REGULATORY COMPLIANCE REPORT

TITLE: FCC & IC Test Report for 15.247 & RSS-210 Frequency Hopping Device

AUTHOR: Jeff Gilbert

REV	CCO	DESCRIPTION OF CHANGE	DATE	APPROVALS	
A		INITIAL RELEASE		Engineering	Jeff Gilbert
				Engineering	Drew Rosenberg

REVISION HISTORY

				Engineering	
				Engineering	
				Engineering	

Test Data Summary

FCC 15.247 / IC RSS-210
Frequency Hopping Device, 908 – 924 MHz
FCC ID: EO9HHSRISM / **IC ID:** 864A-HHSRISM
Model Number:HHSR
OATS Registration Number: FCC 90716, IC 5615

Rule	Description	Max. Reading	Pass/Fail
Part 15.31(e)	Variation of Input Voltage - Conducted	N/A (battery device)	N/A
Part 15.207 / RSS-Gen 7.2.2	AC Powerline Conducted Emissions	N/A (battery device)	N/A
Part 15.247(a)(1) / RSS-210 A8.1(2)	Carrier Frequency Separation	200 kHz	Pass
Part 15.247(a)(1)(i) / RSS-210 A8.1(3)	Number of Hopping Channels	80	Pass
Part 15.247(a)(1)(i) / RSS-210 A8.1(3)	20 dB Bandwidth	167.5 kHz	Pass
Part 15.247(b) (2) / RSS-210 A8.4(1)	RF Power Output - Conducted	-32.72 dBm	Pass
Part 15.247(d) / RSS-210 A8.5	Spurious Emissions - Conducted	28.81 dBc	Pass
Part 15.247(a)(1)(i) / RSS-210 A8.1(3)	Time of Occupancy	11.82 mS	Pass
Parts 15.205 & 15.209 / RSS-210 2.2, 2.6 Tables 1 & 2	Restricted Bands / Spurious Emissions - Radiated	3.81 dB margin @ 3632 MHz	Pass
RSS-210 Gen 7.2.3	Receiver Spurious Emissions	42.93dbuV/m @ 852 MHz	Pass

Rule versions: FCC Part 1 (08-2006), FCC Part 2 (08-2006), FCC Part 15 (08-2006), RSS-Gen Issue 1 (09-2005), RSS-210 Issue 6 (09-2005).
Reference docs: ANSI C63.4-2003, DA 00-705 (03-30-2000).

Cognizant Personnel	
Name Mark Kvamme	Title Test Technician
Name Jeff Gilbert	Title Regulatory Engineer
Name Drew Rosenberg	Title Project Lead

Peripheral Equipment

IBM Laptop; Model T40; s/n – 99-DAHBX
Itron Digital interface board
DVE AC/DC wall mount adapter (5Vdc); Model DSA-009F

15.31(e)

This is a modular approval. The module is intended to be integrated into other devices that are battery powered. For purposes of testing, the module was supplied with DC power via the Digital Interface board, which in turn was powered by the 5Vdc adapter.

15.247(a) (1) / RSS-210 A8.1 (2)

Carrier Frequency Separation

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Verify that the channel separation is > the 20dB bandwidth of a single transmission. The EUT must have its hopping function enabled. Use the following analyzer settings:

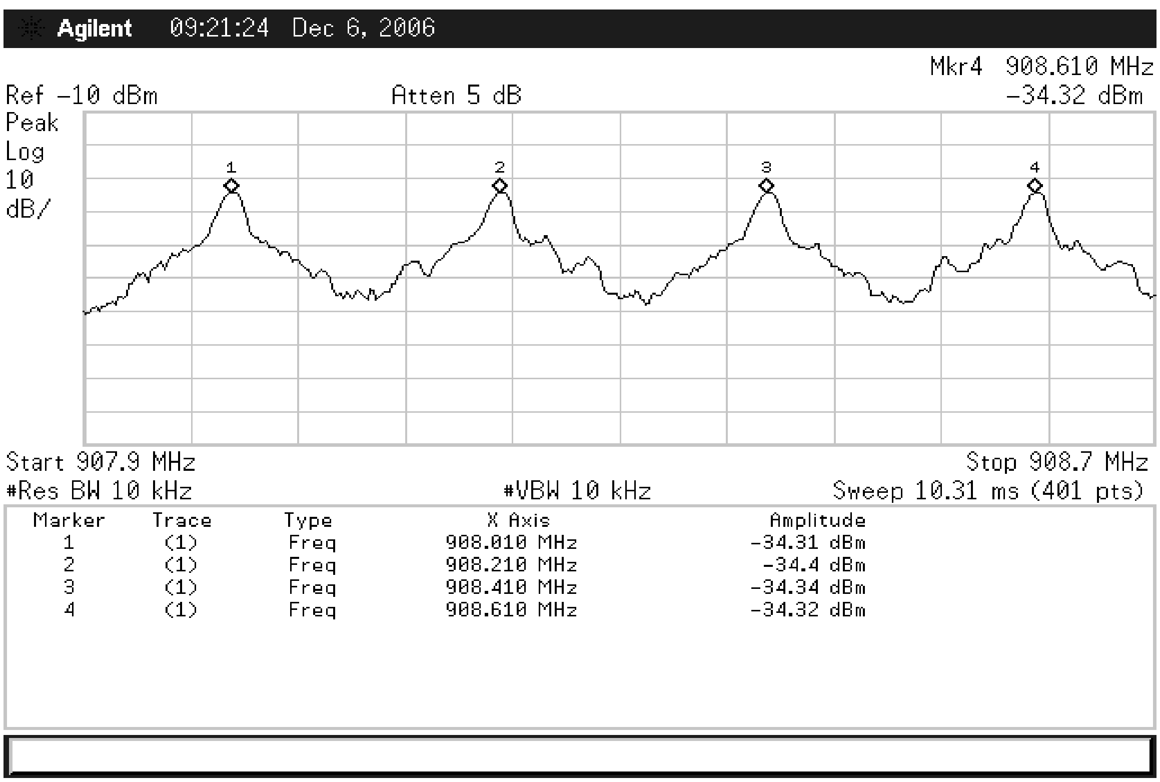
RBW ≥ 1% of the span
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

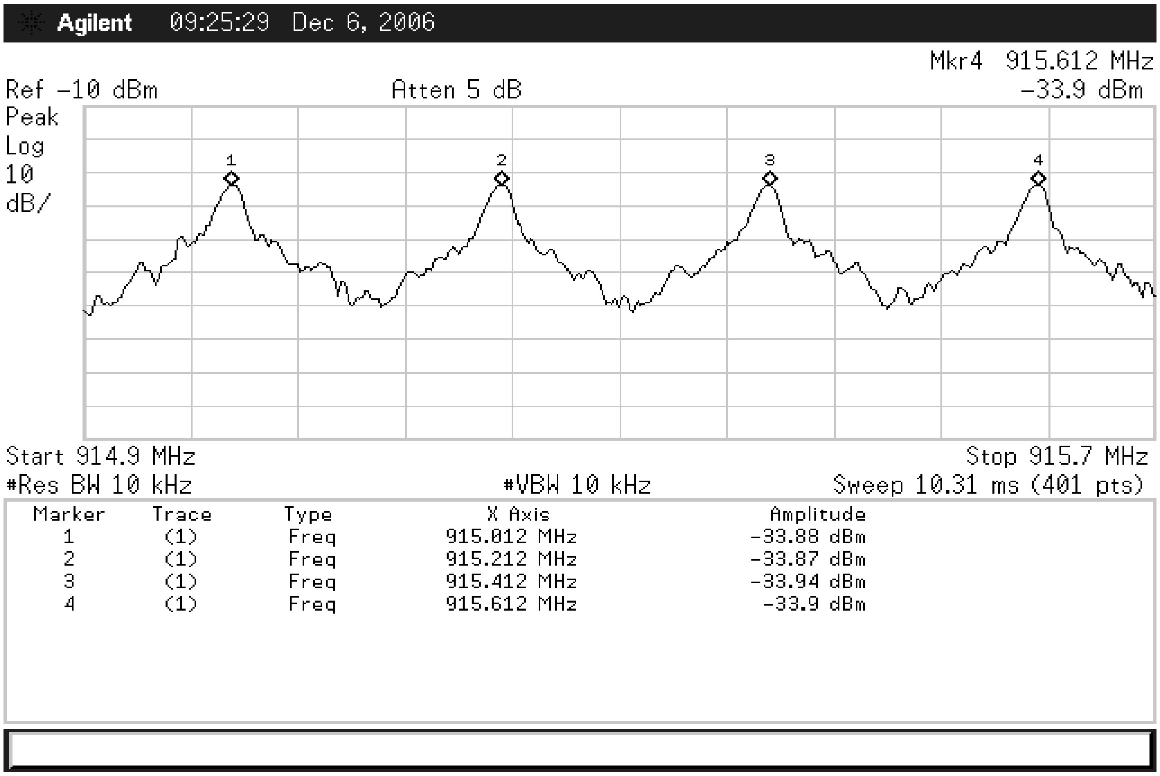
Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

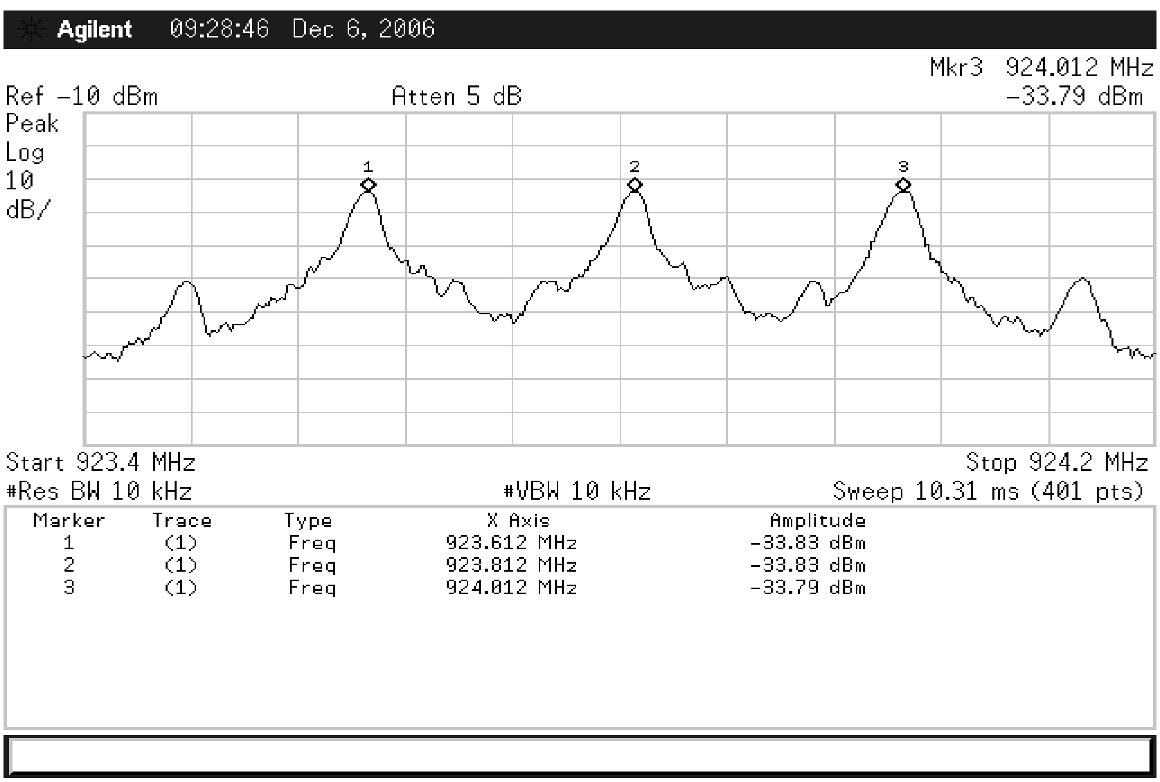
Equipment Used	Serial Number	Cal Date	Due
E4407B	MY45107856	07/14/06	07/14/07

Date	Tested by
12/6/06	Jeff Gilbert

Carrier separation is 200 kHz.




Agilent 09:25:29 Dec 6, 2006
Mkr4 915.612 MHz
Ref -10 dBm
Atten 5 dB
-33.9 dBm
Peak
Log
10
dB/
1
2
3
4
Start 914.9 MHz
Stop 915.7 MHz
#Res BW 10 kHz
#VBW 10 kHz
Sweep 10.31 ms (401 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 915.012 MHz -33.88 dBm
2 (1) Freq 915.212 MHz -33.87 dBm
3 (1) Freq 915.412 MHz -33.94 dBm
4 (1) Freq 915.612 MHz -33.9 dBm


Agilent 09:28:46 Dec 6, 2006
Mkr3 924.012 MHz
Ref -10 dBm
Atten 5 dB
-33.79 dBm
Peak
Log
10
dB/
1
2
3
Start 923.4 MHz
Stop 924.2 MHz
#Res BW 10 kHz
#VBW 10 kHz
Sweep 10.31 ms (401 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 923.612 MHz -33.83 dBm
2 (1) Freq 923.812 MHz -33.83 dBm
3 (1) Freq 924.012 MHz -33.79 dBm

15.247(a) (1) (i) / RSS-210 A8.1 (3)

Number of Hopping Channels

For frequency hopping systems operating in the 902-928 MHz band: If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies.

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

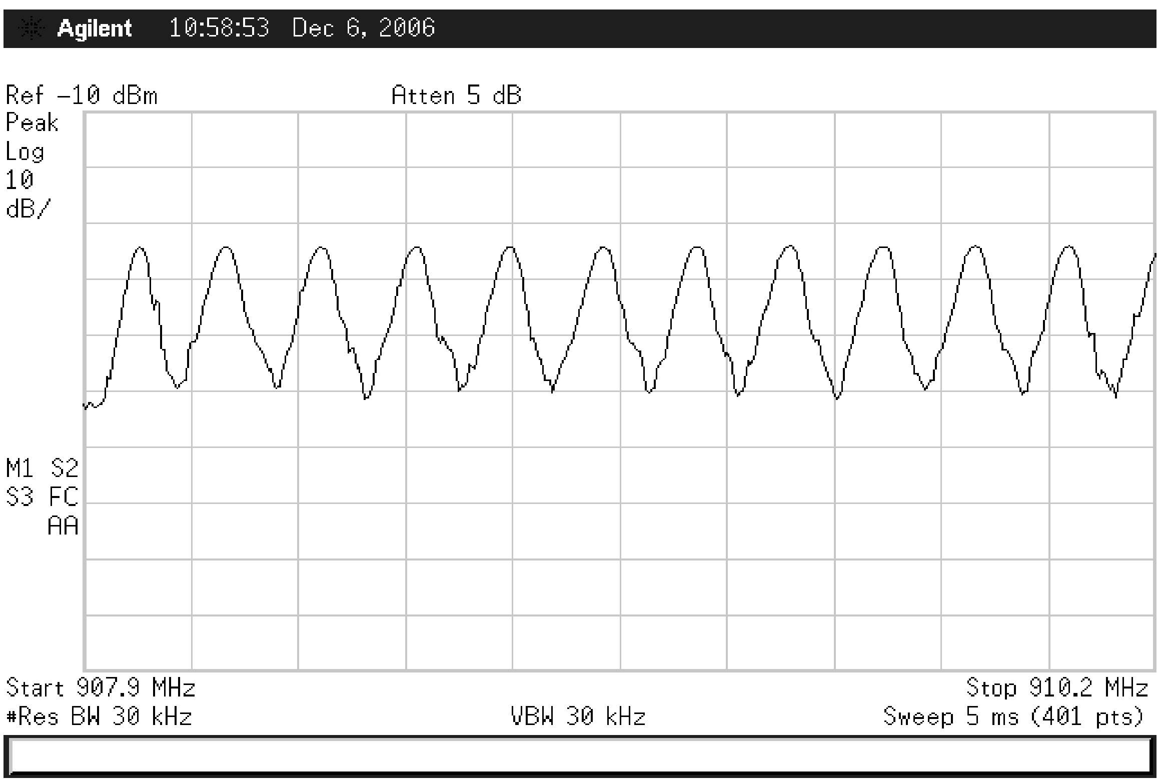
Span = the frequency band of operation
RBW ≥ 1% of the span
VBW ≥ RBW
Sweep = auto
Detector function = Peak
Trace = max hold

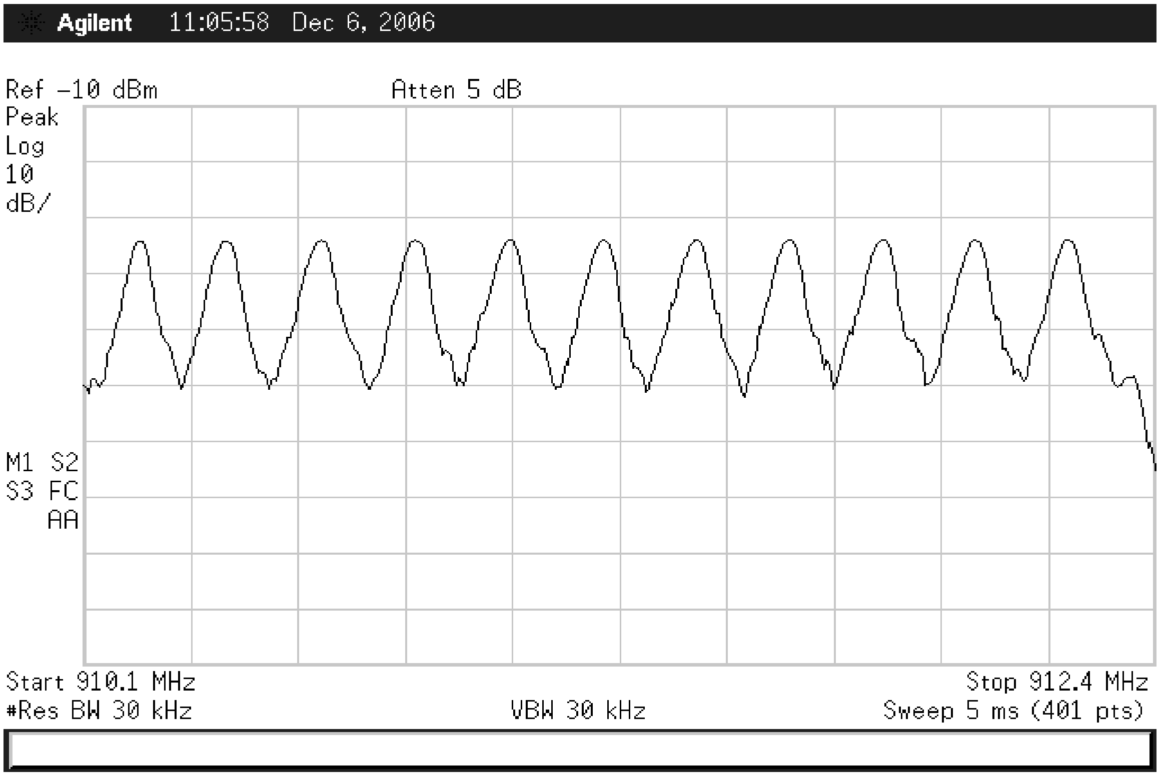
Allow the trace to stabilize. It may prove necessary to break the span up into sections, in order to clearly show all of the hopping frequencies.

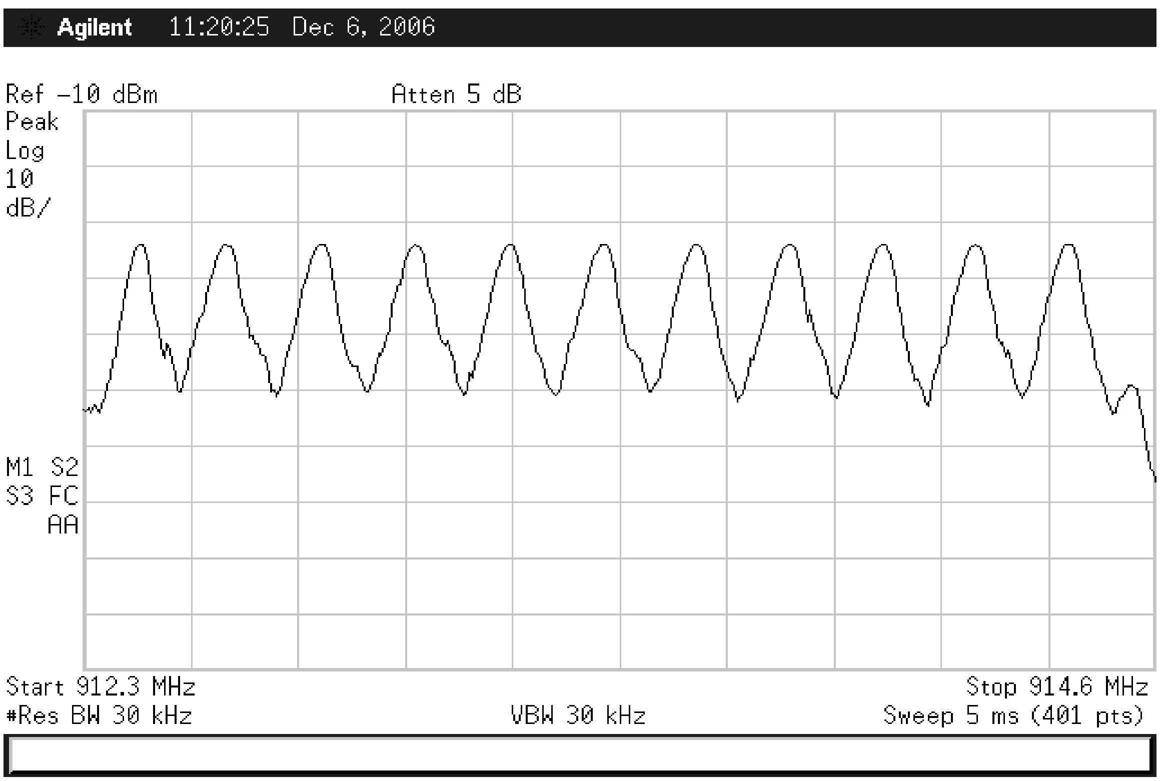
Equipment Used	Serial Number	Cal Date	Due
E4407B	MY45107856	07/14/06	07/14/07

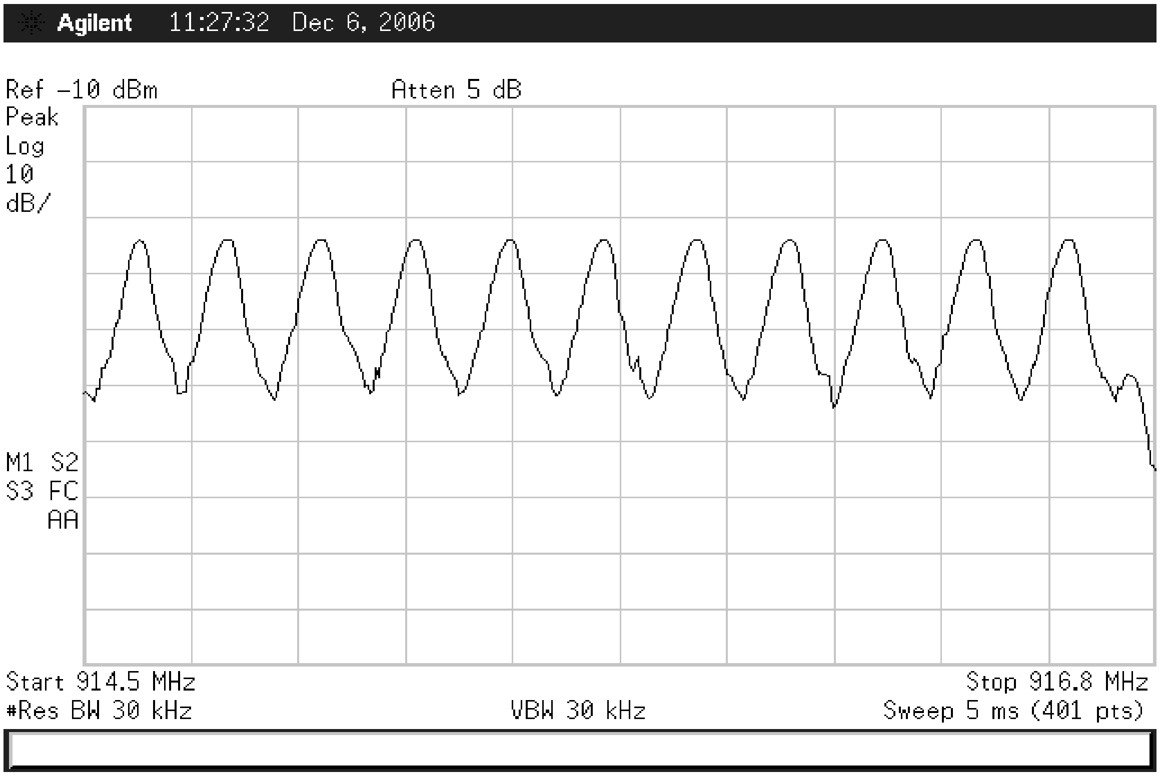
Date	Tested by
12/6/06	Jeff Gilbert

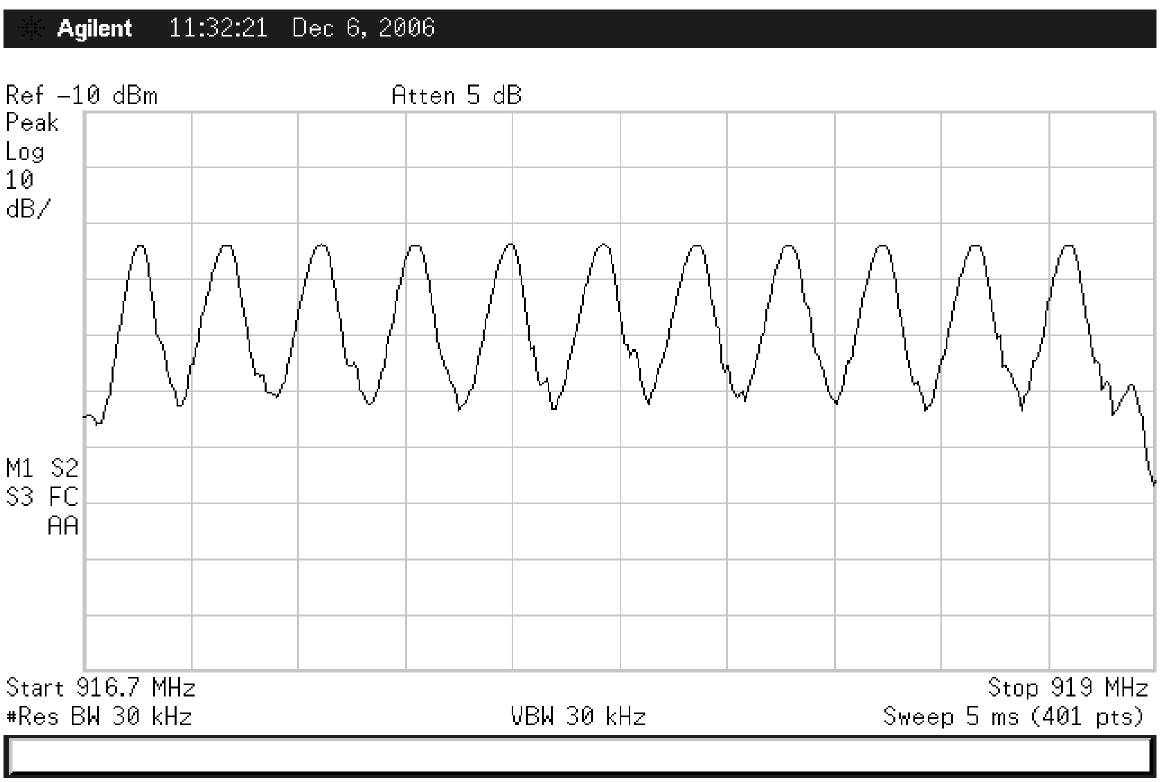
There are 80 channels.

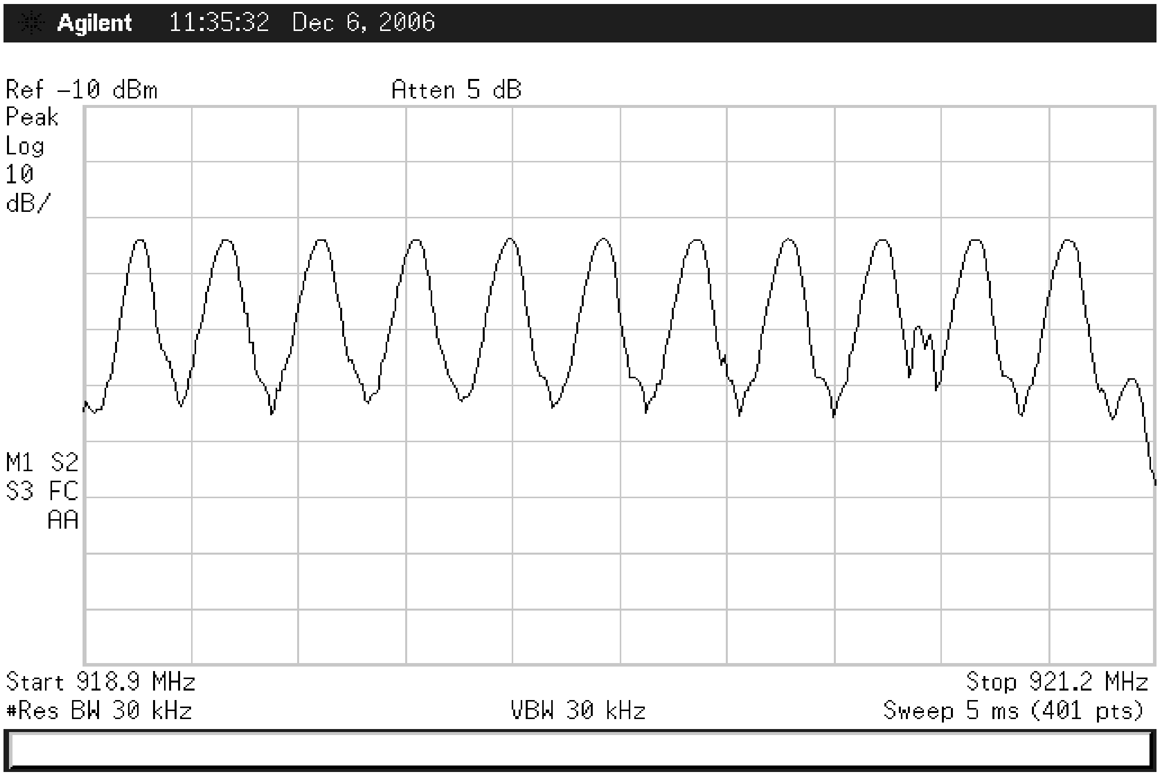


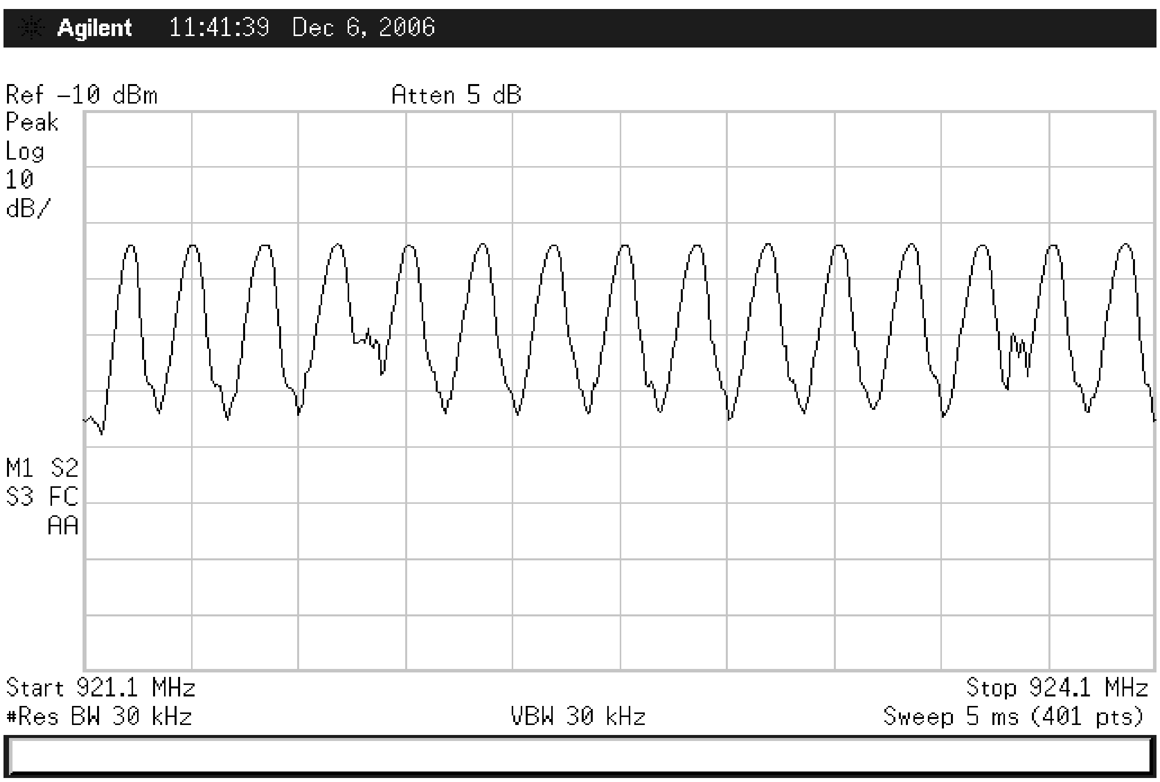

Agilent 11:05:58 Dec 6, 2006
Ref -10 dBm
Atten 5 dB
Peak
Log
10
dB/
M1 S2
S3 FC
AA
Start 910.1 MHz
Stop 912.4 MHz
#Res BW 30 kHz
VBW 30 kHz
Sweep 5 ms (401 pts)


Agilent 11:20:25 Dec 6, 2006
Ref -10 dBm
Atten 5 dB
Peak
Log
10
dB/
M1 S2
S3 FC
AA
Start 912.3 MHz
Stop 914.6 MHz
#Res BW 30 kHz
VBW 30 kHz
Sweep 5 ms (401 pts)


Agilent 11:27:32 Dec 6, 2006
Ref -10 dBm
Atten 5 dB
Peak
Log
10
dB/
M1 S2
S3 FC
AA
Start 914.5 MHz
Stop 916.8 MHz
#Res BW 30 kHz
VBW 30 kHz
Sweep 5 ms (401 pts)


Agilent 11:32:21 Dec 6, 2006
Ref -10 dBm
Atten 5 dB
Peak
Log
10
dB/
M1 S2
S3 FC
AA
Start 916.7 MHz
Stop 919 MHz
#Res BW 30 kHz
VBW 30 kHz
Sweep 5 ms (401 pts)


Agilent 11:35:32 Dec 6, 2006
Ref -10 dBm
Atten 5 dB
Peak
Log
10
dB/
M1 S2
S3 FC
AA
Start 918.9 MHz
Stop 921.2 MHz
#Res BW 30 kHz
VBW 30 kHz
Sweep 5 ms (401 pts)


Agilent 11:41:39 Dec 6, 2006
Ref -10 dBm
Atten 5 dB
Peak
Log
10
dB/
M1 S2
S3 FC
AA
Start 921.1 MHz
Stop 924.1 MHz
#Res BW 30 kHz
VBW 30 kHz
Sweep 5 ms (401 pts)

15.247(a) (1) (i) / RSS-210 A8.1 (3)

20 dB Bandwidth

Verify that the 20 dB bandwidth of the hopping channel is less than 200 kHz.

Use the following spectrum analyzer settings:

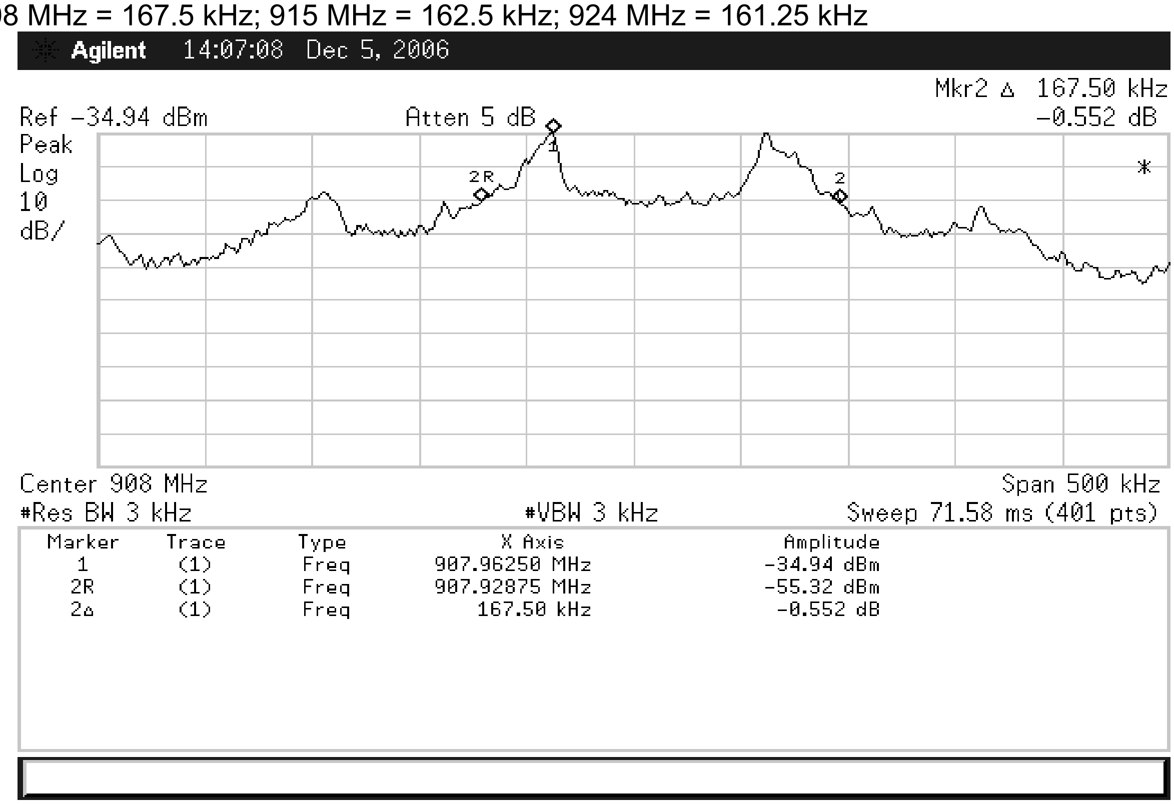
Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel.
RBW ≥ 1% of the 20 dB bandwidth
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

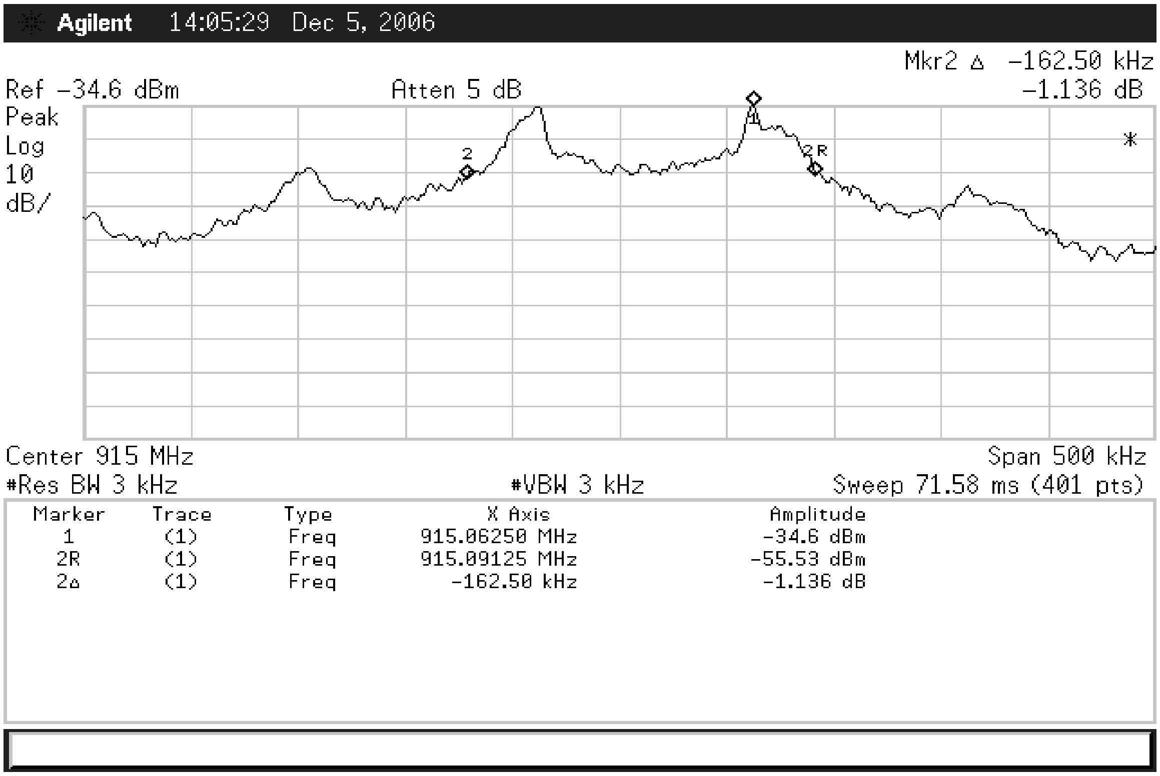
The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the mission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation.

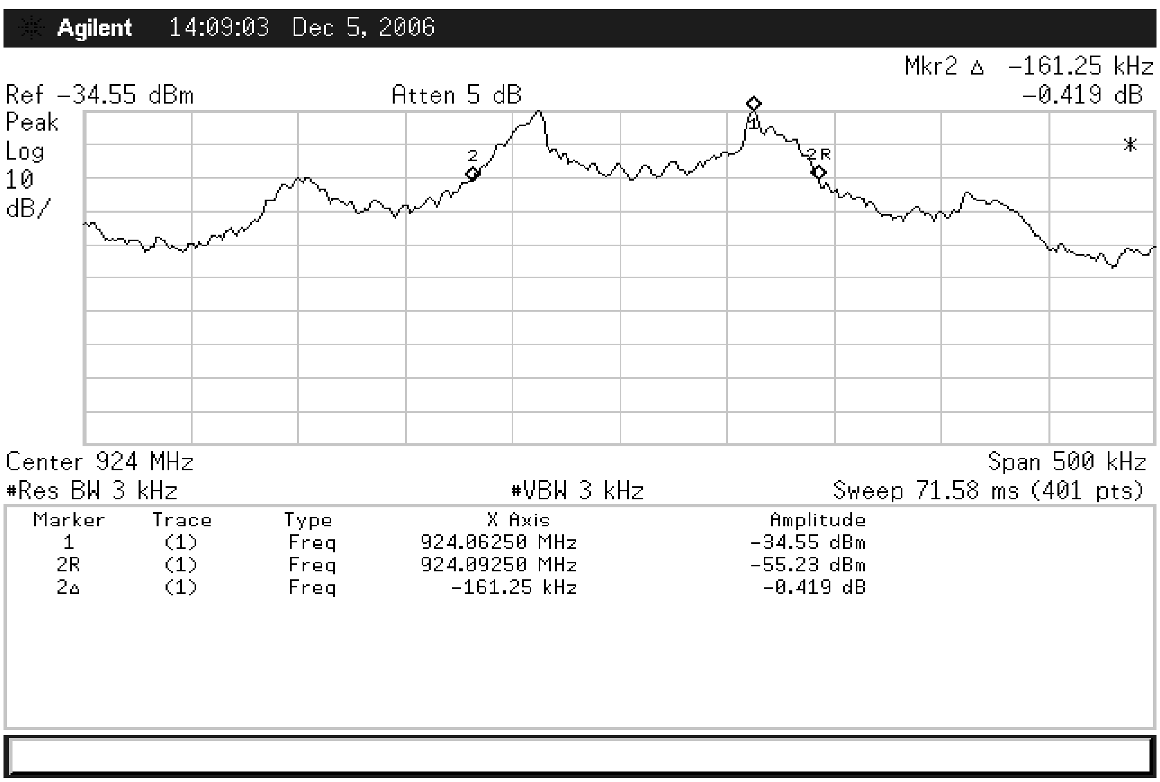
Equipment Used	Serial Number	Cal Date	Due
E4407B	MY45107856	07/14/06	07/14/07

Date	Tested by
12/5/06	Jeff Gilbert

908 MHz = 167.5 kHz; 915 MHz = 162.5 kHz; 924 MHz = 161.25 kHz




Agilent 14:05:29 Dec 5, 2006
Mkr2 Δ -162.50 kHz
-1.136 dB
Ref -34.6 dBm
Atten 5 dB
Peak
Log
10
dB/
Center 915 MHz
Span 500 kHz
#Res BW 3 kHz
#VBW 3 kHz
Sweep 71.58 ms (401 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 915.06250 MHz -34.6 dBm
2R (1) Freq 915.09125 MHz -55.53 dBm
2Δ (1) Freq -162.50 kHz -1.136 dB


Agilent 14:09:03 Dec 5, 2006
Mkr2 Δ -161.25 kHz
-0.419 dB
Ref -34.55 dBm
Atten 5 dB
Peak
Log
10
dB/
Center 924 MHz
Span 500 kHz
#Res BW 3 kHz
#VBW 3 kHz
Sweep 71.58 ms (401 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 924.06250 MHz -34.55 dBm
2R (1) Freq 924.09250 MHz -55.23 dBm
2Δ (1) Freq -161.25 kHz -0.419 dB

15.247(b) (2) / RSS-210 A8.4 (1)

RF Power Output - Conducted

The maximum peak conducted output power of the intentional radiator shall not exceed the following: For frequency hopping systems operating in the 902-928 MHz band: 1 Watt for systems employing at least 50 hopping channels.

Use the following spectrum analyzer settings:

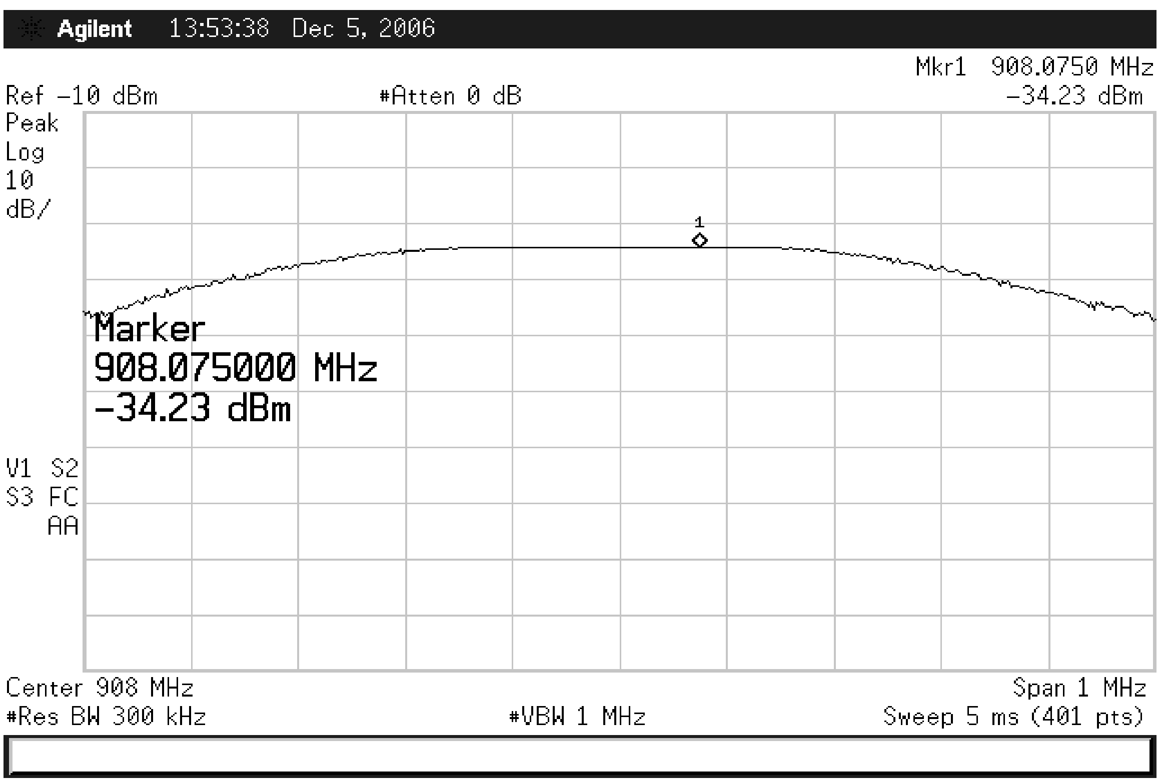
Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel.
RBW > the 20 dB bandwidth of the emission being measured.
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

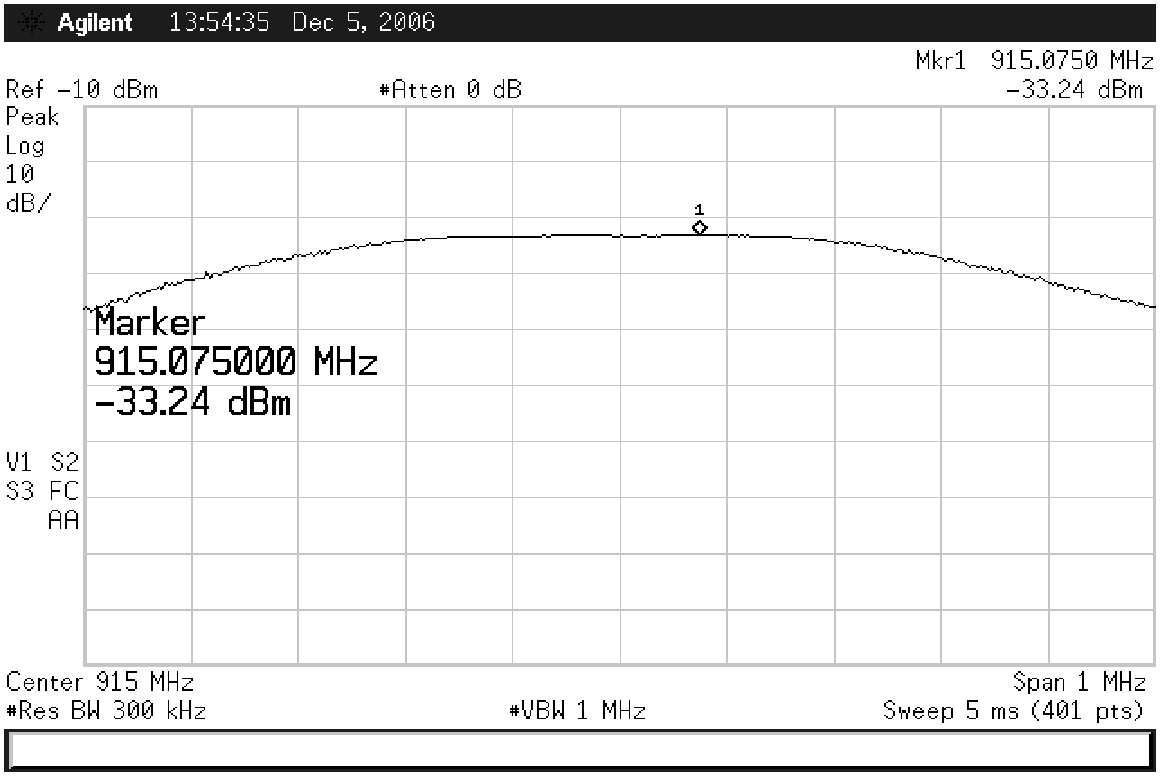
Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power.

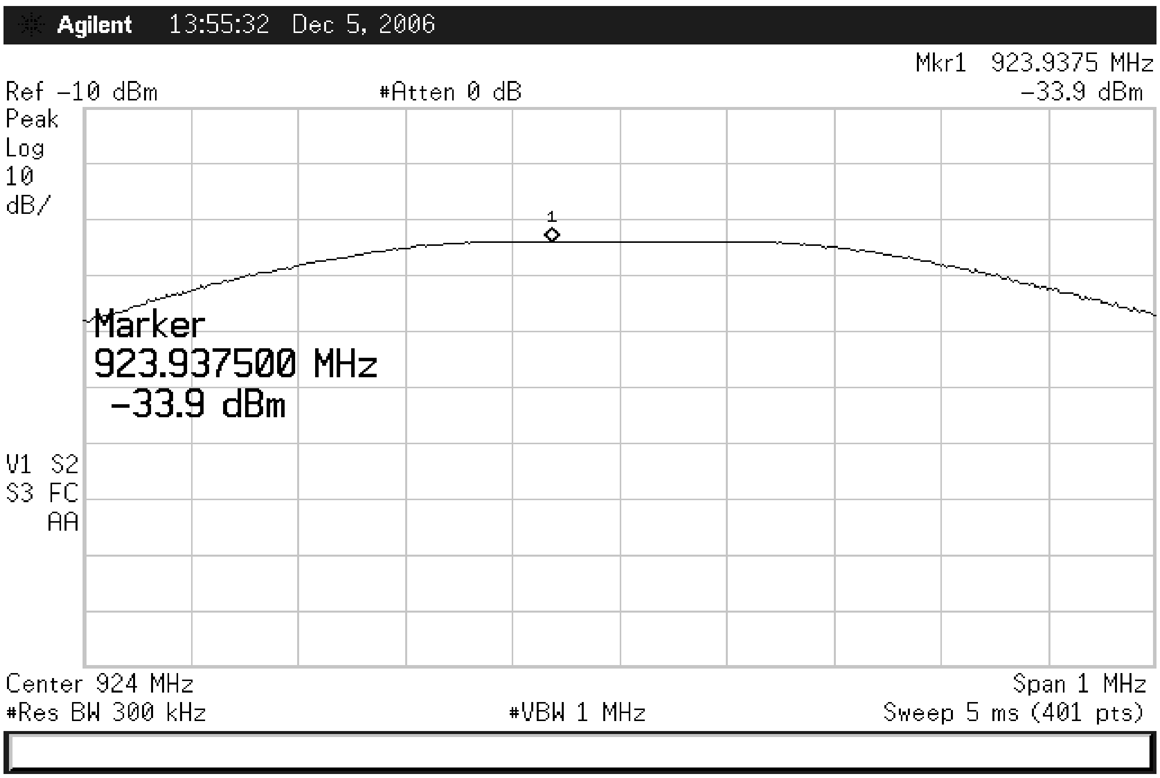
Equipment Used	Serial Number	Cal Date	Due
E4407B	MY45107856	07/14/06	07/14/07

Date	Tested by
12/5/06	Jeff Gilbert

Cable Loss: 908 MHz = 0.54 dB; 915 MHz = 0.52 dB; 924 MHz = 0.53 dB
Final Values: 908 MHz = -33.69 dBm; 915 MHz = -32.72 dBm; 924 MHz = -33.37 dBm




Agilent 13:54:35 Dec 5, 2006
Mkr1 915.0750 MHz
Ref -10 dBm
#Atten 0 dB
-33.24 dBm
Peak
Log
10
dB/
Marker
915.075000 MHz
-33.24 dBm
V1 S2
S3 FC
AA
Center 915 MHz
Span 1 MHz
#Res BW 300 kHz
#VBW 1 MHz
Sweep 5 ms (401 pts)


Agilent 13:55:32 Dec 5, 2006
Mkr1 923.9375 MHz
Ref -10 dBm
#Atten 0 dB
-33.9 dBm
Peak
Log
10
dB/
Marker
923.937500 MHz
-33.9 dBm
V1 S2
S3 FC
AA
Center 924 MHz
Span 1 MHz
#Res BW 300 kHz
#VBW 1 MHz
Sweep 5 ms (401 pts)

15.247 (d) / RSS-210 A8.5

Spurious RF Conducted Emissions

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,

Use the following spectrum analyzer settings:

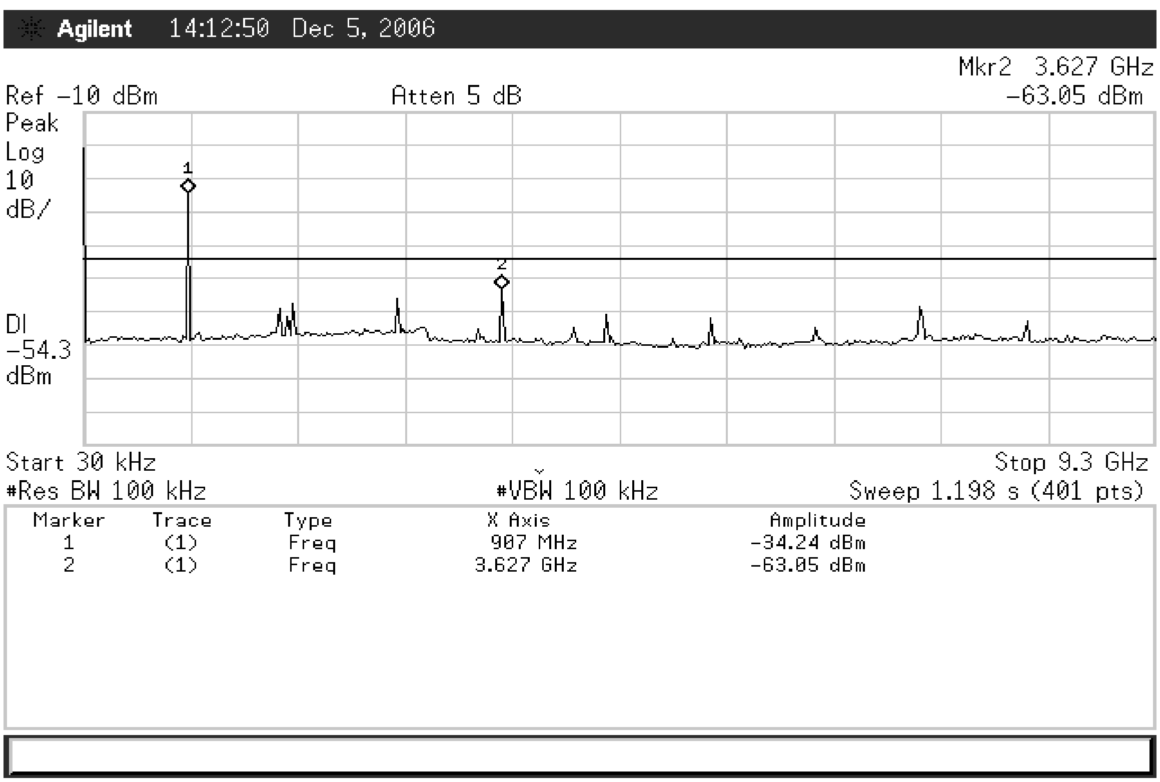
Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic.
RBW = 100 kHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded. The level displayed must comply with the limit specified.

Equipment Used	Serial Number	Cal Date	Due
E4407B	MY45107856	07/14/06	07/14/07

Date	Tested by
12/5/06	Jeff Gilbert

Worst case is shown: 28.81 dBc @ 3.627 GHz



15.247(a) (1) (i) / RSS-210 A8.1 (3)

Time of Occupancy

Verify that the transmitted signal does not occupy a single frequency for more than 400 mS.

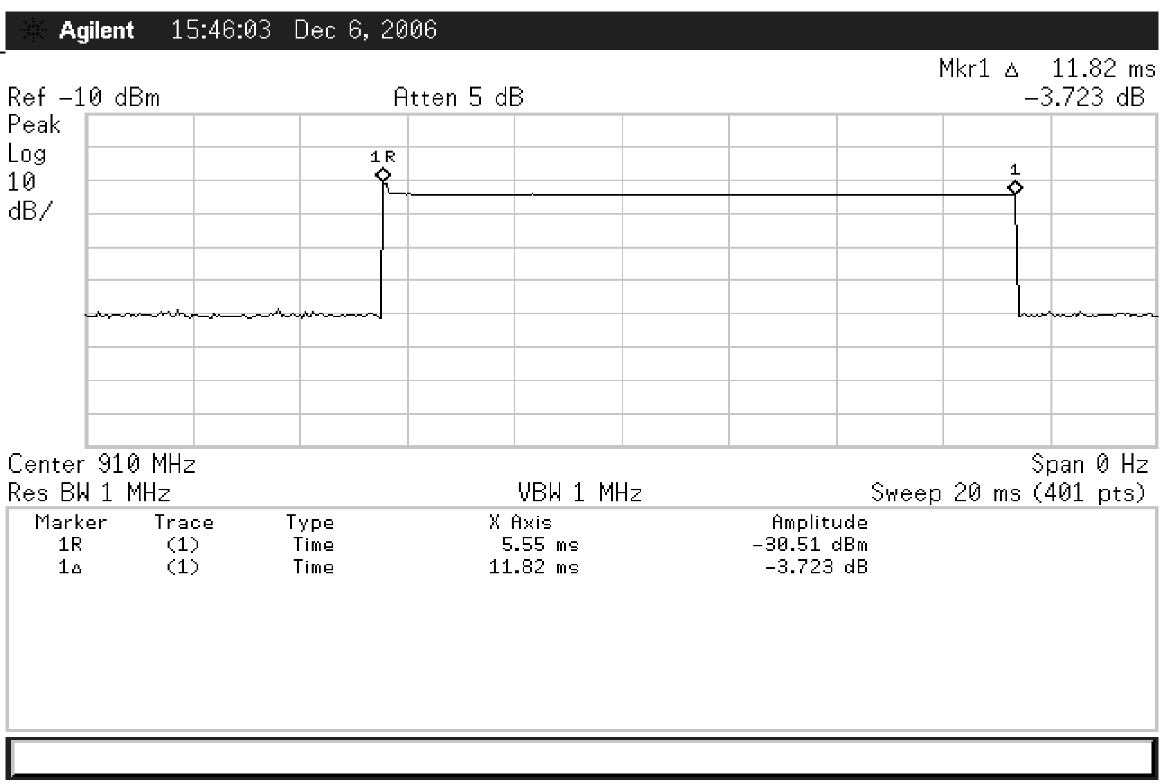
The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:
Span = zero span, centered on a hopping channel
RBW = 1 MHz
VBW ≥ RBW
Sweep = as necessary to capture the entire dwell time per hopping channel
Detector function = peak
Trace = max hold

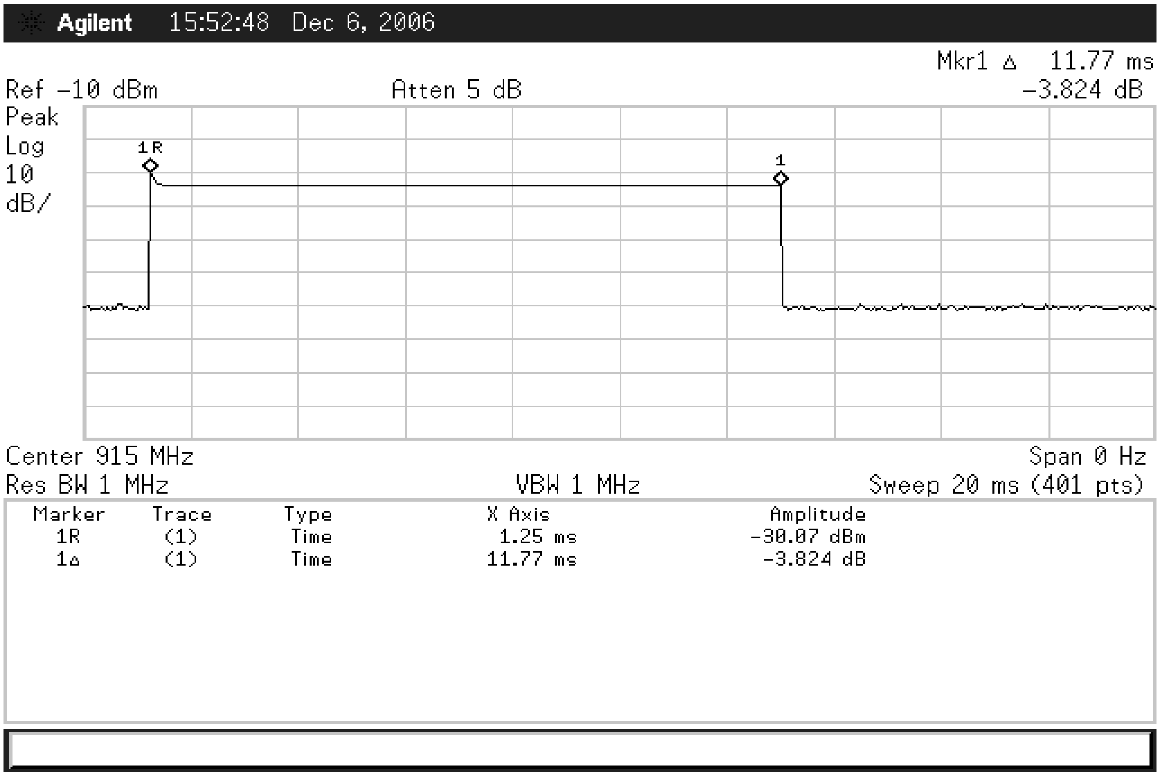
If possible, use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation.

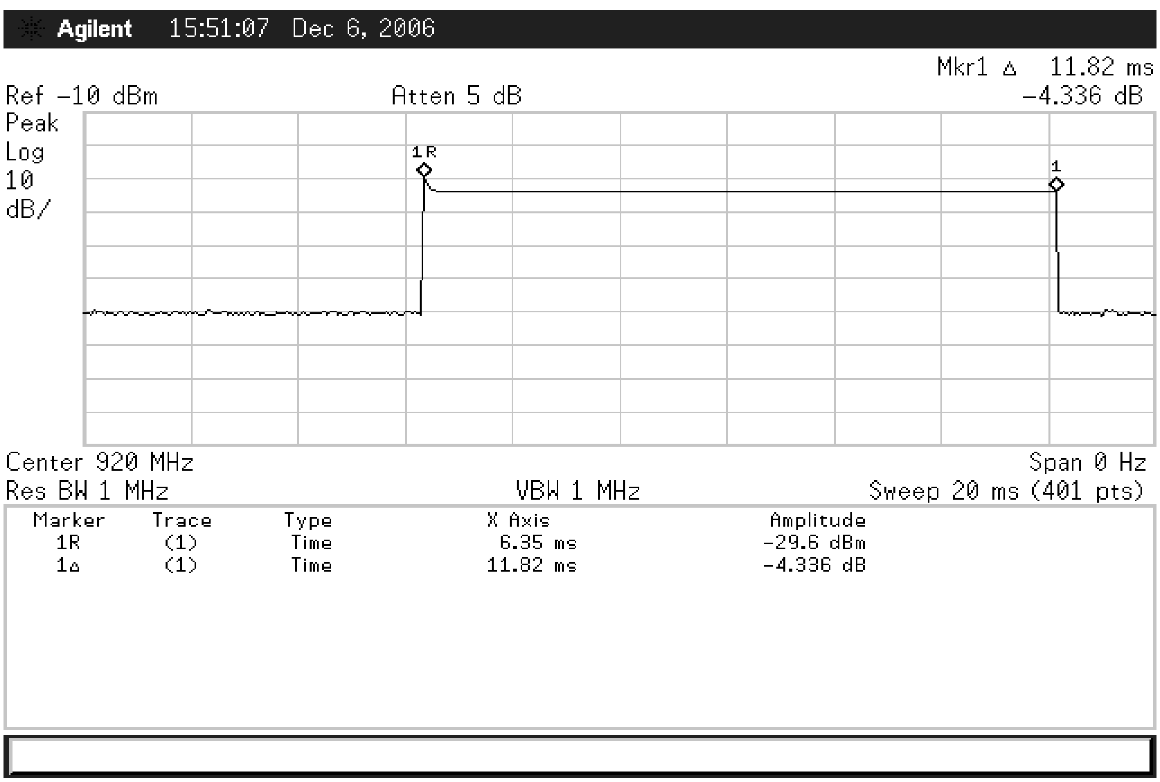
Equipment Used	Serial Number	Cal Date	Due
E4407B	MY45107856	07/14/06	07/14/07

Date	Tested by
12/7/06	Jeff Gilbert

Each transmission is 11.8 mS long. Each transmission takes place on one of 80 different channels in a pseudo-random sequence. All 80 channels are used equally on the average. The algorithm that determines the pseudo-random hop sequence does not allow the device to transmit on the same channel more than once in a 20 second period.




Agilent 15:52:48 Dec 6, 2006
Mkr1 Δ 11.77 ms
Ref -10 dBm
Atten 5 dB
-3.824 dB
Peak
Log
10
dB/
1R
1
Center 915 MHz
Span 0 Hz
Res BW 1 MHz
VBW 1 MHz
Sweep 20 ms (401 pts)
Marker Trace Type X Axis Amplitude
1R (1) Time 1.25 ms -30.07 dBm
1Δ (1) Time 11.77 ms -3.824 dB


Agilent 15:51:07 Dec 6, 2006
Mkr1 Δ 11.82 ms
Ref -10 dBm
Atten 5 dB
-4.336 dB
Peak
Log
10
dB/
1R
1
Center 920 MHz
Span 0 Hz
Res BW 1 MHz
VBW 1 MHz
Sweep 20 ms (401 pts)
Marker Trace Type X Axis Amplitude
1R (1) Time 6.35 ms -29.6 dBm
1Δ (1) Time 11.82 ms -4.336 dB

15.205, 15.209 / RSS-210 2.2, 2.6

Restricted Bands & Spurious Emissions

Only spurious emissions are permitted in any of the frequency bands listed below. The limits stated in 15.209 shall apply. Spurious emissions outside these bands shall also comply with the 15.209 limits.

This test is required for any spurious emission or modulation product that falls in a Restricted Band, as defined in Section 15.205. It must be performed with the highest gain of each type of antenna proposed for use with the EUT. Use the following spectrum analyzer settings:

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

Follow the guidelines in ANSI C63.4-2003 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization, etc. A pre-amp and a high pass filter are required for this test, in order to provide the measuring system with sufficient sensitivity. Allow the trace to stabilize. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, which must comply with the limit specified in Section 15.35(b). Now set the VBW to 10 Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a "duty cycle correction factor", derived from 20log(dwell time/100 ms), in an effort to demonstrate compliance with the 15.209 limit.

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505 1	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2655-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

Equipment Used	Serial Number	Cal Date	Due
Hewlett Packard 437B power meter	3125U16900	5/30/2006	5/30/2007
Hewlett Packard 8481D power sensor	3318A11513	6/6/2006	6/6/2007
Hewlett Packard 8593E spectrum analyzer	3543A02032	10/4/2006	10/4/2007
ETS Lindgren dipole antenna	78573	9/16/2006	9/16/2007
EMCO 3115 double ridge wave guide	9508-4550	3/15/2006	3/15/2007
Hewlett Packard 8673D Signal Generator	6123A01161	12/1/2006	12/1/2007

Frequency range investigated was 30 kHz to 9.3 GHz. See plots on pages 20 – 23.

Date	Temp/Humidity °F / %	Tested by
12/27/2006	50/48	Mark Kvamme

						Amplifier	Ant.	Cable			
Freq.	Antenna	Table	Level		Level	Gain	Factor	Loss	**Level**	Limit	Margin
MHz	Height	Azimuth	dBm	Polarity	dBuV	dB	dB	dB	**dBuV/m**	dBuV/m	dB
908	101	340	-45.55	Vertical	61.45	29.66	27.8	1.55	61.14	94	32.86
916	101	340	-43.42	Vertical	63.58	29.66	27.8	1.55	63.27	94	30.73
924	101	340	-43.49	Vertical	63.51	29.66	27.8	1.55	63.2	94	30.8
1816	101	10	-60	Horizontal	47	34.93	26.9	2.35	41.32	54	12.68
1832	101	10	-60	Horizontal	47	34.93	26.9	2.35	41.32	54	12.68
1848	101	10	-60	Horizontal	47	34.93	26.9	2.35	41.32	54	12.68
2724	101	230	-44.79	Vertical	62.21	46.42	29.3	3.03	48.12	54	5.88
2748	101	230	-47.3	Vertical	59.7	46.42	29.3	3.03	45.61	54	8.39
2772	101	230	-48.81	Vertical	58.19	46.42	29.3	3.03	44.1	54	9.9
3632	136	235	-44.37	Vertical	62.63	47.7	31.6	3.66	50.19	54	3.81
3664	136	235	-46.39	Vertical	60.61	47.7	31.6	3.66	48.17	54	5.83
3696	136	235	-48.28	Vertical	58.72	47.7	31.6	3.66	46.28	54	7.72
4540	101	285	-54	Vertical	53	47.96	32.8	4.31	42.15	54	11.85
4580	101	285	-54	Vertical	53	47.96	32.8	4.31	42.15	54	11.85
4620	101	285	-54	Vertical	53	47.96	32.8	4.31	42.15	54	11.85
5448	116	30	-50.08	Horizontal	56.92	47.19	34.4	4.73	48.86	54	5.14
5496	116	30	-52.69	Horizontal	54.31	47.19	34.4	4.73	46.25	54	7.75
5544	116	30	-54	Horizontal	53	47.19	34.4	4.73	44.94	54	9.06
6356	100	310	-54	Horizontal	53	46.84	35	5.3	46.46	54	7.54
6412	100	310	-54	Horizontal	53	46.84	35	5.3	46.46	54	7.54
6468	100	310	-54	Horizontal	53	46.84	35	5.3	46.46	54	7.54
7264	100	180	-54	Horizontal	53	49.05	36.6	6.14	46.69	54	7.31
7328	100	180	-54	Horizontal	53	49.05	36.6	6.14	46.69	54	7.31
7393	100	180	-54	Horizontal	53	49.05	36.6	6.14	46.69	54	7.31

RSS-Gen 7.2.3 Receiver Spurious Emission Limits

7.2.3.2 Radiated Measurement

All spurious emissions shall comply with the limits of Table 1.

Receiver Spurious Emissions

The receiver shall be operated in the normal receive mode near the mid-point of the band over which the receiver is designed to operate. Unless otherwise specified in the applicable RSS, the radiated emission measurement is the standard measurement method (with the device's antenna in place) to measure receiver spurious emissions. Radiated emission measurements are to be performed using a calibrated open-area test site. As an alternative, the conducted measurement method may be used when the antenna is detachable. In such a case, the receiver spurious signal may be measured at the antenna port. If the receiver is super-regenerative, stabilize it by coupling to it an unmodulated carrier on the receiver frequency (antenna conducted measurement) or by transmitting an unmodulated carrier on the receiver frequency from an antenna in the proximity of the receiver (radiated measurement). Taking care not to overload the receiver, vary the amplitude and frequency of the stabilizing signal to obtain the highest level of the spurious emissions from the receiver. 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, intermediate or carrier frequency), or 30 MHz, whichever is the higher, to at least 3 times the highest tunable or local oscillator frequency, whichever is the higher, without exceeding 40 GHz.

Receiver Spurious Emission Standard

The following receiver spurious emission limits shall be complied with:

(a) If a radiated measurement is made, all spurious emissions shall comply with the limits of Table 1. The resolution bandwidth of the spectrum analyzer shall be 100 kHz for spurious emission measurements below 1.0 GHz, and 1.0 MHz for measurements above 1.0 GHz.

Table 1 - Spurious Emission Limits for Receivers

Spurious Frequency (MHz)	Field Strength (microvolt/m at 3 meters)
30-88	100
88-216	150
216-960	200
Above 960	500

Equipment Used	Serial Number	Cal Date	Due
Hewlett Packard 437B power meter	3125U16900	5/30/2006	5/30/2007
Hewlett Packard 8481D power sensor	3318A11513	6/6/2006	6/6/2007
Hewlett Packard 8593E spectrum analyzer	3543A02032	10/4/2006	10/4/2007
EMCO 3146 Log periodic	9203-2455	10/24/2006	10/24/2007
EMCO 6502 active loop antenna	9509-2970	10/24/2006	10/24/2008
Hewlett Packard 8673D Signal Generator	6123A01161	12/1/2006	12/1/2007
Hewlett Packard 8591E spectrum analyzer	3229A00239	12/5/2006	12/5/2007

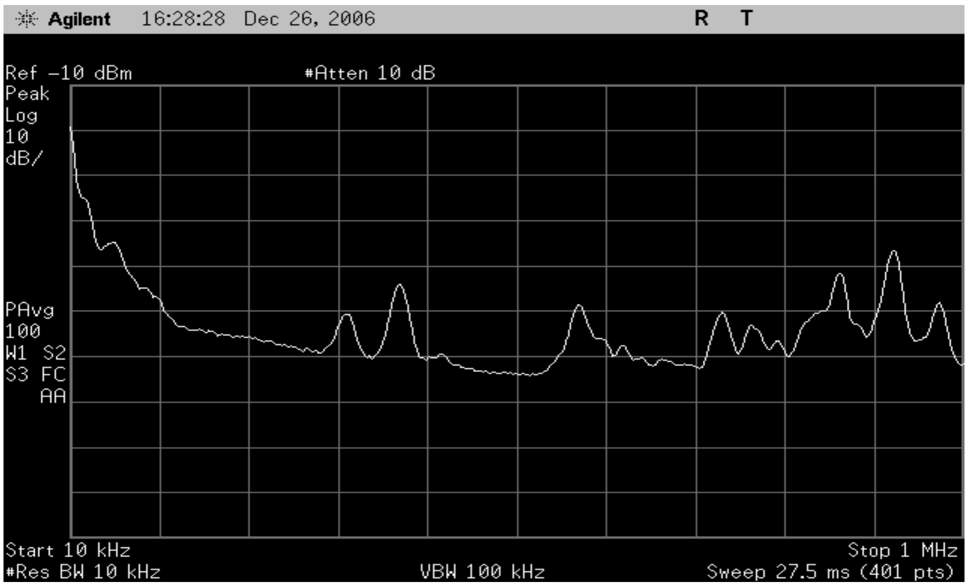
Date	Temp/Humidity ºF / %	Tested by
12/27/2006	78/61	Mark Kvamme

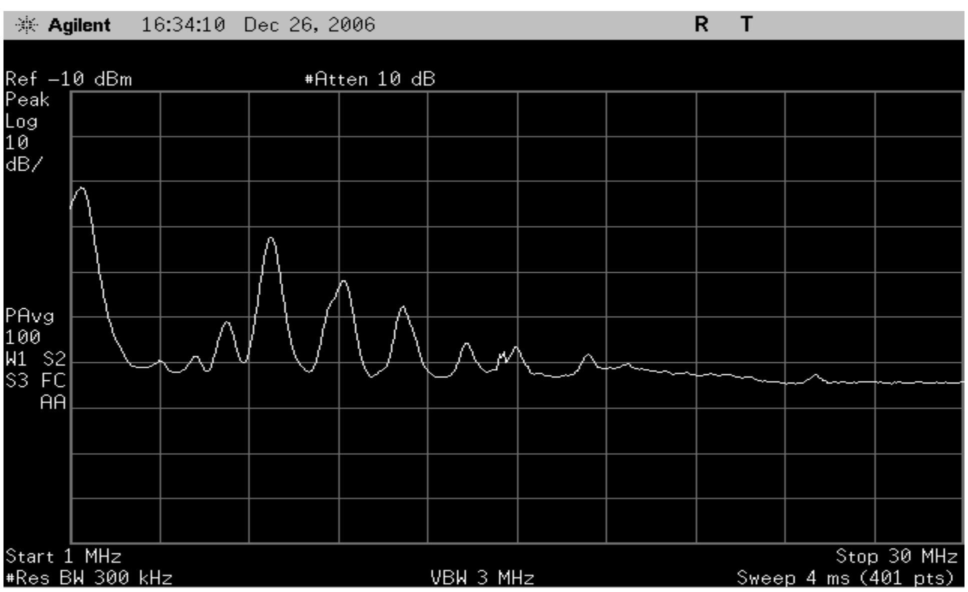
Freq. MHz	Antenna Height	Table Azimuth	Level dBm	Polarity	Level dBuV	Amplifier Gain dB	Ant. Factor dB	Cable Loss dB	**Level dBuV/m**	Limit dBuV/m	Margin dB
852	128	255	-58.78	Vertical	48.22	29.59	22.8	1.5	42.93	46	3.07

Frequency range investigated was 9 kHz to 3 GHz.

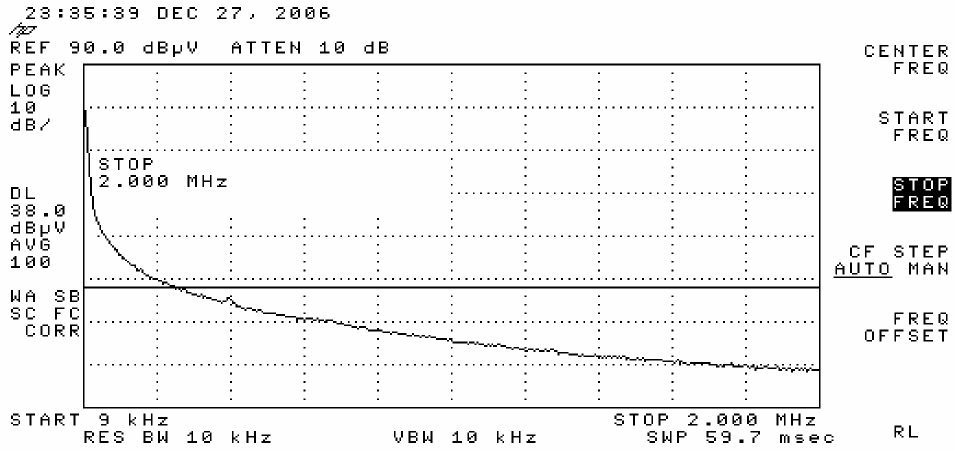
Measurements below 30 MHz

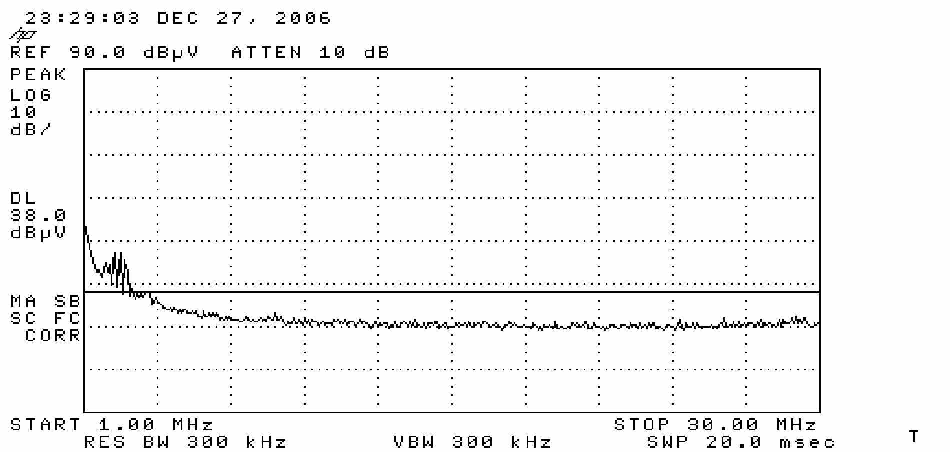
OATS Measurements (high ambient noise)



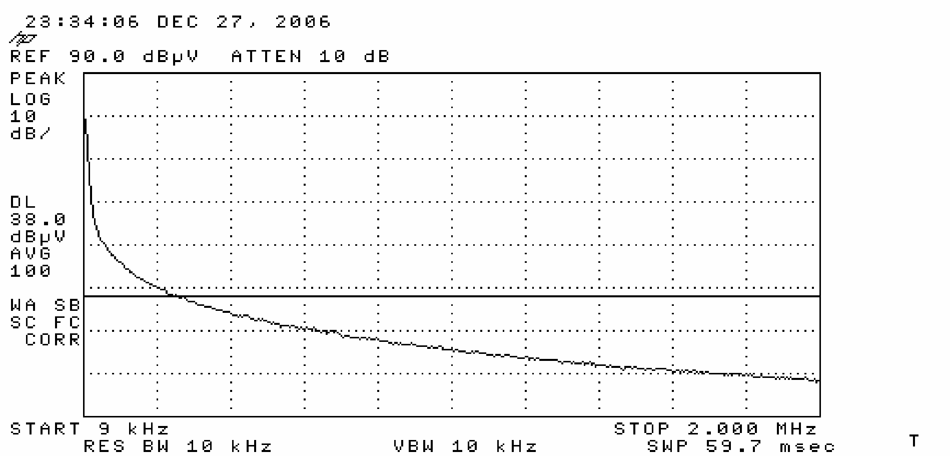


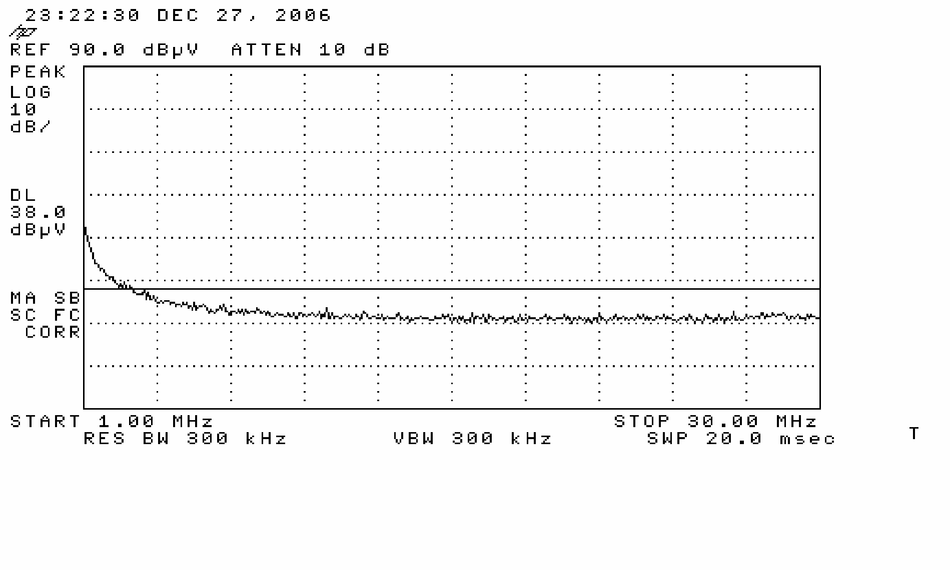
Loop antenna horizontal (anechoic) – due to the noise level on the OATS, meaningful measurements could not be taken. The EUT was scanned in the anechoic chamber to verify that none of the signals above emanated from the EUT.





Loop antenna Vertical (anechoic)




23:22:30 DEC 27, 2006
REF 90.0 dBµV ATTEN 10 dB
PEAK
LOG
10
dB/
DL
38.0
dBµV
MA SB
SC FC
CORR
START 1.00 MHz
STOP 30.00 MHz
RES BW 300 kHz
VBW 300 kHz
SWP 20.0 msec
T

ANNEX A

ALTERNATIVE TEST PROCEDURES

If antenna conducted tests cannot be performed on this device, radiated tests to show compliance with the peak output power limit specified in Section 15.247(b) (2) and the spurious RF conducted emission limit specified in Section 15.247(d) are acceptable. A pre-amp, and, in the latter case, a high pass filter, are required for the following measurements.

1) Calculate the transmitter's peak power using the following equation:

$$E = \frac{\sqrt{30PG}}{d}$$

Where: E is the measured maximum fundamental field strength in V/m, utilizing a RBW ≥ the 20 dB bandwidth of the emission, VBW > RBW, peak detector function. Follow the procedures in C63.4-2003 with respect to maximizing the emission.
G is the numeric gain of the transmitting antenna with reference to an isotropic radiator.
d is the distance in meters from which the field strength was measured.
P is the power in watts for which you are solving:

$$P = \frac{(E \times d)^2}{30G}$$

2) To demonstrate compliance with the spurious RF conducted emission requirement of Section 15.247(d), use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured.
RBW = 100 kHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

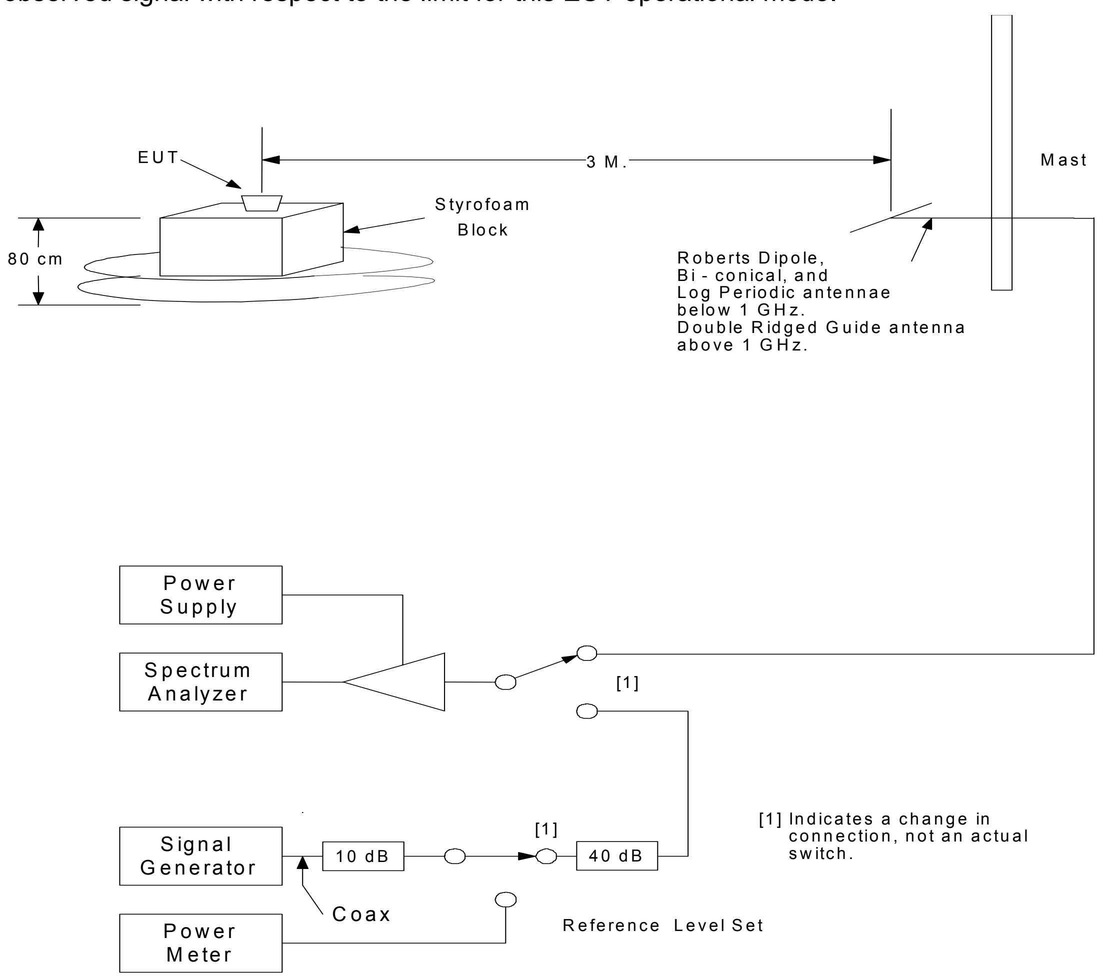
Measure the field strength of both the fundamental emission and all spurious emissions with these settings. Follow the procedures in C63.4-2003 with respect to maximizing the emissions. The measured field strength of all spurious emissions must be below the measured field strength of the fundamental emission by the amount specified in Section 15.247(d). Note that if the emission falls in a Restricted Band, as defined in Section 15.205, the procedure for measuring spurious radiated emissions, listed above, must be followed.

Field Strength Measurement Procedure

This test measures the field strength of radiated emissions using a spectrum analyzer and a receiving antenna in accordance with ANSI C63.4-2003. During the test, the EUT is to be placed on a non-conducting support at 80 cm above the horizontal ground plane of the OATS. The horizontal distance between the antenna and the EUT is to be exactly 3 meters. Levels below 1 GHz are to be measured with the spectrum analyzer resolution bandwidth at 120 kHz and levels at or above 1 GHz are to be measured with the spectrum analyzer resolution bandwidth at 1 MHz.

1) Monitor the frequency range of interest at a fixed antenna height and EUT azimuth.
2) If appropriate, manipulate the system cables to produce the highest amplitude signal relative to the limit. Note the amplitude and frequency of the suspect signal.
3) Rotate the EUT 360° to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, go back to the azimuth and repeat step 2). Otherwise, orient the EUT azimuth to repeat the highest amplitude observation and proceed.

4) Move the antenna over its fully allowed range of travel to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, return to step 2) with the antenna fixed at this height. Otherwise, move the antenna to the height that repeats the highest amplitude observation and proceed.
5) Change the polarity of the antenna and repeat step 2), step 3), and step 4). Compare the resulting suspected highest amplitude signal with that found for the other polarity. Select and note the higher of the two signals.
6) The transmitter shall be replaced by a substitution antenna.
The substitution antenna shall be orientated for vertical polarization and the length of the substitution antenna shall be adjusted to correspond to the frequency of the transmitter. The substitution antenna shall be connected to a calibrated signal generator. If necessary, the input attenuator setting of the measuring receiver shall be adjusted in order to increase the sensitivity of the measuring receiver.
7) The test antenna shall be raised and lowered through the specified range of height to ensure that the maximum signal is received.
8) The input signal to the substitution antenna shall be adjusted to the level that produces a level detected by the measuring receiver, that is equal to the level noted while the transmitter radiated power was measured, corrected for the change of input attenuator setting of the measuring receiver.
9) The input level to the substitution antenna shall be recorded as power level, corrected for any change of input attenuator setting of the measuring receiver.
10) The measurement shall be repeated with the test antenna and the substitution antenna orientated for horizontal polarization.
11) The measure of the effective radiated power is the larger of the two levels recorded at the input to the substitution antenna, corrected for gain of the substitution antenna if necessary. This signal is termed the highest observed signal with respect to the limit for this EUT operational mode.



Marker-Delta Method

In making radiated band-edge measurements, there can be a problem obtaining meaningful data since a measurement instrument that is tuned to a band-edge frequency may also capture some in-band signals when using the resolution bandwidth (RBW) required by measurement procedure ANSI C63.4-1992 (hereafter C63.4). In an effort to compensate for this problem, we have developed the following technique for determining band-edge compliance.

STEP 1) Perform an in-band field strength measurement of the fundamental emission using the RBW and detector function required by C63.4 and our Rules for the frequency being measured. For example, for a device operating in the 902-928 MHz band under Section 15.249, use a 120 kHz RBW with a CISPR QP detector (a peak detector with 100 kHz RBW may alternatively be used). For transmitters operating above 1 GHz, use a 1 MHz RBW, a 1 MHz VBW, and a peak detector (as required by Section 15.35). Repeat the measurement with an average detector (i.e., 1 MHz RBW with 10 Hz VBW). Note: For pulsed emissions, other factors must be included. Please contact the FCC Lab for details if the emission under investigation is pulsed. Also, please note that radiated measurements of the fundamental emission of a transmitter operating under 15.247 are not normally required, but they are necessary in connection with this procedure.

STEP 2) Choose a spectrum analyzer span that encompasses both the peak of the fundamental emission and the band-edge emission under investigation. Set the analyzer RBW to 1% of the total span (but never less than 30 kHz) with a video bandwidth equal to or greater than the RBW. Record the peak levels of the fundamental emission and the relevant band-edge emission (i.e., run several sweeps in peak hold mode). Observe the stored trace and measure the amplitude delta between the peak of the fundamental and the peak of the band-edge emission. This is not a field strength measurement; it is only a relative measurement to determine the amount by which the emission drops at the band-edge relative to the highest fundamental emission level.

STEP 3) Subtract the delta measured in step (2) from the field strengths measured in step (1). The resultant field strengths (CISPR QP, average, or peak, as appropriate) are then used to determine band-edge compliance as required by Section 15.205.

STEP 4) The above "delta" measurement technique may be used for measuring emissions that are up to two "standard" bandwidths away from the band-edge, where a "standard" bandwidth is the bandwidth specified by C63.4 for the frequency being measured. For example, for band-edge measurements in the restricted band that begins at 2483.5 MHz, C63.4 specifies a measurement bandwidth of at least 1 MHz. Therefore you may use the "delta" technique for measuring emissions up to 2 MHz removed from the band-edge. Radiated emissions that are removed by more than two “standard” bandwidths must be measured in the conventional manner.