REGULATORY COMPLIANCE REPORT

TITLE: FCC & IC Test Report for 15.247 & RSS-210 Frequency Hopping Device (100G)
AUTHOR: Jon Mueller

REV	CCO	DESCRIPTION OF CHANGE	DATE	APPROVALS	
1		INITIAL RELEASE		Engineering	Jon Mueller
				Engineering	

REVISION HISTORY

				Engineering	
				Engineering	
				Engineering	

Test Data Summary

FCC 15.247 / IC RSS-210
Frequency Hopping Device (100G), 908 – 924 MHz
FCC ID: EO9100G / **IC ID:** 864D-100G
Device Model: ERG-5000
Model Numbers:
ERG-5000-007, ERG-5000-008
OATS Registration Number: FCC 90716, IC 5615

Rule	Description	Max. Reading	Pass/Fail
Part 15.31(e)	Variation of Input Voltage - Conducted	N/A (battery device)	N/A
Part 15.207 / RSS-Gen 7.2.2	AC Powerline Conducted Emissions	N/A (battery device)	N/A
Part 15.247(a)(1) / RSS-210 A8.1(2)	Carrier Frequency Separation	198 kHz	Pass
Part 15.247(a)(1)(i) / RSS-210 A8.1(3)	Number of Hopping Channels	50	Pass
Part 15.247(a)(1)(i) / RSS-210 A8.1(3)	20dB Bandwidth	106 kHz	Pass
Part 15.247(b) (2) / RSS-210 A8.4(1)	Power Output – conducted	20.88 dBm (.122 W) @ 915 Mhz	Pass
Part 15.247(d) / RSS-210 A8.5	Spurious Emissions - Radiated	-48.23 dBc @1830 Mhz	Pass
Parts 15.205 & 15.209 / RSS-210 2.2, 2.6 Tables 1 & 2	Restricted Bands / Spurious Emissions – Radiated	4.62 dB Margin @ 2765.4 MHz	Pass
Part 15.247(a)(1)(i) / RSS-210 A8.1(3)	Time of Occupancy	5.8 mS	Pass
RSS-210 Gen 7.2.3	Receiver Spurious Emissions	More than 20 dB within spec (under noise floor)	Pass
Parts 1.1310 & 2.1091 / RSS-102	Limits for Maximum Permissible Exposure (MPE)	0.065 mW/cm^2	Pass

Rule versions: FCC Part 1 (01-2006), FCC Part 2 (01-2006), FCC Part 15 (02-2006), 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	Test Technician
Jon Mueller	Regulatory Engineer
Jon Mueller	R&D Manager

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:
EUT configuration: Programmed for field operation. Transmitting Standard Consumption Messages (SCM) on all 50 channels.

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

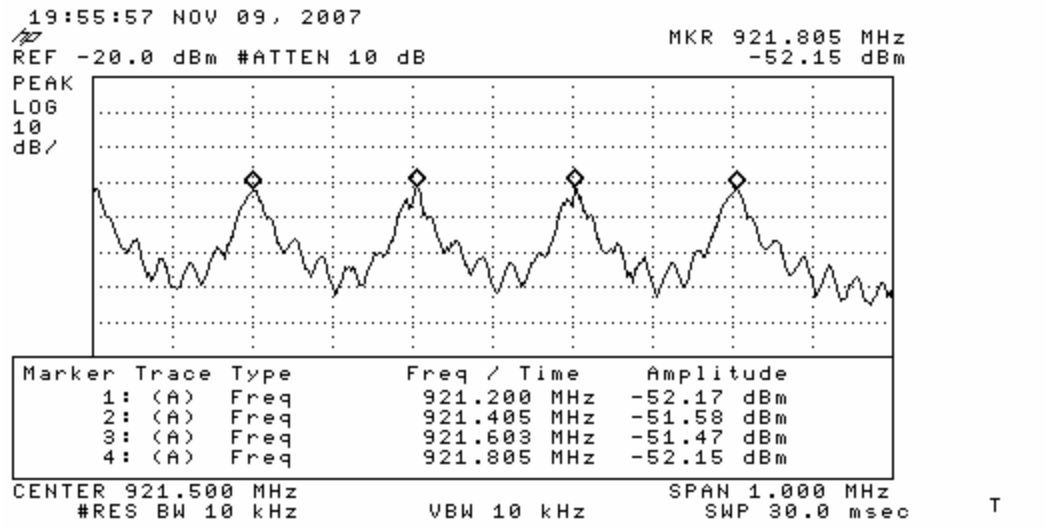
Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section.

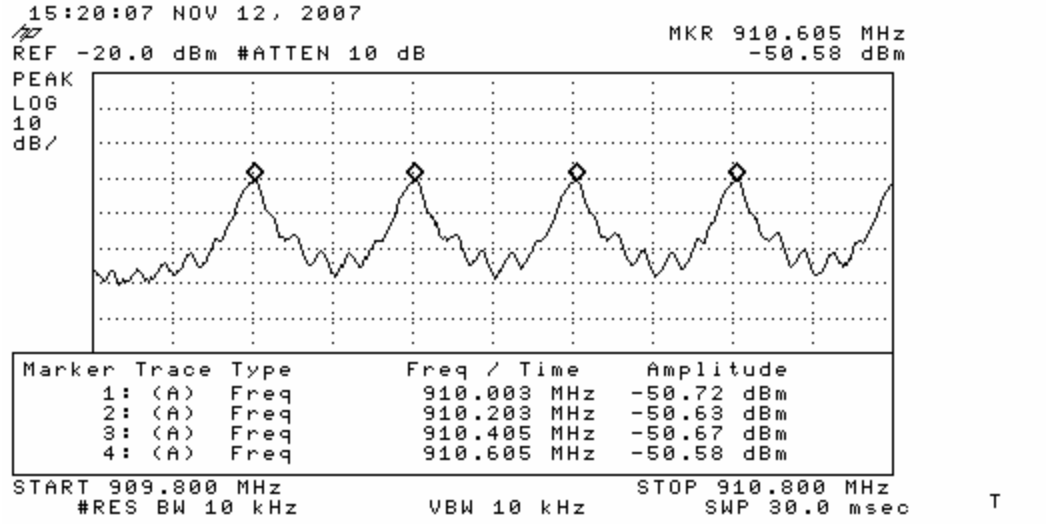
Equipment Used	Serial Number	Cal Date	Due
Hewlett Packard 8591E Spectrum Analyzer	3229A00239	2-Oct-07	2-Oct-08
Roberts Dipole antenna	NA	NA	NA
Cable: Pasternack RG214/U	NA	NA	NA
Anachoic chamber	NA	NA	NA

Date	Tested by
11/9-12/2007	Mark Kvamme

Min carrier separation is 198 kHz.
Max carrier separation is 205 kHz.

Measurement was done radiated in an anechoic chamber


19:55:57 NOV 09, 2007
MKR 921.805 MHz
REF -20.0 dBm #ATTEN 10 dB
-52.15 dBm
PEAK
LOG
10
dB/
Marker Trace Type Freq / Time Amplitude
1: (A) Freq 921.200 MHz -52.17 dBm
2: (A) Freq 921.405 MHz -51.58 dBm
3: (A) Freq 921.603 MHz -51.47 dBm
4: (A) Freq 921.805 MHz -52.15 dBm
CENTER 921.500 MHz
SPAN 1.000 MHz
#RES BW 10 kHz
VBW 10 kHz
SWP 30.0 msec
T


15:20:07 NOV 12, 2007
MKR 910.605 MHz
REF -20.0 dBm #ATTEN 10 dB
-50.58 dBm
PEAK
LOG
10
dB/
Marker Trace Type Freq / Time Amplitude
1: (A) Freq 910.003 MHz -50.72 dBm
2: (A) Freq 910.203 MHz -50.63 dBm
3: (A) Freq 910.405 MHz -50.67 dBm
4: (A) Freq 910.605 MHz -50.58 dBm
START 909.800 MHz
STOP 910.800 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:

EUT configuration: Programmed for field operation. Transmitting Standard Consumption Messages (SCM) on all 50 channels.

Span = the frequency band of operation
RBW ≥ 1% of channel spacing
VBW ≥ RBW
Sweep = auto
Detector function = Peak

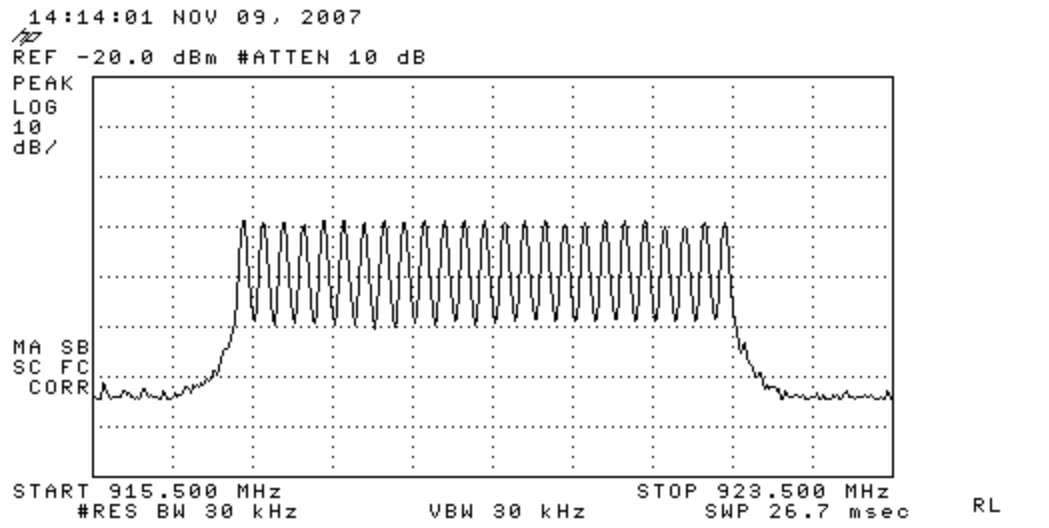
Equipment Used	Serial Number	Cal Date	Due
Hewlett Packard 8591E Spectrum Analyzer	3229A00239	2-Oct-07	2-Oct-08
Roberts Dipole antenna	NA	NA	NA
Cable: Pasternack RG214/U	NA	NA	NA
Anachoic chamber	NA	NA	NA

Date	Tested by
11/8,9/2007	Mark Kvamme

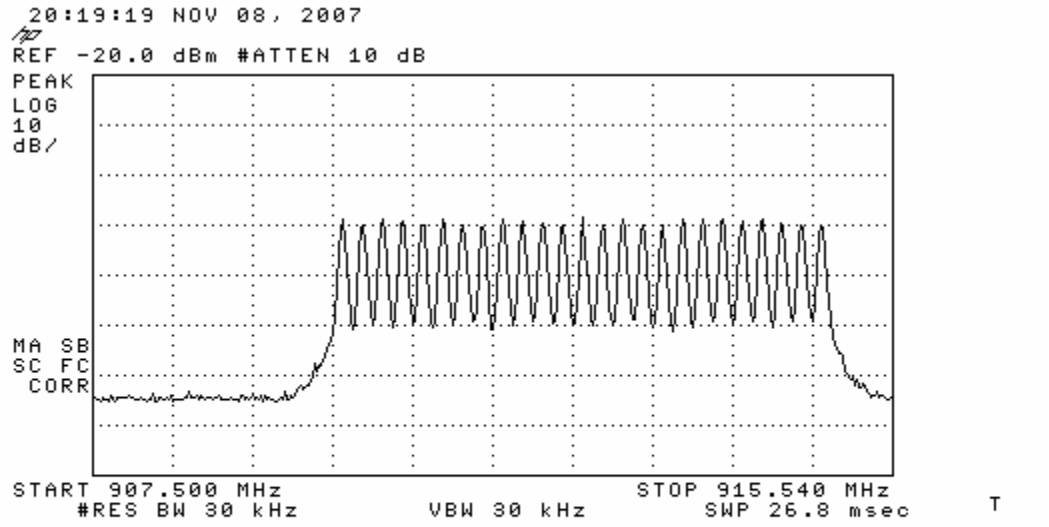
There are 50 channels. The maximum transmissions that will occur in 20 seconds is 6. The maximum number of transmission in 20 seconds that will occur on any one channel is one

Two screen shots of the 50 channels measured radiated in the anechoic chamber

Upper 25 channels



Lower 25 channels



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

20 dB Bandwidth

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

EUT Configuration: The EUT is configured to transmit (special code set) on the low channel (908 MHz), a middle channel (915 MHz), and a high channel (921.8 MHz). The EUT is also configured to transmit every 4 seconds. This enables measurement of peak energy to be made at each location. See Annex B for picture of test setup.

Use the following spectrum analyzer settings:

Span = 400 KHz centered on a hopping channel. 400 KHz is approximately 2 times the 20 dB bandwidth of the hopping channel.

RBW ≥ 1 Mhz when measuring total power.
3Khz (approximately 1% of the 20 dB bandwidth) when measuring -20 dB down relative to total power
VBW ≥ 30 KHz (100 times RBW)
Sweep = auto
Detector function = peak
Trace = max hold

The EUT should be transmitting at its maximum data rate. Set RBW to 1 MHz , select max hold, and measure total TX Power (Reference Power)

Set a reference line 20 dB below the reference power measured in the previous step. Set RBW to 3KHz. Select peak power and capture the modulated spectrum and press View B. This will take several minutes due to the occasional short transmissions.

Place a marker at the lower frequency 20 dB down point on the modulated spectrum. Press Marker Delta and mark the upper frequency 20 dB down point. The indicated delta frequency is the 20 dB bandwidth of the emission, This is also the 99% bandwidth.

In general, If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. For this product only one data rate and modulation mode is used. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

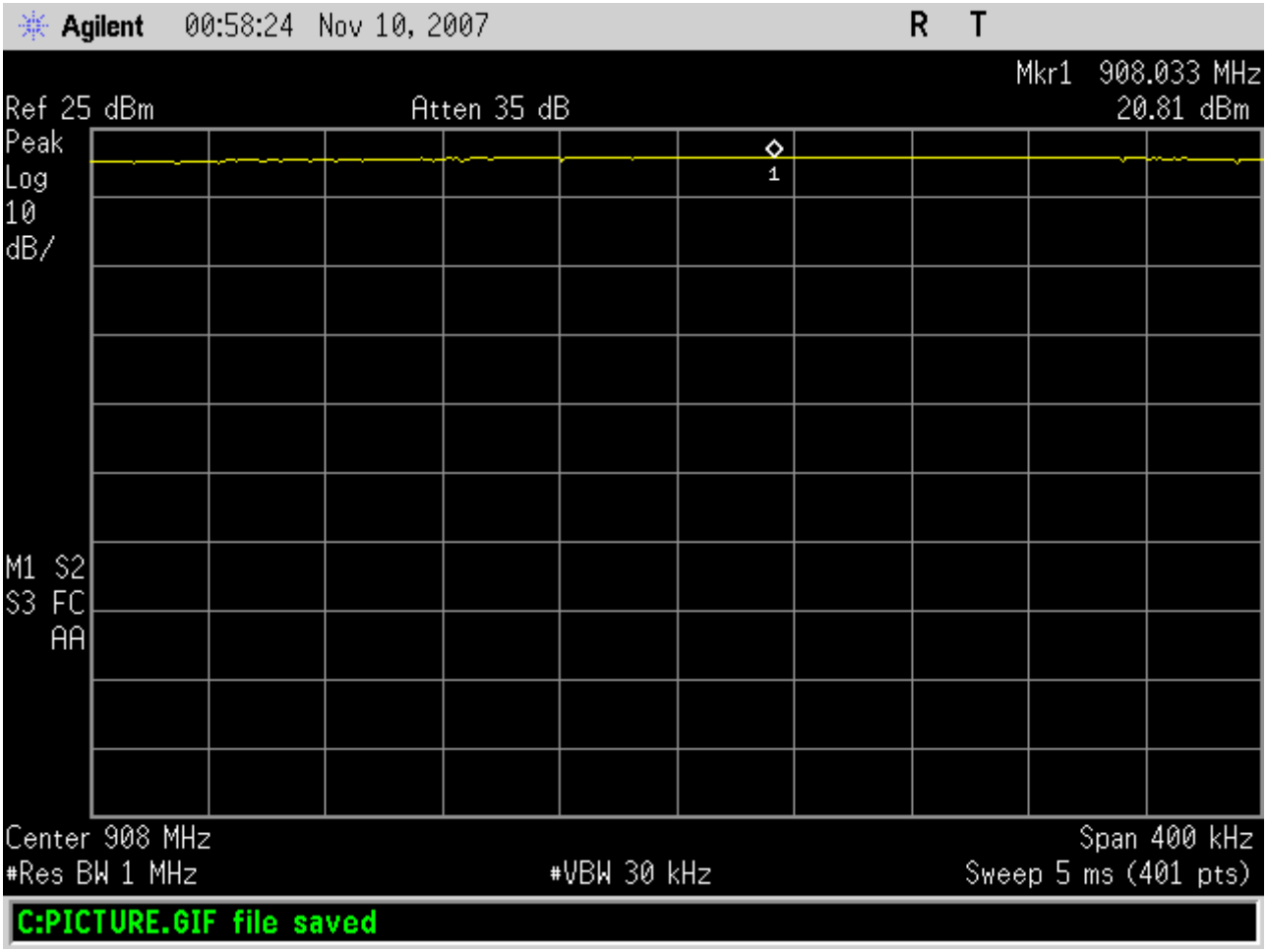
Equipment Used	Serial Number	Cal Date	Due
Spectrum Analyzer	MY45113415	7-Aug-07	8-Aug-08
Huber&Suhner 18 inch. Sma to N	220057 002	3-May-2007	3-May-2008

Date	Tested by
11/8,9,12/2007	Mark Kvamme

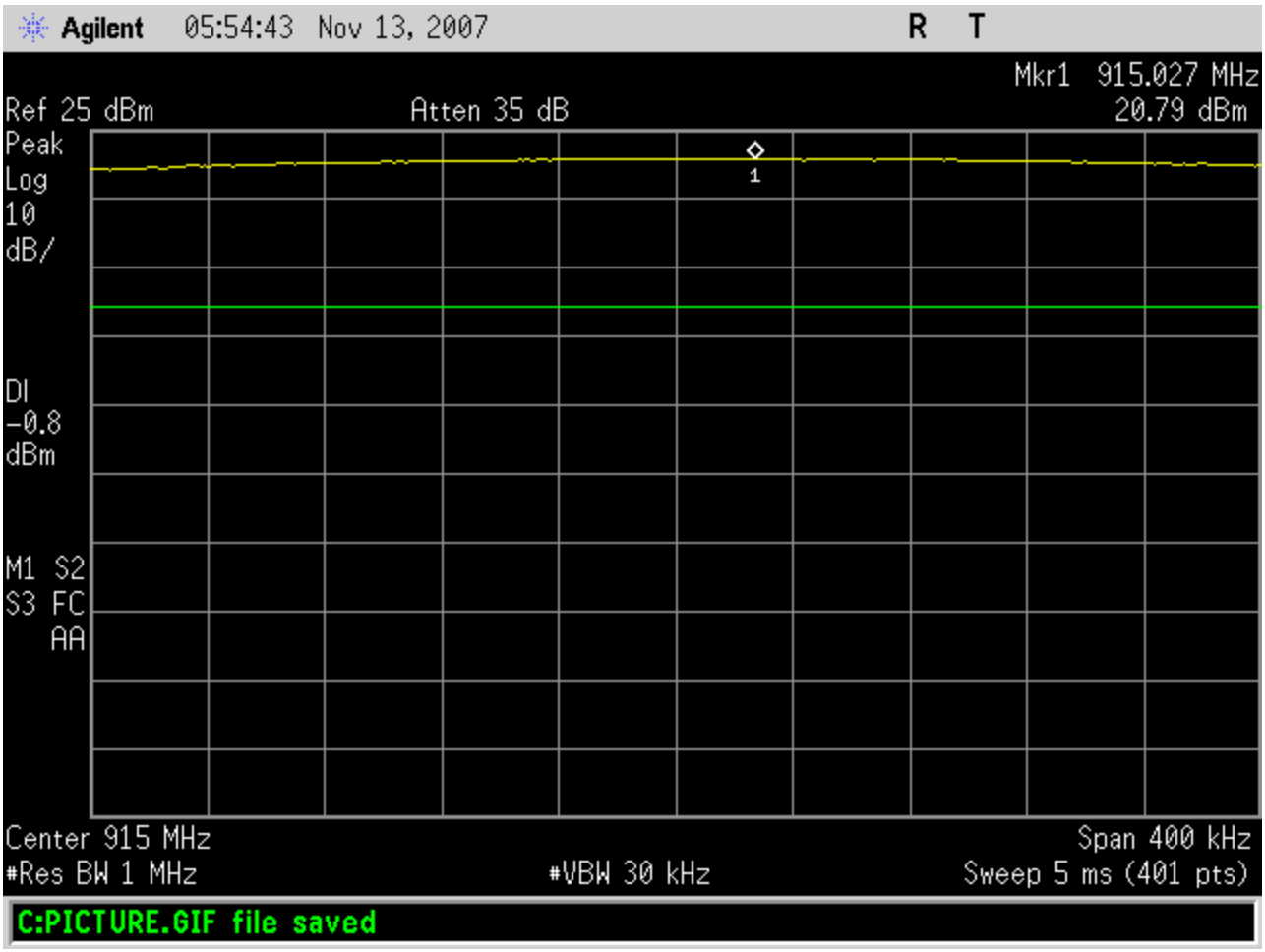
20 dB Occupied Bandwidth

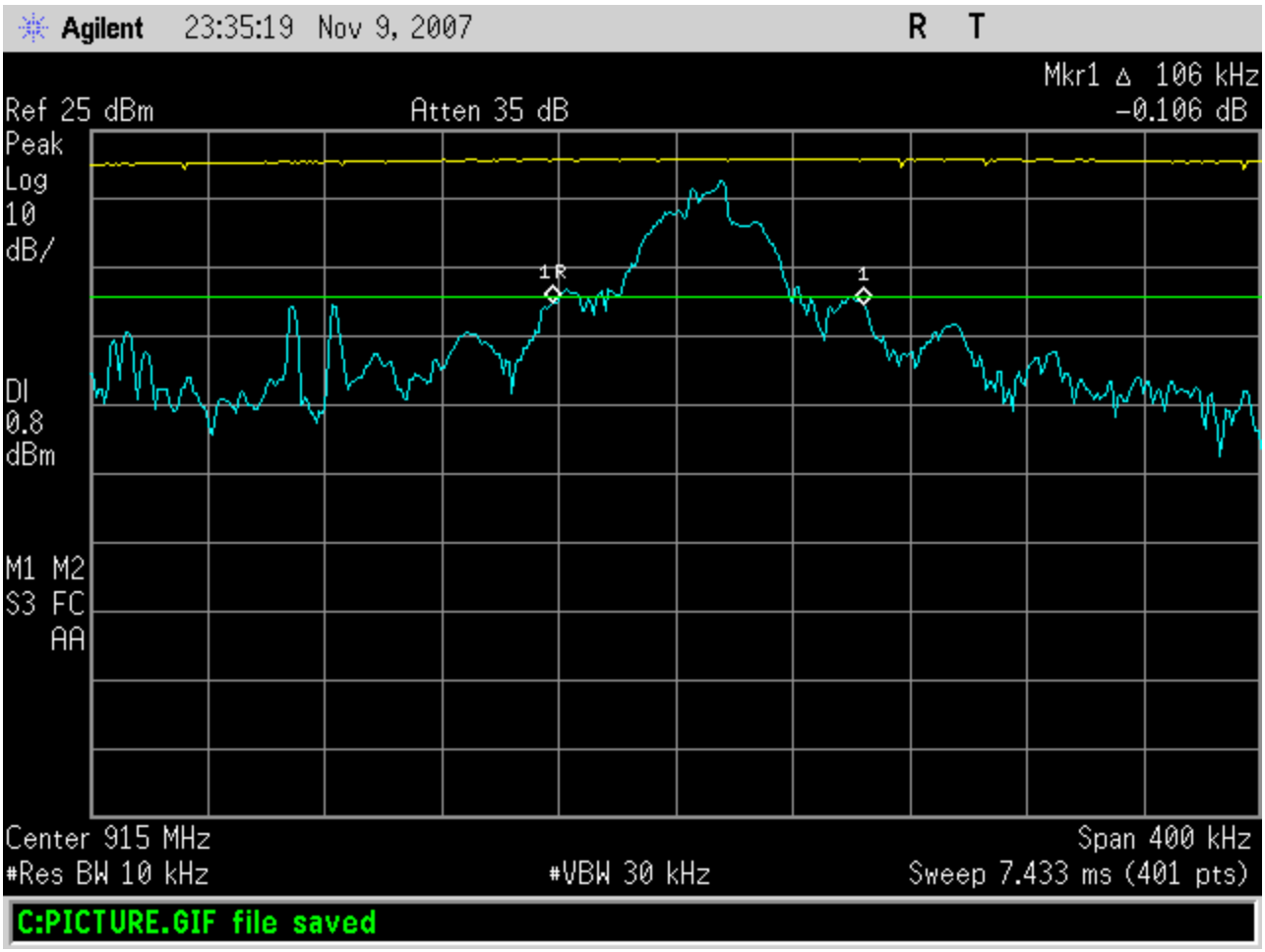
908.000 MHz = 105 kHz
915.000 MHz = 106 kHz

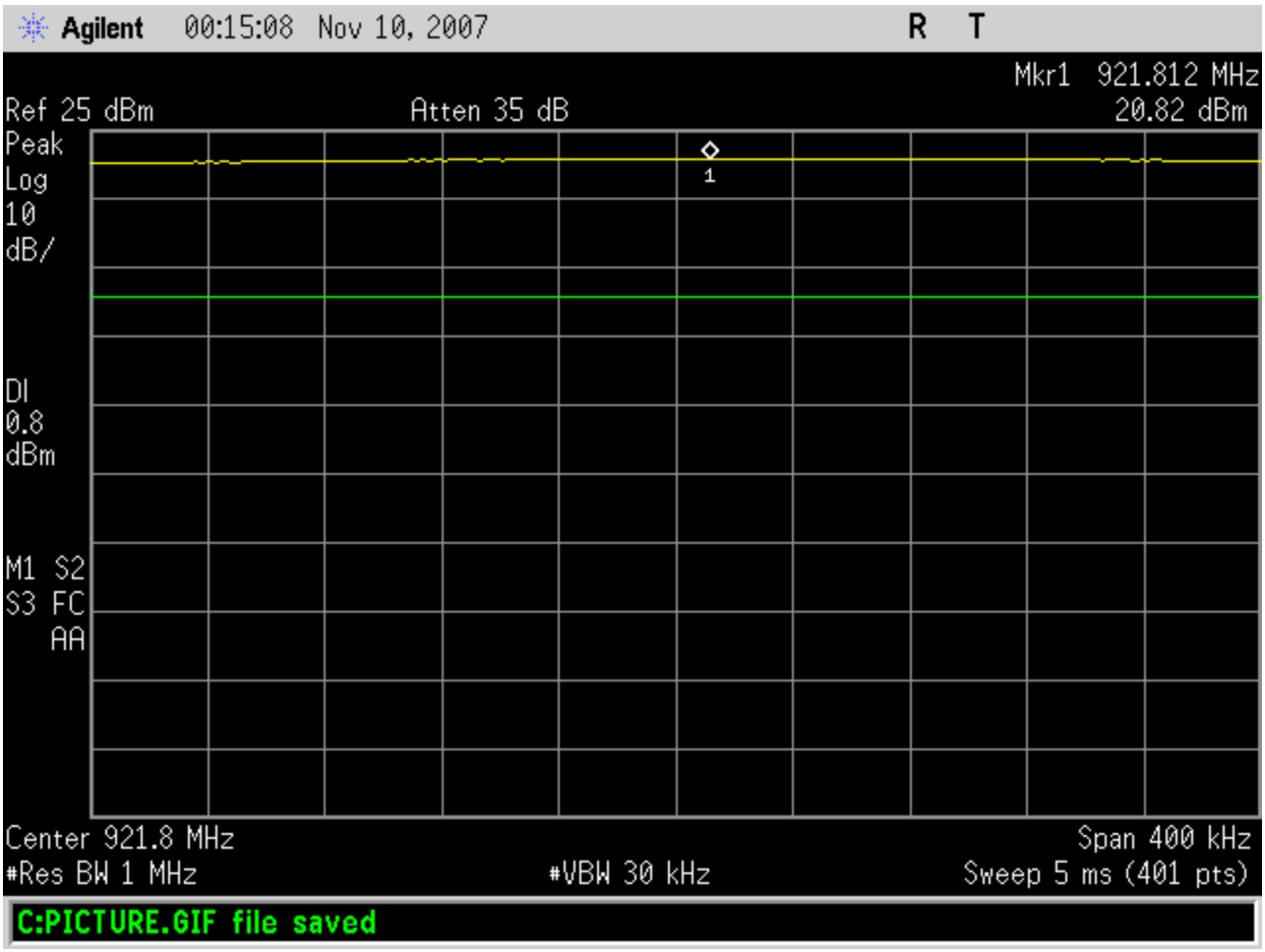
921.800 MHz = 094 kHz




Agilent 01:51:09 Nov 10, 2007
R T
Mkr1 Δ 105 kHz
0.036 dB
Ref 25 dBm
Atten 35 dB
Peak
Log
10
dB/
1R
1
Dl
0.8
dBm
M1 M2
S3 FC
AA
Center 908 MHz
#Res BW 10 kHz
#VBW 30 kHz
Span 400 kHz
Sweep 7.433 ms (401 pts)
C:PICTURE.GIF file saved


Agilent 05:54:43 Nov 13, 2007
R T
Mkr1 915.027 MHz
20.79 dBm
Ref 25 dBm
Atten 35 dB
Peak
Log
10
dB/
1
Dl
-0.8
dBm
M1 S2
S3 FC
AA
Center 915 MHz
#Res BW 1 MHz
#VBW 30 kHz
Span 400 kHz
Sweep 5 ms (401 pts)
C:PICTURE.GIF file saved


Agilent 23:35:19 Nov 9, 2007
R T
Mkr1 Δ 106 kHz
-0.106 dB
Ref 25 dBm
Atten 35 dB
Peak
Log
10
dB/
1R
1
Dl
0.8
dBm
M1 M2
S3 FC
AA
Center 915 MHz
#Res BW 10 kHz
#VBW 30 kHz
Span 400 kHz
Sweep 7.433 ms (401 pts)
C:PICTURE.GIF file saved


Agilent 00:15:08 Nov 10, 2007
R T
Mkr1 921.812 MHz
20.82 dBm
Ref 25 dBm
Atten 35 dB
Peak
Log
10
dB/
1
Dl
0.8
dBm
M1 S2
S3 FC
AA
Center 921.8 MHz
Span 400 kHz
#Res BW 1 MHz
#VBW 30 kHz
Sweep 5 ms (401 pts)
C:PICTURE.GIF file saved


Agilent 00:35:33 Nov 10, 2007
R T
Mkr1 Δ 94 kHz
-0.415 dB
Ref 25 dBm
Atten 35 dB
Peak
Log
10
dB/
1R
1
DI
0.8
dBm
M1 M2
S3 FC
AA
Center 921.8 MHz
Span 400 kHz
#Res BW 10 kHz
#VBW 30 kHz
Sweep 7.433 ms (401 pts)
C:PICTURE.GIF file saved

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.

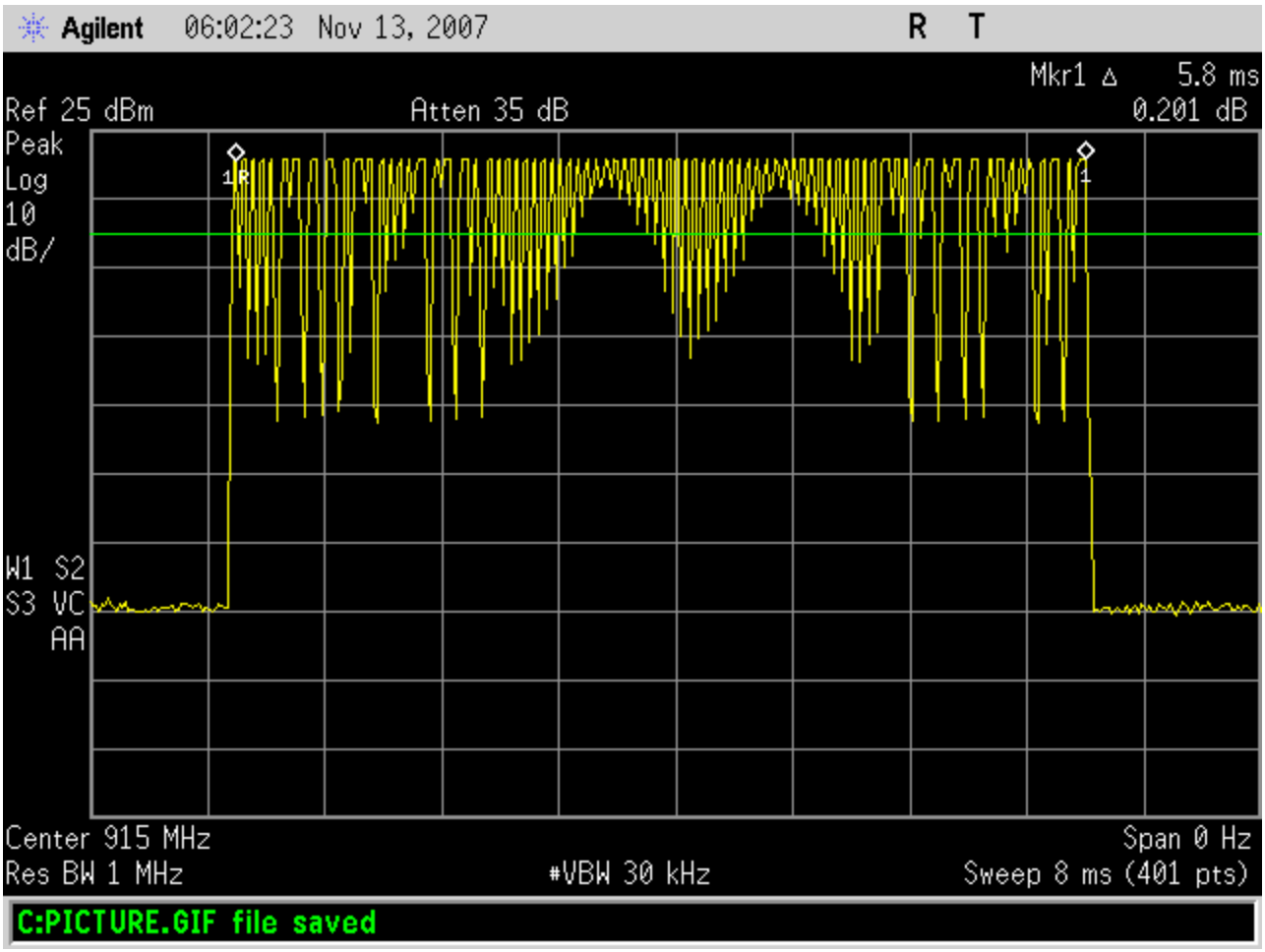
EUT Configuration: The EUT is configured to transmit (special code set) on the low channel (908 MHz), a middle channel (915 MHz), and a high channel (921.8 MHz). The EUT is also configured to transmit every 4 seconds. This configuration is transmitting Standard Consumption Messages and triggered on one specific message. See Annex B for picture of test setup.

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
Spectrum Analyzer	MY45113415	7-Aug-07	8-Aug-08
Huber&Suhner 18 inch. Sma to N	220057 002	3-May-2007	3-May-2008

Date	Tested by
11/12/2007	Mark Kvamme

Each transmission is 5.8 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.


Agilent 06:02:23 Nov 13, 2007
R T
Mkr1 Δ 5.8 ms
0.201 dB
Ref 25 dBm
Atten 35 dB
Peak
Log
10
dB/
W1 S2
S3 VC
AA
Center 915 MHz
Res BW 1 MHz
#VBW 30 kHz
Span 0 Hz
Sweep 8 ms (401 pts)
C:PICTURE.GIF file saved

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

Power Output (Conducted)

For frequency hopping systems operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1.0 W, and the e.i.r.p. shall not exceed 4 W, if the hopset uses 50 or more hopping channels.

EUT Configuration: The EUT is configured to transmit (special code set) on the low channel (908 MHz), a middle channel (915 MHz), and a high channel (921.8 MHz). The EUT is also configured to transmit every 4 seconds. This enables measurement of peak energy to be made at each location. See Annex B for picture of test setup.

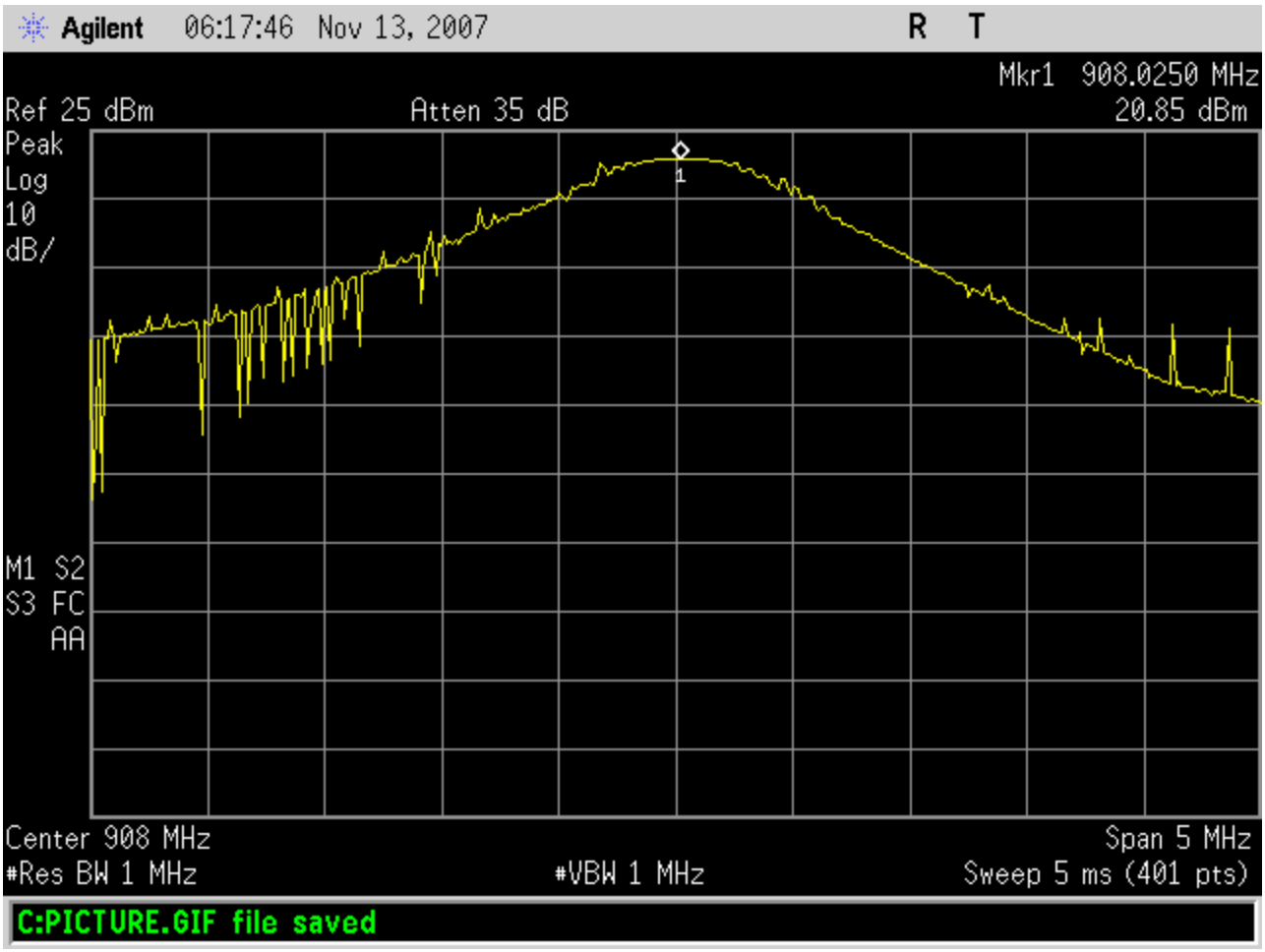
Use the following spectrum analyzer settings:

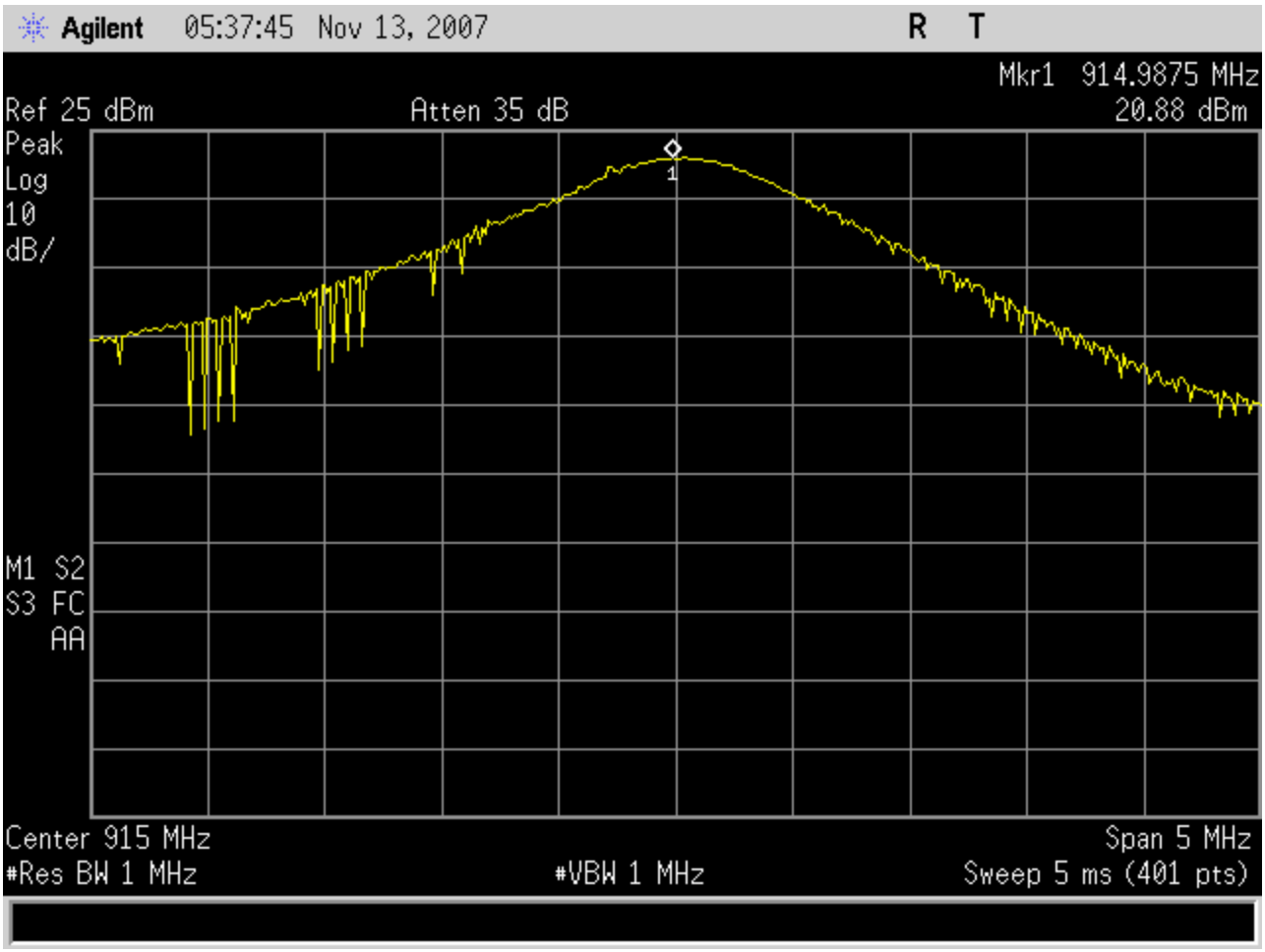
Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel.
RBW > the 20 dB bandwidth of the emission being measured.
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

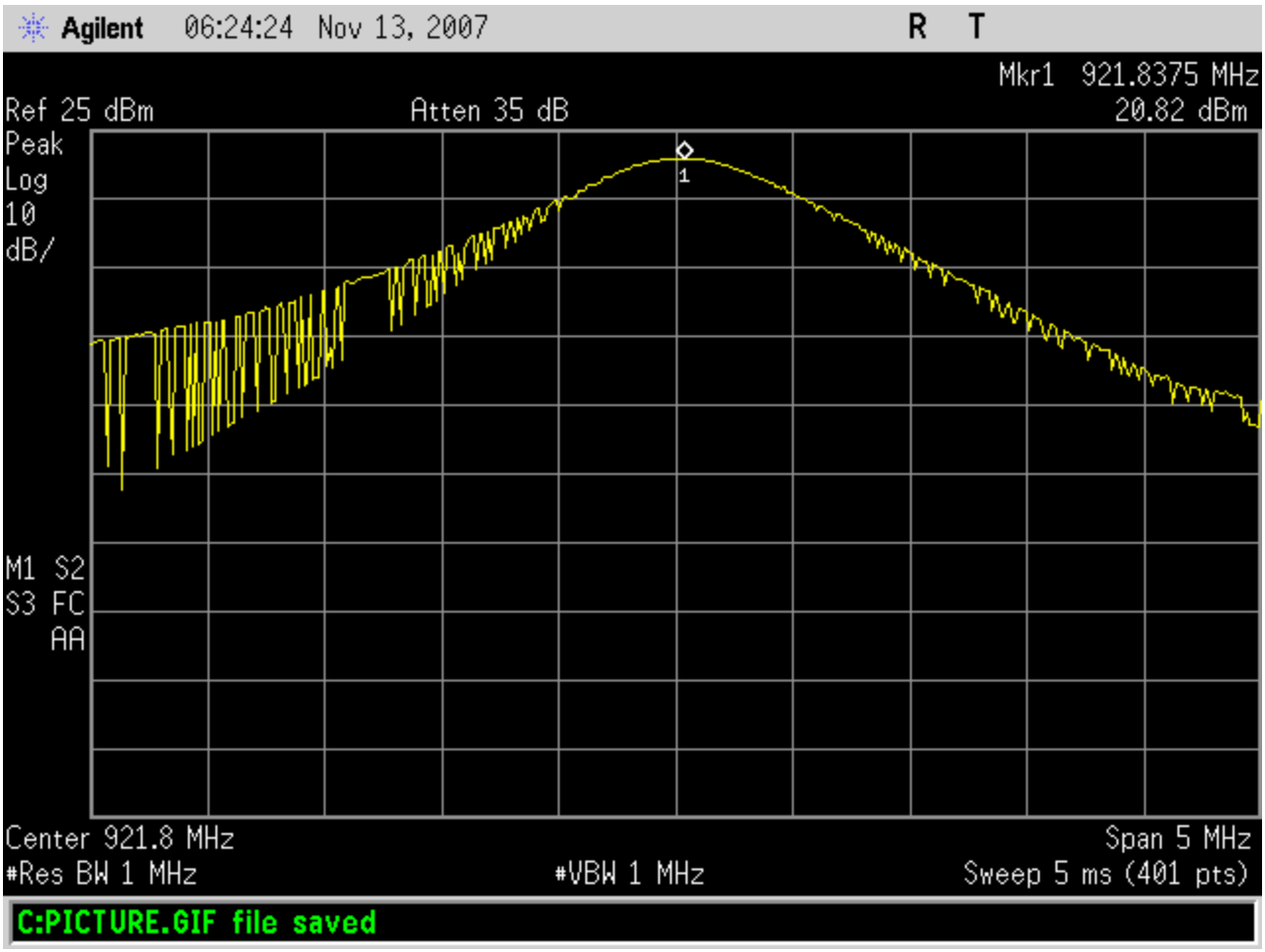
Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power. The limit is specified in one of the subparagraphs of this Section. Submit this plot. A peak responding power meter may be used instead of a spectrum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

Equipment Used	Serial Number	Cal Date	Due
Spectrum Analyzer	MY45113415	7-Aug-07	8-Aug-08
Huber&Suhner 18 inch. Sma to N	220057 002	3-May-2007	3-May-2008

Date	Tested by	Temperature/humidity
11/12/2007	Mark Kvamme	72/38


Agilent 06:17:46 Nov 13, 2007
R T
Mkr1 908.0250 MHz
20.85 dBm
Ref 25 dBm
Atten 35 dB
Peak
Log
10
dB/
M1 S2
S3 FC
AA
Center 908 MHz
#Res BW 1 MHz
#VBW 1 MHz
Span 5 MHz
Sweep 5 ms (401 pts)
C:PICTURE.GIF file saved


Agilent 05:37:45 Nov 13, 2007
R T
Mkr1 914.9875 MHz
20.88 dBm
Ref 25 dBm
Atten 35 dB
Peak
Log
10
dB/
M1 S2
S3 FC
AA
Center 915 MHz
#Res BW 1 MHz
#VBW 1 MHz
Span 5 MHz
Sweep 5 ms (401 pts)


Agilent 06:24:24 Nov 13, 2007
R T
Mkr1 921.8375 MHz
20.82 dBm
Ref 25 dBm
Atten 35 dB
Peak
Log
10
dB/
M1 S2
S3 FC
AA
Center 921.8 MHz
#Res BW 1 MHz
#VBW 1 MHz
Span 5 MHz
Sweep 5 ms (401 pts)
C:PICTURE.GIF file saved

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

EUT Configuration: The EUT is configured to transmit (special code set) on the low channel (908 MHz), a middle channel (915 MHz), and a high channel (921.8 MHz). The EUT is also configured to transmit every 4 seconds. This enables measurement of peak energy to be made at each location. See Annex B for picture of test setup.

Follow the procedure outlined in Annex A of this document.

Equipment Used	Serial Number	Cal Date	Due
Huber&Suhner 40 foot cable	220297 001	09-Apr-07	09-Apr-08
EMCO 3148 Log periodic	9901-1044	24-Oct-06	24-Oct-08
Hewlett Packard 437B Power meter	3125U16900	30-May-06	30-May-08
Hewlett Packard 8481D Power sensor	3318A11513	06-Jun-06	06-Jun-08
EMCO 3115 double ridge wave guide	9508-4550	15-Mar-06	15-Mar-08
EMCO loop antenna model 6502	9509-2970	24-Oct-06	24-Oct-08
Agilent E7405 EMC analyzer 9 khz to 26.5 Mhz	MY45113415	07-Aug-07	07-Aug-08

The power meter and the power sensor are used to verify the gain of the amplifier at each of the frequencies.

Date	Tested by
10/30,31/2007 11/1,2/2007	Mark Kvamme

Frequency range investigated was 9 kHz to 9.3 GHz. Radiated measurements below 30 MHz were performed @ the OATS with a pre-scan done in an anechoic chamber Worst case results are reported below. This approach is used for a cursory check.

Freq. MHz	Ant. Pos.	Level dBm	Level dBuV	Gain dB	Factor dB	Loss dB	**Level dBuV/m**	dbc	Temperature Fahrenheit	Relative Humidity
908.0	Vertical	-26.13	80.87	0.00	29.10	2.70	112.67		48.25	45.01
908.0	Horizontal	-17.15	89.85	0.00	29.10	2.70	121.65		58.77	36.07
915.0	Vertical	-26.03	80.97	0.00	29.10	2.70	112.77		47.15	46.72
915.0	Horizontal	-17.46	89.54	0.00	29.10	2.70	121.34		58.41	37.69
921.8	Vertical	-26.65	80.35	0.00	29.10	2.70	112.15		48.91	50.78
921.8	Horizontal	-17.58	89.42	0.00	29.10	2.70	121.22		51.96	48.08
1830.0	Vertical	-28.68	78.32	46.20	28.00	3.80	63.92	-48.23	49.29	62.73
1830.0	Horizontal	-35.13	71.87	46.20	28.00	3.80	57.47	-54.68	48.36	61.49
6405.0	Vertical	-48.37	58.63	43.50	35.40	7.60	58.13	-54.02	51.39	78.65
6405.0	Horizontal	-51.32	55.68	43.50	35.40	7.60	55.18	-56.97	57.61	69.41

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.

EUT Configuration: The EUT is configured to transmit (special code set) on the low channel (908 MHz), a middle channel (915 MHz), and a high channel (921.8 MHz). The EUT is also configured to transmit every 4 seconds. This enables measurement of peak energy to be made at each location. See Annex B for picture of test setup.

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
Spectrum Analyzer	MY45113415	7-Aug-07	7-Aug-09
Huber&Suhner 40 foot cable	220297 001	9-Apr-07	9-Apr-08
EMCO 3148 Log periodic	9901-1044	24-Oct-06	24-Oct-08
Hewlett Packard 437B Power meter	3125U16900	30-May-06	30-May-08
Hewlett Packard 8481D Power sensor	3318A11513	6-Jun-06	6-Jun-08
EMCO 3115 double ridge wave guide	9508-4550	15-Mar-06	15-Mar-08
Agilent E7405 EMC analyzer 9 khz to 26.5 Mhz	MY45113415	07-Aug-07	07-Aug-08

Date	Tested by
10/29,30/2007 11/13/2007	Mark Kvamme

Frequency range investigated was 9 kHz to 9.3 GHz. Radiated measurements below 30 MHz were performed in a GTEM. A Duty Cycle Correction Factor (20log (dwell time/100mS)) was applied to show compliance to the 15.205 limit. 20log (5.8/100)= -24.73 dB . The maximum allowed correction factor is 20 dB.

freq MHz	polarity polarization	reading dBm	reading dbuV	amplifier gain dB	antenna correction factor dB	cable loss dB	Peak Values dbuV/m dBuV/m	Peak Values dbuV/m with 20db relaxation dBuV/m	limit dBuV/m	margin dB	Date	Fahrenheit	Humidity
2724.00	Vertical	-28.46	78.54	44.40	29.60	4.70	68.44	48.44	54.00	5.56	10/30/2007	50.00	57.00
2724.00	Horizontal	-33.11	73.89	44.40	29.60	4.70	63.79	43.79	54.00	10.21	10/30/2007	50.00	57.00
2745.00	Vertical	-28.46	78.54	44.40	29.60	4.70	68.44	48.44	54.00	5.56	10/29/2007	64.36	48.65
2745.00	Horizontal	-33.43	73.57	44.40	29.60	4.70	63.47	43.47	54.00	10.53	10/29/2007	62.97	51.56
2765.40	Vertical	-27.52	79.48	44.40	29.60	4.70	69.38	49.38	54.00	4.62	11/13/2007	50.00	40.00
2765.40	Horizontal	-34.05	72.95	44.40	29.60	4.70	62.85	42.85	54.00	11.15	11/13/2007	50.00	40.00
3632.00	Vertical	-44.06	62.94	45.30	32.10	5.50	55.24	35.24	54.00	18.76	10/30/2007	50.00	57.00
3632.00	Horizontal	-43.74	63.26	45.30	32.10	5.50	55.56	35.56	54.00	18.44	10/30/2007	50.00	57.00
3660.00	Vertical	-43.48	63.53	45.30	32.10	5.50	55.83	35.83	54.00	18.18	10/29/2007	60.60	55.37
3660.00	Horizontal	-43.29	63.71	45.30	32.10	5.50	56.01	36.01	54.00	17.99	10/29/2007	57.52	59.98
3687.20	Vertical	-42.65	64.35	45.30	32.10	5.50	56.65	36.65	54.00	17.35	11/13/2007	50.00	40.00
3687.20	Horizontal	-44.03	62.97	45.30	32.10	5.50	55.27	35.27	54.00	18.73	11/13/2007	50.00	40.00
4540.00	Vertical	-45.53	61.47	45.30	33.20	6.20	55.57	35.57	54.00	18.43	10/30/2007	50.00	57.00
4540.00	Horizontal	-45.47	61.53	45.30	33.20	6.20	55.63	35.63	54.00	18.37	10/30/2007	50.00	57.00
4575.00	Vertical	-44.57	62.43	45.30	33.20	6.20	56.53	36.53	54.00	17.47	10/29/2007	56.80	60.41
4575.00	Horizontal	-44.90	62.10	45.30	33.20	6.20	56.20	36.20	54.00	17.80	10/29/2007	55.06	64.46
4609.00	Vertical	-43.88	63.12	45.30	33.20	6.20	57.22	37.22	54.00	16.78	11/13/2007	50.00	40.00
4609.00	Horizontal	-43.50	63.50	45.30	33.20	6.20	57.60	37.60	54.00	16.40	11/13/2007	50.00	40.00
5490.00	Vertical	-41.63	65.37	44.40	34.60	6.90	62.47	42.47	54.00	11.53	10/29/2007	54.06	66.85
5490.00	Horizontal	-39.44	67.56	44.40	34.60	6.90	64.66	44.66	54.00	9.34	10/29/2007	53.75	68.08
7320.00	Vertical	-45.18	61.82	44.00	36.60	8.50	62.92	42.92	54.00	11.08	10/30/2007	64.31	59.78
7320.00	Horizontal	-48.57	58.43	44.00	36.60	8.50	59.53	39.53	54.00	14.47	10/30/2007	64.09	59.32
8235.00	Vertical	-47.96	59.04	44.50	38.30	9.10	61.94	41.94	54.00	12.06	10/30/2007	64.60	56.66
8235.00	Horizontal	-49.03	57.98	44.50	38.30	9.10	60.88	40.88	54.00	13.13	10/30/2007	61.45	61.85
9150.00	Vertical	-47.35	59.65	44.10	38.60	9.20	63.35	43.35	54.00	10.65	10/30/2007	60.04	65.39
9150.00	Horizontal	-46.74	60.26	44.10	38.60	9.20	63.96	43.96	54.00	10.04	10/30/2007	58.86	68.57

RSS-Gen 7.2.3 Receiver Spurious Emission Limits

7.2.3.2 Radiated Measurement

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

Receiver Spurious Emissions

The receiver shall be operated in the normal receive mode near the mid-point of the band over which the receiver is designed to operate. Unless otherwise specified in the applicable RSS, the radiated emission measurement is the standard measurement method (with the device's antenna in place) to measure receiver spurious emissions. Radiated emission measurements are to be performed using a calibrated open-area test site. As an alternative, the conducted measurement method may be used when the antenna is detachable. In such a case, the receiver spurious signal may be measured at the antenna port. If the receiver is super-regenerative, stabilize it by coupling to it an 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.

Table 1 - Spurious Emission Limits for Receivers

Frequency range investigated was 30Mhz to 3 GHz with. No radiated emission found.

The measurement that is captured below was done for engineering purposes, to capture the LO frequency. The measurement and calculating with the gain of the antenna, results in amplitude that is more than 70 dB with in specification (see calculation in Annex C). A radiated measurement was made, with the ability to see emissions in excess of 20 dB below the 46 dB uV/m specification, and no receiver emissions were detected.

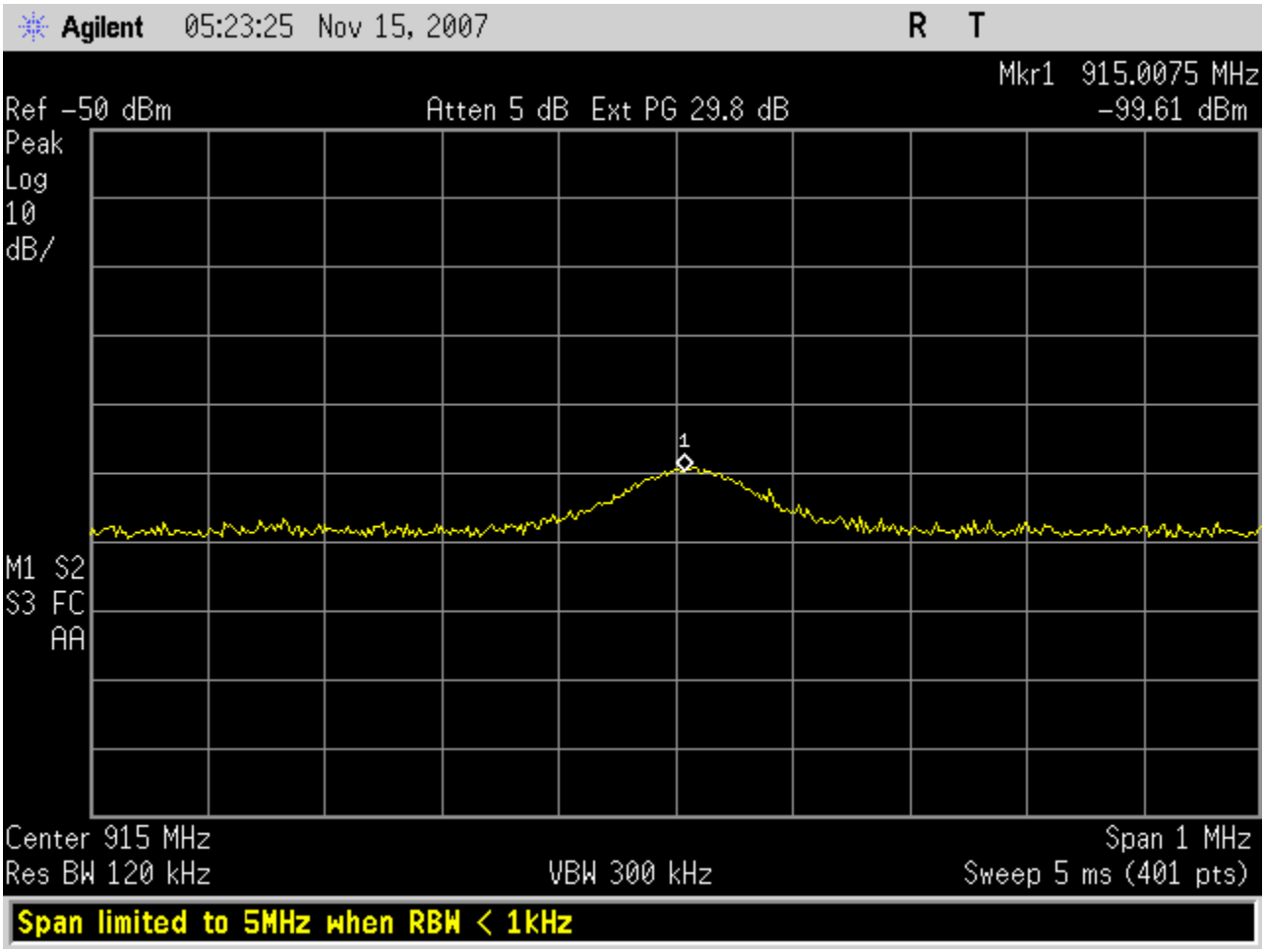
LO frequency measurement

Equipment Used	Serial Number	Cal Date	Due
Huber&Suhner 40 foot cable	220297 001	09-Apr-07	09-Apr-08
Hewlett Packard 437B Power meter	3125U16900	30-May-06	30-May-08
Hewlett Packard 8481D Power sensor	3318A11513	06-Jun-06	06-Jun-08
EMCO 3148 Log periodic	9901-1044	24-Oct-06	24-Oct-08
EMCO 3108 Biconical	9203-2455	24-Oct-06	24-Oct-08
Mini-circuits ZHL-1042J-SMA	D021000-23	02-May-07	02-May-08
Agilent E7405 EMC analyzer 9 khz to 26.5 Mhz	MY45113415	07-Aug-07	07-Aug-08
Huber&Suhner 18 inch. Sma to N	220057 002	3-May-2007	3-May-2008

The power meter and the power sensor are used to verify the gain of the amplifier at each of the frequencies.

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

Date	Temp/Humidity ºF / %	Tested by
11/14/2007	70/42	Mark Kvamme

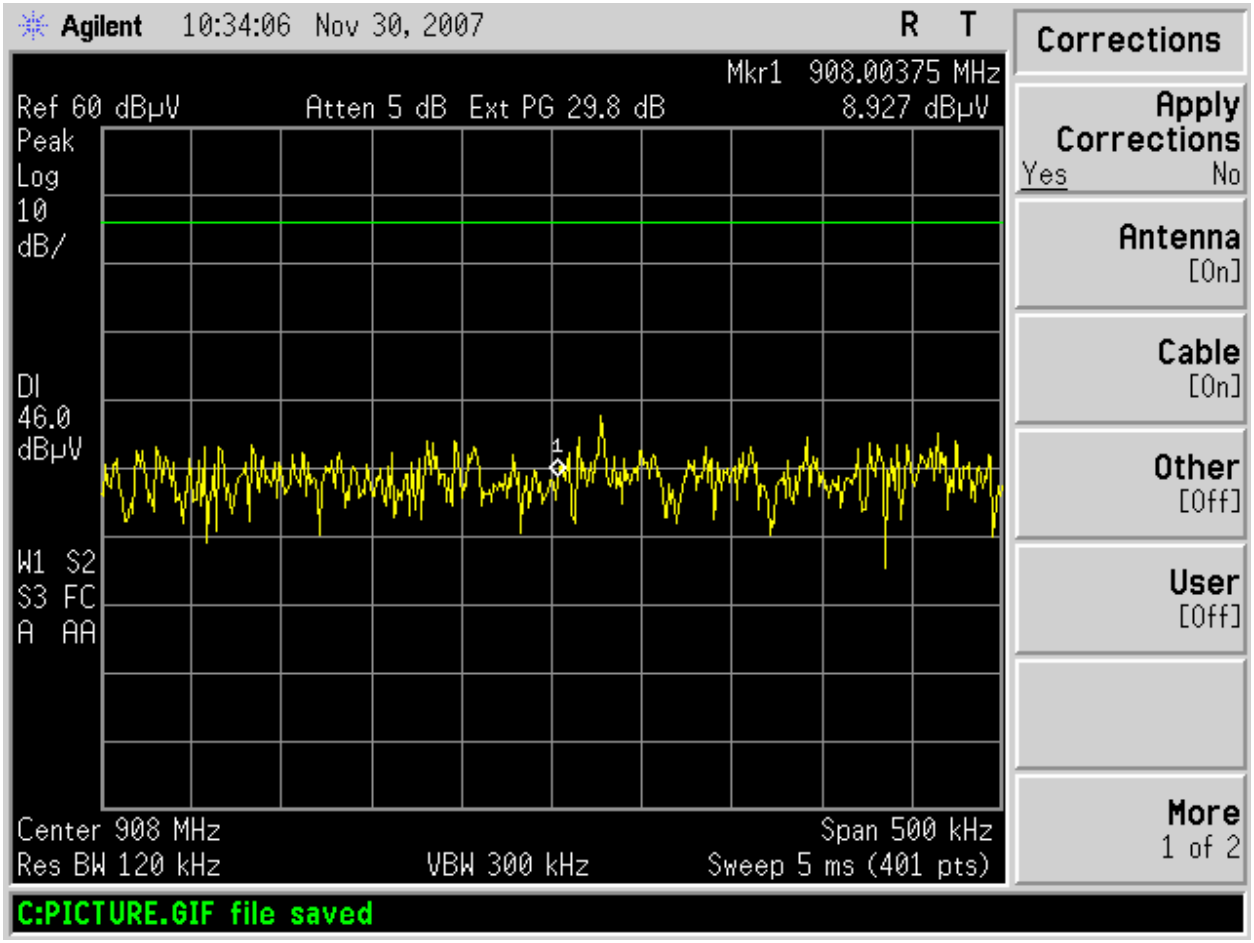


Receiver signal measured conducted with an amplifier gain of 29.8db.

Radiated Measurement for receiver emissions

Equipment Used	Serial Number	Cal Date	Due
Huber&Suhner 40 foot cable	220297 001	9-Apr-07	9-Apr-08
EMCO 3148 Log periodic	9901-1044	24-Oct-06	24-Oct-08
Mini-circuits ZHL-1042J-SMA	D021000-23	2-May-07	2-May-08
Agilent E7405 EMC analyzer 9 khz to 26.5 Mhz	MY45113415	7-Aug-07	7-Aug-08

The corrections for the amplifier, cable and antenna have been entered into the analyzer so the displayed level is correct in dbuV/m.
The amplifier gain is 29.8 db
The antenna correction factor is 24.3
The coax loss is 2.7db



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).

The power density is calculated as:

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

P_d = power density in milliwatts/cm^2
P_t = transmit power in milliwatts
G = numeric antenna gain
r = distance between body and transmitter in centimeters.]

$$P_d \max = \frac{F_{Mhz}}{1500_{mW/cm^2}} = \frac{928Mhz}{1500} = 0.62mW/cm^2$$

FCC / RSS 102 Limit:= 0.62 mW/cm^2

Max antenna gain = 4.27 dBi = 2.67 numeric method of calculation in Annex A
Max TX power = 20.88 dBm = 122.5 mW

$$P_d = \frac{122.5 \times 2.67}{4 \times \pi \times 20^2} = \frac{327.1mW}{5026.5cm^2} = 0.065mW/cm^2$$

ANNEX A

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 C63.4-2003 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

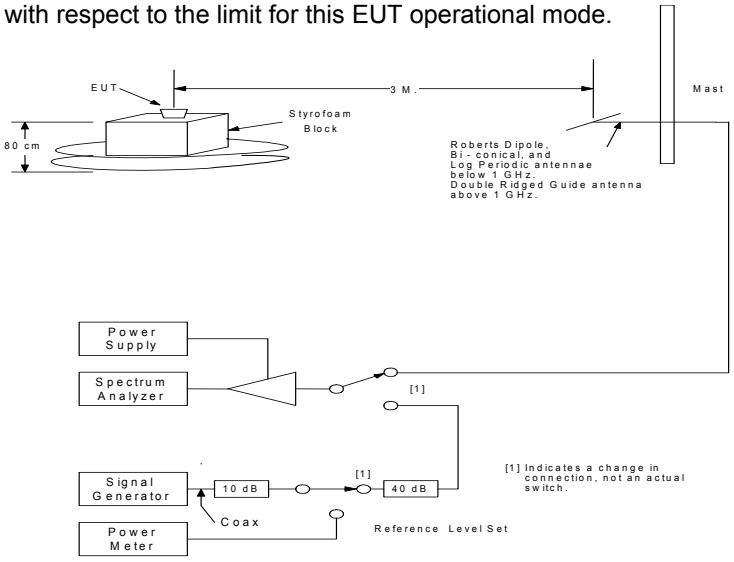
Measure the field strength of both the fundamental emission and all spurious emissions with these settings. Follow the procedures in C63.4-2003 with respect to maximizing the emissions. The measured field strength of all spurious emissions must be below the measured field strength of the fundamental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

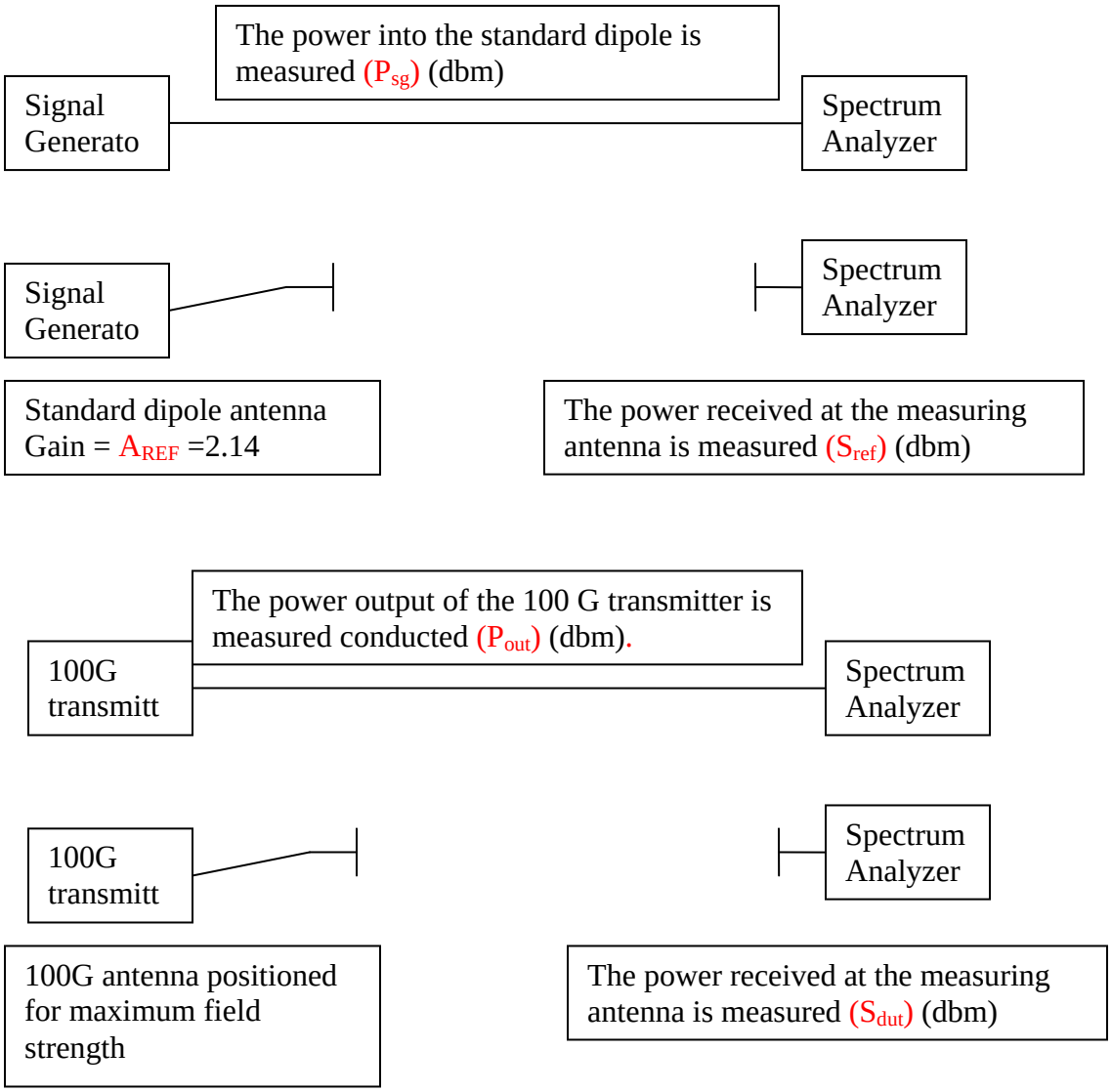
STEP 2) Choose a spectrum analyzer span that encompasses both the peak of the fundamental emission and the band-edge emission under investigation. Set the analyzer RBW to 1% of the total span (but never less than 30 kHz) with a video bandwidth equal to or greater than the RBW. Record the peak levels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

Antenna Gain Measurement Method



A_{REF} = Antenna Gain of the standard dipole (dbi)
A_{DUT}=Antenna Gain of the 100G device (dbi)

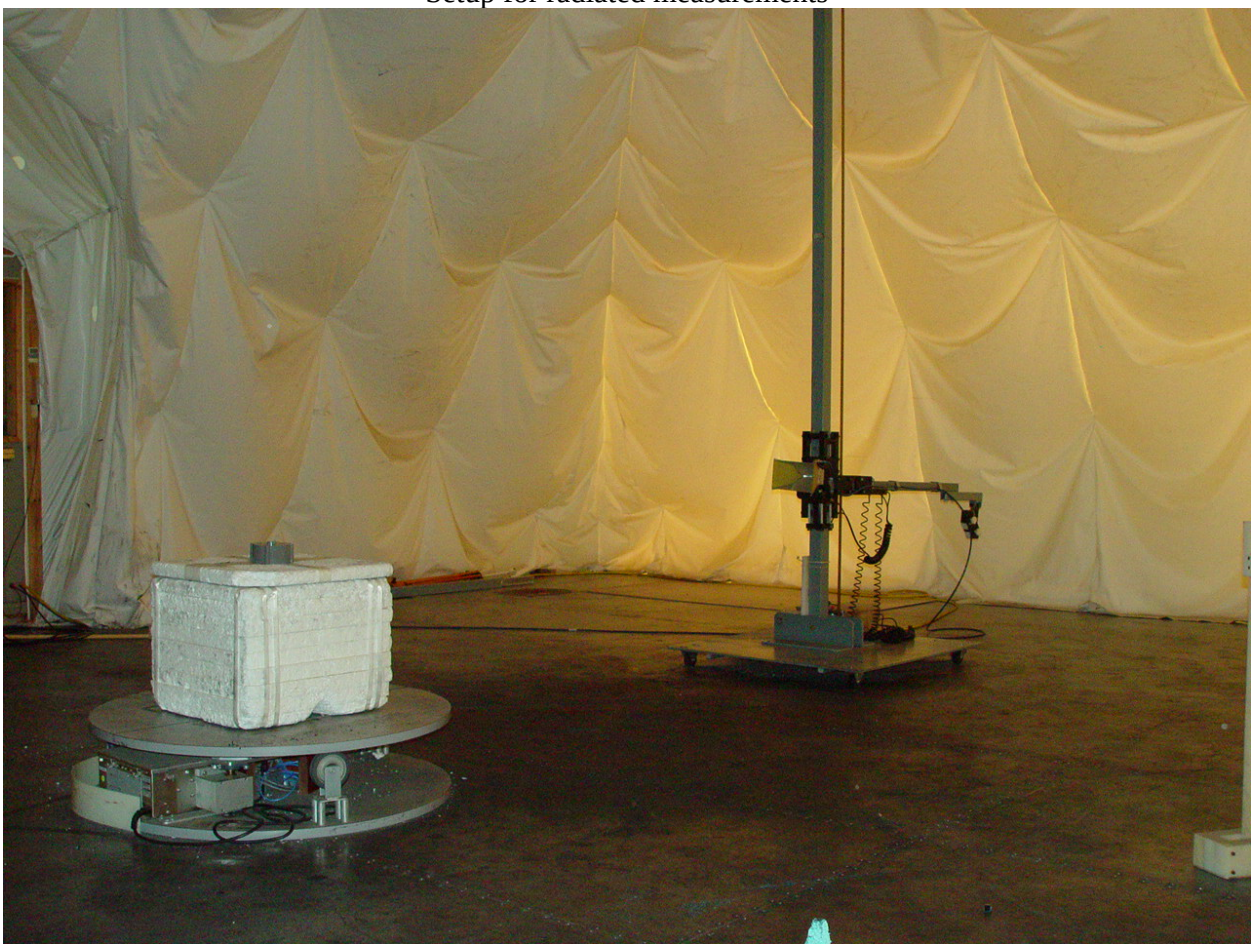
$$P_{SG} + A_{REF} - S_{REF} = Pathloss$$

$$P_{OUT} + A_{DUT} - S_{DUT} = Pathloss$$

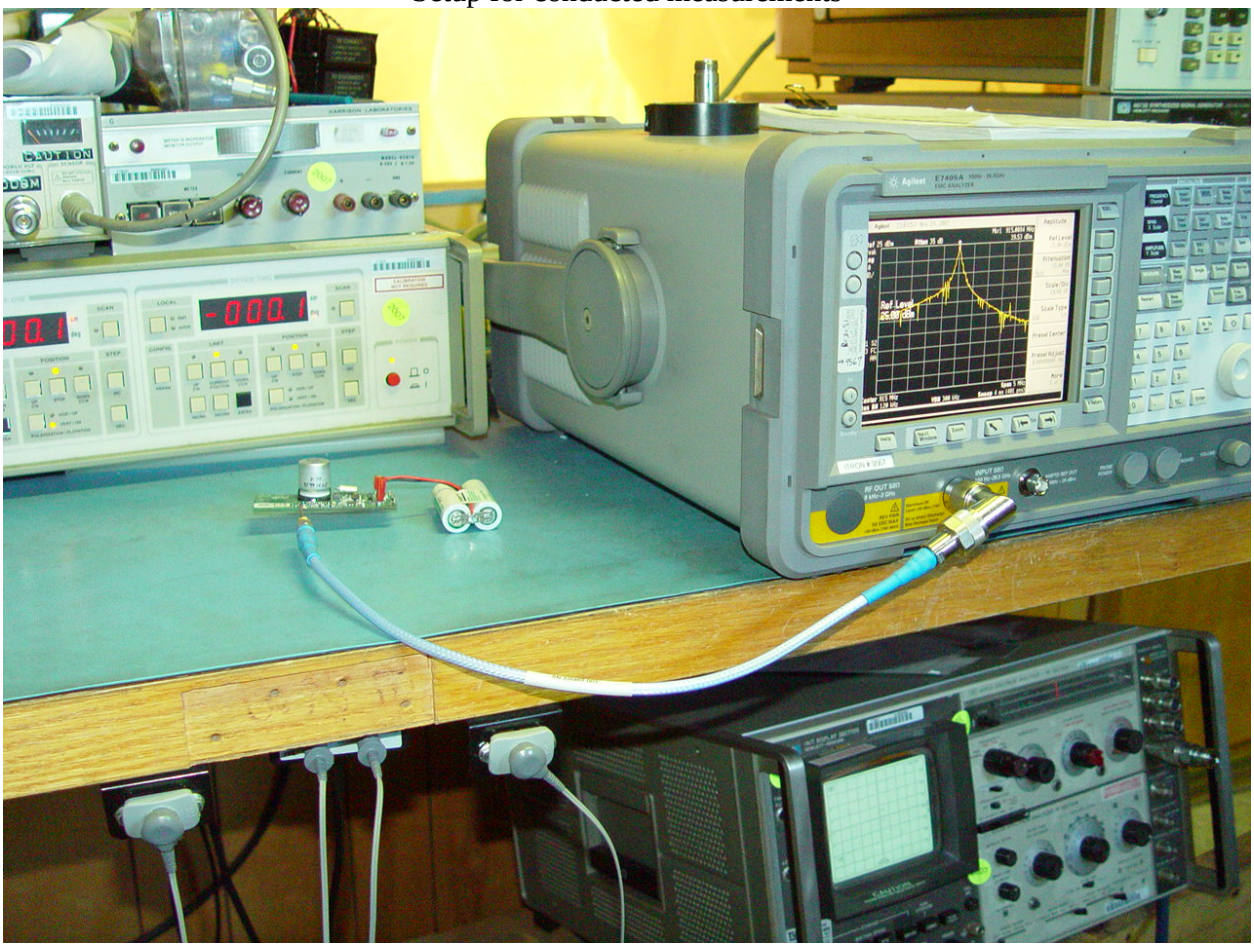
$$P_{SG} + A_{REF} - S_{REF} - P_{OUT} + S_{DUT} = A_{DUT}$$

ANNEX B

Setup for radiated measurements



Setup for conducted measurements



ANNEX C

Receive emission calculated

Path loss = 32.44 + 20log(distance in km) + 20log(frequency in MHz)
= 32.44 – 50.46 + 59.31 = 41.30 $dB|_{924 @ 3 Meters}$
= 32.44 – 50.46 + 59.16 = 41.14 $dB|_{908 @ 3 Meters}$

Antenna gain = 4.27 dB

Conducted measurement = -99.61 dBm

Max field strength at 3 Meters = 50Ω Conducted Measurement$|_{dB}$
- Path loss$|_{dB}$
+ Antenna gain$|_{dB}$
+ Conversion to dBuV/m

Max field strength at 3 Meters = -99.61 dBm – 41.14 dB + 4.27 dB + 107 dB
= -29.48 dBuV/m
= .036 uV/meter @ 3 Meters

Specification limit is 200 uV/m and therefore calculation results in 75.5 dB with specification.