Engineering and Testing for EMC and Safety Compliance

CERTIFICATION APPLICATION REPORT
FCC PART 15.247 & INDUSTRY CANADA RSS-210

Test Lab:	Applicant:
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FCC ID:	RIM-IMON	**GRANTEE FRN NUMBER:**	0009610718
PLAT FORM:	N/A	**RTL WORK ORDER NUMBER:**	2003155
MODEL NUMBER / NAME:	*i*EFM, *i*TLM-1, *i*WPM-T	**RTL QUOTE NUMBER:**	QRTL03-972A
DATE OF TEST REPORT:	October 21, 2003		

American National Standard Institute:	ANSI C63.4: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
FCC Classification:	DSS – Part 15 Spread Spectrum Transmitter Frequency Hopping
FCC Rule Part(s):	Part 15.247: Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz Frequency Hopping System
Industry Canada Standard:	RSS-210: Low Power License-Exempt Radio Communication Devices (All Frequency Bands)
Digital Interface Information	Digital Interface was found to be compliant
Receiver Information	Receiver was found to be compliant

Frequency Range (MHz)	Output Power* (W)	Frequency Tolerance	Emission Designator
902 – 928	0.059	N/A	N/A

* output power is maximum peak conducted

We, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this test report.

Furthermore, there was no deviation from, additions to, or exclusions from the FCC Part 2, FCC Part 15, Industry Canada RSS-210, and ANSI C63.4

Signature: 

Date: October 21, 2003

Typed/Printed Name: Desmond A. Fraser

Position: President

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1 GENERAL INFORMATION

1.1 SCOPE

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz. FCC DA 00-705 Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems was also used for guidance.

IC RSS-210 Section 6.2.2(o): Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz.

The EUT utilizes a frequency hopping system operating in the 902 – 928 MHz band.

1.2 TEST FACILITY

The open area test site and conducted measurement facility used to collect the radiated data is located at 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report and approved by the Federal Communications Commission to perform AC line conducted and radiated emissions testing (ANSI C63.4 1992).

1.3 RELATED SUBMITTAL(S)/GRANT(S)

This is an original application for certification: FCC ID: RIM-IMON.

1.4 MODIFICATIONS

Initially, transmit spurious emissions and emissions from the receiver LO were failing. The modifications described below were performed to achieve compliance. The manufacturer understands that these exact modifications must be performed on all production units.

Transmit Spurious

The antenna connection was broken and replaced by a pi low pass filter comprising two capacitors to ground and a series inductor. The filter roll-off nominally starts at about 1GHz thus providing some attenuation at the second harmonic and more at the third harmonic where it was most needed. Higher harmonics were present and these were found to be exacerbated by overdriving the PA stage beyond its recommended level. The correct drive level was programmed into the driver chip to rectify this problem.

Receive LO leakage (radiated and conducted)

The receiver power supply decoupling capacitors were found not to include low value capacitors suitable for low impedance decoupling at the receiver operating frequency. Values were reselected to include some capacitors close to self resonance at the operating frequency. The placement of one decoupling capacitor very close to the local oscillator tank was found to be coupling LO to the LNA supply rail and it was removed.

2 TEST INFORMATION

2.1 TEST JUSTIFICATION

The EUT was tested in all three orthogonal planes in order to determine worst-case emissions. 902.4914 MHz, 914.6038 MHz and 927.7695 MHz were tested and investigated from 9 kHz to 9.3 GHz. Data for all three frequencies is presented in this report.

The RF circuitry and antenna tested in this report are utilized in three Luna iMonitoring products: the *i*EFM, *i*TLM-1, and *i*WPM-T. Though portions of the digital circuitry of the three products are different, the RF circuitry (including control circuitry) and layout are identical across the three products. But, because the RF circuitry and digital circuitry reside on the same PCB in each device, a modular approval approach would not be applicable. The conducted power of the three products was investigated on three frequencies each to see if any aspect of the digital circuitry influenced the intentional emissions. No significant power variation was found. The *i*TLM-1 was chosen for the remaining testing because of the presence of the ultrasonic transducer, and the physical length of the transducer housing.

The digital portions of the *i*EFM, *i*TLM-1, and *i*WPM-T are subject to verification under FCC Part 15. Additionally, the *i*TLM-1 has an ultrasonic section that meets the definition of 18.107(f) and is subject to verification under FCC Part 18 as a non-consumer ISM device. Verification testing was performed on all three devices, and verification reports exist for each.

Two antennas were tested and can be used with the devices: Nearson S467AH-915S whip antenna and Bluewave EDY9432 Yagi. A reduced power setting must be used with the Bluewave EDY9432 Yagi for compliance with the spurious/harmonic emissions requirements of Part 15. The manufacturer will pre-program the appropriate maximum power before shipment, and ensure that end users can not use the Yagi antenna with a device programmed for use with the whip antenna.

2.2 EXERCISING THE EUT

The EUT was provided with software to continuously transmit on one channel or in the hopping mode during testing. The carrier was also checked to verify that information was being transmitted.

2.3 TEST RESULT SUMMARY

TABLE 2-1: TEST RESULT SUMMARY FOR FCC RULES AND REGULATIONS

STANDARD	TEST	PASS/FAIL OR N/A
FCC 15.205	Compliance with the Restricted Band Edge	Pass
FCC 15.207	Conducted Emissions	N/A
FCC 15.209	Radiated Emissions	Pass
FCC 15.247(a)(2)	Modulated Bandwidth	Pass
FCC 15.247(b)	Power Output	Pass
FCC 15.247(c)	Antenna Conducted Spurious Emissions	Pass

2.4 TEST SYSTEM DETAILS

The FCC identifiers for all applicable equipment, plus descriptions of all cables used in the tested system, are identified in Table 2-2.

TABLE 2-2: EQUIPMENT UNDER TEST (EUT)

Part	Manufacturer	Model	Serial Number	FCC Identifier	Cable Description	RTL Barcode
tank level monitor	Luna iMonitoring	*i*TLM-1	13800023	RIM-IMON	N/A	15426
tank level monitor	Luna iMonitoring	*i*TLM-1	13800021	RIM-IMON	N/A	15400
electronic flow monitor	Luna iMonitoring	*i*EFM	18800005	RIM-IMON	N/A	15399
wireless pressure monitor	Luna iMonitoring	*i*WPM-T	1680003A	RIM-IMON	N/A	15401
battery	Luna iMonitoring	battery	N/A	N/A	N/A	15406
battery holder	Luna iMonitoring	battery holder	N/A	N/A	unshielded internal ribbon	15444
temperature probe	Luna iMonitoring	RTD	N/A	N/A	shielded	15408
whip antenna	Nearson	S467AH-915S	N/A	N/A	N/A	15411
whip antenna	Nearson	S467AH-915S	N/A	N/A	N/A	15410
whip antenna	Nearson	S467AH-915S	N/A	N/A	N/A	15409
Yagi antenna	Bluewave	EDV9432	CD64478	N/A	N/A	15407

TABLE 2-3: SUPPORT EQUIPMENT

Part	Manufacturer	Model	Serial Number	FCC Identifier	Cable Description	RTL Barcode
Pocket PC	Dell	AXIM X5 - HC01U	TW-0W0772-70161-32N-C0CV	DoC	N/A	15413
CFR	Luna iMonitoring	CFR	1180016	RIM-ICFR	N/A	15412

2.5 CONFIGURATION OF TESTED SYSTEM

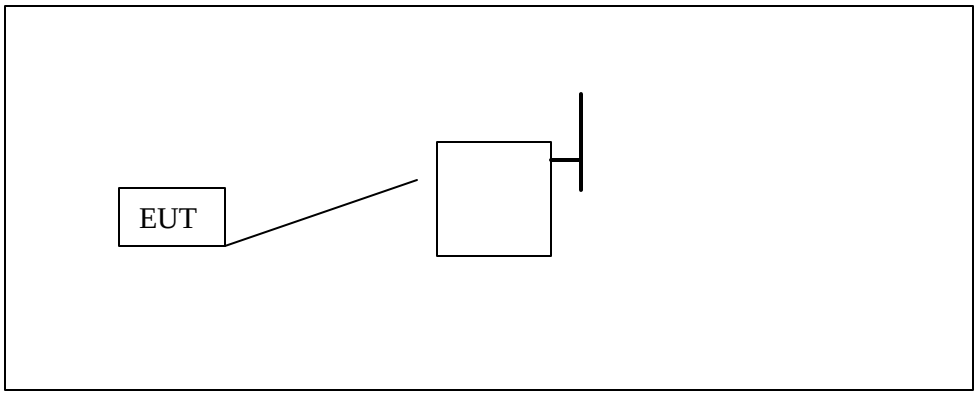


FIGURE 1: WORST CASE CONFIGURATION OF SYSTEM UNDER TEST

3 COMPLIANCE WITH FCC §15.31(m)

In accordance with FCC 15.31(m), and because the EUT utilizes an operating band greater than 10 MHz, three frequencies were investigated for those tests that required the hopping function to be disabled. The following frequencies were tested: 902.4914 MHz, 914.6038 MHz and 927.7695 MHz.

4 COMPLIANCE WITH FCC §15.203

The RF connector used for antenna attachment is a reverse polarity SMA style connector which is not readily available to users through retail distribution.

5 COMPLIANCE WITH FCC §15.204

Please see Appendix B for antenna specifications.

6 COMPLIANCE WITH FCC §15.207

The EUT is strictly battery operated with a solar cell for battery charging.

7 COMPLIANCE WITH THE BAND EDGE – FCC §15.247(c), §15.205; IC RSS-210 §6.3

7.1 TEST PROCEDURE

Compliance with the band edges was performed using the FCC's "Radiated Measurement at a Band Edge" guidance document. The data taken in this report represents the worst case operation.

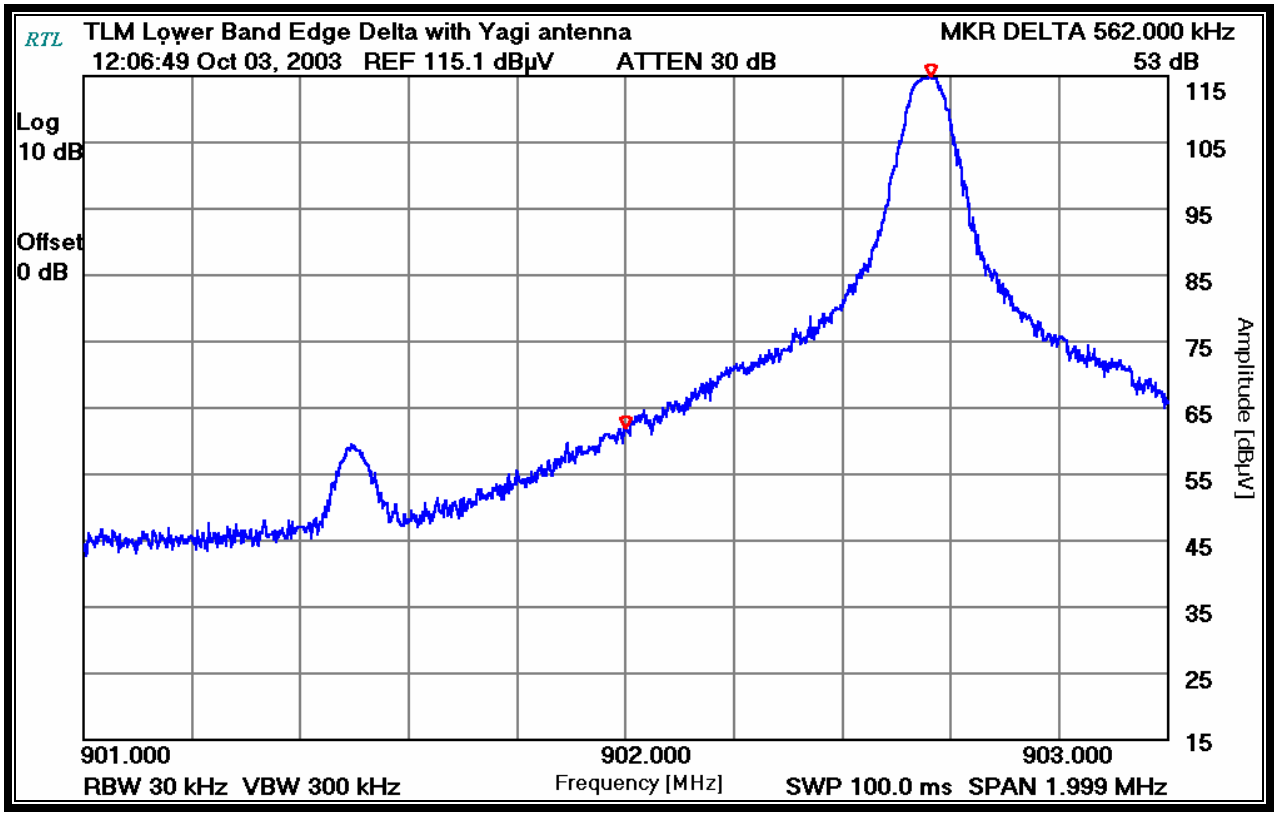
7.2 BAND EDGE TEST EQUIPMENT

TABLE 7-1: BAND EDGE TEST EQUIPMENT

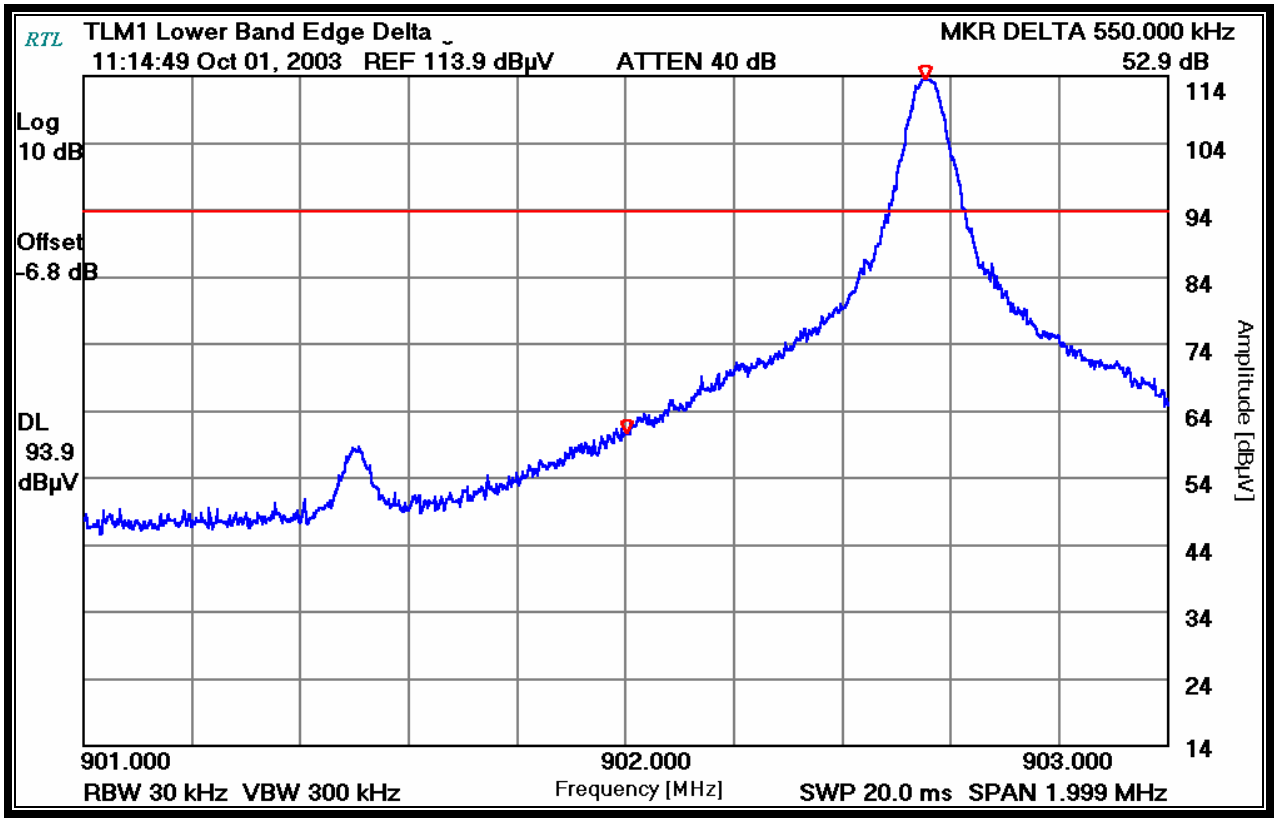
RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901053	Schaffner Chase	CBL6112B	Bi-Log Antenna (20 MHz - 2 GHz)	2648	7/03/04
900930	Hewlett Packard	85662A	Spectrum Analyzer Display Section	3144A20839	5/12/04
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz - 22 GHz)	3138A07771	5/12/04

7.3 RESTRICTED BAND EDGE PLOTS

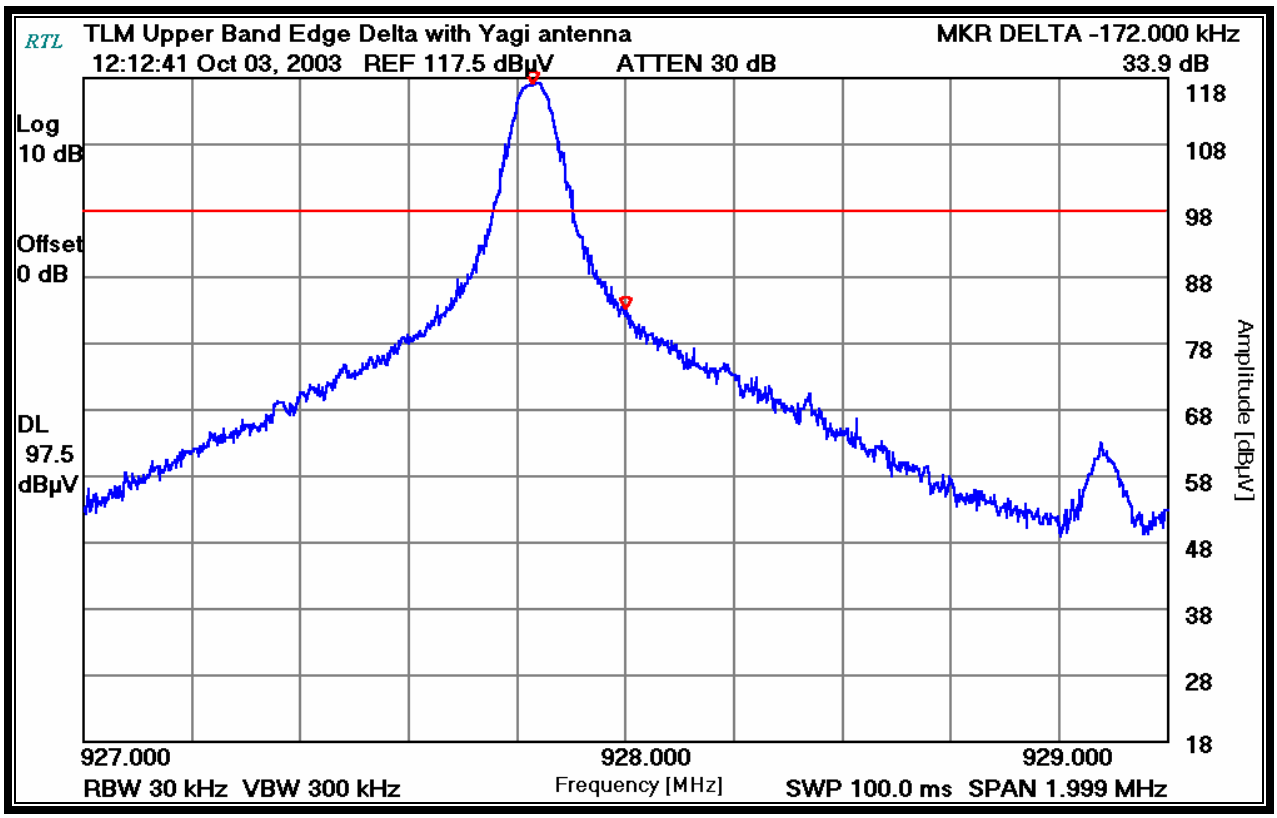
PLOT 7-1: LOWER BAND EDGE: MARKER-DELTA METHOD (TX FREQUENCY: 902.4914 MHz, YAGI ANTENNA)



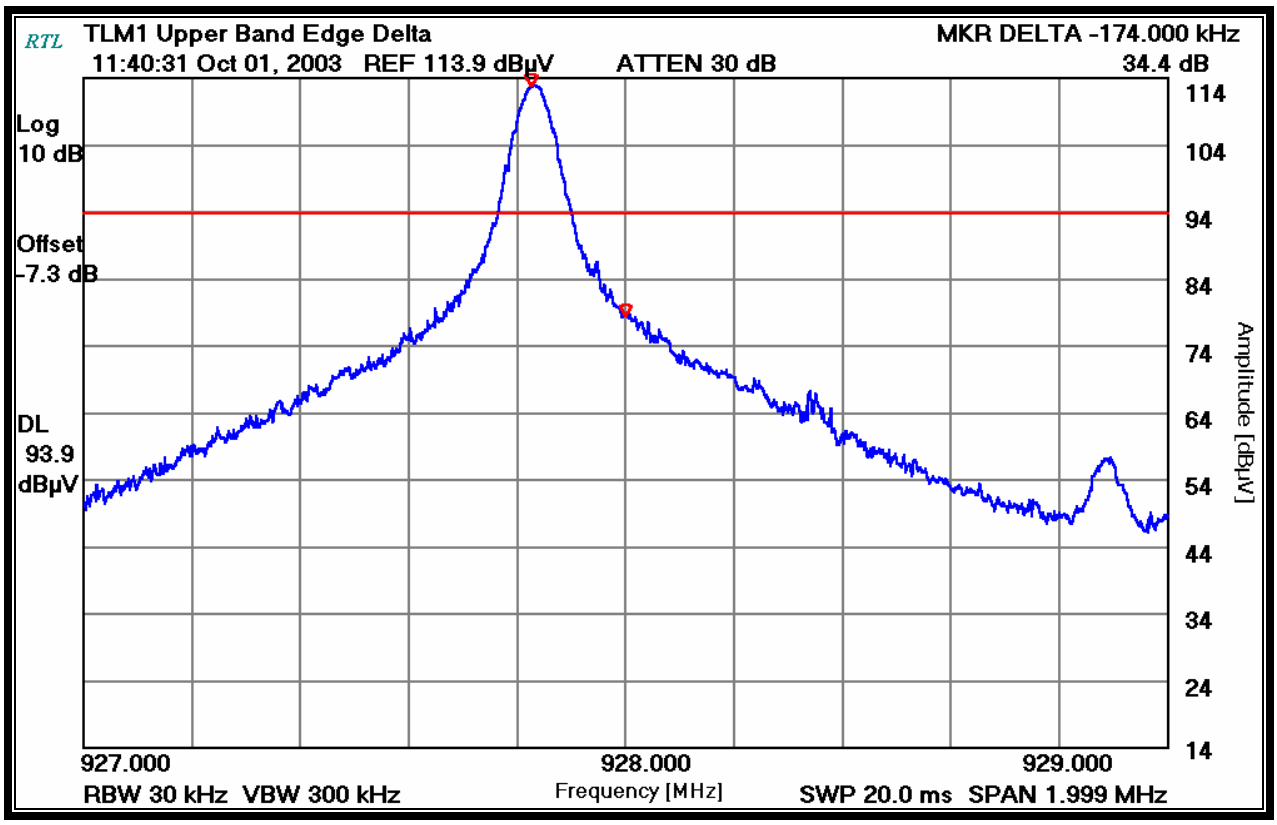
PLOT 7-2: LOWER BAND EDGE: MARKER-DELTA METHOD (TX FREQUENCY: 902.4914 MHz, WHIP ANTENNA)



PLOT 7-3: UPPER BAND EDGE: MARKER-DELTA METHOD (TX FREQUENCY: 927.7695 MHZ, YAGI ANTENNA)



PLOT 7-4: UPPER BAND EDGE: MARKER-DELTA METHOD (TX FREQUENCY: 927.7695 MHZ, WHIP ANTENNA)



TEST PERSONNEL:

Daniel W. Baltzell	Daniel W. Baltzell	October 1 and 3, 2003
Test Engineer	Signature	Dates Of Test

8 RADIATED EMISSION LIMITS RECEIVER/DIGITAL INTERFACE – FCC §15.209; IC RSS-210 §7.3

8.1 RECEIVER/DIGITAL INTERFACE RADIATED EMISSION LIMITS TEST PROCEDURE

Emissions from the digital portion of the transceiver circuitry and the receiver of the EUT were tested and found to comply with the requirements of FCC Part 15.209. Digital emissions from the non-transceiver circuitry and transducer interface circuitry are subject to verification and are provided in a separate verification report held by the manufacturer and test laboratory.

8.2 RECEIVER/DIGITAL INTERFACE RADIATED EMISSIONS TEST EQUIPMENT

TABLE 8-1: RECEIVER/DIGITAL INTERFACE RADIATED EMISSIONS TEST EQUIPMENT

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900889	Hewlett Packard	85685A	RF Preselector for HP 8566B or 8568B (20 Hz - 2 GHz)	3146A01309	3/5/04
900905	Rhein Tech Labs	PR-1040	Amplifier	900905	9/15/04
900969	Hewlett Packard	85650A	Quasi-Peak Adapter	2412A00414	5/12/04
901053	Schaffner Chase	CBL6112B	Bi-Log Antenna (20 MHz - 2 GHz)	2648	7/03/04
900930	Hewlett Packard	85662A	Spectrum Analyzer Display Section	3144A20839	5/12/04
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz - 22 GHz)	3138A07771	5/12/04

8.3 RECEIVER/DIGITAL INTERFACE RADIATED EMISSION LIMITS TEST DATA

TABLE 8-2: DIGITAL INTERFACE RADIATED EMISSION (*i*EFM)

Temperature: 74°F Humidity: 43%									
Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
403.060	Qp	H	0	1.0	39.5	-11.6	27.9	46.0	-18.1
412.890	Qp	H	0	1.0	41.6	-10.9	30.7	46.0	-15.3
427.636	Qp	H	0	1.0	43.5	-11.0	32.5	46.0	-13.5
452.228	Qp	H	90	1.0	37.6	-10.1	27.5	46.0	-18.5
462.059	Qp	H	0	1.0	41.1	-10.1	31.0	46.0	-15.0
845.443	Qp	H	0	1.0	38.1	-4.4	33.7	46.0	-12.3

QP: RES. =100 KHZ, VID= 100 KHZ

TABLE 8-3: DIGITAL INTERFACE RADIATED EMISSION (*i*WPM-T)

Temperature: 77°F Humidity: 43%									
Emission Frequency (MHz)	**Test Detector**	**Antenna Polarity (H/V)**	**Turntable Azimuth (deg)**	**Antenna Height (m)**	**Analyzer Reading (dBuV)**	**Site Correction Factor (dB/m)**	**Emission Level (dBuV/m)**	**Limit (dBuV/m)**	**Margin (dB)**
349.010	Qp	H	0	1.0	33.8	-13.4	20.4	46.0	-25.6
388.331	Qp	H	0	1.0	33.9	-12.3	21.6	46.0	-24.4
427.653	Qp	H	0	1.0	34.0	-11.0	23.0	46.0	-23.0
462.059	Qp	H	355	1.0	40.2	-11.2	29.0	46.0	-17.0
471.889	Qp	H	0	1.0	33.9	-10.0	23.9	46.0	-22.1
511.211	Qp	H	0	1.0	33.8	-8.8	25.0	46.0	-21.0

QP: RES. =100 KHZ, VID= 100 KHZ

TABLE 8-4: DIGITAL INTERFACE RADIATED EMISSION (*i*TLM-1)

Temperature: 77°F Humidity: 43%									
Emission Frequency (MHz)	**Test Detector**	**Antenna Polarity (H/V)**	**Turntable Azimuth (deg)**	**Antenna Height (m)**	**Analyzer Reading (dBuV)**	**Site Correction Factor (dB/m)**	**Emission Level (dBuV/m)**	**Limit (dBuV/m)**	**Margin (dB)**
250.681	Qp	H	30	1.0	33.6	-16.1	17.5	46.0	-28.5
663.574	Qp	H	0	1.0	22.4	-6.8	15.6	46.0	-30.4
707.813	Qp	H	0	1.0	25.4	-6.2	19.2	46.0	-26.8
722.559	Qp	H	0	1.0	31.0	-6.3	24.7	46.0	-21.3
840.527	Qp	H	0	1.0	30.2	-4.6	25.6	46.0	-20.4
870.020	Qp	H	0	1.0	26.0	-4.0	22.0	46.0	-24.0

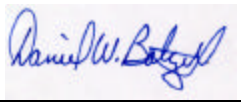
QP: RES. =100 KHZ, VID= 100 KHZ

TABLE 8-5: RECEIVER RADIATED EMISSION (*i*TLM-1)

Temperature: 77°F Humidity: 43%									
Emission Frequency (MHz)	**Test Detector**	**Antenna Polarity (H/V)**	**Turntable Azimuth (deg)**	**Antenna Height (m)**	**Analyzer Reading (dBuV)**	**Site Correction Factor (dB/m)**	**Emission Level (dBuV/m)**	**Limit (dBuV/m)**	**Margin (dB)**
902.665	Qp	H	0	1.0	51.0	-14.9	36.1	46.0	-9.9
914.769	Qp	H	0	1.0	52.3	-10.7	41.6	46.0	-4.4
927.941	Qp	H	0	1.0	53.8	-14.9	38.9	46.0	-7.1
1805.330	Av	H	0	1.0	44.5	-10.3	34.2	54.0	-19.8
1829.537	Av	H	0	1.0	44.3	-14.8	29.5	54.0	-24.5
1855.882	Av	H	0	1.0	39.7	-10.1	29.6	54.0	-24.4

QP: RES. =100 KHZ, VID= 100 KHZ

TEST PERSONNEL:



Daniel W. Baltzell		October 1, 2003
EMC Test Engineer	Signature	Date Of Test

9 RADIATED EMISSION LIMITS; SPURIOUS AND HARMONICS – FCC §15.247; IC RSS-210 §6.3

9.1 RADIATED SPURIOUS EMISSION LIMITS TEST PROCEDURE

Radiated Spurious Emissions applies to harmonics and spurious emissions that fall in the restricted and non-restricted bands. The restricted bands are listed in Part 15.205. The maximum permitted average field strength for the restricted band is listed in Part 15.209. The EUT was tested in the 3 orthogonal planes.

9.2 RADIATED SPURIOUS TEST EQUIPMENT

TABLE 9-1: RADIATED SPURIOUS EMISSIONS TEST EQUIPMENT

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900772	EMCO	3161-02	Horn Antenna (2 - 4 GHz)	9804-1044	3/15/04
900323	EMCO	3160-7	Horn Antennas (8.2 - 12.4 GHz)	9605-1054	6/10/04
900356	EMCO	3160-08	Horn Antennas (12.4 – 18 GHz)	9607-1044	6/10/04
900321	EMCO	3161-03	Horn Antenna (4.0 - 8.2 GHz)	9508-1020	4/10/04
901053	Schaffner & Chase	CBL6112B	Bilog Antenna (20 MHz - 2 GHz)	2648	7/3/04
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz - 22 GHz)	3138A07771	5/12/04
900930	Hewlett Packard	85662A	Spectrum Analyzer Display Section	3144A20839	5/12/04
900932	Hewlett Packard	8449B	Microwave Preamplifier (1 - 26.5 GHz)	3008A00505	4/22/04
901020	Hewlett Packard	8564E	Portable Spectrum Analyzer (9 kHz - 40 GHz)	3943A01719	7/15/04
901232	IW Microwave Products	KPW-1503-2400-KPS	High Frequency RF Cables	240"	1/30/04
901235	IW Microwave Products	KPS-1503-360-KPS	High Frequency RF Cables	36"	1/30/04

9.3 RADIATED EMISSIONS HARMONICS/SPURIOUS TEST DATA

TABLE 9-2: RADIATED EMISSIONS HARMONICS/SPURIOUS (TX FREQUENCY: 902.4914 MHZ, WHIP ANTENNA)

Emission Frequency (MHz)	Analyzer Reading (dBuV) Peak	Analyzer Reading (dBuV) Average	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1805.332	42.3	30.8	29.5	60.3	97.0	-36.7
2707.995	37.0	26.8	10.1	36.9	54.0	-17.1
3610.658	37.7	31.7	11.1	42.8	54.0	-11.2
4513.321	45.0	35.7	14.8	50.5	54.0	-3.5
5415.984	45.0	38.0	13.5	51.5	54.0	-2.5
6318.647	32.7	23.3	13.0	36.3	97.0	-60.7
7221.310	32.5	23.8	12.1	35.9	97.0	-61.1
8123.973	32.5	23.5	11.5	35.0	54.0	-19.0
9026.636	33.5	22.7	16.8	39.5	54.0	-14.5

PEAK: RES. =1 MHZ, VID= 1MHZ; AVERAGE: RES. =1 MHZ, VID= 10HZ

TABLE 9-3: RADIATED EMISSIONS HARMONICS/SPURIOUS (TX FREQUENCY: 914.6038 MHZ, WHIP ANTENNA)

Emission Frequency (MHz)	Analyzer Reading (dBuV) Peak	Analyzer Reading (dBuV) Average	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1829.544	35.0	29.3	30.1	59.4	96.8	-37.5
2744.316	33.3	25.3	10.1	35.4	54.0	-18.6
3659.088	47.0	37.8	10.3	48.1	54.0	-5.9
4573.860	44.3	36.2	15.0	51.2	54.0	-2.8
5488.632	47.3	42.0	13.6	55.6	96.8	-41.2
6403.404	34.8	23.8	13.1	36.9	96.8	-59.9
7318.176	26.0	24.0	11.6	35.6	54.0	-18.4
8232.948	32.3	22.5	16.7	39.2	54.0	-14.8
9147.720	34.0	23.2	16.5	39.7	54.0	-14.3

PEAK: RES. =1 MHZ, VID= 1MHZ; AVERAGE: RES. =1 MHZ, VID= 10HZ

TABLE 9-4: RADIATED EMISSIONS HARMONICS/SPURIOUS (TX FREQUENCY: 927.7695 MHZ, WHIP ANTENNA)

Emission Frequency (MHz)	Analyzer Reading (dBuV) Peak	Analyzer Reading (dBuV) Average	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1855.883	36.3	30.2	30.2	60.4	94.9	-34.5
2783.821	34.3	26.0	9.3	35.3	54.0	-18.7
3711.759	47.8	41.2	10.0	51.2	54.0	-2.8
4639.697	36.3	30.0	15.0	45.0	54.0	-9.0
5567.635	42.7	32.2	14.0	46.2	94.9	-48.8
6495.573	31.8	22.3	12.8	35.1	94.9	-59.8
7423.511	34.5	25.0	12.0	37.0	54.0	-17.0
8351.449	33.3	22.3	16.8	39.1	54.0	-14.9
9279.387	32.0	22.7	16.8	39.5	94.9	-55.4

PEAK: RES. =1 MHZ, VID= 1MHZ; AVERAGE: RES. =1 MHZ, VID= 10HZ

TABLE 9-5: RADIATED EMISSIONS HARMONICS/SPURIOUS (TX FREQUENCY: 902.4914 MHZ, YAGI ANTENNA)

Emission Frequency (MHz)	Analyzer Reading (dBuV) Peak	Analyzer Reading (dBuV) Average	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1805.332	32.2	23.7	29.5	53.2	98.1	-44.9
2707.995	35.3	24.2	10.1	34.3	54.0	-19.7
3610.658	37.0	32.3	11.1	43.4	54.0	-10.6
4513.321	35.2	27.5	14.8	42.3	54.0	-11.7
5415.984	44.2	36.0	13.5	49.5	54.0	-4.5
6318.647	30.8	20.8	13.0	33.8	98.1	-64.3
7221.310	33.3	23.0	12.1	35.1	98.1	-63.0
8123.973	32.3	22.5	11.5	34.0	54.0	-20.0
9026.636	36.2	22.8	16.8	39.6	54.0	-14.4

PEAK: RES. =1 MHZ, VID= 1MHZ; AVERAGE: RES. =1 MHZ, VID= 10HZ

TABLE 9-6: RADIATED EMISSIONS HARMONICS/SPURIOUS (TX FREQUENCY: 914.6038 MHZ, YAGI ANTENNA)

Emission Frequency (MHz)	Analyzer Reading (dBuV) Peak	Analyzer Reading (dBuV) Average	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1829.544	33.7	23.8	30.1	53.9	98.3	-44.4
2744.316	34.2	23.5	10.1	33.6	54.0	-20.4
3659.088	46.0	39.3	10.3	49.6	54.0	-4.4
4573.860	35.0	28.8	15.0	43.8	54.0	-10.2
5488.632	38.3	32.8	13.6	46.4	98.3	-51.9
6403.404	32.7	20.8	13.1	33.9	98.3	-64.4
7318.176	36.3	23.3	11.6	34.9	54.0	-19.1
8232.948	34.3	23.0	16.7	39.7	54.0	-14.3
9147.720	32.8	23.2	16.5	39.7	54.0	-14.3

PEAK: RES. =1 MHZ, VID= 1MHZ; AVERAGE: RES. =1 MHZ, VID= 10HZ

TABLE 9-7: RADIATED EMISSIONS HARMONICS/SPURIOUS (TX FREQUENCY: 927.7695 MHZ, YAGI ANTENNA)

Emission Frequency (MHz)	Analyzer Reading (dBuV) Peak	Analyzer Reading (dBuV) Average	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1855.883	32.5	26.2	30.2	56.4	96.2	-39.8
2783.821	34.8	23.7	9.3	33.0	54.0	-21.0
3711.759	44.8	35.0	10.0	45.0	54.0	-9.0
4639.697	44.7	35.2	15.0	50.2	96.2	-46.0
5567.635	36.2	28.8	14.0	42.8	96.2	-53.4
6495.573	34.0	22.0	12.8	34.8	96.2	-61.4
7423.511	33.2	23.2	12.0	35.2	54.0	-18.8
8351.449	32.8	22.5	16.8	39.3	54.0	-14.7
9279.387	32.0	22.7	16.8	39.5	96.2	-56.7

PEAK: RES. =1 MHZ, VID= 1MHZ; AVERAGE: RES. =1 MHZ, VID= 10HZ

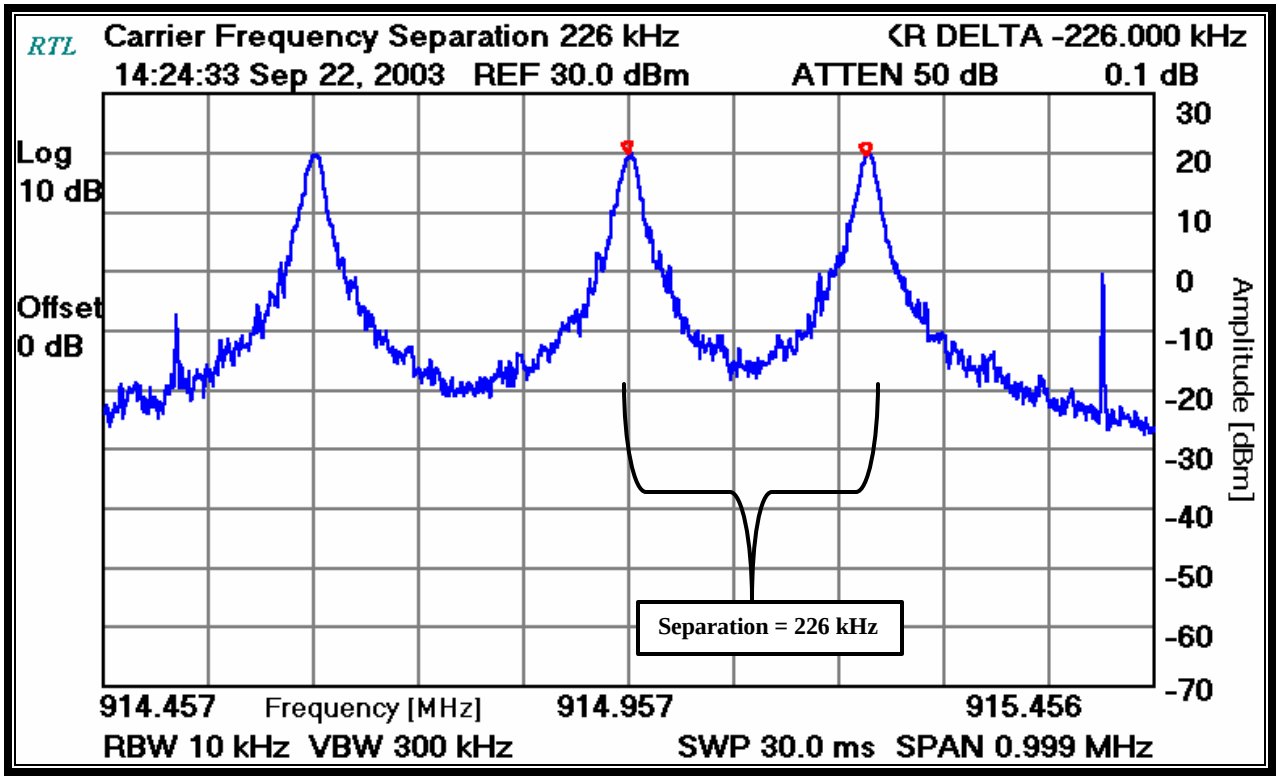
TEST PERSONNEL:

Daniel W. Baltzell		September 26, 2003
EMC Test Engineer	Signature	Date Of Test

10 CARRIER FREQUENCY SEPARATION - §15.247(a)(1)

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. The greatest measured 20 dB bandwidth was 144.2 kHz; since this is greater than 25 kHz, 144.2 kHz should be used as the minimum separation. As shown by the plot below, the EUT met this requirement.

PLOT 10-1: CARRIER FREQUENCY SEPARATION



TEST PERSONNEL:

Daniel W. Baltzell		September 22, 2003
EMC Test Engineer	Signature	Date Of Test

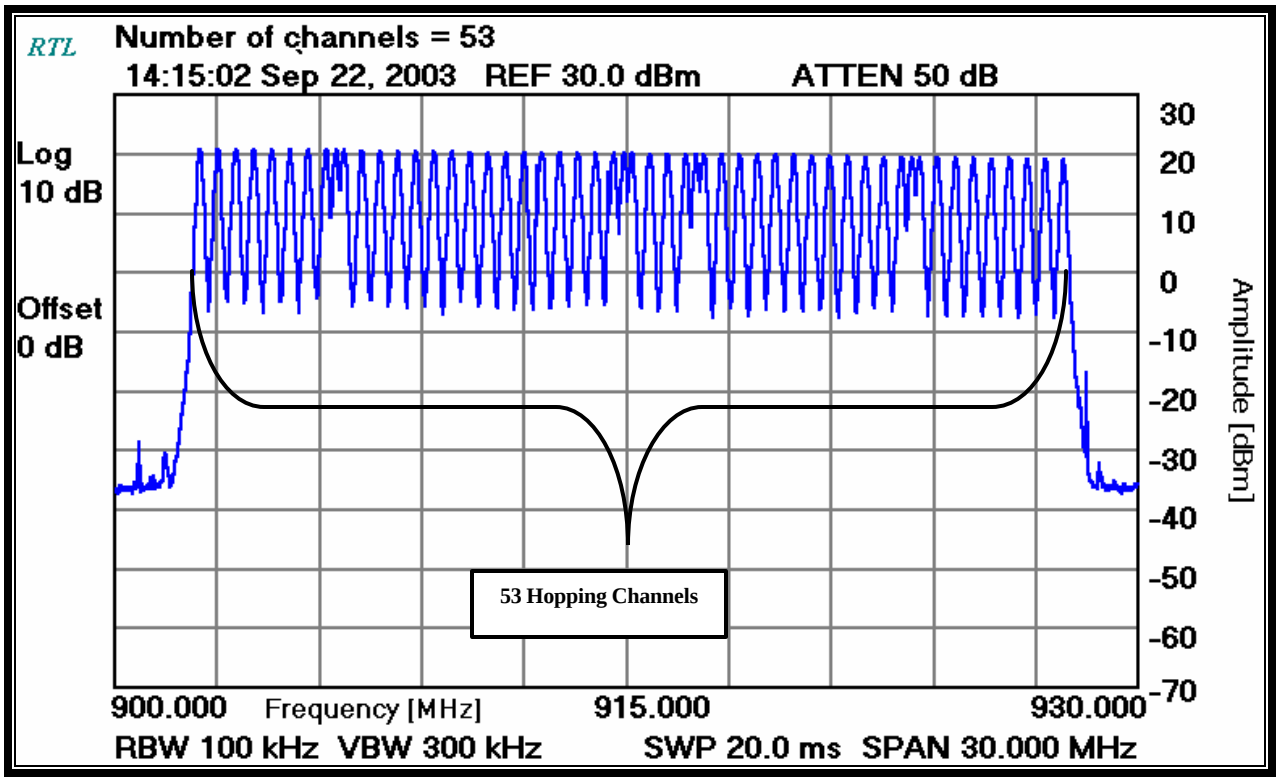
11 HOPPING CHARACTERISTICS – FCC §15.247 (a)(1)(i); IC RSS-210 §6.2.2(O)

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 and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period.

Since the 20 dB bandwidth of the EUT is less than 250 kHz, 50 hopping frequencies must be used. As shown by the plot below, the EUT met this requirement (53 hopping frequencies).

11.1 NUMBER OF HOPPING FREQUENCIES

PLOT 11-1: NUMBER OF HOPPING FREQUENCIES



TEST PERSONNEL:

Daniel W. Baltzell		September 22, 2003
EMC Test Engineer	Signature	Date Of Test

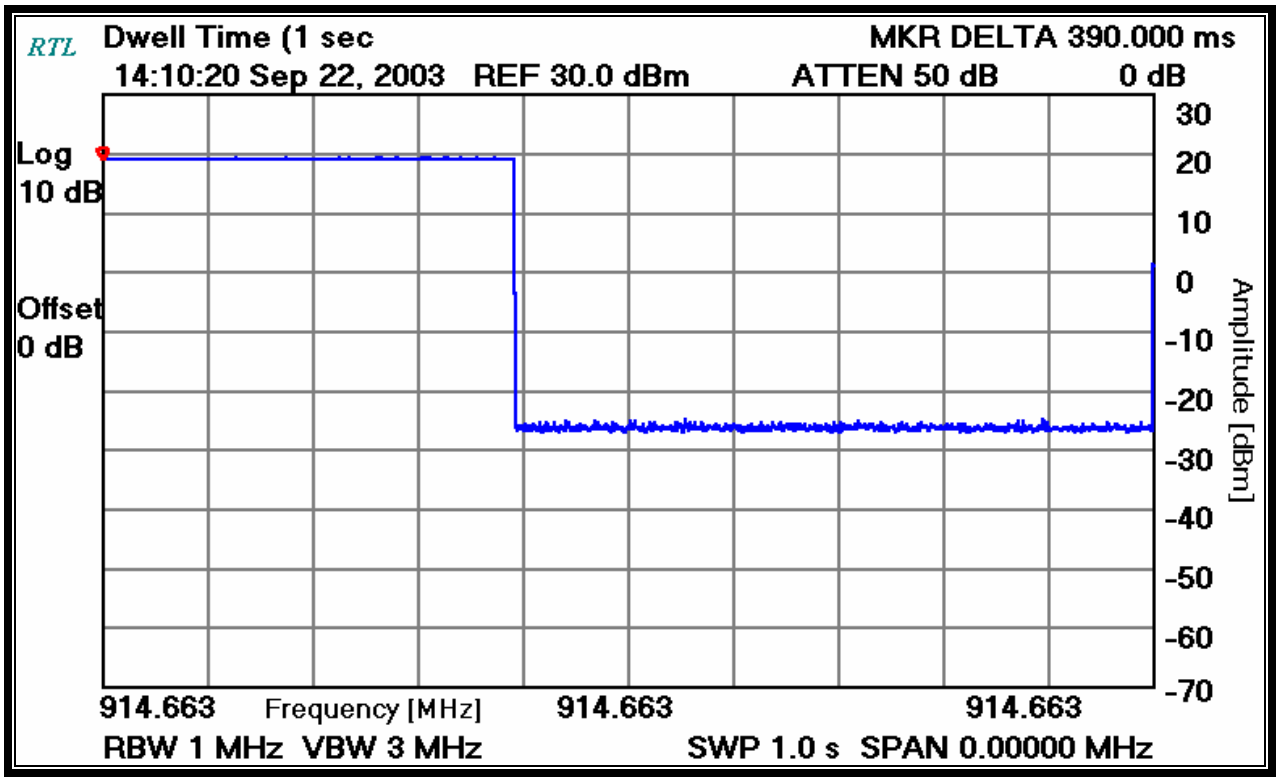
11.2 AVERAGE TIME OF OCCUPANCY

Since the 20 dB bandwidth of the EUT is less than 250 kHz, the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period. As shown by the plot below, the EUT met this requirement (390 ms).

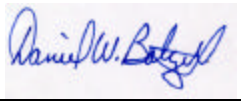
Additionally, In discovery mode a transmitting device alternates between hopping with 1ms dwell time and hopping with 15ms dwell time. Transmission occurs on all 53 channels with 1ms dwell time followed by a single 15ms dwell at the next frequency. The device then stops transmission to listen for a response for approximately 8ms on the same channel and then restarts hopping with 1ms dwell time on all 53 channels followed by a 15ms dwell at the next frequency, etc. In this way the channel with 15ms dwell time advances one position in the hop sequence for each 15ms dwell occurrence (which occurs every 76ms). Thus one 15ms dwell occurs for all 53 channels in the space of 4.028 seconds, and the whole sequence then repeats, typically until discovery of any potential target receiver(s) is complete. The net result is that each channel is occupied for 69 milliseconds in any 4.028 seconds interval, and in any case not more than 400ms in any 20 second period.

In normal transmission a transmitting device channel hops in a pre-defined pseudo random sequence of 53 steps. Hopping is in synchronism with its target receiver with a hop rate of 3 hops per second. Any one channel is occupied for 333ms in this hop sequence which repeats after 53/3 seconds (17.667 seconds). In any case each channel in the hop sequence occupies no more than 400ms in any 20 second period.

PLOT 11-2: TIME OF OCCUPANCY (DWELL TIME)



TEST PERSONNEL:



Daniel W. Baltzell		September 22, 2003
EMC Test Engineer	Signature	Date Of Test

11.3 20 dB BANDWIDTH – FCC §15.247 (a)(1)(i); IC RSS-210 §5.9.1

The minimum 20 dB bandwidths were measured using a 50 ohm spectrum analyzer. The carrier was adjusted on the analyzer so that it was displayed entirely on the Spectrum Analyzer. The sweep time was set to 10 seconds and allowed through several sweeps with the max hold function used in peak detector mode. The resolution bandwidth was set to 100 kHz, and the video bandwidth set at 300 kHz. The minimum 20 dB bandwidths were measured using the spectrum analyzer delta marker set 20 dB down from the peak of the carrier.

The maximum allowed 20 dB bandwidth is 500 kHz. As shown in the following table and plots, the EUT met this requirement.

TABLE 11-1: 20 dB BANDWIDTH TEST EQUIPMENT

RTL ASSET #	MANUFACTURER	MODEL	PART TYPE	SERIAL NUMBER	CALIBRATION DUE DATE
900931	Hewlett Packard	8566B	Spectrum Analyzer (100Hz – 22 GHz)	3138A07771	5/12/04

TABLE 11-2: MODULATED BANDWIDTH TEST DATA

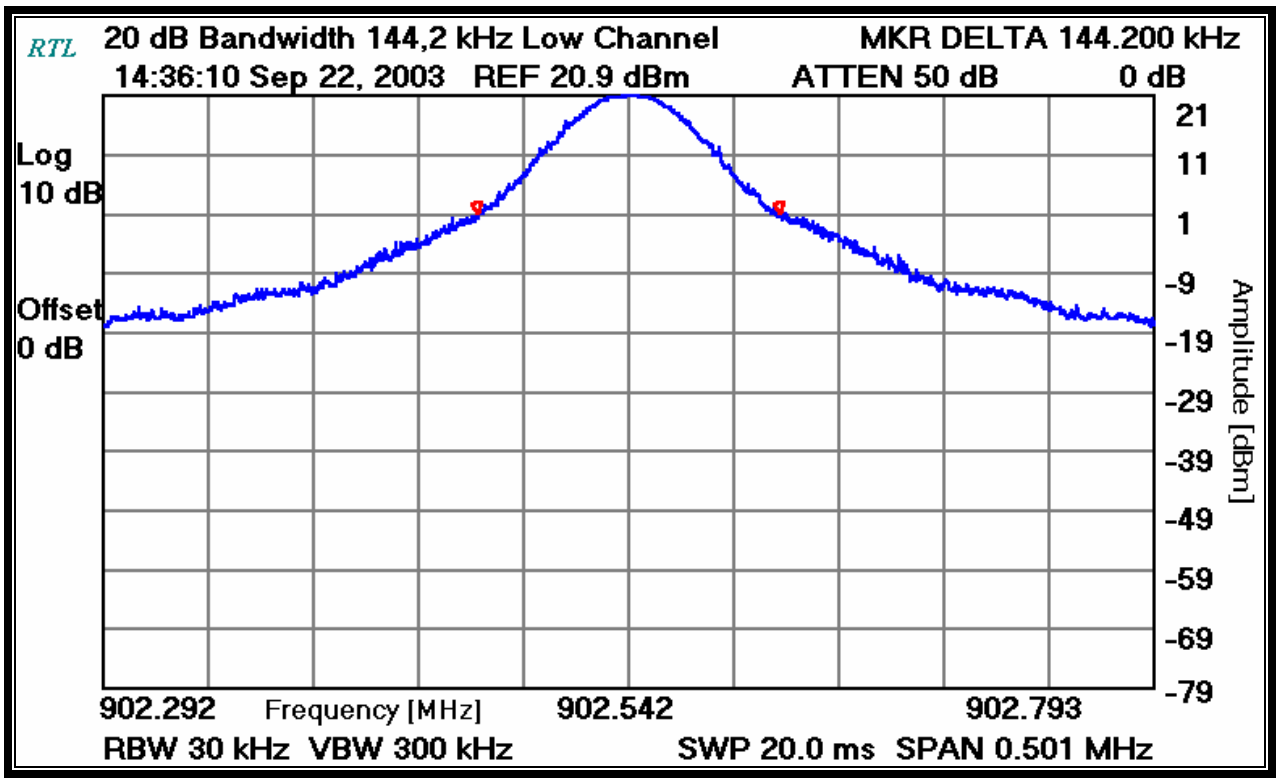
Minimum 20 dB bandwidths

FREQUENCY (MHz)	20 dB BANDWIDTH (kHz)
902.4914	144.2
914.6038	140.8
927.7695	139.3

TEST PERSONNEL:

Daniel W. Baltzell		September 22, 2003
EMC Test Engineer	Signature	Date Of Test

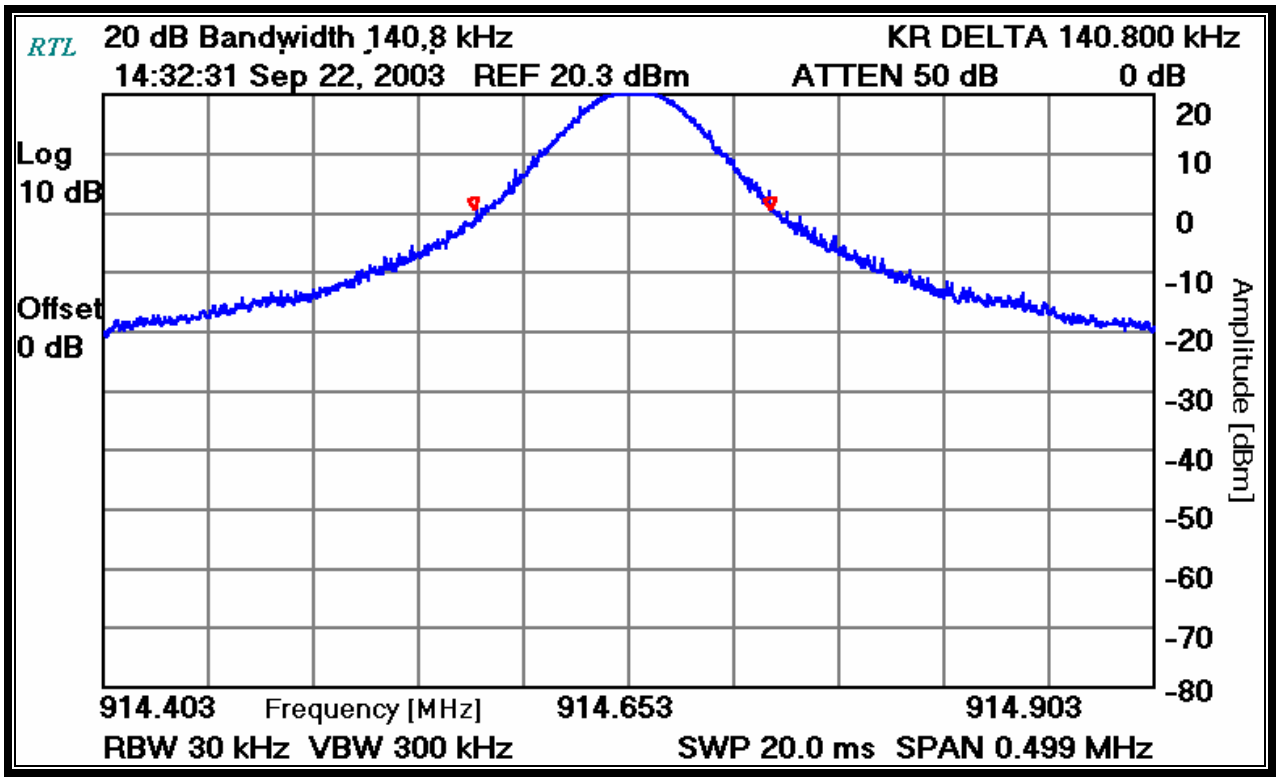
PLOT 11-3: 20 DB BANDWIDTH (TX FREQUENCY: 902.4914 MHZ)



TEST PERSONNEL:

Daniel W. Baltzell		September 22, 2003
EMC Test Engineer	Signature	Date Of Test

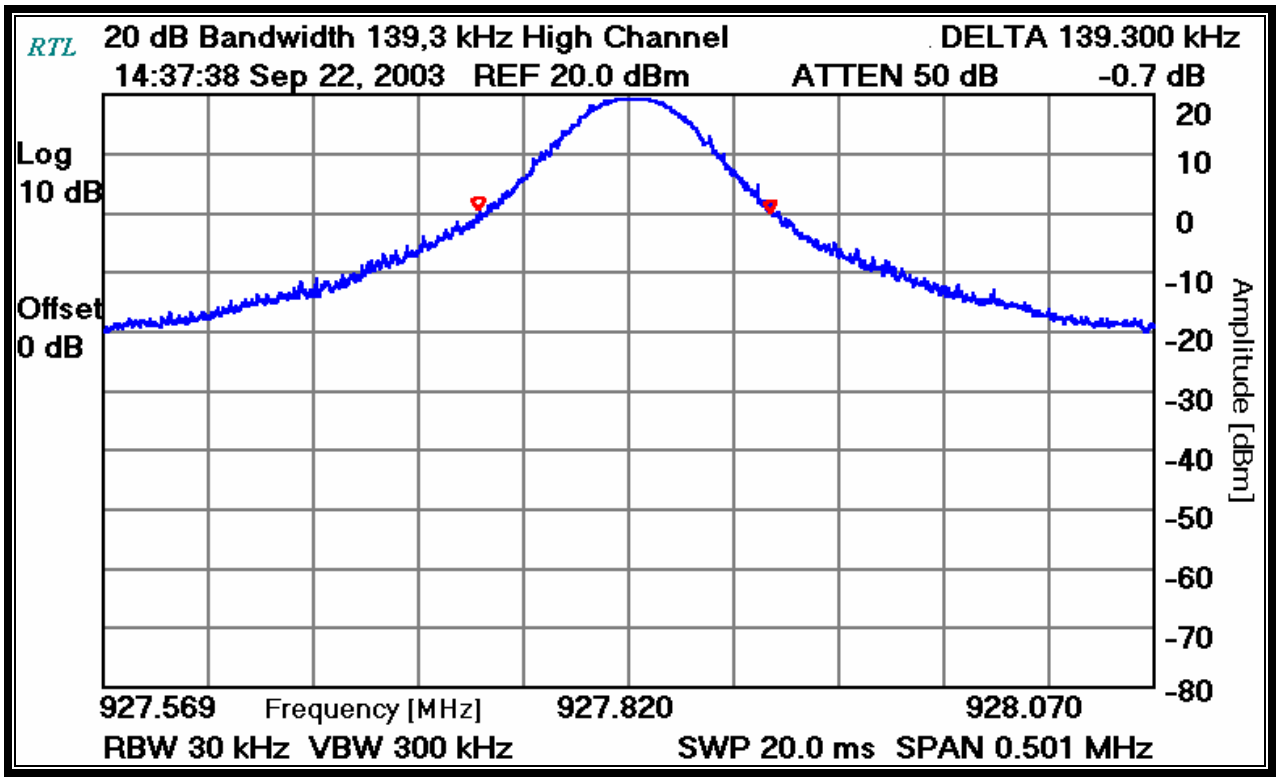
PLOT 11-4: 20 DB BANDWIDTH (TX FREQUENCY: 914.6038 MHZ)



TEST PERSONNEL:

Daniel W. Baltzell		September 22, 2003
EMC Test Engineer	Signature	Date Of Test

PLOT 11-5: 20 DB BANDWIDTH (TX FREQUENCY: 927.7695 MHZ)



TEST PERSONNEL:

Daniel W. Baltzell		September 22, 2003
EMC Test Engineer	Signature	Date Of Test

12 PEAK OUTPUT POWER - FCC §15.247(b)(2); IC RSS-210 §6.2.2(o)(b)

For frequency hopping systems operating in the 902-928 MHz band and employing at least 50 hopping channels, the maximum peak output power is 1 watt. As shown by the table below, the EUT met this requirement.

12.1 CONDUCTED ANTENNA PORT POWER OUTPUT TEST PROCEDURE

A conducted power measurement of the EUT was taken using an Agilent 4416A EPM-P Series Power Meter with an E9323A Peak and Average Power Sensor.

12.2 CONDUCTED ANTENNA PORT POWER OUTPUT TEST EQUIPMENT

TABLE 12-1: CONDUCTED ANTENNA PORT POWER OUTPUT TEST EQUIPMENT

RTL ASSET #	MANUFACTURER	MODEL	PART TYPE	SERIAL NUMBER	CALIBRATION DUE DATE
901186	Agilent Technologies	E9323A	Peak & Avg. Power Sensor (50 MHz - 6 GHz)	US40410380	7/30/04
901184	Agilent Technologies	E4416A	EPM-P Power Meter, Single Channel	GB41050573	7/30/04
901140	Weinschel Corp.	47-10-34 DC-18GHz	Attenuator, 50W 10dB	BK6203	5/13/04

12.3 CONDUCTED ANTENNA PORT POWER OUTPUT TEST DATA

TABLE 12-2: CONDUCTED ANTENNA PORT POWER OUTPUT TEST DATA

FREQUENCY (MHz)	PEAK POWER CONDUCTED OUTPUT POWER SETTING –3 FOR WHIP ANTENNA (dBm)	PEAK POWER CONDUCTED OUTPUT POWER SETTING –3 FOR WHIP ANTENNA (mW)
902.4914	16.5	44.9
914.6038	17.7	58.9
927.7695	16.6	45.2

TABLE 12-3: CONDUCTED ANTENNA PORT POWER OUTPUT TEST DATA

FREQUENCY (MHz)	PEAK POWER CONDUCTED OUTPUT POWER SETTING –6 FOR YAGI ANTENNA (dBm)	PEAK POWER CONDUCTED OUTPUT POWER SETTING –6 FOR YAGI ANTENNA (mW)
902.4914	13.4	21.9
914.6038	13.2	20.9
927.7695	12.4	17.4

TEST PERSONNEL:

Daniel W. Baltzell		October 1 and 3, 2003
EMC Test Engineer	Signature	Date Of Test

13 ANTENNA CONDUCTED SPURIOUS EMISSIONS - §15.247(c); IC RSS-210 §6.2.2(o)(e1)

13.1 ANTENNA CONDUCTED SPURIOUS EMISSIONS TEST PROCEDURES

Antenna spurious emission per FCC 15.247(c) was measured from the EUT antenna port using a 50 ohm spectrum analyzer with the resolution bandwidth set at 100 kHz, and the video bandwidth set at 300 kHz. The modulated carrier was identified at the following frequencies: 902.4914 MHz, 914.6038 MHz and 927.7695 MHz. No other harmonics or spurs were found within 20 dB of the carrier level from 9kHz to the carrier 10^{th} harmonic. See the Antenna Conducted Spurious Noise Table. The low, middle, and high frequencies were investigated and tested.

13.2 ANTENNA CONDUCTED SPURIOUS TEST EQUIPMENT

TABLE 13-1: ANTENNA CONDUCTED SPURIOUS TEST EQUIPMENT

RTL ASSET #	MANUFACTURER	MODEL	PART TYPE	SERIAL NUMBER	CALIBRATION DUE DATE
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz – 22 GHz)	3138A07771	5/12/04

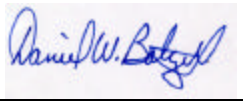
13.3 ANTENNA CONDUCTED SPURIOUS EMISSIONS (TX FREQUENCY: 902.4914 MHz)

Operating Frequency (MHz): 902.4914
Measured Level at 100kHz (dBm): 16.4
Limit (dBm): -3.6

TABLE 13-2: CONDUCTED SPURIOUS EMISSIONS (TX FREQUENCY: 902.4914 MHZ)

Frequency (MHz)	Measured Level (dBm)	Measured Level (dBc)	Limit (dBc)	Margin (dB)
677.160	-48.0	64.4	20.0	-44.4
789.846	-46.0	62.4	20.0	-42.4
991.030	-47.5	63.9	20.0	-43.9
1804.983	-37.1	53.5	20.0	-33.5
2707.474	-53.6	70.0	20.0	-50.0
3609.966	-39.4	55.8	20.0	-35.8
4512.457	-51.0	67.4	20.0	-47.4
5414.948	-40.5	56.9	20.0	-36.9
6317.440	-58.8	75.2	20.0	-55.2
7219.931	-73.7	90.1	20.0	-70.1
8122.423	-48.0	64.4	20.0	-44.4
9024.914	-46.0	62.4	20.0	-42.4

TEST PERSONNEL:



Daniel W. Baltzell		October 1, 2003
EMC Test Engineer	Signature	Date Of Test

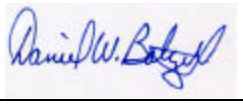
13.4 ANTENNA CONDUCTED SPURIOUS EMISSIONS (TX FREQUENCY: 914.6038 MHz)

Operating Frequency (MHz): 914.6038
Measured Level at 100kHz (dBm): 17.6
Limit (dBm): -2.4

TABLE 13-3: CONDUCTED SPURIOUS EMISSIONS (TX FREQUENCY: 914.6038 MHZ)

Frequency (MHz)	Measured Level (dBm)	Measured Level (dBc)	Limit (dBc)	Margin (dB)
228.562	-59.4	77.0	20.0	-57.0
686.097	-51.9	69.5	20.0	-49.5
799.855	-46.2	63.8	20.0	-43.8
1003.138	-48.0	65.6	20.0	-45.6
1829.208	-34.7	52.3	20.0	-32.3
2743.811	-54.7	72.3	20.0	-52.3
3658.415	-39.1	56.7	20.0	-36.7
4573.019	-50.2	67.8	20.0	-47.8
5487.623	-43.1	60.7	20.0	-40.7
6402.227	-60.7	78.3	20.0	-58.3
7316.830	-73.5	91.1	20.0	-71.1
8231.434	-79.5	97.1	20.0	-77.1
9146.038	-80.0	97.6	20.0	-77.6

TEST PERSONNEL:



Daniel W. Baltzell		October 1, 2003
EMC Test Engineer	Signature	Date Of Test

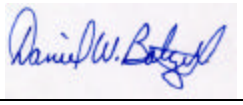
13.5 ANTENNA CONDUCTED SPURIOUS EMISSIONS (TX FREQUENCY: 927.7695 MHz)

Operating Frequency (MHz): 927.7695
Measured Level at 100kHz (dBm): 16.4
Limit (dBm): -3.6

TABLE 13-4: CONDUCTED SPURIOUS EMISSIONS (TX FREQUENCY: 927.7695 MHZ)

Frequency (MHz)	Measured Level (dBm)	Measured Level (dBc)	Limit (dBc)	Margin (dB)
696.109	-44.6	61.0	20.0	-41.0
754.037	-50.0	66.4	20.0	-46.4
811.961	-43.8	60.2	20.0	-40.2
986.812	-50.5	66.9	20.0	-46.9
1016.292	-54.6	71.0	20.0	-51.0
1043.688	-57.7	74.1	20.0	-54.1
1855.539	-39.1	55.5	20.0	-35.5
2783.309	-57.9	74.3	20.0	-54.3
3711.078	-38.2	54.6	20.0	-34.6
4638.848	-48.7	65.1	20.0	-45.1
5566.617	-47.2	63.6	20.0	-43.6
6494.387	-68.3	84.7	20.0	-64.7
7422.156	-75.3	91.7	20.0	-71.7
8349.926	-80.6	97.0	20.0	-77.0
9277.695	-81.0	97.4	20.0	-77.4

TEST PERSONNEL:



Daniel W. Baltzell		October 1, 2003
EMC Test Engineer	Signature	Date Of Test

14 CONCLUSION

The data in this measurement report shows that the EUT as tested, FCC ID: RIM-IMON , when used with the Nearson S467AH-915S and Bluewave EDY9432 Yagi antennas, complies with all the applicable requirements of Parts 2 and 15 of the FCC Rules and Regulations, and Industry Canada RSS-210.