# 9 FCC Part 2.1055: Frequency Stability; Part 22.355: Frequency Tolerance; Part 74.464; Frequency Tolerance; Part 80.209: Frequency Stability; Part 90.213, Part 90.539: Frequency Stability; ISED RSS-119 5.3: Transmitter Frequency Stability

## 9.1 Test Procedure

ANSI C63.26, section 5.6

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 AFC was not locked to the base station.

The temperature was initially set to -30°C and a 1-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.

Part 80.209: 10 ppm. 400-466 MHz 5 ppm

**Part 90.213 Frequency Stability**

(a) Unless noted elsewhere, transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following table.

MINIMUM FREQUENCY STABILITY
[Parts per million (ppm)]

| Frequency range (MHz) | Fixed and base stations | Mobile stations | |
|---|---|---|---|
| | | Over 2 watts output power | 2 watts or less output power |
| Below 25 | [1,2,3] 100 | 100 | 200 |
| 25–50 | 20 | 20 | 50 |
| 72–76 | 5 | ..... | 50 |
| 150–174 | [5,11] 5 | [6] 5 | [4,6] 50 |
| 216–220 | 1.0 | ..... | 1.0 |
| 220–222 [12] | 0.1 | 1.5 | 1.5 |
| 421–512 | [7,11,14] 2.5 | [8] 5 | [8] 5 |
| 806–809 | [14] 1.0 | 1.5 | 1.5 |
| 809–824 | [14] 1.5 | 2.5 | 2.5 |
| 851–854 | 1.0 | 1.5 | 1.5 |
| 854–869 | 1.5 | 2.5 | 2.5 |
| 896–901 | [14] 0.1 | 1.5 | 1.5 |
| 902–928 | 2.5 | 2.5 | 2.5 |
| 902–928 [13] | 2.5 | 2.5 | 2.5 |
| 929–930 | 1.5 | ..... | ..... |
| 935–940 | 0.1 | 1.5 | 1.5 |
| 1427–1435 | [9] 300 | 300 | 300 |
| Above 2450 [10] | ..... | ..... | ..... |

Part 90.213: Mobile stations over 2 W operating power - 1.5 ppm (806-809 MHz, 851-854 MHz, 896-901 MHz, and 935-940 MHz); 2.5 ppm (809-824 MHz, and 854-869 MHz)

**Part 90.539 Frequency Stability**

Transmitters designed to operate in 769–775 MHz and 799–805 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. 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).

The EUT was tested while the AFC was not locked, therefore, the limit is 1.5 ppm. The worst-case deviation was found to be 0.13 ppm.

## 9.2 Test Data

**Table 9-1: Temperature Frequency Stability – 33.0125 MHz**

| Temperature (°C) | Measured Frequency (MHz) | ppm |
|---|---|---|
| -30 | 33.012500 | 0.00 |
| -20 | 33.012500 | 0.00 |
| -10 | 33.012500 | 0.00 |
| 0 | 33.012500 | 0.00 |
| 10 | 33.012500 | 0.00 |
| 20 (reference) | 33.012500 | 0.00 |
| 30 | 33.012500 | 0.00 |
| 40 | 33.012500 | 0.00 |
| 50 | 33.012500 | 0.00 |
| 60 | 33.012500 | 0.00 |

**Table 9-2: Temperature Frequency Stability – 40.0125 MHz**

| Temperature (°C) | Measured Frequency (MHz) | ppm |
|---|---|---|
| -30 | 40.012500 | 0.00 |
| -20 | 40.012500 | 0.00 |
| -10 | 40.012500 | 0.00 |
| 0 | 40.012500 | 0.00 |
| 10 | 40.012500 | 0.00 |
| 20 (reference) | 40.012500 | 0.00 |
| 30 | 40.012500 | 0.00 |
| 40 | 40.012500 | 0.00 |
| 50 | 40.012500 | 0.00 |
| 60 | 40.012500 | 0.00 |

**Table 9-3: Temperature Frequency Stability – 48.9875 MHz**

| Temperature (°C) | Measured Frequency (MHz) | ppm |
|---|---|---|
| -30 | 48.987500 | 0.00 |
| -20 | 48.987500 | 0.00 |
| -10 | 48.987500 | 0.00 |
| 0 | 48.987500 | 0.00 |
| 10 | 48.987500 | 0.00 |
| 20 (reference) | 48.987500 | 0.00 |
| 30 | 48.987500 | 0.00 |
| 40 | 48.987500 | 0.00 |
| 50 | 48.987500 | 0.00 |
| 60 | 48.987500 | 0.00 |

**Table 9-4: Temperature Frequency Stability – 136.0125 MHz**

| Temperature (°C) | Measured Frequency (MHz) | ppm |
|---|---|---|
| -30 | 136.012500 | 0.00 |
| -20 | 136.012500 | 0.00 |
| -10 | 136.012500 | 0.00 |
| 0 | 136.012500 | 0.00 |
| 10 | 136.012500 | 0.00 |
| 20 (reference) | 136.012500 | 0.00 |
| 30 | 136.012500 | 0.00 |
| 40 | 136.012500 | 0.00 |
| 50 | 136.012500 | 0.00 |
| 60 | 136.012500 | 0.00 |

**Table 9-5: Temperature Frequency Stability – 155.0125 MHz**

| Temperature (°C) | Measured Frequency (MHz) | ppm |
|---|---|---|
| -30 | 155.012500 | 0.00 |
| -20 | 155.012500 | 0.00 |
| -10 | 155.012500 | 0.00 |
| 0 | 155.012500 | 0.00 |
| 10 | 155.012500 | 0.00 |
| 20 (reference) | 155.012500 | 0.00 |
| 30 | 155.012500 | 0.00 |
| 40 | 155.012500 | 0.00 |
| 50 | 155.012500 | 0.00 |
| 60 | 155.012500 | 0.00 |

**Table 9-6: Temperature Frequency Stability – 173.9875 MHz**

| Temperature (°C) | Measured Frequency (MHz)) | ppm |
|---|---|---|
| -30 | 173.987099 | -2.30 |
| -20 | 173.987500 | 0.00 |
| -10 | 173.987500 | 0.00 |
| 0 | 173.987500 | 0.00 |
| 10 | 173.987500 | 0.00 |
| 20 (reference) | 173.987500 | 0.00 |
| 30 | 173.987500 | 0.00 |
| 40 | 173.987500 | 0.00 |
| 50 | 173.987500 | 0.00 |
| 60 | 173.987500 | 0.00 |

**Table 9-7: Temperature Frequency Stability – 378.0125 MHz**

| Temperature (°C) | Measured Frequency (MHz) | ppm |
|---|---|---|
| -30 | 378.012500 | 0.00 |
| -20 | 378.012500 | 0.00 |
| -10 | 378.012500 | 0.00 |
| 0 | 378.012500 | 0.00 |
| 10 | 378.012500 | 0.00 |
| 20 (reference) | 378.012500 | 0.00 |
| 30 | 378.012500 | 0.00 |
| 40 | 378.012500 | 0.00 |
| 50 | 378.012500 | 0.00 |
| 60 | 378.012500 | 0.00 |

**Table 9-8: Temperature Frequency Stability – 450.0125 MHz**

| Temperature (°C) | Measured Frequency (MHz) | ppm |
|---|---|---|
| -30 | 450.012500 | 0.00 |
| -20 | 450.012500 | 0.00 |
| -10 | 450.012500 | 0.00 |
| 0 | 450.012500 | 0.00 |
| 10 | 450.012500 | 0.00 |
| 20 (reference) | 450.012500 | 0.00 |
| 30 | 450.012500 | 0.00 |
| 40 | 450.012500 | 0.00 |
| 50 | 450.012500 | 0.00 |
| 60 | 450.012500 | 0.00 |

**Table 9-9: Temperature Frequency Stability – 511.9875 MHz**

| Temperature (°C) | Measured Frequency (MHz)) | ppm |
|---|---|---|
| -30 | 511.987500 | 0.00 |
| -20 | 511.987500 | 0.00 |
| -10 | 511.987500 | 0.00 |
| 0 | 511.987500 | 0.00 |
| 10 | 511.987500 | 0.00 |
| 20 (reference) | 511.987500 | 0.00 |
| 30 | 511.987500 | 0.00 |
| 40 | 511.987500 | 0.00 |
| 50 | 511.987500 | 0.00 |
| 60 | 511.987500 | 0.00 |

**Table 9-10: Temperature Frequency Stability – 772 MHz**

| Temperature (°C) | Measured Frequency (Hz) | ppm |
|---|---|---|
| -30 | 772.000004 | 0.01 |
| -20 | 772.000000 | 0.00 |
| -10 | 772.000051 | 0.07 |
| 0 | 771.999992 | -0.01 |
| 10 | 771.999945 | -0.07 |
| 20 (reference) | 772.000000 | 0.00 |
| 30 | 772.000004 | 0.01 |
| 40 | 772.000043 | 0.06 |
| 50 | 772.000070 | 0.09 |
| 55 | 772.000070 | 0.09 |
| 60 | 772.000027 | 0.04 |

**Table 9-11: Temperature Frequency Stability – 815 MHz**

| Temperature (°C) | Measured Frequency (Hz) | ppm |
|---|---|---|
| -30 | 815.000008 | 0.01 |
| -20 | 815.000000 | 0.00 |
| -10 | 815.000000 | 0.00 |
| 0 | 815.000004 | 0.00 |
| 10 | 814.999945 | -0.07 |
| 20 (reference) | 815.000000 | 0.00 |
| 30 | 814.999996 | 0.00 |
| 40 | 815.000039 | 0.05 |
| 50 | 815.000089 | 0.11 |
| 55 | 815.000059 | 0.07 |
| 60 | 815.000043 | 0.05 |

**Table 9-12: Temperature Frequency Stability – 937.5 MHz**

| Temperature (°C) | Measured Frequency (Hz) | ppm |
|---|---|---|
| -30 | 937.500031 | 0.03 |
| -20 | 937.500000 | 0.00 |
| -10 | 937.500016 | 0.02 |
| 0 | 937.500027 | 0.03 |
| 10 | 937.499949 | -0.05 |
| 20 (reference) | 937.500000 | 0.00 |
| 30 | 937.500031 | 0.03 |
| 40 | 937.500051 | 0.05 |
| 50 | 937.500125 | 0.13 |
| 55 | 937.500086 | 0.09 |
| 60 | 937.500063 | 0.07 |

Measurement uncertainties shown for these tests are expanded uncertainties expressed at the 95% confidence level using a coverage factor K=2. Measurement uncertainty: ±0.5 Hz

**Results: Pass**

**Table 9-13: Test Equipment Used For Testing Temperature Frequency Stability**

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number | Calibration Due Date |
|---|---|---|---|---|---|
| 901627 | Amprobe | 34XR-A | DMM | 13041385A | 2/21/21 |
| 901672 | Rohde & Schwarz | FSEM30 | Spectrum Analyzer | FSEM30 | 4/25/22 |
| 901724 | API Weinschel, Inc. | 48-40-34 | 40 dB 100W Attenuator | CJ8921 | 9/9/20 |
| 901124 | Alinco | DM-33MVT 32A | Power Supply | 1638 | Not Required |

**Test Personnel:**

| Daniel Baltzell | | August 7, 2019<br>September 3, 2018 |
|---|---|---|
| EMC Test Engineer | Signature | Dates of Test |

### 9.2.1 Frequency Stability/Voltage Variation

**Table 9-14: Frequency Stability/Voltage Variation –136.0125 MHz**

| Voltage (VDC) | Measured Frequency (Hz) | ppm |
|---|---|---|
| 11.73 | 136.012500 | 0.00 |
| 13.8(reference) | 136.012500 | 0.00 |
| 15.87 | 136.012500 | 0.00 |

**Table 9-15: Frequency Stability/Voltage Variation – 155.0125 MHz**

| Voltage (VDC) | Measured Frequency (Hz) | ppm |
|---|---|---|
| 11.73 | 155.012500 | 0.00 |
| 13.8(reference) | 155.012500 | 0.00 |
| 15.87 | 155.012500 | 0.00 |

**Table 9-16: Frequency Stability/Voltage Variation – 173.9875 MHz**

| Voltage (VDC) | Measured Frequency (Hz) | ppm |
|---|---|---|
| 11.73 | 173.987500 | 0.00 |
| 13.8(reference) | 173.987500 | 0.00 |
| 15.87 | 173.987500 | 0.00 |

**Table 9-17: Frequency Stability/Voltage Variation –378.0125 MHz**

| Voltage (VDC) | Measured Frequency (Hz) | ppm |
|---|---|---|
| 11.73 | 378.012500 | 0.00 |
| 13.8(reference) | 378.012500 | 0.00 |
| 15.87 | 378.012500 | 0.00 |

**Table 9-18: Frequency Stability/Voltage Variation – 450.0125 MHz**

| Voltage (VDC) | Measured Frequency (Hz) | ppm |
|---|---|---|
| 11.73 | 450.012500 | 0.00 |
| 13.8(reference) | 450.012500 | 0.00 |
| 15.87 | 450.012500 | 0.00 |

**Table 9-19: Frequency Stability/Voltage Variation – 511.9875 MHz**

| Voltage (VDC) | Measured Frequency (Hz) | ppm |
|---|---|---|
| 11.73 | 511.987500 | 0.00 |
| 13.8(reference) | 511.987500 | 0.00 |
| 15.87 | 511.987500 | 0.00 |

**Table 9-20: Frequency Stability/Voltage Variation – 772 MHz**

| Voltage (VDC) | Measured Frequency (Hz) | ppm |
|---|---|---|
| 11.56 | 772.000004 | 0.01 |
| 13.6(reference) | 772.000000 | 0.00 |
| 15.64 | 772.000000 | 0.00 |

**Table 9-21: Frequency Stability/Voltage Variation – 815 MHz**

| Voltage (VDC) | Measured Frequency (Hz) | ppm |
|---|---|---|
| 11.56 | 815.000008 | 0.01 |
| 13.6(reference) | 815.000000 | 0.00 |
| 15.64 | 815.000000 | 0.00 |

**Table 9-22: Frequency Stability/Voltage Variation – 937.5 MHz**

| Voltage (VDC) | Measured Frequency (Hz) | ppm |
|---|---|---|
| 11.56 | 937.500031 | 0.03 |
| 13.6(reference) | 937.500000 | 0.00 |
| 15.64 | 937.500000 | 0.00 |

Measurement uncertainties shown for these tests are expanded uncertainties expressed at the 95% confidence level using a coverage factor K=2. Measurement uncertainty: ±0.5 Hz

**Results: Pass**

**Table 9-23: Test Equipment Used For Testing Frequency Stability/Voltage Variation**

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number | Calibration Due Date |
|---|---|---|---|---|---|
| 901627 | Amprobe | 34XR-A | DMM | 13041385A | 2/21/21 |
| 901672 | Rohde & Schwarz | FSEM30 | Spectrum Analyzer | FSEM30 | 4/25/22 |
| 901724 | API Weinschel, Inc. | 48-40-34 | 40 dB 100W Attenuator | CJ8921 | 9/9/20 |
| 901124 | Alinco | DM-33MVT 32A | Power Supply | 1638 | Not Required |
| 900946 | Tenney Engineering, Inc. | TH65 | Temperature Chamber | 11380 | 4/7/22 |

**Test Personnel:**

| Daniel W. Baltzell | | August 7, 2019<br>September 3, 2018 |
|---|---|---|
| EMC Test Engineer | Signature | Dates of Test |

# 10 FCC §2.1047(a)(b): Modulation Characteristics; Part 74.463: Modulation Requirements; Part 80.213: Modulation Requirements; RSS-119 5.2: Types of Modulation

**Part 80.213 Modulation requirements.**

(a)(2) When phase or frequency modulation is used in the 156–162 MHz band, the peak modulation must be maintained between 75 and 100 percent. A frequency deviation of ±5 kHz is defined as 100 percent peak modulation.
(b) Radiotelephone transmitters using A3E, F3E and G3E emission must have a modulation limiter to prevent any modulation over 100 percent. This requirement does not apply to survival craft transmitters, to transmitters that do not require a license, or to transmitters whose output power does not exceed 3 watts.
(d) Ship and coast station transmitters operating in the 156–162 MHz and 216–220 MHz bands must be capable of proper operation with a frequency deviation that does not exceed ±5 kHz when using any emission authorized by §80.207.
(e) Coast station transmitters operating in the 156–162 MHz band must be equipped with an audio low-pass filter. The filter must be installed between the modulation limiter and the modulated radio frequency stage. At frequencies between 3 kHz and 20 kHz it must have an attenuation greater than at 1 kHz by at least 60log10(f/3) dB where "f" is the audio frequency in kilohertz. At frequencies above 20 kHz the attenuation must be at least 50 dB greater than at 1 kHz.

## 10.1 Test Procedures

### 10.1.1 Audio Frequency Response

ANSI C63.26 2015, section 5.3.3

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:

Audio Frequency Response = 20 LOG (DEVfreq/DEVref)

### 10.1.2 Audio Low Pass Filter Response

ANSI C63.26 2015, section 5.3

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

### 10.1.3 Modulation Limiting

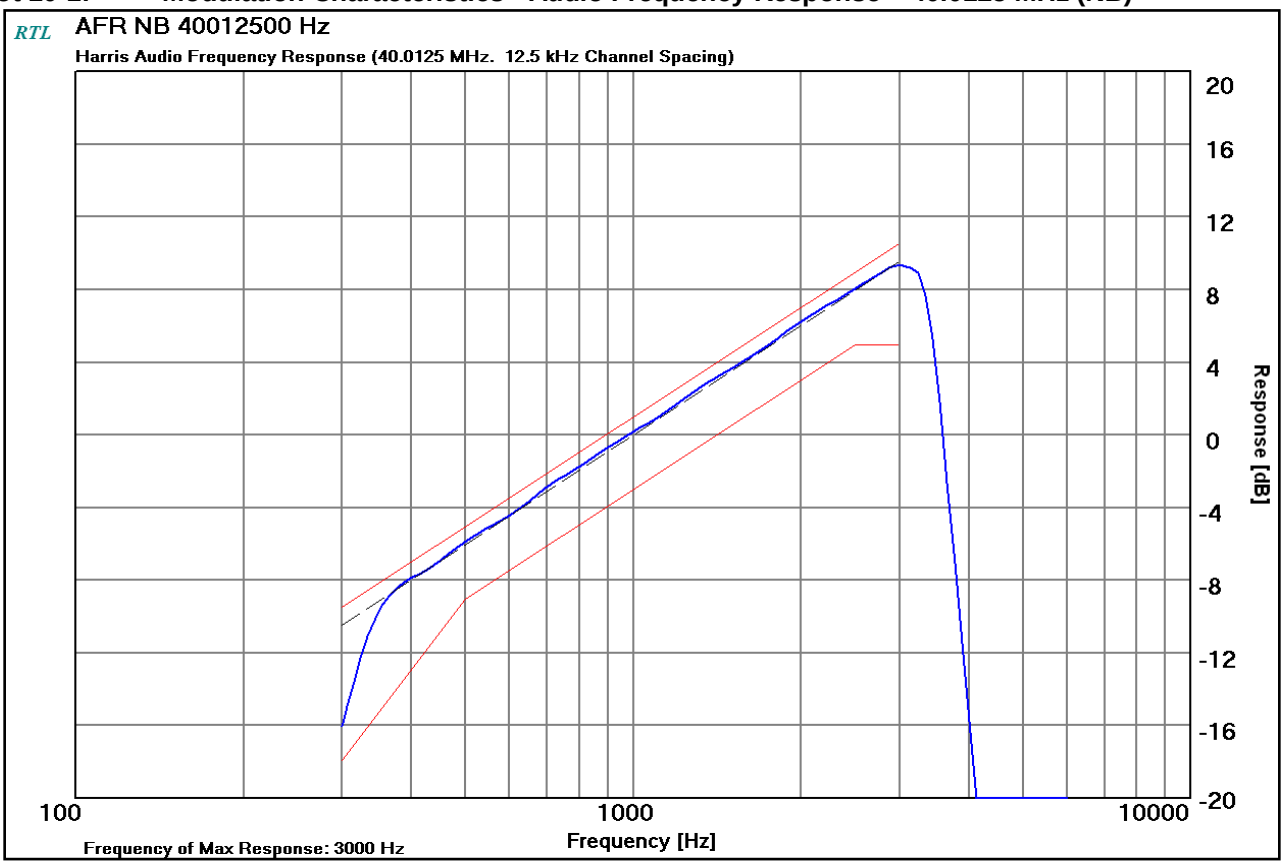
ANSI C63.26 2015, section 5.3.2

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.

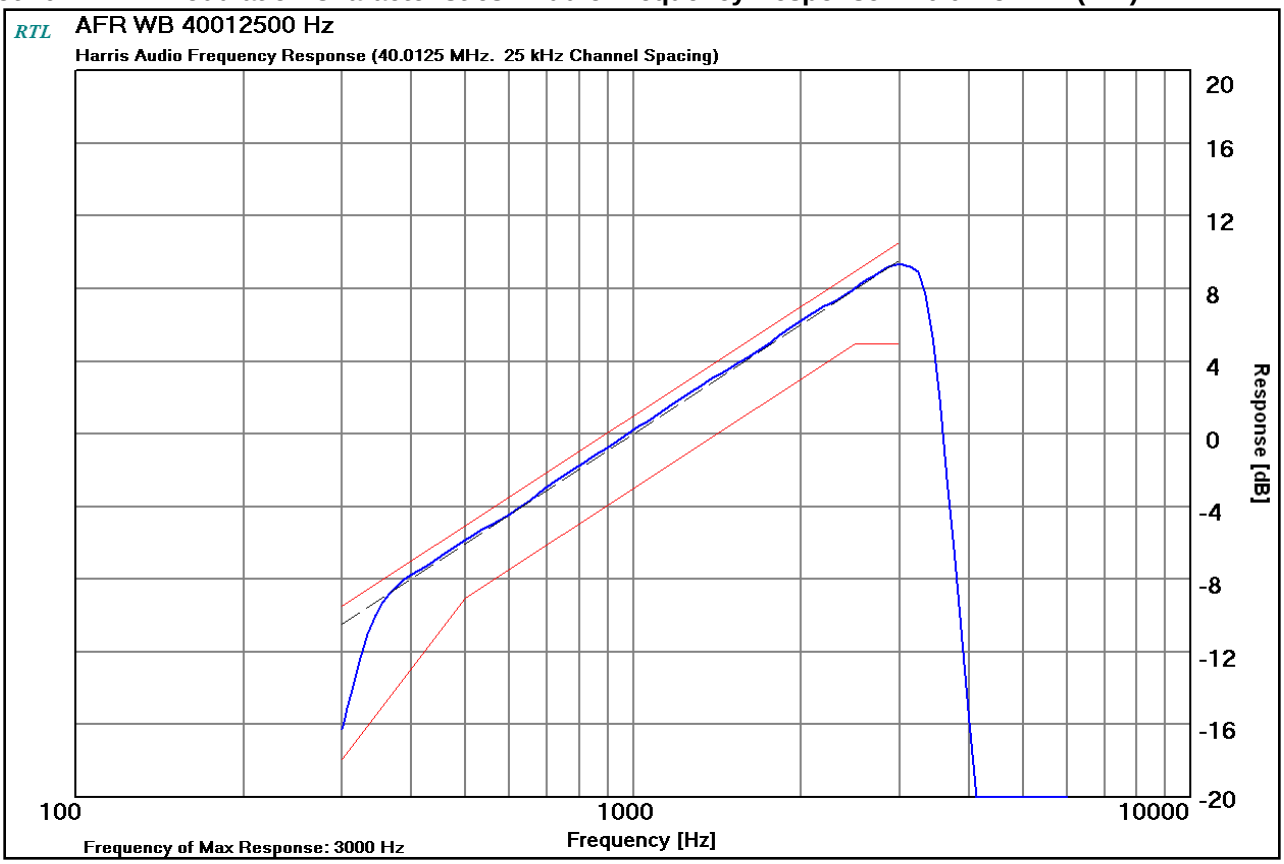
## 10.2 Test Data

### 10.2.1 Audio Frequency Response

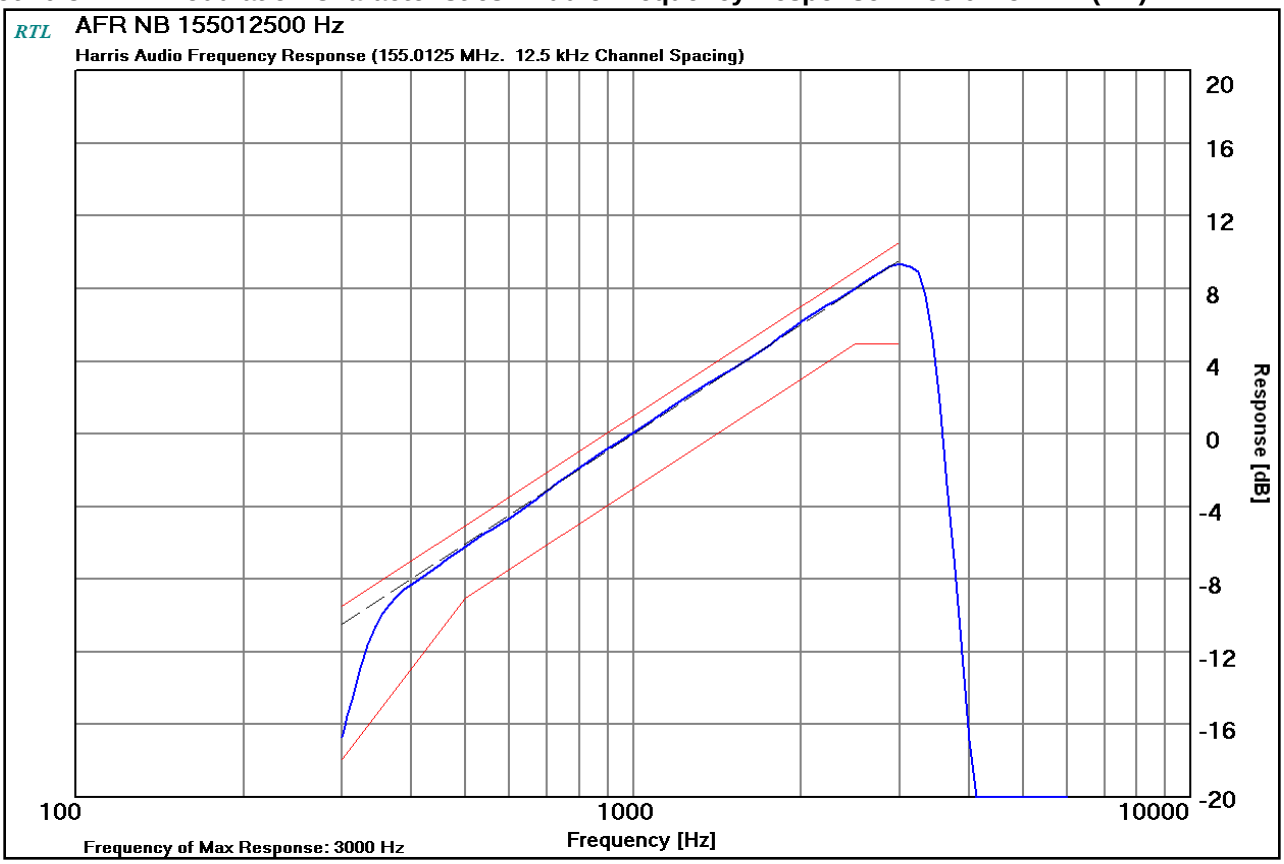
**Plot 10-1: Modulation Characteristics - Audio Frequency Response – 40.0125 MHz (NB)**



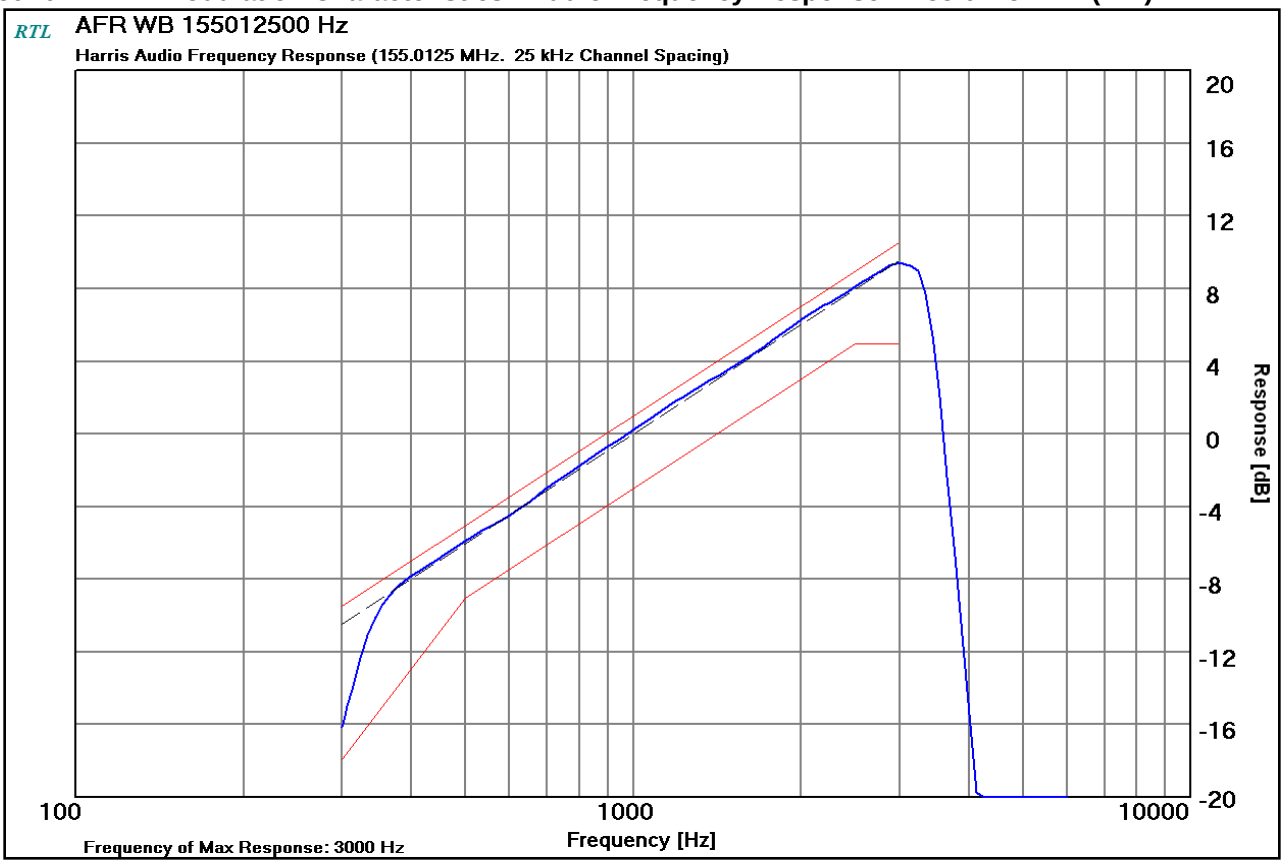
**Plot 10-2: Modulation Characteristics - Audio Frequency Response – 40.0125 MHz (WB)**



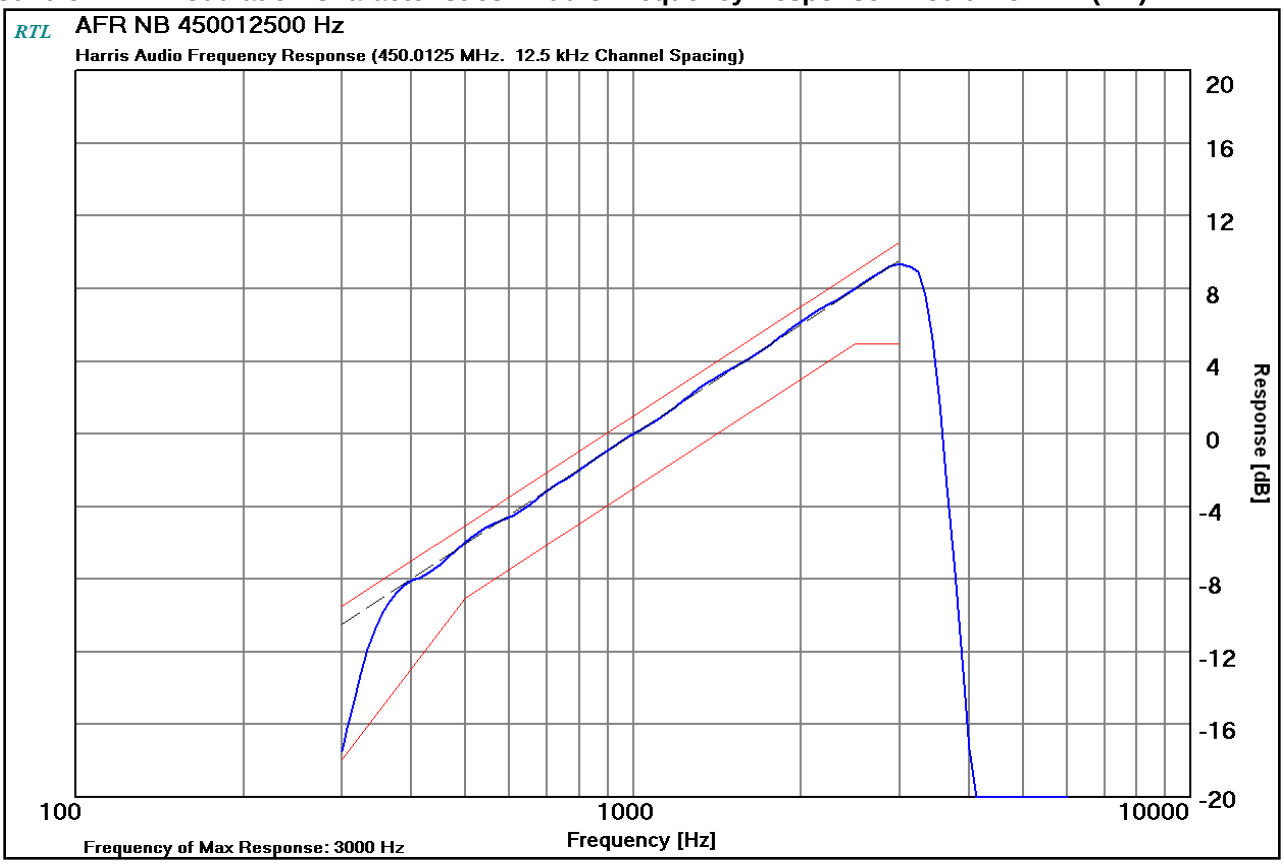
**Plot 10-3: Modulation Characteristics - Audio Frequency Response – 155.0125 MHz (NB)**



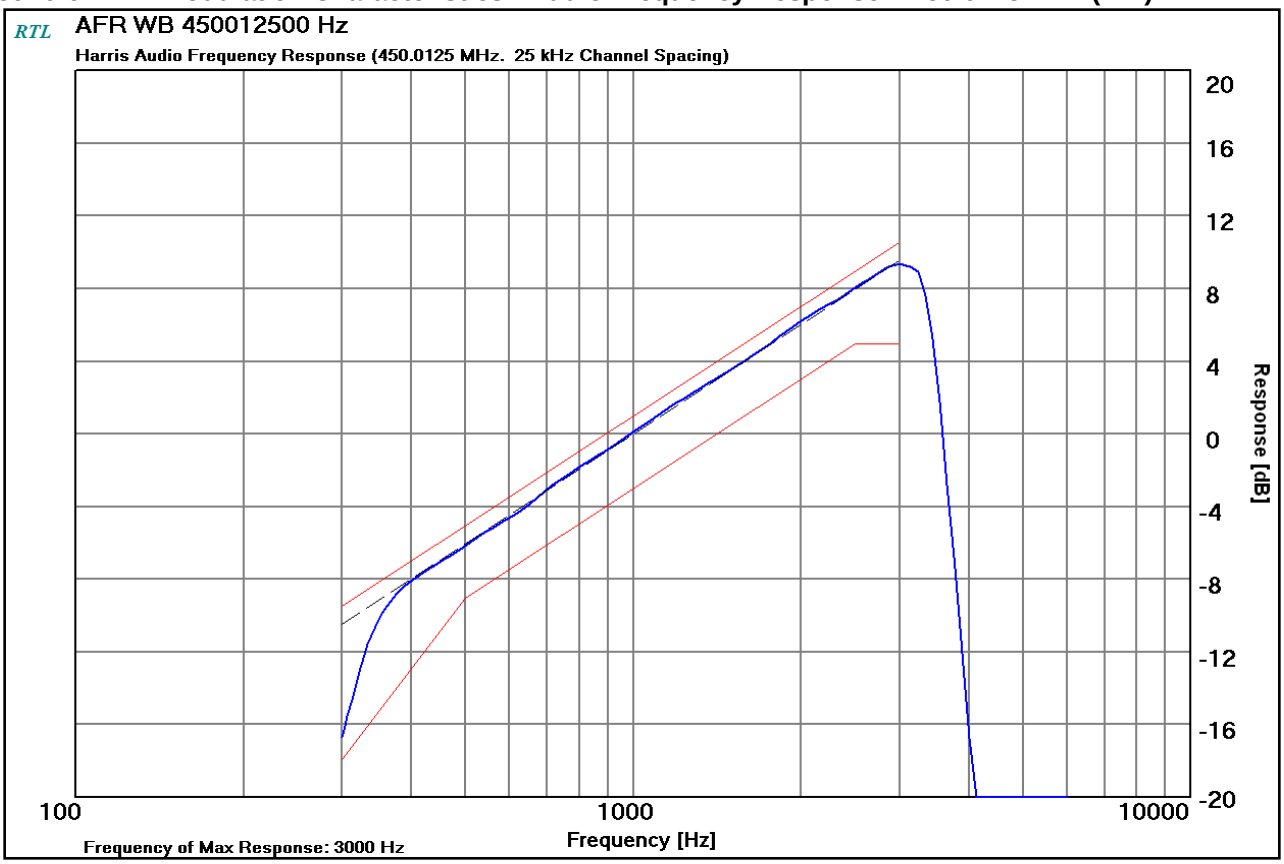
**Plot 10-4: Modulation Characteristics - Audio Frequency Response – 155.0125 MHz (WB)**



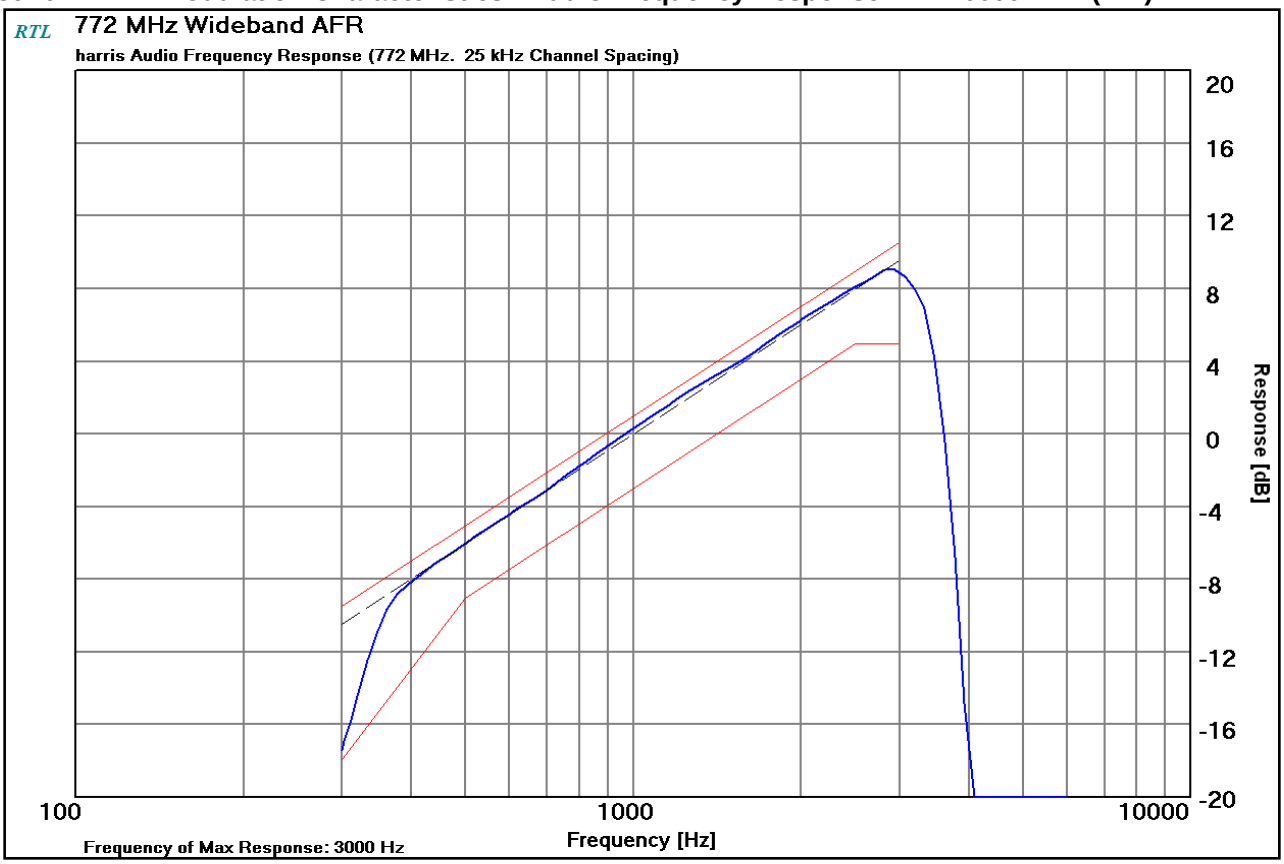
**Plot 10-5: Modulation Characteristics - Audio Frequency Response – 450.0125 MHz (NB)**



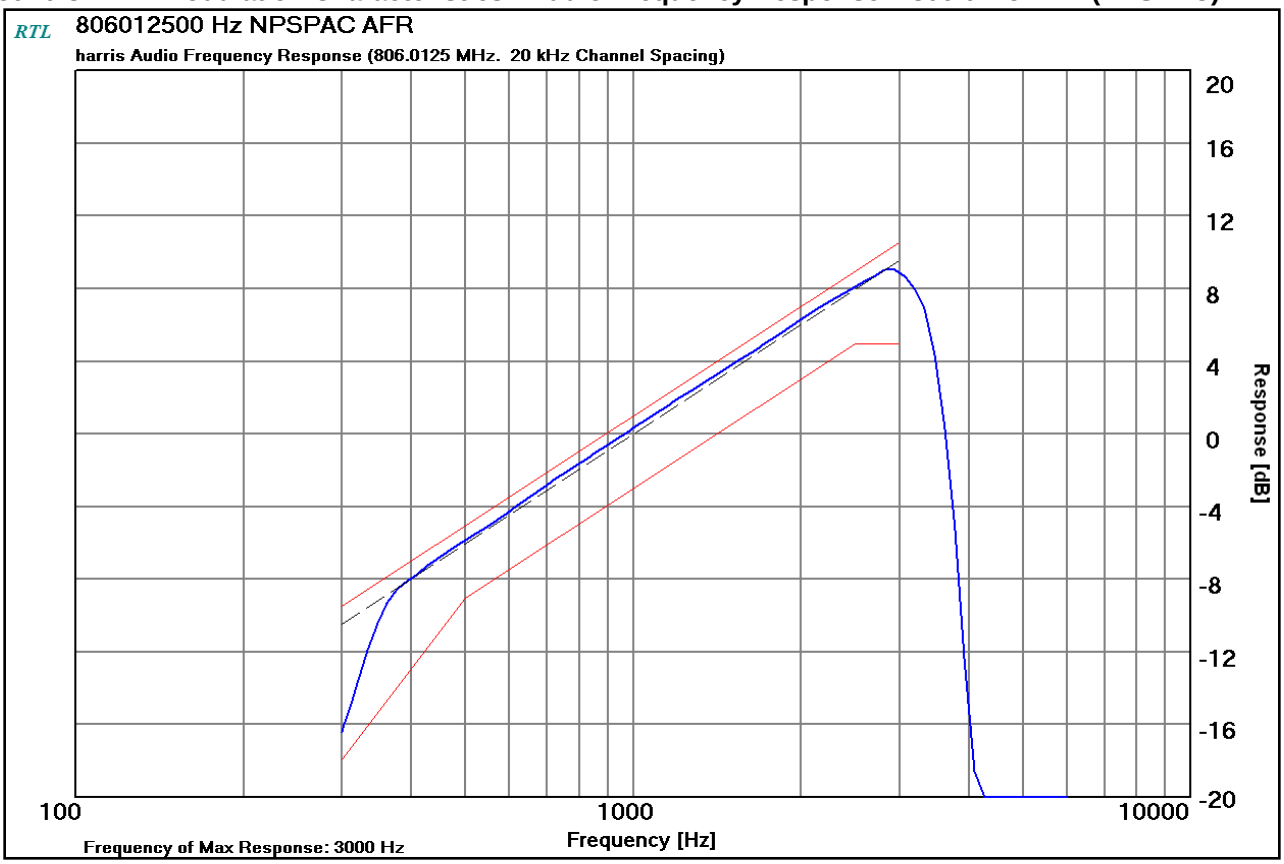
**Plot 10-6: Modulation Characteristics - Audio Frequency Response – 450.0125 MHz (WB)**



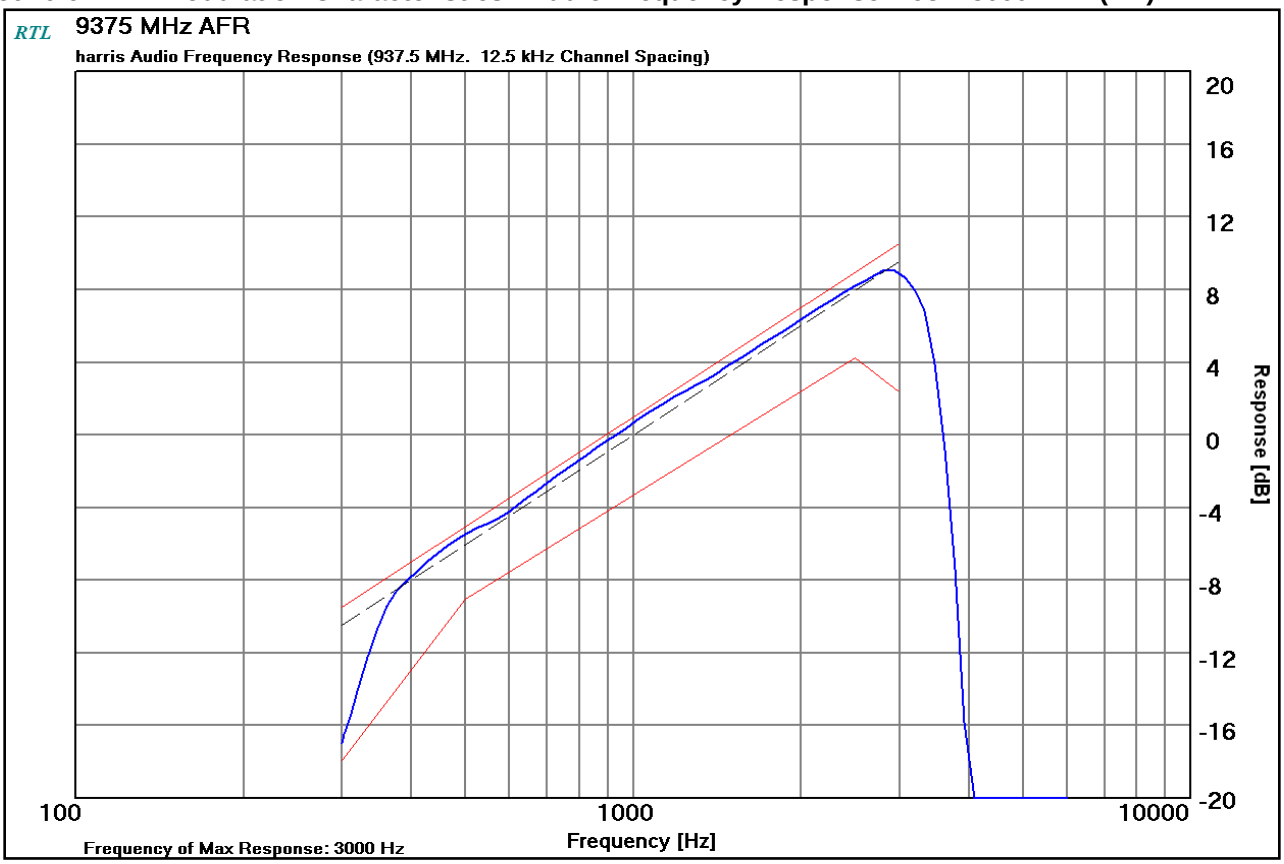
**Plot 10-7: Modulation Characteristics - Audio Frequency Response – 772.0000 MHz (WB)**



**Plot 10-8: Modulation Characteristics - Audio Frequency Response – 806.0125 MHz (NPSPAC)**

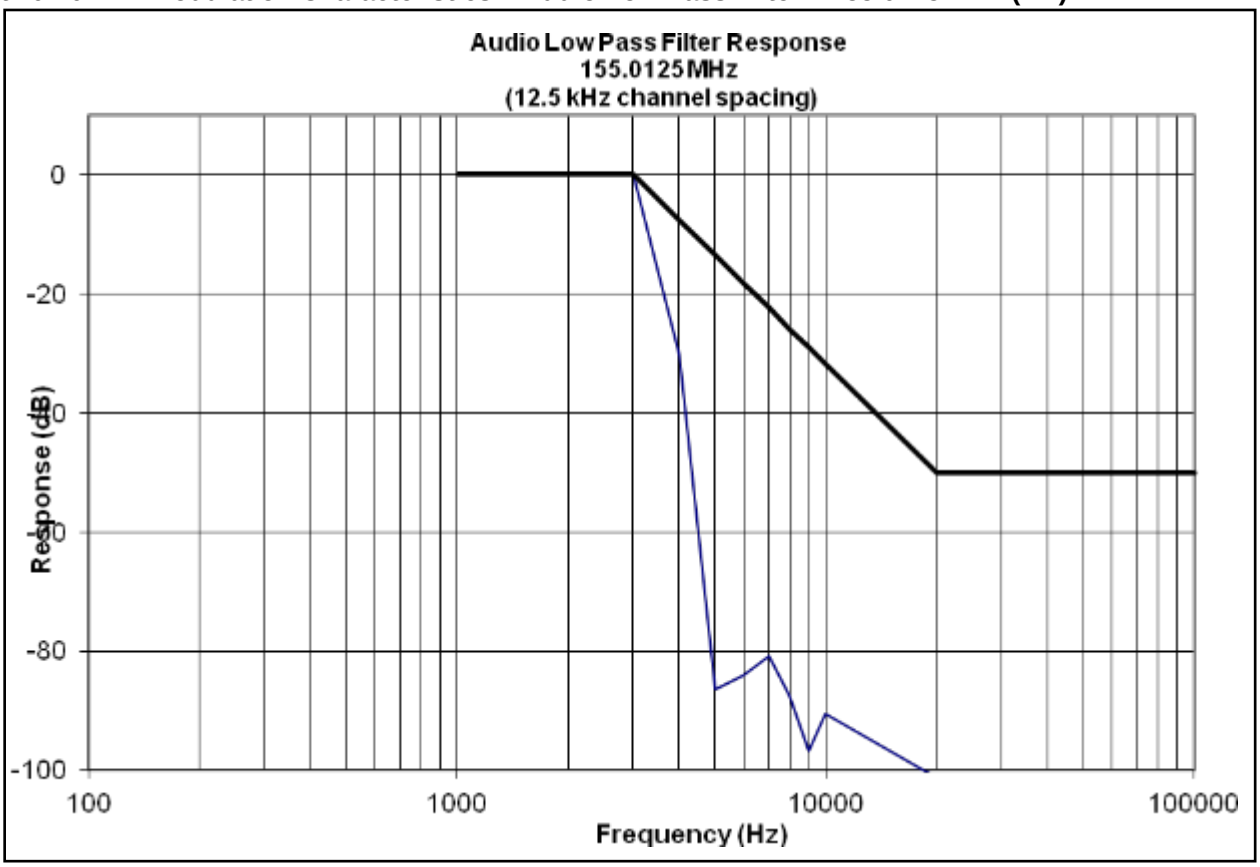


**Plot 10-9: Modulation Characteristics - Audio Frequency Response – 937. 5000 MHz (NB)**

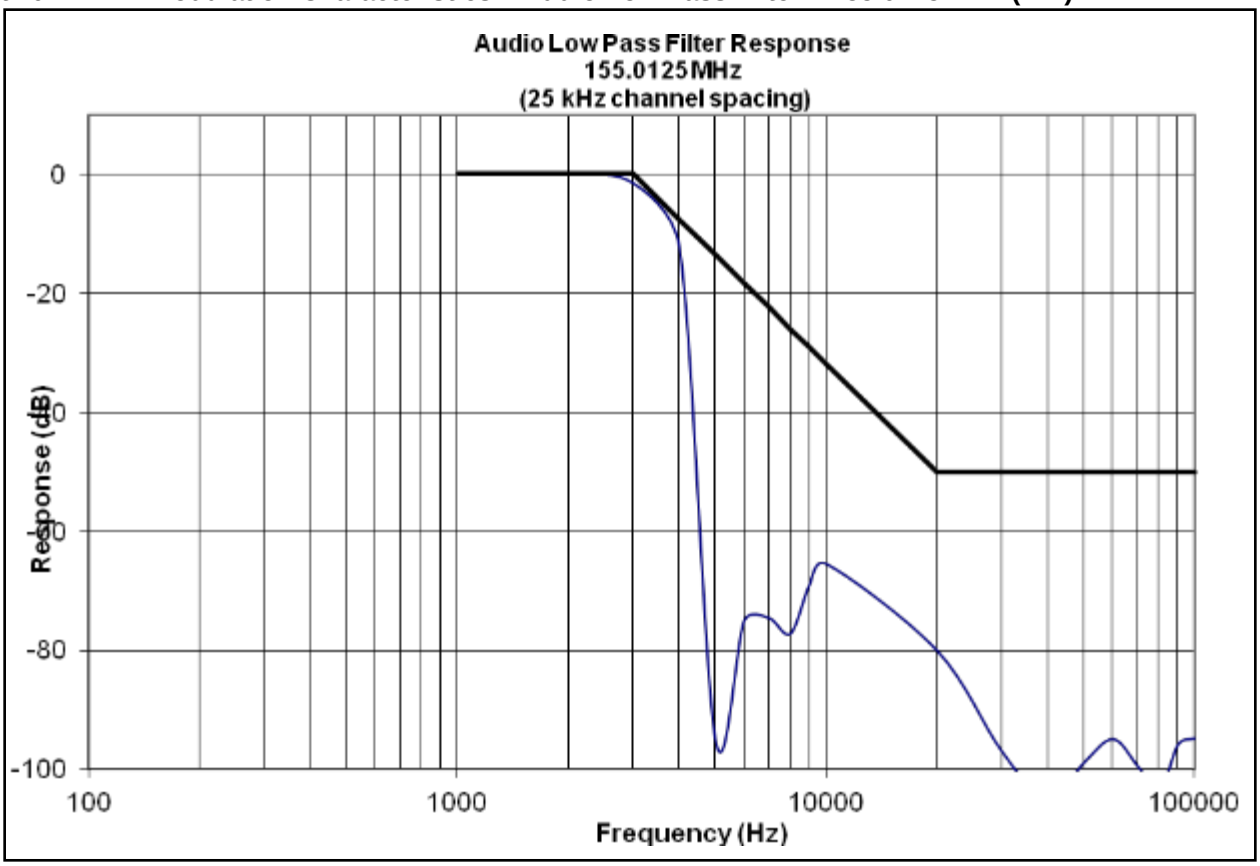


### 10.2.2 Audio Low Pass Filter Response

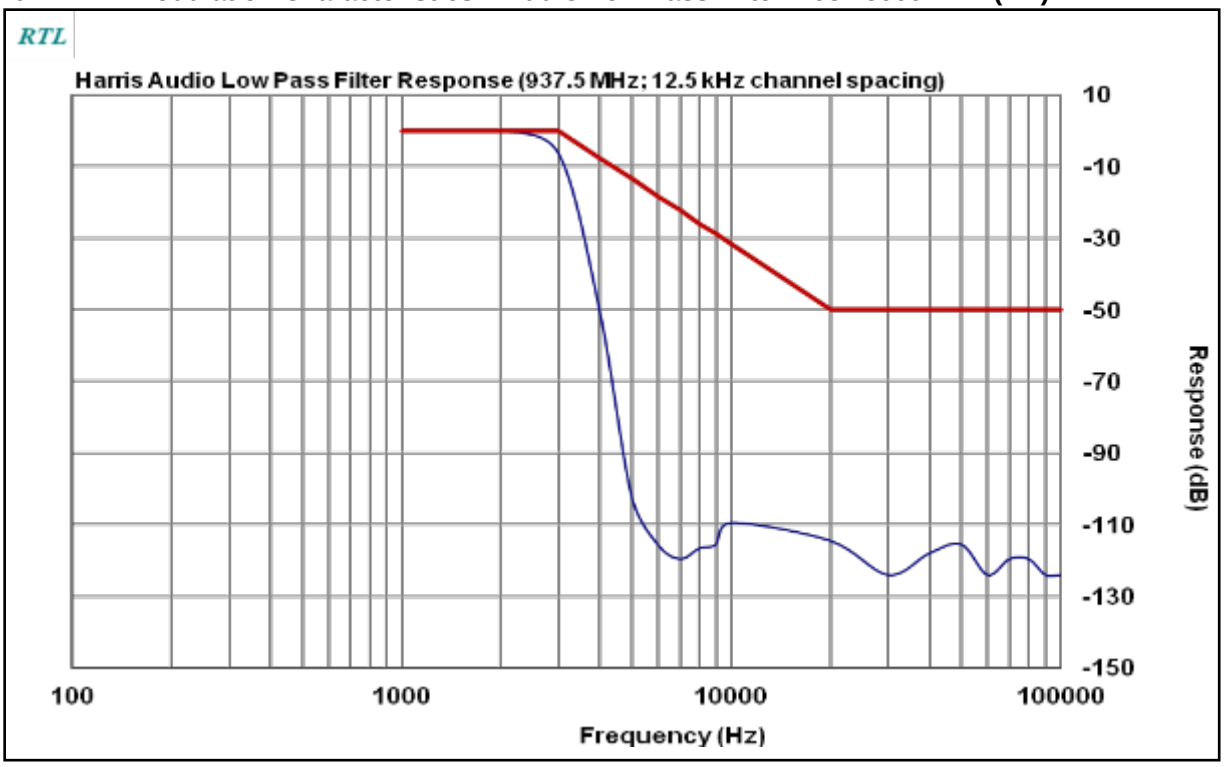
**Plot 10-10: Modulation Characteristics – Audio Low Pass Filter – 155.0125 MHz (NB)**



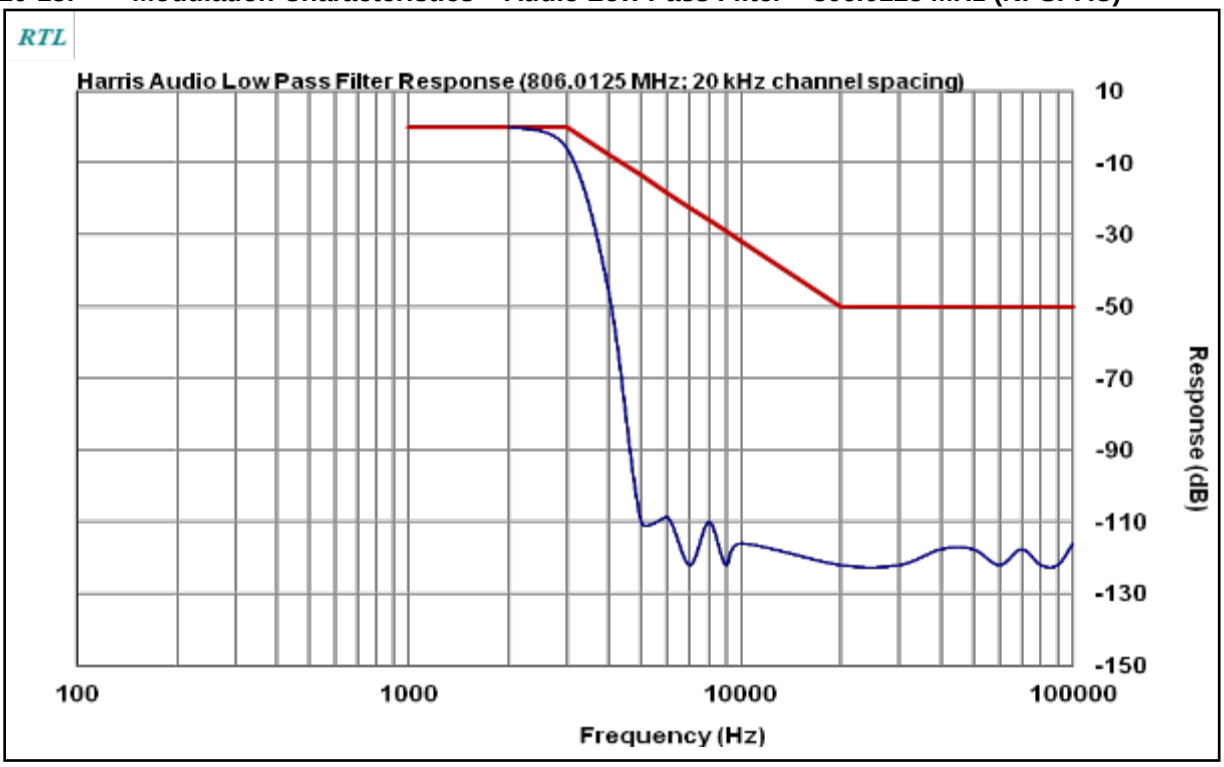
**Plot 10-11: Modulation Characteristics – Audio Low Pass Filter – 155.0125 MHz (WB)**



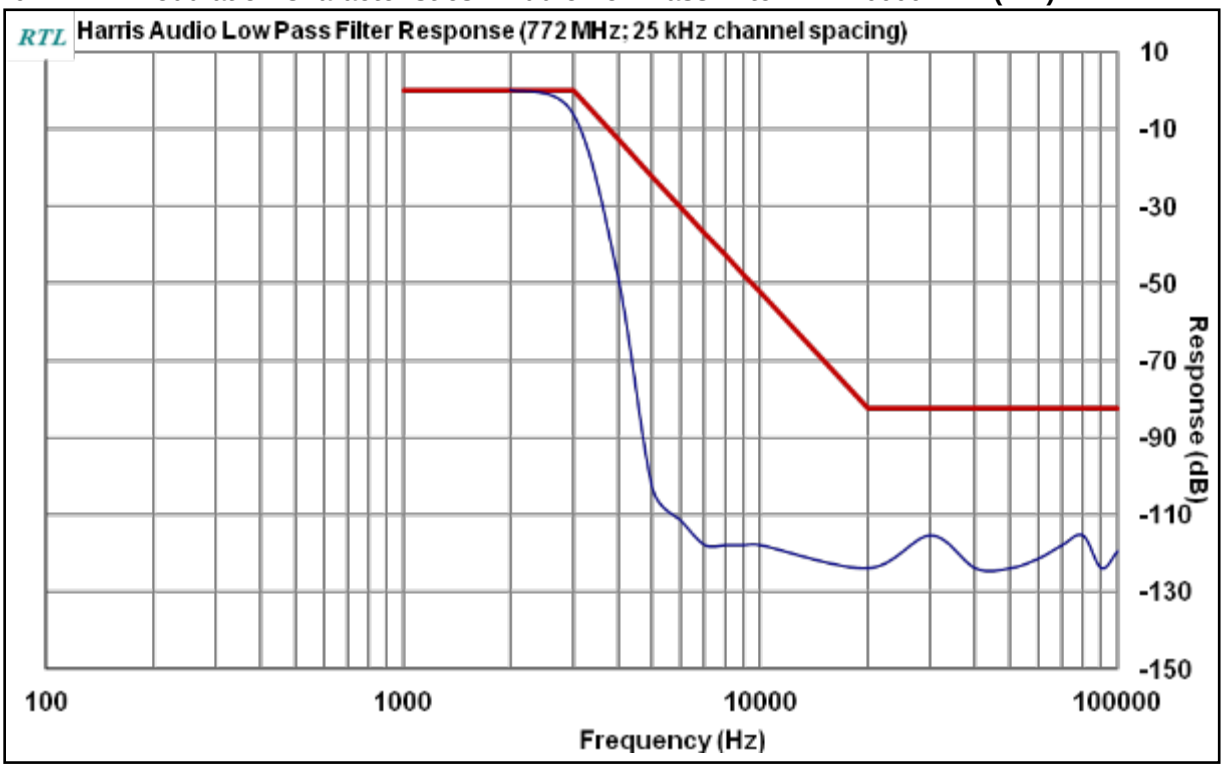
**Plot 10-12: Modulation Characteristics – Audio Low Pass Filter – 937.5000 MHz (NB)**




**Plot 10-13: Modulation Characteristics – Audio Low Pass Filter – 806.0125 MHz (NPSPAC)**

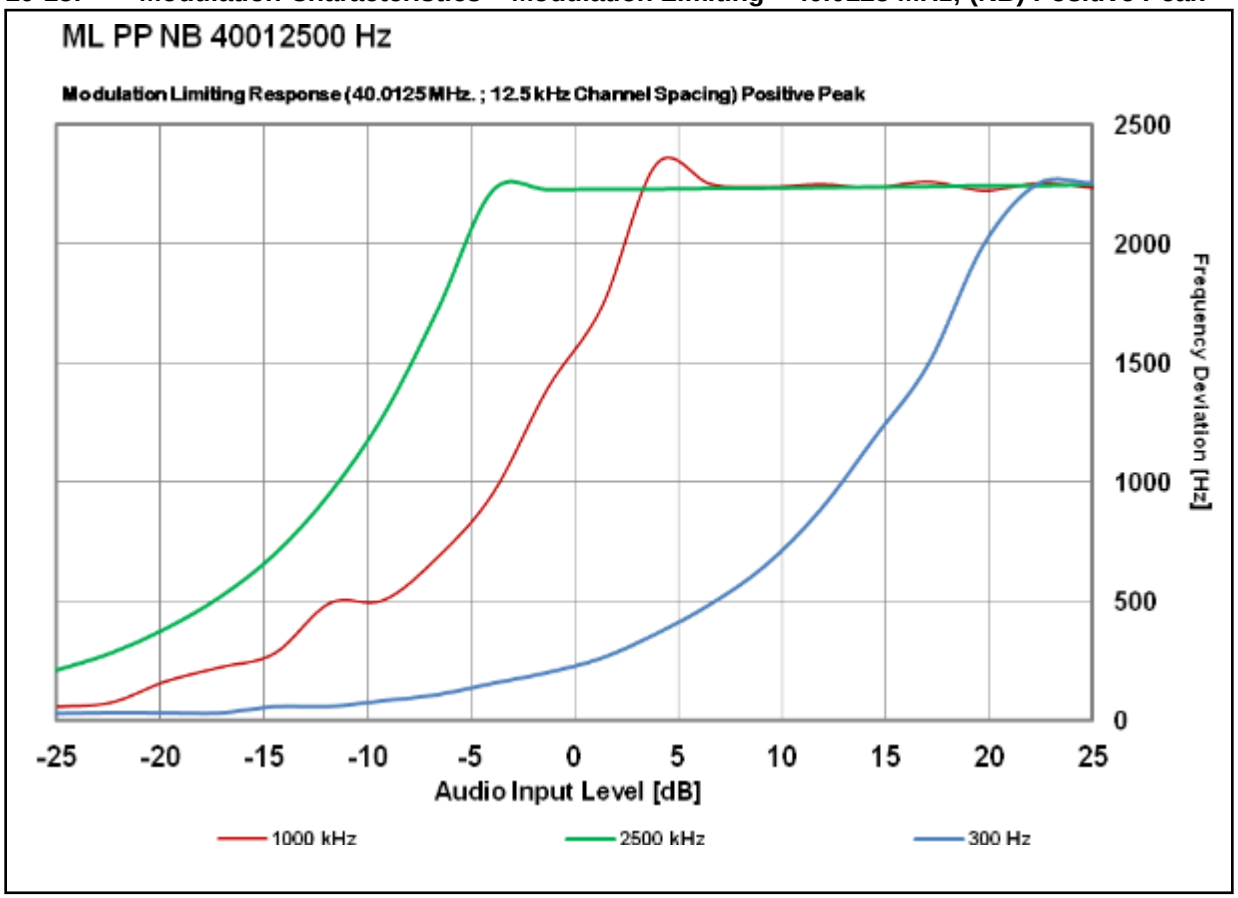


**Plot 10-14: Modulation Characteristics – Audio Low Pass Filter – 772.0000 MHz (WB)**

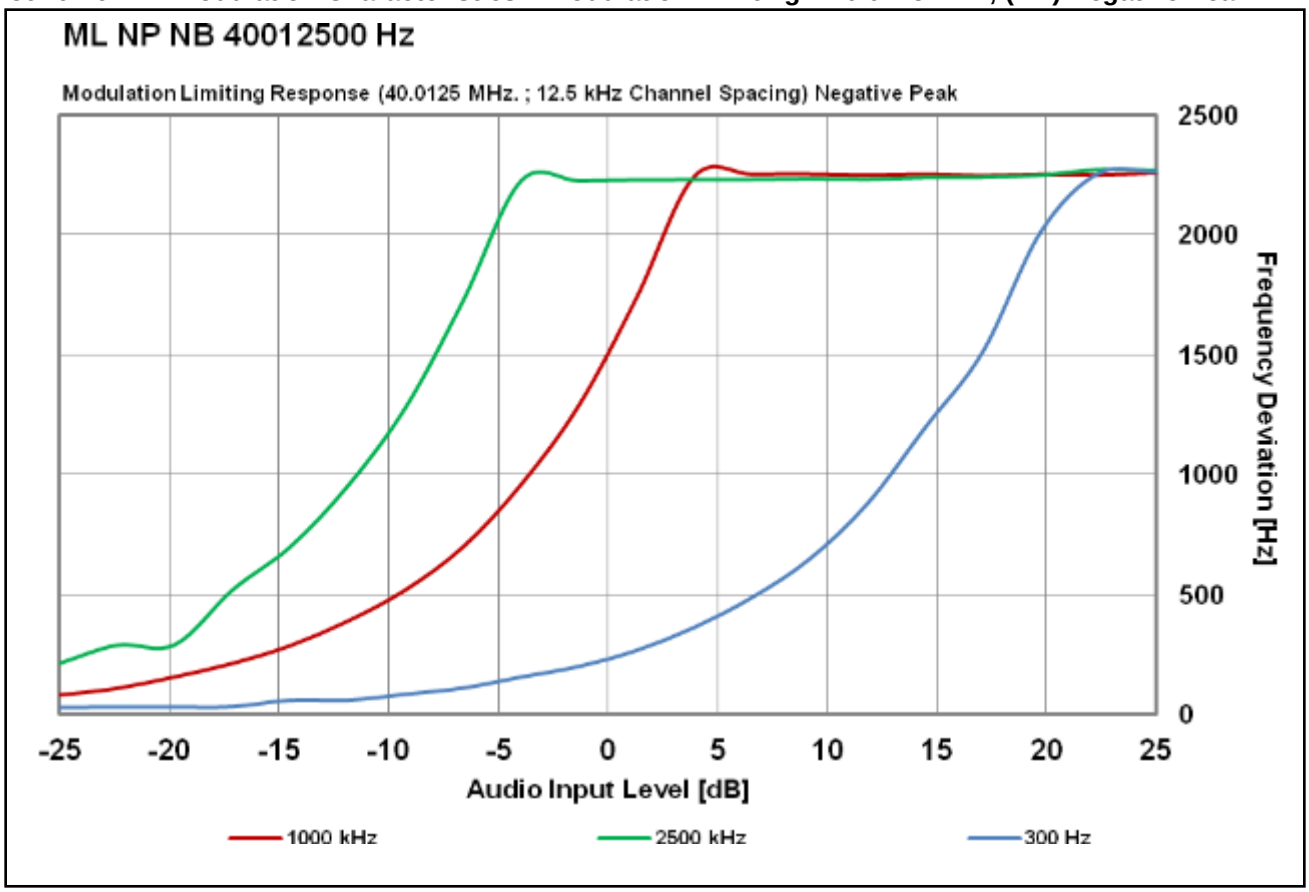


### 10.2.3 Modulation Limiting

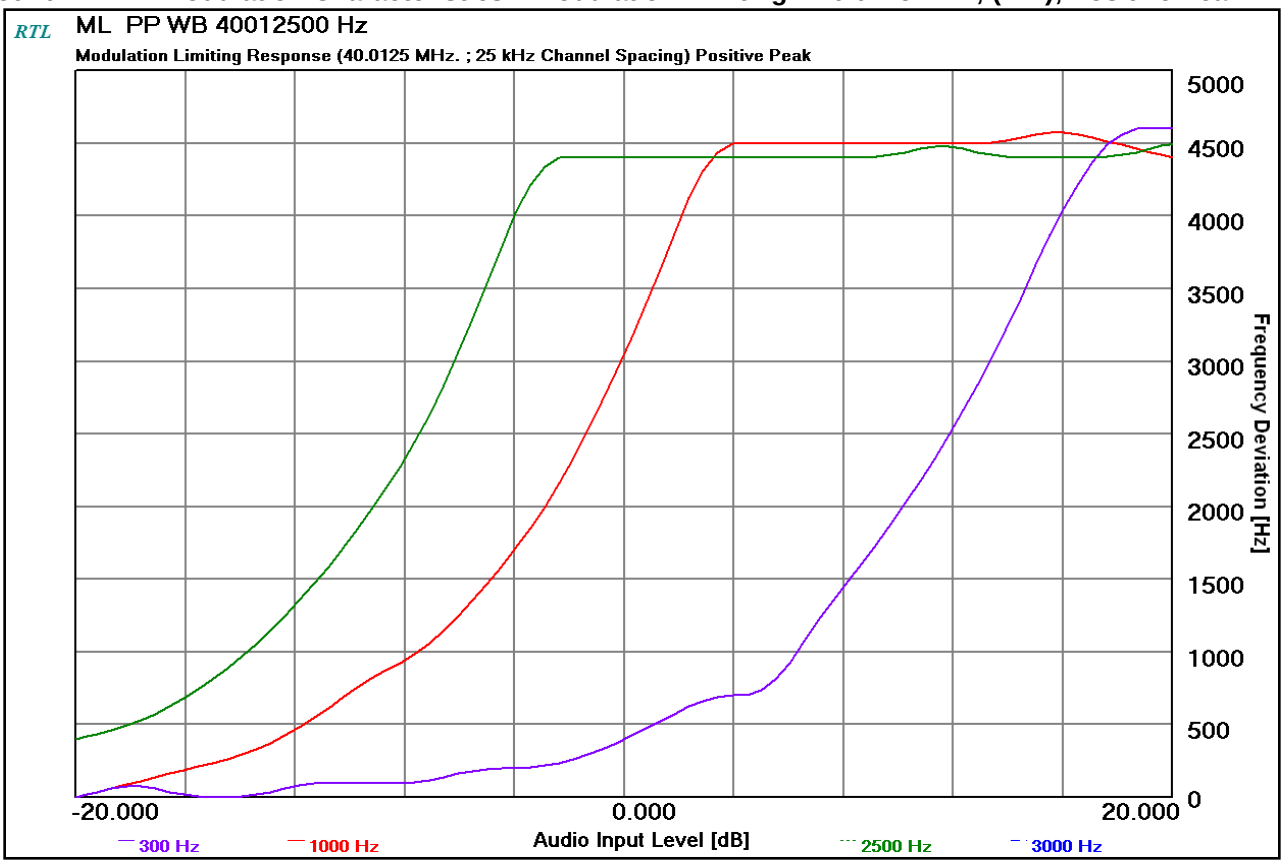
**Plot 10-15: Modulation Characteristics – Modulation Limiting – 40.0125 MHz; (NB) Positive Peak**



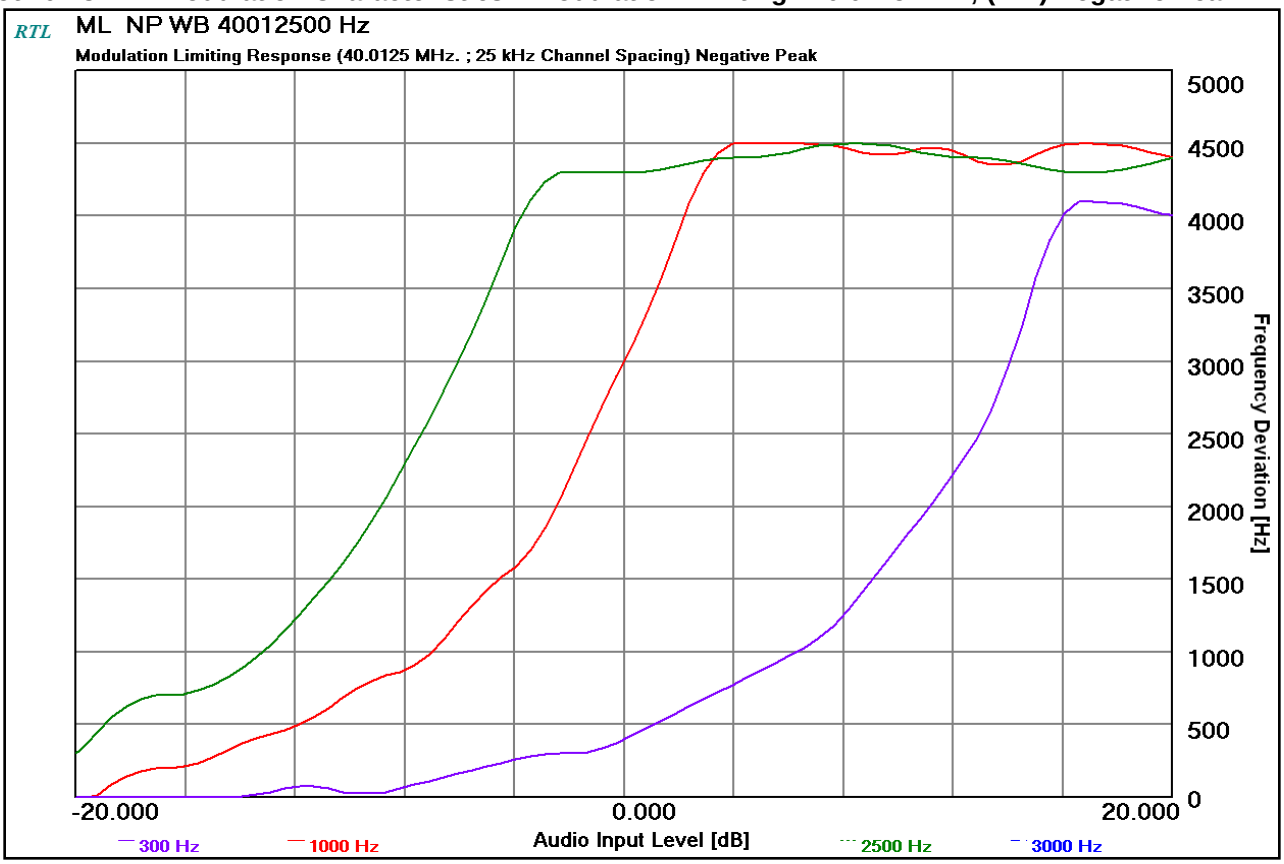
**Plot 10-16: Modulation Characteristics – Modulation Limiting – 40.0125 MHz; (NB) Negative Peak**



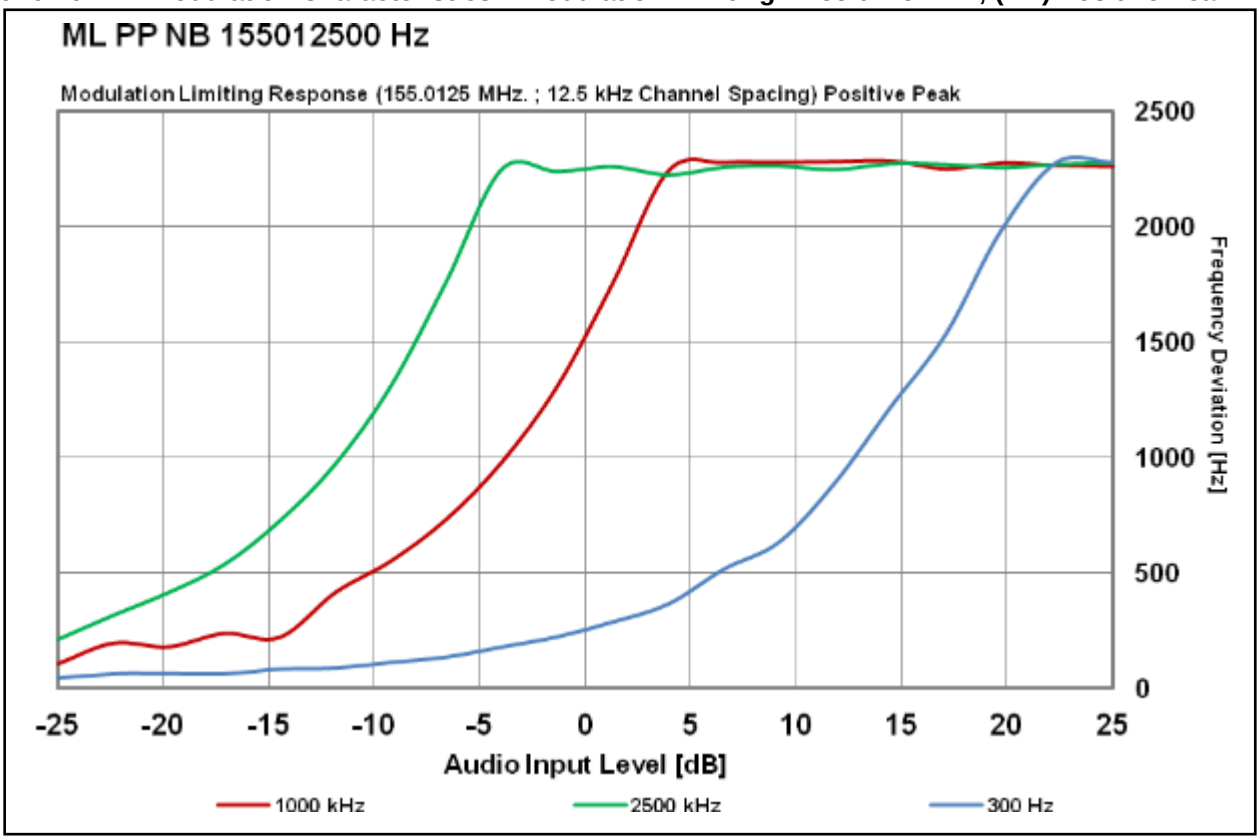
**Plot 10-17: Modulation Characteristics – Modulation Limiting – 40.0125 MHz; (WB); Positive Peak**



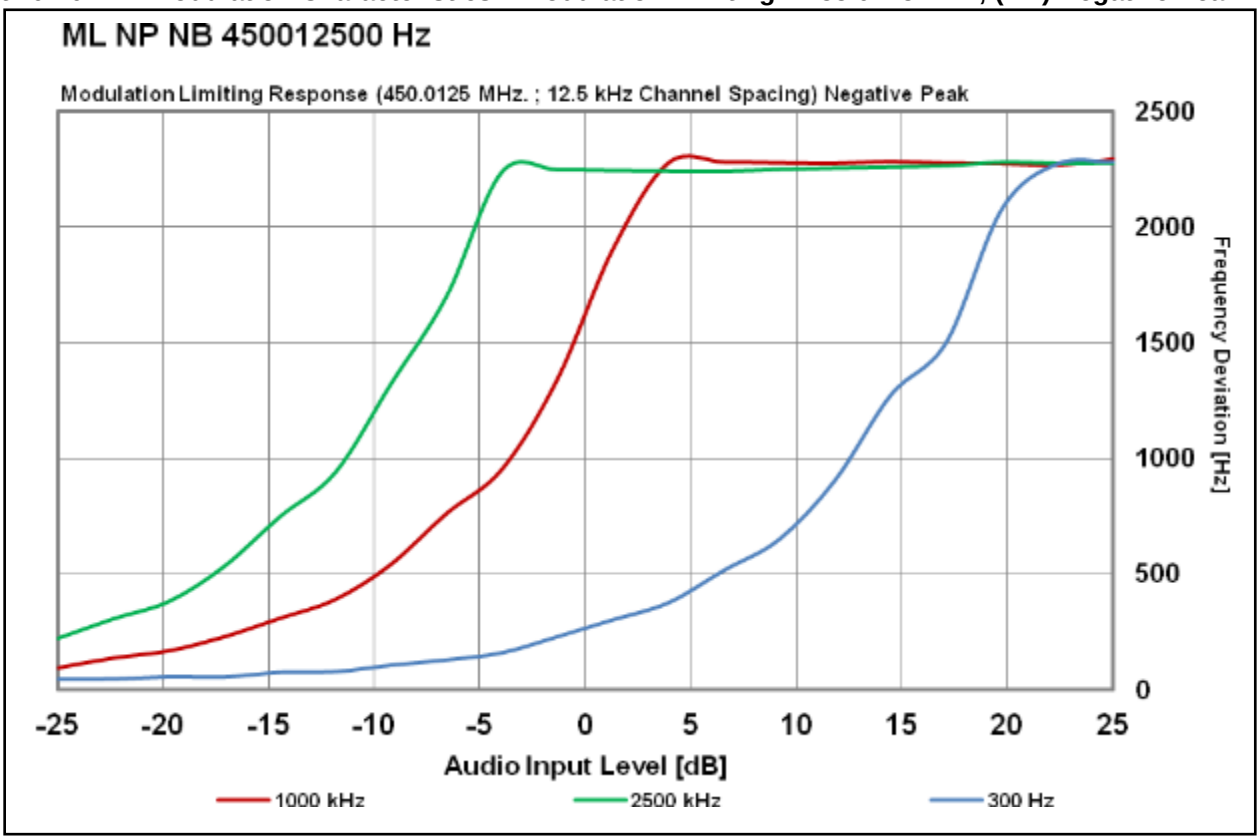
**Plot 10-18: Modulation Characteristics – Modulation Limiting - 40.0125 MHz; (WB) Negative Peak**



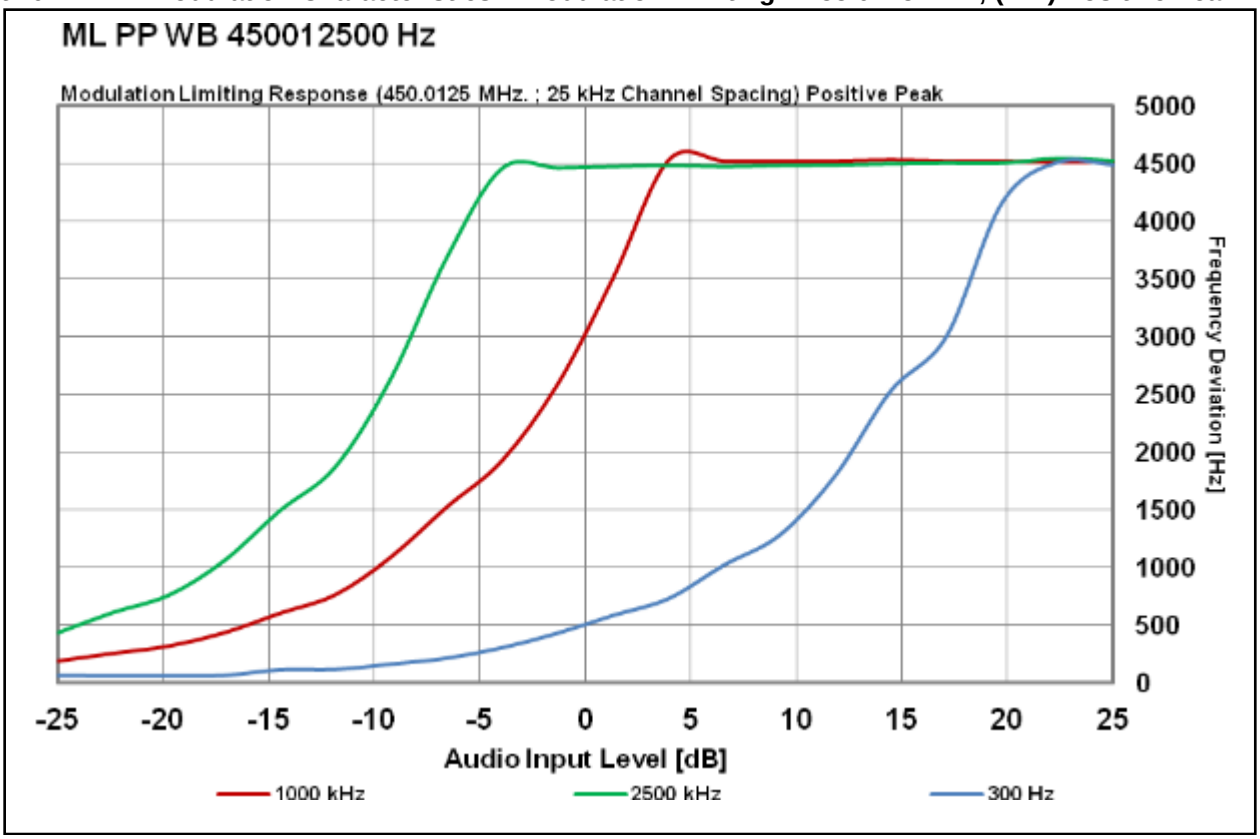
**Plot 10-19: Modulation Characteristics – Modulation Limiting – 155.0125 MHz; (NB) Positive Peak**



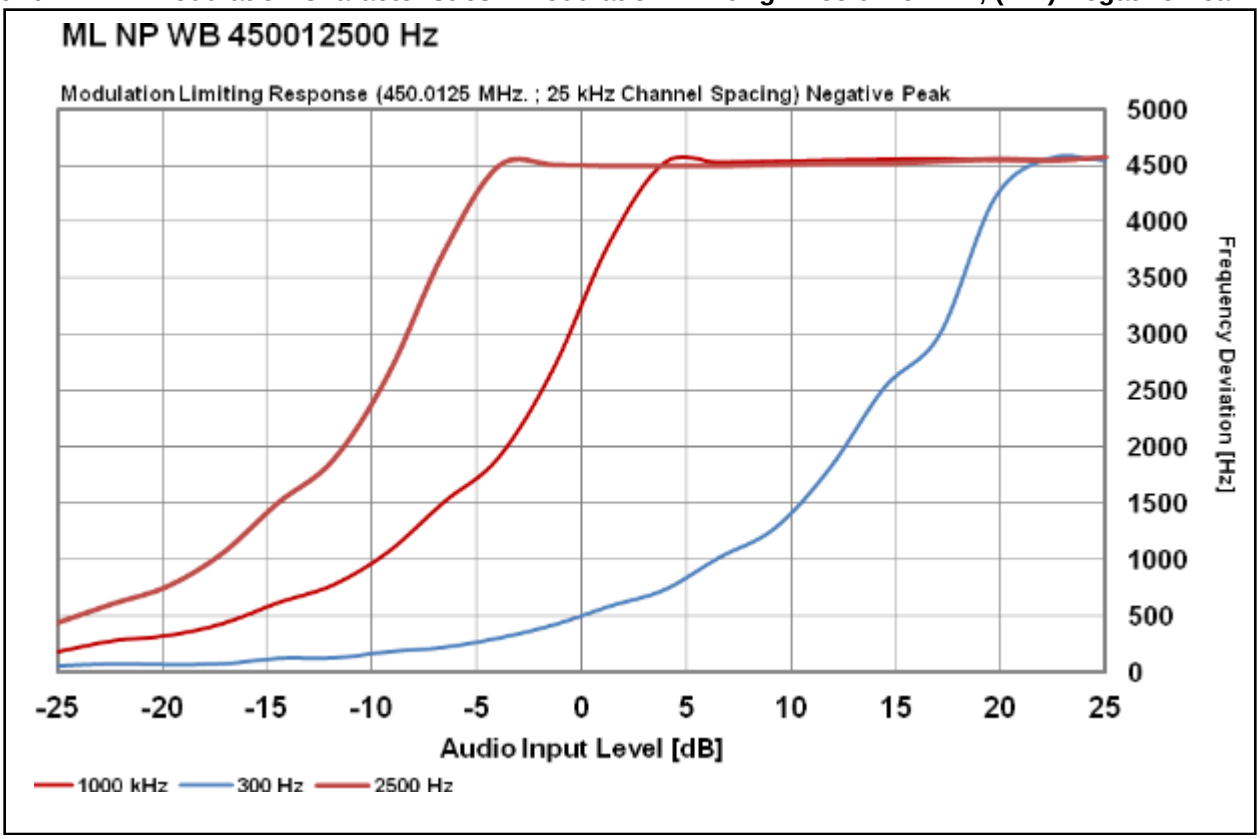
**Plot 10-20: Modulation Characteristics – Modulation Limiting – 155.0125 MHz; (NB) Negative Peak**



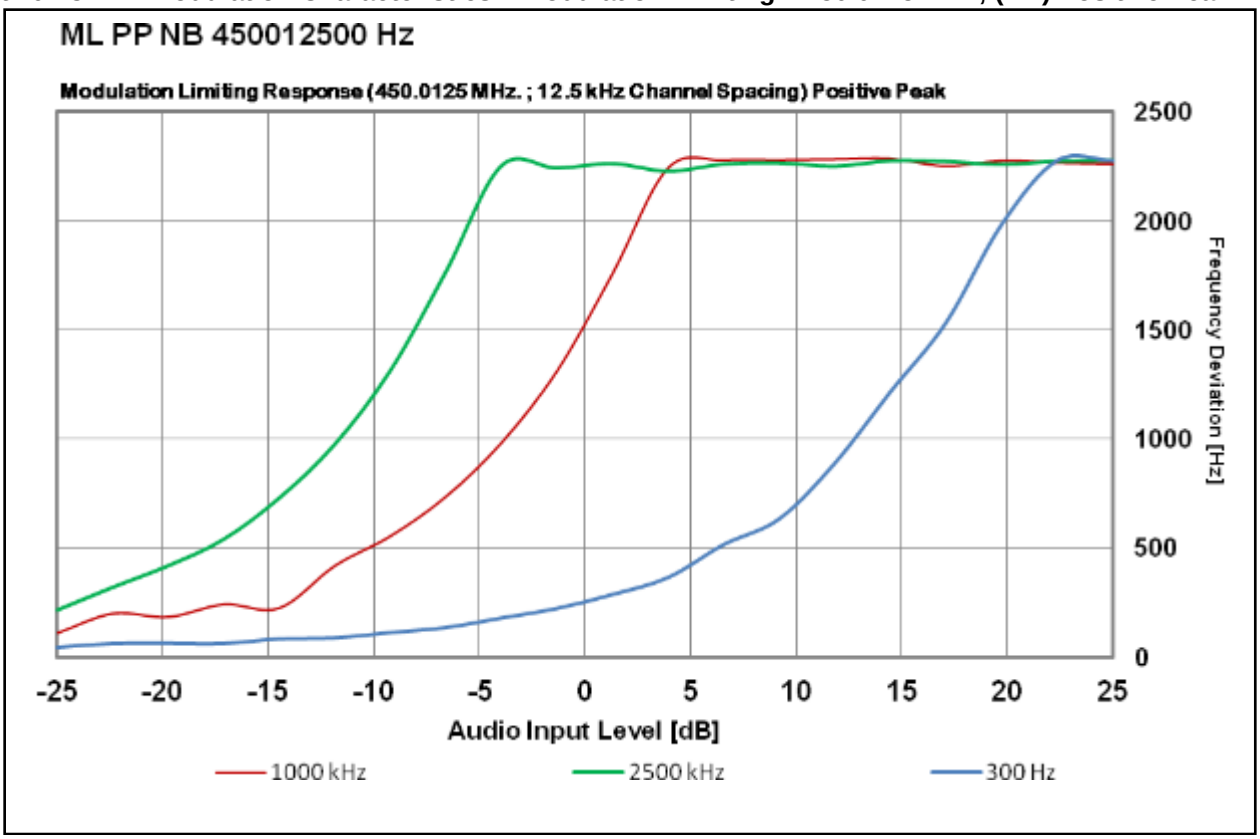
**Plot 10-21: Modulation Characteristics – Modulation Limiting – 155.0125 MHz; (WB) Positive Peak**



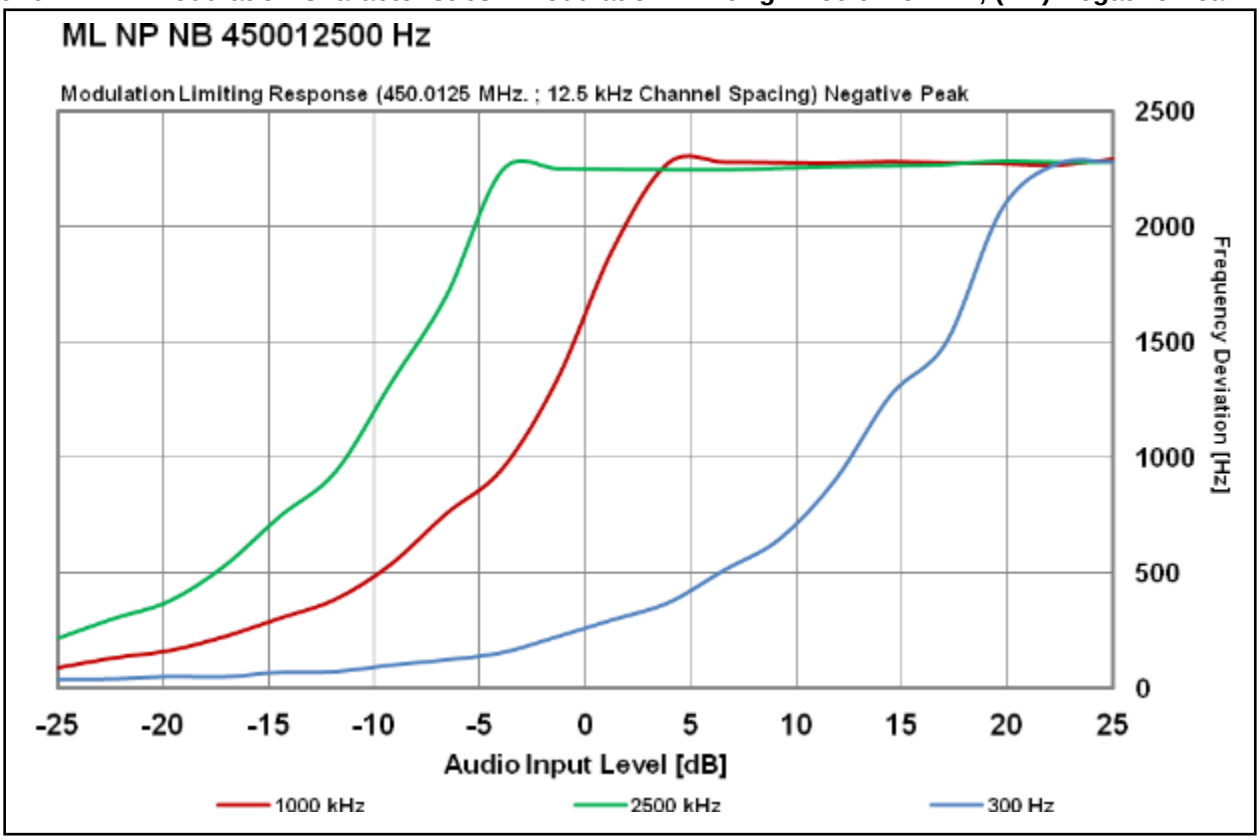
**Plot 10-22: Modulation Characteristics – Modulation Limiting – 155.0125 MHz; (WB) Negative Peak**



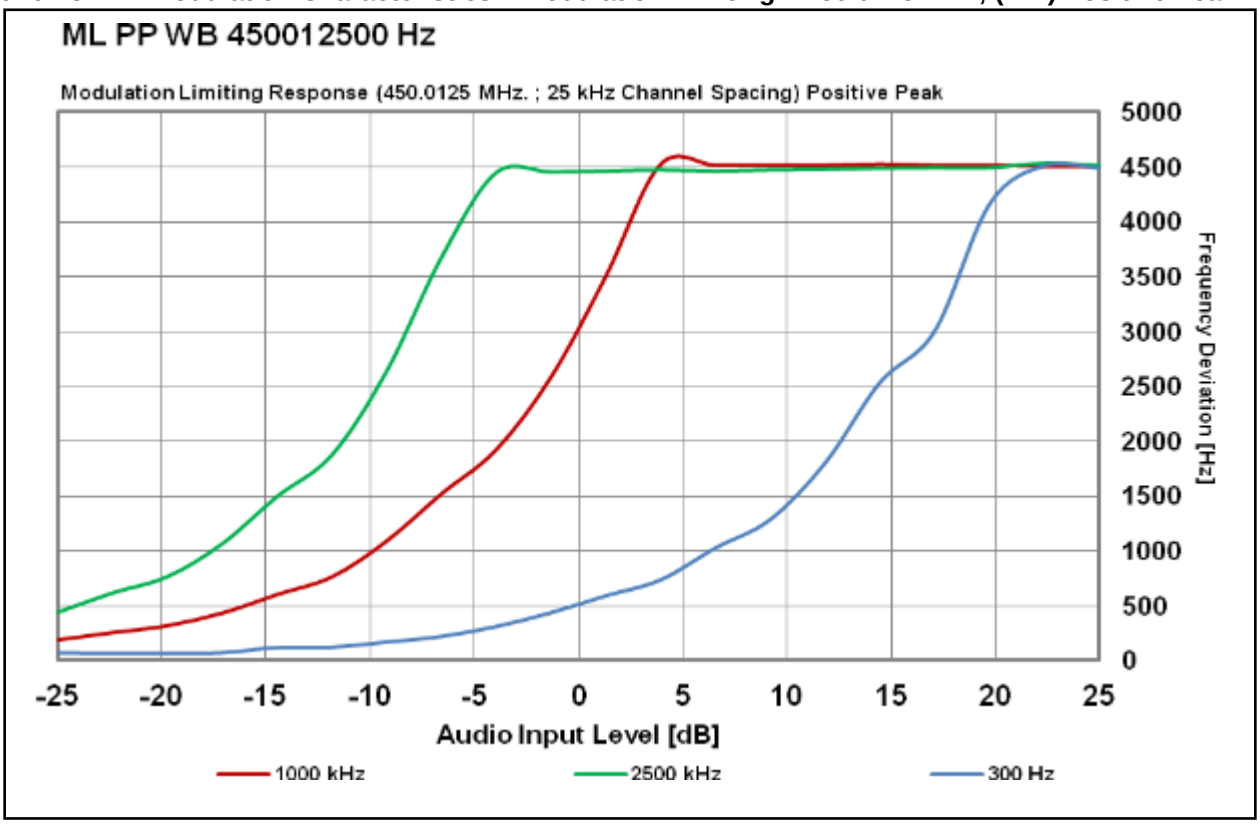
**Plot 10-23: Modulation Characteristics – Modulation Limiting – 450.0125 MHz; (NB) Positive Peak**



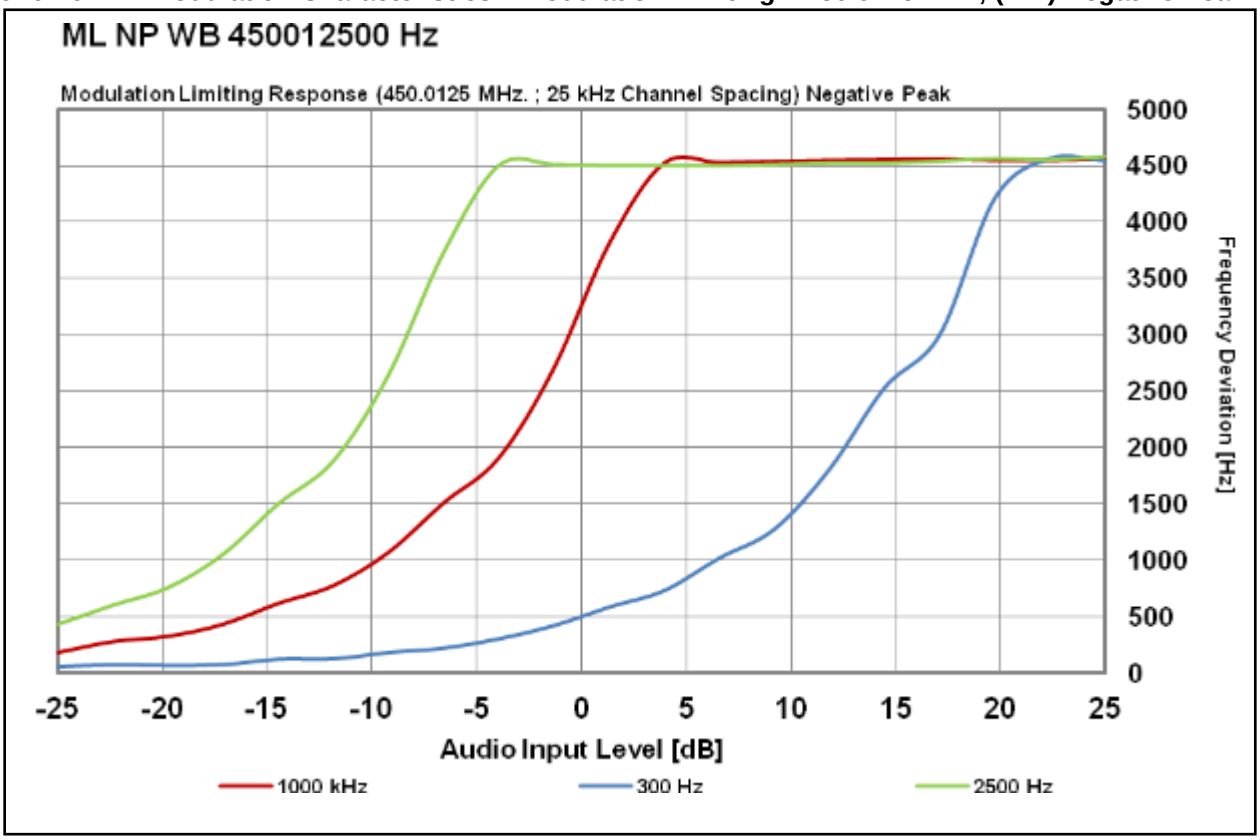
**Plot 10-24: Modulation Characteristics – Modulation Limiting – 450.0125 MHz; (NB) Negative Peak**



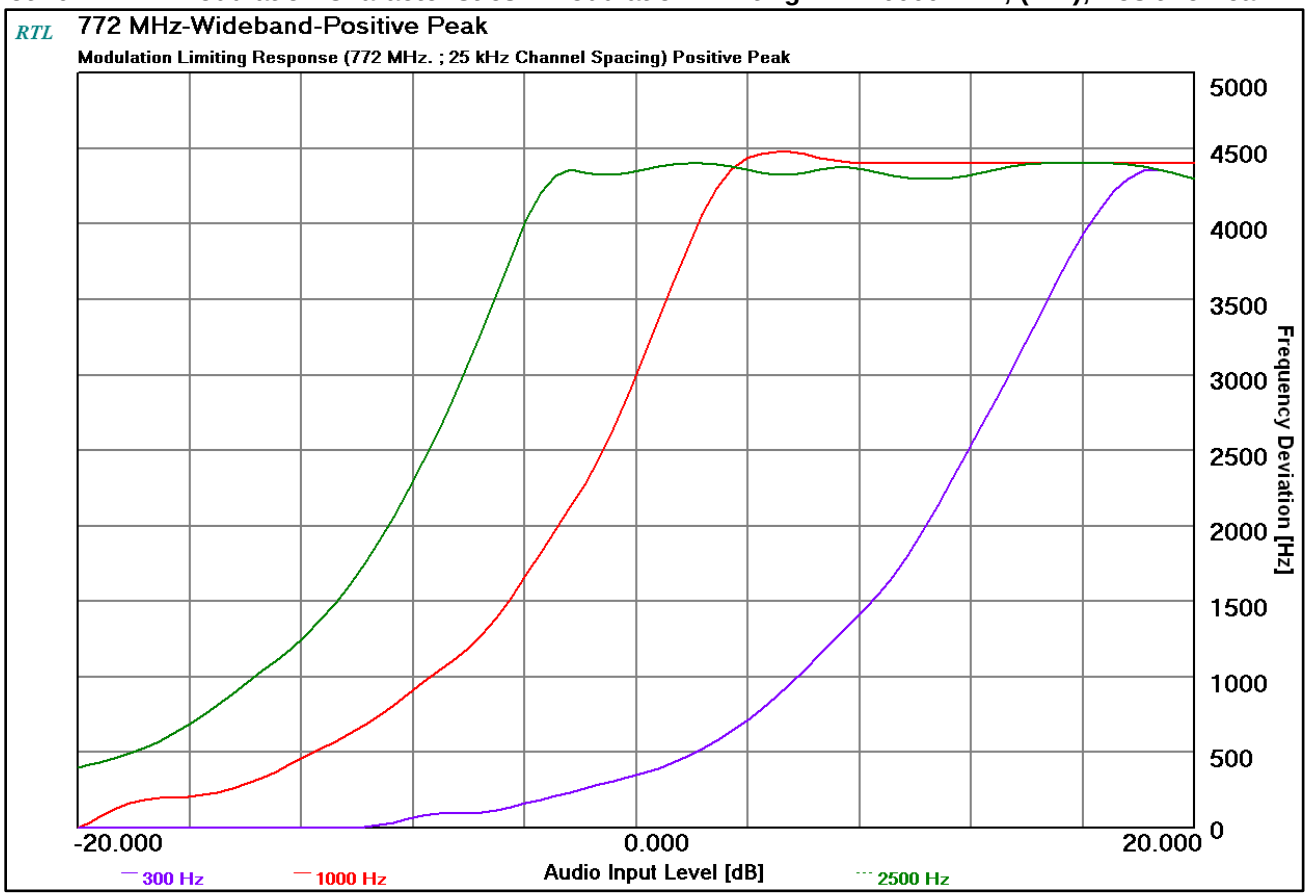
**Plot 10-25: Modulation Characteristics – Modulation Limiting – 450.0125 MHz; (WB) Positive Peak**



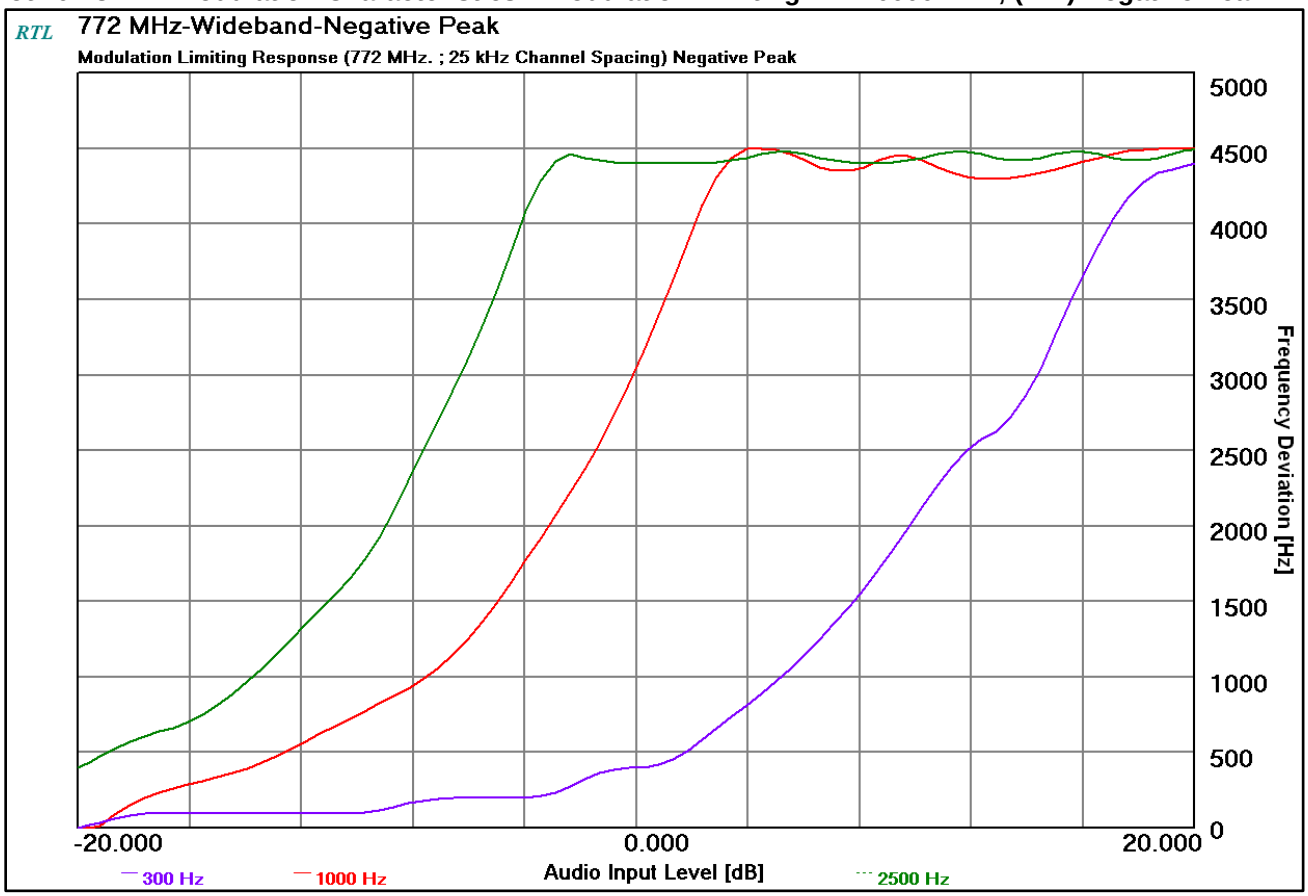
**Plot 10-26: Modulation Characteristics – Modulation Limiting – 450.0125 MHz; (WB) Negative Peak**



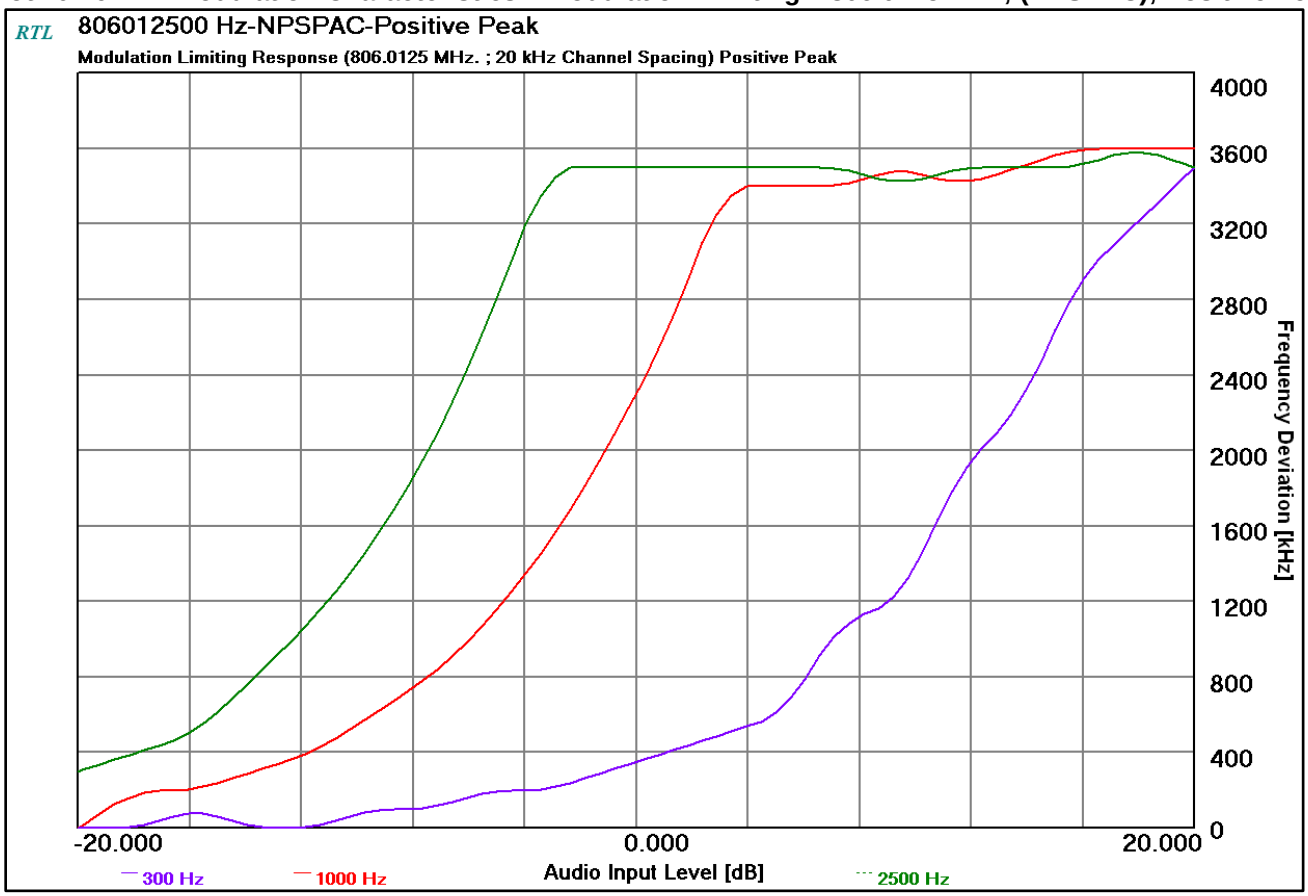
**Plot 10-27: Modulation Characteristics – Modulation Limiting – 772.0000 MHz; (WB); Positive Peak**



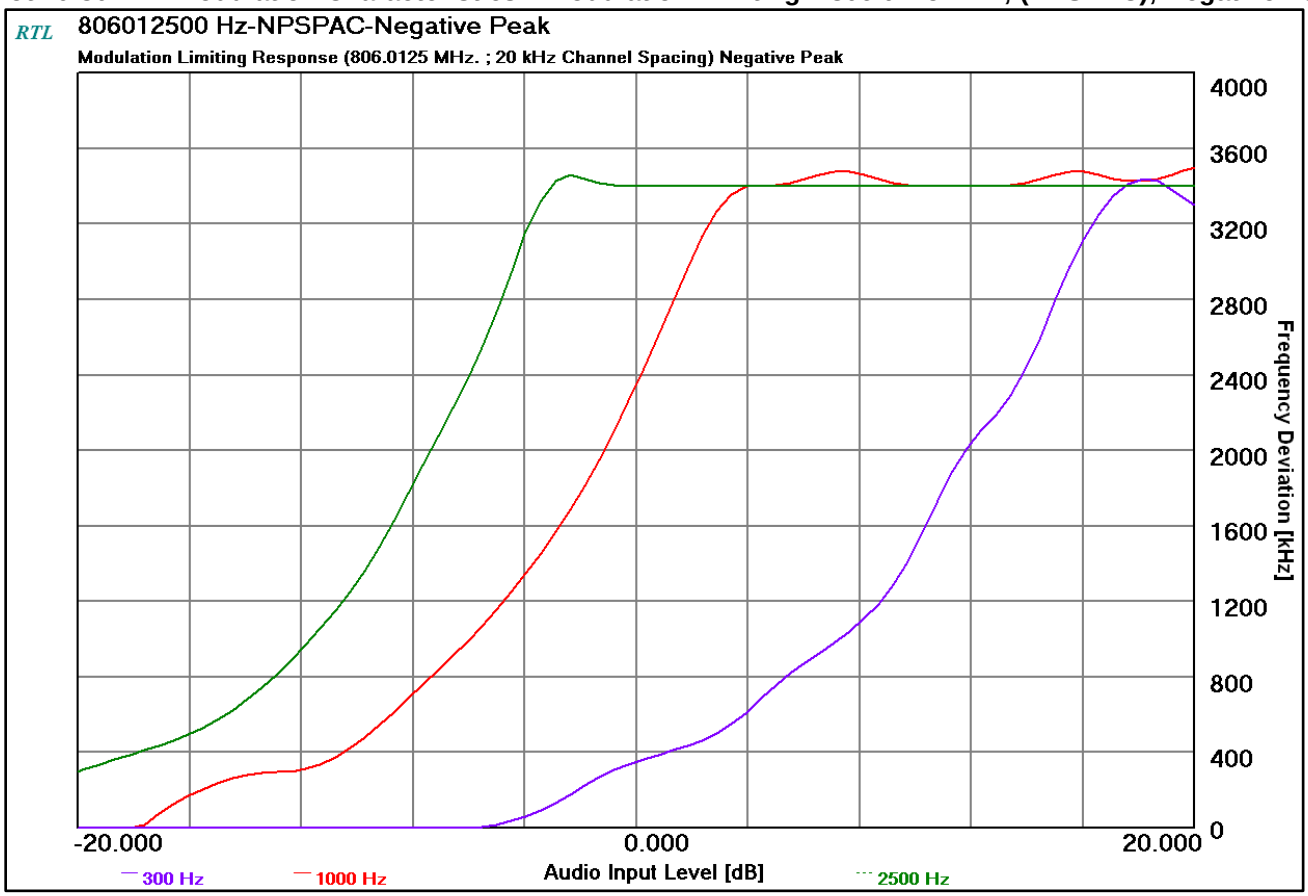
**Plot 10-28: Modulation Characteristics – Modulation Limiting - 772.0000 MHz; (WB) Negative Peak**



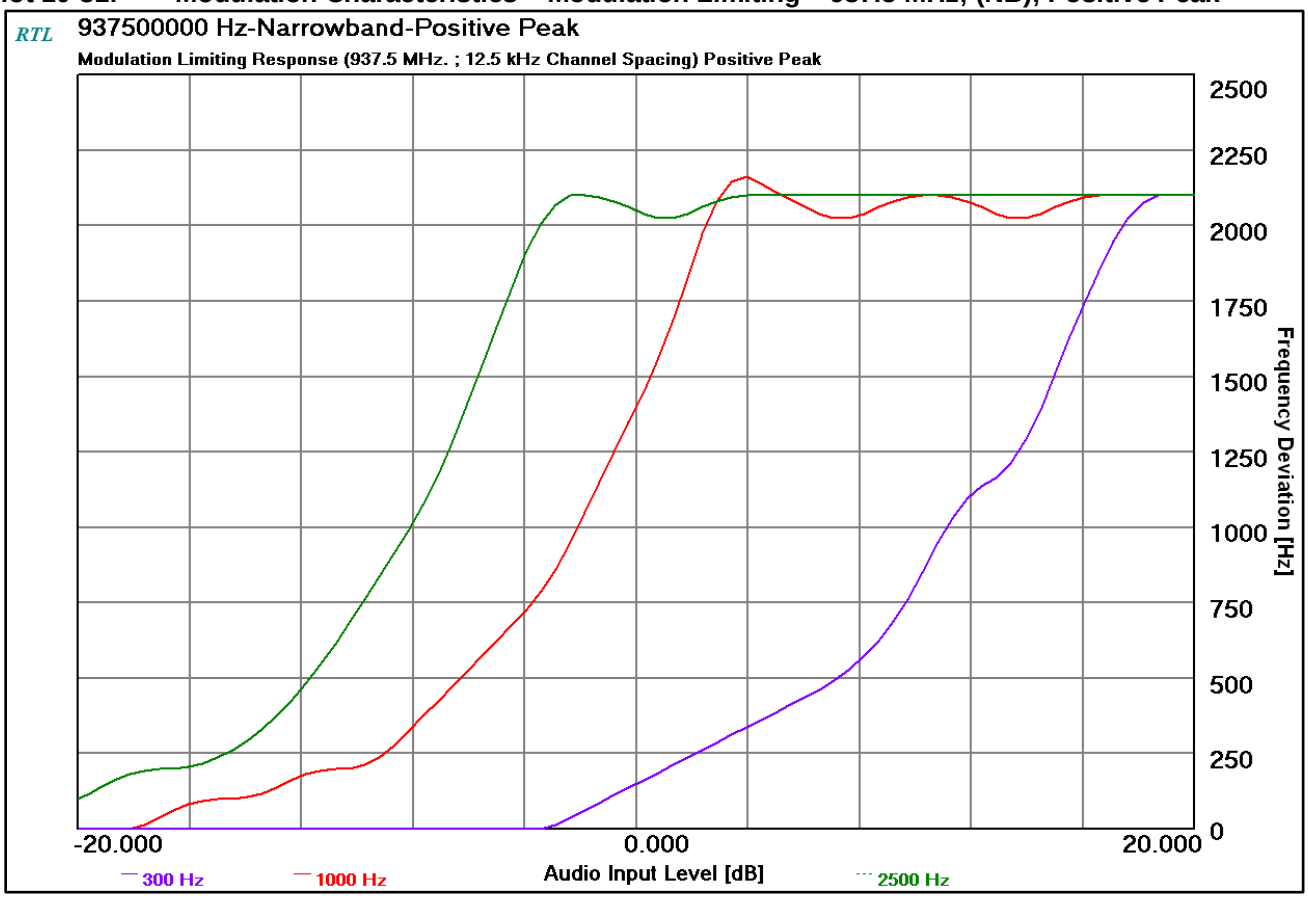
**Plot 10-29: Modulation Characteristics – Modulation Limiting – 806.0125 MHz; (NPSPAC); Positive Peak**



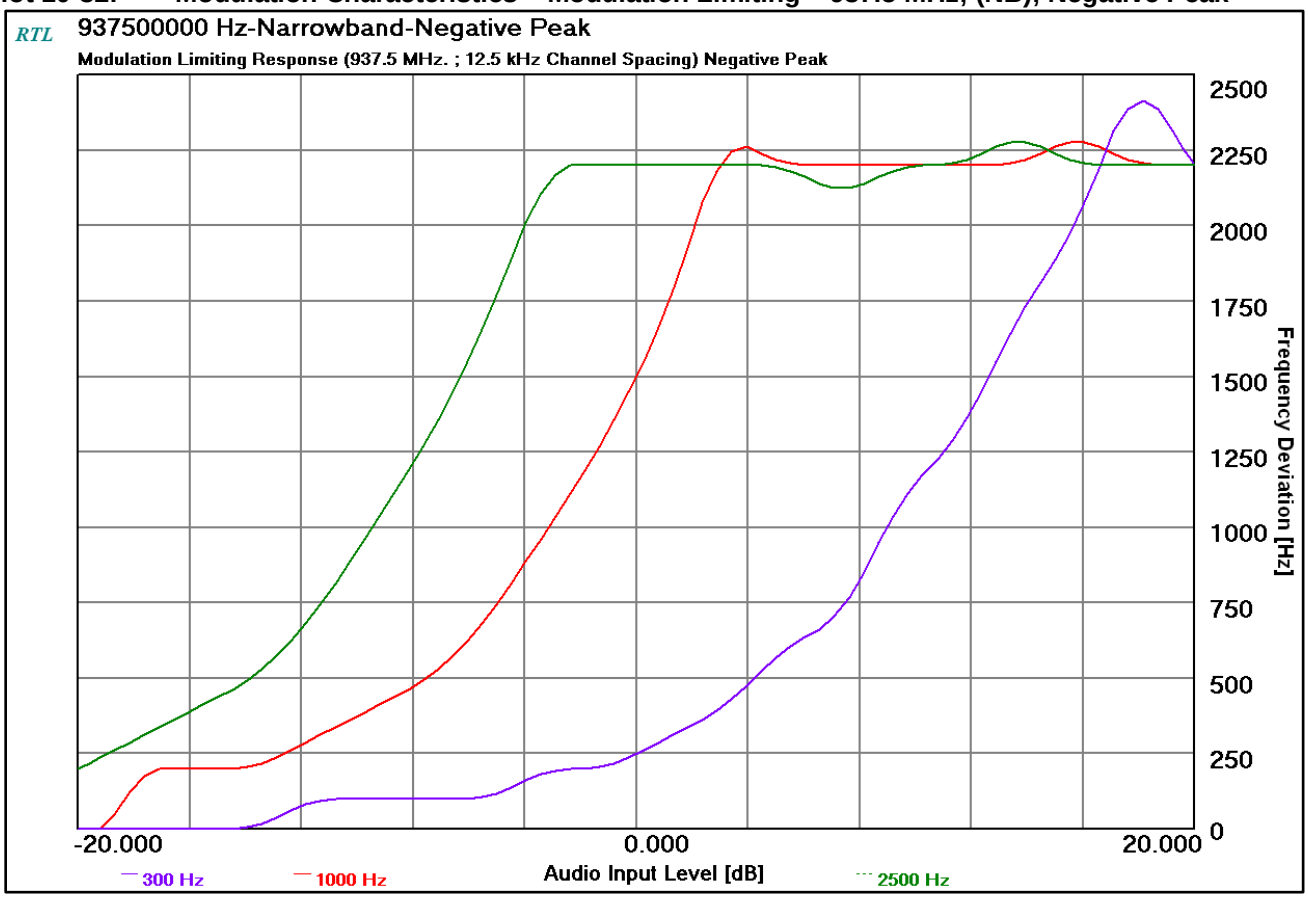
**Plot 10-30: Modulation Characteristics – Modulation Limiting – 806.0125 MHz; (NPSPAC); Negative Peak**



**Plot 10-31: Modulation Characteristics – Modulation Limiting – 937.5 MHz; (NB); Positive Peak**



**Plot 10-32: Modulation Characteristics – Modulation Limiting – 937.5 MHz; (NB); Negative Peak**




Measurement uncertainties shown for these tests are expanded uncertainties expressed at the 95% confidence level using a coverage factor K=2. Measurement uncertainty: ±0.5 Hz/±0.5 dB

**Results: Pass**

**Table 10-1: Test Equipment Used For Testing Modulation Requirements**

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number | Calibration Due Date |
|---|---|---|---|---|---|
| 901057 | Hewlett Packard | 3336B | Synthesizer/ Level Generator | 2514A02585 | 1/31/20 |
| 901118 | Hewlett Packard | 8901A Opt. 002-003 | Modulation Analyzer | 2406A00178 | 1/31/20 |
| 901724 | Weinschel Corporation | 47-20-34 | Attenuator DC-18 GHz 20 dB 100W | BK5859 | 8/7/20 |

**Test Personnel:**

| Daniel Baltzell | | August 18, 2019<br>September 11, 2018 |
|---|---|---|
| EMC Test Engineer | Signature | Dates of Test |

# 11 FCC Rules and Regulations Part 90.214: Transient Frequency Response; Part 74.462(c): Authorized Bandwidth and Emissions; RSS-119 5.9: Transient Frequency Behavior

## 11.1 Test Procedure

TIA-EIA-603-C 2004, section 2.2.3. Transmitter plots were taken with the radio set at high power.

**§90.214 Transient Frequency Behavior**

Transmitters designed to operate in the 150–174 MHz and 421–512 MHz frequency bands must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

| Time intervals [1,2] | Maximum frequency difference [3] | All equipment | |
|---|---|---|---|
| | | 150 to 174 MHz | 421 to 512 MHz |
| **Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels** | | | |
| $t_1$ [4] ..... | ±25.0 kHz | 5.0 ms | 10.0 ms |
| $t_2$ ..... | ±12.5 kHz | 20.0 ms | 25.0 ms |
| $t_3$ [4] ..... | ±25.0 kHz | 5.0 ms | 10.0 ms |
| **Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels** | | | |
| $t_1$ [4] ..... | ±12.5 kHz | 5.0 ms | 10.0 ms |
| $t_2$ ..... | ±6.25 kHz | 20.0 ms | 25.0 ms |
| $t_3$ [4] ..... | ±12.5 kHz | 5.0 ms | 10.0 ms |
| **Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels** | | | |
| $t_1$ [4] ..... | ±6.25 kHz | 5.0 ms | 10.0 ms |
| $t_2$ ..... | ±3.125 kHz | 20.0 ms | 25.0 ms |
| $t_3$ [4] ..... | ±6.25 kHz | 5.0 ms | 10.0 ms |

[1] $t_{on}$ is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.

$t_1$ is the time period immediately following $t_{on}$.

$t_2$ is the time period immediately following $t_1$.

$t_3$ is the time period from the instant when the transmitter is turned off until $t_{off}$.

$t_{off}$ is the instant when the 1 kHz test signal starts to rise.

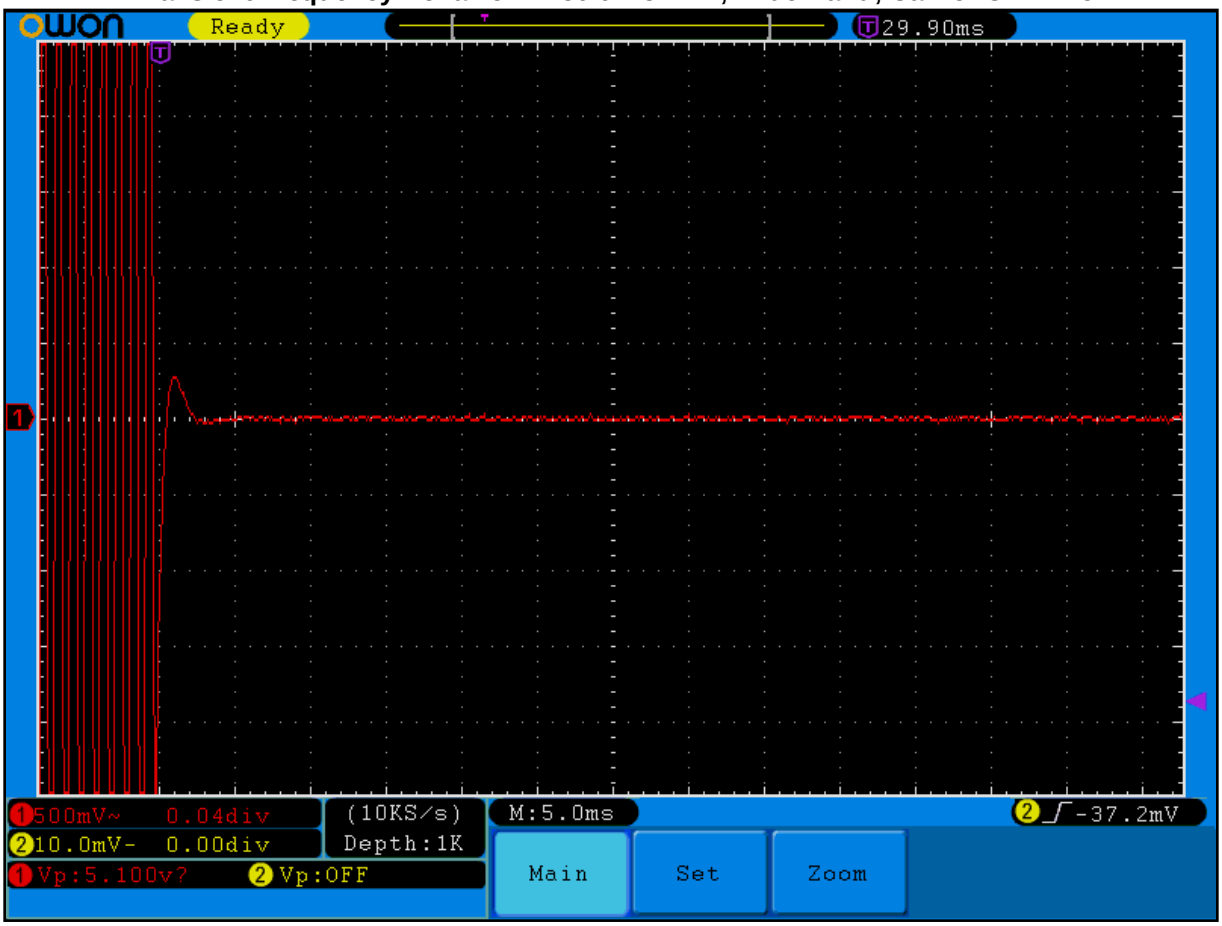
[2] During the time from the end of $t_2$ to the beginning of $t_3$, the frequency difference must not exceed the limits specified in § 90.213.

[3] Difference between the actual transmitter frequency and the assigned transmitter frequency.

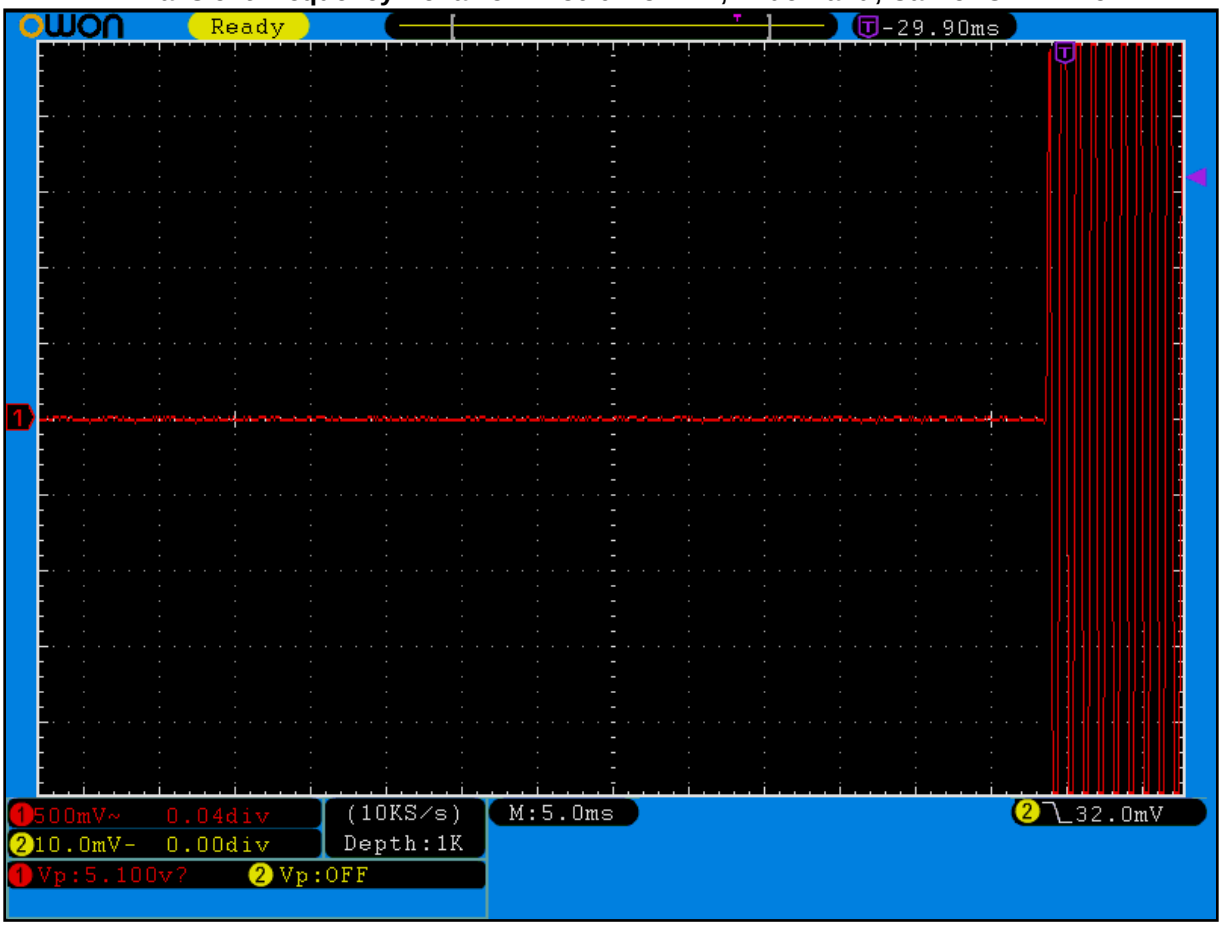
[4] If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

## 11.2 Test Data

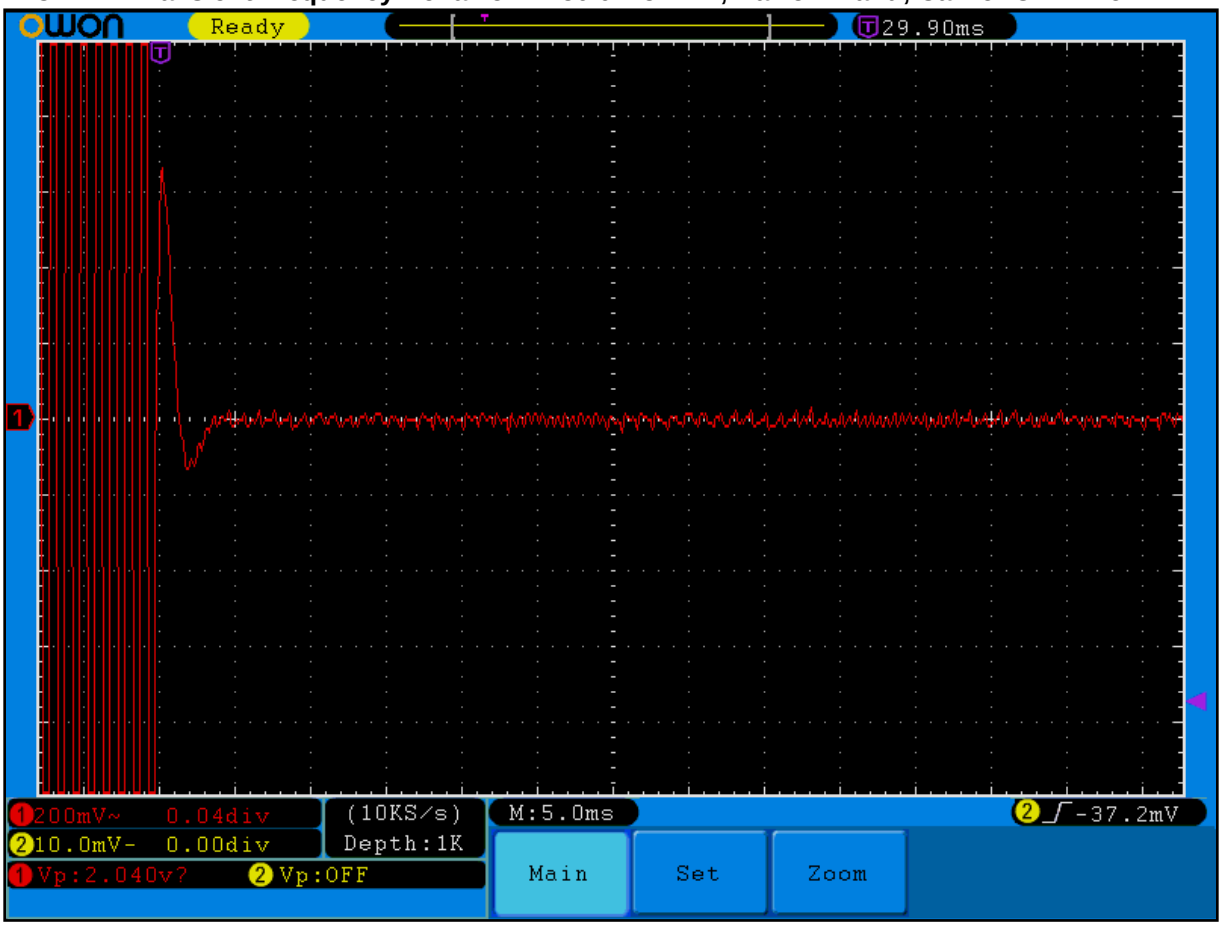
**Plot 11-1: Transient Frequency Behavior – 150.0125 MHz; Wide Band; Carrier ON Time**



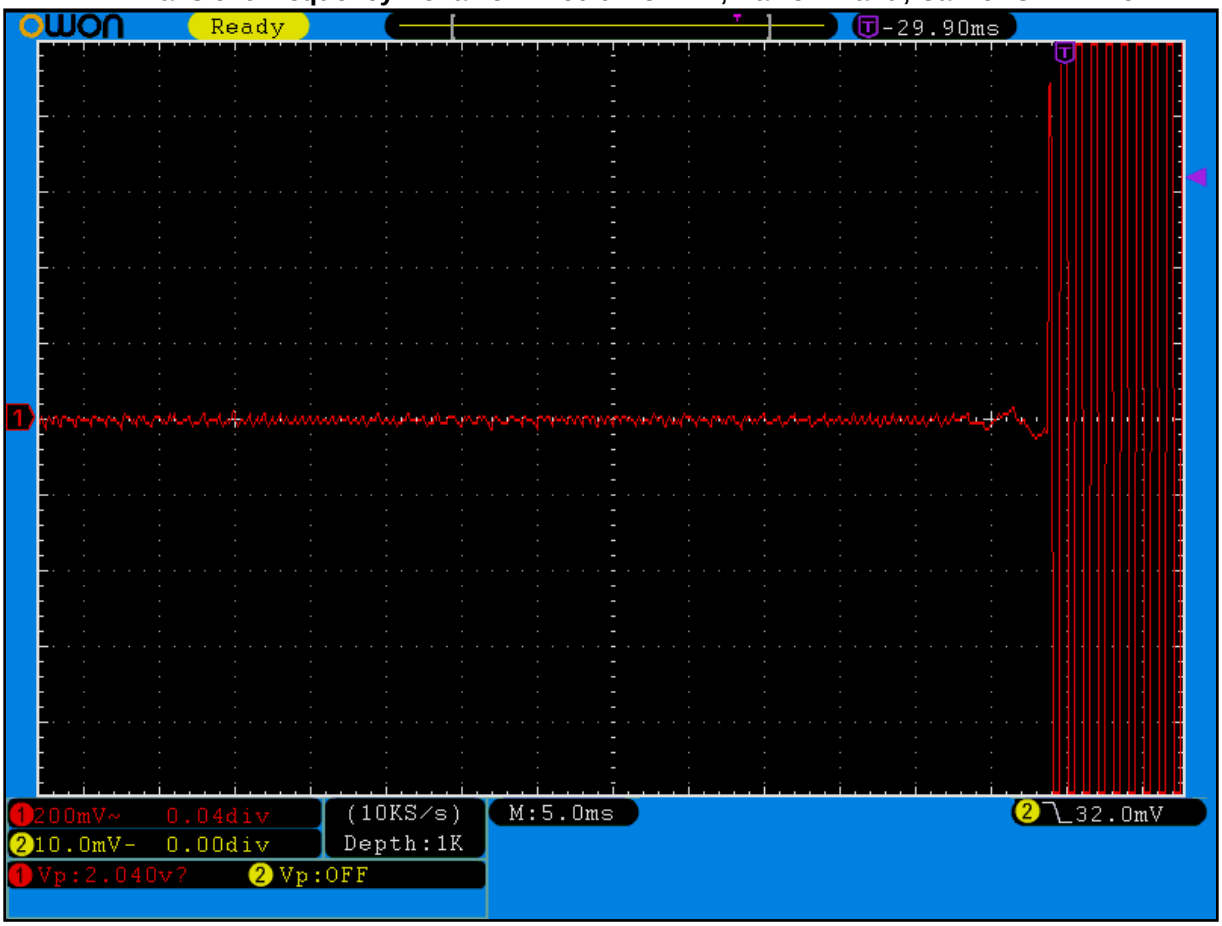
**Plot 11-2: Transient Frequency Behavior – 150.0125 MHz; Wide Band; Carrier OFF Time**



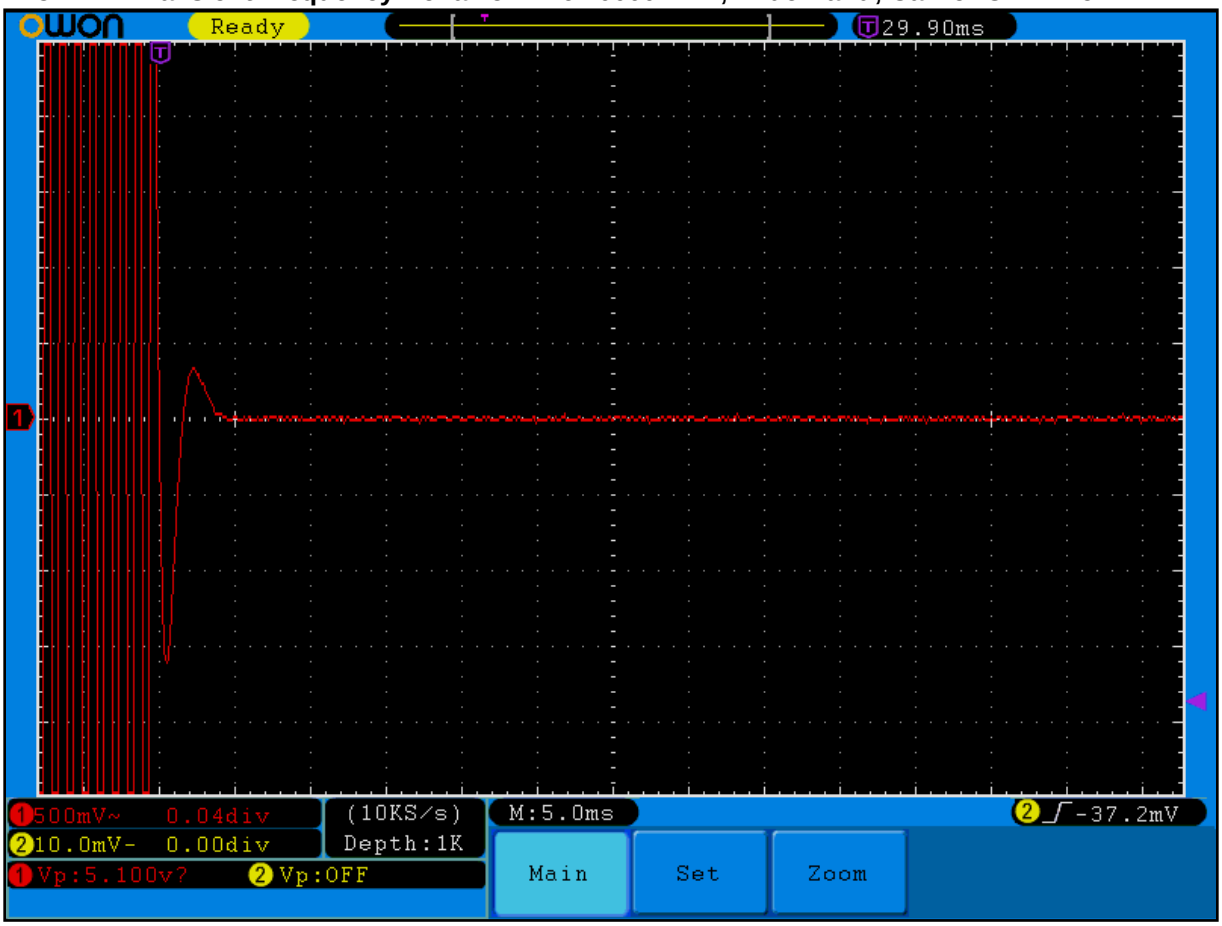
**Plot 11-3: Transient Frequency Behavior – 150.0125 MHz; Narrow Band; Carrier ON Time**



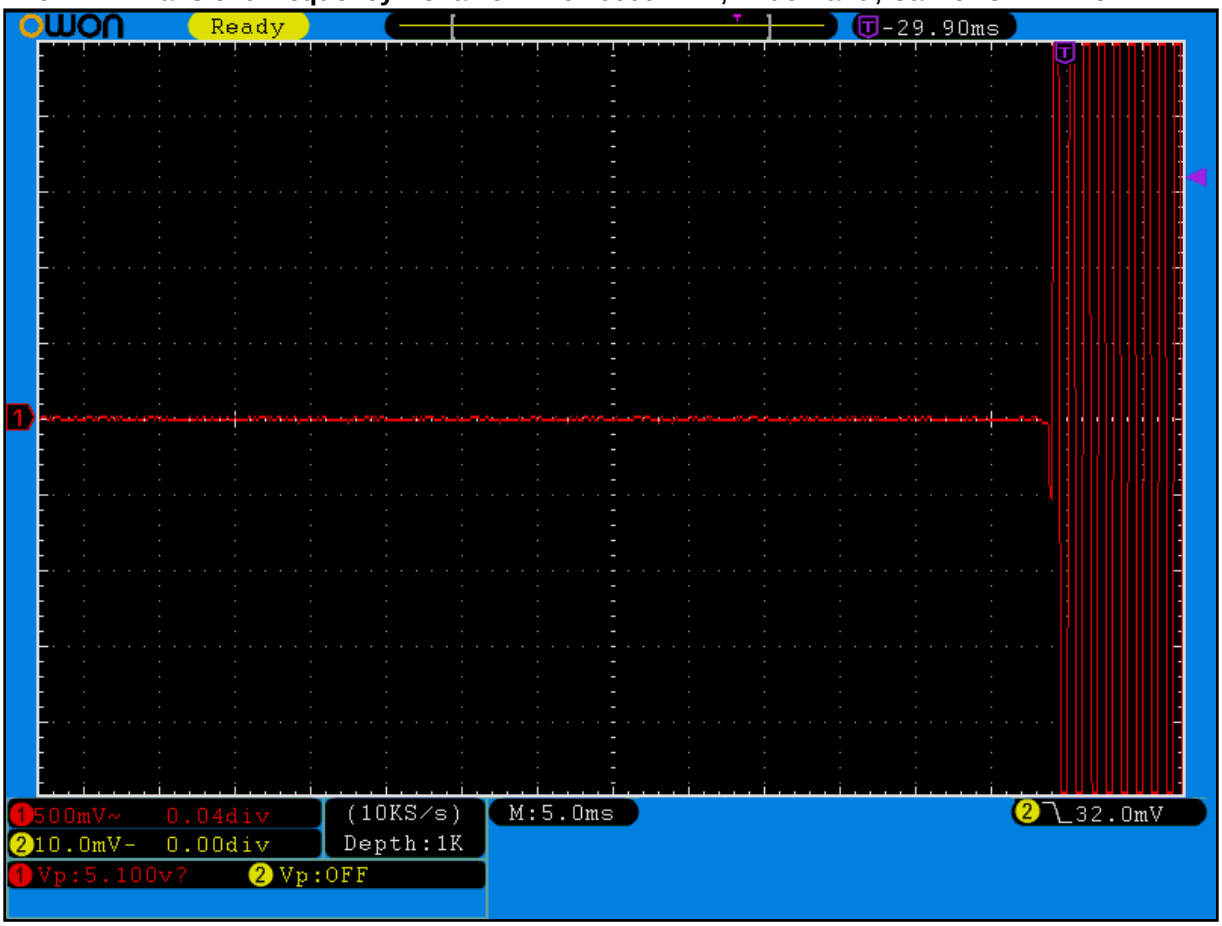
**Plot 11-4: Transient Frequency Behavior – 150.0125 MHz; Narrow Band; Carrier OFF Time**



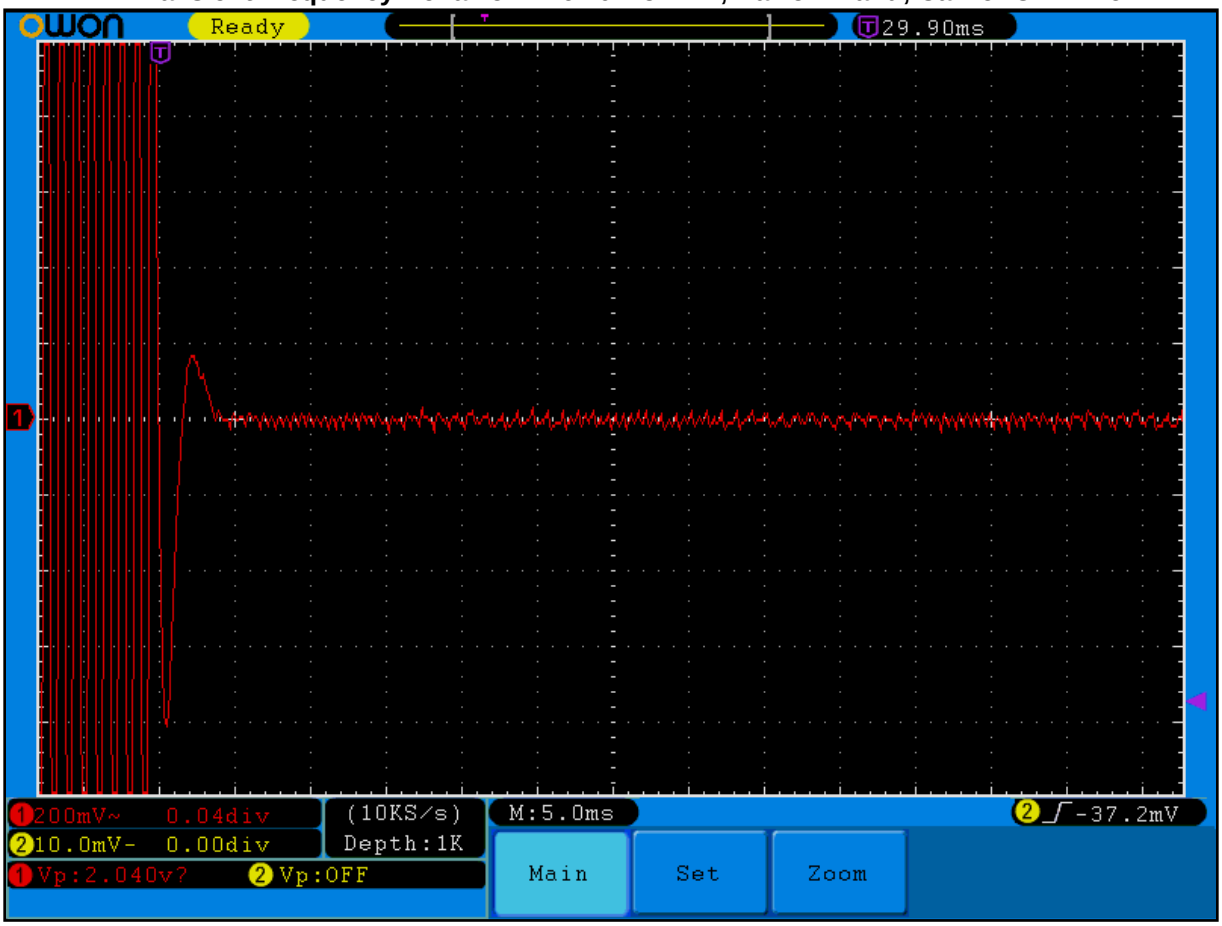
**Plot 11-5: Transient Frequency Behavior – 162.0000 MHz; Wide Band; Carrier ON Time**



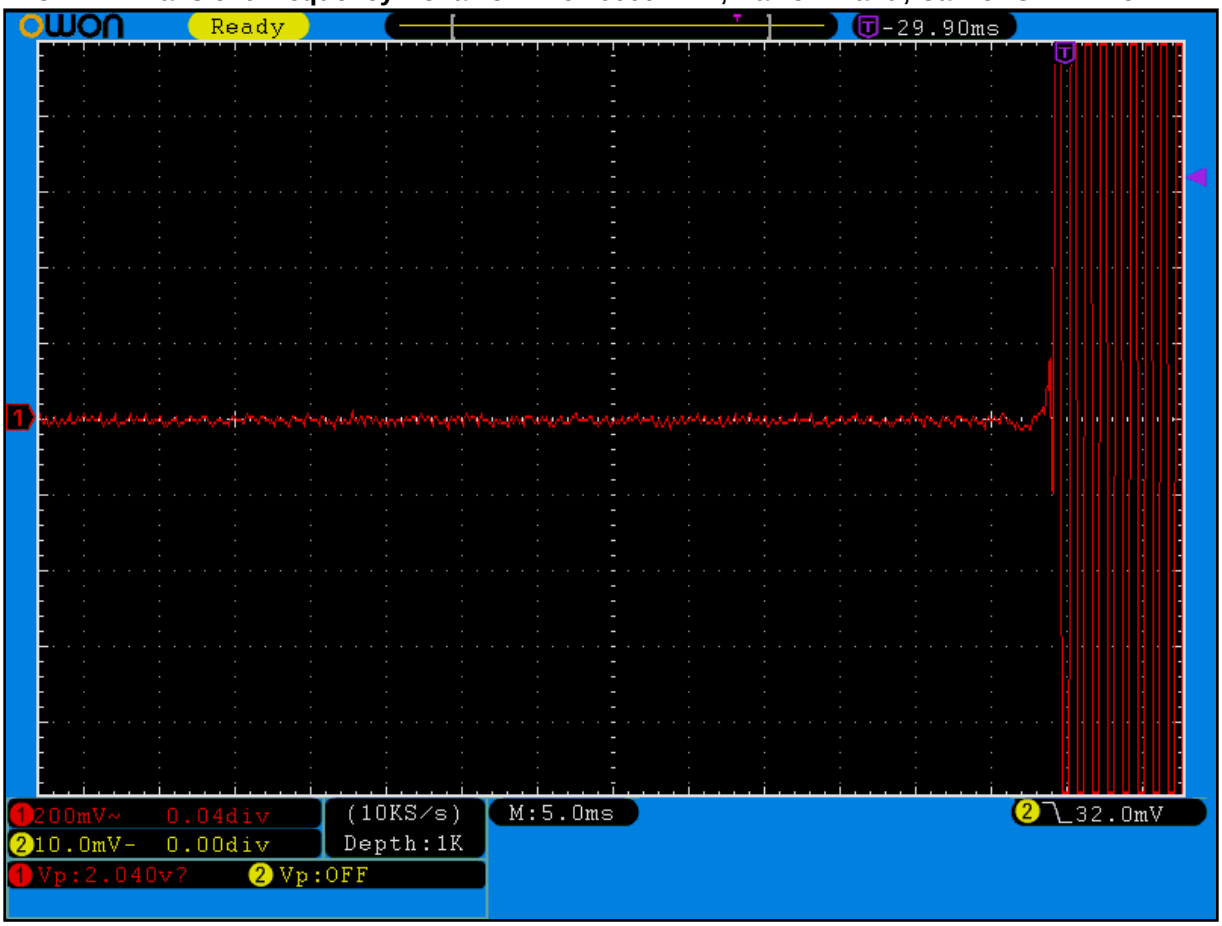
**Plot 11-6: Transient Frequency Behavior – 162.0000 MHz; Wide Band; Carrier OFF Time**



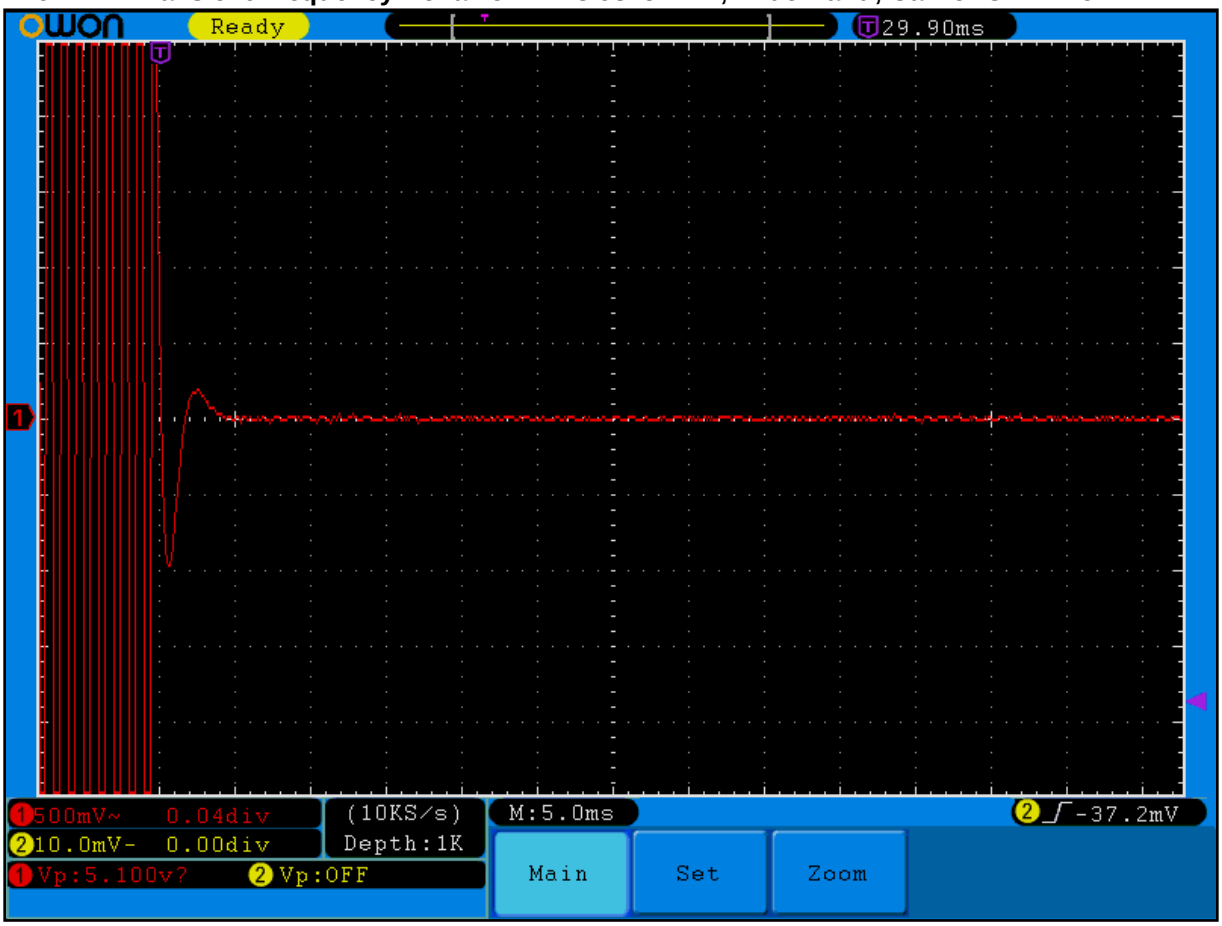
**Plot 11-7: Transient Frequency Behavior – 162.0125 MHz; Narrow Band; Carrier ON Time**



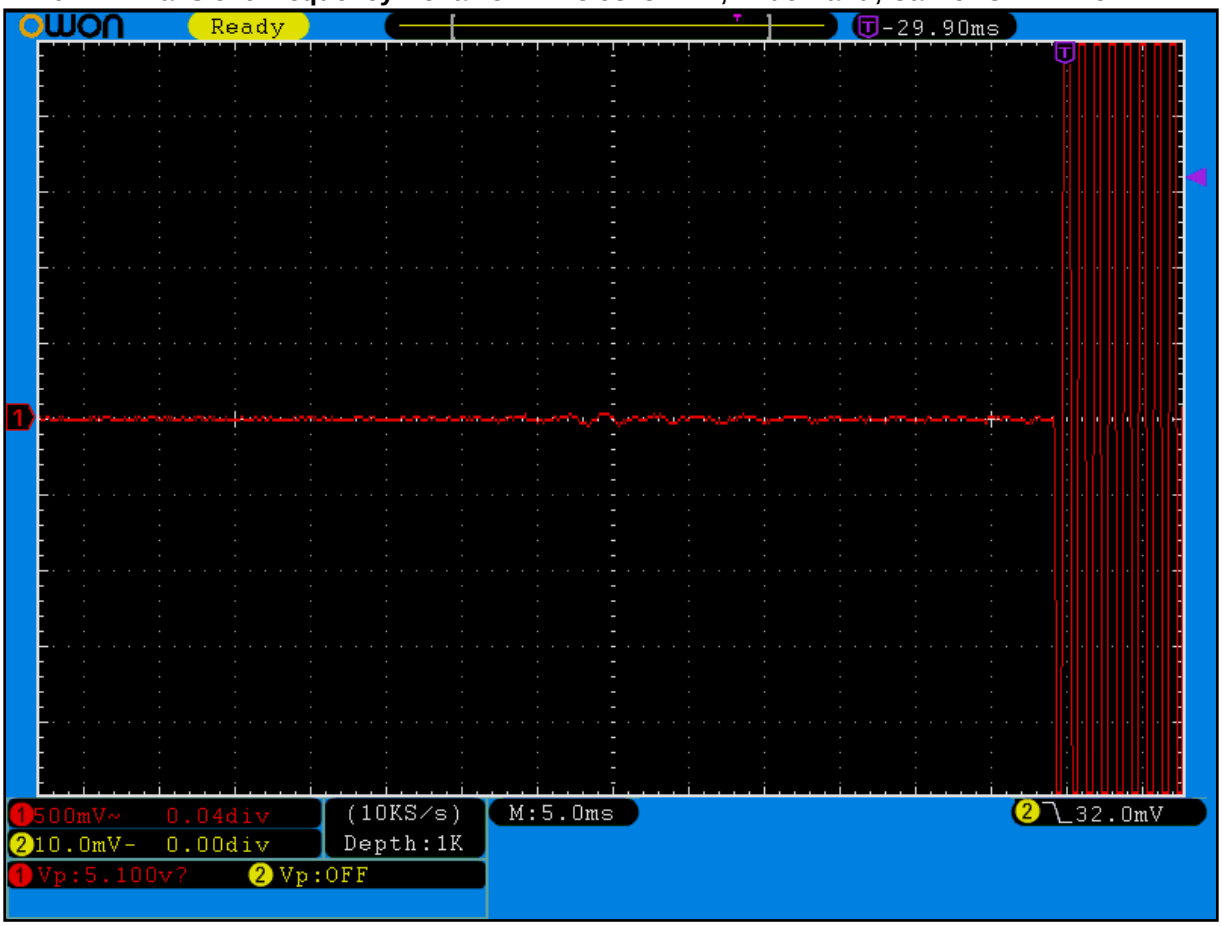
**Plot 11-8: Transient Frequency Behavior – 162.0000 MHz; Narrow Band; Carrier OFF Time**



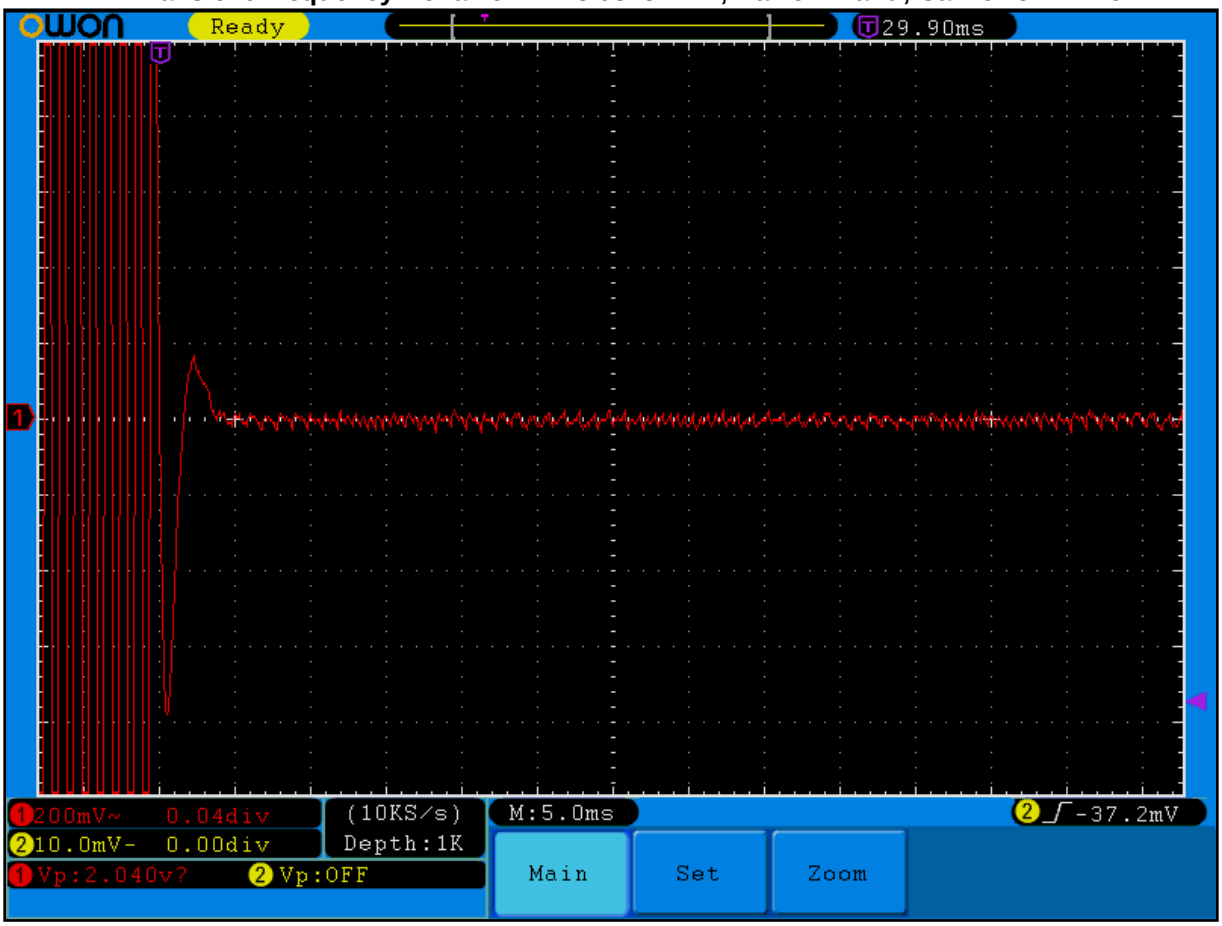
**Plot 11-9: Transient Frequency Behavior – 173.9875 MHz; Wide Band; Carrier ON Time**



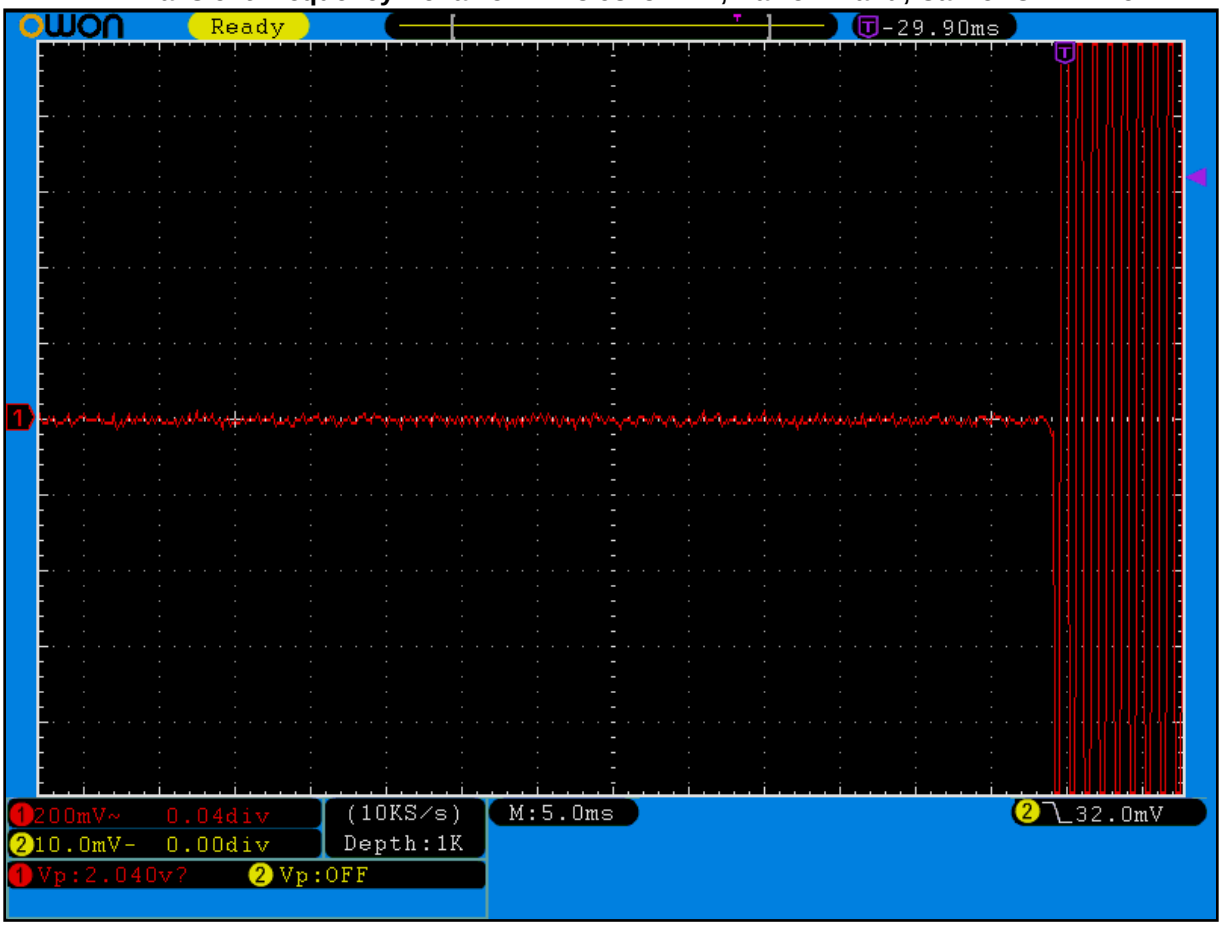
**Plot 11-10: Transient Frequency Behavior – 173.9875 MHz; Wide Band; Carrier OFF Time**



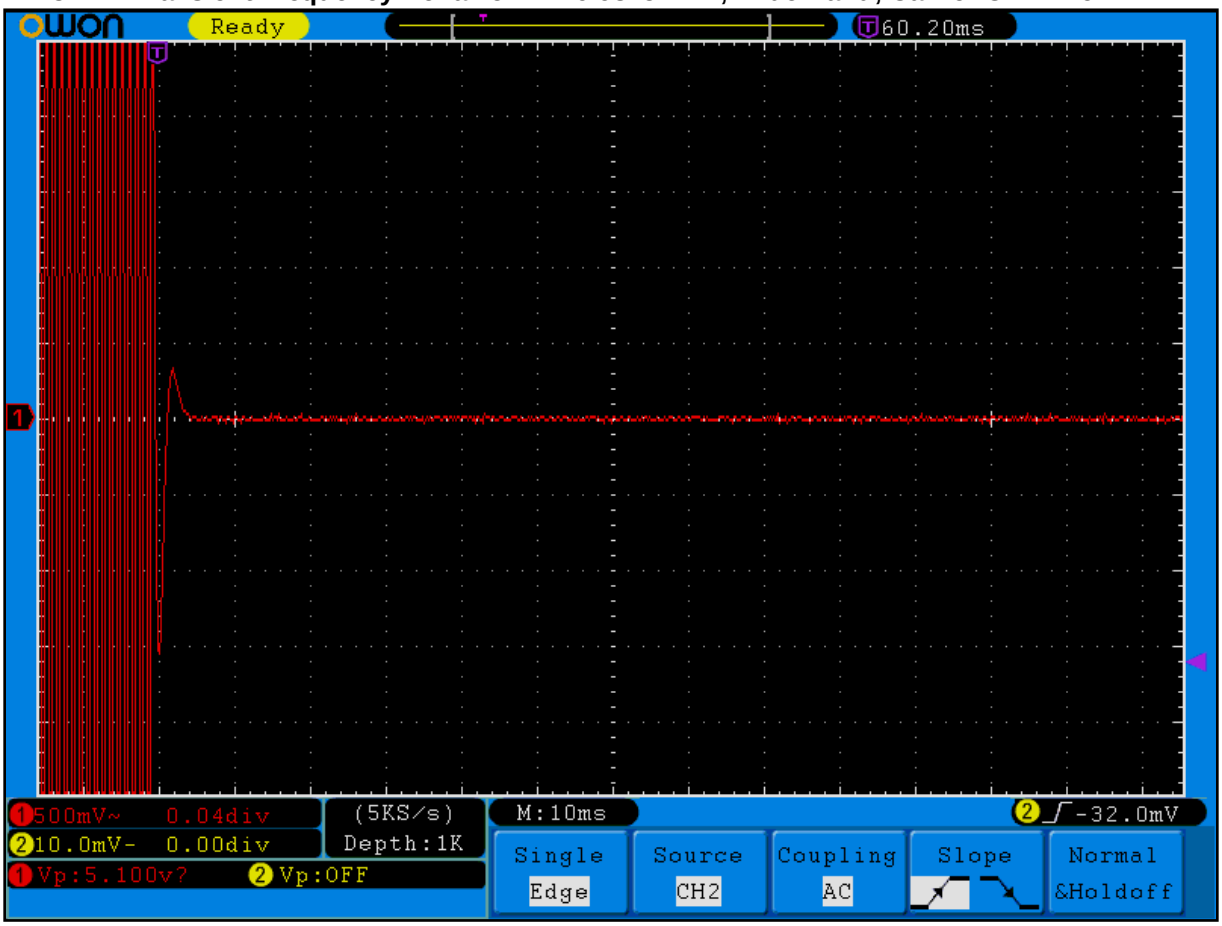
**Plot 11-11: Transient Frequency Behavior – 173.9875 MHz; Narrow Band; Carrier ON Time**



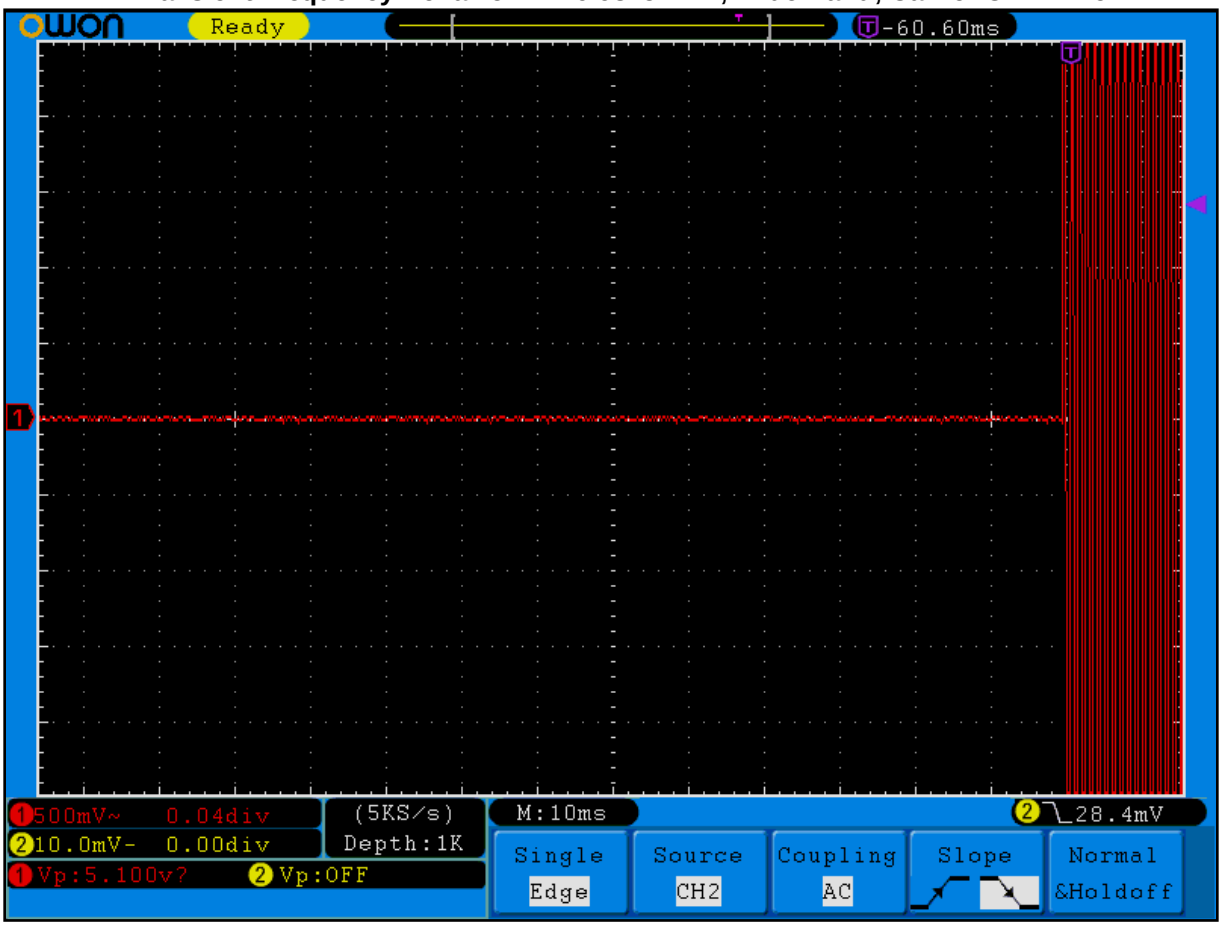
**Plot 11-12: Transient Frequency Behavior – 173.9875 MHz; Narrow Band; Carrier OFF Time**



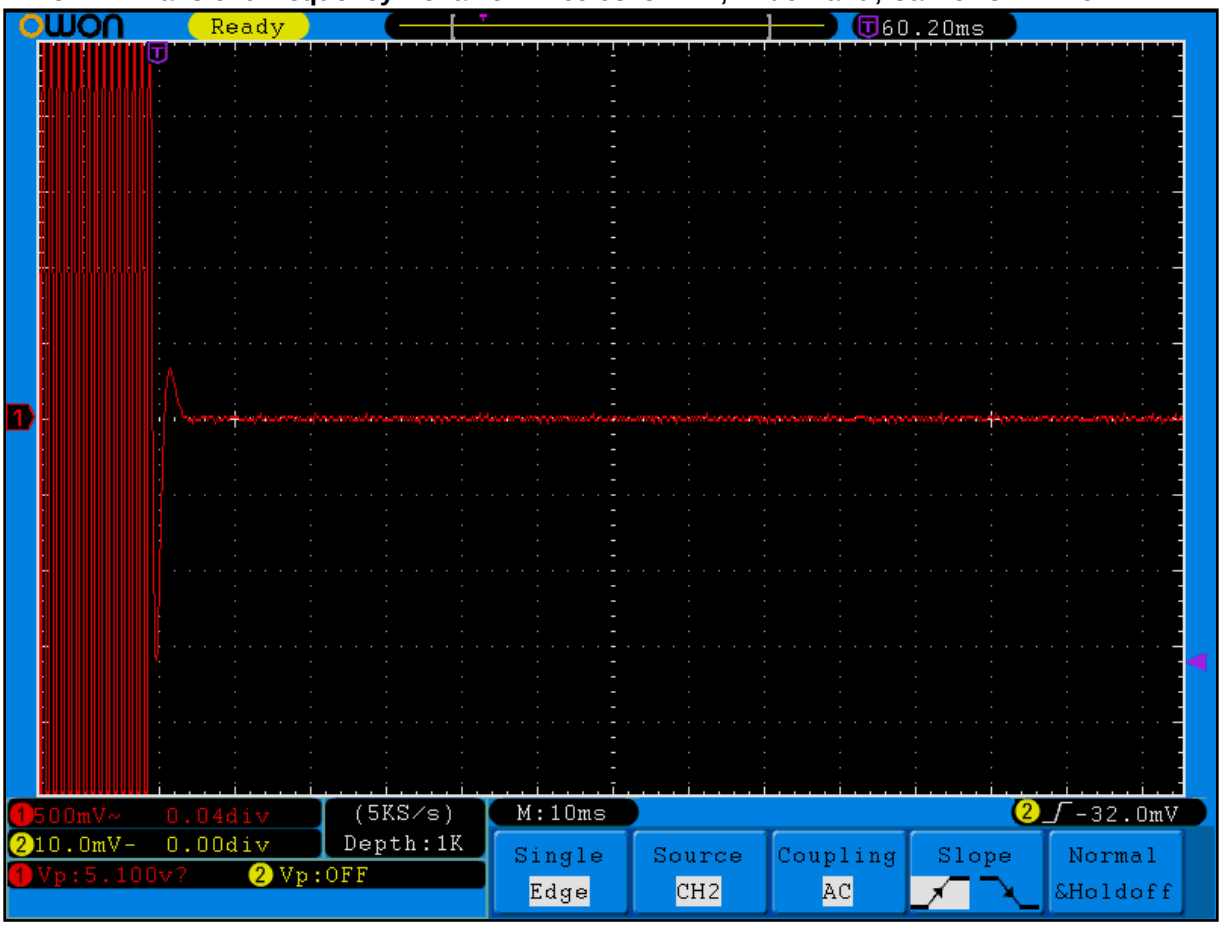
**Plot 11-13: Transient Frequency Behavior – 429.9875 MHz; Wide Band; Carrier ON Time**



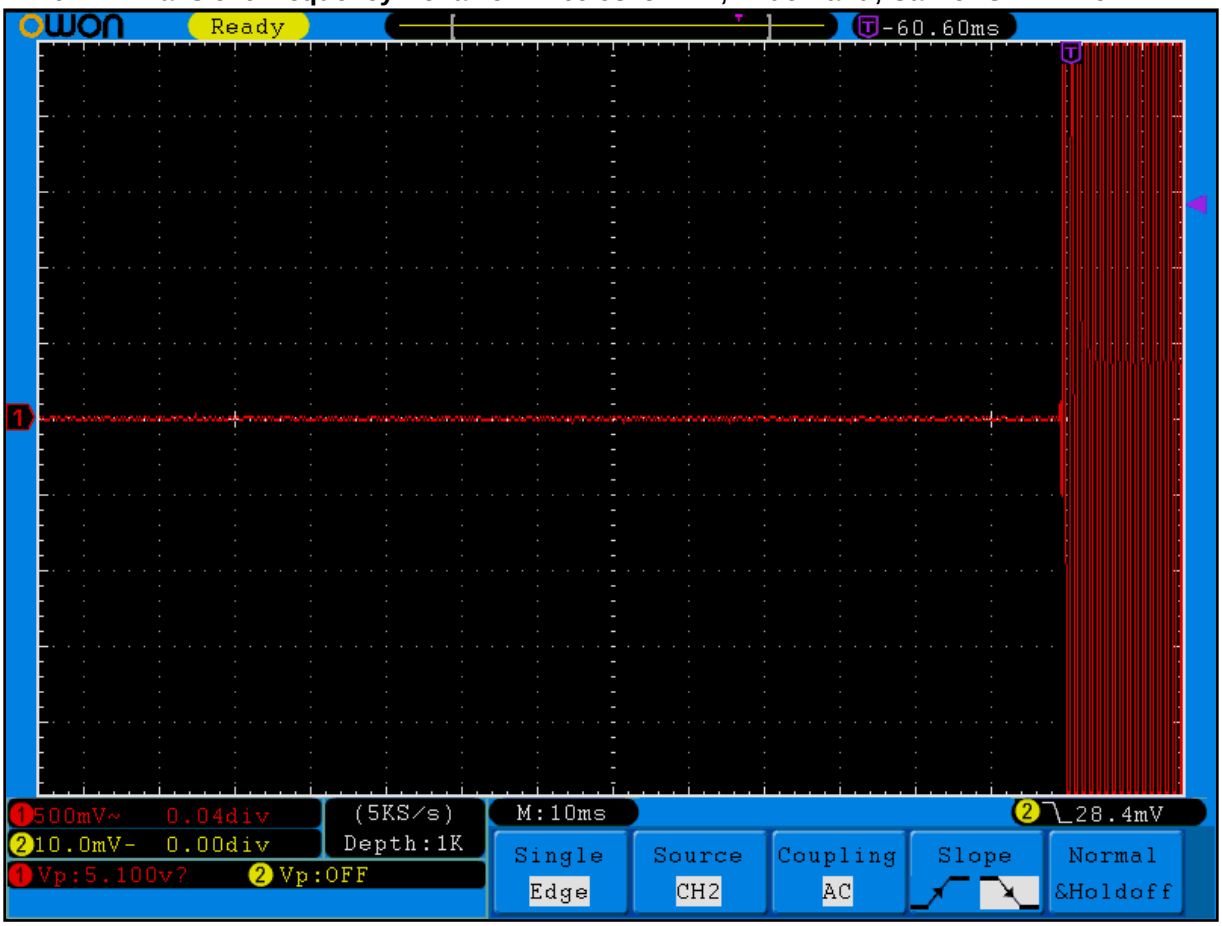
**Plot 11-14: Transient Frequency Behavior – 429.9875 MHz; Wide Band; Carrier OFF Time**



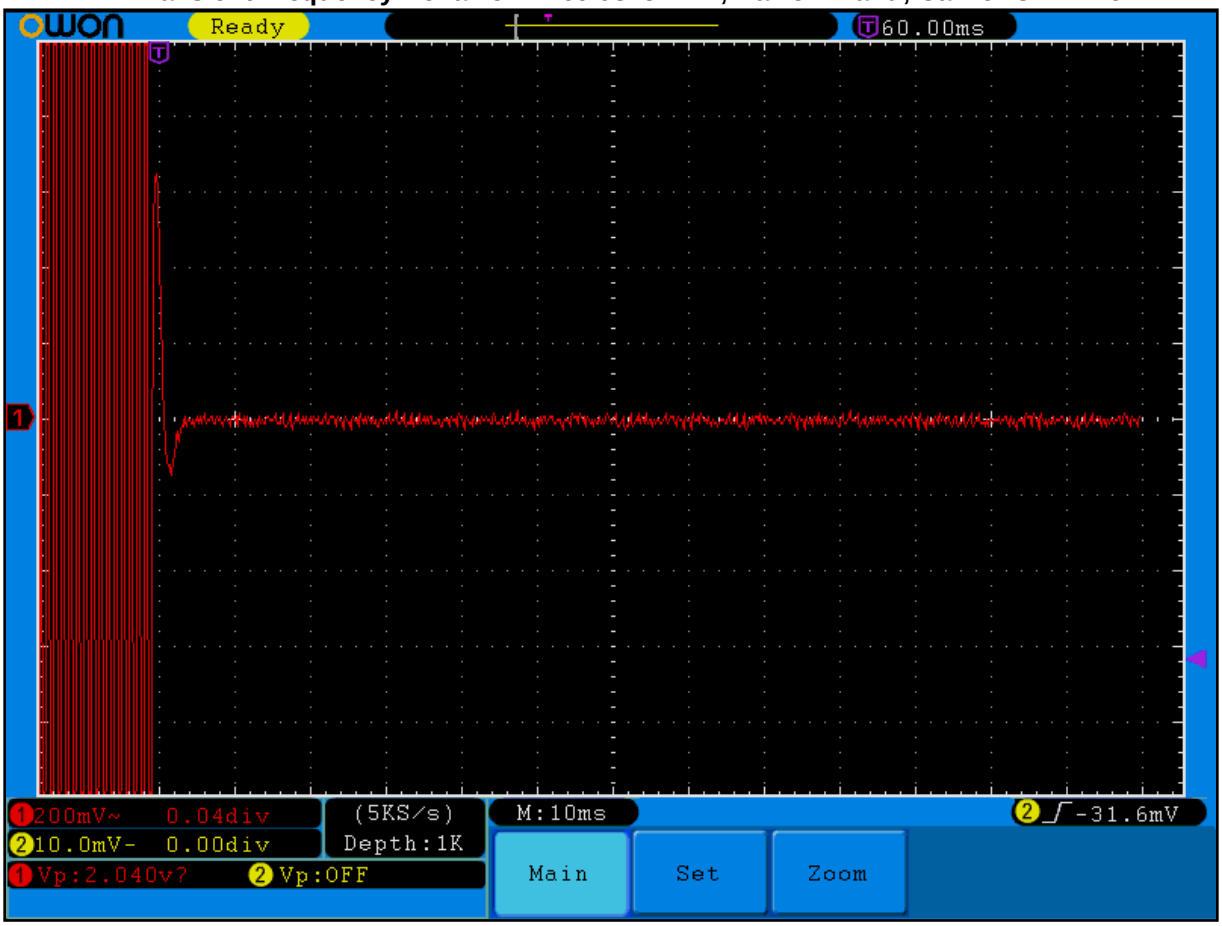
**Plot 11-15: Transient Frequency Behavior – 469.9875 MHz; Wide Band; Carrier ON Time**



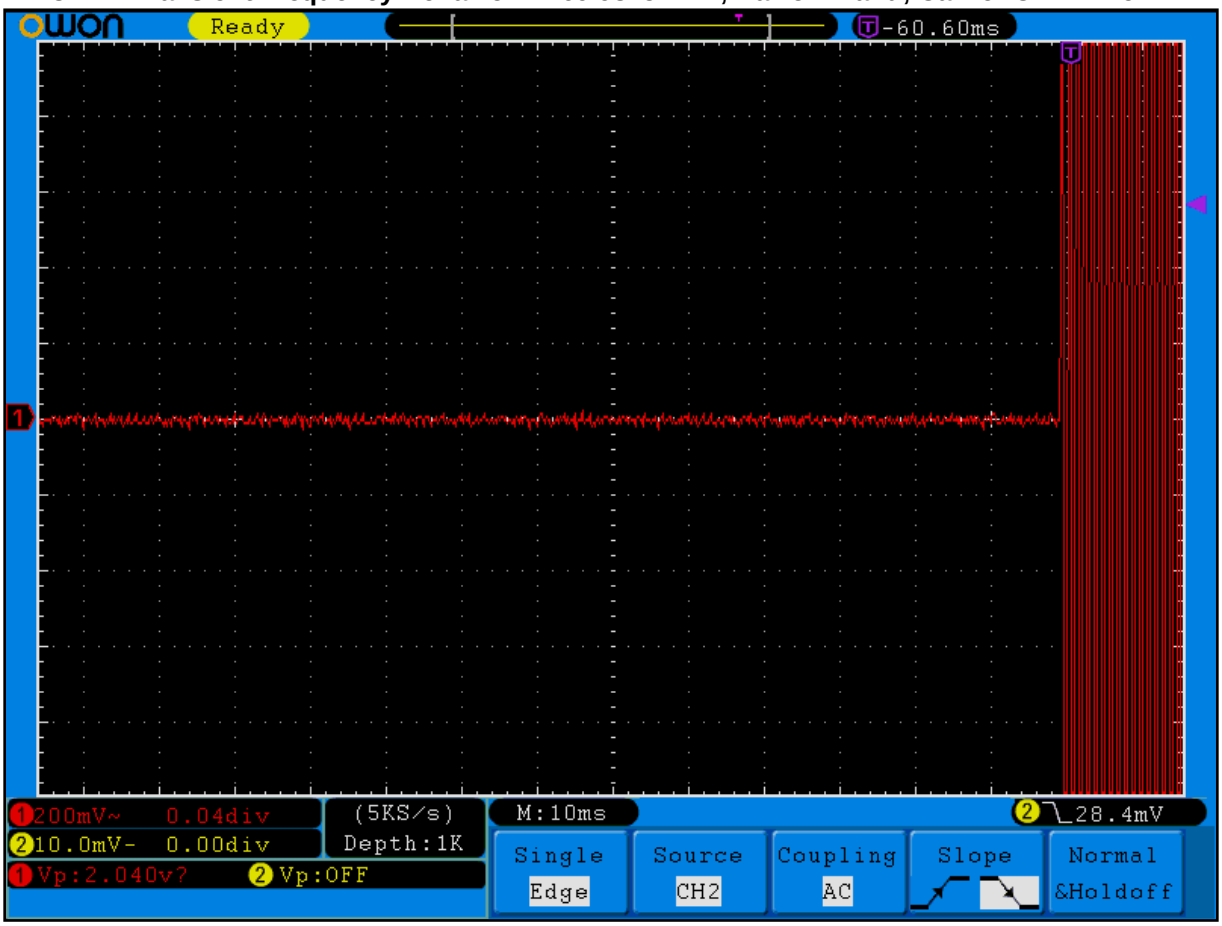
**Plot 11-16: Transient Frequency Behavior – 469.9875 MHz; Wide Band; Carrier OFF Time**



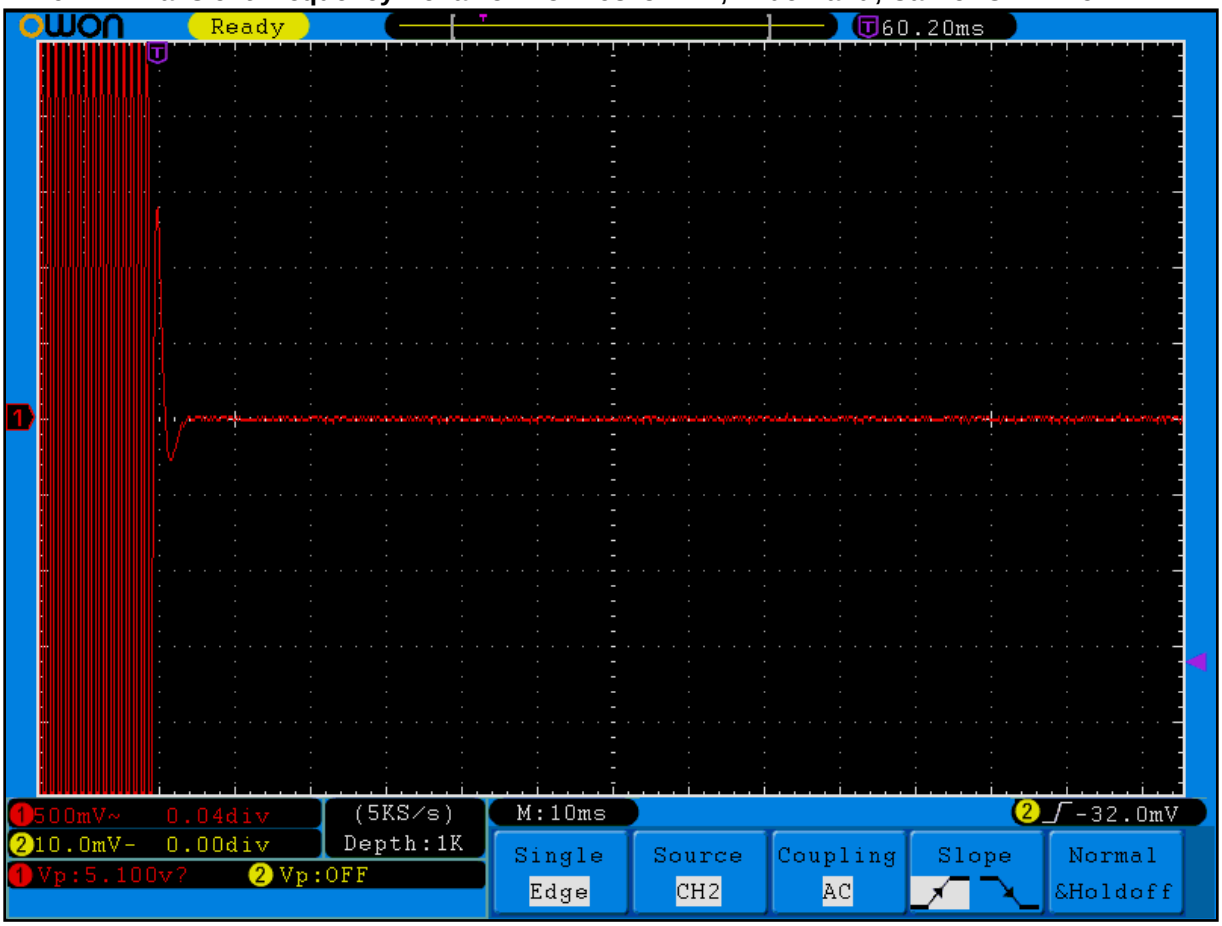
**Plot 11-17: Transient Frequency Behavior – 469.9875 MHz; Narrow Band; Carrier ON Time**



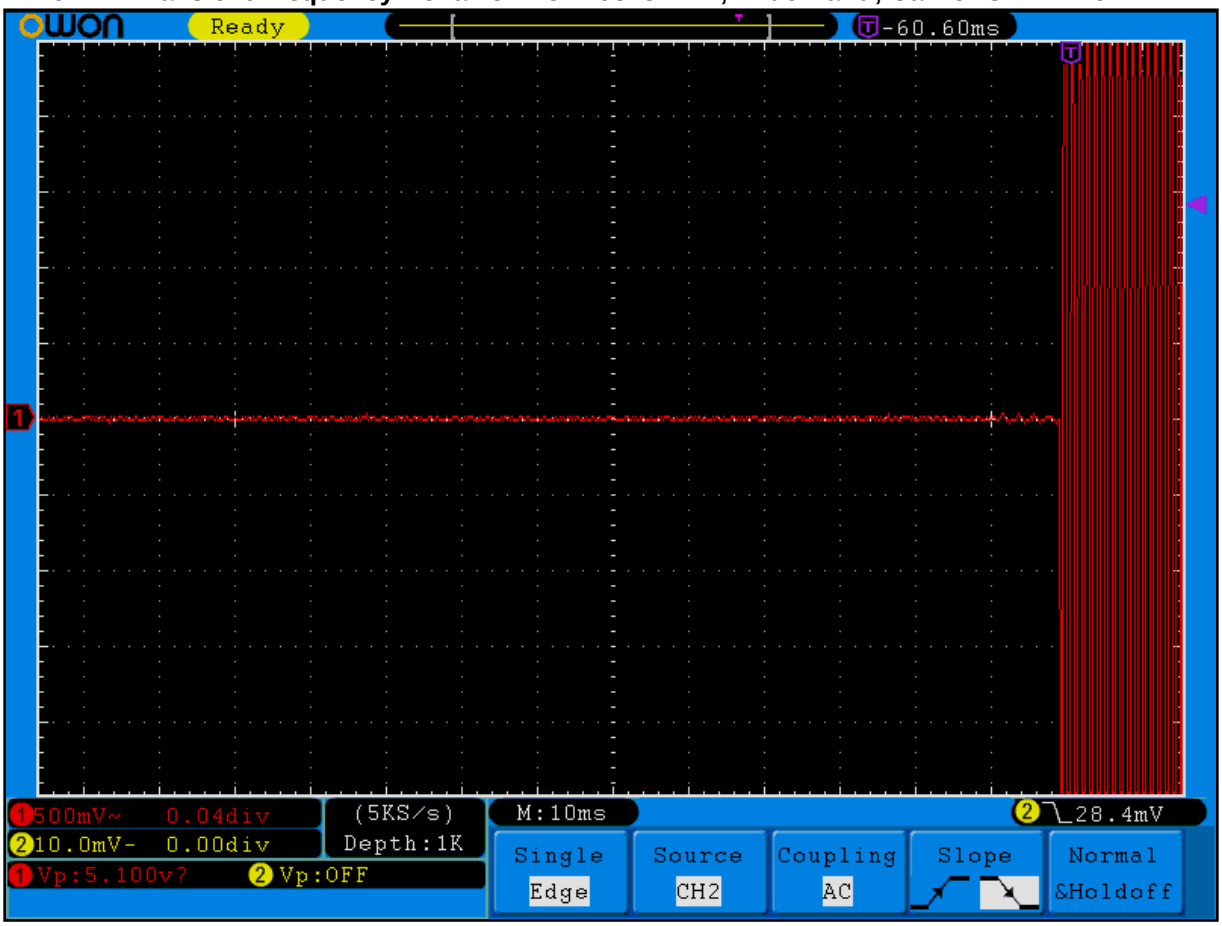
**Plot 11-18: Transient Frequency Behavior – 469.9875 MHz; Narrow Band; Carrier OFF Time**



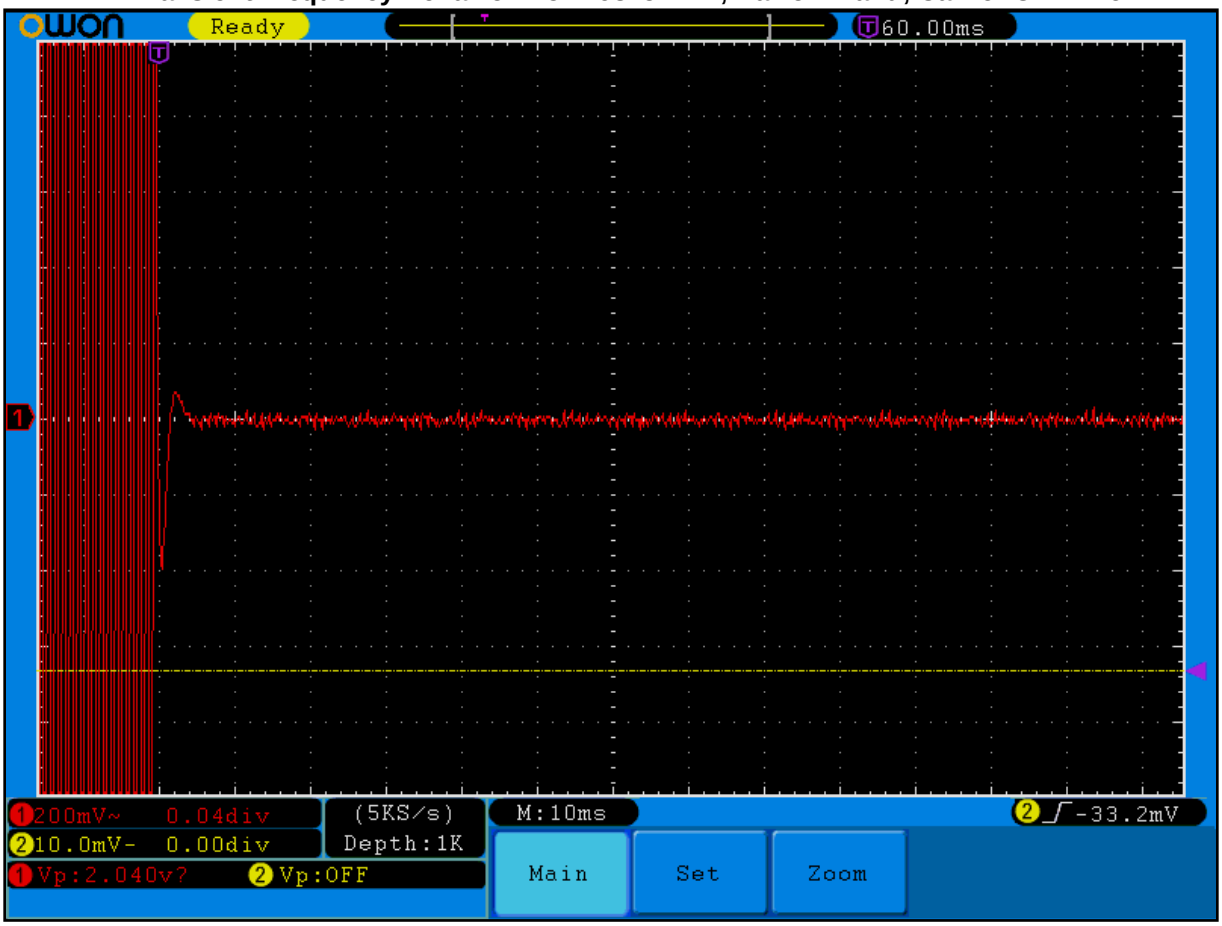
**Plot 11-19: Transient Frequency Behavior – 511.9875 MHz; Wide Band; Carrier ON Time**



**Plot 11-20: Transient Frequency Behavior – 511.9875 MHz; Wide Band; Carrier OFF Time**



**Plot 11-21: Transient Frequency Behavior – 511.9875 MHz; Narrow Band; Carrier ON Time**



**Plot 11-22: Transient Frequency Behavior – 511.9875 MHz; Narrow Band; Carrier OFF Time**

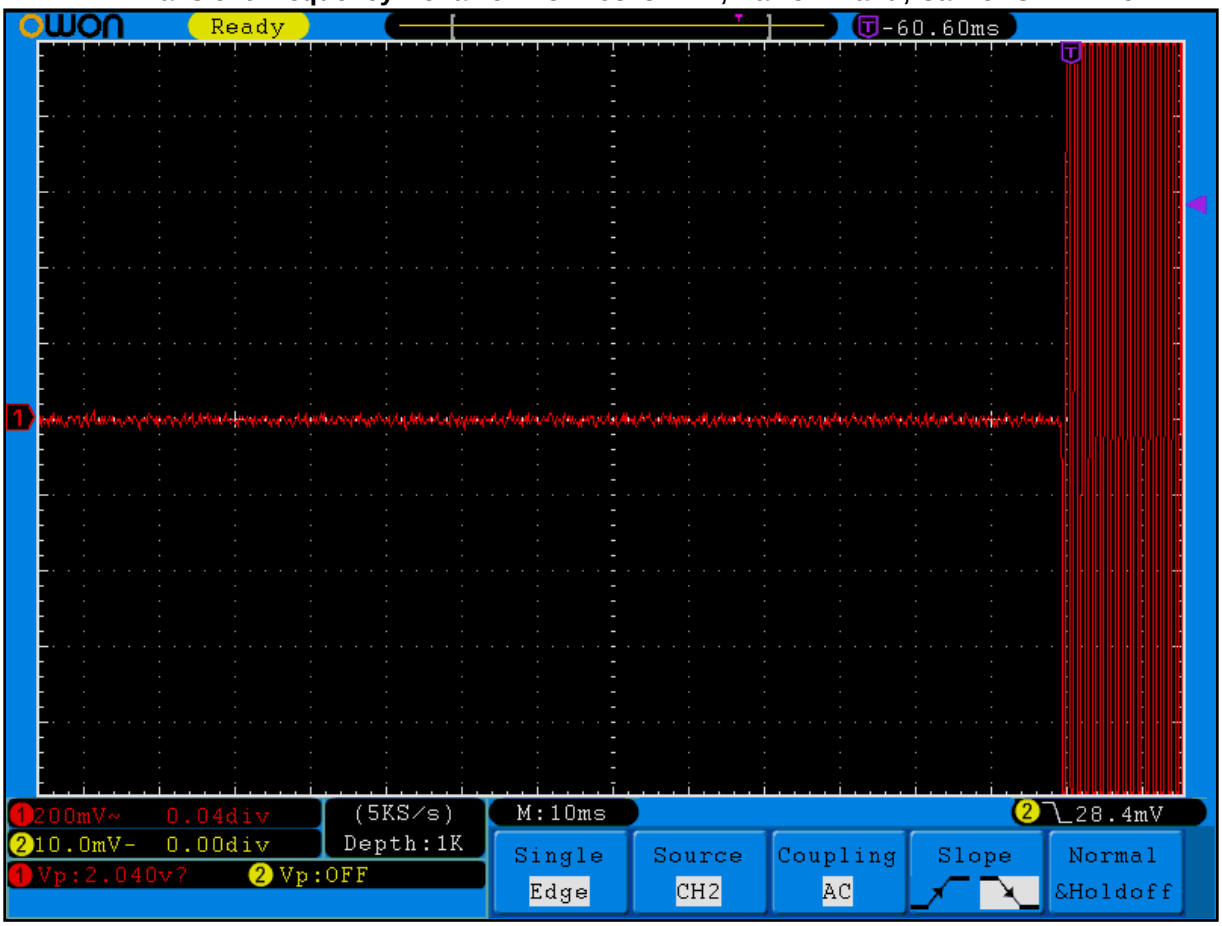



**Table 11-1: Test Equipment Used For Testing Transient Frequency Behavior**

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number | Calibration Due Date |
|---|---|---|---|---|---|
| 901582 | Rhode & Schwarz | SMF 100A | Signal Generator | 1167.0000.02 | 4/24/21 |
| 901118 | Hewlett Packard | HP8901B | Modulation Analyzer (150 kHz–1300 MHz) | 2406A00178 | 1/30/20 |
| 901651 | OWON | SDS7102V | Oscilloscope | B020129 | 4/2/21 |

**Test Personnel:**

| Daniel Baltzell | | August 20, 2019 |
|---|---|---|
| Test Engineer | Signature | Date of Tests |

## 12 FCC Part 2.202: Necessary Bandwidth and Emission Bandwidth

**Voice – 12.5 kHz channel separation**
Calculation:
Max modulation (M) in kHz: 3.0
Max deviation (D) in kHz: 2.5
Constant factor (K): 1 (assumed)
Bn = 2xM+2xDK = 11.0 kHz
Emission designator: 11K0F3E

**Voice – 25 kHz channel separation (NPSPAC)**
Calculation:
Max modulation (M) in kHz: 3.0
Max deviation (D) in kHz: 4
Constant factor (K): 1 (assumed)
Bn = 2xM+2xDK = 14.0 kHz
Emission designator: 14K0F3E

**Voice – 25 kHz channel separation**
Calculation:
Max modulation (M) in kHz: 3.0
Max deviation (D) in kHz: 5
Constant factor (K): 1 (assumed)
Bn = 2M+2DK = 16.0 kHz
Emission designator: 16K0F3E

**P25 – 9600 bps**
Calculation:
Data rate in bps (R) = 9600
Peak deviation of carrier (D) = 1800
Bn = [9600/$\log_2$(4) + 2 (1800) (1) = 8.400 kHz
Emission designator: 8K40F1D, 8K40F1E

**P25 Phase 2 Data/Voice (H-CPM TDMA)**
Calculation:
Data rate in bps (R) =12000
Peak deviation of carrier (D) = 1050
Bn = [12000/$\log_2$(4) + 2 (1050) (1) = 8.1 kHz
Emission designator: 8K10DXW

**2-level FSK 9600 Data/Digital Voice (NB)**
Calculation:
Data rate in bps (R) = 9600
Peak deviation of carrier (D) = 3450
Bn = [9600/log2(4) + 2 (3450) (1) = 11.700 kHz
Emission designator: 11K7F1D, 11K7F1E

**2-level FSK 9600 Data/Digital Voice (WB)**
Calculation:
Data rate in bps (R) = 9600
Peak deviation of carrier (D) = 5600
Bn = [9600/log2(4) + 2 (5600) (1) = 16.000 kHz
Emission designator: 16K0F1D, 16K0F1E

**2-level FSK 9600 Data/Digital Voice (NPSPAC)**
Calculation:
Data rate in bps (R) = 9600
Peak deviation of carrier (D) = 4600
Bn = [9600/log2(4) + 2 (4600) (1) = 14.000 kHz
Emission designator: 14K0F1D, 14K0F1E

**2-level FSK 4800 Data/Digital Voice (XNB)**
Calculation:
Data rate in bps (R) = 4800
Peak deviation of carrier (D) = 1800
Bn = [4800/log2(4) + 2 (2350) (1) = 7.100 kHz
Emission designator: 7K10F1D, 7K10F1E

**HVD SMR**
Calculation:
Data rate in bps (R) = 19200
Signaling states (S) = 4
$B_n = 2(19200)(.96)/\log_2(4) = 18.5$ kHz
Emission designator: 18K5F1W

**HVD NPSPAC**
Calculation:
Data rate in bps (R) = 19200
Signaling states (S) = 4
$B_n = 2(19200)(.67)/\log_2(4) = 12.9$ kHz
Emission designator: 12K9F1W

## 13 Conclusion

The data in this measurement report shows that the Harris Corporation XL-200M Multi-Band Mobile, VL/V/U/7/8/9, FCC ID: OWDTR-0161-E, IC: 3636B-0161, complies with the applicable requirements of Parts 2, 22, 74, 80, 90 and 101 of the FCC Rules and Industry Canada RSS-119.