Engineering and Testing for EMC and Safety Compliance

# TYPE CERTIFICATION REPORT

**M/A COM Private Radio Systems, Inc.**
**3315 Old Forest Road**
**Lynchburg, VA 24501**
**Bryan McWaters (804) 385-2146**

**MODEL: Jaguar 700M 800 MHz Mobile Radio**

**FCC ID: OWDTR-0012-E**

***November 30, 2001***

| STANDARDS REFERENCED FOR THIS REPORT | |
|---|---|
| PART 2: 1999 | FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS |
| PART 15: 1999 | §15.109: RADIATED EMISSIONS LIMITS |
| PART 90: 1998 | PRIVATE LAND MOBILE RADIO SERVICES |
| ANSI C63.4-1992 | STANDARD FORMAT MEASUREMENT/TECHNICAL REPORT PERSONAL COMPUTER AND PERIPHERALS |
| ANSI/TIA/EIA603- 1992 | LAND MOBILE FM OR PM COMMUNICATIONS EQUIPMENT MEASUREMENT AND PERFORMANCE STANDARDS |
| ANSI/TIA/EIA 603-1-1998 | ADDENDUM TO ANSI/TIA/EIA 603-1992 |
| ANSI/TIA/EIA –102.CAAA; 1999 | DIGITAL C4FM/CQPSK TRANSCEIVER MEASUREMENT METHODS |
| RSS-119; Issue 6; 2000 | LAND MOBILE AND FIXED RADIO TRANSMITTERS AND RECEIVERS 27.41 TO 960.0 MHZ |

| Frequency Range | Output Power (W) Conducted | Freq. Tolerance | Emission Designator |
|---|---|---|---|
| 806.0125-823.9875 MHz | 37.1 | 1.5 | 16K0F3E |
| 806.0125-823.9875 MHz | 37.1 | 1.5 | 12K8F1D |
| 806.0125-823.9875 MHz | 37.1 | 1.5 | 12K8F1E |
| 851.0125-868.9875 MHz | 37.1 | 1.5 | 16K0F3E |
| 851.0125-868.9875 MHz | 37.1 | 1.5 | 12K8F1D |
| 851.0125-868.9875 MHz | 37.1 | 1.5 | 12K8F1E |

**REPORT PREPARED BY:**

**Test Engineer:** **Daniel Baltzell**
**Administrative Writer:** **Melissa Fleming**

*Document Number: 2001267 / QRTL01-083*



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# 1 GENERAL INFORMATION

The following Report of a Type Certification, is prepared on behalf of **M/A COM Private Radio Systems, Inc**. in accordance with the Federal Communications Commissions and Industry Canada Rules and Regulations. The Equipment Under Test (EUT) was the **Jaguar 700M 800 MHz Mobile Radio; FCC ID: OWDTR-0012-E**. The test results reported in this document relate only to the item that was tested.

All measurements contained in this application were conducted in accordance with FCC Rules and Regulations CFR 47, Industry Canada RSS-119, and ANSI C63.4 Methods of Measurement of Radio Noise Emissions, 1992. The instrumentation utilized for the measurements conforms to the ANSI C63.4 standard for EMI and Field Strength Instrumentation. Calibration checks are performed regularly on the instruments, and all accessories including high pass filter, coaxial attenuator, preamplifier and cables.

## 1.1 TEST FACILITY

The open area test site and conducted measurement facility used to collect the radiated data is located on the parking lot of Rhein Tech Laboratories, Inc. 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report dated March 3, 1994, submitted to and approved by the Federal Communication Commission to perform AC line conducted and radiated emissions testing (ANSI C63.4 1992).

## 1.2 RELATED SUBMITTAL(S)/GRANT(S)

This is an original application report.

## 1.3 CONFORMANCE STATEMENT

| STANDARDS REFERENCED FOR THIS REPORT | |
|---|---|
| PART 2: 1999 | FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS |
| PART 15: 1999 | §15.109: RADIATED EMISSIONS LIMITS |
| PART 90: 1998 | PRIVATE LAND MOBILE RADIO SERVICES |
| ANSI C63.4-1992 | STANDARD FORMAT MEASUREMENT/TECHNICAL REPORT PERSONAL COMPUTER AND PERIPHERALS |
| ANSI/TIA/EIA603- 1992 | LAND MOBILE FM OR PM COMMUNICATIONS EQUIPMENT MEASUREMENT AND PERFORMANCE STANDARDS |
| ANSI/TIA/EIA 603-1-1998 | ADDENDUM TO ANSI/TIA/EIA 603-1992 |
| ANSI/TIA/EIA –102.CAAA; 1999 | DIGITAL C4FM/CQPSK TRANSCEIVER MEASUREMENT METHODS |
| RSS-119; Issue 6; 2000 | LAND MOBILE AND FIXED RADIO TRANSMITTERS AND RECEIVERS 27.41 TO 960.0 MHZ |

| Frequency Range | Output Power (W) Conducted | Freq. Tolerance | Emission Designator |
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| 806.0125-823.9875 MHz | 37.1 | 1.5 | 12K8F1D |
| 806.0125-823.9875 MHz | 37.1 | 1.5 | 12K8F1E |
| 851.0125-868.9875 MHz | 37.1 | 1.5 | 16K0F3E |
| 851.0125-868.9875 MHz | 37.1 | 1.5 | 12K8F1D |
| 851.0125-868.9875 MHz | 37.1 | 1.5 | 12K8F1E |

We, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this attached test record. No modifications were made to the equipment during testing in order to achieve compliance with these standards.

Furthermore, there was no deviation from, additions to or exclusions from the above standards for Certification methodology.

Signature: _____ Date: November 30, 2001

Typed/Printed Name: Bruno Clavier Position: Vice President of Operations (NVLAP Signatory)

Signature: _____ Date: November 30, 2001

Typed/Printed Name: Daniel W. Baltzell Position: Test Engineer

NVLAP *Accredited by the National Voluntary Accreditation Program for the specific scope of accreditation under Lab Code 200061-0.*

**Note: This report may not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government.**

### 1.4 TESTED SYSTEM DETAILS

Listed below are the identifiers and descriptions of all equipment, cables, and internal devices used with the EUT for this test, as applicable.

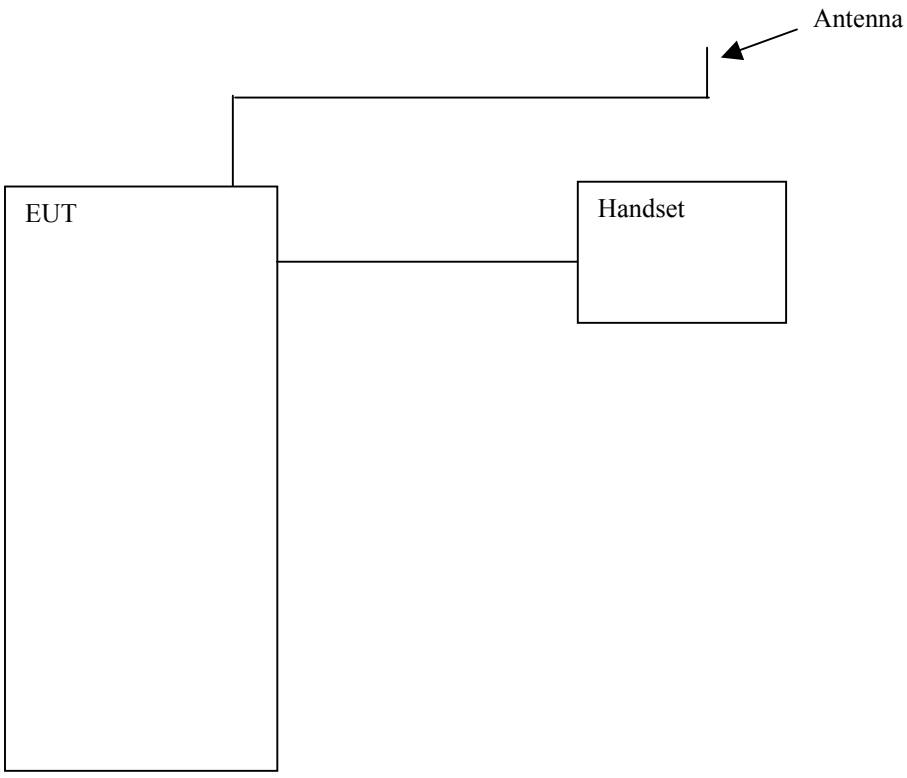
**TABLE 1-1: EQUIPMENT UNDER TEST (EUT)**

| PART | MANUFACTURER | MODEL | SERIAL NUMBER | FCC ID | CABLE DESCRIPTION | RTL BAR CODE |
|---|---|---|---|---|---|---|
| MOBILE RADIO | M/A COM PRIVATE RADIO SYSTEMS, INC. | JAGUAR 700M MOBILE ET180L06B | N/A | OWDTR-0012-E | N/A | 013697 |

**TABLE 1-2: EXTERNAL COMPONENTS USED IN TEST CONFIGURATION**

| PART | MANUFACTURER | MODEL | SERIAL NUMBER | FCC ID | CABLE DESCRIPTION | RTL BAR CODE |
|---|---|---|---|---|---|---|
| HAND MICROPHONE | M/A COM Private Radio Systems, Inc. | 344A4528P55 | N/A | N/A | N/A | 013698 |

**FIGURE 1-1: CONFIGURATION OF TESTED SYSTEM**



## 2 FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FI(dBuV/m) = SAR(dBuV) + SCF(dB/m)
FI = Field Intensity
SAR = Spectrum Analyzer Reading
SCF = Site Correction Factor

The Site Correction Factor (SCF) used in the above equation is determined empirically, and is expressed in the following equation:

SCF(dB/m) = - PG(dB) + AF(dB/m) + CL(dB)

SCF = Site Correction Factor
PG = Pre-amplifier Gain
AF = Antenna Factor
CL = Cable Loss

The field intensity in microvolts per meter can then be determined according to the following equation:

$$FI(uV/m) = 10^{FI(dBuV/m)/20}$$

For example, assume a signal at a frequency of 125 MHz has a received level measured as 49.3 dBuV. The total Site Correction Factor (antenna factor plus cable loss minus preamplifier gain) for 125 MHz is -11.5 dB/m. The actual radiated field strength is calculated as follows:

49.3 dBuV - 11.5 dB/m = 37.8 dBuV/m

$$10^{37.8/20} = 10^{1.89} = 77.6 \text{ uV/m}$$

# 3 RADIATED EMISSIONS

## 3.1 RADIATED MEASUREMENT

Before final measurements of radiated emissions were made on the open-field three meter range, the EUT was scanned indoors at a three meter distance in order to determine its emissions spectrum signature. The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. This process was repeated during final radiated emissions measurements on the open-field range, at each frequency, in order to insure that maximum emission amplitudes were attained.

Final radiated emissions measurements were made on the three-meter, open-field test site. The EUT was placed on a nonconductive turntable approximately 0.8 meters above the ground plane.

At each frequency, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters in order to determine the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarizations.

*Note: Rhein Tech Laboratories, Inc. has implemented procedures to minimize errors that occur from test instruments, calibration, procedures, and test setups. Test instrument and calibration errors are documented from the manufacturer or calibration lab. Other errors have been defined and calculated within the Rhein Tech quality manual, section 6.1. Rhein Tech implements the following procedures to minimize errors that may occur: yearly as well as daily calibration methods, technician training, and emphasis to employees on avoiding error.*

# 4 FCC RULES AND REGULATIONS PART 2 §2.1046 (A): RF POWER OUTPUT: CONDUCTED

## 4.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, section 2.2.1

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

## 4.2 TEST DATA

The following channels (in MHz) were tested: 806.0125, 815.5, 823.9875, 851.0125, 863.0, 868.9875
The Output Power levels are shown.

**CARRIER OUTPUT POWER (UNMODULATED)**

**TABLE 4-1: RF POWER OUTPUT (HIGH POWER)**

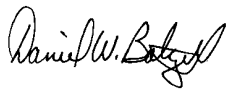
| Channel | Frequency (MHz) | RF Power measured (Watt)* |
|---|---|---|
| 1 | 806.0125 | 36.8 |
| 2 | 815.5000 | 37.1 |
| 3 | 820.9875 | 36.9 |
| 4 | 823.9875 | 36.8 |
| 5 | 851.0125 | 34.4 |
| 6 | 860.5000 | 35.3 |
| 7 | 865.9875 | 36.2 |
| 8 | 868.9876 | 36.3 |

* Measurement accuracy: +/- 3%

**TABLE 4-2: RF POWER OUTPUT (RATED POWER)**

| Rated Power (W) |
|---|
| 35.0 |

TEST PERSONNEL:



DANIEL BALTZELL — TEST TECHNICIAN/ENGINEER
SIGNATURE
NOVEMBER 30, 2001 — DATE OF TEST

**TABLE 4-3: TEST EQUIPMENT USED FOR TESTING (RF POWER OUTPUT - CONDUCTED)**

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number |
|---|---|---|---|---|
| 900770 | Hewlett Packard | 437B | Power Meter | 2949A02966 |
| 901055 | Hewlett Packard | 8901A Opt. 002-003 | Modulation Analyzer | 2545A04102 |
| 900769 | Hewlett Packard | 8481B | Power Sensor | 2702A05059 |

# 5 FCC RULES AND REGULATIONS PART 2 §2.1051: SPURIOUS EMISSIONS AT ANTENNA TERMINALS

## 5.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, Section 2.2.13

The transmitter is terminated with a 50 Ω load and interfaced with a spectrum analyzer.
The transmitter is modulated with a 2,500 Hz sine wave at an input level 16 dB greater than that required to produce 50% of the rated system deviation at 1000 Hz.

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

## 5.2 TEST DATA

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

Limits: Mask B (dBm): P(dBm) – (43+10xLOG P(W))

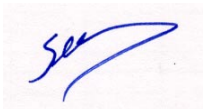
The following channels (in MHz) were investigated: 806.0125, 815.5, 823.9875, 851.0125, 863.0, and 868.9875
The worse case (unwanted emissions) channels are shown. The magnitude of emissions attenuated more than 20 dB below the FCC limit need not be recorded.

**TABLE 5-1: CONDUCTED SPURIOUS EMISSIONS CHANNEL 1 – 806.0125MHZ**

(806.0125 MHz); 25kHz channel spacing; Mask B; Conducted power = 36.8W

| Frequency (MHz) | Level (dBc) | Limit (dBc) | Margin(dB) |
|---|---|---|---|
| 1612.0350 | 106.7 | 58.7 | -48.0 |
| 2418.0475 | 94.7 | 58.7 | -36.0 |
| 3224.0600 | 92.5 | 58.7 | -33.8 |
| 4030.0725 | 103.7 | 58.7 | -45.0 |
| 4836.0850 | 98.7 | 58.7 | -40.0 |
| 5642.0975 | 91.9 | 58.7 | -33.2 |
| 6448.1100 | >100 | | |
| 7254.1225 | >100 | | |
| 8060.1350 | >100 | | |

TEST PERSONNEL:



RACHID SEHB — TEST ENGINEER | SIGNATURE | OCTOBER 12, 2001 — DATE OF TEST

**TABLE 5-2: CONDUCTED SPURIOUS EMISSIONS CHANNEL 5 – 851.0125MHZ**

(851.0125 MHz); 25kHz channel spacing; Mask B; Conducted power = 34.4W

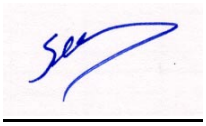
| Frequency (MHz) | Level (dBc) | Limit (dBc) | Margin(dB) |
|---|---|---|---|
| 1702.0250 | 111.4 | 58.4 | -53.0 |
| 2553.0375 | 105.4 | 58.4 | -47.0 |
| 3404.0500 | 103.4 | 58.4 | -45.0 |
| 4255.0625 | 86.7 | 58.4 | -28.3 |
| 5106.0750 | 107.8 | 58.4 | -49.4 |
| 5957.0875 | 102.1 | 58.4 | -43.7 |
| 6808.1000 | >100 | | |
| 7659.1125 | >100 | | |
| 8510.1250 | >100 | | |

**TABLE 5-3: CONDUCTED SPURIOUS EMISSIONS CHANNEL 8 – 868.9875MHZ**

(868.9875 MHz); 25kHz channel spacing; Mask B; Conducted power = 36.3W

| Frequency (MHz) | Level (dBc) | Limit (dBc) | Margin(dB) |
|---|---|---|---|
| 1737.9752 | 105.1 | 58.6 | -46.5 |
| 2606.9628 | 74.8 | 58.6 | -16.2 |
| 3475.9504 | 96.2 | 58.6 | -37.6 |
| 4344.9380 | 85.6 | 58.6 | -27.0 |
| 5213.9256 | 97.9 | 58.6 | -39.3 |
| 6082.9132 | >100 | | |
| 6951.9008 | >100 | | |
| 7820.8884 | >100 | | |
| 8689.8760 | >100 | | |

TEST PERSONNEL:



RACHID SEHB — TEST ENGINEER | SIGNATURE | OCTOBER 12, 2001 — DATE OF TEST

**TABLE 5-4: TEST EQUIPMENT USED FOR TESTING (RADIATED – ERP RF POWER OUTPUT)**

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number |
|---|---|---|---|---|
| 901020 | Hewlett Packard | 8564E | Portable Spectrum Analyzer (9 kHz - 40 GHz) | 3943A01719 |
| 901057 | Hewlett Packard | 3336B | Synthesizer/Level Generator | 2514A02585 |
| 901054 | Hewlett Packard | HP 3586B | Selective Level Meter | 1928A01892 |
| 900913 | Hewlett Packard | 85462A | EMI Receiver RF Section (9 KHz – 6.5 GHz) | 3325A00159 |

# 6 FCC RULES AND REGULATIONS PART 2 §2.1053 (A): FIELD STRENGTH OF SPURIOUS RADIATION

## 6.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, section 2.2.12

Analog Modulation: The transmitter is terminated with a 50 Ω load and is modulated with a 2,500 Hz sine wave at an input level 16 dB greater than that required to produce 50% of the rated system deviation at 1000 Hz.

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

The spurious emissions levels were measured and the device under test was replaced by a substitution antenna connected to a signal generator. This signal generator level was then corrected by subtracting the cable loss from the substitution antenna to the signal generator and the gain of the antenna was further corrected to a half wave dipole.

## 6.2 TEST DATA

### 6.2.1 CFR 47 PART 90.210 REQUIREMENTS

The worst-case emissions test data are shown. The magnitude of emissions attenuated more than 20 dB below the FCC limit need not be recorded.

**TABLE 6-1: FIELD STRENGTH OF SPURIOUS RADIATION CHANNEL 1 – 806.0125MHZ**

(806.0125 MHz) 25k channel spacing; Conducted power = 36.8W; Limit 58.7 dBc (Mask B)

| Frequency (MHz) | S/G level (dBm) | Cable Loss* (dB) | Difference in gain (ref. To 1/2 wave dipole) | Emission level (dBc) | Margin (dB) |
|---|---|---|---|---|---|
| 1612.0350 | -27.6 | 1.3 | 6.8 | 67.8 | -9.1 |
| 2418.0475 | -38.6 | 1.6 | 7.1 | 78.8 | -20.1 |
| 3224.0600 | -44.6 | 1.8 | 8.2 | 83.9 | -25.2 |
| 4030.0725 | -52.6 | 1.9 | 8.5 | 91.7 | -33.0 |
| 4836.0850 | -45.6 | 2.0 | 9.1 | 84.2 | -25.5 |
| 5642.0975 | -44.6 | 1.9 | 8.8 | 83.4 | -24.7 |
| 6448.1100 | -40.6 | 1.3 | 9.9 | 77.7 | -19.0 |
| 7254.1225 | -27.3 | 1.6 | 6.8 | 67.8 | -9.1 |
| 8060.1350 | -38.4 | 1.8 | 7.1 | 78.8 | -20.1 |

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

**TABLE 6-2: FIELD STRENGTH OF SPURIOUS RADIATION CHANNEL 5 – 851.0125MHZ**

(851.0125 MHz) 25k channel spacing; Conducted power = 34.4W; Limit= 58.4 dBc (Mask B)

| Frequency (MHz) | S/G level (dBm) | Cable Loss* (dB) | Difference in gain (ref. To 1/2 wave dipole) | Emission level (dBc) | Margin (dB) |
|---|---|---|---|---|---|
| 1702.02 | -33.9 | 1.3 | 6.8 | 73.8 | -15.4 |
| 2553.03 | -27.9 | 1.6 | 7.1 | 67.8 | -9.4 |
| 3403.04 | -56.9 | 1.8 | 8.2 | 95.9 | -37.5 |
| 4255.06 | -50.9 | 1.9 | 8.5 | 89.7 | -31.3 |
| 5106.07 | -54.9 | 2.0 | 9.1 | 93.2 | -34.8 |
| 5957.09 | -49.9 | 1.9 | 8.8 | 88.4 | -30.0 |
| 6808.05 | <-60.0 | | | | |
| 7659.30 | <-60.0 | | | | |
| 8510.60 | <-60.0 | | | | |

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

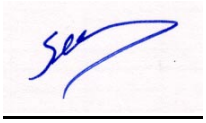
**TABLE 6-3: FIELD STRENGTH OF SPURIOUS RADIATION CHANNEL 8 – 868.9875MHZ**

(868.967 MHz) 25k channel spacing; Conducted power = 36.3W; Limit=58.6 dBc (Mask B)

| Frequency (MHz) | S/G level (dBm) | Cable Loss* (dB) | Difference in gain (ref. To 1/2 wave dipole) | Emission level (dBc) | Margin (dB) |
|---|---|---|---|---|---|
| 1737.9752 | -33.7 | 1.3 | 6.8 | 73.8 | -15.2 |
| 2606.9628 | -26.7 | 1.6 | 7.1 | 66.8 | -8.2 |
| 3475.9504 | -48.7 | 1.8 | 8.2 | 87.9 | -29.3 |
| 4344.9380 | -50.7 | 1.9 | 8.5 | 89.7 | -31.1 |
| 5213.9256 | -54.7 | 2.0 | 9.1 | 93.2 | -34.6 |
| 6082.9132 | -47.7 | 1.9 | 8.8 | 86.4 | -27.8 |
| 6951.9008 | -53.7 | 2.3 | 9.9 | 91.7 | -33.1 |
| 7820.8884 | <-60.0 | | | | |
| 8689.8760 | <-60.0 | | | | |

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

TEST PERSONNEL:



RACHID SEHB — TEST ENGINEER | SIGNATURE | OCTOBER 16, 2001 — DATE OF TEST

**TABLE 6-4: TEST EQUIPMENT USED FOR TESTING (FIELD STRENGTH OF SPURIOUS RADIATION)**

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number |
|---|---|---|---|---|
| 900791 | Schaffner@Chase | CBL6112 | Antenna (25MHz – 2GHz) | 2099 |
| 900932 | Hewlett Packard | 8449B OPT H02 | Preamplifier (1-26.5 GHz) | 3008A00505 |
| 901020 | Hewlett Packard | 8564E | Portable Spectrum Analyzer (9 kHz - 40 GHz) | 3943A01719 |
| 900917 | Hewlett Packard | 8648C | Synthesized. Signal Generator (9 KHz to 3200 MHz) | 3537A01741 |
| 900928 | Hewlett Packard | 83752A | Synthesized Sweeper, 0.01 to 20 GHz | 3610A00866 |

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# 7 FCC RULES AND REGULATIONS PART 2 §2.1049 (C) (1): OCCUPIED BANDWIDTH

OCCUPIED BANDWIDTH - COMPLIANCE WITH THE EMISSION MASKS

## 7.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, section 2.2.11 and TIA/EIA-102.CAAA-1999 section 2.2.5

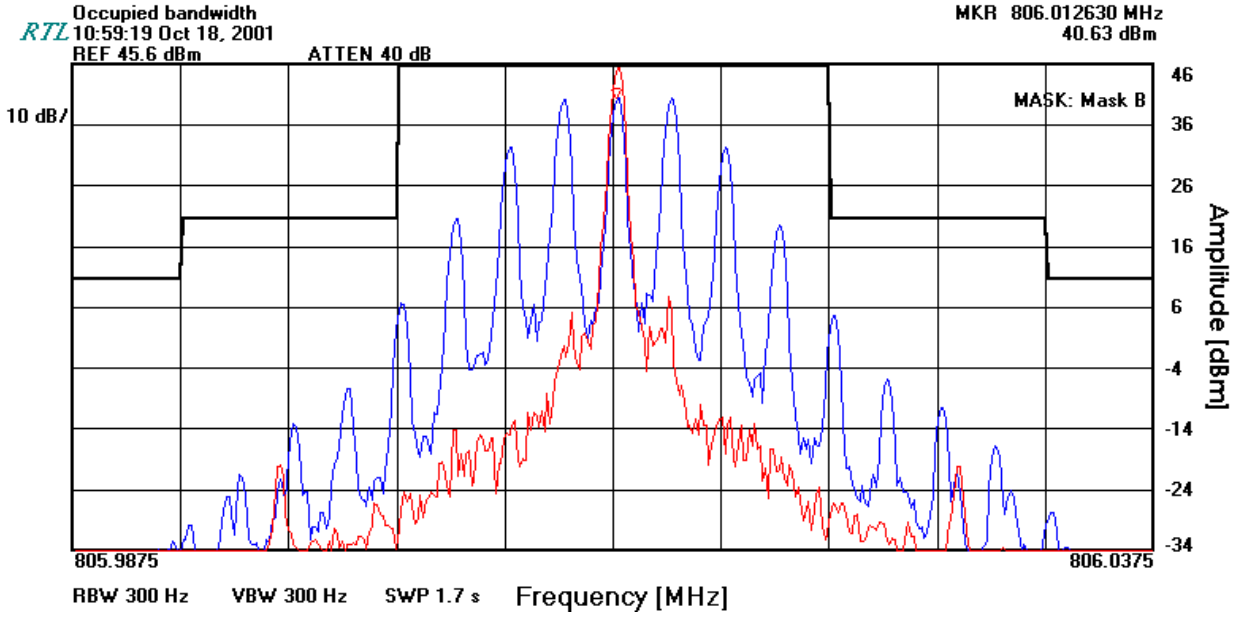
Device with audio modulation: Transmitter is modulated with a 2500 Hz sine wave at an input level of 16 dB greater than that required to produce 50% of rated system deviation at 1000 Hz.

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

## 7.2 TEST DATA

**PLOT 7-1: OCCUPIED BANDWIDTH {25 KHZ CHANNEL BANDWIDTH: MASK B (AUDIO MODULATION: 2,500 HZ)}**

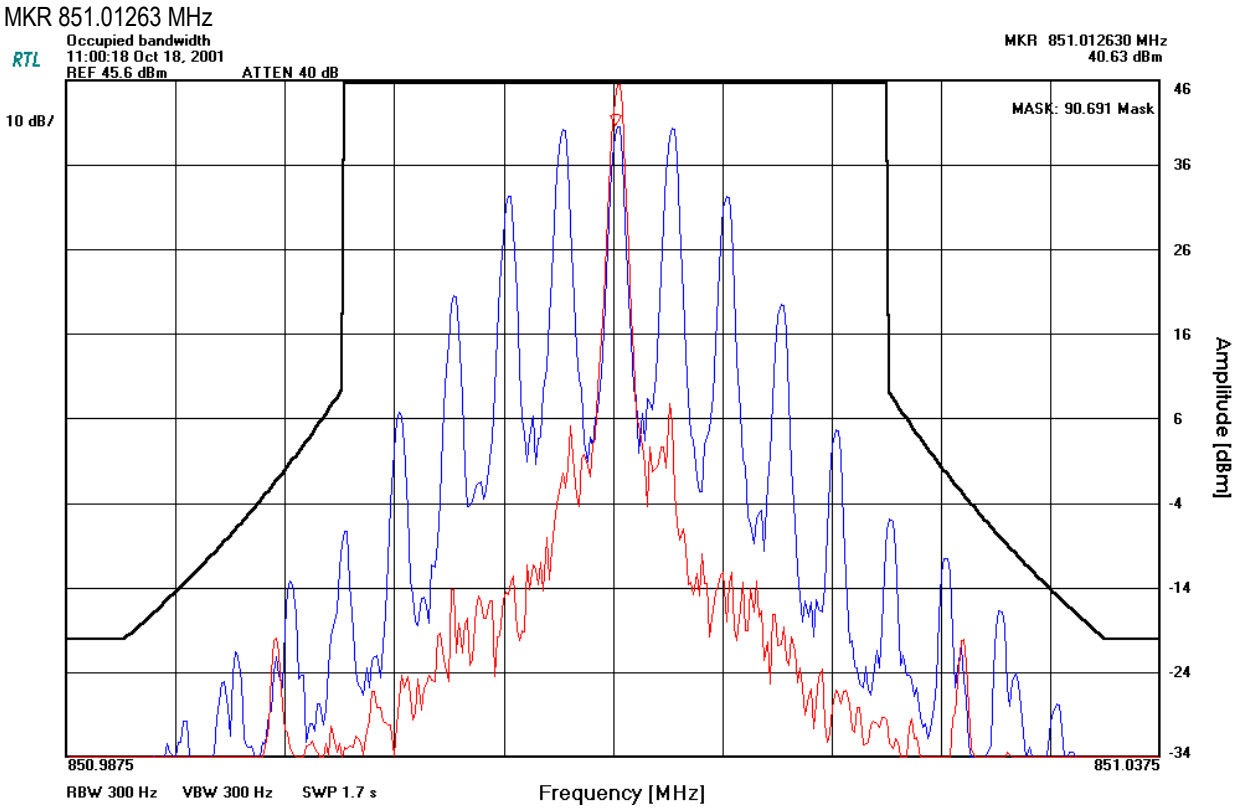
MKR 806.01263 MHz




TEST PERSONNEL:

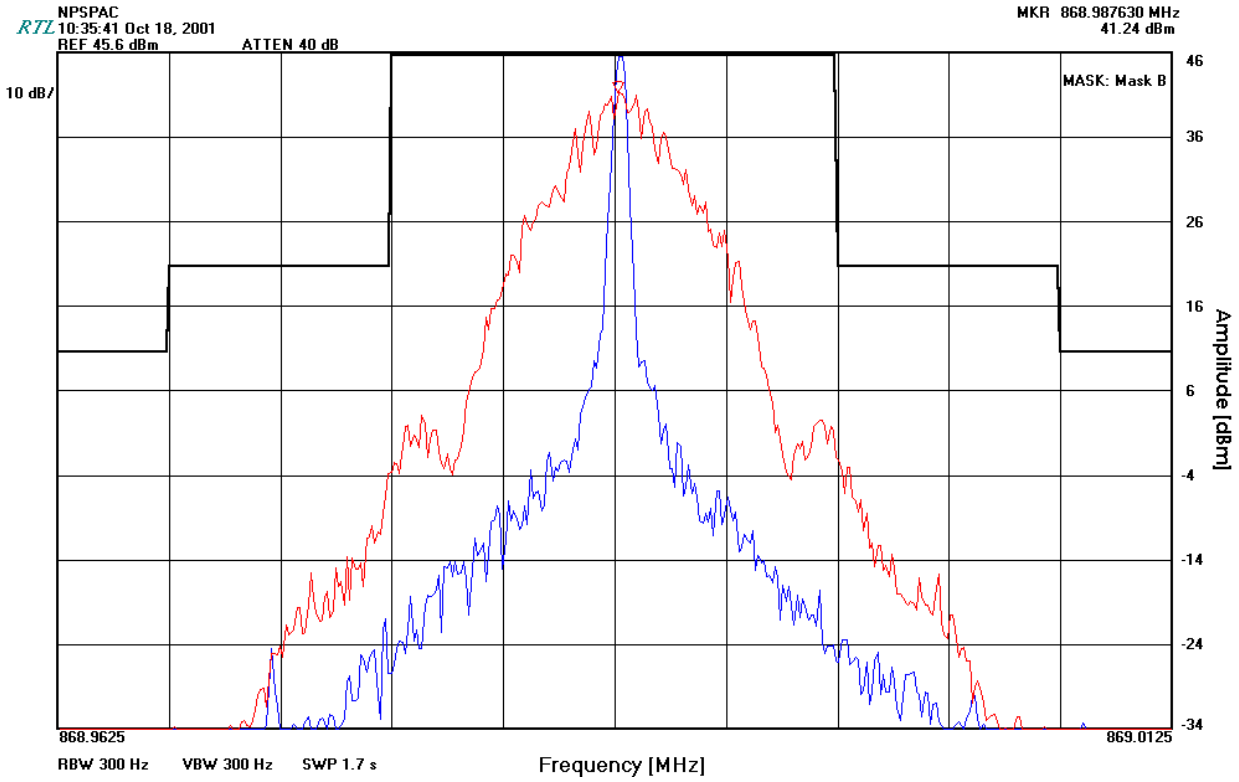
| | | |
|---|---|---|
| DANIEL BALTZELL | | OCTOBER 18, 2001 |
| TEST TECHNICIAN/ENGINEER | SIGNATURE | DATE OF TEST |

**PLOT 7-2: OCCUPIED BANDWIDTH {25 KHZ CHANNEL BANDWIDTH: MASK EA; FCC PART 90.691(AUDIO MODULATION: 2,500 HZ)}**



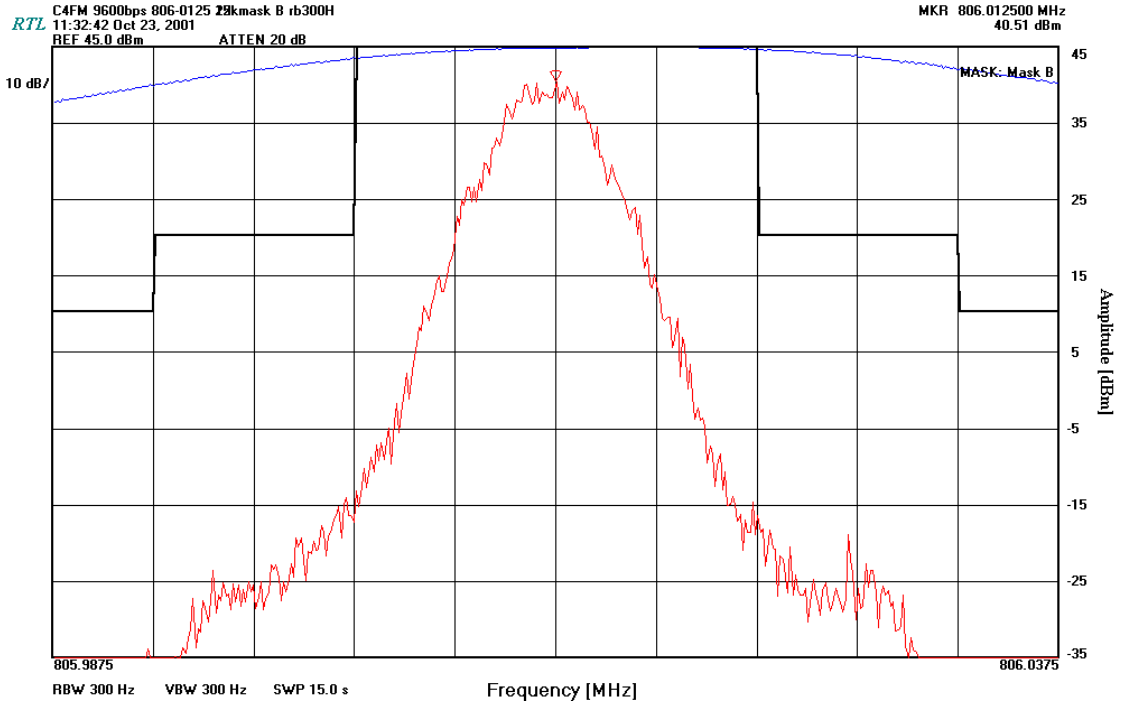
**PLOT 7-3: OCCUPIED BANDWIDTH {MASK B; (NPSPAC DIGITAL MODULATION)}**

MKR 868.98763 MHz



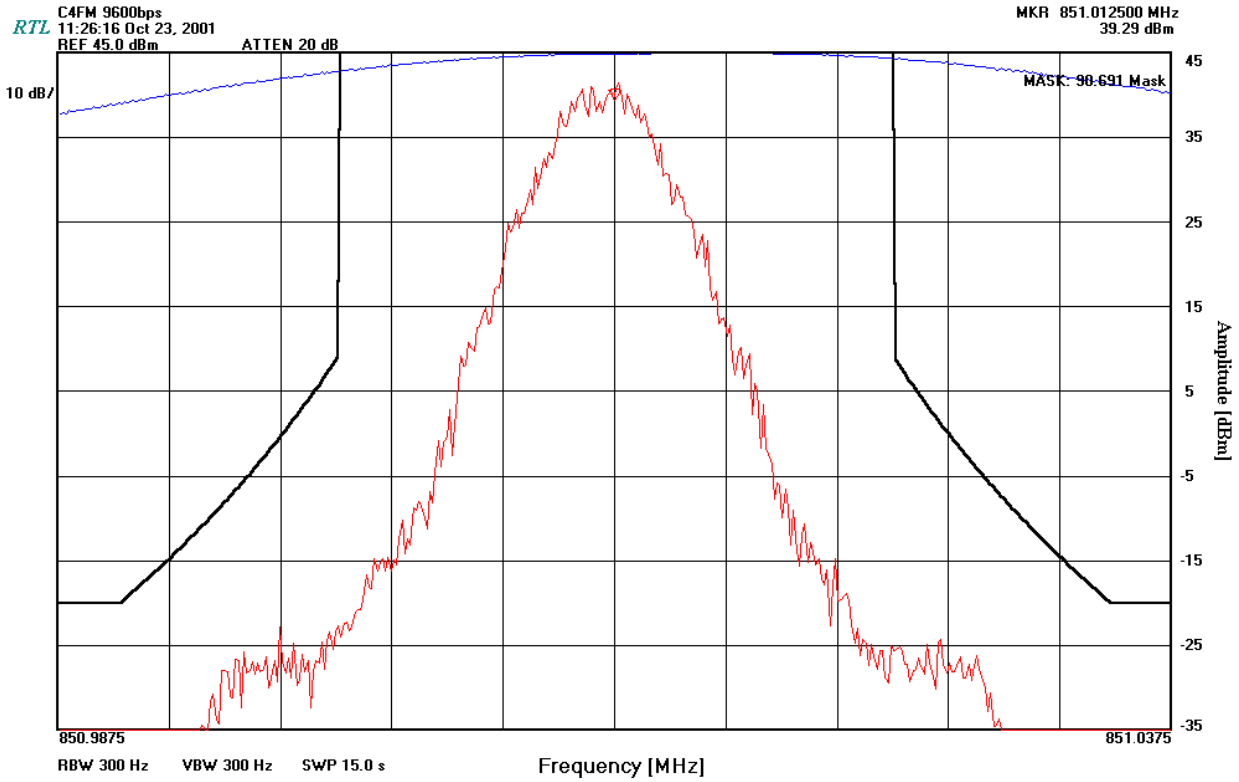

**PLOT 7-4: OCCUPIED BANDWIDTH { MASK B; (C4FM DIGITAL MODULATION)}**

MKR 806.0125 MHz



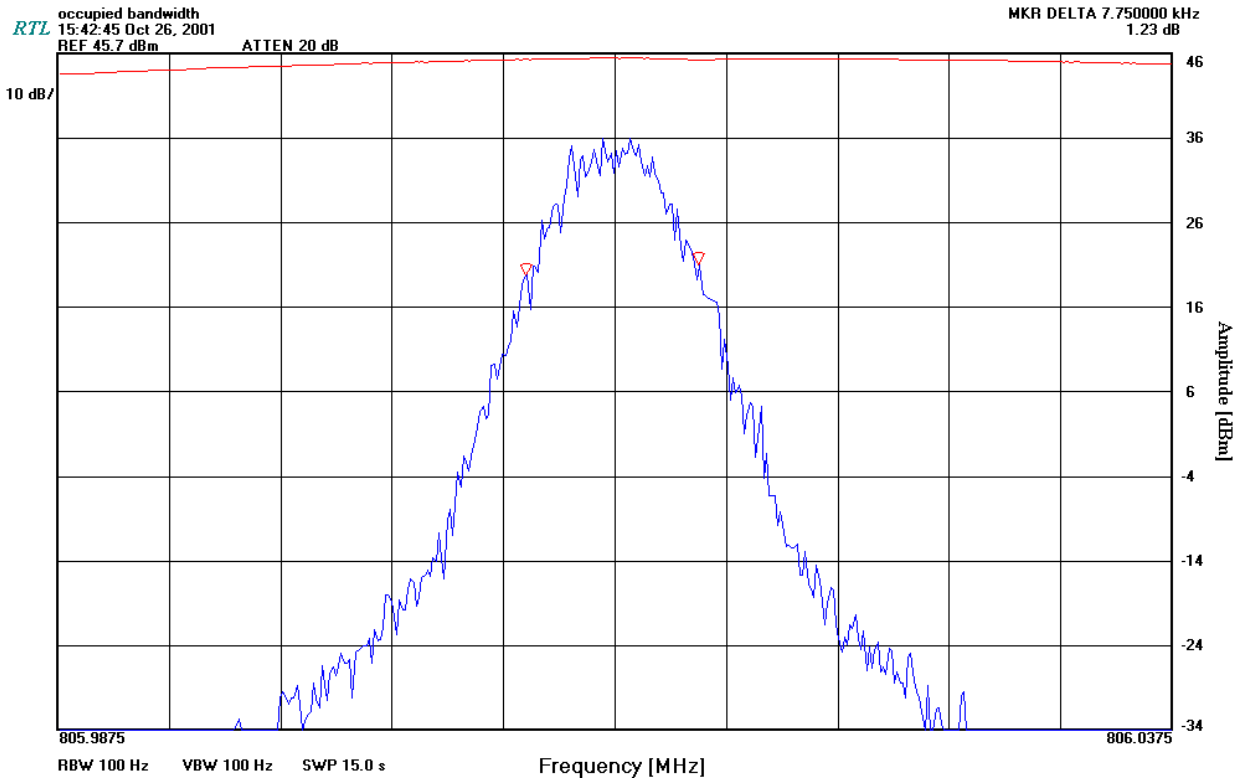
**PLOT 7-5: OCCUPIED BANDWIDTH { MASK EA; FCC PART 90.691(C4FM DIGITAL MODULATION)}**

MKR 851.0125 MHz



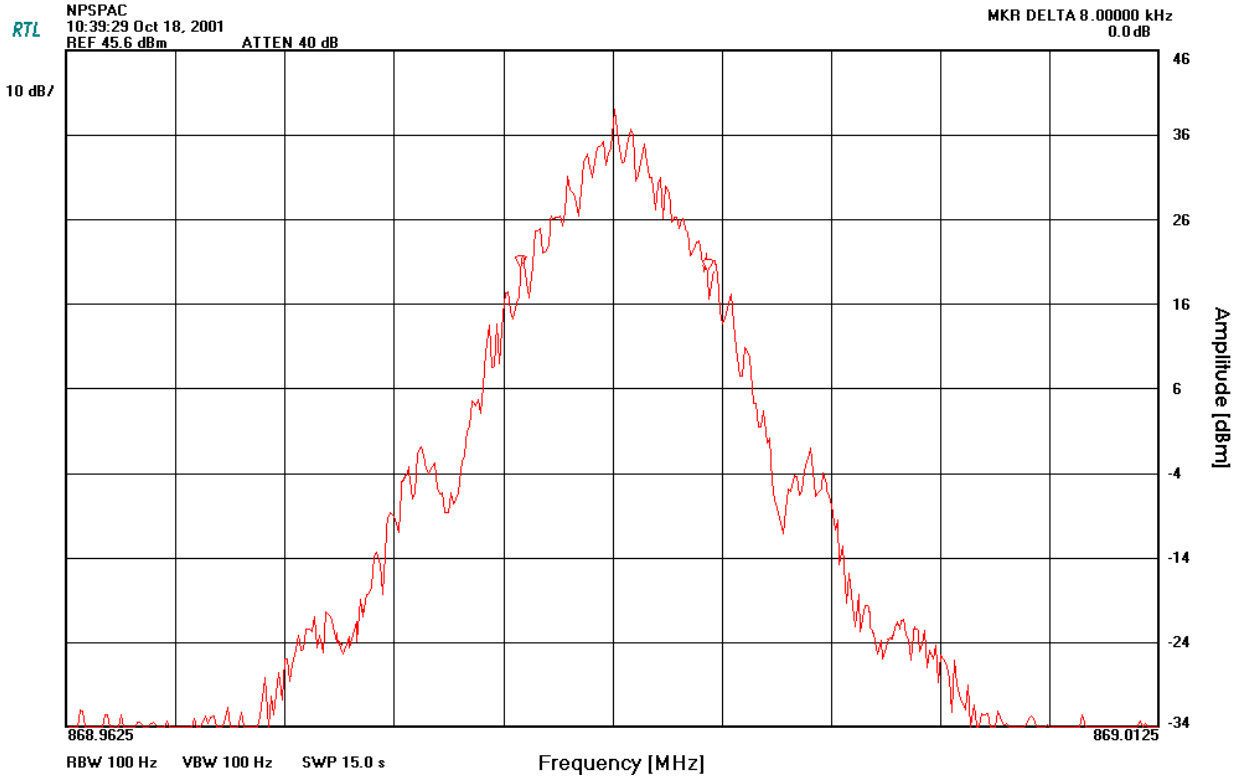

**PLOT 7-6: OCCUPIED BANDWIDTH (C4FM DIGITAL MODULATION)} – 99% POWER BANDWIDTH**

Bandwidth 7.75 kHz; 806.0125 MHz


RTL
occupied bandwidth
15:42:45 Oct 26, 2001
REF 45.7 dBm
ATTEN 20 dB
MKR DELTA 7.750000 kHz
1.23 dB
10 dB/
46
36
26
16
6
-4
-14
-24
-34
Amplitude [dBm]
805.9875
806.0375
RBW 100 Hz
VBW 100 Hz
SWP 15.0 s
Frequency [MHz]

**PLOT 7-7: OCCUPIED BANDWIDTH (NPSPAC DIGITAL MODULATION)} – 99% POWER BANDWIDTH**

Bandwidth 8.0 kHz; 868.9875 MHz




TEST PERSONNEL:

DANIEL BALTZELL
TEST TECHNICIAN/ENGINEER

SIGNATURE

OCTOBER 18, 2001
DATE OF TEST

**TABLE 7-1: TEST EQUIPMENT USED FOR TESTING (OCCUPIED BANDWIDTH)**

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number |
|---|---|---|---|---|
| 901020 | Hewlett Packard | 8564E | Portable Spectrum Analyzer (9 kHz - 40 GHz) | 3943A01719 |

# 8 FCC RULES AND REGULATION PART 2 §2.1055: FREQUENCY STABILITY

## 8.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, section 2.2.2

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

The EUT was evaluated over the temperature range -30°C to +50°C.

The temperature was initially set to -30°C and a 2-hour period was observed for stabilization of the EUT.
The frequency stability was measured within one minute after application of primary power to the transmitter. The temperature was raised at intervals of 10 degrees centigrade through the range. A ½ an hour period was observed to stabilize the EUT at each measurement step and the frequency stability was measured within one minute after application of primary power to the transmitter.
Additionally, the power supply voltage of the EUT was varied from 85% to 115% of the nominal voltage.

The worst-case test data are shown.

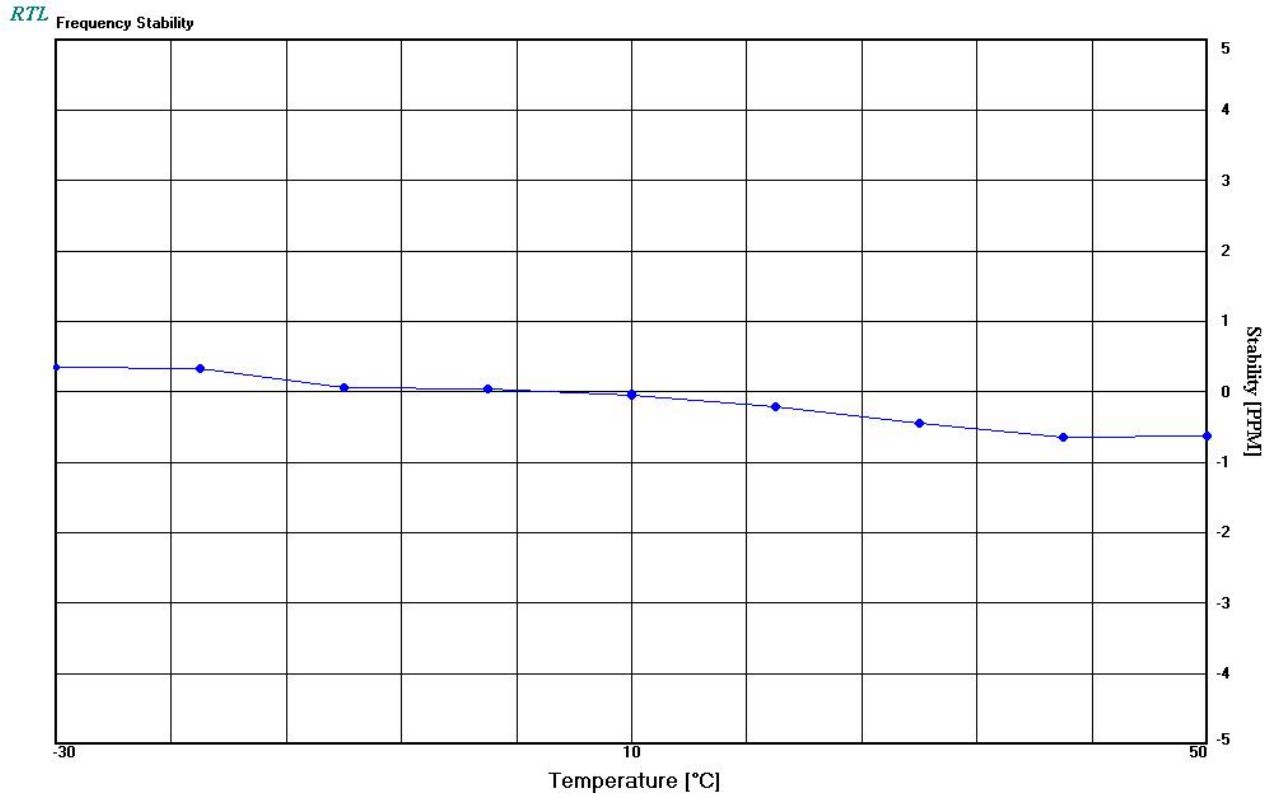
## 8.2 TEST DATA

### 8.2.1 FREQUENCY STABILITY/TEMPERATUARE VARIATION

Limit is 5 ppm for device with a 25 kHz channel bandwidth

The 35 Watt radio was tested with a 25 kHz channel bandwidth.

**PLOT 8-1: TEMPERATURE FREQUENCY STABILITY**




TEST PERSONNEL:

| | | |
|---|---|---|
| DANIEL BALTZELL | | OCTOBER 15, 2001 |
| TEST TECHNICIAN/ENGINEER | SIGNATURE | DATE OF TEST |

**TABLE 8-1: TEMPERATURE FREQUENCY STABILITY**

Worst case deviation was found to be at –30 C of 0.27 ppm.

Channel 5, 823.9875 MHz was measured and found to be as follows:

| Temperature ( C ) | Frequency Measured (MHz) | ppm |
|---|---|---|
| -30 | 823.988570 | 0.35 |
| -20 | 823.988550 | 0.33 |
| -10 | 823.988330 | -0.06 |
| 0 | 823.988320 | -0.05 |
| 10 | 823.988250 | -0.04 |
| 20 | 823.988110 | -0.21 |
| 30 | 823.987910 | -0.45 |
| 40 | 823.987750 | -0.64 |
| 50 | 823.987760 | -0.63 |

TEST PERSONNEL:

DANIEL BALTZELL — TEST TECHNICIAN/ENGINEER

SIGNATURE

OCTOBER 15, 2001 — DATE OF TEST

**TABLE 8-2: TEST EQUIPMENT USED FOR TESTING (FREQUENCY STABILITY/TEMPERATURE)**

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number | Calibration Due Date |
|---|---|---|---|---|---|
| 900946 | Tenney Engineering, Inc. | TH65 | Temperature Chamber with Humidity | 11380 | 11/07/01 |
| 901055 | Hewlett Packard | 8901A Opt. 002-003 | Modulation Analyzer | 2545A04102 | 06/08/01 |

**PLOT 8-2: FREQUENCY STABILITY/VOLTAGE VARIATION**

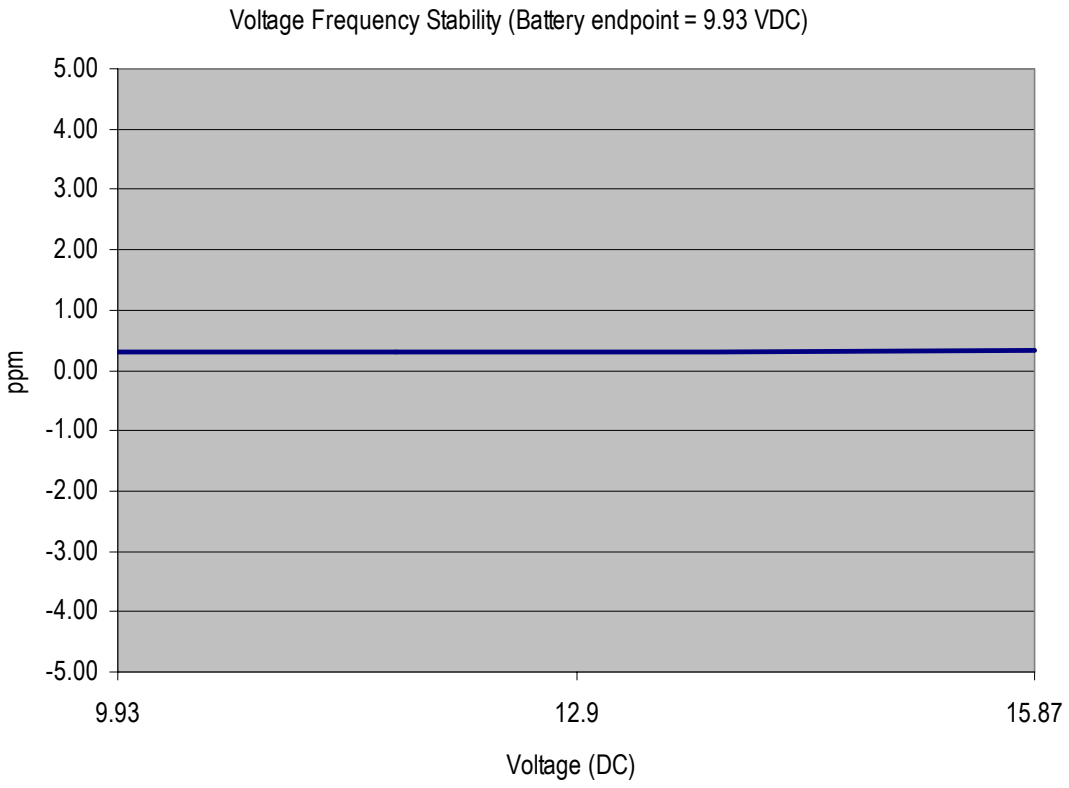



**TABLE 8-3: FREQUENCY STABILITY/VOLTAGE VARIATION**

The battery endpoint was measured at 9.93 VDC. The worse case variation is 0.33 ppm at 15.87 VDC. Channel 1, 806.0125 MHz was measured and found to be:

| Voltage (VDC) | Frequency Measured (MHz) | ppm |
|---|---|---|
| 9.93 | 806.0127380 | 0.30 |
| 11.73 | 806.0127500 | 0.31 |
| 13.8 (nominal) | 806.0127500 | 0.31 |
| 15.87 | 806.0127630 | 0.33 |

TEST PERSONNEL:

DANIEL BALTZELL — TEST TECHNICIAN/ENGINEER

SIGNATURE

OCTOBER 18, 2001 — DATE OF TEST

**TABLE 8-4: TEST EQUIPMENT USED FOR TESTING (FREQUENCY STABILITY/VOLTAGE)**

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number | Calibration Due Date |
|---|---|---|---|---|---|
| 900946 | Tenney Engineering, Inc. | TH65 | Temperature Chamber with Humidity | 11380 | 11/07/01 |
| 901055 | Hewlett Packard | 8901A Opt. 002-003 | Modulation Analyzer | 2545A04102 | 06/08/01 |

# 9 FCC PART 2 §2.1047 (A): MODULATION CHARACTERISTICS - AUDIO FREQUENCY RESPONSE

## 9.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, section 2.2.6

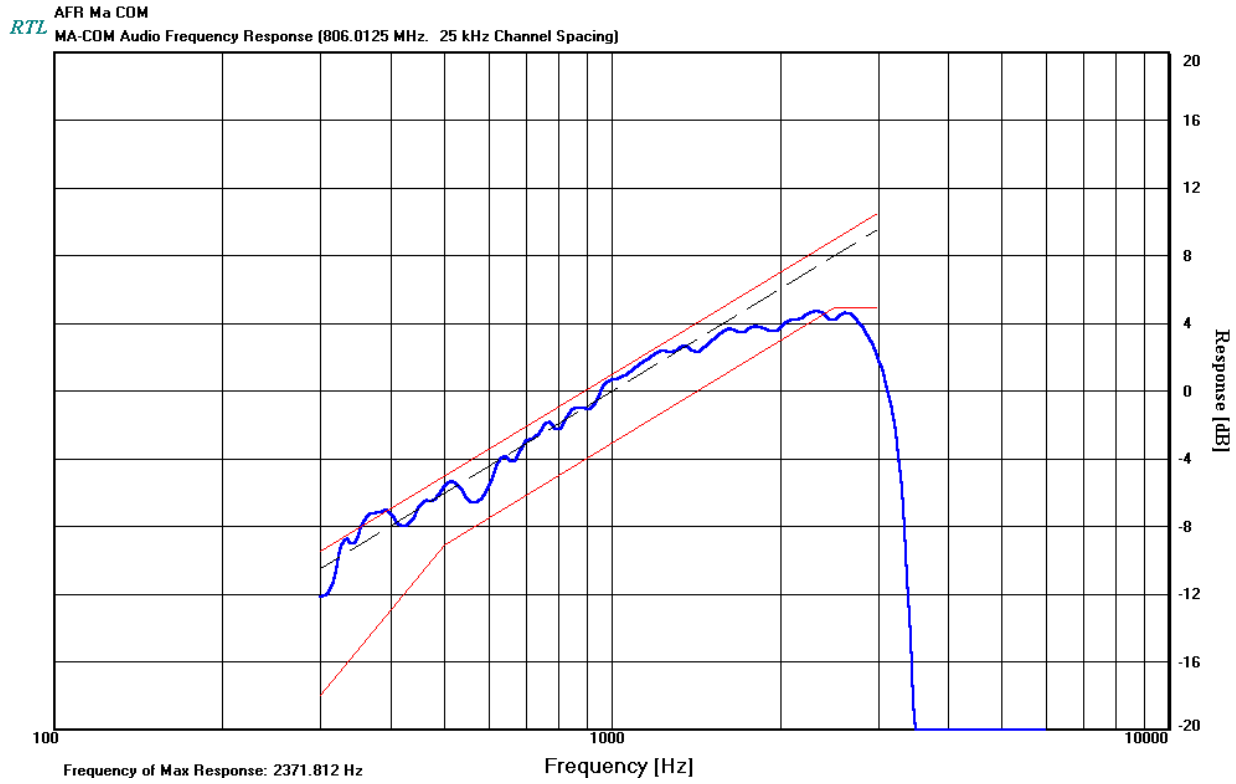
The audio frequency response is the degree of closeness to which the frequency deviation of the transmitter follows a prescribed characteristic.

The input audio level at 1000 Hz is set to produce 20% of the rated system deviation. This point is shown as the 0 dB reference level, noted DEVref.
The audio signal generator was varied from 100Hz to 5kHz with the input level held constant.
The deviation in kHz was recorded using a modulation analyzer as DEVfreq.
The response in dB relative to 1 kHz was calculated as follows:

Audio Frequency Response = 20 LOG (DEVfreq/DEVref)

## 9.2 TEST DATA

### PLOT 9-1: MODULATION CHARACTERISTICS - AUDIO FREQUENCY RESPONSE {25 KHZ CHANNEL BANDWIDTH}




TEST PERSONNEL:

DANIEL BALTZELL
TEST TECHNICIAN/ENGINEER

SIGNATURE

OCTOBER 10, 2001
DATE OF TEST

### TABLE 9-1: TEST EQUIPMENT USED FOR TESTING (AUDIO FREQUENCY RESPONSE)

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number | Calibration Due Date |
|---|---|---|---|---|---|
| 901057 | Hewlett Packard | 3336B | Synthesizer/Level Generator | 2514A02585 | 06/21/01 |
| 901055 | Hewlett Packard | 8901A Opt. 002-003 | Modulation Analyzer | 2545A04102 | 06/08/01 |
| 901054 | Hewlett Packard | 3586B | Selective Level Meter | 1928A01892 | 06/08/01 |

## 10 FCC PART 2 §2.1047 (A): MODULATION CHARACTERISTICS – AUDIO LOW PASS FILTER

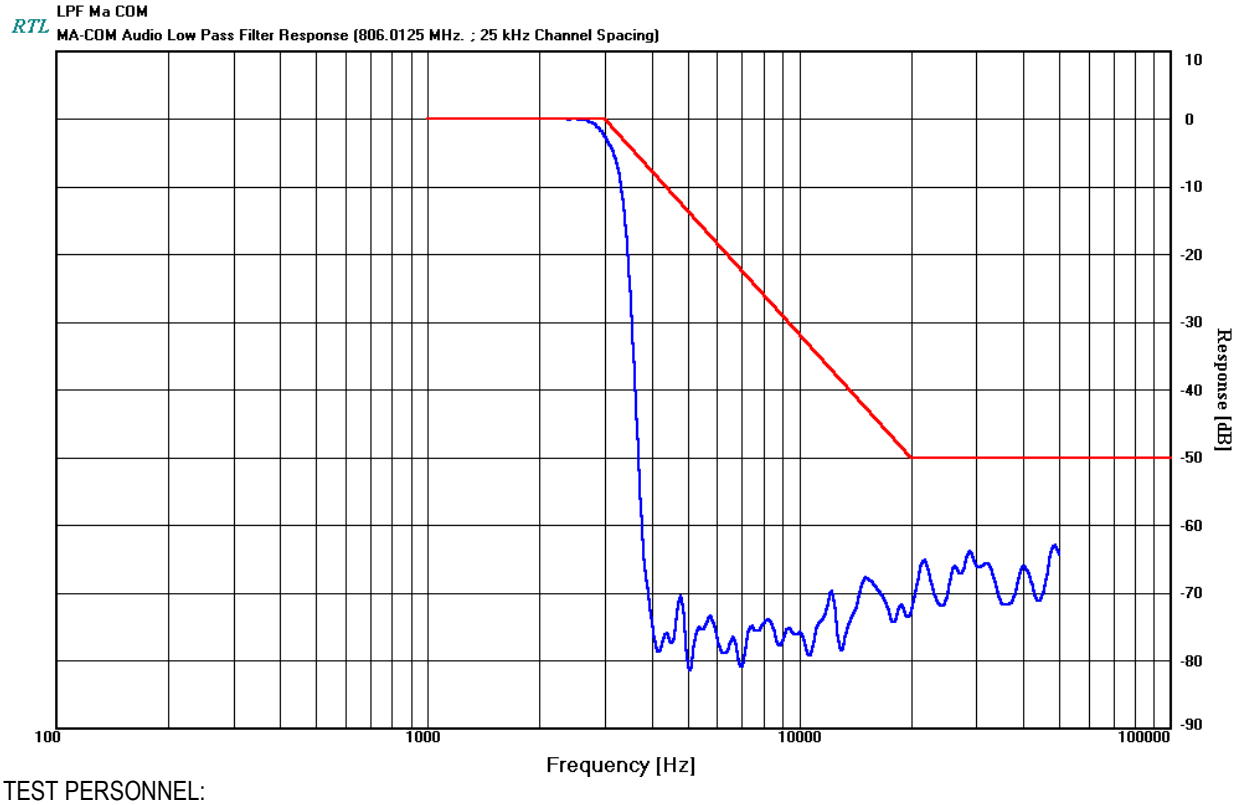
### 10.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, 2.2.15

The Audio Low Pass Filter Response is the frequency response of the post limiter low pass filter circuit above 3000 Hz.

### 10.2 TEST DATA

**PLOT 10-1: MODULATION CHARACTERISTICS – AUDIO LOW PASS FILTER**




TEST PERSONNEL:

DANIEL BALTZELL
TEST TECHNICIAN/ENGINEER

SIGNATURE

OCTOBER 10, 2001
DATE OF TEST

**TABLE 10-1: TEST EQUIPMENT USED FOR TESTING (AUDIO LOW PASS FILTER RESPONSE)**

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number | Calibration Due Date |
|---|---|---|---|---|---|
| 901057 | Hewlett Packard | 3336B | Synthesizer/Level Generator | 2514A02585 | 06/21/01 |
| 901055 | Hewlett Packard | 8901A Opt. 002-003 | Modulation Analyzer | 2545A04102 | 06/08/01 |
| 901054 | Hewlett Packard | 3586B | Selective Level Meter | 1928A01892 | 06/08/01 |

# 11 FCC RULES AND REGULATIONS PART 2 §2.1047 (B): MODULATION CHARACTERISTICS - MODULATION LIMITING

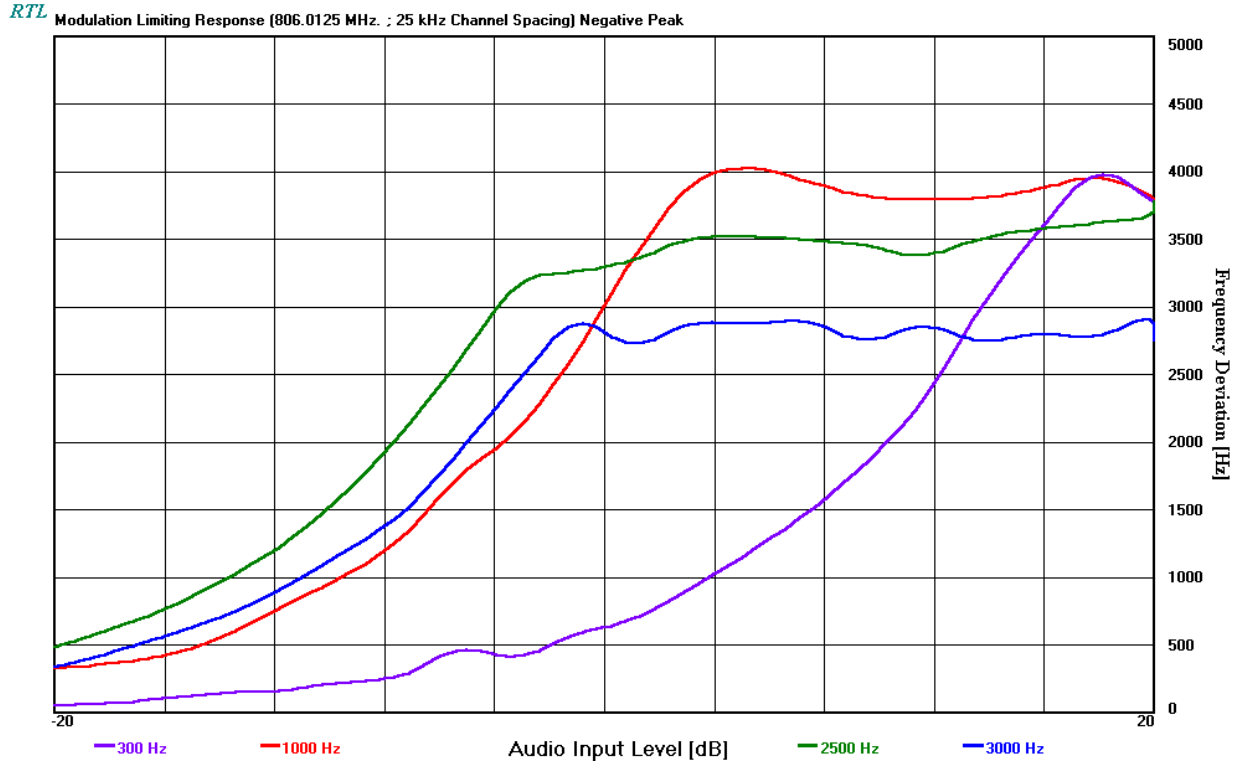
## 11.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, section 2.2.3

The transmitter is adjusted for full rated system deviation. The audio input level is adjusted for 60% of rated system deviation at 1000Hz. Using this level as a reference (0dB) the audio input level is varied from the reference to a level +20 dB above it and –20 dB under it, for modulation frequencies of 300Hz, 1,000Hz, and 2,500Hz. The system deviation obtained as a function of the input level is recorded.
Both Positive and Negative Peak deviations were recorded.

## 11.2 TEST DATA

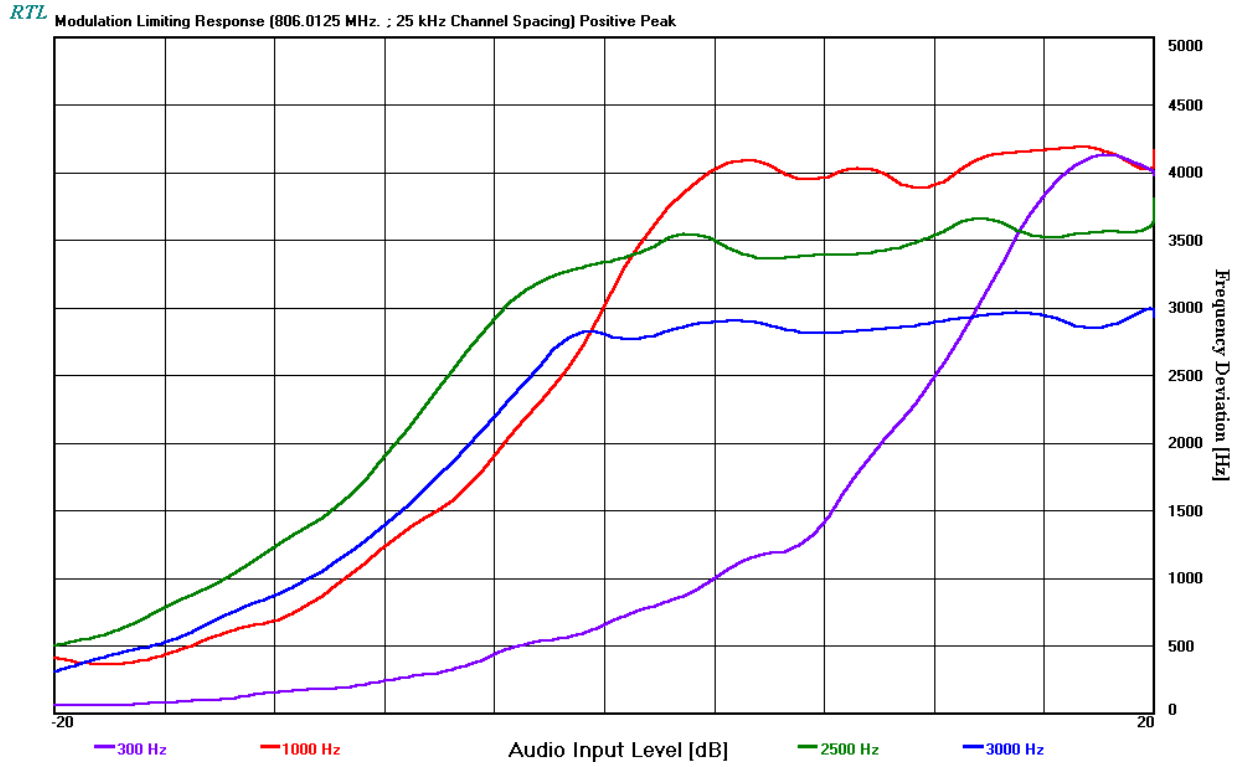
**PLOT 11-1: MODULATION CHARACTERISTICS – MODULATION LIMITING: WIDE BAND NEGATIVE PEAK**




TEST PERSONNEL:

| | | |
|---|---|---|
| DANIEL BALTZELL | | OCTOBER 10, 2001 |
| TEST TECHNICIAN/ENGINEER | SIGNATURE | DATE OF TEST |

**PLOT 11-2: MODULATION CHARACTERISTICS – MODULATION LIMITING: WIDE BAND POSITIVE PEAK**




TEST PERSONNEL:

| | | |
|---|---|---|
| DANIEL BALTZELL | | OCTOBER 10, 2001 |
| TEST TECHNICIAN/ENGINEER | SIGNATURE | DATE OF TEST |

**TABLE 11-1: TEST EQUIPMENT USED FOR TESTING (MODULATION LIMITING)**

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number | Calibration Due Date |
|---|---|---|---|---|---|
| 901057 | Hewlett Packard | 3336B | Synthesizer/Level Generator | 2514A02585 | 06/21/01 |
| 901055 | Hewlett Packard | 8901A Opt. 002-003 | Modulation Analyzer | 2545A04102 | 06/08/01 |
| 901054 | Hewlett Packard | 3586B | Selective Level Meter | 1928A01892 | 06/08/01 |

## 12 FCC RULES AND REGULATIONS PART 2.202: NECESSARY BANDWIDTH AND EMISSION BANDWIDTH

Type of Emission: F3E, F1D, F1E

Necessary Bandwidth and Emission Bandwidth:

Voice - 25kHz channel: 16K0F3E
Calculation:
Max modulation(M) in kHz : 3
Max deviation (D) in kHz: 5
Constant factor (K) : 1 (assumed)
Bn = 2xM+2xDK

Digital voice and data – Talk-around and NPSPAC 20kHz channel/9600 bps
Calculation:
Max modulation(B) in kHz : 4.8
Max deviation (D) in kHz: 4.0
Constant factor (K) : 1(assumed)
Bn = B+2xDK = 12.8 KHz
Emission designator: 12K8F1D, 12K8F1E
Measurement: 99% Occupied Bandwidth
Bn = 8.0 KHz
Emission designator: 8K00F1D, 8K00F1E

C4FM – 9600 bps: 8K10F1D, 8K10F1E
Measurement: 99% Occupied Bandwidth
Bn = 8.1 KHz