ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

Product Name:	**Data collector**
Brand Name:	**Opticon**
Model No.:	**OPN-2006**
Model Difference:	**N/A**
FCC ID:	**Q2Q-OPN2006**
Report No.:	**E2/2014/40023**
Issue Date:	**May 22, 2014**
FCC Rule Part:	**§15.247, Cat: DSS**
Prepared for:	**Opticon Sensors Europe B.V. Opaallaan 35, 2132 XV Hoofddorp, The Netherlands**
Prepared by:	**SGS Taiwan Ltd. Electronics & Communication Laboratory No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803**

Testing Laboratory
0513

VERIFICATION OF COMPLIANCE

Applicant:	Opticon Sensors Europe B.V. Opaallaan 35, 2132 XV Hoofddorp, The Netherlands
Product Name:	OPN-2006
Brand Name:	Opticon
Model No.:	OPN-2006
Model Difference:	N/A
FCC ID:	Q2Q-OPN2006
File Number:	E2/2014/40023
Date of test:	Apr. 18, 2014 ~ May 15, 2014
Date of EUT Received:	Apr. 18, 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 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:	Marcus Tseng	***Date:***	May 22, 2014
	Marcus Tseng / Engineer		
Prepared By:	Violetta Tang	***Date:***	May 22, 2014
	Violetta Tang / Clerk		
Approved By:	Jim Chang	***Date:***	May 22, 2014
	Jim Chang / Supervisor		

Version

Version No.	Date	Description
00	May 22, 2014	Initial creation of document

Table of Contents

1. GENERAL INFORMATION

1.1. Product description

General:

Product Name:	Data collector	
Brand Name:	Opticon	
Model No.:	OPN-2006	
Model Difference:	N/A	
Hardware Version:	N/A	
Software Version:	N/A	
Data Cable (USB):	Model No.: N/A, Supplier: N/A	
Power Supply:	3.7Vdc from Rechargeable Li-Ion Battery or 5Vdc from USB Port	
	Battery:	Model No.: H602025, Supplier: Power Source Energy CO., LTD

Bluetooth_V3.0:

Bluetooth Version:	V3.0
Channel number:	79 channels
Modulation type:	Frequency Hopping Spread Spectrum
Transmit Power:	6.60dBm
Frequency Range:	2.402GHz – 2.480GHz
Dwell Time:	<= 0.4s
Antenna Designation:	Ceramic Antenna, 1.7dBi Model No.: W3008, Supplier: Pulse

The EUT is compliance with Bluetooth standard.

This test report applies for Bluetooth function.

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

This submittal(s) (test report) is intended for **FCC ID: Q2Q-OPN2006** 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 DoC procedure.

1.3. Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.4:2009. 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, Wuku Industrial Zone, Taipei County, Taiwan which are constructed and calibrated to meet the FCC requirements in documents ANSI C63.4:2009. FCC Registration Number is: 990257. Canada Registration Number is: 4620A-4.

The 10 m Open Area Test Sites located on the address of SGS Taiwan Ltd. Electronics & Communication Laboratory No. 29, Pau-Tou-Tsuo Valley Chia-Pau Tsuen, Linkou Hsiang, Taipei county, which is constructed and calibrated to meet the CISPR 22/EN 55022 requirements. SGS Site No. 1(3 &10 meters) and FCC Registration Number: 94644.

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.

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 plane. According to the general criterion in Section 7.1 of ANSI C63.4:2009. 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 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 a placed on as 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 and DA 00-705.

2.4. Configuration of Tested System

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

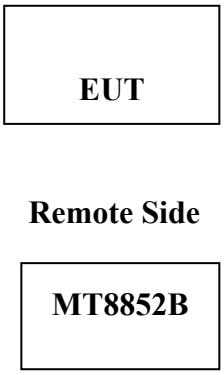


Fig. 2-2 AC Power Line Conducted Emission

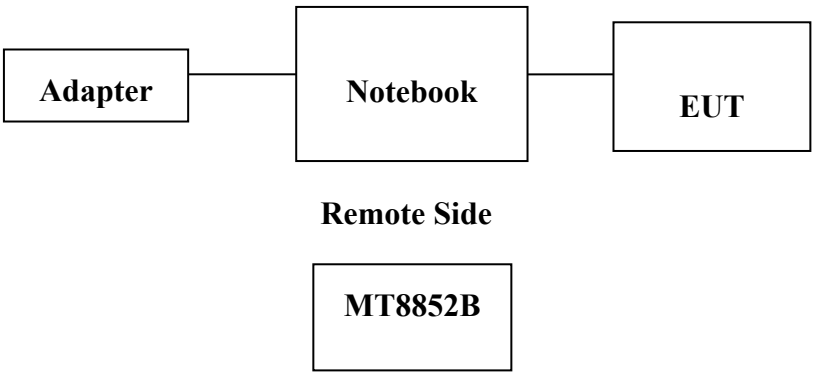


Table 2-1 Equipment Used in Tested System

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.	Bluetooth Test Set	Anritsu	MT8852B	6k00006107	N/A	N/A
3.	Notebook	DELL	E5400	3704625136	N/A	N/A

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

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, BR, 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 (Π/4 DQPSK) with 2Mbps
3DH1/3DH3/3DH5 (8DPSK) with 3Mbps

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.

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.		

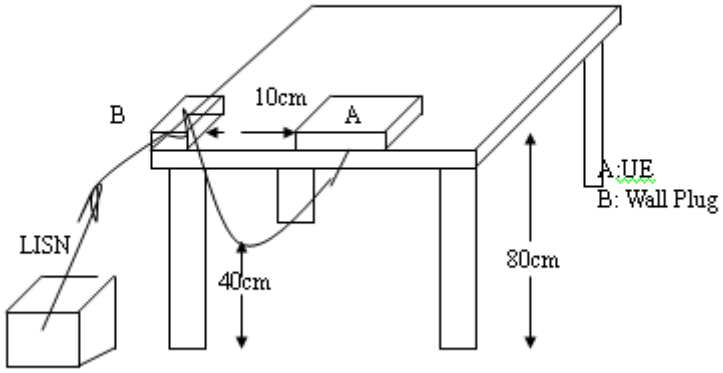
6.2. Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	**MFR**	**MODEL NUMBER**	**SERIAL NUMBER**	**LAST CAL.**	**CAL DUE.**
EMI Test Receiver	R&S	ESCI7	100760	05/27/2013	05/26/2014
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.
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.

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

AC POWER LINE CONDUCTED EMISSION TEST DATA

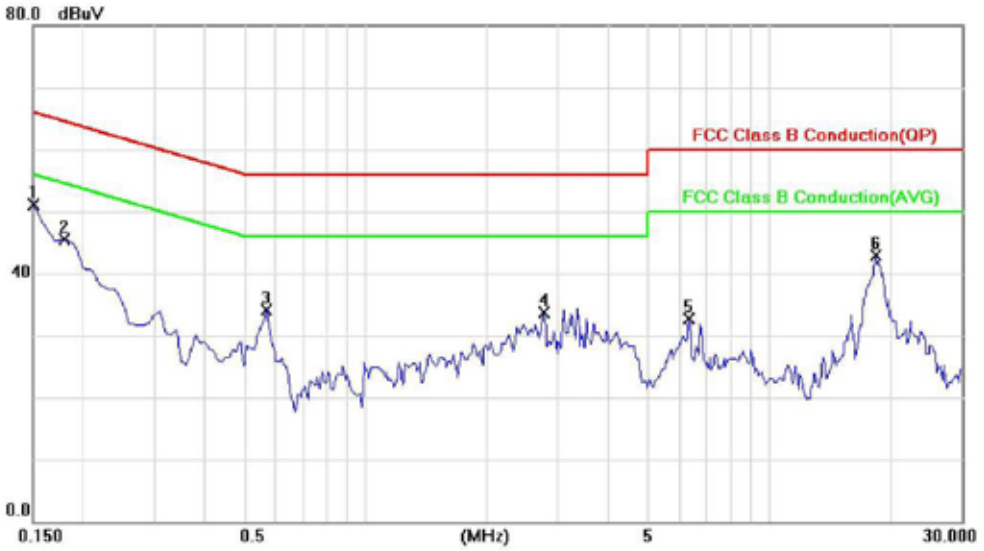
Operation Mode:	Operation mode			Test Date:	May. 08, 2014
Temperature:	26 ℃	Humidity:	60 %	Test By:	Marcus

Site ConductionRoom
Limit: FCC Class B Conduction(QP)
Mode: Operationmode
Note:

Phase: L1
Power: AC 120V/60Hz

Temperature: 26 ℃
Humidity: 60%

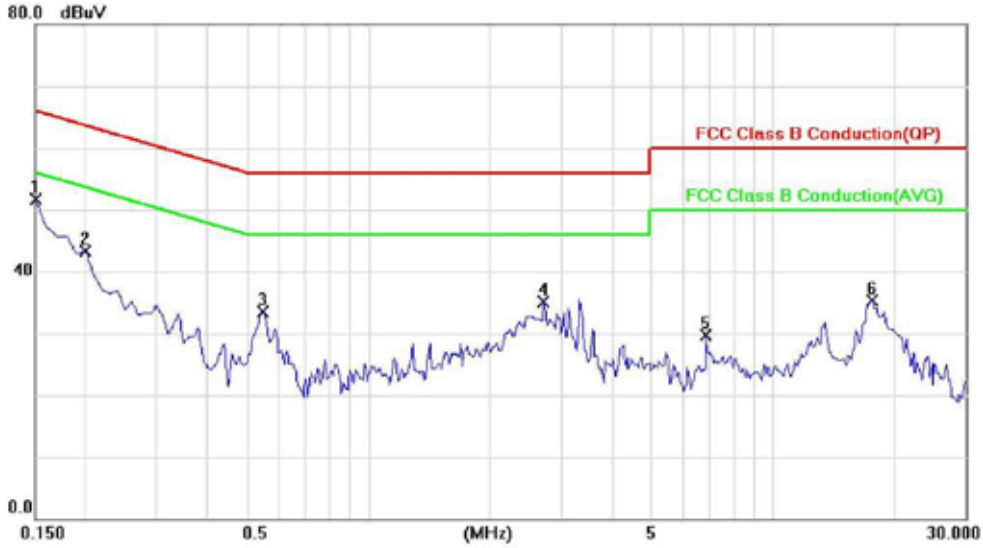
ConductedEmission



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	*	0.1500	51.04	0.16	51.20	66.00	-14.80	peak	
2		0.1800	45.39	0.16	45.55	64.49	-18.94	peak	
3		0.5700	33.88	0.17	34.05	56.00	-21.95	peak	
4		2.7700	33.54	0.23	33.77	56.00	-22.23	peak	
5		6.3400	32.40	0.30	32.70	60.00	-27.30	peak	
6		18.3600	42.58	0.42	43.00	60.00	-17.00	peak	

Site ConductionRoom	Phase:	N	Temperature: 26 ℃
Limit: FCC Class B Conduction(QP)	Power:	AC 120V/60Hz	Humidity: 60%
Mode: Operationmode			
Note:			

ConductedEmission



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	*	0.1500	51.58	0.18	51.76	66.00	-14.24	peak	
2		0.2000	43.19	0.19	43.38	63.61	-20.23	peak	
3		0.5500	33.39	0.21	33.60	56.00	-22.40	peak	
4		2.7200	34.87	0.27	35.14	56.00	-20.86	peak	
5		6.8600	29.43	0.36	29.79	60.00	-30.21	peak	
6		17.6400	34.82	0.53	35.35	60.00	-24.65	peak	

7. PEAK OUTPUT POWER MEASUREMENT

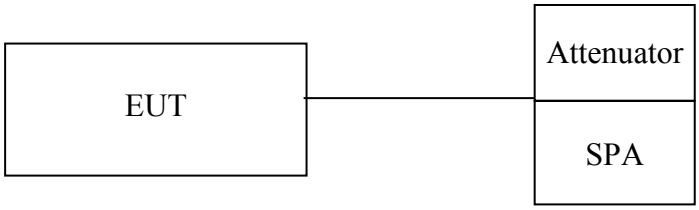
7.1. Standard Applicable

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	05/30/2013	05/29/2014
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:



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 >=20dB bandwidth)
3. Record the max. reading.
4. Repeat above procedures until all default test channel is completed.

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

7.5. Measurement Result

BR mode (GFSK):

Frequency (MHz)	Reading Power (dBm)	Output Power (W)	Limit (W)
2402.00	1.92	0.00156	1
2441.00	4.04	0.00254	1
2480.00	**6.60**	0.00457	1

EDR mode (π/4DQPSK):

Frequency (MHz)	Reading Power (dBm)	Output Power (W)	Limit (W)
2402.00	-0.17	0.00096	0.125
2441.00	2.18	0.00165	0.125
2480.00	5.65	0.00367	0.125

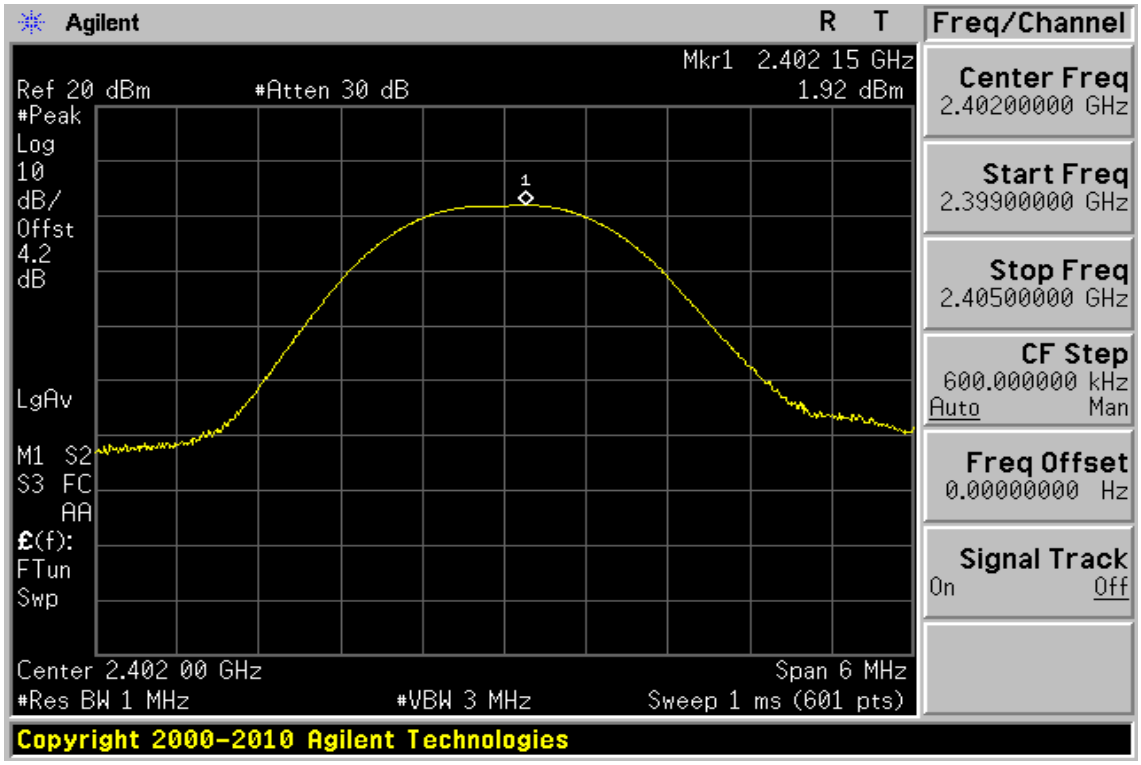
EDR mode (8DPSK):

Frequency (MHz)	Reading Power (dBm)	Output Power (W)	Limit (W)
2402.00	0.20	0.00105	0.125
2441.00	2.44	0.00175	0.125
2480.00	5.77	0.00378	0.125

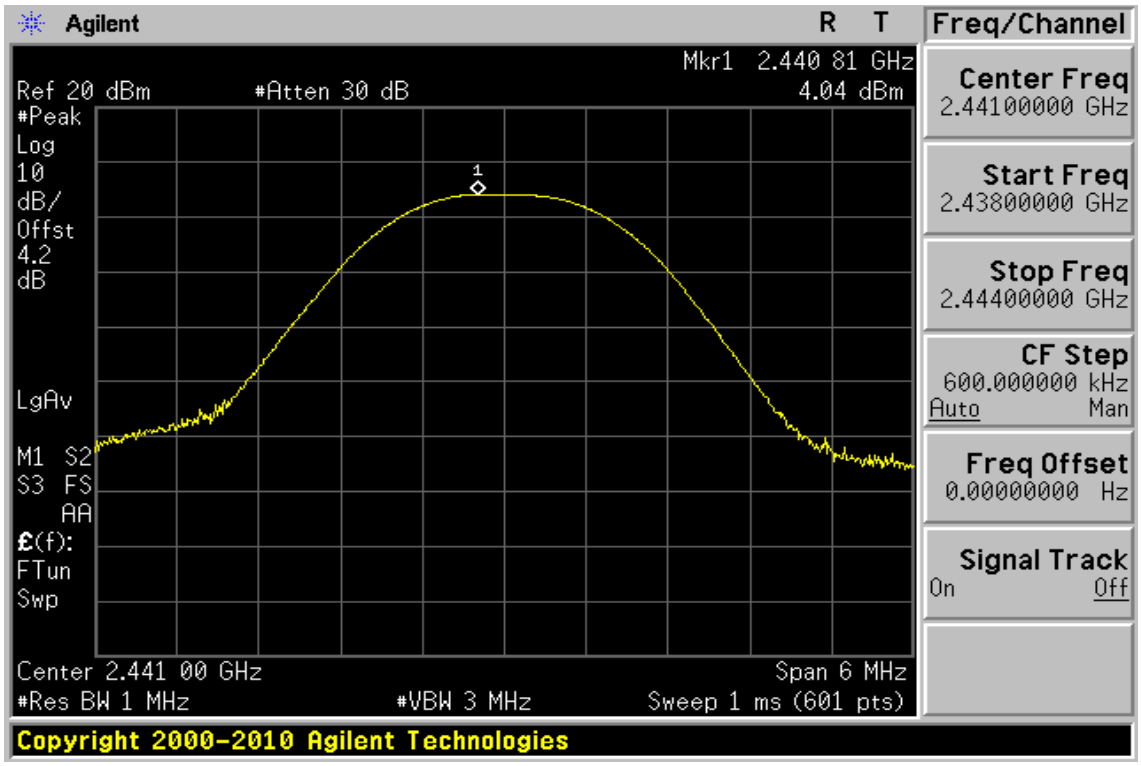
**Note: offset 4.2dB*

Note: Refer to next page for plots.

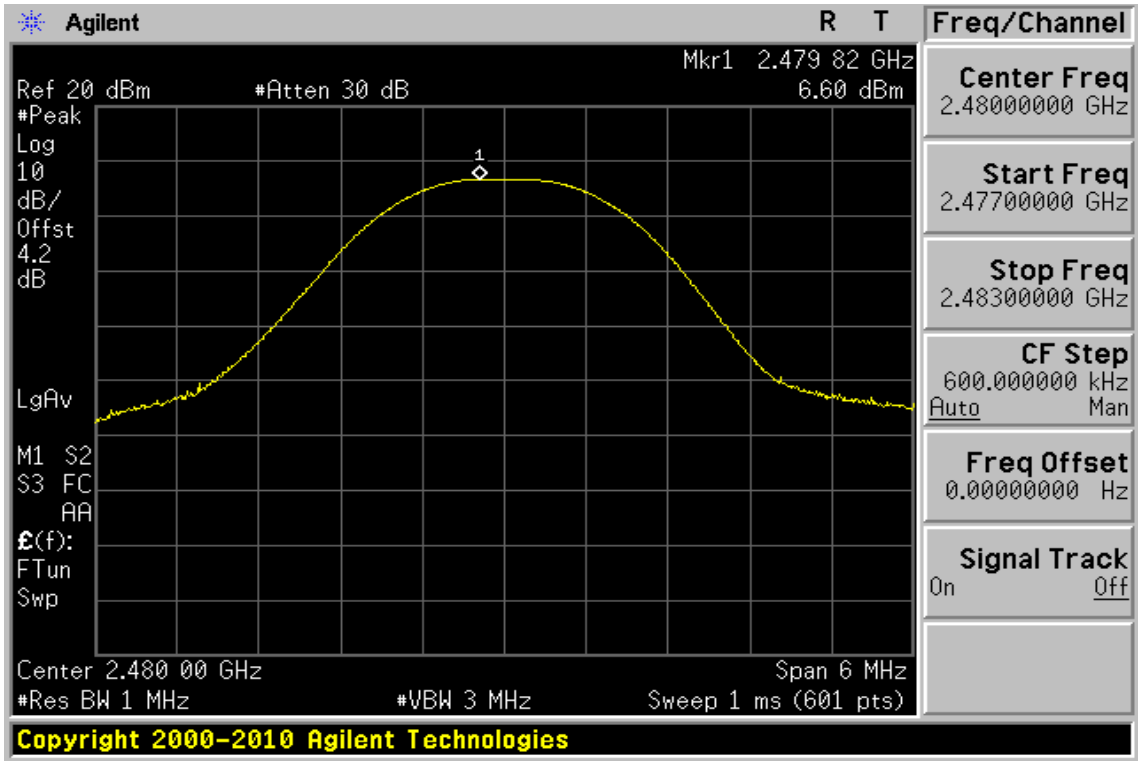
Peak Power Output Data Plot (CH Low) (BR mode GFSK)



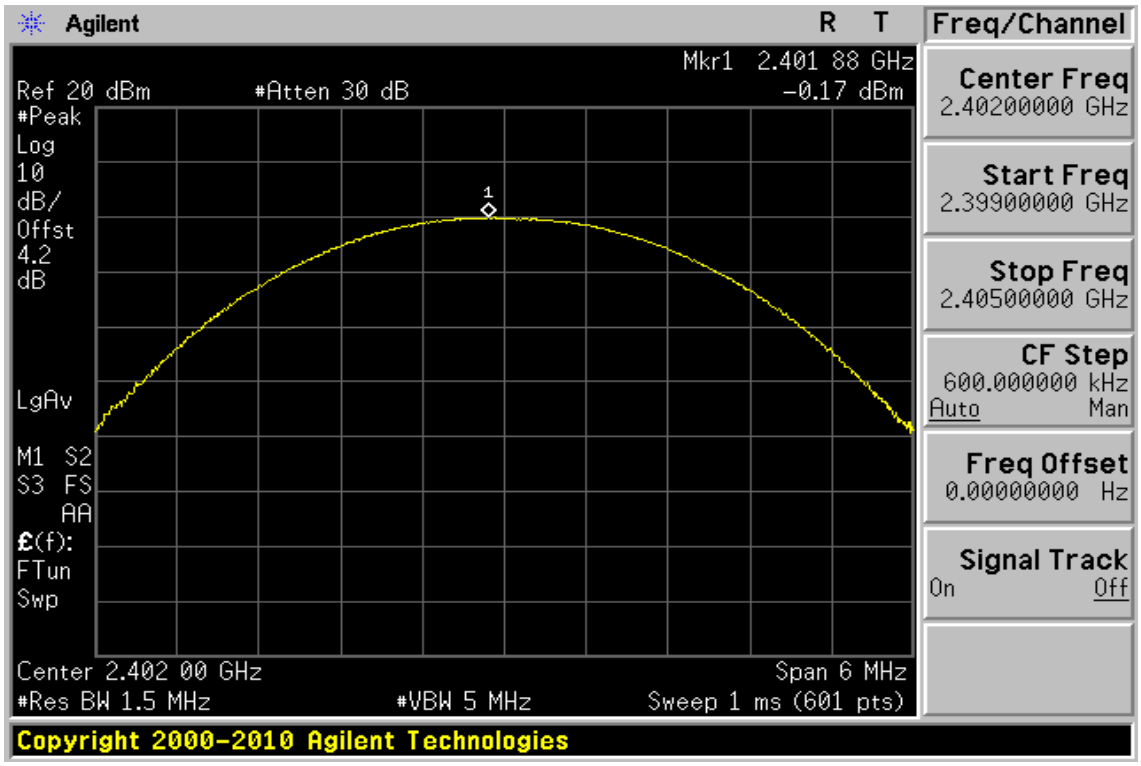
Peak Power Output Data Plot (CH Mid) (BR mode GFSK)



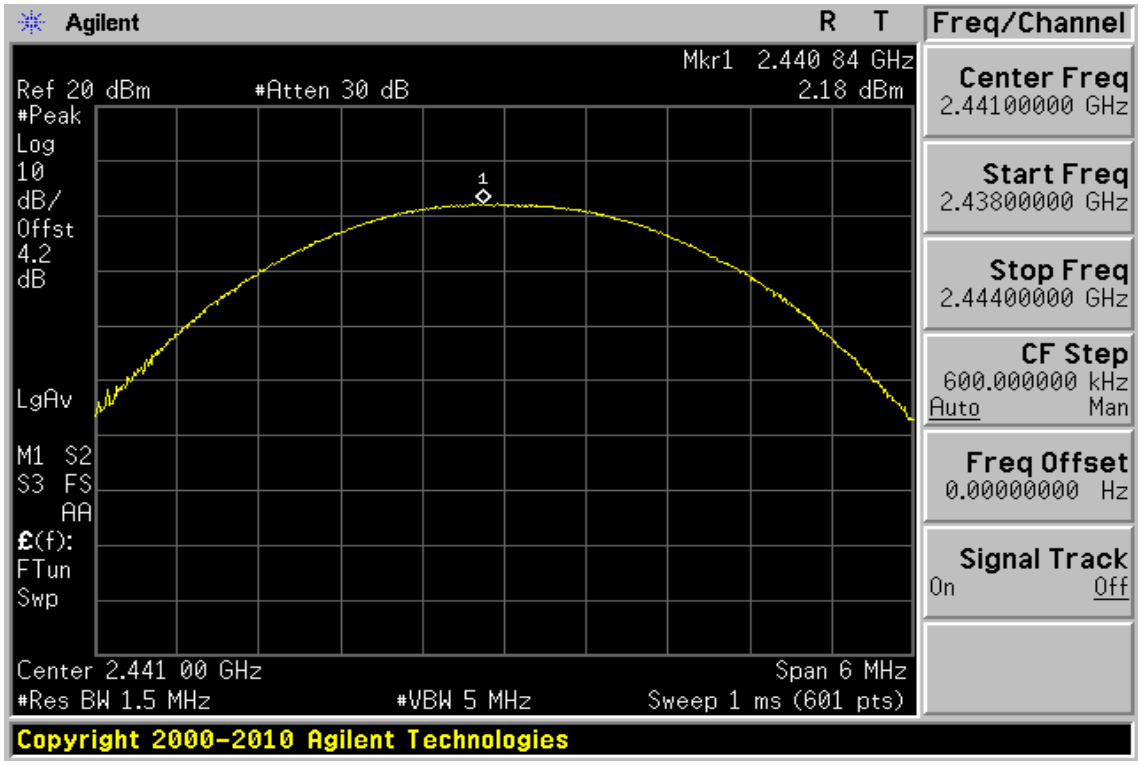
Peak Power Output Data Plot (CH High) (BR mode GFSK)



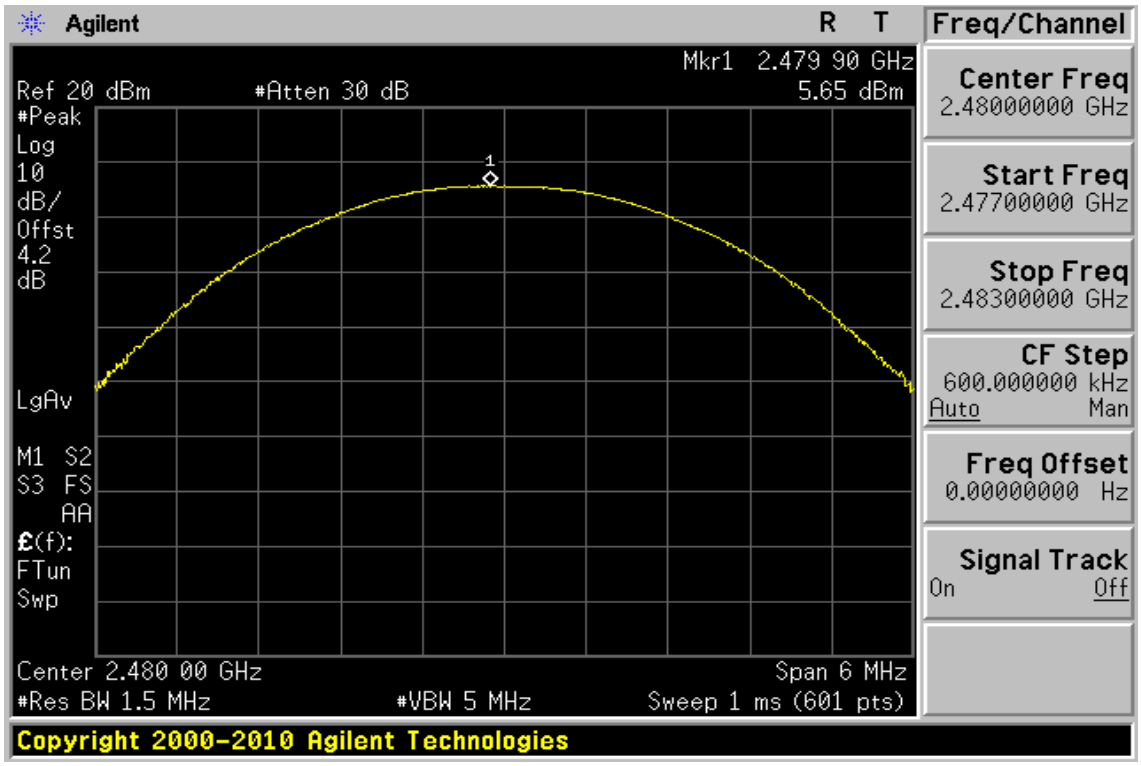
Peak Power Output Data Plot (CH Low) (EDR mode π/4DQPSK)



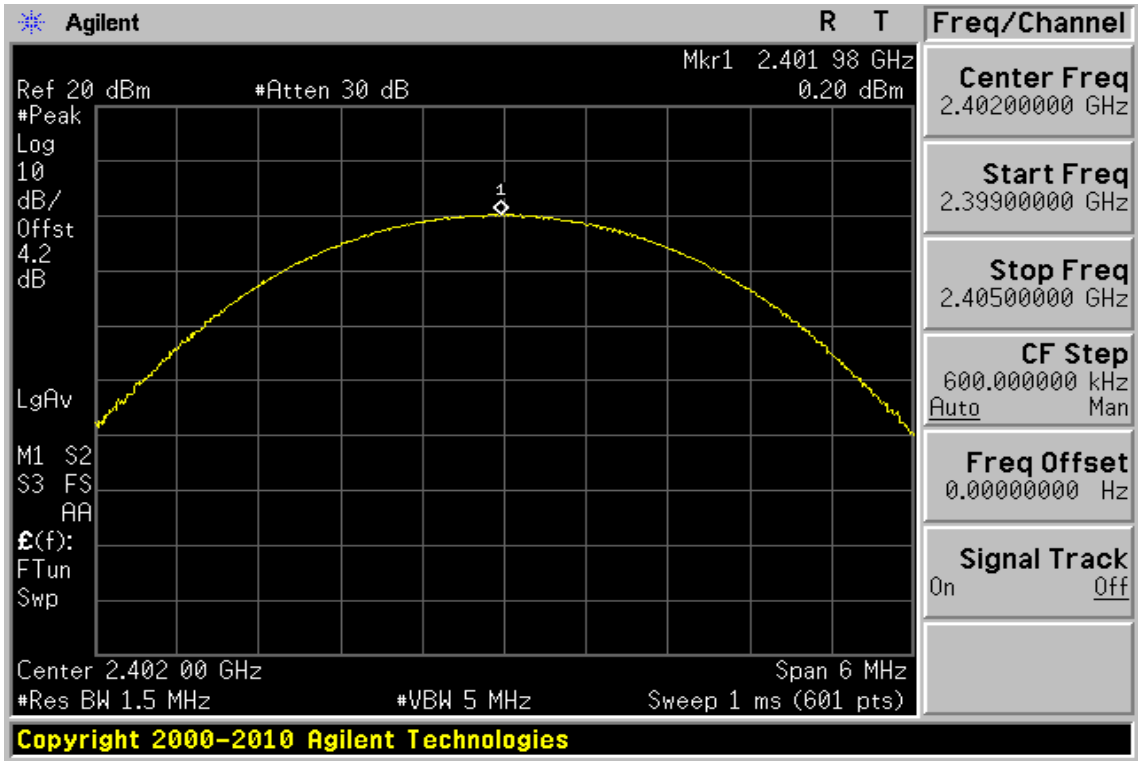
Peak Power Output Data Plot (CH Mid) (EDR mode π/4DQPSK)



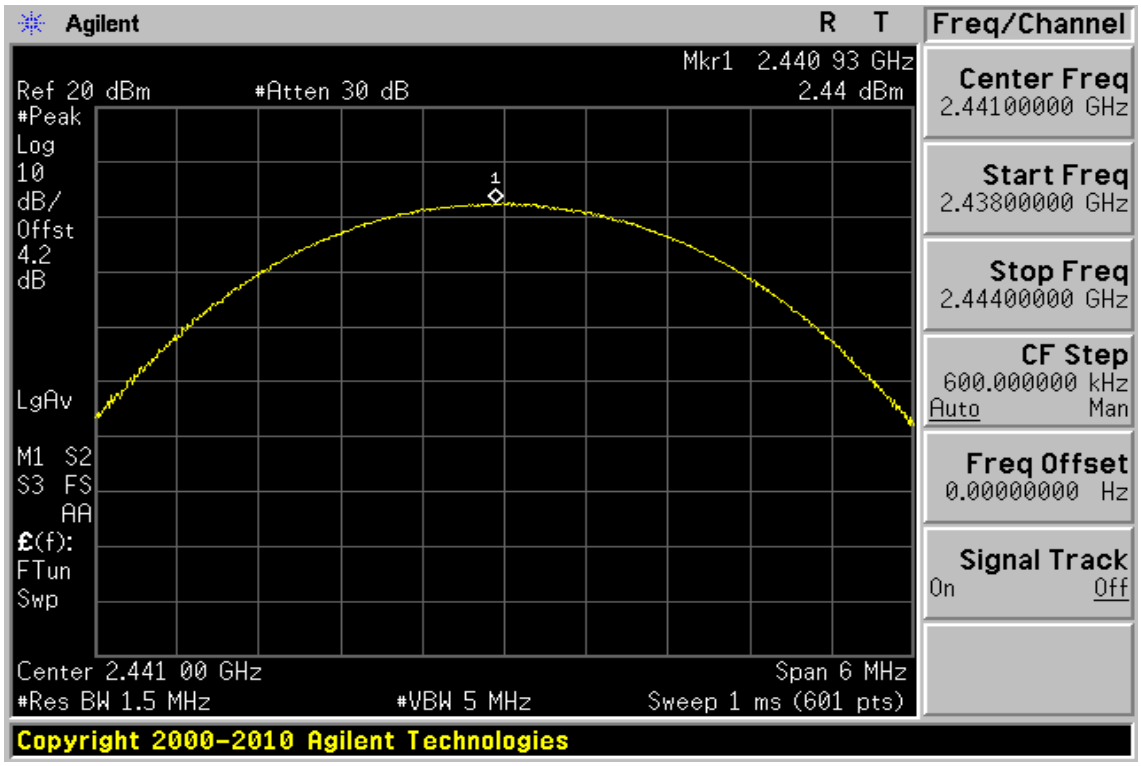
Peak Power Output Data Plot (CH High) (EDR mode π/4DQPSK)



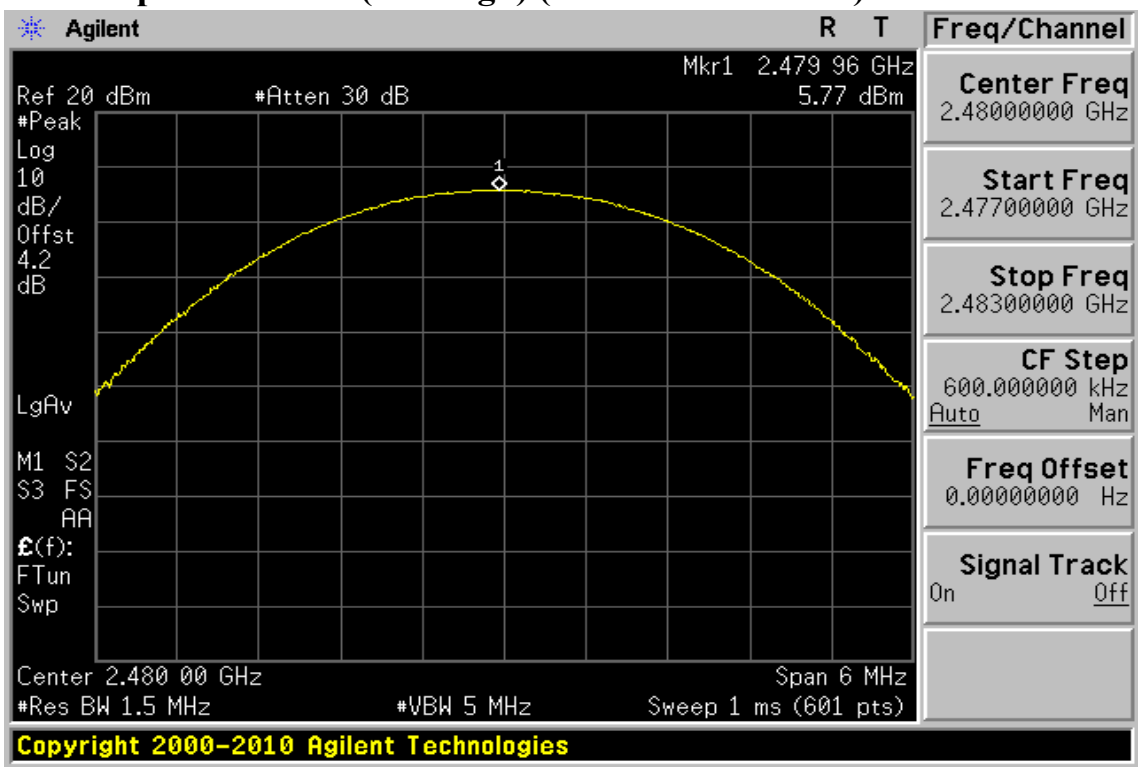
Peak Power Output Data Plot (CH Low) (EDR mode 8DPSK)



Peak Power Output Data Plot (CH Mid) (EDR mode 8DPSK)



Peak Power Output Data Plot (CH High) (EDR mode 8DPSK)



8. 20dB BANDWIDTH

8.1. Standard Applicable

According to §15.247(a)(1), for frequency hopping systems operating in the 2400MHz-2483.5 MHz no limit for 20dB bandwidth.

8.2. Measurement Equipment Used

Refer to section 7.2 for the plot.

8.3. Test Set-up

Refer to section 7.3 for the plot.

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 and Turn on the 99% bandwidth function, max reading.
5. Repeat above procedures until all test default channel is completed

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

8.5. Measurement Result:

20dB Bandwidth: BR mode (GFSK)

CH	Bandwidth (kHz)
Lower	926.385
Mid	927.716
Higher	926.327

20dB Bandwidth: EDR mode (π/4DQPSK)

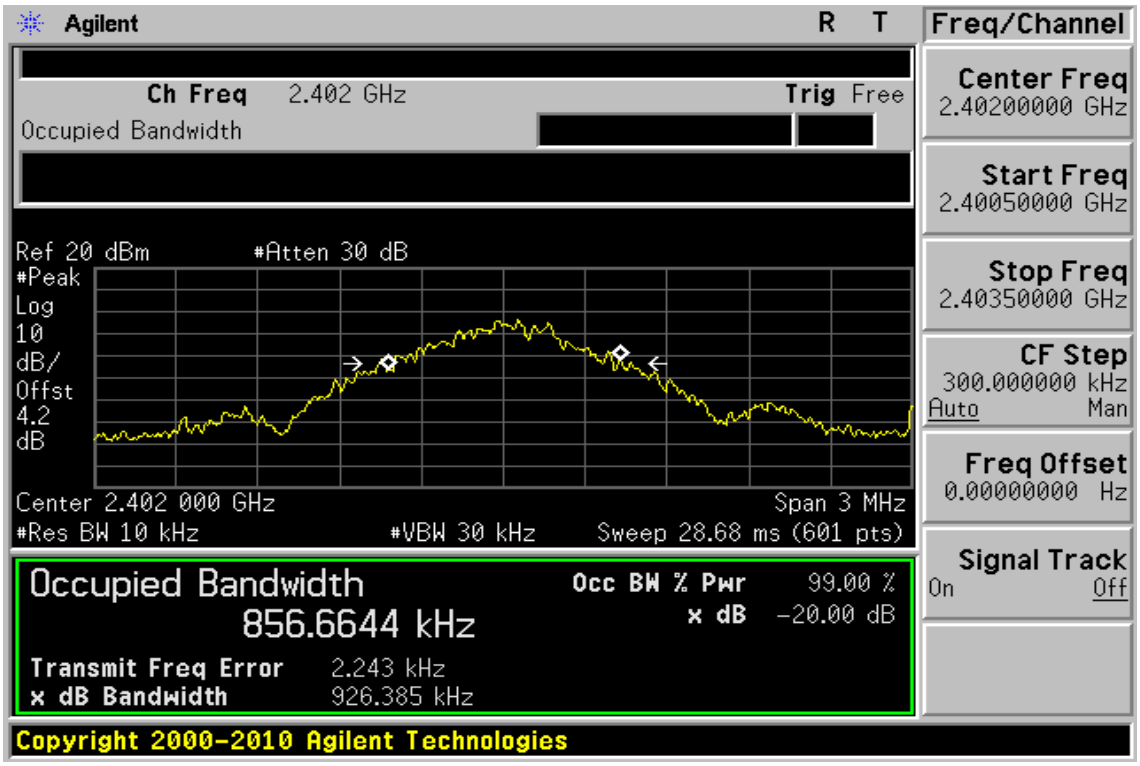
CH	Bandwidth (MHz)	2/3 Bandwidth (MHz)
Lower	1.283	0.855
Mid	1.320	0.880
Higher	1.317	0.878

20dB Bandwidth: EDR mode (8DPSK)

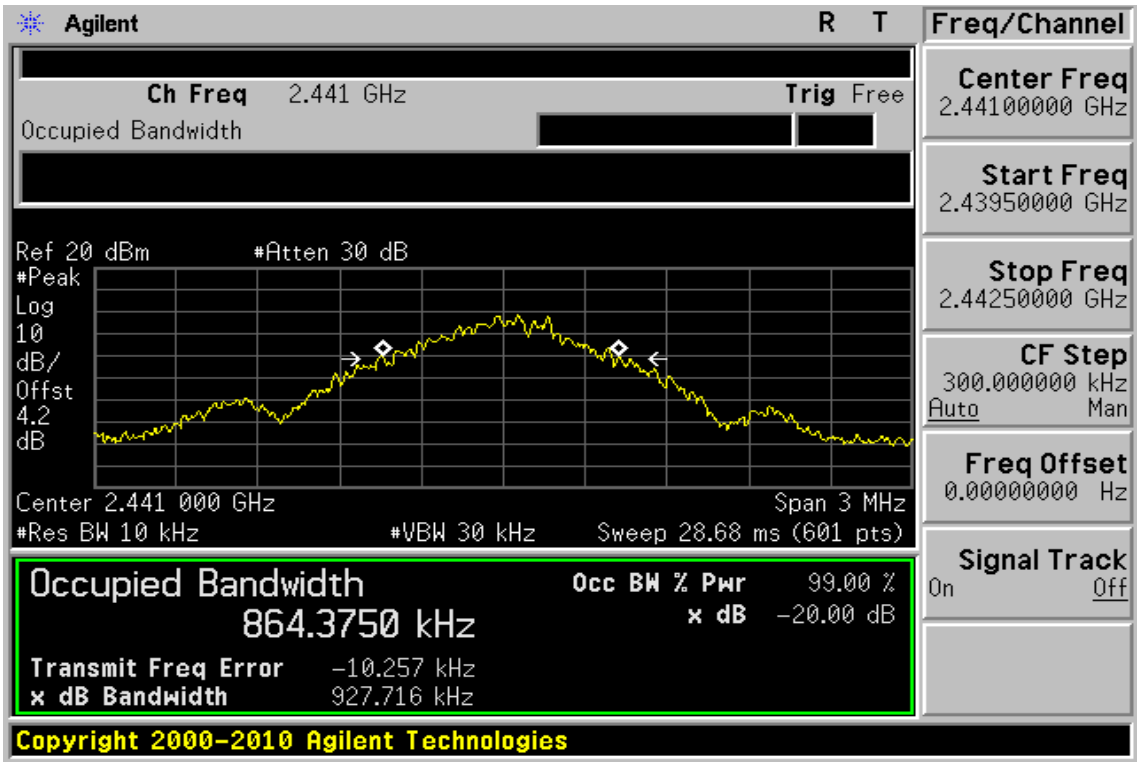
CH	Bandwidth (MHz)	2/3 Bandwidth (MHz)
Lower	1.256	0.837
Mid	1.269	0.846
Higher	1.260	0.840

BR Mode (GFSK)

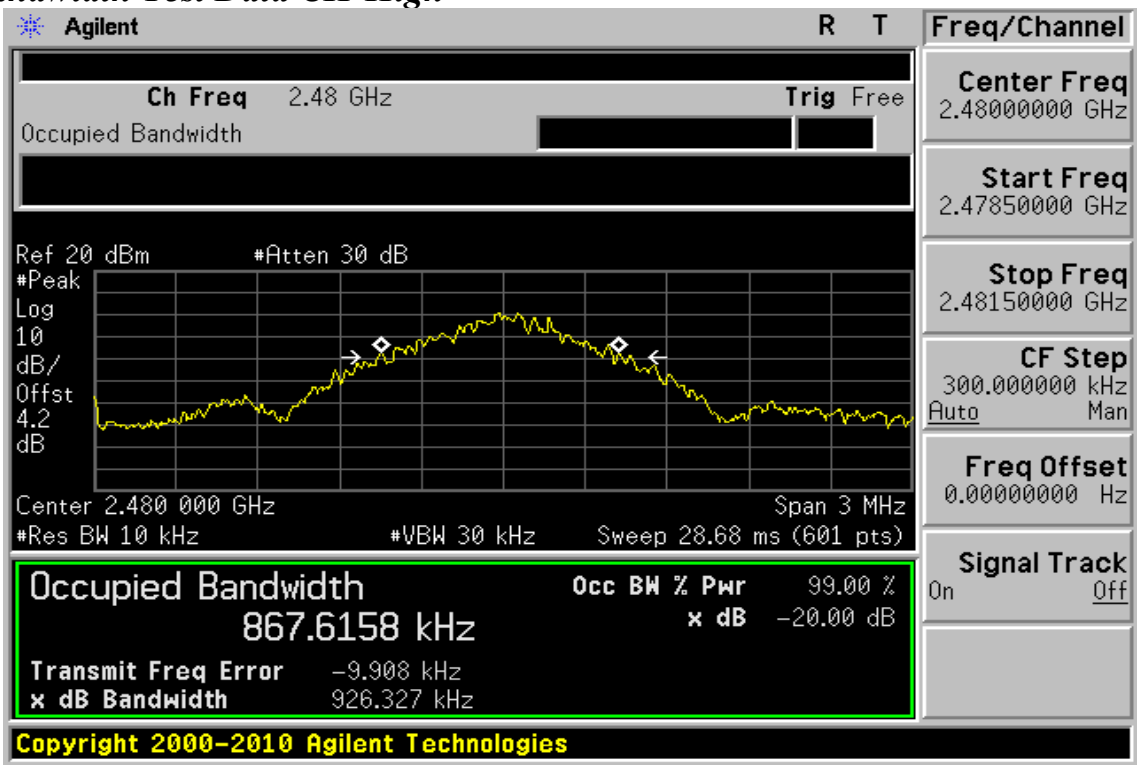
20dB Bandwidth Test Data CH-Low



20dB Bandwidth Test Data CH-Mid

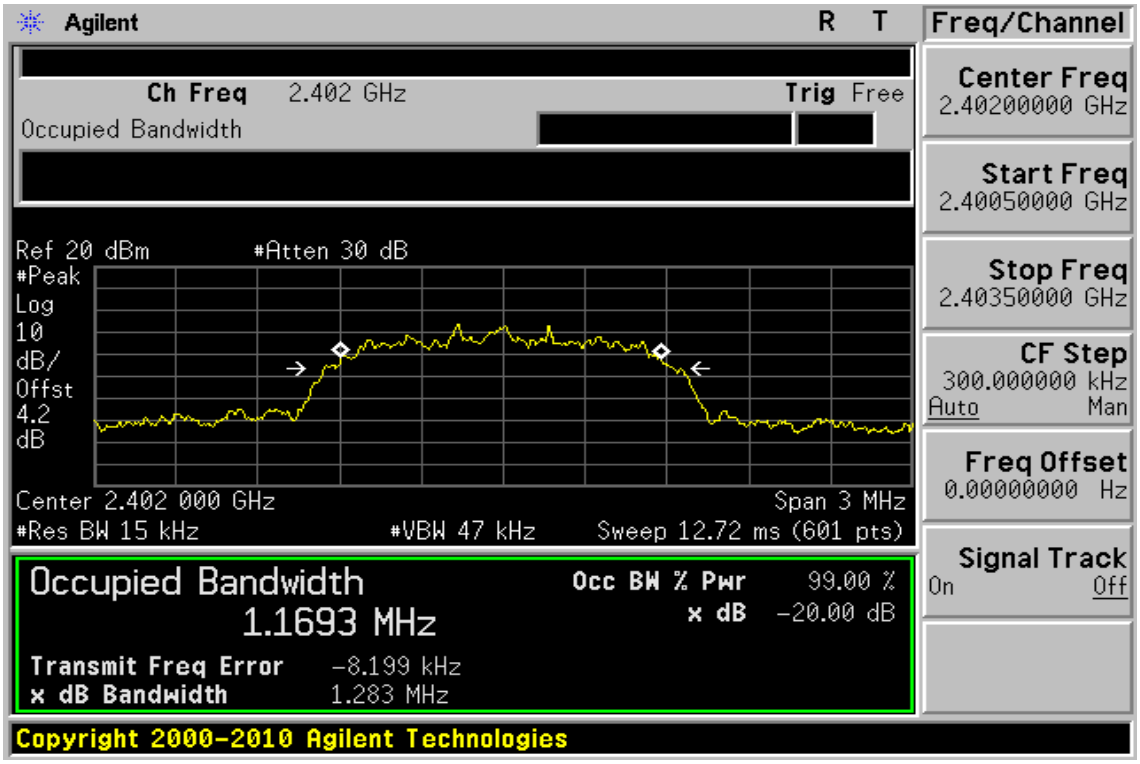


20dB Bandwidth Test Data CH-High

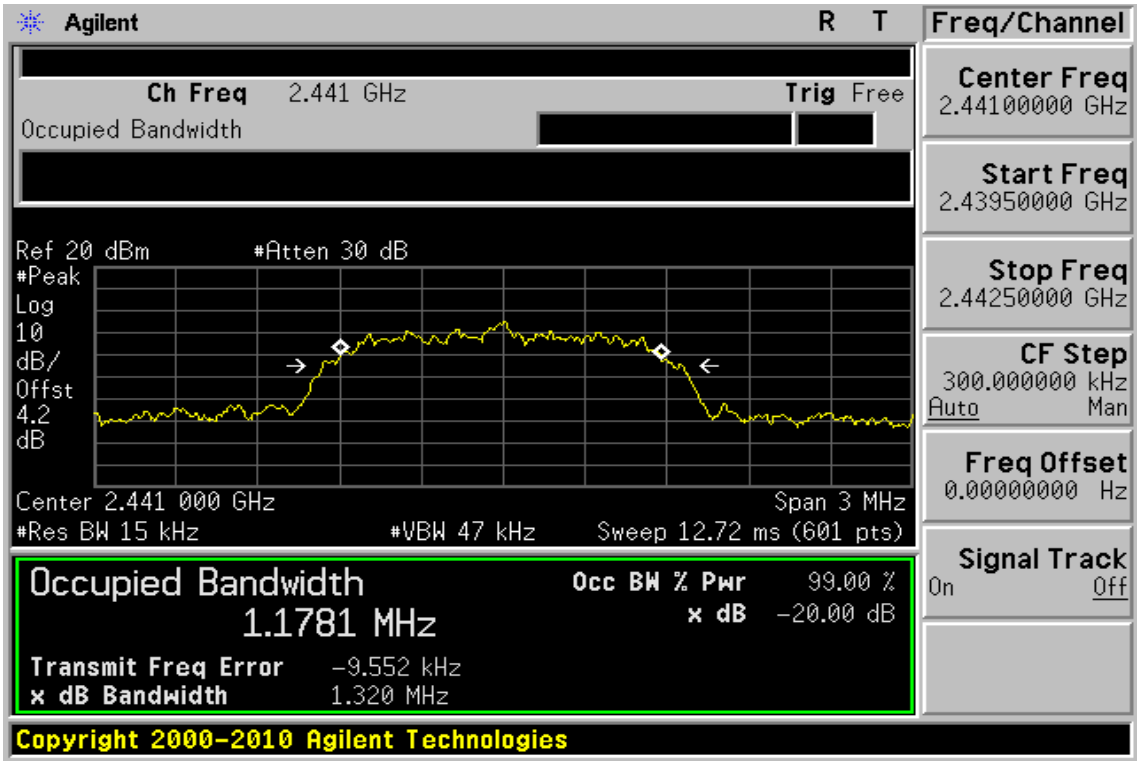


EDR Mode (π/4DQPSK)

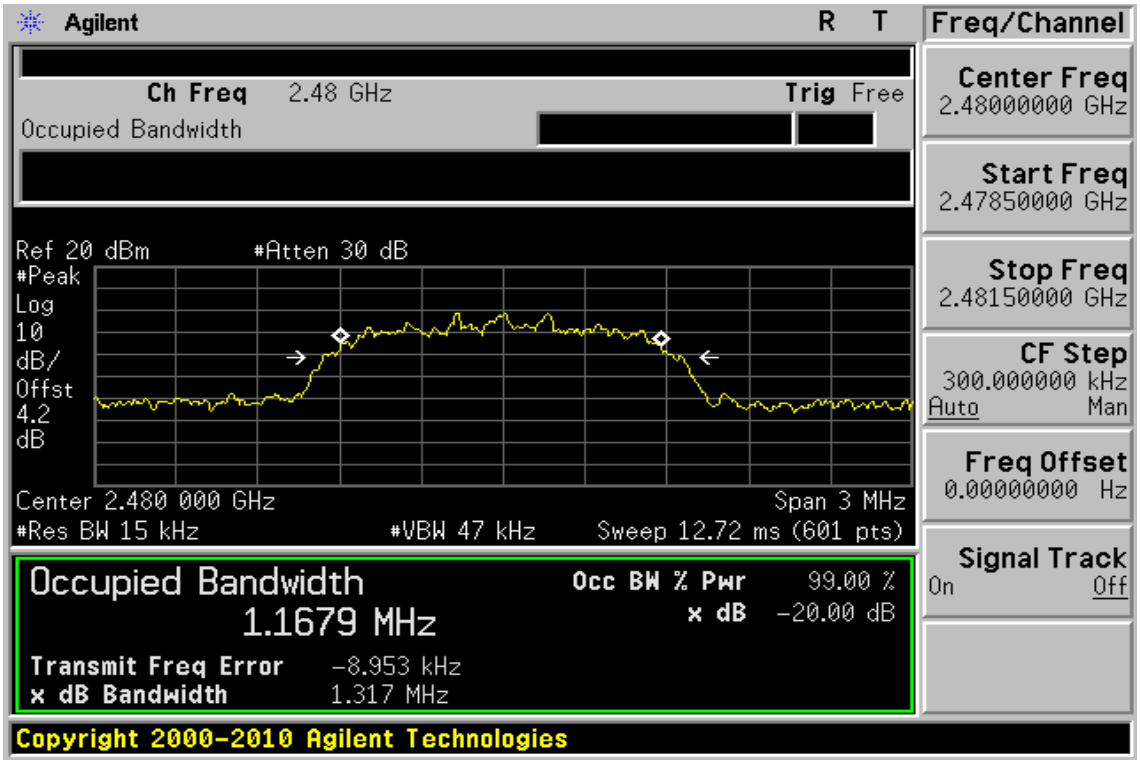
20dB Bandwidth Test Data CH-Low



20dB Bandwidth Test Data CH-Mid

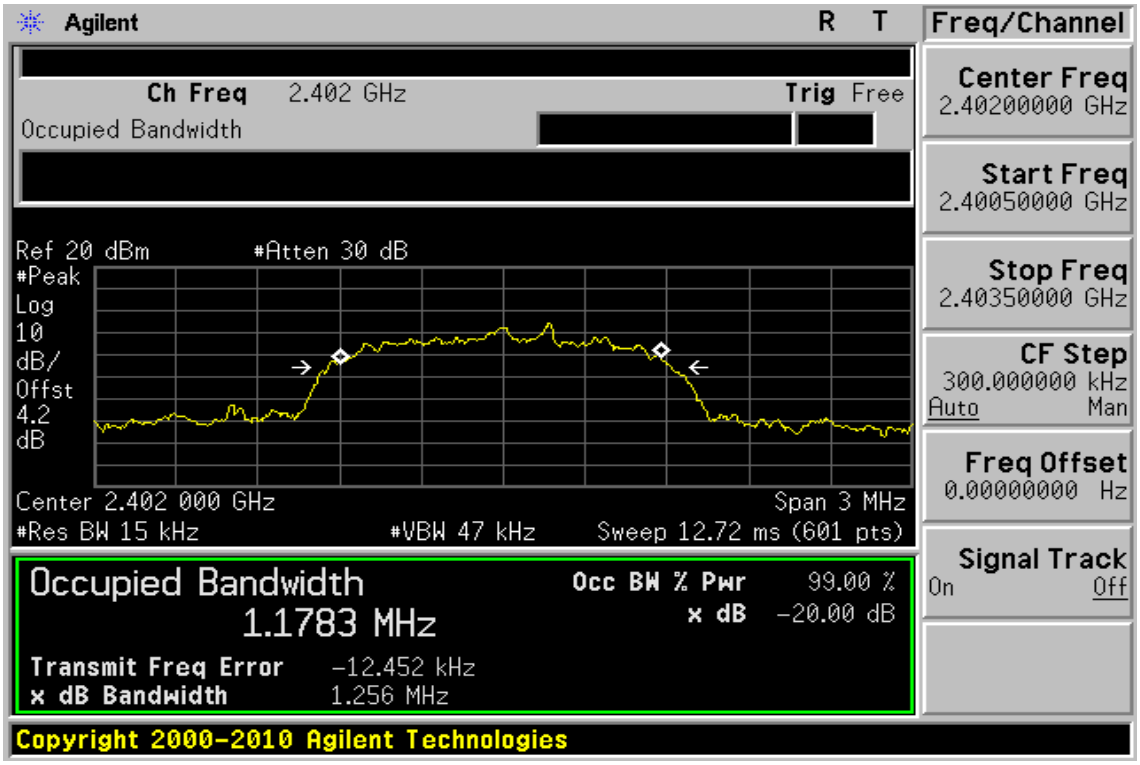


20dB Bandwidth Test Data CH-High

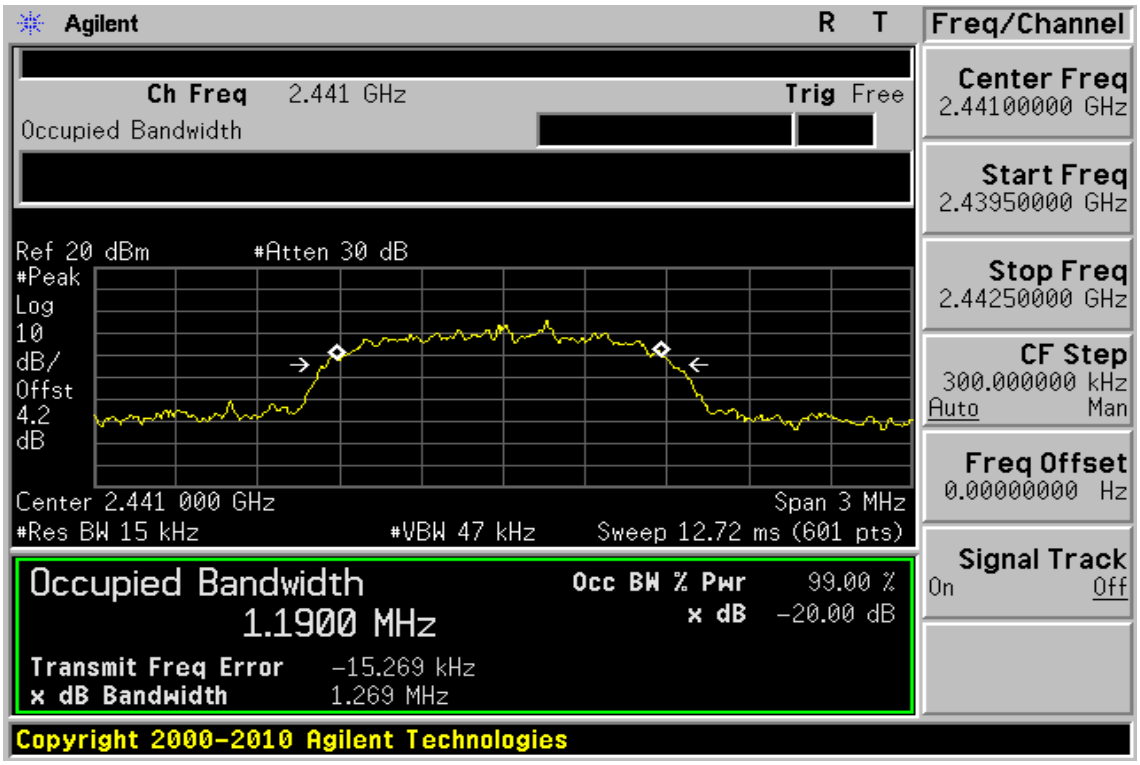


EDR Mode (8DPSK)

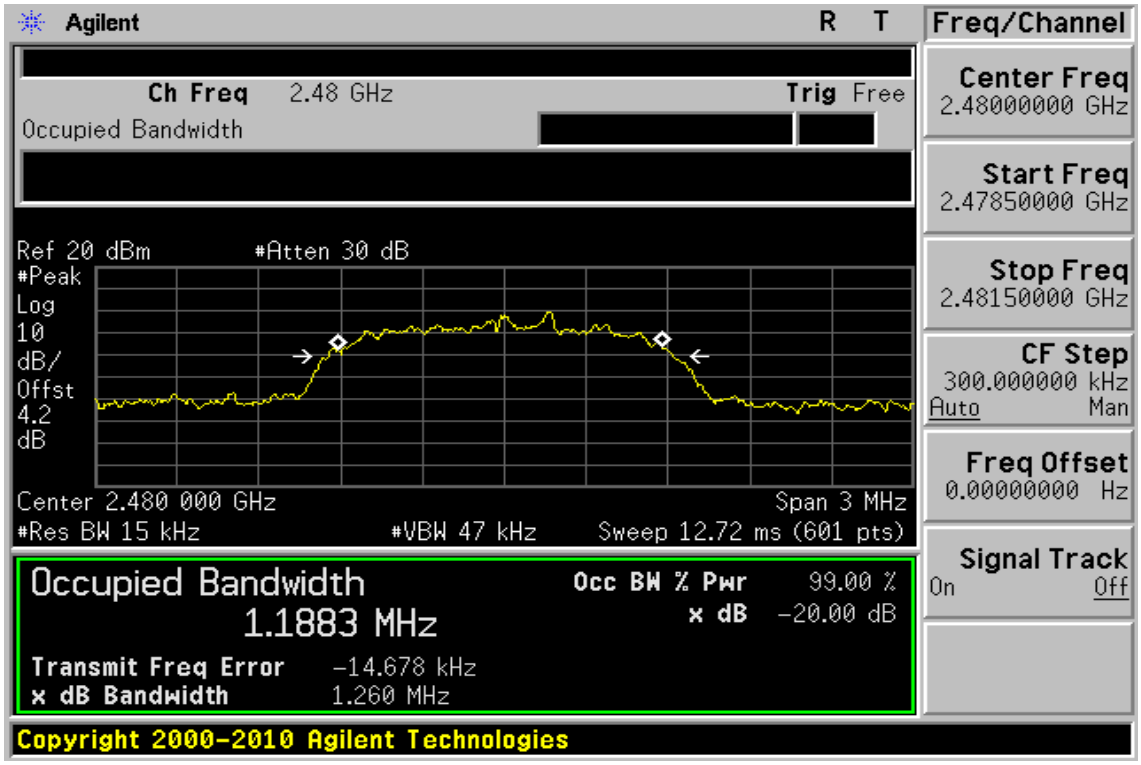
20dB Bandwidth Test Data CH-Low



20dB Bandwidth Test Data CH-Mid



20dB Bandwidth Test Data CH-High



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 in 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 in15.209(a).

9.2. Measurement Equipment Used

9.2.1. Conducted Emission at antenna port:

Refer to section 7.2 for the plot.

9.3. Test SET-UP:

9.3.1. Conducted Emission at antenna port:

Refer to section 7.3 for the plot.

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:

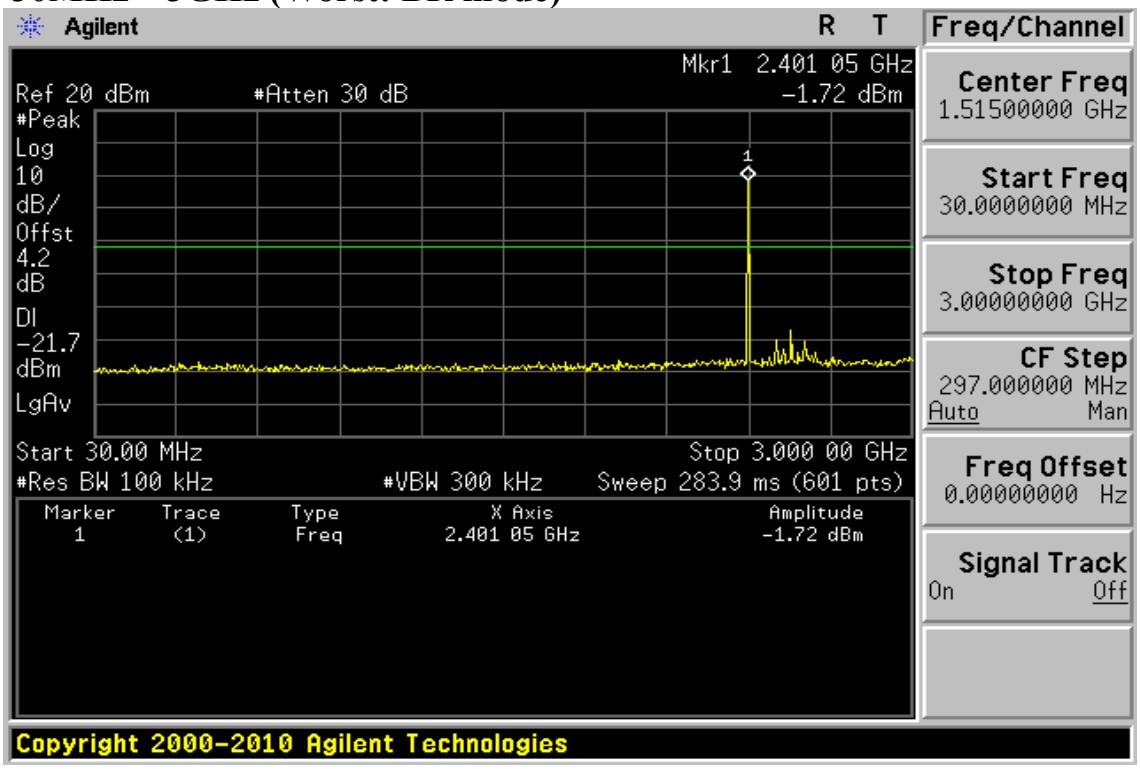
Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

NOTE: cable loss as 6dB that offsets in the spectrum

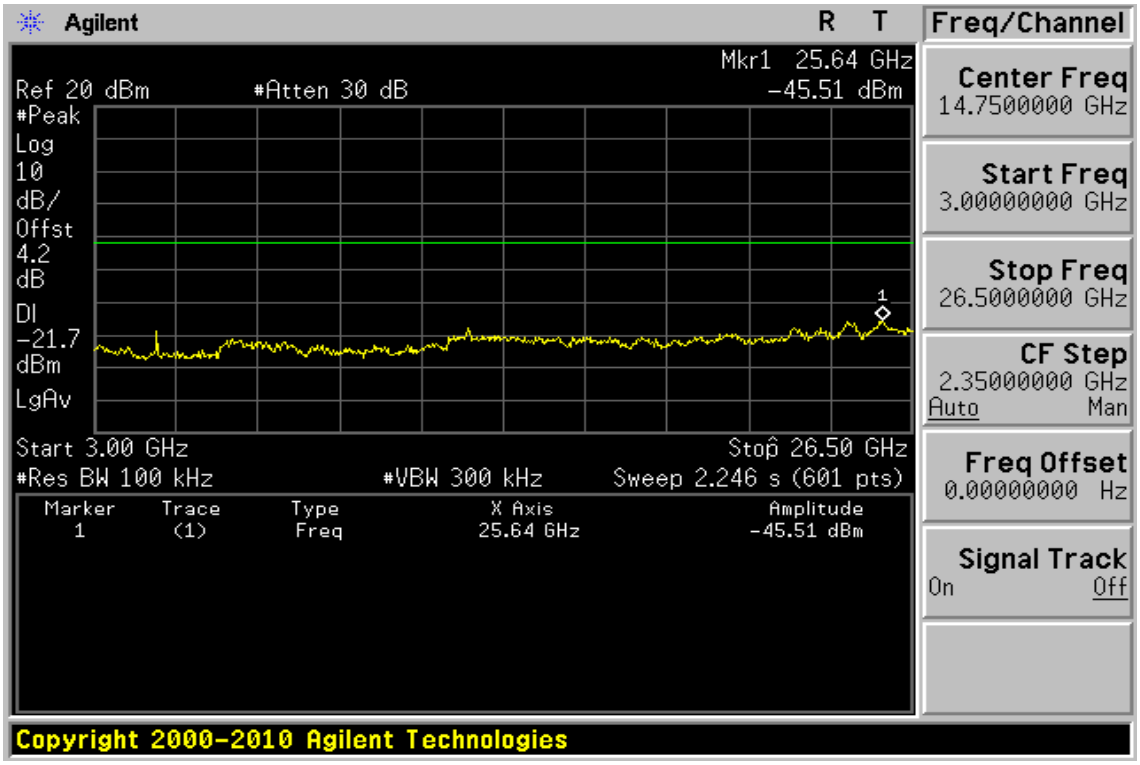
NOTE: the occurrence of the spike on the conducted emission is the signal of the fundamental emission.

9.7 Measurement Result -1 Conducted Spurious Emission Measurement Result

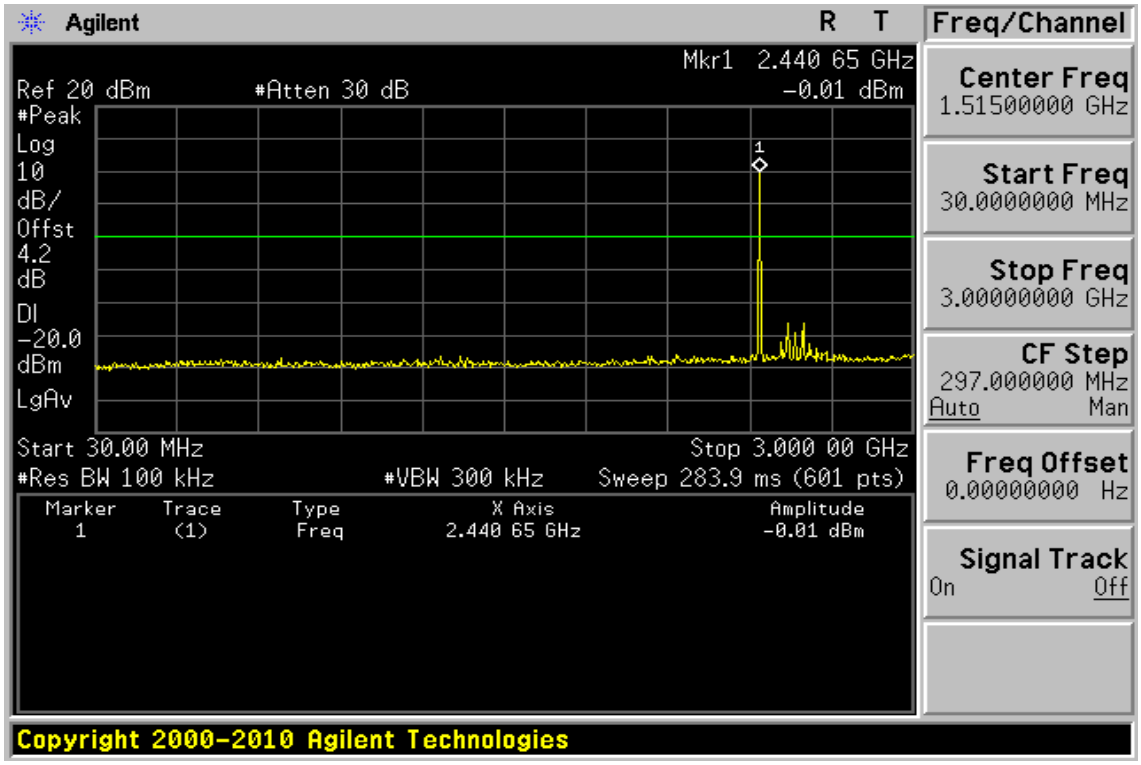
Ch Low 30MHz – 3GHz (Worst: BR mode)



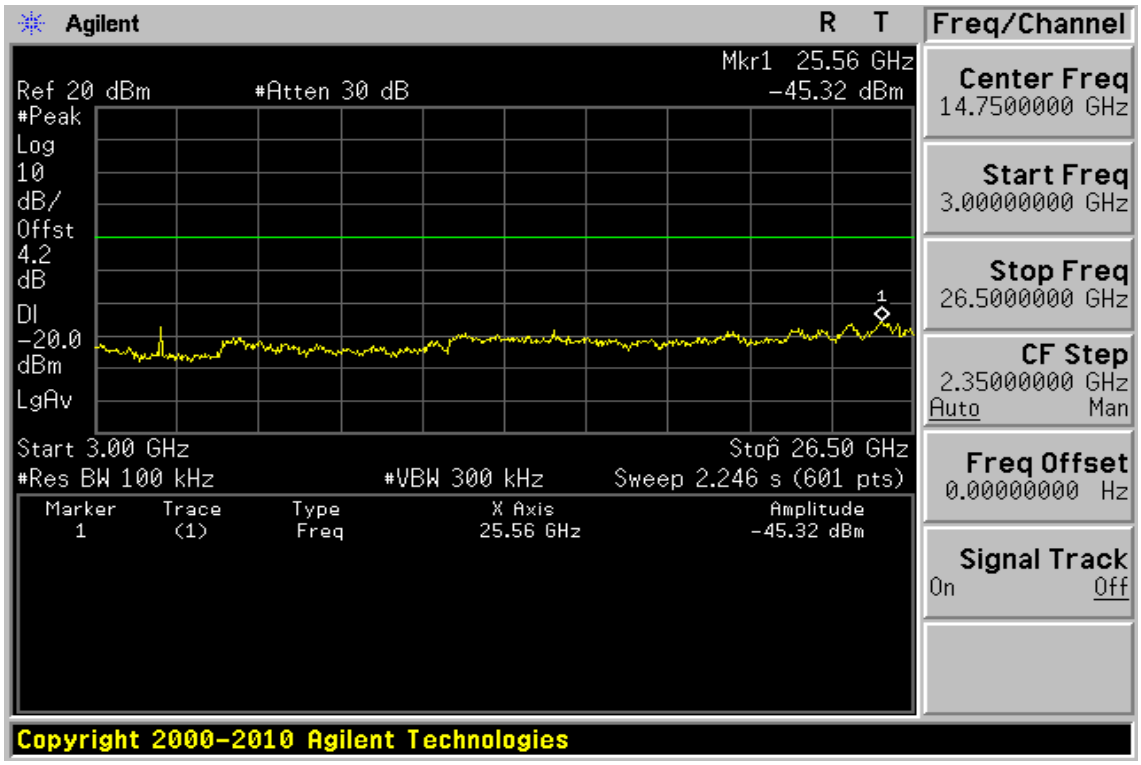
Ch Low 3GHz – 26.5GHz



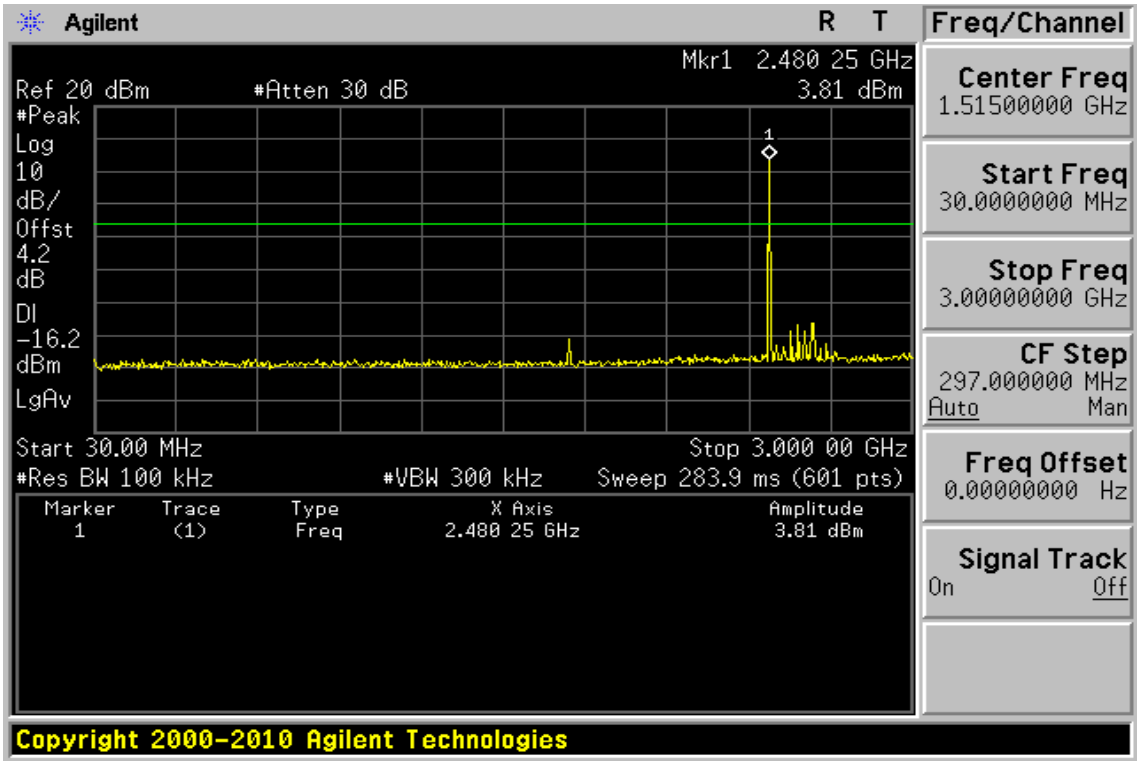
Ch Mid 30MHz – 3GHz



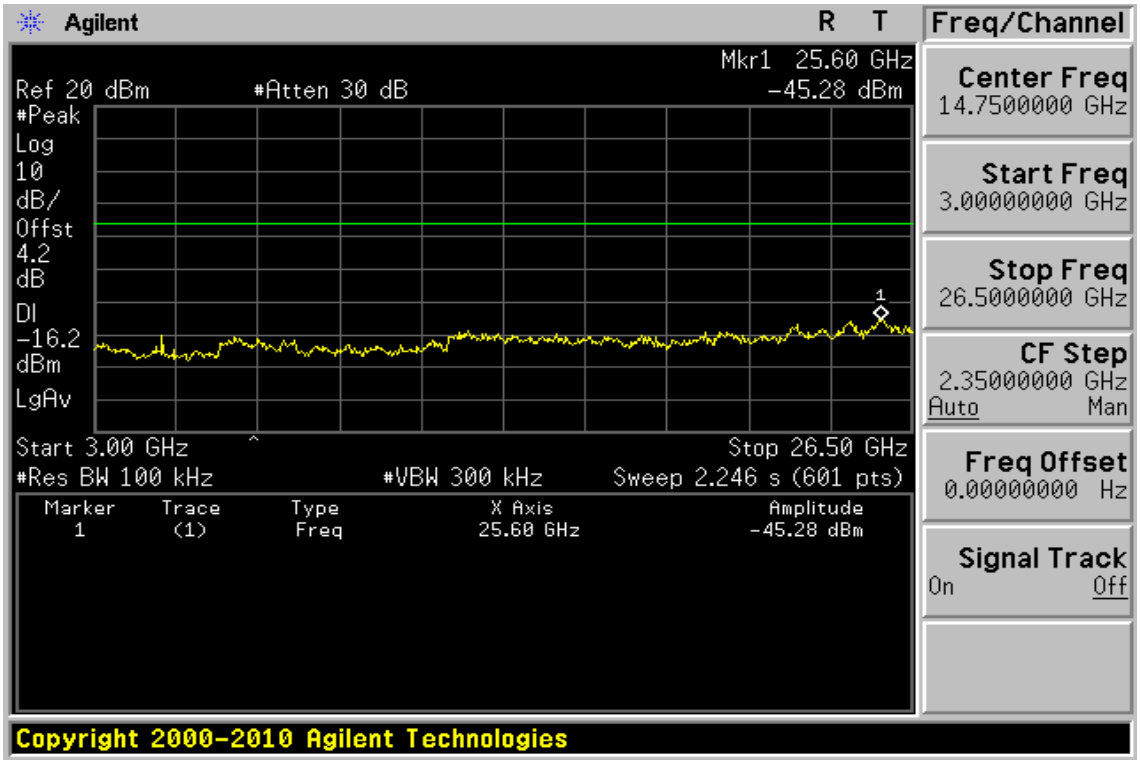
Ch Mid 3GHz – 26.5GHz



Ch High 30MHz – 3GHz

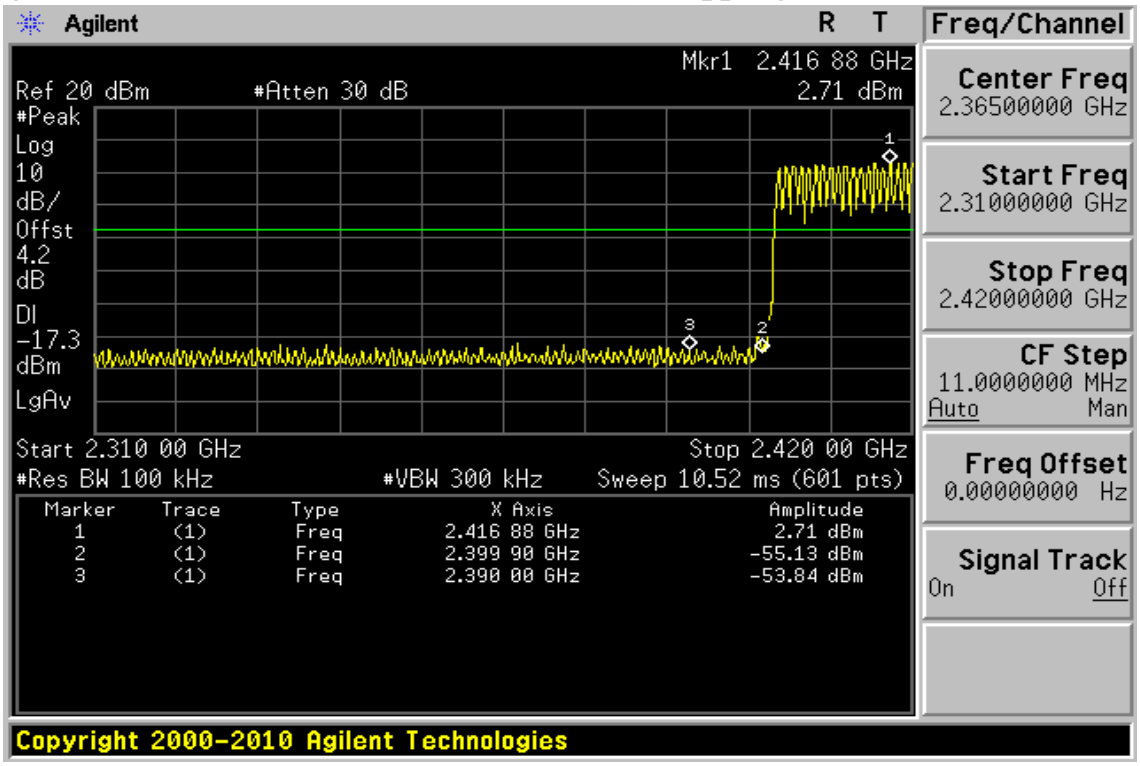


Ch High 3GHz – 26.5GHz

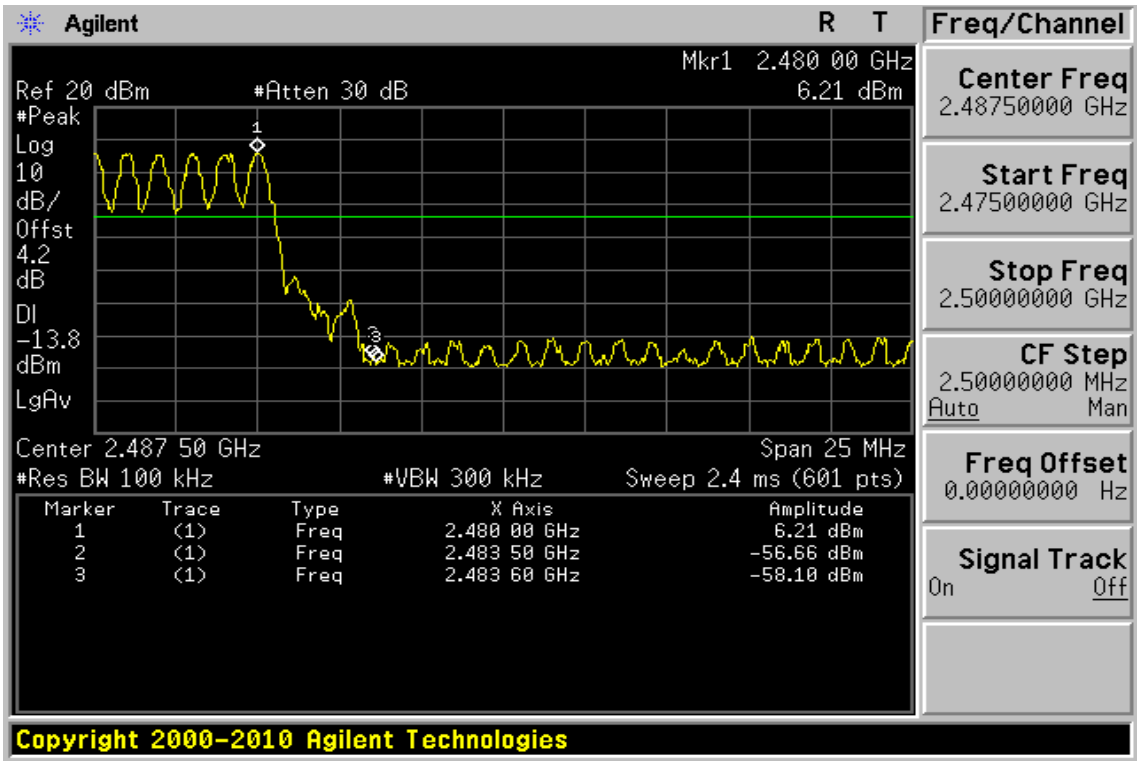


9.7 Measurement Result -2 100 kHz BANDWIDTH OF BNAD EDGE:

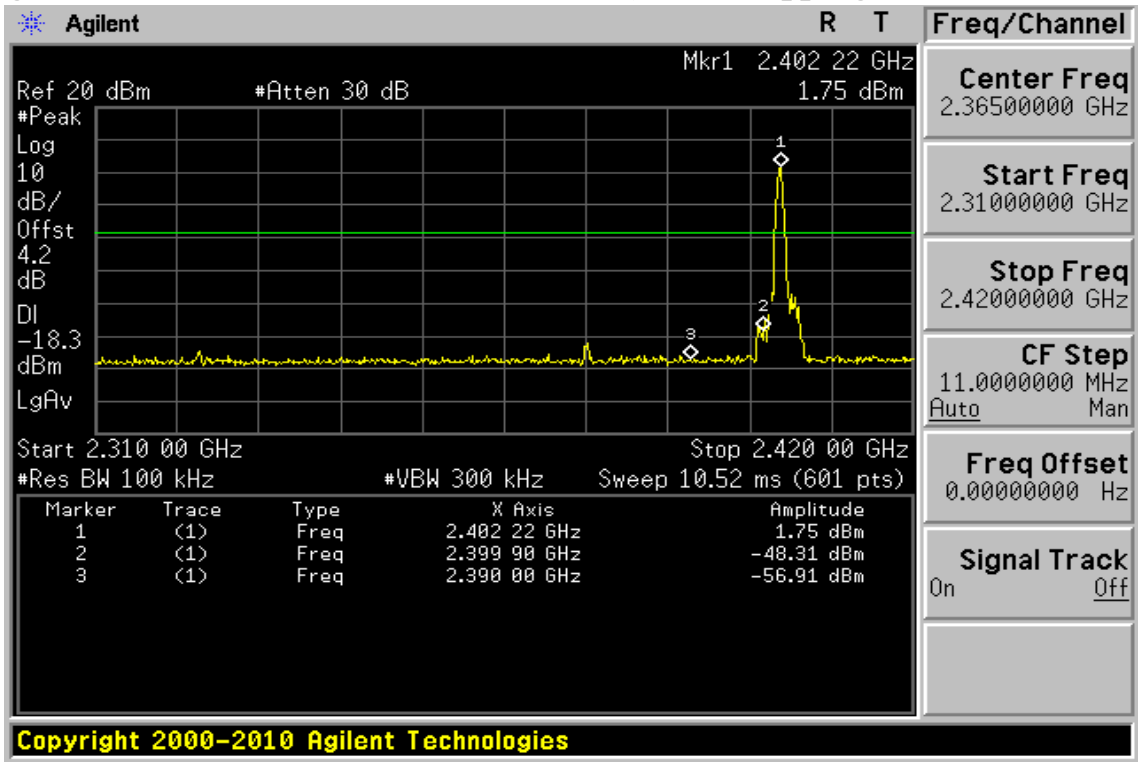
Band Edges Test Data CH-Low (Worst: BR mode) Hopping mode



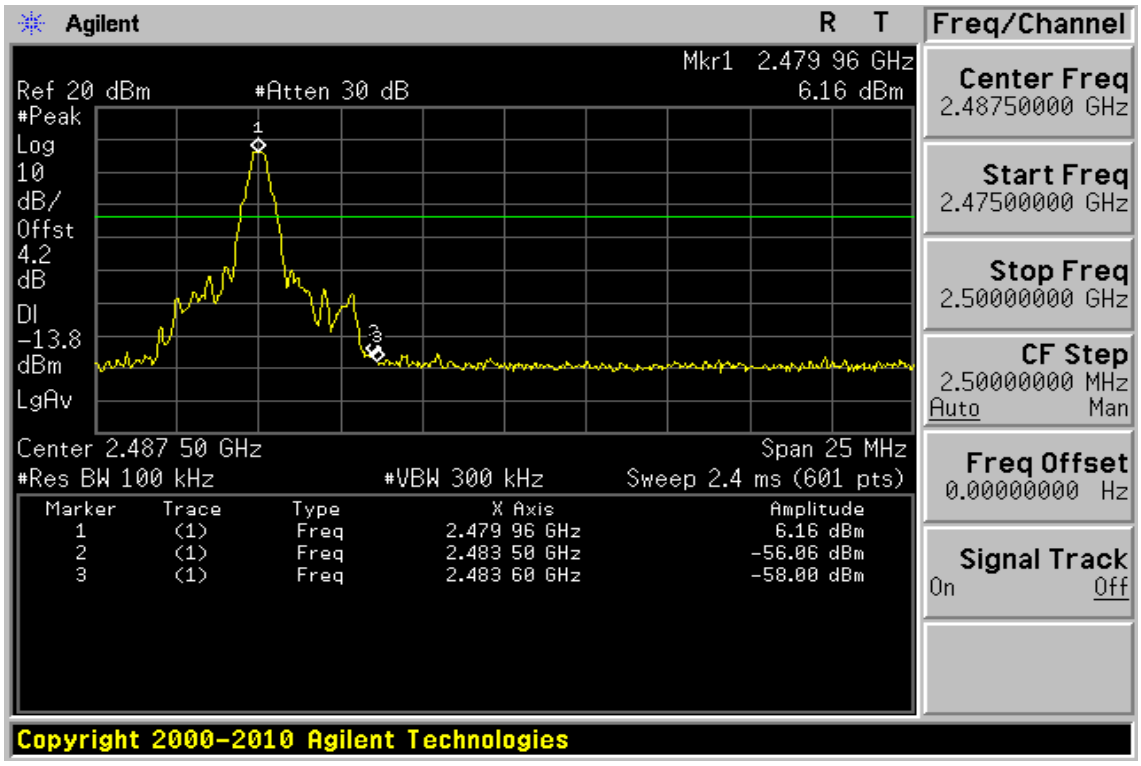
Band Edges Test Data CH-High



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



Band Edges Test Data CH-High



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.

10.2. Measurement Equipment Used:

10.2.1. Radiated emission:

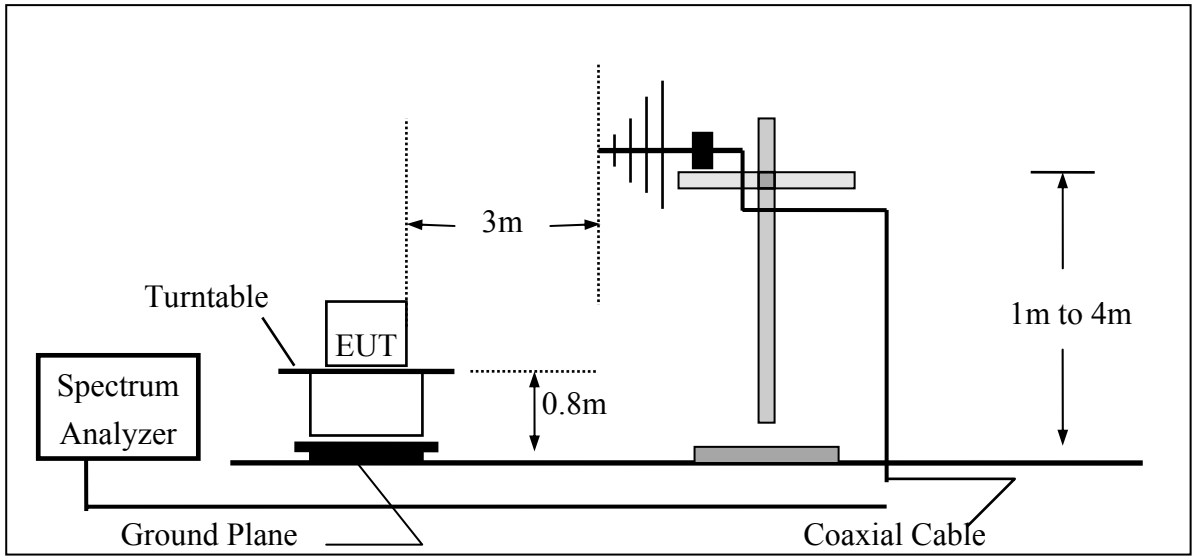
966 Chamber					
EQUIPMENT TYPE	**MFR**	**MODEL NUMBER**	**SERIAL NUMBER**	**LAST CAL.**	**CAL DUE.**
EMI Test Receiver	R&S	ESCI7	100760	05/27/2013	05/26/2014
Spectrum Analyzer	Agilent	E4446A	MY51100003	05/30/2013	05/29/2014
EXA Spectrum Analyzer	Agilent	N9010A	MY50420195	01/20/2014	01/19/2015
Spectrum Analyzer	R&S	FSV-30	101398	10/22/2013	10/21/2014
Loop Antenna	ETS.LINDGREN	6502	00148045	07/05/2013	07/04/2014
Bilog Antenna	SCHWAZBECK	VULB9168	378	01/02/2014	01/01/2015
Horn antenna	ETS.LINDGREN	3117	123995	05/31/2013	05/30/2014
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
3m Site NSA	SGS	966 chamber	N/A	07/15/2013	07/14/2014

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

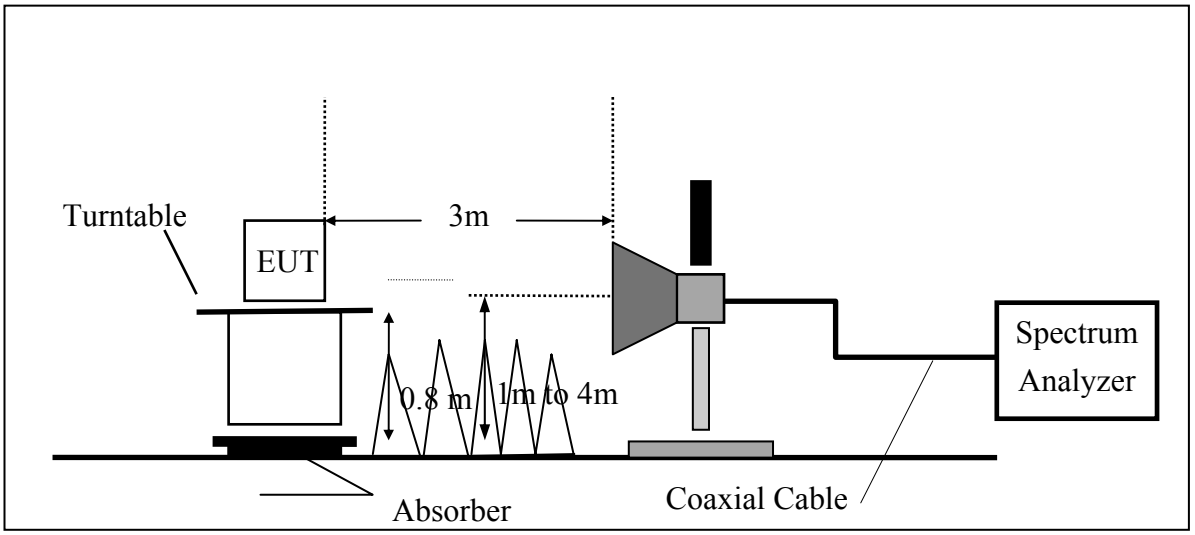
10.3. Test SET-UP:

10.3.1. Radiated emission:

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



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



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 ≥ 1 GHz, 100 kHz for f < 1 GHz

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

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*log(uV/m)
2. Factor(dB) = Antenna Factor(dBμV/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 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

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

Operation Band	:BR+Hopping	Test Date	:2014-05-08
Fundamental Frequency	:2402 MHz	Temp./Humi.	:20.6 deg_C / 61 RH
Operation Mode	:Band Edge LOW	Engineer	:Tin
EUT Pol.	:E2 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	30.35	2.42	32.77	54.00	-21.23
2390.00	E	Peak	42.08	2.42	44.50	74.00	-29.50

Operation Band	:BR+Hopping	Test Date	:2014-05-08
Fundamental Frequency	:2402 MHz	Temp./Humi.	:20.6 deg_C / 61 RH
Operation Mode	:Band Edge LOW	Engineer	:Tin
EUT Pol.	:E2 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	30.38	2.42	32.80	54.00	-21.20
2390.00	E	Peak	42.38	2.42	44.80	74.00	-29.20

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.
"---" : denotes Noise Floor.
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	:2014-05-08
Fundamental Frequency	:2480 MHz	Temp./Humi.	:20.6 deg_C / 61 RH
Operation Mode	:Band Edge HIGH	Engineer	:Tin
EUT Pol.	:E2 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	29.83	2.74	32.57	54.00	-21.43
2483.50	E	Peak	43.22	2.74	45.96	74.00	-28.04

Operation Band	:BR+Hopping	Test Date	:2014-05-08
Fundamental Frequency	:2480 MHz	Temp./Humi.	:20.6 deg_C / 61 RH
Operation Mode	:Band Edge HIGH	Engineer	:Tin
EUT Pol.	:E2 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	30.11	2.74	32.85	54.00	-21.15
2483.50	E	Peak	43.42	2.74	46.16	74.00	-27.84

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

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

Operation Band	:BR	Test Date	:2014-05-08
Fundamental Frequency	:2402 MHz	Temp./Humi.	:20.6 deg_C / 61 RH
Operation Mode	:Band Edge LOW	Engineer	:Tin
EUT Pol.	:E2 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	2.42	32.76	54.00	-21.24
2390.00	E	Peak	43.84	2.42	46.26	74.00	-27.74

Operation Band	:BR	Test Date	:2014-05-08
Fundamental Frequency	:2402 MHz	Temp./Humi.	:20.6 deg_C / 61 RH
Operation Mode	:Band Edge LOW	Engineer	:Tin
EUT Pol.	:E2 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	30.39	2.42	32.81	54.00	-21.19
2390.00	E	Peak	42.87	2.42	45.29	74.00	-28.71

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.
"---" : denotes Noise Floor.
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	:2014-05-08
Fundamental Frequency	:2480 MHz	Temp./Humi.	:20.6 deg_C / 61 RH
Operation Mode	:Band Edge HIGH	Engineer	:Tin
EUT Pol.	:E2 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	30.50	2.74	33.24	54.00	-20.76
2483.50	E	Peak	43.63	2.74	46.37	74.00	-27.63

Operation Band	:BR	Test Date	:2014-05-08
Fundamental Frequency	:2480 MHz	Temp./Humi.	:20.6 deg_C / 61 RH
Operation Mode	:Band Edge HIGH	Engineer	:Tin
EUT Pol.	:E2 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	32.73	2.74	35.47	54.00	-18.53
2483.50	E	Peak	43.52	2.74	46.26	74.00	-27.74

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

10.6.3 Radiated Spurious Emission Measurement Result (Worst case BR mode)

Operation Band	:BR	Test Date	:2014-05-08
Fundamental Frequency	:2402 MHz	Temp./Humi.	:20.6 deg_C / 61 RH
Operation Mode	:TX LOW	Engineer	:Tin
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:VERTICAL

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.
"---" : denotes Noise Floor.

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
39.70	S	Peak	49.10	-13.45	35.65	40.00	-4.35
82.38	S	Peak	43.14	-17.58	25.56	40.00	-14.44
286.08	S	Peak	28.01	-11.47	16.54	46.00	-29.46
481.05	S	Peak	27.62	-7.75	19.87	46.00	-26.13
645.95	S	Peak	28.14	-4.78	23.36	46.00	-22.64
766.23	S	Peak	28.35	-2.79	25.56	46.00	-20.44
4804.00	H	Average	36.96	6.79	43.75	54.00	-10.25
4804.00	H	Peak	42.11	6.79	48.90	74.00	-25.10
7206.00	H	---					
9608.00	H	---					
12010.00	H	---					
14412.00	H	---					
16814.00	H	---					
19216.00	H	---					
21618.00	H	---					
24020.00	H	---					

Operation Band	:BR	Test Date	:2014-05-08
Fundamental Frequency	:2402 MHz	Temp./Humi.	:20.6 deg_C / 61 RH
Operation Mode	:TX LOW	Engineer	:Tin
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:HORIZONTAL

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.
"---" : denotes Noise Floor.

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
40.67	S	Peak	38.36	-13.39	24.97	40.00	-15.03
84.32	S	Peak	36.46	-17.95	18.51	40.00	-21.49
286.08	S	Peak	28.44	-11.47	16.97	46.00	-29.03
469.41	S	Peak	28.06	-7.89	20.17	46.00	-25.83
689.60	S	Peak	27.50	-3.70	23.80	46.00	-22.20
810.85	S	Peak	27.74	-2.15	25.59	46.00	-20.41
4804.00	H	Average	27.17	6.79	33.96	54.00	-20.04
4804.00	H	Peak	38.36	6.79	45.15	74.00	-28.85
7206.00	H	---					
9608.00	H	---					
12010.00	H	---					
14412.00	H	---					
16814.00	H	---					
19216.00	H	---					
21618.00	H	---					
24020.00	H	---					

Operation Band	:BR	Test Date	:2014-05-08
Fundamental Frequency	:2441 MHz	Temp./Humi.	:20.6 deg_C / 61 RH
Operation Mode	:TX MID	Engineer	:Tin
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:VERTICAL

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.
"---" : denotes Noise Floor.

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
39.70	S	Peak	49.29	-13.45	35.84	40.00	-4.16
74.62	S	Peak	42.73	-16.21	26.52	40.00	-13.48
286.08	S	Peak	28.83	-11.47	17.36	46.00	-28.64
425.76	S	Peak	27.71	-8.97	18.74	46.00	-27.26
549.92	S	Peak	29.39	-7.38	22.01	46.00	-23.99
799.21	S	Peak	28.00	-2.31	25.69	46.00	-20.31
4882.00	H	Average	37.98	6.96	44.94	54.00	-9.06
4882.00	H	Peak	43.64	6.96	50.60	74.00	-23.40
7323.00	H	---					
9764.00	H	---					
12205.00	H	---					
14646.00	H	---					
17087.00	H	---					
19528.00	H	---					
21969.00	H	---					
24410.00	H	---					

Operation Band	:BR	Test Date	:2014-05-08
Fundamental Frequency	:2441 MHz	Temp./Humi.	:20.6 deg_C / 61 RH
Operation Mode	:TX MID	Engineer	:Tin
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:HORIZONTAL

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.
"---" : denotes Noise Floor.

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
40.67	S	Peak	37.67	-13.39	24.28	40.00	-15.72
84.32	S	Peak	35.97	-17.95	18.02	40.00	-21.98
385.02	S	Peak	27.50	-9.47	18.03	46.00	-27.97
600.36	S	Peak	28.50	-5.51	22.99	46.00	-23.01
744.89	S	Peak	28.59	-2.92	25.67	46.00	-20.33
994.18	S	Peak	28.19	0.27	28.46	54.00	-25.54
4882.00	H	Average	29.37	6.96	36.33	54.00	-17.67
4882.00	H	Peak	39.38	6.96	46.34	74.00	-27.66
7323.00	H	---					
9764.00	H	---					
12205.00	H	---					
14646.00	H	---					
17087.00	H	---					
19528.00	H	---					
21969.00	H	---					
24410.00	H	---					

Operation Band	:BR	Test Date	:2014-05-08
Fundamental Frequency	:2480 MHz	Temp./Humi.	:20.6 deg_C / 61 RH
Operation Mode	:TX HIGH	Engineer	:Tin
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:VERTICAL

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.
"---" : denotes Noise Floor.

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
39.70	S	Peak	49.37	-13.45	35.92	40.00	-4.08
62.98	S	Peak	39.88	-14.15	25.73	40.00	-14.27
468.44	S	Peak	28.51	-7.90	20.61	46.00	-25.39
601.33	S	Peak	28.66	-5.56	23.10	46.00	-22.90
732.28	S	Peak	29.35	-3.64	25.71	46.00	-20.29
867.11	S	Peak	28.69	-1.62	27.07	46.00	-18.93
4960.00	H	Average	39.22	7.09	46.31	54.00	-7.69
4960.00	H	Peak	45.56	7.09	52.65	74.00	-21.35
7440.00	H	---					
9920.00	H	---					
12400.00	H	---					
14880.00	H	---					
17360.00	H	---					
19840.00	H	---					
22320.00	H	---					
24800.00	H	---					

Operation Band	:BR	Test Date	:2014-05-08
Fundamental Frequency	:2480 MHz	Temp./Humi.	:20.6 deg_C / 61 RH
Operation Mode	:TX HIGH	Engineer	:Tin
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:HORIZONTAL

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.
"---" : denotes Noise Floor.

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
40.67	S	Peak	37.34	-13.39	23.95	40.00	-16.05
84.32	S	Peak	36.70	-17.95	18.75	40.00	-21.25
593.57	S	Peak	29.38	-5.24	24.14	46.00	-21.86
682.81	S	Peak	28.42	-3.67	24.75	46.00	-21.25
864.20	S	Peak	28.65	-1.60	27.05	46.00	-18.95
990.30	S	Peak	27.98	0.09	28.07	54.00	-25.93
4960.00	H	Average	30.79	7.09	37.88	54.00	-16.12
4960.00	H	Peak	40.35	7.09	47.44	74.00	-26.56
7440.00	H	---					
9920.00	H	---					
12400.00	H	---					
14880.00	H	---					
17360.00	H	---					
19840.00	H	---					
22320.00	H	---					
24800.00	H	---					

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*20dB bandwidth of the hopping channel, whichever is greater.

11.2. Measurement Equipment Used:

Refer to section 7.2 for the plot.

11.3. Test Set-up:

Refer to section 7.3 for the plot.

11.4. Measurement Procedure:

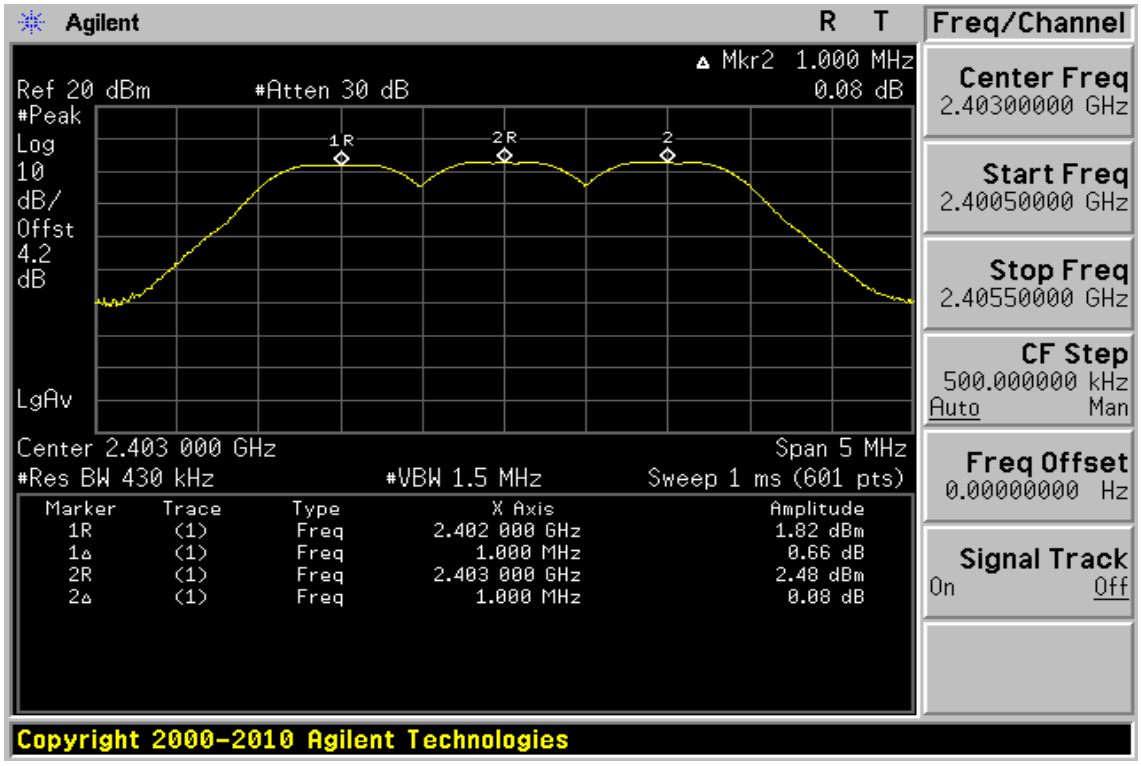
1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = middle of hopping channel.
4. Set the spectrum analyzer as RBW, VBW=100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

11.5. Measurement Result:

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

Note: Refer to next page for plots.

Frequency Separation Test Data



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:

Refer to section 7.2 for the plot.

12.3. Test Set-up:

Refer to section 7.3for the plot.

12.4. Measurement Procedure:

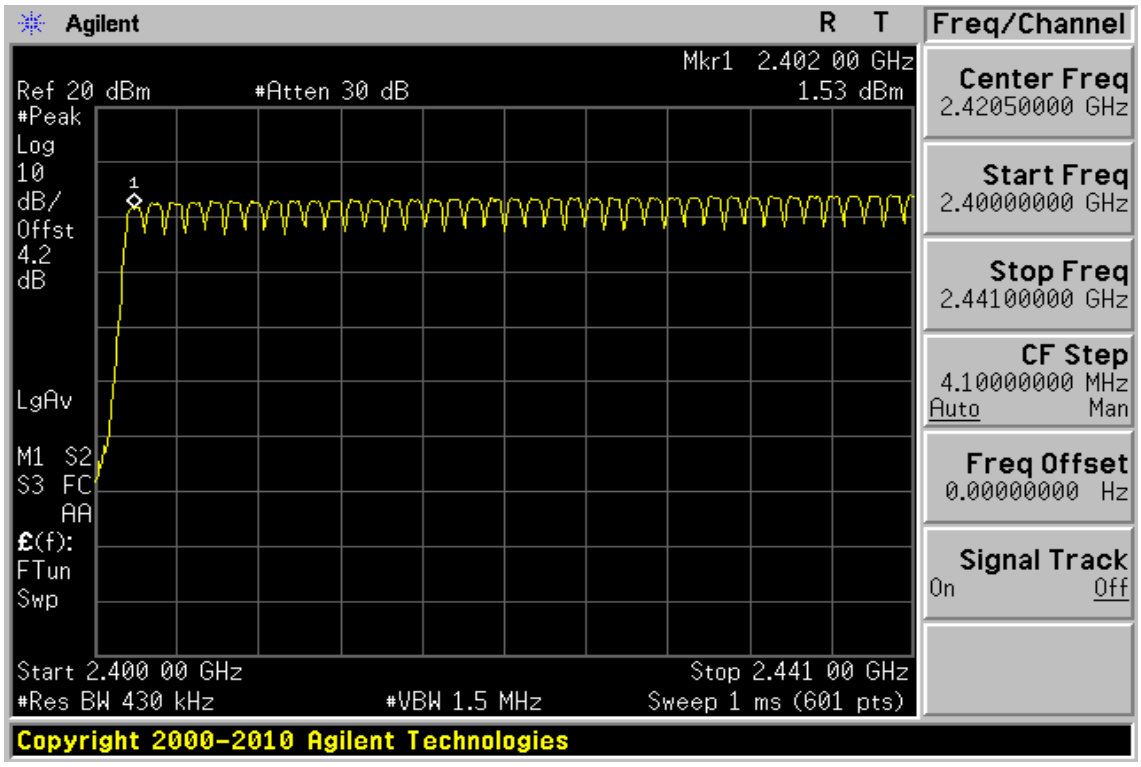
1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set spectrum analyzer Start=2400MHz, Stop = 2483.5MHz, Sweep = auto.
4. Set the spectrum analyzer as RBW=430 kHz, VBW=1.5MHz.,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

12.5. Measurement Result:

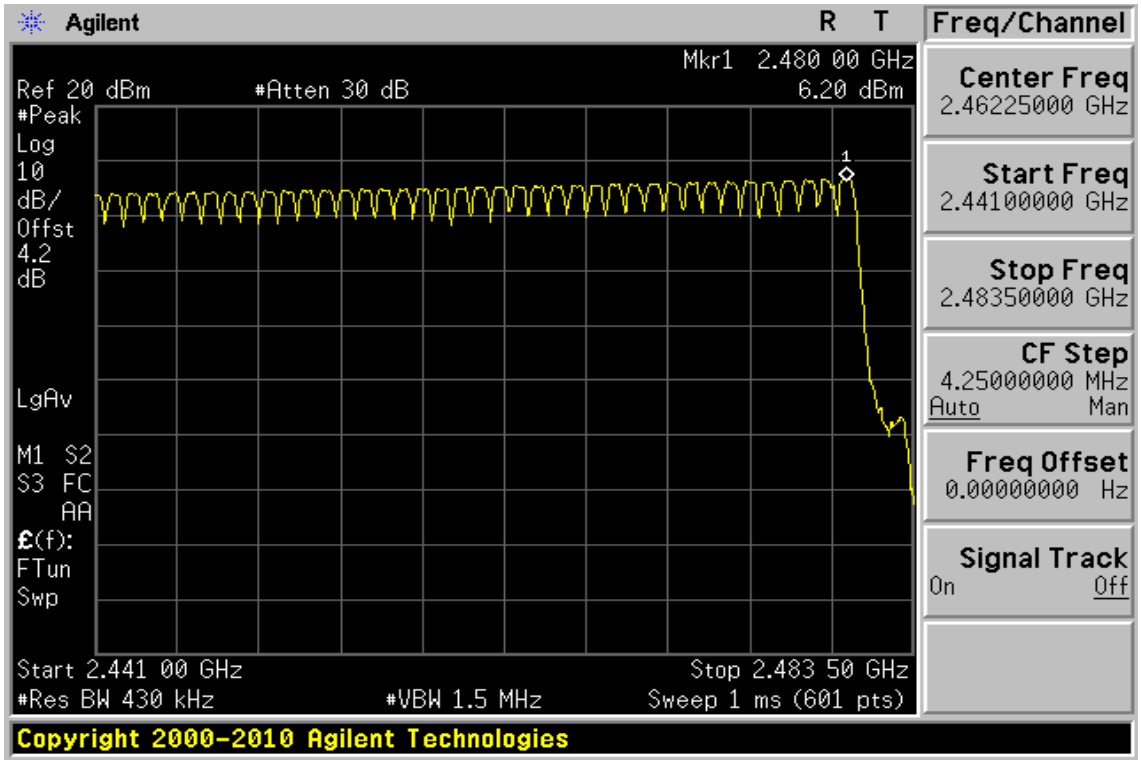
Note: Refer to next page for plots.

Channel Number

2.4 GHz – 2.441GHz



2.441 GHz – 2.4835GHz



13. TIME OF OCCUPANCY (DWELL TIME)

13.1. Standard Applicable

According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400MHz-2483.5MHz. 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:

Refer to section 7.2 for the plot.

13.3. Test Set-up:

Refer to section 7.3for the plot.

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.

13.5. Tabular Result of the Measurement:

1Mbps (GFSK):

Test Channel:	Mode:	Measurement Result (ms):	Limit (ms):
Low:	DH1	119.36	400ms
	DH3	261.28	400ms
	DH5	307.52	400ms
Middle:	DH1	119.36	400ms
	DH3	261.28	400ms
	DH5	307.52	400ms
High:	DH1	119.36	400ms
	DH3	261.28	400ms
	DH5	307.52	400ms

2Mbps (Π/4 DQPSK):

Test Channel:	Mode:	Measurement Result (ms):	Limit (ms):
Middle:	2DH1	119.36	400ms
	2DH3	261.28	400ms
	2DH5	307.52	400ms

3Mbps (8DPSK):

Test Channel:	Mode:	Measurement Result (ms):	Limit (ms):
Middle:	3DH1	119.36	400
	3DH3	261.28	400
	3DH5	307.52	400

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

1Mbps:

CH Low	DH1 time slot	=	0.373 (ms) * (1600/2/79)	* 31.6 =	119.36	(ms)
	DH3 time slot	=	1.633 (ms) * (1600/4/79)	* 31.6 =	261.28	(ms)
	DH5 time slot	=	2.883 (ms) * (1600/6/79)	* 31.6 =	307.52	(ms)
CH Mid	DH1 time slot	=	0.373 (ms) * (1600/2/79)	* 31.6 =	119.36	(ms)
	DH3 time slot	=	1.633 (ms) * (1600/4/79)	* 31.6 =	261.28	(ms)
	DH5 time slot	=	2.883 (ms) * (1600/6/79)	* 31.6 =	307.52	(ms)
CH High	DH1 time slot	=	0.373 (ms) * (1600/2/79)	* 31.6 =	119.36	(ms)
	DH3 time slot	=	1.633 (ms) * (1600/4/79)	* 31.6 =	261.28	(ms)
	DH5 time slot	=	2.883 (ms) * (1600/6/79)	* 31.6 =	307.52	(ms)

2Mbps:

CH Mid	2DH1 time slot	=	0.373 (ms) * (1600/2/79)	* 31.6 =	119.36	(ms)
	2DH3 time slot	=	1.633 (ms) * (1600/4/79)	* 31.6 =	261.28	(ms)
	2DH5 time slot	=	2.883 (ms) * (1600/6/79)	* 31.6 =	307.52	(ms)

3Mbps:

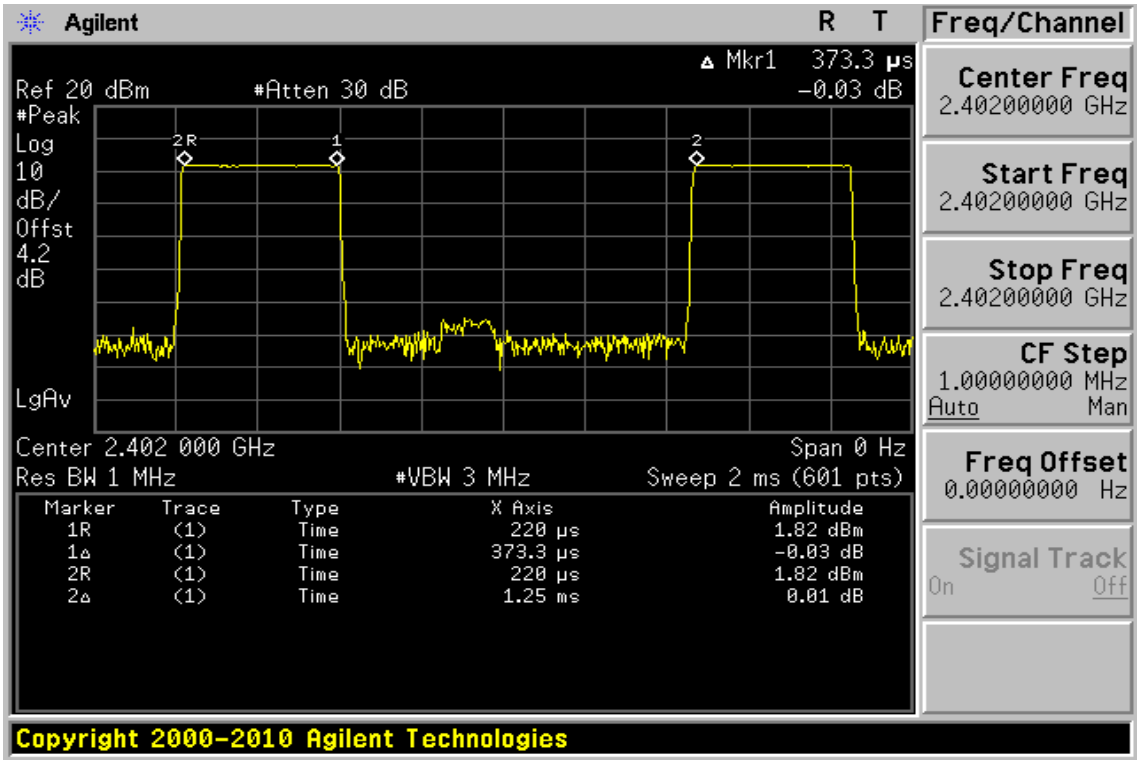
CH Mid	3DH1 time slot	=	0.373 (ms) * (1600/2/79)	* 31.6 =	119.36	(ms)
	3DH3 time slot	=	1.633 (ms) * (1600/4/79)	* 31.6 =	261.28	(ms)
	3DH5 time slot	=	2.883 (ms) * (1600/6/79)	* 31.6 =	307.52	(ms)

13.6. Measurement Result:

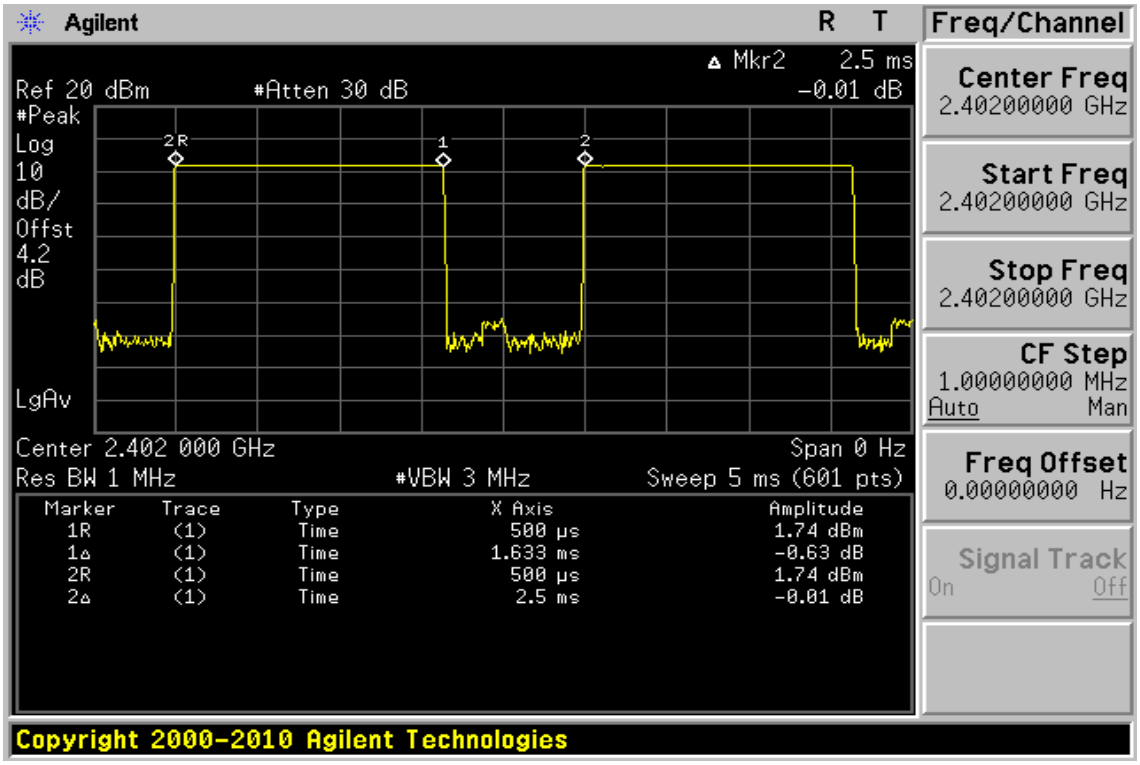
Note: Refer to next page for plots.

CH-Low

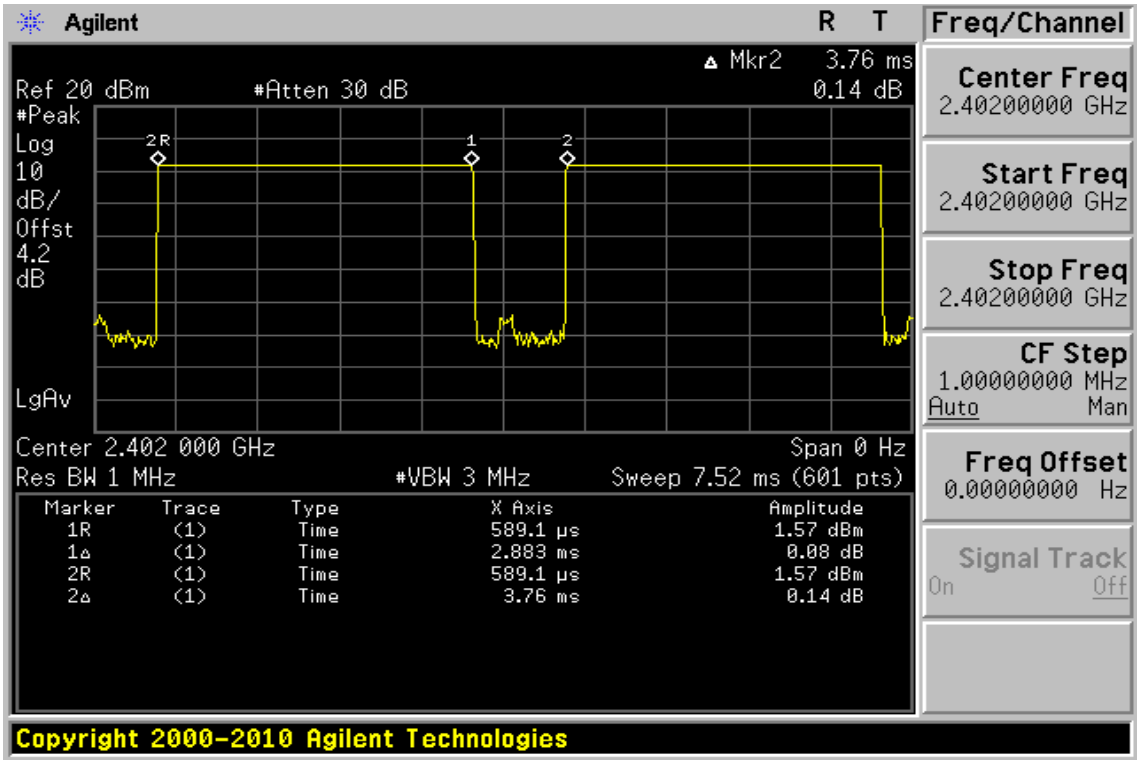
DH1



DH3

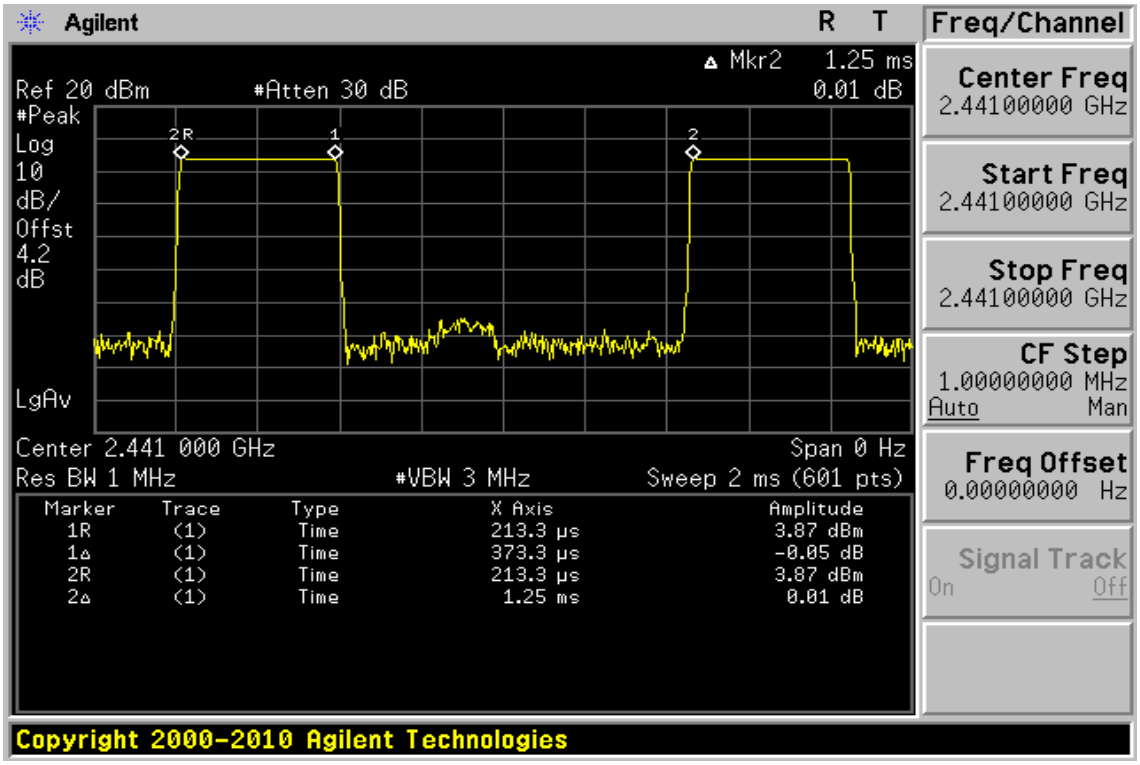


DH5

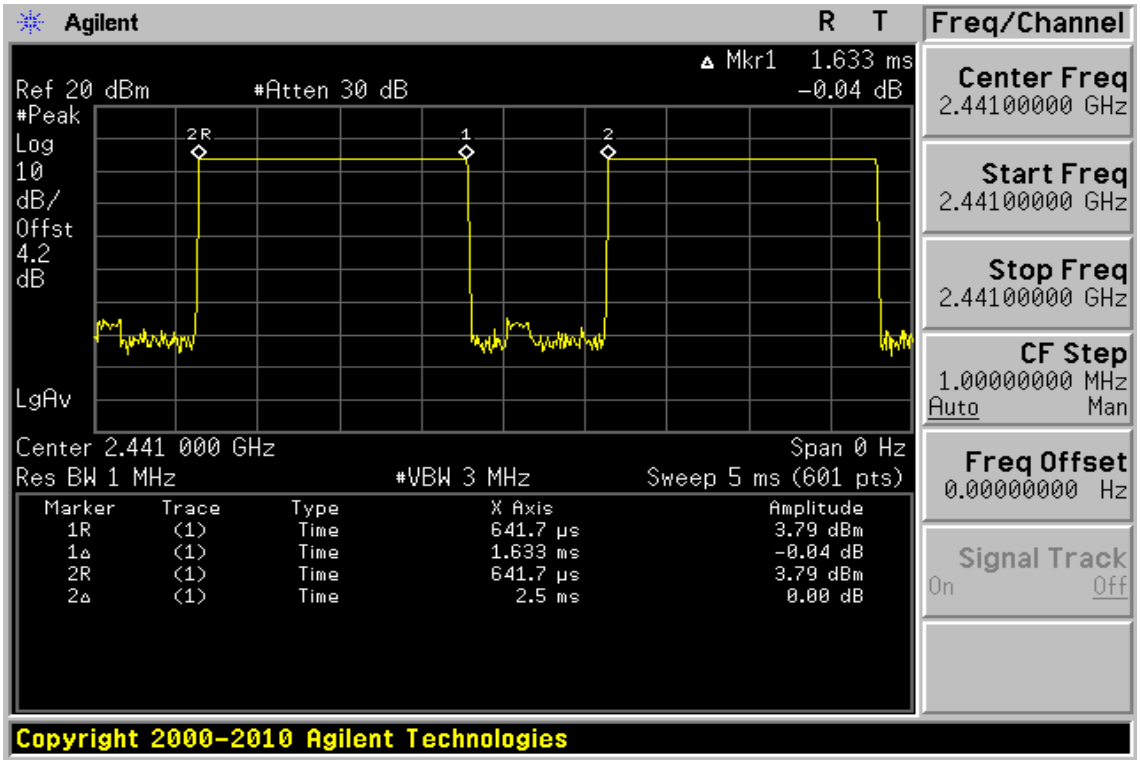


CH-Mid

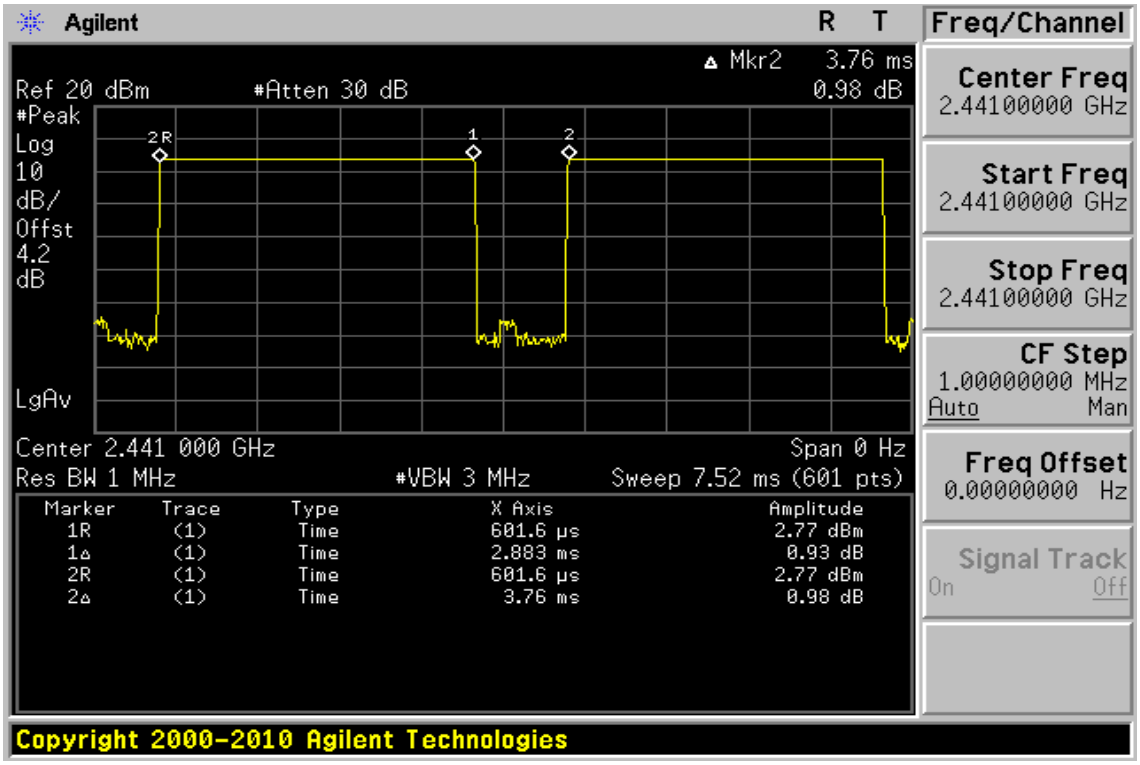
DH1



DH3

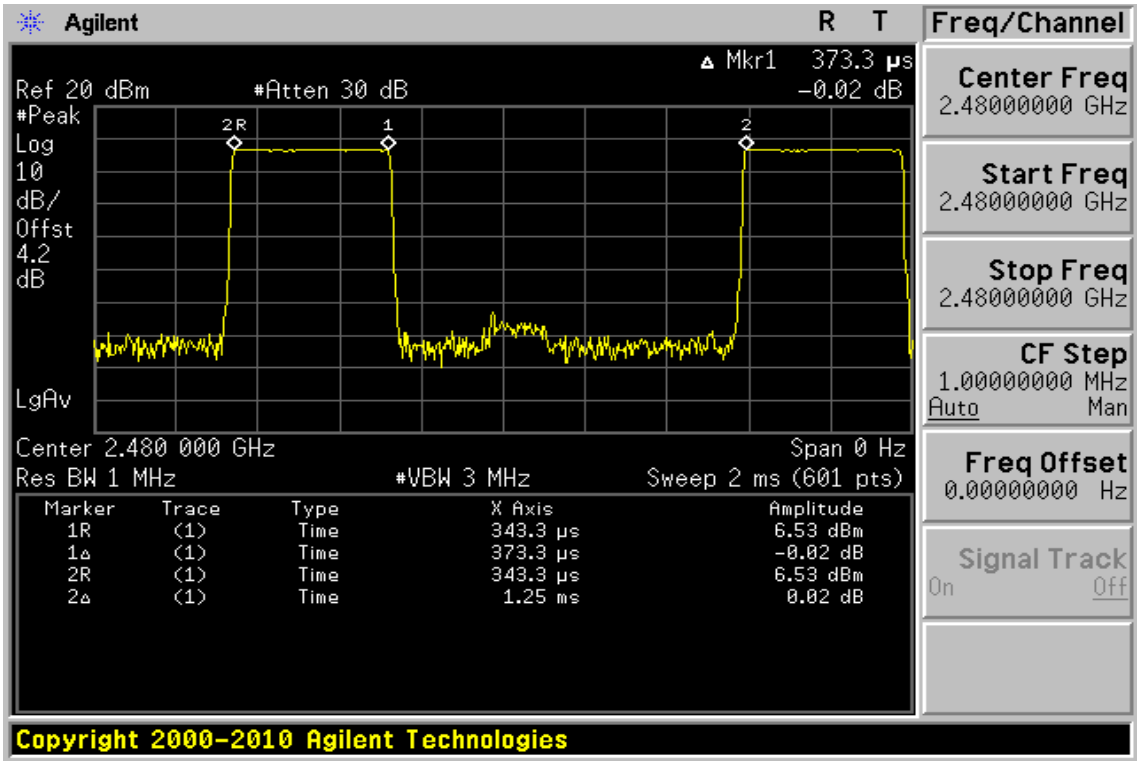


DH5

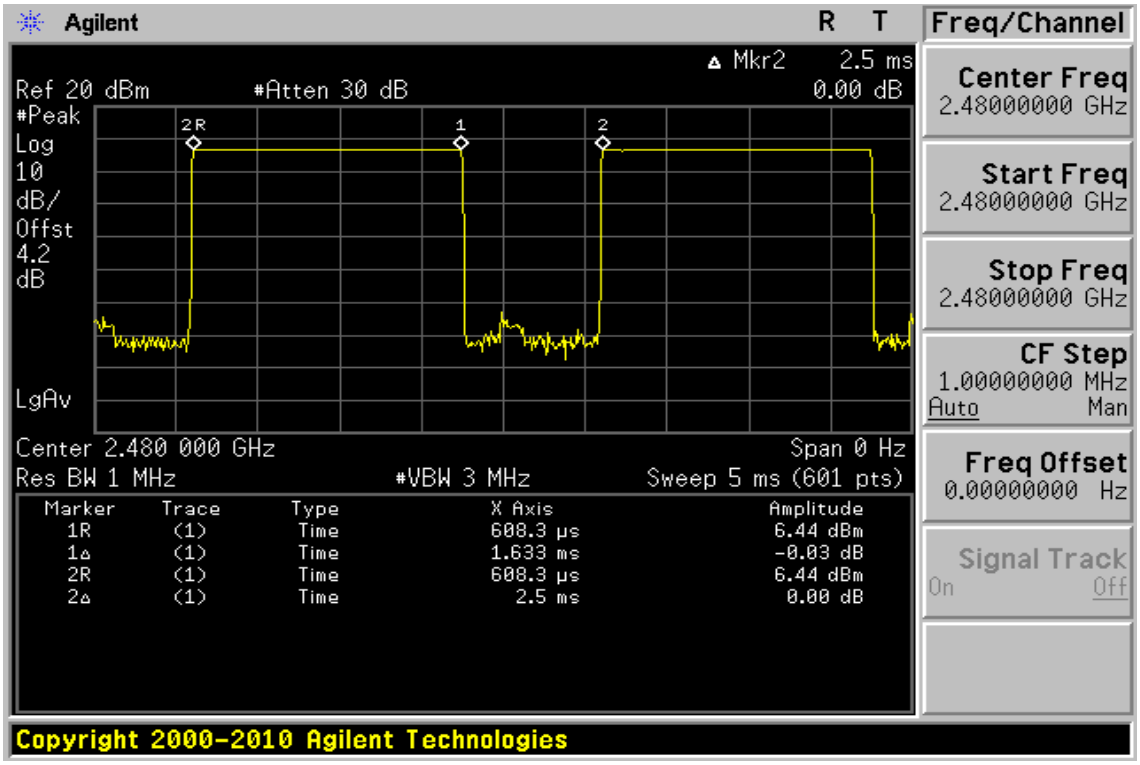


CH-High

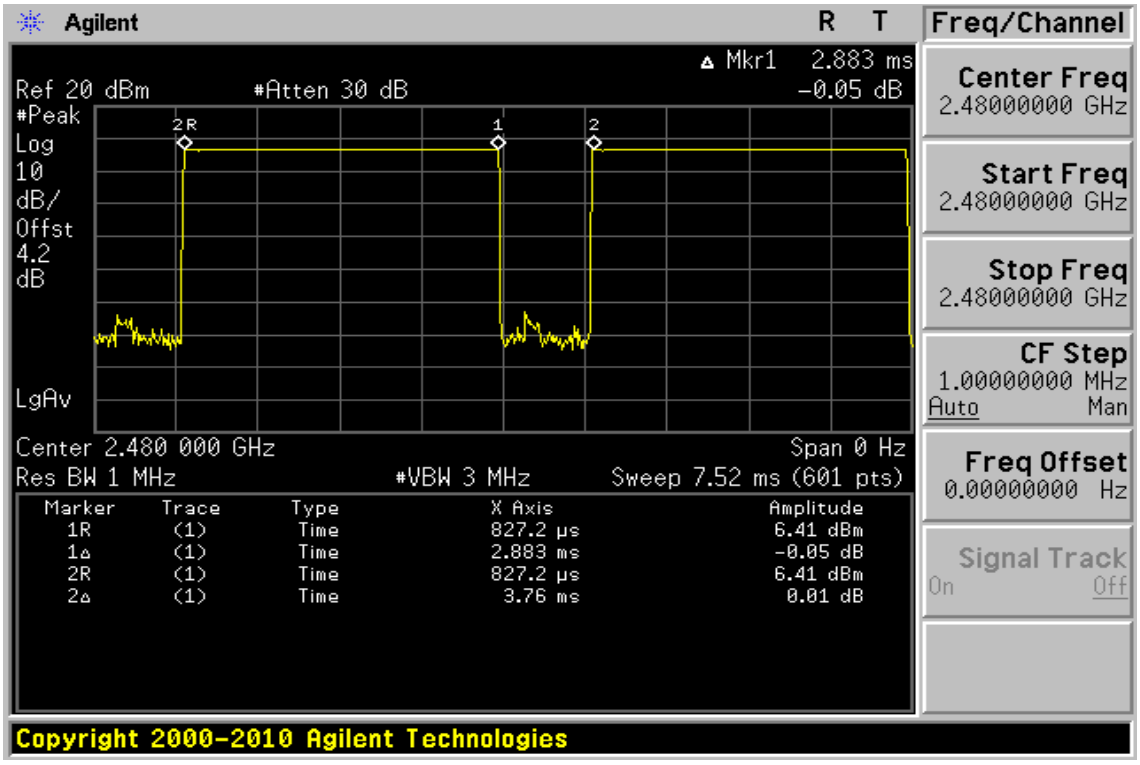
DH1



DH3

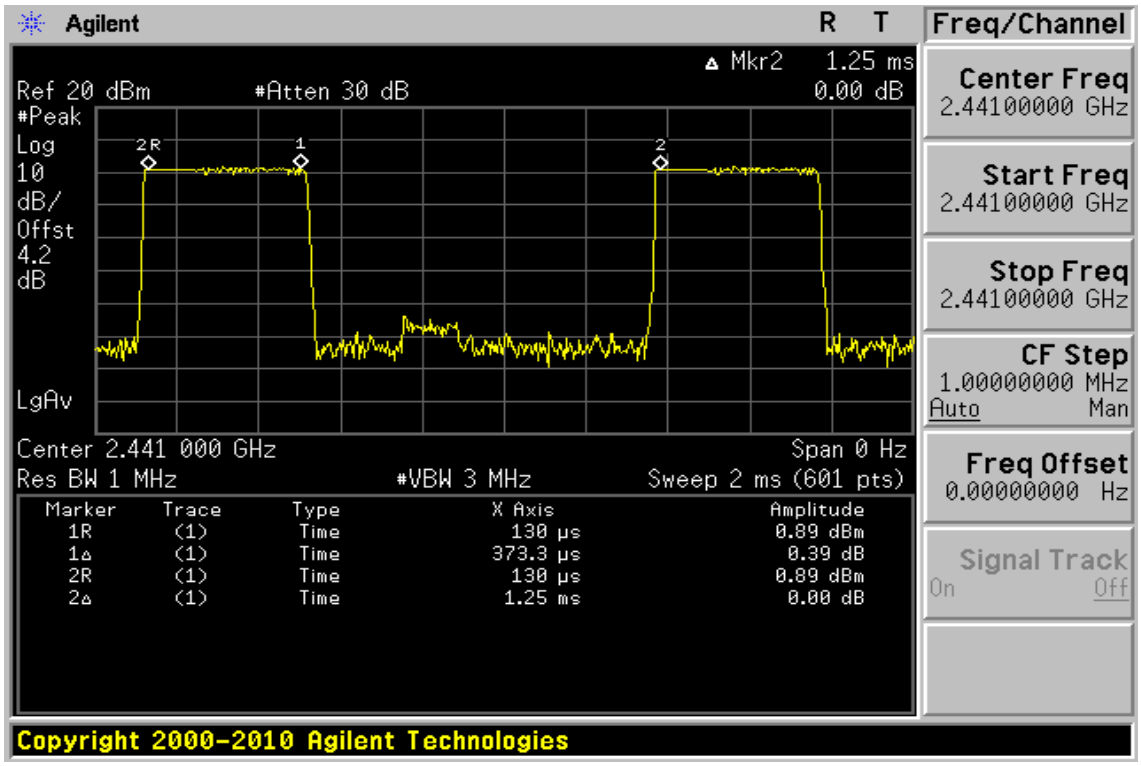


DH5

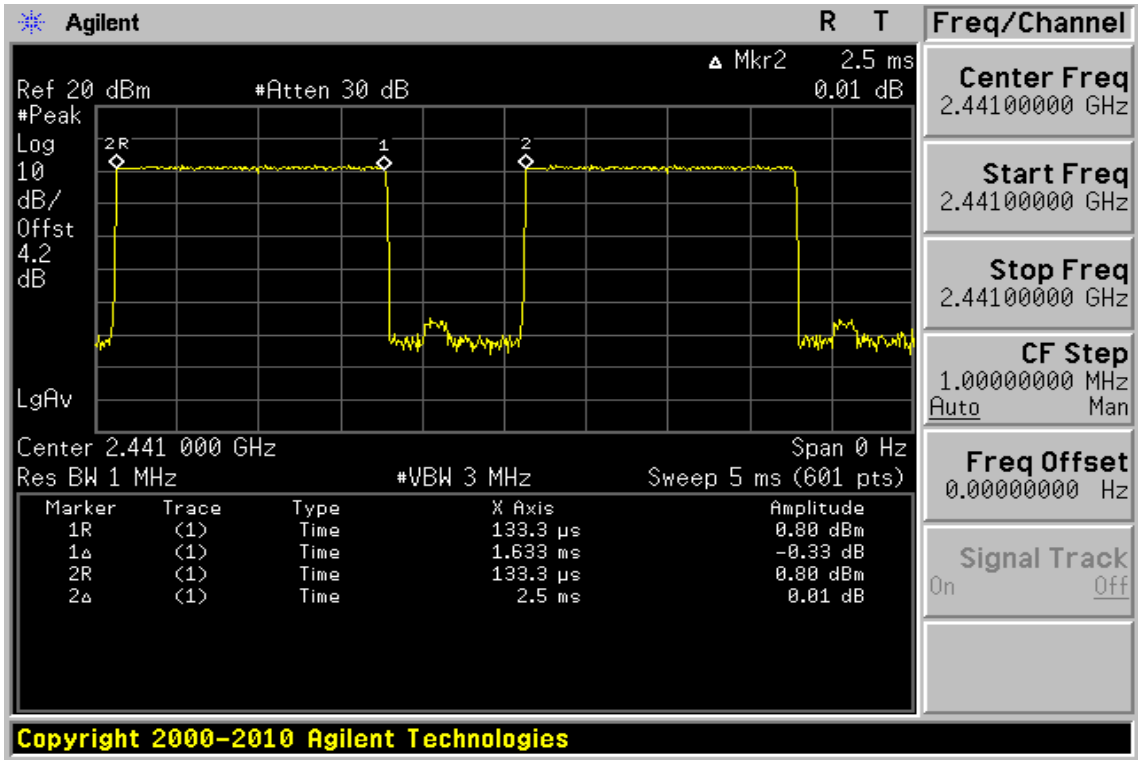


CH-Mid

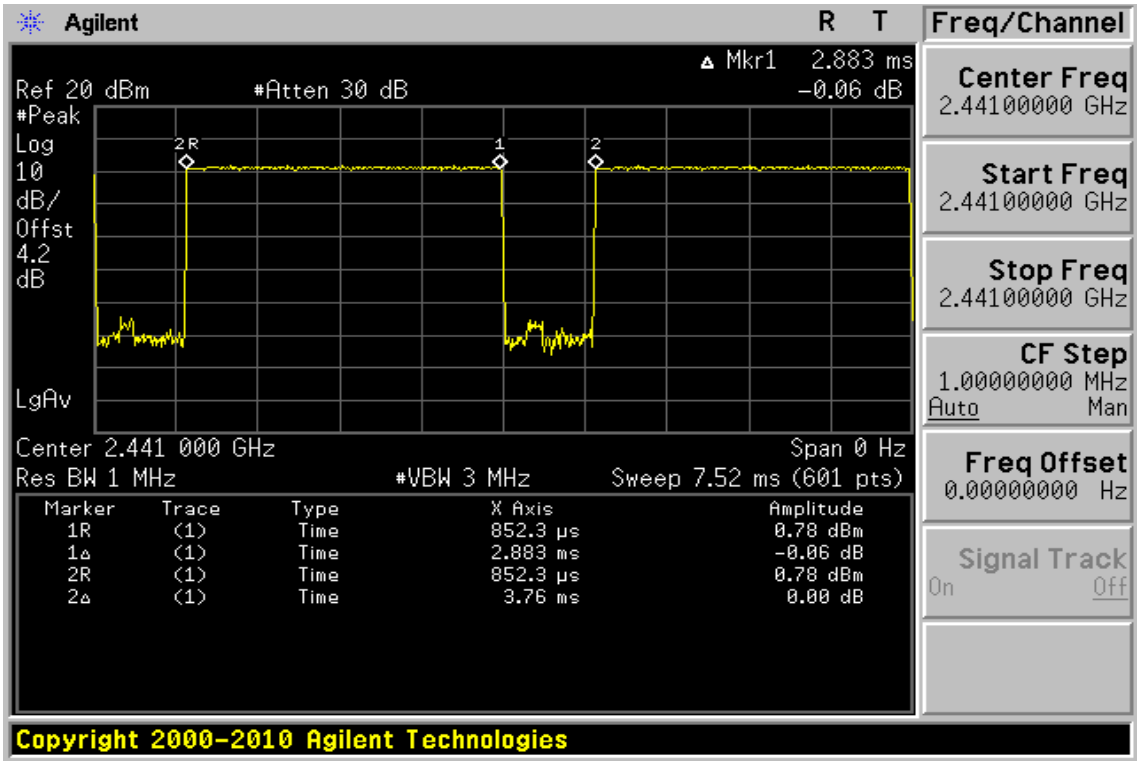
2DH1



2DH3

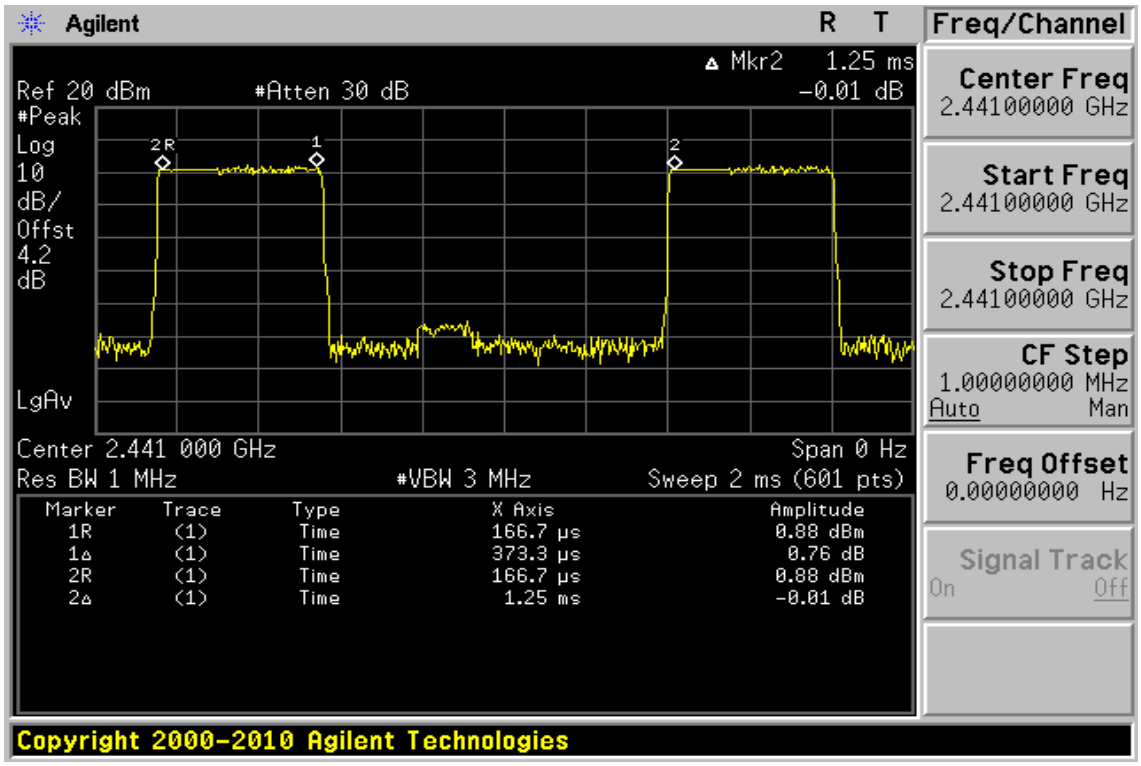


2DH5

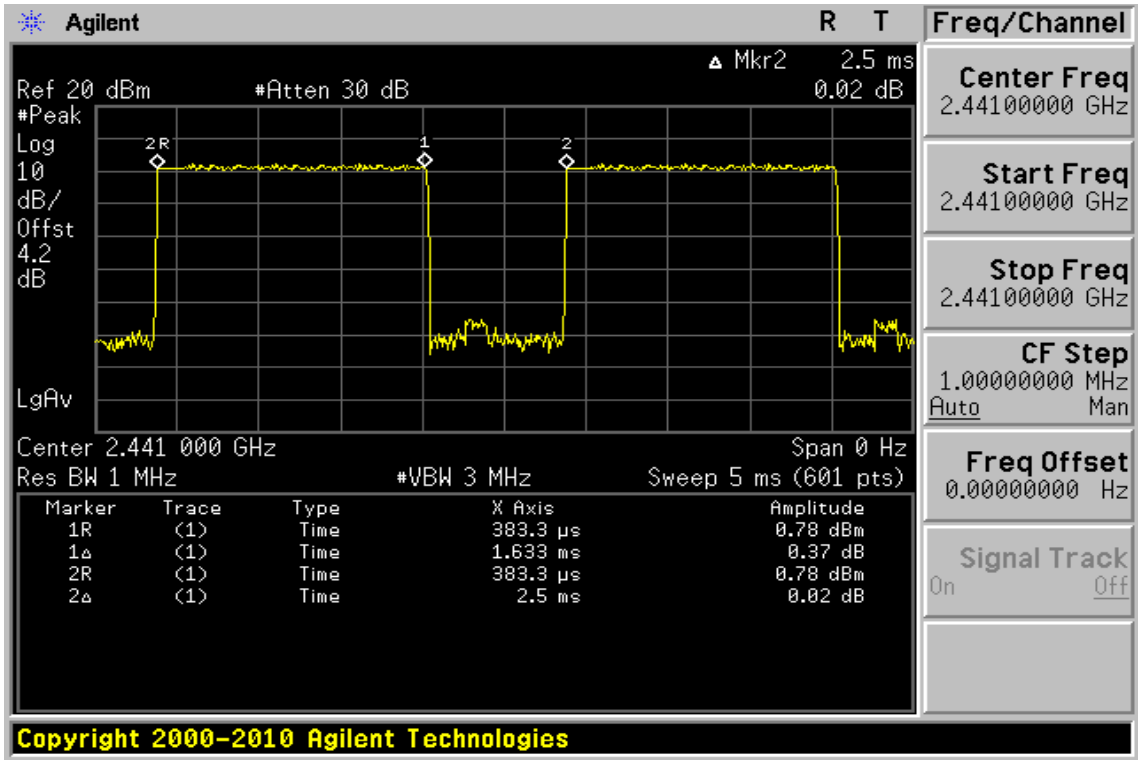


CH-Mid

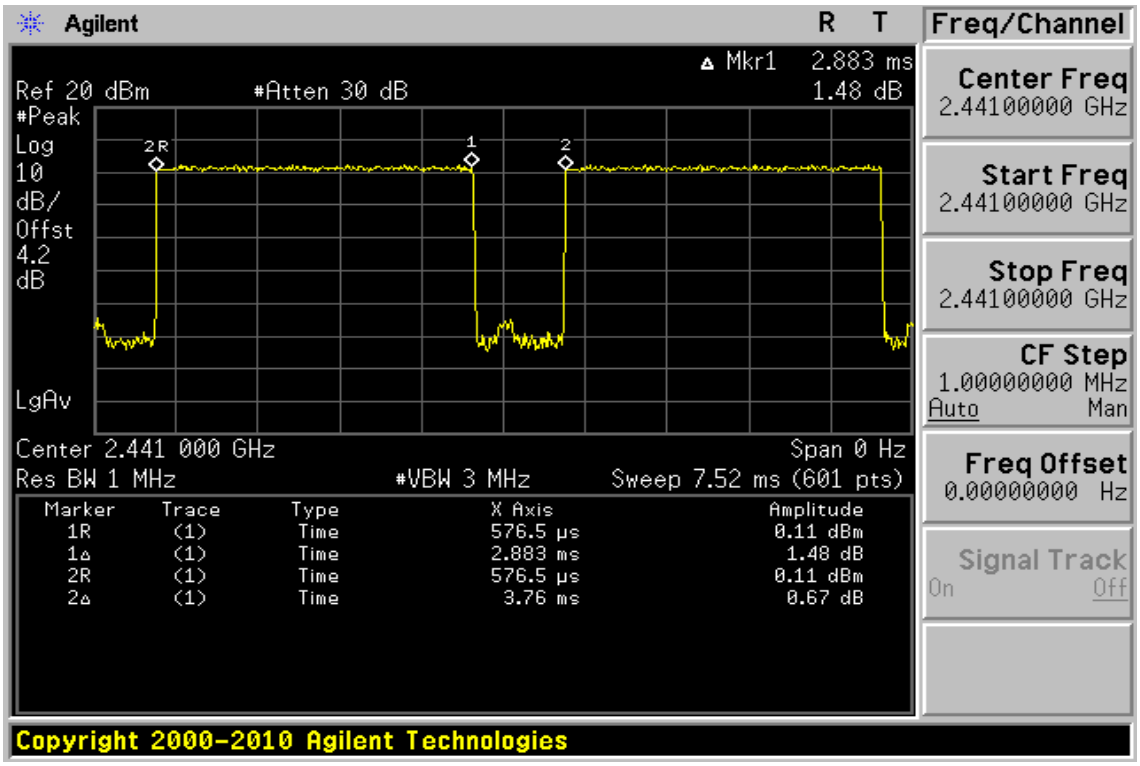
3DH1



3DH3



3DH5



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 1.7dBi, 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.

15. RF Exposure

15.1. Standard Applicable:

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

This is a Portable device with its physical nature to be used nearby, the distance between radiating structure and human is less than 20cm.

As per KDB 447498 D01 $4.3.1.1, The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm, and <= 5m (not to exceed) are determined by:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

f (GHz) is the RF channel transmit frequency in GHz

Power and distance are rounded to the nearest mW and mm before calculation

The operational distance is 5mm with the verification of KDB inquiry, OPN-2006, that KDB941225 D07 can be referred and used to evaluate the most proper way how RF exposure concern shall be met.

15.2. Measurement Result: (Worst: BR mode)

BR mode (GFSK):

Frequency (MHz)	Output Power (dBm)	Duty Cycle	Output Power (mW)
2402.00	1.92	0.771	1.19965
2441.00	4.04	0.768	1.94698
2480.00	6.60	0.771	3.52415

Step 1: (<=5mm)

This is a portable device and the Max output power is (3.52mW) lower than the threshold given and derived as formula given above, where

Bluetooth:

Mode	Frequency	Power (avg in dBm)	Power (avg mw)	Distance (mm)	Threshold (<5mm)
GFSK	2480	6.60	4.570881896	5	1.439646402

Conclusion:

As the result of calculation result indicates, the RF exposure generating from given transmitter (transmitter employed digital modulation) can be excluded from SAR measurement, (<0.3), and therefore is deemed compliant with RF exposure as per KDB 447498 D01, FCC.

~ End of Report ~