compliant
§15.247(a)(1)	20dB Bandwidth	Compliant
§15.203, §15.247(c)	Antenna Requirement	Compliant

4. Description of Test Modes

Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Channel low (2402MHz), mid (2441MHz) and high (2480MHz) with each modulation were chosen for full testing.

The worst case BDR mode was reported for Radiated Emission.

5. Conducted Emission Test

5.1 Standard Applicable:

According to §15.207 frequency range within 150kHz to 30MHz shall not exceed the Limit table as below.

Frequency range MHz	Limits dB(uV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Note 1.The lower limit shall apply at the transition frequencies 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

5.2 Measurement Equipment Used:

Conducted Emission Test Site					
Equipment Type	MFR	Model Number	Serial Number	Last Cal.	Cal Due.
Chamber05 -1 Cable	WOKEN	CFD 300-NL	Chamber05 -1 Cable	08/29/2019	08/29/2020
EMI Receiver 13	ROHDE & SCHWARZ	ESCI	101015	07/25/2019	07/25/2020
LISN 15	ROHDE & SCHWARZ	ENV216	101335	11/22/2019	11/22/2020
LISN 22	ROHDE & SCHWARZ	ENV216	101478	08/13/2019	08/13/2020
Test Software	Farad	EZEMC Ver:ISL-03A2	N/A	N/A	N/A

5.3 EUT Setup:

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.10-2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

5.4 Measurement Procedure:

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

5.5 Measurement Result:

N/A

6. Peak Output Power Measurement

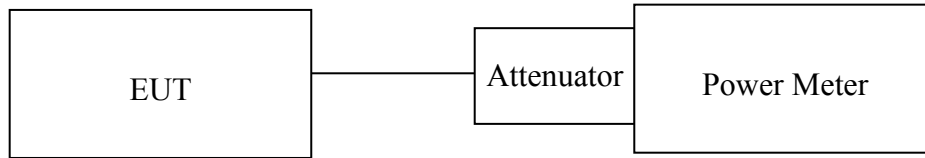
6.1 Standard Applicable:

According to §15.247(b)(1), For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, and all frequency hopping systems in the 5725-5850MHz band: 1Watt. For all other frequency hopping systems in the 2400 – 2483.5MHz band: 0.125 Watts.

6.2 Measurement Equipment Used:

Location Conducted	Equipment Name	Brand	Model	S/N	Last Cal. Date	Next Cal. Date
Conducted	Power Meter	Anritsu	ML2495A	1116010	10/04/2019	10/04/2020
Conducted	Power Sensor	Anritsu	MA2411B	34NKF50	10/04/2019	10/04/2020
Conducted	Power Sensor	DARE	RPR3006W	13I00030SNO33	01/11/2019	01/11/2020
Conducted	Power Sensor	DARE	RPR3006W	14I00889SNO35	06/27/2019	06/27/2020
Conducted	Power Sensor	DARE	RPR3006W	14I00889SNO36	06/27/2019	06/27/2020
Conducted	Temperature Chamber	KSON	THS-B4H100	2287	02/19/2019	02/19/2020
Conducted	DC Power supply	ABM	8185D	N/A	01/10/2019	01/10/2020
Conducted	AC Power supply	EXTECH	CFC105W	NA	N/A	N/A
Conducted	Spectrum analyzer	Keysight	N9010A	MY56070257	10/05/2019	10/05/2020
Conducted	Spectrum analyzer	R&S	FSP40	100116	01/10/2019	01/10/2020
Conducted	Test Software	DARE	Radiation Ver:2013.1.23	NA	NA	NA
Conducted	Test Software	R&S	CMUGO Ver:2.0.0	N/A	N/A	N/A
Conducted	Radio Communication Analyzer	R&S	CMU200	111968	10/29/2019	10/29/2020
Conducted	Radio Communication Analyzer	R&S	CMW500	1201.002K50108 793-JG	10/11/2019	10/11/2020
Conducted	BT Simulator	Agilent	N4010A	MY48100200	NA	NA
Conducted	GPS Simulator	Welnavigate	GS-50	701523	NA	NA

6.3 Test Set-up:



6.4 Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter
3. Record the max. reading.
4. Repeat above procedures until all frequency measured were complete.

6.5 Measurement Result:

BDR Mode

Frequency (MHz)	Peak Reading Power (dBm)	Cable Loss	Output Power (dBm)	Output Power (W)	Limit (W)
Low	-1.33	2.50	1.17	0.00131	1
Mid	-1.00	2.50	1.50	0.00141	1
High	-1.41	2.50	1.09	0.00128	1

EDR 2M Mode

Frequency (MHz)	Peak Reading Power (dBm)	Cable Loss	Output Power (dBm)	Output Power (W)	Limit (W)
Low	-5.24	2.50	-2.74	0.00053	0.125
Mid	-4.90	2.50	-2.40	0.00058	0.125
High	-5.39	2.50	-2.89	0.00051	0.125

EDR 3M Mode

Frequency (MHz)	Peak Reading Power (dBm)	Cable Loss	Output Power (dBm)	Output Power (W)	Limit (W)
Low	-4.79	2.50	-2.29	0.00059	0.125
Mid	-4.47	2.50	-1.97	0.00064	0.125
High	-4.95	2.50	-2.45	0.00057	0.125

Offset: 1dB

7. Spurious Emission Test

7.1 Standard Applicable:

According to §15.247(d), all other emissions outside these bands shall not exceed the general radiated emission limits specified in §15.209(a). And according to §15.33(a)(1), for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

7.2 Measurement Equipment Used:

7.2.1. Conducted Emission at antenna port:

Refer to section 6.2 for details.

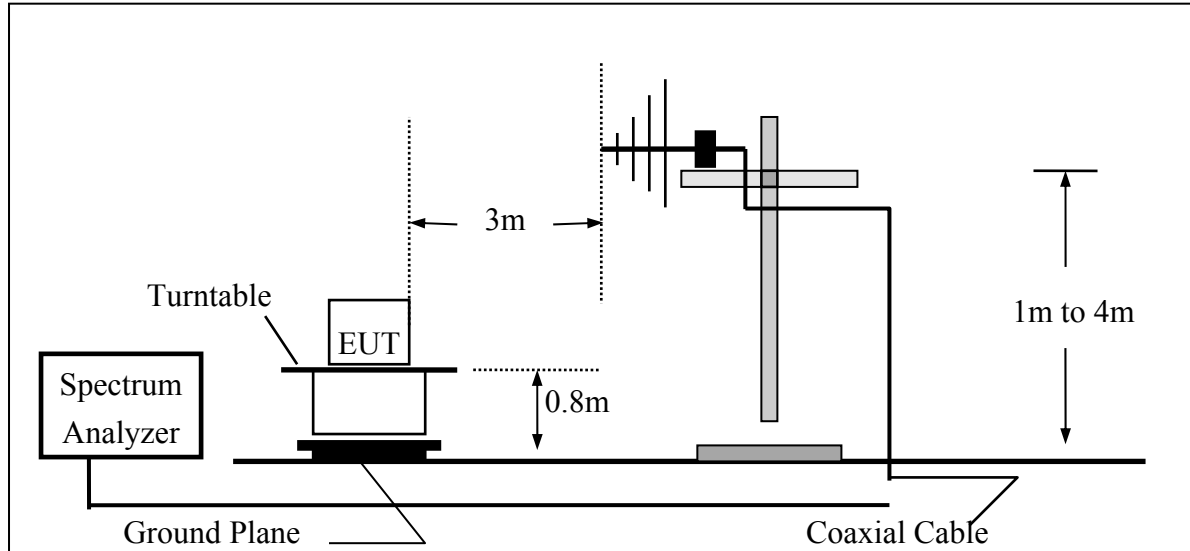
7.2.2. Radiated emission:

Location	Equipment Name	Brand	Model	S/N	Last Cal. Date	Next Cal. Date
Chamber 19	Spectrum analyzer	R&S	FSP40	100116	01/10/2019	01/10/2020
Chamber 19	EMI Receiver	R&S	ESR3	102461	08/08/2018	08/08/2020
Chamber 19	Loop Antenna	EM	EM-6879	271	05/31/2019	05/31/2020
Chamber 19	Bilog Antenna (30MHz-1GHz)	Schwarzbeck	VULB9168 w 5dB Att.	736	01/29/2019	01/29/2020
Chamber 19	Horn antenna (1GHz-18GHz)	Schwarzbeck	9120D	9120D-1627	06/17/2019	06/17/2020
Chamber 19	Horn antenna (18GHz-26GHz)	Com-power	AH-826	081001	11/21/2019	11/21/2021
Chamber 19	Horn antenna (26GHz-40GHz)	Com-power	AH-640	100A	03/29/2019	03/29/2021
Chamber 19	Preamplifier (9kHz-1GHz)	HP	8447F	3113A06362	01/14/2019	01/14/2020
Chamber 19	Preamplifier (1GHz-26GHz)	Agilent	8449B	3008A02471	10/05/2019	10/05/2020
Chamber 19	Preamplifier (26GHz-40GHz)	MITEQ	JS4-26004000-27-5A	818471	05/06/2019	05/06/2020
Chamber 19	RF Cable (9kHz-18GHz)	HUBER SU-HNER	Sucoflex 104A	MY1397/4A	01/17/2019	01/17/2020
Chamber 19	RF Cable (18GHz-40GHz)	HUBER SU-HNER	Sucoflex 102	27963/2&374 21/2	11/27/2019	11/27/2021
Chamber 19	Signal Generator	Anritsu	MG3692A	20311	01/09/2019	01/09/2020
Chamber 19	Test Software	Audix	E3 Ver:6.12023	N/A	N/A	N/A
Chamber 19	Magnetic Field Meter	Combinova	MFM-10	645	10/16/2019	10/16/2020
Chamber 19	Magnetic Field Meter	Combinova	MFM-1000	619	12/06/2018	12/06/2019
Chamber 19	Electric Field Meter	Combinova	EFM-200	402	10/16/2019	10/16/2020
Chamber 19	E-field probe	Narda / Wandel & Goltermann	EF-0691 + NBM-520	D-0135 + D-0526	03/02/2019	03/02/2020

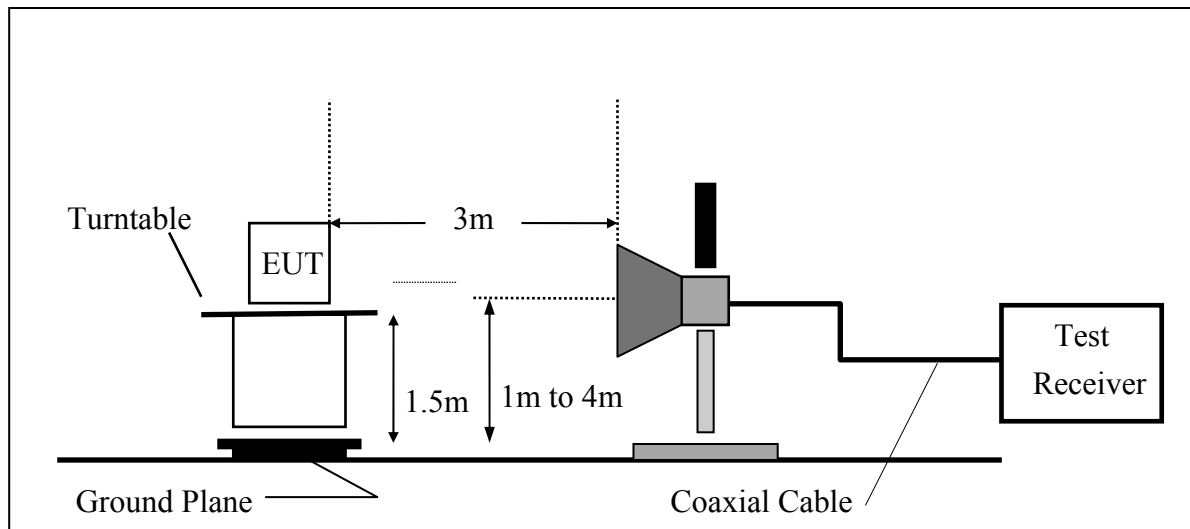
7.3 Test SET-UP:

The test item only performed radiated mode

(A) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(B) Radiated Emission Test Set-Up Frequency Over 1 GHz



7.4 Measurement Procedure:

1. According 414788 section 2, Either OATS or chamber for radiated emission below 30MHz, the test was done at 966 chamber, the test site was evaluated with OATS and the Chamber has test signals level greater than OATS's .
2. The EUT was placed on a turn table which is 0.8m/1.5m above ground plane in 966 chamber.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
5. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna.
6. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
7. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
8. Repeat above procedures until all frequency measured were complete.

Test receiver setting : Blew 1GHz
 Detector : Average(9kHz – 90kHz, 110kHz – 90kHz), Quasi-Peak
 Bandwidth : 200Hz, 120kHz
 Test spectrum setting : Above 1GHz
 Peak : RBW=1MHz, VBW=3MHz, Sweep=auto
 Average (for BLE) : RBW=1MHz, VBW=10Hz, Sweep=auto

Average Measurement Setting (VBW)

Mode	Duty Cycle (%)	T _{on} (us)	T _{off} (us)	1/T _{on} (kHz)	Determined VBW Setting
Bluetooth LE	100	--	--	--	10Hz

7.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

Where	FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
	RA = Reading Amplitude	AG = Amplifier Gain
	AF = Antenna Factor	

7.6 Measurement Result:

Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

Radiated Spurious Emission Measurement Result: (below 1GHz) (Worst case: BDR)

Operation Mode	TX CH Low	Test Date	2019/11/19
Fundamental Frequency	2402MHz	Test By	Bill
Temperature	25	Humidity	60 %

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	171.62	40.89	-5.33	35.56	43.50	-7.94	Peak	VERTICAL
2	256.98	39.02	-5.27	33.75	46.00	-12.25	Peak	VERTICAL
3	362.71	38.61	-2.73	35.88	46.00	-10.12	Peak	VERTICAL
4	428.67	42.50	-1.46	41.04	46.00	-4.96	Peak	VERTICAL
5	561.56	32.96	0.53	33.49	46.00	-12.51	Peak	VERTICAL
6	825.40	25.86	5.07	30.93	46.00	-15.07	Peak	VERTICAL
1	159.01	46.42	-5.00	41.42	43.50	-2.08	Peak	HORIZONTAL
2	362.71	38.78	-2.73	36.05	46.00	-9.95	Peak	HORIZONTAL
3	528.58	36.14	0.24	36.38	46.00	-9.62	Peak	HORIZONTAL
4	627.52	28.52	1.79	30.31	46.00	-15.69	Peak	HORIZONTAL
5	825.40	25.00	5.07	30.07	46.00	-15.93	Peak	HORIZONTAL
6	891.36	23.56	5.94	29.50	46.00	-16.50	Peak	HORIZONTAL

Remark:

- 1 No further spurious emissions detected from the lowest internal frequency and 30MHz.
- 2 Measuring frequencies from the lowest internal frequency to the 1GHz.
- 3 Radiated emissions measured in frequency range from 9MHz to 1000MHz were made with an instrument detector setting 9-90kHz/110-490kHz using PK/AV and other Frequency Band using PK/QP
- 4 Measurement result within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 5 The IF bandwidth of SPA between 9kHz to 30MHz was 10kHz, VBW= 30kHz; between 30MHz to 1GHz was 100kHz, VBW=300kHz.

Radiated Spurious Emission Measurement Result (below 1GHz)

Operation Mode	TX CH Mid	Test Date	2019/11/19
Fundamental Frequency	2441MHz	Test By	Bill
Temperature	25	Humidity	60 %

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	171.62	41.27	-5.33	35.94	43.50	-7.56	Peak	VERTICAL
2	239.52	39.04	-5.80	33.24	46.00	-12.76	Peak	VERTICAL
3	395.69	42.36	-2.08	40.28	46.00	-5.72	Peak	VERTICAL
4	528.58	35.36	0.24	35.60	46.00	-10.40	Peak	VERTICAL
5	627.52	25.32	1.79	27.11	46.00	-18.89	Peak	VERTICAL
6	825.40	25.33	5.07	30.40	46.00	-15.60	Peak	VERTICAL
1	170.65	46.49	-5.25	41.24	43.50	-2.26	Peak	HORIZONTAL
2	296.75	41.25	-3.92	37.33	46.00	-8.67	Peak	HORIZONTAL
3	428.67	37.46	-1.46	36.00	46.00	-10.00	Peak	HORIZONTAL
4	561.56	36.75	0.53	37.28	46.00	-8.72	Peak	HORIZONTAL
5	693.48	28.55	3.00	31.55	46.00	-14.45	Peak	HORIZONTAL
6	825.40	26.73	5.07	31.80	46.00	-14.20	Peak	HORIZONTAL

Remark:

- 1 No further spurious emissions detected from the lowest internal frequency and 30MHz.
- 2 Measuring frequencies from the lowest internal frequency to the 1GHz.
- 3 Radiated emissions measured in frequency range from 9MHz to 1000MHz were made with an instrument detector setting 9-90kHz/110-490kHz using PK/AV and other Frequency Band using PK/QP
- 4 Measurement result within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 5 The IF bandwidth of SPA between 9kHz to 30MHz was 10kHz, VBW= 30kHz; between 30MHz to 1GHz was 100kHz, VBW=300kHz.

Radiated Spurious Emission Measurement Result (below 1GHz)

Operation Mode TX CH High
Fundamental Frequency 2480MHz
Temperature 25

Test Date 2019/11/19
Test By Bill
Humidity 60 %

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	171.62	42.93	-5.33	37.60	43.50	-5.90	Peak	VERTICAL
2	237.58	38.45	-5.95	32.50	46.00	-13.50	Peak	VERTICAL
3	362.71	37.54	-2.73	34.81	46.00	-11.19	Peak	VERTICAL
4	428.67	41.34	-1.46	39.88	46.00	-6.12	Peak	VERTICAL
5	561.56	32.23	0.53	32.76	46.00	-13.24	Peak	VERTICAL
6	825.40	25.27	5.07	30.34	46.00	-15.66	Peak	VERTICAL
1	171.62	46.01	-5.33	40.68	43.50	-2.82	Peak	HORIZONTAL
2	289.96	41.34	-4.15	37.19	46.00	-8.81	Peak	HORIZONTAL
3	403.45	36.52	-1.95	34.57	46.00	-11.43	Peak	HORIZONTAL
4	528.58	38.58	0.24	38.82	46.00	-7.18	Peak	HORIZONTAL
5	693.48	29.07	3.00	32.07	46.00	-13.93	Peak	HORIZONTAL
6	825.40	27.12	5.07	32.19	46.00	-13.81	Peak	HORIZONTAL

Remark:

- 1 No further spurious emissions detected from the lowest internal frequency and 30MHz.
- 2 Measuring frequencies from the lowest internal frequency to the 1GHz.
- 3 Radiated emissions measured in frequency range from 9MHz to 1000MHz were made with an instrument detector setting 9-90kHz/110-490kHz using PK/AV and other Frequency Band using PK/QP
- 4 Measurement result within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 5 The IF bandwidth of SPA between 9kHz to 30MHz was 10kHz, VBW= 30kHz; between 30MHz to 1GHz was 100kHz, VBW=300kHz.

Radiated Spurious Emission Measurement Result (above 1GHz)

Operation Mode	TX CH Low	Test Date	2019/11/19
Fundamental Frequency	2402 MHz	Test By	Bill
Temperature	25	Humidity	60 %

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	4804.00	46.75	-9.41	37.34	74.00	-36.66	Peak	VERTICAL
2	7206.00	42.94	-1.83	41.11	74.00	-32.89	Peak	VERTICAL
1	4804.00	44.96	-9.41	35.55	74.00	-38.45	Peak	HORIZONTAL
2	7206.00	44.08	-1.83	42.25	74.00	-31.75	Peak	HORIZONTAL

Remark:

- 1 Measuring frequencies from the lowest internal frequency to the 10th of fundamental frequency
- 2 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 3 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

Radiated Spurious Emission Measurement Result (above 1GHz)

Operation Mode	TX CH Mid	Test Date	2019/11/19
Fundamental Frequency	2441 MHz	Test By	Bill
Temperature	25	Humidity	60 %

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	4882.00	47.32	-9.21	38.11	74.00	-35.89	Peak	VERTICAL
2	7323.00	43.03	-1.75	41.28	74.00	-32.72	Peak	VERTICAL
1	4882.00	45.41	-9.21	36.20	74.00	-37.80	Peak	HORIZONTAL
2	7323.00	43.82	-1.75	42.07	74.00	-31.93	Peak	HORIZONTAL

Remark:

- 1 Measuring frequencies from the lowest internal frequency to the 10th of fundamental frequency
- 2 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 3 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

Radiated Spurious Emission Measurement Result (above 1GHz)

Operation Mode	TX CH High	Test Date	2019/11/19
Fundamental Frequency	2480 MHz	Test By	Bill
Temperature	25	Humidity	60 %

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	4960.00	48.24	-9.01	39.23	74.00	-34.77	Peak	VERTICAL
2	7440.00	42.03	-1.75	40.28	74.00	-33.72	Peak	VERTICAL
1	4960.00	46.09	-9.01	37.08	74.00	-36.92	Peak	HORIZONTAL
2	7440.00	42.76	-1.75	41.01	74.00	-32.99	Peak	HORIZONTAL

Remark:

- 1 Measuring frequencies from the lowest internal frequency to the 10th of fundamental frequency
- 2 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 3 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

8. 100kHz Bandwidth of Band Edges Measurement

8.1 Standard Applicable:

According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power. 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).

8.2 Measurement Equipment Used:

8.2.1. Conducted Emission at antenna port:

Refer to section 6.2 for details.

8.2.2. Radiated emission:

Refer to section 7.2 for details.

8.3 Test SET-UP:

Refer to section 7.3 for details.

8.4 Measurement Procedure:

- 1 The EUT was placed on a turn table which is 0.8m above ground plane.
- 2 The turn table shall rotate 360 degrees to determine the position of maximum emission level.
- 3 EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
- 4 When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna.
- 5 Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
- 6 And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
- 7 Repeat above procedures until all frequency measured were complete.

8.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$\mathbf{FS = RA + AF + CL - AG}$$

Where	FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
	RA = Reading Amplitude	AG = Amplifier Gain
	AF = Antenna Factor	

8.6 Measurement Result:

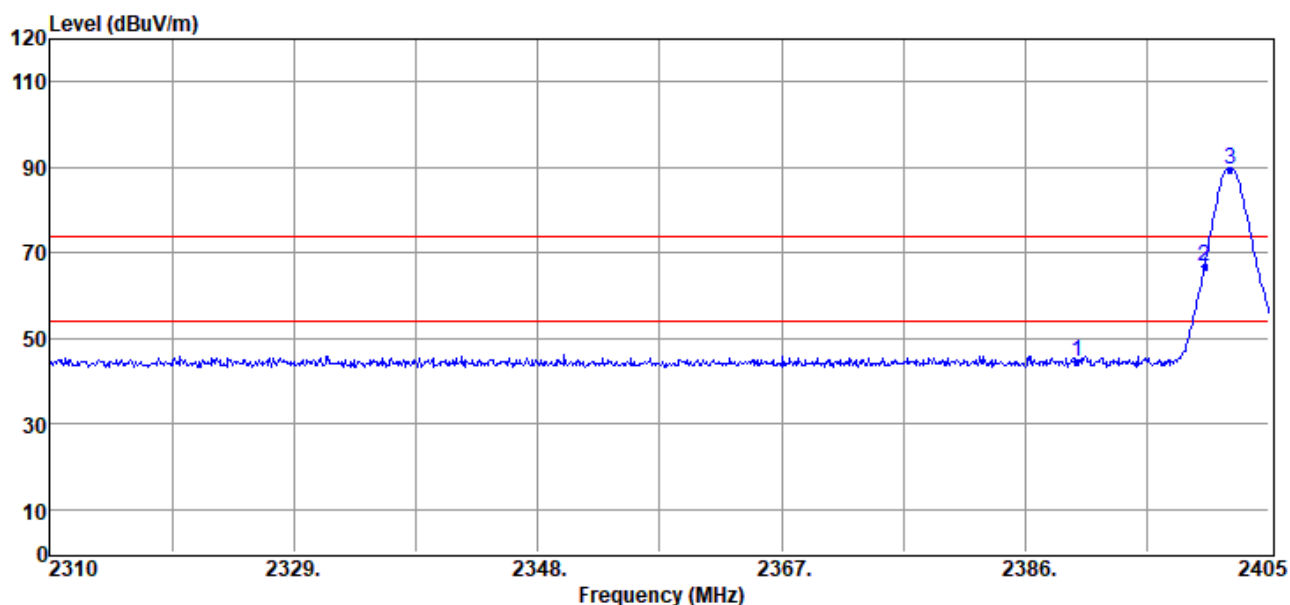
Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

Non-hopping mode:

Radiated Emission: (BDR mode)

Operation Mode TX CH Low
Fundamental Frequency 2402 MHz
Temperature 25

Test Date 2019/11/19
Test By Bill
Humidity 60 %

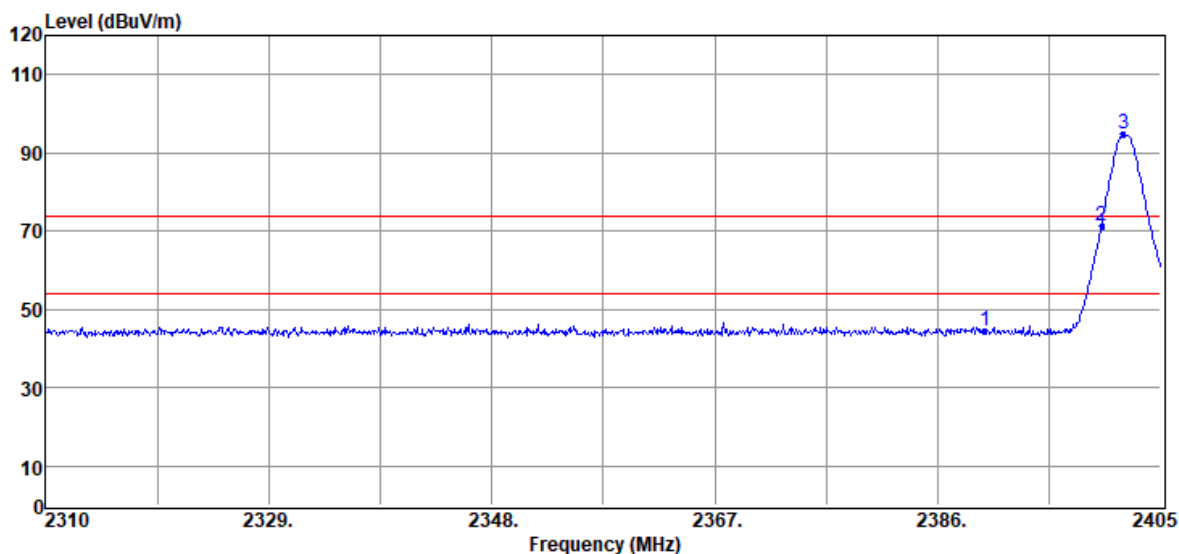


No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	2390.00	60.49	-15.84	44.65	74.00	-29.35	Peak	VERTICAL
2	2400.00	82.51	-15.86	66.65	69.66	-3.01	Peak	VERTICAL
3	2401.96	105.52	-15.86	89.66	F	---	Peak	VERTICAL

Remark:

- 1 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 2 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 3 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 4 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Note: “F” denotes fundamental frequency



No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	2390.00	60.25	-15.84	44.41	74.00	-29.59	Peak	HORIZONTAL
2	2400.00	87.34	-15.86	71.48	74.66	-3.18	Peak	HORIZONTAL
3	2401.87	110.52	-15.86	94.66	F	---	Peak	HORIZONTAL

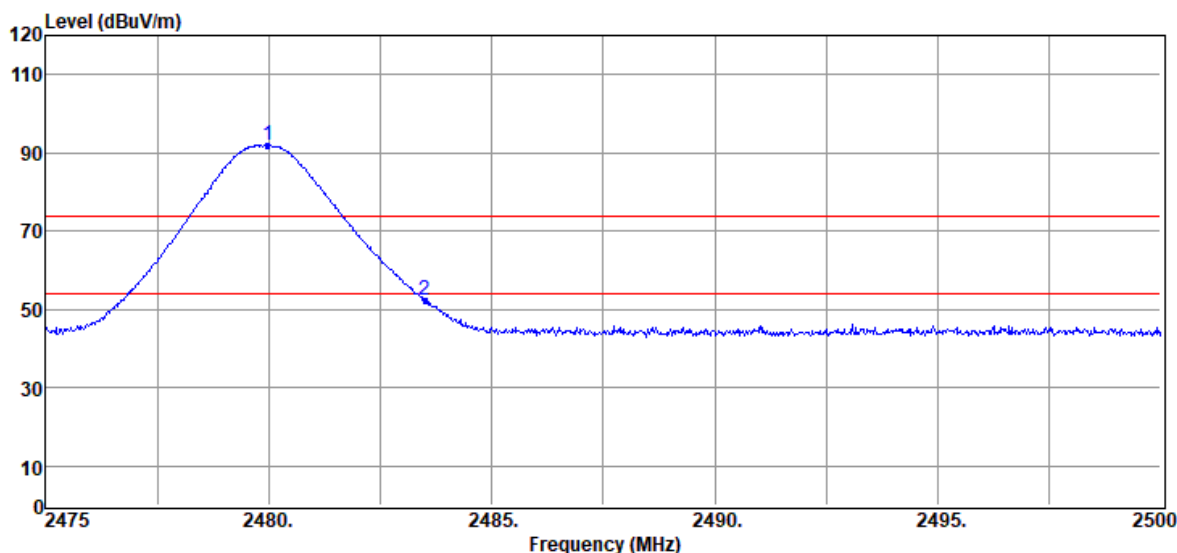
Remark:

- 1 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 2 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 3 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 4 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Note: “F” denotes fundamental frequency

Operation Mode TX CH High
Fundamental Frequency 2480 MHz
Temperature 25

Test Date 2019/11/19
Test By Bill
Humidity 60 %

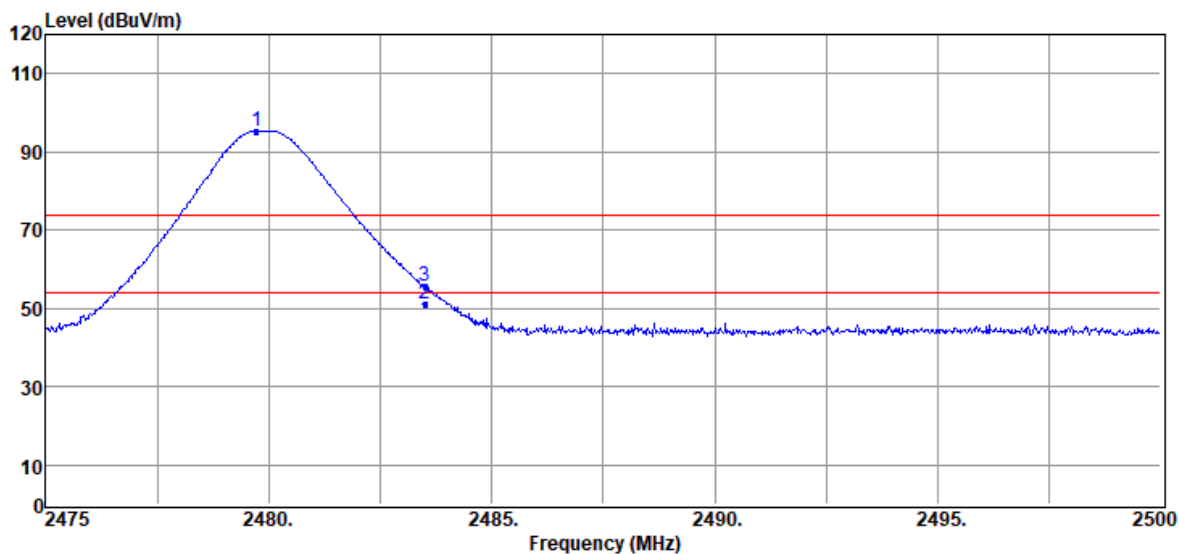


No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	2479.98	107.63	-15.84	91.79	F	---	Peak	VERTICAL
2	2483.50	68.26	-15.84	52.42	74.00	-21.58	Peak	VERTICAL

Remark:

- 1 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 2 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 3 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 4 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Note: “F” denotes fundamental frequency



No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	2479.73	111.22	-15.84	95.38	F	---	Peak	HORIZONTAL
2	2483.50	67.14	-15.84	51.30	54.00	-2.70	Average	HORIZONTAL
3	2483.50	71.42	-15.84	55.58	74.00	-18.42	Peak	HORIZONTAL

Remark:

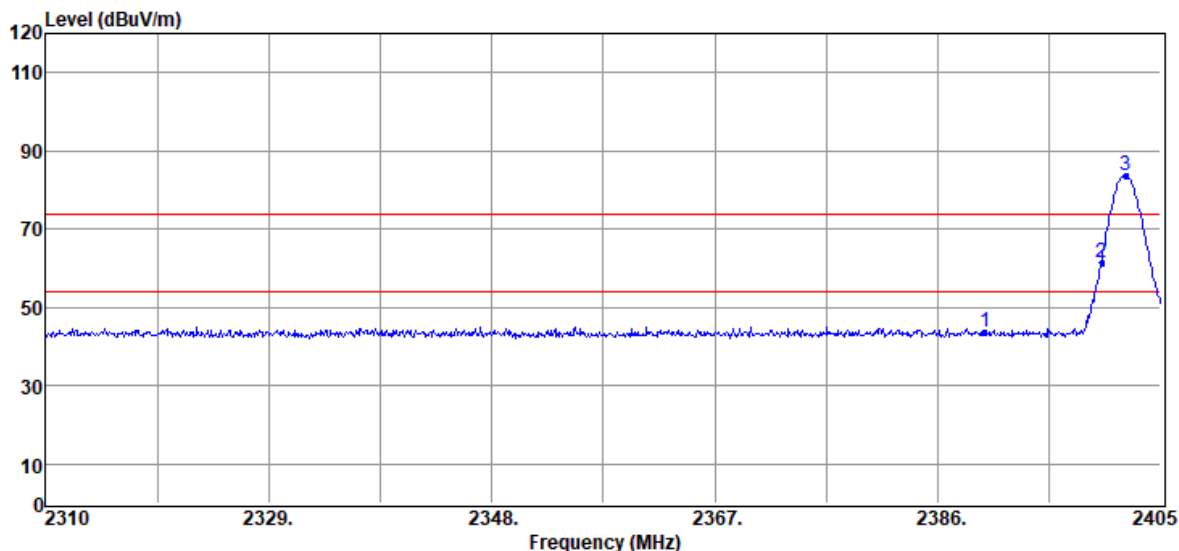
- 1 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 2 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 3 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 4 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Note: “F” denotes fundamental frequency

Radiated Emission (EDR 2M mode):

Operation Mode TX CH Low
Fundamental Frequency 2402 MHz
Temperature 25

Test Date 2019/11/19
Test By Bill
Humidity 60 %

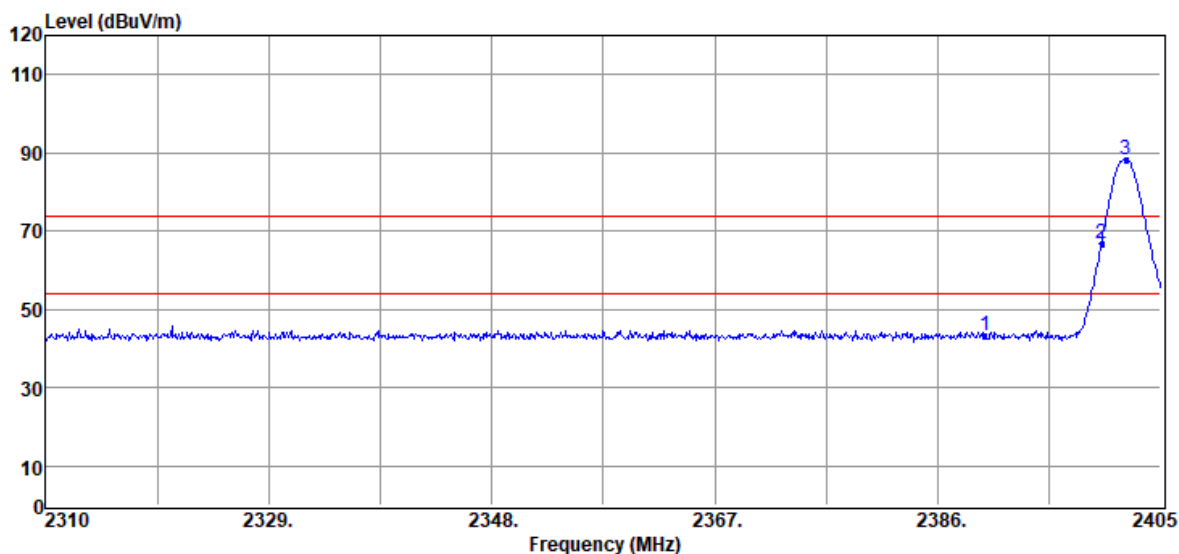


No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	2390.00	59.40	-15.84	43.56	74.00	-30.44	Peak	VERTICAL
2	2400.00	77.41	-15.86	61.55	63.53	-1.98	Peak	VERTICAL
3	2402.06	99.39	-15.86	83.53	F	---	Peak	VERTICAL

Remark:

- 1 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 2 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 3 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 4 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Note: “F” denotes fundamental frequency



No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	2390.00	58.98	-15.84	43.14	74.00	-30.86	Peak	HORIZONTAL
2	2400.00	82.50	-15.86	66.64	68.37	-1.73	Peak	HORIZONTAL
3	2402.06	104.23	-15.86	88.37	F	---	Peak	HORIZONTAL

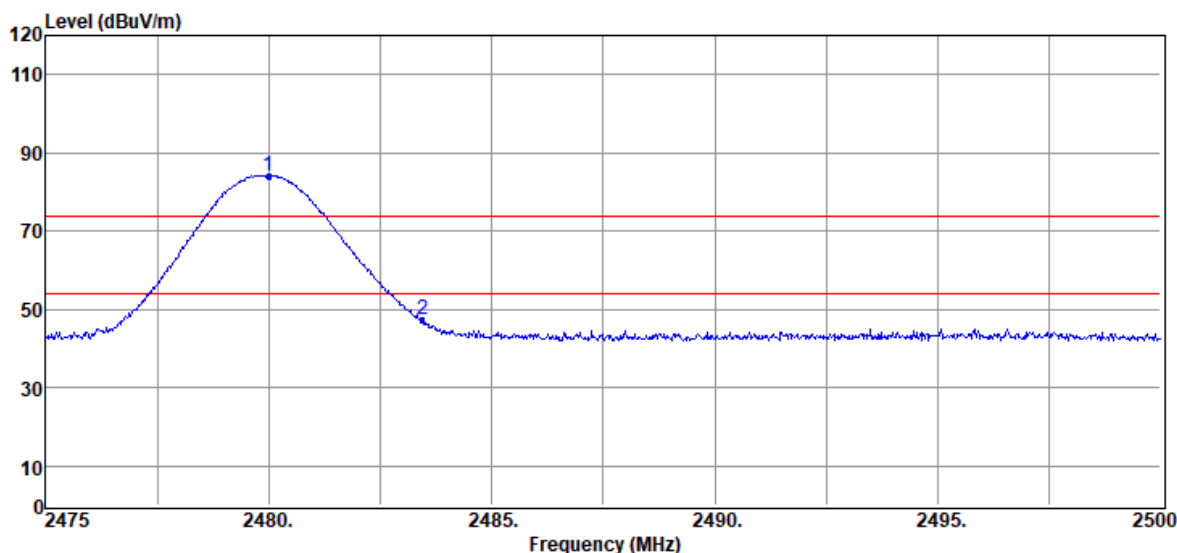
Remark:

- 1 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 2 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 3 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 4 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Note: “F” denotes fundamental frequency

Operation Mode TX CH High
Fundamental Frequency 2480 MHz
Temperature 25

Test Date 2019/11/19
Test By Bill
Humidity 60 %

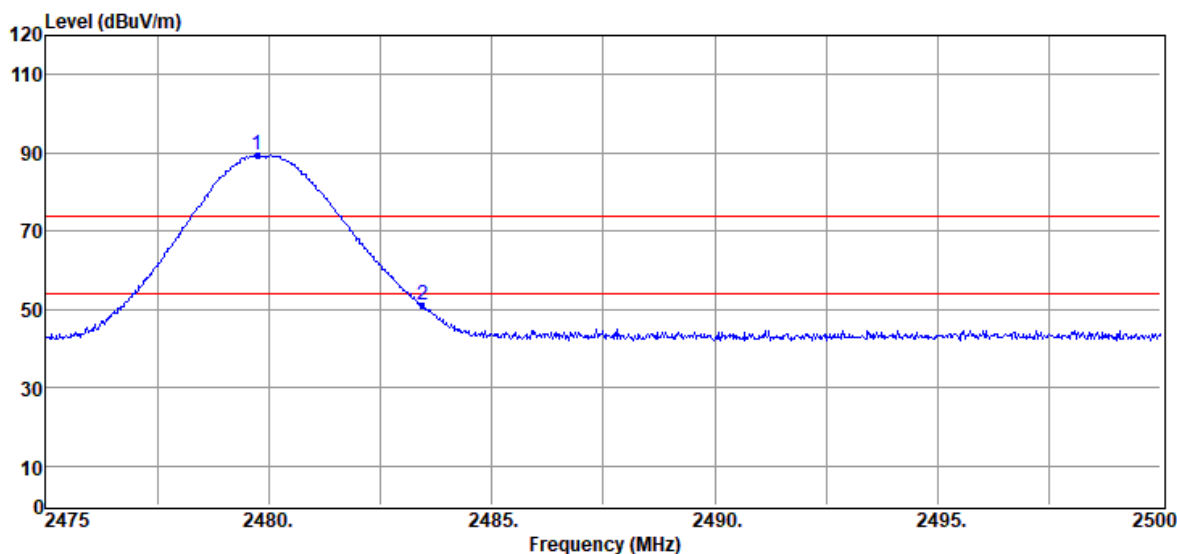


No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	2480.00	100.17	-15.84	84.33	F	---	Peak	VERTICAL
2	2483.45	63.28	-15.84	47.44	74.00	-26.56	Peak	VERTICAL

Remark:

- 1 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 2 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 3 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 4 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Note: “F” denotes fundamental frequency



No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	2479.75	105.22	-15.84	89.38	F	---	Peak	HORIZONTAL
2	2483.45	66.83	-15.84	50.99	74.00	-23.01	Peak	HORIZONTAL

Remark:

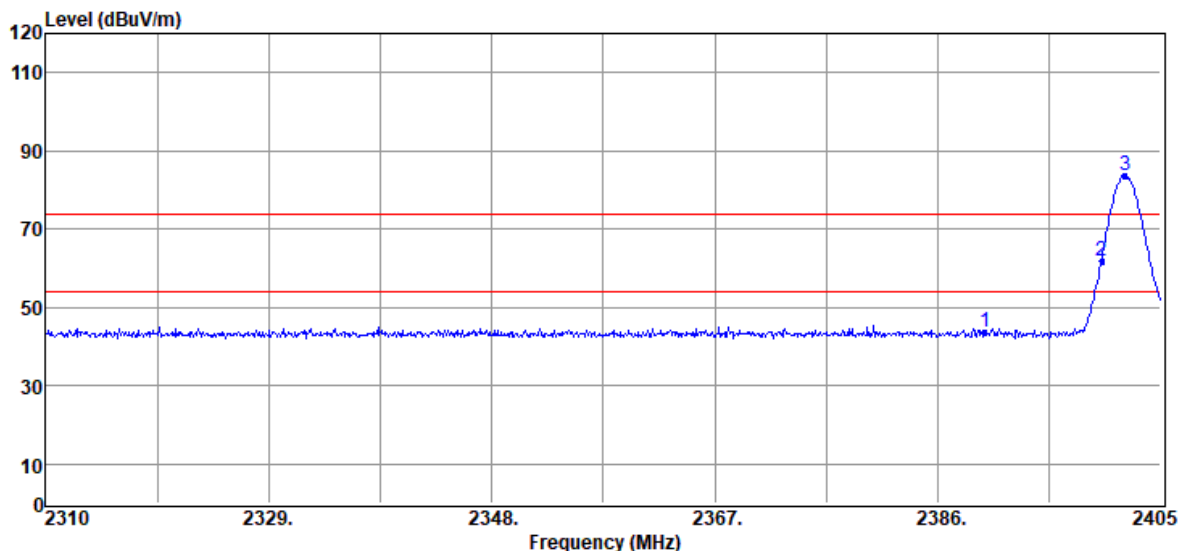
- 1 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 2 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 3 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 4 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Note: “F” denotes fundamental frequency

Radiated Emission (EDR 3M mode):

Operation Mode TX CH Low
Fundamental Frequency 2402 MHz
Temperature 25

Test Date 2019/11/19
Test By Bill
Humidity 60 %

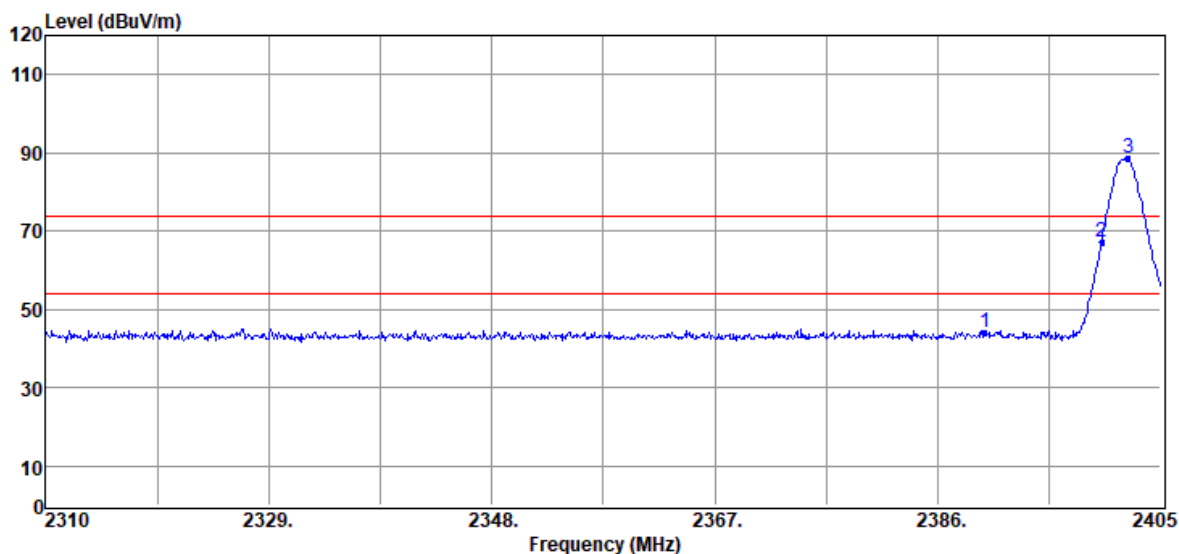


No	Freq MHz	Reading dBUV	Factor dB/m	Level dBUV/m	Limit dBUV/m	Margin dB	Remark	Pol V/H
1	2390.00	59.41	-15.84	43.57	74.00	-30.43	Peak	VERTICAL
2	2400.00	77.87	-15.86	62.01	63.57	-1.56	Peak	VERTICAL
3	2401.96	99.43	-15.86	83.57	F	---	Peak	VERTICAL

Remark:

- 1 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 2 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 3 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 4 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Note: “F” denotes fundamental frequency



No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	2390.00	59.78	-15.84	43.94	74.00	-30.06	Peak	HORIZONTAL
2	2400.00	82.89	-15.86	67.03	68.57	-1.54	Peak	HORIZONTAL
3	2402.25	104.43	-15.86	88.57	F	---	Peak	HORIZONTAL

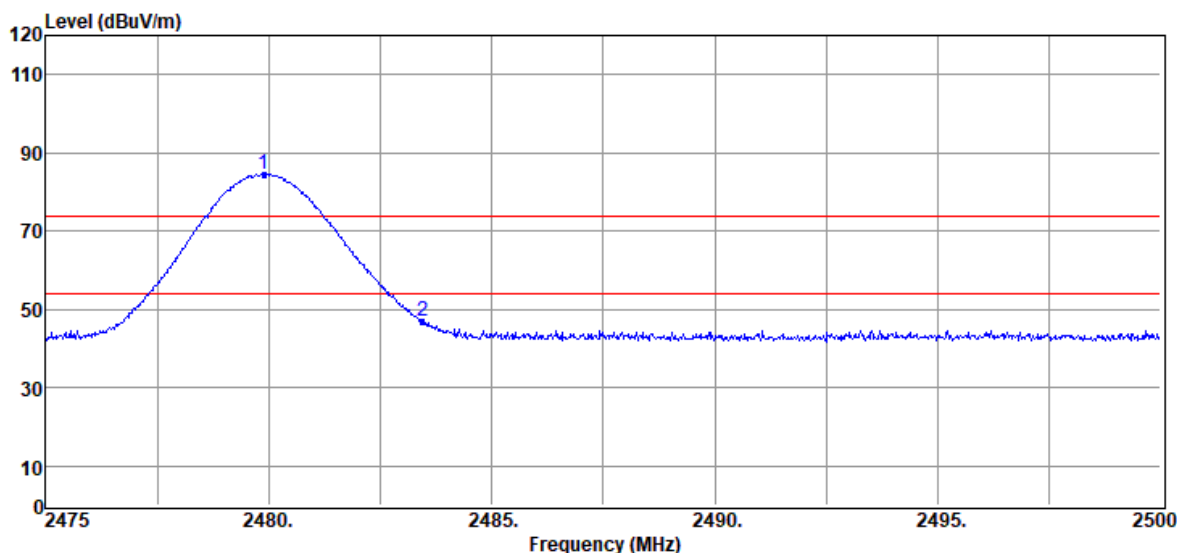
Remark:

- 1 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 2 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 3 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 4 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Note: “F” denotes fundamental frequency

Operation Mode TX CH High
Fundamental Frequency 2480 MHz
Temperature 25

Test Date 2019/11/19
Test By Bill
Humidity 60 %

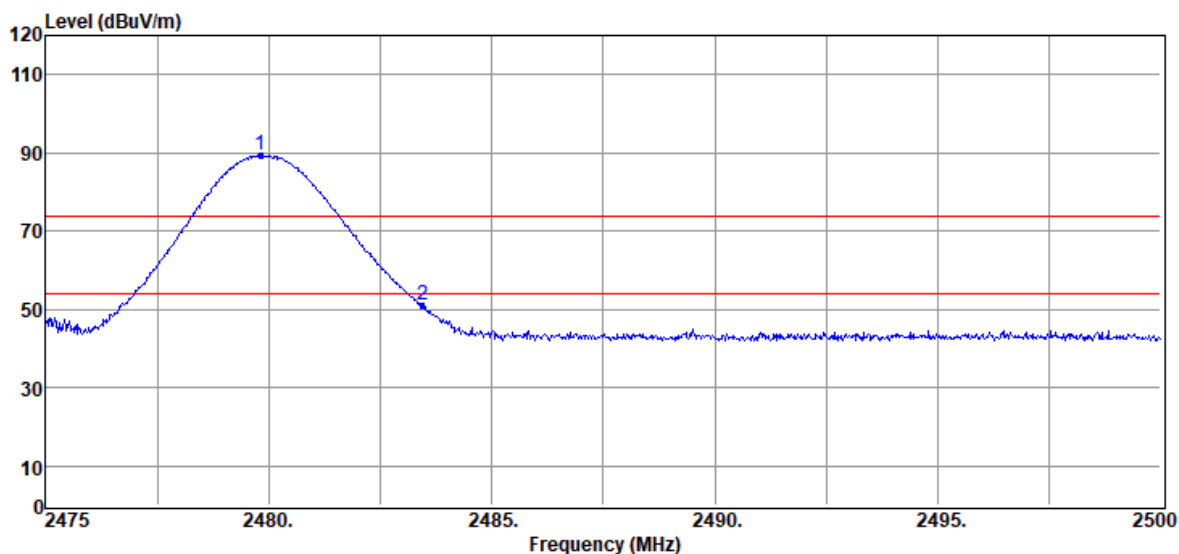


No	Freq MHz	Reading dBUV	Factor dB/m	Level dBUV/m	Limit dBUV/m	Margin dB	Remark	Pol V/H
1	2479.90	100.44	-15.84	84.60	F	---	Peak	VERTICAL
2	2483.45	62.71	-15.84	46.87	74.00	-27.13	Peak	VERTICAL

Remark:

- 1 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 2 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 3 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 4 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Note: “F” denotes fundamental frequency



No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	2479.83	105.48	-15.84	89.64	F	---	Peak	HORIZONTAL
2	2483.45	66.79	-15.84	50.95	74.00	-23.05	Peak	HORIZONTAL

Remark:

- 1 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 2 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 3 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 4 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

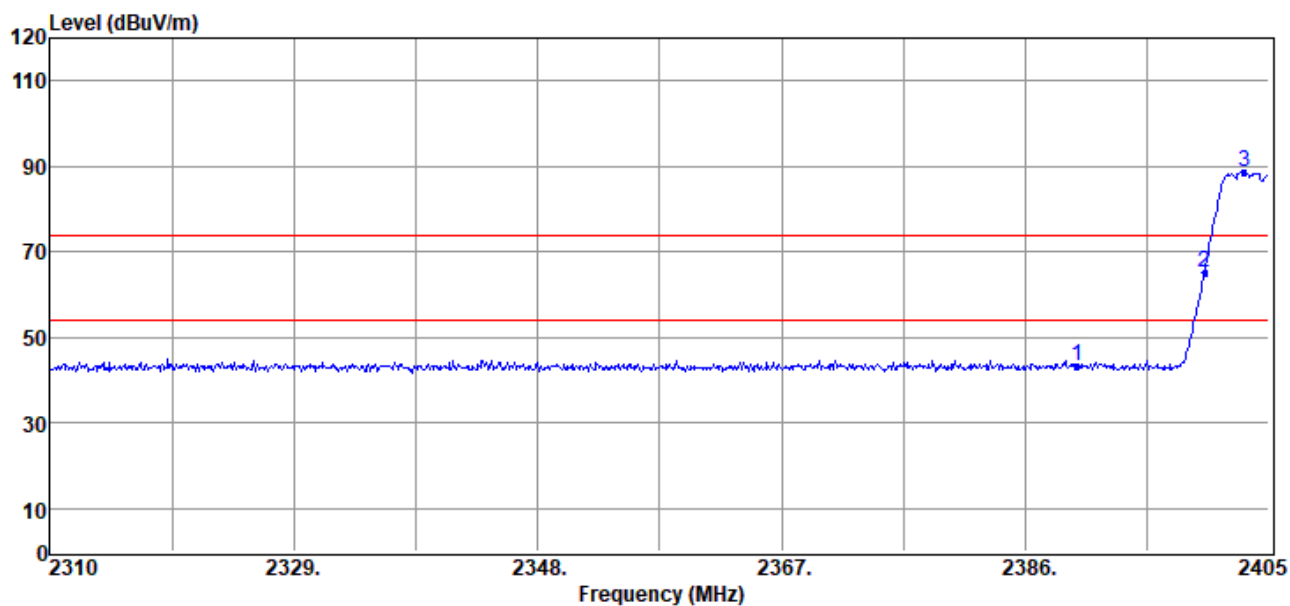
Note: “F” denotes fundamental frequency

Hopping mode:

Radiated Emission: (BDR mode)

Operation Mode TX CH Low
Fundamental Frequency 2402 MHz
Temperature 25

Test Date 2019/11/19
Test By Bill
Humidity 60 %

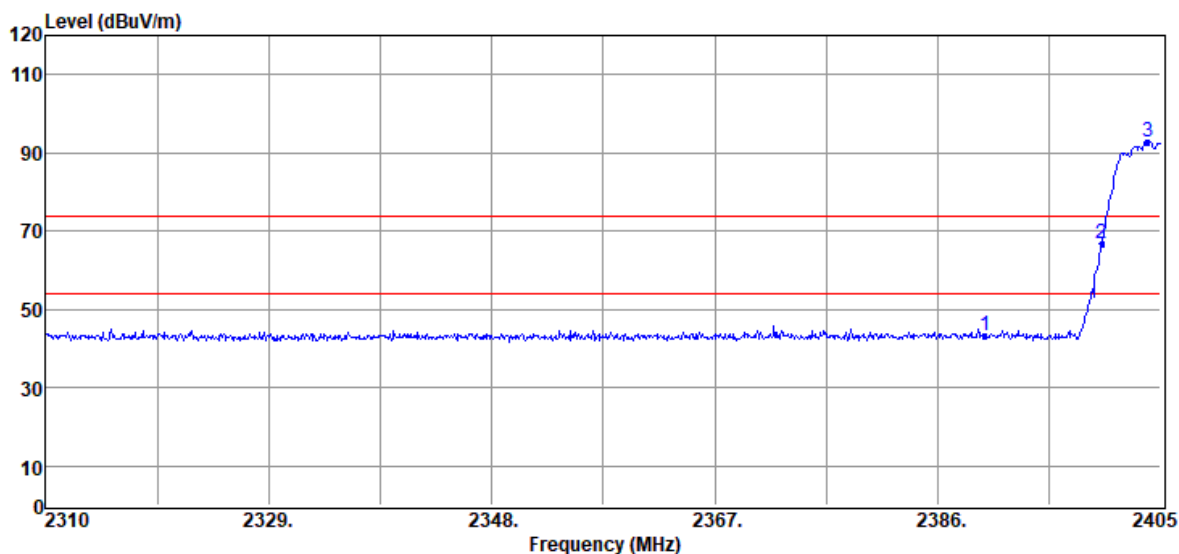


No	Freq MHz	Reading dBUV	Factor dB/m	Level dBUV/m	Limit dBUV/m	Margin dB	Remark	Pol V/H
1	2390.00	59.29	-15.84	43.45	74.00	-30.55	Peak	VERTICAL
2	2400.00	80.90	-15.86	65.04	68.77	-3.73	Peak	VERTICAL
3	2403.10	104.63	-15.86	88.77	F	--	Peak	VERTICAL

Remark:

- 1 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 2 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 3 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 4 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Note: “F” denotes fundamental frequency



No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	2390.00	59.08	-15.84	43.24	74.00	-30.76	Peak	HORIZONTAL
2	2400.00	82.53	-15.86	66.67	72.70	-6.03	Peak	HORIZONTAL
3	2403.86	108.56	-15.86	92.70	F	--	Peak	HORIZONTAL

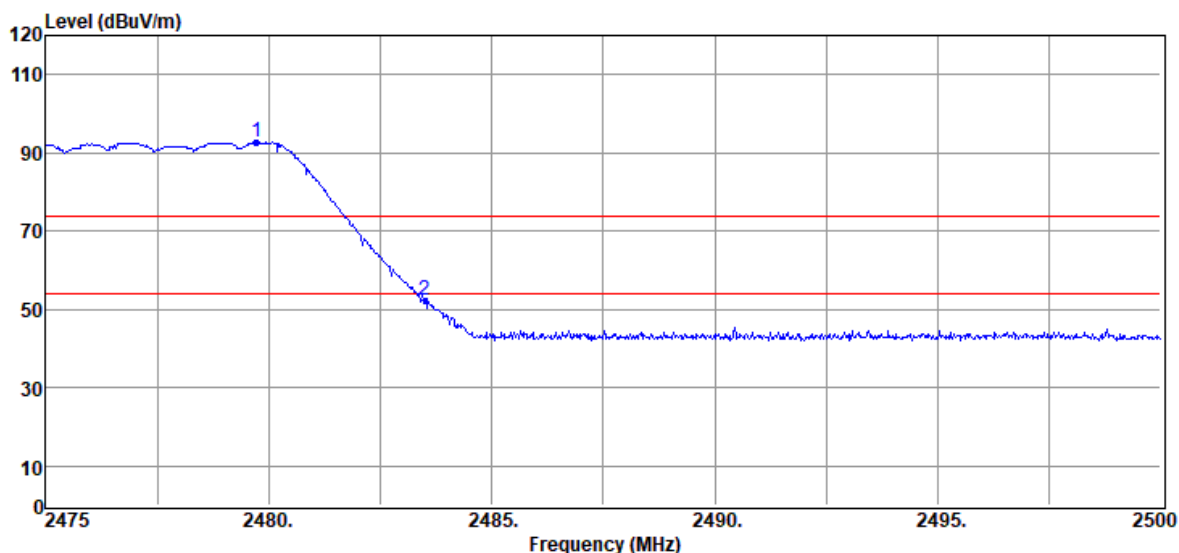
Remark:

- 1 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 2 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 3 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 4 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Note: “F” denotes fundamental frequency

Operation Mode TX CH High
Fundamental Frequency 2480 MHz
Temperature 25

Test Date 2019/11/19
Test By Bill
Humidity 60 %

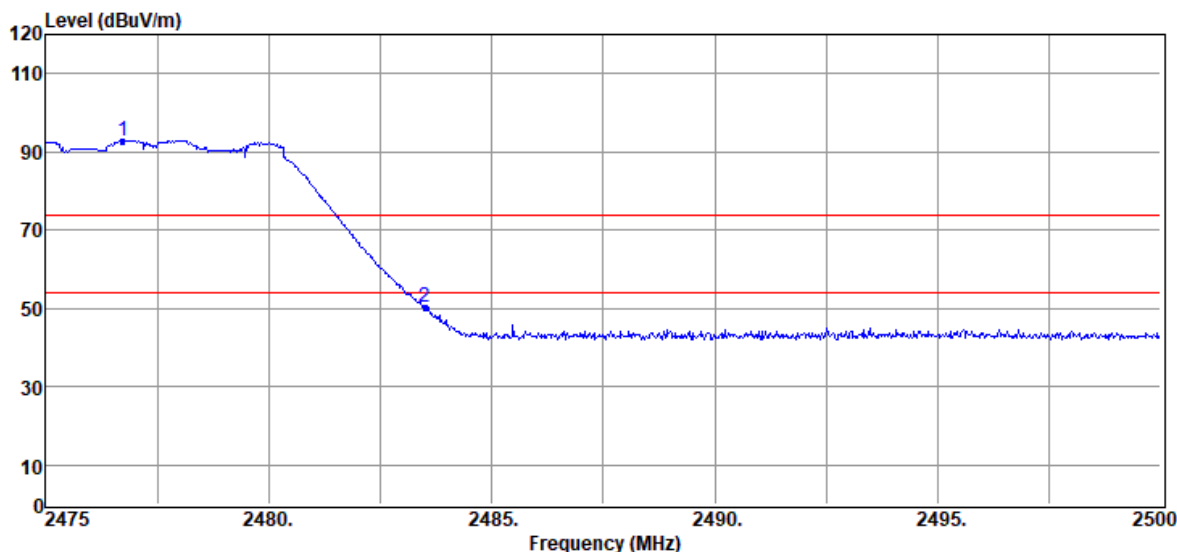


No	Freq MHz	Reading dBUV	Factor dB/m	Level dBUV/m	Limit dBUV/m	Margin dB	Remark	Pol V/H
1	2479.73	108.51	-15.84	92.67	F	--	Peak	VERTICAL
2	2483.50	68.34	-15.84	52.50	74.00	-21.50	Peak	VERTICAL

Remark:

- 1 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 2 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 3 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 4 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Note: “F” denotes fundamental frequency



No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	2476.73	108.63	-15.84	92.79	F	--	Peak	HORIZONTAL
2	2483.50	66.16	-15.84	50.32	74.00	-23.68	Peak	HORIZONTAL

Remark:

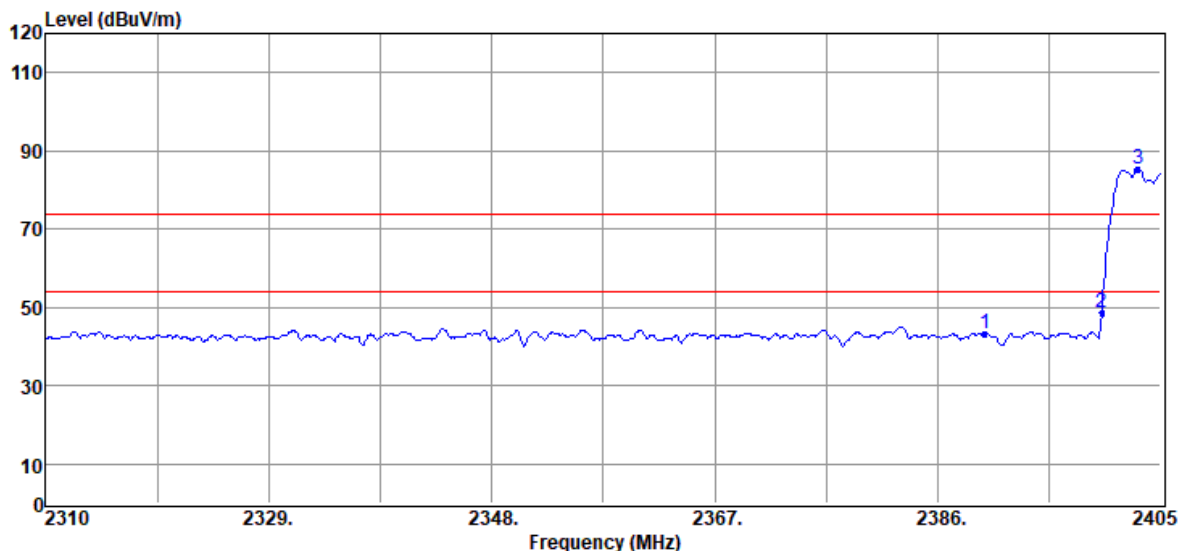
- 1 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 2 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 3 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 4 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Note: “F” denotes fundamental frequency

Radiated Emission (EDR 2M mode):

Operation Mode TX CH Low
Fundamental Frequency 2402 MHz
Temperature 25

Test Date 2019/11/19
Test By Bill
Humidity 60 %

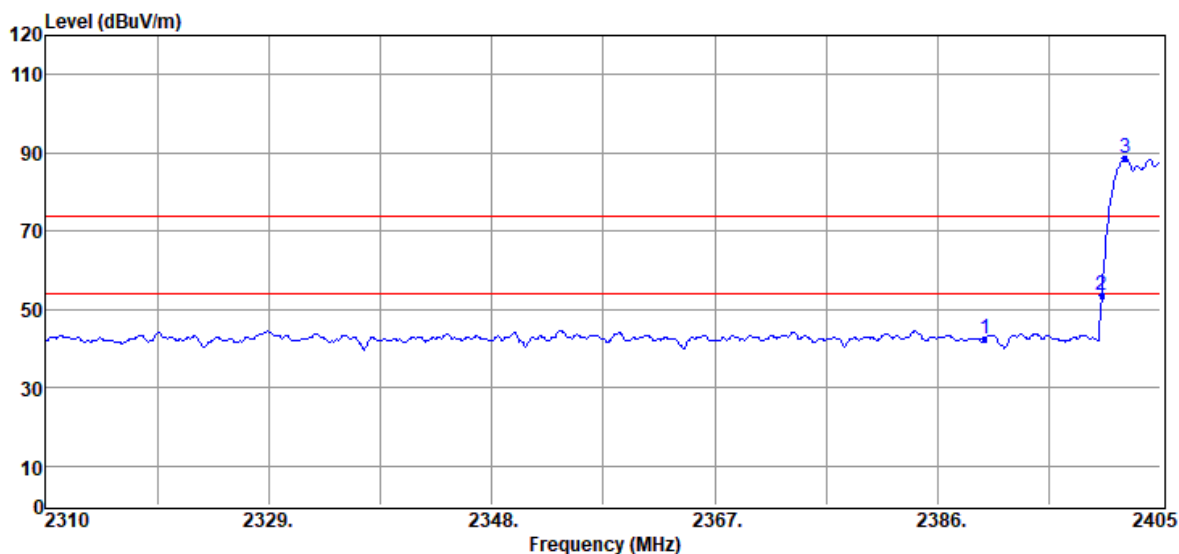


No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	2390.00	58.96	-15.84	43.12	74.00	-30.88	Peak	VERTICAL
2	2400.00	64.60	-15.86	48.74	65.42	-16.68	Peak	VERTICAL
3	2403.10	101.28	-15.86	85.42	F	--	Peak	VERTICAL

Remark:

- 1 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 2 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 3 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 4 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Note: “F” denotes fundamental frequency



No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	2390.00	58.32	-15.84	42.48	74.00	-31.52	Peak	HORIZONTAL
2	2400.00	69.44	-15.86	53.58	68.69	-15.11	Peak	HORIZONTAL
3	2401.96	104.55	-15.86	88.69	F	--	Peak	HORIZONTAL

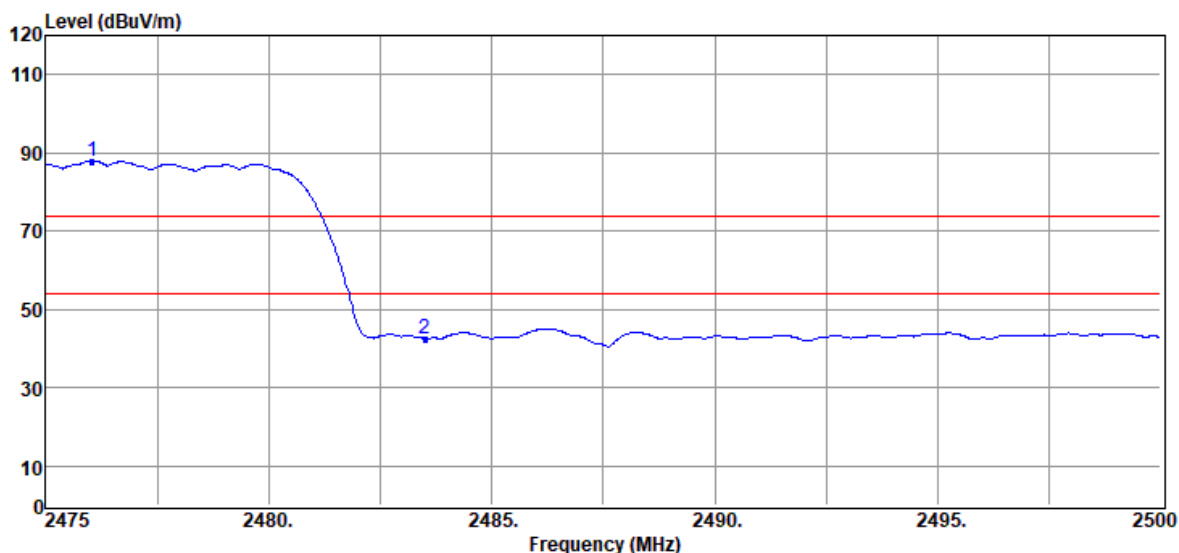
Remark:

- 1 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 2 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 3 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 4 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Note: “F” denotes fundamental frequency

Operation Mode TX CH High
Fundamental Frequency 2480 MHz
Temperature 25

Test Date 2019/11/19
Test By Bill
Humidity 60 %

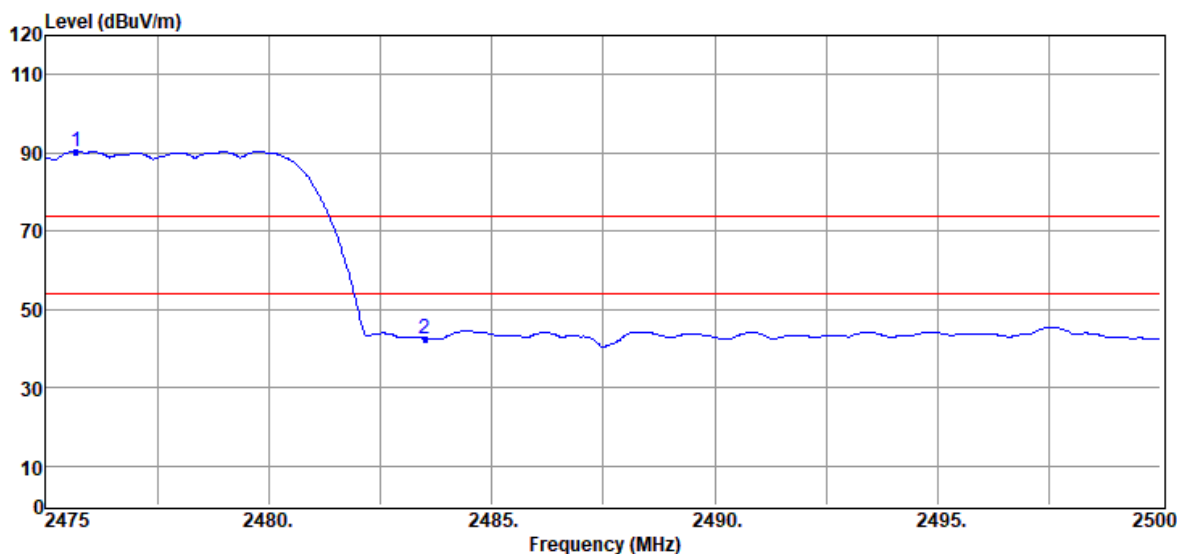


No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	2476.05	103.78	-15.84	87.94	F	--	Peak	VERTICAL
2	2483.50	58.42	-15.84	42.58	74.00	-31.42	Peak	VERTICAL

Remark:

- 1 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 2 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 3 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 4 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Note: “F” denotes fundamental frequency



No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	2475.68	106.22	-15.84	90.38	F	--	Peak	HORIZONTAL
2	2483.50	58.46	-15.84	42.62	74.00	-31.38	Peak	HORIZONTAL

Remark:

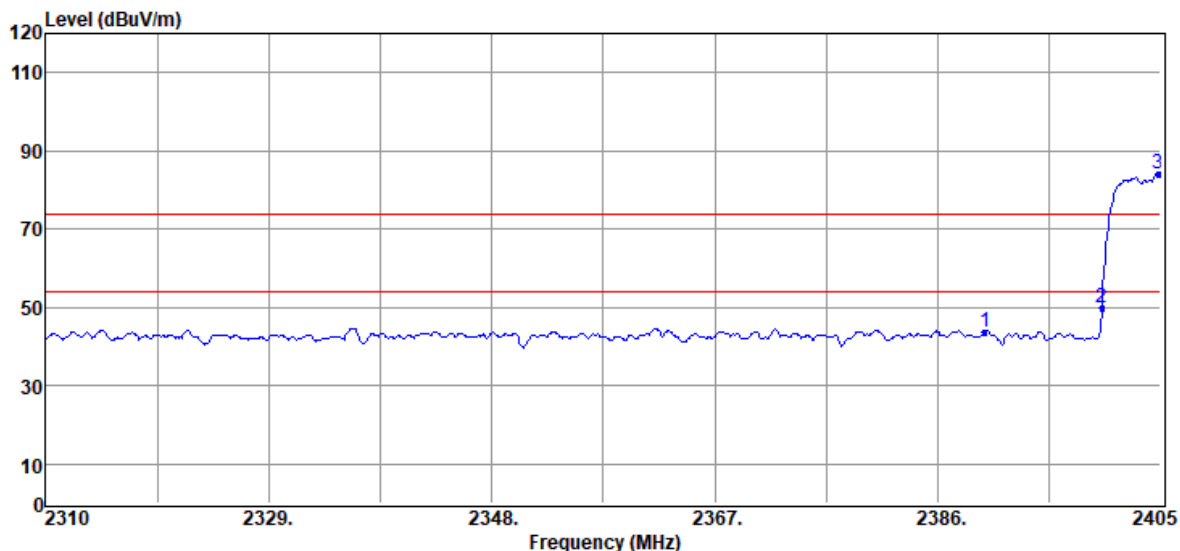
- 1 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 2 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 3 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 4 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Note: “F” denotes fundamental frequency

Radiated Emission (EDR 3M mode):

Operation Mode TX CH Low
Fundamental Frequency 2402 MHz
Temperature 25

Test Date 2019/11/19
Test By Bill
Humidity 60 %

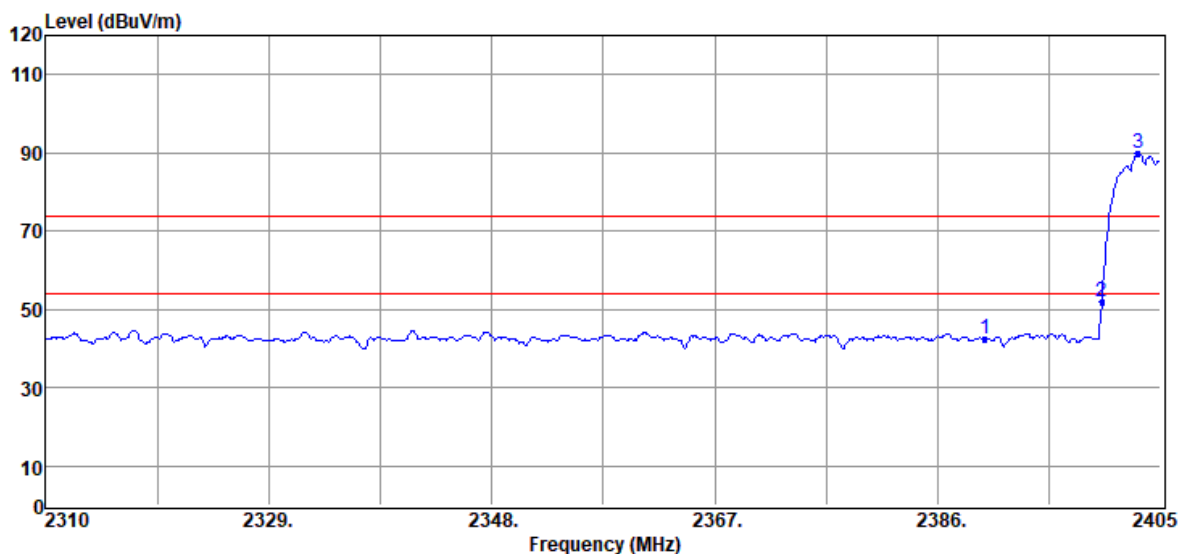


No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	2390.00	59.72	-15.84	43.88	74.00	-30.12	Peak	VERTICAL
2	2400.00	65.88	-15.86	50.02	64.08	-14.06	Peak	VERTICAL
3	2404.81	99.94	-15.86	84.08	F	--	Peak	VERTICAL

Remark:

- 1 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 2 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 3 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 4 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Note: “F” denotes fundamental frequency



No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	2390.00	58.14	-15.84	42.30	74.00	-31.70	Peak	HORIZONTAL
2	2400.00	67.88	-15.86	52.02	69.87	-17.85	Peak	HORIZONTAL
3	2403.10	105.73	-15.86	89.87	F	--	Peak	HORIZONTAL

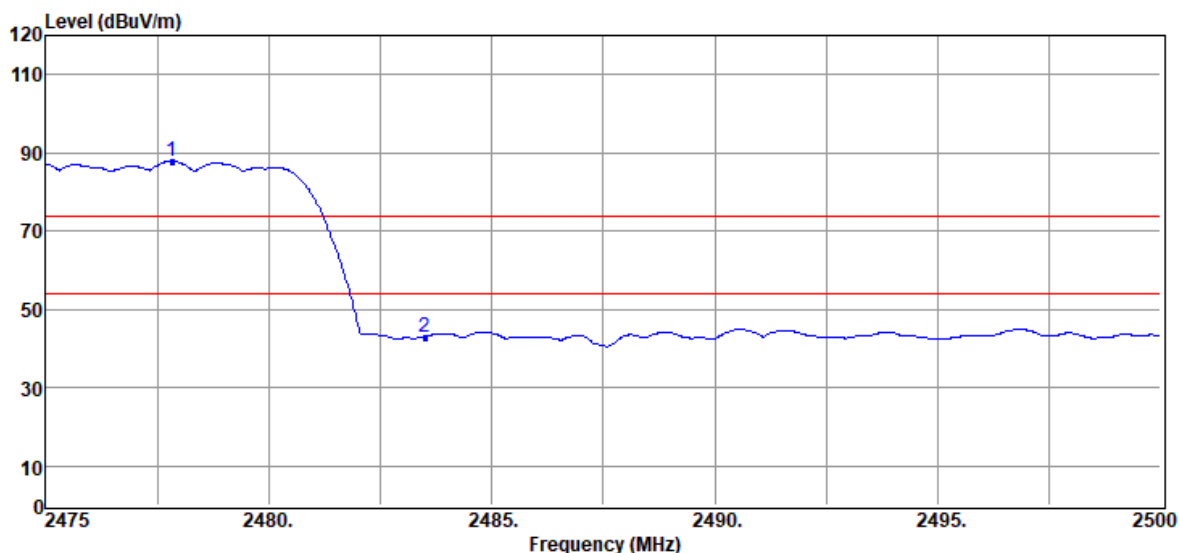
Remark:

- 1 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 2 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 3 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 4 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Note: “F” denotes fundamental frequency

Operation Mode TX CH High
Fundamental Frequency 2480 MHz
Temperature 25

Test Date 2019/11/19
Test By Bill
Humidity 60 %

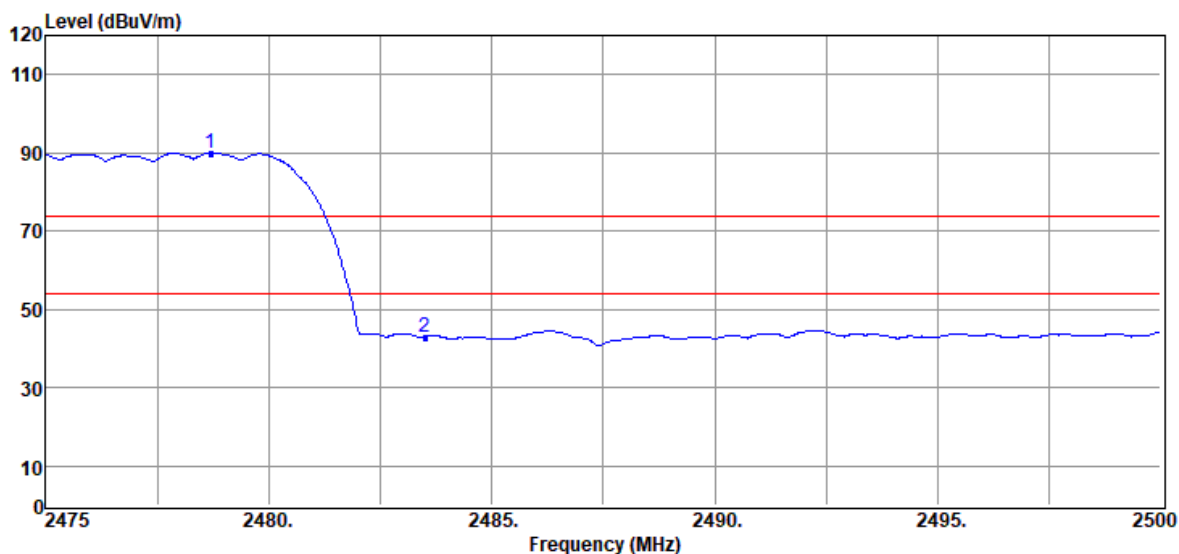


No	Freq MHz	Reading dBUV	Factor dB/m	Level dBUV/m	Limit dBUV/m	Margin dB	Remark	Pol V/H
1	2477.83	103.70	-15.84	87.86	F	--	Peak	VERTICAL
2	2483.50	58.85	-15.84	43.01	74.00	-30.99	Peak	VERTICAL

Remark:

- 1 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 2 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 3 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 4 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Note: “F” denotes fundamental frequency



No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	2478.70	105.78	-15.84	89.94	F	--	Peak	HORIZONTAL
2	2483.50	58.83	-15.84	42.99	74.00	-31.01	Peak	HORIZONTAL

Remark:

- 1 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 2 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 3 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 4 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

Note: “F” denotes fundamental frequency

9. FREQUENCY SEPARATION

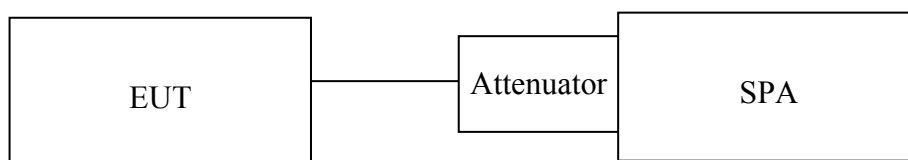
9.1 Standard Applicable:

According to §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater.

9.2 Measurement Equipment Used:

Refer to section 6.2 for details.

9.3 Test Set-up:



9.4 Measurement Procedure:

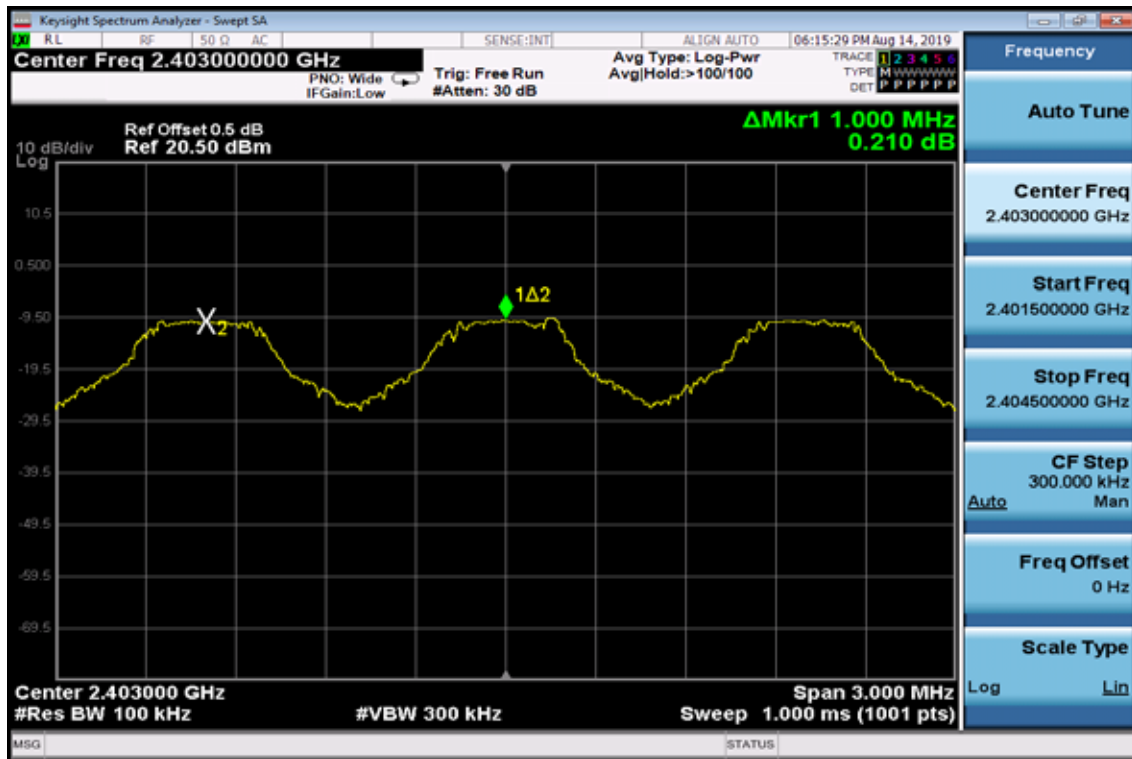
1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = middle of hopping channel .
4. Set the spectrum analyzer as RBW,VBW=100kHz, Adjust Span to 3.0 MHz, Sweep = auto.
5. Max hold. Mark 3 Peaks of hopping channel and record the 3 peaks frequency.

9.5 Measurement Result:

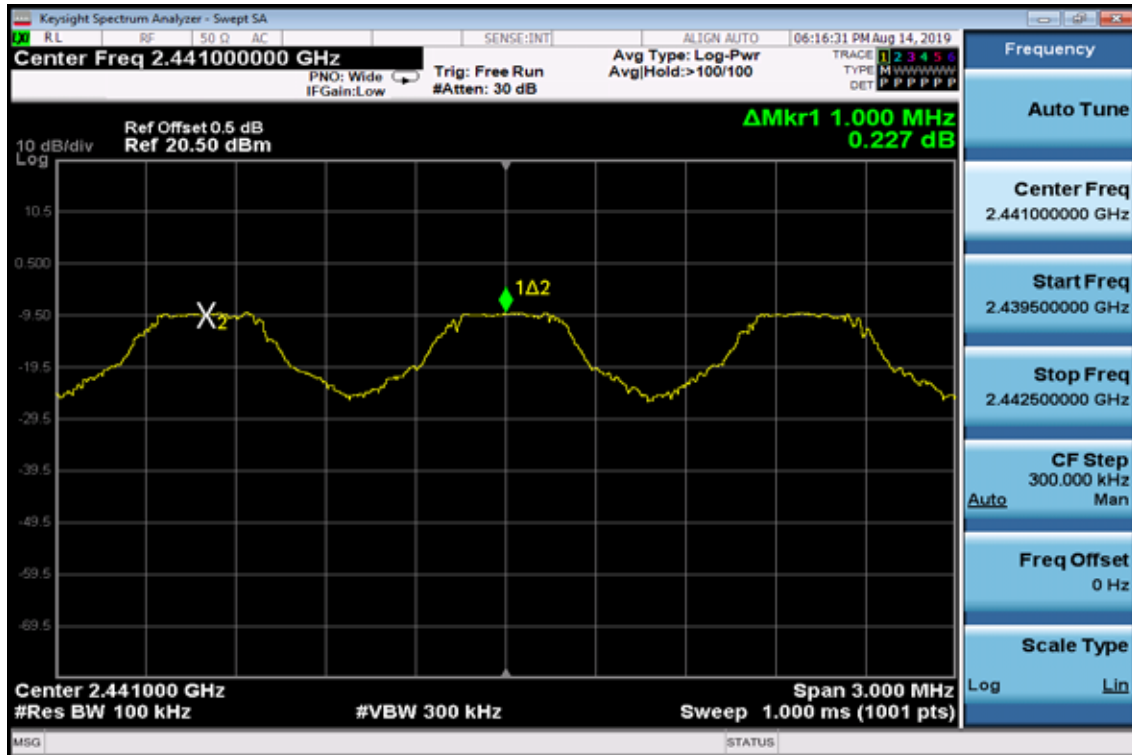
Channel separation (MHz)	Limit	Result
1	25kHz or 2/3 times 20dB bandwidth	PASS

Note: Refer to next page for plots.

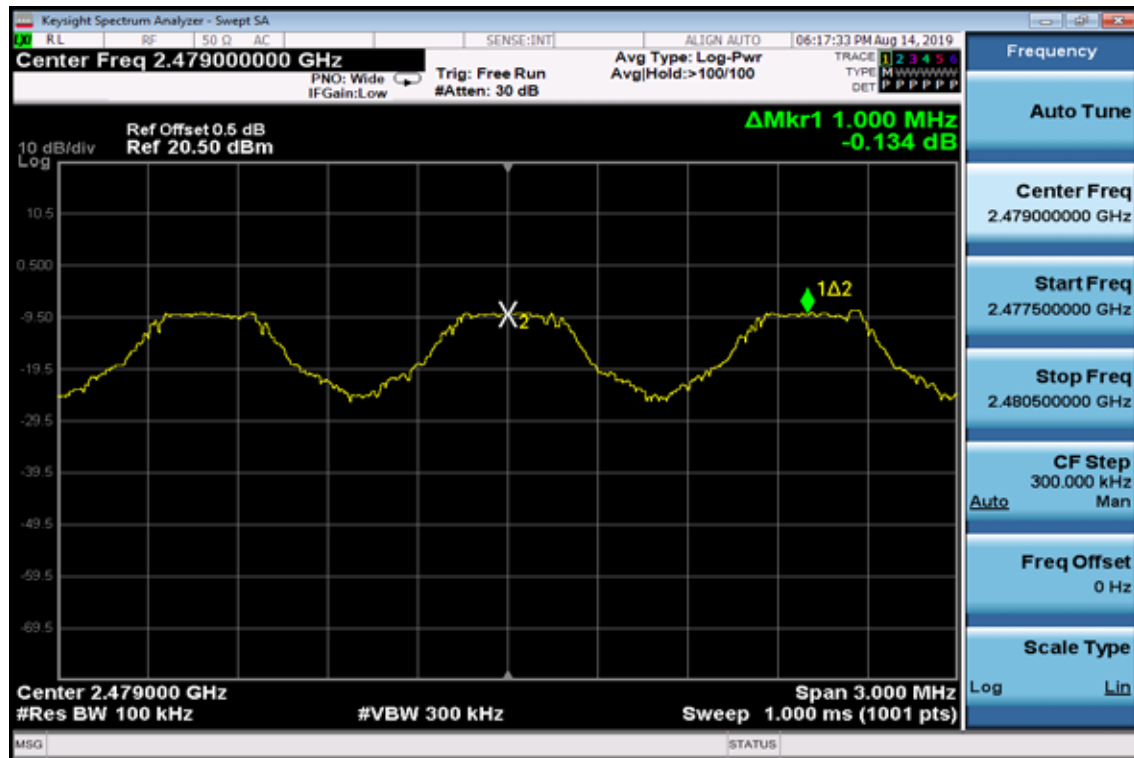
Frequency Separation Test Data Low



Mid



High



10. Number of Hopping Frequency

10.1 Standard Applicable:

According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz bands shall use at least 15 hopping frequencies.

10.2 Measurement Equipment Used:

Refer to section 6.2 for details.

10.3 Test Set-up:

Refer to section 9.3 for details.

10.4 Measurement Procedure:

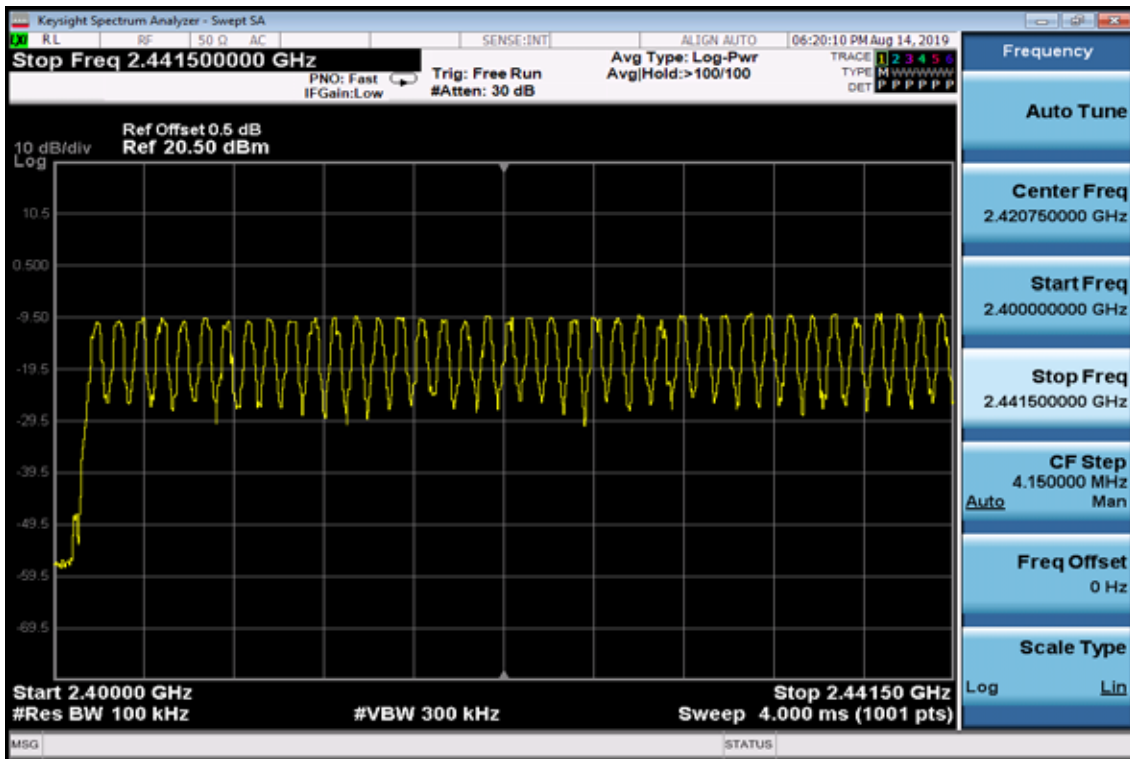
1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set spectrum analyzer Start=2400MHz, Stop = 2441.5MHz and Start=2441.5MHz, Stop = 2483.5MHz, Sweep = auto.
4. Set the spectrum analyzer as RBW=100kHz, VBW=300kHz
5. Max hold, view and count how many channel in the band.

10.5 Measurement Result:

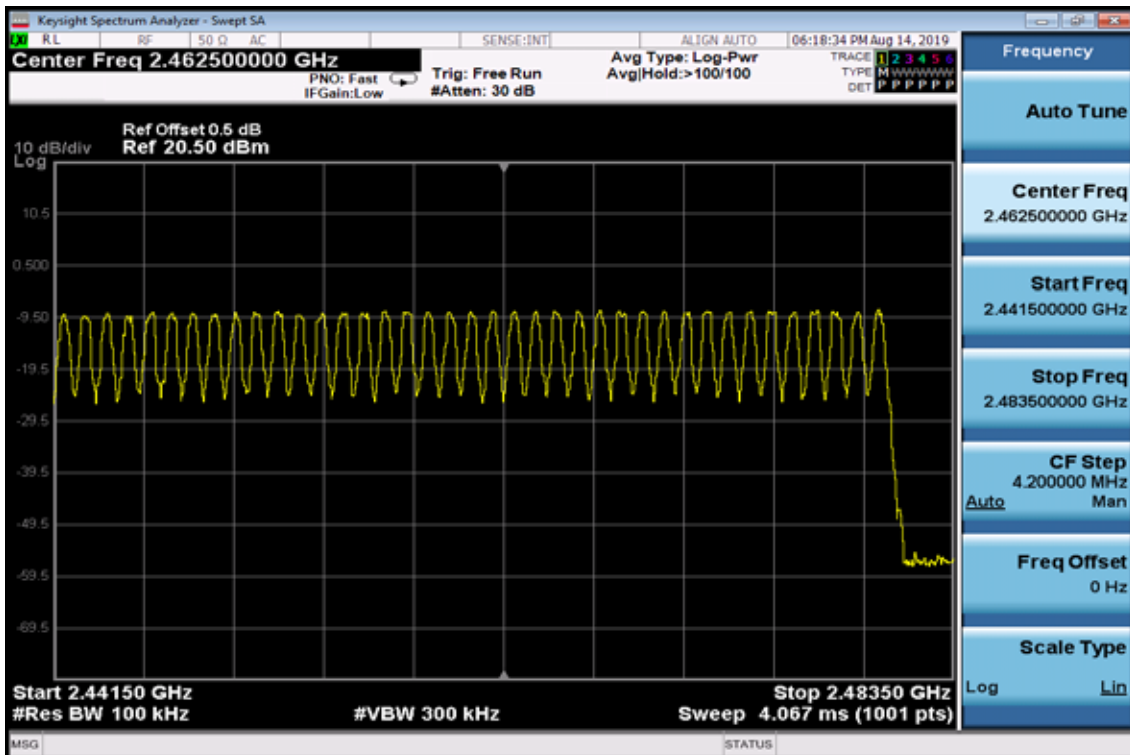
Note: Refer to next page for plots.

Channel Number

2.4 GHz – 2.441.5GHz



2.441.5 GHz – 2.4835GHz



11. Time of Occupancy (Dwell Time)

11.1 Standard Applicable:

According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz. The average time of occupancy on any frequency shall not greater than 0.4 s within period of 0.4 seconds multiplied by the number of hopping channel employed.

11.2 Measurement Equipment Used:

Refer to section 6.2 for details.

11.3 Test Set-up:

Refer to section 9.3 for details.

11.4 Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW / VBW = 1MHz, Span = 0Hz ,
5. Repeat above procedures until all frequency measured were complete.

11.5 Measurement Result:

A period time = 0.4 (ms) * 79 = 31.6 (s)

CH Low	DH1 time slot	=	0.384 (ms)	*	(1600/2/79)	*	31.6 =	122.88	(ms)
	DH3 time slot	=	1.630 (ms)	*	(1600/4/79)	*	31.6 =	260.80	(ms)
	DH5 time slot	=	2.840 (ms)	*	(1600/6/79)	*	31.6 =	302.93	(ms)

CH Mid	DH1 time slot	=	0.376 (ms)	*	(1600/2/79)	*	31.6 =	120.32	(ms)
	DH3 time slot	=	1.640 (ms)	*	(1600/4/79)	*	31.6 =	262.40	(ms)
	DH5 time slot	=	2.840 (ms)	*	(1600/6/79)	*	31.6 =	302.93	(ms)

CH High	DH1 time slot	=	0.376 (ms)	*	(1600/2/79)	*	31.6 =	120.32	(ms)
	DH3 time slot	=	1.630 (ms)	*	(1600/4/79)	*	31.6 =	260.80	(ms)
	DH5 time slot	=	2.880 (ms)	*	(1600/6/79)	*	31.6 =	307.20	(ms)

AFH Mode

A period time = 0.4 (ms) * 20 = 8 (s)

CH Low	DH1 time slot	=	0.384 (ms)	*	(800/2/20)	*	8 =	61.44	(ms)
	DH3 time slot	=	1.630 (ms)	*	(800/4/20)	*	8 =	130.40	(ms)
	DH5 time slot	=	2.840 (ms)	*	(800/6/20)	*	8 =	151.47	(ms)

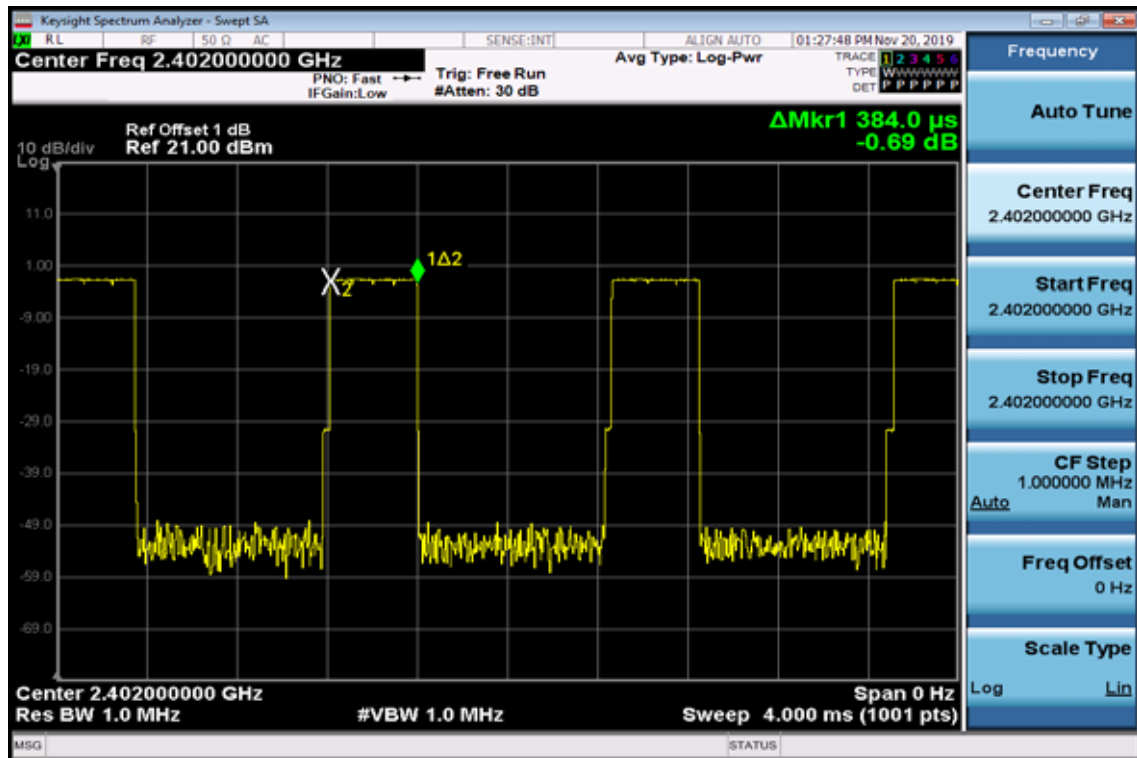
CH Mid	DH1 time slot	=	0.376 (ms)	*	(800/2/20)	*	8 =	60.16	(ms)
	DH3 time slot	=	1.640 (ms)	*	(800/4/20)	*	8 =	131.20	(ms)
	DH5 time slot	=	2.840 (ms)	*	(800/6/20)	*	8 =	151.47	(ms)

CH High	DH1 time slot	=	0.376 (ms)	*	(800/2/20)	*	8 =	60.16	(ms)
	DH3 time slot	=	1.630 (ms)	*	(800/4/20)	*	8 =	130.40	(ms)
	DH5 time slot	=	2.880 (ms)	*	(800/6/20)	*	8 =	153.60	(ms)

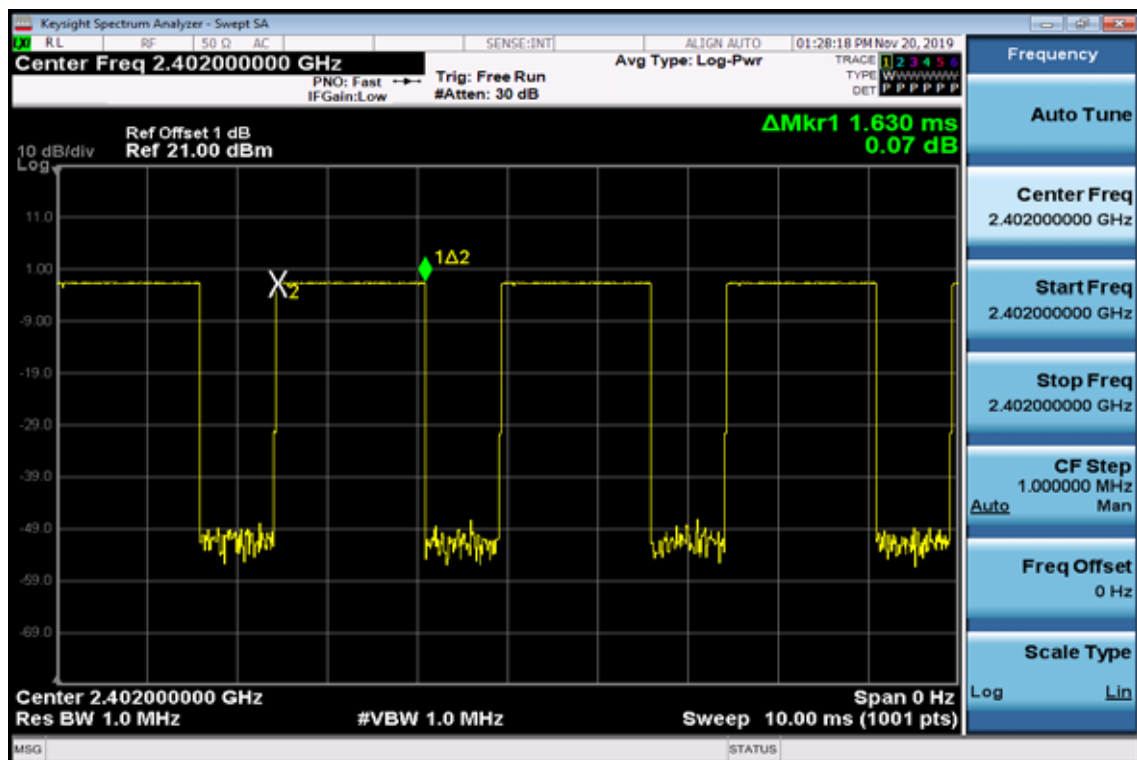
Note: Refer to next page for plots.

Low Channel

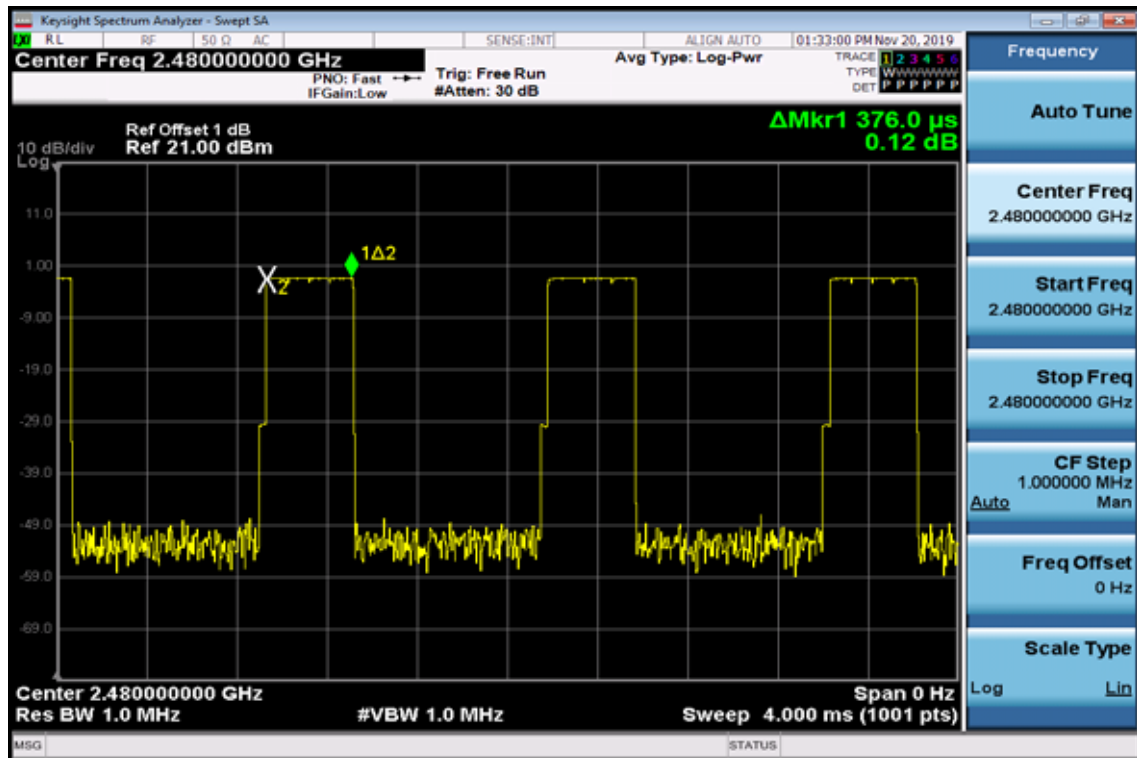
DH1



DH3

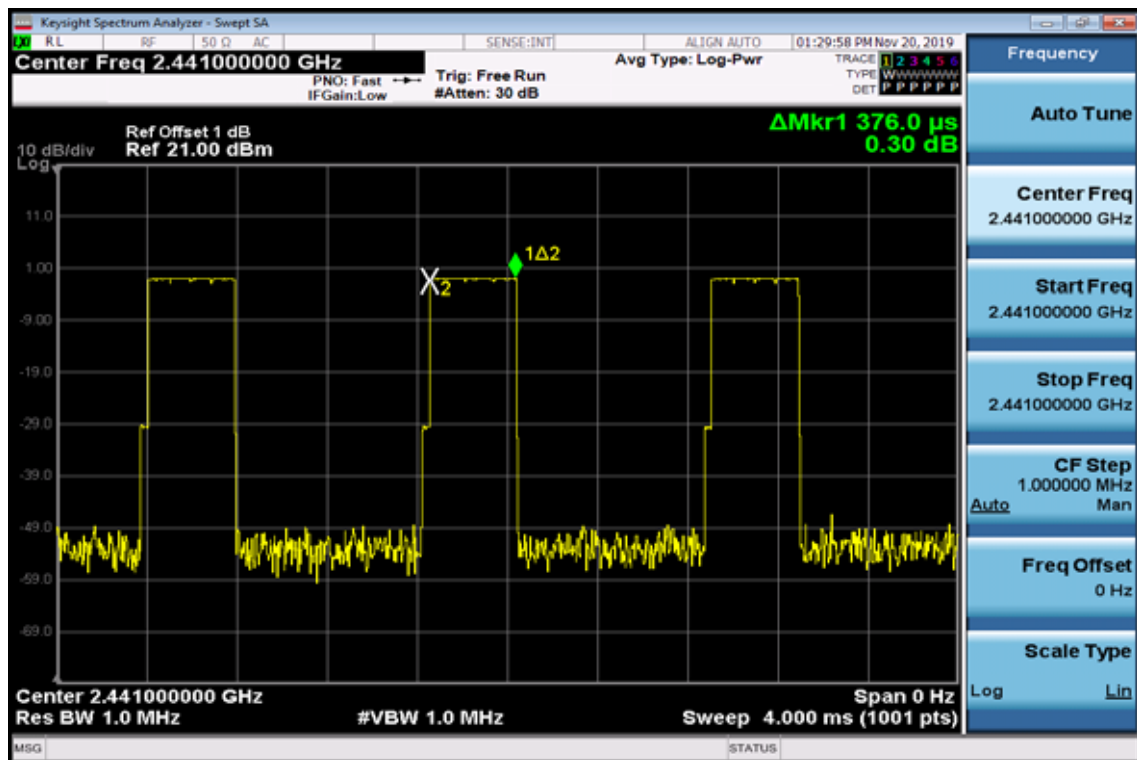


DH5

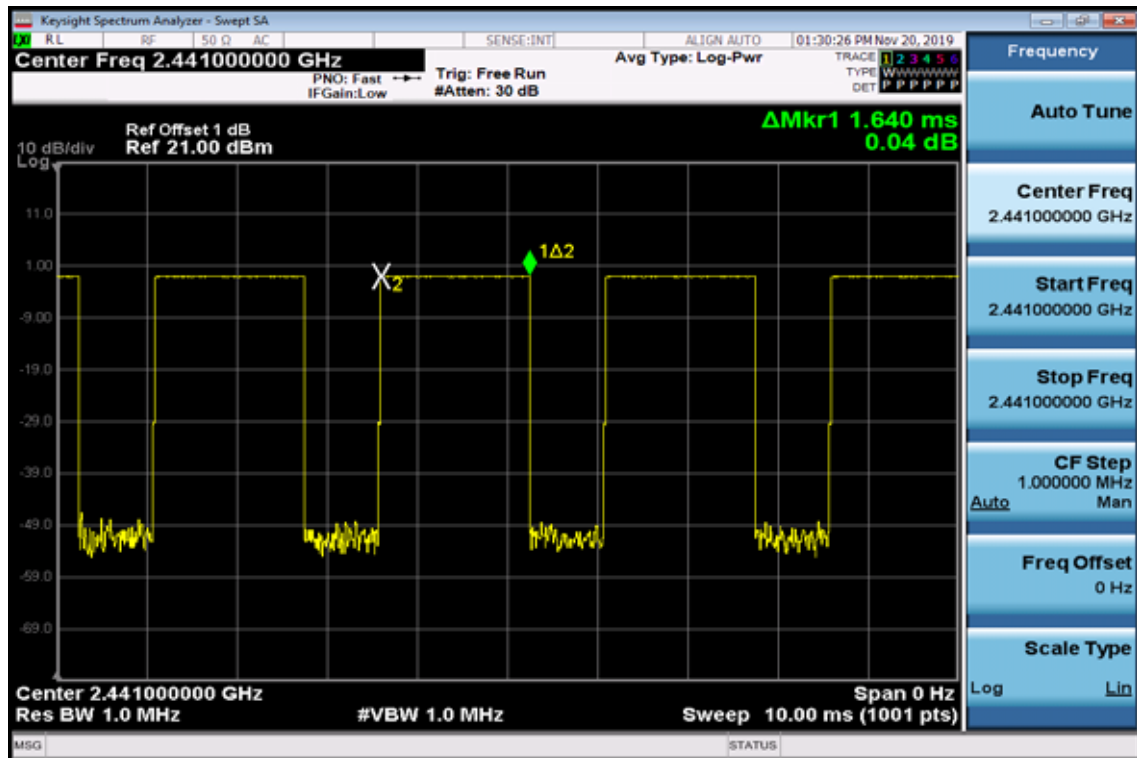


Mid Channel

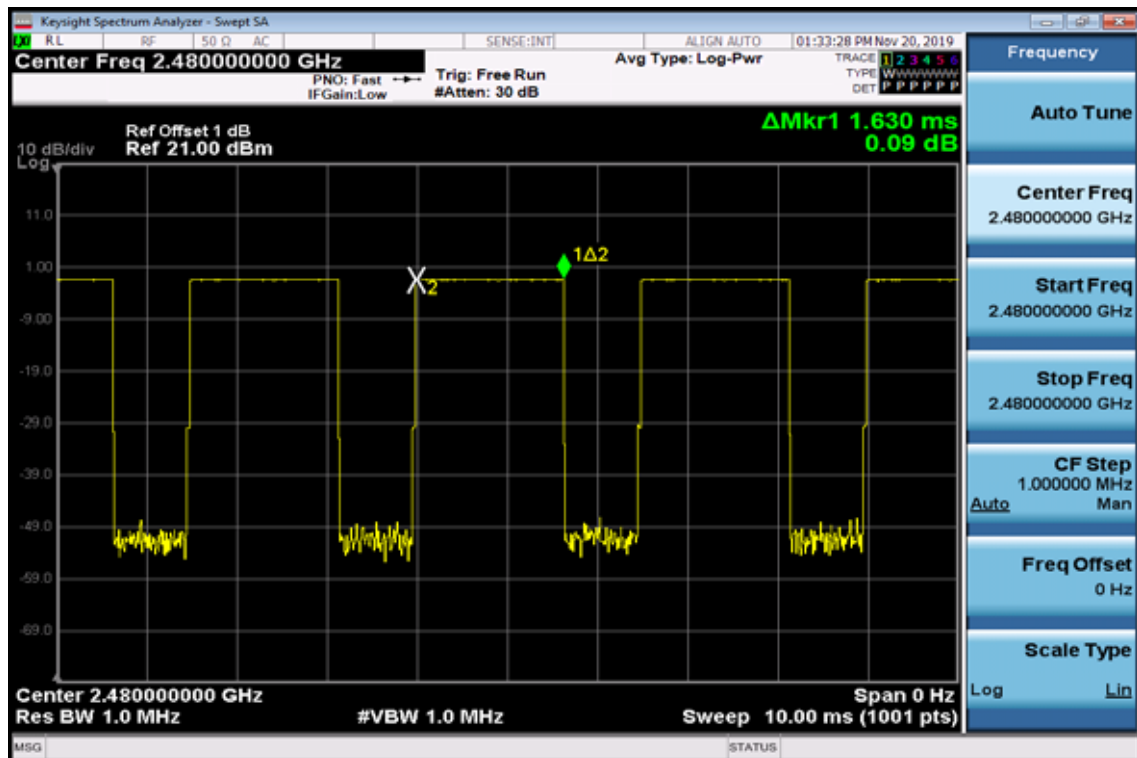
DH1



DH3

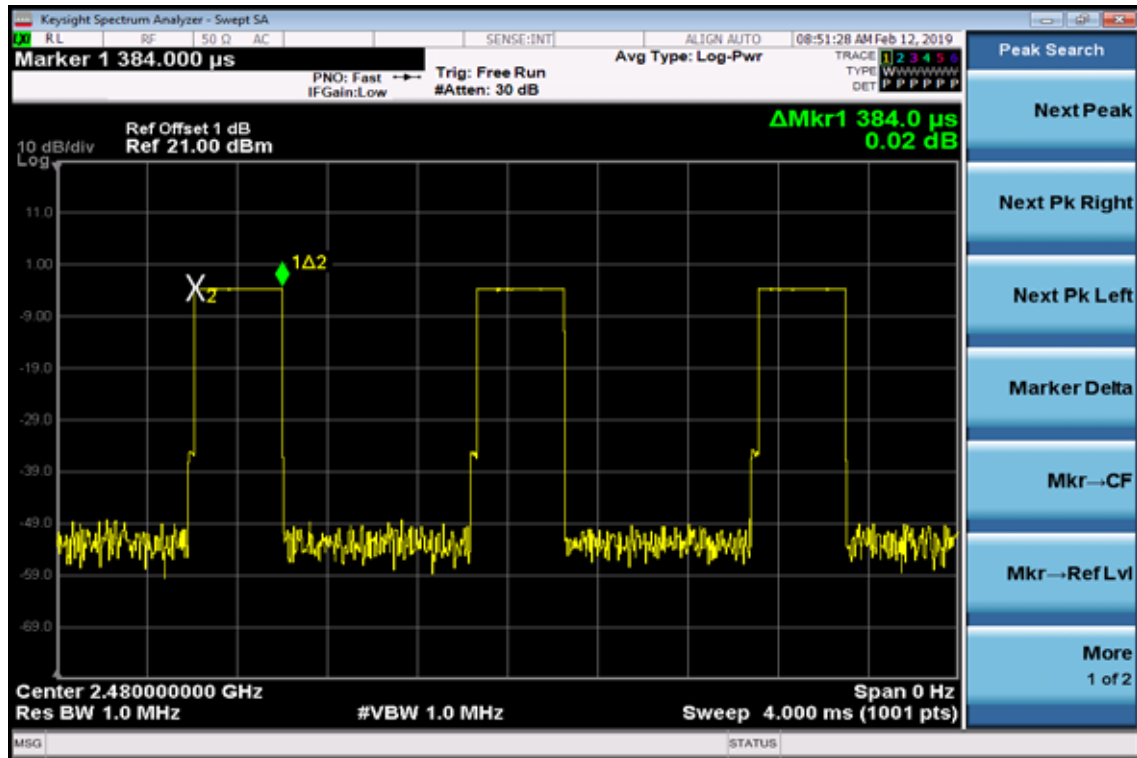


DH5

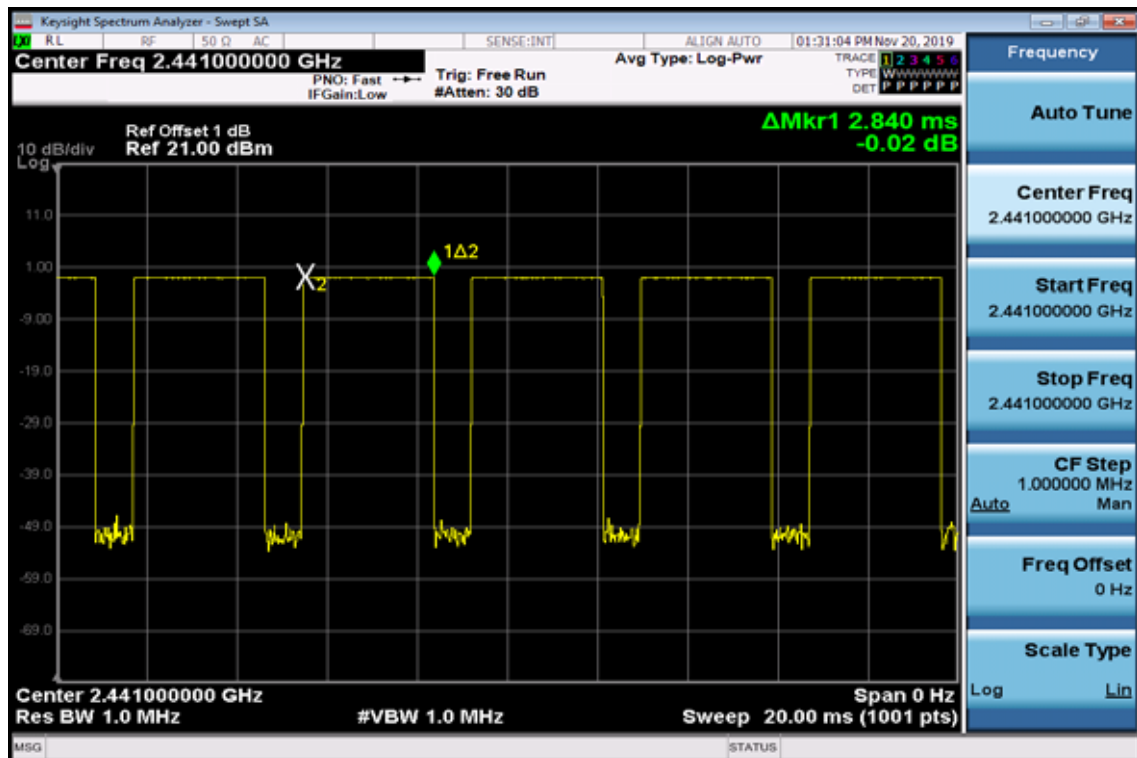


High Channel

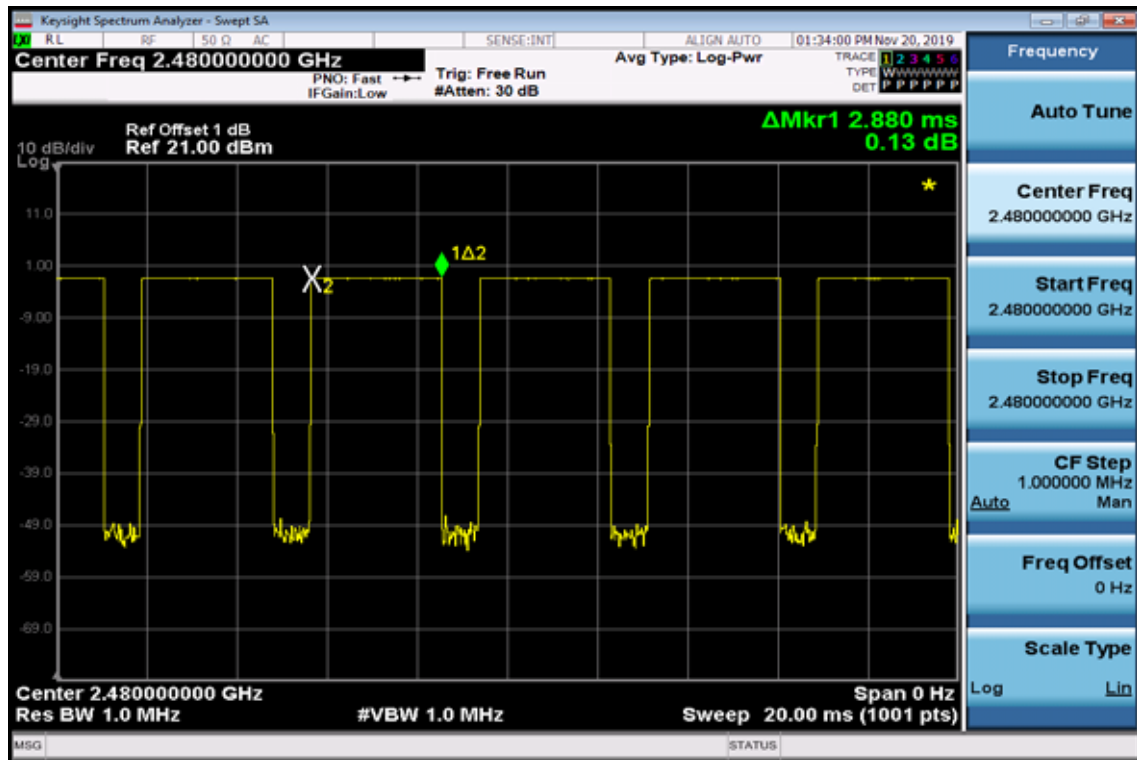
DH1



DH3



DH5



12. 20dB Bandwidth

12.1 Standard Applicable:

According to §15.247(a)(1),and RSS210 A8.1(b) for frequency hopping systems operating in the 2400MHz-2483.5 MHz no limit for 20dB bandwidth.

12.2 Measurement Equipment Used:

Refer to section 6.2 for details.

12.3 Test Set-up:

Refer to section 9.3 for details.

12.4 Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW= 1 % - 5% of Bandwidth., Span= 3MHz, Sweep=auto
4. Mark the peak frequency and -20dB (upper and lower) frequency.
5. Repeat above procedures until all frequency measured were complete.

12.5 Measurement Result:

BDR Mode

CH	20dB Bandwidth (MHz)
Low	0.938
Mid	0.938
High	0.939

EDR 2M Mode

CH	20dB Bandwidth (MHz)	2/3* 20dB Bandwidth (MHz)
Lower	1.380	0.920
Mid	1.358	0.905
Higher	1.359	0.906

EDR 3M Mode

CH	20dB Bandwidth (MHz)	2/3* 20dB Bandwidth (MHz)
Lower	1.319	0.880
Mid	1.319	0.879
Higher	1.319	0.879

Note: Refer to next page for plots.

BDR Mode

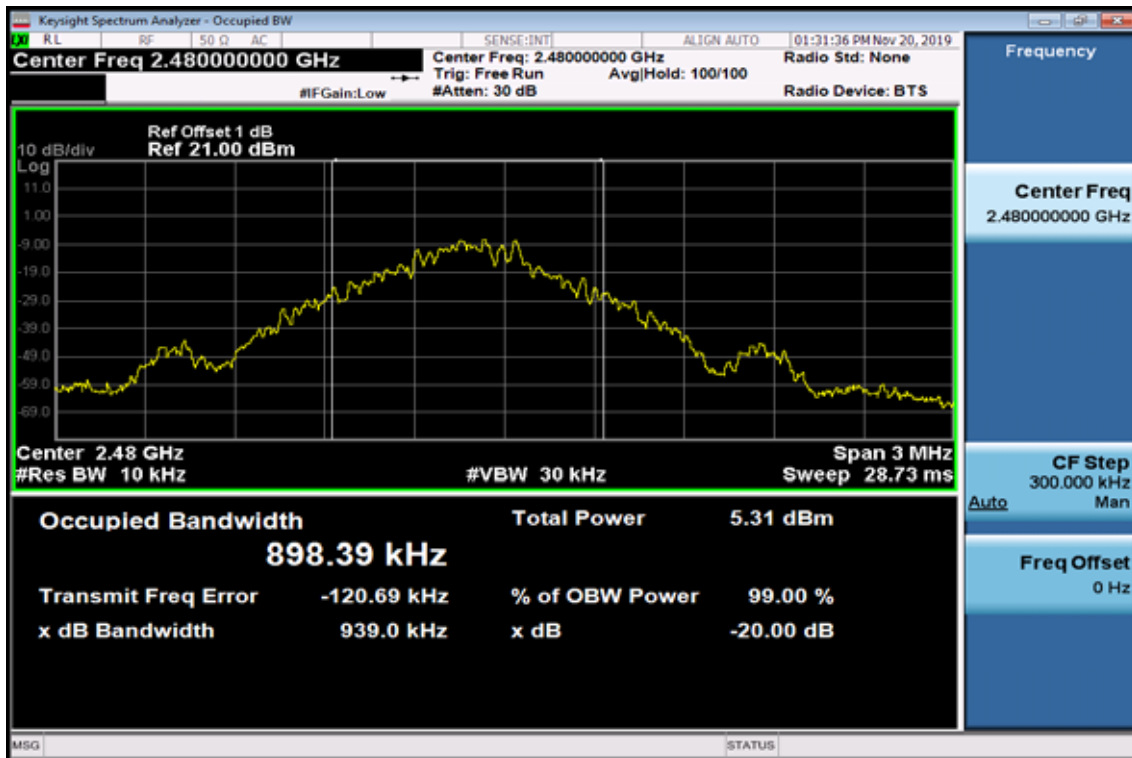
20dB Bandwidth Test Data CH-Low



20dB Bandwidth Test Data CH-Mid

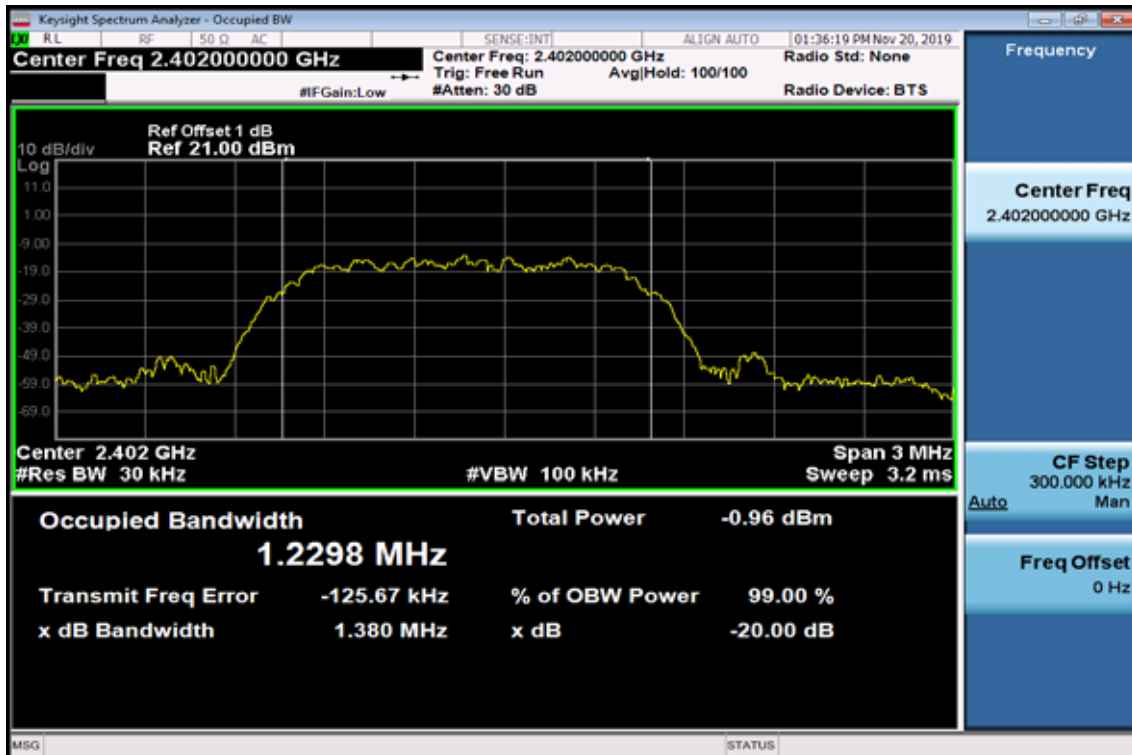


20dB Bandwidth Test Data CH-High

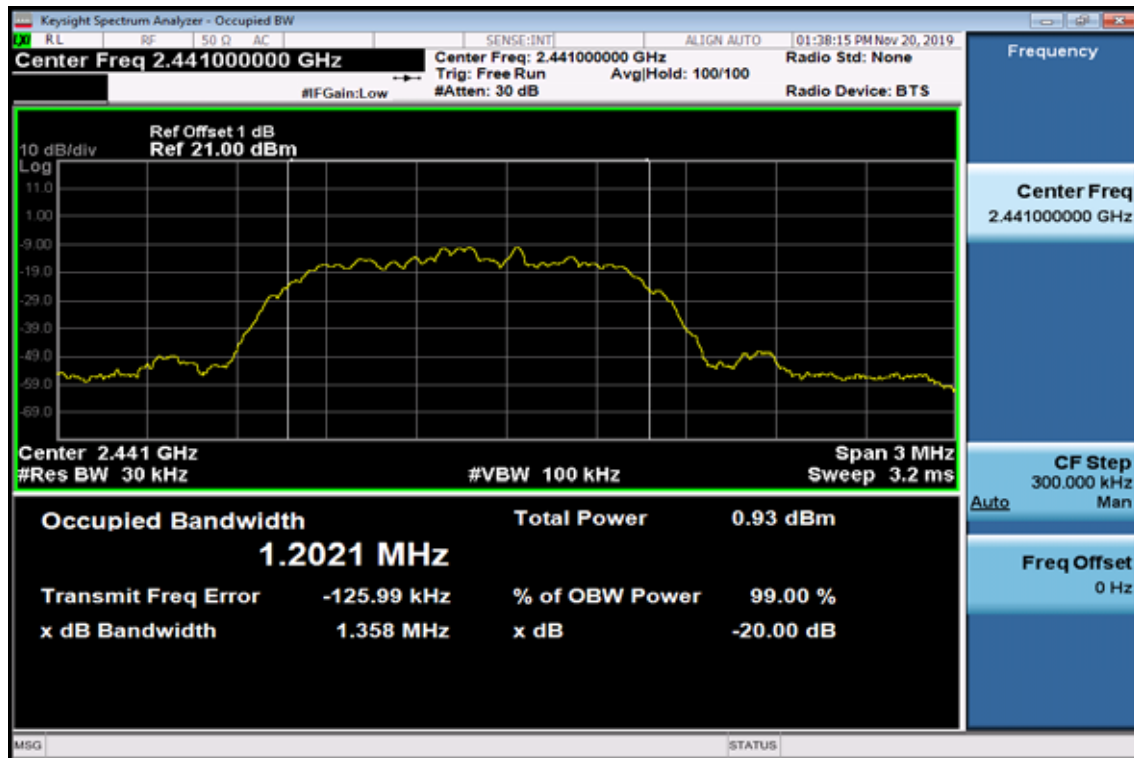


EDR 2M Mode

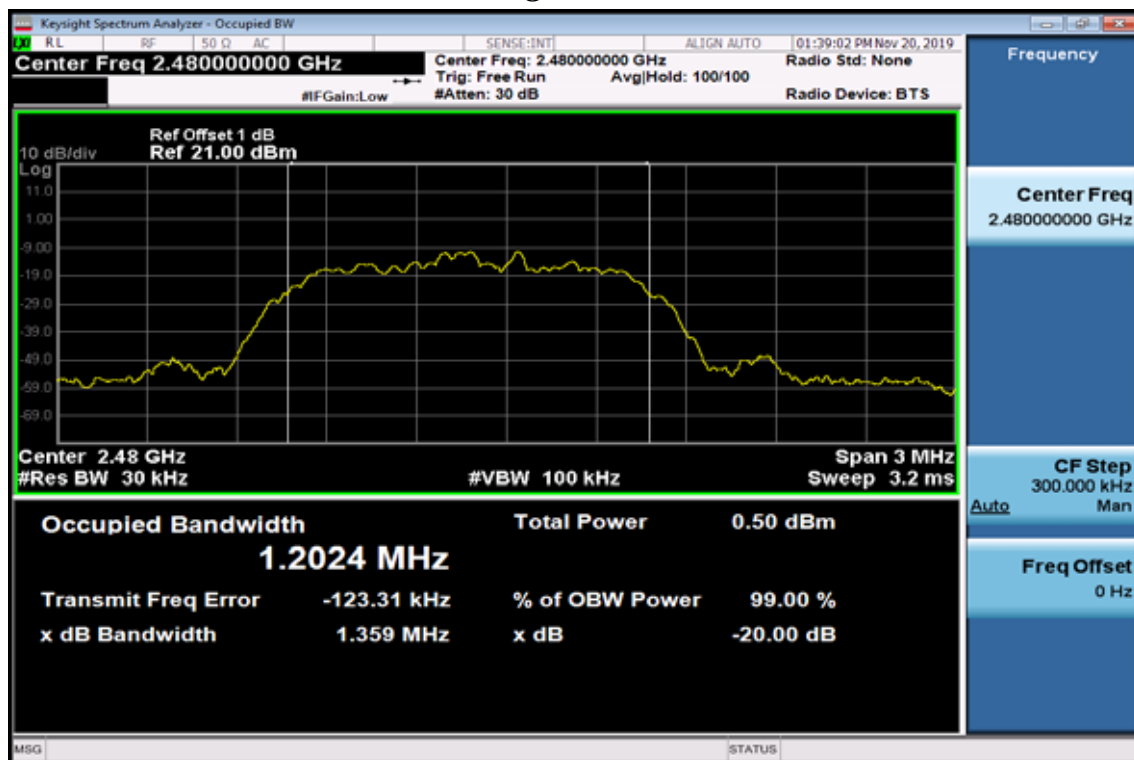
20dB Bandwidth Test Data CH-Low



20dB Bandwidth Test Data CH-Mid

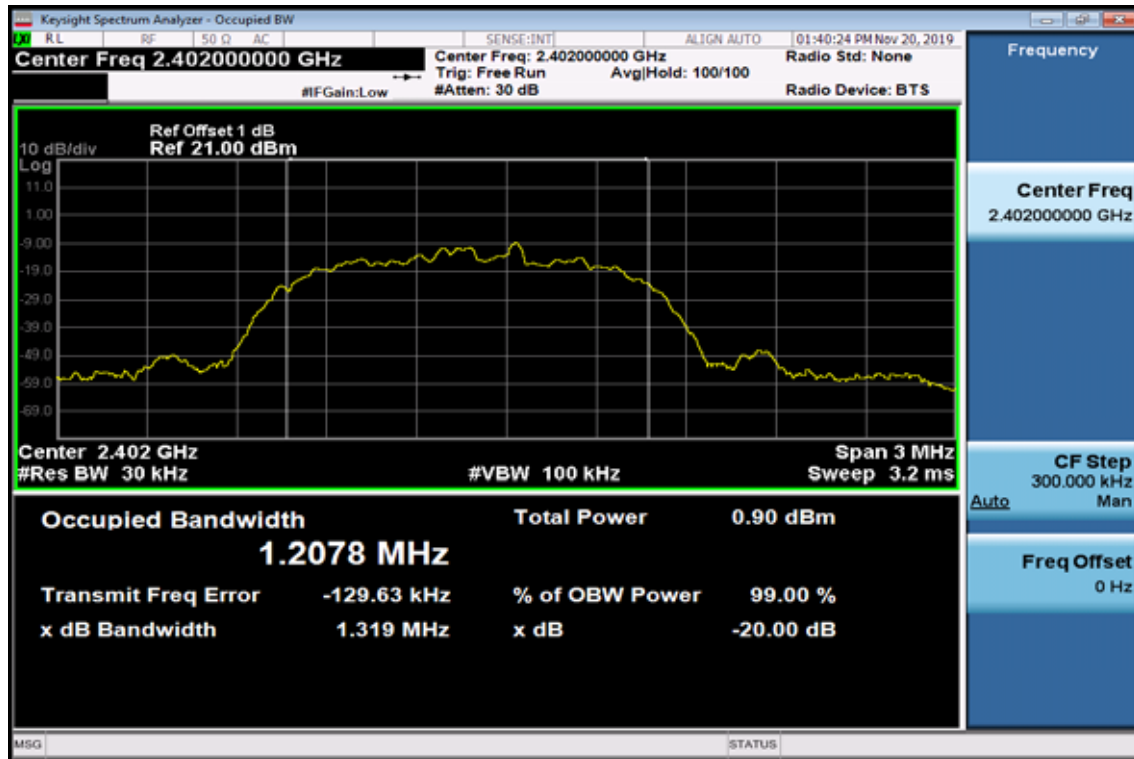


20dB Bandwidth Test Data CH-High

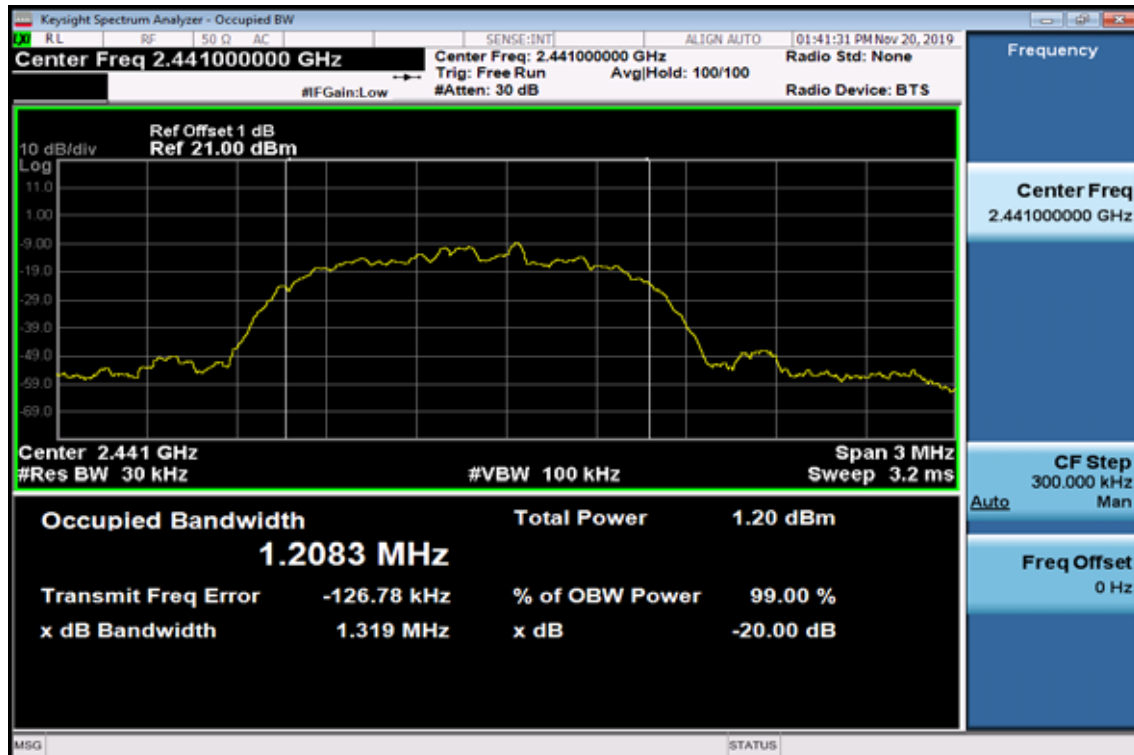


EDR 3M Mode

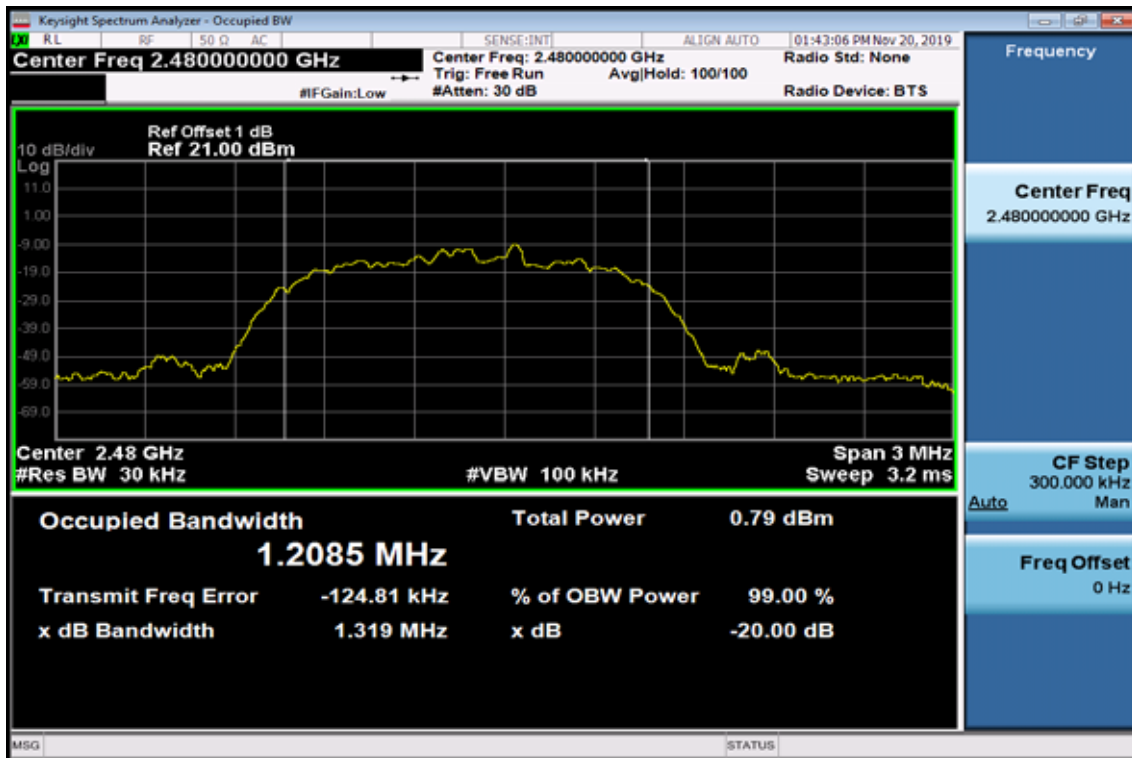
20dB Bandwidth Test Data CH-Low



20dB Bandwidth Test Data CH-Mid



20dB Bandwidth Test Data CH-High



13. Antenna Requirement

13.1 Standard Applicable:

According to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device.

And according to §15.247(c), if transmitting antennas of directional gain greater than 6dBi are used the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

13.2 Antenna Connected Construction:

The directional gains of antenna used for transmitting is 3 dBi, and the antenna type is Dipole antenna which is designed with permanent attachment and no consideration of replacement. Please see EUT photo for details.