Engineering and Testing for EMC and Safety Compliance

Class II Permissive Change Report

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MODEL: M7100 VHF Mobile Radio

FCC ID: OWDTR-0035-E
IC: 3636B-0035

December 5, 2006

Standards Referenced for this Report	
Part 2: 2006	Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
Part 15: 2006	Radio Frequency Devices - §15.109: Radiated Emissions Limits
Part 90: 2006	Private Land Portable Radio Services
ANSI C63.4-2003	American National Standard for Methods of Measurement of Radio Noise Emissions from Low -Voltage Electrical and Electronic Equipment in the Range of 9 kHz – 40 GHz
ANSI/TIA/EIA603-2002	Land Portable FM or PM Communications Equipment - Measurement and Performance Standards
ANSI/TIA/EIA–102.CAAA; 2002	Digital C4FM/CQPSK Transceiver Measurement Methods
RSS-119; Issue 6; 2000	Land Portable and Fixed Radio Transmitters and Receivers 27.41 to 960.0 MHz

Frequency Range (MHz)	Measured Conducted Output Power (W)	Frequency Tolerance (ppm)	Emission Designator
136 – 174	51.5	5.0	16K0F3E (Voice)
136 – 174	51.5	5.0	11K0F3E (Voice)
136 – 174	51.5	2.0	14K2F1D (2 level WB)
136 – 174	51.5	2.0	14K2F1E (2 level WB)
136 – 174	51.5	2.0	9K9F1D (2 level NB 9600)
136 – 174	51.5	2.0	9K9F1E (2 level NB 9600)
136 – 174	51.5	2.0	7K1F1D (2 level NB 4800)
136 – 174	51.5	2.0	7K1F1E (2 level NB 4800)
136 – 174	51.5	2.0	8K4F1D (P25)
136 – 174	51.5	2.0	8K4F1E (P25)

REPORT PREPARED BY TEST ENGINEER: DAN BIGGS

Document Number: 2006192/QRTL06-437

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1 General Information

This Class II Permissive Change report is prepared on behalf of **M/A-COM, Inc**. in accordance with the Federal Communications Commission and Industry Canada Rules and Regulations. The Equipment Under Test (EUT) was the **M7100 Mobile Radio; FCC ID: OWDTR-0035-E, IC: 3636B-0035**. The test results reported in this document relate only to the item that was tested.

All measurements contained in this application were conducted in accordance with FCC Rules and Regulations CFR 47, Industry Canada RSS-119, and ANSI C63.4 Methods of Measurement of Radio Noise Emissions, 2003. The instrumentation utilized for the measurements conforms to the ANSI C63.4 standard for EMI and Field Strength Instrumentation. Calibration checks are performed regularly on the instruments, and all accessories including high pass filter, coaxial attenuator, preamplifier and cables.

1.1 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located on the parking lot of Rhein Tech Laboratories, Inc. 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report submitted to and approved by the Federal Communications Commission to perform AC line conducted and radiated emissions testing (ANSI C63.4 2003).

1.2 Related Submittal(s)/Grant(s)

This is a Class II Permissive Change request for the FCC certification initially issued on March 21, 2005.

Post PA filtering has been improved through a hardware change on the RF board to correct for a transmit instability present with frequency specific narrowband loads. There are no PCB artwork changes, nor are there any transmission mode additions being performed.

2 Tested System Details

The test sample was received on November 15, 2006. Listed below are the identifiers and descriptions of all equipment, cables, and internal devices used with the EUT for this testing, as applicable.

Table 2-1: Equipment under Test (EUT)

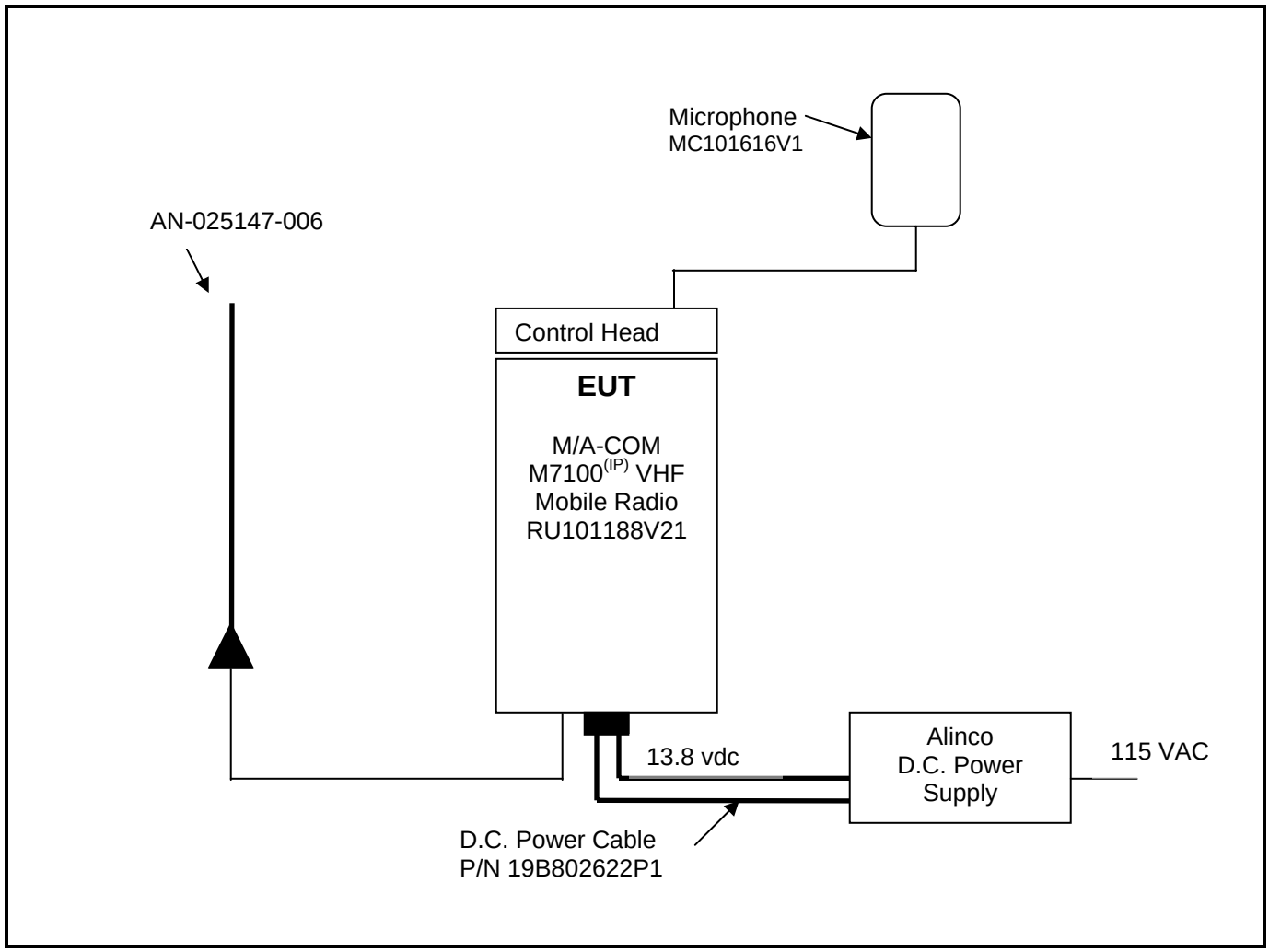
The test sytem contains the following components:

Part	Manufacturer	Model	PN/SN	FCC ID	RTL Bar Code
Radio	M/A-Com, Inc.	M7100	RU101188V21	OWDTR-0035-E	17648
Control Head	M/A-Com, Inc.	N/A	KRY1011632/14	N/A	N/A
Microphone	M/A-Com, Inc.	N/A	MC101616V1	N/A	N/A
Power Cable	M/A-Com, Inc.	N/A	19B802622P1	N/A	N/A
Antenna	M/A-Com, Inc.	WHIP	AN-025147-006	N/A	N/A

Table 2-2: Support Equipment

Part	Manufacturer	Model	PN/SN	FCC ID	RTL Bar Code
DC Power Supply	Alinco	DM -330 MV	0001637	N/A	901126

Figure 2-1: Configuration of Tested System



3 FCC Rules and Regulations Part 2 §2.1033(c)(8) Voltages and Currents Through The Final Amplifying Stage

Nominal DC Voltage: 13.8 VDC
Current: 10.5 AMPS

4 FCC Rules and Regulations Part 2 §2.1046(a): RF Power Output: Conducted; RSS-119 §6.2: Output Power Test

4.1 Test Procedure

ANSI TIA-603-C-2004, section 2.2.1

The EUT was connected with a power sensor/meter through an appropriate 50 ohm attenuator. Attenuator loss was accounted for.

4.2 Test Data

Table 4-1: RF Power Output (High Power): Carrier Output Power (Unmodulated)

Channel	Frequency (MHz)	RF Power Measured (Watt)*
1 (High Power)	136.0	51.6
2 (High Power)	156.0	47.9
3 (High Power)	174.0	45.7

* Measurement accuracy: +/-.02 dB (logarithmic mode)

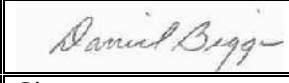
Table 4-2: RF Power Output (Rated Power)

Rated Power (W)
50.0

Table 4-3: Test Equipment Used For Testing RF Power Output - Conducted

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901184	Agilent Technologies	E4416A	EPM-P Power Meter, Single Channel	GB41050573	10/3/07
901356	Agilent Technologies	E9323A	Power Sensor	31764-264	10/3/07
900819	Weinschel Corporation	BF0830	Attenuator 10 db	N/A	12/2/08

Test Personnel:

Dan Biggs		November 28, 2006
Test Engineer	Signature	Date Of Test

5 FCC Rules and Regulations Part 2 §2.1051: Spurious Emissions at Antenna Terminals; Part 90 §90.210: Emissions Masks; RSS-119 §5.8: Transmitter Unwanted Emissions

5.1 Test Procedure

ANSI TIA-603-C-2004, Section 2.2.13.

The transmitter was interfaced with a spectrum analyzer through an appropriate 50 ohm attenuator and a notch filter. The transmitter was operated at maximum power. Attenuator and cable losses were accounted for.

Analog Modulation: The transmitter is terminated with a 50 Ω load and is modulated with a 2,500 Hz sine wave at an input level 16 dB greater than that required to produce 50% of the rated system deviation at 1,000 Hz.

Digital Modulation: Modulated to its maximum extent using a pseudo random data sequence – 9600 bps.

5.2 Test Data

Frequency range of measurement per Part 2.1057: 9 kHz to 10xFc.

Limit: P(dBm) – (43 + 10xLOG P(W))

The worst case (unwanted emissions) channels are shown. The magnitude of emissions attenuated more than 20 dB below the FCC limit need not be recorded.

Table 5-1: Conducted Spurious Emissions – 136 MHz; Wide Band; High Power

Limit = 43 + 10 log (47.1) = 60.1 dBc

Frequency (MHz)	Notch/cable loss (dB)	Level (dBc)	Limit (dBc)	Margin(dB)
272	0.13	96.90	60.13	-36.77
408	0.16	93.67	60.13	-33.54
544	0.19	103.34	60.13	-43.21
680	0.03	101.50	60.13	-41.37
816	0.65	100.68	60.13	-40.55
952	1.07	99.46	60.13	-39.33
1088	1.42	101.11	60.13	-40.98
1224	3.41	98.72	60.13	-38.59
1360	26.77	75.26	60.13	-15.13

Table 5-2: Conducted Spurious Emissions – 154.0 MHz; Wide Band; High Power

Limit = 43 + 10 log (46.8) = 59.8 dBc

Frequency (MHz)	Notch/cable loss (dB)	Level (dBc)	Limit (dBc)	Margin(dB)
308	0.19	80.31	59.80	-20.51
462	0.24	88.96	59.80	-29.16
616	0.05	102.15	59.80	-42.35
770	0.21	100.99	59.80	-41.19
924	1.50	99.40	59.80	-39.60
1078	1.40	98.20	59.80	-38.40
1232	3.64	99.06	59.80	-39.26
1386	8.25	94.35	59.80	-34.55
1540	5.49	94.91	59.80	-35.11

Table 5-3: Conducted Spurious Emissions – 174.0 MHz; Wide Band; High Power

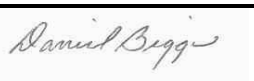
Limit = 43 + 10 log (46.6) = 59.6 dBc

Frequency (MHz)	Notch/cable loss (dB)	Level (dBc)	Limit (dBc)	Margin(dB)
348	0.02	73.68	59.60	-14.08
522	0.03	89.57	59.60	-29.97
696	0.05	102.85	59.60	-43.25
870	1.13	95.77	59.60	-36.17
1044	1.09	100.01	59.60	-40.41
1218	2.99	97.81	59.60	-38.21
1392	18.85	82.45	59.60	-22.85
1566	5.59	95.71	59.60	-36.11
1740	1.60	95.30	59.60	-35.70

Table 5-4: Test Equipment for Testing Conducted Spurious Emissions

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due
901215	Hewlett Packard	8596EM	EMC Analyzer (9 kHz – 12.8 GHz)	3826A00144	10/16/07
901396	MCE Weinschel	48-40-34	Attenuator, 40 dB, DC-18 GHz, 100 W	93453	1/13/09
901424	Insulated Wire Inc.	KPS-1503-360-KPS	RF cable 36"	NA	12/12/06

Test Personnel:

Daniel Biggs		November 28, 2006
Test Engineer	Signature	Date Of Test

6 FCC Rules and Regulations Part 2 §2.1053(a): Field Strength of Spurious Radiation; RSS-119 §6.3: Unwanted Emissions

6.1 Test Procedure

ANSI TIA-603-C-2004, Section 2.2.12

Analog Modulation: The transmitter is terminated with a 50 Ω load and is modulated with a 2,500 Hz sine wave at an input level 16 dB greater than that required to produce 50% of the rated system deviation at 1,000 Hz.

Digital Modulation: Modulated to its maximum extent using a pseudo random data sequence – 9600 bps.

The spurious emissions levels were measured and the device under test was replaced by a substitution antenna connected to a signal generator. This signal generator level was then corrected by subtracting the cable loss from the substitution antenna to the signal generator, and the gain of the antenna was further corrected to a half wave dipole.

P_d(dBm) = P_g(dBm) – cable loss (dB) + antenna gain (dB)

where:

P_d is the dipole equivalent power
P_g is the generator output power into the substitution antenna

6.2 Test Data

6.2.1 CFR 47 Part 90.210 Requirements

The worst case emissions test data are shown. The magnitude of emissions attenuated more than 20 dB below the FCC limit need not be recorded.

Table 6-1: Field Strength of Spurious Radiation – 154.0 MHz; Wide Band; High Power

Limit = 43 + 10 Log P = 59.8 dBc Conducted Power = 46.8 dBm = 47.9 W

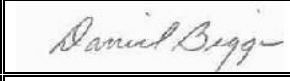
Frequency (MHz)	Spectrum Analyzer Level (dBuV)	Signal Generator Level (dBm)	Cable Loss* (dB)	Antenna Gain (dBd)	Corrected Signal Generator Level (dBc)	Margin (dB)
308	63.1	-45.5	1.2	-0.7	94.2	-34.4
462	57.5	-48.9	1.5	-1.0	98.2	-38.4
616	55.6	-46.8	1.7	-1.6	96.9	-37.1
770	51.9	-50.7	1.8	-1.5	100.8	-41.0
924	51.0	-46.8	2.0	-1.6	97.2	-37.4
1078	40.0	-54.7	2.3	0.6	103.1	-43.3
1232	36.0	-56.1	2.4	2.8	102.5	-42.7
1386	36.0	-47.4	2.6	5.8	91.0	-31.2
1540	34.0	-51.9	3.0	6.3	95.4	-35.6

*This insertion loss corresponds to the cable connecting the RF Signal Generator to the ½ wave dipole antenna.

Table 6-2: Test Equipment Used for Testing Field Strength of Spurious Radiation

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900791	Schaffner-Chase	CBL6112	Antenna (25 MHz – 2 GHz)	2099	6/12/07
900154	Compliance Design, Inc.	Roberts Dipole	Adjustable Elements Dipole 30-1000 MHz Antennas	00401	12/21/06
900814	Electro-Metrics	EM-6961 (RGA-60)	Double Ridges Guide Antenna 1-18 GHz	2310	3/30/09
901020	Hewlett Packard	8564E	Portable Spectrum Analyzer (9 kHz - 40 GHz)	3943A01719	10/28/07
901281	Rhein Tech Laboratories	PR-1040 (10-2000 MHz)	Amplifier	1004	12/8/06
901365	MITEQ	JS4-00102600-41-5P	Amplifier, 15 V, 0.1-26 GHz, 28dB gain	1094152	3/24/07
901426	Insulated Wire Inc.	KPS-1503-3600-KPS	RF Cable, 30'	NA	12/12/06
901425	Insulated Wire, Inc.	KPS-1503-2400-KPS	RF Cable, 20'	NA	12/12/06
901424	Insulated Wire Inc.	KPS-1503-360-KPS	RF Cable 36"	NA	12/12/06

Test Personnel:

Daniel Biggs		November 30, 2006
Test Engineer	Signature	Date Of Test

7 FCC Rules and Regulations Part 2 §2.1049: Occupied Bandwidth; Part 90 §90.210(g): Emissions Masks; RSS-119 §5.8: Transmitter Unwanted Emissions

7.1 Test Procedure

ANSI TIA-603-C-2004, Section 2.2.11.

The transmitter was interfaced with a spectrum analyzer through an appropriate 50 ohm attenuator and a notch filter. Transmitter was operated at maximum power. Attenuator losses were accounted for.

Analog Modulation: The transmitter is terminated with a 50 Ω load and is modulated with a 2,500 Hz sine wave at an input level 16 dB greater than that required to produce 50% of the rated system deviation at 1,000 Hz.

The device uses digital modulation modulated to its maximum extent using a pseudo-random data sequence of 9600 bps.

Limit Mask B:

(1) On any frequency removed from the assigned frequency by more than 50%, but not more than 100% of the authorized bandwidth: At least **25 dB**.
(2) On any frequency removed from the assigned frequency by more than 100%, but not more than 250% of the authorized bandwidth: At least **35 dB**.
(3) On any frequency removed from the assigned frequency by more than 250% of the authorized bandwidth: at least **43 + 10 log (P) dB**.

Limit Mask C:

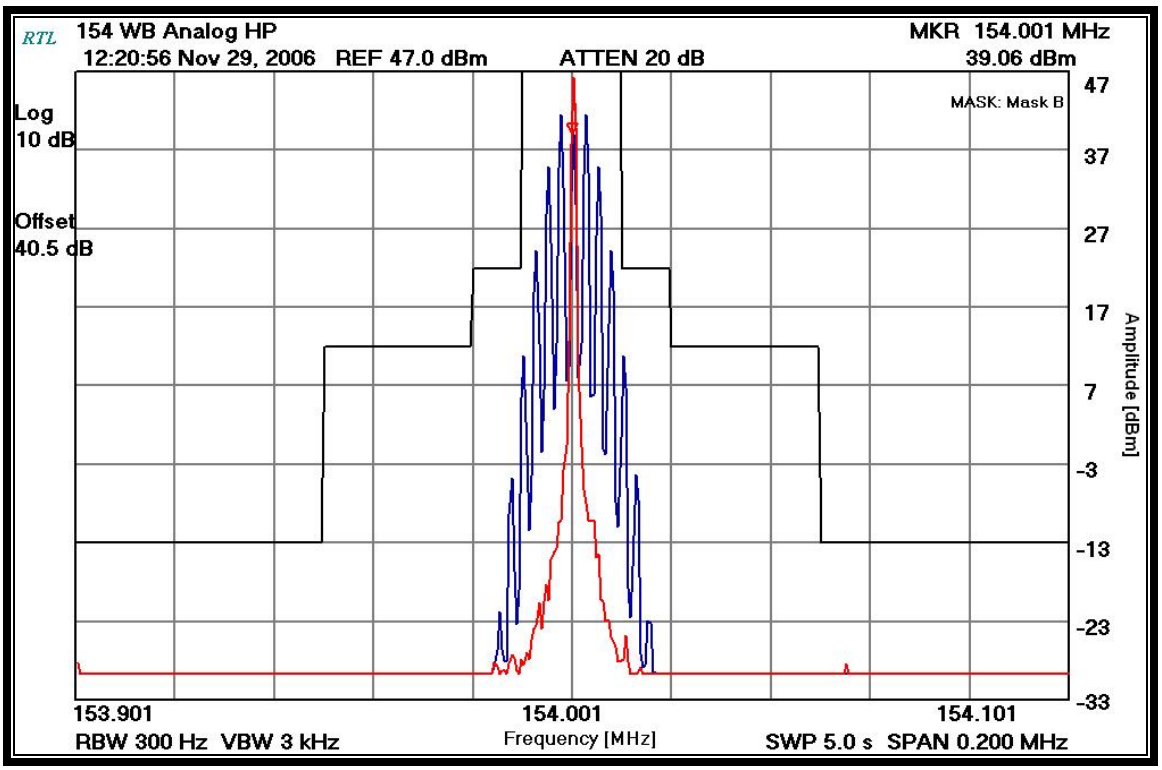
(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5 kHz, but not more than 10KHz: At least **83 log (fd/5) dB**;
(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 10 kHz, but not more than 250% of the authorized bandwidth: At least **29 log (fd^2/11) dB** or 50 dB, whichever is the lesser attenuation;
(3) On any frequency removed from the center of the authorized bandwidth by more than 250% of the authorized bandwidth: At least **43 + 10 log (P) dB**.

Limit Mask D:

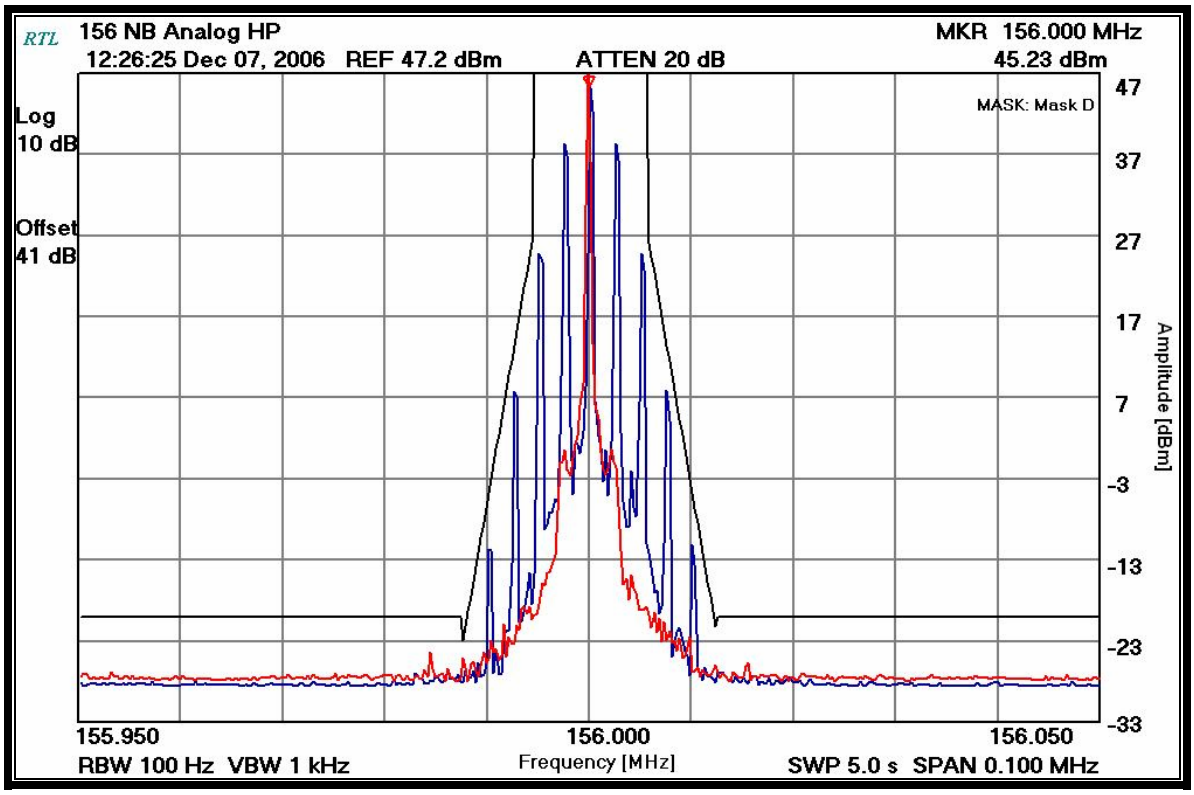
(1) On any frequency removed from the center of the authorized bandwidth f_0: **Zero dB**;
(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5.625 kHz, but not more than 12.5 kHz: At least **7.27(fd-2.88 KHz) dB**;
(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz, At least **50 + 10 log (P) dB or 70 dB**, whichever is the lesser attenuation.

7.2 Test Data

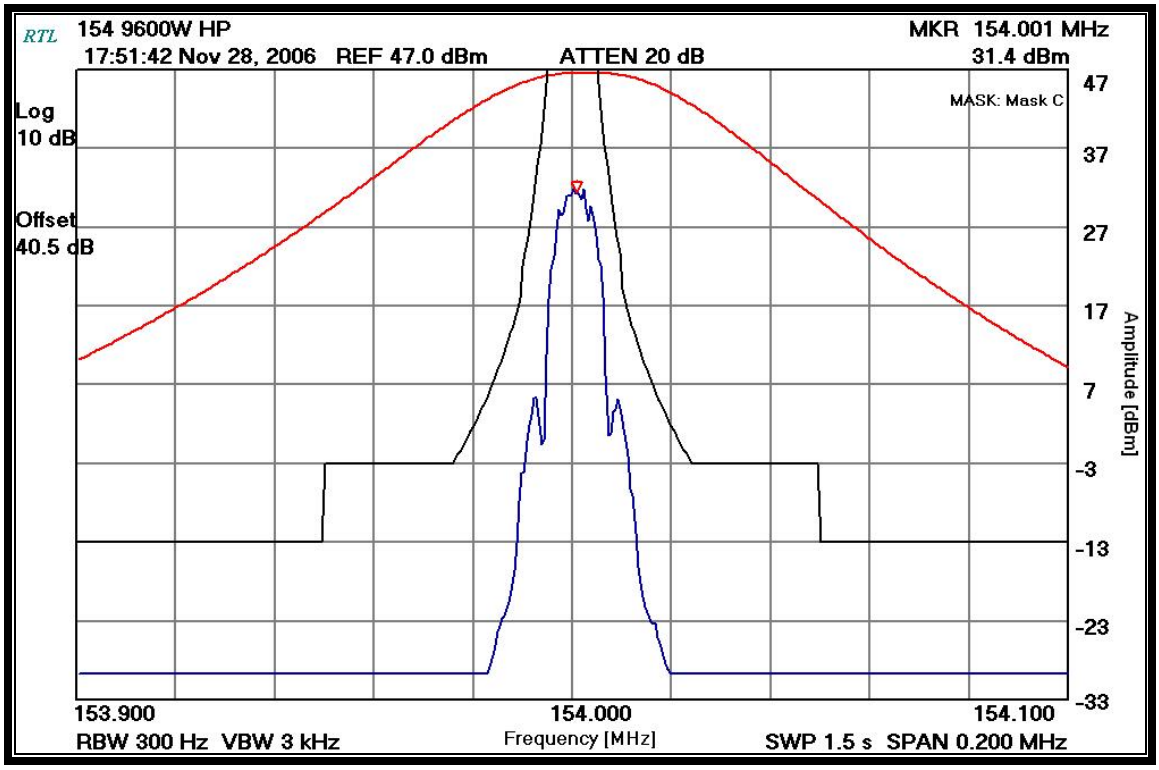
Plot 7-1: Occupied Bandwidth – 154 MHz; Mask B; Wideband; Analog



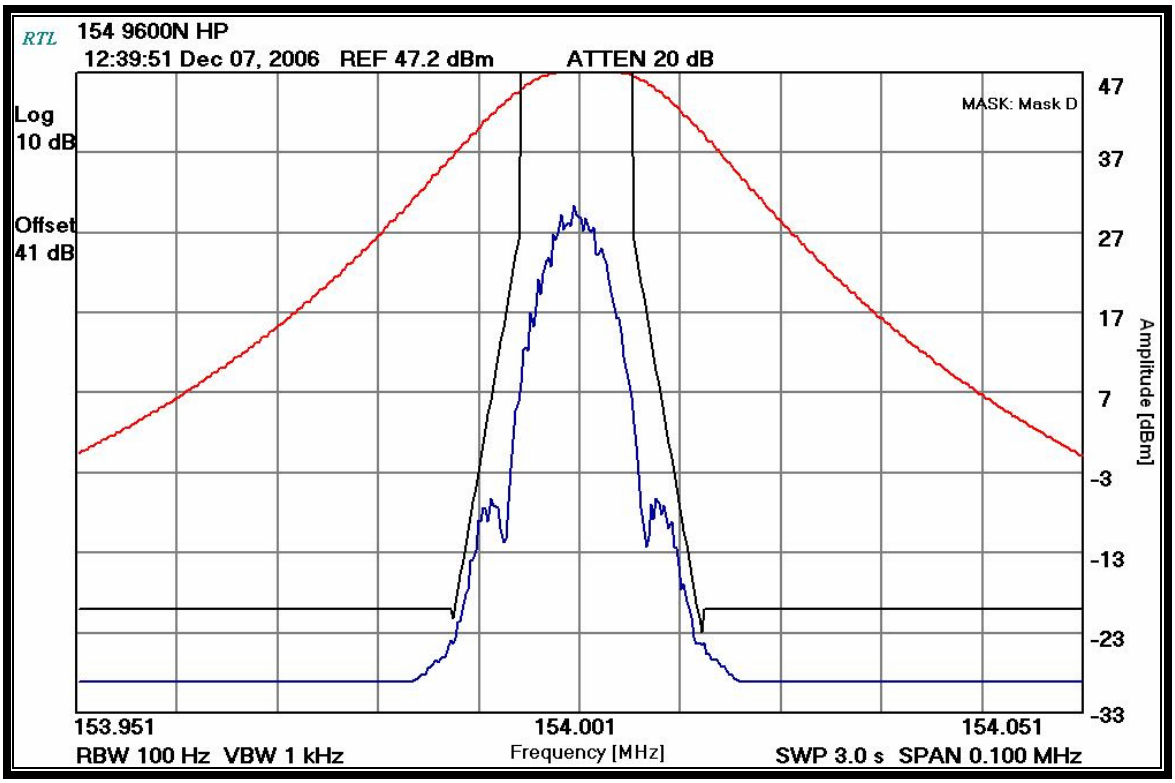
Plot 7-2: Occupied Bandwidth – 154 MHz; Mask D; Narrowband; Analog



Plot 7-3: Occupied Bandwidth – 154 MHz; Mask C; Wideband Digital 9600 BPS



Plot 7-4: Occupied Bandwidth – 154 MHz; Mask D; Narrowband Digital 9600 BPS



Plot 7-5: Occupied Bandwidth – 154 MHz; Mask D; P25 Digital 9600 BPS

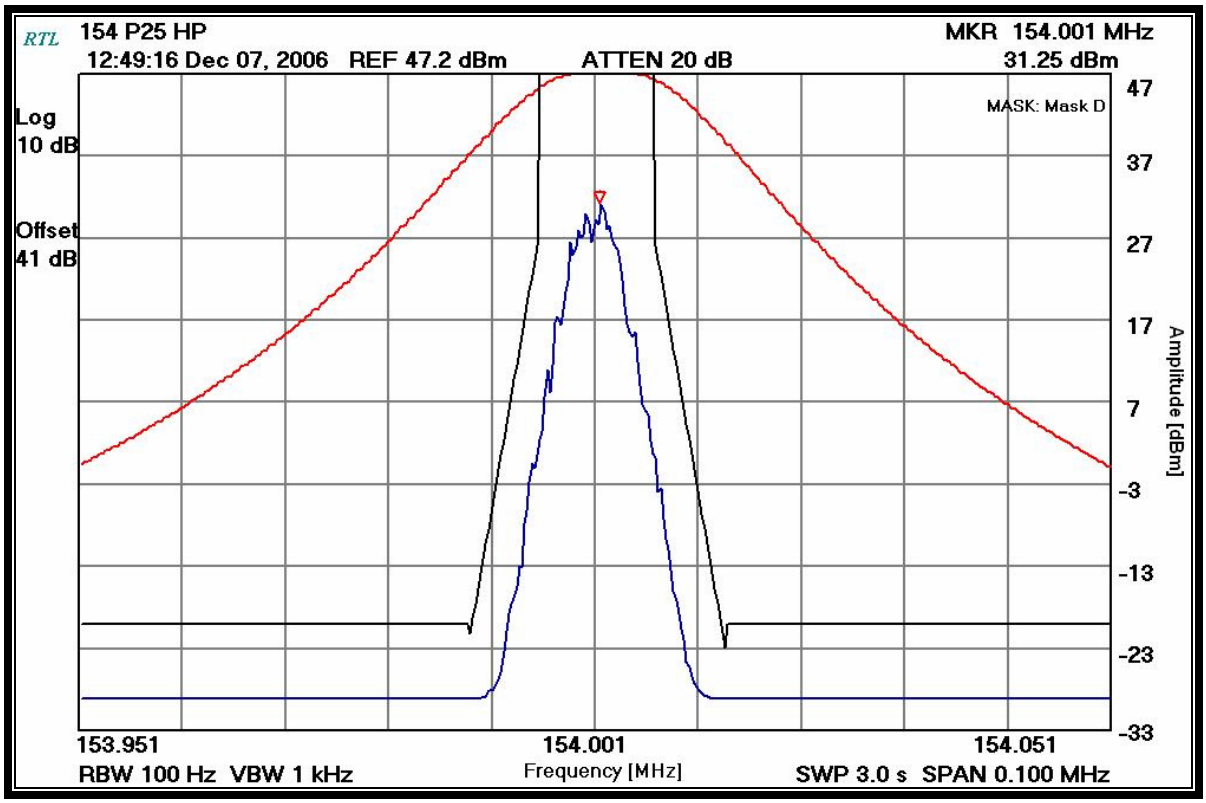


Table 7-1: Test Equipment for Testing Occupied Bandwidth

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due
901215	Hewlett Packard	8596EM	EMC Analyzer (9 kHz – 12.8 GHz)	3826A00144	10/16/07
901396	MCE Weinschel	48-40-34	Attenuator, 40 dB, DC-18 GHz, 100 W	93453	12/02/08

Test Personnel:

Daniel Biggs	Daniel Biggs	November 28 & December 7, 2006
Test Technician/Engineer	Signature	Dates of Tests

8 Radiated Emissions

8.1 Amendments to Emissions Test Methodology

8.1.1 Deviations from Test Methodology

There was no deviation from, additions to, or exclusions from, ANSI C63.4: 2003.

8.2 Radiated Emissions Measurements

8.2.1 Site and Test Description

Before final radiated emissions measurements were made on the OATS, the EUT was scanned indoors at both one and three meter distances. This was done in order to determine its emission spectrum signal. The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. This process was repeated during final radiated emission measurements on the OATS, at each frequency, in order to ensure that maximum emission amplitudes were measured. Final radiated emissions measurements were made on the OATS at a distance of 3 meters. The floor-standing EUT was placed on a nonconductive turntable. At each frequency, the EUT was rotated 360°, and the antenna was raised and lowered from 1 to 4 meters in order to determine the emissions maximum levels. Measurements were taken using both horizontal and vertical antenna polarization. The spectrum analyzer's 6 dB bandwidth was set to 120 kHz, and the analyzer was operated in the quasi-peak detection mode. No video filter less than 10 times the resolution bandwidth was used. The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report.

8.2.2 Field Strength Calculations

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FI\left(dB\mu V/m\right) = SAR\left(dB\mu V\right) + SCF\left(dB/m\right)$$

FI = Field Intensity
SAR = Spectrum Analyzer Reading
SCF = Site Correction Factor

The Site Correction Factor (SCF) used in the above equation is determined empirically, and is expressed in the following equation:

$$SCF\left(dB/m\right) = -PG\left(dB\right) + AF\left(dB/m\right) + CL\left(dB\right)$$

SCF = Site Correction Factor
PG = Pre-Amplifier Gain
AF = Antenna Factor
CL = Cable Loss

The field intensity in microvolts per meter can then be determined according to the following equation:

$$FI\left(\mu V/m\right) = 10^{FI\left(dB\mu V/m\right)/20}$$

For example, assume a signal frequency of 125 MHz has a received level measured as 49.3 dBuV. The total Site Correction Factor (antenna factor plus cable loss minus preamplifier gain) for 125 MHz is –11.5 dB/m. The actual radiated field strength is calculated as follows:

$$49.3dB\mu V - 11.5dB/m = 37.8dB\mu V/m$$
$$10^{37.8/20} = 10^{1.89} = 77.6\mu V/m$$

8.2.3 Measurement Uncertainty

Rhein Tech Laboratories, Inc. has implemented procedures to minimize errors that occur from test instruments, calibration, procedures, and test setups. Test instrument and calibration errors are documented from the manufacturer or calibration lab. Other errors have been defined and calculated within the Rhein Tech Quality Manual, Section 6.1. Rhein Tech implements the following procedures to minimize errors that may occur: yearly as well as daily calibration methods, technician training, and emphasis to employees on avoiding error.

8.2.4 Test Limits

FCC Class B Radiated Emissions	
Frequency (MHz)	**At 3m (dBμV/m)**
30-88	40.0
88-216	43.5
216-960	46.0
>1000	54

8.2.5 Radiated Emissions Data

Table 8-1: Radiated Emissions Test Data

Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
181.100	Qp	H	45	1.5	46.9	-18.2	28.7	43.5	-14.8	Pass
181.100	Qp	V	270	1.0	48.9	-18.2	30.7	43.5	-12.8	Pass
199.067	Qp	H	270	1.0	44.5	-18.1	26.4	43.5	-17.1	Pass
199.067	Qp	V	180	1.0	46.8	-18.1	28.7	43.5	-14.8	Pass
199.100	Qp	H	90	1.5	58.8	-17.5	41.3	43.5	-2.2	Pass
199.100	Qp	V	200	2.0	53.4	-17.8	35.6	43.5	-7.9	Pass
210.126	Qp	H	90	2.0	48.6	-18.1	30.5	43.5	-13.0	Pass
210.126	Qp	V	180	1.0	44.4	-18.1	26.3	43.5	-17.2	Pass
219.100	Qp	H	200	1.0	59.5	-17.3	42.2	46.0	-3.8	Pass
219.100	Qp	V	30	1.5	58.2	-17.2	41.0	46.0	-5.0	Pass
235.931	Qp	H	90	1.0	45.3	-16.3	29.0	46.0	-17.0	Pass
235.931	Qp	V	0	1.0	43.0	-16.3	26.7	46.0	-19.3	Pass

Table 8-2: Test Equipment Used for Testing Radiated Emissions

RTL Asset #	Manufacturer	Model	Part Type	Calibration Due Date
900969	Hewlett Packard	85650A	Quasi-Peak Adapter (30 Hz – 40 GHz)	9/13/07
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz – 22 GHz)	9/13/07
900791	Schaffner-Chase	CBL6112	Antenna (25 MHz – 2 GHz)	6/12/07
900930	Hewlett Packard	85662A	Spectrum Analyzer Display	9/13/07
900889	Hewlett Packard	85685A	RF Preselector for HP 8566B or 8568B	4/12/07

Test Personnel:

Daniel Biggs		November 29, 2006
Test Engineer	Signature	Date Of Test

9 Conclusion

The data in this measurement report shows that the **M/A-COM, Inc**. Model **M7100 VHF Mobile Radio, FCC ID: OWDTR-0035-E, IC: 3636B-0035**, complies with all the requirements of Parts 80, 90, 15 and 2 of the FCC Rules, and Industry Canada RSS-119, Issue 6, 2000.