Engineering and Testing for EMC and Safety Compliance

Accredited under NVLAP Lab Code 200061-0

RF Maximum Permissible Exposure (MPE) Assessment

in

Controlled and Uncontrolled Environments

for

M/A-COM, Inc.
Model: M7200 V-TAC (Vehicular Tactical Network)
700/800 MHz Mobile Radio
FCC ID: BV8M7200VTAC
IC: 3670A-M72VTAC

Prepared For

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February 27, 2007

Report Number: 2007101-004

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1 MPE Measurements and Applicable Regulations

This test report presents the results of Maximum Permissible Exposure (MPE)[1] measurements performed on the M/A-Com, Inc. Model M7200 V-TAC 700/800 MHz Mobile Radio, operating in the frequency ranges 764-806 MHz and 806-869 MHz.

The tests were performed in accordance with TCB training material and the following parts of the FCC Rules and Regulations and Industry Canada Radio Standard Specification:

- FCC OET Bulletin 65, Edition 97-01: "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields"
- FCC Supplement C to OET Bulletin 65, Edition 01-01: "Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions."
- Subpart I, Part 1 of 47 CFR FCC Rules and Regulations, Edition 10-1-06: "Procedures Implementing the National Environmental Policy Act of 1969." Specifically, Paragraph 1.1310: "Radiofrequency Radiation Exposure Limits."
- Subpart J, Part 2 of 47 CFR FCC Rules and Regulations, Edition 10-1-06: "Equipment Authorization Procedures." Specifically, Paragraph 2.1091: "Radiofrequency Radiation Exposure Evaluation: Mobile Devices."
- RSS-102, Issue 2, November 2005: "Spectrum Management and Telecommunications Radio Standards Specification. Radiofrequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands.)."

[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.

2 Identification of the EUT[2]

The EUT is a system comprised of two transceivers, one of which operates in normal 700/800 MHz mobile bands, the other in standard 700/800 MHz base station bands, one roof-mount RF antenna and base, and a control unit. The antenna base has a RF cable for connecting the EUT. The GPS RX antenna base has two cables: a RF cable and a GPS cable. General 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
Device Type	Mobile Radio with Vehicle Rooftop Antenna
EUT Model	M7200 V-TAC
Model and Serial Numbers of Radios	M7200 V-TAC, A40078000001 and A40075000002
Model Number/ Serial Number of the Control Head	MACDOS0003/A4000A16FF8A
EUT FCC ID	BV8M7200VTAC
EUT IC ID	3670A-M72VTAC
Operating Frequency Ranges	764-806 MHz and 806-869 MHz
RF Max Power	13 Watts
TX Duty Cycle	100%
Roofmount Antennas Manufactured by M/A-Com for the EUT	

Part #	Model #	Frequency Range, MHz	Antenna Gain, dBd	Recommended Type of Antenna Base
AN-025167-001	MAMV-AN3J	764-870	3	Standard base
AN-025167-002	MAMV-AN3K	764-870	3	Elevated feed base
AN-025167-004	MAMV-AN3V	764-870	3	GPS RX base
AN-025167-014	MAMV-NAN5U	764-870	5	Standard base
AN-025167-015	MAMV-NAN5V	764-870	5	GPS RX base

Year of Manufacture	2006

Notes:
1. There is no difference between a standard antenna base and an elevated feed base. Photograph 6-3 of this test report shows that the antenna makes the difference: the antenna kit supplied with antenna model MAMV-AN3K has a type of construction which makes an elevated feed base from a standard antenna base.
2. Electrically and mechanically, antenna models MAMV-NAN5U and MAMV-NAN5V are identical. Differences in the model names and part names reflect the fact that these antennas are used with different antenna bases.

[2] Equipment Under Test is hereafter referred to as the EUT

3 Modifications

No modification was made to the EUT during testing.

4 Test Laboratory

The test personnel of Rhein Tech Laboratories, Inc. (RTL) performed testing for which the company is accredited by NVLAP. Figures 4-1 through 4-3 of this test report present a copy of the RTL NVLAP certificate (2006-2007) and copies of the parts of RTL's scope of accreditation applicable for this test report. Testing was performed at the RTL test facility located at 360 Herndon Parkway, Suite 1400, Herndon, VA 20170, USA. Different regulatory bodies, including the FCC and IC, approved this facility for conducting tests and measurements on a contractual basis.

Figure 4-1: RTL NVLAP Certificate of Accreditation for 2006-2007

Figure 4-2: Part of Page 12 of the RTL Scope of Accreditation

NVLAP® **National Voluntary Laboratory Accreditation Program**

ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS

NVLAP LAB CODE 200061-0
Scope Revised: 2006-11-20

NVLAP Code	*Designation / Description*
12/BETS8	BETS-8 (1996): Technical Standards and Requirements for FM Transmitters Operating in Small Remote Communities
12/BETS9	BETS -9 (1996): Technical Standards and Requirements for Television Transmitters Operating in Small Remote Communities
12/RSS102	RSS-102, Issue 2 (November 12, 2005): using IEEE 1528 and/or IEEE C95.3 - Evaluation Procedure for Mobile and Portable Radio Transmiters with respect to Health Canada's Safety Code 6 for Exposure of Humans to Radio Frequency Fields
12/RSS117	RSS-117, Issue 2 (March 30, 1974): Land and Coast Station Transmitters Using A1, A2, A3, A2H or A3H Emissions Operating in the 200 - 535 kHz Band
12/RSS118	RSS-118, Issue 2, Addendum & Amendment (August 19, 1990): Land and Subscriber Stations: Voice, Data, and Tone Modulated, Angle Modulation Radiotelephone Transmitters and Receivers Operating in the Cellular Mobile Bands 824-849 MHz and 869-894 MHz
12/RSS119	RSS-119, Issue 6 (March 25, 2000): Land Mobile and Fixed Radio Transmitters and Receivers, 27.41 to 960 MHz

Figure 4-3: Part of Page 16 of the RTL Scope of Accreditation

NVLAP® National Voluntary Laboratory Accreditation Program

ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS

NVLAP LAB CODE 200061-0
Scope Revised: 2006-11-20

NVLAP Code	*Designation / Description*
12/RSS213	RSS-213, Issue 1 (April 24, 1999): 2 GHz Licence-Exempt Personal Communications Service Devices (PCS)
12/RSS215	RSS-215, Issue 1 (November 6, 1999): Analogue Scanner Receivers
12/RSS243	RSS-243, Issue 2 (November 12, 2005): Active Medical Implant Communications System Devices in the 402 - 405 MHz Band
12/RSS310	RSS-310, Issue 1 (Sept. 2005): Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands): Category II Equipment
12/RSSgen	RSS-Gen, Issue 1 (Sept. 2005): General Requirements and Information for the Certification of Radiocommunication Equipment
RF Exposure Test Methods (SAR & MPE)	
12/C95	IEEE Std C95.3 (2002): IEEE Recommended Practice for Measurements and Computations of Radio Frequency Electronmagnetic Fields With Respect to Human Exposure to Such Fields, 100 kHz - 300 GHz
12/C95b	IEEE C95.1 -1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300 GHz
12/OET65	OET Bulletin 65, Edition 97-01 (August 1997): Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Field
12/OET65c	Supplement C, Edition 01-01 to OET Bulletin 65,Edition 97-01: Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions

5 Test Duration

The EUT was ready for MPE testing on 01/10/07. Testing was finished on 02/15/07.

6 Test Equipment, Accessories and Test Setup

Test equipment used for the measurements is shown in Table 6-1.

Table 6-1: Test Equipment Utilized

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	01/06/08
901183	Wandel & Goltermann	EMR 200[3]	Radiation Meter	AE-0024	01/06/08
901109	SPER Scientific	800041	Digital Higro Thermometer	NA	12/19/07
901366	Control Company	PTB210 Class A	Barometer	W2940009	01/23/2008

During testing, RTL used EUT accessories such as power supplies, a fan and a PC loaded with M/A-Com-provided software to operate the EUT and to control the system. Table 6-2 shows detailed information about the M/A-Com-provided parts of the EUT and necessary accessories.

[3] Per the Operating Manual for the EMR 200 radiation meter, the device, with the Type 8 probe, measures electromagnetic power in the range of 0.00027 - 170 mW/cm^2. The recommended environment is the following: Ambient temperature: (23 ± 3) °C; ambient relative humidity: 25% - 75%.

Table 6-2: the EUT and Accessories

Part	Manufacturer	Model Number/Part Number (if applicable)	SN or comment	FCC ID	IC ID
Mobile Radio	M/A-Com, Inc.	M7200 V-TAC	A40078000001	BV8M7200VTAC	3670A-M72VTAC
Mobile Radio	M/A-Com, Inc.	M7200 V-TAC	A40075000002	BV8M7200VTAC	3670A-M72VTAC
Power Supply	Samlex America, Inc.	SEC 1223	03061-3J04-00763	N/A	NA
Power Supply	Samlex America, Inc.	SEC 1212	03051-2K07-00197	N/A	NA
Control Head	M/A-Com, Inc.	MACDOS0003	A4000A16FF8A	N/A	NA
Antenna # 1	M/A-Com, Inc.	MAMV-AN3J/ AN-025167-001	N/A	N/A	NA
Antenna # 2	M/A-Com, Inc.	MAMV-AN3K/ AN-025167-002	N/A	N/A	NA
Antenna # 3	M/A-Com, Inc.	MAMV-AN3V/ AN-025167-004	N/A	N/A	NA
Antenna # 4	M/A-Com, Inc.	MAMV-NAN5U/ AN-025167-014	N/A	N/A	NA
Antenna # 5	M/A-Com, Inc.	MAMV-NAN5V/ AN-025167-015	N/A	N/A	NA
Antenna Base #1	M/A-Com, Inc.	GPS RX	N/A	N/A	NA
Antenna Base #2	M/A-Com, Inc.	Standard	N/A	N/A	NA
Antenna Base # 3	M/A-Com, Inc.	Elevated feed	N/A	N/A	NA
Fan	Electrix	K128	N/A	N/A	NA
Note	Section 2 of this test report shows what type of antenna base shall be used with each tested antenna.				

To avoid the influence of ambient radiation, RTL conducted MPE measurements in a semi-anechoic chamber. Details of the test setup are as follows:

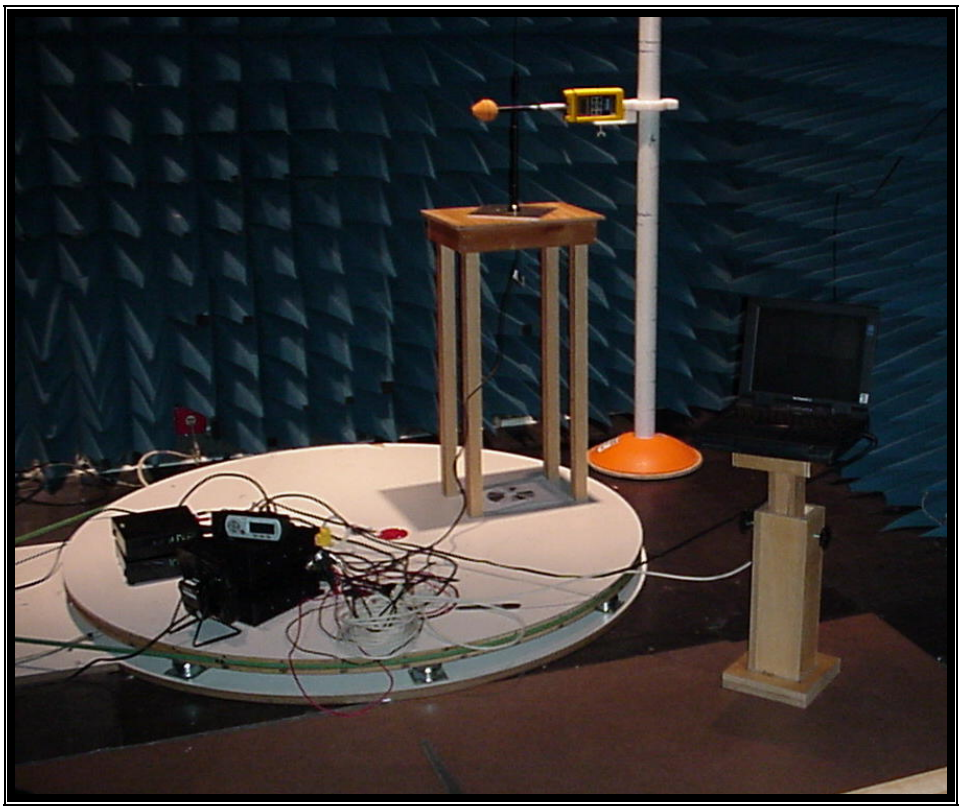
- A tested antenna was installed on the appropriate antenna base, which was connected to the EUT with the 4.5 m RF cable (for a standard antenna base) or with two 4.5 m cables: a RF cable and a GPS cable[4], if the GPS RX antenna base was used.
- When a GPS RX antenna base was used, it (with the attached antenna) was placed on the 20 X 20 cm^2 metal plate (simulating the actual installation environment on the car roof) located on the 80 cm tall wood table. The metal plate was covered by a paper with the drawing of a circle divided by 19 equal angles-azimuth used for rotating a tested antenna.
- When a standard antenna base was used, this base was solidly connected to the center of the metal plate, which was then fixed to the table. The drawing with the angles was placed on the floor under the table and was used for rotating the table with the attached antenna versus azimuth.
- The EUT, its power supplies, a control unit and a fan were located on the wooden platform on which the table stood; the PC was located near this platform.
- The test probe was solidly connected to the radiation meter attached to the plastic mast in front of the EUT's antenna.
- During the MPE measurements, the EUT was set to transmit at maximum RF power and 100% duty cycle.

The typical test setups with different antenna bases are shown in Photographs 6-1 and 6-2.

Photograph 6-1: MPE Test Setup with the Antenna in the GPS RX Antenna Base

[4] The GPS RX base contained a GPS receiving antenna and a preamplifier. Its internal devices receive power through the GPS coax connected to the transceiver. Other bases have no magnet and no GPS antenna with a preamplifier.

Photograph 6-2: MPE Test Setup with the Antenna in the Standard Antenna Base



Photographs 6-3 and 6-4 show the tested antennas and antenna bases.

Photograph 6-3: Tested Antennas

Note to Photograph 6-3:
The following antennas are shown on the photograph, from left to right:

- MAMV-AN3J,
- MAMV-AN3K,
- MAMV-NAN5U or MAMV-NAN5V,
- MAMV-AN3V

Photograph 6-4: Antenna Bases

7 Justification of Transmitting Modes and Frequencies

The EUT's radios can transmit separately or simultaneously with different types of modulations. The worst case test modes were used as described in RTL test report # 2007101-002, which shows that the EUT radiates higher RF power when it transmits in the combined mode (two transmitters operating simultaneously), with each of the radios set to the highest transmitting power. However, even in a combined mode it is necessary to select a certain frequency for each radio to provide a maximum RF power. Table 7-1 shows the test results of report # 2007101-002, based on which we chose the transmitting frequencies to get maximum RF power in the combined mode of the EUT. Note that in Table 7-1, abbreviations VRM or VRB refer to each of the individual radios; P25 or OTP shows the type of modulation in which the highest RF power is radiated. We investigated the EUT with both modulations.

Table 7-1: Radiated Power Versus Frequency for the Combined Mode

Modulation P25		
Frequency of VRM Transmitter, MHz	**Frequency of VRB Transmitter, MHz**	**Radiated RF Power, W**
794.0125	764.0125	12.050
794.0125	**868.9875**	**12.359**
823.9875	764.0125	12.106
823.9875	868.9875	12.331
Modulation OTP		
Frequency of VRM Transmitter, MHz	**Frequency of VRM Transmitter, MHz**	**Radiated RF Power, W**
794.0125	764.0125	12.706
794.0125	**868.9875**	**12.794**
823.9875	764.0125	12.445
823.9875	868.9875	12.589

The test results above show that setting the VRM radio to transmit at 794 MHz and the VRB radio to 869 MHz provides the highest radiated power for both modulations. We used this setting for the MPE measurements.

8 MPE Limits for the EUT

The FCC and IC have the same MPE limit for the EUT's frequency range. These limits for controlled and uncontrolled environments shown below 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".

Table 8-1: FCC/IC MPE Limit for General Population/uncontrolled Environment

Frequency Range, MHz	Power Density (S), mW/cm^2	Averaging Time, min
300-1500	f / 1500	30
Note that "f" in the column for power density is the frequency in MHz		

Table 8-2: FCC/IC MPE Limit for Controlled Environment

Frequency Range, MHz	Power Density (S), mW/cm^2	Averaging Time, min
300-1500	f / 300	6
Note that "f" in the column for power density is the frequency in MHz		

For the chosen frequencies transmitted by the EUT, the MPE power density limits in controlled and uncontrolled environments are shown in Table 8-3.

Table 8-3: MPE Limits for the Frequencies Transmitted by the EUT

Frequency, MHz	MPE Limit for Controlled Environment, mW/cm^2	MPE Limit for Uncontrolled Environment, mW/cm^2
794	2.65	0.53
869	2. 9	0.58

9 Evaluating a Safe Distance for the EUT

Before starting MPE measurements, it is reasonable to evaluate a safe distance, R_{safe}. A commonly used equation for R_{safe} in a far field region is shown in Equation 9-1:

$$R_{safe} = \sqrt{(P_{max} \times G_N \times \eta / 4\pi S,}$$

where G_N is a numerical value for the antenna gain, P_{max} and S are the maximum power input to an antenna and the MPE limit for a power density, respectively; η is the duty cycle (in percentage) divided by 100; η = 1 in our case.

However, it is not possible to use Equation 9-1 without taking into account two circumstances:

1. "S" in Equation 9-1 is a frequency-dependent parameter and for testing we chose the EUT in the combined mode of operation.
2. Cable loss for a cable connecting an antenna base to the EUT may be significant and shall influence the value of the safe distance.

We used the following approach for evaluating the R_{safe}:

- All antenna bases provided for testing had a 4.5 meter cable manufactured by Allgon, model RG-58A/U. Based on the rated cable loss, the loss of energy on a 4.5 meter cable, CL (cable loss) = 2.15 dB. We incorporated this loss into Equation 9-1 through the antenna gain.
- To incorporate the fact that the EUT transmits at two frequencies into the evaluation of the safe distance, we used the test data of test report # 2007101-002, showing that the maximum EUT RF power at 794 MHz is 10 W, and the maximum RF power at 869 MHz is 3 W.

The results of evaluation of R_{safe} are shown in Table 9-1.

Table 9-1: Evaluated R_{safe} for Different Environments

Antenna Gain, dBd	$R_{safe(CL)}$ for Controlled Environment, cm	$R_{safe(CL)}$ for Uncontrolled Environment, cm
3	27.8	61.3
5	34.5	77.0

10 Standard Test Conditions and Engineering Practices

Except as noted herein, the following conditions and procedures were met 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 used for the measurements, ambient conditions shall be in line with the power meter ranges. Actual values of ambient temperature and relative humidity are shown in Section 12 of this test report.

MPE measurement results as shown in Section 12 show the highest measured level of MPE, unless otherwise noted.

11 Measurement Procedure

1. The test setup was organized as described in Section 6 of this test report. The radios, the EUT power supplies, and the control unit were kept at a distance of at least 1.5 meters from the transmitting antenna and at a larger distance from the power density meter, in order to minimize interference with the measurements.
2. Polarization of the EUT's antenna located on the test desk was vertical, which is its polarization in actual use.
3. The EUT at the chosen modulation was set to transmit a maximum RF power. Preliminary measurements started at the distance between the power density probe and the EUT's antenna equal to the evaluated R_{safe} (Table 9-1) applicable either for controlled or uncontrolled environments.
4. Power density measurements were taken at different heights of the probe from the ground (0.1 to 2 m) while rotating versus azimuth from 0° to 360° either a tested antenna (if it was connected to a GPS RX antenna base) or a desk on which a standard antenna base (or the elevated feed antenna base) was fixed.
5. The azimuth between the probe and the antenna position corresponding to the highest MPE level was chosen as the worst case position for the final measurements.
6. The distance between the test probe and the tested antenna was adjusted to the actual safe distance, R_{real}, such that the worst case position corresponding to the highest power density was slightly less than the test limit. Final measurements were conducted at different positions (heights) of the probe from the ground. The measurement results are shown in Section 12.
7. Average values of power density were calculated for the whole human body (0.1 – 2.0 m), for the lower part of the body (0.1 – 0.9 m), and for the upper part of the body (1.0 – 2.0 m). The results of the calculations are shown in Section 12.

12 Test Results

Ambient conditions during the MPE investigation varied in the following ranges:

- Temperature varied from 21 to 23°C.
- Relative humidity varied from 25 to 30%
- Atmospheric pressure varied from 750 to 764 mmHg.

The MPE measurement procedure was in line with the description in Section 11. Both radios were tuned to the chosen frequencies and to the maximum transmitting RF power.

Tables 12-1 through 12-8 demonstrate the test results for the EUT with the MAMV-AN3J antenna (in a standard antenna base) set either to the OTP modulation or to the 25 modulation.

Table 12-1: MPE for AN-025167-001/MAMV-AN3J Antenna, OTP, Controlled Environment

MPE, mW/cm^2, measured at the distance of **19.5 cm** between the probe and the antenna at the height (cm) shown below																			
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
0.02	0.04	0.07	0.04	0.04	0.06	0.31	0.95	2.42	1.31	1.22	0.34	0.18	0.08	0.04	0.03	0.02	0.01	0.01	0.01

Table 12-2: MPE for the Body Parts for MAMV-AN3J Antenna, OTP, Controlled Environment

Part of the body / averaging points	Averaged Power Density at the **R_{real} =19.5 cm**, mW/cm^2
Whole body (0.1 m to 2.0 m)	0.36
Lower body (0.1 m to 0.9 m)	0.44
Upper body (1.0 m to 2.0 m)	0.30

Table 12-3: MPE for AN-025167-001/MAMV-AN3J Antenna, OTP, Uncontrolled Environment

MPE, mW/cm^2, measured at the distance of **52 cm** between the probe and the antenna at the height (cm) shown below																			
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
0.01	0.02	0.02	0.03	0.08	0.13	0.25	0.36	0.51	0.50	0.32	0.15	0.05	0.02	0.02	0.02	0.02	0.02	0.02	0.01

Table 12-4: MPE for the Body Parts for MAMV-AN3J Antenna, OTP, Uncontrolled Environment

Part of the body / averaging points	Averaged Power Density at the **R_{real} = 52 cm**, mW/cm^2
Whole body (0.2 m to 2.0 m)	0.13
Lower body (0.2 m to 0.9 m)	0.16
Upper body (1.0 m to 2.0 m)	0.10

Table 12-5: MPE for AN-025167-001/MAMV-AN3J Antenna, P25, Controlled Environment

MPE, mW/cm^2, measured at the distance of **20 cm** between the probe and the antenna and at the height (cm) below																			
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
0.01	0.01	0.01	0.02	0.03	0.09	0.23	0.77	2.48	1.38	1.11	0.32	0.19	0.12	0.06	0.03	0.02	0.01	0.01	0.01

Table 12-6: MPE for Body Parts for MAMV-AN3J Antenna, P25, Controlled Environment

Part of the body / averaging points	Averaged Power Density at the $\mathbf{R_{real}}$ **= 20 cm**, mW/cm^2
Whole body (0.1 m to 2.0 m)	0.35
Lower body (0.1 m to 0.9 m)	0.41
Upper body (1.0 m to 2.0 m)	0.30

Table 12-7: MPE for AN-025167-001/MAMV-AN3J Antenna, P25, Uncontrolled Environment

MPE, mW/cm^2, measured at the distance of **55 cm** between the probe and the antenna at the height (cm) shown below																			
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
0.01	0.01	0.02	0.02	0.06	0.10	0.21	0.32	0.42	0.51	0.38	0.20	0.08	0.02	0.02	0.02	0.02	0.02	0.02	0.01

Table 12-8: MPE for the Body Parts for MAMV-AN3J Antenna, P25, Uncontrolled Environment

Part of the body / averaging points	Averaged Power Density at the $\mathbf{R_{real}}$ **= 55 cm**, mW/cm^2
Whole body (0.1 m to 2.0 m)	0.12
Lower body (0.1 m to 0.9 m)	0.13
Upper body (1.0 m to 2.0 m)	0.12

Tables 12-9 through 12-16 demonstrate the test results received for the EUT with the MAMV-AN3K antenna (installed in the elevated feed antenna base) set either to the OTP modulation or to the P25 modulation.

Table 12-9: MPE for AN-025167-002/MAMV-AN3K Antenna, OTP, Controlled Environment

MPE, mW/cm^2, measured at the distance of **20 cm** between the probe and the antenna at the height (cm) shown below																			
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
0.01	0.02	0.01	0.02	0.05	0.12	0.36	0.57	1.31	1.81	2.51	1.1	0.60	0.23	0.15	0.08	0.05	0.03	0.03	0.02

Table 12-10: MPE for the Body Parts for MAMV-AN3K Antenna, OTP, Controlled Environment

Part of the body / averaging points	Averaged Power Density at the $\mathbf{R_{real}}$ **= 20 cm**, mW/cm^2
Whole body (0.1 m to 2.0 m)	0.45
Lower body (0.1 m to 0.9 m)	0.27
Upper body (1.0 m to 2.0 m)	0.60

Table 12-11: MPE for AN-025167-002/MAMV-AN3K Antenna, OTP, Uncontrolled Environment

MPE, mW/cm^2, measured at the distance of **50 cm** between the probe and the antenna at the height (cm) shown below																			
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
0.01	0.01	0.02	0.04	0.04	0.05	0.06	0.06	0.06	0.15	0.44	0.51	0.39	0.16	0.06	0.05	0.06	0.04	0.04	0.03

Table 12-12: MPE for the Body Parts for MAMV-AN3K Antenna, OTP, Uncontrolled Cnvironment

Part of the body / averaging points	Averaged Power Density at the $\mathbf{R_{real}}$ **= 50 cm**, mW/cm^2
Whole body (0.1 m to 2.0 m)	0.11
Lower body (0.1 m to 0.9 m)	0.04
Upper body (1.0 m to 2.0 m)	0.18

Table 12-13: MPE for AN-025167-002/MAMV-AN3K Antenna, P25, Controlled Environment

MPE, mW/cm^2, measured at the distance of **18 cm** between the probe and the antenna at the height (cm) shown below																			
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
0.01	0.01	0.01	0.03	0.04	0.12	0.42	0.80	1.32	2.11	2.56	1.11	0.57	0.25	0.16	0.10	0.07	0.03	0.03	0.02

Table 12-14: MPE for the Body Parts for MAMV-AN3K Antenna, P25, Controlled Environment

Part of the body / averaging points	Averaged Power Density at the $\mathbf{R_{real}}$ **= 18 cm**, mW/cm^2
Whole body (0.2 m to 2.0 m)	0.49
Lower body (0.2 m to 0.9 m)	0.31
Upper body (1.0 m to 2.0 m)	0.64

Table 12-15: MPE for AN-025167-002/MAMV-AN3K Antenna, P25, Uncontrolled Environment

MPE, mW/cm^2, measured at the distance of **50 cm** between the probe and the antenna at the height (cm) shown below																			
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
0.02	0.03	0.03	0.05	0.06	0.07	0.09	0.07	0.11	0.21	0.45	0.52	0.38	0.14	0.04	0.02	0.03	0.03	0.03	0.02

Table 12-16: MPE for the Body Parts for MAMV-AN3K Antenna, P25, Uncontrolled Environment

Part of the body / averaging points	Averaged Power Density at the $\mathbf{R_{real}}$ **= 50 cm**, mW/cm^2
Whole body (0.1 m to 2.0 m)	0.12
Lower body (0.1 m to 0.9 m)	0.06
Upper body (1.0 m to 2.0 m)	0.17

Tables 12-17 through 12-24 demonstrate the test results for the EUT with the AN-025167-004/MAMV-AN3V antenna (installed into a GPX RX antenna base) set either to the OTP modulation or to the P25 modulation.

Table 12-17: MPE for AN-025167-004/MAMV-AN3V Antenna, OTP, Controlled Environment

MPE, mW/cm^2, measured at the distance of **21 cm** between the probe and the antenna at the height (cm) shown below																			
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
0.92	0.82	0.48	0.45	0.30	0.40	0.53	1.3	2.5	1.5	0.75	0.19	0.09	0.08	0.05	0.03	0.02	0.02	0.01	0.01

Table 12-18: MPE for the Body Parts for MAMV-AN3V Antenna, OTP, Controlled Environment

Part of the body / averaging points	Averaged Power Density at the $R_{real,}$ = 21 cm, mW/cm^2
Whole body (0.1 m to 2.0 m)	0.52
Lower body (0.1 m to 0.9 m)	0.86
Upper body (1.0 m to 2.0 m)	0.25

Table 12-19: MPE for AN-025167-004/MAMV-AN3V Antenna, OTP, Uncontrolled Environment

MPE, mW/cm^2, measured at the distance of **50 cm** between the probe and the antenna at the height (cm) shown below																			
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
0.07	0.05	0.04	0.12	0.13	0.10	0.19	0.42	0.55	0.47	0.23	0.06	0.02	0.03	0.03	0.02	0.02	0.02	0.01	0.01

Table 12-20: MPE for the Body Parts for MAMV-AN3V Antenna, OTP, Uncontrolled Environment

Part of the body / averaging points	Averaged Power Density at the $R_{real,}$ = 50 cm, mW/cm^2
Whole body (0.1 m to 2.0 m)	0.13
Lower body (0.1 m to 0.9 m)	0.19
Upper body (1.0 m to 2.0 m)	0.08

Table 12-21: MPE for AN-025167-004/MAMV-AN3V Antenna, P25, Controlled Environment

MPE, mW/cm^2, measured at the distance of **20 cm** between the probe and the antenna at the height (cm) shown below																			
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
0.31	0.30	0.32	0.37	0.32	0.34	0.53.	1.73	2.30	0.99	0.85	0.45	0.27	0.11	0.05	0.02	0.02	0.02	0.01	0.01

Table 12-22: MPE for the Body Parts for MAMV-AN3V Antenna, P25, Controlled Environment

Part of the body / averaging points	Averaged Power Density at the $R_{real,}$ = 20 cm, mW/cm^2
Whole body (0.1 m to 2.0 m)	0.47
Lower body (0.1 m to 0.9 m)	0.72
Upper body (1.0 m to 2.0 m)	0.25

Table 12-23: MPE for AN-025167-004/MAMV-AN3V Antenna, P25, Uncontrolled Environment

MPE, mW/cm^2, measured at the distance of **56 cm** between the probe and the antenna at the height (cm) shown below																			
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
0.08	0.08	0.10	0.14	0.08	0.11	0.24	0.36	0.53	0.46	0.35	0.12	0.04	0.03	0.03	0.04	0.04	0.03	0.03	0.03

Table 12-24: MPE for the Body Parts for MAMV-AN3V Antenna, P25, Uncontrolled Environment

Part of the body / averaging points	Averaged Power Density at the $R_{real,}$ = 56 cm, mW/cm^2
Whole body (0.1 m to 2.0 m)	0.15
Lower body (0.1 m to 0.9 m)	0.19
Upper body (1.0 m to 2.0 m)	0.11

Tables 12-25 through 12-32 demonstrate test the results received for the EUT with the AN-025167-014/MAMV-NAN5U antenna set either to the OTP modulation or to the P25 modulation.

Table 12-25: MPE for AN-025167-014/MAMV-NAN5U Antenna, OTP, Controlled Environment

MPE, mW/cm^2, measured at the distance of **20 cm** between the probe and the antenna at the height (cm) shown below																			
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
0.01	0.01	0.02	0.03	0.04.	0.04	0.06	1.80	2.35	1.41	1.20	0.64	0.39	0.49	0.23	0.05	0.02	0.01	0.01	0.01

Table 12-26: MPE for the Body Parts for MAMV-NAN5U Antenna, OTP, Controlled Environment

Part of the body / averaging points	Averaged Power Density at the $R_{real,}$ = 20 cm, mW/cm^2
Whole body (0.1 m to 2.0 m)	0.44
Lower body (0.1 m to 0.9 m)	0.48
Upper body (1.0 m to 2.0 m)	0.41

Table 12-27: MPE for AN-025167-014/MAMV-NAN5U Antenna, OTP, Uncontrolled Environment

MPE, mW/cm^2, measured at the distance **48 cm** between the probe and the antenna at the height (cm) shown below																			
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
0.01	0.01	0.01	0.02	0.04	0.06	0.10	0.33	0.50	0.50	0.37	0.10	0.08	0.06	0.02	0.01	0.01	0.01	0.01	0.01

Table 12-28: MPE for the Body Parts, MAMV-NAN5U Antenna, OTP, Uncontrolled Environment

Part of the body / averaging points	Averaged Power Density at the $R_{real,}$ = 48 cm, mW/cm^2
Whole body (0.1 m to 2.0 m)	0.11
Lower body (0.1 m to 0.9 m)	0.12
Upper body (1.0 m to 2.0 m)	0.11

Table 12-29: MPE for AN-025167-014/MAMV-NAN5U Antenna, P25, Controlled Environment

MPE, mW/cm^2, measured at the distance **19.5 cm** between the probe and the antenna at the height (cm) shown below																			
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
0.01	0.02	0.04	0.05	0.09	0.17	0.24	0.95	2.55	1.83	1.23	0.98	0.71	0.39	0.14	0.05	0.01	0.01	0.01	0.01

Table 12-30: MPE for the Body Parts, MAMV-NAN5U Antenna, P25, Controlled Environment

Part of the body / averaging points	Averaged Power Density at the $R_{real,}$ = 19.5 cm, mW/cm^2
Whole body (0.1 m to 2.0 m)	0.47
Lower body (0.1 m to 0.9 m)	0.46
Upper body (1.0 m to 2.0 m)	0.49

Table 12-31: MPE for AN-025167-014/MAMV-NAN5U Antenna, P25, Uncontrolled Environment

MPE, mW/cm^2, measured at the distance **46 cm** between the probe and the antenna at the height (cm) shown below																			
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
0.01	0.01	0.02	0.03	0.04	0.07	0.16	0.44	0.51	0.54	0.38	0.17	0.12	0.09	0.05	0.02	0.01	0.01	0.01	0.01

Table 12-32: MPE for the Body Parts, MAMV-NAN5U Antenna, P25, Uncontrolled Environment

Part of the body / averaging points	Averaged Power Density at the $R_{real,}$ = 46 cm, mW/cm^2
Whole body (0.1 m to 2.0 m)	0.14
Lower body (0.1 m to 0.9 m)	0.14
Upper body (1.0 m to 2.0 m)	0.13

Tables 12-33 through 12-40 demonstrate test the results received for the EUT with the AN-025167-015/MAMV-NAN5V antenna set either to the OTP modulation or to the P25 modulation.

Table 12-33: MPE for AN-025167-015/MAMV-NAN5V Antenna, OTP, Controlled Environment

MPE, mW/cm^2, measured at the distance **23 cm** between the probe and the antenna at the height (cm) shown below																			
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
0.05	0.11	0.14	0.16	0.25	0.35	1.20	2.30	1.50	0.60	0.40	0.12	0.13	0.15	0.09	0.03	0.02	0.01	0.01	0.01

Table 12-34: MPE for the Body Parts, MAMV-NAN5V Antenna, OTP, Controlled Environment

Part of the body / averaging points	Averaged Power Density at the $R_{real,}$=23 cm, mW/cm^2
Whole body (0.1 m to 2.0 m)	0.38
Lower body (0.1 m to 0.9 m)	0.67
Upper body (1.0 m to 2.0 m)	0.14

Table 12-35: MPE for AN-025167-015/MAMV-NAN5V Antenna, OTP, Uncontrolled Environment

MPE, mW/cm^2, measured at the distance **45 cm** between the probe and the antenna at the height (cm) shown below																			
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
0.06	0.15	0.12	0.11	0.11	0.24	0.19	0.33	0.53	0.48	0.25	0.12	0.11	0.10	0.09	0.03	0.02	0.01	0.01	0.01

Table 12-36: MPE for the Body Parts, MAMV-NAN5V Antenna, OTP, Uncontrolled Environment

Part of the body / averaging points	Averaged Power Density at the R_{real} = 45 cm, mW/cm^2
Whole body (0.1 m to 2.0 m)	0.13
Lower body (0.1 m to 0.9 m)	0.20
Upper body (1.0 m to 2.0 m)	0.11

Table 12-37: MPE for AN-025167-015/MAMV-NAN5V Antenna, P25, Controlled Environment

MPE, mW/cm^2, measured at the distance **22 cm** between the probe and the antenna at the height (cm) shown below																			
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
0.02	0.04	0.09	0.06	0.11	0.15	0.35	1.05	2.25	1.38	0.88	0.68	0.25	0.22	0.30	0.16	0.04	0.02	0.01	0.01

Table 12-38: MPE for the Body Parts, MAMV-NAN5V Antenna, P25, Controlled Environment

Part of the body / averaging points	Averaged Power Density at the $R_{real,}$=22 cm, mW/cm^2
Whole body (0.1 m to 2.0 m)	0.40
Lower body (0.1 m to 0.9 m)	0.46
Upper body (1.0 m to 2.0 m)	0.36

Table 12-39: MPE for AN-025167-015/MAMV-NAN5V Antenna, P25, Uncontrolled Environment

MPE, mW/cm^2, measured at the distance **43 cm** between the probe and the antenna at the height (cm) shown below																			
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
0.07	0.05	0.07	0.08	0.17	0.25	0.30	0.37	0.53	0.46	0.36	0.22	0.15	0.12	0.10	0.09	0.04	0.03	0.02	0.01

Table 12-40: MPE for the Body Parts, MAMV-NAN5V Antenna, P25, Uncontrolled Environment

Part of the body / averaging points	Averaged Power Density at the $R_{real,}$=43 cm, mW/cm^2
Whole body (0.1 m to 2.0 m)	0.17
Lower body (0.1 m to 0.9 m)	0.21
Upper body (1.0 m to 2.0 m)	0.15

13 Conclusion

1. The MPE measurements shown in this report for controlled and uncontrolled environments were conducted per the applicable FCC/IC Rules and Regulations and guiding documents, and determine the minimum safe distance between the EUT antennas and a user.

2. As is shown in Section 12, the measured MPE is below the maximum allowed limits.

3. The User Manual shall have a statement regarding the safe distances similar to the one shown below:

"Based on the worst case modulation mode, maximum radiated RF power and with respect to the 4.5 m cable supplied with the antennas, the following distances are considered as safe distances for controlled and uncontrolled environments for the EUT antennas:

Antenna Part #/Model #/Antenna Base	Safe Distance, R_{safe}, cm	
	Controlled Environment	Uncontrolled Environment
AN-025167-001/MAMV-AN3J/Standard Base	20	55
AN-025167-002/MAMV-AN3K/Elevated Feed Base	20	50
AN-025167-004/MAMV-AN3V/GPS RX Base	21	56
AN-025167-014/MAMV-NAN5U/Standard Base	20	48
AN-025167-015/MAMV-NAN5V/GPS RX Base	23	45