REGULATORY COMPLIANCE REPORT

TITLE: FCC & IC Test Report for 15.247 & RSS-210 IEEE 802.15.4™; ZigBee® Digital Transmission Device, 2.405 - 2.475 GHz

(product model: 2.4GZ, Itron part numbers: OWG-5001/2-001, 002, 003, 004, 009)

AUTHOR: Douglas Knoll

REV	CCO	DESCRIPTION OF CHANGE	DATE	APPROVALS	
_____		INITIAL RELEASE		Engineering	Douglas Knoll
				Regulatory	

REVISION HISTORY

001	n/a	initial version sent to certification house	16jan09	Engineering	
				Regulatory	
002	n/a	response to non-conformities of 27jan09, updated part numbers in summary, corrected a vert to horz in radiated spur table, and band edge procedure clarified.	28jan09	Engineering	
				Regulatory	
				Engineering	
				Regulatory	

Test Data Summary

FCC 15.247 / IC RSS-210

2.4GZ ZigBee® Digital Transmission Device, 2.405 - 2.475 GHz

FCC:EO924GZB

IC ID: 864D-24GZB

Device Models (for IC): 24GZB1, 24GZB2, 24GZB8

Itron Part numbers: OWG-5001/2-001; 002, 003, 004; 009

Serial Numbers: 62, 67, 55

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
15.207 / RSS-210 Sec. 6.6(a)	Power line Conducted Emissions	N/A (battery device)	N/A
Part 15.247(b)(3) / RSS-210 A8.4(4)	Peak RF Power Output – Conducted	0.045 W @ 2440MHz	Pass
Part 15.247(a)(2) / RSS-210 A8.2(a)	6 dB Bandwidth - Conducted	1.617 MHz @ 2475 MHz	Pass
RSS-210 A1.1.3	Bandwidth of Momentary Signals (99% BW)	2.85MHz @ 2475MHz	Pass
Part 15.247(e) / RSS-210 A8.2(b)	Peak Power Spectral Density – Conducted	1.03 dBm @ 2440 MHz	Pass
Part 15.247(d) / RSS-210 A8.5	Spurious Emissions – Conducted	-50.06dBc @ 9760 MHz	Pass
Part 15.247(d) / RSS-210 A8.5	Spurious Emissions – Radiated	-45.57dBc @ 9900 MHz	Pass
Parts 15.205 & 15.209 / RSS-210 2.2, 2.6 Tables 1 & 2	Restricted Bands Spurious Emissions Radiated	51.83 dBµV/m @ 3m (7320 MHz)	Pass
RSS-Gen 7.2.3	Receiver Spurious Emissions – Radiated	41.52 dBuV/m @ 3m (4946 MHz)	Pass
1.1310 & 2.1091 / RSS-102	Maximum Permissible Exposure (MPE)	0.0895W/m^2 @ 20cm	Pass
15.247 (d)	Band-edge compliance of RF Radiated Emissions	41.64 dBuV/m @ 3m (2390)	Pass

Rule versions: FCC Part 1 (10-2006), FCC Part 2 (10-2006), FCC Part 15 (05-04-2007), RSS-Gen Issue 2 (06-2007), RSS-210 Issue 7 (06-2007).
Reference docs: ANSI C63.4-2003, FCC KDB Publication, 558074, March 23, 2005, New Guidance on Measurement for Digital Transmission Systems in Section 15.247.

Cognizant Personnel	
Name Mark Kvamme	Title Test Technician
Name Doug Knoll	Title 2.4GZ Regulatory Engineer

15.31 (e)

This is a battery powered device. Nominal battery voltage is 3.0 Vdc. In order to perform conducted testing of the device, the battery was removed and a DC supply was used in its place. The DC supply was varied between 2.55 Vdc and 3.40 Vdc. The maximum peak RF power was found with the DC supply at 3.40 Vdc. All conducted testing was performed at 3.40 Vdc. All radiated testing was performed using a new battery.

15.207 / RSS-210 Sec. 6.6(a) Power line Conducted Emissions

Measure the AC power line conducted emissions from 150kHz to 30 MHz using a 50μH/50Ω line impedance stabilization network (LISN) according to the procedure specified in ANSI C63.4. Verify that no emissions exceed the following limits:

Frequency (MHz)	Quasi-Peak (dBμV)	Average (dBμV)
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of frequency

DEVICE IS BATTERY OPERATED NOT CONNECTED TO THE POWER LINE. BATTERY IS NOT RECHARGABLE. THERFORE THIS TEST IS N/A.

15.247(b) (3) / RSS-210 A8.4 (4): RF Power Output

The maximum peak conducted output power of the intentional radiator shall not exceed the following: For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

Unit Tested: 55. This is an RF conducted test. Use a direct connection between the antenna port of the transmitter and the spectrum analyzer, through suitable attenuation.

RBW > 6 dB bandwidth of the emission
VBW ≥ RBW
Span = > 6 dB bandwidth of the emission
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	Model Number	Serial Number	Cal Date	Due
Spectrum Analyzer	HP 8560E	3825A03709	June/07	June/09
RF Test Cable	SUCOFLEX 104	220057 002	03/08	03/09
Date	**Tested by**			
1/13/2009	Douglas Knoll			

Cable loss of 0.2 dB was added to the spectrum analyzer as a correction. The marker value in the plots is the true corrected value.

Frequency (MHz)	Corrected Conducted Power (W)
2405	0.040
2440	0.045
2475	0.037

Table 1: Summary Table of Output Power

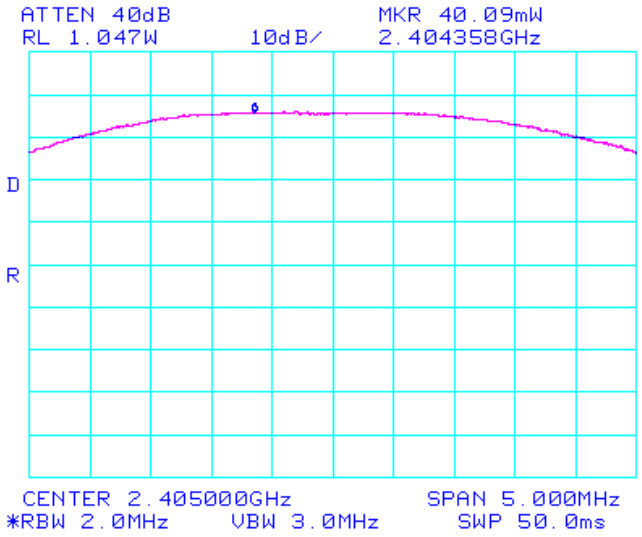


Figure 1: Conducted Power Measurement: f = 2.405GHz

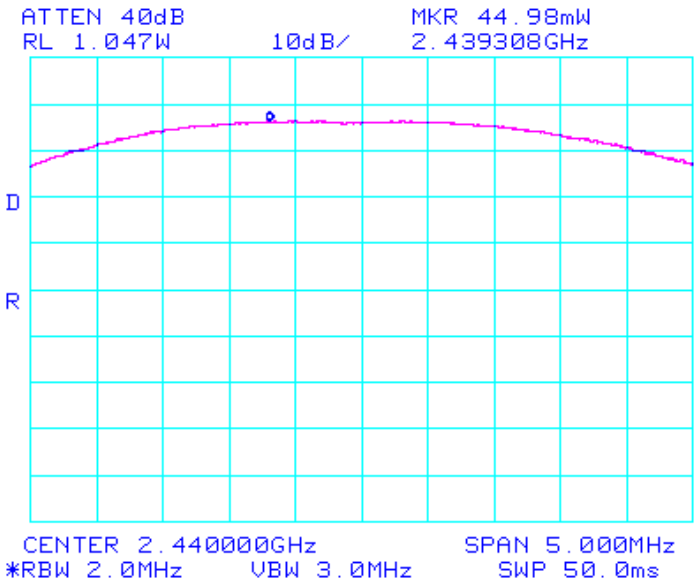


Figure 2: Conducted Power Measurement: f = 2.440GHz

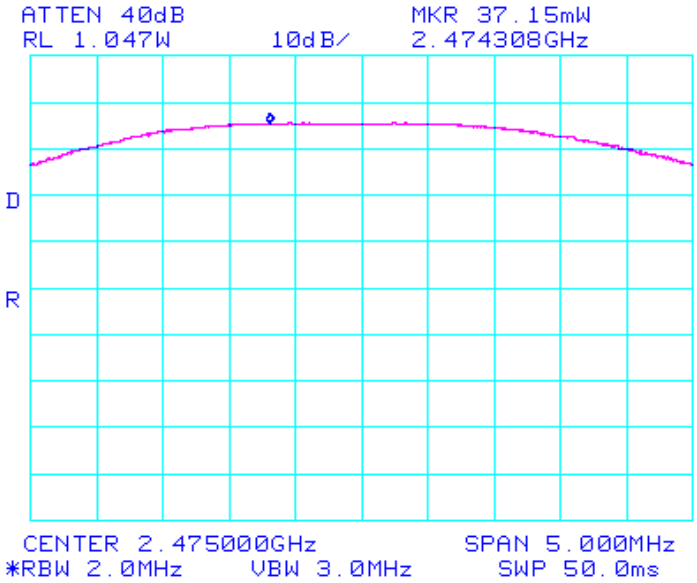


Figure 3: Conducted Power Measurement: f = 2.475GHz

Part 15.247(a) (2) / RSS-210 A8.2 (a): 6 dB Bandwidth

Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Unit Tested: 55. Use the following spectrum analyzer settings:

RBW = 100 kHz
VBW ≥ RBW
Span = 5 MHz
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 6 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 6 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	Model Number	Serial Number	Cal Date	Due
Spectrum Analyzer	HP 8560E	3825A03709	June/07	June/09
RF Test Cable	SUCOFLEX 104	220057 002	03/08	03/09
Date				**Tested by**
1/13/2009				Douglas Knoll

Frequency (MHz)	6 dB Bandwidth (MHz)
2405	1.625
2440	1.633
2475	1.617

Table 2: Summary table of 6dB Bandwidth

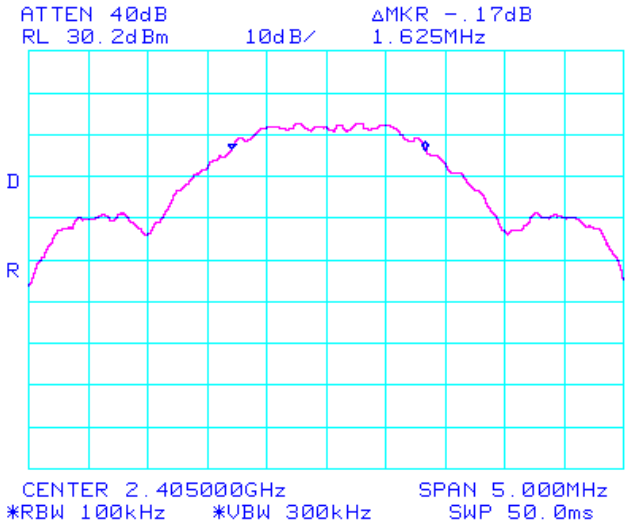


Figure 4: 6 dB Bandwidth f = 2.405 GHz

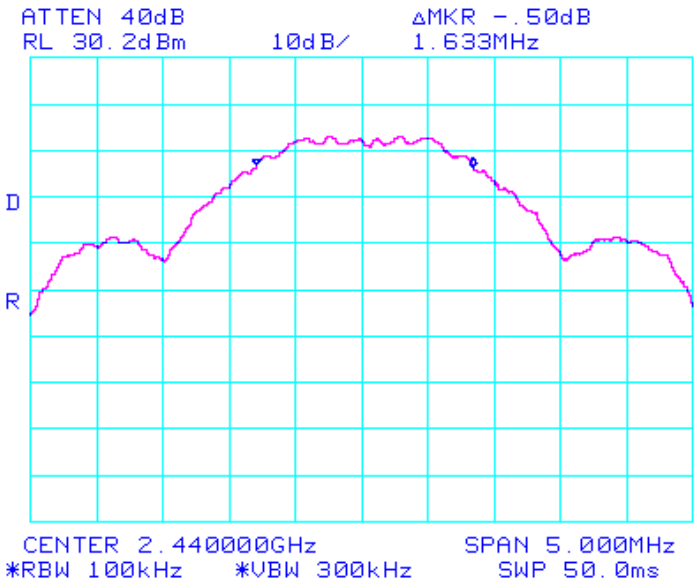


Figure 5: 6 dB Bandwidth f = 2.440 GHz

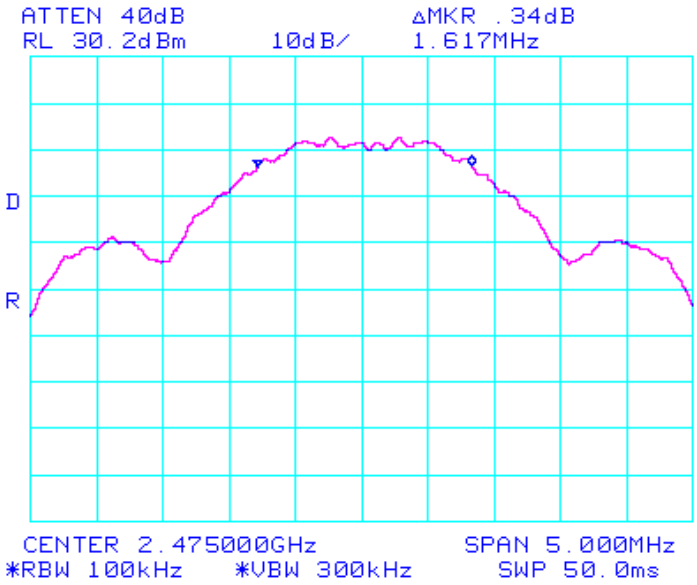


Figure 6: 6 dB Bandwidth f = 2.475 GHz

RSS-210 A1.1.3: Bandwidth if Momentary Signals (99% BW)

For the purpose of Section A1.1, the 99% bandwidth shall be no wider than 0.25% of the centre frequency for devices operating between 70-900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the centre frequency.

Equipment Used	Model Number	Serial Number	Cal Date	Due
Spectrum Analyzer	HP 8560E	3825A03709	June/07	June/09
RF Test Cable	SUCOFLEX 104	220057 002	03/08	03/09
Date				Tested by
1/13/2009				Douglas Knoll

Unit Tested: 55

Frequency (MHz)	Limit 0.5% of center frequency (MHz)	99% Bandwidth (MHz)
2405	12	2.800
2440	12.2	2.800
2475	12.4	2.850

Table 3: Summary table of Bandwidth of Momentary Signals

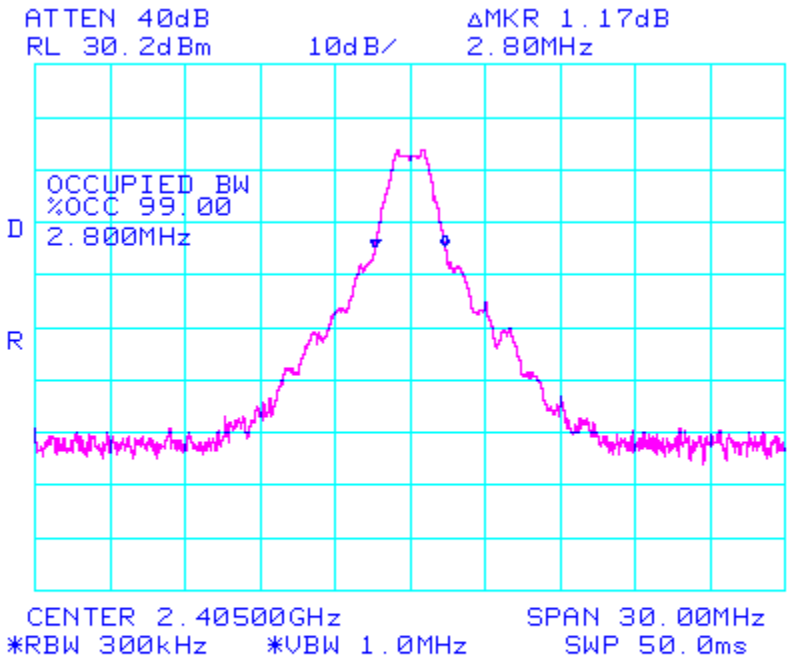


Figure 7: 99% BW f=2.405 GHz

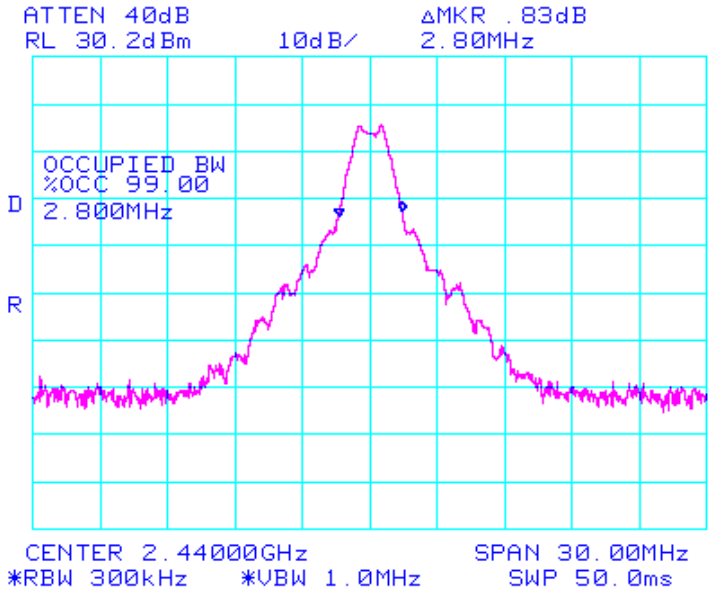


Figure 8: 99% BW f=2.440 GHz

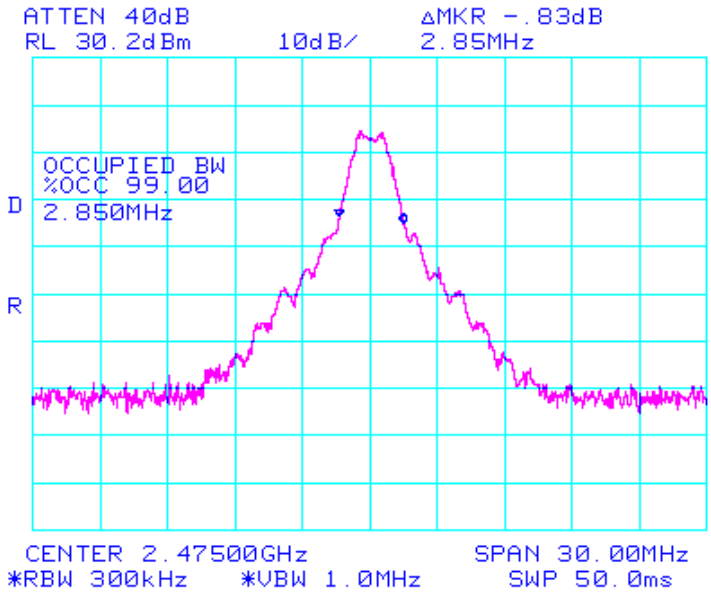


Figure 9: 99% BW f=2.475 GHz

Part 15.247(e) / RSS-210 A8.2 (b): Power Spectral Density

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Unit Tested: 55
Use the following spectrum analyzer settings:

RBW = 3 kHz
VBW ≥ RBW
Span = > 3 dB bandwidth
Sweep = SPAN/3 kHz
Detector function = peak
Trace = max hold

Equipment Used	Model Number	Serial Number	Cal Date	Due
Spectrum Analyzer	HP 8560E	3825A03709	June/07	June/09
RF Test Cable	SUCOFLEX 104	220057 002	03/08	03/09
Date				Tested by
1/28/2009				Douglas Knoll

Cable loss of 0.2 dB was added to the spectrum analyzer as a correction. The marker value in the plots is the true corrected value.

Frequency (MHz)	Corrected Power Spectral Density (dBm)
2405	0.03
2440	1.03
2475	0.20

Table 4: Power Spectral Density
Tested in Accordance with PSD Option 1

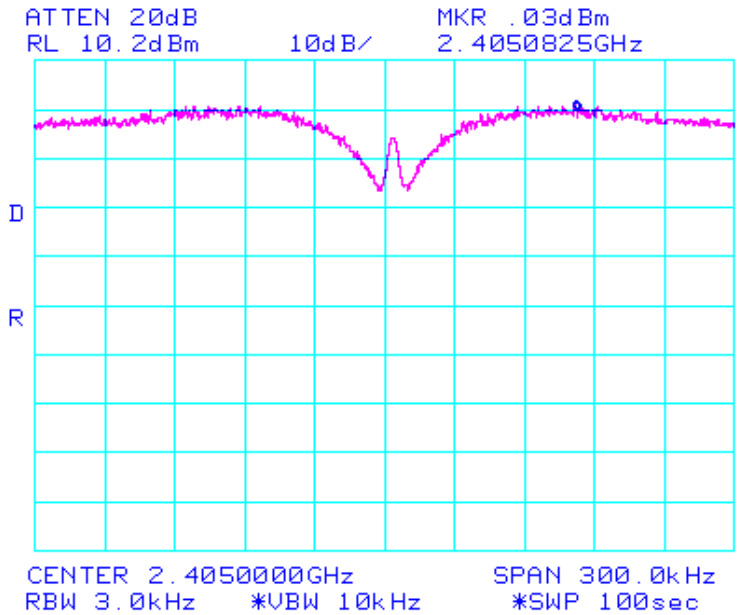


Figure 10: Power Spectral Density f= 2.405 GHz

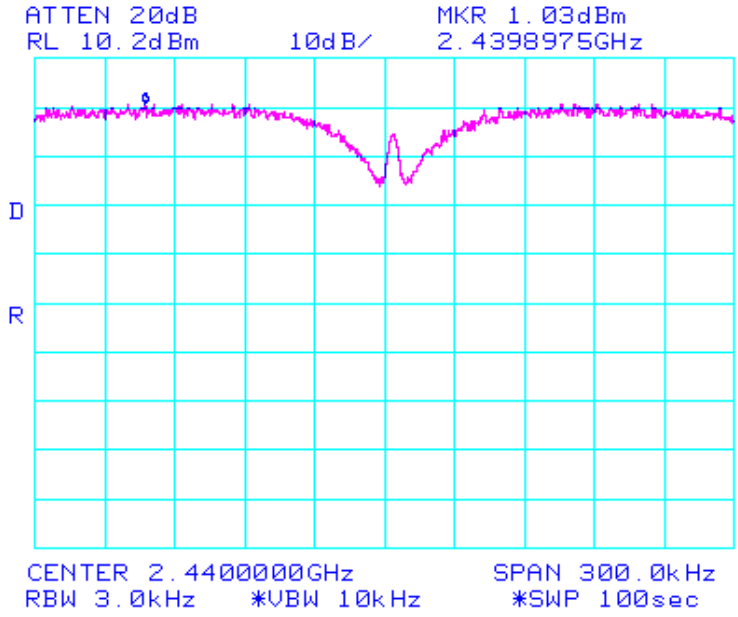


Figure 11: Power Spectral Density f= 2.440 GHz

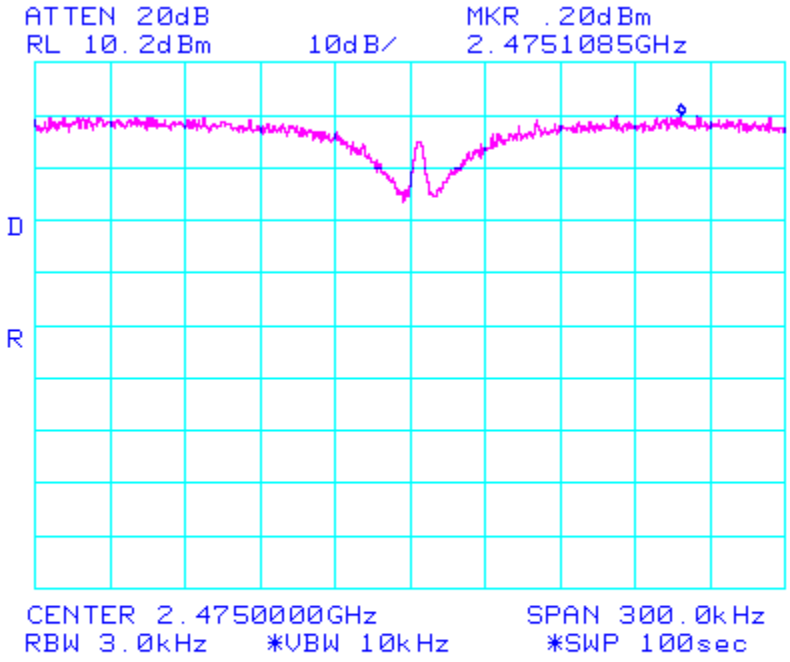


Figure 12: Power Spectral Density f= 2.475 GHz

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,

Unit Tested: 55. 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 tenth 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	Model Number	Serial Number	Cal Date	Due
Spectrum Analyzer	HP 8560E	3825A03709	June/07	June/09
RF Test Cable	SUCOFLEX 104	220058 002	03-May-07	03-May-09
Date				**Tested by**
1/13/2009				Douglas Knoll

Frequency range investigated was 9 kHz to 26 GHz.

Fundamental Frequency (MHz)	Fundamental Power dBm	Spurious RF Frequency (MHz)	Spurious RF Conducted (dBc)
2405	10.26	9620	-52.1
2440	10.52	9760	-50.06
2475	9.76	9900	-52.17

Table 5: Summary table Spurious RF Conducted Emissions

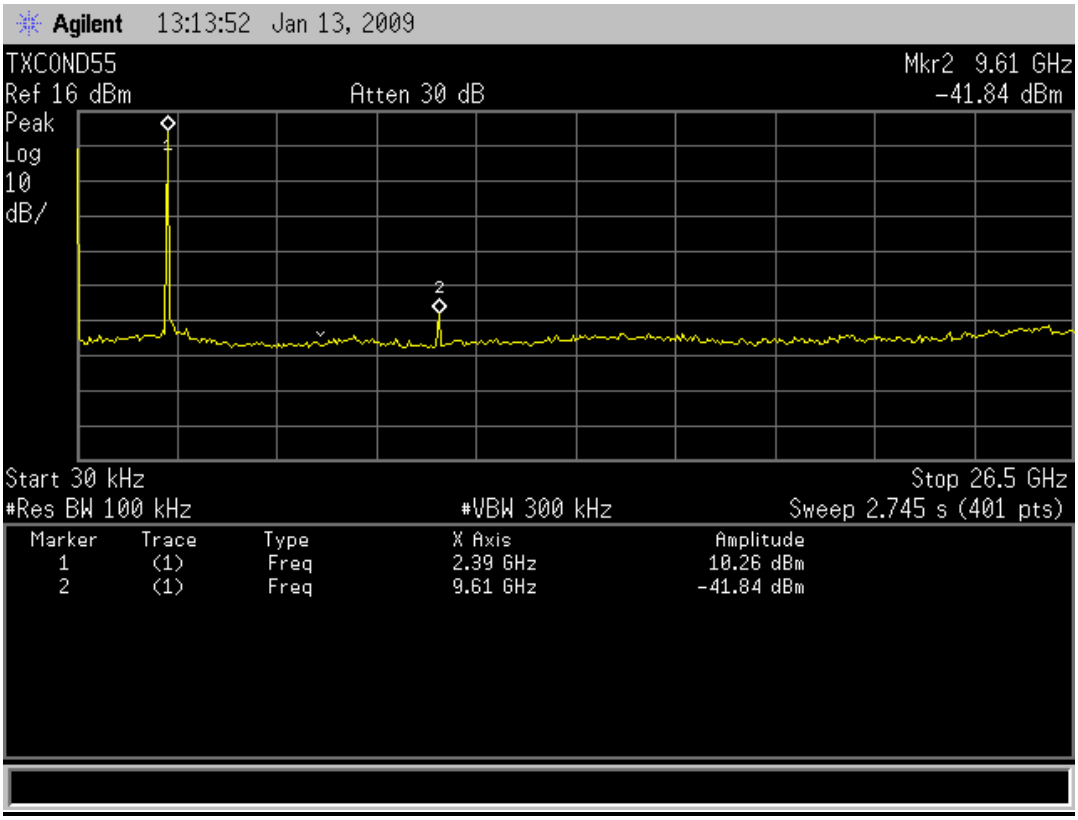


Figure 13: Spurious RF Conducted Emissions f= 2.405 GHz

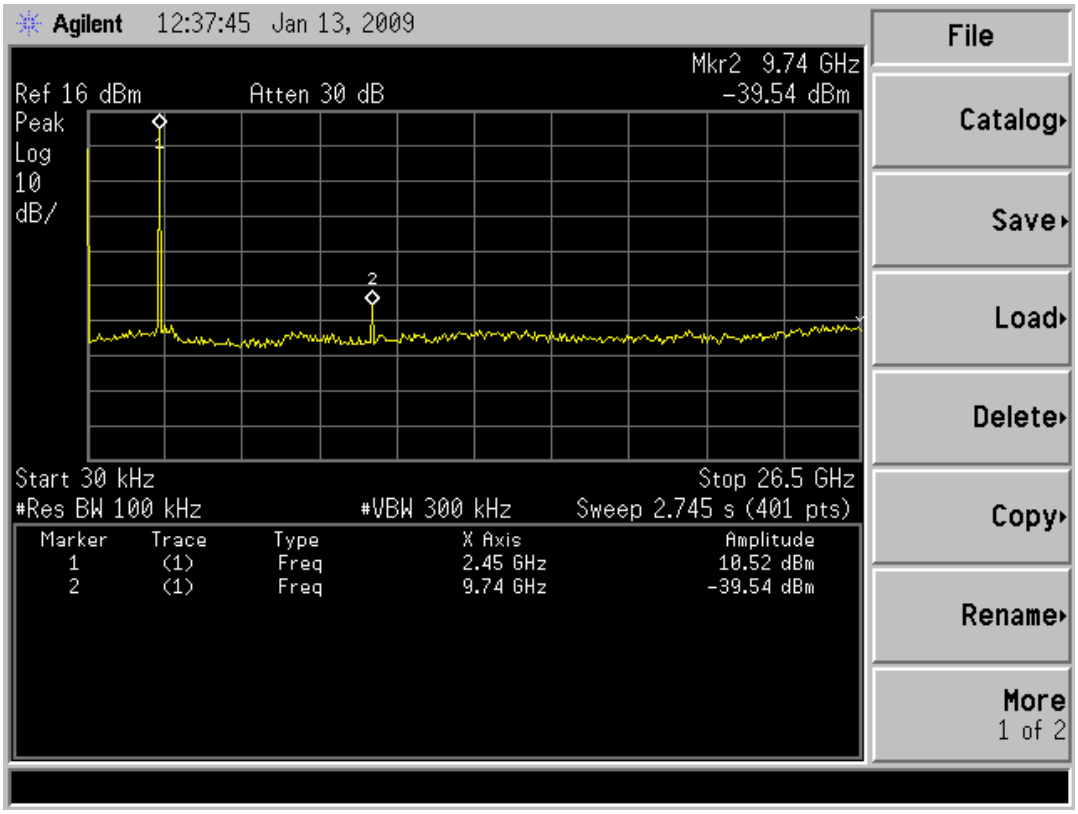


Figure 14: Spurious RF Conducted Emissions f= 2.440 GHz

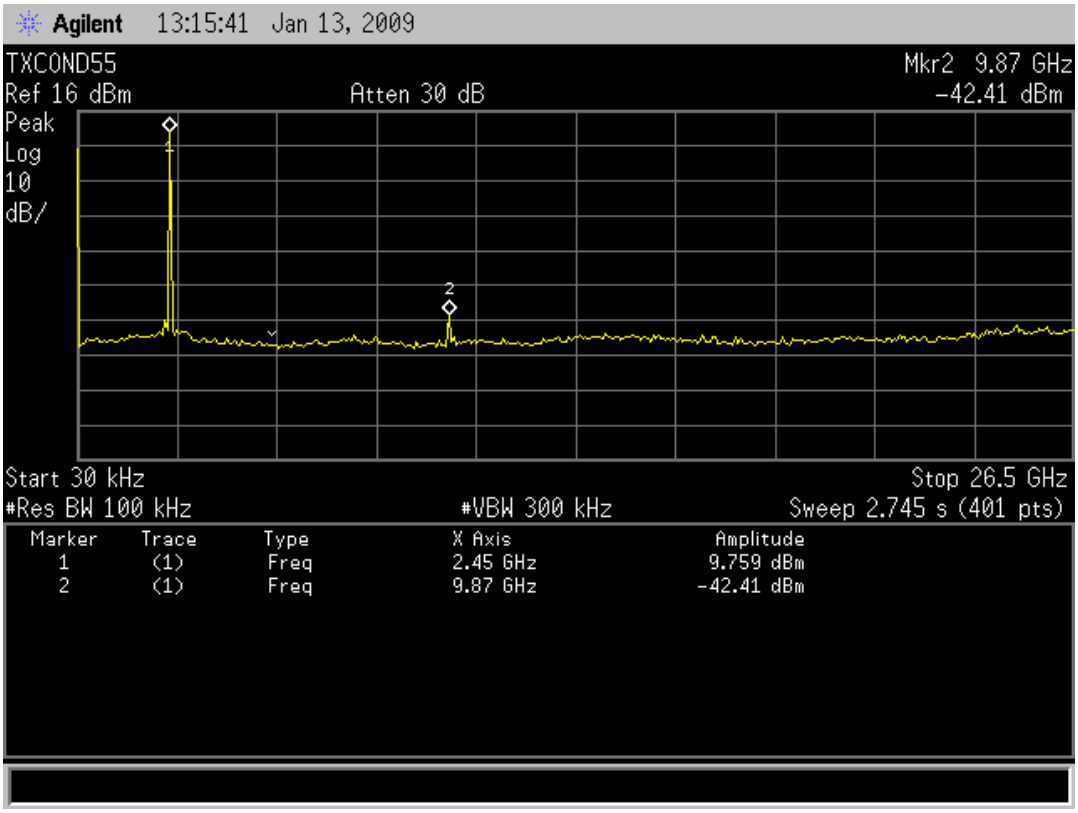


Figure 15: Spurious RF Conducted Emissions f= 2.475 GHz

15.247(d) / RSS-210 A8.5

Radiated Spurious 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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak 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 §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)). (note: 15.247 (b)(3) is for digital modulation.

Follow the procedure outlined in Annex A, and B of this document.

Equipment Used	Serial Number	Cal Date	Due
AH systems preamplifier model PAM 0126	135	12/08	12/09
H/S Sucoflex 40ft cable	220297001	12/3/07	12/3/09
Agilent E7405A Spectrum Analyzer	MY45113415	8/7/07	8/7/09
Emco 6502 Loop (9kHz to 30Mhz)	9509-2970	10/08	10/10
Emco 3110B Biconical (30MHz-to 300MHz)	9807-3129	04oct07	04oct09
Emco 3146 Log Periodic (200Mhz to 1GHz)	9203-3358	03oct07	03oct09
Emco 3115 wave guide (1GHz-18GHz)	9205-3878	3/17/08	3/17/09
AH systems Horn ant. SAS-572 (18GHz to 26.5GHz)	231	2/07	2/09
Date	Tested by	Temperature/humidity	
12/17/08	Douglas Knoll	54°F/33%	

Unit tested w/fresh battery: 62; Frequency range investigated was 9 kHz to 26GHz. Fundamental frequencies; 2405MHz, 2440MHz, 2475MHz

Freq. MHz	Antenna position cm/pol.	Table Azimuth degrees	Level dBm	Level dBuV	Amp Gain dB	Ant. Factor dB	Small Cable Loss dB	High Pass Filter dB	40ft Cable Loss dB	peak Level dBuV/m	emission dBc
9620	126.1cm vertical	96.1	-57.75	49.24	33.98	37.87	0.395	0.5	9.12	63.15	-48.51
9620	116cm horizontal	16.6	-64.01	42.98	33.98	38.87	0.395	0.5	9.12	56.89	-55.06
9760	124cm vertical	99.3	-55.16	51.83	33.83	37.96	0.399	0.45	9.19	66.01	-45.87
9760	112.2cm horizontal	19	-60.98	46.01	33.83	37.96	0.399	0.45	9.19	60.19	-52.14
9900	110.8cm vertical	98	-56.92	50.07	33.16	38.04	0.403	0.42	9.26	65.04	-45.57
9900	105cm horizontal	14	-61.52	45.47	33.16	38.04	0.403	0.42	9.26	60.44	-50.72
444.81	129.1cm vertical	326.7	-66.39	40.60	35.12	17.03	0.2		1.71	24.43	-87.23
444.81	118.5cm horizontal	263.3	-65.06	41.93	35.12	17.04	0.2		1.71	25.77	-86.18
2113.5	103.7cm vertical	307.1	-56.45	50.54	35.48	27.57	0.2		3.97	48.32	-63.34
2113.5	126.2cm horizontal	258.8	-55.04	51.95	35.48	27.67	0.2		3.97	50.37	-61.58
2549.5	188cm vertical	228.2	-56.92	50.07	35.30	28.66	0.2		4.43	48.07	-63.59
2549.5	102cm horizontal	257.8	-53.03	53.96	35.30	28.77	0.2		4.43	52.07	-59.88
479.8	123.4cm vertical	329.8	-66.27	40.72	35.10	18.20	0.2		1.78	25.81	-86.07
2056.5	107.5cm vertical	320.6	-62.04	44.95	35.51	27.54	0.2		3.91	41.1	-70.78
2056.5	100.2cm horizontal	237.9	-61.93	45.06	35.51	27.44	0.2		3.91	41.11	-71.22
2027.3	107.6cm vertical	307.7	-59.45	47.54	35.52	27.37	0.2		3.88	43.48	-67.13
2027.3	100cm horizontal	259.4	-56.03	50.96	35.52	27.47	0.2		3.88	47.00	-64.16
2100	105.2cm vertical	302.4	-58.26	48.73	35.49	27.54	0.2		3.96	44.95	-65.66
2100	100.3cm horizontal	253.5	-57.63	49.36	35.49	27.64	0.2		3.96	45.68	-65.48
2175.5	100cm vertical	302.5	-54.3	52.69	35.46	27.72	0.2		4.04	49.20	-61.41
2175.5	122.3cm horizontal	252.7	-53.4	53.59	35.46	27.82	0.2		4.04	50.20	-60.96
2622.8	100cm vertical	222.6	-55.77	51.22	35.26	28.89	0.2		4.51	49.57	-61.04
2622.8	100cm horizontal	253.1	-53.5	53.49	35.26	29.02	0.2		4.51	51.97	-59.19

15.205, 15.209 / RSS-210 2.2, 2.6

Restricted Bands Spurious Emissions Radiated

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:
(b) Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

Measure the field strength of all transmitter spurious emissions in the restricted bands listed below. Follow the procedure outlined in Annex A and B of this document.

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			

TABLE 6: List of Restricted Bands

Equipment Used	Serial Number	Cal Date	Due
AH systems preamplifier model PAM 0126	135	12/08	12/09
H/S Sucoflex 40ft cable	220297001	12/3/07	12/3/09
Agilent E7405A Spectrum Analyzer	MY45113415	8/7/07	8/7/09
Emco 6502 Loop (9kHz to 30Mhz)	9509-2970	10/08	10/10
Emco 3110B Biconical (30MHz-to 300MHz)	9807-3129	04oct07	04oct09
Emco 3146 Log Periodic (200Mhz to 1GHz)	9203-3358	03oct07	03oct09
Emco 3115 wave guide (1GHz to 18GHz)	9205-3878	3/17/08	3/17/09
AH systems Horn antenna SAS-572	231	2/07	2/09
Date	Tested by	Temperature/humidity	
1/06/09	Douglas Knoll	55°F/32%	

Unit tested w/fresh battery: 62

Average power levels are to be measured on spurious signals above 1GHz. This may be implemented by changing the video bandwidth filter to 10Hz (RBW=1MHz). However the E7405A analyzer does not have a 10Hz video bandwidth filter. For the average power data in this report, a 30Hz video bandwidth filter was used. Since the testing was done on a continuous signal with 100% duty cycle, the 30Hz video filter will give an absolute reading that will be higher than if a 10Hz filter were used. The true margin under the average power limit in a restricted band will be better than recorded here.

Per FCC DA 00-705. a Duty Cycle Correction Factor (20log(dwell time/100mS)) can be applied to show compliance to the 15.209 limit. The maximum allowed correction factor is 20 dB. For this unit Duty Cycle Correction Factor is n/a.

Spurious Emission Limits

Frequency (MHz)	Field Strength (microvolts/meter)	in dBuV/m	Measurement Distance (meters)
0.009-0.490 2400F	2440F (kHz)		300
0.490-1.705 24000F	2400F (kHz)		30
1.705-30.0	30	29.5	30
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

FS (dBuV/) = 20 * log (FS(uV/m))

TABLE 7: Spurious Emission Limits in Restricted Bands

									VBW RBW	1MHz 1MHz	30Hz 1MHz		
Freq. MHz	Ant. Position cm/pol.	Table Azimuth Degrees	peak Level dBm	Avg. Level dBm	Small Cable Loss dB	High Pass Filter dB	Amp Gain dB	Ant. Factor dB/m	Cable Loss dB	Peak Corrected Level dBuV/m	Average Corrected Level dBuV/m	Limit dBuV/m	Margin dB
2257.5	100.2cm vertical	338.7	-53.45	-58.98	0.2	0.00	35.42	27.92	4.12	50.37	44.84	54	9.16
2257.5	145.7cm horiz	258.9	-53.74	-58.62	0.2	0.00	35.42	28.02	4.12	50.18	45.30	54	8.7
2248.3	100.2cm vertical	341.9	-60.23	-69.52	0.2	0.00	35.43	28.00	4.11	43.65	34.36	54	19.64
2248.3	119.3cm horiz	250	-60.23	-69.7	0.2	0.00	35.43	27.90	4.11	43.55	34.08	54	19.92
2218.3	100.5cm vertical	307.1	-61.65	-70.45	0.2	0.00	35.44	27.82	4.08	42.01	33.21	54	20.79
2218.3	117.4cm horiz	246.2	-61.28	-70.82	0.2	0.00	35.44	27.92	4.08	42.48	32.94	54	21.06
2326.8	100cm vertical	290.3	-53.7	-59.8	0.2	0.00	35.39	28.08	4.20	50.39	44.29	54	9.71
2326.8	113.2cm horiz	239.1	-50.92	-56.42	0.2	0.00	35.39	28.18	4.20	53.27	47.77	54	6.23
4810	100cm vertical	6.4	-56.26	-65.4	0.26	0.21	35.13	32.76	6.29	55.13	45.99	54	8.01
4810	109.9cm horiz	60.8	-53.42	-62.26	0.26	0.21	35.13	32.76	6.29	57.97	49.13	54	4.87
4880	109.4cm vertical	7.5	-54.72	-63.63	0.26	0.18	35.16	32.88	6.34	56.78	47.87	54	6.13
4880	108cm horiz	63	-51.84	-60.5	0.26	0.18	35.16	32.88	6.34	59.66	51	54	3.0
4950	135.1cm vertical	183.8	-56.83	-66.44	0.26	0.19	35.19	33.01	6.39	54.84	45.23	54	8.77
4950	103.4cm horiz	56.1	-53.64	-62.9	0.26	0.19	35.19	33.01	6.39	58.03	48.77	54	5.23
7215	106cm vertical	86.5	-54.92	-65.7	0.33	0.16	35.09	35.82	7.79	61.09	50.31	54	3.69
7215	100.2cm horiz	164.6	-60.34	-70.89	0.33	0.16	35.09	35.82	7.79	55.67	45.12	54	8.88
7320	104.6cm vertical	84.2	-54.33	-64.59	0.33	0.16	34.99	36.07	7.85	62.09	51.83	54	2.17
7320	100.5cm horiz	165	-58.04	-68.45	0.33	0.16	34.99	36.07	7.85	58.38	47.97	54	6.033
7425	100.9cm vertical	89.2	-56.29	-66.58	0.33	0.13	34.89	36.32	7.91	60.52	50.23	54	3.77
7425	100cm horiz	163.2	-60.5	-70.75	0.33	0.13	34.89	36.32	7.91	56.31	46.06	54	7.94

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 8.

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 un-modulated carrier on the receiver frequency (antenna conducted measurement) or by transmitting an un-modulated 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.

Equipment Used	Serial Number	Cal Date	Due
Agilent E7405A Spectrum Analyzer	MY45113415	7-Aug-07	7-Aug-09
Huber&Suhner 18 inch. Sma to Sma	220060 002	3-Dec-07	3-Dec-09
Huber&Suhner 40 foot cable	220297 001	3-Dec-07	3-Dec-09
AH systems preamplifer model number PAM 0126	135	12/08	12/09
Emco 3110B Biconical (30MHz-to 300MHz)	9807-3129	04oct07	04oct09
Emco 3146 Log Periodic (200MHz to 1GHz)	9203-3358	03oct07	03oct09
Emco 3115 waveguide (1GHz - 18GHz)	9205-3878	17mar08	17mar10
Date	Tested by	Temp/Humidity, ºF / %	
1/08/09	Douglas Knoll	54/35	

Unit tested w/fresh battery: 63

Table 8- Spurious Emission Limits for Receivers

Spurious Frequency (MHz)	Field Strength (microvolt/m at 3 meters)	in dBuV/m
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

FS(uV/m) = 10 raised to the power of {(dBuV/m)/20}

Frequency range investigated was 30MHz to 15 GHz.

									VBW RBW	1MHz 1MHz	30Hz 1MHz		
Freq. MHz	Ant. Position cm/pol.	Table Azimuth Degrees	peak Level dBm	Avg. Level dBm	Small Cable Loss dB	High Pass Filter dB	Amp Gain dB	Ant. Factor dB/m	Cable Loss dB	Peak Corrected Level dBuV/m	Average Corrected Level dBuV/m	Limit dBuV/m	Margin dB
4806	104.4cm vertical	116	-63.63	-70.59	0.26	0.21	35.13	32.76	6.29	47.76	40.80	54	13.20
4806	100.4cm horiz	135.2	-63.34	-70.35	0.26	0.21	35.13	32.76	6.29	48.05	41.04	54	12.96
4876	102.6cm vertical	116	-63.57	-70.3	0.26	0.18	35.16	32.88	6.34	47.93	41.20	54	12.80
4876	100.1cm horiz	132.9	-64.02	-70.12	0.26	0.18	35.16	32.88	6.34	47.48	41.38	54	12.62
4946	114cm vertical	115.7	-63.75	-70.15	0.26	0.19	35.19	33.01	6.39	47.92	41.52	54	12.48
4946	110.7cm horiz	134.9	-64.05	-70.9	0.26	0.19	35.19	33.01	6.39	47.62	40.77	54	13.23

1.1310 & 2.1091 / RSS-102

Maximum Permissible Exposure (MPE)

Determine the maximum power density for the general / uncontrolled population minimum separation distance of 20 cm.

FCC Limit: f > 1500 MHz = 1mW/cm^2; IC Limit: f=1500 to 15000 MHz = 10W/m^2

The power density is calculated as:

$$P_d = \frac{P_t \times G}{4 \times \pi \times r^2}$$

P_d = power density in watts
P_t = transmit power in milliwatts
G = numeric antenna gain
r = distance between body and transmitter in centimeters.

Other Technical Information:

Antenna Type: Omni
Antenna Gain: 0 dBi
Transmitter Power (Conducted): 45mW
Frequency: 2440 MHz

---

results: P_D = (45x 1) / (4 x pi x 20cm^2) =0.00895mW/cm$^{2=}$ 0.0895W/m^2 @ 20 cm

15.247 (d)
Band-edge compliance of RF Radiated Emissions

see spurious emissions section above for rules.

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

Also, Refer to Restricted Bands Spurious Emissions Radiated section above as the adjacent bands here are Restricted Bands and particular attention was paid to meeting those levels.

Allow the trace to stabilize. 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, and 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.

Item	Model Number	Serial Number	Cal Date	Due
Spectrum Analyzer	E7405A	MY45113415	Aug/08	Aug/09
EMCO 3115 double ridge wave guide	3115	9205-3878	Mar/07	Mar/09
Huber&Suhner 40 foot cable	Sucoflex 100	220297 001	Dec/08	Dec/09
Sucoflex 104 cable	Sucoflex 104	220060 002	May/07	May/09
AH systems preamplifer	PAM 0126	135	Dec/08	Dec/09

Date	Tested by
1/07/09	Douglas Knoll

Unit tested w/fresh battery: 62

Frequency (MHz)	Polarity	Angle of DUT (degrees)	Height of Antenna (cm)	Reading (Peak or Average)	Corrected Maximum Reading (dBuV/m @ 3m)	Radiated Limit dBuV/m	Margin dB
2390	Vertical	104.4	116	Average	41.64	54	12.36
2390	Vertical	104.4	116	Peak	51.69		
2483.5	Vertical	114	115.7	Average	38.37	54	15.63
2483.5	Vertical	114	115.7	Peak	48.44		

Table 6: Summary table of Band Edge Maximum Readings

Band-Edge Measurement Plots @ 3 meters
2310 - 2390 MHz & 2483.5 - 2500 MHz

***Note: All calibration and correction factors for test equipment are entered into the spectrum analyzer (E7405A). The reported data and plots are the corrected reading.*

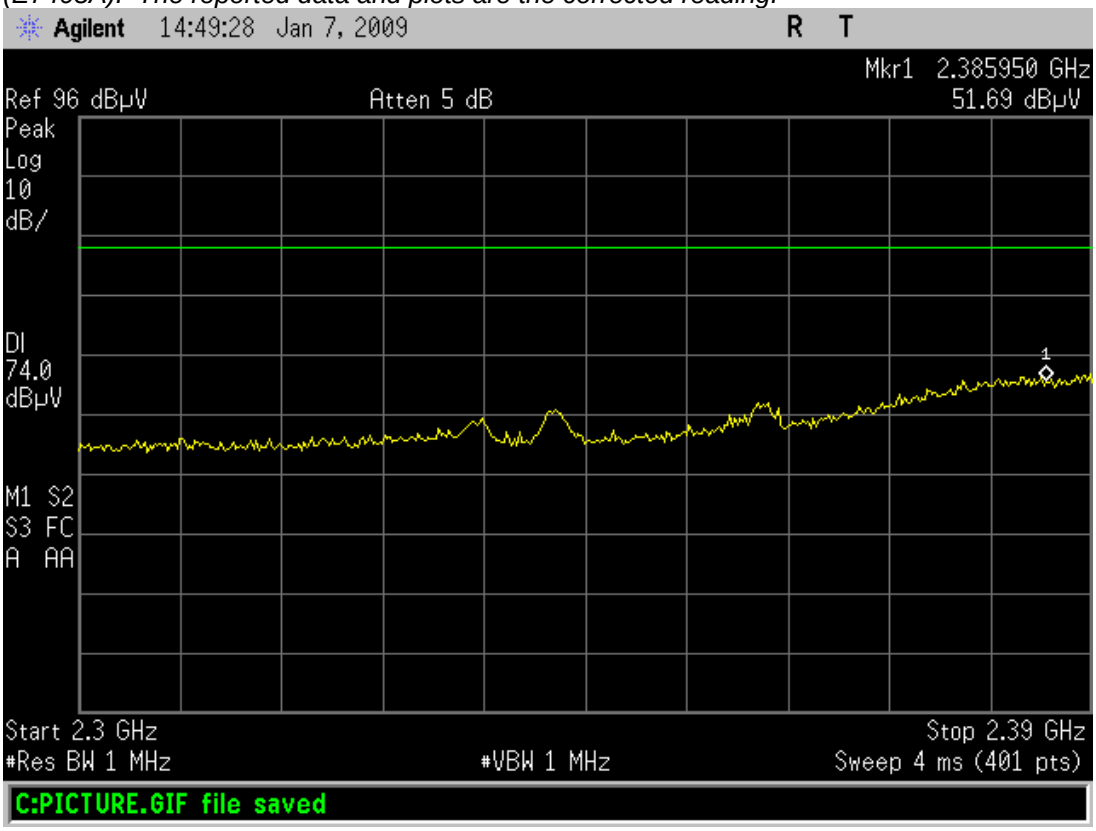


Figure 16: Peak Radiated Band Edge (2405MHz fund)

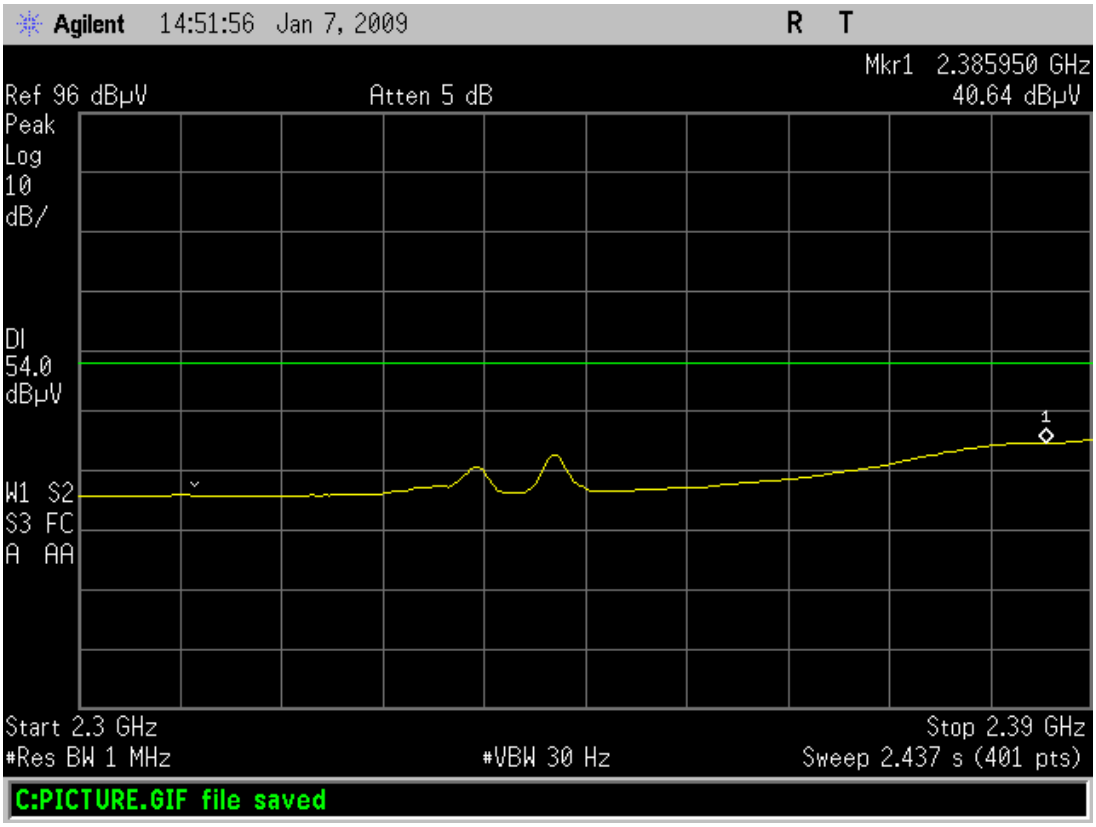


Figure 17: Average Radiated Band Edge (2405MHz fund)

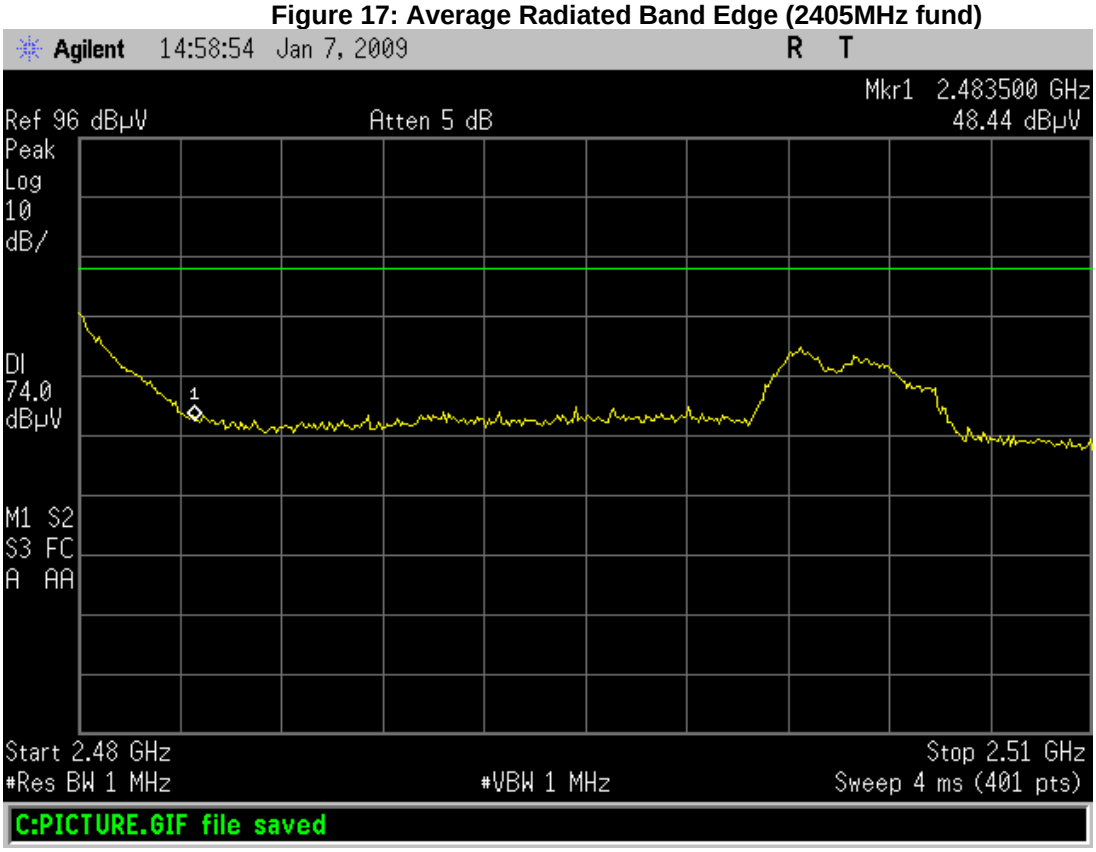


Figure 18: Peak Radiated Band Edge (2475MHz fund)

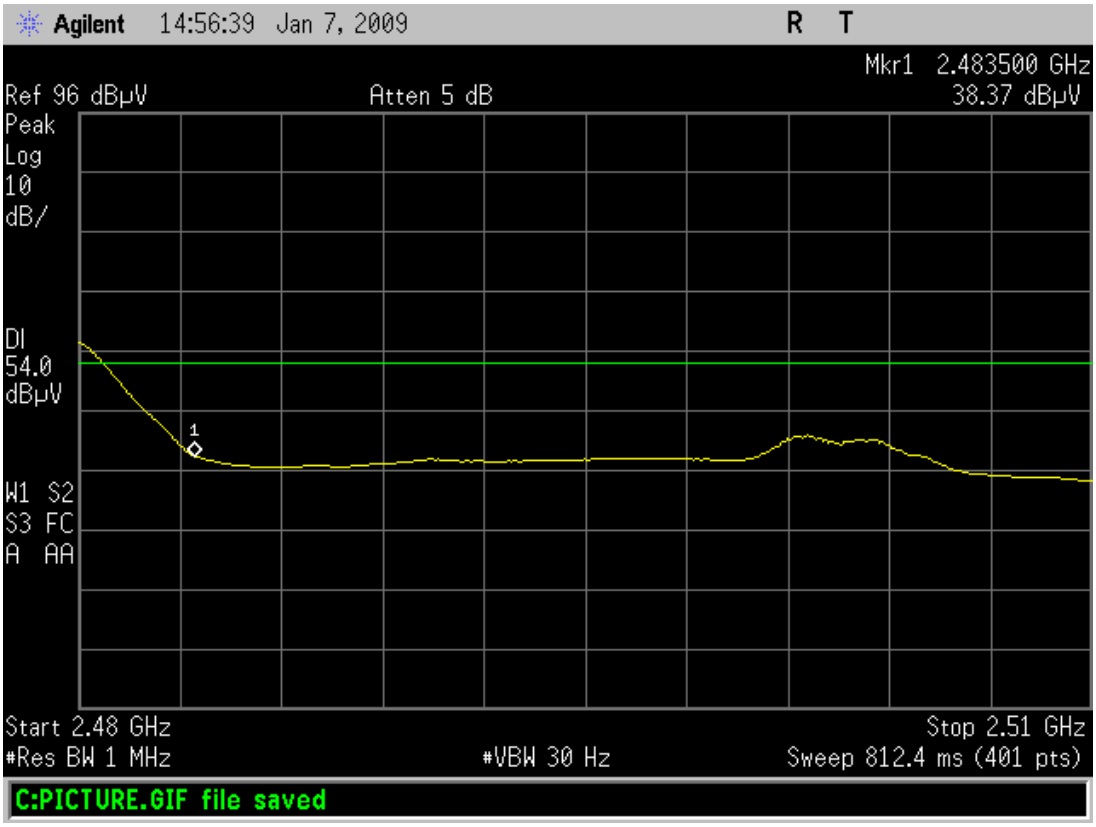


Figure 19: Average Radiated Band Edge (2475MHz fund)

ANNEX A
direct from FCC DA-00-705, March 30, 2000

Spurious RF Conducted Emissions

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. Typically, several plots are required to cover this entire span.

RBW = 100 kHz

VBW $\geq$ 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 in this Section. Submit these plots.

Spurious Radiated Emissions

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 $\geq$ 1 GHz, 100 kHz for f < 1 GHz

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Follow the guidelines in ANSI C63.4-1992 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). Submit this data.

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 emission on which a radiated measurement must be made is located at the edge of the authorized band of operation, then the alternative "marker-delta" method, listed at the end of this document, may be employed.

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.

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.

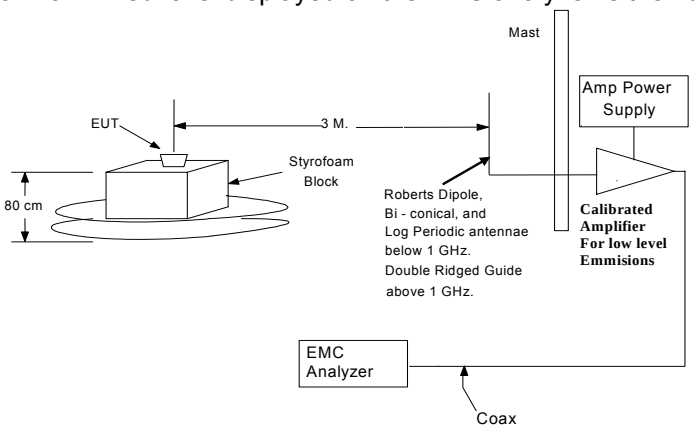
STEP 4) The above "delta" measurement technique may be used for measuring emissions that are up to two "standard" bandwidths away from the band-edge, where a "standard" bandwidth is the bandwidth specified by C63.4 for the frequency being measured. For example, for band-edge measurements in the restricted 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.

ANNEX B

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. The bandwidths used shall be; 200 Hz from 9 kHz to 150 kHz, 9 kHz from 150 kHz to 30 MHz, 120 kHz from 30 MHz to 1000 MHz, and 1 MHz from 1 GHz to 40 GHz, with the detector set to peak hold.

1) The antenna correction factor, preamplifier gain (if the preamplifier is installed), and cable loss are stored in tables in the EMC analyzer and the level at the analyzer is the corrected level in dbuV/m.
2) Monitor the frequency range of interest at a fixed antenna height and EUT azimuth.
3) 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.
4) 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 3). Otherwise, orient the EUT azimuth to repeat the highest amplitude observation and proceed.
5) 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 3) with the antenna fixed at this height. Otherwise, move the antenna to the height that repeats the highest amplitude observation and proceed.
6) Change the polarity of the antenna and repeat step 3), step 4), and step 5). Compare the resulting suspected highest amplitude signal with that found for the other polarity. Select and note the higher of the two signals.
7) The final maximized level displayed on the EMC analyzer is the field strength.



ANNEX C

Several of the FCC parts that are referenced.

Section 15.247(b) (3): For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

1997 FCC Decisions, Amendment of Parts 2 and 15. 7 CR 534, 12 FCC Rcd 7488, 62 FR 26239, 1997 FCC LEXIS 1927. FCC 917-114 Report and Order, Released: April 10, 1997:
Section 15.247(c): Spurious emissions. The following tests are required:

(1) RF antenna conducted test: Set RBW = 100 kHz, Video bandwidth (VBW) > RBW, scan up through 10th harmonic. All harmonics/spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.
(2) Radiated emission test: Applies to harmonics/spurs that fall in the restricted bands listed in Section 15.205. The maximum permitted average field strength is listed in Section 15.209. A pre-amp (and possibly a high-pass filter) is necessary for this measurement. For measurements above 1 GHz, set RBW = 1 MHz, VBW = 10 Hz, Sweep: Auto. If the emission is pulsed, modify the unit for continuous operation, use the settings shown above, then correct the reading by subtracting the peak-average correction factor, derived from the appropriate duty cycle calculation. See Section 15.35(b) and (c).

Section 15.35 Measurement detector functions and bandwidths. - The conducted and radiated emission limits shown in this part are based on the following, unless otherwise specified elsewhere in this part:

(a) …

(b) Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz. When average radiated emission measurements are specified in this part, including average emission measurements below 1000 MHz, there also is a limit on the peak level of the radio frequency emissions. Unless otherwise specified, e.g., see §§15.250, 15.252, 15.255, and 15.509-15.519, the limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device, e.g., the total peak power level. Note that the use of a pulse desensitization correction factor may be needed to determine the total peak emission level. The instruction manual or application note for the measurement instrument should be consulted for determining pulse desensitization factors, as necessary.

(c) Unless otherwise specified, e.g. §15.255(b), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to Declaration of Conformity or verification.