Engineering and Testing for EMC and Safety Compliance

RF Exposure Assessment

Controlled and Uncontrolled Environments
Maximum Permissible Exposure Testing

M/A-COM M7100 800 MHz Mobile Radio
FCC ID: OWDTR-0022-E

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

July 6, 2004

Report Prepared By:
Galina Yushina, Test Engineer

Report Number: 2003158-004 R0.06

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CONFORMANCE STATEMENT

Standard(s) to which conformity is declared:

Standards	Environmental Phenomena
• FCC OET Bulletin 65 • FCC 47 CFR, Paragraphs 1.1310 and 2.1091 • TCB Training Material	Maximum Permissible Exposure and Specific Absorption Rate

Manufacturer's Name	M/A-COM, Inc.
Manufacturer's Address	221 Jefferson Ridge Parkway Lynchburg, VA 24501 USA
Device Classification	Licensed Non-Broadcast Transmitter
Device Type	Mobile 800 MHz PTT Radio Transceiver with either Vehicle Roo Antenna or Motorcycle Mounted Antenna
Model Number	M7100
FCC ID	OWDTR-0022-E
Modulation	FM
TX Frequency Range	806 – 824, 851 – 869 MHz
RF Power Rating	36.4 Watts
Duty Cycle	50%
Antenna(s) Type(s) and Gain(s)	Vehicle Rooftop Antenna: Quarter Wave Vertical, AN102800V1; 2.15 dBi
	Motorcycle Mounted Antenna: Loaded 5/8 Over Half Wave Vertical, LE-OM806HDBK/TNCDS; 5.5 dBi
Year of Manufacture	2003

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

Test Personnel:

Galina Yushina		July 6, 2004
Test Engineer	Signature	Date
Desmond Fraser		July 6, 2004
Supervising Engineer	Signature	Date

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1 MPE MEASUREMENTS AND FCC REGULATIONS

This test report presents the result of Maximum Permissible Exposure (MPE)[1] testing performed on the M/A-Com Mobile Radio Transceiver Model M7100. The tests were performed in accordance with the FCC Rules and Regulations 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 the 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	Licensed Non-Broadcast Transmitter
Device Type	Mobile 800 MHz PTT Radio Transceiver with either Vehicle Roo Antenna or Motorcycle Mounted Antenna
Model Number	M7100
FCC ID	OWDTR-0022-E
Modulation	FM
TX Frequency Range	806 – 824, 851 – 869 MHz
RF Power Rating	36.4 Watts
Duty Cycle	50%
Antenna(s) Type(s) and Gain(s)	Vehicle Rooftop Antenna: Quarter Wave Vertical, AN102800V1; 2.15 dBi
	Motorcycle Mounted Antenna: Loaded 5/8 Over Half Wave Vertical, LE-OM806HDBK/TNCDS; 5.5 dBi
Year of Manufacture	2003

3 RELATED SUBMITTAL/GRANT

The related submittal for the EUT is FCC ID: OWDTR-0022-E.

[1] By definition, maximum permissible exposure (MPE) is rms and peak electric and 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.

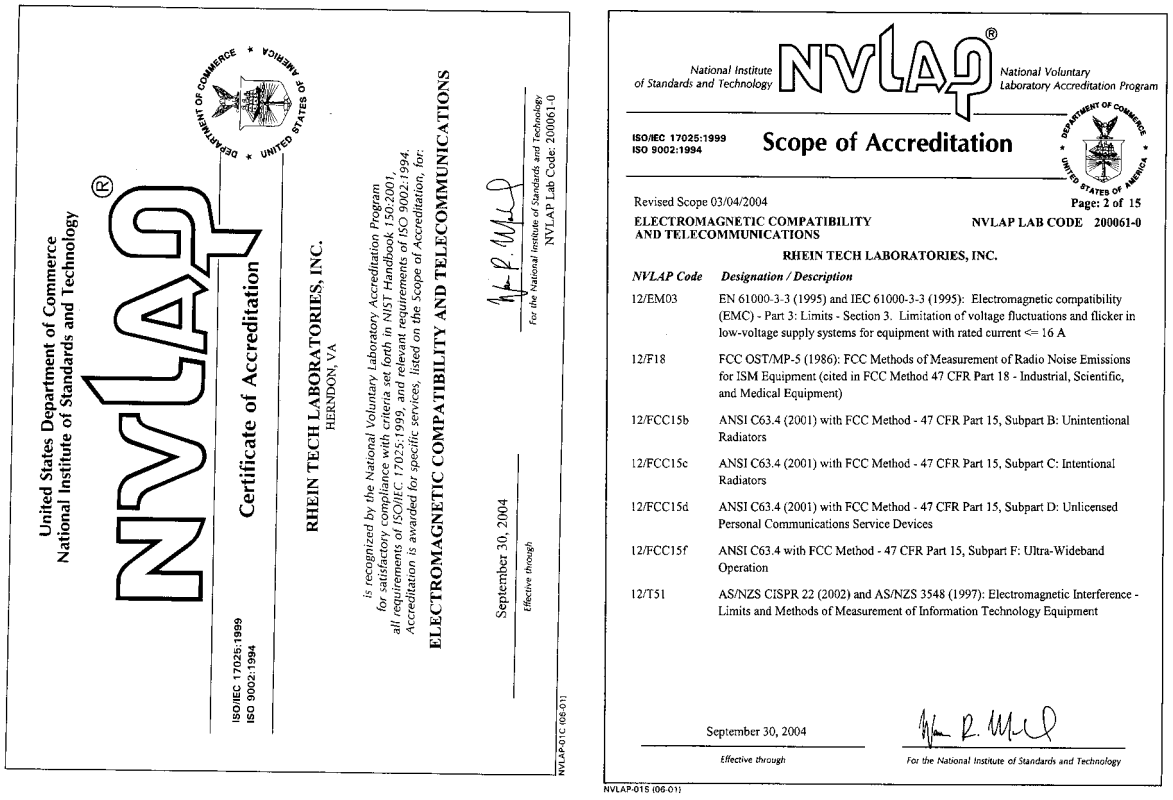
4 MODIFICATIONS

No modifications were made during testing of the EUT.

5 TEST LABORATORY

Tests were performed by Rhein Tech Laboratories, Inc. (RTL). The company is accredited by national and international regulatory bodies against Quality Standard ISO IEC 17025: "General Requirements for Competence of Testing and Calibration Laboratories". RTL's certificates with the scope of accreditation from NVLAP are shown in below.

The RTL test facility is located at 360 Herndon Parkway, Suite 1400, Herndon, Virginia, 20170, USA. This facility is accepted by the FCC where measurement can be performed on a contractual basis.



United States Department of Commerce
National Institute of Standards and Technology

NVLAP

Certificate of Accreditation

ISO/IEC 17025:1999
ISO 9002:1994

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, 2004
Effective through

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

NVLAP-01C (06-01)

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/EM03	EN 61000-3-3 (1995) and IEC 61000-3-3 (1995): Electromagnetic compatibility (EMC) - Part 3: Limits - Section 3. Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current <= 16 A
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 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, 2004
Effective through

For the National Institute of Standards and Technology

NVLAP-01S (06-01)

FIGURE 1: RTL CERTIFICATE OF ACCREDITATION BY NVLAP

6 TEST EQUIPMENT AND TEST SETUP

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

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

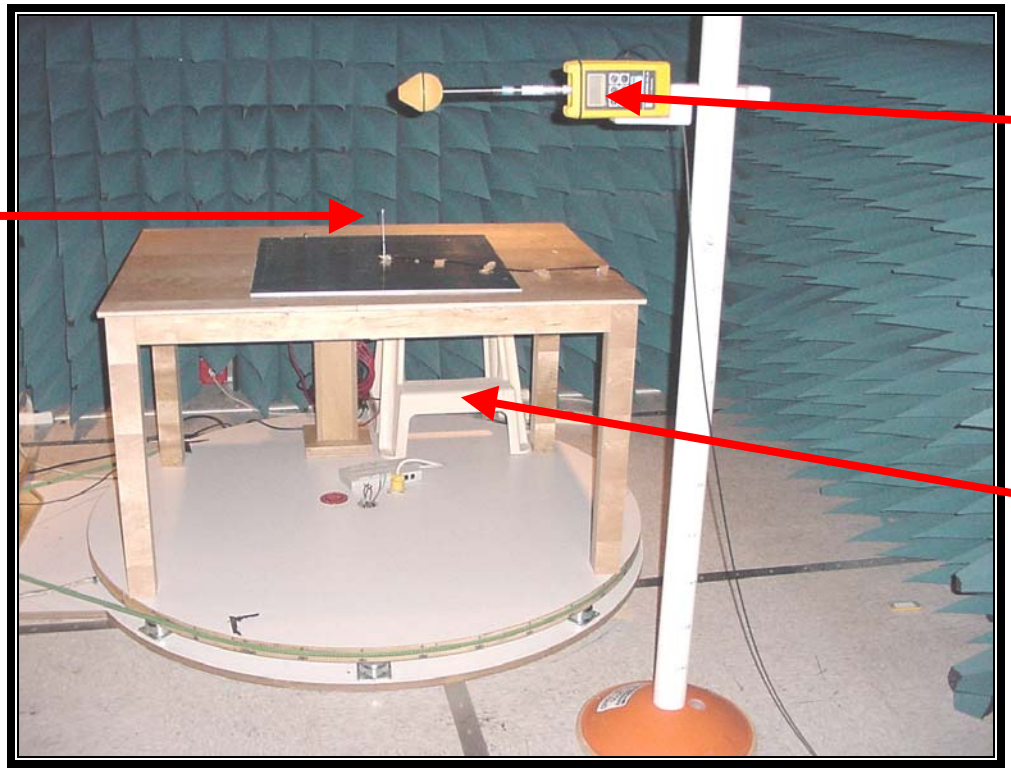
During MPE measurements, two variations of the test setup were used due to the following:
- For the motorcycle-mount antenna, the antenna was solidly connected to the motorcycle mount apparatus, as it would be in normal use.
- For the vehicular-mount antenna, the antenna was connected to a ground plane to simulate the actual installation environment.

Therefore,
- When testing was done for the motorcycle configuration, the EUT within the motorcycle mount apparature was placed on the 70 cm tall wood table located on the 10 cm tall 360° - rotating platform.
- When measurements were taken for the vehicle configuration, only the antenna under test was located on the wood table just referenced above. During these measurements, the desk surface was covered with a 62 cm by 62 cm metal plane.

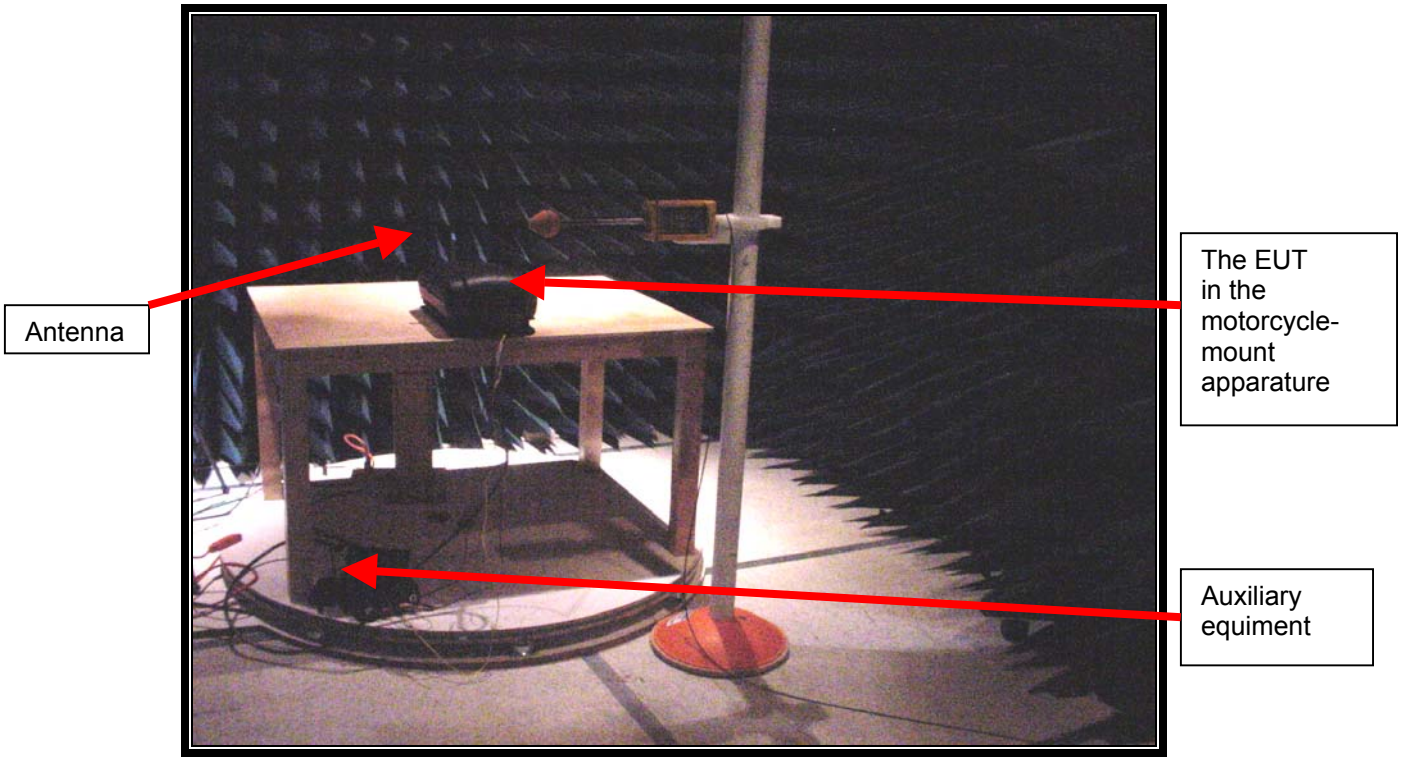
In both cases, the test probe was connected to the radiation meter located on the mast, and was placed in front of the antenna under test. In each setup, the antenna under test was located in the middle of the test table. All auxiliary test equipment was placed so that it did not interfere with the measurements.

During MPE mesurements, the EUT was set to transmit at 50% duty cycle.

The test setups for the vehicle and motorcycle configurations are shown in Photographs 6.1 and 6.2 respectively.



PHOTOGRAPH 6.1: TEST SETUP FOR THE EUT IN VEHICLE USE



PHOTOGRAPH 6.2: TEST SETUP FOR THE EUT IN MOTORCYCLE USE

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 limits for controlled and uncontrolled environments 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

TABLE 7-2: LIMITS FOR MPE FOR OCCUPATIONAL / 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/f2)	6
30-300	61.4	0.163	1.0	6
300-1500	-	-	f/300	6
1500-100,000	-	-	5	6

For the EUT operating in the frequency range of 806 – 869 MHz, the test limits for controlled and uncontrolled environments shall be in the range of 2.687 – 2.897 mW/cm^2 and 0.537 – 0.58 mW/cm^2 respectively.

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. Real values were measured with the thermo-hygro-barometer manufactured by BARIGO, RTL asset 901302, and they are shown together with the test results.

Testing was performed with calibrated test equipment, with the EUT set to transmit at high power with the appropriate duty cycle, if applicable. Measurement results, unless otherwise noted, show the highest measured level of MPE.

9 JUSTIFICATION OF TRANSMITTED FREQUENCY FOR MPE MEASUREMENTS

Measurements of output conductive power of the EUT described in the Type Certification Report number 2003158/ QRTL03-964A showed that the device transmitted stable power in the entire frequency range. The antennas used with this device for the motorcycle and vehicle configuration were investigated on the Network Analyzer Analyzer (HP, Model 8753D, RTL asset: 900926). SWR varied across the frequency range of 806-870 MHz, but the lowest value was at 806 MHz for both antennas. Therefore during the MPE measurements the EUT was set to transmit at 806 MHz.

10 MEASUREMENT PROCEDURE

1. The test setup is described in Section 6 of this test report.
2. Prior to taking any measurements, the measuring system was turned ON and calibrated in accordance with the manufacturer's procedure.
3. The auxiliary equipment necessary to operate the EUT was kept away from the EUT in order to minimize interference with the measurements.
4. The "safe" distance Rs was calculated based on the equation $Rs = \sqrt{(PmaxG/4\pi S)}$, where G is the numerical value for the antenna gain, Pmax and S are the maximum transmitting power and the MPE limit for power density for the transmitting frequency, respectively.
5. The distance between the field probe and the test antenna was adjusted to just slightly less than Rs.
6. The EUT was set to transmit at the highest power.
7. Power density measurements were taken at different heights of the probe from the ground (covering the height of 0.2 to 2 meters) while rotating the EUT versus azimuth in the range of 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. If the power density was found to be greater than the limit, Rs was increased until the limit was met. If the power density was found to be significantly less than the limit, Rs was decreased until the power density was found to be slightly less than the limit.
9. Final measurements were taken at the "worst case" azimuth (that is, the azimuth with the highest power density reading for a given height). The correction factor for the power meter/probe at the transmitting frequency was applied when this adjustment was made. These measurements are shown in Section 10 of this report.
10. 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).

11 TEST RESULTS

The MPE measurements were conducted between 06/15/04 – 06/28/04 by Galina Yushina.

Ambient conditions during the MPE testing:
- Temperature varied from 23 to 26°C,
- Relative humidity varied from 40 to 50%
- Atmospheric pressure varied from 100 kPa to 101 kPa.

The test results are shown in subsections 10.1 and 10.2.

11.1 TEST RESULTS FOR THE EUT IN MOTORCYCLE CONFIGURATION

Description of the EUT in the motorcycle configuration:
Power: 36.4 Watts
Test Frequency: 806 MHz
Antenna type: Loaded 5/8 over half wave vertical (P/N LE-OM803HDBK/TNCDS)
Antenna Gain: 5.5 dBi (Numerical gain: 3.55)
Duty cycle: 50%

Calculated safe distance Rc11 for **uncontrolled environment** with the EUT transmitting at 806 MHz and **50% duty cycle** was equal to √(36400*3.55)/(4*3.14*0.537*2) = **98 cm.**

Calculated safe distance Rc12 for **controlled environment** with the EUT transmitting at 806 MHz and **50% duty cycle** was equal to √(36400*3.55)/(4*3.14*2.687*2) = **44 cm.**

The test results for the motorcycle configuration are shown in Table 10-1. Controlled environment measurements were made with the EUT operating with 50% duty cycle at a distance of 43 cm between the antenna and the probe. For uncontrolled environment measurements, this distance was 96 cm.

TABLE 11-1: MPE TEST RESULTS FOR MOTORCYCLE CONFIGURATION

Probe Height, cm	Power Density for Controlled Environment, mW / cm^2	Power Density for Uncontrolled Environment, mW / cm^2
20	0.104	0.032
40	0.073	0.072
60	0.207	0.192
80	0.663	0.128
100	2.592	0.336
120	0.601	0.534
140	0.249	0.160
160	0.228	0.040
180	0.166	0.072
200	0.083	0.064

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 11-2: AVERAGE MPE VALUES FOR THE BODY FOR MOTORCYCLE CONFIGURATION

Part of the body/ averaging points	Averaged Power Density for Controlled Environment, mW / cm^2	Averaged Power Density for Uncontrolled Environment, mW/cm^2
Whole body (0.2 m to 2.0 m)	0.50	0.163
Lower body (0.2 m to 0.8 m)	0.26	0.106
Upper body (1.0 m to 2.0 m)	0.66	0.200

11.2 TEST RESULTS FOR THE EUT IN VEHICLE CONFIGURATION

Description of the EUT in the vehicle configuration:
Power: 36.4 Watts
Test Frequency: 806 MHz
Antenna type: Quarter wave vertical (P/N AN102800V1)
Antenna Gain: 2.15 dBi (Numerical gain: 1.64)
Duty cycle: 50%

Calculated safe distance Rc21 for **uncontrolled environment** with the EUT transmitting at 806 MHz and **50% duty cycle** was equal to $\sqrt{}$(36400*1.64)/(4*3.14*0.537*2) = **67 cm.**

Calculated safe distance Rc22 for **controlled environment** with the EUT transmitting at 806 MHz and **50% duty cycle** was equal to $\sqrt{}$(36400*1.64)/(4*3.14*2.687*2) = **30 cm.**

The test results for the vehicle configuration are shown in Table 10-3. Controlled environment measurements were made with the EUT operating with 50% duty cycle at a distance of 28 cm between the antenna and the probe. For uncontrolled environment measurements, the distance was 65 cm.

TABLE 11-3: MPE TEST RESULTS FOR THE EUT IN THE VEHICLE CONFIGURATION

Probe Height, cm	Power Density for Controlled Environment, mW / cm^2	Power Density for Uncontrolled Environment, mW / cm^2
20	0.756	0.350
40	1.360	0.442
60	1.187	0.530
80	2.591	0.377
100	1.922	0.287
120	0.432	0.188
140	0.173	0.095
160	0.151	0.055
180	0.130	0.044
200	0.086	0.022

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 10-4.

TABLE 11-4: AVERAGE MPE VALUES FOR THE BODY FOR THE VEHICLE CONFIGURATION OF THE EUT

Part of the body/ averaging points	Averaged Power Density for Controlled Environment, mW / cm^2	Averaged Power Density for Uncontrolled Environment, mW/cm^2
Whole body (0.2 m to 2.0 m)	0.880	0.239
Lower body (0.2 m to 0.8 m)	1.040	0.425
Upper body (1.0 m to 2.0 m)	0.482	0.115

12 CONCLUSION

1. The MPE measurements for controlled and uncontrolled environments shown in this report were conducted per the FCC Rules and Regulations and guidance, and determined the minimum safe distances for both antennas in both configurations of the EUT.

2. The User Manual shall have a statement regarding the safe distances (shown in Section 11 of this report) for the EUT when used in each of the tested configurations and for each environment.

3. The EUT shall have a warning label cautioning the operator about RF exposure hazards.