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Measured Radio Frequency Emissions
From

Raven E1007580 Series
IEEE 802.15.4 Hopping Transceiver
FCC ID: KSME1007580
IC: 2004A-E1007580

Report No. 415031-455
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For:
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Summary
Tests for compliance with FCC Regulations, Part 15.249, and with Industry Canada (IC) Regulations, RSS-210 (A2.9) and RSS-GEN, were performed on Raven E1007580 series transceiver. The DUT is subject to the Rules and Regulations as a transceiver.

In testing competed on September 9, 2008, transmitter fundamental radiated emissions meet the limit by 17.3 dB, restricted bands are met by 4.0 dB (p. 8). Receiver and digital emissions meet the Class B limit by more than 8.6 dB (p. 9). AC power line conducted emissions meet the Class B limit by 4.6 dB.

1 Introduction

Raven E1007580 series was(were) tested for compliance with FCC Regulations, Part 15, Subpart C, adopted under Docket 87-389, April 18, 1989, and with Industry Canada RSS-210, Issue 7, June, 2007. The tests were performed at the University of Michigan Radiation Laboratory Willow Run Test Range following the procedures described in ANSI C63.4-2003 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". The Site description and attenuation characteristics of the Open Site facility are on file with FCC Laboratory, Columbia, Maryland (FCC Reg. No: 91050) and with Industry Canada, Ottawa, ON (File Ref. No: IC 2057A-1).

2 Test Equipment Used

The pertinent test equipment commonly used in our facility for measurements is listed in Table 2.1 below. The middle column identifies the specific equipment used in these tests. The quality system employed at the University of Michigan Radiation Laboratory Willow Run Test Range has been established to ensure all equipment has a clearly identifiable classification, calibration expiry date, and that all calibrations are traceable to national standards.

Table 2.1 Test Equipment.

Test Instrument	Used	Manufacturer/Model	Q Number
Spectrum Analyzer (9kHz-26GHz)	X	Hewlett-Packard 8593E, SN: 3412A01131	HP8593E1
Spectrum Analyzer (9kHz-6.5GHz)	X	Hewlett-Packard 8595E, SN: 3543A01546	JDB8595E
Power Meter		Hewlett-Packard, 432A	HP432A1
Harmonic Mixer (26-40 GHz)		Hewlett-Packard 11970A, SN: 3003A08327	HP11970A1
Harmonic Mixer (40-60 GHz)		Hewlett-Packard 11970U, SN: 2332A00500	HP11970U1
Harmonic Mixer (75-110 GHz)		Hewlett-Packard 11970W, SN: 2521A00179	HP11970W1
Harmonic Mixer (140-220 GHz)		Pacific Millimeter Prod., GMA, SN: 26	PMPGMA1
S-Band Std. Gain Horn		S/A, Model SGH-2.6	SBAND1
C-Band Std. Gain Horn		University of Michigan, NRL design	CBAND1
XN-Band Std. Gain Horn		University of Michigan, NRL design	XNBAND1
X-Band Std. Gain Horn		S/A, Model 12-8.2	XBAND1
X-band horn (8.2- 12.4 GHz)		Narda 640	XBAND2
X-band horn (8.2- 12.4 GHz)		Scientific Atlanta , 12-8.2, SN: 730	XBAND3
K-band horn (18-26.5 GHz)		FXR, Inc., K638KF	KBAND1
Ka-band horn (26.5-40 GHz)		FXR, Inc., U638A	KABAND1
U-band horn (40-60 GHz)		Custom Microwave, HO19	UBAND1
W-band horn(75-110 GHz)		Custom Microwave, HO10	WBAND1
G-band horn (140-220 GHz)		Custom Microwave, HO5R	GBAND1
Bicone Antenna (30-250 MHz)	X	University of Michigan, RLBC-1	LBBIC1
Bicone Antenna (200-1000 MHz)	X	University of Michigan, RLBC-2	HBBIC1
Dipole Antenna Set (30-1000 MHz)	X	University of Michigan, RLDP-1,-2,-3	UMDIP1
Dipole Antenna Set (30-1000 MHz)		EMCO 3121C, SN: 992 (Ref. Antennas)	EMDIP1
Active Rod Antenna (30 Hz-50 MHz)		EMCO 3301B, SN: 3223	EMROD1
Active Loop Antenna (30 Hz-50 MHz)		EMCO 6502, SN:2855	EMLOOP1
Ridge-horn Antenna (300-5000 MHz)	X	University of Michigan	UMRH1
Amplifier (5-1000 MHz)	X	Avantek, A11-1, A25-1S	AVAMP1
Amplifier (5-4500 MHz)	X	Avantek	AVAMP2
Amplifier (4.5-13 GHz)		Avantek, AFT-12665	AVAMP3
Amplifier (6-16 GHz)		Trek	TRAMP1
Amplifier (16-26 GHz)		Avantek	AVAMP4
LISN Box	X	University of Michigan	UMLISN1
Signal Generator		Hewlett-Packard 8657B	HPSG1

3 Device Under Test

3.1 Identification

The DUT is a frequency hopping IEEE 802.15.4 transceiver operating in the 2400 - 2483.5 MHz band built into a bed control unit. The DUT measures approximately 5 x 8 x 1.0 inches. The system is a fully compliant IEEE 802.15.4 transceiver supporting 250 kbps O-QPSK data in 16, 5.0 MHz wide hopping channels from 2405-2480 MHz. The DUT was designed and manufactured by Raven Industries, 4372 Green Ash Drive, Earth City, MO 63045. It is identified as:

Raven IEEE 802.15.4 Transceiver
Model(s): E1007581, E1007582, E1007583, E1007584,
E1007585, E1007586, E1007587
FCC ID: KSME1007580
IC: 2004A- E1007580

3.2 Variants

There are seven variants of this module. E1007581 is fully populated, and is the unit tested. E1007582 has the AIR bed port and the AUX port removed, E1007583 has the Aux Port removed, E1007584 has the Air bed port removed, E1007585 has the Motor 2 port, both Vibe ports, Air Bed Port and Aux Port removed, E1007586 has both Vibe ports, Air Bed Port and Aux Port removed, and the E1007587 removes the Power Down Port, Air Bed Port and Aux Port.

The DUT has only one antenna built into the PCB and has been setup with test software to control channel selection and to enable/disable hopping for testing purposes. Worst case RF emissions were noted when the DUT's external peripherals were removed. In addition to the main unit a number of peripherals controlled by the module were provided and exercised during testing.

3.3 Modes of Operation

This device only operates in a single mode, data transmission. The operating mode of this hopping IEEE 802.15.4 transceiver does not influence peak output power. There is only one transmitter which is driven by identical input parameters.

3.4 EMI Relevant Modifications

No modifications were made to the DUT by this laboratory during testing.

4 Emission Limits

4.1 Radiated Emission Limits

The DUT tested is a 2405-2480 MHz Transmitter, subject to FCC 15.249 and IC RSS-210e A2.9, and all other sections referred to therein. The applicable critical testing frequencies with corresponding emission limits are given in Tables 4.1 and 4.2.

Table 4.1. Radiated Emission Limits (Ref: FCC: 15.249; IC: RSS-210e A2.9)

Frequency (MHz)	Field Strength of Fundamental (mV/m)	Field Strength of Harmonics (μV/m)
902.0 – 928.0	50	500
2400 - 2483.5	50	500
5725.0 – 5875.0	50	500
24000.0 – 24250.0	250	2500

1) Field strength limits are specified at a distance of 3 meters.
2) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209 (Class B), whichever is the lesser attenuation.
3) Peak field strength of any emission above 1GHz shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. (15.35)

Table 4.2 Radiated Emission Limits (FCC:15.109;IC: RSS-210, Table 2) – Receiver/Digital device.

Frequency	Class A ds = 10 m		Class B ds = 3 m	
(MHz)	(μV/m)	dB (μV/m)	(μV/m)	dB (μV/m)
30-88	90	39.0	100	40.0
88-216	150	43.5	150	43.5
219-960	210	46.4	200	46.0
960-	300	49.5	500	54.0

120 kHz BW up to 1 GHz, 1 MHz BW above 1 GHz

4.2 Conducted Emission Limits

Table 4.3. Conducted emission limits (FCC 15.107; IC RSS-Gen 7.2.2 Table 2 (CISPR)).

Frequency	Class A (dBμV)		Class B (dBμV)	
MHz	μV	dBμV	μV	dBμV
0.150 - 0.50	79	66	66 - 56*	56 - 46*
0.50 - 5	73	60	56	46
5 - 30	73	60	60	50

Notes: 1. The lower limit shall apply at the transition frequency
2. The limit decreases linearly with the logarithm of the frequency in the range 0.15-0.50MHz:
*Class B Quasi-peak: dBμV = 50.25 - 19.12*log(f)
*Class B Average: dBμV = 40.25 - 19.12*log(f)
3. 9 kHz RBW

5 Test Procedure and Computations

5.1 Test Procedure: General

Prior to any measurements, all active components of the test setup were allowed a warm-up for a period of approximately one hour, or as recommended by their manufacturers.

5.2 Semi-Anechoic Chamber Measurements

In our chamber, there is a set-up similar to that of an outdoor 3-meter site, with a turntable, an antenna mast, and a ground plane. Instrumentation includes spectrum analyzers and other equipment as needed. For these tests the receiver (horn) antennas were placed on a Styrofoam block or antenna mast, at about 1.2 m height, and the DUT on a turntable at 3 meter distance.

Standard gain horn antennas are used for the measurements. Up to 4.5 GHz, horn antennas are connected directly to a spectrum analyzer via RG-214 coaxial cable. Above 4.5 GHz a pre-amp is added. The cables and the pre-amplifier used are specially calibrated for these tests using a network analyzer. The DUT antenna was rotated in all possible ways and the maximum emission recorded. A photograph in the Test Setup portion of this submittal shows the measurement set-up.

5.3 Open Area Test Site (OATS) Measurements

After the chamber measurements, the emissions were re-measured on the outdoor 3-meter site at fundamental and harmonics up to 1 GHz using tuned dipoles and/or the high frequency Bicone. Photographs included in this filing show the DUT on the Open Area Test Site (OATS).

5.4 Computations and Results

To convert dBm measured on the spectrum analyzer to dB(μV/m), we use the expression

$$E_3(\text{dB}\mu\text{V/m}) = 107 + P_R + K_A - K_G + K_E$$

where P_R = power recorded on spectrum analyzer, dB, measured at 3m
K_A = antenna factor, dB/m
K_G = pre-amplifier gain, including cable loss, dB
K_E = pulse operation correction factor, dB

When presenting the data, the dominant measured emissions at each frequency, under all of the possible orientations, are given. Computations and results are given in Table 5.1.

5.5 Supply 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. Worst case emissions are reported employing a new battery.

6 Other Measurements and Computations

6.1 Radiated Emissions

Table 5.1(a) and Table 5.1(b).

6.2 AC Power Line Conducted Emissions

Table 5.2.

6.3 Peak to Average Ratio

Figure 6.1. Peak to Average Ratio. For the DUT in normal operating mode the peak to average ratio is greater than 20 dB. Three 2.34 ms pulses can exists in any given 100 ms window. See Figure 6.1.

$$K_E = (2.34 \text{ ms x } 3) / 100 \text{ ms} = 0.0702 < 20 \text{ dB}$$

6.4 Emission Bandwidth

Figure 6.2. For this test, the DUT was put in a test mode for continuous data transmission (hopping disabled). The DUT was placed in front of the horn antenna oriented for maximum radiation. The analyzer was set for RBW = 100 kHz ≤ VBW, SPAN= 10 MHz. The 20-dB bandwidth bandwidths were measured for low, mid, and high channels used by the DUT. The resulting measured data is below, and plots are shown in Figure 6.2.

Channel	Frequency	20 dB BW
1	2.405 GHz	2.65 MHz
9	2.445 GHz	2.68 MHz
16	2.480 GHz	2.68 MHz

6.5 Number of Channels

For this test, the DUT was put in normal operating mode (hopping enabled). The DUT was placed in front of the horn antenna at the location of maximum radiation. The analyzer was set for RBW = 100 kHz ≤ VBW, SPAN as needed. The number of channels employed is 16. Plots are shown in Figure 6.3.

6.6 Peak Output Power & Health Hazard EM Radiation Level

For this test, the DUT was put in a test mode for data transmission (hopping disabled). Peak power measurements were made using 3 MHz RBW and 5 MHz VBW on the Spectrum Analyzer. The power was measured from the RF port of DUT (a modified module was provided for this purpose; the antenna is not generally removable). Table 5.1(b) presents the results.

The following table summarizes the power density at a distance of 20 cm from the device as calculated from FCC OET Bulletin 65.

Table 6.3 Potential Health Hazard Radiation Level

Ant.	Ant.Gain (dBi)	Po (mW)	EIRP (mW)	S (mW/cm^2)
PCB	1.0	1.45	1.82	0.00724

The following equations were used in calculating the operating distance (R).

$$EIRP(mW) = Po(mW) \cdot 10^{\frac{Gain(dB)}{10}}$$

and

$$S(mW/cm^2) = \frac{EIRP(mW)}{4 \cdot \Pi \cdot R(cm)^2}, \ R = 20 \text{ cm}$$

6.7 Effect of Supply Voltage Variation

The DUT has been designed to operate from 120 VAC mains power. Using a spectrum analyzer, relative radiated emissions were recorded at the center channel as voltage was varied from 100 to 145 VAC. Figure 6.4 shows the emission variation.

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Table 5.1(a) Highest Emissions Measured

Restricted Band Radiated Emissions											RAVEN H1 Base; FCC/IC
#	Freq. MHz	Ant. Used	Ant. Pol.	Pr dBm	Det.* Used	Ka dB/m	Kg dB	E3** dBμV/m	E3lim dBμV/m	Pass dB	Comments
1	2390.0	Horn S	H/V	-72.5	Pk	21.5	- 1.5	37.5	54.0	16.5	Low Channel, 2405 MHz
2	2390.0	Horn S	H/V	-71.9	Pk	21.5	- 1.5	38.1	54.0	15.9	9th Channel, 2445 MHz
3	2390.0	Horn S	H/V	-73.0	Pk	21.5	- 1.5	37.0	54.0	17.0	High Channel, 2480 MHz
4	2483.5	Horn S	H/V	-72.1	Pk	21.5	- 1.5	37.9	54.0	16.1	Low, noise
5	2483.5	Horn S	H/V	-71.0	Pk	21.5	- 1.5	39.0	54.0	15.0	Mid
6	2483.5	Horn S	H/V	-60.0	Pk	21.5	- 1.5	50.0	54.0	**4.0**	High
7											
8	4810.0	Horn C	H/V	-43.3	Pk	24.6	38.0	30.3	54.0	23.7	Low
9	4890.0	Horn C	H/V	-43.2	Pk	24.6	38.0	30.4	54.0	23.6	Mid
10	4960.0	Horn C	H/V	-43.9	Pk	24.6	38.0	29.7	54.0	24.3	High
11	7215.0	Horn XN	H/V	-	Pk	25.1	36.8	-	N/A	-	Low
12	7335.0	Horn XN	H/V	-49.0	Pk	25.2	36.8	26.4	54.0	27.6	Mid
13	7440.0	Horn XN	H/V	-46.7	Pk	25.3	36.8	28.8	54.0	25.2	High
14	9620.0	Horn X	H/V	-	Pk	27.8	36.8	-	N/A	-	Low
15	9780.0	Horn X	H/V	-	Pk	27.9	36.8	-	N/A	-	Mid
16	9920.0	Horn X	H/V	-	Pk	28.0	36.8	-	N/A	-	High
17	12025.0	Horn X	H/V	-59.9	Pk	31.7	35.7	23.1	54.0	30.9	Low, noise
18	12225.0	Horn X	H/V	-60.1	Pk	31.8	34.0	24.8	54.0	29.2	Mid, noise
19	12400.0	Horn X	H/V	-60.9	Pk	32.0	32.4	25.6	54.0	28.4	High, noise
20	14430.0	Horn Ku	H/V	-	Pk	33.2	17.3	-	N/A	-	Low
21	14670.0	Horn Ku	H/V	-	Pk	33.3	17.3	-	N/A	-	Mid
22	14880.0	Horn Ku	H/V	-	Pk	33.4	17.3	-	N/A	-	High
23	16835.0	Horn Ku	H/V	-	Pk	34.6	34.0	-	N/A	-	Low
24	17115.0	Horn Ku	H/V	-	Pk	34.8	34.0	-	N/A	-	Mid
25	17360.0	Horn Ku	H/V	-	Pk	35.0	34.0	-	N/A	-	High
26	19240.0	Horn K	H/V	-56.9	Pk	32.2	32.0	30.3	54.0	23.7	Low, noise
27	19560.0	Horn K	H/V	-57.1	Pk	32.3	32.0	30.2	54.0	23.8	Mid, noise
28	19840.0	Horn K	H/V	-56.8	Pk	32.3	32.0	30.5	54.0	23.5	High, noise
29	21645.0	Horn K	H/V	-	Pk	32.7	32.0	-	N/A	-	Low
30	22005.0	Horn K	H/V	-	Pk	32.8	32.0	-	N/A	-	Mid
31	22320.0	Horn K	H/V	-53.0	Pk	32.8	32.0	34.8	54.0	19.2	High, noise
32	24050.0	Horn Ka	H/V	-	Pk	33.2	32.0	-	N/A	-	Low
33	24450.0	Horn Ka	H/V	-	Pk	33.3	32.0	-	N/A	-	Mid
34	24800.0	Horn Ka	H/V	-	Pk	33.3	32.0	-	N/A	-	High
35	* Band edge Peak measured with 1 MHz RBW, 3 MHz VBW.										
36	* Harmonics Emissions Peak measured with 3 MHz RBW and 5 MHz VBW, Avg. more than 20 dB below Peak.										
37	** 20 dB maximum permissible duty cycle applied.										

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Table 5.1(b) Highest Emissions Measured

Radiated Fundamental Emissions											RAVEN H1 Base; FCC/IC
#	Freq. MHz	Ant. Used	Ant. Pol.	Pr dBm	Det.* Used	Ka dB/m	Kg dB	E3** dBμV/m	E3lim dBμV/m	Pass dB	Comments
1	2405.0	R-Horn	H/V	-8.0	Pk	23.5	26.5	76.0	94.0	18.0	Lowest channel, conducted
2	2445.0	R-Horn	H/V	-7.5	Pk	23.7	26.4	76.7	94.0	**17.3**	9th channel, conducted
3	2480.0	R-Horn	H/V	-10.5	Pk	23.8	26.4	73.9	94.0	20.1	Highest channel, conducted
4	* includes 20 dB duty cycle										
Conducted Peak Output Power											
#	Freq. MHz	Ant. Used	Ant. Pol.	Pcond dBm	Det.* Used	Pr mW	DUT Ant Gain (dB)	DUT EIRP mW			Comments
5	2405.0	Cond	H/V	1.4	Pk	1.38	1.0	1.74			Lowest channel, conducted
6	2445.0	Cond	H/V	1.5	Pk	1.41	1.0	1.78			9th channel, conducted
7	2480.0	Cond	H/V	1.6	Pk	1.45	1.0	1.82			Highest channel, conducted
8	* Peak measured with 3 MHz RBW and 5 MHz VBW										
Receiver Spurious Emissions											
#	Freq. MHz	Ant. Used	Ant. Pol.	Pr* dBm	Det.* Used	Ka dB/m	Kg dB	E3** dBμV/m	E3lim dBμV/m	Pass dB	Comments
9	2470.0	R-Horn	H/V	-61.0	Pk	23.7	26.4	43.3	54.0	10.7	noise
10	2510.0	R-Horn	H/V	-61.9	Pk	23.8	26.3	42.6	54.0	11.4	noise
11	2545.0	R-Horn	H/V	-62.0	Pk	23.9	26.2	42.7	54.0	11.3	noise
12	5090.0	C-Horn	H/V	-58.7	Pk	24.7	38.0	35.0	54.0	19.0	max all channels, noise
13	7635.0	Xn-Horn	H/V	-55.9	Pk	25.5	36.8	39.8	54.0	14.2	max all channels, noise
14	10180.0	X-Horn	H/V	-60.1	Pk	28.1	36.8	38.2	54.0	15.8	max all channels, noise
15	12725.0	Ku-Horn	H/V	-54.9	Pk	29.3	36.0	45.4	54.0	**8.6**	max all channels, noise
16	* Note: Rx LO is fc+65 MHz.										
Digital Radiated Emissions											
#	Freq. kHz	Ant. Used	Ant. Pol.	Pr dBm	Det. Used	Ka dB/m	Kg dB	E3 dBμV/m	E3lim dBμV/m	Pass dB	Comments
17	33.6	Bic	H	-78.9	Pk	12.3	23.5	16.9	40.0	23.1	
18	64.4	Bic	H	-67.7	Pk	7.8	23.0	24.1	40.0	**15.9**	
19	64.4	Bic	V	-69.6	Pk	7.8	23.0	22.2	40.0	17.8	
20	128.0	Bic	H	-65.0	Pk	10.7	22.2	30.5	43.5	13.0	
21	128.0	Bic	V	-62.4	Pk	10.7	22.2	33.1	43.5	10.4	
22	160.0	Bic	H	-72.9	Pk	13.1	21.7	25.5	43.5	18.0	
23	184.0	Bic	H	-74.9	Pk	14.3	21.4	25.0	43.5	18.5	
24	184.0	Bic	V	-75.7	Pk	14.3	21.4	24.2	43.5	19.3	
25	216.0	Bic	H	-73.7	Pk	14.8	21.0	27.1	43.5	16.4	
###	224.0	Bic	H	-70.4	Pk	14.7	20.9	30.4	46.0	15.6	
###	383.4	SBic	H	-79.6	Pk	20.7	19.1	29.0	46.0	17.0	
###	** 20 dB maximum permissible duty cycle applied.										

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Table 5.2 Highest Conducted Emissions Measured

												Raven H1 Base; FCC/CISPR B
	Freq.	Line	Peak Det., dBµV		Pass	QP Det., dBµV		Pass	Ave. Det., dBµV		Pass	
#	MHz	Side	Vtest	Vlim*	dB*	Vtest	Vlim	dB	Vtest	Vlim	dB	Comments
1	0.27	Hi	46.5	51.1	**4.6**		61.2			51.1		
2	0.47	Hi	40.1	46.4	6.3		56.5			46.4		
3	0.91	Hi	38.8	46.0	7.2		56.0			46.0		
4	1.12	Hi	38.7	46.0	7.3		56.0			46.0		
5	0.75	Hi	38.6	46.0	7.4		56.0			46.0		
6	1.43	Hi	37.7	46.0	8.3		56.0			46.0		
7	0.88	Hi	37.7	46.0	8.3		56.0			46.0		
8	0.97	Hi	37.3	46.0	8.7		56.0			46.0		
9	2.91	Hi	31.3	46.0	14.7		56.0			46.0		
10	7.31	Hi	29.2	50.0	20.8		60.0			50.0		
11	7.84	Hi	28.7	50.0	21.3		60.0			50.0		
12	5.52	Hi	28.1	50.0	21.9		60.0			50.0		
13	18.43	Hi	27.5	50.0	22.5		60.0			50.0		
14	21.12	Hi	27.0	50.0	23.0		60.0			50.0		
15												
16	0.29	Lo	43.3	50.5	7.2		60.6			50.5		
17	0.38	Lo	40.6	48.3	7.7		58.4			48.3		
18	0.75	Lo	40.2	46.0	5.8		56.0			46.0		
19	1.12	Lo	40.0	46.0	6.0		56.0			46.0		
20	0.64	Lo	38.9	46.0	7.1		56.0			46.0		
21	1.01	Lo	38.6	46.0	7.4		56.0			46.0		
22	1.50	Lo	38.1	46.0	7.9		56.0			46.0		
23	0.48	Lo	37.9	46.3	8.4		56.4			46.3		
24	1.05	Lo	39.8	46.0	6.2		56.0			46.0		
25	1.57	Lo	36.6	46.0	9.4		56.0			46.0		
26	2.76	Lo	34.2	46.0	11.8		56.0			46.0		
27	3.78	Lo	31.1	46.0	14.9		56.0			46.0		
28	7.31	Lo	31.0	50.0	19.0		60.0			50.0		
29	12.54	Lo	28.7	50.0	21.3		60.0			50.0		
30	13.51	Lo	27.9	50.0	22.1		60.0			50.0		
31												
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**Average limit* Meas. 09/10/2008; U of Mich.

Since Vpeak >= Vqp >= Vave and if Vtestpeak < Vavelim, then Vqplim and Vavelim are met.

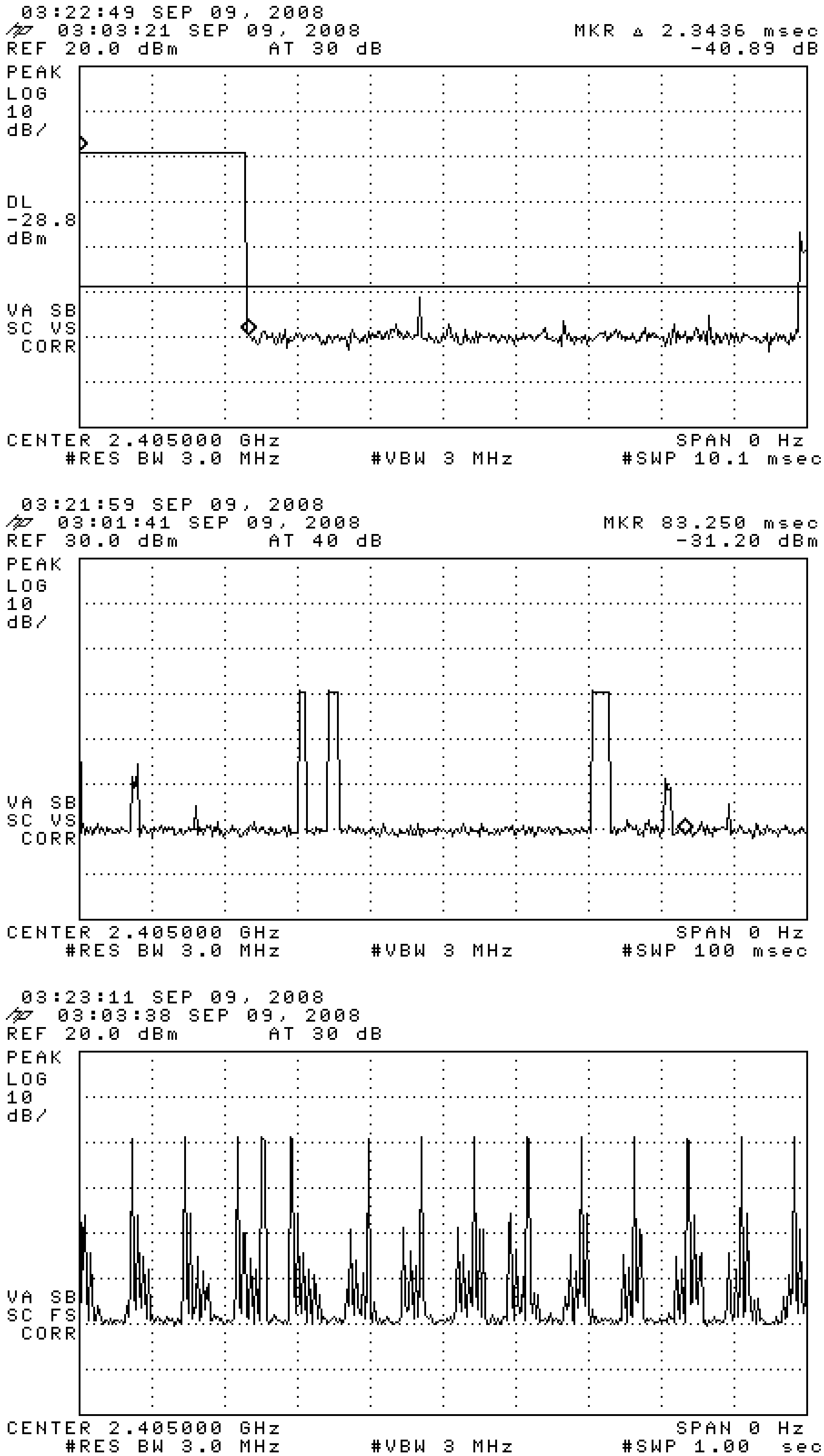
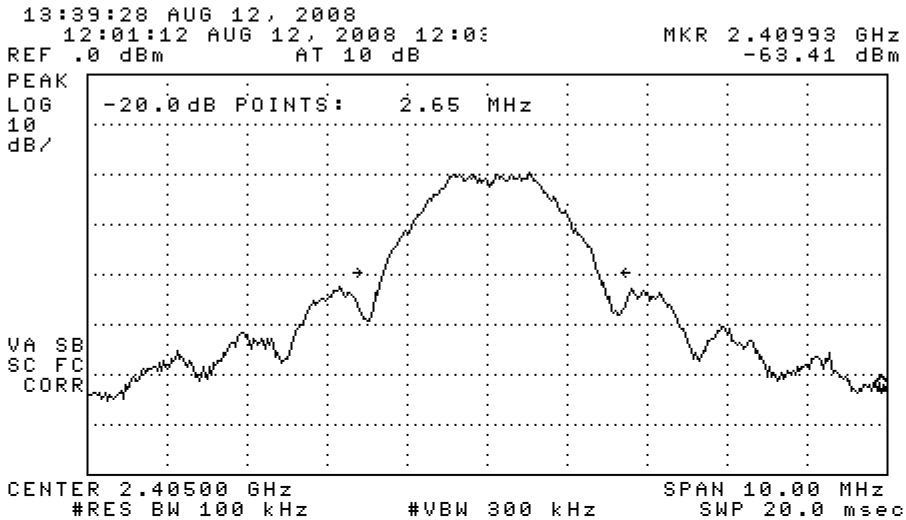
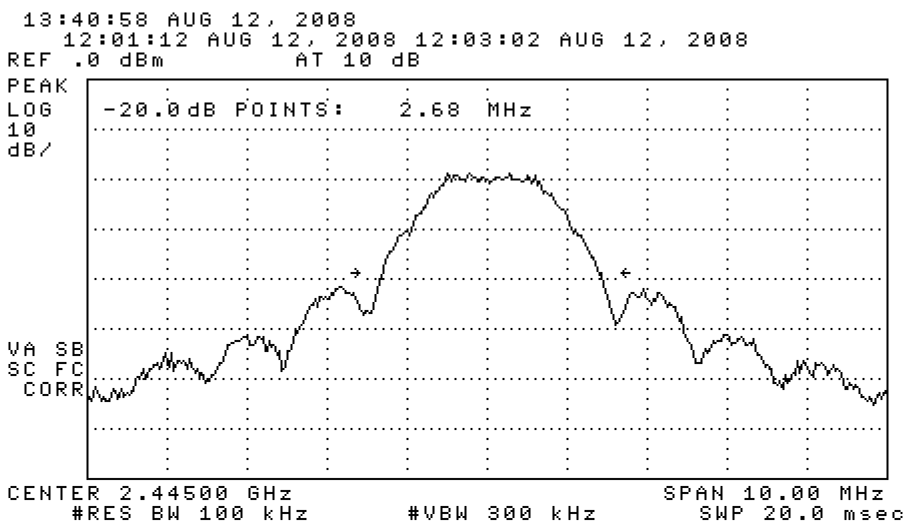


Figure 6.1 Single Channel Dwell Time. (top) Maximum Pulse Width,
(middle) worst case 100 ms window, (bottom) 30 second sample window.
(Only Low Channel shown.)





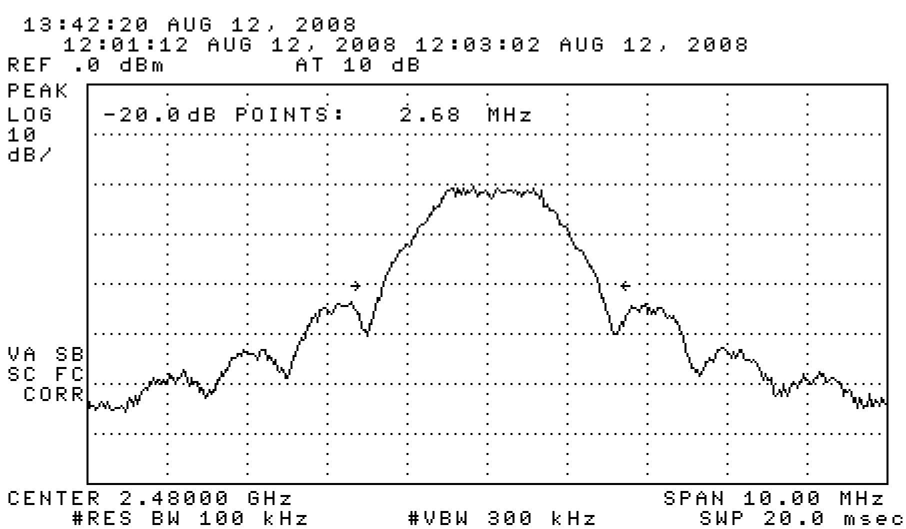


Figure 6.2 Measurement of channel bandwidth.
(top) Low Channel, (middle) Middle Channel, (bottom) High Channel

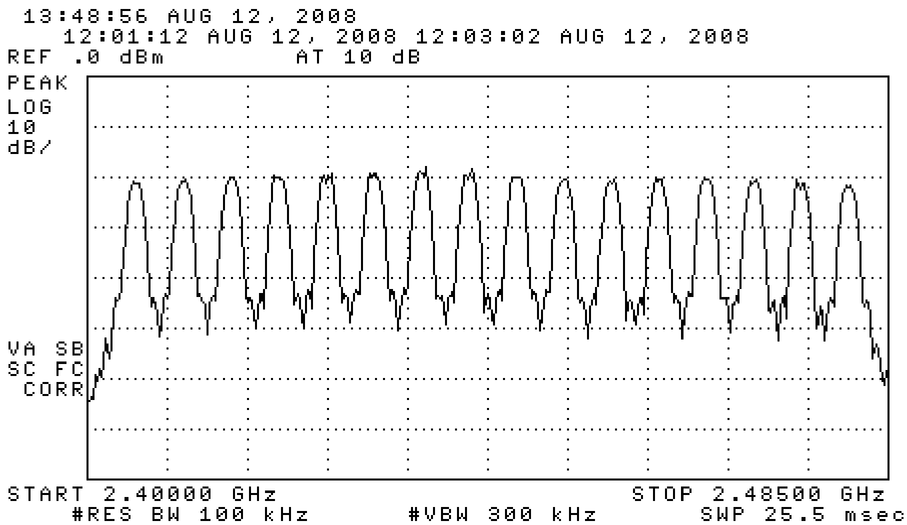


Figure 6.3 Number of Hopping Frequencies.

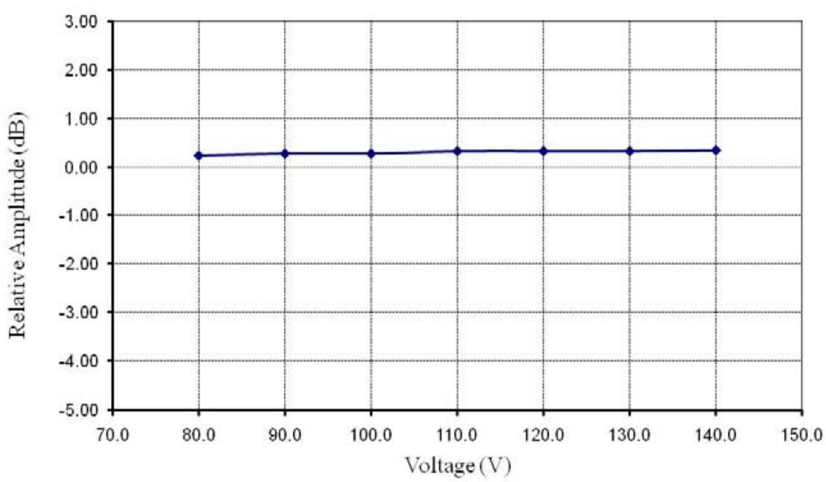
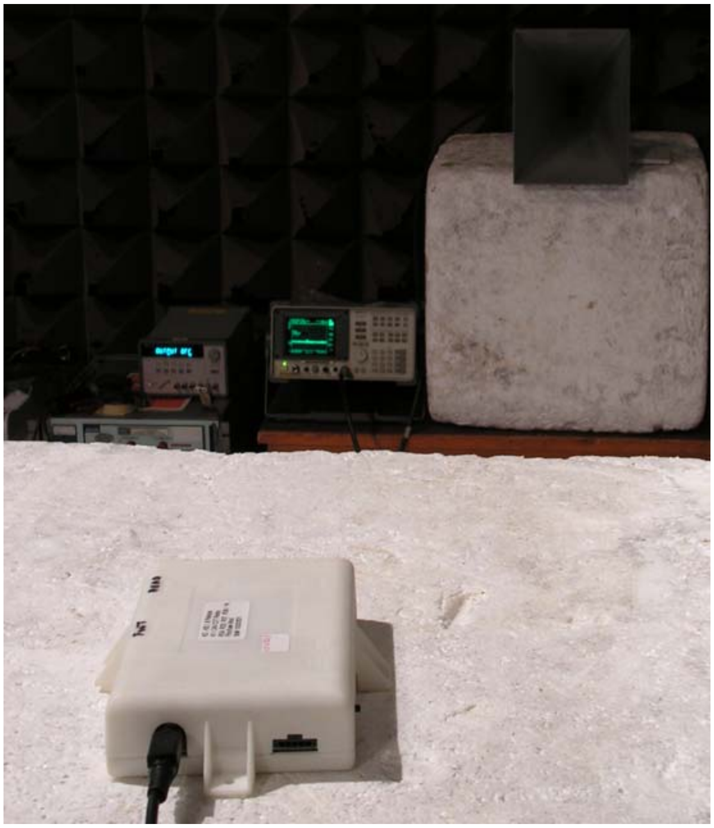


Figure 6.4 Relative emission vs. supply voltage, center channel.



Test Setup (Radiated Emissions) – one of three axes tested

DUT on OATS