Engineering and Testing for EMC and Safety Compliance

RF Exposure Assessment for Uncontrolled Environment

Maximum Permissible Exposure Testing for M/A-COM, Inc. Model: D3100 800 MHz Modem FCC ID: OWDTR-0037-E INDUSTRY CANADA ID: 3636B-0037

M/A-COM, Inc.
221 Jefferson Ridge Parkway
Lynchburg, VA 24501 USA
Telephone: 434-455-9527
Contact: Daryl Popowitch

November 9, 2004

Report Prepared By:
Galina Yushina, Test Engineer

Report Number: 2004178-004. Rev 0.00

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Engineering and Testing for EMC and Safety Compliance

CONFORMANCE STATEMENT

Standard(s) to which conformity is declared:

STANDARDS AND OTHER APPLICABLE DOCUMENTS	ENVIRONMENTAL PHENOMENA
• FCC OET Bulletin 65 • FCC 47 CFR, Paragraphs 1.1310 and 2.1091 • TCB Training Material	Maximum Permissible Exposure (MPE) for Uncontrolled Environment

Manufacturer's Name	M/A-COM, Inc.
Manufacturer's Address	221 Jefferson Ridge Parkway Lynchburg, VA 24501 USA
Device Classification	Non-Broadcast Transmitter
Device Type	Mobile 800 MHz Radio Transceiver with Vehicle Rooftop Antenna
Model Number	D3100
Serial Number	9961478
FCC ID	OWDTR-0037-E
Industry Canada ID	3636B-0037
Mode of Operation	EDACS Data (Protocol)
TX Frequency Range	806 – 825 MHz
RF Power Rating	3.0 Watts
TX Duty Cycle	60%
Antenna Type and Gain	¼-wave Monopole Antenna, 2.15 dBi
Year of Manufacture	2004

We, the undersigned, hereby declare that the equipment specified above conforms to the MPE limits for uncontrolled environments required by the above identified standards at the distance referenced as the safe distance in the attached test report. No modifications were made during testing to the equipment in order to comply with the requirements of the standards.

Test Personnel:

Galina Yushina		November 9, 2004
Test Engineer	Signature	Date
Richard B. McMurray, P.E.	Richard B. McMurray	November 9, 2004
Supervising Engineer	Signature	Date

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1 MPE MEASUREMENTS AND FCC REGULATIONS

This test report presents the results of Maximum Permissible Exposure (MPE)[1] testing performed on the M/A-Com, Inc. Model D3100 Modem. The tests were performed in accordance with the FCC Rules and Regulations: FCC OET Bulletin 65: "Evaluating Compliance with FCC-Specified Guidelines for Human Exposure to Radio Frequency Radiation", Subpart I of Part 1 of 47 CFR FCC Rules and Regulations: "Procedures Implementing the National Environmental Policy Act of 1969", Subpart J of Part 2 of 47 CFR: "Equipment Authorization Procedures", 47 CFR paragraph 1.1310: "Radiofrequency radiation exposure limits", 47 CFR paragraph 2.1091: "Radiofrequency radiation exposure evaluation: mobile and unlicensed devices", and TCB training material.

2 IDENTIFICATION OF THE EUT

The EUT (Equipment Under Test) is described below.

Manufacturer's Name	M/A-COM, Inc.
Manufacturer's Address	221 Jefferson Ridge Parkway Lynchburg, VA 24501 USA
Device Classification	Modem
Device Type	800 MHz Modem with Vehicle Rooftop Antenna
Model Number	D3100
FCC ID	OWDTR-0037-E
Industry Canada ID	3636B-0037
Mode of Operation	EDACS data (Protocol)
TX Frequency Range	806 – 825 MHz
RF Power Rating	3.0 Watts
TX Duty Cycle	60%.
Antenna(s) Type(s) and Gain(s)	Vehicle Rooftop Antenna: Quarter Wave Vertical, Model: AN102800V1; Gain - 2.15 dBi
Year of Manufacture	2004

3 RELATED SUBMITTALS/ GRANTS

- FCC ID: OWDTR-0037-E
- Industry Canada ID: 3636B-0037

[1] By definition, maximum permissible exposure (MPE) is rms or peak electric (or magnetic) field strength, or the plane-wave equivalent power densities associated with these fields to which a person may be exposed without harmful effect and with an acceptable safety factor.

4 MODIFICATIONS

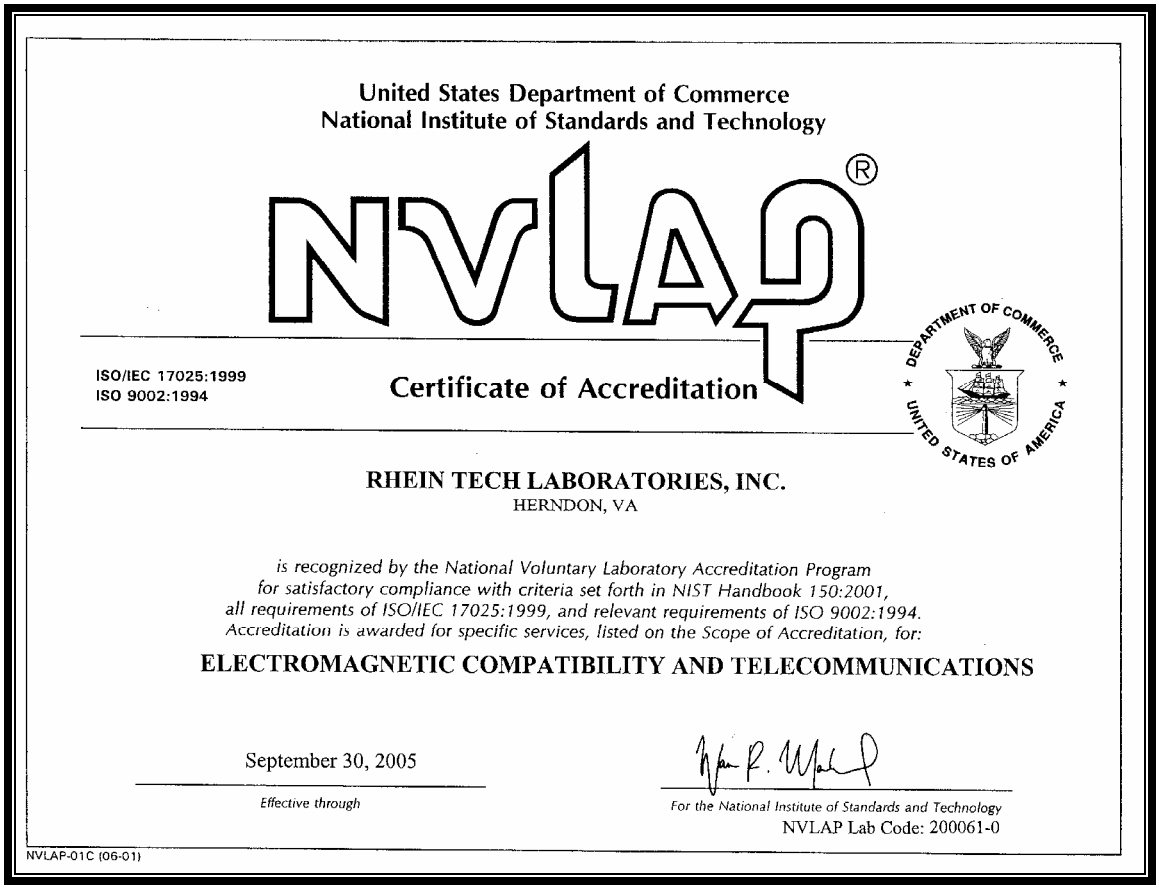
No modifications were made to the EUT during testing.

5 TEST LABORATORY

Tests were performed by Rhein Tech Laboratories, Inc. (RTL) at the test facility located at 360 Herndon Parkway, Suite 1400, Herndon, Virginia, 20170, USA. This facility is accepted by the FCC as a test facility where measurements can be performed on a contractual basis.

RTL is accredited by national and international regulatory bodies against Quality Standard ISO IEC 17025: “General Requirements for Competence of Testing and Calibration Laboratories”. The copy of the NVLAP certificate and an applicable part of the scope of RTL accreditation are shown in Figures 5.1 and 5.2.

FIGURE 5.1: RTL NVLAP ACCREDITATION CERTIFICATE 2004-2005



United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

ISO/IEC 17025:1999
ISO 9002:1994

Certificate of Accreditation

DEPARTMENT OF COMMERCE ★ UNITED STATES OF AMERICA ★

RHEIN TECH LABORATORIES, INC.
HERNDON, VA

is recognized by the National Voluntary Laboratory Accreditation Program for satisfactory compliance with criteria set forth in NIST Handbook 150:2001, all requirements of ISO/IEC 17025:1999, and relevant requirements of ISO 9002:1994. Accreditation is awarded for specific services, listed on the Scope of Accreditation, for:

ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS

September 30, 2005
Effective through

For the National Institute of Standards and Technology
NVLAP Lab Code: 200061-0

NVLAP-01C (06-01)

FIGURE 5.2: NVLAP SCOPE OF ACCREDITATION

National Institute of Standards and Technology — NVLAP® — National Voluntary Laboratory Accreditation Program

ISO/IEC 17025:1999
ISO 9002:1994

Scope of Accreditation

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ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS

NVLAP LAB CODE 200061-0

RHEIN TECH LABORATORIES, INC.

NVLAP Code	*Designation / Description*
12/EM03	IEC 61000-3-3(1995); EN 61000-3-3(1995); AS/NZS 2279.3(1995): EMC - Part 3: Limits - Section 3. Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current up to 16A
12/F18	FCC OST/MP-5 (1986): FCC Methods of Measurement of Radio Noise Emissions for ISM Equipment (cited in FCC Method 47 CFR Part 18 - Industrial, Scientific, and Medical Equipment)
12/FCC15b	ANSI C63.4 (2001) with FCC Method 47 CFR Part 15, Subpart B: Unintentional Radiators
12/FCC15c	ANSI C63.4 (2001) with FCC Method 47 CFR Part 15, Subpart C: Intentional Radiators
12/FCC15d	ANSI C63.4(2001) with FCC Method 47 CFR Part 15, Subpart D: Unlicensed Personal Communications Service Devices
12/FCC15f	ANSI C63.4 (2001) with FCC Method 47 CFR Part 15, Subpart F: Ultra-Wideband Operation
12/T51	AS/NZS CISPR 22 (2002) and AS/NZS 3548 (1997): Electromagnetic Interference - Limits and Methods of Measurement of Information Technology Equipment

September 30, 2005
Effective through

For the National Institute of Standards and Technology

NVLAP-01S (06-01)

6 TEST EQUIPMENT, ACCESSORIES AND TEST SET UP

To avoid influence of ambient radiation, MPE measurements were conducted in a semi-anechoic room. Test equipment used for the measurements are shown in Table 6.1.

TABLE 6-1: LIST OF TEST EQUIPMENT

RTL Barcode	Manufacturer	Model	Equipment Type	Serial Number	Calibration Due Date
901182	Wandel & Goltermann	TYPE-8	E- Field Probe (10 kHz to 3 GHz)	AH-0021	01/06/07
901183	Wandel & Goltermann	EMR 200	Radiation Meter	AE-0024	01/06/07

The following test accessories were used:

- Test Box for D3100, M/A-Com, Model TS103114V1;
- Control Unit, M/A-Com, Model KRY101632/12
- Microphone, M/A-Com, Model MC101616V1

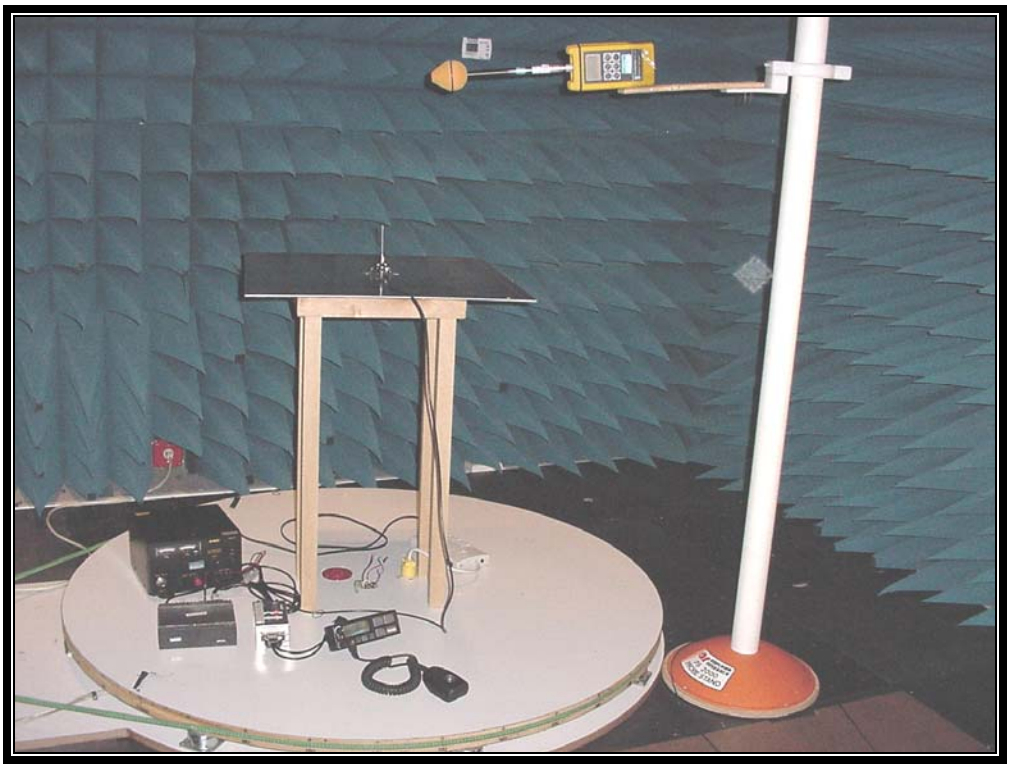
Per EMR-200 Operating Manual, specified measurement range for the type 8 probe is from 0.00027 mW/cm^2 to 170 mW/cm^2. Recommended environment for the probe and the monitor are: Ambient temperature: (23 ± 3) °C; ambient relative humidity: from 25% to 75%.

Test Set up:

During MPE measurements, the EUT's antenna was solidly connected to the center of the 60 cm by 60 cm metal plane to simulate the actual installation environment on the car roof. The metal plane was placed on the 80 cm tall wood table located on the 10 cm tall 360° rotating wooden platform. The EUT was connected to the antenna by an RF cable. The EUT's power supply and accessories were placed on the rotating platform. The test probe was solidly connected to the field / power meter, which was attached to the plastic mast in front of the EUT's antenna.

During the MPE measurements, the EUT was set to transmit at maximum power (3 W) and maximum duty cycle (60%).

The test set up is shown in photograph 1.



PHOTOGRAPH 1: TEST SET UP

7 MPE LIMITS

The FCC limits for MPE are based on the recommended MPE guidelines published by the National Council on Radiation Protection and Measurements in "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields". The recommended limits for radio frequencies in an uncontrolled environment are shown below.

TABLE 7.1: LIMITS FOR MPE FOR GENERAL POPULATION / UNCONTROLLED ENVIRONMENT

Frequency Range, MHz	Electric Field Strength (E), V/m	Magnetic Field Strength (H), A/m	Power Density (S), mW/cm^2	Averaging Time, min
0.3-3.0	614	1.63	(100)	30
3.0-30	824/f	2.19/f	($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	-	-	f/1500	30
1500-100,000	-	-	1.0	30

For a device operating between 806 – 824 MHz, the test limits for electric field or power density shall be between 2.687 – 2.747 mW/cm^2 and 0.537 – 0.549 mW/cm^2, respectively. For the center frequency of the EUT (816 MHz), the test limit is 0.54 mW/cm^2.

8 STANDARD TEST CONDITIONS AND ENGINEERING PRACTICES

Except as noted herein, the following conditions and procedures were fulfilled during the testing.

ANSI C63.4 requires the ambient temperature and relative humidity to be within the ranges of 10°C to 40°C and 10% to 90%, respectively. With respect to the narrower ranges recommended for the power meter (see Section 6), ambient conditions shall be in line with the power meter ranges. Actual values were measured with the thermo-hygro-barometer manufactured by BARIGO, RTL asset 901302, and they are shown in Section 10.

Measurement results, unless otherwise noted, show the highest measured level of MPE.

9 MEASUREMENT PROCEDURE

1. The test set up was organized as described in Section 6 of this test report.
2. Prior to making any measurements, the measuring system was turned ON and calibrated in accordance with the manufacturer's procedure.
3. The remaining equipment necessary to operate the EUT was maintained at a distance from the measurement arrangement in order to minimize interference with the measurements.
4. The "safe" distance R_{safe} was evaluated based on the equation $R_{safe} = \sqrt{(P_{max} \times G \times \eta / 4\pi S)}$, where G is the numerical value for the antenna gain, P_{max} and S are the maximum transmitting power and the MPE limit for power density for the transmitting frequency, respectively, and η is the duty cycle (in percentage) divided by 100.
5. The distance between the field probe and the test antenna was adjusted to R_{safe}.
6. The EUT was set to transmit maximum power with the highest applicable duty cycle.
7. Power density measurements were taken at different heights of the probe from the ground (0.2 to 2 meters) while rotating the EUT from 0 to 360° at each height. The azimuth corresponding to the highest MPE level was chosen as the "worst case" position for the final measurements.
8. Final measurements versus height were conducted with the azimuth between the antenna and the probe corresponding to the "worst case" position; the probe was set to the height where the highest MPE level was measured. The distance between the test probe and the tested antenna was adjusted to the value R_{real} such that the "worst case" position corresponding to the highest power density was slightly less than the test limit. Correction factor for the power meter / probe at the transmitting frequency was taken into account when this adjustment was made. These measurement results are shown in Section 10.
9. Average values were calculated for the whole body (0.2 – 2.0 m), lower body (0.2 – 0.8 m) and upper body (1.0 – 2.0 m).

10 TEST RESULTS

The MPE measurements were conducted 11/04/04 - 11/08/04 by Galina Yushina.

Ambient conditions during the MPE testing:
- Temperature varied from 24 to 25°C,
- Relative humidity varied from 27 to 30%
- Atmospheric pressure varied from 102.6 kPa to 103.6 kPa.

Calculations showed that the "safe" distance is 21 cm.
Measurements of MPE for the EUT were made with the EUT set to transmit at maximum power with 60% duty cycle. The test frequency was chosen as the center frequency of the EUT's operating range (816 MHz). The test results for the worst case MPE are shown in Table 10.1. Measurements were made at a distance of 23 cm between the middle of the antenna and the probe.

TABLE 10-1: THE WORST CASE MPE TEST RESULTS FOR UNCONTROLLED ENVIRONMENT

MPE, mW/cm^2, measured at the height shown below									
20 cm	**40 cm**	**60 cm**	**80 cm**	**100 cm**	**120 cm**	**140 cm**	**160 cm**	**180 cm**	**200 cm**
0.001	0.027	0.015	0.153	0.539	0.442	0.085	0.007	0.003	0.003

The measured power density readings were summed over the number of measurements and the results divided by the number of readings, to calculate the average for the whole body, lower body, and upper body. Results are shown in Table 10.2.

TABLE 10-2: AVERAGE MEASURED MPE VALUES FOR THE BODY

Part of the body / averaging points	Averaged Power Density for Uncontrolled Environment at the Recommended Safe Distance, mW/cm^2
Whole body (0.2 m to 2.0 m)	0.128
Lower body (0.2 m to 0.8 m)	0.049
Upper body (1.0 m to 2.0 m)	0.180

11 CONCLUSION

1. The MPE measurements for uncontrolled environments shown in this report were conducted per the FCC Rules and Regulations and guidance, and determined the minimum safe distance between the antenna and the general population.

2. The User Manual shall have a statement regarding the safe distance (shown in Section 10 of this report).