Engineering and Testing for EMC and Safety Compliance

Type Certification Report

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Model: SkyMASTR 900 MHz Base Station
935–940 MHz

FCC ID: BV8MBS900A100
IC: 3670A-MBS900

July 18, 2006

Standards Referenced for this Report	
Part 2: 2005	Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
Part 90: 2005	Private Land Mobile Radio Services
ANSI TIA-603-C-2004	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
ANSI/TIA/EIA – 102.CAAA; 2002	Digital C4FM/CQPSK Transceiver Measurement Methods
RSS-119 Issue 7: 2006	Land Mobile and Fixed Radio Transmitters and Receivers Operating in the Frequency Range 27.41-960 MHz

Frequency Range (MHz)	Rated Transmit Power Conducted (W)	Measured Frequency Tolerance (ppm)	Emission Designator
935-940	100	0.063	8K5F9W

Report Prepared by Test Engineer: Daniel Biggs

Document Number: 2006090

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1 General Information

The following Type Certification Report is prepared on behalf of **M/A-COM, Inc**. in accordance with the Federal Communications Commission. The Equipment Under Test (EUT) was the **SkyMASTR 900 MHz Base Station; FCC ID: BV8MBS900A100, IC: 3670A-MBS900**. 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. Calibration checks are performed regularly on the instruments, and all accessories including the 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 dated March 3, 1994, submitted to and approved by the Federal Communications Commission, to perform AC line conducted and radiated emissions testing.

1.2 Related Submittal(s)/Grant(s)

This is an original application report.

2 Tested System Details

The EUT is a base station radio that operates in the 935-940 MHz band. The rated RF output power is continuously variable from 10 W to 100.0 W. The EUT is digitally modulated using a 4-level Frequency Shift Keying (FSK) with a symbol rate of 9600 bps.

The test sample was received on July 6, 2006. Listed below are the identifiers and descriptions of all equipment, cables, and internal devices used with the EUT for this test, as applicable.

Model Tested	SkyMASTR 900 MHz Base Station
Frequency Band	935–940 MHz
Modulation Type	4-level Frequency Shift Keying (FSK)
Channel Step Size	12.5 KHz
Authorized Channel Bandwidth	13.6 KHz
Primary Power	110 VAC
Rated Transmitter Output Power	10-100 W
Duty Cycle	Continuous 100%

Table 2-1: Equipment Under Test (EUT)

Part	Manufacturer	Model	PN/SN	FCC ID	RTL Bar Code
Base Station	M/A-Com, Inc.	SkyMASTR Base Station	MASK-900HD	BV8MBS900A100	17363
Digital Controller/Transceiver	M/A-Com, Inc.	N/A	EA-009221-003	N/A	N/A
Amplifier	M/A-Com, Inc.	N/A	EA-009222-003	N/A	N/A
Power Supply	N/A	SE-600-48	N/A	N/A	N/A

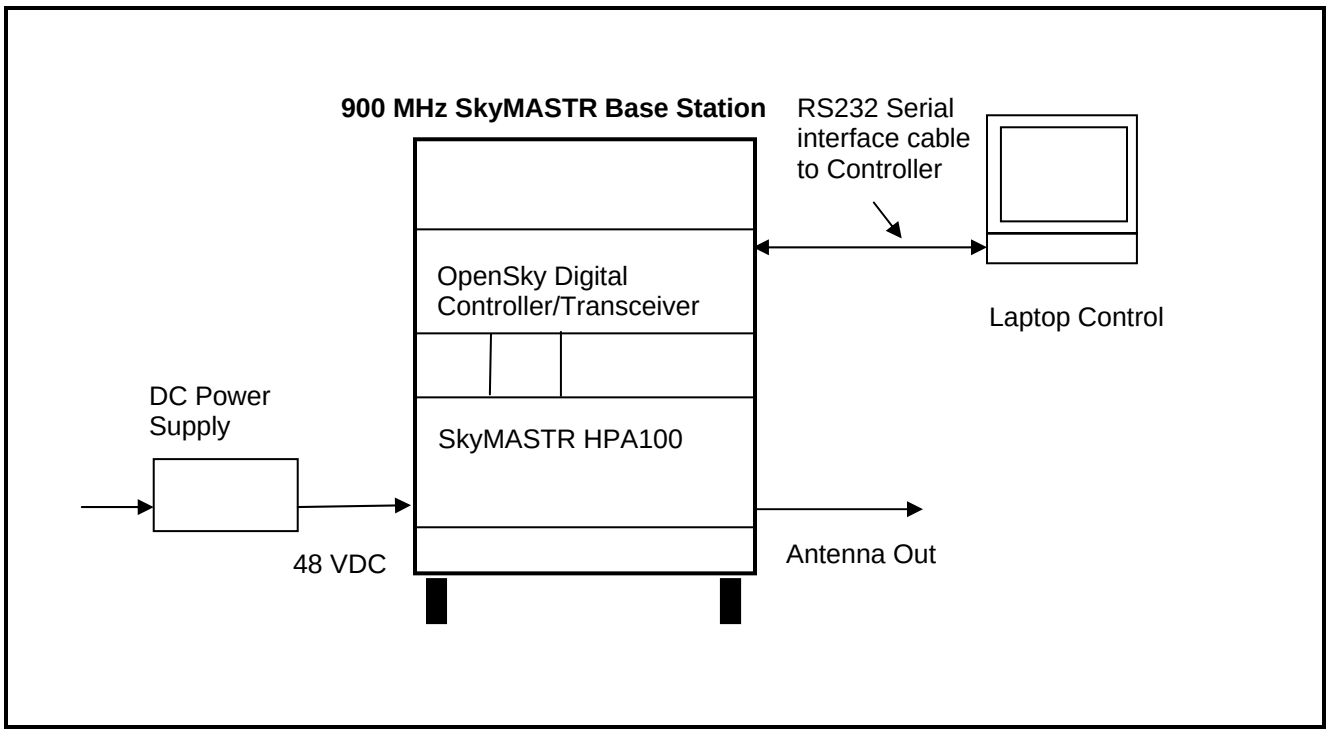
Table 2-2: Ports and Cabling (EUT)

Port	Cable Type	Quantity	Length (feet)	Shield
DC Power	14 AWG	2	6	No
RF Output	N-type	1	N/A	N/A
Data Interface	RS-485	2	N/A	N/A
Data Interface	RS232	2	N/A	N/A

Table 2-3: Support Equipment

Part	Manufacturer	Model	PN/SN	FCC ID	RTL Bar Code
Notebook Computer	Dell	Latitude	N/A	N/A	17337
Interface Cable	N/A	N/A	N/A	N/A	N/A

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 AC Voltage: 28 VDC
Current: 11 AMPS

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

4.1 Test Procedure

ANSI TIA-603-C-2004, Section 2.2.1.

The EUT transmitter output was connected through appropriate 50 ohm attenuator to a spectrum analyzer.

4.2 Test Data

Table 4-1: RF Power Output: Carrier Output Power

Channel	Frequency (MHz)	Peak Power (W)
1	935.0125	100.46
2	937.5000	100.69
3	939.9875	101.39

*Measurement accuracy: +/-.3 dB

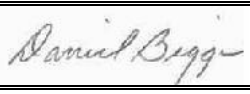
Table 4-2: RF Power Output (Rated Power)

Rated Power
100 W

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

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due
901184/901186	Agilent	E4416A/E9323A	Power Meter/ Sensor	GB41050573/ S420.52510380	09/21/06
901138	MCE Weinschel	48-40-34	Attenuator, 40 dB, DC-18 GHz, 100 W	BK5883	1/13/09

Test Personnel:

Daniel Biggs		July 11, 2006
Test Engineer	Signature	Date Of Tests

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

5.1 Test Procedure

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

The transmitter is terminated with a 50 Ω load and interfaced with a spectrum analyzer.

Device with digital modulation: Modulated to its maximum extent using a pseudo random data sequence – 9600 bps.

5.2 Out of Band Spurious Test Data

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

Limits: P(dBm) – (50+10xLOG P(W))

The following channels (in MHz) were investigated: 935.0125, 937.5000, and 939.9875. 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 – Channel 1; 935.0125 MHz – High Power

12.5 kHz channel spacing; Conducted power = 100.5 W

Frequency (MHz)	Level (dBc)	Limit (dBc)	Margin(dB)
1870.025	90.6	70.0	-20.6
2805.038	90.1	70.0	-20.1
3740.05	103.1	70.0	-33.1
4675.063	97.5	70.0	-27.5
5610.075	103.5	70.0	-33.5
6545.088	98.3	70.0	-28.3
7480.100	95.5	70.0	-25.5
8415.113	100.1	70.0	-30.1
9350.125	95.8	70.0	-25.8

Table 5-2: Conducted Spurious Emissions – Channel 2; 937.5000 MHz – High Power

12.5 kHz channel spacing; Conducted power = 100.7 W

Frequency (MHz)	Level (dBc)	Limit (dBc)	Margin(dB)
1875.0	91.0	70.0	-21.0
2812.5	89.1	70.0	-19.1
3750.0	103.8	70.0	-33.8
4687.5	102.0	70.0	-32.0
5625.0	102.7	70.0	-32.7
6562.5	100.0	70.0	-30.0
7500.0	96.8	70.0	-26.8
8437.5	101.7	70.0	-31.7
9375.0	93.5	70.0	-23.5

Table 5-3: Conducted Spurious Emissions – Channel 3; 939.9875 MHz – High Power

12.5 kHz channel spacing; Conducted power = 101.4 W

Frequency (MHz)	Level (dBc)	Limit (dBc)	Margin(dB)
1879.975	91.1	70.1	-21.0
2819.963	90.6	70.1	-20.5
3759.95	104.0	70.1	-33.9
4699.938	101.8	70.1	-31.7
5639.925	102.6	70.1	-32.5
6579.913	99.4	70.1	-29.3
7519.9	98.6	70.1	-28.5
8459.888	102.4	70.1	-32.3
9399.875	91.4	70.1	-21.3

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	09/22/06
901132	Par Electronics	UHF SN(806-902)	UHF Notch Filter	N/A	02/1/09
901138	MCE Weinschel	48-40-34	Attenuator, 40 dB,	BK5883	1/13/09

Test Personnel:

Daniel Biggs		July 11, 2006
Test Technician/Engineer	Signature	Date Of Test

6 FCC Rules and Regulations Part 90 §90.210(j) and Part 2 §2.1049(c): Occupied Bandwidth (Emissions Masks); RSS-119 §5.8.8: Emissions Masks

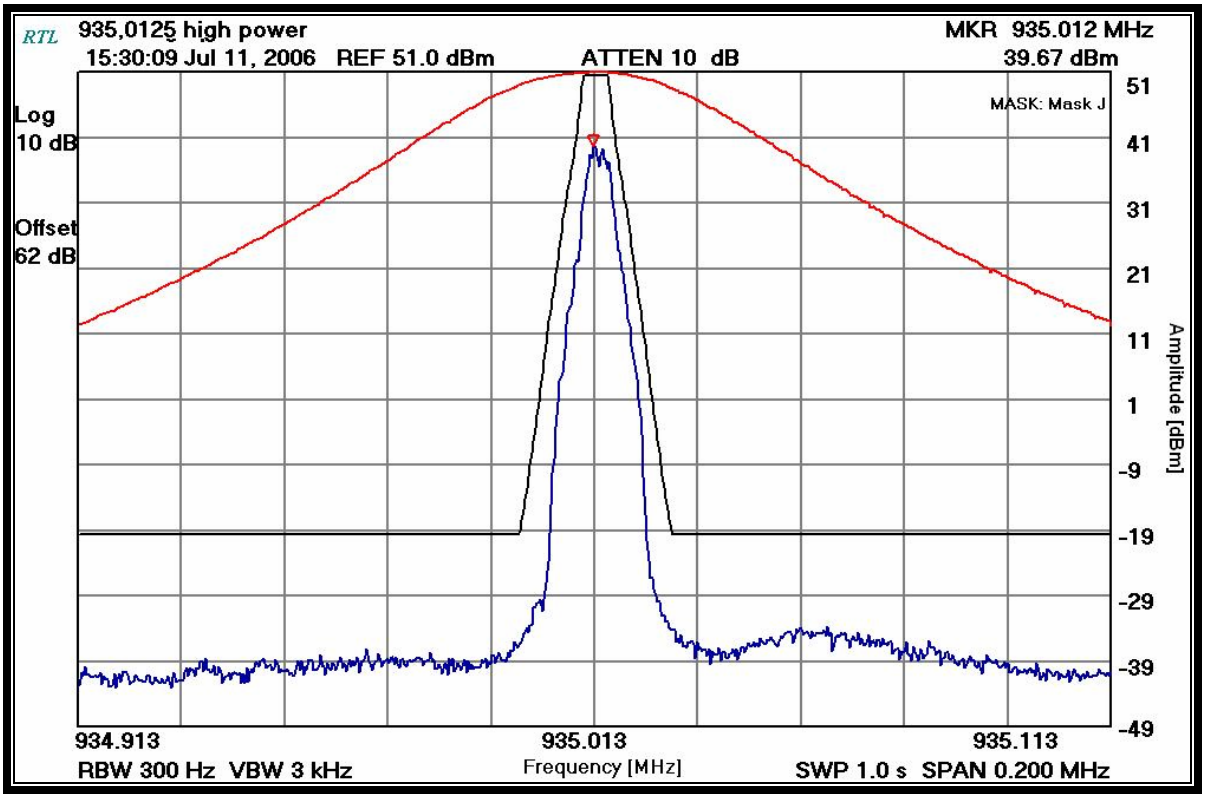
6.1 Test Procedure

Device with digital modulation: Modulated to its maximum extent using a pseudo random data sequence – 9600 bps.

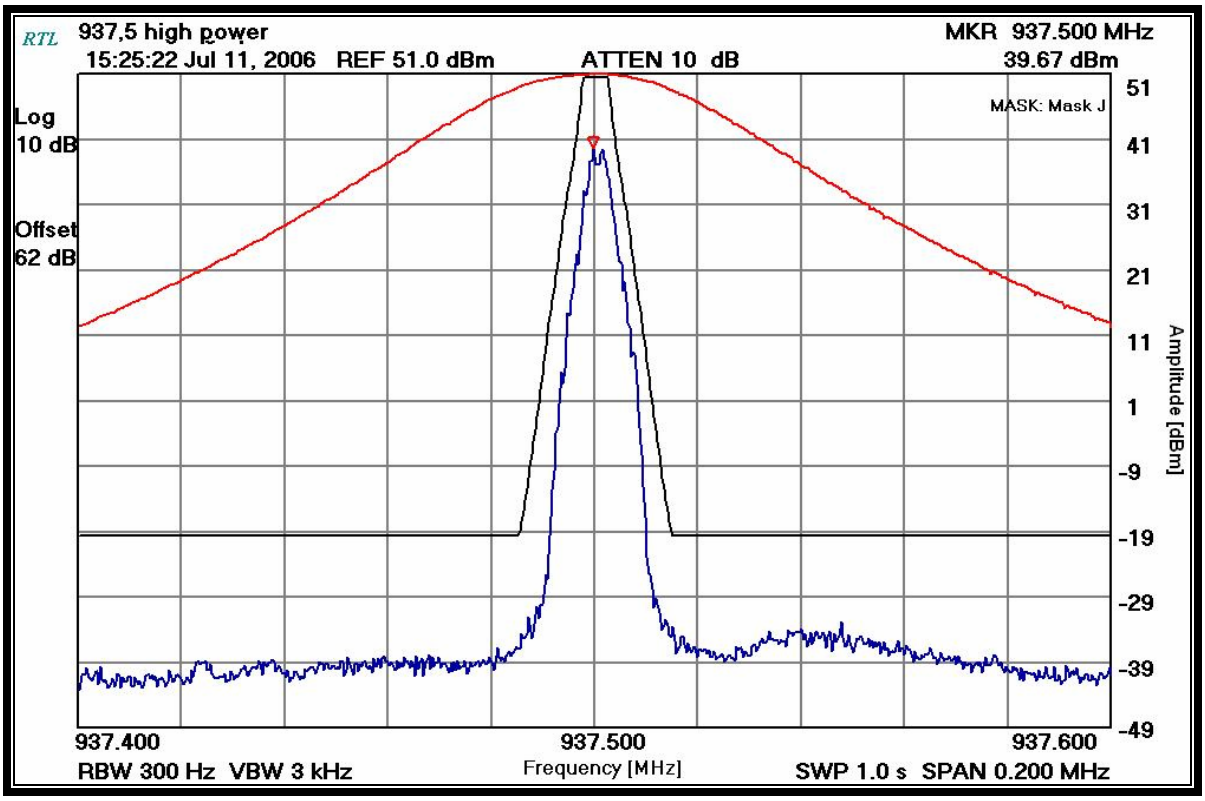
ANSI TIA-603-C-2004, Section 2.2.11.

6.2 In Band Spurious Test Data

Plot 6-1: Occupied Bandwidth/Emissions Masks; Channel 1 – 935.0125 MHz



Plot 6-2: Occupied Bandwidth/Emissions Masks; Channel 2 – 937.5000 MHz



Plot 6-3: Occupied Bandwidth/Emissions Masks; Channel 3 – 939.9875 MHz

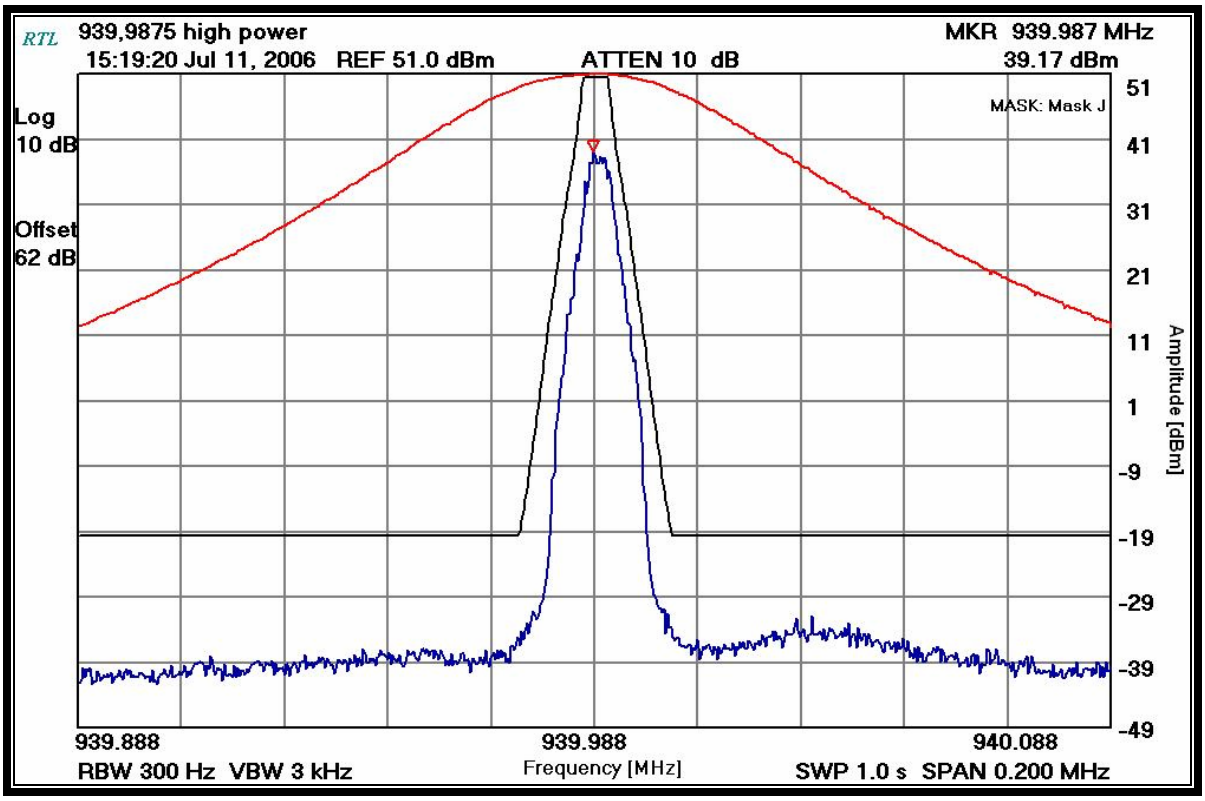


Table 6-1: Test Equipment for Testing Occupied Bandwidth/Emissions Masks

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due
901020	Hewlett Packard	8564E	Portable Spectrum Analyzer (9 kHz - 40 GHz)	3943A01719	9/14/06
901138	MCE Weinschel	48-40-34	Attenuator, 40 dB, DC-18 GHz, 100 W	BK5883	1/13/09

Test Personnel:

Daniel Biggs	Daniel Biggs	July 11, 2006
Test Engineer	Signature	Date Of Tests

7 FCC Rules and Regulations Part 90 §90.210(j) and Part 2 §2.1053(a): Field Strength of Spurious Radiation; RSS-119 §5.8: Unwanted Emissions

7.1 Test Procedure

ANSI TIA-603-C-2004, section 2.2.12.

The EUT was set to center channel and output power was set to maximum.

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

The EUT was placed on a non-conducting table 80 cm above the ground plane. The antenna-to-EUT distance is 3 m. The EUT is rotated through 360 degrees to maximize emissions. The antenna is scanned in both vertical and horizontal polarizations. 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.

The EUT was scanned from 30 GHz to the 10th harmonic of the fundamental. The spectrum analyzer resolution bandwidth is set to 1 MHz, and the video bandwidth is set to 1 MHz.

The spurious radiated emissions limit is calculated as follows:

Limits: P(dBm) – (50+10xLOG P(W))

7.2 Test Data

7.2.1 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 7-1: Field Strength of Spurious Radiation: Channel 2 – 937.5000 MHz (High Power)

Limit = 70.0
Conducted Power = 50.03 dBm = 100.7 W

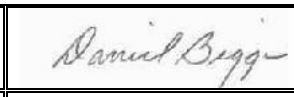
Frequency (MHz)	Polarization (H/V)	Spectrum Analyzer Level (dBuV)	Signal Generator Level (dBm)	Cable Loss* (dB)	Antenna Gain (dBd)	SG Level Corrected (dBc)	Limit	Margin (dB)
1875.00	V	36.0	-29.9	5.0	6.6	78.3	70.0	-8.3
2812.50	V	76.1	-26.2	5.3	6.7	74.4	70.0	-4.3
3750.00	V	62.9	-35.5	6.1	7.6	84.1	70.0	-14.0
4687.50	H	52.3	-41.5	5.8	8.5	88.9	70.0	-18.8
5625.00	H	41.2	-51.5	7.5	8.6	100.5	70.0	-30.4
6562.50	-	SNF	-	-	-	-	-	-
7500.00	-	SNF	-	-	-	-	-	-
8437.50	-	SNF	-	-	-	-	-	-
9375.00	-	SNF	-	-	-	-	-	-

*This insertion loss corresponds to the cable connecting the RF Signal Generator to the ½ wave dipole antenna. Note: SNF = Spectrum Analyzer Noise Floor

Table 7-2: Test Equipment for Testing Field Strength of Spurious Radiation

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due
901053	Schaffner-Chase	CBL6112	Antenna (25 MHz – 2 GHz)	2648	11/1/06
900932	Hewlett Packard	8449B OPT H02	Preamplifier (1 - 26.5 GHz)	3008A00505	8/3/06
901020	Hewlett Packard	8564E	Portable Spectrum Analyzer (9 kHz - 40 GHz)	3943A01719	9/14/06
900928	Hewlett Packard	HP 83752A	Synthesized Sweeper (.01 – 20 GHz)	3610A00866	11/10/06
900772	EMCO	3161-02	Horn Antennas (2 – 4 GHz)	9504-1044	5/20/07
900321	EMCO	3161-03	Horn Antennas (4 – 8 GHz)	9508-1020	5/20/07
900323	EMCO	3160-07	Horn Antennas (8.2 – 12 GHz)	9605-1054	7/2/06
901262	ETS	3115	Double ridge horn (1 – 26 GHz)	6748	4/19/08
901422	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		July 17, 2006
Test Engineer	Signature	Date Of Tests

8 FCC Rules and Regulations Part 90 §90.213(a) and Part 2 §2.1055: Frequency Stability; RSS-119 §5.3: Frequency Stability

8.1 Test Procedure

ANSI TIA-603-C-2004, section 2.3.1 and 2.3.2.

The carrier frequency stability is the ability of the transmitter to maintain an assigned carrier frequency.

The EUT was evaluated over the temperature range -30°C to +60°C.

The temperature was initially set to -30°C and a 2-hour period was observed for stabilization of the EUT. The frequency stability was measured within one minute after application of primary power to the transmitter. The temperature was raised at intervals of 10°C through the range. A ½ hour period was observed to stabilize the EUT at each measurement step, and the frequency stability was measured within one minute after application of primary power to the transmitter. Additionally, the power supply voltage of the EUT was varied +/-15% nominal input voltage.

The worst-case test data are shown below in Table 8-1 and Table 8-2.

8.2 Frequency Stability Test Data

8.2.1 Frequency Stability/Temperature Variation

Table 8-1: Frequency Stability/Temperature Variation – Channel 2 - 937.5000 MHz

Temperature (°C)	Channel Frequency (MHz)	Measured Frequency (MHz)	Delta Freq (MHz)	ppm
-30	937.5	937.499941	-0.0000590	0.063
-20	937.5	937.500035	0.0000350	0.037
-10	937.5	937.500031	0.0000310	0.033
0	937.5	937.499942	-0.0000580	0.062
10	937.5	937.500007	0.0000068	0.007
20	937.5	937.499942	-0.0000580	0.062
30	937.5	937.499965	-0.0000350	0.037
40	937.5	937.499975	-0.0000252	0.027
50	937.5	937.499975	-0.0000247	0.026
60	937.5	937.499982	-0.0000179	0.019

8.2.2 Frequency Stability/Voltage Variation

Table 8-2: Frequency Stability/Voltage Variation – Channel 2 - 937.5000 MHz

Voltage (VAC)	Channel Frequency (MHz)	Measured Frequency (MHz)	Delta Freq (MHz)	ppm
40.8	937.5	937.500054	0.0000544	0.06
48	937.5	937.500004	0.0000038	0.00
55.2	937.5	937.499997	-0.0000033	0.00

Table 8-3: Test Equipment for Testing Frequency Stability

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due
900946	Tenney Engineering, Inc.	TH65	Temperature Chamber with Humidity	11380	02/04/06
901413	Agilent	E4448	Spectrum Analyzer	US44020346	11/2/06
900948	MCE Weinschel	47-10-43	Attenuator, 10 dB, DC-18 GHz, 50 W	BH1487	12/2/08
901424	Insulated Wire, Inc.	KPS-1503-360-KPS	RF cable 36"	NA	12/12/06
901354	Meterman	37XR	Digital Multimeter	N/A	8/31/06

Test Personnel:

Daniel Biggs		July 14, 2006
Test Engineer	Signature	Date Of Tests

9 FCC Rules and Regulations Part 2 §2.202: Necessary Bandwidth and Emission Bandwidth

FCC Mask 90.210(j):

Type of Emission: F9W
Digital Voice and Data: 9600 BPS

Calculation:

B(n) = (R/Log{2}S + 2KD), where Log{2} is Log base 2

where:

R = 9.6 kilobits per second [raw data rate]
S = 4 [4-level FSK]
D = 3 kHz [Peak FM Deviation]
K = 0.617
d = normalized deviation factor of 1.2

B(n) = 8.502 or 8K5

FCC Emission Designator: 8K5F9W

10 Conclusion

The data in this measurement report shows that the **M/A-COM, Inc**. **SkyMASTR 900 MHz Base Station, FCC ID: BV8MBS900A100, IC: 3670A-MBS900,** complies with all the applicable requirements of FCC Parts 90, 15 and 2 and Industry Canada RSS-119.