CHOMERICS
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TEST SERVICES

EMC EVALUATION OF THE
M/A-COM
OPENSKY CELL SITE BASE STATION
MODEL MCS-0001
IN ACCORDANCE WITH THE
FCC PART 90 CERTIFICATION
AND
FCC PART 15 SUBPART C CERTIFICATION

Prepared For: **M/A-COM**
1011 PAWTUCKET BOULEVARD
POST OFFICE BOX 3295
LOWELL, MASSACHUSETTS 01854
ATTENTION: DENNIS MARTINEZ

Prepared By: **ROBERT FOSTER**
CHOMERICS TEST SERVICES
77 DRAGON COURT
WOBURN, MASSACHUSETTS 01888

Date: **FEBRUARY 10, 2000**

Test Report Number: **EMI2453.US.00**

Test Technician or Engineer: _____

CTS Approved Signatory: _____

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LIST OF DEFINITIONS/ABBREVIATIONS

AC	Alternating Current
BB	Broadband
BW	Bandwidth
cm	Centimeter
C.P.U.	Calibrate Prior to Use
dB	Decibel
DC	Direct Current
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
ER	Electric Radiation
EUT	Equipment Under Test
GHz	Gigahertz
Hz	Hertz
I-face	Interface
kHz	Kilohertz
m	Meter
MHz	Megahertz
mm	Millimeter
mS	Millisecond
mV	Millivolt
MR	Magnetic Radiation
NB	Narrowband
N.C.R.	No Calibration Required
PLC	Power Line Conduction
PPS	Pulses Per Second
uF	Microfarad
uH	Microhenry
uS	Microsecond
uV	Microvolt
U.W.C.	Use With Calibrated Equipment

1.0 GENERAL

1.1 Introduction

1.1.1 Purpose

The purpose of this report is to document the performance of the M/A-Com OpenSky Cell Site Base Station during a variety of radio-performance tests and record the test requirements and procedures used. At the request of M/A-Com, the tests were performed by Chomerics Test Service (CTS) of Woburn, Massachusetts. The assessment will determine the compliance or non-compliance to the requirements set by FCC Part 90 and Part 2.

No representative from M/A-Com was present for testing. Testing was performed during the period of December 7, 1999 to January 21, 2000 under purchase order number 252221.

1.1.2 Requirements

The requirements for the sequence of tests performed on the M/A-Com OpenSky Cell Site Base Station are as follows:

Output Power

The RF output of the OpenSky Cell Site Base Station must be within ±1dB of the manufacturer's rated output.

Please note: This is not a FCC requirement but used for information purposes only.

Occupied Bandwidth
FCC Part 2.989

The Occupied Bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the means power radiated are each equal to 0.5% of the total mean power radiated by a given emission.

Emission Mask and Spurious Emissions at Antenna Terminals
FCC Part 90.210 and Part 2.991

Mask B

The following emission mask shall be followed. The power of any emission must be below the unmodulated carrier power (P) as follows:

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

Mask G

The following emission mask shall be followed. The power of any emission must be below the unmodulated carrier power (P) as follows:

1. On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5kHz 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 10kHz, but no more than 250% of the authorized bandwidth:
   At least 116 log (fd/6.1) dB or 50 + 10 log(P) dB or 70dB, 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.

Mask H

The following emission mask shall be followed. The power of any emission must be below the unmodulated carrier power (P) as follows:

1. On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 4kHz or less:
   Zero dB
2. On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 4kHz but not more than 8.5kHz:
   At least 107 log (fd/4) dB.
2. On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 15kHz, but not more than 25kHz:
   At least 116 log (fd/6.1)
3. On any frequency removed from the center of the authorized bandwidth by more than 25kHz:
   At least 43 + 10 Log (P) dB.

Channel Spacing/Bandwidth
FCC Part 90.209

The following Channel Spacing/Bandwidth shall be followed:

Frequency Band MHz	Channel Spacing kHz	Authorized Bandwidth kHz
806-821 / 851-866	25	20
821-824 / 866-869	12.5	20

Field Strength of Spurious Radiation
FCC Part 2.933

The field strength of each harmonic and other spurious emissions shall be below 43 + 10 Log (P) when measured in an open field test site. The frequency range under investigation is 30MHz to 8690MHz.

P = to 25 watts
Limit = 43 + 10 log (25)= 56.98dB under

Modulation Characteristics
FCC Part 2.987

The modulation curve showing the percentage of modulation versus the modulation input voltage will be supplied.

Frequency Stability
FCC Part 90.213 and 2.955

The transmitter shall have the following Frequency Stability over the temperature range of –30°C to +50°F.

Radiated and Conducted Emissions "Receiver"
FCC Part 15

The receiver shall meet the FCC Part 15 Subpart B Class B radiated and conducted emissions limits.

Radiated Emissions 2.4GHz Receiver

The radiated emission requirements are FCC Part 15 Subparts B, 30MHz through 1000MHz and up to the tenth harmonic of operation (24.5GHz).

Radiated Field Strength of Fundamental and Harmonics Emissions

The radiated harmonics requirements are FCC Part 15 Subpart C 15.249. Field Strength of Fundamental Frequency 50mV/m = 74dBuv/m. Field Strength of harmonics 500uV/m 54dBuv/m.

1.2 Administrative Data

1.2.1 Test Facility

Chomerics Test Facility is recognized under the National Voluntary Laboratory Accreditation Program (NVLAP) for NVLAP Codes 12/C01 and 12/R01. Tests within this report not conforming to 12/C01 and 12/R01 NVLAP Codes are not covered under Chomerics NVLAP accreditation.

Chomerics Test Facility operates under the current revision of Chomerics Quality Assurance (QA) Manual Document Number QA002.

The QA manual has been constructed to reflect a quality program in accordance with the requirements of the National Institute of Standards and Technology (NIST), ISO 9002, ISO Guide 25, NIST Handbook 150, EN 45001, MIL-I-45208A, MIL-STD-461D, 462D and Chomerics Quality Assurance Program (QAP).

The QA manual outlines and describes the procedures for establishing and maintaining the quality of analysis, research, inspection, and testing within Chomerics Test Service (CTS).

This report does not represent an endorsement by the U.S. Government.

The results and/or conclusions within this test report refer and/or apply only to the unit(s) tested as defined by this report.

Measurements performed for this test are traceable to the National Institute of Standards and Technology (NIST) based on the fact that all test equipment used for the measurements were previously calibrated using standards traceable to NIST.

No deviations, additions to, or exclusions from the test specification(s) were made.

The system amplitude accuracy for the measurements made during the radiated emission tests was ±3dB.

1.2.2 Equipment Calibration

The calibration of Chomerics test facility equipment is controlled under the current edition of Chomerics Laboratory Test Equipment Calibration Manual Document Number QA001.

The test equipment used throughout this test sequence conforms to laboratory calibration standards, MIL-STD-45662, traceable to the National Institute of Standards and Technology. The date of the next due scheduled calibration is listed in each test section for the applicable equipment.

All test equipment is calibrated in one year intervals

1.2.3 Personnel

The test personnel used to perform or supervise the tests are accredited by the National Association of Radio and Telecommunications Engineers, Inc. (NARTE) as Certified Electromagnetic Compatibility Engineers (N.C.E.) and Technicians (N.C.T.).

1.3 Test Set-up

1.3.1 Test Site Matrix

The test locations used for the emissions and immunity tests are as follows: (Refer to Section 1.3.2 for test site descriptions).

Test Performed	Test Site
Output Power	Test Site A
Occupied Bandwidth	Test Site A
Emission Mask and Spurious Emissions at Antenna Terminals	Test Site A
Channel Spacing/Bandwidth	Test Site A
Field Strength of Spurious Radiation	Test Site A
Modulation Characteristics	M/A-Com
Frequency Stability	Safety Lab
Radiated/Conducted Emissions	Test Site A
Radiated Field Strength of F_o & Harmonics 2.4GHz	Test Site A

1.3.2 Test Site Descriptions

The following is a list of the test sites and descriptions of each. Refer to Section 1.3.1 for specific test sites used for testing.

Open Area Test Site A: Chomerics Open Area Test Site "A" if used for this test program is located in the lower parking lot attached to the Seeger Building at Chomerics, 84 Dragon Court, Woburn, Massachusetts (see Figure 1). Parking is permitted on one side of test site "A" at a discrete distance from the imaginary ellipse.

The Open Area Test Site A enclosure is a wooden structure measuring 56 x 30 x 25 feet in size with galvanized steel sheet metal used as the ground plane. The structure is sized to allow 3 meter measurements and is heated and/or air conditioned.

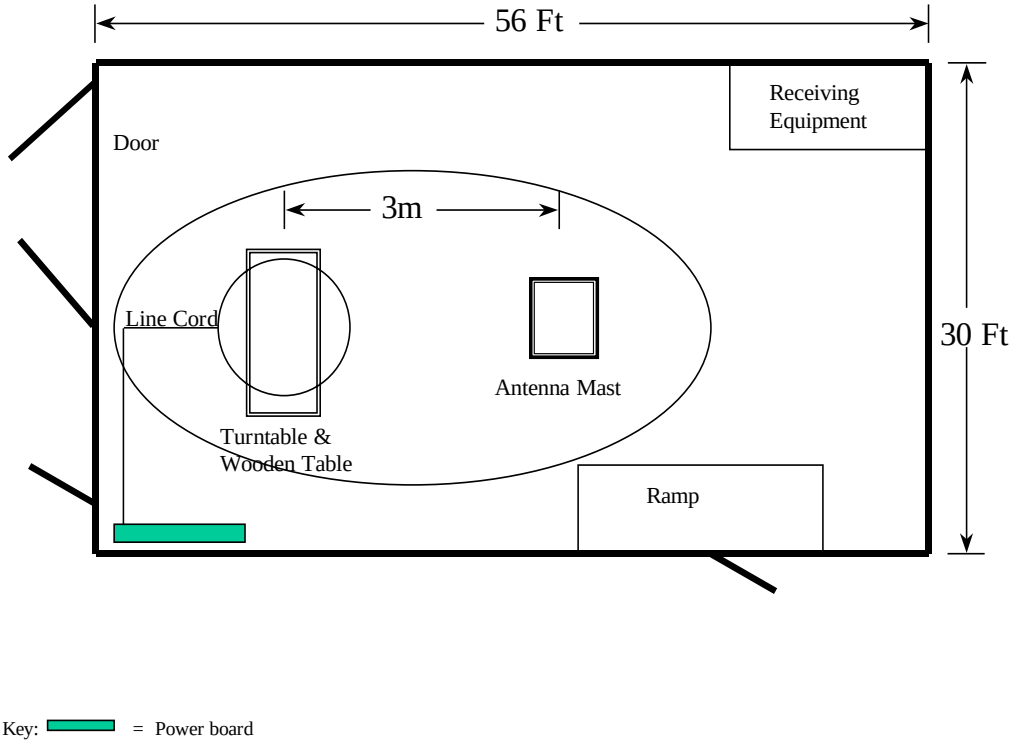
The structure used to support equipment under test is an EMCO 4 foot diameter motorized turntable. For tabletop equipment, a wooden table measuring 1.5 x 1 meter in size is positioned at the center of the turntable, at the proper height above the ground plane.

The area at the end of the Open Area Test Site “A” is the location for the test personnel and equipment to ensure they are outside the imaginary ellipse.

The available AC power within Open Area Test Site “A” is 120V 60Hz Single Phase 60Amps; 208V 60Hz Three Phase 60Amps; 208V 60Hz Single Phase 60Amps; 230V 50Hz Single Phase 50Amps.

This Site is listed with the Federal Communications Commissions (FCC).

OPEN AREA TEST SITE A
Figure 1



Open Area Test Site B: Chomerics Open Area Test Site "B" if used for this test program is located in the lower parking lot behind the Seeger Building at Chomerics, 84 Dragon Court, Woburn, Massachusetts (see Figure 2). Parking is permitted on one side of test site "B" at a discrete distance from the imaginary ellipse.

The Open Area Test Site “B” enclosure is a wooden structure measuring 56 x 30 x 25 feet in size with galvanized steel sheet metal used as the ground plane. The structure is sized to allow both 3 and 10 meter measurements and is heated and/or air conditioned.

The structure used to support equipment under test is a 14 foot diameter motorized turntable. The sheet metal surface is flush with the ground plane. To ground the turntable, 175 copper fingers (1" x 1.5") are mounted around the outer edge of the turntable using machine screws. The spring fingers are equally spaced and provide a uniform interface between the turntable metal surface and ground plane. For tabletop equipment, a wooden table measuring 1.5 x 1 meter in size is positioned at the center of the turntable, at the proper height above the ground plane.

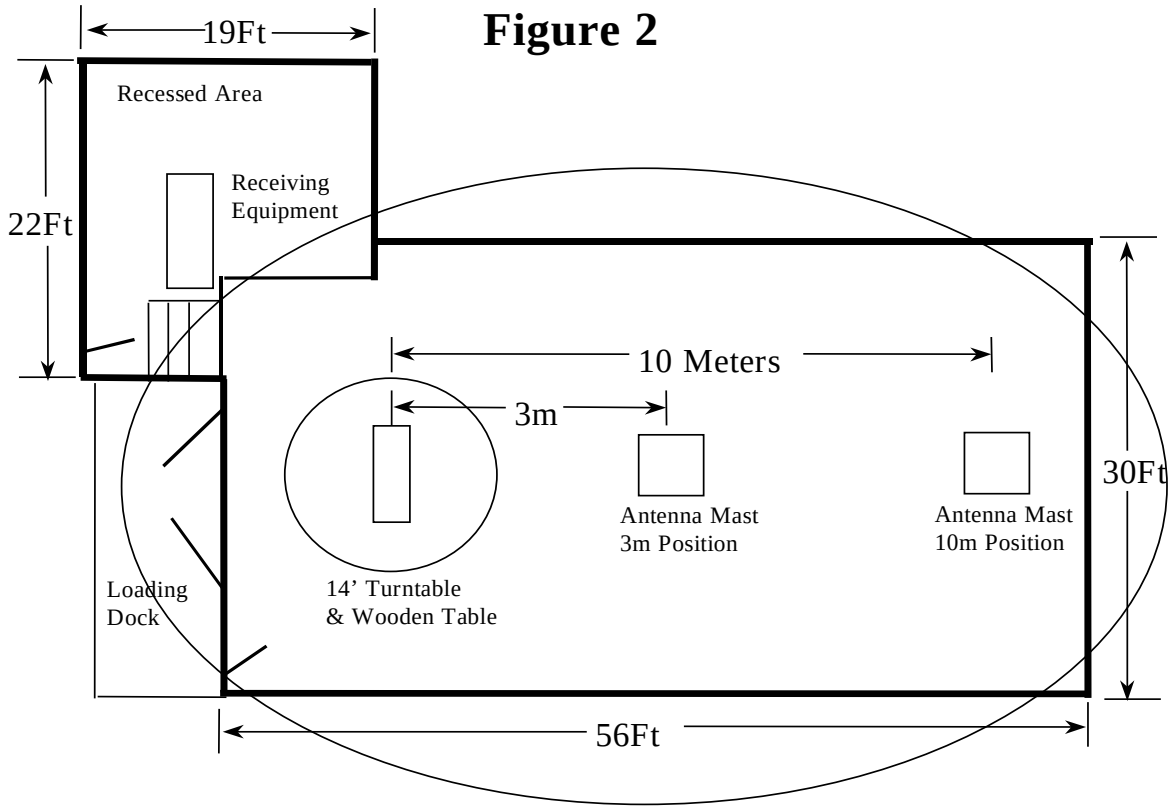
The addition at the end of the Open Area Test Site "B" is the location for the test personnel and equipment to ensure they are outside the imaginary ellipse.

The available AC power within Open Area Test Site "B" is 120V 60Hz Single Phase 60Amps; 208V 60Hz Three Phase 60Amps; 208V 60Hz Single Phase 60Amps; 230V 50Hz Single Phase 50Amps.

This site is listed with the Federal Communications Commissions (FCC).

OPEN AREA TEST SITE B

Figure 2



Test Chamber A: Chomerics Test Chamber A, if used for this test program, is located in the Seeger Building at Chomerics, 84 Dragon Court, Woburn, Massachusetts (see Figure 3). The shielded enclosures (test chambers) were manufactured and installed by Universal Shielding Corporation of Deer Park, New York. Attenuation tests have demonstrated that the shielded enclosures meet the attenuation requirements of MIL-STD-285 and NSA 65-6. The main test chamber is 22 x 10 x 10 feet in size with an adjacent enclosure that is 8 x 8 x 8 feet in size. The adjacent room, used for support equipment, and the main test chamber are connected together and referenced to the same single point ground.

When needed for tabletop equipment, a wooden table measuring 3 x 9 feet in size is positioned within the test chamber. When used for MIL-STD-461D tests the tabletop surface is covered with a copper sheet and grounded to the test chamber wall so that the resistance is less than 2.5 milliohms.

The power line filters supplying the power to the enclosures provide 100dB of attenuation from 10kHz to 10GHz. The adjacent room, used for support equipment, and the main test chamber have independent AC power obtained from independent AC power line filters.

The available AC power in Test Chamber A is 120V 60Hz Single Phase 100Amps; 120V 400Hz Three Phase 50Amps; 208V 60Hz Three Phase 100Amps; 208V 60Hz Single Phase 100Amps; 230V 50Hz Single Phase 50Amps.

Test Chamber B: Chomerics Test Chamber B, if used for this test program, is located in the Seeger Building at Chomerics, 84 Dragon Court, Woburn, Massachusetts (see Figure 3). The shielded enclosures (test chambers) were manufactured and installed by Universal Shielding Corporation of Deer Park, New York. Attenuation tests have demonstrated that the shielded enclosures meet the attenuation requirements of MIL-STD-285 and NSA 65-6.

The main test chamber is 22 x 10 x 10 feet in size with an adjacent enclosure that is 8 x 8 x 8 feet in size. The adjacent room, used for support equipment, and the main test chamber are connected together and referenced to the same single point ground.

Test Chamber B is lined with Rantec ferrite absorber tiles FT-100. All surfaces of the room are lined with FT-100. The floor is lined with removable tiles. This absorber material allows the test chamber to meets the 0-6dB field uniformity requirements of IEC 1000-4-3 and ENV50140.

There are two access panels between the main test chamber and the support room. The access panels are covered with absorber tiles. The absorber tiles can be removed from the access panels.

The power line filters supplying the power to the enclosures provide 100dB of attenuation from 10kHz to 10GHz. The adjacent rooms, used for support equipment, and the main test chamber have independent AC power obtained from independent AC power line filters.

The available AC power in Test Chamber B is 120V 60Hz Single Phase 30Amps; 208V 60Hz Three Phase 30Amps; and 230V 50Hz Single Phase 30Amps: A wooden table 3 x 6 feet in size is used for tabletop equipment.

Only one power line frequency is available in the chamber at a time, 50, 60 or 400 cycle, unless power is brought through an access panel.

Test Chamber C: Chomerics Test Chamber C, if used for this test program, is located in the Seeger Building at Chomerics, 84 Dragon Court, Woburn, Massachusetts (see Figure 3). The shielded enclosures (test chambers) were manufactured and installed by Universal Shielding Corporation of Deer Park, New York.

Attenuation tests have demonstrated that the shielded enclosures meet the attenuation requirements of MIL-STD-285 and NSA 65-6. The main test chamber is 16 x 20 x 10 feet in size with two adjacent enclosures on either side which are 8 x 8 x 8 and 8 x 12 x 10 feet in size, respectively.

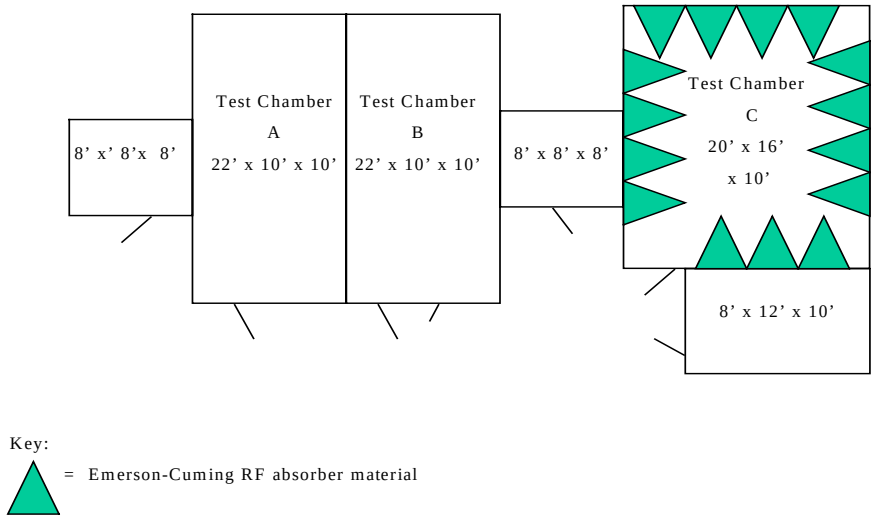
Test Chamber C is lined with Emerson-Cuming RF absorber material. This absorber material meets the following absorption specifications: 80MHz 6dB, 300MHz 30dB, 500MHz 35dB, 1GHz 40dB, and 3 to 24 GHz 50dB. Each of the two adjacent rooms used for support equipment and the main test chamber are connected together and referenced to the same single point ground.

When needed for tabletop equipment, a wooden table measuring 3 x 9 feet in size is positioned within the test chamber. When used for MIL-STD-461D tests, the tabletop surface is covered with a copper sheet and grounded to the test chamber wall so that the resistance is less than 2.5 milliohms. When used for radiated electromagnetic field tests, to some standards, the copper tabletop surface is removed.

The available AC power in Test Chamber C is 120V 60Hz AC Single Phase 60Amps; 230V 50Hz AC Single Phase 50Amps; 115V 400Hz AC Three Phase 30Amps (through access panel); 208V 60Hz AC Three Phase AC 30Amps (through access panel).

The power line filters supplying the power to the enclosures provide 100dB of attenuation from 10kHz to 10GHz. Each of the two adjacent rooms used for support equipment and the main test chamber has independent AC power obtained from independent AC power line filters.

Immunity Lab Layout
Figure 3



EC Lab A: Chomerics EC Lab A is located in the Seeger Building at Chomerics, 84 Dragon Court, Woburn, Massachusetts.

EC Lab A is a typical room measuring 20 x 16 feet with an aluminum sheet metal (8 x 12 feet in size) in the center of the floor for a ground plane. When needed for tabletop equipment, a wooden table (0.8 meters in height) is placed on the metal ground plane that extends at least 0.1m beyond all sides of the table. A removable 3 x 6 foot sheet of aluminum is placed on top of the wooden table when a horizontal coupling plane is required.

The appropriate connections, as needed for each test, are used to interconnect the table horizontal coupling plane, ground plane floor, test equipment, and earth ground.

The available AC power in the EC Lab A is 120V 60Hz AC Single Phase 60Amps; 230V 50Hz AC Single Phase 50Amps; and 208V 60Hz AC Three Phase AC 30Amps.

EC Lab A is equipped with air and water services for use with equipment that requires it.

The humidity in EC Lab A can be automatically controlled in the range of 20% to 60%.

EC Lab B: Chomerics EC Lab B is located in the Seeger Building at Chomerics, 84 Dragon Court, Woburn, Massachusetts.

EC Lab B is a typical room measuring 12 x 14 feet with a copper sheet (6 x 8 feet in size) in the center of the floor for a ground plane. When needed for tabletop equipment, a wooden table (0.8 meters in height) is placed on the metal ground plane that extends at least 0.1m beyond all sides of the table. A removable 3 x 6 foot sheet of aluminum is placed on top of the wooden table when a horizontal coupling plane is required.

The appropriate connections, as needed for each test, are used to interconnect the table horizontal coupling plane, ground plane floor, test equipment, and earth ground.

The available AC power in the EC Lab B is 120V 60Hz AC Single Phase 60Amps, 230V 50Hz AC Single Phase 50Amps; and 208V 60Hz AC Three Phase AC 30Amps.

The humidity in EC Lab B can be automatically controlled in the range of 20% to 60%.

1.3.3 Equipment Under Test

A detailed description of the Equipment Under Test is located in Appendix D.

2.0 SUMMARY

The terms "Passed" or "Failed" in this section are intended to guide the reader as to whether or not the EUT met the minimum Performance Criteria that can be interpreted from the FCC Parts 2, 15 and 90. The "Results" paragraph in each test section to follow, and the test data sheets, will outline specifically how the EUT performed during each test.

Output Power	Passed
Occupied Bandwidth	Passed
Emission Mask and Spurious Emissions at Antenna Terminals	Passed
Channel Spacing/Bandwidth	Passed
Field Strength of Spurious Radiation	Passed
Frequency Stability	Passed
Radiated Emission Receiver	Passed
Conducted Emission Receiver	Passed
Radiated F_o and Harmonics of 2.4GHz	Passed

2.1 Summary of Recommendations

The M/A-Com OpenSky Cell Site Base Station will not require modifications in order to insure compliance with FCC Parts 2, 15 and 90.

3.0 TESTS PERFORMED

3.1 Output Power

3.1.1 Equipment Used

Test Equipment		Asset #	Serial #	Cal Date
X	H/P E4401 Spectrum Analyzer	N/A	4895C76451	04/00
X	Narda 769-30 High Power Attenuator	284	03793	C.P.U.
X	Narda 769-20 High Power Attenuator	471	02951	C.P.U.

3.1.2 Test Conditions

For measurement of the output power, the OpenSky Cell Site Base Station was placed inside a shielded room. The ambient temperature of the room was 20°C.

The OpenSky Cell Site Base Station was configured to operate in a normal full power transmit mode. The OpenSky Cell Site Base Station was set up and powered by 120V 60Hz for the test.

3.1.3 Test Method

The output of the OpenSky Cell Site Base Station was measured at four frequencies between the frequency range of 851MHz to 869MHz. The output of the transmitter was connected to two high power attenuators. The attenuators were connected to a Spectrum Analyzer. See Figure 4 for test set-up.

The frequencies measured are as follows:

Channel No.	Base Frequency MHz
1	851.0125
600	865.9875
601	866.0125
830	868.9875

3.1.4 Results

The output power of the M/A-Com OpenSky Cell Site Base Station is within ±1dB throughout the frequency range.

3.2 Occupied Bandwidth

3.2.1 Equipment Used

Test Equipment		Asset #	Serial #	Cal Date
X	H/P E4401 Spectrum Analyzer	N/A	4895C76451	04/00
X	Narda 769-30 High Power Attenuator	284	03793	C.P.U.
X	Narda 769-20 High Power Attenuator	471	02951	C.P.U.

3.2.2 Test Conditions

For measurement of the occupied bandwidth, the OpenSky Cell Site Base Station was placed inside a shielded room. The ambient temperature of the room was 20°C.

The OpenSky Cell Site Base Station was configured to operate in a normal full power transmit mode. The OpenSky Cell Site Base Station was set up and powered by 120V 60Hz for the test.

3.2.3 Test Method

The output of the OpenSky Cell Site Base Station was measured at four frequencies between the frequency range of 851MHz to 869MHz. The output of the transmitter was connected to two high power attenuators. The attenuators were connected to a Spectrum Analyzer. See Figure 4 for test set-up.

The frequencies measured are as follows:

Channel No.	Base Frequency MHz
1	851.0125
300	858.0125
600	865.9875
601	866.0125
715	867.5125
830	868.9875

3.2.4 Results

The M/A-Com OpenSky Cell Site Base Station meets the requirements of FCC Part 2 .989 Occupied Bandwidth.

3.3 Emissions Mask and Spurious Emissions at Antenna Terminals

3.3.1 Equipment Used

Test Equipment		Asset #	Serial #	Cal Date
X	H/P E4401 Spectrum Analyzer	N/A	4895C76451	04/00
X	Narda 769-30 High Power Attenuator	284	03793	C.P.U.
X	Narda 769-20 High Power Attenuator	471	02951	C.P.U.

3.3.2 Test Conditions

The Emissions Mask measurements of the OpenSky Cell Site Base Station were made inside a shielded room. The ambient temperature of the room was 20°C.

The OpenSky Cell Site Base Station was configured to operate in a normal full power transmit mode. The OpenSky Cell Site Base Station was set up and powered by 120V 60Hz for the test.

3.3.3 Test Method

The output of the OpenSky Cell Site Base Station was measured at one frequency 851MHz. The output was compared to the Emissions Mask B, G, and H of FCC Part 90.210.

The output of the transmitter was connected to two high power attenuators. The attenuators were connected to a Spectrum Analyzer. See Figure 4 for test set-up.

The frequencies measured are as follows:

Channel No.	Base Frequency MHz
1	851.0125

A full scan from 5 MHz to 10 GHz was performed for Channel 1 851.0125 only.

3.3.4 Results

The M/A-Com OpenSky Cell Site Base Station meets the requirements of FCC Part 90.210 and Part 2.991 Emissions Mask and Spurious Emissions at Antenna Terminals.

3.4 Channel Spacing/Bandwidth

3.4.1 Equipment Used

Test Equipment		Asset #	Serial #	Cal Date
X	H/P E4401 Spectrum Analyzer	N/A	4895C76451	04/00
X	Narda 769-30 High Power Attenuator	284	03793	C.P.U.
X	Narda 769-20 High Power Attenuator	471	02951	C.P.U.

3.4.2 Test Conditions

The Channel Spacing/Bandwidth measurements of the OpenSky Cell Site Base Station were made inside a shielded room. The ambient temperature of the room was 20°C.

The OpenSky Cell Site Base Station was configured to operate in a normal full power transmit mode. The OpenSky Cell Site Base Station was set up and powered by 120V 60Hz for the test.

3.4.3 Test Method

The output of the OpenSky Cell Site Base Station was measured at four frequencies. The channel spacing and bandwidth were checked.

The output of the transmitter was connected to two high power attenuators. The attenuators were connected to a Spectrum Analyzer. See Figure 4 for test set-up.

The frequencies measured are as follows:

Channel No.	Base Frequency MHz
1	851.0125
2	851.0375
601	866.0125
602	866.0135

3.4.4 Results

The M/A-Com OpenSky Cell Site Base Station meets the requirements of FCC Part 90.209 Channel Spacing/Bandwidth.

3.5 Field Strength of Spurious Radiation Electromagnetic Emissions

3.5.1 Equipment Used

Test Equipment		Asset #	Serial #	Cal Date
X	Tektronix 496 Spectrum Analyzer	1	B010559	10/00
X	H/P E4401 Spectrum Analyzer	N/A	4895C76451	04/00
X	Rhode and Schwartz ESV Test Receiver	15	875931049	9/00
X	Hewlett Packard 8447D Pre Amp	4	2727A06065	01/00
X	EMCO 3120 Tuned Dipole Antenna B1	477	56	01/00
X	EMCO 3121 Tuned Dipole Antenna B2	478	176	01/00
X	EMCO 3121 Tuned Dipole Antenna B3	479	728	01/00
X	EMCO 3115 Microwave Horn Antenna	376	2796	01/00

3.5.2 Test Conditions

For radiated emissions testing, the EUT was set up above the turntable on a wooden table 10 meters from a tuned dipole antenna within Open Area Test Site B.

The OpenSky Cell Site Base Station was configured to operate in the full power mode of operation to maximize the emissions. The EUT was set up and powered by 120V 60Hz for radiated emission tests. The output of the OpenSky Cell Site Base Station was connected to a load. The worst case signals detected were recorded.

3.5.3 Test Method

The test method of ANSI C63.4 was followed. For the radiated emission measurements, a manual scan was performed from 30MHz to 10GHz. During this scan, the antenna, turntable and EUT's cable positions were manipulated to maximize the emission levels in a given frequency band displayed on the spectrum analyzer.

3.5.4 Results

The M/A-Com OpenSky Cell Site Base Station meets the FCC Part 2.993 Field Strength of Spurious Radiated Electromagnetic Emissions requirements.

3.6 Modulation Characteristics

The modulation characteristics of the audio filter were supplied by M/A-Com. They are attached in Appendix C.

3.7 Frequency Stability

3.7.1 Equipment Used

Test Equipment		Asset #	Serial #	Cal Date
X	H/P E4401 Spectrum Analyzer	N/A	4895C76451	04/00
X	Cincinnati Sub Zero ZH-32-2H/AC Temperature Chamber	544	Z09712530	05/00
X	Narda 769-30 High Power Attenuator	284	03793	C.P.U.
X	Narda 769-20 High Power Attenuator	471	02951	C.P.U.

3.7.2 Test Conditions

The Frequency Stability measurements of the OpenSky Cell Site Base Station were made inside a Temperature/Humidity Chamber and Test Site A.

The OpenSky Cell Site Base Station was configured to operate in a normal full power transmit mode. The OpenSky Cell Site Base Station was set up and powered by 120V 60Hz for the test.

3.7.3 Test Method

The output of the OpenSky Cell Site Base Station was measured at two frequencies. The frequency stability of the output was measured. The frequency selected was 851.0125 MHz.

With the OpenSky Cell Site Base Station in the temperature chamber, the output of the transmitter was connected to two high power attenuators. The attenuators were connected to a Spectrum Analyzer. See Figure 5 for test set-up.

The temperature was measured by placing a thermal couple on the RF chain. The Temperature was varied from -30° to +50°C in 10° steps. At each 10° step, the output of the OpenSky Cell Site Base Station was measured for frequency stability.

The OpenSky Cell Site Base Station was turned off between each 10° step. The OpenSky Cell Site Base Station was allowed two minutes for warm up before the frequency was measured.

The Input Voltage was controlled with the Elgar Power Source. The Input Voltage was varied from 90 to 140V 60Hz. The voltage was varied in 5V steps.

3.7.4 Results

The M/A-Com OpenSky Cell Site Base Station meets the Frequency Stability requirements of FCC Part 90.210 and Part 2.995.

3.8 Radiated Electromagnetic Emissions Receiver

3.8.1 Equipment Used

Test Equipment		Asset #	Serial #	Cal Date
X	Tektronix 496 Spectrum Analyzer	1	B010559	10/00
X	H/P E4401 Spectrum Analyzer	N/A	4895C76451	04/00
X	Rhode and Schwartz ESV Test Receiver	15	875931049	09/00
X	Hewlett Packard 8447D Pre Amp	4	2727A06065	01/00
X	EMCO 3120 Tuned Dipole Antenna B1	477	56	01/00
X	EMCO 3121 Tuned Dipole Antenna B2	478	176	01/00
X	EMCO 3121 Tuned Dipole Antenna B3	479	728	01/00
X	EMCO 3115 Microwave Horn Antenna	376	2796	01/00

3.8.2 Test Conditions

For radiated emissions testing, the EUT was set up above the turntable on a wooden table 10 meters from a tuned dipole antenna within Open Area Test Site B.

The OpenSky Cell Site Base Station was configured to operate in the non-transmitting mode of operation to maximize the emissions. The EUT was set up and powered by 120V 60Hz for radiated emission tests. The worst case signals detected were recorded.

3.8.3 Test Method

The test method of ANSI-C63.4 was followed for Class B equipment. For the radiated emission measurements, a manual scan was performed from 30MHz to 10GHz. During this scan, the antenna, turntable and EUT's cable positions were manipulated to maximize the emission levels in a given frequency band displayed on the spectrum analyzer.

3.8.4 Results

The M/A-Com OpenSky Cell Site Base Station meets the requirements for Radiated Emissions as required by FCC Part 15 Subpart B for Class B equipment.

3.9 Conducted Electromagnetic Emissions Receiver

3.9.1 Equipment Used

Test Equipment		Asset #	Serial #	Cal Date
X	Tektronix 496 Spectrum Analyzer	1	B010559	10/00
X	Rhode and Schwartz ESH-2 Test Receiver	16	8799631020	09/00
X	Polarad ESH2-25 Artificial Mains Network	23	890484/016	01/00

3.9.2 Test Conditions

Conducted emissions testing was performed with small devices placed on the table and with the test receiver connected to the Line Impedance Stabilization Network (LISN) or Artificial Mains Network.

The EUT was configured to operate in the non-transmit mode of operation to maximize the emissions. The OpenSky Cell Site Base Station was set up and powered by 120V 60Hz for conducted emission tests. The worst case signals detected were recorded.

3.9.3 Test Method

The test method of ANSI-C63.4 was followed for Class B equipment. For conducted emissions testing, a manual scan was performed from 450kHz to 30MHz with the EUT powered through the Artificial Mains Network.

3.9.4 Results

The M/A-Com OpenSky Cell Site Base Station meets the requirements for Conducted Emissions as required by FCC Part 15 Subpart B for Class B equipment.

3.10 Radiated Field Strength of F_o & Harmonics of 2.4GHz Transmitter

3.10.1 Equipment Used

Test Equipment		Asset #	Serial #	Cal Date
X	Tektronix 496 Spectrum Analyzer	1	B010559	10/00
X	H/P E4401 Spectrum Analyzer	N/A	4895C76451	04/00
X	Rhode and Schwartz ESV Test Receiver	15	875931049	09/00
X	Hewlett Packard 8447D Pre Amp	4	2727A06065	01/00
X	EMCO 3120 Tuned Dipole Antenna B1	477	56	01/00
X	EMCO 3121 Tuned Dipole Antenna B2	478	176	01/00
X	EMCO 3121 Tuned Dipole Antenna B3	479	728	01/00
X	EMCO 3115 Microwave Horn Antenna	376	2796	01/00

3.10.2 Test Conditions

The OpenSky Cell Site Base Station was up above the turntable on a wooden table 3 meters from a tuned dipole antenna within Open Area Test Site A.

The OpenSky Cell Site Base Station was configured to operate in the non-transmitting mode of operation to maximize the emissions. The EUT was set up and powered by 120V 60Hz for radiated emission tests. The worst case signals detected were recorded.

3.10.3 Test Method

The test method of ANSI-C63.4 was followed. For the radiated emission measurements of the fundamental and harmonics a manual scan was performed from 30MHz to 26.4GHz. During this scan, the antenna, turntable and EUT's cable positions were manipulated to maximize the emission levels in a given frequency band displayed on the spectrum analyzer.

3.10.4 Results

The M/A-Com OpenSky Cell Site Base Station meets the requirements for FCC Part 15 Subpart C 15.249.

3.11 Radiated Electromagnetic Emissions Receiver

3.11.1 Equipment Used

Test Equipment		Asset #	Serial #	Cal Date
X	Tektronix 496 Spectrum Analyzer	1	B010559	10/00
X	H/P E4401 Spectrum Analyzer	N/A	4895C76451	04/00
X	Rhode and Schwartz ESV Test Receiver	15	875931049	09/00
X	Hewlett Packard 8447D Pre Amp	4	2727A06065	01/00
X	EMCO 3120 Tuned Dipole Antenna B1	477	56	01/00
X	EMCO 3121 Tuned Dipole Antenna B2	478	176	01/00
X	EMCO 3121 Tuned Dipole Antenna B3	479	728	01/00
X	EMCO 3115 Microwave Horn Antenna	376	2796	01/00

3.11.2 Test Conditions

For radiated emissions testing, the EUT was set up above the turntable on a wooden table 3 meters from a tuned dipole antenna within Open Area Test Site B.

The OpenSky Cell Site Base Station was configured to operate in the non-transmitting mode of operation to maximize the emissions. The EUT was set up and powered by 120V 60Hz for radiated emission tests. The worst case signals detected were recorded.

3.11.3 Test Method

The test method of ANSI-C63.4 was followed for Class B equipment. For the radiated emission measurements, a manual scan was performed from 30MHz to 26.4GHz. During this scan, the antenna, turntable and EUT's cable positions were manipulated to maximize the emission levels in a given frequency band displayed on the spectrum analyzer.

3.11.4 Results

The M/A-Com OpenSky Cell Site Base Station meets the requirements for Radiated Emissions as required by FCC Part 15 Subpart B for Class B equipment.

APPENDIX A

TEST DATA

CHANNEL SPACING

CUSTOMER: M/A-COM
EQUIPMENT: OPENSKY CELL SITE BASE STATION
TESTED BY: ROBERT FOSTER

DATE: 1/14/00
TEST NUMBER: N/A
OPERATING MODE: FULL POWER

Frequency MHz	Measured Spacing kHz	6dB Bandwidth kHz
Channel 1 851.0128	24.9KHz	15kHz
Channel 2 851.0377		15kHz
Channel 601 866.0128	11.5kHz	15kHz
Channel 602 866.0137		14kHz

FREQUENCY STABILITY
Temperature vs. Frequency

CUSTOMER: M/A-COM
EQUIPMENT: OPENSKY CELL SITE BASE STATION
TESTED BY: ROBERT FOSTER
TEST SPEC: PART 2.1055

DATE: 12/7/00
TEST NUMBER: N/A
OPERATING MODE: FULL POWER

Center Frequency 851.0126 MHz at 20°C

Temperature	Frequency MHz
-30°C	851.0126
-20°C	851.0127
-10°C	851.0126
0°C	851.0124
10°C	851.0129
20°C	851.0126
30°C	851.0128
40°C	851.0127
50°C	851.0126

Maximum Deviation 30Hz at 10°C

FREQUENCY STABILITY
Input Voltage vs. Frequency

CUSTOMER: M/A-COM
EQUIPMENT: OPENSKY CELL SITE BASE STATION
TESTED BY: ROBERT FOSTER
TEST SPEC: PART 2.1055

DATE: 12/7/00
TEST NUMBER: N/A
OPERATING MODE: FULL POWER

Center Frequency 851.0126 MHz at 120V 60Hz

Temperature	Frequency MHz
90	851.0126
95	851.0126
100	851.0126
105	851.0127
110	851.0128
120	851.0126
125	851.0128
130	851.0127
135	851.0125
140	851.0126

Maximum Deviation 20Hz at 10°C

OUTPUT POWER

CUSTOMER: M/A-COM **DATE: 1/13/00**
EQUIPMENT: OPENSKY CELL SITE BASE STATION **TEST NUMBER: N/A**
TESTED BY: ROBERT FOSTER **OPERATING MODE: FULL POWER**

Channel No.	Base Frequency MHz	Output Power dB
1	851.0125	43.5
600	865.9875	43.8
601	866.0125	43.7
830	868.9875	43.7

OCCUPIED BANDWIDTH
Part 2.989

CUSTOMER: M/A-COM **DATE: 12/27/99**
EQUIPMENT: OPENSKY CELL SITE BASE STATION **TEST NUMBER: N/A**
TESTED BY: ROBERT FOSTER **OPERATING MODE: FULL POWER**

0.5% of Lower and 99% of Upper

Channel No.	Base Frequency MHz	Occupied Bandwidth
1	851.0125	Within Spec.
300	858.0125	Within Spec
600	865.9875	Within Spec
601	866.0125	Within Spec
715	867.5125	Within Spec
830	868.9875	Within Spec

RADIATED E FIELD EMISSION MEASUREMENTS

CUSTOMER: M/A-COM
EQUIPMENT: OPENSKY CELL SITE BASE STATION
TESTED BY: R. FOSTER
OPERATING MODE: TRANSMIT INTO LOAD

BANDWIDTH: [X] 100 KHZ (PEAK)/120 KHZ (QP)
OTHER (SPECIFY)
FREQUENCY RANGE: [X] 30MHZ – 1 GHZ

DATE: 1/12/00
TEST NUMBER: N/A
COUPLING DEVICE: EMCO 3121, 3115, EATON HORN
TEST SPEC: FCC PART 15 & 90 OPEN FIELD EMISSIONS
PROCEDURE: ANSI C63.4

ANTENNA DISTANCE: [X] 3 METERS [ ] 10 METERS

FREQUENCY MHZ	PEAK MEASURED LEVEL -dBm	QUASI-PEAK MEASURED LEVEL dBuV	ANTENNA HEIGHT (METERS)	TURNTABLE AZIMUTH (DEGREES)	ANTENNA H/V	ANTENNA FAC/CABLE LOSS dB	FIELD LEVEL dBuV/m **	LIMIT dBuV/m (QP)
50	-	19	2.2	0	V	6.6	25.6	40
53	-	17	2.2	0	V	6.9	23.9	40
55	-	16	2.2	0	V	7.2	23.2	40
130	-	16	1.7	90	V	13.4	29.4	43.5
132	-	26	1.7	90	V	13.5	39.5	43.5
200	-	21	1.0	45	V	17.6	38.6	43.5
865	-	30	1.0	45	V	8.5	38.5	46
1730	81	-	1.0	45	V	12.6	39.6	54

**** All signals greater than 3dB from the limit are calculate to the nearest whole number.**
**** Field Level (dBuV/m) = [107 – Measured level (dBm)] + Antenna Factor/Cable Loss (dB)**
Ambient Temperature: 72°F Humidity: 30% Atmospheric Pressure: 29.8″

CONDUCTED EMISSION MEASUREMENTS

CUSTOMER: MA/COM
EQUIPMENT: OPENSKY CELL SITE
TESTED BY: ROBERT FOSTER
OPERATING MODE: FULL POWER
BANDWIDTH: [ ] 200 KHZ [X] 9 KHZ [ ] 10 KHZ

DATE: 1/12/00
TEST NUMBER: N/A
COUPLING DEVICE: POLARAD LISN
TEST SPEC: EN55022 FCC PART 15 CLASS B
PROCEDURE: ANSI C63.4

FREQUENCY RANGE: [ ] 10 KHZ – 30 MHZ
[ ] 150 KHZ – 30 MHZ [X] 450 KHZ – 30 MHZ
OTHER (SPECIFY)
110/208 V AC [X] 240V AC [ ] OTHER [ ]

50 HZ [ ] 60 HZ [X]SINGLE Ø [X] 3Ø [ ]

FREQUENCY MHZ	PEAK MEASURED LEVEL dBuV				AVERAGE MEASURED LEVEL dBuV				QUASI-PEAK MEASURED LEVEL dBuV				LIMIT dBuV	
	AØ	BØ	CØ	NØ	AØ	BØ	CØ	NØ	AØ	BØ	CØ	NØ	Average	Quasi-Peak
0.48									42			42		48
0.78									44			44		48
1.1									44			44		48
1.2									42			42		48
1.4									41			41		48
1.8									41			41		48
2.0									37			37		48
4.0									37			37		48
7.0									39			39		48
8.0									38			38		48
10.0									34			34		48

✱ All signals greater than 3dB from the limit are calculated to the nearest whole number.
Ambient Temperature: 72°F Humidity: 30% Atmospheric Pressure: 29.8″

RADIATED FIELD STRENGTH of F_o and HARMONICS

CUSTOMER: M/A-COM
EQUIPMENT: OPENSKY CELL SITE BASE STATION
TESTED BY: R. FOSTER
OPERATING MODE: TRANSMIT INTO LOAD

BANDWIDTH: [X] 100 KHZ (PEAK)/120 KHZ (QP)
OTHER (SPECIFY)
FREQUENCY RANGE: [X] 30MHZ – 1 GHZ

DATE: 1/12/00
TEST NUMBER: N/A
COUPLING DEVICE: EMCO 3121, 3115, EATON HORN
TEST SPEC: FCC PART 15 & 90 OPEN FIELD EMISSIONS
PROCEDURE: ANSI C63.4

ANTENNA DISTANCE: [X] 3 METERS [ ] 10 METERS

FREQUENCY MHZ	AVERAGE MEASURED LEVEL dBuV	QUASI-PEAK MEASURED LEVEL dBuV	ANTENNA HEIGHT (METERS)	TURNTABLE AZIMUTH (DEGREES)	ANTENNA H/V	ANTENNA FAC/CABLE LOSS dB	FIELD LEVEL dBuV/m **	LIMIT dBuV/m (QP)
2.438	42	-	1	0	V	27.9	69.7	74
4.876	15	-	1	0	V	35	50	54
7.314	10	-	1	0	V	35	45	54
9.752	10	-	1	0	V	37	47	54

**** All signals greater than 3dB from the limit are calculate to the nearest whole number.**
**** Field Level (dBuV/m) = [107 – Measured level (dBm)] + Antenna Factor/Cable Loss (dB)**
Ambient Temperature: 72°F Humidity: 30% Atmospheric Pressure: 29.8″

RADIATED E FIELD EMISSION 2.4GHz RECEIVER

CUSTOMER: M/A-COM
EQUIPMENT: OPENSKY CELL SITE BASE STATION
TESTED BY: R. FOSTER
OPERATING MODE: TRANSMIT INTO LOAD

BANDWIDTH: [X] 100 KHZ (PEAK)/120 KHZ (QP)
OTHER (SPECIFY)
FREQUENCY RANGE: [X] 30MHZ – 1 GHZ

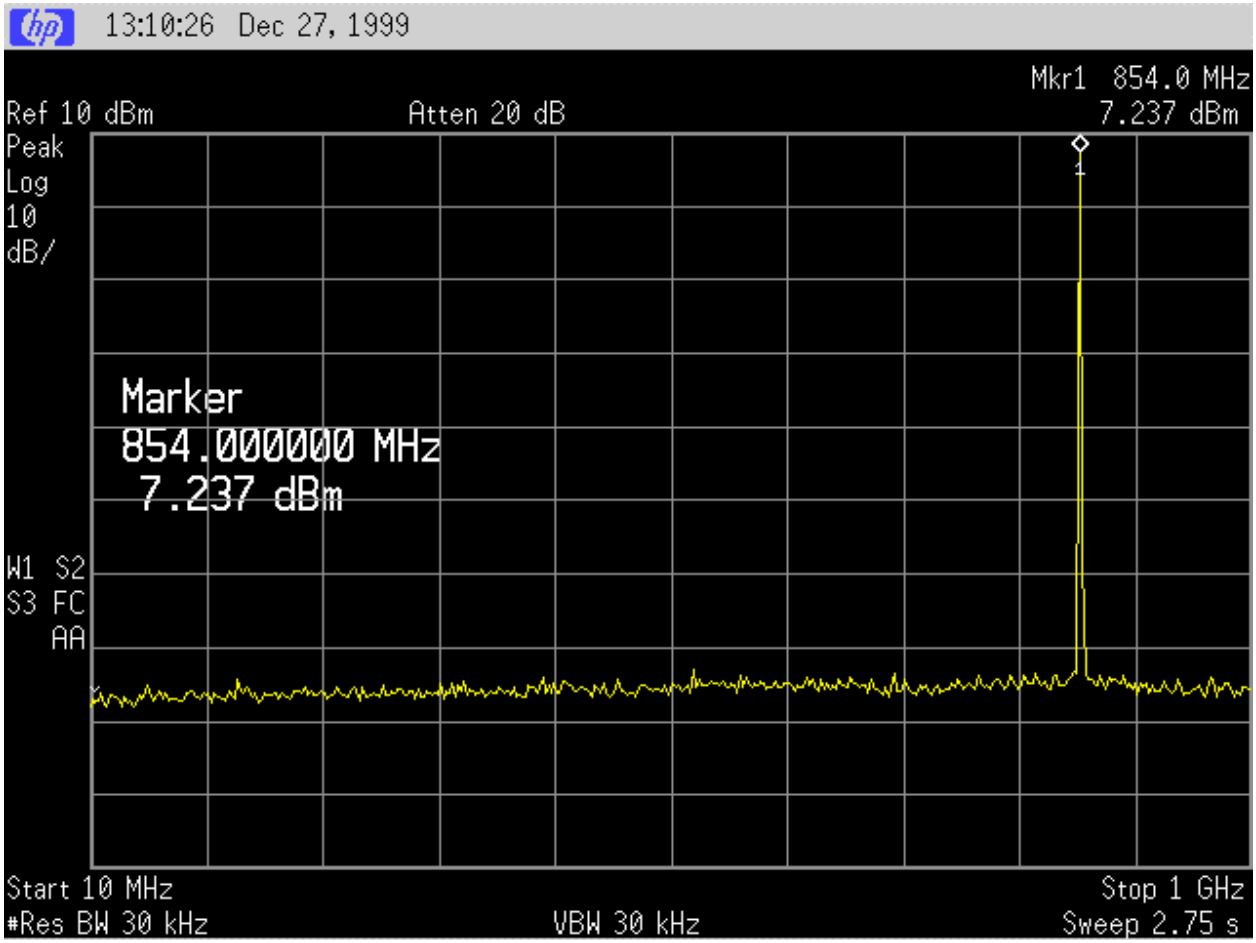
DATE: 1/12/00
TEST NUMBER: N/A
COUPLING DEVICE: EMCO 3121, 3115, EATON HORN
TEST SPEC: FCC PART 15 & 90 OPEN FIELD EMISSIONS
PROCEDURE: ANSI C63.4

ANTENNA DISTANCE: [X] 3 METERS [ ] 10 METERS

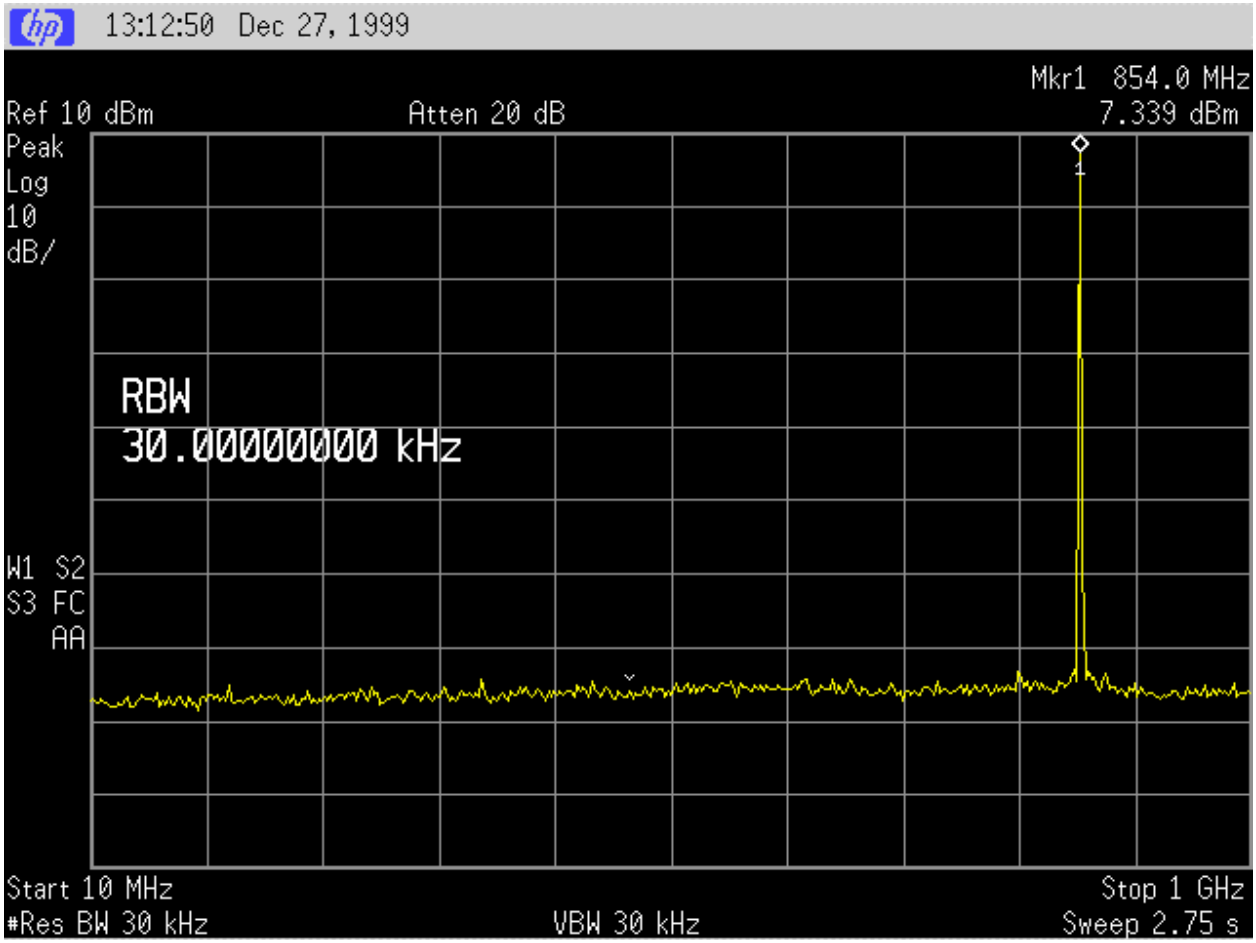
FREQUENCY MHZ	PEAK MEASURED LEVEL -dBm	QUASI-PEAK MEASURED LEVEL dBuV	ANTENNA HEIGHT (METERS)	TURNTABLE AZIMUTH (DEGREES)	ANTENNA H/V	ANTENNA FAC/CABLE LOSS dB	FIELD LEVEL dBuV/m **	LIMIT dBuV/m (QP)
50	-	19	2.2	0	V	6.6	25.6	40
53	-	17	2.2	0	V	6.9	23.9	40
55	-	16	2.2	0	V	7.2	23.2	40
130	-	16	1.7	90	V	13.4	29.4	43.5
132	-	26	1.7	90	V	13.5	39.5	43.5
200	-	21	1.0	45	V	17.6	38.6	43.5
865	-	30	1.0	45	V	8.5	38.5	46
1730	81	-	1.0	45	V	12.6	39.6	54

**** All signals greater than 3dB from the limit are calculate to the nearest whole number.**
**** Field Level (dBuV/m) = [107 – Measured level (dBm)] + Antenna Factor/Cable Loss (dB)**
Ambient Temperature: 72°F Humidity: 30% Atmospheric Pressure: 29.8″

Output of OpenSky Cell Site. Mask B, H, &G



Output of OpenSky Cell Site. Mask B, H, &G



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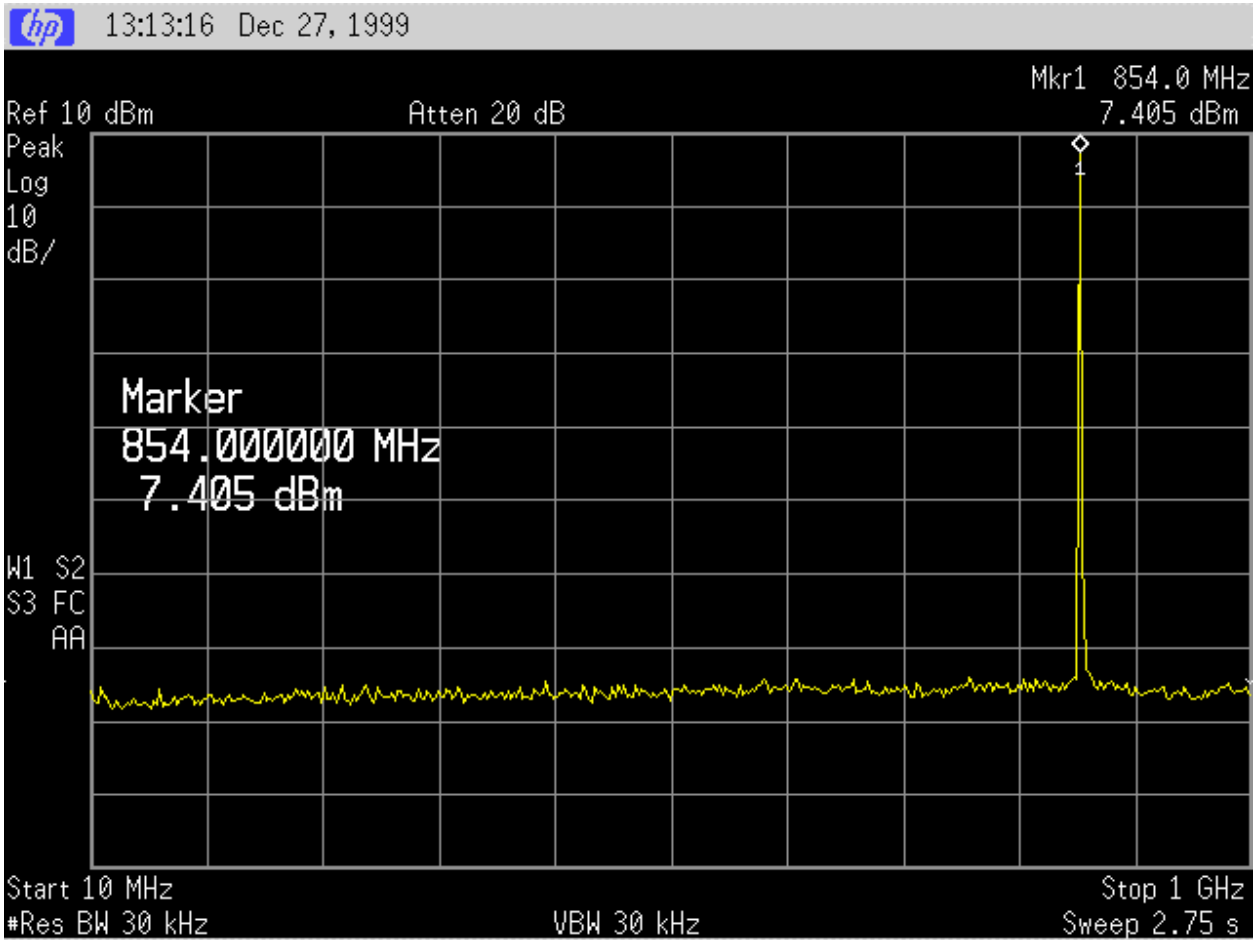

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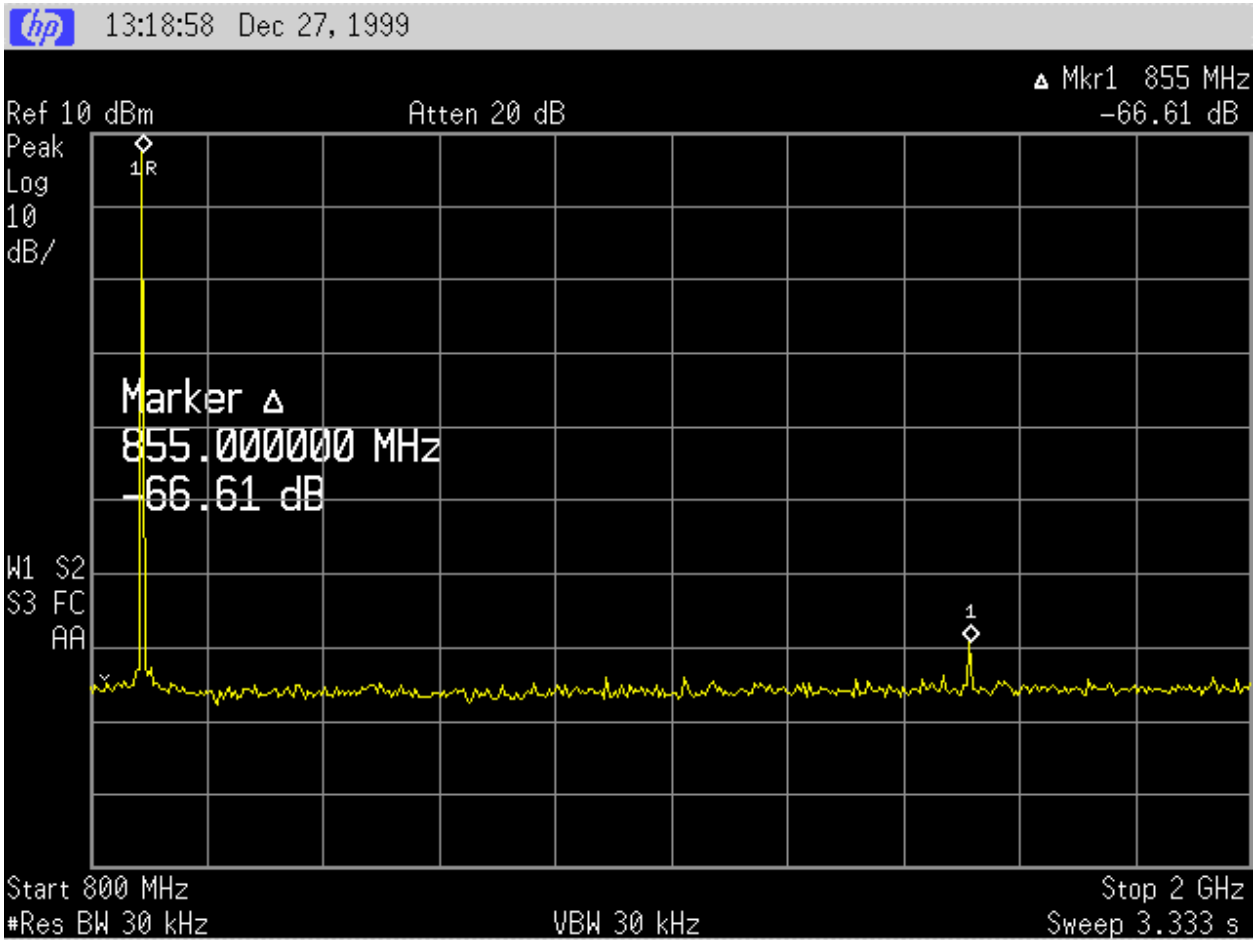

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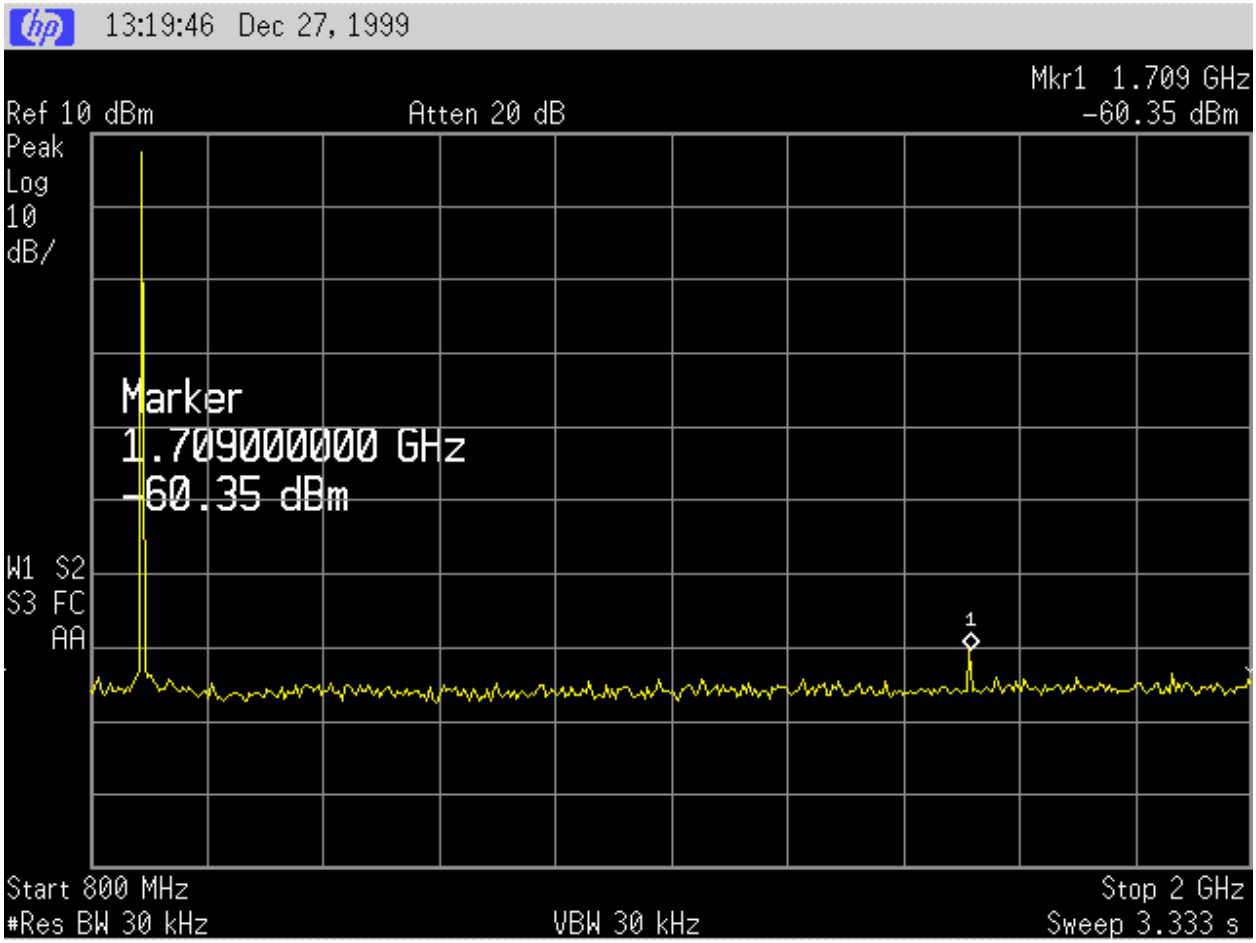
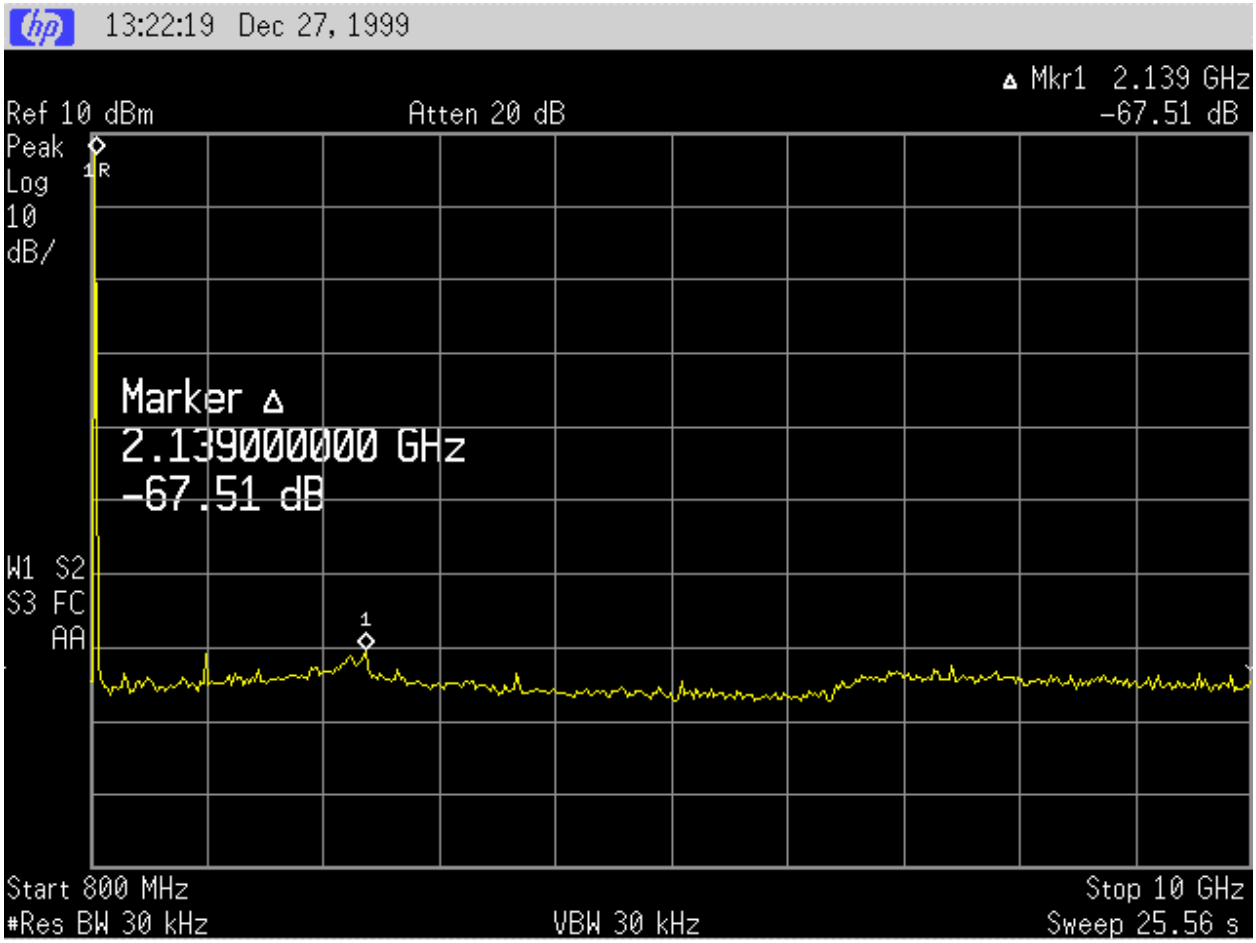
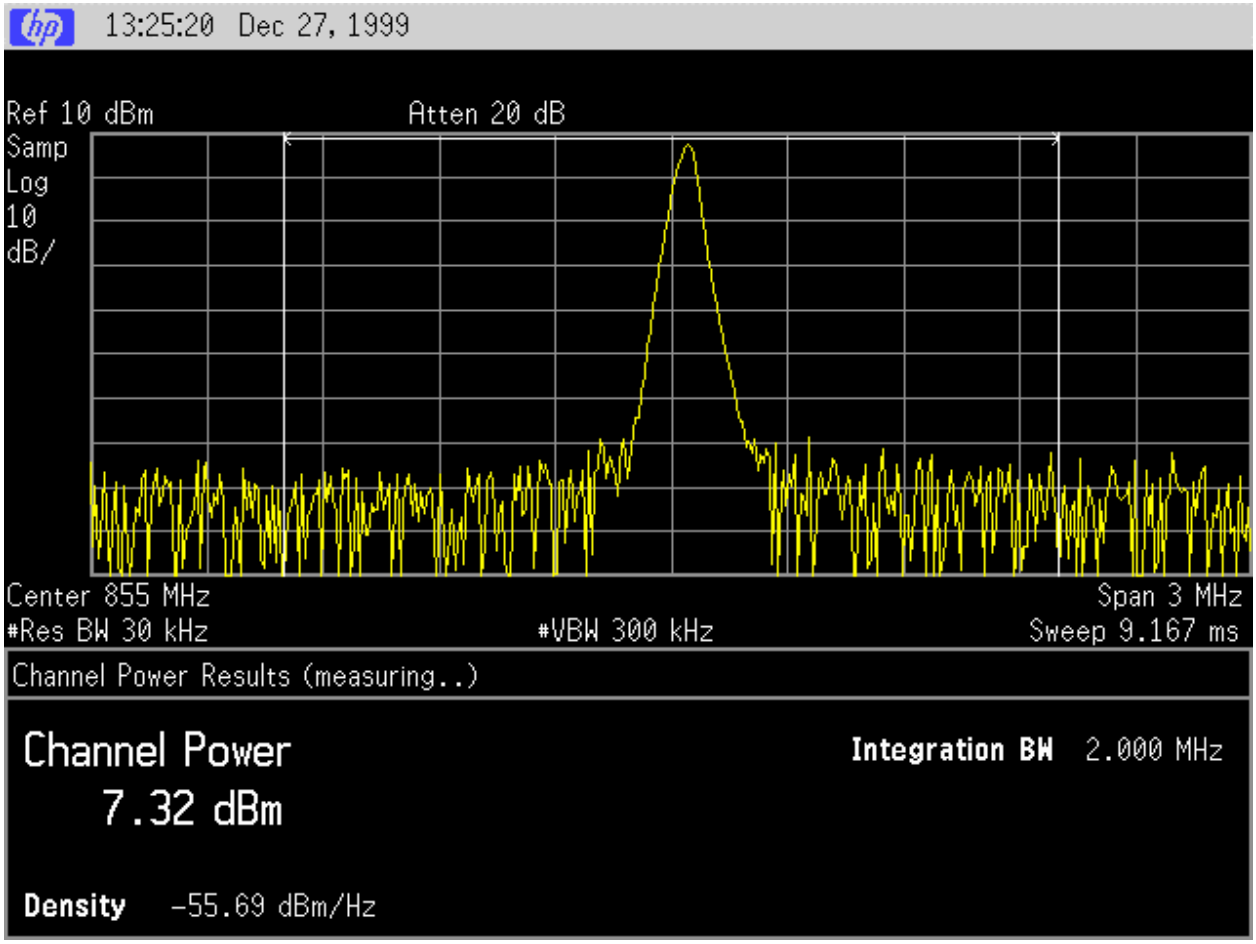


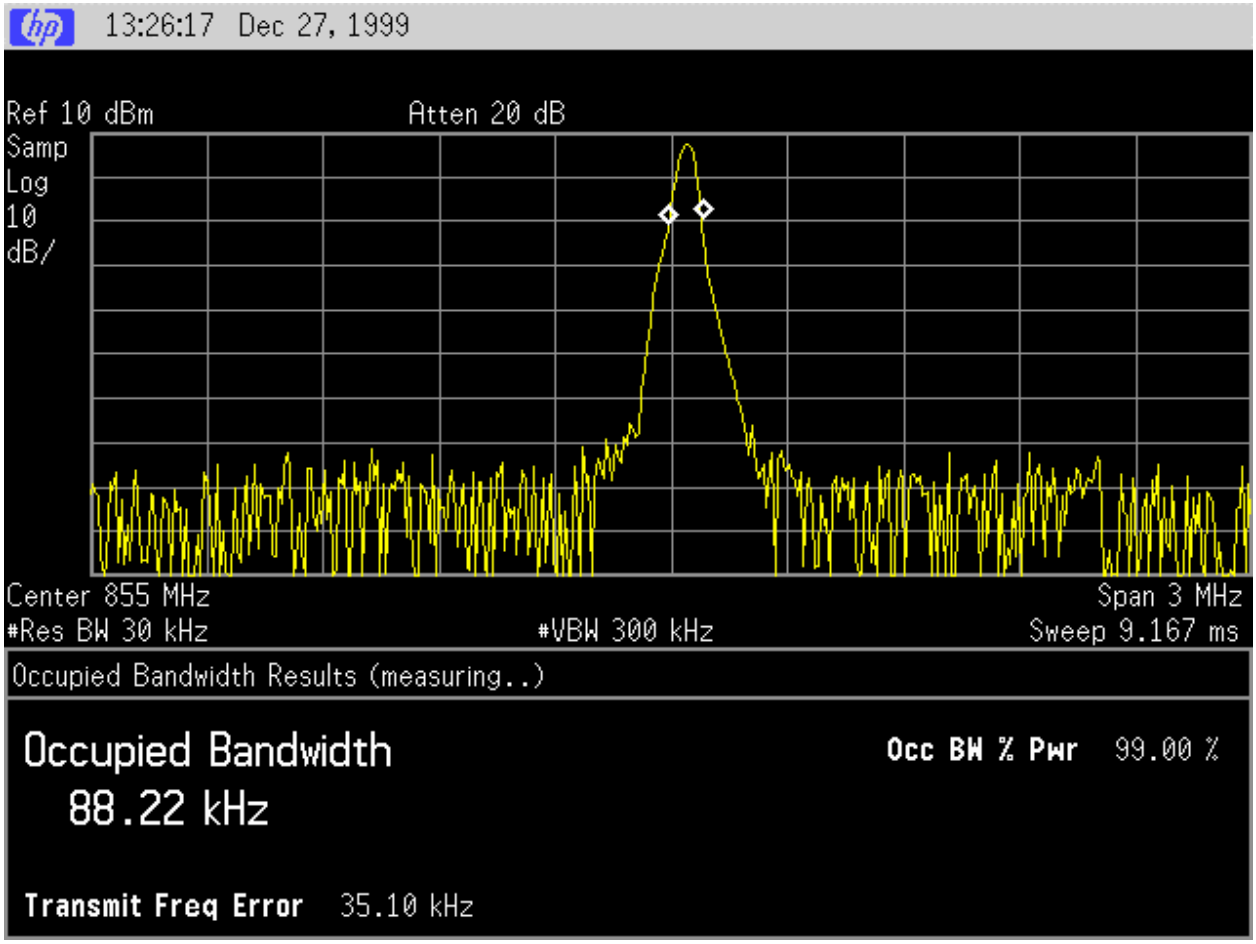
Output of OpenSky Cell Site. Mask B, H, &G



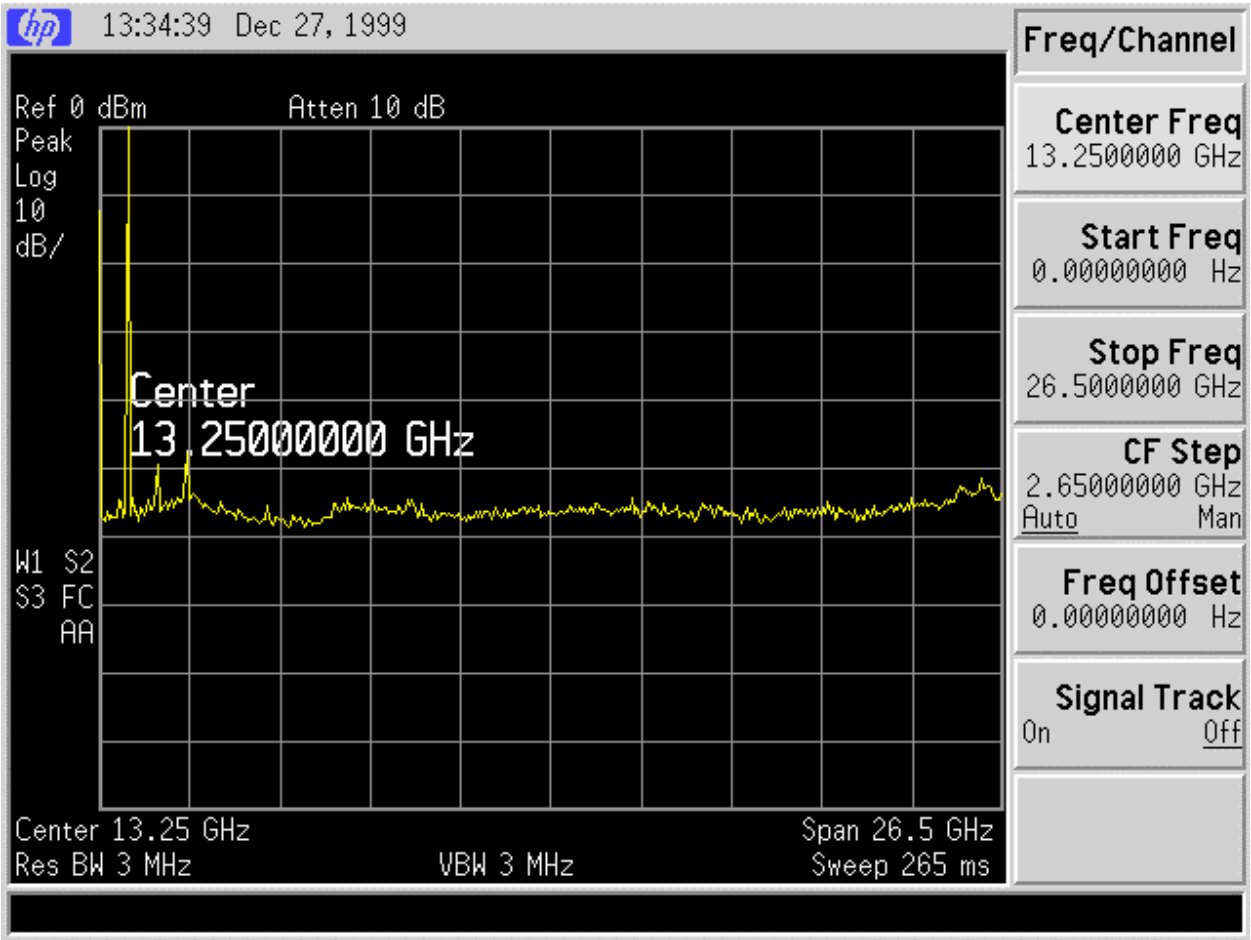
Channel Power of OpenSky Cell Site



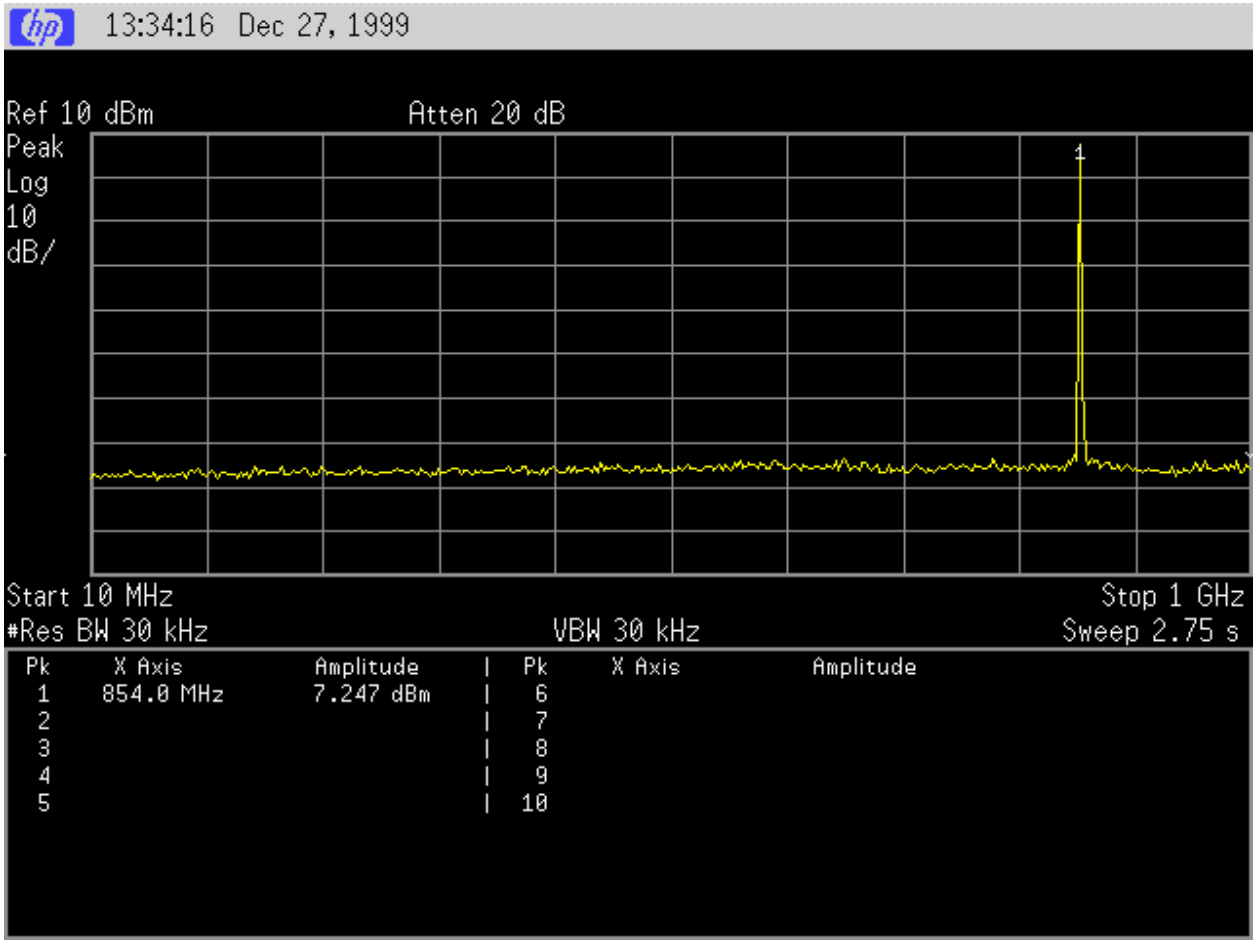
Percent Power with in Occupied Bandwidth of OpenSky Cell Site



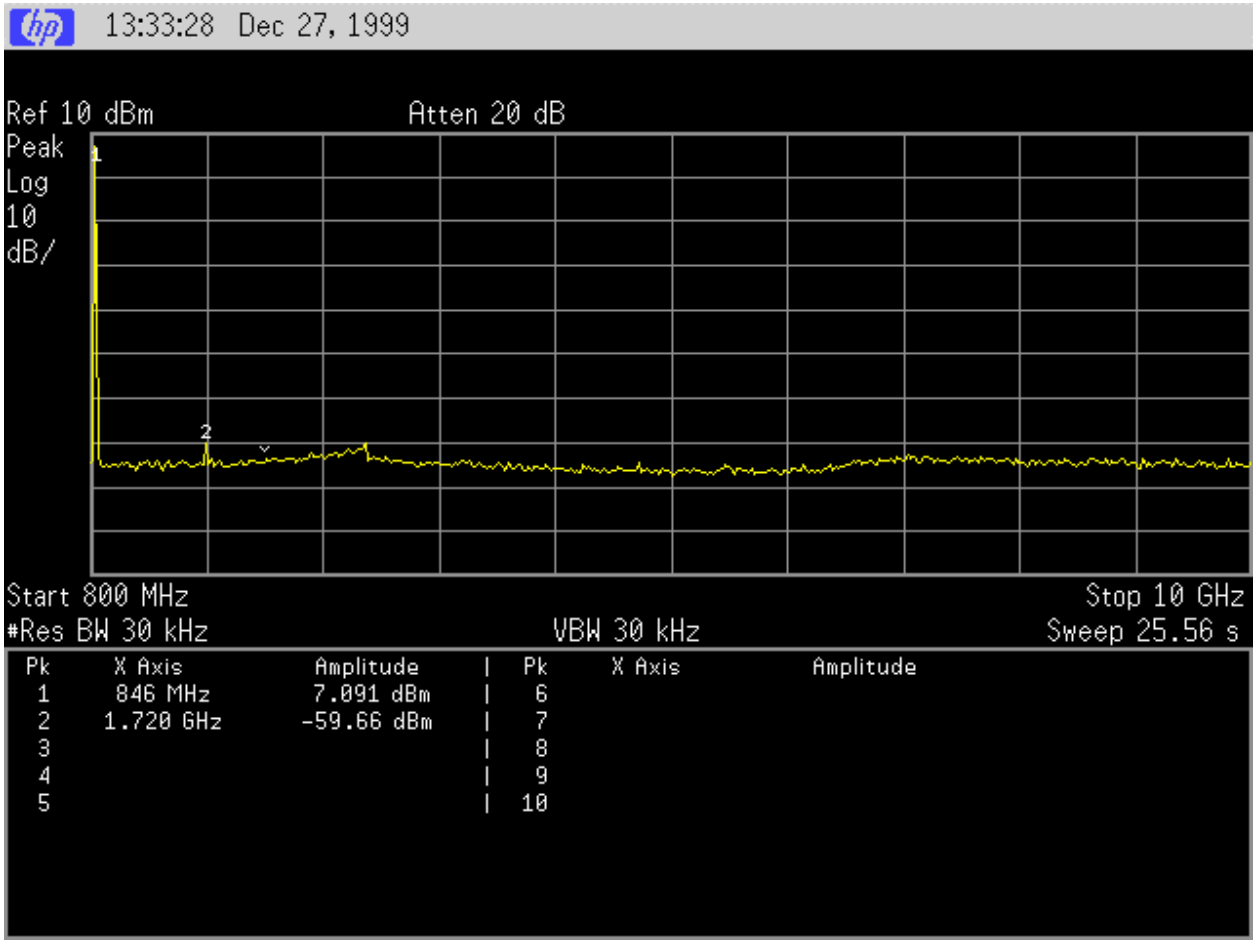
Output of OpenSky Cell Site. Mask B, H, &G



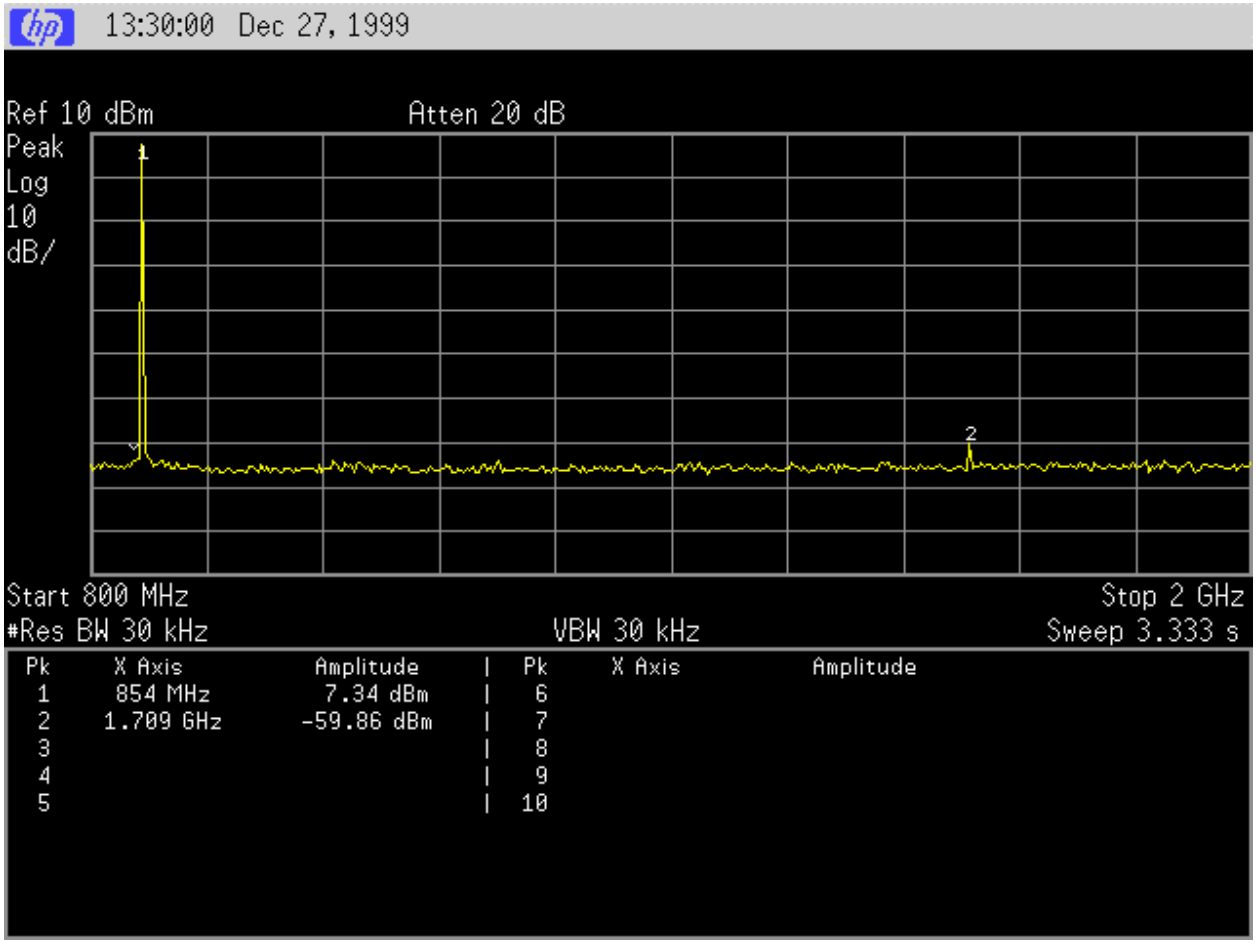
Output of OpenSky Cell Site. Mask B, H, &G



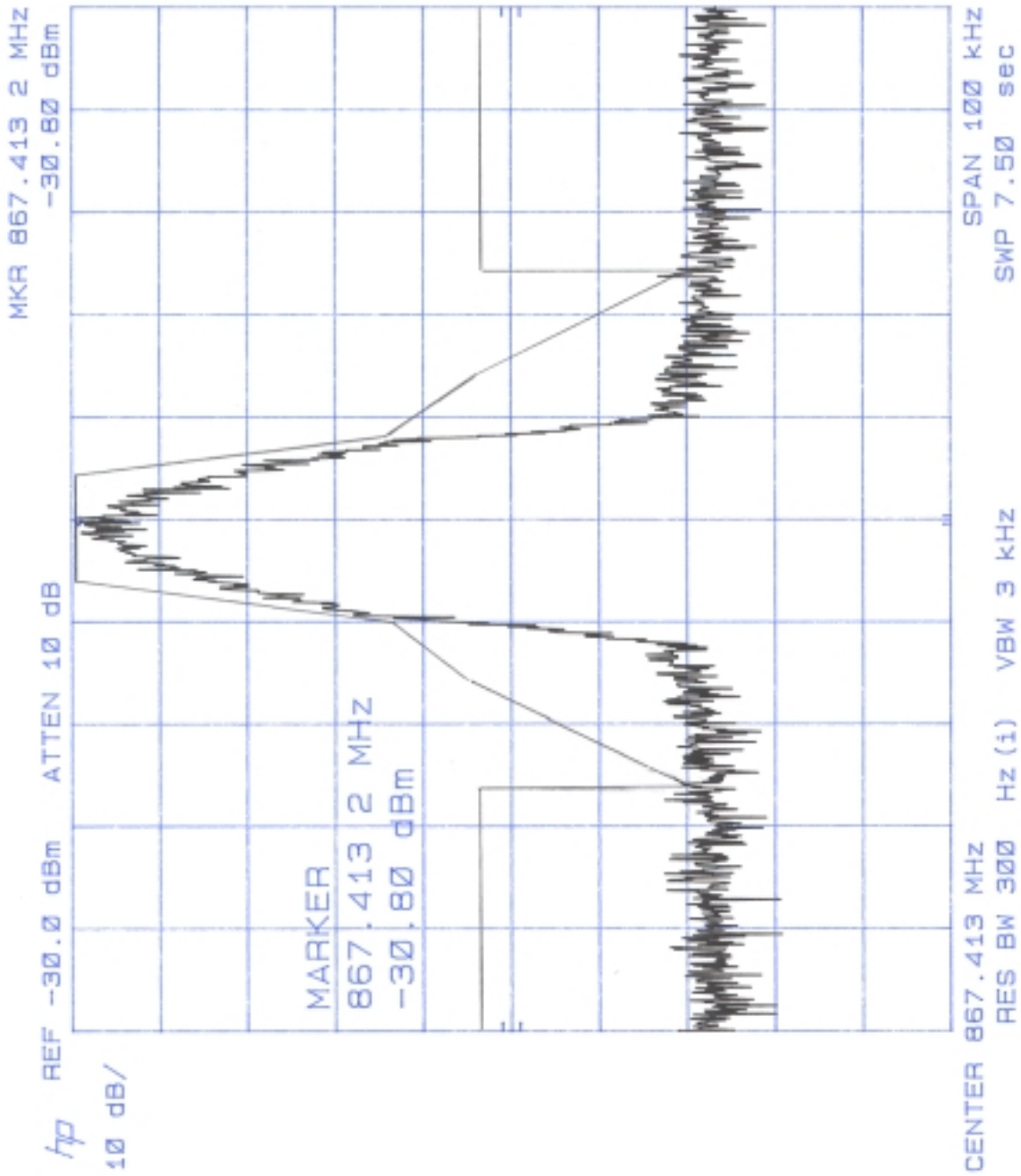
Output of OpenSky Cell Site. Mask B, H, &G



Output of OpenSky Cell Site. Mask B, H, &G

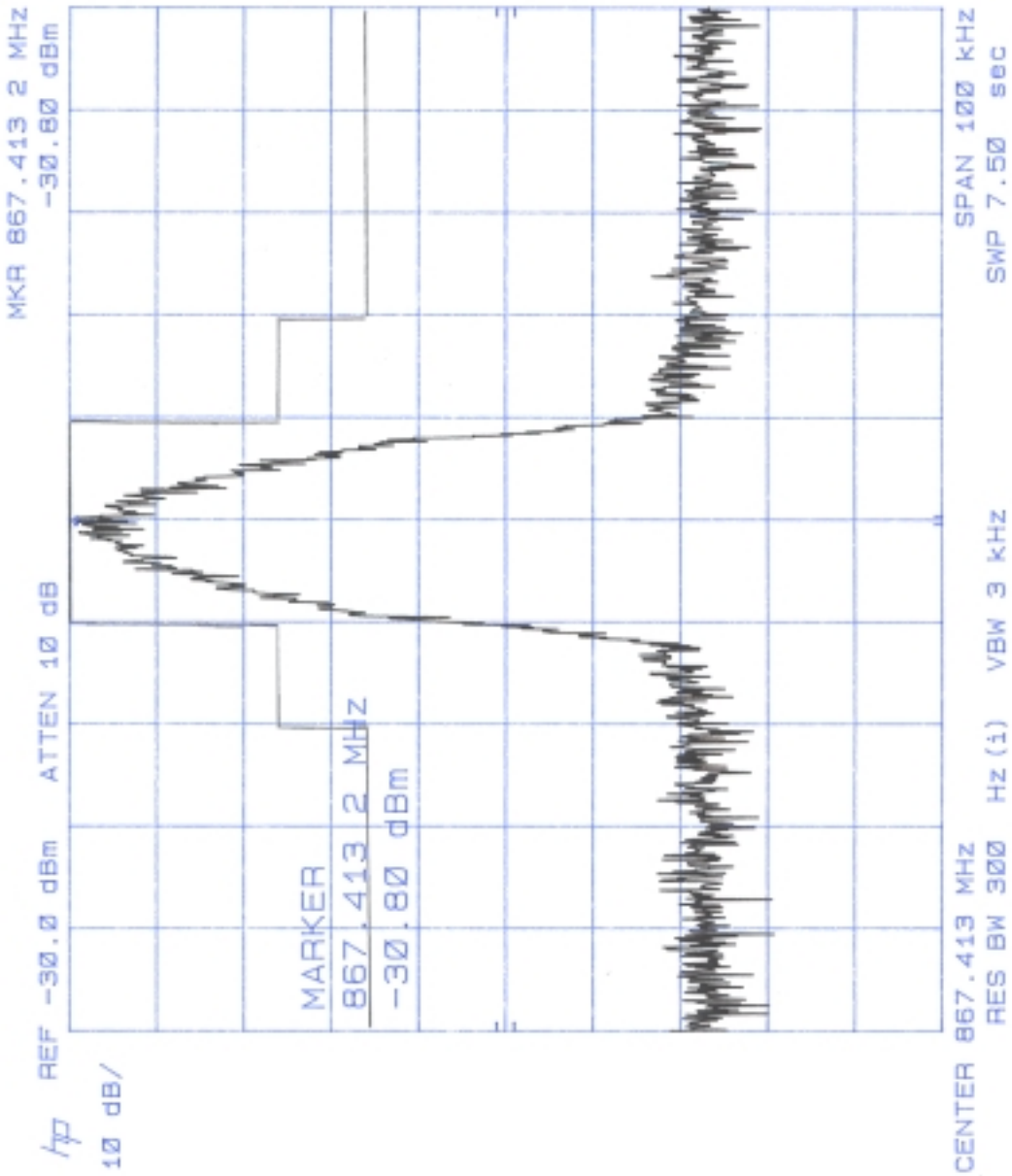


Output of OpenSky Cell Site. Mask H

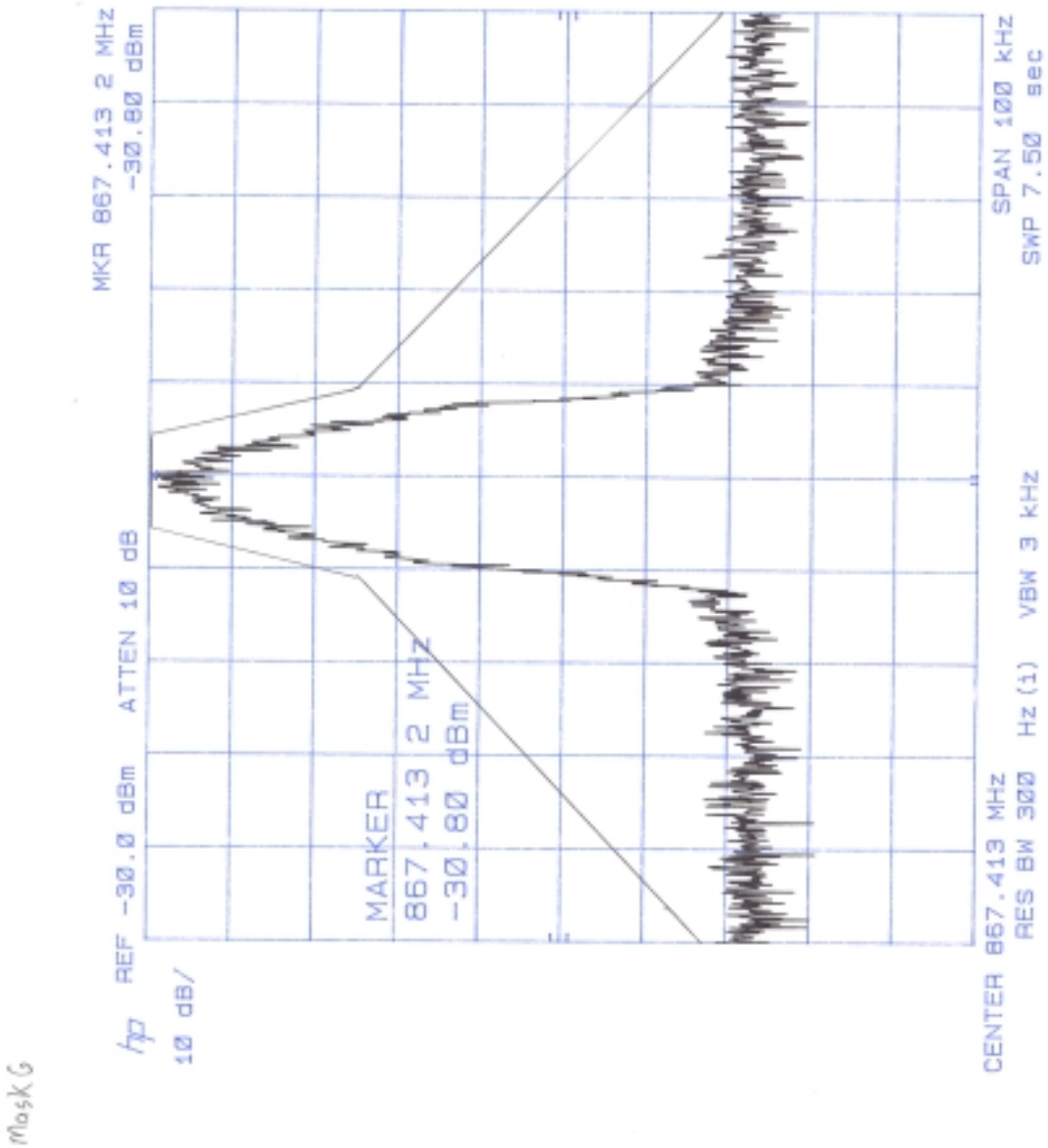


Mask H

Output of OpenSky Cell Site. Mask B



Output of OpenSky Cell Site. Mask G



APPENDIX B

SET-UP PHOTOGRAPHS

PHOTOGRAPHIC DOCUMENTATION

CUSTOMER: M/A-COM
EQUIPMENT: OPENSKY CELL SITE BASE STATION
TESTED BY: ROBERT FOSTER
OPERATING MODE: FULL LOAD

DATE: 1/12/00
TEST NUMBER: N/A
COUPLING DEVICE: EMCO 3121,3115, EATON HORN
TEST SPEC: FCC PART 15 SUBPART C

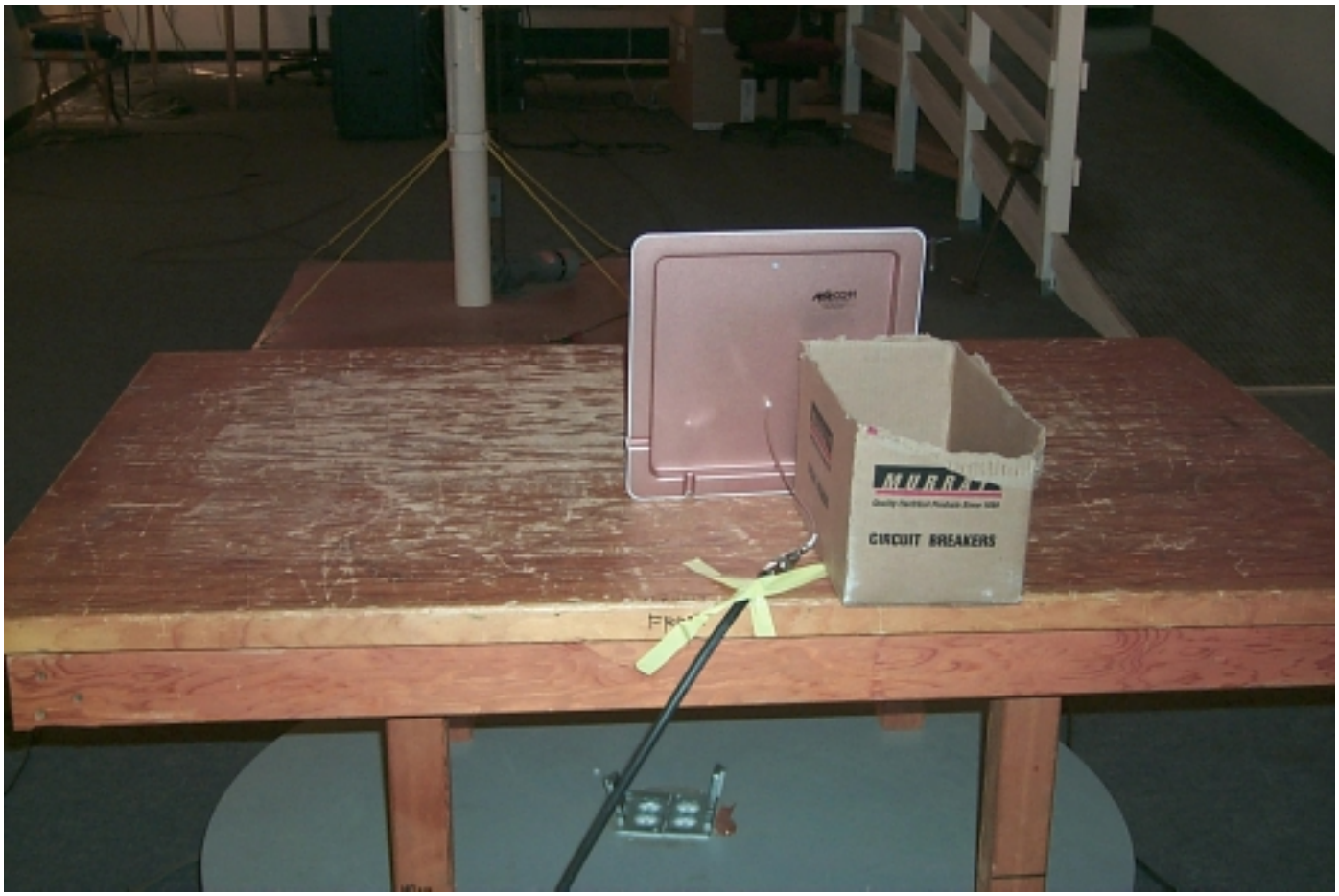
Photograph Description: Test Setup

FORM CTS PHOTO

PHOTOGRAPHIC DOCUMENTATION

CUSTOMER: M/A-COM
EQUIPMENT: OPENSKY CELL SITE BASE STATION
TESTED BY: ROBERT FOSTER
OPERATING MODE: FULL LOAD

DATE: 1/12/00
TEST NUMBER: N/A
COUPLING DEVICE: EMCO 3121,3115, EATON HORN
TEST SPEC: FCC PART 15 SUBPART C



Photograph Description: Test Setup

FORM CTS PHOTO

PHOTOGRAPHIC DOCUMENTATION

CUSTOMER: M/A-COM
EQUIPMENT: OPENSKY CELL SITE BASE STATION
TESTED BY: ROBERT FOSTER
OPERATING MODE: FULL LOAD

DATE: 1/12/00
TEST NUMBER: N/A
COUPLING DEVICE: EMCO 3121,3115, EATON HORN
TEST SPEC: FCC PART 90

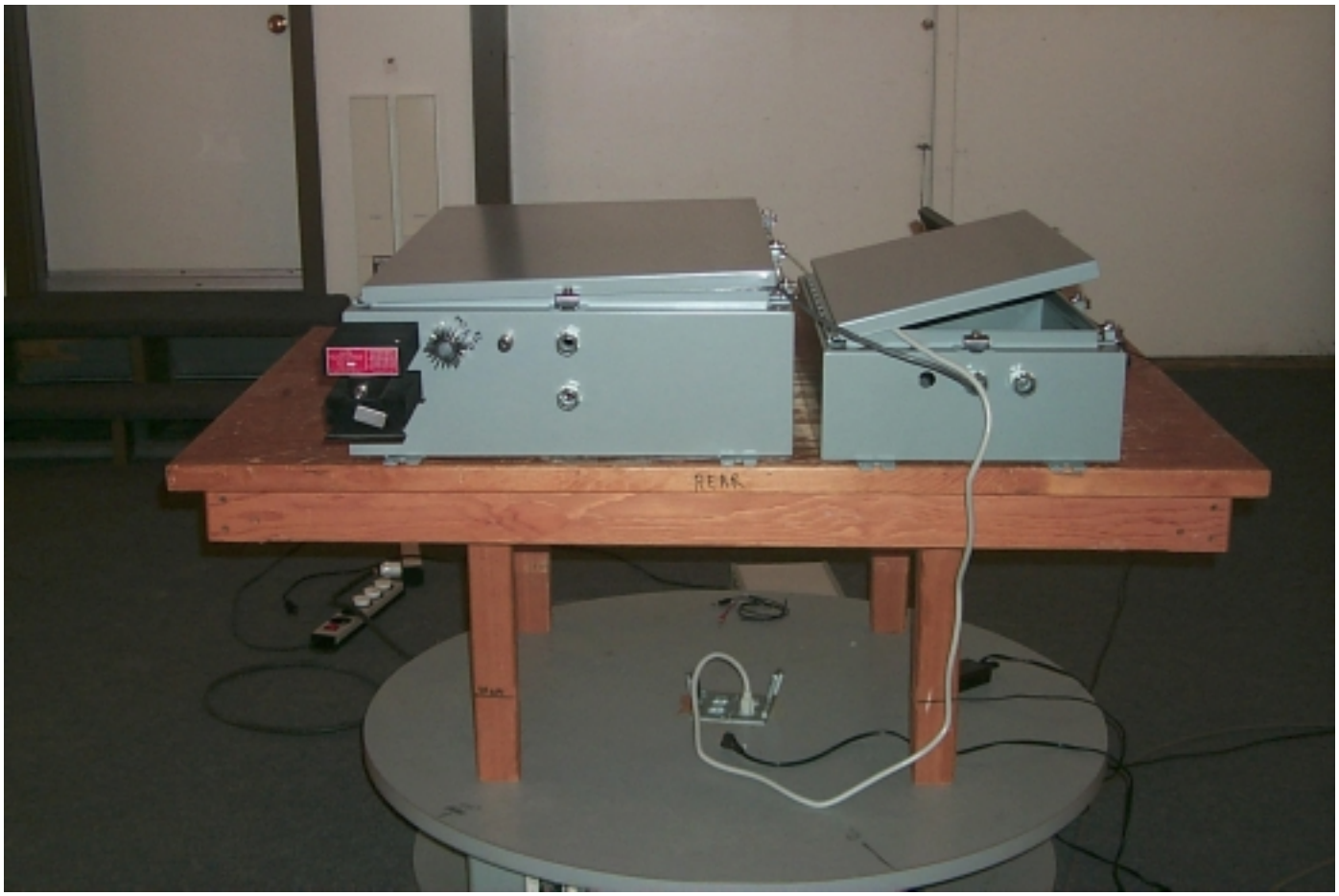
Photograph Description: Test Setup

FORM CTS PHOTO

PHOTOGRAPHIC DOCUMENTATION

CUSTOMER: M/A-COM
EQUIPMENT: OPENSKY CELL SITE BASE STATION
TESTED BY: ROBERT FOSTER
OPERATING MODE: FULL LOAD

DATE: 1/12/00
TEST NUMBER: N/A
COUPLING DEVICE: EMCO 3121,3115, EATON HORN
TEST SPEC: FCC PART 90



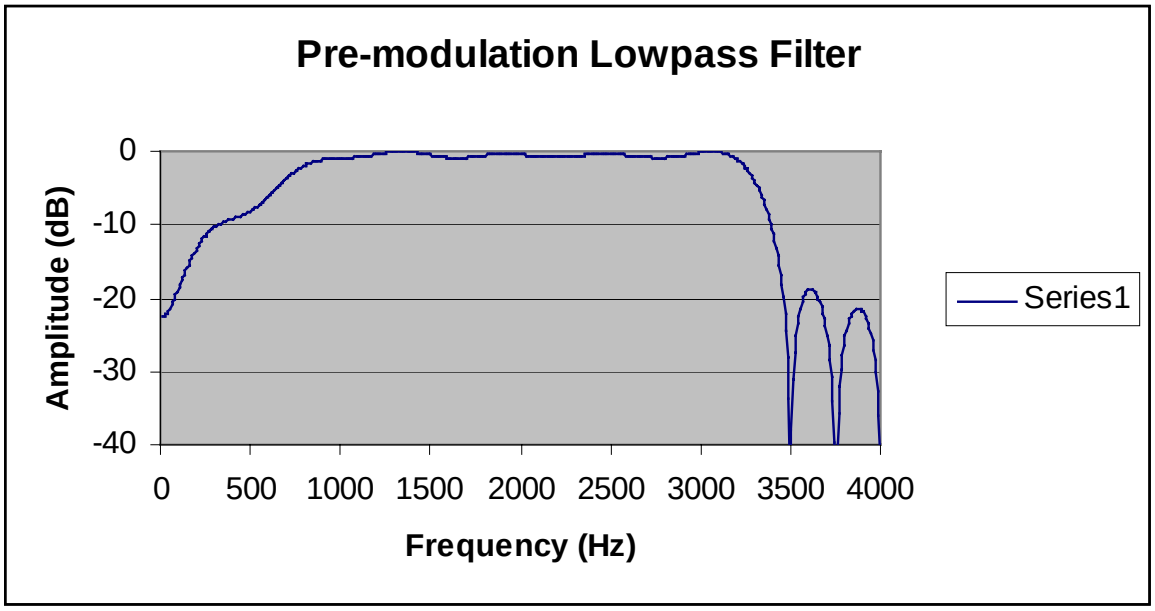
Photograph Description: Test Setup

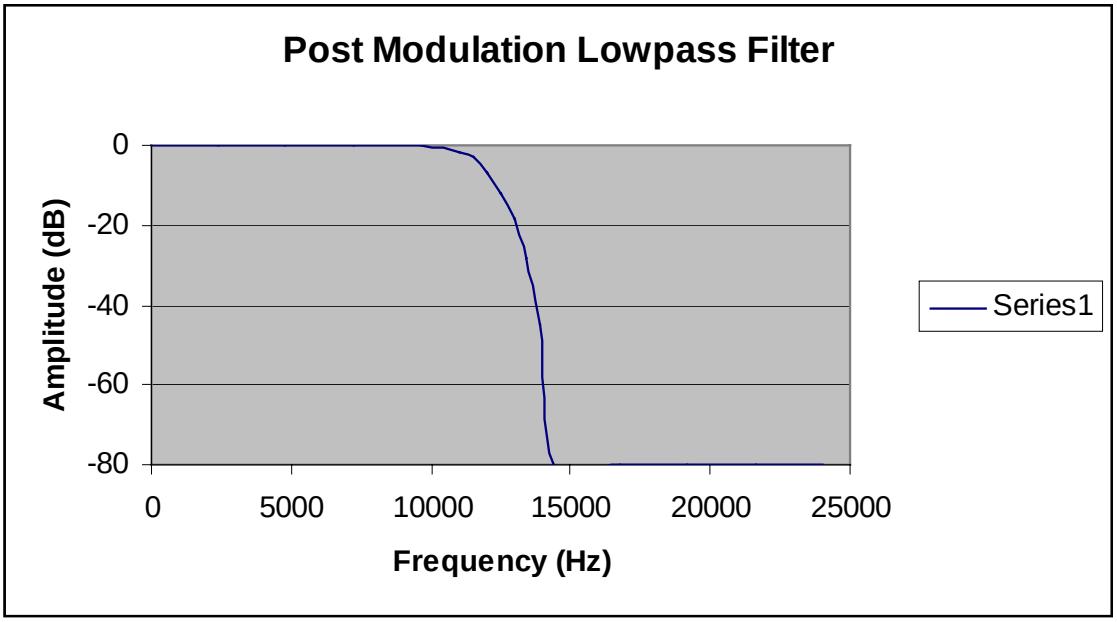
FORM CTS PHOTO

APPENDIX C
CUSTOMER SUPPLIED
MODULATION CHARACTERISTICS

Audio Filter Used For FM Transmission

The OpenSky Cell Site Base Station transmitter includes lowpass filtering before and after FM modulation. The lowpass filter before modulation is shown below. A more selective filter is provided after modulation. Its response is also included.





Description of Modulation System

The digital modes, FMP, OCP, and OTP, use a 4 level guassian frequency shift keying (GFSK) signal to send data at a symbol rate of 9600 baud and a corresponding data rate of 19.2kbits/sec. Before FM modulation symbols are filtered by a guassian filter with a B_B T=0.7 and peak frequency deviation of 5.5 kHz. All data, control and encoded voice are sent using the GFSK waveform. All baseband signal processing, filtering, tone generation, and modulation is implemented by digital signal processing (DSP) software and is therefore not subject to temperature drift and aging effects.

APPENDIX D

CUSTOMER SUPPLIED EQUIPMENT DESCRIPTION

Cell Site Base Station Overview

Within the OpenSky network, the cell site base station functions as a link that provides voice and data connectivity between OpenSky wireless communication devices, such as mobile and portable radios, and the wireline infrastructure of the OpenSky network. Operating in the OpenSky network architecture, the base station provides a data rate of 19.2 kbps for all OpenSky protocols (OCP, OTP and FMP).

The OpenSky protocols, FMP (Federal Express Mobile Protocol), OCP (Opensky Communication Protocol), and OTP (Opensky Trunking Protocol) are fully digital, TDMA network protocols. For all modes, the OpenSky Cell Site Base Station implements a complete seven-layer protocol stack.

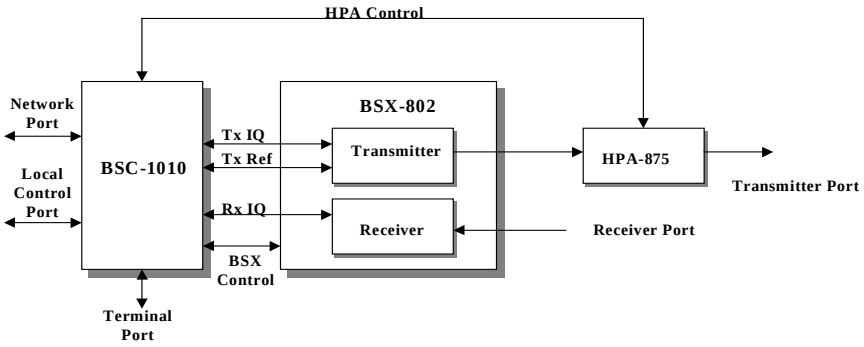
Note that for all three protocols, the base station hardware operates identically. Only the software is different. Thus the accompanying detailed technical theory of operation is applicable for any operational mode.

Although voice is supported in FMP, it is digital voice; all modulation is digital. The digital modulation technique used is 4-level Gaussian Frequency Shift Keying (GFSK), with a symbol rate of 9600 Hz (data rate of 19.2 kbps).

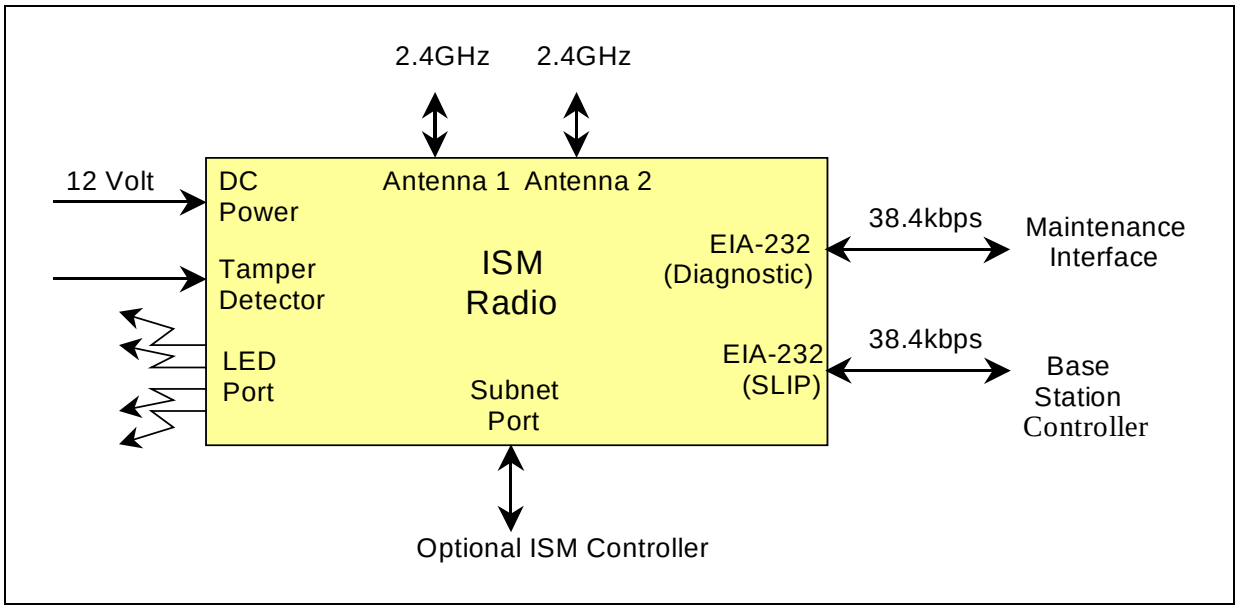
This high data rate is supported simultaneously on the transmit and receive channels. The cell site base station provides this full duplex connectivity by transmitting over SMR channels with frequencies ranging from 851-869 MHz, with the corresponding receive channels utilizing the frequency range 806-824 MHz; the receive channel is 45 MHz below the selected transmitter frequency channel. The RF bandwidth utilized for both transmission and reception is 25 kHz.

The Cell Site Base Station operates full duplex with a nominal maximum output power of 25 Watts. At this maximum output power, the cell site base station is ideally suited to “fill in” coverage in areas not served by large, conventional base stations.

The standard base station is comprised of five distinct modules: the Base Station Controller (BSC), Base Station Transceiver (BSX), ISM Wireless Modem (ISM), Preselector/LNA (PLNA) and the High Power Amplifier (HPA). An interconnection diagram for these modules is shown below.



ISM – Industrial, Scientific and Medical Wireless Modem: The ISM is a wireless modem that operates in the 2.4 GHz unlicensed frequency band. It serves as the interconnection between the OpenSky Cell Site Base Station and the OpenSky network.
The use of the ISM eliminates the need for a wireline connection to the cell site and, therefore, the cost of providing a leased line. Eliminated also by the use of the ISM, is the need to route telephone cable through rugged terrain where cell sites are typically deployed.

The ISM connects directly to the network port of the DCX though a RS-232 serial connection. The ISM also requires two antennas for diversity to improve the error rate over the wireless link.

Shown below is a top-level block diagram of the ISM.