REGULATORY COMPLIANCE REPORT

TITLE: FCC & IC Test Report for 15.247 & RSS-210 Frequency Hopping Device (DECO Repeater)

AUTHOR: Jeff Gilbert

REV	CCO	DESCRIPTION OF CHANGE	DATE	APPROVALS	
1		INITIAL RELEASE	4-4-06	Engineering	Jeff Gilbert
				Engineering	

REVISION HISTORY

				Engineering	
				Engineering	
				Engineering	

Summary

FCC 15.247 / IC RSS-210
Frequency Hopping Transceiver (Deco Repeater), 910 – 920 MHz
FCC ID: EO9DEC08 / **IC ID:** 864D-DEC08
Device Model: RFD-SPI, 8 Channel, Deco
Serial Number: 65900038
OATS Registration Number: FCC 90716, IC 5615

Rule	Description	Max. Reading	Pass/Fail
Part 15.31(e)	Variation of Input Voltage - Conducted	<0.2 dB variation	Pass
Part 15.207 / RSS-Gen 7.2.2	AC Powerline Conducted Emissions	>15dB margin	Pass
Part 15.247(a)(1) / RSS-210 A8.1(2)	Carrier Frequency Separation - Conducted	>20 dB (200 kHz)	Pass
Part 15.247(a)(1)(i) / RSS-210 A8.1(3)	Number of Hopping Channels - Conducted	50	Pass
Part 15.247(a)(1)(i) / RSS-210 A8.1(3)	20dB Bandwidth - Conducted	131.3 kHz	Pass
Part 15.247(a)(1)(i) / RSS-210 A8.1(3)	Time of Occupancy	46.2 mS	Pass
Part 15.247(b) (2) / RSS-210 A8.4(1)	Power Output - Conducted	27.91 dBm	Pass
Part 15.247(d) / RSS-210 A8.5	Spurious Emissions - Conducted	-28.8dBc @1.893 GHz	Pass
Parts 15.205 & 15.209 / RSS-210 2.2, 2.6 Tables 1 & 2	Restricted Bands / Spurious Emissions - Radiated	2.14 dB margin @ 3.68 GHz	Pass
RSS-210 Gen 7.2.3	Receiver Spurious Emissions	80.85 pW@ 609.7 MHz	Pass
Parts 1.1310 & 2.1091 / RSS-102	Limits for Maximum Permissible Exposure (MPE)	0.16 mW/cm^2	Pass

Rule versions: FCC Part 1 (01-2006), FCC Part 2 (01-2006), FCC Part 15 (02-01-2006), RSS-102 (11-2005), RSS-210 Issue 6 (09-2005), RSS-Gen Issue 1 (09-2005).
Reference docs: ANSI C63.4-2003, DA 00-705 (03-30-2000), OET65 (08-1997), OET65C (06-2001), IEEE C95.3-2002.

Cognizant Personnel

Name	Title
Mark Kvamme	Senior Technician
Jeff Gilbert	Regulatory Engineer
Scott Cumeralto	Project Lead

FCC Part 15.31(e)

Input Voltage Variation

For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

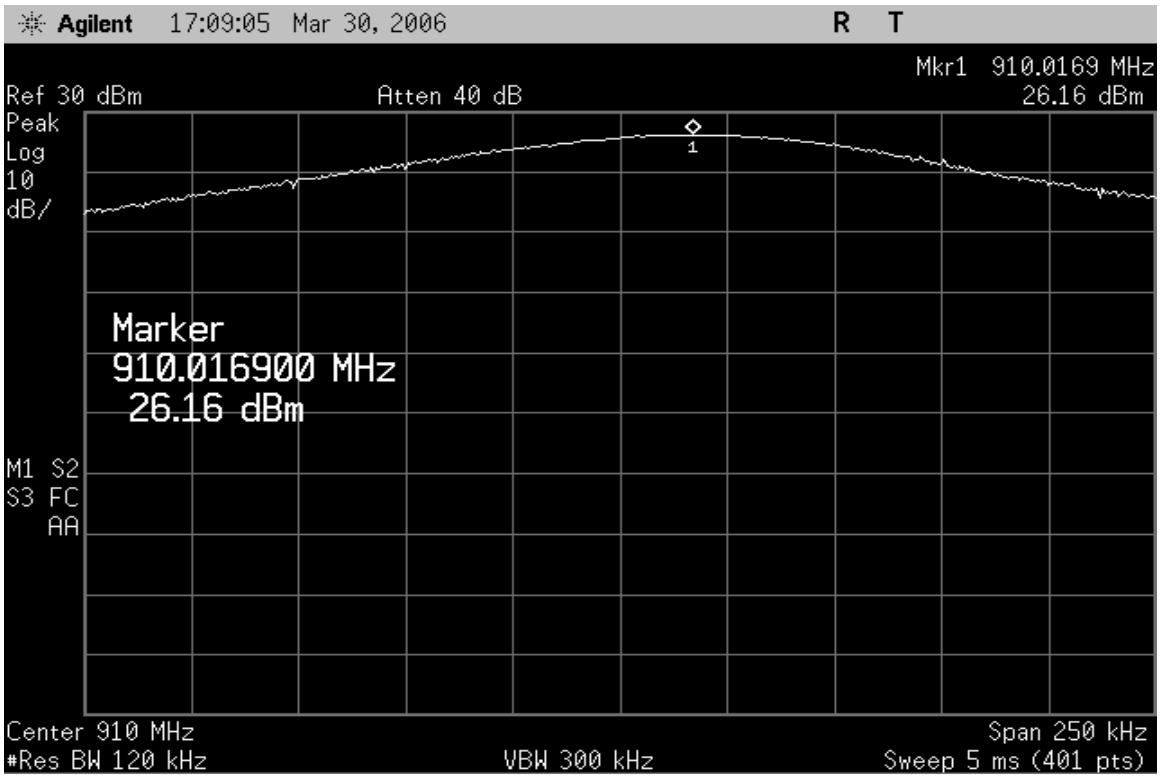
Determine if the transmitter's RF properties change when the input power of the device is varied between 85% and 115% of the device's rated input voltage.
If the RF properties do change, all tests performed to assess compliance must be performed on the worst case configuration.

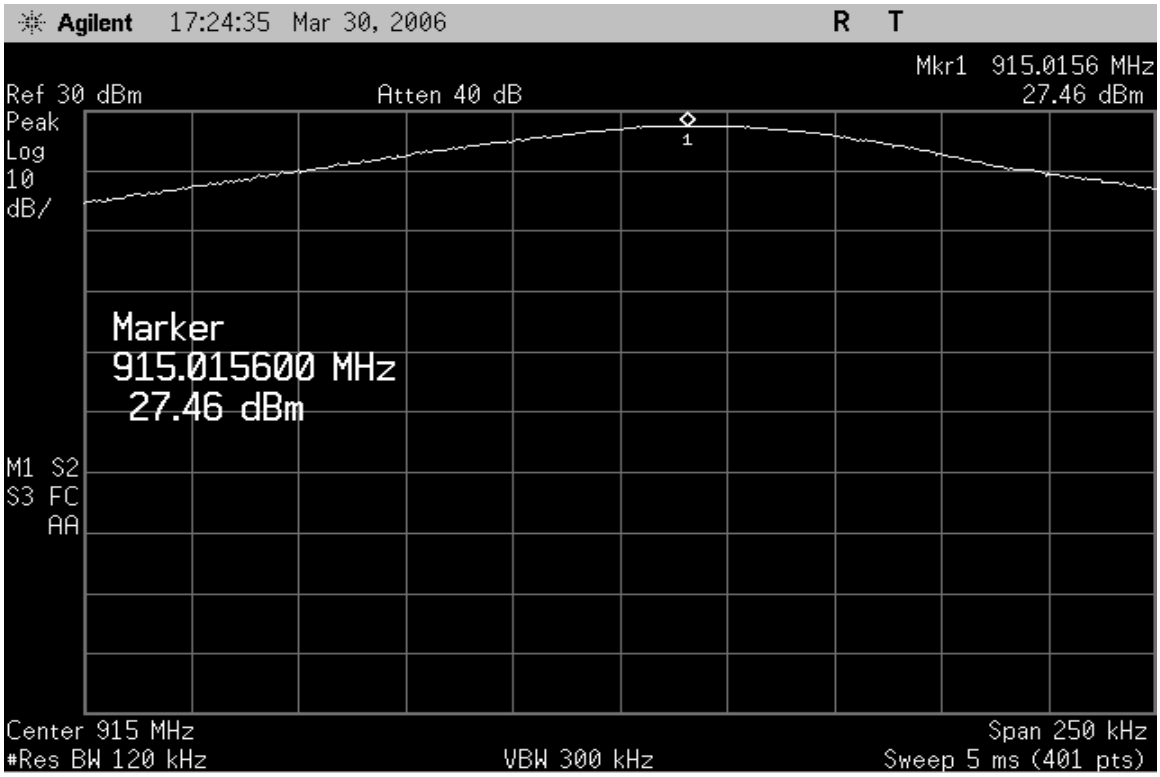
Equipment Used	Serial Number	Cal Date	Due
HP E4408B	US40240538	3-APR-05	3-APR-06

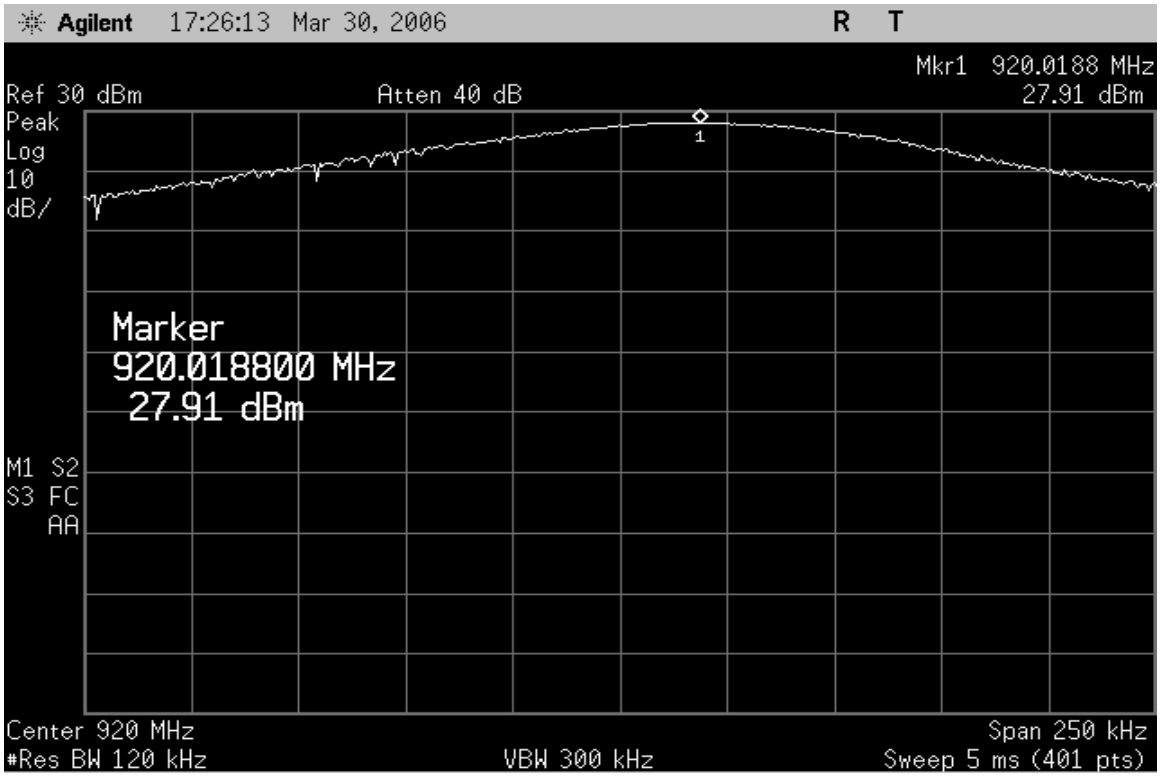
Date	Temp/Humidity ºF / %	Tested by
3/30/2006	59/76%	Mark Kvamme

Unit Tested: 65900038

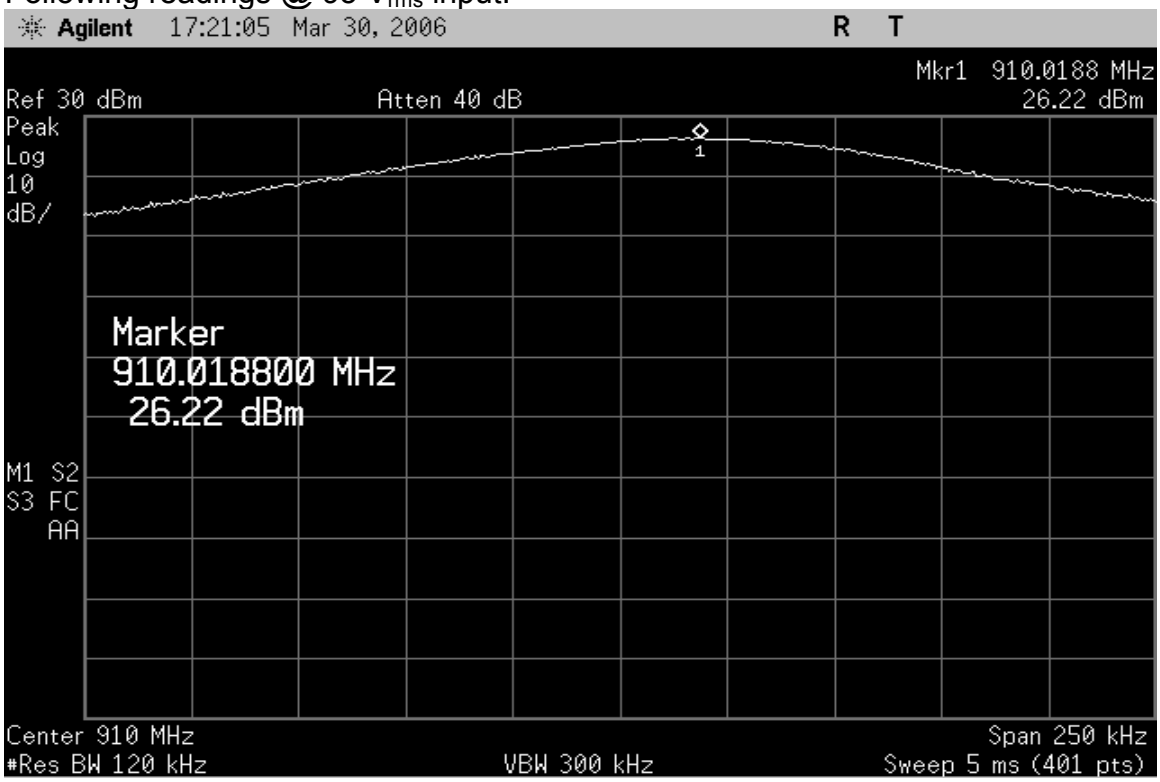
Following readings @ 250 V_{rms} input.

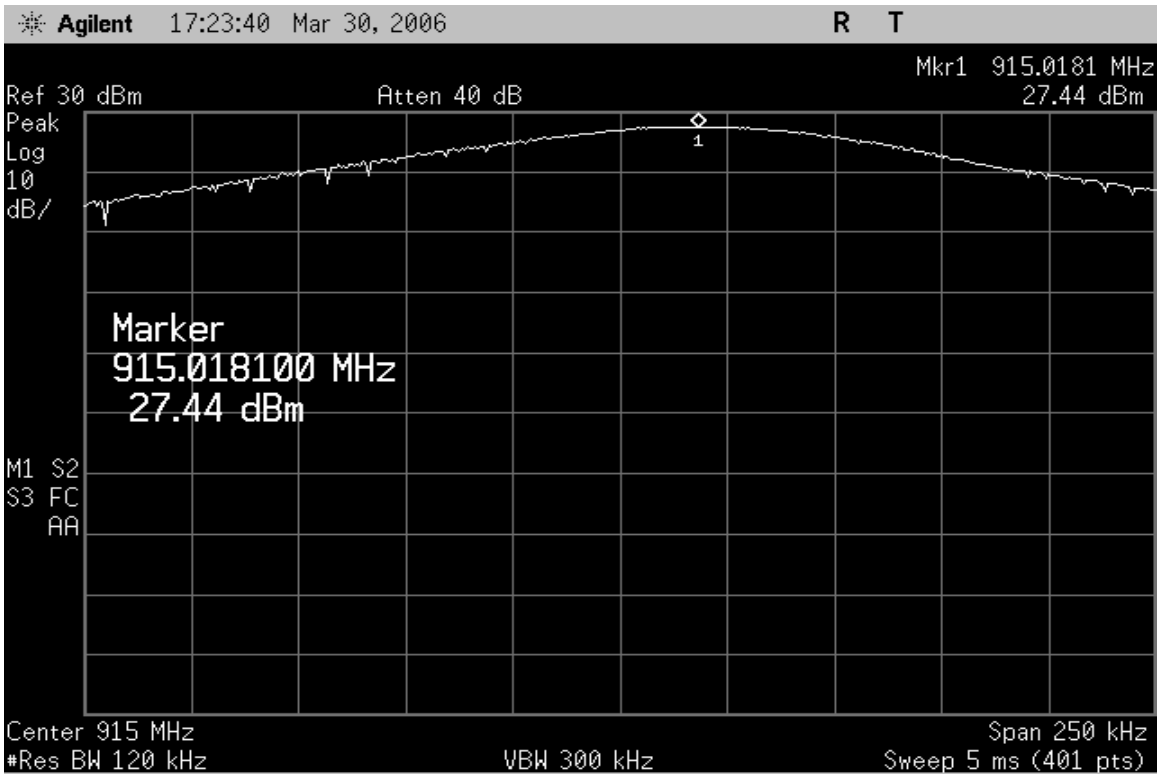


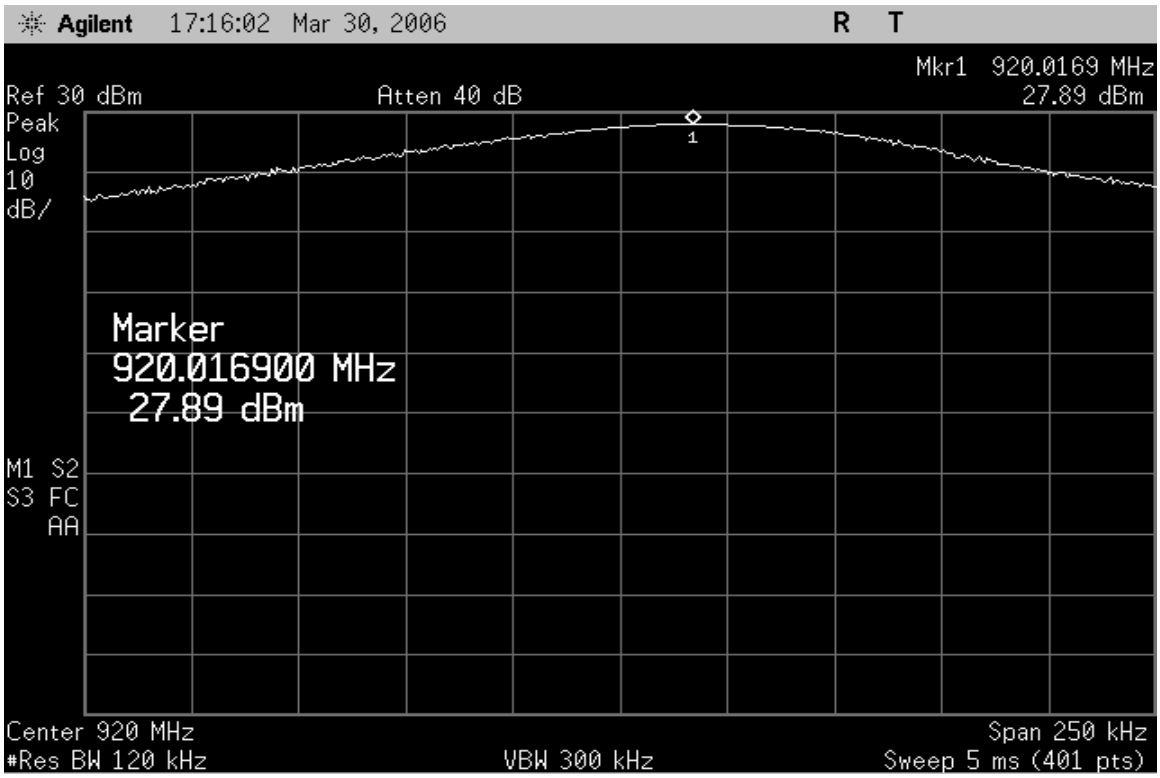

Agilent 17:24:35 Mar 30, 2006
R T
Mkr1 915.0156 MHz
27.46 dBm
Ref 30 dBm
Atten 40 dB
Peak
Log
10
dB/
Marker
915.015600 MHz
27.46 dBm
M1 S2
S3 FC
AA
Center 915 MHz
#Res BW 120 kHz
VBW 300 kHz
Span 250 kHz
Sweep 5 ms (401 pts)


Agilent 17:26:13 Mar 30, 2006
R T
Mkr1 920.0188 MHz
27.91 dBm
Ref 30 dBm
Atten 40 dB
Peak
Log
10
dB/
Marker
920.018800 MHz
27.91 dBm
M1 S2
S3 FC
AA
Center 920 MHz
#Res BW 120 kHz
VBW 300 kHz
Span 250 kHz
Sweep 5 ms (401 pts)

Following readings @ 95 V_{rms} input.






Agilent 17:16:02 Mar 30, 2006
R T
Mkr1 920.0169 MHz
27.89 dBm
Ref 30 dBm
Atten 40 dB
Peak
Log
10
dB/
Marker
920.016900 MHz
27.89 dBm
M1 S2
S3 FC
AA
Center 920 MHz
#Res BW 120 kHz
VBW 300 kHz
Span 250 kHz
Sweep 5 ms (401 pts)

15.207 / RSS-Gen 7.2.2

Powerline Conducted Emissions

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Measure the AC powerline conducted emissions in accordance with the most recent version of ANSI C63.4 from 150 kHz to 30 MHz using a 50 µH / 50 Ω line impedance stabilization network (LISN). Verify that no emissions exceed the following limits:

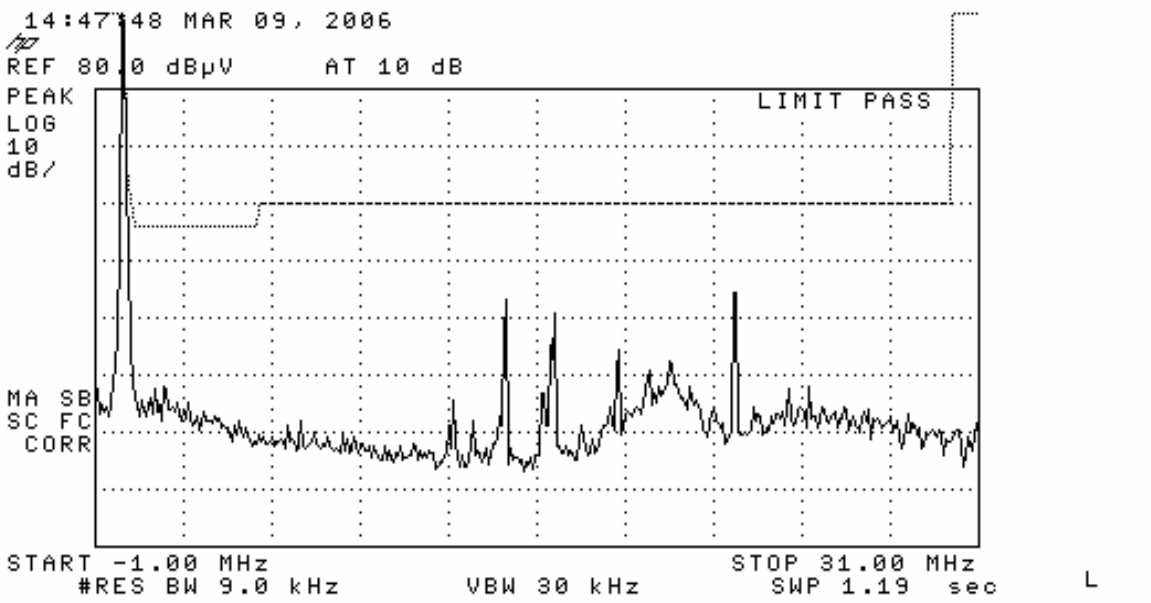
Frequency (MHz)	Quasi-Peak (dBµV)	Average (dBµV)
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

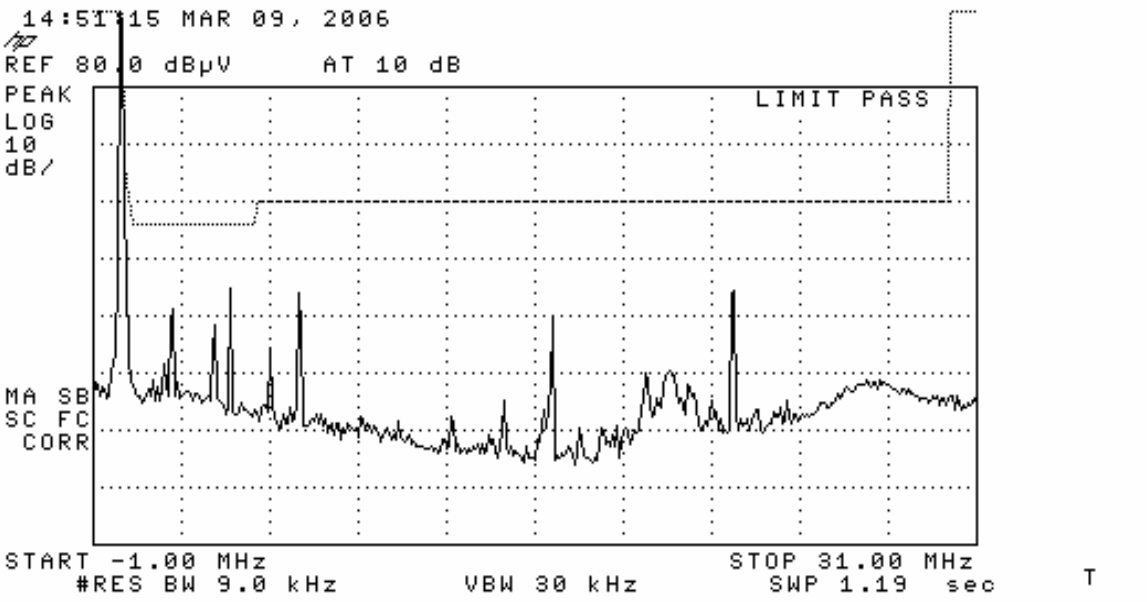
*Decreases with the logarithm of frequency

Equipment Used	Serial Number	Cal Date	Due
HP8593E	3543A02032	9/9/04	9/9/06
EMCO 3821/2	9605-2535	2/28/06	2/28/07

Date	Temp/Humidity ºF / %	Tested by
3/9/2006	55/29%	Mark Kvamme

Unit tested: 65900038




14:51:15 MAR 09, 2006
REF 80.0 dBµV
AT 10 dB
PEAK
LOG
10
dB/
LIMIT PASS
MA SB
SC FC
CORR
START -1.00 MHz
#RES BW 9.0 kHz
VBW 30 kHz
STOP 31.00 MHz
SWP 1.19 sec
T

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

Carrier Frequency Separation

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

Verify that the channel separation is > the 20dB bandwidth of a single transmission.

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

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

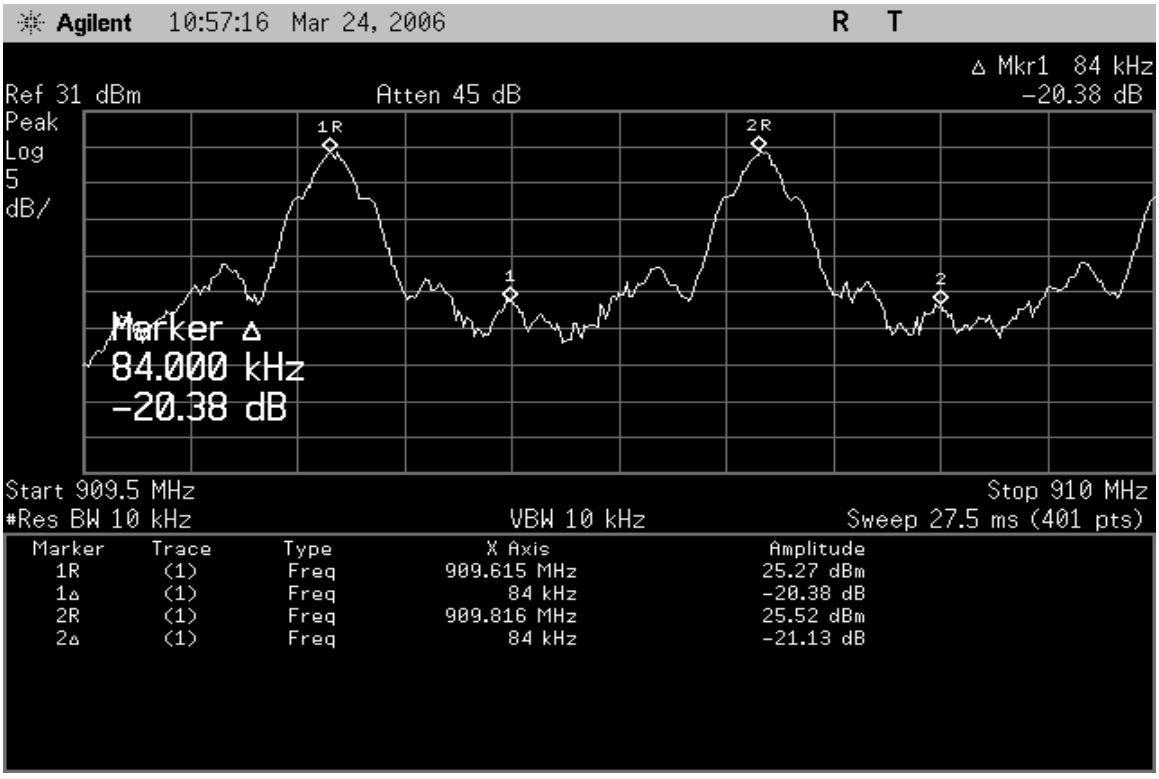
Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section. Submit this plot.

Equipment Used	Serial Number	Cal Date	Due
HP E4408B	US40240538	3-APR-05	3-APR-06

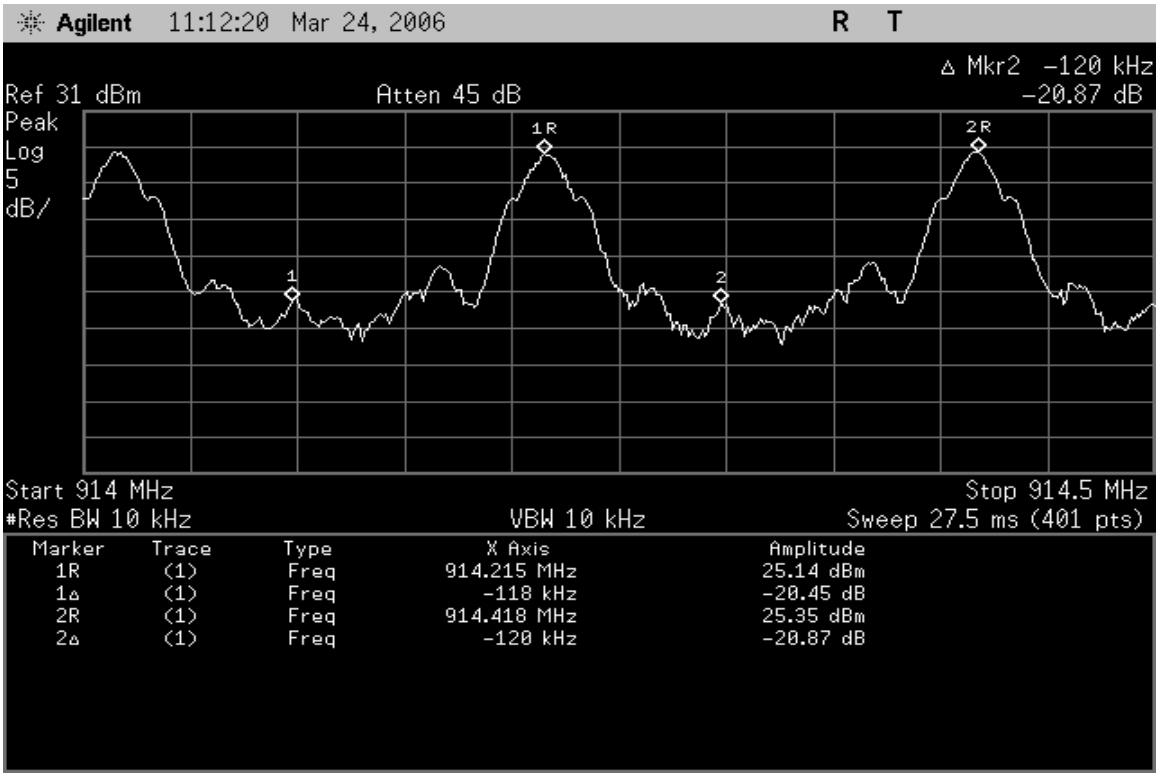
Date	Temp/Humidity ºF / %	Tested by
3/24/2006	58/31%	Mark Kvamme

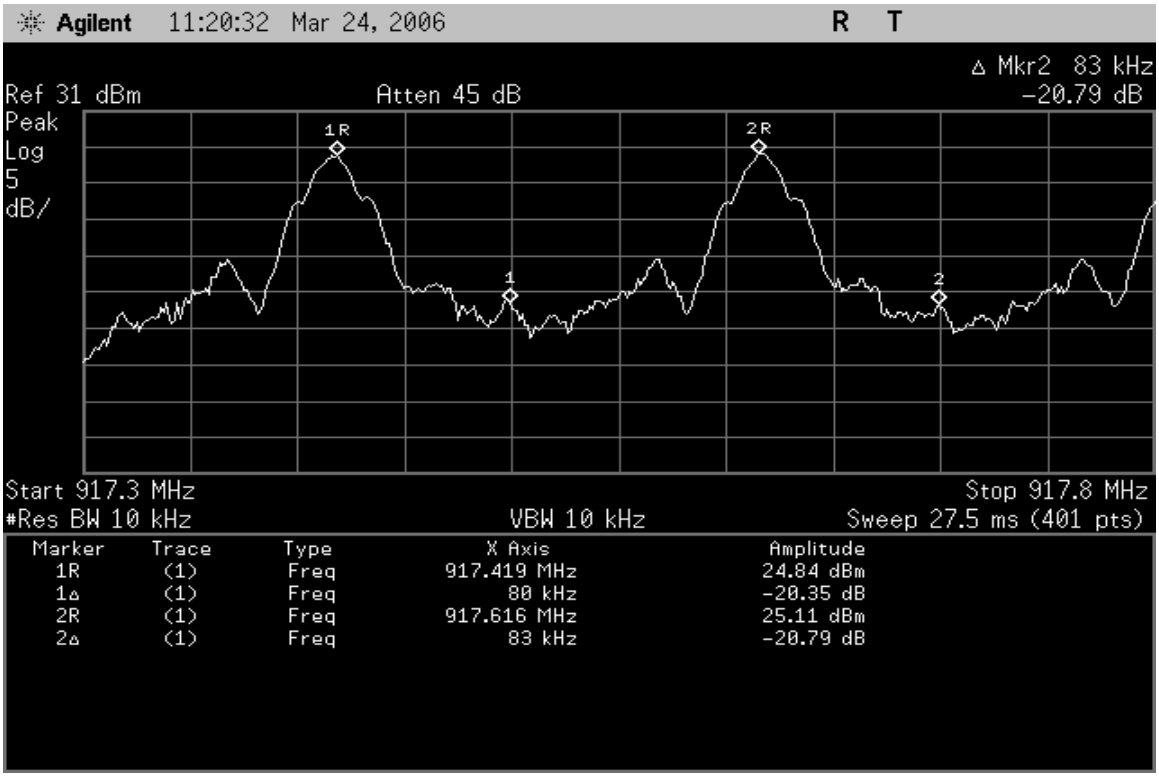
Unit tested: 65900038

Plot # 1 carrier separation is 201 kHz. This is greater than the max 20 dB BW of 131.3 kHz.

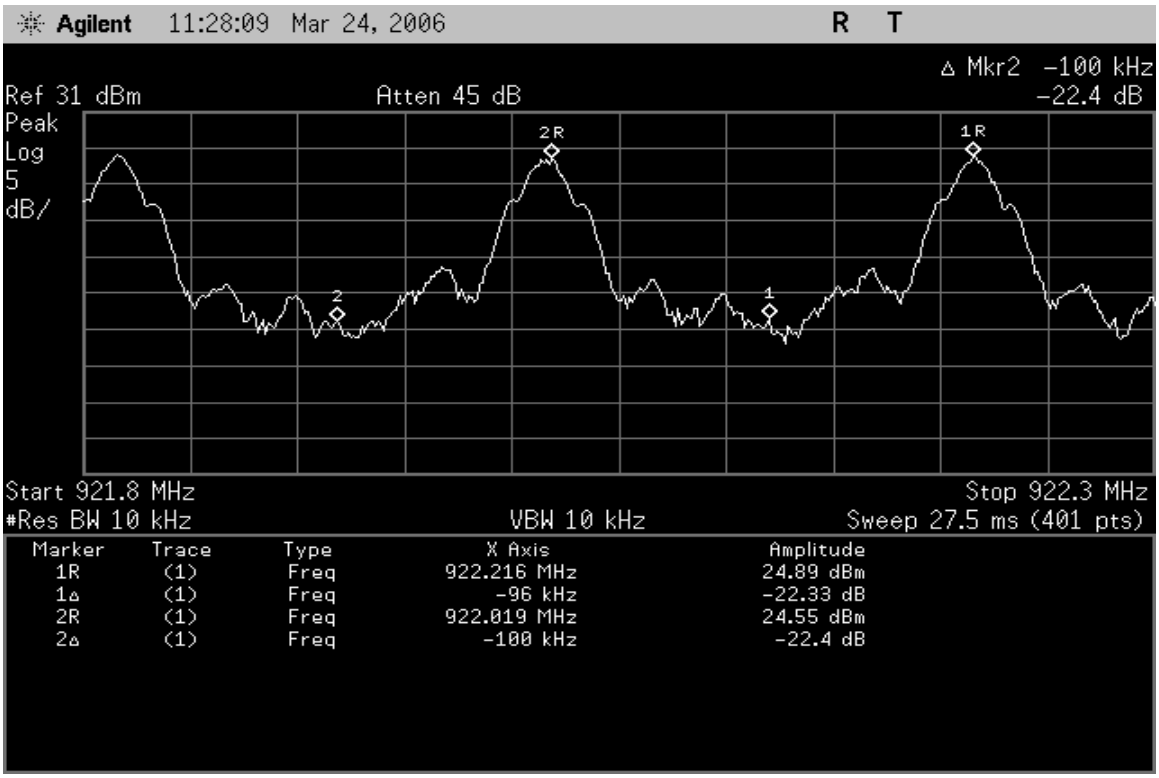


Plot # 2 carrier separation is 203 kHz. This is greater than the max 20 dB BW of 131.3 kHz.
Plot # 3 carrier separation is 197 kHz. This is greater than the max 20 dB BW of 131.3 kHz.





Plot # 4 carrier separation is 197 kHz. This is greater than the max 20 dB BW of 131.3 kHz.



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

Number of Hopping Channels

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

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

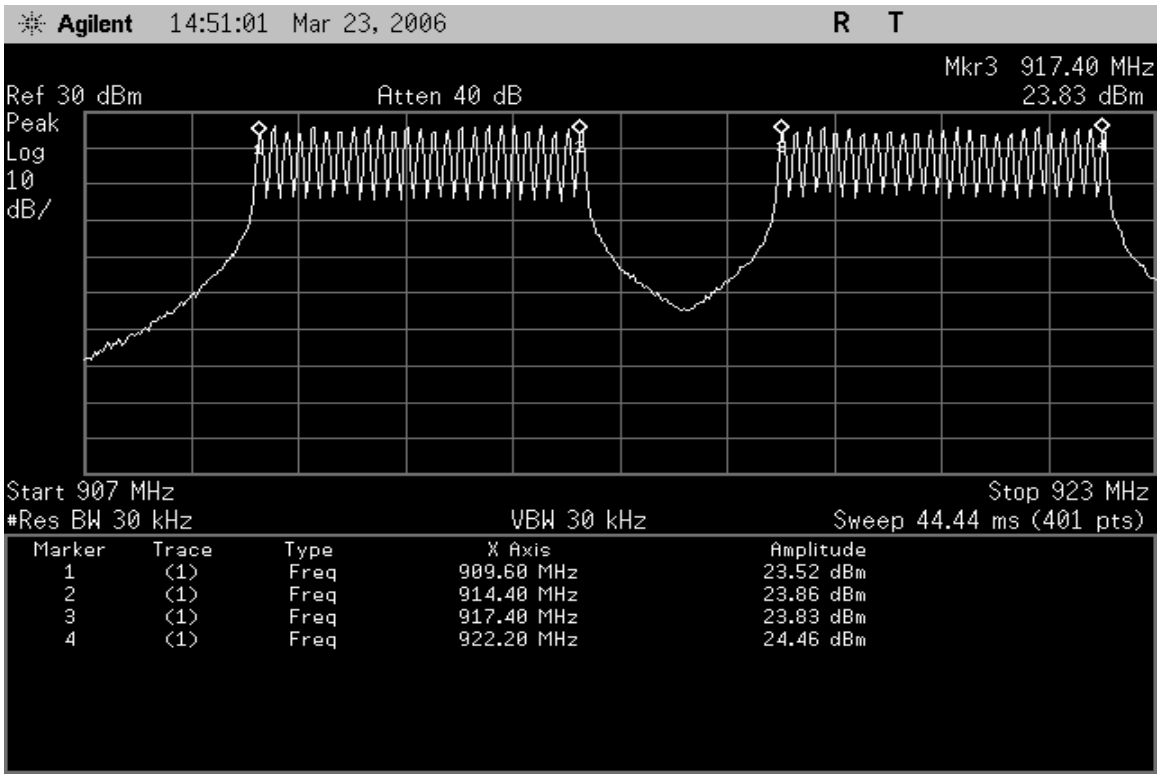
Span = the frequency band of operation
RBW ≥ 1% of the span
VBW ≥ RBW
Sweep = auto
Detector function = Peak
Trace = max hold

Allow the trace to stabilize. It may prove necessary to break the span up into sections, in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

Equipment Used	Serial Number	Cal Date	Due
HP E4408B	US40240538	3-APR-05	3-APR-06

Date	Temp/Humidity ºF / %	Tested by
3/23/2006	55/27%	Mark Kvamme

Unit tested: 65900038
There are 50 channels.



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

20 dB Bandwidth

Verify that the 20 dB bandwidth of the hopping channel is less than 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. Submit this plot(s).

Equipment Used	Serial Number	Cal Date	Due
HP E4408B	US40240538	3-APR-05	3-APR-06

Date	Temp/Humidity ºF / %	Tested by
3/24/2006	58/31%	Mark Kvamme

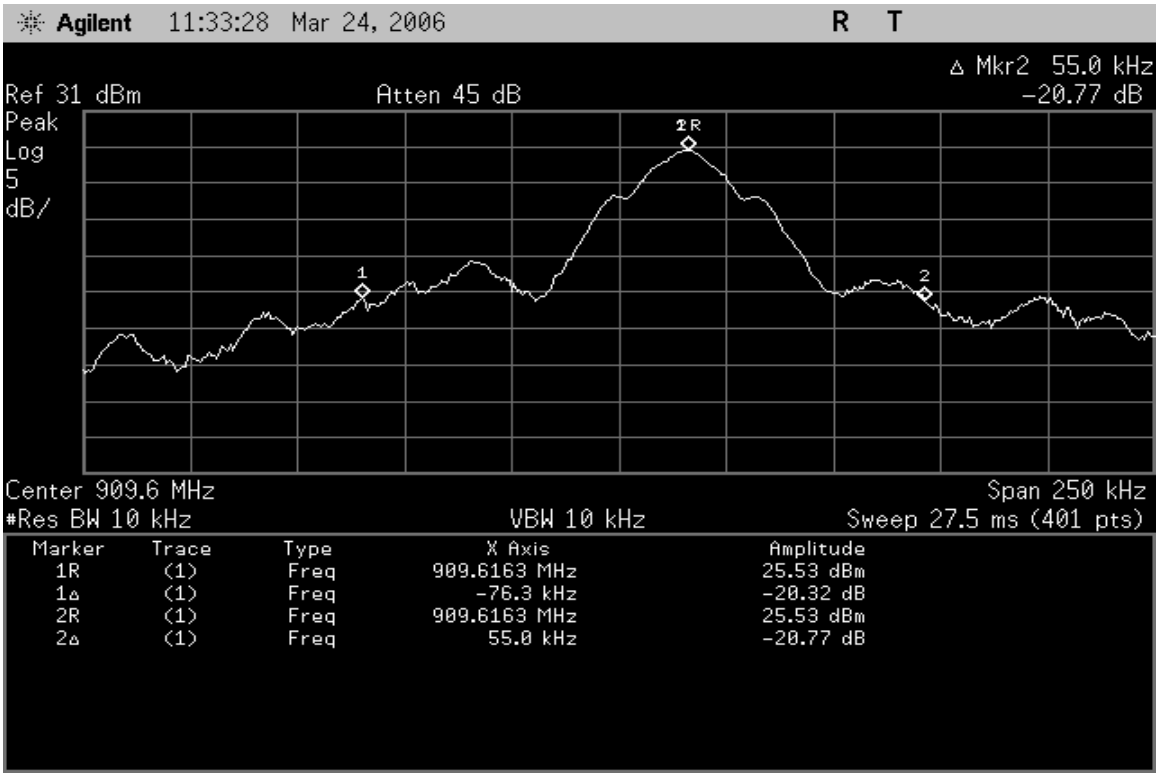
Unit tested: 65900038

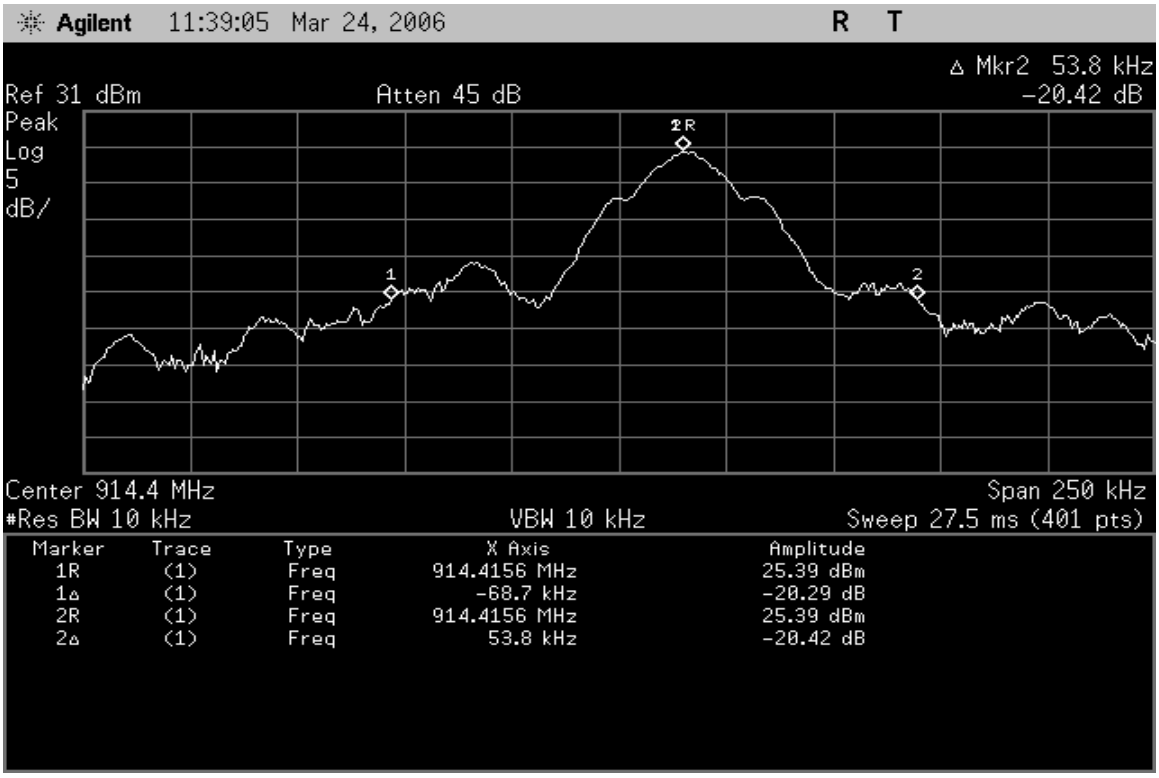
20 dB BW for 909.6163 MHz = (55 kHz + 76.3 kHz) = 131.3 kHz

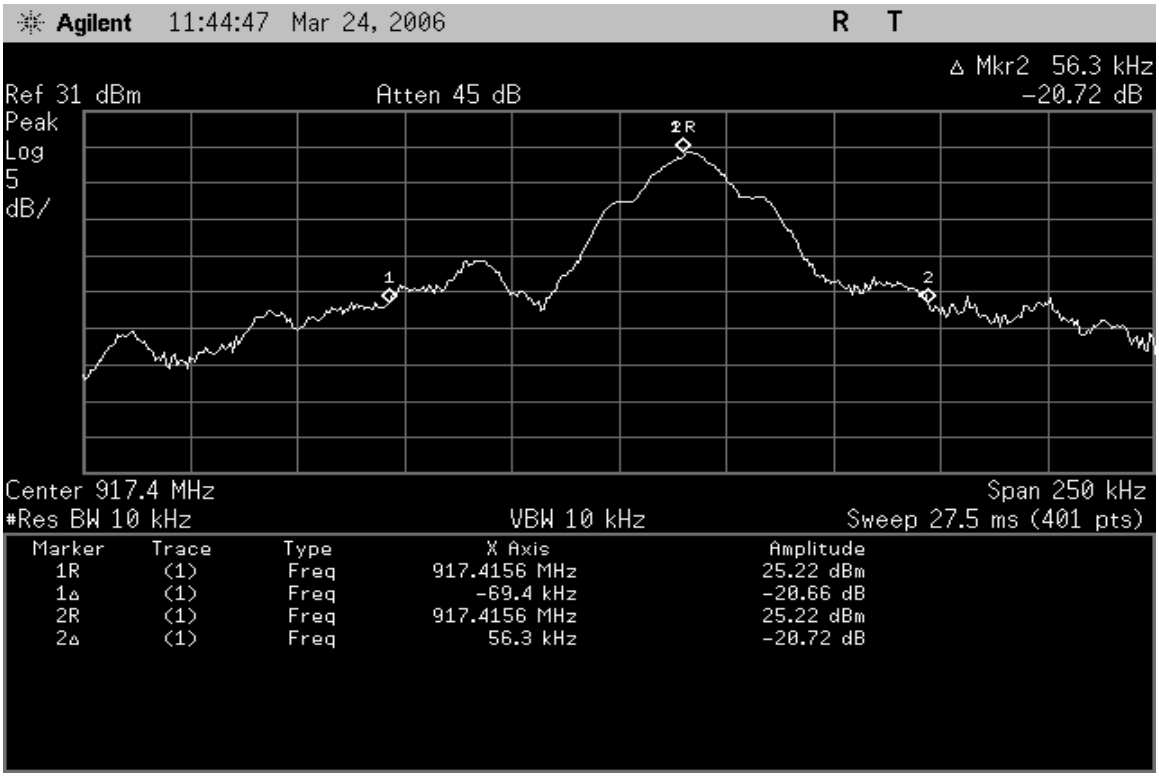
20 dB BW for 914.4156 MHz = (53.8 kHz + 68.7 kHz) = 122.5 kHz

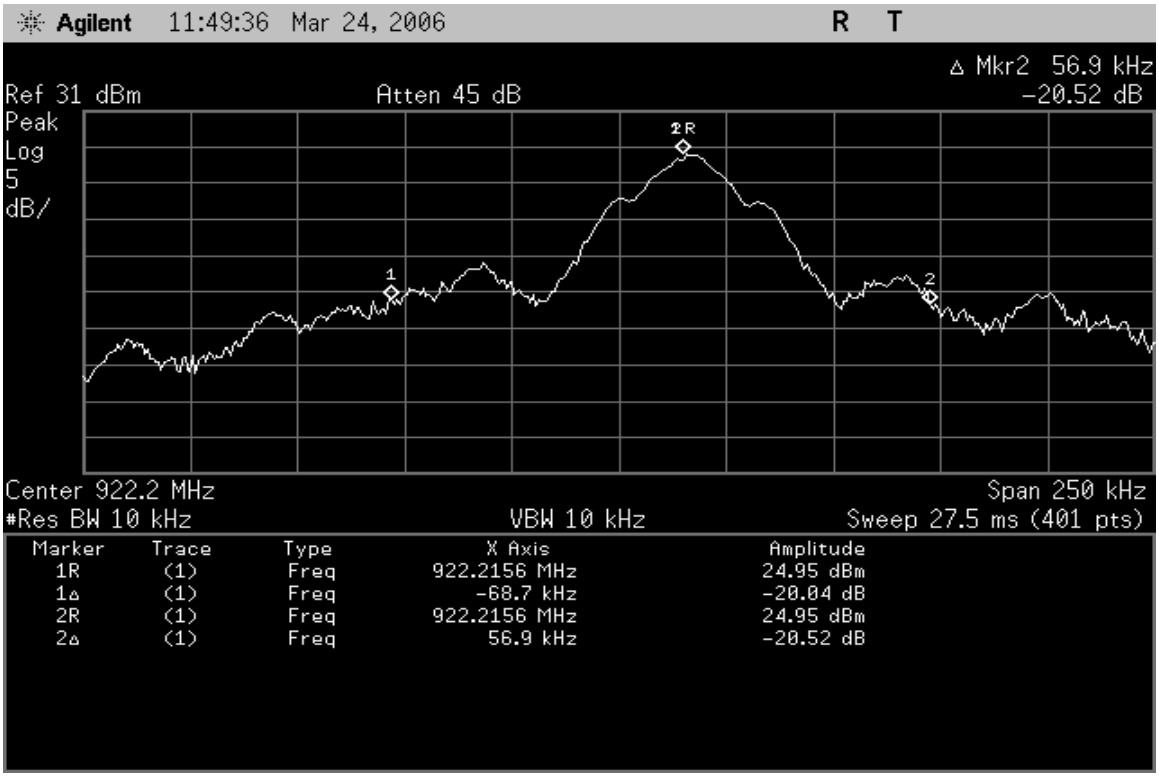
20 dB BW for 917.4156 MHz = (56.3 kHz + 69.4 kHz) = 125.7 kHz

20 dB BW for 922.2156 MHz = (56.9 kHz + 68.7 kHz) = 125.6 kHz




Agilent 11:39:05 Mar 24, 2006
R T
Δ Mkr2 53.8 kHz
-20.42 dB
Ref 31 dBm
Atten 45 dB
Peak
Log
5
dB/
1R
1
2
Center 914.4 MHz
#Res BW 10 kHz
VBW 10 kHz
Span 250 kHz
Sweep 27.5 ms (401 pts)
Marker Trace Type X Axis Amplitude
1R (1) Freq 914.4156 MHz 25.39 dBm
1Δ (1) Freq -68.7 kHz -20.29 dB
2R (1) Freq 914.4156 MHz 25.39 dBm
2Δ (1) Freq 53.8 kHz -20.42 dB


Agilent 11:44:47 Mar 24, 2006
R T
Δ Mkr2 56.3 kHz
-20.72 dB
Ref 31 dBm
Atten 45 dB
Peak
Log
5
dB/
1R
1
2
Center 917.4 MHz
#Res BW 10 kHz
VBW 10 kHz
Span 250 kHz
Sweep 27.5 ms (401 pts)
Marker Trace Type X Axis Amplitude
1R (1) Freq 917.4156 MHz 25.22 dBm
1Δ (1) Freq -69.4 kHz -20.66 dB
2R (1) Freq 917.4156 MHz 25.22 dBm
2Δ (1) Freq 56.3 kHz -20.72 dB


Agilent 11:49:36 Mar 24, 2006
R T
Δ Mkr2 56.9 kHz
-20.52 dB
Ref 31 dBm
Atten 45 dB
Peak
Log
5
dB/
2R
1
2
Center 922.2 MHz
Span 250 kHz
#Res BW 10 kHz
VBW 10 kHz
Sweep 27.5 ms (401 pts)
Marker Trace Type X Axis Amplitude
1R (1) Freq 922.2156 MHz 24.95 dBm
1Δ (1) Freq -68.7 kHz -20.04 dB
2R (1) Freq 922.2156 MHz 24.95 dBm
2Δ (1) Freq 56.9 kHz -20.52 dB

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

Time of Occupancy

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

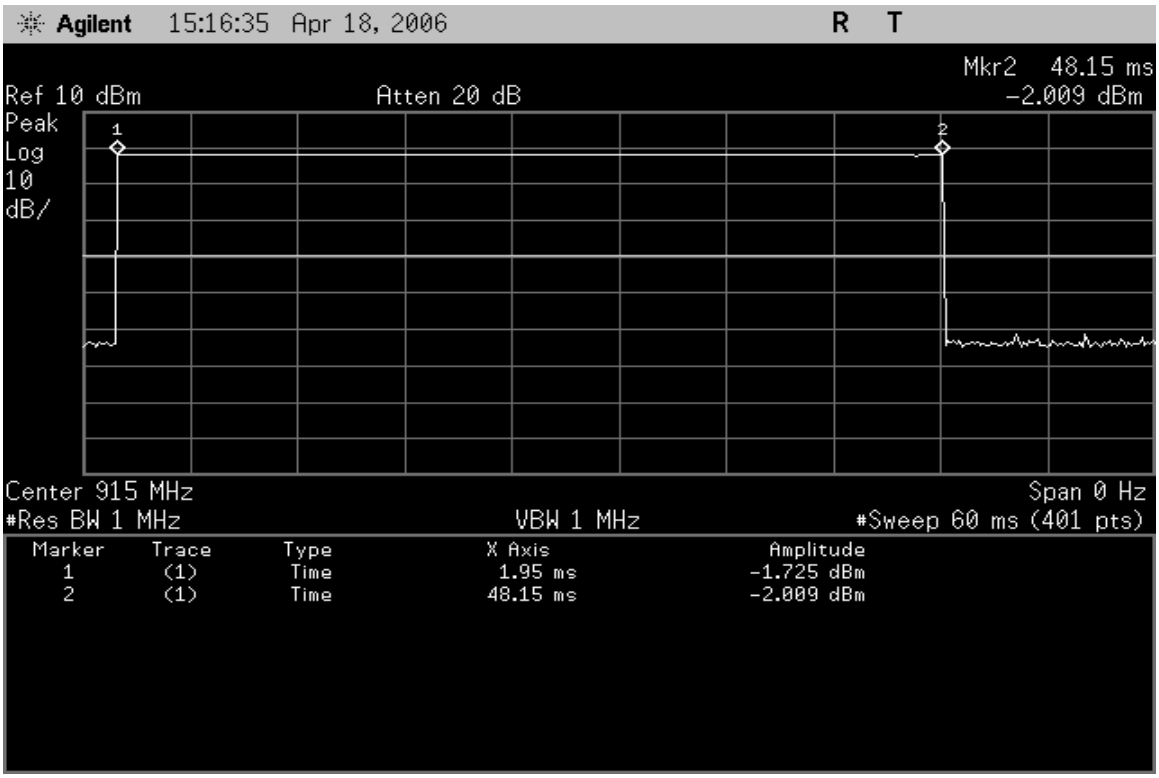
The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:
Span = zero span, centered on a hopping channel
RBW = 1 MHz
VBW ≥ RBW
Sweep = as necessary to capture the entire dwell time per hopping channel
Detector function = peak
Trace = max hold
If possible, use the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

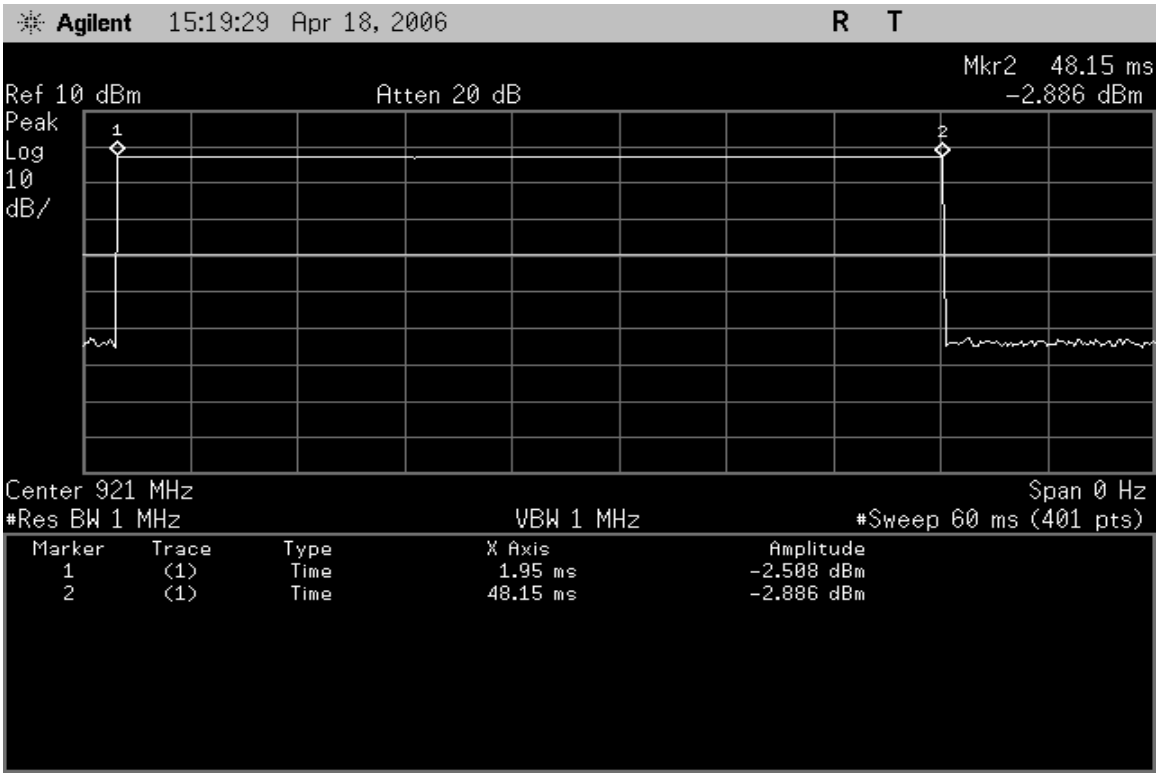
Equipment Used	Serial Number	Cal Date	Due
HP E4408B	US40240538	3-APR-05	3-APR-06

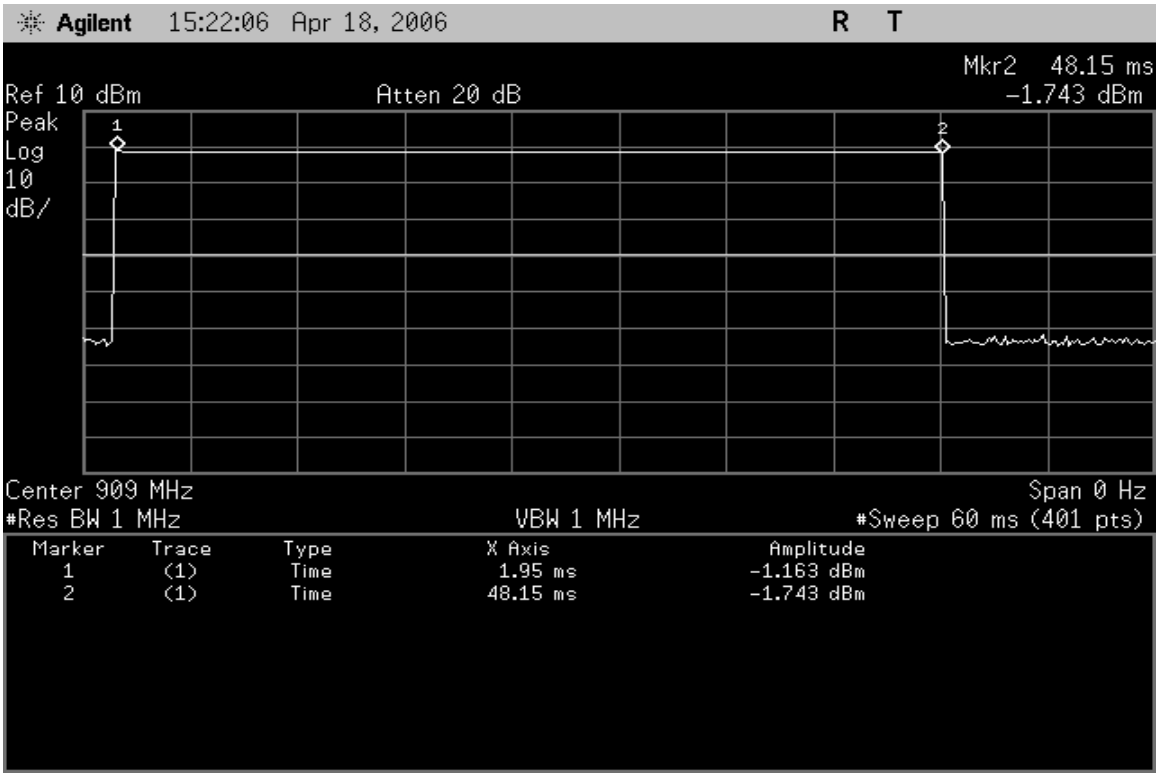
Date	Temp/Humidity ºF / %	Tested by
4/18/2006	60 / 30%	Mark Kvamme

Unit tested: 65900038

The longest transmission is 46.2 mS long. Each transmission takes place on one of 50 different channels in a pseudo-random sequence. All 50 channels are used equally on the average. The algorithm that determines the pseudo-random hop sequence does not allow the device to transmit on the same channel more than once in a 20 second period. The maximum possible occupancy time on any one frequency is 46.2 mS within a 20 second period.


Agilent 15:16:35 Apr 18, 2006
R T
Mkr2 48.15 ms
-2.009 dBm
Ref 10 dBm
Atten 20 dB
Peak
Log
10
dB/
1
2
Center 915 MHz
Span 0 Hz
#Res BW 1 MHz
VBW 1 MHz
#Sweep 60 ms (401 pts)
Marker Trace Type X Axis Amplitude
1 (1) Time 1.95 ms -1.725 dBm
2 (1) Time 48.15 ms -2.009 dBm


Agilent 15:19:29 Apr 18, 2006
R T
Mkr2 48.15 ms
-2.886 dBm
Ref 10 dBm
Atten 20 dB
Peak
Log
10
dB/
1
2
Center 921 MHz
Span 0 Hz
#Res BW 1 MHz
VBW 1 MHz
#Sweep 60 ms (401 pts)
Marker Trace Type X Axis Amplitude
1 (1) Time 1.95 ms -2.508 dBm
2 (1) Time 48.15 ms -2.886 dBm


Agilent 15:22:06 Apr 18, 2006
R T
Mkr2 48.15 ms
-1.743 dBm
Ref 10 dBm
Atten 20 dB
Peak
Log
10
dB/
1
2
Center 909 MHz
Span 0 Hz
#Res BW 1 MHz
VBW 1 MHz
#Sweep 60 ms (401 pts)
Marker Trace Type X Axis Amplitude
1 (1) Time 1.95 ms -1.163 dBm
2 (1) Time 48.15 ms -1.743 dBm

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:

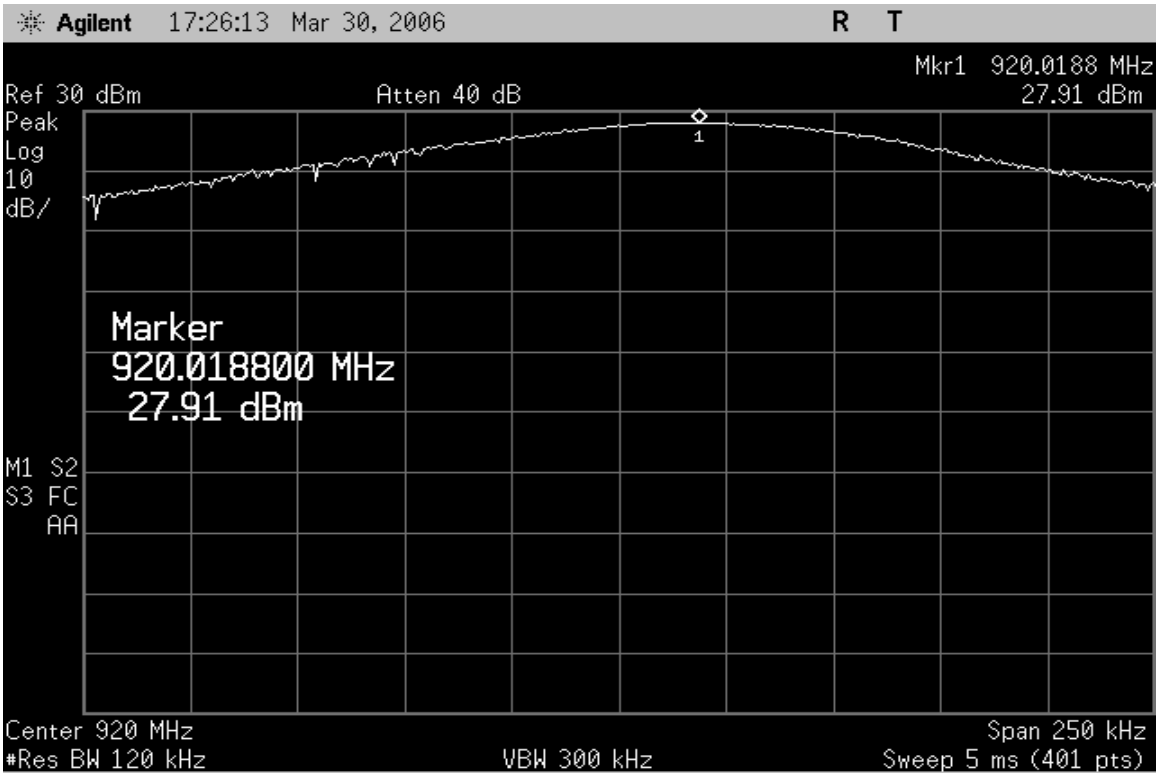
Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel.
RBW > the 20 dB bandwidth of the emission being measured.
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

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 E4408B	US40240538	3-APR-05	3-APR-06

Date	Temp/Humidity ºF / %	Tested by
3/30/2006	59/76%	Mark Kvamme

Unit tested: 65900038



15.247(d) / RSS-210 A8.5

Spurious Emissions - Conducted

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. Attenuation below the general limits specified in Section 15.209(a) is not required.

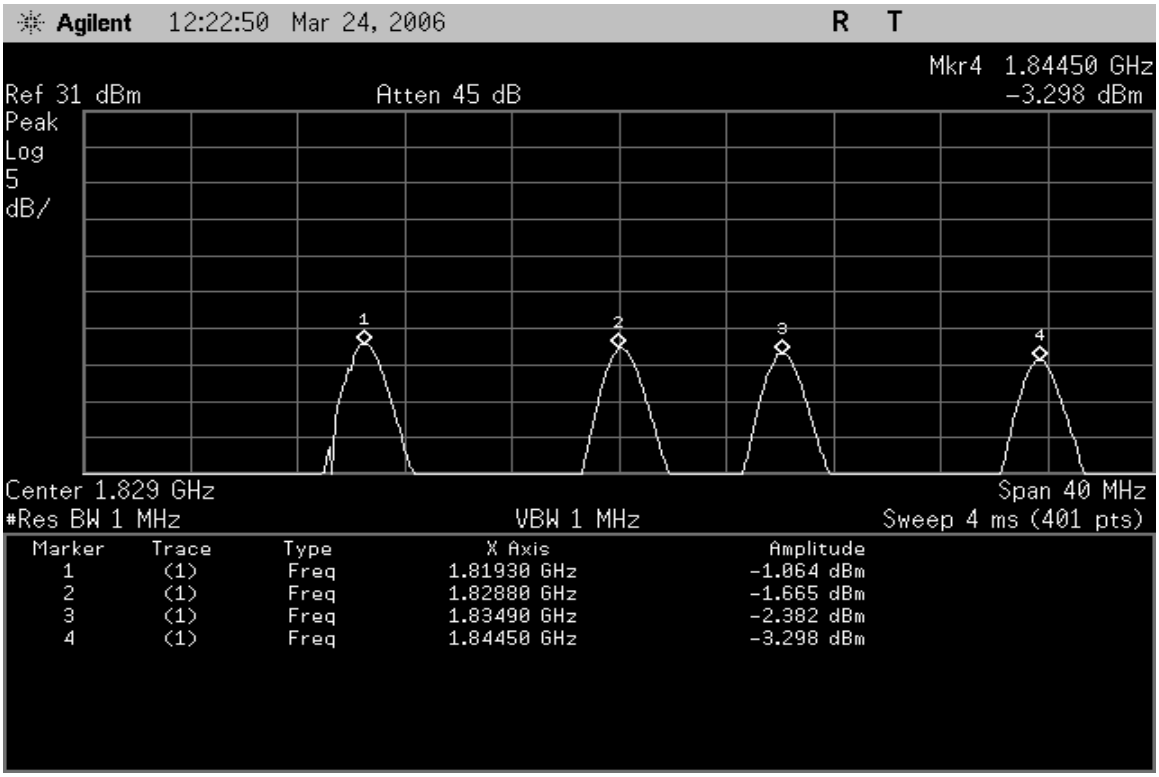
Follow the procedure outlined in Annex A of this document.

Equipment Used	Serial Number	Cal Date	Due
HP E4408B	US40240538	3-APR-05	3-APR-06
EMCO 6502	9509-2970	10/22/04	10/22/06

Date	Temp/Humidity ºF / %	Tested by
3/24/2006	58/31%	Mark Kvamme

Unit tested: 65900038
The frequency investigated was 10 kHz to 9.2 GHz.

27.74 dBm -1.06dBm = 28.2dBc
Seventh Harmonic was < -60dBm



15.205, 15.209 / RSS-210 2.2, 2.6

Restricted Bands & Spurious Emissions

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

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

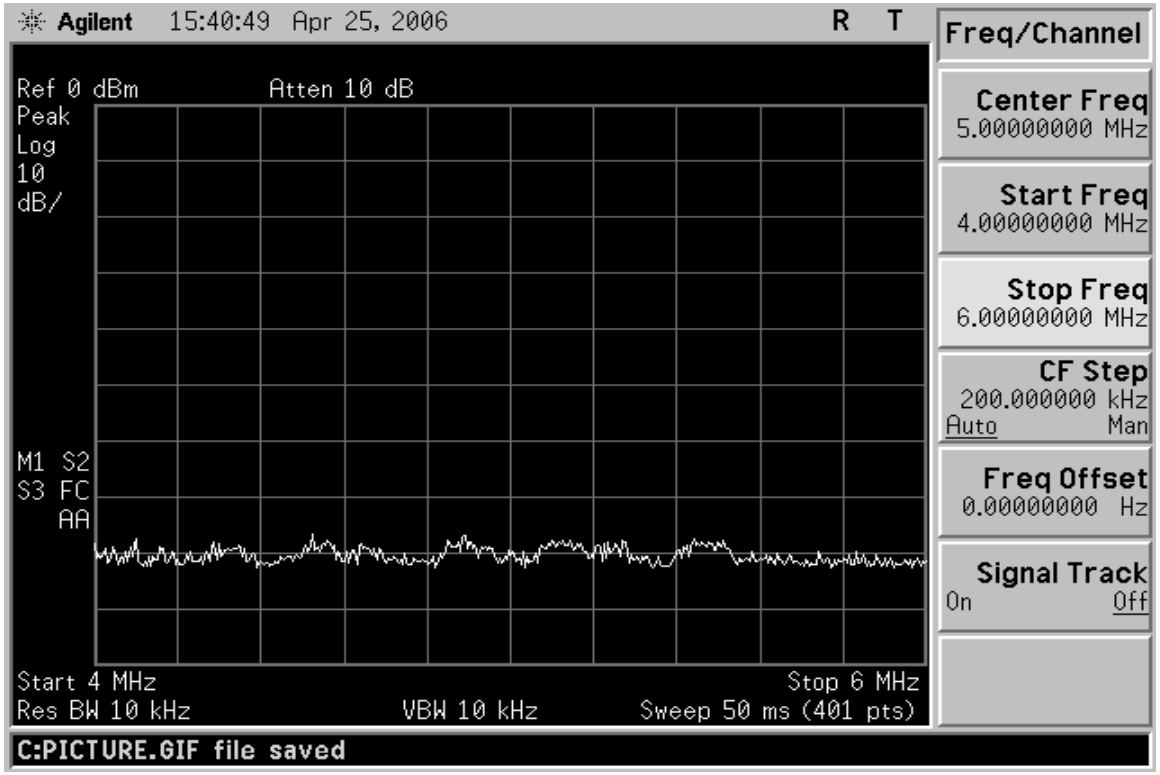
MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505 1	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	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			

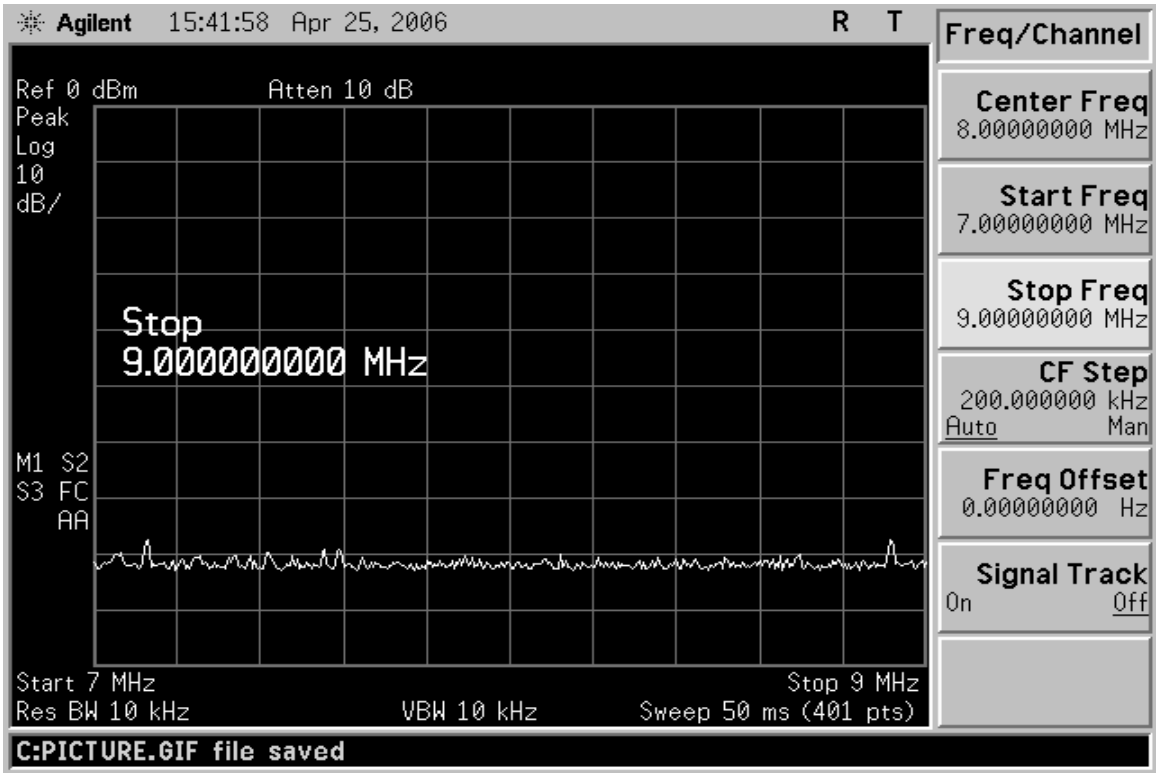
Equipment Used	Serial Number	Cal Date	Due
HP437B	3125U11553	11/10/04	11/10/06
HP8481D	3318A08626	12/1/04	12/1/06
HP E4408B	US40240538	4/3/05	4/3/06
EMCO 3115	9205-3878	4/13/04	4/13/06
EMCO 6502	9509-2970	10/22/04	10/22/06

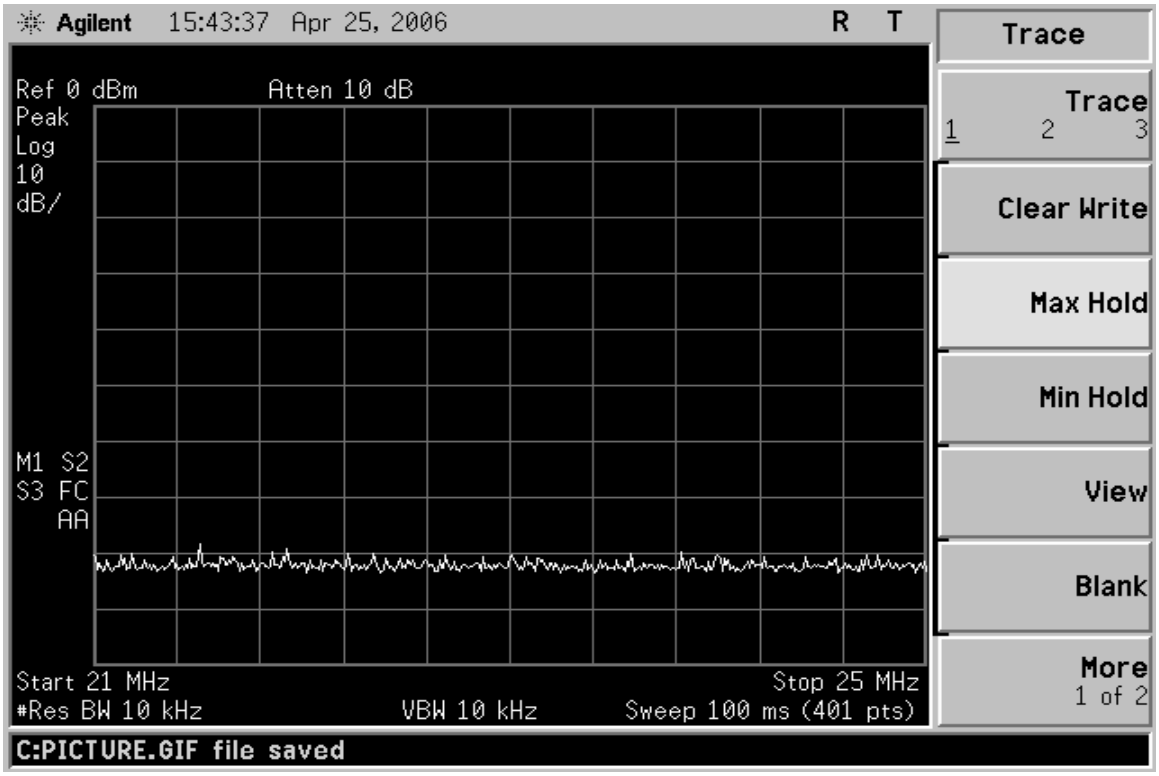
Date	Tested by	Temperature/ humidity
3/30/2006	Mark Kvamme	59F / 76%

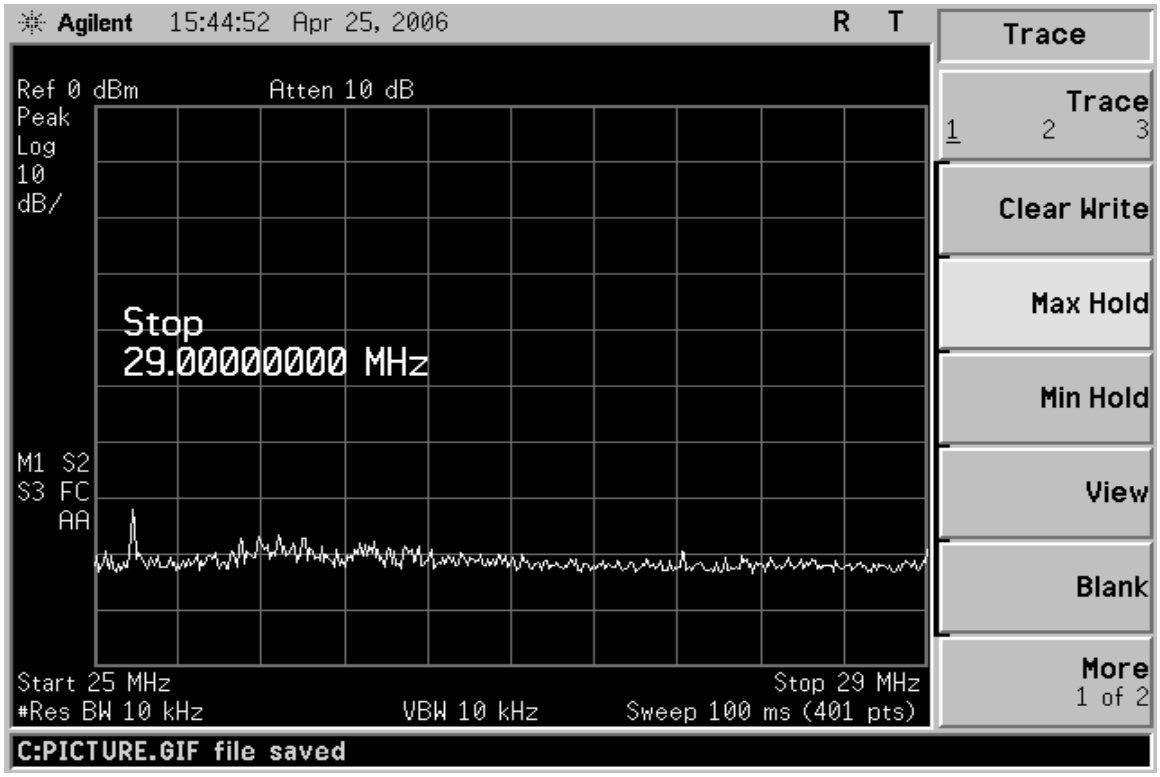
Unit tested: 65900038
The frequency investigated was 10 kHz to 9.2 GHz.
The unit transmits Manchester Encoded messages. Each of the messages is 92 bytes (736 bits) long.
There are 20 bits of sync data on the front of the packet for a total of 756 bits at a bit rate of 16.384 kbps.
Message Period is: 756/16.384 kbps = 44.16 mS
During the transmission of messages, the Transmit Duty Cycle can be computed.
% Duty Cycle Transmit = 756 bits x (1/16.384 kbps) x 0.5 x 100% / 100 mS
% Duty Cycle Transmit =23.07 %
Note: The .5 factor is a result of Manchester Encoded Data.
Expressing the correction factor for Duty Cycle in dB:
dB Duty Cycle Transmit = 20 Log (Duty Cycle)
dB Duty Cycle Transmit = 20 Log (.2307)
dB Duty Cycle Transmit = -12.74 dB
The maximum relaxation allowed is 20 dB.

Freq.	Ant.	Antenna Height / Table	Level		Level	Amplifier Gain	Ant. Factor	Cable Loss	Duty Cycle Correction	**Corrected Level**	Peak Limit	Margin
MHz	Pos.	Azimuth	dBm		dBuV	dB	dB	dB		**dBuV/m**	dBuV/m	dB
2730	H	108/235	-37.7	Peak	69.3	42.4	29.4	3	12.74	46.66	54	7.34
3680	V	100/10	-34.0	Peak	73.0	43.3	31.7	3.2	12.74	51.86	54	2.14
4600	V	100/75	-41.8	Peak	65.2	45.8	32.4	4	12.74	43.06	54	10.94
5460	H	100/305	-39.5	Peak	67.5	44.7	34.1	5	12.74	49.16	54	4.84
7360	V	100/105	-50.5	Peak	56.5	48.2	36.1	6.4	12.74	38.06	54	15.94




Agilent 15:41:58 Apr 25, 2006
R T
Ref 0 dBm
Atten 10 dB
Peak
Log
10
dB/
Stop
9.000000000 MHz
M1 S2
S3 FC
AA
Start 7 MHz
Stop 9 MHz
Res BW 10 kHz
VBW 10 kHz
Sweep 50 ms (401 pts)
Freq/Channel
Center Freq
8.00000000 MHz
Start Freq
7.00000000 MHz
Stop Freq
9.00000000 MHz
CF Step
200.000000 kHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
C:PICTURE.GIF file saved


Agilent 15:43:37 Apr 25, 2006
R T
Ref 0 dBm
Atten 10 dB
Peak
Log
10
dB/
M1 S2
S3 FC
AA
Start 21 MHz
Stop 25 MHz
#Res BW 10 kHz
VBW 10 kHz
Sweep 100 ms (401 pts)
Trace
Trace
1 2 3
Clear Write
Max Hold
Min Hold
View
Blank
More
1 of 2
C:PICTURE.GIF file saved


Agilent 15:44:52 Apr 25, 2006
R T
Ref 0 dBm
Atten 10 dB
Peak
Log
10
dB/
Stop
29.00000000 MHz
M1 S2
S3 FC
AA
Start 25 MHz
#Res BW 10 kHz
VBW 10 kHz
Stop 29 MHz
Sweep 100 ms (401 pts)
Trace
Trace
1 2 3
Clear Write
Max Hold
Min Hold
View
Blank
More
1 of 2
C:PICTURE.GIF file saved

RSS-Gen 7.2.3 Receiver Spurious Emission Limits

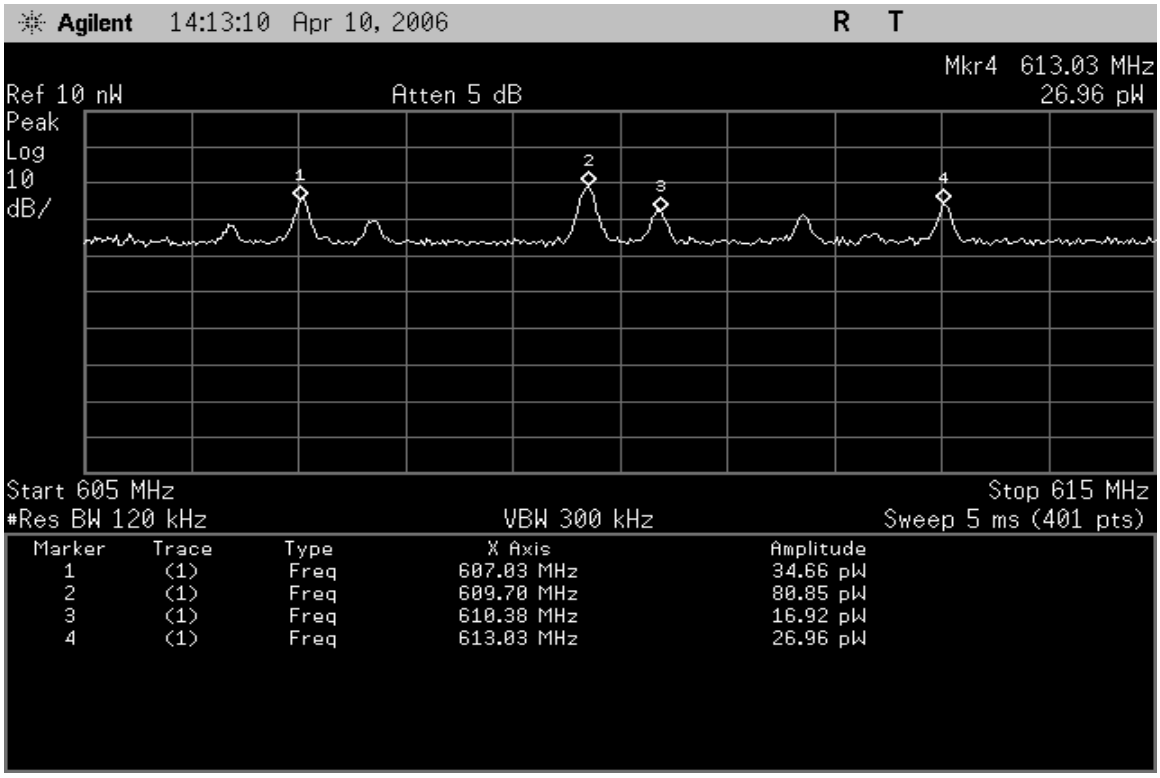
Antenna Conducted Measurement

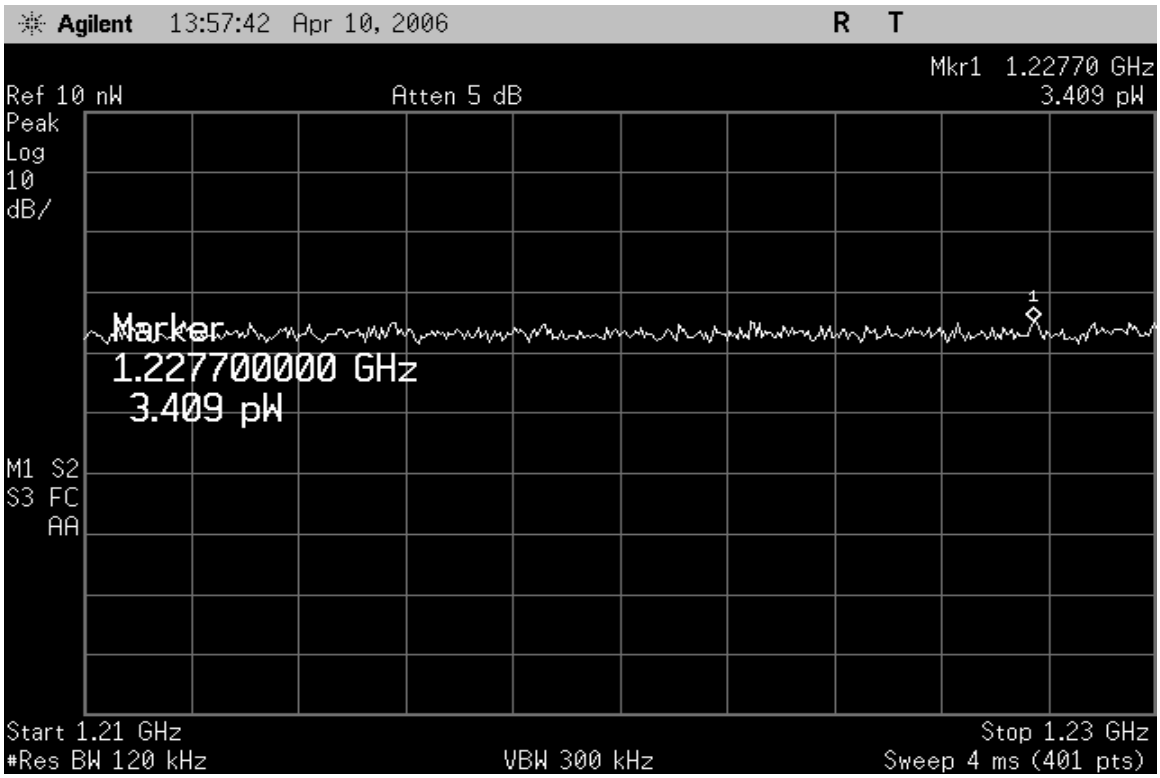
If the device has a detachable antenna of known antenna impedance, then the antenna conducted method is permitted in lieu of a radiated measurement.
Receiver spurious emissions at any discrete frequency shall not exceed 2 nanowatts in the band 30-1000 MHz, or 5 nanowatts above 1 GHz.

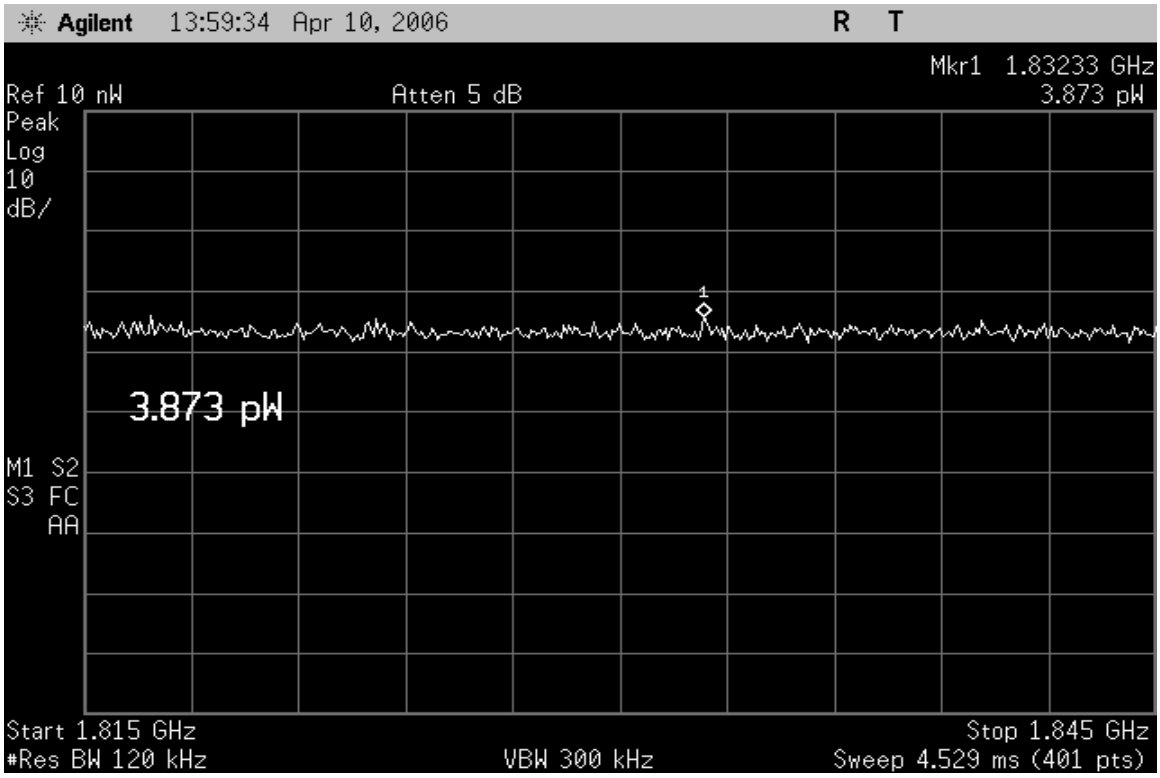
Equipment Used	Serial Number	Cal Date	Due
HP E4408B	US40240538	3-APR-06	3-APR-07

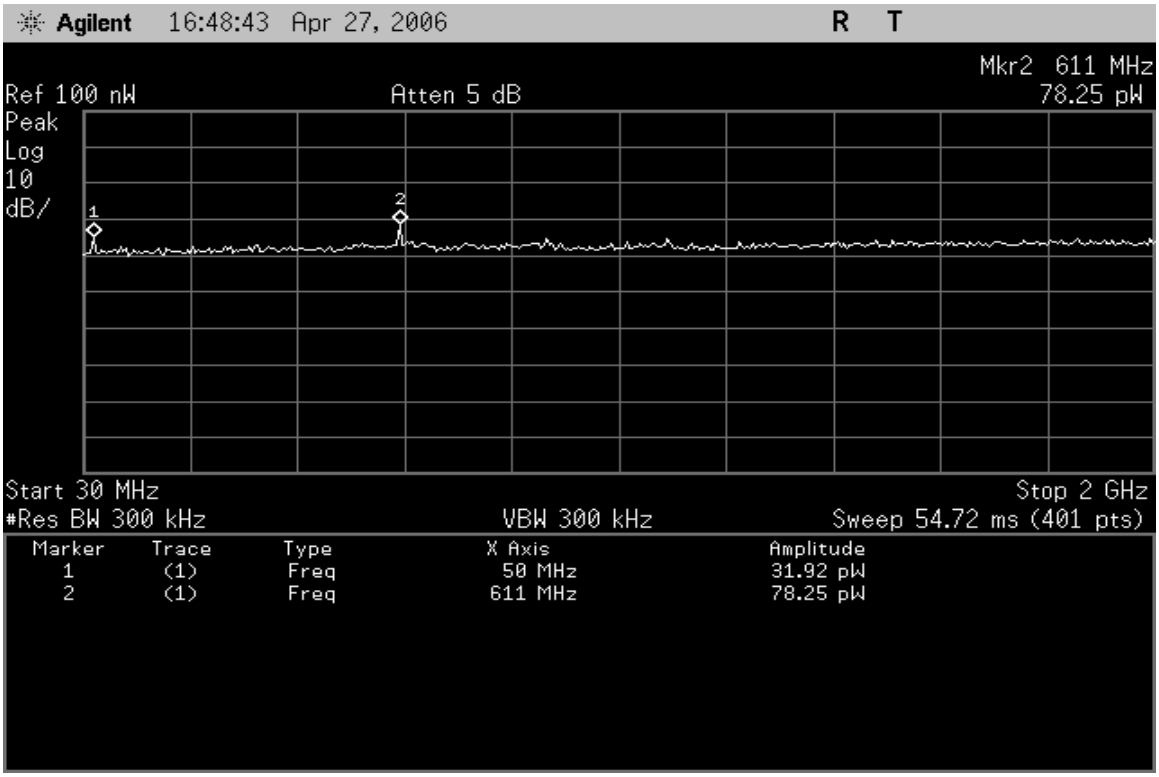
Date	Temp/Humidity ºF / %	Tested by
4/10/2006	72/20	Mark Kvamme

Conducted testing was performed.
The maximum emission found was 80.85 pW @ 609.7 MHz.
2 nW – 80.85 pW = Margin of 1.91 nW.
The second and third harmonics were checked.

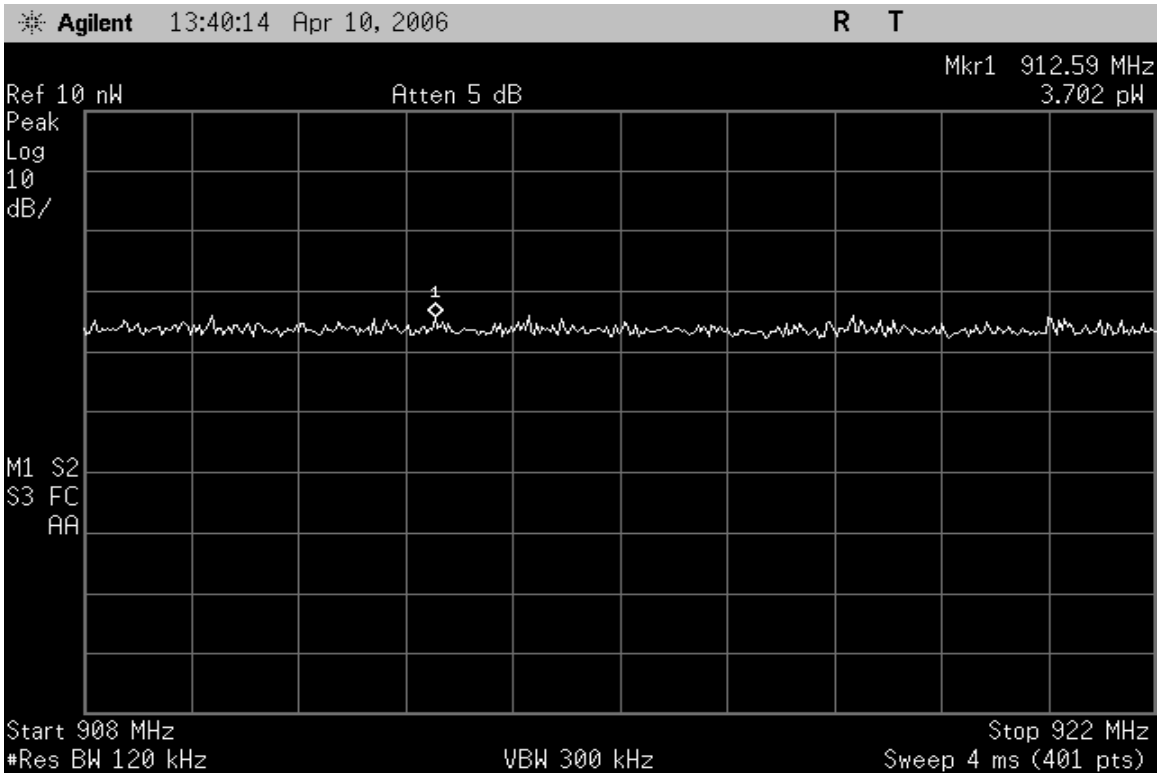


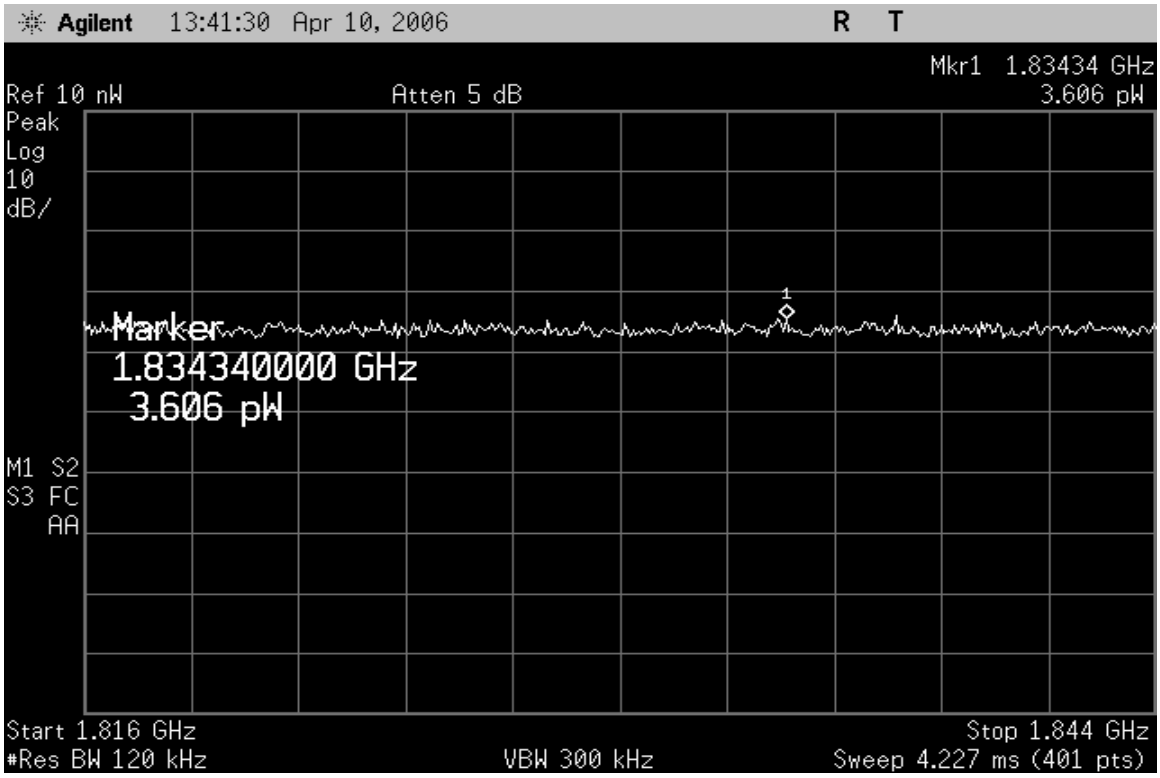

Agilent 13:57:42 Apr 10, 2006
R T
Mkr1 1.22770 GHz
3.409 pW
Ref 10 nW
Atten 5 dB
Peak
Log
10
dB/
Marker
1.227700000 GHz
3.409 pW
M1 S2
S3 FC
AA
Start 1.21 GHz
#Res BW 120 kHz
VBW 300 kHz
Stop 1.23 GHz
Sweep 4 ms (401 pts)

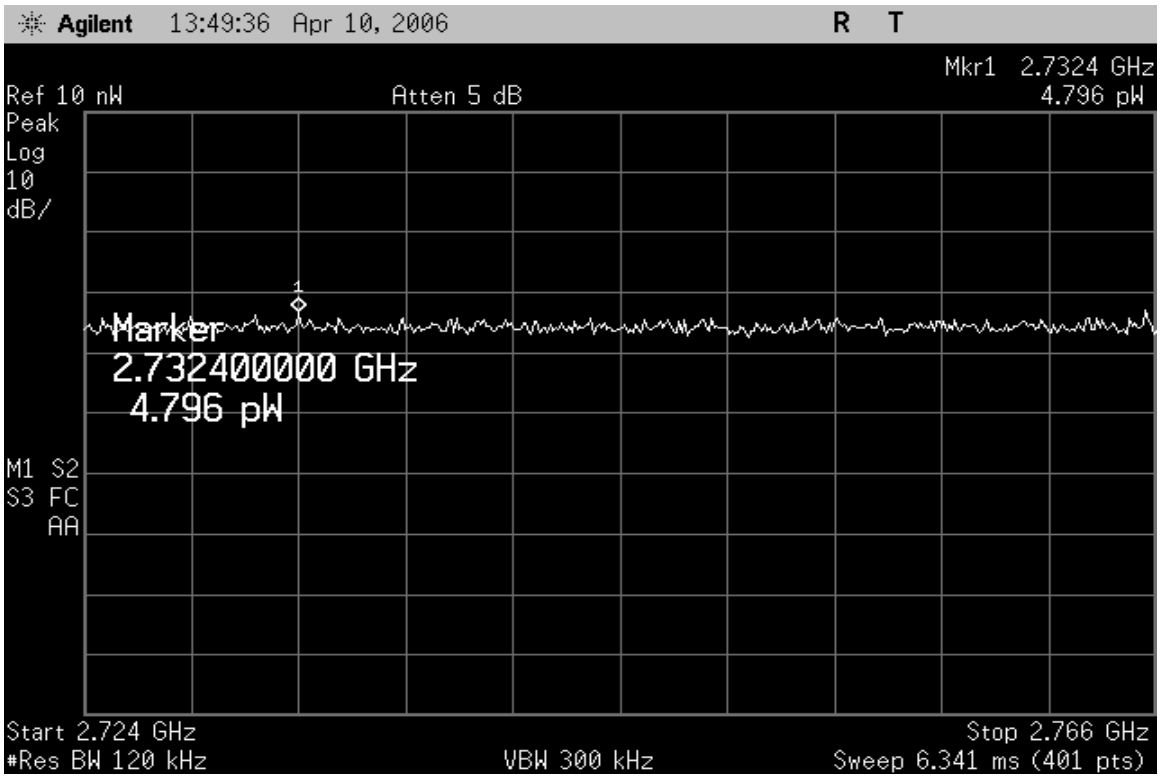

Agilent 13:59:34 Apr 10, 2006
R T
Mkr1 1.83233 GHz
3.873 pW
Ref 10 nW
Atten 5 dB
Peak
Log
10
dB/
3.873 pW
M1 S2
S3 FC
AA
Start 1.815 GHz
#Res BW 120 kHz
VBW 300 kHz
Stop 1.845 GHz
Sweep 4.529 ms (401 pts)

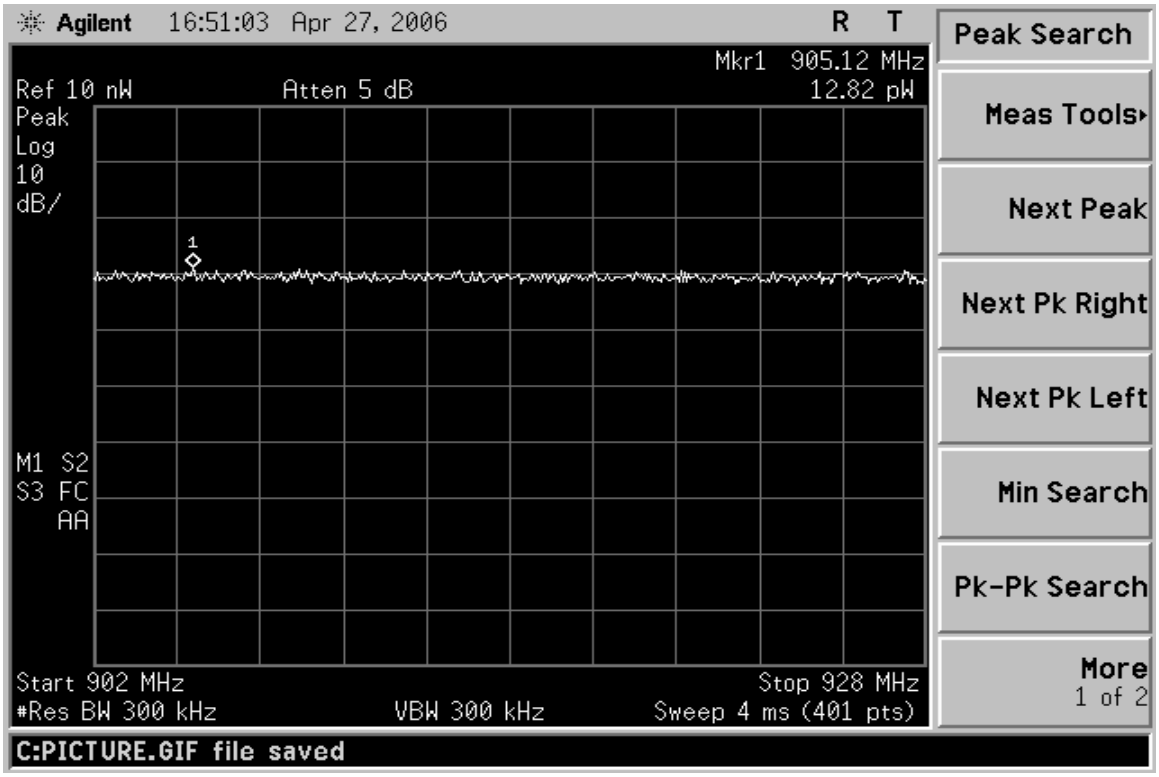


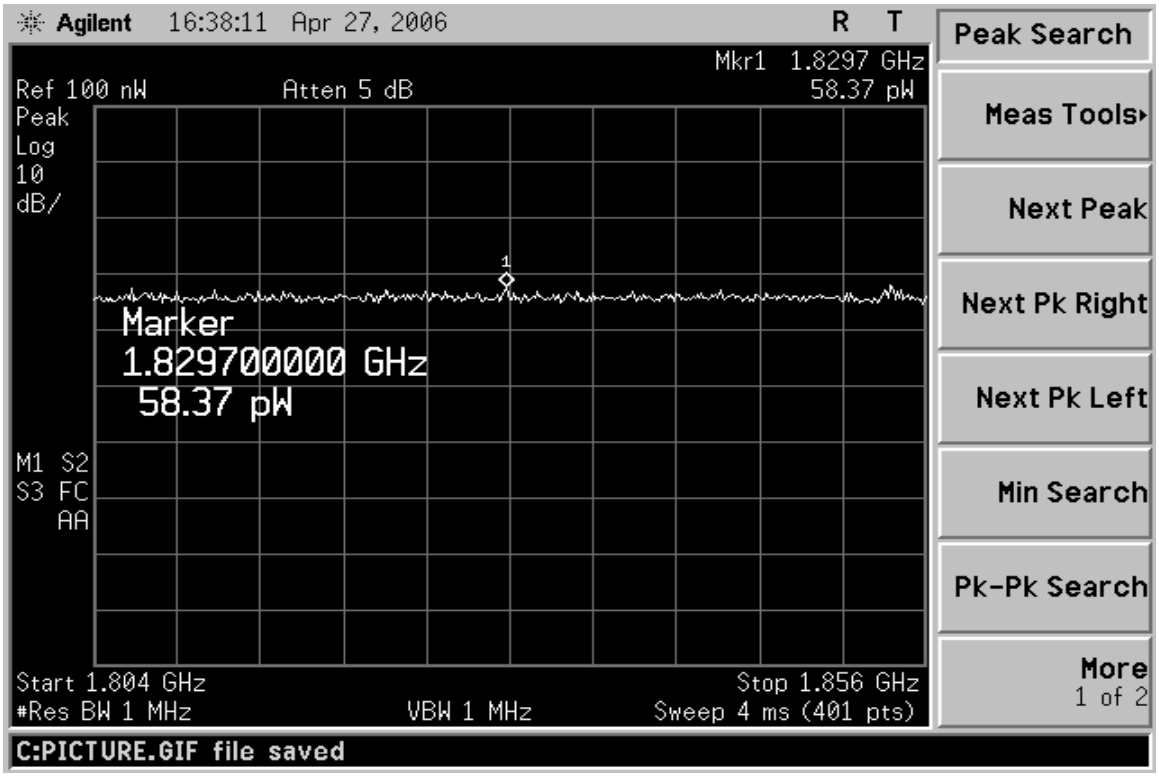
The receiver was set to RX on frequencies 910,911,912,915,916,918,919,920. This band as well as the 2nd and 3rd of this band were checked.

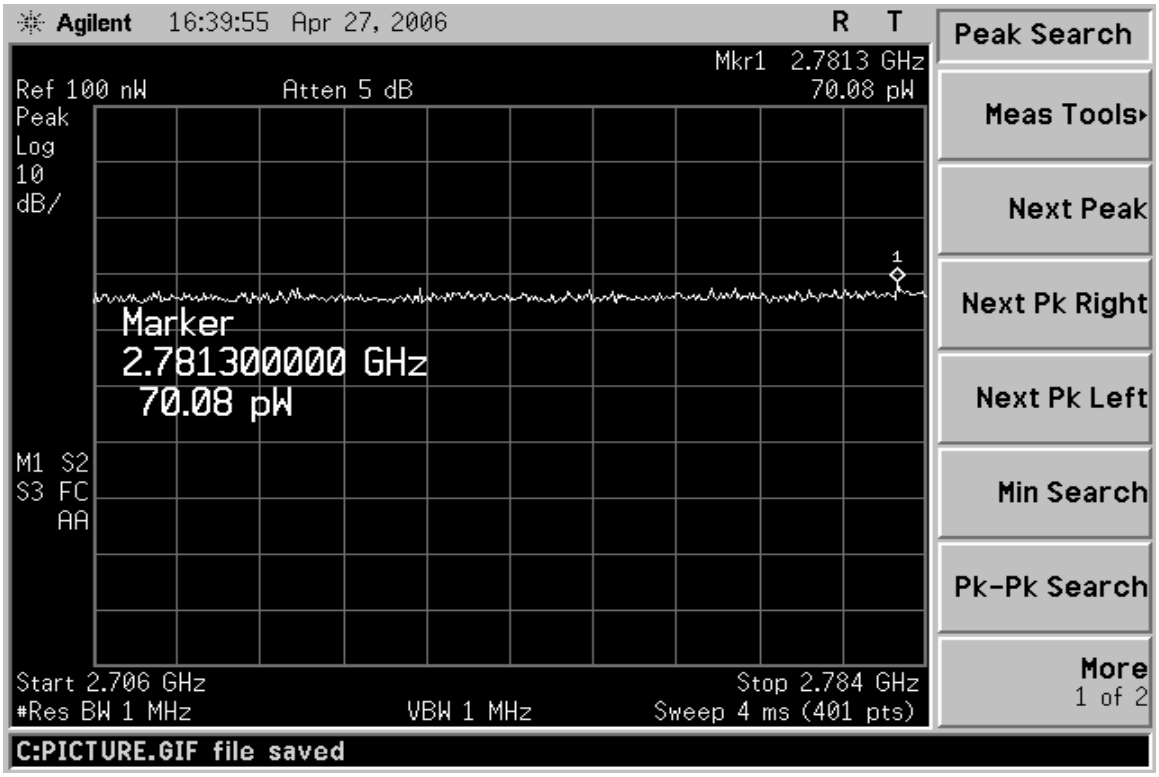



Agilent 13:41:30 Apr 10, 2006
R T
Mkr1 1.83434 GHz
3.606 pW
Ref 10 nW
Atten 5 dB
Peak
Log
10
dB/
Marker
1.834340000 GHz
3.606 pW
M1 S2
S3 FC
AA
Start 1.816 GHz
#Res BW 120 kHz
VBW 300 kHz
Stop 1.844 GHz
Sweep 4.227 ms (401 pts)


Agilent 13:49:36 Apr 10, 2006
R T
Mkr1 2.7324 GHz
4.796 pW
Ref 10 nW
Atten 5 dB
Peak
Log
10
dB/
Marker
2.732400000 GHz
4.796 pW
M1 S2
S3 FC
AA
Start 2.724 GHz
#Res BW 120 kHz
VBW 300 kHz
Stop 2.766 GHz
Sweep 6.341 ms (401 pts)


Agilent 16:51:03 Apr 27, 2006
R T
Mkr1 905.12 MHz
12.82 pW
Ref 10 nW
Atten 5 dB
Peak
Log
10
dB/
M1 S2
S3 FC
AA
Start 902 MHz
#Res BW 300 kHz
VBW 300 kHz
Stop 928 MHz
Sweep 4 ms (401 pts)
Peak Search
Meas Tools
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
More
1 of 2
C:PICTURE.GIF file saved


Agilent 16:38:11 Apr 27, 2006
R T
Mkr1 1.8297 GHz
58.37 pW
Ref 100 nW
Atten 5 dB
Peak
Log
10
dB/
Marker
1.829700000 GHz
58.37 pW
M1 S2
S3 FC
AA
Start 1.804 GHz
#Res BW 1 MHz
VBW 1 MHz
Stop 1.856 GHz
Sweep 4 ms (401 pts)
Peak Search
Meas Tools
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
More
1 of 2
C:PICTURE.GIF file saved


Agilent 16:39:55 Apr 27, 2006
R T
Mkr1 2.7813 GHz
70.08 pW
Ref 100 nW
Atten 5 dB
Peak
Log
10
dB/
Marker
2.781300000 GHz
70.08 pW
M1 S2
S3 FC
AA
Start 2.706 GHz
#Res BW 1 MHz
VBW 1 MHz
Stop 2.784 GHz
Sweep 4 ms (401 pts)
Peak Search
Meas Tools
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
More
1 of 2
C:PICTURE.GIF file saved

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. (f_{MHz} / 1500 mW/cm^2)

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

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

The power density is calculated as:

FCC Limit:

$$910 \ / 1500 \ = 0.61 \ mW \ / cm^2 @ \ 20 \ cm$$

Max antenna gain = 1.0 dBi = 1.26 numeric

Max TX power = 27.91 dBm = 618.02 mW

$$P_D = \frac{618.02 \times 1.26}{4 \times \pi \times 20^2} = 0.16 \, mW \ / cm^2 @ 20 \, cm$$

ANNEX A

15.247 (d)

Band-edge compliance of RF Conducted Emissions

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, 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 bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. 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. Submit this plot.

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 10^{th} 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 C63.4-2003 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization, etc. A pre-amp and a high pass filter are required for this test, in order to provide the measuring system with sufficient sensitivity. Allow the trace to stabilize. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, which must comply with the limit specified in Section 15.35(b). 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

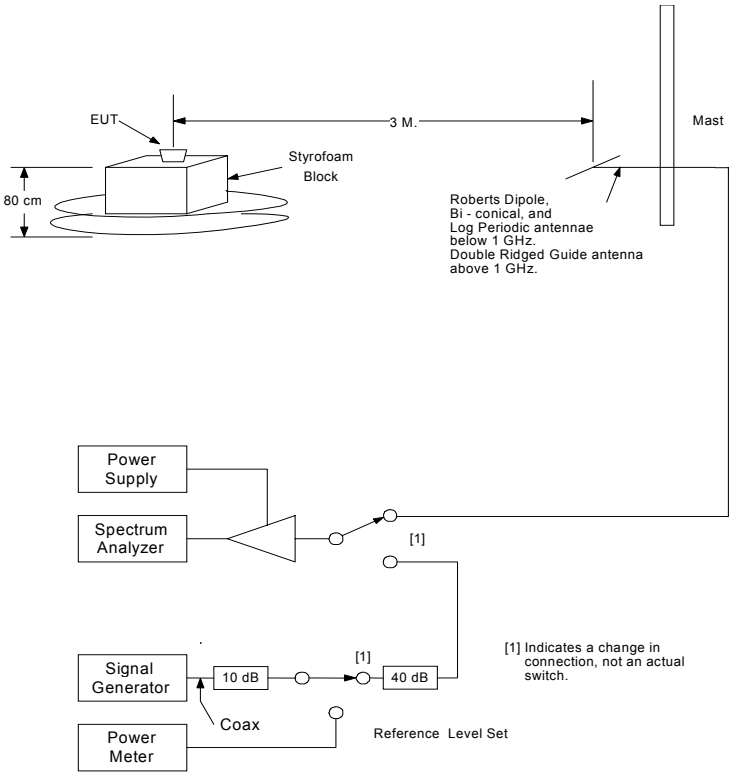
Measure the field strength of both the fundamental emission and all spurious emissions with these settings. Follow the procedures in C63.4-2003 with respect to maximizing the emissions. The measured field strength of all spurious emissions must be below the measured field strength of the fundamental 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.

Field Strength Measurement Procedure

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

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

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



Marker-Delta Method

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

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

STEP 2) Choose a spectrum analyzer span that encompasses both the peak of the fundamental emission and the band-edge emission under investigation. Set the analyzer RBW to 1% of the total span (but never less than 30 kHz) with a video bandwidth equal to or greater than the RBW. Record the peak levels of the fundamental emission and the relevant band-edge emission (i.e., run several sweeps

in peak hold mode). Observe the stored trace and measure the amplitude delta between the peak of the fundamental and the peak of the band-edge emission. This is not a field strength measurement; it is only a relative measurement to determine the amount by which the emission drops at the band-edge relative to the highest fundamental emission level.

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

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