ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

Product Name:	**Diagnostic Ultrasound System**
Brand Name:	**Qisda**
Model No.:	**UH100**
Model Difference:	**N/A**
FCC ID:	**VRSUH100I**
Report No.:	**ER/2015/80174**
Issue Date:	**Oct. 05, 2015**
FCC Rule Part:	**§15.247, Cat: DSS**
Prepared for:	**QISDA CORPORATION** **NO.157, SHAN-YING ROAD, SHAN-TING LI, GUEISHAN DIST., TAOYUAN CITY 333, 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:	QISDA CORPORATION NO.157, SHAN-YING ROAD, SHAN-TING LI, GUEISHAN DIST., TAOYUAN CITY 333, TAIWAN, R.O.C.
Product Name:	Diagnostic Ultrasound System
Brand Name:	Qisda
Model No.:	UH100
Model Difference:	N/A
FCC ID:	VRSUH100I
Report Number:	ER/2015/80174
Date of test:	Aug. 28, 2015 ~ Oct. 02, 2015
Date of EUT Received:	Aug. 28, 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:	Aken Huang	***Date:***	Oct. 05, 2015
	Aken Huang / Engineer		
Prepared By:	Tiffany Kao	***Date:***	Oct. 05, 2015
	Tiffany Kao / Clerk		
Approved By:	Jim Chang	***Date:***	Oct. 05, 2015
	Jim Chang / Asst. Manager		

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Revision History

Report Number	Revision	Description	Issue Date
ER/2015/80174	Rev.00	Initial creation of document	Oct. 05, 2015

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1. GENERAL INFORMATION

1.1. Product description

General:

Product Name:	Diagnostic Ultrasound System	
Brand Name:	Qisda	
Model No.:	UH100	
Model Difference:	N/A	
Transducer:	1. Model No.: C52A, Supplier: Qisda Corporation 2. Model No.: L115A, Supplier: Qisda Corporation 3. Model No.: P42A, Supplier: Qisda Corporation 4. Model No.: E94A, Supplier: Qisda Corporation	
Product SW/HW version:	N/A/ N/A	
Radio SW/HW version:	N/A / N/A	
Test SW Version:	N/A	
RF power setting in TEST SW:	N/A	
Power Supply:	10.8Vdc form Rechargeable Li-ion Battery or 19V from AC/DC Adapter	
	Battery:	Model No.: QIC3000, Supplier: T-GEE Electronic Co., Ltd.
	Adapter:	Model No.: ATM065-P190, Supplier: Adapter Technology Co., Ltd.

Bluetooth_BR+EDR:

Bluetooth Version:	V4.0 dual mode+EDR
Channel number:	79 channels
Modulation type:	Frequency Hopping Spread Spectrum
Transmit Power:	8.24dBm
Frequency Range:	2.402GHz – 2.480GHz
Dwell Time:	<= 0.4s
Antenna Designation:	PIFA Antenna, Antenna Gain: 2.70dBi

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1.2. Product Feature of Equipment Under Test

The equipment under Test (Here after Called: EUT) is supporting Bluetooth, WLAN and GPS features, and below is details of information.

Product Feature	
Product Name:	Diagnostic Ultrasound System
Brand Name:	Qisda
Model No.:	UH100
Model Difference:	N/A
FCC ID:	VRSUH100I
Wi-Fi Specification	802.11 a/b/g/n
Bluetooth Version	V4.0 dual mode
Receiver:	GPS

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. (TAF code 0513)

FCC Registration Numbers are: 628985

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 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.

2.3.2 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 1.2dB and splitter 3.2dB splitter. Offset = RF cable loss (dB)+ splitter(dB) =1.2 + 3.24 = 4.4(dB)

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2.5. Configuration of Tested System

Fig. 2-1 Radiated, Conducted (Antenna Port) Emission

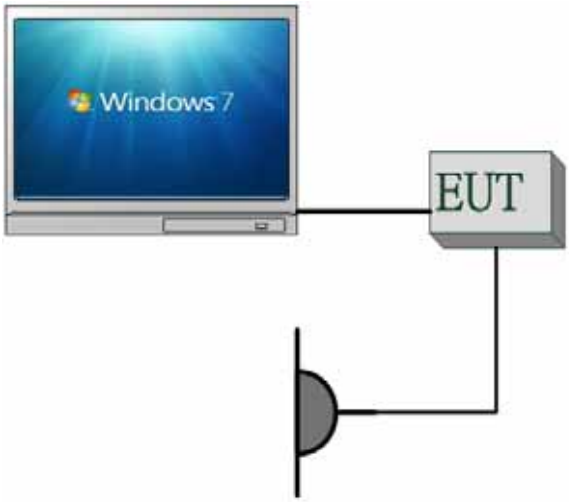

Fig. 2-2 AC Power Line Conducted Emission

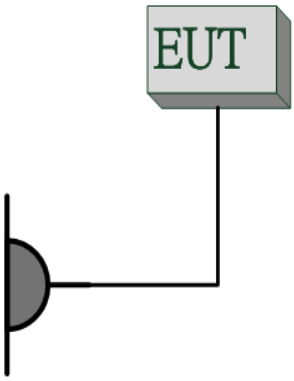

Table 2-1 Equipment Used in Tested System

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.	Notebook	Lenovo	L412	LR-027LM	N/A	N/A

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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 E2 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
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	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 : **Vertical**)	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**)	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	12/12/2014	12/11/2015
Coaxial Cables	N/A	N30N30-1042-150cm	N/A	01/06/2015	01/07/2016
LISN	Schwarzbeck	NSLK 8127	8127-648	06/09/2015	06/08/2016
LISN	Rolf-Heine	NNB-2/16Z	99012	03/04/2015	03/03/2016
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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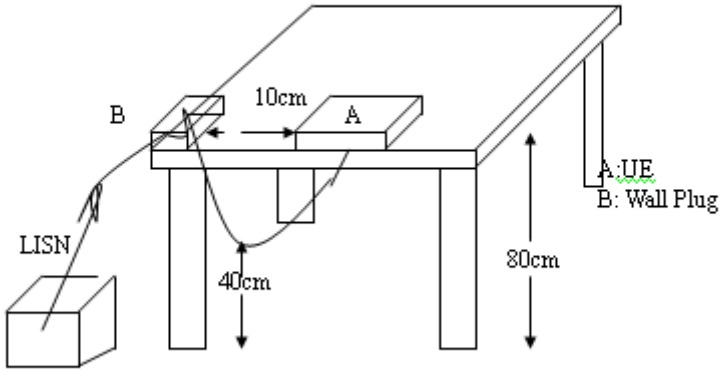
6.4. Test SET-UP (Block Diagram of Configuration)



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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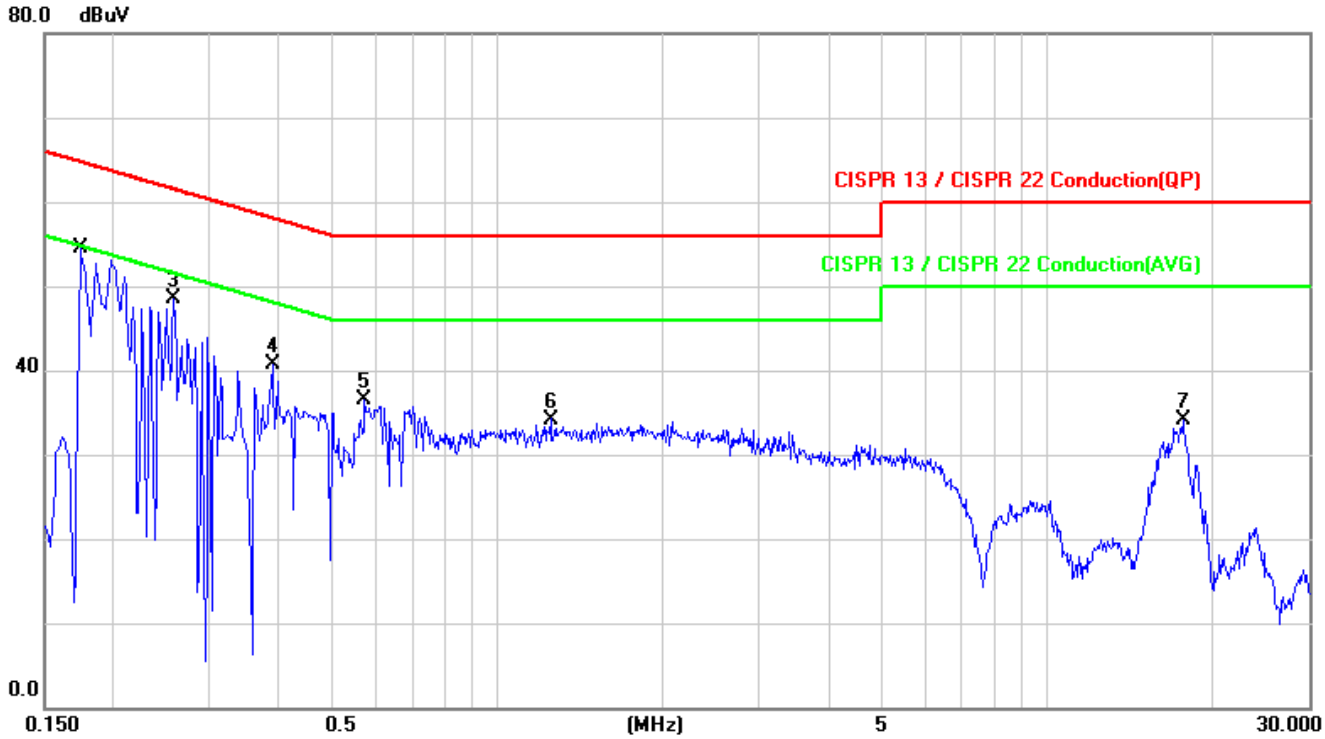
AC POWER LINE CONDUCTED EMISSION TEST DATA

Operation Mode:	Operation mode			Test Date:	Sep. 24, 2015
Temperature:	26 ℃	Humidity:	54 %	Test By:	Vito
				Phase:	L1 / N



No.	Mk.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Comment
		(MHz)	dBuV	(dB)	(dBuV)	(dBuV)	(dB)		
1		0.1740	47.80	0.08	47.88	64.77	-16.89	QP	
2		0.1740	19.10	0.08	19.18	54.77	-35.59	AVG	
3	*	0.2580	48.34	0.10	48.44	61.50	-13.06	peak	
4		0.3900	40.58	0.16	40.74	58.06	-17.32	peak	
5		0.5740	36.28	0.25	36.53	56.00	-19.47	peak	
6		1.2500	33.74	0.46	34.20	56.00	-21.80	peak	
7		17.6940	33.48	0.58	34.06	60.00	-25.94	peak	

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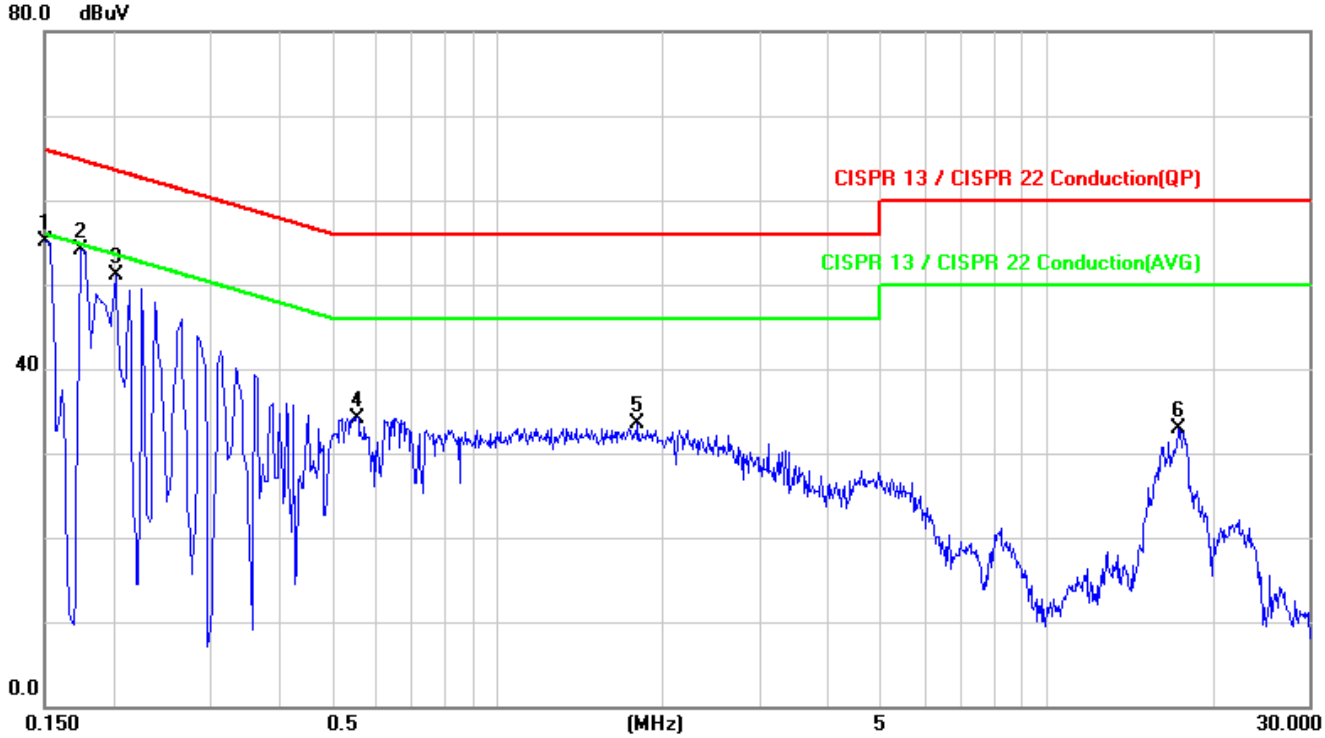

No.	Mk.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Comment
		(MHz)	dBuV	(dB)	(dBuV)	(dBuV)	(dB)		
1		0.1500	55.03	0.14	55.17	66.00	-10.83	peak	
2	*	0.1740	53.89	0.14	54.03	64.77	-10.74	peak	
3		0.2020	50.90	0.13	51.03	63.53	-12.50	peak	
4		0.5580	33.91	0.29	34.20	56.00	-21.80	peak	
5		1.8060	32.83	0.61	33.44	56.00	-22.56	peak	
6		17.3260	32.30	0.62	32.92	60.00	-27.08	peak	

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7. PEAK OUTPUT POWER MEASUREMENT

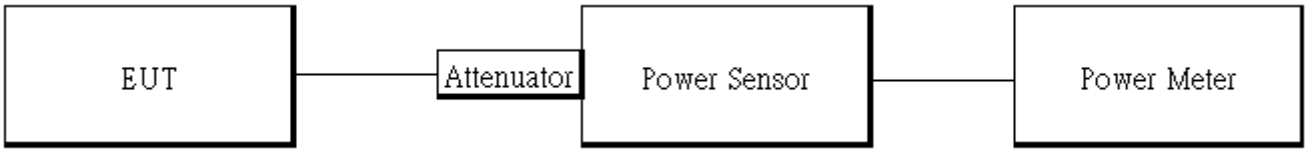
7.1. Standard Applicable

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.
Power Meter	Anritsu	ML2496A	1326001	06/23/2015	06/22/2016
Power Sensor	Anritsu	MA2411B	1315048	06/23/2015	06/22/2016
Spectrum Analyzer	Agilent	N9010A	MY53400256	10/15/2014	10/14/2015
DC Block	PASTERNACK	PE8210	RF29	12/19/2014	12/18/2015
Splitter	RF-LAMBAD	RFLT2W1G18G	RF35	12/19/2014	12/18/2015
Attenuator	WOKEN	218FS-10	RF23	12/19/2014	12/18/2015

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:

Channel	Frequency (MHz)	Output Power (dBm)	Output Power	Limit (mW)
0	2402.00	5.66	3.68129	1000
39	2441.00	5.27	3.36512	1000
78	2480.00	5.06	3.20627	1000

2M EDR mode:

Channel	Frequency (MHz)	Output Power (dBm)	Output Power	Limit (mW)
0	2402.00	7.91	6.18016	125
39	2441.00	7.54	5.67545	125
78	2480.00	7.32	5.39511	125

3M EDR mode:

Channel	Frequency (MHz)	Output Power (dBm)	Output Power	Limit (mW)
0	2402.00	**8.24**	6.66807	125
39	2441.00	7.85	6.09537	125
78	2480.00	7.66	5.83445	125

**Note: Measured by power meter, as cable loss+ Duty cycle factor that offsets on the power meter*

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8. 20dB BANDWIDTH MEASUREMENT

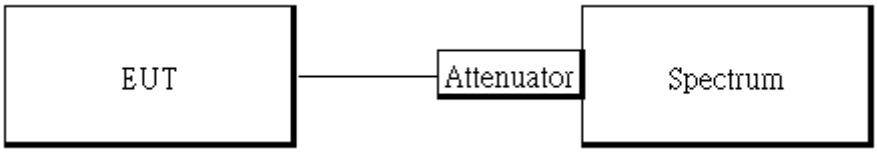
8.1. Standard Applicable

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.
Spectrum Analyzer	Agilent	N9010A	MY53400256	10/15/2014	10/14/2015
DC Block	PASTERNACK	PE8210	RF29	12/19/2014	12/18/2015
Splitter	RF-LAMBAD	RFLT2W1G18G	RF35	12/19/2014	12/18/2015
Attenuator	WOKEN	218FS-10	RF23	12/19/2014	12/18/2015

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

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)	20 dB Bandwidth (MHz)
0	2402	0.9237
39	2441	0.9261
78	2480	0.9256

π/4-DQPSK

Channel	Channel	20 dB Bandwidth (MHz)	2/3 Bandwidth
0	2402	1.32	0.88
39	2441	1.33	0.89
78	2480	1.32	0.88

8-DPSK

Channel	Channel	20 dB Bandwidth (MHz)	2/3 Bandwidth
0	2402	1.27	0.85
39	2441	1.27	0.85
78	2480	1.31	0.87

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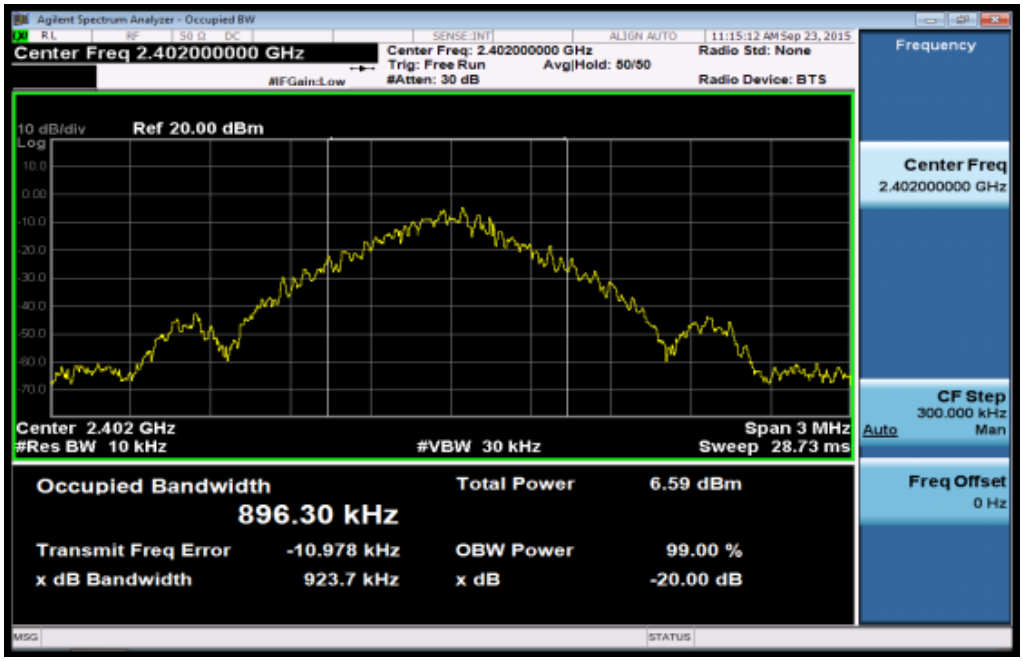
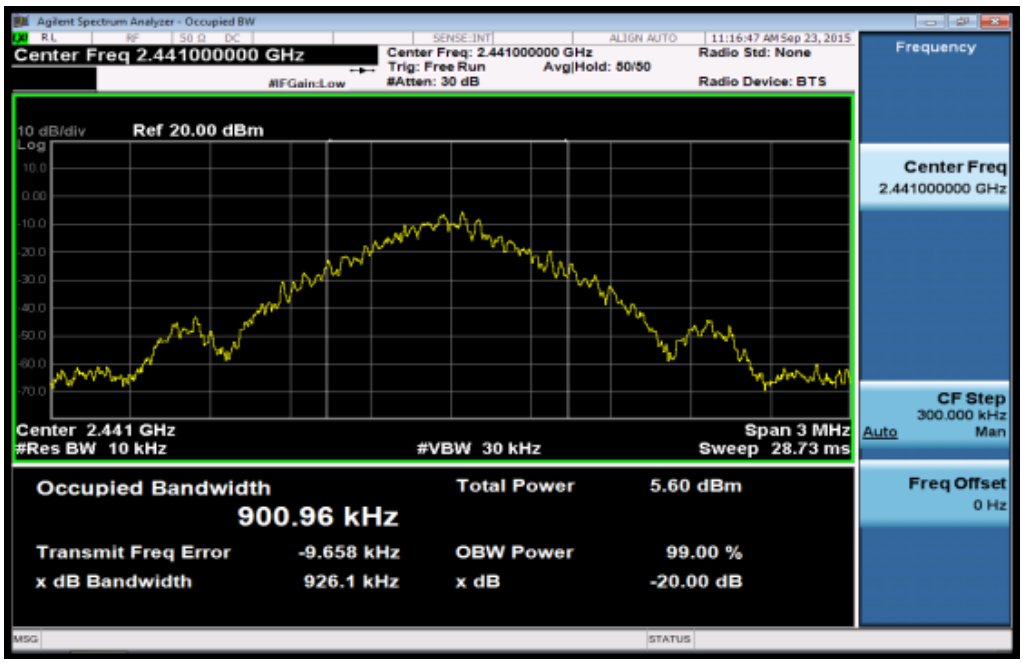
20dB Band Width Test Data CH-Low (GFSK mode)



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



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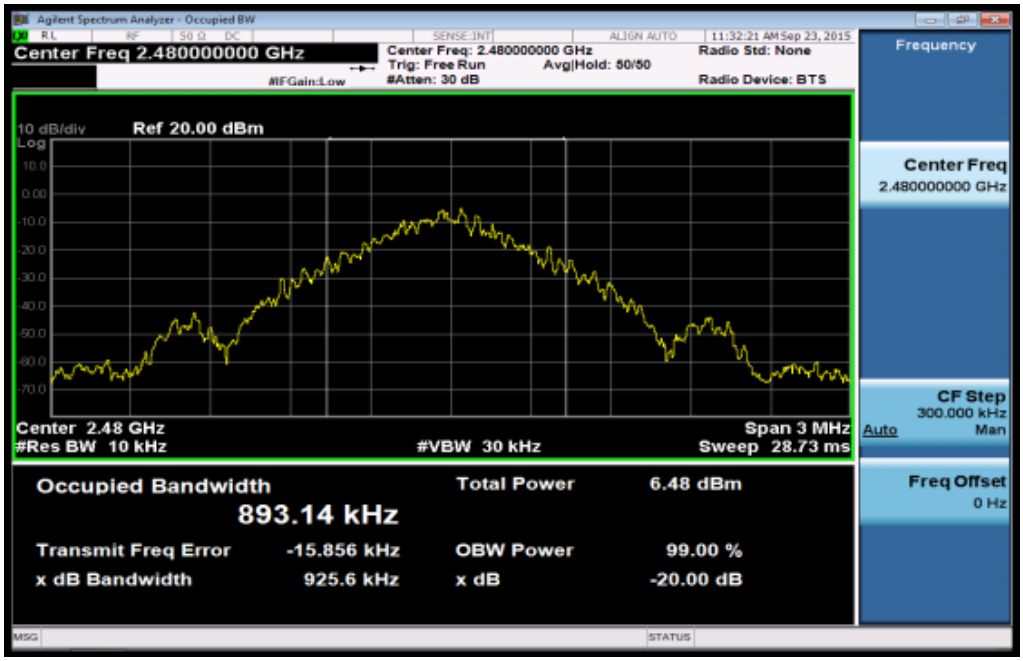
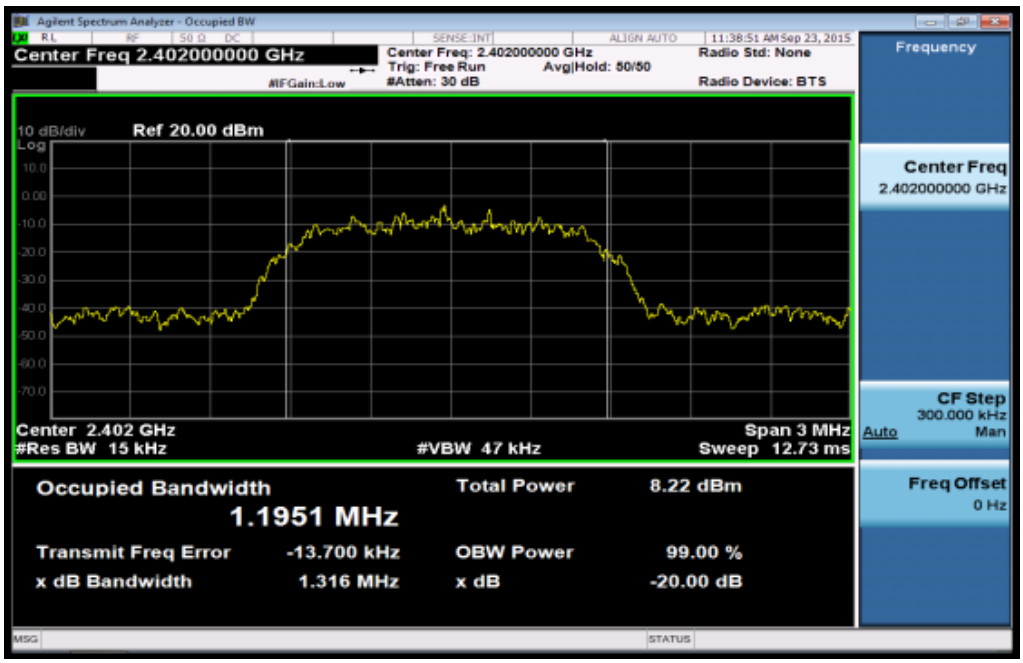
20dB Band Width Test Data CH-High (GFSK mode)



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



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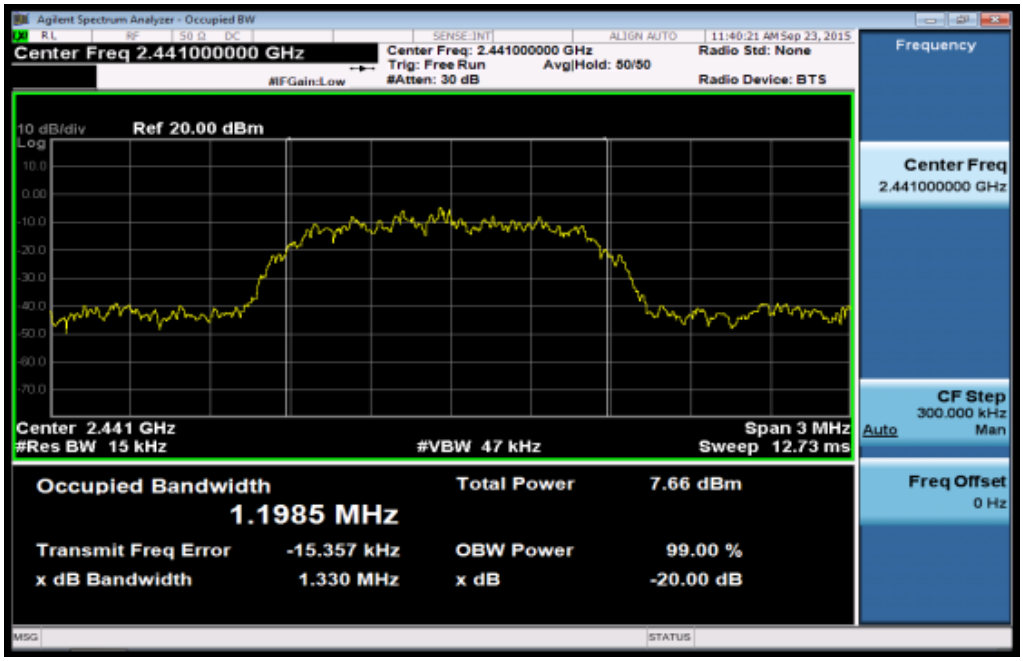
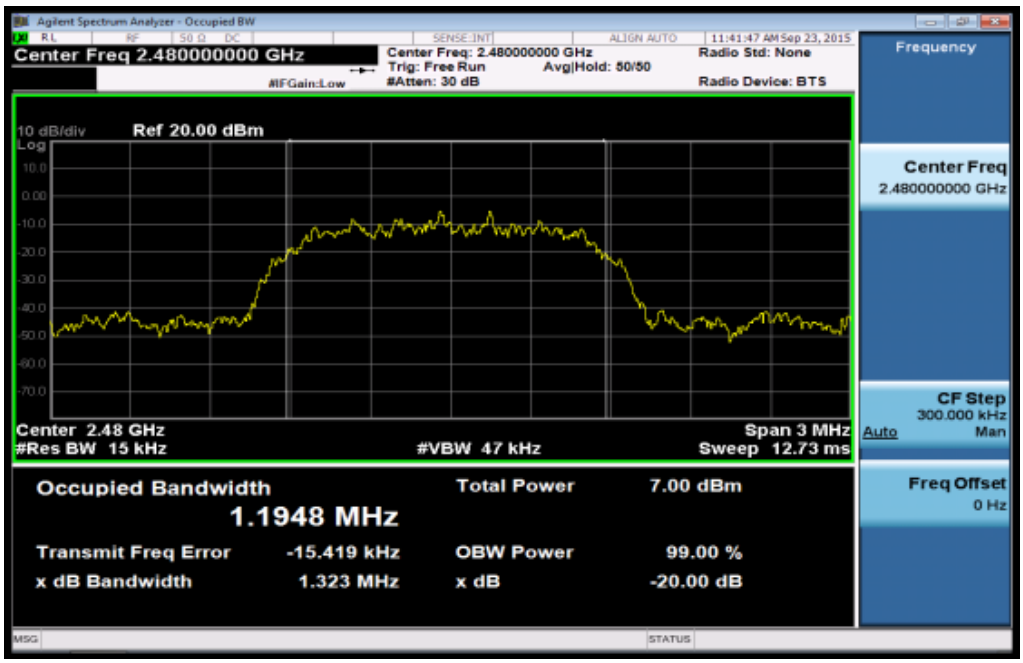
20dB Band Width Test Data CH-Mid (π/4-DQPSK mode)



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



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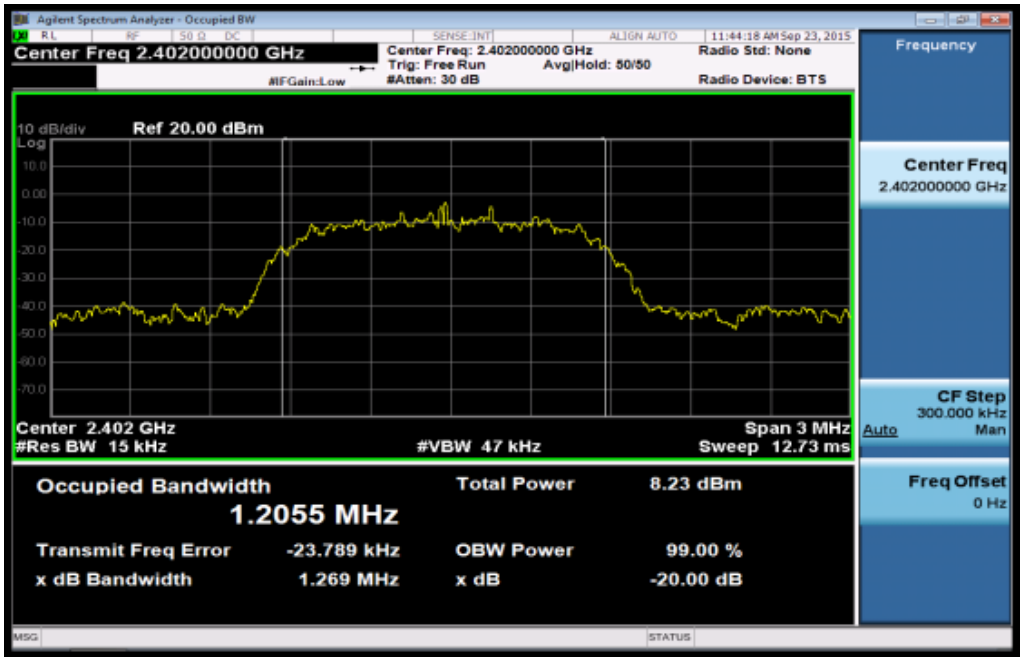
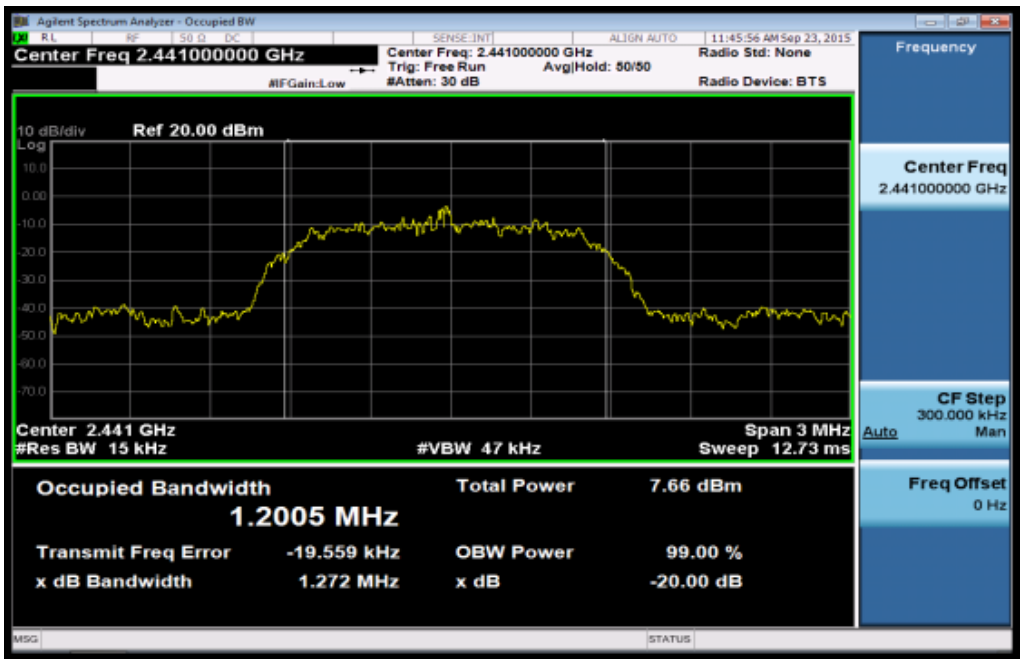
20dB Band Width Test Data CH-Low (8-DPSK mode)



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



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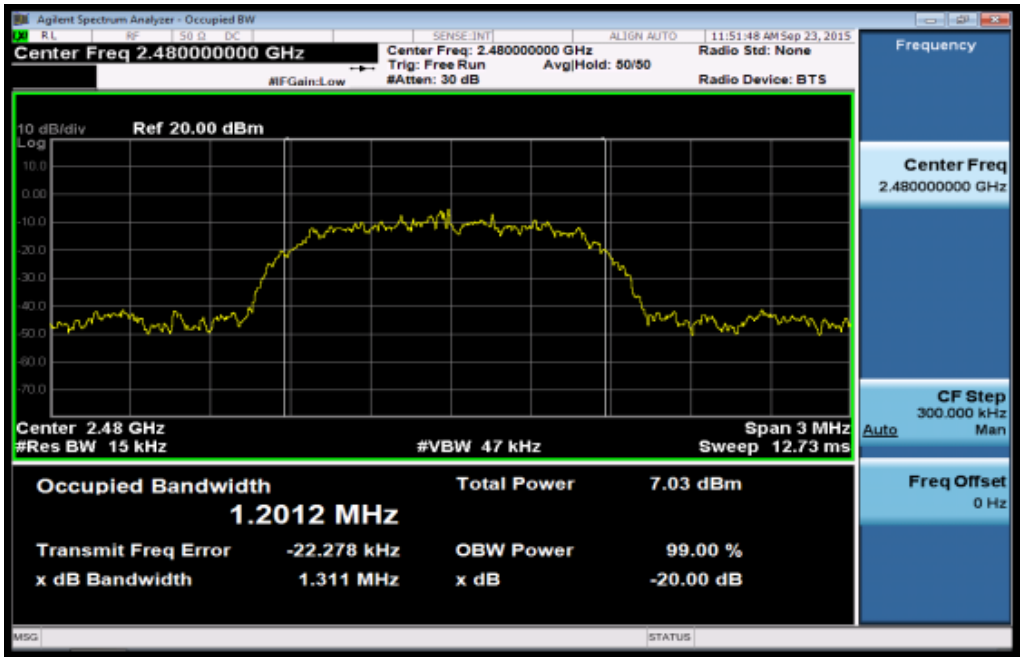
20dB Width Test Data CH-High (8-DPSK mode)



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9. CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

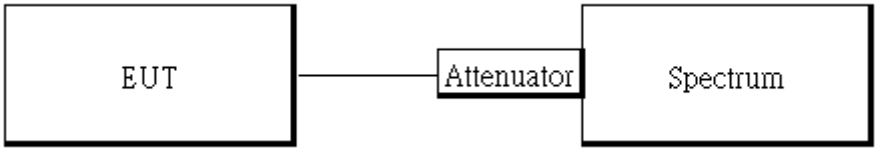
9.1. Standard Applicable

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.
Spectrum Analyzer	Agilent	N9010A	MY53400256	10/15/2014	10/14/2015
DC Block	PASTERNACK	PE8210	RF29	12/19/2014	12/18/2015
Splitter	RF-LAMBAD	RFLT2W1G18G	RF35	12/19/2014	12/18/2015
Attenuator	WOKEN	218FS-10	RF23	12/19/2014	12/18/2015

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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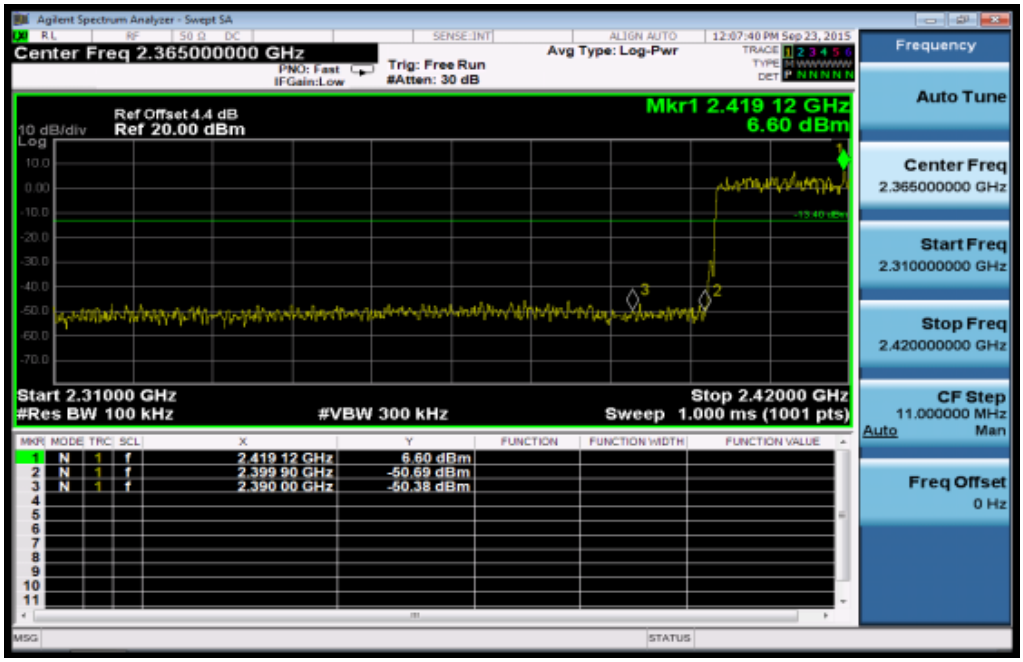
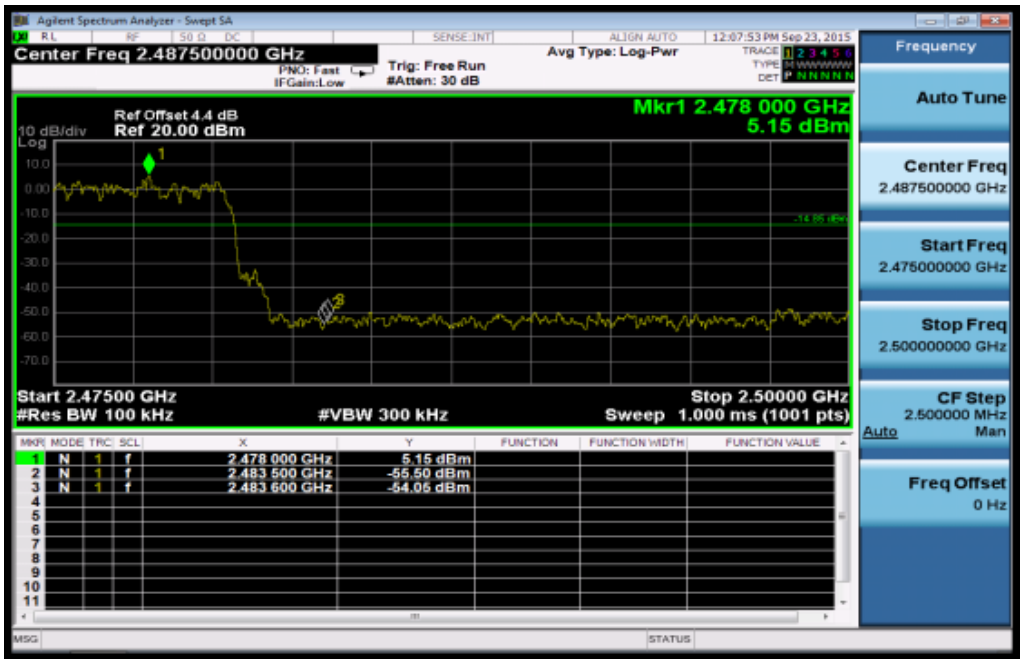
Band Edges Test Data CH-Low (Hopping mode)



Band Edges Test Data CH-High



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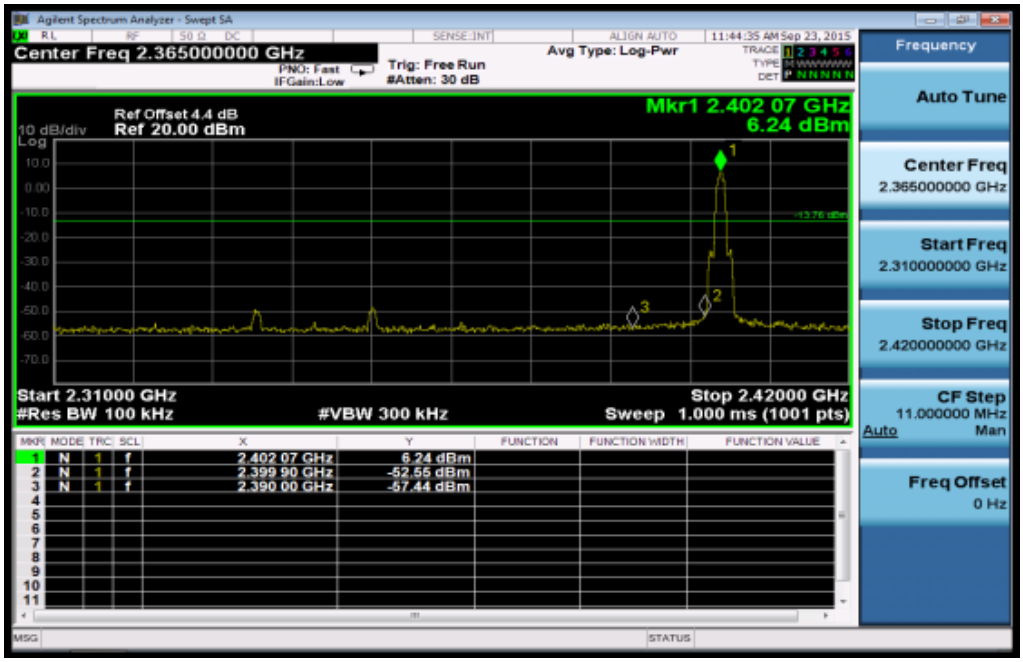
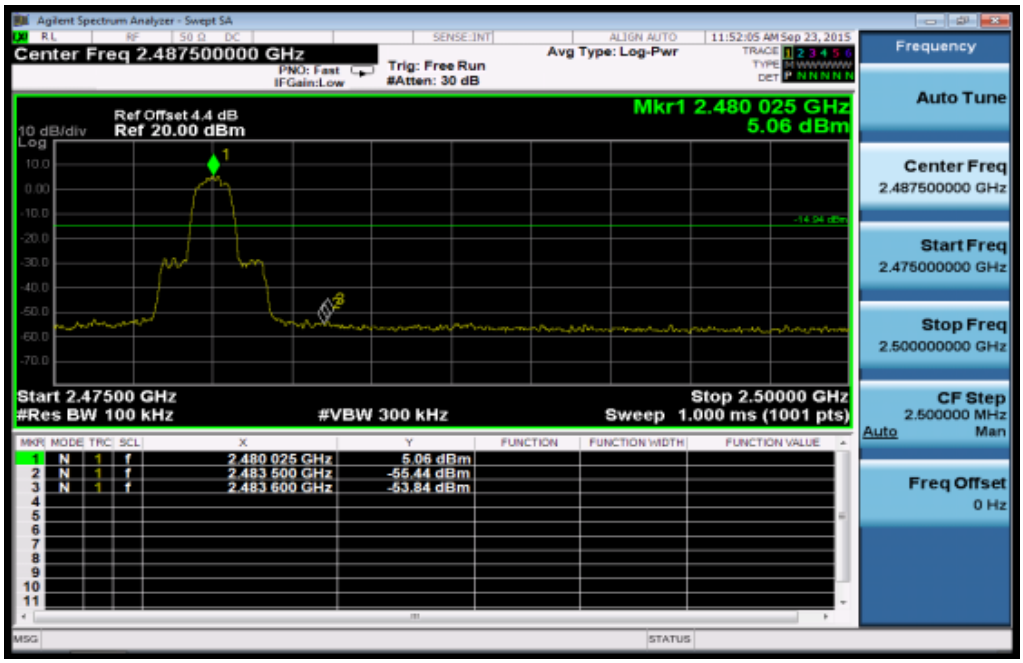
Band Edges Test Data CH-Low (Non-Hopping mode)



Band Edges Test Data CH-High



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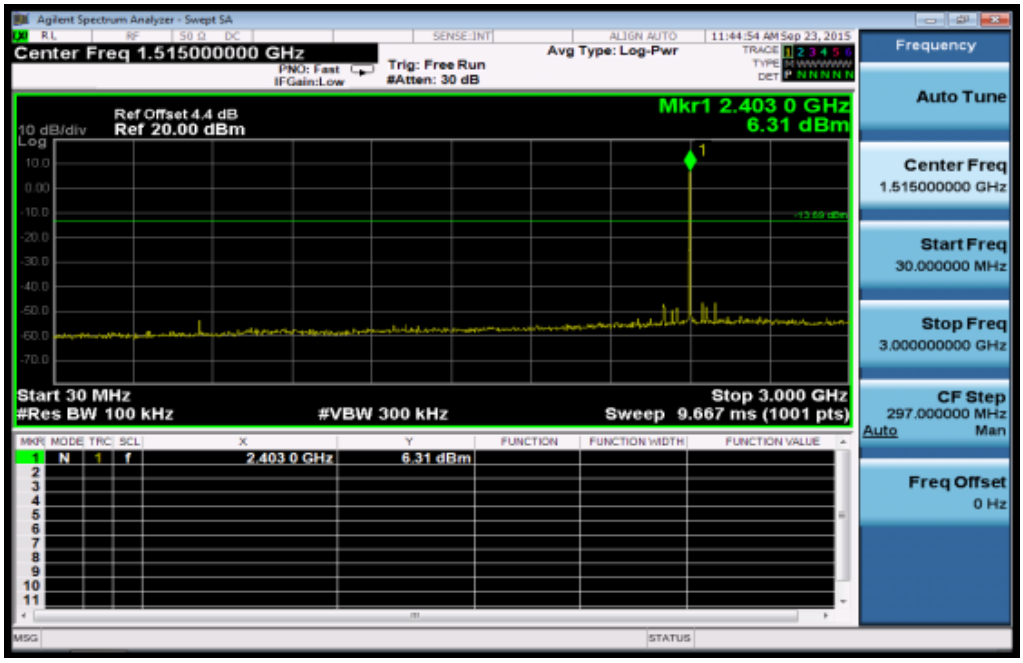
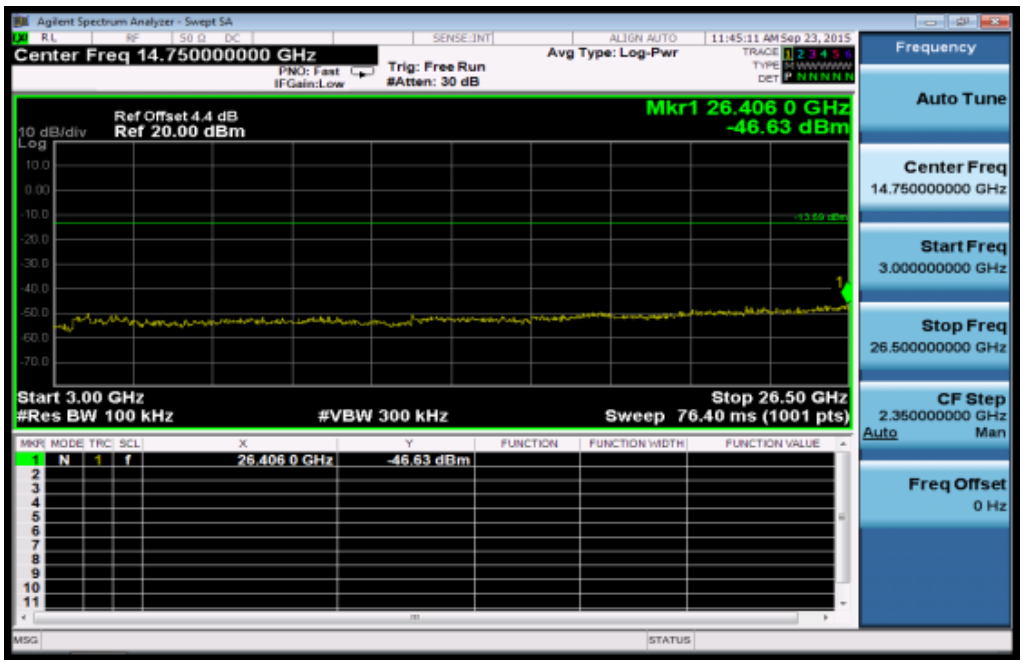
Conducted Spurious Emission Measurement Result

Ch Low 30MHz – 3GHz



Ch Low 3GHz – 26.5GHz



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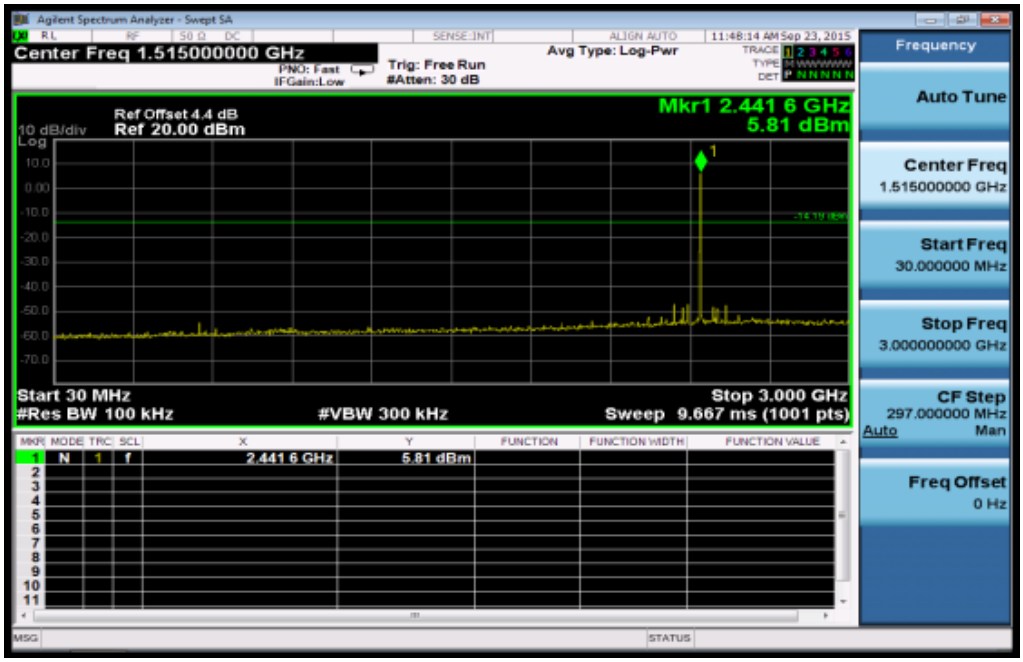
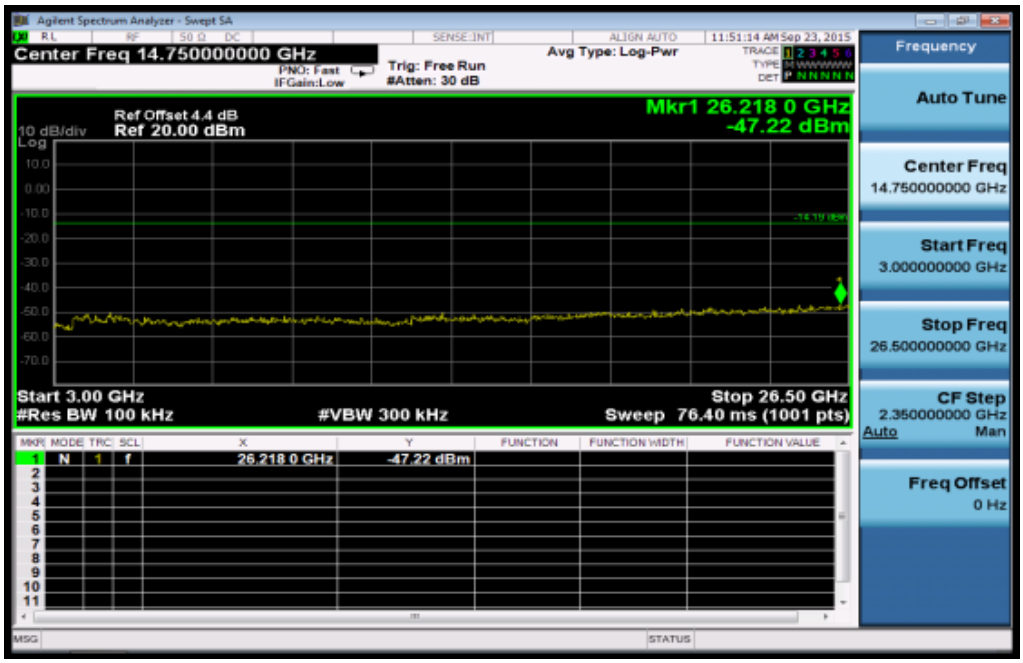
Ch Mid 30MHz – 3GHz



Ch Mid 3GHz – 26.5GHz



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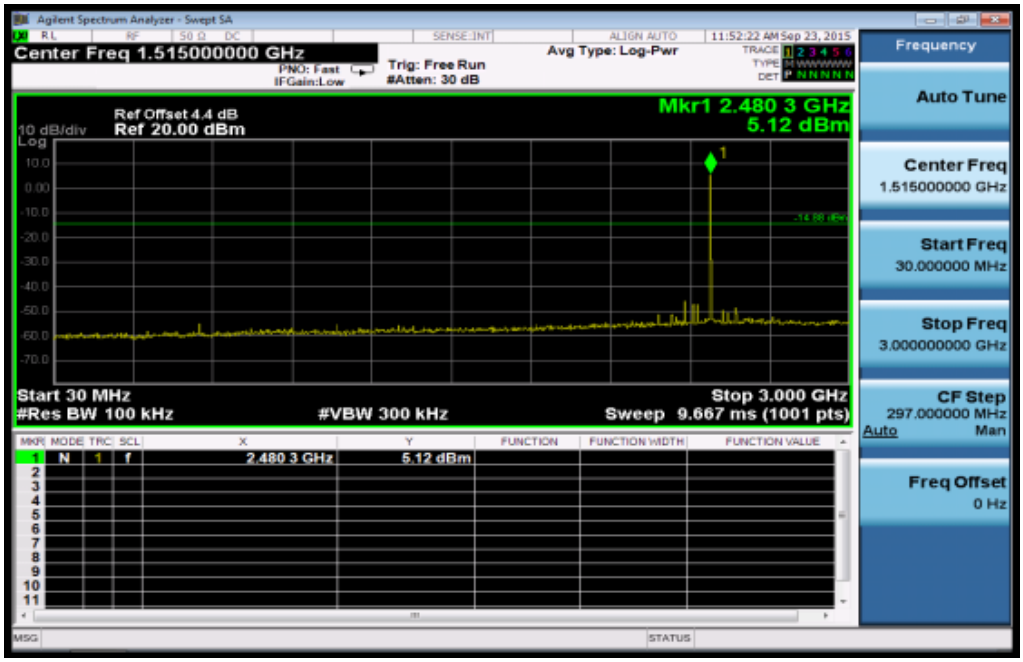
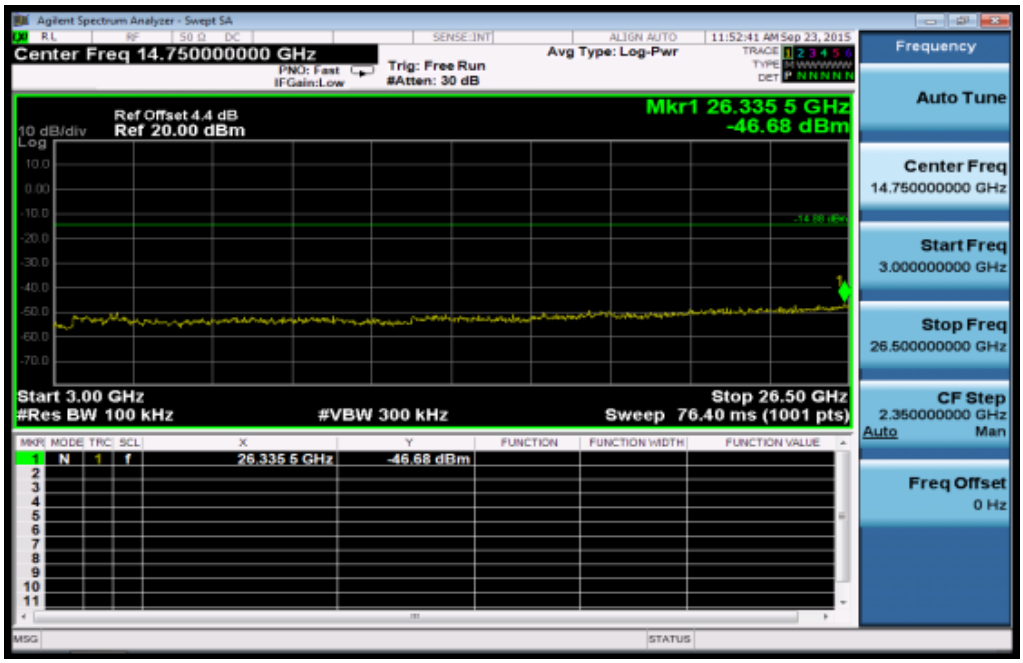
Ch High 30MHz – 3GHz



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	04/09/2015	04/08/2016
Loop Antenna	ETS-Lindgren	6502	00143303	12/09/2014	12/08/2015
Broadband Antenna	TESEQ	CBL 6112D	35240	12/05/2014	12/04/2015
Horn Antenna	ETS-Lindgren	3117	00143272	12/08/2014	12/07/2015
Horn Antenna	ETS-Lindgren	3160-09	00117911	11/13/2014	11/12/2015
Horn Antenna	ETS-Lindgren	3160-10	00117783	11/13/2014	11/12/2015
Pre Amplifier	EMC Instruments	EMC330	980096	12/19/2014	12/18/2015
Pre Amplifier	EMC Instruments	EMC0011830	980199	12/19/2014	12/18/2015
Pre Amplifier	R&S	SCU-18	10204	12/19/2014	12/18/2015
Pre Amplifier	R&S	SCU-26	100780	12/19/2014	12/18/2015
Coaxial Cable	Huber+Suhner	RG 214/U	966Rx 9K-30M	12/19/2014	12/18/2015
Coaxial Cable	Huber+Suhner	RG 214/U SUCOFLEX 104	966Rx 30M-3G	12/19/2014	12/18/2015
Coaxial Cable	Huber+Suhner	SUCOFLEX 104	966Rx 1G-18G	12/19/2014	12/18/2015
Coaxial Cable	Huber+Suhner	mini 141-12 SUCOFLEX 104	966Rx 18G-40G	12/19/2014	12/18/2015
Coaxial Cable	Huber+Suhner	SUCOFLEX 104	966Tx 30M-18G	12/19/2014	12/18/2015
Coaxial Cable	Huber+Suhner	SUCOFLEX 102	966Tx 18G-40G	12/19/2014	12/18/2015
Attenuator	WOKEN	218FS-10	RF27	12/19/2014	12/18/2015
Site NSA	SGS	966 Chamber C	SAC-C	03/04/2015	03/03/2016
Site VSWR	SGS	966 Chamber C	SAC-C	03/04/2015	03/03/2016
DC Power Supply	HOLA	DP-3003	D7070035	05/04/2015	05/03/2016
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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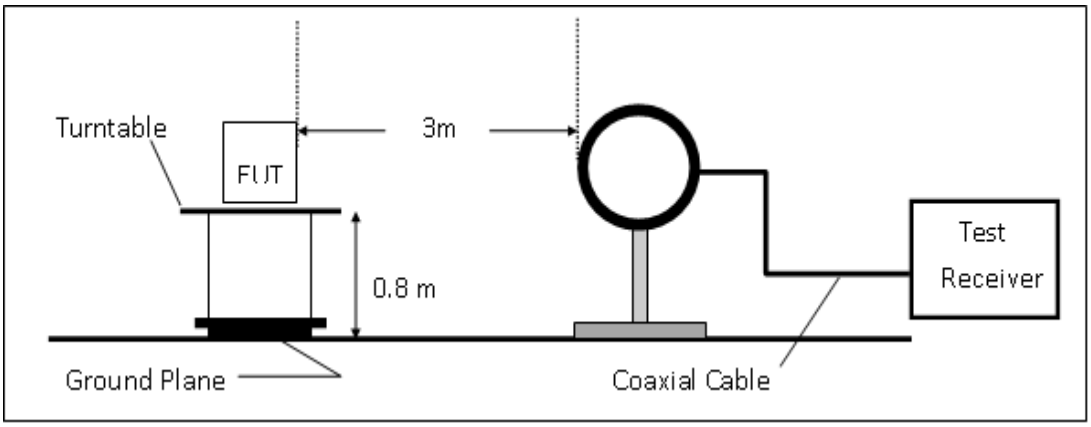
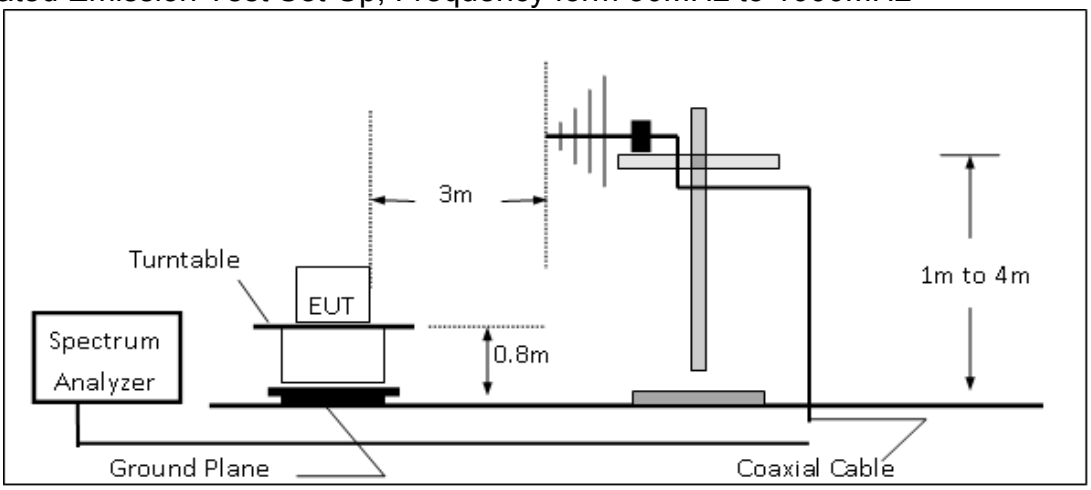
10.3. Test SET-UP

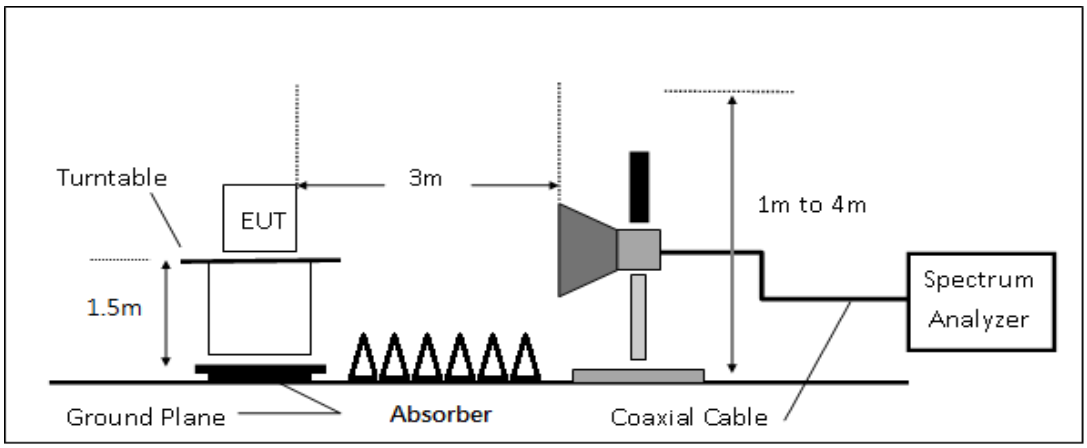
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



(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 0.8m 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 EDR Hopping	Test Date :	2015/9/24
Fundamental Frequency :	2402 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	BE CH LOW	Test Engineer :	Vito
EUT Pol. :	E2	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	55.92	-6.84	49.07	74	-24.93
2390.00	E	Average	42.01	-6.84	35.17	54	-18.83

Operation Mode :	BT EDR Hopping	Test Date :	2015/9/24
Fundamental Frequency :	2402 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	BE CH LOW	Test Engineer :	Vito
EUT Pol. :	E2	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	57.30	-6.84	50.45	74	-23.55
2390.00	E	Average	41.84	-6.84	35.00	54	-19.00

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Operation Mode :	BT EDR Hopping	Test Date :	2015/9/24
Fundamental Frequency :	2480 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	BE CH HIGH	Test Engineer :	Vito
EUT Pol. :	E2	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	54.27	-6.38	47.88	74	-26.12
2483.50	E	Average	41.74	-6.38	35.36	54	-18.64

Operation Mode :	BT EDR Hopping	Test Date :	2015/9/24
Fundamental Frequency :	2480 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	BE CH HIGH	Test Engineer :	Vito
EUT Pol. :	E2	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	55.06	-6.38	48.67	74	-25.33
2483.50	E	Average	41.73	-6.38	35.35	54	-18.65

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

Operation Mode :	BT EDR	Test Date :	2015/9/24
Fundamental Frequency :	2402 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	BE CH LOW	Test Engineer :	Vito
EUT Pol. :	E2	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
2341.10	S	Peak	60.50	-7.01	53.49	74	-20.51
2341.10	S	Average	41.35	-7.01	34.34	54	-19.66
2390.00	E	Peak	56.41	-6.84	49.57	74	-24.43
2390.00	E	Average	41.15	-6.84	34.31	54	-19.69

Operation Mode :	BT EDR	Test Date :	2015/9/24
Fundamental Frequency :	2402 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	BE CH LOW	Test Engineer :	Vito
EUT Pol. :	E2	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
2338.50	S	Peak	57.99	-7.02	50.97	74	-23.03
2338.50	S	Average	46.65	-7.02	39.63	54	-14.37
2390.00	E	Peak	54.36	-6.84	47.51	74	-26.49
2390.00	E	Average	40.90	-6.84	34.06	54	-19.94

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Operation Mode :	BT EDR	Test Date :	2015/9/24
Fundamental Frequency :	2480 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	BE CH HIGH	Test Engineer :	Vito
EUT Pol. :	E2	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	53.96	-6.38	47.58	74	-26.42
2483.50	E	Average	41.46	-6.38	35.08	54	-18.92

Operation Mode :	BT EDR	Test Date :	2015/9/24
Fundamental Frequency :	2480 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	BE CH HIGH	Test Engineer :	Vito
EUT Pol. :	E2	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	54.19	-6.38	47.81	74	-26.19
2483.50	E	Average	41.45	-6.38	35.07	54	-18.93
2484.03	S	Peak	58.13	-6.38	51.75	74	-22.25
2484.03	S	Average	41.24	-6.38	34.86	54	-19.14

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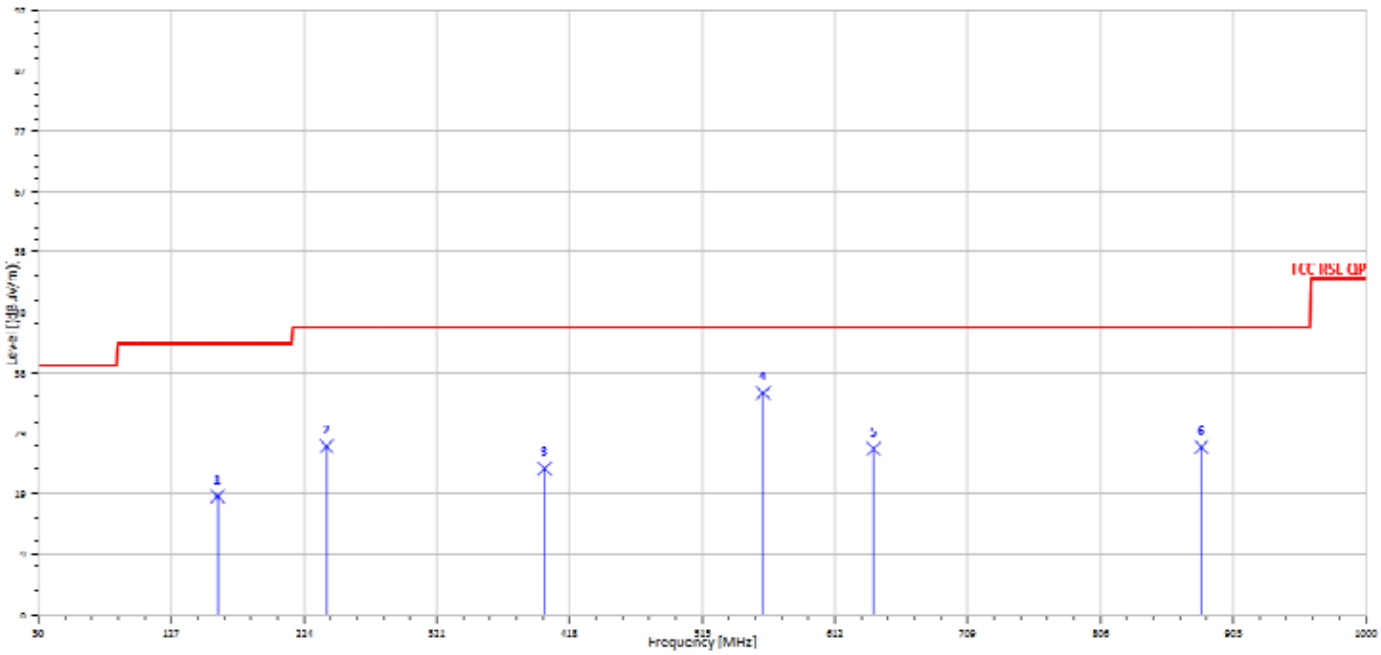
Radiated Spurious Emission Measurement Result:

For Frequency form 30MHz to 1000MHz

Operation Mode :	BT EDR	Test Date :	2015/9/24
Fundamental Frequency :	2402 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	TX CH LOW	Test Engineer :	Vito
EUT Pol. :	E2	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
160.95	S	Peak	41.21	-22.24	18.98	43.5	-24.52
240.49	S	Peak	50.22	-23.18	27.03	46	-18.97
399.57	S	Peak	42.14	-18.73	23.41	46	-22.59
559.62	S	Peak	51.62	-16.09	35.53	46	-10.47
640.13	S	Peak	40.28	-13.66	26.62	46	-19.38
879.72	S	Peak	38.17	-11.23	26.94	46	-19.06

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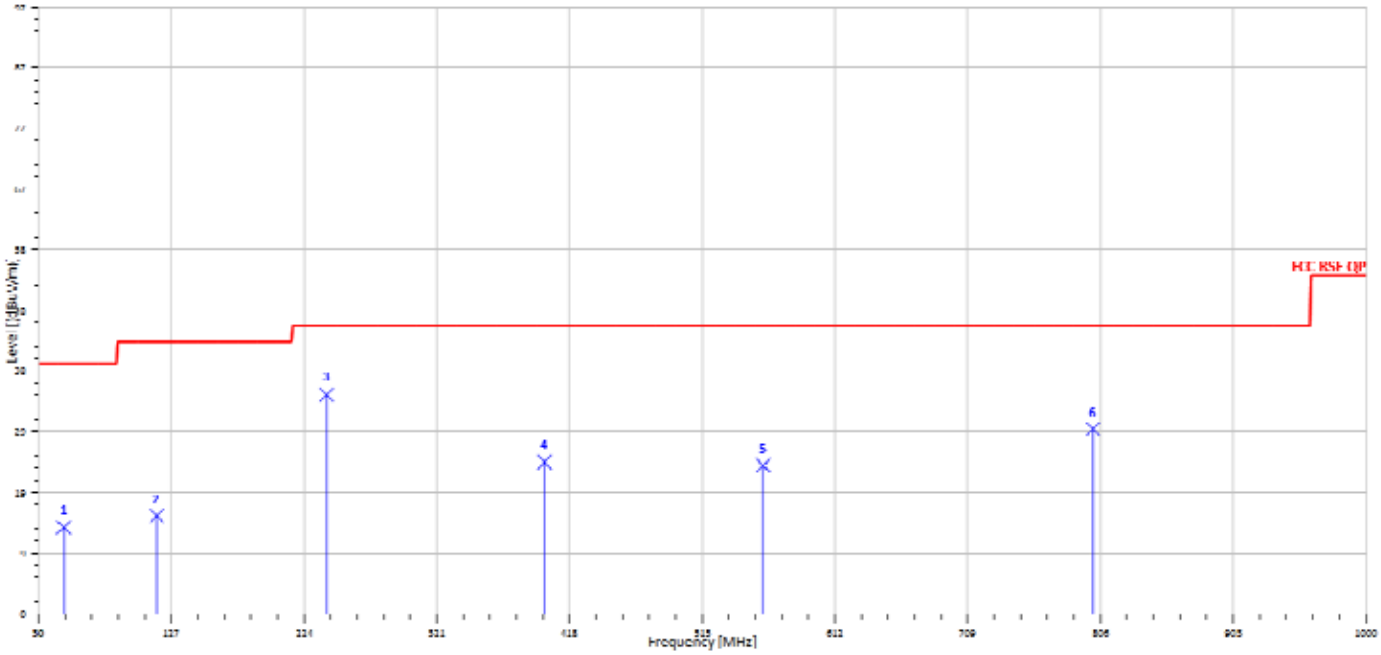
Operation Mode :	BT EDR	Test Date :	2015/9/24
Fundamental Frequency :	2402 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	TX CH LOW	Test Engineer :	Vito
EUT Pol. :	E2	Measurement Antenna Pol. :	Horizontal



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
48.43	S	Peak	37.26	-23.54	13.72	40	-26.28
116.33	S	Peak	40.63	-25.04	15.60	43.5	-27.90
240.49	S	Peak	58.23	-23.18	35.05	46	-10.95
399.57	S	Peak	42.93	-18.73	24.20	46	-21.80
559.62	S	Peak	39.77	-16.09	23.69	46	-22.31
800.18	S	Peak	41.78	-12.28	29.50	46	-16.50

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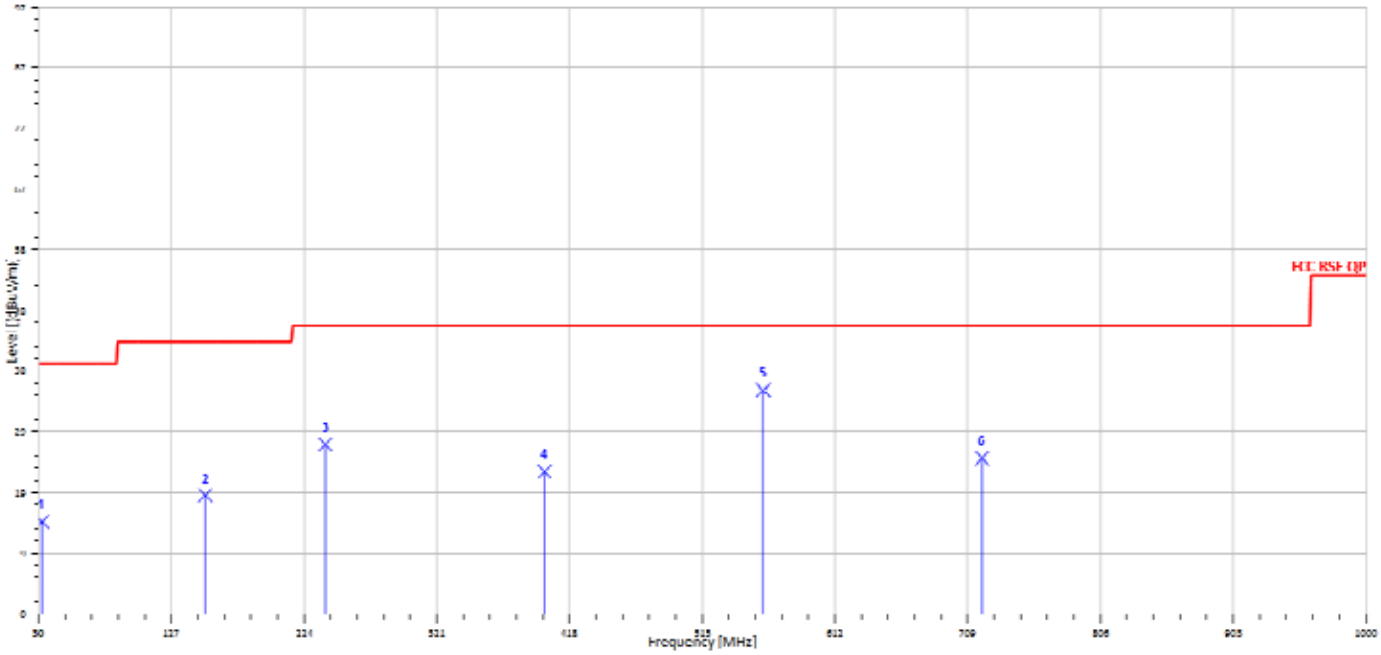
Operation Mode :	BT EDR	Test Date :	2015/9/24
Fundamental Frequency :	2441 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	TX CH MID	Test Engineer :	Vito
EUT Pol. :	E2	Measurement Antenna Pol. :	Vertical



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
32.91	S	Peak	38.94	-24.30	14.64	40	-25.36
152.22	S	Peak	41.14	-22.19	18.95	43.5	-24.55
239.52	S	Peak	50.22	-23.21	27.00	46	-19.00
399.57	S	Peak	41.47	-18.73	22.74	46	-23.26
559.62	S	Peak	51.81	-16.09	35.72	46	-10.28
719.67	S	Peak	37.76	-12.94	24.82	46	-21.18

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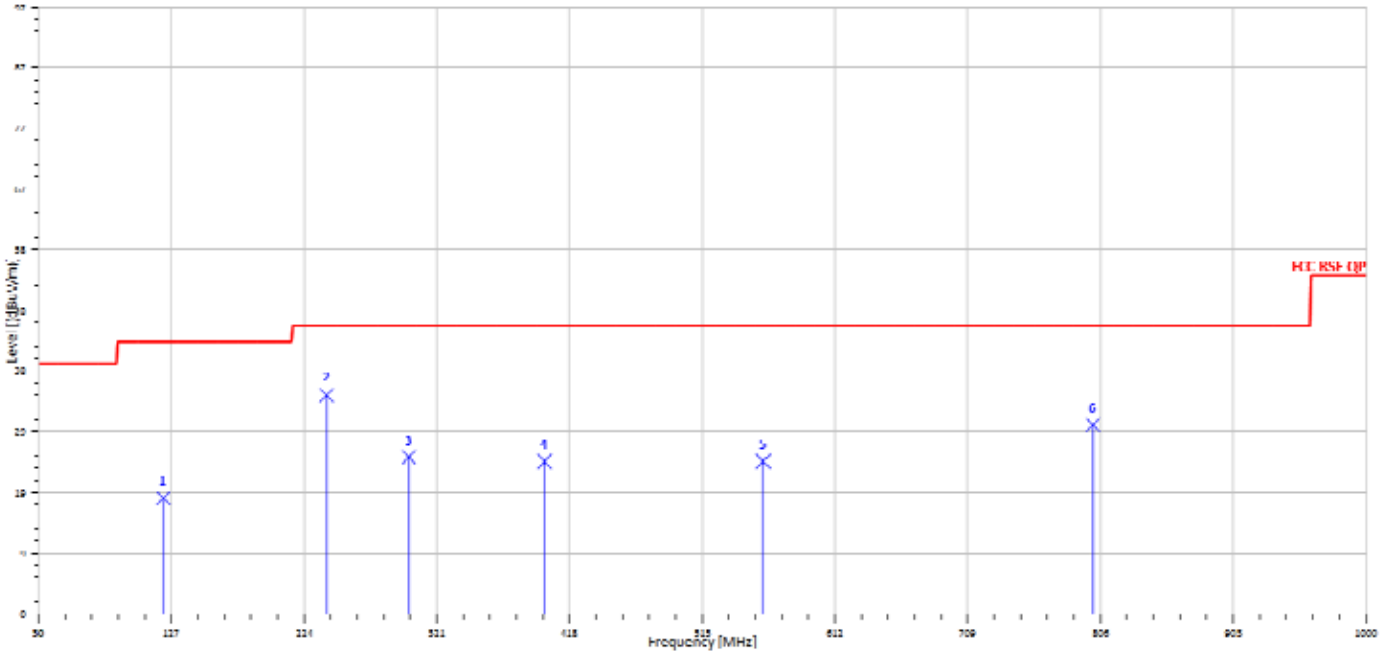
Operation Mode :	BT EDR	Test Date :	2015/9/24
Fundamental Frequency :	2441 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	TX CH MID	Test Engineer :	Vito
EUT Pol. :	E2	Measurement Antenna Pol. :	Horizontal



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
121.18	S	Peak	43.18	-24.69	18.49	43.5	-25.01
240.49	S	Peak	58.16	-23.18	34.97	46	-11.03
300.63	S	Peak	46.57	-21.61	24.96	46	-21.04
399.57	S	Peak	43.03	-18.73	24.30	46	-21.70
559.62	S	Peak	40.40	-16.09	24.32	46	-21.68
800.18	S	Peak	42.48	-12.28	30.20	46	-15.80

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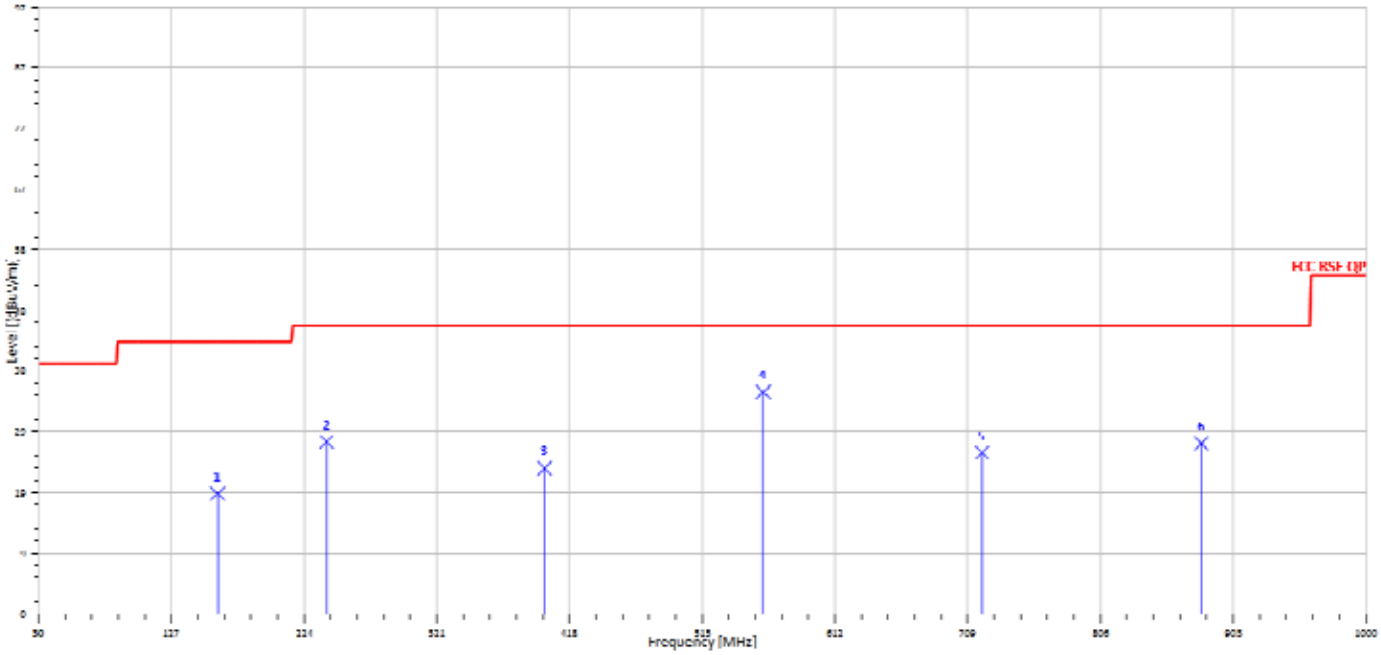
Operation Mode :	BT EDR	Test Date :	2015/9/24
Fundamental Frequency :	2480 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	TX CH HIGH	Test Engineer :	Vito
EUT Pol. :	E2	Measurement Antenna Pol. :	Vertical



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
160.95	S	Peak	41.43	-22.24	19.20	43.5	-24.30
240.49	S	Peak	50.63	-23.18	27.44	46	-18.56
399.57	S	Peak	42.01	-18.73	23.28	46	-22.72
559.62	S	Peak	51.54	-16.09	35.46	46	-10.54
719.67	S	Peak	38.61	-12.94	25.67	46	-20.33
879.72	S	Peak	38.40	-11.23	27.17	46	-18.83

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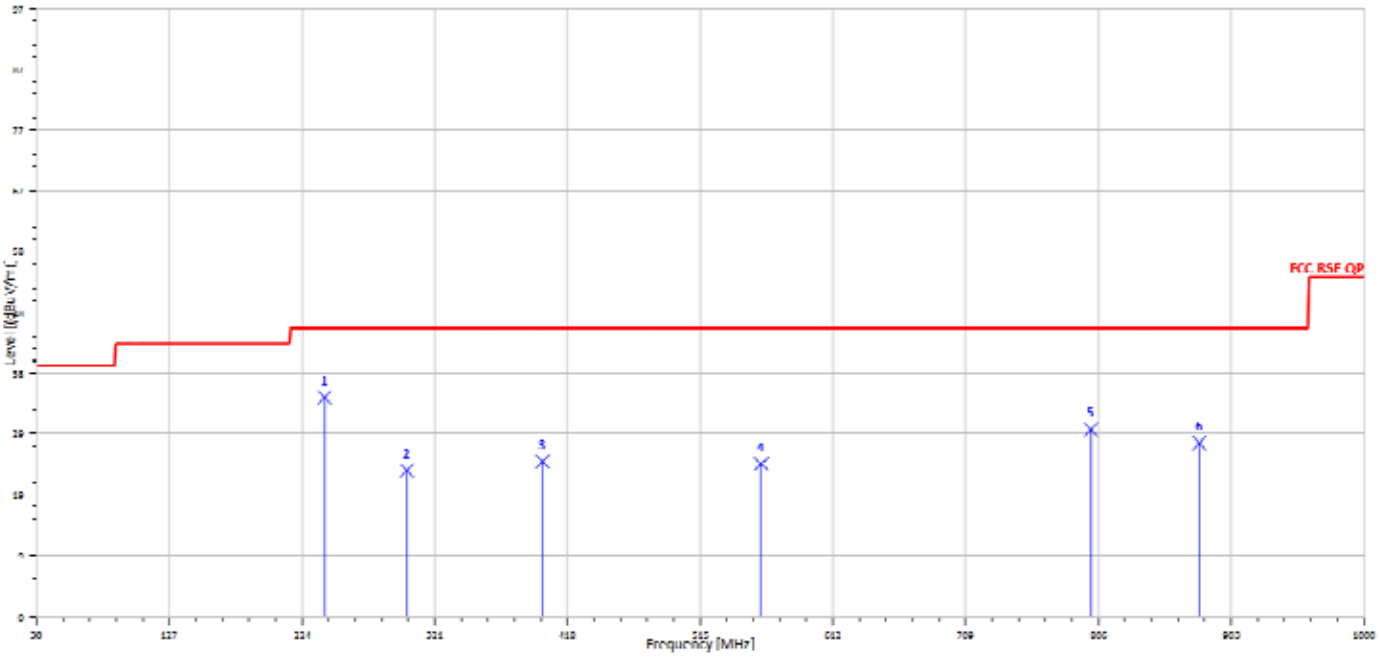
Operation Mode :	BT EDR	Test Date :	2015/9/24
Fundamental Frequency :	2480 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	TX CH HIGH	Test Engineer :	Vito
EUT Pol. :	E2	Measurement Antenna Pol. :	Horizontal



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
240.49	S	Peak	58.11	-23.18	34.93	46	-11.07
300.63	S	Peak	44.89	-21.61	23.28	46	-22.72
399.57	S	Peak	43.46	-18.73	24.73	46	-21.27
559.62	S	Peak	40.42	-16.09	24.34	46	-21.66
800.18	S	Peak	42.01	-12.28	29.73	46	-16.27
879.72	S	Peak	38.92	-11.23	27.69	46	-18.31

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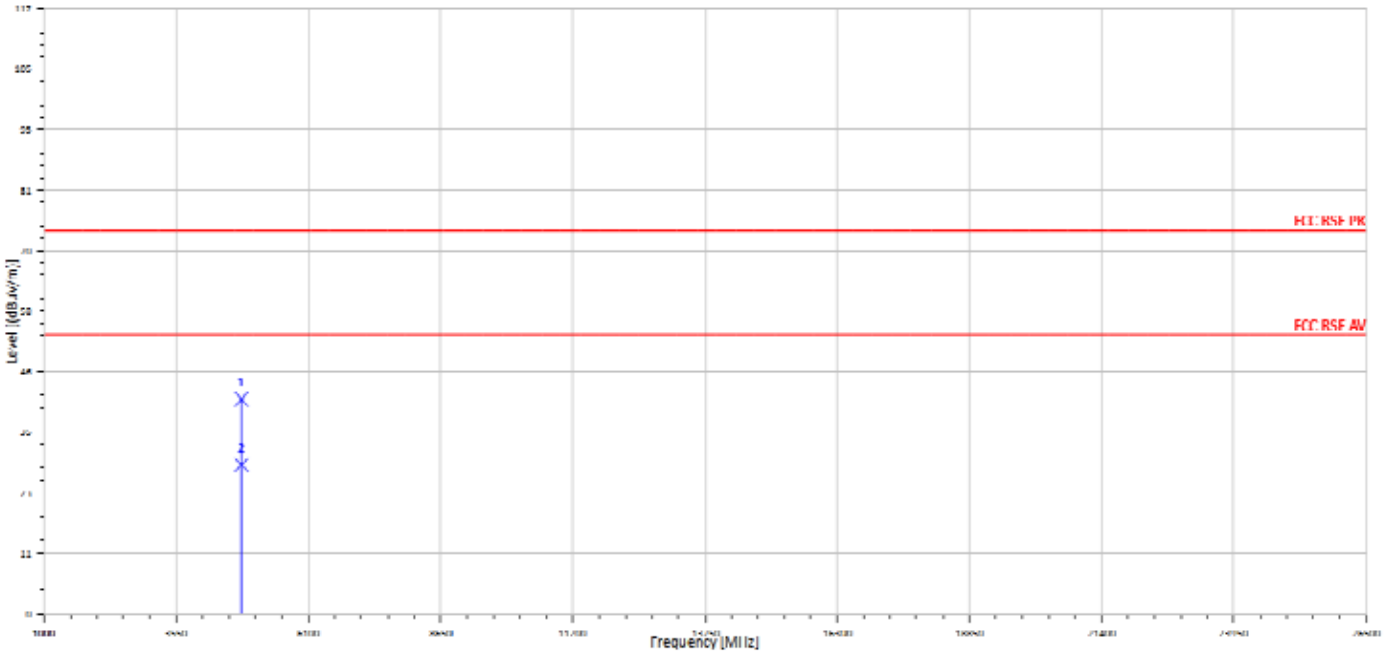
No.134,WuKungRoad,NewTaipeiIndustrialPark,WukuDistrict,NewTaipeiCity,Taiwan24803/新北市五股區新北產業園區五工路 134 號
t (886-2) 2299-3279 f (886-2) 2298-0488 www.tw.sgs.com

Radiated Spurious Emission Measurement Result:
For Frequency above 1 GHz

Operation Mode :	BT EDR	Test Date :	2015/9/24
Fundamental Frequency :	2402 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	TX CH LOW	Test Engineer :	Vito
EUT Pol. :	E2	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	42.67	-1.16	41.52	74	-32.48
4804.00	H	Average	29.88	-1.16	28.72	54	-25.28

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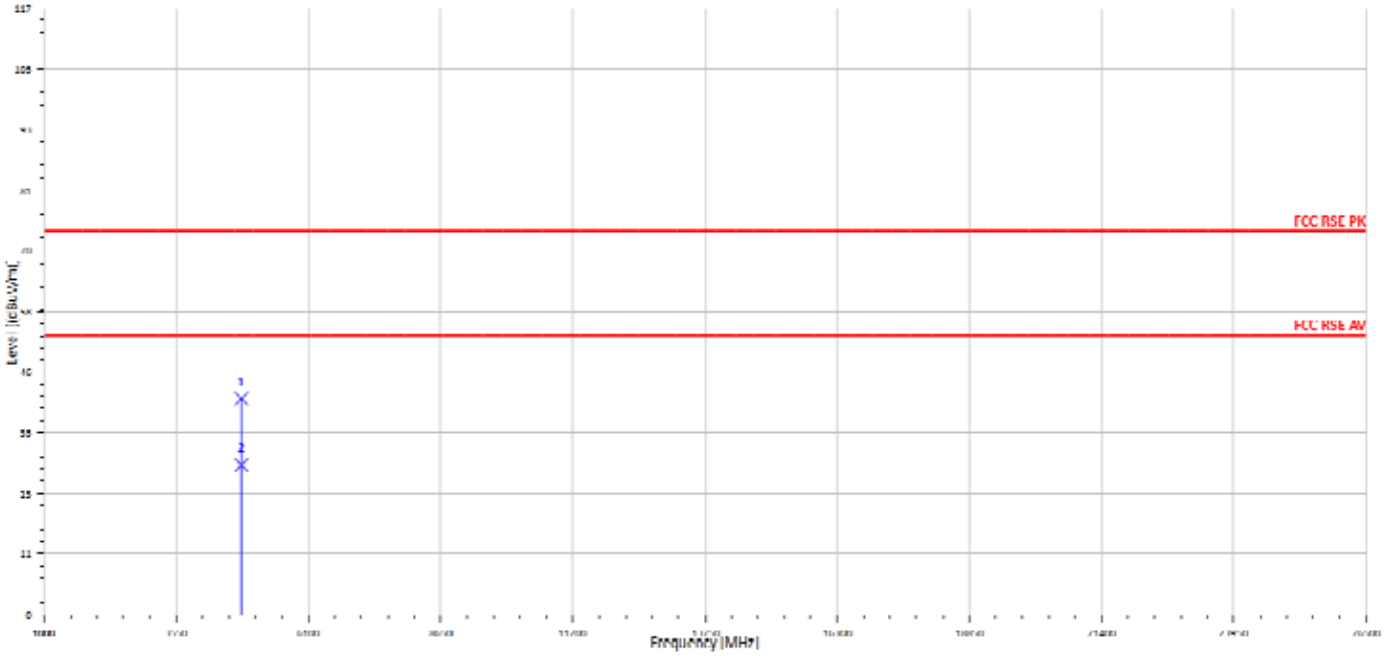
Operation Mode :	BT EDR	Test Date :	2015/9/24
Fundamental Frequency :	2402 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	TX CH LOW	Test Engineer :	Vito
EUT Pol. :	E2	Measurement Antenna Pol. :	Horizontal



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	42.74	-1.16	41.58	74	-32.42
4804.00	H	Average	29.97	-1.16	28.81	54	-25.19

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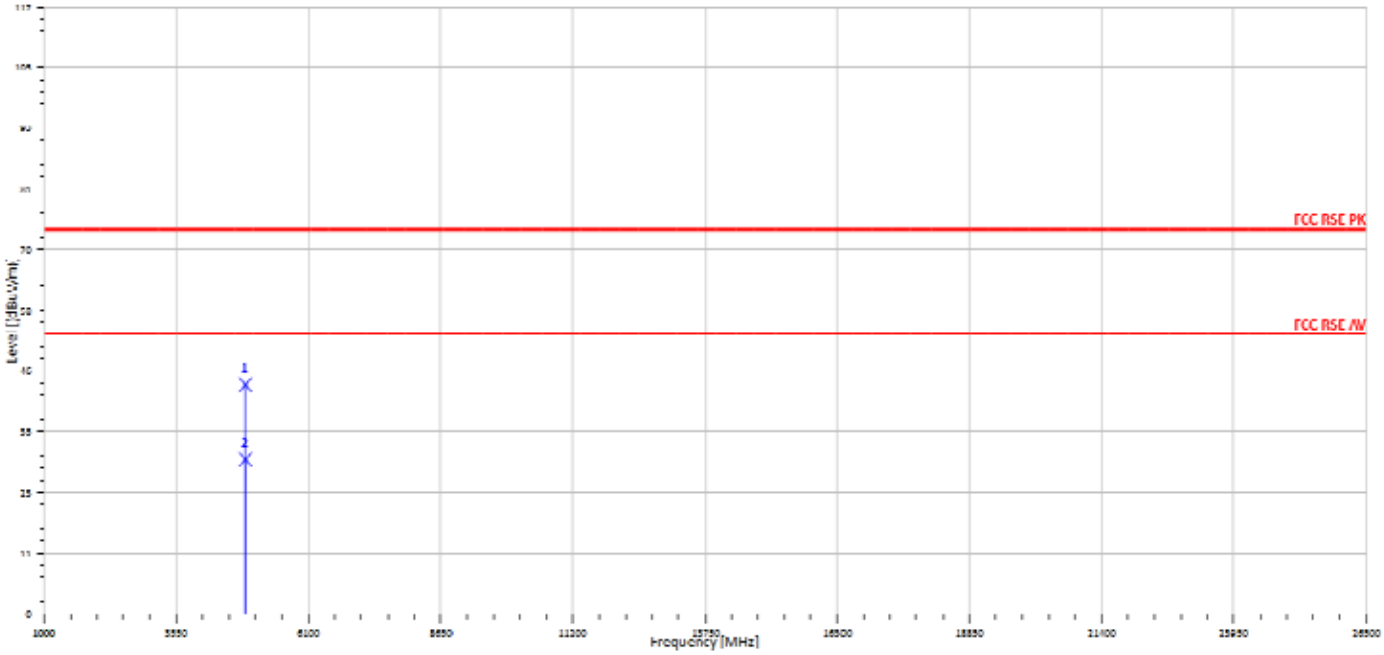
Operation Mode :	BT EDR	Test Date :	2015/9/24
Fundamental Frequency :	2441 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	TX CH MID	Test Engineer :	Vito
EUT Pol. :	E2	Measurement Antenna Pol. :	Vertical



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	44.81	-0.70	44.11	74	-29.89
4882.00	H	Average	30.38	-0.70	29.68	54	-24.32

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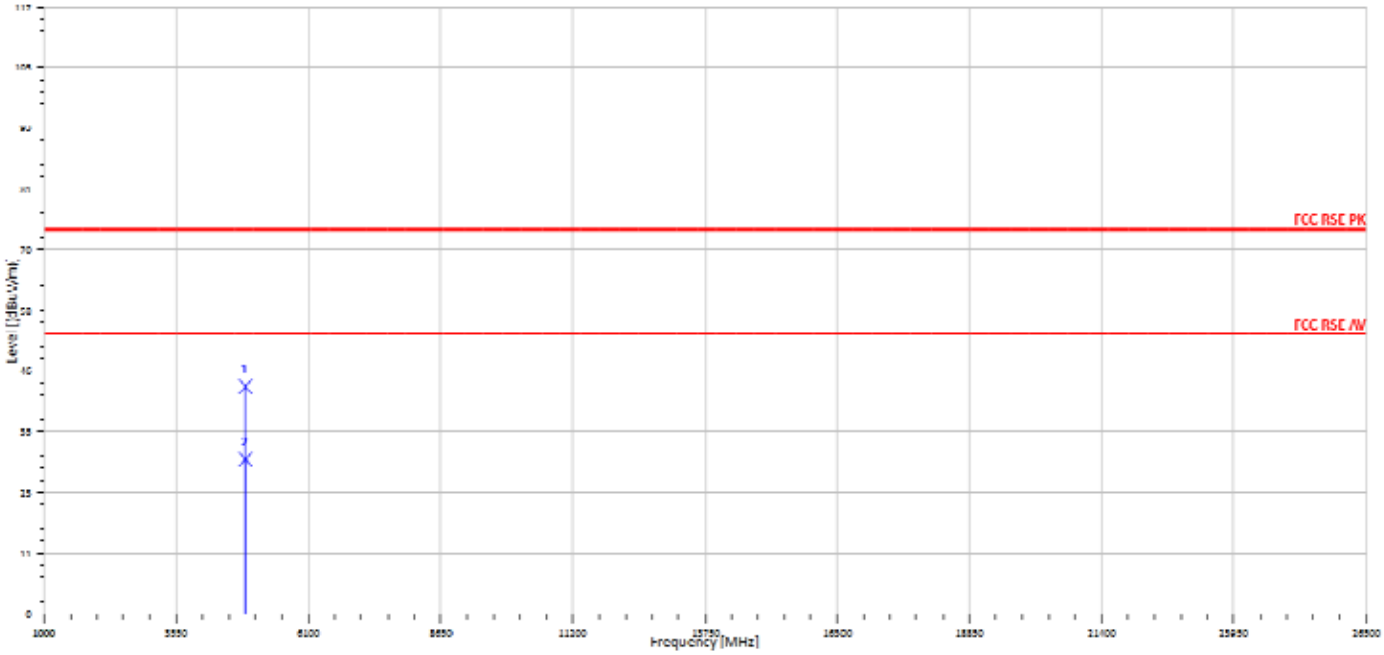
Operation Mode :	BT EDR	Test Date :	2015/9/24
Fundamental Frequency :	2441 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	TX CH MID	Test Engineer :	Vito
EUT Pol. :	E2	Measurement Antenna Pol. :	Horizontal



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	44.46	-0.70	43.76	74	-30.24
4882.00	H	Average	30.41	-0.70	29.71	54	-24.29

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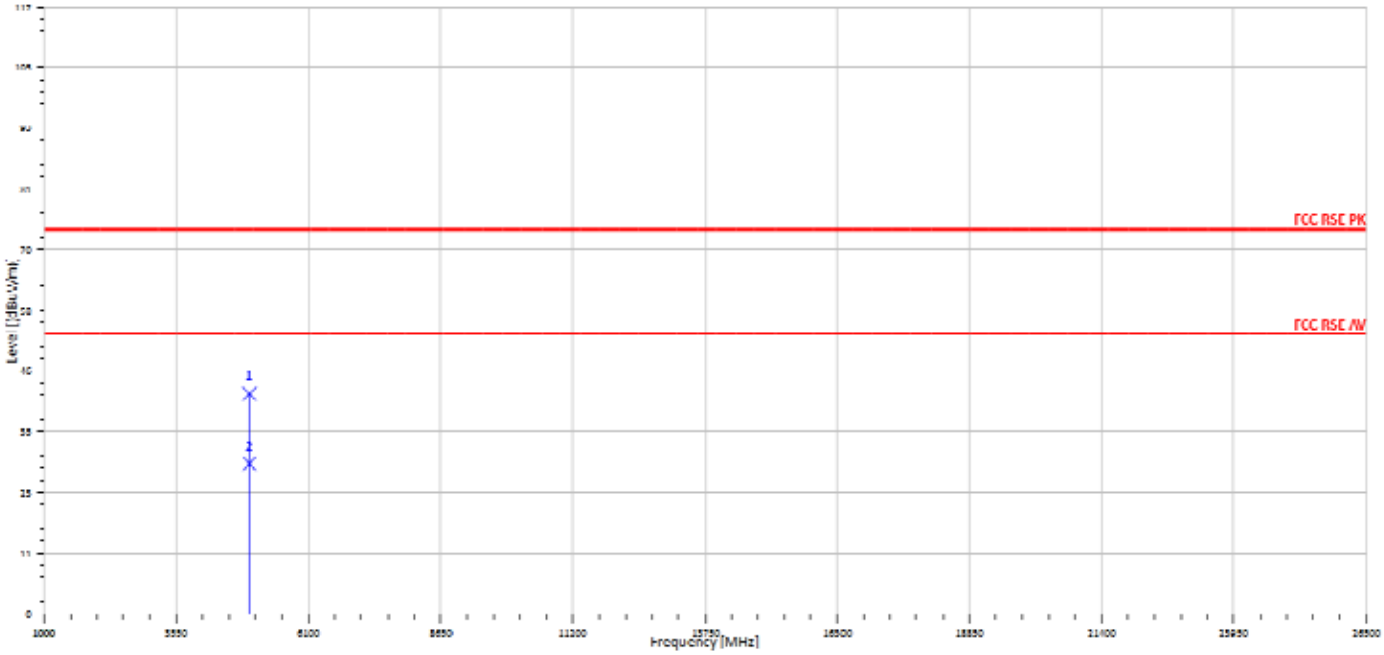
Operation Mode :	BT EDR	Test Date :	2015/9/24
Fundamental Frequency :	2480 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	TX CH HIGH	Test Engineer :	Vito
EUT Pol. :	E2	Measurement Antenna Pol. :	Vertical



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	H	Peak	43.10	-0.66	42.44	74	-31.56
4960.00	H	Average	29.56	-0.66	28.90	54	-25.10

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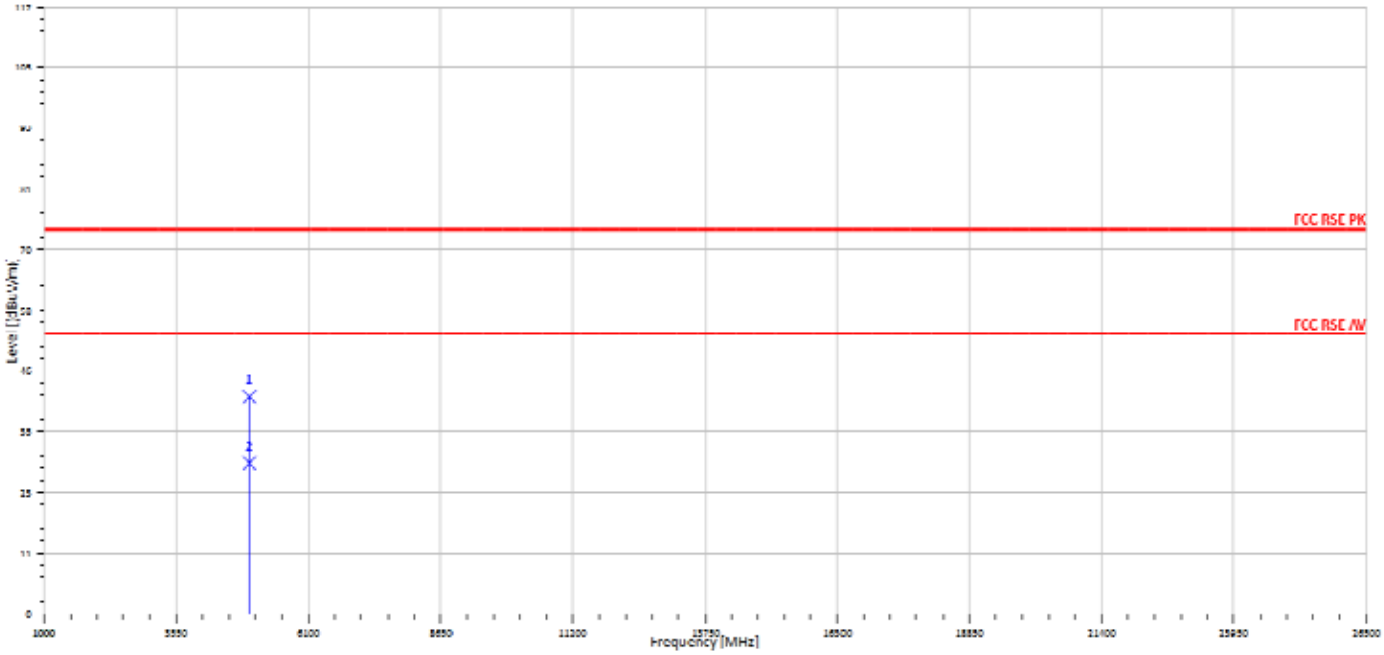
Operation Mode :	BT EDR	Test Date :	2015/9/24
Fundamental Frequency :	2480 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	TX CH HIGH	Test Engineer :	Vito
EUT Pol. :	E2	Measurement Antenna Pol. :	Horizontal



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	42.51	-0.66	41.86	74	-32.14
4960.00	H	Average	29.65	-0.66	28.99	54	-25.01

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11. FREQUENCY SEPARATION

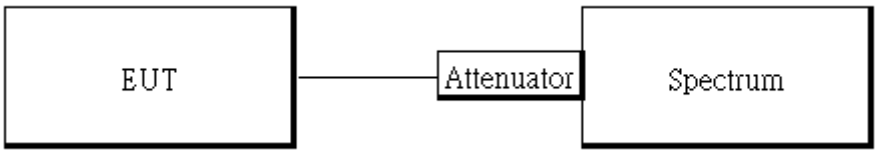
11.1. Standard Applicable

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	N9010A	MY53400256	10/15/2014	10/14/2015
DC Block	PASTERNACK	PE8210	RF29	12/19/2014	12/18/2015
Splitter	RF-LAMBAD	RFLT2W1G18G	RF35	12/19/2014	12/18/2015
Attenuator	WOKEN	218FS-10	RF23	12/19/2014	12/18/2015

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

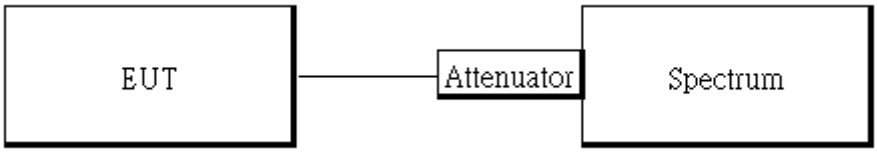
12.1. Standard Applicable

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	N9010A	MY53400256	10/15/2014	10/14/2015
DC Block	PASTERNACK	PE8210	RF29	12/19/2014	12/18/2015
Splitter	RF-LAMBAD	RFLT2W1G18G	RF35	12/19/2014	12/18/2015
Attenuator	WOKEN	218FS-10	RF23	12/19/2014	12/18/2015

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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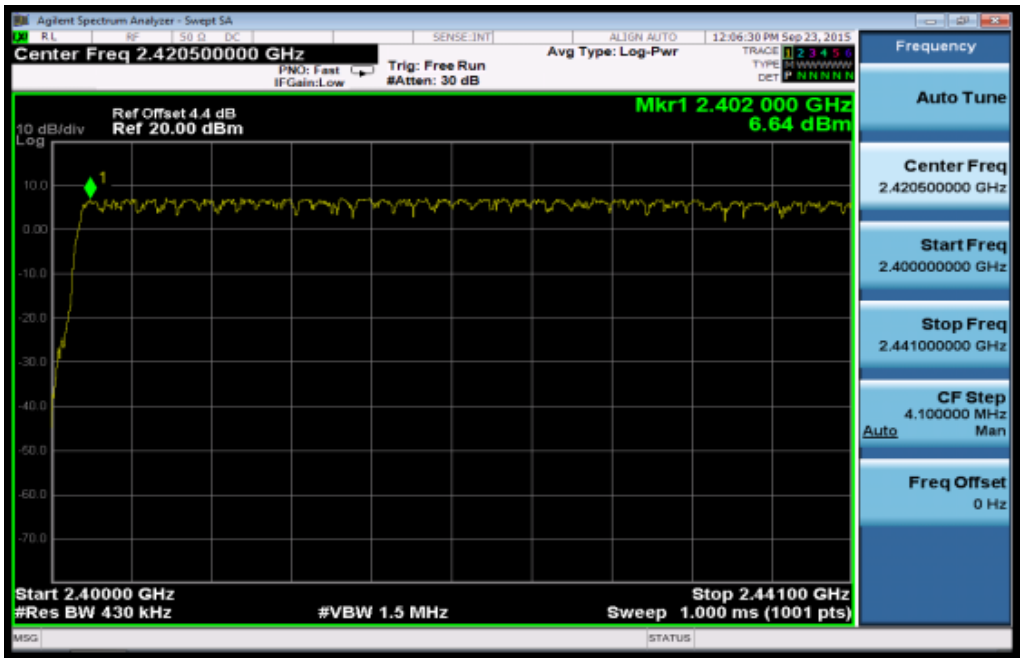
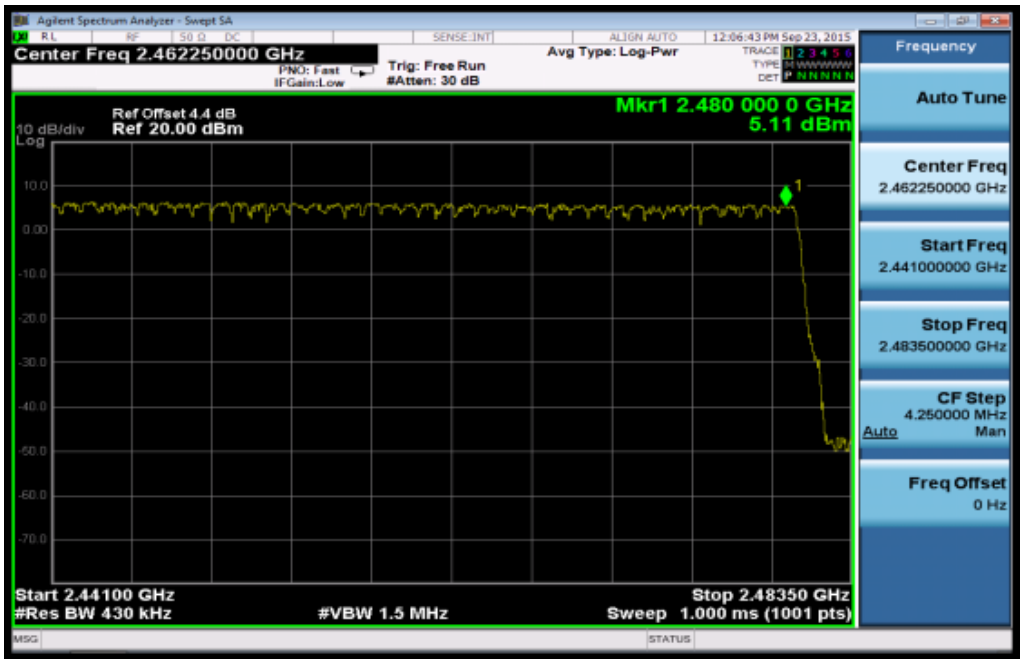
Channel Number

2.4 GHz – 2.441GHz



2.441 GHz – 2.4835GHz



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13. TIME OF OCCUPANCY (DWELL TIME)

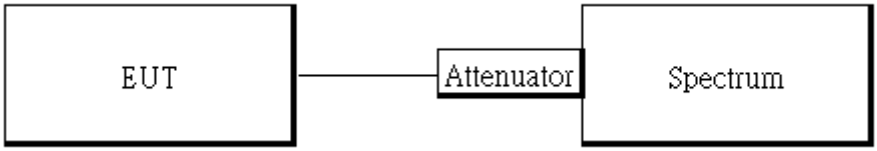
13.1. Standard Applicable

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	Agilent	N9010A	MY53400256	10/15/2014	10/14/2015
DC Block	PASTERNACK	PE8210	RF29	12/19/2014	12/18/2015
Splitter	RF-LAMBAD	RFLT2W1G18G	RF35	12/19/2014	12/18/2015
Attenuator	WOKEN	218FS-10	RF23	12/19/2014	12/18/2015

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	126.40	400ms
	DH3	262.72	400ms
	DH5	309.87	400ms
39	DH1	126.40	400ms
	DH3	262.72	400ms
	DH5	309.87	400ms
78	DH1	126.40	400ms
	DH3	264.64	400ms
	DH5	309.87	400ms

π/4 DQPSK (2Mbps)

Channel	PACKET TYPE	Measurement Result (ms)	Limit (ms)
39	DH1	127.68	400ms
	DH3	264.64	400ms
	DH5	309.87	400ms

8-DPSK (3Mbps)

Channel	PACKET TYPE	Measurement Result (ms)	Limit (ms)
39	DH1	128.00	400ms
	DH3	264.64	400ms
	DH5	309.87	400ms

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

GFSK (1Mbps):

CH Low	DH1 time slot	=	0.395	*	(1600/2/79)	*	31.6	=	126.40	(ms)
	DH3 time slot	=	1.642	*	(1600/4/79)	*	31.6	=	262.72	(ms)
	DH5 time slot	=	2.905	*	(1600/6/79)	*	31.6	=	309.87	(ms)
CH Mid	DH1 time slot	=	0.395	*	(1600/2/79)	*	31.6	=	126.40	(ms)
	DH3 time slot	=	1.642	*	(1600/4/79)	*	31.6	=	262.72	(ms)
	DH5 time slot	=	2.905	*	(1600/6/79)	*	31.6	=	309.87	(ms)
CH High	DH1 time slot	=	0.395	*	(1600/2/79)	*	31.6	=	126.40	(ms)
	DH3 time slot	=	1.654	*	(1600/4/79)	*	31.6	=	264.64	(ms)
	DH5 time slot	=	2.905	*	(1600/6/79)	*	31.6	=	309.87	(ms)

π/4 -DQPSK (2Mbps):

CH Mid	2DH1 time slot	=	0.399	*	(1600/2/79)	*	31.6	=	127.68	(ms)
	2DH3 time slot	=	1.654	*	(1600/4/79)	*	31.6	=	264.64	(ms)
	2DH5 time slot	=	2.905	*	(1600/6/79)	*	31.6	=	309.87	(ms)

8-DPSK (3Mbps):

CH Mid	3DH1 time slot	=	0.400	*	(1600/2/79)	*	31.6	=	128.00	(ms)
	3DH3 time slot	=	1.654	*	(1600/4/79)	*	31.6	=	264.64	(ms)
	3DH5 time slot	=	2.905	*	(1600/6/79)	*	31.6	=	309.87	(ms)

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AFH Mode:

GFSK (1Mbps) for AFH Mode			
Hopping Channel Number	**PACKET TYPE**	**Measurement Result (ms)**	**Limit (ms)**
20	DH5	154.93	400ms
π/4 DQPSK (2Mbps) for Mode			
Hopping Channel Number	**PACKET TYPE**	**Measurement Result (ms)**	**Limit (ms)**
20	DH5	154.93	400ms
8-DPSK (3Mbps) for AFH Mode			
Hopping Channel Number	**PACKET TYPE**	**Measurement Result (ms)**	**Limit (ms)**
20	DH5	154.93	400ms

GFSK (1Mbps):

DH5 time sl = 2.905 (ms) * (800/6/20) * 8 = 154.93 (ms)

π/4 -DQPSK (2Mbps):

2DH5 time s = 2.905 (ms) * (800/6/20) * 8 = 154.93 (ms)

8-DPSK (3Mbps):

3DH5 time s = 2.905 (ms) * (800/6/20) * 8 = 154.93 (ms)

13.6. Measurement Result

Note: Refer to next page for plots.

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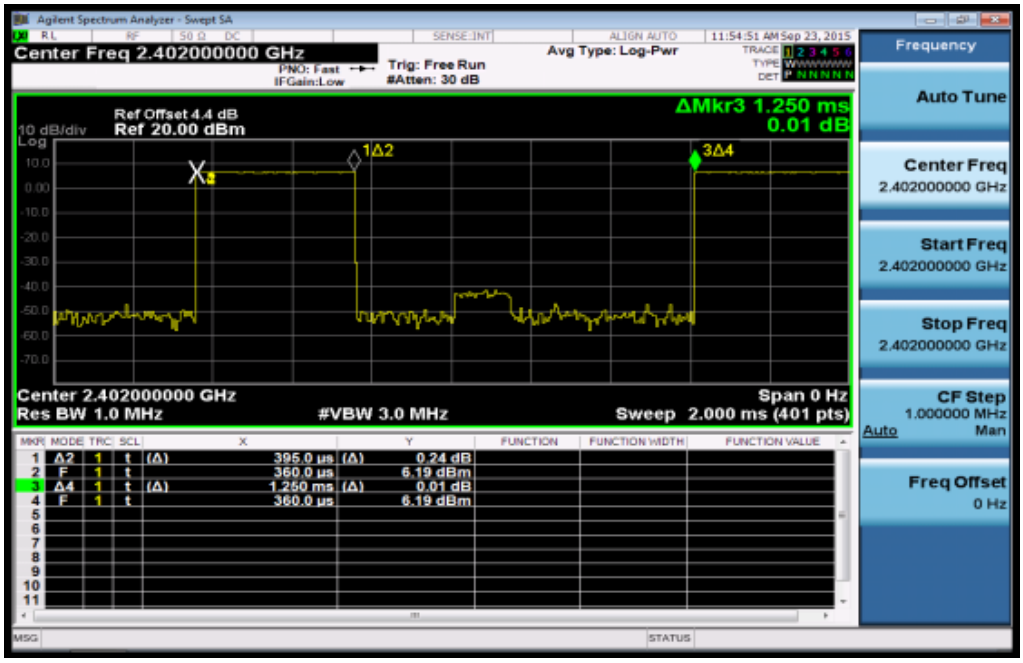
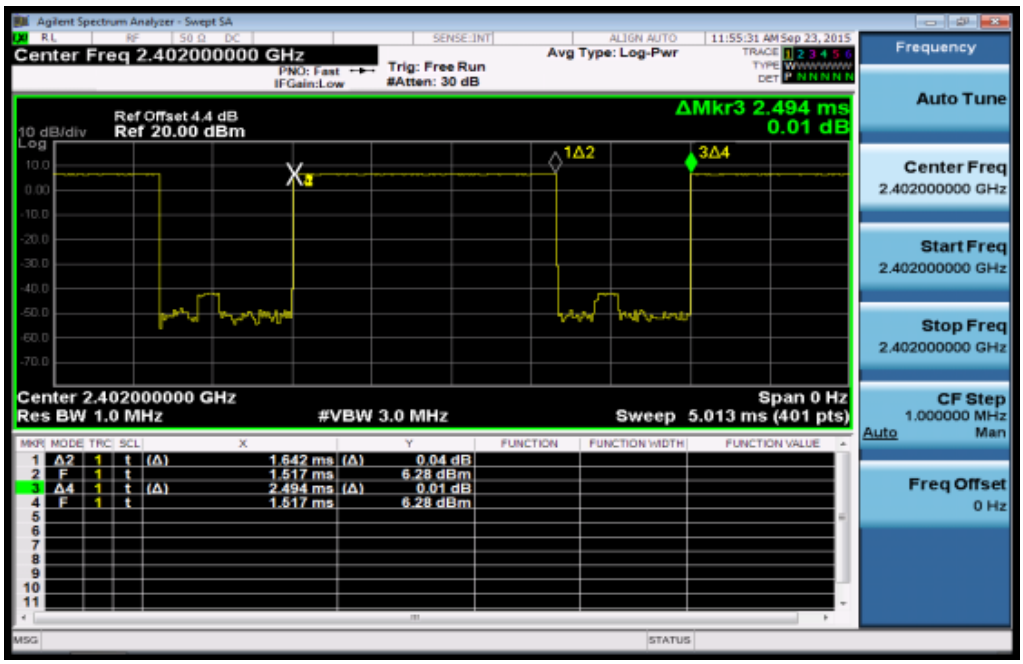
CH-Low
DH1



DH3



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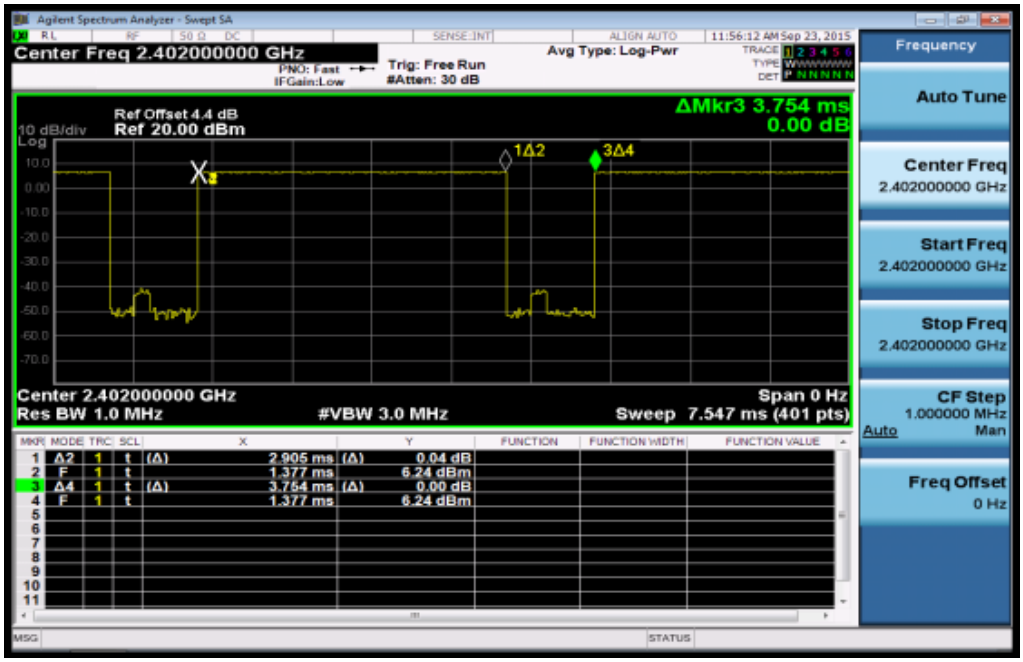
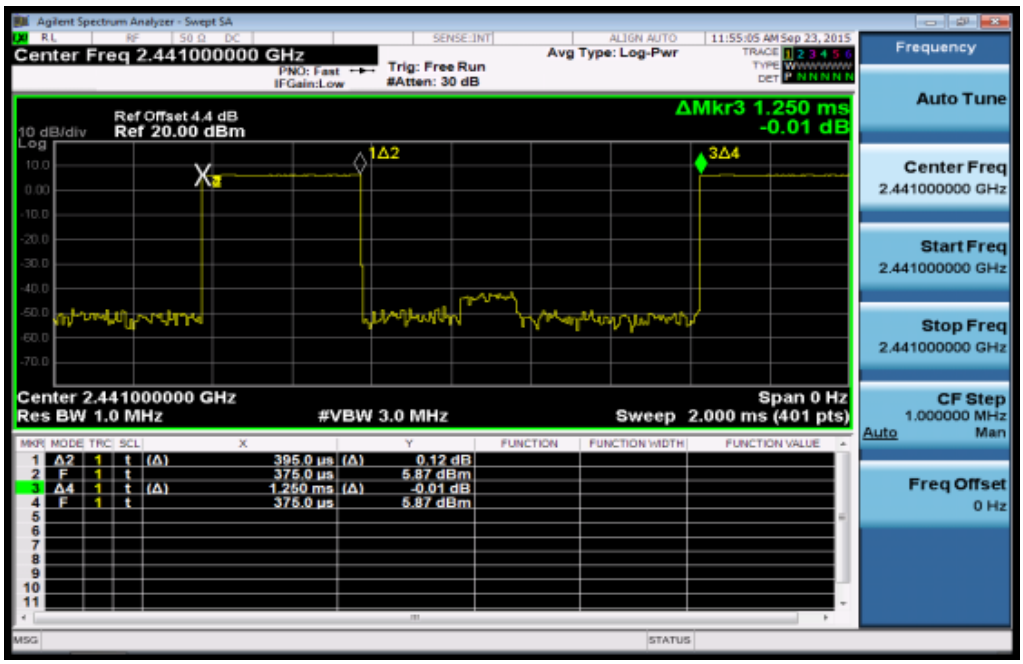
DH5



CH-Mid

DH1



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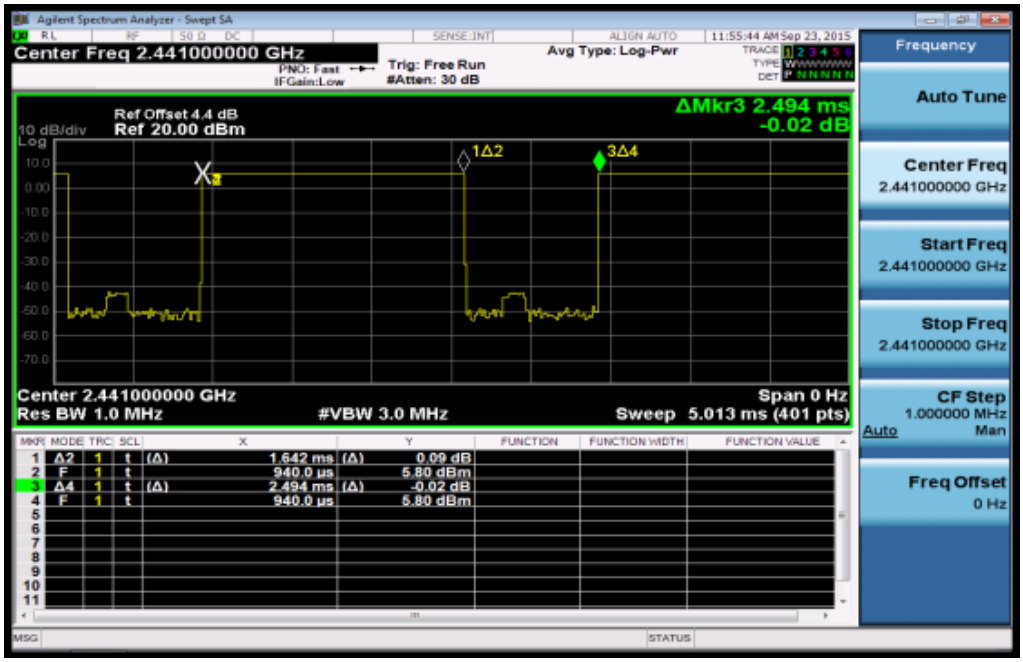
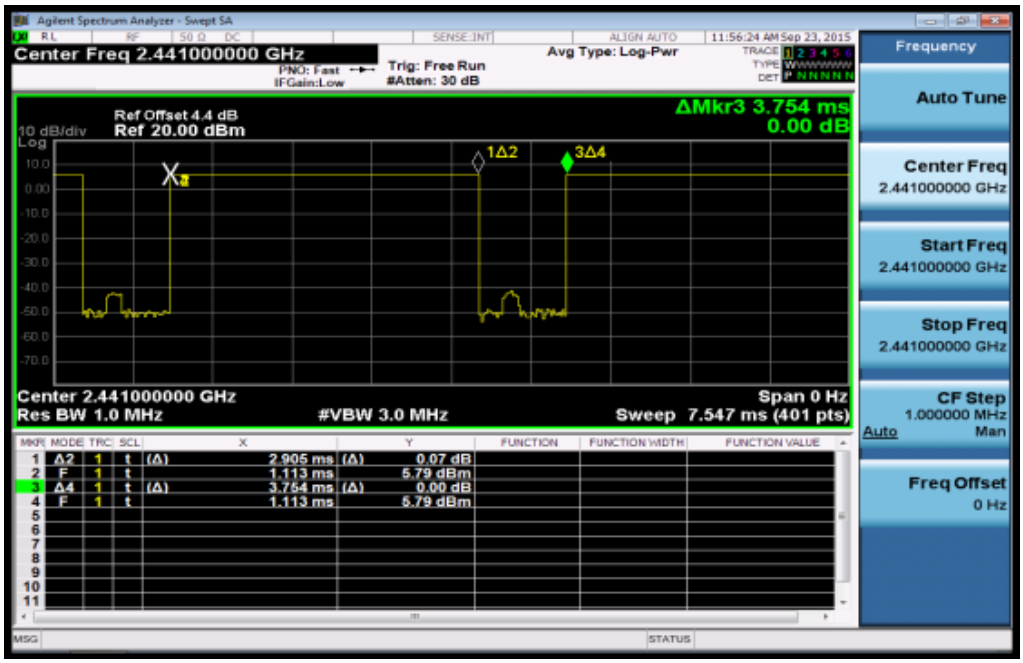
DH3



DH5



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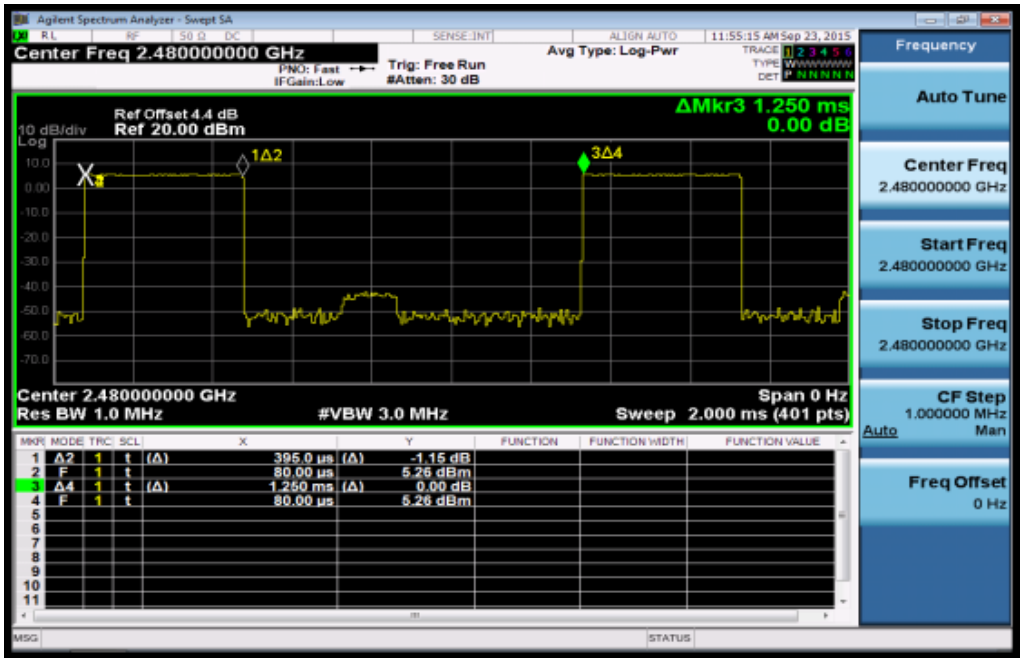
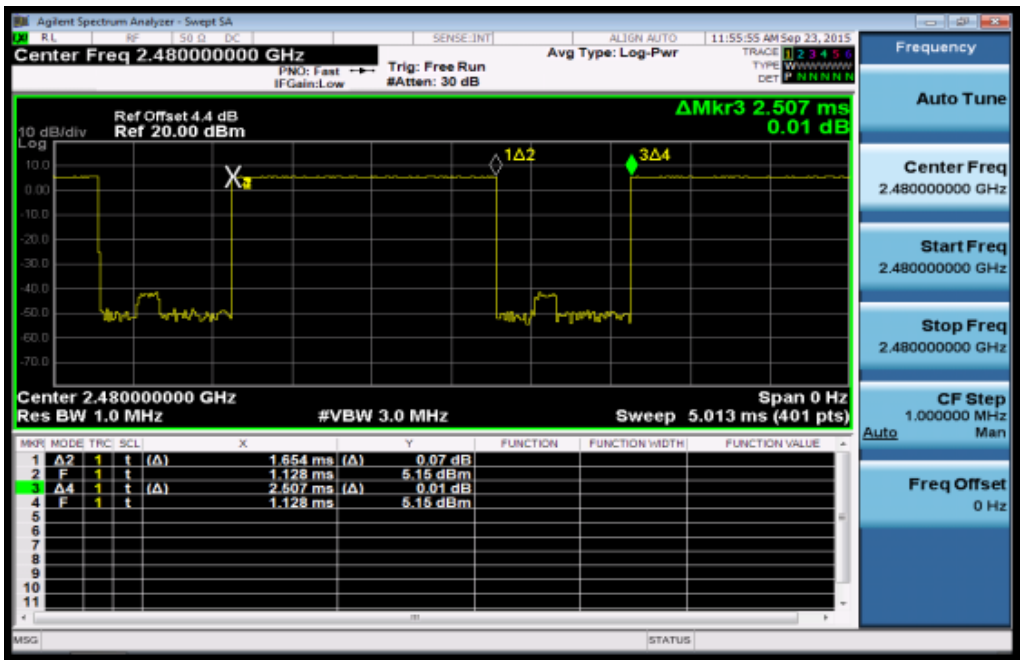
CH-High
DH1



DH3



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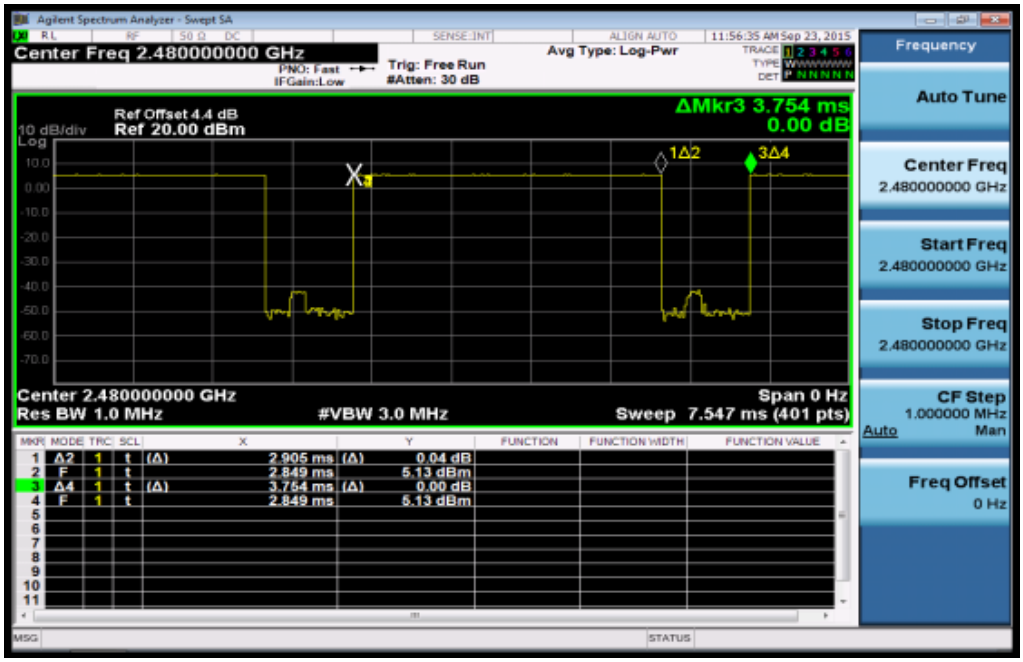
DH5



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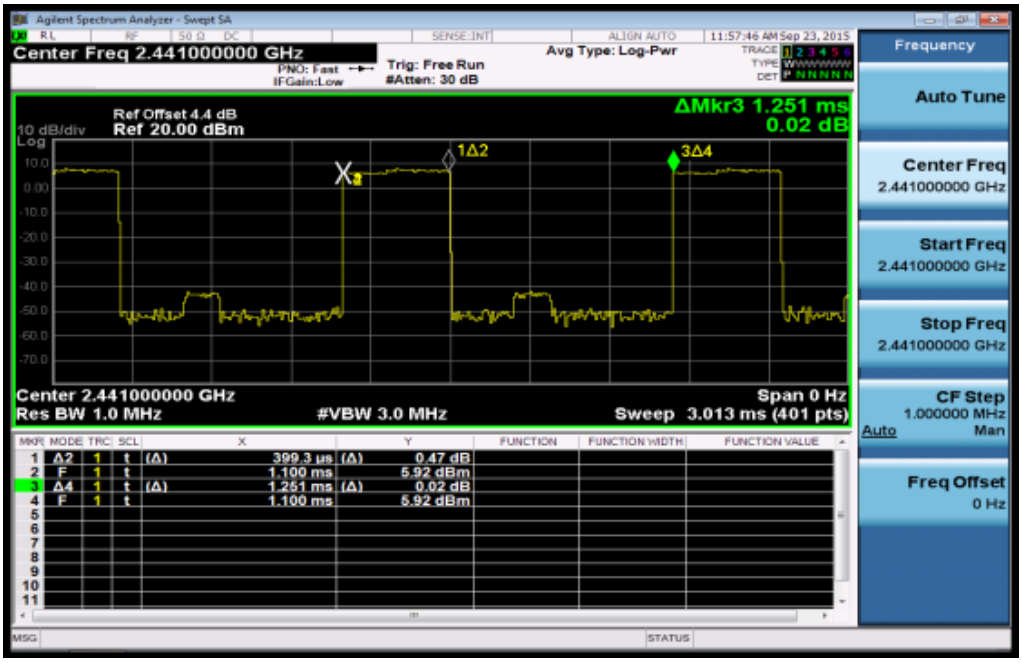
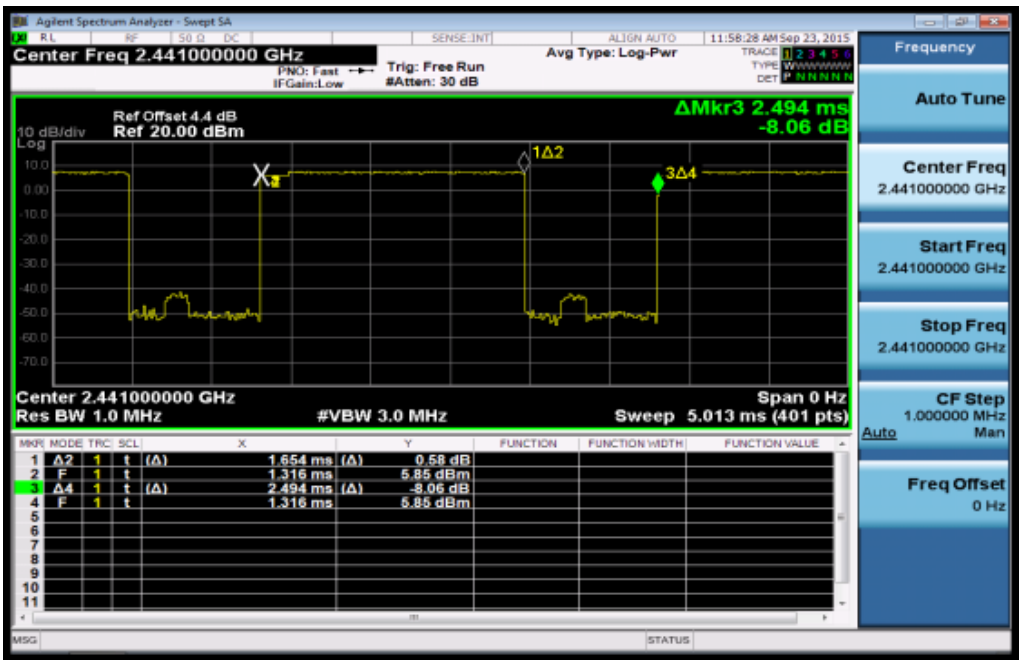
CH-Mid

2DH1



2DH3



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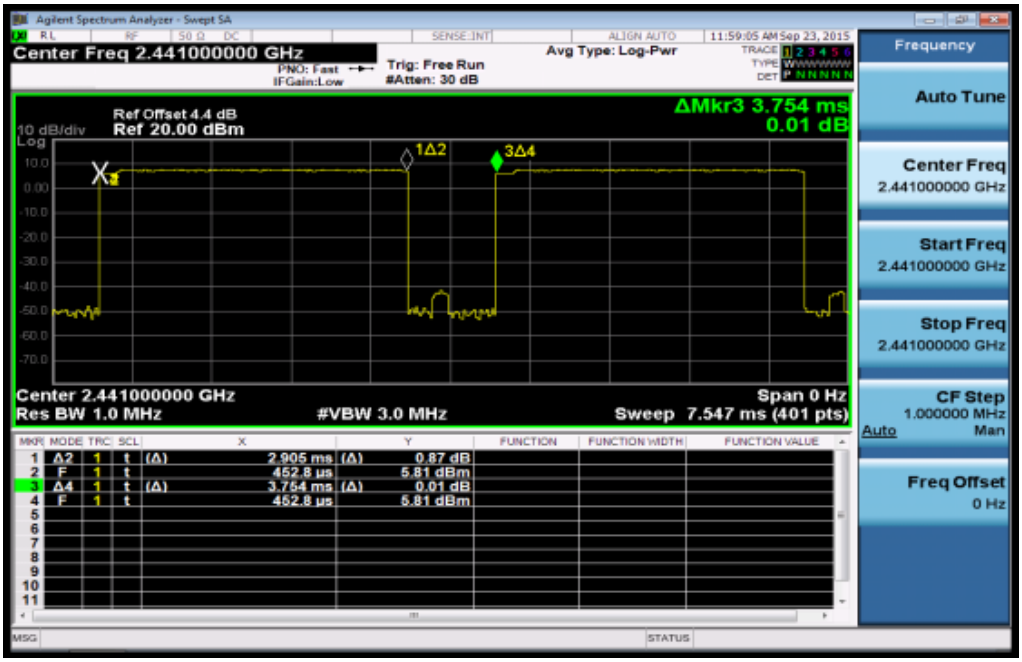
2DH5



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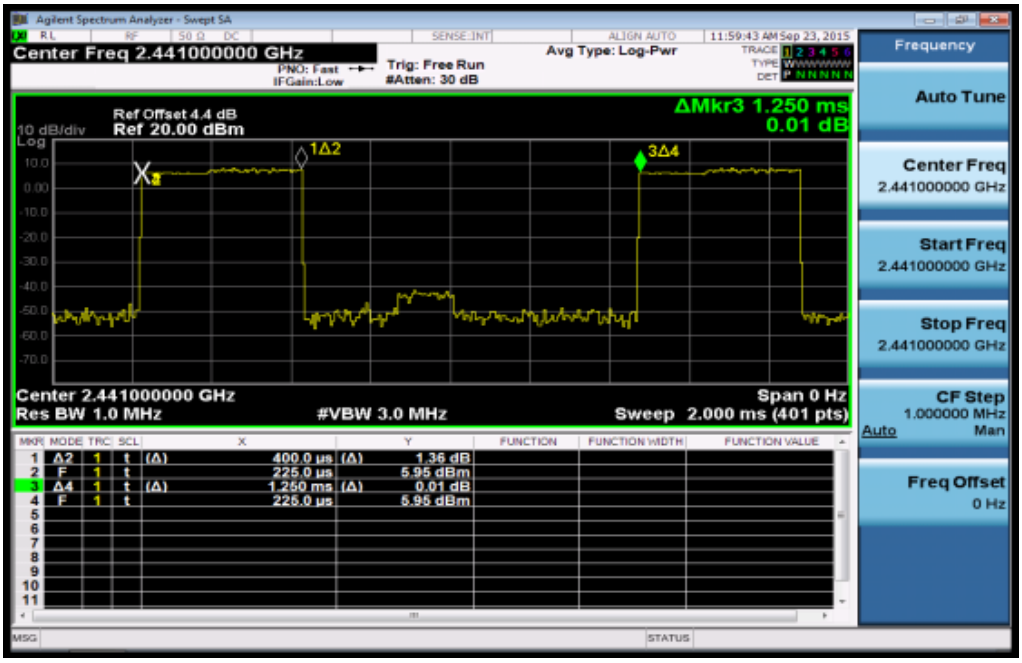
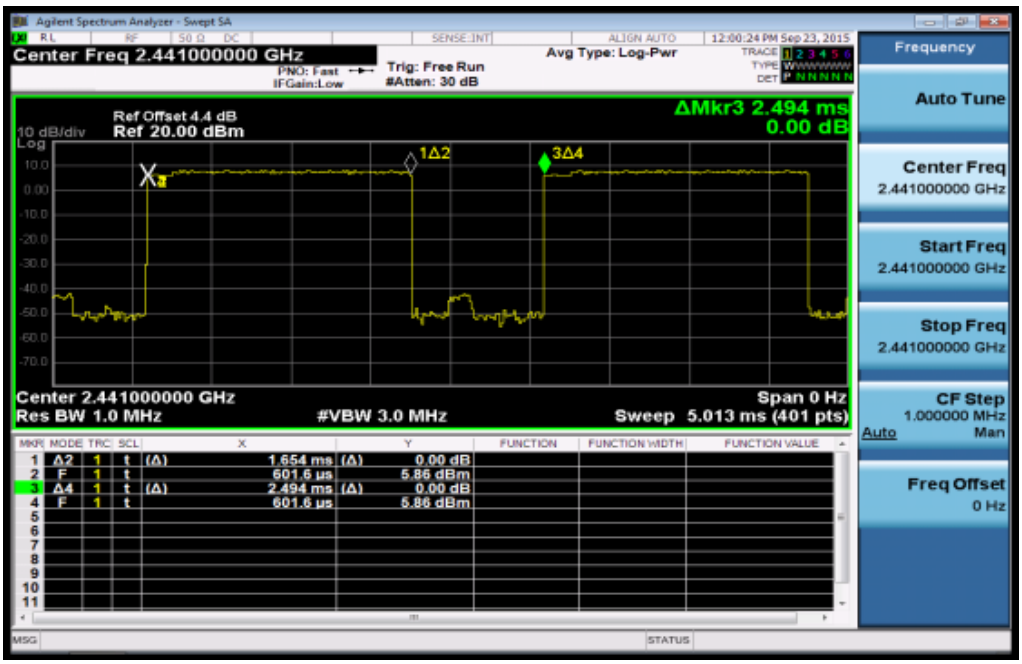
CH-Mid

3DH1



3DH3



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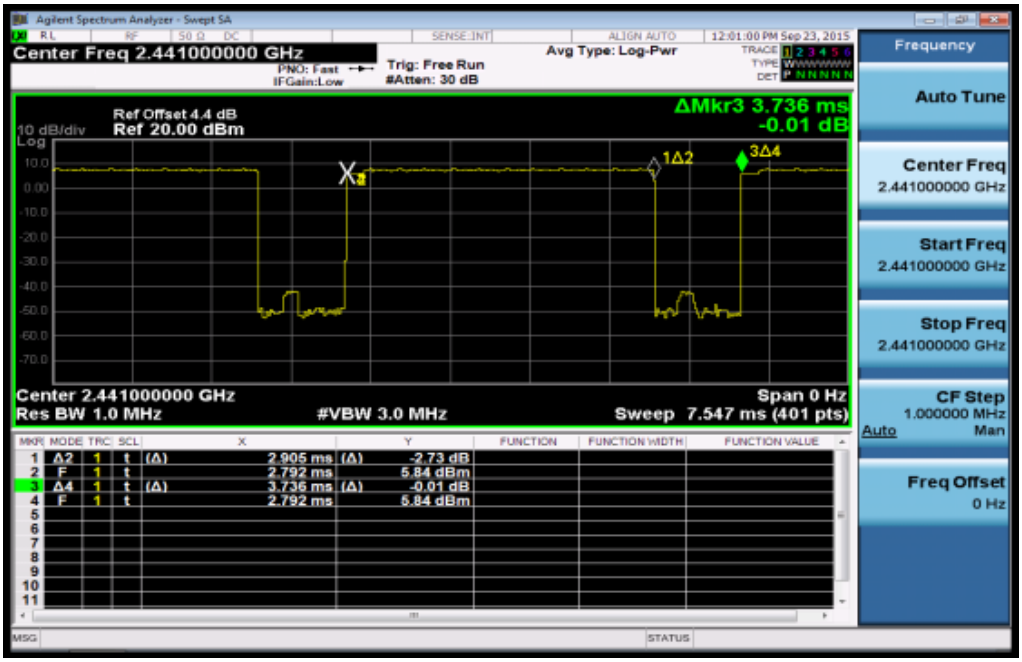
3DH5



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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.

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.

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15. MAXIMUM PERMISSIBLE EXPOSURE (MPE)

15.1. Standard Applicable:

According to §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

This is a Mobile device, the MPE is required.

According to §1.1310 and §2.1093 RF exposure is calculated.

Limits for Maximum Permissive Exposure (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	F/1500	30
1500-15000	/	/	1.0	30

F = frequency in MHz

* = Plane-wave equipment power density

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15.2. Maximum Permissible Exposure (MPE) Evaluation

Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)
2402	**8.24**	0.00667	1
2442	7.85	0.00610	1
2480	7.66	0.00583	1

MPE Prediction

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$S=PG/4\pi R^2$

Where: S = Power density

P = Power input to antenna

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Distance to the center of radiation of the antenna

Maximum peak output power at antenna input	8.24	(dBm)
Maximum peak output power at antenna input	6.6680677	(mW)
Duty cycle:	77	(%)
Maximum Pav :	5.1344121	(mW)
Antenna gain (Maximum):	2.7	(dBi)
Antenna gain (linear):	1.8620871	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2402	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.0019030	(mW/cm^2)

Measurement Result

The predicted power density level at 20cm is 0.0019mW/cm^2. This is below the uncontrolled exposure limit of 1mW/cm^2 at 2402MHz.

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