ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

Product Name:	**ASUS Phone**
Brand Name:	**ASUS**
Model No.:	**ASUS_X014D**
Model Difference:	**N/A**
FCC ID:	**MSQX014D**
Report No.:	**E2/2016/80079**
Issue Date:	**Sep. 05, 2016**
FCC Rule Part:	**§15.247, Cat: DSS**
Prepared for:	**ASUSTek Computer Inc. 4F , No.150, Li-Te Rd., Beitou, Taipei 112, Taiwan, R.O.C**
Prepared by:	**SGS Taiwan Ltd. Electronics & Communication Laboratory No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333**

Testing Laboratory
0513

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VERIFICATION OF COMPLIANCE

Applicant:	ASUSTek Computer Inc. 4F , No.150, Li-Te Rd., Beitou, Taipei 112, Taiwan, R.O.C
Product Name:	ASUS Phone
Brand Name:	ASUS
Model No.:	ASUS_X014D
Model Difference:	N/A
FCC ID:	MSQX014D
Report Number:	E2/2016/80079
Date of test:	Aug. 23, 2016 ~ Aug. 26, 2016
Date of EUT Received:	Aug. 23, 2016

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:	Aken Huang	***Date:***	Sep. 05, 2016
	Aken Huang / Engineer		
Prepared By:	Karen Huang	***Date:***	Sep. 05, 2016
	Karen Huang / Clerk		
Approved By:	Jim Chang	***Date:***	Sep. 05, 2016
	Jim Chang / Asst. Manager		

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Revision History

Report Number	Revision	Description	Issue Date
E2/2016/80079	Rev.00	Initial creation of document	Sep. 05, 2016

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1. GENERAL INFORMATION

1.1. Product description

General:

Product Name:	ASUS Phone	
Brand Name:	ASUS	
Model No.:	ASUS_X014D	
Model Difference:	N/A	
Product SW/HW version:	12.2.0.50 / ER2	
Radio SW/HW version:	N/A / N/A	
Test SW Version:	N/A	
RF power setting in TEST SW:	N/A	
Headset	Model No.: AR-101, Supplier: 1MORE	
USB Cable	1. Model No.: L65U2009-CS-B, Supplier: Luxshare-ICT 2. Model No.: 130-26314 CABLE USB A TO MICRO USB B 5P, Supplier: HONGLIN	
Power Supply:	7.4Vdc from rechargeable battery and 15Vdc from adapter	
	Battery:	Model No.: B11P1428, Supplier: TWS .
	Adapter:	1. Model No.: AD2061320, Supplier: PI 2. Model No.: PA-1050- 39, Supplier: LITEON 3. Model No.: AS0102, Supplier: SALCOMP

Bluetooth_BR+EDR:

Bluetooth Version:	V4.0 dual mode
Channel number:	79 channels
Modulation type:	GFSK +π/4DQPSK+8DPSK
Transmit Power:	11.75dBm
Frequency Range:	2.402GHz – 2.480GHz
Dwell Time:	<= 0.4s
Antenna Designation:	Embedded inverted-F antenna, Gain: -1.6dBi

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1.2. Product Feature of Equipment Under Test

The equipment under Test (Hereafter Called: EUT) is supporting GSM / WCDMA, Bluetooth, and 802.11b\g\n Wi-Fi feature, and below is details of information:

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Product Feature	
Product Name:	ASUS Phone
Brand Name:	ASUS
Model No.:	ASUS_X014D
Model Difference:	N/A
FCC ID:	MSQX014D
GSM Operating Band(s)	GSM 850/1900MHz
GPRS / EGPRS Multi Slot Class	GPRS Class 12
WCDMA Operating Band(s)	FDD Band II / V
WCDMA Rel. Version	Rel.7
Bluetooth Version	V4.0 dual mode
Wi-Fi	802.11 b\g\n

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

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.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333 (TAF code 0513)

FCC Registration Numbers are: 735305

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

1.1.1 Conducted Emissions

The EUT is a placed on as 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.

1.1.2 Radiated Emissions

The EUT is a placed on as 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 0.9dB.

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2.5. Configuration of Tested System

Fig. 2-1 Configuration of Radiated & Conducted Tested System

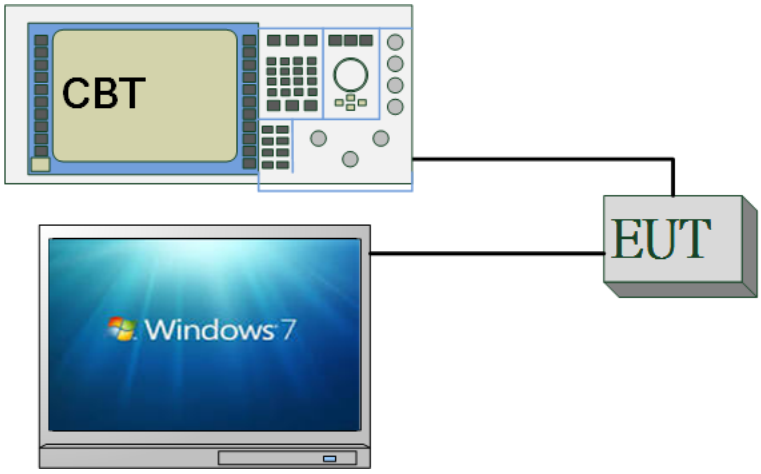

Fig. 2-2 Conducted (Antenna Port) Configuration

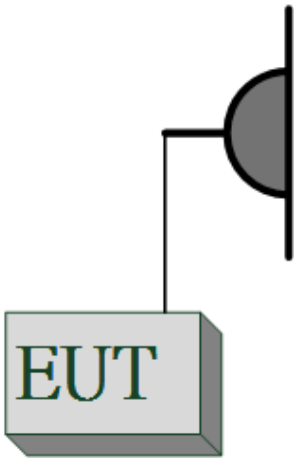

Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1.	Bluetooth Test Software	N/A	N/A	N/A	N/A	N/A
2.	Bluetooth Test Set	R&S	CBT	101140	N/A	N/A
2.	Notebook	Lenovo	L430	R9-YYG88	Shielded	Un-shielded

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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(a)(1)	20dB Bandwidth	Compliant
§15.247(d)	Conducted Band Edge and Spurious Emission	Compliant
§15.247(d)	Radiated Band Edge and Spurious Emission	Compliant
§15.247(a)(1)	Frequency Separation	Compliant
§15.247(a)(1)(iii)	Number of hopping frequency	Compliant
§15.247(a)(1)(iii)	Time of Occupancy	Compliant
§15.203 §15.247(b)	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:

RADIATED EMISSION TEST (BELOW 1 GHz)					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	PACKET TYPE	ANTENNA PORT
Bluetooth	0 to 78	0,39,78	8-DPSK	3DH5	Main
RADIATED EMISSION TEST (ABOVE 1 GHz)					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	PACKET TYPE	ANTENNA PORT
Bluetooth	0 to 78	0,39,78	8-DPSK	3DH5	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 E1 position was reported.

ANTENNA PORT CONDUCTED MEASUREMENT:

CONDUCTED TEST					
Peak Output Power, 20dB Band Width					
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	π/4-DQPSK	2DH5	Main
	0 to 78	0,39,78	8-DPSK	3DH5	Main
Band Edge					
Bluetooth	0 to 78	0,78	GFSK	DH5	Main
	0 to 78	0,39,78	8-DPSK	3DH5	Main
Frequency Separation					
Bluetooth	0 to 78	0,1,2	GFSK	DH5	Main
Number of hopping frequency					
Bluetooth	0 to 78	0 to 78	GFSK	DH5	Main
Time of Occupancy (Dwell time)					
Bluetooth	0 to 78	0,39,78	GFSK	DH1/DH3/DH5	Main
Bluetooth	0 to 78	39	π/4-DQPSK	2DH1 / 2DH3 / 2DH5	Main
Bluetooth	0 to 78	39	8-DPSK	3DH1 / 3DH3 / 3DH5	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 : **Vertical**)	9kHz-30MHz: +/-2.87dB
	30MHz - 180MHz: +/- 3.37dB
	180MHz -417MHz: +/- 3.19dB
	0.417GHz-1GHz: +/- 3.19dB
	1GHz - 18GHz: +/- 4.04dB
	18GHz - 40GHz: +/- 4.04dB

Measurement uncertainty (Polarization : **Horizontal**)	9kHz-30MHz: +/-2.87dB
	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	ESCI 7	100950	12/12/2015	12/11/2016
Coaxial Cables	N/A	N30N30-1042-150cm	N/A	02/07/2016	02/06/2017
LISN	Schwarzbeck	NSLK 8127	8127-648	03/11/2016	03/10/2017
Test Software	Farad	EZ-EMC	Ver. SGS-03A2	N.C.R.	N.C.R.

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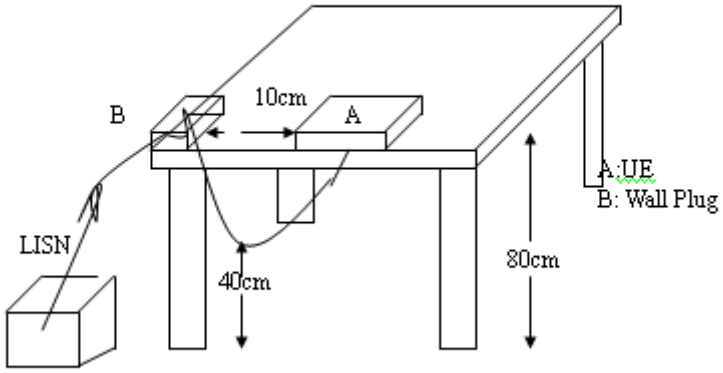
6.4. Test SET-UP (Block Diagram of Configuration)



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

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

Note2: The * reveals the worst-case results that closet to the limit.

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AC POWER LINE CONDUCTED EMISSION TEST DATA

Operation Mode:	Operation mode	Test By:	Jerry

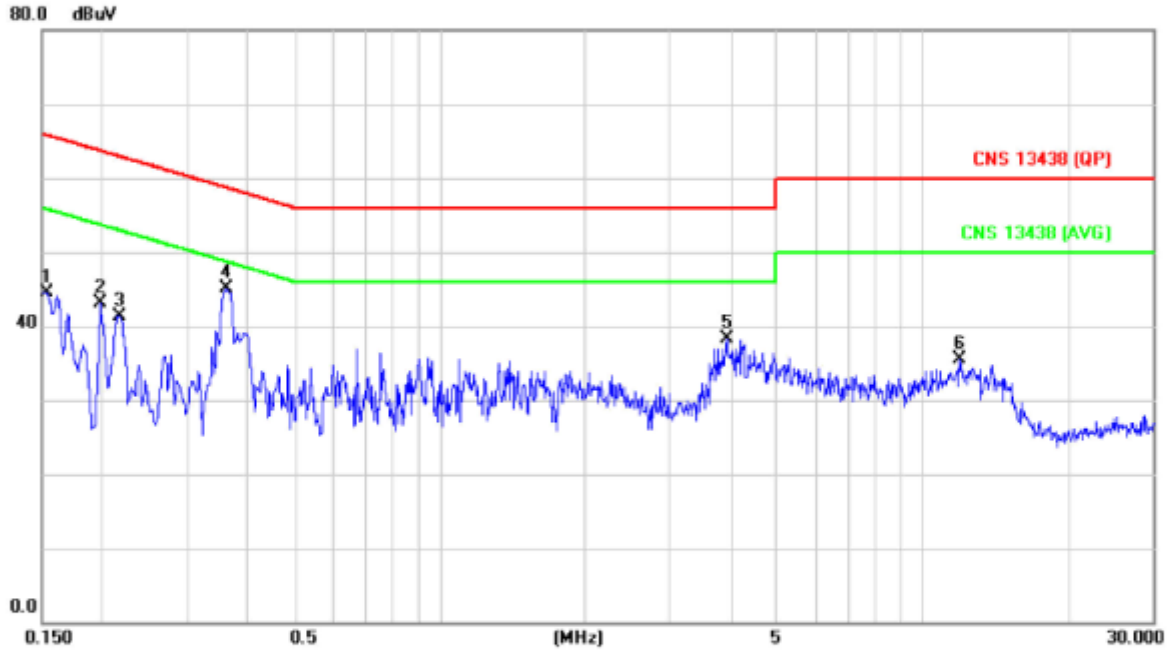
Site : Conduction Room
Limit: CNS 13438 (QP)
Mode: AD02061320
Note:

Phase: L1
Power: AC 110V/60Hz

Temperature: 23 ℃
Humidity: 67 %

Conducted Emission

File :Condution Data :#487 Date: 2016/9/2 Time: 下午 07:33:50



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1540	24.74	19.72	44.46	65.78	-21.32	peak	
2		0.1980	23.42	19.71	43.13	63.69	-20.56	peak	
3		0.2180	21.62	19.72	41.34	62.89	-21.55	peak	
4	*	0.3620	25.29	19.81	45.10	58.68	-13.58	peak	
5		3.9340	18.27	19.96	38.23	56.00	-17.77	peak	
6		11.9620	15.43	20.16	35.59	60.00	-24.41	peak	

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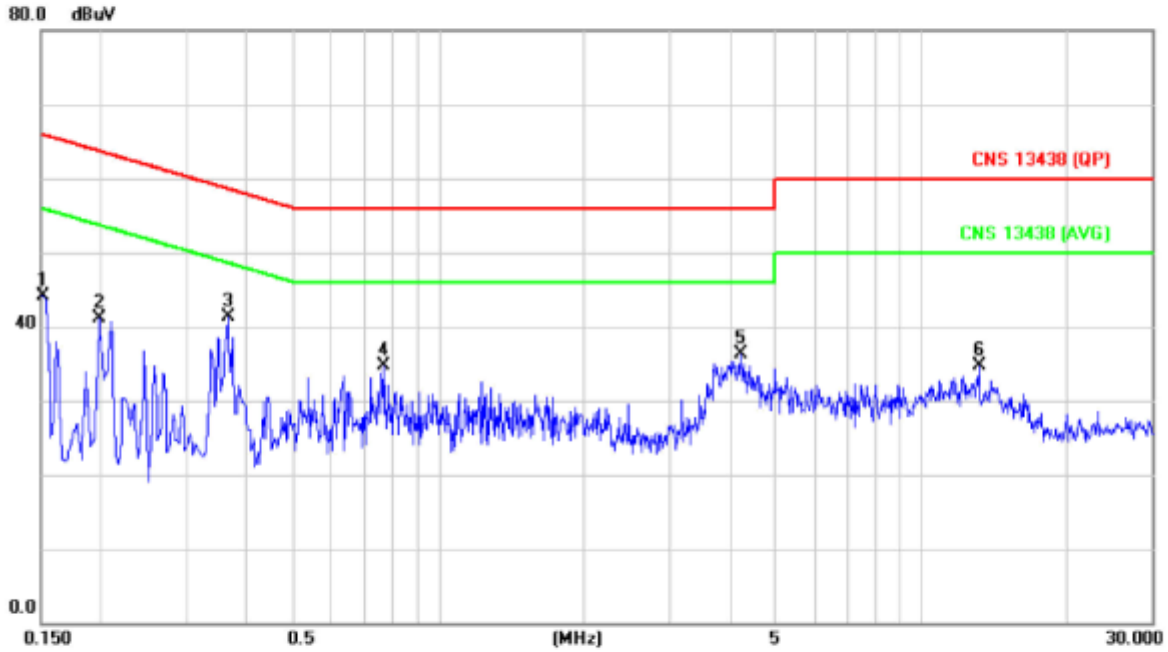
Site :	Conduction Room	Phase:	N	Temperature:	23 ℃
Limit:	CNS 13438 (QP)	Power:	AC 110V/60Hz	Humidity:	67 %
Mode:	AD02061320				
Note:					

Conducted Emission

File :Condution Data :#488 Date: 2016/9/2 Time: 下午 07:34:50



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1516	24.28	19.73	44.01	65.91	-21.90	peak	
2		0.1980	21.41	19.72	41.13	63.69	-22.56	peak	
3	*	0.3660	21.40	19.82	41.22	58.59	-17.37	peak	
4		0.7740	14.73	19.92	34.65	56.00	-21.35	peak	
5		4.2460	16.40	19.97	36.37	56.00	-19.63	peak	
6		13.1940	14.39	20.25	34.64	60.00	-25.36	peak	

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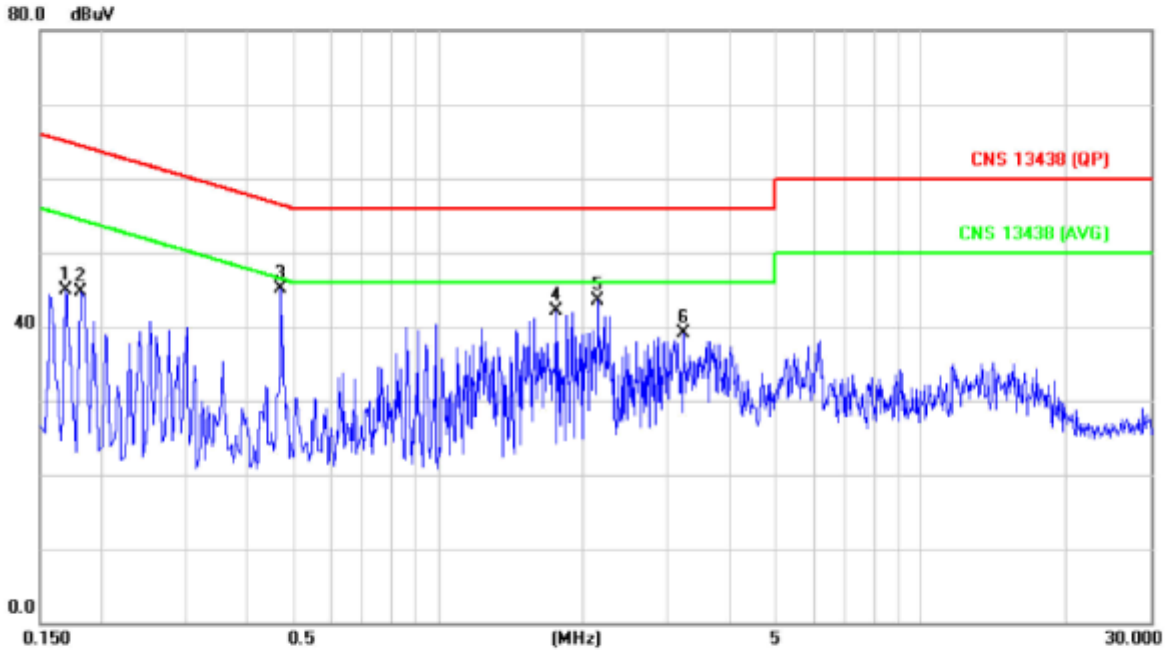
Site :	Conduction Room	Phase:	L1	Temperature:	23 ℃
Limit:	CNS 13438 (QP)	Power:	AC 110V/60Hz	Humidity:	67 %
Mode:	PA-1050-39				
Note:					

Conducted Emission

File :Condution Data :#486 Date: 2016/9/2 Time: 下午 07:29:54



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1700	25.10	19.72	44.82	64.96	-20.14	peak	
2		0.1820	25.04	19.71	44.75	64.39	-19.64	peak	
3	*	0.4740	25.14	19.88	45.02	56.44	-11.42	peak	
4		1.7620	22.21	19.93	42.14	56.00	-13.86	peak	
5		2.1460	23.62	19.93	43.55	56.00	-12.45	peak	
6		3.2260	19.23	19.95	39.18	56.00	-16.82	peak	

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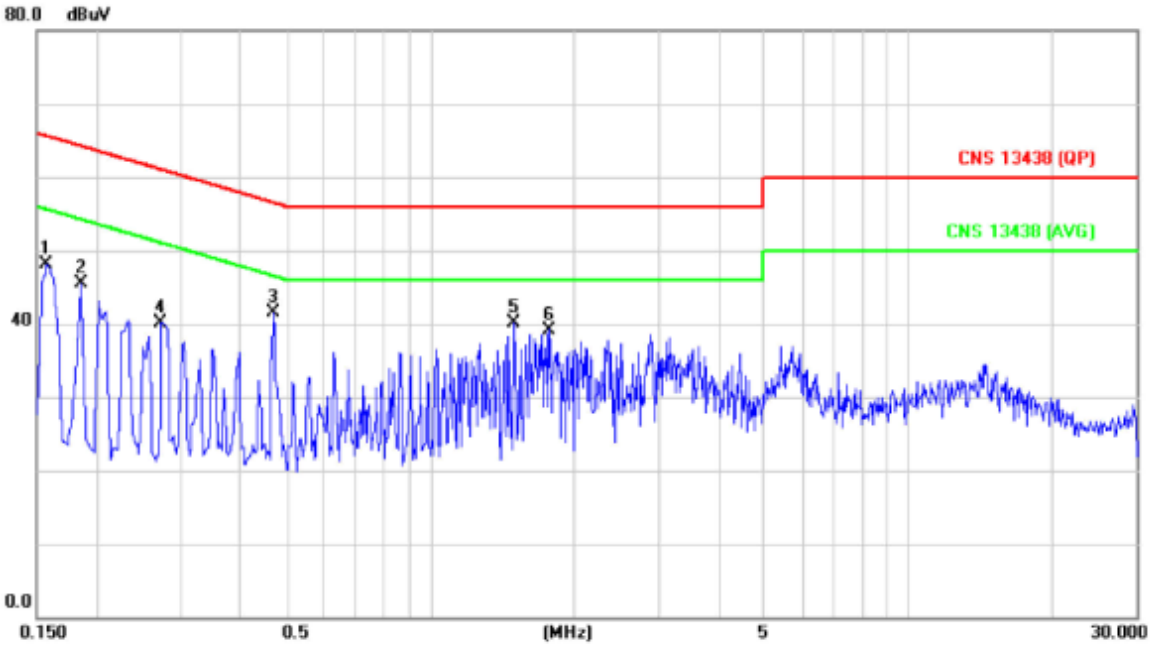
Site :	Conduction Room	Phase:	N	Temperature:	23 ℃
Limit:	CNS 13438 (QP)	Power:	AC 110V/60Hz	Humidity:	67 %
Mode:	PA-1050-39				
Note:					

Conducted Emission

File :Condution Data :#485 Date: 2016/9/2 Time: 下午 07:28:16



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1580	28.35	19.73	48.08	65.57	-17.49	peak	
2		0.1860	25.75	19.72	45.47	64.21	-18.74	peak	
3	*	0.4700	21.61	19.89	41.50	56.51	-15.01	peak	
4		0.2740	20.36	19.77	40.13	61.00	-20.87	peak	
5		1.5020	20.22	19.93	40.15	56.00	-15.85	peak	
6		1.7780	19.26	19.94	39.20	56.00	-16.80	peak	

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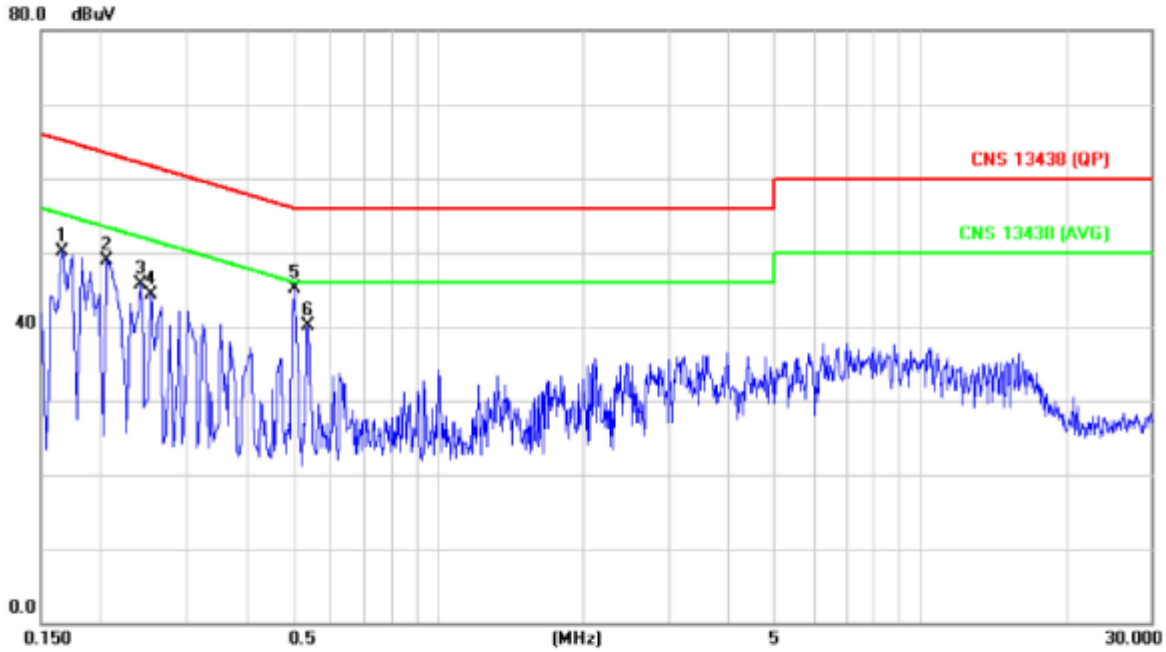
Site : Conduction Room
Limit: CNS 13438 (QP)
Mode: AS0102
Note:

Phase: L1
Power: AC 110V/60Hz

Temperature: 23 ℃
Humidity: 67 %

Conducted Emission

File :Condution Data :#490 Date: 2016/9/2 Time: 下午 07:38:35



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1660	30.48	19.72	50.20	65.16	-14.96	peak	
2		0.2060	29.20	19.71	48.91	63.37	-14.46	peak	
3		0.2420	25.92	19.74	45.66	62.03	-16.37	peak	
4		0.2540	24.49	19.75	44.24	61.63	-17.39	peak	
5	*	0.5060	25.17	19.90	45.07	56.00	-10.93	peak	
6		0.5380	20.20	19.90	40.10	56.00	-15.90	peak	

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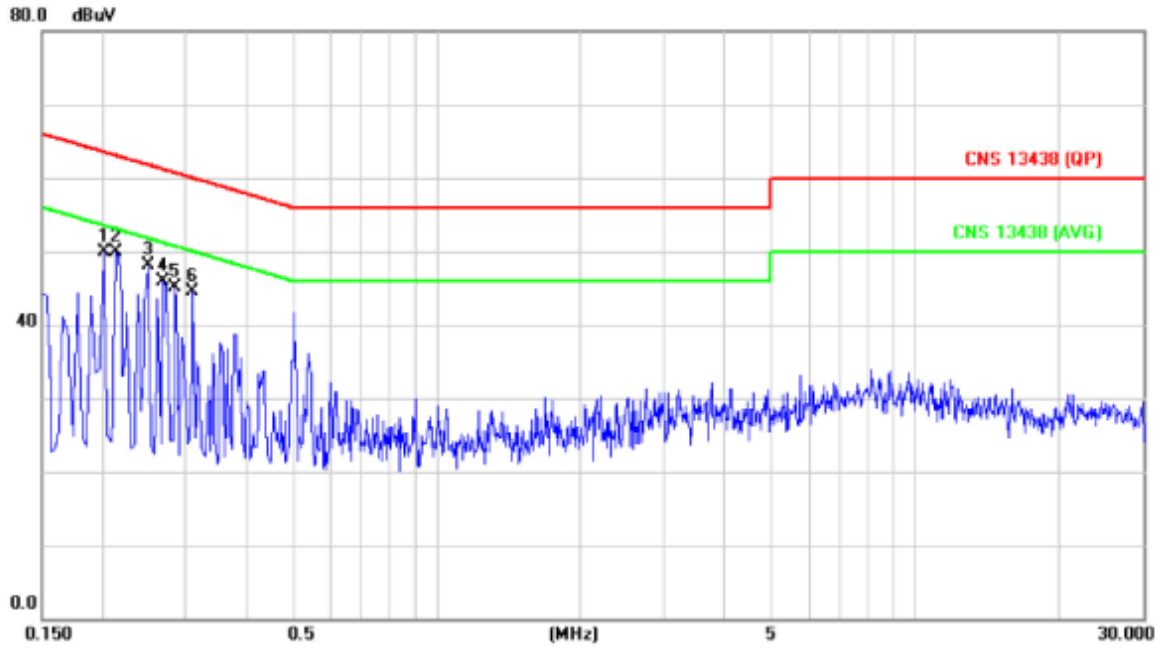
Site :	Conduction Room	Phase:	N	Temperature:	23 ℃
Limit:	CNS 13438 (QP)	Power:	AC 110V/60Hz	Humidity:	67 %
Mode:	AS0102				
Note:					

Conducted Emission

File :Condution Data :#489 Date: 2016/9/2 Time: 下午 07:37:35



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.2020	30.23	19.72	49.95	63.53	-13.58	peak	
2	*	0.2140	30.16	19.73	49.89	63.05	-13.16	peak	
3		0.2500	28.33	19.75	48.08	61.76	-13.68	peak	
4		0.2700	26.22	19.77	45.99	61.12	-15.13	peak	
5		0.2860	25.39	19.78	45.17	60.64	-15.47	peak	
6		0.3100	24.75	19.78	44.53	59.97	-15.44	peak	

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7. PEAK OUTPUT POWER MEASUREMENT

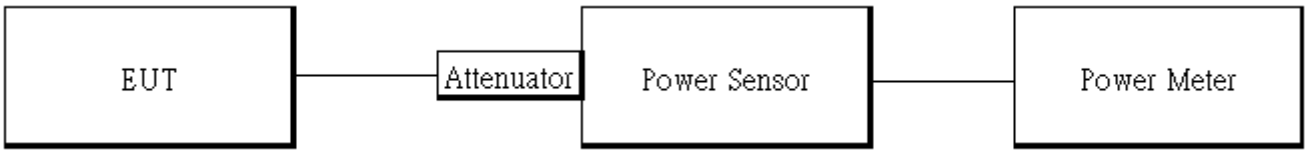
7.1. Standard Applicable

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.
Spectrum Analyzer	KEYSIGHT	N9010A	MY54510568	04/14/2016	04/13/2017
Power Meter	Anritsu	ML2496A	1326001	06/23/2016	06/22/2017
Power Sensor	Anritsu	MA2411B	1315048	06/23/2016	06/22/2017
Power Sensor	Anritsu	MA2411B	1315049	06/23/2016	06/22/2017
Coaxial Cable 30cm	WOKEN	00100A1F1A195C	RF01	12/12/2015	12/11/2016
DC Block	PASTERNACK	PE8210	RF29	12/12/2015	12/11/2016
Splitter	RF-LAMBAD	RFLT2W1G18G	RF35	12/12/2015	12/11/2016
Attenuator	WOKEN	218FS-10	RF23	12/12/2015	12/11/2016

7.3. Test Set-up:



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.

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7.5. Measurement Result

1M BR mode (Peak):

CH	Freq. (MHz)	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
0	2402	11.35	13.646	125
39	2441	11.51	14.158	125
78	2480	**11.75**	14.962	125

1M BR mode (Average):

CH	Freq. (MHz)	Max. Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
0	2402	9.83	9.616	125
39	2441	9.95	9.886	125
78	2480	10.30	10.715	125

2M EDR mode (Peak):

CH	Freq. (MHz)	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
0	2402	11.26	13.366	125
39	2441	11.34	13.614	125
78	2480	**11.67**	14.689	125

2M EDR mode (Average):

CH	Freq. (MHz)	Max. Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
0	2402	7.54	5.675	125
39	2441	7.70	5.888	125
78	2480	7.95	6.237	125

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3M EDR mode (Peak):

CH	Freq. (MHz)	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
0	2402	11.31	13.521	125
39	2441	11.42	13.868	125
78	2480	**11.54**	14.256	125

3M EDR mode (Average):

CH	Freq. (MHz)	Max. Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
0	2402	7.63	5.794	125
39	2441	7.54	5.675	125
78	2480	8.01	6.324	125

NOTE: cable loss as 4.2dB that offsets in the spectrum

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8. 20dB BANDWIDTH MEASUREMENT

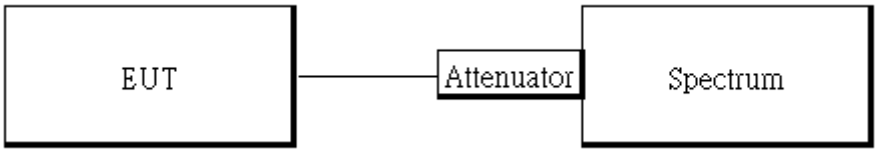
8.1. Standard Applicable

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.
EXA Spectrum Analyzer	Agilent	N9030A	MY53120760	02/26/2016	02/25/2017
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2016	01/01/2017
Splitter	Agilent	11636B	N/A	01/02/2016	01/01/2017
Attenuator	Mini-Circuit	BW-S10W2+	2	01/02/2016	01/01/2017

8.3. Test Set-up



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. Mark the peak frequency and –20dB (upper and lower) frequency
6. Repeat above procedures until all test default channel is completed.

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8.5. Measurement Result

20dB Bandwidth

GFSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	0.9235	0.62
Mid	0.9237	0.62
High	0.9235	0.62

π/4-DQPSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	1.313	0.88
Mid	1.309	0.87
High	1.309	0.87

8-DPSK

CH	20 dB BW (MHz)	2/3 BW (MHz)
Low	1.267	0.84
Mid	1.269	0.85
High	1.269	0.85

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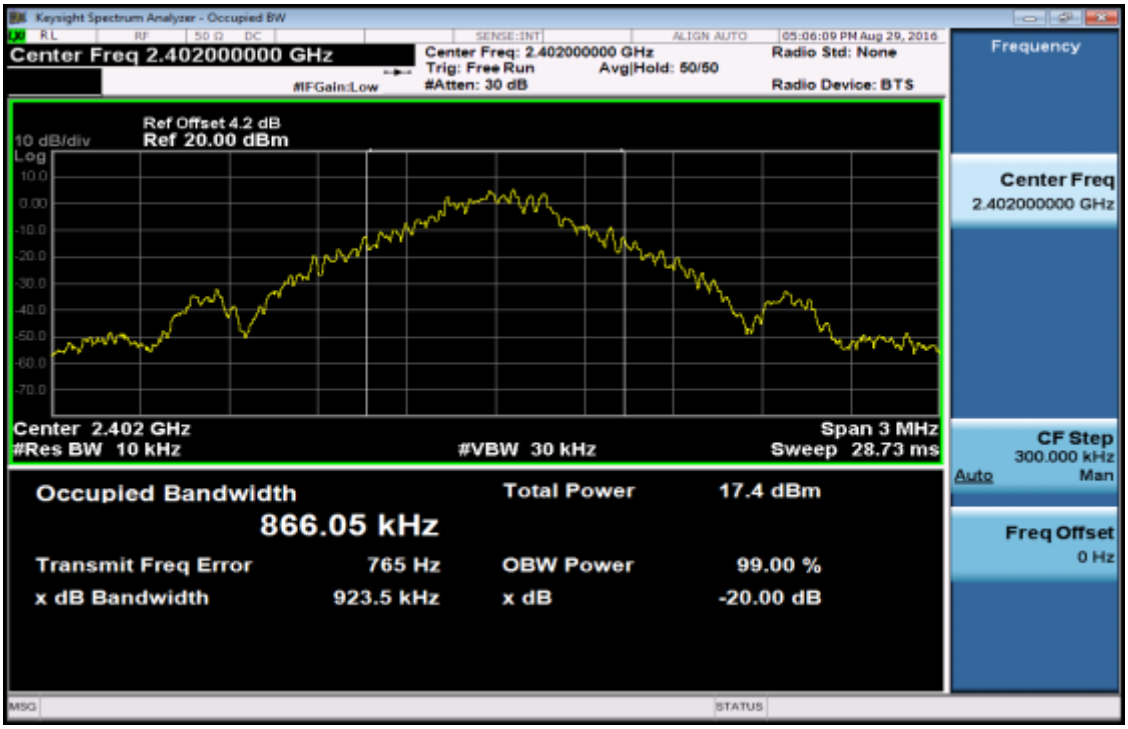
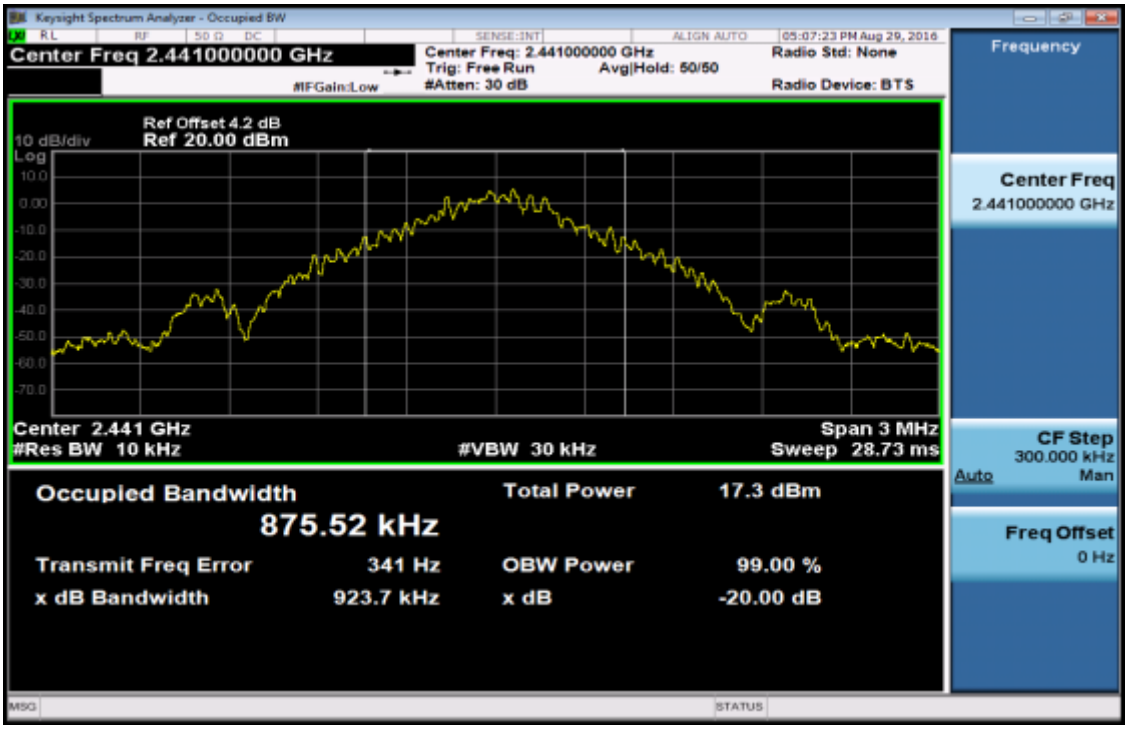
20dB Band Width Test Data CH-Low (GFSK mode)



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



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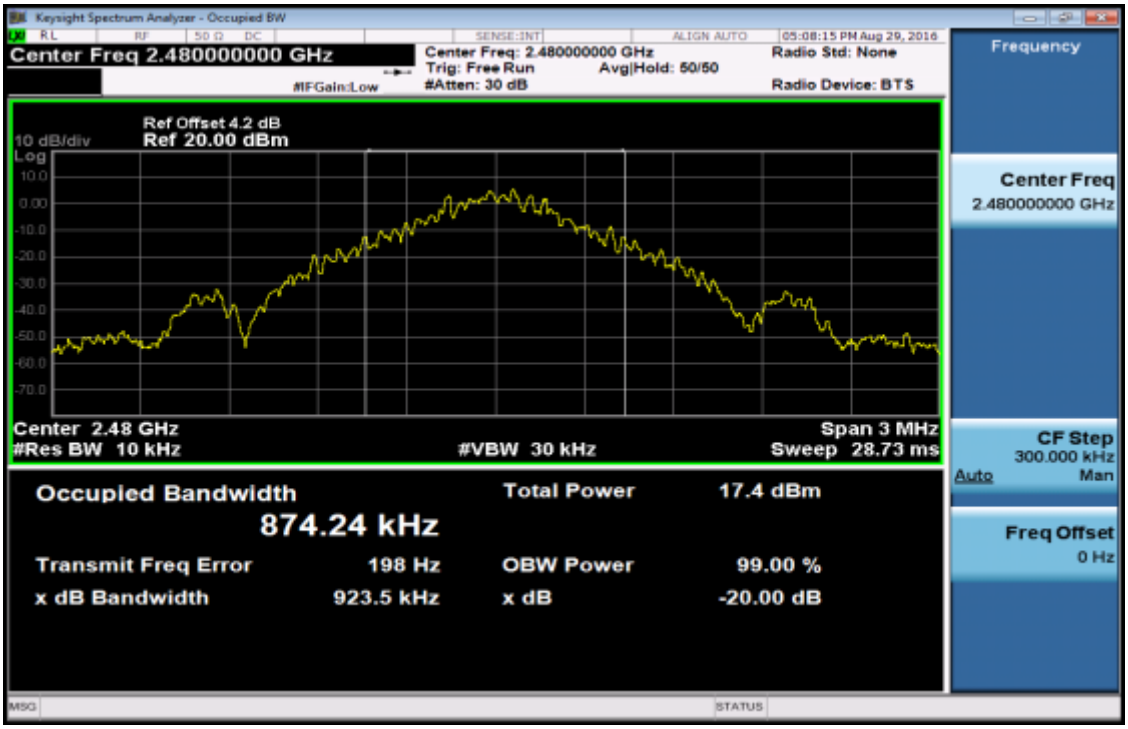
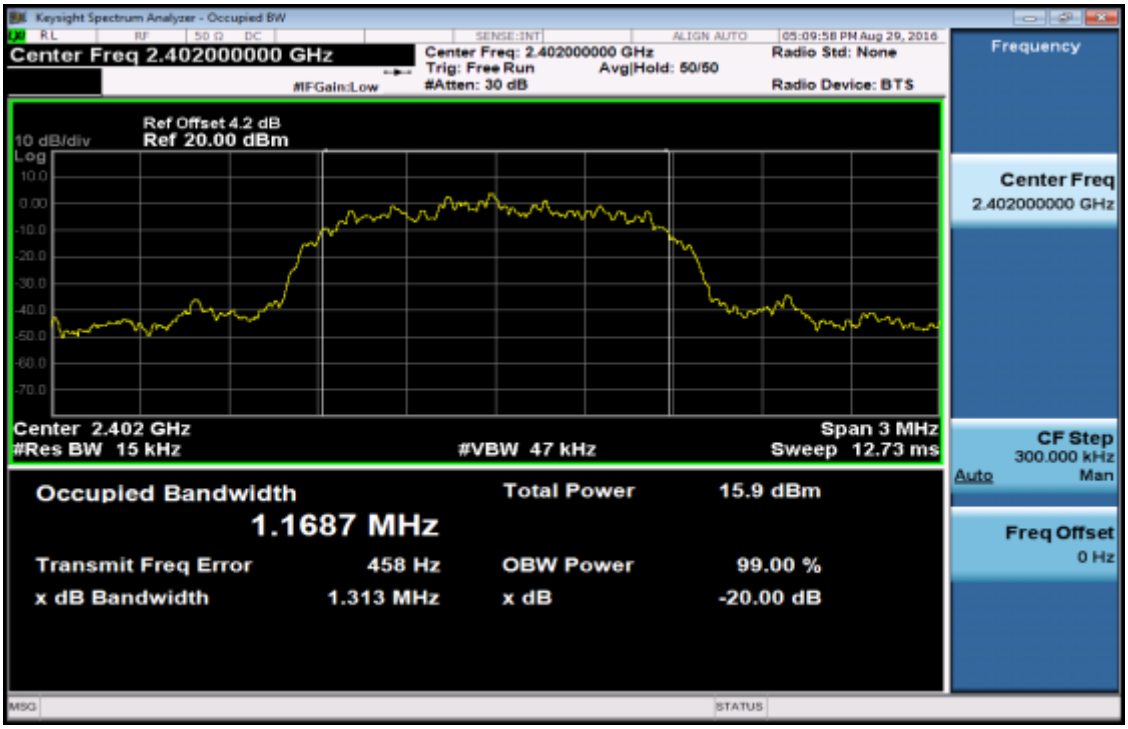
20dB Band Width Test Data CH-High (GFSK mode)



20dB Band Width Test Data CH-Low (π/4-DQPSK mode)



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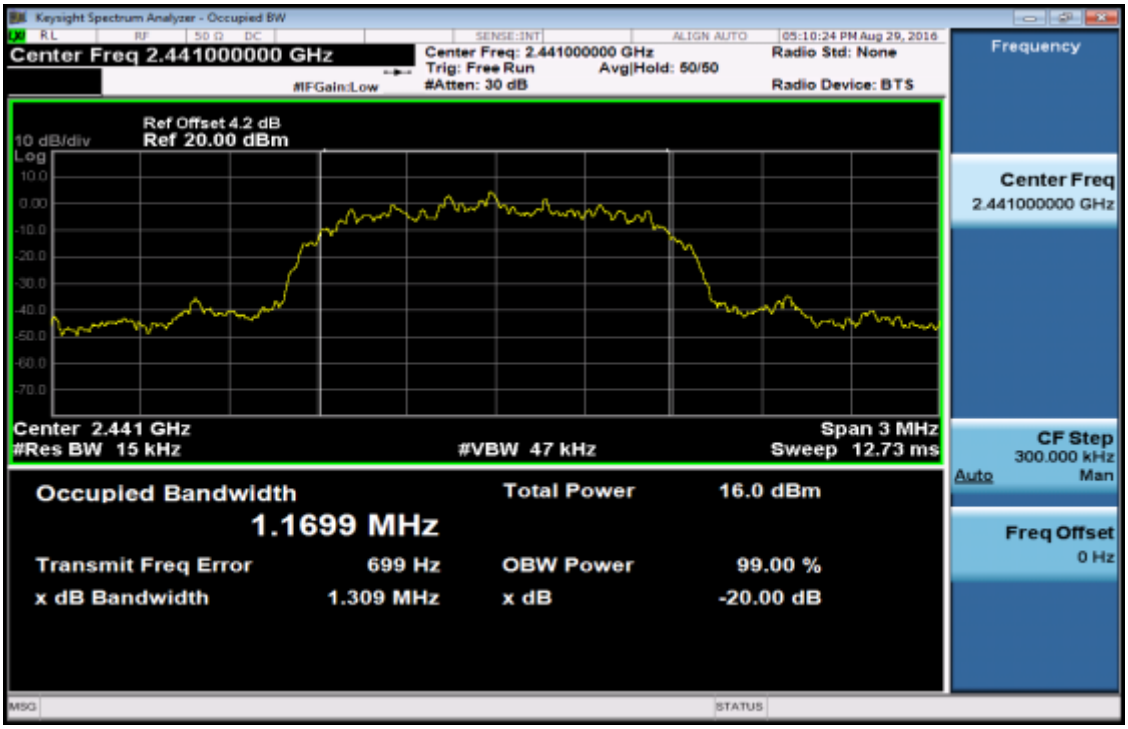
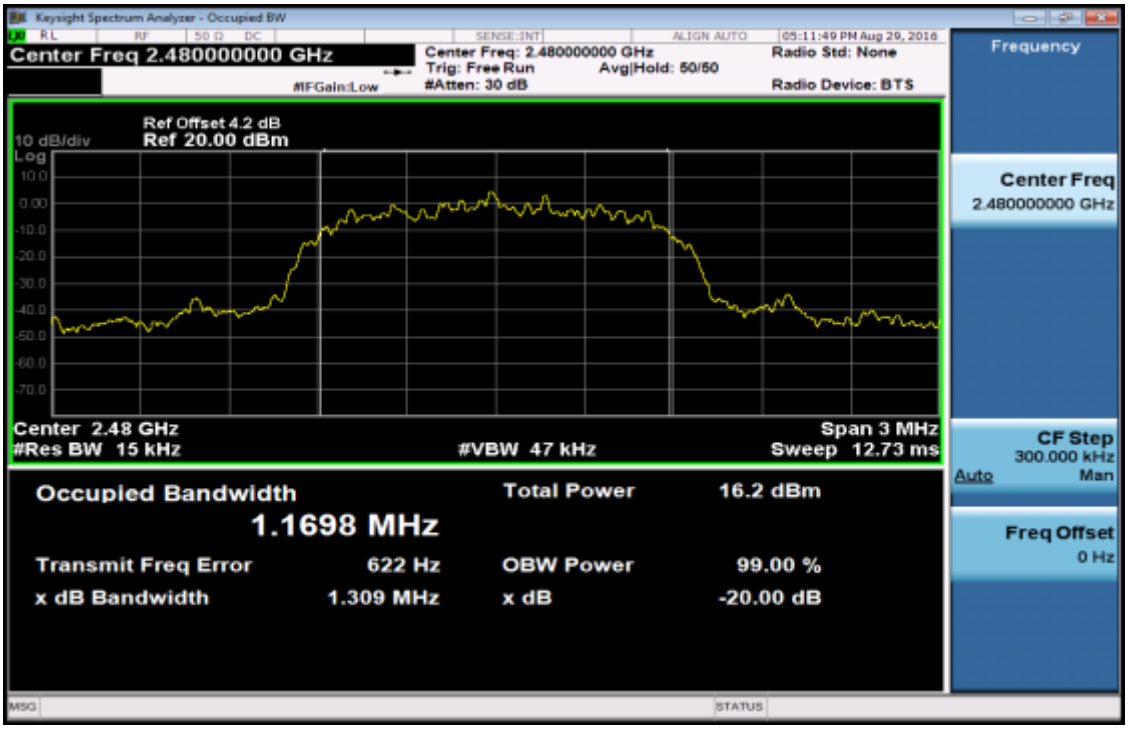
20dB Band Width Test Data CH-Mid (π/4-DQPSK mode)



20dB Band Width Test Data CH-High (π/4-DQPSK mode)



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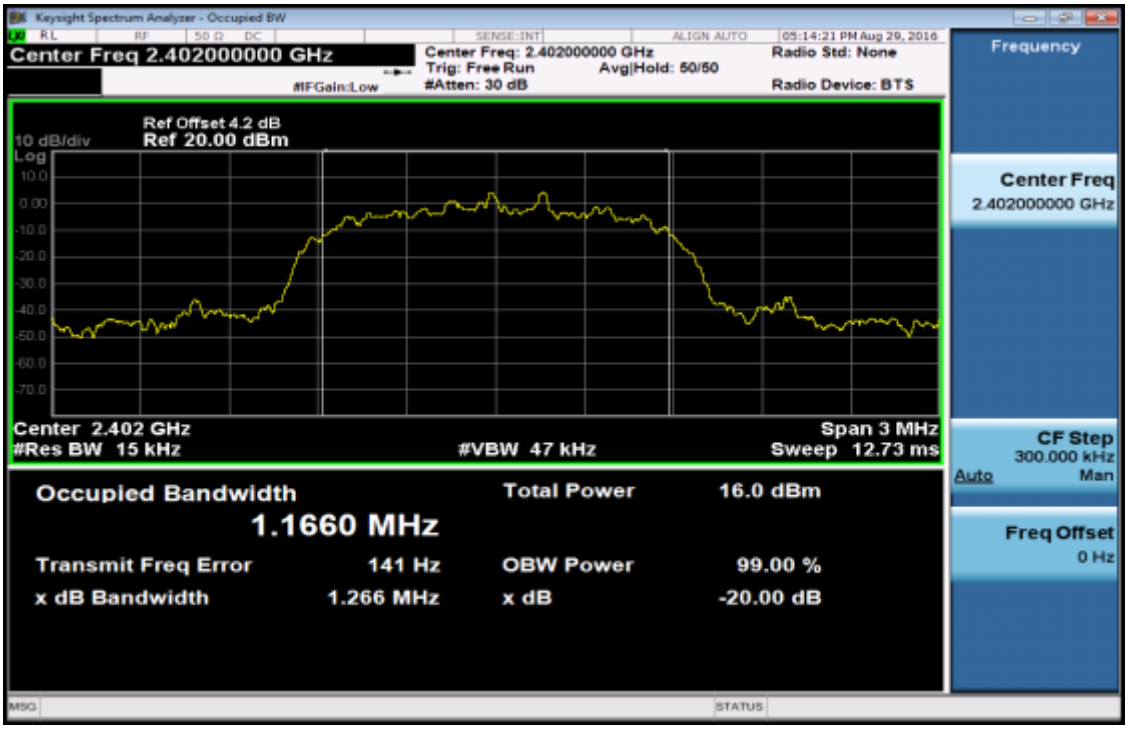
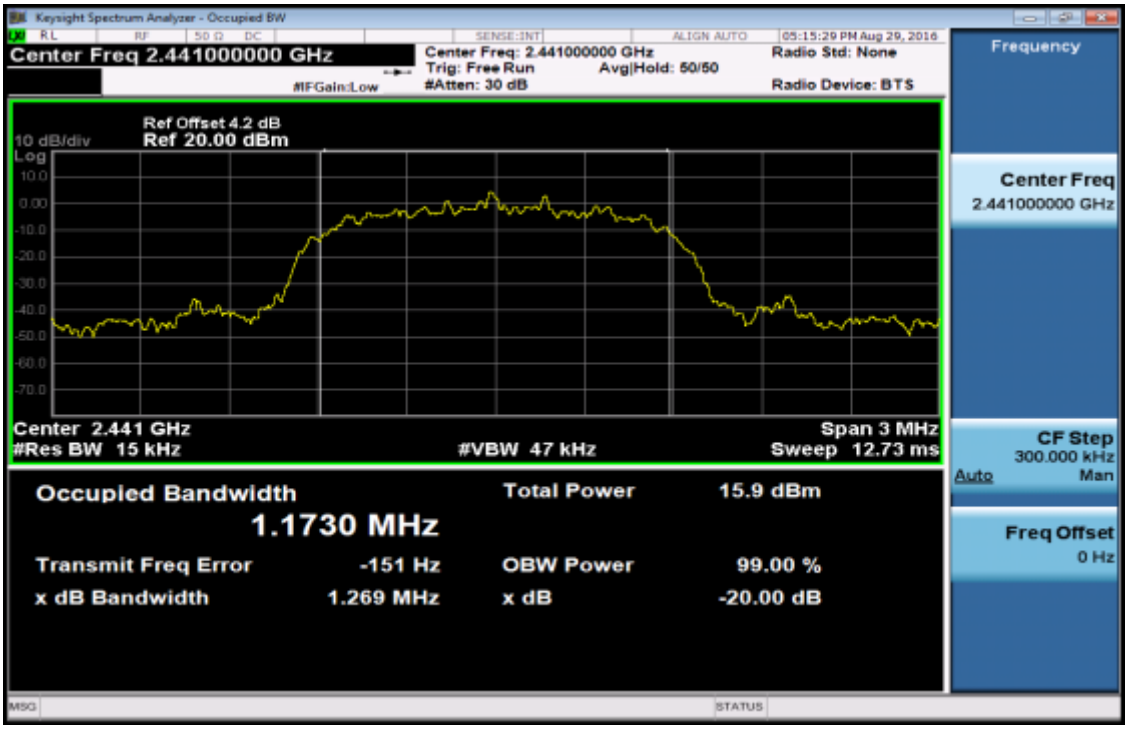
20dB Band Width Test Data CH-Low (8-DPSK mode)



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



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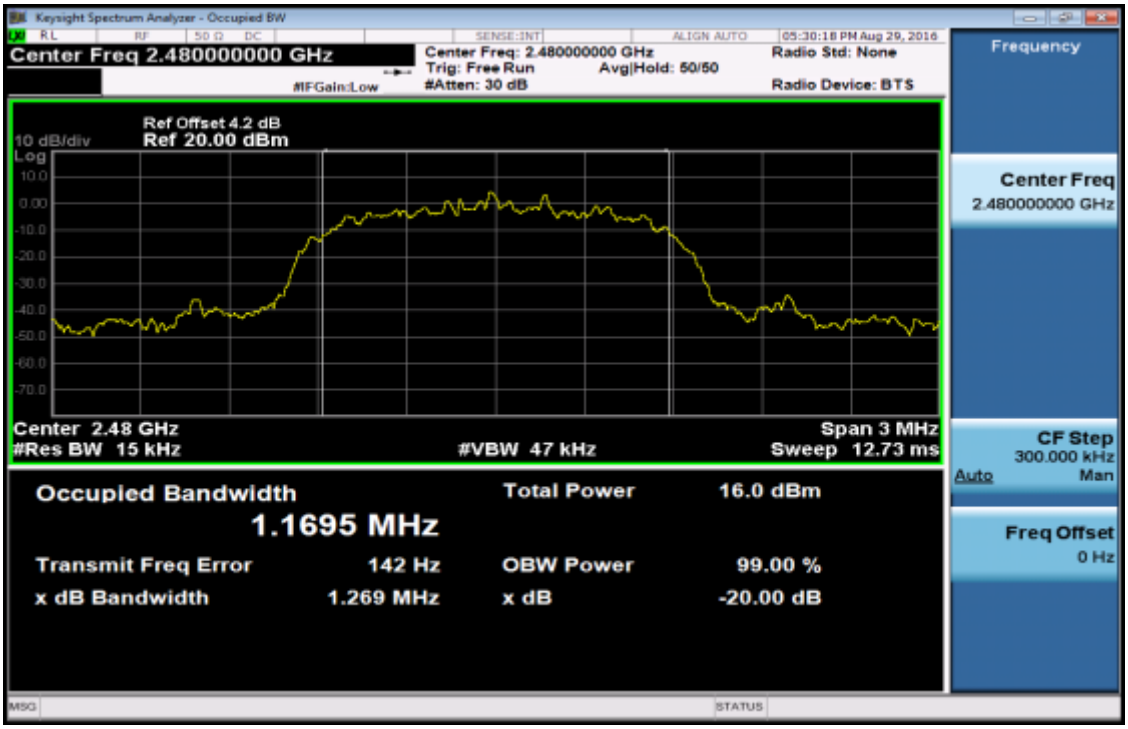
20dB Width Test Data CH-High (8-DPSK mode)



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9. CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

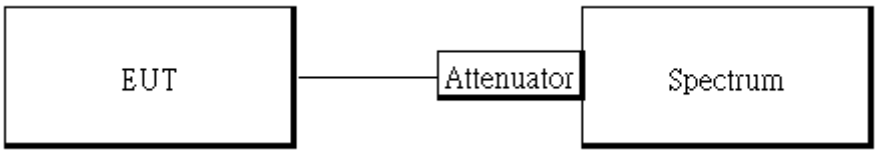
9.1. Standard Applicable

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).

9.2. Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EXA Spectrum Analyzer	Agilent	N9030A	MY53120760	02/26/2016	02/25/2017
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2016	01/01/2017
Splitter	Agilent	11636B	N/A	01/02/2016	01/01/2017
Attenuator	Mini-Circuit	BW-S10W2+	2	01/02/2016	01/01/2017

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.

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

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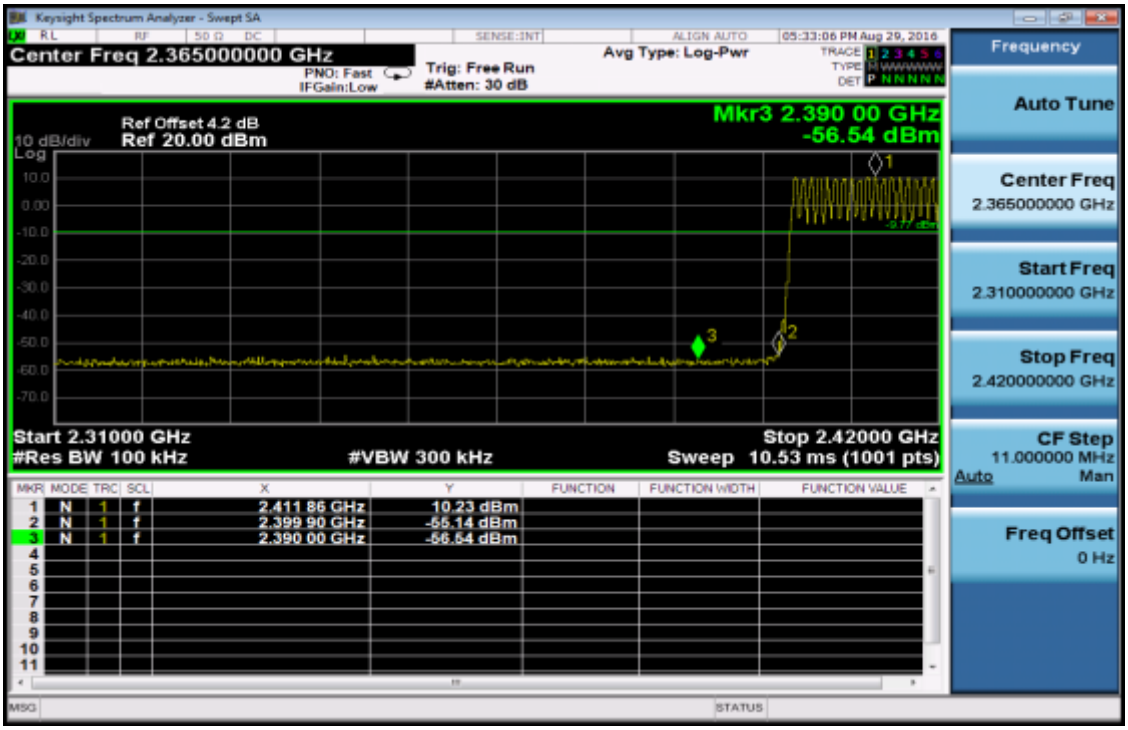
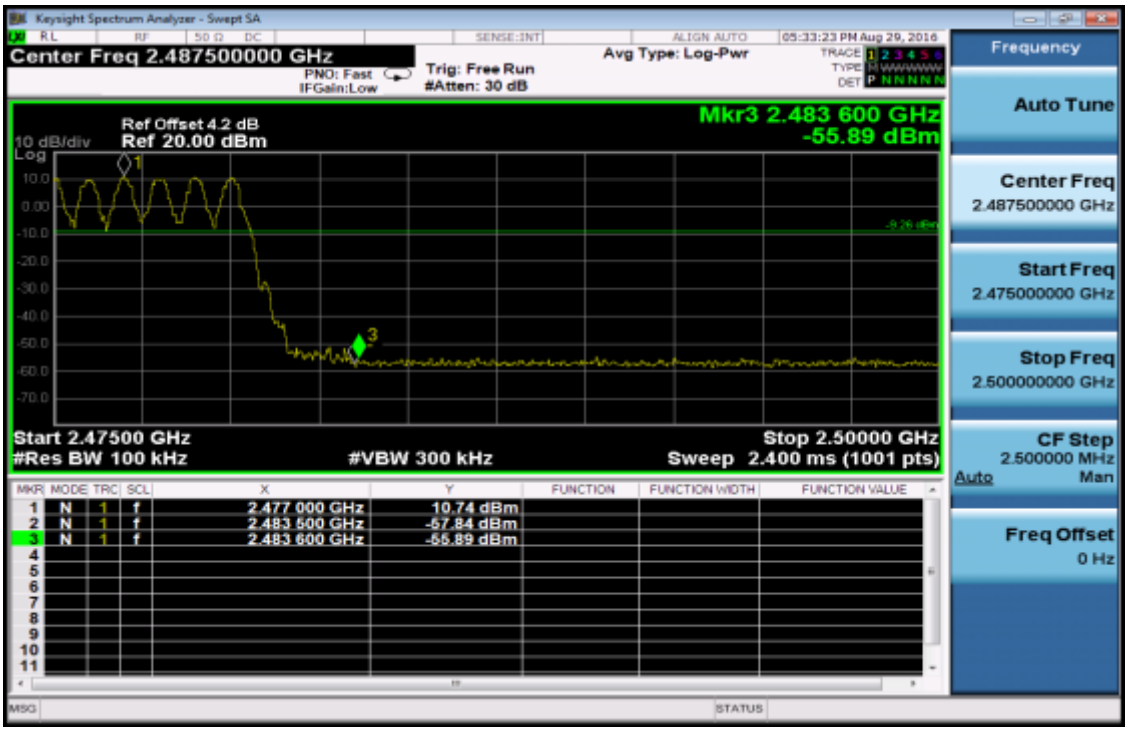
Band Edges Test Data CH-Low (Hopping mode) (GFSK)



Band Edges Test Data CH-High



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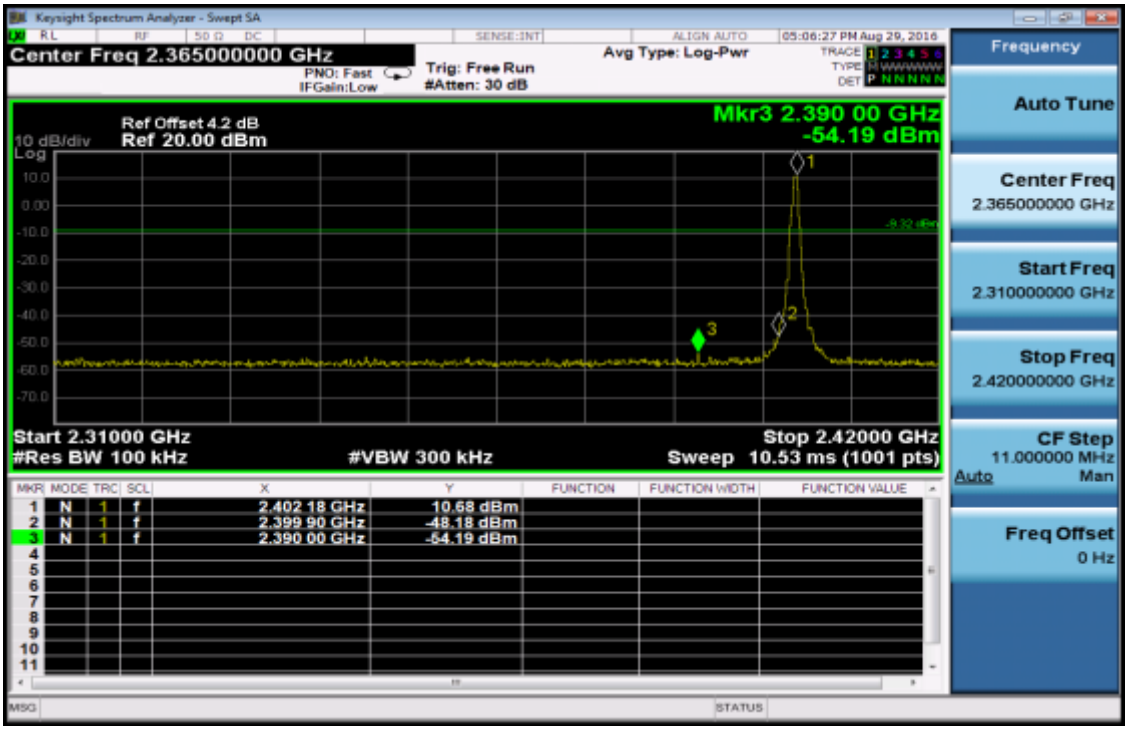
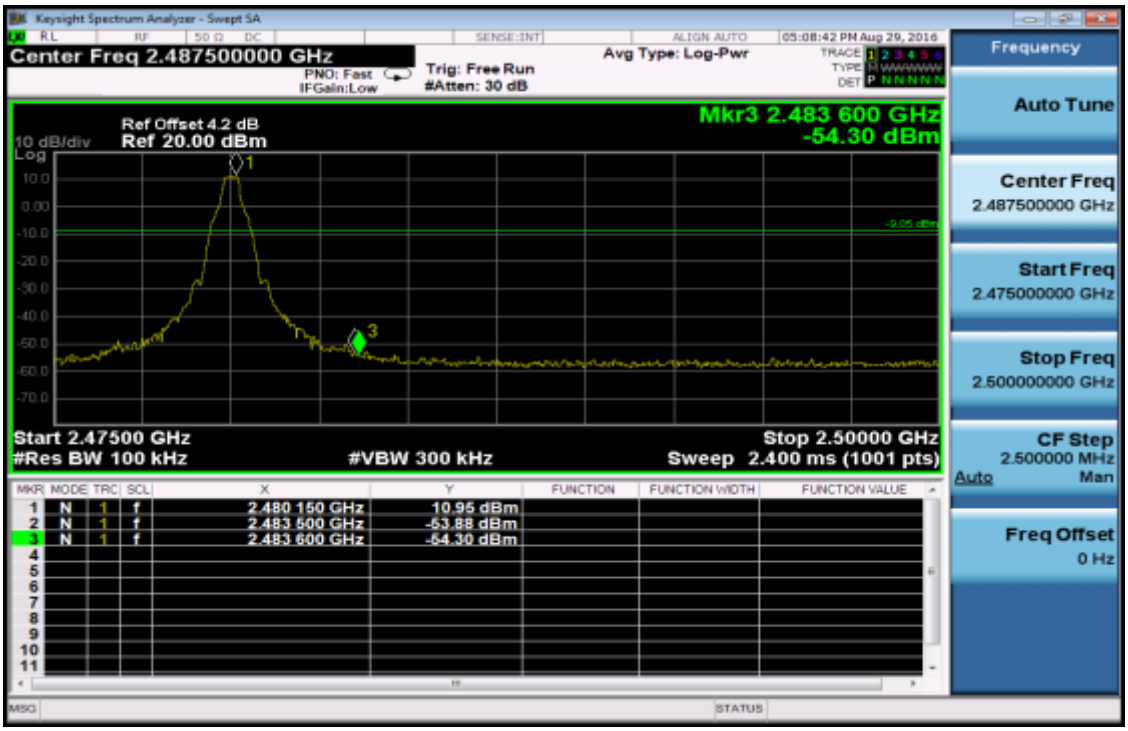
Band Edges Test Data CH-Low (Non-Hopping mode)



Band Edges Test Data CH-High



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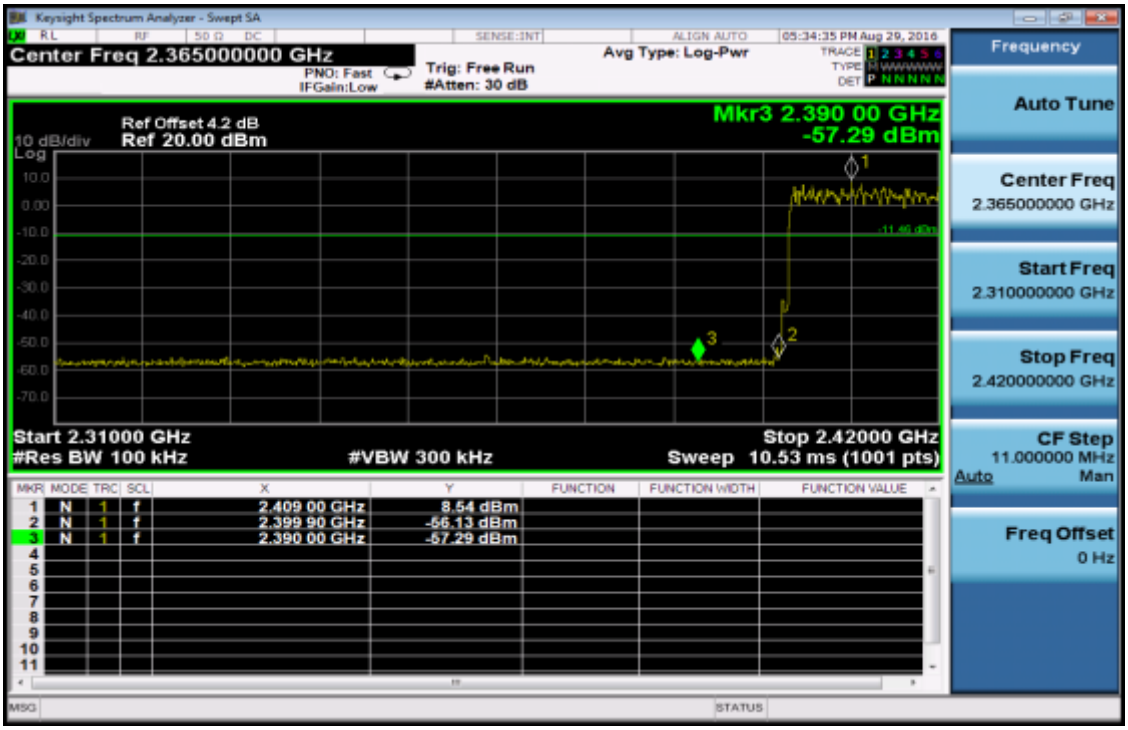
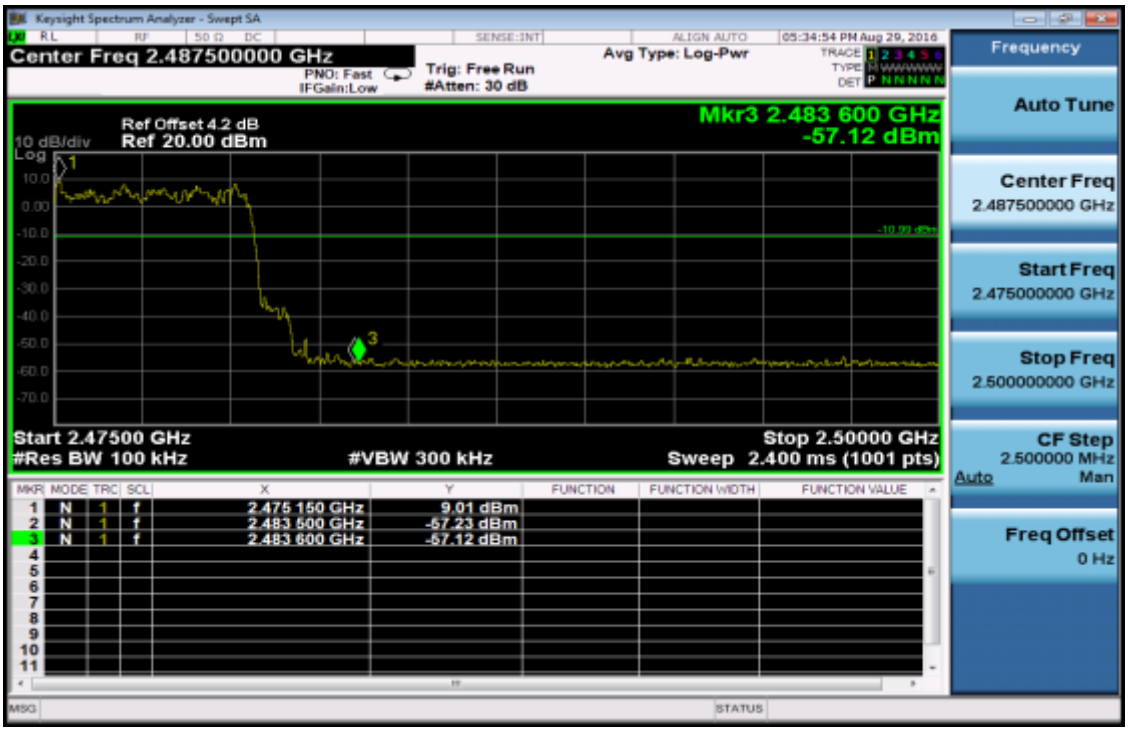
Band Edges Test Data CH-Low (Hopping mode) (8DPSK)



Band Edges Test Data CH-High



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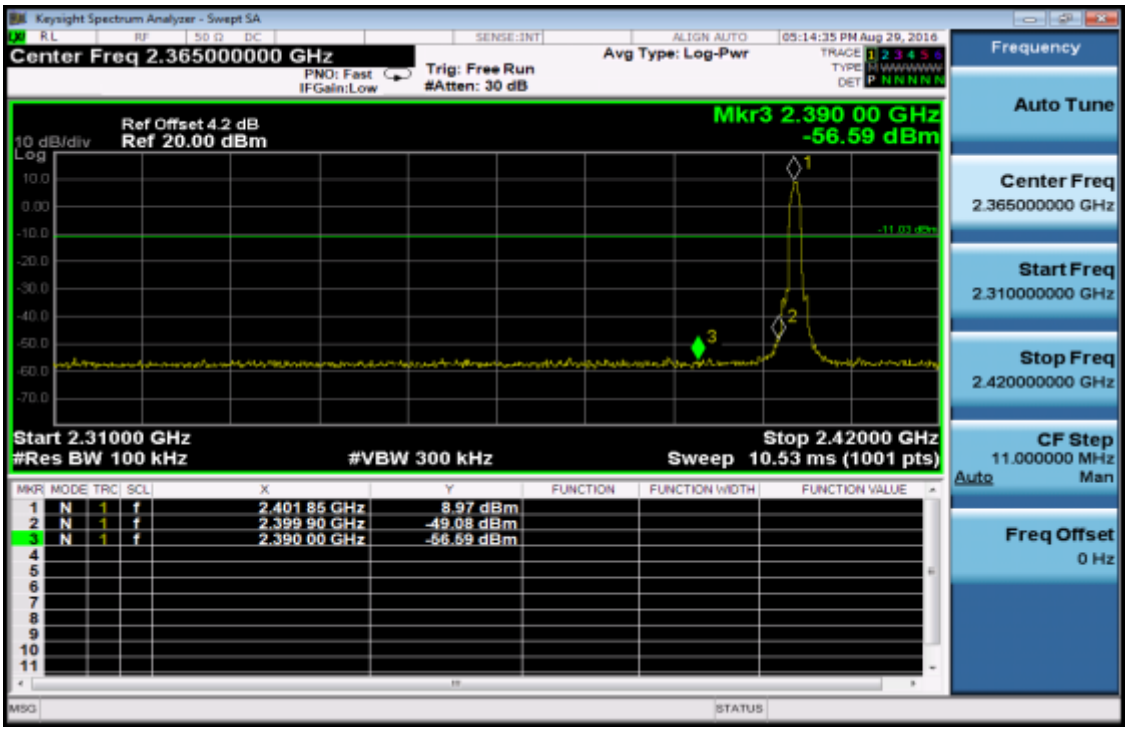
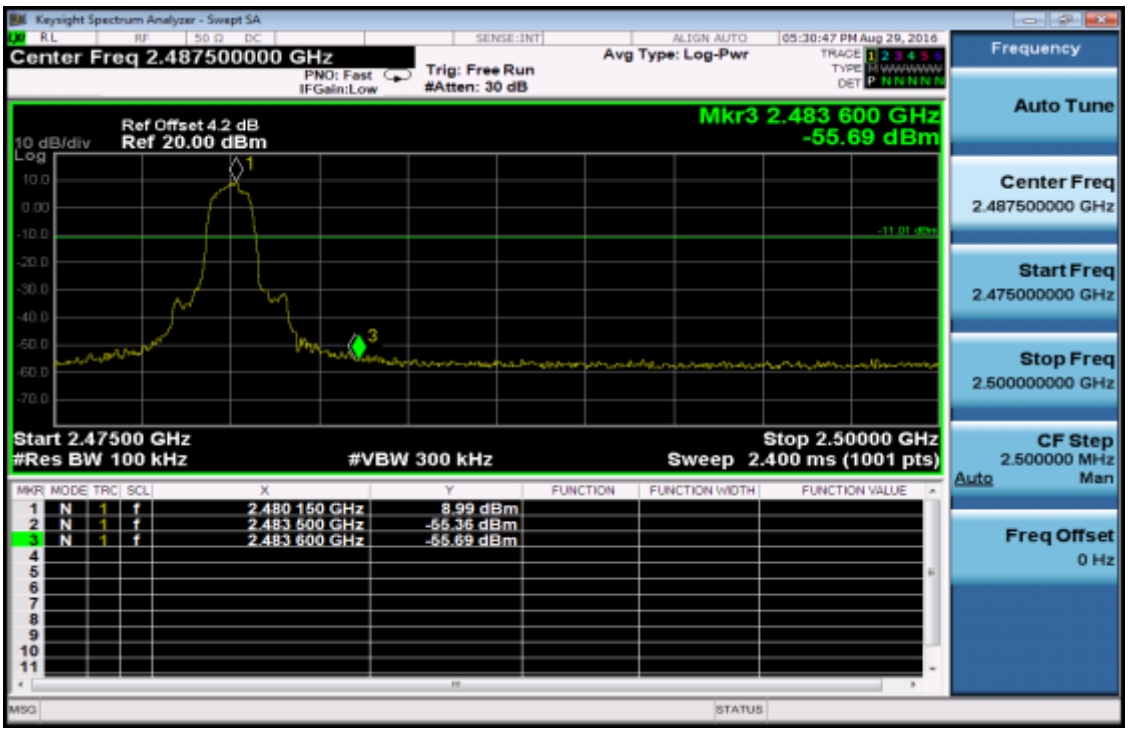
Band Edges Test Data CH-Low (Non-Hopping mode)



Band Edges Test Data CH-High



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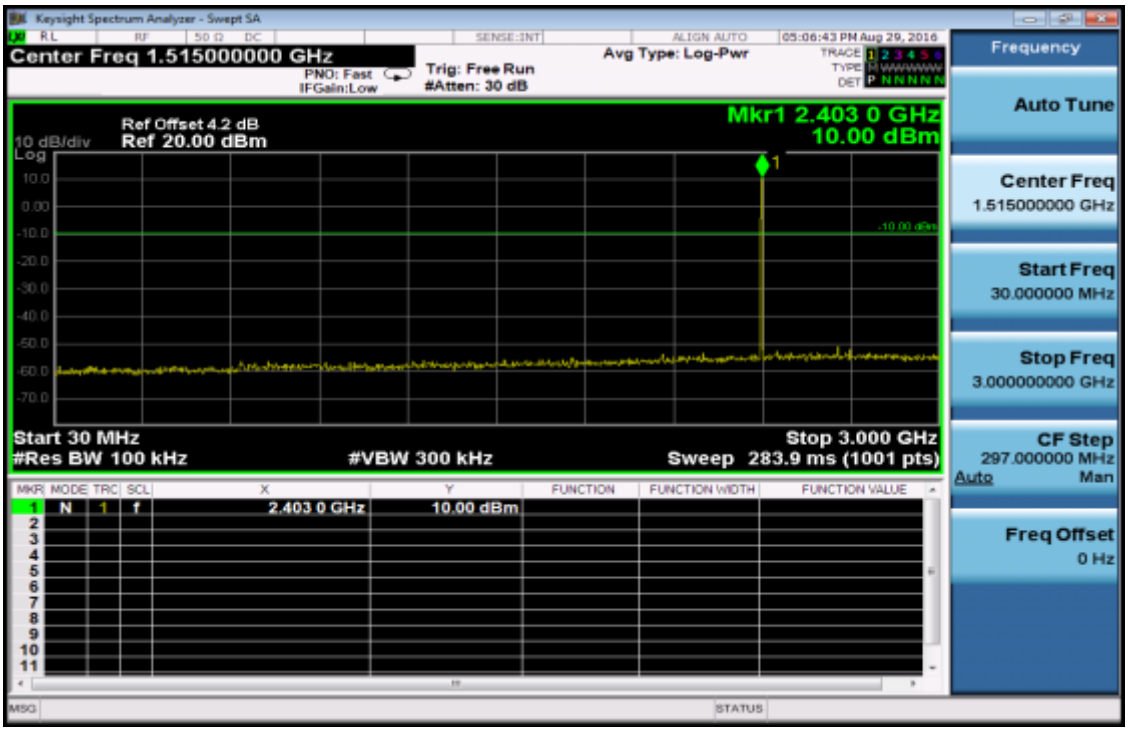
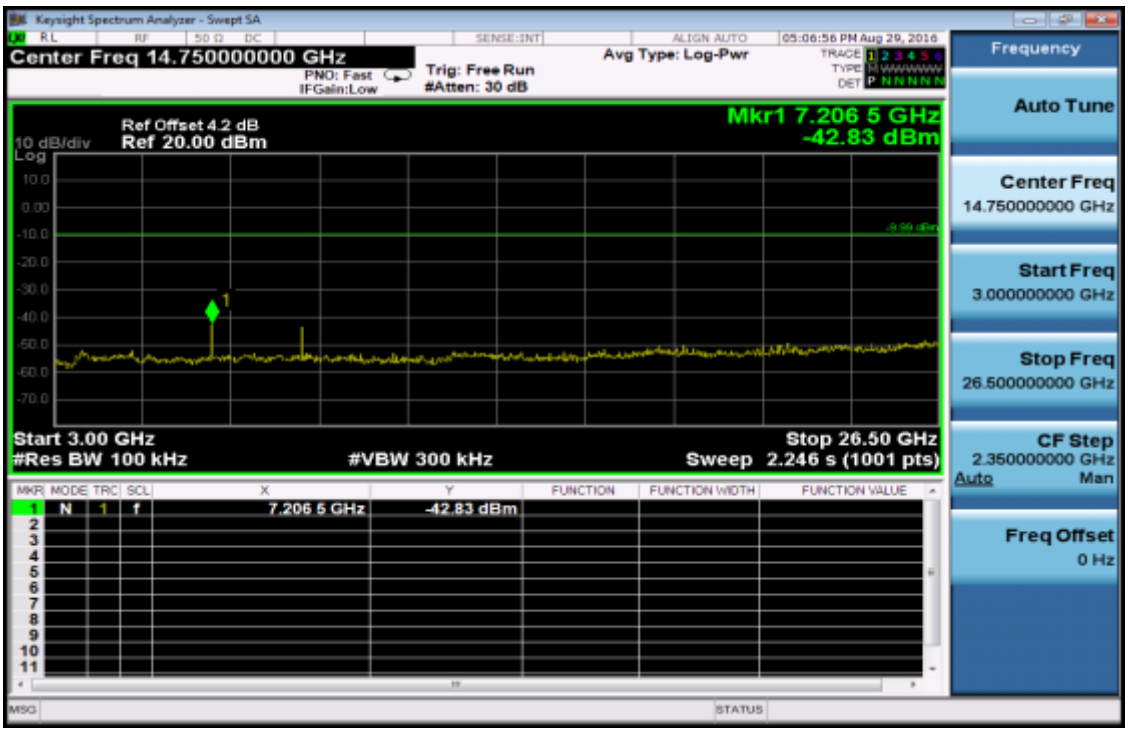
Conducted Spurious Emission Measurement Result (GFSK)

Ch Low 30MHz – 3GHz



Ch Low 3GHz – 26.5GHz



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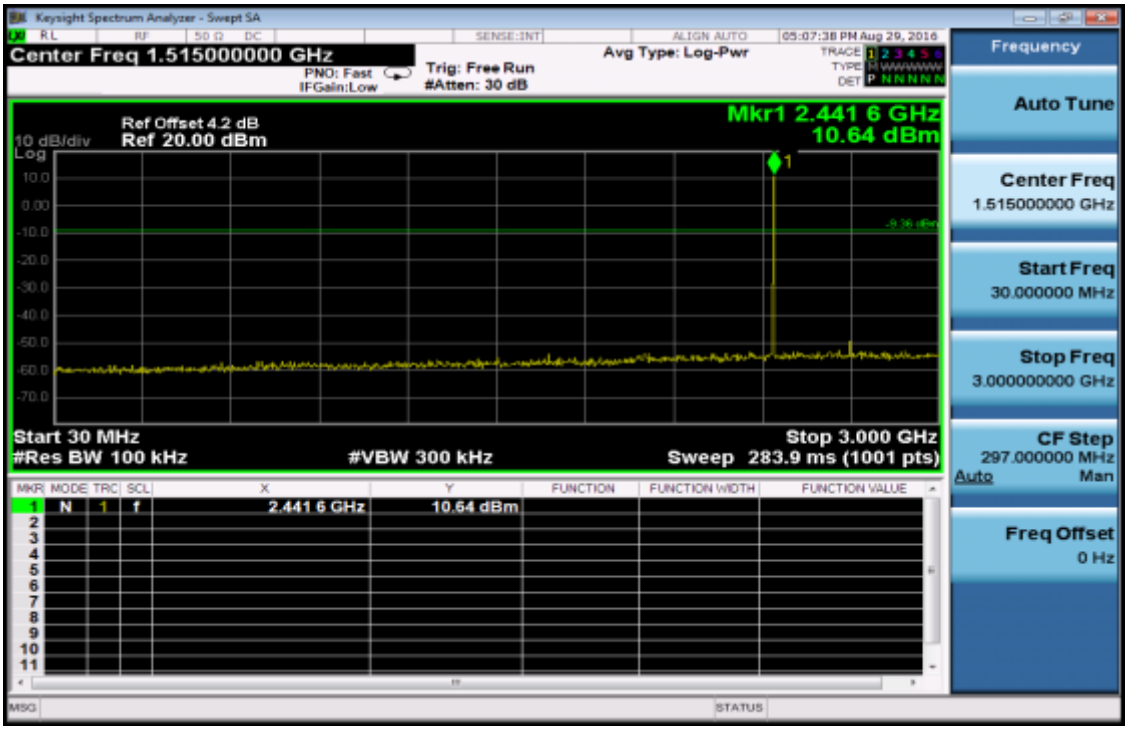
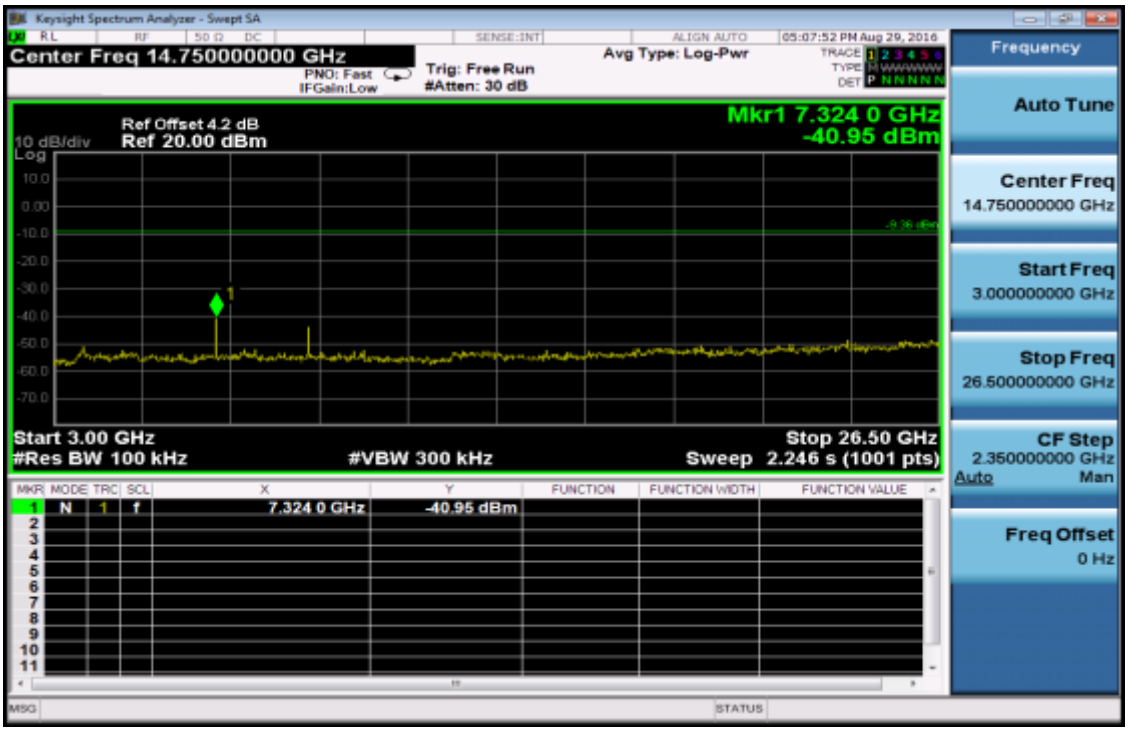
Ch Mid 30MHz – 3GHz



Ch Mid 3GHz – 26.5GHz



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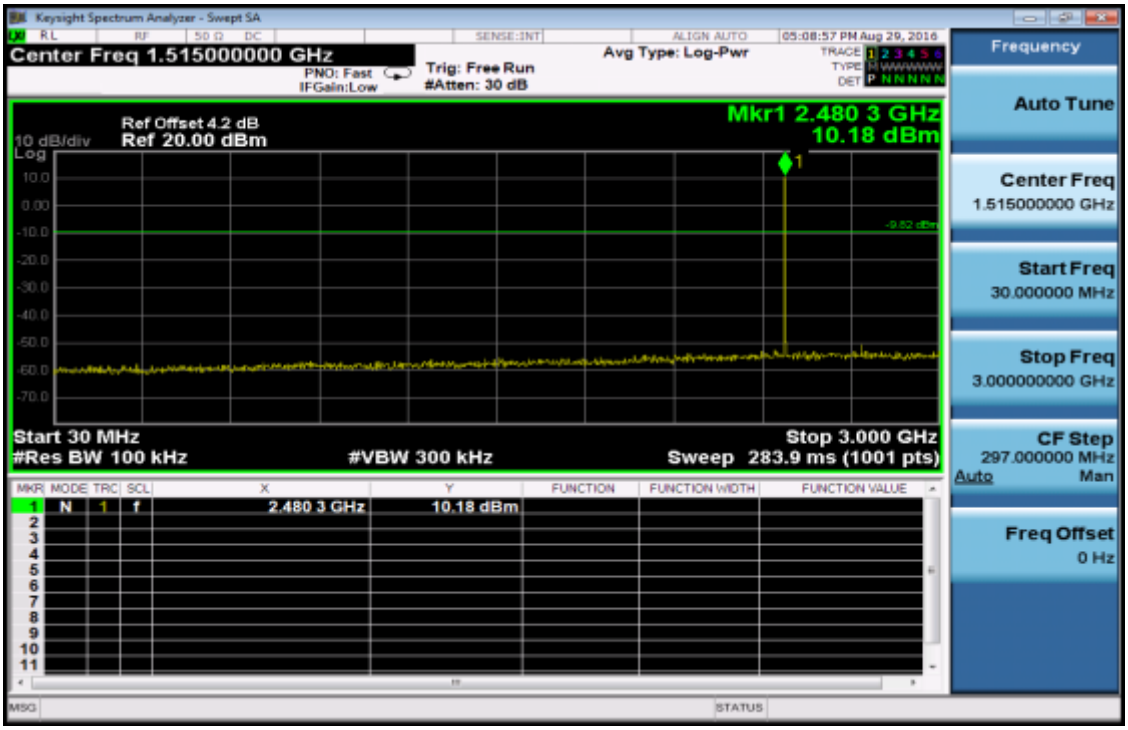
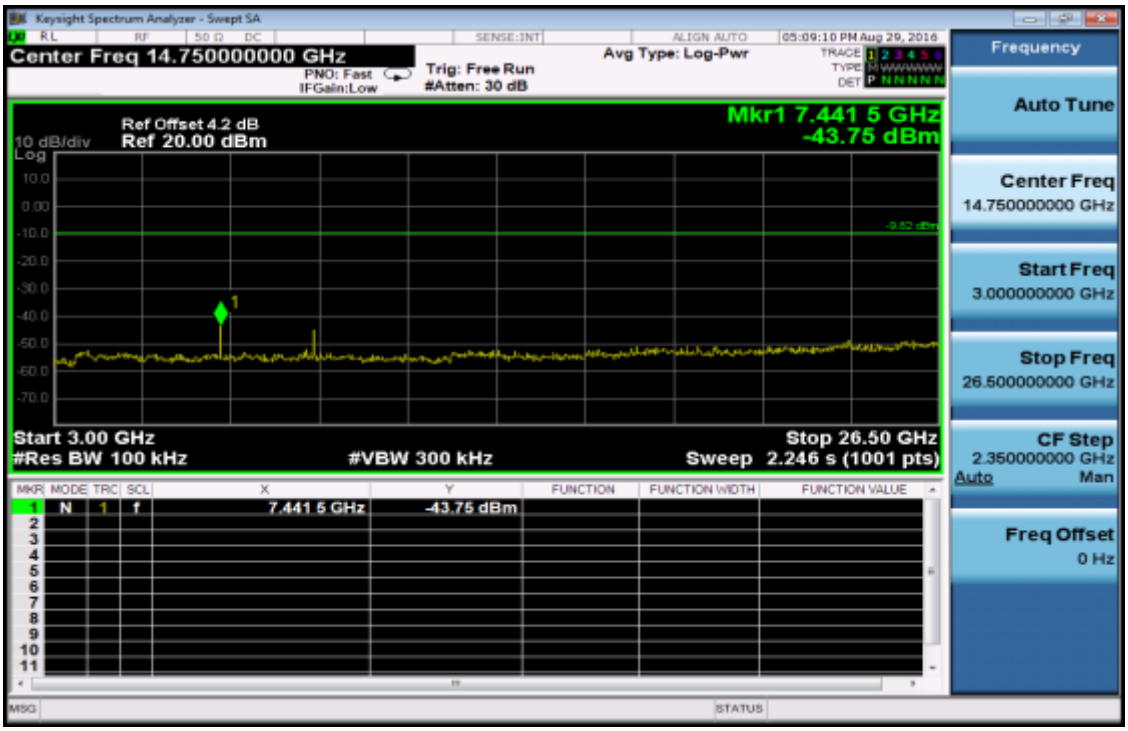
Ch High 30MHz – 3GHz



Ch High 3GHz – 26.5GHz



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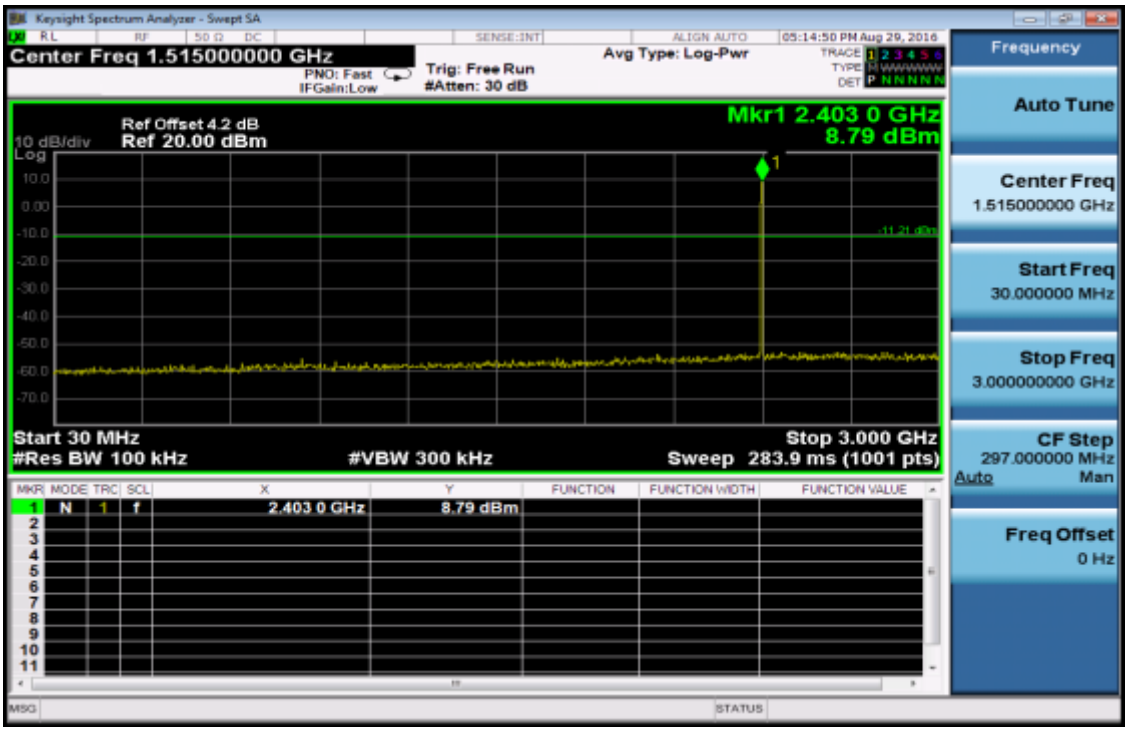
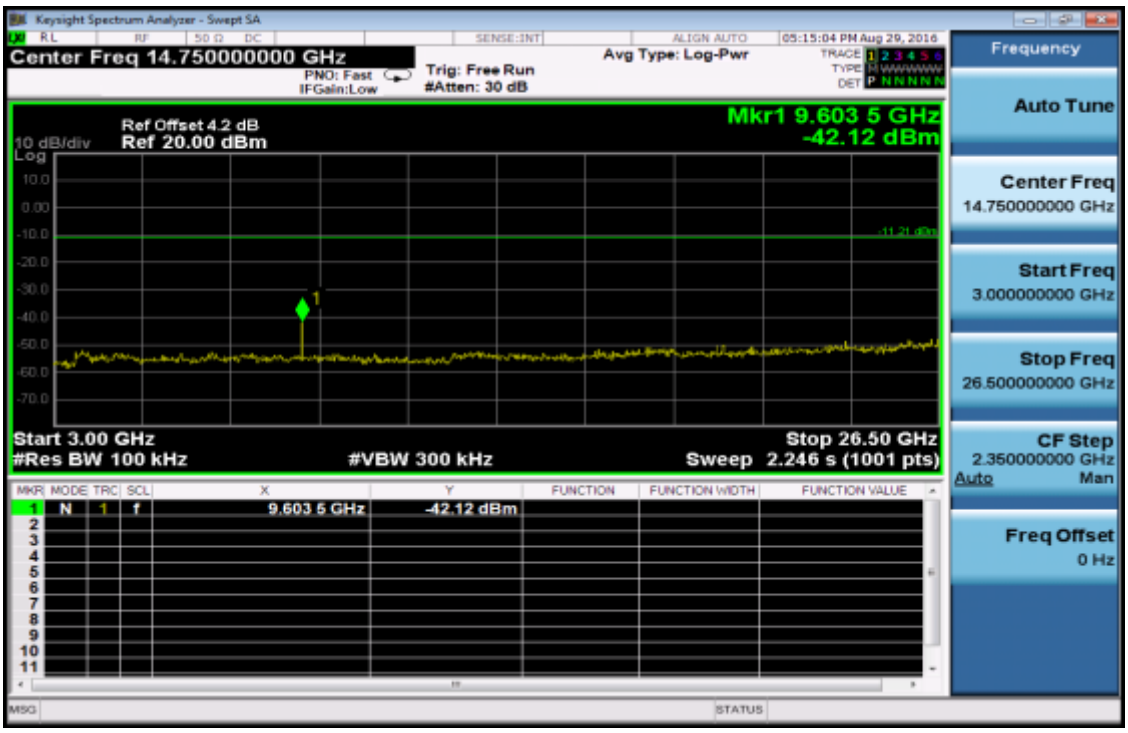
Conducted Spurious Emission Measurement Result (8DPSK)

Ch Low 30MHz – 3GHz



Ch Low 3GHz – 26.5GHz



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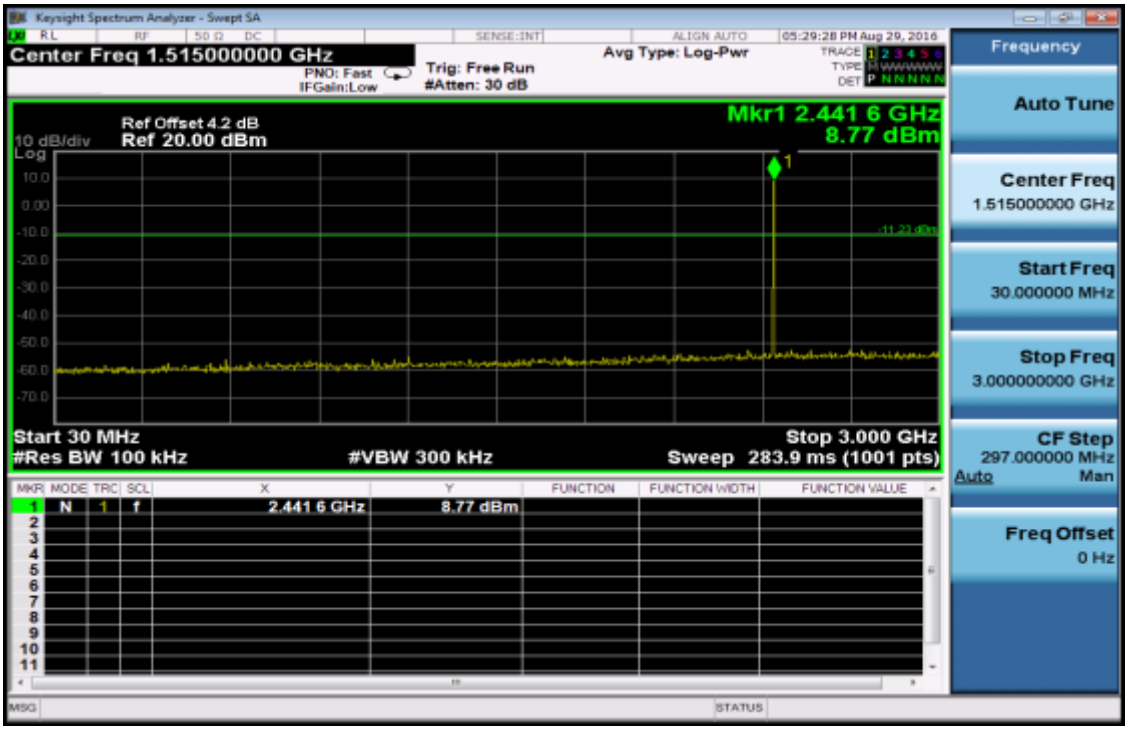
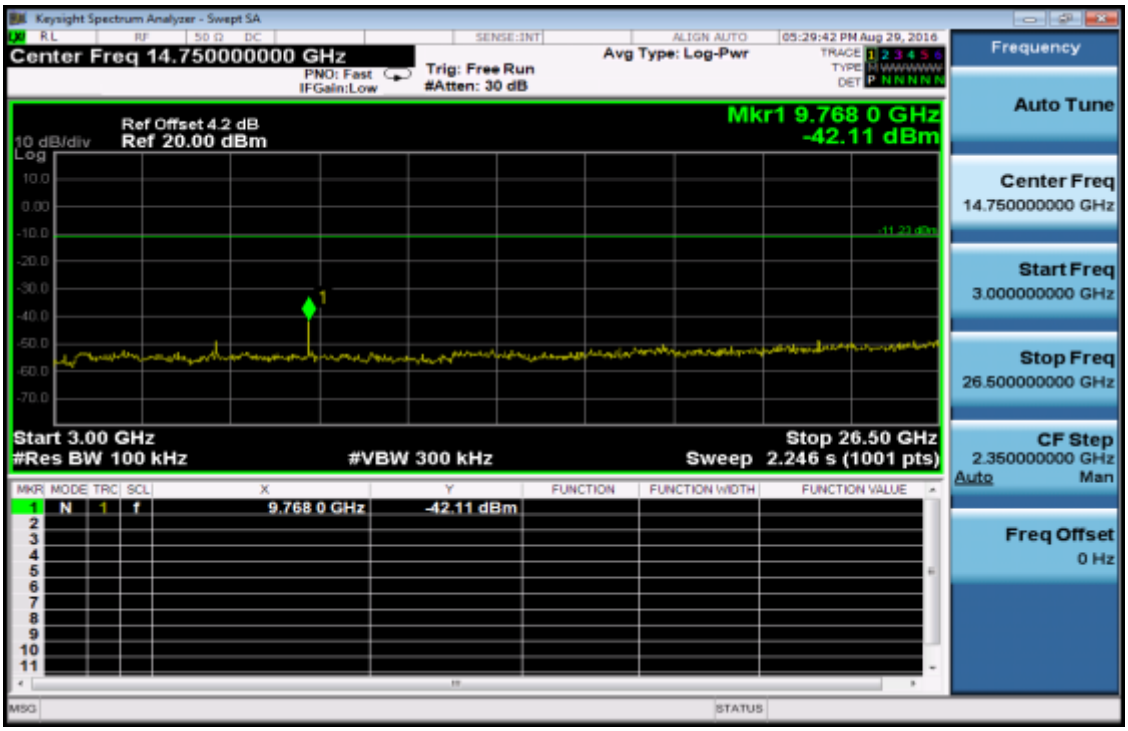
Ch Mid 30MHz – 3GHz



Ch Mid 3GHz – 26.5GHz



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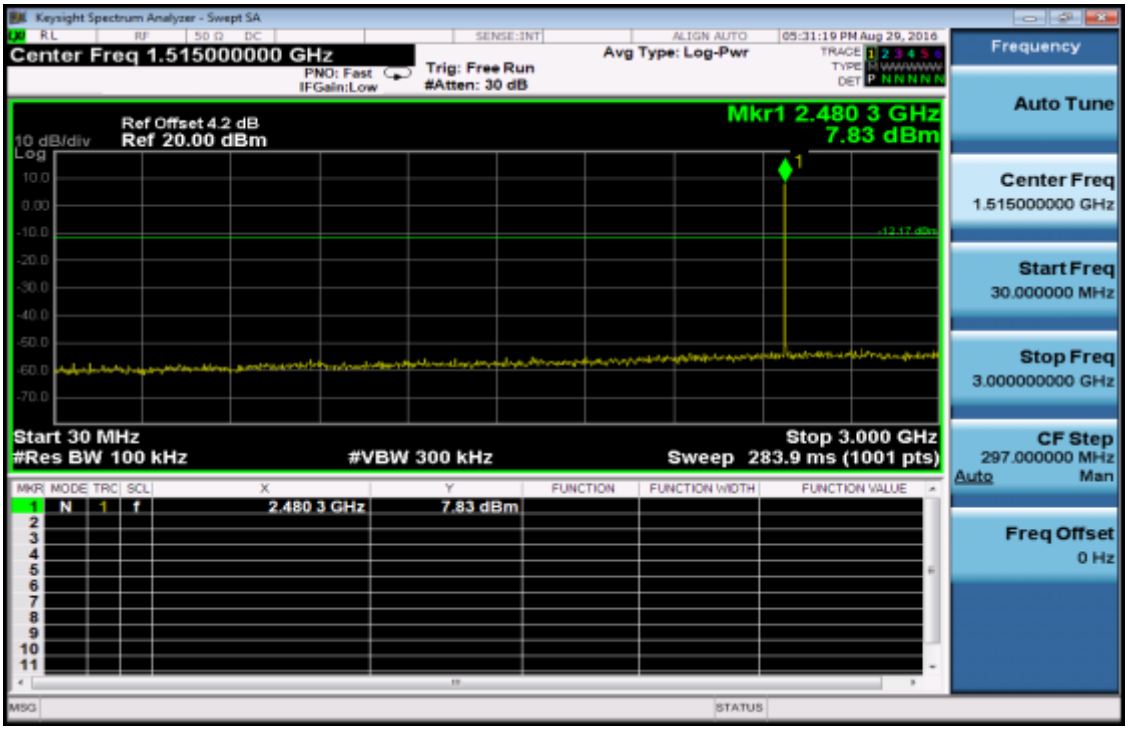
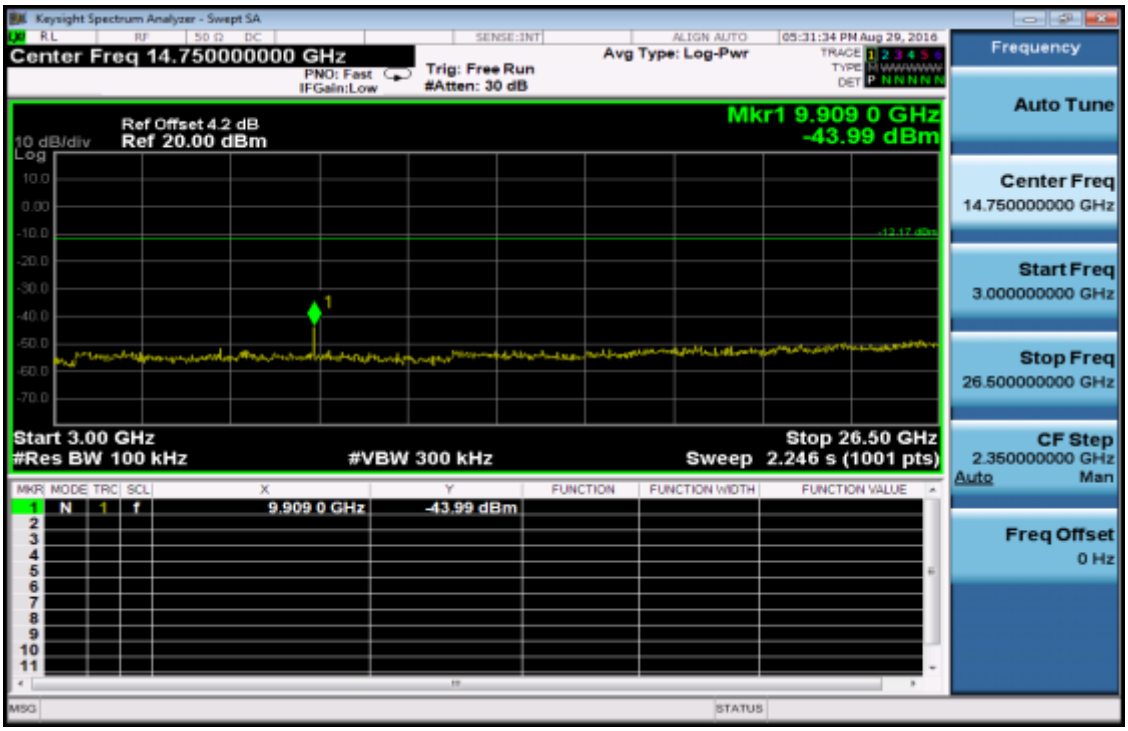
Ch High 30MHz – 3GHz



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 (dBμV/m) = 20 log Emission level (dBμV/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	ESU 40	100363	04/12/2016	04/11/2017
Loop Antenna	ETS-Lindgren	6502	00143303	12/23/2015	12/22/2016
Broadband Antenna	TESEQ	CBL 6112D	35240	10/28/2015	10/27/2016
Horn Antenna	ETS-Lindgren	3117	00143272	12/16/2015	12/15/2016
Horn Antenna	Schwarzbeck	BBHA9170	185	07/18/2016	07/17/2017
Pre Amplifier	EMC Instruments	EMC330	980096	12/12/2015	12/11/2016
Pre Amplifier	EMC Instruments	EMC0011830	980199	12/12/2015	12/11/2016
Pre Amplifier	R&S	SCU-18	10204	12/12/2015	12/11/2016
Pre Amplifier	R&S	SCU-26	100780	12/12/2015	12/11/2016
Coaxial Cable	Huber+Suhner	RG 214/U	966Rx 9K-30M	12/12/2015	12/11/2016
Coaxial Cable	Huber+Suhner	RG 214/U SUCOFLEX 104	966Rx 30M-3G	12/12/2015	12/11/2016
Coaxial Cable	Huber+Suhner	SUCOFLEX 104	966Rx 1G-18G	12/12/2015	12/11/2016
Coaxial Cable	Huber+Suhner	mini 141-12 SUCOFLEX 104	966Rx 18G-40G	12/12/2015	12/11/2016
Coaxial Cable	Huber+Suhner	SUCOFLEX 104	966Tx 30M-18G	12/12/2015	12/11/2016
Coaxial Cable	Huber+Suhner	SUCOFLEX 102	966Tx 18G-40G	12/12/2015	12/11/2016
Attenuator	WOKEN	218FS-10	RF27	12/12/2015	12/11/2016
Site NSA	SGS	966 Chamber C	SAC-C	03/04/2016	03/03/2017
Site VSWR	SGS	966 Chamber C	SAC-C	03/04/2016	03/03/2017
DC Power Supply	HOLA	DP-3003	D7070035	05/04/2016	05/03/2017
Controller	MF	MF-7802	N/A	N.C.R.	N.C.R.
Antenna Master	MF	N/A	N/A	N.C.R.	N.C.R.
Turn Table	MF	N/A	N/A	N.C.R.	N.C.R.
Test Software	World-Pallas	Dr. E	V 3.0 Lite	N.C.R.	N.C.R.

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

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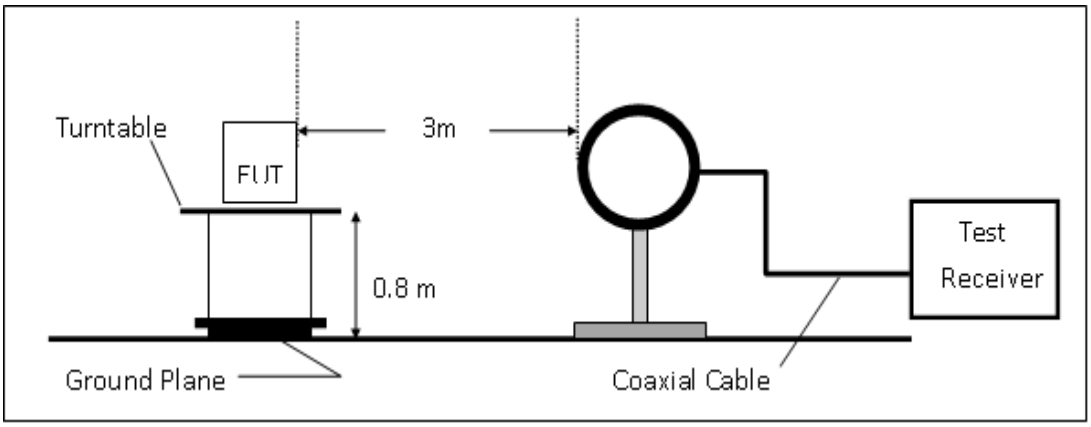
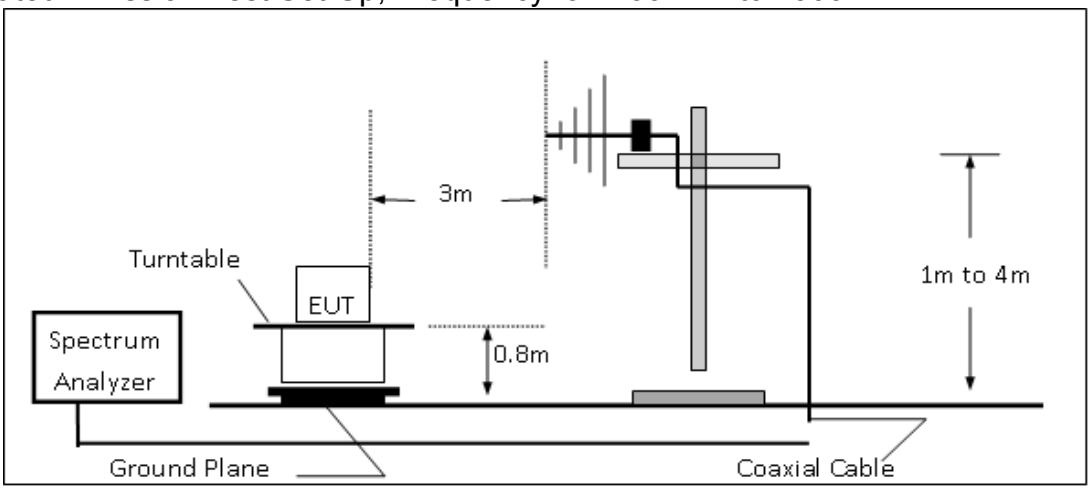
10.3. Test SET-UP

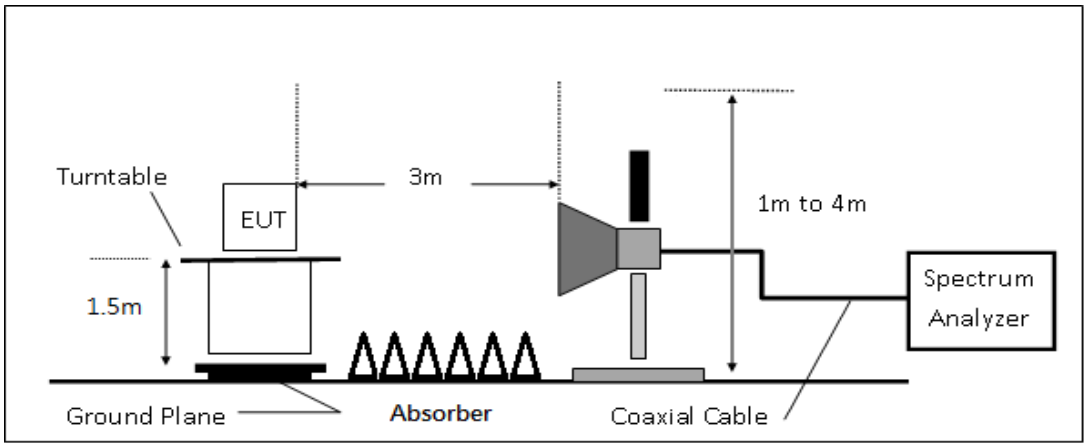
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



(B) Radiated Emission Test Set-Up, Frequency form 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 ≥ 1 GHz, 100 kHz for f < 1 GHz, VBW ≥ 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 = N1*L1=N2*L2+…+N(n-1)*LN(n-1)+N(n)*L(n)
   Where N1 is number of type 1 pulses, L1 is length of type 1 pulses, etc.
   Average Emission Level = Peak Emission Level + 20*log (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 dBuV/m, which converts 20*log(uV/m)

Actual FS(dBμV/m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV/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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Member of SGS Group

Radiated Band Edge Measurement Result: (Hopping Mode)

Operation Mode :	BT BR Hopping	Test Date :	2016/8/25
Fundamental Frequency :	2402 MHz	Temp. / Humi. :	24.deg_C/57RH
Operation Band :	BE CH LOW	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Vertical

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2390.00	E	Peak	43.19	6.62	49.81	74	-24.19
2390.00	E	Average	19.26	6.62	25.88	54	-28.12

Operation Mode :	BT BR Hopping	Test Date :	2016/8/25
Fundamental Frequency :	2402 MHz	Temp. / Humi. :	24.deg_C/57RH
Operation Band :	BE CH LOW	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Horizontal

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2390.00	E	Peak	42.94	6.62	49.55	74	-24.45
2390.00	E	Average	19.58	6.62	26.20	54	-27.80

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Operation Mode :	BT BR Hopping	Test Date :	2016/8/25
Fundamental Frequency :	2480 MHz	Temp. / Humi. :	24.deg_C/57RH
Operation Band :	BE CH HIGH	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Vertical

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	E	Peak	53.99	6.96	60.96	74	-13.04
2483.50	E	Average	20.98	6.96	27.94	54	-26.06

Operation Mode :	BT BR Hopping	Test Date :	2016/8/25
Fundamental Frequency :	2480 MHz	Temp. / Humi. :	24.deg_C/57RH
Operation Band :	BE CH HIGH	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Horizontal

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	E	Peak	54.85	6.96	61.82	74	-12.18
2483.50	E	Average	21.02	6.96	27.98	54	-26.02

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Operation Mode :	BT EDR Hopping	Test Date :	2016/8/25
Fundamental Frequency :	2402 MHz	Temp. / Humi. :	24.deg_C/57RH
Operation Band :	BE CH LOW	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Vertical

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2390.00	E	Peak	43.47	6.62	50.09	74	-23.91
2390.00	E	Average	19.74	6.62	26.36	54	-27.64

Operation Mode :	BT EDR Hopping	Test Date :	2016/8/25
Fundamental Frequency :	2402 MHz	Temp. / Humi. :	24.deg_C/57RH
Operation Band :	BE CH LOW	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Horizontal

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2390.00	E	Peak	43.39	6.62	50.01	74	-23.99
2390.00	E	Average	19.91	6.62	26.53	54	-27.47

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Operation Mode :	BT EDR Hopping	Test Date :	2016/8/25
Fundamental Frequency :	2480 MHz	Temp. / Humi. :	24.deg_C/57RH
Operation Band :	BE CH HIGH	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Vertical

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	E	Peak	54.11	6.96	61.08	74	-12.92
2483.50	E	Average	21.12	6.96	28.08	54	-25.92

Operation Mode :	BT EDR Hopping	Test Date :	2016/8/25
Fundamental Frequency :	2480 MHz	Temp. / Humi. :	24.deg_C/57RH
Operation Band :	BE CH HIGH	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Horizontal

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	E	Peak	54.60	6.96	61.57	74	-12.43
2483.50	E	Average	21.24	6.96	28.20	54	-25.80

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

Operation Mode :	BT BR	Test Date :	2016/8/25
Fundamental Frequency :	2402 MHz	Temp. / Humi. :	24.deg_C/57RH
Operation Band :	BE CH LOW	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Vertical

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2390.00	E	Peak	43.90	6.62	50.51	74	-23.49
2390.00	E	Average	19.21	6.62	25.83	54	-28.17

Operation Mode :	BT BR	Test Date :	2016/8/25
Fundamental Frequency :	2402 MHz	Temp. / Humi. :	24.deg_C/57RH
Operation Band :	BE CH LOW	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Horizontal

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2390.00	E	Peak	44.46	6.62	51.07	74	-22.93
2390.00	E	Average	19.54	6.62	26.16	54	-27.84

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Operation Mode :	BT BR	Test Date :	2016/8/25
Fundamental Frequency :	2480 MHz	Temp. / Humi. :	24.deg_C/57RH
Operation Band :	BE CH HIGH	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Vertical

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	E	Peak	54.59	6.96	61.55	74	-12.45
2483.50	E	Average	21.33	6.96	28.29	54	-25.71

Operation Mode :	BT BR	Test Date :	2016/8/25
Fundamental Frequency :	2480 MHz	Temp. / Humi. :	24.deg_C/57RH
Operation Band :	BE CH HIGH	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Horizontal

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	E	Peak	54.95	6.96	61.91	74	-12.09
2483.50	E	Average	21.96	6.96	28.92	54	-25.08

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Operation Mode :	BT EDR	Test Date :	2016/8/25
Fundamental Frequency :	2402 MHz	Temp. / Humi. :	24.deg_C/57RH
Operation Band :	BE CH LOW	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Vertical

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2390.00	E	Peak	44.30	6.62	50.92	74	-23.08
2390.00	E	Average	19.87	6.62	26.49	54	-27.51

Operation Mode :	BT EDR	Test Date :	2016/8/25
Fundamental Frequency :	2402 MHz	Temp. / Humi. :	24.deg_C/57RH
Operation Band :	BE CH LOW	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Horizontal

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2390.00	E	Peak	44.14	6.62	50.76	74	-23.24
2390.00	E	Average	19.94	6.62	26.56	54	-27.44

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Operation Mode :	BT EDR	Test Date :	2016/8/25
Fundamental Frequency :	2480 MHz	Temp. / Humi. :	24.deg_C/57RH
Operation Band :	BE CH HIGH	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Vertical

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	E	Peak	54.42	6.96	61.38	74	-12.62
2483.50	E	Average	19.76	6.96	26.72	54	-27.28

Operation Mode :	BT EDR	Test Date :	2016/8/25
Fundamental Frequency :	2480 MHz	Temp. / Humi. :	24.deg_C/57RH
Operation Band :	BE CH HIGH	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Horizontal

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	E	Peak	54.87	6.96	61.83	74	-12.17
2483.50	E	Average	19.90	6.96	26.86	54	-27.14

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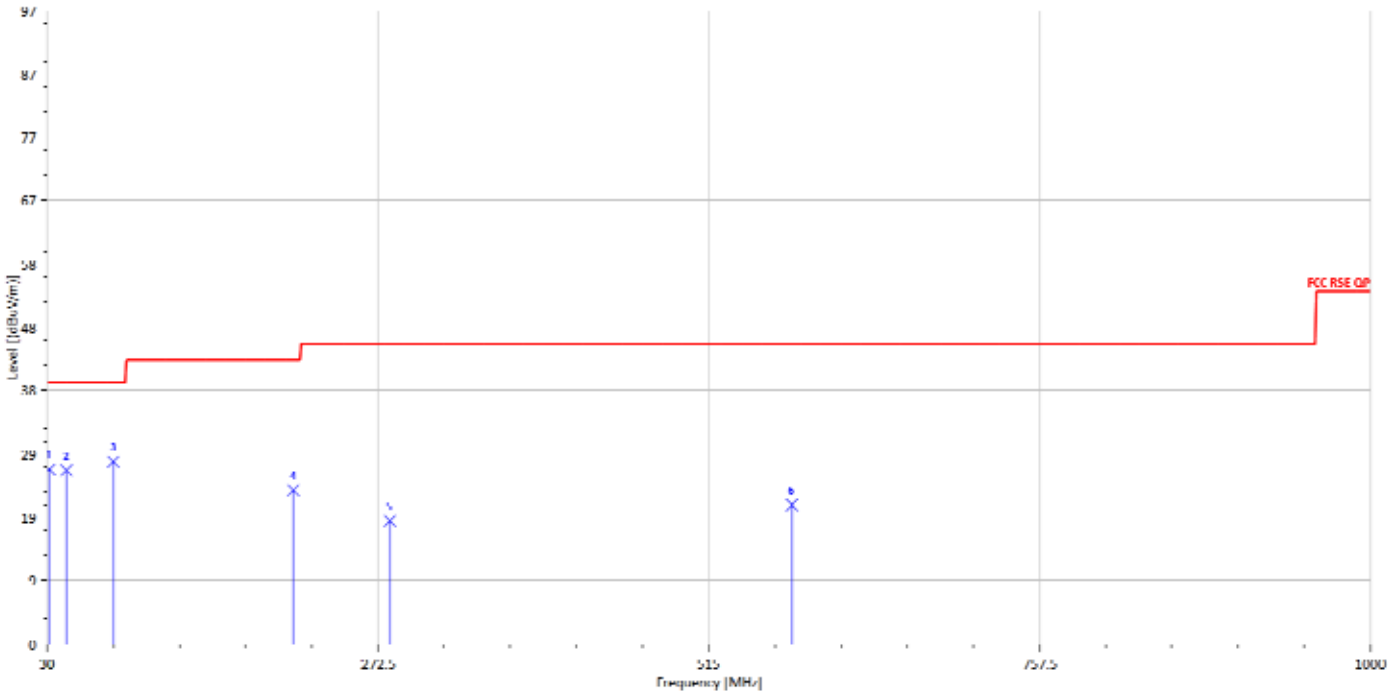
Radiated Spurious Emission Measurement Result:
For Frequency form 30MHz to 1000MHz

Operation Mode :	BT BR	Test Date :	2016/8/25
Fundamental Frequency :	2402 MHz	Temp. / Humi. :	24.8 deg_C/60RH
Operation Band :	TX CH LOW	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Vertical



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
31.94	S	Peak	40.88	-14.17	26.72	40	-13.28
44.55	S	Peak	48.69	-22.12	26.58	40	-13.42
78.50	S	Peak	54.92	-27.00	27.92	40	-12.08
210.42	S	Peak	46.41	-22.90	23.50	43.5	-20.00
281.23	S	Peak	38.56	-19.65	18.91	46	-27.09
576.11	S	Peak	33.75	-12.45	21.30	46	-24.70

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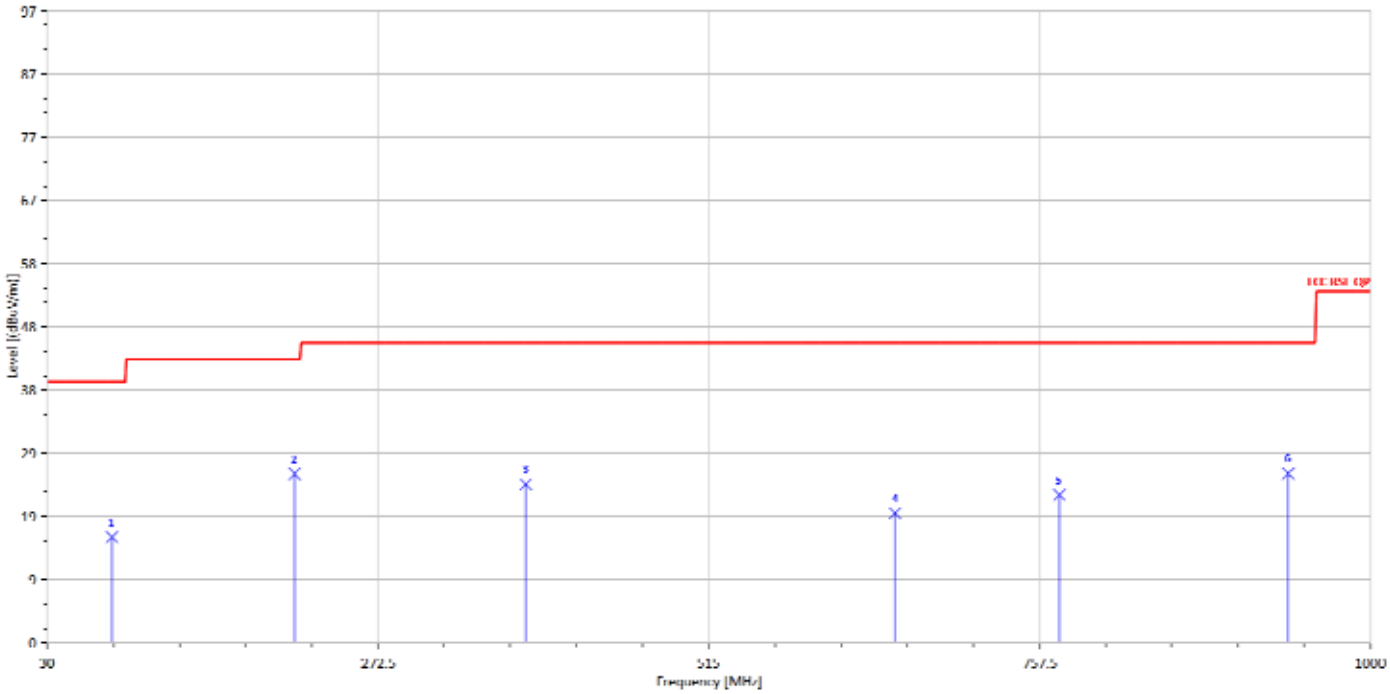
Operation Mode :	BT BR	Test Date :	2016/8/25
Fundamental Frequency :	2402 MHz	Temp. / Humi. :	24.8 deg_C/60RH
Operation Band :	TX CH LOW	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Horizontal



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
77.53	S	Peak	43.23	-27.08	16.15	40	-23.85
211.39	S	Peak	48.81	-22.91	25.90	43.5	-17.60
381.14	S	Peak	40.80	-16.45	24.35	46	-21.65
651.77	S	Peak	31.13	-11.27	19.86	46	-26.14
772.05	S	Peak	32.94	-10.23	22.71	46	-23.29
939.86	S	Peak	33.58	-7.62	25.96	46	-20.04

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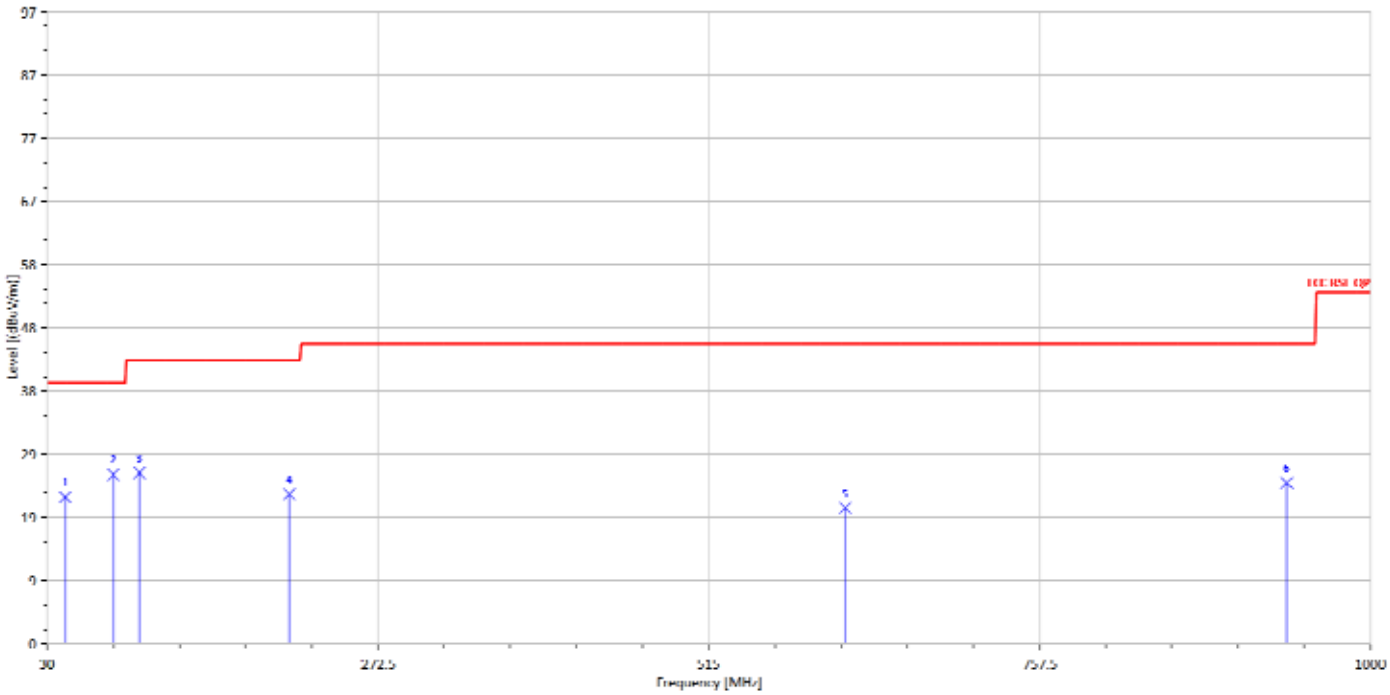
Operation Mode :	BT BR	Test Date :	2016/8/25
Fundamental Frequency :	2441 MHz	Temp. / Humi. :	24.8 deg_C/60RH
Operation Band :	TX CH MID	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Vertical



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
43.58	S	Peak	43.95	-21.44	22.51	40	-17.49
78.50	S	Peak	52.92	-27.00	25.92	40	-14.08
97.90	S	Peak	50.39	-24.19	26.20	43.5	-17.30
207.51	S	Peak	45.96	-22.98	22.98	43.5	-20.52
614.91	S	Peak	33.14	-12.28	20.86	46	-25.14
938.89	S	Peak	32.35	-7.63	24.72	46	-21.28

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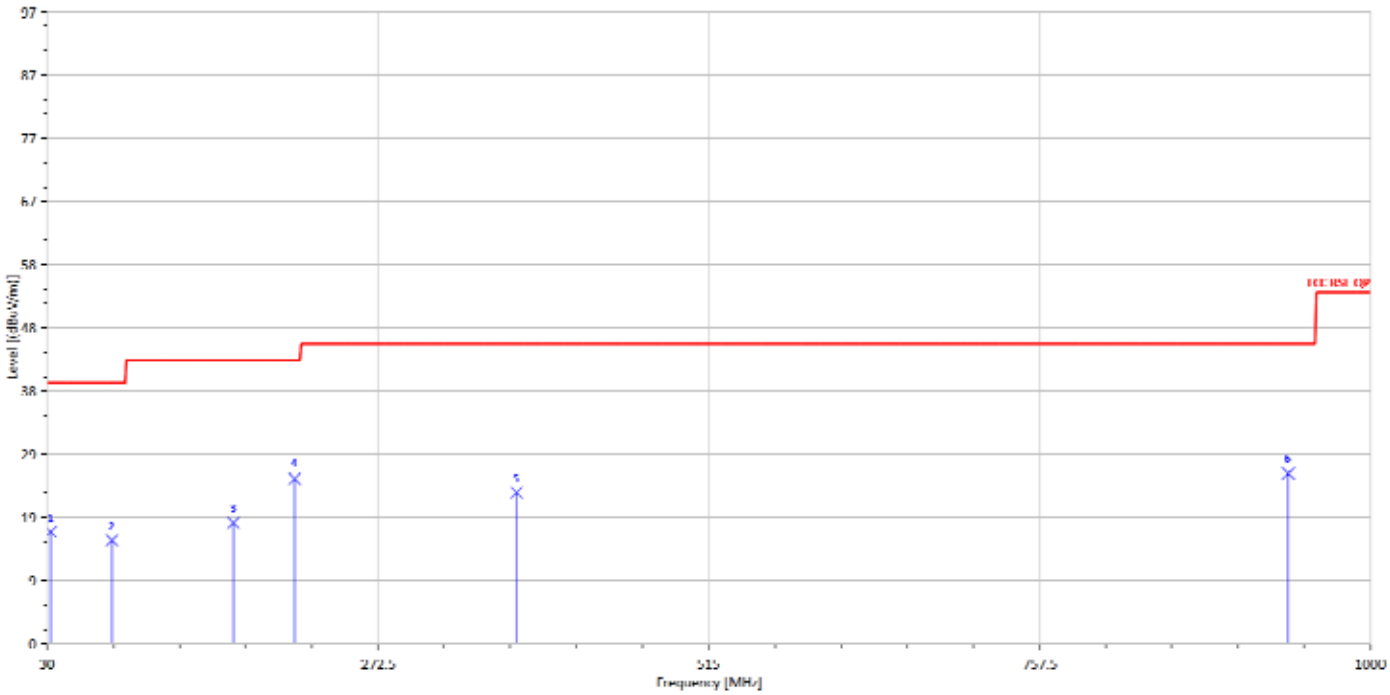
Operation Mode :	BT BR	Test Date :	2016/8/25
Fundamental Frequency :	2441 MHz	Temp. / Humi. :	24.8 deg_C/60RH
Operation Band :	TX CH MID	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Horizontal



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
32.91	S	Peak	31.82	-14.69	17.12	40	-22.88
77.53	S	Peak	42.90	-27.08	15.82	40	-24.18
166.77	S	Peak	42.15	-23.63	18.52	43.5	-24.98
211.39	S	Peak	48.24	-22.91	25.33	43.5	-18.17
374.35	S	Peak	39.94	-16.71	23.22	46	-22.78
939.86	S	Peak	33.73	-7.62	26.11	46	-19.89

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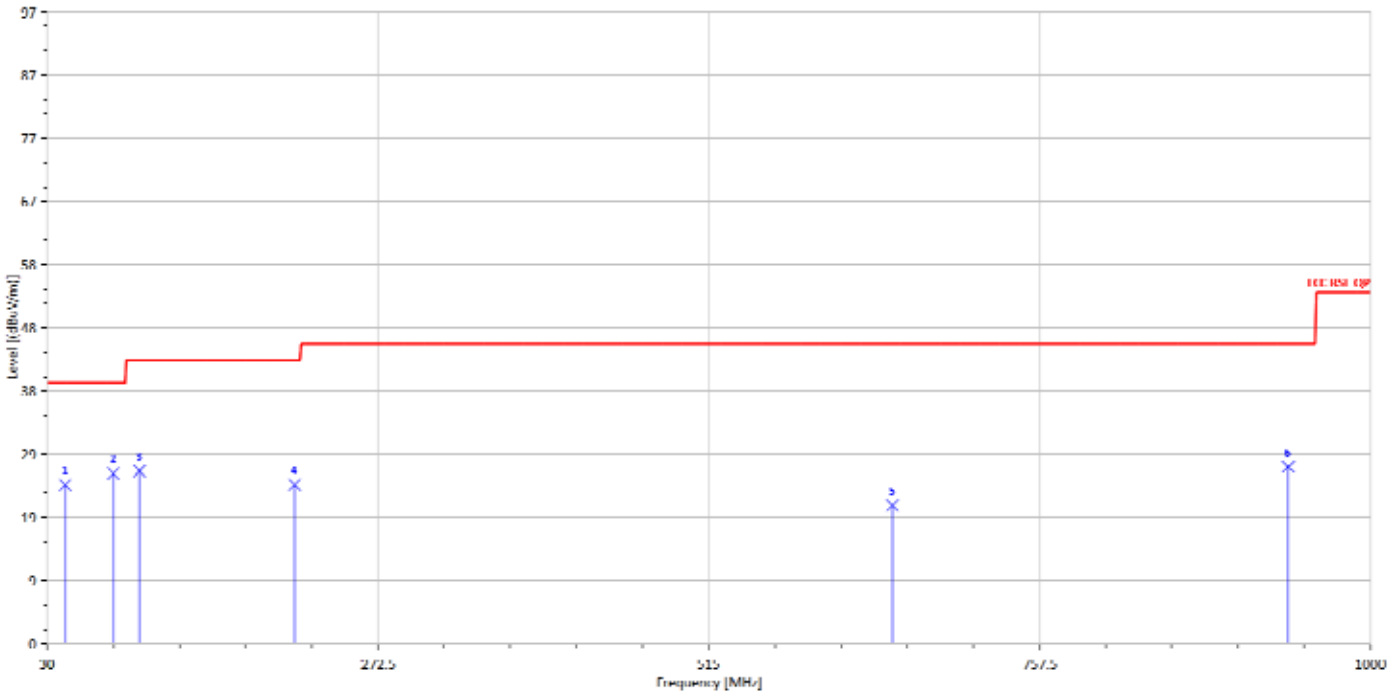
Operation Mode :	BT BR	Test Date :	2016/8/25
Fundamental Frequency :	2480 MHz	Temp. / Humi. :	24.8 deg_C/60RH
Operation Band :	TX CH HIGH	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Vertical



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
43.58	S	Peak	45.84	-21.44	24.40	40	-15.60
78.50	S	Peak	53.09	-27.00	26.09	40	-13.91
97.90	S	Peak	50.67	-24.19	26.48	43.5	-17.02
211.39	S	Peak	47.33	-22.91	24.42	43.5	-19.08
649.83	S	Peak	32.42	-11.20	21.23	46	-24.77
939.86	S	Peak	34.70	-7.62	27.08	46	-18.92

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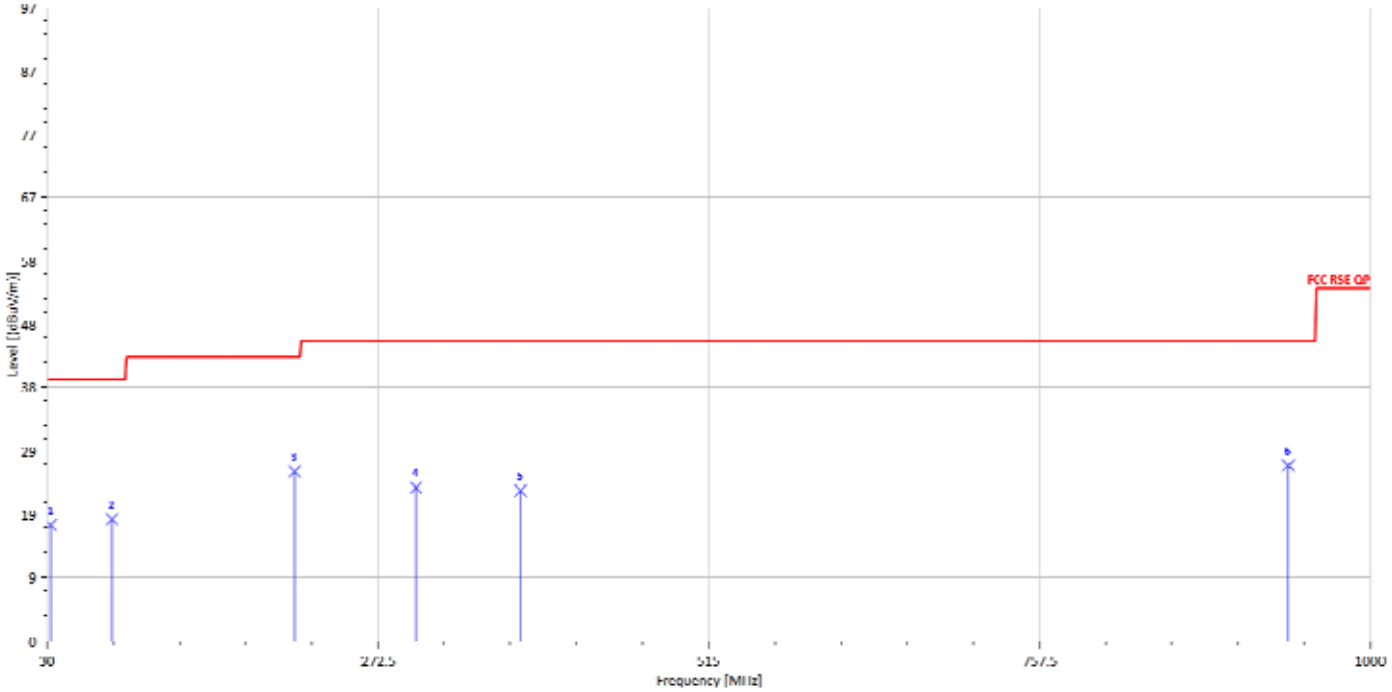
Operation Mode :	BT BR	Test Date :	2016/8/25
Fundamental Frequency :	2480 MHz	Temp. / Humi. :	24.8 deg_C/60RH
Operation Band :	TX CH HIGH	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Horizontal



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
32.91	S	Peak	32.49	-14.69	17.80	40	-22.20
77.53	S	Peak	45.74	-27.08	18.66	40	-21.34
211.39	S	Peak	48.84	-22.91	25.93	43.5	-17.57
300.63	S	Peak	42.75	-19.24	23.50	46	-22.50
377.26	S	Peak	39.67	-16.59	23.08	46	-22.92
939.86	S	Peak	34.48	-7.62	26.85	46	-19.15

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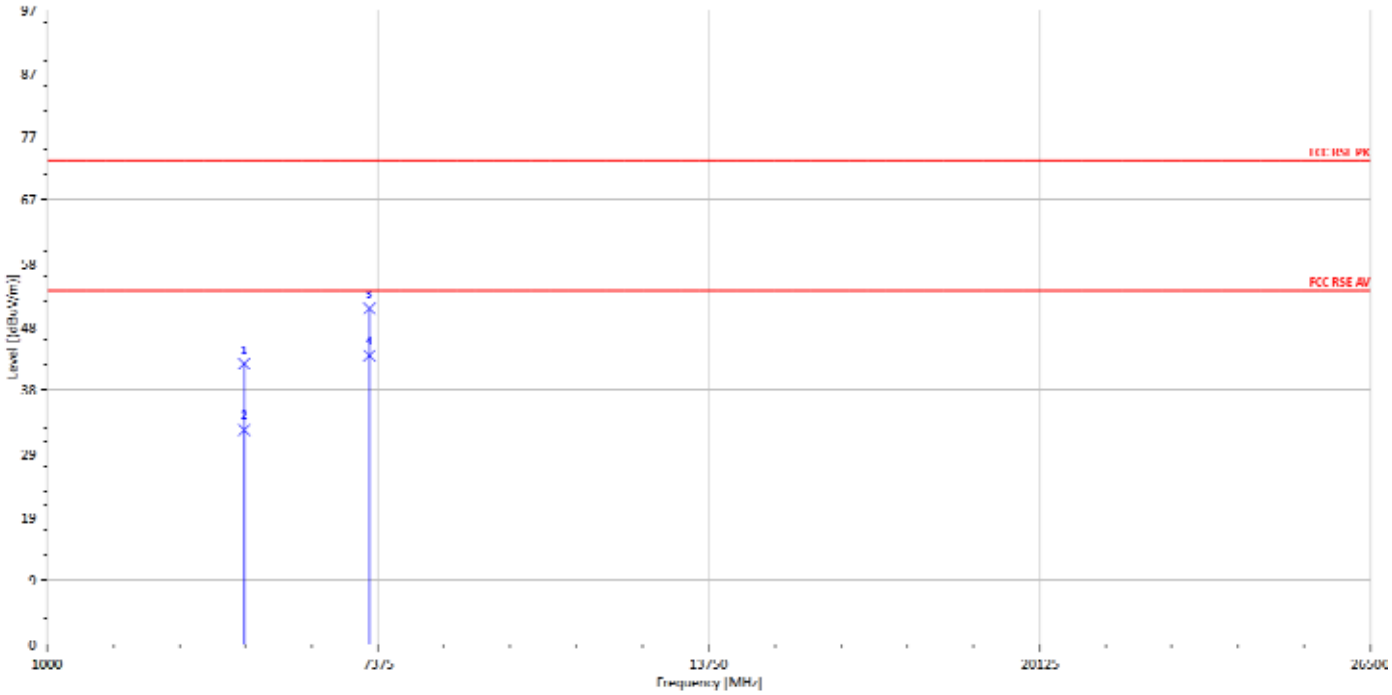
Radiated Spurious Emission Measurement Result:
For Frequency above 1 GHz

Operation Mode :	BT BR	Test Date :	2016/8/25
Fundamental Frequency :	2402 MHz	Temp. / Humi. :	24.8 deg_C/60RH
Operation Band :	TX CH LOW	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Vertical



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4804.00	H	Peak	31.86	10.98	42.83	74	-31.17
4804.00	H	Average	21.78	10.98	32.76	54	-21.24
7206.00	H	Peak	36.09	15.14	51.24	74	-22.76
7206.00	H	Average	28.97	15.14	44.11	54	-9.89

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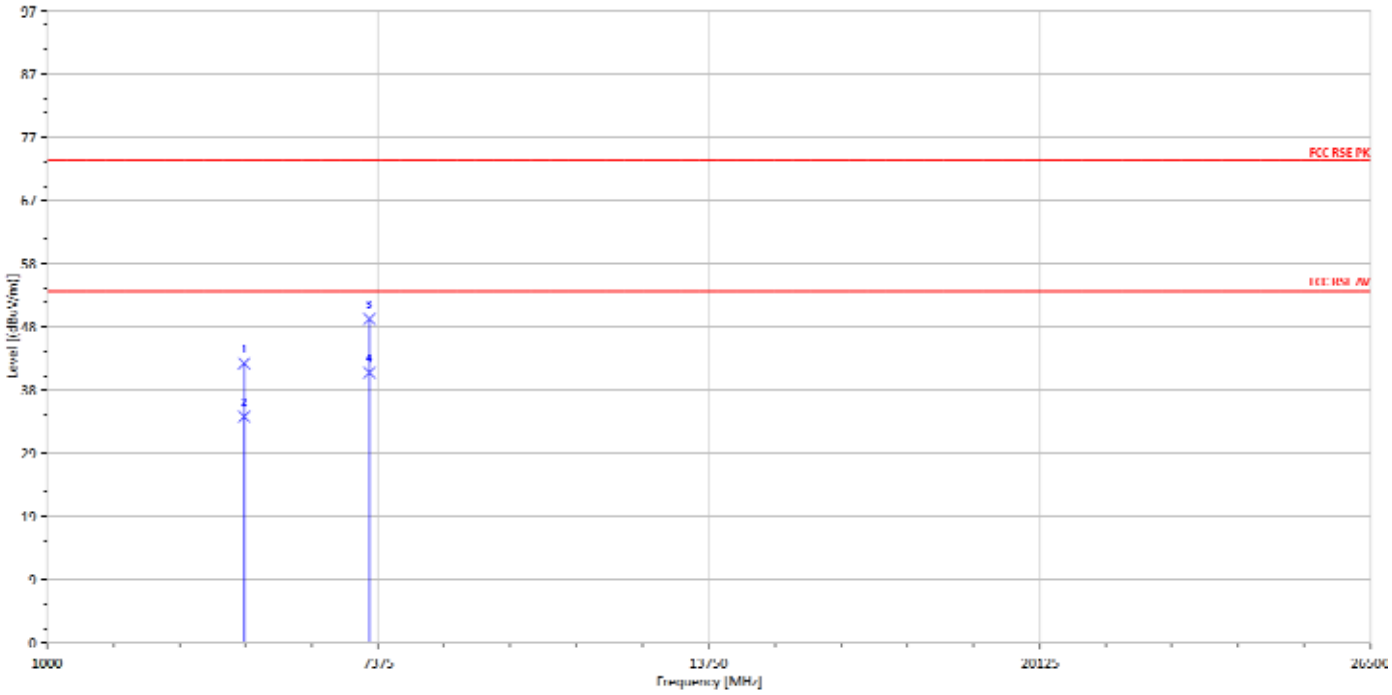
Operation Mode :	BT BR	Test Date :	2016/8/25
Fundamental Frequency :	2402 MHz	Temp. / Humi. :	24.8 deg_C/60RH
Operation Band :	TX CH LOW	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Horizontal



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4804.00	H	Peak	31.84	10.98	42.81	74	-31.19
4804.00	H	Average	23.72	10.98	34.70	54	-19.30
7206.00	H	Peak	34.57	15.14	49.71	74	-24.29
7206.00	H	Average	26.23	15.14	41.37	54	-12.63

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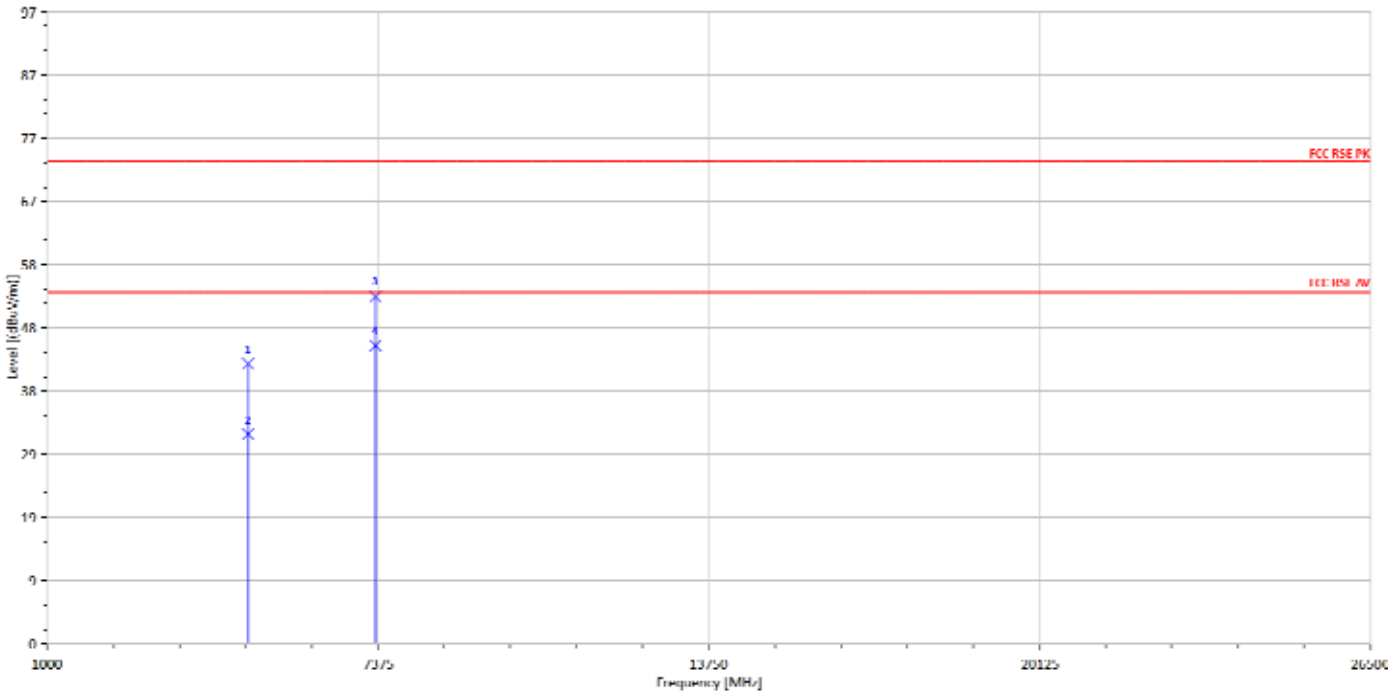
Operation Mode :	BT BR	Test Date :	2016/8/25
Fundamental Frequency :	2441 MHz	Temp. / Humi. :	24.8 deg_C/60RH
Operation Band :	TX CH MID	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Vertical



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
4882.00	H	Peak	32.01	10.91	42.92	74	-31.08
4882.00	H	Average	21.23	10.91	32.14	54	-21.86
7323.00	H	Peak	37.94	15.37	53.31	74	-20.69
7323.00	H	Average	30.36	15.37	45.73	54	-8.27

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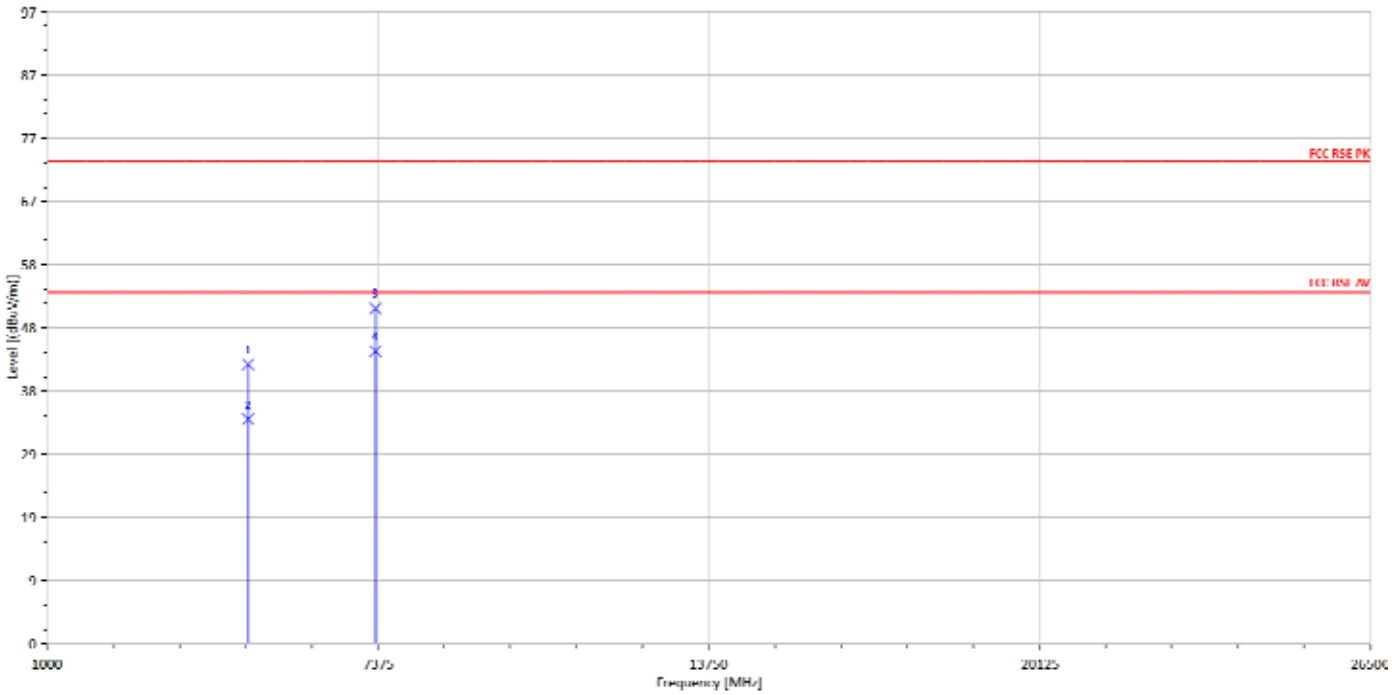
Operation Mode :	BT BR	Test Date :	2016/8/25
Fundamental Frequency :	2441 MHz	Temp. / Humi. :	24.8 deg_C/60RH
Operation Band :	TX CH MID	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Horizontal



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4882.00	H	Peak	31.91	10.91	42.82	74	-31.18
4882.00	H	Average	23.55	10.91	34.46	54	-19.54
7323.00	H	Peak	36.12	15.37	51.49	74	-22.51
7323.00	H	Average	29.49	15.37	44.86	54	-9.14

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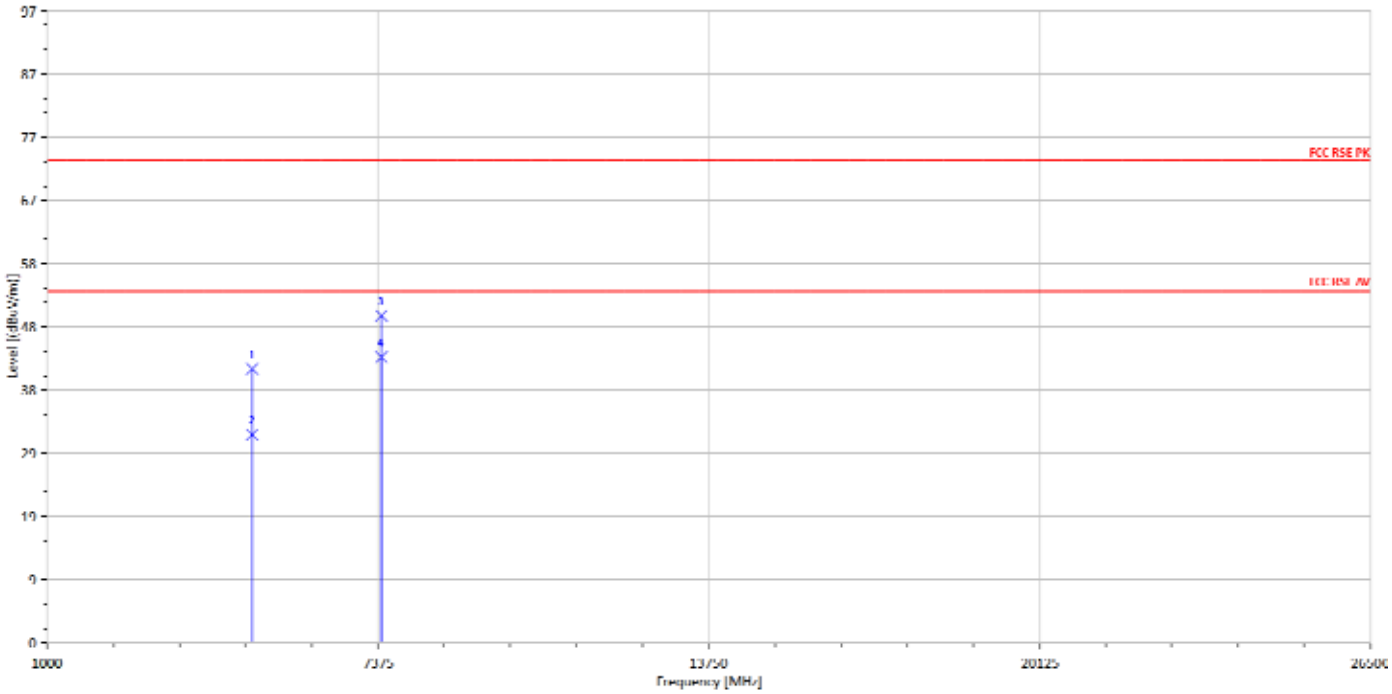
Operation Mode :	BT BR	Test Date :	2016/8/25
Fundamental Frequency :	2480 MHz	Temp. / Humi. :	24.8 deg_C/60RH
Operation Band :	TX CH HIGH	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Vertical



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
4960.00	S	Peak	30.97	10.99	41.96	74	-32.04
4960.00	S	Average	20.91	10.99	31.90	54	-22.10
7440.00	S	Peak	34.56	15.65	50.21	74	-23.79
7440.00	S	Average	28.15	15.65	43.80	54	-10.20

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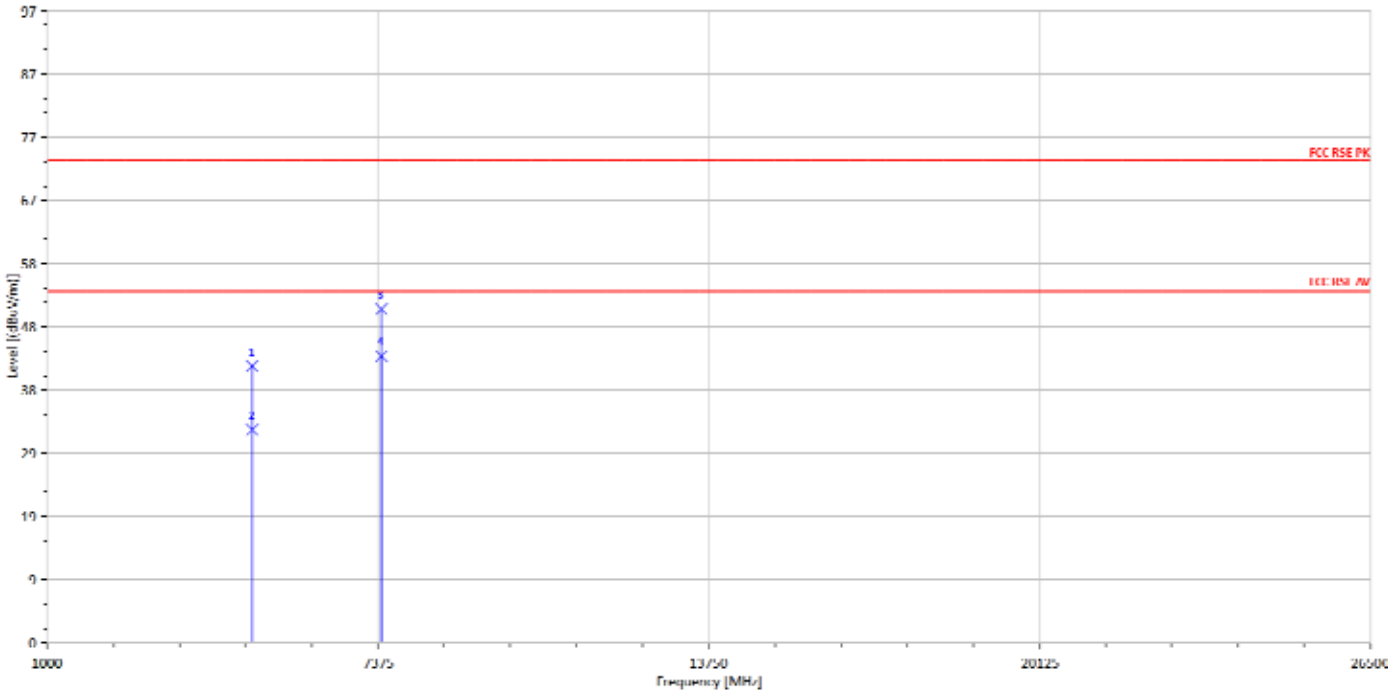
Member of SGS Group

Operation Mode :	BT BR	Test Date :	2016/8/25
Fundamental Frequency :	2480 MHz	Temp. / Humi. :	24.8 deg_C/60RH
Operation Band :	TX CH HIGH	Test Engineer :	Ashton
EUT Pol. :	E1	Measurement Antenna Pol. :	Horizontal



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4960.00	H	Peak	31.41	10.99	42.40	74	-31.60
4960.00	H	Average	21.67	10.99	32.66	54	-21.34
7440.00	H	Peak	35.59	15.65	51.24	74	-22.76
7440.00	H	Average	28.30	15.65	43.95	54	-10.05

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11. FREQUENCY SEPARATION

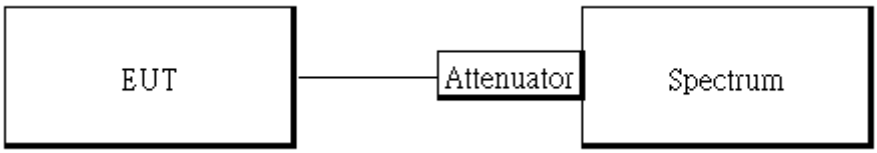
11.1. Standard Applicable

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	KEYSIGHT	N9010A	MY54510568	04/14/2016	04/13/2017
DC Block	PASTERNACK	PE8210	RF29	12/12/2015	12/11/2016
Splitter	RF-LAMBAD	RFLT2W1G18G	RF35	12/12/2015	12/11/2016
Coaxial Cable 30cm	WOKEN	00100A1F1A195C	RF01	12/12/2015	12/11/2016
Bluetooth Tester	R&S	CBT	101140	10/19/2015	10/18/2016

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

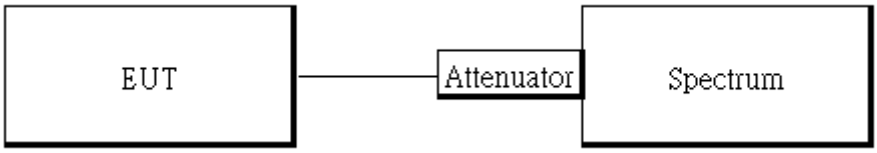
12.1. Standard Applicable

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	KEYSIGHT	N9010A	MY54510568	04/14/2016	04/13/2017
DC Block	PASTERNACK	PE8210	RF29	12/12/2015	12/11/2016
Splitter	RF-LAMBAD	RFLT2W1G18G	RF35	12/12/2015	12/11/2016
Coaxial Cable 30cm	WOKEN	00100A1F1A195C	RF01	12/12/2015	12/11/2016
Bluetooth Tester	R&S	CBT	101140	10/19/2015	10/18/2016

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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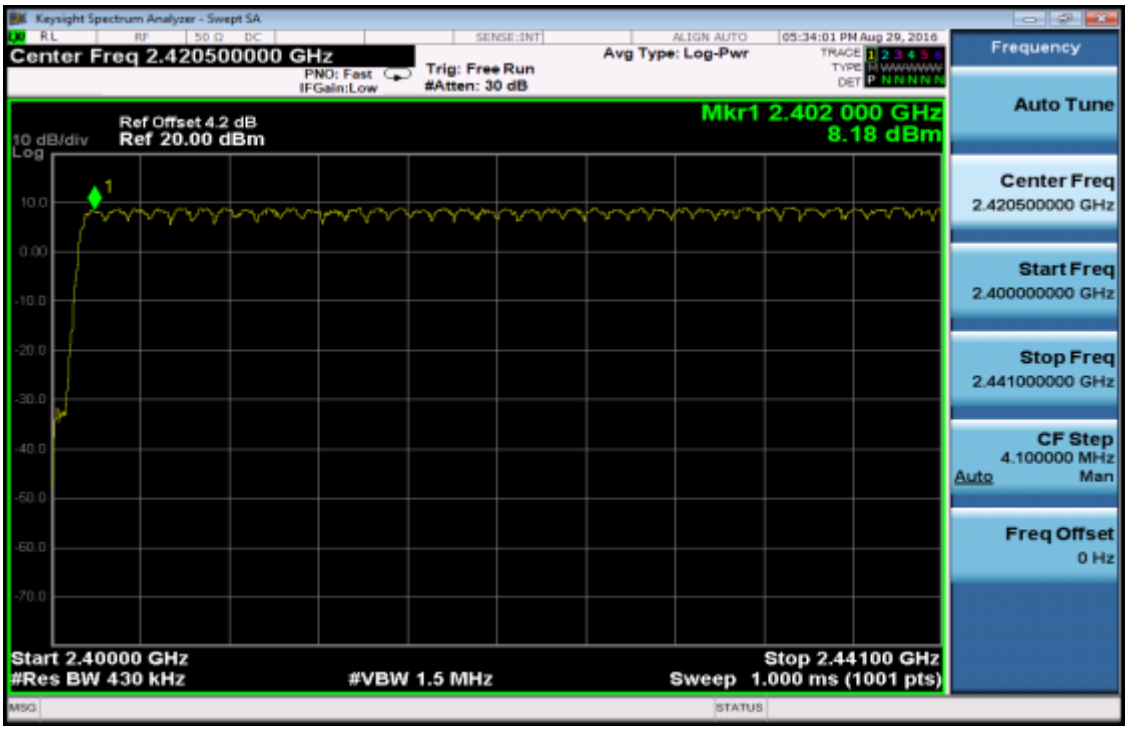
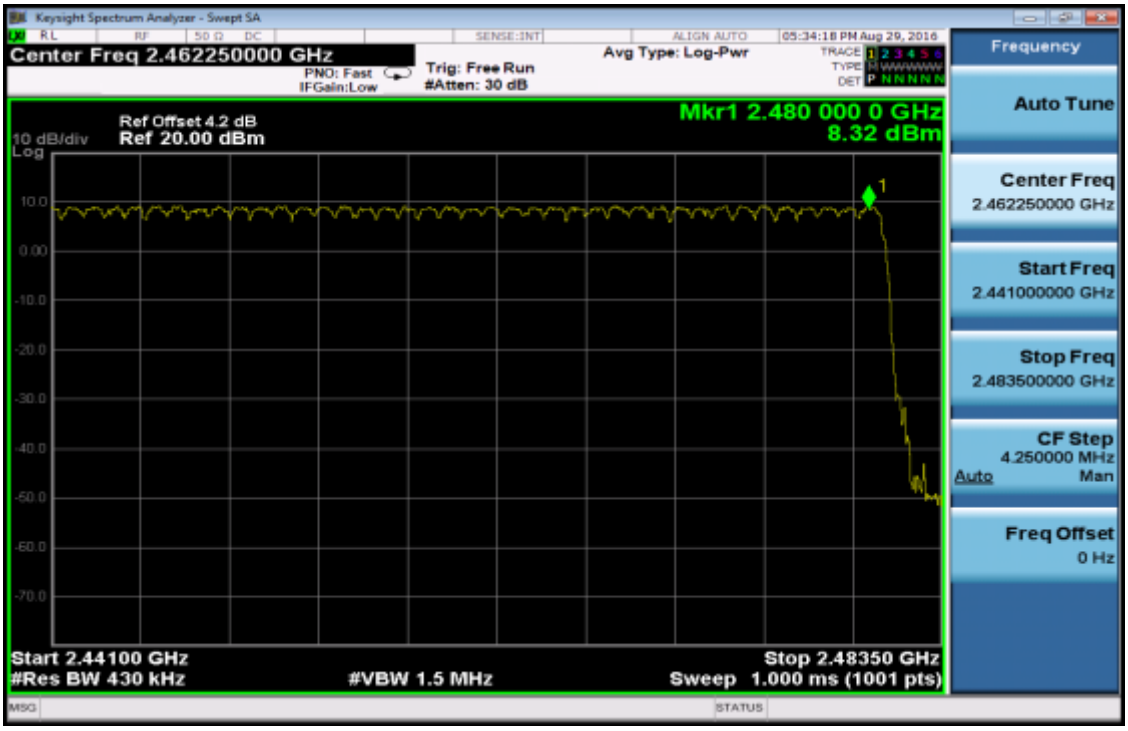
Channel Number

2.4 GHz – 2.441GHz



2.441 GHz – 2.4835GHz



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13. TIME OF OCCUPANCY (DWELL TIME)

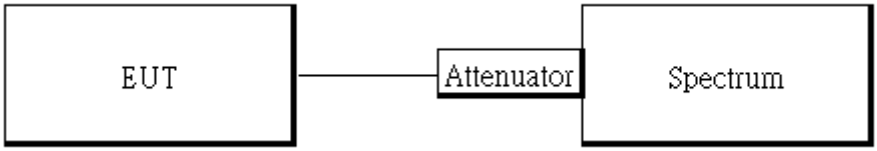
13.1. Standard Applicable

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	KEYSIGHT	N9010A	MY54510568	04/14/2016	04/13/2017
DC Block	PASTERNACK	PE8210	RF29	12/12/2015	12/11/2016
Splitter	RF-LAMBAD	RFLT2W1G18G	RF35	12/12/2015	12/11/2016
Coaxial Cable 30cm	WOKEN	00100A1F1A195C	RF01	12/12/2015	12/11/2016
Bluetooth Tester	R&S	CBT	101140	10/19/2015	10/18/2016

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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13.5. Tabular Result of the Measurement

GFSK (1Mbps)

Channel	PACKET TYPE	Measurement Result (ms)	Limit (ms)
0	DH1	121.60	400ms
	DH3	262.72	400ms
	DH5	308.59	400ms
39	DH1	122.94	400ms
	DH3	260.64	400ms
	DH5	307.20	400ms
78	DH1	123.20	400ms
	DH3	260.64	400ms
	DH5	306.67	400ms

π/4 DQPSK (2Mbps)

Channel	PACKET TYPE	Measurement Result (ms)	Limit (ms)
39	DH1	122.94	400ms
	DH3	262.72	400ms
	DH5	308.59	400ms

8-DPSK (3Mbps)

Channel	PACKET TYPE	Measurement Result (ms)	Limit (ms)
39	DH1	122.94	400ms
	DH3	262.72	400ms
	DH5	308.59	400ms

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

GFSK (1Mbps):

CH Low	DH1 time slot	=	0.380	*	(1600/2/79)	*	31.6	=	121.60	(ms)
	DH3 time slot	=	1.642	*	(1600/4/79)	*	31.6	=	262.72	(ms)
	DH5 time slot	=	2.893	*	(1600/6/79)	*	31.6	=	308.59	(ms)
CH Mid	DH1 time slot	=	0.384	*	(1600/2/79)	*	31.6	=	122.94	(ms)
	DH3 time slot	=	1.629	*	(1600/4/79)	*	31.6	=	260.64	(ms)
	DH5 time slot	=	2.880	*	(1600/6/79)	*	31.6	=	307.20	(ms)
CH High	DH1 time slot	=	0.385	*	(1600/2/79)	*	31.6	=	123.20	(ms)
	DH3 time slot	=	1.629	*	(1600/4/79)	*	31.6	=	260.64	(ms)
	DH5 time slot	=	2.875	*	(1600/6/79)	*	31.6	=	306.67	(ms)

π/4 -DQPSK (2Mbps):

CH Mid	2DH1 time slot	=	0.384	*	(1600/2/79)	*	31.6	=	122.94	(ms)
	2DH3 time slot	=	1.642	*	(1600/4/79)	*	31.6	=	262.72	(ms)
	2DH5 time slot	=	2.893	*	(1600/6/79)	*	31.6	=	308.59	(ms)

8-DPSK (3Mbps):

CH Mid	3DH1 time slot	=	0.384	*	(1600/2/79)	*	31.6	=	122.94	(ms)
	3DH3 time slot	=	1.642	*	(1600/4/79)	*	31.6	=	262.72	(ms)
	3DH5 time slot	=	2.893	*	(1600/6/79)	*	31.6	=	308.59	(ms)

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GFSK (1Mbps) for AFH Mode			
Hopping Channel Number	**PACKET TYPE**	**Measurement Result (ms)**	**Limit (ms)**
20	DH5	153.33	400ms
π/4 DQPSK (2Mbps) for Mode			
Hopping Channel Number	**PACKET TYPE**	**Measurement Result (ms)**	**Limit (ms)**
20	DH5	154.29	400ms
8-DPSK (3Mbps) for AFH Mode			
Hopping Channel Number	**PACKET TYPE**	**Measurement Result (ms)**	**Limit (ms)**
20	DH5	154.29	400ms

GFSK (1Mbps):

DH5 time sl = 2.875 (ms) * (800/6/20) * 8 = 153.33 (ms)

π/4 -DQPSK (2Mbps

2DH5 time = 2.893 (ms) * (800/6/20) * 8 = 154.29 (ms)

8-DPSK (3Mbps):

3DH5 time = 2.893 (ms) * (800/6/20) * 8 = 154.29 (ms)

13.6. Measurement Result

Note: Refer to next page for plots.

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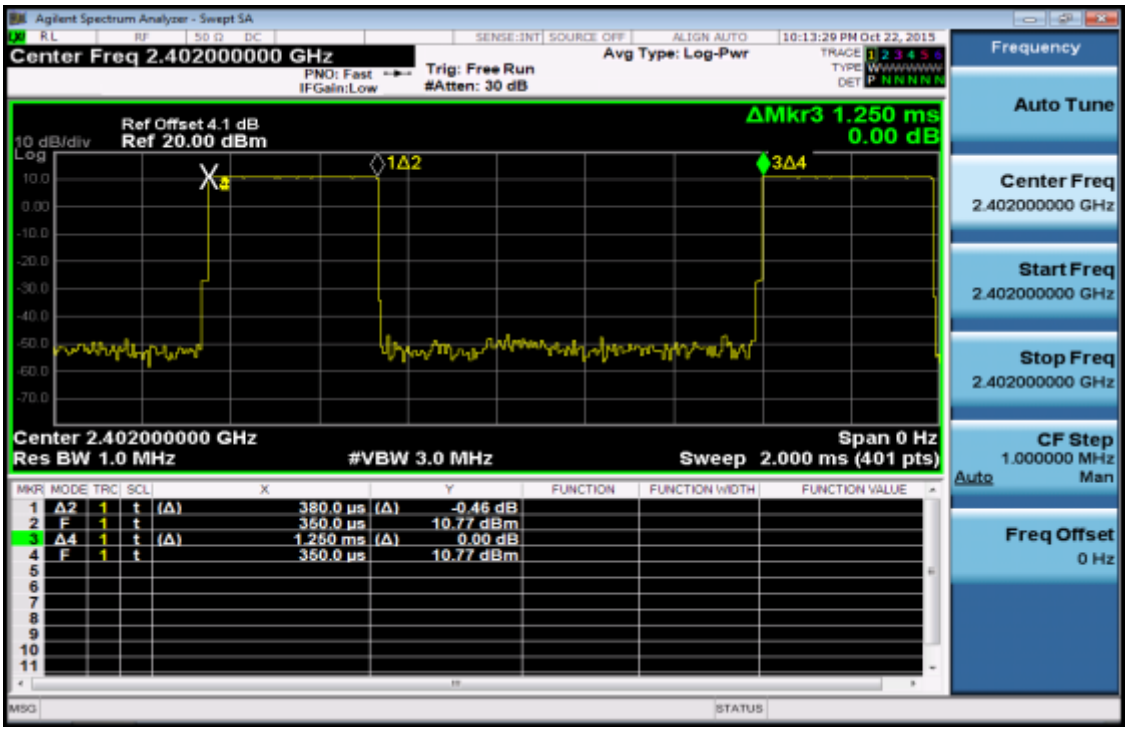
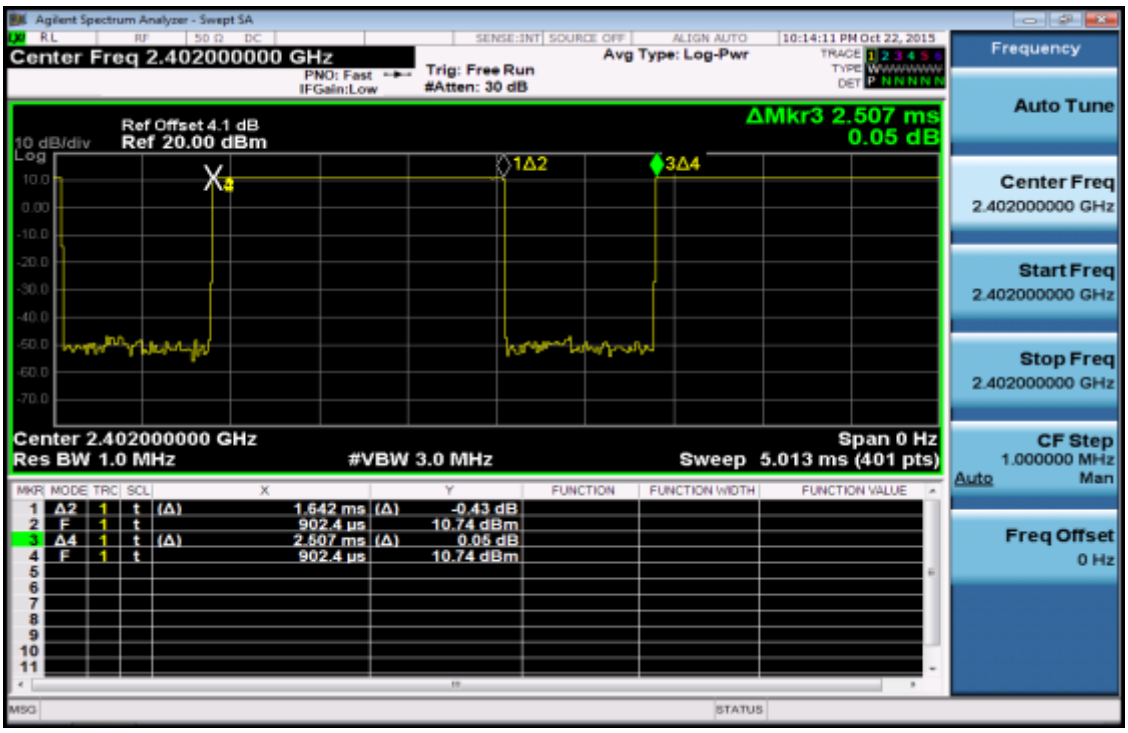
CH-Low
DH1



DH3



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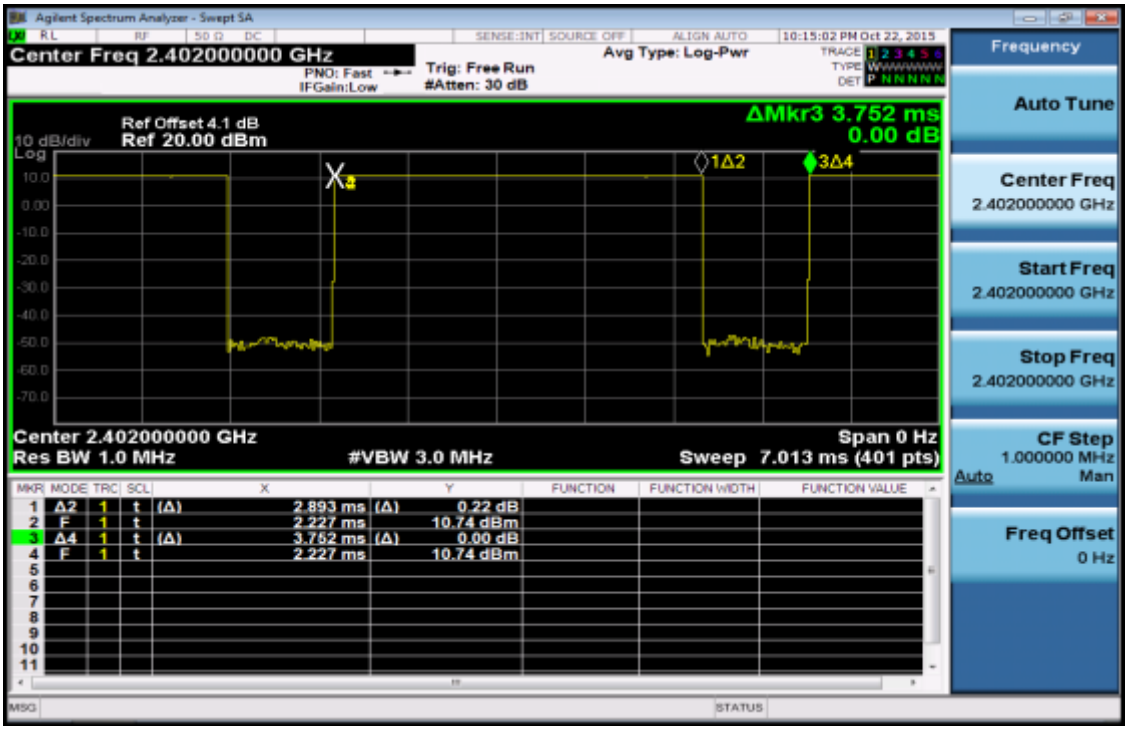
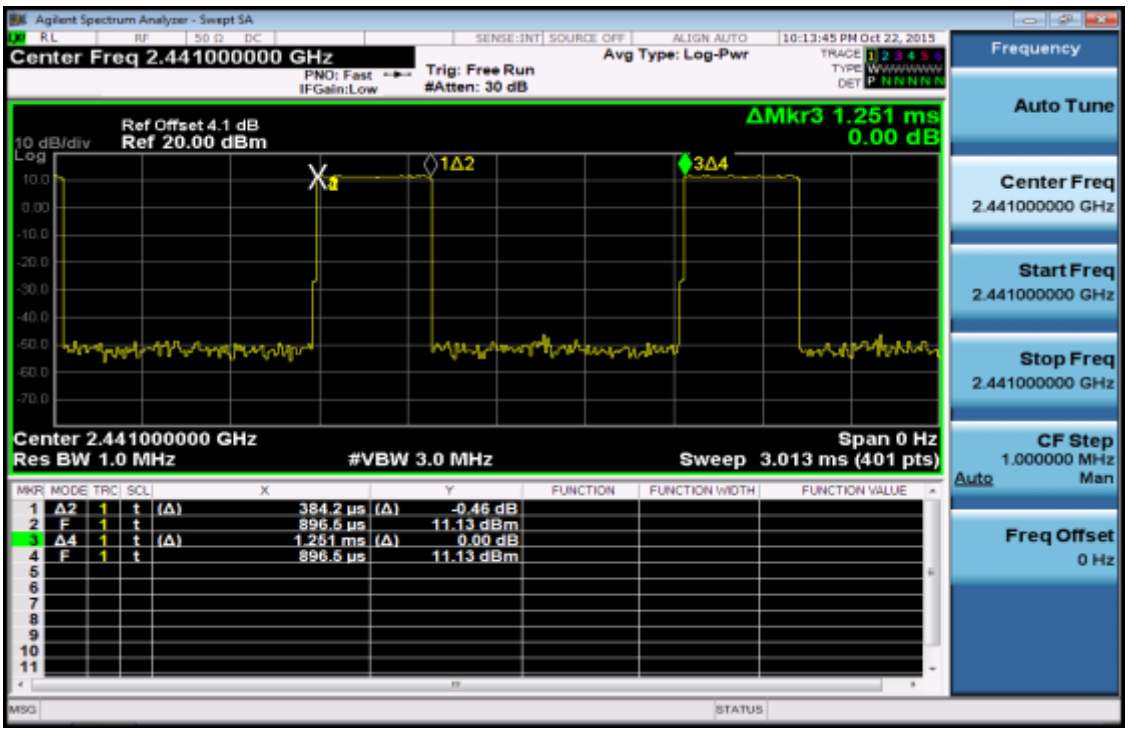
DH5



CH-Mid
DH1



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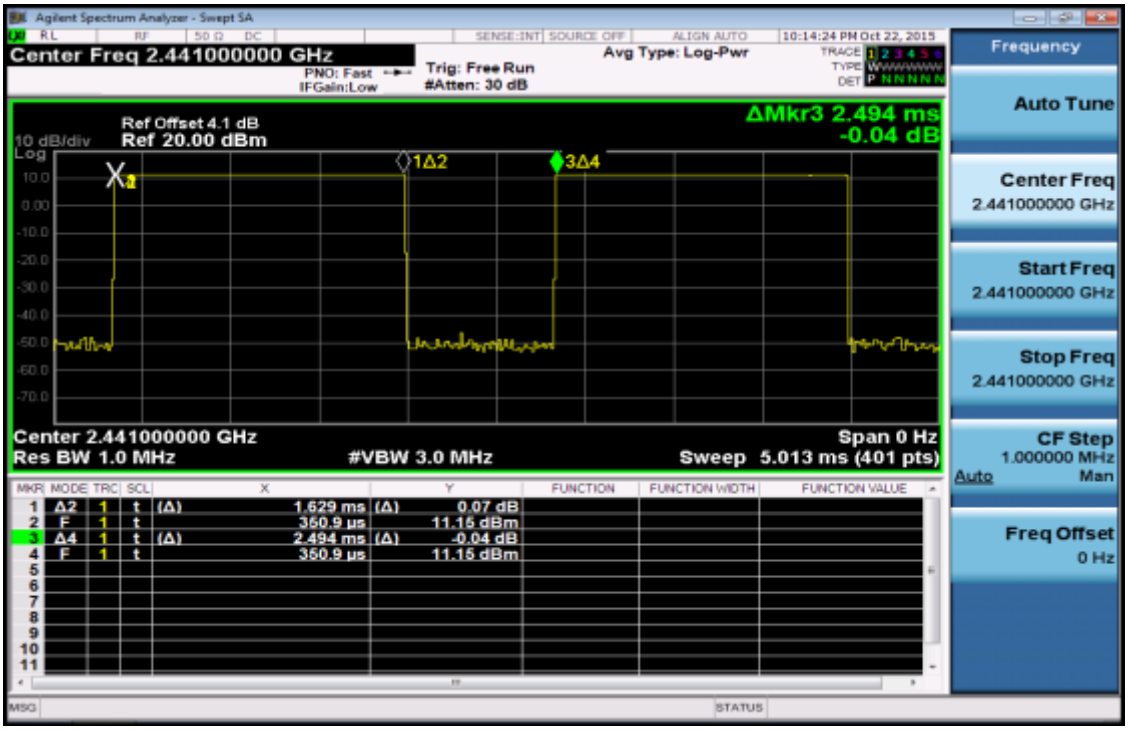
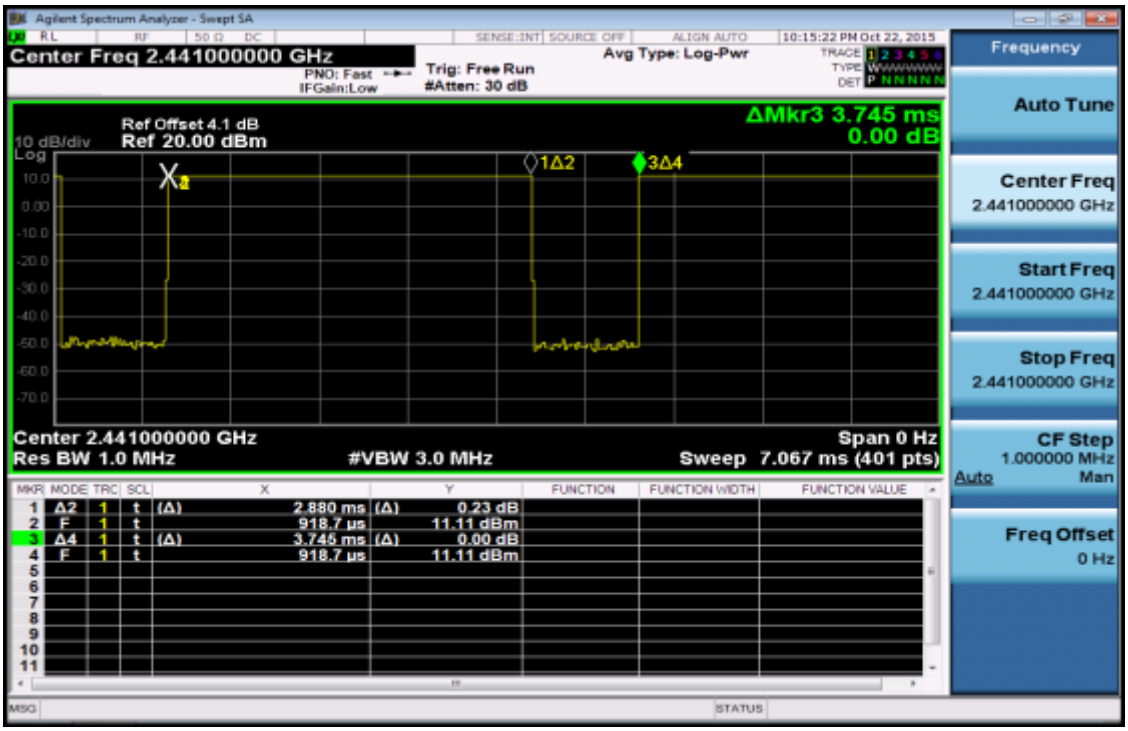
DH3



DH5



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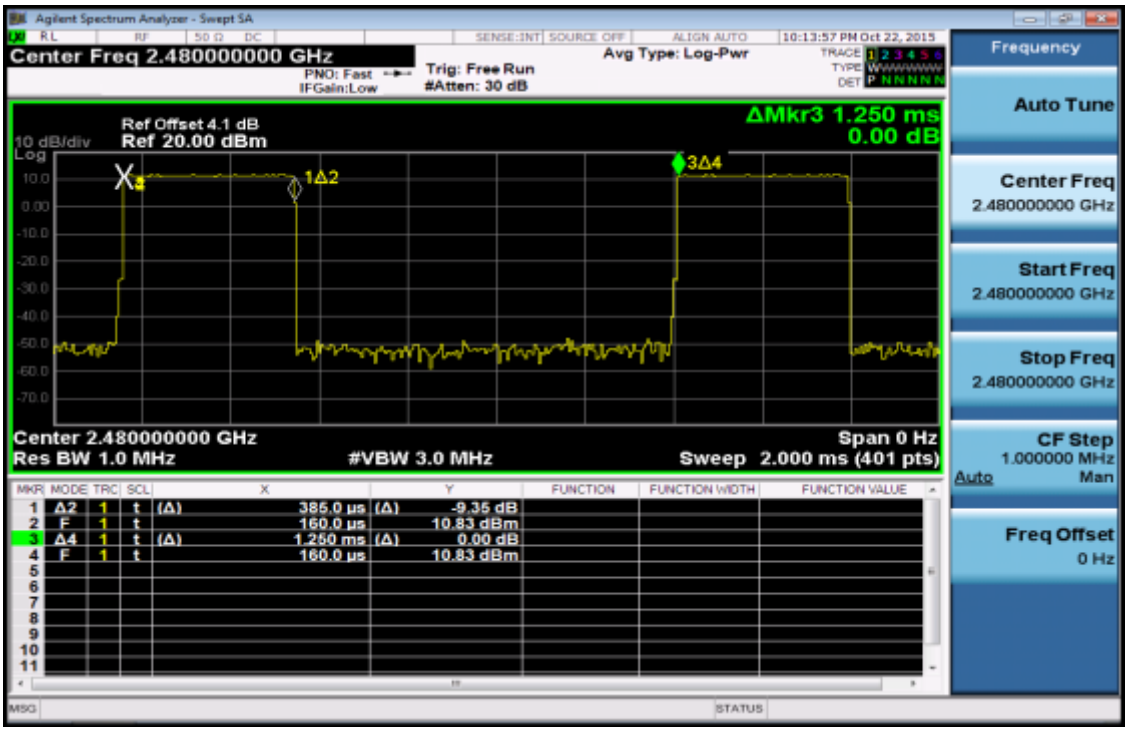
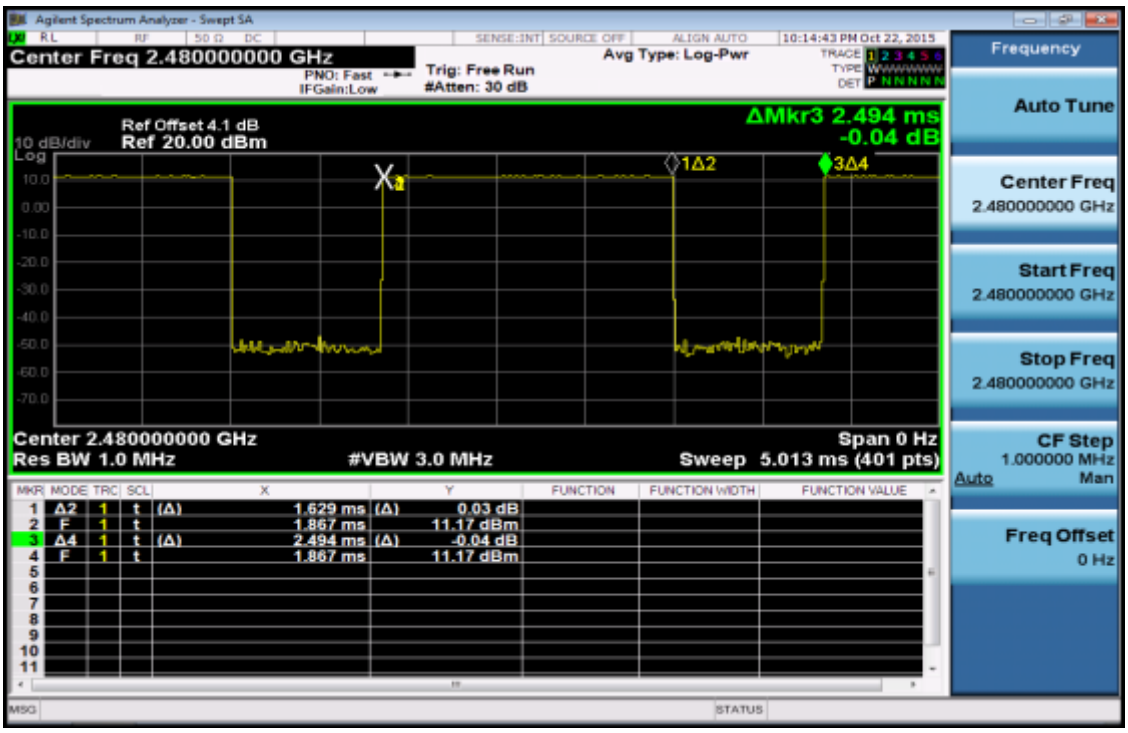
CH-High
DH1



DH3



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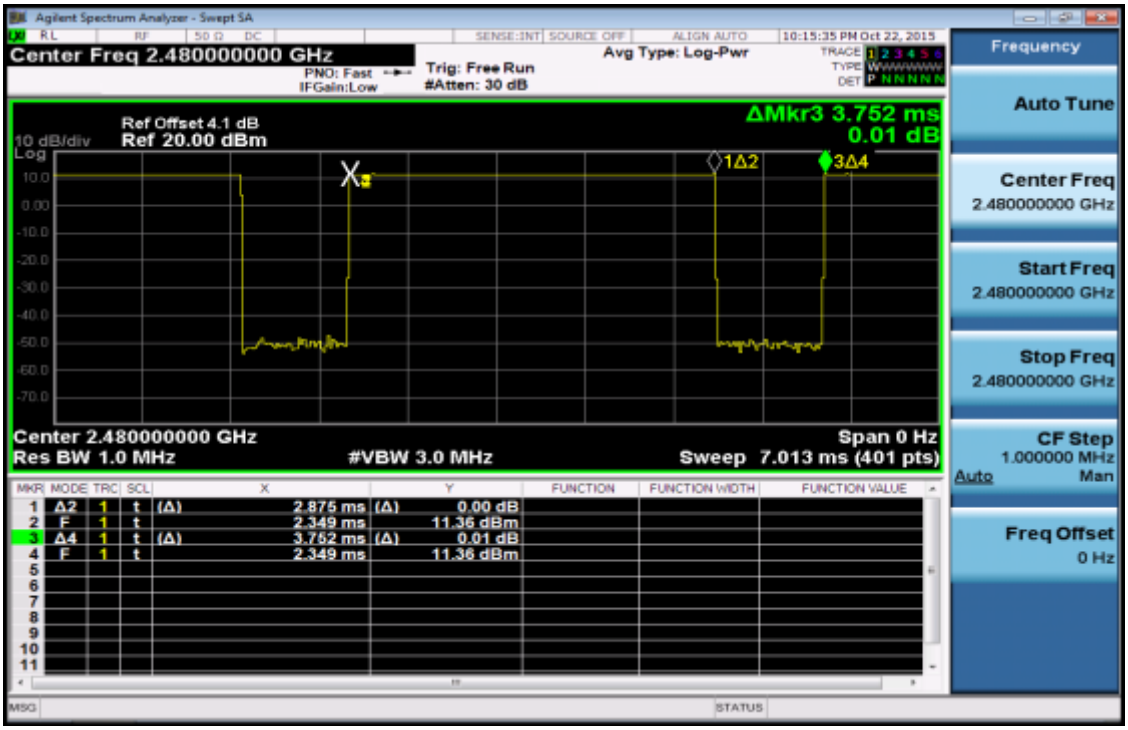
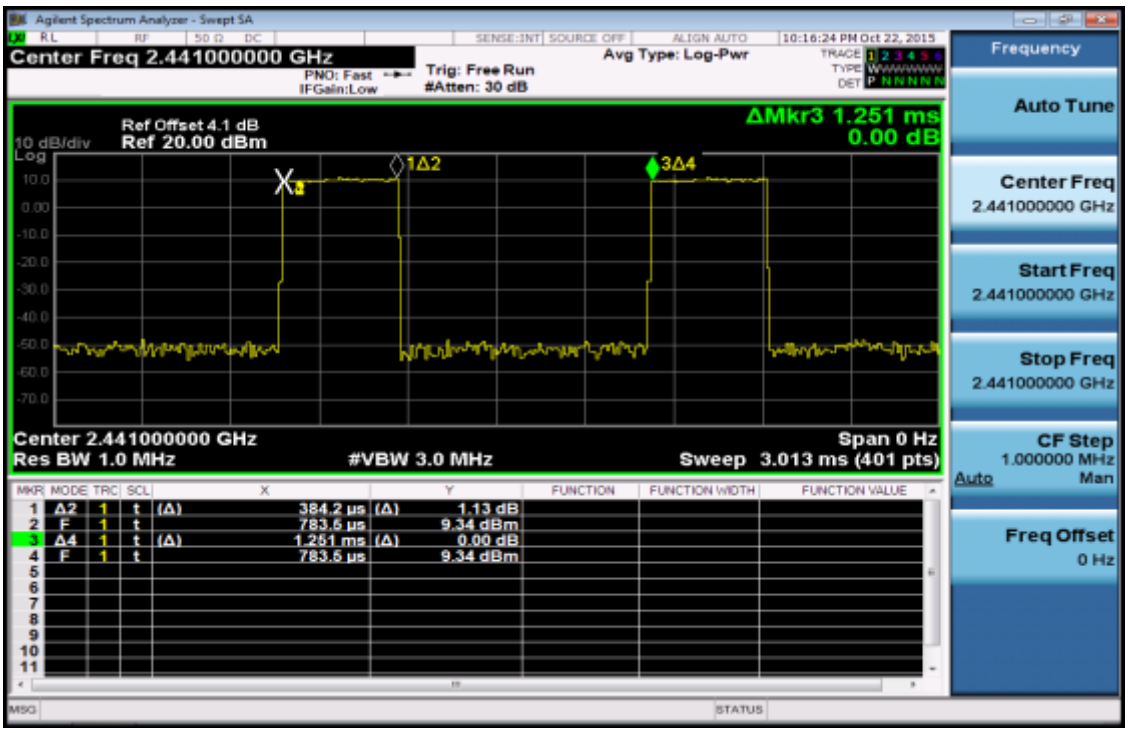
DH5



CH-Mid
2DH1



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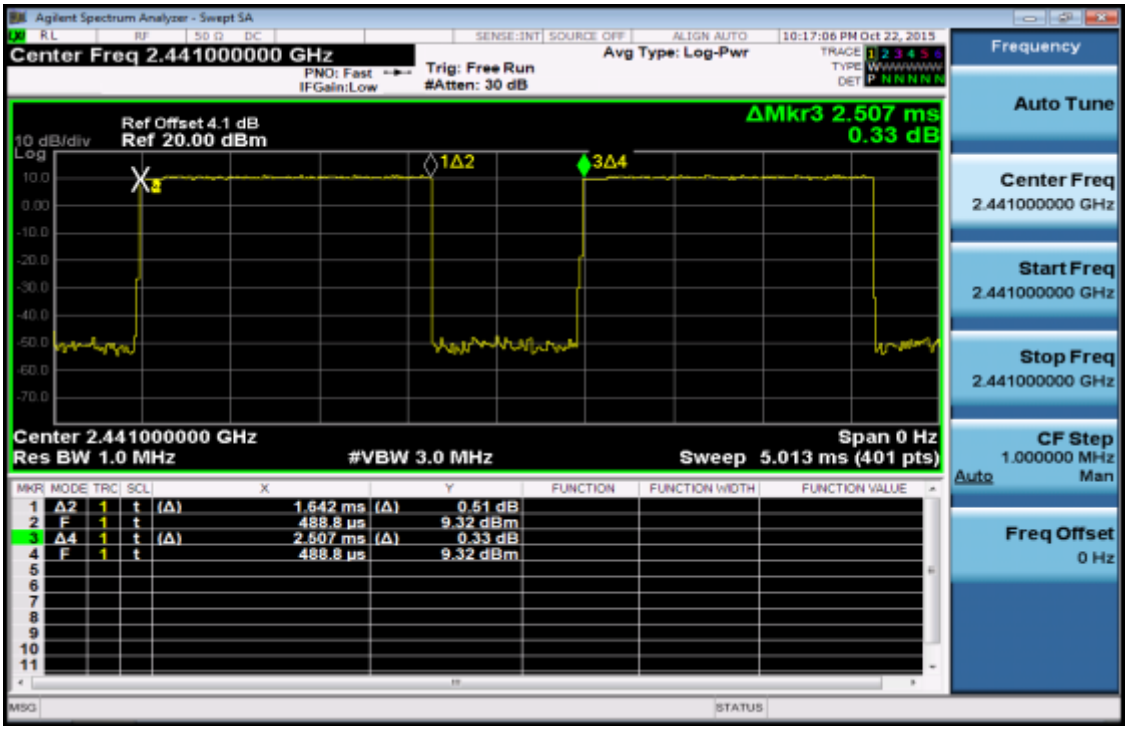
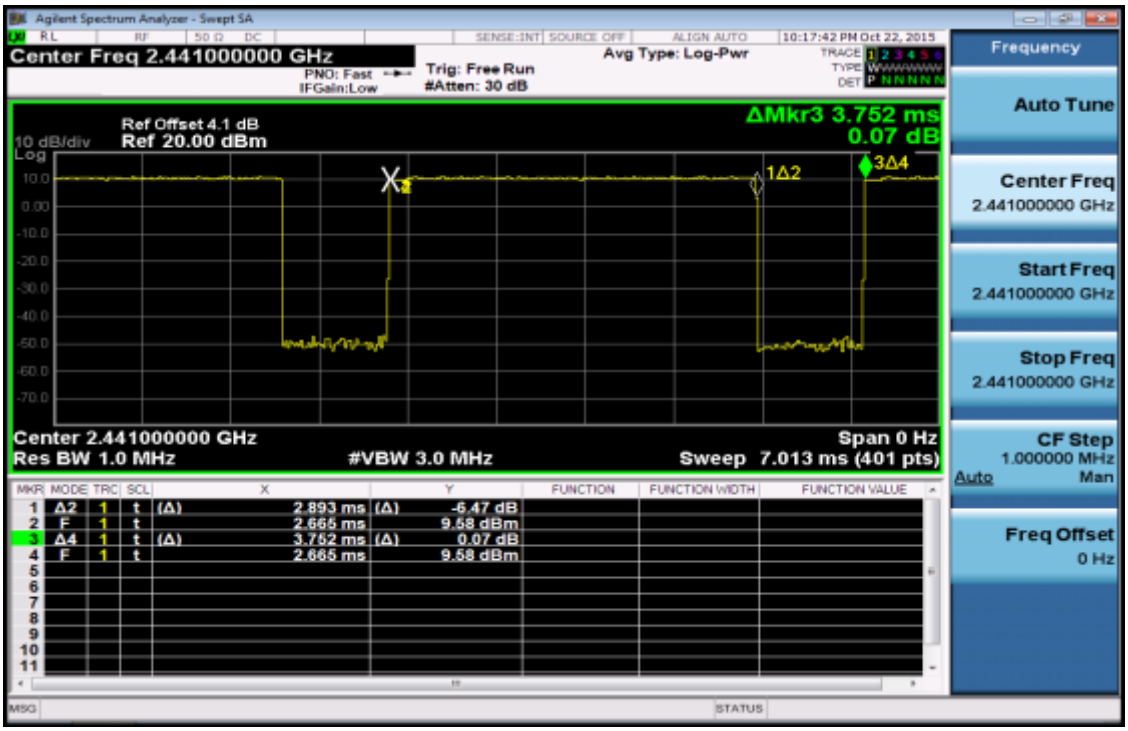
2DH3



2DH5



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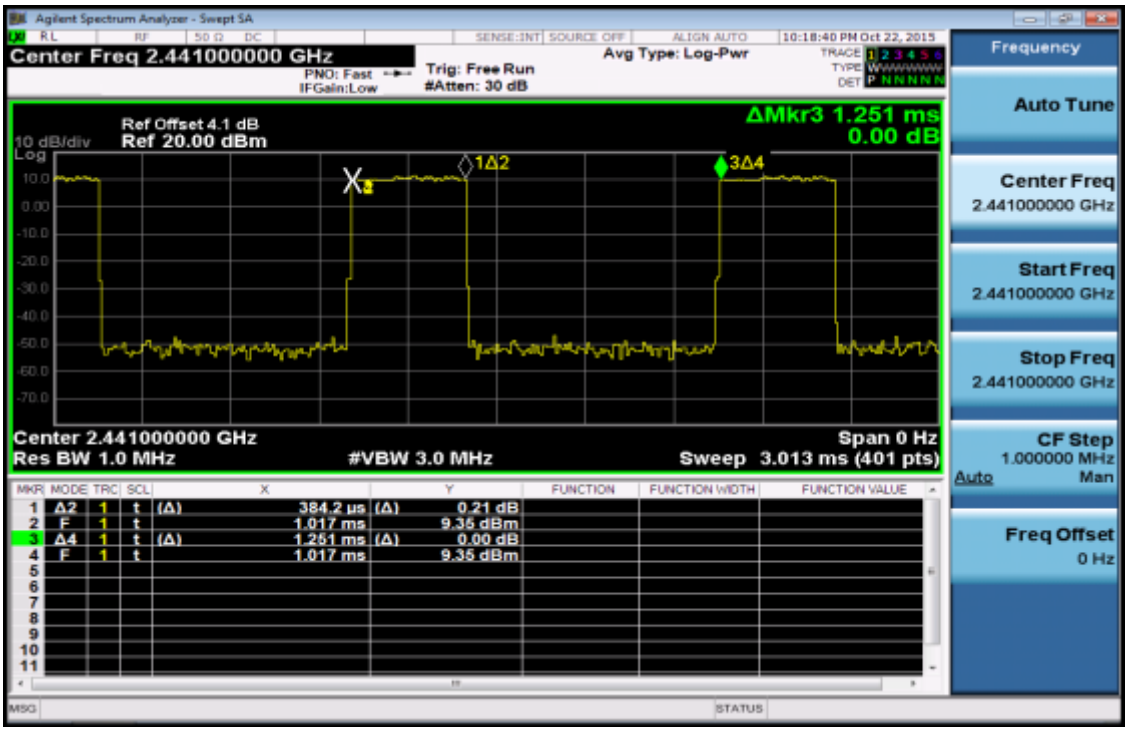
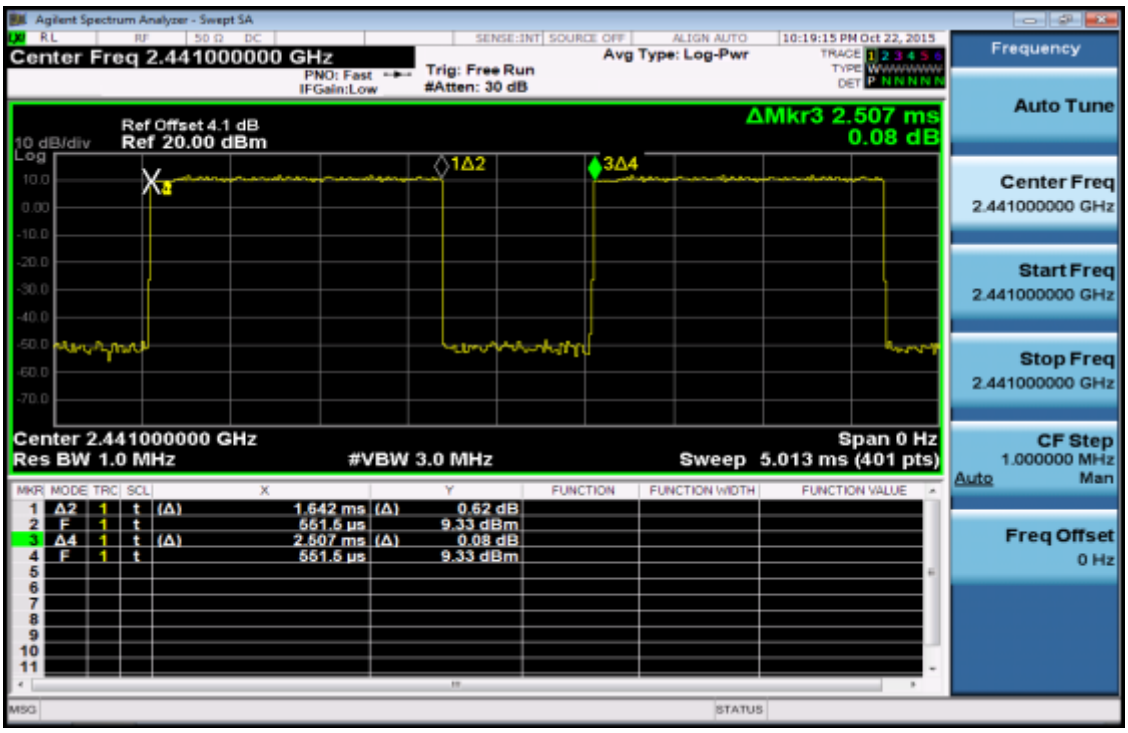
CH-Mid

3DH1



3DH3



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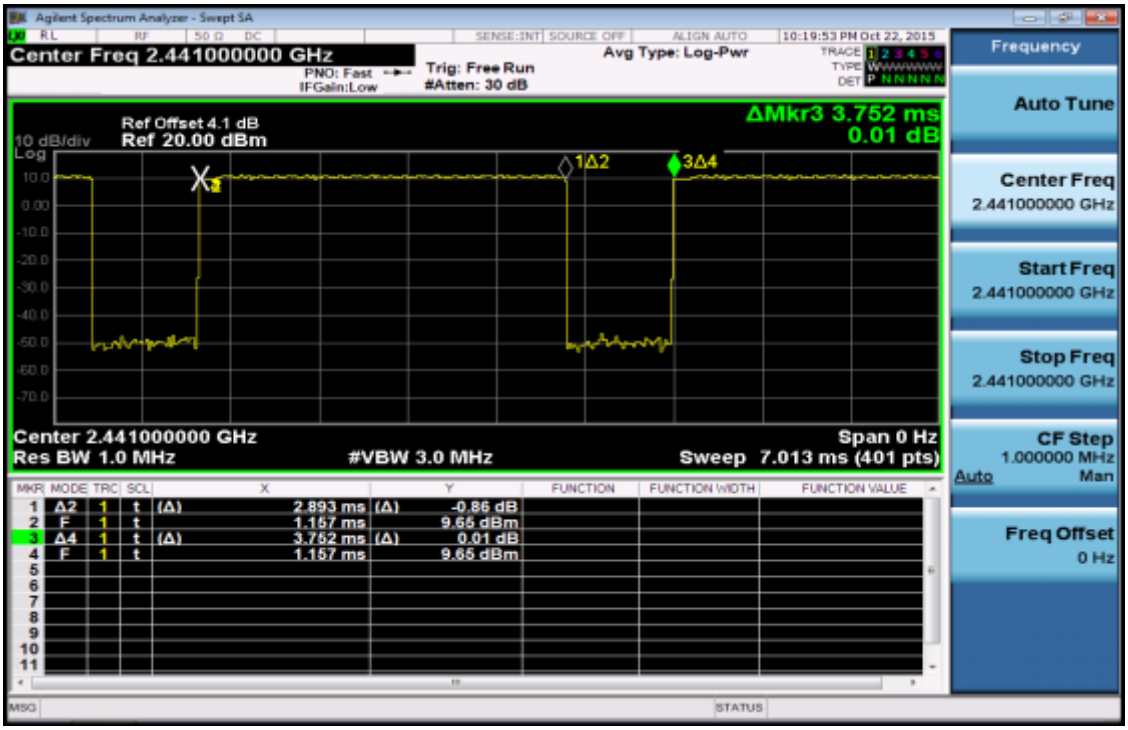
3DH5



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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.

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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