

**EMC EVALUATION OF THE
M/A-COM
OPENSKY PORTABLE RADIO
MODEL P800
IN ACCORDANCE WITH THE
FCC PARTS 2, 15 AND 90 CERTIFICATION**

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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 P800 Portable Radio 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 15, Part 90 and Part 2.

Testing was performed during the period of April 17 through May 30, 2002 under purchase order number 71999.

1.1.2 Requirements

The requirements for the sequence of tests performed on the M/A-Com OpenSky P800 Portable Radio is as follows:

**Occupied Bandwidth
FCC Part 2.10498**

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 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.

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3. 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 $116 \log (fd/6.1)$
4. On any frequency removed from the center of the authorized bandwidth by more than 25kHz: At least $43 + 10 \log (P)$ dB.

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 9000MHz.

P = to 3 watts

Limit = $43 + 10 \log (3) = 43.95\text{dB}$ under

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 $+50^{\circ}\text{F}$. The transmitter shall have the following Frequency Stability over the battery voltage range of 7.3VDC (nominal) to 6.093VDC (battery end-point).

The frequency stability for a mobile/portable station is 1.5ppm as stated in the Minimum Frequency Stability table of Part 90.213.

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 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 H	Passed
Conducted Spurious Emissions at Antenna Terminals	Passed
Field Strength of Spurious Radiation	Passed
Frequency Stability	Passed
Radiated Emission Receiver	Passed

1.2.1 Summary of Recommendations

The M/A-Com OpenSky P800 Portable Radio will not require modifications in order to insure compliance with FCC Parts 2, 15 and 90.

1.3 Administrative Data

1.3.1 Test Facility

Chomerics test facility is recognized under the National Voluntary Laboratory Accreditation Program (NVLAP) for NVLAP Codes 12F01; FCC test methods – 47 CFR Part 15 – Digital Devices, 12F01a; Conducted Emissions, and 12F01b; Radiated Emissions under NVLAP Accreditation Number 100296-0. Tests within this report not conforming to these NVLAP Codes are not covered under Chomerics NVLAP accreditation. Chomerics NVLAP accreditation covers test method 12/CIS22 for IEC/CISPR 22:1993, 12/CIS22a for IEC/CISPR 22 Amendment 1:1995 and Amendment 2:1996. Chomerics NVLAP accreditation code 12/CIS22b covers Chinese National Standard CNS 13438:1997.

Chomerics Radiated and Conducted Emissions testing to AS/NZS3548 is accredited to the Australian Telecommunications Authority (AUSTEL) under file number A92/TH/0048.

Chomerics' Open Area Test Sites A and B are accredited for Radiated and Conducted Emissions through Industry Canada under file numbers IC2959A and IC2959B respectively.

Chomerics' Open Area Test Site A is accredited to the Voluntary Control Council for Interference (VCCI) in Japan for Radiated and Conducted Emissions testing under file R-749 and C-770 respectively.

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 test 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 $\pm 3\text{dB}$. Chomerics Test Services measurement uncertainty calculations are available for review upon request.

1.3.2 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

1.3.3 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.).

1.4 Test Set-up

1.4.1 Test Site Matrix

The test locations used for the emissions and immunity tests are as follows: (Refer to Section 1.4.2 for test site descriptions).

Test Performed

Output Power
Occupied Bandwidth
Emission Mask
Conducted Spurious Emissions at Antenna Terminals
Field Strength of Spurious Radiation
Frequency Stability
Radiated Emissions Receiver

Test Site

Test Site A
Test Site A
Test Site A
Test Site A
Test Site A
Safety Lab
Test Site A

1.4.2 Test Site Descriptions

The following is a list of the test sites and descriptions of each. Refer to Section 1.4.1 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.

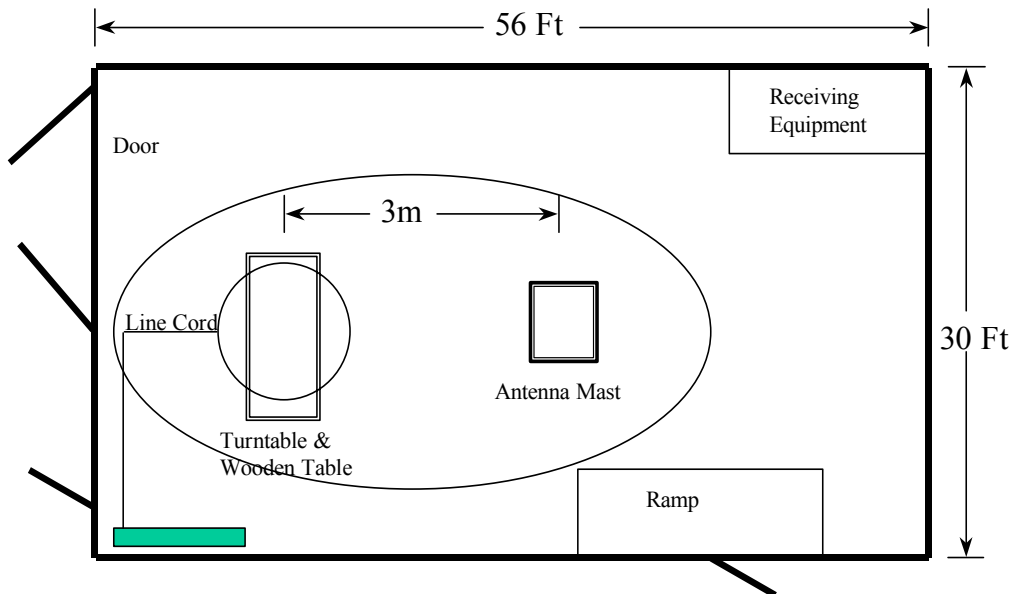
The area at the end of the Open Area Test Site "A" is the location for the test personnel and equipment to ensure they are outside the imaginary ellipse.

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.

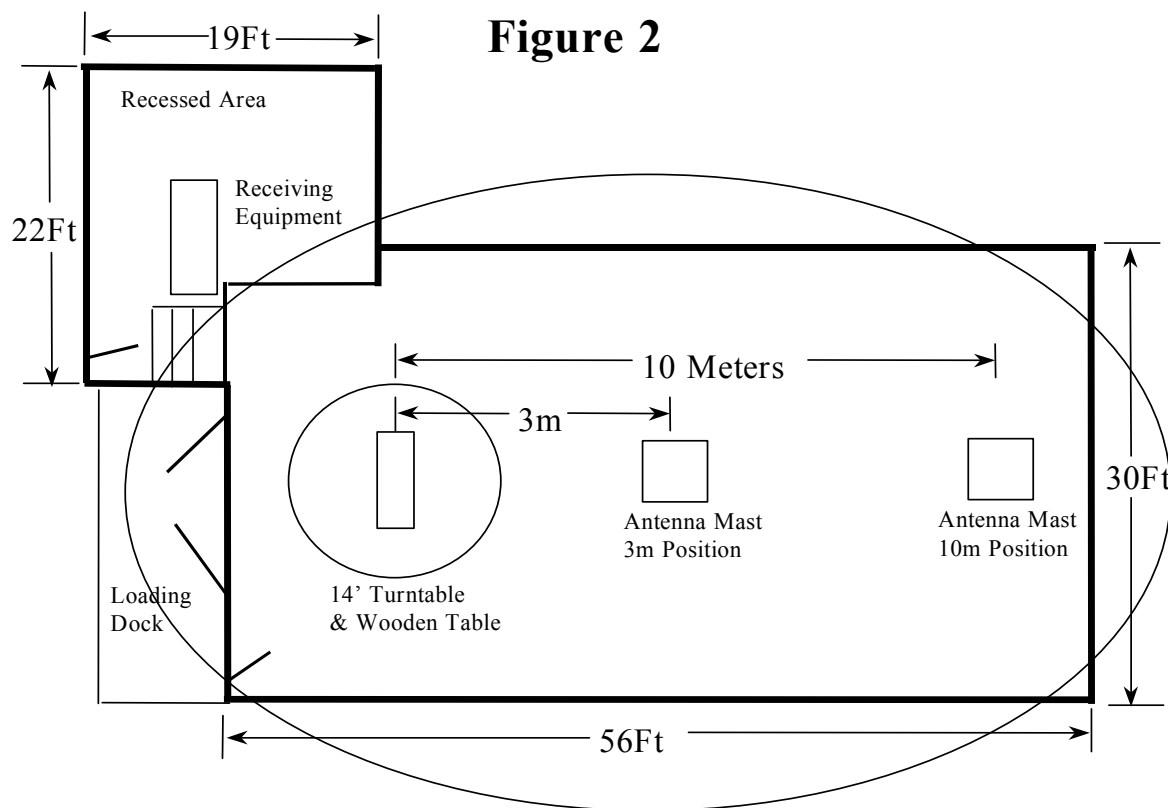
The addition at the end of the Open Area Test Site "B" is the location for the test personnel and equipment to ensure they are outside the imaginary ellipse.

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 SERVICES

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 meet 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.

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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.

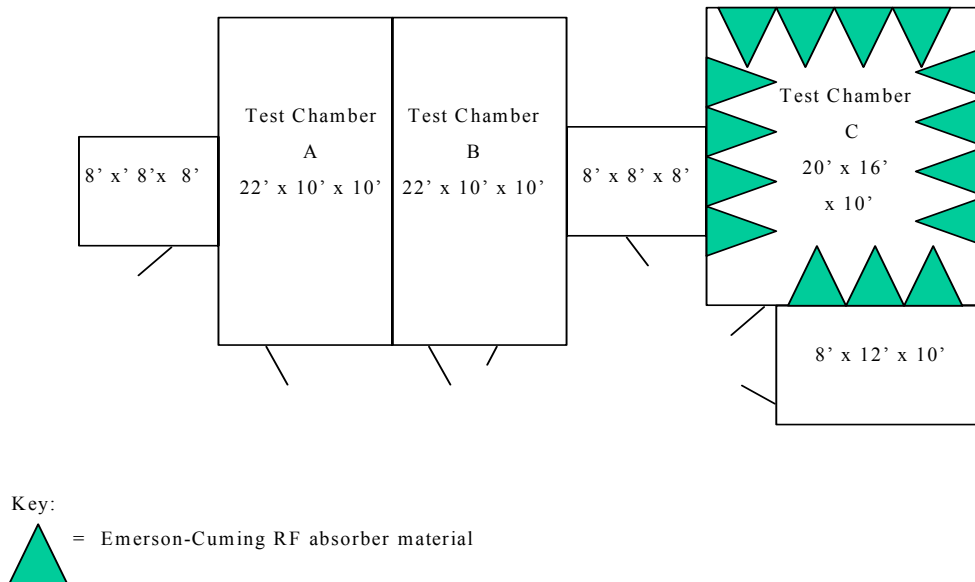
Test Chamber C is lined with Emerson-Cuming RF absorber material. This absorber material meets the following absorption specifications: 80MHz 6dB, 300MHz 30dB, 500MHz 35dB, 1GHz 40dB, and 3 to 24 GHz 50dB. Each of the two adjacent rooms used for support equipment and the main test chamber are connected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

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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%.

Safety Lab: The Safety Test Laboratory is located in the Seeger Building at Chomerics, 84 Dragon Court, Woburn, Massachusetts.

The power in the test lab consists of a 208 Volt, three phase, 200 Amp distribution panel which feeds a power bus which has various types of American and European single and three phase receptacles. The largest of which is a 100 Amp three- phase service with its own disconnect switch. This distribution panel also provides power to a programmable power source capable of providing three- phase power up to 312 V Line to Neutral at up to 10 kVA total power. The output of this programmable power source also feeds a distribution panel that feeds a power bus with various types of American and European single and three phase receptacles.

The lab contains a 32 cubic foot temperature and humidity chamber that is required by most safety standards for temperature and humidity preconditioning of equipment.

1.4.3 Equipment Under Test

A detailed description of the Equipment Under Test is located in the M/A-Com manual attached to the certification package.