REGULATORY COMPLIANCE REPORT

TITLE: FCC & IC Test Report for 15.247 & RSS-210 Frequency Hopping Device 100W/WP-phase3.3
AUTHOR: Roger Mulcahy

REV	CCO	DESCRIPTION OF CHANGE	DATE	APPROVALS	
001		INITIAL RELEASE		Engineering	
				Regulatory	

REVISION HISTORY

A		for initial upload	15jun11	Engineering	
				Regulatory	
B		updated for questions		Engineering	
				Regulatory	
				Engineering	
				Regulatory	

Test Data Summary

FCC 15.247 / IC RSS-210
Frequency Hopping Transmitter 100WB, 903 – 926.8 MHz
FCC ID:EWQ100WB
IC:864D-100WB
Device Models (for IC): 100WB
OATS Registration Number: FCC 90716, IC 864D-1

Rule	Description	Spec Limit	Max. Reading	Pass/ Fail
Part 15.247 (a)(1)	System Receivers		Match this device	Pass
Part 15.31(e)	Variation of Input Voltage – Conducted	N/A	N/A	N/A
Part 15.207 / RSS-Gen 7.2.2	AC Power line Conducted Emissions	46 to 56 dBuV	N/A	N/A
Part 15.247(a)(1) / RSS-210 A8.1(b)	Carrier Frequency Separation – Conducted	Minimum 115 kHz	200kHz CW @ 903 MHz	Pass
Part 15.247(a)(1)(i) / RSS-210 A8.1(c)	Number of Hopping Channels – Conducted	Minimum 50 channels	50 channels AM modulation 120 channels FM Modulation	Pass
Part 15.247(a)(1)(i) / RSS 210 8.1 (a)	20dB Bandwidth – Conducted	Maximum 250 kHz	110kHzAM @926.8MHz 82kHz FM @926.8MHz	Pass
Part 15.247(a)(1)(i);(g); (h) / RSS-210 A8.1(c)	Time of Occupancy, Short Burst, Intelligence	Maximum 400 ms. In 20 second period	283.4 mS	Pass
Part 15.247(b) (2) / RSS-210 A8.4(1)	Power Output – Conducted	Maximum 1 Watt	.321 Watts FM @915MHz .301 Watts AM @903MHz	Pass
Part 15.247(d) / RSS-210 A8.5	Spurious Emissions – Radiated	Maximum -20 dBc	-42.76dBc @5490MHz AM	Pass
Parts 15.205 & 15.209 / RSS-210 2.2, 2.6 Tables 1 & 2	Restricted Bands / Spurious Emissions – Radiated	Maximum 54 dBuV/m Average Maximum 74 dBuV/m Peak	53.20dBuV/m Average FM @5418MHz 42.19dBuV/m Average AM @ 5418MHz 72.35 dBuV/m Peak @ 5418MHz AM	Pass
RSS-Gen 7.2.3 and Unintentional Part 15.109	Receiver Spurious Emissions	table below	No emissions noise floor is 27dbuV/m	Pass
Parts 1.1310 & 2.1091(mobile) or 2.1093 (portable) / RSS-102 Sec 4.2	Limits for Maximum Permissible Exposure (MPE)	Maximum 0.61 mW / cm^2 @ 20cm 6.1 W / M^2 (@ 0.2M)	0.319 mW / cm^2 @ 20 cm 3.19 W/M^2 @ 0.2 M	Pass

15.247 (d)	Band-edge compliance of RF Conducted Emissions	Maximum -20 dBc	--31.21dBc AM @ 903 MHz	Pass

Rule versions: FCC Part 1; FCC Part 2; FCC Part 15, RSS-102 Issue 4 (03-2010); RSS-210 Issue 8 (12-2010); RSS-Gen Issue 3 (12-2010).
Reference docs: ANSI C63.4-2003; DA 00-705 (03-30-2000); OET65 (08-1997); OET65C (06-2001); IEEE C95.3-2002.
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Cognizant Personnel	
Name _Roger Mulcahy	Title Test Technician
Name Jay Holcomb	Title Regulatory Manager
Name Jason Woodruff	Title Project Lead

CONDITIONS DURING TESTING

No Modifications to the EUT were necessary during the testing.

FCC 15.31(m) – IC _n/a_; Number of Channels
This device was tested on three channels.

ANSI C63.4 - Temperature and Humidity During Testing
The temperature during testing was within +10º C and +40º C.
The Relative humidity was between 10% and 90%.
RSS-Gen 4.3: Tests shall be performed at ambient temperature

EQUIPMENT UNDER TEST (EUT) DESCRIPTION
Itron declares that the EUT tested was representative of a production unit.

EQUIPMENT UNDER TEST

EUT Module

Manuf:	Itron, Inc.
Itron Model:	Itron 100W/WP (Customer nomenclature)Endpoint
FCC/IC cert #:	100WB
Serial Number(s)	200087 and 200063 or Listed Below
Power source	Fresh Batteries, Fully charged Batteries or Battery simulator.

Plot Information
In the zero span measurements, the line in the display is the trigger level.

15.247(a)(1)

System receivers

… … …The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

THIS DEVICE IS OPERATED IN SYSTEMS THAT THE READING DEVICES, HAVE INPUT BANDWIDTHS THAT MATCH THIS DEVICE AND THAT STAY IN SYNCRONIZATION.

15.31(e)

Variation of Supply Voltage

Vary the supply voltage from 85% to 115% of the nominal voltage. If the power level of the fundamental signal varies with supply voltage, record the voltage level at which the fundamental signal is at its highest and use that voltage level for all further testing.

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

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. BATTER IS NOT RECHARGABLE. THERFORE THIS TEST IS N/A.

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

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:

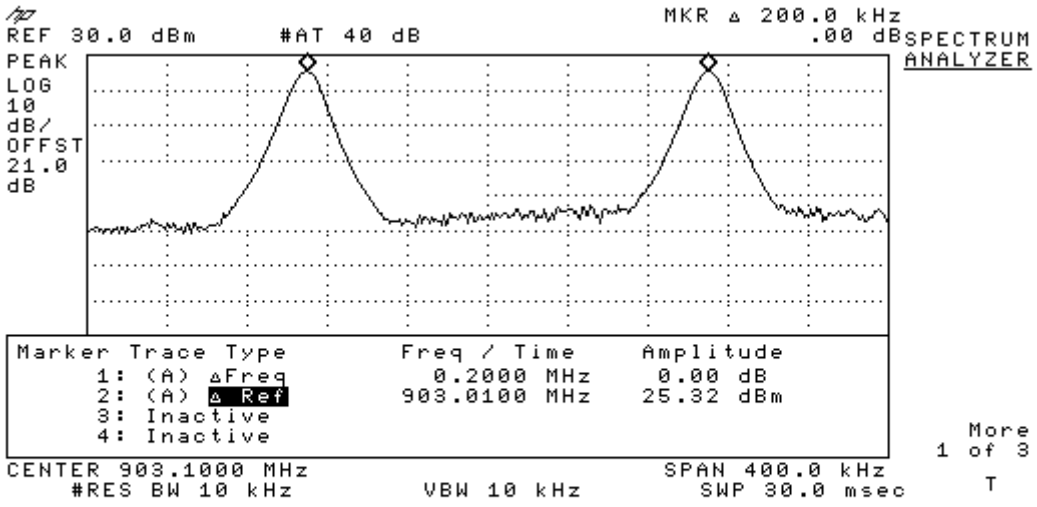
RBW ≥ 1% of the span
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

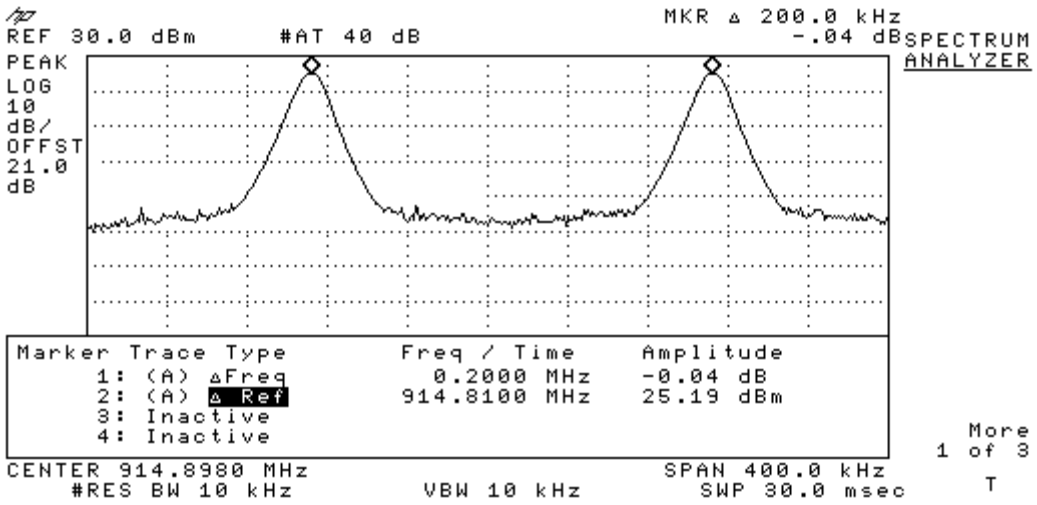
Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section.

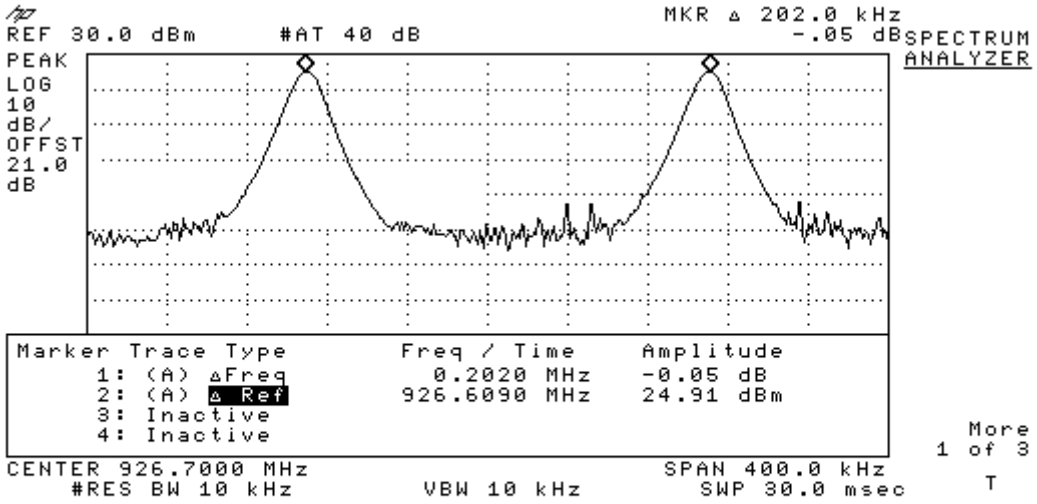
Equipment Used	Serial Number	Cal Date	Due
HP 8593E	3543A02032	12/3/2010	12/3/2011
Date	**Tested by**		
5/12/2011	Roger Mulcahy		

Unit tested w/fresh battery: 200087

Frequency (MHz)/channel	Mode	Channel Separation (kHz)	Frequency (MHz)/channel
903.005 / 5	*CW*	*200*	*903.205 / 6*
914.810 / 64	*CW*	*200*	*915.016 / 65*
926.609 / 123	*CW*	*202*	*926.811 / 124*




REF 30.0 dBm
#AT 40 dB
MKR Δ 200.0 kHz
-.04 dB
SPECTRUM
ANALYZER
PEAK
LOG
10
dB/
OFFST
21.0
dB
Marker Trace Type
1: (A) ΔFreq
2: (A) Δ Ref
3: Inactive
4: Inactive
Freq / Time
0.2000 MHz
914.8100 MHz
Amplitude
-0.04 dB
25.19 dBm
More
1 of 3
CENTER 914.8980 MHz
#RES BW 10 kHz
VBW 10 kHz
SPAN 400.0 kHz
SWP 30.0 msec
T


REF 30.0 dBm
#AT 40 dB
MKR Δ 202.0 kHz
-.05 dB
SPECTRUM
ANALYZER
PEAK
LOG
10
dB/
OFFST
21.0
dB
Marker Trace Type
1: (A) ΔFreq
2: (A) Δ Ref
3: Inactive
4: Inactive
Freq / Time
0.2020 MHz
926.6090 MHz
Amplitude
-0.05 dB
24.91 dBm
More
1 of 3
CENTER 926.7000 MHz
#RES BW 10 kHz
VBW 10 kHz
SPAN 400.0 kHz
SWP 30.0 msec
T

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

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:

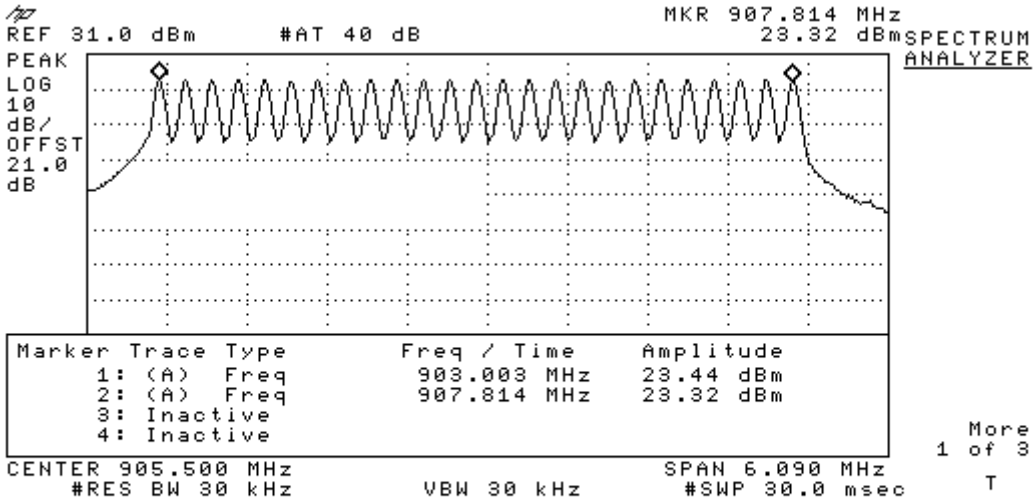
Span = the frequency band of operation
RBW ≥ 1% of the span
VBW ≥ RBW
Sweep = auto
Detector function = Peak
Trace = max hold

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. The limit is specified in one of the subparagraphs of this Section.

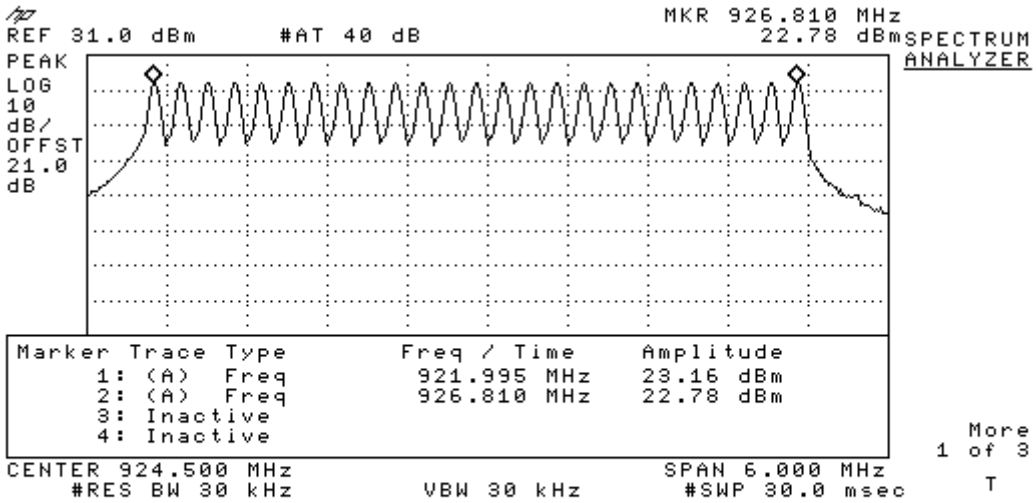
Equipment Used	Serial Number	Cal Date	Due
HP 8593E	3543A02032	12/3/2010	12/3/2011
Date	**Tested by**		
5/13/2011 to 5/16/2011	Roger Mulcahy		

Unit tested w/fresh battery: 200087
System uses 50 channels AM Mode and 120 channels FM Mode.

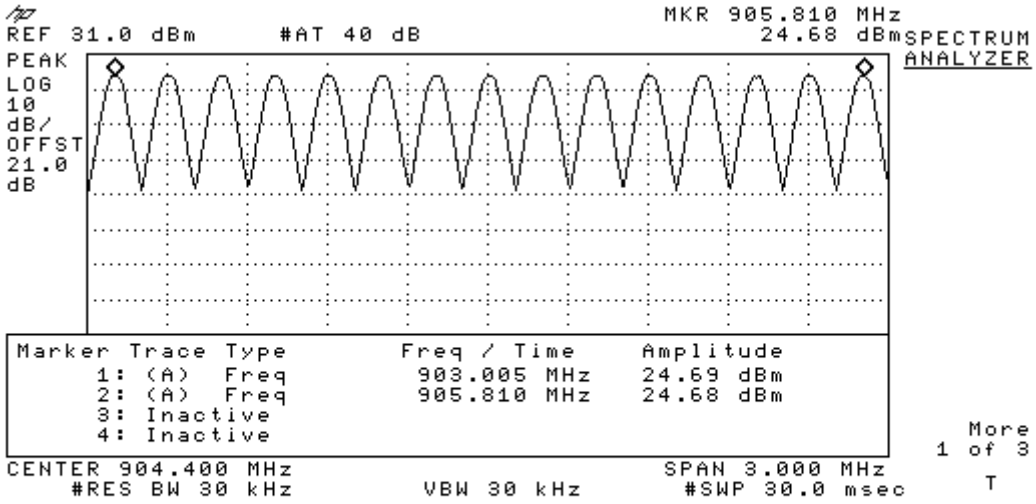
Channels 5 to 29 AM Mode



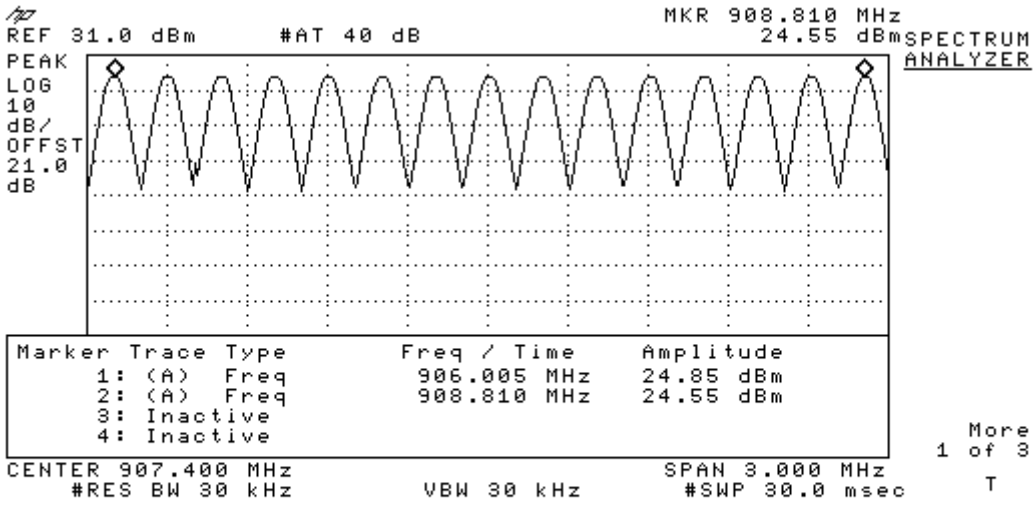
Channels 100 to 124 AM Mode



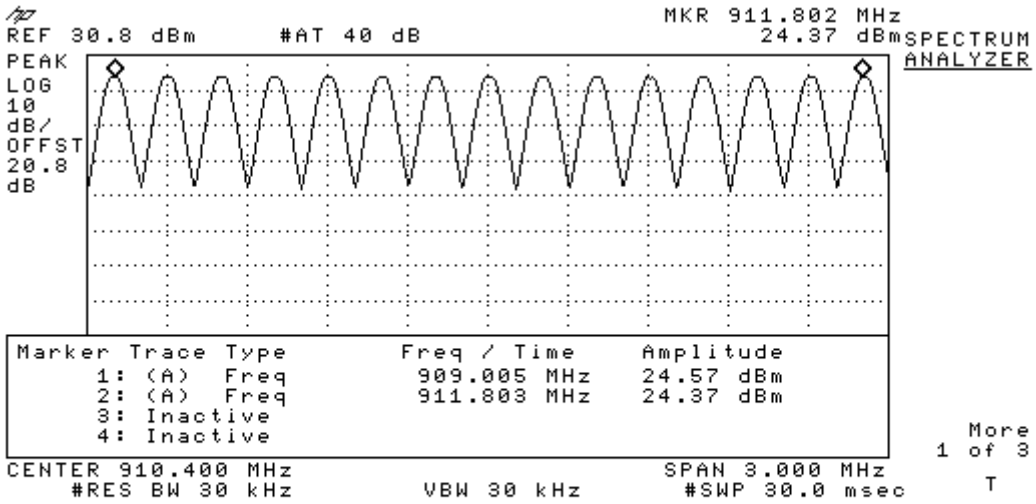
Channel 5 to 19 FM Mode



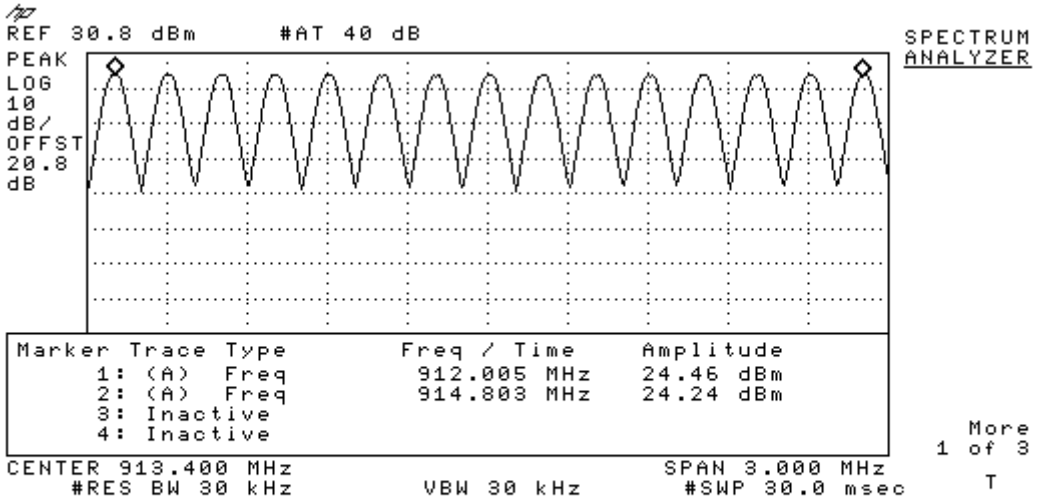
Channel 20 to 34 FM Mode



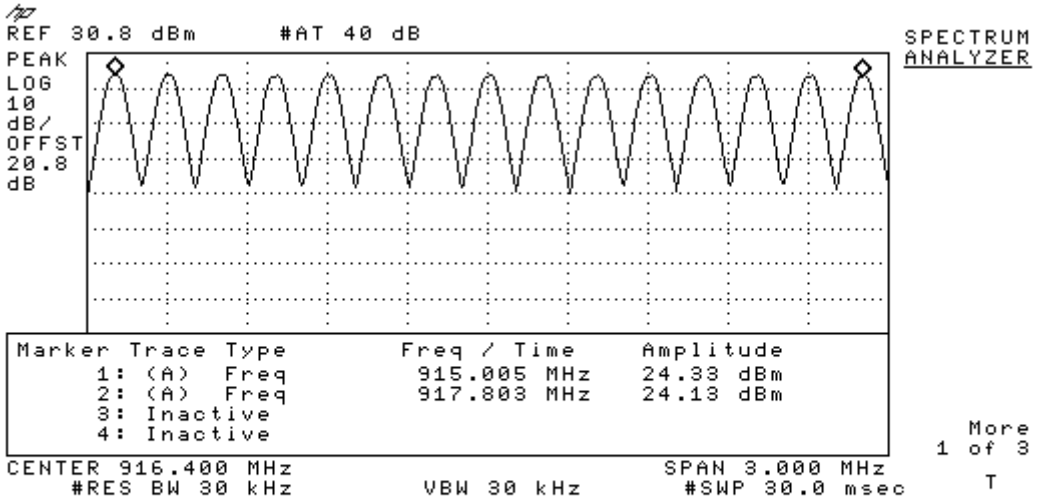
Channels 35 to 49 FM Mode



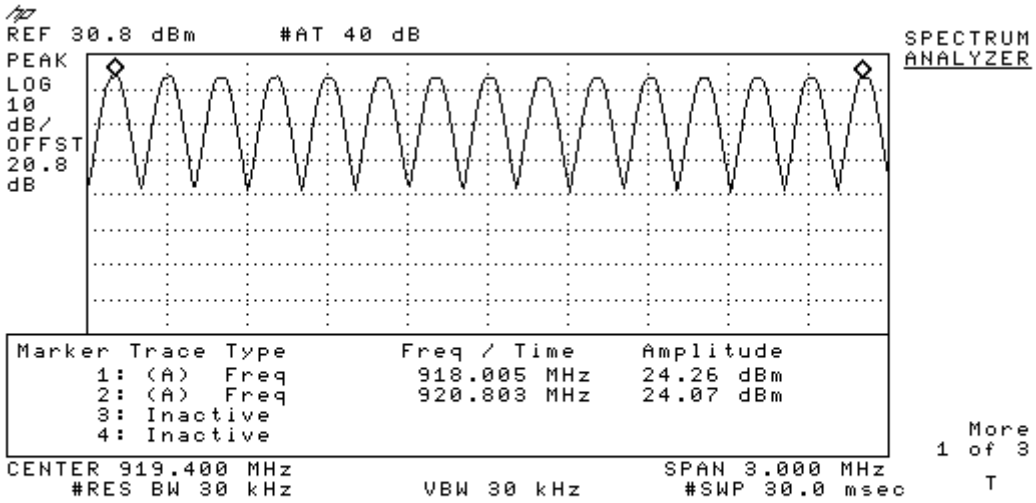
Channel 50 to 64 FM Mode



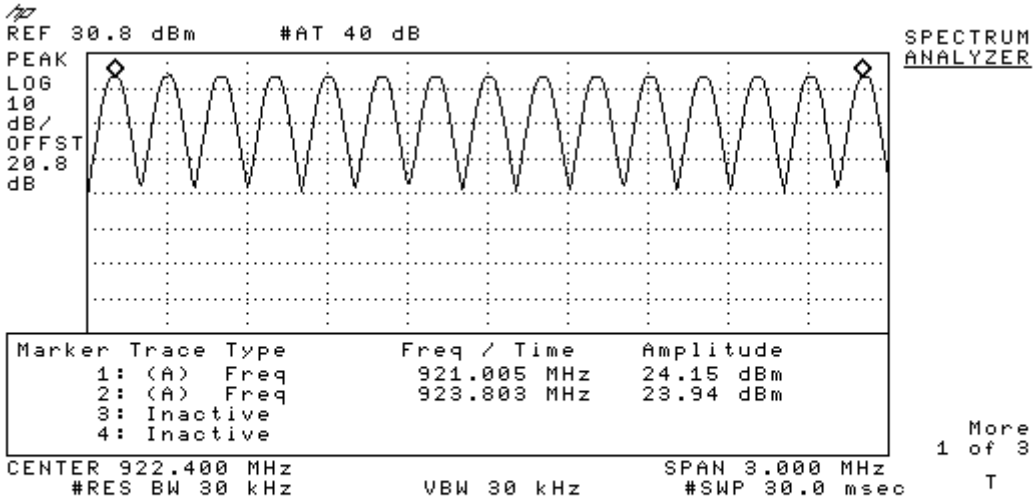
Channel 65 to 79 FM Mode



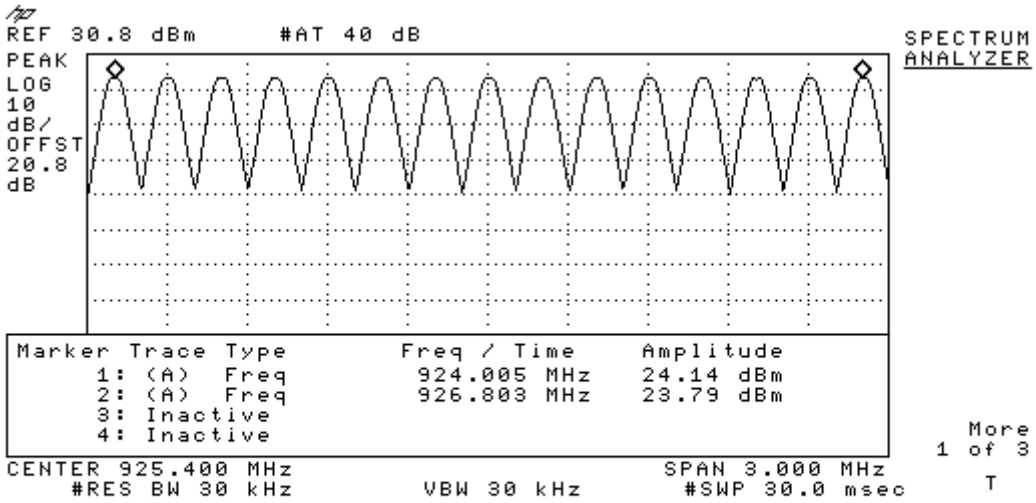
Channel 80 to 94 FM Mode



Channel 95 to 109 FM Mode



Channel 110 to 124 FM Mode



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

20 dB Bandwidth

Verify that the 20 dB bandwidth of the hopping channel is less than 250 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

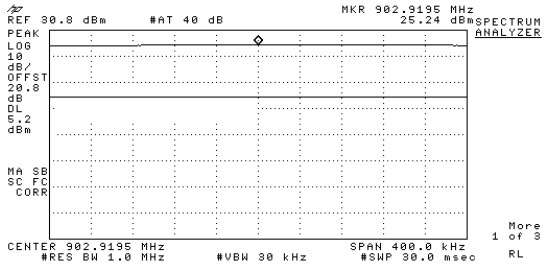
The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the 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. The limit is specified in one of the subparagraphs of this Section.

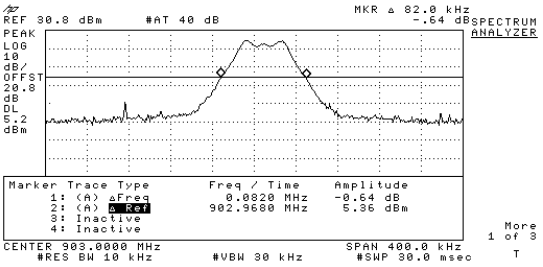
Equipment Used	Serial Number	Cal Date	Due
HP 8593E	3543A02032	12/3/2010	12/3/2011
Date	**Tested by**		
5/16/2011 to 5/17/2011	Roger Mulcahy		

Unit tested w/fresh battery: 200087

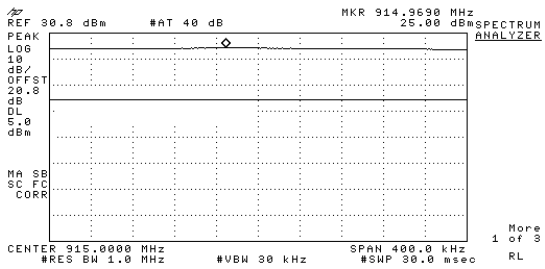
Frequency (MHz)/channel	Bandwidth	Mode	Power level
903 / 5	*82 kHz*	*FM*	*E*
915 / 65	*81 kHz*	*FM*	*E*
926.8 / 124	*82 kHz*	*FM*	*E*
903 / 5	*97 kHz*	*AM*	*C*
915 / 65	*106 kHz*	*AM*	*C*
926.8 / 124	*110 KHz*	*AM*	*C*

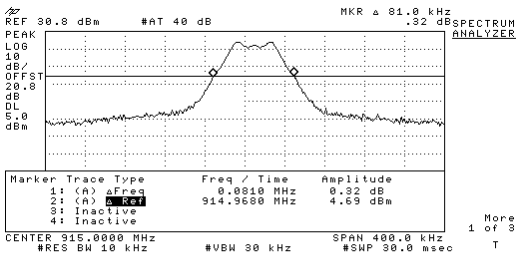
FM Mode 903 MHz, Channel 5



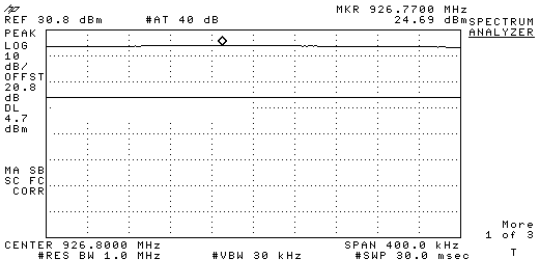


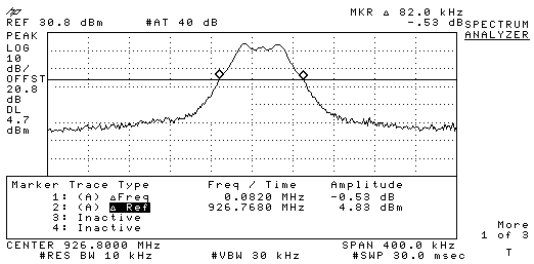
FM Mode 915 MHz, Channel 65



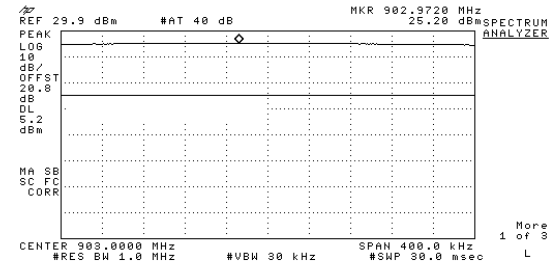


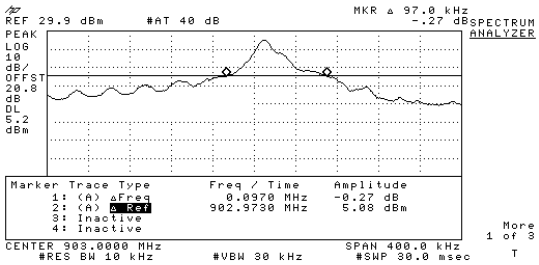
FM Mode 926.8 MHz, Channel 124



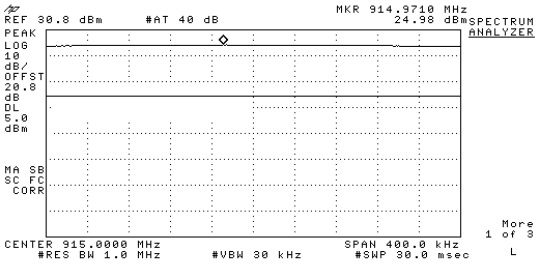


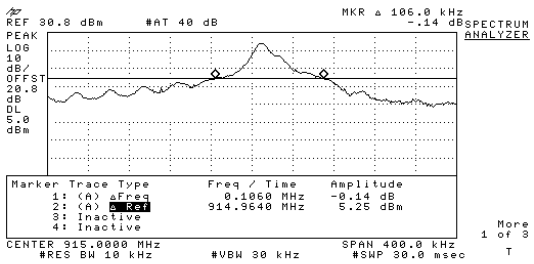
AM Mode 903 MHz, Channel 5



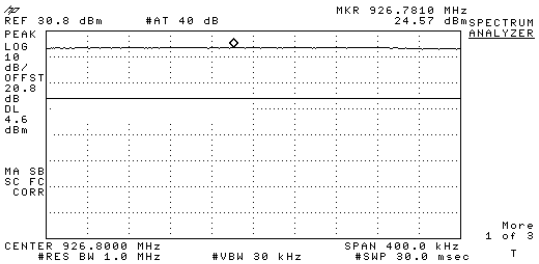


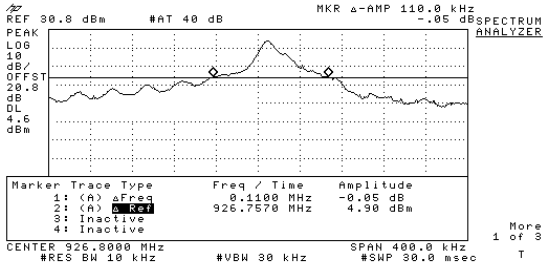
AM Mode 915 MHz, Channel 65





AM Mode 926.8 MHz, Channel 124





15.247(a) (1) (i); (g); (h) / RSS-210 A8.1 (c)

Time of Occupancy

Verify that the transmitted signal does not occupy a single frequency for more than 400 mS in a 20 second period.

Short Bursts

… a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

Intelligence

The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

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.

The maximum possible occupancy time on any one frequency is 400 mS within a 20 second period.

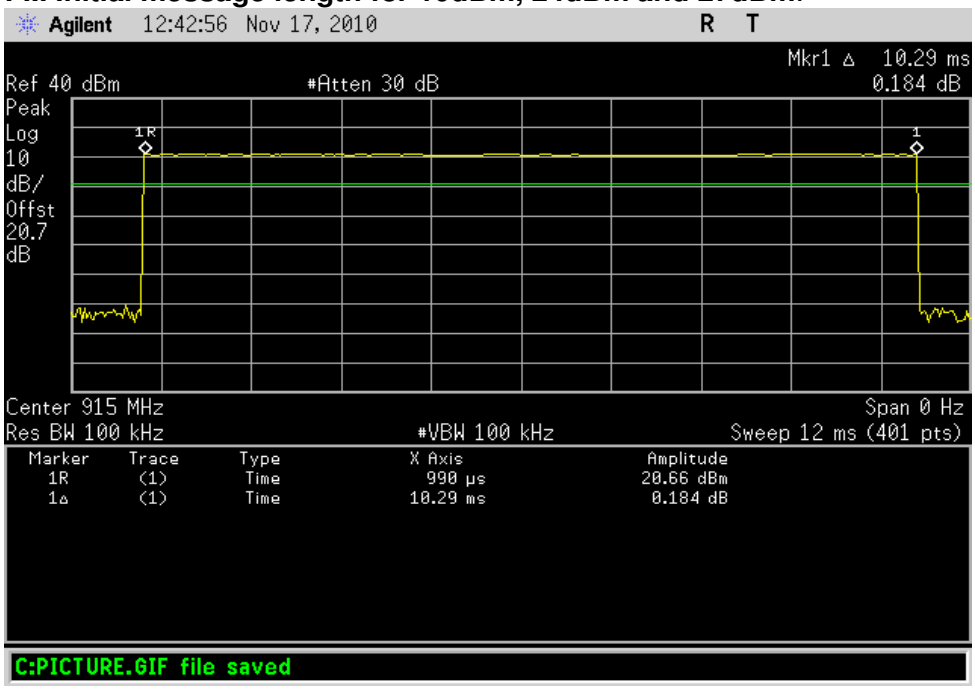
The system this product is used in does not incorporate any type of intelligence to avoid the simultaneous occupancy of individual hopping frequencies.

Equipment Used	Serial Number	Cal Date	Due
Agilent E4402B	My44210913	10/7/2010	10/7/2012
Date	**Tested by**		
11/17/2010	Roger Mulcahy		

Mode	dBm	Initial message length	Number of Initial messages	Two way message length	Number of two way messages	Total transmission time in 20 second period (milliseconds)
AM	24,10	22.4	1	52.2	5	283.4
FM	24,10	10.29	1	23.25	5	126.54
AM	27	22.4	1	25.8	5	151.4
FM	27	10.29	1	11.34	5	66.99

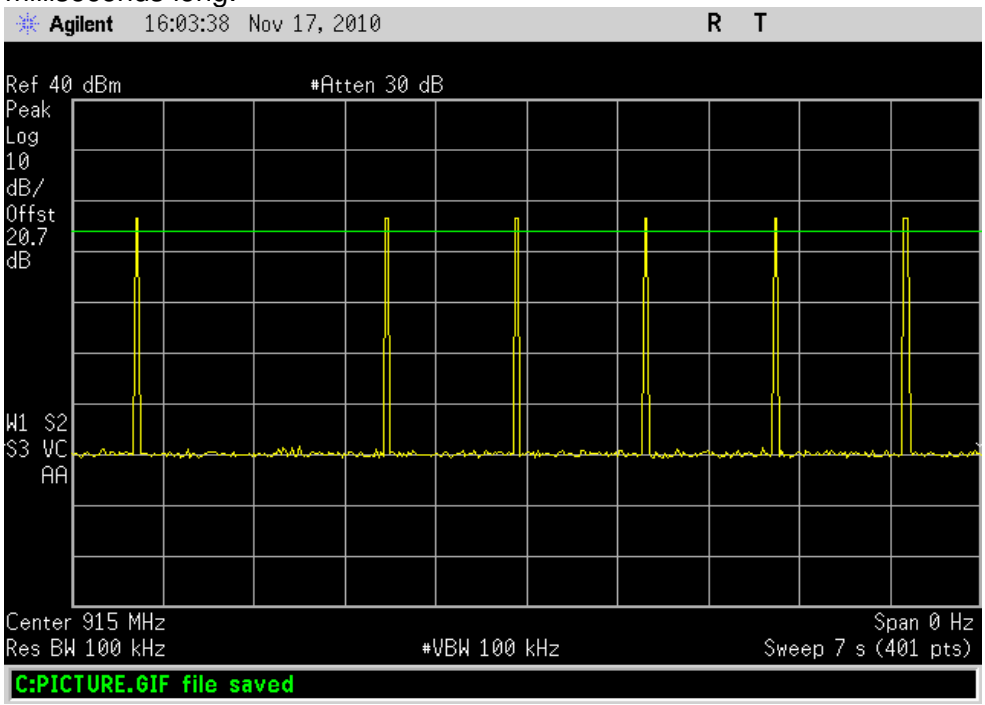
Unit tested w/fresh battery: *200063*

FM Initial message length for 10dBm, 24dBm and 27dBm.

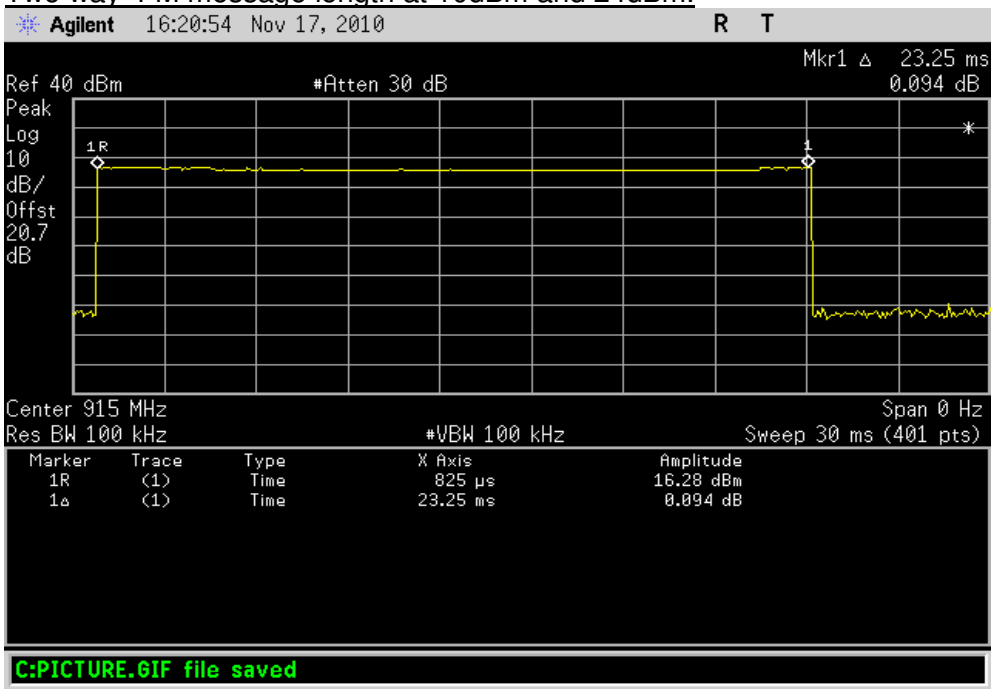


FM mode of operation at 10dBm and 24dBm.

The maximum transmissions on a single channel during a 20 second period are six. The initial message is 10.29 milliseconds long and the 5 linked messages are identical and each are 23.25 milliseconds long.

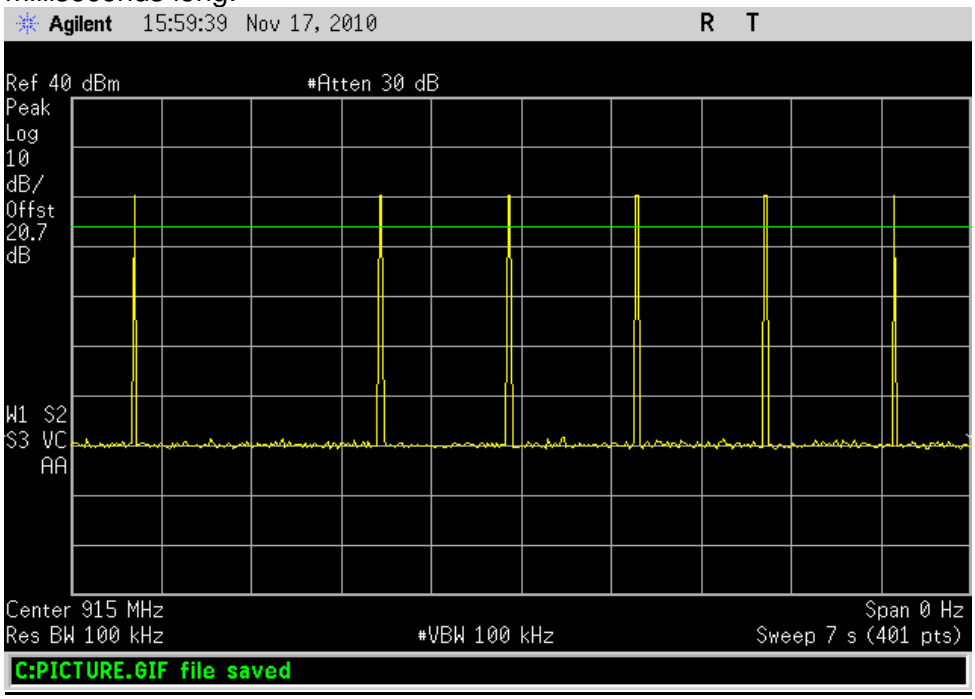


Two way FM message length at 10dBm and 24dBm.

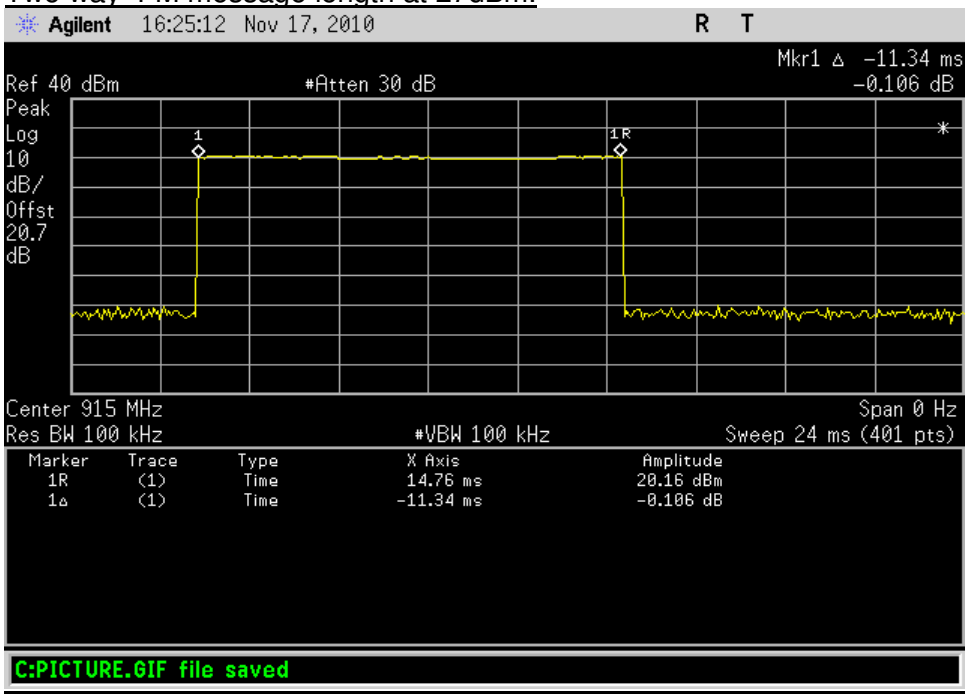


FM mode of operation at 27dBm.

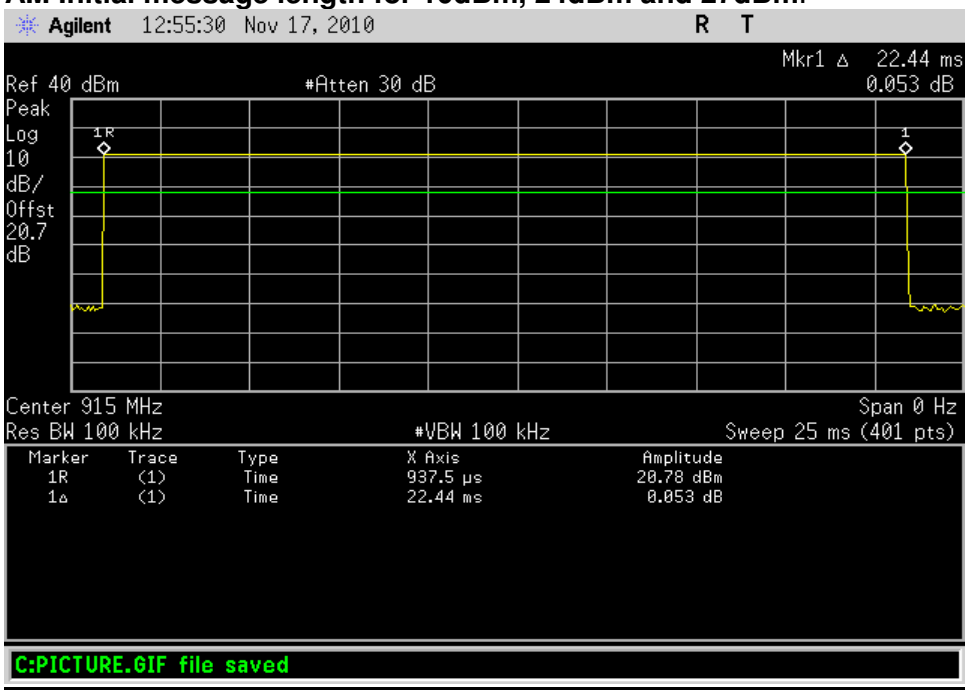
The maximum transmissions on a single channel during a 20 second period are six. The initial message is 10.29 milliseconds long and the 5 linked messages are identical and each are 11.34 milliseconds long.



Two way_FM message length at 27dBm.

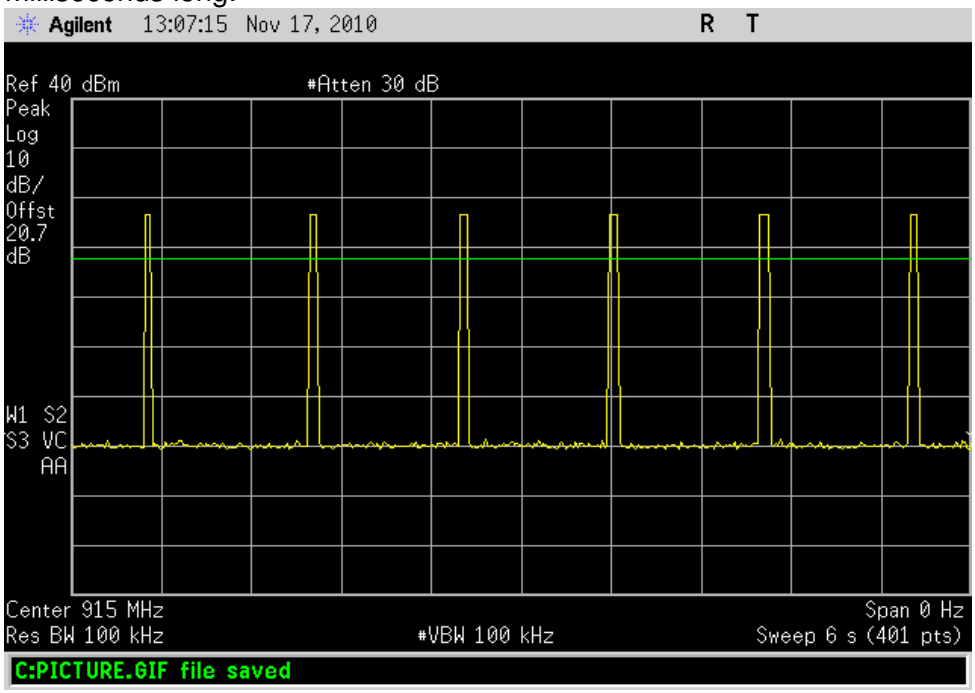


AM Initial message length for 10dBm, 24dBm and 27dBm.

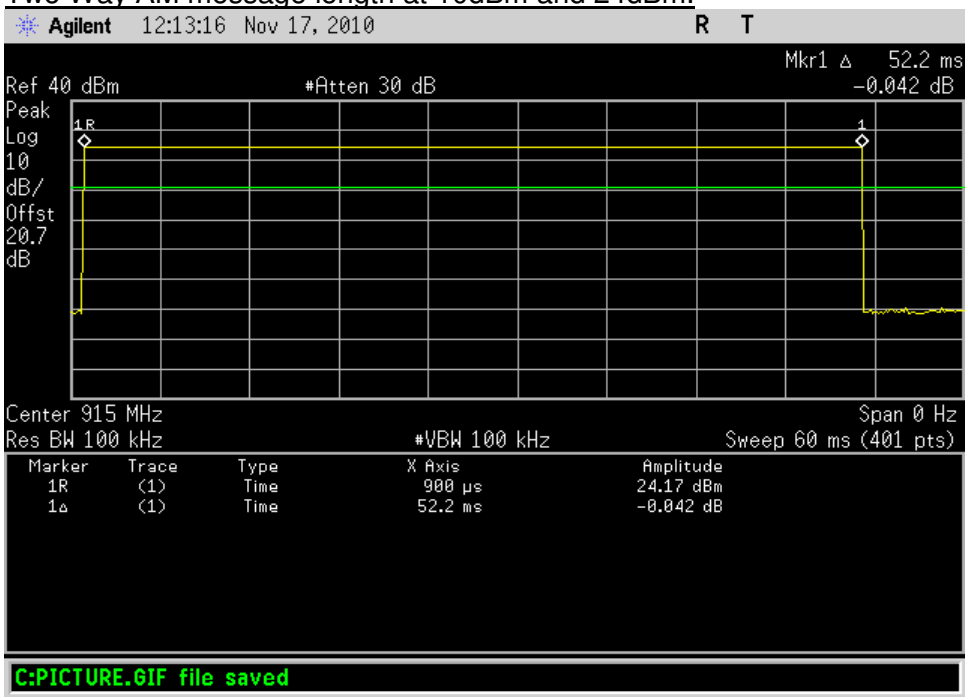


AM mode of operation at 10dBm and 24dBm.

The maximum transmissions on a single channel during a 20 second period are six. The initial message is 22.4 milliseconds long and the 5 linked messages are identical and each are 52.2 milliseconds long.

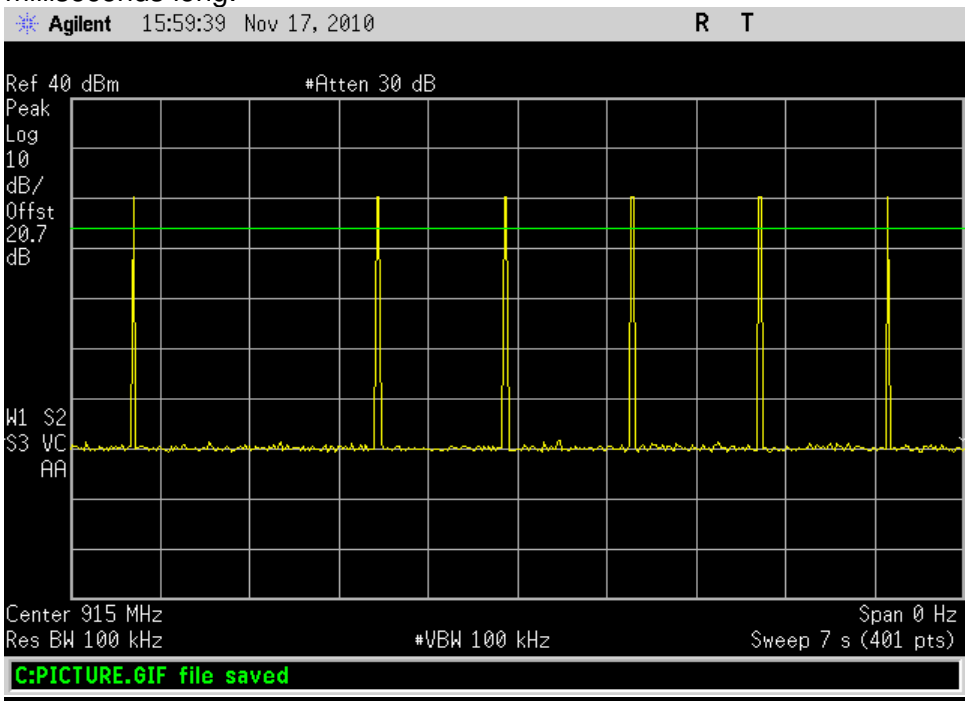


Two Way AM message length at 10dBm and 24dBm.

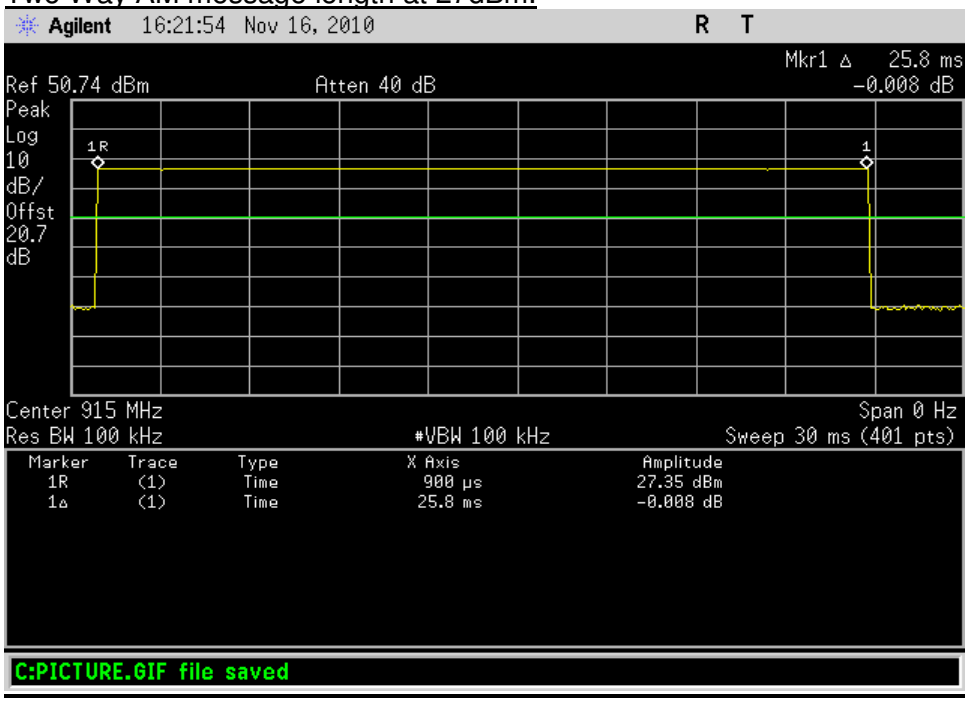


AM mode of operation at 27dBm.

The maximum transmissions on a single channel during a 20 second period are six. The initial message is 22.4 milliseconds long and the 5 linked messages are identical and each are 25.8 milliseconds long.



Two Way AM message length at 27dBm.



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

Power Output

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
Set RF level offset=cable loss

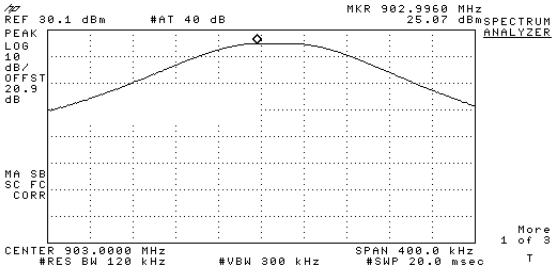
Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power. The limit is specified in one of the subparagraphs of this Section. Submit this plot. A peak responding power meter may be used instead of a spectrum analyzer.

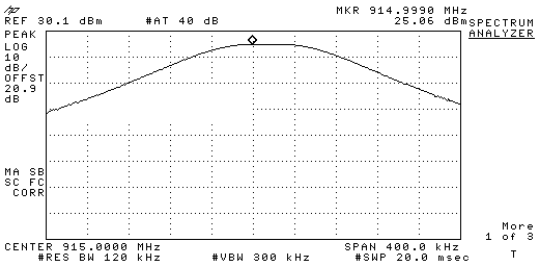
Equipment Used	Serial Number	Cal Date	Due
HP 8593E	3543A02032	12/3/2010	12/3/2011
Date	**Tested by**		
5/12/2011 to 5/13/2011	Roger Mulcahy		

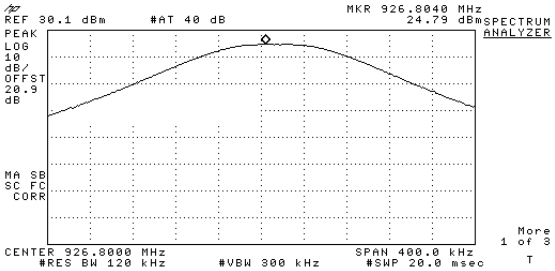
Unit tested w/fresh battery: *200087*

Frequency (MHz)/channel	Mode	Power level	Power (dBm)	Power (Watts)
903 / 5	*FM*	*E*	*25.06*	.321
915 / 65	*FM*	*E*	*25.06*	.321
926.8 / 124	*FM*	*E*	*24.79*	.301
903 / 5	*AM*	*E*	*24.79*	.301
915 / 65	*AM*	*E*	*24.76*	.299
926.8 / 124	*AM*	*E*	*24.41*	.276
903 / 5	*FM*	*C*	*21.84*	.153
915 / 65	*FM*	*C*	*21.65*	.146
926.8 / 124	*FM*	*C*	*21.42*	.138
903 / 5	*AM*	*C*	*21.60*	.144
915 / 65	*AM*	*C*	*21.49*	.140
926.8 / 124	*AM*	*C*	*21.31*	.135
903 / 5	*FM*	*8*	*7.50*	.057
915 / 65	*FM*	*8*	*7.61*	.058
926.8 / 124	*FM*	*8*	*7.54*	.057
903 / 5	*AM*	*8*	*7.43*	.053
915 / 65	*AM*	*8*	*7.45*	.056
926.8 / 124	*AM*	*8*	*7.36*	.054

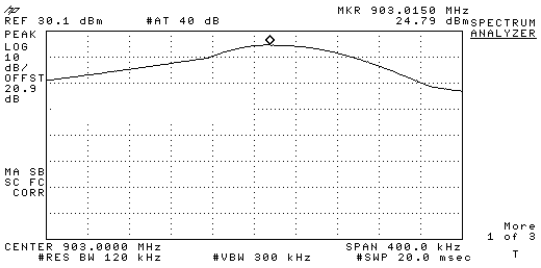
FM Mode, power level E, Channels 5,65,124

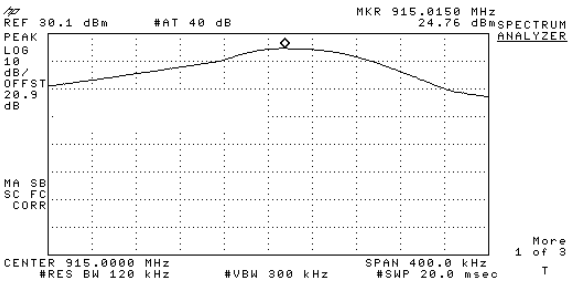


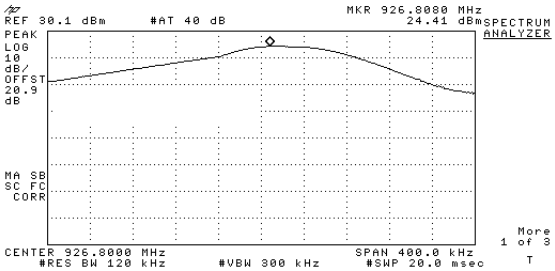




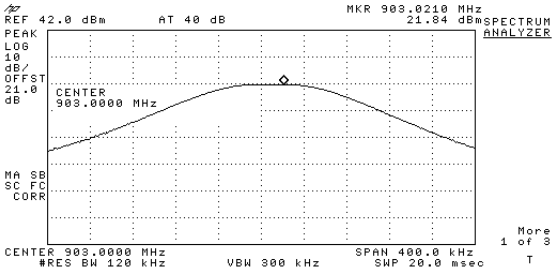
AM Mode, power level E, Channels 5,65,124

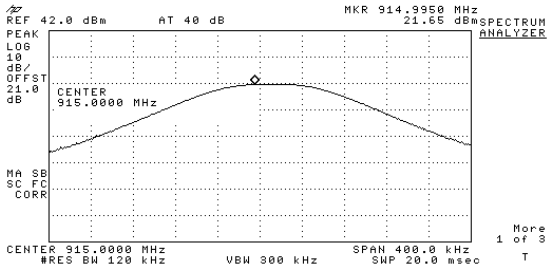


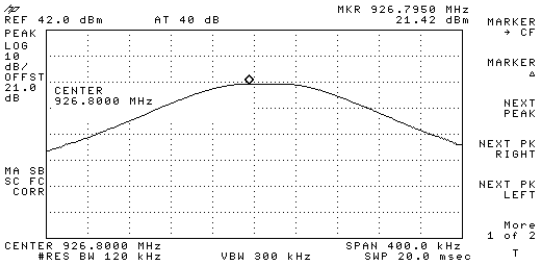




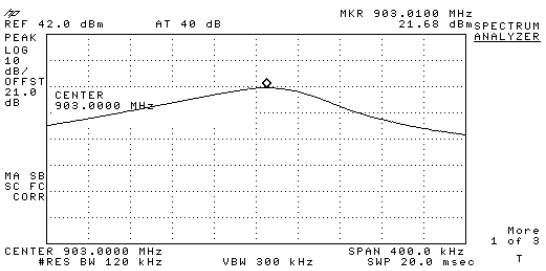
FM Mode, power level C, Channels 5,65,124

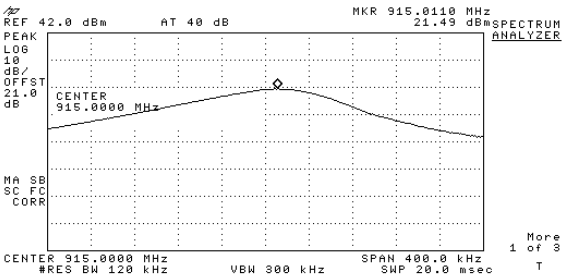


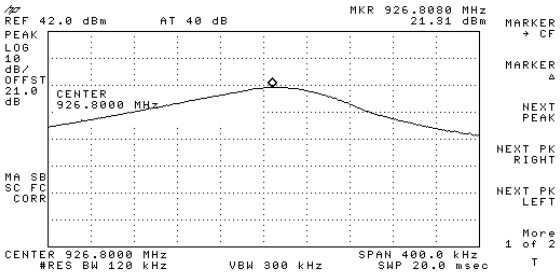




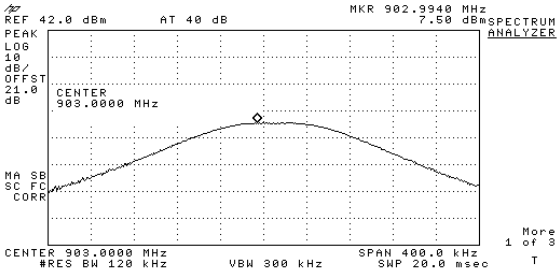
AM Mode, power level C, Channels 5,65,124

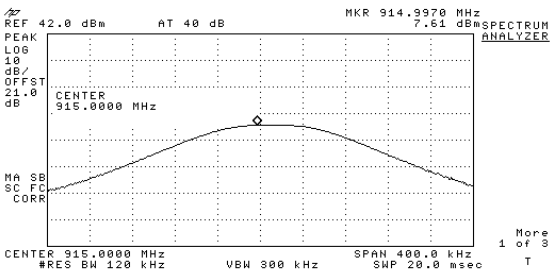


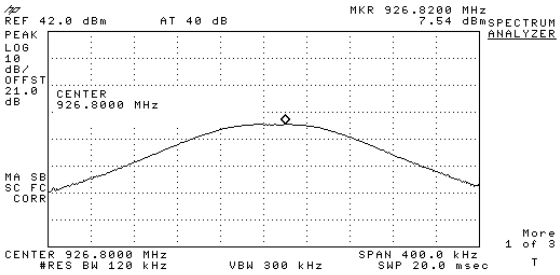




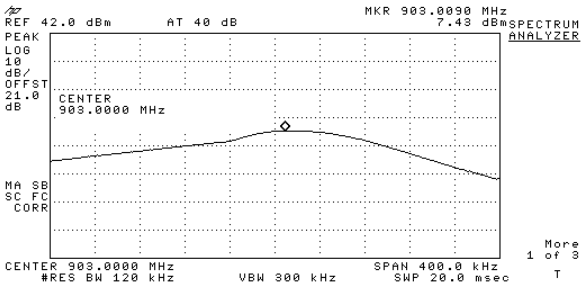
FM Mode, power level 8, Channels 5,65,124

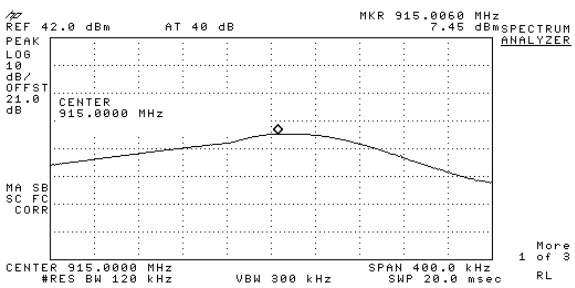


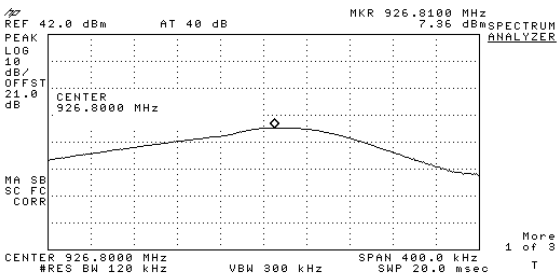




AM Mode, power level 8, Channels 5,65,124







15.247(d) / RSS-210 A8.5

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
Agilent E7405A Spectrum Analyzer	MY45113415	8/4/2010	8/4/2011
AH systems preamplifer PAM 0126	135	11/17/2010	11/17/2011
Huber&Suhner 40 foot cable	220297001	12/3/2009	12/3/2011
microwave circuits 1.3ghz high pass filter	405735	8/16/2010	8/16/2011
Sucoflex cable 36”	104	9/17/2009	9/17/2011
EMCO 3148 Log periodic	9901-1044	9/9/2010	9/9/2012
EMCO 3108Biconical antenna	9203-2455	9/9/2010	9/9/2012
EMCO 3115 double ridge wave guide	9508-4550	3/22/2010	3/22/2012
EMCO loop antenna model 6502	9509-2970	10/7/2010	10/7/2012
Date	Tested by	Temperature/humidity	
5-2-2011 to 5-11-2011	Roger Mulcahy	75 F/26	

Unit tested w/fresh battery: 200087
Frequency range investigated was 9 kHz to 9.28GHz.

FM Mode, power level E

1	2	3	4	5	6	7	8	9	10
Freq. MHz	Ant. Pos. Vert. or Horz.	Antenna Height / Table Azimuth	Level dBm	Cable Loss dB	Ant. Factor dB/m	Amplifier Gain dB	peak corrected Level dBuV/m	emissions dBc	Margin dB
915	Vertical	107/290	-8.21	2.6	24.5	N/A	125.89		
5490	Vertical	100/220	-28.35	7.41	34.22	-37.43	82.85	-43.04	23.04
5560.8	Vertical	100/220	-31.33	7.46	34.16	-37.43	79.86	-46.03	26.03
5560.8	Horizontal	100/80	-31.67	7.46	34.16	-37.43	79.52	-46.37	26.37
5490	Horizontal	100/320	-34.7	7.41	34.22	-37.43	76.5	-49.39	29.39
1830	Vertical	100/240	-30.9	4.53	26.95	-36.95	70.63	-55.26	35.26
1830	Horizontal	160/170	-35.77	4.53	26.95	-36.95	65.76	-60.13	40.13

[8] = [4] + [5] + [6] - [7]+107; [9] = [8] - Power Out first rows; [10] = -20 – [9]

AM Mode, power level E

1	2	3	4	5	6	7	8	9	10
Freq. MHz	Ant. Pos. Vert. or Horz.	Antenna Height / Table Azimuth	Level dBm	Cable Loss dB	Ant. Factor dB/m	Amplifier Gain dB	peak corrected Level dBuV/m	emissions dBc	Margin dB
915	Vertical	107/290	-8.29	2.6	24.5	N/A	125.81		
5490	Vertical	100/220	-28.15	7.41	34.22	-37.43	83.05	-42.76	22.76
5560.8	Vertical	100/220	-31.57	7.46	34.16	-37.43	79.62	-46.19	26.19
5560.8	Horizontal	100/80	-32.85	7.46	34.16	-37.43	78.34	-47.47	27.47
5490	Horizontal	100/320	-35.12	7.41	34.22	-37.43	76.08	-49.73	29.73
1830	Vertical	100/240	-31.2	4.53	26.95	-36.95	70.33	-55.48	35.48
1830	Horizontal	160/170	-35.96	4.53	26.95	-36.95	65.57	-60.24	40.24

[8] = [4] + [5] + [6] - [7]+107; [9] = [8] - Power Out first rows; [10] = -20 – [9]

FM Mode, power level C

1	2	3	4	5	6	7	8	9	10
Freq. MHz	Ant. Pos. Vert. or Horz.	Antenna Height / Table Azimuth	Level dBm	Cable Loss dB	Ant. Factor dB/m	Amplifier Gain dB	peak corrected Level dBuV/m	emissions dBc	Margin dB
915	Vertical	107/290	-11.44	2.6	24.5	N/A	122.66		
1806	Vertical	100/270	-35.78	4.51	26.86	-36.94	65.65	-57.01	37.01
1830	Vertical	100/270	-36.82	4.53	26.95	-36.95	64.71	-57.95	37.95
5560.8	Vertical	108/70	-48.74	7.46	34.16	-37.43	62.45	-60.21	40.21
5490	Vertical	100/70	-49.5	7.41	34.22	-37.43	61.7	-60.96	40.96
1830	Horizontal	115/170	-41.57	4.53	26.95	-36.95	59.96	-62.7	42.7
1806	Horizontal	120/140	-42.93	4.51	26.86	-36.94	58.5	-64.16	44.16

[8] = [4] + [5] + [6] - [7]+107; [9] = [8] - Power Out first rows; [10] = -20 – [9]

AM Mode, power level C

1	2	3	4	5	6	7	8	9	10
Freq. MHz	Ant. Pos. Vert. or Horz.	Antenna Height / Table Azimuth	Level dBm	Cable Loss dB	Ant. Factor dB/m	Amplifier Gain dB	peak corrected Level dBuV/m	emissions dBc	Margin dB
915	Vertical	107/290	-11.66	2.6	24.5	N/A	122.44		
1806	Vertical	100/270	-35.78	4.51	26.86	-36.94	65.65	-56.79	36.79
1830	Vertical	100/270	-36.82	4.53	26.95	-36.95	64.71	-57.73	37.73
5560.8	Vertical	108/70	-48.74	7.46	34.16	-37.43	62.45	-59.99	39.99
5490	Vertical	100/70	-49.5	7.41	34.22	-37.43	61.7	-60.74	40.74
1830	Horizontal	115/170	-41.57	4.53	26.95	-36.95	59.96	-62.48	42.48
1806	Horizontal	120/140	-42.93	4.51	26.86	-36.94	58.5	-63.94	43.94

[8] = [4] + [5] + [6] - [7]+107; [9] = [8] - Power Out first rows; [10] = -20 – [9]

FM Mode, power level 8

1	2	3	4	5	6	7	8	9	10
Freq. MHz	Ant. Pos. Vert. or Horz.	Antenna Height / Table Azimuth	Level dBm	Cable Loss dB	Ant. Factor dB/m	Amplifier Gain dB	peak corrected Level dBuV/m	emissions dBc	Margin dB
915	Vertical	107/290	-25.58	2.6	24.5	N/A	108.52		
1853.6	Vertical	100/240	-39.32	4.55	27.03	-36.94	62.3	-46.22	26.22
5560.8	Vertical	100/130	-49.02	7.46	34.16	-36.95	62.17	-46.35	26.35
5490	Vertical	100/230	-49.51	7.41	34.22	-37.43	61.69	-46.83	26.83
1806	Vertical	100/230	-40.52	4.51	26.86	-37.43	60.91	-47.61	27.61
1830	Vertical	100/230	-42.77	4.53	26.95	-36.95	58.76	-49.76	29.76
1853.6	Horizontal	105/130	-42.71	4.55	27.03	-36.94	58.91	-49.61	29.61

[8] = [4] + [5] + [6] - [7]+107; [9] = [8] - Power Out first rows; [10] = -20 – [9]

AM Mode, power level 8

1	2	3	4	5	6	7	8	9	10
Freq. MHz	Ant. Pos. Vert. or Horz.	Antenna Height / Table Azimuth	Level dBm	Cable Loss dB	Ant. Factor dB/m	Amplifier Gain dB	peak corrected Level dBuV/m	emissions dBc	Margin dB
915	Vertical	107/290	-25.53	2.6	24.5	N/A	108.57		
1853.6	Vertical	100/240	-39.63	4.55	27.03	-36.96	61.99	-46.58	26.58
5560.8	Vertical	100/130	-49.21	7.46	34.16	-37.43	61.98	-46.59	26.59
5490	Vertical	100/230	-49.58	7.41	34.22	-37.43	61.62	-46.95	26.95
1806	Vertical	99/230	-40.56	4.51	26.86	-36.94	60.87	-47.7	27.7
1830	Vertical	100/230	-42.87	4.53	26.95	-36.95	58.66	-49.91	29.91
1853.6	Horizontal	105/130	-42.71	4.55	27.03	-36.96	58.91	-49.66	29.66

[8] = [4] + [5] + [6] - [7]+107; [9] = [8] - Power Out first rows; [10] = -20 – [9]

15.205, 15.209 / RSS-210 2.2, 2.6

Restricted Bands Spurious Emissions

(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	13.36-13.41	399.9-410	5.35-5.46
0.495-0.505 (FCC)	16.42-16.423	608-614	7.25-7.75
2.1735-2.1905	16.69475-16.69525	960- 1427*	8.025-8.5
4.125-4.128	16.80425-16.80475	1435-1626.5	9.0-9.2
4.17725-4.17775	25.5-25.67	1645.5-1646.5	9.3-9.5
4.20725-4.20775	37.5-38.25	1660-1710	10.6-12.7
5.677-5.683 (IC)	73-74.6	1718.8-1722.2	13.25-13.4
6.215-6.218	74.8-75.2	2200-2300	14.47-14.5
6.26775-6.26825	108-121.94	2310-2390	15.35-16.2
6.31175-6.31225	123-138	2483.5-2500	17.7-21.4
8.291-8.294	149.9-150.05	2655-2900**	22.01-23.12
8.362-8.366	156.52475-156.52525	3260-3267	23.6-24.0
8.37625-8.38675	156.7-156.9	3332-3339	31.2-31.8
8.41425-8.41475	162.0125-167.17	3345.8-3358	36.43-36.5
12.29-12.293	167.72-173.2	3600-4400	Above 38.6
12.51975-12.52025	240-285	4.5-5.15	
12.57675-12.57725	322-335.4		

- for reference the FCC has relaxed some of the restricted bands and IC has not. In the FCC rules today: *960-1240 and *1300-1427MHz; **2690-2900MHz;

Equipment Used	Serial Number	Cal Date	Due
Agilent E7405A Spectrum Analyzer	MY45113415	8/4/2010	8/4/2011
HP 8593E	3543A02032	12/3/2010	12/3/2011
AH systems preamplifer PAM 0126	135	11/17/2010	11/17/2011
Huber&Suhner 40 foot cable	220297001	12/3/2009	12/3/2011
microwave circuits 1.3ghz high pass filter	405735	8/16/2010	8/16/2011
Sucoflex cable 36”	104	9/17/2009	9/17/2011
EMCO 3148 Log periodic	9901-1044	9/9/2010	9/9/2012
EMCO 3108Biconical antenna	9203-2455	9/9/2010	9/9/2012
EMCO 3115 double ridge wave guide	9508-4550	3/22/2010	3/22/2012
EMCO loop antenna model 6502	9509-2970	10/7/2010	10/7/2012
Date	Tested by	Temperature/humidity	
5-2-2011 to 5-11-2011	Roger Mulcahy	75 F/26	

Unit tested w/fresh battery: *200087*

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.

Time averaging

20 log (5.85ms / 100mS) = -24.65 dB
dwell time is defined here as: 5.85 ms.

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	200	43.5	3
216-960	200	46	3
Above 960	500	54	3

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

FM Mode, power level E

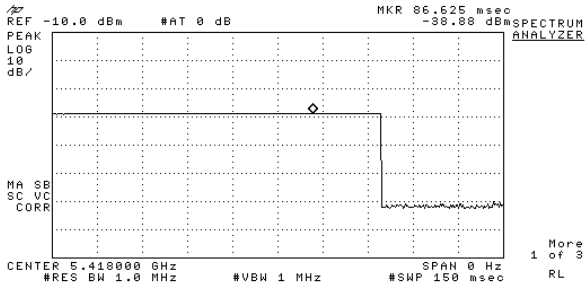
1	2	3	4	5	6	7	8	9	10	11	12	13
`	Ant.	VBW ≥ RBW	10Hz VBW				VBW ≥ RBW			Corr Factor 18.91dB		
	Pos.						Peak			Average*		
Freq. MHz	vert or horz.	Peak Level dBuV	Average Level dBuV	Cable Loss dB	Ant. Factor dB/m	Amplifier Gain dB	Corrected Level dBuV/m	Peak Limit dBuV/m	Peak Margin dB	Corrected Level dBuV/m	Average Limit dBuV/m	Average Margin dB
5418	Vertical	-39.07		7.36	34.15	-37.33	72.11	74	1.89	53.2	54	0.8
2709	Horizontal	-32.52		5.21	28.87	-36.53	72.03	74	1.97	53.12	54	0.88
2709	Vertical	-34.35		5.21	28.87	-36.53	70.2	74	3.8	51.29	54	2.71
4515	Vertical	-40.58		6.68	32.38	-36.92	68.56	74	5.44	49.65	54	4.35
4575	Vertical	-40.82		6.73	32.43	-36.9	68.44	74	5.56	49.53	54	4.47
2745	Horizontal	-36.78		5.24	28.94	-36.49	67.91	74	6.09	49	54	5

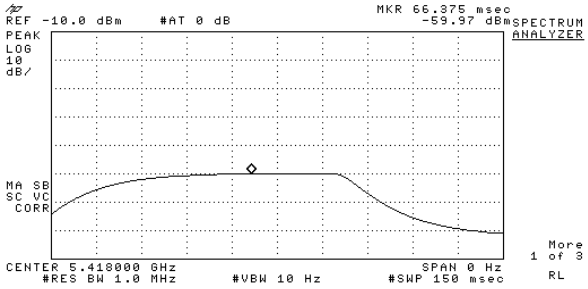
[8] = [3]+[5}+[6]-[7]; [9] from table above; [10] = [9] – [8]
[11] = [4]+[5]+[6]+[7] – * Duty Cycle Corr. Factor; [12] from table above; [13] = [12] – [11]
[10] = [9]-[8}

AM Mode, power level E

1	2	3	4	5	6	7	8	9	10	11	12	13
`	Ant.	VBW ≥ RBW	10Hz VBW				VBW ≥ RBW			Corr Factor 18.91dB		
	Pos.						Peak			Average*		
Freq. MHz	vert or horz.	Peak Level dBuV	Average Level dBuV	Cable Loss dB	Ant. Factor dB/m	Amplifier Gain dB	Corrected Level dBuV/m	Peak Limit dBuV/m	Peak Margin dB	Corrected Level dBuV/m	Average Limit dBuV/m	Average Margin dB
5418	Vertical	-38.83	-59.97	7.36	34.15	-37.33	72.35	74	1.65	39.47	54	14.53
2709	Horizontal	-32.61	-56.94	5.21	28.87	-36.53	71.94	74	2.06	35.87	54	18.13
2709	Vertical	-34.59	-57.26	5.21	28.87	-36.53	69.96	74	4.04	35.55	54	18.45
4515	Vertical	-39.74	-62.25	6.68	32.38	-36.92	69.52	74	4.48	35.27	54	18.73
4575	Vertical	-40.88	-62.63	6.73	32.43	-36.9	68.26	74	5.74	34.77	54	19.23
2745	Horizontal	-36.78	-58.84	5.24	28.94	-36.49	67.91	74	6.09	34.11	54	19.89

[8] = [3]+[5}+[6]-[7]; [9] from table above; [10] = [9] – [8]
[11] = [4]+[5]+[6]+[7] – * Duty Cycle Corr. Factor; [12] from table above; [13] = [12] – [11]
[10] = [9]-[8}





FM Mode, power level C

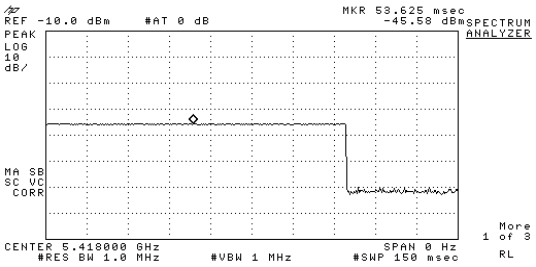
1	2	3	4	5	6	7	8	9	10	11	12	13
`	Ant.	VBW ≥ RBW	10Hz VBW				VBW ≥ RBW			Corr Factor		
	Pos.						Peak			12.67dB Average*		
Freq.	vert or	Peak Level	Average Level	Cable Loss	Ant. Factor	Amplifier Gain	Corrected Level	Peak Limit	Peak Margin	Corrected Level	Average Limit	Average Margin
MHz	horz.	dBuV	dBuV	dB	dB/m	dB	dBuV/m	dBuV/m	dB	dBuV/m	dBuV/m	dB
5418	Vertical	-45.41		7.36	34.15	-37.33	65.77	74	8.23	53.10	54	0.90
2709	Horizontal	-42.05		5.21	28.87	-36.53	62.5	74	11.5	49.83	54	4.17
2709	Vertical	-42.38		5.21	28.87	-36.53	62.17	74	11.83	49.50	54	4.50
2745	Vertical	-45.05		5.24	28.94	-36.49	59.64	74	14.36	46.97	54	7.03
2745	Horizontal	-46.42		5.24	28.94	-36.49	58.27	74	15.73	45.60	54	8.40

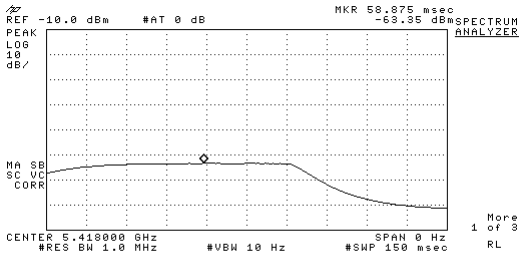
[8] = [3]+[5}+[6]-[7]; [9] from table above; [10] = [9] – [8]
[11] = [4]+[5]+[6]+[7] – * Duty Cycle Corr. Factor; [12] from table above; [13] = [12] – [11]
[10] = [9]-[8}

AM Mode, power level C

1	2	3	4	5	6	7	8	9	10	11	12	13
`	Ant.	VBW ≥ RBW	10Hz VBW				VBW ≥ RBW			Corr Factor		
	Pos.						Peak			5.64dB Average*		
Freq.	vert or	Peak Level	Average Level	Cable Loss	Ant. Factor	Amplifier Gain	Corrected Level	Peak Limit	Peak Margin	Corrected Level	Average Limit	Average Margin
MHz	horz.	dBuV	dBuV	dB	dB/m	dB	dBuV/m	dBuV/m	dB	dBuV/m	dBuV/m	dB
5418	Vertical	-45.58	-63.35	4.51	26.86	-36.94	65.6	74	8.4	42.19	54	11.81
2709	Horizontal	-42.1	-61.55	4.53	26.95	-36.95	62.45	74	11.55	37.36	54	16.64
2709	Vertical	-42.41	-61.56	7.46	34.16	-37.43	62.14	74	11.86	37.35	54	16.65
2745	Vertical	-45.05	-62.77	7.41	34.22	-37.43	59.64	74	14.36	36.28	54	17.72
2745	Horizontal	-46.42	-64.11	4.53	26.95	-36.95	58.27	74	15.73	34.94	54	19.06

[8] = [3]+[5}+[6]-[7]; [9] from table above; [10] = [9] – [8]
[11] = [4]+[5]+[6]+[7] – * Duty Cycle Corr. Factor; [12] from table above; [13] = [12] – [11]
[10] = [9]-[8}





FM Mode, power level 8

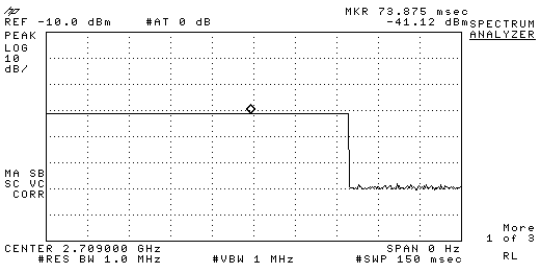
1	2	3	4	5	6	7	8	9	10	11	12	13
`	Ant.	VBW ≥ RBW	10Hz VBW				VBW ≥ RBW Peak			Corr Factor 12.67dB Average*		
Freq.	Pos. vert or	Peak Level	Average Level	Cable Loss	Ant. Factor	Amplifier Gain	Corrected Level	Peak Limit	Peak Margin	Corrected Level	Average Limit	Average Margin
MHz	horz.	dBuV	dBuV	dB	dB/m	dB	dBuV/m	dBuV/m	dB	dBuV/m	dBuV/m	dB
2709	Vertical	-42.1		5.21	28.87	-36.53	62.45	74	11.55	49.78	54	4.22
2745	Vertical	-43.62		5.24	28.94	-36.49	61.07	74	12.93	48.4	54	5.6
2745	Horizontal	-43.68		5.24	28.94	-36.49	61.01	74	12.99	48.34	54	5.66
2709	Horizontal	-45.23		5.21	28.87	-36.53	59.32	74	14.68	46.65	54	7.35
2780.4	Horizontal	-44.63		5.27	29.01	-36.45	60.2	74	13.8	47.53	54	6.47

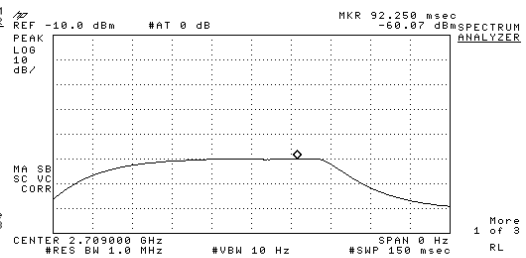
[8] = [3]+[5}+[6]-[7]; [9] from table above; [10] = [9] – [8]
[11] = [4]+[5]+[6]+[7] – * Duty Cycle Corr. Factor; [12] from table above; [13] = [12] – [11]
[10] = [9]-[8}

AM Mode, power level 8

1	2	3	4	5	6	7	8	9	10	11	12	13
`	Ant.	VBW ≥ RBW	10Hz VBW				VBW ≥ RBW Peak			Corr Factor 5.64dB Average*		
Freq.	Pos. vert or	Peak Level	Average Level	Cable Loss	Ant. Factor	Amplifier Gain	Corrected Level	Peak Limit	Peak Margin	Corrected Level	Average Limit	Average Margin
MHz	horz.	dBuV	dBuV	dB	dB/m	dB	dBuV/m	dBuV/m	dB	dBuV/m	dBuV/m	dB
2709	Horizontal	-41.12	-60.1	5.21	28.87	-36.53	63.43	74	10.57	38.81	54	15.19
2709	Vertical	-42.21	-60.38	5.21	28.87	-36.53	62.34	74	11.66	38.53	54	15.47
2745	Vertical	-43.68	-61.45	5.24	28.94	-36.49	61.01	74	12.99	37.6	54	16.4
2745	Horizontal	-43.73	-61.75	5.24	28.94	-36.49	60.96	74	13.04	37.3	54	16.7
2780.4	Horizontal	-44.77	-62.11	5.27	29.01	-36.45	60.06	74	13.94	37.08	54	16.92

[8] = [3]+[5}+[6]-[7]; [9] from table above; [10] = [9] – [8]
[11] = [4]+[5]+[6]+[7] – * Duty Cycle Corr. Factor; [12] from table above; [13] = [12] – [11]
[10] = [9]-[8}





RSS-Gen 7.2.3 Receiver Spurious Emission Limits and Unintentional 15.109

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 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	8/4/2010	8/4/2011
AH systems preamplifer PAM 0126	135	11/17/2010	11/17/2011
Huber&Suhner 40 foot cable	220297001	12/3/2009	12/3/2011
Sucoflex cable 36"	104	9/17/2009	9/17/2011
EMCO 3148 Log periodic	9901-1044	9/9/2010	9/9/2012
EMCO 3108Biconical antenna	9203-2455	9/9/2009	9/9/2012
EMCO 3115 double ridge wave guide	9508-4550	3/22/2010	3/22/2012
Date	Tested by	Temp/Humidity, ºF / %	
5/12/2011	Roger Mulcahy	78F / 25%	

Unit tested w/fresh battery: *200087*

Table 1- 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 9.28 GHz. Emissions from the Receiver were below the noise floor.

No emissions noise floor is 27dBuV/m

1.1310 & 2.1091(mobile) or 2.1093(portable) / RSS-102 Sec 4.2-Canada Safety Code 6; Table 5

Maximum Permissible Exposure (MPE)

Radiofrequency radiation exposure limits. - The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

1.1307 (b) In addition to the actions listed in paragraph (a) of this section, Commission actions granting construction permits, licenses to transmit or renewals thereof, equipment authorizations or modifications in existing facilities, require the preparation of an Environmental Assessment (EA) if the particular facility, operation or transmitter would cause human exposure to levels of radiofrequency radiation in excess of the limits in §§1.1310 and 2.1093 of this chapter.

	unit 200087 Field strenth (dBuV/m)	EIRP (dbm)	unit 200087 conducted power (dbm)	conducted power (watts)	antenna gain (dbi)	antenna gain numeric
FM	125.89	31.89	25.06	.321	6.9	5.0
AM	125.81	31.81	24.79	.316	7.0	5.0

Determine the maximum power density for the general / uncontrolled population minimum separation distance of 20 cm. (f_{MHz} / 1500 mW/cm^2 == f_{MHz} / 150 W/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 *mW/cm^2*
P_t = transmit power in milliwatts
G = numeric antenna gain
r = distance between body and transmitter in centimeters.

FCC Limits: 915MHz / 1500 = 0.61mW / cm^2 @ 20cm
IC Limits: 915MHz / 150 = 6.1 W / M^2 (@ 0.2M)

FM Mode
Max antenna gain = 6.9 dBi = 5.0 numeric
Max TX power = 25.06 dBm = 321 milliwatts

results: P_D = (321 x 5.0) / (4 x pi x 20cm^2) = 0.319 mW / cm^2 @ 20 cm
W/m2 = 10 times mW/cm^2 = 3.19 *W/M^2* @ 0.2 M

AM Mode
Max antenna gain = 7.0 dBi = 5.0 numeric
Max TX power = 24.79 dBm = 316 milliwatts

results: P_D = (316 x 5.0) / (4 x pi x 20cm^2) = .314 mW / cm^2 @ 20 cm
W/m2 = 10 times mW/cm^2 = 3.14 *W/M^2* @ 0.2 M

These results are not in excess of the limits set forth in the rules, therefore an EA is not required.

15.247 (d)

Band-edge compliance of RF Conducted and 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

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.

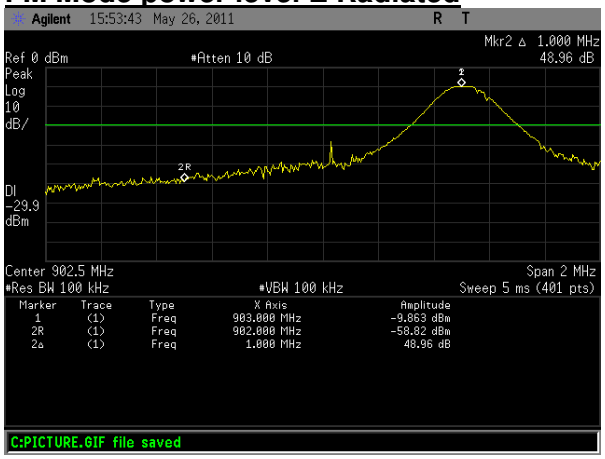
Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit.

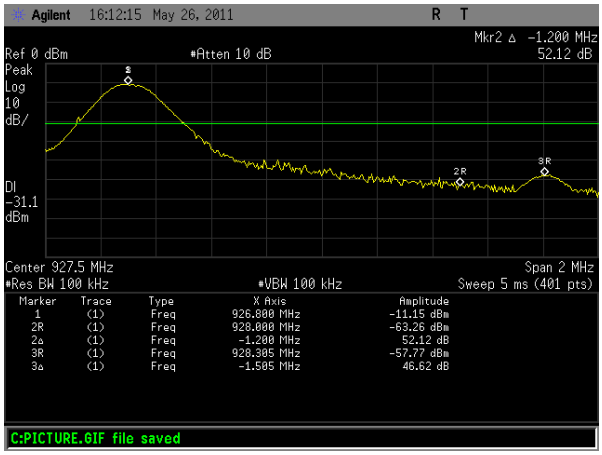
Equipment Used	Serial Number	Cal Date	Due
Agilent E4402B	My44210913	10/7/2010	10/7/2012
Date	**Tested by**		
5/26/2011	Roger Mulcahy		

Frequency (MHz)/channel	Mode	Power level	Band edge (dBc)
903 / 5 Radiated	*FM*	*E*	*-48.96*
926.8 / 124 Radiated	*FM*	*E*	*-52.12*
903 / 5 Radiated	*AM*	*E*	*-32.42*
926.8 / 124 Radiated	*AM*	*E*	*-33.7*
903 / 5 Radiated	*FM*	*8*	*-42.19*
926.8 / 124 Radiated	*FM*	*8*	*-40.84*
903 / 5 Radiated	*AM*	*8*	*-31.21*
926.8 / 124 Radiated	*AM*	*8*	*-33.42*

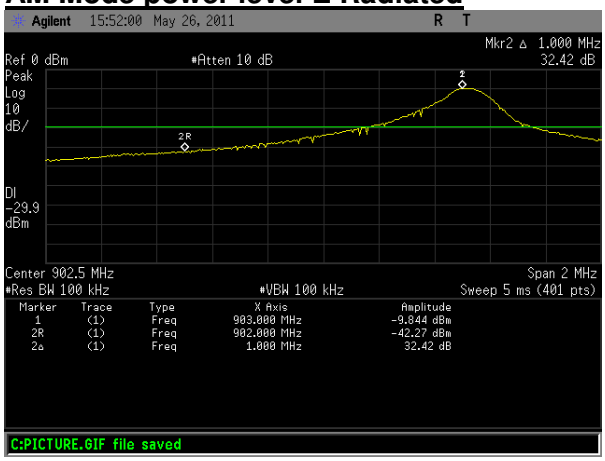
Unit tested w/fresh battery: 200087

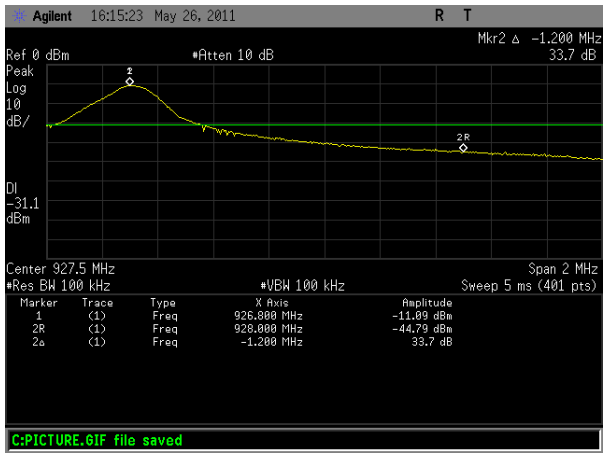
FM Mode power level E Radiated



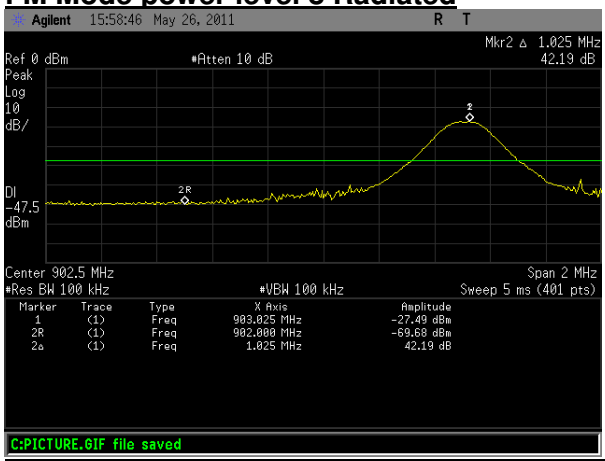


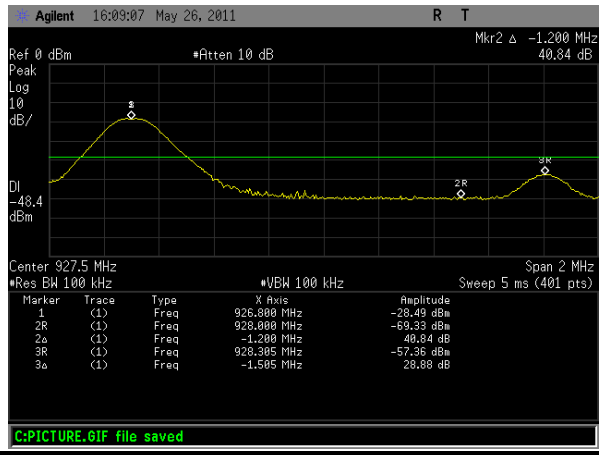
AM Mode power level E Radiated



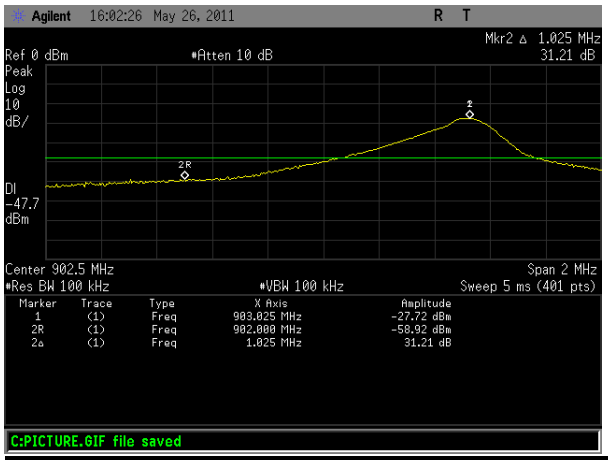


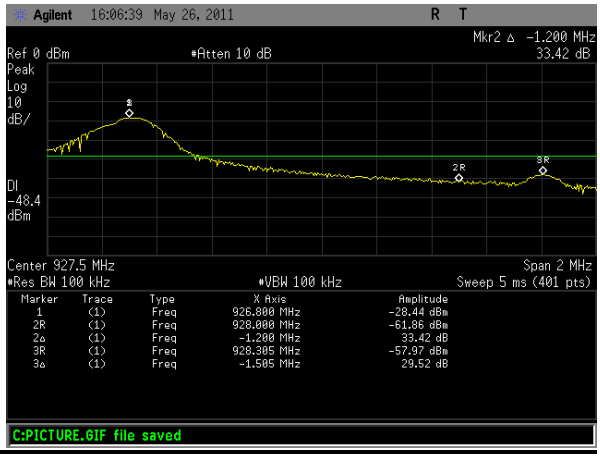
FM Mode power level 8 Radiated





AM Mode power level 8 Radiated





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 ≥ 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 ≥ 1 GHz, 100 kHz for f < 1 GHz

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

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

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.

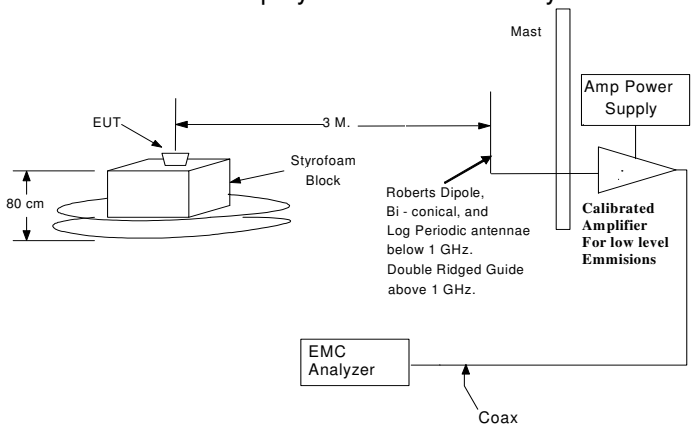
STEP 4) The above "delta" measurement technique may be used for measuring emissions that are up to two "standard" bandwidths away from the band-edge, where a "standard" bandwidth is the bandwidth specified by C63.4 for the frequency being measured. For example, for band-edge measurements in the restricted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