Report on Test Measurements

Measurements Report
The measurement report shows compliance information against the pertinent technical standards. Each parameter is measured generally at the low end, middle, and at the high end of the applicable frequency band. Each section of the report contains either verbiage or a graph (or graphs) which show compliance to applicable standards as required, explains testing method used, and indicates what the applicable specification is.

Information and performance relative to 25 kHz 'wideband' operation is included in the report. Although wideband operation in the 150-174 MHz and 421-512 MHz bands is no longer allowable for rule part 90 in the US, it is available for other FCC rule parts and in use in other countries, including Industry Canada.

The time division multiple access (TDMA) mode of operation provides two voice paths in a 12.5 kHz channel bandwidth and a data rate of 9600 bits per second bits per second in a channel bandwidth of 12.5 kHz. This is equivalent to one voice path per 6.25 kHz of channel bandwidth and 4800 bits per second or greater in a 6.25 kHz channel bandwidth. The SLR 5700 conforms to the spectrum efficiency requirements of FCC rule § 90.203 (j) (5).

A list of test equipment for all sections, and certification signoff page are included at the end of the measurement report.

SUBMITTED MEASURED DATA -- INDEX

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E1-2.2	MOTOTRBO™ Digital Modulation, Middle of Band
E1-2.3	MOTOTRBO™ Digital Modulation, High End of Band
E1-3	Conducted Spurious Emissions: Setup, Specifications, and Index
E1-3.1	Conducted Spurious Harmonic Emissions, Power 60 Watts
E1-3.2	Conducted Spurious Harmonic Emissions, Power 1 Watt
E1-3.3	Conducted Spurious Emission Spectrum, 60 Watts, Low End of Band
E1-3.4	Conducted Spurious Emission Spectrum, 60 Watts, Middle of Band
E1-3.5	Conducted Spurious Emission Spectrum, 60 Watts, High End of Band
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E1-5	Frequency Stability: Setup, Specifications, and Index
E1-5.1	Frequency Stability Vs Temperature
E1-5.2	Frequency Stability Vs Voltage

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Measurements Report

SUBMITTED MEASURED DATA – INDEX (Continued)

EXHIBIT	**DESCRIPTION**
E1-6	Frequency Transient Behavior: Setup, Specifications, and Index
E1-6.1, 2, 3	Frequency Transient Behavior, 25 kHz Channel Key-Up
E1-6.4, 5, 6	Frequency Transient Behavior, 25 kHz Channel De-Key
E1-6.7, 8, 9	Frequency Transient Behavior, 12.5 kHz Channel Key-Up
E1-6.10, 11, 12	Frequency Transient Behavior, 12.5 kHz Channel De-key
E1-7	Audio Frequency Response – Modulation Characteristics: Setup, Specifications, and Index
E1-7.1, 2, 3	Audio Frequency Response – 25 kHz Channels
E1-7.4, 5, 6	Audio Frequency Response – 12.5 kHz Channels
E1-8	Audio Modulation Limiting – Modulation Characteristics: Setup, Specifications, and Index
E1-8.1, 2, 3	Audio Modulation Limiting – 25 kHz Channels
E1-8.4, 5, 6	Audio Modulation Limiting – 12.5 kHz Channels
E1-9	Occupied Bandwidth Description – Analog Modulation: Setup, Specifications, and Index
E1-9.1, 2, 3	Occupied Bandwidth Plots – Low End of Band – Tone / PL / DPL – 25 kHz Channels
E1-9.4, 5, 6	Occupied Bandwidth Plots – Middle of Band – Tone / PL / DPL – 25 kHz Channels
E1-9.7, 8, 9	Occupied Bandwidth Plots – High End of Band – Tone / PL / DPL – 25 kHz Channels
E1-9.10, 11, 12	Occupied Bandwidth Plots – Low End of Band – Tone / PL / DPL – 12.5 kHz Channels
E1-9.13, 14, 15	Occupied Bandwidth Plots – Middle of Band – Tone / PL / DPL – 12.5 kHz Channels
E1-9.16, 17, 18	Occupied Bandwidth Plots – High End of Band – Tone / PL / DPL – 12.5 kHz Channels
E1-11	Test Equipment Used
E1-12	Statement of Certification

Report on Test Measurements

RF Power Output Data

The RF power output was measured with the indicated voltage applied to and current into the final RF amplifying device(s). The DC current indicated is the total for the final RF amplifier stage.

Frequency Modulation Mode (Analog and Digital):

	138 MHz	155 MHz	174 MHz	
Measured RF output	60	60	60	Watts
DC Voltage, final RF amplifier stage/stages	13.6	13.6	13.6	Volts
DC Current, final RF amplifier stage/stages	7.9	7.7	7.8	Amperes
Input power for final RF amplifying device(s)	107	105	106	Watts
Primary Radio Input Supply Voltage	120	120	120	Volts AC
Minimum Measured RF output	1	1	1	Watts
DC Voltage, final RF amplifier stage/stages	13.6	13.6	13.6	Volts
Normal DC Current	1.5	1.5	1.5	Amperes
Input power for final RF amplifying device(s)	20	20	20	Watts
Primary Radio Input Supply Voltage	120	120	120	Volts AC

Report on Test Measurements

Occupied Bandwidth – MOTOTRBO™ Digital Modulation, 12.5 kHz Channel Spacing
MOTOTRBO™ Digital Modulation can be used in a system configuration based upon channel usage as described in Exhibit B. The 'F7E' and 'FXE' emission designators provide usage for telephony, the 'F7D' and 'FXD' designators provide usage for data / telecommand, and the 'F7W' and 'FXW' designators provide for usage as a combination of telephony and telecommand. All are spectrally identical. The occupied bandwidth chart references the following setup and specification requirements.

Modulation Type:	MOTOTRBO™ Digital Modulation
Emission Designator:	7K60F7W, 7K60F7D, 7K60F7E, 7K60FXD, 7K60FXE, 7X60FXW
Channelization:	12.5 kHz
Power Setting:	60 Watts

Specification Requirement 47 CFR §90.210(d) and IC RSS-119 section 5.8.3 - Emission Limits – "D-Mask":
Emission *Mask D.* For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth (f_0) to 5.625 kHz removed from f_0: *Zero dB*

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: *At least 7.27 *(f_d –2.88 kHz) dB*

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: *At least 50 plus 10 $\log_{10}$(P) dB or 70 dB, whichever is the lesser attenuation.*

(4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide to capture the true peak emission of the equipment under test. In order to show compliance with the emissions mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to ensure that the emission profile is developed.

Necessary Bandwidth Calculation:
The necessary bandwidth of the modulation per the formulas defined in 47 CFR §2.202(g) / TRC-43 section 8 is as follows:
Four Level Frequency Modulation is used to modulate a carrier with a digital bit stream: Data Rate: R = 9600 bps; Bits per Symbol: S=2; Modulation rate in baud = B = 9600 / 2 = 4800; Max Modulation Frequency = M = ½* B = 2400 Hz; Deviation at the outer symbols is 1.944 kHz; A square root raised cosine filter is implemented for the modulation low pass filter with the following magnitude response, |F(f)|:

$|F(f)| = 1$ for $|f| \leq 1920$ Hz
$|F(f)| = |\cos(\pi f / 1920)|$ for $1920 \text{ Hz} < |f| \leq 2880$ Hz
$|F(f)| = 0$ for $|f| > 2880$ Hz
where f = frequency in hertz.

Max Mod Freq, M= ½B	*Max Deviation, D*	*2M+2DK (K=.72)*	*Nec BW*
2.4 kHz	1.944 kHz	7.60 kHz	7K60

(Continued)

Report on Test Measurements

Occupied Bandwidth – MOTOTRBO™ Digital Modulation, 12.5 kHz Channel Spacing (continued)

Measurement Procedure and Instrument Settings:

Emission Measurement Analyzer Settings

Horizontal:	12.5 kHz per Division	Resolution BW:	100 Hz
Vertical:	10 dB per Division	Video BW:	10 kHz
Sweep Time:	72 Seconds (<2 kHz/Sec)	Span:	125 kHz
Detector:	Peak		

Measured Occupied Bandwidth

Resolution BW:	100 Hz
Span:	125 kHz
Number of Points:	6401
Integration Time:	22.156 ms

Test Procedure:

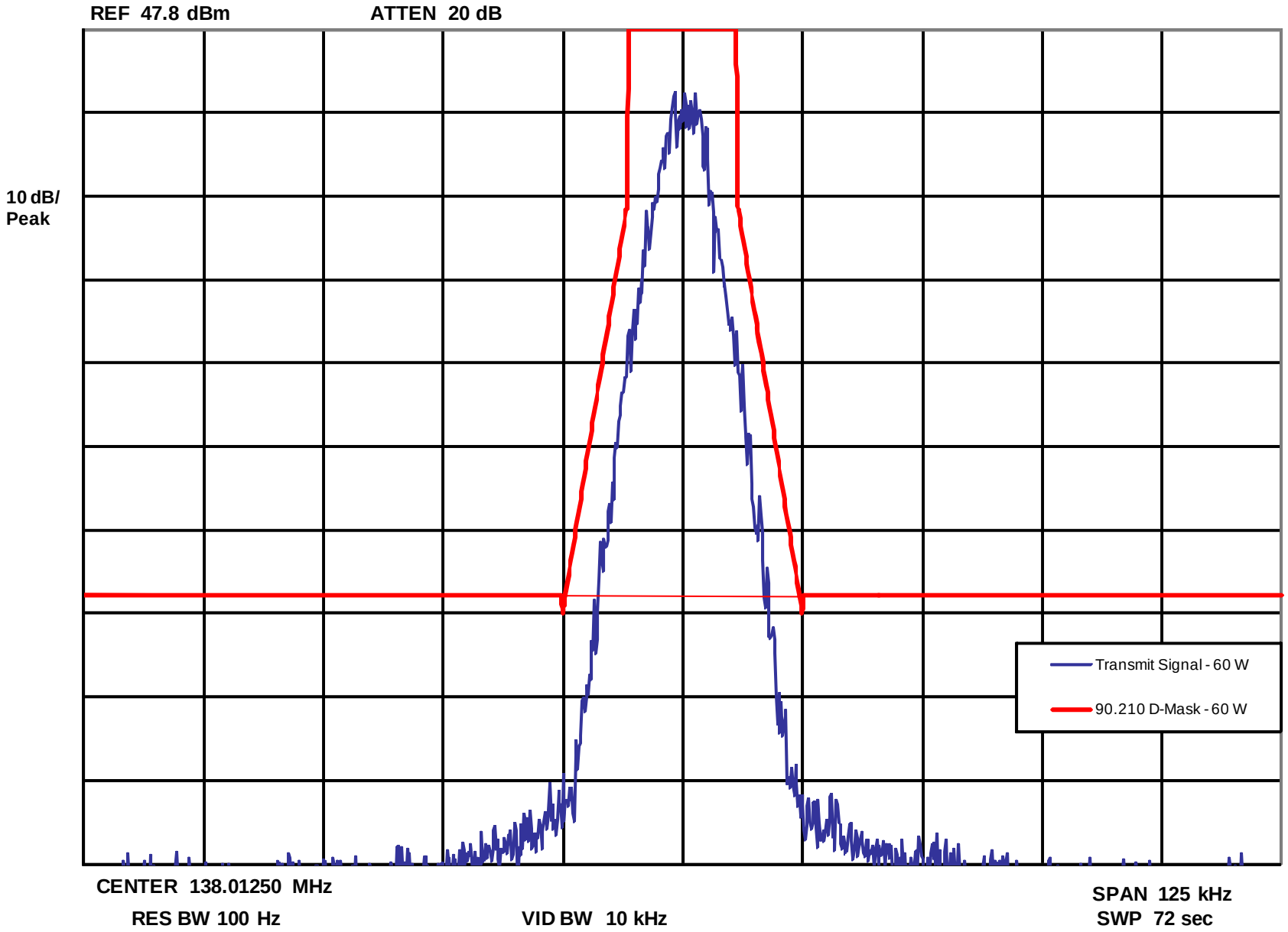
1) Adjust the spectrum analyzer per the values specified in the Emission Measurement Analyzer Settings.
2) Modulate the transmitter with the appropriate signaling pattern, (pseudorandom data) and key the transmitter at the full power rating. Use the analyzer controls to set this signal to the full-scale reference line. Allow the analyzer to sweep fully and store the sweep.
3) Use the band power marker function of the spectrum analyzer to measure the power of the carrier.
4) Use the carrier power value from the previous step to generate the emission mask limit.
5) Plot the resulting analyzer trace and the emission mask limit, add text and labeling as appropriate.
6) Adjust the signal analyzer resolution BW and span as indicated above, use the Occupied Bandwidth function to record the value.

EXHIBIT	DESCRIPTION	Meas Occ BW
E1-2.1	Occupied Bandwidth – MOTOTRBO™ Digital Modulation, Low End of Band	7.51 kHz
E1-2.2	Occupied Bandwidth – MOTOTRBO™ Digital Modulation, Middle of Band	7.52 kHz
E1-2.3	Occupied Bandwidth – MOTOTRBO™ Digital Modulation, High End of Band	7.58 kHz

Report on Test Measurements

Occupied Bandwidth – MOTOTRBO™ Digital Modulation – Emission Designator: 7K60F7W, 7K60F7D, 7K60F7E, 7K60FXD, 7K60FXE – Low End of Band

Occupied Bandwidth -- MOTOTRBO™ Digital Modulation - 60 Watts



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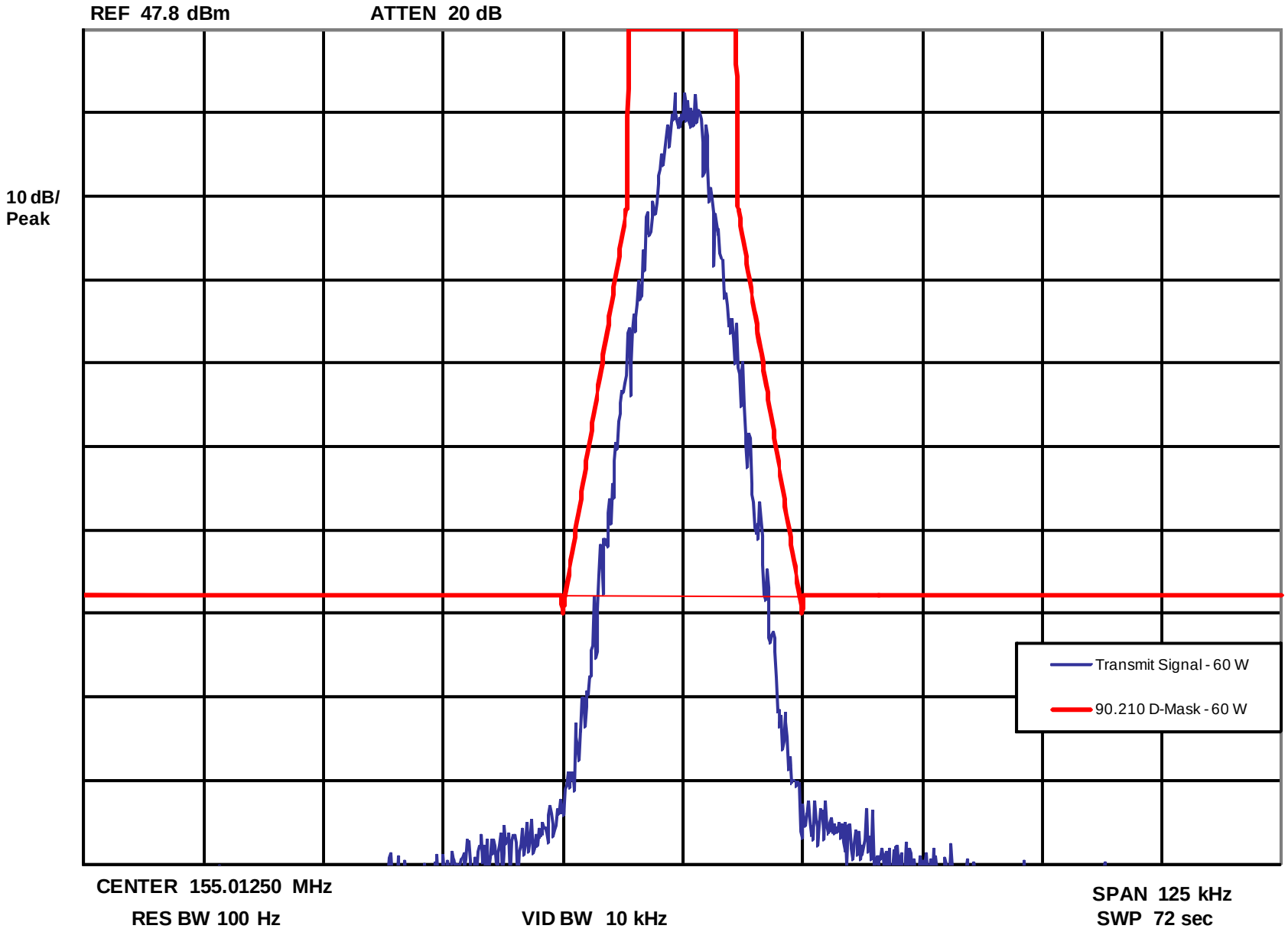
Occupied Bandwidth – MOTOTRBO™ Digital Modulation – Emission Designator: 7K60F7W, 7K60F7D, 7K60F7E, 7K60FXD, 7K60FXE – Middle of Band

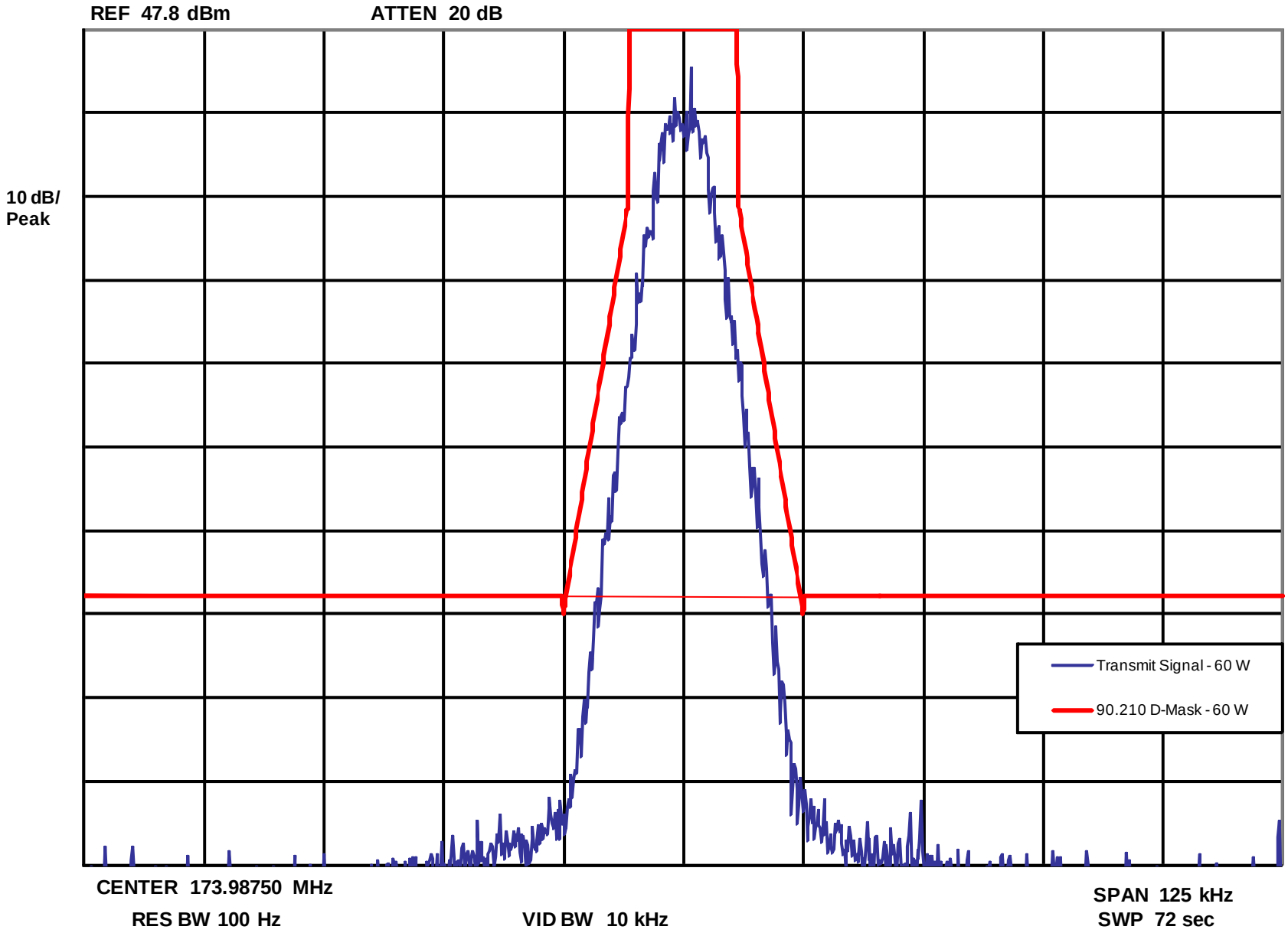
Occupied Bandwidth -- MOTOTRBO™ Digital Modulation - 60 Watts



Report on Test Measurements

Occupied Bandwidth – MOTOTRBO™ Digital Modulation – Emission Designator: 7K60F7W, 7K60F7D, 7K60F7E, 7K60FXD, 7K60FXE – High End of Band

Occupied Bandwidth -- MOTOTRBO™ Digital Modulation - 60 Watts



Report on Test Measurements

Conducted Spurious Emissions – Harmonics and Emission Spectrum

Specification Requirement 47 CFR §90.210(b) and IC RSS-119 section 5.8.1 - Emission Limits – "B-Mask":
For transmitters equipped with an audio low pass filter and designed to operate with a 25 kHz channel spacing (authorized bandwidth 20 kHz), the power of any emission must be below the unmodulated carrier power (P) as follows:

On any frequency removed from the assigned frequency by a displacement frequency (F_d in kHz) of:
c) >50 kHz *at least 43+10 * Log_{10} (P) dB.*

Specification Requirement 47 CFR §90.210(d) and IC RSS-119 section 5.8.3 - Emission Limits – "D-Mask":
Emission *Mask D:* For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:
(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: *At least 50 plus 10 log_{10}(P) dB or 70 dB, whichever is the lesser attenuation.*

Modulation: Analog Frequency Modulation – this is also representative of the performance of MOTOTRBO™ Digital Modulation, which is 4-level frequency modulation of the carrier.

Carrier Frequencies: Carrier frequencies of 136.0125, 138.0125, 155.0125, and 173.9875 MHz were measured for conducted carrier harmonics at the high rated power.

Carrier frequencies of 138.0125, 155.0125, and 173.9875 MHz were measured for conducted spurious emission measurements.

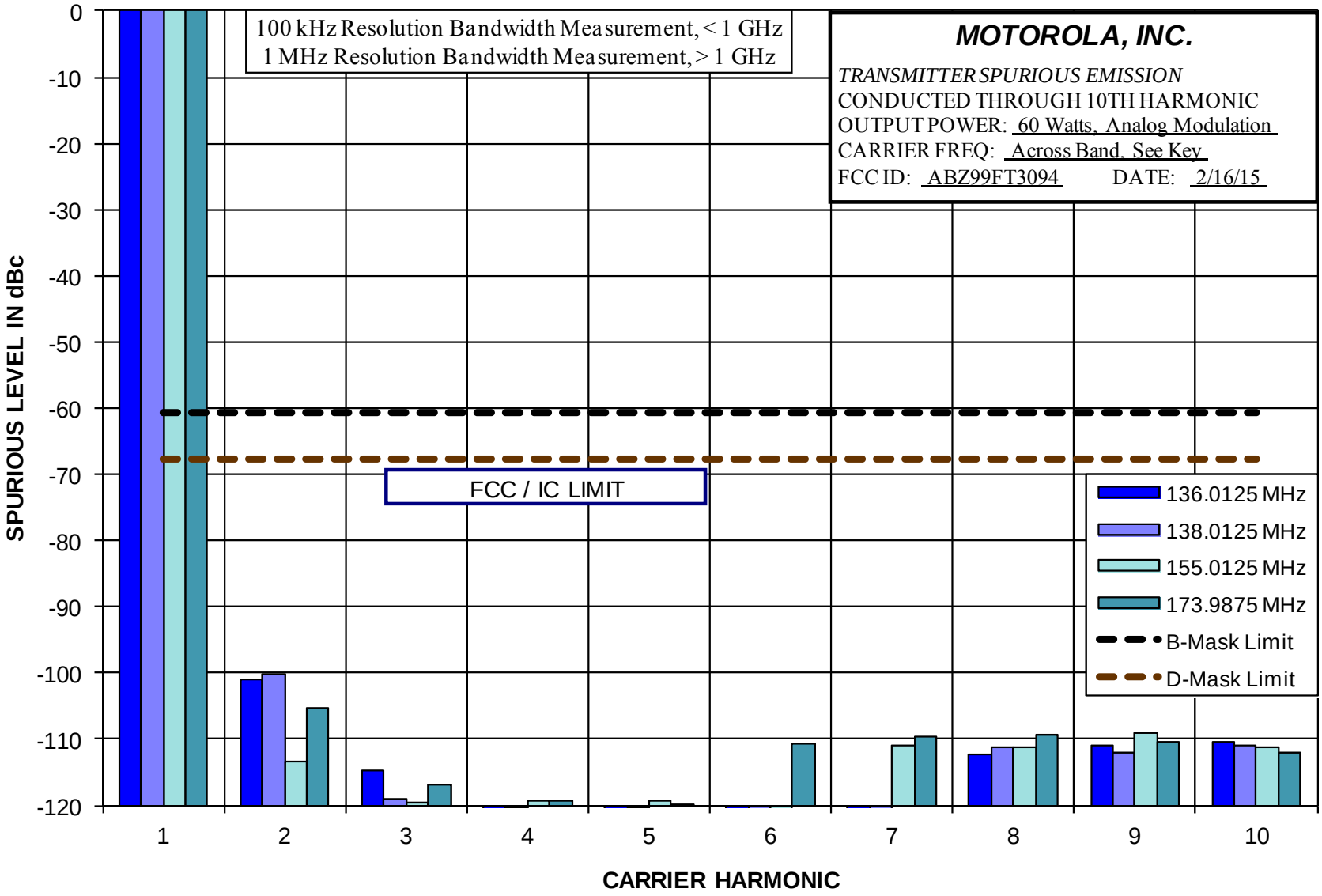
These frequencies represent the low end, center, and high end of the band, and are representative of the full 136-174 MHz operating band.

Only the worst case specification limit is shown.

EXHIBIT	DESCRIPTION
E1-3.1	Conducted Spurious Harmonic Emissions, Power Output 60 Watts The specification limit is -67.8 dBc
E1-3.2	Conducted Spurious Harmonic Emissions, Power Output 1 Watt The specification limit is -50.0 dBc
E1-3.3	Conducted Spurious Emission Spectrum, 200 MHz Span, Power 60 Watts, Low End of Band
E1-3.4	Conducted Spurious Emission Spectrum, 200 MHz Span, Power 60 Watts, Middle of Band
E1-3.5	Conducted Spurious Emission Spectrum, 200 MHz Span, Power 60 Watts, High End of Band The specification limit is -67.8 dBc

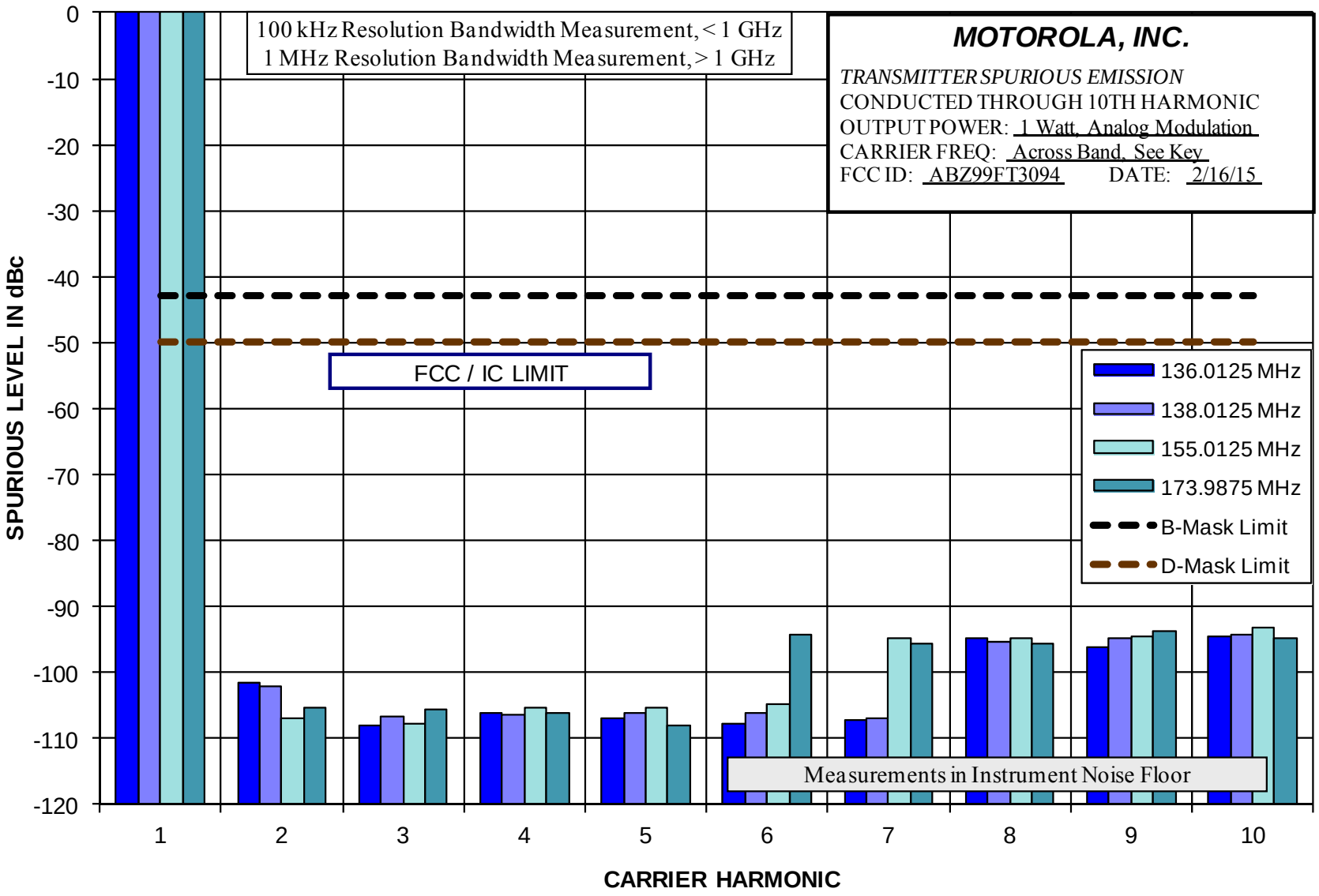
Report on Test Measurements

Conducted Spurious Harmonic Emissions – 60 Watts



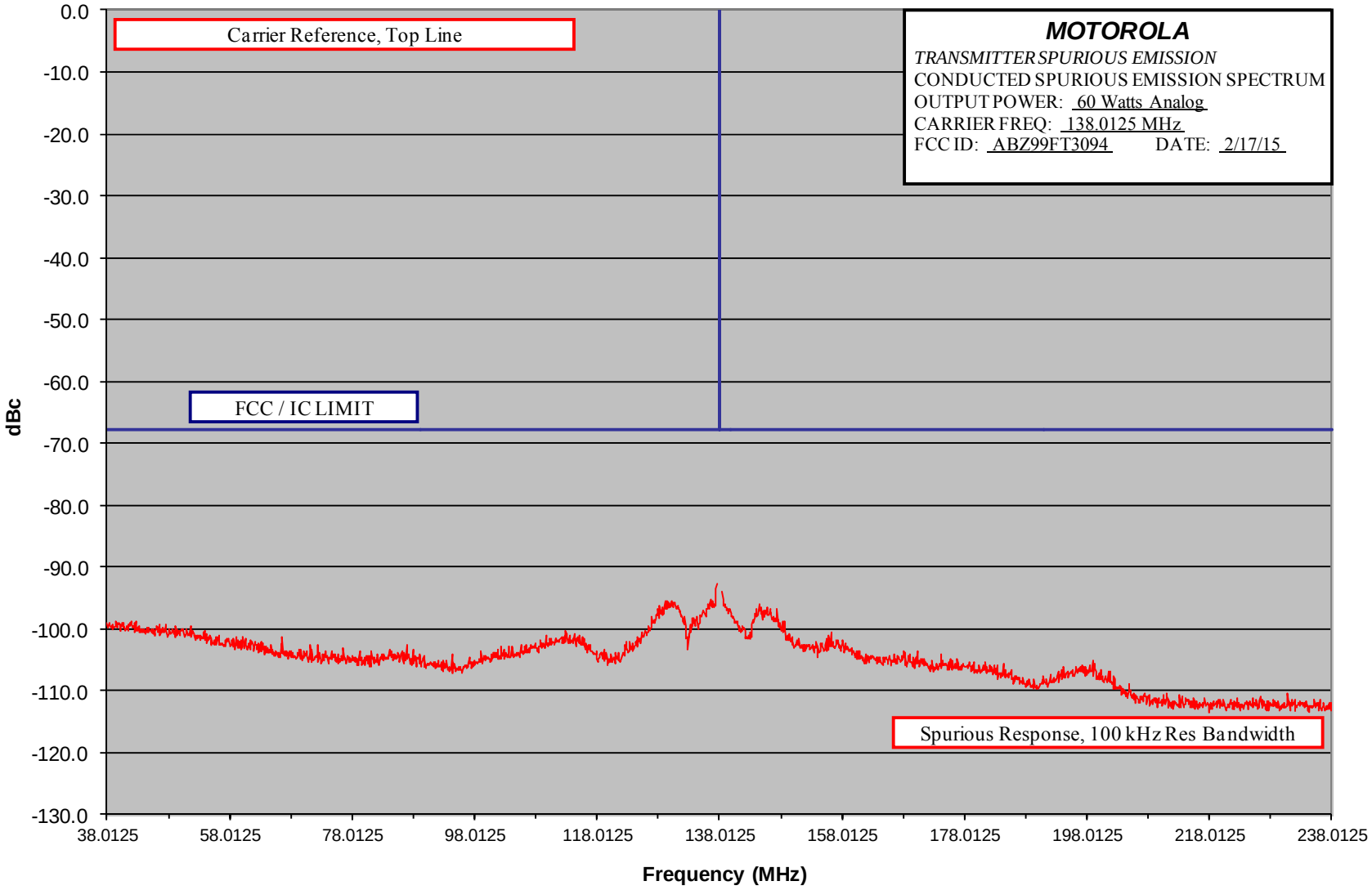
Report on Test Measurements

Conducted Spurious Harmonic Emissions – 1 Watt



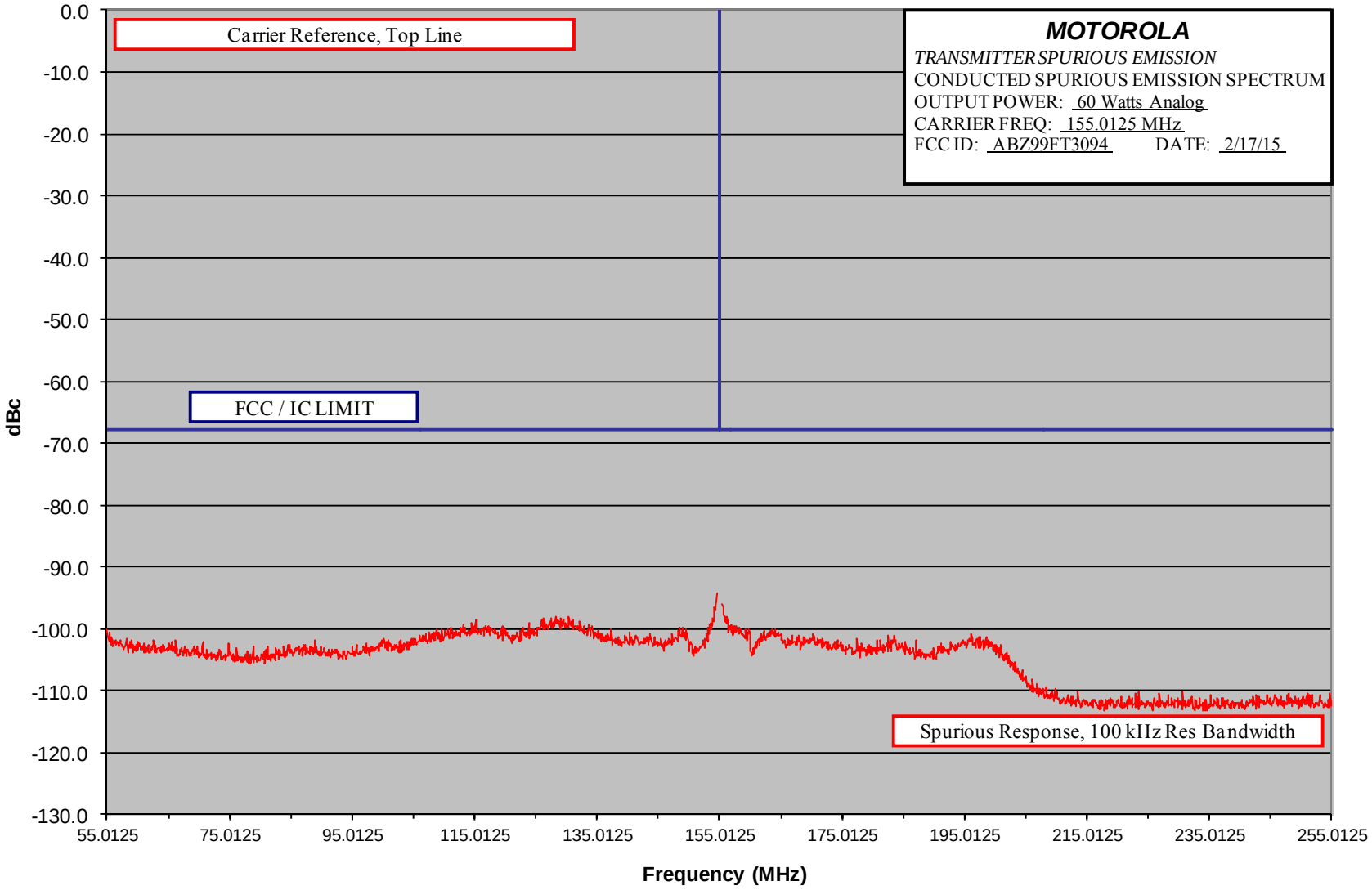
Report on Test Measurements

Conducted Spurious Emission Spectrum – 60 Watts – 200 MHz Span – Low End of Band



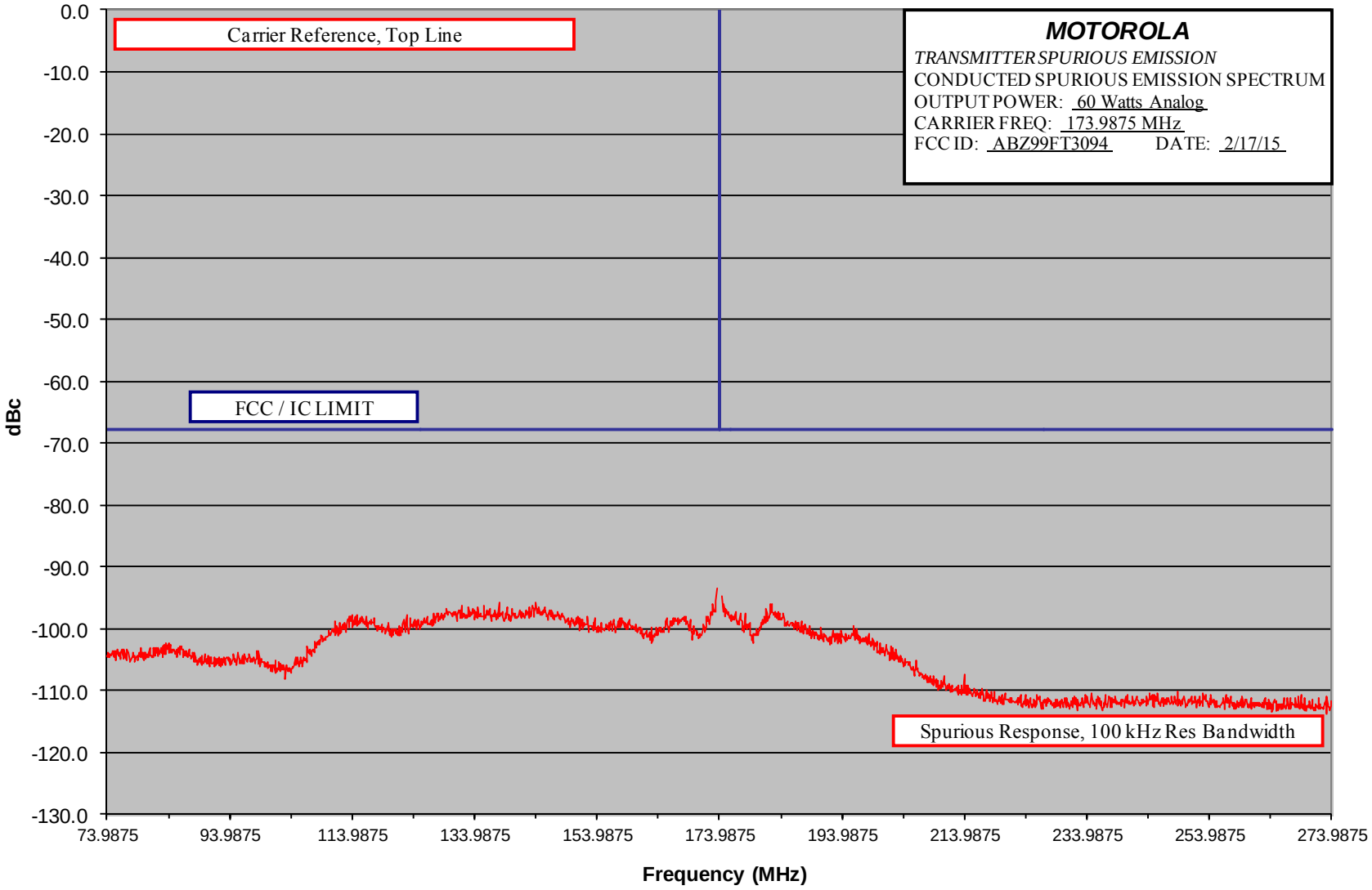
Report on Test Measurements

Conducted Spurious Emission Spectrum – 60 Watts – 200 MHz Span – Middle of Band



Report on Test Measurements

Conducted Spurious Emission Spectrum – 60 Watts – 200 MHz Span – High End of Band



Report on Test Measurements

Radiated Spurious Emissions, Harmonics

Specification Requirement 47 CFR §90.210(b) and IC RSS-119 section 5.8.1 - Emission Limits – "B-Mask":
For transmitters equipped with an audio low pass filter and designed to operate with a 25 kHz channel spacing (authorized bandwidth 20 kHz), the power of any emission must be below the unmodulated carrier power (P) as follows:

On any frequency removed from the assigned frequency by a displacement frequency (F_d in kHz) of:
c) >50 kHz *at least 43+10 * Log_{10} (P) dB.*

Specification Requirement 47 CFR §90.210(d) and IC RSS-119 section 5.8.3 - Emission Limits – "D-Mask":
Emission *Mask D:* For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:
(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: *At least 50 plus 10 log_{10}(P) dB or 70 dB, whichever is the lesser attenuation.*

Modulation: Analog Frequency Modulation – this is also representative of the performance of MOTOTRBO™ Digital Modulation, which is 4-level frequency modulation of the carrier.

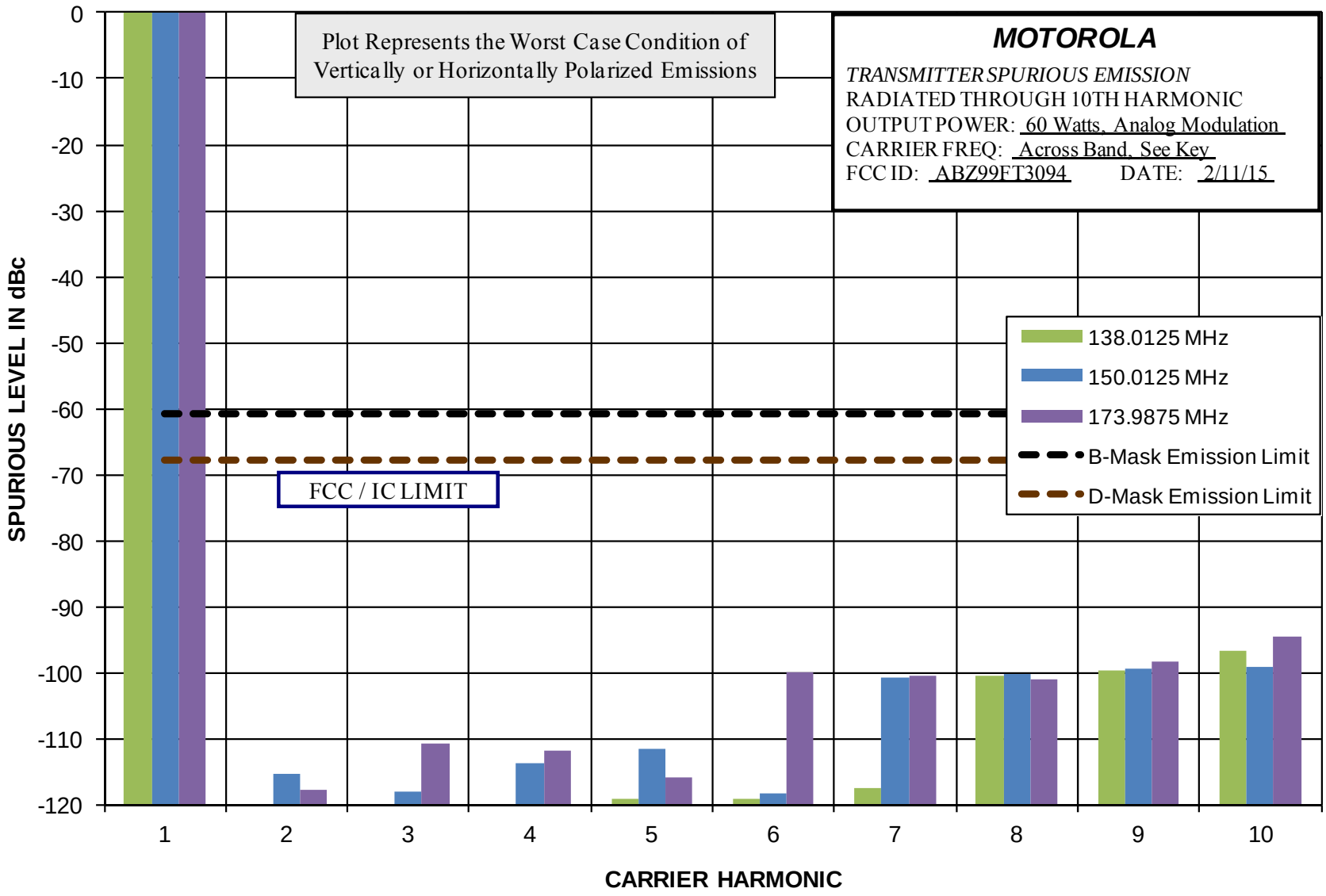
Carrier Frequencies: Carrier frequencies of 138.0125, 150.0125, and 173.9875 MHz were measured for radiated carrier harmonics at the high rated power. These frequencies represent the low end, center, and high end of the band, and are representative of the full 138-174 MHz operating band.

A carrier frequency of 150.0125 MHz was measured for radiated carrier harmonics at the low rated power. This frequency represents the center of the 138-174 MHz band, and is representative of the full 138-174 MHz operating band at this power level.

EXHIBIT	DESCRIPTION
E1-4.1	Radiated Spurious Harmonic Emissions, Power Output 60 Watts The specification limit is -67.8 dBc
E1-4.2	Radiated Spurious Harmonic Emissions, Power Output 1 Watt The specification limit is -50.0 dBc

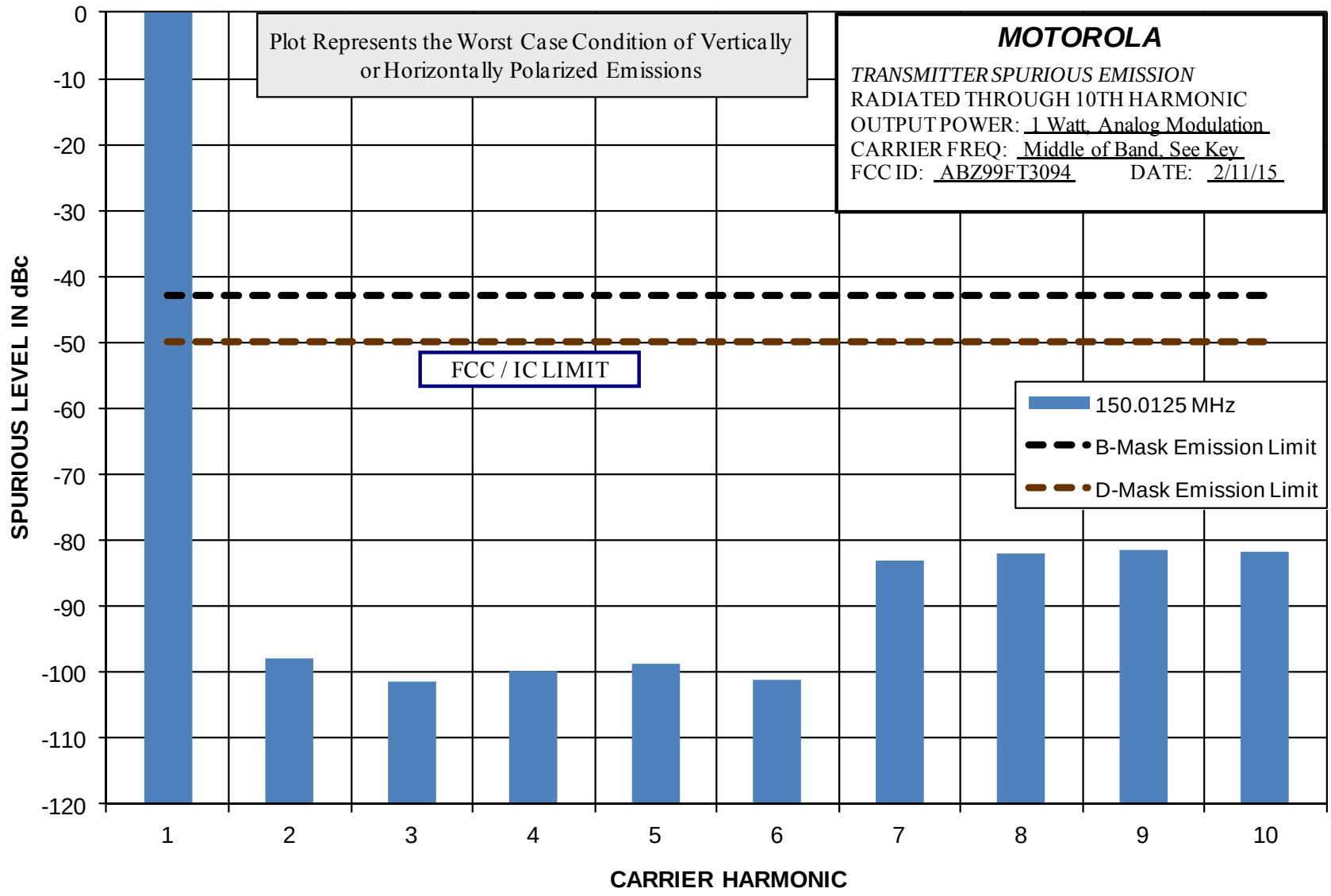
Report on Test Measurements

Radiated Spurious Harmonic Emissions — 60 Watts



Report on Test Measurements

Radiated Spurious Harmonic Emissions — 1 Watt



Report on Test Measurements

Oscillator Frequency Stability

Manufacturer data for the system site frequency standard was used in generation of the following frequency stability exhibits.

Specification Requirement IC RSS-119 section 5.3:

Fixed and Base stations operating at 138-174 MHz and 12.5 kHz / 15 kHz channel bandwidth must have a frequency stability of better than +/- 2.5 PPM, and those operating at 138-174 MHz and 25 kHz / 30 kHz channel bandwidth must have a frequency stability of better than +/- 5.0 PPM.

Specification Requirement: Reference Part 90.213

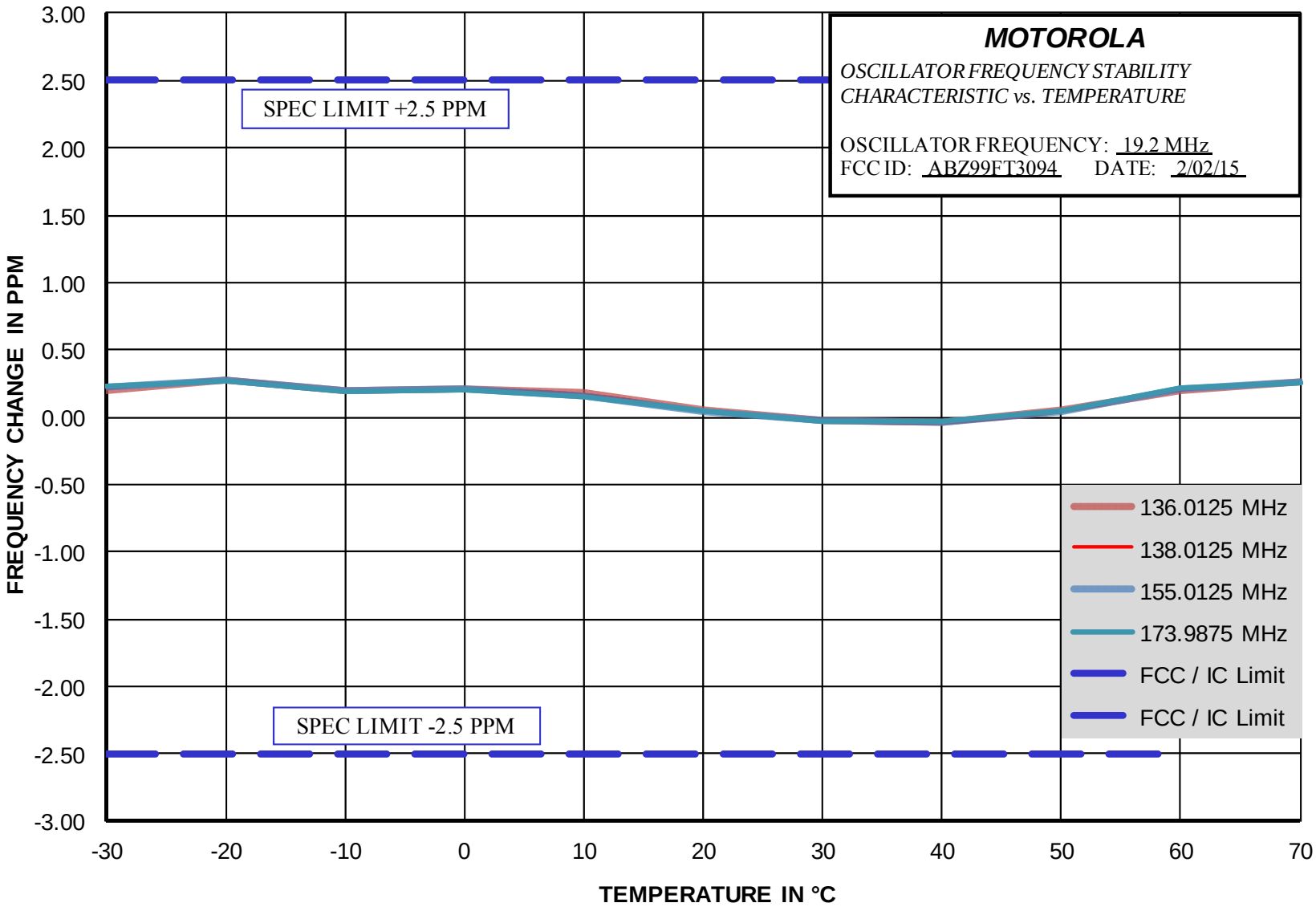
Fixed and Base stations operating at 150-174 MHz and 12.5 kHz channel bandwidth must have a frequency stability of better than +/- 2.5 PPM.

Only the more stringent specification limit is shown on the frequency stability exhibits.
Performance was measured at carrier frequencies across the operating band.

EXHIBIT	DESCRIPTION
E1-5.1	Frequency Stability Vs Temperature
E1-5.2	Frequency Stability Vs Voltage

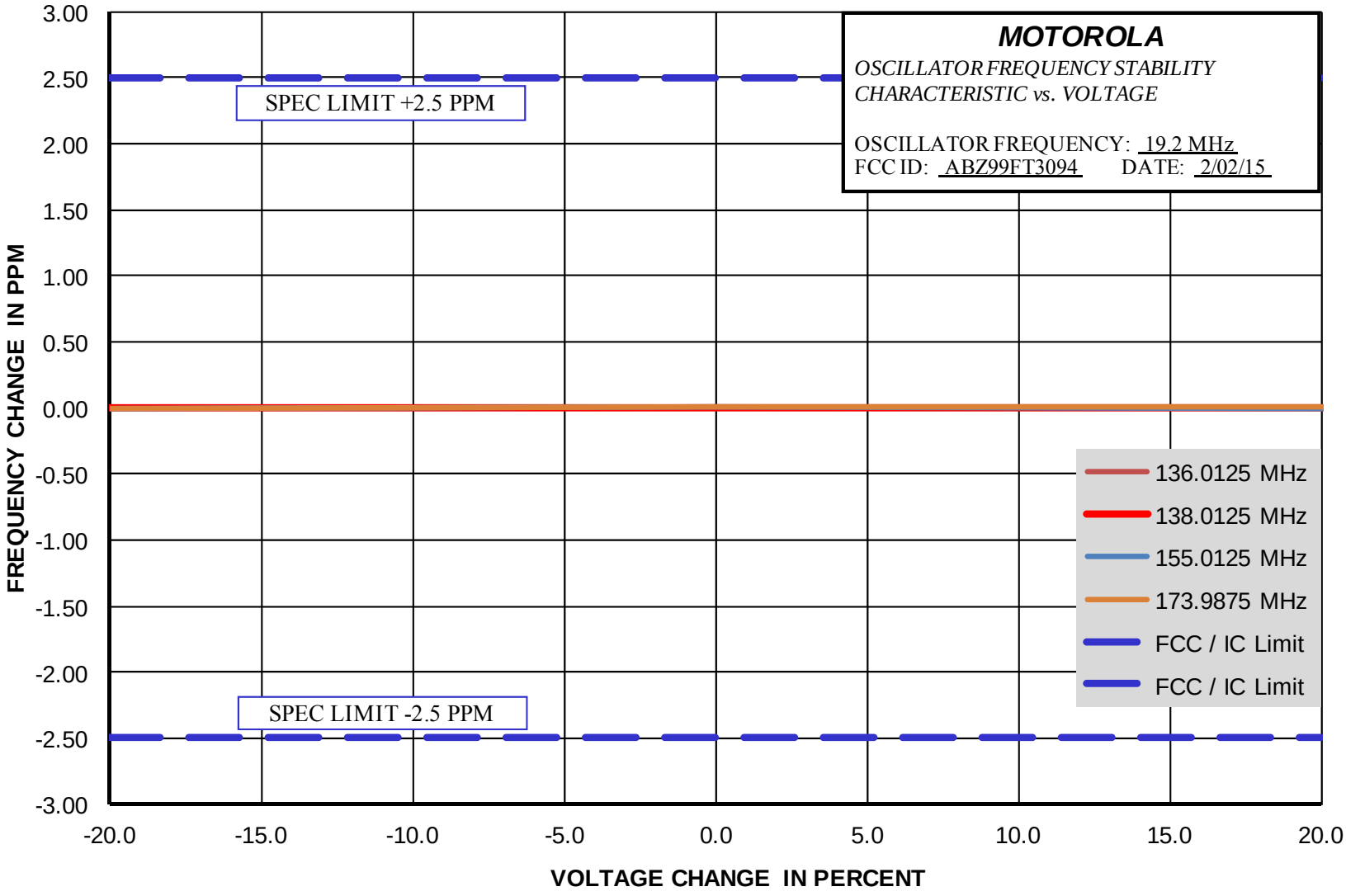
Report on Test Measurements

Frequency Stability Vs Temperature



Report on Test Measurements

Frequency Stability Vs Voltage



Report on Test Measurements

Frequency Transient Behavior

Specification Requirement 47 CFR §90.214 and IC RSS-119 section 5.9:

Transmitters designed to operate in the 138-174 MHz (150-174 MHz for FCC) frequency band must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated below:

Transient Frequency Behavior 25 kHz Channels

For time intervals:

a. t_1 = 5 ms Maximum Frequency Difference ±25 kHz

b. t_2 = 20 ms Maximum Frequency Difference ±12.5 kHz

c. t_3 = 5 ms Maximum Frequency Difference ±25 kHz

Transient Frequency Behavior 12.5 kHz Channels

For time intervals:

a. t_1 = 5 ms Maximum Frequency Difference ±12.5 kHz

b. t_2 = 20 ms Maximum Frequency Difference ±6.25 kHz

c. t_3 = 5 ms Maximum Frequency Difference ±12.5 kHz

Where t_1 and t_2 are times immediately following when the transmitter is turned on, and t_3 is the time from when the transmitter is turned off.

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 / RSS-119 section 5.3.

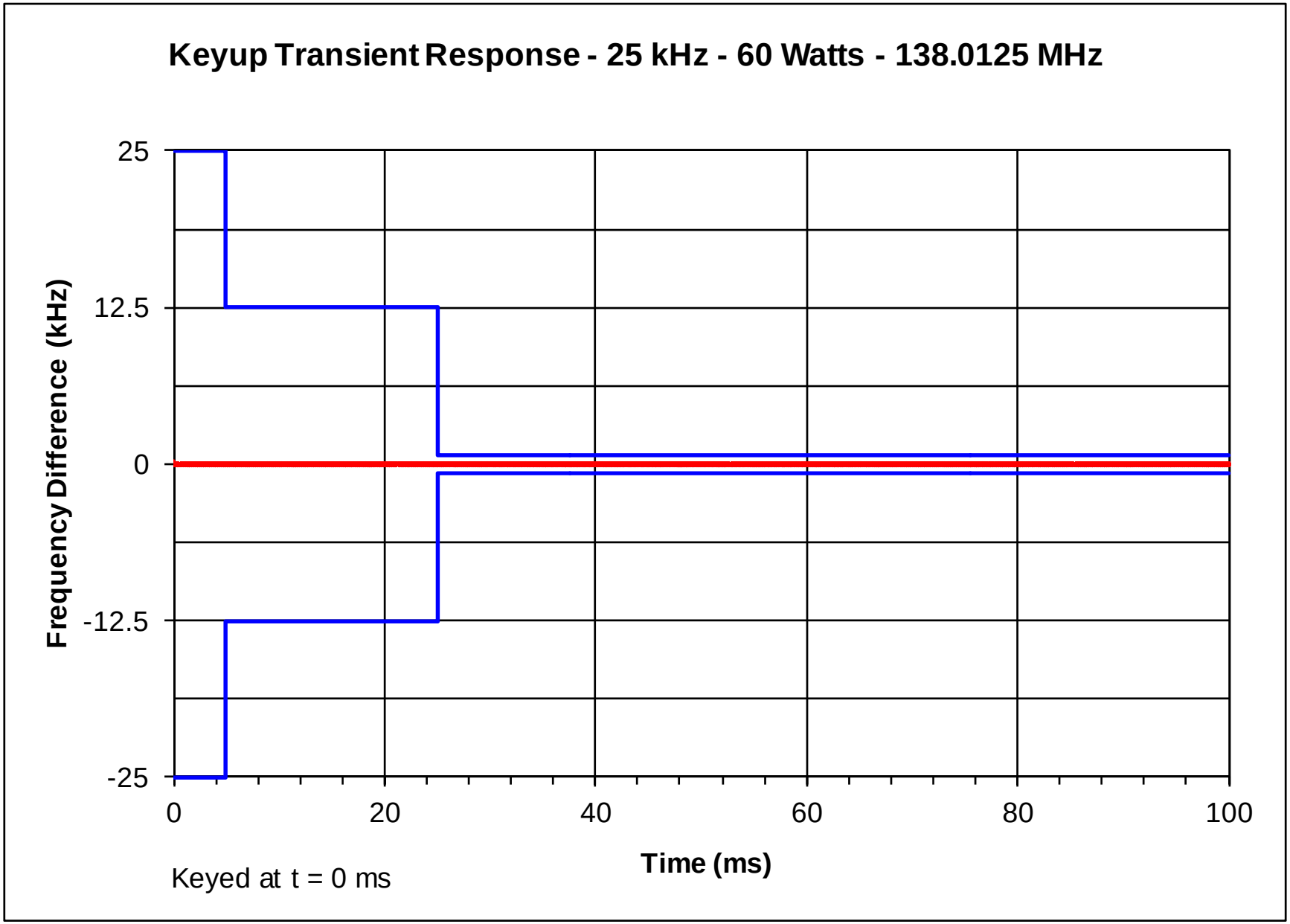
Modulation: Analog Mode Frequency Modulation

Carrier Frequencies: Performance was measured at carrier frequencies at the low end, middle, and high end of the operating band.

EXHIBIT	DESCRIPTION
E1-6.1, 2, 3	Frequency Transient Behavior, 25 kHz Channel Key-Up
E1-6.4, 5, 6	Frequency Transient Behavior, 25 kHz Channel De-Key
E1-6.7, 8, 9	Frequency Transient Behavior, 12.5 kHz Channel Key-Up
E1-6.10, 11, 12	Frequency Transient Behavior, 12.5 kHz Channel De-key

Report on Test Measurements

Frequency Transient – Key-Up – 25 kHz Channels – Low End of Band



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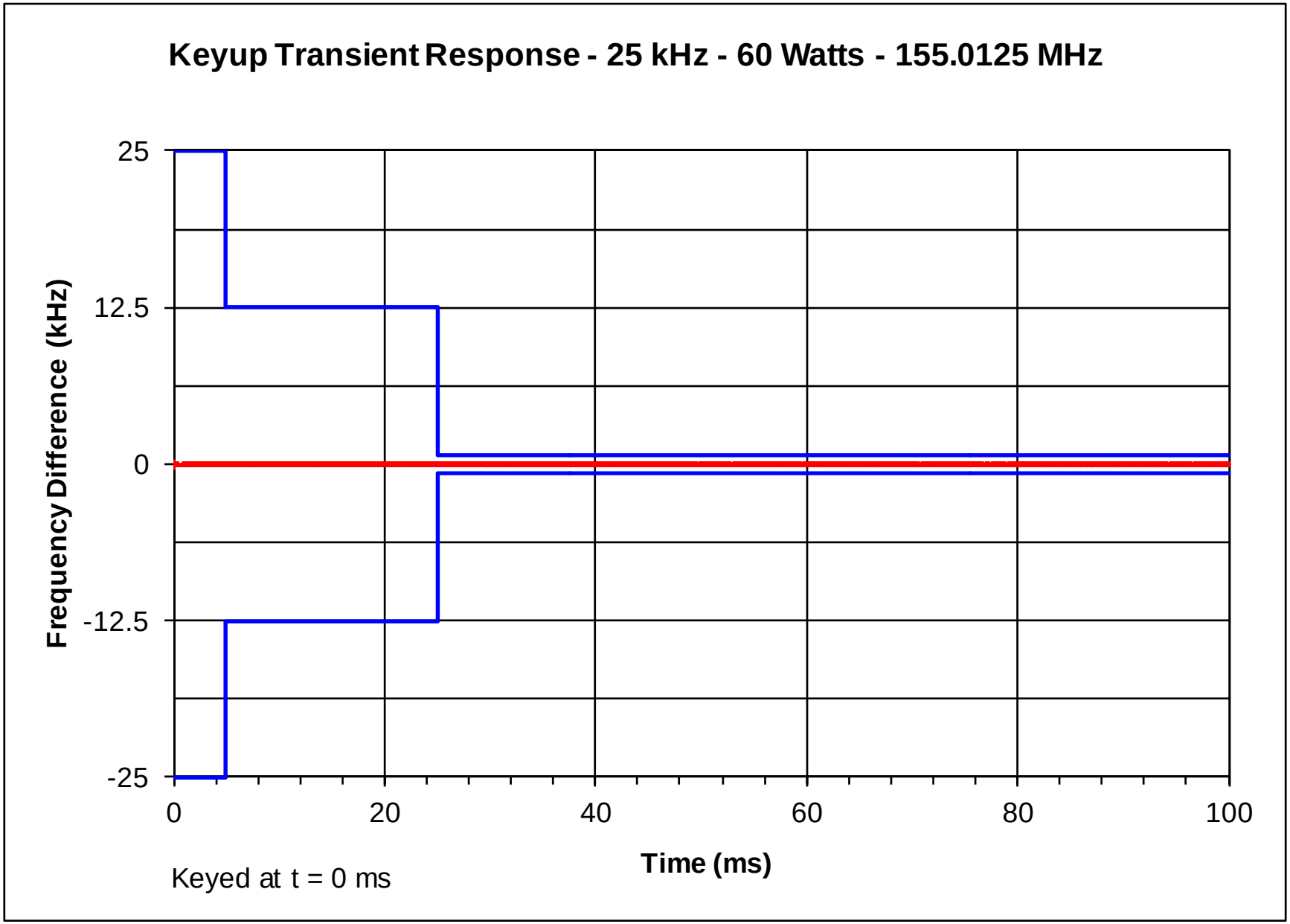
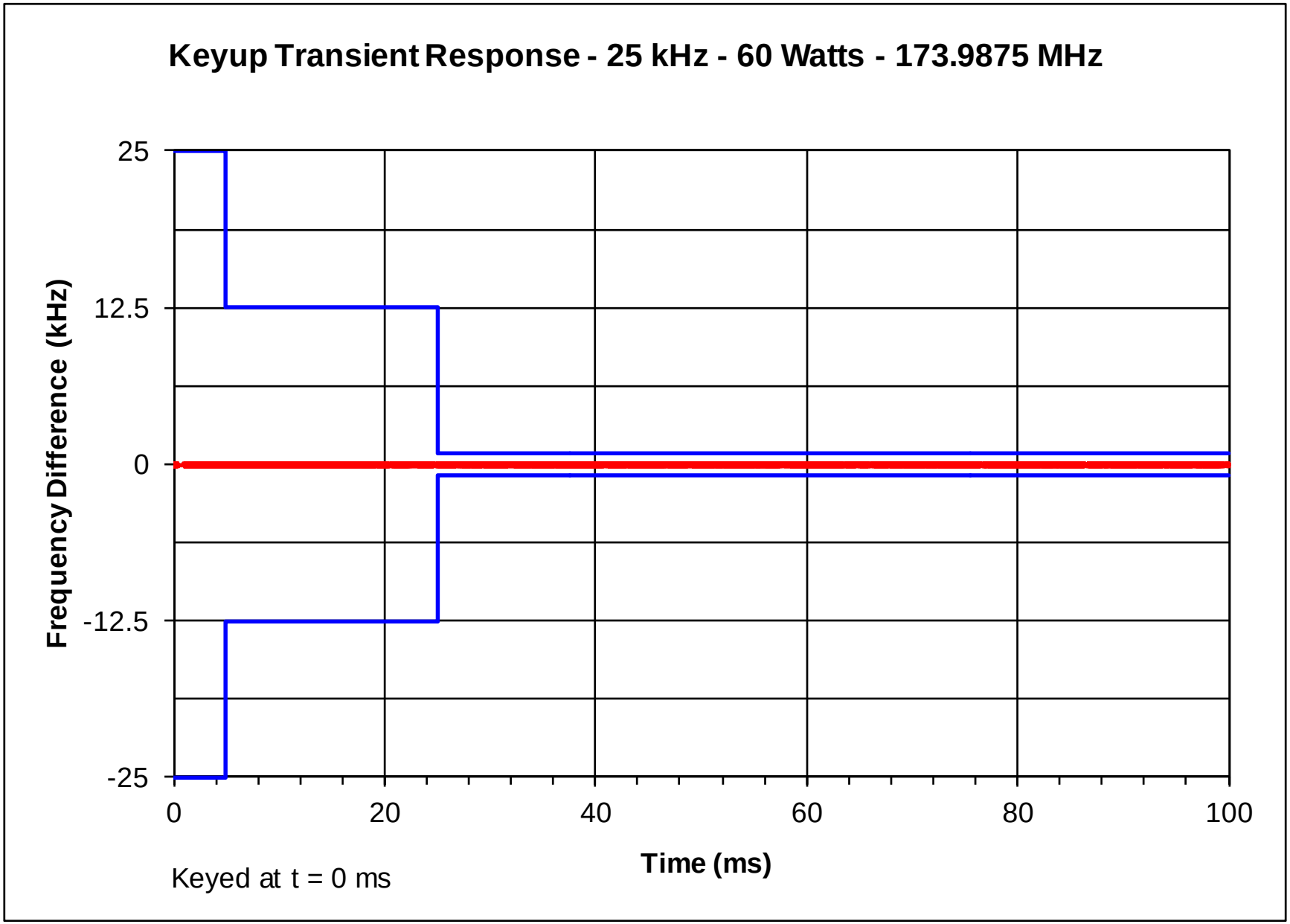
Frequency Transient – Key-Up – 25 kHz Channels – Middle of Band



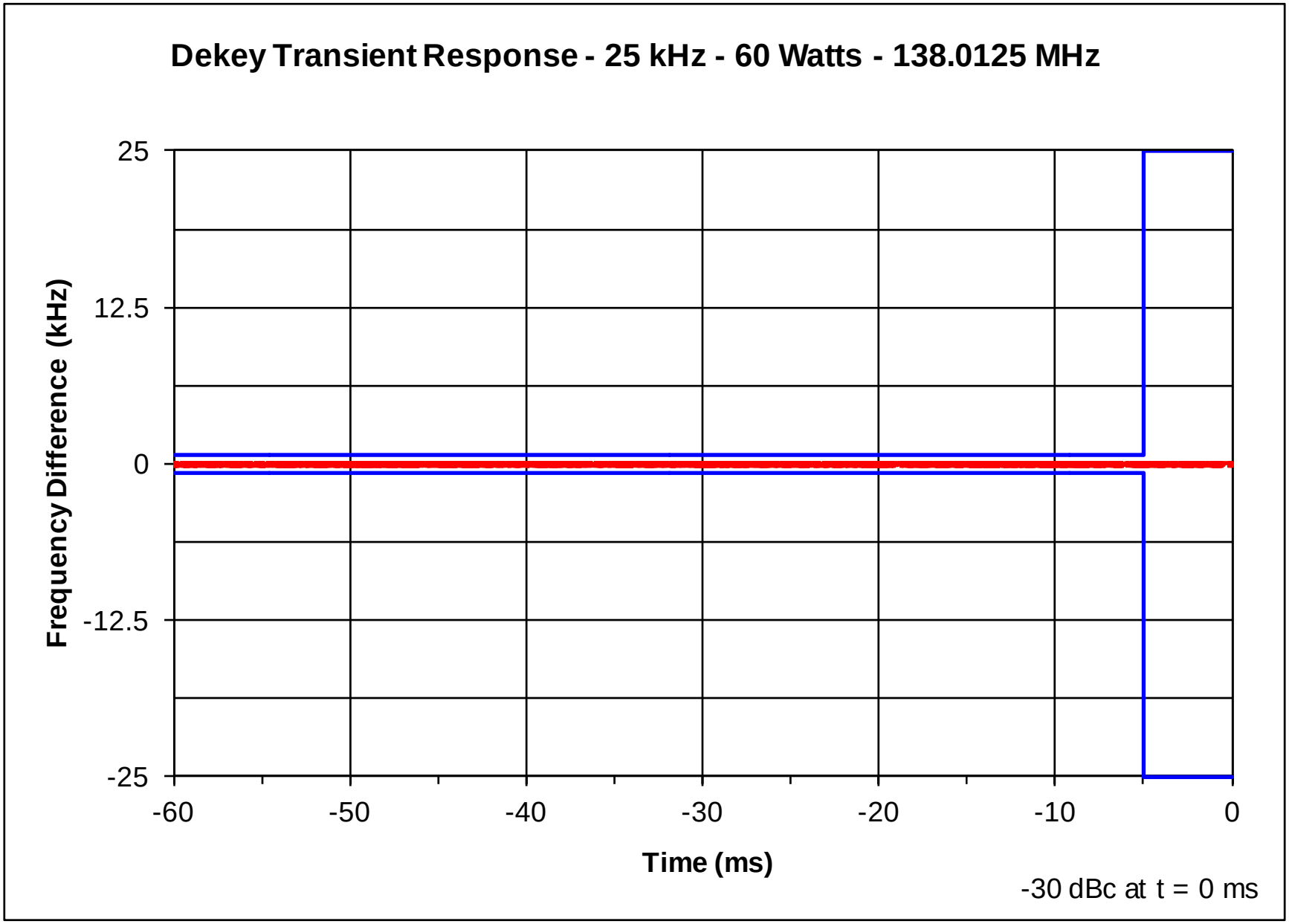
Report on Test Measurements

Frequency Transient – Key-Up – 25 kHz Channels – High End of Band



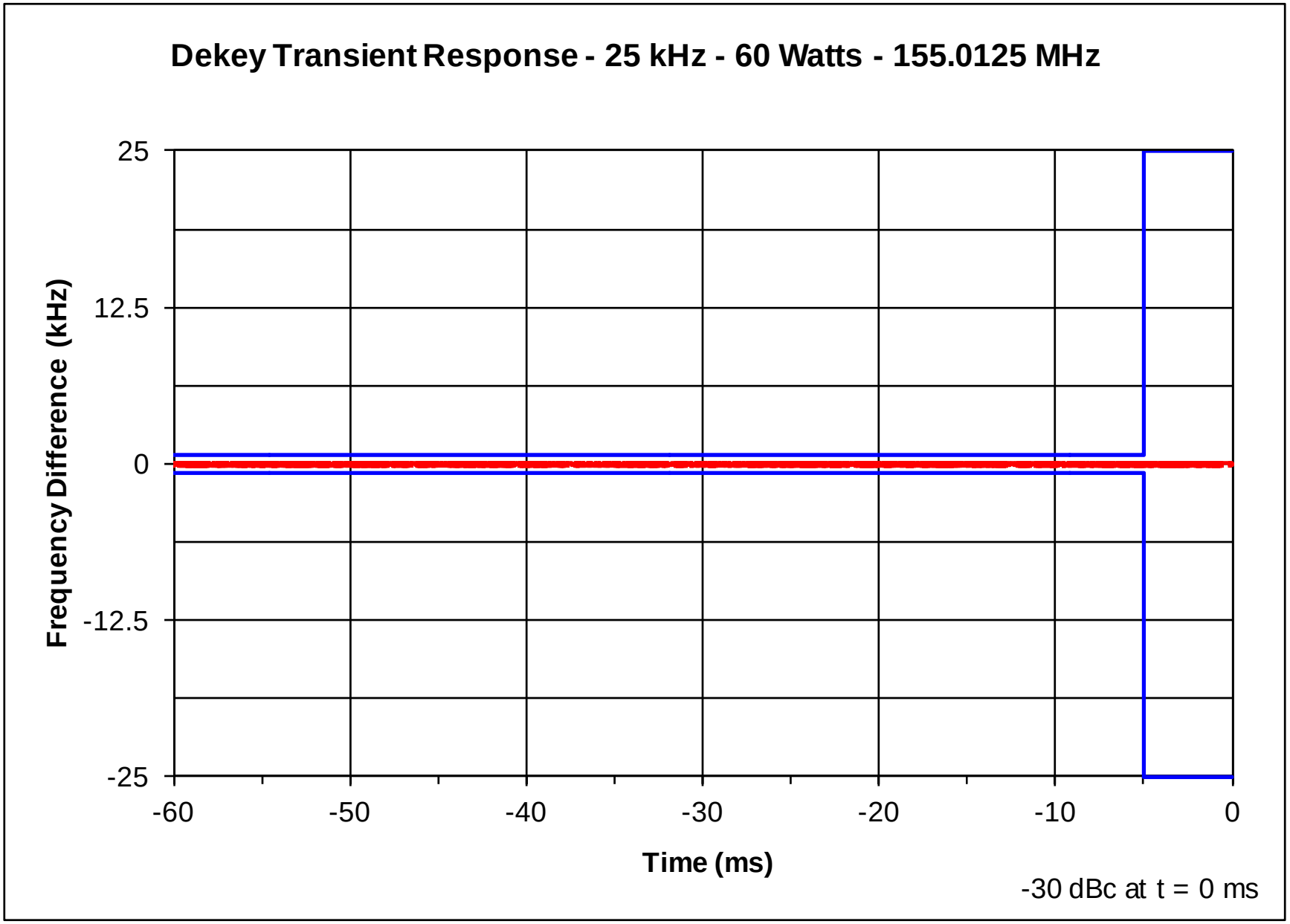
Report on Test Measurements

Frequency Transient – De-Key – 25 kHz Channels – Low End of Band



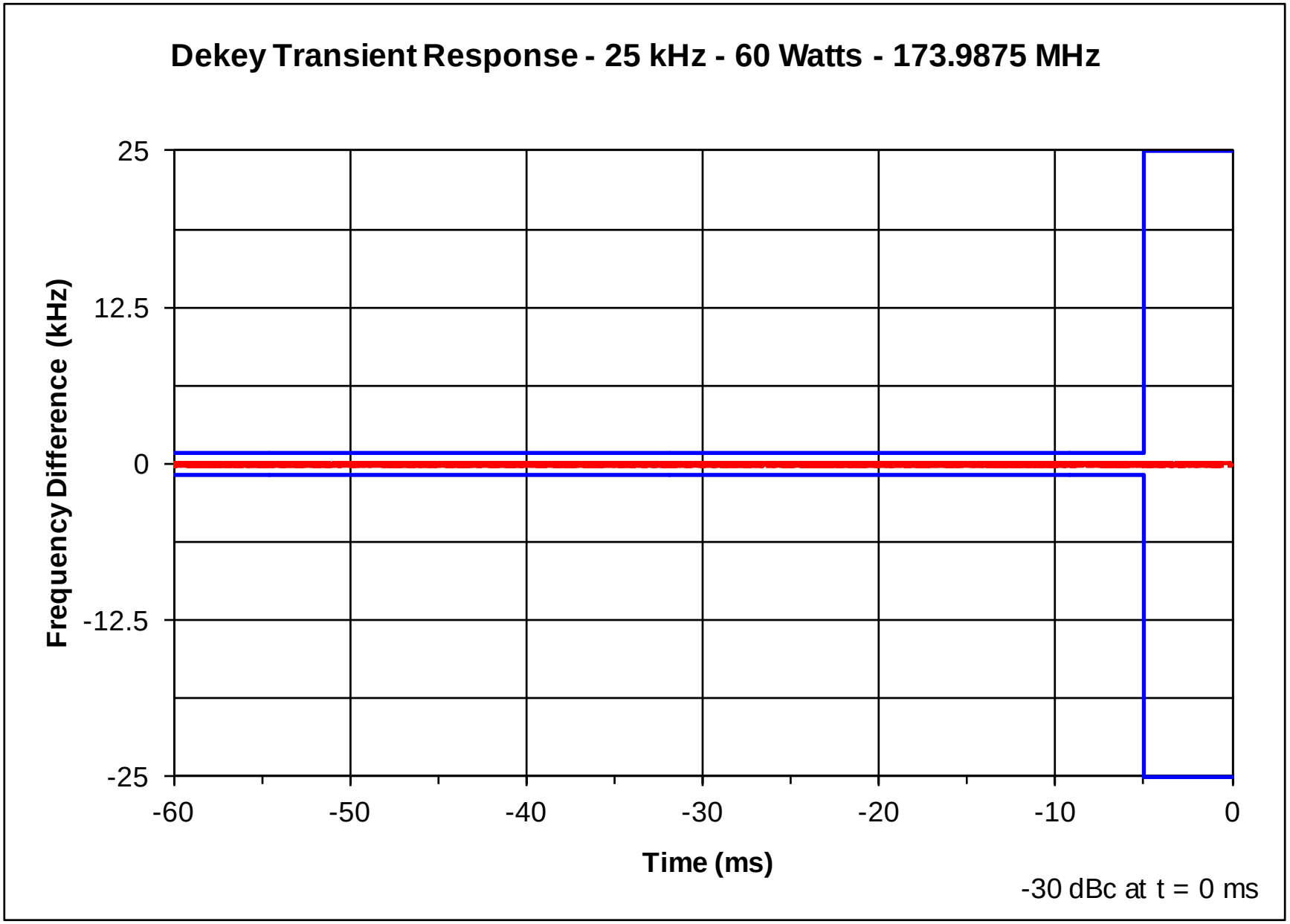
Report on Test Measurements

Frequency Transient – De-Key – 25 kHz Channels – Middle of Band



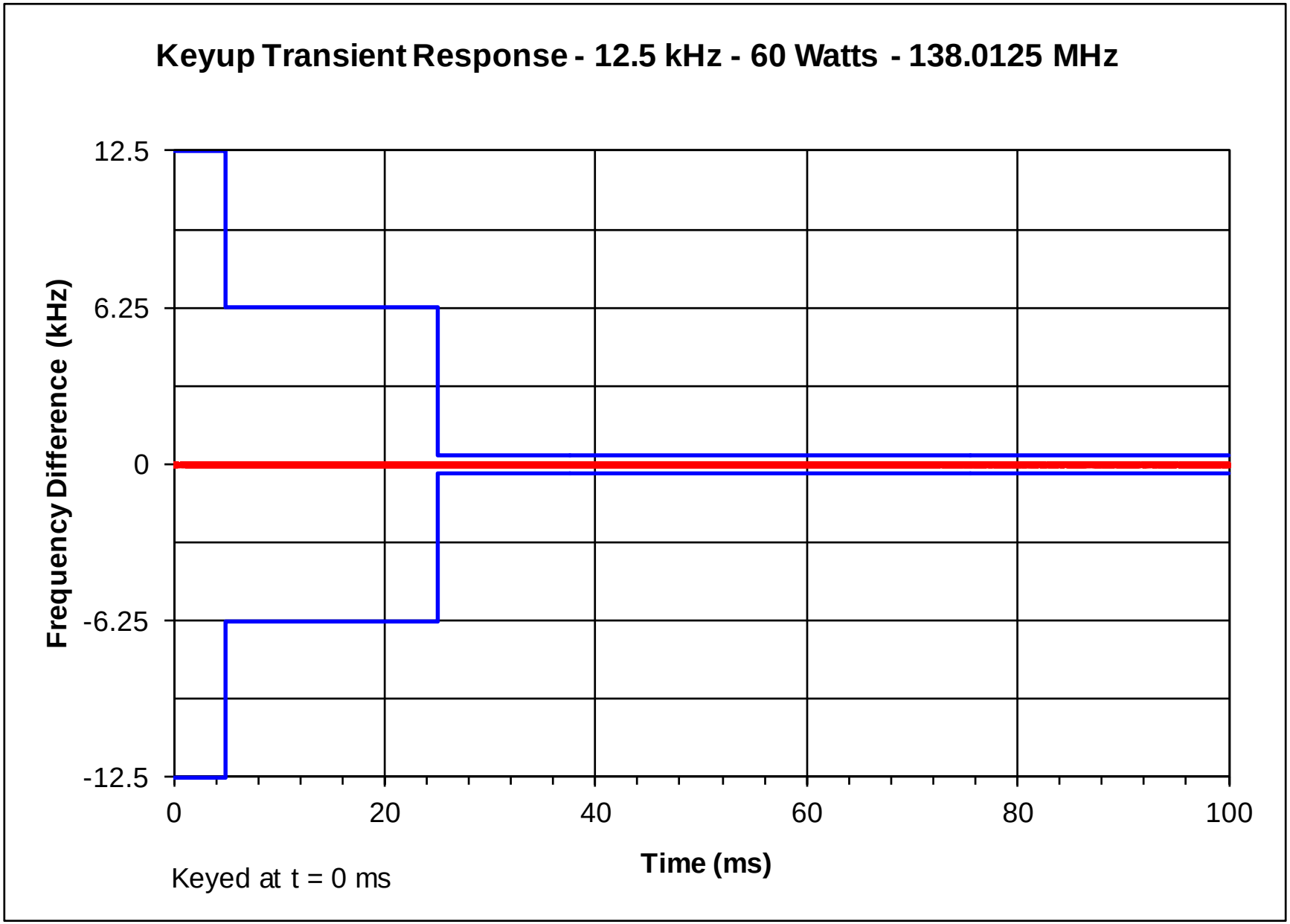
Report on Test Measurements

Frequency Transient – De-Key – 25 kHz Channels – High End of Band



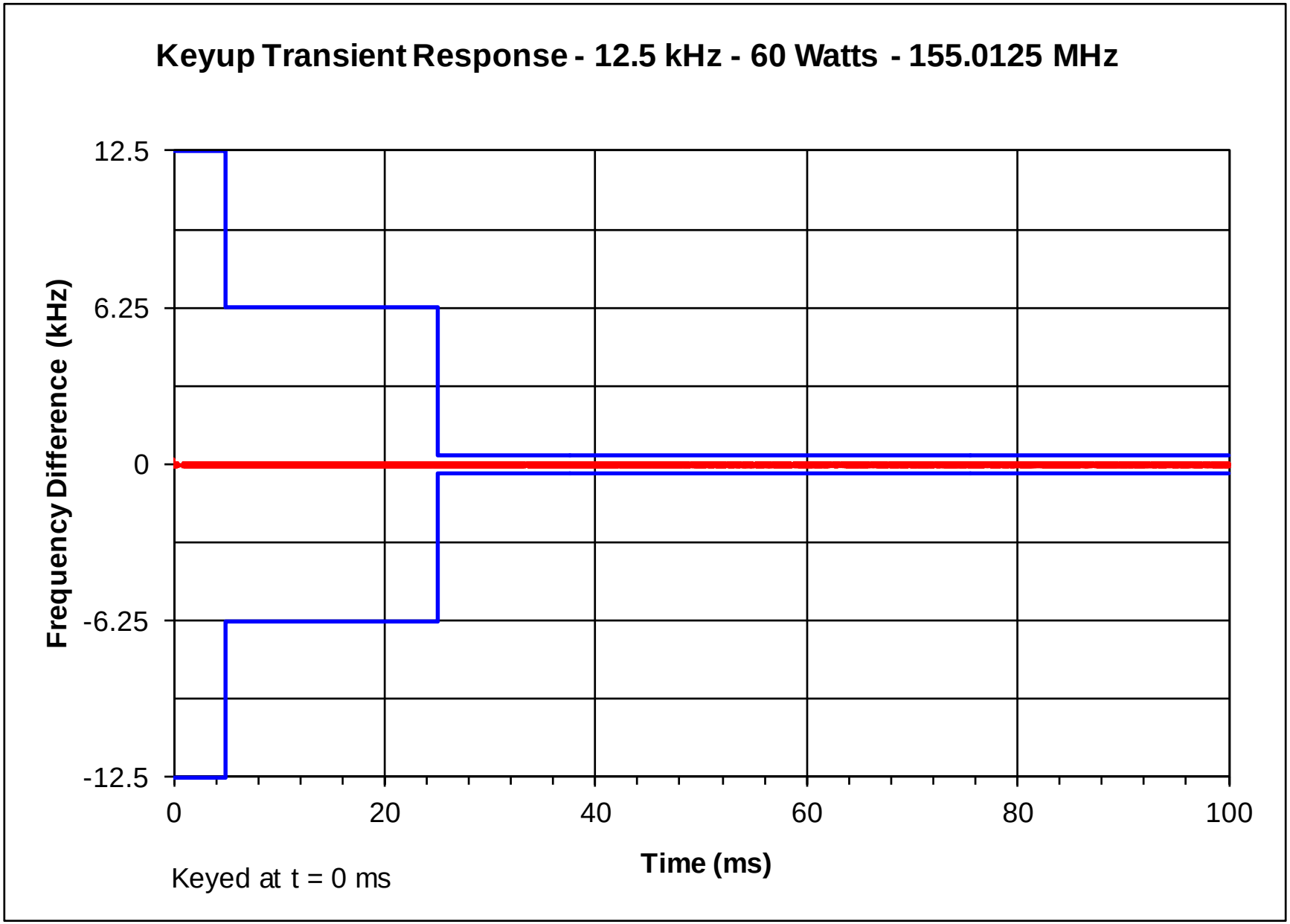
Report on Test Measurements

Frequency Transient – Key-Up – 12.5 kHz Channels – Low End of Band



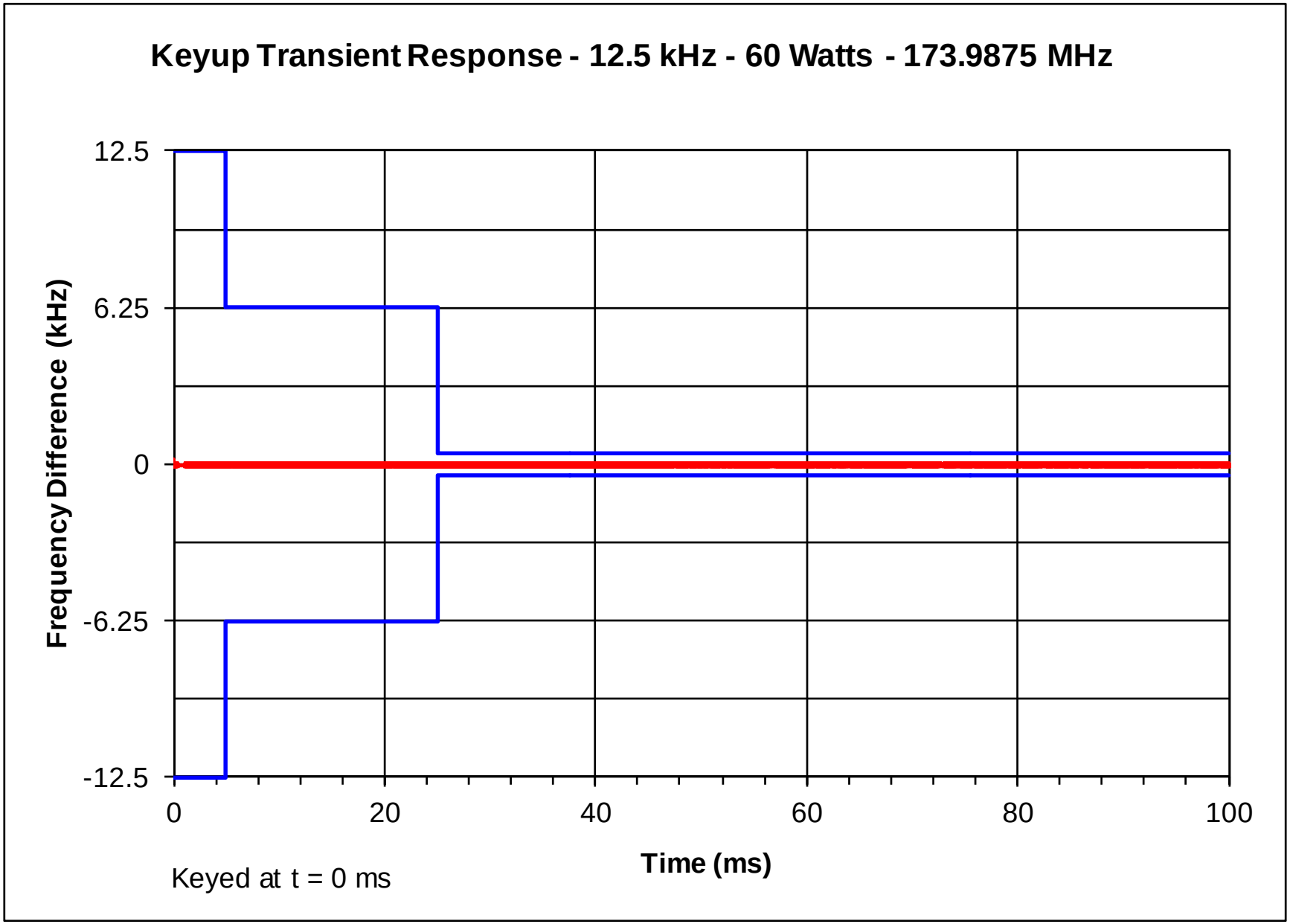
Report on Test Measurements

Frequency Transient – Key-Up – 12.5 kHz Channels – Middle of Band



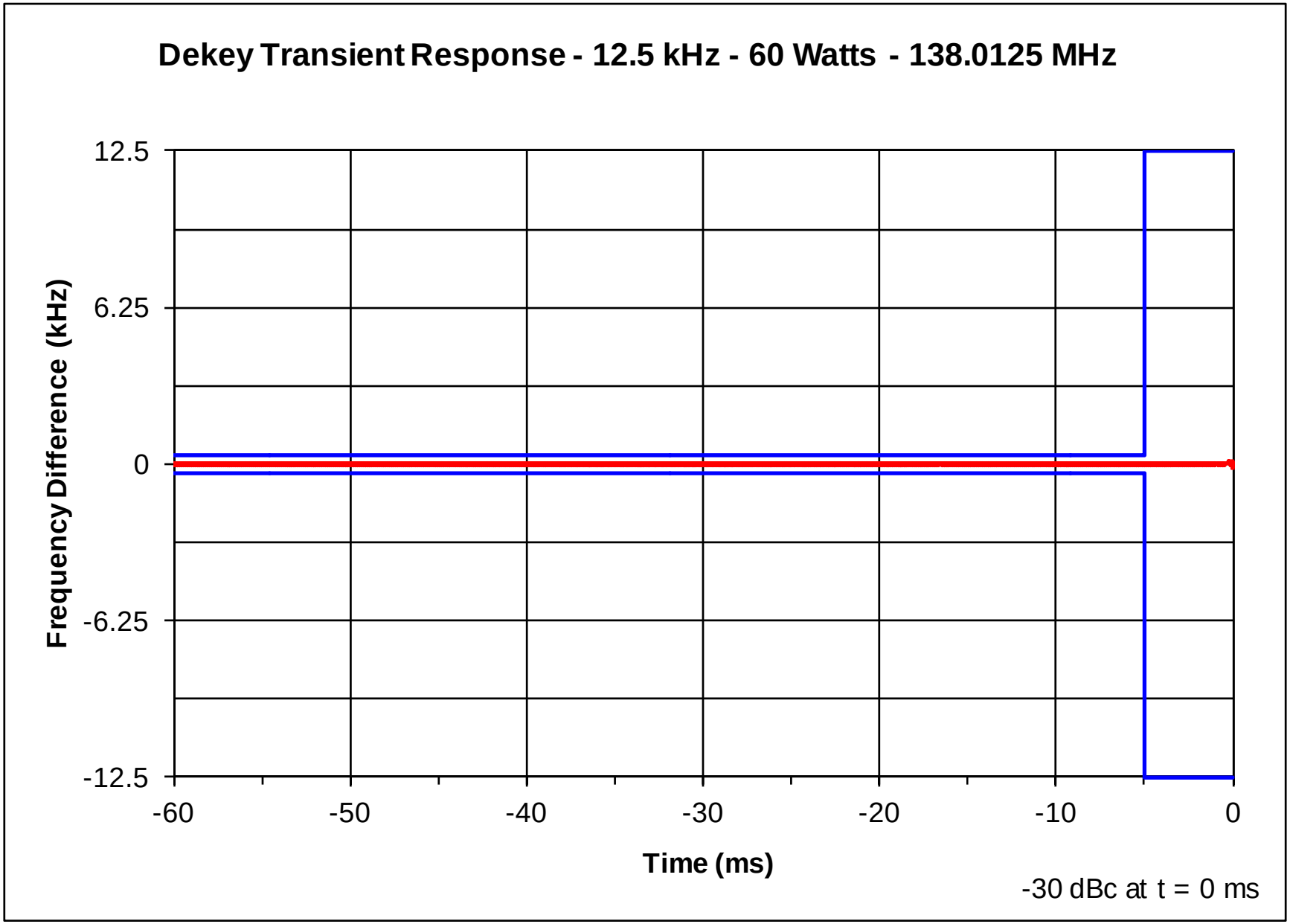
Report on Test Measurements

Frequency Transient – Key-Up – 12.5 kHz Channels – High End of Band



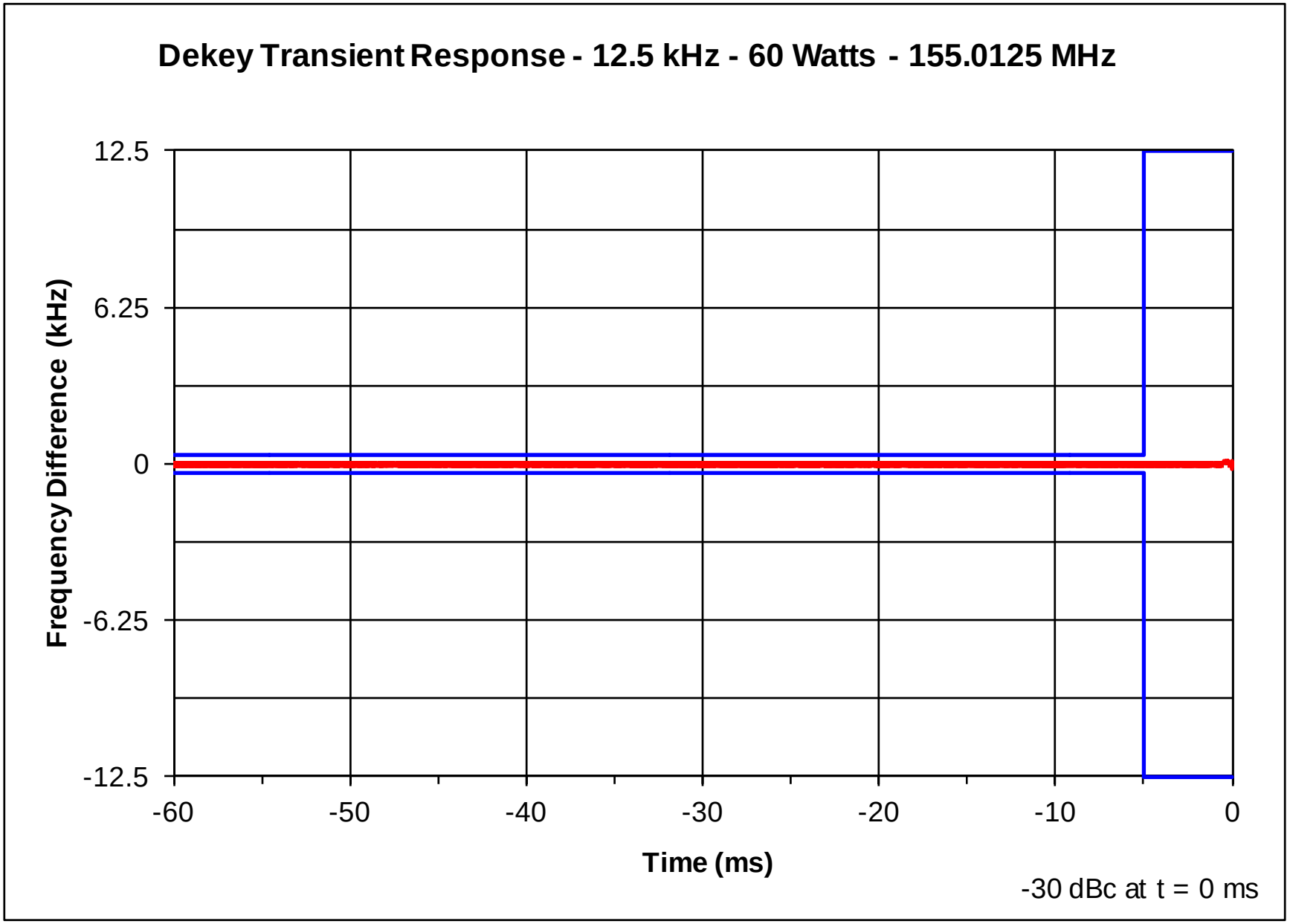
Report on Test Measurements

Frequency Transient – De-Key – 12.5 kHz Channels – Low End of Band



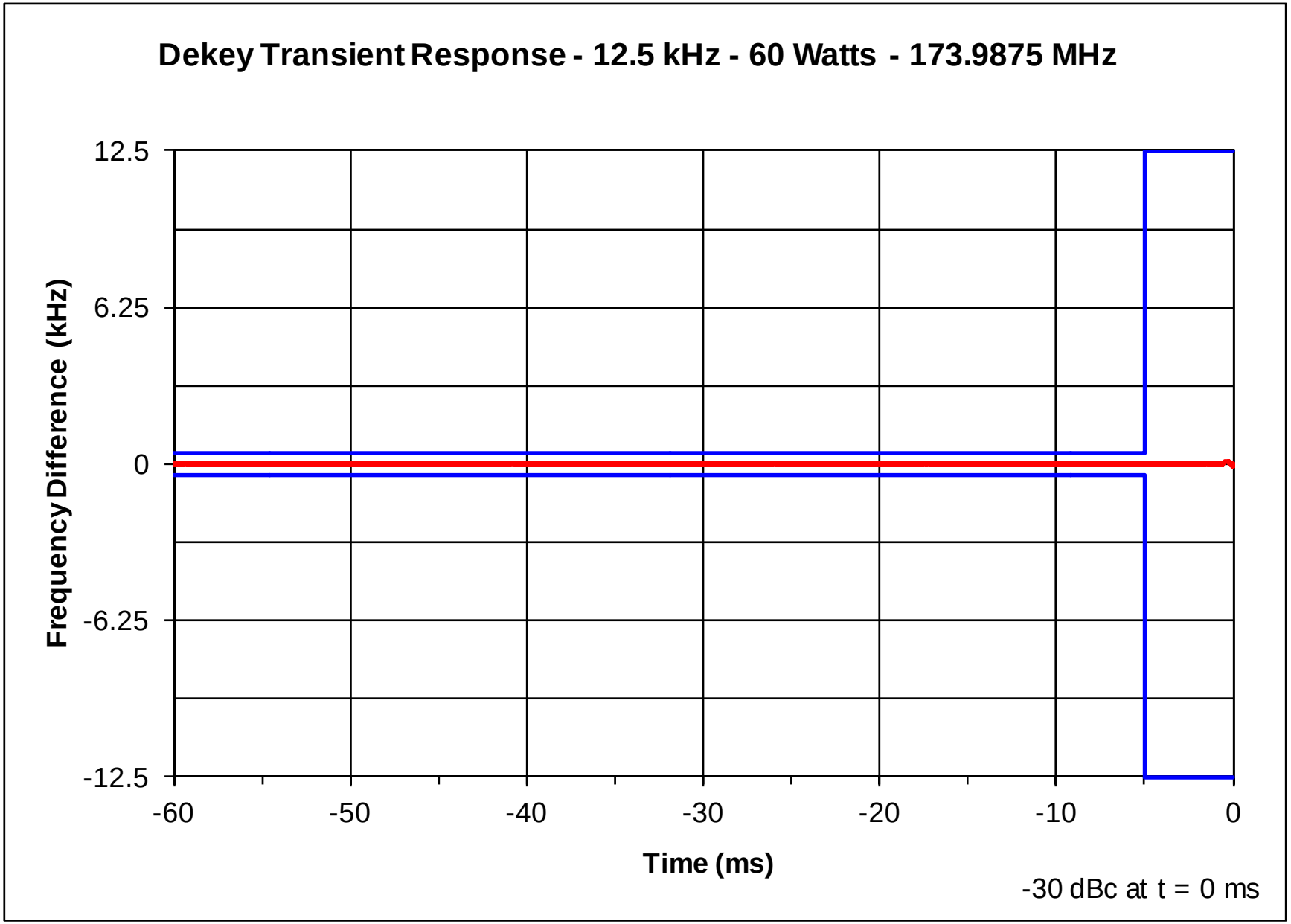
Report on Test Measurements

Frequency Transient – De-Key – 12.5 kHz Channels – Middle of Band



Report on Test Measurements

Frequency Transient – De-Key – 12.5 kHz Channels – High End of Band



Report on Test Measurements

Audio Frequency Response

Specification Requirement per TIA 603:
Audio Frequency Response, 25 kHz Channels*:* The audio frequency response from 300 Hz to 3000 Hz shall not vary more than +1 dB or -3 dB from a true 6 dB per octave pre-emphasis characteristic as referenced to the 1000 Hz level, with an additional 6 dB per octave attenuation allowed from 500 Hz to 300 Hz, and an additional 6 dB per octave attenuation is allowed from 2500 Hz to 3000 Hz in equipment operating in the 25 MHz to 869 MHz range.

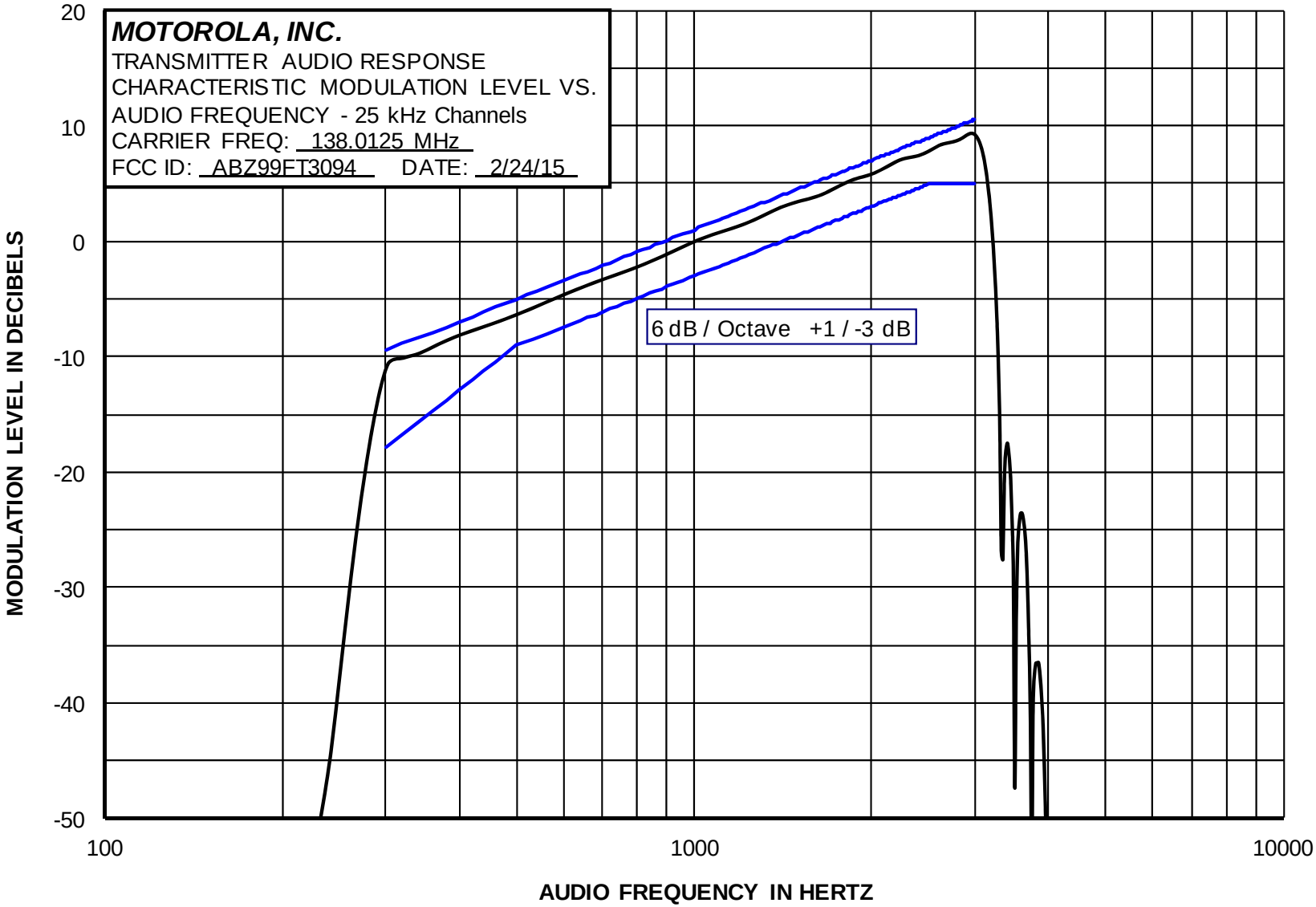
Audio Frequency Response, 12.5 kHz Channels*:* The audio frequency response from 300 Hz to 3000 Hz shall not vary more than +1 dB or -3 dB from a true 6 dB per octave pre-emphasis characteristic as referenced to the 1000 Hz level, with an additional 6 dB per octave attenuation allowed from 500 Hz to 300 Hz. An additional 6 dB per octave rolloff is allowed from 2300 Hz to 2700 Hz, and an additional 12 dB per octave is allowed from 2700 Hz to 3000 Hz in equipment operating in the 896 MHz to 940 MHz range or for 12.5 kHz channel operation.

Modulation:	Audio Test Tone
Carrier Frequency:	Performance was measured at carrier frequencies at the low end, middle, and high end of the operating band
Specification:	The specification limit is shown on the response plots

EXHIBIT	DESCRIPTION
E1-7.1	Audio Frequency Response – Modulation Characteristics, 25 kHz Channels – Low End of Band
E1-7.2	Audio Frequency Response – Modulation Characteristics, 25 kHz Channels – Middle of Band
E1-7.3	Audio Frequency Response – Modulation Characteristics, 25 kHz Channels – High End of Band
E1-7.4	Audio Frequency Response – Modulation Characteristics, 12.5 kHz Channels – Low End of Band
E1-7.5	Audio Frequency Response – Modulation Characteristics, 12.5 kHz Channels – Middle of Band
E1-7.6	Audio Frequency Response – Modulation Characteristics, 12.5 kHz Channels – High End of Band

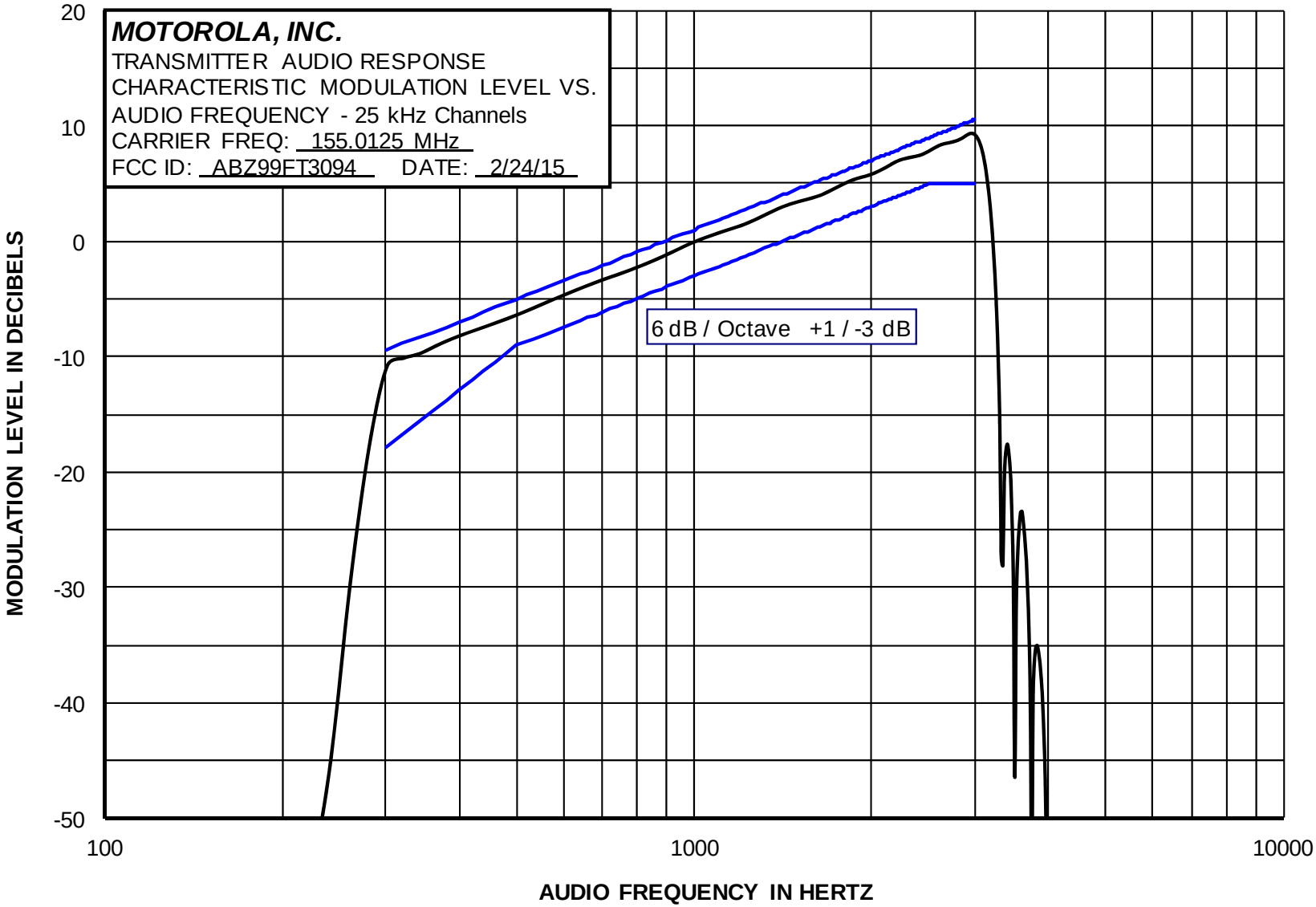
Report on Test Measurements

Audio Frequency Response – 25 kHz Channels – Low End of Band



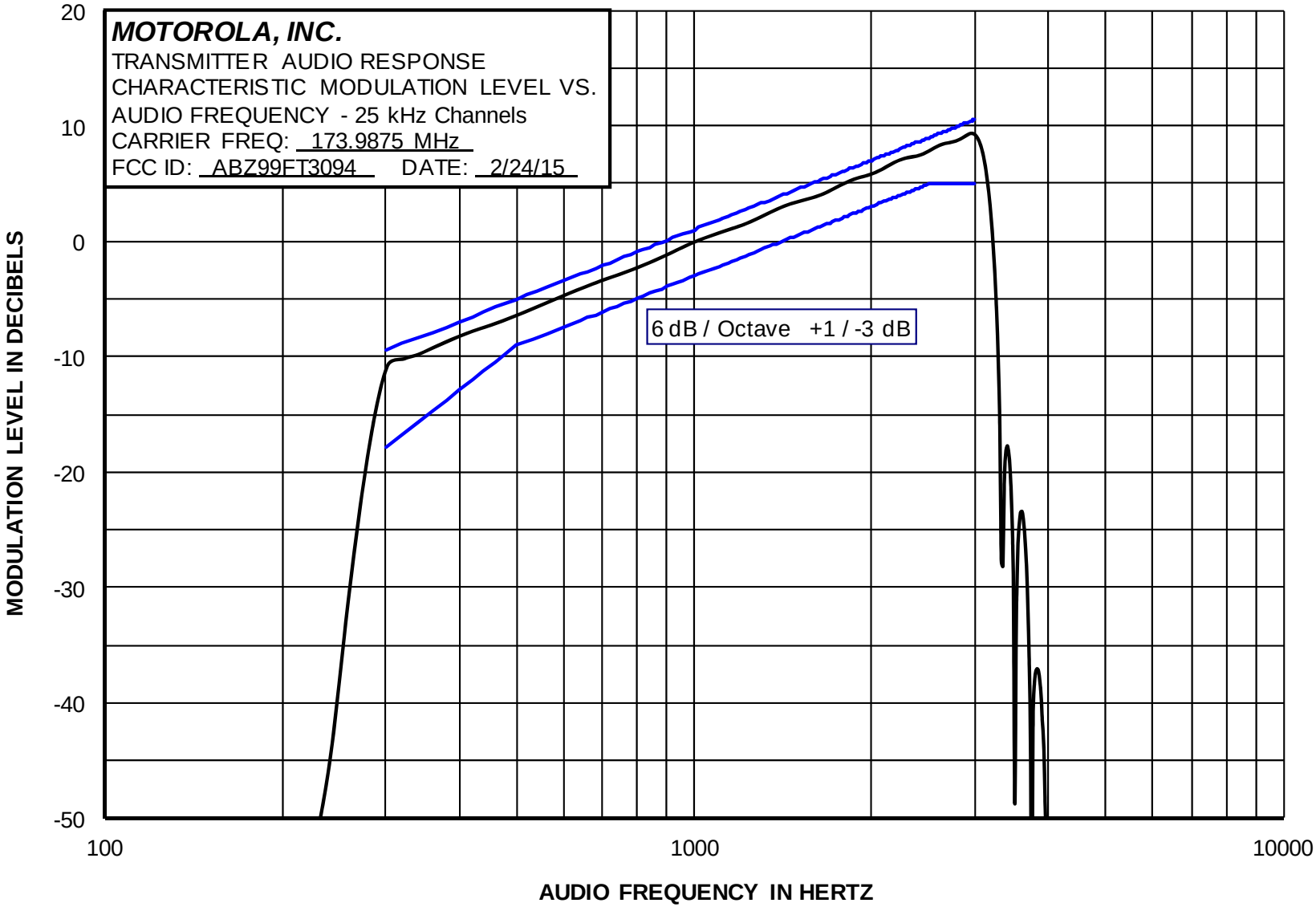
Report on Test Measurements

Audio Frequency Response – 25 kHz Channels – Middle of Band



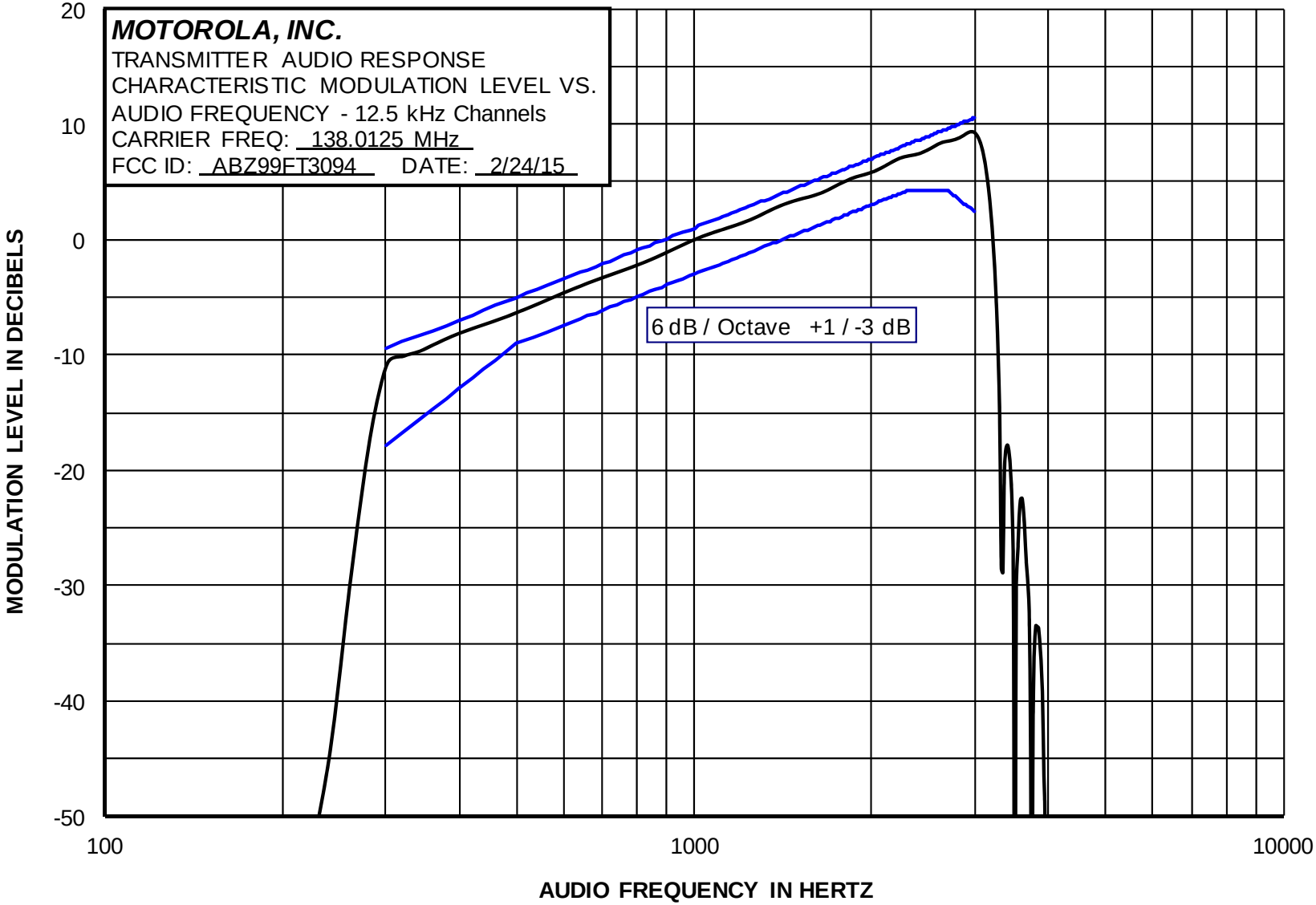
Report on Test Measurements

Audio Frequency Response – 25 kHz Channels – High End of Band



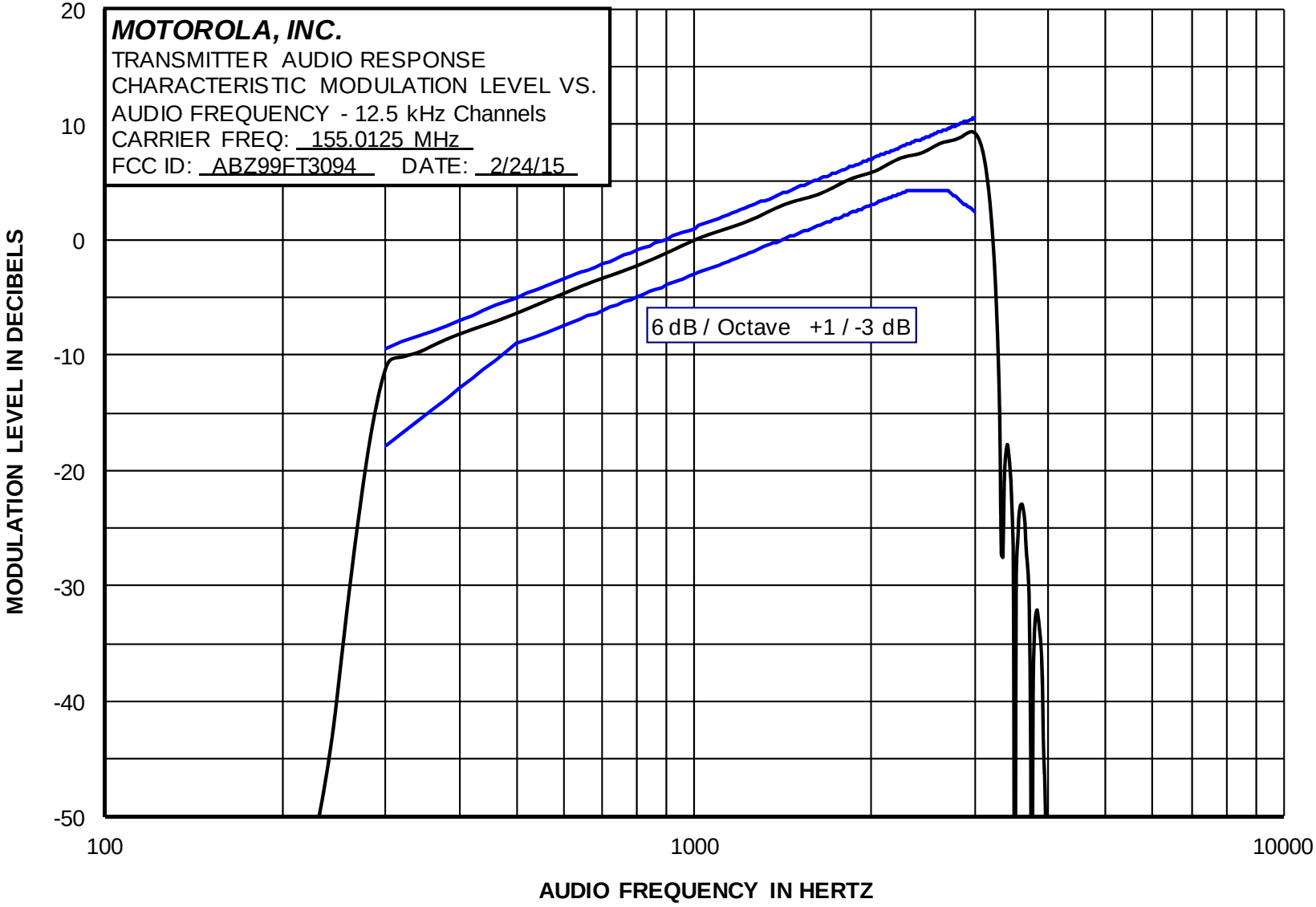
Report on Test Measurements

Audio Frequency Response – 12.5 kHz Channels – Low End of Band



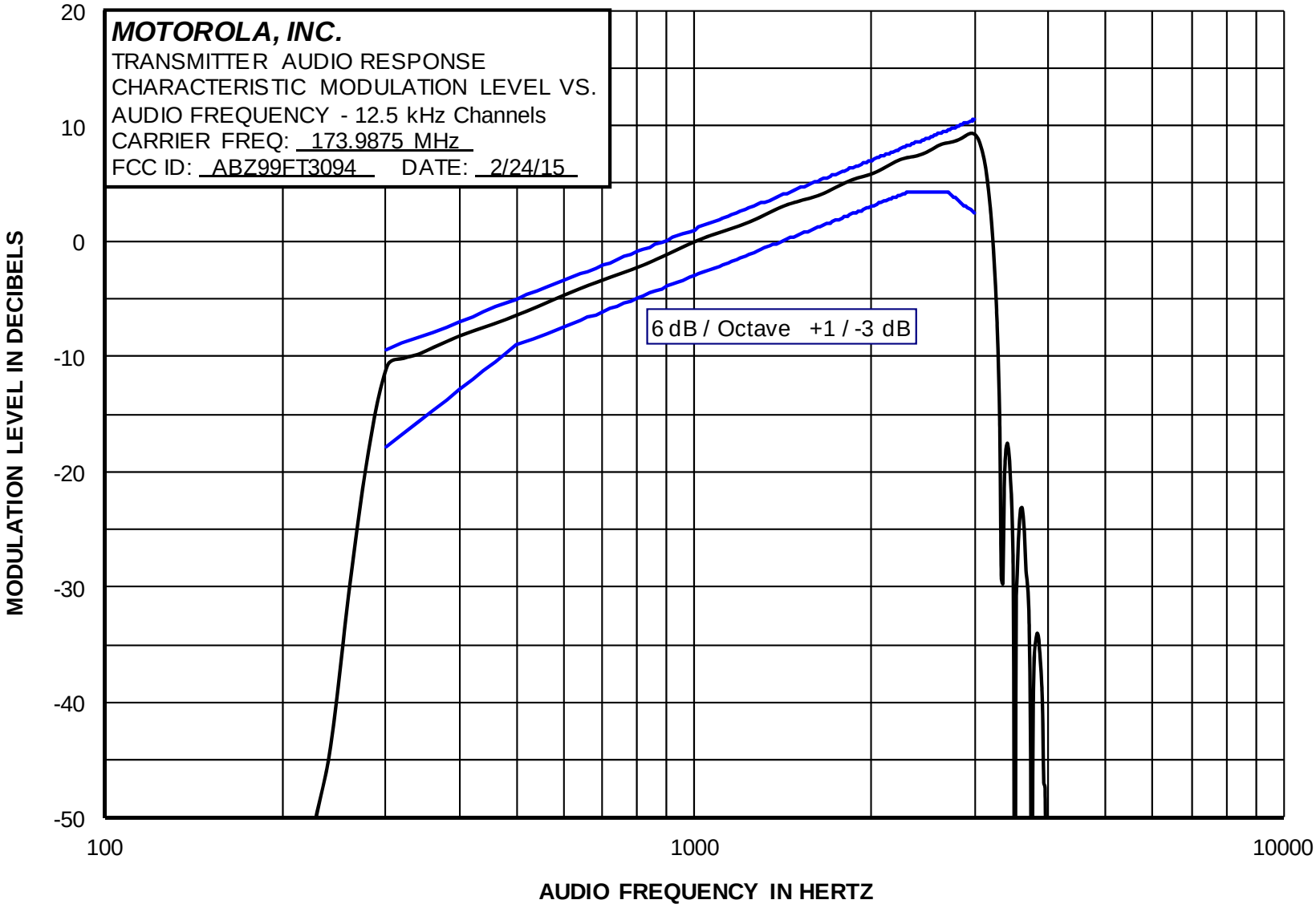
Report on Test Measurements

Audio Frequency Response – 12.5 kHz Channels – Middle of Band



Report on Test Measurements

Audio Frequency Response – 12.5 kHz Channels– High End of Band



Report on Test Measurements

Modulation Limiting

Specification Requirement per TIA 603:
Modulation Limiting, 25 kHz Channels*:* The maximum instantaneous peak and steady state deviations shall not exceed the rated system deviation of +/- 5 kHz at any audio frequency or change in level as specified in the method of measurement.

The minimum value of modulation limiting shall be at least 60% of the rated system deviation, or 3 kHz.

Modulation Limiting, 12.5 kHz Channels*:* The maximum instantaneous peak and steady state deviations shall not exceed the rated system deviation of +/- 2.5 kHz at any audio frequency or change in level as specified in the method of measurement.

The minimum value of modulation limiting shall be at least 60% of the rated system deviation, or 1.5 kHz.

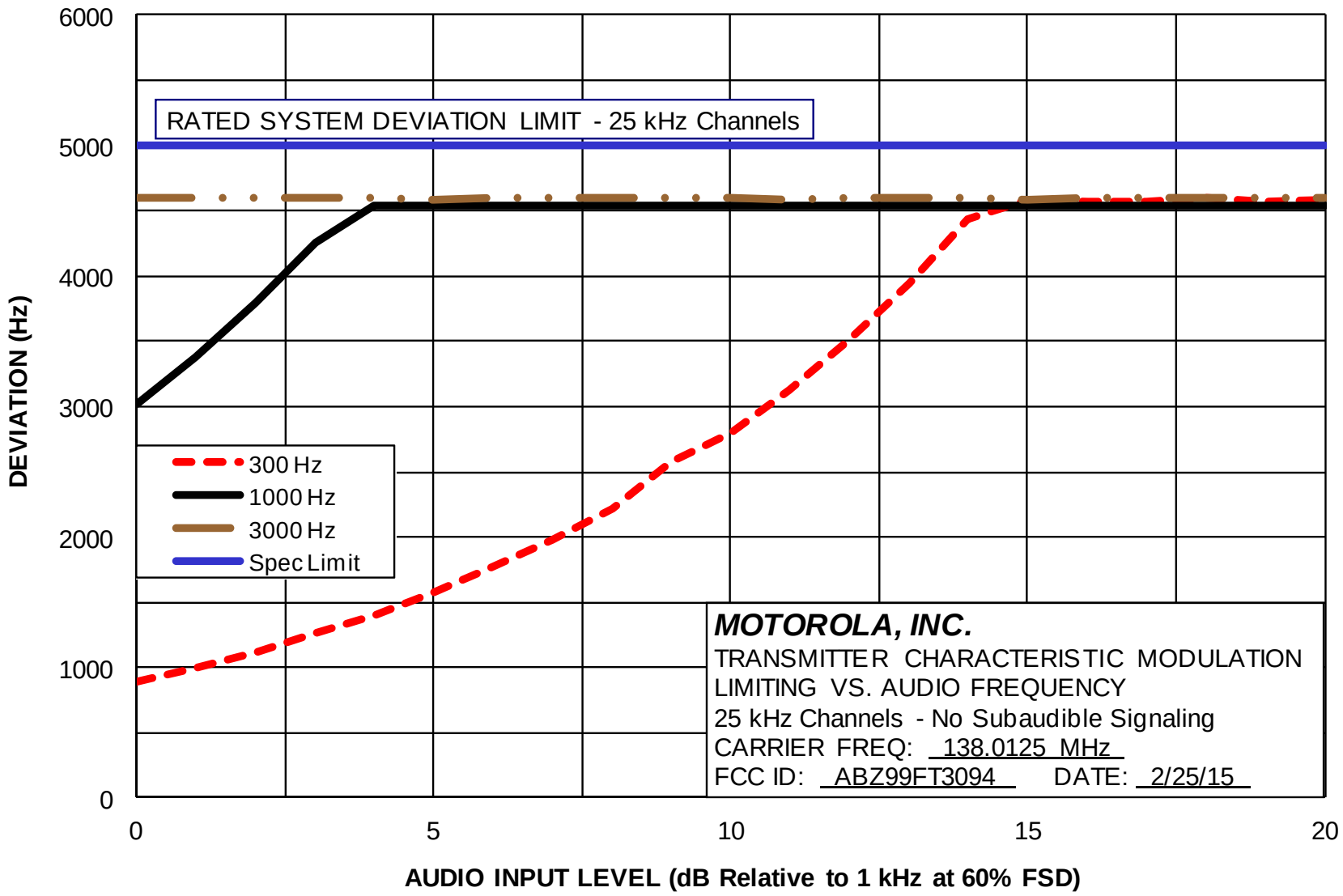
Modulation:	Audio Test Tone, Varying Frequency between 300 Hz and 3000 Hz
Carrier Frequency:	Performance was measured at carrier frequencies at the low end, middle, and high end of the operating band
Specification:	5 kHz max for 25 kHz channels, 2.5 kHz max for 12.5 kHz channels as shown on charts

Modulation Limiting Response Plots:

EXHIBIT	DESCRIPTION
E1-8.1	Audio Modulation Limiting – Modulation Characteristics, 25 kHz Channels – Low End of Band
E1-8.2	Audio Modulation Limiting – Modulation Characteristics, 25 kHz Channels – Middle of Band
E1-8.3	Audio Modulation Limiting – Modulation Characteristics, 25 kHz Channels – High End of Band
E1-8.4	Audio Modulation Limiting – Modulation Characteristics, 12.5 kHz Channels – Low End of Band
E1-8.5	Audio Modulation Limiting – Modulation Characteristics, 12.5 kHz Channels – Middle of Band
E1-8.6	Audio Modulation Limiting – Modulation Characteristics, 12.5 kHz Channels – High End of Band

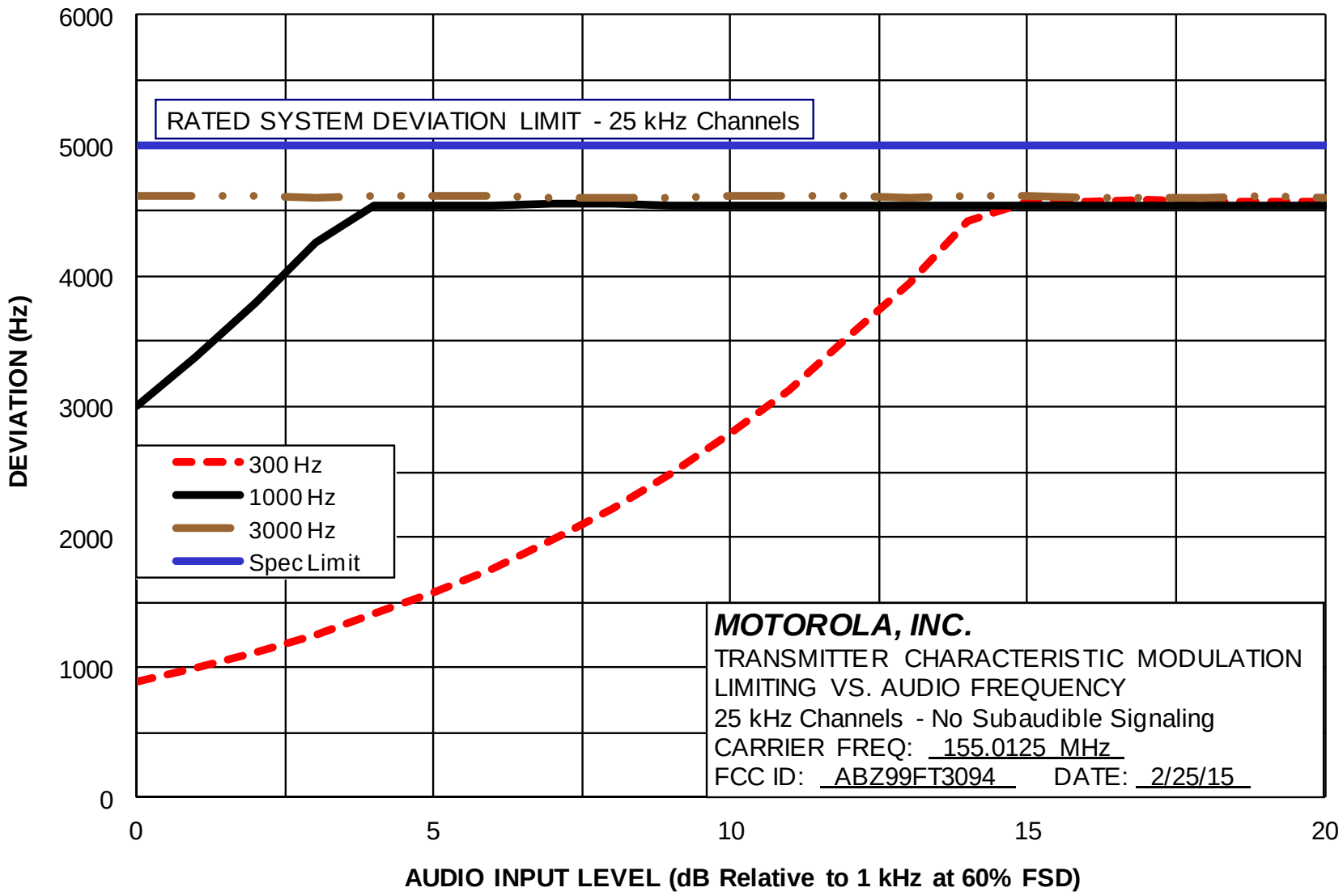
Report on Test Measurements

Modulation Limiting – 25 kHz Channels – Low End of Band



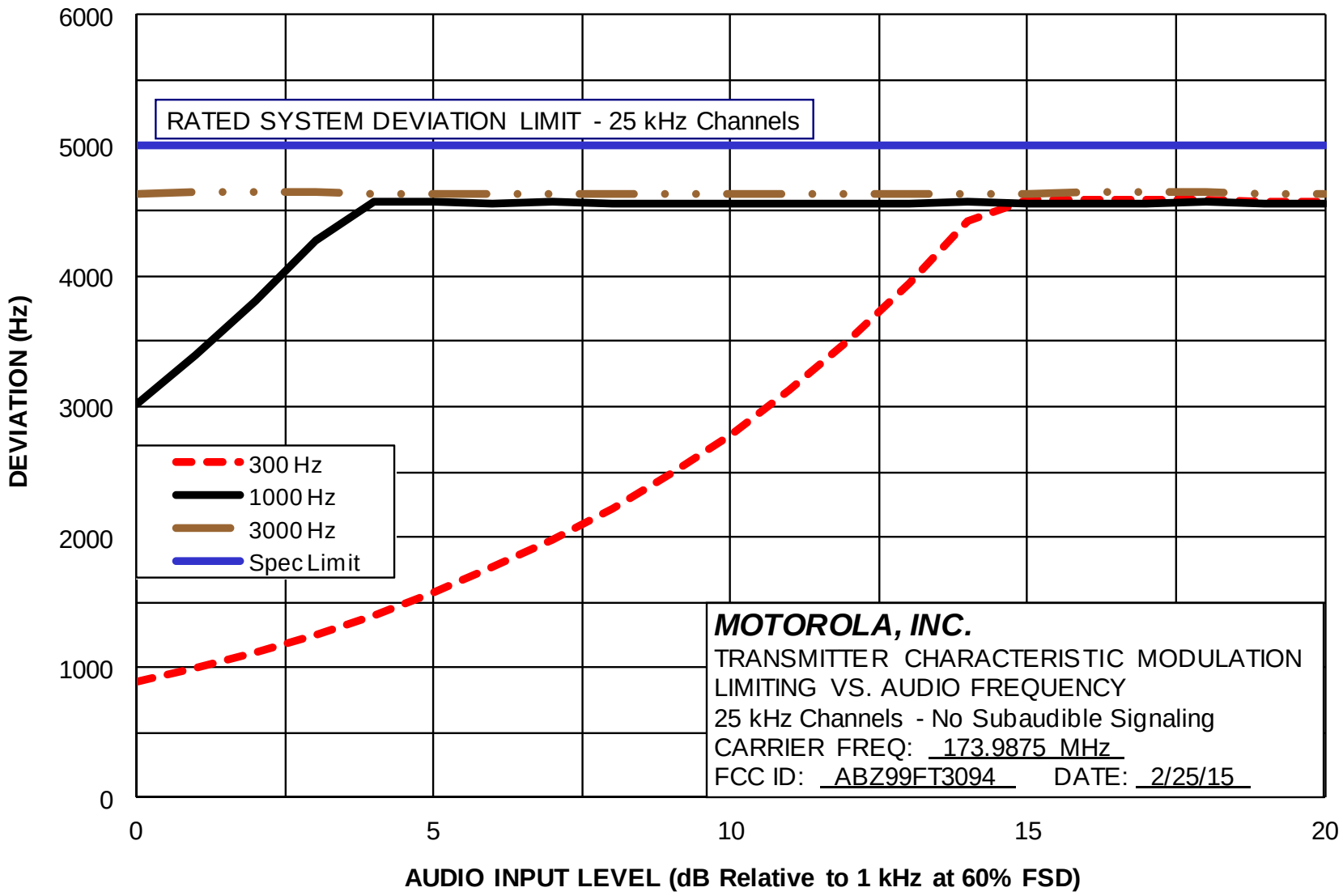
Report on Test Measurements

Modulation Limiting – 25 kHz Channels – Middle of Band



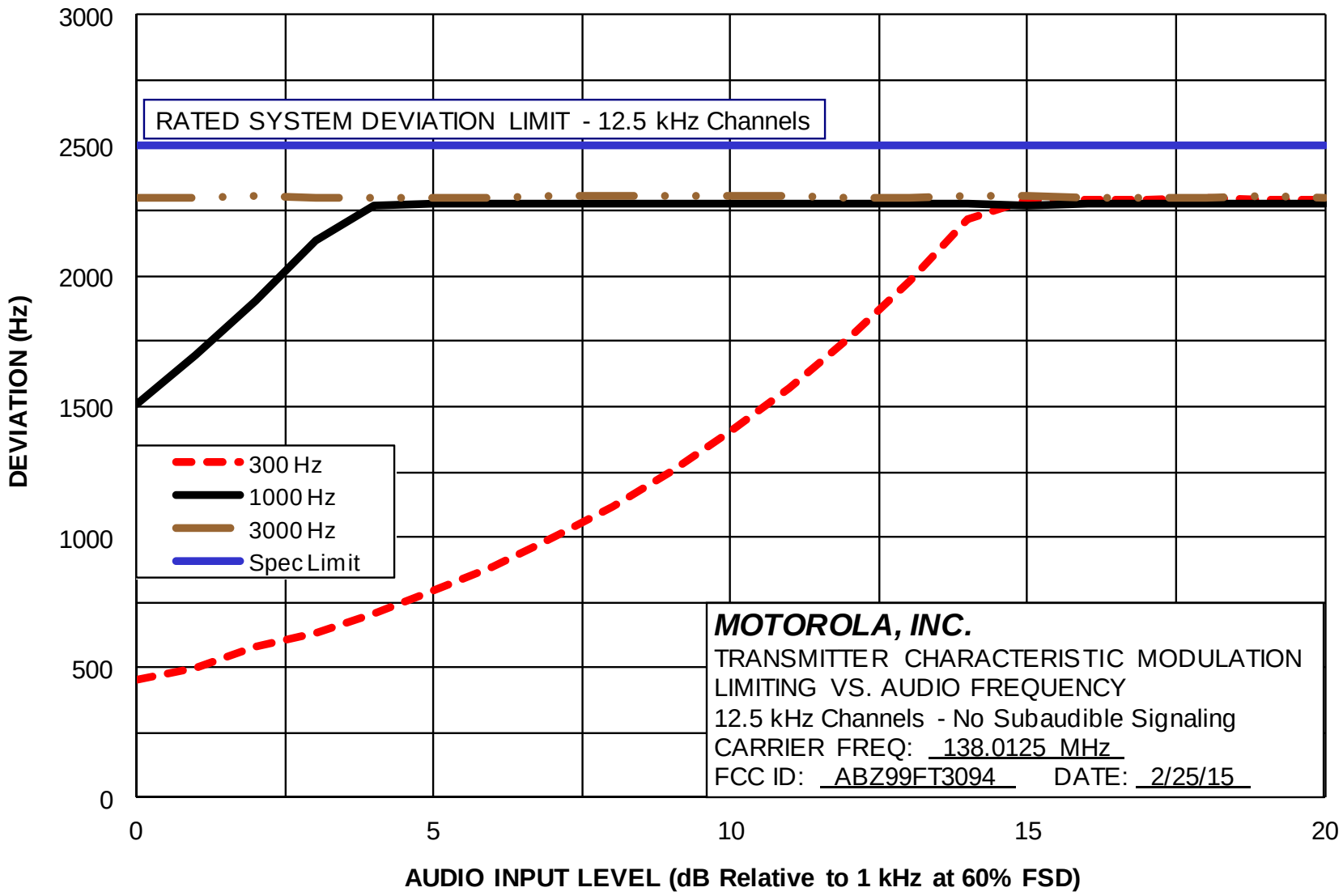
Report on Test Measurements

Modulation Limiting – 25 kHz Channels – High End of Band



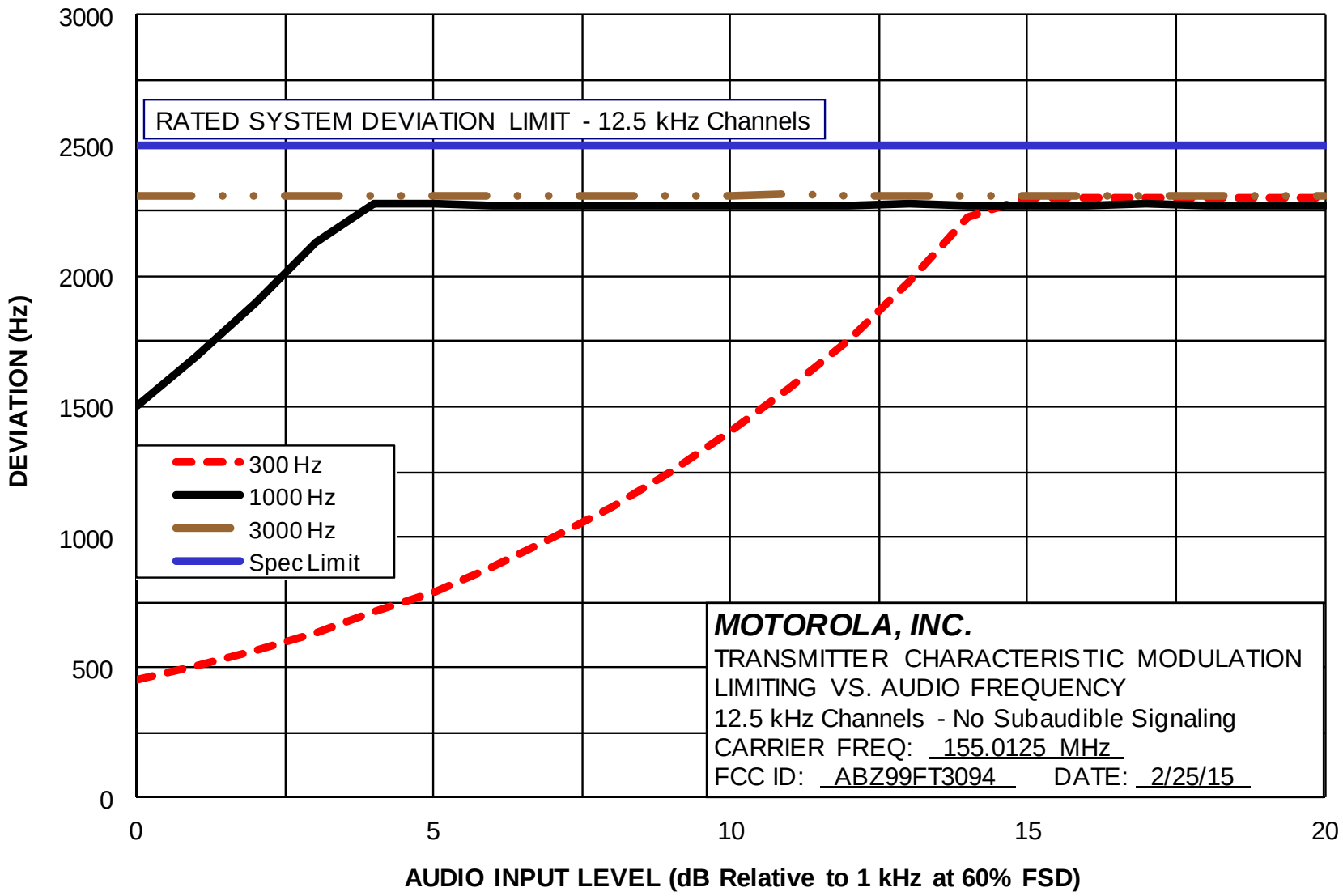
Report on Test Measurements

Modulation Limiting – 12.5 kHz Channels – Low End of Band



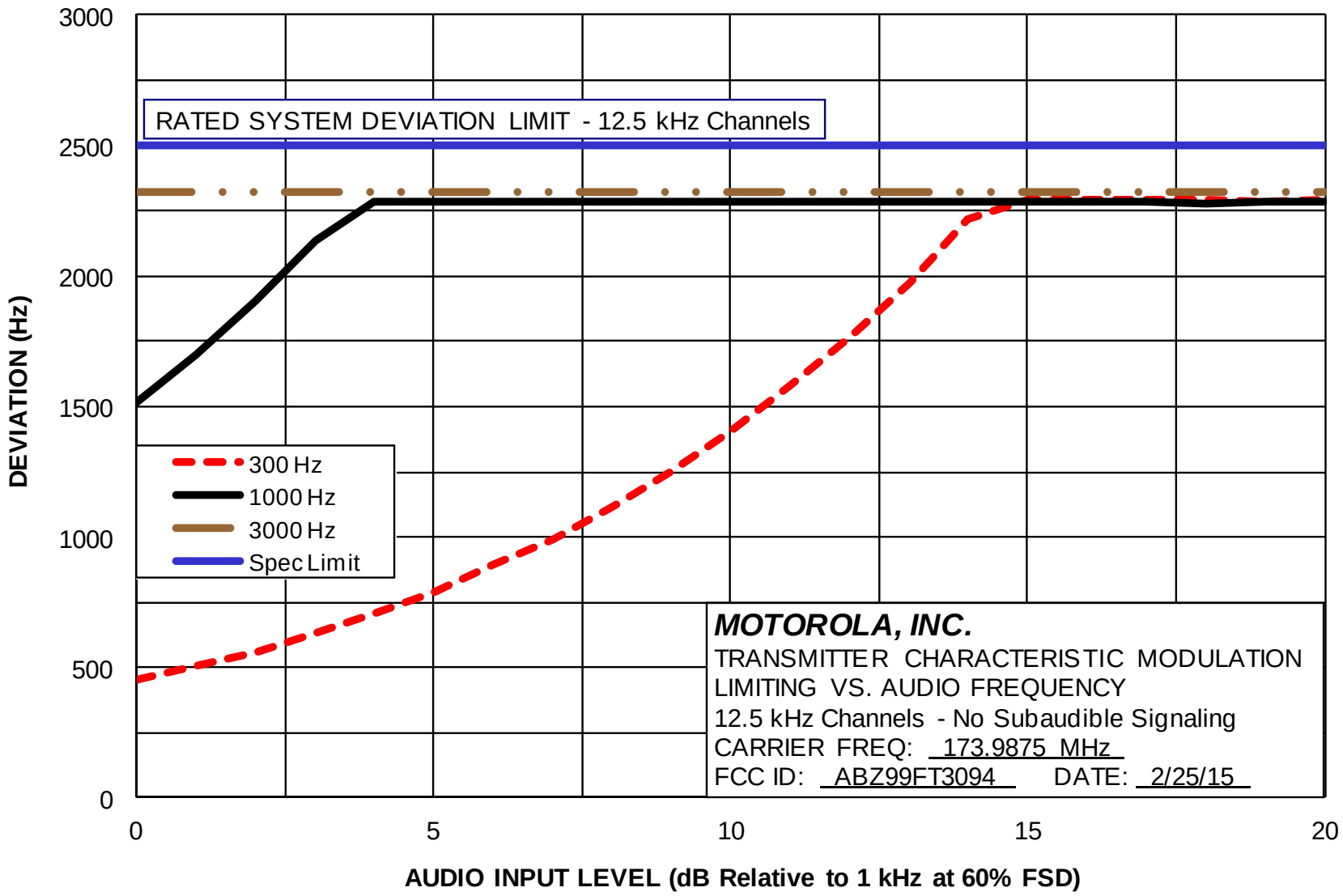
Report on Test Measurements

Modulation Limiting – 12.5 kHz Channels – Middle of Band



Report on Test Measurements

Modulation Limiting – 12.5 kHz Channels – High End of Band



Report on Test Measurements

Occupied Bandwidth – Analog Voice Frequency Modulation, 25 kHz Channel Spacing
The exhibits in this section show occupied bandwidth plots for analog voice modulation. Data is shown with the modulating audio tone itself, the tone plus Private Line (PL) sub-audible tone signaling, and tone plus Digital Private Line (DPL) sub-audible signaling. PL is a Continuous Tone Coded Squelch System (CTCSS), a method of using low frequency sub audible tones to share a single radio channel among multiple users. DPL is a digital version of Private Line.

The occupied bandwidth charts reference the following setup and specification requirements.

Modulation Type:	Analog Voice
Emission Designator:	16K0F3E
Channelization:	25 kHz
Deviation Limit:	±5.0 kHz Max
Power Setting:	60 Watts

Specification Requirement 47 CFR §90.210(b) and IC RSS-119 section 5.8.1 - Emission Limits – "B-Mask":
For transmitters equipped with an audio low pass filter and designed to operate with a 25 kHz channel spacing (authorized bandwidth 20 kHz), the power of any emission must be below the unmodulated carrier power (P) as follows:

On any frequency removed from the assigned frequency by a displacement frequency (F_d in kHz) of:

a)	>10 kHz up to and including 20 kHz	*At least 25 dB;*
b)	>20 kHz up to and including 50 kHz	*At least 35 dB;*
c)	>50 kHz	*at least 43+10 * Log_{10} (P) dB.*

Necessary Bandwidth Calculation:
The necessary bandwidth of the modulation per the formulas defined in 47 CFR §2.202(g) / TRC-43 section 8 is as follows:

Max Mod Freq, M	*Max Deviation, D*	*2*(M+D)*	*Nec BW*
3 kHz	5 kHz	16 kHz	16K0

Measurement Procedure and Instrument Settings:

Emission Measurement Analyzer Settings

Horizontal:	12.5 kHz per Division	Resolution BW:	300 Hz
Vertical:	10 dB per Division	Video BW:	10 kHz
Sweep Time:	72 Seconds (<2 kHz/Sec)	Span:	125 kHz
Detector:	Peak		

Measured Occupied Bandwidth

Resolution BW:	300 Hz
Span:	125 kHz
Number of Points:	6401
Integration Time:	7.3875 ms

Test Procedure:
1) Key the station with no modulation to obtain the unmodulated carrier reference level on the analyzer. Use the analyzer controls to set this reference to a full-scale reference line. Store this analyzer trace in trace A.
2) Modulate the transmitter with a 2500 Hz sine wave at an input level 16 dB greater than that necessary to produce 50% of rated system deviation.
3) Allow the analyzer to sweep, and record the resultant emission levels in trace B.
4) Plot the resulting analyzer trace. The occupied bandwidth mask is then added along with additional labeling as appropriate.
5) Adjust the signal analyzer resolution BW and span as indicated above, use the Occupied Bandwidth function to record the value.

EXHIBIT	**DESCRIPTION**	**Meas Occ BW: No PL PL DPL**
E1-9.1, 2, 3	Occupied Bandwidth, Analog, 25 kHz Channels, Low End of Band	15.06, 13.48, 13.37 kHz
E1-9.4, 5, 6	Occupied Bandwidth, Analog, 25 kHz Channels, Middle of Band	15.07, 13.57, 13.42 kHz
E1-9.7, 8, 9	Occupied Bandwidth, Analog, 25 kHz Channels, High End of Band	15.07, 13.70, 13.49 kHz

Report on Test Measurements

Occupied Bandwidth – Analog Voice Frequency Modulation, 12.5 kHz Channel Spacing
The exhibits in this section show occupied bandwidth plots for analog voice modulation. Data is shown with the modulating audio tone itself, the tone plus Private Line (PL) sub-audible tone signaling, and tone plus Digital Private Line (DPL) sub-audible signaling. PL is a Continuous Tone Coded Squelch System (CTCSS), a method of using low frequency sub audible tones to share a single radio channel among multiple users. DPL is a digital version of Private Line.

The occupied bandwidth charts reference the following setup and specification requirements.

Modulation Type:	Analog Voice
Emission Designator:	11K0F3E
Channelization:	12.5 kHz
Deviation Limit:	±2.5 kHz Max
Power Setting:	60 Watts

Specification Requirement 47 CFR §90.210(d) and IC RSS-119 section 5.8.3 - Emission Limits – "D-Mask":
Emission *Mask D.* For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth (f_0) to 5.625 kHz removed from f_0: *Zero dB*

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: *At least 7.27 *(f_d –2.88 kHz) dB*

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: *At least 50 plus 10 $\log_{10}$(P) dB or 70 dB, whichever is the lesser attenuation.*

(4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide to capture the true peak emission of the equipment under test. In order to show compliance with the emissions mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to ensure that the emission profile is developed.

Necessary Bandwidth Calculation (Analog Emission):
The necessary bandwidth of the modulation signal per the formulas defined in 47 CFR 2.202 (b) is as follows:

Max Mod Freq, M	*Max Deviation, D*	*2*(M+D)*	*Nec BW*
3 kHz	2.5 kHz	11 kHz	11K0

Measurement Procedure and Instrument Settings:

Emission Measurement Analyzer Settings

Horizontal:	12.5 kHz per Division	Resolution BW:	100 Hz
Vertical:	10 dB per Division	Video BW:	10 kHz
Sweep Time:	72 Seconds (<2 kHz/Sec)	Span:	125 kHz
Detector:	Peak		

Measured Occupied Bandwidth

Resolution BW:	100 Hz
Span:	125 kHz
Number of Points:	6401
Integration Time:	22.156 ms

(continued next page)

Report on Test Measurements

Occupied Bandwidth –12.5 kHz Channel Spacing (continued)

Test Procedure (Analog Voice):

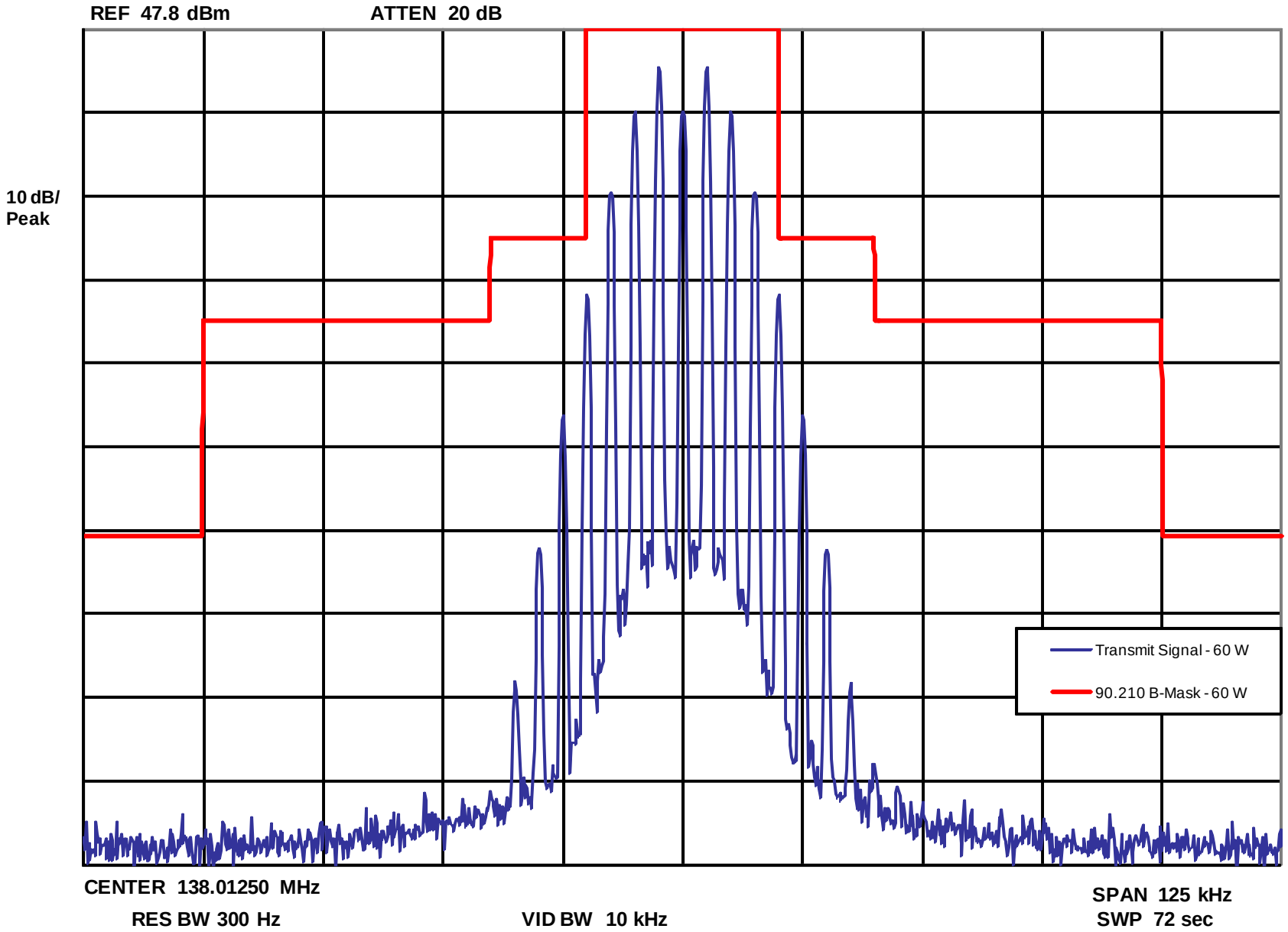
1) Key the station with no modulation to obtain the unmodulated carrier reference level on the analyzer. Use the analyzer controls to set this reference to a full-scale reference line. Store this analyzer trace in trace A.
2) Modulate the transmitter with a 2500 Hz sine wave at an input level 16 dB greater than that necessary to produce 50% of rated system deviation.
3) Allow the analyzer to sweep, and record the resultant emission levels in trace B.
4) Plot the resulting analyzer trace. The occupied bandwidth mask is then added along with additional labeling as appropriate.
5) Adjust the signal analyzer resolution BW and span as indicated above, use the Occupied Bandwidth function to record the value.

EXHIBIT	DESCRIPTION	Meas Occ BW: No PL PL DPL
E1-9.10, 11, 12	Occupied Bandwidth, Analog, 12.5 kHz Channels, Low End of Band	10.00, 9.31, 9.17 kHz
E1-9.13, 14, 15	Occupied Bandwidth, Analog, 12.5 kHz Channels, Middle of Band	10.00, 9.33, 9.19 kHz
E1-9.16, 17, 18	Occupied Bandwidth, Analog, 12.5 kHz Channels, High End of Band	10.01, 9.37, 9.21 kHz

Report on Test Measurements

Occupied Bandwidth – Carrier with 2500 Hz Audio Tone, 25 kHz Channels – Emission Designator: 16K0F3E – Low End of Band

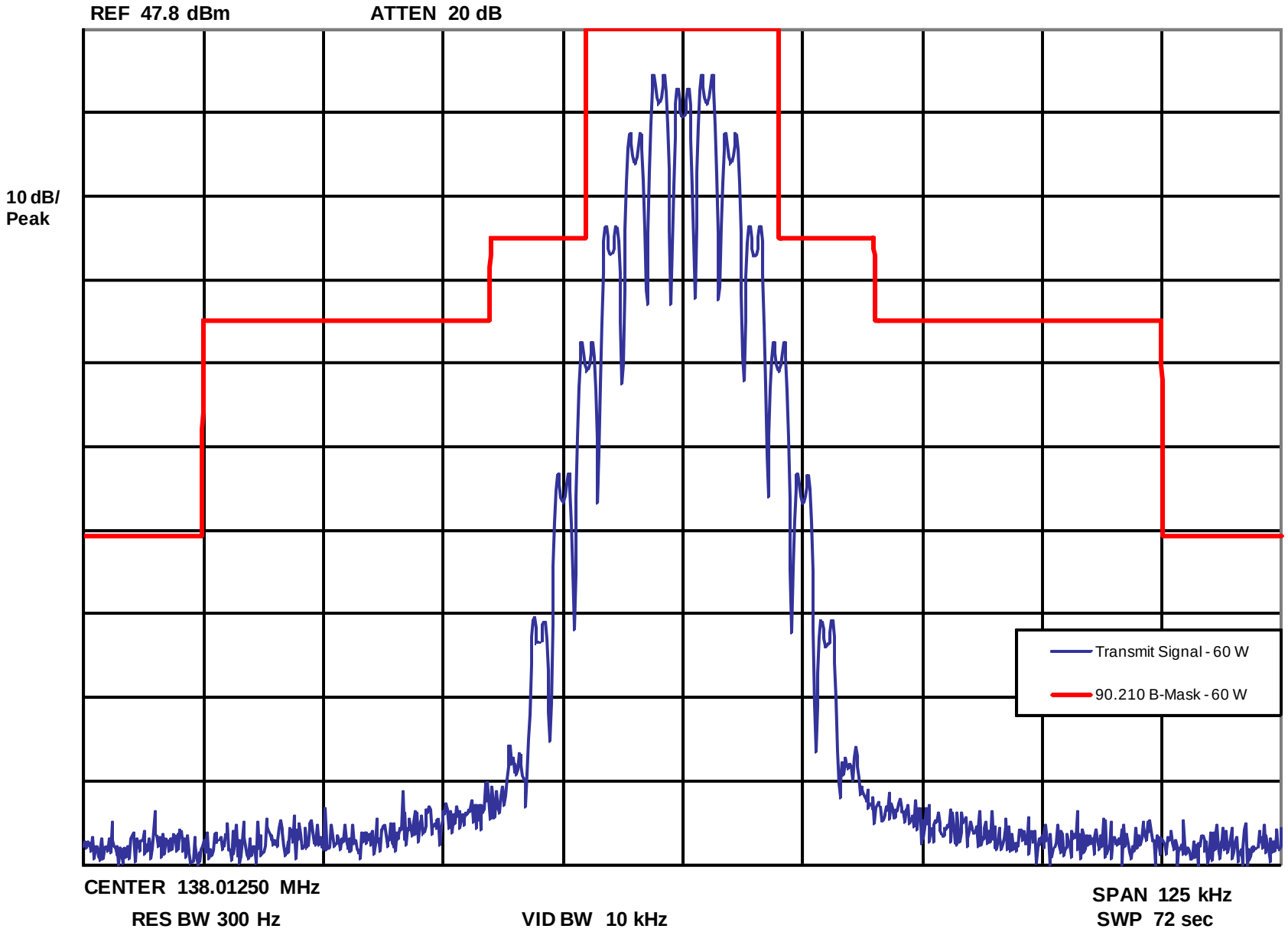
Occupied Bandwidth - 25 kHz Channels - Carrier with 2500 Hz Audio Tone



Report on Test Measurements

Occupied Bandwidth – Carrier with 2500 Hz Audio Tone and Private Line (PL) Signaling, 25 kHz Channels – Emission Designator: 16K0F3E – Low End of Band

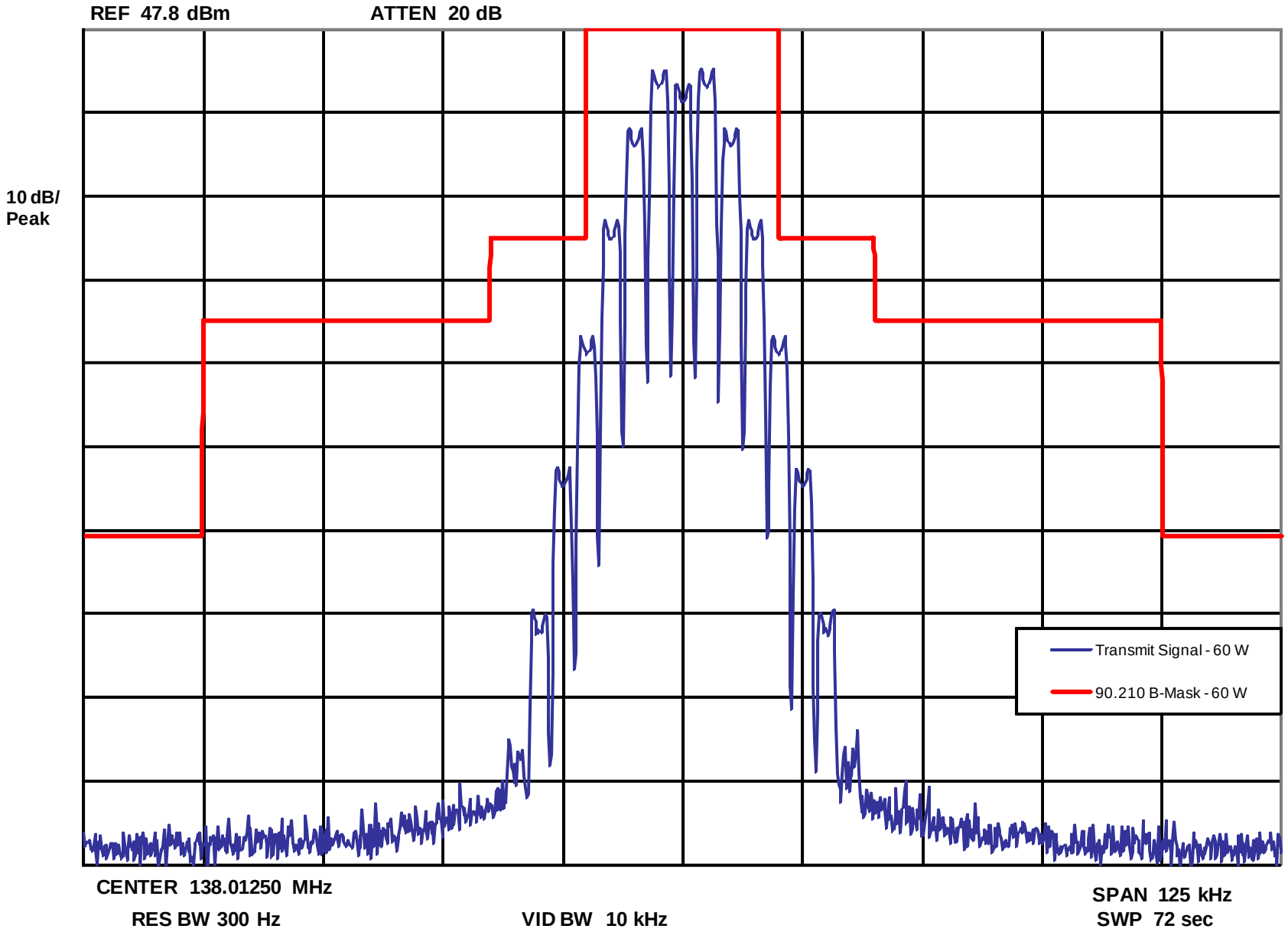
Occupied Bandwidth - 25 kHz Channels - Carrier with 2500 Hz Audio and 123 Hz PL



Report on Test Measurements

Occupied Bandwidth – Carrier with 2500 Hz Tone and Digital Private Line (DPL) Signaling, 25 kHz Channels – Emission Designator: 16K0F3E – Low End of Band

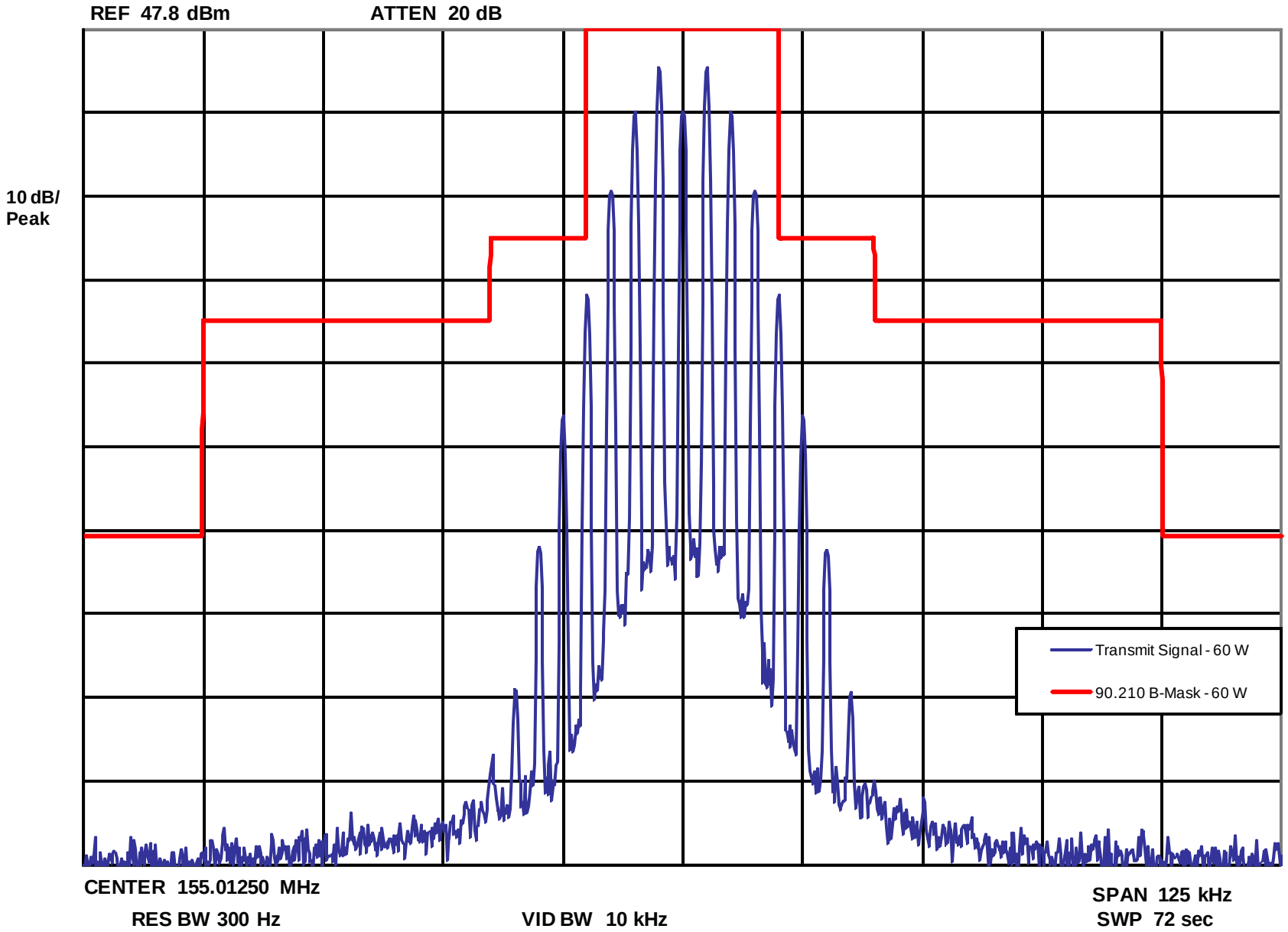
Occupied Bandwidth - 25 kHz Channels - Carrier with 2500 Hz Audio and 627 DPL



Report on Test Measurements

Occupied Bandwidth – Carrier with 2500 Hz Audio Tone, 25 kHz Channels – Emission Designator: 16K0F3E – Middle of Band

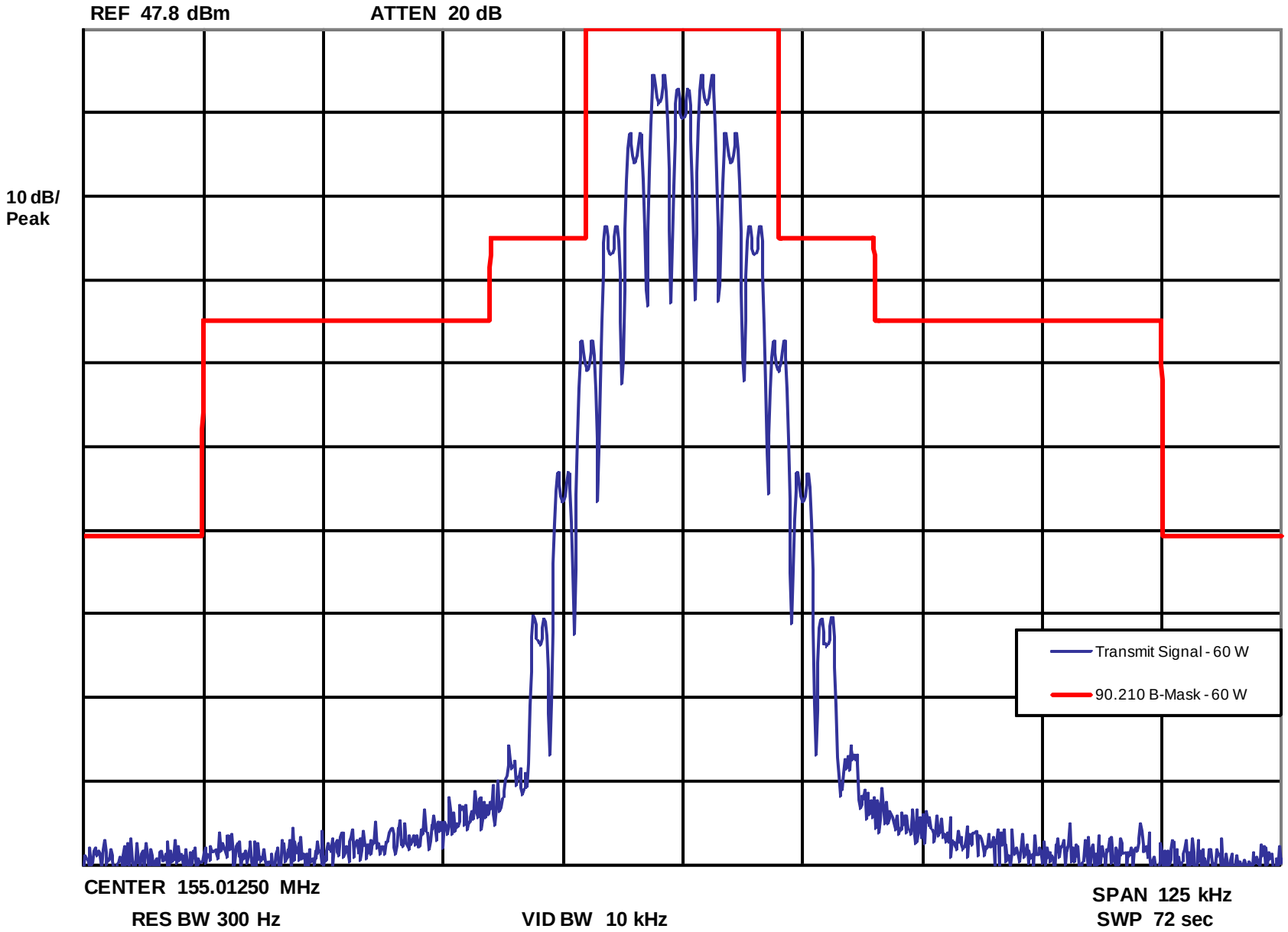
Occupied Bandwidth - 25 kHz Channels - Carrier with 2500 Hz Audio Tone



Report on Test Measurements

Occupied Bandwidth – Carrier with 2500 Hz Audio Tone and Private Line (PL) Signaling, 25 kHz Channels – Emission Designator: 16K0F3E – Middle of Band

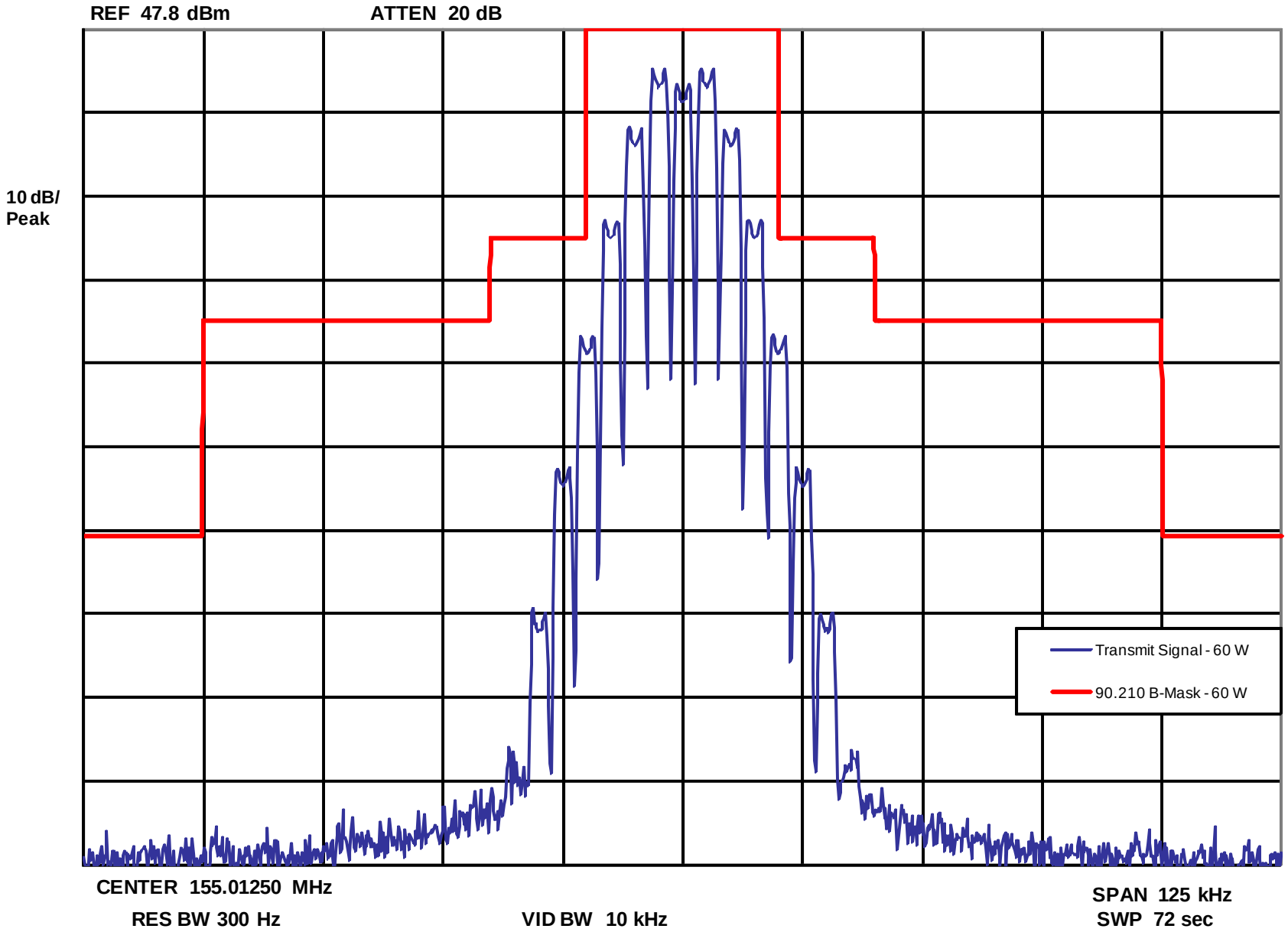
Occupied Bandwidth - 25 kHz Channels - Carrier with 2500 Hz Audio and 123 Hz PL



Report on Test Measurements

Occupied Bandwidth – Carrier with 2500 Hz Tone and Digital Private Line (DPL) Signaling, 25 kHz Channels – Emission Designator: 16K0F3E – Middle of Band

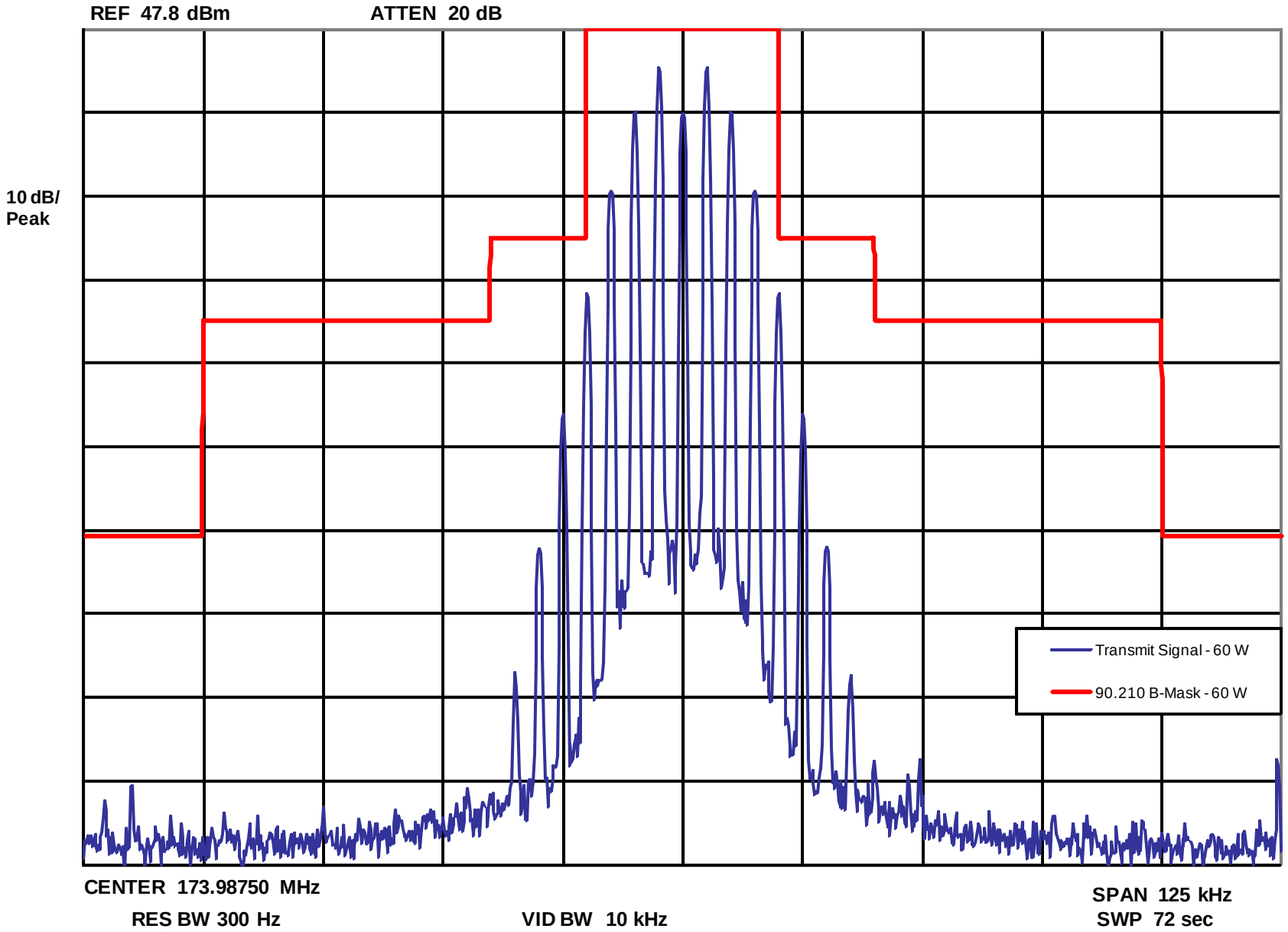
Occupied Bandwidth - 25 kHz Channels - Carrier with 2500 Hz Audio and 627 DPL



Report on Test Measurements

Occupied Bandwidth – Carrier with 2500 Hz Audio Tone, 25 kHz Channels – Emission Designator: 16K0F3E – High End of Band

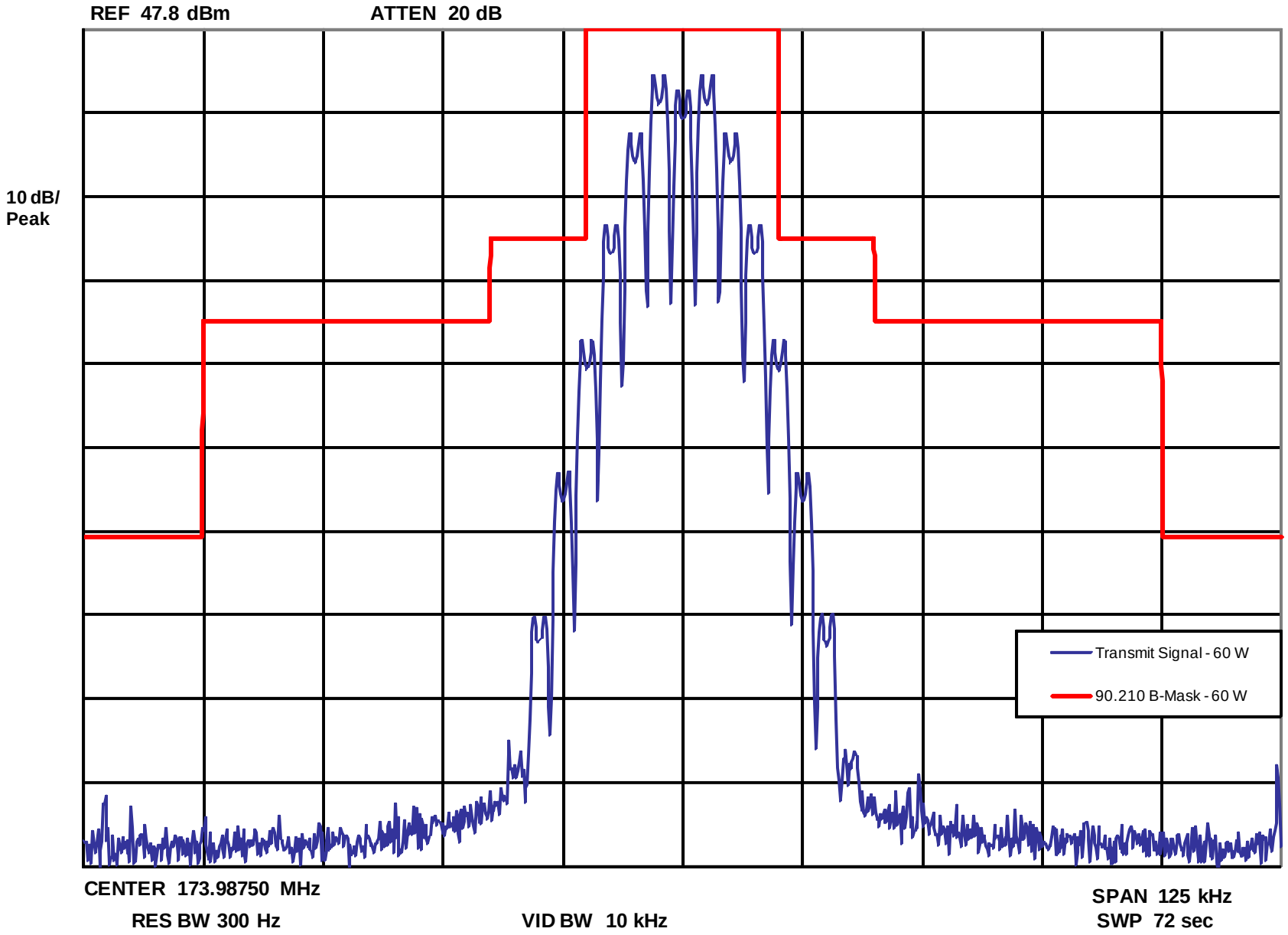
Occupied Bandwidth - 25 kHz Channels - Carrier with 2500 Hz Audio Tone



Report on Test Measurements

Occupied Bandwidth – Carrier with 2500 Hz Audio Tone and Private Line (PL) Signaling, 25 kHz Channels – Emission Designator: 16K0F3E – High End of Band

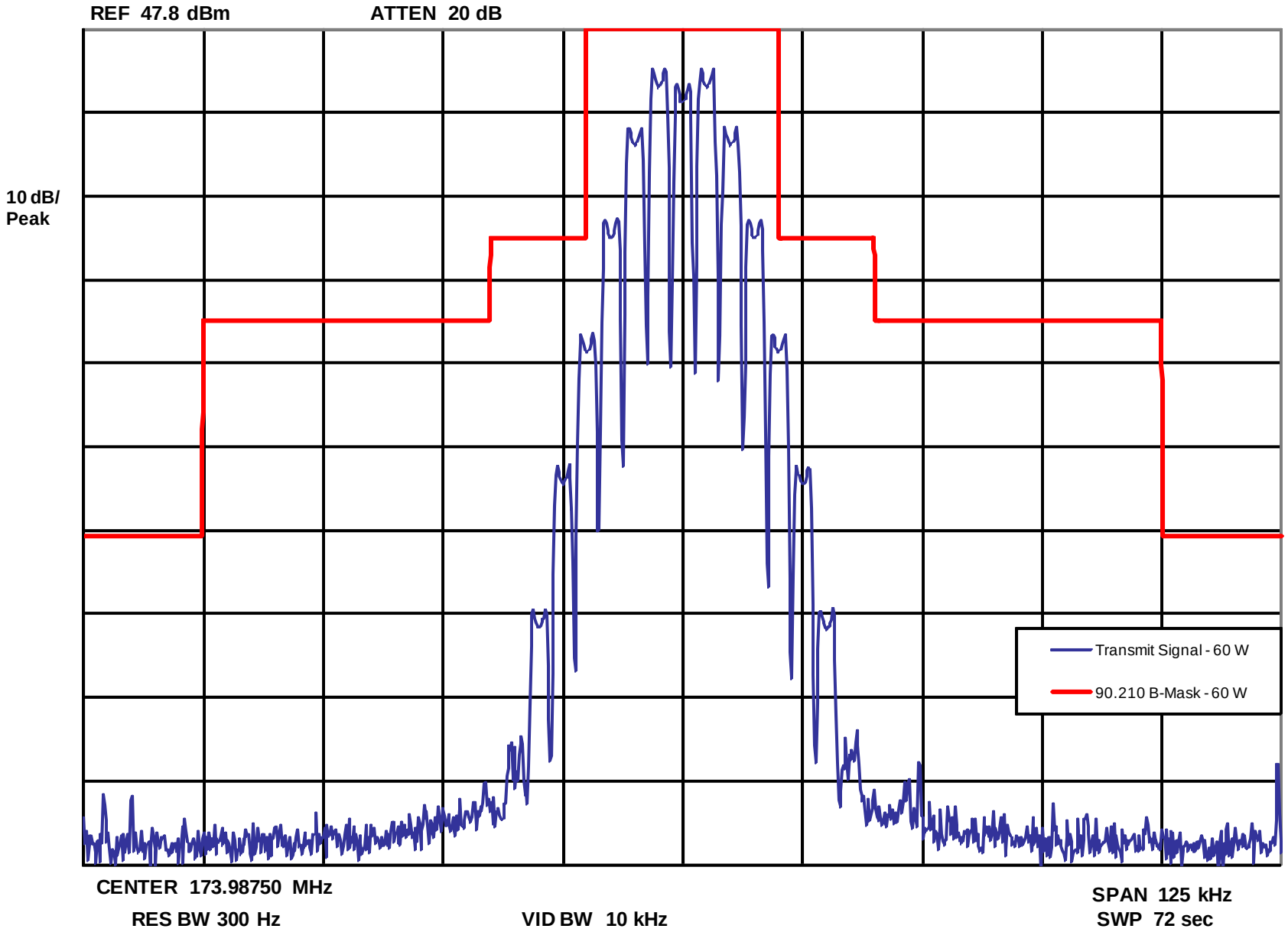
Occupied Bandwidth - 25 kHz Channels - Carrier with 2500 Hz Audio and 123 Hz PL



Report on Test Measurements

Occupied Bandwidth – Carrier with 2500 Hz Tone and Digital Private Line (DPL) Signaling, 25 kHz Channels – Emission Designator: 16K0F3E – High End of Band

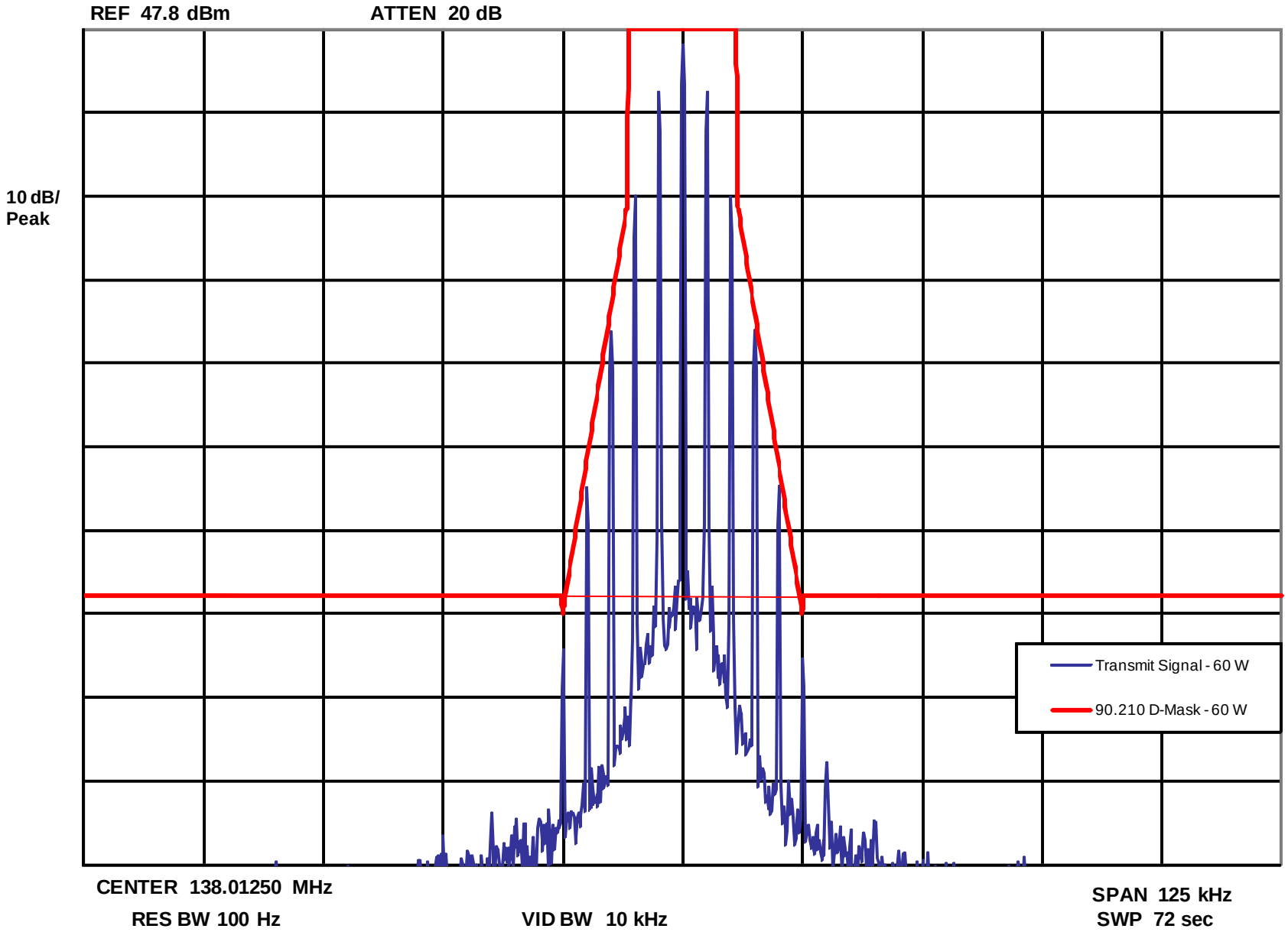
Occupied Bandwidth - 25 kHz Channels - Carrier with 2500 Hz Audio and 627 DPL



Report on Test Measurements

Occupied Bandwidth – Carrier with 2500 Hz Audio Tone, 12.5 kHz Channels – Emission Designator: 11K0F3E – Low End of Band

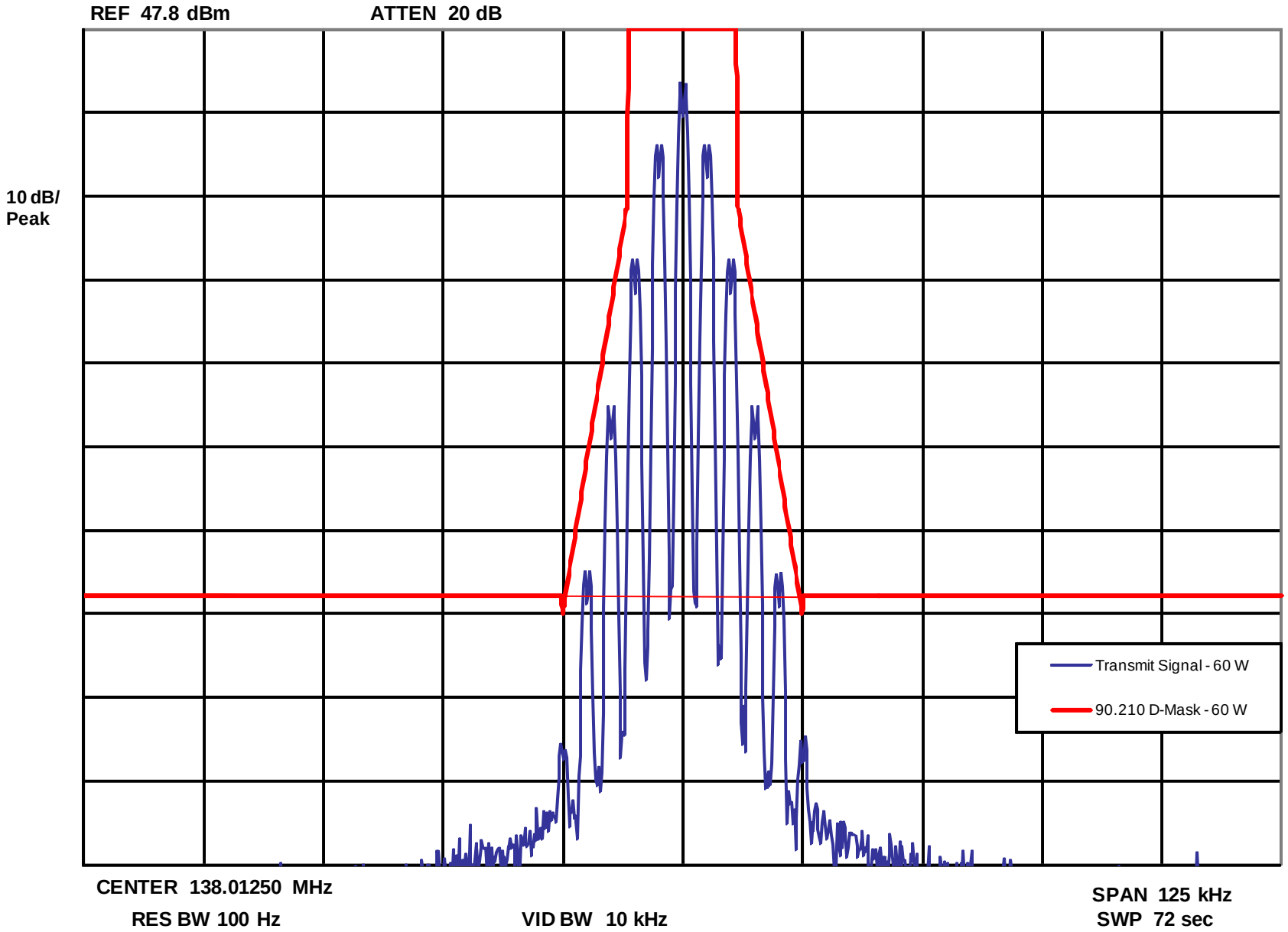
Occupied Bandwidth - 12.5 kHz Channels - Carrier with 2500 Hz Audio Tone



Report on Test Measurements

Occupied Bandwidth – Carrier with 2500 Hz Audio Tone and Private Line (PL) Signaling, 12.5 kHz Channels – Emission Designator: 11K0F3E – Low End of Band

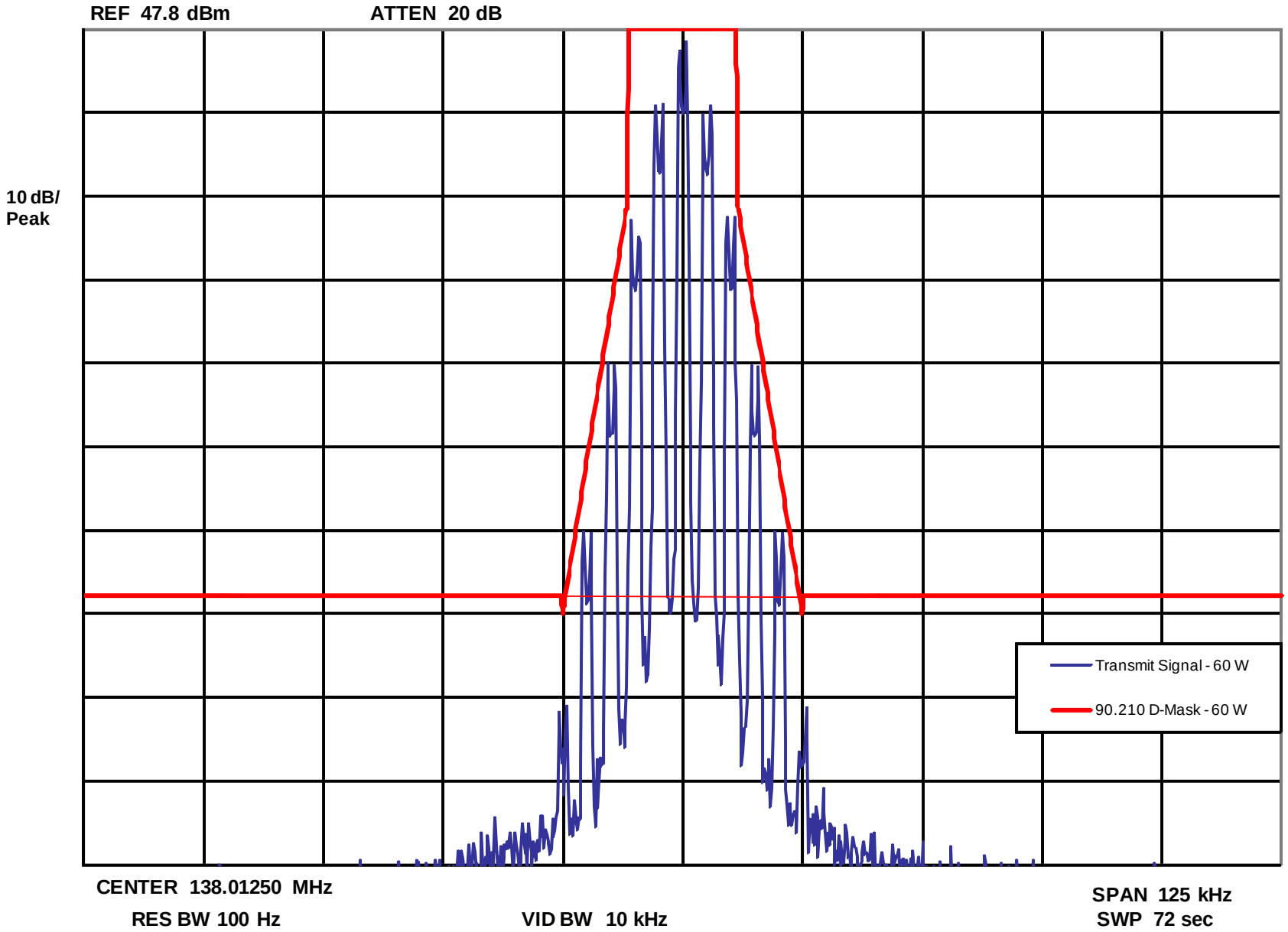
Occupied Bandwidth - 12.5 kHz Channels - Carrier with 2500 Hz Audio and 123 Hz PL



Report on Test Measurements

Occupied Bandwidth – Carrier w/ 2500 Hz Tone and Digital Private Line (DPL) Signaling, 12.5 kHz Channels – Emission Designator: 11K0F3E – Low End of Band

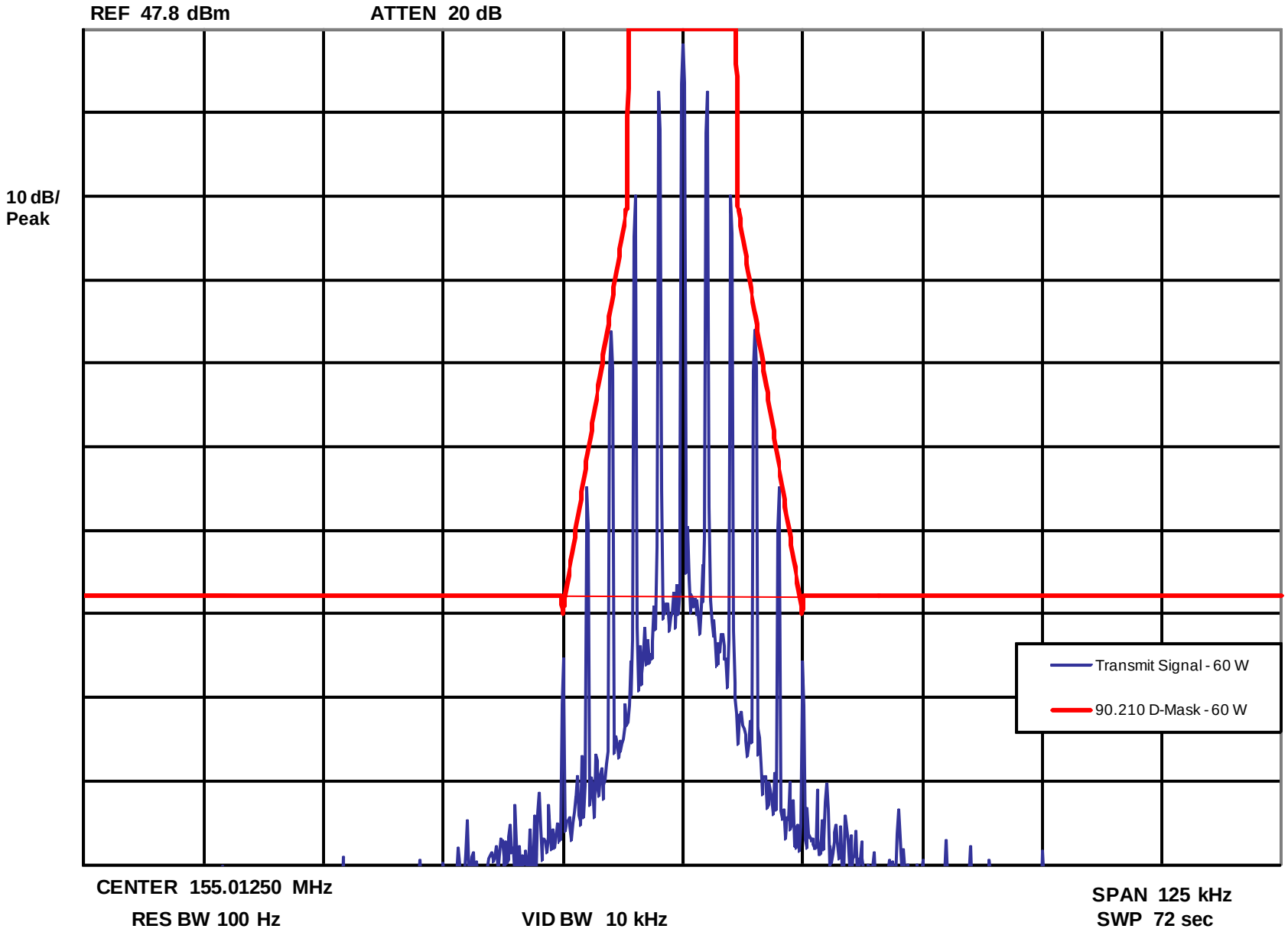
Occupied Bandwidth - 12.5 kHz Channels - Carrier with 2500 Hz Audio and 627 DPL



Report on Test Measurements

Occupied Bandwidth – Carrier with 2500 Hz Audio Tone, 12.5 kHz Channels – Emission Designator: 11K0F3E – Middle of Band

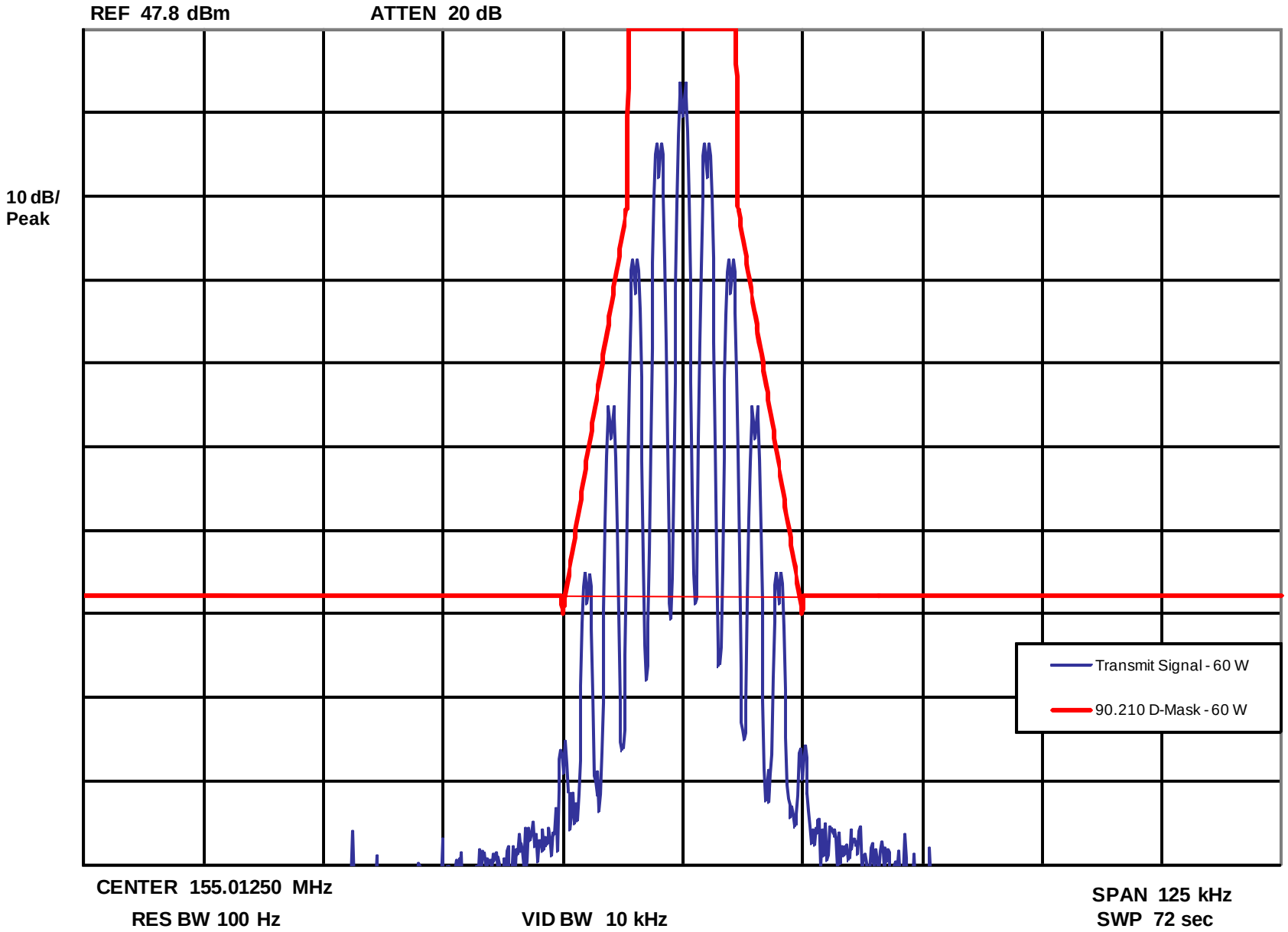
Occupied Bandwidth - 12.5 kHz Channels - Carrier with 2500 Hz Audio Tone



Report on Test Measurements

Occupied Bandwidth – Carrier with 2500 Hz Audio Tone and Private Line (PL) Signaling, 12.5 kHz Channels – Emission Designator: 11K0F3E – Middle of Band

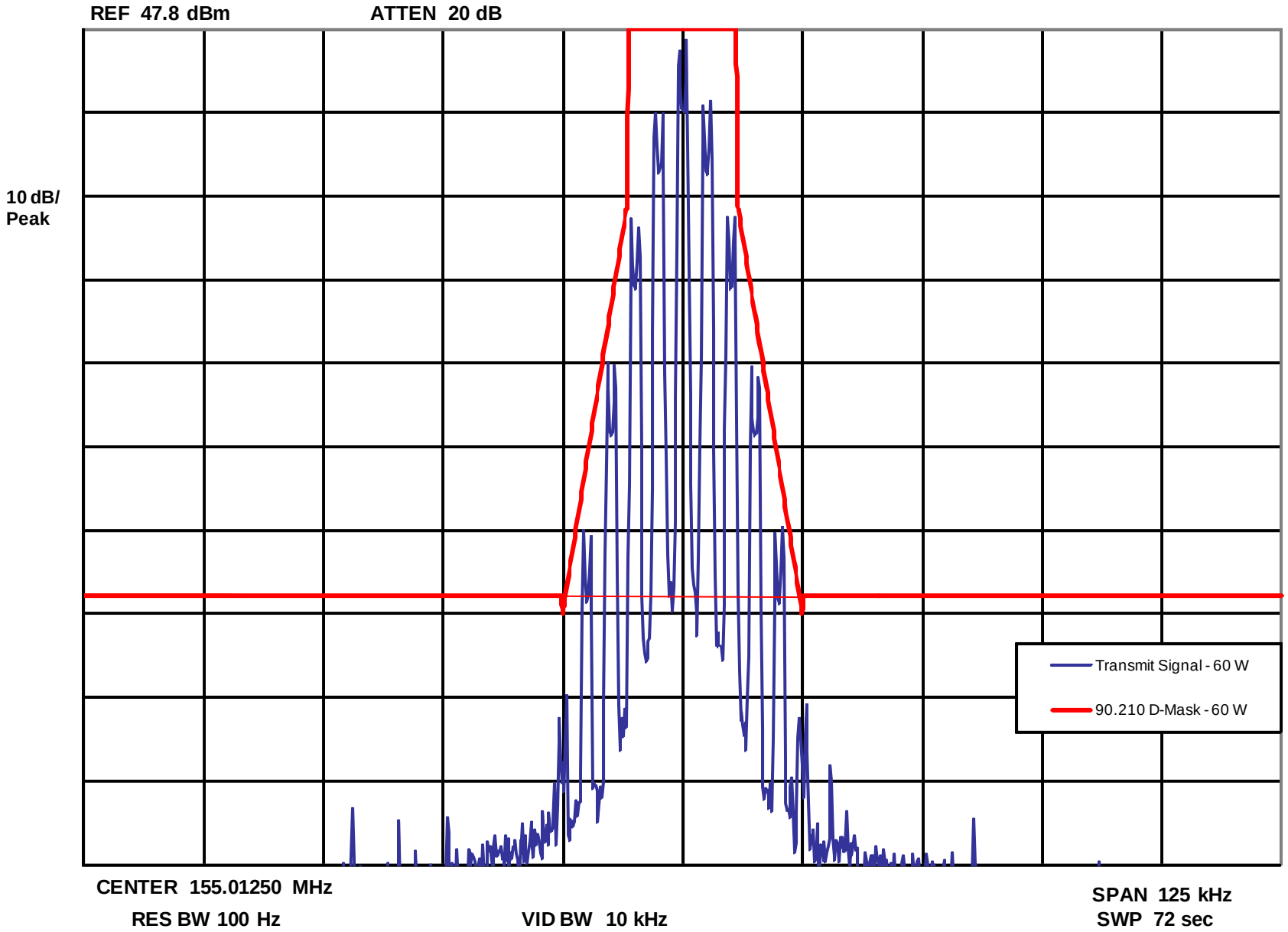
Occupied Bandwidth - 12.5 kHz Channels - Carrier with 2500 Hz Audio and 123 Hz PL



Report on Test Measurements

Occupied Bandwidth – Carrier with 2500 Hz Tone and Digital Private Line (DPL) Signaling, 12.5 kHz Channels – Emission Designator: 11K0F3E – Middle of Band

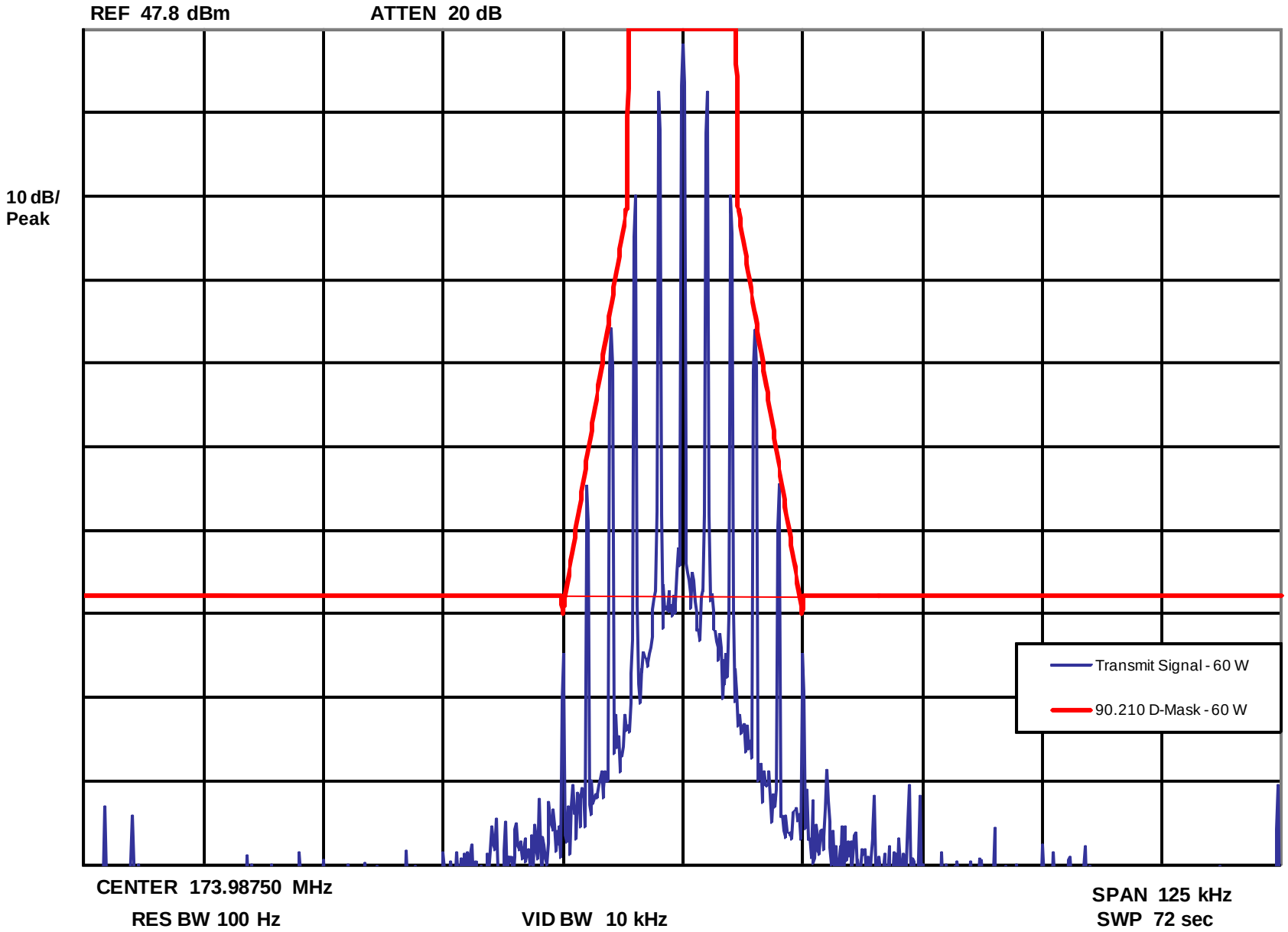
Occupied Bandwidth - 12.5 kHz Channels - Carrier with 2500 Hz Audio and 627 DPL



Report on Test Measurements

Occupied Bandwidth – Carrier with 2500 Hz Audio Tone, 12.5 kHz Channels – Emission Designator: 11K0F3E – High End of Band

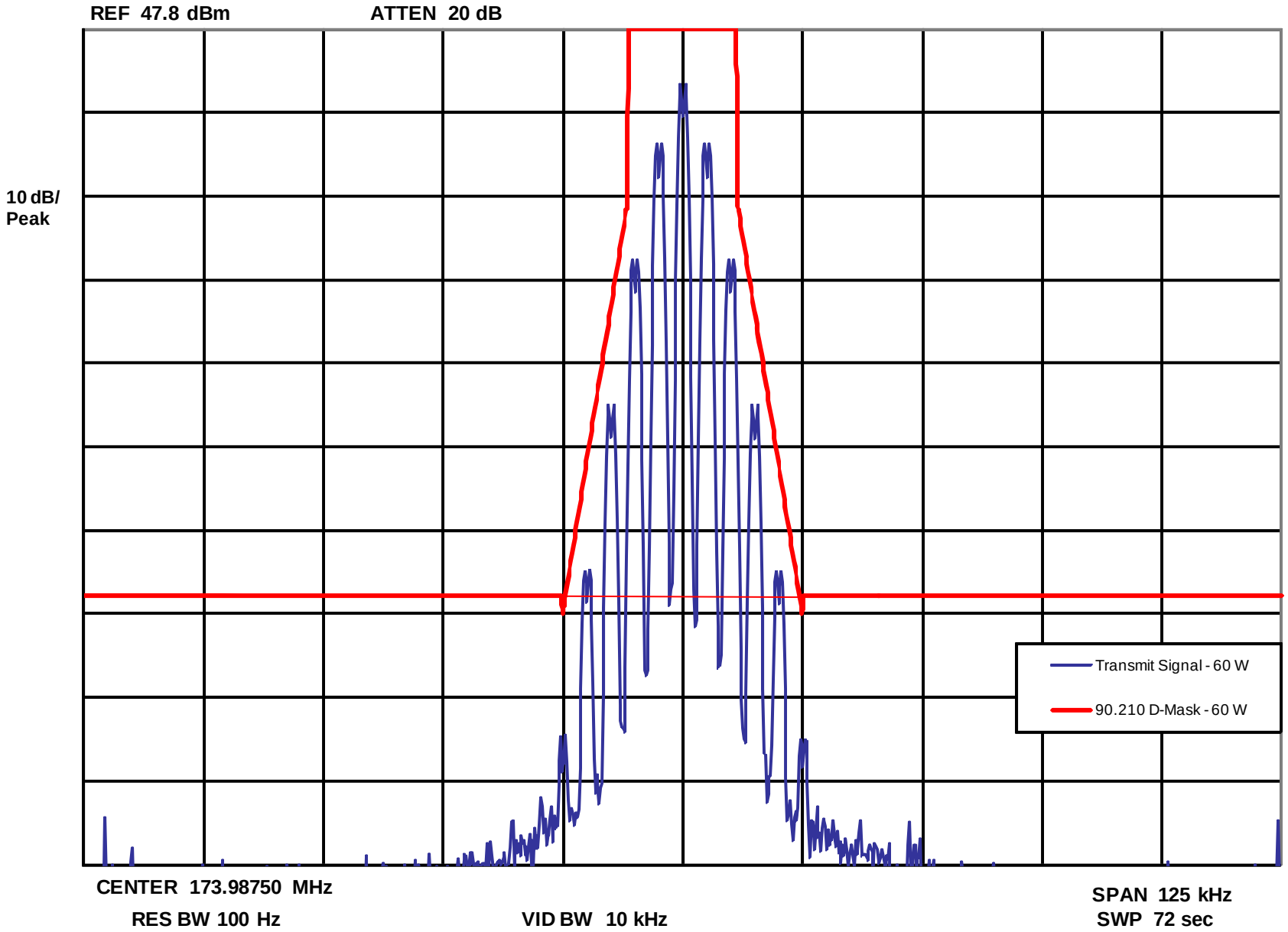
Occupied Bandwidth - 12.5 kHz Channels - Carrier with 2500 Hz Audio Tone



Report on Test Measurements

Occupied Bandwidth – Carrier with 2500 Hz Audio Tone and Private Line (PL) Signaling, 12.5 kHz Channels – Emission Designator: 11K0F3E – High End of Band

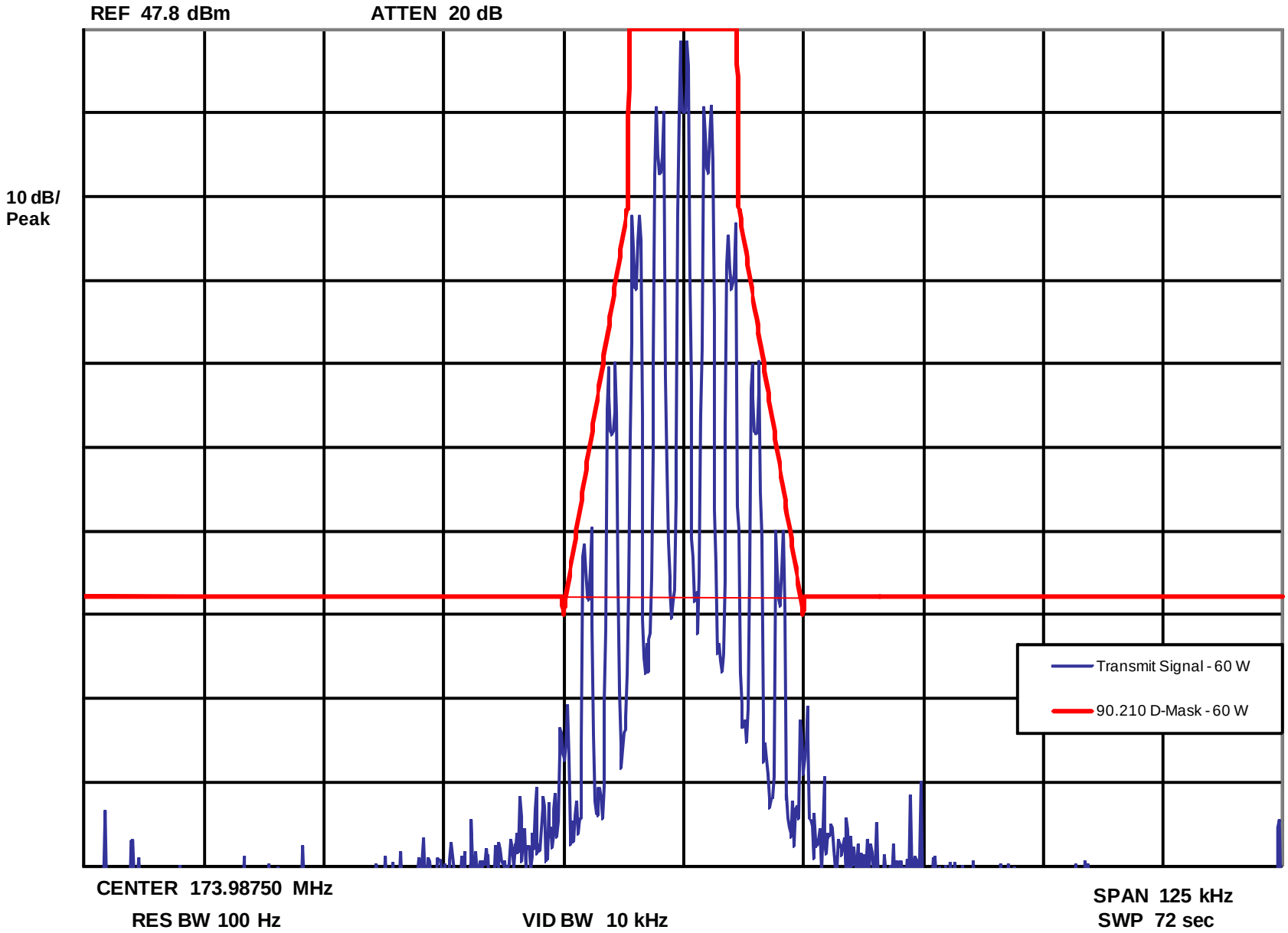
Occupied Bandwidth - 12.5 kHz Channels - Carrier with 2500 Hz Audio and 123 Hz PL



Report on Test Measurements

Occupied Bandwidth – Carrier w/ 2500 Hz Tone and Digital Private Line (DPL) Signaling, 12.5 kHz Channels – Emission Designator: 11K0F3E – High End of Band

Occupied Bandwidth - 12.5 kHz Channels - Carrier with 2500 Hz Audio and 627 DPL



Report on Test Measurements

Test Equipment List

MODEL	MANUFACTURER	DESCRIPTION	Serial No.	Last Cal	Next Cal
Conducted Harmonics / Conducted Spurious Emission Spectrum					
438A	Hewlett Packard	RF Power Meter	3048U02448	05/07/13	05/07/16
E4440A	Agilent	Spectrum Analyzer	MY46185813	10/10/12	10/10/15
8482A	Hewlett Packard	Power Sensor	GG00004032	05/14/14	05/14/17
Frequency Stability					
N9030A	Agilent	Spectrum Analyzer	MY49430131	05/08/13	05/08/16
6032A	Hewlett Packard	DC Power Supply	2721A02032	Correlated to DMM (*)	
34401A	Hewlett Packard	Digital Multimeter (*)	3146A59752	10/01/14	10/01/15
6813B	Hewlett Packard	AC Power Supply	MY41000361	03/12/13	03/12/16
Occupied Bandwidth / Modulation Limiting / Audio Frequency Response / Frequency Transients					
N9030A	Agilent	Spectrum Analyzer	MY49430625	10/10/13	10/10/15
U8903A	Agilent	Audio analyzer	MY50510002	10/05/13	10/05/16
Misc					
Notch Filter	Telewave	TWPC-3910-1	5547	no calibration required	
3020A	Narda	Directional Coupler	41902	no calibration required	
(Various)	Weinschel	RF Load	Various	no calibration required	
(Various)	Narda	RF Attenuators	Various	no calibration required	

Radiated and Power Supply Conducted Emissions

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
CDX8	COMPUTER	ELITE	WORKSTATION			N/A	
GSD3	SIGNAL GENERATOR	ROHDE & SCHWARZ	SMB100A	104454	9 kHz-6 GHz	9/10/2014	9/10/2015
NDP1	TUNED DIPOLE ANTENNA	EMCO	3121C-DB3	313	140-400 MHz	4/17/2014	4/17/2015
NDQ1	TUNED DIPOLE ANTENNA	EMCO	3121C-DB4	313	400-1000 MHz	4/17/2014	4/17/2015
NTA3	BILOG ANTENNA	TESEQ	6112D	32853	25-1000 MHz	2/19/2014	2/19/2015
NWP1	DOUBLE RIDGED WAVEGUIDE ANTENNA	EATON	3115	2100	1 GHz-12.4 GHz	7/22/2014	7/22/2015
NWQ1	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS-LINDGREN	3117	66655	1 GHz-18 GHz	3/11/2014	3/11/2015
PLF1	CISPR16 50UH LISN	ELITE	CISPR16/70A	001	.15-30 MHz	6/5/2014	6/5/2015
PLF3	CISPR16 50UH LISN	ELITE	CISPER16/70A	003	.15-30 MHz	6/5/2014	6/5/2015
RAKI	RF SECTION	HEWLETT PACKARD	85462A	3411A00181	0.009-6500 MHz	3/19/2014	3/19/2015
RAKJ	RF FILTER SECTION	HEWLETT PACKARD	85460A	3330A00154	---	3/19/2014	3/19/2015
RBA0	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB26	100145	20 Hz-26.5 GHz	3/7/2014	3/7/2015
T1E2	10DB 25W ATTENUATOR	WEINSCHEL	46-10-43	AU1884	DC-18 GHz	8/11/2014	8/11/2015

Report on Test Measurements

Statement of Certification

The technical data supplied with this application, having been taken under my supervision is hereby duly certified. The following is a statement of my qualifications:

College Degree: **BSEE, Valparaiso University, Valparaiso, Indiana, USA**
MSEE, Illinois Institute of Technology, Chicago, Illinois, USA

__33__ years of Design and Development experience in the field of two-way radio communication.

NAME: **Ken Weiss**

SIGNATURE: _____

DATE: **March 12, 2015**

POSITION: **Senior Staff Engineer**

I hereby certify that the above application was prepared under my direction and that to the best of my knowledge and belief, the facts set forth in the application and accompanying technical data are true and correct:

NAME: **Bob Sarocka**

SIGNATURE: _____

DATE: **March 12, 2015**

POSITION: **Engineering Section Manager**