FCC Part 90 Test Report
for
M/A-Com, Inc.
on the
M-803 Vehicular Tactical Unit
Model: MAMROS0016

FCC ID: BV8M803VTAC

Test Report #: 3019505
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	Nicholas Abbondante, Test Engineer
	Robert Martin, Senior Technical Manager

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1.0 Summary of Tests

FCC ID: BV8M803VTAC
Model No.: MAMROS0016

FCC RULE	DESCRIPTION OF TEST	RESULTS	REPORT PAGE
2.1046	RF Power Output	Passed	8
2.1049, 90.209(b)(5), 90.210	Occupied Bandwidth, Bandwidth Limitation, Emission Masks	Passed	9
2.1051	Out-of-Band Emissions at Antenna Terminals	Passed	10
2.1053, 90.205, 90.635	Field Strength of Spurious Radiation	Passed	12
2.1047	Modulation Characteristics	N/A	--
2.1055	Frequency Stability vs. Temperature	Passed	13
2.1055	Frequency Stability vs. Voltage	Passed	14
2.914	Transient Frequency Behavior	N/A	15
2.1091, 2.1093	RF Exposure	Passed	19

Test Engineer: _____ Date: _____
Nicholas Abbondante

Senior Technical Manager: _____ Date: _____
Robert Martin

2.0 General Description

2.1 Product Description

The M-803 Vehicular Tactical (VTAC) Unit is a versatile voice and data radio designed for the mobile environment. The M-803 operates in the 800 MHz SMR and NPSPAC frequency bands. Two production versions of the M-803 Vehicular Tactical (VTAC) Unit were received on February 4, 2002 in good condition. Only the OpenSky digital modulation (OTP/ORP which employs a GSFK modulation) software was provided and tested. The two identical OpenSky VTAC configurations were the Trunk Mount Mobile Radio Unit with Vehicle Repeater Base, RF combiner and control head (M/A-Com Model MAMROS0016)

Subassembly:	Serial Numbers, Configuration 1:	Serial Numbers, Configuration 2:
VRM	A40070000196	A40070000229
VRB	A400700001B4	A4007000018A
RF Combiner	A40090100001	A40090100002
Control Head	A4000A10003B	A4000A1000A2

The EUT has been tested at the request of

Company: M/A-Com
1011 Pawtucket Blvd.
Lowell, MA, 01853-2395
Name of contact: Andy Moysenko
Telephone: (978) 442-4762
Fax: (978) 442-5442

Overview of M-803 VTAC Unit

Applicant	M/A-Com
Trade Name	M-803 Vehicular Tactical Unit (VTAC)
FCC Identifier	BV8M803VTAC
Use of Product	Voice and Data Communication
Type of Modulation	GFSK and FM
Bit Rate	19200 bps
Baud Rate	9600
Occupied Bandwidth	15.8 kHz measured
RF Output	18 Watts measured VRM , 17 Watts measured at the VRB
DC voltage and current into the final RF amplifying device	Voltage: 12VDC Current: 9A
Frequency Range	806 – 824 MHz and 851 – 869 MHz
Transmitter L.O. Frequency	736 – 754 MHz, 921 – 939 MHz, 966 – 984 MHz
Max. Number of Channels	830
Antenna(e) & Gain	0 dBd and 3 dBd
Detachable Antenna?	[X] Yes [ ] No
Receiver L.O. Frequency	58 MHz, 70.455 MHz, 736 – 754 MHz, 921 – 939 MHz, 966 – 984 MHz
External Input	[X] Audio [X] Digital Data

2.2 Related Submittal(s) Grants

None.

2.3 Test Facility

Radiated Testing:
Site 2C (Middle Site) is a 3m and 10m sheltered EMI measurement range located in a light commercial environment in Boxborough, Massachusetts. It meets the technical requirements of ANSI C63.4-1992 and CISPR 22:1993/EN 55022:1994 for radiated and conducted emission measurements. The shelter structure is entirely fiberglass and plastic, with outside dimensions of 33 ft x 57 ft. The structure resembles a quonset hut with a center ceiling height of 16.5 ft.

The testing floor is covered by a galvanized sheet metal ground plane that is earth-grounded via copper rods around the perimeter of the site. The joints between individual metal sheets are bridged with a 2 inch wide metal strips to provide low RF impedance contact throughout. The sheets of metal are screwed in place with stainless steel, round-head screws every three inches. Site illumination and HVAC are provided from beneath the ground reference plane through flush entry ports, the port covers are electrically bonded to the ground plane.

A flush metal turntable with 12 ft. diameter and 5000 lb. load capacity is provided for floor-standing equipment. A wooden table 80 cm high is used for table-top equipment. The turntable is electrically connected to the ground plane with three copper straps. The straps are connected to the turntable at the center of it with ground braid. The copper straps are directly connected to the ground plane at the edges of the turntable. The turntable is located on the south end of the structure and the antennas are mounted 3 and 10 meters away to the north. The antenna mast is a non-conductive with remote control of antenna height and polarization. The antenna height is adjustable from 1 to 4 meters.

All final radiated emission measurements are performed with the testing personnel and measurement equipment located below the ground reference plane. The site has a full basement underneath the turntable where support equipment may be remotely located. Operation of the antenna, turntable and equipment under test is controlled by remote controls that manipulate the antenna height and polarization and with a turntable control. Test personnel are located below the ellipse when measurements are performed, however the site maintains the ability of having personnel manipulate cables while monitoring test equipment. Ambient radiated emissions are 6 dB or more below the relevant FCC emission limits.

AC mains power is brought to the equipment under test through a power line filter, to remove ambient conducted noise. 50 Hz (240 VAC single phase), 60 Hz power (120 VAC single phase, 208 VAC three phase), and 60 Hz (480 VAC three phase) are available. Conducted emission measurements are performed with a Line Impedance Stabilization Network (LISN) or Artificial Mains Network (AMN) bonded to the ground reference plane. A removable vertical ground plane (2 meter X 2 meter area) is used for line-conducted measurements for table top equipment. The vertical ground plane is electrically connected to the reference ground plane.

2.4 Test Equipment and Support Equipment

Test Equipment

Description	Manufacturer	Model Number	Serial Number	Cal Due Date
Average Power Meter	Boonton	4232A	55601	12/21/02
EMI Receiver Set W/RF Filter	Hewlett Packard	8542E	3427A00126	12/07/02
Cable, SMA – SMA <18 GHz	Sucoflex	104PE	CBLSHF203	2/21/01
Cable, SMA – SMA <18 GHz	Sucoflex	104PE	CBLSHF201	2/21/01
Generator, Synthesized Sweep	Hewlett Packard	83620A	3213A01244	9/20/02
Horn Antenna	EMCO	3115	9512-4632	10/9/02
Power Sensor	Boonton	51011-4B	31990	12/21/02
50-Ohm Load	Weinschel	1430-4	BE5403	Cal Verified
Low to High Temperature Chamber	Bryant Manufacturing Associates	TH-5S	1207	7/17/02
Chart Recorder (TH-5S)	Honeywell	DR45AT	0028Y047153900001	6/25/02
Broadband Antenna	Compliance Design	B300	00674	5/10/02
Antenna	EMCO	3142	9711-1223	10/08/02
Horn Antenna	EMCO	3115	9602-4675	5/29/02
Spectrum Analyzer	Agilent	E7405A	US40240205	11/02/02
Test Vehicle	Oldsmobile	1994 Cutlass Supreme	1G3WH55M2RD302262	No Cal
30 dB Attenuator	Weinschel Corporation	23-30-34	AR6008	8/24/02
6 dB Attenuator	Weinschel Corporation	47-6-34	BE7734, BE7731, BE7733, BE7732	8/14/02

Support Equipment			
Description	**Manufacturer**	**Model Number**	**Serial Number**
40 dBAttenuator	Pasternack	PE7021-40	N/L
Laptop Computer Compaq Armada	Compaq	1456VQL10H(INT)	1J9ACX54M21E
Laptop Computer Compaq Armada	Compaq	7800 6300/T/8000/V/M/1	7919CB630126
Fan	Electrix	N619	N/L
Standard 3 dB Gain Whip Antenna	Antenna Specialists	ASPA1850M	N/L
3 dB Gain Puck Antenna	Antenna Plus	AP3000B	N/L
0 dB Gain Transit Antenna	Antenna Specialists	ASP930	N/L
Standard 3 dB Gain Elevated Whip Antenna	Antenna Specialists	ASPSA912M	N/L
Standard Unity Gain Whip Antenna	Maxrad	Z322	N/L
Microphone	M/A-Com	CTC000247	N/L
DC Power Supply	Hewlett Packard	6652A	3548A-02817
Speaker	Kenwood	KES-4	N/L
DC Power Supply	Hewlett Packard	6652A	MY40000256

Cables					
Quantity	**Type**	**Length (m)**	**Shielding**	**Ferrite**	**Connector Type**
2	Serial Cable	4	No	No	Metal w/360
1	Microphone Cable	1	No	No	Plastic
4	DC Power Cable	4	No	No	Plastic
1	AC Power Cable	2	No	No	Plastic
1	Speaker Cable	2	No	No	Plastic

3.0 RF Power Output

FCC § 2.1046, § 90.205(i), § 90.635(d)

3.1 Test Procedure

The transmitter output was connected to a calibrated coaxial attenuator, the other end of which was connected to an average power meter. The readings were taken from the power meter in dBm.

Requirement: The RF Power Output must be below 20 dBW.

3.2 Test Results

Results: Passed

Conducted RF Output Power

Frequency (MHz)	Description	Value (dBm)	Value (dBW)	Limit (dBW)
806.0125	Low Channel, VRM	42.11	12.11	20
816.3625	Middle Channel, VRM	42.55	12.55	20
823.9875	High Channel, VRM	42.00	12.00	20
851.0125	Low Channel, VRB	41.11	11.11	20
861.3625	Middle Channel, VRB	40.78	10.78	20
868.9875	High Channel, VRB	39.66	9.66	20
806.0125 & 851.0125	Low Channel Combined	44.65	14.65	20
816.3625 & 861.3625	Middle Channel Combined	44.76	14.76	20
823.9875 & 868.9875	High Channel Combined	44.00	14.00	20

4.0 Occupied Bandwidth, Bandwidth Limitation, Emission Masks

FCC §2.1049, 90.209(b)(5), 90.210

4.1 Test Procedure

The antenna was disconnected from the transmitter and a spectrum analyzer was connected to the transmitter RF output through sufficient attenuation to prevent overloading of the analyzer. The resolution bandwidth of the spectrum analyzer was set up to 300 Hz in the 100 kHz span around the transmit frequency, and the spectrum of the transmitting signal was recorded. This spectrum was compared to the required emission mask. Readings were taken of the carrier power at low, middle, and high values of the transmit frequency using an average power meter. These readings are used to determine the upper limit for the applicable emissions masks.

Occupied bandwidth was measured using the 99% power function on the spectrum analyzer.

The emission designators were defined as 15K8F7D and 15K8F7E, where 15.8 kHz is the Necessary Bandwidth, determined using the maximum Occupied Bandwidth. The EUT implements a digital data stream through software GFSK modulation which shapes and constrains the Necessary Bandwidth and therefore the equations for Necessary Bandwidth are not appropriate.

4.2 Test Results

Plots of the test results can be found in appendix A.

Frequency (MHz)	Occupied Bandwidth (kHz)	Authorized Bandwidth (kHz)
807.2375 (Low Channel, VRM)	14.0	20
816.3625 (Middle Channel, VRM)	15.3	20
823.9875 (High Channel, VRM)	15.8	20
807.2375 (Low Channel, VRB)	15.5	20
816.3625 (Middle Channel, VRB)	14.8	20
823.9875 (High Channel, VRB)	14.5	20

Results: Passed

5.0 Out-of-Band Emissions at Antenna Terminals

FCC §2.1051, FCC §90.210

5.1 Test Procedure

The RF output of the transceiver was connected to a spectrum analyzer through sufficient attenuation to prevent overloading the analyzer; a high-pass or band stop filter is used where necessary to prevent the fundamental emission from overloading the analyzer. The resolution bandwidth of the spectrum analyzer was set at 100 kHz below 1 GHz. Above 1 GHz the bandwidth was set to 1 MHz. Sufficient scans were taken to show the out-of-band emissions, if any, up to 10th harmonic.

Requirement: The power of emissions must be attenuated below the power of the unmodulated carrier (P) on any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth at least (43 + 10 log P) dB. P is the measured RF output power of 18 Watts. Therefore all emissions should be attenuated by 55.5 dB below the carrier power. Note that all plots were made through 68.4 dB of attenuation and cable loss.

5.2 Test Results

Plots can be located in appendix B. Note that no emissions were detected emanating from the antenna port other than the two fundamentals.

Results: Passed

6.0 Field Strength of Spurious Radiation

FCC §2.1053, §90.210

6.1 Test Procedure

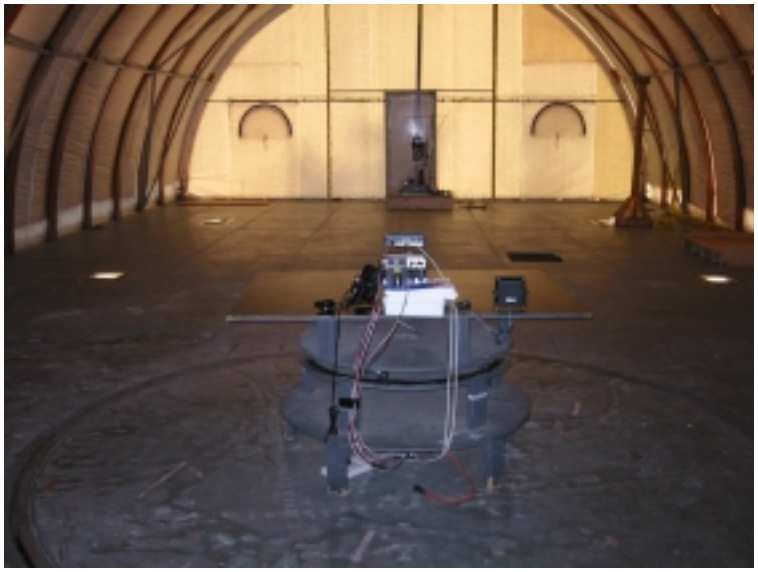
The transmitter was placed on a wooden turntable. The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT.

The Field Strength (FS) in the frequency range up to tenth harmonic of the fundamental frequency was measured. At the frequencies where the FS exceed 62.3 dBuV/m, the EIRP of spurious emissions was measured by the substitution method using the double-ridged horn antenna. The FS=62.3 dBuV/m corresponds to the EIRP equal –33 dBm which is 20 less than the limit (-13 dBm), adjusted by 9.5 dB to account for the test distance of 3 meters, adjusted by the gain of a typical dipole antenna, 2.14 dBi. The Radiated Power was measured by the substitution method using horn antenna connected to a generator. Power P (in dBm) was calculated as follows:

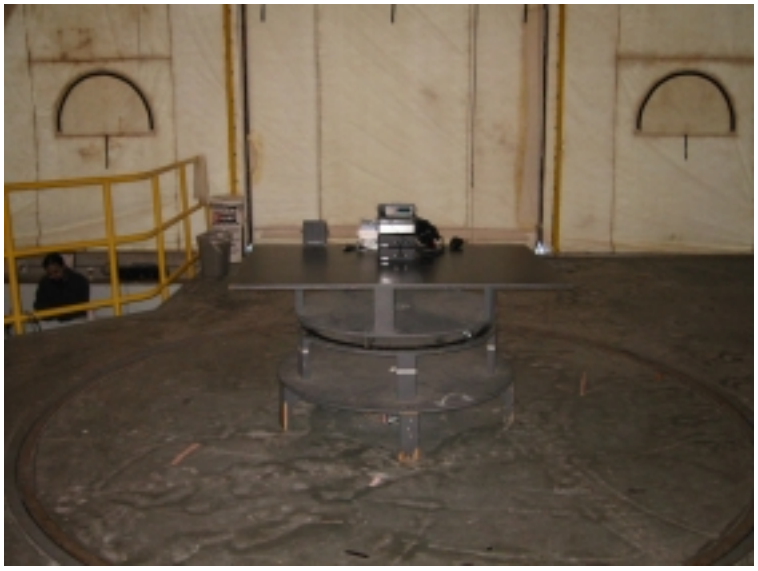
$$P = P_{sg} – L + G_H - G_d$$

Where G_H is the gain of the transmit horn antenna attached to the signal generator
L is the loss in the cable between the signal generator and the transmit antenna
P_{sg} is the generator output power (on the end of the cable connected to an antenna)
G_d is 2.14 dBi – the gain of the half-wave dipole.

Photographs of the test setup used to test for radiated emissions from the EUT chassis are below. Requirement: The power into a dipole required to duplicate the chassis emission must be below –13 dBm.



Radiated Spurious Test Setup, Front View



Radiated Spurious Test Setup, Back View

6.2 Test Results

Frequency (MHz)	Power (dBm)	Power Limit (dBm)
1633	-17.64	-13
1723	-17.84	-13
2450	-13.84	-13
2585	-20.84	-13
3265	-20.14	-13
3445	-22.54	-13
4900	-15.04	-13
5170	-18.04	-13
5715	-21.44	-13
6531	-13.14	-13

Results: Pass

7.0 Frequency Stability vs Temperature

FCC § 2.1055, § 90.213

7.1 Test Procedure

The equipment under test was connected to an external DC power supply and the RF output was connected to a spectrum analyzer through an attenuator pad. The EUT was placed inside the temperature chamber. The DC power cable, RF output cable, exited the chamber through an opening insulated to minimize heat flow. After the temperature stabilized for approximately 20 minutes, the frequency of the output signal was recorded from the analyzer.

Requirement: The frequency must not deviate by more than 1.5 parts-per-million (ppm) in the frequency band 806-821/851-866 MHz, and 2.5 ppm in the frequency band 821-824/866-869 MHz. The tighter limit of 1.5 ppm will be applied from 806-824 MHz in order to show compliance, with the lowest frequency 806 MHz and 851 MHz selected from each band to provide the lowest possible limit.

7.2 Test Results

VRM

Temperature, C	Reading (MHz)	Difference (Hz)	Limit (Hz)
+50	816.362	1000	1209
+40	816.362	1000	1209
+30	816.363	0	1209
+20	816.363	0 (Nominal Value)	1209
+10	816.363	0	1209
0	816.363	0	1209
-10	816.363	0	1209
-20	816.363	0	1209
-30	816.363	0	1209

VRB

Temperature, C	Reading (MHz)	Difference (Hz)	Limit (Hz)
+50	861.362	1000	1277
+40	861.363	0	1277
+30	861.363	0	1277
+20	861.363	0 (Nominal Value)	1277
+10	861.363	0	1277
0	861.364	1000	1277
-10	861.363	0	1277
-20	861.364	1000	1277
-30	861.362	1000	1277

Results: Passed

8.0 Frequency Stability vs Voltage

FCC §2.995(d)(2)

8.1 Test Procedure

An external variable DC power supply was connected to the EUT. The frequency of the transmitter was measured for 115% of the DC nominal value and for 85% of the nominal value.

Requirement: The frequency must not deviate by more than 1.5 parts-per-million (ppm) in the frequency band 806-821 MHz, and 2.5 ppm in the frequency band 821-824 MHz. The tighter limit of 1.5 ppm will be applied from 806-824 MHz in order to show compliance, with the lowest frequency 806 MHz selected to provide the lowest possible limit.

8.2 Test Results

VRM

Voltage, VDC	Reading (Hz)	Difference (Hz)	Limit (Hz)
11.73 (85%)	816.364	1000	1209
12.42 (90%)	816.362	1000	1209
13.11 (95%)	816.363	0	1209
13.8 (100%)	816.363	0 (Nominal Voltage)	1209
14.49 (105%)	816.363	0	1209
15.18 (110%)	816.362	1000	1209
15.87 (115%)	816.362	1000	1209

VRB

Voltage, VDC	Reading (Hz)	Difference (Hz)	Limit (Hz)
11.73 (85%)	861.362	1000	1278
12.42 (90%)	861.364	1000	1278
13.11 (95%)	861.362	1000	1278
13.8 (100%)	861.363	0 (Nominal Voltage)	1278
14.49 (105%)	861.364	1000	1278
15.18 (110%)	861.363	0	1278
15.87 (115%)	861.363	0	1278

Results: Passed

9.0 Transient Frequency Behavior

FCC §90.214

9.1 Test Procedure

This test is required for transmitters operating the frequency bands 150-174 MHz and 421-512 MHz. The EUT does not transmit in these bands.

9.2 Test Results

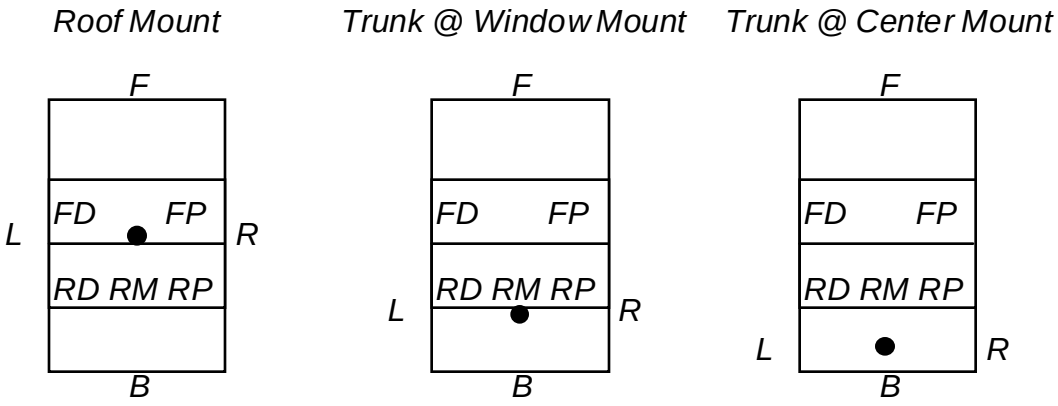
Results: Not Applicable

10.0 RF Exposure

FCC §2.1091, §2.1093

10.1 Test Procedure

The EUT was activated at full power, and connected to the five antennas that will be provided for use with it. Each antenna was placed at three different positions on a test vehicle, the center of the roof, the center of the trunk, and centered on the trunk at the back window, excepting the puck and transit style antennas, which were placed at the roof and center of the trunk. These are typical mounting points. A measurement antenna was connected to a spectrum analyzer, and peak readings of the field strength were taken at various test points outside and inside of the vehicle. Measurement antenna height and polarization were varied at each point to produce the worst-case value. Below are diagrams showing the transmit antenna mounting point and the corresponding test point locations and designations.



F = Front *FD = Front Driver Side* *RP = Rear Passenger Side*
L = Left *FP = Front Passenger Side* ● *= Transmit Antenna*
R = Right *RD = Rear Driver Side*
B = Back *RM = Rear Middle*

The readings at the spectrum analyzer are in dBuV/m. The limits are expressed in mW/cm^2. An equation that relates these two values is

$E = 20 \text{ LOG } (1x10^6 (377*10*P)^{1/2})$

where E is the measured voltage in dBuV/m, and P is the power density in mW/cm^2. The factor 377 is the impedance of free space, a constant. The obtained power density can then be compared to the limits. The power density limit for uncontrolled exposure is f/1500, where f is the transmit frequency. The worst case limits are at the lowest transmit frequency, and the measured RF output power of the EUT at the antenna port was maximum at the lowest transmit frequency. Therefore the lowest transmit frequency of 806.0125 MHz was selected as the worst case frequency and the limit for Maximum Permissible Exposure (MPE) was determined to be 0.537

mW/cm^2.

The distance between the transmit antenna and the test points is measured, and compared to a calculated Minimum Safe Distance (MSD). The MSD is determined by taking the maximum power output at the antenna terminals and adding the gain of the transmit antenna to determine the Effective Isotropic Radiated Power (EIRP). The EIRP assumed to radiate spherically from the transmit antenna and the Minimum Safe Distance is the radius of a sphere large enough that the radiated power density at the surface is equal to the limits for Maximum Permissible Exposure (MPE). The following equation relates the EIRP (mW) of the transmitter and P (mW/cm^2), the power density at radius r (cm):

$EIRP = P*4*Pi*r^2$

VRM:
$EIRP_{3dB}$ = maximum radio output (42.5 dBm) + maximum antenna gain (3 dB) = 45.5 dBm
$EIRP_{0dB}$ = maximum radio output (42.5 dBm) + maximum antenna gain (0 dB) = 42.5 dBm

VRB:
$EIRP_{3dB}$ = maximum radio output (41 dBm) + maximum antenna gain (3 dB) = 44 dBm
$EIRP_{0dB}$ = maximum radio output (41 dBm) + maximum antenna gain (0 dB) = 41 dBm

Therefore,

$MSD_{3dB} = [(EIRP1 + EIRP2)/(4*Pi*P)]^{1/2}$ = 95 cm
$MSD_{0dB} = [(EIRP1 + EIRP2)/(4*Pi*P)]^{1/2}$ = 67 cm

Roof Mounting on Test Vehicle

Trunk @ Window Mounting on Test Vehicle

Trunk @ Center Mounting on Test Vehicle

10.2 Test Results

Data fields in the format (low frequency data)/(high frequency data).

Antenna Specialists ASPSA912M 3dB Gain Roof Mount

Test Point	Field Strength Reading (dBuV/m)	Field Strength Reading (mW/cm^2)	Total Field Strength (mW/cm^2)	MPE Limit (mW/cm^2)	Test Point Distance (cm)	MSD Limit (cm)
Front	140.11 / 139.36	0.027 / 0.023	0.050	0.537	294.0	95
Back	141.80 / 142.45	0.040 / 0.047	0.087	0.537	203.0	95
Left	156.25 / 146.06	0.112 / 0.107	0.219	0.537	97.0	95
Right	148.14 / 147.90	0.173 / 0.164	0.336	0.537	110.0	95
Front Driver	136.80 / 130.31	0.013 / 0.003	0.016	0.537	55.0	95
Front Passenger	135.11 / 131.26	0.009 / 0.004	0.012	0.537	54.0	95
Rear Driver	135.22 / 130.83	0.009 / 0.003	0.012	0.537	55.0	95
Rear Middle	132.02 / 129.10	0.004 / 0.002	0.006	0.537	48.0	95
Rear Passenger	135.80 / 135.57	0.010 / 0.010	0.020	0.537	60.0	95

Antenna Specialists ASPSA912M 3dB Gain Trunk @ Window Mount

Test Point	Field Strength Reading (dBuV/m)	Field Strength Reading (mW/cm^2)	Total Field Strength (mW/cm^2)	MPE Limit (mW/cm^2)	Test Point Distance (cm)	MSD Limit (cm)
Front	136.48 / 135.81	0.012 / 0.010	0.022	0.537	429.0	95
Back	***151.23 / 150.69***	***0.352 / 0.311***	***0.663***	0.537	73.0	95
Left	147.81 / 147.63	0.160 / 0.154	0.314	0.537	100.0	95
Right	149.63 / 149.19	0.244 / 0.220	0.464	0.537	100.0	95
Front Driver	141.26 / 139.81	0.035 / 0.025	0.061	0.537	165.0	95
Front Passenger	143.13 / 139.30	0.055 / 0.025	0.077	0.537	165.0	95
Rear Driver	145.42 / 144.34	0.092 / 0.072	0.164	0.537	85.0	95
Rear Middle	144.51 / 143.30	0.075 / 0.057	0.132	0.537	75.0	95
Rear Passenger	145.11 / 143.57	0.086 / 0.060	0.146	0.537	85.0	95

Antenna Specialists ASPSA912M 3dB Gain Trunk @ Center Mount

Test Point	Field Strength Reading (dBuV/m)	Field Strength Reading (mW/cm^2)	Total Field Strength (mW/cm^2)	MPE Limit (mW/cm^2)	Test Point Distance (cm)	MSD Limit (cm)
Front	135.30 / 134.95	0.009 / 0.008	0.017	0.537	454.0	95
Back	***153.02 / 152.08***	***0.532 / 0.428***	***0.960***	0.537	47.0	95
Left	147.21 / 147.83	0.140 / 0.161	0.300	0.537	100.0	95
Right	147.22 / 147.83	0.140 / 0.161	0.301	0.537	100.0	95
Front Driver	141.35 / 142.03	0.036 / 0.042	0.079	0.537	185.0	95
Front Passenger	142.72 / 142.76	0.050 / 0.050	0.100	0.537	185.0	95
Rear Driver	146.62 / 144.31	0.122 / 0.072	0.193	0.537	105.0	95
Rear Middle	144.85 / 145.04	0.081 / 0.085	0.166	0.537	100.0	95
Rear Passenger	145.78 / 144.47	0.100 / 0.074	0.175	0.537	105.0	95

Antenna Specialists ASPA1850M 3dB Gain Roof Mount

Test Point	Field Strength Reading (dBuV/m)	Field Strength Reading (mW/cm^2)	Total Field Strength (mW/cm^2)	MPE Limit (mW/cm^2)	Test Point Distance (cm)	MSD Limit (cm)
Front	136.54 / 139.00	0.012 / 0.021	0.033	0.537	294.0	95
Back	139.99 / 142.31	0.026 / 0.045	0.072	0.537	203.0	95
Left	***149.58 / 150.66***	***0.241 / 0.309***	***0.550***	0.537	97.0	95
Right	147.71 / 149.82	0.157 / 0.254	0.411	0.537	110.0	95
Front Driver	133.58 / 138.1	0.006 / 0.017	0.023	0.537	55.0	95
Front Passenger	137.86 / 136.22	0.016 / 0.011	0.027	0.537	54.0	95
Rear Driver	139.23 / 138.56	0.022 / 0.019	0.041	0.537	55.0	95
Rear Middle	137.18 / 139.24	0.014 / 0.022	0.036	0.537	48.0	95

Rear Passenger	138.64 / 138.80	0.019 / 0.020	0.040	0.537	60.0	95

Antenna Specialists ASPA1850M 3dB Gain Trunk @ Window Mount

Test Point	Field Strength Reading (dBuV/m)	Field Strength Reading (mW/cm^2)	Total Field Strength (mW/cm^2)	MPE Limit (mW/cm^2)	Test Point Distance (cm)	MSD Limit (cm)
Front	134.79 / 136.76	0.008 / 0.013	0.020	0.537	429.0	95
Back	***150.84 / 151.38***	***0.322 / 0.364***	***0.686***	0.537	73.0	95
Left	147.66 / 147.54	0.155 / 0.151	0.305	0.537	100.0	95
Right	146.97 / 147.11	0.132 / 0.136	0.268	0.537	100.0	95
Front Driver	144.74 / 144.29	0.079 / 0.071	0.150	0.537	165.0	95
Front Passenger	147.34 / 145.82	0.144 / 0.101	0.245	0.537	165.0	95
Rear Driver	***150.99 / 151.82***	***0.333 / 0.403***	***0.736***	0.537	85.0	95
Rear Middle	148.37 / 148.43	0.182 / 0.185	0.367	0.537	75.0	95
Rear Passenger	149.17 / 149.07	0.219 / 0.214	0.433	0.537	85.0	95

Antenna Specialists ASPA1850M 3dB Gain Trunk @ Center Mount

Test Point	Field Strength Reading (dBuV/m)	Field Strength Reading (mW/cm^2)	Total Field Strength (mW/cm^2)	MPE Limit (mW/cm^2)	Test Point Distance (cm)	MSD Limit (cm)
Front	136.09 / 138.85	0.011 / 0.020	0.031	0.537	454.0	95
Back	***151.92 / 153.71***	***0.413 / 0.623***	***1.036***	0.537	47.0	95
Left	146.38 / 147.03	0.115 / 0.134	0.249	0.537	100.0	95
Right	145.74 / 145.92	0.099 / 0.104	0.203	0.537	100.0	95
Front Driver	141.63 / 142.13	0.039 / 0.043	0.082	0.537	185.0	95
Front Passenger	142.13 / 144.01	0.043 / 0.067	0.110	0.537	185.0	95
Rear Driver	143.89 / 147.06	0.065 / 0.135	0.200	0.537	105.0	95
Rear Middle	147.89 / 149.19	0.163 / 0.220	0.383	0.537	100.0	95
Rear Passenger	146.93 / 148.45	0.131 / 0.186	0.316	0.537	105.0	95

Maxrad Z322 0dB Gain Roof Mount

Test Point	Field Strength Reading (dBuV/m)	Field Strength Reading (mW/cm^2)	Total Field Strength (mW/cm^2)	MPE Limit (mW/cm^2)	Test Point Distance (cm)	MSD Limit (cm)
Front	135.53 / 136.06	0.009 / 0.010	0.020	0.537	294.0	67
Back	137.13 / 137.34	0.014 / 0.014	0.028	0.537	203.0	67
Left	148.29 / 148.86	0.179 / 0.204	0.383	0.537	97.0	67
Right	144.41 / 145.84	0.073 / 0.102	0.175	0.537	110.0	67
Front Driver	131.51 / 132.25	0.003 / 0.004	0.008	0.537	55.0	67
Front Passenger	130.76 / 133.21	0.003 / 0.006	0.009	0.537	54.0	67
Rear Driver	136.63 / 136.37	0.012 / 0.011	0.024	0.537	55.0	67
Rear Middle	135.07 / 139.07	0.009 / 0.021	0.030	0.537	48.0	67
Rear Passenger	137.05 / 135.73	0.013 / 0.010	0.023	0.537	60.0	67

Maxrad Z322 0dB Gain Trunk @ Window Mount

Test Point	Field Strength Reading (dBuV/m)	Field Strength Reading (mW/cm^2)	Total Field Strength (mW/cm^2)	MPE Limit (mW/cm^2)	Test Point Distance (cm)	MSD Limit (cm)
Front	136.25 / 134.45	0.011 / 0.007	0.019	0.537	429.0	67
Back	149.00 / 149.07	0.211 / 0.214	0.425	0.537	73.0	67
Left	145.05 / 142.25	0.085 / 0.045	0.129	0.537	100.0	67
Right	145.70 / 145.61	0.099 / 0.097	0.195	0.537	100.0	67
Front Driver	145.18 / 143.36	0.087 / 0.057	0.145	0.537	165.0	67
Front Passenger	144.98 / 139.93	0.083 / 0.026	0.110	0.537	165.0	67

Rear Driver	150.44 / 147.51	0.294 / 0.150	0.443	0.537	85.0	67
Rear Middle	146.81 / 145.98	0.127 / 0.105	0.232	0.537	75.0	67
Rear Passenger	148.90 / 144.17	0.206 / 0.069	0.275	0.537	85.0	67

Maxrad Z322 0dB Gain Trunk @ Center Mount

Test Point	Field Strength Reading (dBuV/m)	Field Strength Reading (mW/cm^2)	Total Field Strength (mW/cm^2)	MPE Limit (mW/cm^2)	Test Point Distance (cm)	MSD Limit (cm)
Front	135.94 / 136.63	0.010 / 0.012	0.023	0.537	454.0	67
Back	***151.48 / 152.12***	***0.373 / 0.432***	***0.805***	0.537	47.0	67
Left	147.29 / 146.48	0.142 / 0.118	0.260	0.537	100.0	67
Right	146.45 / 146.49	0.117 / 0.118	0.235	0.537	100.0	67
Front Driver	139.79 / 139.94	0.025 / 0.026	0.051	0.537	185.0	67
Front Passenger	140.89 / 141.81	0.033 / 0.040	0.073	0.537	185.0	67
Rear Driver	143.39 / 143.17	0.058 / 0.055	0.113	0.537	105.0	67
Rear Middle	147.08 / 146.07	0.135 / 0.107	0.243	0.537	100.0	67
Rear Passenger	144.60 / 145.38	0.076 / 0.092	0.168	0.537	105.0	67

Antenna Specialists Transit Antenna ASP930 0dB Gain Roof Mount

Test Point	Field Strength Reading (dBuV/m)	Field Strength Reading (mW/cm^2)	Total Field Strength (mW/cm^2)	MPE Limit (mW/cm^2)	Test Point Distance (cm)	MSD Limit (cm)
Front	138.25 / 137.54	0.018 / 0.015	0.033	0.537	294.0	67
Back	144.02 / 143.15	0.067 / 0.055	0.122	0.537	203.0	67
Left	149.47 / 148.24	0.235 / 0.177	0.412	0.537	97.0	67
Right	148.08 / 147.22	0.170 / 0.140	0.310	0.537	110.0	67
Front Driver	134.74 / 133.51	0.008 / 0.006	0.014	0.537	55.0	67
Front Passenger	137.82 / 136.28	0.016 / 0.011	0.027	0.537	54.0	67
Rear Driver	138.44 / 135.98	0.019 / 0.011	0.029	0.537	55.0	67
Rear Middle	138.75 / 135.07	0.020 / 0.009	0.028	0.537	48.0	67
Rear Passenger	138.91 / 135.86	0.021 / 0.010	0.031	0.537	60.0	67

Antenna Specialists Transit Antenna ASP930 0dB Gain Trunk @ Center Mount

Test Point	Field Strength Reading (dBuV/m)	Field Strength Reading (mW/cm^2)	Total Field Strength (mW/cm^2)	MPE Limit (mW/cm^2)	Test Point Distance (cm)	MSD Limit (cm)
Front	135.51 / 135.93	0.009 / 0.010	0.020	0.537	454.0	67
Back	***152.28 / 150.07***	***0.448 / 0.270***	***0.718***	0.537	47.0	67
Left	149.88 / 147.99	0.258 / 0.167	0.425	0.537	100.0	67
Right	148.81 / 146.90	0.202 / 0.130	0.332	0.537	100.0	67
Front Driver	144.98 / 142.66	0.083 / 0.049	0.132	0.537	185.0	67
Front Passenger	144.38 / 141.67	0.073 / 0.039	0.112	0.537	185.0	67
Rear Driver	147.66 / 144.77	0.155 / 0.080	0.234	0.537	105.0	67
Rear Middle	148.16 / 146.71	0.174 / 0.124	0.298	0.537	100.0	67
Rear Passenger	148.25 / 147.84	0.177 / 0.161	0.339	0.537	105.0	67

Antenna Plus Puck Antenna AP8000B 3dB Gain Roof Mount

Test Point	Field Strength Reading (dBuV/m)	Field Strength Reading (mW/cm^2)	Total Field Strength (mW/cm^2)	MPE Limit (mW/cm^2)	Test Point Distance (cm)	MSD Limit (cm)
Front	131.86 / 136.69	0.004 / 0.012	0.016	0.537	294.0	95
Back	136.87 / 138.44	0.013 / 0.019	0.031	0.537	203.0	95
Left	142.30 / 140.05	0.045 / 0.026	0.072	0.537	97.0	95
Right	145.06 / 145.11	0.085 / 0.086	0.171	0.537	110.0	95

Front Driver	135.11 / 136.60	0.009 / 0.012	0.021	0.537	55.0	95
Front Passenger	136.40 / 131.52	0.012 / 0.004	0.015	0.537	54.0	95
Rear Driver	137.75 / 137.05	0.016 / 0.013	0.029	0.537	55.0	95
Rear Middle	137.23 / 136.44	0.014 / 0.012	0.026	0.537	48.0	95
Rear Passenger	139.14 / 137.88	0.022 / 0.016	0.038	0.537	60.0	95

Antenna Plus Puck Antenna AP8000B 3dB Gain Trunk @ Center Mount

Test Point	Field Strength Reading (dBuV/m)	Field Strength Reading (mW/cm^2)	Total Field Strength (mW/cm^2)	MPE Limit (mW/cm^2)	Test Point Distance (cm)	MSD Limit (cm)
Front	131.47 / 130.27	0.004 / 0.003	0.007	0.537	454.0	95
Back	***151.24 / 149.55***	***0.353 / 0.239***	***0.592***	0.537	47.0	95
Left	146.74 / 140.73	0.125 / 0.031	0.157	0.537	100.0	95
Right	147.35 / 143.09	0.144 / 0.054	0.198	0.537	100.0	95
Front Driver	140.21 / 136.31	0.028 / 0.011	0.039	0.537	185.0	95
Front Passenger	141.42 / 136.65	0.037 / 0.012	0.049	0.537	185.0	95
Rear Driver	144.91 / 141.14	0.082 / 0.034	0.117	0.537	105.0	95
Rear Middle	144.48 / 138.65	0.074 / 0.019	0.094	0.537	100.0	95
Rear Passenger	143.66 / 141.9	0.061 / 0.041	0.103	0.537	105.0	95

It can be seen from the above tables that all of the field strength readings (bolded italicized readings) that exceeded the MPE limit are within the MSD. Additionally, those readings that exceeded the MPE limit all had a direct line-of-sight between the EUT transmit antenna and the field strength measurement antenna.

The EUT's transmitter is activated by bursty data transmissions and the operator keying a microphone which classifies the device as a Push-To-Talk (PTT) device. PTT allows a 50% averaging power factor reduction that corresponds to a 3 dB reduction in the measured field strength reading. The table below applies the power factor reduction for those test points that exceeded the MPE limit.

Over limit reading adjustment for Push to Talk 50% averaging factor

Test Point	Field Strength Reading – 3 dB PTT AVG Factor (dBuV/m)	Field Strength Reading – 3 dB PTT AVG Factor (mW/cm^2)	Test Point Distance (cm)	Limit (mW/cm^2)	Antenna	Mounting
Back	148.23 / 147.69	0.176 + 0.156 = 0.332	100	0.537	Antenna Specialists ASPSA912M	Trunk @ Window
Back	150.02 / 149.08	0.266 + 0.215 = 0.481	100	0.537	Antenna Specialists ASPSA912M	Trunk @ Center
Left	146.58 / 147.66	0.121 + 0.155 = 0.275	97	0.537	Antenna Specialists ASPA1850M	Roof
Back	147.84 / 148.38	0.161 + 0.183 = 0.344	100	0.537	Antenna Specialists ASPA1850M	Trunk @ Window
Rear Driver	147.99 / 148.82	0.167 + 0.202 = 0.369	85	0.537	Antenna Specialists ASPA1850M	Trunk @ Window
Back	148.92 / 150.71	0.207 + 0.312 = 0.519	100	0.537	Antenna Specialists ASPA1850M	Trunk @ Center
Back	148.48 / 149.12	0.187 + 0.217 = 0.404	100	0.537	Maxrad Z322	Trunk @ Center
Back	149.28 / 147.07	0.225 + 0.135 = 0.360	100	0.537	Antenna Specialists ASP930	Trunk @ Center

Back	148.24 / 146.55	0.177 + 0.120 = 0.297	100	0.537	Antenna Plus AP8000B	Trunk @ Center

There are two possible types of usage of this radio system, designated as “Scene of Incidence” and “Coverage Extension”. In Scene of Incidence mode, the VRB only will be transmitting full duty cycle when nearby radios are keyed up. This allows use of the Push-To-Talk averaging factor. In the Coverage Extension mode, there are two further possibilities. Either the the radio user is keying up the radio, in which case both the VRM and VRB will be operating simultaneously in full duplex mode (50% duty cycle). In this full duplex mode, both the VRM and VRB are initiated by keying by the user or by keying of nearby radios, respectively, and therefore can use the Push-To-Talk average factor. When the user does not key the VRM, the VRB will continue to operate, this time with a 100% duty cycle, but still responding to keying of nearby radios, falling once again into the category of a Push-To-Talk device. Having adjusted the over limit values for the Push to Talk average factor, it can be seen that the transmitters comply with the requirements for RF exposure levels with both transmitting at 100% duty cycle simultaneously.

This radio has been tested and complies with the FCC RF exposure limits for Uncontrolled Exposure and Occupational exposure. The difference is in the minimum safe distance that people must be away from the antenna when transmitting RF energy. To assure optimal radio performance and that human exposure to RF electromagnetic energy is within the guidelines, transmit only when people are at least the minimum distance away from a properly installed antenna. The following table lists the minimal distances.

Measured Power of OpenSky Mobile Radio	Antenna Gain	MSD from Transmitting Antenna, General Population / Uncontrolled Exposure	MSD from Transmitting Antenna, Occupational / Controlled Exposure
42 dBm VRB and 41 dBm VRM	0 dB	70 cm (27.5 inches)	30.6 cm (12 inches)
42 dBm VRB and 41 dBm VRM	3 dB	1 meter (39.4 inches)	43.2 cm (17 inches)
Results: Passed			