

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

Product Name: Mobile Phone

Brand Name: Sony

Type No.: PM-0854-BV

Model Difference: N/A

FCC ID: PY7-PM0854

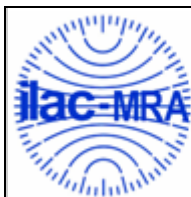
Report No.: ER/2014/B0044

Issue Date: Jan. 19, 2015

FCC Rule Part: §15.247, Cat: DSS

Prepared for: Sony Mobile Communications AB
Nya Vattentorget 22188 Lund/Sweden

Prepared by: SGS Taiwan Ltd.
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VERIFICATION OF COMPLIANCE

Applicant: Sony Mobile Communications AB
Nya Vattentorget 22188 Lund/Sweden

Product Name: Mobile Phone

Brand Name: Sony

Type No.: PM-0854-BV

Model Difference: N/A

FCC ID: PY7-PM0854

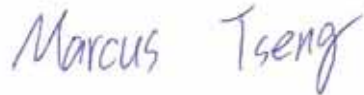
File Number: ER/2014/B0044

Date of test: Nov. 06, 2014 ~ Nov. 21, 2014

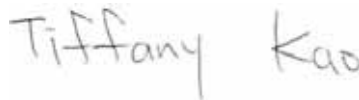
Date of EUT Received: Nov. 06, 2014

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 C63.4:2009 & ANSI C63.10:2009 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15.247. The test results of this report relate only to the tested sample identified in this report.

Test By:**Date:**

Jan. 19, 2015

Marcus Tseng / Engineer**Prepared By:****Date:**

Jan. 19, 2015

Tiffany Kao / Clerk**Approved By:****Date:**

Jan. 19, 2015

Jim Chang / Supervisor

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Revision History

Report Number	Revision	Description	Issue Date
ER/2014/B0044	Rev.00	Initial creation of document	Dec. 08, 2014
ER/2014/B0044	Rev.01	Updated HW, SW, and internal photo	Jan. 09, 2015
ER/2014/B0044	Rev.02	Revised Measurement Procedure of Peak Output Power Measurement	Jan. 19, 2015

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1. GENERAL INFORMATION

1.1. Product description

General:

Product Name:	Mobile Phone	
Brand Name:	Sony	
Type No.:	PM-0854-BV	
Model Difference:	N/A	
Data Cable (USB):	Model No.: EC450, Supplier: K-one Type No.: AI-0700, Length: 100 cm	
Simple Hands-Free (SHF-White):	Model No.: MH410c, Supplier: Foster Electric Type No.: AG-1100	
Car Charger:	Model No.: AN400, Supplier: Salcomp Type No.: CAA-0003013	
BT PHF:	Model No.: SBH20, Supplier: Sony Type No.: RD-0010 coupling with Simple Hands Free (Model No.: MH755, Supplier: BALDA, Type No.: AG-0503)	
Hardware Version:	A	
Software Version:	25.0.A.0.33	
Power Supply:	3.8Vdc	
	Battery:	Model No.: LIS1574ERPC, Supplier: Sony Type No.: N/A
	Adapter:	Model No.: EP800, Supplier: Salcomp Type No.: CAA-0002016-US

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Bluetooth_BR+EDR:

Bluetooth Version:	V4.1 dual mode + HS
Channel number:	79 channels
Modulation type:	Frequency Hopping Spread Spectrum
Transmit Power:	5.38dBm
Frequency Range:	2.402GHz – 2.480GHz
Dwell Time:	<= 0.4s
Antenna Designation:	PIFA Antenna, Gain: 2.52dBi

Bluetooth Low Energy:

Frequency Range:	2402 – 2480MHz
Bluetooth Version:	V4.1 dual mode + HS
Channel number:	40 channels
Modulation type:	GFSK
Transmit Power:	-1.49dBm (Peak)
Antenna Designation:	PIFA Antenna, Gain: 2.52dBi

WLAN 2.4GHz:

Wi-Fi	Frequency Range	Channels	Rated Power	Modulation Technology
11b/g	2412-2462	11	b: 18.87dBm g: 22.66dBm	DSSS, OFDM
11n	HT20 2412-2462	11	HT20: 21.09dBm	OFDM
11n	HT40 2422-2452	7	HT40: 22.22dBm	OFDM
Antenna Designation:		PIFA Antenna, Gain: 2.52dBi		
Modulation type:		CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM		
Transition Rate:		802.11 b: 1/2/5.5/11 Mbps; 802.11 g: 6/9/12/18/24/36/48/54 Mbps 802.11 n_20MHz: 6.5 – 72.2Mbps 802.11 n_40MHz: 13.5 –135Mbps		

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WLAN 5GHz:

Wi-Fi	Frequency Range	Channels	Avg. Power	Modulation Technology
11a	5150~5250	4	13.96dBm	OFDM
	5250~5350	4	13.99dBm	
	5470~5725	8	13.96dBm	
	5725-5850	5	13.79dBm	
11n	HT20 5150~5250	4	HT20: 12.99dBm	OFDM
	HT20 5250~5350	4	HT20: 12.95dBm	
	HT20 5470~5725	8	HT20: 12.99dBm	
	HT20 5725-5850	5	HT20: 12.79dBm	
11n	HT40 5150~5250	2	HT40: 11.95dBm	OFDM
	HT40 5250~5350	2	HT40: 11.93dBm	
	HT40 5470~5725	3	HT40: 11.96dBm	
	HT40 5725-5850	2	HT40: 11.98dBm	
Antenna Designation	PIFA Antenna, 5GHz Gain: -0.54dBi (5150MHz-5250MHz) 5GHz Gain: -0.89dBi (5250MHz-5350MHz) 5GHz Gain: -0.34dBi (5470MHz-5725MHz) 5GHz Gain: -0.19dBi (5725MHz-5850MHz)			
Modulation type	64QAM, 16QAM, QPSK, BPSK for OFDM			
Transition Rate:	802.11 a: 6/9/12/18/24/36/48/54 Mbps 802.11 n_20MHz: 6.5 – 65.0Mbps 802.11 n_40MHz: 13.5 – 135.0Mbps			

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GSM / WCDMA/ LTE:

Cellular Phone Standards Frequency Range and Power	Operating Frequency		Rated Power
	GSM/GPRS 850, Class 12	824.2 MHz– 848.8 MHz	33dBm
	EDGE 850, Class 12	824.2 MHz– 848.8 MHz	27dBm
	GSM/GPRS 1900, Class 12	1850.2MHz – 1909.8MHz	30dBm
	EDGE 1900, Class 12	1850.2MHz – 1909.8MHz	26dBm
	WCDMA/HSUPA/HSDPA /HSPA+ Band II	1852.4MHz – 1907.6MHz	24dBm
	WCDMA/HSUPA/HSDPA /HSPA+ Band IV	1712.4MHz - 1752.6MHz	24dBm
	WCDMA/HSUPA/HSDPA /HSPA+ Band V	826.4MHz - 846.6MHz	24dBm
	1.4MHz BW LTE-Band 2	1850MHz– 1909.3MHz	23dBm
	3MHz BW LTE-Band 2	1851.5MHz – 1908.5MHz	23dBm
	5MHz BW LTE-Band 2	1852.5MHz – 1907.5MHz	23dBm
	10MHz BW LTE-Band 2	1855MHz – 1905MHz	23dBm
	15MHz BW LTE-Band 2	1857.5MHz – 1902.5MHz	23dBm
	20MHz BW LTE-Band 2	1860MHz – 1900MHz	23dBm
	1.4MHz BW LTE-Band 4	1710.7MHz– 1754.3MHz	23dBm
	3MHz BW LTE-Band 4	1711.5MHz – 1753.5MHz	23dBm
	5MHz BW LTE-Band 4	1712.5MHz – 1752.5MHz	23dBm
	10MHz BW LTE-Band 4	1715MHz – 1750MHz	23dBm
	15MHz BW LTE-Band 4	1717.5MHz – 1747.5MHz	23dBm
	20MHz BW LTE-Band 4	1720MHz – 1745MHz	23dBm
	5MHz BW LTE-Band 5	2502.5MHz – 2567.5MHz	23dBm
	10MHz BW LTE-Band 5	2505.0MHz – 2565.0MHz	23dBm
	15MHz BW LTE-Band 5	2507.5MHz – 2562.5MHz	23dBm
	20MHz BW LTE-Band 5	2510.0MHz – 2560MHz	23dBm

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Cellular Phone Standards Frequency Range and Power	Operating Frequency		Rated Power
	5MHz BW LTE-Band 7	2502.5MHz – 2567.5MHz	23dBm
	10MHz BW LTE-Band 7	2505.0MHz – 2565.0MHz	23dBm
	15MHz BW LTE-Band 7	2507.5MHz – 2562.5MHz	23dBm
	20MHz BW LTE-Band 7	2510.0MHz – 2560MHz	23dBm
Type of Emission:	GSM 850: 252KGXW, GSM 1900: 251KGXW GPRS 850: 248KGXW, GPRS 1900: 253KGXW EDGE 850: 259KG7W, EDGE 1900: 253KG7W WCDMA Band II: 4M21F9W, WCDMA Band IV: 4M22F9W, WCDMA Band V: 4M21F9W HSDPA Band II: 4M21F9W, HSDPA Band IV: 4M21F9W, HSDPA Band V: 4M21F9W HSUPA Band II: 4M21F9W, HSUPA Band IV: 4M22F9W, HSUPA Band V: 4M22F9W 1.4MHz BW LTE-Band 2 QPSK: 1M10G7D 1.4MHz BW LTE-Band 2 16QAM: 1M10D7W 3MHz BW LTE-Band 2 QPSK: 2M71G7D 3MHz BW LTE-Band 2 16QAM: 2M71D7W 5MHz BW LTE-Band 2 QPSK: 4M53G7D 5MHz BW LTE-Band 2 16QAM: 4M53D7W 10MHz BW LTE-Band 2 QPSK: 9M01G7D 10MHz BW LTE-Band 2 16QAM: 9M02D7W 15MHz BW LTE-Band 2 QPSK: 13M52G7D 15MHz BW LTE-Band 2 16QAM: 13M49D7W 20MHz BW LTE-Band 2 QPSK: 18M01G7D 20MHz BW LTE-Band 2 16QAM: 17M98D7W 1.4MHz BW LTE-Band 4 QPSK: 1M09G7D 1.4MHz BW LTE-Band 4 16QAM: 1M10D7W 3MHz BW LTE-Band 4 QPSK: 2M71G7D 3MHz BW LTE-Band 4 16QAM: 2M71D7W 5MHz BW LTE-Band 4 QPSK: 4M51G7D 5MHz BW LTE-Band 4 16QAM: 4M53D7W 10MHz BW LTE-Band 4 QPSK: 9M00G7D 10MHz BW LTE-Band 4 16QAM: 8M97D7W 15MHz BW LTE-Band 4 QPSK: 13M50G7D 15MHz BW LTE-Band 4 16QAM: 13M48D7W 20MHz BW LTE-Band 4 QPSK: 17M99D7W 20MHz BW LTE-Band 4 16QAM: 17M98D7W		

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Type of Emission:	5MHz BW LTE-Band 5 QPSK: 1M10G7D 5MHz BW LTE-Band 5 16QAM: 1M10D7W 10MHz BW LTE-Band 5 QPSK: 2M71G7D 10MHz BW LTE-Band 5 16QAM: 2M71D7W 15MHz BW LTE-Band 5 QPSK: 4M53G7D 15MHz BW LTE-Band 5 16QAM: 4M54D7W 20MHz BW LTE-Band 5 QPSK: 9M02G7D 20MHz BW LTE-Band 5 16QAM: 9M05D7W 5MHz BW LTE-Band 7 QPSK: 4M54G7D 5MHz BW LTE-Band 7 16QAM: 4M53D7W 10MHz BW LTE-Band 7 QPSK: 8M98G7D 10MHz BW LTE-Band 7 16QAM: 8M99D7W 15MHz BW LTE-Band 7 QPSK: 13M49G7D 15MHz BW LTE-Band 7 16QAM: 13M46D7W 20MHz BW LTE-Band 7 QPSK: 17M94G7D 20MHz BW LTE-Band 7 16QAM: 18M01D7W
IMEI:	00440245-354865-7

The report applied for Bluetooth BR+EDR.

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

This submittal(s) (test report) is intended for **FCC ID: PY7-PM0854** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules. The composite system (digital device) is compliance with FCC part 15; Subpart B is authorized under the certification procedure.

1.3. Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.4:2009 and ANSI C63.10:2009. Radiated testing was performed at an antenna to EUT distance 3 meters. Tested in accordance with FCC Public Notice DA 00-705 – Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems

1.4. Test Facility

The measurement facilities used to collect the 3m Radiated Emission and AC power line conducted data are located on the address of SGS Taiwan Ltd. Electronics & Communication Laboratory No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan which are constructed and calibrated to meet the FCC requirements in documents ANSI C63.4: 2009 & ANSI C63.10:2009. FCC Registration Numbers are: 990257, Canada Registration Number: 4620A-4.

The 10 m Open Area Test Sites located on the address of SGS Taiwan Ltd. Electronics & Communication Laboratory No.2, Keji 1st Rd., Guishan Township, Taoyuan County, Taiwan, which is constructed and calibrated to meet the CISPR 22/EN 55022 requirements. SGS Site No. 1(3 &10 meters) and FCC Registration Number: 455997.

1.5. Special Accessories

There is no special accessory used while test was conducted.

1.6. Equipment Modifications

There was no modification incorporated into the EUT.

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2. SYSTEM TEST CONFIGURATION

2.1. EUT Configuration

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

2.2. EUT Exercise

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

2.3. Test Procedure

2.3.1 Conducted Emissions

The EUT is placed on a turn table which is 0.8 m above ground plane. According to the general criterion in Section 7.1 of ANSI C63.4:2009 & 6.2 ANSI 63.10:2009. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz, and the measurement procedure 7.3 in ANSI 63.4:2009 & 6.2.2, and 6.2.3 in ANSI 63.10:2009 is followed to carry out the test. The CISPR Quasi-Peak and Average detector mode is employed according to §15.107

2.3.2 Radiated Emissions

The EUT is placed on a turn table which is 0.8 m above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes 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 according to the requirements in Section 8 and 13 and of ANSI C63.4:2009, & Section 6.3, 6.4, 6.5, and 6.6 of ANSI 63.10:2009 and DA 00-705.

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2.4. Configuration of Tested System

Fig. 2-1 Radiated Emission

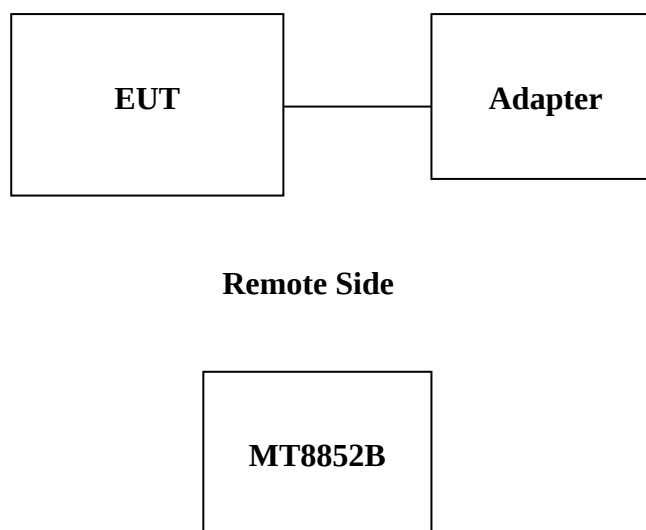


Fig. 2-2 Conducted (Antenna Port) Configuration

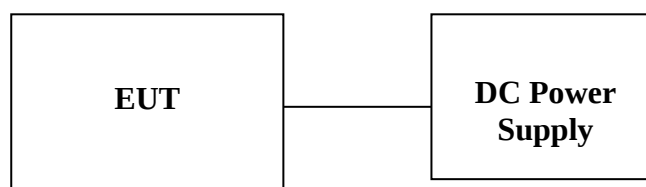


Table 2-1 Equipment Used in Tested System

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	Anritsu	MT8852B	6k00006107	N/A	N/A
3.	DC Power Supply	HP	E3640A	KR93300208	N/A	N/A

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Fig. 2-3 AC Power Line Conducted Emission

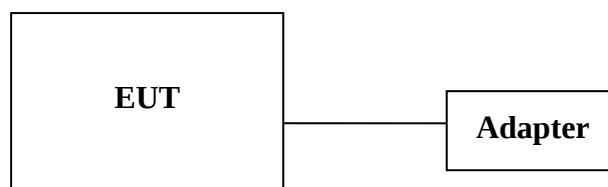


Table 2-2 Equipment Used in Tested System

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

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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)	100 kHz Bandwidth Of Frequency Band Edges	Compliant
§15.247(d) §15.209(a) (f)	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	Antenna Requirement	Compliant

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4. DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Channel Low, Mid and High with highest rated data rate were chosen as worst case for full testing. The field strength of spurious radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for Bluetooth Transmitter for channel Low, Mid and High the worst case E2 position was reported.

Channel Low: channel 1 at 2402MHz

Channel Mid: channel 39 at 2441MHz

Channel High: channel 78 at 2480MHz

In comparison with BR and EDR mode, emission carried out by BR is chosen as the most representative measurement to perform measurement of radiated spurious emission pursuant to Part 15C. Modulation, EDR, is selected to be performed for 100 kHz Bandwidth Band Edge, Conducted Spurious Emission, Frequency Separation, Number of hopping frequency due to its characteristics of wider bandwidth.

Data type being used to conduct the measurement:

DH1/DH3/DH5 (GFSK) with 1Mbps

2DH1/2DH3/2DH5 ($\pi/4$ DQPSK) with 2Mbps

3DH1/3DH3/3DH5 (8DPSK) with 3Mbps

Type no, PM-0854-BV, and Type no PM-0850-BV share the equivalently identical enclosure, material of coating, I/O function, PCB board, display, and power source. In addition, PM-0854-BV, and Type no PM-0850-BV implement the same Bluetooth/WLAN chipset/module with the same antenna that operates with the same transmitted power level. Hence, this given test report contains the identical test results that inherent from PM-0850-BV.

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5. MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.586 dB
Peak Output Power	+/- 1.55 dB
20dB Bandwidth	+/- 123.36 Hz
100 KHz Bandwidth Of Frequency Band Edges	+/- 1.55 dB
Frequency Separation	+/- 123.36 Hz
Number of hopping frequency	+/- 123.36 Hz
Time of Occupancy	+/- 123.36 Hz
Temperature	+/- 0.8 °C
Humidity	+/- 4.7 %
DC / AC Power Source	DC= +/- 1%, 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

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

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

6.2. Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESCI7	100760	05/26/2014	05/25/2015
LISN	Rolf-Heine	NNB-2/16Z	99012	03/26/2014	03/25/2015
LISN	FCC	FCC-LISN-50/250-25-2-01	04034	03/19/2014	03/18/2015
Coaxial Cables	N/A	WK CE Cable	N/A	11/26/2013	11/25/2014

6.3. EUT Setup

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.4:2009 & ANSI 63.10:2009.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

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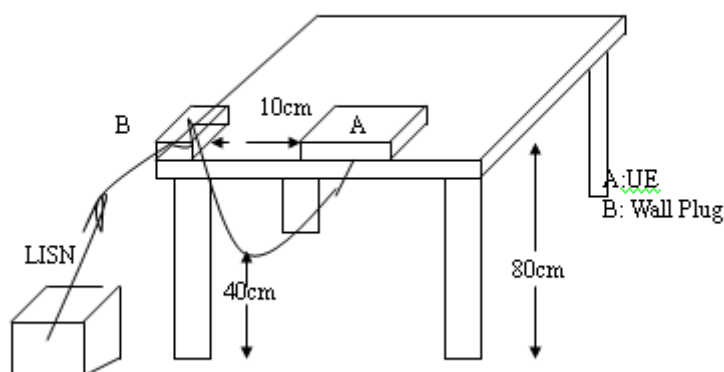
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6.4. Test SET-UP (Block Diagram of Configuration)



6.5. Measurement Procedure

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

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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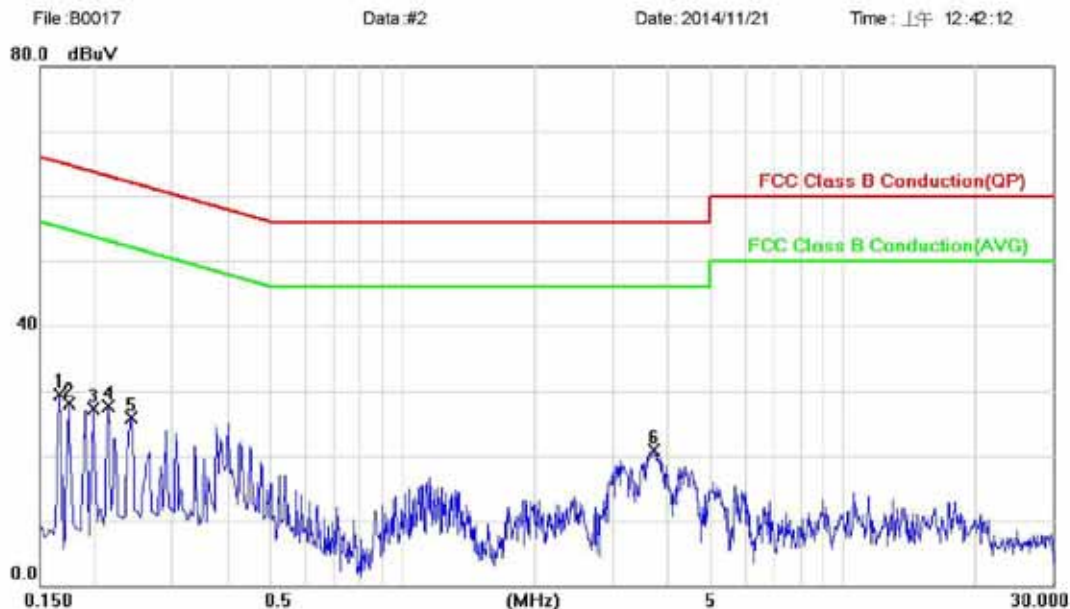
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AC POWER LINE CONDUCTED EMISSION TEST DATA

Operation Mode:	Operation mode			Test Date:	Nov. 21, 2014
Temperature:	26	Humidity:	60 %	Test By:	Tin
Model No.:	EP800				

Site: ConductionRoom Phase: **L1** Temperature: 24 °C
Limit: FCC Class B Conduction(QP) Power: AC 120V/60Hz Humidity: 66%
Mode: Operation
Note: Adapter:3113W 22 608033

Conducted Emission



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1660	29.45	0.05	29.50	65.16	-35.66	peak	
2		0.1740	28.02	0.05	28.07	64.77	-36.70	peak	
3		0.1980	27.23	0.06	27.29	63.69	-36.40	peak	
4		0.2140	27.56	0.06	27.62	63.05	-35.43	peak	
5		0.2420	25.82	0.06	25.88	62.03	-36.15	peak	
6	*	3.7260	20.68	0.17	20.85	56.00	-35.15	peak	

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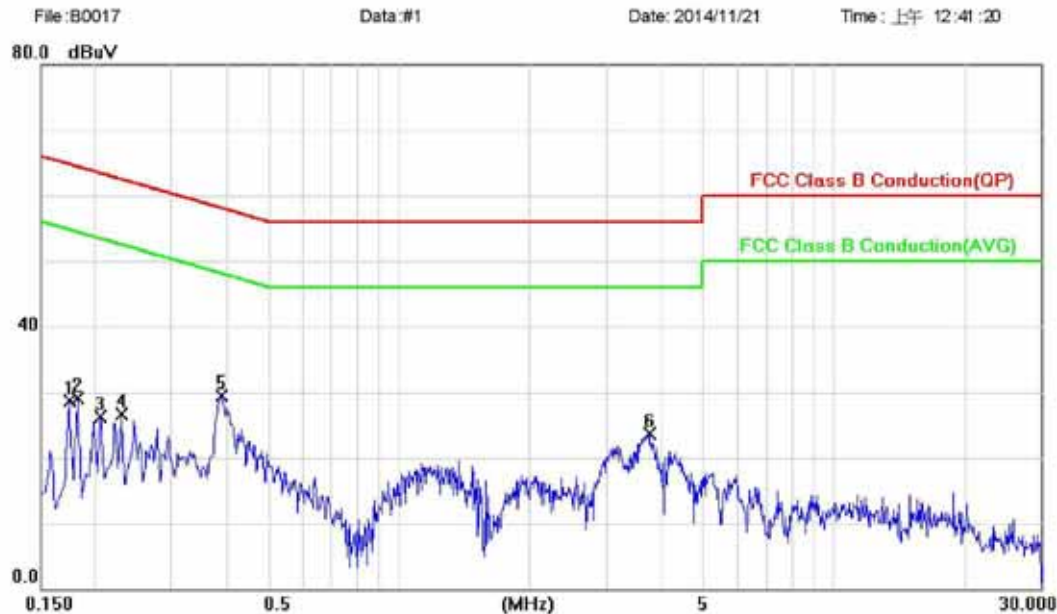
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Site: ConductionRoom
Limit: FCC Class B Conduction(QP)
Mode: Operation
Note: Adapter:3113W 22608033

Phase: **N**
Power: AC 120V/60Hz

Temperature: 24 °C
Humidity: 68%

Conducted Emission



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector	Comment
		MHz	dBuV	dB	dBuV	dBuV	dB		
1		0.1740	28.73	0.05	28.78	64.77	-35.99	peak	
2		0.1820	29.13	0.06	29.19	64.39	-35.20	peak	
3		0.2060	26.22	0.06	26.28	63.37	-37.09	peak	
4		0.2300	26.62	0.06	26.68	62.45	-35.77	peak	
5 *		0.3900	29.53	0.07	29.60	58.06	-28.46	peak	
6		3.7620	23.48	0.17	23.65	56.00	-32.35	peak	

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7. PEAK OUTPUT POWER MEASUREMENT

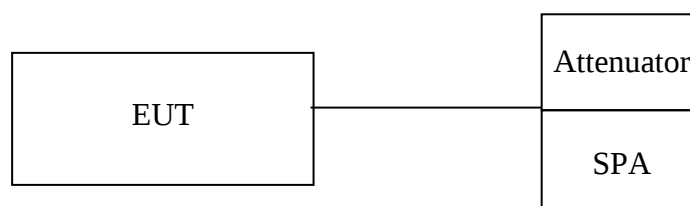
7.1. Standard Applicable

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

7.2. Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	ML2495A	1005007	01/13/2014	01/12/2015
Power Sensor	Anritsu	MA2411B	917032	01/13/2014	01/12/2015
Spectrum Analyzer	Agilent	E4446A	MY51100003	05/19/2014	05/18/2015
Spectrum Analyzer	Agilent	E4440A	MY45304525	03/08/2014	03/07/2015
DC Block	Mini-Circuits	BLK-18-S+	1	02/27/2014	02/26/2015
Low Loss Cable	HUBER+SUHNER	SUCOFLEX 104PEA	N/A	01/03/2014	01/02/2015
Attenuator	Mini-Circuit	BW-S10W2+	002	02/27/2014	02/26/2015
Splitter	Agilent	11636B	N/A	02/27/2014	02/26/2015

7.3. Test Set-up:



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7.4. Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. 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 $\geq$ 20dB bandwidth)
3. Record the max. reading.
4. Repeat above procedures until all default test channel is completed.

NOTE: cable loss as 4dB that offsets in the spectrum

7.5. Measurement Result

1M BR mode:

Frequency (MHz)	Reading Power (dBm)	Output Power (dBm)	Output Power (W)	Limit (W)
2402.00	3.50	3.50	0.00224	1
2441.00	5.38	5.38	0.00345	1
2480.00	4.42	4.42	0.00277	1

2M EDR mode:

Frequency (MHz)	Reading Power (dBm)	Output Power (dBm)	Output Power (W)	Limit (W)
2402.00	3.13	3.13	0.00206	0.125
2441.00	4.74	4.74	0.00298	0.125
2480.00	3.80	3.80	0.00240	0.125

3M EDR mode:

Frequency (MHz)	Reading Power (dBm)	Output Power (dBm)	Output Power (W)	Limit (W)
2402.00	3.24	3.24	0.00211	0.125
2441.00	4.80	4.80	0.00302	0.125
2480.00	3.90	3.90	0.00245	0.125

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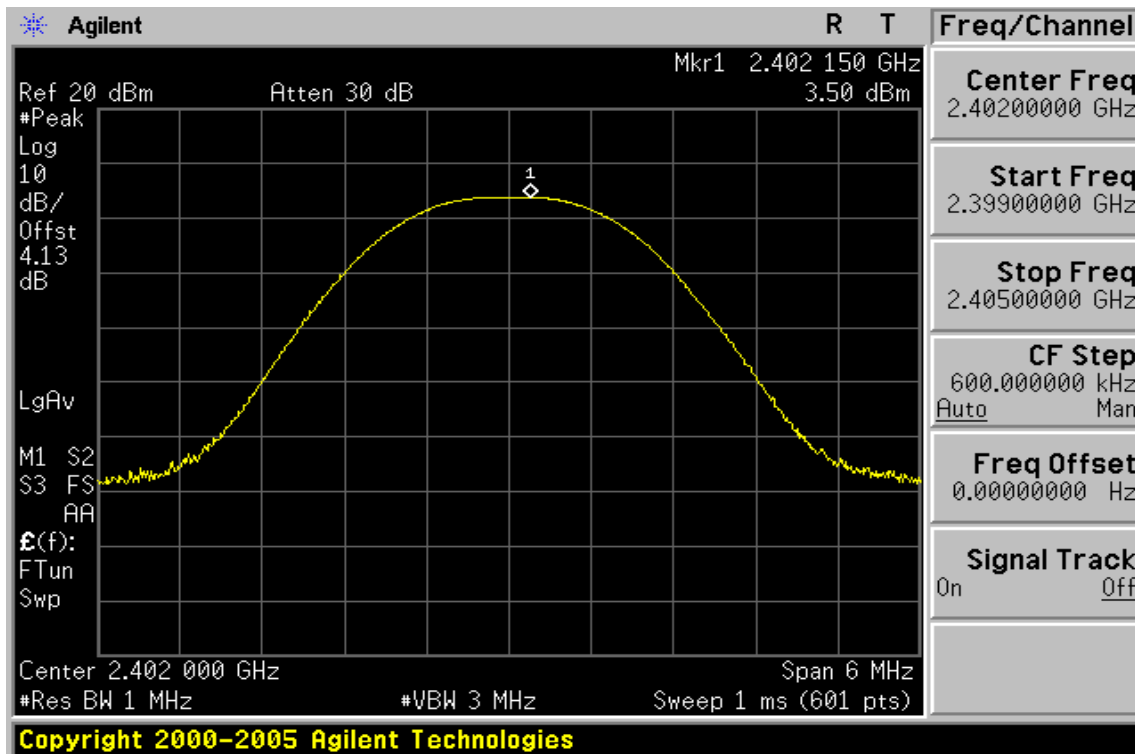
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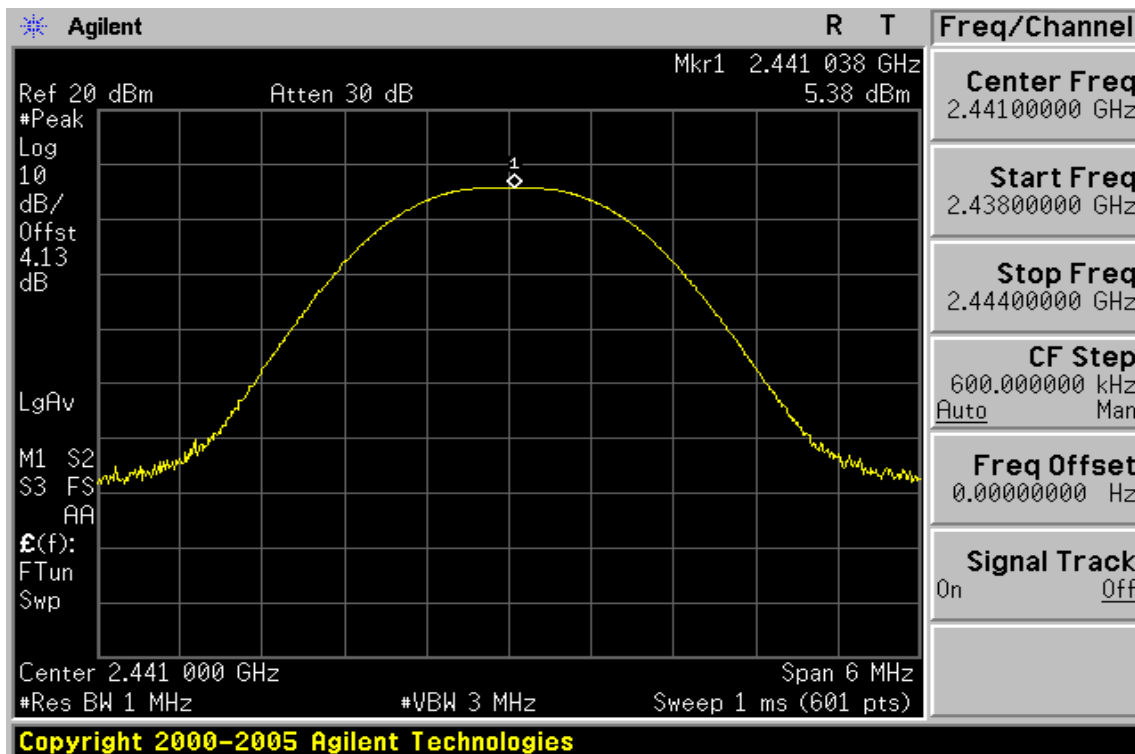
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Peak Power Output Data Plot (CH Low) (1M BR mode)



Peak Power Output Data Plot (CH Mid) (1M BR mode)



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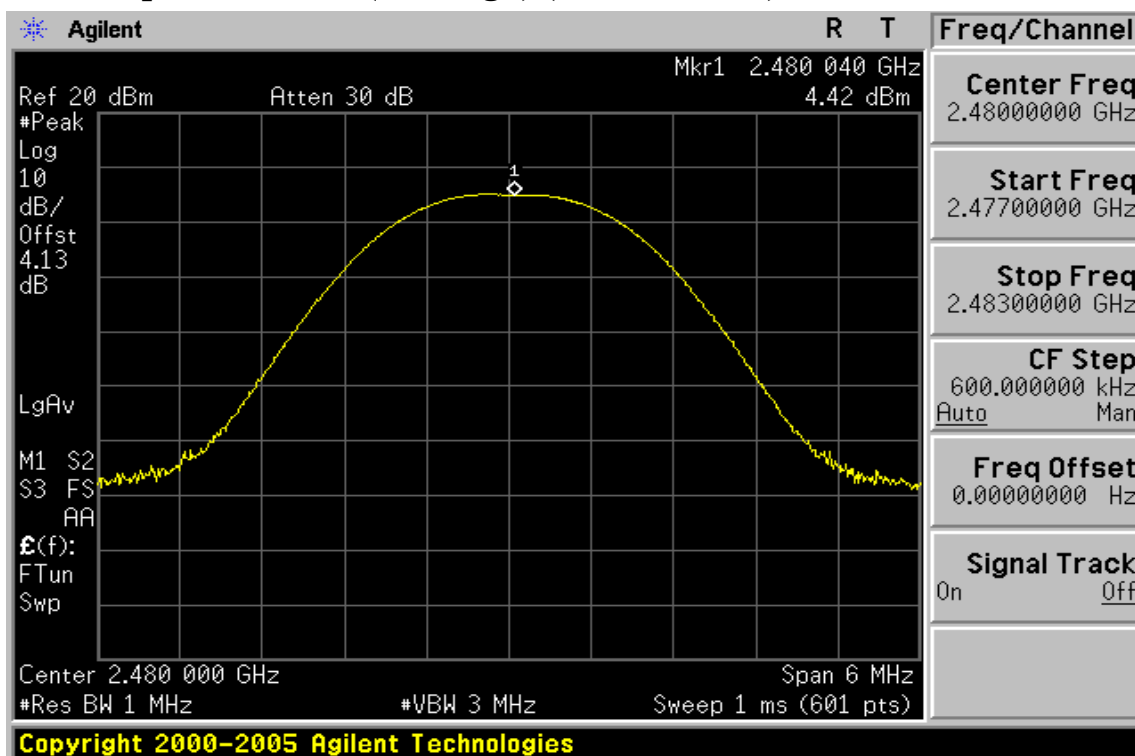
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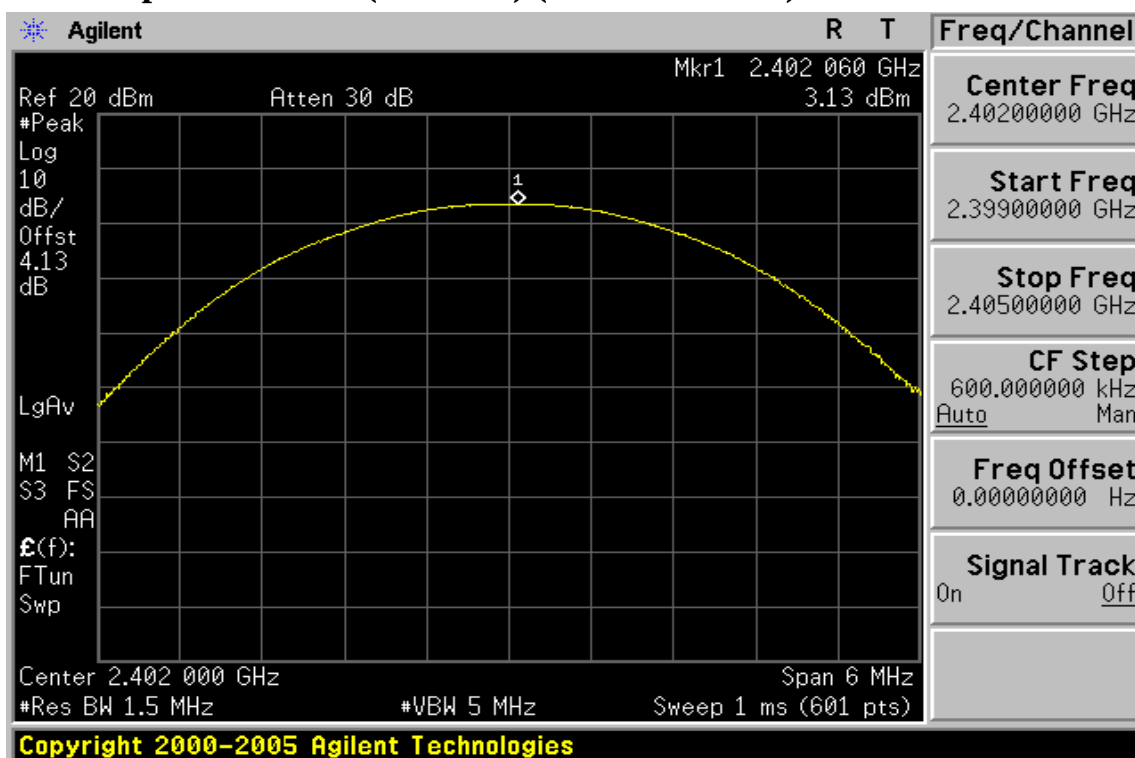
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Peak Power Output Data Plot (CH High) (1M BR mode)



Peak Power Output Data Plot (CH Low) (2M EDR mode)



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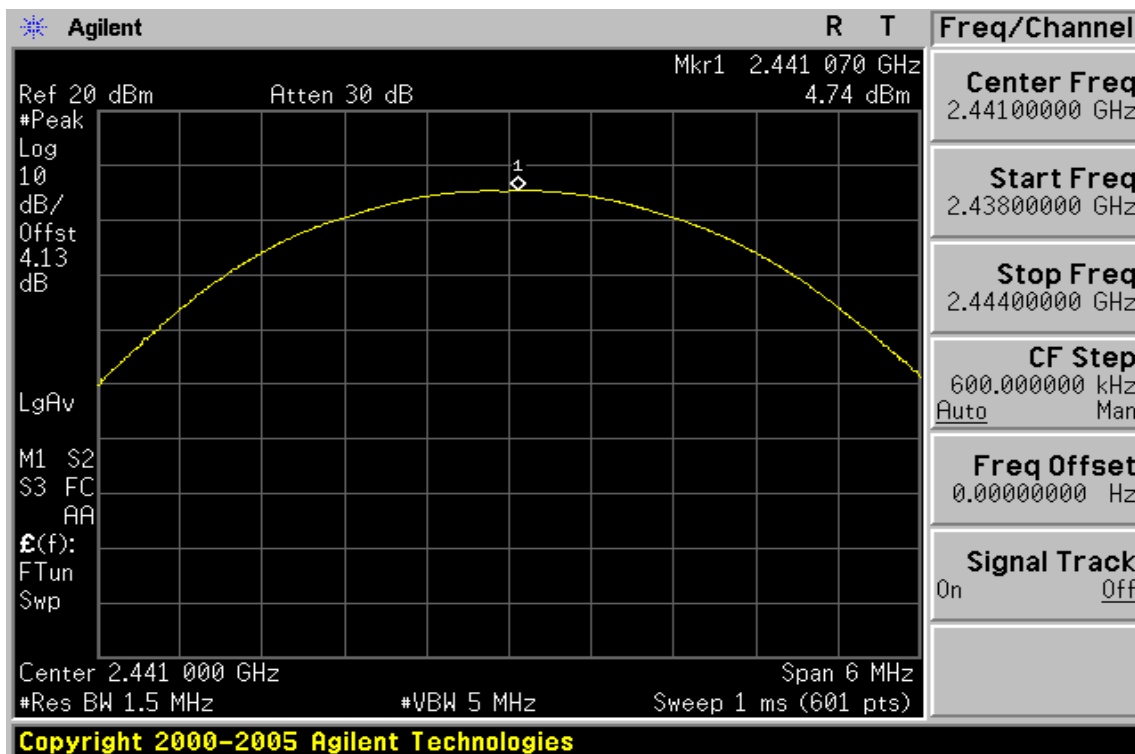
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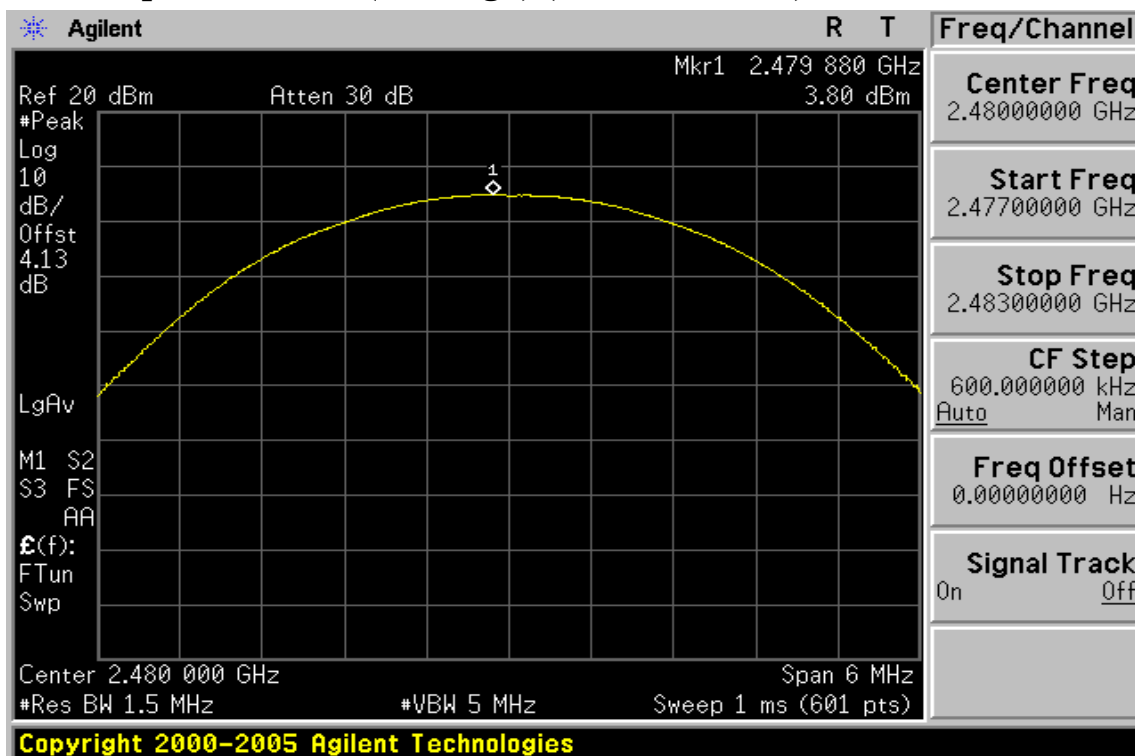
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Peak Power Output Data Plot (CH Mid) (2M EDR mode)



Peak Power Output Data Plot (CH High) (2M EDR mode)



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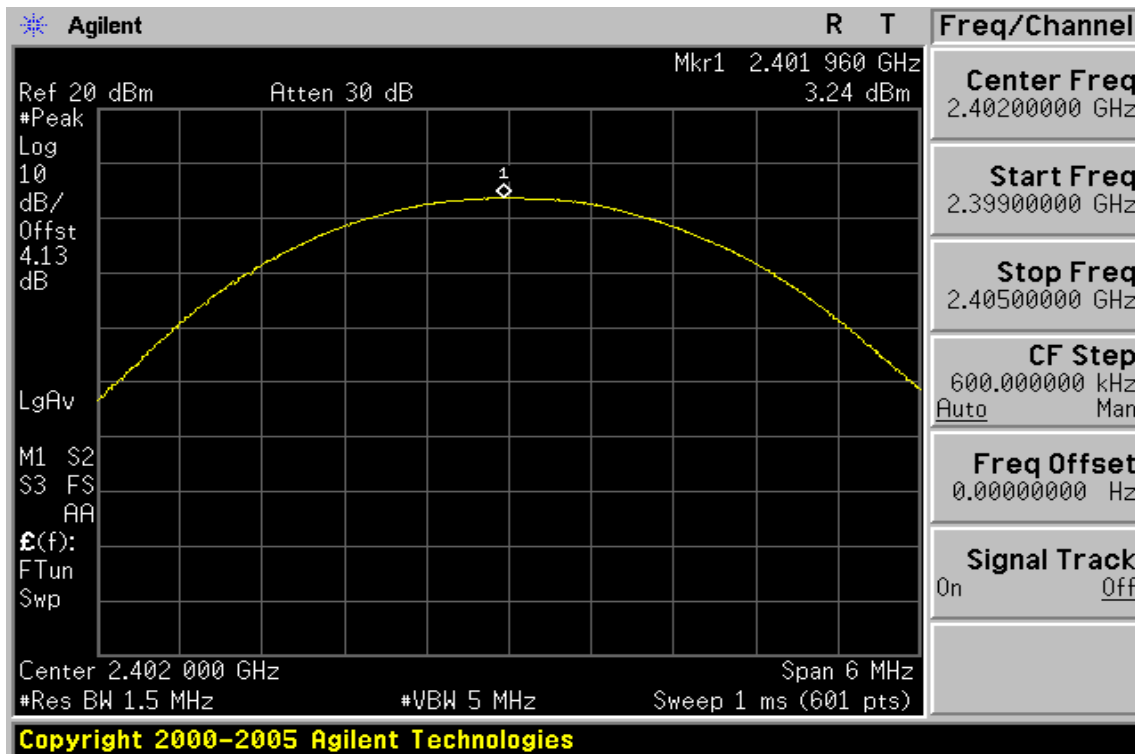
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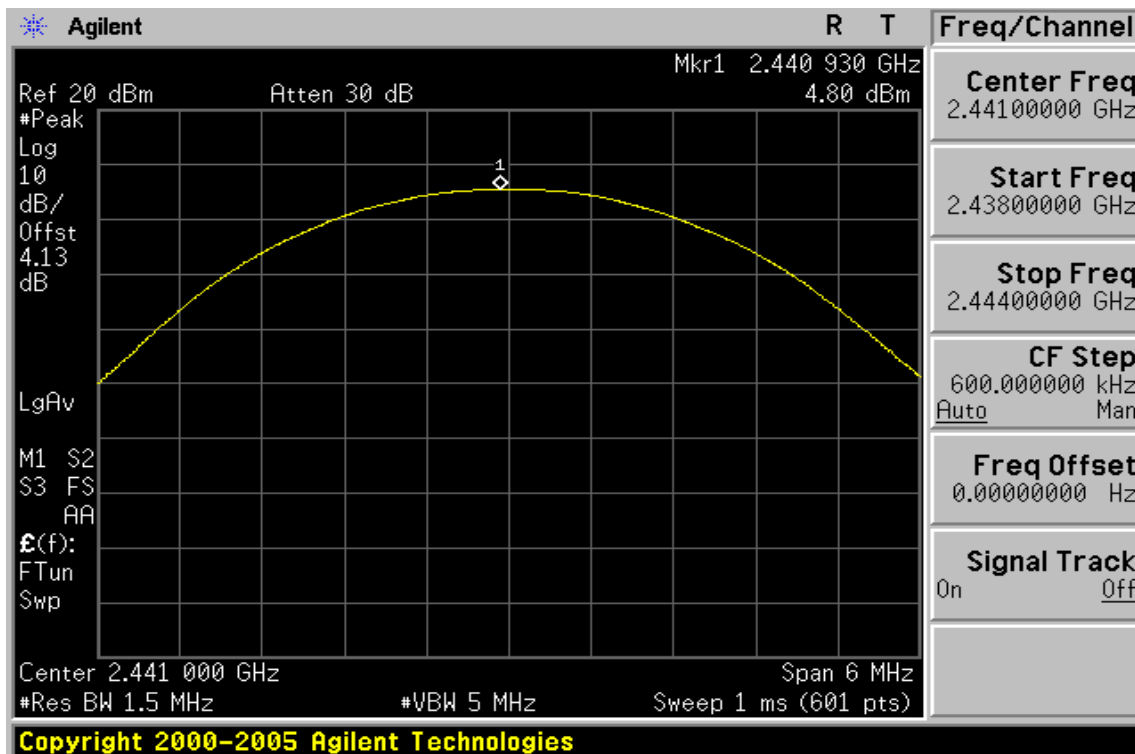
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Peak Power Output Data Plot (CH Low) (3M EDR mode)



Peak Power Output Data Plot (CH Mid) (3M EDR mode)



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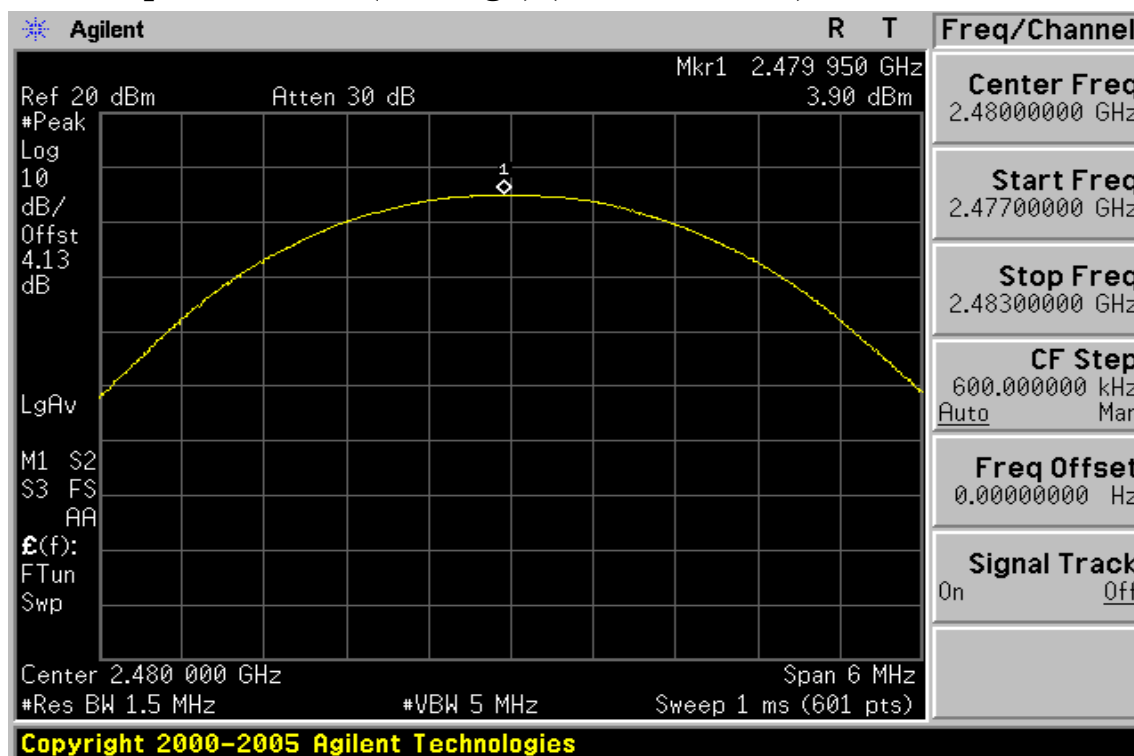
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Peak Power Output Data Plot (CH High) (3M EDR mode)



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8. 20dB BANDWIDTH

8.1. Standard Applicable

For 20dB Bandwidth

According to §15.247(a)(1) 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.
Power Meter	Anritsu	ML2495A	1005007	01/13/2014	01/12/2015
Power Sensor	Anritsu	MA2411B	917032	01/13/2014	01/12/2015
Spectrum Analyzer	Agilent	E4446A	MY51100003	05/19/2014	05/18/2015
Spectrum Analyzer	Agilent	E4440A	MY45304525	03/08/2014	03/07/2015
DC Block	Mini-Circuits	BLK-18-S+	1	02/27/2014	02/26/2015
Low Loss Cable	HUBER+SUHNER	SUCOFLEX 104PEA	N/A	01/03/2014	01/02/2015
Attenuator	Mini-Circuit	BW-S10W2+	002	02/27/2014	02/26/2015
Splitter	Agilent	11636B	N/A	02/27/2014	02/26/2015

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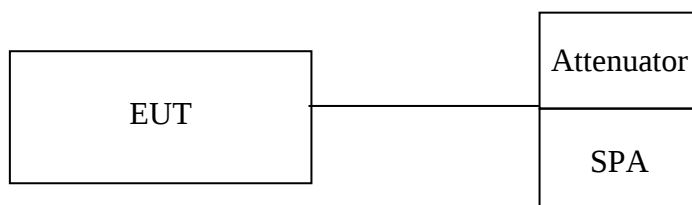
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8.3. Test Set-up



8.4. Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW=10 kHz (1 % of 20 dB Bandwidth.), VBW = 30 kHz, Span= 3MHz, Sweep=auto, Detector = Peak, and Max hold for 20dB Bandwidth test.
4. Mark the peak frequency and -20dB (upper and lower) frequency
5. Repeat above procedures until all test default channel is completed

NOTE: cable loss as 4.13dB that offsets in the spectrum

NOTE2: For the plot of bandwidth measurement, the marker of the 20dB BW is arrow-mark

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8.5. Measurement Result:

1M BR mode:

CH	Bandwidth (MHz)
Low	0.928
Mid	0.928
High	0.927

2M EDR mode:

CH	Bandwidth (MHz)	2/3 Bandwidth (MHz)
Low	1.304	0.869
Mid	1.307	0.871
High	1.313	0.875

3M EDR mode:

CH	Bandwidth (MHz)	2/3 Bandwidth (MHz)
Lower	1.258	0.839
Mid	1.259	0.839
High	1.264	0.843

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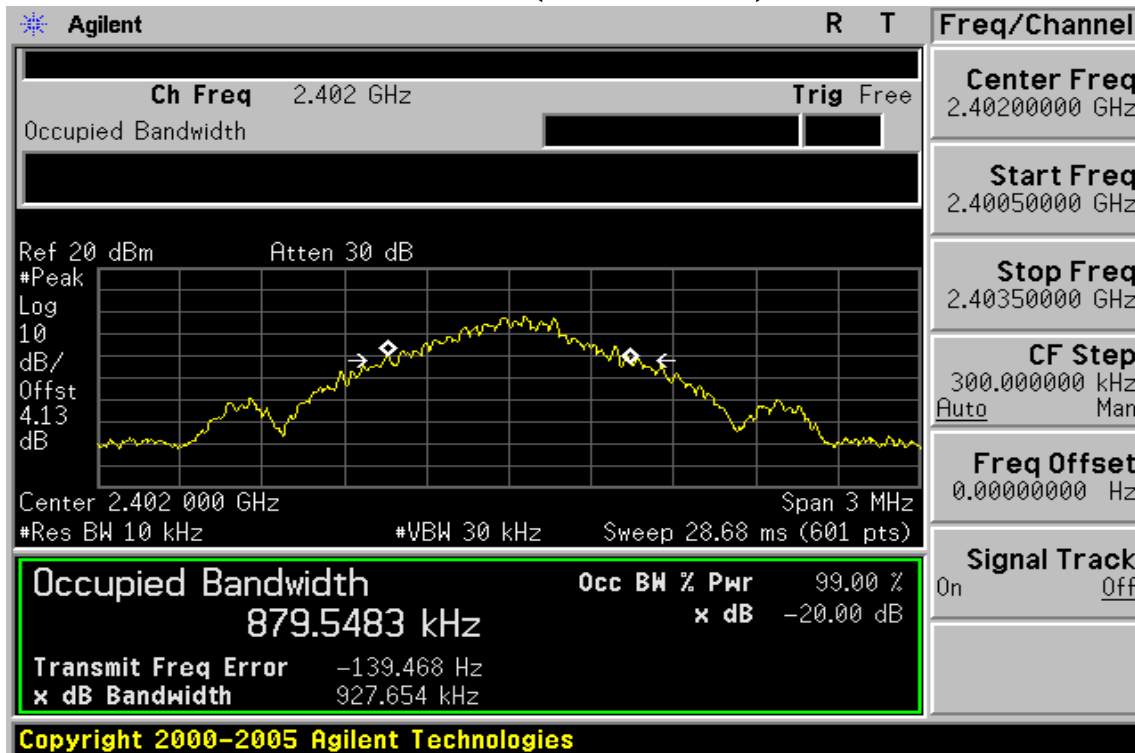
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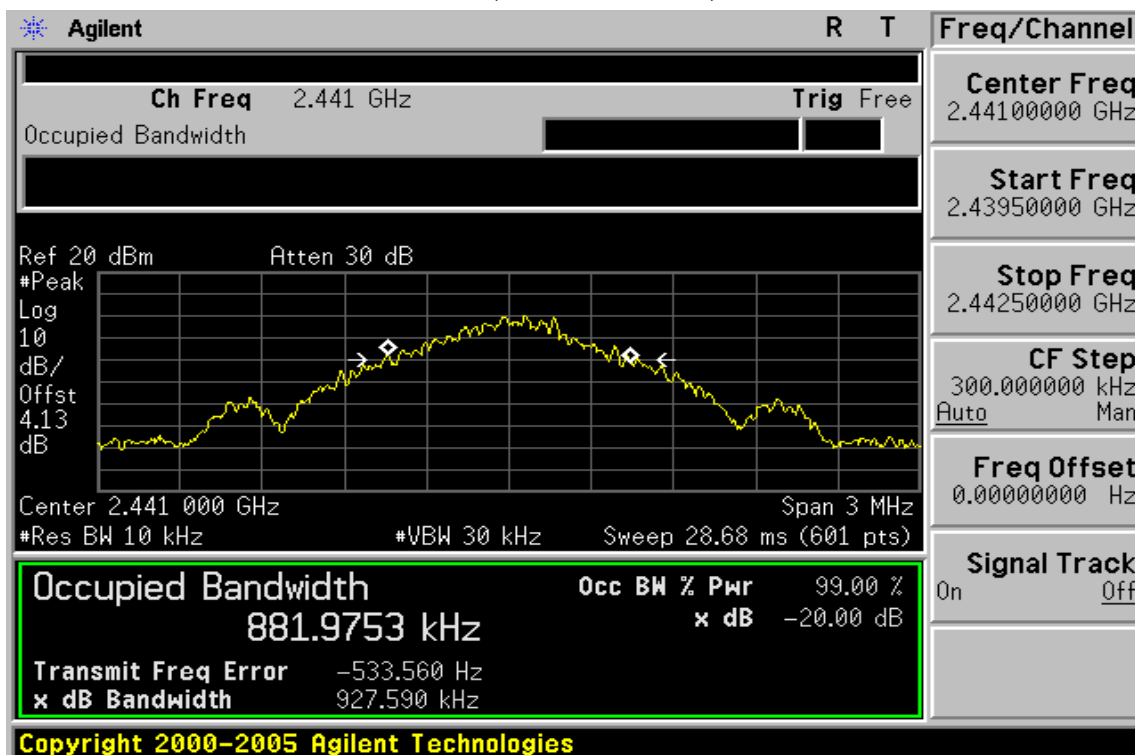
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20dB Band Width Test Data CH-Low (1M BR mode)



20dB Band Width Test Data CH-Mid (1M BR mode)



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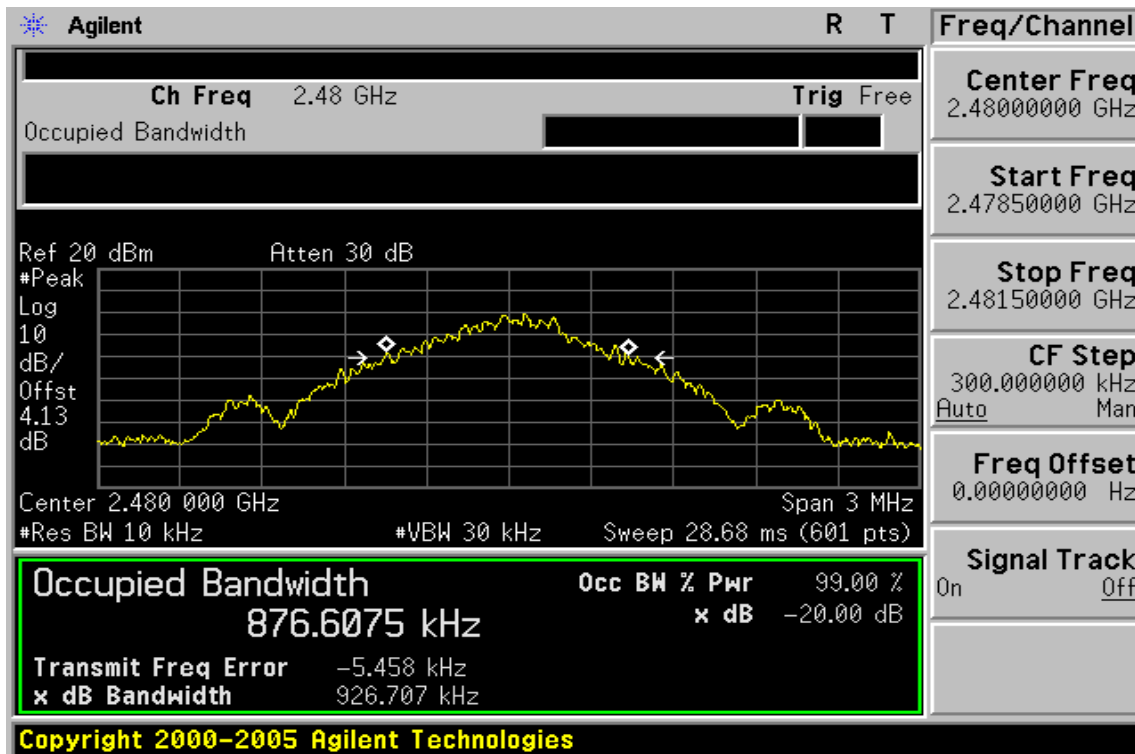
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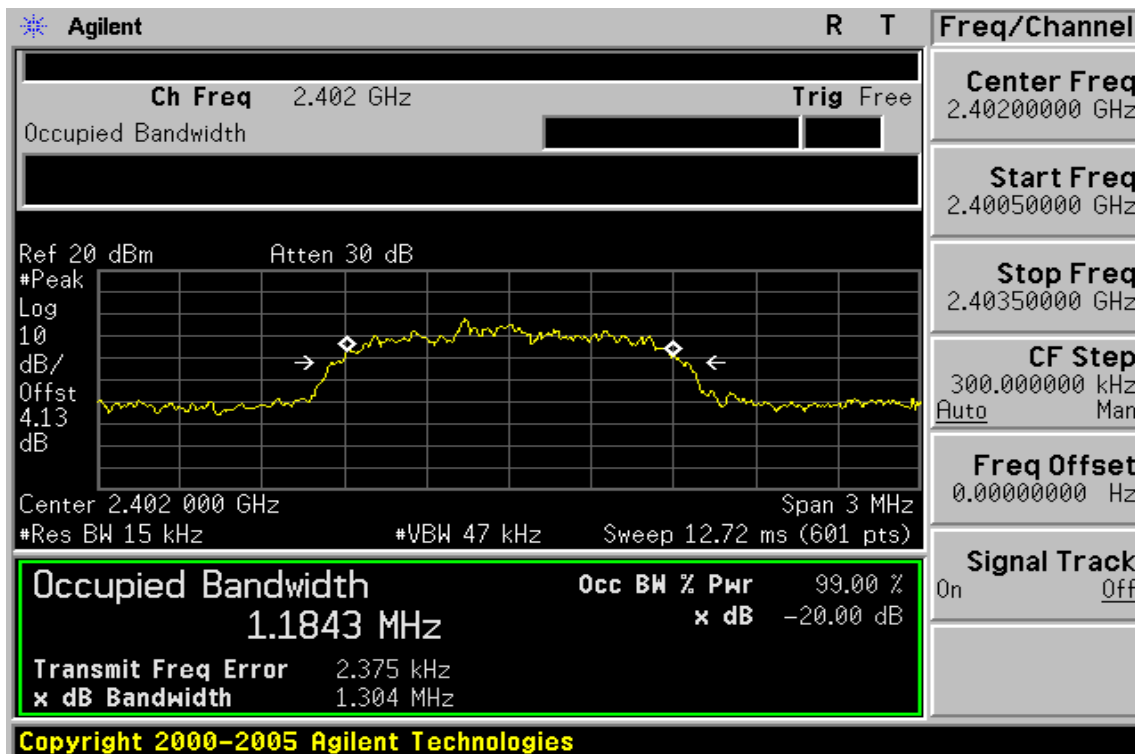
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20dB Width Test Data CH-High (1M BR mode)



20dB Band Width Test Data CH-Low (2M EDR mode)



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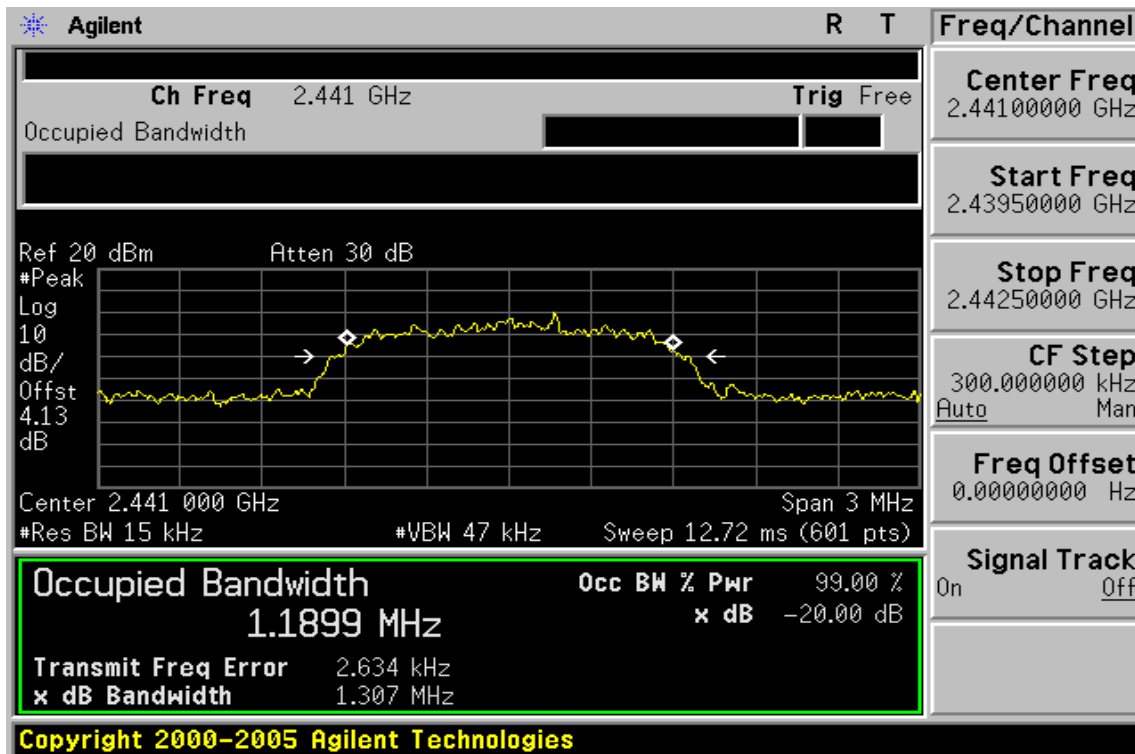
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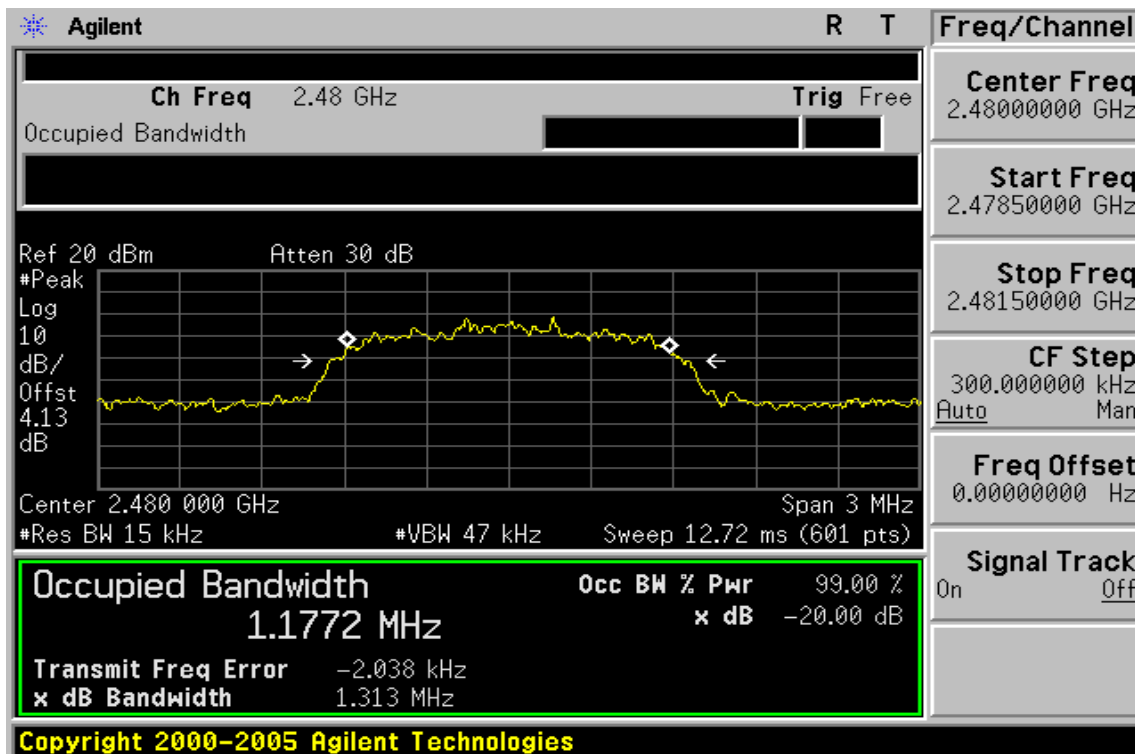
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20dB Band Width Test Data CH-Mid (2M EDR mode)



20dB Band Width Test Data CH-High (2M EDR mode)



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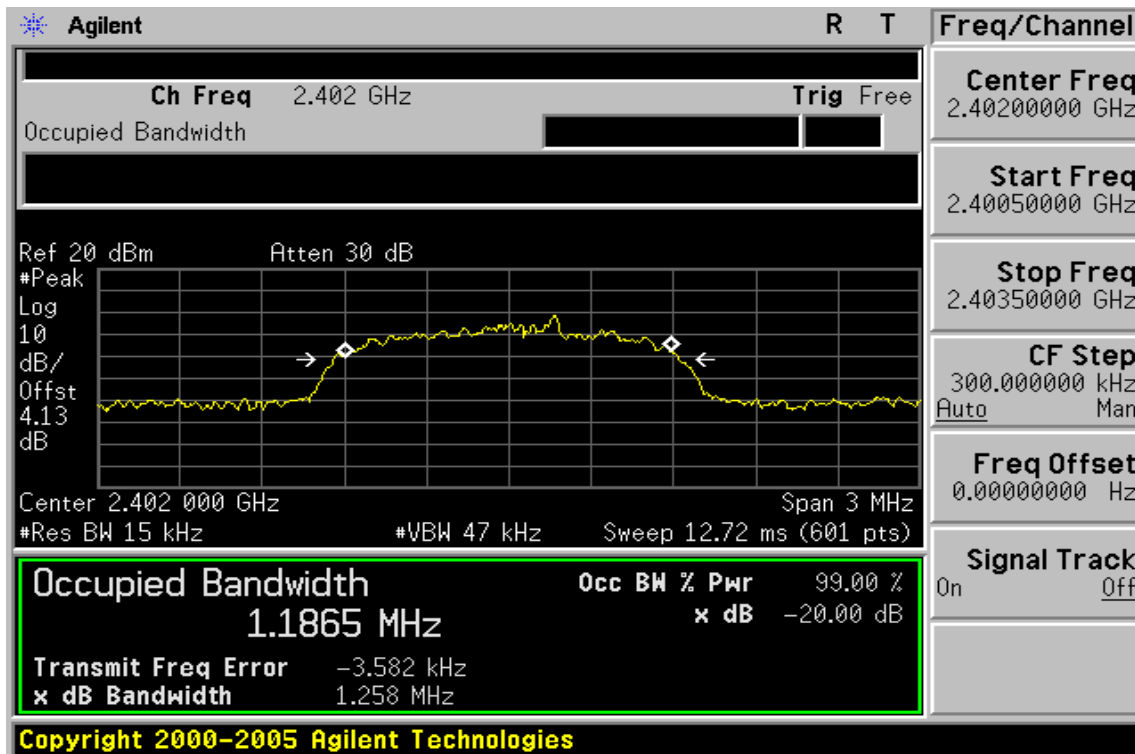
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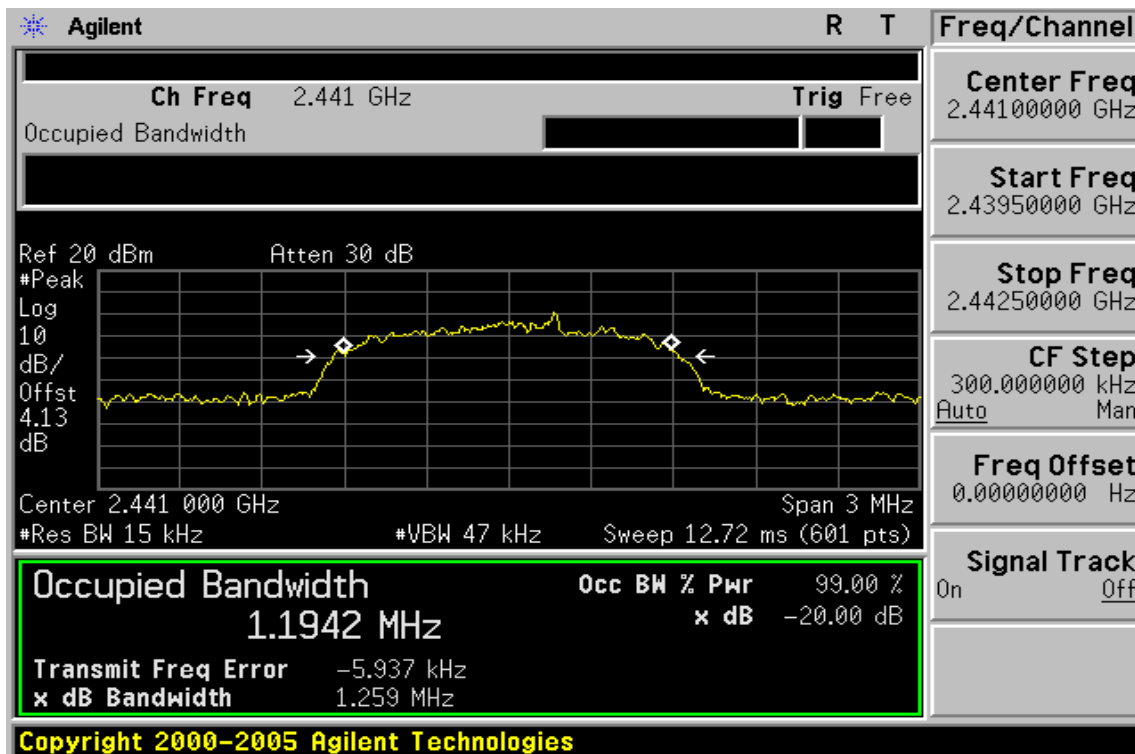
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20dB Band Width Test Data CH-Low (3M EDR mode)



20dB Band Width Test Data CH-Mid (3M EDR mode)



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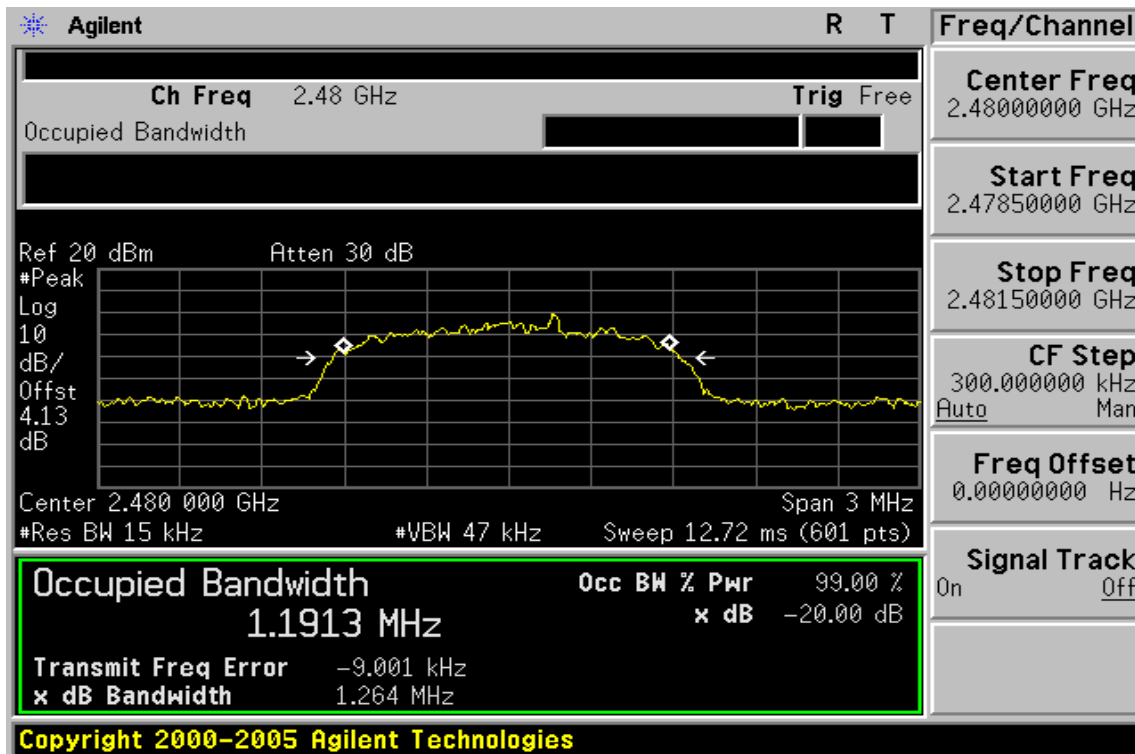
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20dB Width Test Data CH-High (3M EDR mode)



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9. BAND EDGES EMISSION MEASUREMENT

9.1. Standard Applicable

According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

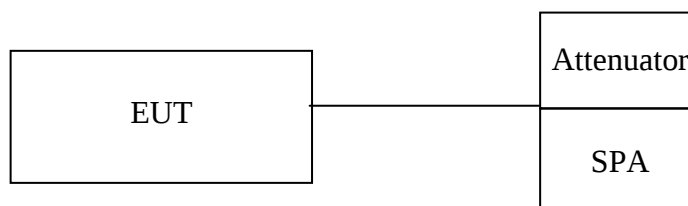
9.2. Measurement Equipment Used

9.2.1. Conducted Emission at antenna port:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Agilent	E4446A	MY51100003	05/19/2014	05/18/2015
Spectrum Analyzer	Agilent	E4440A	MY45304525	03/08/2014	03/07/2015
DC Block	Mini-Circuits	BLK-18-S+	1	02/27/2014	02/26/2015
Low Loss Cable	HUBER+SUHNER	SUCOFLEX 104PEA	N/A	01/03/2014	01/02/2015
Attenuator	Mini-Circuit	BW-S10W2+	002	02/27/2014	02/26/2015
Splitter	Agilent	11636B	N/A	02/27/2014	02/26/2015

9.3. Test SET-UP:

9.3.1. Conducted Emission at antenna port:



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9.4. Measurement Procedure

100 kHz BANDWIDTH OF BAND EDGES:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW, VBW=300 kHz, Sweep = auto
5. Mark Peak, 2.390GHz and 2.4835GHz and record the max. level.
6. Repeat above procedures until all frequency measured were complete.

Out-Of-Band EMISSION

1. To connect Antenna Port of EUT to Spectrum.
2. Set RBW = 100K & VBW = 300K on Spectrum.
3. Sweep the frequency to determine spurious emission as seen on spectrum from span of 30MHz to 3G, 3G to 8G, 8G to 13G, 13G to 18G and 18G to 26.5GHz
4. Via Software, combine 5 spans of frequency range into two plots containing the range of 30MHz to 3GHz, and 3GHz to 26.5GHz.

9.5. 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	

9.6. Measurement Result -1 Out-Of-Band EMISSION:

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

NOTE: cable loss as 4.13dB that offsets in the spectrum

NOTE: the occurrence of the spike on the conducted emission is the signal of the fundamental emission.

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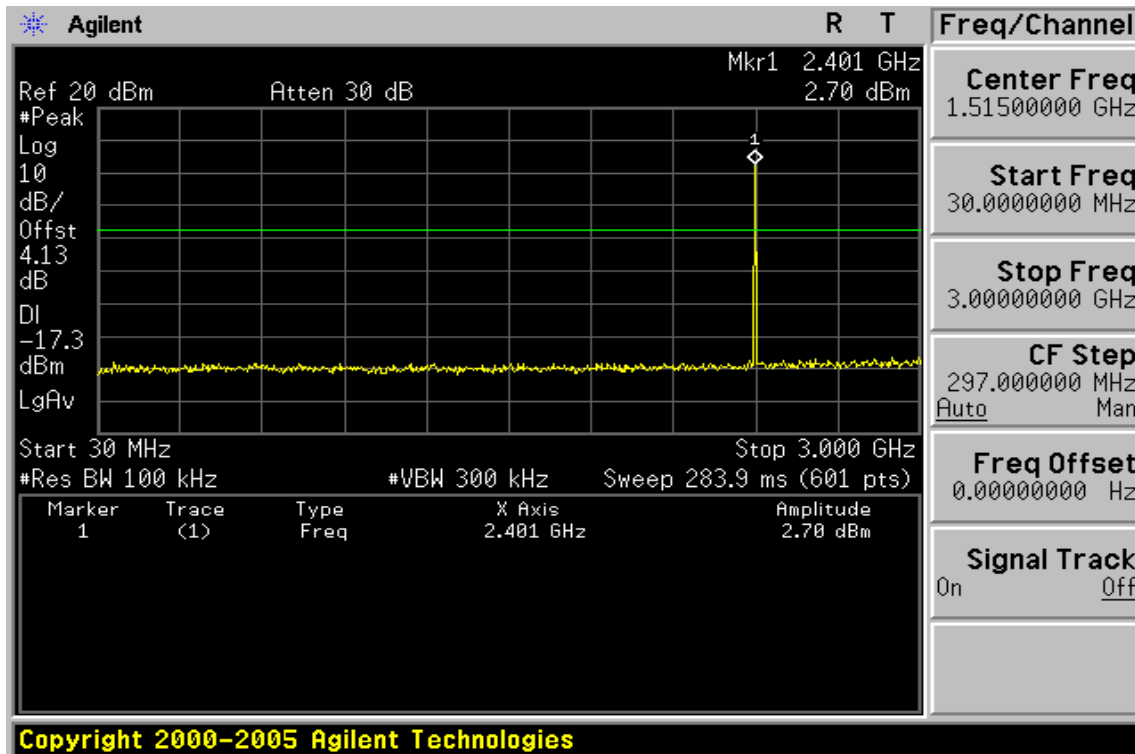
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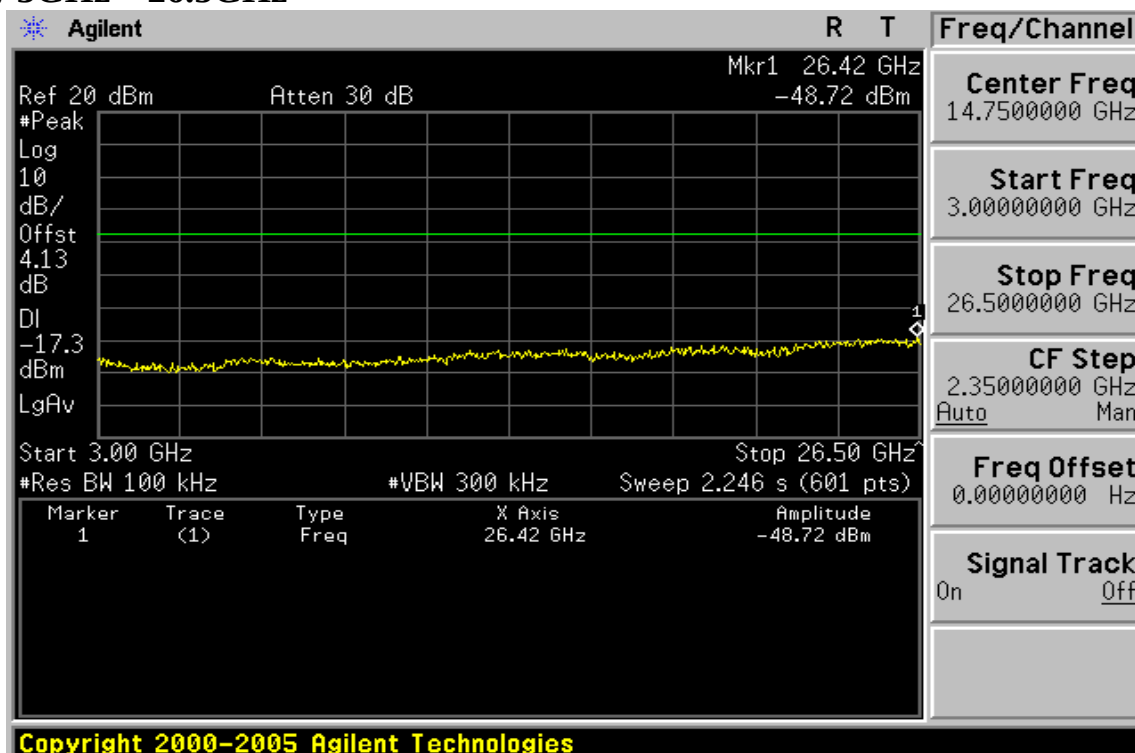
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9.7 Measurement Result -1 Conducted Spurious Emission Measurement Result (Worst: BR mode)

Ch Low 30MHz – 3GHz



Ch Low 3GHz – 26.5GHz



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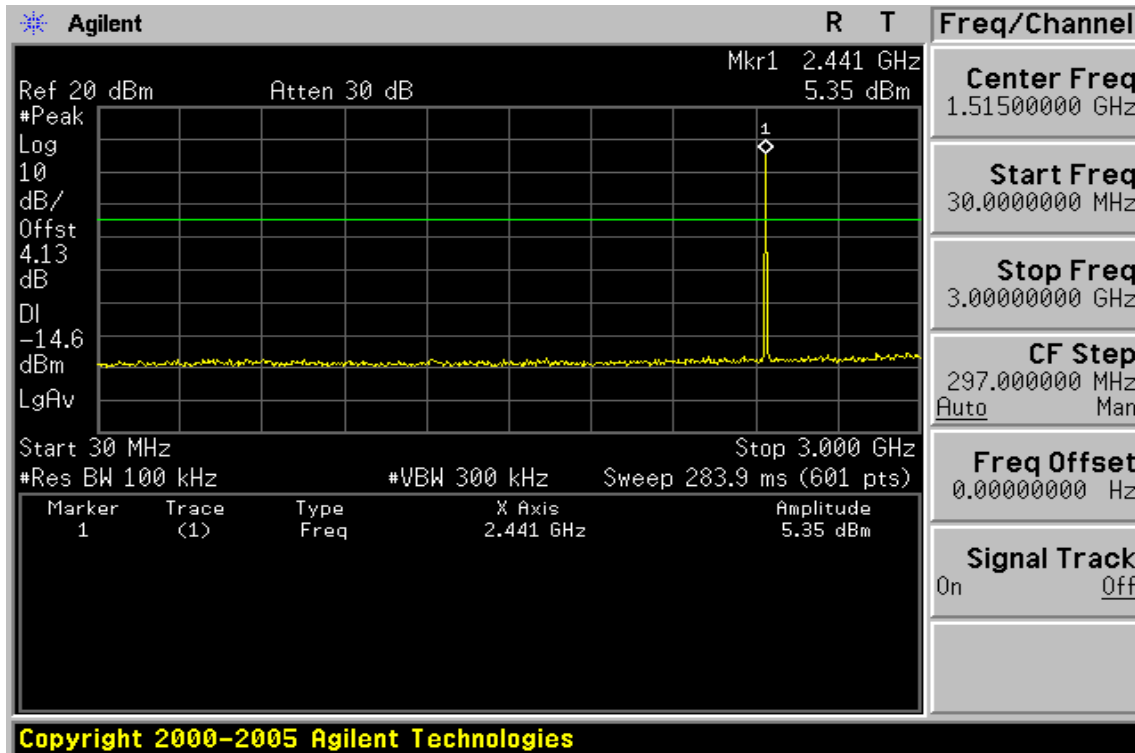
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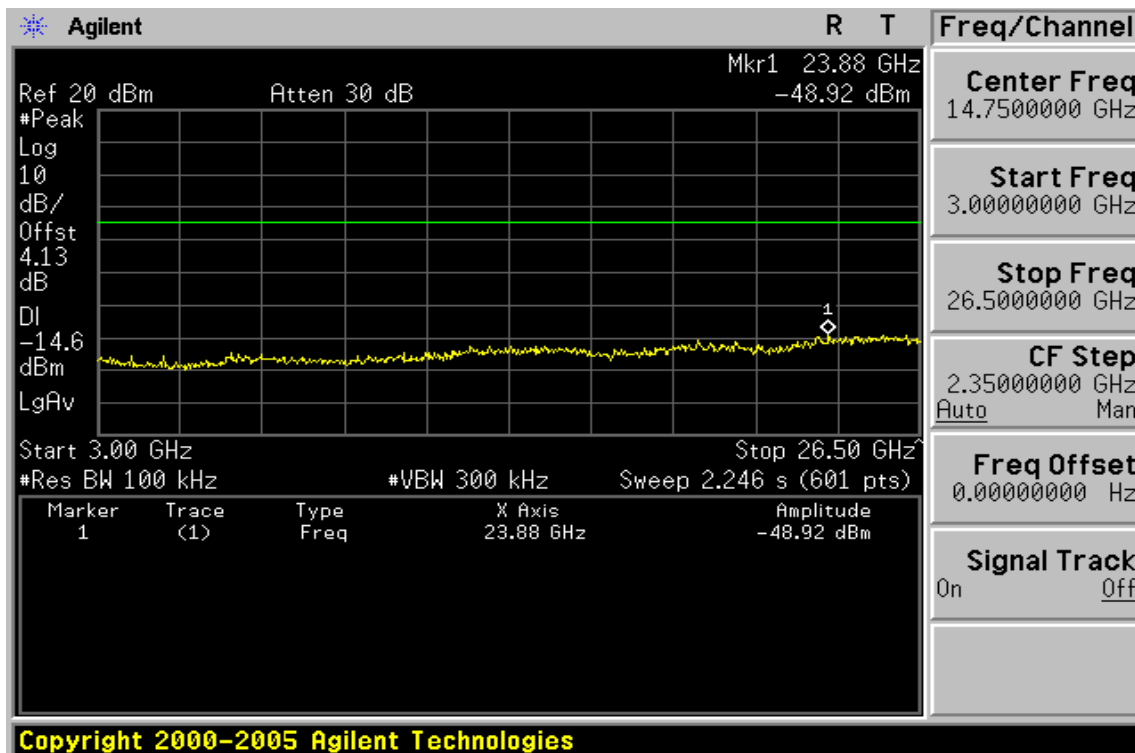
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Ch Mid 30MHz – 3GHz



Ch Mid 3GHz – 26.5GHz



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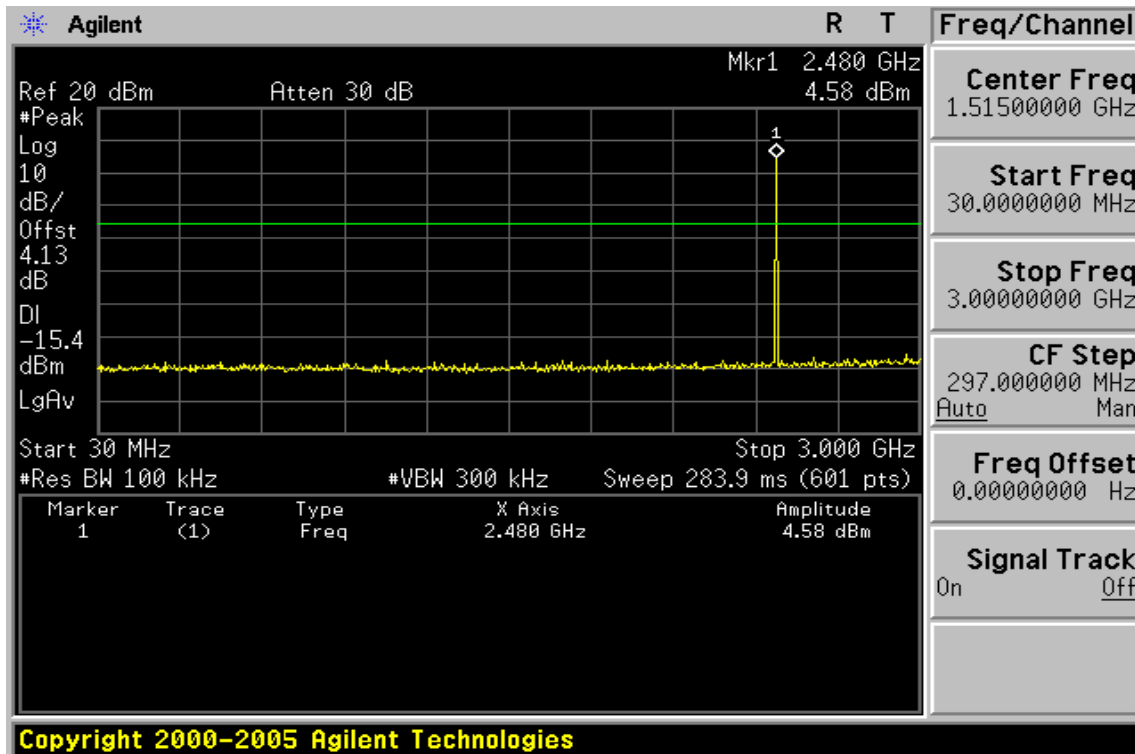
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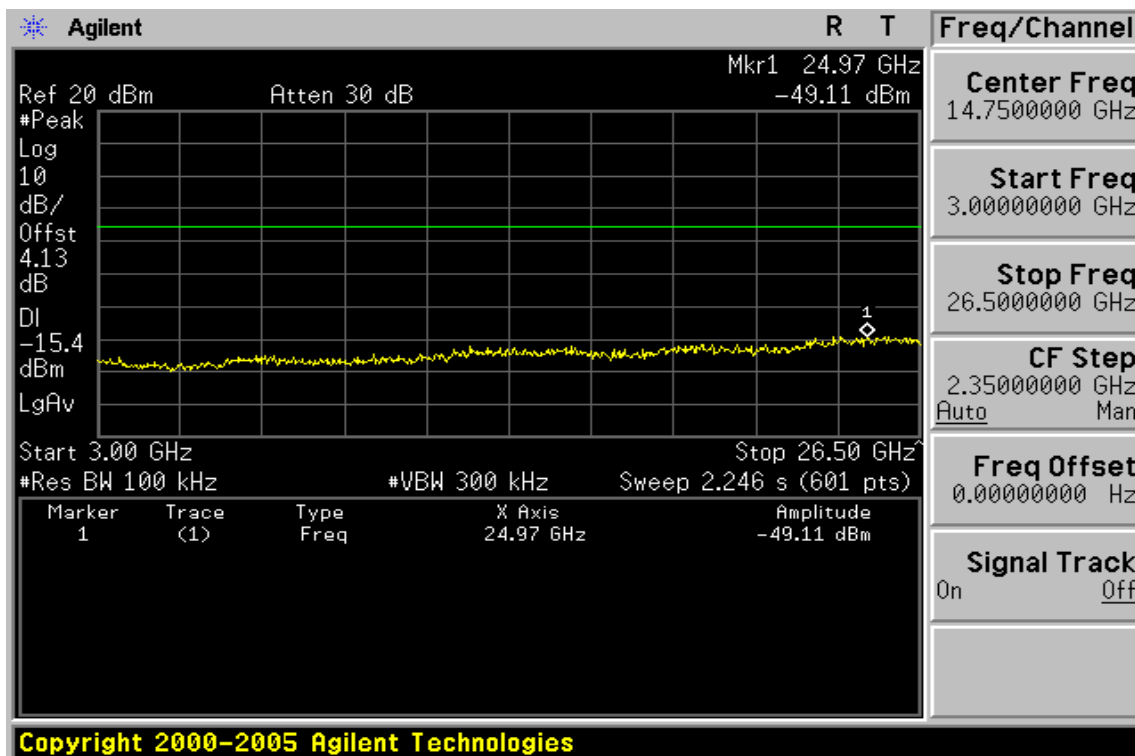
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Ch High 30MHz – 3GHz



Ch High 3GHz – 26.5GHz



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Tabular Results:**Out of Band emission at antenna terminals – Bluetooth (BR- The Worst)**

Fundamental Frequency :2402 MHz Engineer :Nick
 Operation Mode :TX Low

Freq. (MHz)	Note F/H/E/S	Reading dBm	Limit dBm	Safe Margin dB
2401.00	Ref	2.70	---	---
<30	S	---	-17.30	---
30-1000	S	---	-17.30	---
4804.00	H	---	-17.30	---
7206.00	H	---	-17.30	---
9608.00	H	---	-17.30	---
12010.00	H	---	-17.30	---
14412.00	H	---	-17.30	---
16814.00	H	---	-17.30	---
19216.00	H	---	-17.30	---
21618.00	H	---	-17.30	---
24020.00	H	---	-17.30	---
26420.00	S	-48.72	-17.30	31.42

Note : “H” : denotes Harmonic Frequency. “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor. Ref: Reference Signal

Note2: Limit = Ref (the highest emission of the fundamental) – 20dBm

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Fundamental Frequency :2441 MHz Engineer :Nick
Operation Mode :TX Mid

Freq. (MHz)	Note F/H/E/S	Reading dBm	Limit dBm	Safe Margin dB
2441.00	Ref	5.35	--	---
<30	S	--	-14.60	---
30-1000	S	--	-14.60	---
4882.00	H	--	-14.60	---
7323.00	H	--	-14.60	---
9764.00	H	--	-14.60	---
12205.00	H	--	-14.60	---
14646.00	H	--	-14.60	---
17087.00	H	--	-14.60	---
19528.00	H	--	-14.60	---
21969.00	H	--	-14.60	---
23880.00	S	-48.92	-14.60	34.32
24410.00	H	--	-14.60	---

Note : “H” : denotes Harmonic Frequency. “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

Note2: Limit = Ref (the highest emission of the fundamental) – 20dBm

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Fundamental Frequency :2480 MHz Engineer :Nick
Operation Mode :TX High

Freq. (MHz)	Note F/H/E/S	Reading dBm	Limit dBm	Safe Margin dB
2480.00	Ref	4.58	--	--
<30	S	--	-15.40	--
30-1000	S	--	-15.40	--
4960.00	H	--	-15.40	--
7440.00	H	--	-15.40	--
9920.00	H	--	-15.40	--
12400.00	H	--	-15.40	--
14880.00	H	--	-15.40	--
17360.00	H	--	-15.40	--
19840.00	H	--	-15.40	--
22320.00	H	--	-15.40	--
24970.00	S	-49.11	-15.40	33.71
24800.00	H	--	-15.40	--

Note : “H” : denotes Harmonic Frequency. “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

Note2: Limit = Ref (the highest emission of the fundamental) – 20dBm

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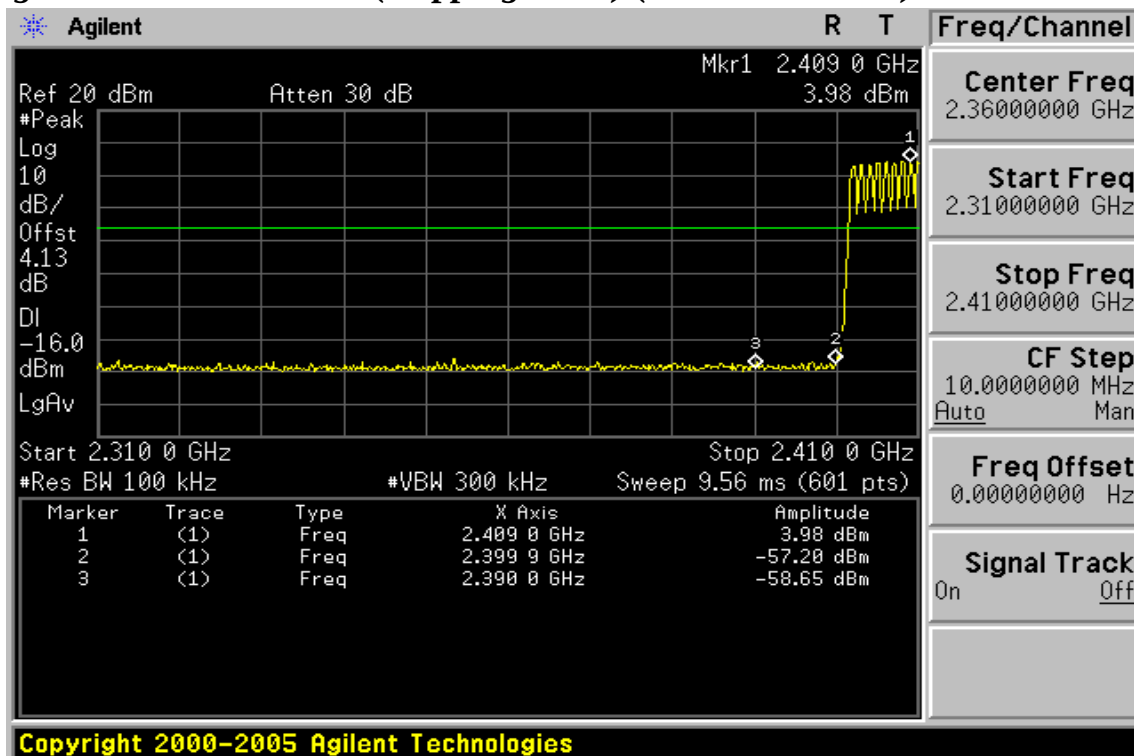
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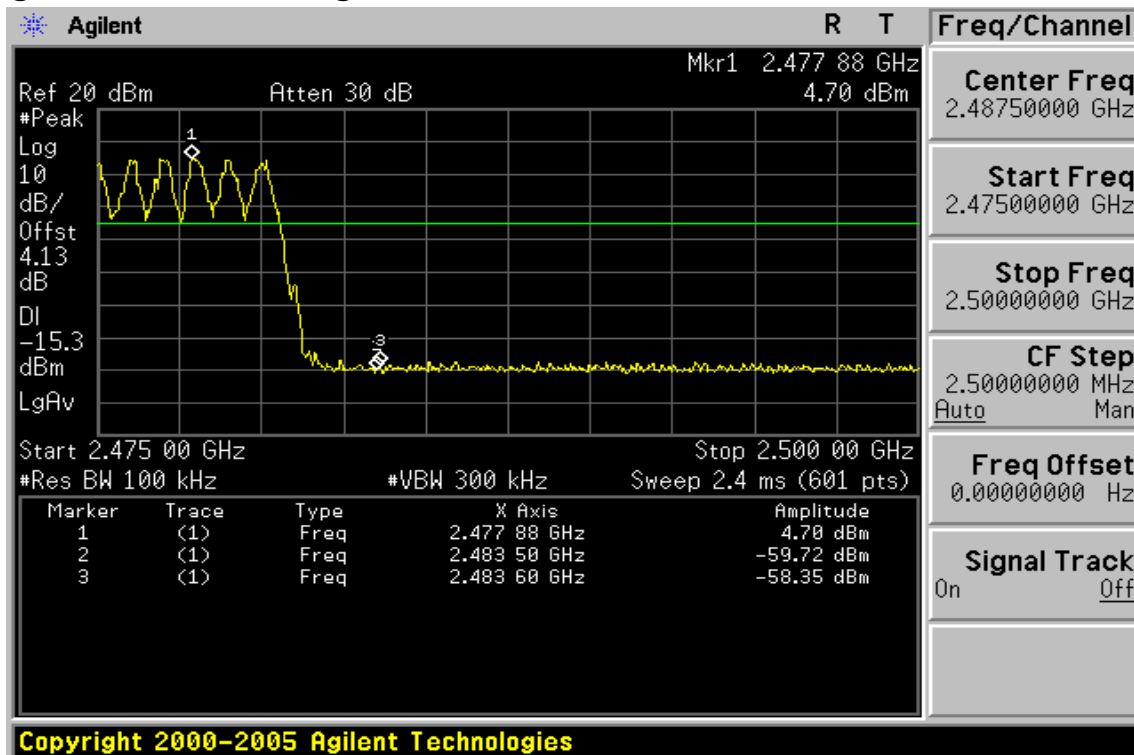
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9.7 Measurement Result -2 100 kHz BANDWIDTH OF BAND EDGE:

Band Edges Test Data CH-Low (Hopping mode) (Worst: BR mode)



Band Edges Test Data CH-High



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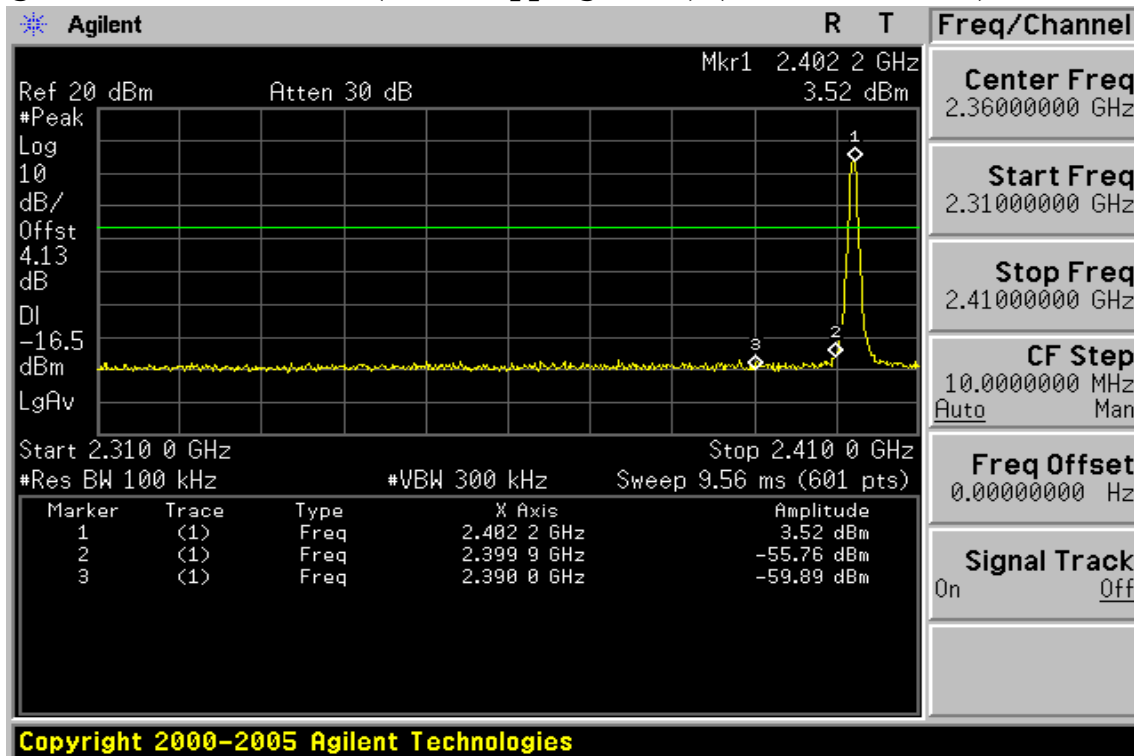
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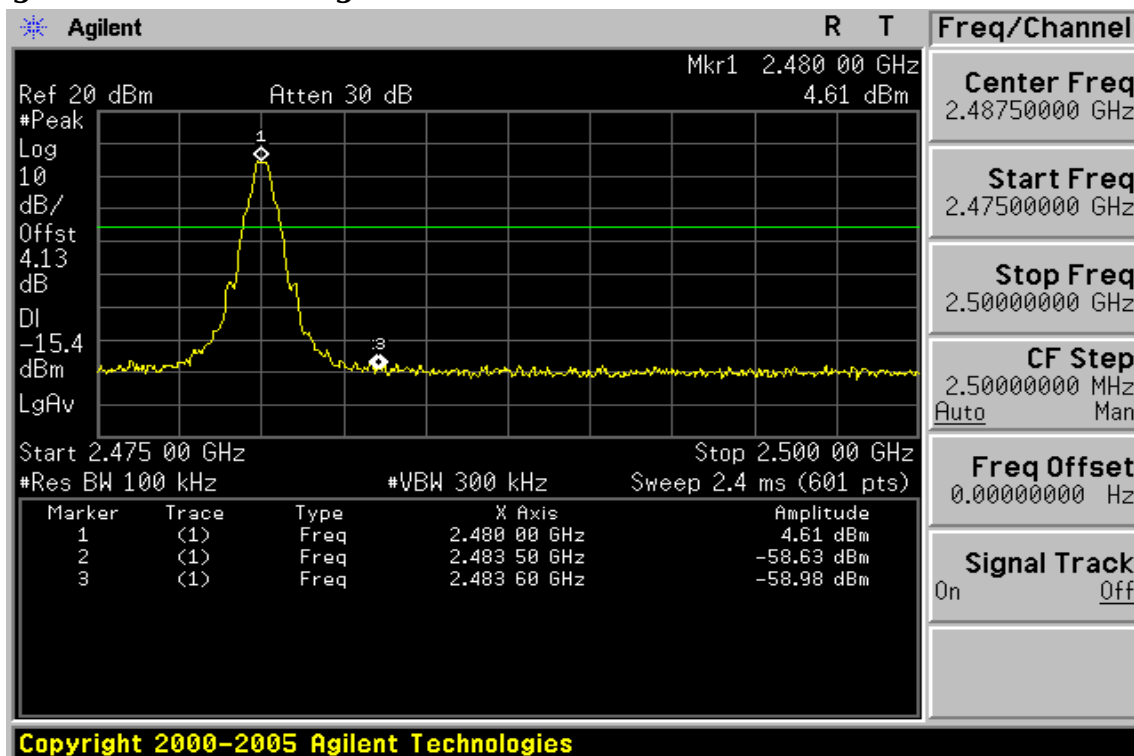
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Band Edges Test Data CH-Low (Non-Hopping mode) (Worst: BR mode)



Band Edges Test Data CH-High



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**Bluetooth BR – The Worst**

Frequency (GHz)	Results (dBm)	Ref (dBm)	Limit (dBm)	Verdict
2.3999	-55.76	3.25	-16.50	Pass
2.4835	-58.35	4.70	-15.30	Pass

Note: Limit = Ref (The highest level of emission) dBm – 20dBm

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10. SPURIOUS RADIATED EMISSION TEST

10.1. Standard Applicable

According to §15.247(d),

Emission at antenna port:

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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Radiated Spurious Emission

Attenuation below the general limits specified in § 15.209(a) is not required. 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) (see § 15.205(c)).

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.

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10.2. Measurement Equipment Used:

10.2.1. Radiated emission:

966 Chamber					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESCI7	100760	05/26/2014	05/25/2015
Spectrum Analyzer	Agilent	E4446A	MY51100003	05/19/2014	05/18/2015
EXA Spectrum Analyzer	Agilent	N9010A	MY50420195	01/20/2014	01/19/2015
Spectrum Analyzer	R&S	FSV-30	101398	10/07/2014	10/06/2015
Loop Antenna	ETS.LINDGREN	6502	00148045	07/03/2014	07/02/2015
Bilog Antenna	SCHWAZBECK	VULB9168	378	01/02/2014	01/01/2015
Horn antenna	ETS.LINDGREN	3117	123995	05/19/2014	05/18/2015
Horn Antenna	Schwarzbeck	BBHA9170	184	01/23/2014	01/22/2015
Pre-Amplifier	Agilent	8447D	2944A07676	01/03/2014	01/02/2015
Pre-Amplifier	Agilent	8449B	3008A00578	01/03/2014	01/02/2015
Pre-Amplifier	EMC Instruments Corp.	EMC184045	980135	01/24/2014	01/23/2015
Filter 2400-2483.5 MHz	EWT	EWT-14-0166	M2	02/27/2014	02/26/2015
Attenuator	Mini-Circuit	BW-S10W2+	004	02/27/2014	02/26/2015
Turn Table	HD	DT420	N/A	N.C.R	N.C.R
Antenna Tower	HD	MA240-N	240/657	N.C.R	N.C.R
Controller	HD	HD100	N/A	N.C.R	N.C.R
Low Loss Cable	Huber Suhner	966_Rx	9	01/03/2014	01/02/2015

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

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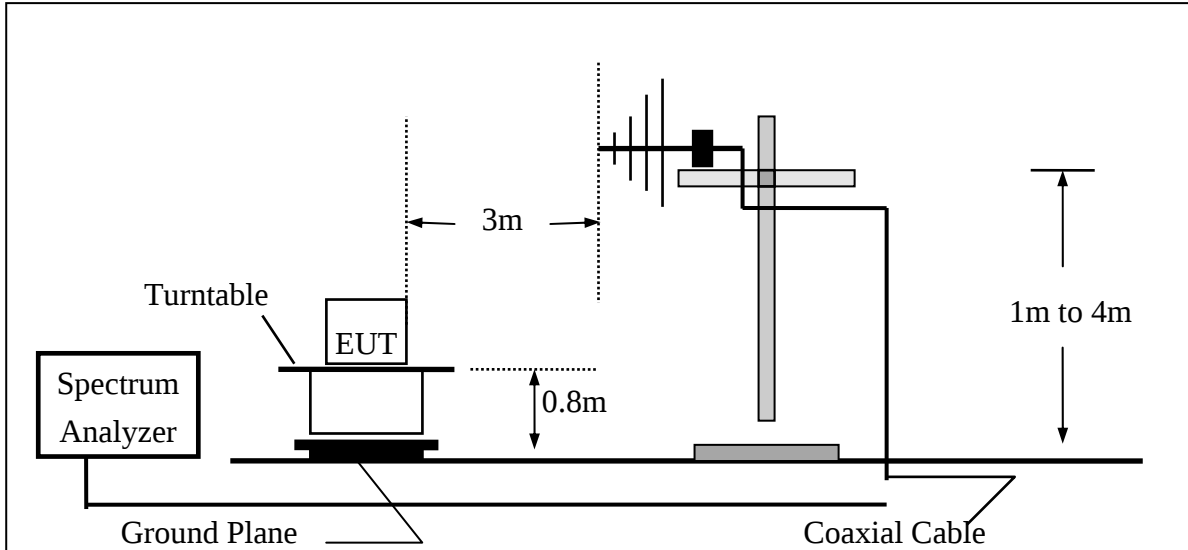
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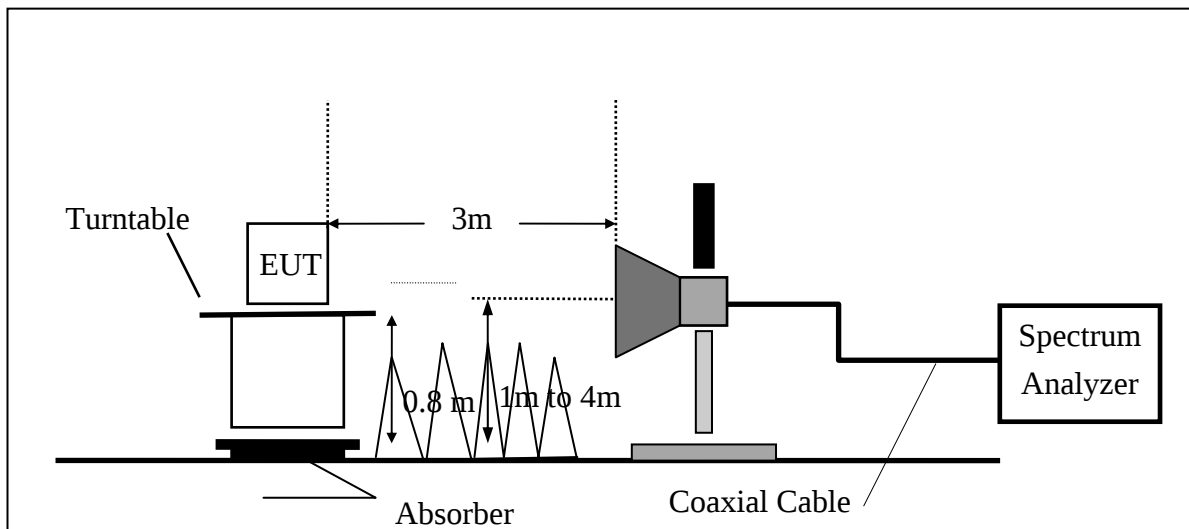
10.3. Test SET-UP:

10.3.1. Radiated emission:

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



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



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10.4. Measurement Procedure:

Radiated Emission:

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

Auxiliary Procedure (Setting on Spectrum to capture the reading of emission level):

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

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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	

Remark:

1. The limit of the emission level is expressed in dBuV/m, which converts $20 \cdot \log(uV/m)$
2. $Factor(dB) = Antenna\ Factor(dB\mu V/m) + Cable\ Loss(dB) - Pre_Amplifier\ Gain(dB)$

10.6. Measurement Result:

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

Note: For measurement plot of radiation revealing the compliance of 15.209, please refer to Appendix I.

Note: For the tabular table as presents below, “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency. “E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor

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10.6.1 Radiated Emission – Band Edge: (Hopping Mode) (Worst: BR mode)

Operation Band	:BR+Hopping	Test Date	:2014-11-07
Fundamental Frequency	:2402 MHz	Temp./Humi.	:23 deg_C / 58 RH
Operation Mode	:Band Edge LOW	Engineer	:Tin
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
2390.00	E	Average	30.34	2.48	32.82	54.00	-21.18
2390.00	E	Peak	41.15	2.48	43.63	74.00	-30.37

Operation Band	:BR+Hopping	Test Date	:2014-11-07
Fundamental Frequency	:2402 MHz	Temp./Humi.	:23 deg_C / 58 RH
Operation Mode	:Band Edge LOW	Engineer	:Tin
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
2390.00	E	Average	30.98	2.48	33.46	54.00	-20.54
2390.00	E	Peak	42.24	2.48	44.72	74.00	-29.28

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Operation Band	:BR+Hopping	Test Date	:2014-11-07
Fundamental Frequency	:2480 MHz	Temp./Humi.	:23 deg_C / 58 RH
Operation Mode	:Band Edge HIGH	Engineer	:Tin
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dB μ V	dB	dB μ V / m	dB μ V / m	dB
2483.50	E	Average	30.37	2.84	33.21	54.00	-20.79
2483.50	E	Peak	42.81	2.84	45.65	74.00	-28.35

Operation Band	:BR+Hopping	Test Date	:2014-11-07
Fundamental Frequency	:2480 MHz	Temp./Humi.	:23 deg_C / 58 RH
Operation Mode	:Band Edge HIGH	Engineer	:Tin
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dB μ V	dB	dB μ V / m	dB μ V / m	dB
2483.50	E	Average	30.15	2.84	32.99	54.00	-21.01
2483.50	E	Peak	42.40	2.84	45.24	74.00	-28.76

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

Operation Band	:BR	Test Date	:2014-11-07
Fundamental Frequency	:2402 MHz	Temp./Humi.	:23 deg_C / 58 RH
Operation Mode	:Band Edge LOW	Engineer	:Tin
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dB μ V	dB	dB μ V / m	dB μ V / m	dB
2390.00	E	Average	30.36	2.48	32.84	54.00	-21.16
2390.00	E	Peak	41.84	2.48	44.32	74.00	-29.68

Operation Band	:BR	Test Date	:2014-11-07
Fundamental Frequency	:2402 MHz	Temp./Humi.	:23 deg_C / 58 RH
Operation Mode	:Band Edge LOW	Engineer	:Tin
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dB μ V	dB	dB μ V / m	dB μ V / m	dB
2390.00	E	Average	30.35	2.48	32.83	54.00	-21.17
2390.00	E	Peak	43.39	2.48	45.87	74.00	-28.13

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Operation Band	:BR	Test Date	:2014-11-07
Fundamental Frequency	:2480 MHz	Temp./Humi.	:23 deg_C / 58 RH
Operation Mode	:Band Edge HIGH	Engineer	:Tin
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
2483.50	E	Average	30.37	2.84	33.21	54.00	-20.79
2483.50	E	Peak	45.74	2.84	48.58	74.00	-25.42

Operation Band	:BR	Test Date	:2014-11-07
Fundamental Frequency	:2480 MHz	Temp./Humi.	:23 deg_C / 58 RH
Operation Mode	:Band Edge HIGH	Engineer	:Tin
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
2483.50	E	Average	31.57	2.84	34.41	54.00	-19.59
2483.50	E	Peak	44.82	2.84	47.66	74.00	-26.34

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10.6.2 Radiated Spurious Emission Measurement Result (worst case BR mode)

Operation Band	:BR	Test Date	:2014-11-07
Fundamental Frequency	:2402 MHz	Temp./Humi.	:23 deg_C / 58 RH
Operation Mode	:TX LOW	Engineer	:Tin
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dB μ V	dB	dB μ V / m	dB μ V / m	dB
34.85	S	Peak	48.17	-13.86	34.31	40.00	-5.69
161.92	S	Peak	37.94	-12.45	25.49	43.50	-18.01
225.94	S	Peak	39.01	-14.14	24.87	46.00	-21.13
386.96	S	Peak	31.03	-9.34	21.69	46.00	-24.31
596.48	S	Peak	28.98	-5.25	23.73	46.00	-22.27
942.77	S	Peak	27.25	0.17	27.42	46.00	-18.58
4804.00	H	Average	25.68	6.75	32.43	54.00	-21.57
4804.00	H	Peak	41.13	6.75	47.88	74.00	-26.12
7206.00	H	---					
9608.00	H	---					
12010.00	H	---					
14412.00	H	---					
16814.00	H	---					
19216.00	H	---					
21618.00	H	---					
24020.00	H	---					

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Operation Band	:BR	Test Date	:2014-11-07
Fundamental Frequency	:2402 MHz	Temp./Humi.	:23 deg_C / 58 RH
Operation Mode	:TX LOW	Engineer	:Tin
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dB μ V	dB	dB μ V / m	dB μ V / m	dB
31.94	S	Peak	38.52	-13.88	24.64	40.00	-15.36
149.31	S	Peak	29.16	-12.73	16.43	43.50	-27.07
408.30	S	Peak	27.14	-8.83	18.31	46.00	-27.69
567.38	S	Peak	28.56	-5.94	22.62	46.00	-23.38
733.25	S	Peak	28.49	-3.42	25.07	46.00	-20.93
947.62	S	Peak	27.76	0.25	28.01	46.00	-17.99
4804.00	H	Average	25.07	6.75	31.82	54.00	-22.18
4804.00	H	Peak	39.29	6.75	46.04	74.00	-27.96
7206.00	H	---					
9608.00	H	---					
12010.00	H	---					
14412.00	H	---					
16814.00	H	---					
19216.00	H	---					
21618.00	H	---					
24020.00	H	---					

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Operation Band	:BR	Test Date	:2014-11-07
Fundamental Frequency	:2441 MHz	Temp./Humi.	:23 deg_C / 58 RH
Operation Mode	:TX MID	Engineer	:Tin
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
31.94	S	Peak	50.16	-13.88	36.28	40.00	-3.72
108.57	S	Peak	39.16	-16.28	22.88	43.50	-20.62
152.22	S	Peak	37.74	-12.62	25.12	43.50	-18.38
225.94	S	Peak	38.73	-14.14	24.59	46.00	-21.41
388.90	S	Peak	30.82	-9.31	21.51	46.00	-24.49
738.10	S	Peak	27.84	-3.08	24.76	46.00	-21.24
4882.00	H	Average	31.11	6.93	38.04	54.00	-15.96
4882.00	H	Peak	39.43	6.93	46.36	74.00	-27.64
7323.00	H	---					
9764.00	H	---					
12205.00	H	---					
14646.00	H	---					
17087.00	H	---					
19528.00	H	---					
21969.00	H	---					
24410.00	H	---					

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Operation Band	:BR	Test Date	:2014-11-07
Fundamental Frequency	:2441 MHz	Temp./Humi.	:23 deg_C / 58 RH
Operation Mode	:TX MID	Engineer	:Tin
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
30.97	S	Peak	39.63	-13.89	25.74	40.00	-14.26
236.61	S	Peak	29.23	-13.50	15.73	46.00	-30.27
286.08	S	Peak	29.45	-11.51	17.94	46.00	-28.06
518.88	S	Peak	29.00	-7.30	21.70	46.00	-24.30
699.30	S	Peak	27.98	-3.95	24.03	46.00	-21.97
916.58	S	Peak	27.32	-0.33	26.99	46.00	-19.01
4882.00	H	Average	32.05	6.93	38.98	54.00	-15.02
4882.00	H	Peak	40.66	6.93	47.59	74.00	-26.41
7323.00	H	---					
9764.00	H	---					
12205.00	H	---					
14646.00	H	---					
17087.00	H	---					
19528.00	H	---					
21969.00	H	---					
24410.00	H	---					

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Operation Band	:BR	Test Date	:2014-11-07
Fundamental Frequency	:2480 MHz	Temp./Humi.	:23 deg_C / 58 RH
Operation Mode	:TX HIGH	Engineer	:Tin
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dB μ V	dB	dB μ V / m	dB μ V / m	dB
31.94	S	Peak	49.74	-13.88	35.86	40.00	-4.14
149.31	S	Peak	36.83	-12.73	24.10	43.50	-19.40
223.03	S	Peak	40.53	-14.24	26.29	46.00	-19.71
396.66	S	Peak	30.96	-9.14	21.82	46.00	-24.18
744.89	S	Peak	27.87	-2.73	25.14	46.00	-20.86
954.41	S	Peak	27.81	0.31	28.12	46.00	-17.88
4960.00	H	Average	30.99	7.08	38.07	54.00	-15.93
4960.00	H	Peak	40.61	7.08	47.69	74.00	-26.31
7440.00	H	---					
9920.00	H	---					
12400.00	H	---					
14880.00	H	---					
17360.00	H	---					
19840.00	H	---					
22320.00	H	---					
24800.00	H	---					

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Operation Band	:BR	Test Date	:2014-11-07
Fundamental Frequency	:2480 MHz	Temp./Humi.	:23 deg_C / 58 RH
Operation Mode	:TX HIGH	Engineer	:Tin
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dB μ V	dB	dB μ V / m	dB μ V / m	dB
31.94	S	Peak	38.90	-13.88	25.02	40.00	-14.98
154.16	S	Peak	27.71	-12.55	15.16	43.50	-28.34
286.08	S	Peak	28.47	-11.51	16.96	46.00	-29.04
440.31	S	Peak	30.72	-8.62	22.10	46.00	-23.90
593.57	S	Peak	29.41	-5.13	24.28	46.00	-21.72
913.67	S	Peak	27.59	-0.39	27.20	46.00	-18.80
4960.00	H	Average	31.20	7.08	38.28	54.00	-15.72
4960.00	H	Peak	38.41	7.08	45.49	74.00	-28.51
7440.00	H	---					
9920.00	H	---					
12400.00	H	---					
14880.00	H	---					
17360.00	H	---					
19840.00	H	---					
22320.00	H	---					
24800.00	H	---					

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11. FREQUENCY SEPARATION

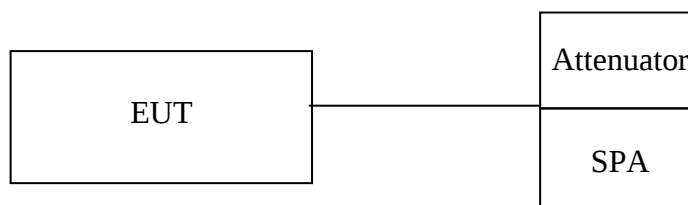
11.1. Standard Applicable

According to §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25 kHz or the $2/3 \times 20\text{dB}$ 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	E4446A	MY51100003	05/19/2014	05/18/2015
Spectrum Analyzer	Agilent	E4440A	MY45304525	03/08/2014	03/07/2015
DC Block	Mini-Circuits	BLK-18-S+	1	02/27/2014	02/26/2015
Low Loss Cable	HUBER+SUHNER	SUCOFLEX 104PEA	N/A	01/03/2014	01/02/2015
Attenuator	Mini-Circuit	BW-S10W2+	002	02/27/2014	02/26/2015
Splitter	Agilent	11636B	N/A	02/27/2014	02/26/2015

11.3. Test Set-up:



11.4. Measurement Procedure:

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

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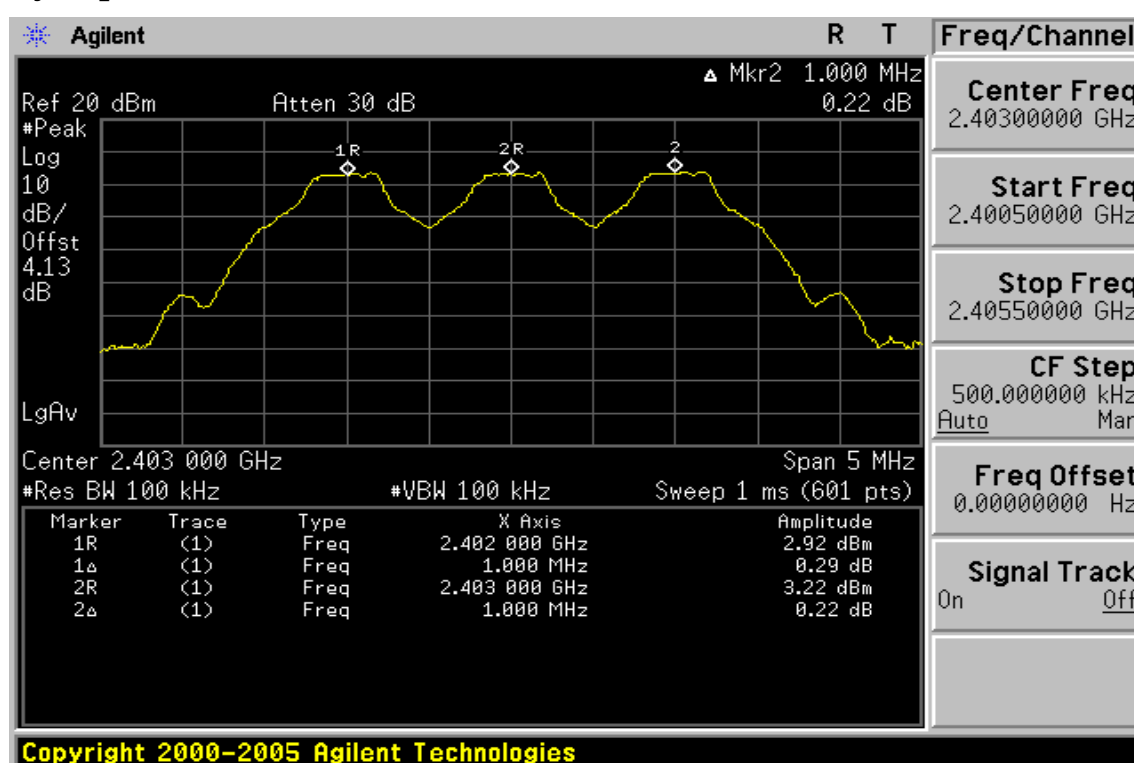
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11.5. Measurement Result:

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

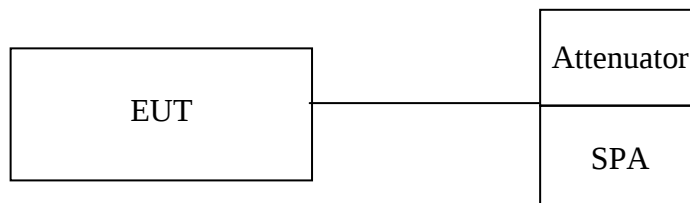
12.1. Standard Applicable

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

12.2. Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Agilent	E4446A	MY51100003	05/19/2014	05/18/2015
Spectrum Analyzer	Agilent	E4440A	MY45304525	03/08/2014	03/07/2015
DC Block	Mini-Circuits	BLK-18-S+	1	02/27/2014	02/26/2015
Low Loss Cable	HUBER+SUHNER	SUCOFLEX 104PEA	N/A	01/03/2014	01/02/2015
Attenuator	Mini-Circuit	BW-S10W2+	002	02/27/2014	02/26/2015
Splitter	Agilent	11636B	N/A	02/27/2014	02/26/2015

12.3. Test Set-up:



12.4. Measurement Procedure:

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

12.5. Measurement Result:

Note: Refer to next page for plots.

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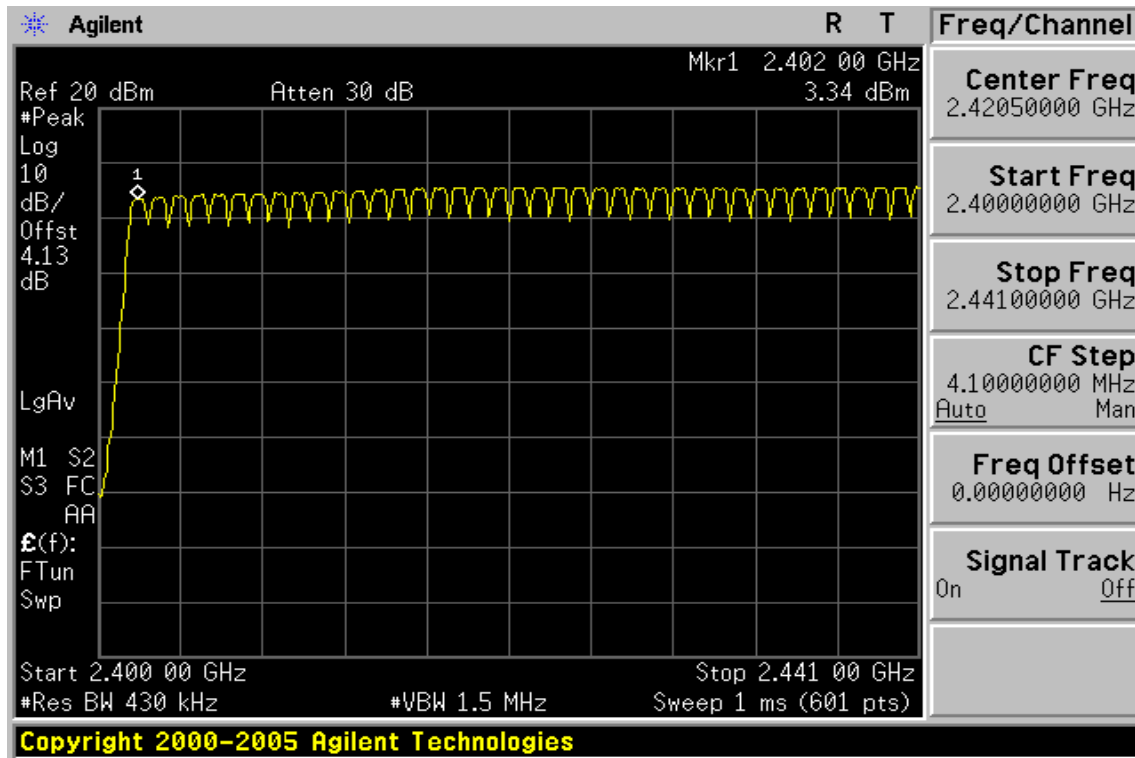
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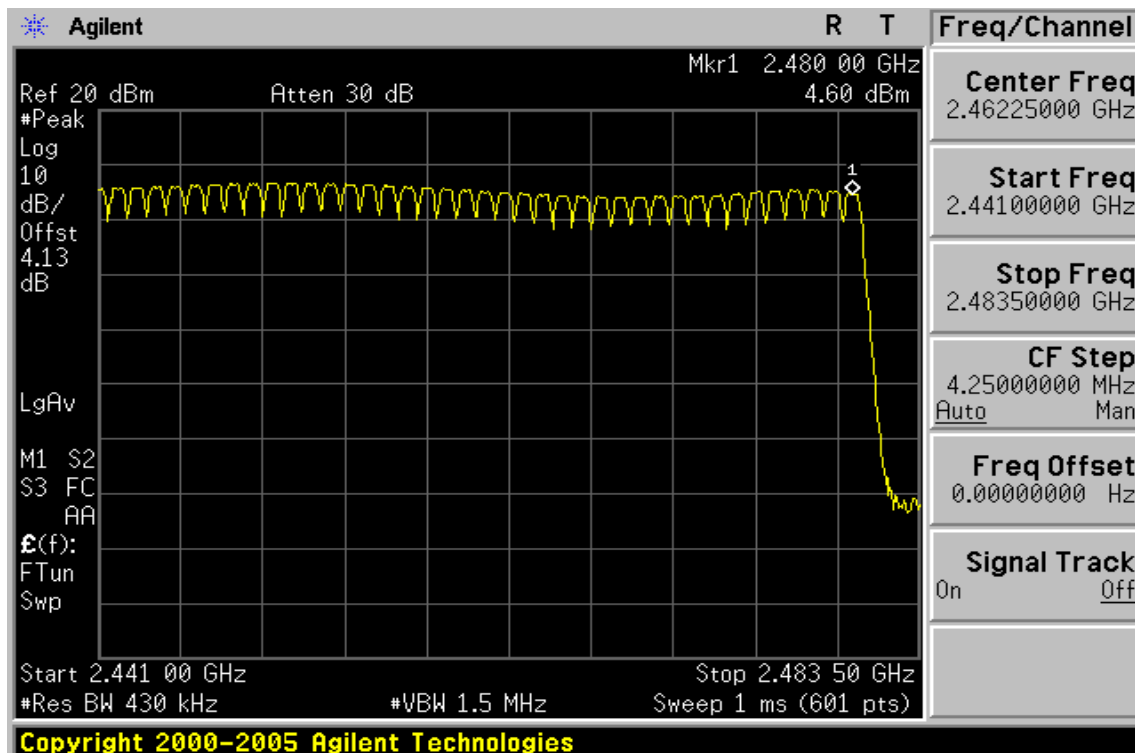
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Channel Number

2.4 GHz – 2.441GHz



2.441 GHz – 2.4835GHz



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Tabular Data of Total Channel Number:

	<i>Channel Number</i>	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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13. TIME OF OCCUPANCY (DWELL TIME)

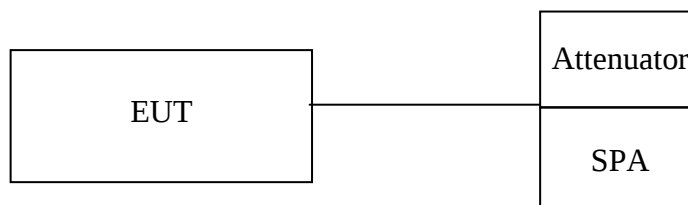
13.1. Standard Applicable

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

13.2. Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Agilent	E4446A	MY51100003	05/19/2014	05/18/2015
Spectrum Analyzer	Agilent	E4440A	MY45304525	03/08/2014	03/07/2015
DC Block	Mini-Circuits	BLK-18-S+	1	02/27/2014	02/26/2015
Low Loss Cable	HUBER+SUHNER	SUCOFLEX 104PEA	N/A	01/03/2014	01/02/2015
Attenuator	Mini-Circuit	BW-S10W2+	002	02/27/2014	02/26/2015
Splitter	Agilent	11636B	N/A	02/27/2014	02/26/2015

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. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW, VBW=1MHz, 3MHz, Span = 0Hz , Detector = Peak, Adjust Sweep = 2~7ms.
5. 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

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:

1Mbps (GFSK):

Test Channel:	Mode:	Measurement Result (ms):	Limit (ms):
Low:	DH1	118.40	400ms
	DH3	260.00	400ms
	DH5	306.13	400ms
Middle:	DH1	118.40	400ms
	DH3	260.00	400ms
	DH5	306.13	400ms
High:	DH1	118.40	400ms
	DH3	260.00	400ms
	DH5	306.13	400ms

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

Test Channel:	Mode:	Measurement Result (ms):	Limit (ms):
Middle:	2DH1	118.40	400ms
	2DH3	260.00	400ms
	2DH5	306.13	400ms

3Mbps (8DPSK):

Test Channel:	Mode:	Measurement Result (ms):	Limit (ms):
Middle:	3DH1	118.40	400
	3DH3	260.00	400
	3DH5	306.13	400

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

1Mbps:

CH Low DH1 time slot = $0.370 \text{ (ms)} * (1600/2/79) * 31.6 = 118.40 \text{ (ms)}$

DH3 time slot = $1.625 \text{ (ms)} * (1600/4/79) * 31.6 = 260.00 \text{ (ms)}$

DH5 time slot = $2.870 \text{ (ms)} * (1600/6/79) * 31.6 = 306.13 \text{ (ms)}$

CH Mid DH1 time slot = $0.370 \text{ (ms)} * (1600/2/79) * 31.6 = 118.40 \text{ (ms)}$

DH3 time slot = $1.625 \text{ (ms)} * (1600/4/79) * 31.6 = 260.00 \text{ (ms)}$

DH5 time slot = $2.870 \text{ (ms)} * (1600/6/79) * 31.6 = 306.13 \text{ (ms)}$

CH High DH1 time slot = $0.370 \text{ (ms)} * (1600/2/79) * 31.6 = 118.40 \text{ (ms)}$

DH3 time slot = $1.625 \text{ (ms)} * (1600/4/79) * 31.6 = 260.00 \text{ (ms)}$

DH5 time slot = $2.870 \text{ (ms)} * (1600/6/79) * 31.6 = 306.13 \text{ (ms)}$

2Mbps:

CH Mid 2DH1 time slot = $0.370 \text{ (ms)} * (1600/2/79) * 31.6 = 118.40 \text{ (ms)}$

2DH3 time slot = $1.625 \text{ (ms)} * (1600/4/79) * 31.6 = 260.00 \text{ (ms)}$

2DH5 time slot = $2.870 \text{ (ms)} * (1600/6/79) * 31.6 = 306.13 \text{ (ms)}$

3Mbps:

CH Mid 3DH1 time slot = $0.370 \text{ (ms)} * (1600/2/79) * 31.6 = 118.40 \text{ (ms)}$

3DH3 time slot = $1.625 \text{ (ms)} * (1600/4/79) * 31.6 = 260.00 \text{ (ms)}$

3DH5 time slot = $2.870 \text{ (ms)} * (1600/6/79) * 31.6 = 306.13 \text{ (ms)}$

13.6. Measurement Result:

Note: Refer to next page for plots.

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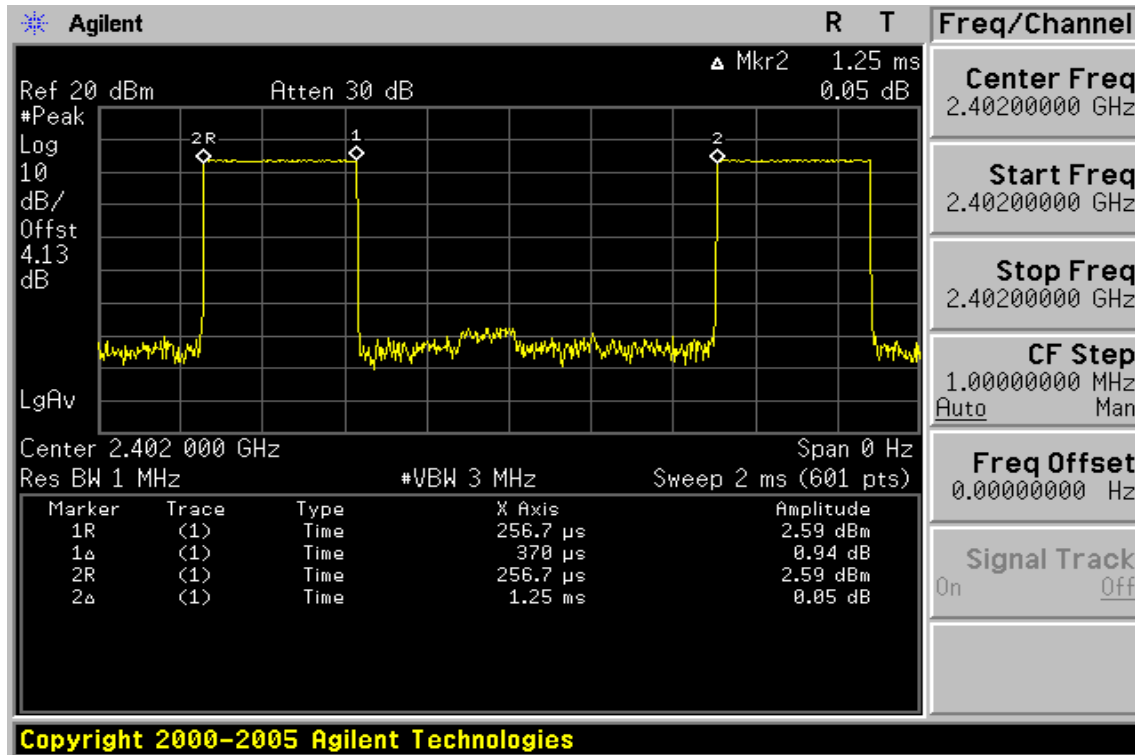
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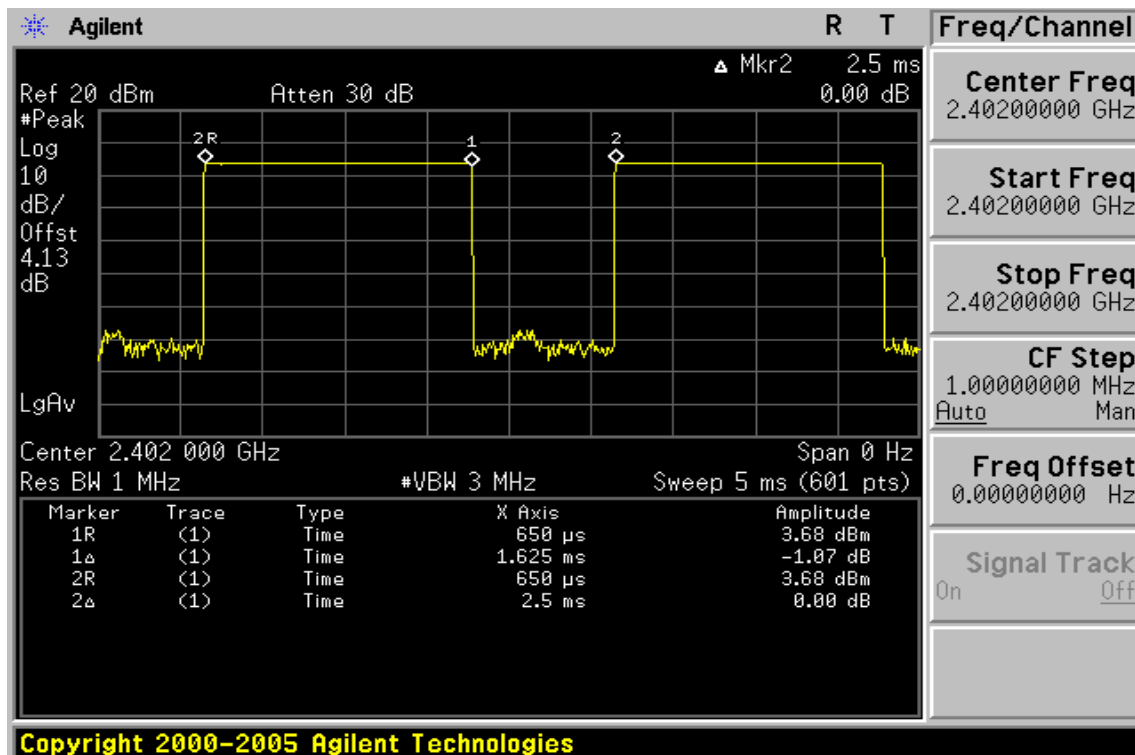
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CH-Low

DH1



DH3



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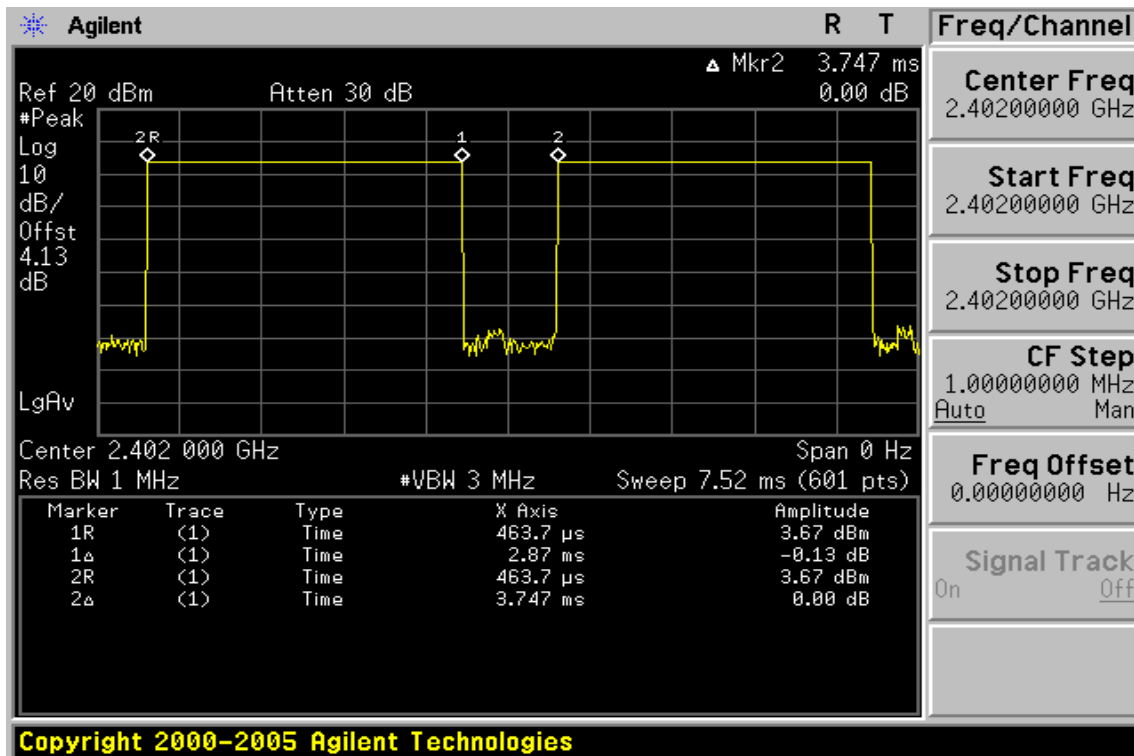
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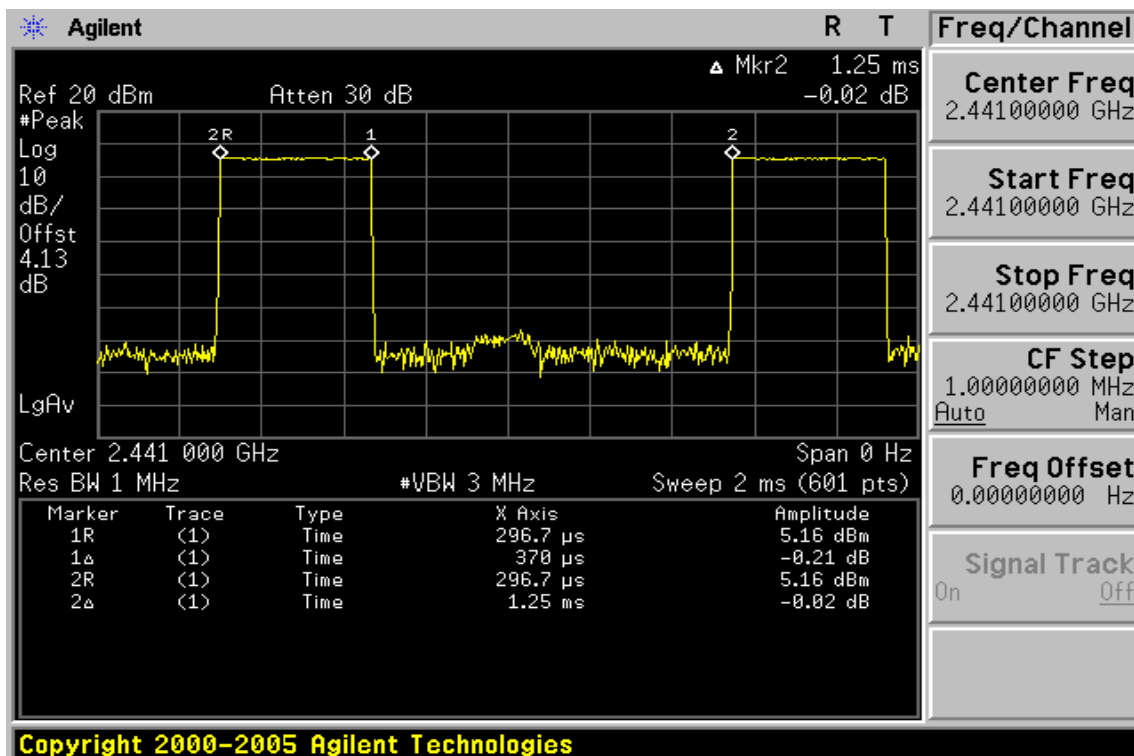
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DH5



CH-Mid

DH1



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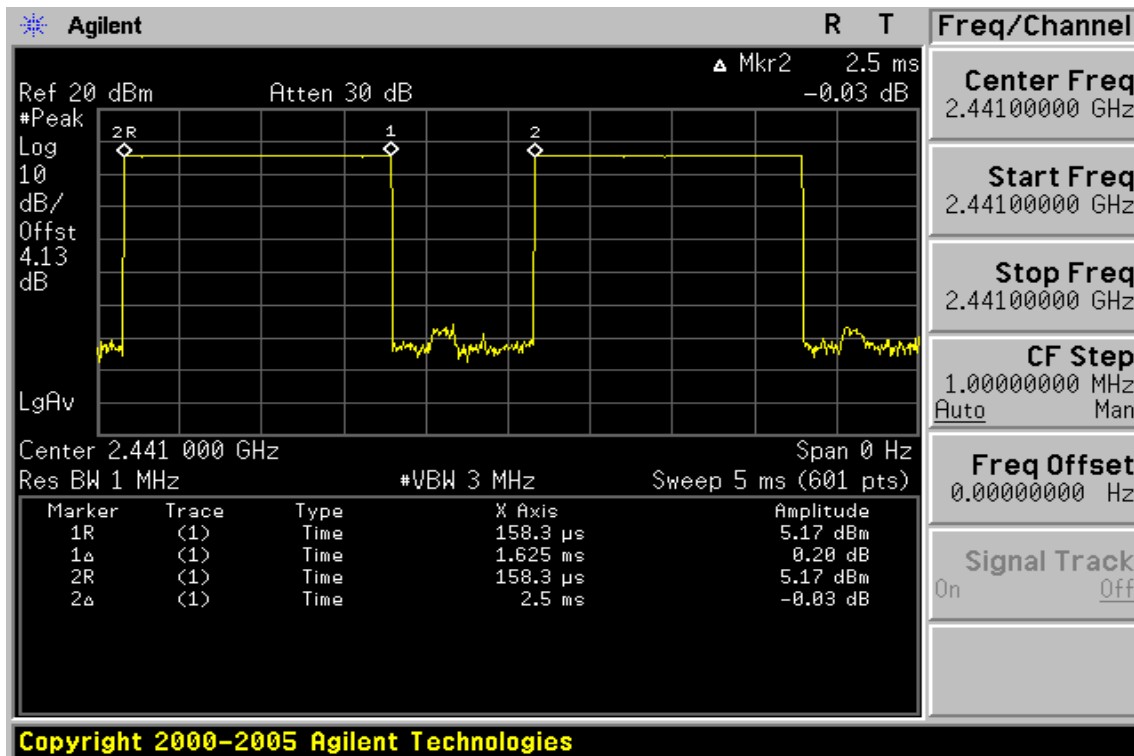
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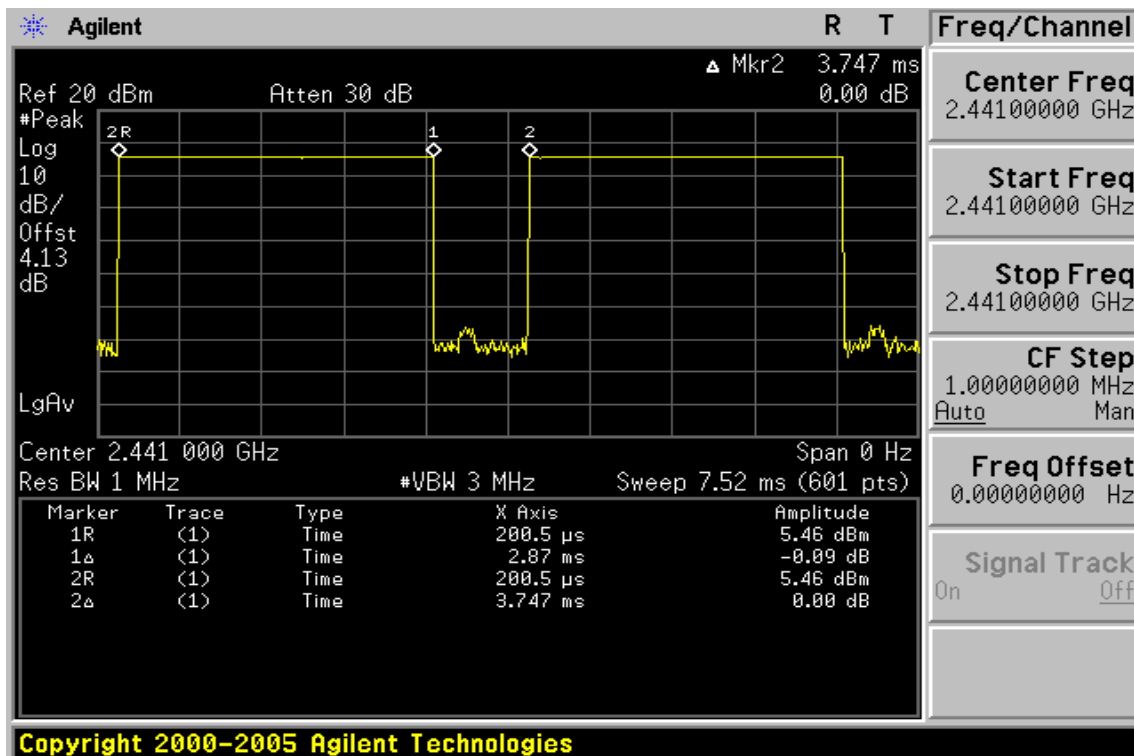
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DH3



DH5



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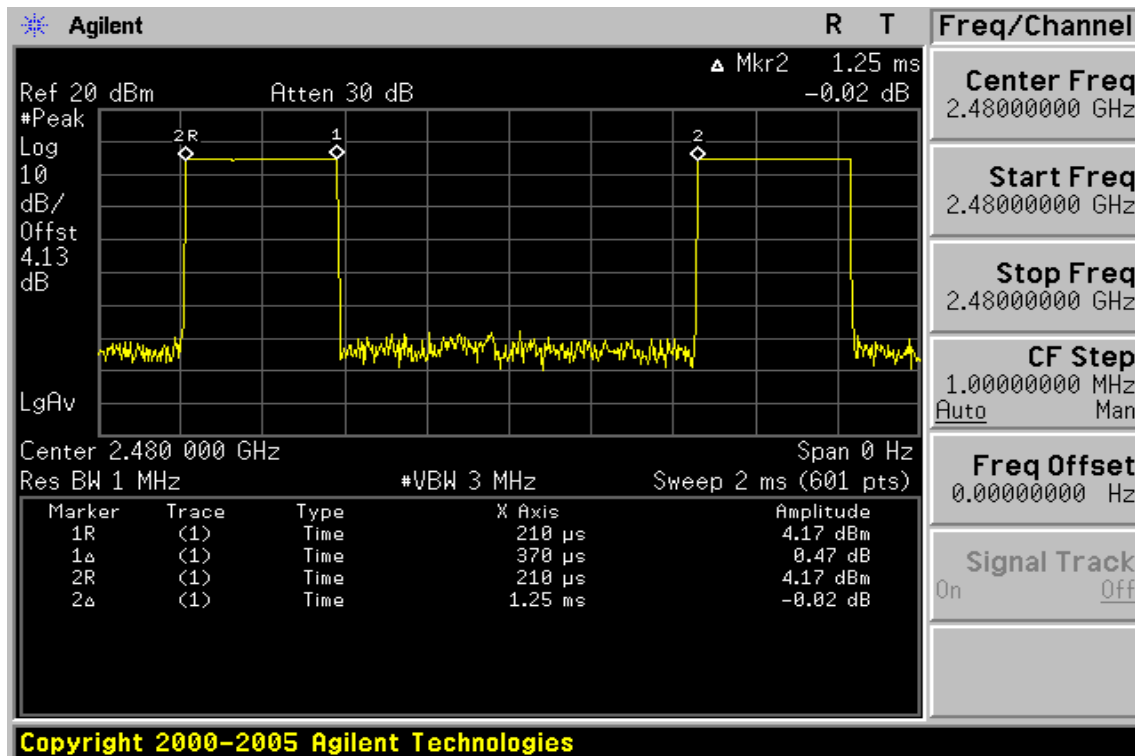
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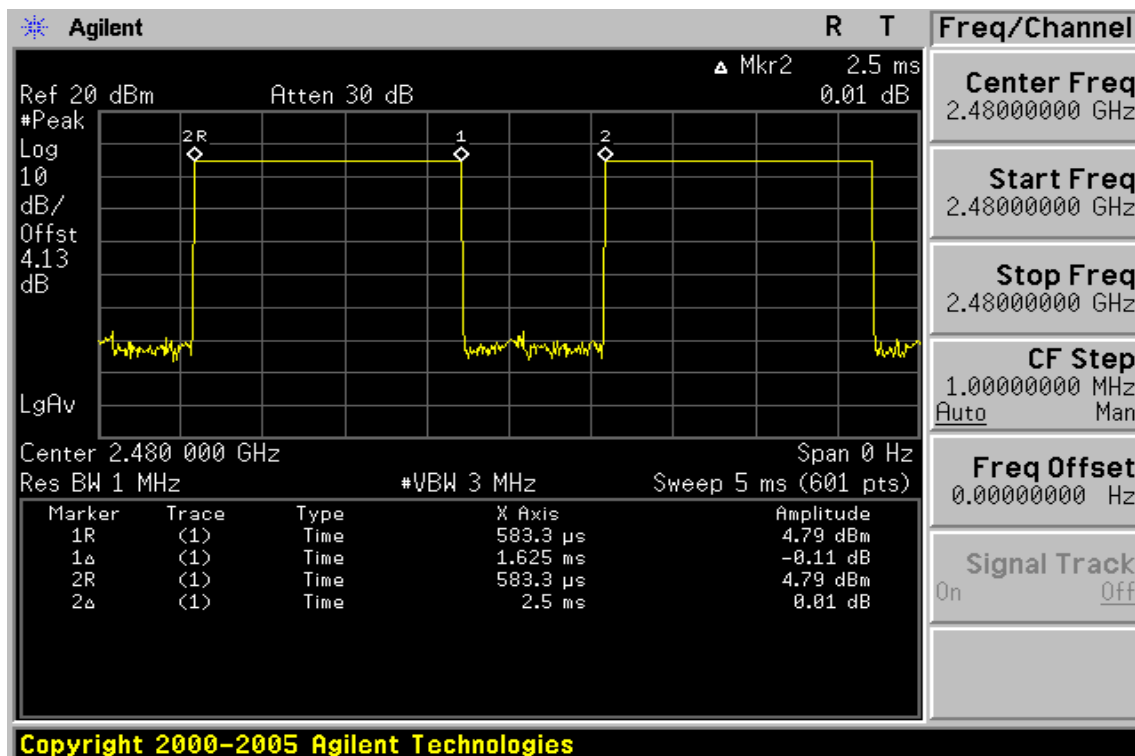
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CH-High

DH1



DH3



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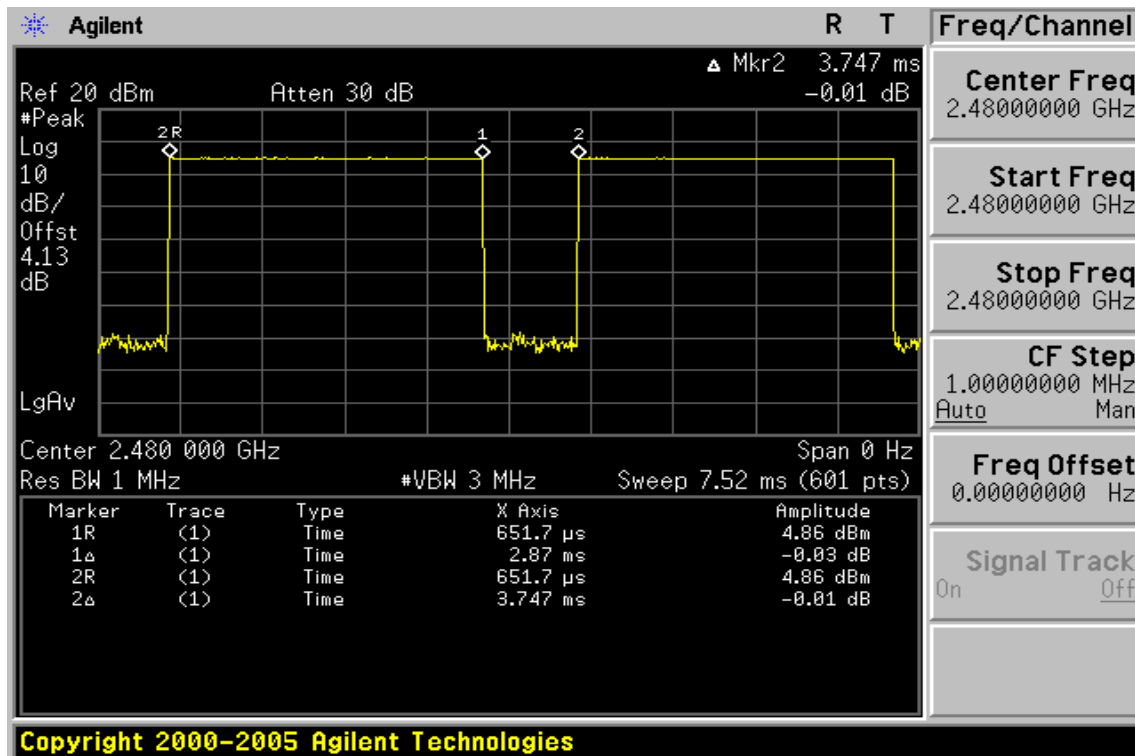
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DH5



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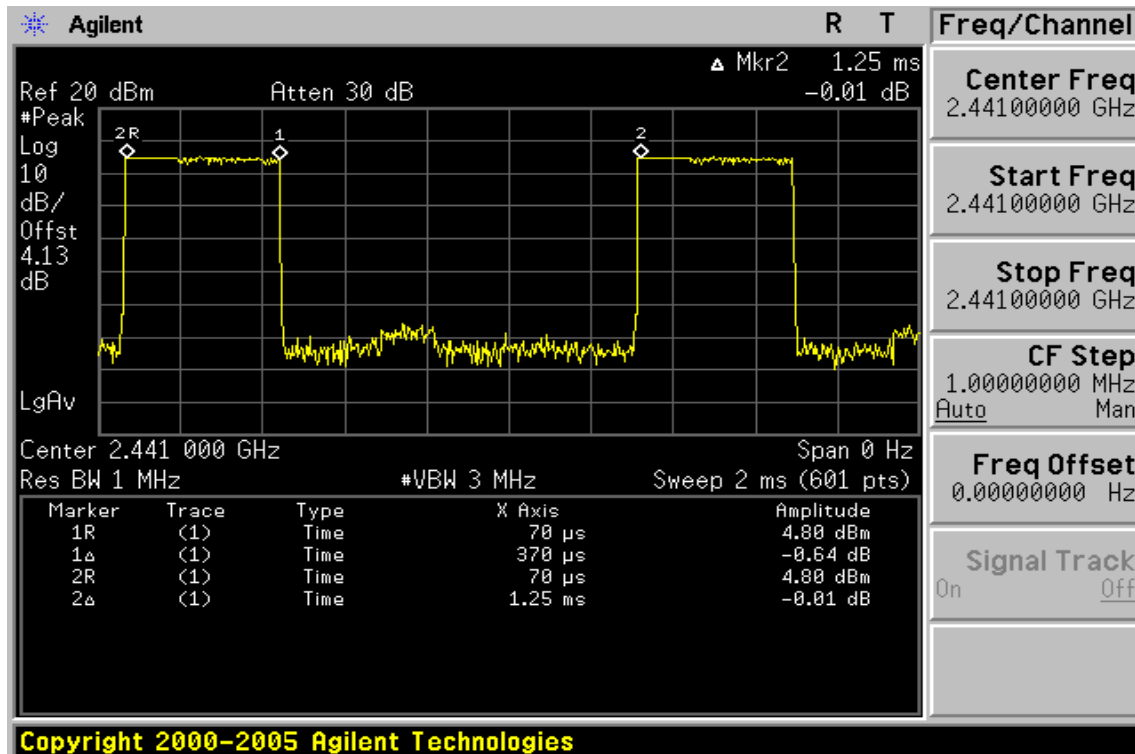
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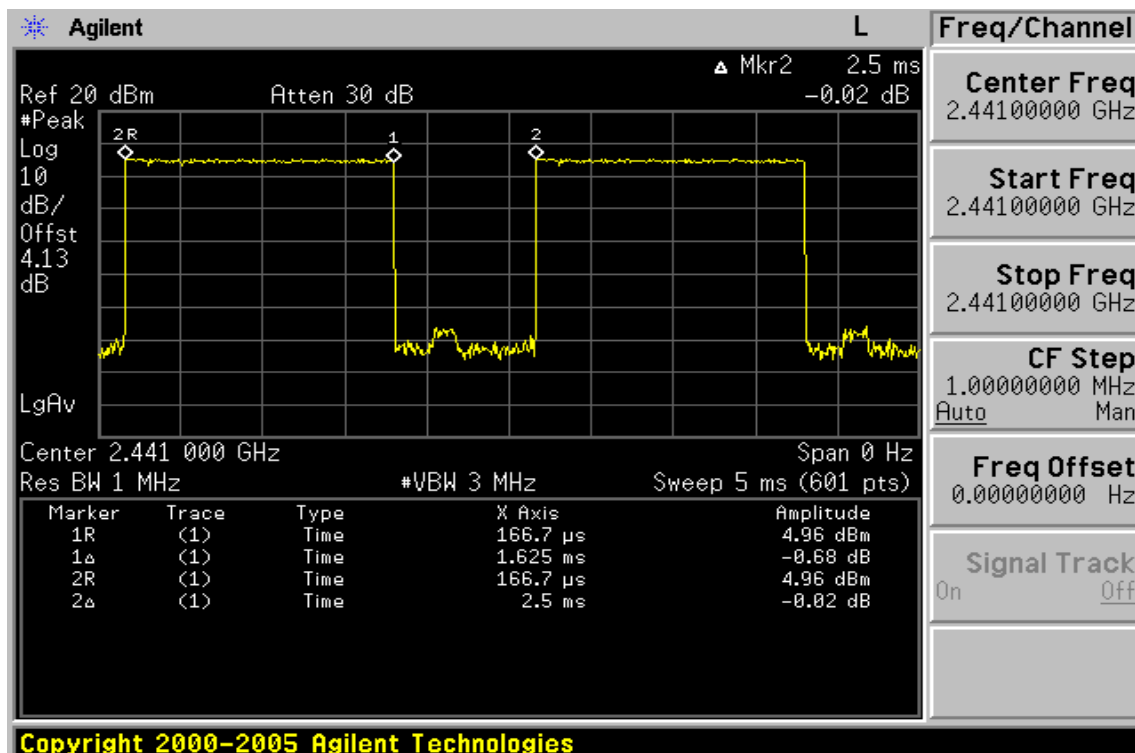
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CH-Mid

2DH1



2DH3



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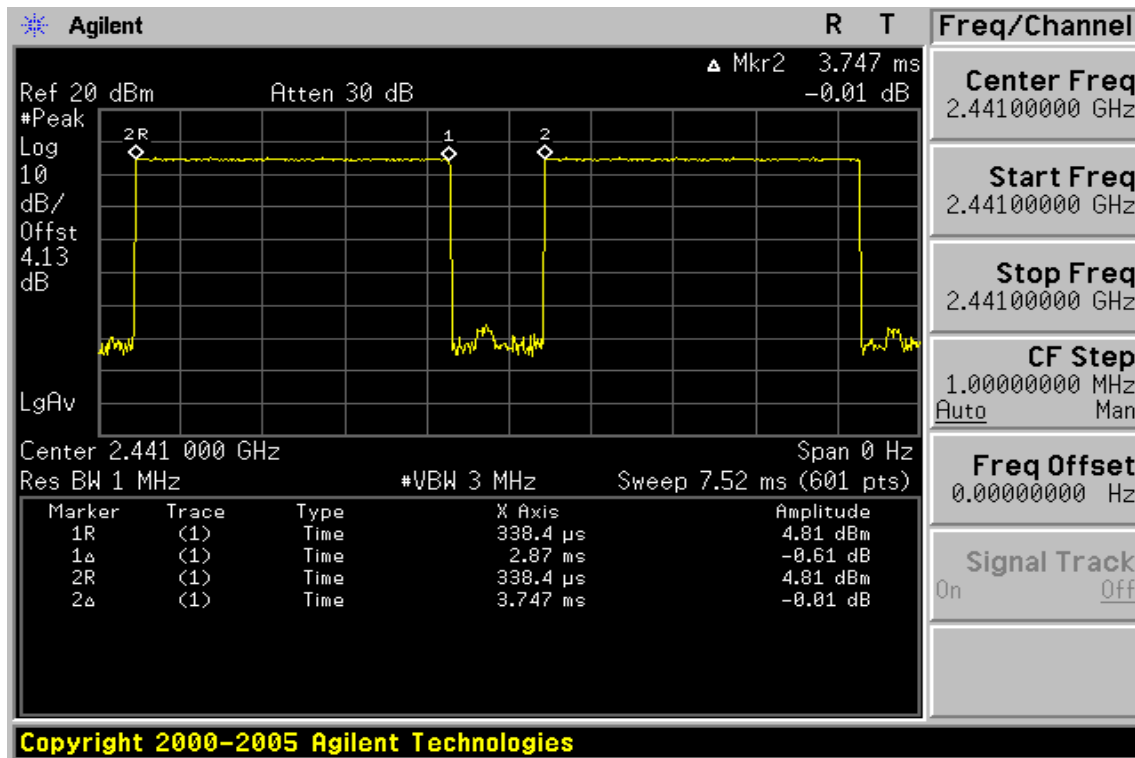
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2DH5



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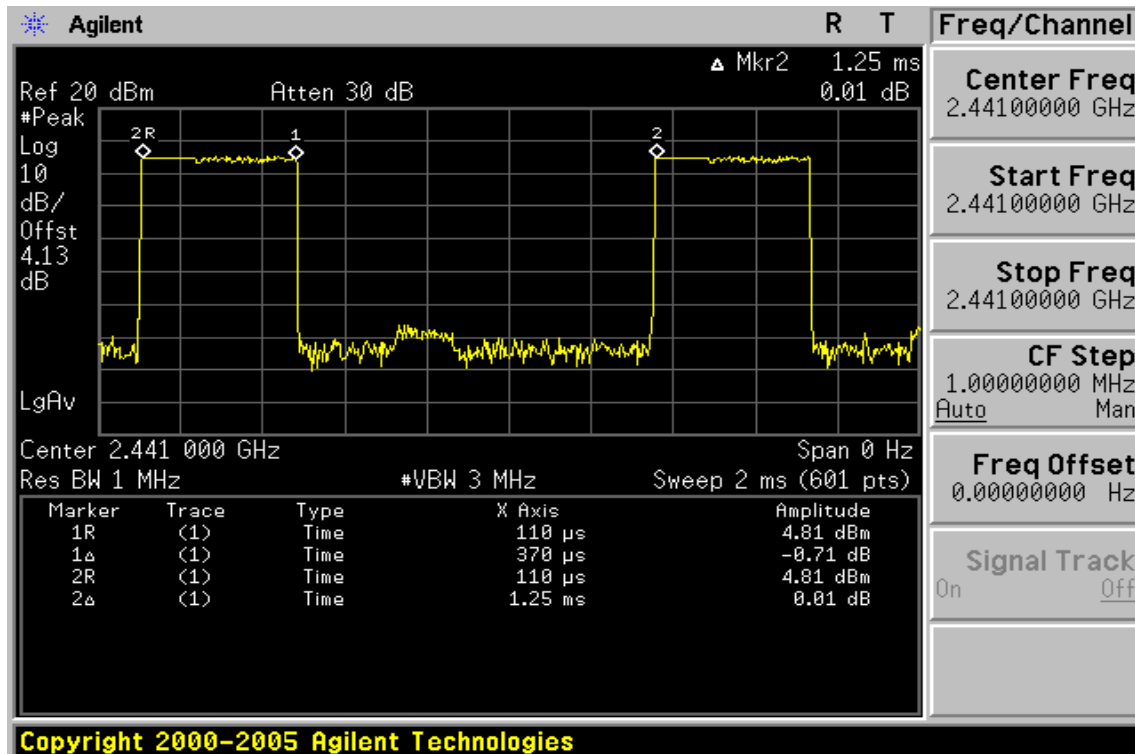
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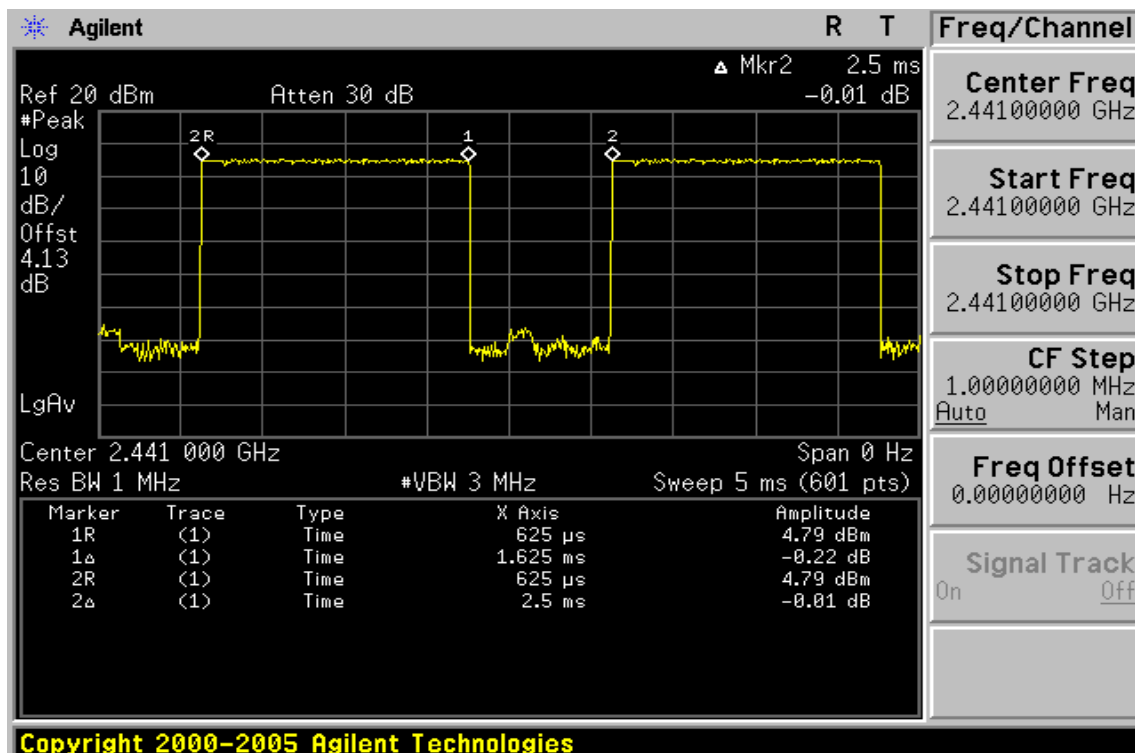
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CH-Mid

3DH1



3DH3



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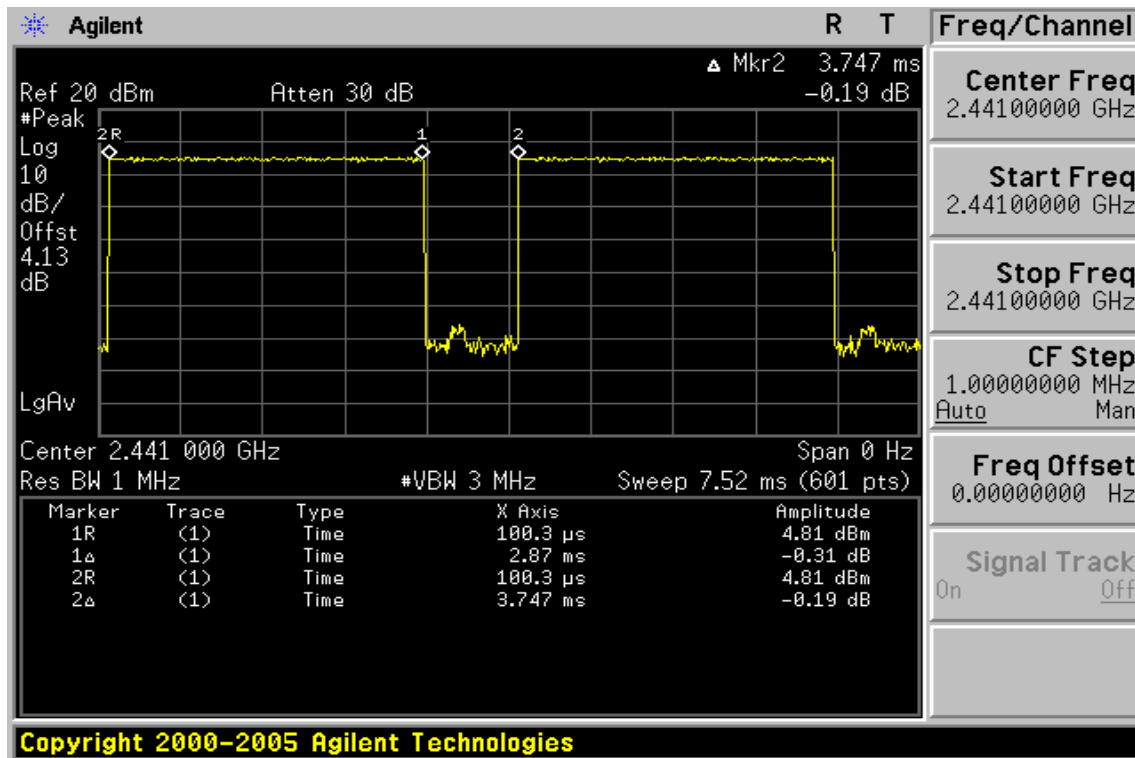
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3DH5



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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.

14.2. Antenna Connected Construction

The directional gains of antenna used for transmitting is 2.52dBi, and the antenna connector is designed with unique type RF connector and no consideration of replacement. Please see EUT photo and antenna spec. for details.

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APPENDIX 1

MEASUREMENT PLOT OF RADIATED SPURIOUS EMISSION

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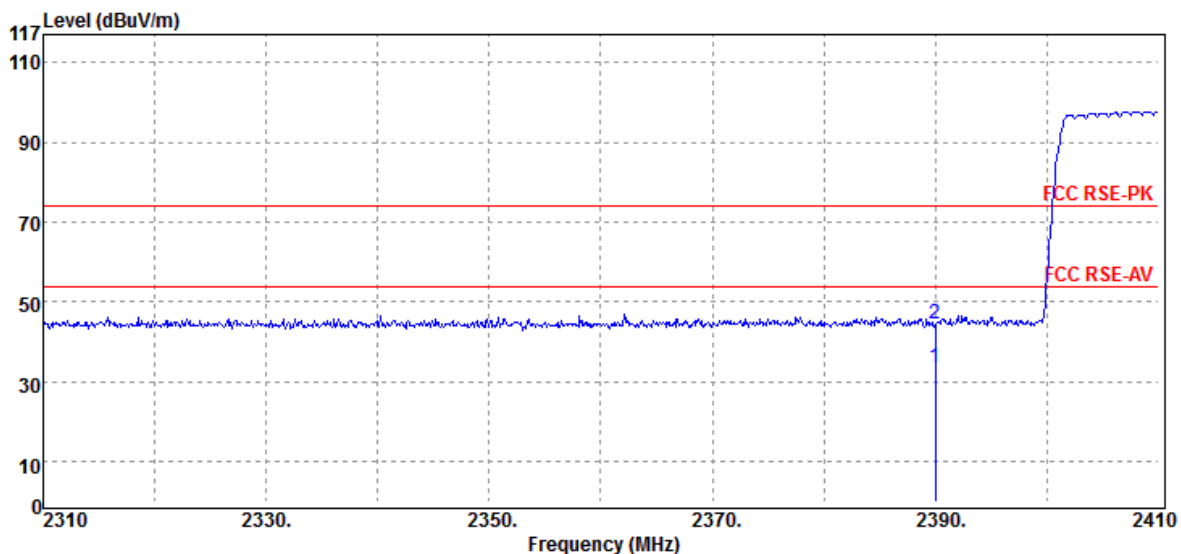
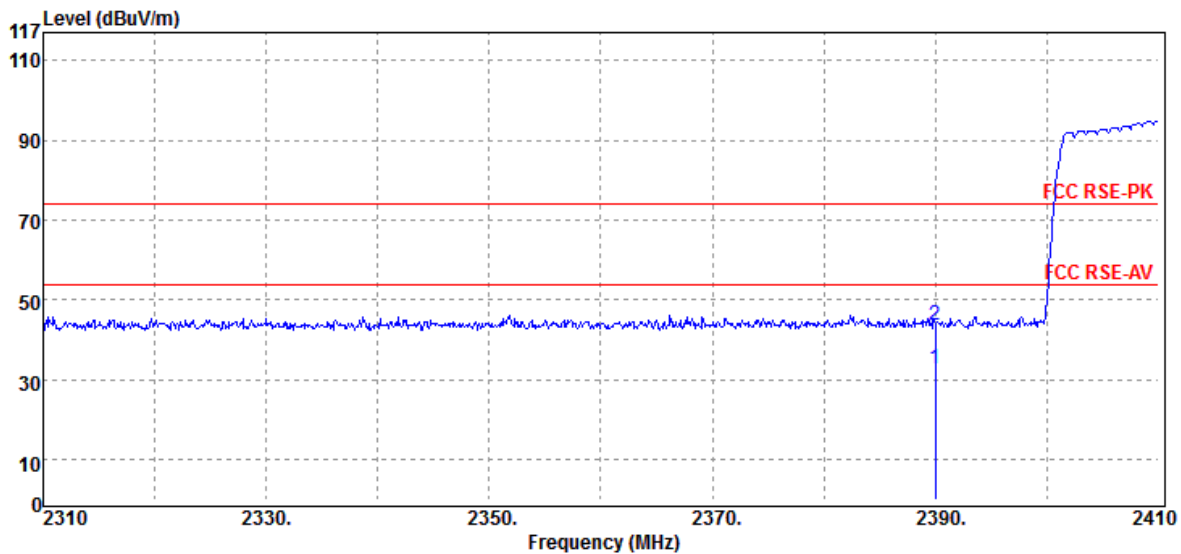
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Band Edges Radiated Emission: (Hopping Mode)

Note: The emission that surpasses the limit of peak represents the fundamental emission of the operation that does not account to be conformed to the limit of the interest.

Note: The trace on RE (radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

Operation Band	:BR+Hopping	Test Date	:2014-11-07
Fundamental Frequency	:2402 MHz	Temp./Humi.	:23 deg_C / 58 RH
Operation Mode	:Band Edge LOW	Engineer	:Tin
EUT Pol.	:H Plane	Measurement Antenna Pol.	:Ver. / Hor.



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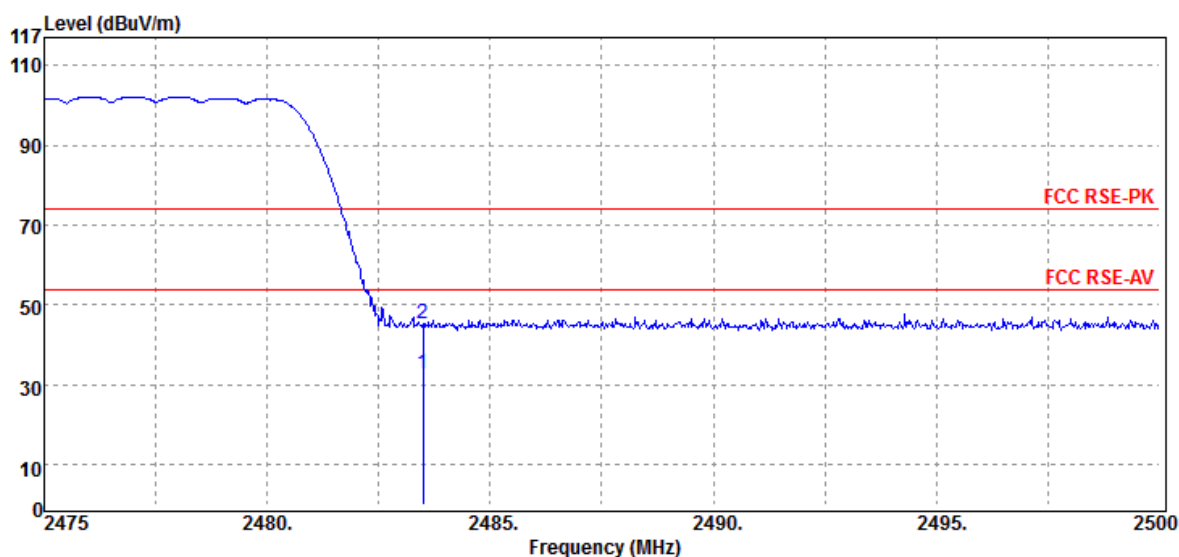
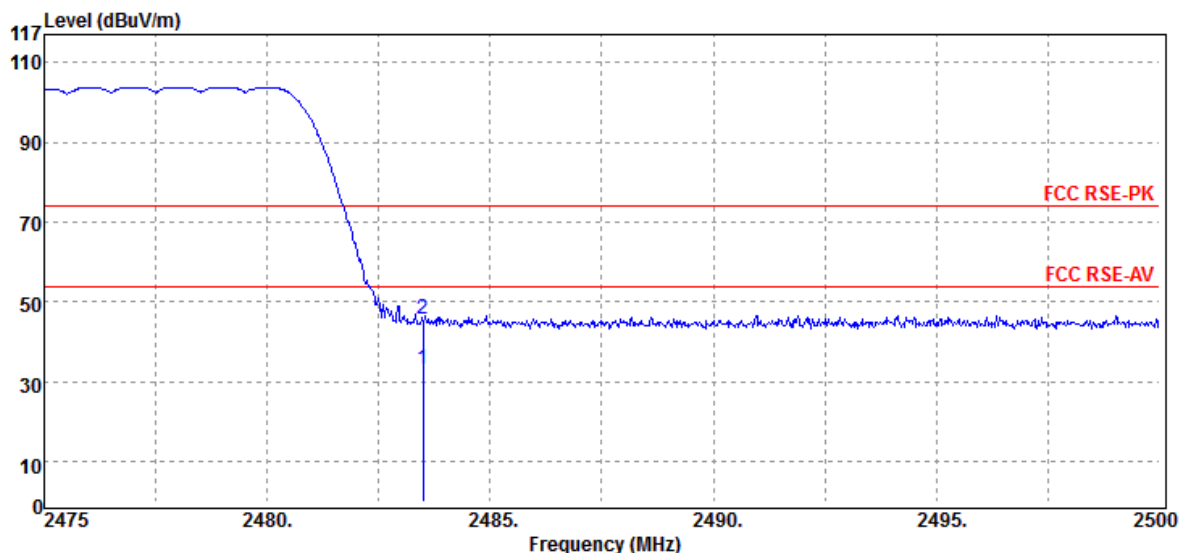
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Operation Band	:BR+Hopping	Test Date	:2014-11-07
Fundamental Frequency	:2480 MHz	Temp./Humi.	:23 deg_C / 58 RH
Operation Mode	:Band Edge HIGH	Engineer	:Tin
EUT Pol.	:H Plane	Measurement Antenna Pol.	:Ver. / Hor.



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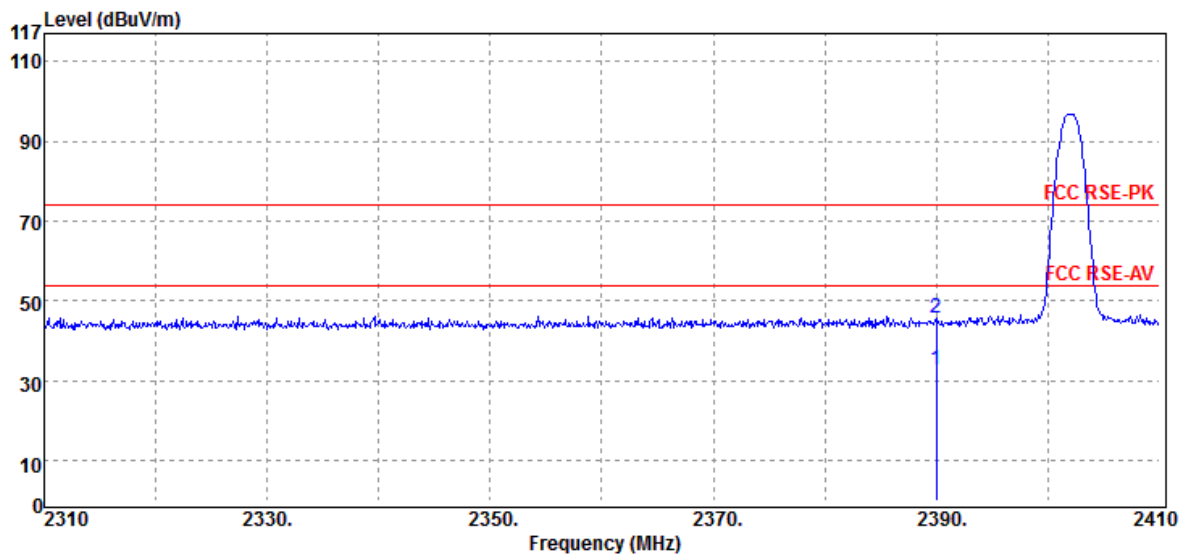
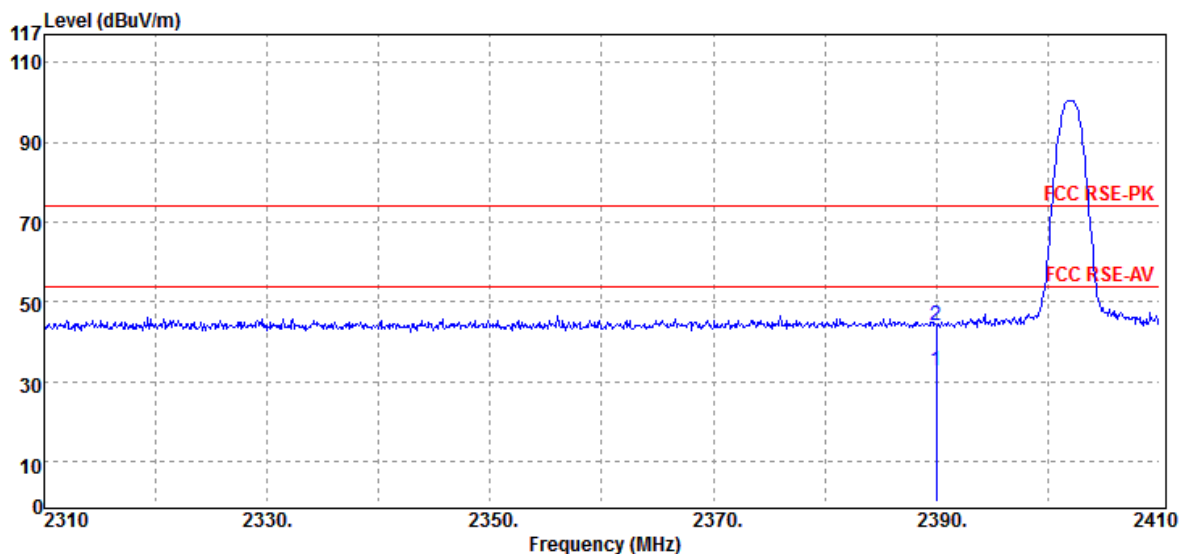
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Band Edges Radiated Emission: (Non-Hopping Mode)

Note: The emission that surpasses the limit of peak represents the fundamental emission of the operation that does not account to be conformed to the limit of the interest.

Note: The trace on RE (radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

Operation Band	:BR	Test Date	:2014-11-07
Fundamental Frequency	:2402 MHz	Temp./Humi.	:23 deg_C / 58 RH
Operation Mode	:Band Edge LOW	Engineer	:Tin
EUT Pol.	:H Plane	Measurement Antenna Pol.	:Ver. / Hor.



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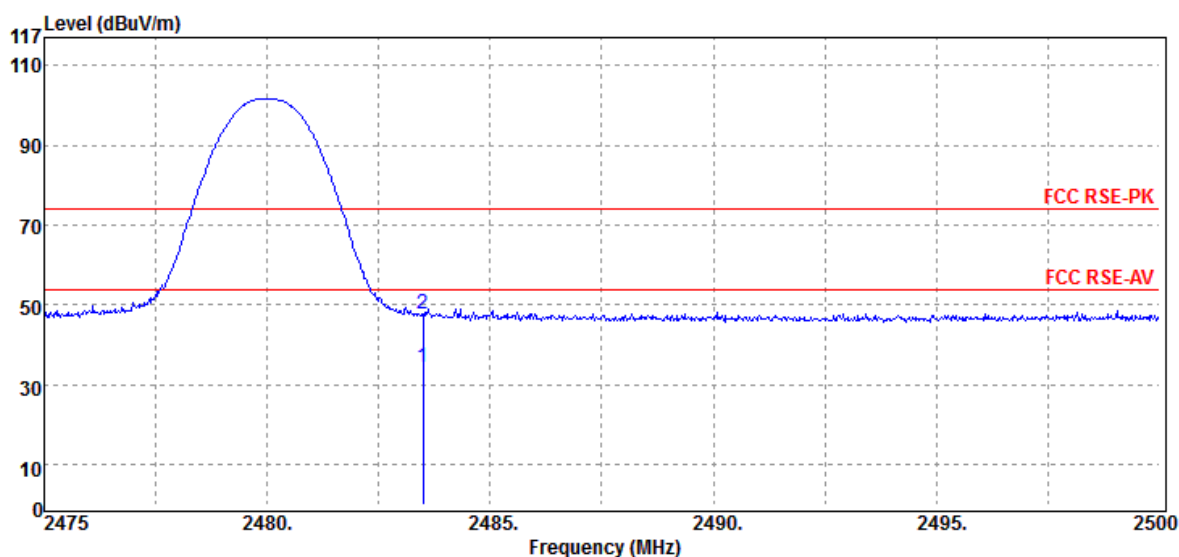
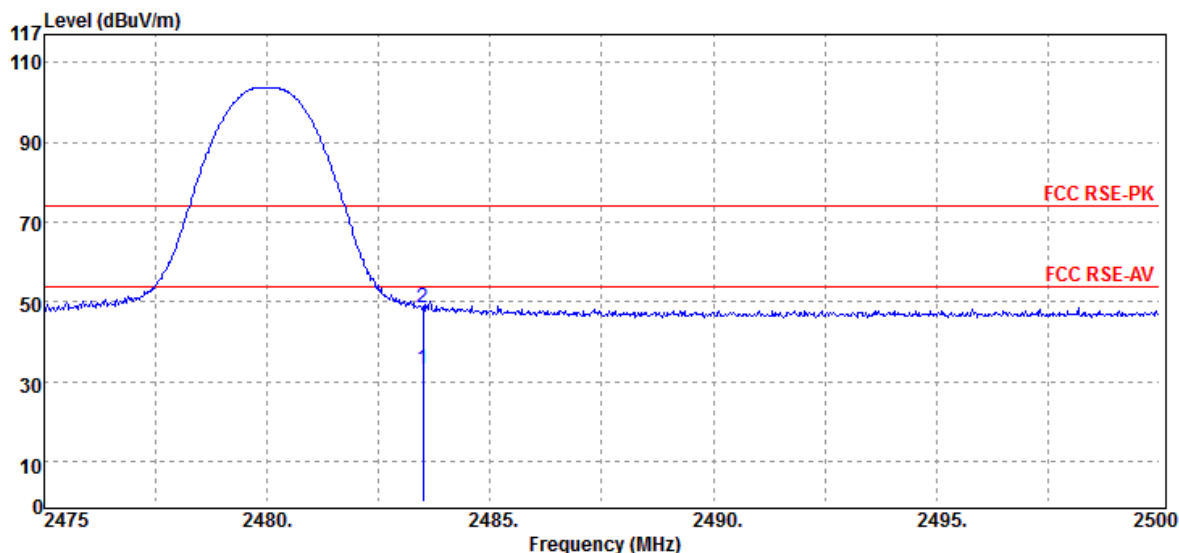
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Operation Band	:BR	Test Date	:2014-11-07
Fundamental Frequency	:2480 MHz	Temp./Humi.	:23 deg_C / 58 RH
Operation Mode	:Band Edge HIGH	Engineer	:Tin
EUT Pol.	:H Plane	Measurement Antenna Pol.	:Ver. / Hor.



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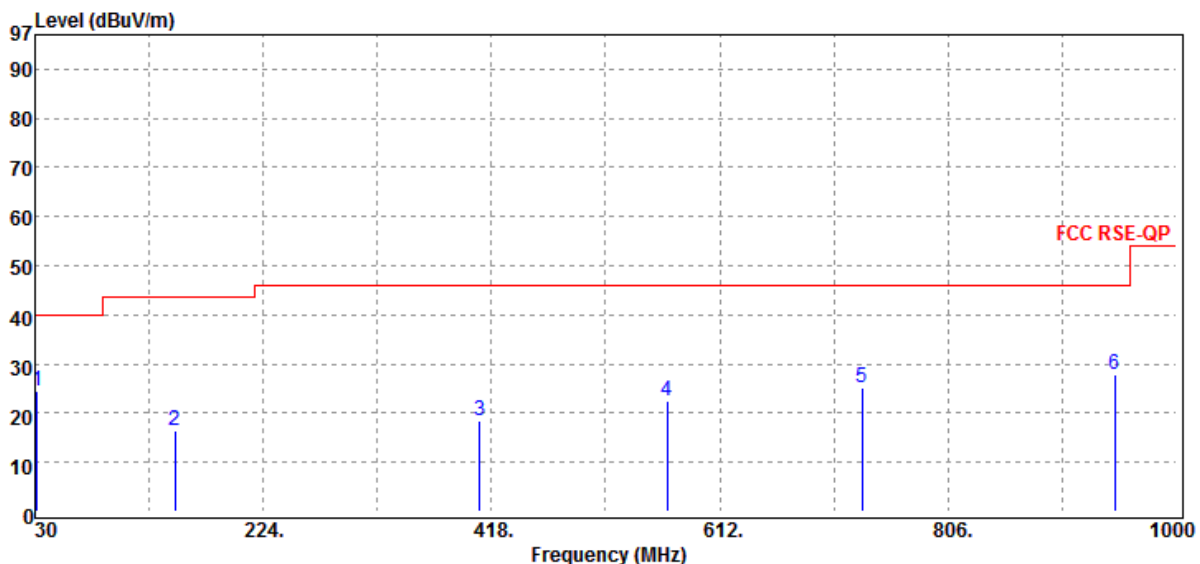
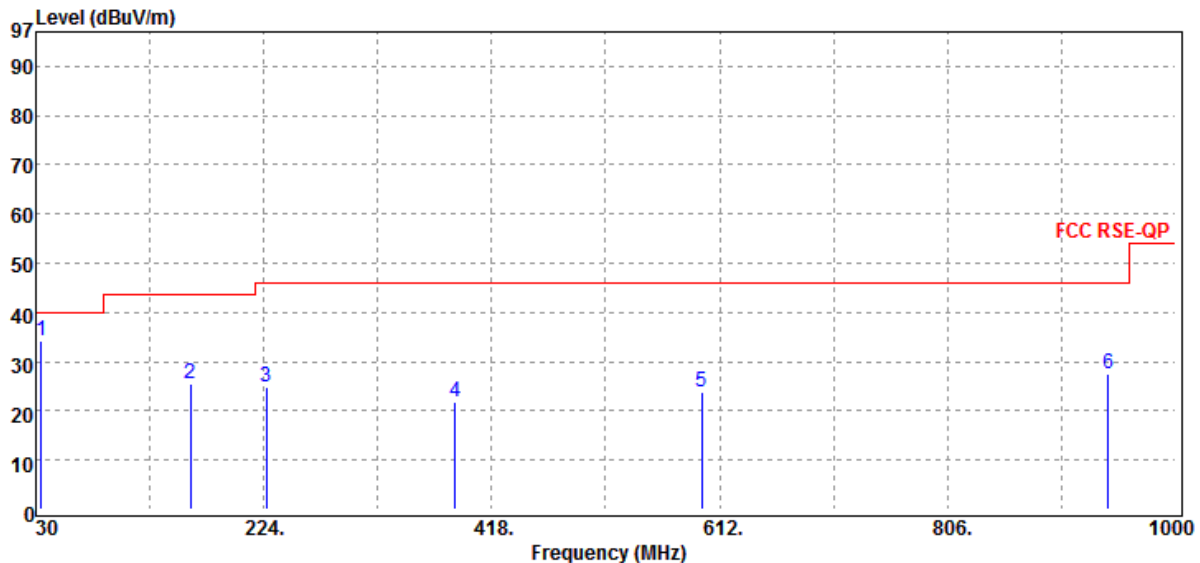
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Radiated Spurious Emission Measurement photos Result (below 1GHz)

Note: The trace on RE (radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

Operation Band	:BR	Test Date	:2014-11-07
Fundamental Frequency	:2402 MHz	Temp./Humi.	:23 deg_C / 58 RH
Operation Mode	:TX LOW	Engineer	:Tin
EUT Pol.	: H Plane	Measurement Antenna Pol.	:Ver. / Hor.



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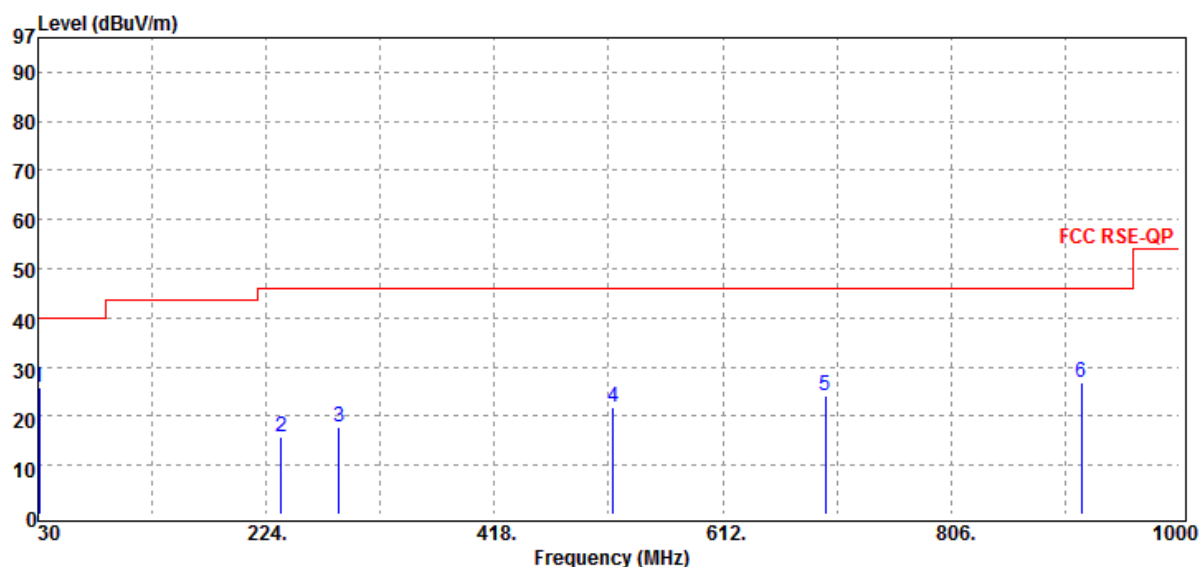
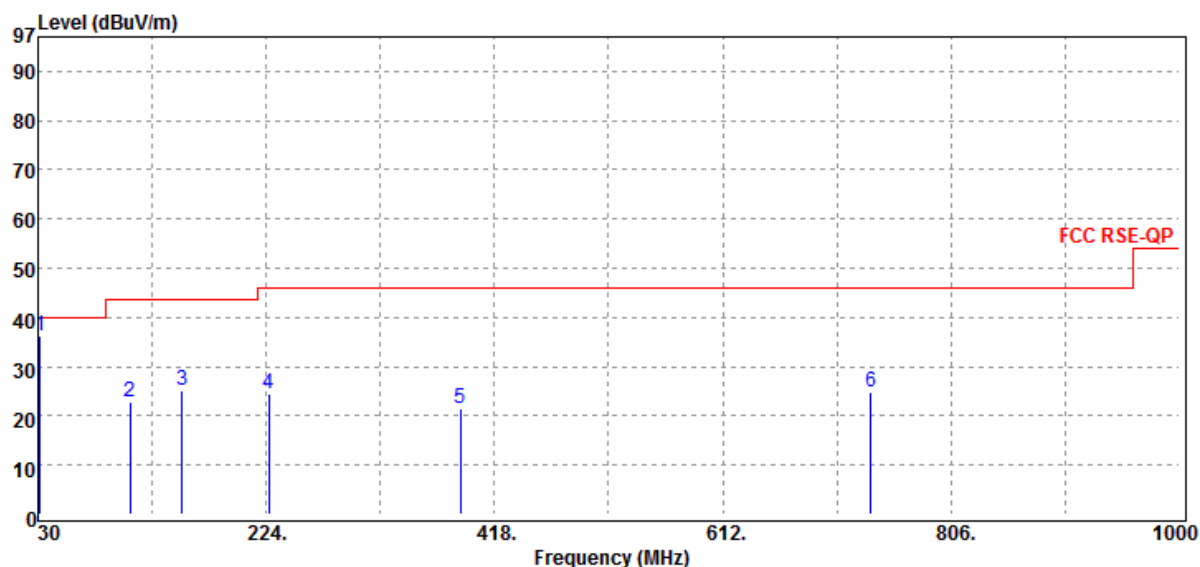
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Operation Band	:BR	Test Date	:2014-11-07
Fundamental Frequency	:2441 MHz	Temp./Humi.	:23 deg_C / 58 RH
Operation Mode	:TX MID	Engineer	:Tin
EUT Pol.	: H Plane	Measurement Antenna Pol.	:Ver. / Hor.



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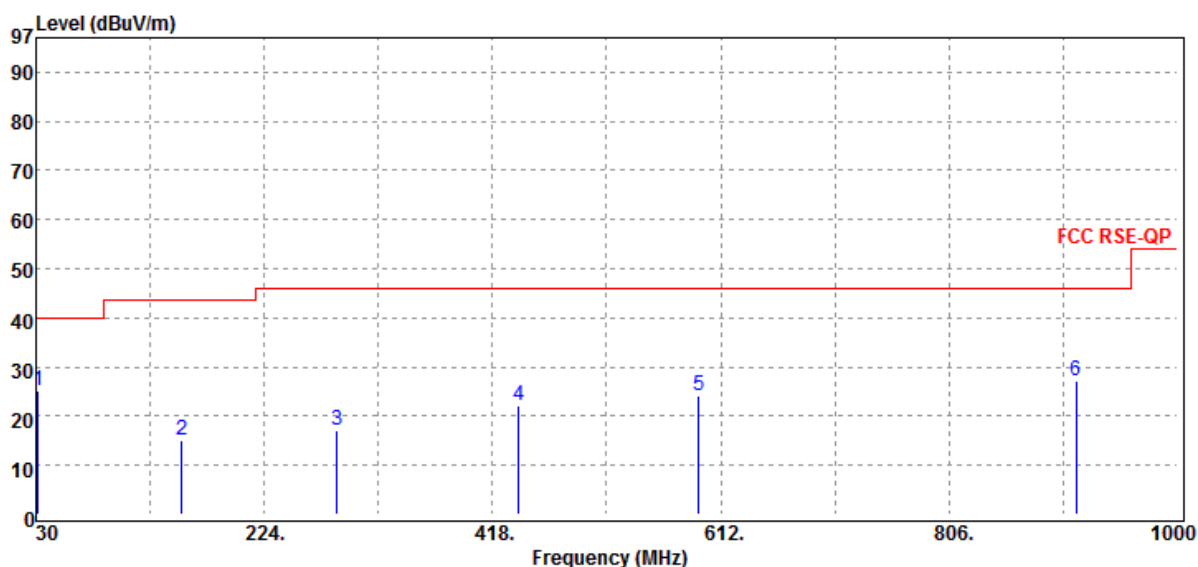
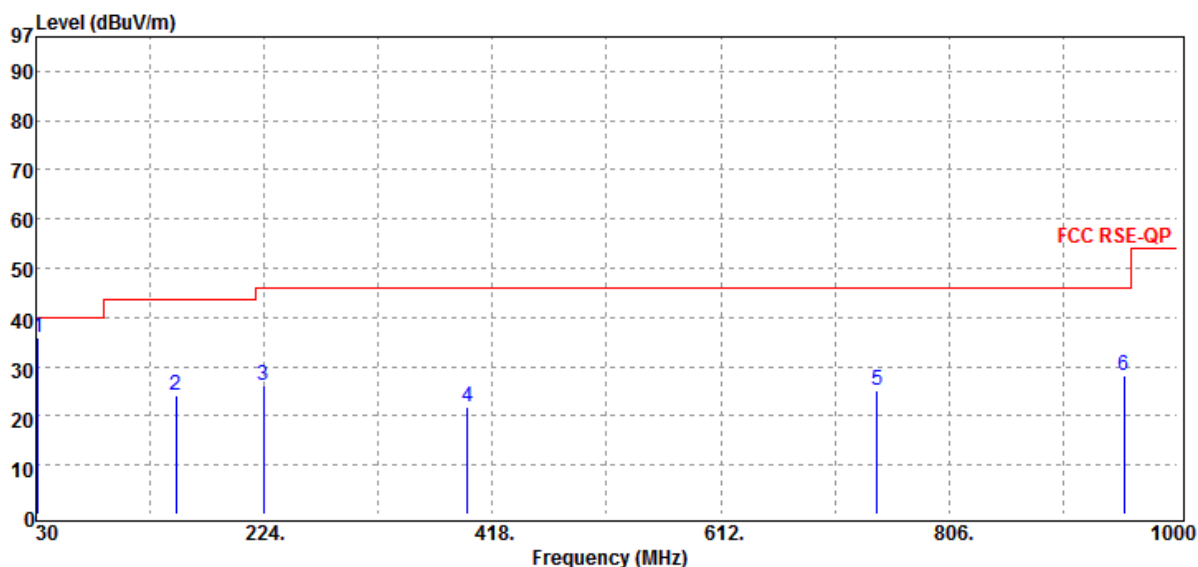
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Operation Band :BR
Fundamental Frequency :2480 MHz
Operation Mode :TX HIGH
EUT Pol. : H Plane

Test Date :2014-11-07
Temp./Humi. :23 deg_C / 58 RH
Engineer :Tin
Measurement Antenna Pol. :Ver. / Hor.



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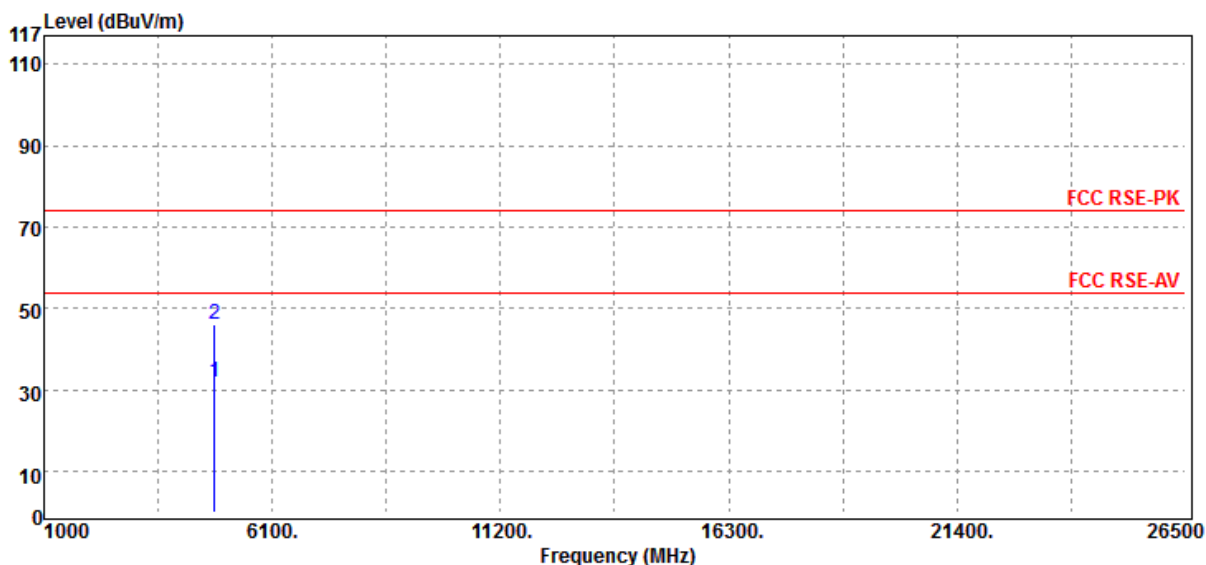
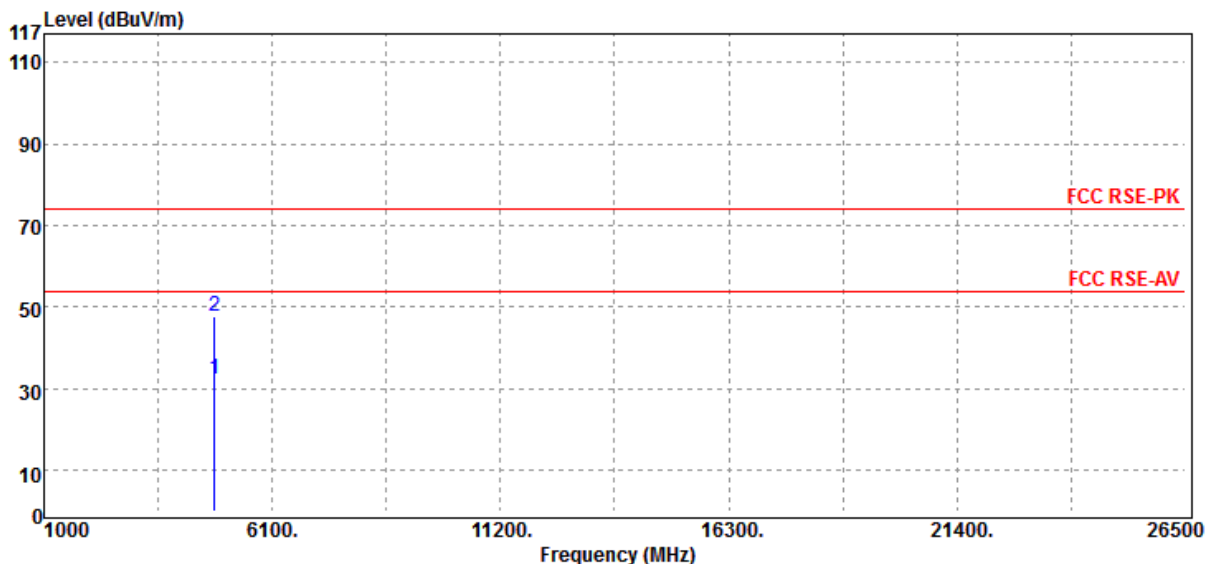
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Radiated Spurious Emission Measurement photos Result (above 1GHz)

Operation Band	:BR	Test Date	:2014-11-07
Fundamental Frequency	:2402 MHz	Temp./Humi.	:23 deg_C / 58 RH
Operation Mode	:TX LOW	Engineer	:Tin
EUT Pol.	:H Plane	Measurement Antenna Pol.	:Ver. / Hor.



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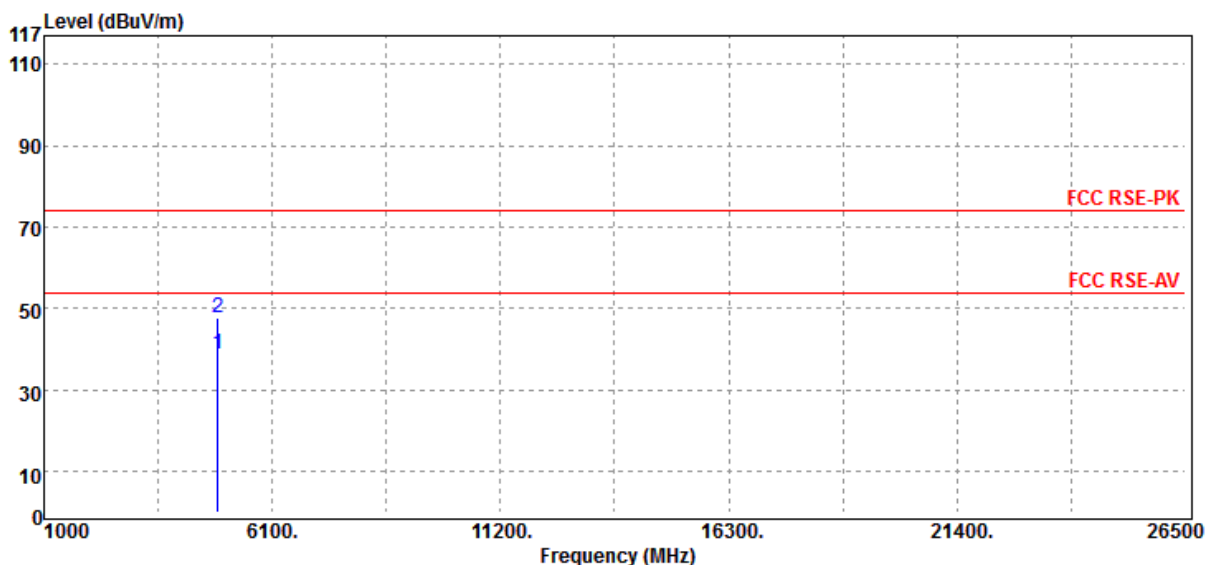
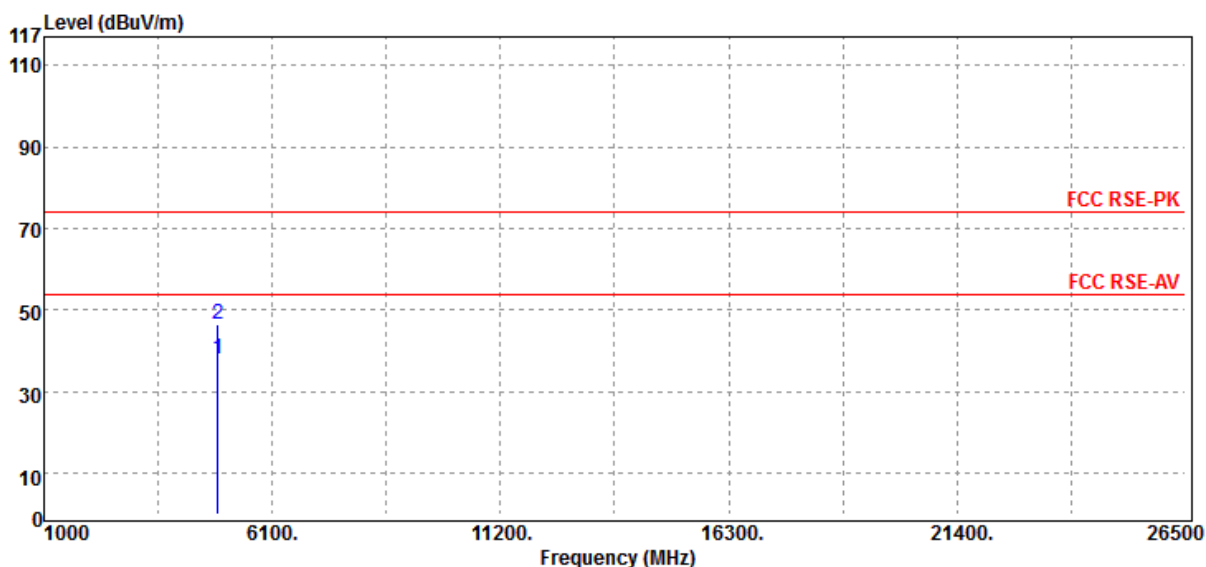
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Operation Band	:BR	Test Date	:2014-11-07
Fundamental Frequency	:2441 MHz	Temp./Humi.	:23 deg_C / 58 RH
Operation Mode	:TX MID	Engineer	:Tin
EUT Pol.	:H Plane	Measurement Antenna Pol.	:Ver. / Hor.



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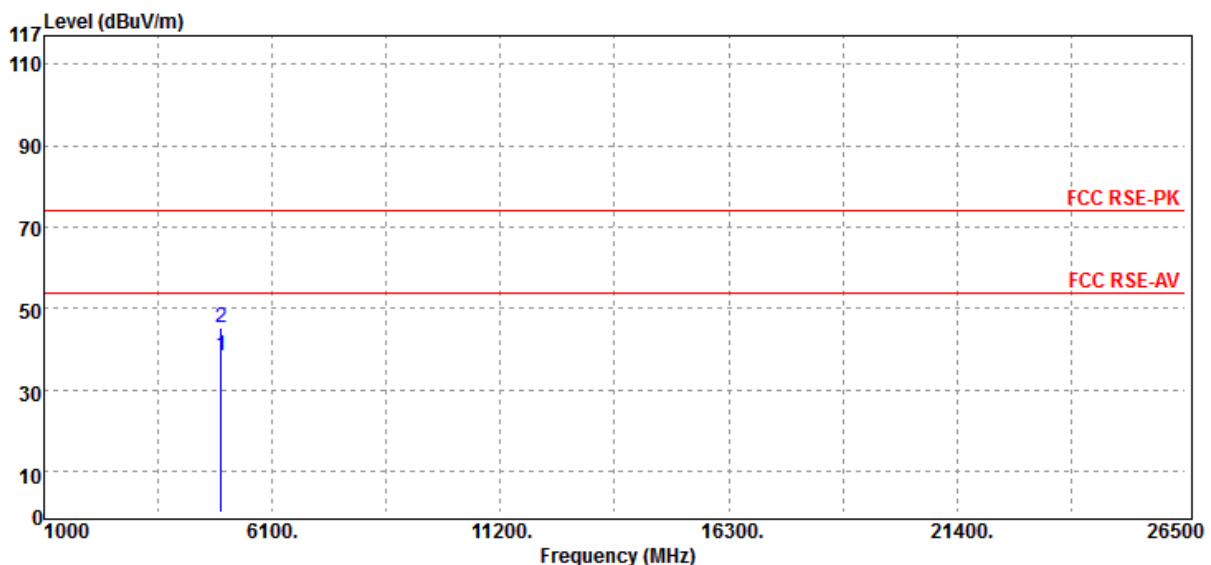
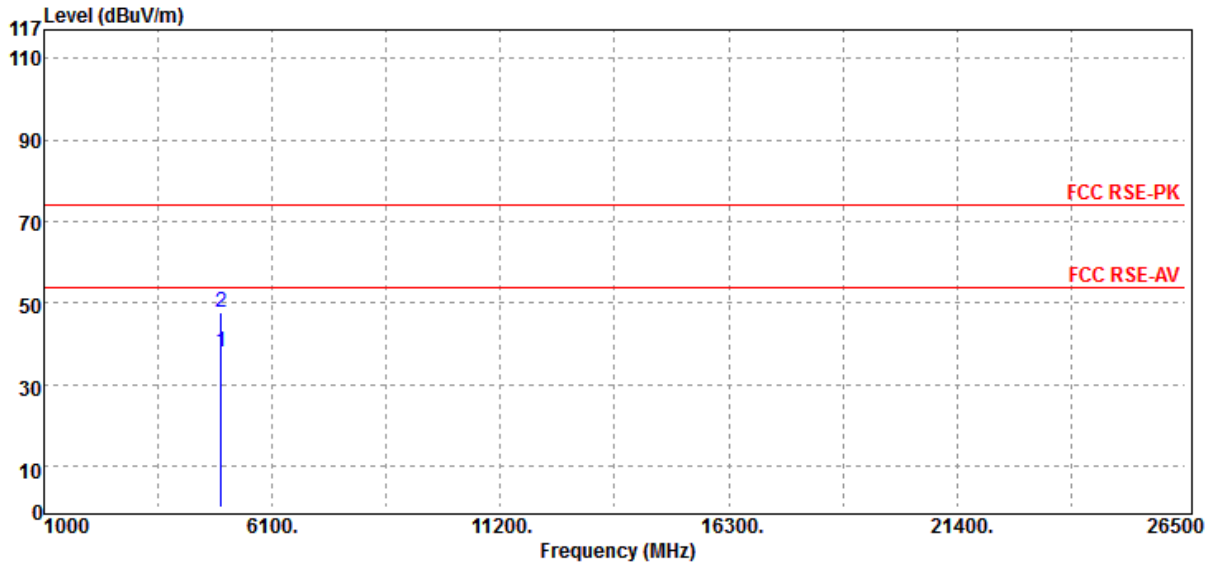
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Operation Band	:BR	Test Date	:2014-11-07
Fundamental Frequency	:2480 MHz	Temp./Humi.	:23 deg_C / 58 RH
Operation Mode	:TX HIGH	Engineer	:Tin
EUT Pol.	:H Plane	Measurement Antenna Pol.	:Ver. / Hor.



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