



Engineering Solutions & Electromagnetic Compatibility Services

RF Maximum Permissible Exposure (MPE) Report for Controlled and Uncontrolled Environments

Harris Corporation
221 Jefferson Ridge Parkway
Lynchburg, VA 24501
Daryl Popowitch
Phone: (434) 455-9527

Model: XG-25M 700/800 MHz Radio

**FCC ID: OWDTR-0076-E
IC: 3636B-0076**

May 7, 2013

Report Prepared by: Dan Baltzell

Document Number: 2012287MPE

This report may not be reproduced, except in full, without the written approval of Rhein Tech Laboratories, Inc. and Harris Corporation. Test results relate only to the item tested.

These tests are accredited and meet the requirements of ISO/IEC 17025 as verified by ANSI-ASQ National Accreditation Board/ACLASS. Refer to certificate and scope of accreditation AT-1445.

Table of Contents

1	MPE Measurements and Applicable Regulations	3
2	Identification of the EUT	4
3	Modifications	4
4	Test Laboratory.....	4
5	Test Dates.....	4
6	Antenna Information	5
7	Test Equipment, Accessories and Test Setup.....	5
8	Justification of Transmitting Mode and Frequency	6
9	MPE Limits for the EUT	7
10	Calculating the Safe Distance from the EUT's Antenna	8
11	Standard Test Conditions and Engineering Practices	8
12	Measurement Procedure	9
13	Test Results	10
14	Conclusion	12

1 MPE Measurements and Applicable Regulations

This test report presents the results of Maximum Permissible Exposure (MPE) measurements performed on the Harris Corporation Model XG-25M, in the 700 MHz and 800 MHz frequency bands. The tests were performed in accordance with TCB training material and the following FCC Rules and Regulations:

- IEEE Std C95.1: 2005: "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz – 300 GHz",
- IEEE Std C95.3: 2002: "IEEE Recommended Practice for Measurements and Computations of Radio Frequency Electromagnetic Fields with Respect to Human Exposure to Such Fields, 100 kHz – 300 GHz",
- 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 Emission",
- Subpart I, Part 1 of 47 CFR FCC Rules and Regulations, 2012: "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, 2012: "Equipment Authorization Procedures." Specifically, Paragraph 2.1091: "Radiofrequency Radiation Exposure Evaluation: Mobile Devices"
- IC RSS-102 Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands), Issue 4 March 2010 (updated December 2010)

2 Identification of the EUT

The EUT is a combination of a mobile radio and an antenna. The EUT was tested with one antenna which was placed on a metal plate during testing to simulate the vehicle mounting surface. The mounting plate acted as a determinable ground plane for the antenna. This MPE report covers the EUT with the antennas described below.

Manufacturer's Name	Harris Corporation
Manufacturer's Address	221 Jefferson Ridge Parkway Lynchburg, VA 24501
Device Type	Mobile
Model of the EUT	XG-25M
Serial Number of the Radio	A40201000506
FCC/IC ID of the EUT	FCC ID: OWDTR-0076-E IC: 3636B-0076
Operating Frequency Ranges (for the specific configuration in this report)	FCC: 769 – 775 MHz, 799 – 805 MHz, 806 – 824 MHz, and 851 – 869 MHz
RF Max Conducted Power, Rated	35 W
TX Duty Cycle	50%
Antenna Tested	Dual band 764-870 MHz element AN-225001-005 5 dBd (7.15 dBi)
Year of Manufacture	2013

3 Modifications

No modifications were made to the EUT during testing.

4 Test Laboratory

Testing was performed at the Rhein Tech Laboratories (RTL) test facility located at 360 Herndon Parkway, Suite 1400, Herndon, VA, 20170, by RTL personnel. Various regulatory bodies, including the FCC, approved this facility for conducting tests and measurements on a contractual basis.

5 Test Dates

Testing was performed May 3, 2013.

6 Antenna Information

The following antenna/mounts were tested for the MPE investigation.

Description	Gain	Mount Type	Antenna Part #
Harris Corporation	5 dBd (7.15 dBi)	Roof	AN-225001-005

7 Test Equipment, Accessories and Test Setup

Test equipment used for the measurements is shown in Table 7-1.

Table 7-1: Test Equipment

RTL Asset #	Manufacturer	Model	Equipment Type	Serial Number	Calibration Due Date
901177	Narda	TYPE-9	Field Probe	N-0050	1/21/14
901183	Narda	EMC 200	Field Meter	AE-0024	1/21/14
901358	Aeroflex/Weinschel	47-3-34	Attenuator, 3 dB 0.1 - 18 GHz	BS0146	3/25/16

Table 7-2: EUT and Accessories

Part	Manufacturer	Model	PN/SN	RTL Bar Code
Radio	Harris Corporation	XG-25M	A40153000B04	21006
Dual Band 764-870 MHz Element	Harris Corporation	AN-225001-005	N/A	21001
Standard Roof Mount with GPS	Harris Corporation	AN-125001-006	N/A	21010

Details of the test setup are as follows:

- The EUT was mounted on a wood table 80 cm tall.
- The antenna was mounted on a metal plate (roof mount only) with azimuth indicators and placed in the middle of a separate table.
- The control unit and power supply were located at a distance of at least 1.5 meters from the EUT's antenna to minimize interference.
- The test probe was solidly connected to the radiation meter, and then 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 with a 50% duty cycle (based on FCC guidance for PTT radio usage).

8 Justification of Transmitting Mode and Frequency

The EUT is able to transmit with a non-modulated carrier and with various types of modulations at a maximum rated power of 35 W. Analog modulation was chosen to represent worst-case for the MPE measurements. The MPE distance measurements were conducted at two representative carrier frequencies since there are two bands of operation for this radio. The frequencies chosen were representative of the actual measured conducted powers in each of the bands.

9 MPE Limits for the EUT

Shown below in Tables 9-1 and 9-2 are the MPE limits for uncontrolled and controlled environments respectively. The limits 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 9-1: FCC MPE Limit and Averaging Time in an Uncontrolled Environment

Frequency Range, MHz	Power Density (S), mW/cm ²	Averaging Time, min
300-1500	f/1500, where "f" is the frequency in MHz	30

Table 9-2: FCC MPE Limit and Averaging Time in a Controlled Environment

Frequency Range, MHz	Power Density (S), mW/cm ²	Averaging Time, min
300-1500	f/300, where "f" is the frequency in MHz	6

The MPE limits for the EUT are shown in Table 9-3.

Table 9-3: MPE Limits for the Investigated Frequencies

Frequency (MHz)	MPE Limit (S) Controlled Environment (mW/cm ²)	MPE Limit (S) Uncontrolled Environment (mW/cm ²)
771.0000	2.57	0.51
860.0000	2.87	0.57

10 Calculating the Safe Distance from the EUT's Antenna

Before starting MPE measurements, we calculated the safe distance, R_{safe} using the following formula:

$$R_{\text{safe}} = \sqrt{\frac{P_{\text{max}} \cdot G_n \cdot \eta}{4\pi \cdot S}}$$

G_n : antenna gain (numeric)

P_{max} : maximum power input to the antenna (mW)

S : power density limit (mW/cm²) respectively

η : duty cycle (decimal number), for these measurements $\eta = 0.5$

R_{safe} = cm

The cable loss of the RF cable connecting the EUT and the antenna under test decreases the RF power delivered to the antenna and influences the value of the safe distance.

Based on the specification for the cable supplied with these antennas, the cable loss in the frequency range of interest is approximately 0.67 dB; the cable loss is typically used to reduce the antenna gain to determine the calculated R_{safe} . However, in this case since the cable loss is relatively low and to calculate a worst case starting distance, the cable loss is ignored when calculating R_{safe} , which is the starting point of the actual MPE measurements.

Table 10-1 presents the results of R_{safe} calculations:

Table 10-1: Calculated R_{safe}

Antenna Gain (dBi)	R_{safe} , Controlled Environment (cm)	R_{safe} , Uncontrolled Environment (cm)
7.15	53	119

11 Standard Test Conditions and Engineering Practices

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

1. 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 13 of this test report.

2. Measurement results presented in Section 13, Test Results, unless otherwise noted, show the highest measured level of MPE.

12 Measurement Procedure

1. The test setup was as described in Section 7 of this test report.
2. Polarization of the EUT's antenna was vertical, which is its polarization in actual use.
3. The EUT at the chosen modulation was set to transmit at the chosen frequency at maximum RF power and at 50% duty cycle (50% duty cycle is simulated either by lowering the radio's power by 3 dB or by using a 3 dB pad on the output of the radio). During preliminary measurements, we set the distance between the power density probe and the investigated EUT's antenna equal to the average calculated R_{safe} (Table 10-1) 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 meters) while rotating versus azimuth (from 0° to 360°) the antenna.
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. For the final measurements, we adjusted the distance between the test probe and the tested antenna to the real safe distance, R_{real} , such that the measured highest power density in the "worst case" position was the same or slightly less than the test limit.
7. The measurement results of final measurements conducted at the chosen azimuth and different heights of the probe above the ground are shown in Section 13.
8. Average values of power density were calculated for the imaginary 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 calculations are shown in Section 13.

13 Test Results

Ambient conditions during the MPE investigation were as follows:

- Temperature: 25.5°C
- Relative humidity: 23%

The MPE measurement procedure was performed per the description in Section 12. Tables 13-1 through 13-2 demonstrate the test results.

Table 13-1: MPE Data (771 MHz)

Measuring Antenna Height (cm)	Occupational/ Controlled Environment	General Population/ Uncontrolled Environment
	7.15 dBi Antenna, 34 cm (mW/cm ²)	7.15 dBi Antenna, 76 cm (mW/cm ²)
10	0.09	0.08
20	0.05	0.05
30	0.04	0.01
40	0.06	0.08
50	0.04	0.05
60	0.05	0.07
70	0.13	0.10
80	0.31	0.21
90	0.94	0.29
100	1.09	0.45
110	0.59	0.38
120	0.56	0.23
130	0.60	0.10
140	0.65	0.18
150	0.24	0.15
160	0.76	0.18
170	0.73	0.10
180	0.10	0.06
190	0.11	0.03
200	0.42	0.01

Table 13-2: MPE Data (860 MHz)

Measuring Antenna Height (cm)	Occupational/ Controlled Environment	General Population/ Uncontrolled Environment
	7.15 dBi Antenna, 32 cm (mW/cm ²)	7.15 dBi Antenna, 72 cm (mW/cm ²)
10	0.04	0.04
20	0.03	0.04
30	0.02	0.05
40	0.01	0.03
50	0.04	0.03
60	0.05	0.05
70	0.17	0.05
80	0.15	0.09
90	1.95	0.27
100	1.33	0.39
110	0.86	0.37
120	0.28	0.29
130	0.08	0.09
140	0.10	0.03
150	0.08	0.05
160	0.05	0.12
170	0.02	0.06
180	0.01	0.05
190	0.01	0.04
200	0.02	0.02

Table 13-3: MPE for Body Parts

Part of the Body (averaging points)	Occupational/ Controlled Environment	General Population/ Uncontrolled Environment
	7.15 dBi Antenna, 771/860 MHz (mW/cm ²)	7.15 dBi Antenna, 771/860 MHz (mW/cm ²)
Whole Body (0.1 m to 2.0 m)	0.32	0.12
Lower Body (0.1 m to 0.9 m)	0.23	0.09
Upper Body (1.0 m to 2.0 m)	0.40	0.15

14 Conclusion

1. The MPE measurements for controlled and uncontrolled environments shown in this report were conducted per the applicable FCC/IC Rules, Regulations and Guidance, and determined the minimum safe distances between a user and the EUT antenna.
2. As is shown in Section 13, the measured MPE are below the maximum allowed limits.
3. The User Manual shall include RF radiation safety warnings and the following table:

Antenna	Safe Distance, R_{safe} , (cm)	
	Controlled Environment	Uncontrolled Environment
AN-225001-005 (5 dBd/7.15 dBi)	32	72