

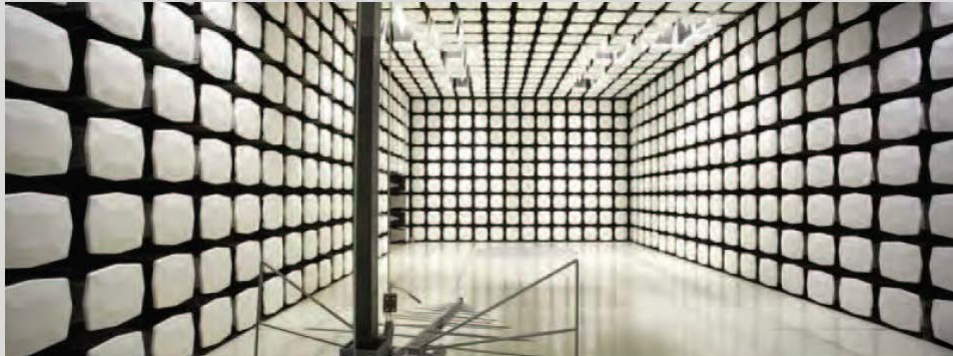


## **FreeWave Technologies, Inc.**

**MM2**

**Report No. FREW0015.3**

**FCC 2.1091:2013 Maximum Permissible Exposure Level**



Report Prepared By Northwest EMC Inc.

NORTHWEST EMC – (888) 364-2378 – [www.nwemc.com](http://www.nwemc.com)

California – Minnesota – Oregon – New York – Washington

**Certificate of Evaluation**  
Date of Evaluation: November 25, 2013  
FreeWave Technologies, Inc.  
Model: MM2

**Emissions**

Description of Evaluation	Specification	Evaluation Method	Pass/Fail
Maximum Permissible Exposure	FCC 2.1091:2013	KDB 447498 D01 General RF Exposure Guidance v05r01	<b>Pass</b>

**Approved By:**



Don Facteau, IS Manager



NVLAP Lab Code: 200630-0

*This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government of the United States of America.*

*Product compliance is the responsibility of the client, therefore the tests and equipment modes of operation represented in this report were agreed upon by the client, prior to testing. This Report may only be duplicated in its entirety. The results of this test pertain only to the sample(s) tested. The specific description is noted in each of the individual sections of the test report supporting this certificate of test.*

Revision Number	Description	Date	Page Number
00	None		

## Barometric Pressure

The recorded barometric pressure has been normalized to sea level.

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## United States

**FCC** - Designated by the FCC as a Telecommunications Certification Body (TCB). Certification chambers, Open Area Test Sites, and conducted measurement facilities are listed with the FCC.

**A2LA** - Accredited by A2LA to ISO / IEC Guide 65 as a product certifier. This allows Northwest EMC to certify transmitters to FCC and IC specifications.

**NVLAP** - Each laboratory is accredited by NVLAP to ISO 17025

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## Canada

**IC** - Recognized by Industry Canada as a Certification Body (CB). Certification chambers and Open Area Test Sites are filed with IC.

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## European Union

**European Commission** – Validated by the European Commission as a Conformity Assessment Body (CAB) under the EMC directive and as a Notified Body under the R&TTE Directive.

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## Australia/New Zealand

**ACMA** - Recognized by ACMA as a CAB for the acceptance of test data.

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## Korea

**KCC / RRA** - Recognized by KCC's RRA as a CAB for the acceptance of test data.

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## Japan

**VCCI** - Associate Member of the VCCI. Conducted and radiated measurement facilities are registered.

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## Taiwan

**BSMI** – Recognized by BSMI as a CAB for the acceptance of test data.

**NCC** - Recognized by NCC as a CAB for the acceptance of test data.

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## Singapore

**IDA** – Recognized by IDA as a CAB for the acceptance of test data.

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## Hong Kong

**OFTA** – Recognized by OFTA as a CAB for the acceptance of test data.

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## Vietnam

**MIC** – Recognized by MIC as a CAB for the acceptance of test data.

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## Russia

**GOST** – Accredited by Certinform VNIINMASH, CERTINFO, SAMTES, and Federal CHEC to perform EMC and Hygienic testing for Information Technology products to GOST standards.

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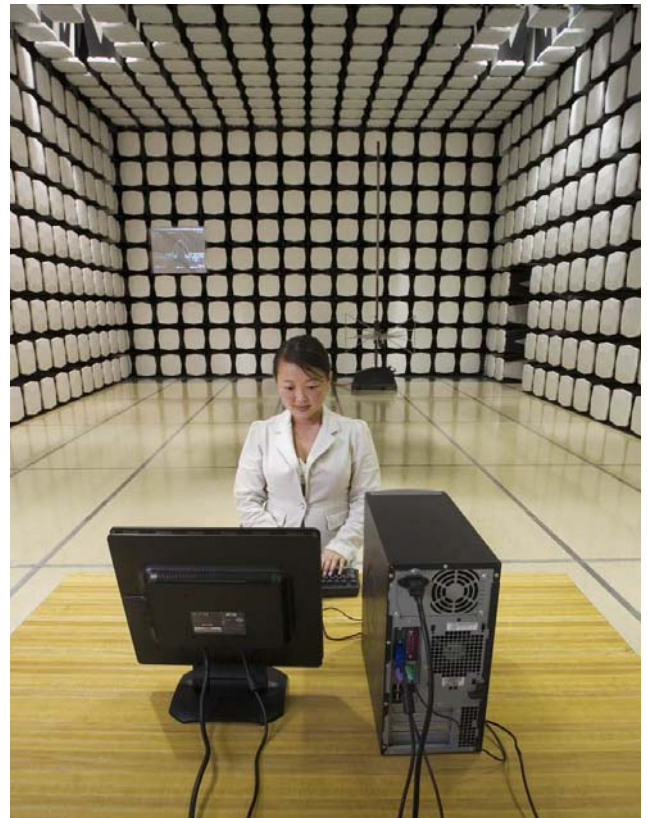
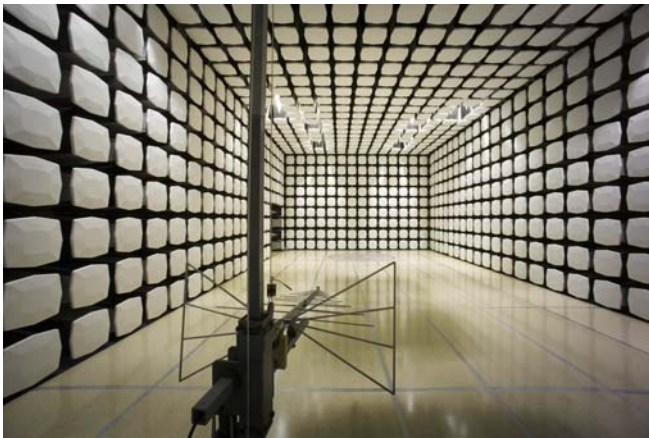
## SCOPE

For details on the Scopes of our Accreditations, please visit:

<http://www.nwemc.com/accreditations/>



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<b>VCCI</b>				
A-0108	A-0029		A-0109	A-0110
<b>Industry Canada</b>				
2834D-1, 2834D-2	2834B-1, 2834B-2, 2834B-3		2834E-1	2834C-1
<b>NVLAP</b>				
NVLAP Lab Code: 200630-0	NVLAP Lab Code: 200676-0	NVLAP Lab Code: 200761-0	NVLAP Lab Code: 200881-0	NVLAP Lab Code: 200629-0



**Client and Equipment Under Test (EUT) Information**

<b>Company Name:</b>	FreeWave Technologies, Inc.
<b>Address:</b>	5395 Pearl Parkway, Suite 100
<b>City, State, Zip:</b>	Boulder, CO 80301
<b>Test Requested By:</b>	Dean Busch
<b>Model:</b>	MM2
<b>Date of Evaluation:</b>	November 25, 2013

**Information Provided by the Party Requesting the Test****Functional Description of the EUT (Equipment Under Test):**

The 900 MHz FHSS radio transmits through one antenna and is not co-located with any other radio. The highest gain antennas of each type are a Omni antenna of 8.15 dBi and a Directional of 12.0 dBi. The product is subject to professional installation only. The output power will be lowered to meet the + 36 dBm EIRP limit.

**Objective:**

To demonstrate compliance with FCC requirements for RF exposure for 2.1091 mobile devices

## OVERVIEW

Human exposure to RF emissions from mobile devices (47 CFR §2.1091) may be evaluated based on the MPE limits adopted by the FCC for electric and magnetic field strength and/or power density, as appropriate, since exposures are assumed to occur at distances of 20 cm or more from persons. ANSI C95.1-1992 specifies a minimum separation distance of 20 cm for performing reliable field measurements to determine adherence to MPE limits. If the minimum separation distance between a transmitter and nearby persons is more than 20 cm under normal operating conditions, compliance with MPE limits may be determined at such distance from the transmitter. When applicable, operation instructions and prominent warning labels may be used to alert the exposed persons to maintain a specified distance from the transmitter or to limit their exposure durations and usage conditions to ensure compliance. If the use of warning labels on a transmitter is not effective or desirable, the alternative of performing SAR evaluation with the device at its closest range to persons under normal operating conditions may be used. The field strength and power density limits adopted by the FCC are based on whole-body averaged exposure and the assumption of RF field levels relate most accurately to estimating whole-body averaged SAR. This means some local values of exposures exceeding the stated field strength and power density limits may not necessarily imply non-compliance if the spatial average of spatially averaged RF fields over the exposed portions of a person's body does not exceed the limits.

## COMPLIANCE WITH 2.1091

*"Mobile devices that operate in the Cellular Radiotelephone Service, the Personal Communications Services, the Satellite Communications Services, the General Wireless Communications Service, the Wireless Communications Service, the Maritime Services and the Specialized Mobile Radio Service authorized under subpart H of part 22 of this chapter, parts 24, 25, 26 and 27 of this chapter, part 80 of this chapter (ship earth stations devices only) and part 90 of this chapter are subject to routine environmental evaluation for RF exposure prior to equipment authorization or use if they operate at frequencies of 1.5 GHz or below and their effective radiated power (ERP) is 1.5 watts or more, or if they operate at frequencies above 1.5 GHz and their ERP is 3 watts or more. Unlicensed personal communications service devices, unlicensed millimeter wave devices and unlicensed NII devices authorized under §§15.253, 15.255, and 15.257, and subparts D and E of part 15 of this chapter are also subject to routine environmental evaluation for RF exposure prior to equipment authorization or use if their ERP is 3 watts or more or if they meet the definition of a portable device as specified in §2.1093(b) requiring evaluation under the provisions of that section. **All other mobile and unlicensed transmitting devices are categorically excluded from routine environmental evaluation for RF exposure prior to equipment authorization or use, except as specified in §§1.1307(c) and 1.1307(d) of this chapter. Applications for equipment authorization of mobile and unlicensed transmitting devices subject to routine environmental evaluation must contain a statement confirming compliance with the limits specified in paragraph (d) of this section as part of their application.**"*

**The EUT will only be used with a separation distance of 20 centimeters or greater between the antenna and the body of the user or nearby persons and can therefore be considered a mobile transmitter per 47 CFR 2.1091(b). Per 47 CFR 1.1310, the EUT meets the General Population / Uncontrolled exposure limits listed in Table 1.**

## COMPLIANCE WITH FCC KDB 447498 D01 General RF Exposure Guidance V05

The 900 MHz FHSS radio transmits through one antenna and is not co-located with any other radio. The highest gain antennas of each type are a Omni antenna of 8.15 dBi and a Directional of 12.0 dBi. The product is subject to professional installation only. The output power will be lowered to meet the + 36 dBm EIRP limit. The instructions to the professional installer specify a minimum 23 cm separation distance from the transmitting antenna.

"KDB 447498 D01 General RF Exposure Guidance v05" provides the procedures, requirements, and authorization policies for mobile and portable devices. Section 7.1 best fits the exposure condition described in this report. Since this mobile device is categorically excluded from routine evaluation; simple calculations may

be used to estimate the power density to demonstrate compliance with 47 CFR 1.1310 requirements. The attached estimate shows MPE limits are met at a 23 cm boundary.

**FCC LIMITS FOR MPE**

**Limits for General Population /Uncontrolled Exposure: 47 CFR 1.1310**

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm <sup>2</sup> )	Averaging Time (minutes)
0.3 - 1.34	614	1.63	*(100)	30
1.34 - 30	824/f	2.19/f	*(180/f <sup>2</sup> )	30
30 - 300	27.5	0.073	0.2	30
300 - 1500			f/1500	30
1500 - 100000			1	30

f = frequency in MHz

\* = Plane-wave equivalent power density

**METHOD OF EVALUATION**

Per the professional installation instructions, the exposure level for the radio is evaluated at a 23 cm distance from the radio's transmitting antenna using the general equation:

$$S = \frac{P * G}{4 * \pi * R^2}$$

Where: S = power density (mW/cm<sup>2</sup>)

P = power input to the antenna (mW)

G = numeric power gain relative to an isotropic radiator

R = distance to the center of the radiation of the antenna (23 cm as specified in the professional installation instructions)

P\*G = EIRP

Solving for S, the maximum power density 23 cm from the transmitting antenna is determined.



EUT:	MM2	Work Order:	FREW0015
Serial Number:	NA	Date:	11/25/13
Customer:	FreeWave Technologies, Inc.	Temperature (°C):	NA
Attendees:	N/A	Rel. Humidity (%):	NA
Customer Project:	N/A	Bar. Pres. (mb):	NA
Evaluated By:	Rod Peloquin	Power:	NA
		Job Site:	NA

**TEST SPECIFICATIONS**

Specification:	Method:
FCC 2.1091:2013	KDB 447498 D01 General RF Exposure Guidance v05r01

**COMMENTS**

See Product Description

**DEVIATIONS FROM TEST STANDARD**

None

Signature

**MPE Estimates for Individual Devices**

Radio	Antenna Type	Antenna Manufacturer	Antenna Part No.	Transmit Frequency (MHz)	Max Peak Conducted Output Power <sup>1</sup> (mW)	Duty Cycle <sup>2</sup>	Duty Cycle Corrected Output Power (mW)	Antenna Gain (dBi)	Minimum Antenna Cable Loss (dB)	Power Density @ 23 cm (mW/cm <sup>2</sup> )	General Population Exposure Limit from 1.1310 (mW/cm <sup>2</sup> )
900 MHz FHSS	Yagi	Wavelink	PRO890-12	915	991.1	0.01	9.911	12	0	0.024	0.610

Note #1: This device is subject to professional installation. The output power will be lowered to meet the + 36 dBm EIRP limit.

Note #2: The dwell time data in the EMC report shows that for any number of hopping channels, the duty cycle = 0.01 for the operating band. (0.31753 s / 32 s = 0.0099228)