Excellence in Compliance Testing

Certification Test Report

FCC ID: OOSNRMH902
IC: 9378A-NRMH902

FCC Rule Part: 15.247
IC Radio Standards Specification: RSS-210

ACS Report Number: 10-0346.W06.11.A

Manufacturer: L3 Nova Engineering
Model(s): MH902

Test Begin Date: October 13, 2010
Test End Date: October 15, 2010

Report Issue Date: December 21, 2010

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612-0

This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

Reviewed by: _____
Kirby Munroe
Director, Wireless Certifications
ACS, Inc.

This report contains 23 pages

TABLE OF CONTENTS

1 GENERAL 3

1.1 PURPOSE 3
1.2 PRODUCT DESCRIPTION 3
1.3 TEST METHODOLOGY AND CONSIDERATIONS 3

2 TEST FACILITIES 4

2.1 LOCATION 4
2.2 LABORATORY ACCREDITATIONS/RECOGNITIONS/CERTIFICATIONS 4
2.3 RADIATED EMISSIONS TEST SITE DESCRIPTION 5
2.3.1 Semi-Anechoic Chamber Test Site 5
2.3.2 Open Area Tests Site (OATS) 6
2.4 CONDUCTED EMISSIONS TEST SITE DESCRIPTION 7

3 APPLICABLE STANDARD REFERENCES 7

4 LIST OF TEST EQUIPMENT 8

5 SUPPORT EQUIPMENT 9

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM 9

7 SUMMARY OF TESTS 10

7.1 ANTENNA REQUIREMENT – FCC: SECTION 15.203 10
7.2 POWER LINE CONDUCTED EMISSIONS – FCC: SECTION 15.207 IC: RSS-GEN 7.2.2 10
7.2.1 Measurement Procedure 10
7.2.2 Measurement Results 10
7.3 RADIATED EMISSIONS – FCC: SECTION 15.109 (UNINTENTIONAL RADIATION) IC: RSS-210 2.6 . 13
7.3.1 Measurement Procedure 13
7.3.2 Measurement Results 13
7.4 PEAK OUTPUT POWER - FCC SECTION 15.247(B)(2) IC: RSS-210 A8.4(1) 14
7.4.1 Measurement Procedure (Conducted Method) 14
7.4.2 Measurement Results 14
7.5 CHANNEL USAGE REQUIREMENTS 15
7.5.1 Carrier Frequency Separation – FCC: Section 15.247(a)(1) IC: RSS-210 A8.1(b) 15
7.5.1.1 Measurement Procedure 15
7.5.1.2 Measurement Results 15
7.5.2 Number of Hopping Channels – FCC: Section 15.247(a)(1)(i) IC: RSS-210 A8.1(c) 15
7.5.3 Channel Dwell Time – FCC: Section 15.247(a)(1)(i) IC: RSS-210 A8.1(c) 16
7.5.3.1 Measurement Procedure 16
7.5.3.2 Measurement Results 16
7.5.4 20dB / 99% Bandwidth - FCC: Section 15.247(a)(1)(i) IC: RSS-210 A8.1(c) 17
7.5.4.1 Measurement Procedure 17
7.5.4.2 Measurement Results 17
7.6 BAND-EDGE COMPLIANCE AND SPURIOUS EMISSIONS-FCC 15.247(D) IC: RSS-210 A8.5 19
7.6.1 Band-Edge Compliance of RF Conducted Emissions 19
7.6.1.1 Measurement Procedure 19
7.6.1.2 Measurement Results 19
7.6.2 RF Conducted Spurious Emissions 20
7.6.2.1 Measurement Procedure 20
7.6.2.2 Measurement Results 20
7.6.3 Radiated Spurious Emissions - FCC Section 15.205 IC: RSS-210 2.6 22
7.6.3.1 Measurement Procedure 22
7.6.3.2 Duty Cycle Correction 22
7.6.3.3 Measurement Results 22
7.6.3.4 Sample Calculation: 23

8 CONCLUSION 23

1 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations and Industry Canada's Radio Standards Specification RSS-210 for Certification of a single modular approval.

1.2 Product description

The L3 Nova Engineering model MH902 is a frequency hopping spread spectrum (FHSS) transceiver tailored for industrial applications that operates in the 902 to 928 MHz frequency band.

Manufacturer Information:
L3 Nova Engineering
4393 Digital Way
Mason, OH 45040

Technical details:

Band of operation:	902-928 MHz
Number of hopping channels:	51
Channel spacing	500 KHz
Over the air data rate:	650 Kbps
Modulation format:	GFSK
RF connector:	SMA
Antennas:	Laird Part No. FG9026, 8 dBi Omnidirectional Laird Part No. YS8966 11 dBi Yagi
Cables:	Omni Antenna - 60' LMR-400, Insertion Loss 2.4dB Yagi Antenna - 130' LMR-400, Insertion Loss 5.1dB

Test Sample Serial Number(s): 0006

Test Sample Condition: The test samples were provided in good working order with no visible defects.

1.3 Test Methodology and Considerations

The MH902 is installed with a specific cable type and length per antenna. Those cables were provided and included in the test setup for radiated and AC power line conducted emissions. The cable insertion loss is utilized for determining compliance per Part 15.247(b)(4). The antenna gain is offset by the cable insertion loss providing total gain of less than 6dBi. The MH902 is professionally installed.

2 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions
5015 B.U. Bowman Drive
Buford, GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program (NVLAP), Lab Code 200612-0. Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

The Semi-Anechoic Chamber Test Site, Open Area Test Site (OATS) and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC, Industry Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

FCC Registration Number: 894540
Industry Canada Lab Code: IC 4175A-1
VCCI Member Number: 1831

- VCCI OATS Registration Number R-1526
- VCCI Conducted Emissions Site Registration Number: C-1608

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 150cm in diameter and is located 160cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chases from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

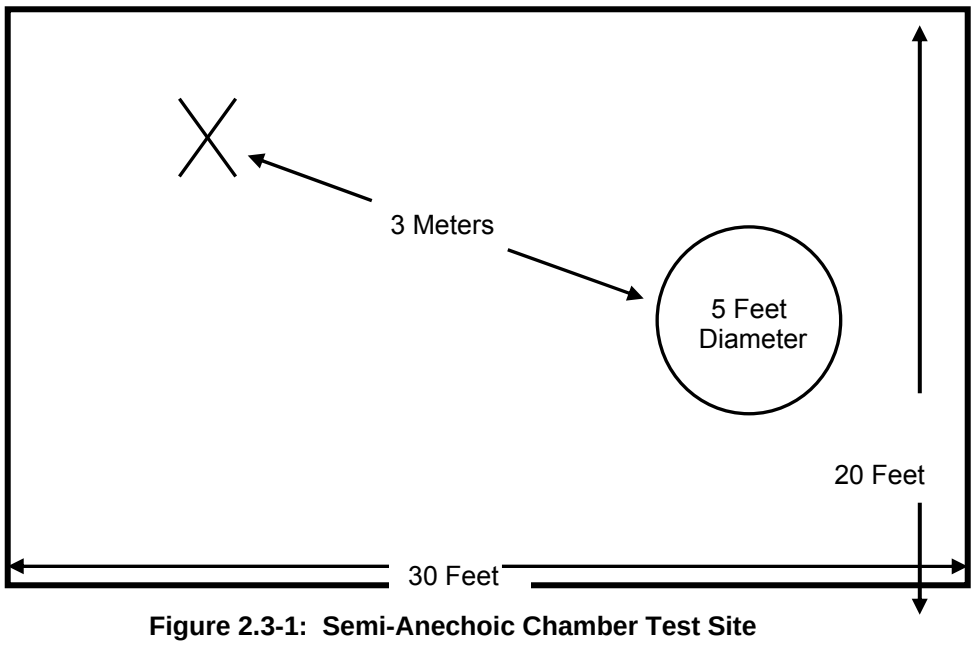

Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.3.2 Open Area Tests Site (OATS)

The open area test site consists of a 40' x 66' concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide a continuous seam. Rivets are spaced every 3" in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12' beyond the turntable edge and 16' beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8' copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10' flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4" PVC chases from the pit to the control room that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane; however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 2.3-2 below:

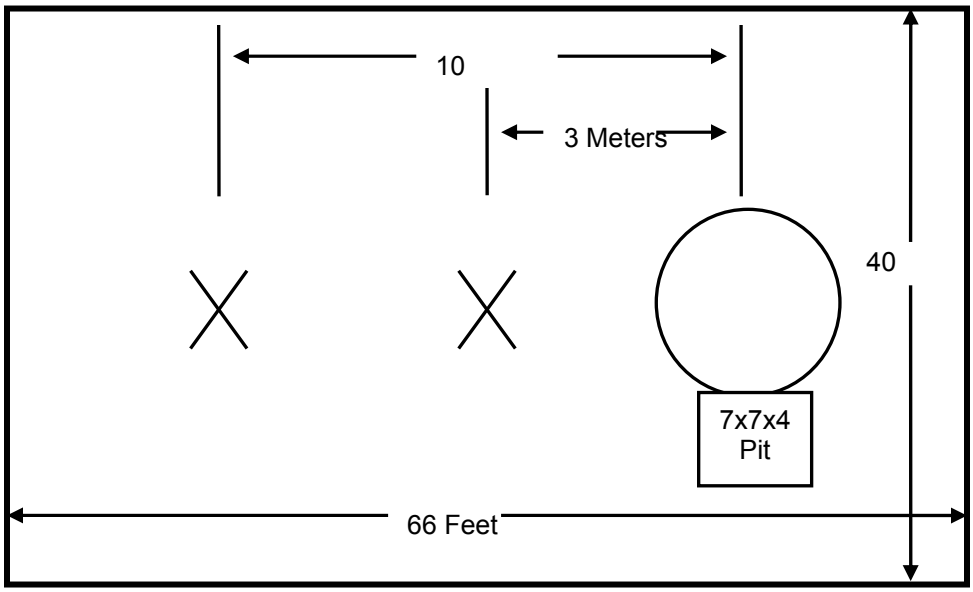

Figure 2.3-2: Open Area Test Site

2.4 Conducted Emissions Test Site Description

The AC mains conducted EMI site is located in the main EMC lab. It consists of an 8' x 8' solid aluminum horizontal group reference plane (GRP) bonded every 3" to an 8' X 8' vertical ground plane.

The site is of sufficient size to test table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.4.

A diagram of the room is shown below in figure 4.1.3-1:

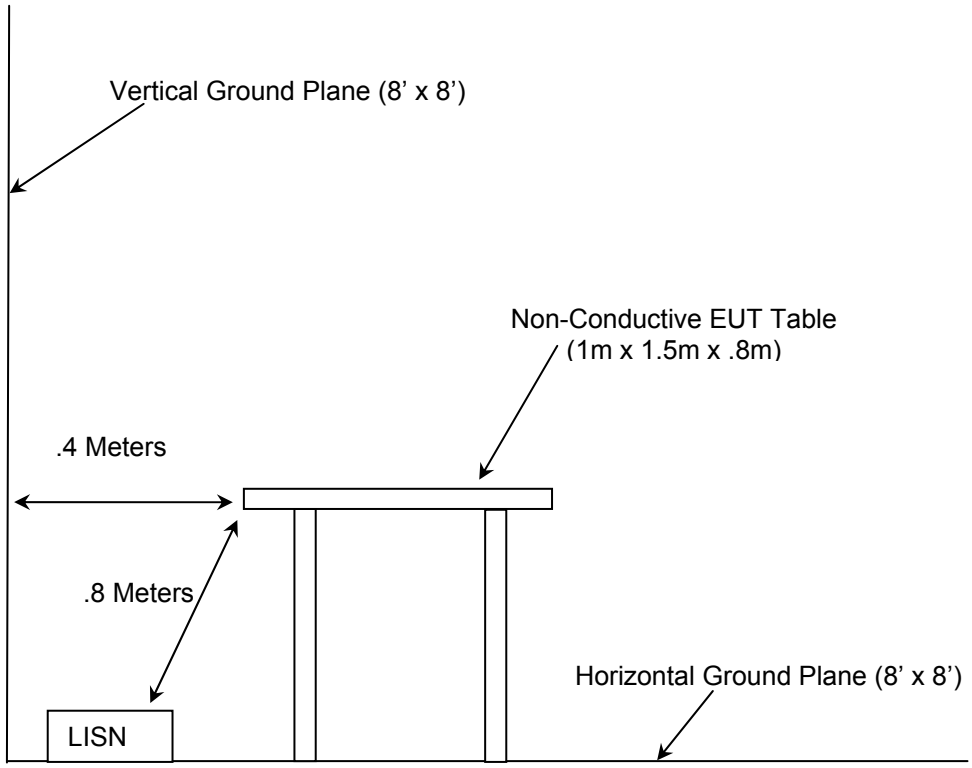

Figure 2.4-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2003: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2010
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2010
- FCC Public Notice DA 00-705 - Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems, March 30, 2000
- Industry Canada Radio Standards Specification: RSS-210 - Low-power License-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, Issue 8 June 2010
- Industry Canada Radio Standards Specification: RSS-GEN – General Requirements and Information for the Certification of Radiocommunication Equipment, Issue 3, June 2010.

4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
1	Rohde & Schwarz	ESMI - Display	Spectrum Analyzers	833771/007	9/23/2010	9/23/2012
2	Rohde & Schwarz	ESMI-Receiver	Spectrum Analyzers	839587/003	9/23/2010	9/23/2012
3	Rohde & Schwarz	ESMI - Display	Spectrum Analyzers	839379/011	2/2/2009	2/2/2011
4	Rohde & Schwarz	ESMI - Receiver	Spectrum Analyzers	833827/003	2/2/2009	2/2/2011
25	Chase	CBL6111	Antennas	1043	9/13/2010	9/13/2012
30	Spectrum Technologies	DRH-0118	Antennas	970102	5/8/2009	5/8/2011
73	Agilent	8447D	Amplifiers	2727A05624	5/26/2010	5/26/2011
153	EMCO	3825/2	LISN	9411-2268	1/11/2009	1/11/2011
167	ACS	Chamber EMI Cable Set	Cable Set	167	1/25/2010	1/25/2011
168	Hewlett Packard	11947A	Attenuators	44829	2/4/2010	2/4/2011
283	Rohde & Schwarz	FSP40	Spectrum Analyzers	1000033	8/31/2010	8/31/2011
291	Florida RF Cables	SMRE-200W-12.0-SMRE	Cables	None	12/7/2010	12/7/2011
292	Florida RF Cables	SMR-290AW-480.0-SMR	Cables	None	12/7/2010	12/7/2011
324	ACS	Belden	Cables	8214	7/9/2010	7/9/2011
337	Microwave Circuits	H1G513G1	Filters	282706	7/16/2010	7/16/2011
338	Hewlett Packard	8449B	Amplifiers	3008A01111	10/29/2010	10/29/2011
340	Aeroflex/Weinschel	AS-20	Attenuators	7136	10/5/2010	10/5/2011
422	Florida RF	SMS-200AW-72.0-SMR	Cables	805	1/26/2010	1/26/2011

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number
1	Power Supply	Phihong	PSA15R-150P	NA
2	Dipole Antenna	Laird	FG9026	NA
3	Yagi Antenna	Laird	YS8966	NA
4	Switch	Netgear	FS108P	1DL16C2T001C3
5	Switch Power Supply	D-Link	VAN90C-480B	10053805331-2A

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

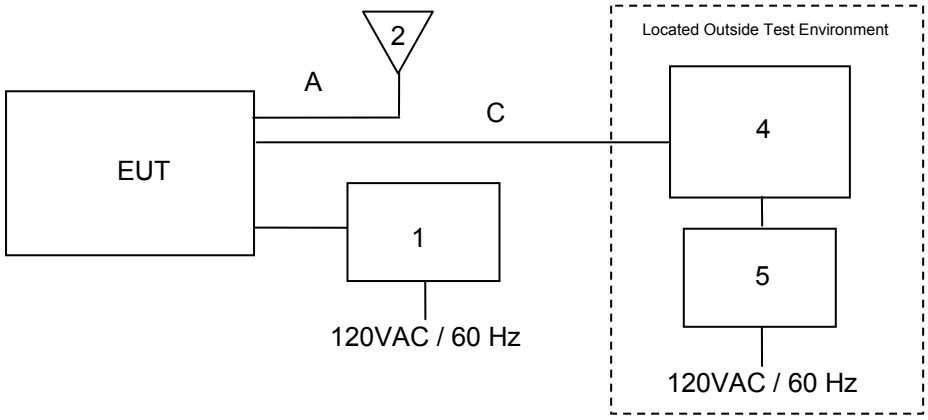

Figure 1: Radiated & AC Power Line Conducted Emissions Setup – Omni Antenna

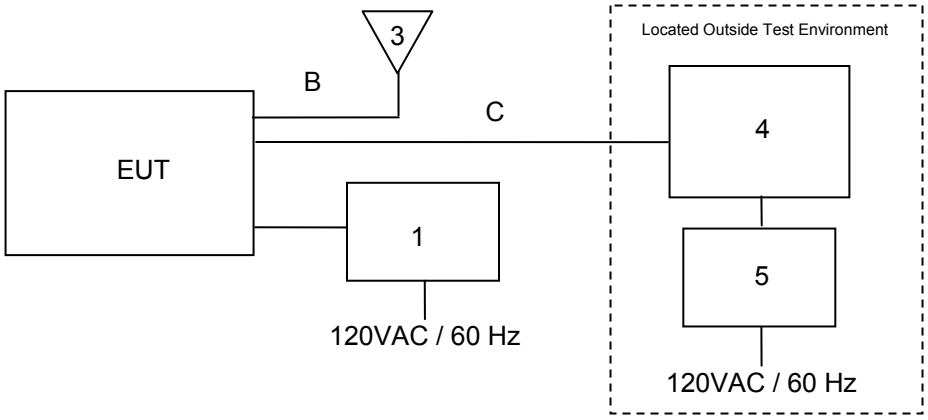

Figure 2: Radiated & AC Power Line Conducted Emissions Setup – Yagi Antenna

A – 60' LMR-400 Coaxial Cable - Shielded
B – 130' LMR-400 Coaxial Cable - Shielded
C – 20' RJ45 Cable – Shielded

Figure 6-1: EUT Test Setup

7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement – FCC: Section 15.203

The MH902 utilizes a SMA connector and is professionally installed.

7.2 Power Line Conducted Emissions – FCC: Section 15.207 IC: RSS-Gen 7.2.2

7.2.1 Measurement Procedure

ANSI C63.4 sections 6 and 7 were the guiding documents for this evaluation. Conducted emissions were performed from 150kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 9kHz and the video bandwidth set to 30kHz. The calculation for the conducted emissions is as follows:

Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss
Margin = Applicable Limit - Corrected Reading

7.2.2 Measurement Results

Results of the test are shown below in and Tables 7.2.2-1 to 7.2.2-4.

Table 7.2.2-1: Line 1 Conducted EMI Results – Omni Antenna

Frequency (MHz)	Level (dBuV)	Transducer (dB)	Limit (dBuV)	Margin (dB)	Line	PE	Detector
0.318	40.7	10	60	19.1	L1	FLO	QP
9.222	40.8	9.9	60	19.2	L1	FLO	QP
9.558	42.7	9.9	60	17.3	L1	FLO	QP
9.624	42.7	9.9	60	17.3	L1	FLO	QP
9.69	41.4	9.9	60	18.6	L1	FLO	QP
9.894	42.8	9.9	60	17.2	L1	FLO	QP
9.96	42.5	9.9	60	17.5	L1	FLO	QP
10.092	42.4	9.9	60	17.6	L1	FLO	QP
10.428	42	9.9	60	18	L1	FLO	QP
10.83	40.9	9.9	60	19.1	L1	FLO	QP
0.336	34.1	10	49	15.2	L1	FLO	AVG
9.09	37.7	9.9	50	12.3	L1	FLO	AVG
9.492	39.3	9.9	50	10.7	L1	FLO	AVG
9.762	37.4	9.9	50	12.6	L1	FLO	AVG
9.828	36.7	9.9	50	13.3	L1	FLO	AVG
9.894	37.9	9.9	50	12.1	L1	FLO	AVG
10.092	38.2	9.9	50	11.8	L1	FLO	AVG
10.428	38.1	9.9	50	11.9	L1	FLO	AVG
10.83	37.3	9.9	50	12.7	L1	FLO	AVG

Table 7.2.2-2: Line 2 Conducted EMI Results – Omni Antenna

Frequency (MHz)	Level (dBuV)	Transducer (dB)	Limit (dBuV)	Margin (dB)	Line	PE	Detector
0.318	43.5	10	60	16.3	L2	FLO	QP
8.958	37.4	9.9	60	22.6	L2	FLO	QP
9.294	41.5	9.9	60	18.5	L2	FLO	QP
9.36	40.3	9.9	60	19.7	L2	FLO	QP
9.696	42	9.9	60	18	L2	FLO	QP
9.828	41.3	9.9	60	18.7	L2	FLO	QP
10.098	42.1	9.9	60	17.9	L2	FLO	QP
10.164	42.1	9.9	60	17.9	L2	FLO	QP
11.034	41.1	9.9	60	18.9	L2	FLO	QP
0.27	39.5	10	51	11.6	L2	FLO	AVG
8.958	33.1	9.9	50	16.9	L2	FLO	AVG
9.162	37.2	9.9	50	12.8	L2	FLO	AVG
9.36	34.2	9.9	50	15.8	L2	FLO	AVG
9.696	36.1	9.9	50	13.9	L2	FLO	AVG
9.762	35.4	9.9	50	14.6	L2	FLO	AVG
10.002	13.9	9.9	50	36.1	L2	FLO	AVG
10.23	34.5	9.9	50	15.5	L2	FLO	AVG
10.296	32.2	9.9	50	17.8	L2	FLO	AVG
11.034	34.1	9.9	50	15.9	L2	FLO	AVG

Table 7.2.2-3: Line 1 Conducted EMI Results – Yagi Antenna

Frequency (MHz)	Level (dBuV)	Transducer (dB)	Limit (dBuV)	Margin (dB)	Line	PE	Detector
0.324	40.5	10	60	19.1	L1	FLO	QP
9.222	40.9	9.9	60	19.1	L1	FLO	QP
9.624	41.4	9.9	60	18.6	L1	FLO	QP
9.69	41.1	9.9	60	18.9	L1	FLO	QP
9.756	40	9.9	60	20	L1	FLO	QP
10.158	41.4	9.9	60	18.6	L1	FLO	QP
10.56	41	9.9	60	19	L1	FLO	QP
0.336	34.4	10	49	14.9	L1	FLO	AVG
9.156	37.8	9.9	50	12.2	L1	FLO	AVG
9.558	38.8	9.9	50	11.2	L1	FLO	AVG
9.69	37.6	9.9	50	12.4	L1	FLO	AVG
9.894	38.1	9.9	50	11.9	L1	FLO	AVG
10.092	36.9	9.9	50	13.1	L1	FLO	AVG
10.428	37.8	9.9	50	12.2	L1	FLO	AVG
10.56	37	9.9	50	13	L1	FLO	AVG

Table 7.2.2-4: Line 2 Conducted EMI Results – Yagi Antenna

Frequency (MHz)	Level (dBuV)	Transducer (dB)	Limit (dBuV)	Margin (dB)	Line	PE	Detector
0.402	39.5	10.1	58	18.3	L2	FLO	QP
8.76	40.4	9.9	60	19.6	L2	FLO	QP
9.63	41.8	9.9	60	18.2	L2	FLO	QP
9.696	41.4	9.9	60	18.6	L2	FLO	QP
9.828	40	9.9	60	20	L2	FLO	QP
10.002	29.5	9.9	60	30.5	L2	FLO	QP
10.098	40.8	9.9	60	19.2	L2	FLO	QP
14.31	41.7	9.8	60	18.3	L2	FLO	QP
0.402	37.3	10.1	48	10.6	L2	FLO	AVG
8.694	34.9	9.9	50	15.1	L2	FLO	AVG
9.564	34.6	9.9	50	15.4	L2	FLO	AVG
9.63	35.3	9.9	50	14.7	L2	FLO	AVG
9.762	34.4	9.9	50	15.6	L2	FLO	AVG
9.828	33.3	9.9	50	16.7	L2	FLO	AVG
10.002	13	9.9	50	37	L2	FLO	AVG
14.244	35.4	9.8	50	14.6	L2	FLO	AVG

7.3 Radiated Emissions – FCC: Section 15.109 (Unintentional Radiation) IC: RSS-210 2.6

7.3.1 Measurement Procedure

Radiated emissions tests were performed over the frequency range of 30MHz to 5GHz. Measurements of the radiated field strength were made at a distance of 3m from the boundary of the equipment under test (EUT) and the receiving antenna. The antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. Radiated measurements above 30MHz and below 1GHz were made with the Spectrum Analyzer's resolution bandwidth set to 120 KHz using a Quasi-peak detector. Above 1GHz, peak and average measurements are taken with the RBW and VBW were set to 1MHz and 3MHz respectively.

7.3.2 Measurement Results

Results of the test are given in Tables 7.3.2-1 to 7.3.2-2 below:

Table 7.3.2-1: Radiated Emissions Tabulated Data – Omni Antenna

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
33.4	--------	41.22	V	-8.64	---------	32.58	--------	40.0	---------	7.4
43.627	--------	48.35	V	-13.71	---------	34.64	--------	40.0	---------	5.4
60.16	--------	47.62	V	-19.60	---------	28.02	--------	40.0	---------	12.0
68.95	--------	46.61	V	-19.28	---------	27.33	--------	40.0	---------	12.7
130.294	--------	38.99	V	-13.41	---------	25.58	--------	43.5	---------	17.9
701.45	--------	19.90	V	-1.01	---------	18.89	--------	46.0	---------	27.1
957.97	--------	19.75	H	3.12	---------	22.87	--------	46.0	---------	23.1

* Note: All emissions above 957.97 MHz were attenuated below the permissible limit.

Table 7.3.2-2: Radiated Emissions Tabulated Data – Yagi Antenna

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
31.49	---------	38.06	V	-7.60	---------	30.46	--------	40.0	---------	9.5
45.47	---------	48.11	V	-14.64	---------	33.47	--------	40.0	---------	6.5
50.04	---------	50.30	V	-17.01	---------	33.29	--------	40.0	---------	6.7
86.04	---------	41.87	V	-16.85	---------	25.02	--------	40.0	---------	15.0
97.09	---------	45.88	V	-15.17	---------	30.71	--------	43.5	---------	12.8
199.98	---------	43.06	V	-15.40	---------	27.66	--------	43.5	---------	15.8

* Note: All emissions above 199.98 MHz were attenuated below the permissible limit.

7.4 Peak Output Power - FCC Section 15.247(b)(2) IC: RSS-210 A8.4(1)

7.4.1 Measurement Procedure (Conducted Method)

The 20dB bandwidth of the EUT was within the resolution bandwidth of spectrum analyzer, therefore the power measurement was made using the spectrum analyzer method. The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The resolution and video bandwidth were set to > 20 dB bandwidth of the emission measured. The device employs >50 channels therefore the power is limited to 1 Watt.

7.4.2 Measurement Results

Results are shown in Table 7.4.2-1 and Figures 7.4.2-1 to 7.4.2-3 below.

Table 7.4.2-1: RF Output Power

Frequency [MHz]	Level [dBm]
902.3	28.89
914.8	29.47
927.3	29.12

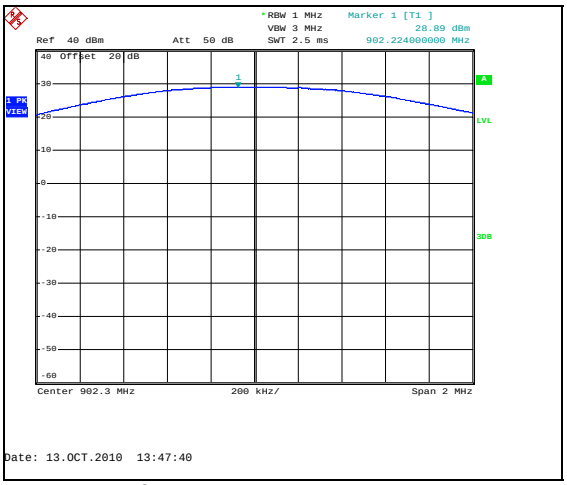

Figure 7.4.2-1: Output Power – LCH

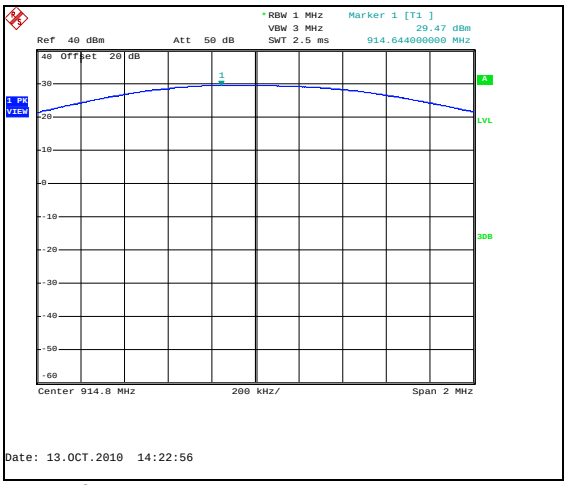

Figure 7.4.2-2: Output Power – MCH

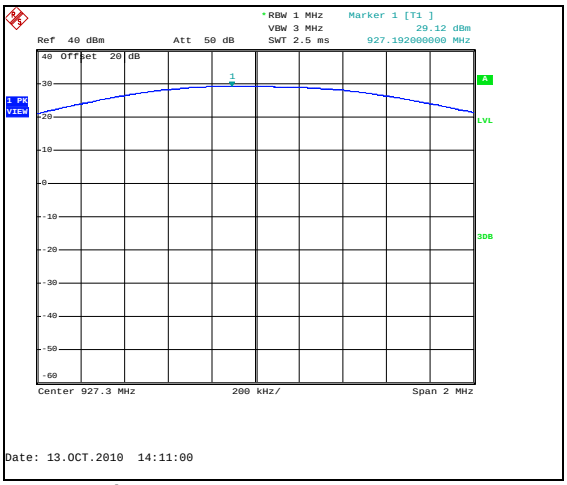

Figure 7.4.2-3: Output Power – HCH

7.5 Channel Usage Requirements

7.5.1 Carrier Frequency Separation – FCC: Section 15.247(a)(1) IC: RSS-210 A8.1(b)

7.5.1.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer was set wide enough to capture two adjacent peaks and the RBW and VBW were set to ≥ 1% of the span.

7.5.1.2 Measurement Results

The adjacent channel separation was measured to be 500 kHz. Results are shown below in Figure 7.5.1.2-1.

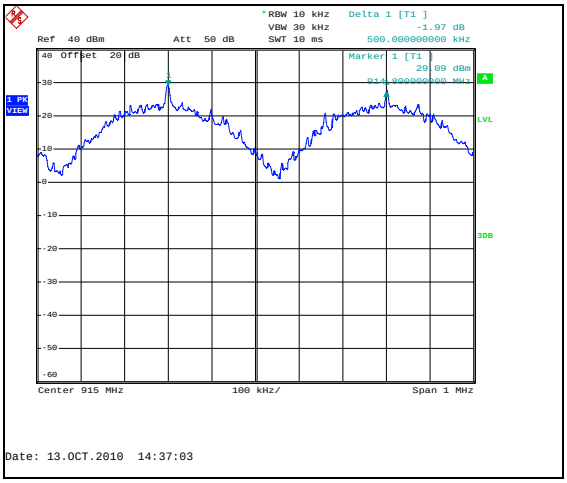

Figure 7.5.1.2-1: Channel Separation

7.5.2 Number of Hopping Channels – FCC: Section 15.247(a)(1)(i) IC: RSS-210 A8.1(c)

The 20dB bandwidth of the device is greater than 250 kHz. The device employs > 25 hopping channels as required. Results are shown below in Figure 7.5.2-1.

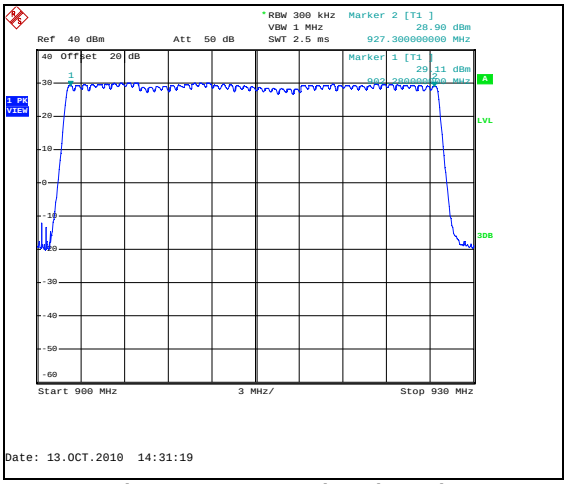

Figure 7.5.2-1: Hopping Channels

7.5.3 Channel Dwell Time – FCC: Section 15.247(a)(1)(i) IC: RSS-210 A8.1(c)

7.5.3.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The hopping channel is centered on the analyzer and the span set to 0 Hz. The RBW was set to 1 MHz and the VBW to 3 MHz. Sweep time was adjusted to capture the burst duration of the emission. The marker–delta function of the analyzer was employed to measure the burst duration and repetition.

7.5.3.2 Measurement Results

The duration of the RF transmission was measured as 19.14 ms. The maximum time of occupancy on any channel in a 10 second period is shown as 38.28 ms. A single transmission and the transmission repetition are shown in figures 7.5.3.2-1 to 7.5.3.2-2 below.

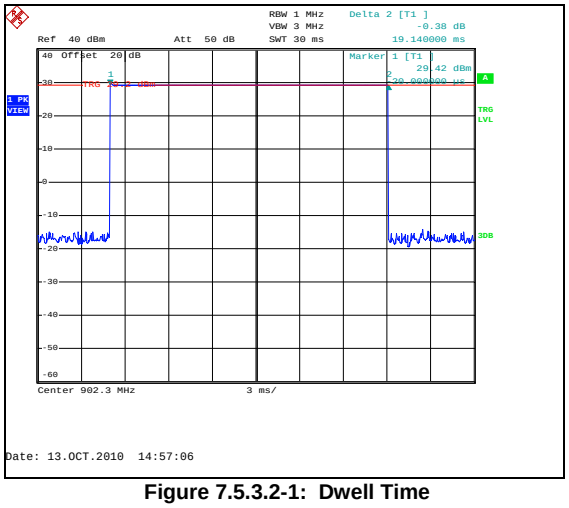

Figure 7.5.3.2-1: Dwell Time

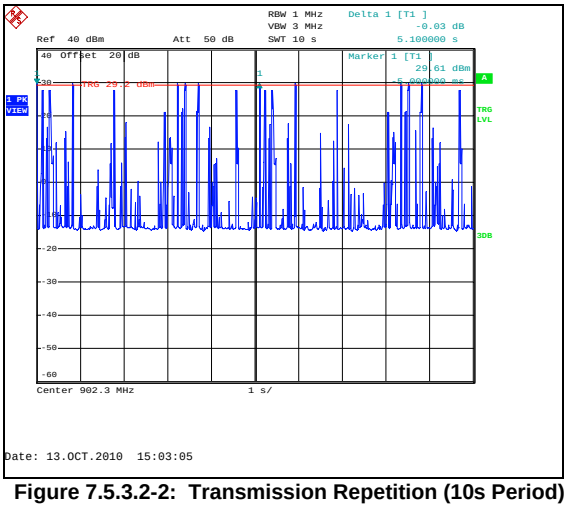

Figure 7.5.3.2-2: Transmission Repetition (10s Period)

7.5.4 20dB / 99% Bandwidth - FCC: Section 15.247(a)(1)(i) IC: RSS-210 A8.1(c)

7.5.4.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The spectrum analyzer span was set to 2 to 3 times the estimated bandwidth of the emission. The RBW was to ≥ 1% of the estimated emission bandwidth. The trace was set to max hold with a peak detector active. The Delta function of the analyzer was utilized to determine the 20 dB bandwidth of the emission.

The 99% occupied bandwidth was measured with the spectrum analyzer span set to fully display the emission and approximately 20dB below the peak level. The RBW was to 1% to 3% of the approximate emission width. The trace was set to max hold with a peak detector active. The occupied bandwidth measurement function of the analyzer was used for the 99% bandwidth.

7.5.4.2 Measurement Results

Results are shown below in Table 7.5.4.2-1 and Figures 7.5.4.2-1 through 7.5.4.2-6.

Table 7.5.4.2-1: 20dB / 99% Bandwidth

Frequency [MHz]	20dB Bandwidth [kHz]	99% Bandwidth [kHz]
902.3	410.0	410.4
914.8	422.0	416.4
927.3	420.0	411.6

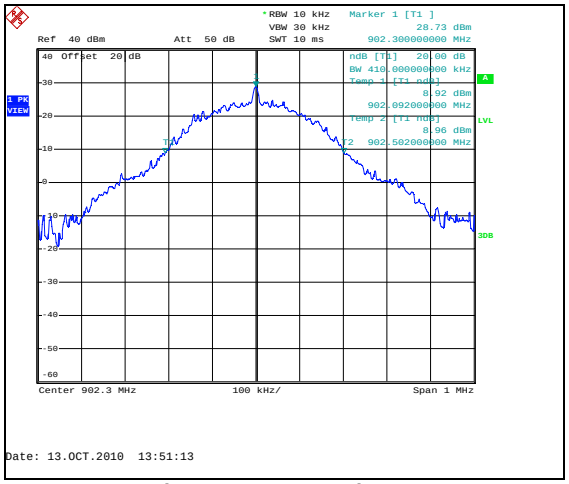

Figure 7.5.4.2-1: 20dB BW LCH

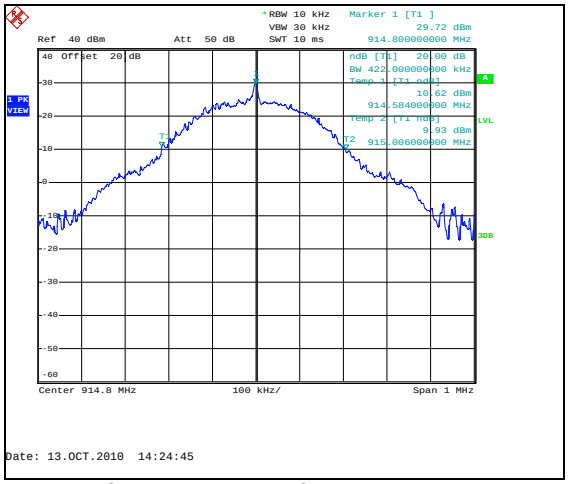

Figure 7.5.4.2-2: 20dB BW MCH

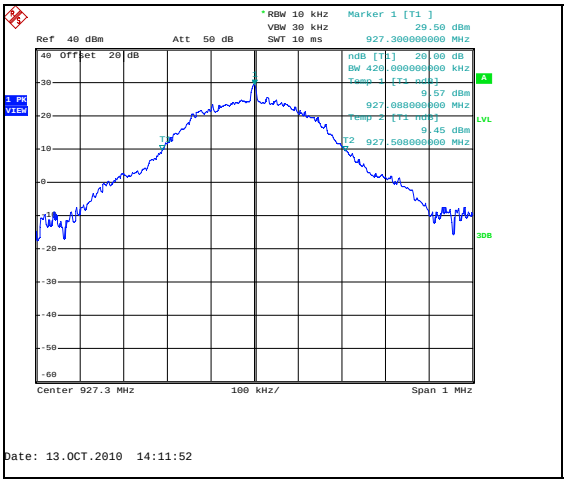

Figure 7.5.4.2-3: 20dB BW HCH

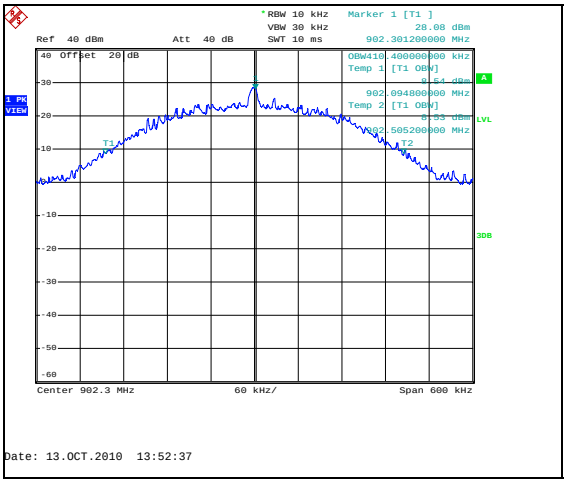

Figure 7.5.4.2-4: 99% BW LCH

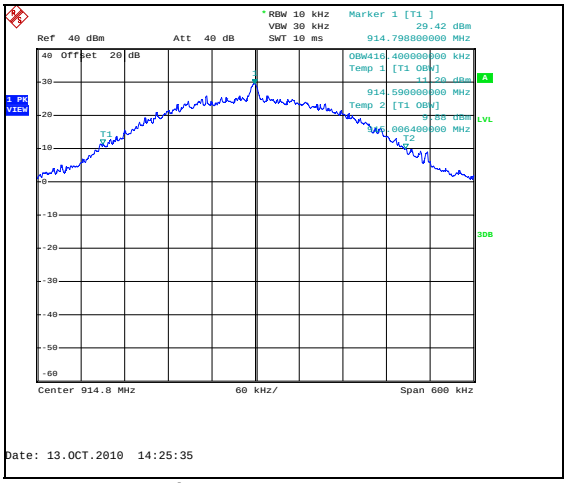

Figure 7.5.4.2-5: 99% BW MCH

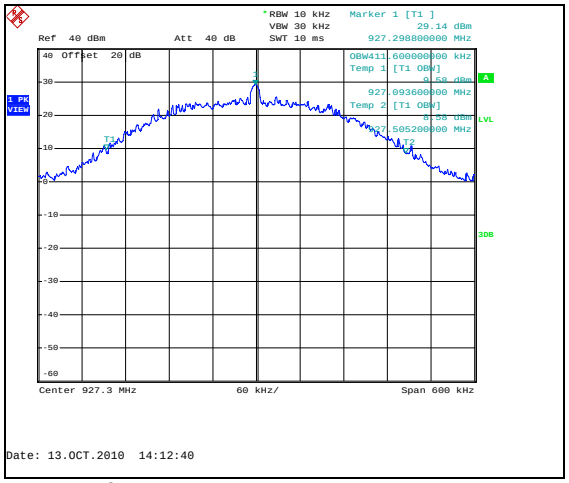

Figure 7.5.4.2-6: 99% BW HCH

7.6 Band-Edge Compliance and Spurious Emissions-FCC 15.247(d) IC: RSS-210 A8.5

7.6.1 Band-Edge Compliance of RF Conducted Emissions

7.6.1.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The EUT was investigated at the lowest and highest channel available to determine band-edge compliance. For each measurement the spectrum analyzer's RBW was set to ≥ 1% of the span, and the VBW was set to ≥ 3 times RBW.

7.6.1.2 Measurement Results

Results are shown in the figures 7.6.1.2-1 to 7.6.1.2.4 below.

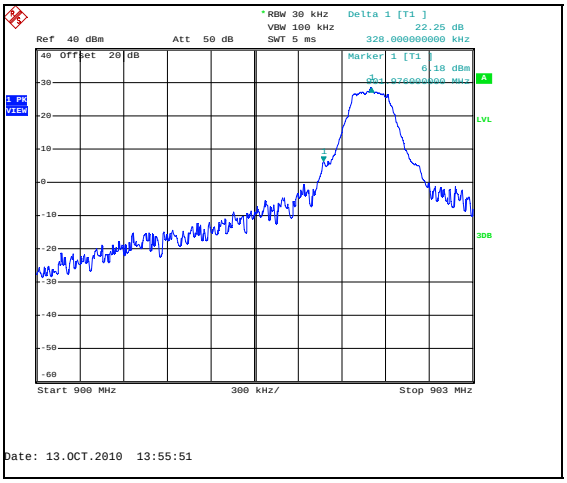

Figure 7.6.1.2-1: Lower Band-edge

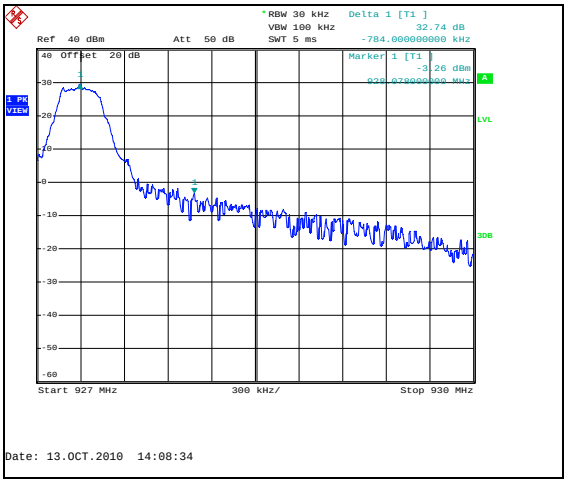

Figure 7.6.1.2-2: Upper Band-edge

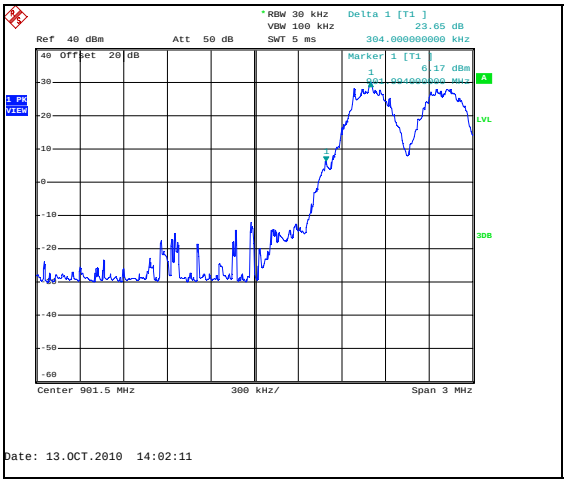

Figure 7.6.1.2-3: Lower Band-edge – Hopping

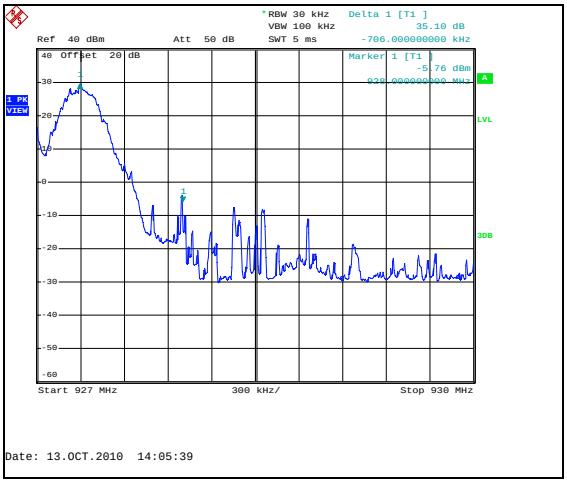

Figure 7.6.1.2-4: Upper Band-edge - Hopping

7.6.2 RF Conducted Spurious Emissions

7.6.2.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The EUT was investigated for conducted spurious emissions from 30MHz to 10GHz, 10 times the highest fundamental frequency. Measurements were made at the low, center and high channels of the EUT. For each measurement, the spectrum analyzer's RBW was set to 100kHz. A peak detector function was used with the trace set to max hold.

7.6.2.2 Measurement Results

Results are shown below in Figures 7.6.2.2-1 to 7.6.2.2-6:

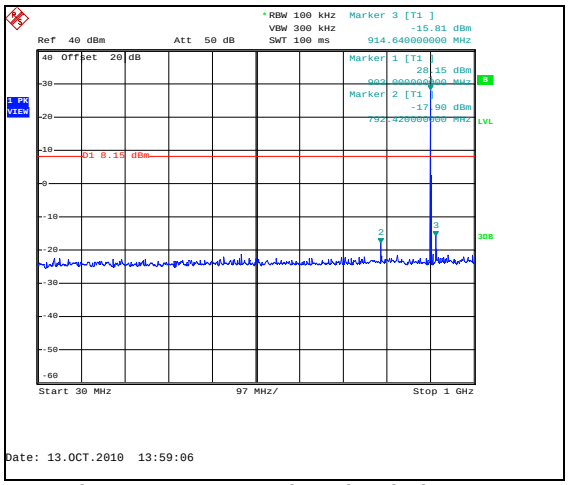

Figure 7.6.2.2-1: Conducted Emissions - LCH

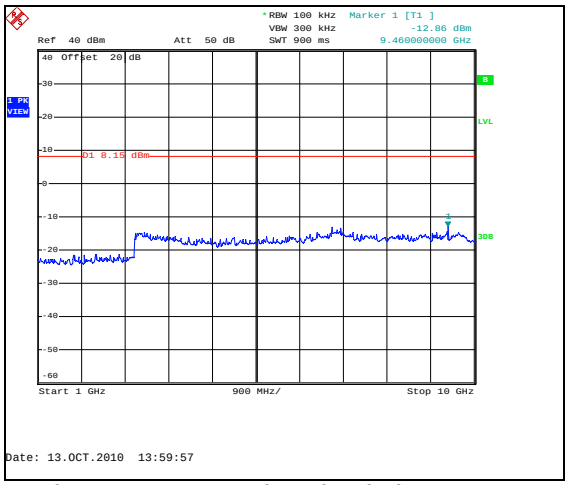

Figure 7.6.2.2-2: Conducted Emissions - LCH

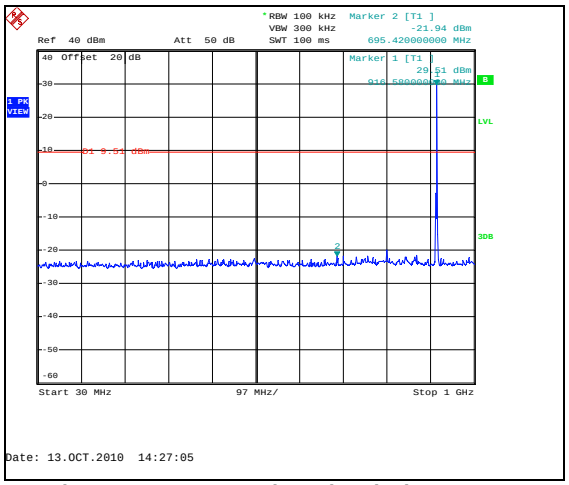

Figure 7.6.2.2-3: Conducted Emissions - MCH

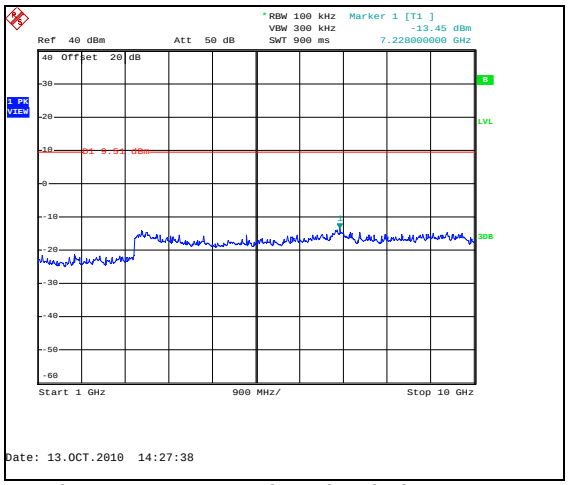

Figure 7.6.2.2-4: Conducted Emissions - MCH

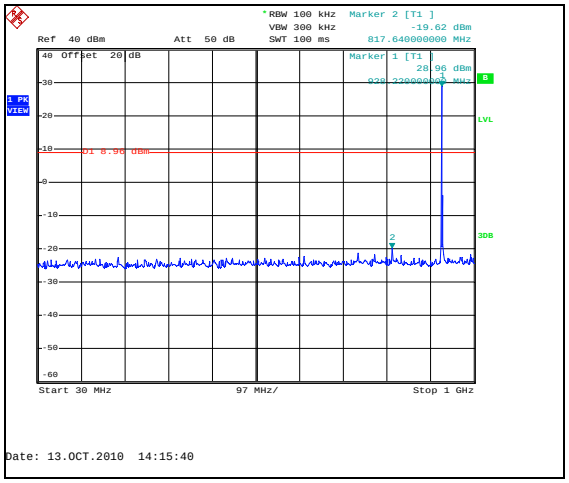

Figure 7.6.2.2-5: Conducted Emissions - HCH

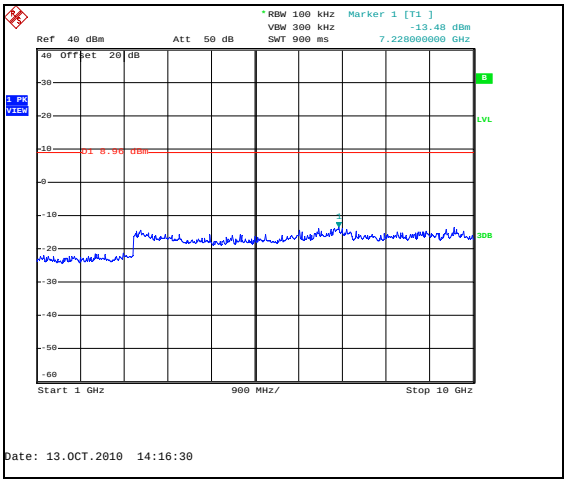

Figure 7.6.2.2-6: Conducted Emissions - HCH

7.6.3 Radiated Spurious Emissions - FCC Section 15.205 IC: RSS-210 2.6

7.6.3.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 30MHz to 10GHz, 10 times the highest fundamental frequency.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 120 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000MHz, peak measurements made with RBW and VBW of 1 MHz and 3MHz respectively.

The EUT was caused to generate a continuous carrier signal on the hopping channel.

7.6.3.2 Duty Cycle Correction

For average radiated measurements, using a 19.14% duty cycle based on channel dwell time, the measured level was reduced by a factor 14.36dB. The duty cycle correction factor is determined using the formula: 20log (19.14/100) = 14.36dB.

7.6.3.3 Measurement Results

Radiated spurious emissions found in the band of 30MHz to 10GHz are reported in the Tables 7.6.3.2-1 to 7.6.3.2-2 below.

Table 7.6.3.2-1: Radiated Spurious Emissions – Omni-directional Antenna

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel										
109.9	---------	43.62	H	-13.91	---------	29.71	--------	43.5	---------	13.8
109.9	---------	53.62	V	-13.91	---------	39.71	--------	43.5	---------	3.8
1011	64.94	61.74	H	-12.68	52.26	34.70	74.0	54.0	21.70	19.3
1011	73.91	72.36	V	-12.68	61.23	45.32	74.0	54.0	12.80	8.7
4511.5	50.04	40.41	H	2.37	52.41	28.42	74.0	54.0	21.60	25.6
4511.5	55.12	45.75	V	2.37	57.49	33.76	74.0	54.0	16.50	20.2
5413.8	50.01	40.29	H	4.87	54.88	30.79	74.0	54.0	19.10	23.2
5413.8	49.17	39.83	V	4.87	54.04	30.33	74.0	54.0	20.00	23.7
Middle Channel										
109.9	---------	39.43	H	-13.91	---------	25.52	--------	43.5	---------	18.0
109.9	---------	52.08	V	-13.91	---------	38.17	--------	43.5	---------	5.3
1024	63.24	60.83	H	-12.57	50.67	33.90	74.0	54.0	23.30	20.1
1024	74.11	72.38	V	-12.57	61.54	45.45	74.0	54.0	12.50	8.6
4574	50.01	41.00	H	2.56	52.57	29.20	74.0	54.0	21.40	24.8
4574	52.86	45.47	V	2.56	55.42	33.67	74.0	54.0	18.60	20.3
9148	50.47	39.53	H	10.12	60.59	35.29	74.0	54.0	13.40	18.7
High Channel										
109.9	---------	39.43	H	-13.91	---------	25.52	--------	43.5	---------	18.00
109.9	---------	56.85	V	-13.91	---------	42.94	--------	43.5	---------	0.60
1037	62.41	59.18	H	-12.46	49.95	32.36	74.0	54.0	24.10	21.60
1037	73.71	72.03	V	-12.46	61.25	45.21	74.0	54.0	12.80	8.80
4636.5	52.55	45.70	H	2.74	55.29	34.08	74.0	54.0	18.70	19.90
4636.5	54.01	47.40	V	2.74	56.75	35.78	74.0	54.0	17.20	18.20

Table 7.6.3.2-2: Radiated Spurious Emissions – Yagi Antenna

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel										
109.8	---------	51.75	H	-13.91	---------	37.84	--------	43.5	---------	5.7
109.8	---------	55.74	V	-13.91	---------	41.83	--------	43.5	---------	1.7
1011	69.29	66.93	H	-12.68	56.61	39.89	74.0	54.0	17.40	14.1
1011	73.91	71.70	V	-12.68	61.23	44.66	74.0	54.0	12.80	9.3
4511.5	58.09	50.52	H	2.37	60.46	38.53	74.0	54.0	13.50	15.5
4511.5	51.85	42.34	V	2.37	54.22	30.35	74.0	54.0	19.80	23.6
5413.8	48.11	38.84	H	4.87	52.98	29.34	74.0	54.0	21.00	24.7
Middle Channel										
109.8	---------	46.16	H	-13.91	---------	32.25	--------	43.5	---------	11.3
109.8	---------	50.12	V	-13.91	---------	36.21	--------	43.5	---------	7.3
1024	66.32	63.50	H	-12.57	53.75	36.57	74.0	54.0	20.30	17.4
1024	72.55	69.69	V	-12.57	59.98	42.76	74.0	54.0	14.00	11.2
4574	56.82	51.00	H	2.56	59.38	39.20	74.0	54.0	14.60	14.8
4574	52.35	45.06	V	2.56	54.91	33.26	74.0	54.0	19.10	20.7
9148	52.55	42.88	H	10.12	62.67	38.64	74.0	54.0	11.30	15.4
9148	49.12	38.74	V	10.12	59.24	34.50	74.0	54.0	14.80	19.5
High Channel										
109.8	---------	48.85	H	-13.91	---------	34.94	--------	43.5	---------	8.60
109.8	---------	53.95	V	-13.91	---------	40.04	--------	43.5	---------	3.50
1037	72.46	70.10	H	-12.46	60.00	43.28	74.0	54.0	14.00	10.70
1037	73.93	72.36	V	-12.46	61.47	45.54	74.0	54.0	12.50	8.50
4636.5	58.47	53.64	H	2.74	61.21	42.02	74.0	54.0	12.80	12.00
4636.5	53.47	47.09	V	2.74	56.21	35.47	74.0	54.0	17.80	18.50

7.6.3.4 Sample Calculation:

$R_C = R_U + CF_T$

Where:

CF_T = Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)
R_U = Uncorrected Reading
R_C = Corrected Level
AF = Antenna Factor
CA = Cable Attenuation
AG = Amplifier Gain
DC = Duty Cycle Correction Factor

Example Calculation: Peak
Corrected Level: 64.94 - 12.68 = 52.26dBuV/m
Margin: 74dBuV/m – 52.26dBuV/m = 21.7dB

Example Calculation: Average
Corrected Level: 61.74 - 12.68 – 14.36 = 34.70dBuV/m
Margin: 54dBuV/m – 34.70dBuV/m = 19.3dB

8 CONCLUSION

In the opinion of ACS, Inc. the MH902, manufactured by L3 Nova Engineering meets the requirements of FCC Part 15 subpart C and Industry Canada's Radio Standards Specification RSS-210.

END REPORT