

**NATIONAL CERTIFICATION LABORATORY**  
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**FCC REPORT OF RADIO INTERFERENCE**

for

**Microhard Systems Inc**  
**#209 - 12 Manning Close N.E.**  
**Calgary, Alberta Canada**

**FCC ID: NS999P2**

**May 13, 1999**

## **TABLE OF CONTENTS**

Application Form 731  
FCC Label Drawing and Location

- 1.0** Introduction
- 1.1** Summary
- 2.0** Description of Equipment Under Test (EUT)
- 3.0** Test Program
- 4.0** Test Configuration
- 5.0** Conducted Emissions Scheme
- 6.0** Radiated Emissions Scheme

### **TABLES**

- Table 1. Support Equipment
- Table 2. Interface Cables
- Table 3. Measurement Equipment

### **EXHIBITS**

- Exhibit 1. EUT Photographs
- Exhibit 2. Schematic Diagram
- Exhibit 3. User Manual
- Exhibit 4. Explanation of 15.247(1)/(1)i

## 1.0 Introduction

This report has been prepared on behalf of Microhard Systems, Inc., to support the attached Application for Certification of a Part 15 Spread Spectrum Transmitter module. The Equipment Under Test was the **Model MHX-900 Wireless Modem Transceiver OEM Module**.

Radio-Noise Emissions tests were performed according to *FCC Public Notice 54797, titled "Guidance on Measurements for Direct Sequence SST"*. The measuring equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

Testing was performed at National Certification Laboratory in Ellicott City, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch. FCC acceptance was granted on May 26, 1993.

## 1.1 Summary

The Microhard Systems, Inc. **Model MHX-900** complies with the FCC limits (15.247) for a Frequency Hopping SST.

## 2.0 Description of Equipment Under Test (EUT)

The EUT Features:

Reverse TNC Antenna Connector per 15.203
+ 30 dBm RF Output Max.
902 - 928 MHz Freq. Range
350 kHz 20 dB Emission Bandwidth
64 Hopping Channels
400 Khz Channel Separation
172.8 kbps Data Rate (Radio Link)

### **3.0 Test Program**

This report contains measurement charts and data as evidence for the following tests performed:

1. (15.247 b) Peak RF output power.
2. (15.247 c) Field strength of harmonics and spurious out-of-band emissions.
3. (15.247 c) RF Antenna Conducted of harmonics and spurious out-of-band emissions.
4. (15.247 a) 20 dB Emission Bandwidth.
5. (15.207) Power Line Conducted Emissions.

### **4.0 Test Configuration**

RF antenna conducted output tests such as Bandwidth, Spurious/Harmonics, and Power output, were taken with the transmitter antenna connector feeding directly into the spectrum analyzer via external 30 dB attenuator. The analyzer's internal attenuator was adjusted to prevent overloading of the front end. The transmitter is modulated at 115.2 kbps which is the highest available data rate.

Field strength measurements were taken with the transmitter feeding a yagi, or omni antenna aimed at the receiving measurement antenna. Testing was performed using the highest gain antenna from each design family (yagi, omni) with the power setting at 1 watt for the omni antenna, and 100 mW for the higher gain yagi.

A list of all possible antennas that will be sold with the MRX-900 Wireless Modem is included in Table 1 of this report.

### **PEAK POWER TEST RESULTS**

Limit: 1.0 watts (30 dBm)

Condition: Transmitter is set to a single FM modulated channel

Readings from spectrum analyzer with 1 MHz Resolution BW setting:

<b>Channel 1:</b>	<b>902.5 MHz</b>	<b>-</b>	<b>+29.4 dBm</b>
<b>Channel 32:</b>	<b>915.0 MHz</b>	<b>-</b>	<b>+29.8 dBm</b>
<b>Channel 64:</b>	<b>927.8 MHz</b>	<b>-</b>	<b>+29.2 dBm</b>

SEE FOLLOWING 3 PLOTS OF MODULATED CARRIER

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PEAK POWER MEASUREMENTS - MODULATED WITH 1 MHZ RES. BW



PEAK POWER MEASUREMENTS - MODULATED WITH 1 MHZ RES. BW



## **20 dB EMISSION BANDWIDTH**

Maximum 20 dB BW: 0.500 MHz  
RBW Setting on S.A.: 10 kHz

Condition: Transmitter is set to a single channel FM modulated at

115.2 kbps

Readings from spectrum analyzer:

Channel 1:	902.5 MHz	-	196 kHz
Channel 32:	915.0 MHz	-	196 kHz
Channel 64:	927.8 MHz	-	204 kHz

SEE FOLLOWING PLOT 3 PLOTS OF MODULATED CARRIER

20 DB EMISSION BANDWIDTH - MODULATED WITH 10 KHZ RES. BW

20 DB EMISSION BANDWIDTH - MODULATED WITH 10 KHZ RES. BW



## **RF ANTENNA CONDUCTED SPURIOUS/HARMONICS EMISSIONS**

Limit: 20 dB below Carrier Level Measured with 100 kHz RBW  
RBW Setting on S.A.: 100 kHz

Condition: Transmitter is set to a single FM modulated channel.  
RF power = 30 dBm

Three separate Measurements are performed to show harmonic and spurious emissions generated with the transmitter tuned to low,

middle, and high parts of the spectral range.

SEE FOLLOWING 3 PLOTS & DATA TABLES

## FCC PART 15.247(c) - CONDUCTED SPURIOUS EMISSIONS

Frequency of Carrier = 902.5 MHz

Limit = 20 dBc

Condition: Transmitter is set to a single FM modulated channel.

### TEST RESULTS

LIMIT: -20 dB FROM PEAK CARRIER

<u>COMPONENT</u>	<u>FREQUENCY (MHZ)</u>	<u>RESULT (dB FROM PEAK)</u>
HARMONIC	1805.00	- 58.4
HARMONIC	2707.50	- 62.0
HARMONIC	3610.00	- 73.0
HARMONIC	4512.50	- 73.0
HARMONIC	5415.00	- 74.0
HARMONIC	6317.50	- 75.0
HARMONIC	7220.00	- 75.0
HARMONIC	8122.50	- 75.0
HARMONIC	9025.00	- 75.0



**FCC PART 15.247(c) - CONDUCTED SPURIOUS EMISSIONS**

**Frequency of Carrier = 915.00 MHz**

**Limit = 20 dBc**

**Condition: Transmitter is set to a single FM modulated channel.**

**TEST RESULTS**

LIMIT: -20 dB FROM PEAK CARRIER

<u>COMPONENT</u>	<u>FREQUENCY (MHZ)</u>	<u>RESULT (dB FROM PEAK)</u>
HARMONIC	1830.00	- 56.8
HARMONIC	2745.00	- 67.0
HARMONIC	3660.00	- 71.0
HARMONIC	4572.00	- 72.0
HARMONIC	5490.00	- 70.0
HARMONIC	6405.00	- 73.0
HARMONIC	7320.00	- 74.0
HARMONIC	8235.00	- 75.0
HARMONIC	9150.00	- 75.0

**FCC PART 15.247(c) - CONDUCTED SPURIOUS EMISSIONS**

**Frequency of Carrier = 927.8 MHz**

**Limit = 20 dBc**

**Condition: Transmitter is set to a single FM modulated channel.**

**TEST RESULTS**

LIMIT: -20 dB FROM PEAK CARRIER

<u>COMPONENT</u>	<u>FREQUENCY (MHZ)</u>	<u>RESULT (dB FROM PEAK)</u>
HARMONIC	1855.60	- 57.0
HARMONIC	2783.40	- 69.0
HARMONIC	3711.20	- 72.0
HARMONIC	4639.00	- 73.0
HARMONIC	5566.80	- 71.0
HARMONIC	6494.60	- 74.0

HARMONIC	7422.40	- 74.0
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HARMONIC	8350.20	- 75.0
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HARMONIC	9278.00	- 75.0
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CONDUCTED HARMONICS EMISSIONS - MODULATED WITH 100 KHZ RES. BW  
**LOW CHANNEL**

**0                  Fc                  2Fc                  3Fc                  4Fc**

CONDUCTED HARMONICS EMISSIONS - MODULATED WITH 100 KHZ RES. BW  
**MID CHANNEL**

**0**

**Fc**

**2Fc**

**3Fc**

**4Fc**

CONDUCTED HARMONICS EMISSIONS - MODULATED WITH 100 KHZ RES. BW  
**HIGH CHANNEL**

**0                      Fc                      2Fc                      3Fc                      4Fc**

#### **4.0 Test Configuration**

##### **RADIATED EMISSIONS**

The EUT was set up on the center of the test table, in a manner which follows the general guidelines of ANSI C63.4, Section 6 "General Operating Conditions and Configurations".

This is described below:

## **5.0 Conducted Emissions Scheme**



The EUT is placed on an 80 cm high 1 X 1.5 m non-conductive table. Power to the RF modem is provided through a Solar Corporation 50  $\Omega$ /50  $\mu$ H Line Impedance Stabilization Network bonded to a 2.2 X 2 meter horizontal ground plane, and a 2.2 X 2 meter vertical ground plane. The LISN has its AC input supplied from a filtered AC power source. A separate LISN provides AC power to the peripheral equipment. I/O cables are moved about to obtain maximum emissions.

The 50  $\Omega$  output of the LISN is connected to the input of the spectrum analyzer and emissions in the frequency range of 450 kHz to 30 MHz are searched. The detector function is set to quasi-peak and the resolution bandwidth is set at 9 kHz, with all post-detector filtering no less than 10 times the resolution bandwidth for final measurements. All emissions within 20 dB of the limit are recorded in the data tables.

## FCC CLASS B CONDUCTED EMISSIONS DATA

EUT: MHX-900  
CLIENT: MICROHARD

## **6.0 Radiated Emissions Scheme**

The EUT is placed on an 80 cm high 1 X 1.5 meter

non-conductive motorized turntable for radiated testing on the 3-meter open area test site. The emissions from the EUT are measured continuously at every azimuth by rotating the turntable. Guided horn and log periodic broadband antennas are mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna is varied between 1 and 4 meters. Both the horizontal and vertical field components are measured.

The RF spectrum is searched from 30 MHz - 9.280 GHz.

The output from the antenna is connected to the input of the preamplifier. The preamp out is connected to the spectrum analyzer. The detector function is set to **Peak**. The resolution bandwidth of the spectrum analyzer is set at 120 kHz, for the frequency range of 30-1000 MHz, and 1 MHz for the range of 1 GHz-9 GHz. A 10 Hz video BW setting is used to average readings above 1 GHz. All emissions within 20 dB of the limit are recorded in the data tables.

To convert the spectrum analyzer reading into a quantified E-field level to allow comparison with the FCC limits, it is necessary to account for various calibration factors. These factors include cable loss (CL) and antenna factors (AF). The AF/CL in dB/m is algebraically added to the Spectrum Analyzer Voltage in dB $\mu$ V to obtain the Radiated Electric Field in dB $\mu$ V/m. This level is then compared with the FCC limit.

**Example:**

Spectrum Analyzer Volt:            VdB $\mu$ V

Composite Factor:                AF/CLdB/m

Electric Field:            EdB $\mu$ V/m = VdB $\mu$ V + AF/CLdB/m

Linear Conversion: EuV/m = Antilog (EdB $\mu$ V/m/20)

## FCC CLASS B RADIATED EMISSIONS DATA

CLIENT: MICROHARD

EUT: MHX-900

CARRIER: 902.5 MHZ @ 1000 mW

ANTENNA: 5 dB OMNI

CARRIER: 915 MHZ @ 1000 mW

ANTENNA: 5 dB OMNI

CARRIER: 927.8 MHZ @ 1000 mW  
ANTENNA: 5 dB OMNI

CARRIER: 902.5 MHZ @ 100 mW  
ANTENNA: 14 dB YAGI

CARRIER: 915 MHZ @ 100 mW  
ANTENNA: 14 dB YAGI

CARRIER: 927.8 MHZ @ 100 mW  
ANTENNA: 14 dB YAGI

**Table 1**  
**Support Equipment**

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14 dB Yagi Antenna - Sinclabs - SUY-90213

12 dB Yagi Antenna - Sinclabs - SUY-90211

8 dB Yagi Antenna - Sinclabs - SUY-90207

2.5 dB Omni Antenna - 900 MHz Rubber Ducky

5 dB Omni Antenna - Sinclabs

**Table 2**

**Interface Cables Used**

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1. A 1.2 meter RS-232 serial shielded cable is used to connect the EUT to the Host computer.
2. 1 feet of low-loss coaxial cable used to connect the EUT to the TX antenna (Reverse TNC to SMC connectors).



### Table 3

#### Measurement Equipment Used

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The following equipment is used to perform measurements:

HP 435A RF Peak Power Meter	- Serial No. 1362016
EMCO Model 3110 Biconical Antenna	- Serial No. 1619
Antenna Research MWH-1825B Horn Antenna	- Serial No. 1005
EMCO Model 3115 Ridged Horn Antenna	- Serial No. 3007
HP 8348A Preamplifier	- Serial No. 197-2564A
Solar 8012-50-R-24-BNC LISN	- Serial No. 924867
Bird 8306-300-N 30dB Attenuator	- S/N: 29198391515
HP 14IT w/8555A Spectrum Analyzer	- Serial No. 6-95-1124
4 Meter Antenna Mast	
Motorized Turntable	
Heliac FSJ1-50A 1/4" Superflex Coax Cable (12 Ft.)	

