CHOMERICS

# EMC EVALUATION OF THE M/A-COM OPEN SKY DIGITAL BASE STATION MODEL IBS-750 MULTI-MODE IN ACCORDANCE WITH THE FCC PART 90 CERTIFICATION

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**Test Technician or Engineer:** _____

**CTS Approved Signatory:** _____



Parker Seals

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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 Open Sky Digital 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 October through December 1998 under purchase order number 229343.

### 1.1.2 Requirements

The requirements for the sequence of tests performed on the M/A-Com Open Sky Digital Base Station are as follows:

## Output Power

The RF output of the Open Sky Digital 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**

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).

**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 75 watts
Limit = 43 + 10 log (75)= 61.75dB 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.

## 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 Chamber A |
| Occupied Bandwidth | Test Chamber A |
| Emission Mask and Spurious Emissions at Antenna Terminals | Test Chamber A |
| Channel Spacing/Bandwidth | Test Chamber A |
| Field Strength of Spurious Radiation | Open Area Test Site A |
| Modulation Characteristics | M/A-Com |
| Frequency Stability | Safety Lab A |
| Radiated/Conducted Emissions | Open Area 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.

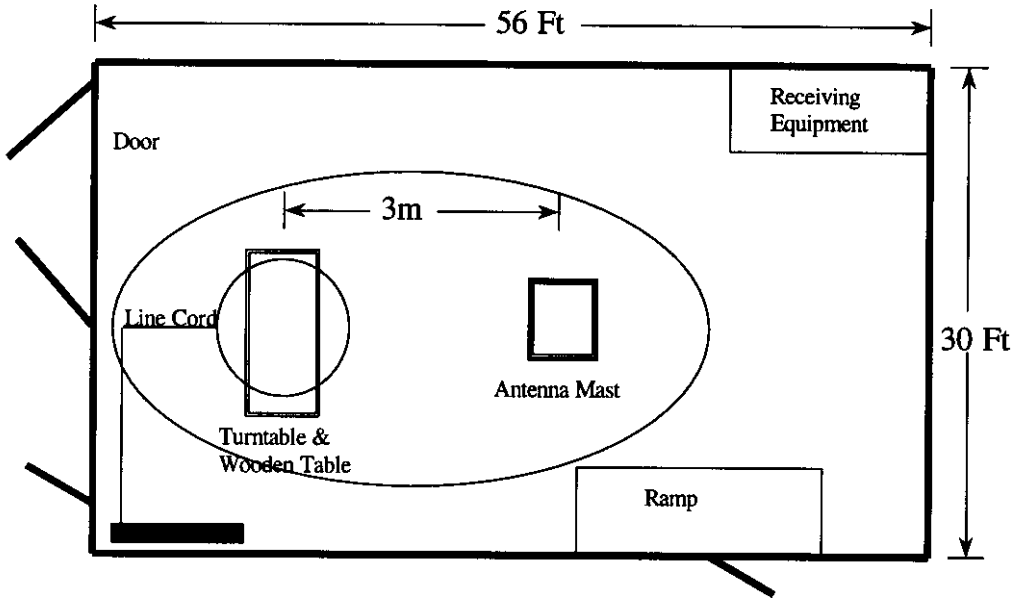
The structure used to support equipment under test is an EMCO 4 foot diameter motorized turntable. For tabletop equipment, a wooden table measuring 1.5 x 1 meter in size is positioned at the center of the turntable, at the proper height above the ground plane.

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




Key: ▬ = Power board

**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.

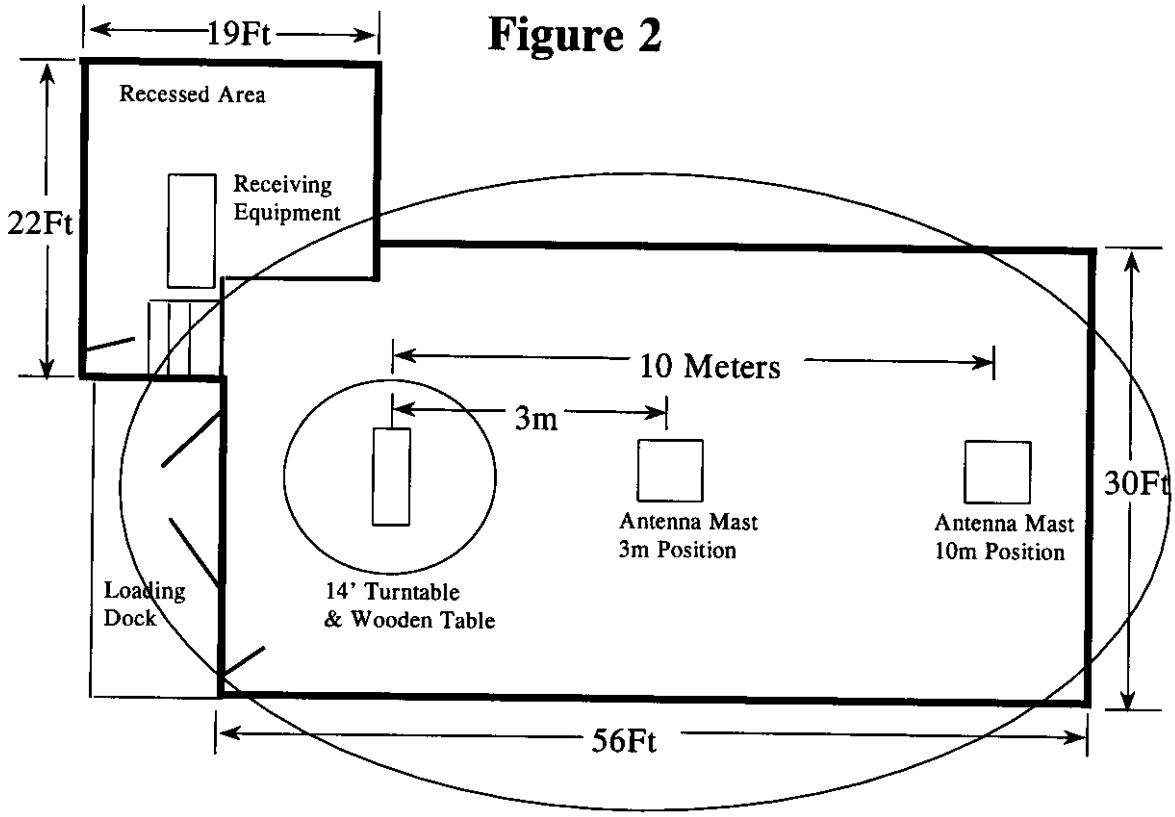
The addition at the end of the Open Area Test Site "B" is the location for the test personnel and equipment to ensure they are outside the imaginary ellipse.

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.

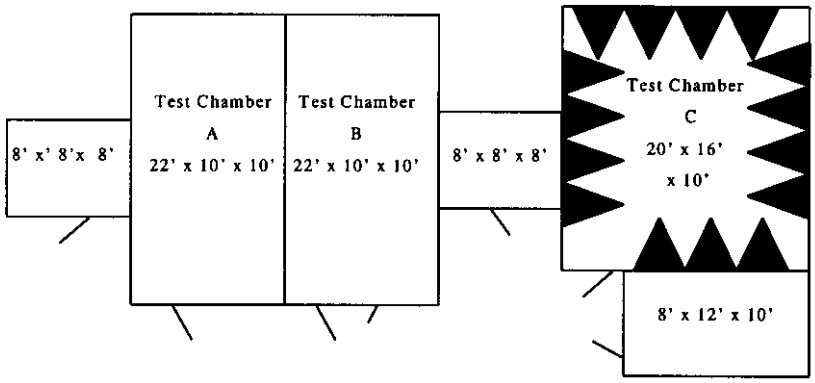
Test Chamber C is lined with Emerson-Cuming RF absorber material. This absorber material meets the following absorption specifications: 80MHz 6dB, 300MHz 30dB, 500MHz 35dB, 1GHz 40dB, and 3 to 24 GHz 50dB. Each of the two adjacent rooms used for support equipment and the main test chamber are connected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

When needed for table top 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 table top 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




Key:

= Emerson-Cuming RF absorber material

**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 |

## 2.1 Summary of Recommendations

The M/A-Com Open Sky Digital 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 8566B Spectrum Analyzer | 47 | 2637A04064 | 07/99 |
| X | H/P 85658A RF Preselector | 48 | 2648A00483 | 07/99 |
| X | H/P OPT 462 Display | 46 | 2648A14289 | 07/99 |
| 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 Open Sky Digital was placed inside a shielded room. The ambient temperature of the room was 20°C.

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

### 3.1.3 Test Method

The output of the Open Sky Digital was measured at six 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 |

### 3.1.4 Results

The output power of the M/A-Com Open Sky Digital 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 8566B Spectrum Analyzer | 47 | 2637A04064 | 07/99 |
| X | H/P 85658A RF Preselector | 48 | 2648A00483 | 07/99 |
| X | H/P OPT 462 Display | 46 | 2648A14289 | 07/99 |
| 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 Open Sky Digital was placed inside a shielded room. The ambient temperature of the room was 20°C.

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

### 3.2.3 Test Method

The output of the Open Sky Digital was measured at six 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 Open Sky Digital 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 8566B Spectrum Analyzer | 47 | 2637A04064 | 07/99 |
| X | H/P 85658A RF Preselector | 48 | 2648A00483 | 07/99 |
| X | H/P OPT 462 Display | 46 | 2648A14289 | 07/99 |
| 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 Open Sky Digital were made inside a shielded room. The ambient temperature of the room was 20°C.

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

### 3.3.3 Test Method

The output of the Open Sky Digital was measured at six frequencies between the frequency range of 851MHz to 869MHz. The output was compared to the Emissions Mask B 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 Open Sky Digital 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 8566B Spectrum Analyzer | 47 | 2637A04064 | 07/99 |
| X | H/P 85658A RF Preselector | 48 | 2648A00483 | 07/99 |
| X | H/P OPT 462 Display | 46 | 2648A14289 | 07/99 |
| 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 Open Sky Digital were made inside a shielded room. The ambient temperature of the room was 20°C.

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

### 3.4.3 Test Method

The output of the Open Sky Digital 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 Open Sky Digital 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 | 10/99 |
| X | Tektronix 494 AP Spectrum Analyzer | 543 | B010201 | 9/99 |
| X | Rhode and Schwartz ESV Test Receiver | 15 | 875931049 | 9/99 |
| X | Hewlett Packard 8447D Pre Amp | 4 | 2727A06065 | 1/99 |
| X | EMCO 3120 Tuned Dipole Antenna B1 | 477 | 56 | 1/99 |
| X | EMCO 3121 Tuned Dipole Antenna B2 | 478 | 176 | 1/99 |
| X | EMCO 3121 Tuned Dipole Antenna B3 | 479 | 728 | 1/99 |
| X | EMCO 3115 Microwave Horn Antenna | 376 | 2796 | 1/99 |

# Test Setup

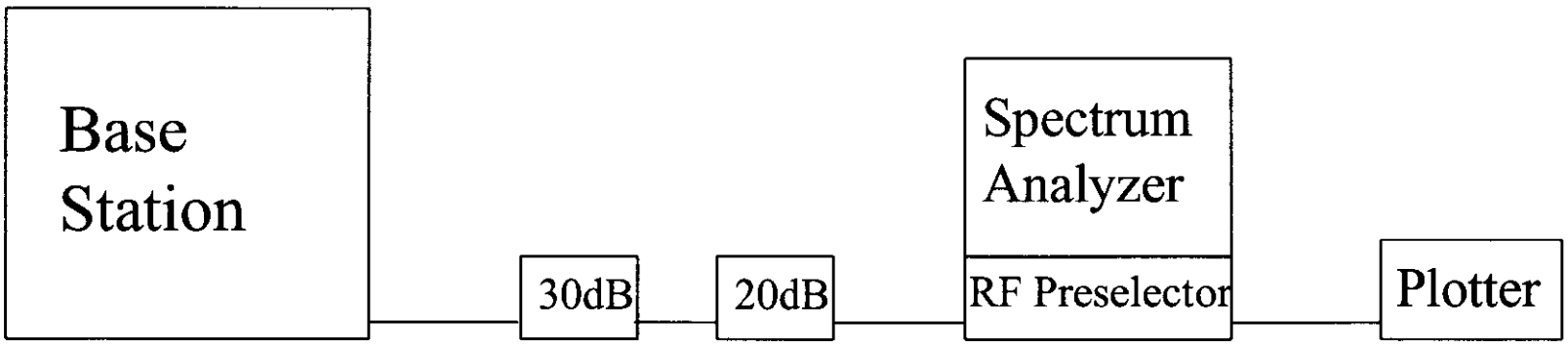



Figure 4

### 3.5.2 Test Conditions

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

The Open Sky Digital 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 Open Sky Digital 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 Open Sky Digital 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 8566B Spectrum Analyzer | 47 | 2637A04064 | 07/99 |
| X | H/P 85658A RF Preselector | 48 | 2648A00483 | 07/99 |
| X | H/P OPT 462 Display | 46 | 2648A14289 | 07/99 |
| X | Cincinatti Sub Zero ZH-32-2H/AC Temp.Chamber | 544 | Z09712530 | 05/99 |
| 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 Open Sky Digital were made inside a Temperature/Humidity Chamber.

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

### 3.7.3 Test Method

The output of the Open Sky Digital was measured at two frequencies. The frequency stability of the output was measured. The frequency selected was 851.0125 MHz.

With the Open Sky Digital 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 Open Sky Digital was measured for frequency stability.

The Open Sky Digital was turned off between each 10° step. The Open Sky Digital was allowed two minutes for warm up before the frequency was measured.

### 3.7.4 Results

The M/A-Com Open Sky Digital Base Station meets the Frequency Stability requirements of FCC Part 90.210 and Part 2.995.

# Test Setup

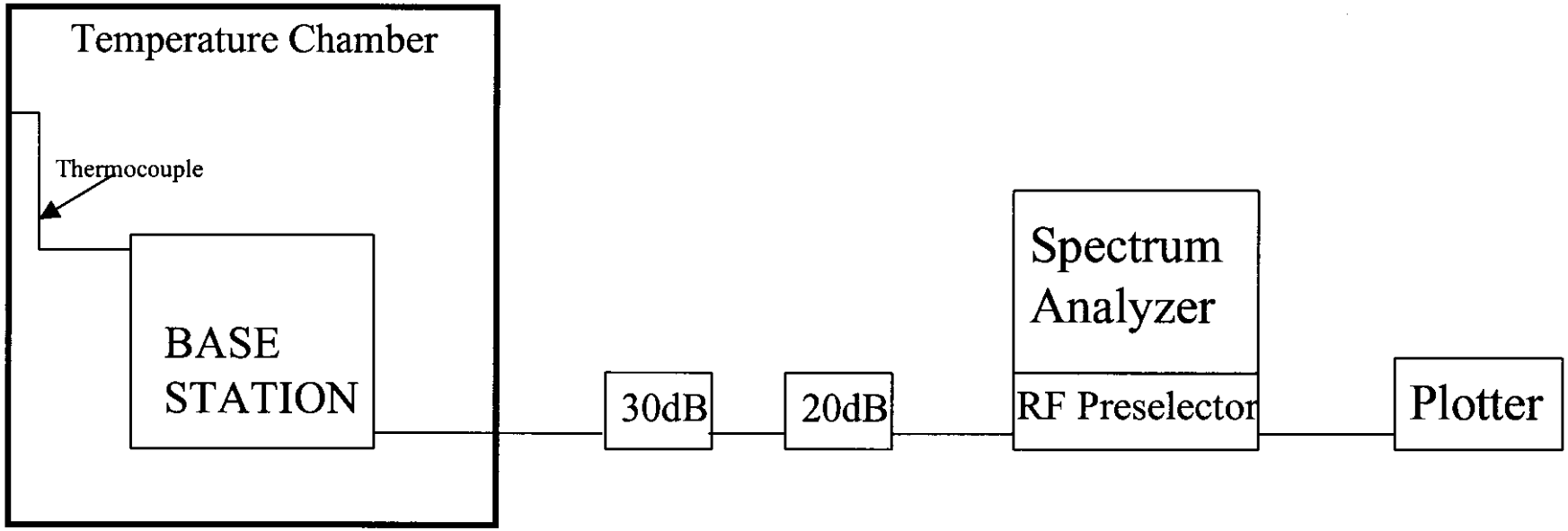



Figure 5

## 3.8 Radiated Electromagnetic Emissions Receiver

### 3.8.1 Equipment Used

| | Test Equipment | Asset # | Serial # | Cal Date |
|---|---|---|---|---|
| X | Tektronix 496 Spectrum Analyzer | 1 | B010559 | 10/99 |
| X | Tektronix 494 AP Spectrum Analyzer | 543 | B010201 | 9/99 |
| X | Rhode and Schwartz ESV Test Receiver | 15 | 875931049 | 9/99 |
| X | Hewlett Packard 8447D Pre Amp | 4 | 2727A06065 | 1/99 |
| X | EMCO 3120 Tuned Dipole Antenna B1 | 477 | 56 | 1/99 |
| X | EMCO 3121 Tuned Dipole Antenna B2 | 478 | 176 | 1/99 |
| X | EMCO 3121 Tuned Dipole Antenna B3 | 479 | 728 | 1/99 |
| X | EMCO 3115 Microwave Horn Antenna | 376 | 2796 | 1/99 |

### 3.8.2 Test Conditions

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

The Open Sky Digital 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 Open Sky Digital 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 | 10/99 |
| X | Rhode and Schwartz ESH-2 Test Receiver | 16 | 8799631020 | 9/99 |
| X | Polarad ESH2-25 Artificial Mains Network | 23 | 890484/016 | 1/99 |

### 3.9.2 Test Conditions

Conducted emissions testing was performed with small devices placed on the table but 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 Open Sky Digital 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 Open Sky Digital Base Station meets the requirements for Conducted Emissions as required by FCC Part 15 Subpart B for Class B equipment.

# APPENDIX A

# TEST DATA

## OUTPUT POWER

CUSTOMER: MACOM
EQUIPMENT: Digital Base Station
TESTED BY: R. Foster
OPERATING MODE: Full Power
DATE: Dec 4 1998
TEST NUMBER: 3
COUPLING DEVICE: NA
TEST SPEC: OUTPUT Power

| Channel No. | Base Frequency MHz | Output Power dB |
|---|---|---|
| 1 | 851.0125 | +48.7 |
| 300 | 858.0125 | +48.6 |
| 600 | 865.9875 | +48.8 |
| 601 | 866.0125 | +48.6 |
| 715 | 867.5125 | +48.5 |
| 830 | 868.9875 | +48.5 |



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# OCCUPIED BANDWIDTH
## Part 2.989

CUSTOMER: MACOM
EQUIPMENT: Digital Base Station
TESTED BY: R. Foster
OPERATING MODE: Normal full Power

DATE: December 6 1998
TEST NUMBER: 2
COUPLING DEVICE: NA
TEST SPEC: Occupied Bandwidth

**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 |



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## CHANNEL SPACEING

CUSTOMER: MACOM
EQUIPMENT: Digital Base Station
TESTED BY: R-Fosh
OPERATING MODE: Full Power

DATE: Dec. 4, 1998
TEST NUMBER: 4
COUPLING DEVICE: NA
TEST SPEC: CHANNEL SPACEING

| Frequency MHz | Measured Spacing kHz | 6dB Bandwidth kHz |
|---|---|---|
| **Channel 1 851.0128** | **24.9KHz** | **15kHz** |
| **Channel 2 851.0377** | | **15kHz** |
| **Channel 601 866.0128** | **11kHz** | **15kHz** |
| **Channel 602 866.0137** | | **14kHz** |



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# FREQUENCY STABILITY
## Temperature vs Frequency

CUSTOMER: MACOM
EQUIPMENT: Digital Base Station
TESTED BY: R. Foster
OPERATING MODE: Full Power

DATE: Nov. 30 - Dec 3 1988
TEST NUMBER: 1
COUPLING DEVICE: NA
TEST SPEC: Freq. Stability

Center Frequency 851.0125 MHz at 20°C

| Temperature | Frequency MHz |
|---|---|
| **-30°C** | **851.0130** |
| **-20°C** | **851.0145** |
| **-10°C** | **851.0129** |
| **0°C** | **851.0130** |
| **10°C** | **851.0132** |
| **20°C** | **851.0125** |
| **30°C** | **851.0129** |
| **40°C** | **851.0139** |
| **50°C** | **851.0127** |

Maximum Deviation .1ppm at 40°C



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CHOMERICS

[redacted] Seals

# TEST SERVICES

## RADIATED E FIELD EMISSION MEASUREMENTS

CUSTOMER: MACom

EQUIPMENT: Digital Base Station

TESTED BY: R. Foster

BANDWIDTH: [ X ] 100 kHz (PEAK)/120 kHz (QP)

OTHER (SPECIFY) _____

DATE: October 24, 1998

TEST NUMBER: 1

OPERATING MODE: Full Power Xmitting in Loop

TEST SPEC: 20556421 FCC Part 15 Class

PROCEDURE: ANSI C63.4

FREQUENCY RANGE: [ ] 30MHz - 1 GHz [ ] 11.76 GHz - 12.7 GHz

OTHER (SPECIFY) 30MHz - 100Hz

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

| FREQUENCY MHz | PEAK MEASURED LEVEL -dBm | QUASSI-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 | - | 10.5 | 2 1/2 | 0 | V | 6.6 | 17.1 | 29.5 |
| 52 | - | 15 | 2 1/2 | 0 | V | 6.8 | 21.6 | 29.5 |
| 54 | - | 15 | 2 1/2 | 0 | V | 7.0 | 21.6 | 29.5 |
| 130 | - | 10 | 3 | 90 | V | 13.4 | 23.4 | 33.0 |
| 132 | - | 12 | 3 | 90 | V | 13.5 | 25.5 | 33.0 |
| 199 | - | 10 | 1 | 180 | V | 12.6 | 22.6 | 33.0 |
| 855 | - | 15 | 1 | 180 | H | 8.5 | 23.5 | 35.5 |
| 1710 | 83 | - | 1 | 0 | H | 12.6 | 26.6 | 43.5 |
| | | No other Signals Detected | | | | | | |
| | | | | | | | | |
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| | | | | | | | | |
| | | | | | | | | |

** 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)

mbient Temperature: 70 °F

Humidity: 40 %

Atmospheric Pressure: 30 "

FORM CTSDS001R

Document #: EMI1953.US.99

Date: March 23, 1999



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CHOMERICS [redacted] Seals

# TEST SERVICES

## RADIATED E FIELD EMISSION MEASUREMENTS

CUSTOMER: MAcom
EQUIPMENT: Digital Base Station
TESTED BY: R. Foster
BANDWIDTH: [ X ] 100 kHz (PEAK)/120 kHz (QP)
OTHER (SPECIFY) _____

DATE: October 24, 1998
TEST NUMBER: 2
OPERATING MODE: Receiving
TEST SPEC: FCC Pt 15 class B
PROCEDURE: ANSI C63.4

FREQUENCY RANGE: [ X ] 30MHz - 1 GHz [ ] 11.76 GHz - 12.7 GHz
ANTENNA DISTANCE: [ X ] 3 METERS [ ] 10 METERS
OTHER (SPECIFY) 30 MHz - 10GHz

| FREQUENCY MHz | PEAK MEASURED LEVEL -dBm | QUASSI-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 | - | 10 | 2½ | 0 | V | 6.6 | 16.6 | 29.5 |
| 52 | - | 14 | 2½ | 0 | V | 6.8 | 20.8 | 29.5 |
| 120 | - | 15 | 1 | 180 | V | 13.4 | 28.4 | 330 |
| 133 | - | 10 | 1 | 270 | V | 13.6 | 23.6 | 330 |
| 200 | - | 10 | 1 | 180 | V | 17.7 | 29.7 | 330 |
| | | No Other Signals Detected | | | | | | |

** 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: 70 °F
Humidity: 40 %
Atmospheric Pressure: 30 "

FORM CTSDS001R

Document #: EMI1953.U599
Date: March23,1999



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CHOMERICS

[redacted] Seals

# TEST SERVICES

## CONDUCTED EMISSION MEASUREMENTS

CUSTOMER: MACom

EQUIPMENT: Digital Base Station

TESTED BY: R. Foster

DATE: October 24, 1998

TEST NUMBER: 3

OPERATING MODE: Receiving & Full Power

TEST SPEC: FCC 15.209/FCC Class B

PROCEDURE: ANSI C63.4

BANDWITH: [ ] 200 Hz [ ] 9kHz [ ] 10 kHz

FREQUENCY RANGE: [ ] 10 kHz–30 MHz [ ] 150 kHz–30 MHz [X] 450 kHz–30 MHz

110/208 V AC [X] 240V AC [ ] OTHER [ ]

50 Hz [ ] 60 Hz [X] SINGLE Ø [ ] 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 |
| | | | | | No Signals detected | | | | | | | | | |
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** All signals greater than 3dB from the limit are calculated to the nearest whole number.

Ambient Temperature: 70 °F

Humidity: 40 %

Atmospheric Pressure: 30 "

FORM CTSDS002C

Document #: EMI1953.U599

Date: March 23, 1999



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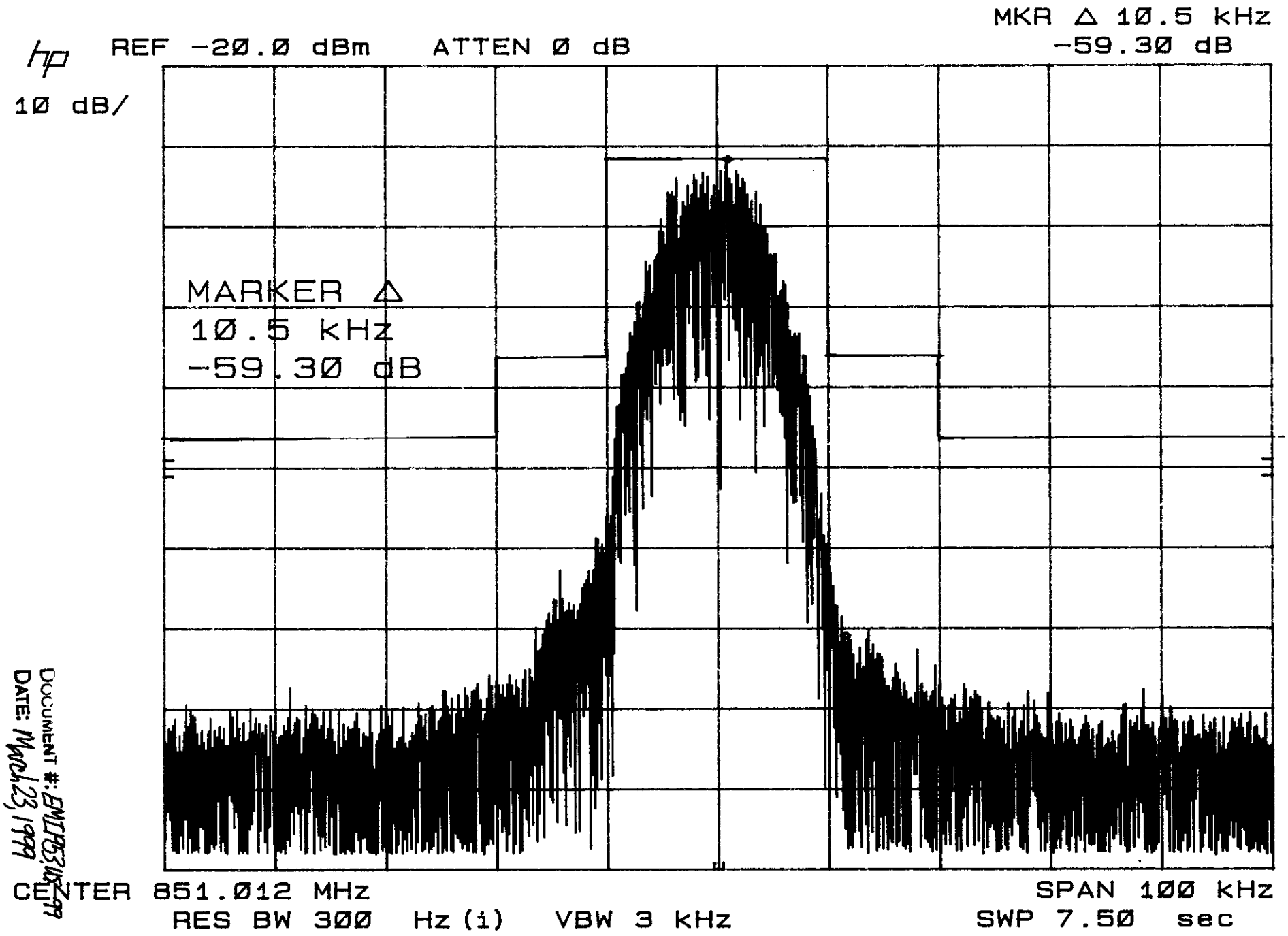
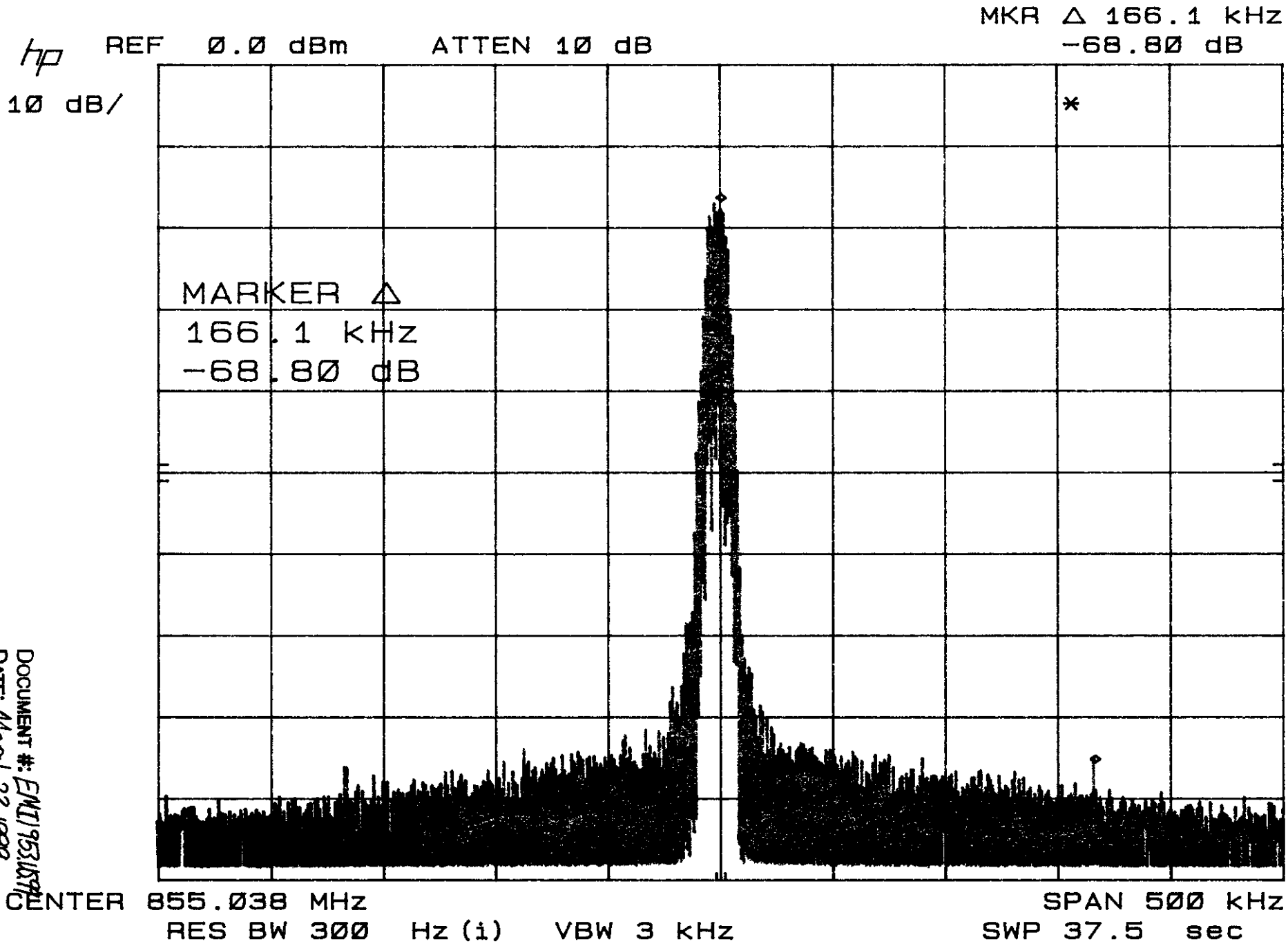
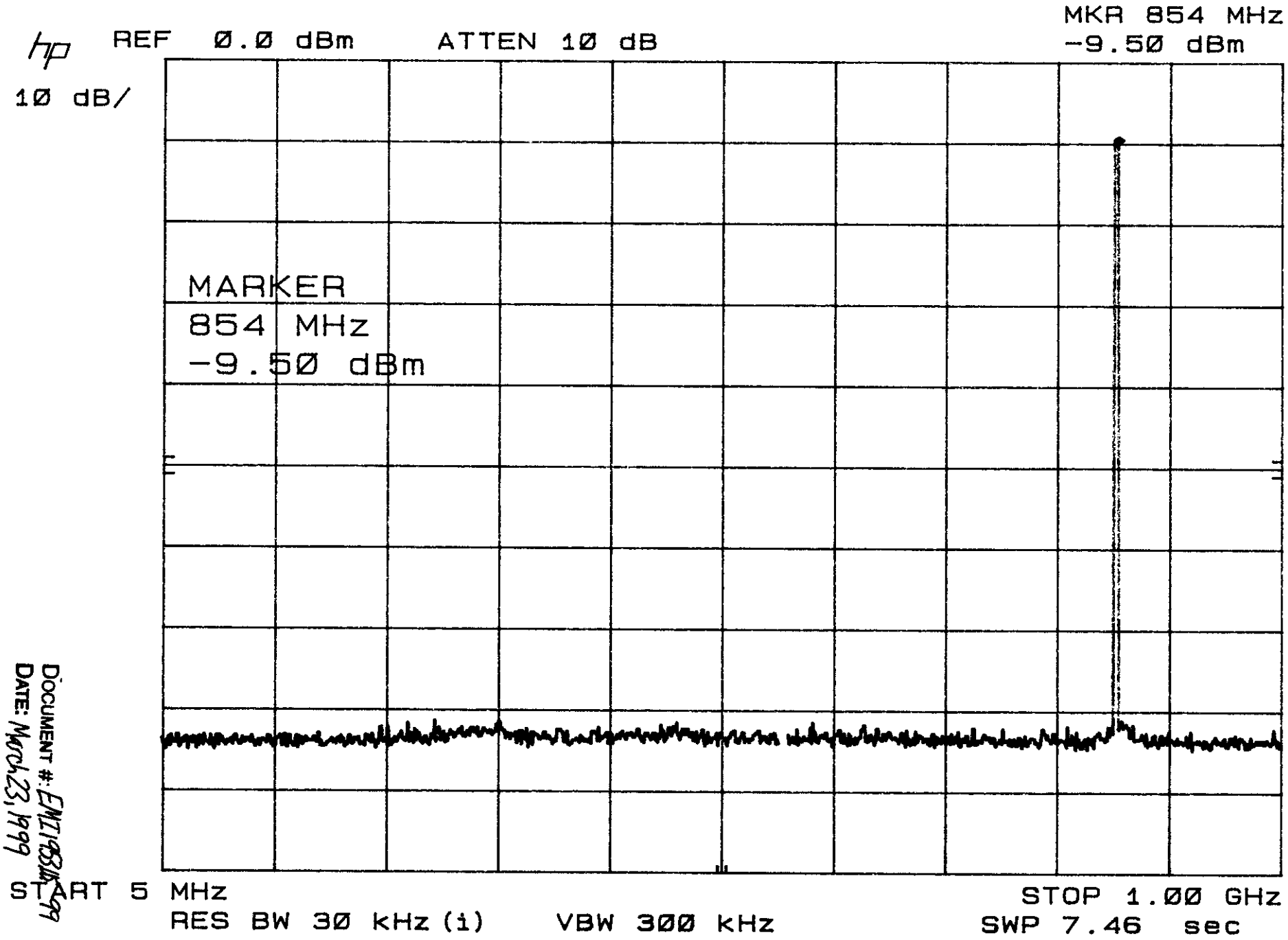
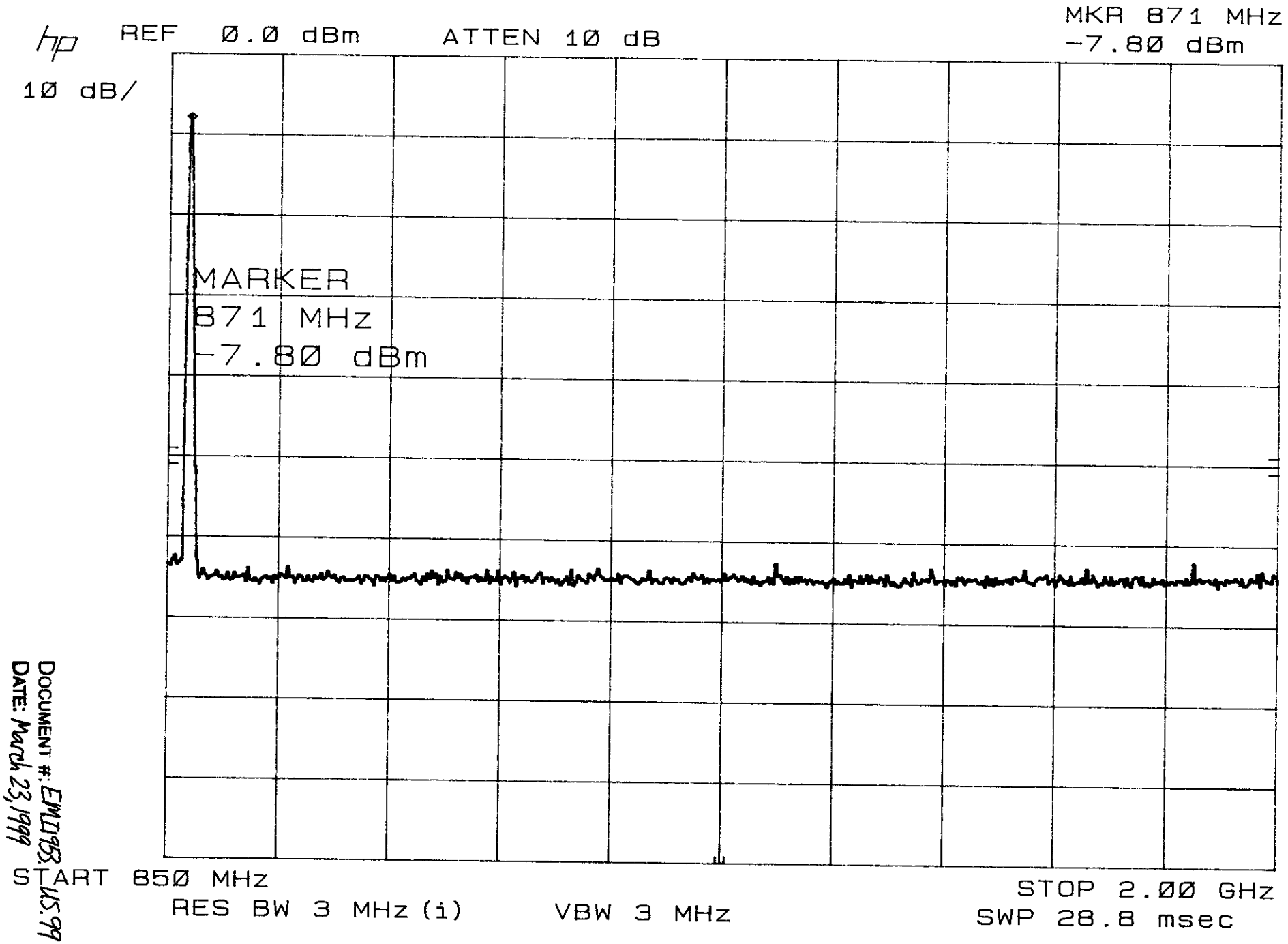
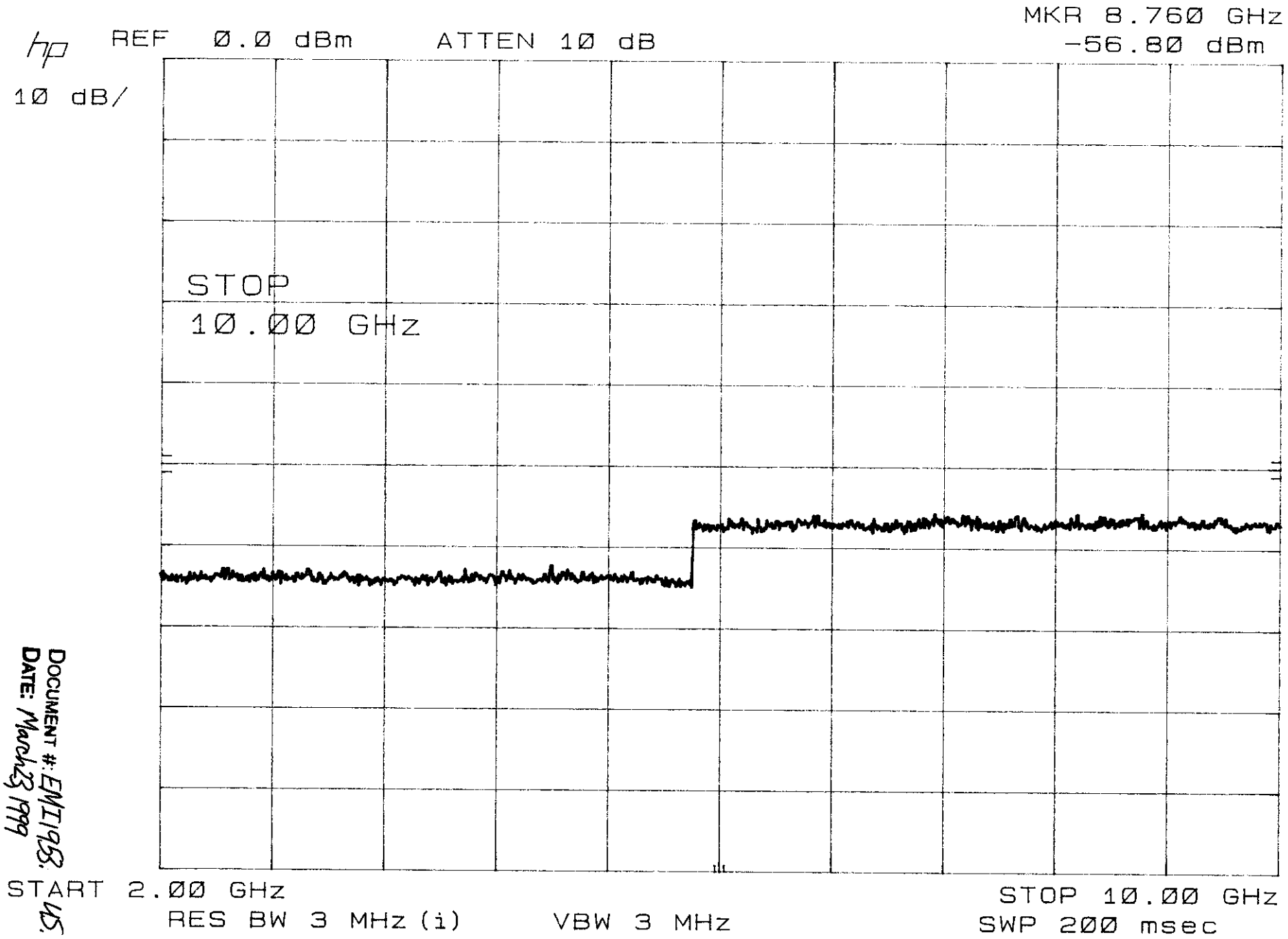

MKR Δ 10.5 kHz
-59.30 dB
REF -20.0 dBm
ATTEN 0 dB
10 dB/
MARKER Δ
10.5 kHz
-59.30 dB
CENTER 851.012 MHz
SPAN 100 kHz
RES BW 300 Hz (i)
VBW 3 kHz
SWP 7.50 sec


MKR Δ 166.1 kHz
-68.80 dB
hp
REF 0.0 dBm
ATTEN 10 dB
10 dB/
MARKER Δ
166.1 kHz
-68.80 dB
CENTER 855.038 MHz
SPAN 500 kHz
RES BW 300 Hz (i)
VBW 3 kHz
SWP 37.5 sec


REF 0.0 dBm
ATTEN 10 dB
MKR 854 MHz
-9.50 dBm
10 dB/
MARKER
854 MHz
-9.50 dBm
START 5 MHz
RES BW 30 kHz (i)
VBW 300 kHz
STOP 1.00 GHz
SWP 7.46 sec


hp
REF 0.0 dBm
ATTEN 10 dB
MKR 871 MHz
-7.80 dBm
10 dB/
MARKER
871 MHz
-7.80 dBm
START 850 MHz
RES BW 3 MHz (i)
VBW 3 MHz
STOP 2.00 GHz
SWP 28.8 msec

CHN1


hp
REF 0.0 dBm
ATTEN 10 dB
MKR 8.760 GHz
-56.80 dBm
10 dB/
STOP
10.00 GHz
START 2.00 GHz
RES BW 3 MHz (i)
VBW 3 MHz
STOP 10.00 GHz
SWP 200 msec

# APPENDIX B

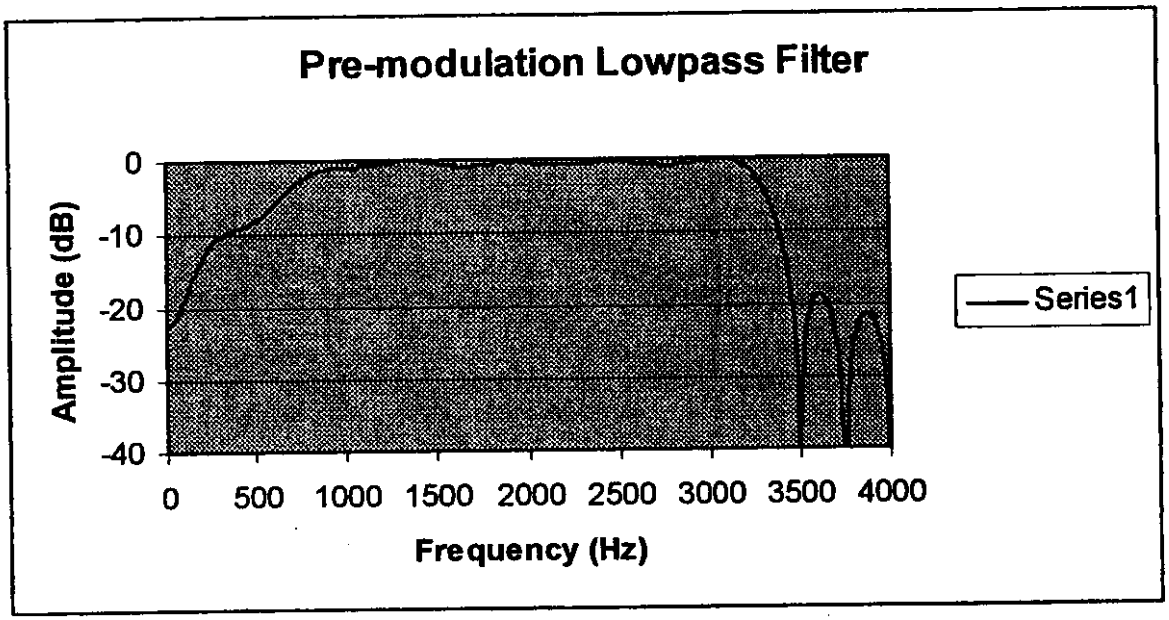
# SET-UP PHOTOGRAPHS

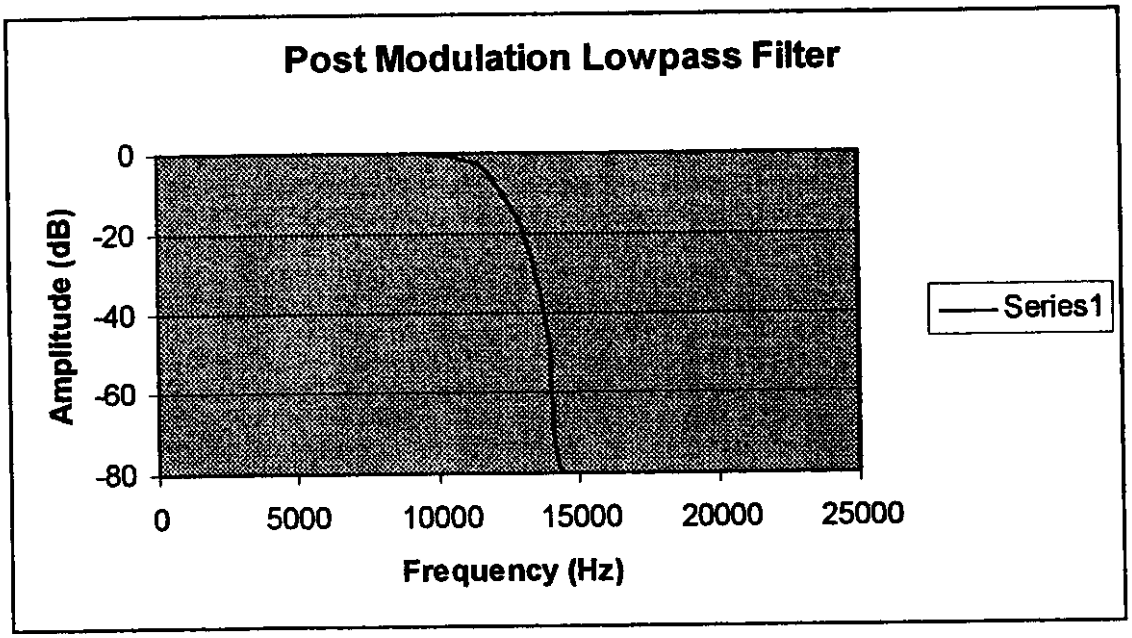
# APPENDIX C

# CUSTOMER SUPPLIED MODULATION CHARACTERISTICS

# Audio Filter Used For FM Transmission

The OpenSky 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

## Introduction to the OpenSky Digital Base Station

*Base Station Overview*

Within the OpenSky network, the 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 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.

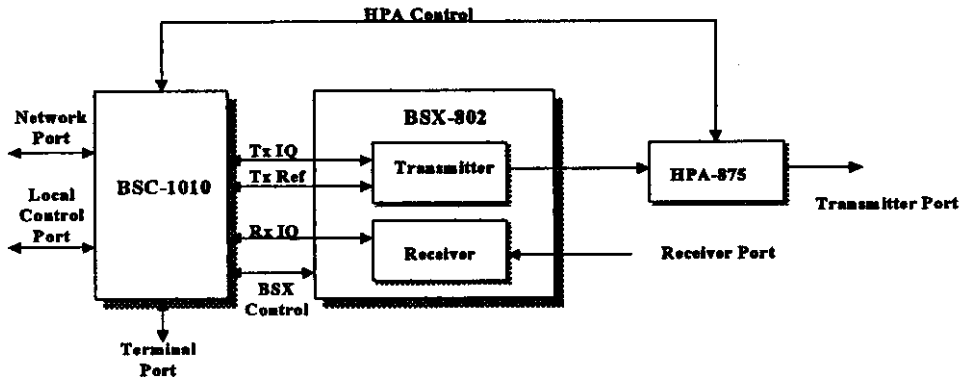
Although voice is supported in FMP, it is digital voice; all modulation is digital. The digital modulation technique used is 4-level Gaussian Minimum Shift Keying (GMSK), with a symbol rate of 9600 Hz (data rate of 19.2 kbps).

This high data rate is supported simultaneously on the transmit and receive channels. The 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 Base Station operates full duplex with a nominal maximum output power of 75 Watts. At this maximum output power, the base station can cover up to a thirty-mile radius—given normal terrain—and provide service for up to 200 users.

Physically, the standard base station consists of three chassis and all the associated interconnect cables. The three chassis are mounted in a rugged 19" standard equipment rack. Base stations may be augmented through the addition of specific options such as a duplexer.

The standard base station is comprised of three distinct functional units: the Base Station Controller (BSC-1010), Base Station Transceiver (BSX-802), and the High Power Amplifier (HPA-875.) An interconnection diagram for these chassis is shown below.




The base station's flexibility allows customers the freedom to implement site configurations that can range from a single base station to multiple base stations requiring additional RF and control networks.

Benefits of the OpenSky Base Station

The value inherent from owning an OpenSky Base Station is derived from three central benefits. These benefits are increased capacity, software upgrades and long hardware life.

The suite of current OpenSky protocols provide SMR channel utilization that exceeds that offered by any competitors' products. Through the use of digital voice compression and efficient modulation techniques, OpenSky protocols are able to provide true, "as advertised" high data rates. Given the increasingly high cost of RF spectrum, the ability to maximize channel capacity provides direct financial benefit.

To ensure that channel usage continues to outpace all other current technology, the OpenSky base station's performance can be continually improved through software upgrades. The unique architecture of the OpenSky Base Station is differentiated from its competitors as being software-based, rather than hardware-based. Since all signal processing functions are performed in software, it is a simply a matter of loading new software-based protocols as they are developed, to improve even the current high rate.

An additional benefit that stems from the ability to enhance performance through software-based upgrades is increased hardware life. With an eye toward the goal of extending the time until hardware obsolescence, the OpenSky Base Station is designed for maximum hardware flexibility. This hardware flexibility combined with software-based upgrades, increases the useful life of the OpenSky Base Station, leading directly to a very low cost of ownership.

*Summary of Key Features*

The OpenSky Base Station employs a modular design approach. All three functional elements—the BSC-1010, BSX-802 and HPA-875--are self-contained within their respective chassis. This modular approach offers customers the benefit of ease of service. Replacement of any of the three main functional components can be accomplished in minutes. All three functional elements of the base station are separately mounted within the 19" equipment rack, making chassis substitution a simple matter of a few mounting screws and a couple of cables.

This 19" 4U rack also includes the required integral cooling fans and AC power supply. The division of the three main functional elements and the power supply into separate metal enclosures minimizes spurious emissions and component interaction.

**BSC-1010 - Base Station Controller:** The BSC-1010 is the processing engine of the base station. Utilizing software exclusively, the BSC-1010 implements all base station network and digital signal-processing functions. These functions include the Physical Layer (PHY), Medium Access Control (MAC), Mobile Data Link Protocol (MDLP), Radio Resource Management (RRM), Network Management (NMS) and Secondary Registration.

**BSX-802 - Base Station Transceiver:** The BSX-802 consists of a transmitter and receiver section, each of which implements the corresponding analog transmit and receive functions.

As seen in the accompanying figure, during transmission, the BSC-1010 generates an In-Phase/Quadrature (IQ) baseband signal that is routed to the baseband input of the BSX-802 transmitter. The BSX-802 transmitter converts this baseband signal to a RF output signal, at the selected SMR channel frequency. The nominal output power of this output signal is 0 dBm when measured into a 50 Ω load.

The receiver section of the BSX-802 essentially reverses the transmit process. The antenna routes the desired receive signal to the RF input of the BSX-802. The receiver section converts the signal to a baseband I/Q signal that is routed to the BSC-1010 for further processing.

A DC reference signal is also provided by the BSC-1010 to the BSX-802 to provide a common reference for both the receive and transmit I/Q baseband signals.

**HPA-875 - High Power Amplifier:** The HPA-875 provides the high power transmit signal to the antenna. To generate this transmit signal, the HPA-875 amplifies the nominal 0 dBm RF input provided by the BSX-802, to generate a maximum output power of 75 Watts.

The HPA-875 also includes an RS-485 communications port that provides control, monitoring, and alarm generation. The HPA-875's output power is controllable via this RS-485 connection from the BSC-1010. Using this serial connection the BSC-1010 can adjust the output power of the HPA-875 from 15 to 75 Watts.

The HPA-875 generates alarms in the case of excessive reflected power or input power, low power output and over-temperature alarms. These alarms are reported to the BCS-1010 and subsequently relayed through the NMS interface across the network port.

Signal input power above 6 dBm causes the HPA to generate an input overdrive alarm and de-key the HPA-875 output. Input signal levels below –10 dBm may prevent the HPA-875 from generating full output power. This condition generates a power leveling control loop alarm, which de-keys the HPA-875.

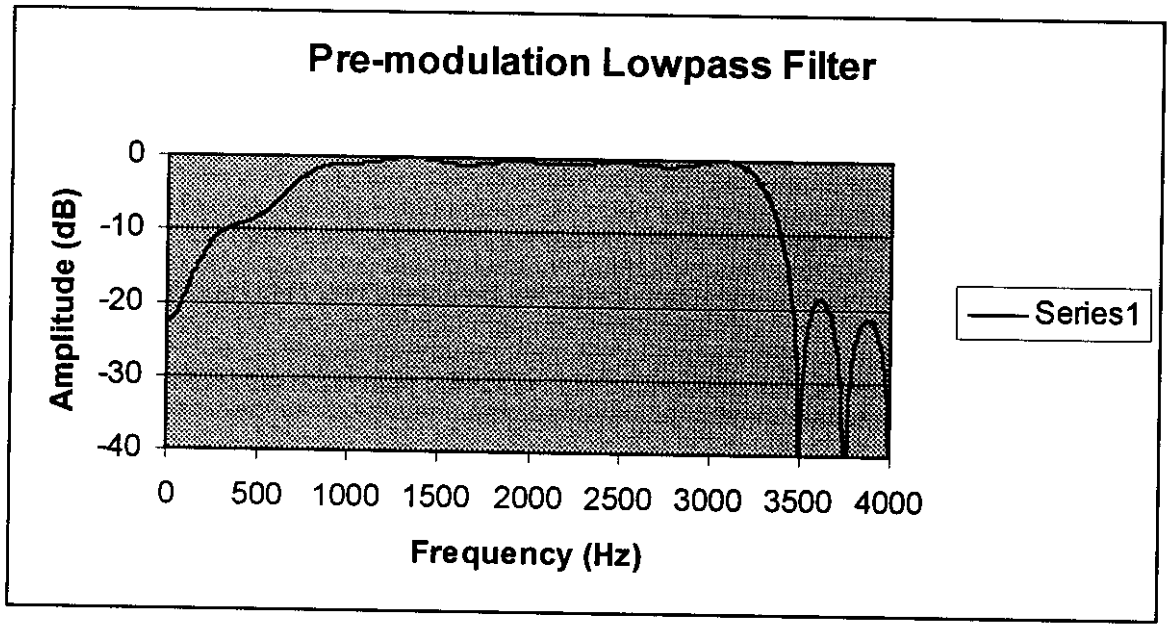
As described previously, the HPA-875 provides a programmable 15 – 75 watt RF output signal into a 50Ω load. Output protection insures no damage to the HPA from any mismatch condition. However, a programmable threshold on reflected power would normally de-key the HPA under mismatch conditions.

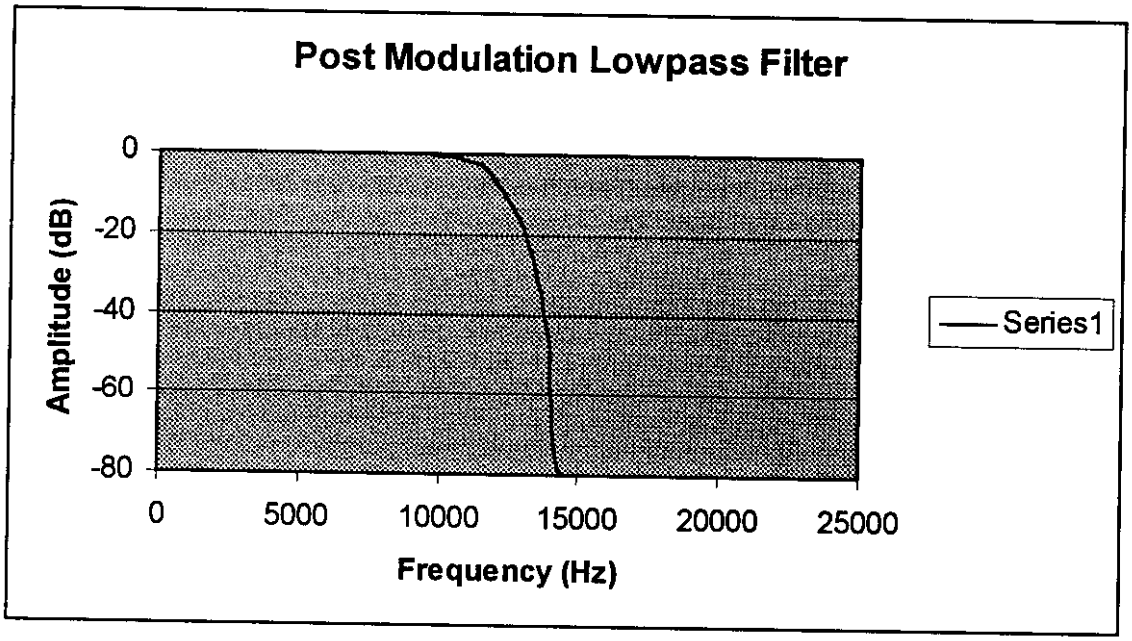
**AC Power Strip:** The rack-mounted power strip provides all electrical power to the base station. This power strip provides a maximum power output of 1875 Watts and can accept line voltages from 95-135 AC.

The input to the power strip is through a standard three-prong AC plug, with the line length being ten feet.

# Audio Filter Used For FM Transmission

The OpenSky 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.