REGULATORY COMPLIANCE REPORT

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

AUTHOR: Jeff Gilbert

REV	CCO	DESCRIPTION OF CHANGE	DATE	APPROVALS	
1		INITIAL RELEASE		Engineering	Jeff Gilbert
				Engineering	Paul Goebel

REVISION HISTORY

				Engineering	
				Engineering	
				Engineering	

Summary

Test Data Summary

FCC 15.247 / IC RSS-210
Frequency Hopping Transmitter (909 – 922 MHz)
FCC ID: EO9-5XESS / **IC ID:** 864D-5XESS
Device Model: *5XESS*
Serial Number: 326
OATS Registration Number: FCC 90716, IC 5615

Rule	Description	Max. Reading	Pass/Fail
Part 15.31(e)	Variation of Input Voltage	N/A (DC device)	Pass
Part 15.207 / RSS-Gen 7.2.2	AC Powerline Conducted Emissions	N/A	Pass
Part 15.247(a)(1) / RSS-210 A8.1(2)	Carrier Frequency Separation - Radiated	197 kHz	Pass
Part 15.247(a)(1)(i) / RSS-210 A8.1(3)	Number of Hopping Channels - Radiated	50	Pass
Part 15.247(a)(1)(i) / RSS-210 A8.1(3)	20dB Bandwidth - Radiated	140.5 kHz	Pass
Part 15.247(b) (2) / RSS-210 A8.4(1)	Power Output – Radiated (EIRP)	19.66 dBm	Pass
Part 15.247(a)(1)(i) / RSS-210 A8.1(3)	Time of Occupancy	44.25 mS	Pass
Part 15.247(d) / RSS-210 A8.5	Spurious Emissions - Radiated	28.97 dBc	Pass
Parts 15.205 & 15.209 / RSS-210 2.2, 2.6 Tables 1 & 2	Restricted Bands / Spurious Emissions - Radiated	50.84 dBµV/m	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).

Cognizant Personnel	
Name Mark Kvamme	Title Test Technician
Name Jeff Gilbert	Title Regulatory Engineer
Name Paul Goebel	Title Project Lead

15.31(e)
Variation of Input Voltage

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.

This is a modular approval. The module is intended to be integrated into electricity meters that supply the module with DC voltage. This device has its own DC voltage regulation. For purposes of testing, the module was supplied with DC voltage from an HP 6284A power supply.

Part 15.207 / RSS-Gen 7.2.2
AC 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 mH/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. See ANSI C63.4-2003 for the proper set up and test procedures.

Frequency of Emission (MHz)	Limit (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

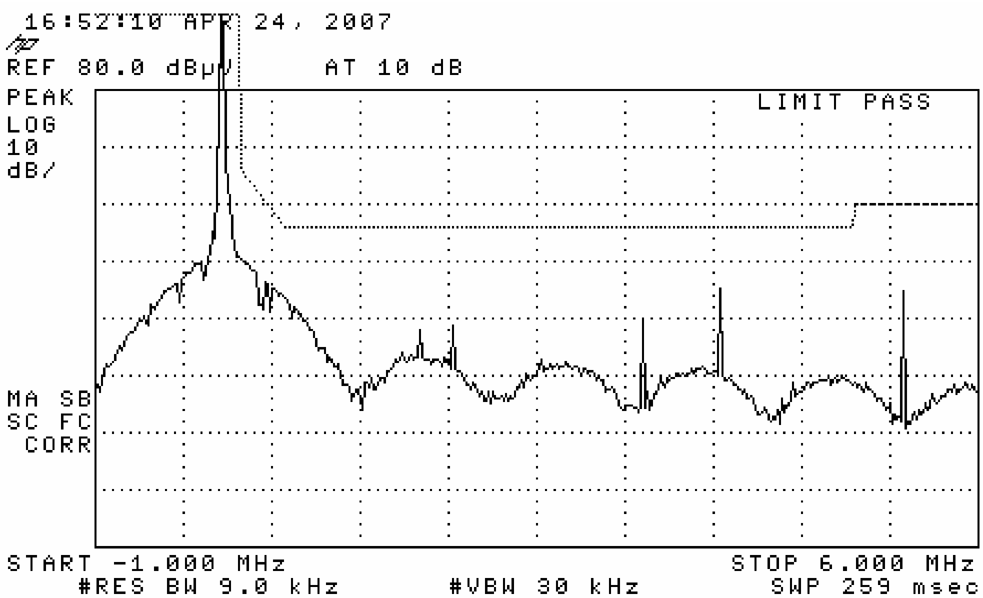
* Decreases with the logarithm of the frequency.

This is a modular approval. The module is intended to be integrated into electricity meters that supply the module with DC voltage. This device was tested in a representative configuration to ensure that, while transmitting, the electricity meter into which it was installed did not fail the applicable limits.

Equipment Used	Serial Number	Cal Date	Cal Due
Hewlett Packard 8593E	3543A02032	4-Oct-06	4-Oct-07
EMCO Model 3821/2 LISN	9508-2436	14-Feb-07	14-Feb-08

Date	Tested by
3/24/2007	Mark Kvamme

Unit tested: 326



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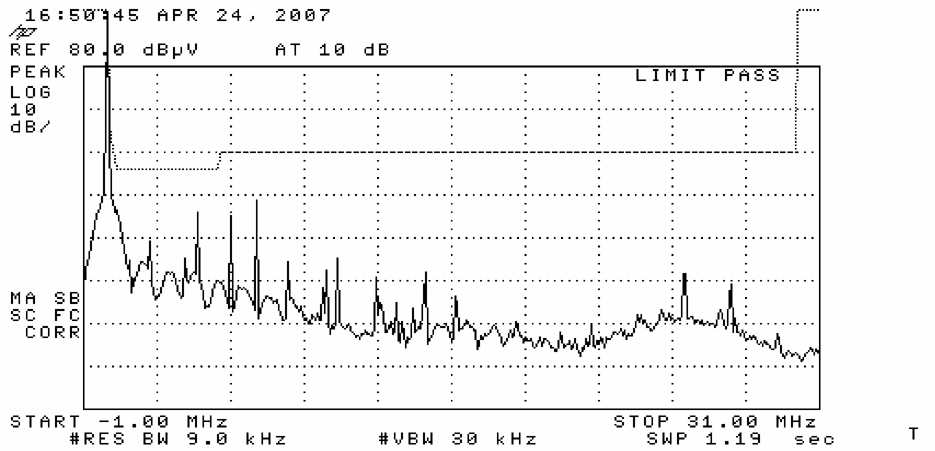
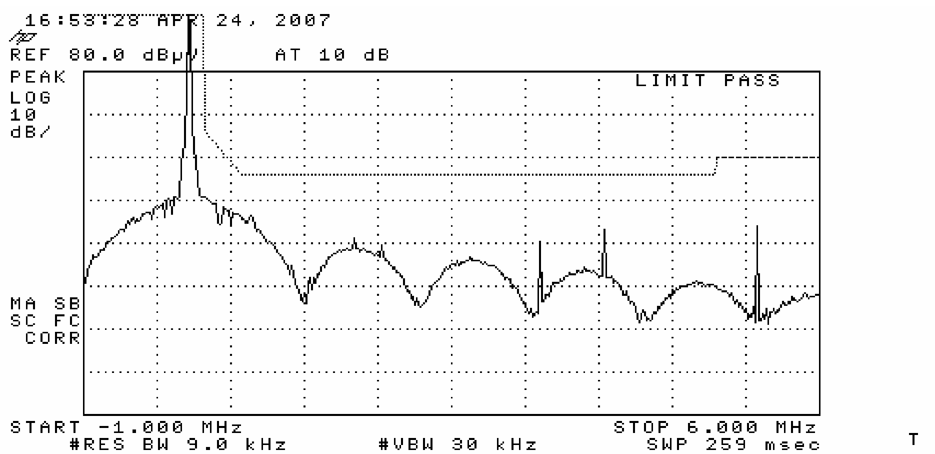
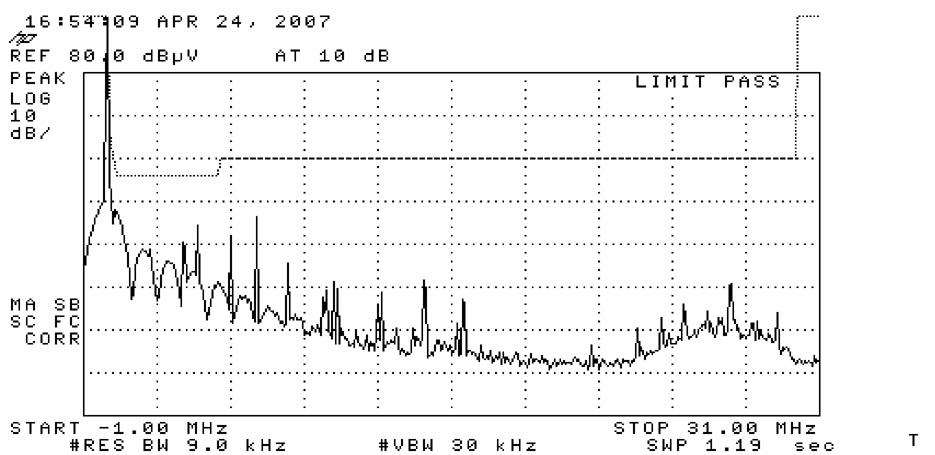

16:50:45 APR 24, 2007
REF 80.0 dBμV AT 10 dB
PEAK
LOG
10
dB/
LIMIT PASS
MA SB
SC FC
CORR
START -1.00 MHz
#RES BW 9.0 kHz
#VBW 30 kHz
STOP 31.00 MHz
SWP 1.19 sec
T


16:53:28 APR 24, 2007
REF 80.0 dBμV AT 10 dB
PEAK
LOG
10
dB/
LIMIT PASS
MA SB
SC FC
CORR
START -1.000 MHz
#RES BW 9.0 kHz
#VBW 30 kHz
STOP 6.000 MHz
SWP 259 msec
T


16:54:09 APR 24, 2007
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:

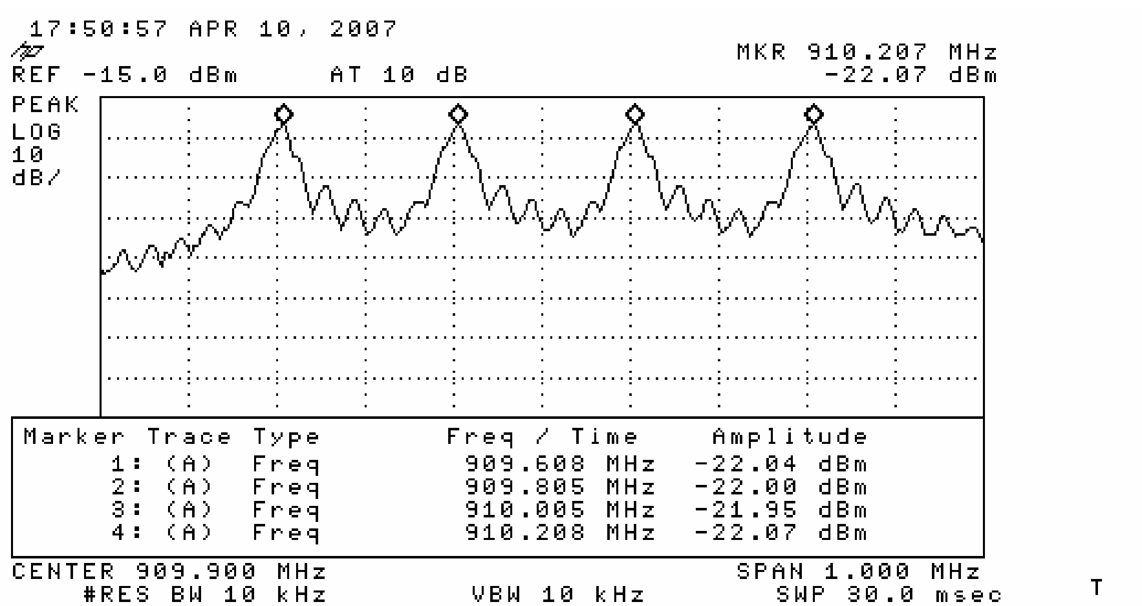
RBW ≥ 1% of the span
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

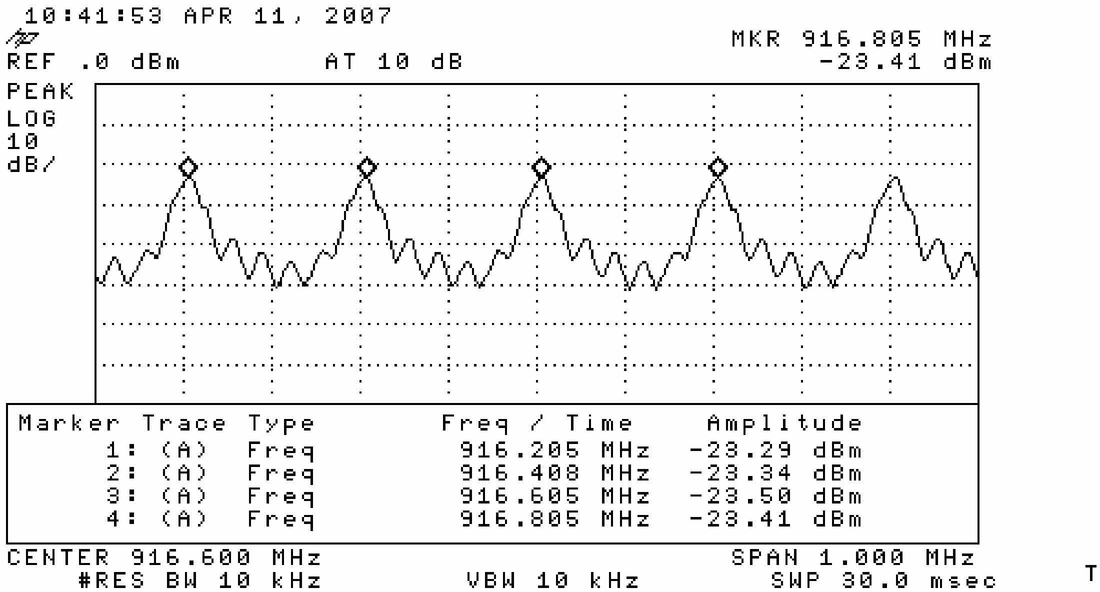
Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

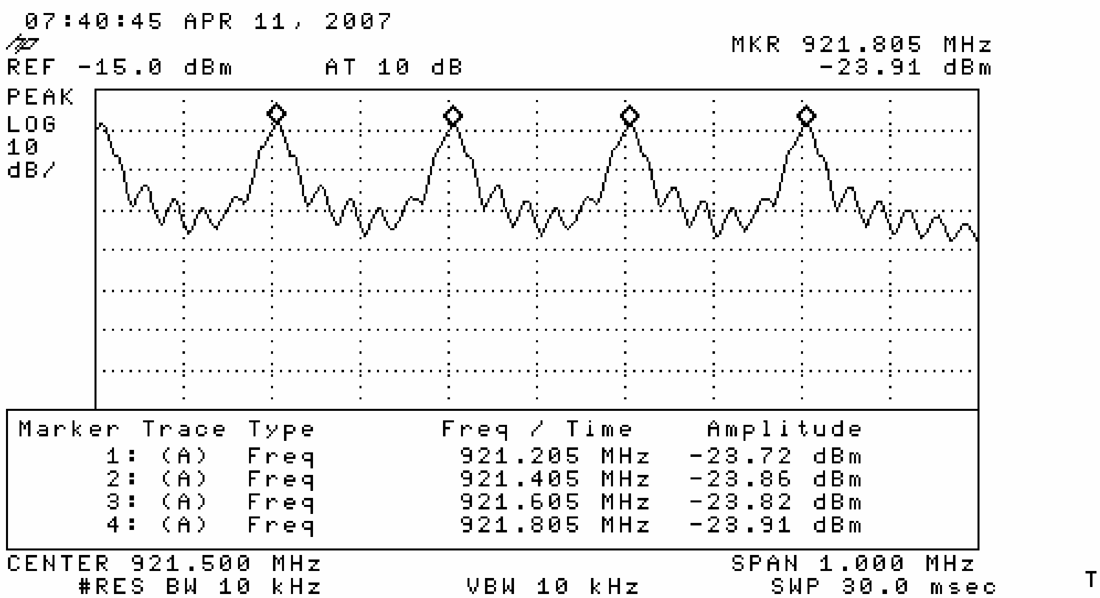
Equipment Used	Serial Number	Cal Date	Cal Due
HP8593E	3543A02032	10/6/2006	10/6/2007

Date	Tested by
3/20/2007	Mark Kvamme

Unit tested: 326 (197 kHz)




10:41:53 APR 11, 2007
MKR 916.805 MHz
REF .0 dBm
AT 10 dB
-23.41 dBm
PEAK
LOG
10
dB/
Marker Trace Type Freq / Time Amplitude
1: (A) Freq 916.205 MHz -23.29 dBm
2: (A) Freq 916.408 MHz -23.34 dBm
3: (A) Freq 916.605 MHz -23.50 dBm
4: (A) Freq 916.805 MHz -23.41 dBm
CENTER 916.600 MHz
SPAN 1.000 MHz
#RES BW 10 kHz
VBW 10 kHz
SWP 30.0 msec
T


07:40:45 APR 11, 2007
MKR 921.805 MHz
REF -15.0 dBm
AT 10 dB
-23.91 dBm
PEAK
LOG
10
dB/
Marker Trace Type Freq / Time Amplitude
1: (A) Freq 921.205 MHz -23.72 dBm
2: (A) Freq 921.405 MHz -23.86 dBm
3: (A) Freq 921.605 MHz -23.82 dBm
4: (A) Freq 921.805 MHz -23.91 dBm
CENTER 921.500 MHz
SPAN 1.000 MHz
#RES BW 10 kHz
VBW 10 kHz
SWP 30.0 msec
T

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

Number of Hopping Channels

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

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

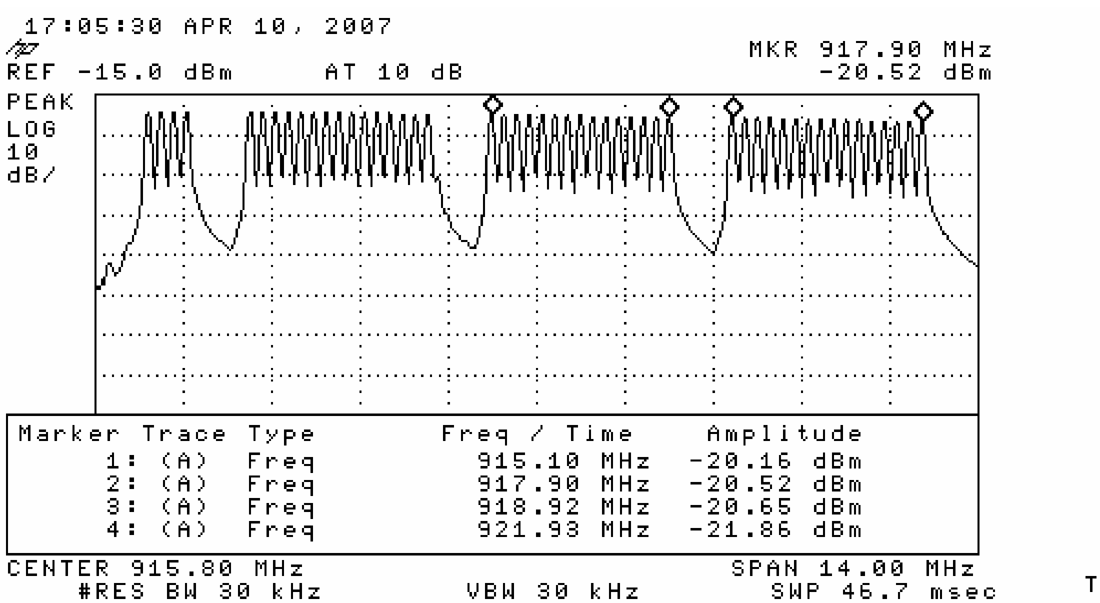
Span = the frequency band of operation
RBW ≥ 1% of the span
VBW ≥ RBW
Sweep = auto
Detector function = Peak
Trace = max hold

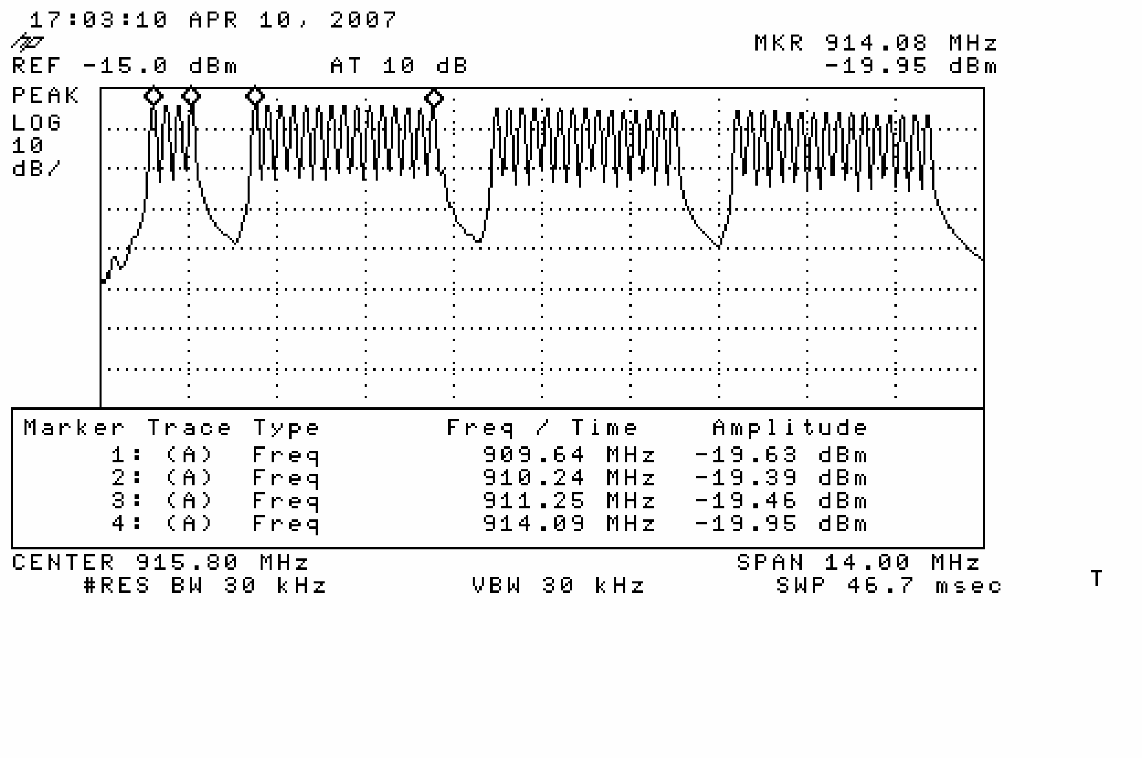
Allow the trace to stabilize. It may prove necessary to break the span up into sections, in order to clearly show all of the hopping frequencies.

Equipment Used	Serial Number	Cal Date	Cal Due
HP8593E	3543A02032	10/6/2006	10/6/2007

Date	Tested by
3/20/2007	Mark Kvamme

Unit tested: 326 – There are 50 channels




17:03:10 APR 10, 2007
MKR 914.08 MHz
REF -15.0 dBm
AT 10 dB
-19.95 dBm
PEAK
LOG
10
dB/
Marker Trace Type Freq / Time Amplitude
1: (A) Freq 909.64 MHz -19.63 dBm
2: (A) Freq 910.24 MHz -19.39 dBm
3: (A) Freq 911.25 MHz -19.46 dBm
4: (A) Freq 914.09 MHz -19.95 dBm
CENTER 915.80 MHz
SPAN 14.00 MHz
#RES BW 30 kHz
VBW 30 kHz
SWP 46.7 msec
T

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:

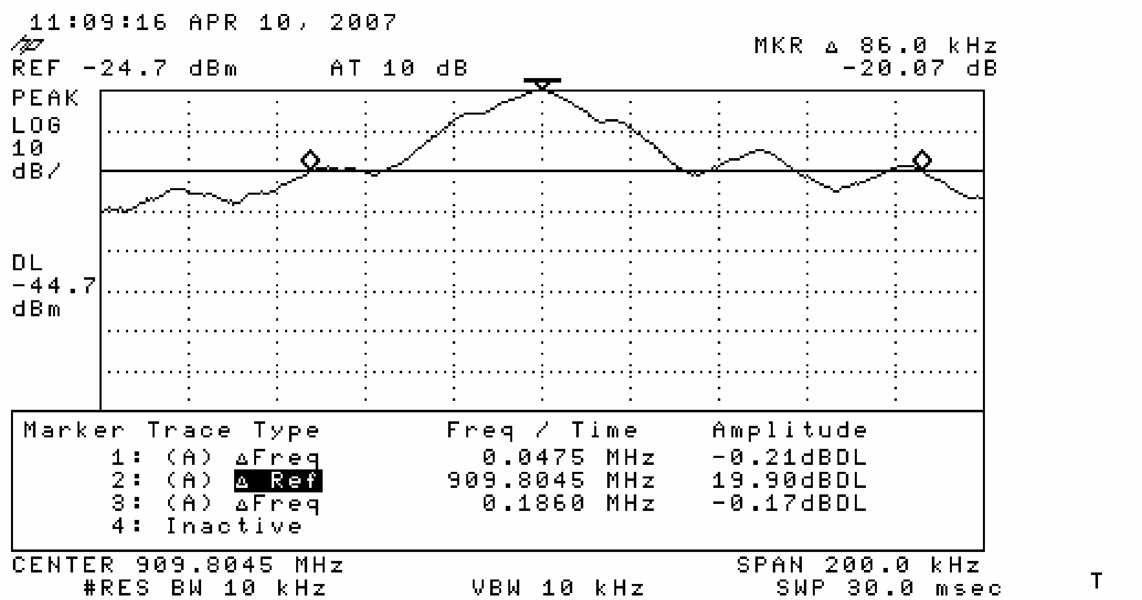
Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel.
RBW ≥ 1% of the 20 dB bandwidth
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

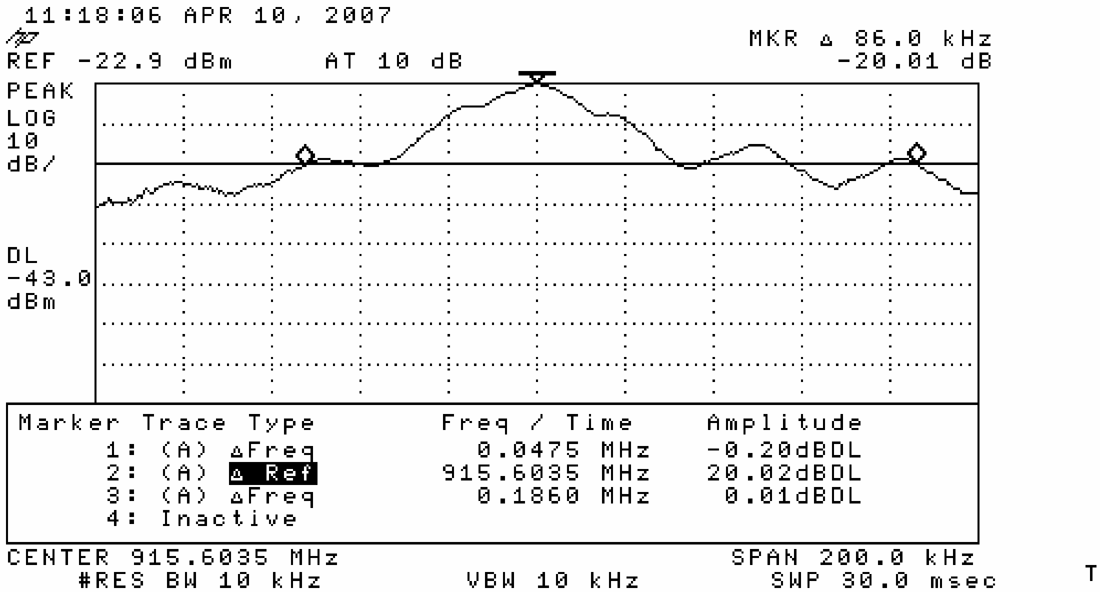
The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the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

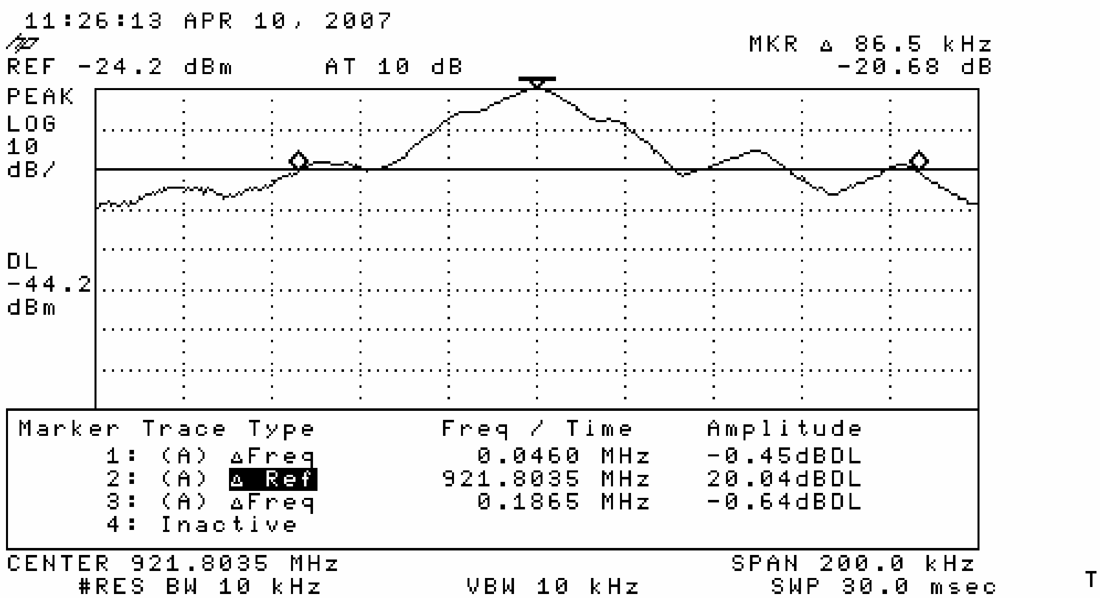
Equipment Used	Serial Number	Cal Date	Cal Due
HP8593E	3543A02032	10/6/2006	10/6/2007

Date	Tested by
3/20/2007	Mark Kvamme

Unit tested: 326 (140.5 kHz @ 921.8 MHz)




11:18:06 APR 10, 2007
MKR Δ 86.0 kHz
-20.01 dB
REF -22.9 dBm
AT 10 dB
PEAK
LOG
10
dB/
DL
-43.0
dBm
Marker Trace Type
Freq / Time
Amplitude
1: (A) ΔFreq 0.0475 MHz -0.20dBDL
2: (A) Δ Ref 915.6035 MHz 20.02dBDL
3: (A) ΔFreq 0.1860 MHz 0.01dBDL
4: Inactive
CENTER 915.6035 MHz
SPAN 200.0 kHz
#RES BW 10 kHz
VBW 10 kHz
SWP 30.0 msec
T


11:26:13 APR 10, 2007
MKR Δ 86.5 kHz
-20.68 dB
REF -24.2 dBm
AT 10 dB
PEAK
LOG
10
dB/
DL
-44.2
dBm
Marker Trace Type
Freq / Time
Amplitude
1: (A) ΔFreq 0.0460 MHz -0.45dBDL
2: (A) Δ Ref 921.8035 MHz 20.04dBDL
3: (A) ΔFreq 0.1865 MHz -0.64dBDL
4: Inactive
CENTER 921.8035 MHz
SPAN 200.0 kHz
#RES BW 10 kHz
VBW 10 kHz
SWP 30.0 msec
T

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

Power Output

The maximum peak 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. A peak responding power meter may be used instead of a spectrum analyzer.

Equipment description	Model	serial number	Last cal date	Next due date
Hewlett Packard 8593E Spectrum Analyzer	HP8593E	3543A02032	04-Oct-06	04-Oct-07
Huber & Suhner 40 foot cable	Sucoflex 100	N/A	09-Apr-07	09-Jul-07
Hewlett Packard 437B Power meter	HP437B	3125U16900	30-May-06	30-May-08
Hewlett Packard 8481D Power sensor	HP8481D	3318A11513	06-Jun-06	06-Jun-08
Roberts Dipole	Dipole	4106	27-Oct-06	27-Oct-08

Date	Tested by	Temperature/humidity
3/23/2007	Mark Kvamme	61F / 50%

Frequency (MHz)	Rx antenna orientation	(A) DUT reading on spectrum analyzer (dBm)	(B) TX antenna reading on spectrum analyzer (dBm)	(C) TX antenna gain (dB)	(D) TX antenna power input (dBm)	EIRP (dBm)=(A)-(B)+(C)+(D)
909.8	Horizontal	-22.28	-46.18	1.2	-9.85	15.25
909.8	Vertical	-19.9	-49.11	0.3	-9.85	19.66
915.6	Horizontal	-21.74	-46.18	1.2	-9.85	15.79
915.6	Vertical	-20.1	-49.11	0.3	-9.85	19.46
921.8	Horizontal	-23.08	-46.18	1.2	-9.85	14.45
921.8	Vertical	-21.8	-49.11	0.3	-9.85	17.76

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

Time of Occupancy

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

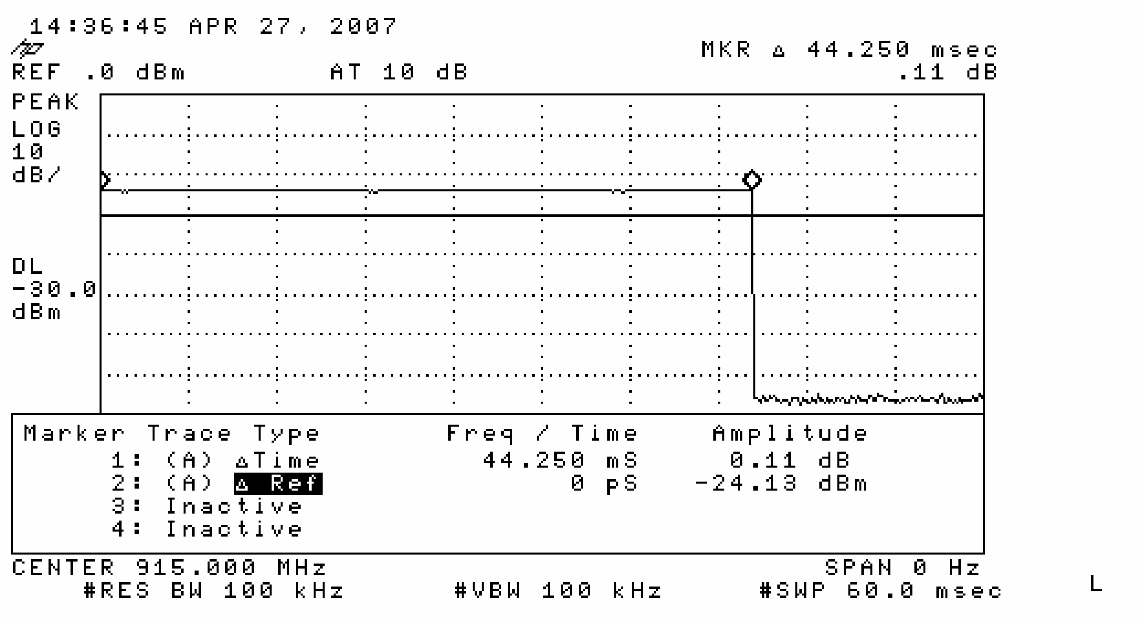
The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:
Span = zero span, centered on a hopping channel
RBW = 1 MHz
VBW ≥ RBW
Sweep = as necessary to capture the entire dwell time per hopping channel
Detector function = peak
Trace = max hold

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

Equipment Used	Serial Number	Cal Date	Due
HP8593E	3543A02032	10/6/2006	10/6/2007

Date	Tested by
4/27/07	Mark Kvamme

Each transmission is 44.25 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.



15.247(d) / RSS-210 A8.5

Spurious Emissions -Radiated

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 description	Model	serial number	Last cal date	Next due date
Hewlett Packard 8593E Spectrum Analyzer	HP8593E	3543A02032	04-Oct-06	04-Oct-07
Huber & Suhner 40 foot cable	Sucoflex 100	N/A	09-Apr-07	09-Jul-07
ETS Lindgren dipole antenna	3121C-DB4	00078573	02-Sep-06	02-Sep-08
JCA technology JCA010-415 (0.1 to 10 GHz)	JCA010-415	103	02-Feb-07	02-May-07
Mini-circuits High Pass Filter (1700-3800 MHz)	VHF-1320	15542	09-Apr-07	09-Jul-07
EMCO 3115 double ridge wave guide	EMCO 3115	9508-4550	15-Mar-06	15-Mar-08
EMCO active loop antenna	6502	9509-2970	10/24/2006	10/24/2008

Date	Tested by	Temperature/humidity
3/18/2007	Mark Kvamme	58F / 45%

Unit tested: 326
Frequency range investigated was 9 MHz to 9.2 GHz.

Frequency (MHz)	Rx antenna orientation	DUT reading on spectrum analyzer (dBm)	Cable loss (dBm)	Amplifier Gain (dB)	Antenna correction factor (dB)	Field strength (dBµV/m)	level (dBc)	limit (20dBc)	Margin (dB)
909.8	Horizontal	-22.28	2.7	0	27.8	115.22			
909.8	Vertical	-19.9	2.7	0	27.8	117.6			
915.6	Horizontal	-21.74	2.7	0	27.8	115.76			
915.6	Vertical	-20.1	2.7	0	27.8	117.4			
921.8	Horizontal	-23.08	2.7	0	27.8	114.42			
921.8	Vertical	-21.8	2.7	0	27.8	115.7			
869.6	Horizontal	-36.72	2.7	19.1	24.1	77.98	37.72	95.7	17.72
869.6	Vertical	-26.97	2.7	19.1	23.1	86.73	28.97	95.7	8.97
1830	Horizontal	-31.9	3.8	43.4	28	63.5	52.2	95.7	32.2
1830	Vertical	-33.2	3.8	43.7	26.9	60.8	54.9	95.7	34.9
5490	Horizontal	-42.88	4.5	44.8	34.6	58.42	57.34	95.76	37.34
5490	Vertical	-49.43	4.5	44.8	34.5	51.77	65.63	97.4	45.63
6405	Horizontal	-51.65	5.2	44	35.4	51.95	63.75	95.7	43.75
6405	Vertical	-52.35	5.2	44	35	50.85	64.85	95.7	44.85

15.205, 15.209 / RSS-210 2.2, 2.6

Restricted Bands

Only spurious emissions are permitted in any of the frequency bands listed below.

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 description	Model	serial number	Last cal date	Next due date
Hewlett Packard 8593E Spectrum Analyzer	HP8593E	3543A02032	04-Oct-06	04-Oct-07
Huber & Suhner 40 foot cable	Sucoflex 100	N/A	09-Apr-07	09-Jul-07
JCA technology JCA010-415 (0.1 to 10GHz)	JCA010-415	103	02-Feb-07	02-May-07
Mini-circuits ZHL-1042J-SMA (0.1 to 4.2 GHz)	ZHL-1042J-SMA	D021000-23	02-Feb-07	02-May-07
Mini-circuits High Pass Filter (1700-3800 MHz)	VHF-1320	15542	09-Apr-07	09-Jul-07
EMCO 3115 double ridge wave guide	EMCO 3115	9508-4550	15-Mar-06	15-Mar-08
EMCO 3148 Log periodic	EMCO 3148	9901-1044	24-Oct-06	24-Oct-08
EMCO active loop antenna	6502	9509-2970	10/24/2006	10/24/2008

Date	Tested by	Temperature/humidity
3/18/2007	Mark Kvamme	58F / 45%

Unit tested: 326
Frequency range investigated was 9 kHz to 9.2 GHz

A Duty Cycle Correction Factor (20log(dwell time/100mS)) was applied to show compliance to the 15.209 limit.

$$20\log\left(\frac{44.25ms}{100ms}\right) = 7.08dB$$

Frequency (MHz)	Rx Antenna Orientation	DUT reading on Spectrum Analyzer (dBm)	Cable Loss (dB)	Amplifier Gain (dB)	Antenna Correction Factor (dB)	Field Strength (dBuV/m)	Duty Cycle Correction Factor (dB)	Limit (dBuV/m)	Margin (dB)
2745	Horizontal	-38.68	4.7	44.7	29.6	57.92	7.08	54	3.16
2745	Vertical	-41.67	4.7	44.7	29.3	54.63	7.08	54	6.45
3660	Horizontal	-42.82	5.5	45.4	32.1	56.38	7.08	54	4.7
3660	Vertical	-47.28	5.5	45.4	31.7	51.52	7.08	54	9.56
4575	Horizontal	-46	4	45.4	33.2	52.8	7.08	54	8.28
4575	Vertical	-46.78	4	45.4	32.8	51.62	7.08	54	9.46
7320	Horizontal	-50.95	5.6	44.4	36.6	53.85	7.08	54	7.23
7320	Vertical	-51.2	5.6	44.4	36.3	53.3	7.08	54	7.78
8235	Horizontal	-51.18	6.3	45	38.3	55.42	7.08	54	5.66
8235	Vertical	-49.34	6.3	45	37.2	56.16	7.08	54	4.92
9150	Horizontal	-51.93	6.7	44.7	38.6	55.67	7.08	54	5.41
9150	Vertical	-52.02	6.7	44.7	37.9	54.88	7.08	54	6.2
974	Horizontal	-68	2.7	19.1	23.8	46.4	7.08	54	14.68
974	Vertical	-64.68	2.7	19.1	23.2	49.12	7.08	54	11.96

ANNEX A

ALTERNATIVE TEST PROCEDURES

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

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

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

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

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

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

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

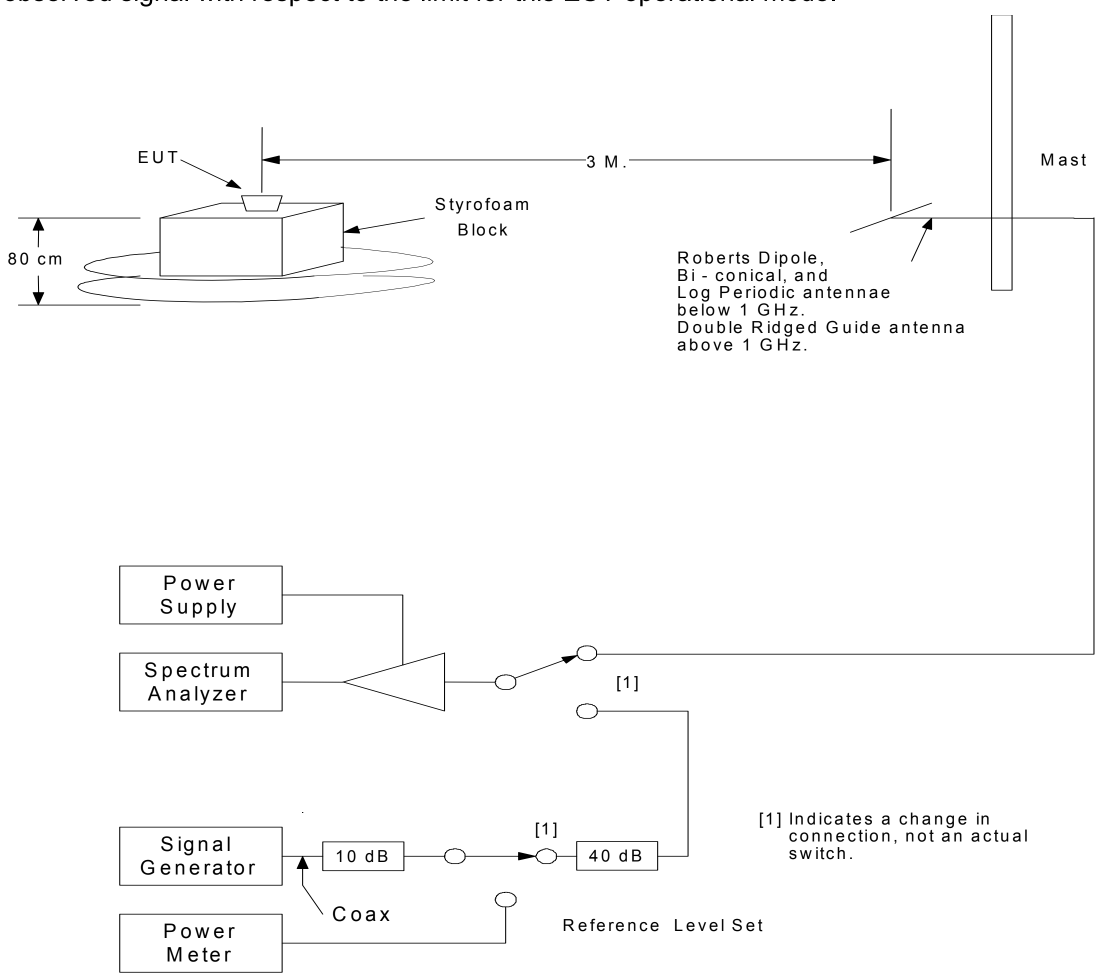
Measure the field strength of both the fundamental emission and all spurious emissions with these settings. Follow the procedures in C63.4-2003 with respect to maximizing the emissions. The measured field strength of all spurious emissions must be below the measured field strength of the fundamental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

Field Strength Measurement Procedure

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

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

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



Marker-Delta Method

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

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

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

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

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