Engineering and Testing for EMC and Safety Compliance

Class II Permissive Change Report

M/A-Com, Inc.
221 Jefferson Ridge Parkway
Lynchburg, VA 24501
Daryl Popowitch
Phone: (434) 455-9527
E-Mail: popowitda@tycoelectronics.com

MODEL: CS-7200 OpenSky Control Station

FCC ID: BV8M7200
IC: 3670A-M7200

April 16, 2007

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 TIA-603-C-2004	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

REPORT PREPARED BY TEST ENGINEER: DAN BALTZELL

Document Number: 2007152/QRTL07-089

Frequency Range (MHz)	Measured Output Power (W) Conducted	Frequency Tolerance (ppm)	Modulation	Mode	Emission Designator
806-824	14.3	1.5	P25 (digitized data)	Trunked/Conventional	8K4F1D
806-824	14.6	1.5	P25 (digitized voice)	Trunked/Conventional	8K4F1E
851-869	14.4	1.5	P25 (digitized data)	T/A	8K4F1D
851-869	14.3	1.5	P25 (digitized voice)	T/A	8K4F1E
806-824	14.2	1.5	OTP	SMR/NPSPAC Trunked	12K1F9W
806-809	15.2	1.5	Analog FM (NPSPAC)	Trunked/Conventional	14K0F3E
806-821	15.1	1.5	Analog FM (SMR)	Trunked/Conventional	16K0F3E
821-824	15.4	1.5	Analog FM (SMR)	Trunked/Conventional	16K0F3E
821-824	15.2	1.5	Analog FM (NPSPAC)	Trunked/Conventional	14K0F3E
851-854	14.8	1.5	Analog FM (NPSPAC)	T/A	14K0F3E
851-869	14.4	1.5	Analog FM (SMR)	T/A	16K0F3E
866-869	14.3	1.5	Analog FM (NPSPAC)	T/A	14K0F3E
806-809	14.4	1.5	2-level (digitized data)	NPSPAC Trunked/Conventional	11K9F1D
806-809	14.4	1.5	2-level (digitized voice)	NPSPAC Trunked/Conventional	11K9F1E
806-809	14.3	1.5	2-level (digitized data)	SMR Trunked/Conventional	14K2F1D
806-809	14.3	1.5	2-level (digitized voice)	SMR Trunked/Conventional	14K2F1E
809-824	14.2	1.5	2-level (digitized data)	SMR Trunked/Conventional	14K2F1D
809-824	14.2	1.5	2-level (digitized voice)	SMR Trunked/Conventional	14K2F1E
821-824	14.2	1.5	2-level (digitized data)	NPSPAC Trunked/Conventional	11K9F1D
821-824	14.2	1.5	2-level (digitized voice)	NPSPAC Trunked/Conventional	11K9F1E
851-854	15.2	1.5	2-level (digitized data)	NPSPAC T/A	11K9F1D
851-854	15.2	1.5	2-level (digitized voice)	NPSPAC T/A	11K9F1E
851-854	15.1	1.5	2-level (digitized data)	SMR T/A	14K2F1D
851-854	15.1	1.5	2-level (digitized voice)	SMR T/A	14K2F1E
854-866	15.1	1.5	2-level (digitized data)	SMR T/A	14K2F1D
854-866	15.1	1.5	2-level (digitized voice)	SMR T/A	14K2F1E
866-869	15.2	1.5	2-level (digitized data)	SMR T/A	14K2F1D
866-869	15.2	1.5	2-level (digitized voice)	SMR T/A	14K2F1E
866-869	15.4	1.5	2-level (digitized data)	NPSPAC T/A	11K9F1D
866-869	15.4	1.5	2-level (digitized voice)	NPSPAC T/A	11K9F1E

360 Herndon Parkway
Suite 1400
Herndon, VA 20170
Phone: 703-689-0368 Fax: 703-689-2056

Frequency Range (MHz)	Measured Output Power (W) Conducted	Frequency Tolerance (ppb)	Modulation	Mode	Emission Designator
764-767, 773-776, 794-797, 803-806	14.0	400	P25 (digitized data)	T/A, Trunked/Conventional	8K4F1D
764-767, 773-776, 794-797, 803-806	14.0	400	P25 (digitized voice)	T/A, Trunked/Conventional	8K4F1E
794-797, 803-806	14.0	400	OTP	Trunked	12K1F9W
764-767, 773-776, 794-797, 803-806	15.0	400	Analog FM (12.5 kHz spaced)	T/A, Trunked/Conventional	11K0F3E

These powers are as listed on the original grant.

Table of Contents

Table of Figures

Table of Tables

Table of Appendices

Table of Photographs

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 **CS-7200 OpenSky Control Station** to be listed under BV8M7200 as a product variant to the M7200 mobile radio grant**; FCC ID: BV8M7200**, **IC: 3670A-M7200**. 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 and Industry Canada RSS-119. 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 approved by the Federal Communications Commission to perform AC line conducted and radiated emissions testing.

1.2 Related Submittal(s)/Grant(s)

This is a Class II Permissive Change request; the original FCC grant was issued on October 4, 2005.

This permissive change is being requested since the EUT has been mounted within an external chassis/housing and a power supply has been added, the user control head is the only other difference between the models.

The CS-7200 OpenSky Control Station is made up of a M7200 mobile radio which was tested. The control station is a product variant of the mobile radio, which is to be listed under BV8M7200 as a product variant to the M7200 mobile radio grant

.

2 Tested System Details

Listed below are the identifiers and descriptions of all equipment, cables, and internal devices used with the EUT for this testing, as applicable. The EUT was tested on one channel, 806.0125 MHz, for radiated receiver and transmitter emissions testing. Transmitter radiated spurious emissions was tested in analog mode.

Table 2-1: Equipment Under Test (EUT)

Part	Manufacturer	Model	PN/SN	FCC ID	RTL Bar Code
Control Station	M/A Com, Inc.	M7200 Series	A40059000001	BV8M7200	17873
Control Head	M/A Com, Inc.	SP-103	A4000F00337E	N/A	17493

Table 2-2: Support Equipment

Part	Manufacturer	Model	PN/SN	FCC ID	RTL Bar Code
Laptop Computer	Dell	Inspiron 6400	N/A	N/A	901465

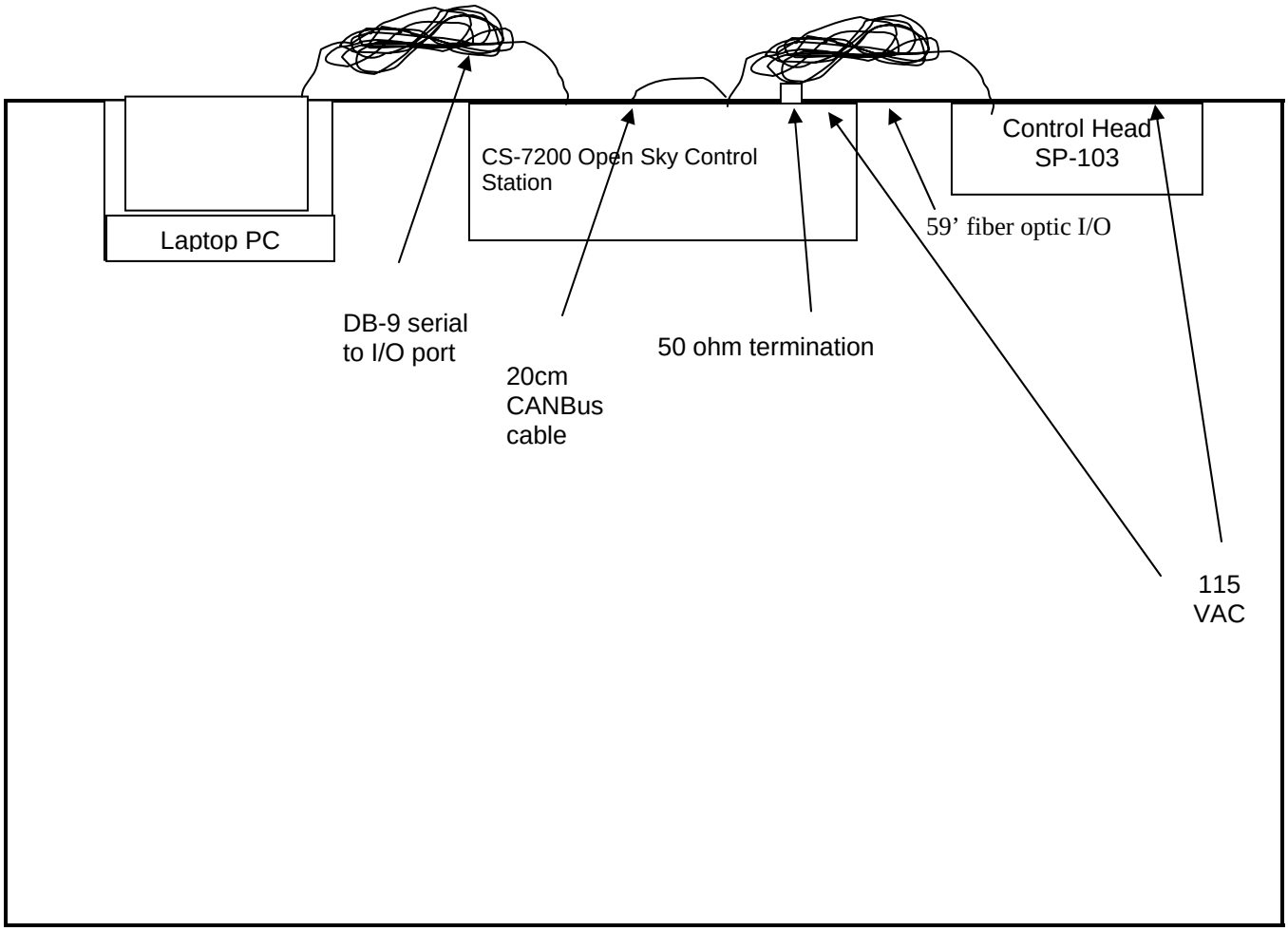


Figure 2-1: Configuration of Tested System

3 FCC Rules and Regulations Part 2 §2.1046(a): RF Power Output: Conducted; RSS-119 §5.4: Output Power Test

3.1 Test Procedure

ANSI TIA-603-C-2004, section 2.2.1

The EUT was connected to a coaxial attenuator having a 50 Ω load impedance.

3.2 Test Data

Table 3-1: RF Power Output (High Power): Carrier Output Power (Unmodulated)

Frequency (MHz)	RF Power Measured
806.0125	41.65 dBm (14.6 W)

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

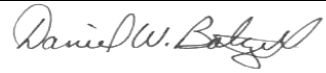
Table 3-2: RF Power Output (Rated Power)

Rated Power
41.76 dBm (15.0 W)

Table 3-3: 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
901139	Weinschel Corp.	48-20-34 DC-18GHz	Attenuator, 100 W 20 dB	BK5859	1/13/09

TEST PERSONNEL:

Dan Baltzell		April 9, 2007
Test Engineer	Signature	Date Of Test

4 FCC Rules and Regulations Part 2 §2.1053(a): Field Strength of Spurious Radiation; RSS-119 §5.8.10.2: Out-of-Band Emissions

4.1 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.

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.

4.2 Test Data

4.2.1 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 4-1: Field Strength of Spurious Radiation – 806.0125 MHz

Limit = 43 + 10 Log P = 54.7 dBc
Conducted Power = 41.7 dBm = 14.6 W

Frequency (MHz)	Spectrum Analyzer Level (dBuV)	Signal Generator Level (dBm)	Cable Loss* (dB)	Antenna Gain (dBd)	Corrected Signal Generator Level (dBc)	Margin (dB)
1612.0250	77.5	-26.1	5.7	7.3	66.2	-11.5
2418.0375	65.2	-38.8	6.8	9.1	78.2	-23.5
3224.0500	60.4	-38.6	8.5	9.6	79.2	-24.5
4030.0625	67.0	-20.4	9.4	9.5	62.0	-7.3
4836.0750	54.0	-35.5	10.7	10.4	77.5	-22.8
5642.0875	52.6	-37.6	11.0	10.6	79.7	-25.0
6448.1000	48.7	-40.6	12.1	11.4	83.0	-28.3
7254.1125	46.4	-40.9	12.6	11.1	84.1	-29.4
8060.1250	32.3	-52.5	13.0	11.2	96.0	-41.3

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

Table 4-2: Test Equipment Used for Testing Field Strength of Spurious Radiation

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900791	Chase	CBL6111B	Bilog antenna 30 MHz–2000 MHz	N/A	6/12/07
901364	MITEQ	JS4-00102600-41-5P	Amplifier, 0.1-26 GHz, 28dB gain	N/A	3/12/08
901215	Hewlett Packard	8596EM	Spectrum Analyzer 9 kHz-12.8 GHz	3826A00144	10/16/07
900928	Hewlett Packard	83752A	Synthesized Sweeper, 0.01-20 GHz	3610A00866	11/30/07
901426	Insulated Wire Inc.	KPS-1503-3600-KPS	RF cable, 30'	NA	12/5/07
901425	Insulated Wire, Inc.	KPS-1503-2400-KPS	RF cable, 20'	NA	12/5/07
901424	Insulated Wire Inc.	KPS-1503-360-KPS	RF cable 36"	NA	12/5/07
900927	Tektronix	ASG 100	Audio Signal Generator	B03274 V2.3	N/A
901413	Agilent Technologies	E4448A	Spectrum Analyzer	US44020346	12/14/07

TEST PERSONNEL:

Daniel Baltzell		April 9, 2007
Test Engineer	Signature	Date Of Test

5 AC Conducted Emissions

5.1 Site and Test Description

The power line conducted emissions measurements were performed in a Series 81 type shielded enclosure manufactured by Rayproof. The EUT was assembled on a wooden table 80 centimeters high. Power was fed to the EUT through a 50 ohm/50 microhenry Line Impedance Stabilization Network (LISN). The EUT LISN was fed power through an A.C. filter box on the outside of the shielded enclosure. The filter box and EUT LISN housing are bonded to the ground plane of the shielded enclosure. A second LISN, the peripheral LISN, provides isolation for the EUT test peripherals. This peripheral LISN was also fed A.C. power. A metal power outlet box, which is bonded to the ground plane and electrically connected to the peripheral LISN, powers the EUT host peripherals.

The spectrum analyzer was connected to the A.C. line through an isolation transformer. The 50 ohm output of the EUT LISN was connected to the spectrum analyzer input through a Solar 100 kHz high-pass filter. The filter is used to prevent overload of the spectrum analyzer from noise below 100 kHz. Conducted emission levels were measured on each current-carrying line with the spectrum analyzer operating in the CISPR quasi-peak mode (or peak mode if applicable). The analyzer's 6 dB bandwidth was set to 9 kHz. Video filter less than 10 times the resolution bandwidth is not used. Average measurements are performed in linear mode using a 10 kHz resolution bandwidth, a 1 Hz video bandwidth, by increasing the sweep time in order to obtain a calibrated measurement. The emission spectrum was scanned from 150 kHz to 30 MHz. The highest emission amplitudes relative to the appropriate limits were measured and have been recorded. The limits for Class A and Class B are contained therein.

5.2 Test Limits

Class A Line-Conducted Emissions		
	Limit (dBµV)	
Frequency (MHz)	Quasi-Peak	Average
0.15 to 0.50	79	66
0.50 to 30.0	73	60

Class B Line-Conducted Emissions		
	Limit (dBµV)	
Frequency (MHz)	Quasi-Peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5.00	56	46
5.00 to 30.00	60	50

5.3 Conducted Emissions Test Results

Table 5-1: Conducted Emissions First AC Line In, Standby Mode; Neutral Side (Line 1)

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	FCC 15.207 QP Limit (dBuV)	FCC 15.207 QP Margin (dBuV)	FCC 15.207 AV Limit (dBuV)	FCC 15.207 AV Margin (dBuV)	Pass/ Fail
0.160	Pk	45.9	0.2	46.1	65.5	-19.4	55.5	-9.4	Pass
0.212	Pk	38.1	0.2	38.3	63.1	-24.8	53.1	-14.8	Pass
0.279	Pk	29.7	0.3	30.0	60.8	-30.8	50.8	-20.8	Pass
11.590	Pk	32.2	2.1	34.3	60.0	-25.7	50.0	-15.7	Pass
17.670	Pk	29.0	2.5	31.5	60.0	-28.5	50.0	-18.5	Pass
26.780	Pk	30.2	2.9	33.1	60.0	-26.9	50.0	-16.9	Pass

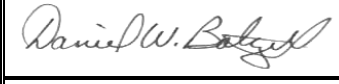
Table 5-2: Conducted Emissions First AC Line In, Standby Mode; Hot Side (Line 2)

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	FCC 15.207 QP Limit (dBuV)	FCC 15.207 QP Margin (dBuV)	FCC 15.207 AV Limit (dBuV)	FCC 15.207 AV Margin (dBuV)	Pass/ Fail
0.153	Pk	49.3	0.2	49.5	65.8	-16.3	55.8	-6.3	Pass
0.228	Pk	39.7	0.2	39.9	62.5	-22.6	52.5	-12.6	Pass
0.309	Pk	33.5	0.3	33.8	60.0	-26.2	50.0	-16.2	Pass
11.590	Pk	31.1	2.1	33.2	60.0	-26.8	50.0	-16.8	Pass
17.670	Pk	29.7	2.5	32.2	60.0	-27.8	50.0	-17.8	Pass
26.810	Pk	28.5	2.9	31.4	60.0	-28.6	50.0	-18.6	Pass

Table 5-3: Test Equipment Used for Testing Conducted Emissions

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900339	Hewlett Packard	85650A	Quasi-Peak Adapter 30 Hz-1 GHz	2521A00743	9/14/07
900968	Hewlett Packard	8567A	Spectrum Analyzer 10 kHz-1.5 GHz	2602A00160	9/14/07
901083	AFJ International	LS16	16A LISN (110 V)	16010020080	3/28/08

TEST PERSONNEL:

Daniel Baltzell		April 9, 2007
Test Engineer	Signature	Date Of Test

6 Radiated Emissions

6.1 Amendments to Emissions Test Methodology

6.1.1 Deviations from Test Methodology

There was no deviation from, additions to, or exclusions from the test method.

6.2 Radiated Emissions Measurements

6.2.1 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.

6.2.2 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:

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

6.2.3 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.

6.2.4 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

6.2.5 Radiated Emissions Data

Table 6-1: Radiated Emissions Test Data

Emission Frequency (MHz)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
48.878	38.9	-19.9	19.0	40.0	-21.0	Pass
270.520	53.7	-16.6	37.1	46.0	-8.9	Pass
516.094	47.8	-11.4	36.4	46.0	-9.6	Pass
576.026	49.3	-9.8	39.5	46.0	-6.5	Pass
1032.153	22.7	-4.7	18.0	54.0	-36.0	Pass
1548.230	15.5	-1.1	14.4	54.0	-39.6	Pass

Table 6-2: Test Equipment Used for Testing Radiated Emissions

RTL Asset #	Manufacturer	Model	Part Type	Calibration Due Date	Calibration Due Date
900791	Chase	CBL6111B	Bilog antenna 30 MHz–2000 MHz	N/A	6/12/07
901364	MITEQ	JS4-00102600-41-5P	Amplifier, 0.1-26 GHz, 28dB gain	N/A	3/12/08
901215	Hewlett Packard	8596EM	Spectrum Analyzer 9 kHz-12.8 GHz	3826A00144	10/16/07
901426	Insulated Wire Inc.	KPS-1503-3600-KPS	RF cable, 30'	NA	12/5/07
901425	Insulated Wire, Inc.	KPS-1503-2400-KPS	RF cable, 20'	NA	12/5/07

TEST PERSONNEL:

Daniel Baltzell		April 9, 2007
Test Engineer	Signature	Date Of Test

7 Conclusion

The data in this measurement report shows that the **M/A-COM, Inc**. Model **CS-7200 OpenSky Control Station, FCC ID: BV8M7200, IC: 3670A-M7200,** complies with all the requirements of Parts 90, 15 and 2 of the FCC Rules, and Industry Canada RSS-119.