

## ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

### INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT AND INDUSTRY CANADA RSS 247

OF

<b>Product Name:</b>	<b>BT DEX</b>
<b>Brand Name:</b>	<b>BitTek</b>
<b>Model No.:</b>	<b>DX30</b>
<b>Model Difference:</b>	<b>N/A</b>
<b>FCC ID:</b>	<b>SPYBTS003</b>
<b>IC:</b>	<b>20658-BTS003</b>
<b>Report No.:</b>	<b>ER/2015/90015</b>
<b>Issue Date:</b>	<b>Sep. 25, 2015</b>
<b>FCC Rule Part:</b>	<b>§15.247, Cat: DSS</b>
<b>IC Rule Part:</b>	<b>RSS-247 issue 1 :2015</b>
<b>Prepared for:</b>	<b>BitTek Co., LTD. 6F., No. 115, Wugong 3rd Rd., Wugu Dist., New Taipei City 248, Taiwan</b>
<b>Prepared by:</b>	<b>SGS Taiwan Ltd. Electronics &amp; Communication Laboratory No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803</b>



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## VERIFICATION OF COMPLIANCE

**Applicant:** Bitatek Co., LTD.  
6F., No. 115, Wugong 3rd Rd., Wugu Dist., New Taipei City 248,  
Taiwan

**Product Name:** BT DEX

**Brand Name:** BitaTek

**Model No.:** DX30

**Model Difference:** N/A

**FCC ID:** SPYBTS003

**IC:** 20658-BTS003

**Report Number:** ER/2015/90015

**Date of test:** Sep. 04, 2015 ~ Sep. 25, 2015

**Date of EUT Received:** Sep. 04, 2015

**We hereby certify that:**

The above equipment was tested by SGS Taiwan Ltd. Electronics & Communication Laboratory. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits.

The test results of this report relate only to the tested sample identified in this report.

**Test By:**

JJ Chen

**Date:**

Sep. 25, 2015

*JJ Chen / Engineer*

**Prepared By:**

Karen Huang

**Date:**

Sep. 25, 2015

*Karen Huang / Clerk*

**Approved By:**

Jim Chang

**Date:**

Sep. 25, 2015

*Jim Chang / Asst. Manager*

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## Revision History

Report Number	Revision	Description	Issue Date
ER/2015/90015	Rev.00	Initial creation of document	Sep. 25, 2015

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## 1. GENERAL INFORMATION

### 1.1. Product description

General:

Product Name:	BT DEX	
Brand Name:	BitTek	
Model No.:	DX30	
Model Difference:	N/A	
Product SW/HW version:	V0.94 / DEX ES2	
Radio SW/HW version:	N/A	
Test SW Version:	N/A	
RF power setting in TEST SW:	N/A	
Data Cable:	Model No.: DX30; Supplier: Bitatek	
4-Slot Charger:	Model No.: DX30; Supplier: Bitatek	
Power Supply:	3.6Vdc from rechargeable battery	
	Battery:	Model No.: DX30, Supplier: JMS

Bluetooth\_BR+EDR:

Bluetooth Version:	Bluetooth V4.0 dual mode
Channel number:	79 channels
Modulation type:	Frequency Hopping Spread Spectrum
Transmit Power:	4.37dBm
Frequency Range:	2.402GHz – 2.480GHz
Dwell Time:	<= 0.4s
Antenna Designation:	Chip Antenna ,Gain: 5.79dBi

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## 1.2. Product Feature of Equipment Under Test

The equipment under Test (Hereafter Called: EUT) is BT DEX supporting, Bluetooth and NFC features, and below is details of information.

Product Feature	
Product Name:	BT DEX
Brand Name:	BitaTek
Model Difference:	DX30
Model No.:	N/A
FCC ID:	SPYBTS003
IC:	20658-BTS003
Bluetooth Version	Bluetooth V4.0 dual mode
NFC	Receiver

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

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### 1.3. Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247

FCC Public Notice DA 00-705 Measurement Guidelines

Canada RSS-247 issue 1: 2015

RSS-Gen Issue 4:2014

ANSI C63.10:2013

Note:

1. All test items have been performed and record as per the above standards.
2. The composite system is compliance with FCC Subpart B is authorized under a DoC procedure.

### 1.4. Test Facility

SGS Taiwan Ltd. Electronics & Communication Laboratory No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803 (TAF code 0513)

FCC Registration Numbers are: 990257

Canada Registration Number: 4620A-4.

### 1.5. Special Accessories

There is no special accessory used while test was conducted.

### 1.6. Equipment Modifications

There was no modification incorporated into the EUT.

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## 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

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

### 2.3. Test Procedure

#### 2.3.1 Conducted Emissions

The EUT is placed on a turn table which is 0.8 m above ground plan. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz,. The CISPR Quasi-Peak and Average detector mode is employed according to §15.207. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

#### 2.3.2 Radiated Emissions

The EUT is placed on a turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plan. For emission measurements above 1 GHz, the table height shall be 1.5 m. 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 and 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.

### 2.4. Measurement Results Explanation Example

#### For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuation factor between EUT conducted port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly EUT RF output level.

#### Note:

The spectrum analyzer offset is derived from RF cable loss and attenuator factor. Following shows an offset computation example with cable loss 3.50dB.

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## 2.5. Configuration of Tested System

Fig. 2-1 Configuration of Tested System

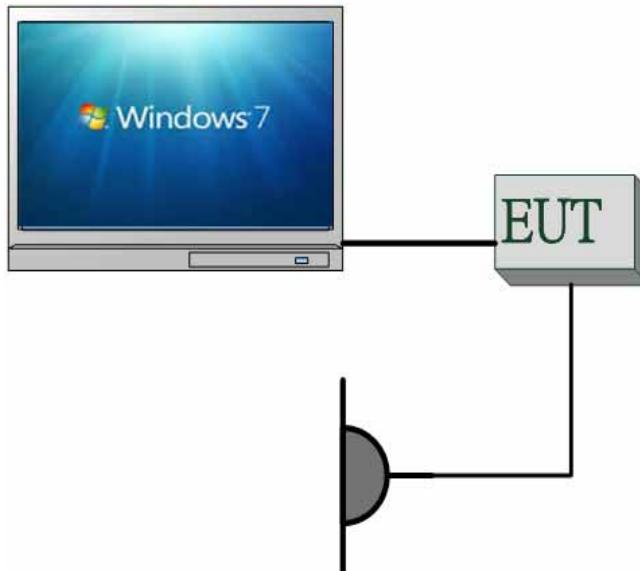


Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/ Model No.	Series No.	Data Cable	Power Cord
1.	BT Test Software	N/A	N/A	N/A	N/A	N/A
2.	Notebook	Lenovo	L420	LR-7HXZA	Shielded	Un-shielded

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### 3. SUMMARY OF TEST RESULTS

FCC Rules / IC Rules	Description Of Test	Result
§15.207(a) RSS-Gen §8.8	AC Power Line Conducted Emission	N/A
§15.247(b)(1) RSS-247 §5.4 (2)	Peak Output Power	Compliant
§15.247(a)(1) RSS-247 §5.1 (1) RSS-Gen §6.6	20dB & 99% Bandwidth	Compliant
§15.247(d) RSS-247 §5.5	Conducted Band Edge and Spurious Emission	Compliant
§15.247(d) RSS-247 §5.5	Radiated Band Edge and Spurious Emission	Compliant
§15.247(a)(1) RSS-247 §5.1 (2)	Frequency Separation	Compliant
§15.247(a)(1)(iii) RSS-247 §5.1 (4)	Number of hopping frequency	Compliant
§15.247(a)(1)(iii) RSS-247 §5.1 (4)	Time of Occupancy	Compliant
§15.203 §15.247(b) RSS- Gen §6.7 RSS- Gen §8.3	Antenna Requirement	Compliant

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## 4. DESCRIPTION OF TEST MODES

### 4.1. Operated in 2400 ~ 2483.5MHz Band

79 channels are provided for Bluetooth

CH	FREQUENCY	CH	FREQUENCY	CH	FREQUENCY	CH	FREQUENCY
0	2402 MHz	20	2422 MHz	40	2442 MHz	70	2462 MHz
1	2403 MHz	21	2423 MHz	41	2443 MHz	71	2463 MHz
2	2404 MHz	22	2424 MHz	42	2444 MHz	72	2464 MHz
3	2405 MHz	23	2425 MHz	43	2445 MHz	73	2465 MHz
4	2406 MHz	24	2426 MHz	44	2446 MHz	74	2466 MHz
5	2407 MHz	25	2427 MHz	45	2447 MHz	75	2467 MHz
6	2408 MHz	26	2428 MHz	46	2448 MHz	76	2468 MHz
7	2409 MHz	27	2429 MHz	47	2449 MHz	77	2469 MHz
8	2410 MHz	28	2430 MHz	48	2450 MHz	78	2470 MHz
9	2411 MHz	29	2431 MHz	49	2451 MHz	79	2471 MHz
10	2412 MHz	30	2432 MHz	50	2452 MHz	70	2472 MHz
11	2413 MHz	31	2433 MHz	51	2453 MHz	71	2473 MHz
12	2414 MHz	32	2434 MHz	52	2454 MHz	72	2474 MHz
13	2415 MHz	33	2435 MHz	53	2455 MHz	73	2475 MHz
14	2416 MHz	34	2436 MHz	54	2456 MHz	74	2476 MHz
15	2417 MHz	35	2437 MHz	55	2457 MHz	75	2477 MHz
16	2418 MHz	36	2438 MHz	56	2458 MHz	76	2478 MHz
17	2419 MHz	37	2439 MHz	57	2459 MHz	77	2479 MHz
18	2420 MHz	38	2440 MHz	58	2460 MHz	78	2480 MHz
19	2421 MHz	39	2441 MHz	59	2461 MHz		

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**4.2. The Worst Test Modes and Channel Details**

- 1 The EUT has been tested under operating condition.
- 2 Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.
- 3 Investigation has been done on all the possible configurations for searching the worst case.

**RADIATED EMISSION TEST:**

<b>RADIATED EMISSION TEST (BELOW 1 GHz)</b>					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	PACKET TYPE	ANTENNA PORT
Bluetooth	0 to 78	0,39,78	GFSK	DH5	MAIN
<b>RADIATED EMISSION TEST (ABOVE 1 GHz)</b>					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	PACKET TYPE	ANTENNA PORT
Bluetooth	0 to 78	0,39,78	GFSK	DH5	MAIN

**Note:**

The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for Bluetooth BR+EDR Transmitter for channel Low, Mid and High, the worst case E2 position was reported.

**ANTENNA PORT CONDUCTED MEASUREMENT:**

<b>CONDUCTED TEST</b>					
<b>Peak Output Power, 20dB Band Width</b>					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	PACKET TYPE	ANTENNA PORT
Bluetooth	0 to 78	0,39,78	GFSK	DH5	MAIN
	0 to 78	0,39,78	$\pi/4$ -DQPSK	2DH5	MAIN
	0 to 78	0,39,78	8-DQPK	3DH5	MAIN
<b>Band Edge</b>					
Bluetooth	0 to 78	0,78	GFSK	DH5	MAIN
<b>Frequency Separation</b>					
Bluetooth	0 to 78	0,1,2	GFSK	DH5	MAIN
<b>Number of hopping frequency</b>					
Bluetooth	0 to 78	0 to 78	GFSK	DH5	MAIN
<b>Time of Occupancy (Dwell time)</b>					
Bluetooth	0 to 78	0,39,78	GFSK	DH1/DH3/DH5	MAIN
Bluetooth	0 to 78	39	$\pi/4$ -DQPSK	DH1/DH3/DH5	MAIN
Bluetooth	0 to 78	39	8-DPSK	DH1/DH3/DH5	MAIN

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## 5. MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.586 dB
Peak Output Power	+/- 0.84 dB
20dB Bandwidth	+/- 51.33 Hz
100 KHz Bandwidth Of Frequency Band Edges	+/- 0.84 dB
Frequency Separation	+/- 51.33 Hz
Number of hopping frequency	+/- 51.33 Hz
Time of Occupancy	+/- 51.33 Hz
Temperature	+/- 0.65 °C
Humidity	+/- 4.6 %
DC / AC Power Source	DC= +/- 0.13%, AC= +/- 0.2%

### Radiated Spurious Emission:

Measurement uncertainty (Polarization : <b>Vertical</b> )	30MHz - 180MHz: +/- 3.37dB
	180MHz -417MHz: +/- 3.19dB
	0.417GHz-1GHz: +/- 3.19dB
	1GHz - 18GHz: +/- 4.04dB
	18GHz - 40GHz: +/- 4.04dB
Measurement uncertainty (Polarization : <b>Horizontal</b> )	30MHz - 167MHz: +/- 4.22dB
	167MHz -500MHz: +/- 3.44dB
	0.5GHz-1GHz: +/- 3.39dB
	1GHz - 18GHz: +/- 4.08dB
	18GHz - 40GHz: +/- 4.08dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

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## 6. CONDUCTED EMISSION TEST

### 6.1. Standard Applicable

Frequency within 150 kHz 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.

### 6.2. Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESCI7	100760	05/04/2015	05/03/2016
LISN	SCHWARZ BECK	NSLK 8127	8127-649	05/15/2015	05/14/2016
LISN	FCC	FCC-LISN-50/250-2 5-2-01	04034	03/13/2015	03/12/2016
Coaxial Cables	N/A	WK CE Cable	N/A	11/26/2014	11/25/2015
EMI Test Receiver	R&S	ESCI7	100760	05/04/2015	05/03/2016

### 6.3. EUT Setup

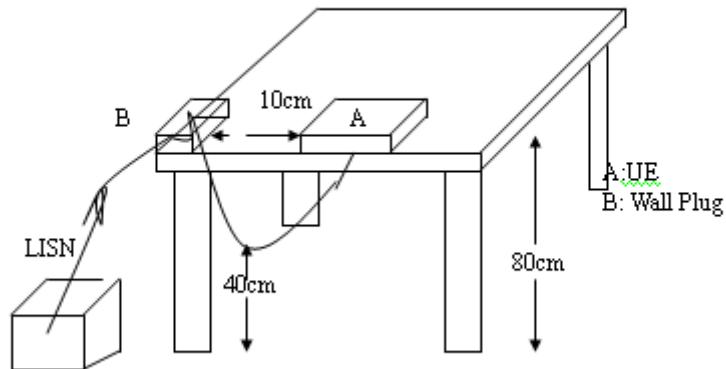
1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI 63.10:2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

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## 6.4. Test SET-UP (Block Diagram of Configuration)



## 6.5. Measurement Procedure

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

## 6.6. Measurement Result

N/A, EUT powered by rechargeable battery.

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## 7. PEAK OUTPUT POWER MEASUREMENT

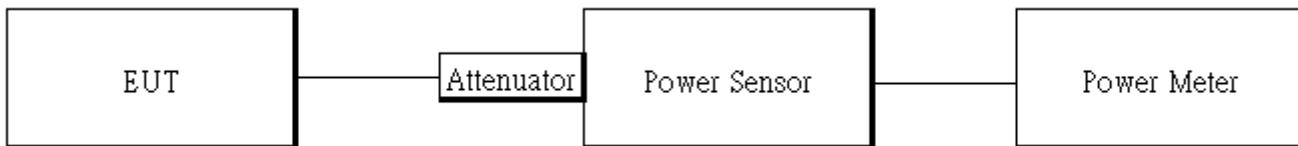
### 7.1. Standard Applicable

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, The Limit: 1Watt. For all other frequency hopping systems in the 2400 – 2483.5MHz band: The Limit: 0.125 Watts. The power limit for 1Mbps is 1watt, and 2Mbps, 3Mbps and AFH mode are 0.125 watts.

### 7.2. Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	ML2495A	1005007	12/20/2014	12/19/2015
Power Sensor	Anritsu	MA2411B	917032	12/20/2014	12/19/2015
Spectrum Analyzer	Agilent	E4446A	MY51100003	01/29/2015	01/28/2016
Low Loss Cable	HUBER+SUHNE R	SUCOFLEX 104PEA	N/A	01/02/2015	01/01/2016
Spectrum Analyzer	Agilent	E4440A	MY45304525	05/05/2015	05/04/2016
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2015	01/01/2016
Attenuator	Mini-Circuit	BW-S10W2+	002	01/02/2015	01/01/2016
Splitter	Agilent	11636B	N/A	01/02/2015	01/01/2016

### 7.3. Test Set-up:



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#### 7.4. Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter or spectrum. (Max Hold, Detector = Peak, RBW >=20dB bandwidth)
4. Record the max. reading.
5. Repeat above procedures until all default test channel is completed.

#### 7.5. Measurement Result

GFSK (1 Mbps)				
Channel	Frequency (MHz)	Output Power (dBm)	Output Power (mW)	Limit (mW)
0	2402.00	2.01	1.58855	1000
39	2441.00	3.67	2.32809	1000
78	2480.00	<b>4.37</b>	2.73527	1000
$\pi/4$ -DQPSK (2 Mbps)				
Channel	Frequency (MHz)	Output Power (dBm)	Output Power (mW)	Limit (mW)
0	2402.00	-0.12	0.97275	125
39	2441.00	1.95	1.56675	125
78	2480.00	3.11	2.04644	125
8-DPSK (3 Mbps)				
Channel	Frequency (MHz)	Output Power (dBm)	Output Power (mW)	Limit (mW)
0	2402.00	0.10	1.02329	125
39	2441.00	2.14	1.63682	125
78	2480.00	3.27	2.12324	125

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## 8. 20dB & 99% BANDWIDTH MEASUREMENT

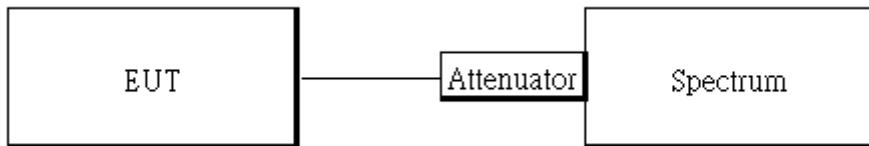
### 8.1. Standard Applicable

For frequency hopping systems operating in the 2400MHz-2483.5 MHz no limit for 20dB bandwidth.

### 8.2. Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Agilent	E4446A	MY51100003	01/29/2015	01/28/2016
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2015	01/01/2016
Attenuator	Mini-Circuit	BW-S10W2+	002	01/02/2015	01/01/2016
Splitter	Agilent	11636B	N/A	01/02/2015	01/01/2016

### 8.3. Test Set-up



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## 8.4. Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set the spectrum analyzer as RBW=10 kHz (1 % of 20 dB Bandwidth.), VBW = 30 kHz, Span= 3MHz, Sweep=auto, Detector = Peak, and Max hold for 20dB Bandwidth test.
5. Repeat above procedure for 99% Bandwidth, but set RBW to 1% of the span, and detector = sample.
6. Mark the peak frequency and –20dB (upper and lower) frequency and Turn on the 99% bandwidth function,
7. Max reading. Repeat above procedures until all test default channel is completed

**NOTE:**

1. For the plot of bandwidth measurement, the marker of the 20dB BW is arrow-mark

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## 8.5. Measurement Result

GFSK				
Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)	2/3 Bandwidth (MHz)
0	2402	0.922	0.8591	---
39	2441	0.924	0.8682	---
78	2480	0.923	0.8462	---
$\pi/4$ -DQPSK				
Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)	2/3 Bandwidth (MHz)
0	2402	1.32	1.1896	0.88
39	2441	1.33	1.1948	0.89
78	2480	1.32	1.1903	0.88
8-DPSK				
Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)	2/3 Bandwidth (MHz)
0	2402	1.31	1.1894	0.87
39	2441	1.27	1.1994	0.85
78	2480	1.27	1.1734	0.85

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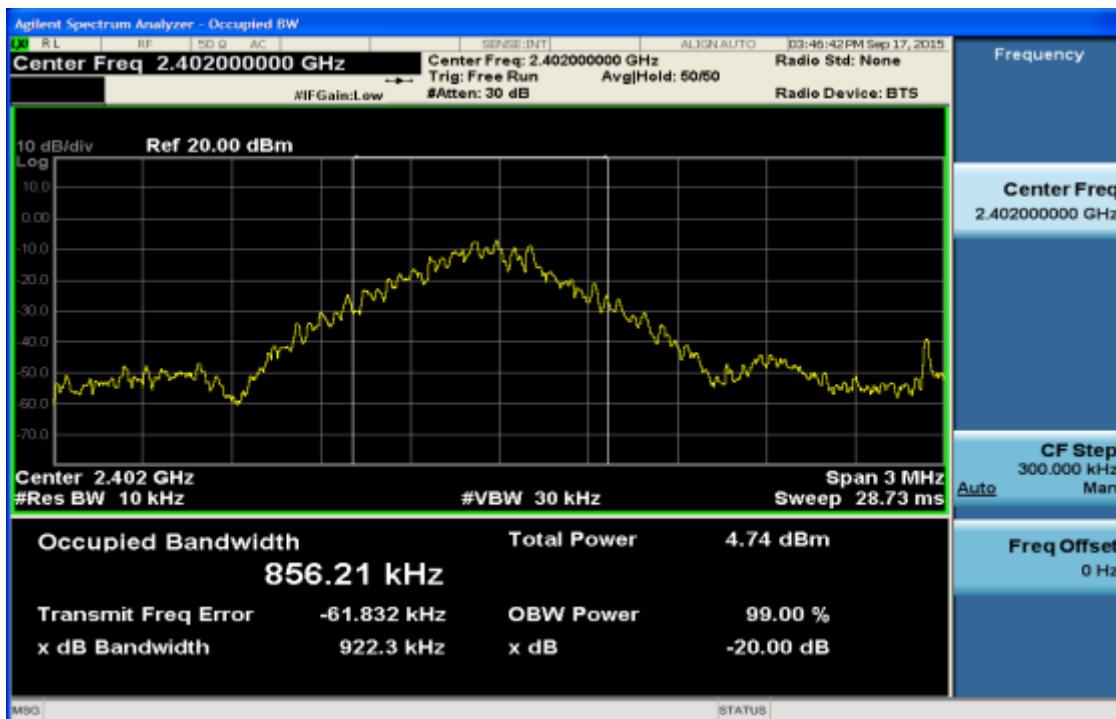
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f (886-2) 2298-0488

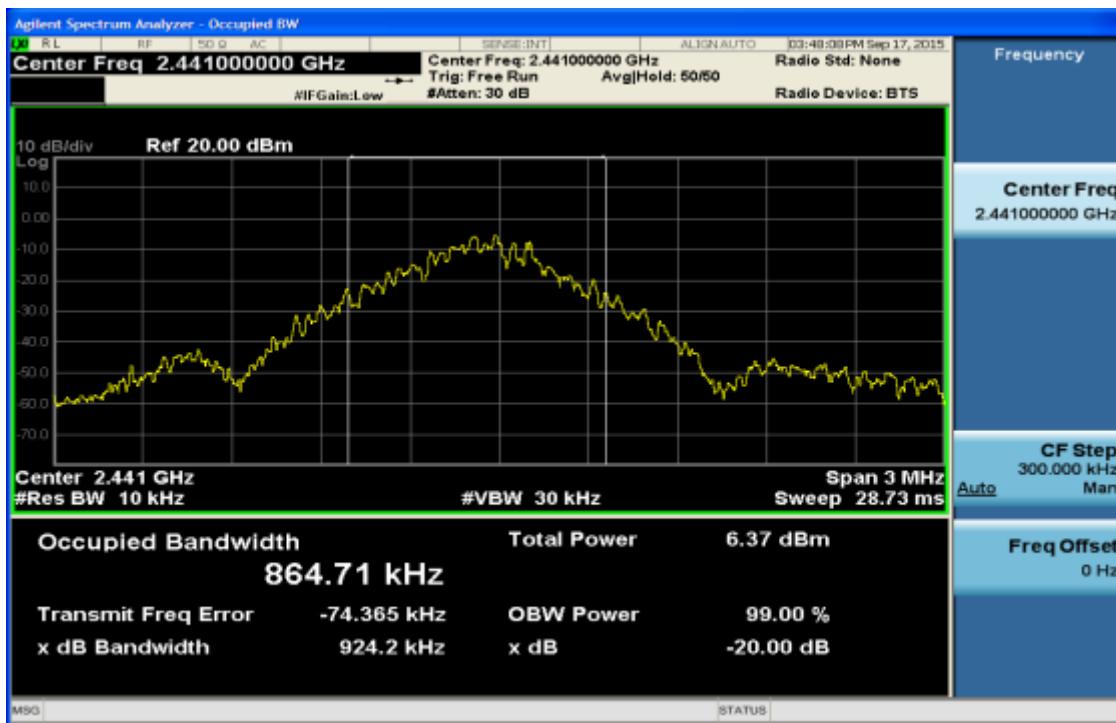
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## 20dB Band Width Test Data CH-Low (GFSK mode)



## 20dB Band Width Test Data CH-Mid (GFSK mode)

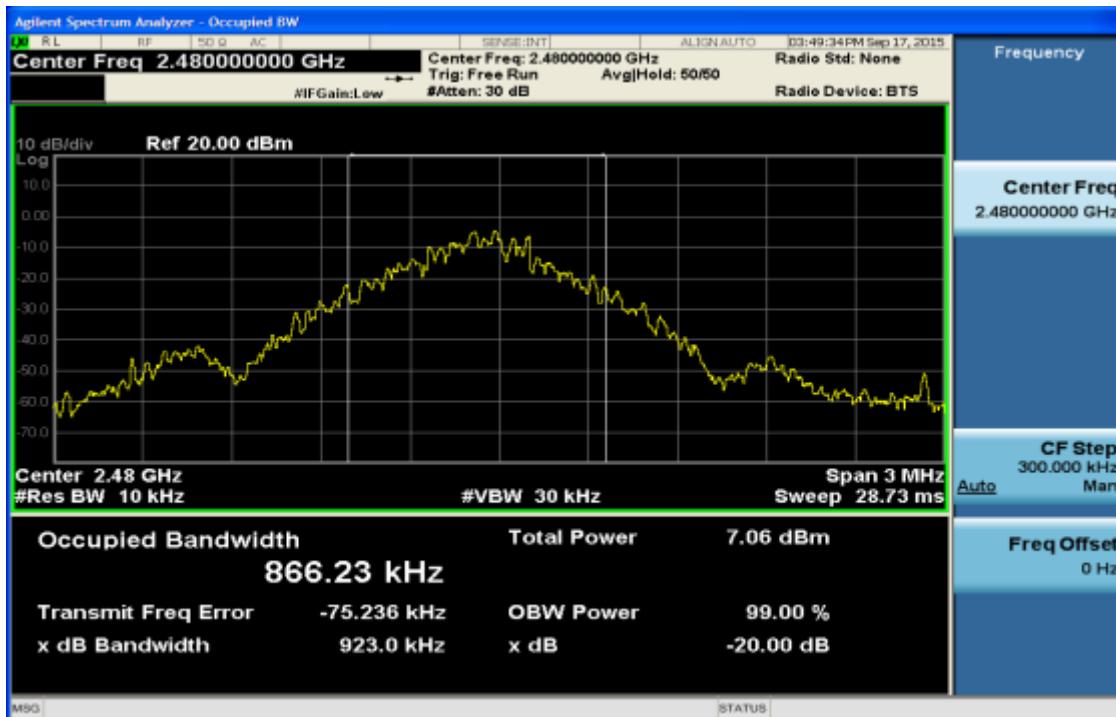
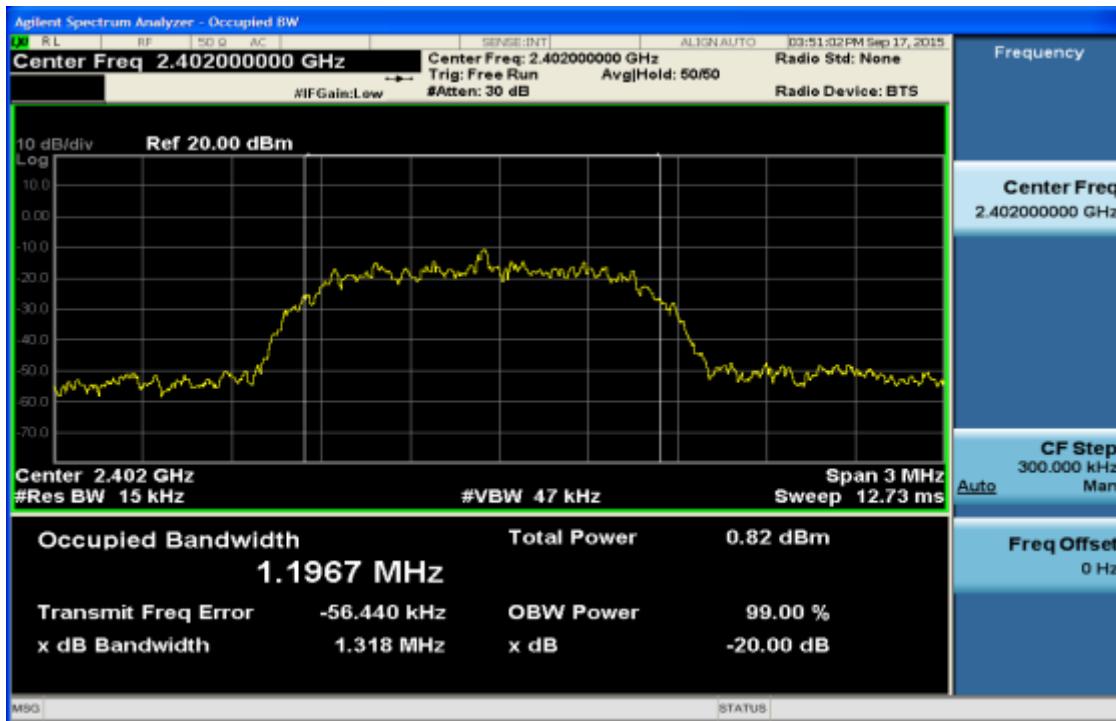


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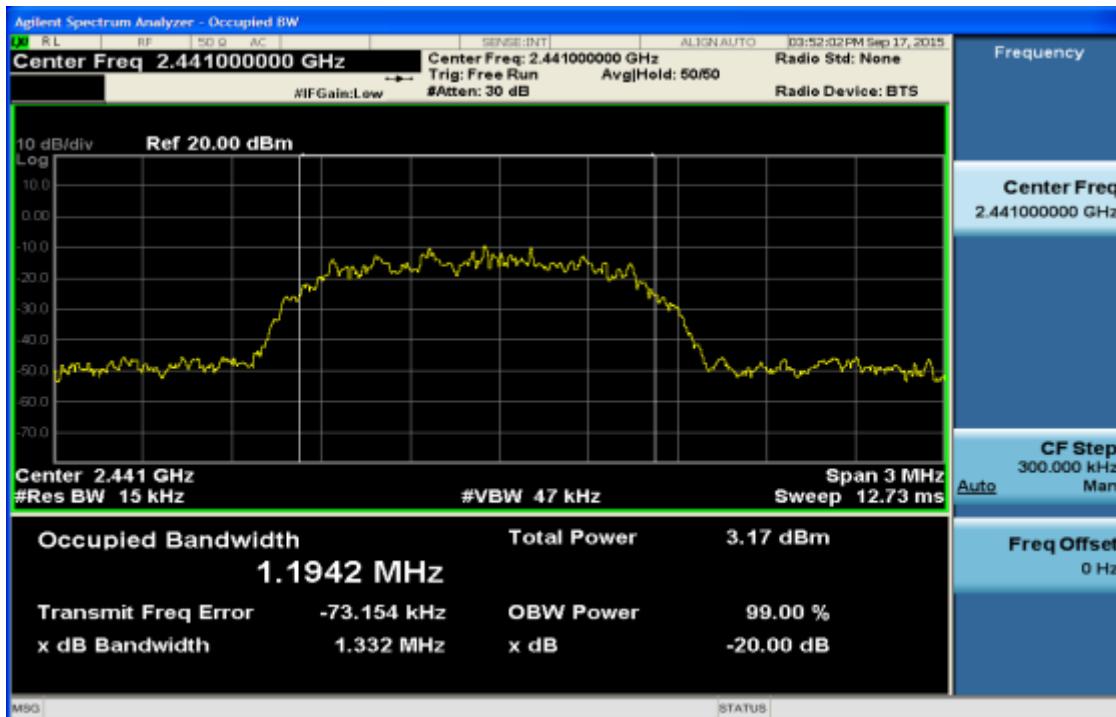
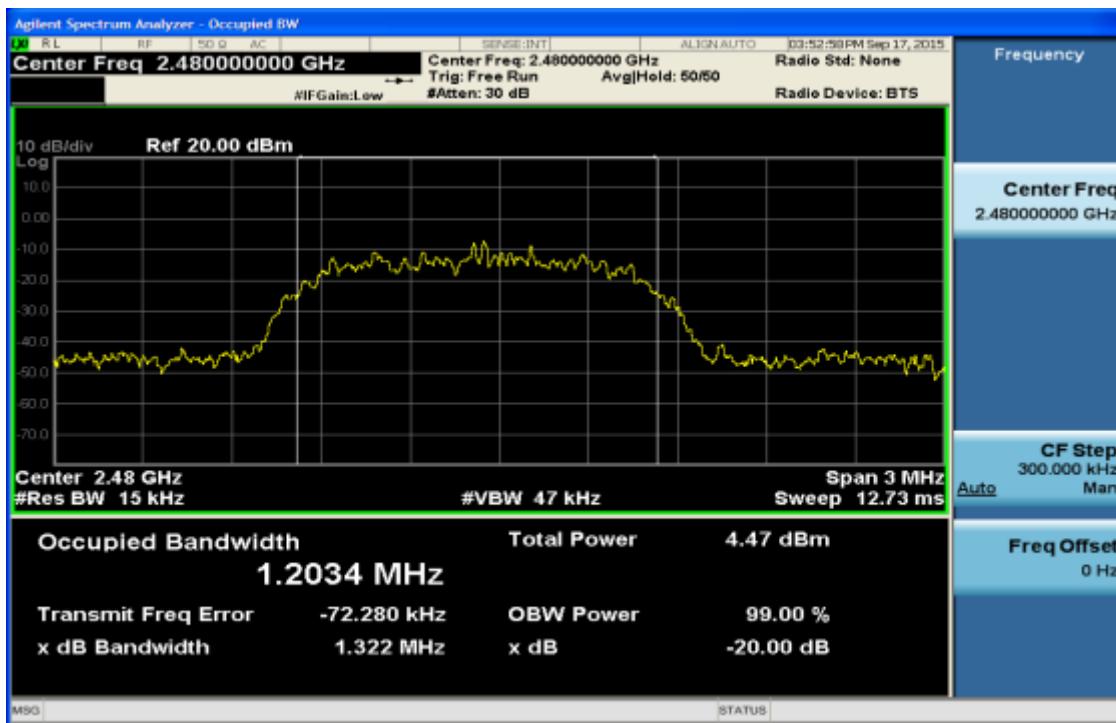
## 20dB Band Width Test Data CH-High (GFSK mode)

20dB Band Width Test Data CH-Low ( $\pi/4$ -DQPSK mode)

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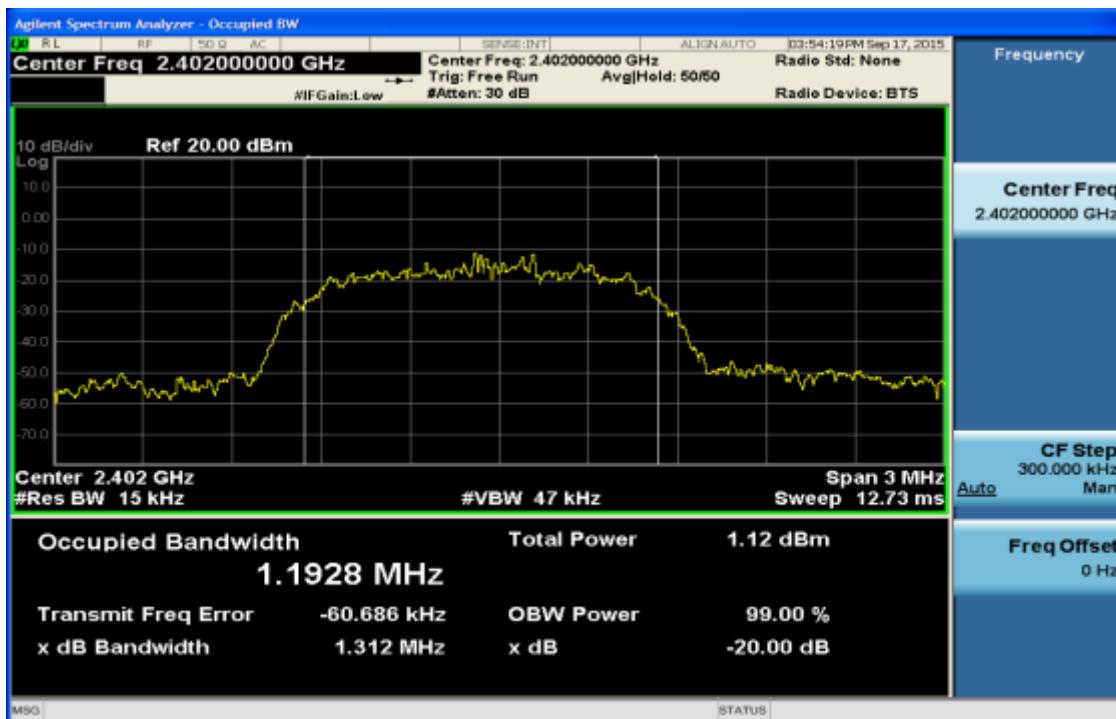
20dB Band Width Test Data CH-Mid ( $\pi/4$ -DQPSK mode)20dB Band Width Test Data CH-High ( $\pi/4$ -DQPSK mode)

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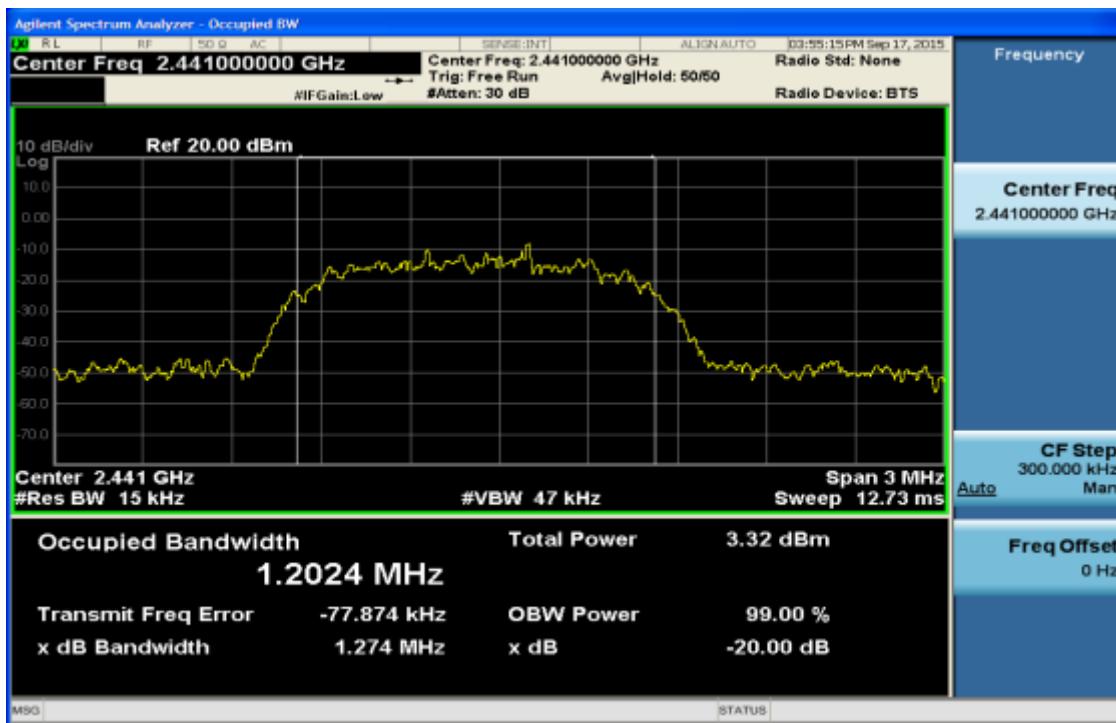
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## 20dB Band Width Test Data CH-Low (8-DPSK mode)



## 20dB Band Width Test Data CH-Mid (8-DPSK mode)

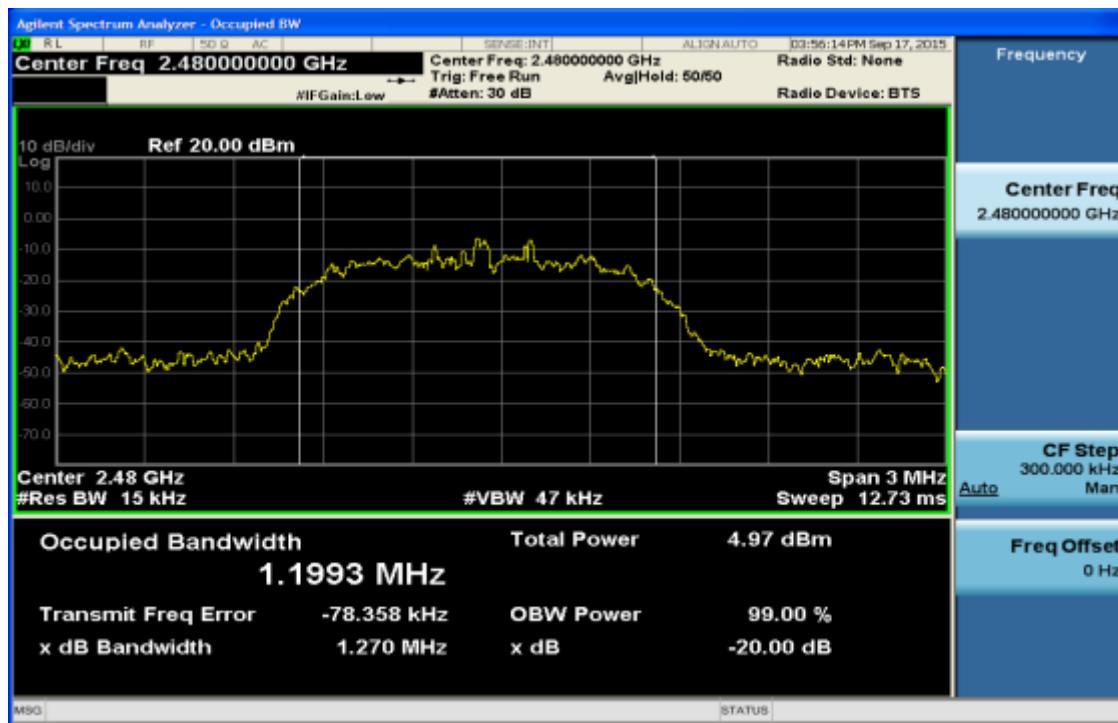


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## 20dB Width Test Data CH-High (8-DPSK mode)

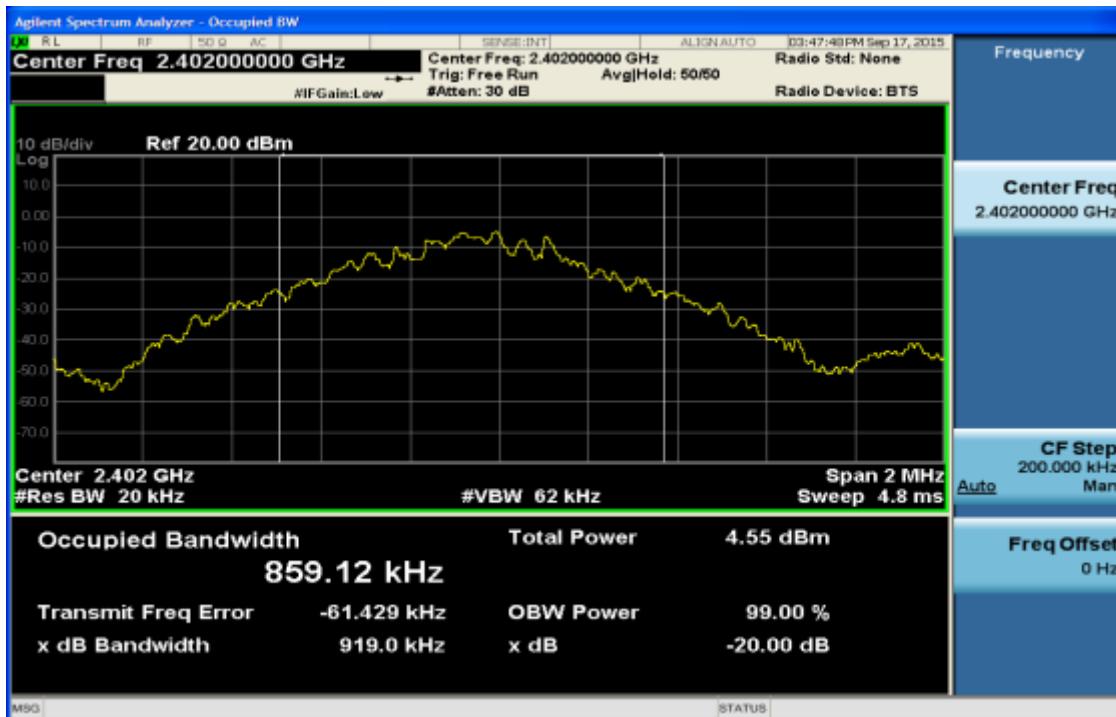


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## 99% Band Width Test Data CH-Low (GFSK mode) (IC)



## 99% Band Width Test Data CH-Mid (GFSK mode)

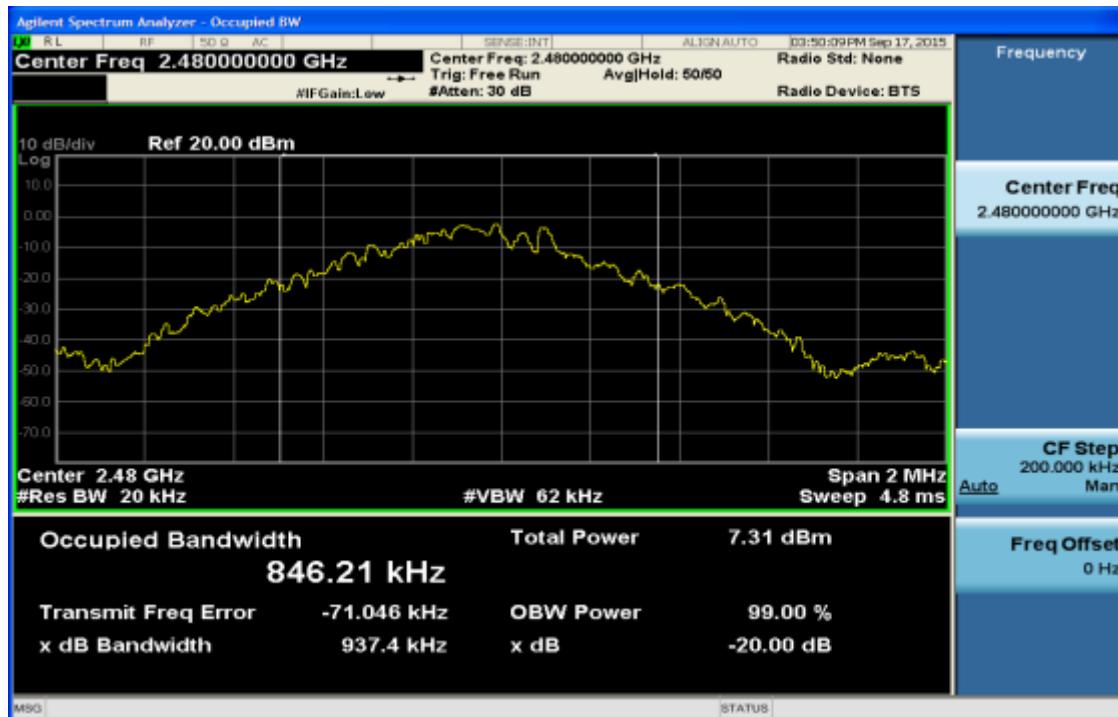


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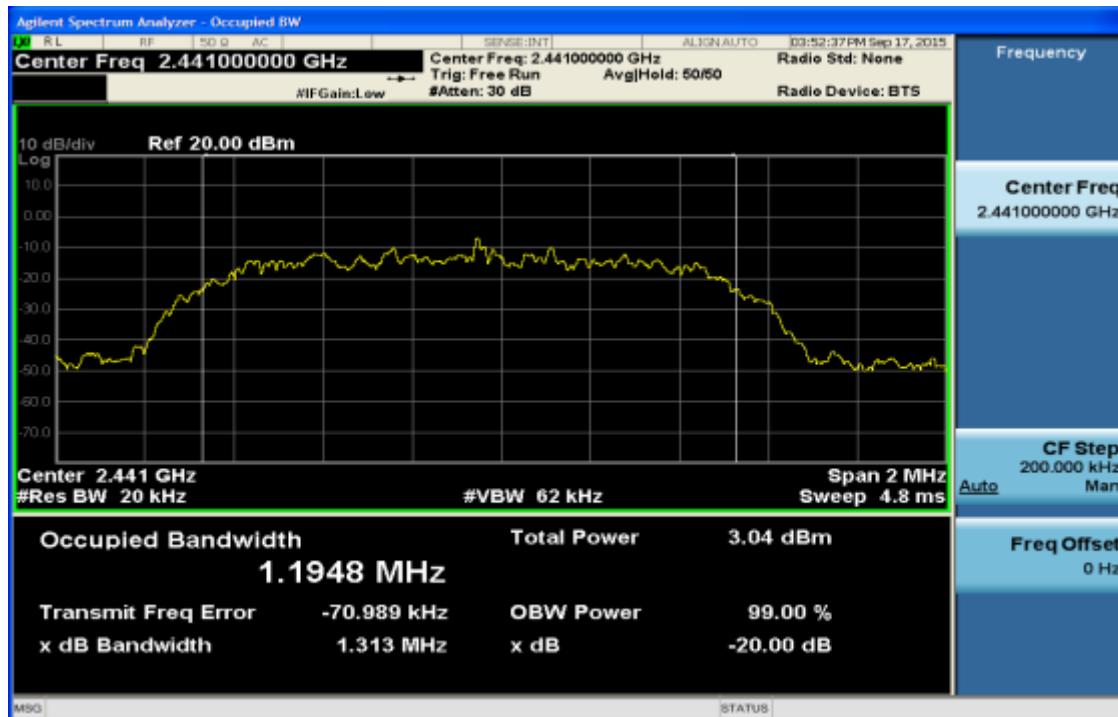
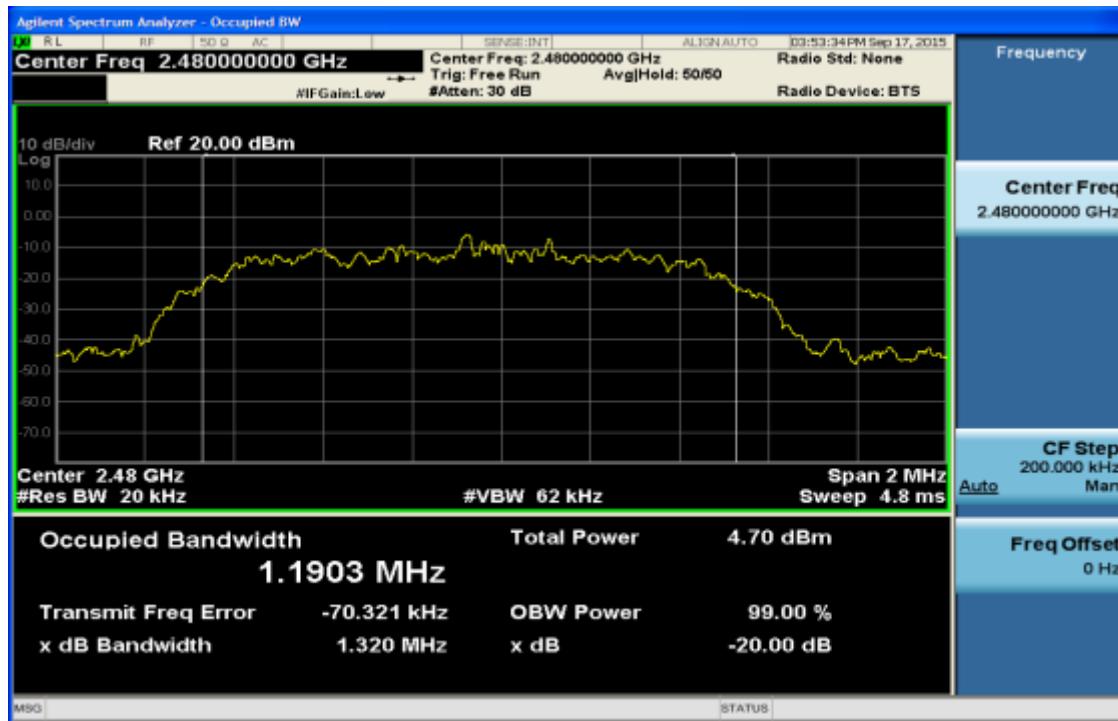
## 99% Band Width Test Data CH-High (GFSK mode)

99% Band Width Test Data CH-Low ( $\pi/4$ -DQPSK mode)

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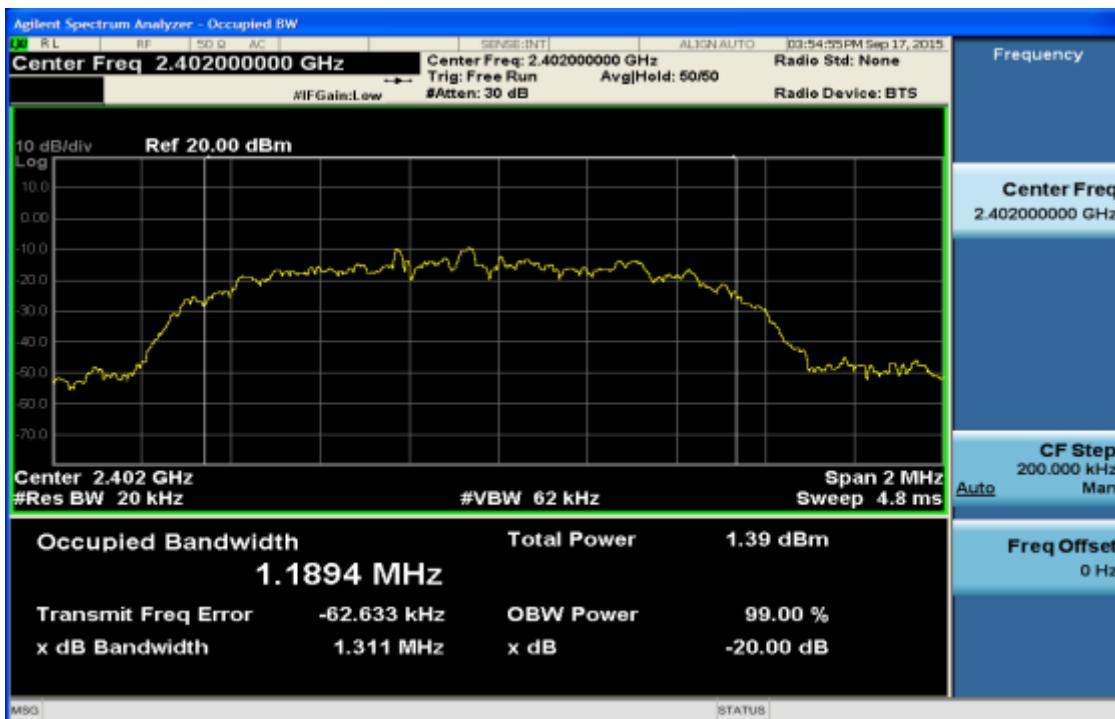
99% Band Width Test Data CH-Mid ( $\pi/4$ -DQPSK mode)99% Band Width Test Data CH-High ( $\pi/4$ -DQPSK mode)

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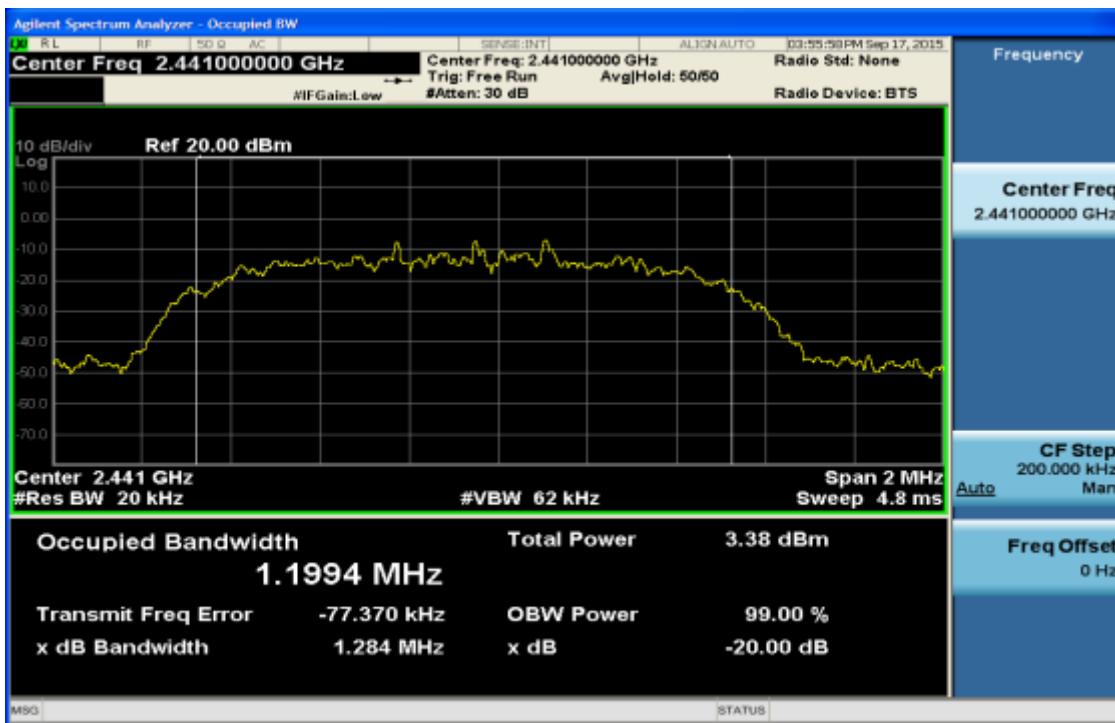
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## 99% Band Width Test Data CH-Low (8-DPSK mode)



## 20dB &amp; 99% Band Width Test Data CH-Mid (8-DPSK mode)

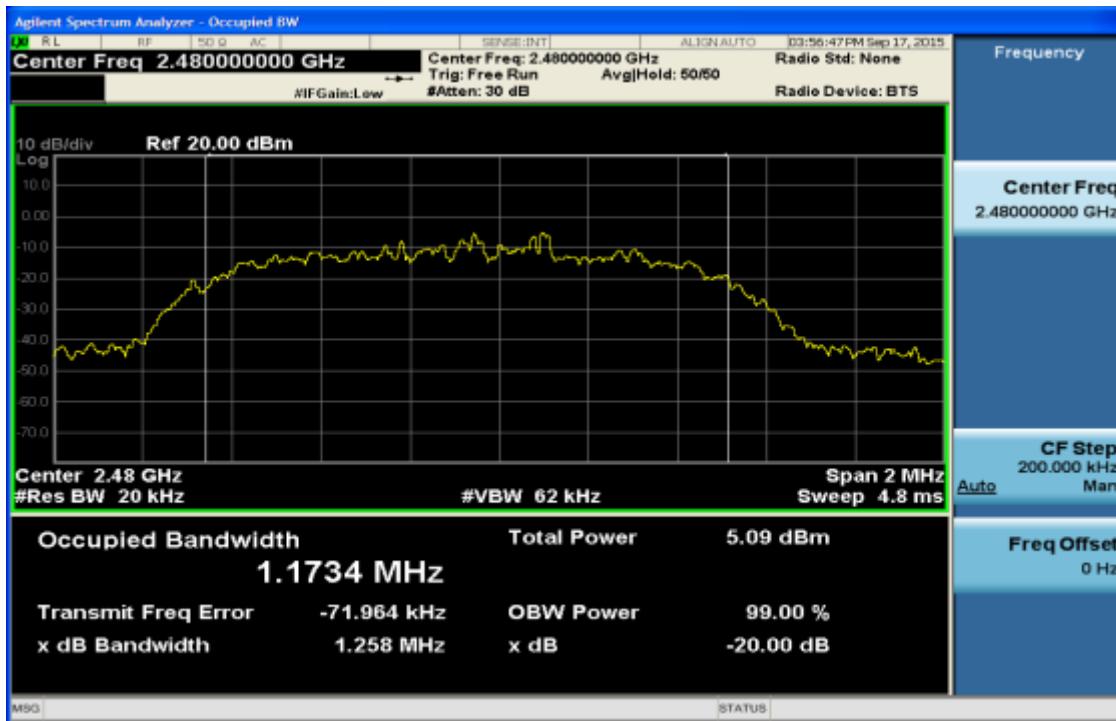


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## 99% Width Test Data CH-High (8-DPSK mode)



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## 9. CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

### 9.1. Standard Applicable

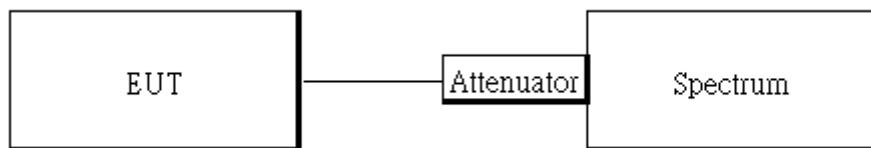
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. 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).

If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

### 9.2. Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Agilent	E4440A	MY45304525	05/05/2015	05/04/2016
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2015	01/01/2016
Attenuator	Mini-Circuit	BW-S10W2+	002	01/02/2015	01/01/2016
Splitter	Agilent	11636B	N/A	01/02/2015	01/01/2016

### 9.3. Test SET-UP



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## 9.4. Measurement Procedure

### Conducted Band Edge:

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set center frequency of spectrum analyzer = operating frequency.
5. Set the spectrum analyzer as RBW=100 kHz, VBW=300 kHz, Sweep = auto
6. Mark Peak, 2.3999GHz and 2.4836GHz and record the max. level.
7. Repeat above procedures until all frequency measured were complete.

### Conducted Spurious Emission:

1. To connect Antenna Port of EUT to Spectrum.
2. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
3. Set RBW = 100 kHz & VBW = 300 kHz, Detector =Peak, Sweep = Auto
4. Allow trace to fully stabilize.
5. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
6. Repeat above procedures until all default test channel measured were complete.

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	

## 9.5. Measurement Result

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

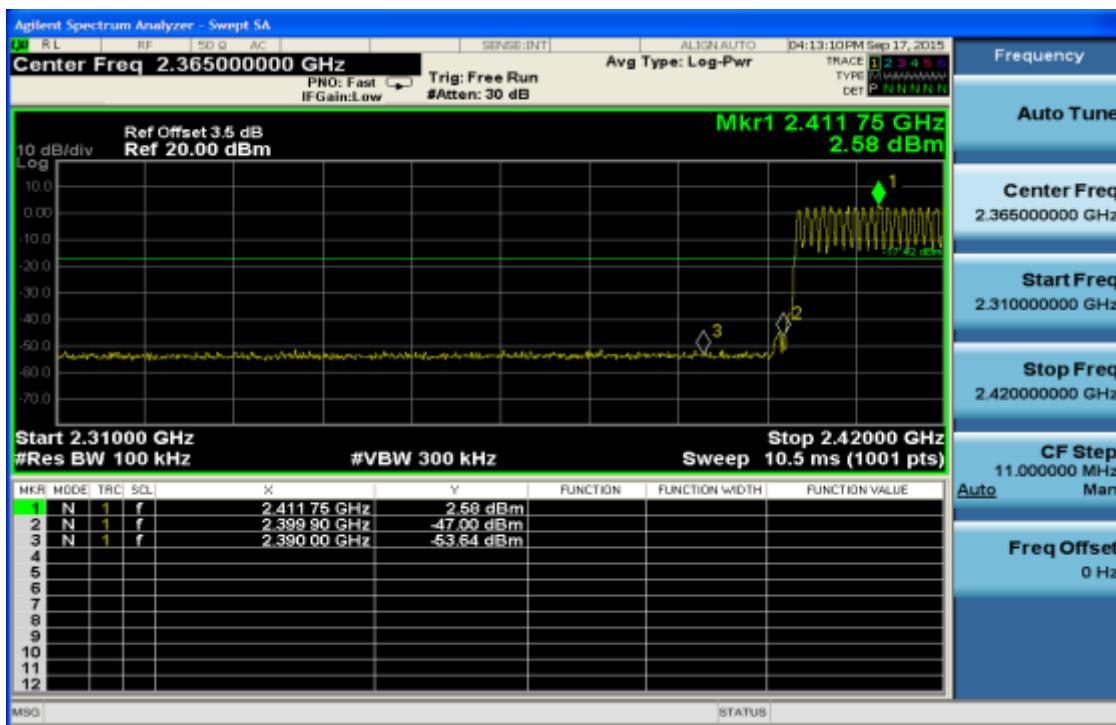
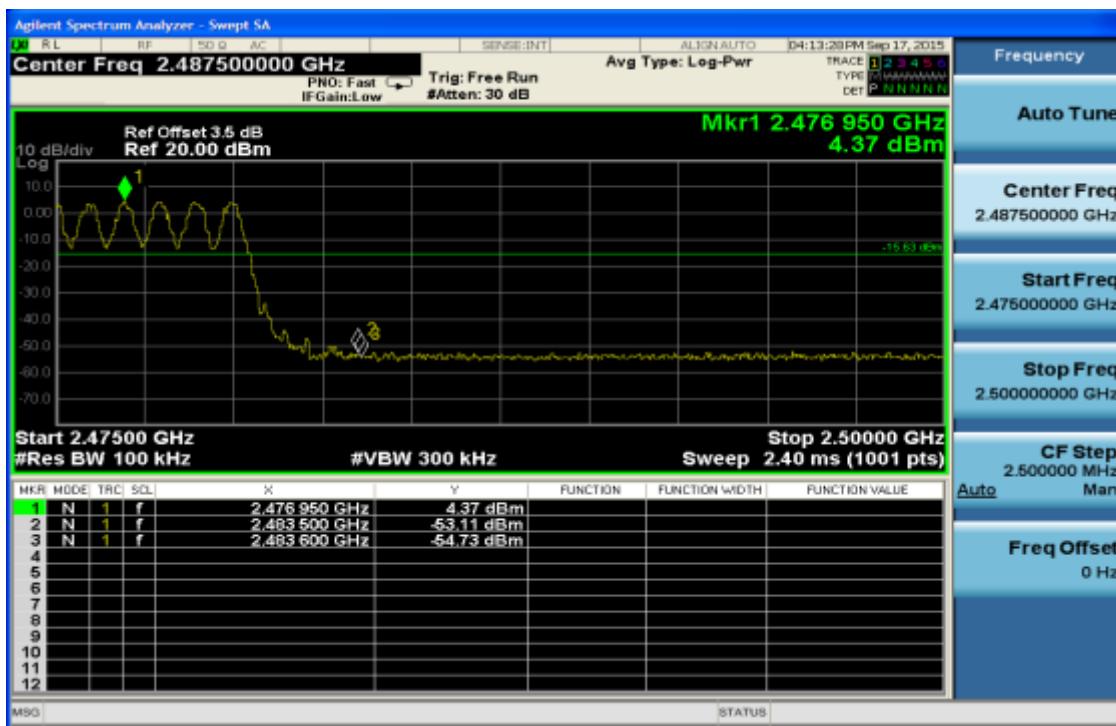
1. The occurrence of the spike on the conducted emission is the signal of the fundamental emission.

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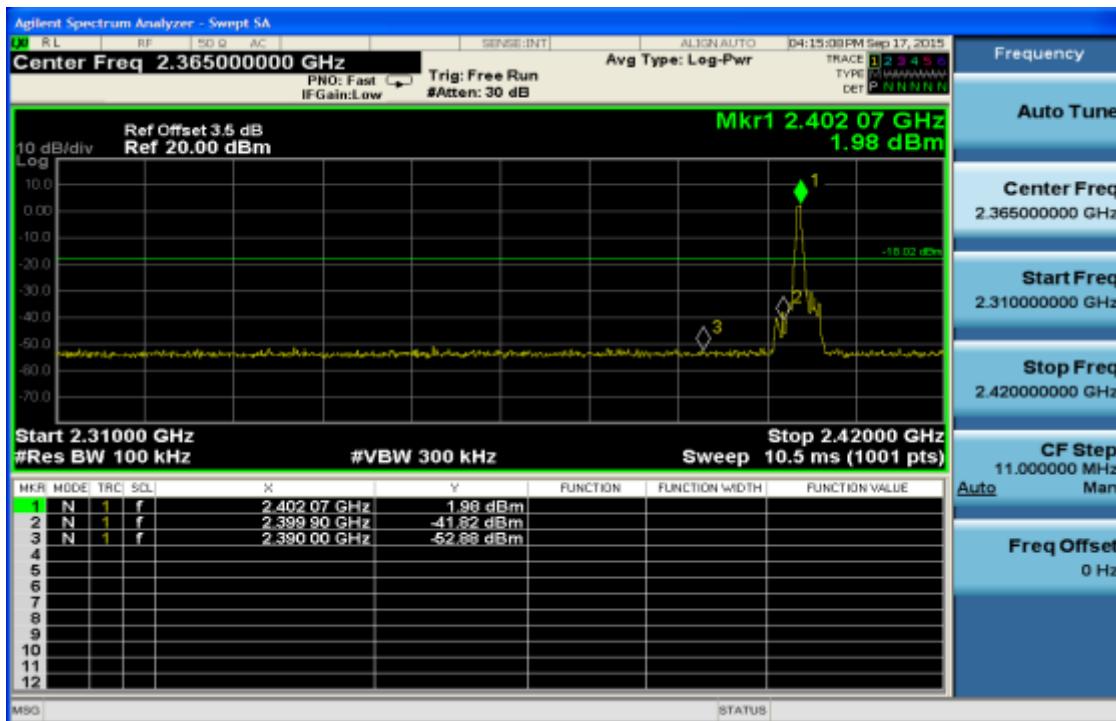
SGS Taiwan Ltd. No.134,WuKungRoad,NewTaipeiIndustrialPark,WukuDistrict,NewTaipeiCity,Taiwan24803/新北市五股區新北產業園區五工路134號

**Band Edges Test Data CH-Low (Hopping mode)****Band Edges Test Data CH-High**

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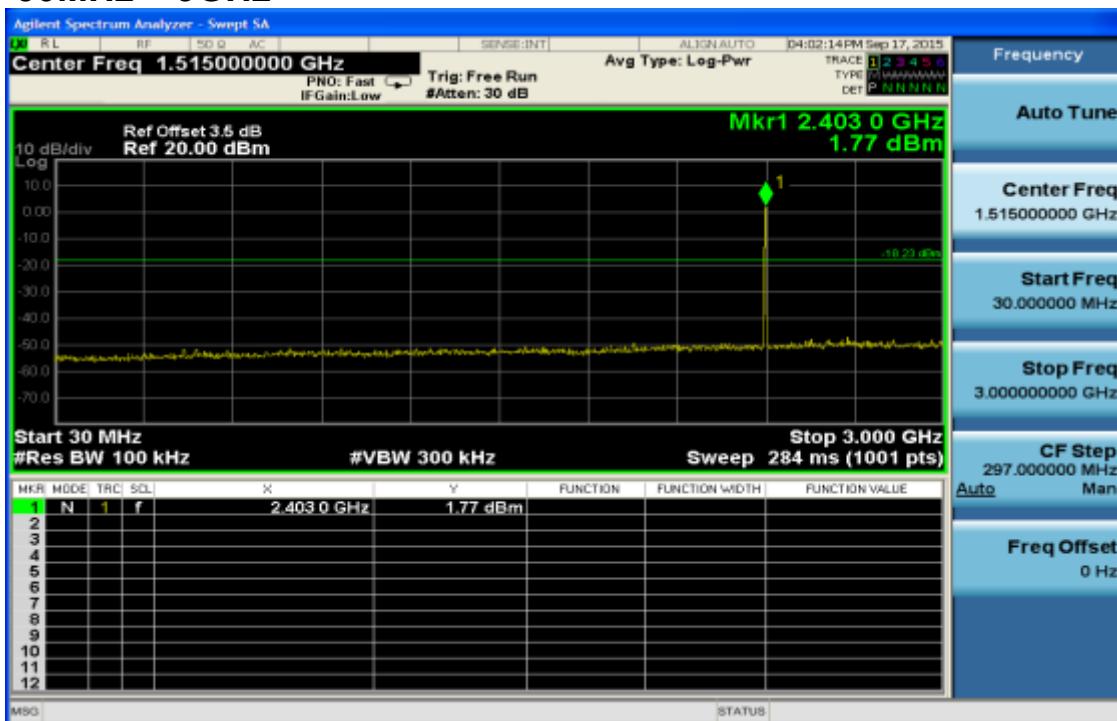
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**Band Edges Test Data CH-Low (Non-Hopping mode)****Band Edges Test Data CH-High**

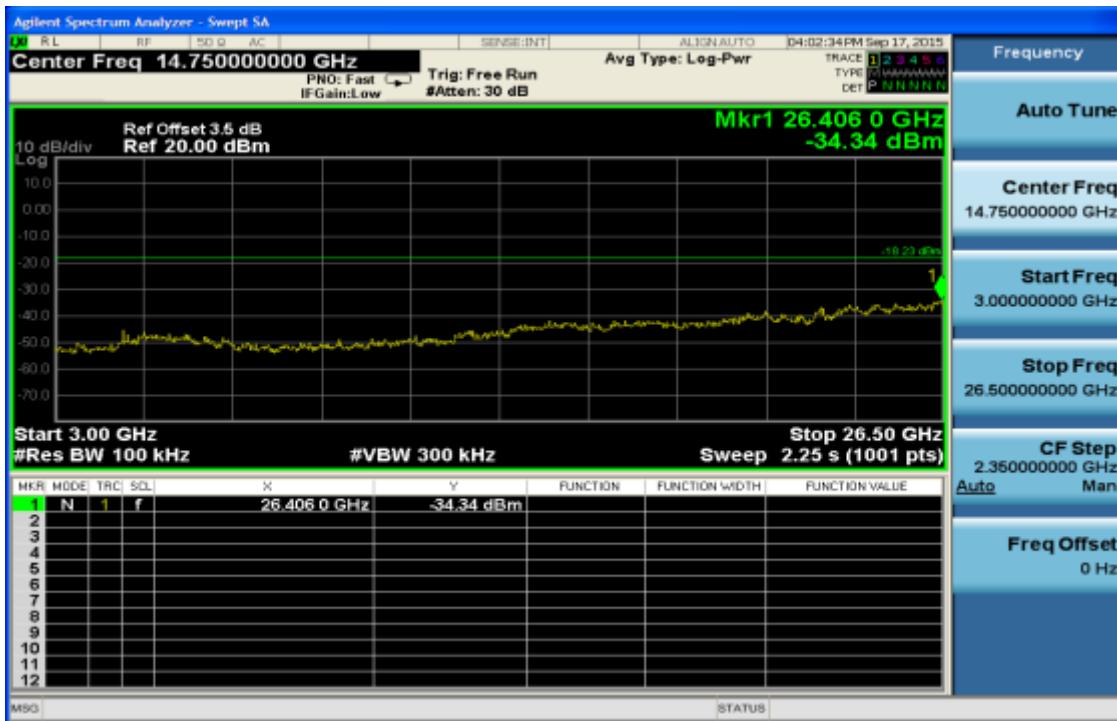
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Conducted Spurious Emission Measurement Result  
Ch Low 30MHz – 3GHz

## Ch Low 3GHz – 26.5GHz

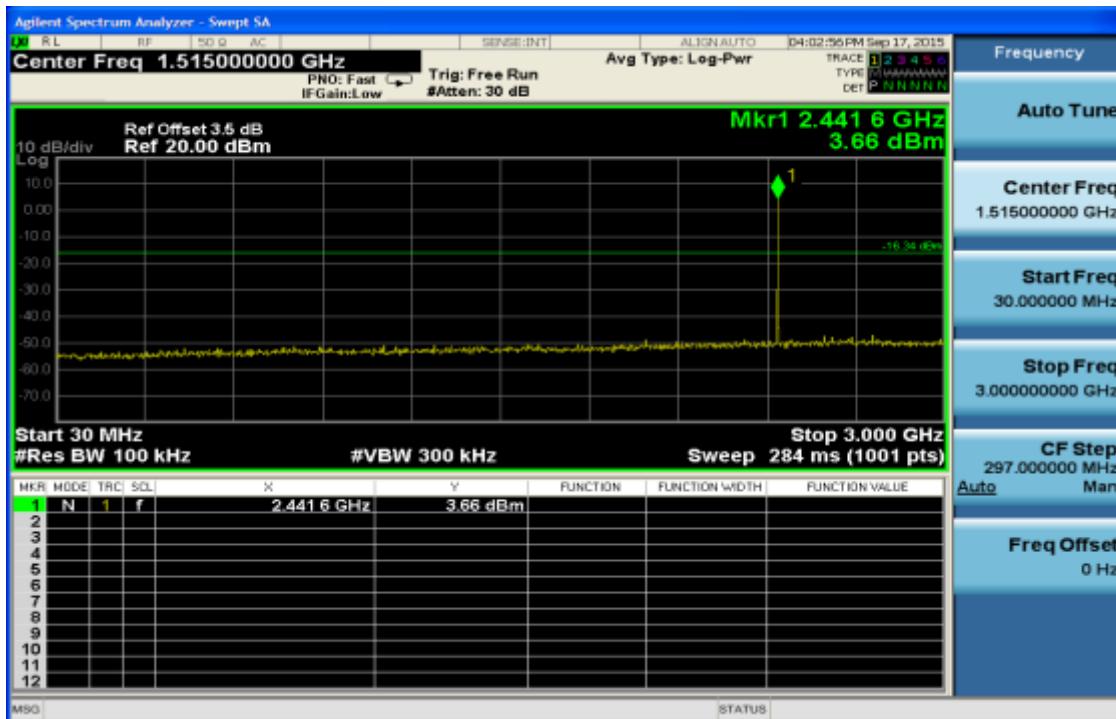


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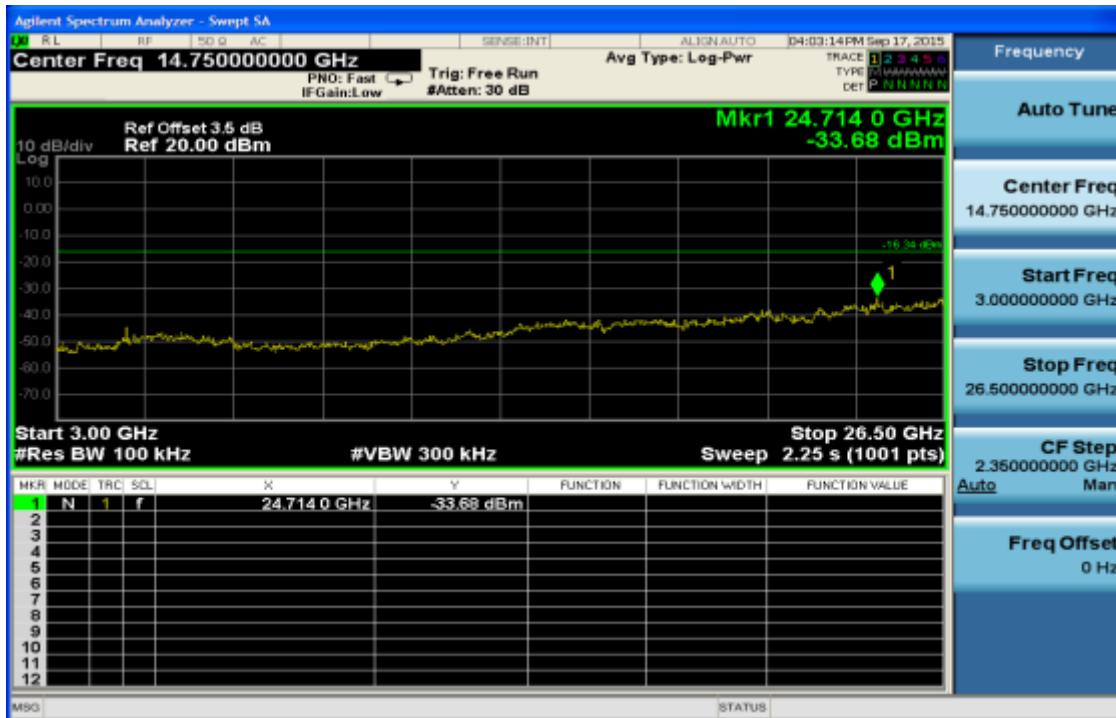
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## Ch Mid 30MHz – 3GHz



## Ch Mid 3GHz – 26.5GHz

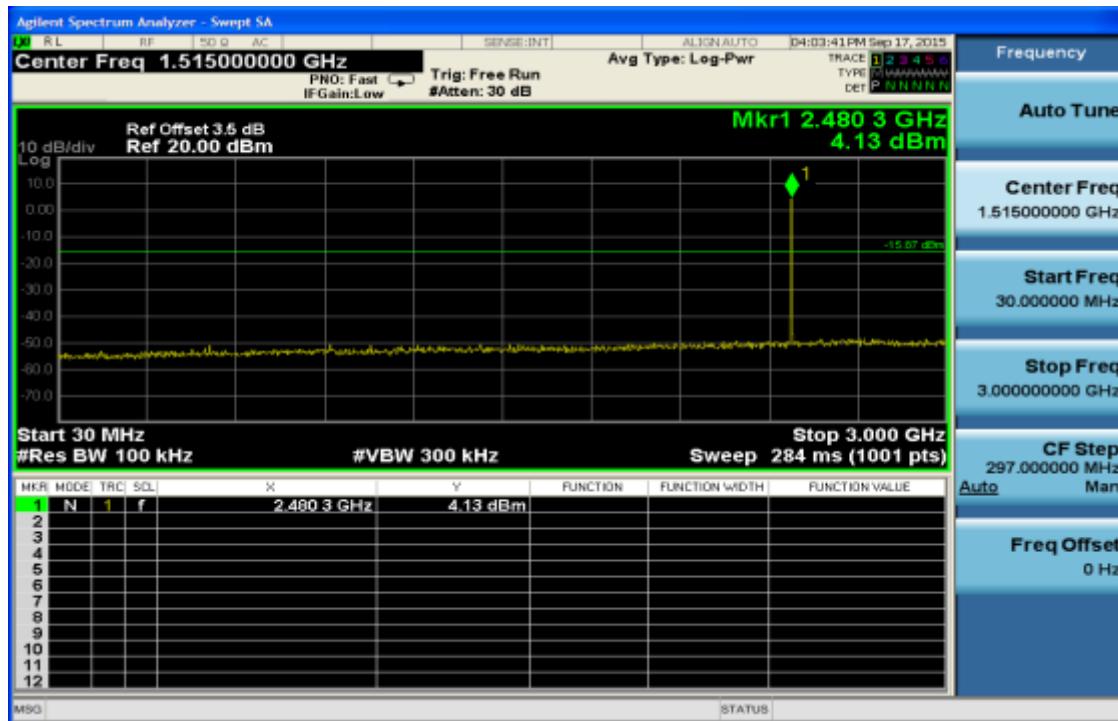


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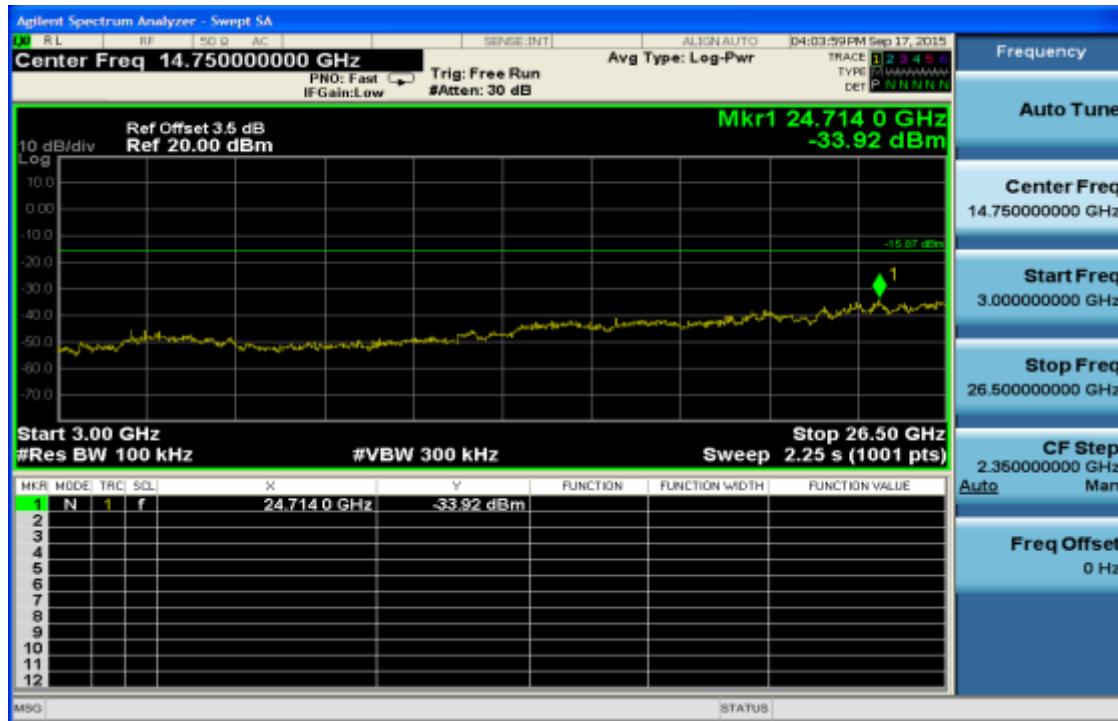
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## Ch High 30MHz – 3GHz



## Ch High 3GHz – 26.5GHz



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## 10. RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT

### 10.1. Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands must also comply with the §15.209 limit as below.

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.

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

**Note:**

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dB $\mu$ V/m) = 20 log Emission level (dB $\mu$ V/m)

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## 10.2. Measurement Equipment Used

966 Chamber					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESCI7	100760	05/04/2015	05/03/2016
Spectrum Analyzer	Agilent	E4446A	MY51100003	01/29/2015	01/28/2016
EXA Spectrum Analyzer	Agilent	N9010A	MY50420195	12/22/2014	12/21/2015
Spectrum Analyzer	R&S	FSV-30	101398	10/07/2014	10/06/2015
Loop Antenna	ETS.LINDGREN	6502	00143303	12/9/2014	12/08/2015
Bilog Antenna	SCHWAZBECK	VULB9168	378	12/23/2014	12/22/2015
Horn antenna	ETS.LINDGREN	3117	123995	05/05/2015	05/04/2016
Horn Antenna	Schwarzbeck	BBHA9170	184	12/25/2014	12/24/2015
Pre-Amplifier	Agilent	8447D	2944A07676	01/02/2015	01/01/2016
Pre-Amplifier	Agilent	8449B	3008A00578	01/02/2015	01/01/2016
Pre-Amplifier	EMC Instruments Corp.	EMC184045	980135	01/02/2015	01/01/2016
Filter 2400-2483.5 MHz	EWT	EWT-14-0166	M2	01/02/2015	01/01/2016
Attenuator	Mini-Circuit	BW-S10W2+	004	01/02/2015	01/01/2016
Turn Table	HD	DT420	N/A	N.C.R	N.C.R
Antenna Tower	ChamPro	AM-BS-4500-B	060776-ABS	N.C.R	N.C.R
Controller	ChamPro	EM1000	060776	N.C.R	N.C.R
Low Loss Cable	Huber Suhner	966_Rx	9	01/02/2015	01/01/2016
3m Site NSA	SGS	966 chamber	N/A	07/01/2015	06/30/2016

NOTE: N.C.R refers to Not Calibrated Required.

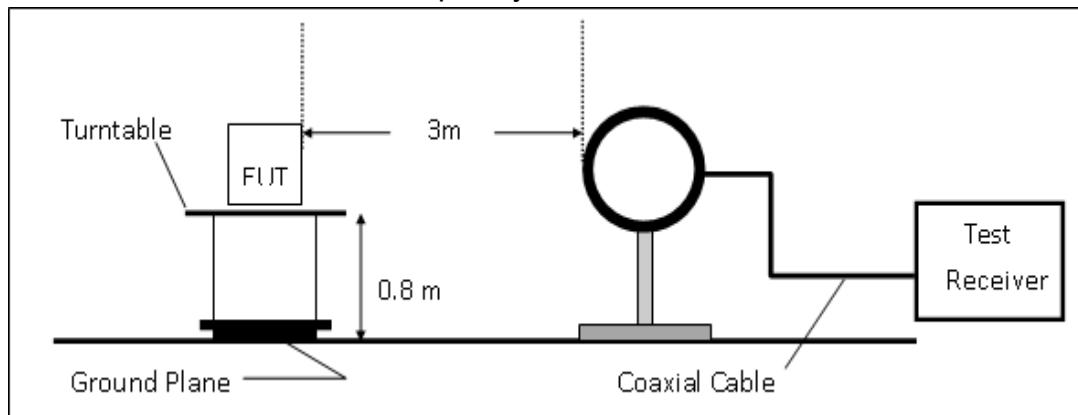
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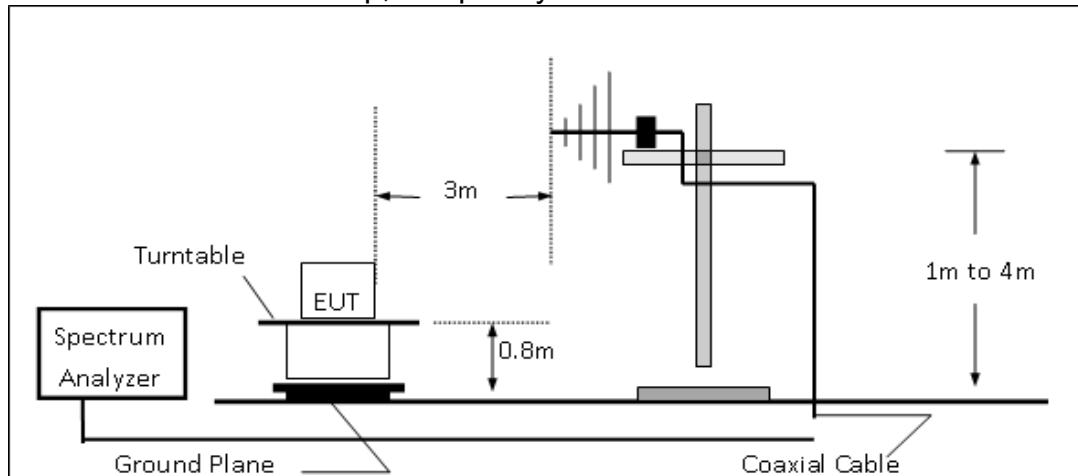
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### 10.3. Test SET-UP

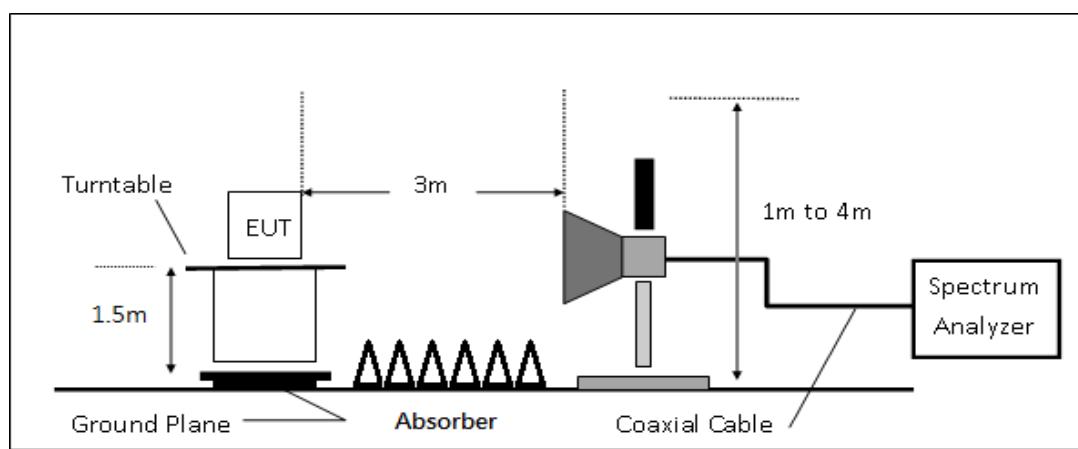
#### (A) Radiated Emission Test Set-UP Frequency Below 30MHz.



#### (B) Radiated Emission Test Set-UP, Frequency from 30MHz to 1000MHz



#### (C) Radiated Emission Test Set-UP Frequency Over 1 GHz



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## 10.4. Measurement Procedure

### Radiated Emission

1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
2. The EUT was placed on a turn table with 0.8m for frequency < 1GHz and 1.5m for frequency > 1GHz above ground plan.
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. Use the follow spectrum analyzer setting:
  - (1) Span = wide enough to fully capture the emission being measured
  - (2) RBW = 1 MHz for  $f \geq 1$  GHz, 100 kHz for  $f < 1$  GHz, VBW  $\geq$  RBW, Sweep = auto, Detector function = peak, Trace = max hold
  - (3) For average measurement: use duty cycle correction factor method per 15.35(c)  
Duty Cycle = On time/100 milliseconds  
On time =  $N_1 \cdot L_1 = N_2 \cdot L_2 + \dots + N(n-1) \cdot L(n-1) + N(n) \cdot L(n)$   
Where  $N_1$  is number of type 1 pulses,  $L_1$  is length of type 1 pulses, etc.  
Average Emission Level = Peak Emission Level +  $20 \cdot \log(\text{duty Cycle})$
6. 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.
7. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
8. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
9. Repeat above procedures until all frequency of the interest measured were complete.

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## 10.5. 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	

The limit of the emission level is expressed in dB $\mu$ V/m, which converts  $20 \log(uV/m)$

Actual FS(dB $\mu$ V/m) = SPA. Reading level(dB $\mu$ V) + Factor(dB)

Factor(dB) = Antenna Factor(dB $\mu$ V/m) + Cable Loss(dB) – Pre\_Amplifier Gain(dB)

### Note :

“F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

## 10.6. Test Results of Radiated Spurious Emissions form 9 KHz to 30 MHz

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit per 15.31(o) was not reported.

## 10.7. Measurement Result

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

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**Radiated Band Edge Measurement Result: (Hopping Mode)**

Operation Band :BR+Hopping Test Date :2015-09-08  
 Fundamental Frequency :2402 MHz Temp./Humi. :23 deg\_C / 62 RH  
 Operation Mode :Band Edge LOW Engineer :JJ  
 EUT Pol. :E2 Plan Measurement Antenna Pol. :VERTICAL

Freq.	Note	Detector	Spectrum		Factor	Actual	Limit	Margin
			Mode	Reading Level				
MHz	F/H/E/S	PK/QP/AV	dB $\mu$ V	dB	dB $\mu$ V/m	dB $\mu$ V/m	dB	
2390.00	E	Average	27.80	5.16	32.96	54.00	-21.04	
2390.00	E	Peak	40.15	5.16	45.31	74.00	-28.69	

Operation Band :BR+Hopping Test Date :2015-09-08  
 Fundamental Frequency :2402 MHz Temp./Humi. :23 deg\_C / 62 RH  
 Operation Mode :Band Edge LOW Engineer :JJ  
 EUT Pol. :E2 Plan Measurement Antenna Pol. :HORIZONTAL

Freq.	Note	Detector	Spectrum		Factor	Actual	Limit	Margin
			Mode	Reading Level				
MHz	F/H/E/S	PK/QP/AV	dB $\mu$ V	dB	dB $\mu$ V/m	dB $\mu$ V/m	dB	
2390.00	E	Average	27.82	5.16	32.98	54.00	-21.02	
2390.00	E	Peak	40.01	5.16	45.17	74.00	-28.83	

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Operation Band :BR+Hopping  
 Fundamental Frequency :2480 MHz  
 Operation Mode :Band Edge HIGH  
 EUT Pol. :E2 Plan

Test Date :2015-09-08  
 Temp./Humi. :23 deg\_C / 62 RH  
 Engineer :JJ  
 Measurement Antenna Pol. :VERTICAL

Freq.	Note	Detector	Spectrum		Factor	Actual	Limit	Margin
			Mode	Reading Level				
MHz	F/H/E/S	PK/QP/AV	dB $\mu$ V	dB	dB $\mu$ V/m	dB $\mu$ V/m	dB	
2483.50	E	Average	28.46	6.01	34.47	54.00	-19.53	
2483.50	E	Peak	42.35	6.01	48.36	74.00	-25.64	

Operation Band :BR+Hopping  
 Fundamental Frequency :2480 MHz  
 Operation Mode :Band Edge HIGH  
 EUT Pol. :E2 Plan

Test Date :2015-09-08  
 Temp./Humi. :23 deg\_C / 62 RH  
 Engineer :JJ  
 Measurement Antenna Pol. :HORIZONTAL

Freq.	Note	Detector	Spectrum		Factor	Actual	Limit	Margin
			Mode	Reading Level				
MHz	F/H/E/S	PK/QP/AV	dB $\mu$ V	dB	dB $\mu$ V/m	dB $\mu$ V/m	dB	
2483.50	E	Average	29.04	6.01	35.05	54.00	-18.95	
2483.50	E	Peak	45.21	6.01	51.22	74.00	-22.78	

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**10.6.2 Radiated Emission – Band Edge (Non-Hopping Mode):**

Operation Band :BR Test Date :2015-09-08  
 Fundamental Frequency :2402 MHz Temp./Humi. :23 deg\_C / 62 RH  
 Operation Mode :Band Edge LOW Engineer :JJ  
 EUT Pol. :E2 Plan Measurement Antenna Pol. :VERTICAL

Freq.	Note	Detector	Spectrum		Factor	Actual	Limit	Margin
			Mode	Reading Level				
MHz	F/H/E/S	PK/QP/AV	dB $\mu$ V	dB	dB $\mu$ V/m	dB $\mu$ V/m	dB	
2390.00	E	Average	27.91	5.16	33.07	54.00	-20.93	
2390.00	E	Peak	40.00	5.16	45.16	74.00	-28.84	

Operation Band :BR Test Date :2015-09-08  
 Fundamental Frequency :2402 MHz Temp./Humi. :23 deg\_C / 62 RH  
 Operation Mode :Band Edge LOW Engineer :JJ  
 EUT Pol. :E2 Plan Measurement Antenna Pol. :HORIZONTAL

Freq.	Note	Detector	Spectrum		Factor	Actual	Limit	Margin
			Mode	Reading Level				
MHz	F/H/E/S	PK/QP/AV	dB $\mu$ V	dB	dB $\mu$ V/m	dB $\mu$ V/m	dB	
2390.00	E	Average	27.92	5.16	33.08	54.00	-20.92	
2390.00	E	Peak	40.71	5.16	45.87	74.00	-28.13	

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Operation Band :BR Test Date :2015-09-08  
 Fundamental Frequency :2480 MHz Temp./Humi. :23 deg\_C / 62 RH  
 Operation Mode :Band Edge HIGH Engineer :JJ  
 EUT Pol. :E2 Plan Measurement Antenna Pol. :VERTICAL

Freq.	Note	Detector	Spectrum		Factor	Actual	Limit	Margin
			Mode	Reading Level				
MHz	F/H/E/S	PK/QP/AV	dB $\mu$ V	dB	dB $\mu$ V/m	dB $\mu$ V/m	dB	
2483.50	E	Average	29.55	6.01	35.56	54.00	-18.44	
2483.50	E	Peak	41.94	6.01	47.95	74.00	-26.05	

Operation Band :BR Test Date :2015-09-08  
 Fundamental Frequency :2480 MHz Temp./Humi. :23 deg\_C / 62 RH  
 Operation Mode :Band Edge HIGH Engineer :JJ  
 EUT Pol. :E2 Plan Measurement Antenna Pol. :HORIZONTAL

Freq.	Note	Detector	Spectrum		Factor	Actual	Limit	Margin
			Mode	Reading Level				
MHz	F/H/E/S	PK/QP/AV	dB $\mu$ V	dB	dB $\mu$ V/m	dB $\mu$ V/m	dB	
2483.50	E	Average	31.77	6.01	37.78	54.00	-16.22	
2483.50	E	Peak	44.53	6.01	50.54	74.00	-23.46	

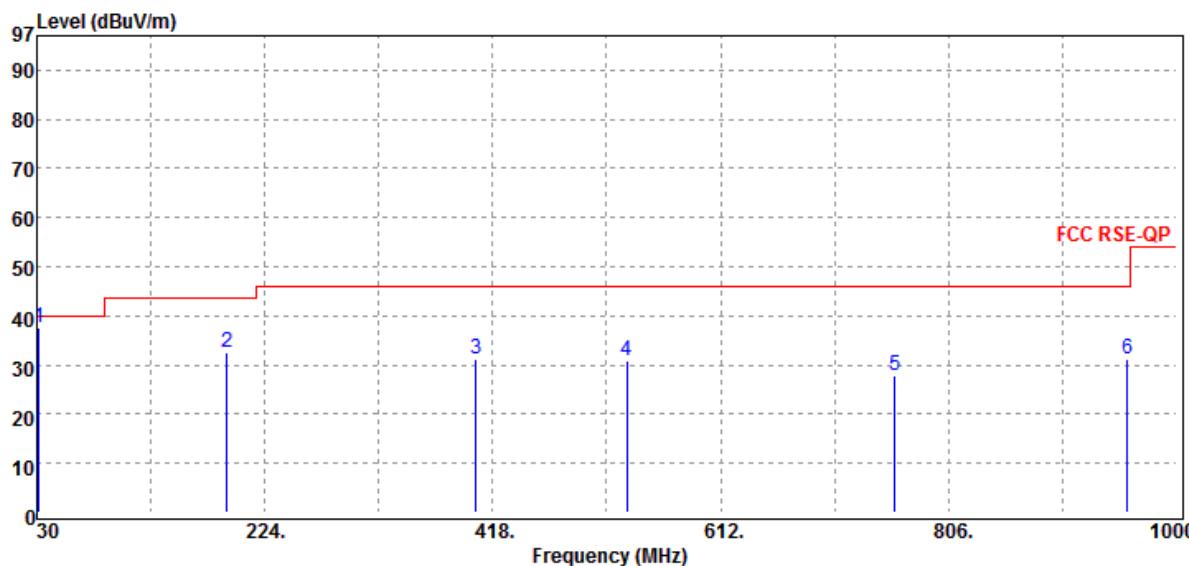
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**Radiated Spurious Emission Measurement Result:****For Frequency form 30MHz to 1000MHz**

Operation Band	:BR	Test Date	:2015-09-08
Fundamental Frequency	:2402 MHz	Temp./Humi.	:23 deg_C / 62 RH
Operation Mode	:TX LOW	Engineer	:JJ
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode	Spectrum Reading	Factor	Actual FS	Limit @3m	Margin
			Level dB $\mu$ V				
31.94	S	Peak	47.89	-10.22	37.67	40.00	-2.33
191.99	S	Peak	44.31	-11.65	32.66	43.50	-10.84
403.45	S	Peak	37.09	-5.96	31.13	46.00	-14.87
532.46	S	Peak	34.89	-4.03	30.86	46.00	-15.14
760.41	S	Peak	26.85	1.11	27.96	46.00	-18.04
958.29	S	Peak	27.64	3.62	31.26	46.00	-14.74

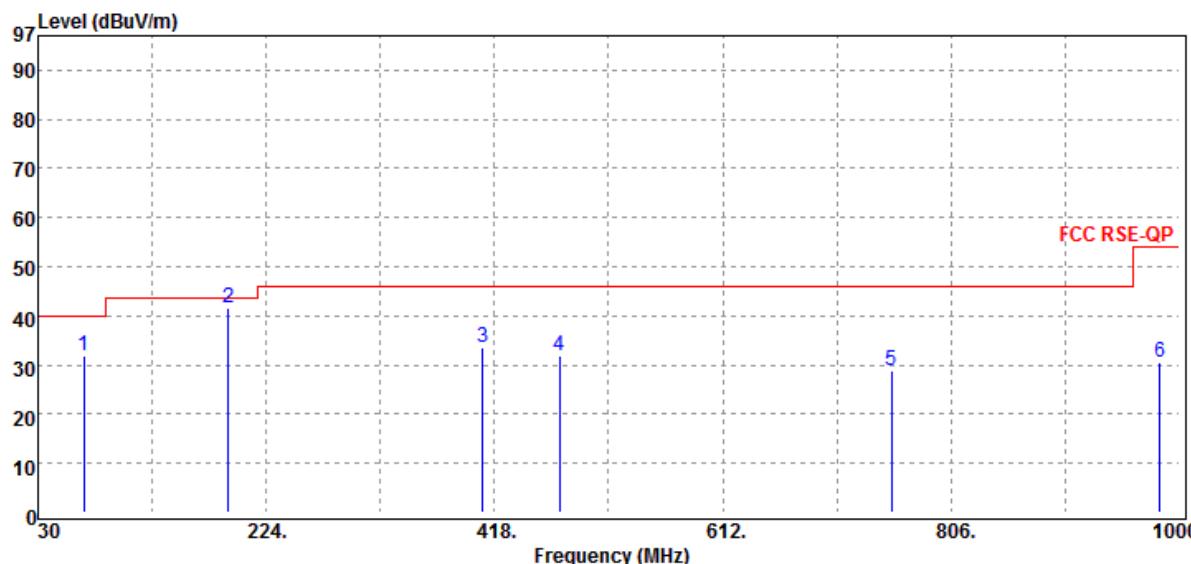
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Operation Band :BR  
 Fundamental Frequency :2402 MHz  
 Operation Mode :TX LOW  
 EUT Pol. :E2 Plan

Test Date :2015-09-08  
 Temp./Humi. :23 deg\_C / 62 RH  
 Engineer :JJ  
 Measurement Antenna Pol. :HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode	Spectrum		Factor	Actual FS	Limit @3m	Margin
			PK/QP/AV	Reading Level dB $\mu$ V				
68.80	S	Peak	43.54	-11.50	32.04	40.00	-7.96	
191.99	S	Peak	53.25	-11.65	41.60	43.50	-1.90	
408.30	S	Peak	39.32	-5.90	33.42	46.00	-12.58	
473.29	S	Peak	36.70	-4.93	31.77	46.00	-14.23	
755.56	S	Peak	28.12	0.80	28.92	46.00	-17.08	
983.51	S	Peak	27.00	3.38	30.38	54.00	-23.62	

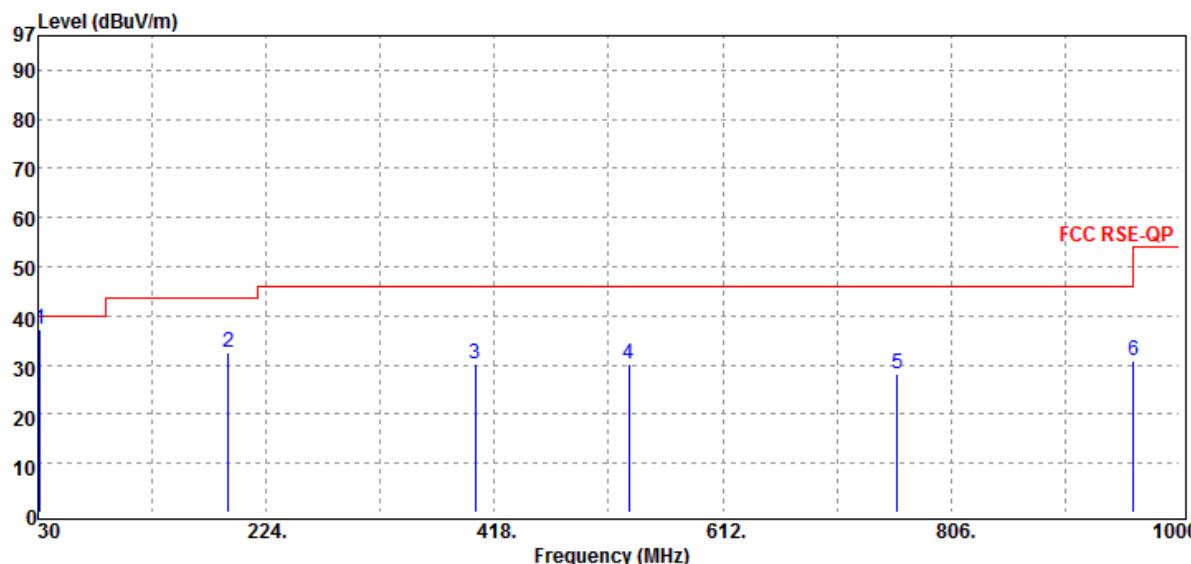
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Operation Band :BR  
 Fundamental Frequency :2441 MHz  
 Operation Mode :TX MID  
 EUT Pol. :E2 Plan

Test Date :2015-09-08  
 Temp./Humi. :23 deg\_C / 62 RH  
 Engineer :JJ  
 Measurement Antenna Pol. :VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level		Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
			Reading	Level dB $\mu$ V				
31.94	S	Peak	47.42	-10.22	37.20	40.00	-2.80	
191.99	S	Peak	44.31	-11.65	32.66	43.50	-10.84	
401.51	S	Peak	36.03	-5.98	30.05	46.00	-15.95	
532.46	S	Peak	34.13	-4.03	30.10	46.00	-15.90	
760.41	S	Peak	27.23	1.11	28.34	46.00	-17.66	
961.20	S	Peak	27.11	3.68	30.79	54.00	-23.21	

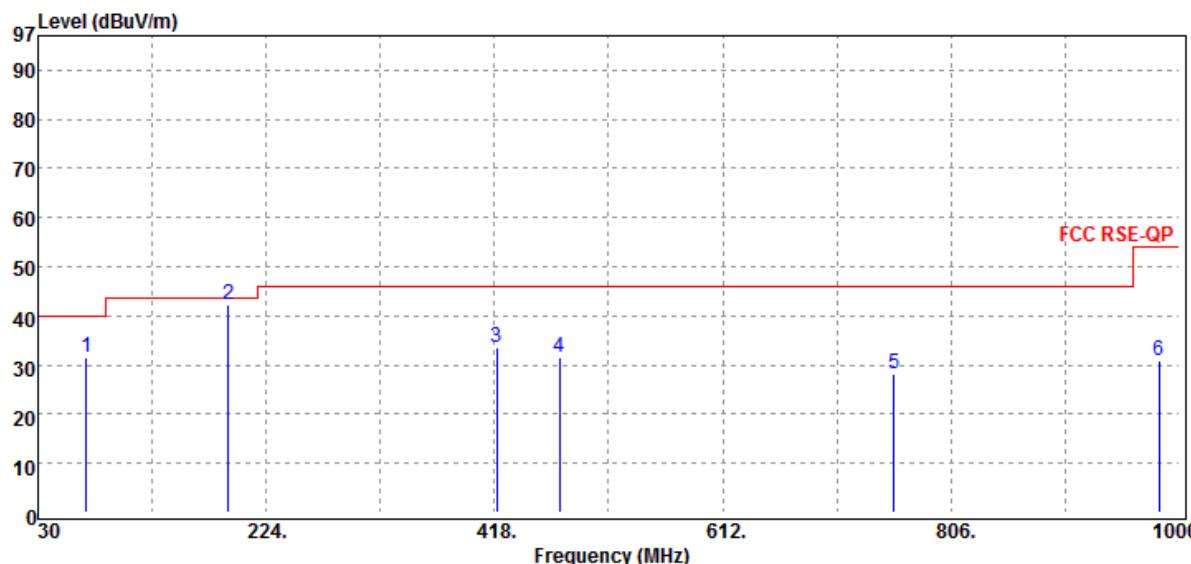
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Operation Band :BR  
 Fundamental Frequency :2441 MHz  
 Operation Mode :TX MID  
 EUT Pol. :E2 Plan

Test Date :2015-09-08  
 Temp./Humi. :23 deg\_C / 62 RH  
 Engineer :JJ  
 Measurement Antenna Pol. :HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode	Spectrum		Factor	Actual FS dB <sup>μ</sup> V/m	Limit @3m dB <sup>μ</sup> V/m	Margin dB
			PK/QP/AV	Reading Level dB <sup>μ</sup> V				
70.74	S	Peak	43.40	-11.79	31.61	40.00	-8.39	
191.99	S	Peak	53.83	-11.65	42.18	43.50	-1.32	
419.94	S	Peak	39.41	-5.68	33.73	46.00	-12.27	
473.29	S	Peak	36.59	-4.93	31.66	46.00	-14.34	
757.50	S	Peak	27.06	0.97	28.03	46.00	-17.97	
982.54	S	Peak	27.47	3.38	30.85	54.00	-23.15	

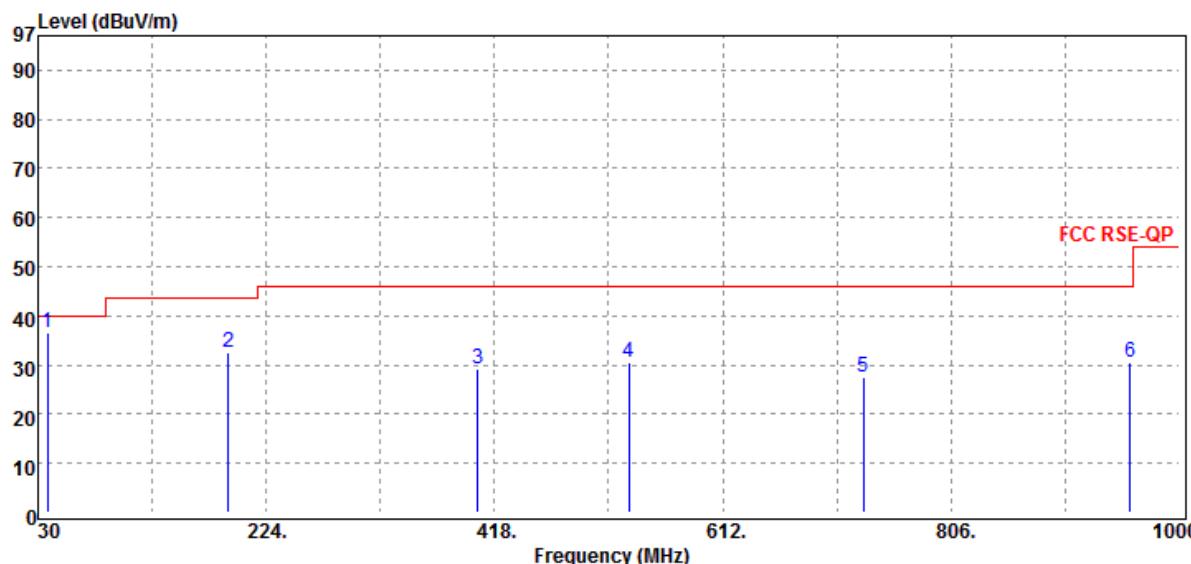
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Operation Band :BR  
 Fundamental Frequency :2480 MHz  
 Operation Mode :TX HIGH  
 EUT Pol. :E2 Plan

Test Date :2015-09-08  
 Temp./Humi. :23 deg\_C / 62 RH  
 Engineer :JJ  
 Measurement Antenna Pol. :VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level		Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
			Reading	Level dB $\mu$ V				
37.76	S	Peak	46.66	-9.95	36.71	40.00	-3.29	
191.99	S	Peak	44.23	-11.65	32.58	43.50	-10.92	
403.45	S	Peak	35.22	-5.96	29.26	46.00	-16.74	
532.46	S	Peak	34.50	-4.03	30.47	46.00	-15.53	
731.31	S	Peak	28.23	-0.83	27.40	46.00	-18.60	
958.29	S	Peak	26.93	3.62	30.55	46.00	-15.45	

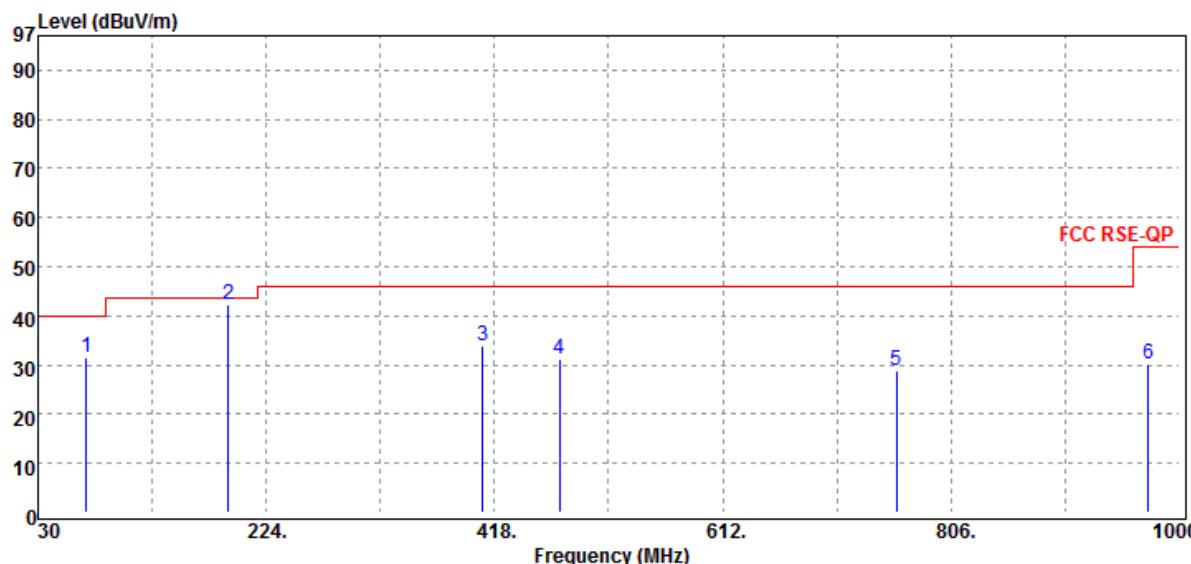
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Operation Band :BR  
 Fundamental Frequency :2480 MHz  
 Operation Mode :TX HIGH  
 EUT Pol. :E2 Plan

Test Date :2015-09-08  
 Temp./Humi. :23 deg\_C / 62 RH  
 Engineer :JJ  
 Measurement Antenna Pol. :HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level		Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
			Reading	Level dB $\mu$ V				
70.74	S	Peak	43.20	-11.79	31.41	40.00	-8.59	
191.99	S	Peak	53.79	-11.65	42.14	43.50	-1.36	
408.30	S	Peak	39.70	-5.90	33.80	46.00	-12.20	
473.29	S	Peak	36.24	-4.93	31.31	46.00	-14.69	
759.44	S	Peak	27.67	1.07	28.74	46.00	-17.26	
973.81	S	Peak	26.58	3.53	30.11	54.00	-23.89	

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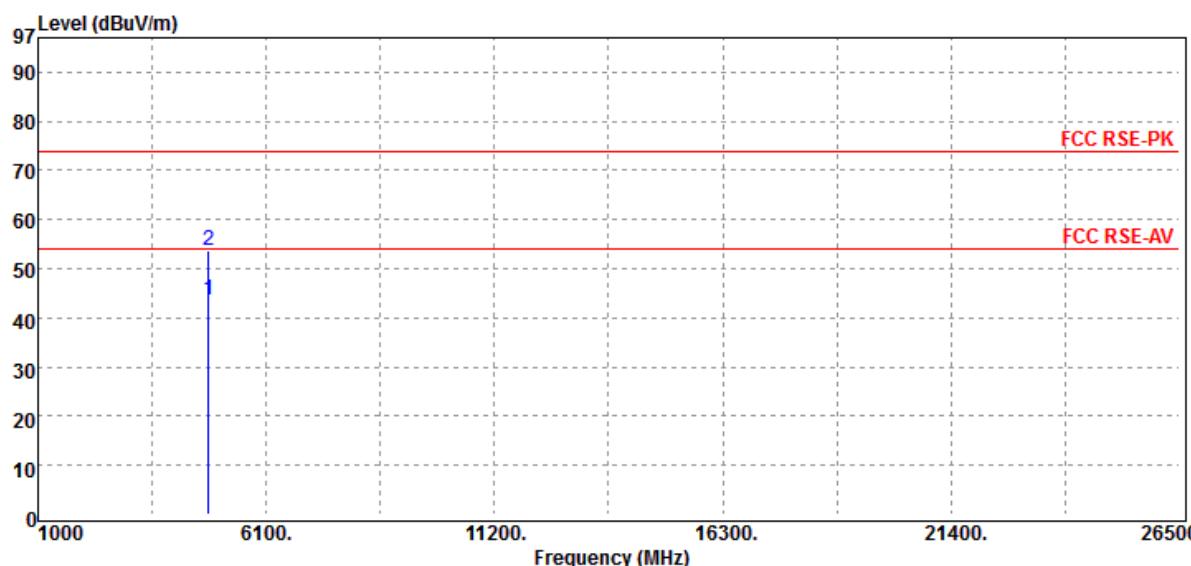
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## Radiated Spurious Emission Measurement Result:

## For Frequency above 1 GHz

Operation Band	:BR	Test Date	:2015-09-08
Fundamental Frequency	:2402 MHz	Temp./Humi.	:23 deg_C / 62 RH
Operation Mode	:TX LOW	Engineer	:JJ
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode	Spectrum	Factor	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
			Reading				
		PK/QP/AV	Level dB $\mu$ V	dB			
4804.00	H	Average	34.10	9.56	43.66	54.00	-10.34
4804.00	H	Peak	44.04	9.56	53.60	74.00	-20.40

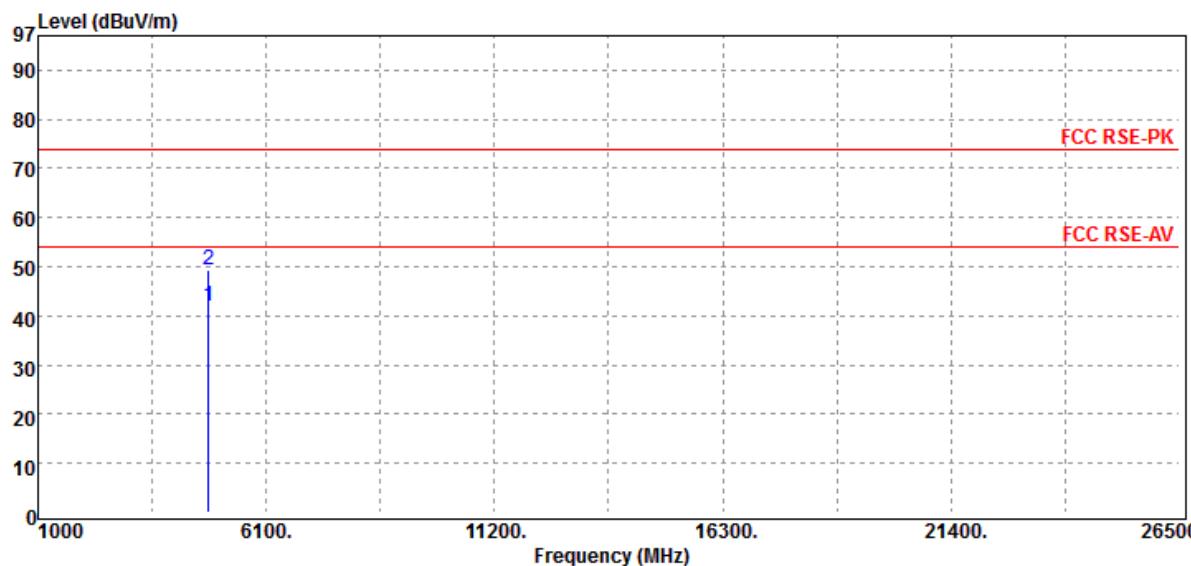
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Operation Band :BR  
 Fundamental Frequency :2402 MHz  
 Operation Mode :TX LOW  
 EUT Pol. :E2 Plan

Test Date :2015-09-08  
 Temp./Humi. :23 deg\_C / 62 RH  
 Engineer :JJ  
 Measurement Antenna Pol. :HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode	Spectrum		Factor	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
			PK/QP/AV	Reading Level dB $\mu$ V				
4804.00	H	Average	32.48	9.56	42.04	54.00	-11.96	
4804.00	H	Peak	39.65	9.56	49.21	74.00	-24.79	

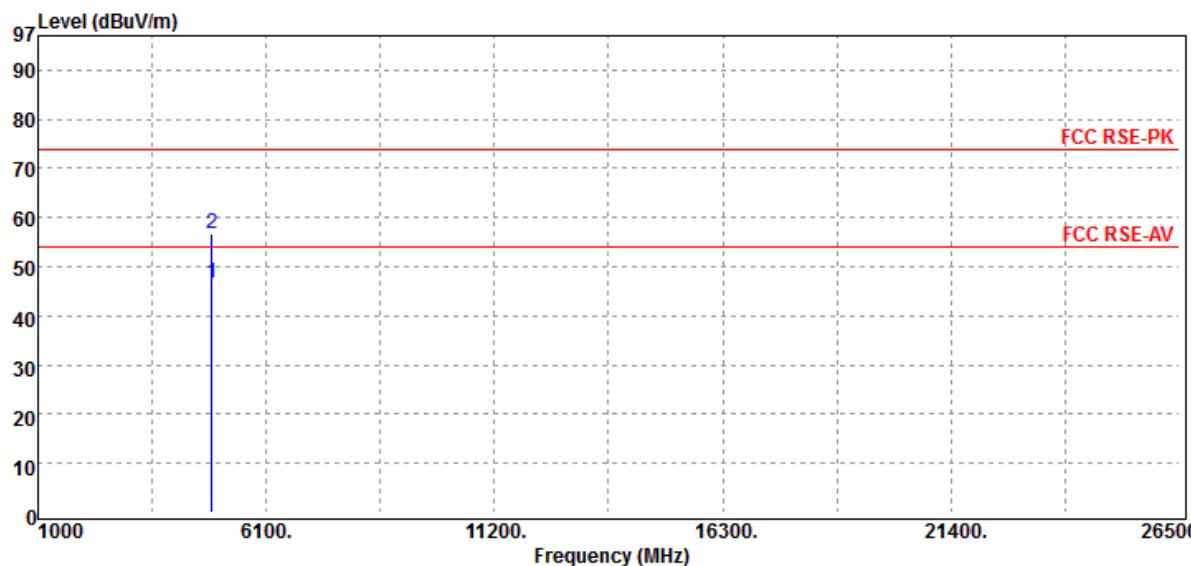
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Operation Band :BR  
 Fundamental Frequency :2441 MHz  
 Operation Mode :TX MID  
 EUT Pol. :E2 Plan

Test Date :2015-09-08  
 Temp./Humi. :23 deg\_C / 62 RH  
 Engineer :JJ  
 Measurement Antenna Pol. :VERTICAL



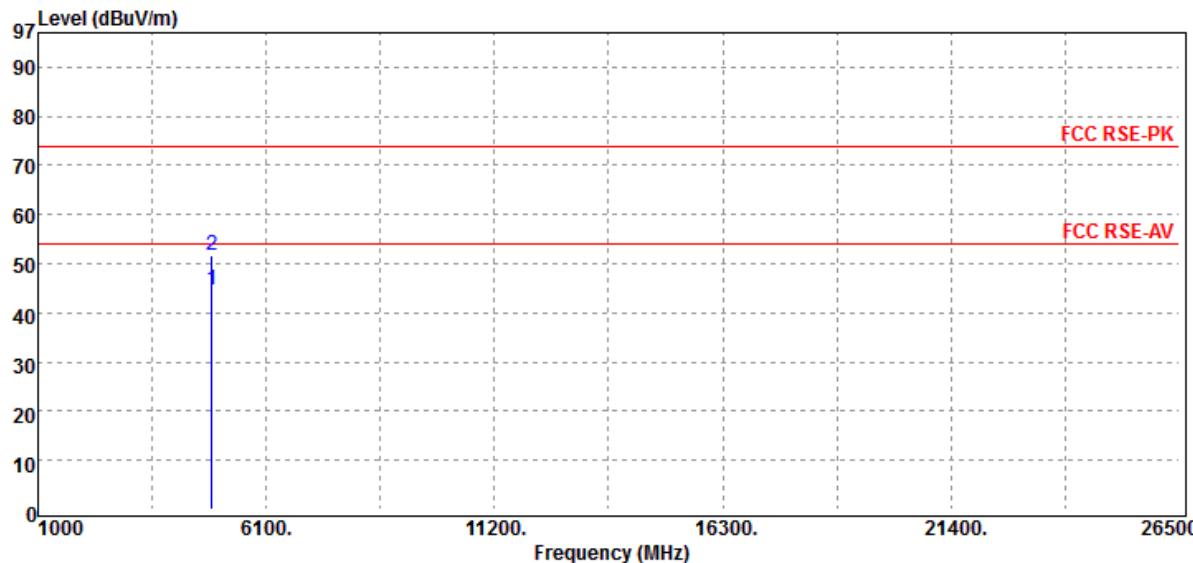
Freq. MHz	Note F/H/E/S	Detector Mode	Spectrum Reading	Factor	Actual FS	Limit	Margin
						dB $\mu$ V/m	dB $\mu$ V/m
4882.00	H	Average	36.88	9.85	46.73	54.00	-7.27
4882.00	H	Peak	46.76	9.85	56.61	74.00	-17.39

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Operation Band :BR  
Fundamental Frequency :2441 MHz  
Operation Mode :TX MID  
EUT Pol. :E2 Plan  
Test Date :2015-09-08  
Temp./Humi. :23 deg\_C / 62 RH  
Engineer :JJ  
Measurement Antenna Pol. :HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
						dB $\mu$ V/m	dB
4882.00	H	Average	34.80	9.85	44.65	54.00	-9.35
4882.00	H	Peak	42.00	9.85	51.85	74.00	-22.15

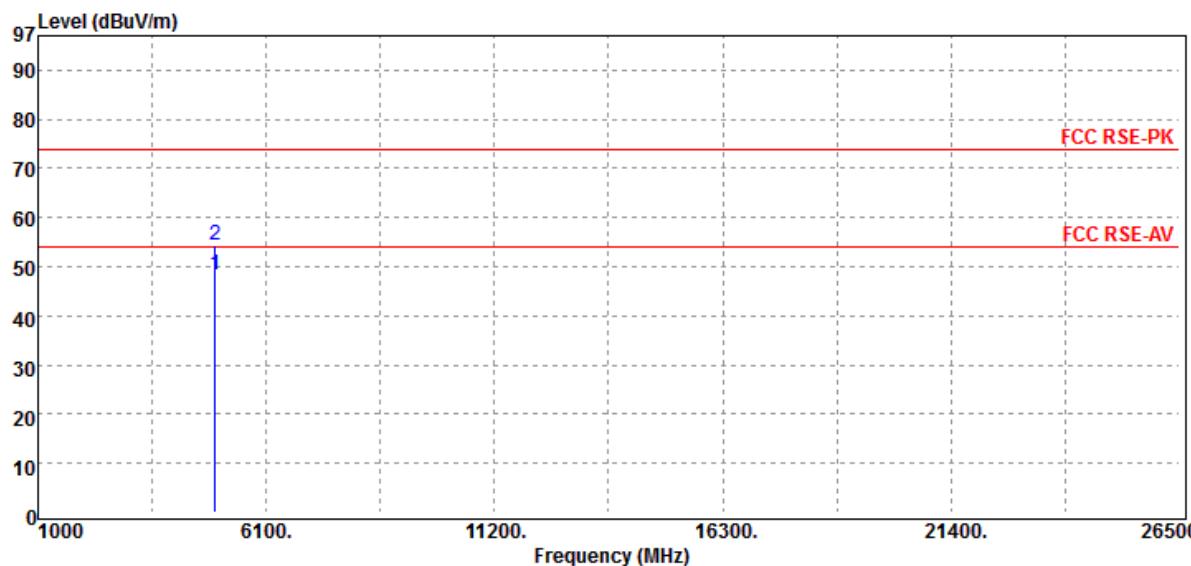
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Operation Band :BR  
 Fundamental Frequency :2480 MHz  
 Operation Mode :TX HIGH  
 EUT Pol. :E2 Plan

Test Date :2015-09-08  
 Temp./Humi. :23 deg\_C / 62 RH  
 Engineer :JJ  
 Measurement Antenna Pol. :VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode	Spectrum		Factor	Actual FS dB <sup>μ</sup> V/m	Limit @3m dB <sup>μ</sup> V/m	Margin dB
			PK/QP/AV	Reading Level dB <sup>μ</sup> V				
4960.00	H	Average		38.53	9.86	48.39	54.00	-5.61
4960.00	H	Peak		44.52	9.86	54.38	74.00	-19.62

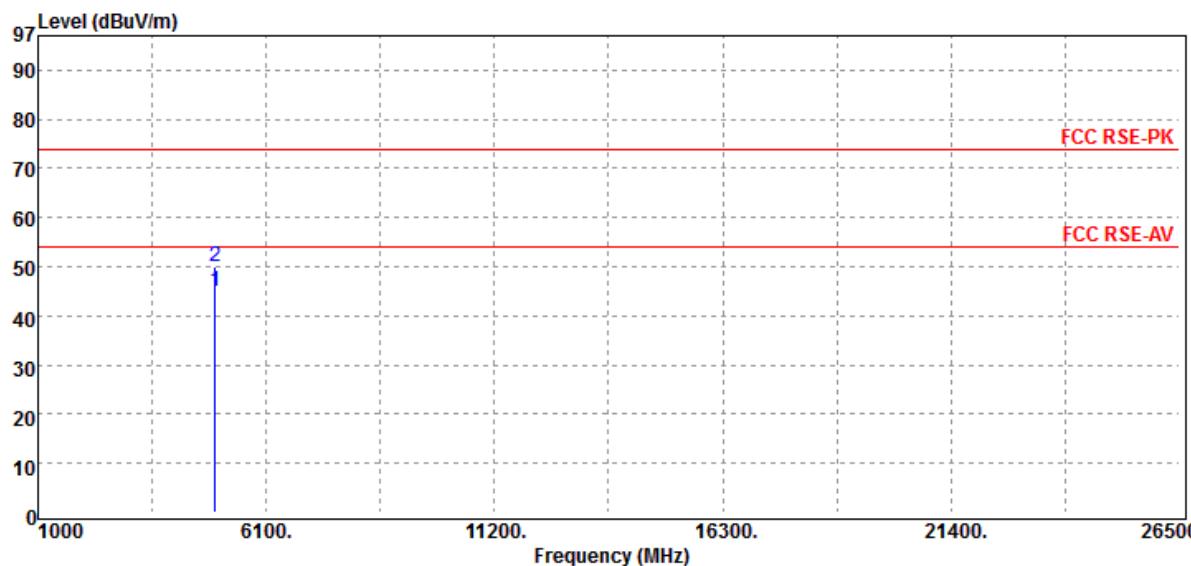
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Operation Band :BR  
 Fundamental Frequency :2480 MHz  
 Operation Mode :TX HIGH  
 EUT Pol. :E2 Plan

Test Date :2015-09-08  
 Temp./Humi. :23 deg\_C / 62 RH  
 Engineer :JJ  
 Measurement Antenna Pol. :HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode	Spectrum		Factor	Actual FS dB <sup>μ</sup> V/m	Limit @3m dB <sup>μ</sup> V/m	Margin dB
			PK/QP/AV	Reading Level dB <sup>μ</sup> V				
4960.00	H	Average	35.14	9.86	45.00	54.00	-9.00	
4960.00	H	Peak	40.13	9.86	49.99	74.00	-24.01	

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## 11. FREQUENCY SEPARATION

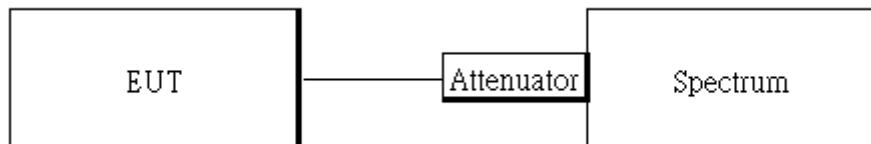
### 11.1. Standard Applicable

Frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25 kHz or the 2/3\*20dB bandwidth of the hopping channel, whichever is greater.

### 11.2. Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Agilent	E4440A	MY45304525	05/05/2015	05/04/2016
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2015	01/01/2016
Attenuator	Mini-Circuit	BW-S10W2+	002	01/02/2015	01/01/2016
Splitter	Agilent	11636B	N/A	01/02/2015	01/01/2016

### 11.3. Test Set-up



### 11.4. Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set center frequency of spectrum analyzer = middle of hopping channel.
5. Set the spectrum analyzer as RBW, VBW=100 kHz, Adjust Span to 5MHz, Sweep = auto.
6. Max hold. Mark 3 Peaks of hopping channel and record the 3 peaks frequency.

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## 11.5. Measurement Result

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

## Frequency Separation Test Data



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## 12. NUMBER OF HOPPING FREQUENCY

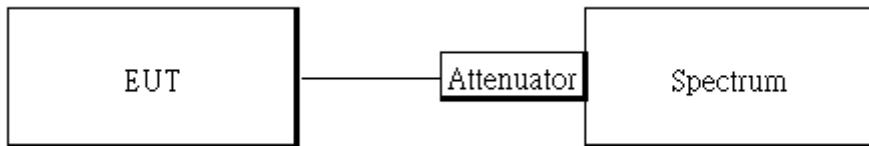
### 12.1. Standard Applicable

Frequency hopping systems operating in the 2400MHz-2483.5 MHz bands shall use at least 15 hopping frequencies.

### 12.2. Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Agilent	E4440A	MY45304525	05/05/2015	05/04/2016
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2015	01/01/2016
Attenuator	Mini-Circuit	BW-S10W2+	002	01/02/2015	01/01/2016
Splitter	Agilent	11636B	N/A	01/02/2015	01/01/2016

### 12.3. Test Set-up



### 12.4. Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set spectrum analyzer Start=2400MHz, Stop = 2483.5MHz, Sweep = auto.
5. Set the spectrum analyzer as RBW=430 kHz, VBW=1.5MHz., Detector = Peak
6. Max hold, view and count how many channel in the band.

### 12.5. Measurement Result

#### Tabular Data of Total Channel Number

	Channel Number	Limit
2.4 GHz – 2.441GHz	40	>15
2.441 GHz – 2.4835GHz	39	
2.4GHz ~2.4835GHz	(40+39) = 79	

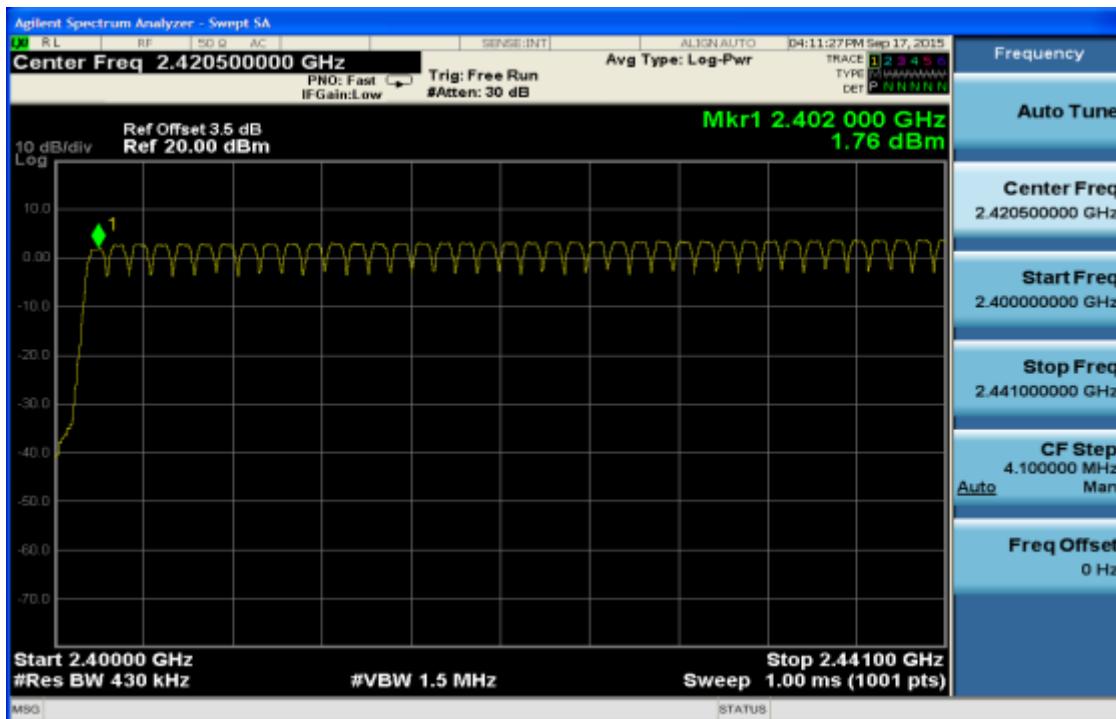
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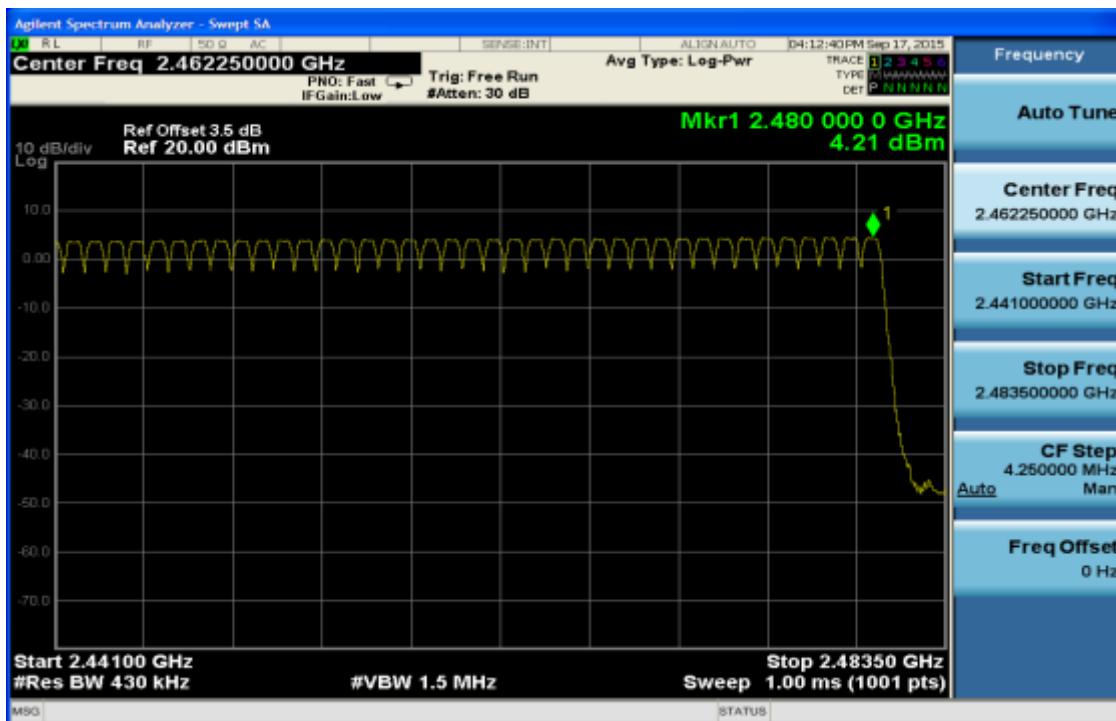
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## Channel Number

2.4 GHz – 2.441GHz



2.441 GHz – 2.4835GHz



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## 13. TIME OF OCCUPANCY (DWELL TIME)

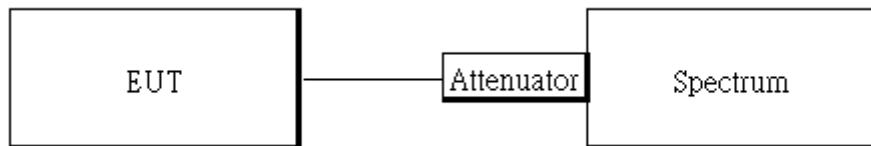
### 13.1. Standard Applicable

Frequency hopping systems operating in the 2400MHz-2483.5MHz. 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.

### 13.2. Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Agilent	E4440A	MY45304525	05/05/2015	05/04/2016
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2015	01/01/2016
Attenuator	Mini-Circuit	BW-S10W2+	002	01/02/2015	01/01/2016
Splitter	Agilent	11636B	N/A	01/02/2015	01/01/2016

### 13.3. Test Set-up



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### 13.4. Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set center frequency of spectrum analyzer = operating frequency.
5. Set the spectrum analyzer as RBW, VBW=1MHz, 3MHz, Span = 0Hz , Detector = Peak, Adjust Sweep = 2~8ms.
6. Repeat above procedures until all frequency of the interest measured were complete.

Formula Deduced: time occupancy of one time slot X Hopping rate / total slot in one channel / total channel that hops X period of working channels.

Where, standard hopping rate is 1600 hops/s, slot in one channel for DH1, DH3, and DH5 is 2, 4, and 6, respectively.

DH1 consists of single time slot of the uplink, and one slot of the downlink Total Slot: 2

DH3 consists of three time slot of the uplink, and one slot of the downlink. Total Slot: 4

DH5 consists of five time slot of the uplink, and one slot of the downlink. Total Slot: 6

In AFH mode, hopping rate is 800 hop/s with 6 slots in 20 hopping channels with channel hopping rate (800 / 6 / 20) in Occupancy Time Limit (0.4 \* 20) (S), Hop Over Occupancy Time comes to (800 / 6 / 20) \* (0.4 \* 20) = 53.33

Note: the result of the complete test default channel at 1Mbps is recorded on the test report, 2Mbps, and 3Mbps only records the measurement result at middle channel that reveals no much deviation.

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台灣檢驗科技股份有限公司

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**13.5. Tabular Result of the Measurement**

<b>GFSK (1Mbps)</b>			
<b>Channel</b>	<b>PACKET TYPE</b>	<b>Measurement Result (ms)</b>	<b>Limit (ms)</b>
0	DH1	125.44	400ms
	DH3	264.64	400ms
	DH5	309.87	400ms
39	DH1	124.80	400ms
	DH3	262.72	400ms
	DH5	309.87	400ms
78	DH1	126.40	400ms
	DH3	264.64	400ms
	DH5	307.95	400ms
<b>π/4 DQPSK (2Mbps)</b>			
<b>Channel</b>	<b>PACKET TYPE</b>	<b>Measurement Result (ms)</b>	<b>Limit (ms)</b>
39	2DH1	129.92	400ms
	2DH3	264.64	400ms
	2DH5	309.87	400ms
<b>8-DPSK (3Mbps)</b>			
<b>Channel</b>	<b>PACKET TYPE</b>	<b>Measurement Result (ms)</b>	<b>Limit (ms)</b>
39	3DH1	129.60	400ms
	3DH3	264.64	400ms
	3DH5	309.87	400ms

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

**GFSK (1Mbps):**

$$\text{CH Low DH1 time slot} = 0.4 \text{ (ms)} * (1600/2/79) * 31.6 = 125 \text{ (ms)}$$

$$\text{DH3 time slot} = 1.7 \text{ (ms)} * (1600/4/79) * 31.6 = 265 \text{ (ms)}$$

$$\text{DH5 time slot} = 2.9 \text{ (ms)} * (1600/6/79) * 31.6 = 310 \text{ (ms)}$$

$$\text{CH Mid DH1 time slot} = 0.4 \text{ (ms)} * (1600/2/79) * 31.6 = 125 \text{ (ms)}$$

$$\text{DH3 time slot} = 1.6 \text{ (ms)} * (1600/4/79) * 31.6 = 263 \text{ (ms)}$$

$$\text{DH5 time slot} = 2.9 \text{ (ms)} * (1600/6/79) * 31.6 = 310 \text{ (ms)}$$

$$\text{CH High DH1 time slot} = 0.4 \text{ (ms)} * (1600/2/79) * 31.6 = 126 \text{ (ms)}$$

$$\text{DH3 time slot} = 1.7 \text{ (ms)} * (1600/4/79) * 31.6 = 265 \text{ (ms)}$$

$$\text{DH5 time slot} = 2.9 \text{ (ms)} * (1600/6/79) * 31.6 = 308 \text{ (ms)}$$

 **$\pi/4$  -DQPSK (2Mbps):**

$$\text{CH Mid 2DH1 time slot} = 0.4 \text{ (ms)} * (1600/2/79) * 31.6 = 130 \text{ (ms)}$$

$$\text{2DH3 time slot} = 1.7 \text{ (ms)} * (1600/4/79) * 31.6 = 265 \text{ (ms)}$$

$$\text{2DH5 time slot} = 2.9 \text{ (ms)} * (1600/6/79) * 31.6 = 310 \text{ (ms)}$$

**8-DPSK (3Mbps):**

$$\text{CH Mid 3DH1 time slot} = 0.4 \text{ (ms)} * (1600/2/79) * 31.6 = 130 \text{ (ms)}$$

$$\text{3DH3 time slot} = 1.7 \text{ (ms)} * (1600/4/79) * 31.6 = 265 \text{ (ms)}$$

$$\text{3DH5 time slot} = 2.9 \text{ (ms)} * (1600/6/79) * 31.6 = 310 \text{ (ms)}$$

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**AFH Mode:**

<b>GFSK (1Mbps) for AFH Mode</b>			
<b>Hopping Channel Number</b>	<b>PACKET TYPE</b>	<b>Measurement Result (ms)</b>	<b>Limit (ms)</b>
20	DH5	153.97	400ms
<b><math>\pi/4</math> DQPSK (2Mbps) for Mode</b>			
<b>Hopping Channel Number</b>	<b>PACKET TYPE</b>	<b>Measurement Result (ms)</b>	<b>Limit (ms)</b>
20	DH5	154.93	400ms
<b>8-DPSK (3Mbps) for AFH Mode</b>			
<b>Hopping Channel Number</b>	<b>PACKET TYPE</b>	<b>Measurement Result (ms)</b>	<b>Limit (ms)</b>
20	DH5	154.93	400ms

**GFSK (1Mbps):**

$$\text{DH5 time slot} = 2.9 \text{ (ms)} * (800/6/20) * 8 = 153.97 \text{ (ms)}$$

 **$\pi/4$  -DQPSK (2Mbps):**

$$\frac{\text{2DH5 time slot}}{2} = 2.9 \text{ (ms)} * (800/6/20) * 8 = 154.93 \text{ (ms)}$$

**8-DPSK (3Mbps):**

$$\frac{\text{3DH5 time slot}}{3} = 2.9 \text{ (ms)} * (800/6/20) * 8 = 154.93 \text{ (ms)}$$

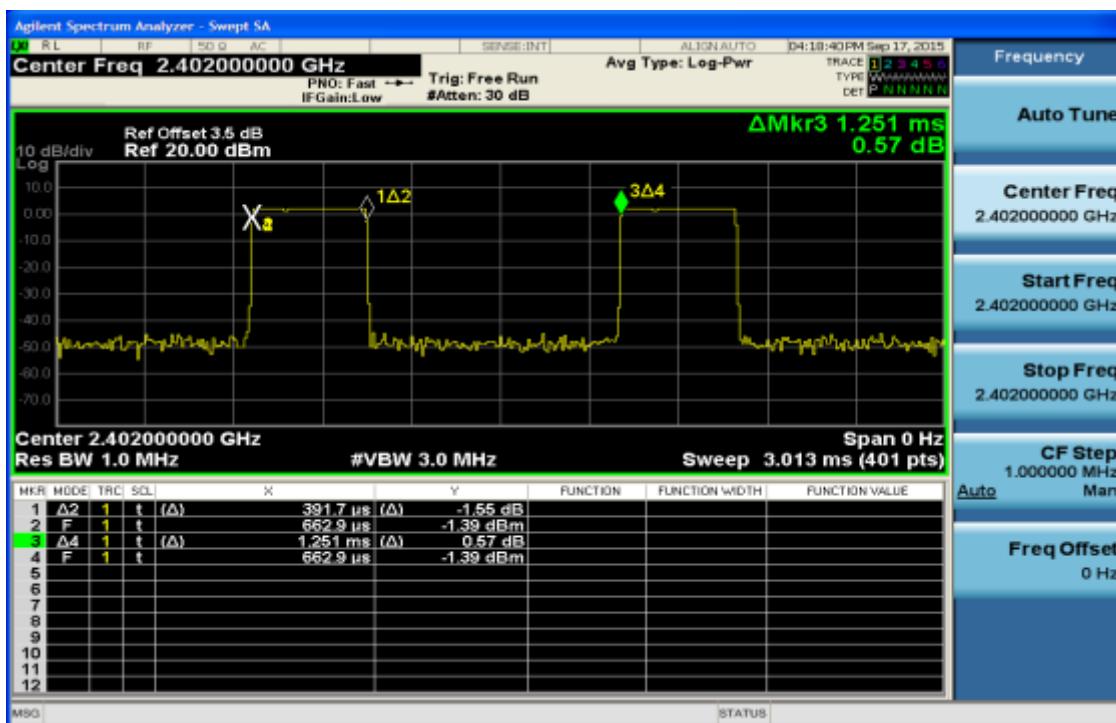
**13.6. Measurement Result**

Note: Refer to next page for plots.

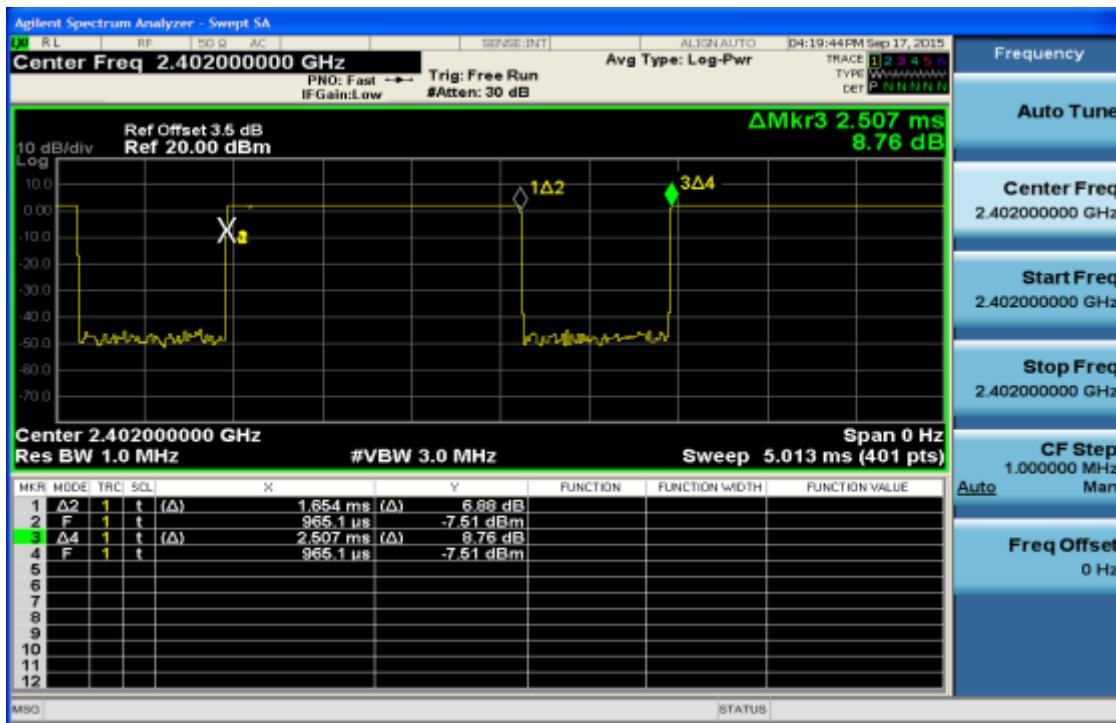
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CH-Low  
DH1

## DH3

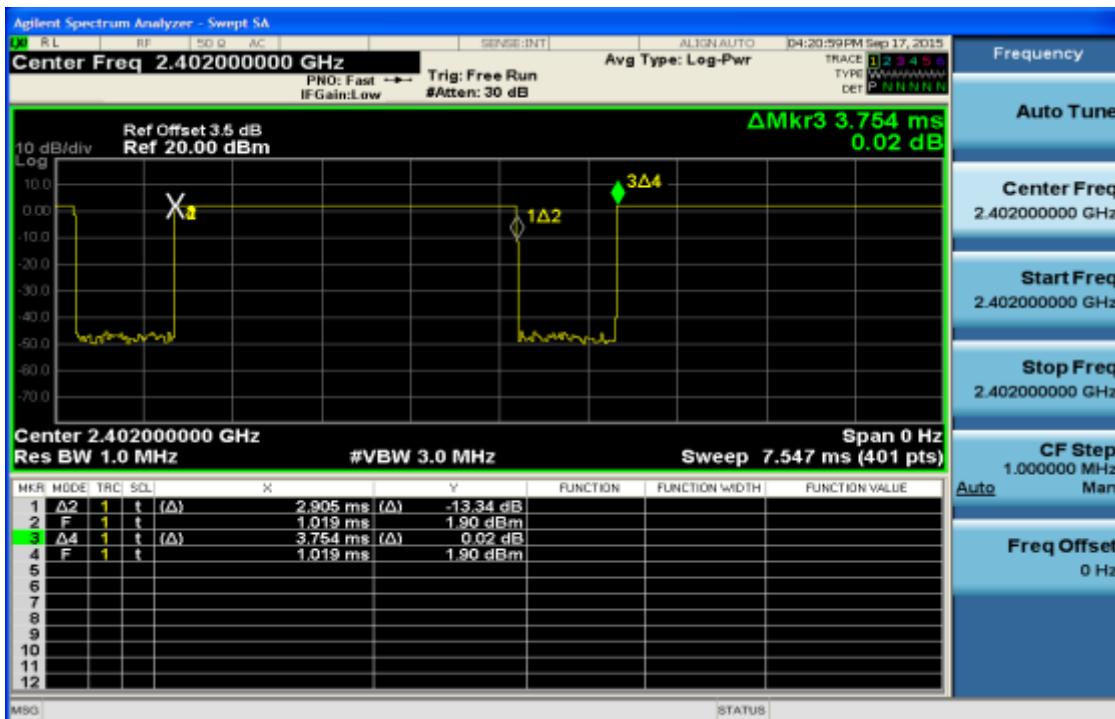


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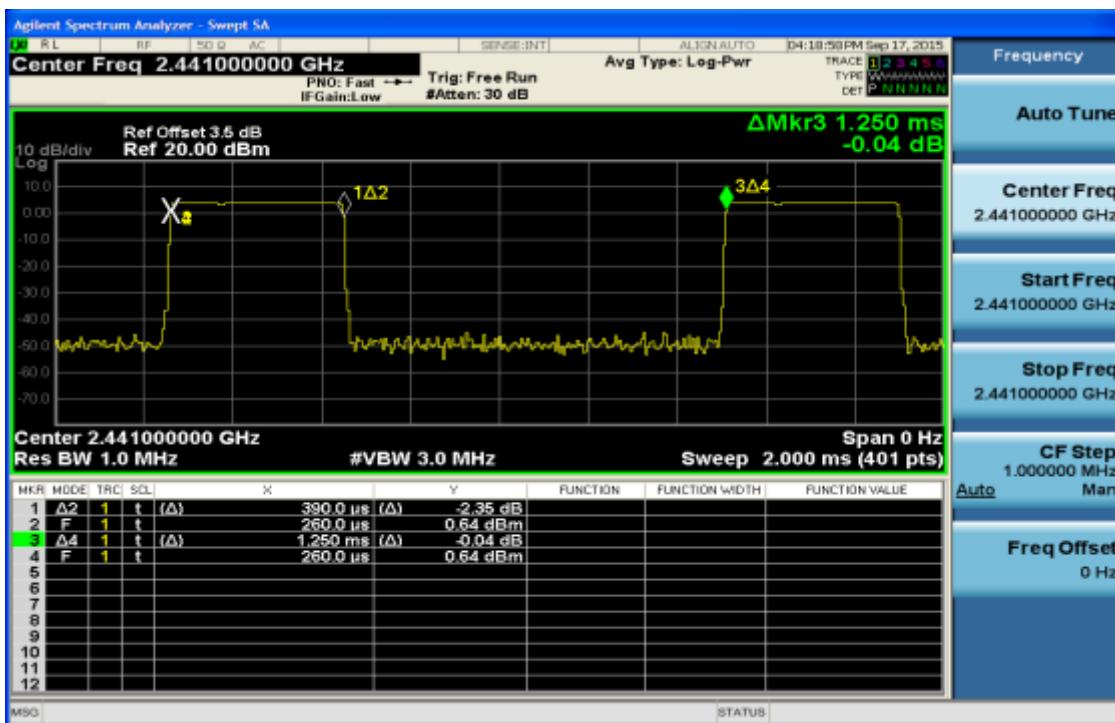
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## DH5



## CH-Mid

## DH1

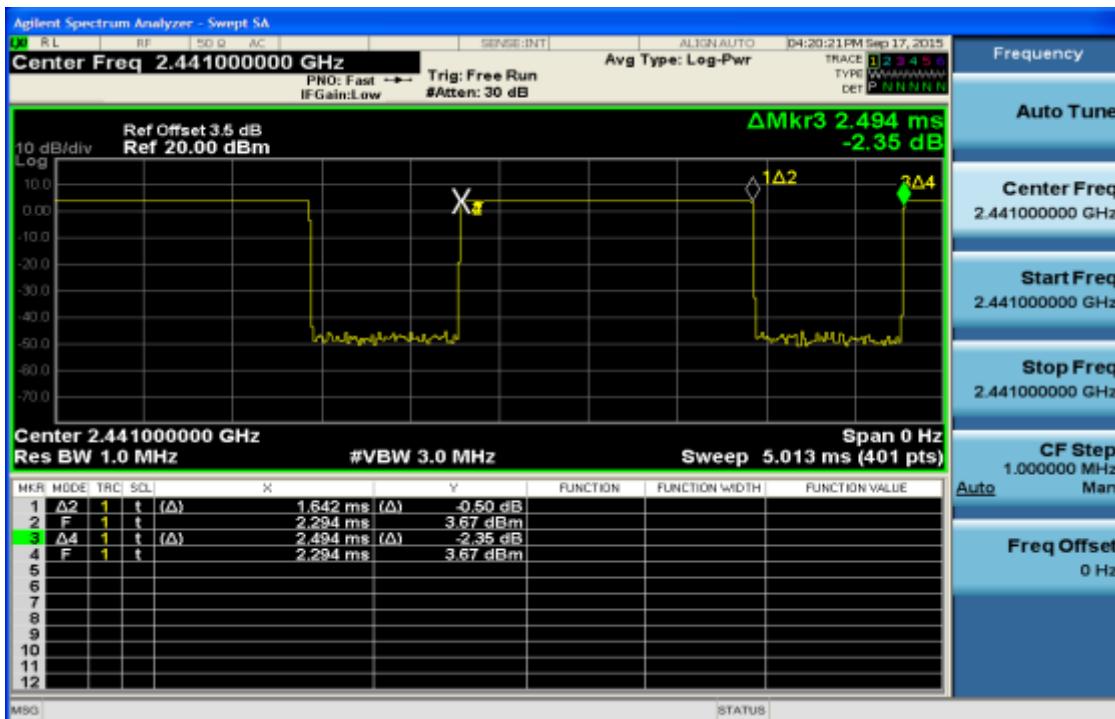


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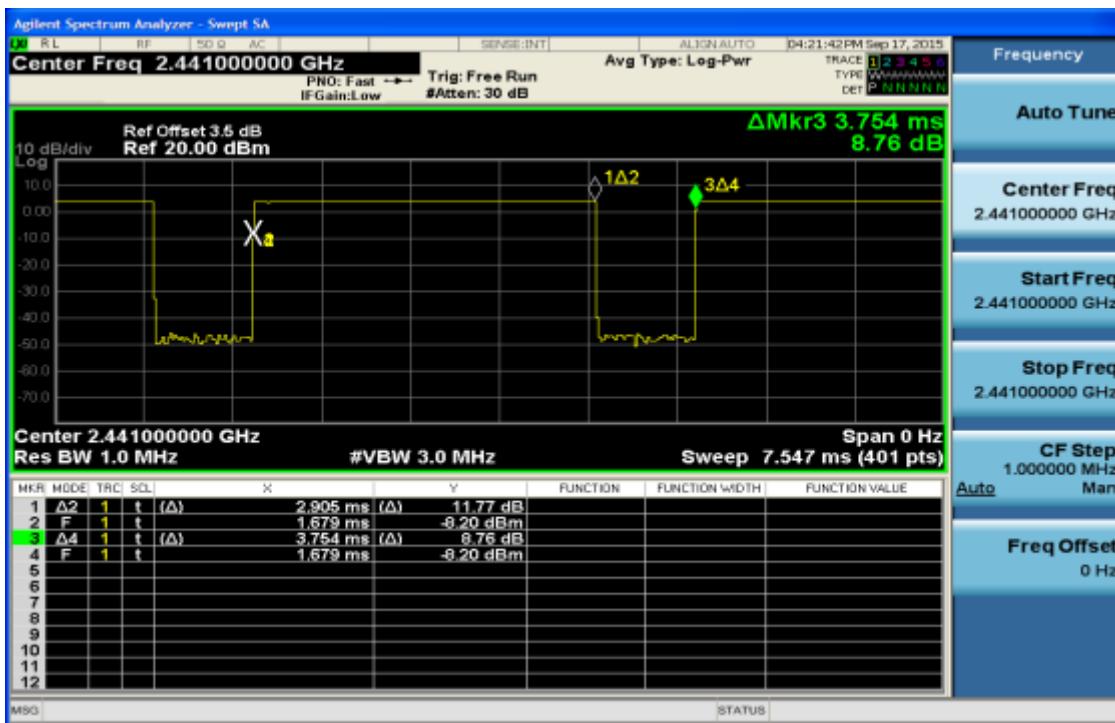
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## DH3



## DH5



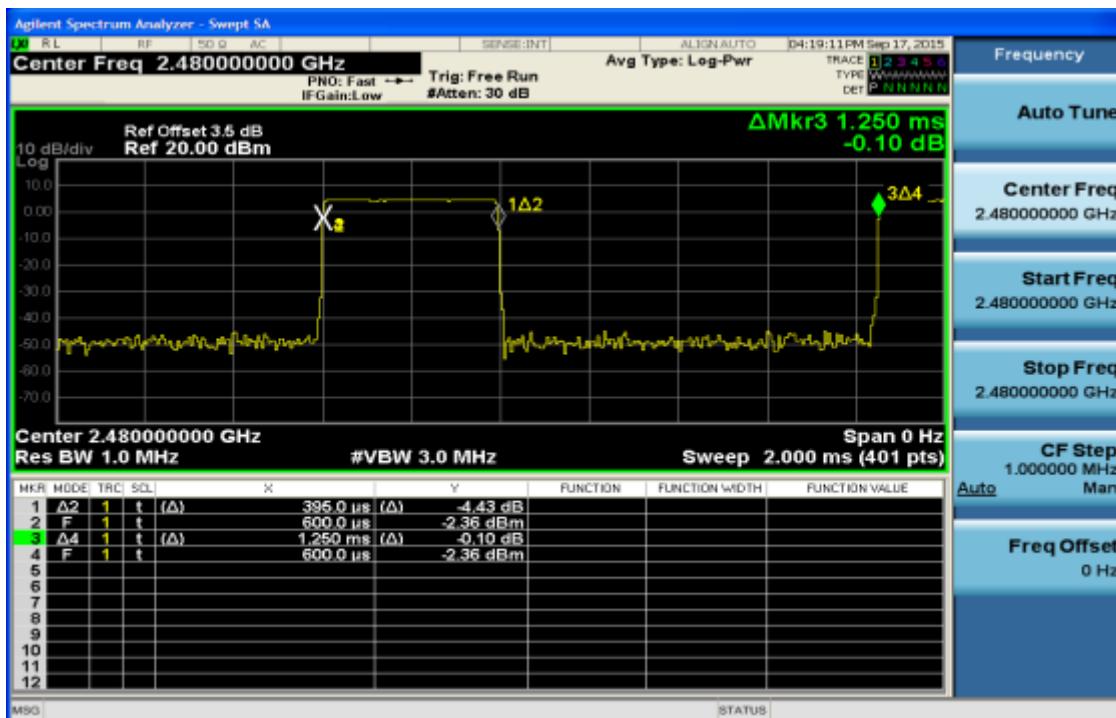
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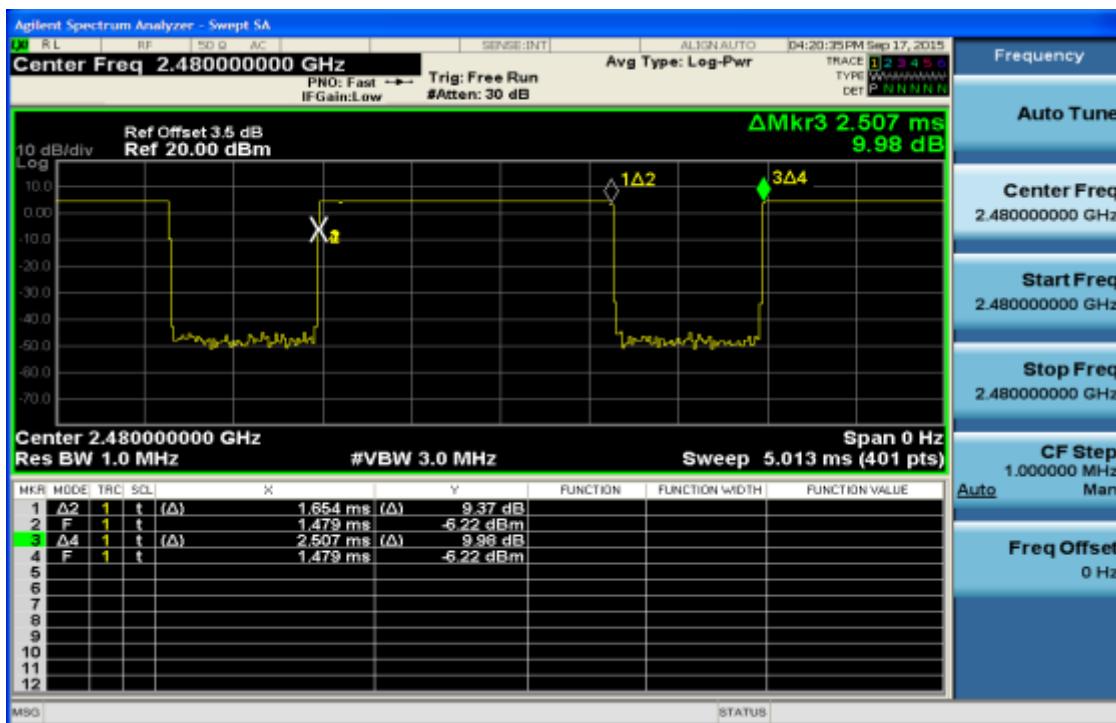
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## CH-High

## DH1



## DH3

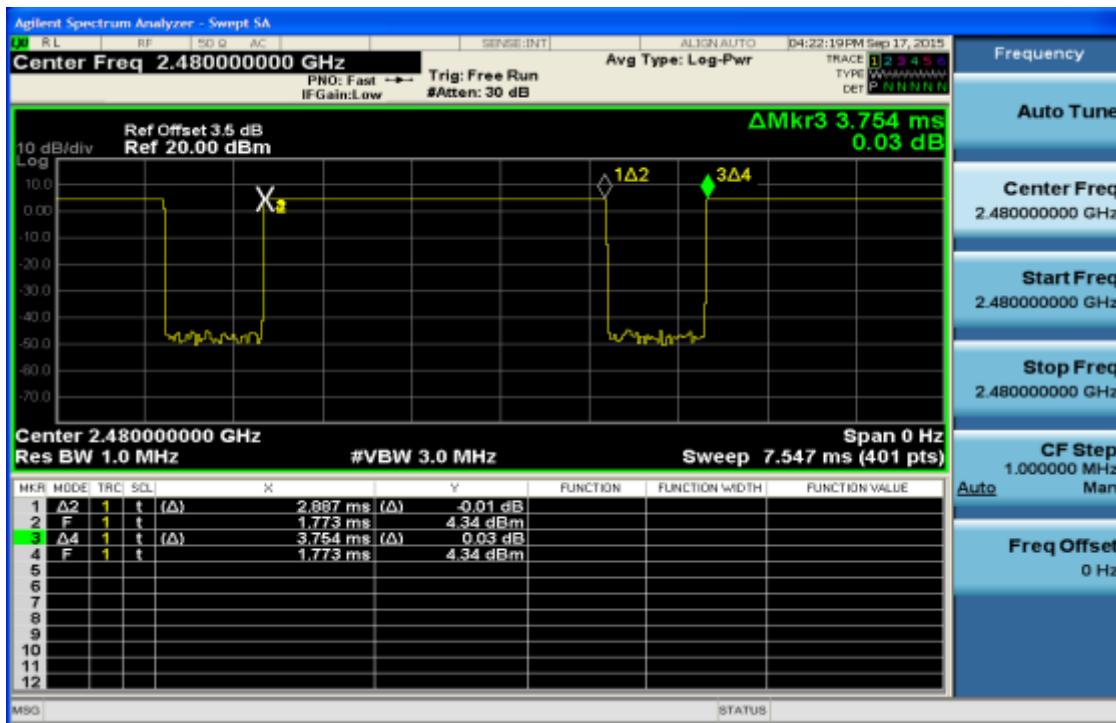


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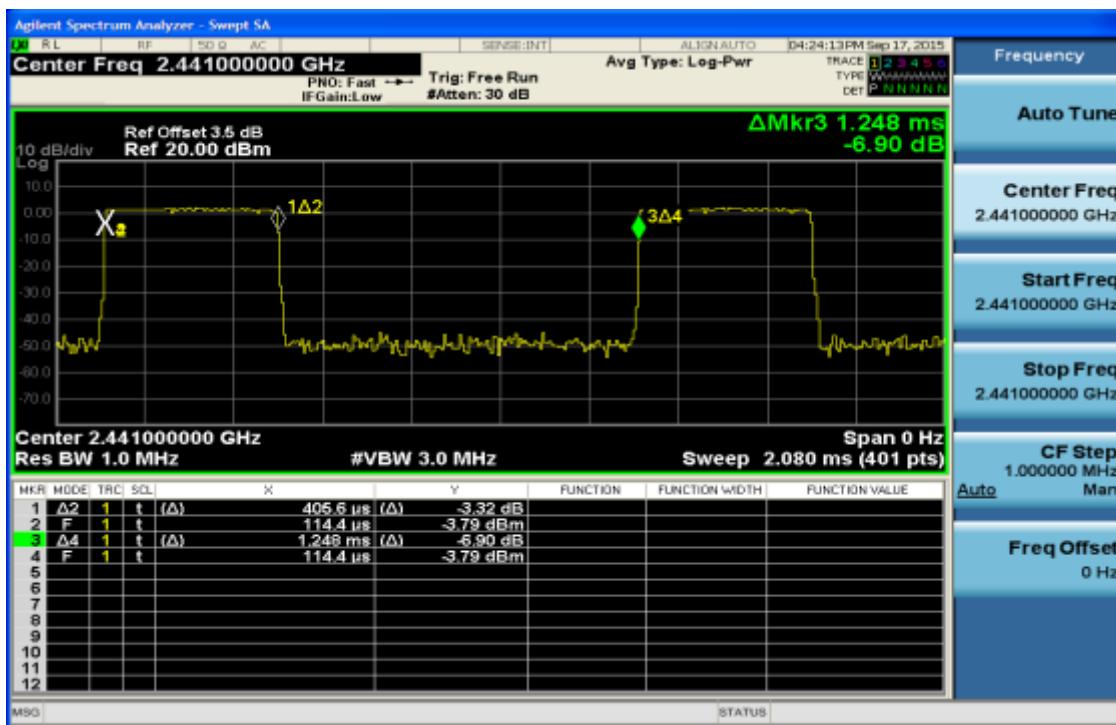
DH5



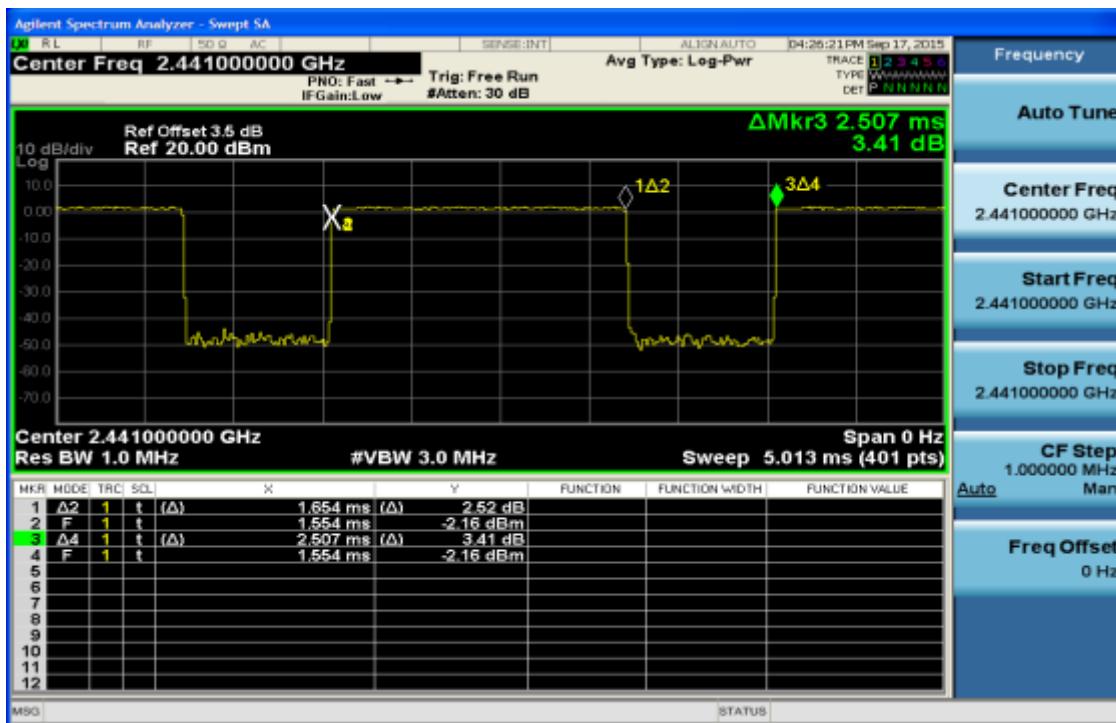
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CH-Mid  
2DH1

## 2DH3

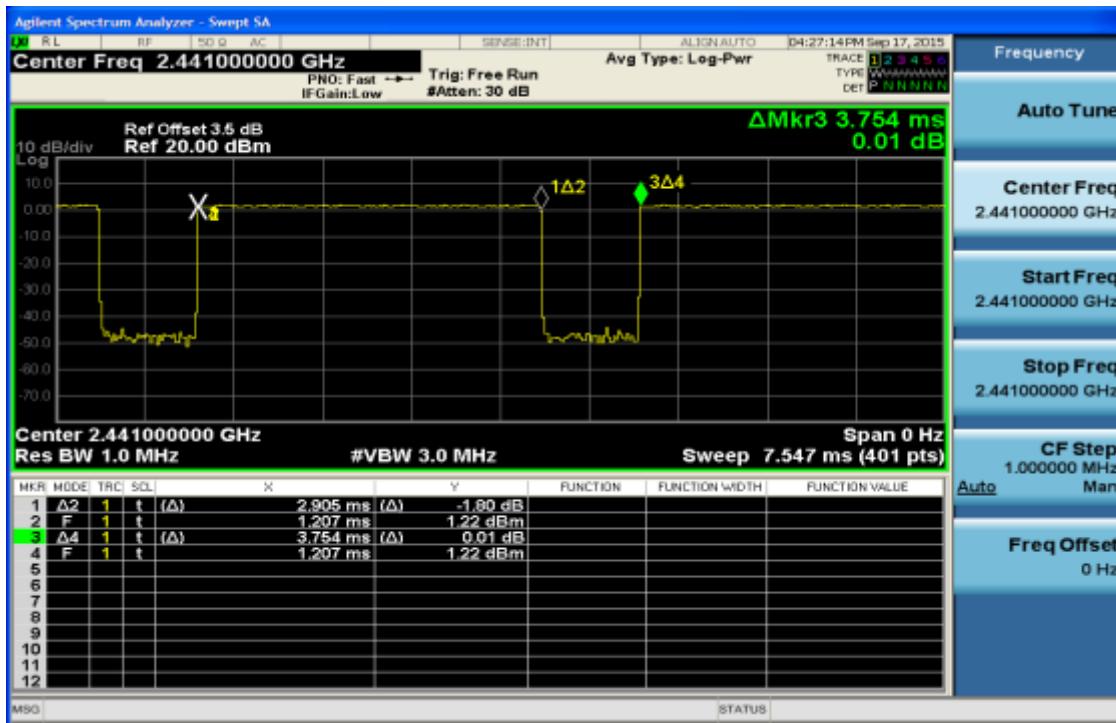


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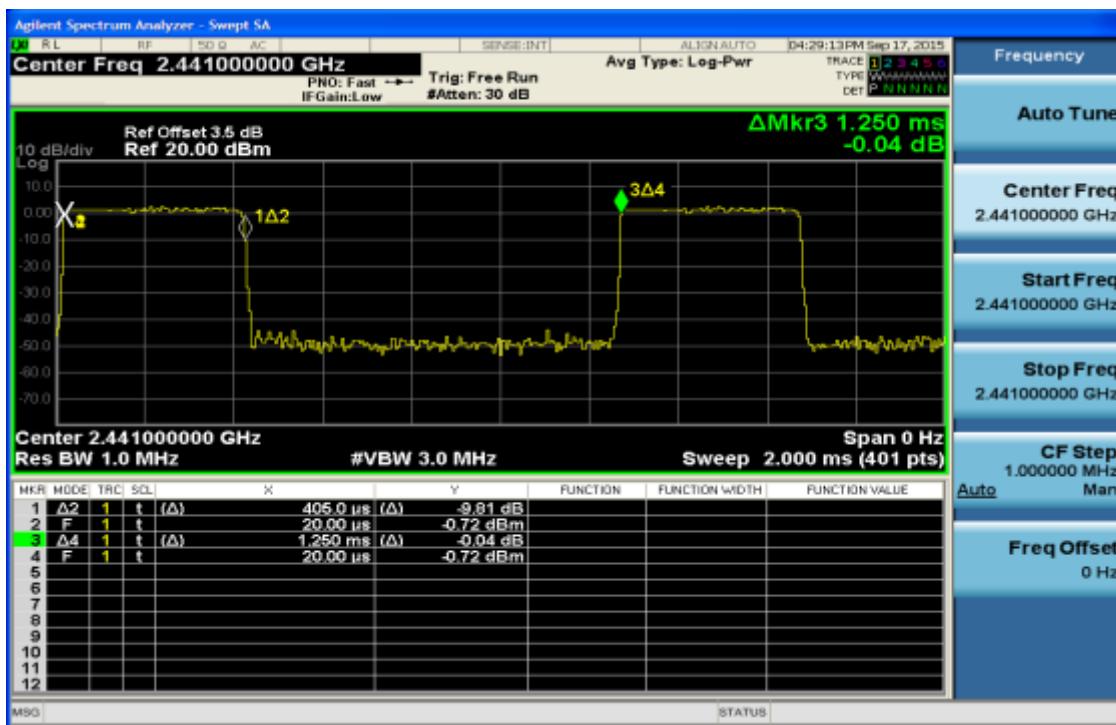
2DH5



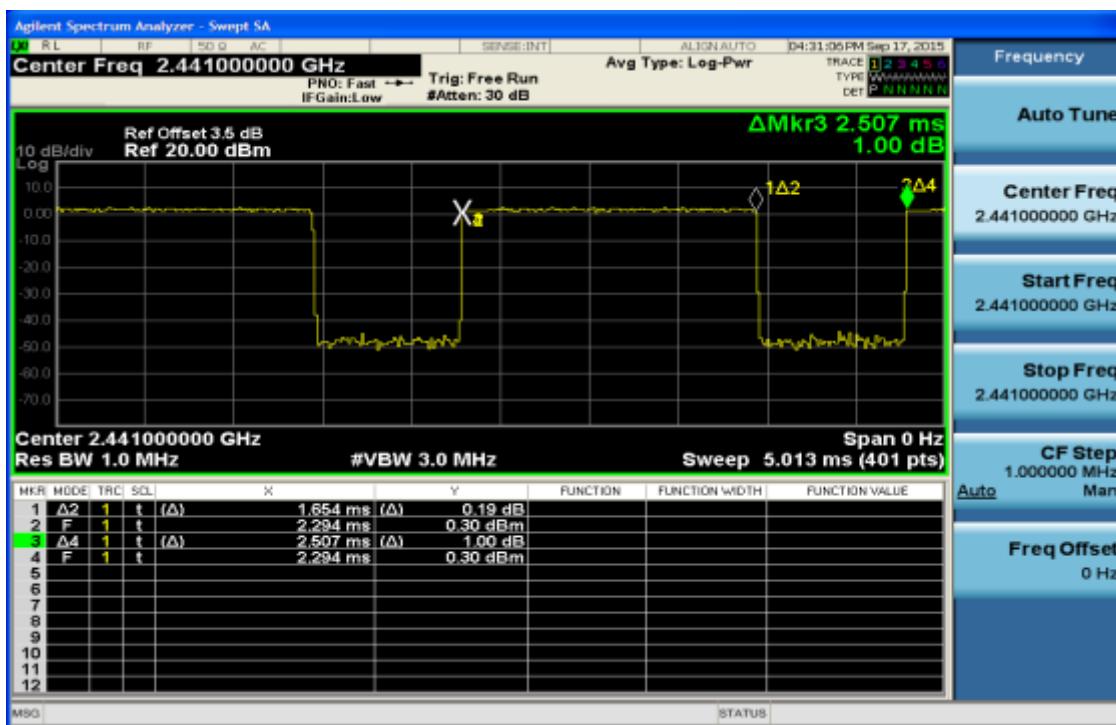
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CH-Mid  
3DH1

## 3DH3

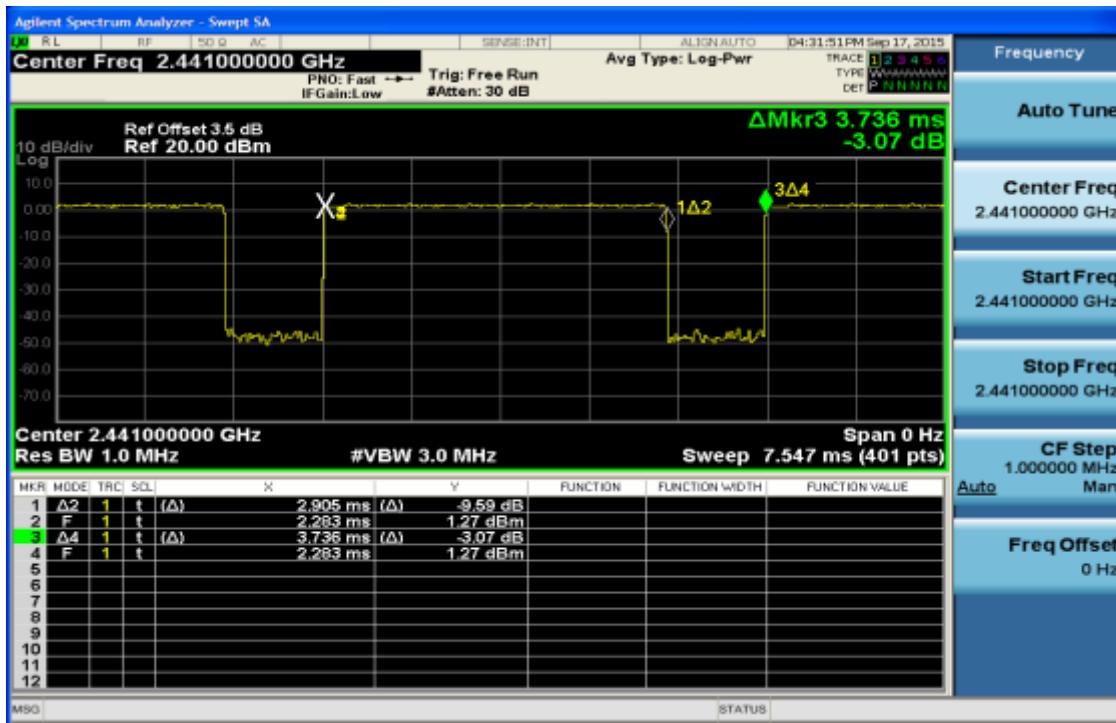


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## 3DH5



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## 14. ANTENNA REQUIREMENT

### 14.1. Standard Applicable

For intentional device, 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.

If the transmitting antenna is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi.

According to RSS-GEN 8.3

The applicant for equipment certification, as per RSP-100, must provide a list of all antenna types that may be used with the licence-exempt transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna.

Licence-exempt transmitters that have received equipment certification may operate with different types of antennas. However, it is not permissible to exceed the maximum equivalent isotropically radiated power (e.i.r.p.) limits specified in the applicable standard (RSS) for the licence-exempt apparatus.

Testing shall be performed using the highest gain antenna of each combination of licence-exempt transmitter and antenna type, with the transmitter output power set at the maximum level.<sup>9</sup> When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna manufacturer.

### 14.2. Antenna Connected Construction

An embedded-in antenna design is used.

The antenna connector is designed with unique type RF connector and no consideration of replacement. Please see EUT photo and antenna spec. for details.

The antenna gain is less than 6dBi. Therefore, it is not necessary to reduce maximum output power limit.

*~ End of Report ~*

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