

# TEST REPORT

of

## FCC Part 15 Subpart C

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

**Product :** UHD Set-Top Box  
**Brand:** AirTies  
**Model:** Air7415B  
**Model Difference:** N/A  
**FCC ID:** Z3WAIR7415B  
**FCC Rule Part:** §15.247, Cat: DSS  
**Applicant:** AirTies Wireless Networks  
**Address:** Mithat Uluünlü Sok. No:23, Esentepe Şişli, İstanbul/Turkey

**Test Performed by:**  
**International Standards Laboratory**

<LT Lab.>

\*Site Registration No.

BSMI: SL2-IN-E-0013; MRA TW1036; TAF: 0997; IC: IC4067B-3;

\*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-18LR100FCDSS**  
**Issue Date : 2018/09/04**



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, NVLAP or any agency of the Government.

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



## VERIFICATION OF COMPLIANCE

**Applicant:** AirTies Wireless Networks  
**Product Description:** UHD Set-Top Box  
**Brand Name:** AirTies  
**Model No.:** Air7415B  
**Model Difference:** N/A  
**Date of Test:** 2018/03/01 ~ 2018/04/24  
**Date of EUT Received:** 2018/03/01

### 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.

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:**

*Barry Lee*

**Date:**

2018/09/04

*Barry Lee / Sr. Engineer*

**Prepared By:**

*Elisa Chen*

**Date:**

2018/09/04

*Elisa Chen / Sr. Engineer*

**Approved By:**

*Dino Chen*

**Date:**

2018/09/04

*Dino Chen / Sr. Engineer*



## Version

Version No.	Date	Description
00	2018/04/27	Initial creation of document
01	2018/09/04	Adding new adapter

## Uncertainty of Measurement

Description Of Test	Uncertainty
Conducted Emission (AC power line)	2.586 dB
Field Strength of Spurious Radiation	<=30MHz: 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

<b>1. GENERAL INFORMATION .....</b>	<b>6</b>
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
<b>2. SYSTEM TEST CONFIGURATION .....</b>	<b>8</b>
2.1. EUT Configuration .....	8
2.2. EUT Exercise .....	8
2.3. Test Procedure .....	8
2.4. Configuration of Tested System .....	9
<b>3. SUMMARY OF TEST RESULTS .....</b>	<b>10</b>
<b>4. DESCRIPTION OF TEST MODES .....</b>	<b>10</b>
<b>5. AC POWER LINE CONDUCTED EMISSION TEST .....</b>	<b>11</b>
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
<b>6. PEAK OUTPUT POWER MEASUREMENT .....</b>	<b>15</b>
6.1. Standard Applicable: .....	15
6.2. Measurement Equipment Used: .....	15
6.3. Test Set-up: .....	15
6.4. Measurement Procedure: .....	15
6.5. Measurement Result: .....	16
<b>7. 100kHz BANDWIDTH OF BAND EDGES MEASUREMENT .....</b>	<b>17</b>
7.1. Standard Applicable: .....	17
7.2. Measurement Equipment Used: .....	17
7.3. Test SET-UP: .....	19
7.4. Measurement Procedure: .....	20
7.5. Field Strength Calculation .....	20
7.6. Measurement Result: .....	20
<b>8. SPURIOUS EMISSION TEST .....</b>	<b>33</b>
8.1. Standard Applicable: .....	33
8.2. Measurement Equipment Used: .....	33
8.3. Test SET-UP: .....	33
8.4. Measurement Procedure: .....	34
8.5. Field Strength Calculation .....	34
8.6. Measurement Result: .....	34



<b>9. FREQUENCY SEPARATION .....</b>	<b>41</b>
9.1. Standard Applicable: .....	41
9.2. Measurement Equipment Used: .....	41
9.3. Test Set-up: .....	41
9.4. Measurement Procedure: .....	41
9.5. Measurement Result: .....	41
<b>10. NUMBER OF HOPPING FREQUENCY .....</b>	<b>44</b>
10.1. Standard Applicable: .....	44
10.2. Measurement Equipment Used: .....	44
10.3. Test Set-up: .....	44
10.4. Measurement Procedure: .....	44
10.5. Measurement Result: .....	44
<b>11. TIME OF OCCUPANCY (DWELL TIME) .....</b>	<b>46</b>
11.1. Standard Applicable: .....	46
11.2. Measurement Equipment Used: .....	46
11.3. Test Set-up: .....	46
11.4. Measurement Procedure: .....	46
11.5. Measurement Result: .....	47
<b>12. 20dB Bandwidth Bandwidth .....</b>	<b>53</b>
12.1. Standard Applicable: .....	53
12.2. Measurement Equipment Used: .....	53
12.3. Test Set-up: .....	53
12.4. Measurement Procedure: .....	53
12.5. Measurement Result: .....	54
<b>13. ANTENNA REQUIREMENT .....</b>	<b>60</b>
13.1. Standard Applicable: .....	60
13.2. Antenna Connected Construction: .....	60



## 1. GENERAL INFORMATION

### 1.1. Product Description

General:

Product Name:	UHD Set-Top Box	
Brand:	AirTies	
Model:	Air7415B	
Model different:	N/A	
Power Supply:	12Vdc from AC/DC adapter	
	Model	MSA-C1000CS12-12A-DE
	Model	MSA-C1000CS12.0-12A-US
USB port	1	
Gigabit LAN	1	
S/PDIF	1	
HDMI	1	
AV Out	1	

Bluetooth:

Frequency Range:	2402 – 2480MHz	
Bluetooth Version:	V2.1	V4.1
Channel number:	79 channels, 1MHz step	40 channels, 2MHz step
Modulation type:	GFSK	GFSK
Tune-up power	11.01 dBm	8.40 dBm
Power Tolerance:	+/- 2.0 dBm	
Dwell Time:	N/A	
Antenna Designation:	Printed Antenna , -5.70 dBi	

The EUT is compliance with BT2.1 and BLE Standard.

This test report applies for Bluetooth EDR V2.1.

**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: Z3WAIR7415B** filing to comply with Section 15.247 of the FCC Part 15C, Subpart C Rules.

## 1.3. Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4: 2014. Radiated testing was performed at an antenna to EUT distance 3 meters.

Tested in accordance with FCC Public Notice DA 00-705

## 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** <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 ANSI C63.4: 2014, ANSI C63.10: 2013. FCC Registration Number is: 872200; Designation Number is: TW1036, Canada Registration Number: 4067B-3.

## 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 operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements.

### **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 5 and 7 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.

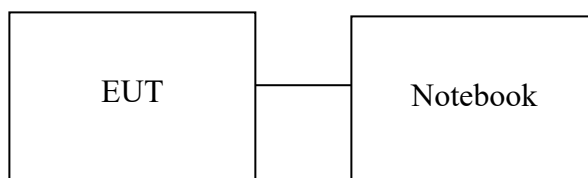
#### **2.3.2 Radiated Emissions**

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**



**Table 1 Equipment Used in Tested System**

Item	Equipment	Mfr/Brand	Model/ Type No.	Series No.	Data Cable	Power Cord
1	NB	HP	440i	NA	Non-shielded	Non-shielded



### 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)	TX 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. AC POWER LINE 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.
Conduction 04-3 Cable	WOKEN	CFD 300-NL	Conduction 04 -3	09/11/2017	09/10/2018
EMI Receiver 16	Rohde & Schwarz	ESCI	101221	10/23/2017	10/22/2018
LISN 18	ROHDE & SCHWARZ	ENV216	101424	02/04/2018	02/03/2019
LISN 19	ROHDE & SCHWARZ	ENV216	101425	03/06/2018	03/05/2019
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 ANSI C63.4-2009.
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:**

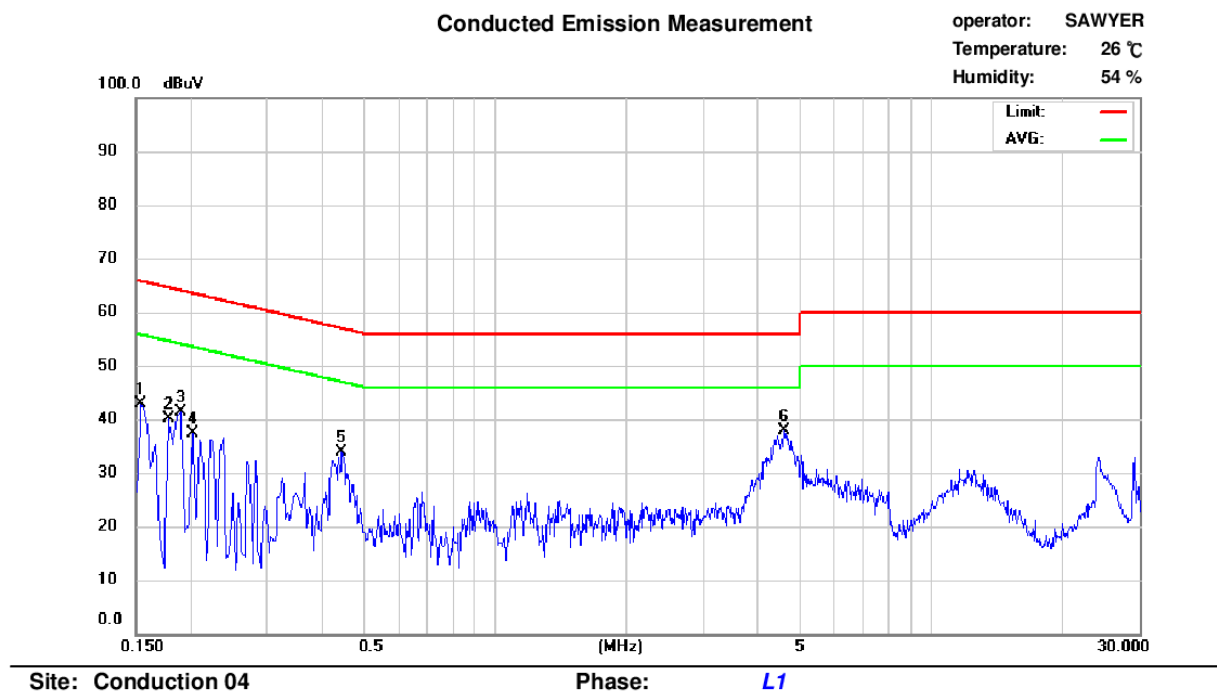
The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. Significant peaks are then marked as shown on the following data page, and these signals are then quasi-peaked.

Note: Refer to next page for measurement data and plots.



## AC POWER LINE CONDUCTED EMISSION TEST DATA

Operation Mode:	Operation Mode	Test Date:	2018/03/05
-----------------	----------------	------------	------------



No.	Frequency (MHz)	QP_R (dBuV)	AVG_R (dBuV)	Correct Factor (dB)	QP Emission (dBuV)	QP Limit (dBuV)	QP Margin (dB)	AVG Emission (dBuV)	AVG Limit (dBuV)	AVG Margin (dB)
1	0.154	32.41	17.21	9.94	42.35	65.78	-23.43	27.15	55.78	-28.63
2	0.178	25.35	7.73	9.93	35.28	64.58	-29.30	17.66	54.58	-36.92
3	0.190	27.74	12.77	9.93	37.67	64.04	-26.37	22.70	54.04	-31.34
4	0.202	26.83	9.86	9.93	36.76	63.53	-26.77	19.79	53.53	-33.74
5	0.446	19.64	13.32	9.92	29.56	56.95	-27.39	23.24	46.95	-23.71
6	4.602	21.86	10.73	10.08	31.94	56.00	-24.06	20.81	46.00	-25.19

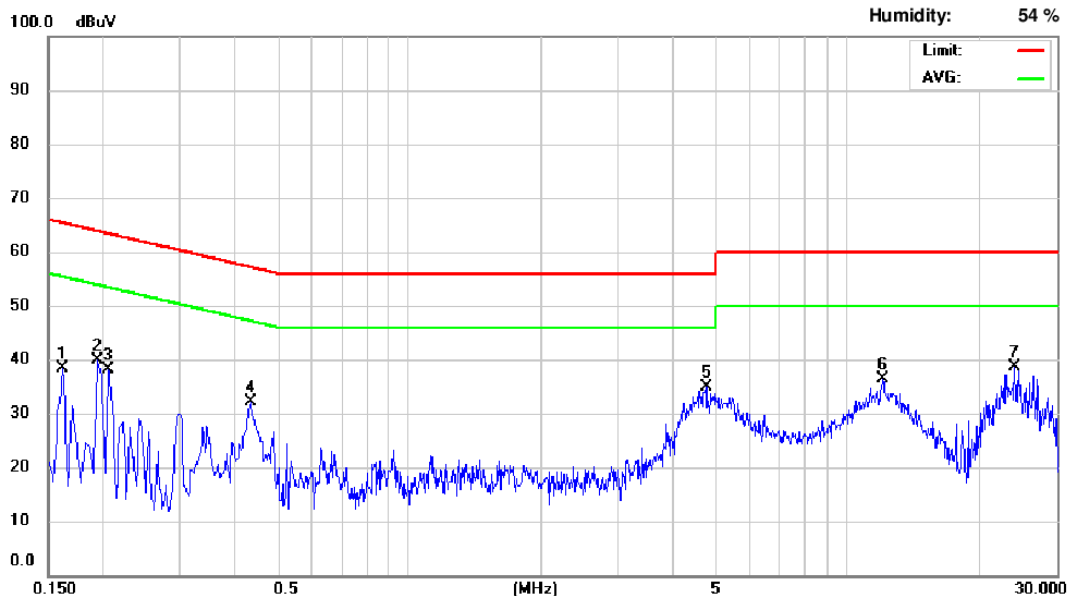


Conducted Emission Measurement

operator: SAWYER

Temperature: 26 °C

Humidity: 54 %



Site: Conduction 04

Phase: N

No.	Frequency (MHz)	QP_R (dBuV)	AVG_R (dBuV)	Correct Factor (dB)	QP Emission (dBuV)	QP Limit (dBuV)	QP Margin (dB)	AVG Emission (dBuV)	AVG Limit (dBuV)	AVG Margin (dB)
1	0.162	30.37	14.97	9.30	39.67	65.36	-25.69	24.27	55.36	-31.09
2	0.194	26.77	12.73	9.30	36.07	63.86	-27.79	22.03	53.86	-31.83
3	0.206	23.03	8.05	9.30	32.33	63.37	-31.04	17.35	53.37	-36.02
4	0.434	22.74	16.66	9.31	32.05	57.18	-25.13	25.97	47.18	-21.21
5	4.758	22.46	15.40	9.49	31.95	56.00	-24.05	24.89	46.00	-21.11
6	12.058	25.06	18.39	9.68	34.74	60.00	-25.26	28.07	50.00	-21.93
7	24.046	9.02	3.67	9.90	18.92	60.00	-41.08	13.57	50.00	-36.43



## 6. PEAK OUTPUT POWER MEASUREMENT

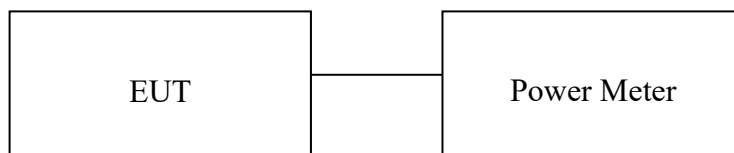
### 6.1. Standard Applicable:

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:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter 05	Anritsu	ML2495A	1116010	09/07/2017	09/06/2018
Power Sensor 05	Anritsu	MA2411B	34NKF50	09/07/2017	09/06/2018
Power Sensor 06	DARE	RPR3006W	13I00030SNO33	12/12/2017	12/11/2018
Power Sensor 07	DARE	RPR3006W	13I00030SNO34	12/12/2017	12/11/2018
Temperature Chamber	KSON	THS-B4H100	2287	12/02/2017	12/01/2018
DC Power supply	ABM	8185D	N/A	11/06/2017	11/05/2018
AC Power supply	EXTECH	CFC105W	NA	12/25/2017	12/24/2018
Attenuator	Woken	Watt-65m3502	11051601	NA	NA
Splitter	MCLI	PS4-199	12465	12/26/2017	12/25/2019
Spectrum analyzer	keysight	N9010A	MY56070257	07/07/2017	07/06/2018
Spectrum analyzer	R&S	FSP40	100143	11/02/2017	11/01/2018
Test Software	DARE	Radimation Ver:2013.1.23	NA	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 or spectrum. (Channel power function, RBW, VBW = 1MHz)
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	10.25	0.00	10.25	0.01058	1
Mid	10.76	0.00	10.76	0.01190	1
High	11.01	0.00	11.01	0.01261	1

### EDR 2M Mode

Frequency (MHz)	Peak Reading Power (dBm)	Cable Loss	Output Power (dBm)	Output Power (W)	Limit (W)
Low	9.08	0.00	9.08	0.00809	0.125
Mid	9.39	0.00	9.39	0.00869	0.125
High	9.03	0.00	9.03	0.00800	0.125

### EDR 3M Mode

Frequency (MHz)	Peak Reading Power (dBm)	Cable Loss	Output Power (dBm)	Output Power (W)	Limit (W)
Low	9.64	0.00	9.64	0.00920	0.125
Mid	9.94	0.00	9.94	0.00985	0.125
High	9.56	0.00	9.56	0.00903	0.125

*Offset: 1dB*



## **7. 100kHz BANDWIDTH OF BAND EDGES MEASUREMENT**

### **7.1. 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).

### **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:**

Chamber 19( 966 Chamber)					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer 21(26.5GHz)	Agilent	N9010A	MY52100117	06/30/2017	06/29/2018
EMI Receiver	SCHWARZBECK	FCVU1534	1534149	12/07/2017	12/06/2018
Dipole antenna	SCHWARZBECK	VHAP,30-300	919	12/28/2017	12/27/2019
Dipole antenna	SCHWARZBECK	UHAP,300-1000	1195	12/28/2017	12/27/2019
Loop Antenna9K-30M	EM	EM 6879	271	11/01/2016	10/31/2018
Bilog Antenna30-1G	SCHWARZBECK	VULB9168	736	07/21/2017	07/20/2018
Horn antenna1-18G	ETS	3117	00066665	11/29/2017	11/28/2018
Horn antenna26-40G(05)	Com-power	AH-640	100A	02/22/2017	02/21/2019
Horn antenna18-26G(04)	Com-power	AH-826	081001	11/21/2017	11/20/2019
Preamplifier9-1000M	HP	8447F	NA	12/08/2017	12/07/2018
Preamplifier1-18G	MITEQ	AFS44-00101800-25-10P-44	1329256	07/26/2017	07/25/2018
Preamplifier1-26G	EM	EM01M26G	NA	11/24/2017	11/23/2018
Preamplifier26-40G	MITEQ	JS-26004000-27-5A	818471	11/20/2017	11/19/2019
Cable1-18G	HUBER SUHNER	Sucoflex 106	NA	11/24/2017	11/23/2018
Cable UP to 1G	HUBER SUHNER	RG 214/U	NA	10/02/2017	10/01/2018
SUCOFLEX 1GHz~40GHz cable	HUBER SUHNER	Sucoflex 102	27963/2&37421/2	11/02/2017	11/01/2019
Signal Generator	R&S	SMU200A	102330	03/14/2018	03/13/2019
Signal Generator	Anritsu	MG3692A	50405	12/07/2017	12/06/2018
2.4G Filter	Micro-Tronics	Brm50702	76	12/25/2017	12/24/2018
Test Software	Audix	E3 Ver:6.12023	N/A	N/A	N/A



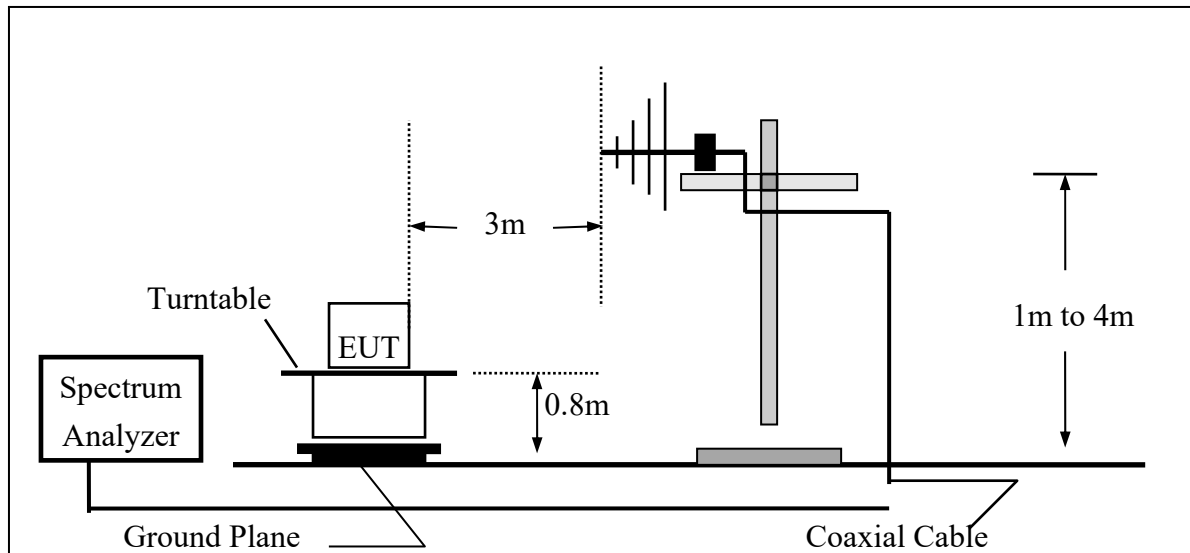
### 7.3. Test SET-UP:

#### 7.3.1. Conducted Emission at antenna port:

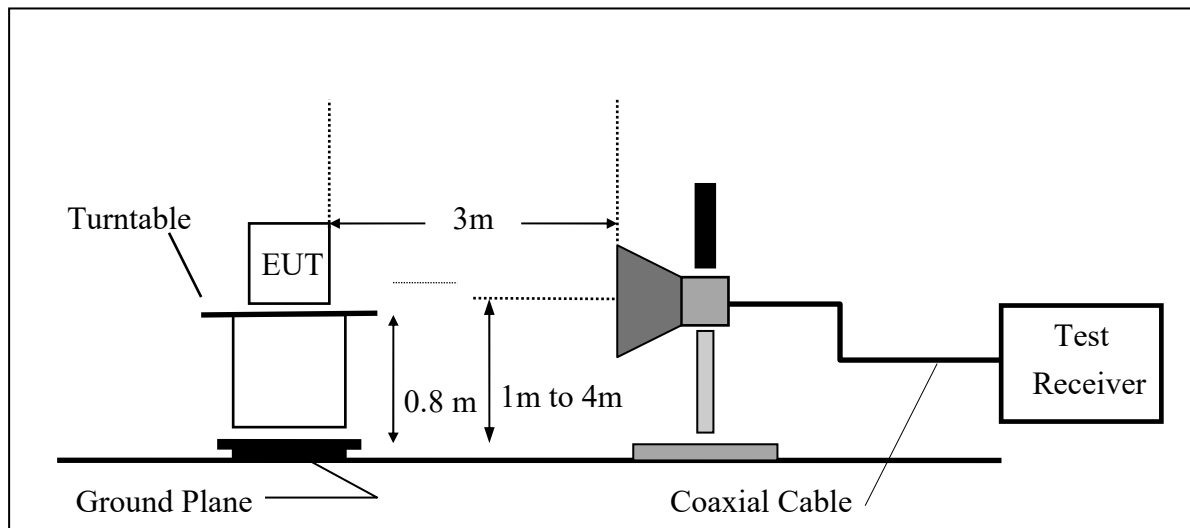
Refer to section 6.3 for details.

#### 7.3.2. Radiated emission:

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



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





#### 7.4. 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=100kHz, Span=25MHz, Sweep = auto
5. Mark Peak, 2.390GHz and 2.4835GHz and record the max. level.
6. Repeat above procedures until all frequency measured were complete.

#### 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.

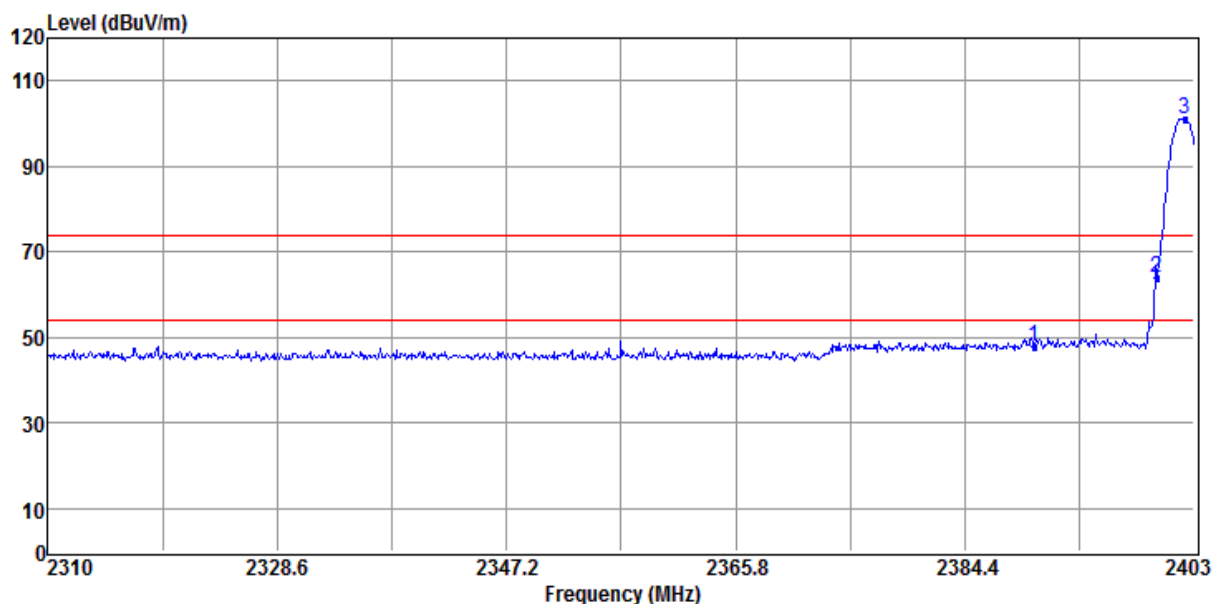


## Band Edges:

### Radiated Emission: (BDR mode)

Operation Mode TX CH Low  
Fundamental Frequency 2402 MHz  
Temperature 25 °C

Test Date 2018/04/02  
Test By Barry  
Humidity 60 %



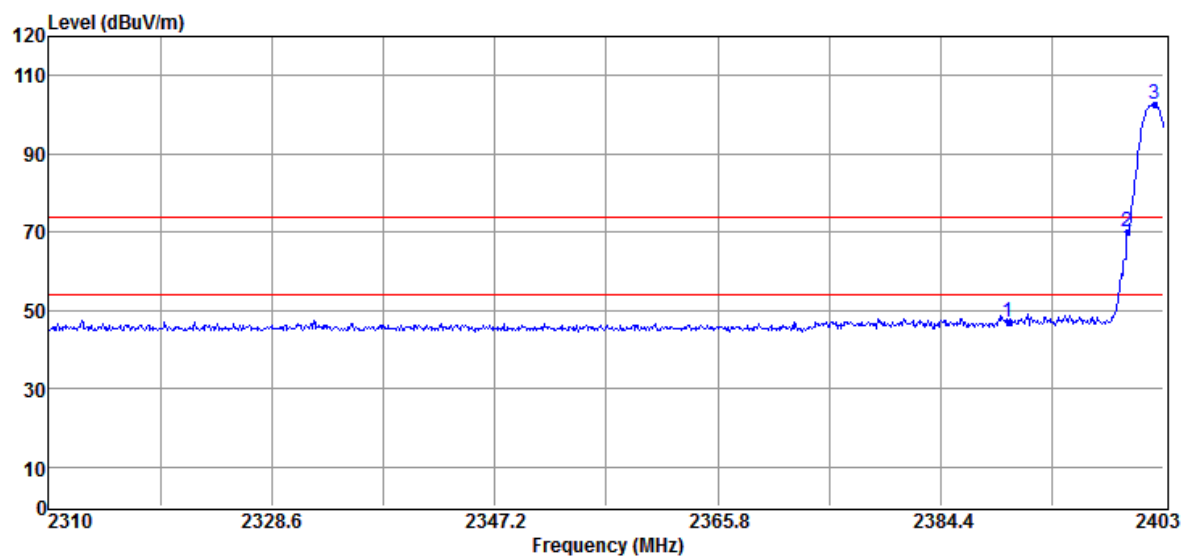
No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	2390.00	51.11	-3.15	47.96	74.00	-26.04	Peak	VERTICAL
2	2400.00	67.10	-3.16	63.94	80.98	-17.04	Peak	VERTICAL
3	2402.26	104.14	-3.16	100.98	F	---	Peak	VERTICAL

#### Remark:

- 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.
- 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.
- Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 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	Over L imit dB	Remark	Pol V/H
1	2390.00	50.09	-3.15	46.94	74.00	-27.06	Peak	HORIZONTAL
2	2400.00	73.38	-3.16	70.22	82.50	-12.28	Peak	HORIZONTAL
3	2402.26	105.66	-3.16	102.50	F	---	Peak	HORIZONTAL

**Remark:**

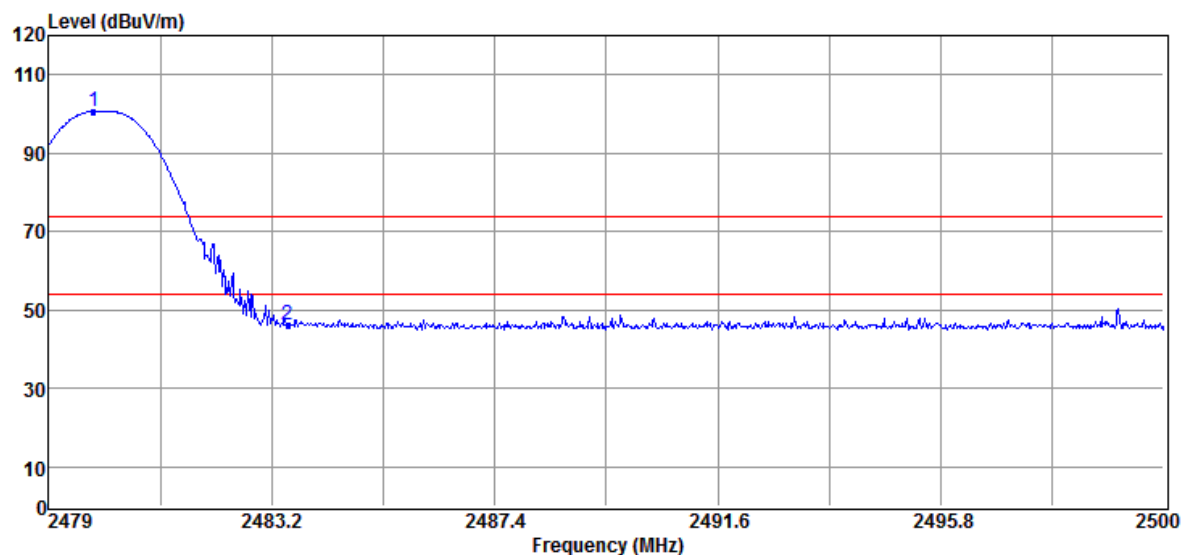
- 1 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 2 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated 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 °C

Test Date 2018/04/02  
Test By Barry  
Humidity 60 %



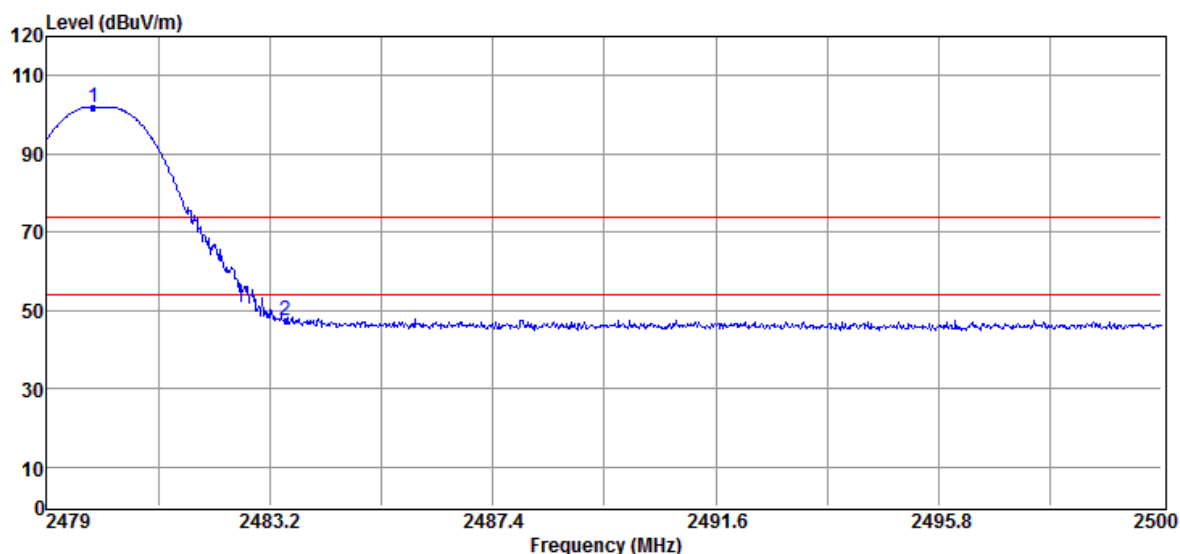
No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	2479.84	103.72	-3.11	100.61	F	---	Peak	VERTICAL
2	2483.50	49.27	-3.11	46.16	74.00	-27.84	Peak	VERTICAL

Remark:

- 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.
- 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.
- Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 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	Over L imit dB	Remark	Pol V/H
1	2479.88	105.17	-3.11	102.06	F	---	Peak	HORIZONTAL
2	2483.50	50.50	-3.11	47.39	74.00	-26.61	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.

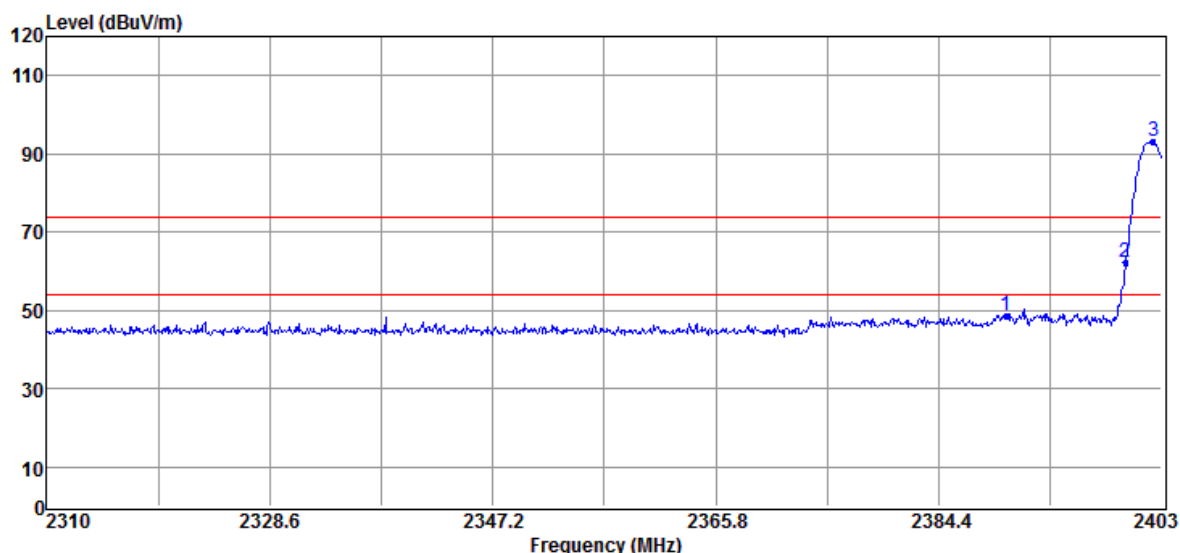
**Note: “F” denotes fundamental frequency**



# Radiated Emission: (EDR 2M mode)

Operation Mode TX CH Low  
Fundamental Frequency 2402 MHz  
Temperature 25 °C

Test Date 2018/04/02  
Test By Barry  
Humidity 60 %



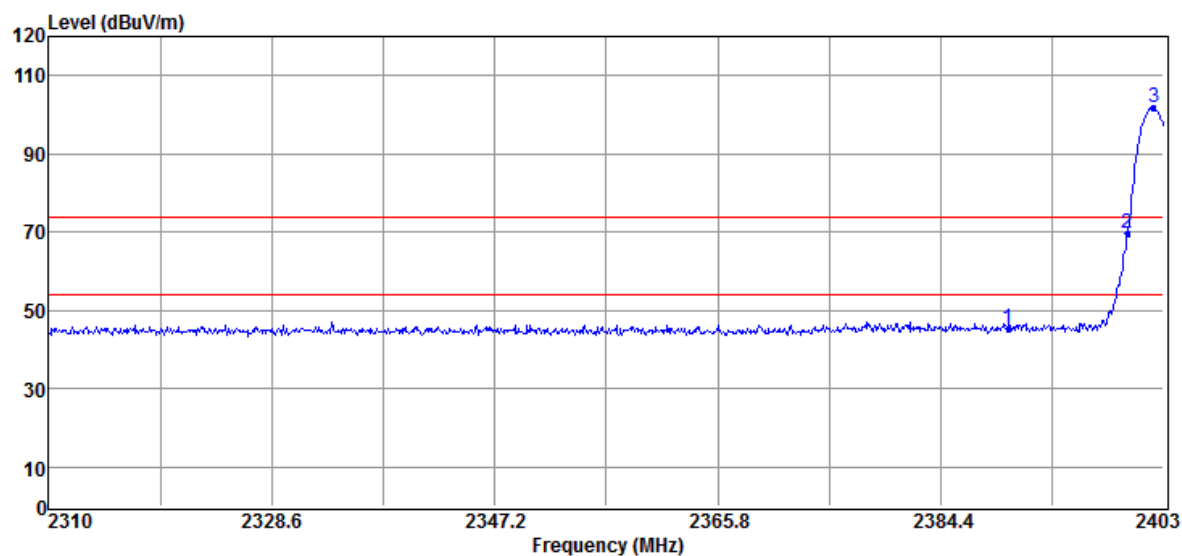
No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	2390.00	51.83	-3.15	48.68	74.00	-25.32	Peak	VERTICAL
2	2400.00	65.31	-3.16	62.15	73.13	-10.98	Peak	VERTICAL
3	2402.35	96.29	-3.16	93.13	F	--	Peak	VERTICAL

## Remark:

- 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.
- 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.
- Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 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	Over L imit dB	Remark	Pol V/H
1	2390.00	48.56	-3.15	45.41	74.00	-28.59	Peak	HORIZONTAL
2	2400.00	72.72	-3.16	69.56	81.70	-12.14	Peak	HORIZONTAL
3	2402.16	104.86	-3.16	101.70	F	--	Peak	HORIZONTAL

Remark:

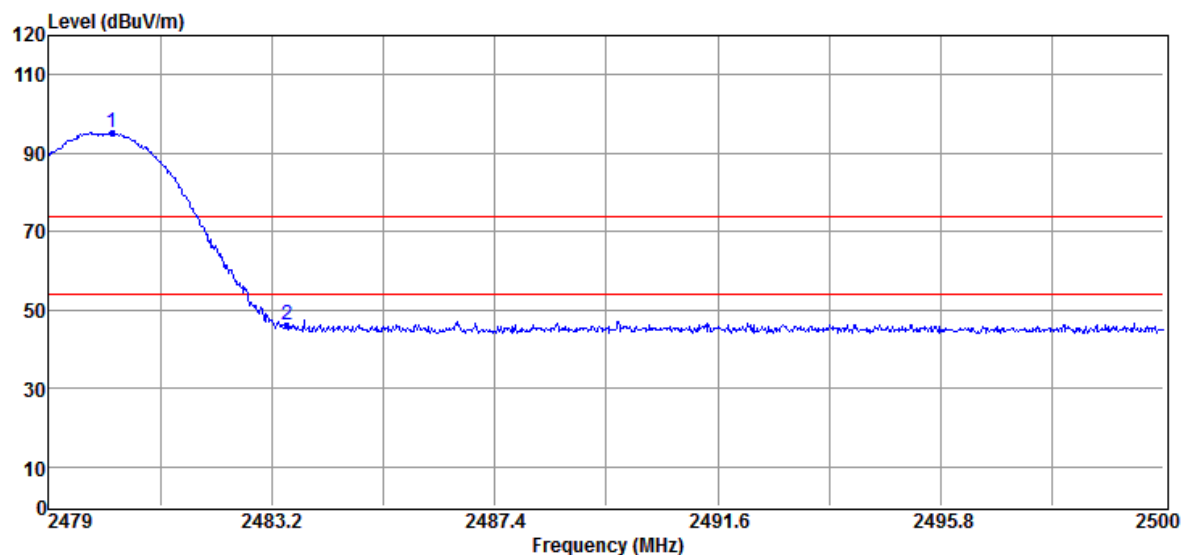
- 1 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 2 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated 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 °C

Test Date 2018/04/02  
Test By Barry  
Humidity 60 %



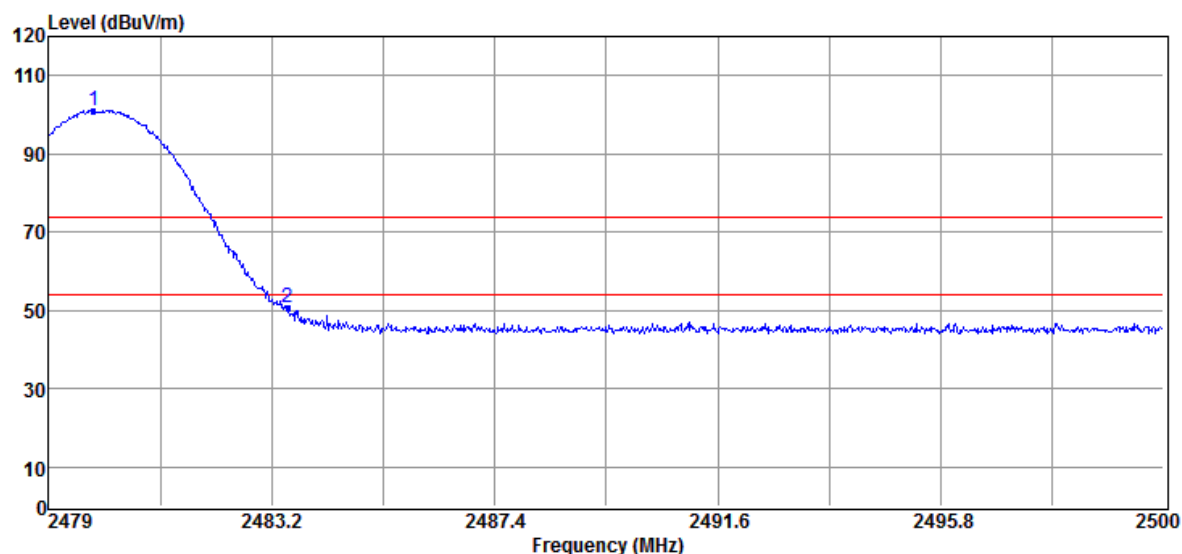
No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	2480.20	98.34	-3.11	95.23	F	--	Peak	VERTICAL
2	2483.49	49.30	-3.11	46.19	74.00	-27.81	Peak	VERTICAL

**Remark:**

- 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.
- 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.
- Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 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	Over L imit dB	Remark	Pol V/H
1	2479.84	104.20	-3.11	101.09	F	--	Peak	HORIZONTAL
2	2483.50	53.96	-3.11	50.85	74.00	-23.15	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.

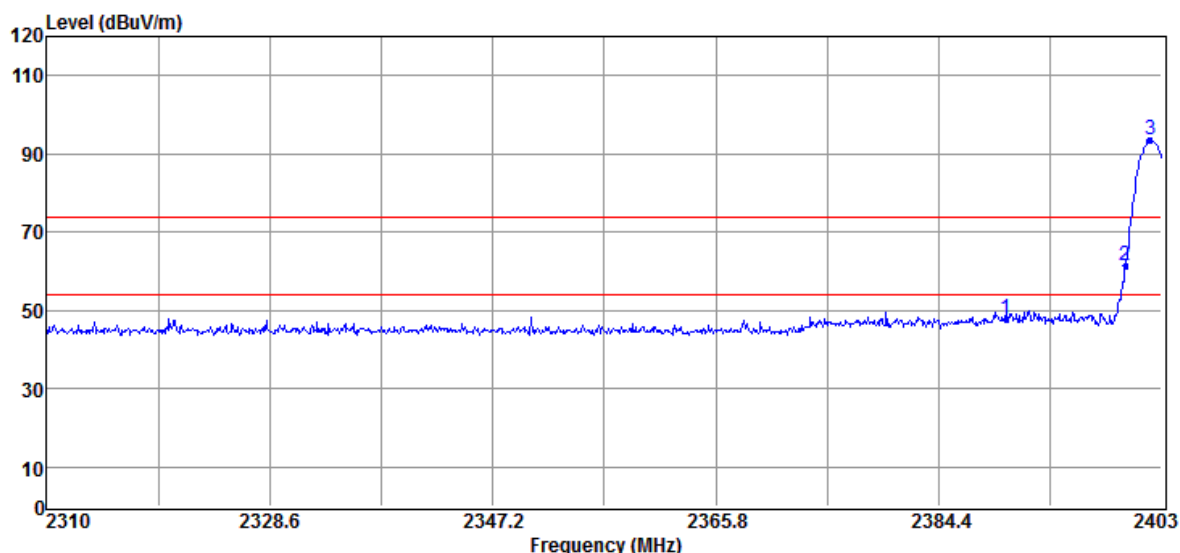
**Note: “F” denotes fundamental frequency**



# **Radiated Emission: (EDR 3M mode)**

Operation Mode TX CH Low  
Fundamental Frequency 2402 MHz  
Temperature 25 °C

Test Date 2018/04/02  
Test By Barry  
Humidity 60 %



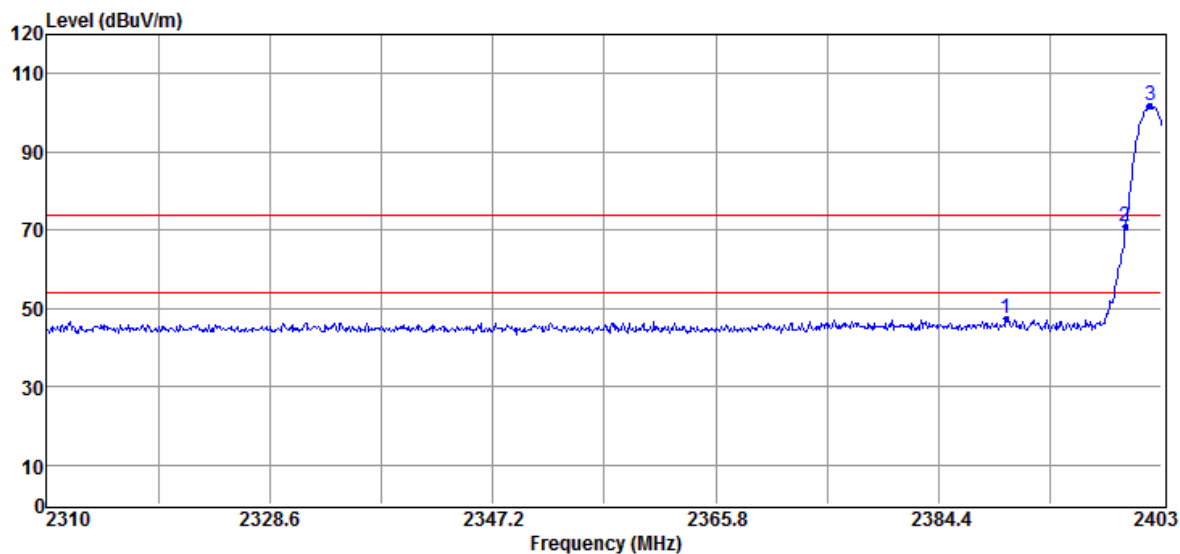
No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	2390.00	51.06	-3.15	47.91	74.00	-26.09	Peak	VERTICAL
2	2400.00	64.78	-3.16	61.62	73.47	-11.85	Peak	VERTICAL
3	2402.07	96.63	-3.16	93.47	F	--	Peak	VERTICAL

## **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	Over L imit dB	Remark	Pol V/H
1	2390.00	50.40	-3.15	47.25	74.00	-26.75	Peak	HORIZONTAL
2	2400.00	73.89	-3.16	70.73	81.82	-11.09	Peak	HORIZONTAL
3	2402.07	104.98	-3.16	101.82	F	--	Peak	HORIZONTAL

**Remark:**

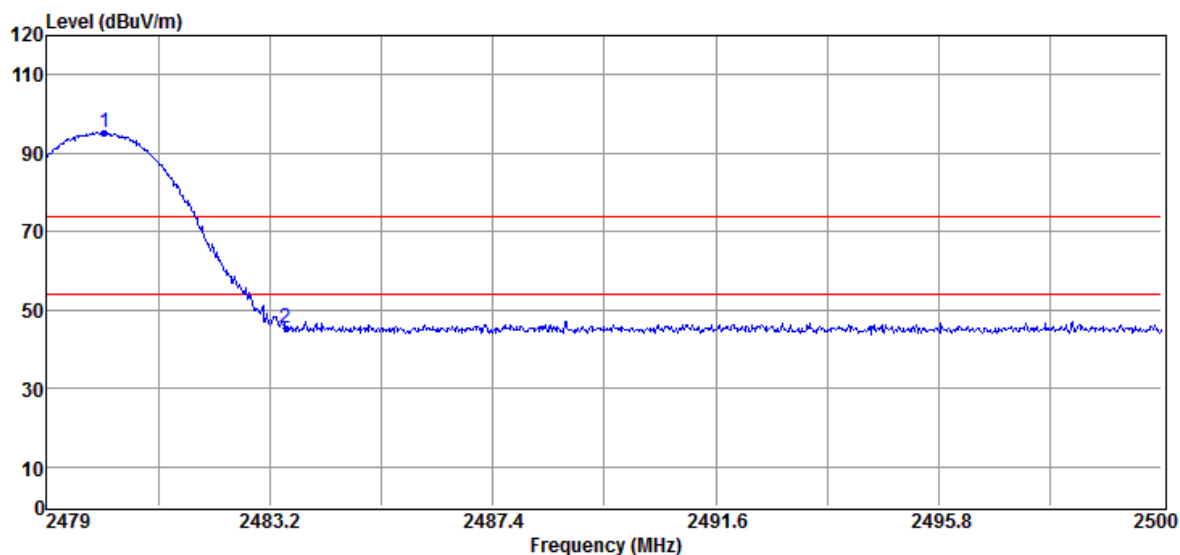
- 1 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 2 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated 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 °C

Test Date 2018/04/02  
Test By Barry  
Humidity 60 %



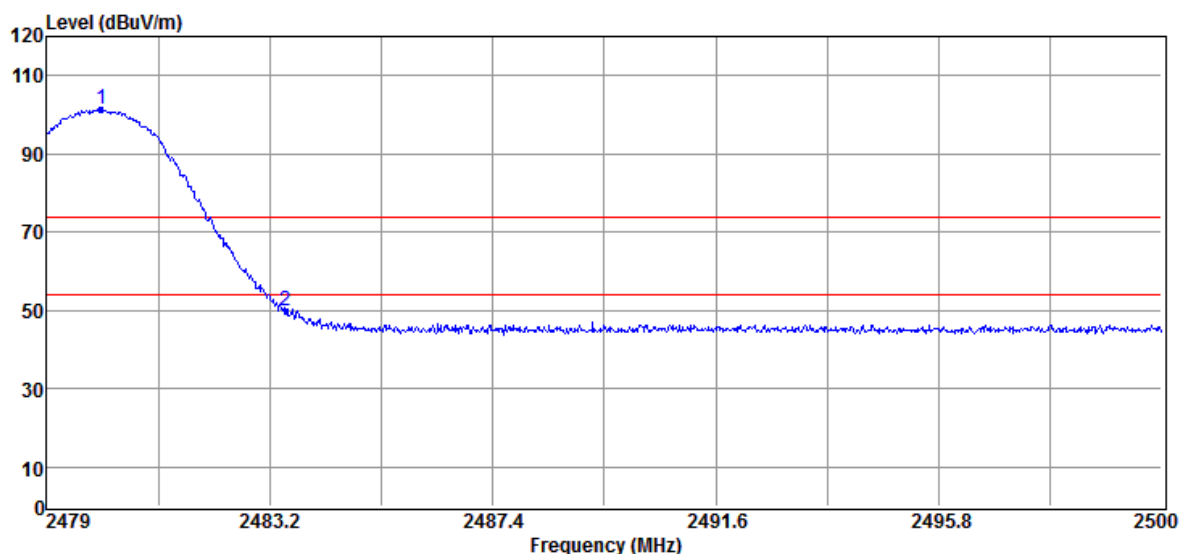
No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	2480.09	98.46	-3.11	95.35	F	--	Peak	VERTICAL
2	2483.50	48.61	-3.11	45.50	74.00	-28.50	Peak	VERTICAL

Remark:

- 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.
- 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.
- Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 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	Over L imit dB	Remark	Pol V/H
1	2480.03	104.40	-3.11	101.29	F	--	Peak	HORIZONTAL
2	2483.50	52.96	-3.11	49.85	74.00	-24.15	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**



## **8. SPURIOUS EMISSION TEST**

### **8.1. 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.

### **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:**

#### **8.3.1. Conducted Emission at antenna port:**

Refer to section 6.3 for details.

#### **8.3.2. Radiated emission:**

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:

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

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.



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

Operation Mode TX CH Low  
Fundamental Frequency 2402MHz  
Temperature 25 °C

Test Date 2018/04/02  
Test By Barry  
Humidity 60 %

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	32.91	36.12	-8.02	28.10	40.00	-11.90	Peak	VERTICAL
2	170.65	36.30	-7.39	28.91	43.50	-14.59	Peak	VERTICAL
3	293.84	30.61	-6.16	24.45	46.00	-21.55	Peak	VERTICAL
4	382.11	31.06	-4.36	26.70	46.00	-19.30	Peak	VERTICAL
5	516.94	44.85	-2.20	42.65	46.00	-3.35	Peak	VERTICAL
6	659.53	28.10	0.26	28.36	46.00	-17.64	Peak	VERTICAL
1	134.76	34.60	-8.04	26.56	43.50	-16.94	Peak	HORIZONTAL
2	170.65	39.03	-7.39	31.64	43.50	-11.86	Peak	HORIZONTAL
3	381.14	30.61	-4.39	26.22	46.00	-19.78	Peak	HORIZONTAL
4	494.63	35.98	-2.53	33.45	46.00	-12.55	Peak	HORIZONTAL
5	515.97	41.07	-2.22	38.85	46.00	-7.15	Peak	HORIZONTAL
6	739.07	36.92	1.88	38.80	46.00	-7.20	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 30 MHz to 1000MHz were made with an instrument using Peak / QP detector mode.
- 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 30MHz to 1GHz was 100kHz, VBW=300kHz.



### Radiated Spurious Emission Measurement Result (below 1GHz)

Operation Mode TX CH Mid  
Fundamental Frequency 2441MHz  
Temperature 25 °C

Test Date 2018/04/02  
Test By Barry  
Humidity 60 %

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	133.79	32.38	-8.15	24.23	43.50	-19.27	Peak	VERTICAL
2	170.65	37.20	-7.39	29.81	43.50	-13.69	Peak	VERTICAL
3	229.82	33.55	-8.75	24.80	46.00	-21.20	Peak	VERTICAL
4	385.99	30.75	-4.27	26.48	46.00	-19.52	Peak	VERTICAL
5	515.97	38.95	-2.22	36.73	46.00	-9.27	Peak	VERTICAL
6	778.84	28.59	2.41	31.00	46.00	-15.00	Peak	VERTICAL
1	134.76	34.51	-8.04	26.47	43.50	-17.03	Peak	HORIZONTAL
2	174.53	38.92	-7.91	31.01	43.50	-12.49	Peak	HORIZONTAL
3	307.42	30.55	-5.83	24.72	46.00	-21.28	Peak	HORIZONTAL
4	382.11	30.44	-4.36	26.08	46.00	-19.92	Peak	HORIZONTAL
5	493.66	35.31	-2.54	32.77	46.00	-13.23	Peak	HORIZONTAL
6	522.76	41.26	-2.11	39.15	46.00	-6.85	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 30 MHz to 1000MHz were made with an instrument using Peak / QP detector mode.
- 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 30MHz to 1GHz was 100kHz, VBW=300kHz.



# **Radiated Spurious Emission Measurement Result (below 1GHz)**

Operation Mode TX CH High  
Fundamental Frequency 2480MHz  
Temperature 25 °C

Test Date 2018/04/02  
Test By Barry  
Humidity 60 %

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	172.59	38.31	-7.65	30.66	43.50	-12.84	Peak	VERTICAL
2	235.64	32.25	-8.36	23.89	46.00	-22.11	Peak	VERTICAL
3	295.78	30.35	-6.10	24.25	46.00	-21.75	Peak	VERTICAL
4	391.81	31.23	-4.14	27.09	46.00	-18.91	Peak	VERTICAL
5	491.72	40.18	-2.57	37.61	46.00	-8.39	Peak	VERTICAL
6	729.37	39.67	1.66	41.33	46.00	-4.67	Peak	VERTICAL
1	134.76	34.43	-8.04	26.39	43.50	-17.11	Peak	HORIZONTAL
2	170.65	37.68	-7.39	30.29	43.50	-13.21	Peak	HORIZONTAL
3	305.48	31.47	-5.85	25.62	46.00	-20.38	Peak	HORIZONTAL
4	493.66	38.01	-2.54	35.47	46.00	-10.53	Peak	HORIZONTAL
5	521.79	45.58	-2.12	43.46	46.00	-2.54	Peak	HORIZONTAL
6	729.37	38.46	1.66	40.12	46.00	-5.88	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 30 MHz to 1000MHz were made with an instrument using Peak / QP detector mode.
- 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 30MHz to 1GHz was 100kHz, VBW=300kHz.



### Radiated Spurious Emission Measurement Result (above 1GHz)

Operation Mode TX CH Low  
Fundamental Frequency 2402 MHz  
Temperature 25 °C

Test Date 2018/04/02  
Test By Barry  
Humidity 60 %

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	1994.00	41.88	-5.39	36.49	74.00	-37.51	Peak	VERTICAL
2	4804.00	31.16	3.23	34.39	74.00	-39.61	Peak	VERTICAL
1	1497.00	42.19	-7.33	34.86	74.00	-39.14	Peak	HORIZONTAL
2	4804.00	31.15	3.23	34.38	74.00	-39.62	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 “F” denotes fundamental frequency; “H” denotes harmonics frequency. “S” denotes spurious frequency.
- 4 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.
- 5 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 6 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.



### Radiated Spurious Emission Measurement Result (above 1GHz)

Operation Mode TX CH Mid  
Fundamental Frequency 2441 MHz  
Temperature 25 °C

Test Date 2018/04/02  
Test By Barry  
Humidity 60 %

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	1987.00	43.82	-5.44	38.38	74.00	-35.62	Peak	VERTICAL
2	4882.00	31.05	3.41	34.46	74.00	-39.54	Peak	VERTICAL
1	2001.00	37.65	-5.34	32.31	74.00	-41.69	Peak	HORIZONTAL
2	4882.00	32.41	3.41	35.82	74.00	-38.18	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 “F” denotes fundamental frequency; “H” denotes harmonics frequency. “S” denotes spurious frequency.
- 4 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.
- 5 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 6 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.



### Radiated Spurious Emission Measurement Result (above 1GHz)

Operation Mode TX CH High  
Fundamental Frequency 2480 MHz  
Temperature 25 °C

Test Date 2018/04/02  
Test By Barry  
Humidity 60 %

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	2029.00	39.58	-4.95	34.63	74.00	-39.37	Peak	VERTICAL
2	4960.00	31.96	3.60	35.56	74.00	-38.44	Peak	VERTICAL
1	1994.00	37.24	-5.39	31.85	74.00	-42.15	Peak	HORIZONTAL
2	4960.00	31.65	3.60	35.25	74.00	-38.75	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 “F” denotes fundamental frequency; “H” denotes harmonics frequency. “S” denotes spurious frequency.
- 4 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.
- 5 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 6 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.



## 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.

According to RSS 210 issue 8, A8.1(b), frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.

### 9.2. Measurement Equipment Used:

Refer to section 6.2 for details.

### 9.3. Test Set-up:

Refer to section 6.3 for details.

### 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:

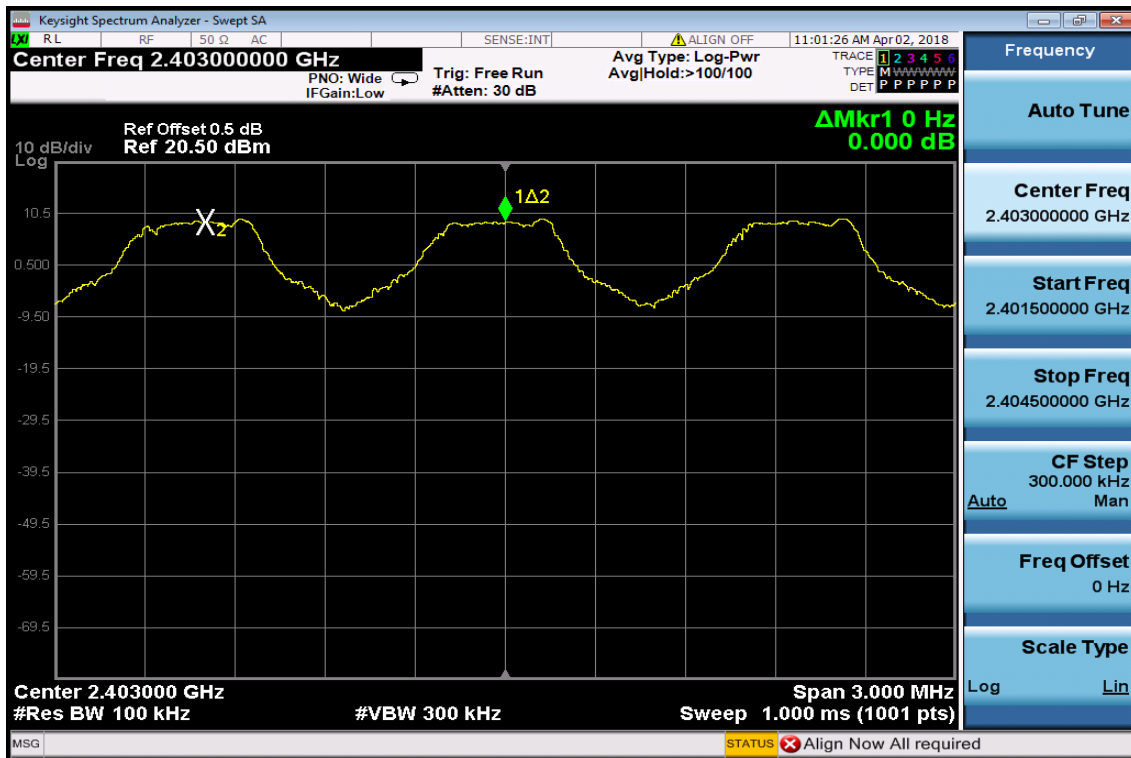
Channel separation (MHz)	Limit	Result
1	$\geq 25\text{KHz}$ or 2/3 times 20dB bandwidth	PASS

Note: Refer to next page for plots.

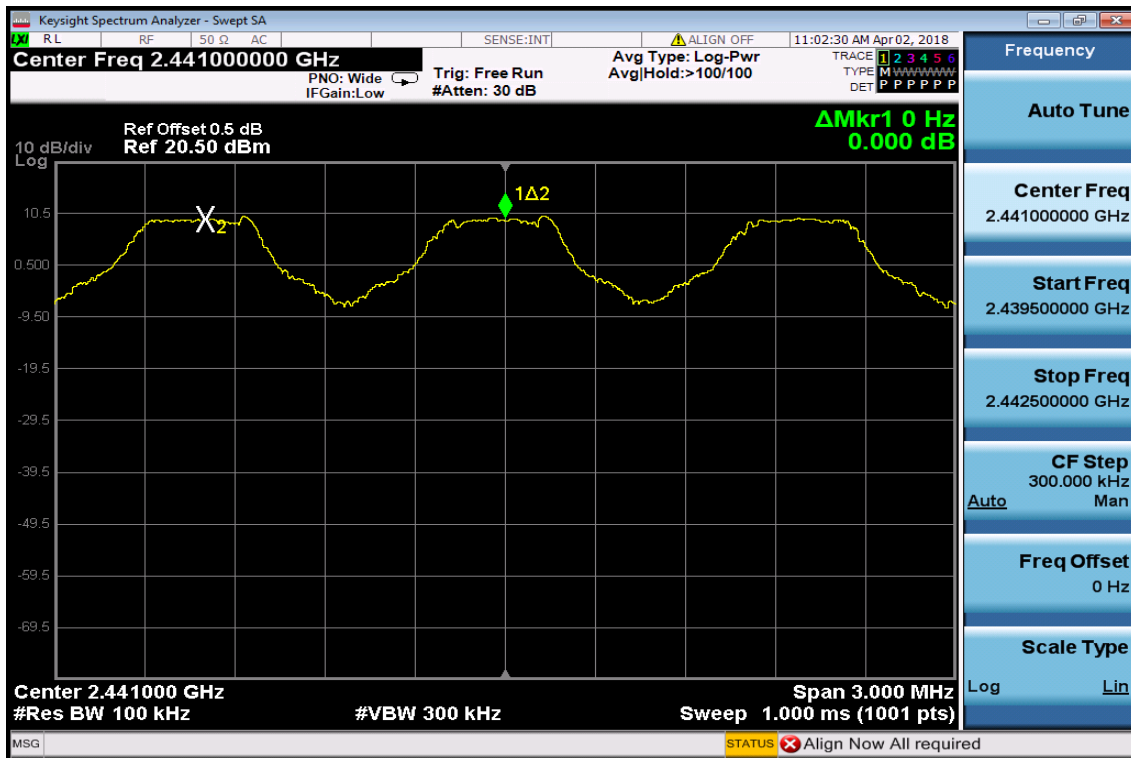


## Frequency Separation Test Data

### Low

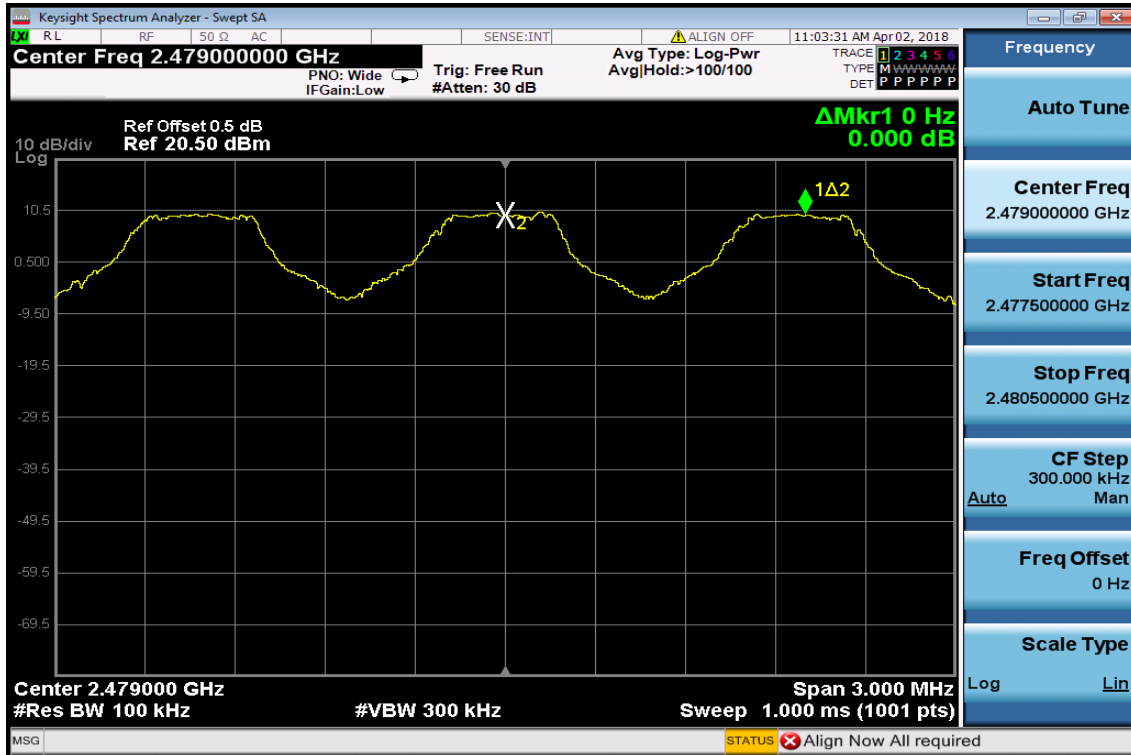


### Mid





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 6.3 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 = 2441MHz and Start=2441MHz, Stop = 2483.5MHz, Sweep = auto.
4. Set the spectrum analyzer as RBW=300kHz, VBW=1MHz
5. Max hold, view and count how many channel in the band.

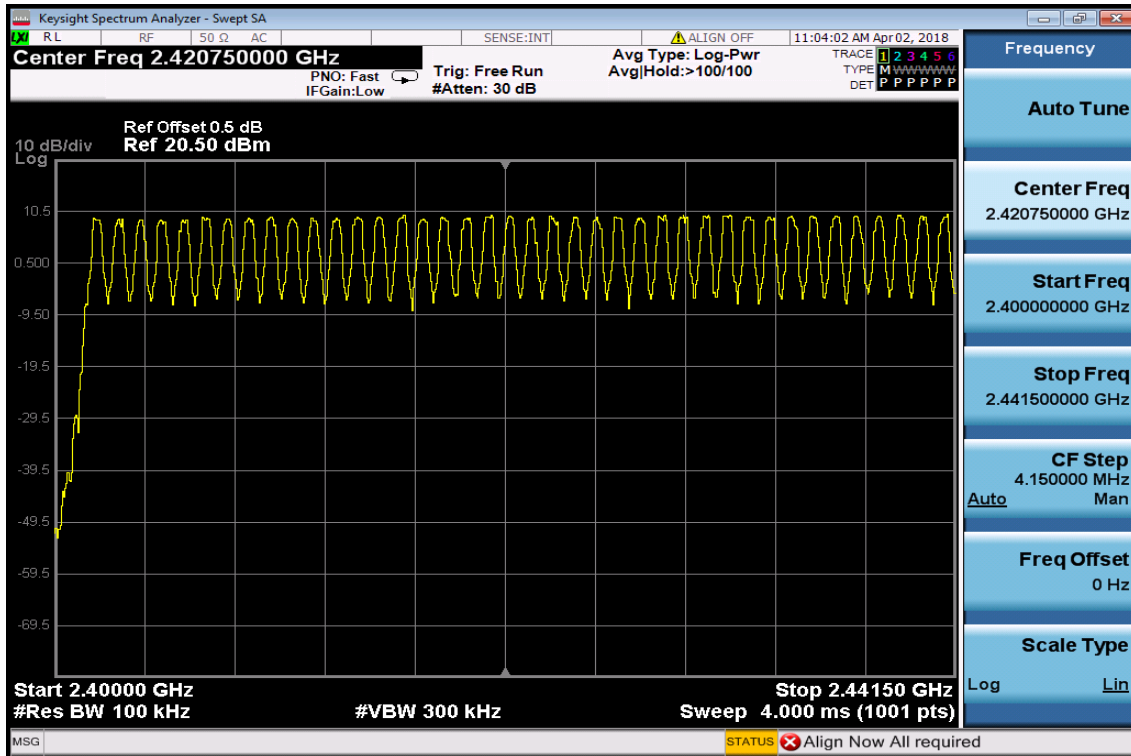
### **10.5. Measurement Result:**

Test Result : 79 Channel > 15 Channel

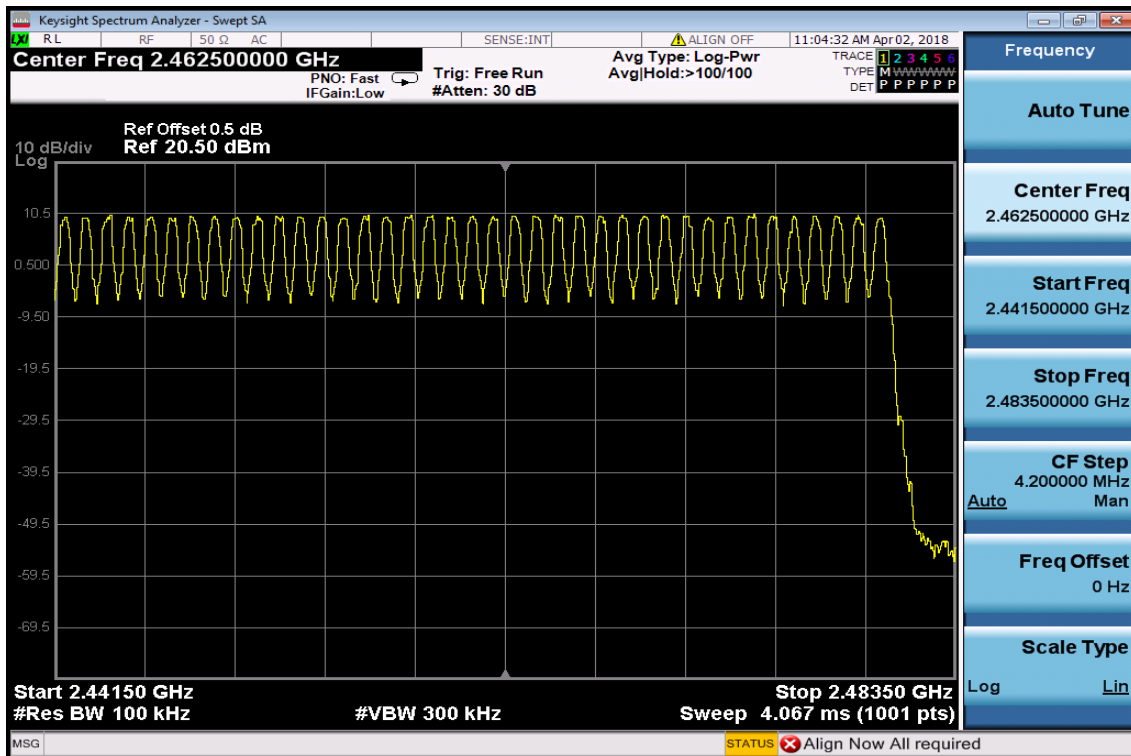
Note: Refer to next page for plots.



## Channel Number 2.4 GHz – 2.441GHz



## 2.441 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 6.3 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 , Adjust Sweep = 2.5ms.
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	=	0.376 (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	=	2.900 (ms)	*	(1600/6/79) * 31.6 =	309.33 (ms)

CH Mid	DH1 time slot	=	0.380 (ms)	*	(1600/2/79) * 31.6 =	121.60 (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)

CH High	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	=	2.880 (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	=	0.376 (ms)	*	(800/2/20) * 8 =	60.16 (ms)
	DH3 time slot	=	1.640 (ms)	*	(800/4/20) * 8 =	131.20 (ms)
	DH5 time slot	=	2.900 (ms)	*	(800/6/20) * 8 =	154.67 (ms)

CH Mid	DH1 time slot	=	0.380 (ms)	*	(800/2/20) * 8 =	60.80 (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)

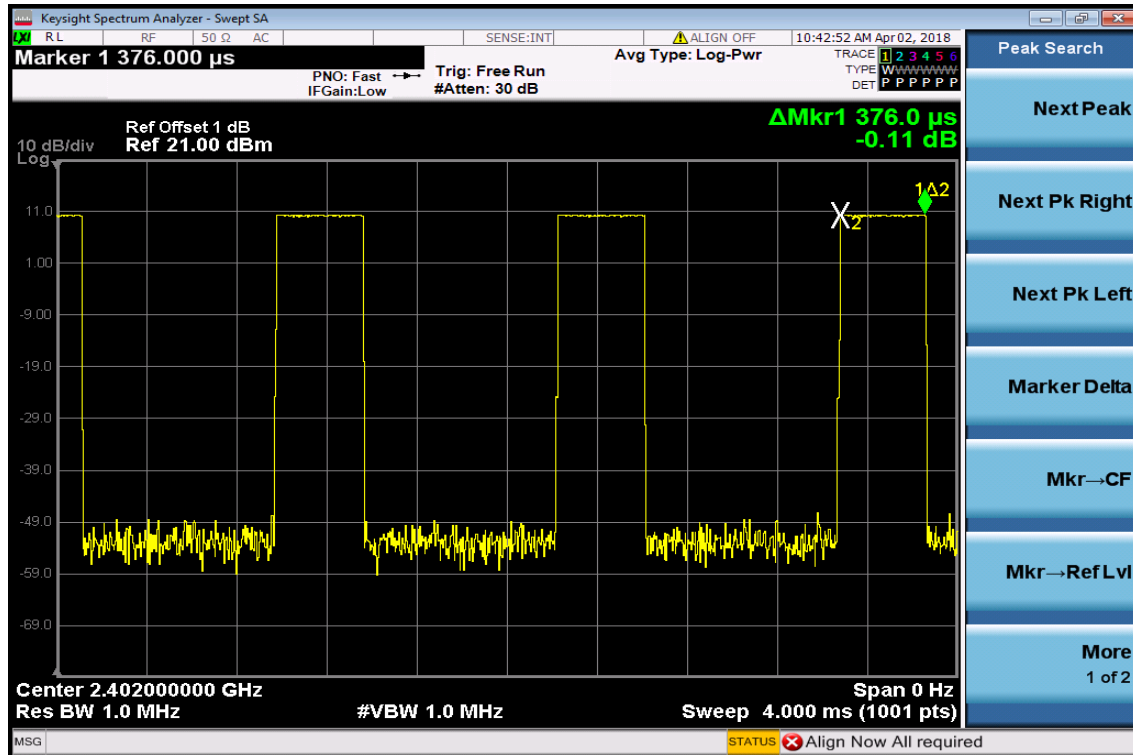
CH High	DH1 time slot	=	0.376 (ms)	*	(800/2/20) * 8 =	60.16 (ms)
	DH3 time slot	=	1.640 (ms)	*	(800/4/20) * 8 =	131.20 (ms)
	DH5 time slot	=	2.880 (ms)	*	(800/6/20) * 8 =	153.60 (ms)

Note: Refer to next page for plots.

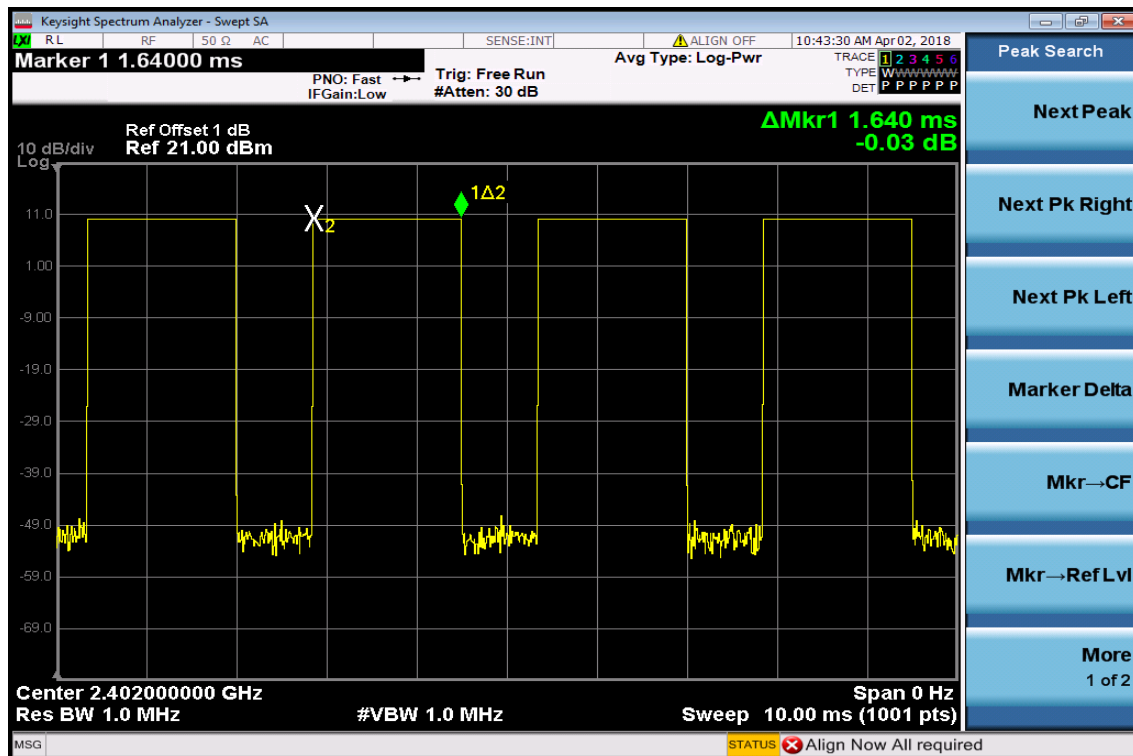


## Low Channel

### DH1

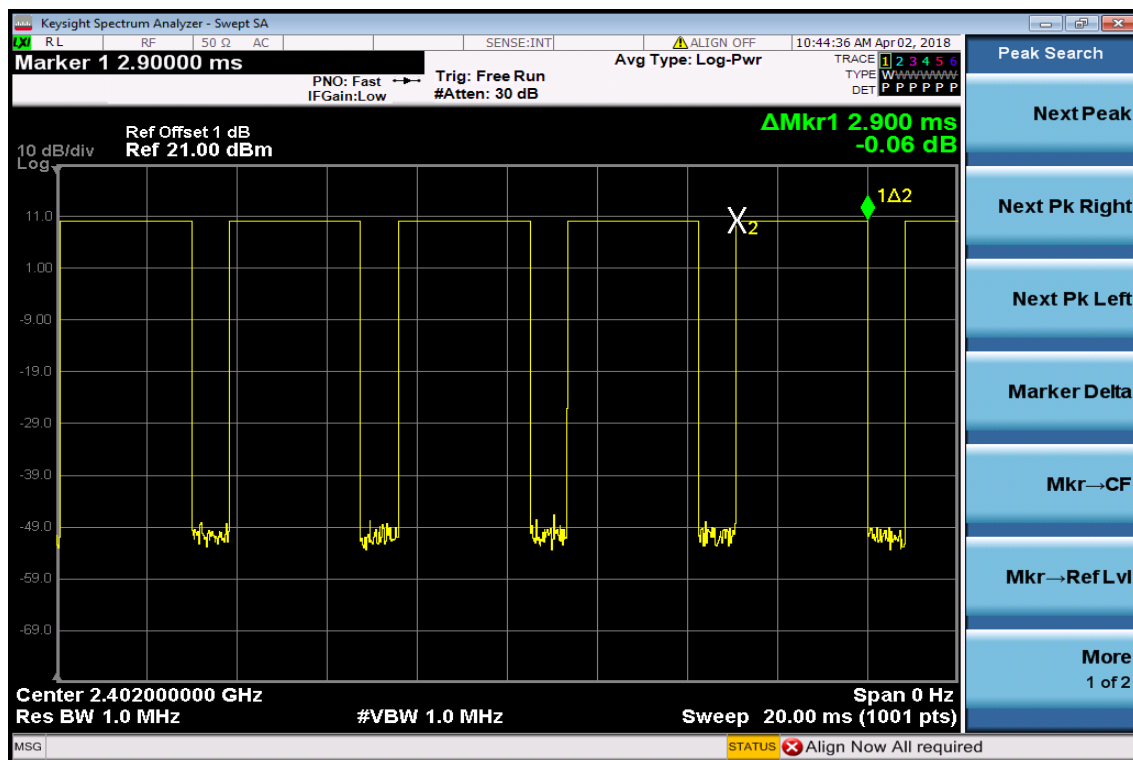


### DH3



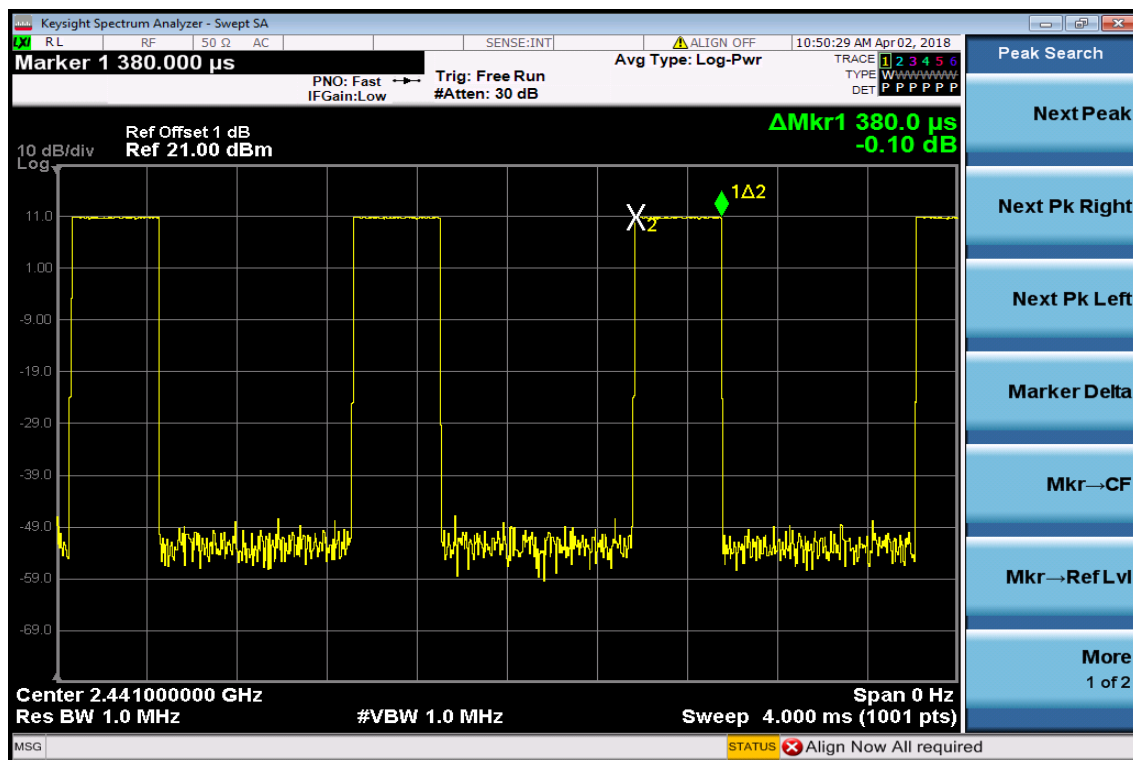


## DH5



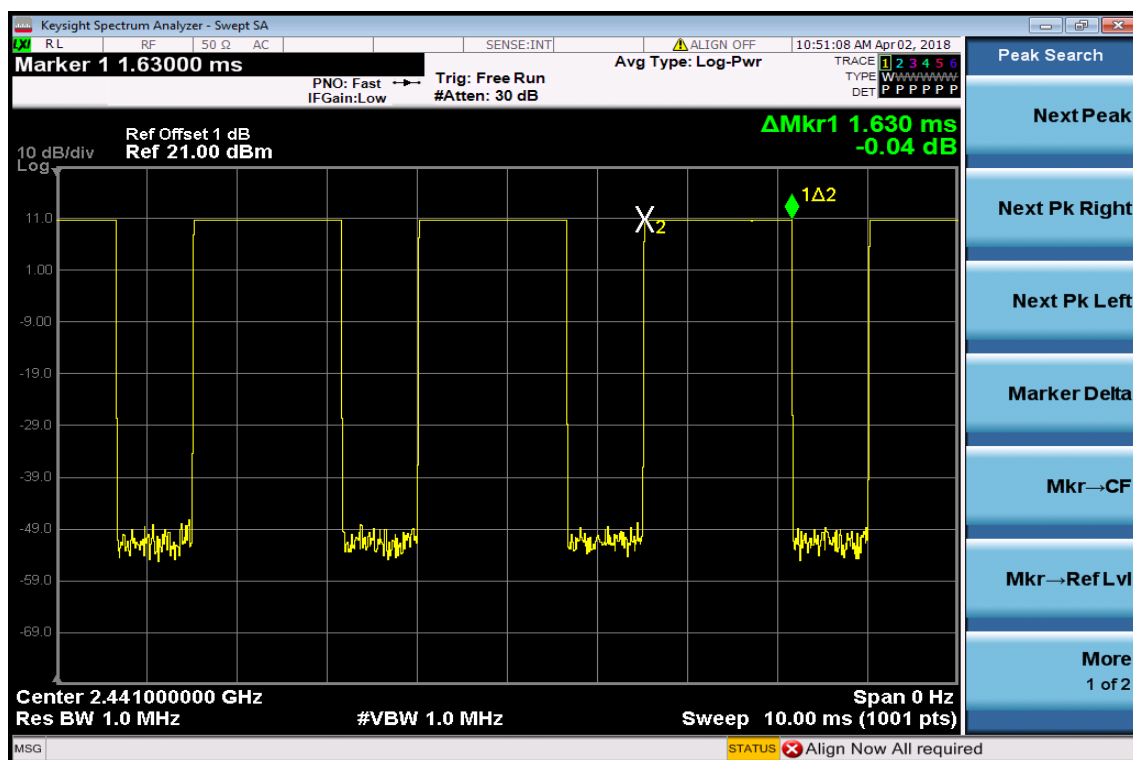
## Mid Channel

## DH1

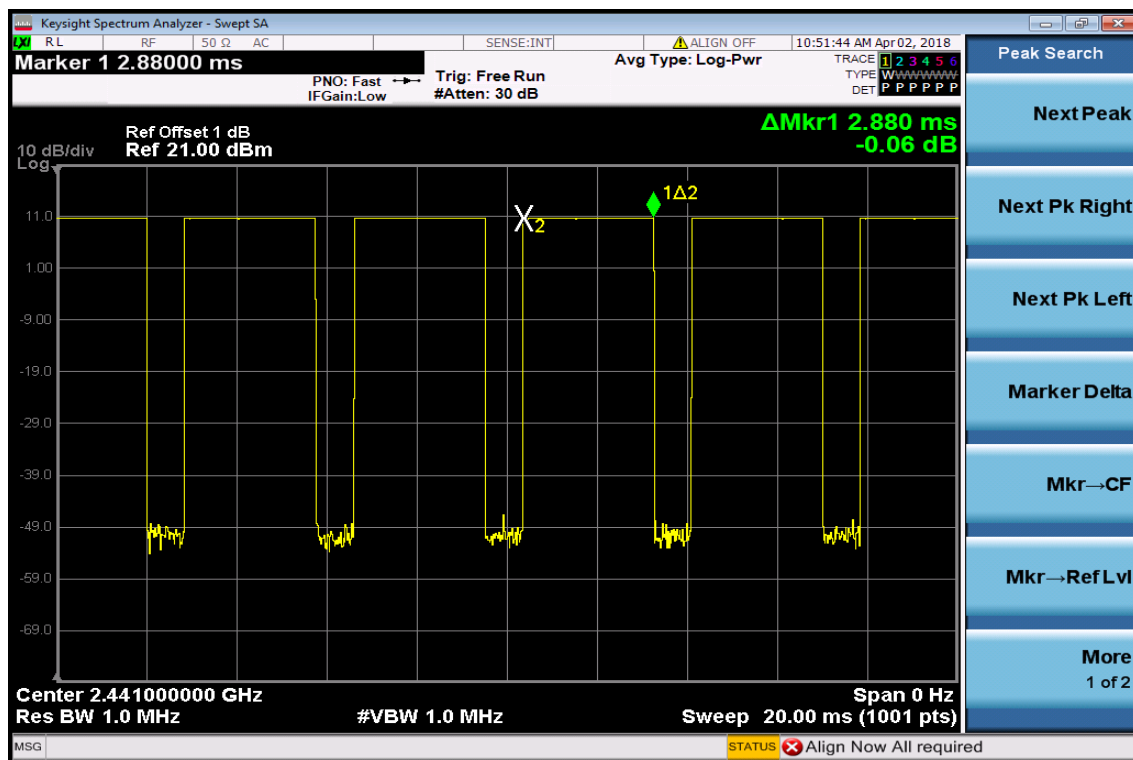




### DH3



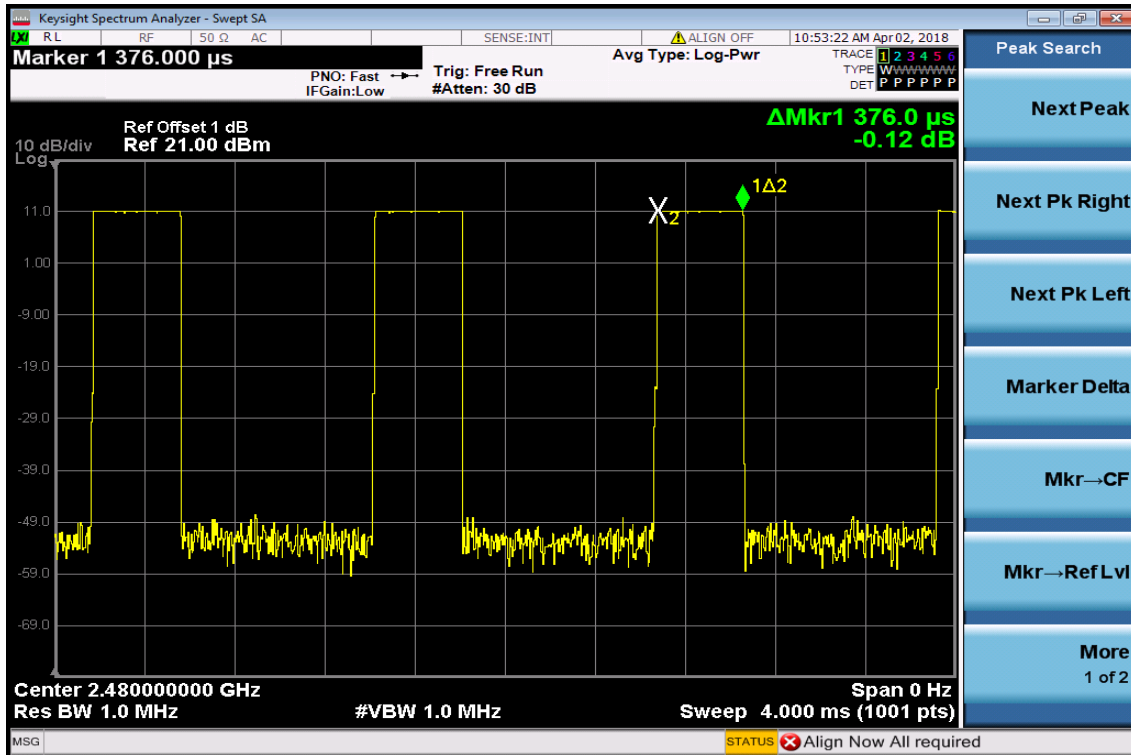
### DH5



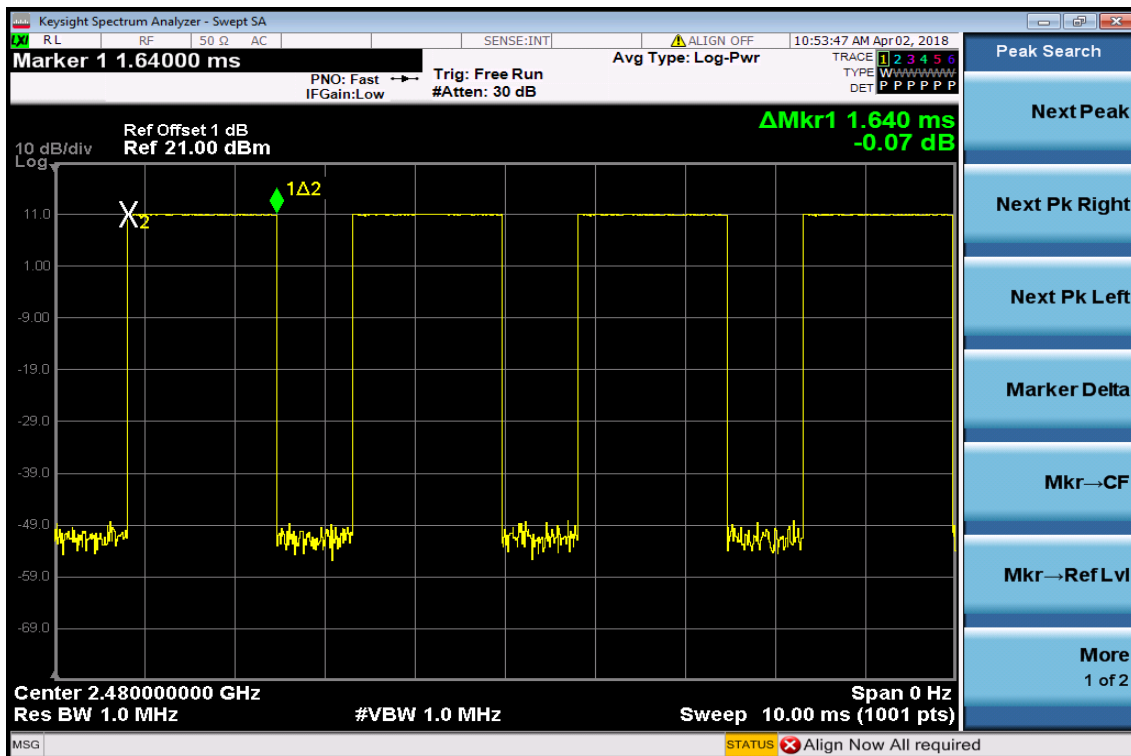


## High Channel

### DH1

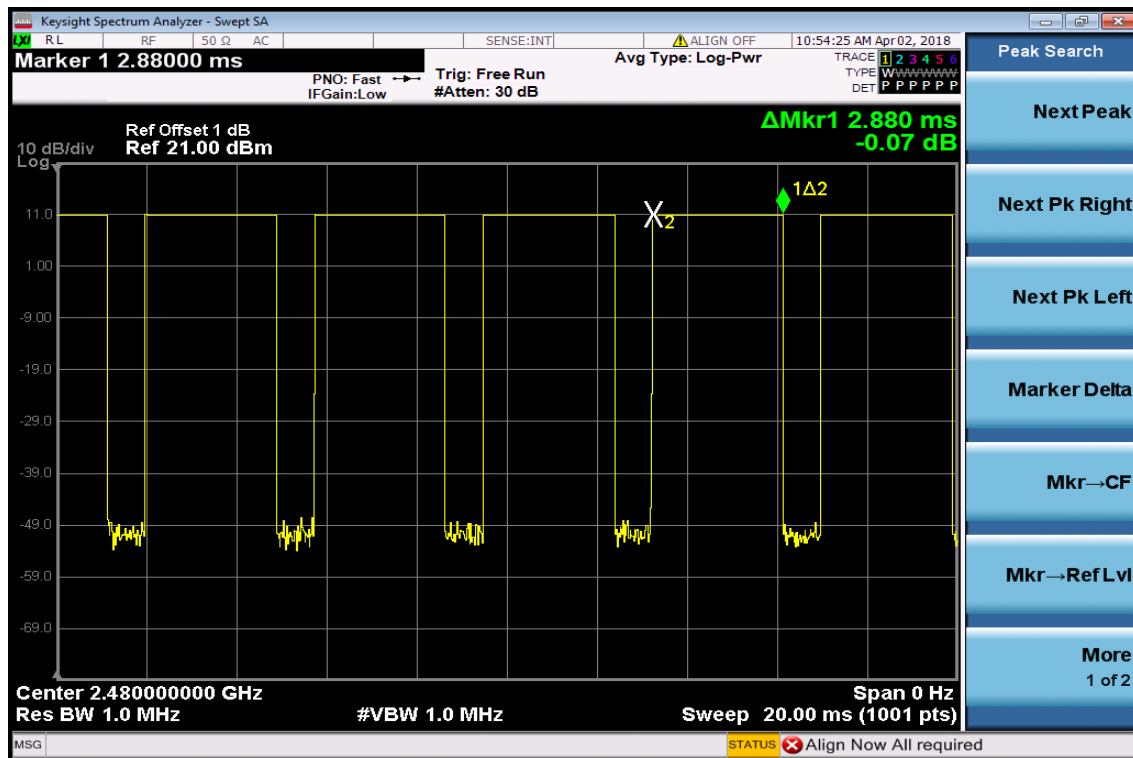


### DH3





DH5





## **12. 20dB Bandwidth Bandwidth**

### **12.1. Standard Applicable:**

According to §15.247(a)(1), 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 6.3 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=10kHz (1 % 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	99% Bandwidth
	(MHz)	
Low	0.923	0.882
Mid	0.923	0.882
High	0.923	0.883

### EDR 2M Mode

CH	20dB Bandwidth	$\frac{2}{3}^*$ 20dB Bandwidth	99% Bandwidth
	(MHz)		
Lower	1.348	0.899	1.205
Mid	1.351	0.901	1.205
Higher	1.352	0.901	1.204

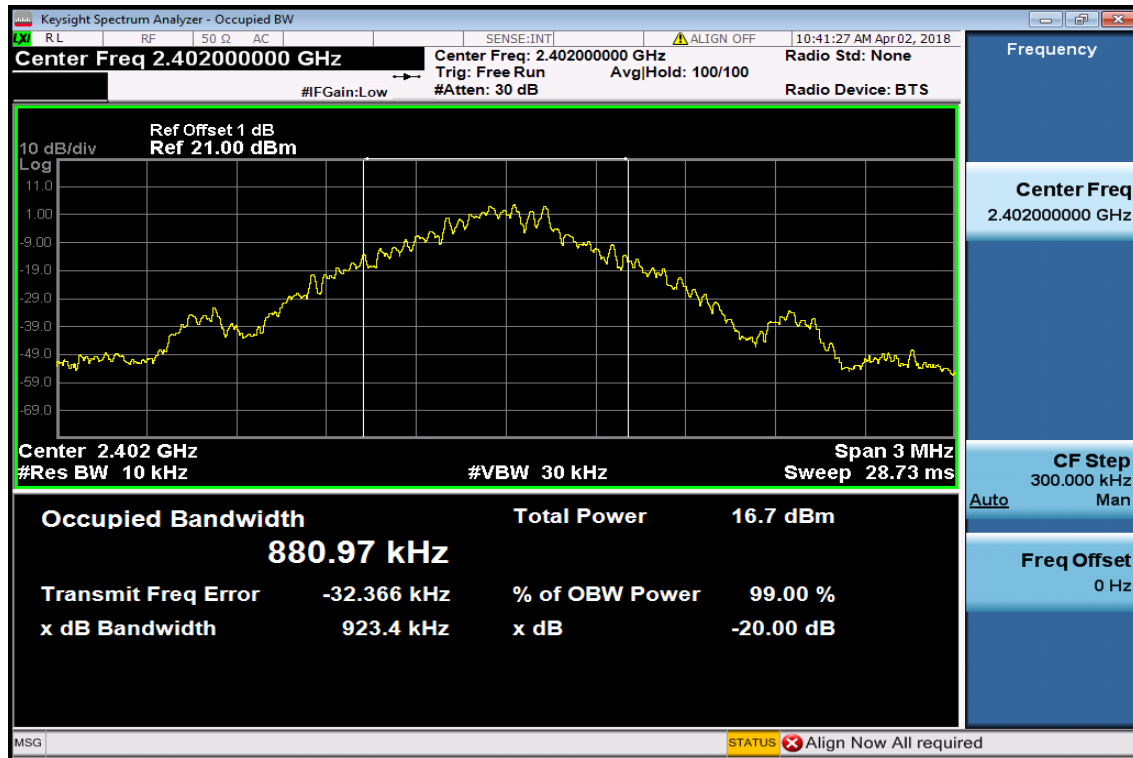
### EDR 3M Mode

CH	20dB Bandwidth	$\frac{2}{3}^*$ 20dB Bandwidth	99% Bandwidth
	(MHz)		
Lower	1.314	0.876	1.209
Mid	1.316	0.877	1.209
Higher	1.316	0.877	1.209

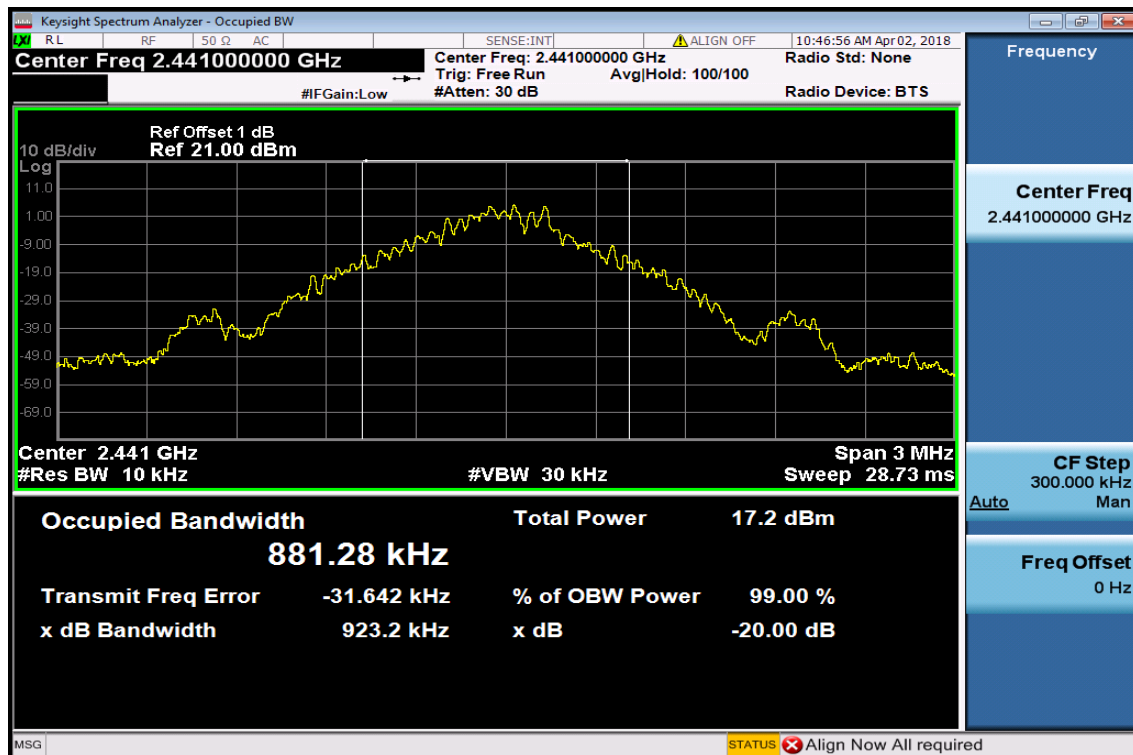
Note: Refer to next page for plots.



## BDR Mode 20dB Bandwidth Test Data CH-Low

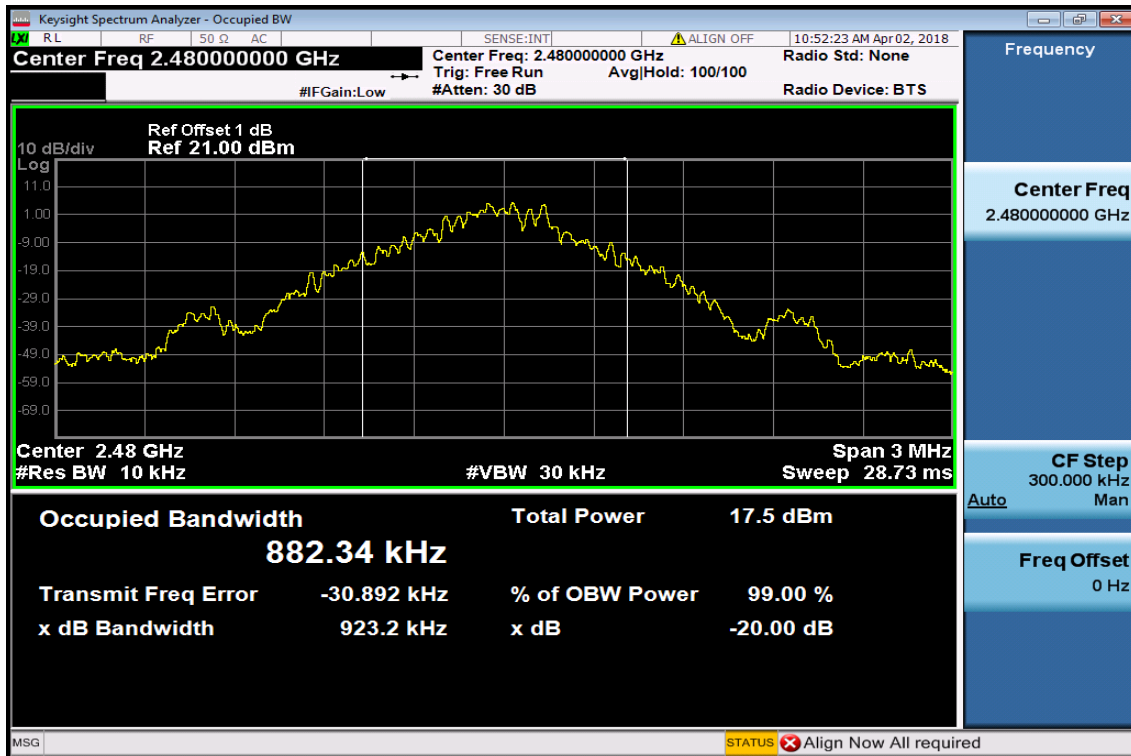


## 20dB Bandwidth Test Data CH-Mid



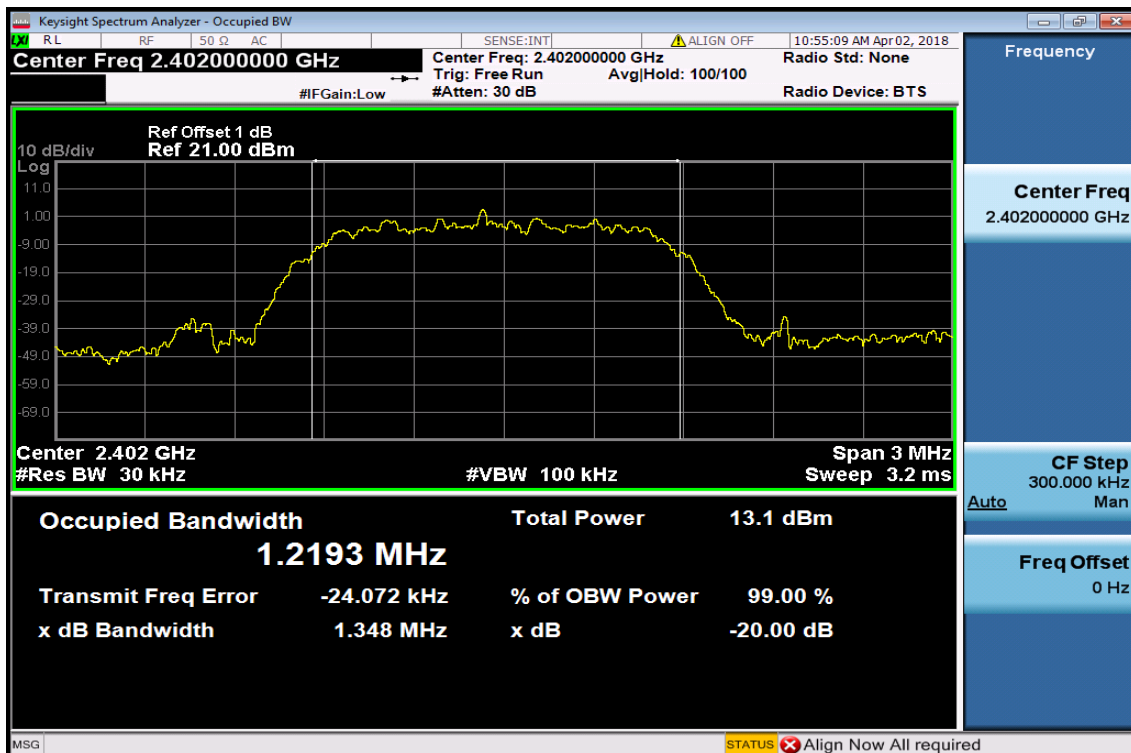


## 20dB Bandwidth Test Data CH-High



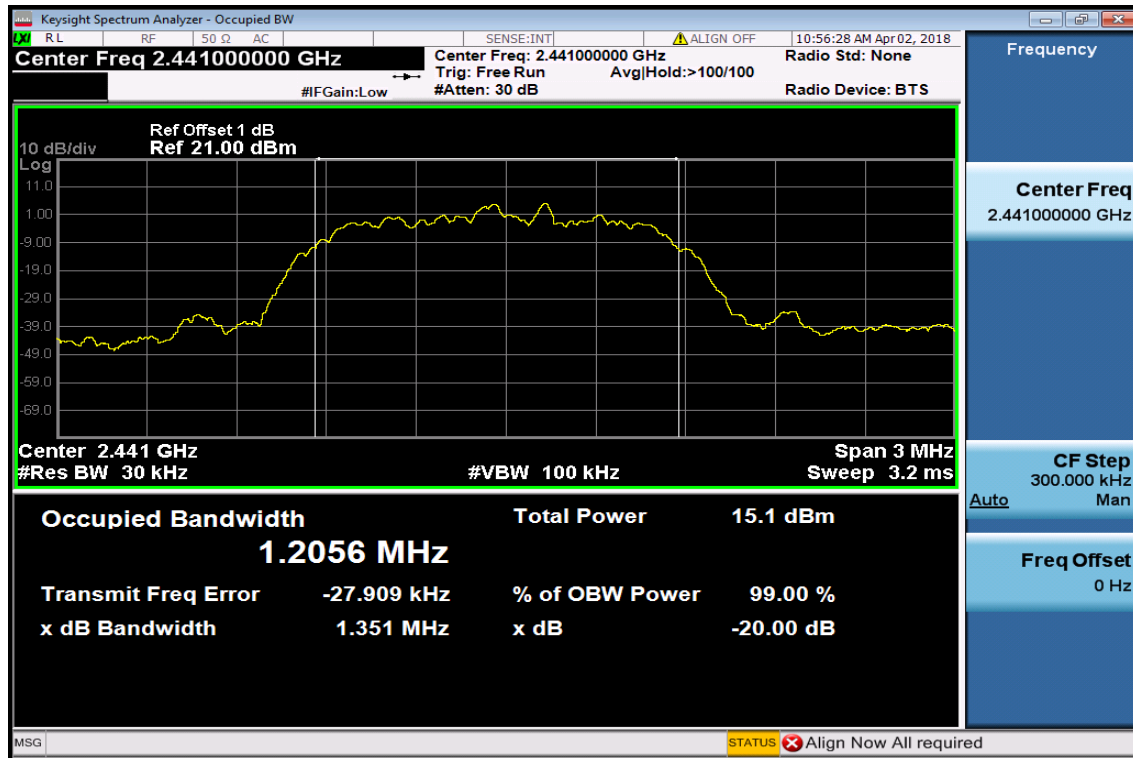
## EDR 2M Mode

## 20dB Bandwidth Test Data CH-Low

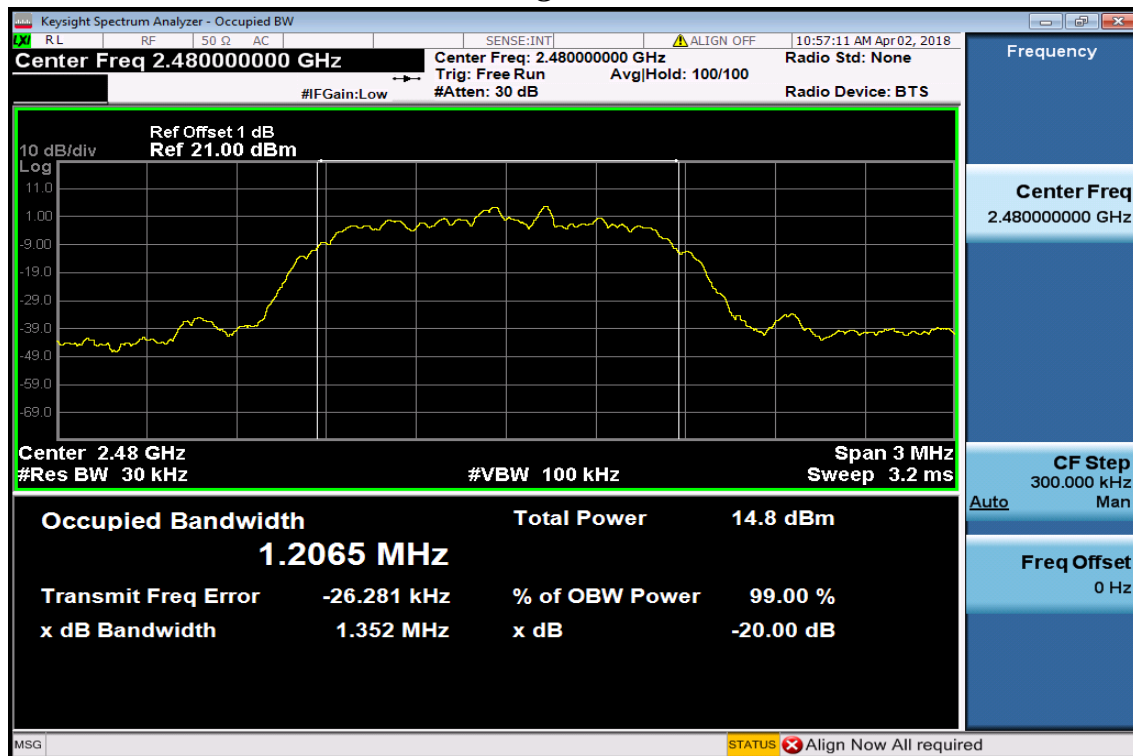




## 20dB Bandwidth Test Data CH-Mid



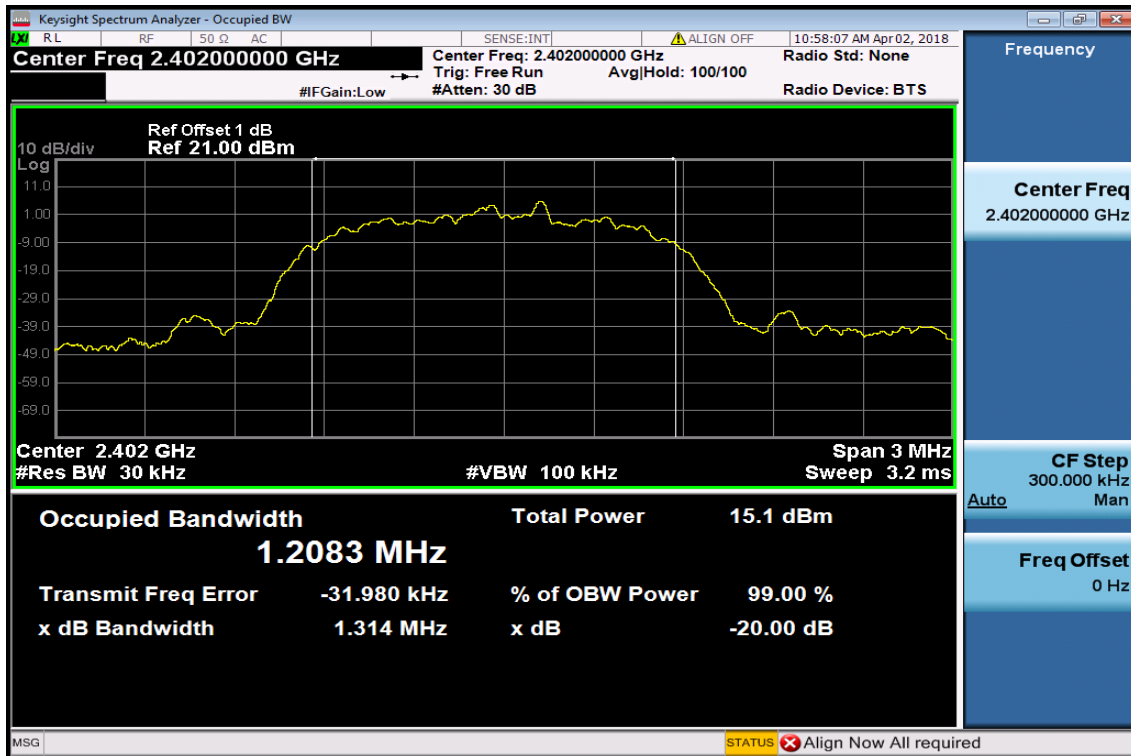
## 20dB Bandwidth Test Data CH-High



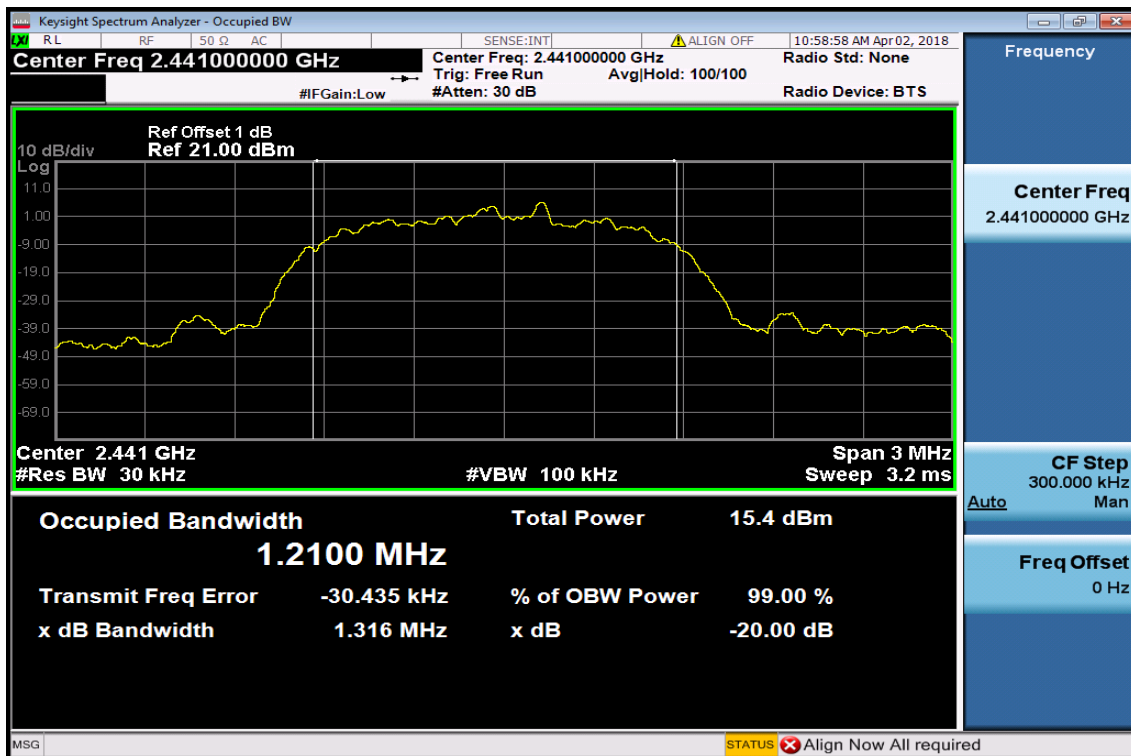


## EDR 3M Mode

### 20dB Bandwidth Test Data CH-Low

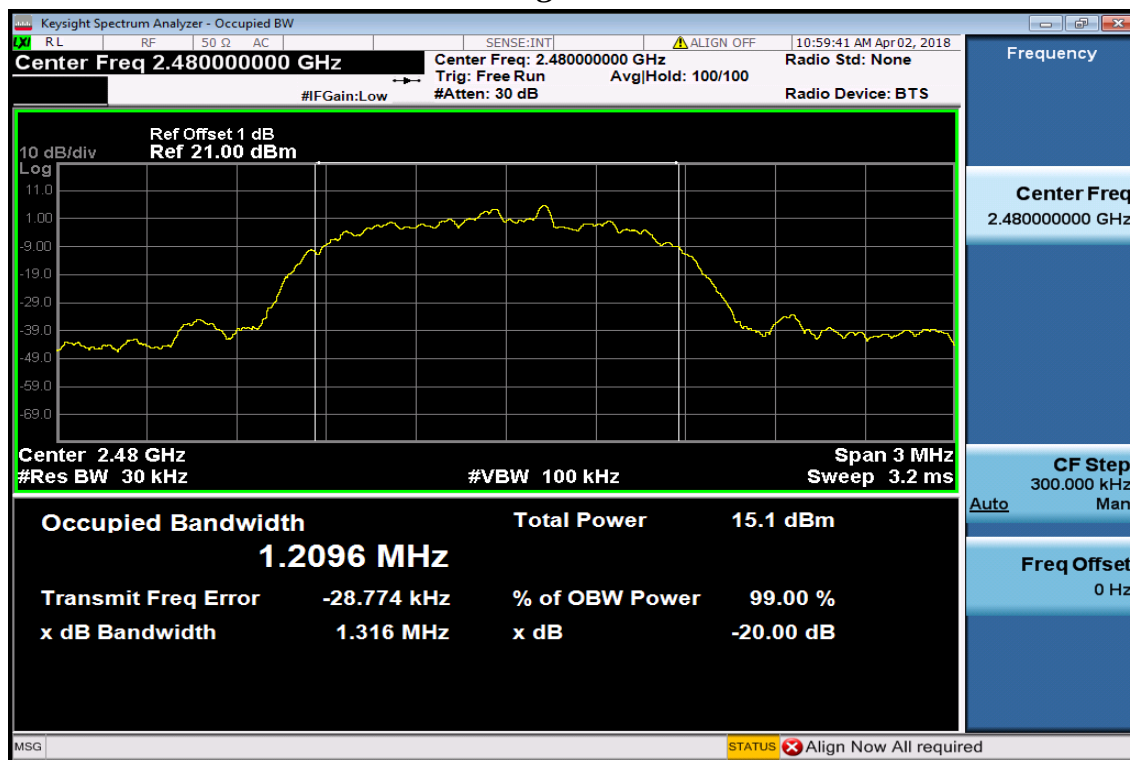


### 20dB Bandwidth Test Data CH-Mid





## 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 -5.70dBi, and the antenna is designed with fixed type and no consideration of replacement. Please see EUT photo and antenna spec. for details.