

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

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 1 hour 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.

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 0.52 ppm.

Table 9-1: Environmental Conditions

Date	Temperature (°C)	Humidity (%)	Atmospheric Pressure (kPa)
01/17/2024	23.9	19	101.8

9.2 Test Data

Table 9-2: Temperature Frequency Stability – 136.0125 MHz

Temperature (°C)	Measured Frequency (MHz)	ppm
-30	136.012492	-0.06
-20	136.012492	-0.06
-10	136.012500	0.00
0	136.012522	0.16
10	136.012520	0.15
20 (reference)	136.012500	0.00
30	136.012508	0.06
40	136.012510	0.07
50	136.012514	0.10
60	136.012514	0.10

Table 9-3: Temperature Frequency Stability – 156.8000 MHz

Temperature (°C)	Measured Frequency (MHz)	ppm
-30	156.800010	0.06
-20	156.800014	0.09
-10	156.800018	0.11
0	156.800030	0.19
10	156.800026	0.17
20 (reference)	156.800000	0.00
30	156.800012	0.08
40	156.800008	0.05
50	156.800024	0.15
60	156.800018	0.11

Table 9-4: Temperature Frequency Stability – 173.9875 MHz

Temperature (°C)	Measured Frequency (MHz)	ppm
-30	173.987509	0.05
-20	173.987507	0.04
-10	173.987513	0.07
0	173.987521	0.12
10	173.987515	0.09
20 (reference)	173.987500	0.00
30	173.987501	0.01
40	173.987505	0.03
50	173.987499	-0.01
60	173.987507	0.04

Table 9-5: Temperature Frequency Stability – 378.0125 MHz

Temperature (°C)	Measured Frequency (MHz)	ppm
-30	378.012493	-0.02
-20	378.012565	0.17
-10	378.012571	0.19
0	378.012593	0.25
10	378.012567	0.18
20 (reference)	378.012500	0.00
30	378.012547	0.12
40	378.012571	0.19
50	378.012587	0.23
60	378.012563	0.17

Table 9-6: Temperature Frequency Stability – 392.0000 MHz

Temperature (°C)	Measured Frequency (MHz)	ppm
-30	392.000020	0.05
-20	392.000060	0.15
-10	392.000072	0.18
0	392.000086	0.22
10	392.000064	0.16
20 (reference)	392.000000	0.00
30	392.000038	0.10
40	392.000026	0.07
50	392.000086	0.22
60	392.000052	0.13

Table 9-7: Temperature Frequency Stability – 405.9875 MHz

Temperature (°C)	Measured Frequency (MHz)	ppm
-30	405.987533	0.08
-20	405.987567	0.17
-10	405.987571	0.17
0	405.987591	0.22
10	405.987567	0.17
20 (reference)	405.987500	0.00
30	405.987541	0.10
40	405.987553	0.13
50	405.987585	0.21
60	405.987551	0.13

Table 9-8: Temperature Frequency Stability – 406.1125 MHz

Temperature (°C)	Measured Frequency (MHz)	Ppm
-30	406.112463	-0.09
-20	406.112571	0.17
-10	406.112563	0.16
0	406.112591	0.22
10	406.112557	0.14
20 (reference)	406.112500	0.00
30	406.112511	0.03
40	406.112569	0.17
50	406.112555	0.14
60	406.112557	0.14

Table 9-9: Temperature Frequency Stability – 464.0000 MHz

Temperature (°C)	Measured Frequency (MHz)	Ppm
-30	463.999913	-0.19
-20	464.000025	0.05
-10	464.000029	0.06
0	464.000045	0.10
10	463.999999	0.00
20 (reference)	464.000000	0.00
30	463.999977	-0.05
40	464.000027	0.06
50	464.000059	0.13
60	464.000025	0.05

Table 9-10: Temperature Frequency Stability – 521.9875 MHz

Temperature (°C)	Measured Frequency (MHz)	ppm
-30	521.987460	-0.08
-20	521.987470	-0.06
-10	521.987460	-0.08
0	521.987498	0.00
10	521.987456	-0.08
20 (reference)	521.987500	0.00
30	521.987438	-0.12
40	521.987490	-0.02
50	521.987568	0.13
60	521.987468	-0.06

Table 9-11: Temperature Frequency Stability – 768.0125 MHz

Temperature (°C)	Measured Frequency (Hz)	ppm
-30	768.012538	0.05
-20	768.012596	0.12
-10	768.012556	0.07
0	768.012614	0.15
10	768.012548	0.06
20 (reference)	768.012500	0.00
30	768.012564	0.08
40	768.012650	0.20
50	768.012560	0.08
60	768.012574	0.10

Table 9-12: Temperature Frequency Stability – 772.0000 MHz

Temperature (°C)	Measured Frequency (Hz)	ppm
-30	772.000052	0.07
-20	772.000088	0.11
-10	772.000090	0.12
0	772.000098	0.13
10	772.000030	0.04
20 (reference)	772.000000	0.00
30	772.000082	0.11
40	772.000170	0.22
50	772.000000	0.00
60	772.000092	0.12

Table 9-13: Temperature Frequency Stability – 775.9875 MHz

Temperature (°C)	Measured Frequency (Hz)	ppm
-30	798.012618	0.15
-20	798.012628	0.16
-10	798.012610	0.14
0	798.012640	0.18
10	798.012586	0.11
20 (reference)	798.012500	0.00
30	798.012578	0.10
40	798.012684	0.23
50	798.012570	0.09
60	798.012638	0.17

Table 9-14: Temperature Frequency Stability – 802.0000 MHz

Temperature (°C)	Measured Frequency (Hz)	ppm
-30	802.000048	0.06
-20	802.000074	0.09
-10	802.000076	0.09
0	802.000072	0.09
10	802.000024	0.03
20 (reference)	802.000000	0.00
30	802.000054	0.07
40	802.000174	0.22
50	802.000058	0.07
60	802.000070	0.09

Table 9-15: Temperature Frequency Stability – 805.9875 MHz

Temperature (°C)	Measured Frequency (Hz)	ppm
-30	805.987481	-0.02
-20	805.987517	0.02
-10	805.987535	0.04
0	805.987509	0.01
10	805.987449	-0.06
20 (reference)	805.987500	0.00
30	805.987505	0.01
40	805.987599	0.12
50	805.987531	0.04
60	805.987517	0.02

Table 9-16: Temperature Frequency Stability – 806.0125 MHz

Temperature (°C)	Measured Frequency (Hz)	ppm
-30	806.012631	0.16
-20	806.012659	0.20
-10	806.012673	0.21
0	806.012636	0.17
10	806.012599	0.12
20 (reference)	806.012500	0.00
30	806.012631	0.16
40	806.012751	0.31
50	806.012641	0.17
60	806.012661	0.20

Table 9-17: Temperature Frequency Stability – 815.0000 MHz

Temperature (°C)	Measured Frequency (Hz)	ppm
-30	815.000069	0.08
-20	815.000085	0.10
-10	815.000119	0.15
0	815.000055	0.07
10	815.000025	0.03
20 (reference)	815.000000	0.00
30	815.000087	0.11
40	815.000189	0.23
50	815.000077	0.09
60	815.000083	0.10

Table 9-18: Temperature Frequency Stability – 823.9875 MHz

Temperature (°C)	Measured Frequency (Hz)	ppm
-30	823.987511	0.01
-20	823.987553	0.06
-10	823.987547	0.06
0	823.987505	0.01
10	823.987479	-0.03
20 (reference)	823.987500	0.00
30	823.987527	0.03
40	823.987657	0.19
50	823.987501	0.00
60	823.987549	0.06

Table 9-19: Temperature Frequency Stability – 851.0125 MHz

Temperature (°C)	Measured Frequency (Hz)	ppm
-30	851.012530	0.04
-20	851.012566	0.08
-10	851.012568	0.08
0	851.012532	0.04
10	851.012494	-0.01
20 (reference)	851.012500	0.00
30	851.012634	0.16
40	851.012726	0.27
50	851.012556	0.07
60	851.012544	0.05

Table 9-20: Temperature Frequency Stability – 860.0000 MHz

Temperature (°C)	Measured Frequency (Hz)	ppm
-30	860.000025	0.03
-20	860.000089	0.10
-10	860.000113	0.13
0	860.000053	0.06
10	860.000013	0.02
20 (reference)	860.000000	0.00
30	860.000103	0.12
40	860.000231	0.27
50	860.000063	0.07
60	860.000107	0.12

Table 9-21: Temperature Frequency Stability – 860.0000 MHz

Temperature (°C)	Measured Frequency (Hz)	ppm
-30	868.987483	-0.02
-20	868.987529	0.03
-10	868.987047	-0.52
0	868.987491	-0.01
10	868.987459	-0.05
20 (reference)	868.987500	0.00
30	868.987537	0.04
40	868.987703	0.23
50	868.987527	0.03
60	868.987539	0.04

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 9-22: Test Equipment Used For Testing Temperature Frequency Stability

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901350	Meterman	33XR	Multimeter	040402802	10/18/2027
901773	Rohde & Schwarz	FSW50	Analyzer	101021	05/30/2027
900957	Weinschel Corp	68-20-43	100W Attenuator 20 dB	LT394	04/25/2027
901727	Insulated Wire Inc.	KPS-1503-360-KPR	SMK RF Cables 36"	NA	11/30/2027
2679	GW Instek	PSS-3203	Power Supply	B200344	N/A

Test Personnel:

Daniel W. Baltzell
EMC Test Engineer



Signature

February 13, 2025
Date of Test

9.2.1 Frequency Stability/Voltage Variation

Table 9-23: Frequency Stability/Voltage Variation –136.0125 MHz

Voltage (VDC)	Measured Frequency (Hz)	ppm
(Battery End-Point) 5.0	136.012370	-0.96
6.12	136.012508	0.06
7.2(reference)	136.012500	0.00
8.28	136.012493	-0.05

Table 9-24: Frequency Stability/Voltage Variation – 156.8000 MHz

Voltage (VDC)	Measured Frequency (Hz)	ppm
(Battery End-Point) 5.0	156.799830	-1.08
6.12	156.800004	0.03
7.2(reference)	156.800000	0.00
8.28	156.799999	-0.01

Table 9-25: Frequency Stability/Voltage Variation –173.9875 MHz

Voltage (VDC)	Measured Frequency (Hz)	ppm
(Battery End-Point) 5.0	173.987315	-1.06
6.12	173.987496	-0.02
7.2(reference)	173.987500	0.00
8.28	173.987483	-0.10

Table 9-26: Frequency Stability/Voltage Variation – 378.0125 MHz

Voltage (VDC)	Measured Frequency (Hz)	ppm
(Battery End-Point) 5.0	378.012125	-0.99
6.12	378.012535	0.00
7.2(reference)	378.012500	0.00
8.28	378.012518	0.05

Table 9-27: Frequency Stability/Voltage Variation –392.0000 MHz

Voltage (VDC)	Measured Frequency (Hz)	ppm
(Battery End-Point) 5.0	391.999610	-0.99
6.12	392.000020	0.05
7.2(reference)	392.000000	0.00
8.28	391.999997	-0.01

Table 9-28: Frequency Stability/Voltage Variation – 405.9875 MHz

Voltage (VDC)	Measured Frequency (Hz)	ppm
(Battery End-Point) 5.0	405.987074	-1.05
6.12	405.987536	0.09
7.2(reference)	405.987500	0.00
8.28	405.987522	0.05

Table 9-29: Frequency Stability/Voltage Variation –406.1125 MHz

Voltage (VDC)	Measured Frequency (Hz)	ppm
(Battery End-Point) 5.0	406.112073	-1.05
6.12	406.112503	0.01
7.2(reference)	406.112500	0.00
8.28	406.112510	0.02

Table 9-30: Frequency Stability/Voltage Variation – 464.0000 MHz

Voltage (VDC)	Measured Frequency (Hz)	ppm
(Battery End-Point) 5.0	463.999468	-1.15
6.12	464.000000	0.00
7.2(reference)	464.000000	0.00
8.28	463.999939	-0.13

Table 9-31: Frequency Stability/Voltage Variation –521.9875 MHz

Voltage (VDC)	Measured Frequency (Hz)	ppm
(Battery End-Point) 5.0	521.986859	-1.23
6.12	521.987500	0.00
7.2(reference)	521.987500	0.00
8.28	521.987444	-0.11

Table 9-32: Frequency Stability/Voltage Variation – 768.0125 MHz

Voltage (VDC)	Measured Frequency (Hz)	ppm
(Battery End-Point) 5.0	768.011711	-1.03
6.12	768.012572	0.09
7.2(reference)	768.012500	0.00
8.28	768.012483	-0.02

Table 9-33: Frequency Stability/Voltage Variation –772.0000 MHz

Voltage (VDC)	Measured Frequency (Hz)	ppm
(Battery End-Point) 5.0	771.999213	-1.02
6.12	772.000108	0.14
7.2(reference)	772.000000	0.00
8.28	772.000086	0.11

Table 9-34: Frequency Stability/Voltage Variation – 775.9875 MHz

Voltage (VDC)	Measured Frequency (Hz)	ppm
(Battery End-Point) 5.0	775.986743	-0.98
6.12	775.987614	0.15
7.2(reference)	775.987500	0.00
8.28	775.987538	0.05

Table 9-35: Frequency Stability/Voltage Variation –798.0125 MHz

Voltage (VDC)	Measured Frequency (Hz)	ppm
(Battery End-Point) 5.0	798.011747	-0.94
6.12	798.012628	0.16
7.2(reference)	798.012500	0.00
8.28	798.012560	0.08

Table 9-36: Frequency Stability/Voltage Variation – 802.0000 MHz

Voltage (VDC)	Measured Frequency (Hz)	ppm
(Battery End-Point) 5.0	801.999201	-1.00
6.12	802.000078	0.10
7.2(reference)	802.000000	0.00
8.28	801.999986	-0.02

Table 9-37: Frequency Stability/Voltage Variation –805.9875 MHz

Voltage (VDC)	Measured Frequency (Hz)	ppm
(Battery End-Point) 5.0	805.986646	-1.06
6.12	805.987521	0.03
7.2(reference)	805.987500	0.00
8.28	805.987425	-0.09

Table 9-38: Frequency Stability/Voltage Variation – 806.0125 MHz

Voltage (VDC)	Measured Frequency (Hz)	ppm
(Battery End-Point) 5.0	806.011762	-0.92
6.12	806.012641	0.17
7.2(reference)	806.012500	0.00
8.28	806.012563	0.08

Table 9-39: Frequency Stability/Voltage Variation –815.0000 MHz

Voltage (VDC)	Measured Frequency (Hz)	ppm
(Battery End-Point) 5.0	814.999194	-0.99
6.12	815.000095	0.12
7.2(reference)	815.000000	0.00
8.28	815.000025	0.03

Table 9-40: Frequency Stability/Voltage Variation – 823.9875 MHz

Voltage (VDC)	Measured Frequency (Hz)	ppm
(Battery End-Point) 5.0	823.986662	-1.02
6.12	823.987529	0.04
7.2(reference)	823.987500	0.00
8.28	823.987429	-0.09

Table 9-41: Frequency Stability/Voltage Variation –851.0125 MHz

Voltage (VDC)	Measured Frequency (Hz)	ppm
(Battery End-Point) 5.0	851.011631	-1.02
6.12	851.012560	0.07
7.2(reference)	851.012500	0.00
8.28	851.012522	0.03

Table 9-42: Frequency Stability/Voltage Variation – 860.0000 MHz

Voltage (VDC)	Measured Frequency (Hz)	ppm
(Battery End-Point) 5.0	859.999106	-1.04
6.12	860.000085	0.10
7.2(reference)	860.000000	0.00
8.28	860.000049	0.06

Table 9-43: Frequency Stability/Voltage Variation – 868.9875 MHz

Voltage (VDC)	Measured Frequency (Hz)	ppm
(Battery End-Point) 5.0	868.986494	-1.16
6.12	868.987497	0.00
7.2(reference)	868.987500	0.00
8.28	868.987435	-0.07

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

Results: Pass

Table 9-44: 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	02/21/2026
901773	Rohde & Schwarz	FSW50	Analyzer	101021	05/30/2027
901139	Weinschel Corp.	48-20-34 DC-18GHz	Attenuator, 100W 20dB	BK5859	10/14/2027
900946	Tenney Engineering, Inc.	TH65	Temperature Chamber	11380	06/23/2027
2679	GW Instek	PSS-3203	Power Supply	B200344	N/A

Test Personnel:

Daniel W. Baltzell EMC Test Engineer	 Signature	February 12-13, 2025 Dates of Test
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10 FCC §2.1047(a)(b): Modulation Characteristics; Part 74.463: Modulation Requirements; Part 80.213: Modulation Requirements

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 $60\log_{10}(f/3)$ 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 = $20 \text{ LOG } (\text{DEVfreq}/\text{DEVref})$

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.

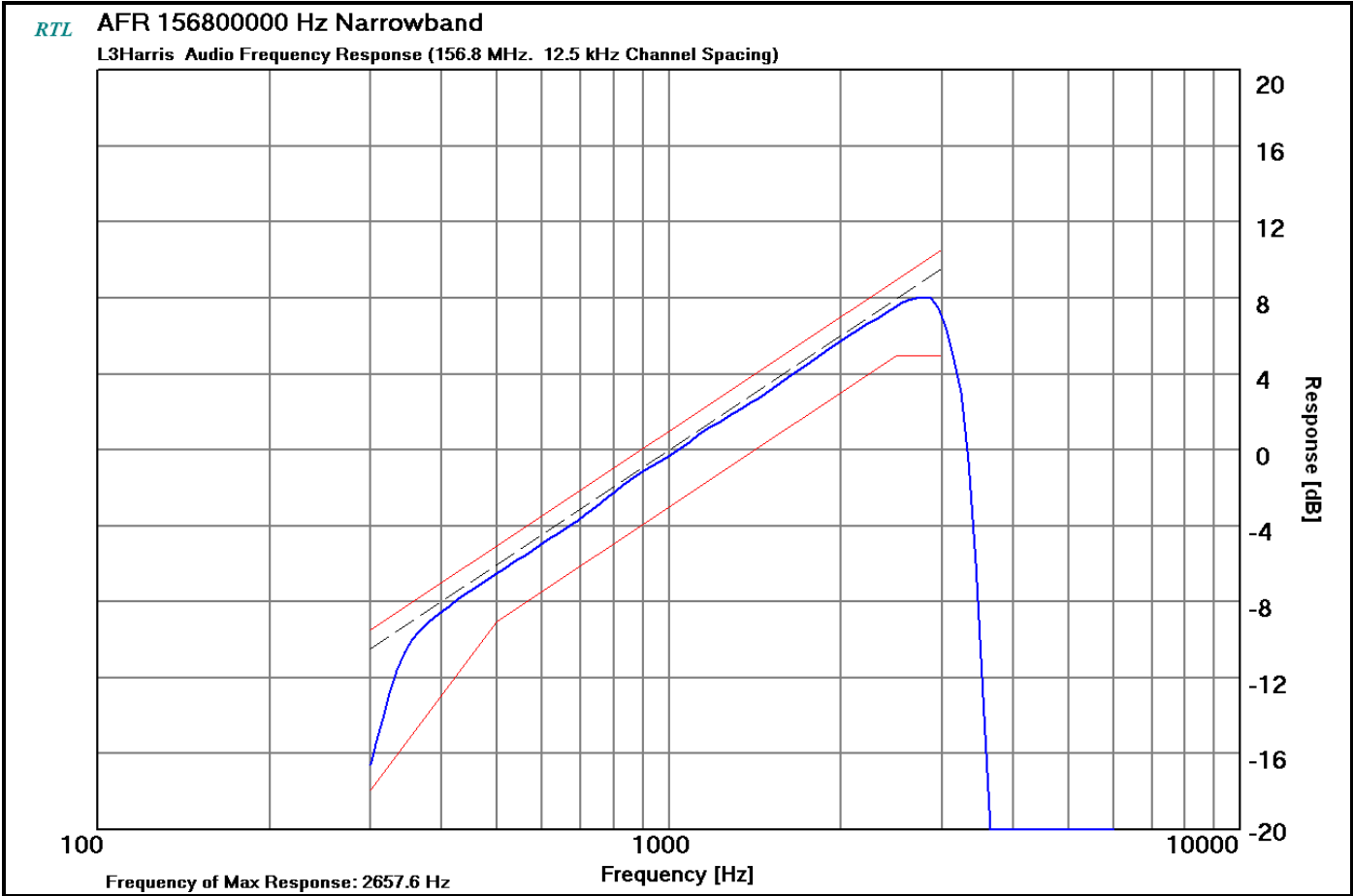
10.2 Test Data

Table 10-1: Environmental Conditions

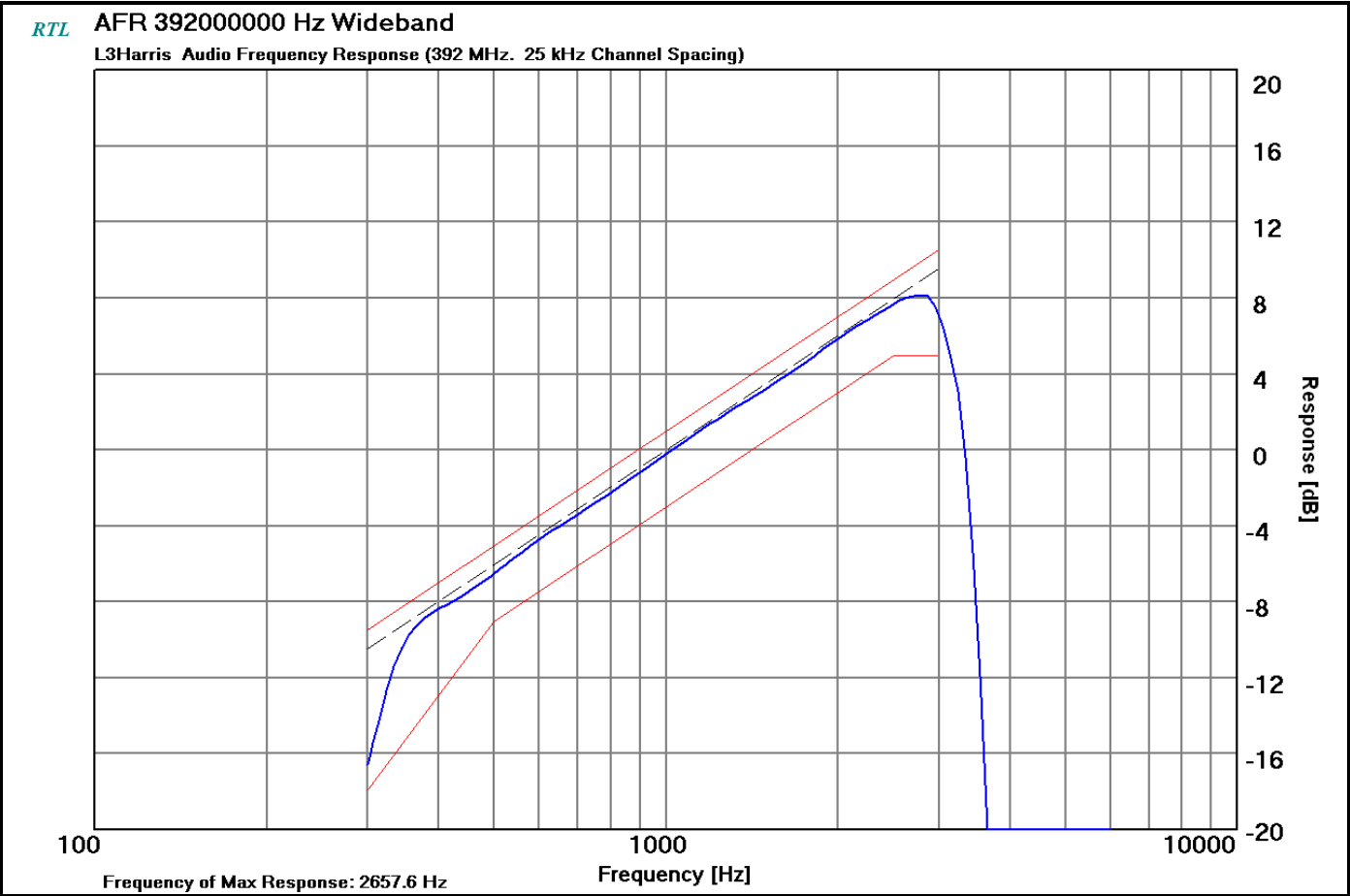
Date	Temperature (°C)	Humidity (%)	Atmospheric Pressure (kPa)
01/15/2025	23.6	19	100.1

10.2.1 Audio Frequency Response

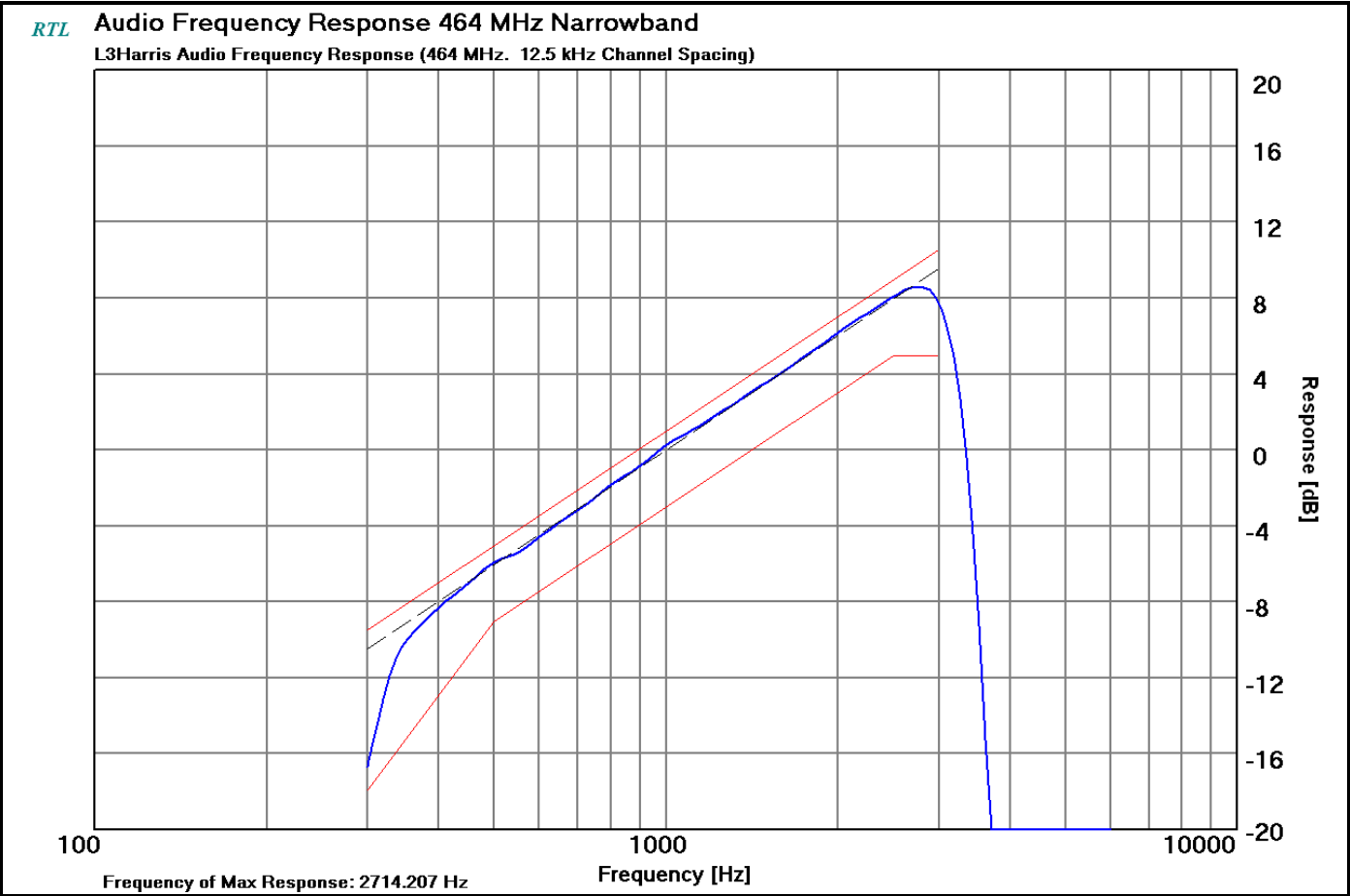
Plot 10-1: Modulation Characteristics - Audio Frequency Response – 156.8000 MHz (NB)



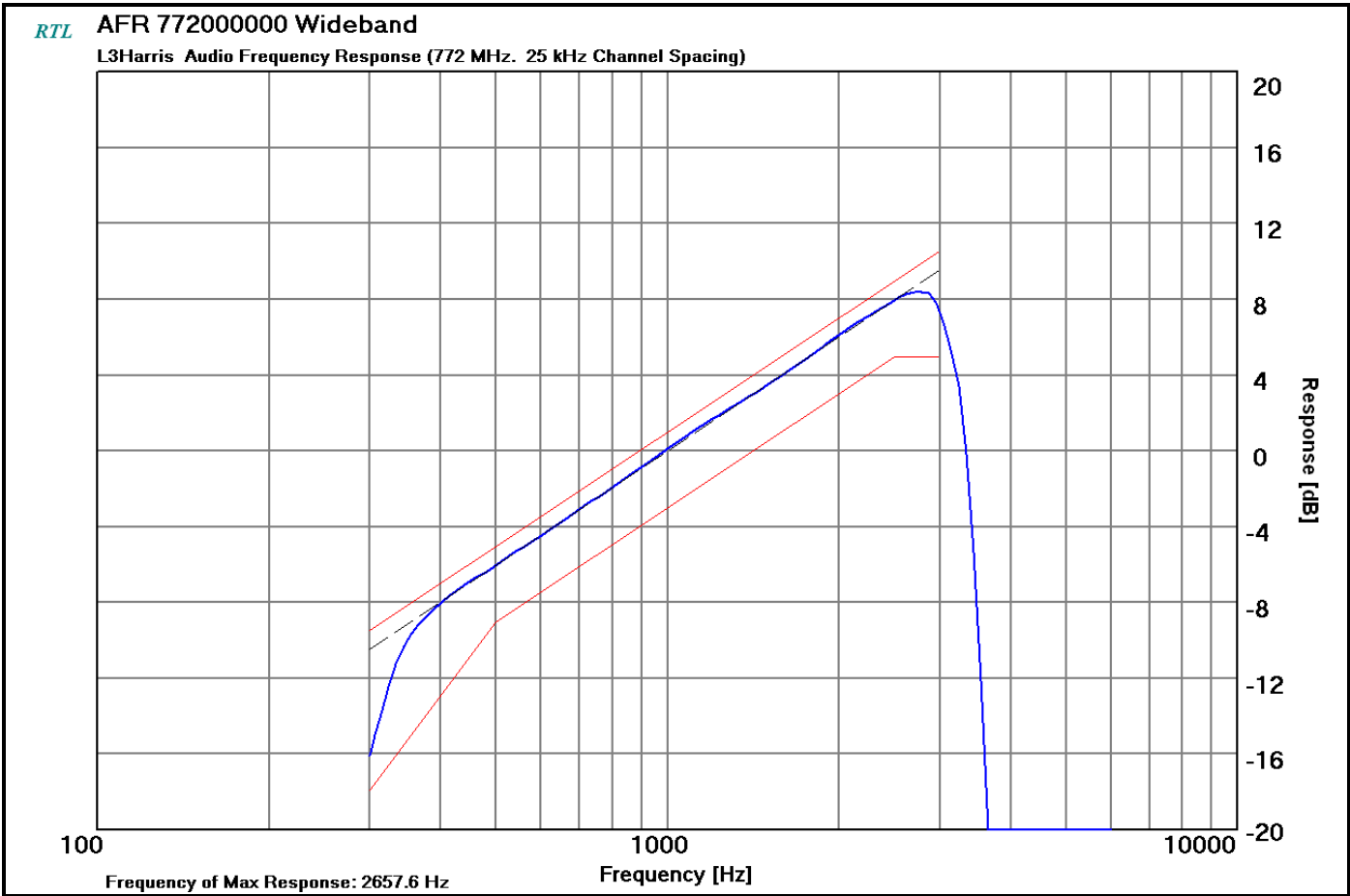
Plot 10-2: Modulation Characteristics - Audio Frequency Response – 392.0000 MHz (WB)



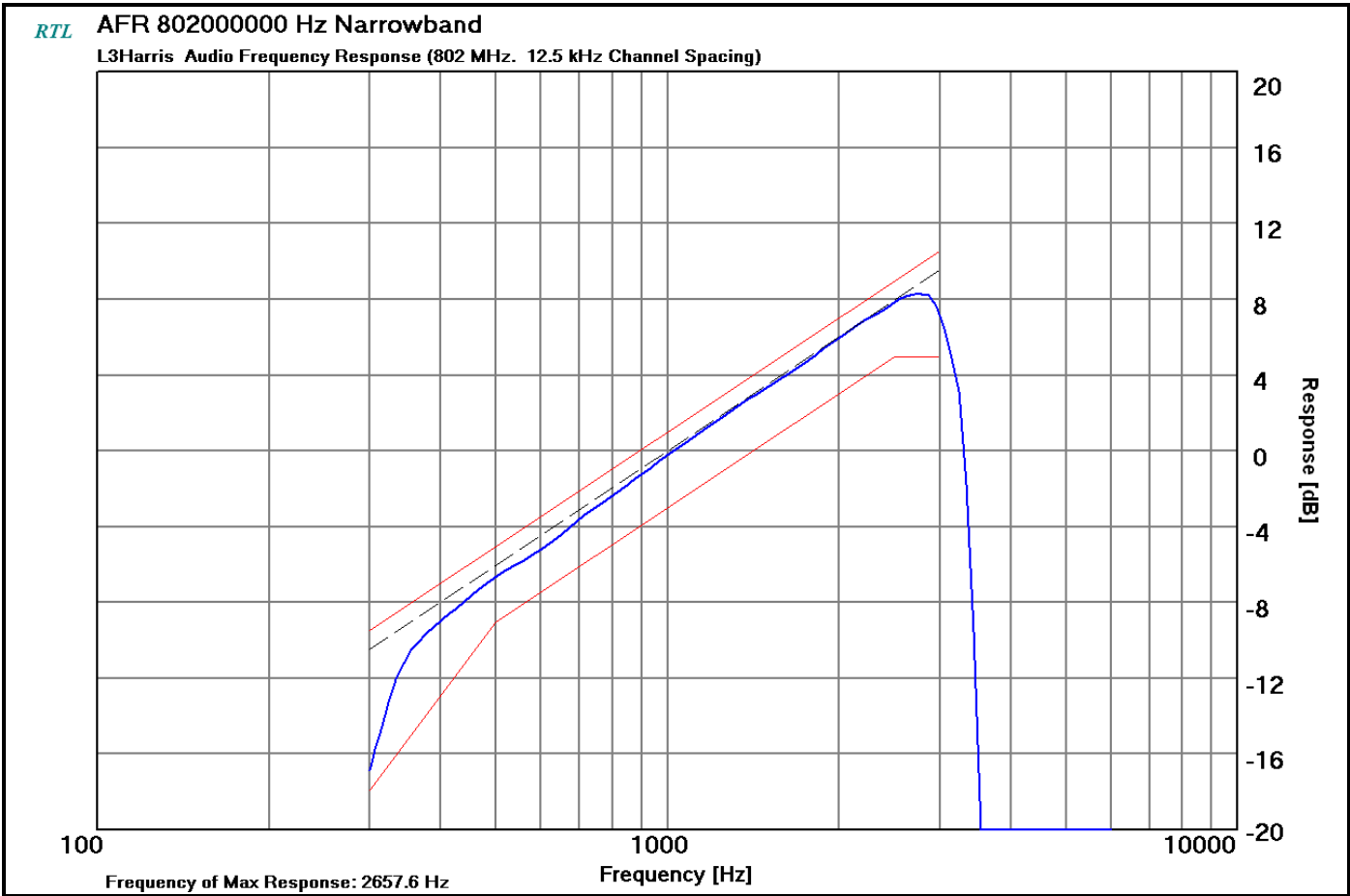
Plot 10-3: Modulation Characteristics - Audio Frequency Response – 464.0000 MHz (NB)



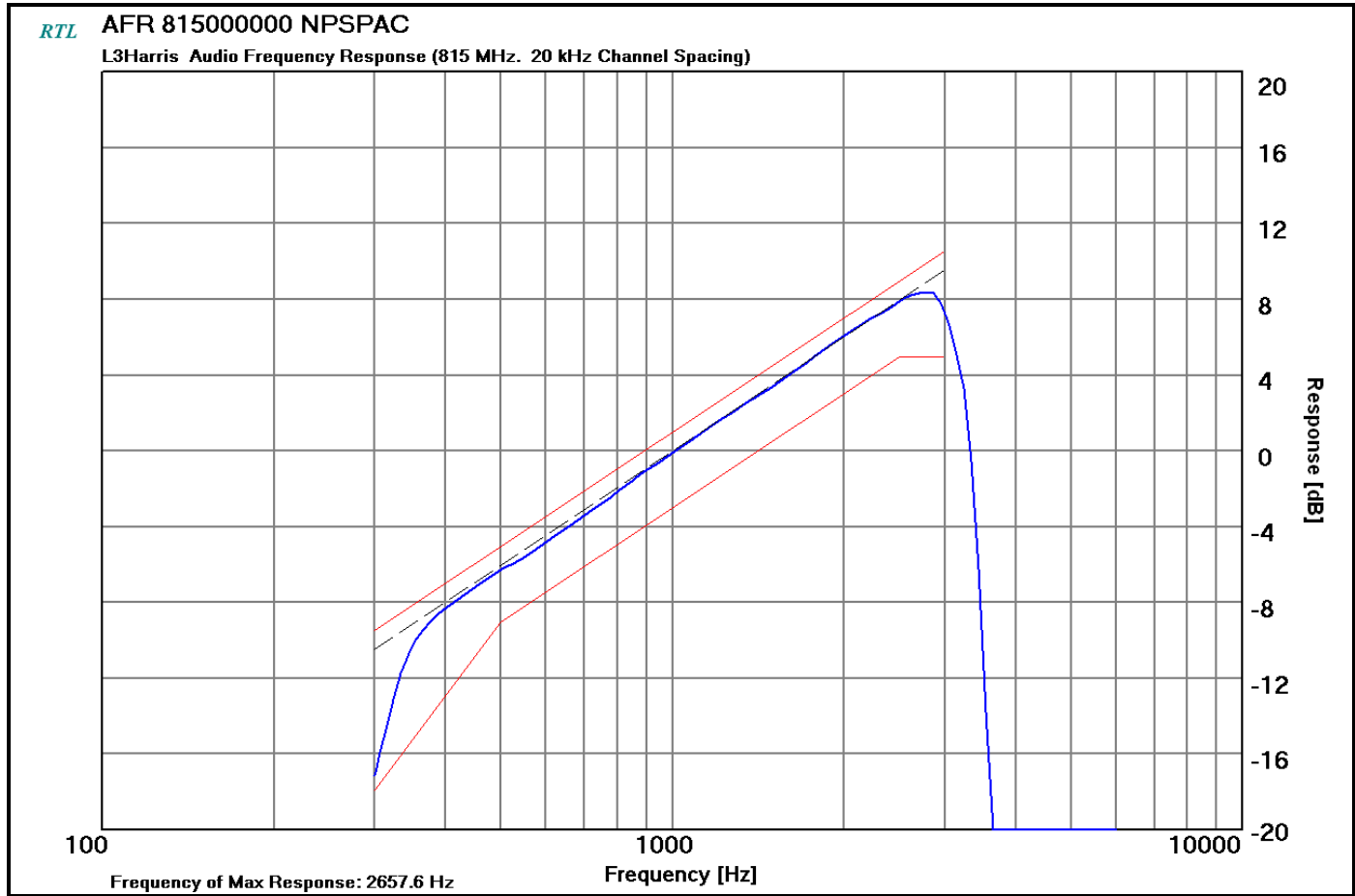
Plot 10-4: Modulation Characteristics - Audio Frequency Response – 772.0000 MHz (WB)



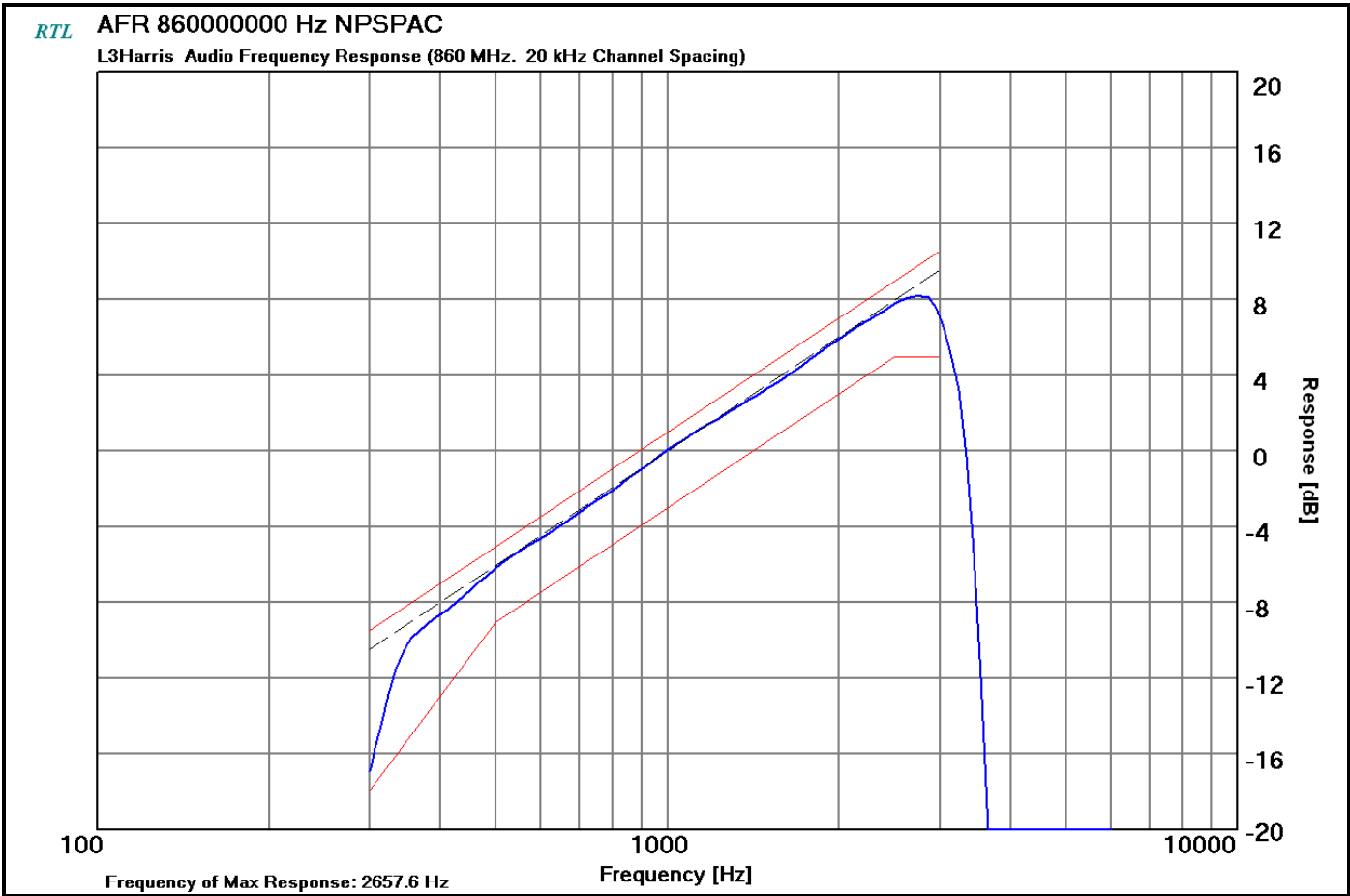
Plot 10-5: Modulation Characteristics - Audio Frequency Response – 802.0000 MHz (NB)



Plot 10-6: Modulation Characteristics - Audio Frequency Response – 815.0000 MHz (NPSPAC)

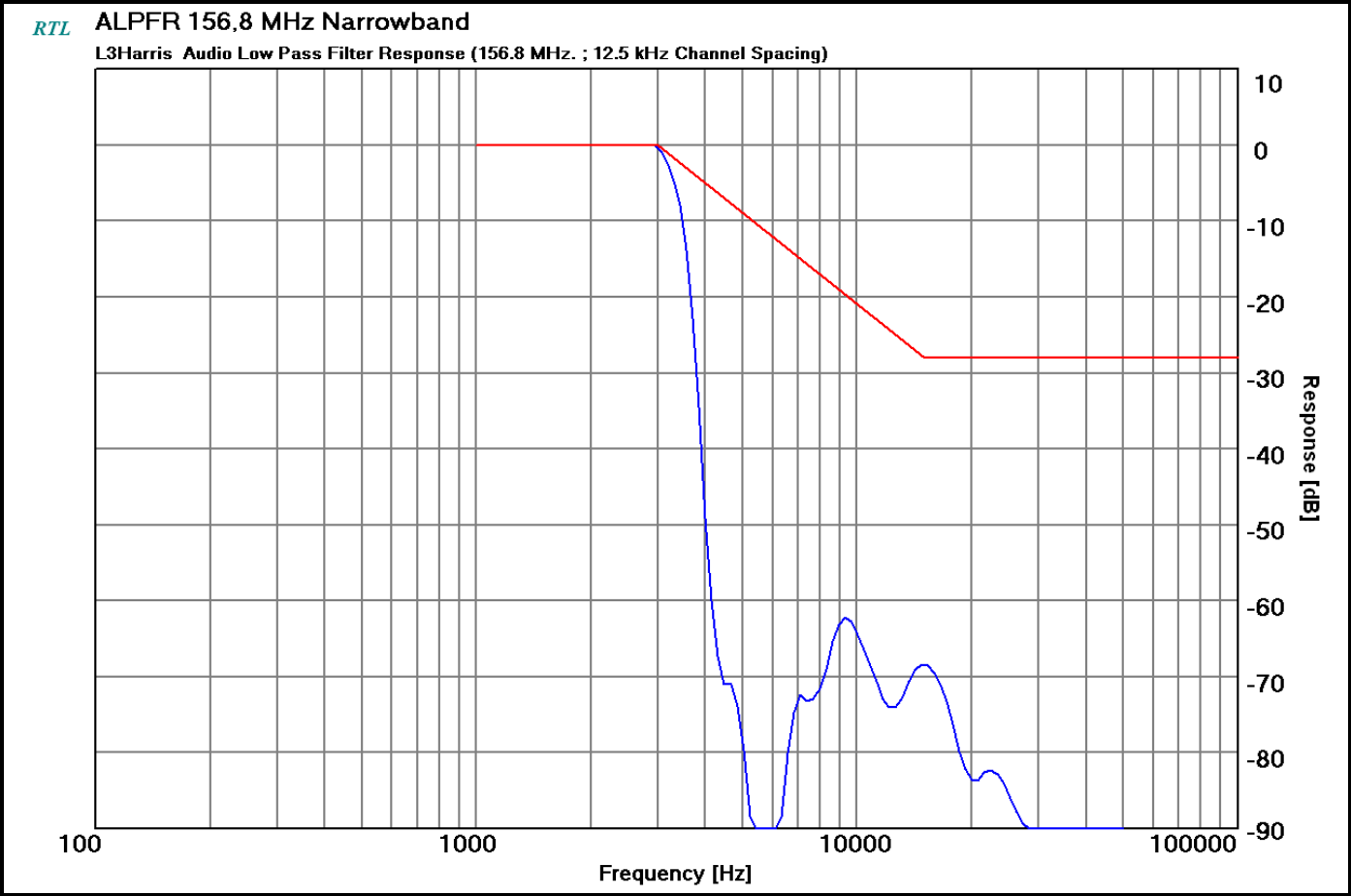


Plot 10-7: Modulation Characteristics - Audio Frequency Response – 860.0000 MHz (NPSPAC)

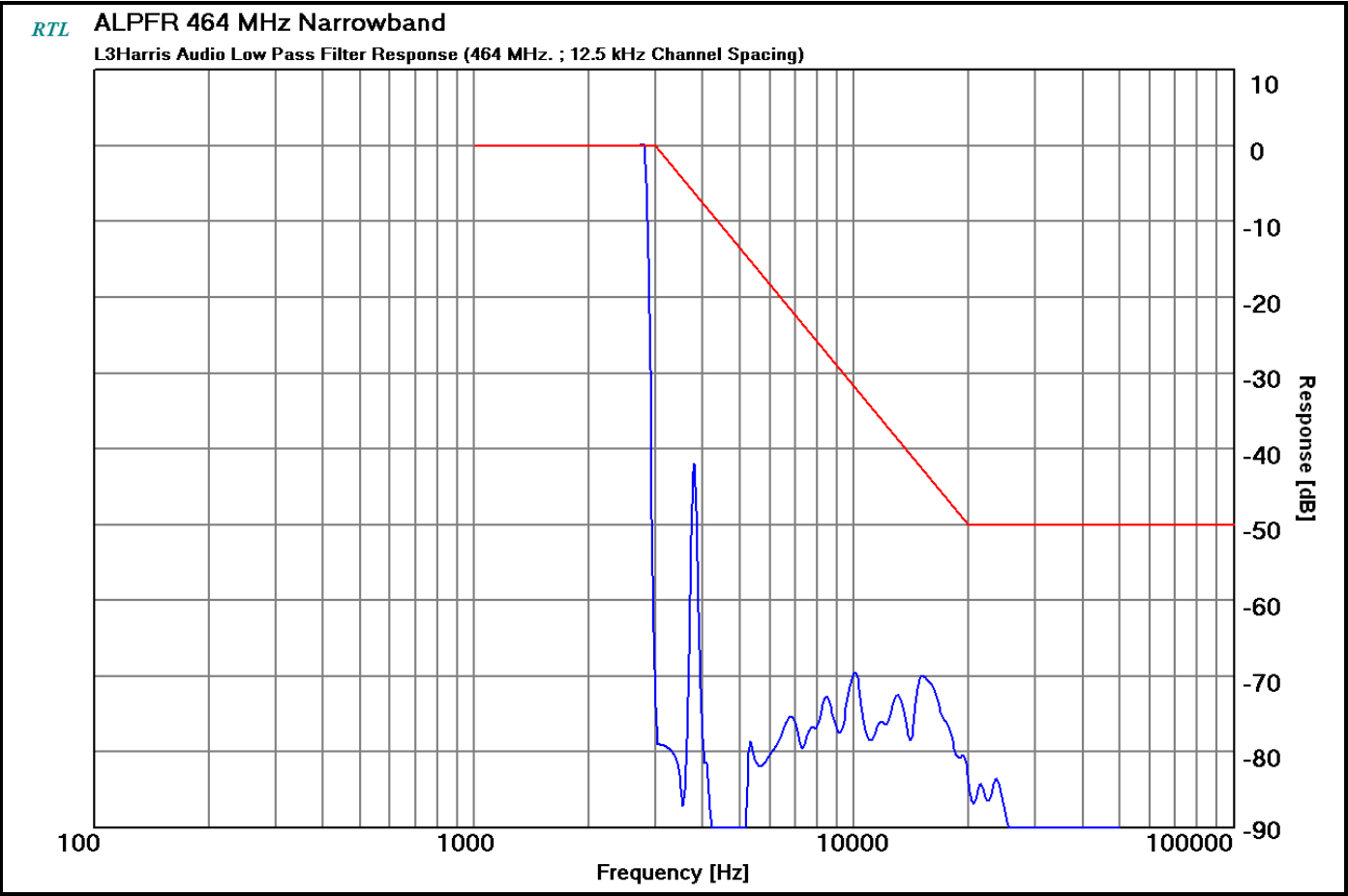


10.2.2 Audio Low Pass Filter Response

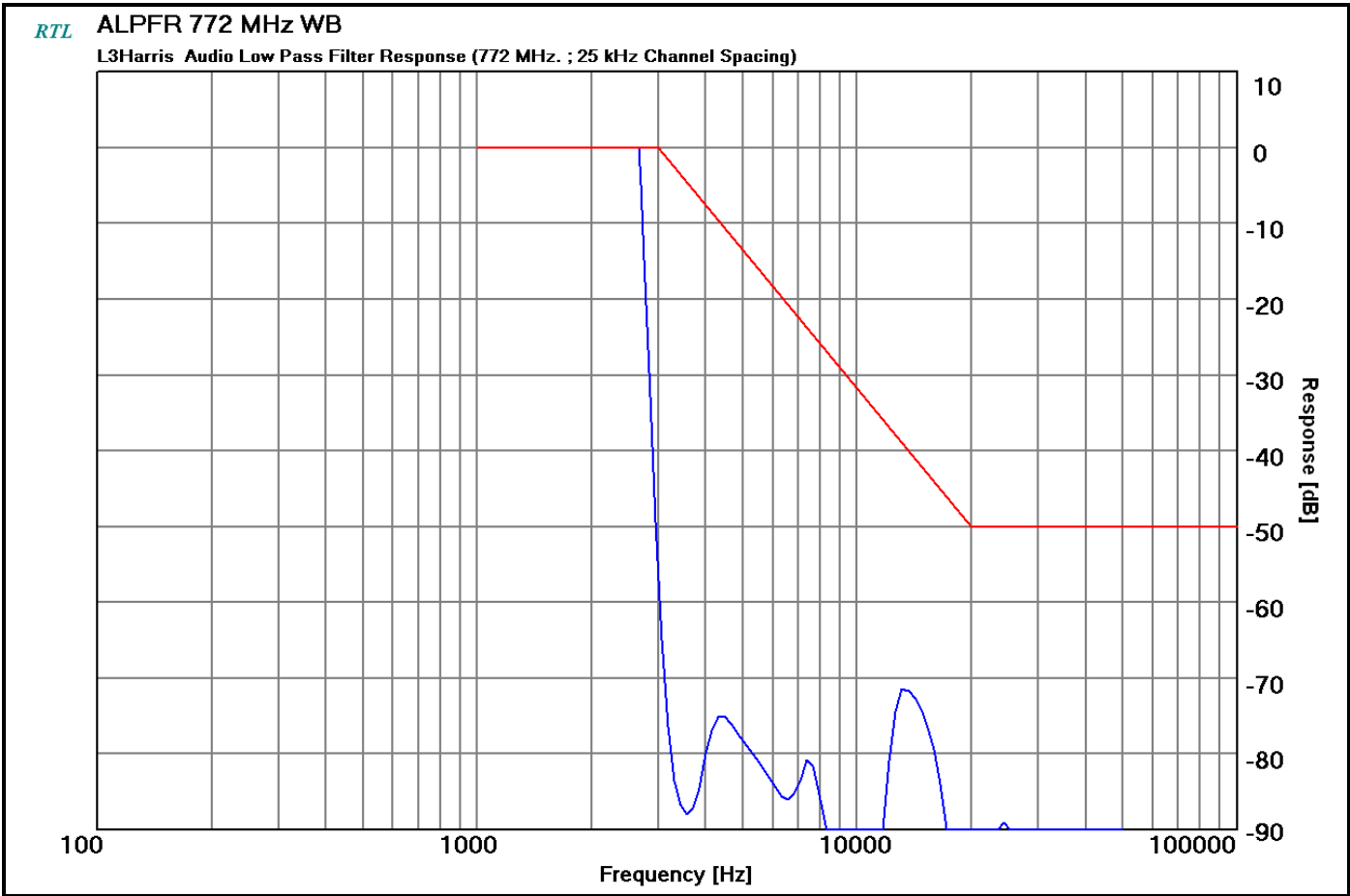
Plot 10-8: Modulation Characteristics – Audio Low Pass Filter – 156.8000 MHz (NB)



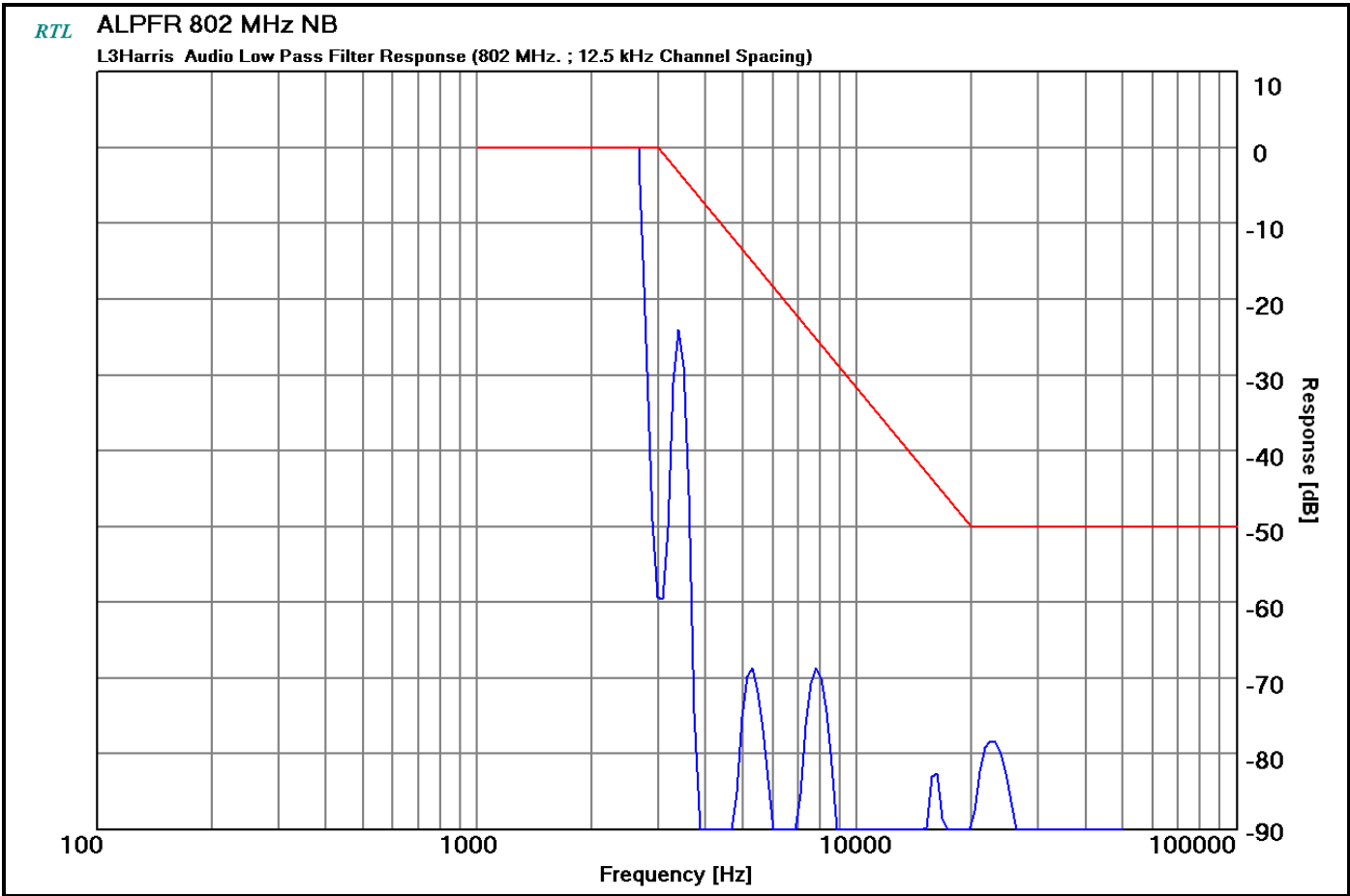
Plot 10-9: Modulation Characteristics – Audio Low Pass Filter – 464.0000 MHz (NB)



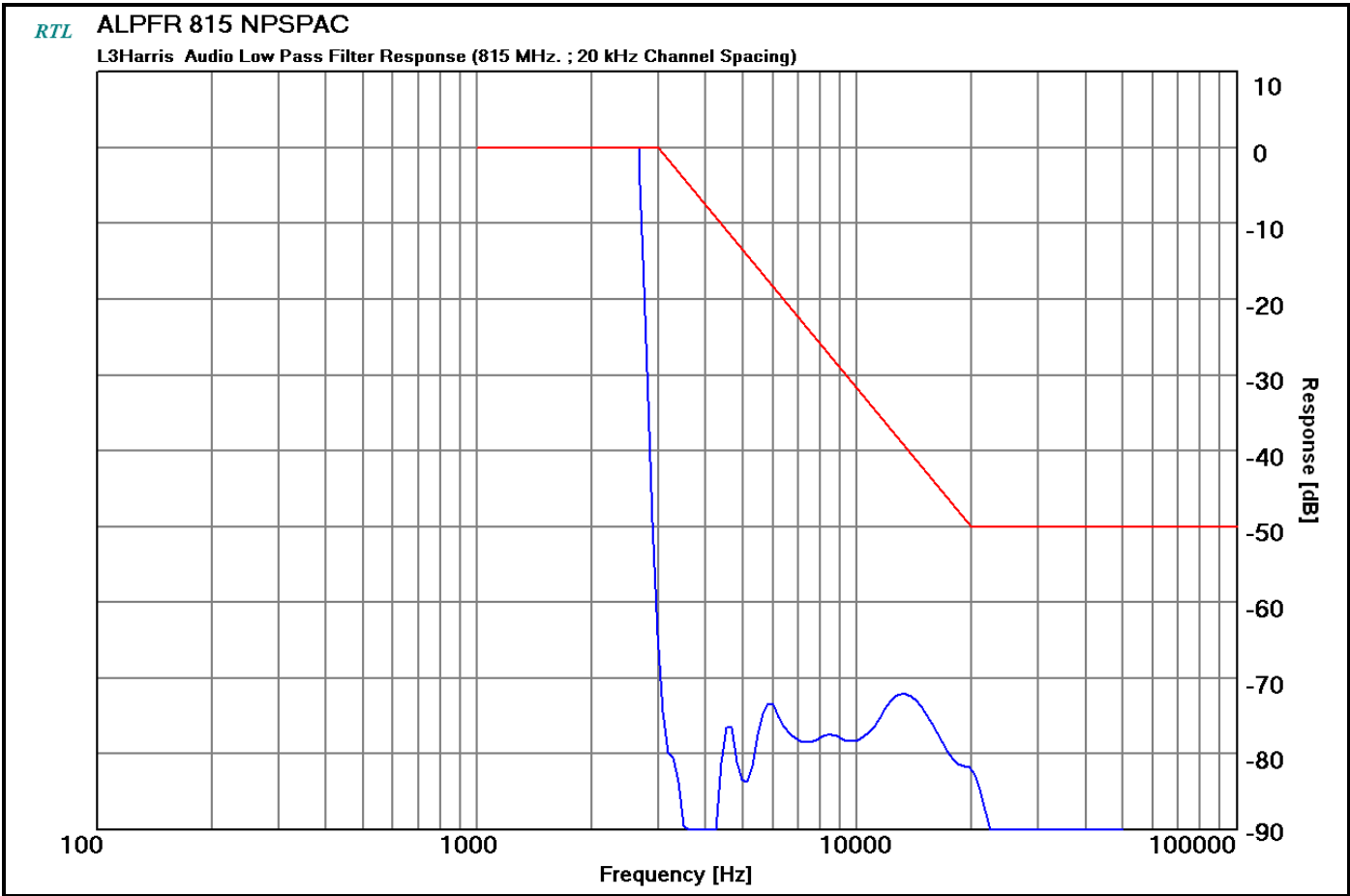
Plot 10-10: Modulation Characteristics – Audio Low Pass Filter – 772.0000 MHz (WB)



Plot 10-11: Modulation Characteristics – Audio Low Pass Filter – 802.0000 MHz (NB)



Plot 10-12: Modulation Characteristics – Audio Low Pass Filter – 815.0000 MHz (NPSPAC)

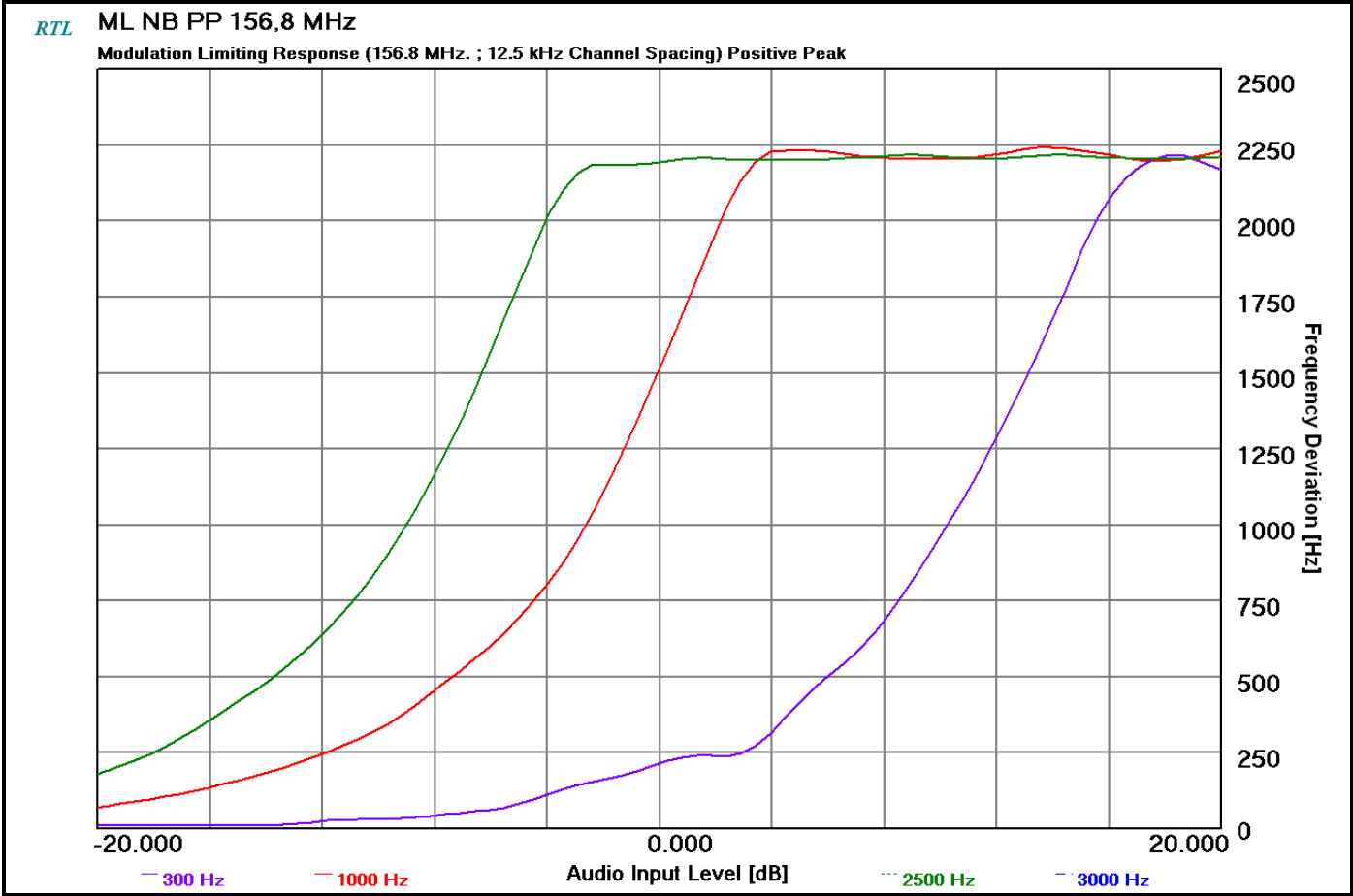


Plot 10-13: Modulation Characteristics – Audio Low Pass Filter –860.0000 MHz (NB)

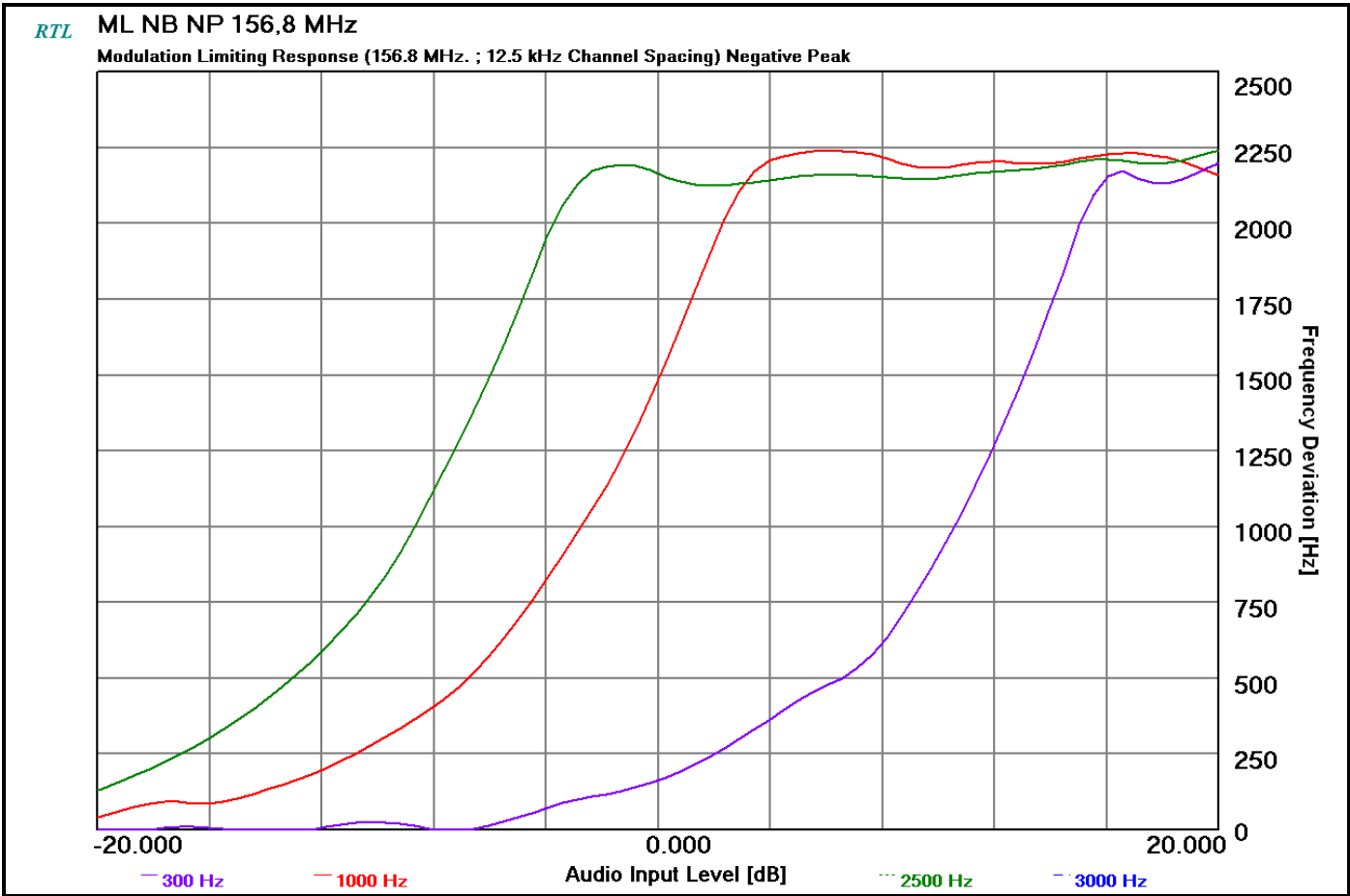


10.2.3 Modulation Limiting

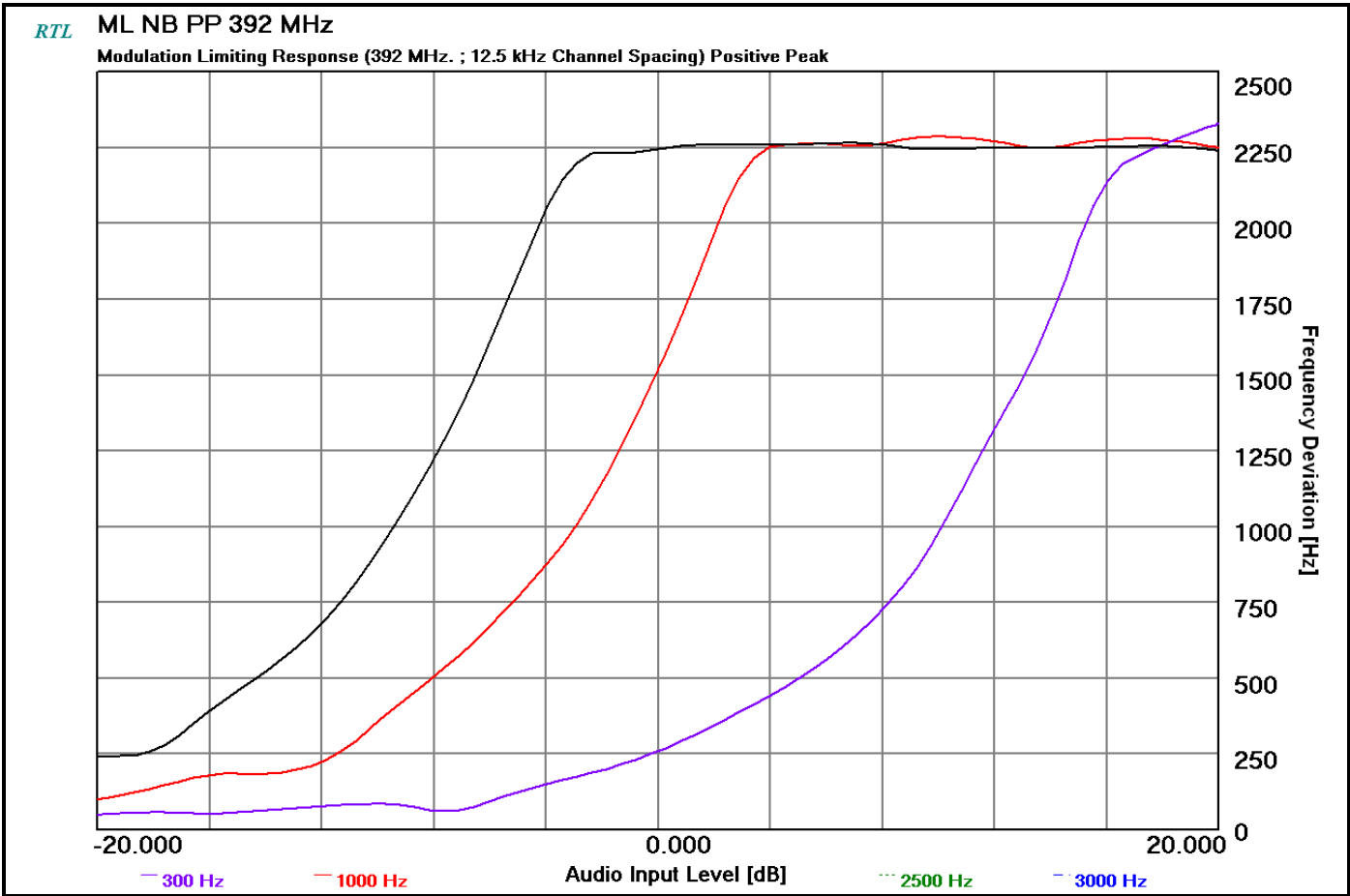
Plot 10-14: Modulation Characteristics – Modulation Limiting – 156.8000 MHz; (NB) Positive Peak



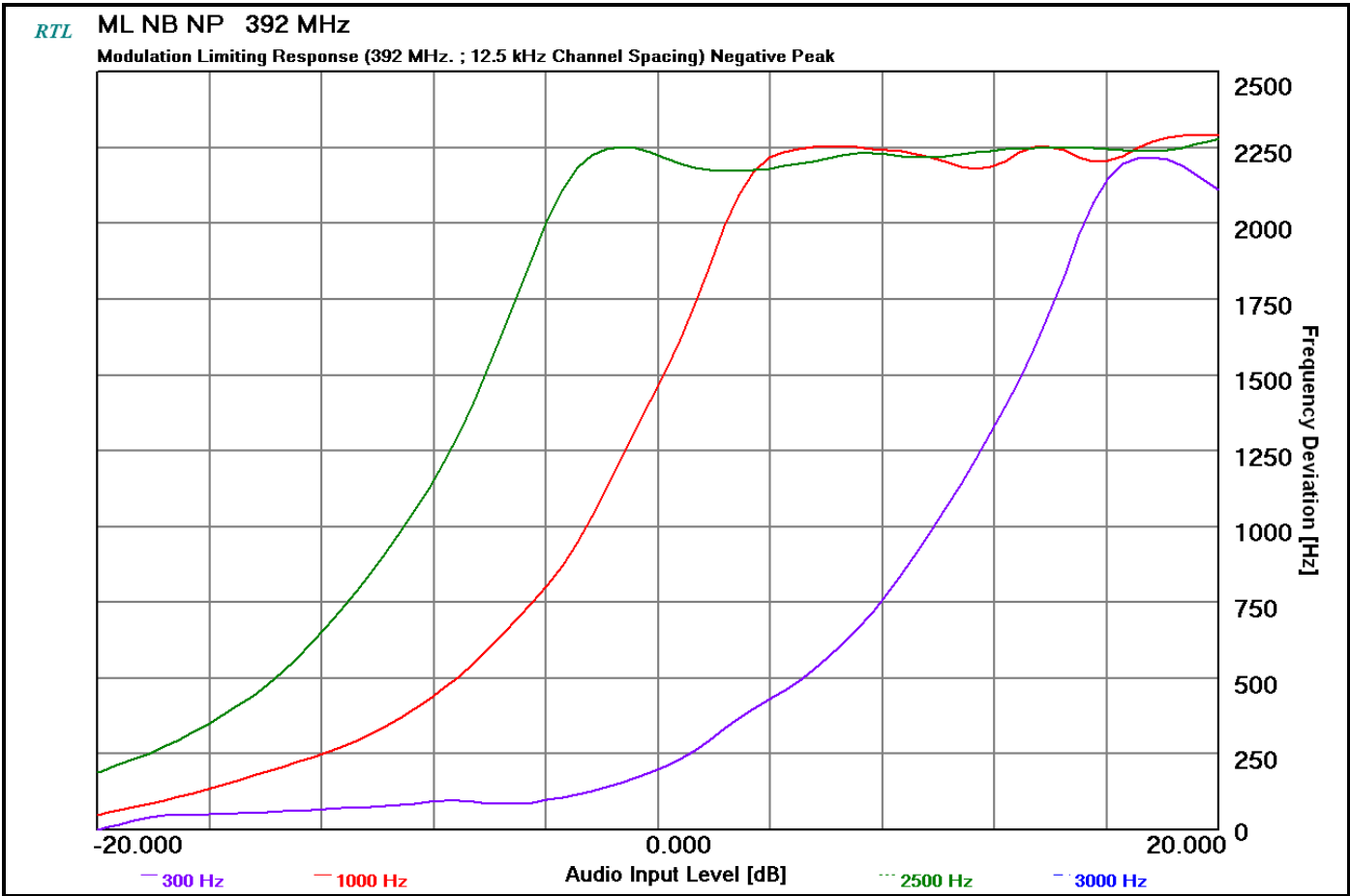
Plot 10-15: Modulation Characteristics – Modulation Limiting – 156.8000 MHz; (NB) Negative Peak



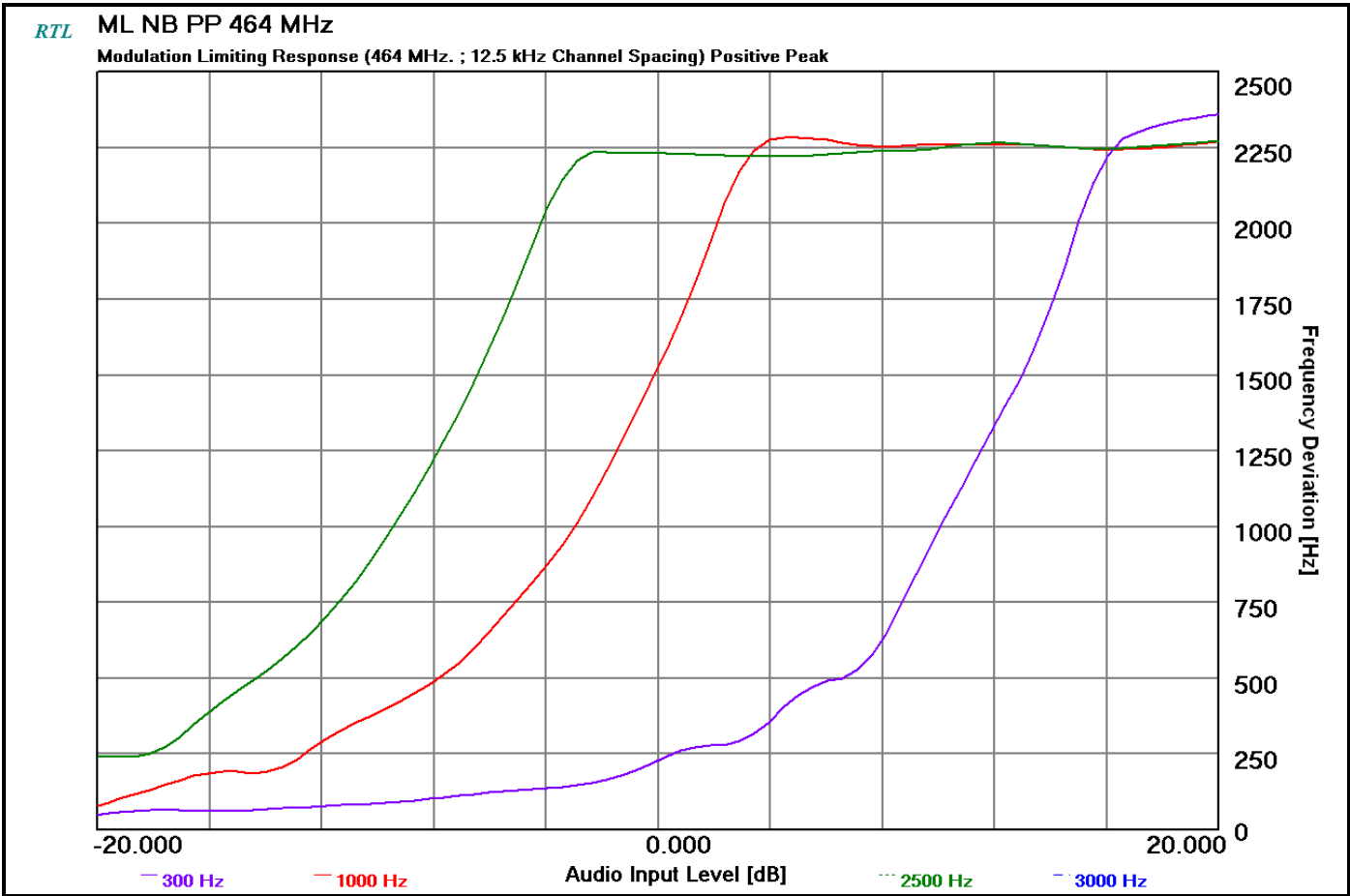
Plot 10-16: Modulation Characteristics – Modulation Limiting – 392.0000 MHz; (NB) Positive Peak



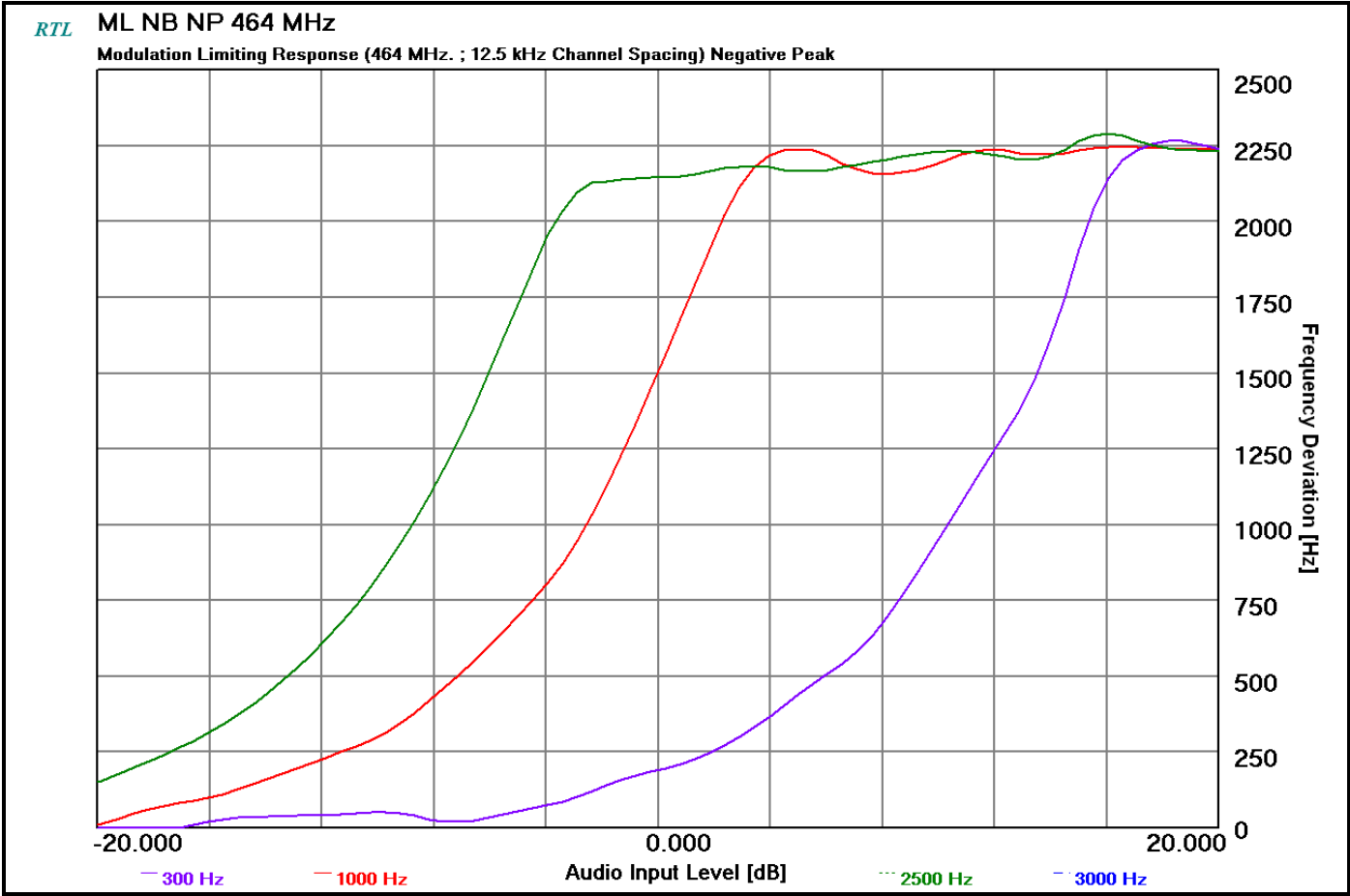
Plot 10-17: Modulation Characteristics – Modulation Limiting – 392.0000 MHz; (NB) Negative Peak



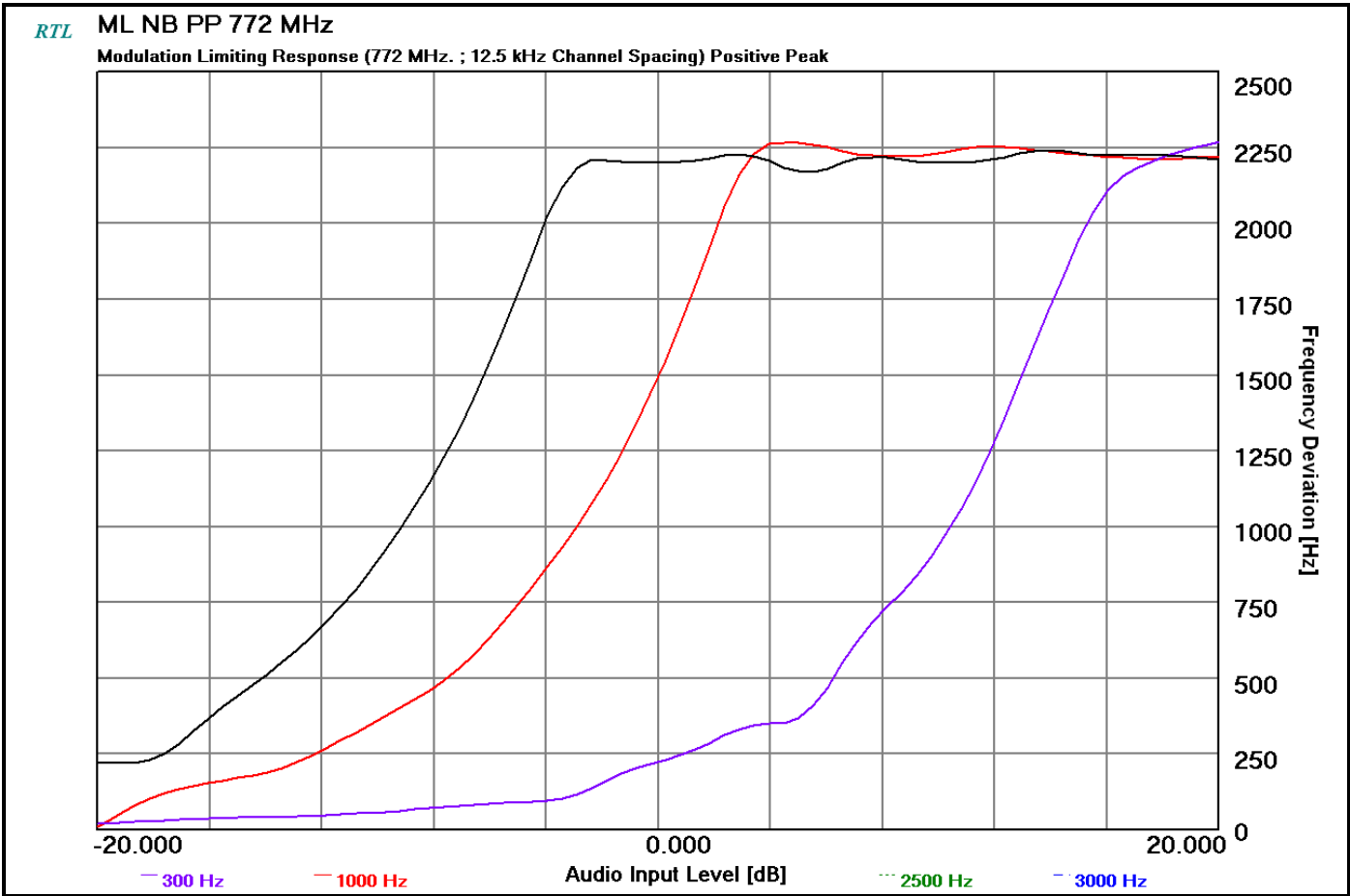
Plot 10-18: Modulation Characteristics – Modulation Limiting – 464.0000 MHz; (NB) Positive Peak



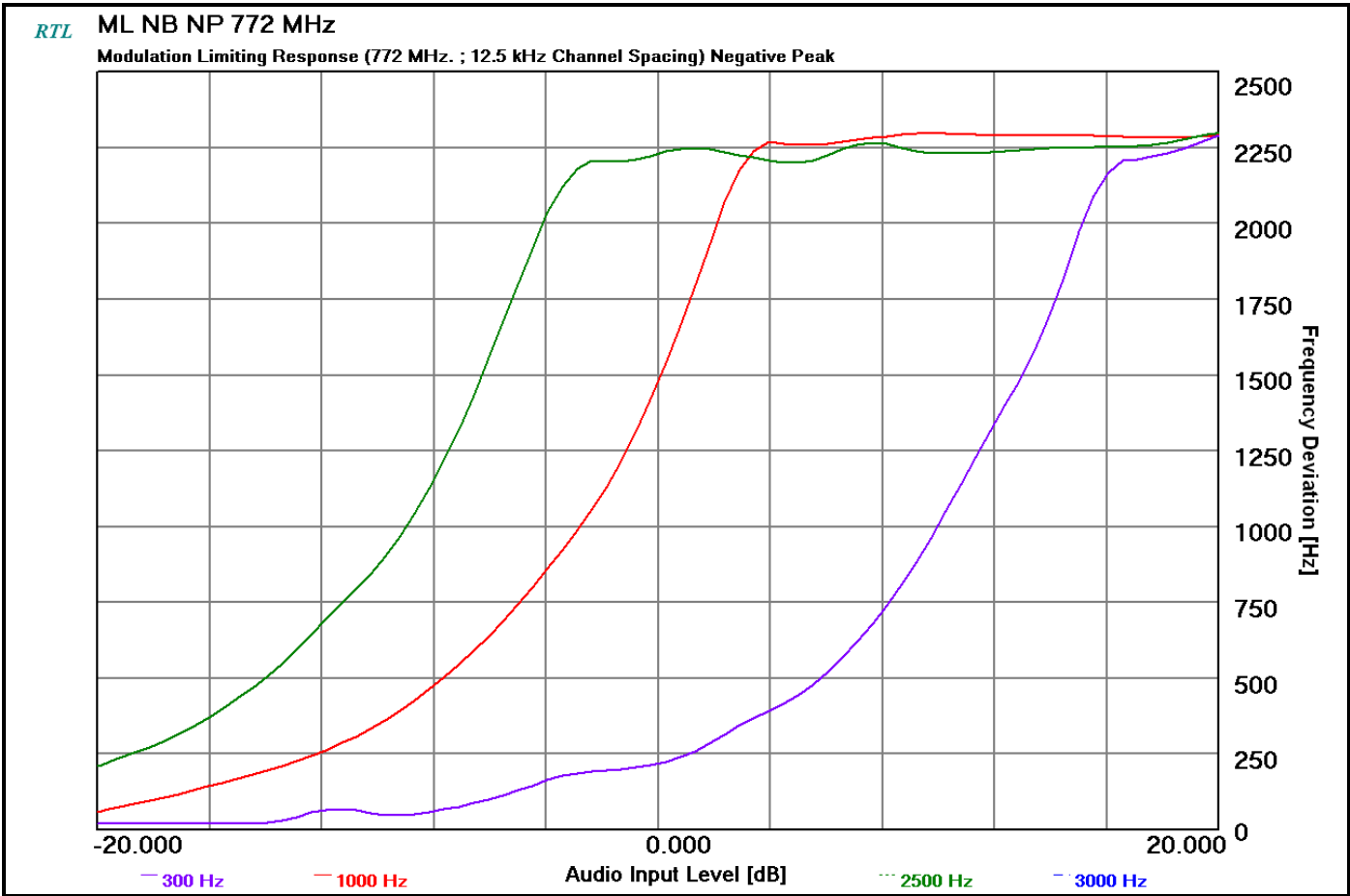
Plot 10-19: Modulation Characteristics – Modulation Limiting – 464.0000 MHz; (NB) Negative Peak



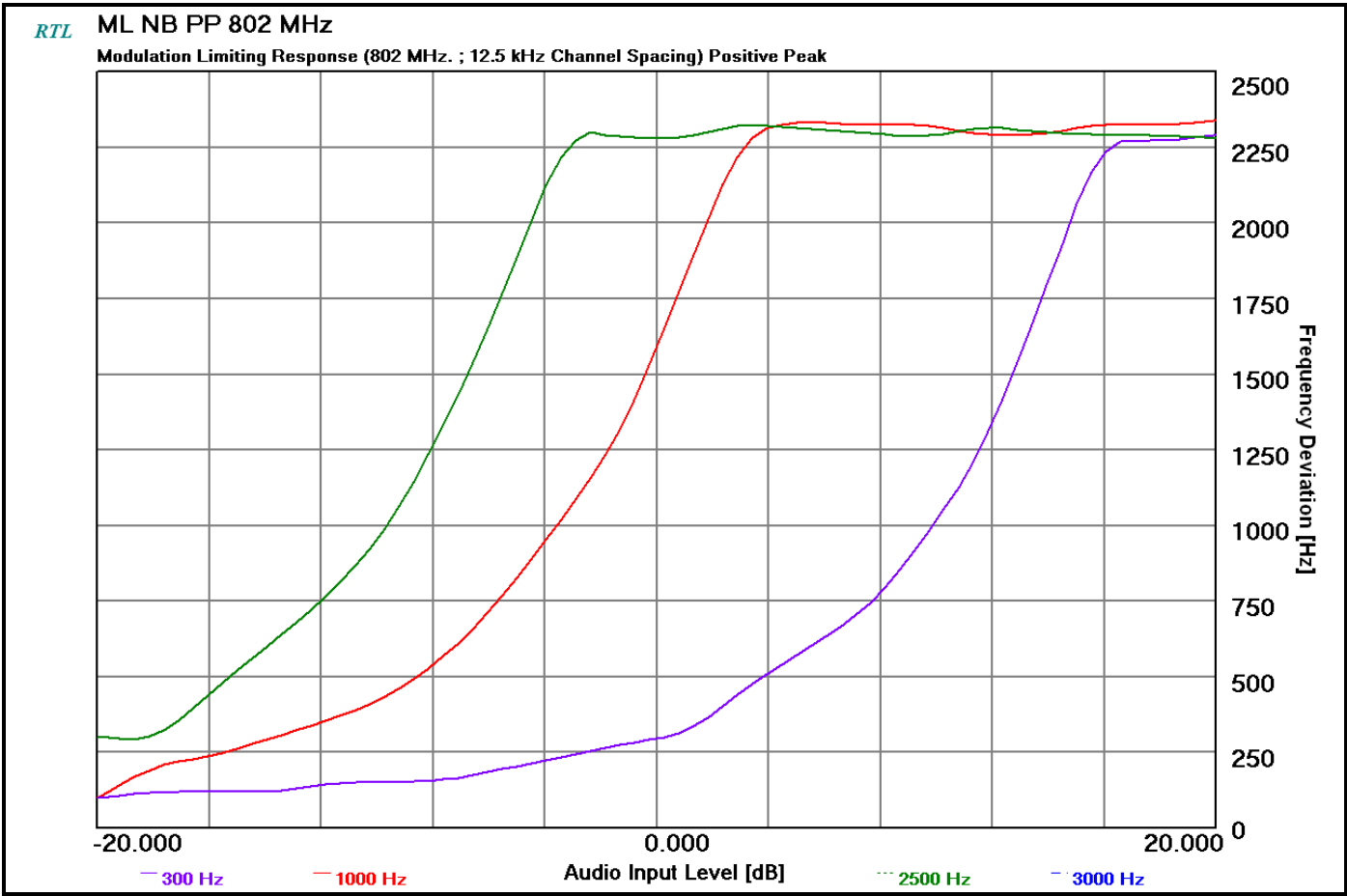
Plot 10-20: Modulation Characteristics – Modulation Limiting – 772.0000 MHz; (NB) Positive Peak



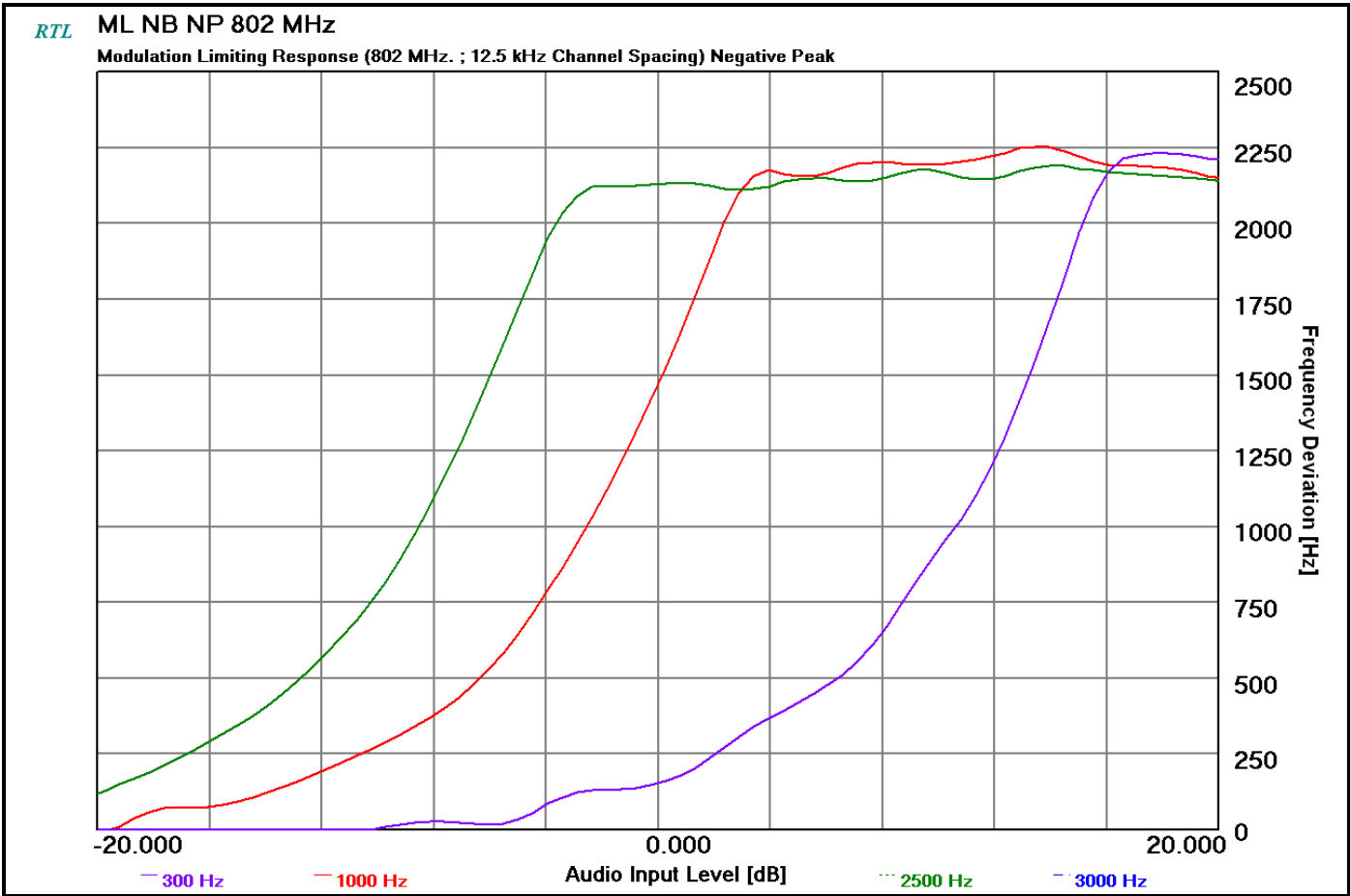
Plot 10-21: Modulation Characteristics – Modulation Limiting – 772.0000 MHz; (NB) Negative Peak



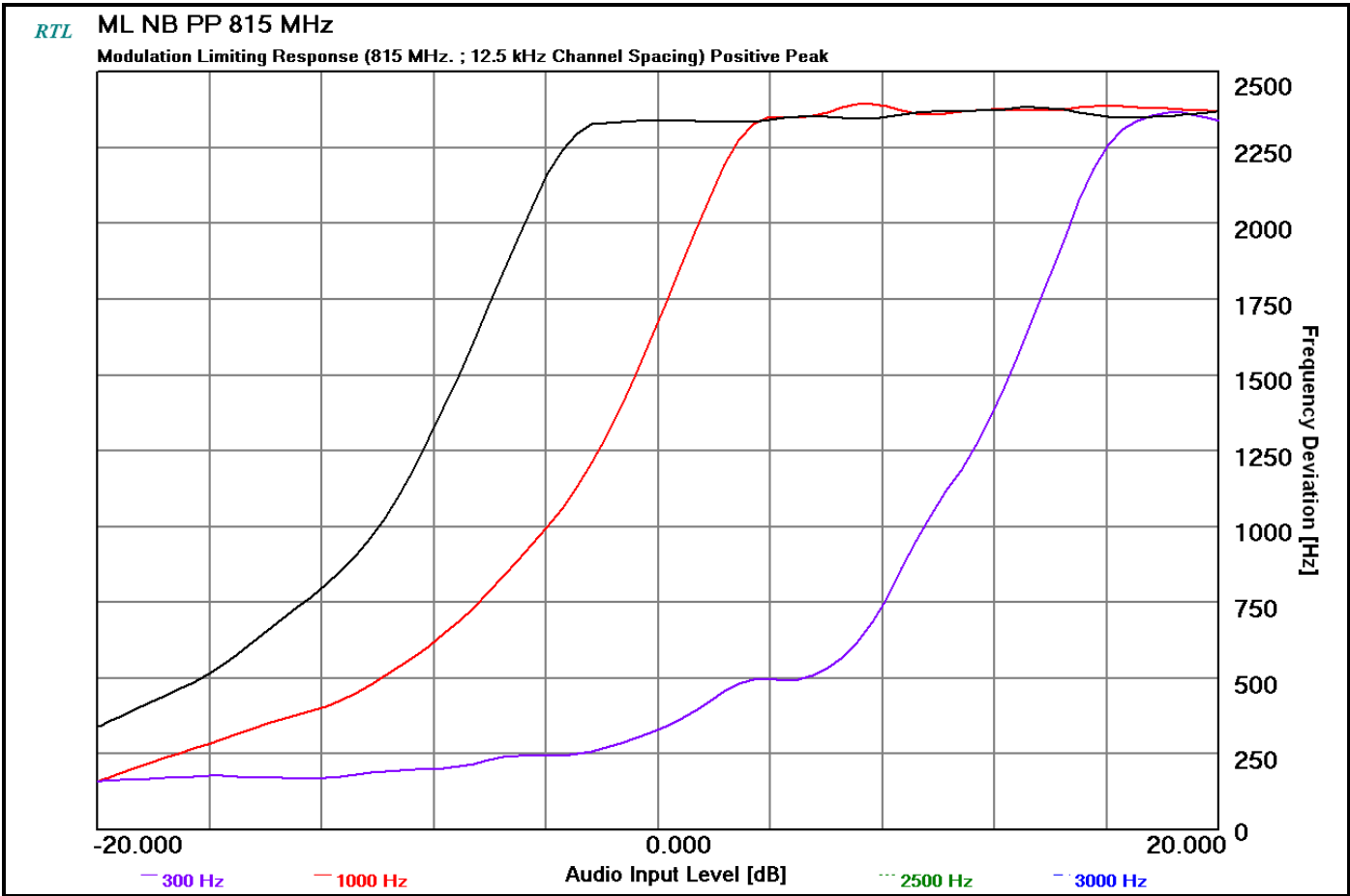
Plot 10-22: Modulation Characteristics – Modulation Limiting – 802.0000 MHz; (NB); Positive Peak



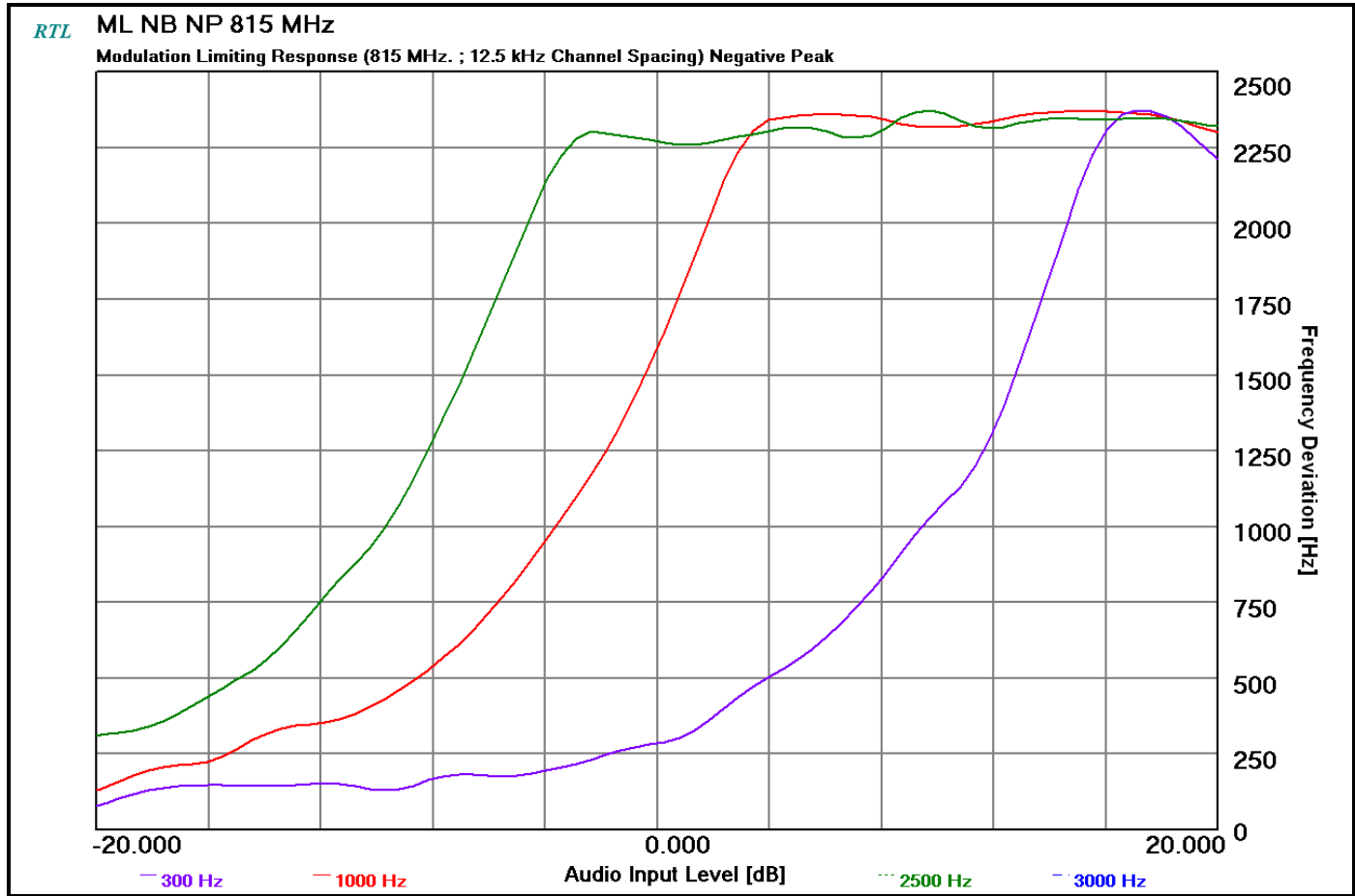
Plot 10-23: Modulation Characteristics – Modulation Limiting - 802.0000 MHz; (NB) Negative Peak



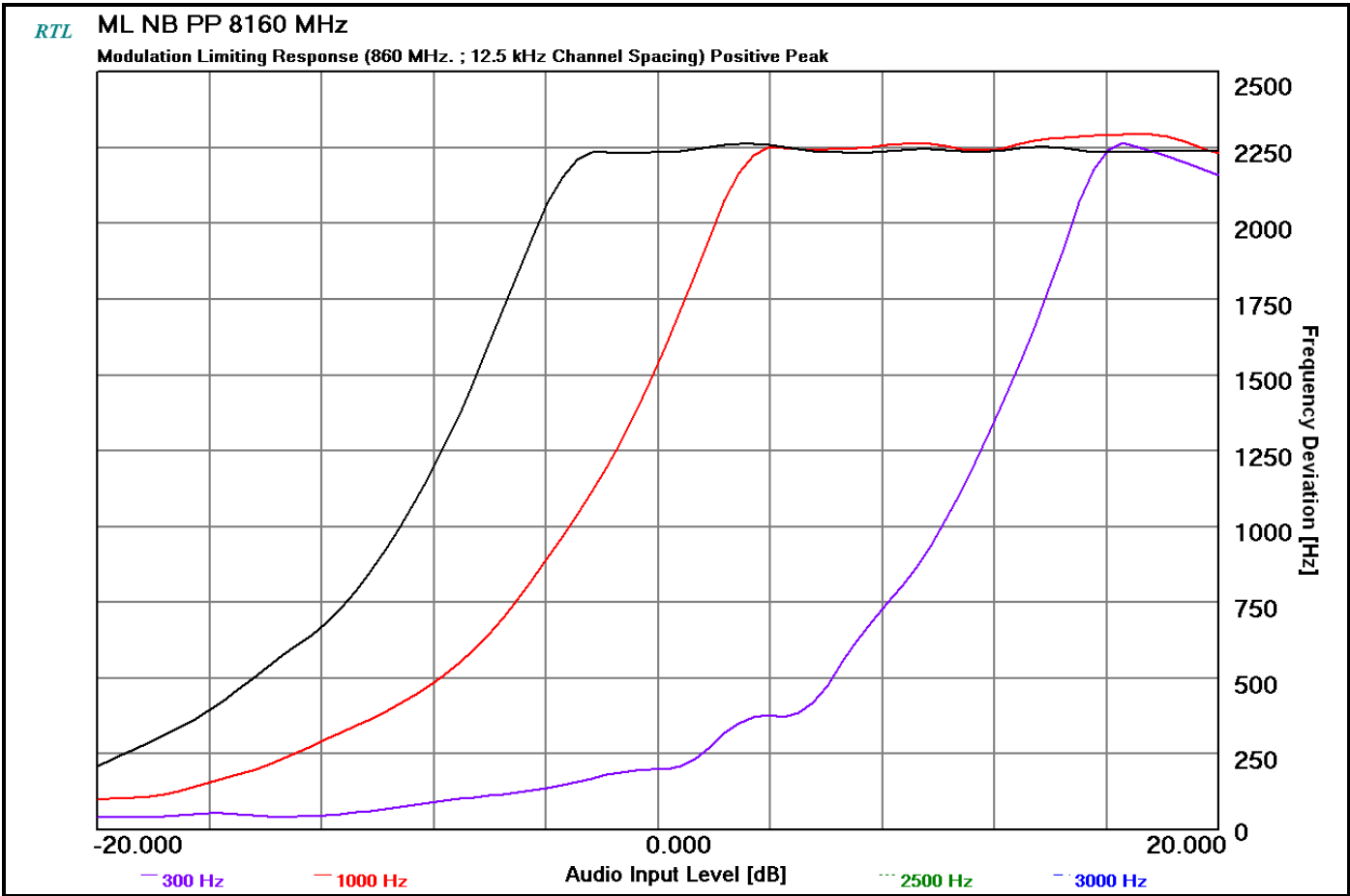
Plot 10-24: Modulation Characteristics – Modulation Limiting – 815.0000 MHz; (NB); Positive Peak



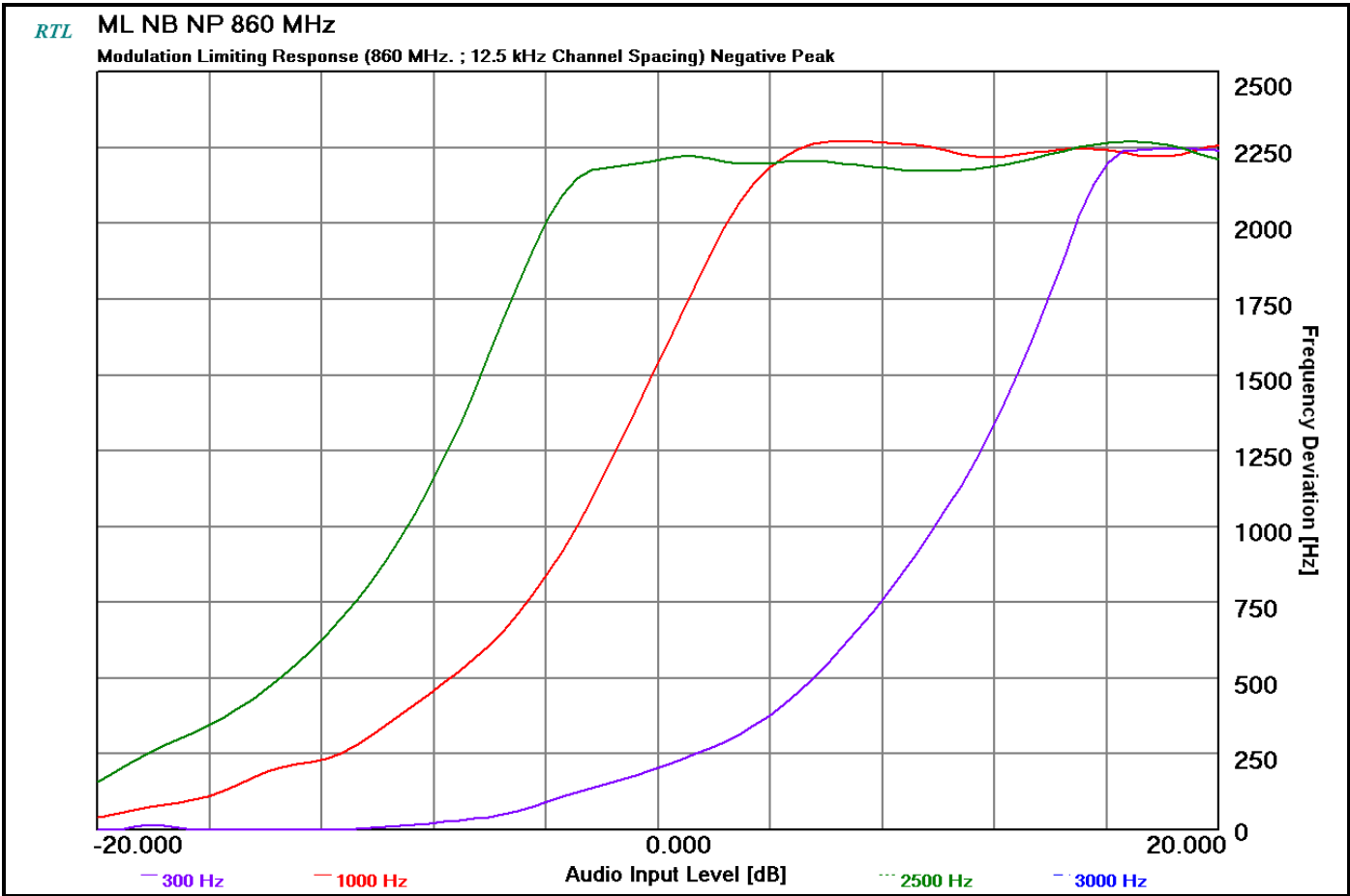
Plot 10-25: Modulation Characteristics – Modulation Limiting – 815.0000 MHz; (NB); Negative Peak



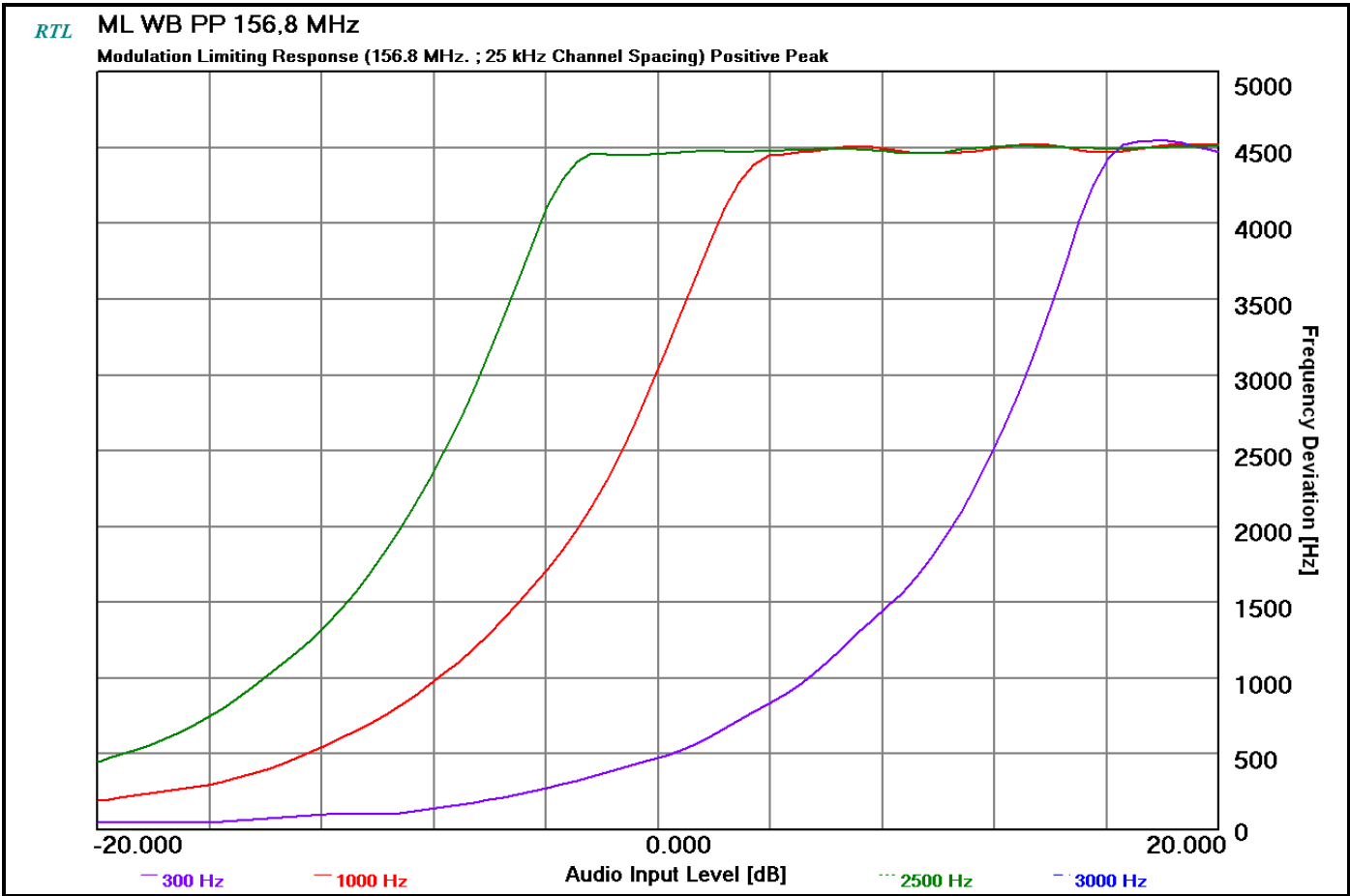
Plot 10-26: Modulation Characteristics – Modulation Limiting – 860.0000 MHz; (NB); Positive Peak



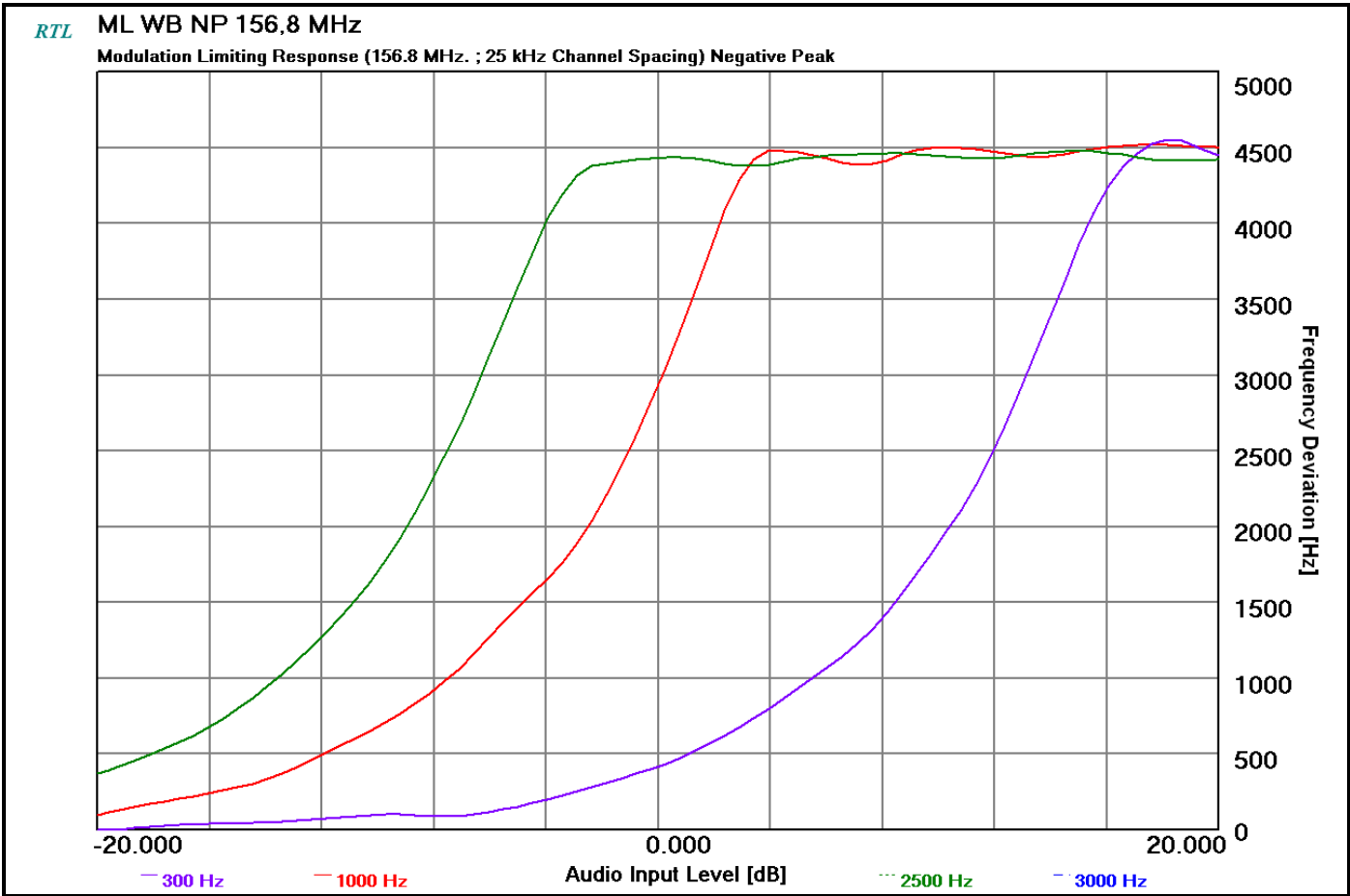
Plot 10-27: Modulation Characteristics – Modulation Limiting – 860.0000 MHz; (NB); Negative Peak



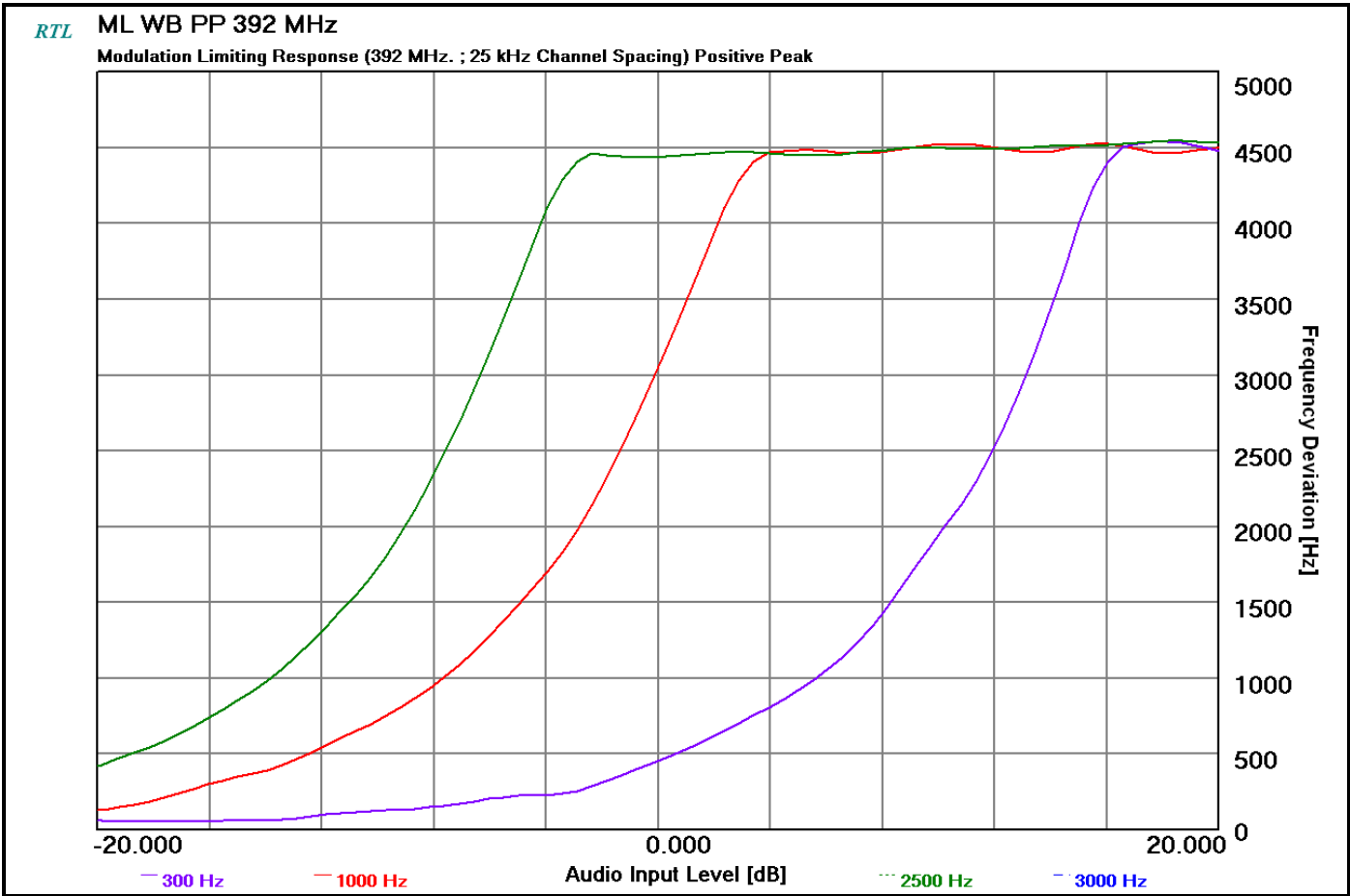
Plot 10-28: Modulation Characteristics – Modulation Limiting – 156.8000 MHz; (WB) Positive Peak



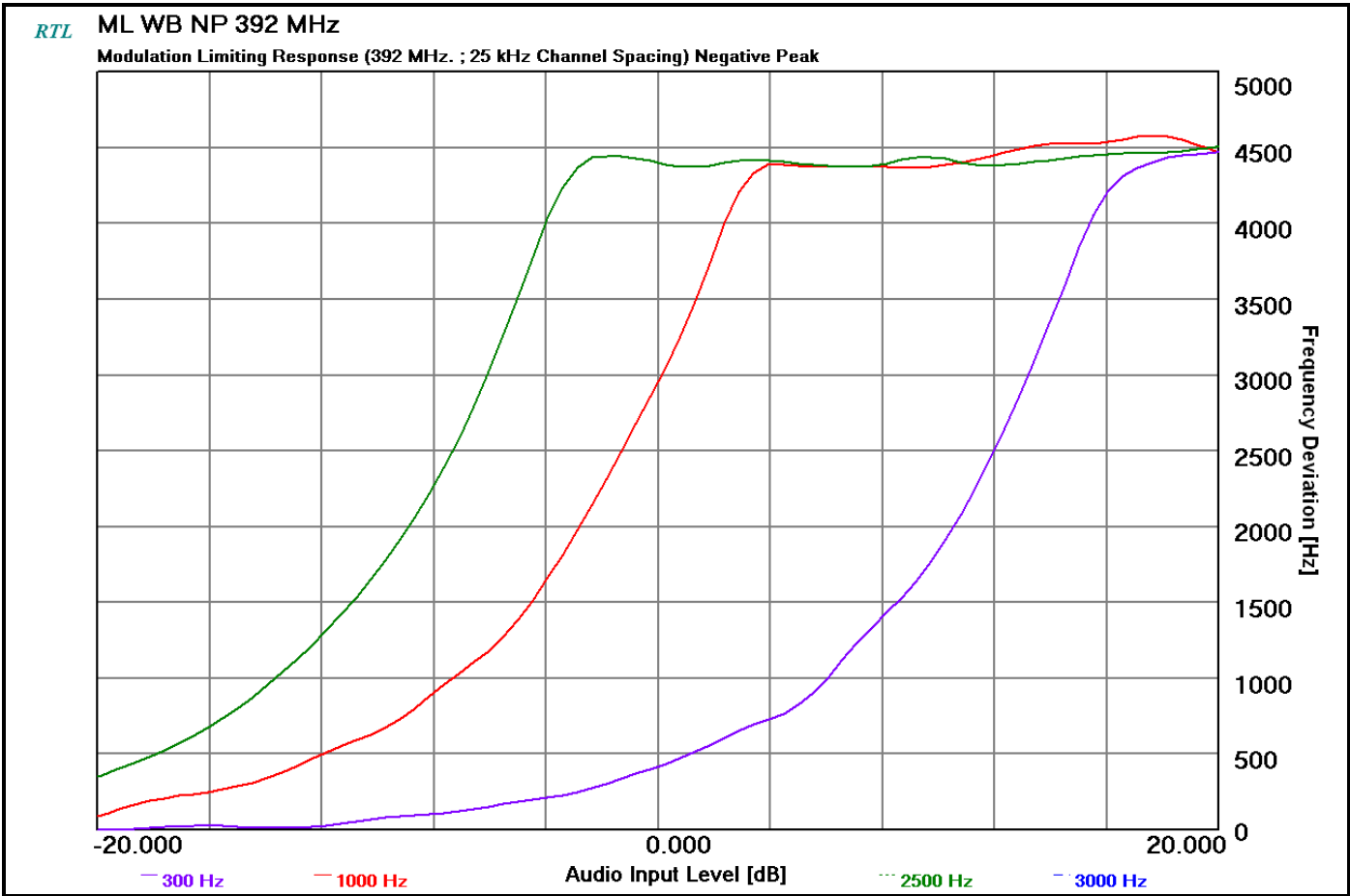
Plot 10-29: Modulation Characteristics – Modulation Limiting – 156.8000 MHz; (WB) Negative Peak



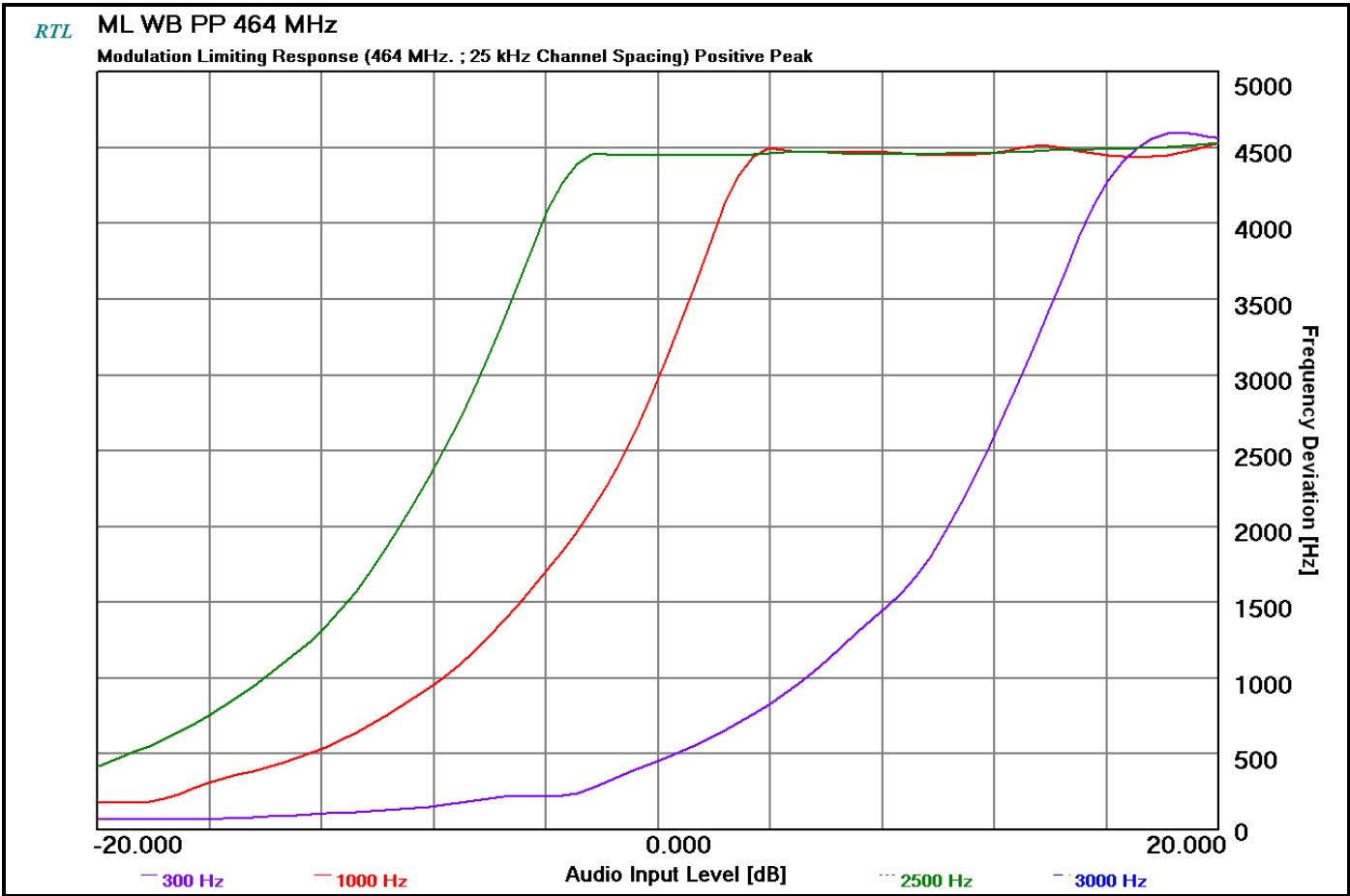
Plot 10-30: Modulation Characteristics – Modulation Limiting – 392.0000 MHz; (WB) Positive Peak



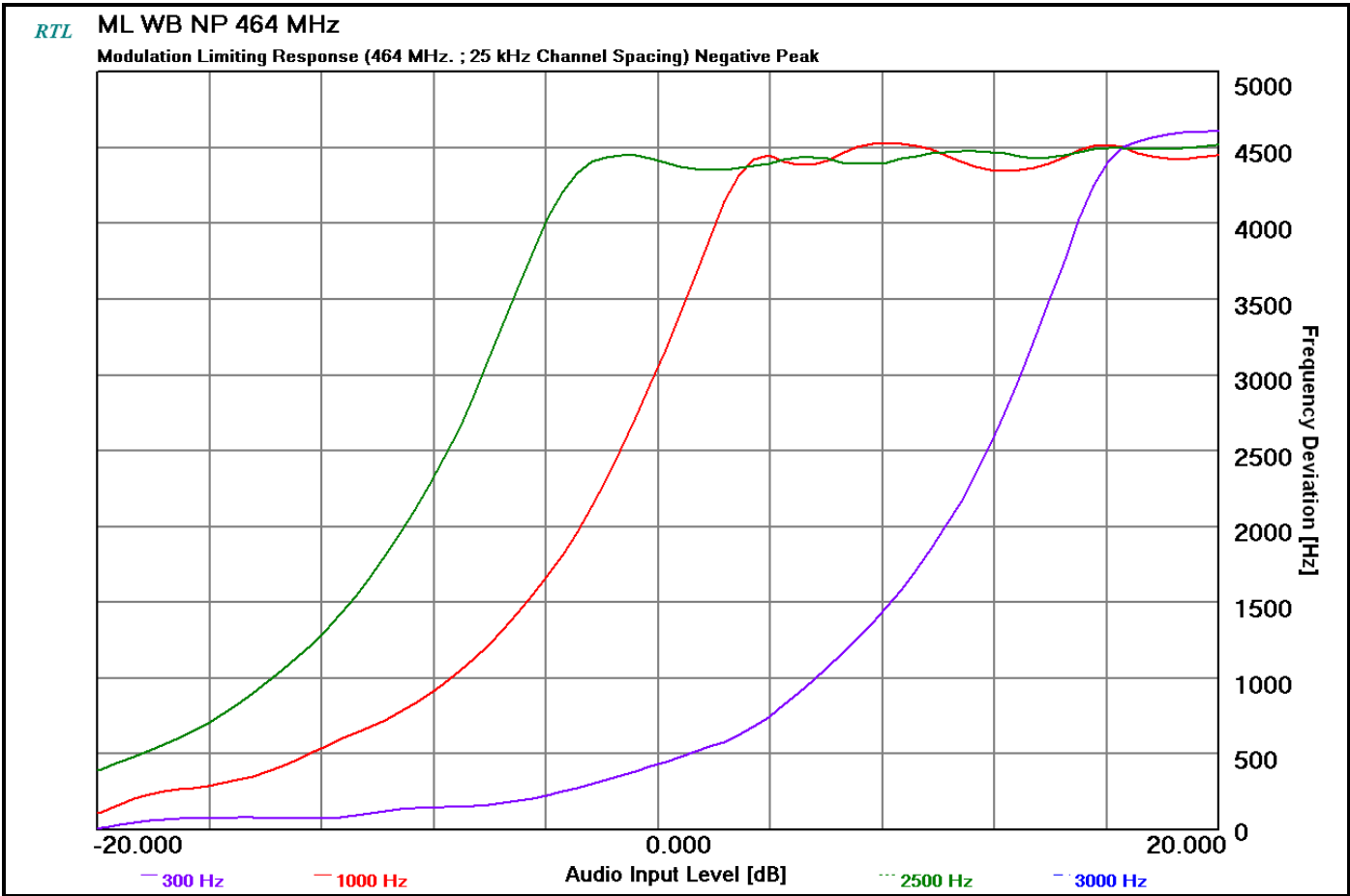
Plot 10-31: Modulation Characteristics – Modulation Limiting – 392.0000 MHz; (WB) Negative Peak



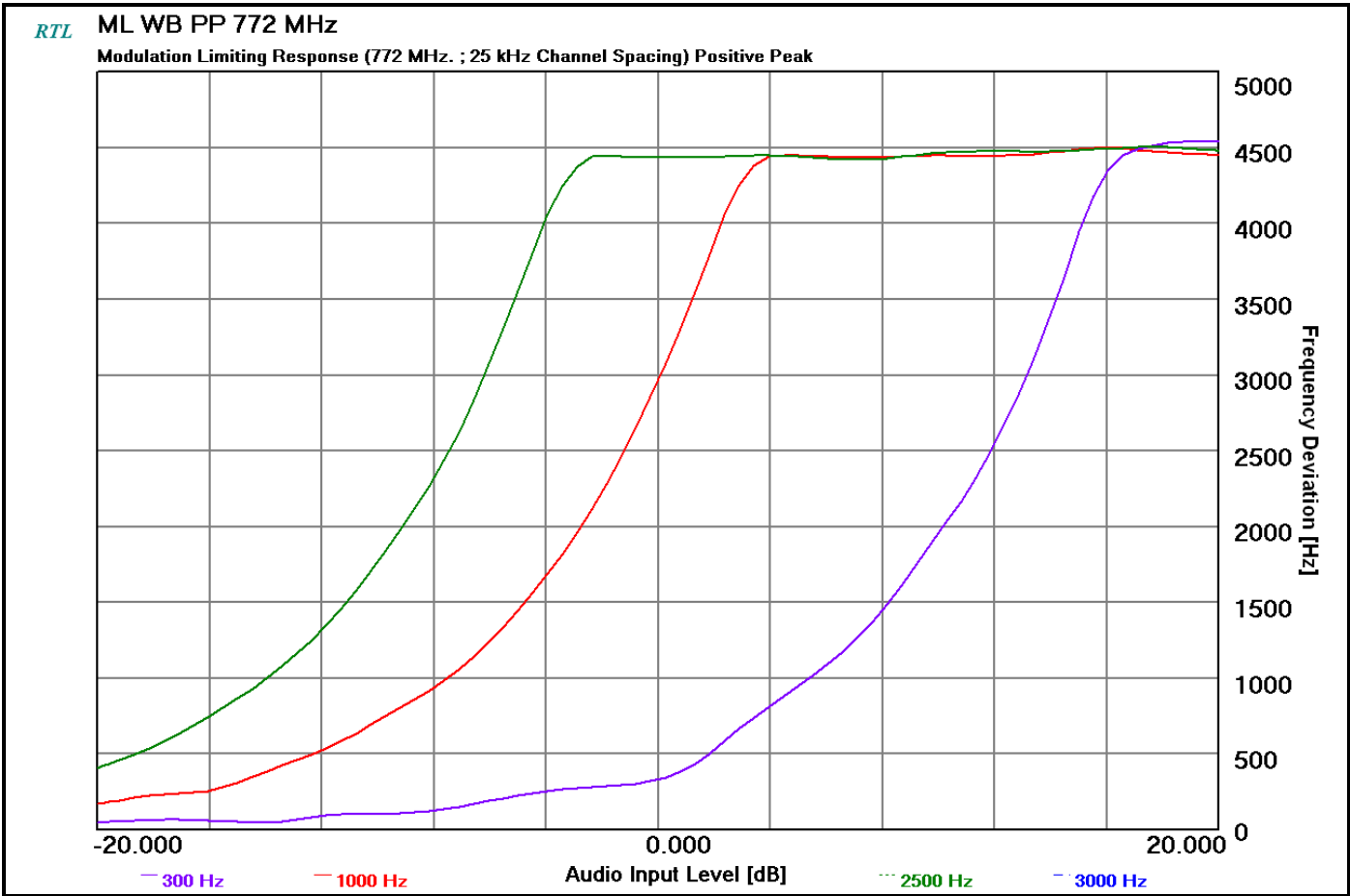
Plot 10-32: Modulation Characteristics – Modulation Limiting – 464.0000 MHz; (WB) Positive Peak



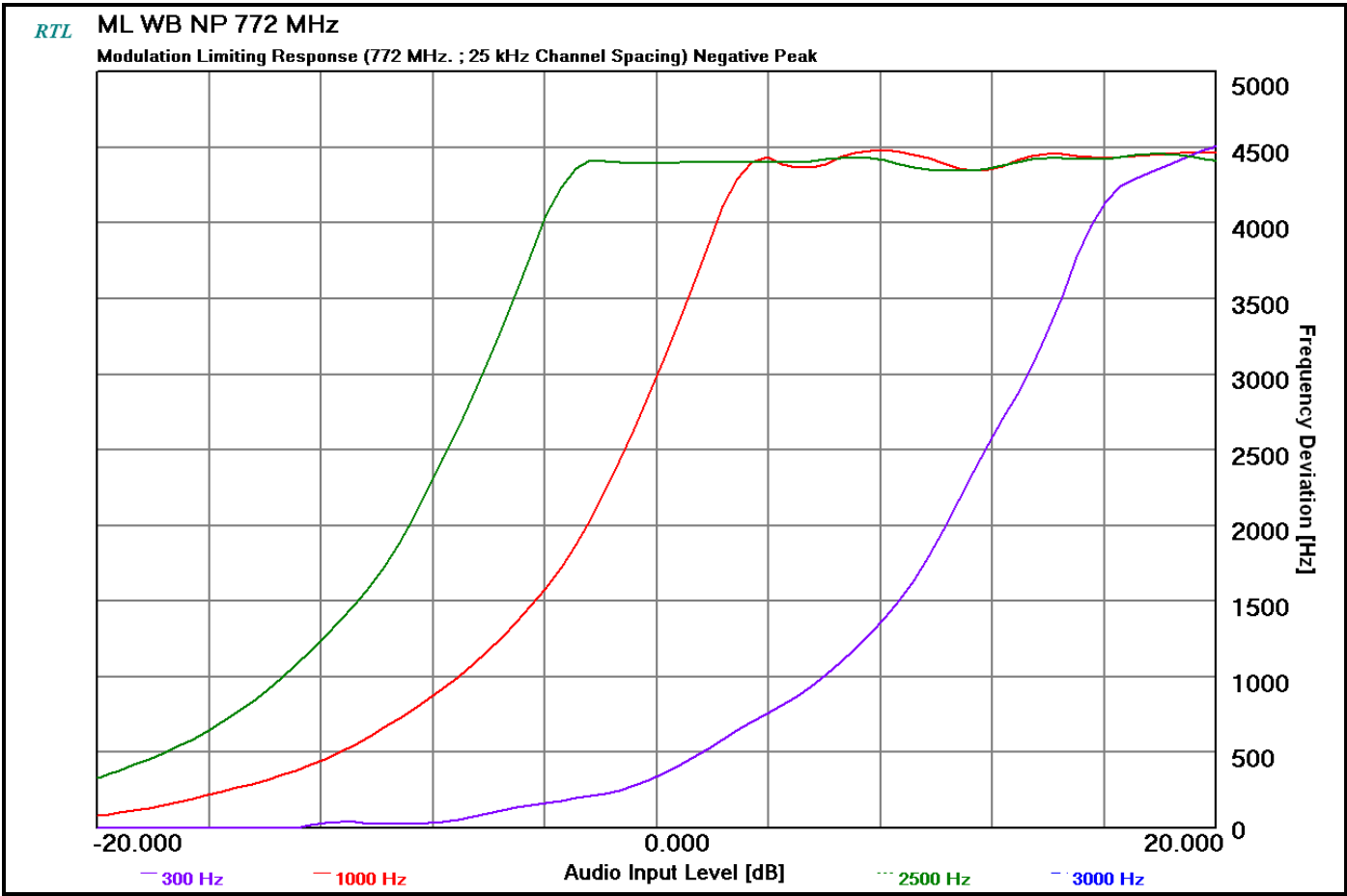
Plot 10-33: Modulation Characteristics – Modulation Limiting – 464.0000 MHz; (WB) Negative Peak



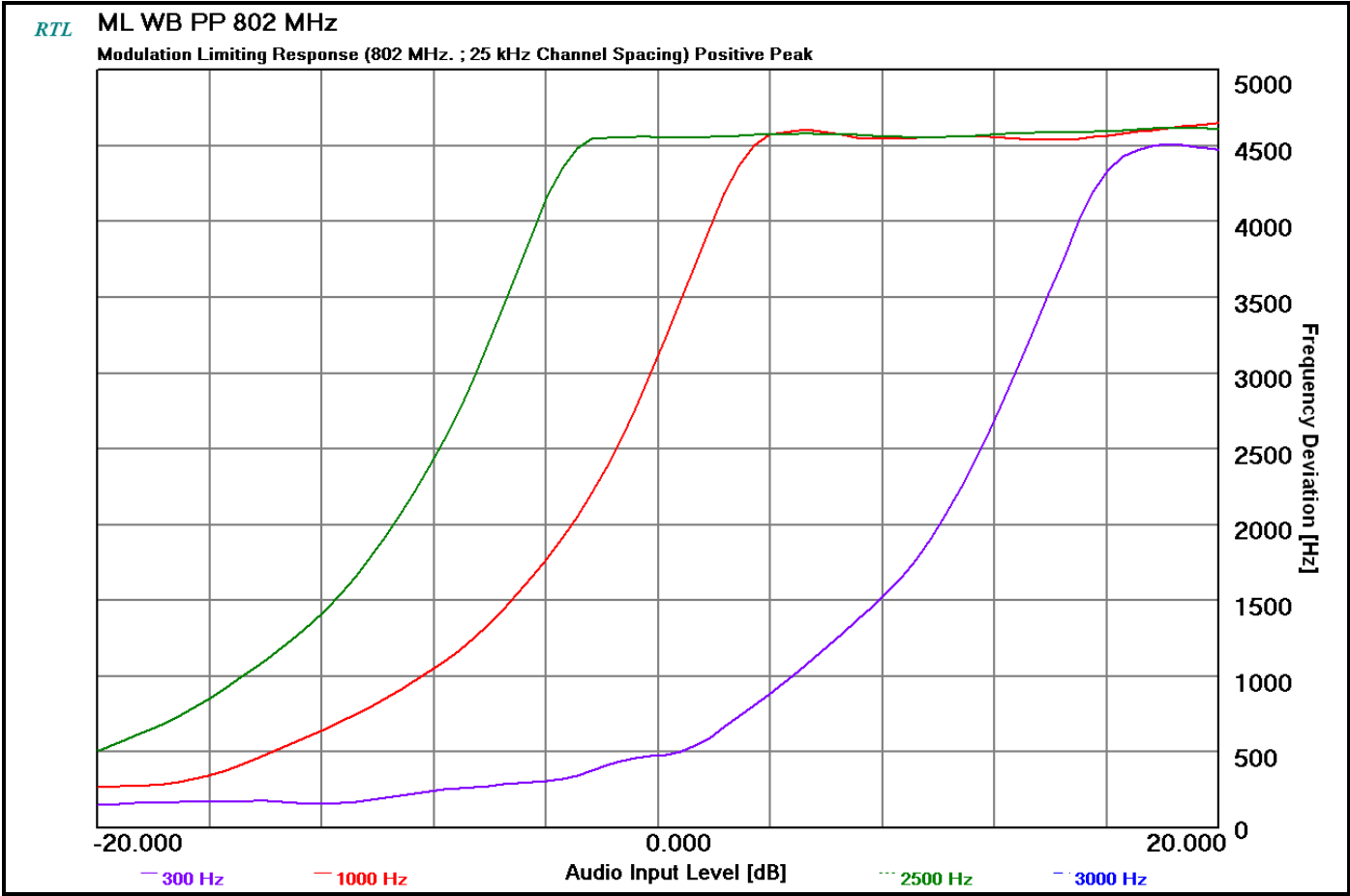
Plot 10-34: Modulation Characteristics – Modulation Limiting – 772.0000 MHz; (WB) Positive Peak



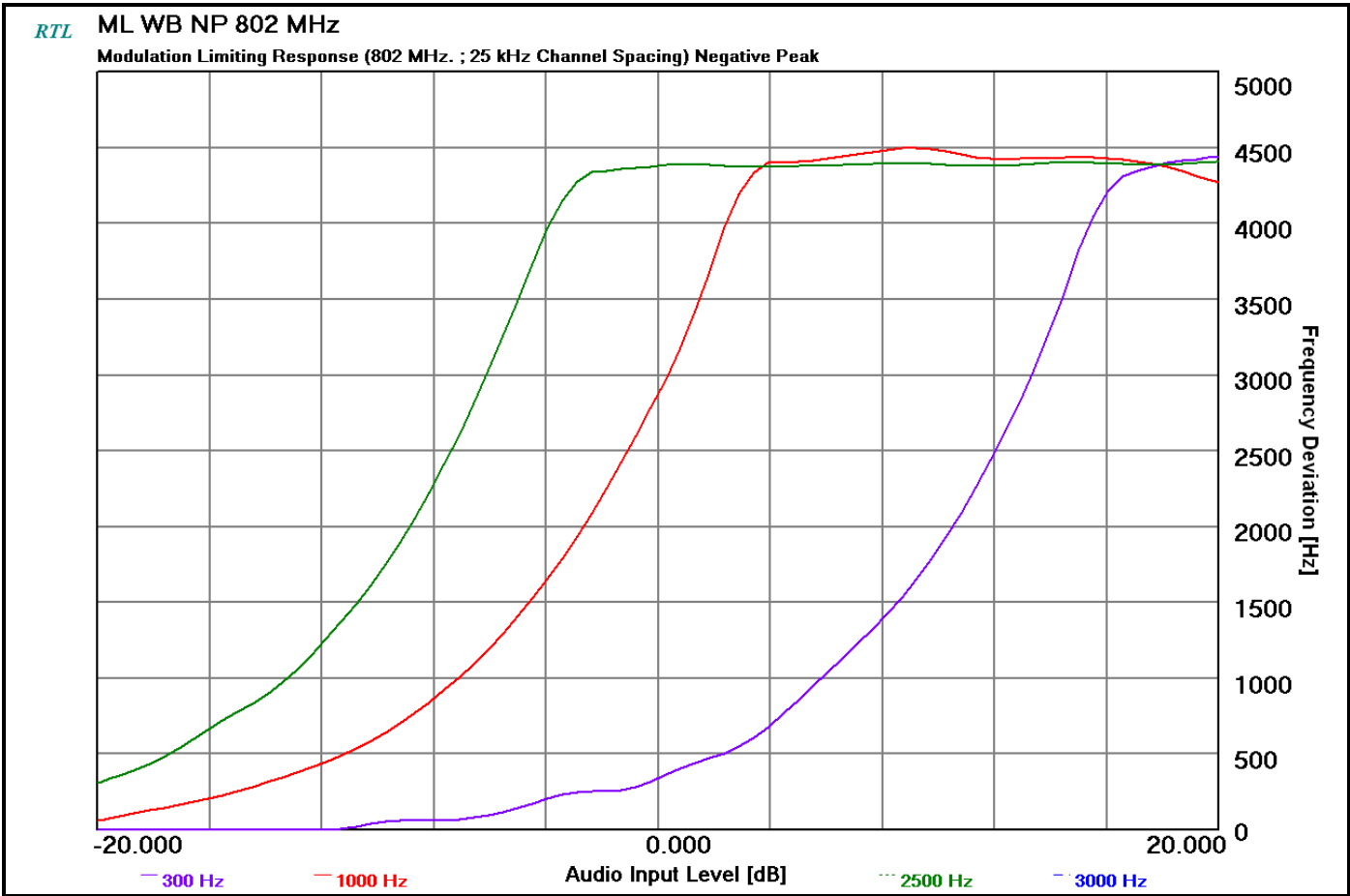
Plot 10-35: Modulation Characteristics – Modulation Limiting – 772.0000 MHz; (WB) Negative Peak



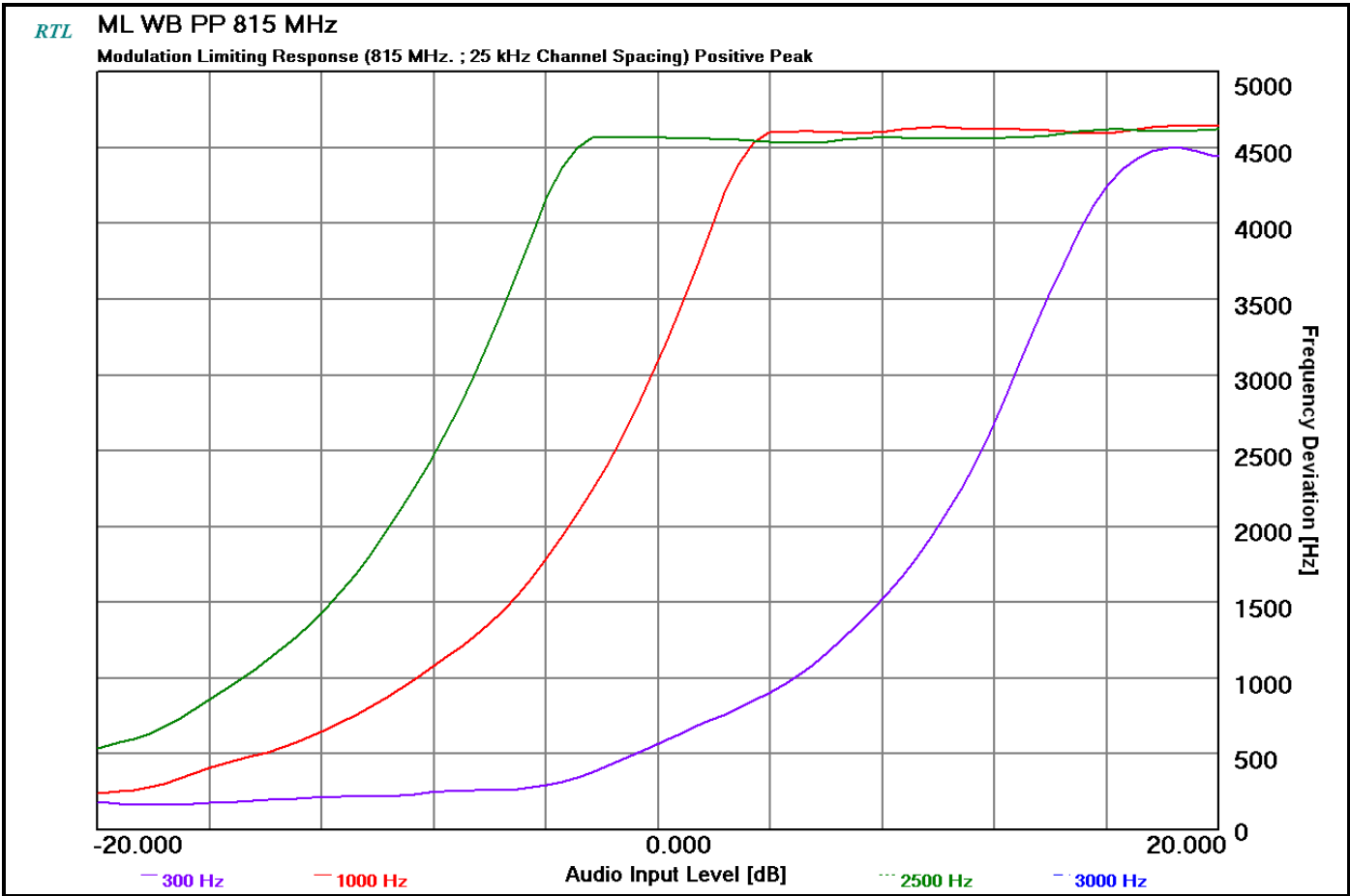
Plot 10-36: Modulation Characteristics – Modulation Limiting – 802.0000 MHz; (WB); Positive Peak



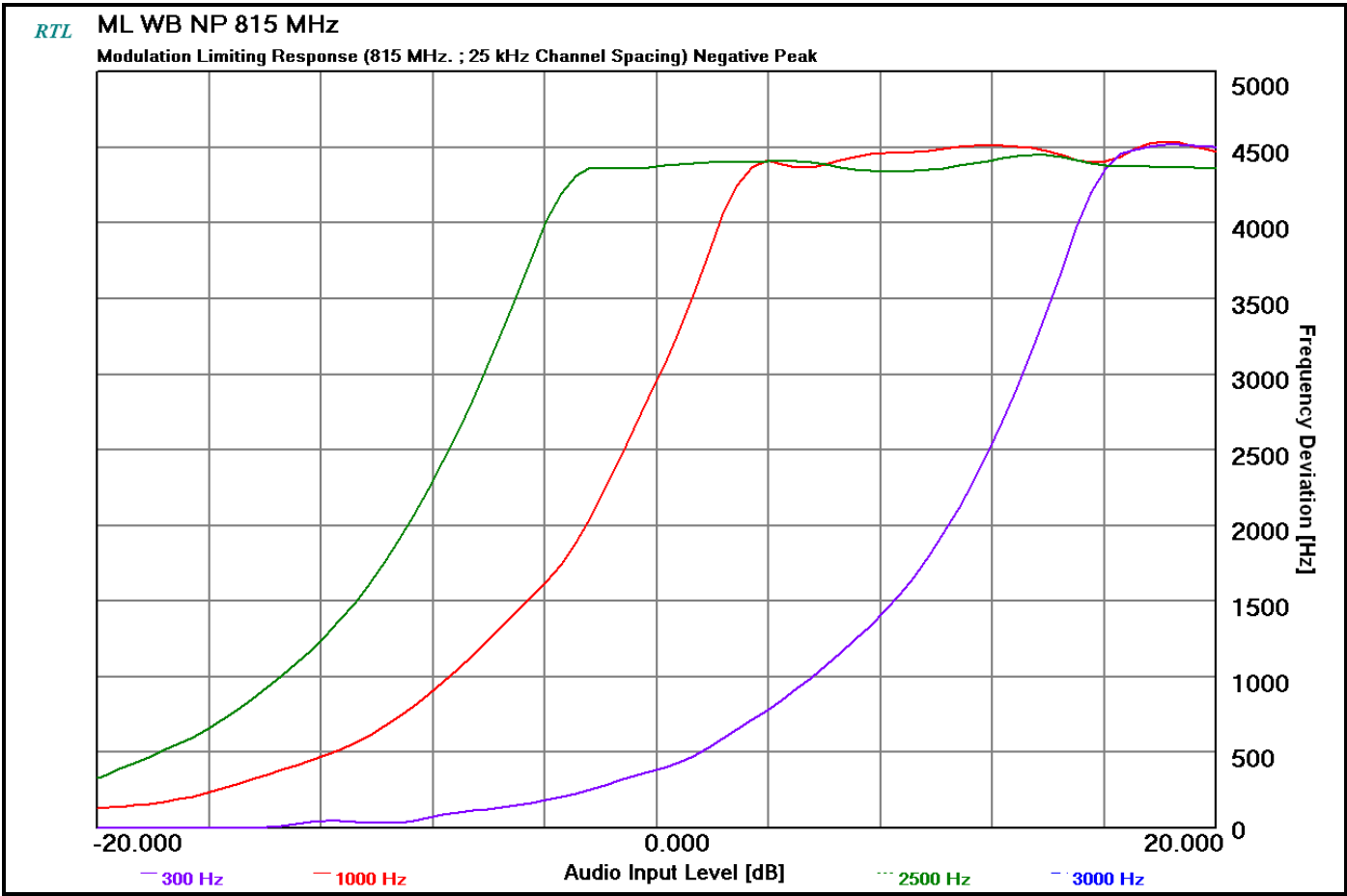
Plot 10-37: Modulation Characteristics – Modulation Limiting - 802.0000 MHz; (WB) Negative Peak



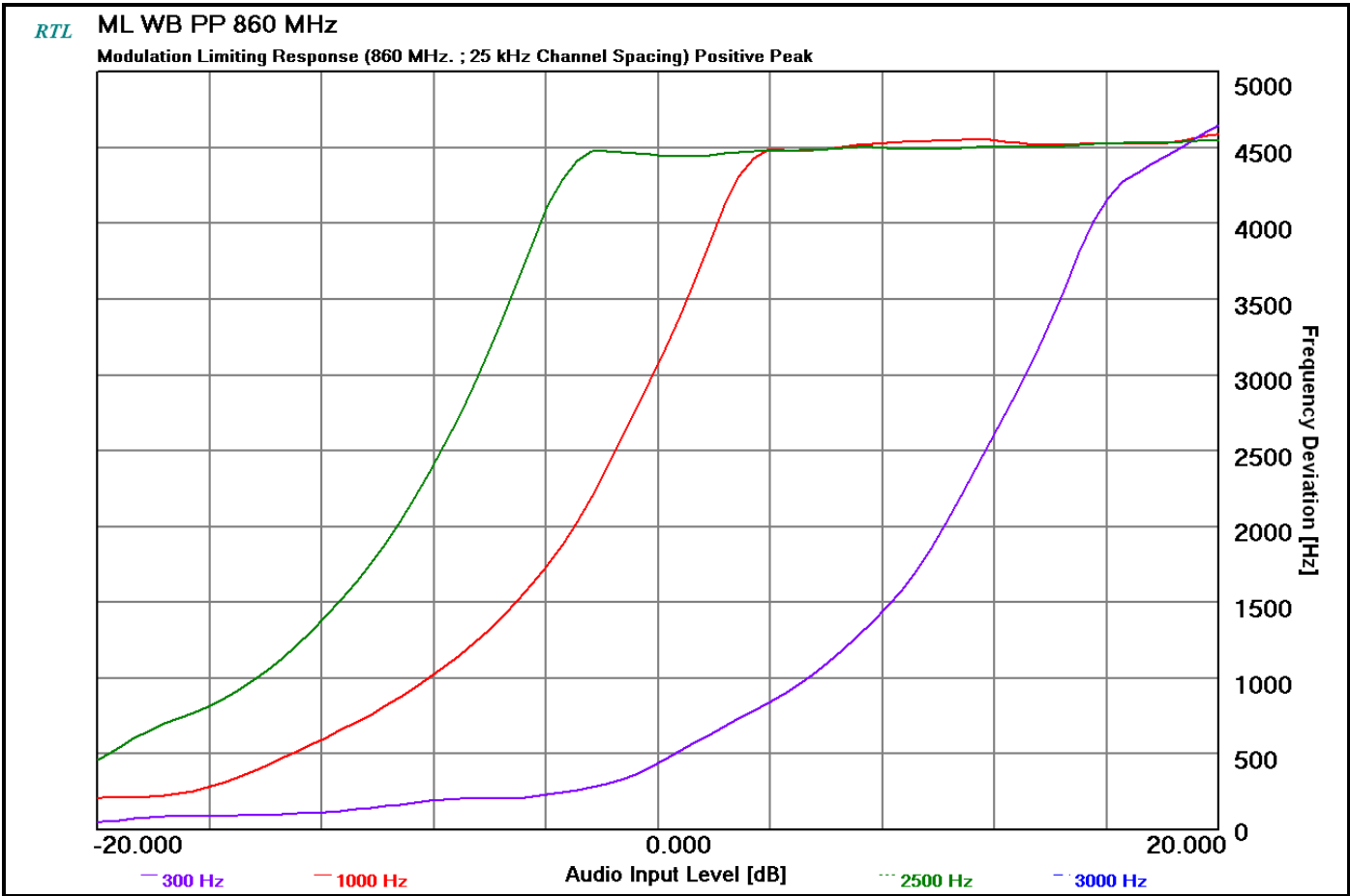
Plot 10-38: Modulation Characteristics – Modulation Limiting – 815.0000 MHz; (WB); Positive Peak



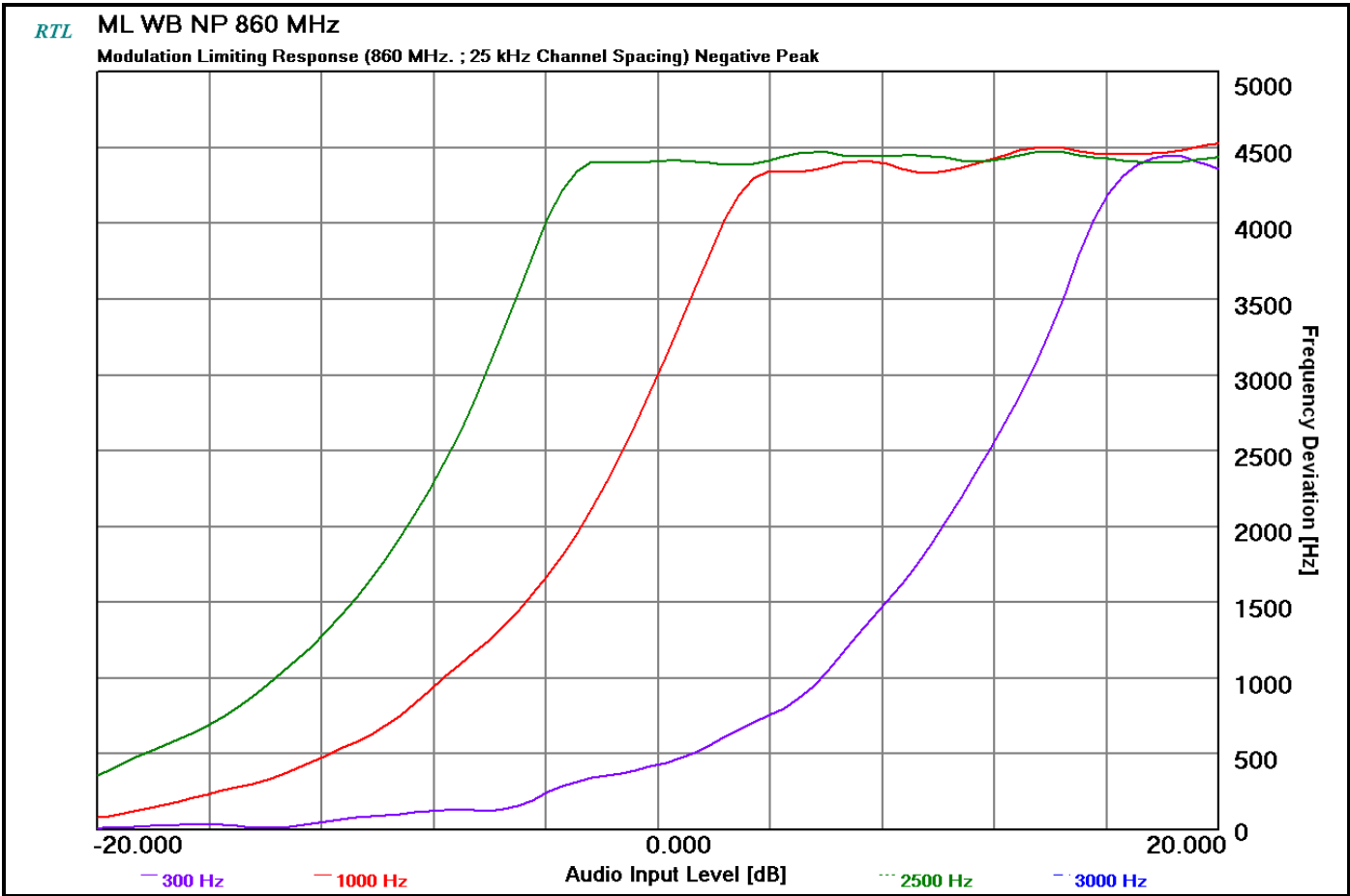
Plot 10-39: Modulation Characteristics – Modulation Limiting – 815.0000 MHz; (WB); Negative Peak



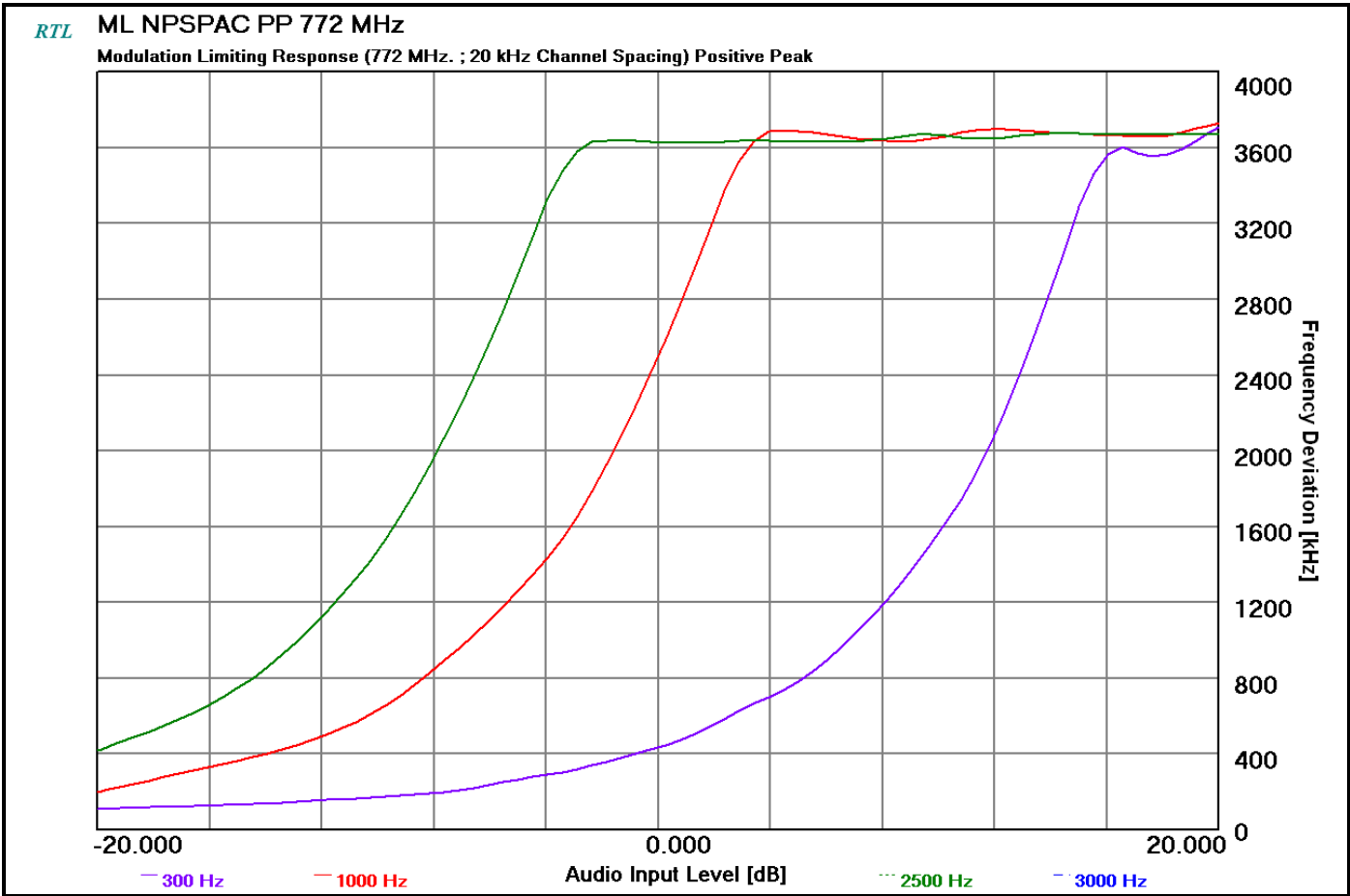
Plot 10-40: Modulation Characteristics – Modulation Limiting – 860.0000 MHz; (WB); Positive Peak



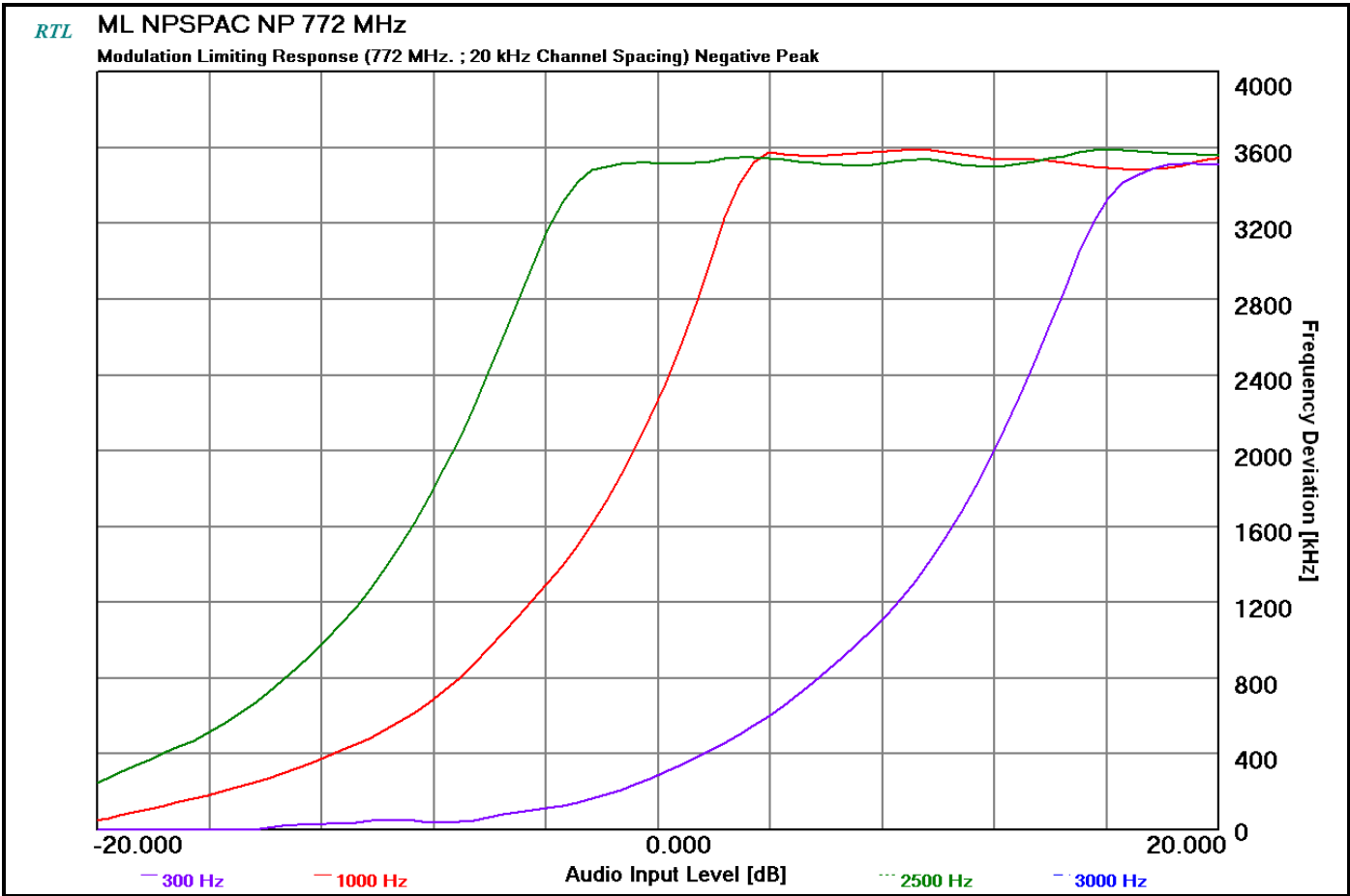
Plot 10-41: Modulation Characteristics – Modulation Limiting – 860.0000 MHz; (WB); Negative Peak



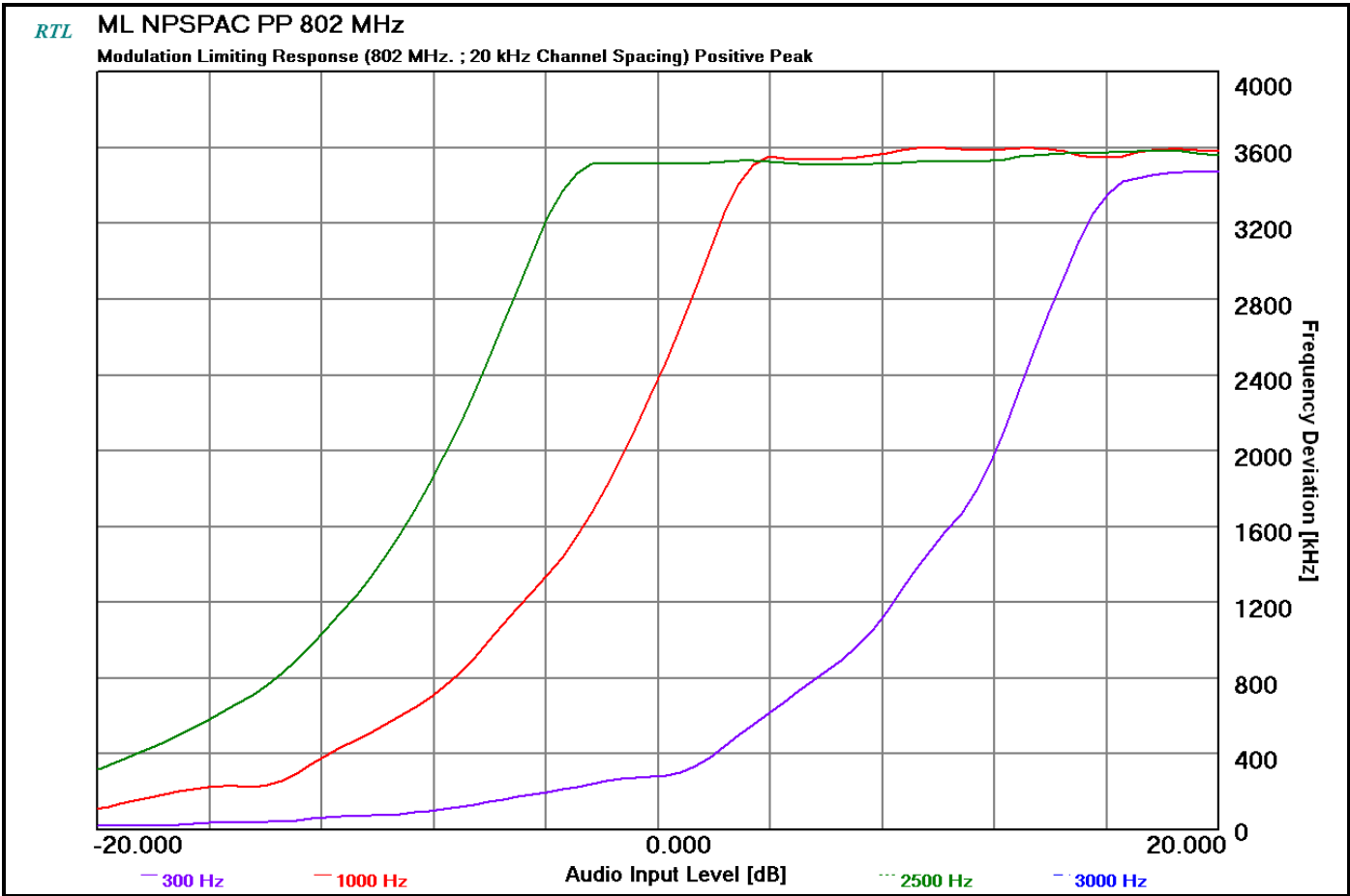
Plot 10-42: Modulation Characteristics – Modulation Limiting – 772.0000 MHz; (NPSPAC) Positive Peak



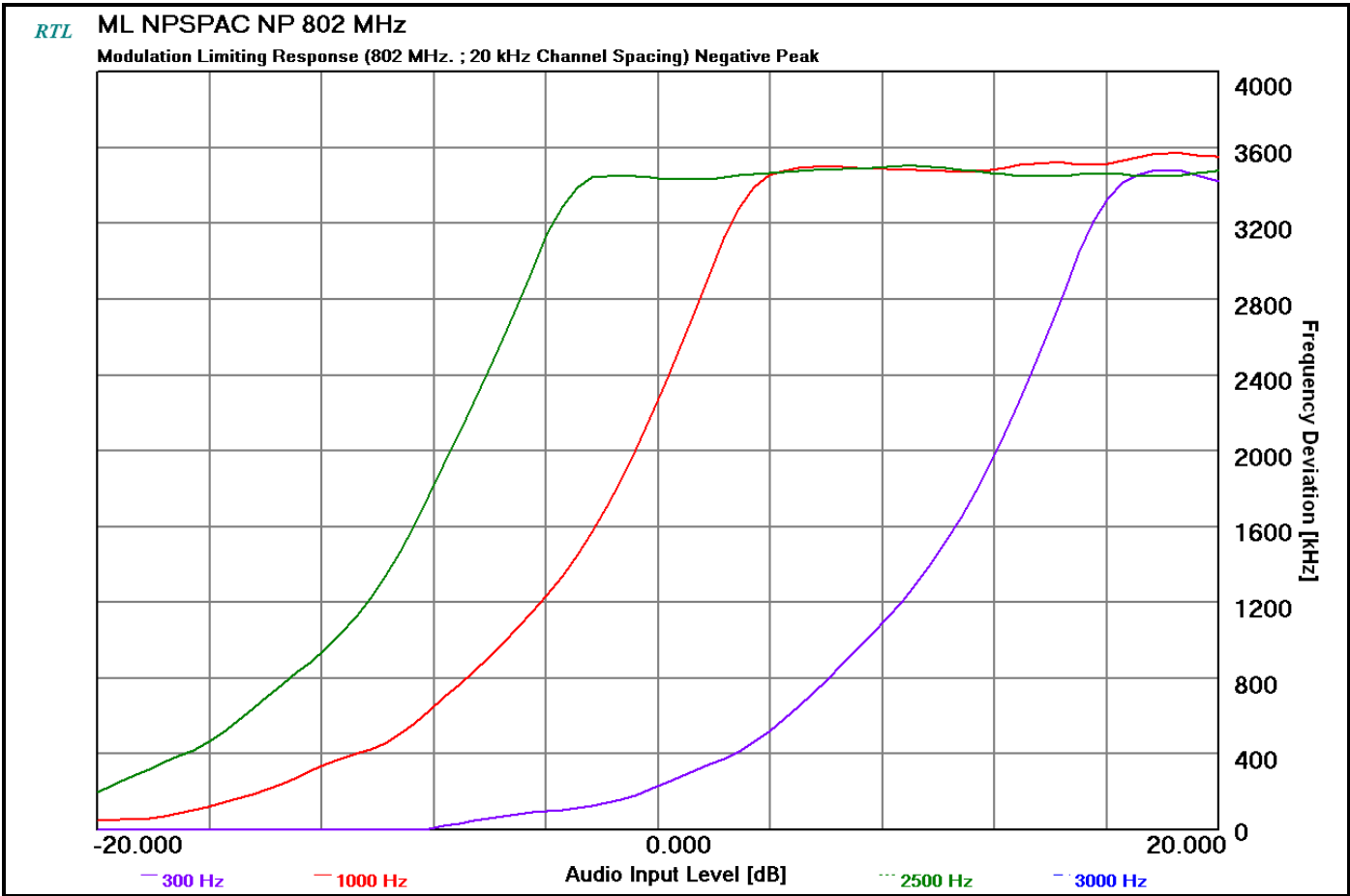
Plot 10-43: Modulation Characteristics – Modulation Limiting – 772.0000 MHz; (NPSPAC) Negative Peak



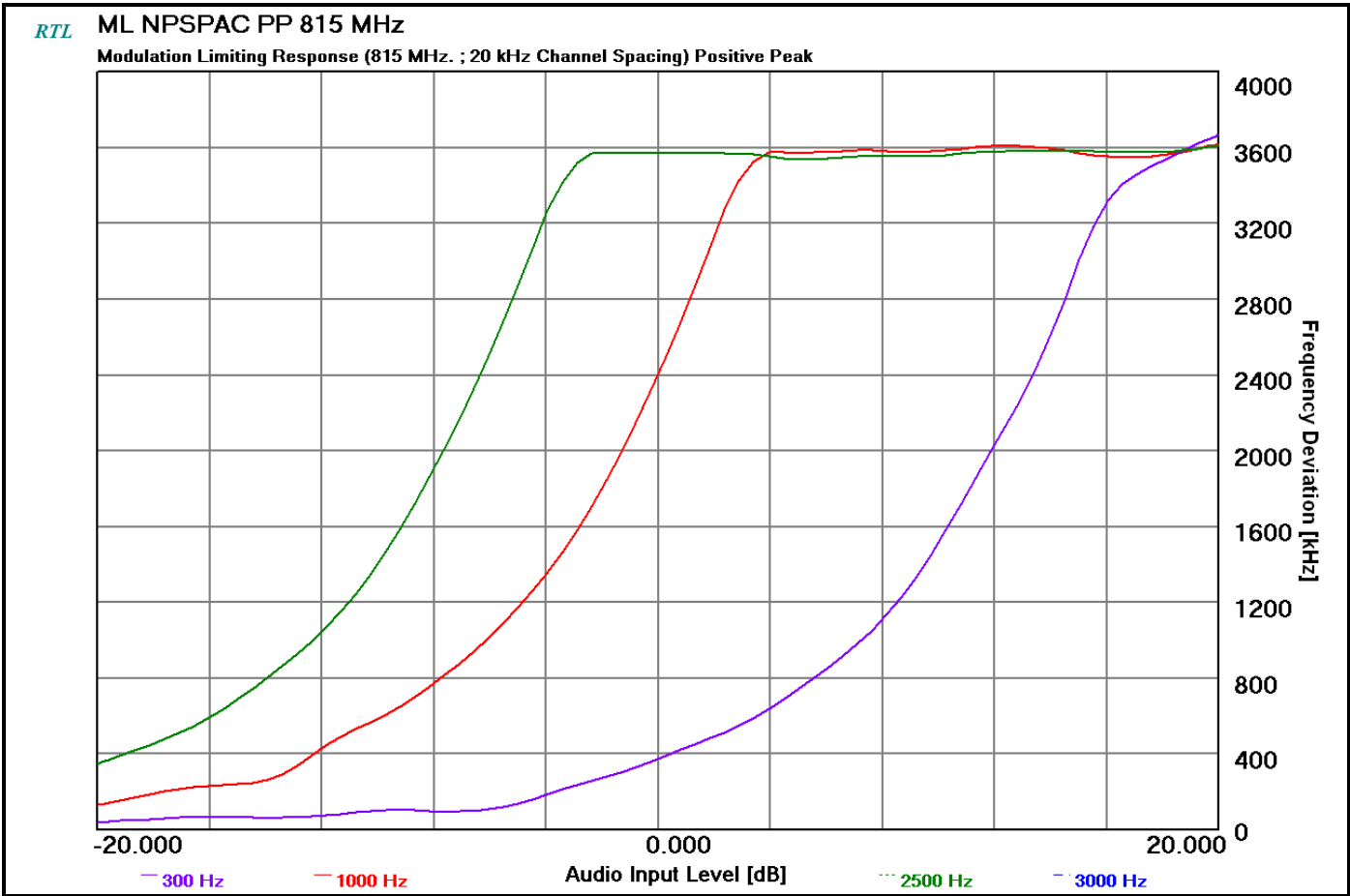
Plot 10-44: Modulation Characteristics – Modulation Limiting – 802.0000 MHz; (NPSPAC); Positive Peak



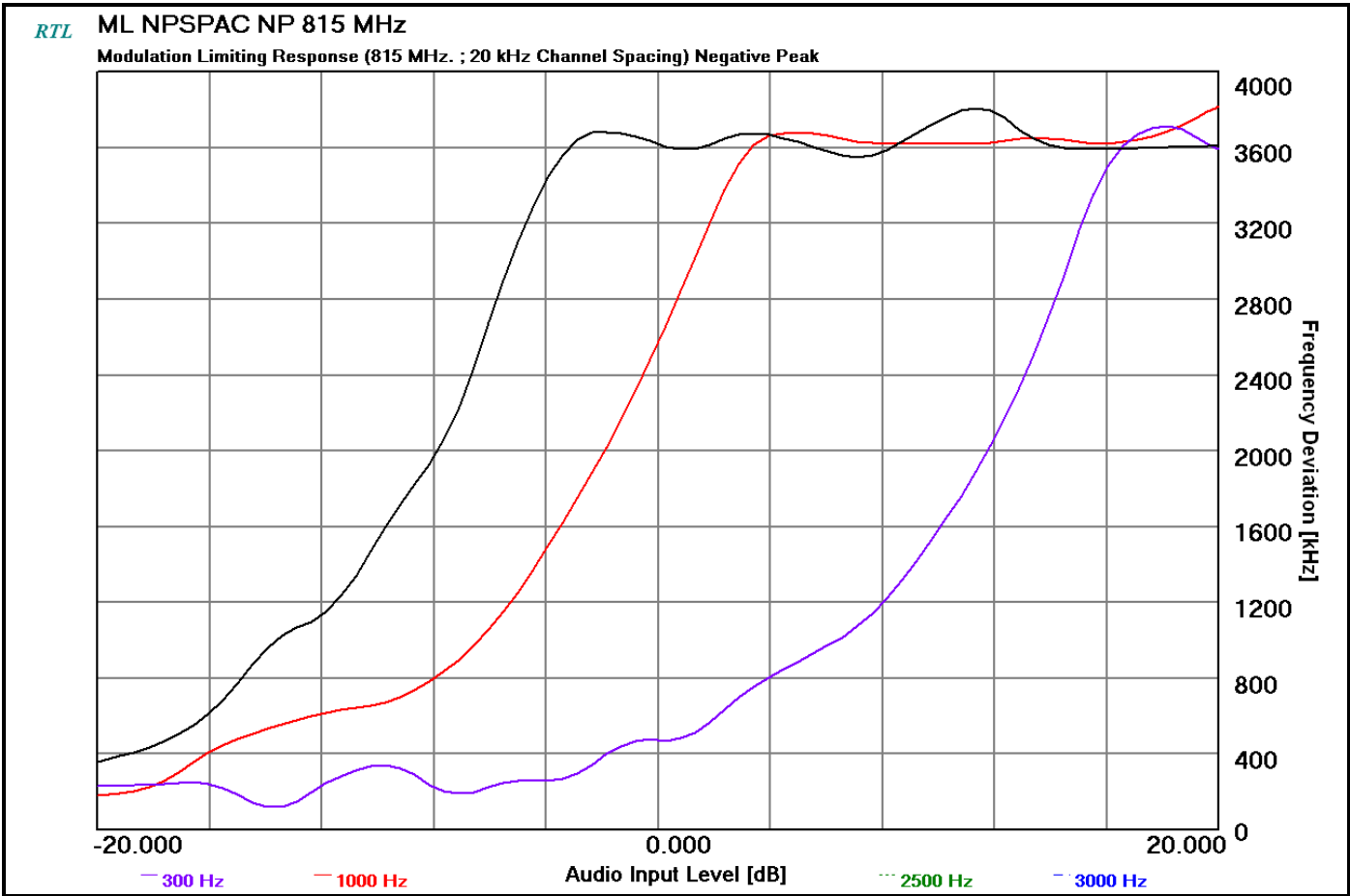
Plot 10-45: Modulation Characteristics – Modulation Limiting - 802.0000 MHz; (NPSPAC) Negative Peak



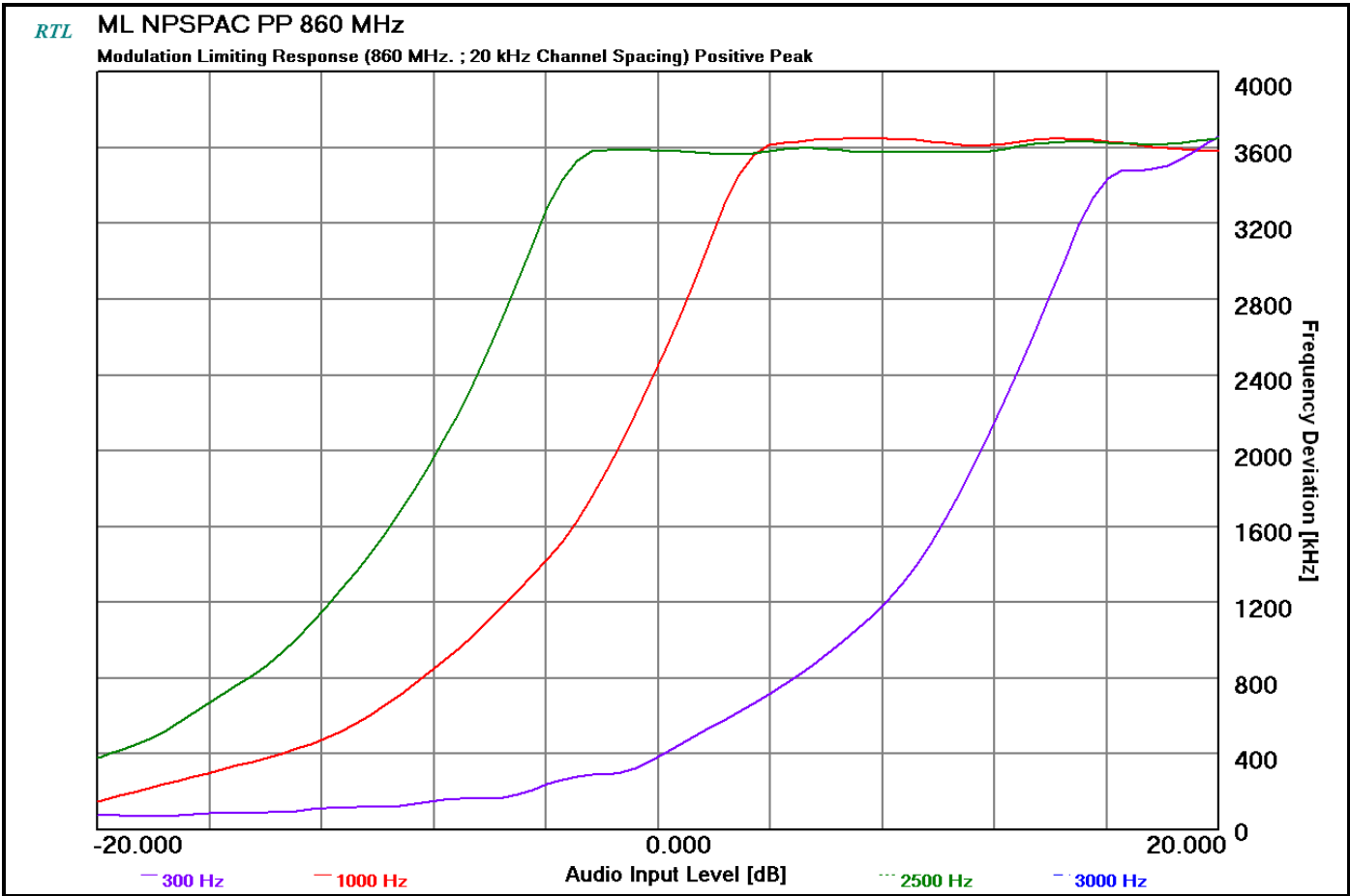
Plot 10-46: Modulation Characteristics – Modulation Limiting – 815.0000 MHz; (NPSPAC); Positive Peak



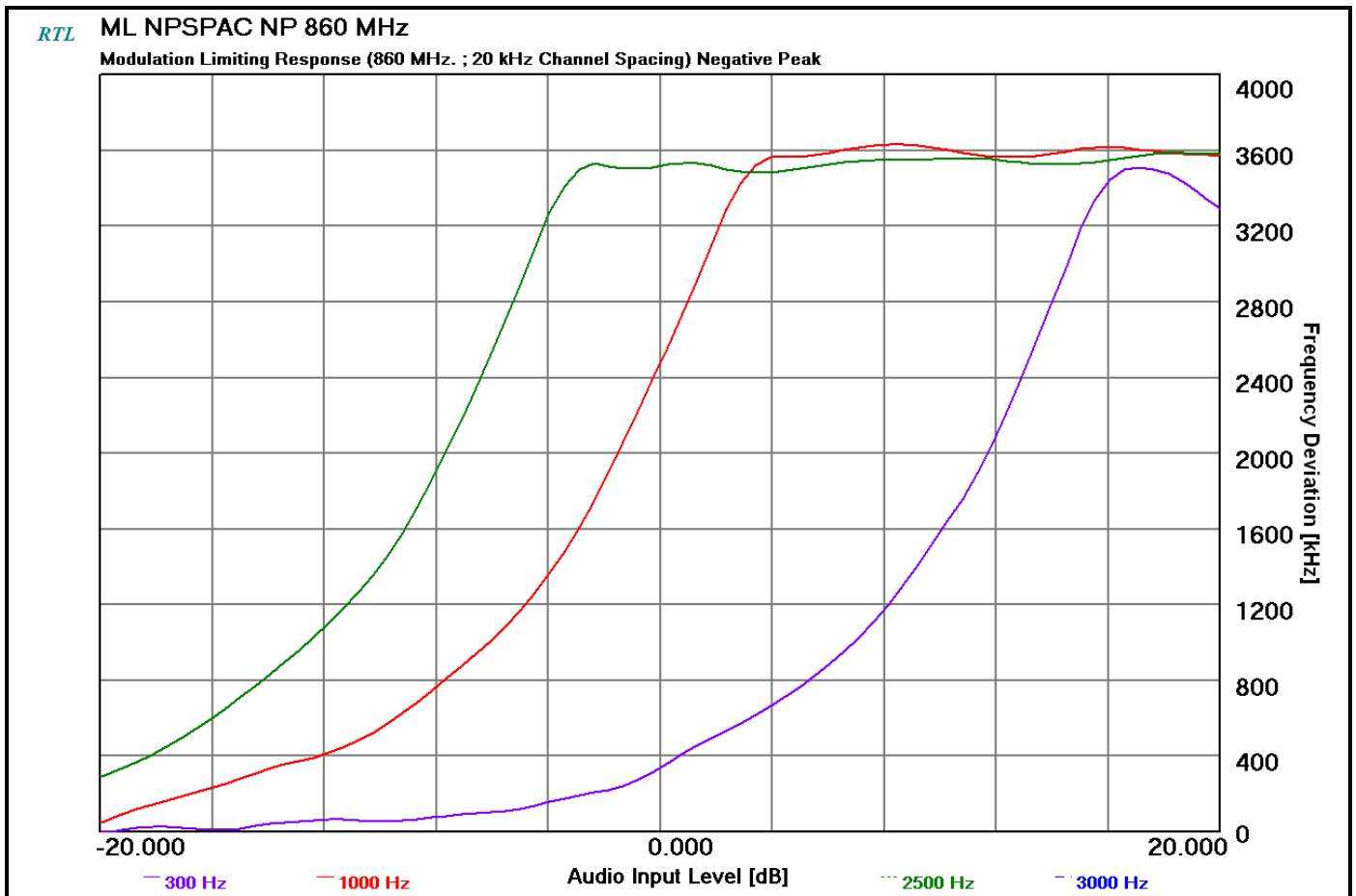
Plot 10-47: Modulation Characteristics – Modulation Limiting – 815.0000 MHz; (NPSPAC); Negative Peak



Plot 10-48: Modulation Characteristics – Modulation Limiting – 860.0000 MHz; (NPSPAC); Positive Peak



Plot 10-49: Modulation Characteristics – Modulation Limiting – 860.0000 MHz; (NPSPAC); 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 10-2: Test Equipment Used For Testing Modulation Requirements

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901760	Hewlett Packard	3336B	Synthesizer/ Level Generator	2514A02585	03/28/2027
901118	Hewlett Packard	8901A Opt. 002-003	Modulation Analyzer	2406A00178	11/03/2027
901337	Narda Microline	766-10	Attenuator (DC-4GHz, 10 dB, 20W)	6242	02/21/2026
901759	Hewlett Packard	3586B	Selective Level Meter	2510A03886	04/04/2027

Test Personnel:

Daniel W. Baltzell
 EMC Test Engineer

Daniel W. Baltzell

Signature

February 15, 2025
 Date of Test

11 FCC Rules and Regulations Part 90.214: Transient Frequency Response; Part 74.462(c): Authorized Bandwidth and Emissions

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.

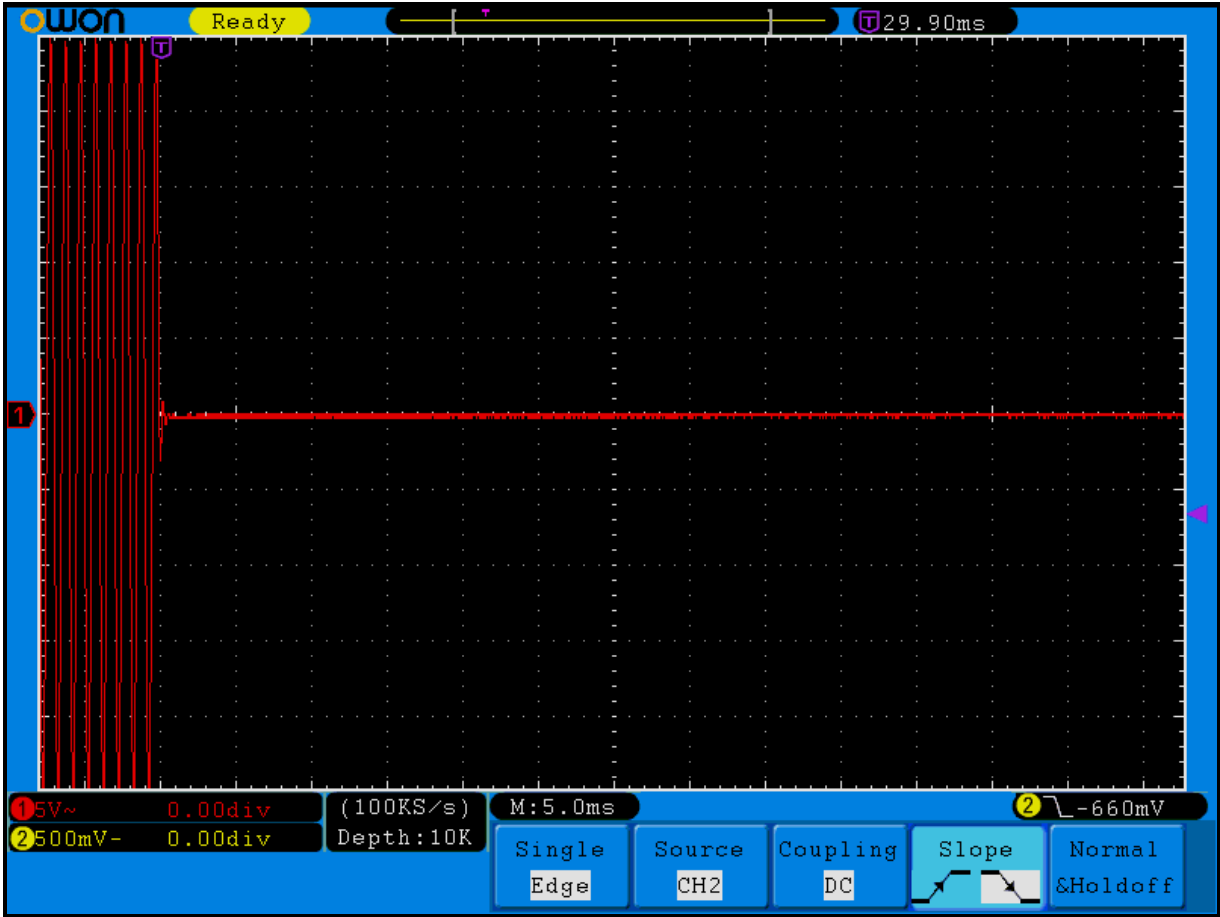
18%, 75.1°, 30.58"

11.2 Test Data

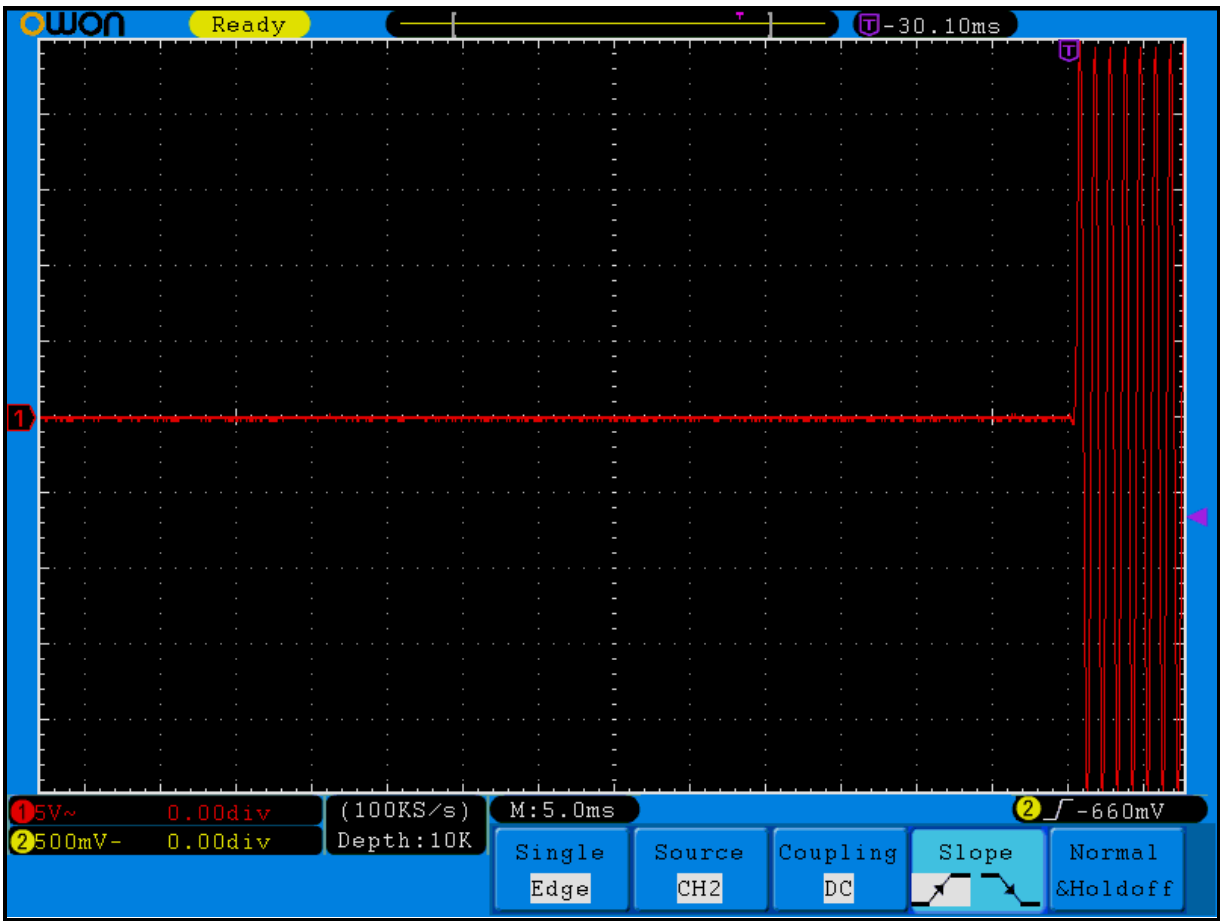
Table 11-1: Environmental Conditions

Date	Temperature (°C)	Humidity (%)	Atmospheric Pressure (kPa)
02/14/2025	23.9	18	103.6

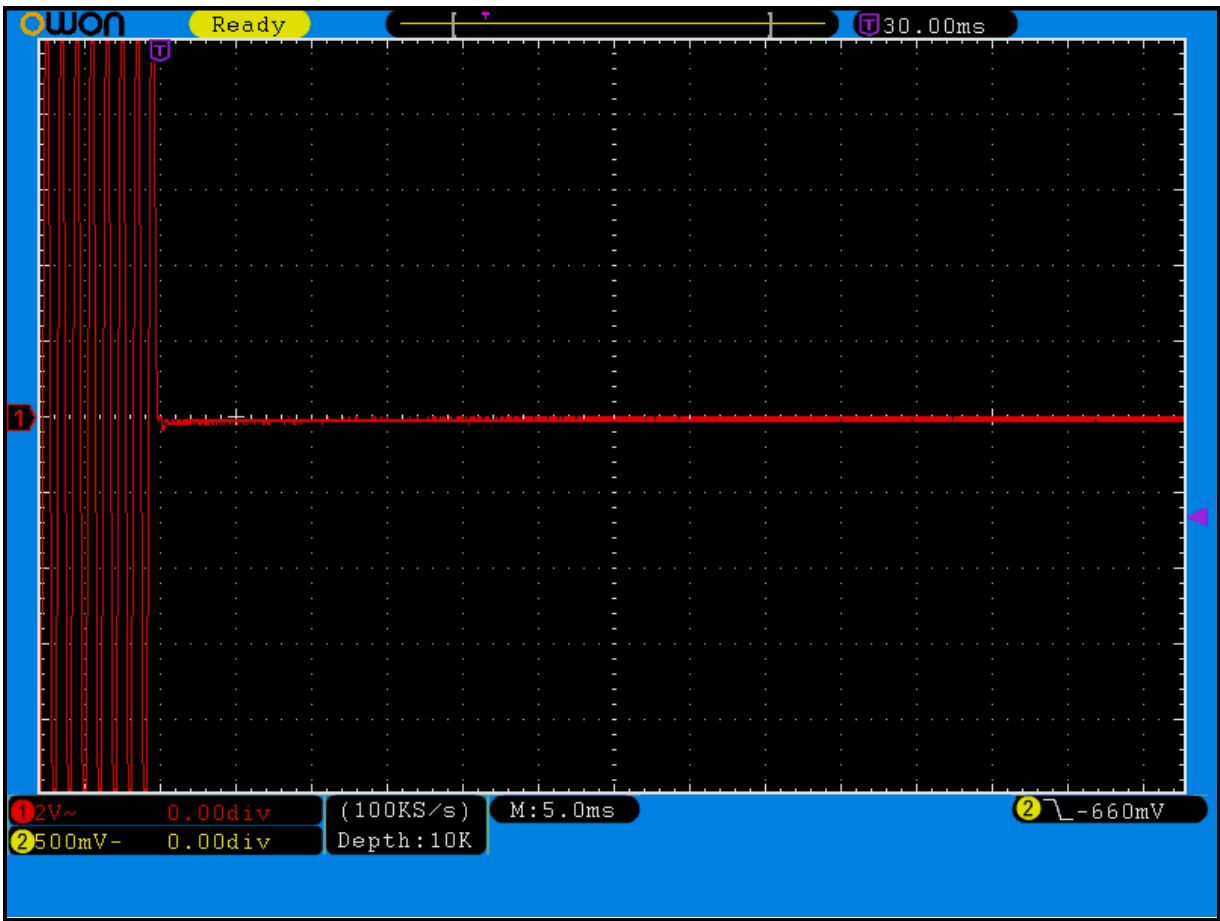
Plot 11-1: Transient Frequency Behavior – 156.8000 MHz; Wide Band; Carrier ON Time



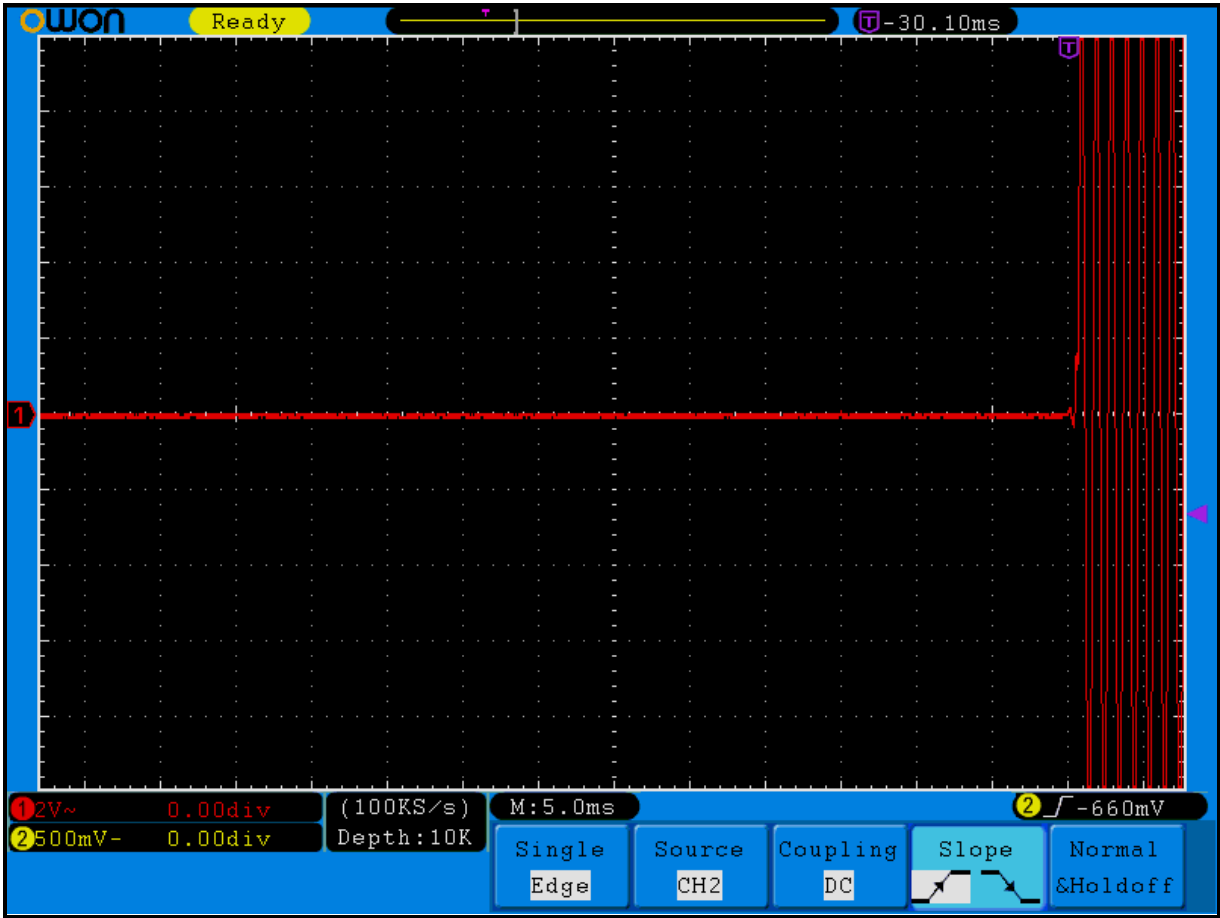
Plot 11-2: Transient Frequency Behavior – 156.8000 MHz; Wide Band; Carrier OFF Time



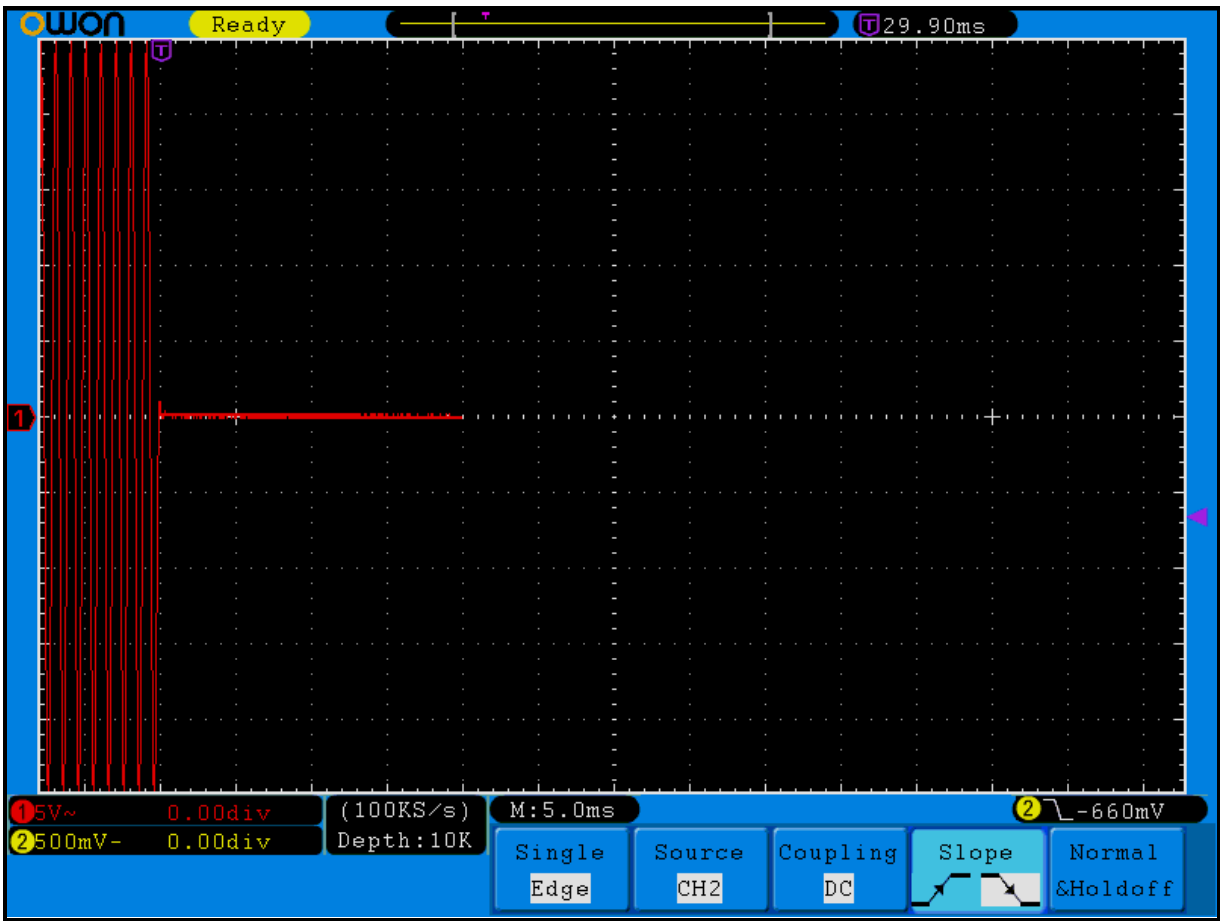
Plot 11-3: Transient Frequency Behavior – 156.8000 MHz; Narrow Band; Carrier ON Time



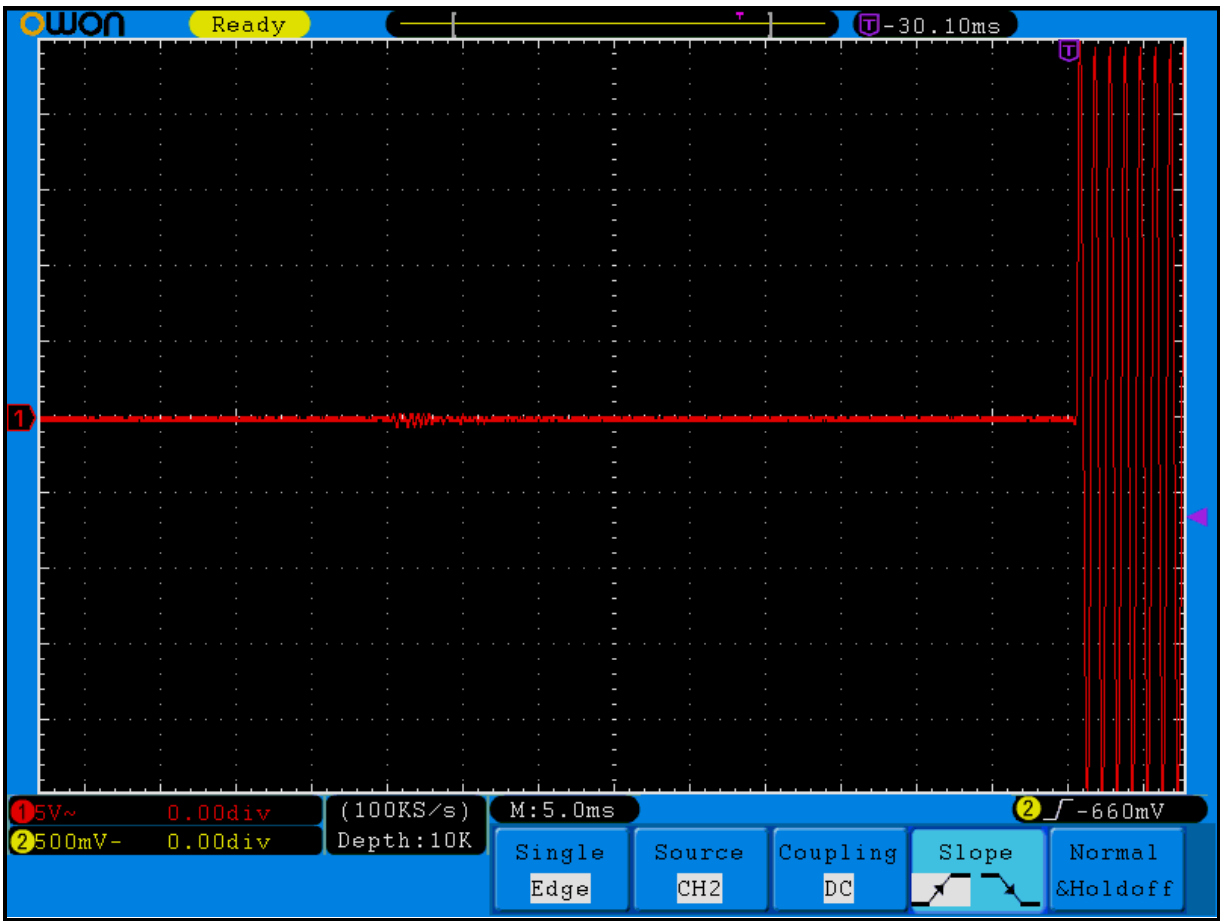
Plot 11-4: Transient Frequency Behavior – 156.8000 MHz; Narrow Band; Carrier OFF Time



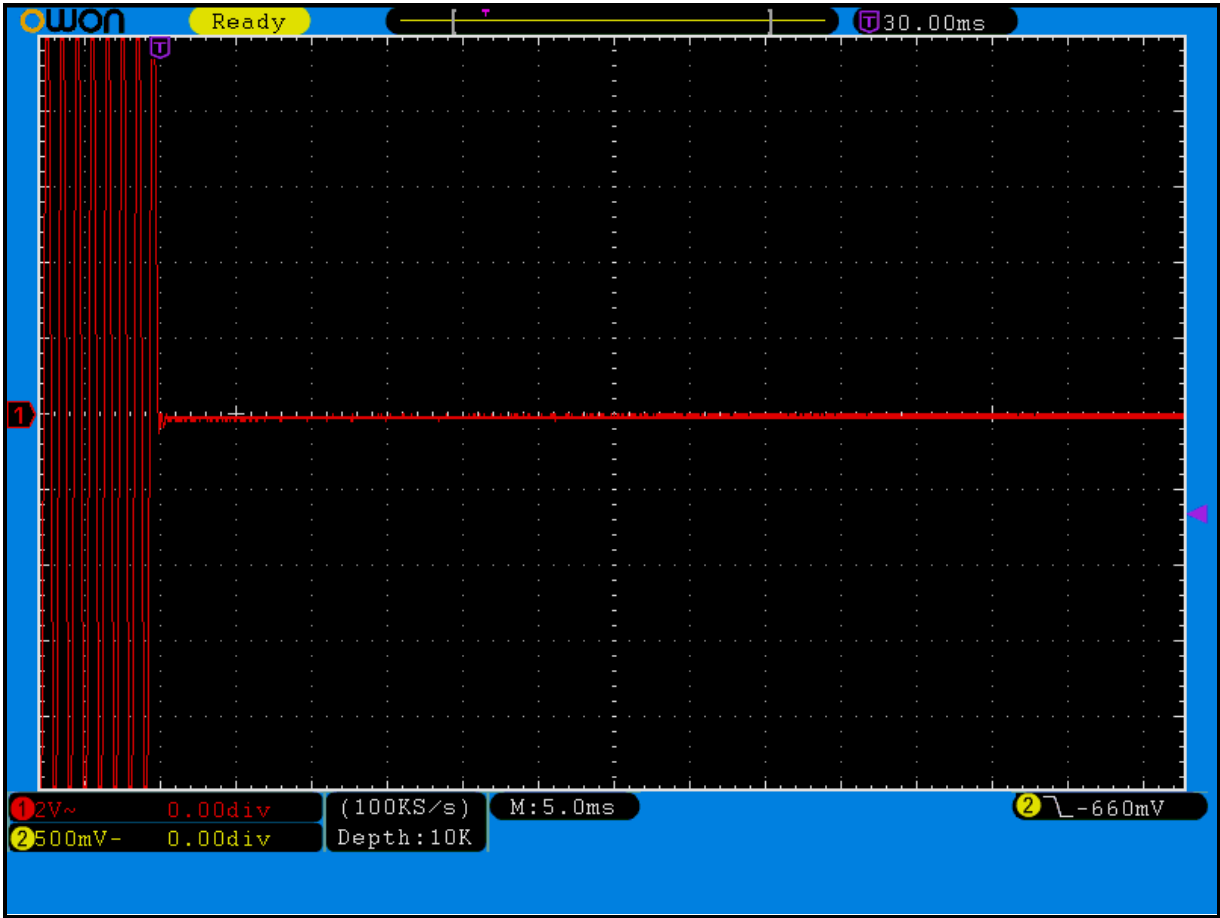
Plot 11-5: Transient Frequency Behavior – 173.9875 MHz; Wide Band; Carrier ON Time



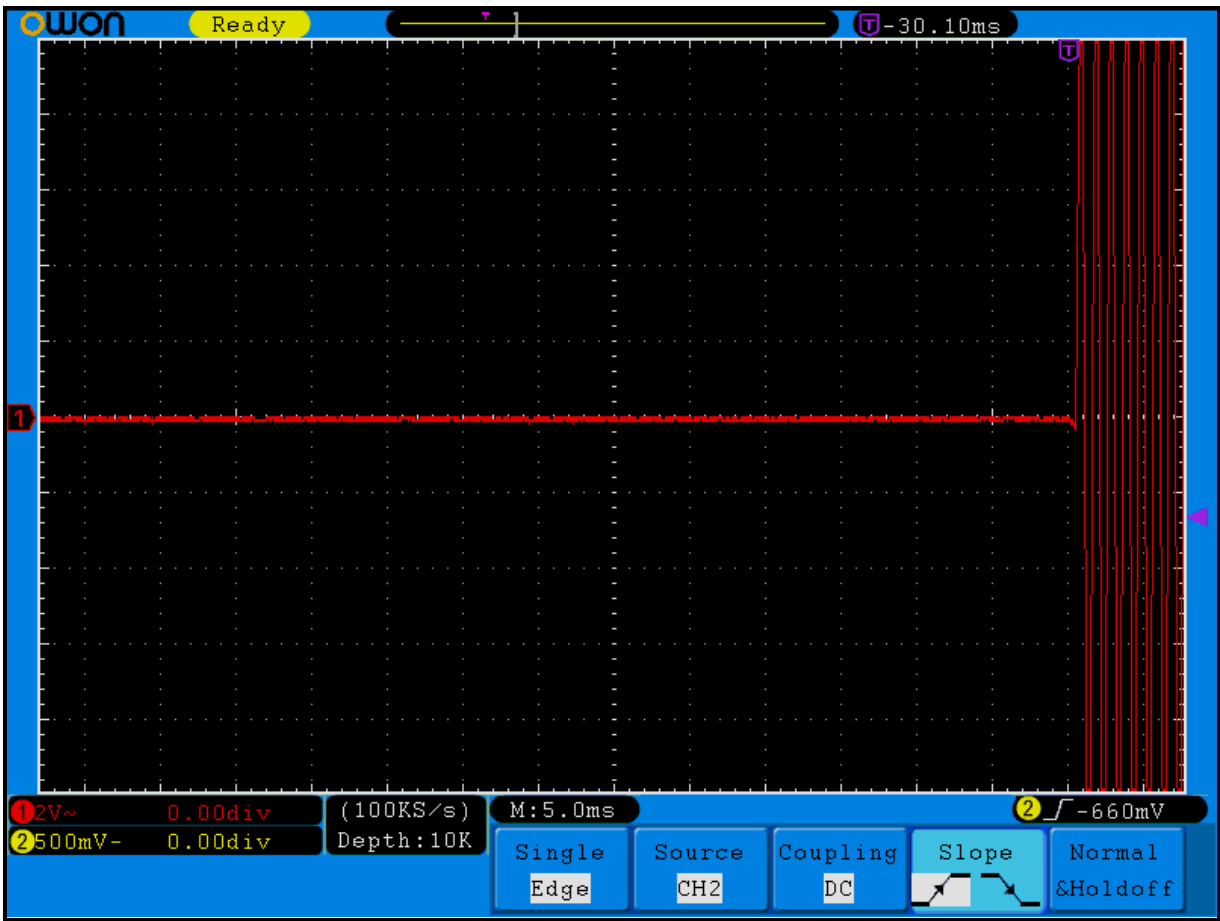
Plot 11-6: Transient Frequency Behavior – 173.9875 MHz; Wide Band; Carrier OFF Time



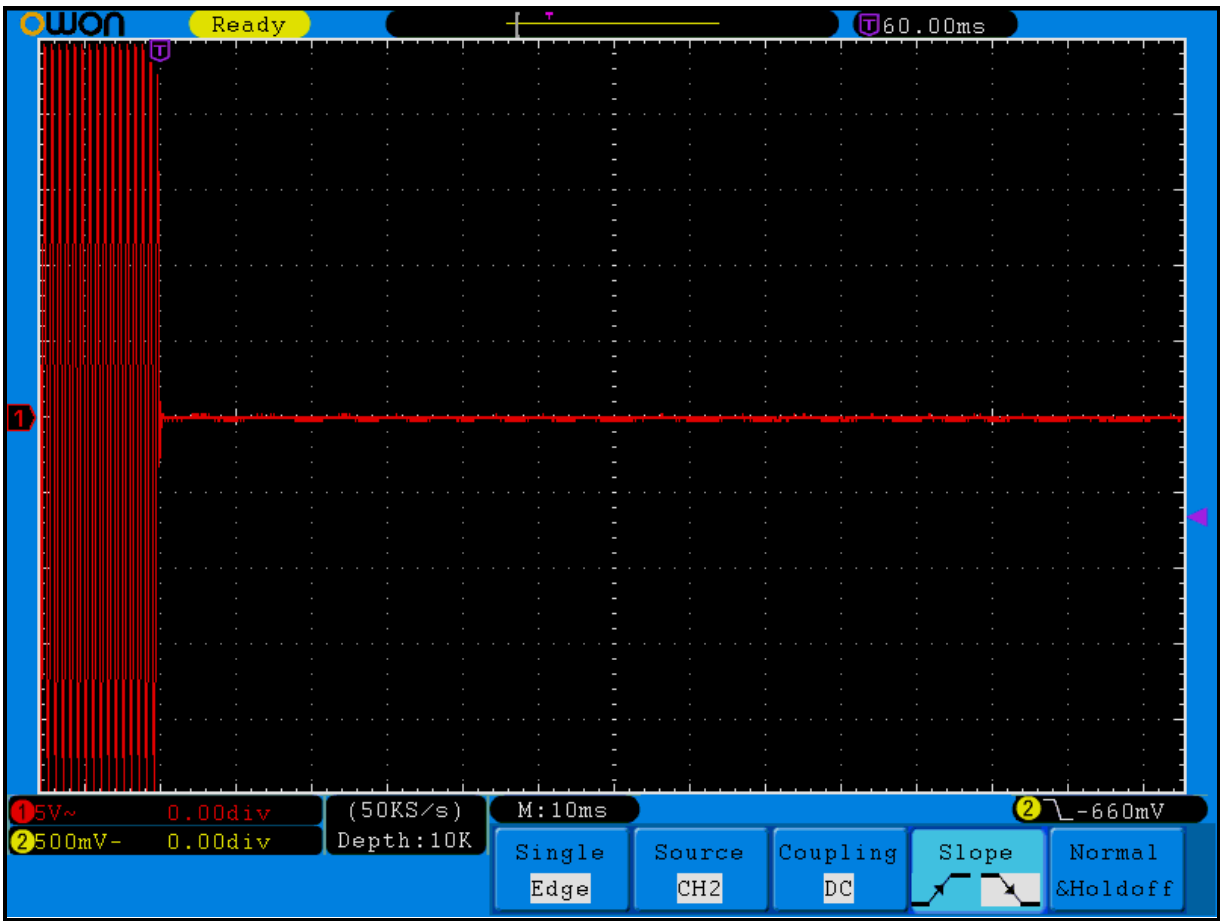
Plot 11-7: Transient Frequency Behavior – 173.9875 MHz; Narrow Band; Carrier ON Time



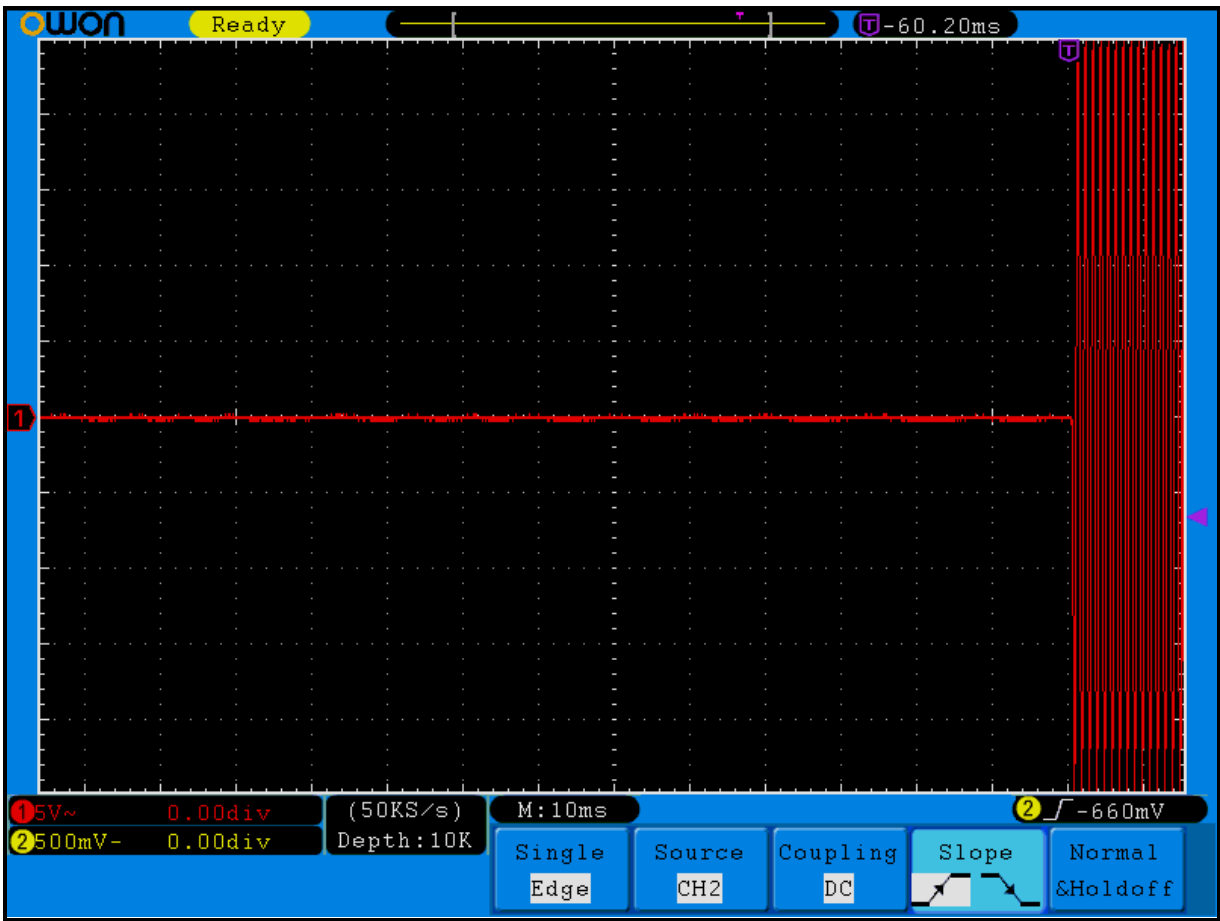
Plot 11-8: Transient Frequency Behavior – 173.9875 MHz; Narrow Band; Carrier OFF Time



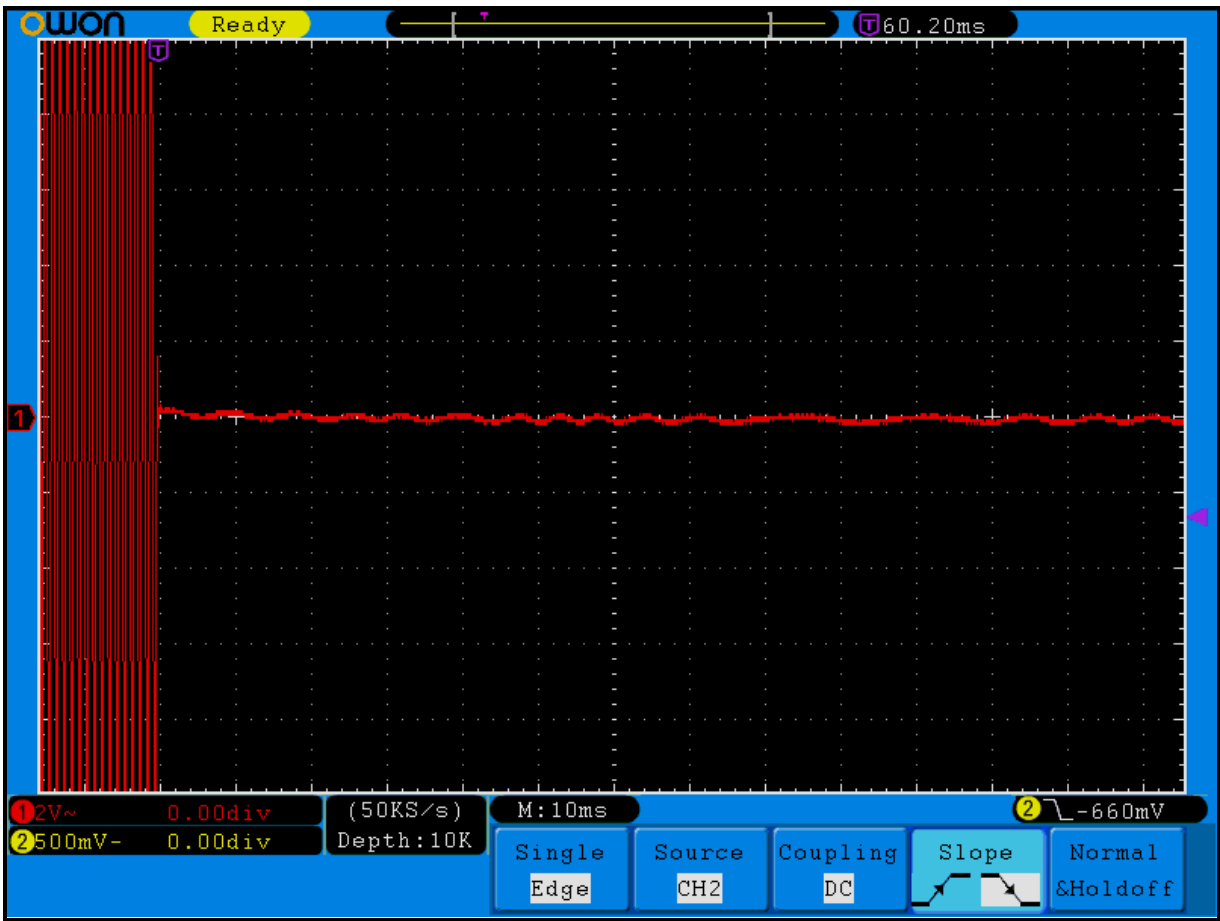
Plot 11-9: Transient Frequency Behavior – 464.0000 MHz; Wide Band; Carrier ON Time



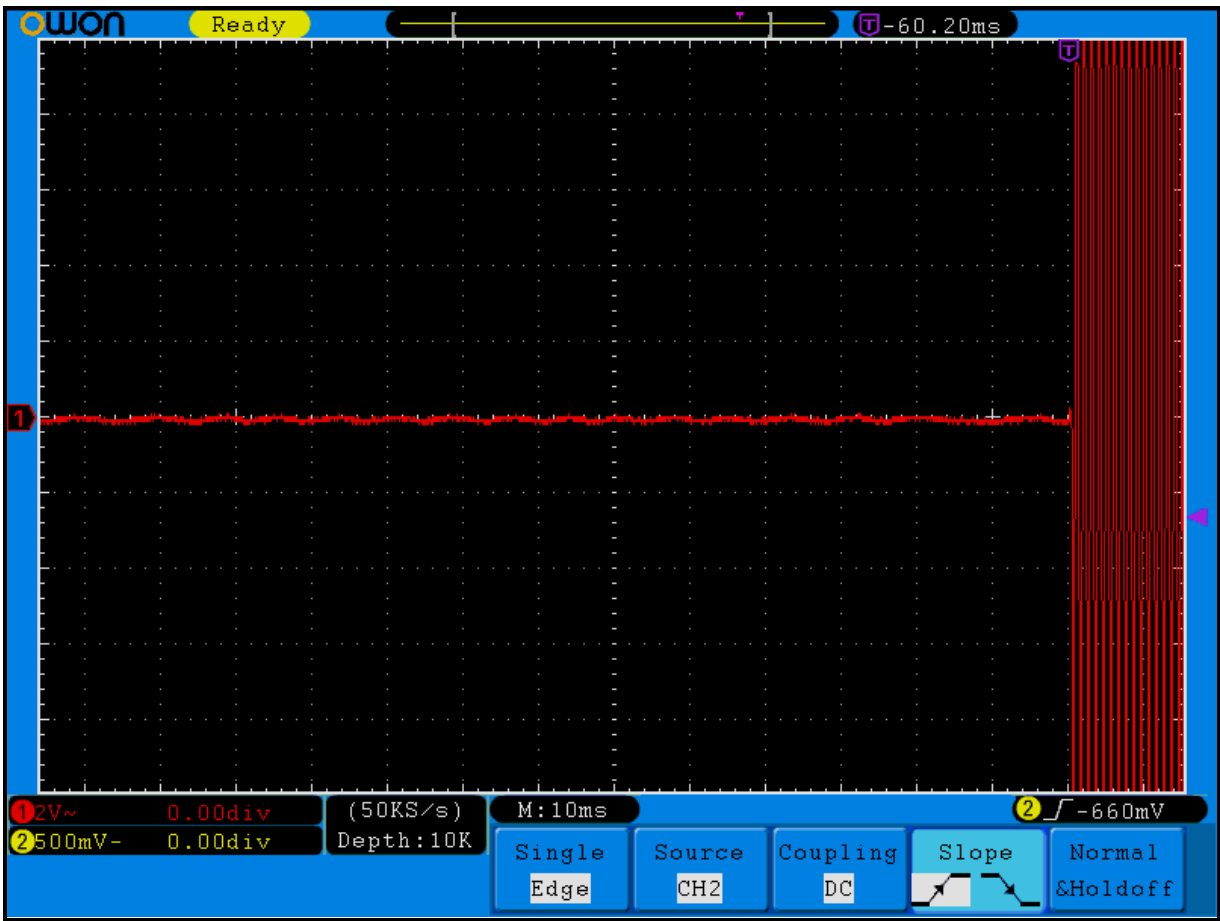
Plot 11-10: Transient Frequency Behavior – 464.0000 MHz; Wide Band; Carrier OFF Time



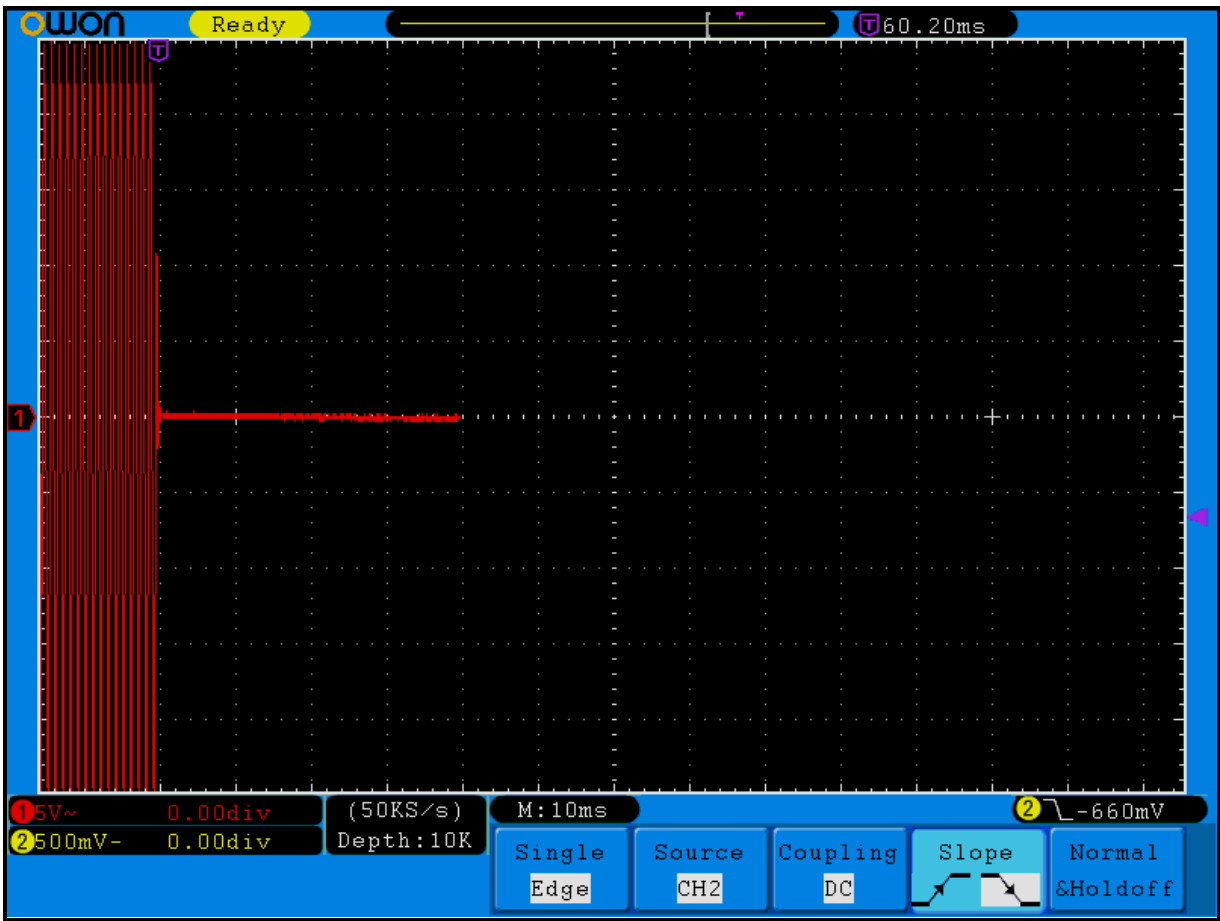
Plot 11-11: Transient Frequency Behavior – 464.0000 MHz; Narrow Band; Carrier ON Time



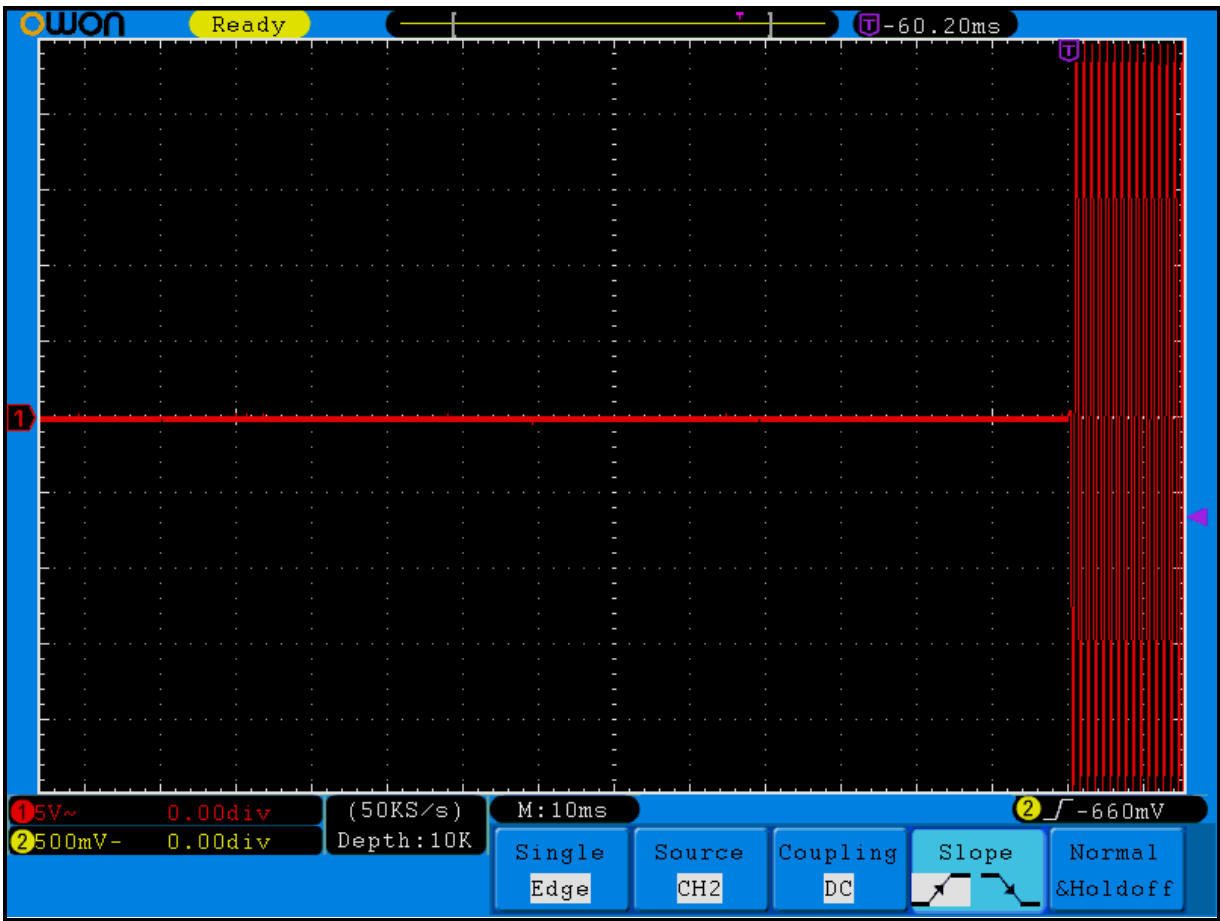
Plot 11-12: Transient Frequency Behavior – 464.0000 MHz; Narrow Band; Carrier OFF Time



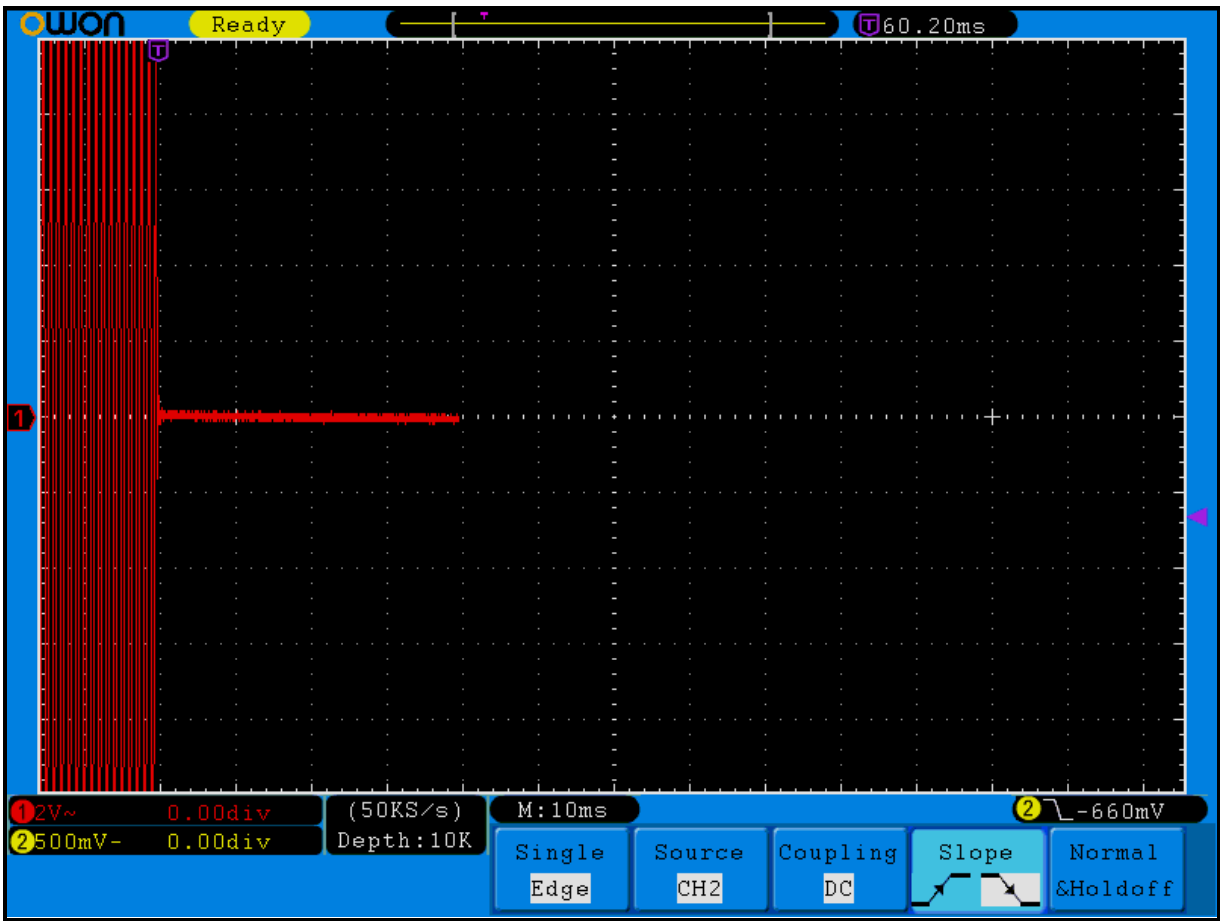
Plot 11-13: Transient Frequency Behavior – 521.9875 MHz; Wide Band; Carrier ON Time



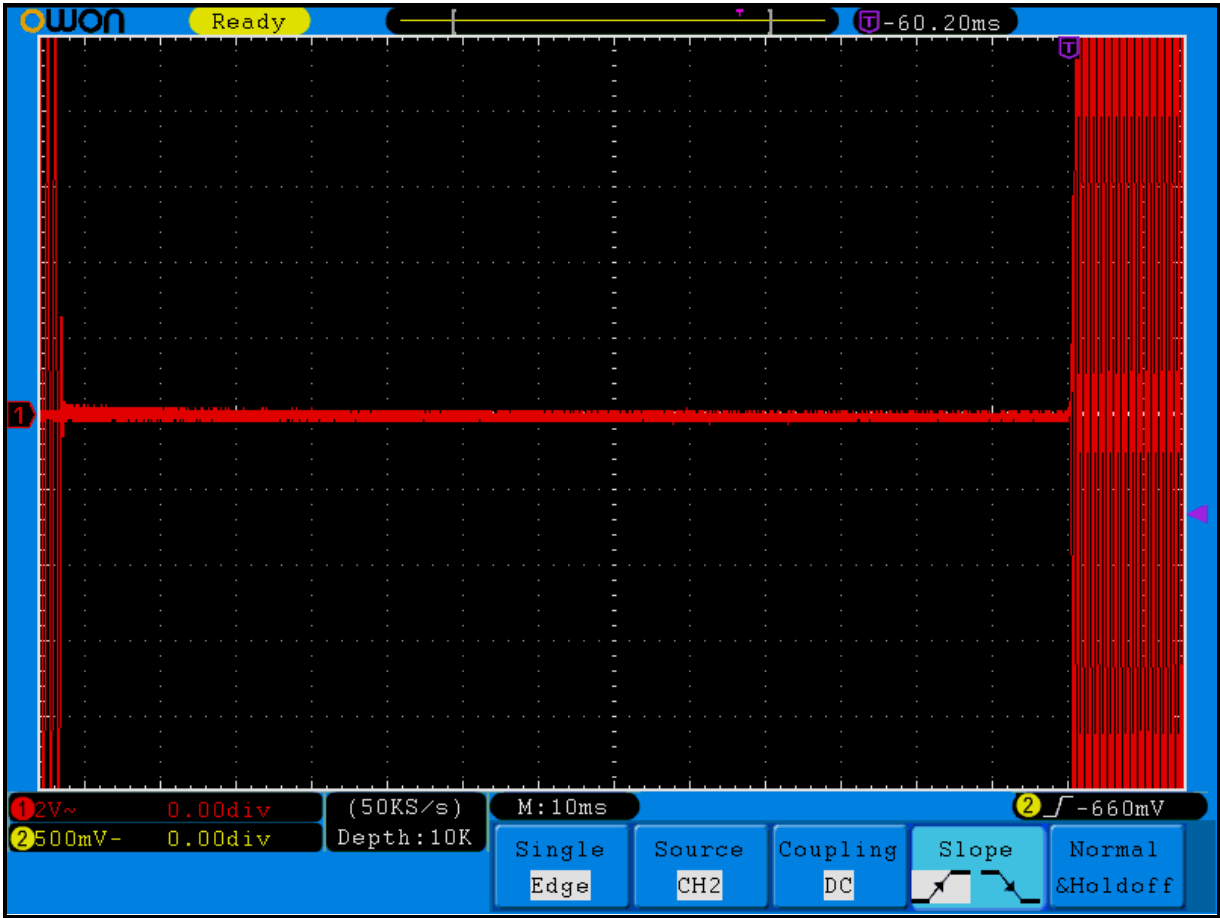
Plot 11-14: Transient Frequency Behavior – 521.9875 MHz; Wide Band; Carrier OFF Time



Plot 11-15: Transient Frequency Behavior – 521.9875 MHz; Narrow Band; Carrier ON Time



Plot 11-16: Transient Frequency Behavior – 521.9875 MHz; Narrow Band; Carrier OFF Time



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

Results: Pass

Table 11-2: Test Equipment For Transient Frequency Behavior Tests

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900917	Hewlett Packard	8648C	Signal Generator (9 KHz to 3200 MHz)	3537A01741	08/16/2027
901118	Hewlett Packard	HP8901B	Modulation Analyzer 150kHz-1300MHz	2406A00178	11/02/2027
901776	OWON	SmartDS7102V	Oscilloscope	SDS7102V2011088	05/13/2027
901337	Narda Microline	766-10	Attenuator (DC-4GHz, 10 dB, 20W)	6242	02/21/2026
901463	Werlatone Inc.	C1795	Directional coupler, 100W, 40 dB, 1-1000 MHz	4067	09/15/2027
901263	Agilent	.01-12 GHz	SMA Detector	2936A05505	Not Required

Test Personnel:

Daniel W. Baltzell
 Test Engineer



Signature

February 14, 2025
 Date of Tests

12 FCC Part 2.202: Necessary Bandwidth and Emission Bandwidth

NB 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)

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

Emission designator: 11K0F3E

Voice – 20 kHz channel separation (NPSPAC)

Calculation:

Max modulation (M) in kHz: 3.0

Max deviation (D) in kHz: 4

Constant factor (K): 1 (assumed)

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

Emission designator: 14K0F3E

WB Voice – 25 kHz channel separation

Calculation:

Max modulation (M) in kHz: 3.0

Max deviation (D) in kHz: 5

Constant factor (K): 1 (assumed)

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

Emission designator: 16K0F3E

P25 – 9600 bps

Calculation:

Data rate in bps (R) = 9600

Peak deviation of carrier (D) = 1800

Symbols = 4

$B_n = [9600 / \log_2(4) + 2 (1800) (1)] = 8.400 \text{ kHz}$

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

$B_n = [12000 / \log_2(4) + 2 (1050) (1)] = 8.1 \text{ kHz}$

Emission designator: 8K10DXW

2-level FSK 9600 Data/Digital Voice (NB)

Calculation:

Data rate in bps (R) = 9600

Peak deviation of carrier (D) = 3450

$B_n = [9600 / \log_2(4) + 2 (3450) (1)] = 11.700 \text{ kHz}$

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

$B_n = [9600 / \log_2(4) + 2 (5600) (1)] = 16.000 \text{ kHz}$

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

$B_n = [9600/\log_2(4) + 2(4600)](1) = 14.000 \text{ kHz}$

Emission designator: 14K0F1D, 14K0F1E

HVD SMR

Calculation:

Data rate in bps (R) = 19200

Signaling states (S) = 4

$B_n = 2(19200)(.96)/\log_2(4) = 18.5 \text{ kHz}$

Emission designator: 18K5F1W

HVD NPSPAC

Calculation:

Data rate in bps (R) = 19200

Signaling states (S) = 4

$B_n = 2(19200)(.67)/\log_2(4) = 12.9 \text{ kHz}$

Emission designator: 12K9F1W

13 Conclusion

The data in this measurement report show that the L3Harris Technologies, Inc. XL-200P Multi-Band Portable Radio, VHF/UHF/700/800 MHz, and the XL-185P and the XL-150P Single-Band Portable Radios, FCC ID: OWDTR-0179-E, comply with the applicable requirements of Parts 2, 22, 74, 80, and 90 of the FCC Rules.

THIS IS THE END OF THE TEST REPORT