Engineering Test Services

FCC Part 101 / RSS 119 transmitter
952MHz – 960MHz

Device Model: 900MHz Magnum Handheld

Rule	Description	Max. Reading	Pass/Fail
FCC 101.113 / RSS-119 sec. 6.2	EIRP of Fundamental Emissions	25.69 dBm	Pass
FCC 101.111a(5)	Transmit Mask - FCC	N/A	Pass
RSS-119 Sec. 6.4(d)	Transmit Mask – Canada	N/A	Pass
FCC 101.109 / RSS-119 Table 1	Occupied Bandwidth	3.13 kHz	Pass
FCC 101.111(a)(5)(iv) / RSS-119 Sec. 6.4(d)	EIRP of Transmitter Spurious emissions	-26.9 dBm	Pass
FCC 101.107 / RSS-119 Table 5	Frequency Stability	.00002%	Pass
FCC 1.1310 / Health Canada Safety Code 6	MPE evaluation	0.013mW/cm^2	Pass
RSS-119 Sec. 8	Receiver spurious emissions	Noise Floor	Pass

Cognizant Personnel

Drew Rosenberg Name	Regulatory Engineer Title
Mark Kvamme Name	Senior Technician Title
David Beliveau Name	Senior Engineer Title

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Test 1: FCC Part 101.113
RSS-119 Sec. 6.2

Output Power Limits

Canada:

1. Output power must be +/-1dB of rated power.
2. Output power must be less than 4W (6dBW)

FCC:

Measure the EIRP of the transmitter fundamental using the antenna substitution procedure (appendix A). The EIRP of the transmitter may not exceed:

Frequency (MHz)	Fixed (dBW)	Mobile (dBW)
952-860	40	14

Equipment Used	Asset Number
Roberts Dipole Ant.	6294
Log Periodic Ant.	16248
Log Periodic Ant. (reference)	12005
Spectrum Analyzer	2064147
Power Meter	01872025
Power Sensor	00012392

Date	Temp/Humidity ºF / %	Tested by
08/20/2004	64 / 27	Mark Kvamme
9/15/2004	70 / 95	Mark Kvamme

FCC Test:

Note: 954.5MHz data taken on 8/20/04 using antenna asset number 6294.
Note: 957MHz data taken on 9/15/04 using antenna asset number 12005.

Fill in the white spaces in the table below for each frequency measured:

Frequency (MHz)	Polarity	Analyzer Reading of Device Emissions (dBm)	Analyzer Reading of Generator Emissions (dBm)	Difference (add to ERP reading)	Substitution Antenna Gain (dBi)	Generator Output (dBm)	EIRP (dBm)
954.5	Vertical	-17.116	-40.76	23.644	1.2	0.849	25.693
957	Vertical	-10.16	-27.92	17.76	6.6	-0.32	24.04

Canada Test:

Frequency	Reading (dBm)	Attenuation (dB)	Power Level (dBm)	Rated Power (dBm)	Deviation (dB)
954.5	-27.76	50	22.24	23	-0.76
957	12.5	10	22.5	23	-0.5

Test 2: FCC Part 101.109 / RSS-119 Table 1

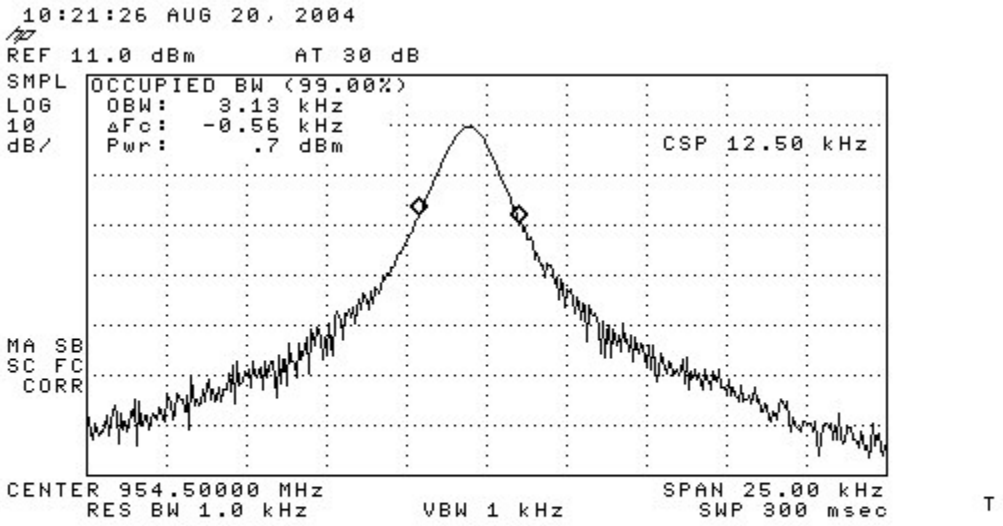
Occupied Bandwidth

Measure the occupied bandwidth (99% bandwidth). The Occupied bandwidth may not exceed 12.5kHz (US) or 11.25kHz (Canada).

Equipment Used	Asset Number
Roberts Dipole Ant.	6294
Spectrum Analyzer	2064147

Date	Temp/Humidity ºF / %	Tested by
08/20/2004	64 / 57	Mark Kvamme

Place a screen capture of the measurement below:



Test 3: FCC Part 101.111a(5)

Transmitter Mask (US)

Equipment Used	Asset Number
Roberts Dipole Ant.	6294
Spectrum Analyzer	10202

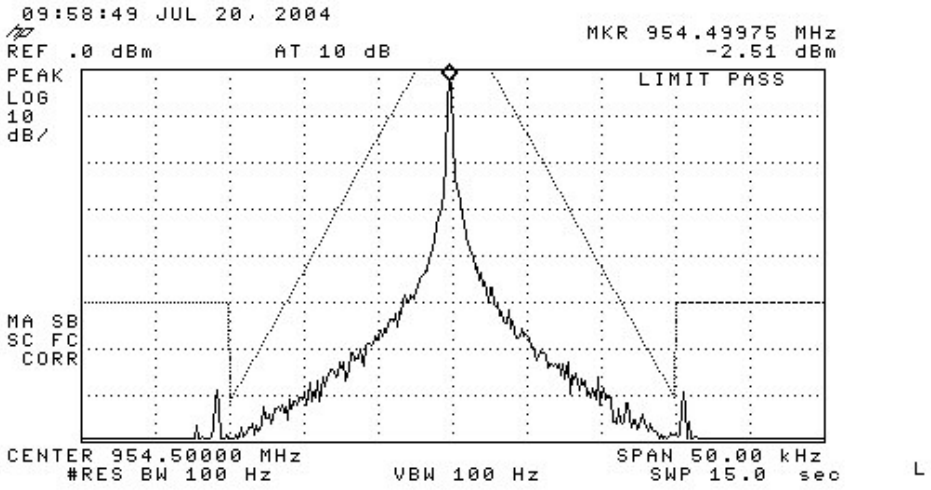
Measure the transmitter mask, referenced to an unmodulated carrier, according to the following schedule:

Minimum Displacement Frequency (kHz)	Maximum Displacement Frequency (kHz)	Attenuation below unmodulated carrier (dB)
2.5	6.25	53*log(fd/2.5)
6.25	9.5	103*log(fd/3.9)
9.5	15	157*log(fd/5.3)
15	>15	50+Log(P) or 70

Date	Temp/Humidity ºF / %	Tested by
08/20/2004	64 / 57	Mark Kvamme

50+log(P) = 50+log(0.2W) = 43.01dB > 70dB

Note: Limit lines at >15kHz offset shown below are 50dB down from carrier:



Test 3: RSS-119 Sec. 6.4(d)

Transmitter Mask (Canada)

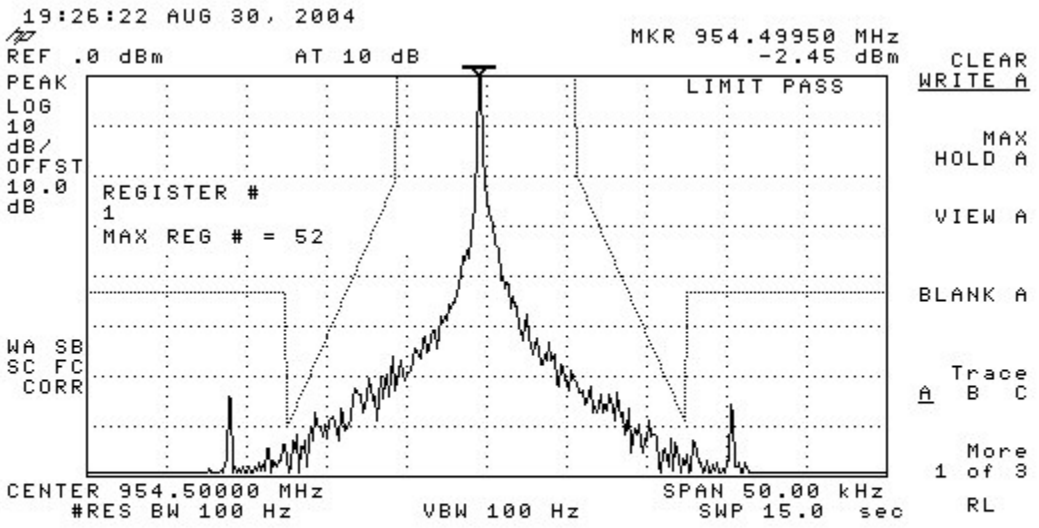
Equipment Used	Asset Number
Spectrum Analyzer	10202

Date	Temp/Humidity ºF / %	Tested by
MM/DD/YY	73 / 55	Drew Rosenberg

Measure the transmitter mask, referenced to an unmodulated carrier, according to the following schedule:

Minimum Displacement Frequency (kHz)	Maximum Displacement Frequency (kHz)	Attenuation below unmodulated carrier (dB)
0	5.625	0
5.625	12.5	7.27*(fd-2.88)
12.5	> 12.5	50+log(P) or 70

50+log(P) = 50+log(0.2W) = 43.01dB > 70dB



Test 5: FCC Part 101.111(a)(5)(iv)

Spurious Emissions

Measure the EIRP of all transmitter spurious emissions that are >15kHz away from the center of the fundamental peak. The EIRP of these emissions may not exceed 50+log(P) or 70dB below the EIRP of the fundamental (measured in test 1). Use the antenna substitution procedure to perform these measurements (appendix A).

Equipment Used	Asset Number
Substitution Antenna	6412
Receive Antenna	16256
Spectrum Analyzer	10202

Date	Temp/Humidity ºF / %	Tested by
08/20/2004	64 / 57	Mark Kvamme

50+log(P) = 50+log(0.2W) = 43.01dB > 70dB

From Test 1: Fundamental EIRP = 25.69dBm

Limit = 25.69dBm – 43.01dB = -17.32dBm

Fill in the white spaces in the table below for each frequency measured:

Frequency (MHz)	Polarity	Analyzer Reading of Device Emissions (dBm)	Analyzer Reading of Generator Emissions (dBm)	Difference (add to ERP reading)	Substitution Antenna Gain (dBi)	Generator Output (dBm)	EIRP (dBm)
1909.00	**vert**	**-57.28**	-57	-0.28	7.7	-34.32	-26.9
2863.5	**vert**	**-67.46**	-67.6	0.14	9.2	-45.7	-36.36
4772.5	**vert**	**-56.2**	-55.59	-0.61	9.9	-63.22	-53.93
5727	**vert**	**-55.42**	-55.7	0.28	10.7	-58.63	-47.65
3818.00	**horz**	**-52.42**	-52.54	0.12	9.3	-60.44	-51.02

Test 6: FCC Part 101.107

Frequency Stability

At the device's rated voltage level, measure the carrier frequency at every 10 degrees from -30ºC to +50ºC. At +20ºC, measure the carrier frequency with the device powered at 85% and 115% of the device's rated voltage level. If the device is battery powered, then measurements should be made at the maximum and cutoff battery voltages.

The carrier frequency may not deviate from the reference level measured at +20ºC and with the device powered at its rated voltage level by more than +/- 0.00015%.

Equipment Used	Serial Number
Frequency Counter	3404A00385

Fill in the white spaces in the following tables. For tables that do not apply, enter a "-":

Temperature (ºC)	20	-30	-20	-10	0
Frequency (MHz)	954.499705	954.499939	954.500096	954.499847	954.499749
Deviation (%)	0.00000%	0.00002%	0.00004%	0.00001%	0.00000%

Temperature (ºC)	20	10	30	40	50
Frequency (MHz)	954.499705	954.499832	954.499703	954.499598	954.499517
Deviation (%)	0.00000%	0.00001%	0.00000%	-0.00001%	-0.00002%

Input Voltage (% of nominal voltage)	100%	85%	115%
Frequency (Hz)	-	-	-
Deviation (%)	-	-	-

Battery Voltage	Peak 8.2V	Cutoff 6.8V
Frequency (Hz)	954.499680	954.499670
Deviation (%)	0.00000%	0.00000%

Test 7: FCC part 1.1310(A) / Health Canada Safety Code 6

Maximum Permissible Exposure (MPE) evaluation
For Occupational/controlled environments

Determine the minimum safe distance from the transmitter where a power density of $(f_{MHz}/300)mW/cm^2$ is not exceeded (the Canadian limit is f/30, but the FCC limit is more stringent). The power density is calculated as:

$P_d = P_t * G/4\pi r^2$, where:

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

Max $P_d = 960/300 = 3.2mW/cm^2$
$P_t = +23dBm = 200mW$
G = 2.1dBi = 1.62 numeric gain
r = 20cm

Duty Cycle = 19.44%

- When transmitting, the duty cycle is 50%
- Transmit cycle is 3.5 seconds transmit, 5.5 seconds receive
- 0.5*[3.5/(3.5+5.5)] = 19.44%

$(200mW)*(1.62)*(.1944)/4\pi r^2 = .013\ mW/cm^2$

Test 8: RSS-119 Sec. 8

Receiver Spurious Emissions

Receiver spurious emissions may not exceed the following limits:

Frequency (MHz)	Field Strength (uV/m)
30-88	100
88-216	150
216-960	200
960-1610	500
> 1610	1000

Equipment Used	Asset Number
Antenna	6294
Spectrum Analyzer	206417
Amplifier	SN:D021000-23

Date	Temp/Humidity ºF / %	Tested by
08/31/2004	74 / 66	Drew Rosenberg

The local oscillator of the receiver is 916MHz. When measured off of the antenna port, the receiver could not be found. An attempt was made to perform this measurement at the three meter site. Again, the receiver could not be found.

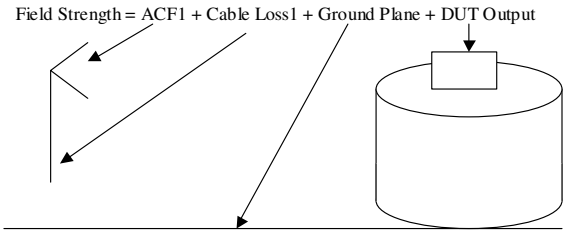
Below are the details in tabular format:

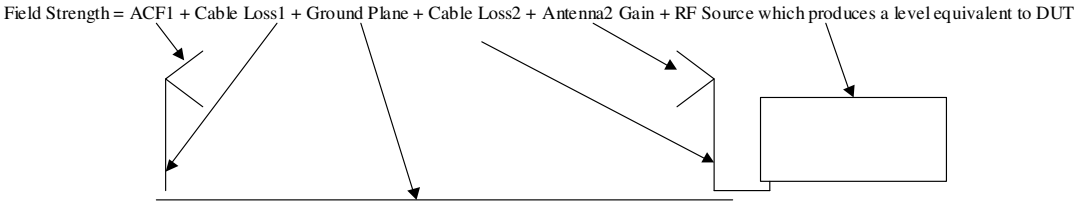
Freq. (MHz)	Measurement Type	Pol.	Reading (dBm)	Reading (dBuV)	ACF	Cable Loss	Amp. Gain	Final Reading
916	Conducted (NF)	N/A	-87.4	-	-	0	29.3	-116.7dBm
916	Radiated (NF)	N/A	-87.4	19.69	29.8	1.55	29.3	21.74 dBuV/m

**NF = Noise floor*

Appendix A – Antenna Substitution Method of EIRP Measurement

First, measure the field strength of the device in accordance with the procedure in Appendix B. Second, replace the device with an antenna and connect the antenna to the output of a signal generator. Set the signal generator to the same frequency as the device emission that is being measured. Adjust the height of receiving antenna to give the highest reading. Repeat with the substitution antenna in the vertical position. Bring the position back to the polarity and height that results in the highest field strength reading. Set the signal generator to a power that results in the same field strength reading as that of the device emission. The gain of the transmitting antenna, output power of the generator, and loss of the cable can then be used to determine the EIRP of the device.





Appendix B – Field Strength Measurement Procedure

This test measures the field strength of radiated emissions using a spectrum analyzer and a receiving antenna in accordance with ANSI C63.4-2003. During the test, the EUT is to be placed on a non-conducting support at 80 cm above the horizontal ground plane of the OATS. The horizontal distance between the antenna and the DUT 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 b). 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 b) 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 b), step c), and step d). Compare the resulting suspected highest amplitude signal with that found for the other polarity. Select and note the higher of the two signals. This signal is termed the highest observed signal with respect to the limit for this EUT operational mode.