

## **10 FCC RULES AND REGULATION PART 2 §2.1055: FREQUENCY STABILITY; PART 90 §90.539: FREQUENCY STABILITY; RSS-119 §7: FREQUENCY STABILITY**

### **10.1 Test Procedure**

ANSI/TIA/EIA-603-2002, 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 +60°C.

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

Limit for 800 band:

§90.213: Mobile stations over 2 W operating power - 1.5 ppm.

Limit for 700 band:

§90.539: Transmitters designed to operate in 764-776 MHz and 794-806 MHz frequency bands must meet the frequency stability requirements in this section.

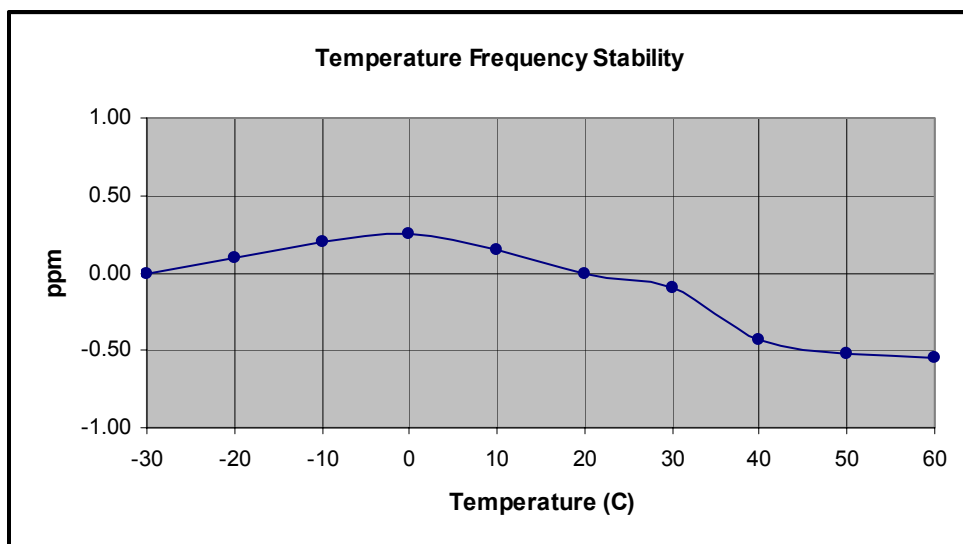
- (a) Mobile, portable and control transmitters must normally use automatic frequency control (AFC) to lock on to the base station signal.
- (b) The frequency stability of base transmitters operating in the narrowband segment must be 100 parts per billion or better.
- (c) The frequency stability of mobile, portable, and control transmitters operating in the narrowband segment must be 400 parts per billion or better when AFC is locked to the base station.

Note: When AFC is not locked to the base station, the frequency stability must be at least 1.0 ppm for 6.25 kHz, 1.5 ppm for 12.5 kHz (2 channel aggregate), and 2.5 ppm for 25 kHz (4 channel aggregate).

## 10.2 Test Data

### 10.2.1 Frequency Stability/Temperature Variation

**PLOT 10-1: TEMPERATURE FREQUENCY STABILITY – 800 BAND**

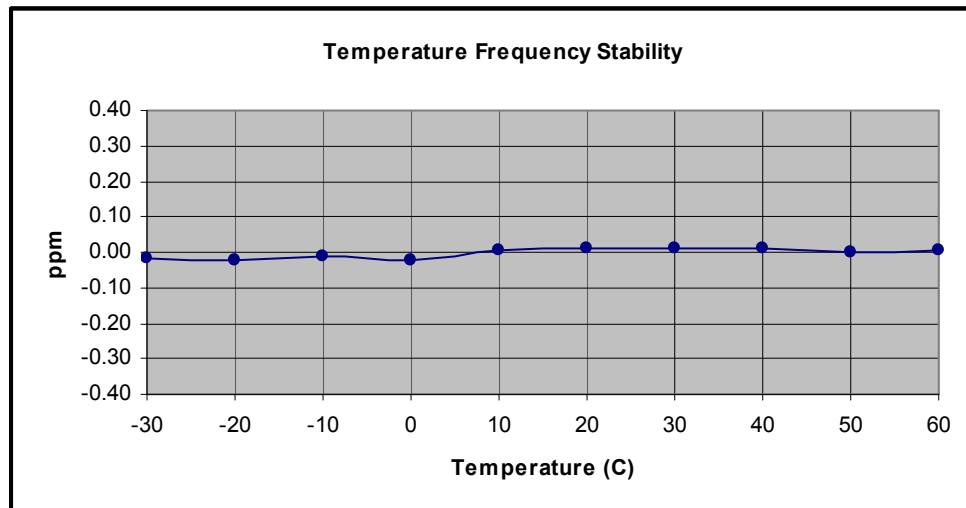


**TABLE 10-1: TEMPERATURE FREQUENCY STABILITY – 806.0125 MHZ**

Worst-case deviation was found to be -0.55 ppm

| Temperature (C) | Measured Frequency (MHz) | ppm   |
|-----------------|--------------------------|-------|
| -30             | 806.012295               | 0.00  |
| -20             | 806.012369               | 0.09  |
| -10             | 806.012458               | 0.20  |
| 0               | 806.012497               | 0.25  |
| 10              | 806.012412               | 0.15  |
| 20              | 806.012295               | 0.00  |
| 30              | 806.012215               | -0.10 |
| 40              | 806.011946               | -0.43 |
| 50              | 806.011872               | -0.52 |
| 60              | 806.011851               | -0.55 |

**PLOT 10-2: TEMPERATURE FREQUENCY STABILITY – 700 BAND**



**TABLE 10-2: TEMPERATURE FREQUENCY STABILITY – 794.0125 MHZ**

Worst-case deviation was found to be -.02 ppm

| Temperature (C) | Measured Frequency (MHz) | ppm   |
|-----------------|--------------------------|-------|
| -30             | 794.0119865              | -0.02 |
| -20             | 794.0119819              | -0.02 |
| -10             | 794.0119915              | -0.01 |
| 0               | 794.0119828              | -0.02 |
| 10              | 794.0120035              | 0.01  |
| 20              | 794.0120065              | 0.01  |
| 30              | 794.0120082              | 0.01  |
| 40              | 794.0120085              | 0.01  |
| 50              | 794.0120009              | 0.00  |
| 60              | 794.0120016              | 0.00  |

**TABLE 10-3: TEST EQUIPMENT USED FOR TESTING FREQUENCY STABILITY/TEMPERATURE**

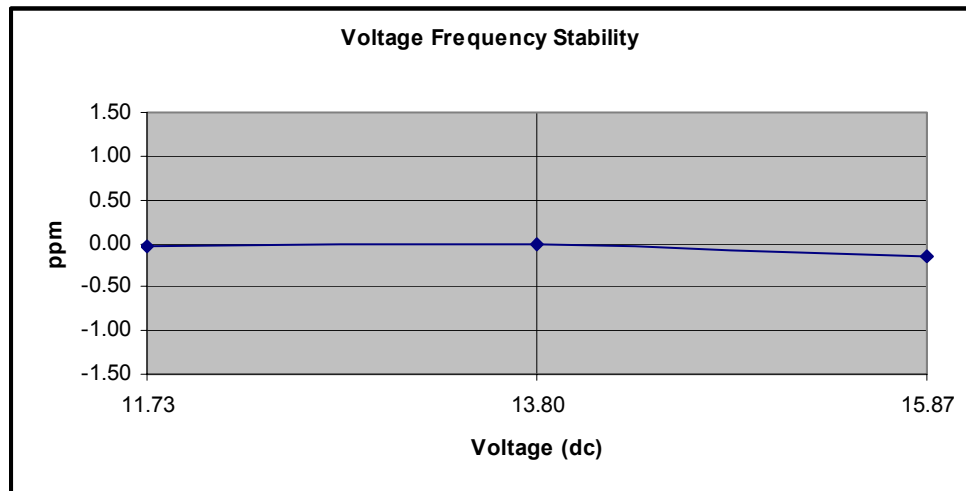
| RTL Asset # | Manufacturer             | Model  | Part Type                         | Serial Number | Calibration Date |
|-------------|--------------------------|--------|-----------------------------------|---------------|------------------|
| 900946      | Tenney Engineering, Inc. | TH65   | Temperature Chamber with Humidity | 11380         | 02/04/06         |
| 901300      | Agilent                  | 53131A | Frequency Counter                 | MY40001345    | 11/17/05         |

**TEST PERSONNEL:**

|                          |                                                                                   |                 |
|--------------------------|-----------------------------------------------------------------------------------|-----------------|
| Daniel Biggs             |  | August 24, 2005 |
| Test Technician/Engineer | Signature                                                                         | Date Of Test    |

## 10.2.2 Frequency Stability/Voltage Variation

**PLOT 10-3: VOLTAGE FREQUENCY STABILITY – 800 BAND**

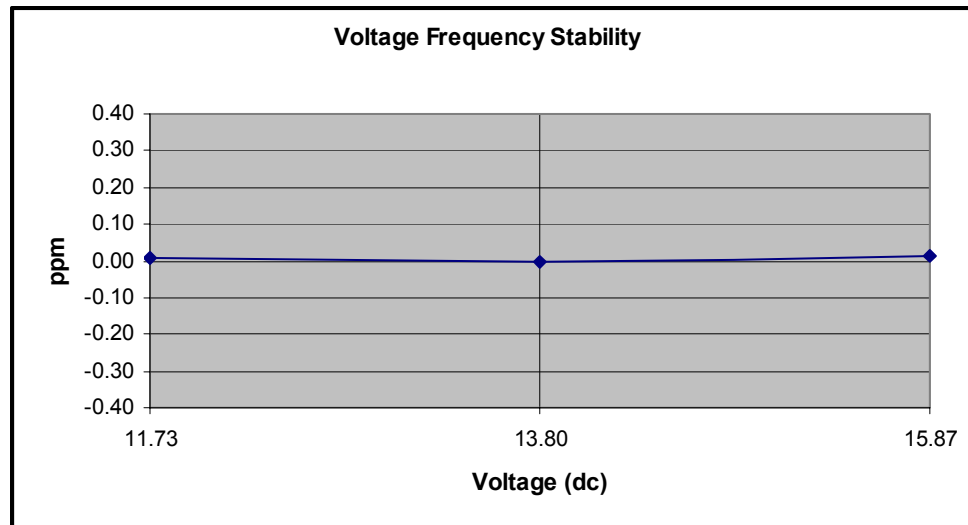


**TABLE 10-4: FREQUENCY STABILITY/VOLTAGE VARIATION – 806.0125 MHZ**

Worst-case variation is -.15 ppm

| Voltage (VDC) | Measured Frequency (MHz) | ppm   |
|---------------|--------------------------|-------|
| 11.73         | 806.011975               | -0.04 |
| 13.80         | 806.012004               | 0.00  |
| 15.87         | 806.011884               | -0.15 |

**PLOT 10-4: VOLTAGE FREQUENCY STABILITY – 700 BAND**



**TABLE 10-5: FREQUENCY STABILITY/VOLTAGE VARIATION – 794.0125 MHZ**

Worst-case variation is -.01 ppm

| Voltage (VDC) | Measured Frequency (MHz) | ppm  |
|---------------|--------------------------|------|
| 11.73         | 794.0119865              | 0.01 |
| 13.80         | 794.0119819              | 0.00 |
| 15.87         | 794.0119915              | 0.01 |

**TABLE 10-6: TEST EQUIPMENT USED FOR TESTING FREQUENCY STABILITY/VOLTAGE**

| RTL Asset # | Manufacturer | Model  | Part Type         | Serial Number | Calibration Date |
|-------------|--------------|--------|-------------------|---------------|------------------|
| 901300      | Agilent      | 53131A | Frequency Counter | MY40001345    | 11/17/05         |
| 901350      | Meterman     | 33XR   | Multimeter        | 040402802     | 08/03/06         |

TEST PERSONNEL:

|                          |                                                                                     |                 |
|--------------------------|-------------------------------------------------------------------------------------|-----------------|
| Daniel Biggs             |  | August 25, 2005 |
| Test Technician/Engineer | Signature                                                                           | Date Of Test    |

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

### 11.1 Test Procedure

ANSI/TIA/EIA-603-2002, section 2.2.6

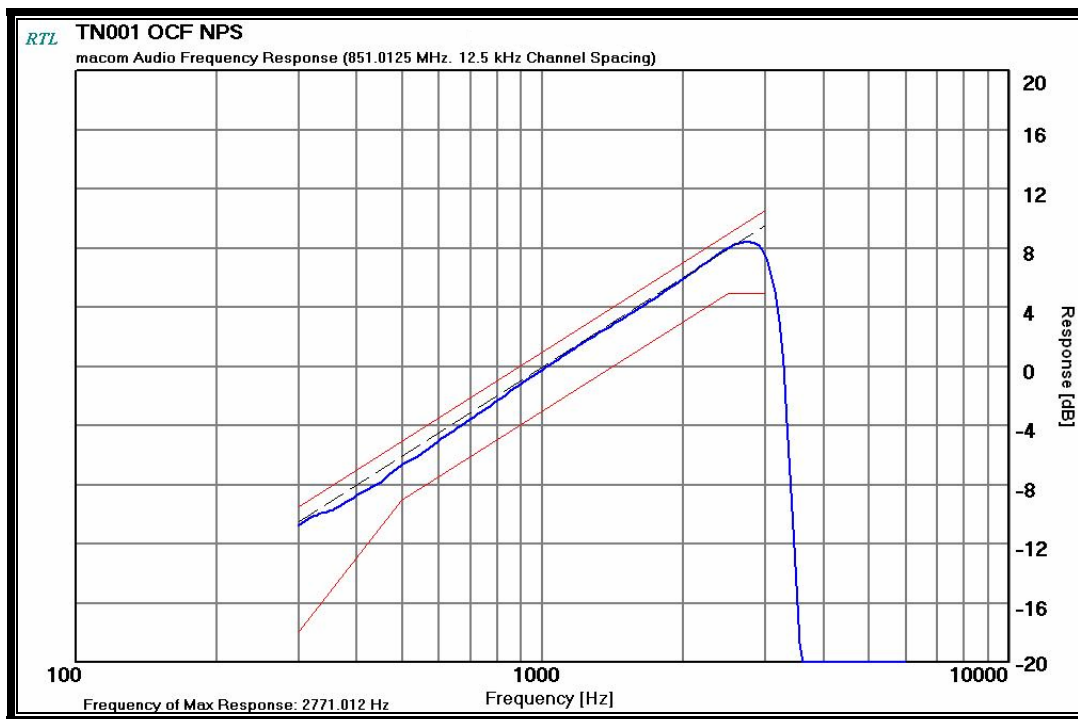
The audio frequency response is the degree of closeness to which the frequency deviation of the transmitter follows a prescribed characteristic.

The input audio level at 1000 Hz was 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 100 Hz to 5 kHz 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:

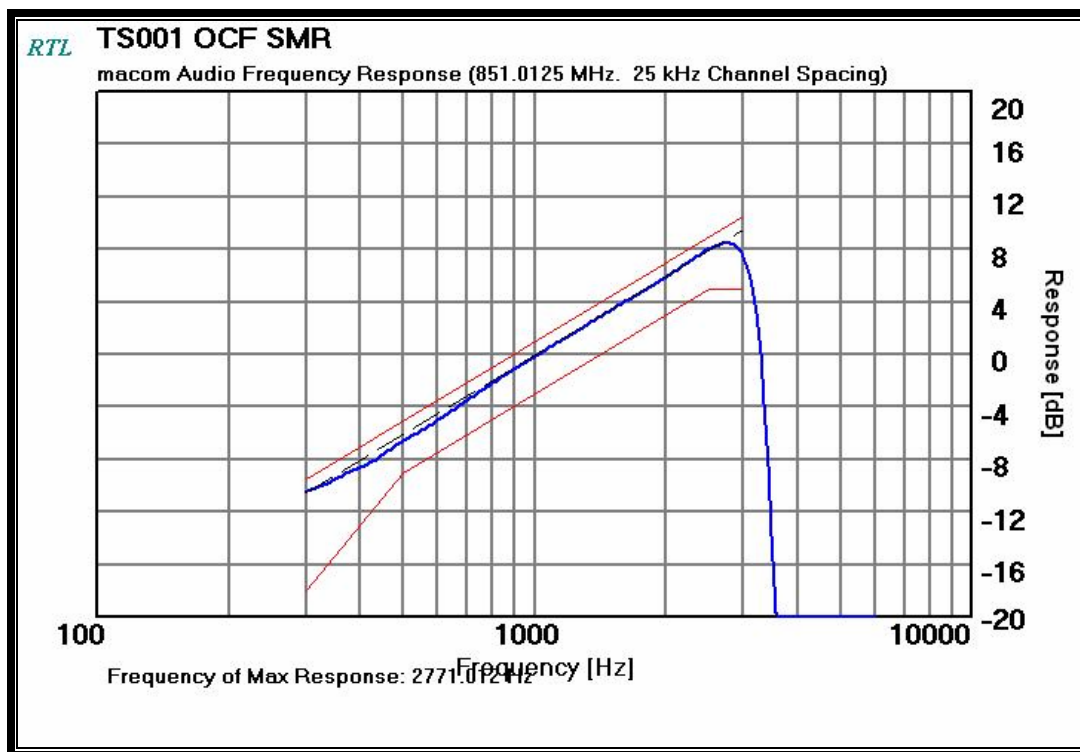
$$\text{Audio Frequency Response} = 20 \text{ LOG } (\text{DEVfreq}/\text{DEVref})$$

### 11.2 Test Data

#### PLOT 11-1: MODULATION CHARACTERISTICS - AUDIO FREQUENCY RESPONSE – NPSPAC



**PLOT 11-2: MODULATION CHARACTERISTICS - AUDIO FREQUENCY RESPONSE – SMR**



**TABLE 11-1: 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    | 09/08/05             |
| 901118      | Hewlett Packard | 8901A Opt. 002-003 | Modulation Analyzer         | 2406A00178    | 07/13/06             |
| 901054      | Hewlett Packard | 3586B              | Selective Level Meter       | 1928A01892    | 09/08/05             |

**TEST PERSONNEL:**

|                          |                                                                                     |                |
|--------------------------|-------------------------------------------------------------------------------------|----------------|
| Daniel Biggs             |  | August 8, 2005 |
| Test Technician/Engineer | Signature                                                                           | Date Of Test   |

## 12 FCC PART 2 §2.1047(A): MODULATION CHARACTERISTICS – AUDIO LOW PASS FILTER; RSS-119 §6.6: AUDIO LOW-PASS FILTER

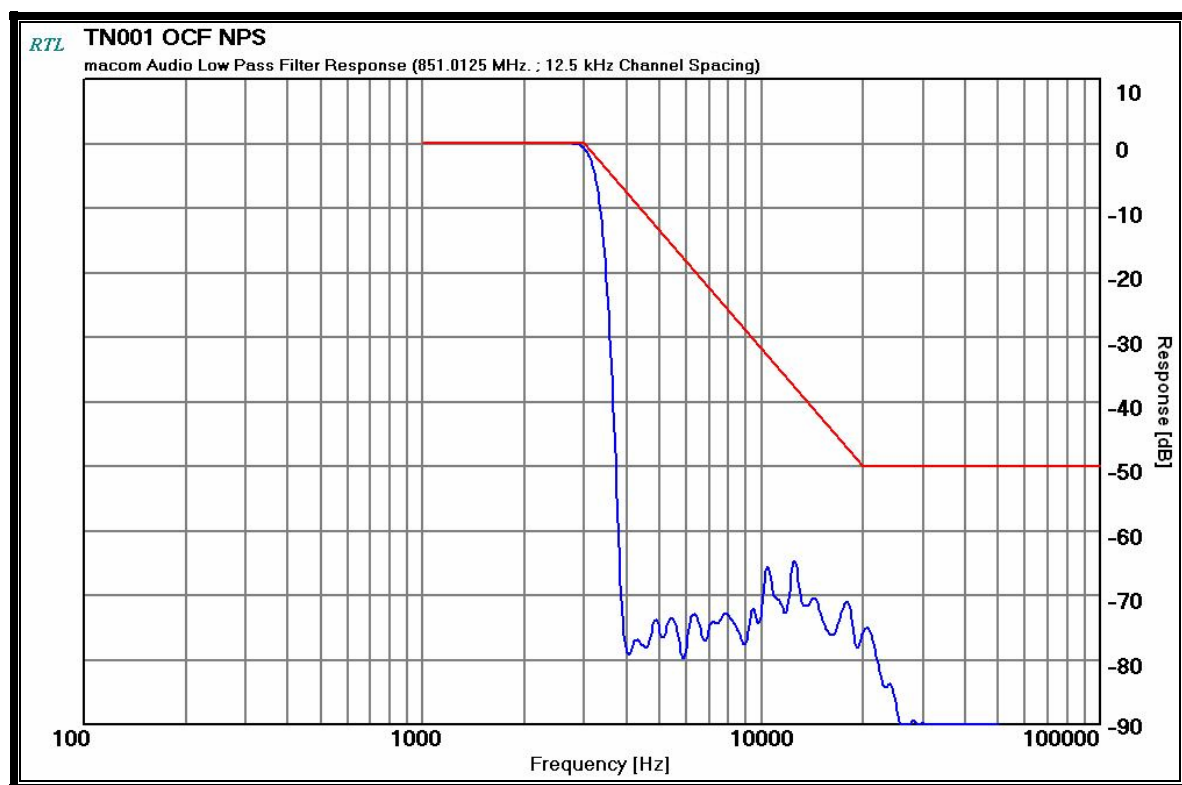
### 12.1 Test Procedure

ANSI/TIA/EIA-603-2002, 2.2.15

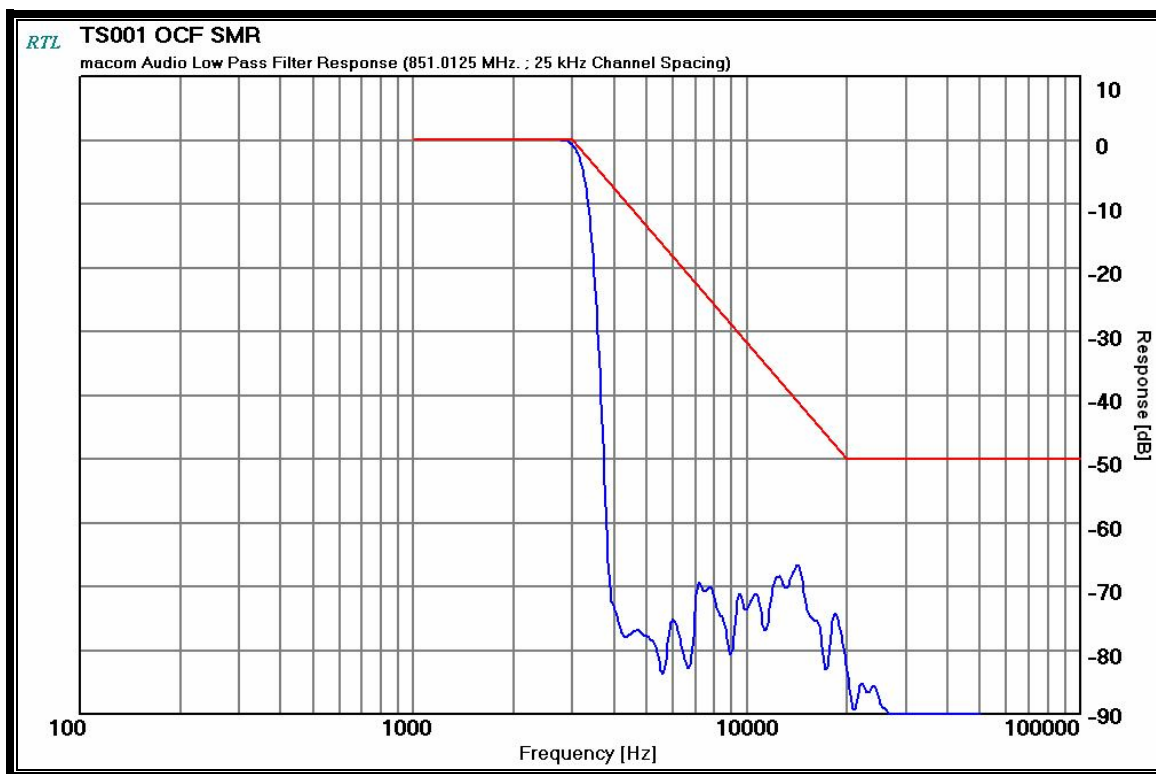
The Audio Low Pass Filter Response is the frequency response of the post limiter low pass filter circuit above 3000 Hz.

### 12.2 Test Data

PLOT 12-1: MODULATION CHARACTERISTICS – AUDIO LOW PASS FILTER – NPSPAC



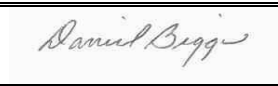
**PLOT 12-2: MODULATION CHARACTERISTICS – AUDIO LOW PASS FILTER – SMR**



**TABLE 12-1: 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    | 09/08/05             |
| 901118      | Hewlett Packard | 8901A Opt. 002-003 | Modulation Analyzer         | 2406A00178    | 07/13/06             |
| 901054      | Hewlett Packard | 3586B              | Selective Level Meter       | 1928A01892    | 09/08/05             |

**TEST PERSONNEL:**

|                          |                                                                                     |                |
|--------------------------|-------------------------------------------------------------------------------------|----------------|
| Daniel Biggs             |  | August 8, 2005 |
| Test Technician/Engineer | Signature                                                                           | Date Of Test   |

### 13 FCC RULES AND REGULATIONS PART 2 §2.1047(B): MODULATION CHARACTERISTICS - MODULATION LIMITING; RSS-119 §6.6: FM MODULATION LIMITING AND AUDIO LOW-PASS FILTER

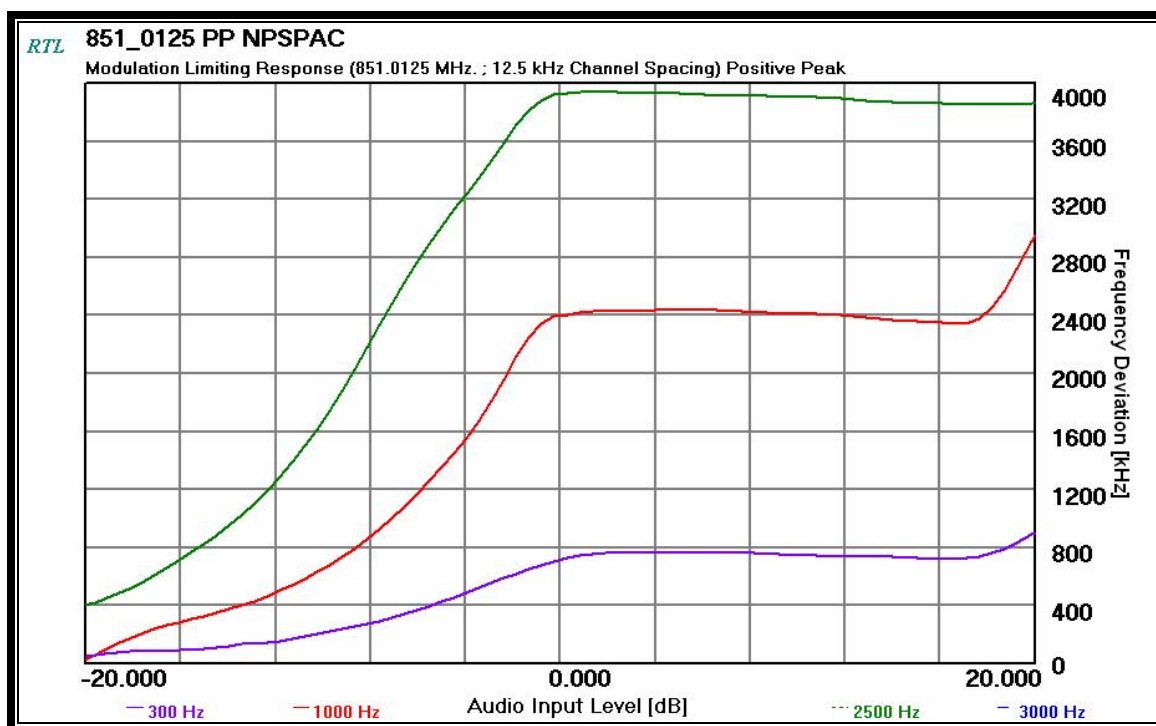
#### 13.1 Test Procedure

ANSI/TIA/EIA-603-2002, section 2.2.3

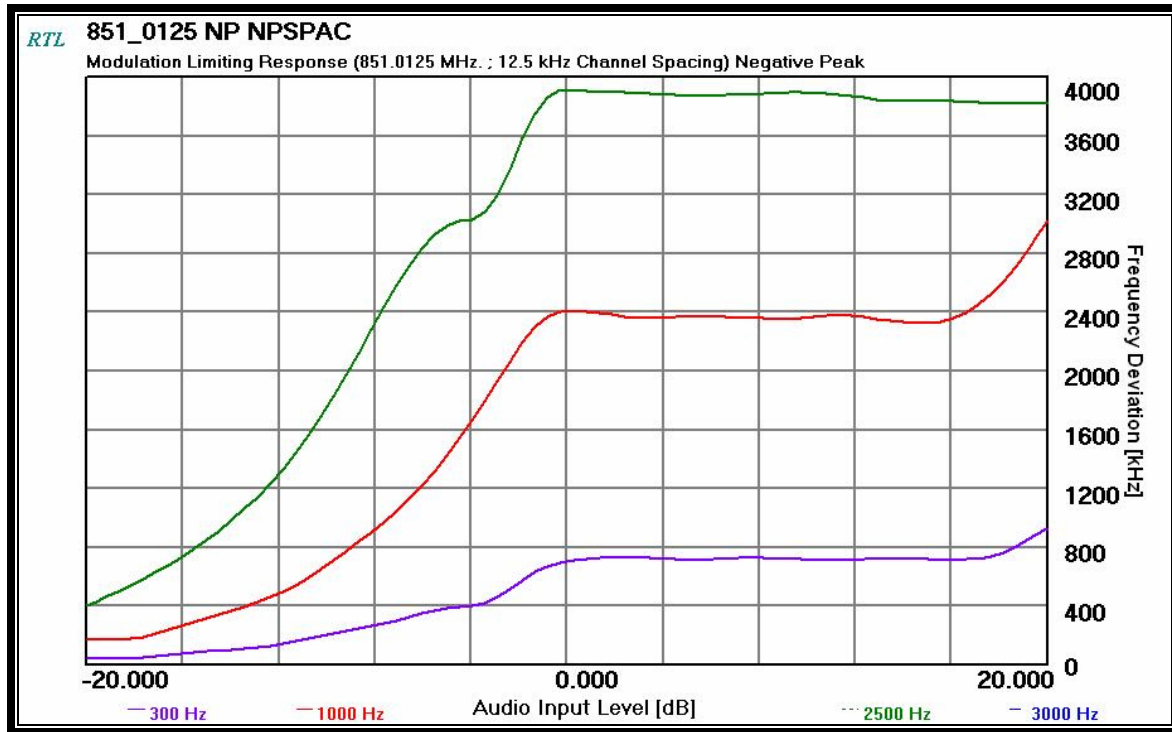
The transmitter was adjusted for full rated system deviation. The audio input level was adjusted for 60% of rated system deviation at 1000 Hz. Using this level (0 dB) as a reference, the audio input level was varied from the reference +/-20 dB for modulation frequencies of 300 Hz, 1,000 Hz, and 2,500 Hz. The system deviation obtained as a function of the input level was recorded. Both positive and negative peak deviations were recorded.

#### 13.2 Test Data

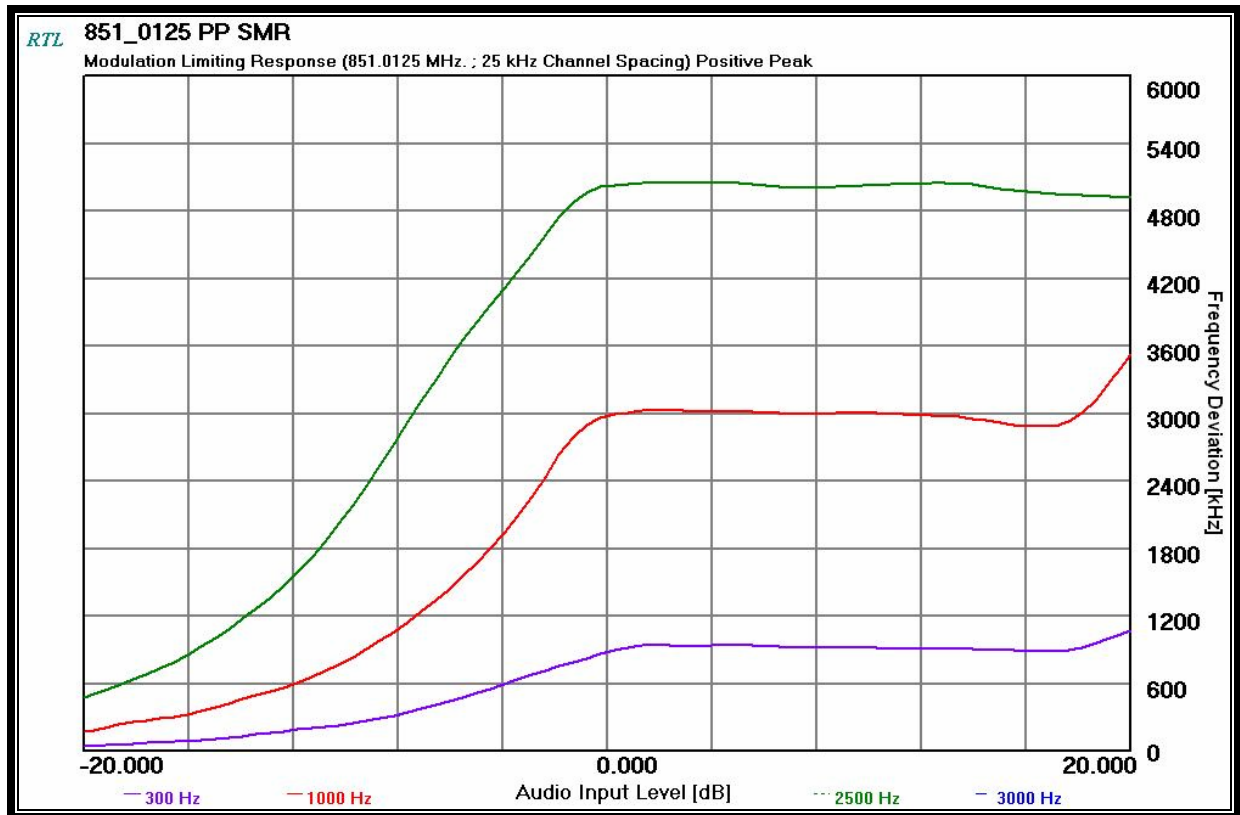
**PLOT 13-1: MODULATION CHARACTERISTICS – MODULATION LIMITING: NPSPAC; POSITIVE PEAK**



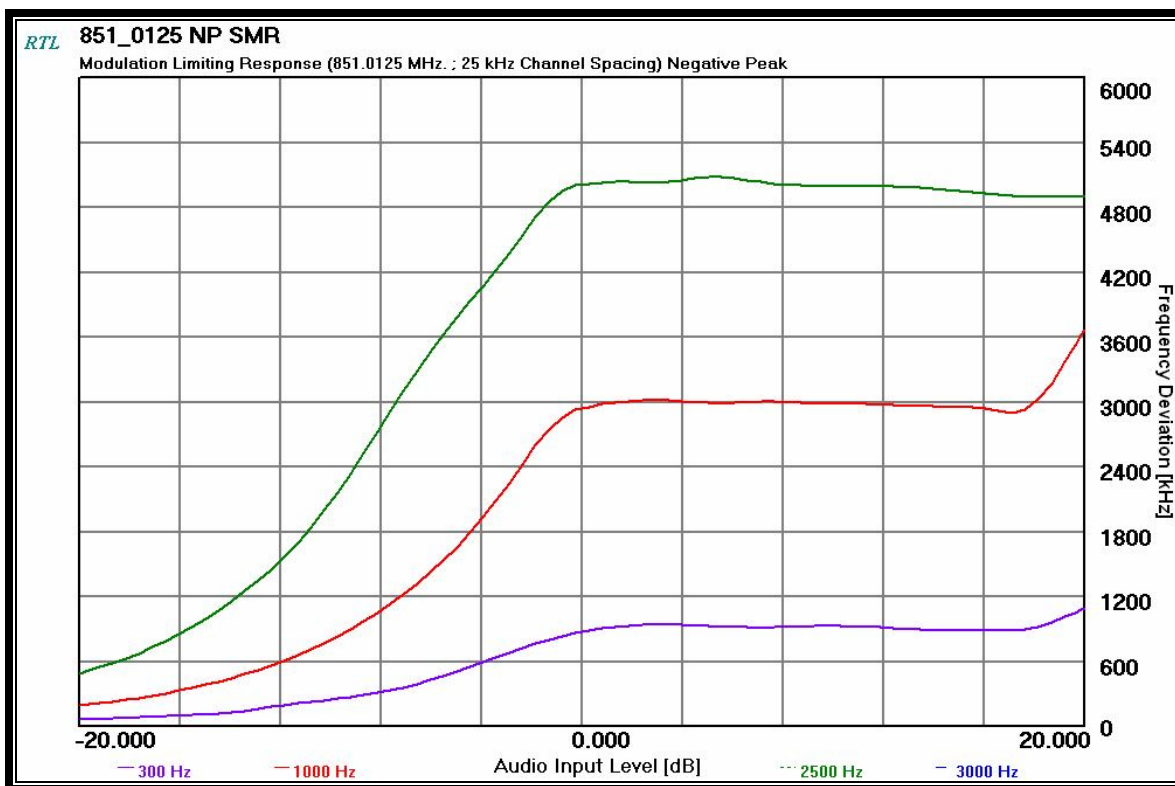
**PLOT 13-2: MODULATION CHARACTERISTICS – MODULATION LIMITING: NPSPAC; NEGATIVE PEAK**



**PLOT 13-3: MODULATION CHARACTERISTICS – MODULATION LIMITING: SMR; POSITIVE PEAK**



**PLOT 13-4: MODULATION CHARACTERISTICS – MODULATION LIMITING: SMR; NEGATIVE PEAK**



**TABLE 13-1: 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    | 09/08/05             |
| 901118      | Hewlett Packard | 8901A Opt. 002-003 | Modulation Analyzer         | 2406A00178    | 07/13/06             |
| 901054      | Hewlett Packard | 3586B              | Selective Level Meter       | 1928A01892    | 09/08/05             |

**TEST PERSONNEL:**

|                          |                     |                |
|--------------------------|---------------------|----------------|
| Daniel Biggs             | <i>Daniel Biggs</i> | August 9, 2005 |
| Test Technician/Engineer | Signature           | Date Of Test   |

## **14 FCC RULES AND REGULATIONS PART 2 §2.202: NECESSARY BANDWIDTH AND EMISSION BANDWIDTH**

### **Analog FM**

#### **764-767/773-776 MHz Talkaround; 794-797/803-806 MHz Trunked/Conventional**

##### Calculation:

Max modulation (M) in kHz: 3.0

Max deviation (D) in kHz: 2.5

Constant factor (K): 1 (default)

$B_n = 2 \times M + 2 \times D \times K = 11.0 \text{ kHz}$

Emission designator: 11K0F3E

#### **806-824 MHz Trunked/Conventional; 851-869 MHz Talkaround**

##### Calculation:

Max modulation (M) in kHz: 3.0

Max deviation (D) in kHz: 5.0

Constant factor (K): 1 (default)

$B_n = 2 \times M + 2 \times D \times K = 16.0 \text{ kHz}$

Emission designator: 16K0F3E

#### **806-824 MHz Trunked/Conventional; 851-869 MHz Talkaround on NPSPAC Channels**

##### Calculation:

Max modulation (M) in kHz: 3.0

Max deviation (D) in kHz: 4.0

Constant factor (K): 1 (default)

$B_n = 2 \times M + 2 \times D \times K = 14.0 \text{ kHz}$

Emission designator: 14K0F3E

### **OTP Modulation**

#### **794-797/803-806 MHz Trunked**

##### Calculation:

Data rate in bps (R) = 19,200

Peak deviation of carrier (D) = 3,750 Hz

Number of state in each symbol (S) = 4

$K = 0.334$

$B_n = [R / \log_2(4) + 2(D)(K)] = 12.1 \text{ kHz}$

Emission designator: 12K1F9W

#### **806-809, 809-821, 821-824 MHz SMR/NPSPAC Trunked**

##### Calculation:

Data rate in bps (R) = 19,200

Peak deviation of carrier (D) = 3750 Hz

Number of state in each symbol (S) = 4

$K = 0.334$

$B_n = [R / \log_2(4) + 2(D)(K)] = 12.1 \text{ kHz}$

Emission designator: 12K1F9W

## 2-Level Voice/Data

### **806-809, 821-824 NPSPAC Trunked/Conventional; 851-854, 866-869 MHz NPSPAC Talkaround**

#### Calculation:

Data rate in bps (R) = 9,600

Peak deviation of carrier (D) = 2,400 Hz

$2D/R = 0.5$

$B_n = (3.86 \cdot D) + (0.027 \cdot R) = 11,856 \text{ kHz}$

Emission designator: 11K9F1D, 11K9F1E

### **806-809, 809-821, 821-824 SMR Trunked/Conventional; 851-854, 854-866, 866-869 MHz SMR Talkaround**

#### Calculation:

Data rate in bps (R) = 9,600

Peak deviation of carrier (D) = 3,000 Hz

$2D/R = 0.625$

$B_n = (3.86 \cdot D) + (0.027 \cdot R) = 14,172 \text{ kHz}$

Emission designator: 14K2F1D, 14K2F1E

## P25 Voice/Data

### **764-767/773-776 Talkaround; 794-797/803-806 MHz Trunked/Conventional**

#### Calculation:

Data rate in bps (R) = 9,600

Peak deviation of carrier (D) = 1,800 Hz

Number of state in each symbol (S) = 4

$B_n = [R/\log_2(4) + 2(D)(1)] = 8,400 \text{ kHz}$

Emission designator: 8K4F1D, 8K4F1E

### **806-824, 851-869 MHz Trunked or Conventional, Talkaround**

#### Calculation:

Data rate in bps (R) = 9,600

Peak deviation of carrier (D) = 1,800 Hz

Number of state in each symbol (S) = 4

$B_n = [R/\log_2(4) + 2(D)(1)] = 8,400 \text{ kHz}$

Emission designator: 8K4F1D, 8K4F1E

## 15 CONCLUSION

The data in this measurement report shows that the **M/A-COM, Inc. Model M7200 Series Mobile Radio; FCC ID: BV8M7200**, complies with all the requirements of Parts 90, 15 and 2 of the FCC Rules, and Industry Canada RSS-119, Issue 6, 2000.