

**MOTOROLA**

CGISS EME Test Laboratory
8000 West Sunrise Blvd
Fort Lauderdale, FL. 33322

EME Compliance Test Report

Attention:	Federal Communication Commission
Date of Report:	December 17, 2002
Report Revision(s):	Rev. A
Device Manufacturer:	Motorola
Device Description:	Mobile UHF analog radio 1-25 Watts; 4/8 Ch. Mini UHF
Classification:	Occupational/Controlled Exposure
FCC ID:	AZ492FT4856
Device Model:	FUE1020A
Test Period:	11/6/02, 12/16/02
Test Engineer:	Jim Fortier (Sr. Staff Engineer)
Author:	Michael Sailsman (EME Regulatory Affairs Liaison)

Note: Based on the information and the testing results provided herein, the undersigned certifies that when used as stated in the operating instructions supplied, said product complies with all applicable national and international reference standards and guidelines.

Signature on File

12/18/02

Ken Enger

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Date Approved

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REVISION HISTORY

Date	Revision	Comments
11/8/02	O	Initial release Prototype results
12/17/02	A	Addition of results from additional antenna assessment

1.0 Product Description



FCC ID: AZ492FT4856, model FUE1020A is a mobile transceiver that utilizes frequency modulation (FM) half duplex transmission technology. The intended use of the radio is Push-To-Talk (PTT) while the device is properly installed in a vehicle with an external antenna mounted at the center of the roof or trunk.

This device is marketed to Commercial, Government, and Industrial Users and therefore is classified as Occupational/Controlled Exposure. The intended users of this device are informed and aware professionals operating this device in accordance with the User Manual instructions including maintaining a maximum operational transmit duty cycle of 50%. In accordance with FCC requirements, the passengers inside the vehicle and the bystanders external to the vehicle are evaluated to the General Population/Uncontrolled Exposure Limits. The transmit frequency band is 438-470 MHz. The rated power of the device is 1 to 25 watts with a maximum conducted power output of 28 watts.

2.0 Offered Options and Accessories

Antenna

HAE4003A	450-470 MHz ¼ wave 0dBi antenna; 14.9cm
TAE6053A	430-450 MHz ¼ wave 0dBi antenna; 15.3cm
HAE4011A	450-470MHz 3.5dBi gain antenna; 71.8cm

3.0 Measurement Standards

Measurements were performed according to FCC Limits Per 47 CFR 2.1091 (b) for General Population/Uncontrolled RF Exposure.

For frequencies ranging from 438-470 MHz the MPE (Maximum Permissible Exposure) limit to electromagnetic energy in equivalent plane wave free-space power density is 0.30 mW/cm^2 .

4.0 Data Collection Consideration

Power density testing was performed with DUT installed in a 1991 Ford Taurus (4-door). Measurement data was taken with the vehicle running at idle and the vehicle battery measuring 14.0 volts.

5.0 Measurement System Uncertainty Levels

The information below presents an estimate of the possible errors that are associated with the measurement system.

<u>Description</u>	<u>Error</u>
NARDA Survey Meter	$\pm 3\%$
Repeatability Accuracy	$\pm 7\%$

6.0 Method of Measurement

6.1 EME measurements made on trunk mounted antennas (for reference, see Antenna Location Layout drawings in Appendix)

6.1.1 External vehicle EME measurement (Antenna mounted at trunk center)

With the survey meter and probe, take ten (10) measurements, at the standard test distance of 60 cm to the antenna, from the back of the vehicle in a vertical line and then average the results. These measurements are taken and recorded at every twenty (20) centimeters over a range starting at twenty (20) centimeters above ground and ending at 2.0 meters; this would be representative of a person standing behind a vehicle during a mobile radio transmission.

6.1.2 Internal vehicle EME measurement (Antenna mounted at trunk center)

While rotating survey meter probe through 180 degrees to ensure that the highest level is found, scan the inside of the vehicle, both front and back seating areas, for the highest level in each location. After the highest level is found, scan vertically making two (2) additional measurements within an area approximately 40 cm wide (representing the width of a person) so as to have a total of three (3) measured points as indicated below that will be averaged.

- a) Head area
- b) Chest area
- c) Lower Trunk area

6.2 EME measurements made on center roof mounted antennas (for reference, see Antenna Location Layout drawings in Appendix)

6.2.1 External vehicle EME measurement

With the survey meter and probe, take ten (10) measurements, at the standard test distance of 60 cm from the vehicle-mounted antenna, in a vertical line and then

average the results. These measurements are taken and recorded at every twenty (20) centimeters over a range starting at twenty (20) centimeters above ground and ending at 2.0 meters; this would be representative of a person standing next to a vehicle during a mobile radio transmission.

Note: Actual test distance was 110cm; this is the closest distance that can be achieved to an antenna mounted to the center of the vehicle used for MPE compliance assessment.

6.2.2 Internal vehicle EME measurement

While rotating survey meter probe through 180 degrees to ensure that the highest level is found, scan the inside of the vehicle, both front and back seating areas, for the highest level in each location. After the highest level is found, scan vertically making two (2) additional measurements within an area approximately 40 cm wide (representing the width of a person) so as to have a total of three (3) measured points as indicated below that will be averaged.

- a) Head area
- b) Chest area
- c) Lower Trunk area

7.0 Test Site

The test site is the Motorola Commercial Government Industrial Solution Sector (CGISS) world wide electromagnetic exposure (EME) open area test site located at 8000 W. Sunrise Blvd., Plantation, FL. 33322.

8.0 Measurement System/Equipment

The minimum equipment required will mainly consist of a test vehicle, radio frequency radiation test set consisting of an Electromagnetic Radiation Survey Meter, E-Field Test Probe, and typical antenna configurations.

Below are the test equipment used to assess compliance:

- a) Automobile: 1991 Ford Taurus, 4-Door
- b) E-Field Survey Meter - NARDA Model 8718; Calibration date: 4/23/02
- c) E-Field (Electric Field) Probe - NARDA Model 8722B (300 kHz - 40 Ghz);
Calibration date: 3/28/02
- d) Antennas - (1/4 wave 0dBi and a 3.5dBi gain)

9.0 Test Unit Description

Power density measurements were performed on a 1-25 watt mobile radio; model number FUE1020A serial number 2. The frequency band of the mobile was 438-470 MHz; the test frequencies were 438.025, 454.675, 460.025, and 469.975 MHz. The ¼ wave 0dBi and ¼ wave 3.5dBi mobile antennas listed in section 2.0 were used to assess MPE compliance.

10.0 Test Set-Up Description

Following are the standard mobile antenna test configurations used for this product. (for reference, see Antenna Location Layout drawings in Appendix)

- a) ¼ wave antenna models TAE6053A, HAE4003A as well as a 3.5 dBi gain antenna model HAE4011A mounted on the center of the trunk.
- b) ¼ wave antenna, model HAE4003A mounted on the center of the roof. This antenna was selected because it exhibited the highest MPE results during the 60 cm trunk testing.

11.0 Test Results

Measurements were taken with the antenna located in two areas: the roof center, and trunk center. Below is the raw MPE data for all measured grid points. Results are based on a 50% duty cycle with the radio operating in accordance with the User Manual instructions. The bolded power density results represents the highest MPE results observed.

Raw MPE Data; Test Frequencies and measured Po:

438.025 MHz (Po=28.6), 454.675 MHz (Po=28.3), 460.025 MHz (Po=28.0), 469.975 MHz (Po = 28.6W)

Meter reads in % of controlled limit; controlled limit = 1.51mW/cm² for 300-1500 MHz

(Cal factors presented herein are automatically accounted for in the meter used for assessments)

Vehicle spec. limits = 0.30 mW/cm²

External Vehicle Power Density (Pwr. Den. (cal.)) = average over body/2

Internal Vehicle Power Density (Pwr. Den. (cal.)) = average over (head/chest/leg)/2

Note: The average over the body test methodology is consistent with IEEE/ANSI C95.1-1999 guidelines

External Vehicle MPE Assessment @ 438.025 MHz						
Antenna Location	Antenna /gain	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm ²)	Pwr. Density (mW/cm ²)
Trunk	TAE6053A/0dB	60	E	1.06	0.288	0.144
Measurement grid						
Test position	Height (cm)	% of control limit	Test position	Height (cm)	% of control limit	
1	20	6.0	6	120	38.0	
2	40	8.0	7	140	27.0	
3	60	13.0	8	160	19.0	
4	80	21.0	9	180	12.0	
5	100	39.0	10	200	8.0	

External Vehicle MPE Assessment @454.675MHz						
Antenna Location	Antenna /gain	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm^2)	Pwr. Density (mW/cm^2)
Trunk	HAE4003A/0dB	60	E	1.06	0.071	0.036
Measurement grid						
Test position	Height (cm)	% of control limit	Test position	Height (cm)	% of control limit	
1	20	2.4	6	120	9.2	
2	40	2.2	7	140	7.6	
3	60	3.0	8	160	4.5	
4	80	5.0	9	180	3.0	
5	100	8.4	10	200	2.0	

External Vehicle MPE Assessment @460.025 MHz						
Antenna Location	Antenna /gain	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm^2)	Pwr. Density (mW/cm^2)
Trunk	HAE4003A /0dB	60	E	1.06	0.315	0.157
Measurement grid						
Test position	Height (cm)	% of control limit	Test position	Height (cm)	% of control limit	
1	20	8.5	6	120	46.0	
2	40	11.5	7	140	34.0	
3	60	13.5	8	160	18.0	
4	80	23.5	9	180	8.0	
5	100	40.0	10	200	5.5	

External Vehicle MPE Assessment @469.975 MHz						
Antenna Location	Antenna /gain	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm^2)	Pwr. Density (mW/cm^2)
Trunk	HAE4003A /0dB	60	E	1.06	0.267	0.134
Measurement grid						
Test position	Height (cm)	% of control limit	Test position	Height (cm)	% of control limit	
1	20	8.5	6	120	41.0	
2	40	8.5	7	140	27.5	
3	60	11.0	8	160	14.0	
4	80	19.0	9	180	6.5	
5	100	38.0	10	200	3.0	

External Vehicle MPE Assessment @460.025MHz						
Antenna Location	Antenna /gain	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm ²)	Pwr. Density (mW/cm ²)
Roof	HAE4003A /0dB	limited to 110	E	1.06	0.148	0.074
Measurement grid						
Test position	Height (cm)	% of control limit	Test position	Height (cm)	% of control limit	
1	20	1.2	6	120	6.5	
2	40	1.5	7	140	13.5	
3	60	3.0	8	160	22.0	
4	80	5.5	9	180	21.5	
5	100	5.5	10	200	17.5	

External Vehicle MPE Assessment @454.675MHz						
Antenna Location	Antenna /gain	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm ²)	Pwr. Density (mW/cm ²)
Trunk	HAE4011A /3.5dB	60	E	1.06	0.065	0.032
Measurement grid						
Test position	Height (cm)	% of control limit	Test position	Height (cm)	% of control limit	
1	20	1.2	6	120	10.4	
2	40	1.2	7	140	9.5	
3	60	1.5	8	160	5.3	
4	80	2.1	9	180	3.5	
5	100	4.1	10	200	4.0	

External Vehicle MPE Assessment @460.025MHz						
Antenna Location	Antenna /gain	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm ²)	Pwr. Density (mW/cm ²)
Trunk	HAE4011A /3.5dB	60	E	1.06	0.239	0.12
Measurement grid						
Test position	Height (cm)	% of control limit	Test position	Height (cm)	% of control limit	
1	20	2.7	6	120	35.0	
2	40	2.4	7	140	40.0	
3	60	4.2	8	160	20.0	
4	80	5.7	9	180	14.0	
5	100	13.0	10	200	19.0	

External Vehicle MPE Assessment @469.975MHz						
Antenna Location	Antenna /gain	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm^2)	Pwr. Density (mW/cm^2)
Trunk	HAE4011A /3.5dB	60	E	1.06	0.205	0.102
Measurement grid						
Test position	Height (cm)	% of control limit	Test position	Height (cm)	% of control limit	
1	20	3.0	6	120	33.5	
2	40	2.6	7	140	31.0	
3	60	4.5	8	160	13.5	
4	80	7.5	9	180	9.6	
5	100	13.0	10	200	12.5	

Internal Vehicle MPE Assessment @438.025 MHz						
Antenna Location	Antenna /gain	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Leg Back/Front seats (mW/cm^2)	S.A.R. calculated Back/Front seats (mW/g)
Trunk	TAE6053A/0dB	Highest reading	E	1.06	0.40/0.26	<= 0.25
Measurement grid						
Test position	% of control limit Head		% of control limit Chest		% of control limit Leg	
Back seat	55.0		14.0		11.0	
Front seat	35		8		9	

Internal Vehicle MPE Assessment @454.675 MHz						
Antenna Location	Antenna /gain	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Leg Back/Front seats (mW/cm^2)	S.A.R. calculated Back/Front seats (mW/g)
Trunk	HAE4003A/0dB	Highest reading	E	1.06	0.096/0.06	<= 0.25
Measurement grid						
Test position	% of control limit Head		% of control limit Chest		% of control limit Leg	
Back seat	11.0		5.0		3.0	
Front seat	6.0		3.5		2.5	

Internal Vehicle MPE Assessment @460.025 MHz						
Antenna Location	Antenna /gain	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Leg Back/Front seats (mW/cm^2)	S.A.R. calculated Back/Front seats (mW/g)
Trunk	HAE4003A/0dB	Highest reading	E	1.06	0.36/0.32	<= 0.25
Measurement grid						
Test position	% of control limit Head		% of control limit Chest		% of control limit Leg	
Back seat	35.0		14.0		22.0	
Front seat	35.0		17.0		12.0	

Internal Vehicle MPE Assessment @469.975 MHz						
Antenna Location	Antenna /gain	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Leg Back/Front seats (mW/cm^2)	S.A.R. calculated Back/Front seats (mW/g)
Trunk	HAE4003A/0dB	Highest reading	E	1.06	0.33/0.317	<= 0.25
Measurement grid						
Test position	% of control limit Head		% of control limit Chest		% of control limit Leg	
Back seat	31.0		21.0		13.0	
Front seat	38.0		14.0		11.0	

Internal Vehicle MPE Assessment @454.675 MHz						
Antenna Location	Antenna /gain	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Leg Back/Front seats (mW/cm^2)	S.A.R. calculated Back/Front seats (mW/g)
Trunk	HAE4011A/3.5dB	Highest reading	E	1.06	0.06/0.041	<= 0.25
Measurement grid						
Test position	% of control limit Head		% of control limit Chest		% of control limit Leg	
Back seat	6.0		4.0		2.0	
Front seat	3.0		3.0		2.2	

Internal Vehicle MPE Assessment @460.025 MHz						
Antenna Location	Antenna /gain	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Leg Back/Front seats (mW/cm^2)	S.A.R. calculated Back/Front seats (mW/g)
Trunk	HAE4011A/3.5dB	Highest reading	E	1.06	0.294/0.225	<= 0.25
Measurement grid						
Test position	% of control limit Head		% of control limit Chest		% of control limit Leg	
Back seat	31.0		17		9.5	
Front seat	19.6		14.0		10.5	

Internal Vehicle MPE Assessment @469.975 MHz						
Antenna Location	Antenna /gain	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Leg Back/Front seats (mW/cm^2)	S.A.R. calculated Back/Front seats (mW/g)
Trunk	HAE4011A/3.5dB	Highest reading	E	1.06	0.144/0.149	<= 0.25
Measurement grid						
Test position	% of control limit Head		% of control limit Chest		% of control limit Leg	
Back seat	14.0		8.0		5.6	
Front seat	13.0		9.0		6.5	

Internal Vehicle MPE Assessment @460.025 MHz						
Antenna Location	Antenna /gain	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Leg Back/Front seats (mW/cm^2)	S.A.R. calculated Back/Front seats (mW/g)
Roof	HAE4003A /0dB	Highest reading	E	1.06	0.055/0.10	<= 0.25
Measurement grid						
Test position	% of control limit Head		% of control limit Chest		% of control limit Leg	
Back seat	5.5		3.5		2.0	
Front seat	5.0		5.0		10.5	

12.0 Conclusion

Depending on the test frequency, compliance assessments were performed with an output power range of 28.0W to 28.6W. The highest power density result for this product is 0.157 mW/cm². The maximum RF power allowable will be equal to the upper limit of the final test factory transmit power specification of 28.0W.

Note: EQUIVALENT SAR FOR FREQUENCIES OF 100-530 MHz

The final SAR (Specific Absorption Rate) values are evaluated through the following calculation based on measurements completed by MFRL (Motorola Florida Research Lab) on both VHF and UHF high power mobile radios feeding a quarter-wave length monopole antenna, trunk mounted, on a phantom located on the back seat of test vehicle: Reference: "Field Strengths and Specific Absorption Rates in Automotive Environments", by D. McCoy, D. Zakharia, and Q. Balzano, IEEE Trans. Vehicular Tech. Vol. 48 (4): pp. 1287-1303, July, 1999

PTT (PUSH-TO-TALK) OPERATION

$SAR (mW/g) = ((\text{measured RF power out}/130) * 2.314 [50\% \text{ duty cycle}]$

Formula definitions:

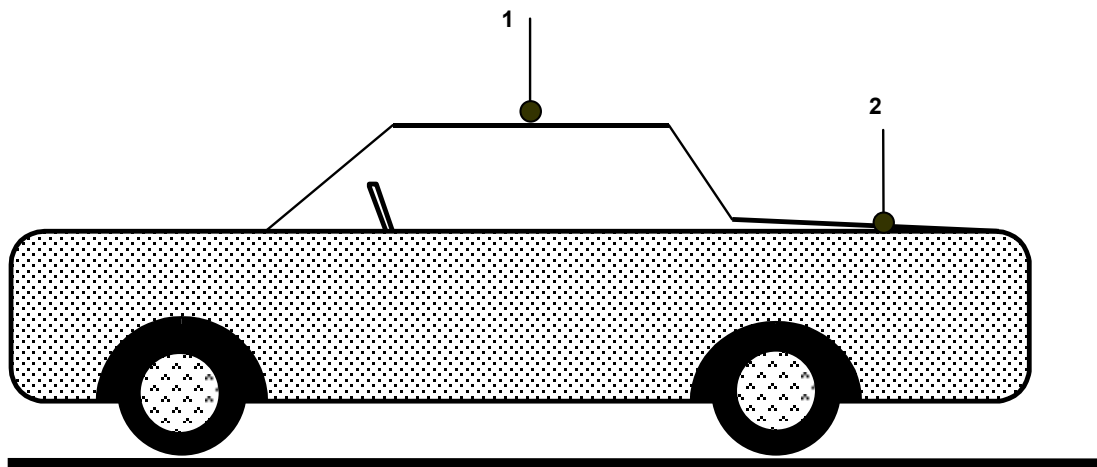
"130" = RF mobile power (W) feeding a quarter-wave length antenna in original research document.

"2.314" the SAR resulting from that 130 Watt mobile feeding a quarter-wave length antenna in original research document.

The measurement results clearly demonstrate compliance with the FCC Limits Per 47 CFR 2.1091 (d) for General Population/Uncontrolled RF Exposure.

APPENDIX

ANTENNA LOCATION DRAWING



- 1 - Roof (center)
- 2 - Trunk (center)

