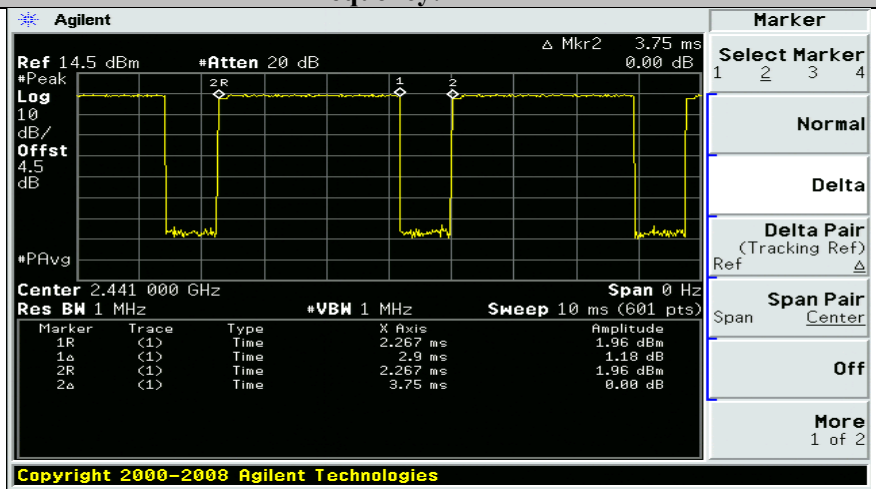
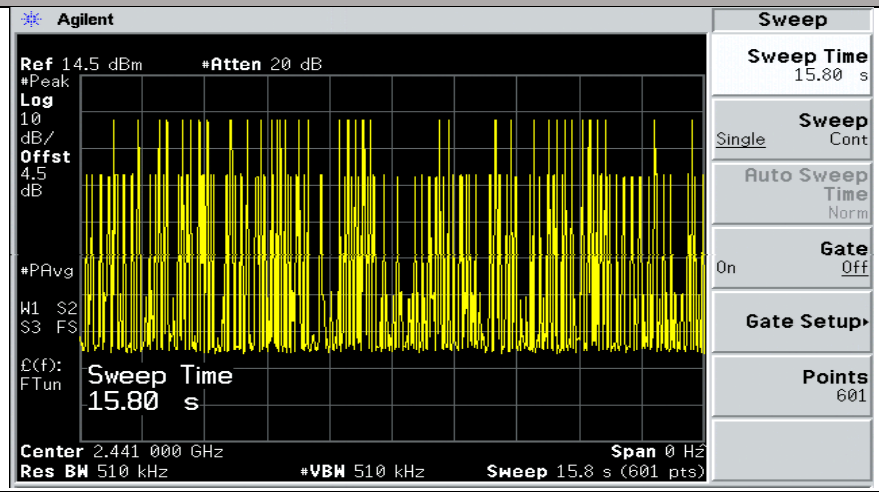
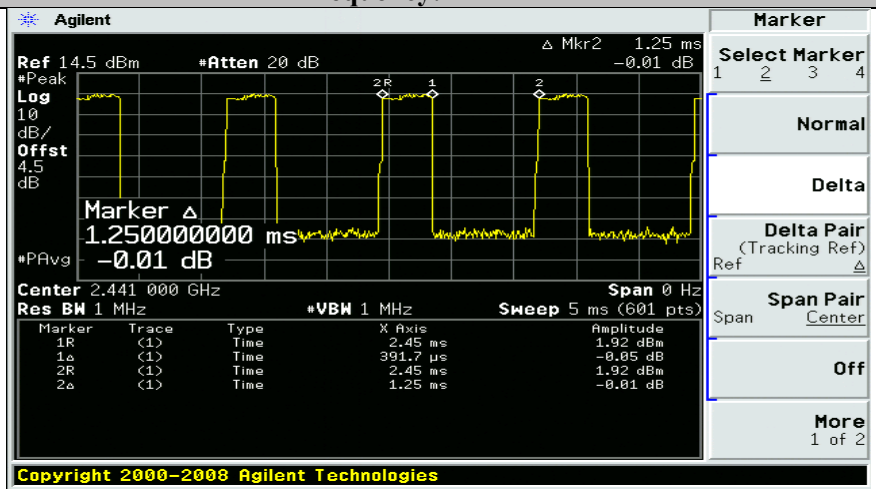
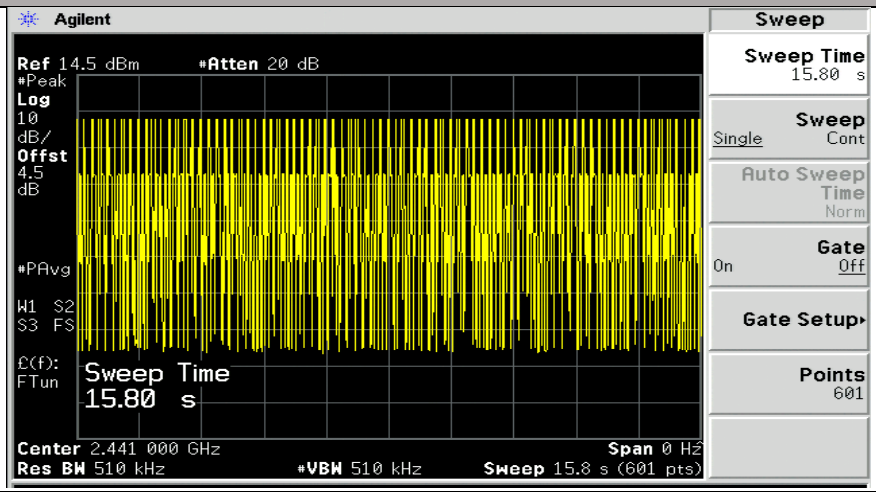
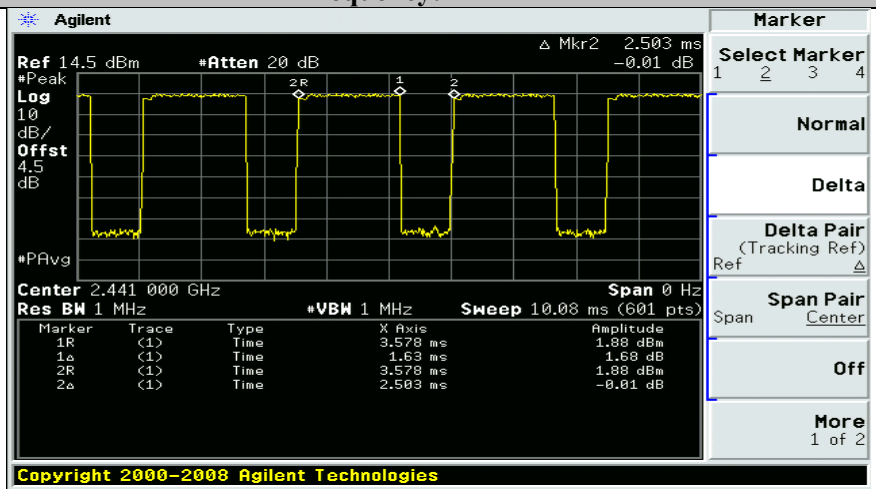
Dwell Time	
Frequency: 2441 MHz	
Mode: π/4 DQPSK	
Number of bins in 15.8s	
Mode: π/4 DQPSK	

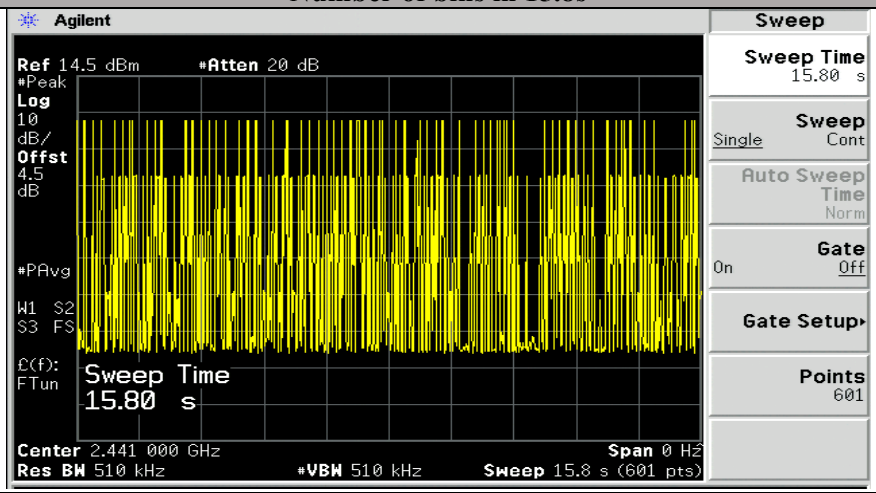
Average Time of Occupancy Calculation	
Mode/Packet Type **π/4DQPSK/ 2-DH5**	Dwell Time = **2.9 ms** Total bins in 15.8s = 46 Max. Allowed time = 0.4 s x No. of available channels = 0.4s x 79 = 31.6s Total bins in 31.6s = 46 (in 15.8s) x 2 = 92 bins Total time occupancy (in 31.6s) = 92 x 2.9ms = **266.8ms** or 0.2668s

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

Dwell Time	
Frequency: 2441 MHz	
Mode: 8DPSK	
Number of bins in 15.8s	
Mode: 8DPSK	
Mode/Packet Type **8DPSK / 3-DH1**	Dwell Time = **0.392** Total bins in 15.8 s = 149 Max. Allowed time = 0.4 s x No. of available channels = 0.4s x 79 = 31.6s Total bins in 31.6s = 149 (in 15.8s) x 2 = 298 bins Total time occupancy (in 31.6s) = 298 x 0.392ms = **116.816ms** or 0.1168s

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

Dwell Time
Frequency: 2441 MHz

Mode: 8DPSK

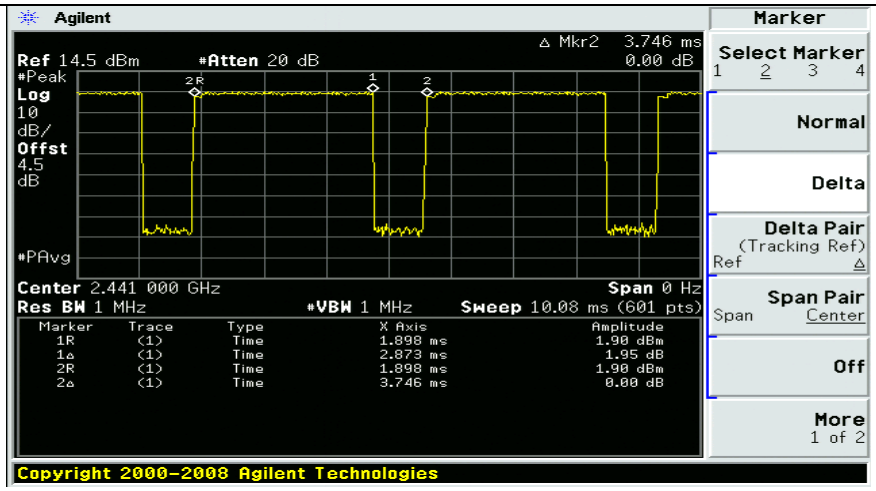
Number of bins in 15.8s

Mode: 8DPSK

Mode/Packet Type **8DPSK / 3-DH3**	Dwell Time = **1.63ms** Total bins in 15.8 s = 80 Max. Allowed time = 0.4 s x No. of available channels = 0.4s x 79 = 31.6s Total bins in 31.6s = 80 (in 15.8s) x 2 = 160 bins Total time occupancy (in 31.6s) = 160 x 1.63ms = **260.8ms** or 0.2608s

Dwell Time
Frequency: 2441 MHz

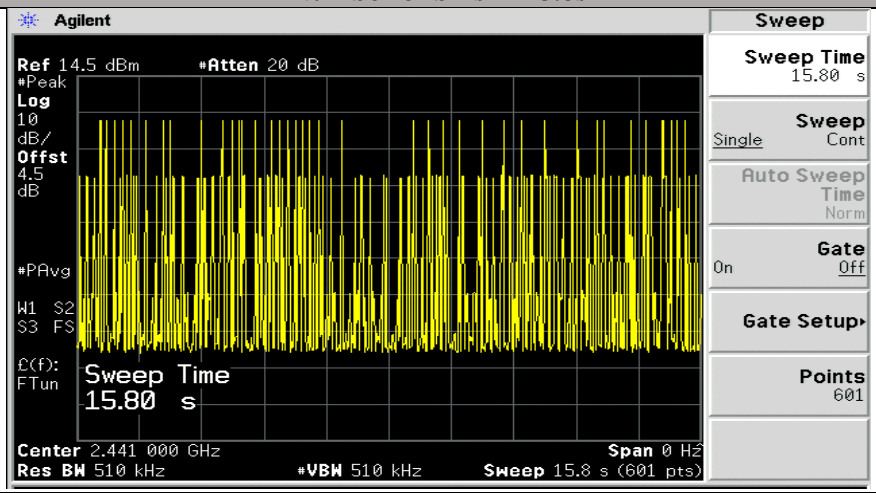
This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

Mode: 8DPSK



Number of bins in 15.8s

Mode: 8DPSK



Mode/Packet Type **8DPSK / 3-DH5**	Dwell Time = **2.873ms** Total bins in 15.8s = 41 Max. Allowed time = 0.4 s x No. of available channels = 0.4s x 79 = 31.6s Total bins in 31.6s = 41 (in 15.8s) x 2 = 82 bins Total time occupancy (in 31.6s) = 82 x 2.873ms = **235.586ms** or 0.2355s

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

A.6 Conducted Band Edge

A.6.1 Limits

15.247 (d) & RSS-247 (5.5)

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. Attenuation below the general limits specified in FCC §15.209(a) & RSS-Gen is not required.

A.6.2 Test Procedure

Refer to Public notice DA-00 705

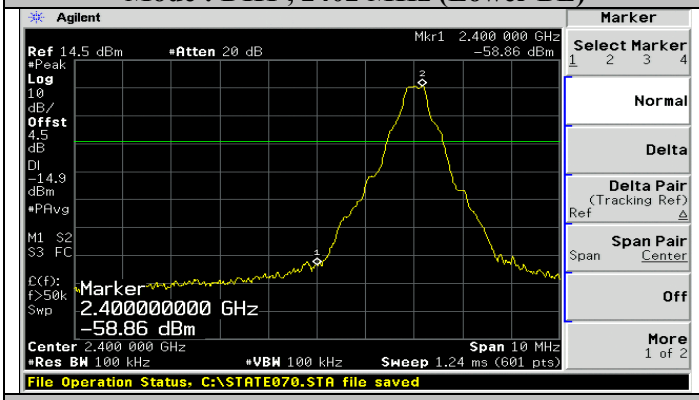
- Use the following spectrum analyzer settings:
- Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation
- RBW ≥ 1% of the span
- VBW ≥ RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Allow the trace to stabilize.
- Set the Bluetooth in hopping disabled mode. Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. The marker-delta value now displayed must comply with the limit specified in this Section. Submit this plot.
- Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit. Submit this plot.

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

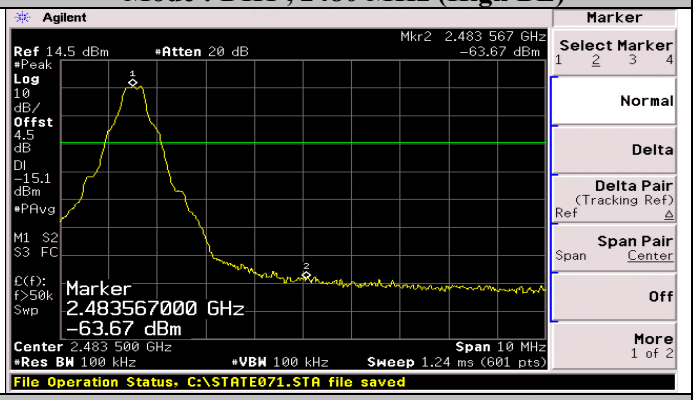
A.6.3 Conducted Band Edge Graphical Test Results

Conducted Band Edge (Hoping Disable)

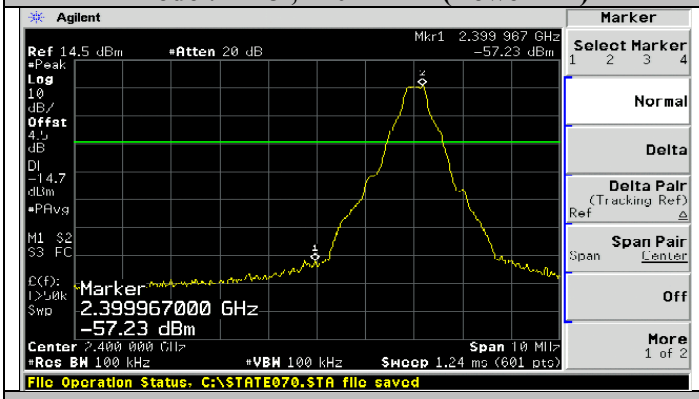
Mode : DH1 , 2402 MHz (Lower BE)



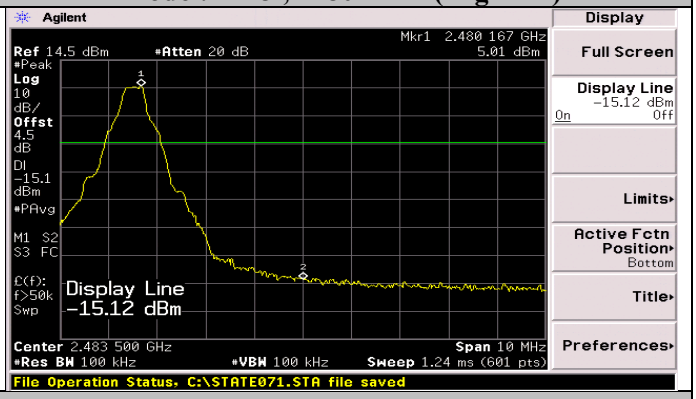
Mode : DH1 , 2480 MHz (High BE)



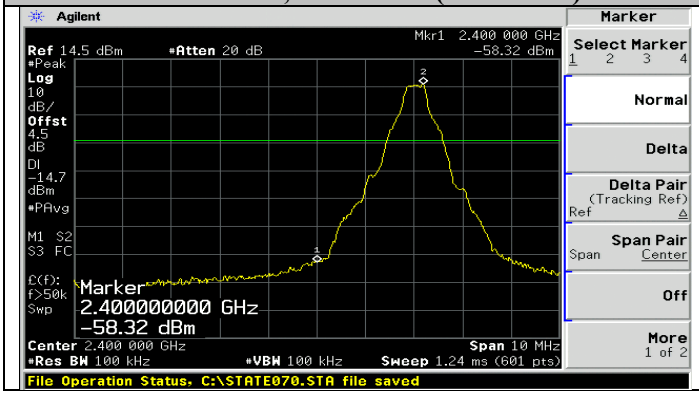
Mode : DH3 , 2402 MHz (Lower BE)



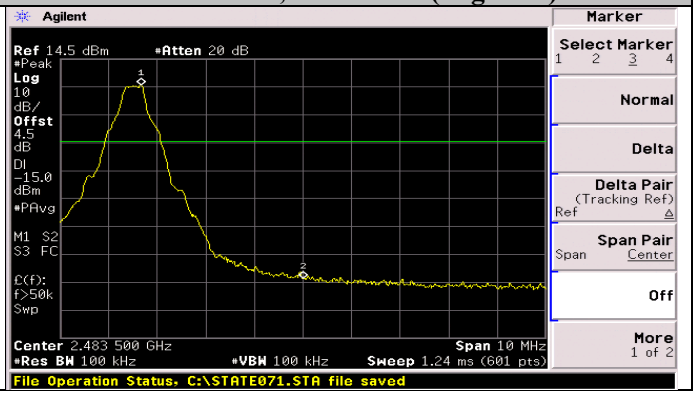
Mode : DH3 , 2480 MHz (High BE)



Mode : DH5, 2402 MHz (Lower BE)



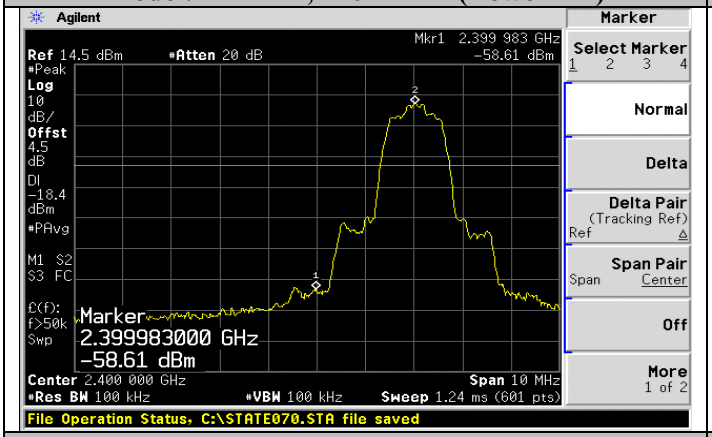
Mode : DH5, 2480 MHz (High BE)



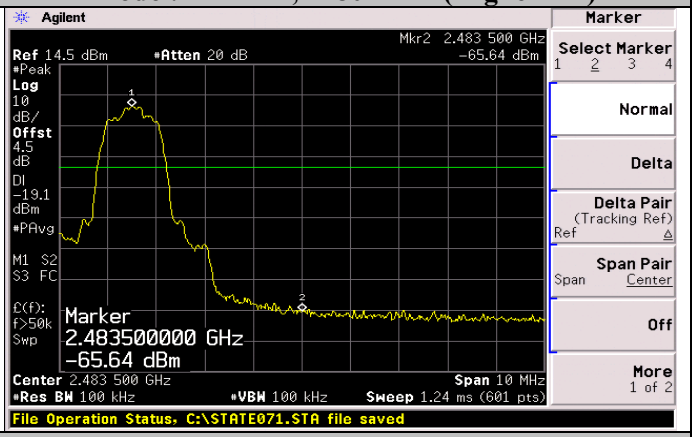
This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

Conducted Band Edge (Hopping Disable)

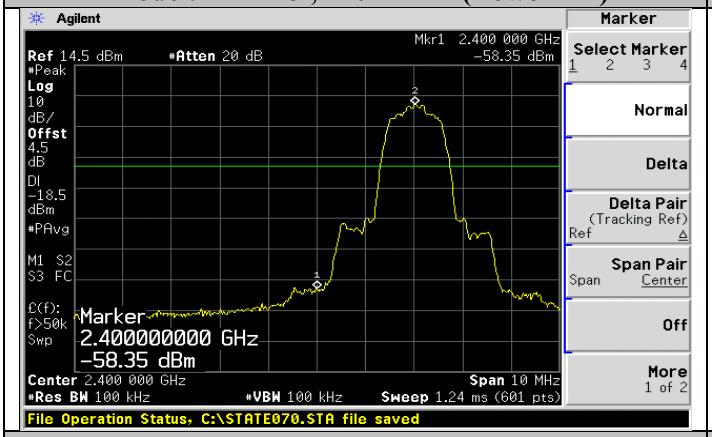
Mode : 2 - DH1 , 2402 MHz (Lower BE)



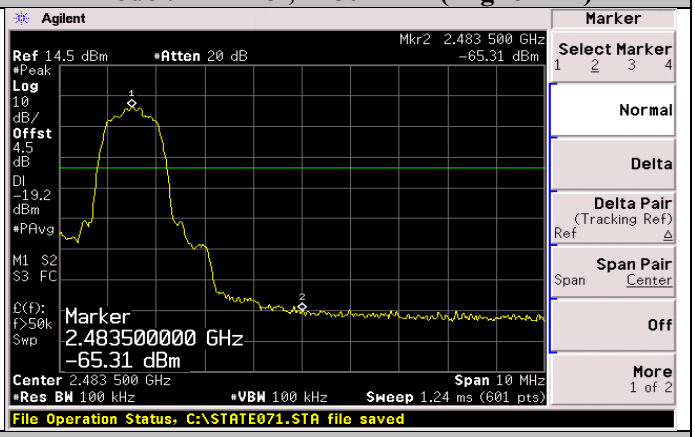
Mode : 2 - DH1 , 2480 MHz (Higher BE)



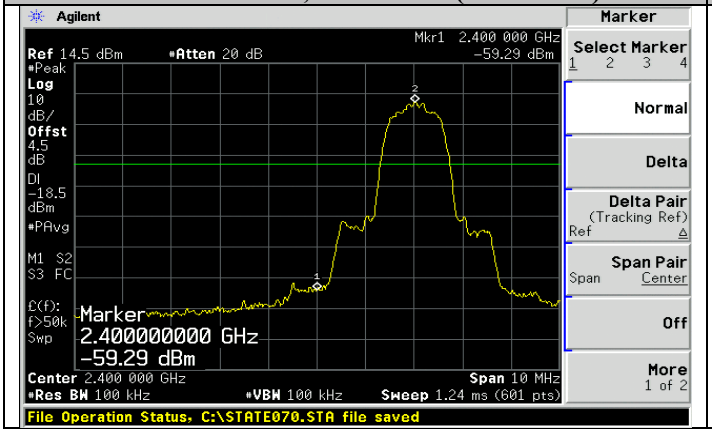
Mode : 2 - DH3 , 2402 MHz (Lower BE)



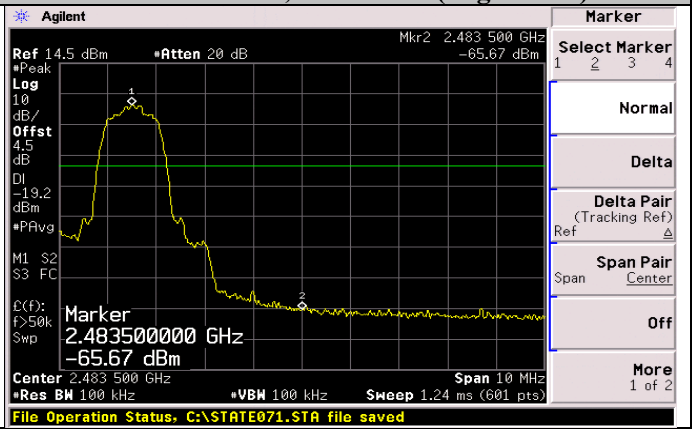
Mode : 2 - DH3 , 2480 MHz (Higher BE)



Mode : 2 - DH5, 2402 MHz (Lower BE)



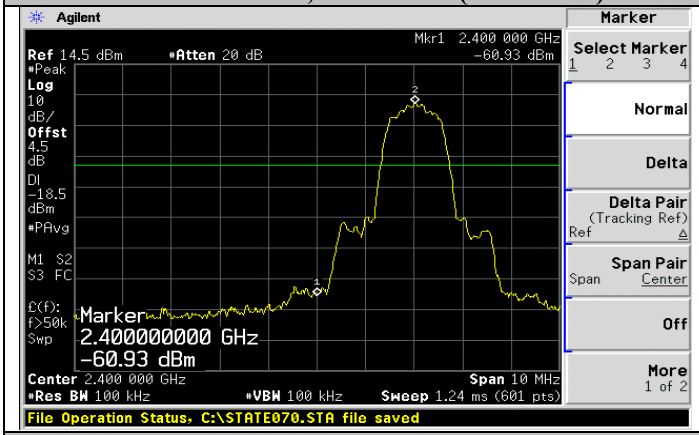
Mode : 2 - DH5, 2480 MHz (Higher BE)



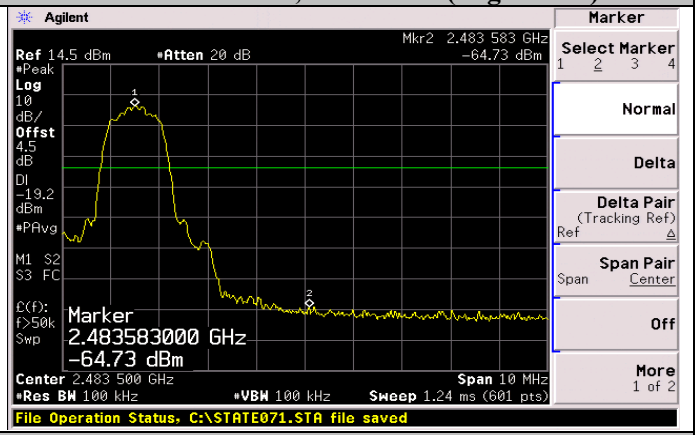
Conducted Band Edge (Hopping Disable)

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

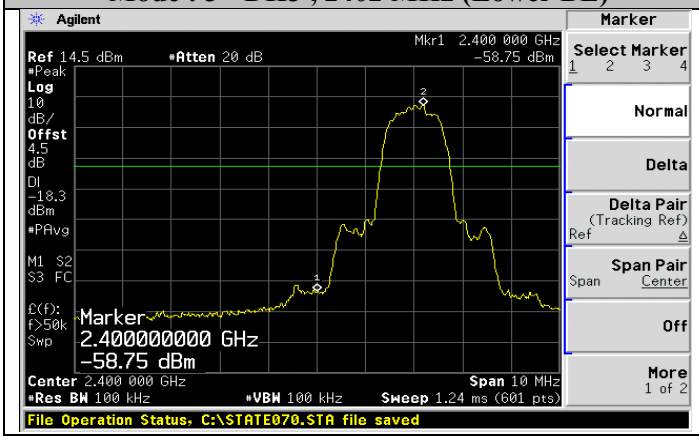
Mode : 3 - DH1 , 2402 MHz (Lower BE)



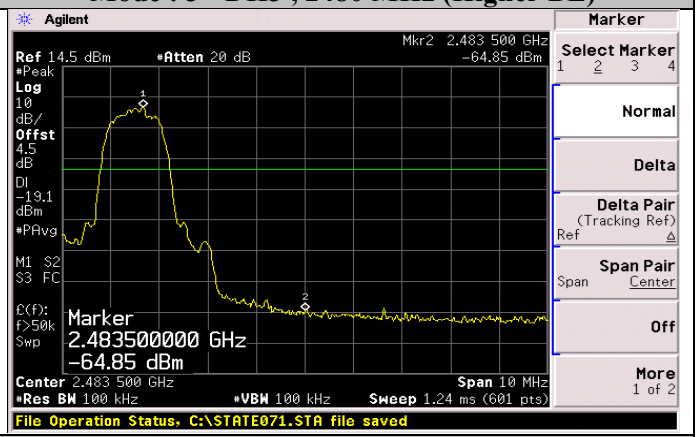
Mode : 3 - DH1 , 2480 MHz (Higher BE)



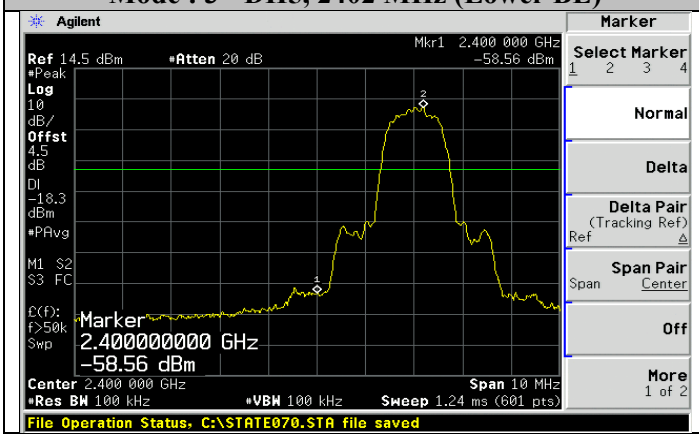
Mode : 3 - DH3 , 2402 MHz (Lower BE)



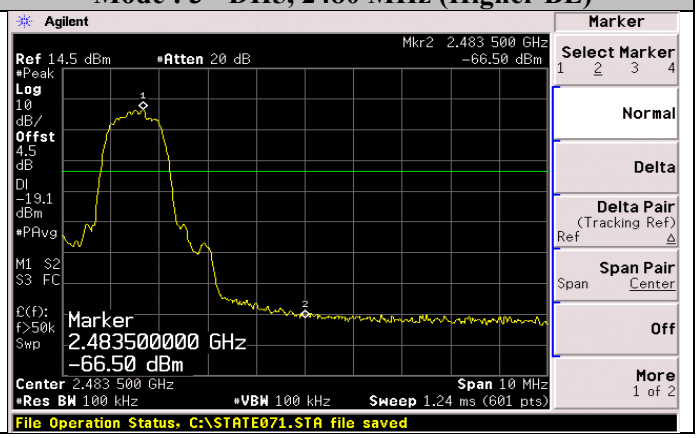
Mode : 3 - DH3 , 2480 MHz (Higher BE)



Mode : 3 - DH5, 2402 MHz (Lower BE)



Mode : 3 - DH5, 2480 MHz (Higher BE)

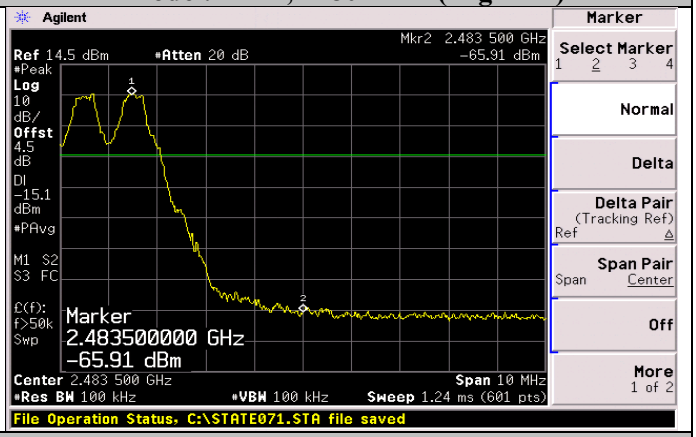


This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

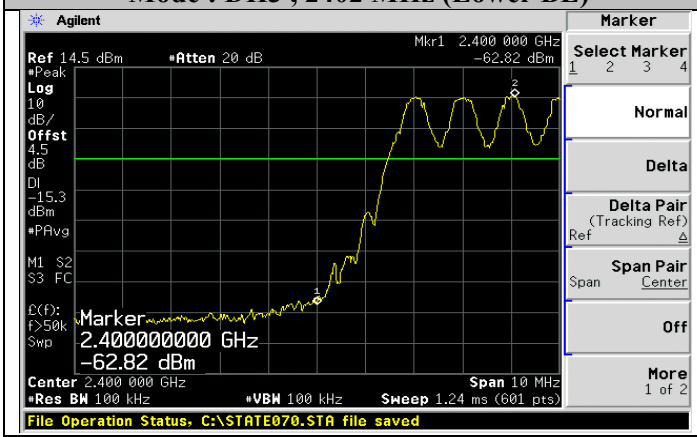
Conducted Band Edge (Hopping Enable)

Mode : DH1 , 2402 MHz (Lower BE)

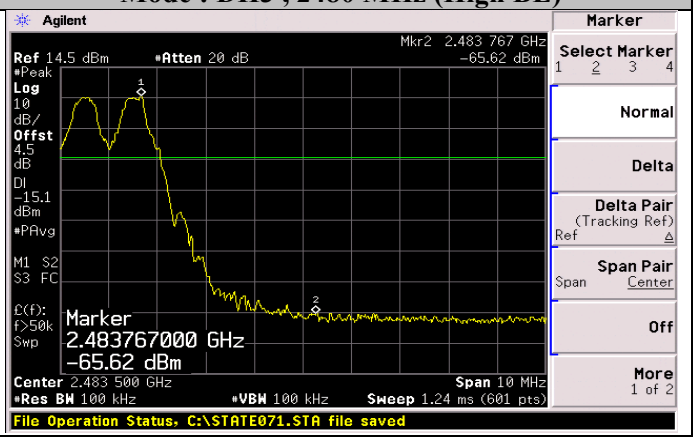
Mode : DH1 , 2480 MHz (High BE)



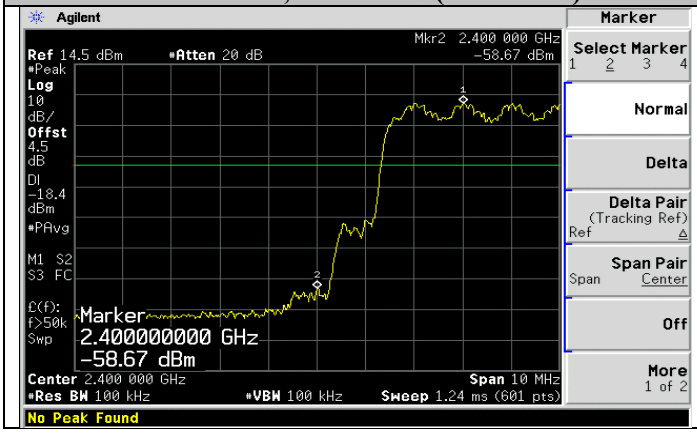
Mode : DH3 , 2402 MHz (Lower BE)



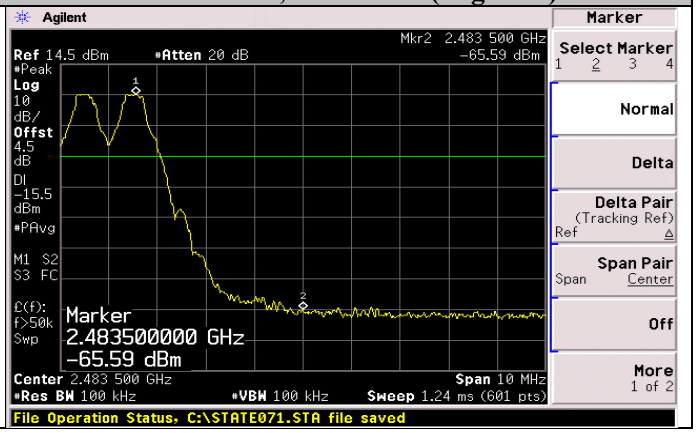
Mode : DH3 , 2480 MHz (High BE)



Mode : DH5, 2402 MHz (Lower BE)



Mode : DH5, 2480 MHz (High BE)

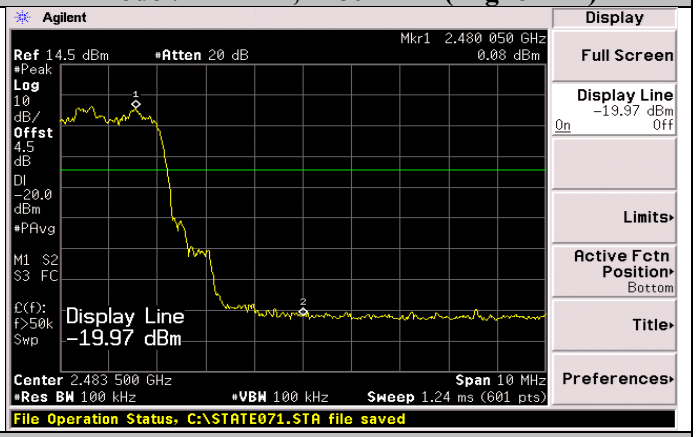


This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

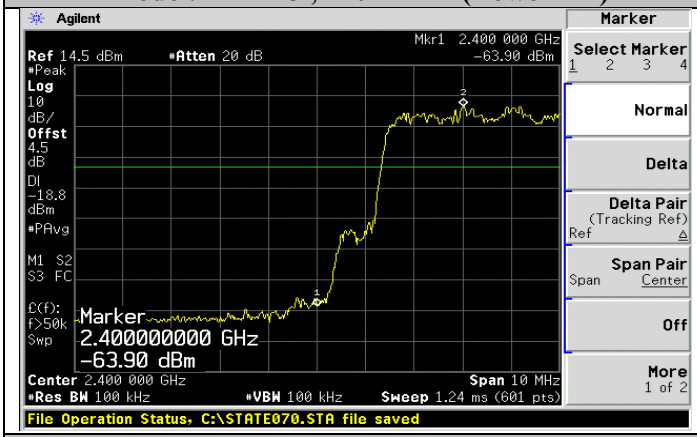
Conducted Band Edge (Hopping Enable)

Mode : 2 - DH1 , 2402 MHz (Lower BE)

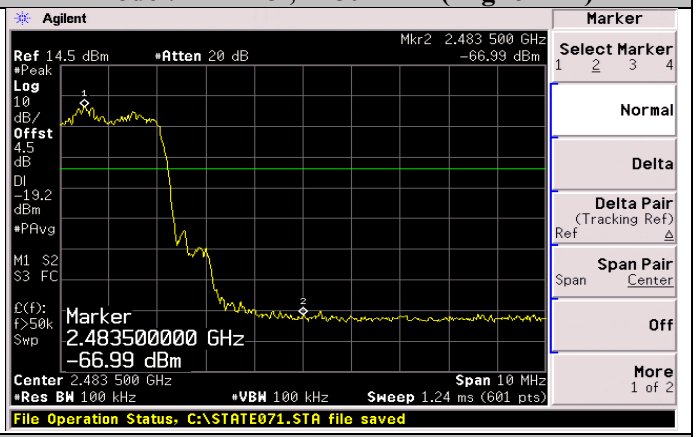
Mode : 2 - DH1 , 2480 MHz (Higher BE)



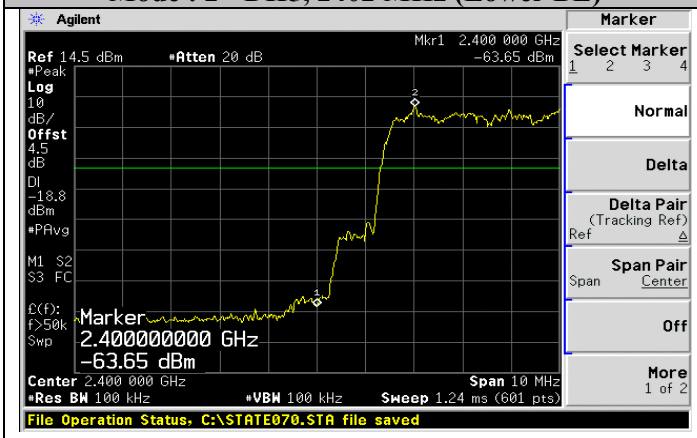
Mode : 2 - DH3 , 2402 MHz (Lower BE)



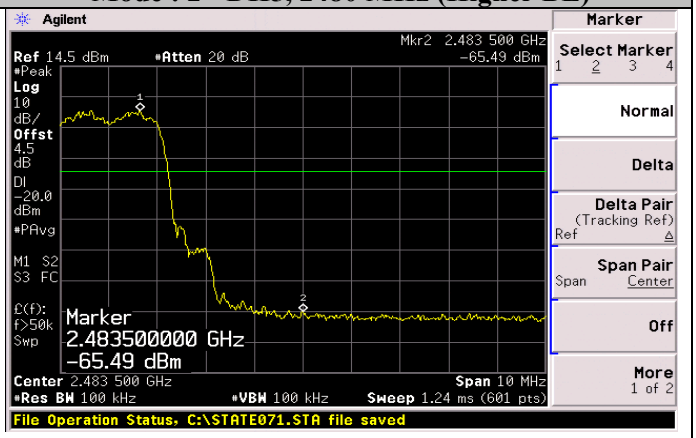
Mode : 2 - DH3 , 2480 MHz (Higher BE)



Mode : 2 - DH5, 2402 MHz (Lower BE)



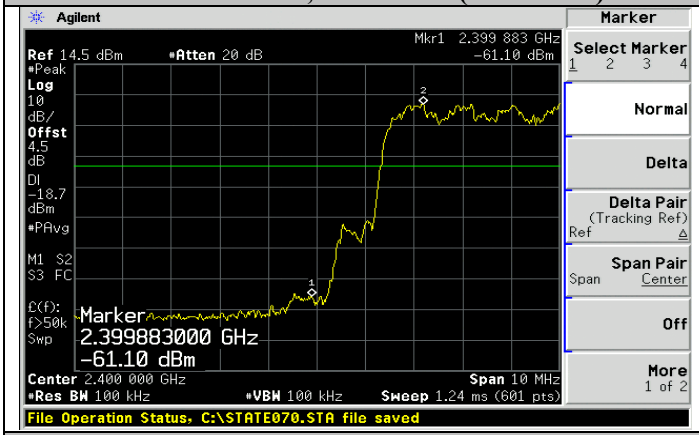
Mode : 2 - DH5, 2480 MHz (Higher BE)



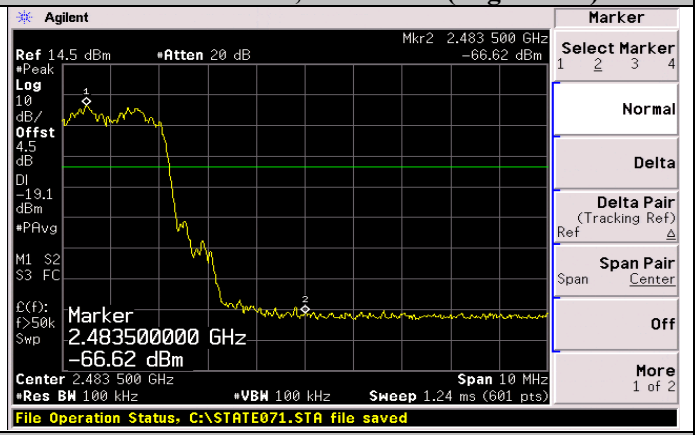
Conducted Band Edge (Hopping Enable)

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

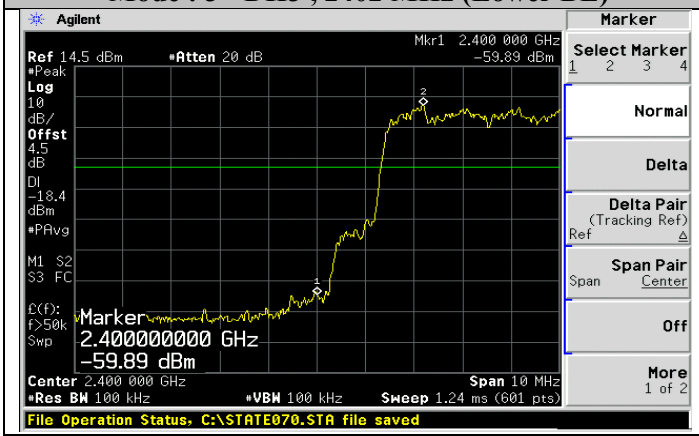
Mode : 3 - DH1 , 2402 MHz (Lower BE)



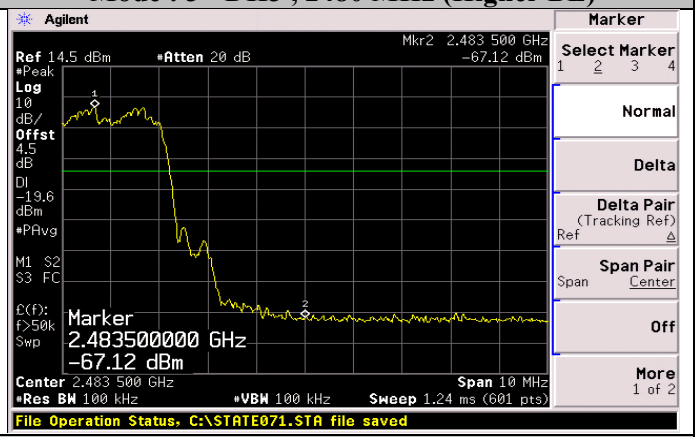
Mode : 3 - DH1 , 2480 MHz (Higher BE)



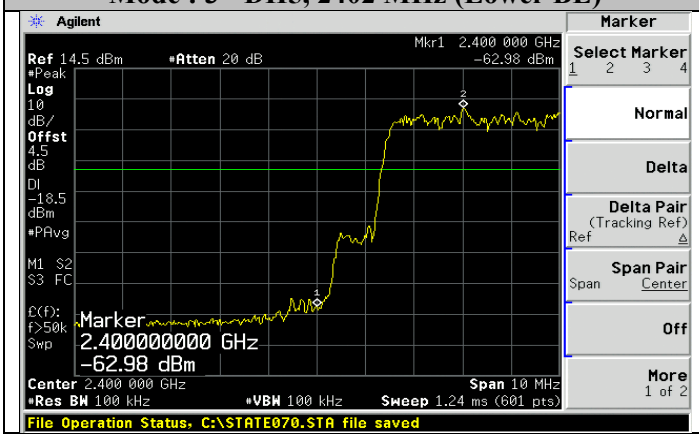
Mode : 3 - DH3 , 2402 MHz (Lower BE)



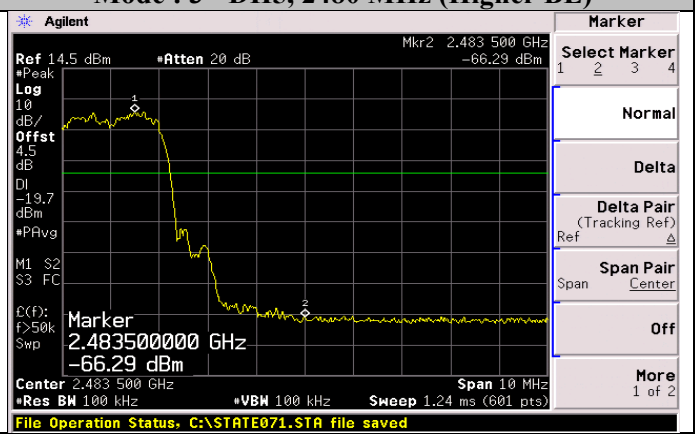
Mode : 3 - DH3 , 2480 MHz (Higher BE)



Mode : 3 - DH5, 2402 MHz (Lower BE)



Mode : 3 - DH5, 2480 MHz (Higher BE)



This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

A.7 Restricted Bands

A.7.1 Limits

FCC 15.247(e); RSS-Gen 8.10

FCC: Radiated emissions which fall in the restricted bands, as defined in FCC §15.205(a), must also comply with the radiated emission limits specified in Sec. 15.209(a).

RSS: Unwanted emissions falling into restricted bands of Table 6 shall comply with the limits specified in RSS-Gen

A.7.2 Test Procedure

Refer to Public notice DA-00 705

- Set the Bluetooth in the transmitter mode at the maximum level.
- Use the following spectrum analyzer settings:

For peak measurement:

- Span = wide enough to fully capture the emission being measured.
- RBW = 1 MHz for above 1 GHz
- VBW ≥ RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Allow the trace to stabilize.
- Set the marker on the peak of any spurious emission using peak search function. The level displayed must comply with the limit specified in this Section
- Submit this plot.

For average measurement:

- Span = wide enough to fully capture the emission being measured.
- RBW = 1 MHz for above 1 GHz
- VBW =10 Hz
- Sweep = auto
- Detector function = peak
- Allow the trace to stabilize.
- Set the marker on the peak of any spurious emission using peak search function. The level displayed must comply with the limit specified in this Section
- Submit this plot.

RSS: Unwanted emissions falling into restricted bands of Table 3 shall comply with the limits specified in RSS-Gen 7.2.5.

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

A.7.3 Restricted Bands Test Data

Operating Frequency (MHz)	Data Rate (Mbps)	DCCF (dB)	A.G (dBi)	Restricted Bands (MHz)	Max. Power Level (dBm)	E.I.R.P (dBm)	Limit (dBm)	Result
GFSK/DH1								
2402	1	N/A	2.4	2310–2390	-56.99	-54.99	-21.2	Pass
2402	1	N/A	2.4	2310–2390	-68.00*	-65.60*	-41.2*	Pass
2480	1	N/A	2.4	2483.5-2500	-49.76	-47.36	-21.2	Pass
2480	1	N/A	2.4	2483.5-2500	-65.02*	-62.62*	-41.2*	Pass
GFSK/DH3								
2402	1	N/A	2.4	2310–2390	-56.38	-53.98	-21.2	Pass
2402	1	N/A	2.4	2310–2390	-67.98*	-65.58*	-41.2*	Pass
2480	1	N/A	2.4	2483.5-2500	-50.45	-48.05	-21.2	Pass
2480	1	N/A	2.4	2483.5-2500	-63.33*	-60.93*	-41.2*	Pass
GFSK/DH5								
2402	1	N/A	2.4	2310–2390	-56.06	-53.66	-21.2	Pass
2402	1	N/A	2.4	2310–2390	-66.83*	-64.43*	-41.2*	Pass
2480	1	N/A	2.4	2483.5-2500	-50.15	-47.75	-21.2	Pass
2480	1	N/A	2.4	2483.5-2500	-62.92*	-60.52*	-41.2*	Pass

Note 1: Correction factors (ext. attenuation + cable loss) are compensated in the offset function of the measuring instrument. The readings with * at the end represent measurements in average.

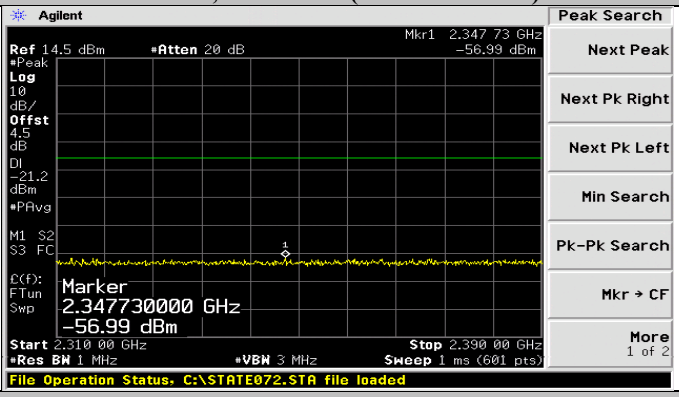
Note 2: GFSK modulation produces the highest output power which represents the worst case.

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

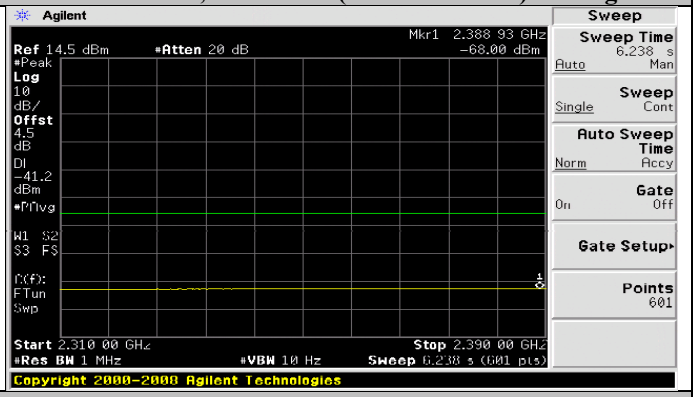
A.7.4 Restricted Bands Graphical Test Results

Modulation : GFSK, Lower Restricted Bands (2310-2390MHz)

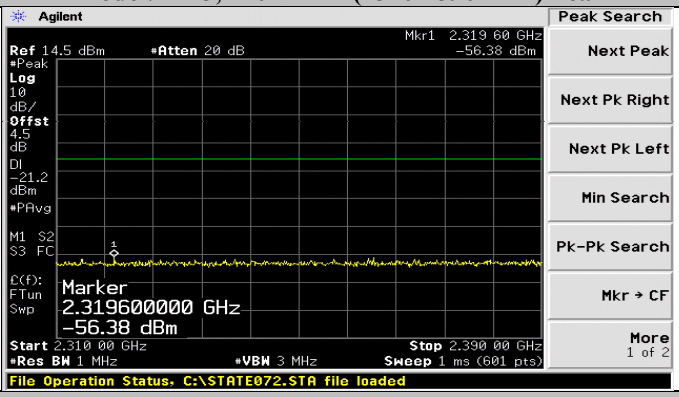
Mode : DH1, 2402 MHz (2310-2390MHz) Peak



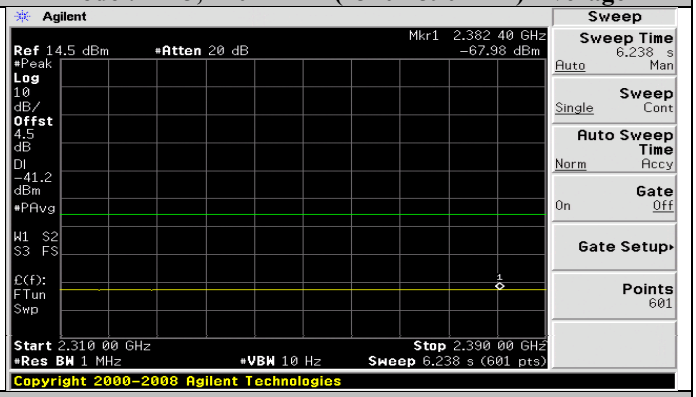
Mode : DH1, 2402 MHz (2310-2390MHz) Average



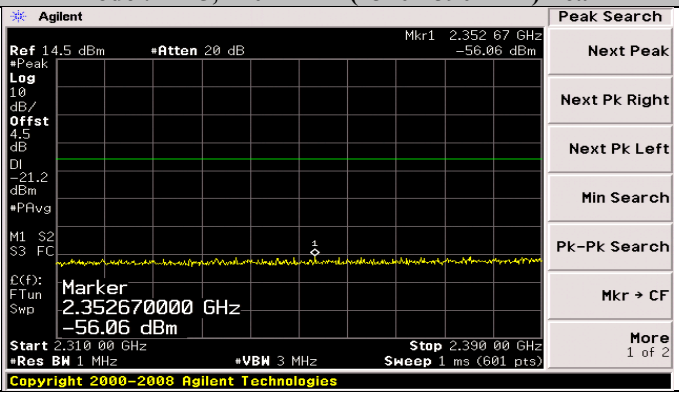
Mode : DH3, 2402 MHz (2310-2390MHz) Peak



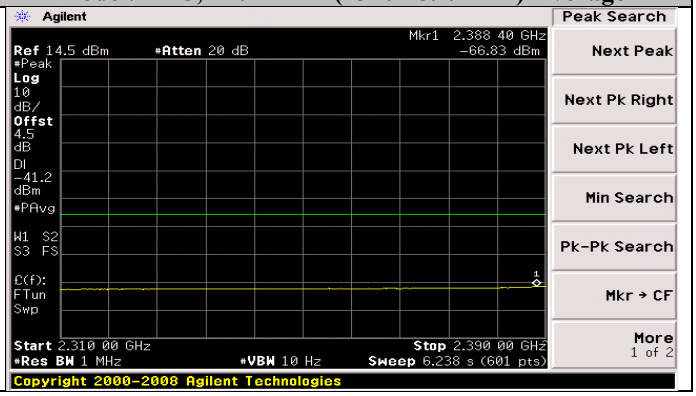
Mode : DH3, 2402 MHz (2310-2390MHz) Average



Mode : DH5, 2402 MHz (2310-2390MHz) Peak



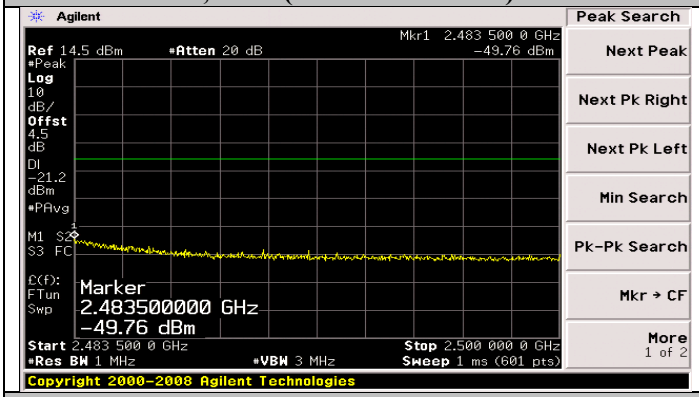
Mode : DH5, 2402 MHz (2310-2390MHz) Average



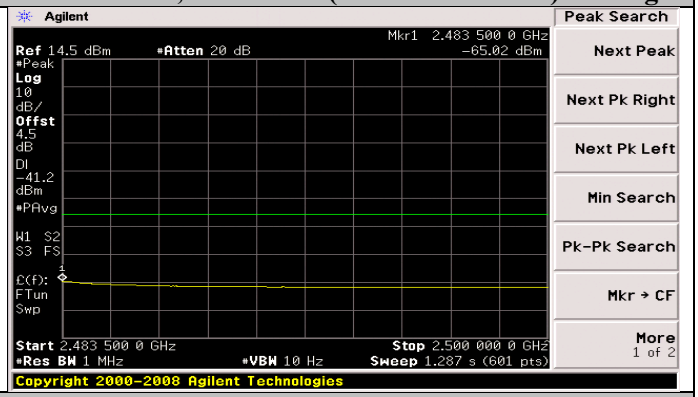
This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

Modulation : GFSK, Upper Restricted Bands (2483.5-2500MHz)

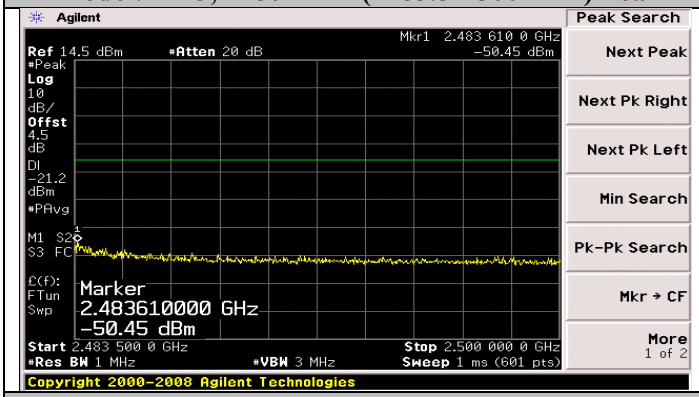
Mode : DH1, 2480 (2483.5-2500MHz) MHz Peak



Mode : DH1, 2480 MHz (2483.5-2500MHz) Average

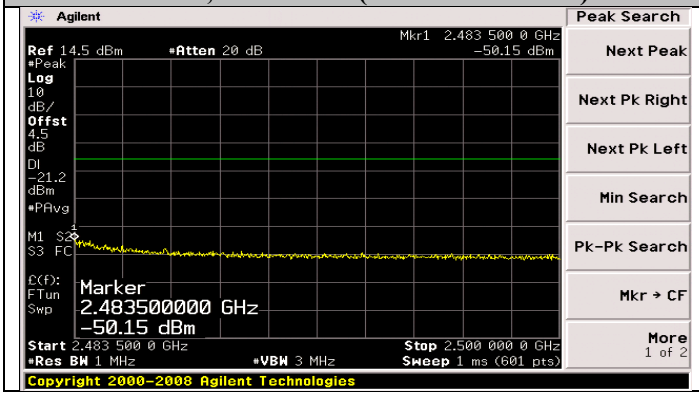


Mode : DH3, 2480 MHz (2483.5-2500MHz) Peak

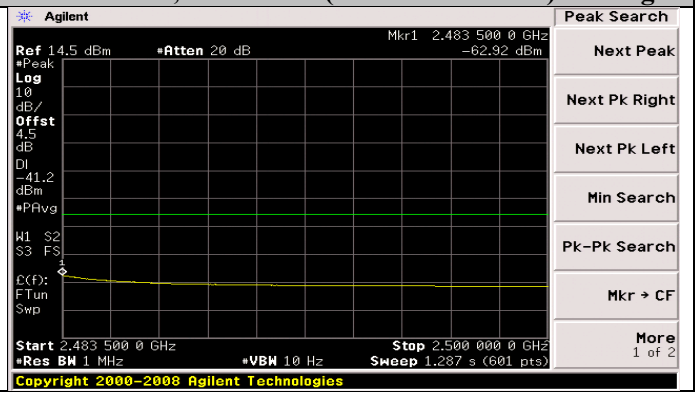


Mode : DH3, 2480 MHz (2483.5-2500MHz) Average

Mode : DH5, 2480 MHz (2483.5-2500MHz) Peak



Mode : DH5, 2480 MHz (2483.5-2500MHz) Average



This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

Appendix B: Radiated Test Results

B.1 Transmitter Spurious Emissions & Restricted Bands

Emissions on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

Restricted Bands

RSS-Gen 8.10 (**b**) Unwanted emissions that fall into restricted bands of Table 6 shall comply with the limits specified in RSS-Gen; and (**c**) Unwanted emissions that do not fall within the restricted frequency bands of Table 6 shall comply either with the limits specified in the applicable RSS or with those specified in this RSS-Gen.

Table 6 Restricted Bands

MHz	MHz	GHz
0.090-0.110	74.8-75.2	9.0-9.2
2.1735-2.1905	108-138	9.3-9.5
3.020-3.026	156.52475-156.52525	10.6-12.7
4.125-4.128	156.7-156.9	13.25-13.4
4.17725-4.17775	240-285	14.47-14.5
4.20725-4.20775	322-335.4	15.35-16.2
5.677-5.683	399.9-410	17.7-21.4
6.215-6.218	608-614	22.01-23.12
6.26775-6.26825	960-1427	23.6-24.0
6.31175-6.31225	1435-1626.5	31.2-31.8
8.291-8.294	1645.5-1646.5	36.43-36.5
8.362-8.366	1660-1710	Above 38.6
8.37625-8.38675	1718.8-1722.2	*
8.41425-8.41475	2200-2300	
12.29-12.293	2310-2390	
12.51975-12.52025	2655-2900	
12.57675-12.57725	3260-3267	
13.36-13.41	3332-3339	
16.42-16.423	3345.8-3358	
16.69475-16.69525	3500-4400	
16.80425-16.80475	4500-5150	
25.5-25.67	5350-5460	
37.5-38.25	7250-7750	
73-74.6	8025-8500	

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

B.1.1 Limits

FCC 15.209; RSS-Gen 8.10 Issue 4

The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the table specified in the table in FCC§15.209(a) and in RSS-Gen 8.9 table 4.

15.209 (a) except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (uV/meter)	Field strength (dBuV/meter)	Measurement distance (meters)
30-88	100**	40 Qp	3
88-216	150**	43.5 Qp	3
216-960	200**	46 Qp	3
Above 960	500	54 Av / 74 Pk	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz However, operation within These frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz Radiated emission limits in these three bands are based on measurements employing an average detector

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

B.1.2 Test Procedure

Ref. C63.10-2013 section 6.5 & 6.6

Test Procedure
1. Using Vasona software, configure the spectrum analyzer as shown above (be sure to enter all losses between the transmitter output and the spectrum analyzer). 2. Place the radio in hopping on single channel transmit mode. Maximize Turntable (find worst case table angle) and maximize Antenna (find worst case height). 3. Use the peak marker function to determine the maximum amplitude level. 4. Center marker frequency and perform final measurement in Quasi-peak (≤ 1Ghz) and Average (above 1 GHz) 4. Record at least 6 highest readings for the worst case operating mode.

Ref. C63.10-2013 section 4 / CISPR16-1-1

Test Parameters
Span = Entire frequency range or segment if necessary. Reference Level = 80 dBuV RBW = 100 kHz (less than or equal to 1 GHz); 1 MHz (above 1 GHz) VBW ≥ 3 x RBW Detector = Peak & Quasi-Peak (frequency range 30 MHz to 1 GHz); Peak & Average (frequency range above 1 GHz); Changing VBW to 10 Hz for average measurement Sweep Time = Couple

. The system was evaluated up to 26 GHz but there were no measurable emissions above 18 GHz.
. These data represent the worst case mode data for all supported operating modes and antennas.

- For emissions below 1000 MHz, measurements shall be performed using a CISPR quasi-peak detector and the related measurement bandwidth. As an alternative to CISPR quasi-peak measurement, compliance with the emission limit can be demonstrated using measuring equipment employing a peak detector function properly adjusted for factors such as pulse desensitization as required, with an equal or greater measurement bandwidth relative to the applicable CISPR quasi-peak bandwidth.
- Above 1000 MHz, measurements shall be performed using an average detector with a minimum Resolution bandwidth of 1 MHz

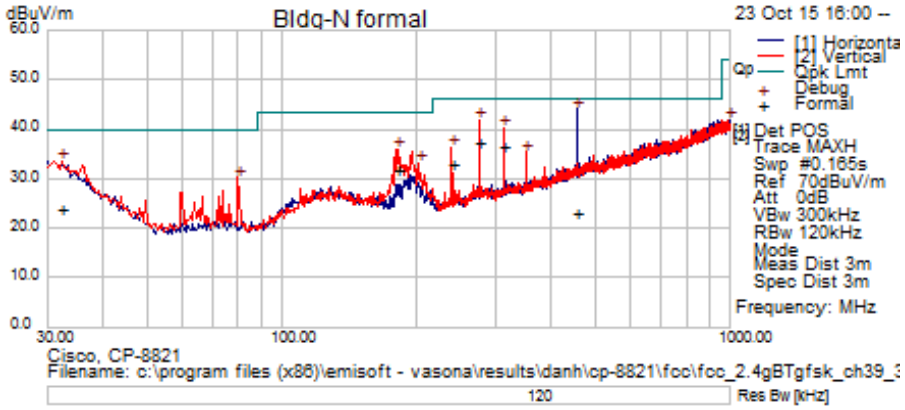
Note1: A Notch Filter was used during formal testing from 1 – 18GHz to help prevent the front end of the analyzer from over loading. The Notch filters used are designed to suppress TX fundamental frequency but do not effect harmonics of the fundamental frequency from being measured

Note2: The data displayed on the plots detailed in this appendix were measured using a 'Peak Detector'. Please refer to the results table for the detectors used during formal measurements

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

B.1.3 Transmitter Radiated Spurious Emissions Graphical Data Results

Subtest Date:	23-Oct-2015
Engineer	Danh Le
Lab Information	Building N, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	30MHz-1GHz
Comments on the above Test Results	GFSK/DH3, Tx Channel 39 (2441 MHz)

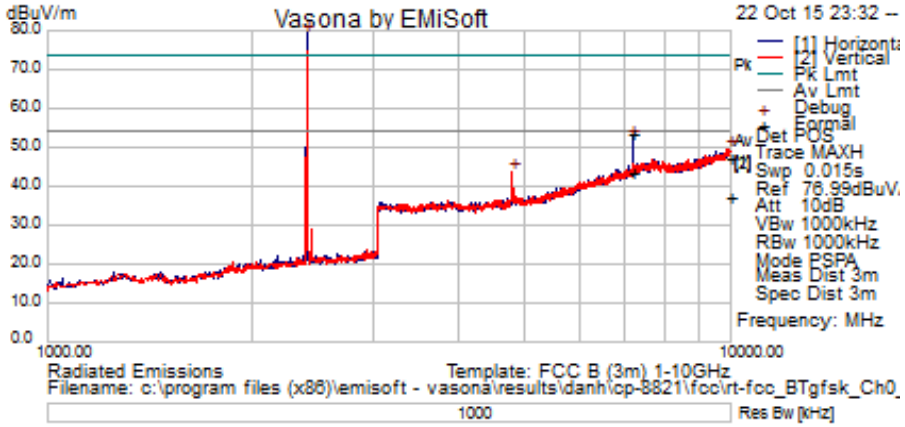


Title: **TX Spurious Emissions from 30MHz-1GHz – Ch39 (2441 MHz)**

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
276.4628	22.13	2.11	13.3	37.54	Quasi Max	V	103	0	46	-8.46	Pass	Tx/Ch39
32.295	4.13	0.73	19.13	23.99	Quasi Max	V	192	14	40	-16.01	Pass	Tx/Ch39
313.3443	20.74	2.25	13.77	36.76	Quasi Max	V	112	23	46	-9.24	Pass	Tx/Ch39
239.6205	19.17	1.96	11.78	32.91	Quasi Max	V	127	174	46	-13.09	Pass	Tx/Ch39
180.3115	19.29	1.7	10.9	31.89	Quasi Max	V	137	300	43.5	-11.61	Pass	Tx/Ch39
456.38	3.45	2.73	16.93	23.11	Quasi Max	H	326	330	46	-22.89	Pass	Tx/Ch39

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

Subtest Date:	22-Oct-2015
Engineer	Danh Le
Lab Information	Building N, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	1-10GHz
Comments on the above Test Results	GFSK/DH3, Tx Channel 1 (2402 MHz)

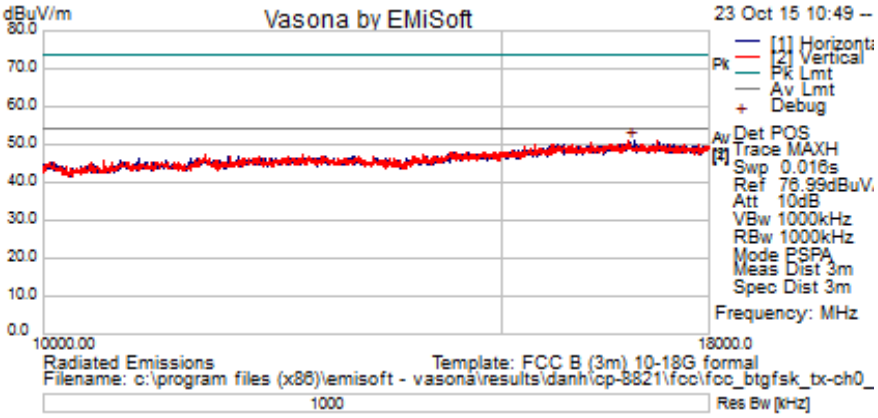


Title: **TX Spurious Emissions from 1-10GHz – Ch1 (2402 MHz)**

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
2400.625	84.3	6.5	-11.3	79.4	Peak	H	175	342	54.0	25.4	N/A	Fundamental
7206.323	47.07	11.95	-5.61	53.41	Peak	H	172	6	74	-20.59	Pass	Tx/Ch1
9977.678	35.54	14.51	-2.62	47.44	Peak	V	316	84	74	-26.56	Pass	Tx/Ch1
7206.323	37.41	11.95	-5.61	43.75	Average	H	172	6	54	-10.25	Pass	Tx/Ch1
9977.678	25.13	14.51	-2.62	37.03	Average	V	316	84	54	-16.97	Pass	Tx/Ch1

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

Subtest Date:	22-Oct-2015
Engineer	Danh Le
Lab Information	Building N, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	10-18GHz
Comments on the above Test Results	GFSK/DH3, Tx Channel 1 (2402 MHz)

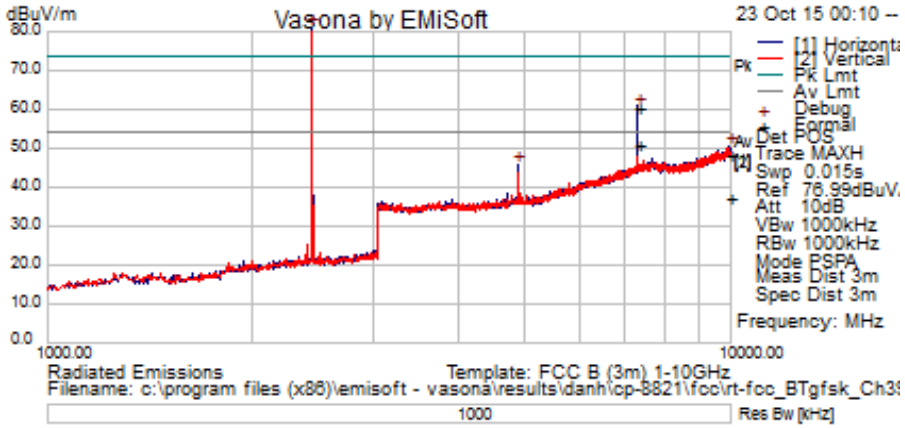


Title: **TX Spurious Emissions from 10-18GHz – Ch1 (2402 MHz)**

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
16780	43.72	19.61	-12.18	51.15	Peak	V	275	286	54	-2.85	Pass	Tx/Ch1

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

Subtest Date:	23-Oct-2015
Engineer	Danh Le
Lab Information	Building N, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	1-10GHz
Comments on the above Test Results	GFSK/DH3, Tx Channel 39 (2441 MHz)

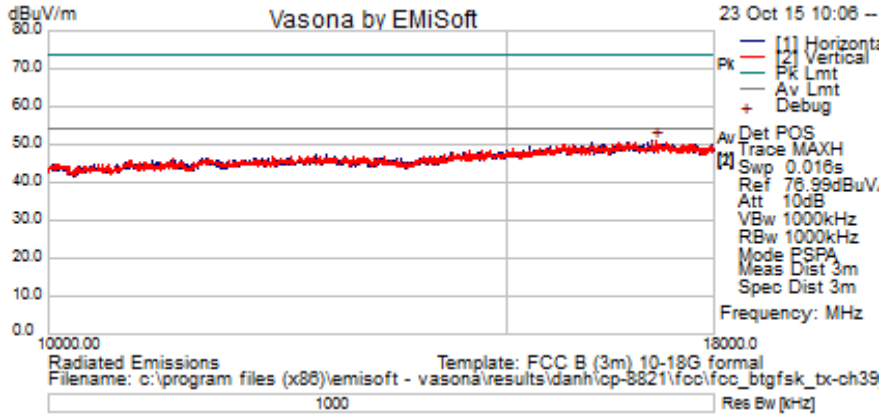


Title: **TX Spurious Emissions from 1-10GHz – Ch39 (2441 MHz)**

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
2440.000	85.7	6.6	-11.1	81.1	Peak	H	125	8	54.0	27.1	N/A	Fundamental
7323.403	53.75	12.07	-5.24	60.59	Peak	H	147	9	74	-13.41	Pass	Tx/Ch39
9976.123	36.21	14.51	-2.62	48.1	Peak	H	361	344	74	-25.9	Pass	Tx/Ch39
7323.403	44.26	12.07	-5.24	51.09	Average	H	147	9	54	-2.91	Pass	Tx/Ch39
9976.123	25.19	14.51	-2.62	37.08	Average	H	361	344	54	-16.92	Pass	Tx/Ch39

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

Subtest Date:	23-Oct-2015
Engineer	Danh Le
Lab Information	Building N, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	10-18GHz
Comments on the above Test Results	GFSK/DH3, Tx Channel 39 (2441 MHz)

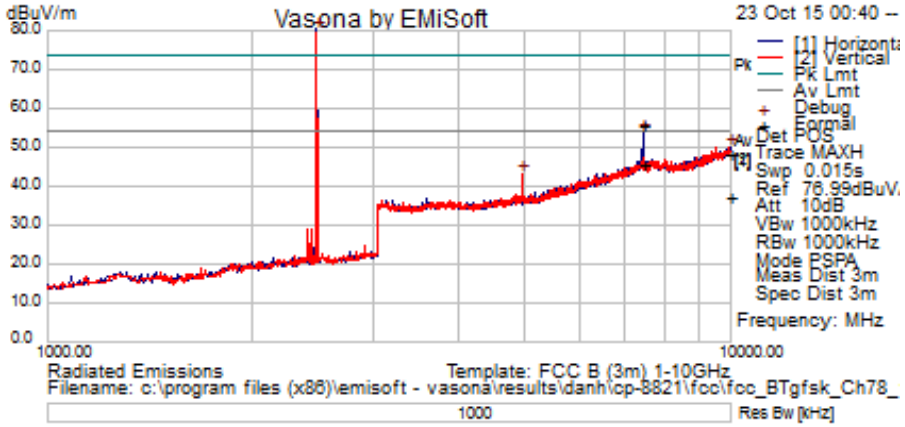


Title: **TX Spurious Emissions from 10-18GHz – Ch39 (2441 MHz)**

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
17095	43.95	19.78	-12.68	51.06	Peak	V	225	300	54	-2.94	Pass	Tx/Ch39

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

Subtest Date:	23-Oct-2015
Engineer	Danh Le
Lab Information	Building N, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	1-10GHz
Comments on the above Test Results	GFSK/DH3, Tx Channel 78 (2480 MHz)

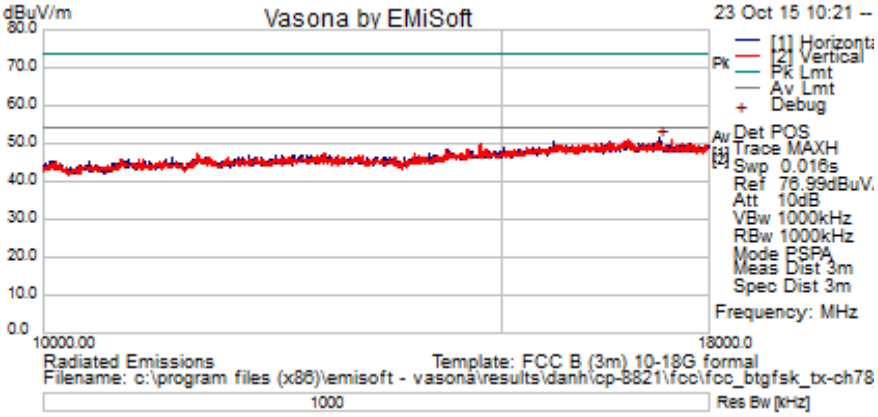


Title: **TX Spurious Emissions from 1-10GHz – Ch78 (2480 MHz)**

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
2479.375	84.8	6.6	-10.9	80.5	Peak	H	225	0	54.0	26.5	N/A	Fundamental
9989.805	36.22	14.53	-2.66	48.09	Peak	H	137	38	74	-25.91	Pass	Tx/Ch78
7439.55	48.59	12.21	-5.18	55.62	Peak	H	296	186	74	-18.38	Pass	Tx/Ch78
9989.805	25.2	14.53	-2.66	37.07	Average	H	137	38	54	-16.93	Pass	Tx/Ch78
7439.55	38.67	12.21	-5.18	45.7	Average	H	296	186	54	-8.3	Pass	Tx/Ch78

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

Subtest Date:	23-Oct-2015
Engineer	Danh Le
Lab Information	Building N, 5m Anechoic
Subtest Title	Transmitter Spurious Emissions
Frequency Range	10-18GHz
Comments on the above Test Results	GFSK/DH3, Tx Channel 78 (2480 MHz)



Title: **TX Spurious Emissions from 10-18GHz – Ch78 (2480 MHz)**

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
17250	43.95	19.96	-12.63	51.29	Peak	H	175	277	54	-2.71	Pass	Tx/Ch78

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

B.2 Receiver Spurious Emissions

Those emissions generated in receiver and radiated from the receiver either via the antenna path or via the control power, and audio cables that may be used with the receivers

RSS-GEN: Receivers are required to comply with the limits of spurious emissions as set out in this section. Receiver emission measurements are to be performed as per the normative test method referenced in Section 3.

B.2.1 Limits.

RSS-Gen Section 5.0 / 7.1: The receiver shall be operated in the normal receive mode near the mid-point of the band in which the receiver is designed to operate. And spurious emissions from the receivers shall not exceed the radiated limits shown in the table 2 in section 7.1.2 of RSS-Gen.

For either method, the search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator frequency, intermediate or carrier frequency), or 30 MHz, whichever is higher, to at least 3 times the highest turntable or local oscillator frequency whichever is higher, without exceeding 40 GHz.

For emissions below 1000 MHz, measurements shall be performed using a CISPR quasi-peak detector and the related measurement bandwidth. Above 1000 MHz, measurements shall be performed using an average detector with a minimum resolution bandwidth of 1 MHz.

As an alternative to CISPR quasi-peak measurement, compliance with the emission limit can be demonstrated using measuring equipment employing a peak detector function properly adjusted for factors such as pulse desensitization as required, with an equal or greater than the applicable CISPR quasi-peak bandwidth or 1 MHz bandwidth, respectively.

Table 2: Radiated Limits of Receiver Spurious Emissions

Frequency (MHz)	Field strength (uV/meter)*	Field strength (dBuV/meter)	Measurement distance (meters)
30-88	100	40 Qp	3
88-216	150	43.5 Qp	3
216-960	200	46 Qp	3
Above 960	500	54 Av / 74 Pk	3

*Measurements for compliance with limits in the above table may be performed at distances other than 3 metres, in accordance with Section 6.5.

This report represents the worst case data for all supported operating modes and antennas. There are no measurable emissions above 18 GHz.

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

B.2.2 Test Procedure

Ref. ANSI C63.10-2013 section 6.5 & 6.6

Test Procedure
1. Set the EUT in receiver mode. 2. Using Vasona software, configure the spectrum analyzer as shown above (be sure to enter all losses between the transmitter output and the spectrum analyzer). 3. Place the radio in receiver mode. Maximize Turntable (find worst case table angle) and maximize Antenna (find worst case height). 4. Use the peak marker function to determine the maximum amplitude level. 5. Center marker frequency and perform final measurement in Quasi-peak (below 1Ghz) and Average (above 1 GHz) 6. Record at least 6 highest readings for the worst case operating mode.

ANSI C63.10: 2013 section 4.1.4 (Quasi-Peak) / section 12.7.6 (peak), section 12.7.5, section 12.7.7.3 (VBW average),

Test parameters
(i) Span = Entire frequency range or segment if necessary. (ii) Reference Level = 80 dBuV (iii) RBW = 100 kHz (less than or equal to 1 GHz); 1 MHz (above 1 GHz) (iv) VBW ≥ 3 x RBW (v) Detector = Peak & Quasi-Peak (frequency range 30 MHz to 1 GHz); Peak & Average (frequency range above 1 GHz); Change VBW to 10 Hz for average measurement (vi) Sweep Time = Couple

. The system was evaluated up to 40 GHz but there were no measurable emissions above 18 GHz.
. These data represent the worst case mode data for all supported operating modes and antennas.

- For emissions below 1000 MHz, measurements shall be performed using a CISPR quasi-peak detector and the related measurement bandwidth. As an alternative to CISPR quasi-peak measurement, compliance with the emission limit can be demonstrated using measuring equipment employing a peak detector function properly adjusted for factors such as pulse desensitization as required, with an equal or greater measurement bandwidth relative to the applicable CISPR quasi-peak bandwidth.
- Above 1000 MHz, measurements shall be performed using an average detector with a minimum Resolution bandwidth of 1 MHz

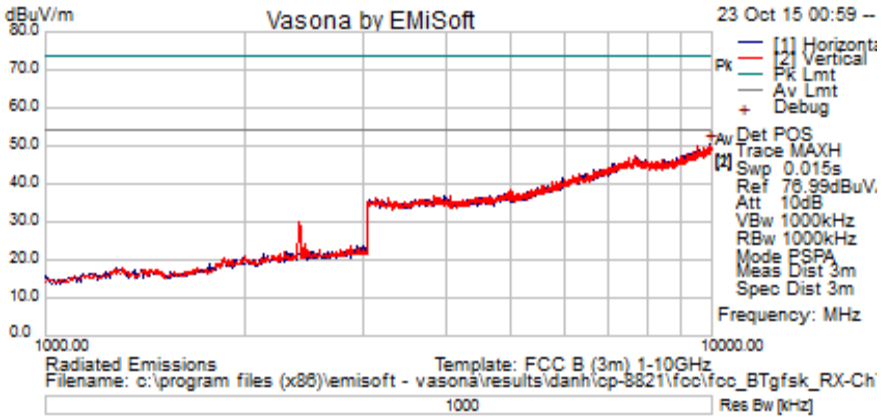
Note1: A Notch Filter was used during formal testing from 1 – 18GHz to help prevent the front end of the analyzer from over loading. The Notch filters used are designed to suppress TX fundamental frequency but do not effect harmonics of the fundamental frequency from being measured

Note2: The data displayed on the plots detailed in the graphical test results section were measured using a 'Peak Detector'. Please refer to the results table for the detectors used during formal measurements.

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

B.2.3 Receiver Spurious Emissions Graphical Data Results

Subtest Date:	23-Oct-2015
Engineer	Danh Le
Lab Information	Building N, 5m Anechoic
Subtest Title	Receiver Spurious Emissions
Frequency Range	1-10GHz
Comments on the above Test Results	Receiver mode

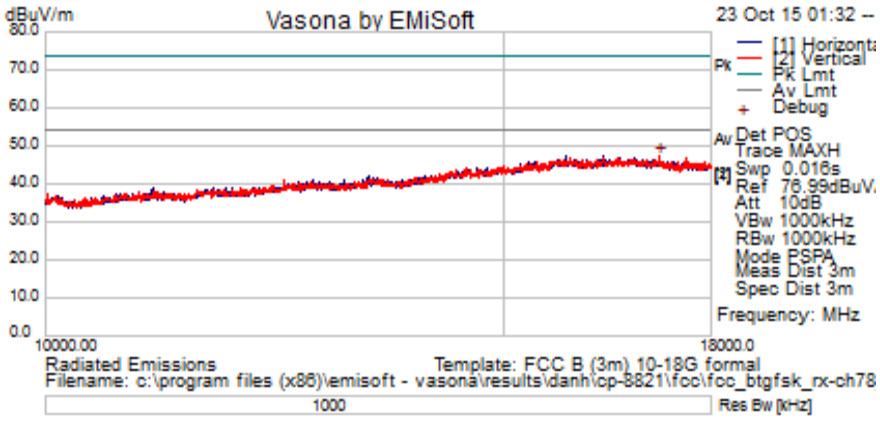


Title: **RX Spurious Emissions from 1-10GHz**

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
9943.75	38.75	14.48	-2.71	50.52	Peak	H	200	23	54	-3.48	Pass	Rx mode

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

Subtest Date:	23-Oct-2015
Engineer	Danh Le
Lab Information	Building N, 5m Anechoic
Subtest Title	Receiver Spurious Emissions
Frequency Range	10-18GHz
Comments on the above Test Results	Receiver mode



Title: **RX Spurious Emissions from 10-18GHz**

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	AF (dB)	Level (dBuV)	Detector	Polarity	Height (cm)	Azt (Deg)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
17195	40.37	19.8	-12.69	47.49	Peak	V	175	248	54	-6.51	Pass	Rx mode

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

B.3 AC Power Line Conducted Emissions

FCC 15.207 (a)

Except when the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply, either directly or indirectly (such as with a battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in the table in these sections. The more stringent limit applies at the frequency range boundaries.

RSS-Gen 8.8 Issue 4

B.3.1 Limits.

FCC 15.207

Except when the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply, either directly or indirectly (such as with a battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in the table in these sections. The more stringent limit applies at the frequency range boundaries.

RSS-Gen 8.8 Issue 4

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz-30 MHz, shall not exceed the limits in Table 3.

Unless the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply either directly or indirectly (such as with a battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in Table 3 below. The more stringent limit applies at the frequency range boundaries.

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

B.3.2 Test Procedure

Measurement requirements
Ref: C63.10:2013, section 6.2.2

Measured levels of ac power-line conducted emission shall be the emission voltages from the voltage probe or across the 50 Ω LISN port (to which the EUT is connected), where permitted, terminated into a 50 Ω measuring instrument, or where permitted or required, the emission currents on the power line sensed by a current probe. All emission voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord by the use of mating plugs and receptacles on the LISN, if used. Equipment shall be tested with power cords that are normally supplied or recommended by the
manufacturer, and that have electrical and shielding characteristics that are the same as those cords normally supplied or recommended by the manufacturer. For those measurements, using a LISN, the 50 Ω measuring port is terminated by a measuring instrument having a 50 Ω input impedance. All other ports are terminated in 50 Ω loads. Figure 5, Figure 6, and Figure 7 show typical test setups for ac power-line conducted emissions testing (see 6.13). For information about the use of a RF-shielded (screen) room, vertical conducting plane and voltage probe, see ANSI C63.4.

Tabletop devices shall be placed on a platform of nominal size, 1 m by 1.5 m, raised 80 cm above thereference ground plane. The vertical conducting plane or wall of an RF-shielded (screen) room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on the reference ground-plane or on insulating material as described in ANSI C63.4. All other surfaces of tabletop or floor standing EUTs shall be at least 80 cm from any other grounded conducting surface, including the case or cases of one or more LISNs.

Final ac power-line conducted emission measurements
Ref: C63.10:2013, section 6.2.5

Based on the exploratory tests of the EUT performed in 6.2.4, the one EUT cable configuration and arrangement and mode of operation that produced the emission with the highest amplitude relative to the limit is selected for the final measurement, while applying the appropriate modulating signal to the EUT. If the EUT is relocated from an exploratory test site to a final test site, the highest emissions shall be remaximized at the final test location before final ac power-line conducted emission measurements are
performed. The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment in the system) is then performed for the full frequency range for which the EUT is being tested for compliance without further variation of the EUT arrangement, cable positions, or EUT mode of operation. If the EUT is comprised of equipment units that have their own separate ac power connections, e.g., floor-standing equipment with independent power cords for each shelf that are able to connect directly to the ac power network, each
current-carrying conductor of one unit is measured while the other units are connected to a second (or more) LISN(s). All units shall be separately measured. If a power strip is provided by the manufacturer, to supply all of the units making up the EUT, only the conductors in the power cord of the power strip shall be measured.

Record the six highest EUT emissions relative to the limit of each of the current-carrying conductors of the power cords of the equipment that comprises the EUT over the frequency range specified by the procuring or regulatory agency. Diagram or photograph the test setup that was used. See Clause 8 for full reporting requirements.

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

Ref. C63.10:2013, section 6.2

Test Procedure
1. Using Vasona software, configure the spectrum analyzer as shown above (be sure to enter all losses between the transmitter output and the spectrum analyzer). 2. Set the radio in a hopping on single channel transmit mode. 3. Connect cable end to LISN Hot port and other cable end to the spectrum Analyzer/EMC receiver RF input port. Terminate the LISN neutral port with a 50 Ω impedance terminator. 4. Sweep the frequency range from 150 kHz to 30 MHz (segment if necessary) 5. Use the peak marker function to determine the maximum amplitude level. 6. Center marker frequency and perform final measurement using applicable detector (Quasi-Pk/Average). 7. Record at least 6 highest reading for the worst case operating modes in Quasi-peak/Average. 8. Repeat the test on Neutral lead. 9. Repeat step 3 – 7 with the radio sets in the Receiver mode. 10. Record at least 6 highest reading in Quasi-peak/Average

Ref. C63.10:2013, section 4 / CISPR16-1-1

Test Parameters
Span = Entire frequency range or segment if necessary. Reference Level = 70 dBuV RBW = 9 kHz VBW ≥ 3 x RBW Sweep Time = Couple Detector = Quasi-Peak & Average

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

B.3.3 Recorded Test Data and Graphical Test results

AC Conducted Emissions Test Result Tables for hopping on middle channel with GFSK/DH3 mode (Peak, Quasi-Peak & Average)

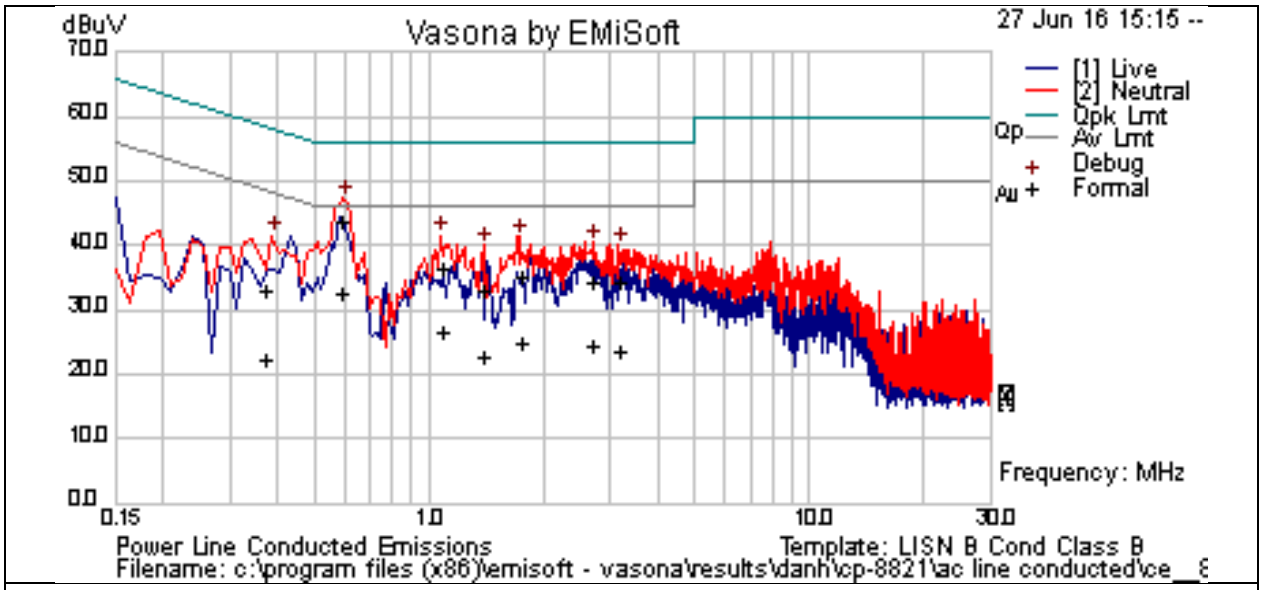
Subtest Date:	27-Jun-2016
Engineer	Danh Le
Lab Information	Building N, formal immunity room
Subtest Title	AC Conducted Emissions
Frequency Range	150 kHz - 30 MHz
Comments on the above Test Results	Hopping on Ch39 (2441 MHz) with GFSK modulation / DH3 packet type – 1 Mbps

Frequency (MHz)	Raw (dBuV)	Cab Loss (dB)	Factors (dB)	Level (dBuV)	Detector	Lines (Live/Neutral)	Limit (dBuV)	Margin (dB)	Results Pass / Fail	Comments
0.59235	23.69	20.04	0.04	43.77	Quasi Peak	Neutral	56	-12.23	Pass	TX / Ch39
1.089714	16.27	20.01	0.04	36.31	Quasi Peak	Neutral	56	-19.69	Pass	TX / Ch39
1.738098	15.05	19.99	0.05	35.09	Quasi Peak	Neutral	56	-20.91	Pass	TX / Ch39
2.693913	14.49	19.99	0.05	34.53	Quasi Peak	Neutral	56	-21.47	Pass	TX / Ch39
1.380747	13.18	19.99	0.05	33.21	Quasi Peak	Neutral	56	-22.79	Pass	TX / Ch39
3.150141	14.09	20.01	0.05	34.15	Quasi Peak	Neutral	56	-21.85	Pass	TX / Ch39
0.370854	12.77	20.23	0.04	33.05	Quasi Peak	Neutral	58.48	-25.43	Pass	TX / Ch39
0.59235	12.72	20.04	0.04	32.8	Average	Neutral	46	-13.2	Pass	TX / Ch39
1.089714	6.74	20.01	0.04	26.79	Average	Neutral	46	-19.21	Pass	TX / Ch39
1.738098	4.73	19.99	0.05	24.77	Average	Neutral	46	-21.23	Pass	TX / Ch39
2.693913	4.6	19.99	0.05	24.64	Average	Neutral	46	-21.36	Pass	TX / Ch39
1.380747	2.66	19.99	0.05	22.7	Average	Neutral	46	-23.3	Pass	TX / Ch39
3.150141	3.68	20.01	0.05	23.74	Average	Neutral	46	-22.26	Pass	TX / Ch39
0.370854	2.17	20.23	0.04	22.45	Average	Neutral	48.48	-26.03	Pass	TX / Ch39

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

AC Conducted Graphical Test Results for GFSK/DH3 Mode:

Note: The data displayed on the plots detailed in this section were measured using a 'Peak Detector'. Please refer to the results table for the detectors used during final measurements.



Title: **TX Conducted Emissions from 150kHz – 30MHz – Ch6 (2437 MHz) - Peak**

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

Appendix C: List of Test Equipment Used to perform the test

Equip#	Manufacturer/ Model	Description	Last Cal	Next Due
CIS004882	EMC Test Systems / 3115	Double Ridged Guide Horn Antenna	19-AUG-15	19-Aug-16
CIS041944	Sunol Sciences / JB1	Combination Bi-Log Antenna, 30MHz-2GHz	21-JUL-15	21-JUL-16
CIS18313	HP / 8447D OPT 011	Dual Amplifier (0.1 – 13000 MHz)	28-APR-15	28-APR-16
CIS005691	Miteq / NSP1800-25-S1	Broadband Preamplifier (1-18GHz)	26-JUN-15	25-JUN-16
CIS39123	Cisco / THO118	Broadband Preamplifier (1-18GHz)	31-MAR-15	31-MAR-16
CIS008100	Cisco / NSA 5m Chamber	NSA 5m Chamber	26-AUG-15	26-AUG-16
CIS024905	Agilent / E4440A	Precision Spectrum Analyzer	25-SEP-15	25-SEP-16
CIS035624	Rohde & Schwarz / ESCI	EMI Test Receiver	04-JUN-15	04-JUN-16
CIS44907	Rohde & Schwarz / ESCI	EMI Test Receiver	14-AUG-15	14-AUG-16
CIS08191	Fisher Custom Comm / FCC-450B-2.4-N	Pulse Limiter	07-JUL-15	07-JUL-16
CIS019208	TTE / H785-150K-50-21378	High Pass Filter 150KHz	09-DEC-15	09-DEC-16
CIS006565	Fisher Custom Com / 50/250-50-2-02	LISN (9kHz-30MHz)	03-MAR-16	03-MAR-17
CIS023911	Fisher Custom Com / 50-2-RA-NEMA-5-20R	LISN Receptacle Adaptor	03-MAR-16	03-MAR-17
CIS008531	Huber + Suhner / RG-223	25 ft RG-223 Cable	10-NOV-15	10-NOV-16
CIS051784	Huber+Suhner / Sucoflex 106PA	RF Coaxial Cable, up to 18GHz	06-JAN-15	06-JAN-16
CIS023697	Micro-Coax / UFB197C-1-3144-504504	RF Coaxial Cable, up to 18GHz, 314.4 in	06-JAN-15	06-JAN-16
CIS008023	Huber+Suhner /Sucoflex SF106A	3 meter Sucoflex cable	06-JAN-15	06-JAN-16
CIS006697	Lufft / 5063-33W	Temperature/Humidity Gauge	09-MAR-15	09-MAR-16
CIS054416	Huber + Suhner/ Sucoflex 106PA	Sucoflex N Type Blue 3ft cable	28-APR-15	28-APR-16
CIS040503	Agilent Technologies / E4440A	Precision Spectrum Analyzer	10-JUN-15	10-JUN-16

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

Appendix D: Abbreviation Key and Definitions

The following table defines abbreviations used within this test report.

Abbreviation	Description	Abbreviation	Description
EMC	Electro Magnetic Compatibility	°F	Degrees Fahrenheit
EMI	Electro Magnetic Interference	°C	Degrees Celsius
EUT	Equipment Under Test	Temp	Temperature
ITE	Information Technology Equipment	S/N	Serial Number
TAP	Test Assessment Schedule	Qty	Quantity
ESD	Electro Static Discharge	Emf	Electromotive force
EFT	Electric Fast Transient	RMS	Root mean square
EDCS	Engineering Document Control System	Qp	Quasi Peak
Config	Configuration	Av	Average
CIS#	Cisco Number (unique identification number for Cisco test equipment)	Pk	Peak
Cal	Calibration	kHz	Kilohertz ($1x10^3$)
EN	European Norm	MHz	MegaHertz ($1x10^6$)
IEC	International Electro technical Commission	GHz	Gigahertz ($1x10^9$)
CISPR	International Special Committee on Radio Interference	H	Horizontal
CDN	Coupling/Decoupling Network	V	Vertical
LISN	Line Impedance Stabilization Network	dB	decibel
PE	Protective Earth	V	Volt
GND	Ground	kV	Kilovolt ($1x10^3$)
L1	Line 1	µV	Microvolt ($1x10^{-6}$)
L2	Line2	A	Amp
L3	Line 3	µA	Micro Amp ($1x10^{-6}$)
DC	Direct Current	mS	Milli Second ($1x10^{-3}$)
RAW	Uncorrected measurement value, as indicated by the measuring device	µS	Micro Second ($1x10^{-6}$)
RF	Radio Frequency	µS	Micro Second ($1x10^{-6}$)
SLCE	Signal Line Conducted Emissions	M	Meter
Meas dist	Measurement distance	Spec dist	Specification distance
N/A or NA	Not Applicable	SL	Signal Line (or Telecom Line)
P	Power Line	L	Live Line
N	Neutral Line	R	Return
S	Supply	AC	Alternating Current

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

Appendix E: Software Used to Perform Testing

EMIsoft Vasona, version 6.024

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

Appendix F: Test Procedures

Measurements were made in accordance with

- ANSI C63.10:2013 Procedure for Compliance Testing of Unlicensed Wireless Devices
- RSS Gen Issue 4 General requirements for Compliance of Radio Apparatus
- Public Notice DA Public notice DA-00 705

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

Appendix G: Scope of Accreditation (A2LA certificate number 1178-01)

The scope of accreditation of Cisco Systems, Inc. can be found on the A2LA web page at:

http://www.a2la.org/scopepdf/1178-01.pdf

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential

Appendix H: Test Assessment Plan

Compliance Test Plan (Excel) EDCS#-1534002
Target Power Tables EDCS#-882940

Appendix I: Worst Case Justification

Worst case modes were selected by ANSI C63.10 2013 Section **5.6.2.2**

For devices with multiple operating modes, measurements on the middle channel can be used to determine the worst-case mode(s). The worst-case modes are as follows:

a) Band edge requirements—Measurements on the mode with the widest bandwidth can be used to cover the same channel (center frequency) on modes with narrower bandwidth that have the same or lower output power for each modulation family (e.g., OFDM and direct sequence spread spectrum).

b) Spurious emissions—Measure the mode with the highest output power and the mode with the highest output power spectral density for each modulation family (e.g., OFDM and direct sequence spread spectrum).

c) In-band PSD—Measurements on the mode with the narrowest bandwidth can be used to cover all modes within the same modulation family of an equal or lower output power provided the result is less than 50% of the limit.

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
Cisco Systems, Inc. Company Confidential