Engineering and Testing for EMC and Safety Compliance

RF Exposure Assessment for Controlled and Uncontrolled Environments

Maximum Permissible Exposure Testing for M/A-COM, Inc. Model: OpenSky M-803 VTAC 800 MHz Mobile Radio

FCC ID: BV8VTAC800

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

April 13, 2005

Report Prepared By:
Galina Yushina, Test Engineer

Report Number: 2005029-004 Rev 0.02

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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 Controlled and Uncontrolled Environment

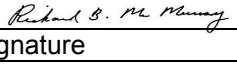
Device for which conformity is declared:

Manufacturer's Name	M/A-COM, Inc.
Manufacturer's Address	221 Jefferson Ridge Parkway Lynchburg, VA 24501 USA
Trade Name	OpenSky V-TAC (Vehicular Tactical Network) 800 MHz Mobile Radio
Device Classification	Licensed Non-Broadcast Transceiver
Device Type	Mobile 800 MHz Radio Transceiver with Vehicle Rooftop Antenna
Model Number	M-803 VTAC
Serial Numbers	03061-3J04-00763 (VRB transceiver); 03051-2K07-00197 (VRM transceiver)
FCC ID	BV8VTAC800
TX Frequency Ranges	806 – 824 MHz and 851 – 869 MHz
RF Max Power Rating	24.6 Watts
TX Duty Cycle	50%
Antenna(s) to be used with the device	Rooftop mount antenna, model ASPA 1850, 5/8 wave over 1/4 wave, 3dBd (5 dBi), vertical ground plane
Year of Manufacture	2005

We, the undersigned, hereby declare that the equipment specified above conforms to the MPE limits for controlled and 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		March 31, 2005
Test Engineer	Signature	Date

Richard B. McMurray, P.E.		March 31, 2005
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 OpenSky M-803 VTAC (Vehicular Tactical Unit) 800 MHz Radio. 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 system consists of an 800 MHz transceiver (VRM), a repeater (VRB), an RF combiner and is controlled by a control head/microphone. The EUT consists of two transceivers that can transmit simultaneously, which connect to a single antenna through a combiner. Since both transceivers can transmit simultaneously, simultaneous transmission was determined to be the worst case mode of operation for power measurements, and therefore represents worst case for the MPE measurements. Detailed information about the EUT is shown below.

Manufacturer's Name	M/A-COM, Inc.
Manufacturer's Address	221 Jefferson Ridge Parkway Lynchburg, VA 24501 USA
Model Number	M-803 VTAC
FCC ID	BV8VTAC800
Use of Product	Voice and Data Communication
Device Classification	Licensed Non-Broadcast Transmitter
Device Type	800 MHz Modem with Vehicle Rooftop Antenna
Type of Modulation	GFSK and FM
Bit Rate	19200 bps
Baud rate	9600
TX Frequency Ranges	806 – 824 MHz and 851 – 869 MHz
RF Power Rating	24.6 W
Duty Cycle	50%
External Input	Digital data
Antenna(s) Type(s) and Gain(s)	Detachable Rooftop Mount, ASPA 1850 series, 3 dBd (5 dBi) gain
Year of Manufacture	2005

[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.

3 MODIFICATIONS

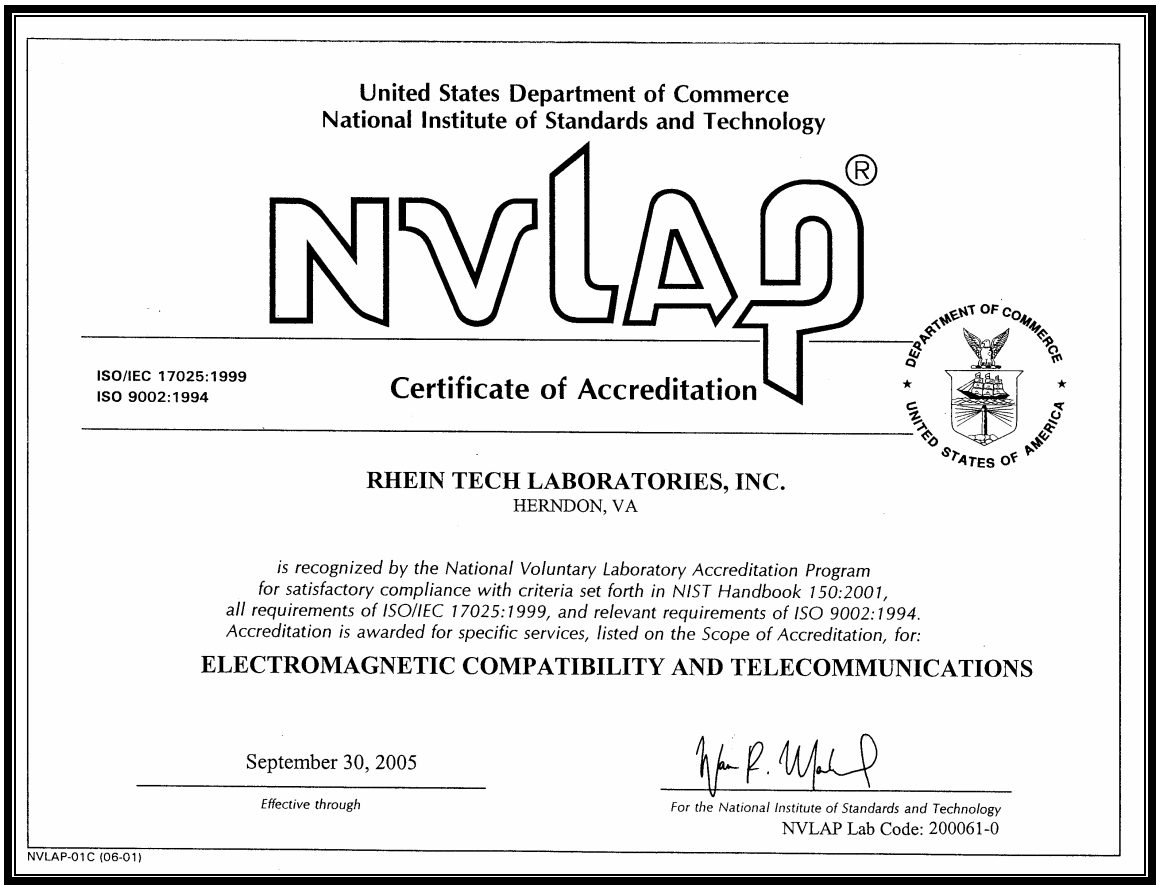
No modifications were made to the EUT during testing.

4 TEST LABORATORY

Tests were performed by Rhein Tech Laboratories, Inc. (RTL). 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 NVLAP certificate and scope of applicable accreditation are shown in Figures 4.1 through 4.3.

The RTL test facility is 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.

FIGURE 4.1: 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 4.2: 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

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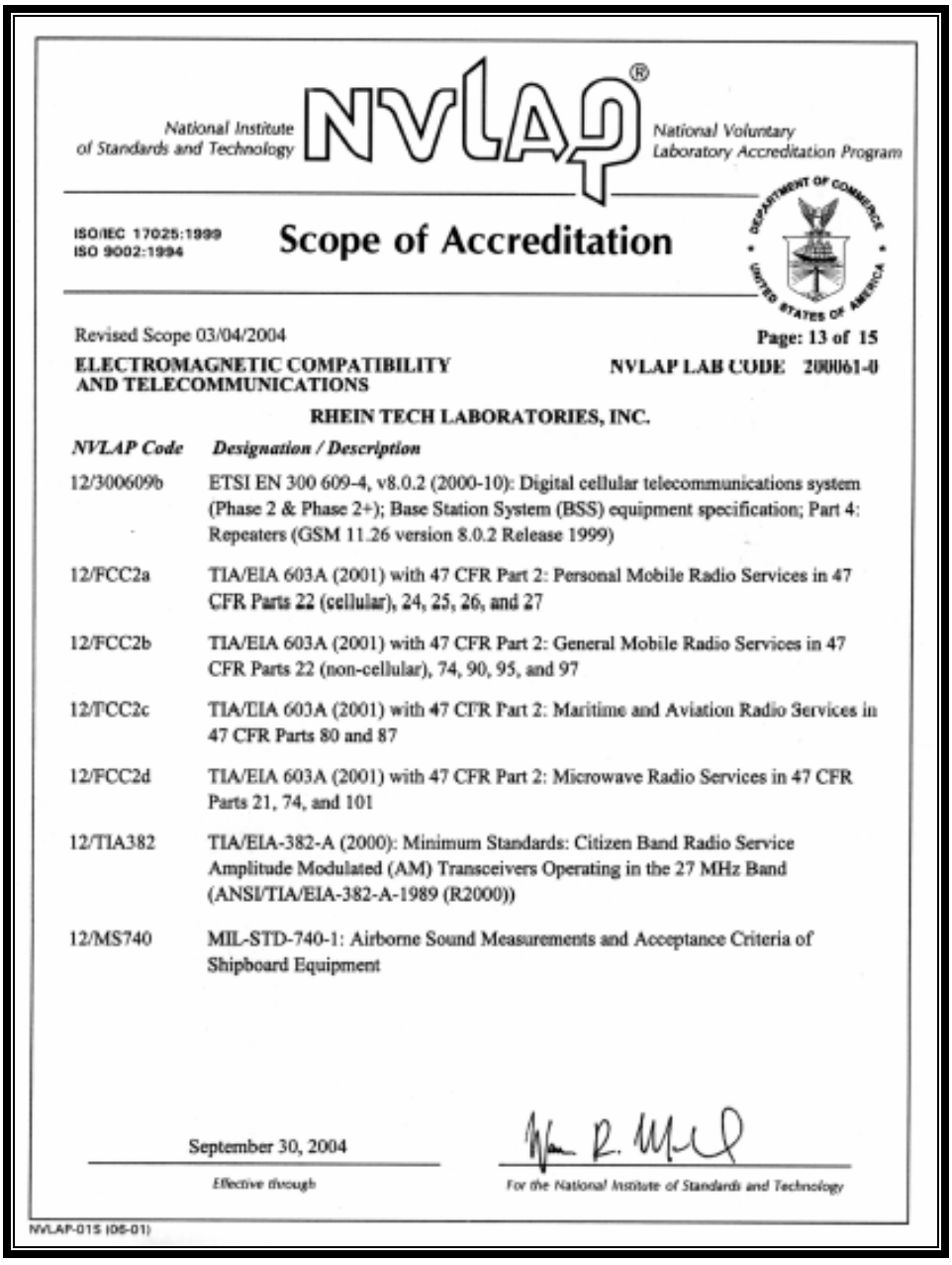
For the National Institute of Standards and Technology

NVLAP-01S (06-01)

FIGURE 4.3: 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

Revised Scope 03/04/2004

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ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS

NVLAP LAB CODE 200061-0

RHEIN TECH LABORATORIES, INC.

NVLAP Code	*Designation / Description*
12/300609b	ETSI EN 300 609-4, v8.0.2 (2000-10): Digital cellular telecommunications system (Phase 2 & Phase 2+); Base Station System (BSS) equipment specification; Part 4: Repeaters (GSM 11.26 version 8.0.2 Release 1999)
12/FCC2a	TIA/EIA 603A (2001) with 47 CFR Part 2: Personal Mobile Radio Services in 47 CFR Parts 22 (cellular), 24, 25, 26, and 27
12/FCC2b	TIA/EIA 603A (2001) with 47 CFR Part 2: General Mobile Radio Services in 47 CFR Parts 22 (non-cellular), 74, 90, 95, and 97
12/FCC2c	TIA/EIA 603A (2001) with 47 CFR Part 2: Maritime and Aviation Radio Services in 47 CFR Parts 80 and 87
12/FCC2d	TIA/EIA 603A (2001) with 47 CFR Part 2: Microwave Radio Services in 47 CFR Parts 21, 74, and 101
12/TIA382	TIA/EIA-382-A (2000): Minimum Standards: Citizen Band Radio Service Amplitude Modulated (AM) Transceivers Operating in the 27 MHz Band (ANSI/TIA/EIA-382-A-1989 (R2000))
12/MS740	MIL-STD-740-1: Airborne Sound Measurements and Acceptance Criteria of Shipboard Equipment

September 30, 2004
Effective through

For the National Institute of Standards and Technology

NVLAP-01S (06-01)

5 TEST EQUIPMENT, ACCESSORIES AND TEST SET UP

To avoid influence of ambient radiation, MPE measurements were conducted in a semi-anechoic room. A list of test equipment used for the measurements is shown in Table 5.1.

TABLE 5.1: 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
901109	SPER Scientific	800041	Digital Higro Thermometer	NA	11/09/05
901366	Control Company	PTB210 Class A	Barometer	W2940009	07/02/2006

Per the Operating Manual for the EMR 200 radiation meter, the specified measurement power range for the type 8 probe is 0.00027 - 170 mW/cm^2. The recommended environment for the probe and the radiation meter are: ambient temperature: 23 $\pm$ 3°C; ambient relative humidity: 25% - 75%.

No accessories were used with the EUT, except for a PC loaded with the M/A-Com provided software to operate and control the system.

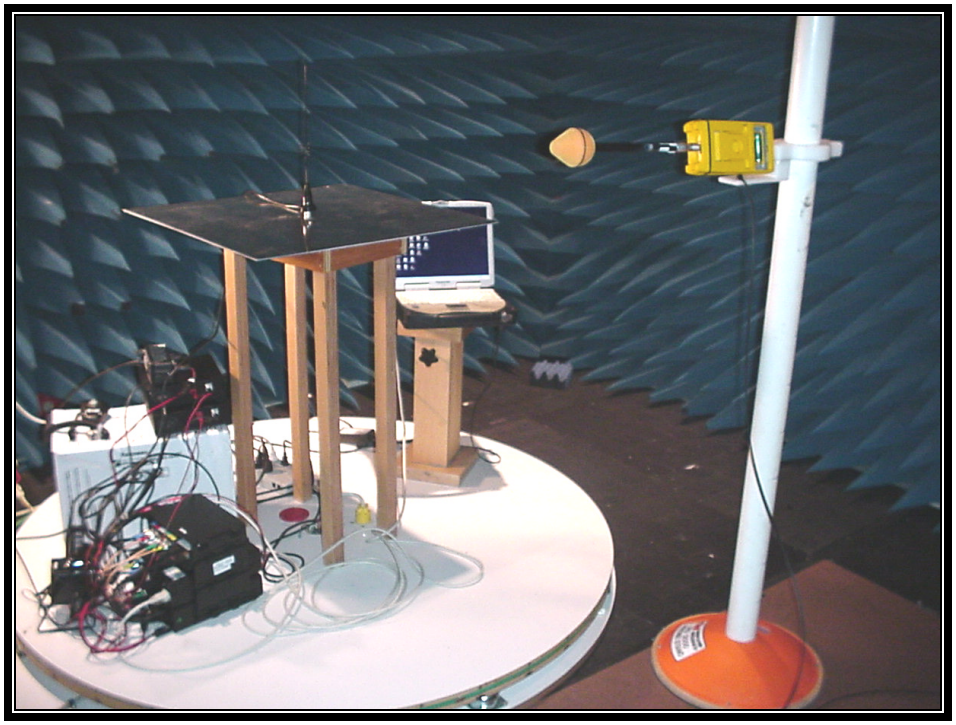
Test Set up:

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 17' long. The EUT, as well as the PC were placed on the rotating platform below the metal plane with the antenna. The test probe was solidly connected to the field power meter. The field power meter was attached to the plastic mast in front of the EUT's antenna.

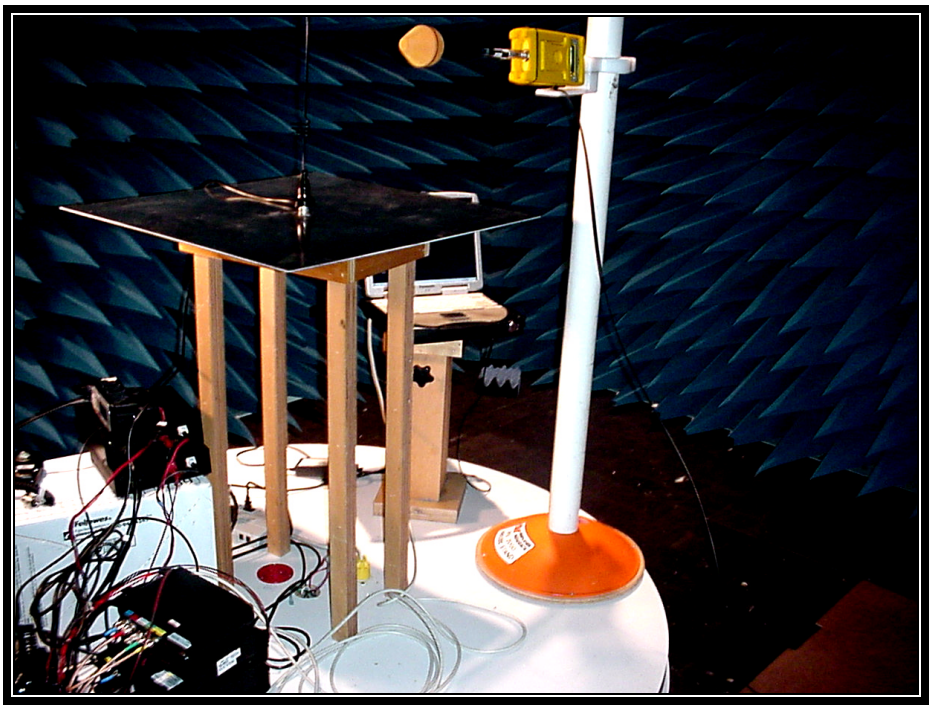
During the MPE measurements, the EUT was set to transmit at maximum power (24.6 W). As the EUT is PTT Part 90 transmitter, a 50% duty cycle may be taken into account. Rather than using an attenuator, this attenuation was simulated by using the manufacturer provided RF cable, which, together with the connectors, had 3 dB loss. In actual installations, the 17' cable may be cut to length by the installer, so our test setup represents a worst case installation of effectively 0' of cable.

The test set up is shown in photographs 5.1 and 5.2 for measurements applicable for controlled and uncontrolled environments.

PHOTOGRAPH 5.1: TEST SET UP FOR MPE MEASUREMENTS FOR CONTROLLED ENVIRONMENT



PHOTOGRAPH 5.2: TEST SETUP FOR MPE MEASUREMENTS FOR UNCONTROLLED ENVIRONMENT



6 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 uncontrolled and controlled environments are shown below.

TABLE 6.1: LIMITS FOR MPE IN 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

TABLE 6.2: LIMITS FOR MPE DATA IN CONTROLLED 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)	6
3.0-30	1842/f	4.89/f	($900/f^2$)	6
30-300	61.4	0.163	1.0	6
300-1500	-	-	f/300	6
1500-100,000	-	-	5	6

For a device operating in the frequency range of 806 – 824 MHz, the test limits for power density in controlled and uncontrolled environment shall be in the ranges of 2.687–2. 747 mW/cm^2 and 0.53–0.549 mW/cm^2, respectively. In the frequency range of 851 – 869 MHz, the test limits for power density in controlled and uncontrolled environment shall be in the ranges of 2.837 – 2.897 mW/cm^2 and 0.567 – 0.579 mW/cm^2, respectively.

The RF output power measurements for the EUT described in RTL test report number 2005029 show that the EUT radiates maximum power (24.6 W) when both transmitters transmit simultaneously at 806 MHz and 851 MHz.

As the lower frequency provides a more conservative evaluation, the MPE test limits for controlled and uncontrolled environments were chosen based on the lowest power density limit, e.g. the limit 806 MHz. Therefore, the safe distances were evaluated based on the MPE limits for controlled and uncontrolled environments of 2.687 mW/cm^2 and 0.53 mW/cm^2, respectively.

7 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 5), ambient conditions shall be in line with the power meter ranges. Actual values of ambient temperature and relative humidity were measured (please refer to Section 9).

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

8 MEASUREMENT PROCEDURE

1. The test setup was organized as described in Section 5 of this test report. Polarization of the EUT's antenna was vertical, which is its position in actual use.
2. Prior to making any measurements, the measuring system was turned ON and calibrated in accordance with the EMR-200 Operating Manual.
3. The EUT (except for its antenna) and the PC were kept at a distance from the measurement arrangement in order to minimize interference with the measurements.
   The "safe" distance was first evaluated by calculation, based on the 50% duty cycle and the highest transmitting power of the system (24.6 W). Evaluation was 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 power input to antenna and the chosen (as described in Section 6) MPE limit for power density, respectively; η is the duty cycle (in percentage) divided by 100. R_{safe} for uncontrolled and controlled environments was 76.5 cm and 34 cm, respectively.
5. The distance between the field probe and the EUT's antenna was adjusted to the appropriate R_{safe}.
6. The EUT was set to transmit such that transmission simulated maximum power with the highest applicable duty cycle (50%).
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 position of the probe. 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. The correction factor for the power meter / probe at the transmitting frequency was taken into account when this adjustment was made. Then power density measurements were conducted at different positions of the probe from the ground. The measurement results are shown in Section 9.
9. Average values of power density 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).

9 TEST RESULTS

The MPE measurements were conducted 03/27/05 - 03/30/05 by Galina Yushina.

Ambient conditions during the MPE testing:
Temperature varied from 24 to 26°C.
Relative humidity varied from 30 to 37%
Atmospheric pressure varied from 755 to 762 mmHg

Measurements were conducted as described in Section 8 taking into account justifications shown in Sections 5 and 6. Measurements were made at the distance between the probe and the antenna for uncontrolled and controlled environments of 75 cm and 34 cm, respectively.
The test results for the worst case MPE for controlled and uncontrolled environments are shown in Table 9.1 and 9.2.

TABLE 9.1: THE WORST CASE MPE TEST RESULTS FOR CONTROLLED 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**
0.09	0.08	0.08	0.23	2.65	1.74	0.64	0.34	0.15	0.14

TABLE 9.2: 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**
0.04	0.07	0.16	0.22	0.51	0.53	0.20	0.02	0.04	0.03

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 Tables 9.3 and 9.4 for controlled and uncontrolled environments.

TABLE 9.3: AVERAGED MEASURED MPE VALUES FOR THE BODY IN CONTROLLED ENVIRONMENT

Part of the body / averaging points	Averaged Power Density for Controlled Environments at the Recommended Safe Distance, mW/cm^2	Limit mW/cm^2
Whole body (0.2 m to 2.0 m)	0.614	2.687
Lower body (0.2 m to 0.8 m)	0.120	2.687
Upper body (1.0 m to 2.0 m)	0.993	2.687

TABLE 9.4: AVERAGED MEASURED MPE VALUES FOR THE BODY IN UNCONTROLLED ENVIRONMENT

Part of the body / averaging points	Averaged Power Density for Uncontrolled Environments at the Recommended Safe Distance, mW/cm^2	Limit mW/cm^2
Whole body (0.2 m to 2.0 m)	0.182	0.53
Lower body (0.2 m to 0.8 m)	0.122	0.53
Upper body (1.0 m to 2.0 m)	0.222	0.53

10 CONCLUSION

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

2. The User Manual shall have a statement regarding the safe distance (shown in Section 9 of this report).

3. A variety of antennas are available for use with this device. The antenna with the worst case gain (3 dBd; worst case separation distance) was tested and presented in this report.

4. As is shown in Tables 9.3 and 9.4 on the previous page, the measured MPE is well below the maximum allowed limits.