Report on Test Measurements

Measurements Report
The measurement report shows compliance information against the pertinent technical standards. Each section of the report contains either verbiage or graphs which show compliance to applicable standards as required. Each section also explains testing method and indicates what the applicable specification is.
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

Report on Test Measurements

Measurements Report

SUBMITTED MEASURED DATA – INDEX (Continued)

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. The DC current indicated is the total for the final RF amplifier stage, consisting of six parallel power transistors.

Linear Modulation Mode:

Measured RF output	**100**	Watts, Average
DC Voltage	**24.0**	Volts
DC Current	**16.0**	Amperes
Input power for final RF amplifying device(s)	**384**	Watts
Primary Radio Input Supply Voltage	**120**	Volts AC
Minimum Measured RF output	**2**	Watts, Average
Normal DC Voltage	**21.0**	Volts
Normal DC Current	**5.0**	Amperes
Input power for final RF amplifying device(s)	**105**	Watts
Primary Radio Input Supply Voltage	**120**	Volts AC

Frequency Modulation and Compatible 4-Level Frequency Modulation Mode:

Measured RF output	**100**	Watts
DC Voltage	**21.0**	Volts
DC Current	**16.0**	Amperes
Input power for final RF amplifying device(s)	**336**	Watts
Primary Radio Input Supply Voltage	**120**	Volts AC
Minimum Measured RF output	**2**	Watts
Normal DC Voltage	**21.0**	Volts
Normal DC Current	**5.0**	Amperes
Input power for final RF amplifying device(s)	**105**	Watts
Primary Radio Input Supply Voltage	**120**	Volts AC

Report on Test Measurements

Occupied Bandwidth – Linear Simulcast Modulation (LSM), 12.5 kHz Channel Spacing
There is one exhibit shown for Linear Simulcast Modulation. It can be used in a system configuration based upon channel usage as described in Exhibit B. The occupied bandwidth chart references the following setup and specification requirements.

Modulation Type:	Linear Simulcast Modulation, LSM
Emission Designator:	8K70D1W
Channelization:	12.5 kHz
Power Setting:	100 Watts, Average

Specification Requirement § 90.210(d) Emission Limits:
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 signal is not calculable per the formulas defined in 47 CFR 2.202 (b). Specifically, although the modulation for this emission is a composite modulation, the equations given in the composite tables in 2.202 are not applicable since none of them adequately approximate the form of digital modulation used. The necessary bandwidth of 8.70 kHz is based upon a 99% power measurement of the transmitter spectrum, per 2.202 (a).

Measurement Procedure and Instrument Settings:
Emission Measurement Analyzer Settings:

Horizontal:	12.5 kHz per Division	Resolution Bandwidth:	100 Hz
Vertical:	10 dB per Division	Video Bandwidth:	10 kHz
Sweep Time:	72 Seconds (<2000 Hz / Second)	Span:	125 kHz
Detector Mode:	Peak		

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 in a 12.5 kHz bandwidth.
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.

EXHIBIT	DESCRIPTION
E1-2.1	Occupied Bandwidth - Linear Simulcast Modulation (LSM)

Report on Test Measurements

Occupied Bandwidth – Compatible 4-Level Frequency Modulation (C4FM), 12.5 kHz Channel Spacing
There is one exhibit shown for C4FM. It can be used in a system configuration based upon channel usage as described in Exhibit B. The occupied bandwidth chart references the following setup and specification requirements.

Modulation Type:	Compatible 4-Level Frequency Modulation, C4FM
Emission Designator:	8K10F1E, 8K10F1D
Channelization:	12.5 kHz
Power Setting:	100 Watts

Specification Requirement § 90.210(d) Emission Limits:
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: An occupied bandwidth of 8.10 kHz was measured for this emission, per 2.202 paragraph (a) of the Rules and Regulations, as that bandwidth which contains 99% of the power in the transmitted signal. For this system, the necessary bandwidth has been chosen to be the same as the occupied bandwidth, thereby per paragraph (b) (2), the necessary bandwidth is 8K10.

Measurement Procedure and Instrument Settings:
Emission Measurement Analyzer Settings:

Horizontal:	12.5 kHz per Division	Resolution Bandwidth:	100 Hz
Vertical:	10 dB per Division	Video Bandwidth:	10 kHz
Sweep Time:	72 Seconds (<2000 Hz / Second)	Span:	125 kHz
Detector Mode:	Peak		

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 in a 12.5 kHz bandwidth.
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.

EXHIBIT	DESCRIPTION
E1-2.2	Occupied Bandwidth - Compatible 4-Level Frequency Modulation (C4FM)

Report on Test Measurements

Occupied Bandwidth – TDMA Linear Simulcast Modulation (LSM), 12.5 kHz Channel Spacing
There is one exhibit shown for Linear Simulcast Modulation. It can be used in a system configuration based upon channel usage as described in Exhibit B. The occupied bandwidth chart references the following setup and specification requirements.

Modulation Type:	TDMA Linear Simulcast Modulation, LSM
Emission Designator:	8K70D7W
Channelization:	12.5 kHz
Power Setting:	100 Watts, Average

Specification Requirement § 90.210(d) Emission Limits:
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:

(2) 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 signal is not calculable per the formulas defined in 47 CFR 2.202 (b). Specifically, although the modulation for this emission is a composite modulation, the equations given in the composite tables in 2.202 are not applicable since none of them adequately approximate the form of digital modulation used. The necessary bandwidth of 8.70 kHz is based upon a 99% power measurement of the transmitter spectrum, per 2.202 (a).

Measurement Procedure and Instrument Settings:
Emission Measurement Analyzer Settings:

Horizontal:	12.5 kHz per Division	Resolution Bandwidth:	100 Hz
Vertical:	10 dB per Division	Video Bandwidth:	10 kHz
Sweep Time:	72 Seconds (<2000 Hz / Second)	Span:	125 kHz
Detector Mode:	Peak		

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 in a 12.5 kHz bandwidth.
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.

EXHIBIT	DESCRIPTION
E1-2.3	Occupied Bandwidth - TDMA Linear Simulcast Modulation (LSM)

Report on Test Measurements

Occupied Bandwidth – TDMA Compatible 4-Level Frequency Modulation (C4FM), 12.5 kHz Channel Spacing
There is one exhibit shown for C4FM. It can be used in a system configuration based upon channel usage as described in Exhibit B. The occupied bandwidth chart references the following setup and specification requirements.

Modulation Type:	TDMA Compatible 4-Level Frequency Modulation, C4FM
Emission Designator:	8K10F7W
Channelization:	12.5 kHz
Power Setting:	100 Watts

Specification Requirement § 90.210(d) Emission Limits:
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:

(2) 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: An occupied bandwidth of 8.10 kHz was measured for this emission, per 2.202 paragraph (a) of the Rules and Regulations, as that bandwidth which contains 99% of the power in the transmitted signal. For this system, the necessary bandwidth has been chosen to be the same as the occupied bandwidth, thereby per paragraph (b) (2), the necessary bandwidth is 8K10.

Measurement Procedure and Instrument Settings:
Emission Measurement Analyzer Settings:

Horizontal:	12.5 kHz per Division	Resolution Bandwidth:	100 Hz
Vertical:	10 dB per Division	Video Bandwidth:	10 kHz
Sweep Time:	72 Seconds (<2000 Hz / Second)	Span:	125 kHz
Detector Mode:	Peak		

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 in a 12.5 kHz bandwidth.
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.

EXHIBIT	DESCRIPTION
E1-2.4	Occupied Bandwidth - TDMA Compatible 4-Level Frequency Modulation (C4FM)

Report on Test Measurements

Occupied Bandwidth –H-DQPSK, P25 Two Slot TDMA Digital Modulation, 12.5 kHz Channel Spacing
There is one exhibit shown for Phase 2 Modulation. It can be used in a system configuration based upon channel usage as described in Exhibit B. The occupied bandwidth chart references the following setup and specification requirements.

Modulation Type: H-DQPSK, P25 Two Slot TDMA Digital Modulation
Emission Designator: 9K80D7W

Channelization: 12.5 kHz
Power Setting: 100 Watts, Average

Specification Requirement § 90.210(d) Emission Limits:
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 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 signal is not calculable per the formulas defined in 47 CFR 2.202 (b). Specifically, although the modulation for this emission is a composite modulation, the equations given in the composite tables in 2.202 are not applicable since none of them adequately approximate the form of digital modulation used. The necessary bandwidth of 8.70 kHz is based upon a 99% power measurement of the transmitter spectrum, per 2.202 (a).

Measurement Procedure and Instrument Settings:
Emission Measurement Analyzer Settings:

Horizontal:	12.5 kHz per Division	Resolution Bandwidth:	100 Hz
Vertical:	10 dB per Division	Video Bandwidth:	10 kHz
Sweep Time:	72 Seconds (<2000 Hz / Second)	Span:	125 kHz
Detector Mode:	Peak		

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 in a 12.5 kHz bandwidth.
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.

EXHIBIT	DESCRIPTION
E1-2.5	Occupied Bandwidth - H-DQPSK P25 Two Slot TDMA Digital Modulation

Report on Test Measurements

Occupied Bandwidth – Linear Simulcast Modulation (LSM)

Occupied Bandwidth -- Linear Simulcast Modulation - 8K70D1W - 100 Watts (Average)

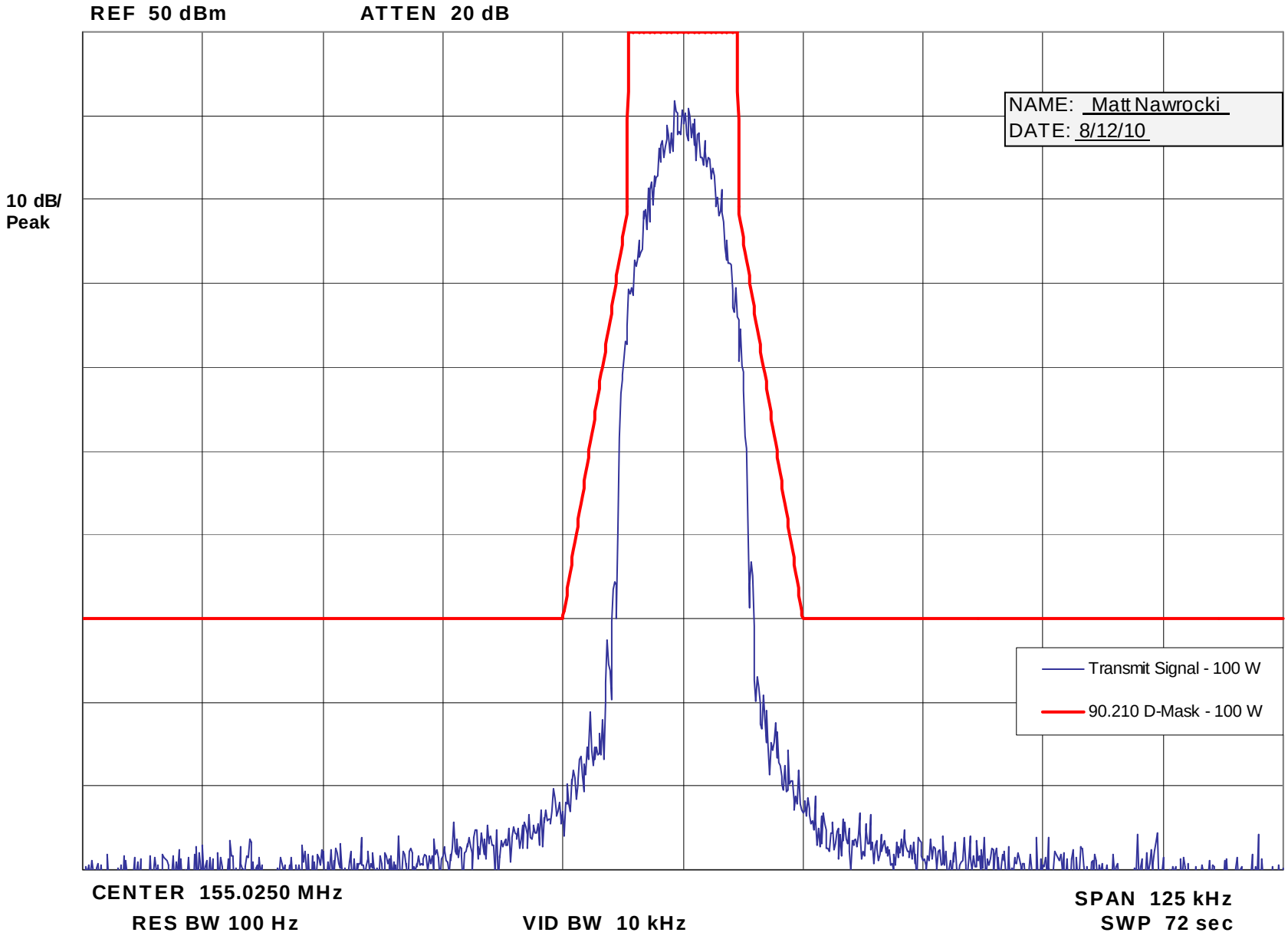


EXHIBIT E1-2.1

Report on Test Measurements

Occupied Bandwidth – Compatible 4-Level Frequency Modulation (C4FM)

Occupied Bandwidth -- Compatible 4-Level Frequency Modulation - 8K10F1E and 8K10F1D - 100 W

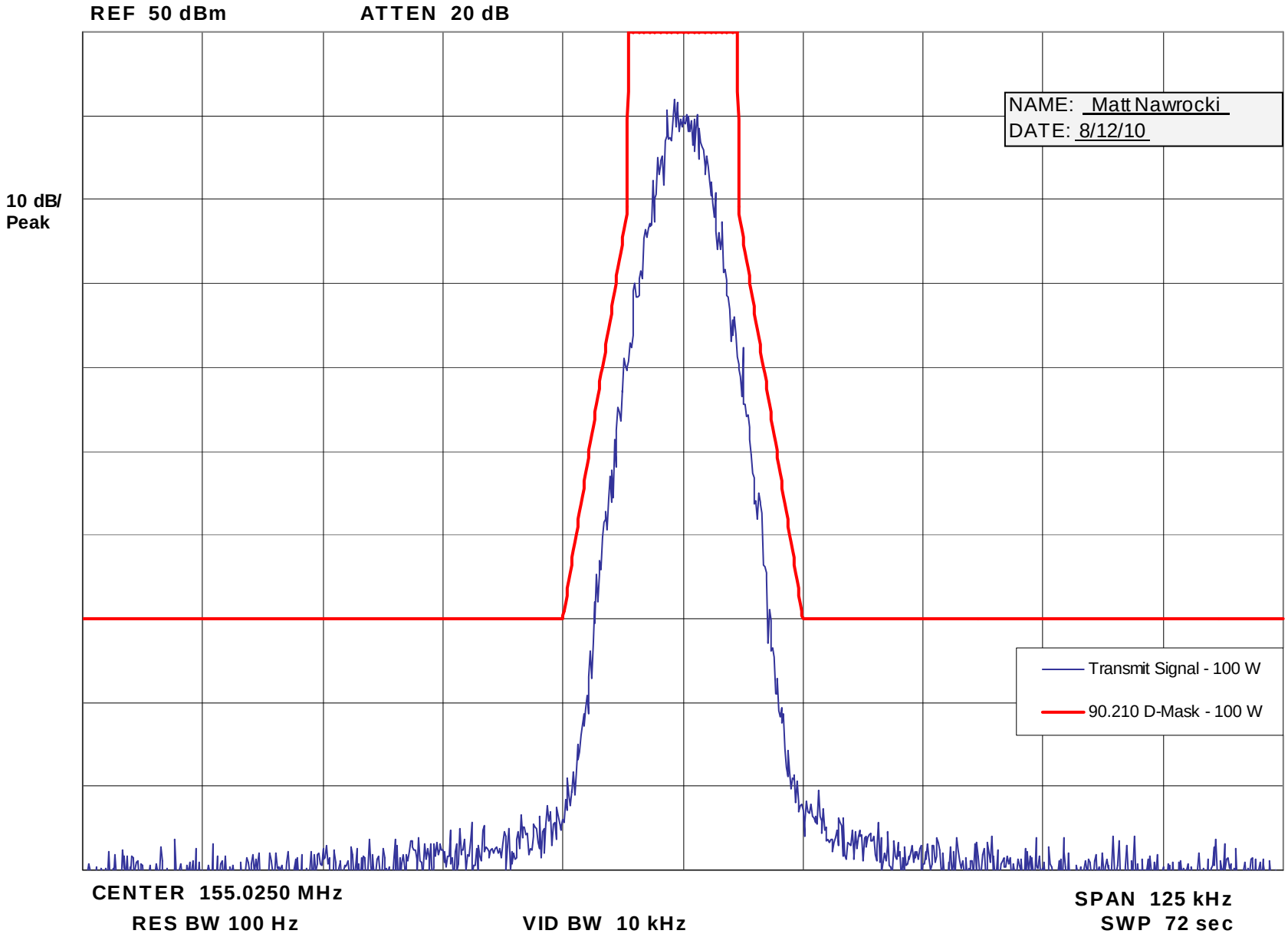


EXHIBIT E1-2.2

APPLICANT: MOTOROLA **EQUIPMENT TYPE: ABZ89FC3799**

Report on Test Measurements

Occupied Bandwidth – TDMA Linear Simulcast Modulation (LSM)

Occupied Bandwidth -- TDMA Linear Simulcast Modulation - 8K70D7W - 100 Watts (Average)

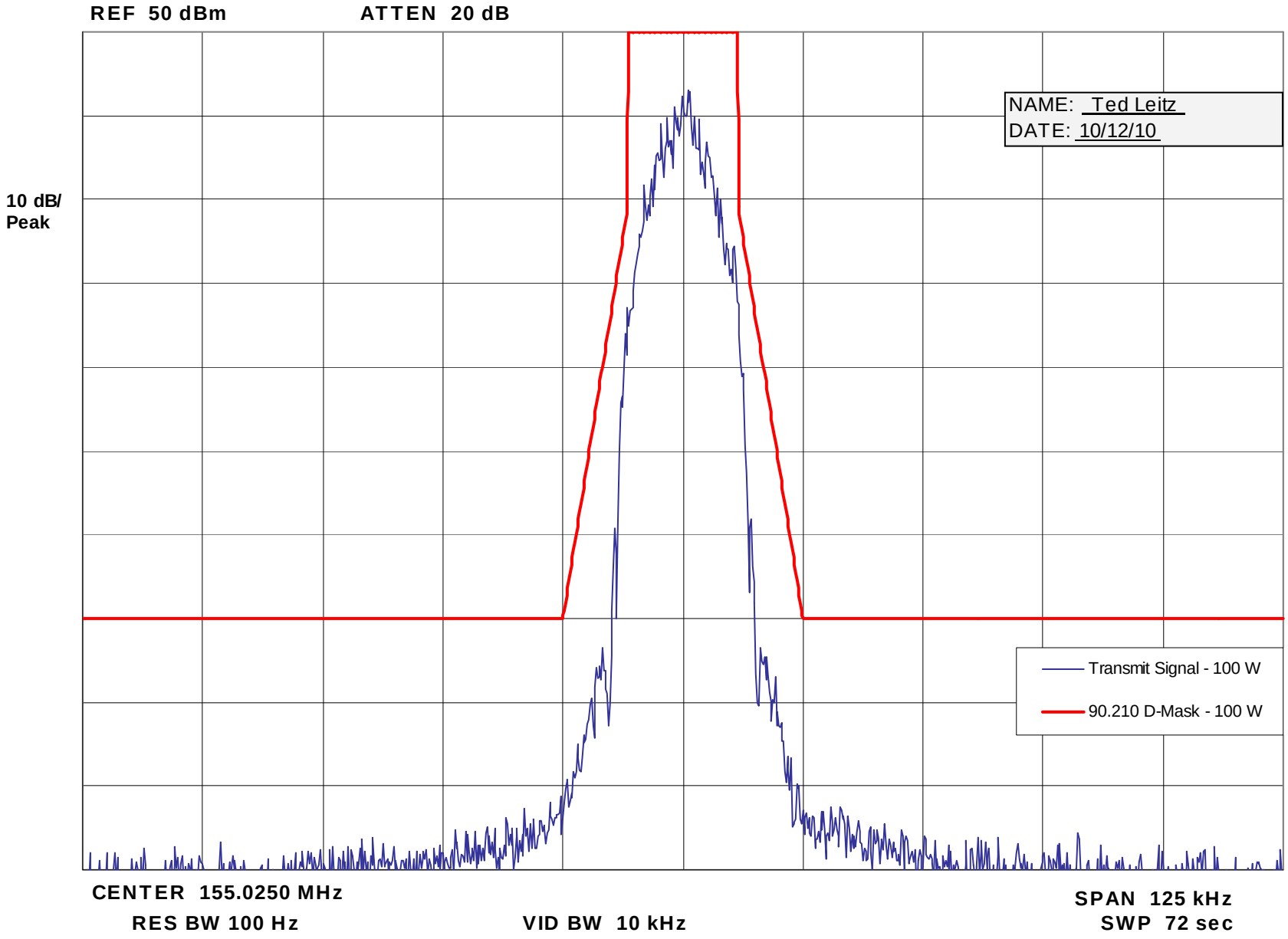


EXHIBIT E1-2.3

APPLICANT: MOTOROLA **EQUIPMENT TYPE: ABZ89FC3799**

Report on Test Measurements

Occupied Bandwidth – TDMA Compatible 4-Level Frequency Modulation (C4FM)

Occupied Bandwidth -- TDMA Compatible 4-Level Frequency Modulation - 8K10F7W - 100 Watts

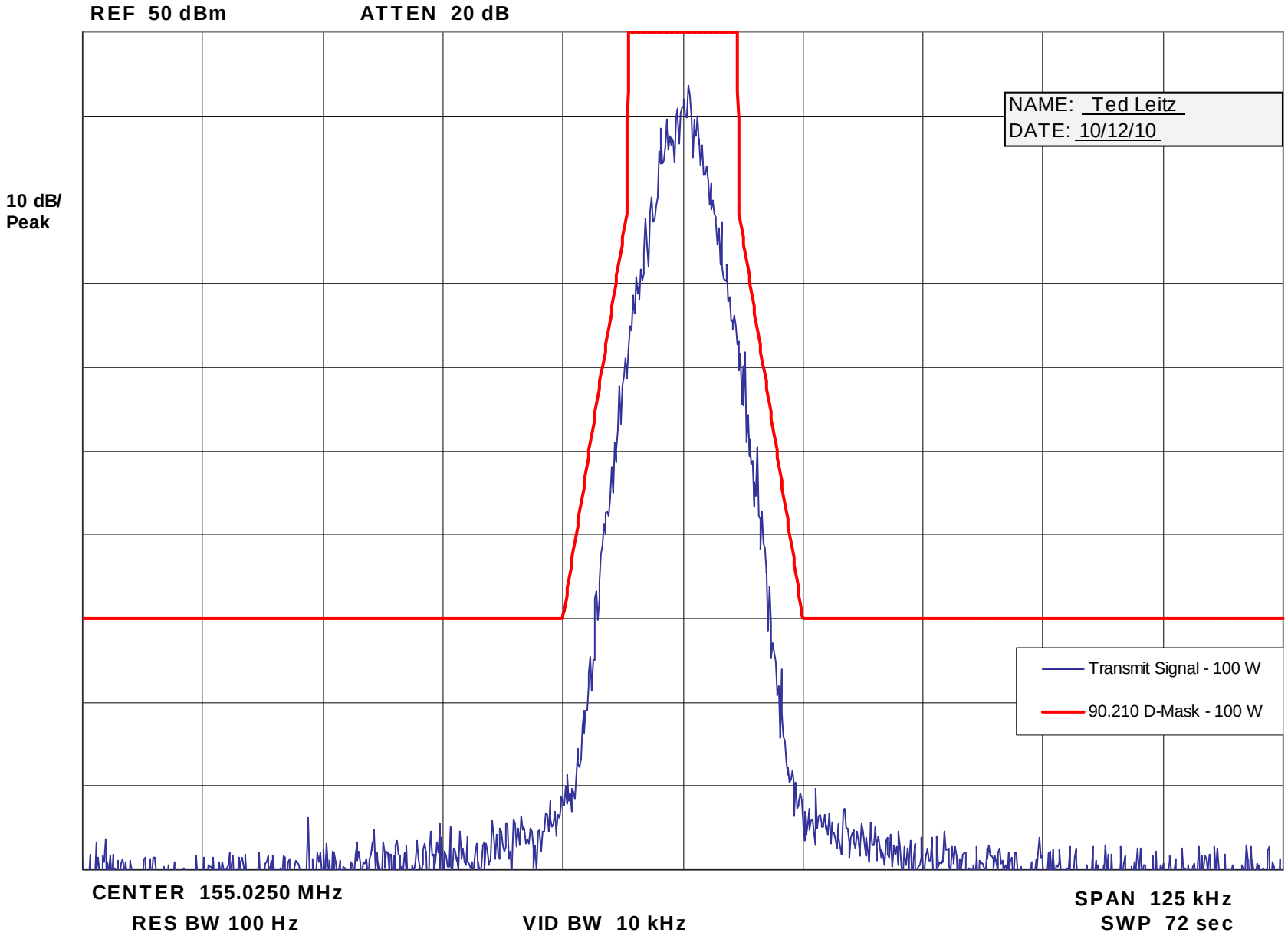


EXHIBIT E1-2.4

Report on Test Measurements

Occupied Bandwidth – H-DQPSK, P25 Two Slot TDMA Digital Modulation

Occupied Bandwidth -- H-DQPSK P25 Two Slot TDMA Digital Modulation - 9K80D7W - 100 W (Avg)

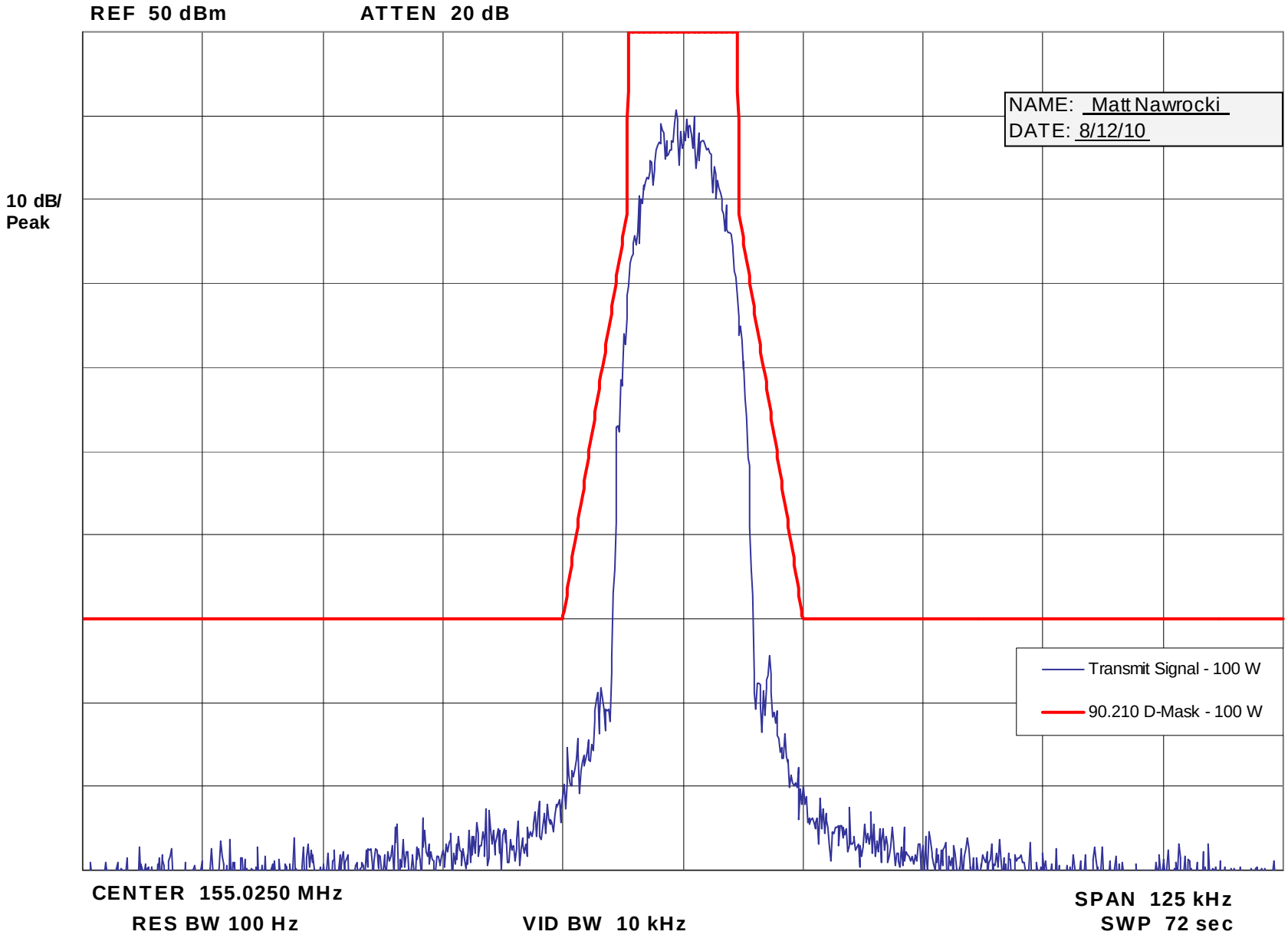


EXHIBIT E1-2.5

Report on Test Measurements

Conducted Spurious Emissions, Harmonics and Close-In

Specification Requirement § 90.210(d) Emission Limits:
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.*

Specification Requirement § 90.210(b) Emission Limits:
Emission *Mask B:* 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 *least 50 plus 10 log_{10}(P) dB or 80 dB; (whichever is the lesser attenuation).*

Modulation: Linear Simulcast Modulation (LSM), or Compatible 4-Level Frequency Modulation (C4FM)–Pseudorandom data, or Analog Frequency Modulation as indicated

Carrier Frequencies: Carrier frequencies of 136.0, 153.5, and 174.0 MHz were measured for conducted carrier harmonics. These frequencies represent the low end, center, and high end of the 136-174 MHz band, and are representative of the full 136-174 MHz operating band. A representative frequency of 162.0125 was used for the close-in conducted measurements.

EXHIBIT	DESCRIPTION
E1-3.1	Conducted Spurious Emissions, Harmonics, Power Output 100 Watts, LSM The specification limit is -70.0 dBc
E1-3.2	Conducted Spurious Emissions, Harmonics, Power Output 2 Watts, LSM The specification limit is -53.0 dBc
E1-3.3	Conducted Spurious Emissions, Harmonics, Power Output 100 Watts, C4FM The specification limit is -70.0 dBc
E1-3.4	Conducted Spurious Emissions, Harmonics, Power Output 2 Watts, C4FM The specification limit is -53.0 dBc
E1-3.5	Conducted Spurious Emissions, Harmonics, Power Output 100 Watts, Analog The specification limit is -70.0 dBc
E1-3.6	Conducted Spurious Emissions, Harmonics, Power Output 2 Watts, Analog The specification limit is -53.0 dBc
E1-3.7	Conducted Spurious Emissions, Close-In, 100 MHz Span, Power Output at 100 Watts, LSM The specification limit is -70.0 dBc
E1-3.8	Conducted Spurious Emissions, Close-In, 100 MHz Span, Power Output at 100 Watts, C4FM The specification limit is -70.0 dBc
E1-3.9	Conducted Spurious Emissions, Close-In, 100 MHz Span, Power Output at 100 Watts, Analog The specification limit is -70.0 dBc

Report on Test Measurements

Conducted Emission – Harmonics – 100 Watts LSM

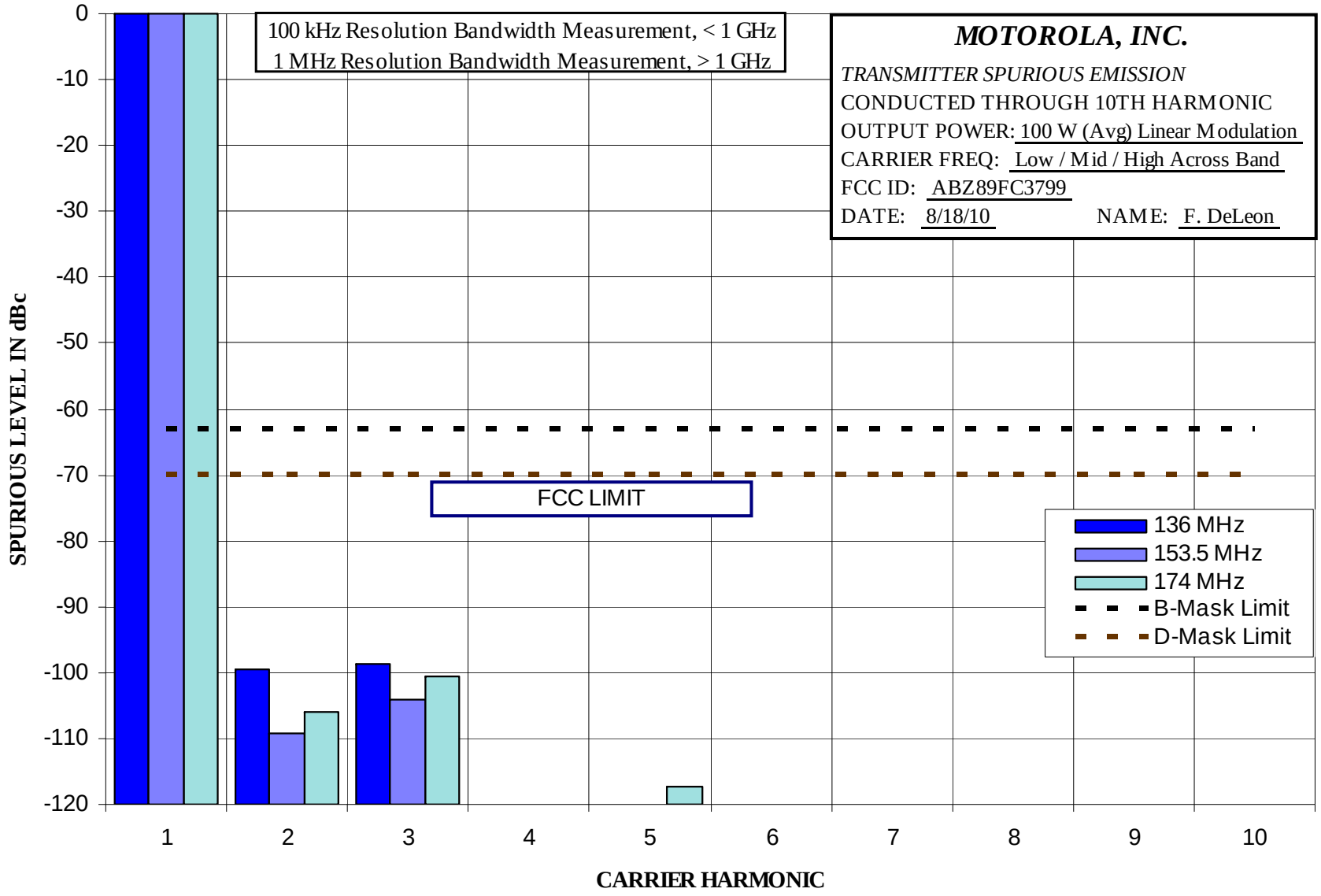


EXHIBIT E1-3.1

APPLICANT: MOTOROLA **EQUIPMENT TYPE: ABZ89FC3799**

Report on Test Measurements

Conducted Emission – Harmonics – 2 Watts LSM

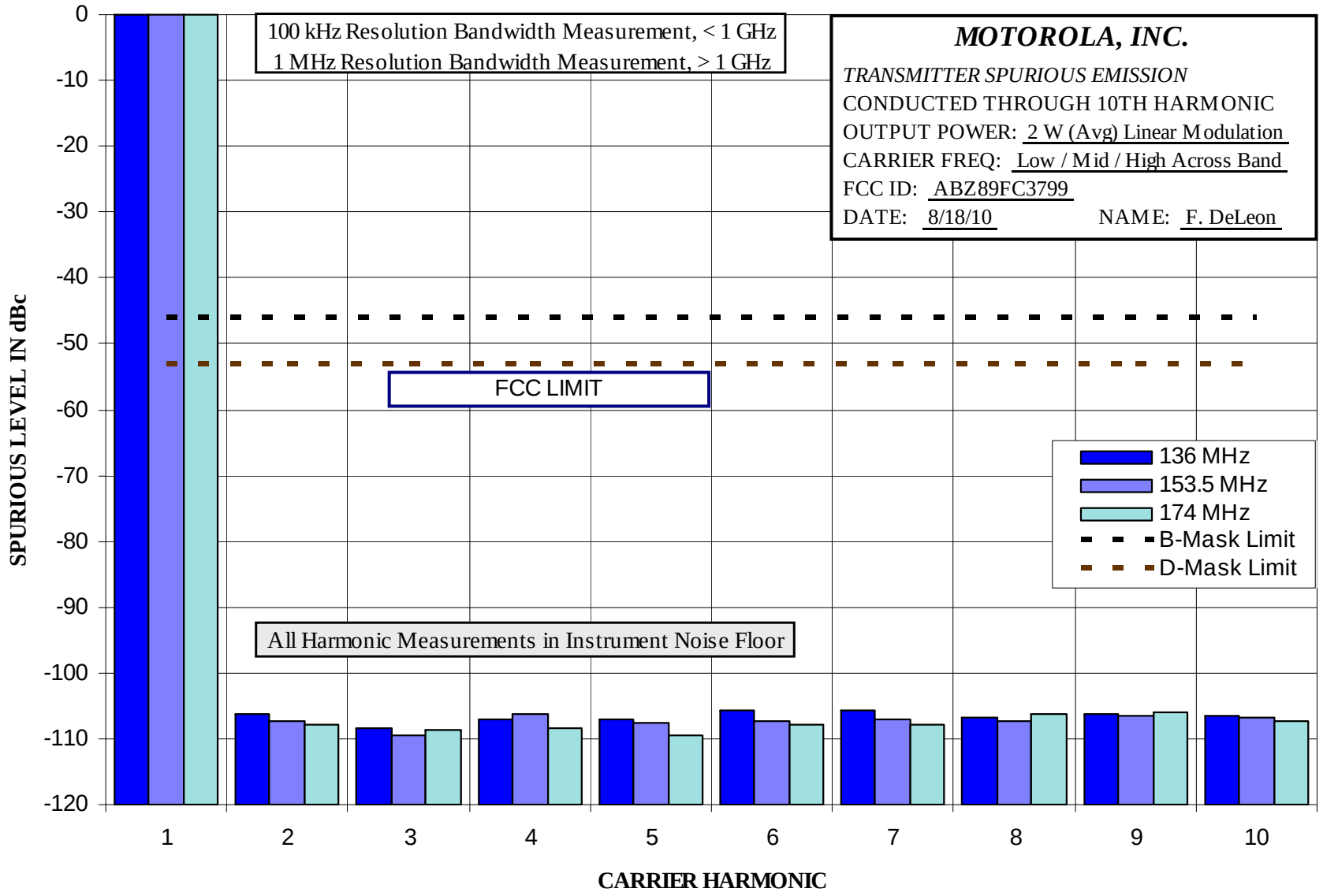


EXHIBIT E1-3.2

Report on Test Measurements

Conducted Emission – Harmonics – 100 Watts C4FM

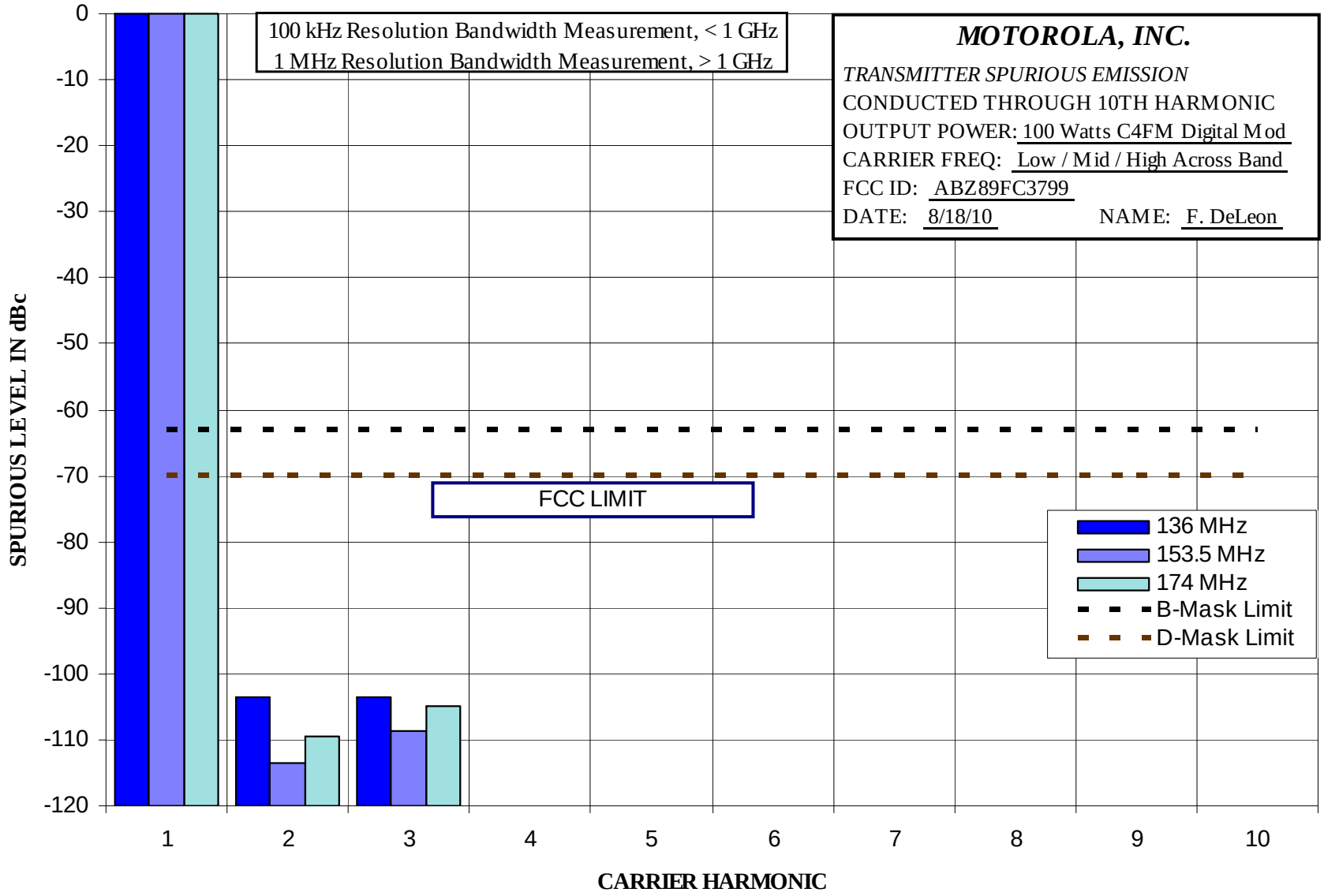


EXHIBIT E1-3.3

Report on Test Measurements

Conducted Emission – Harmonics – 2 Watts C4FM

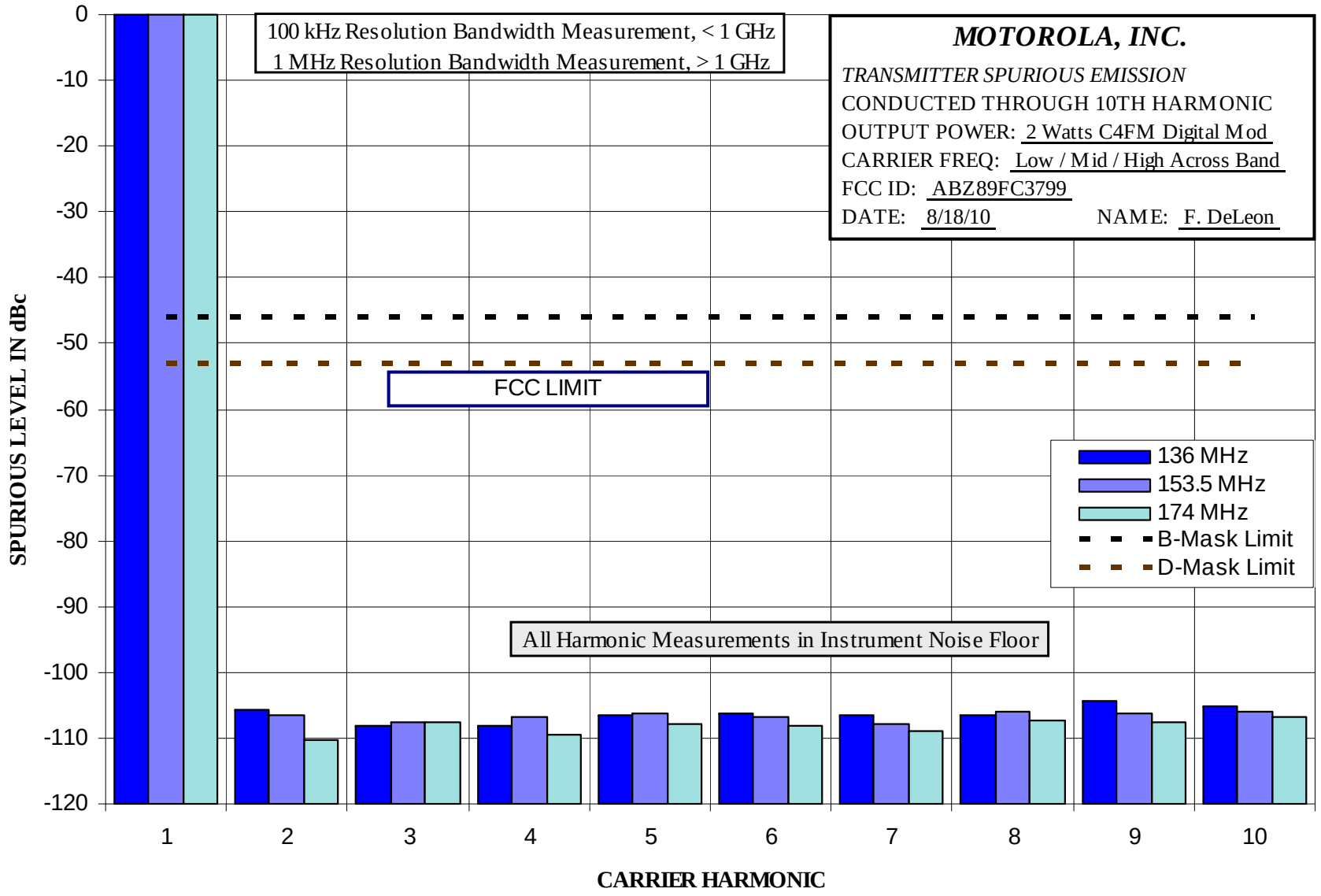


EXHIBIT E1-3.4

Report on Test Measurements

Conducted Emission – Harmonics – 100 Watts Analog

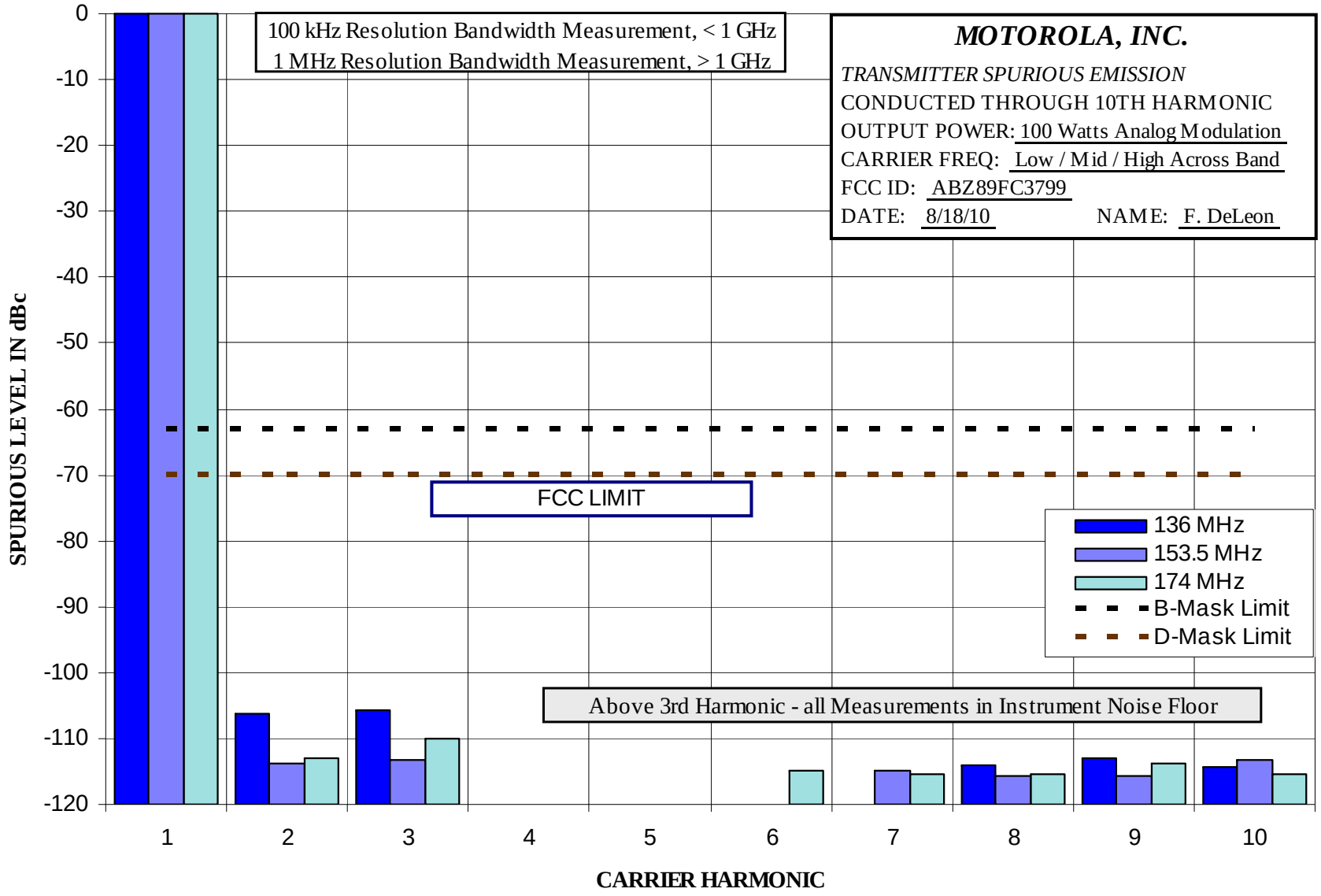


EXHIBIT E1-3.5

Report on Test Measurements

Conducted Emission – Harmonics – 2 Watts Analog

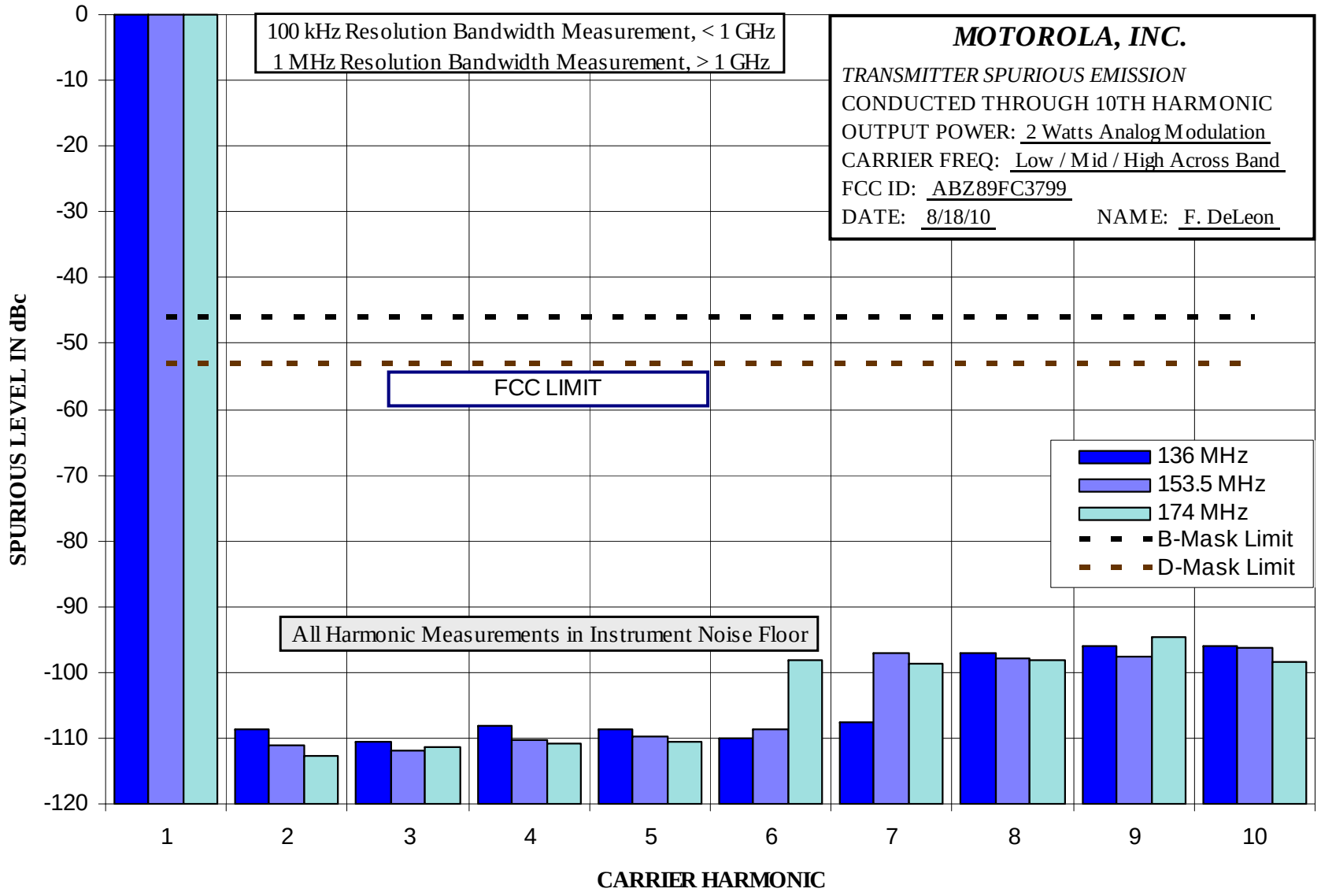


EXHIBIT E1-3.6

APPLICANT: MOTOROLA **EQUIPMENT TYPE: ABZ89FC3799**

Report on Test Measurements

Conducted Emission – Close-In – 100 Watts LSM – 100 MHz Span

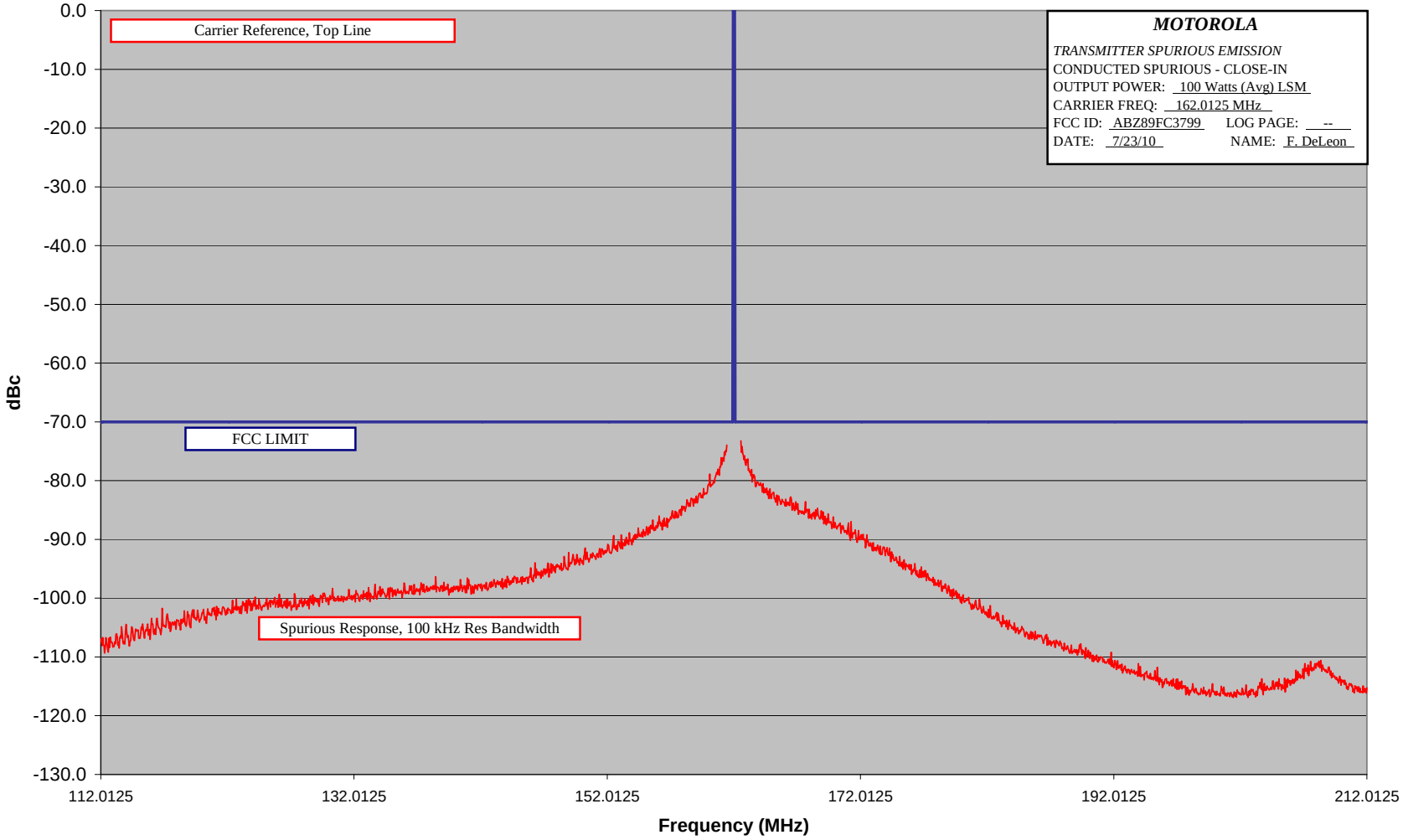


EXHIBIT E1-3.7

APPLICANT: MOTOROLA **EQUIPMENT TYPE: ABZ89FC3799**

Report on Test Measurements

Conducted Emission – Close-In – 100 Watts C4FM – 100 MHz Span

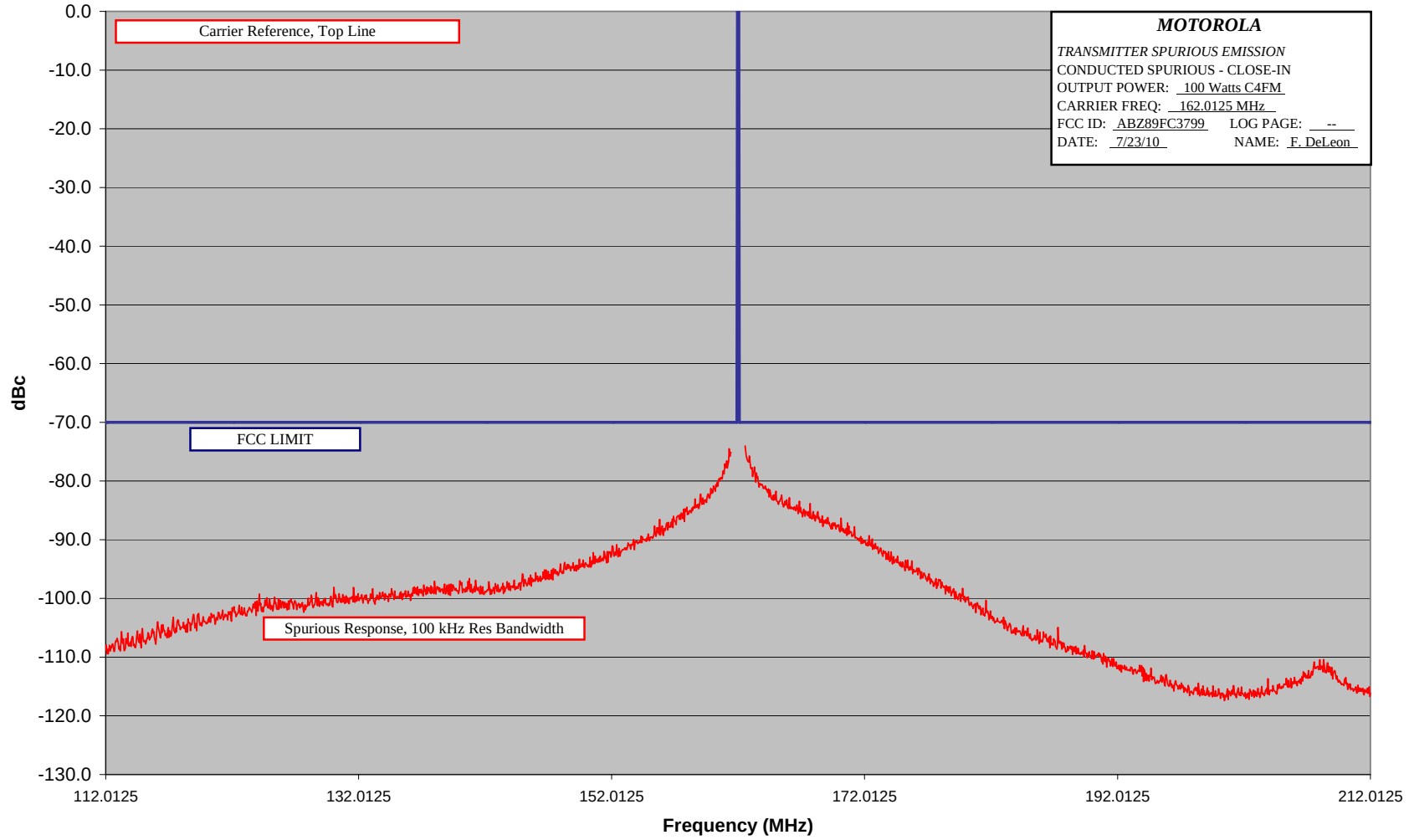


EXHIBIT E1-3.8

APPLICANT: MOTOROLA **EQUIPMENT TYPE: ABZ89FC3799**

Report on Test Measurements

Conducted Emission – Close-In – 100 Watts Analog – 100 MHz Span

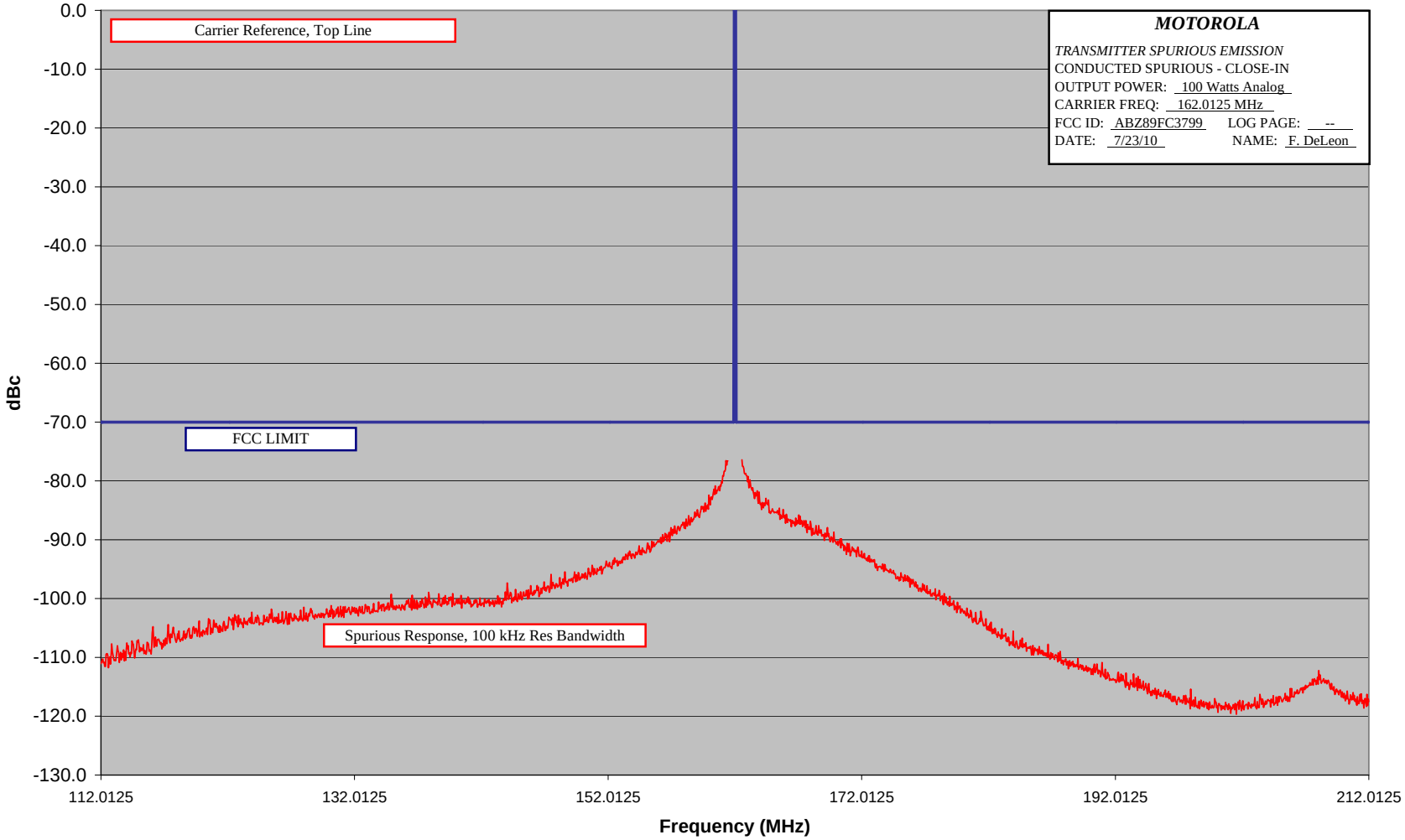


EXHIBIT E1-3.9

Report on Test Measurements

Radiated Spurious Emissions, Harmonics

Specification Requirement § 90.210(d) Emission Limits:
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.*

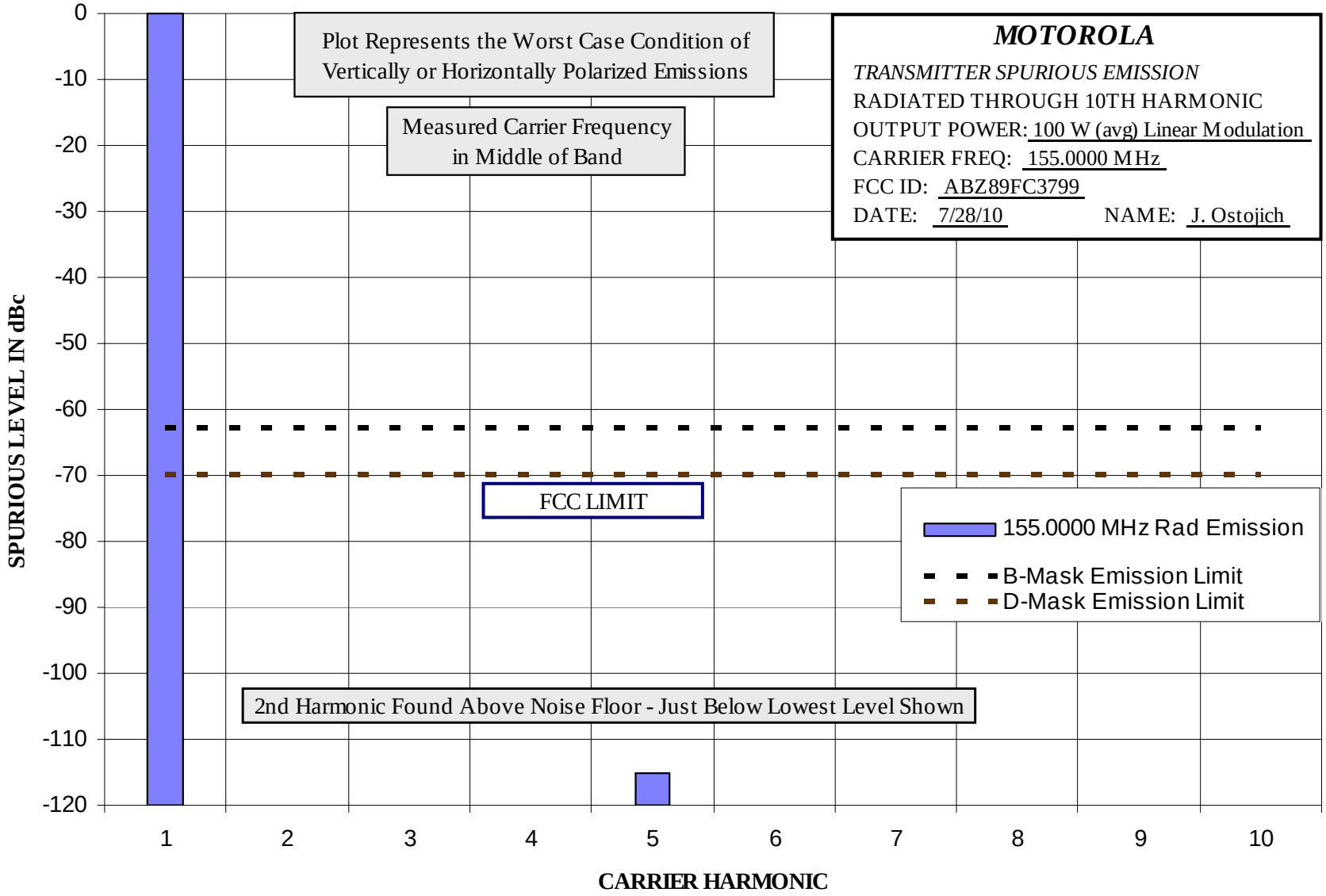
Modulation: Linear Simulcast Modulation (LSM) Pseudorandom data or Frequency Modulation (Analog) as indicated

Carrier Frequencies: A carrier frequency of 161.0125 MHz was measured. The radiated result at this frequency is representative of performance across the 136-174 MHz operating band

EXHIBIT	DESCRIPTION
E1-4.1	Radiated Spurious Emissions, Harmonics, Power Output 100 Watts, LSM The specification limit is -70.0 dBc
E1-4.2	Radiated Spurious Emissions, Harmonics, Power Output 2 Watts, LSM The specification limit is -53.0 dBc
E1-4.3	Radiated Spurious Emissions, Harmonics, Power Output 100 Watts, Analog The specification limit is -70.0 dBc
E1-4.4	Radiated Spurious Emissions, Harmonics, Power Output 2 Watts, Analog The specification limit is -53.0 dBc

Report on Test Measurements

Radiated Emission – Harmonics – 100 Watts – Linear Simulcast Modulation (LSM)



Report on Test Measurements

Radiated Emission – Harmonics – 2 Watts – Linear Simulcast Modulation (LSM)

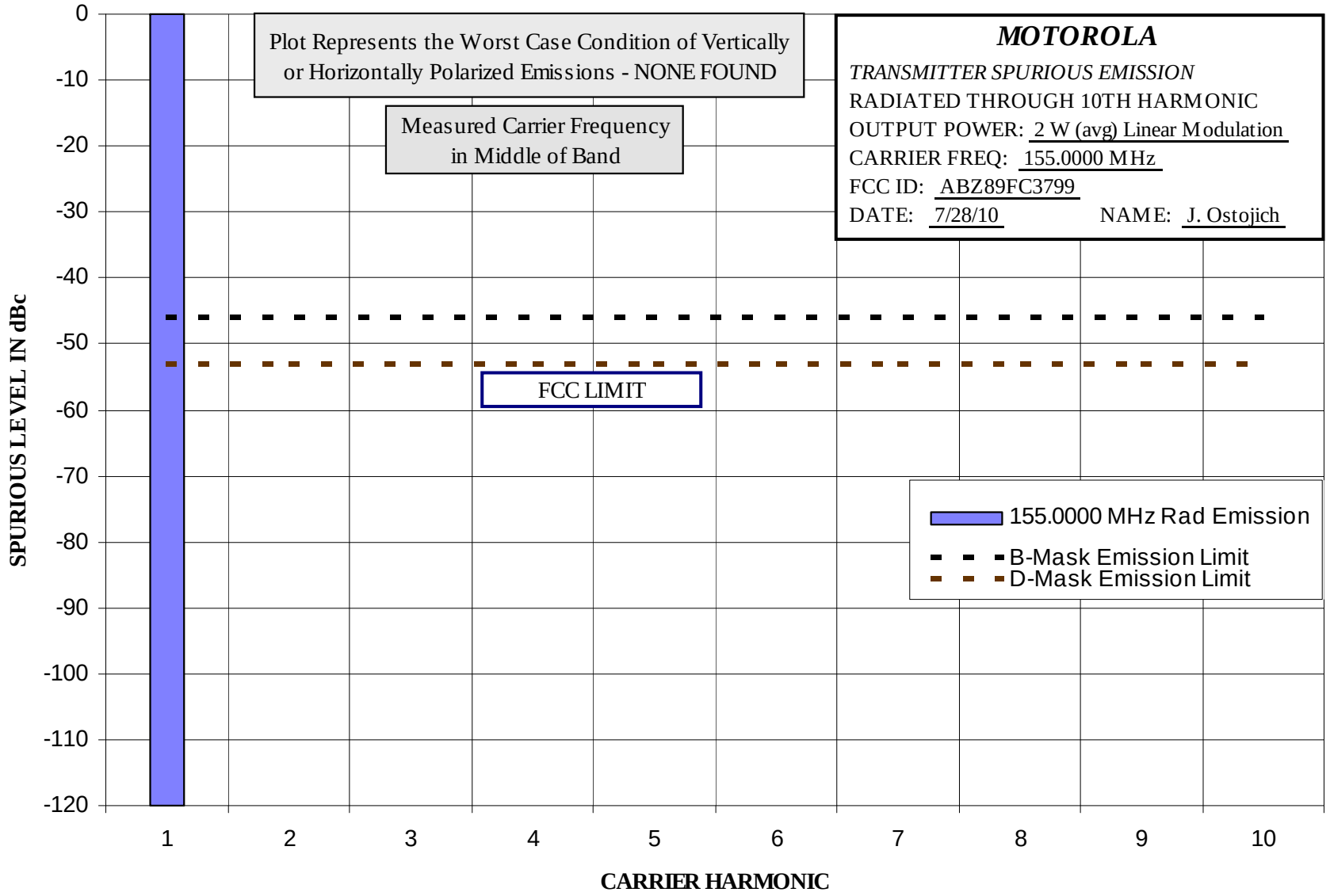
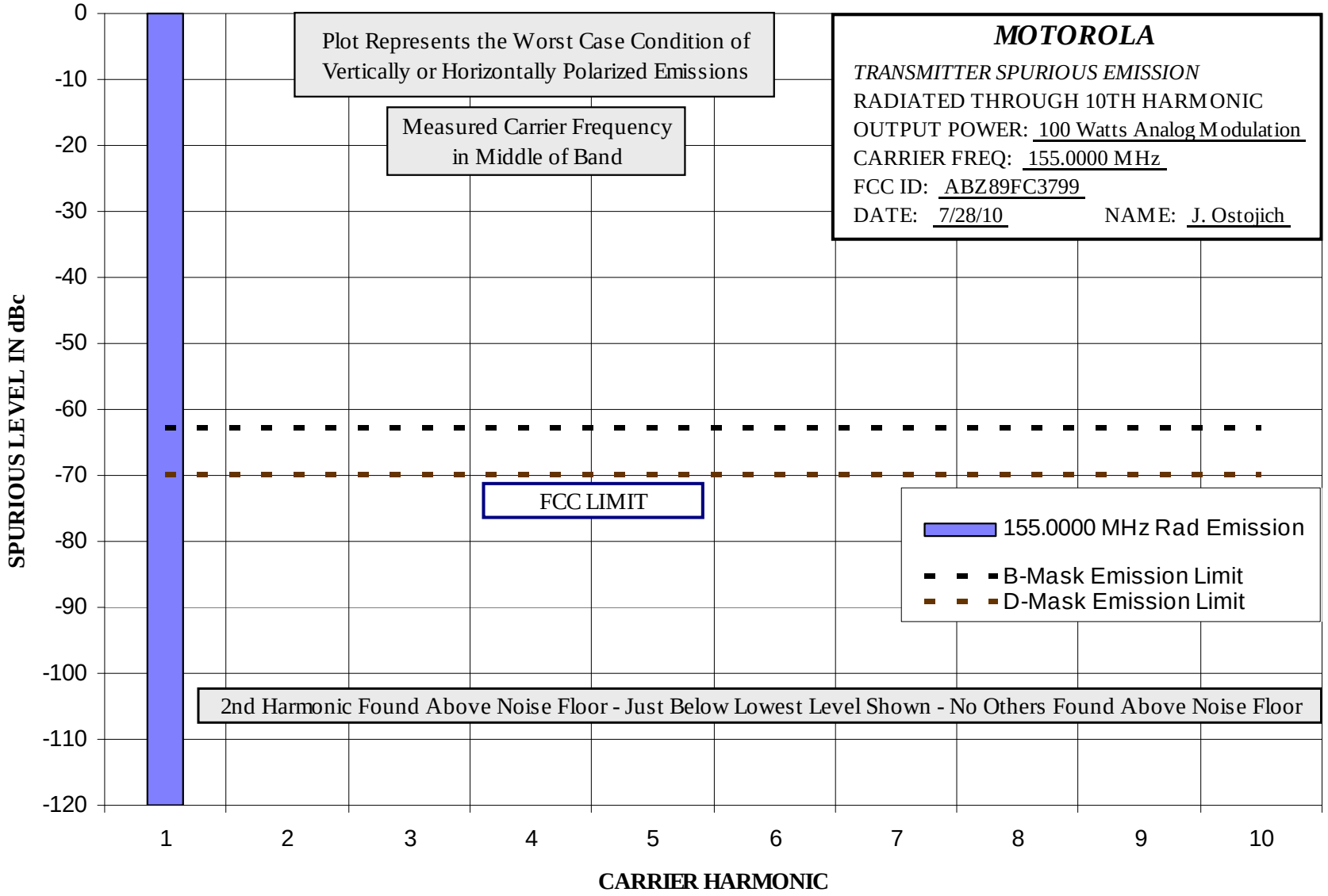


EXHIBIT E1-4.2

Report on Test Measurements

Radiated Emission – Harmonics – 100 Watts – Analog Frequency Modulation



Report on Test Measurements

Radiated Emission – Harmonics – 2 Watts – Analog Frequency Modulation

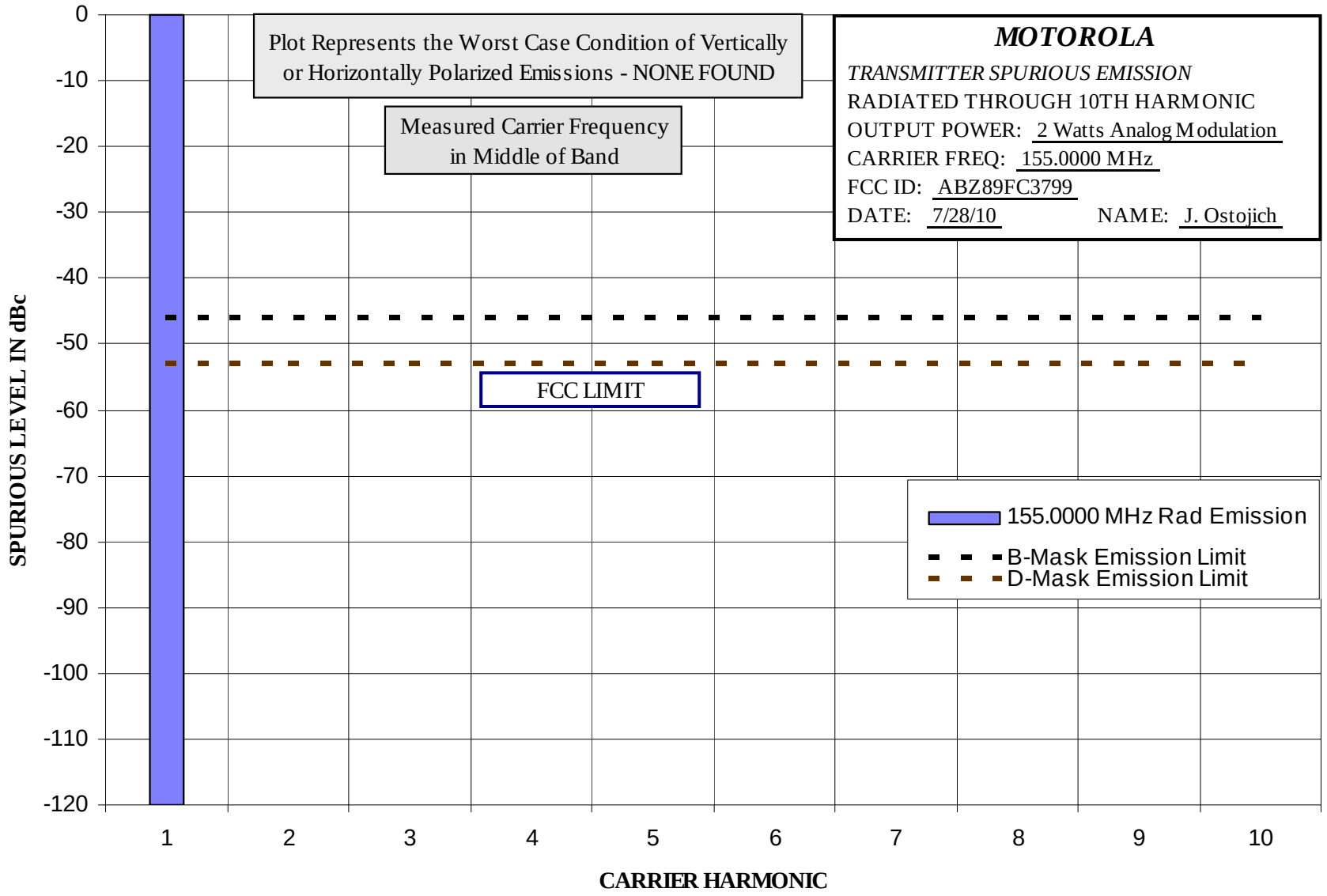


EXHIBIT E1-4.4

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: 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.

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

APPLICANT: MOTOROLA **EQUIPMENT TYPE: ABZ89FC3799**

Report on Test Measurements

Frequency Stability Vs Temperature

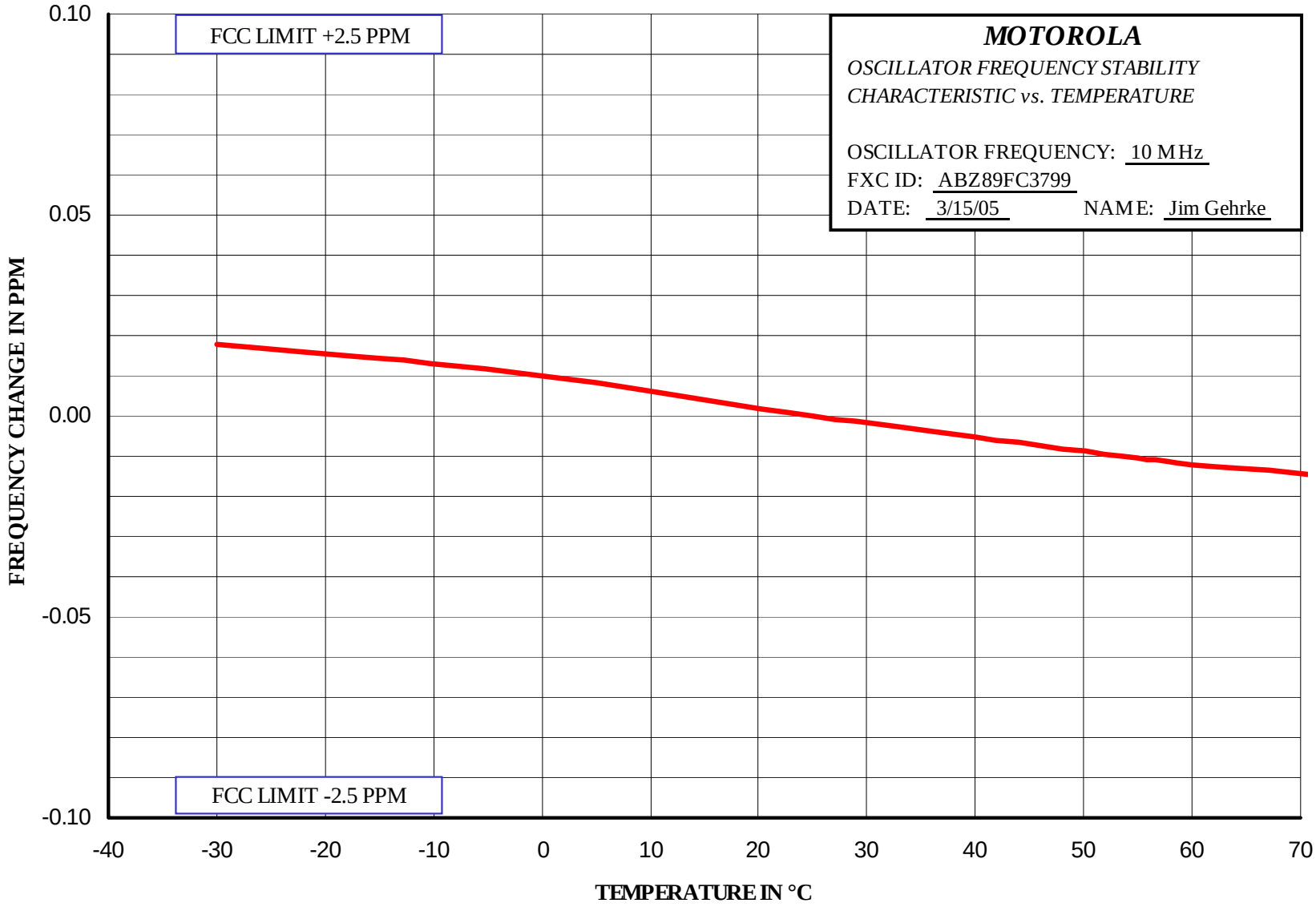


EXHIBIT E1-5.1

APPLICANT: MOTOROLA **EQUIPMENT TYPE: ABZ89FC3799**

Report on Test Measurements

Frequency Stability Vs Voltage

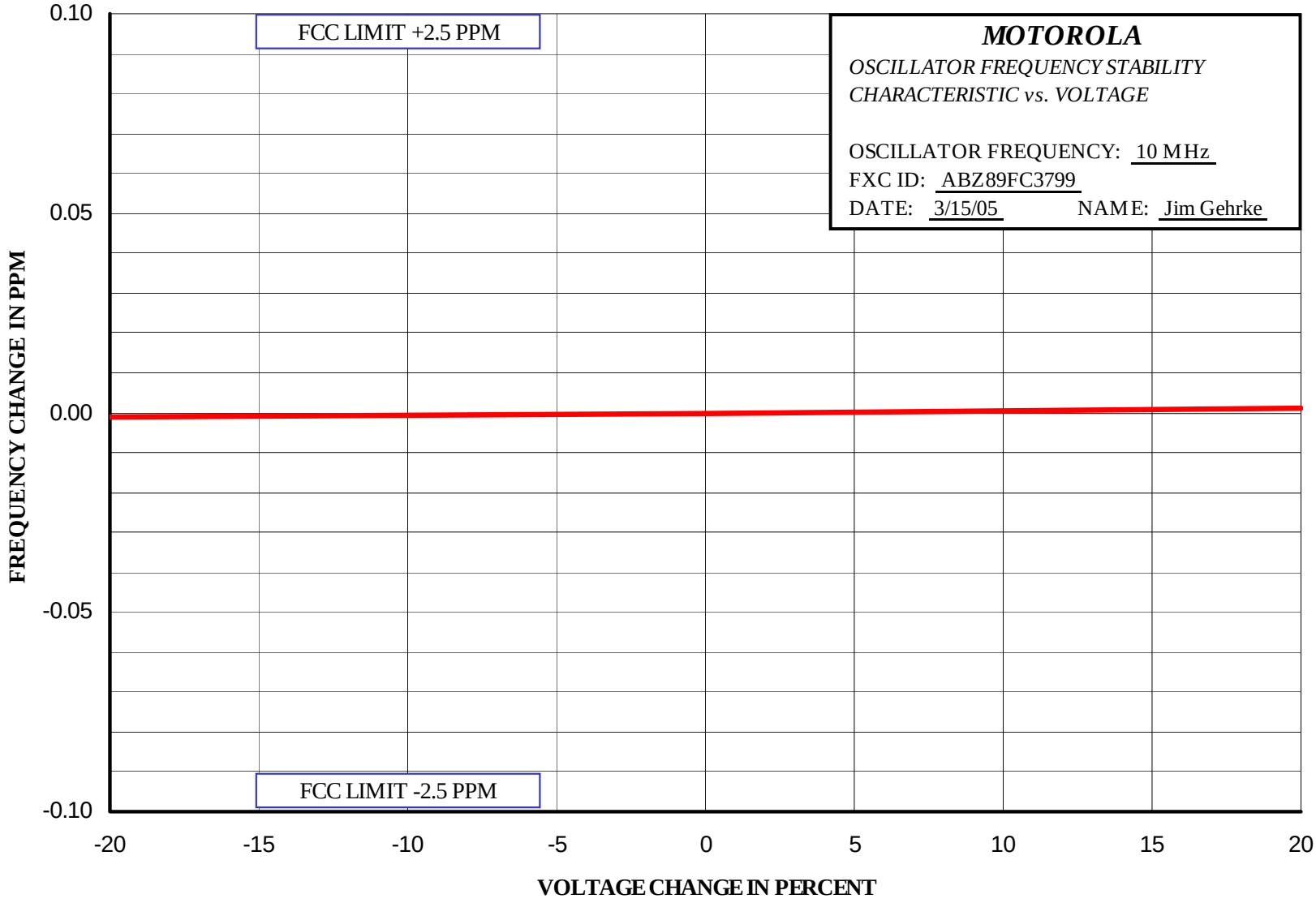


EXHIBIT E1-5.2

Report on Test Measurements

Frequency Transient Behavior

Specification Requirement: Reference Part 90.214

Transmitters designed to operate in the 150-174 MHz 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 t1 and t2 are times immediately following when the transmitter is turned on, and t3 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.

Modulation: Analog Mode Frequency Modulation
Carrier Frequencies: Performance at a carrier frequency of 155.0250 MHz was measured. This frequency represents the center of the 136-174 MHz operating band

EXHIBIT	DESCRIPTION
E1-6.1	Frequency Transient Behavior, 25 kHz Channel Key-Up
E1-6.2	Frequency Transient Behavior, 25 kHz Channel De-Key
E1-6.3	Frequency Transient Behavior, 12.5 kHz Channel Key-Up
E1-6.4	Frequency Transient Behavior, 12.5 kHz Channel De-key

The unit was tested at various power levels across the operating range. Power level was found to be irrelevant to performance according to this standard.

APPLICANT: MOTOROLA **EQUIPMENT TYPE: ABZ89FC3799**

Frequency Transient – Key-up – 25 kHz Channels

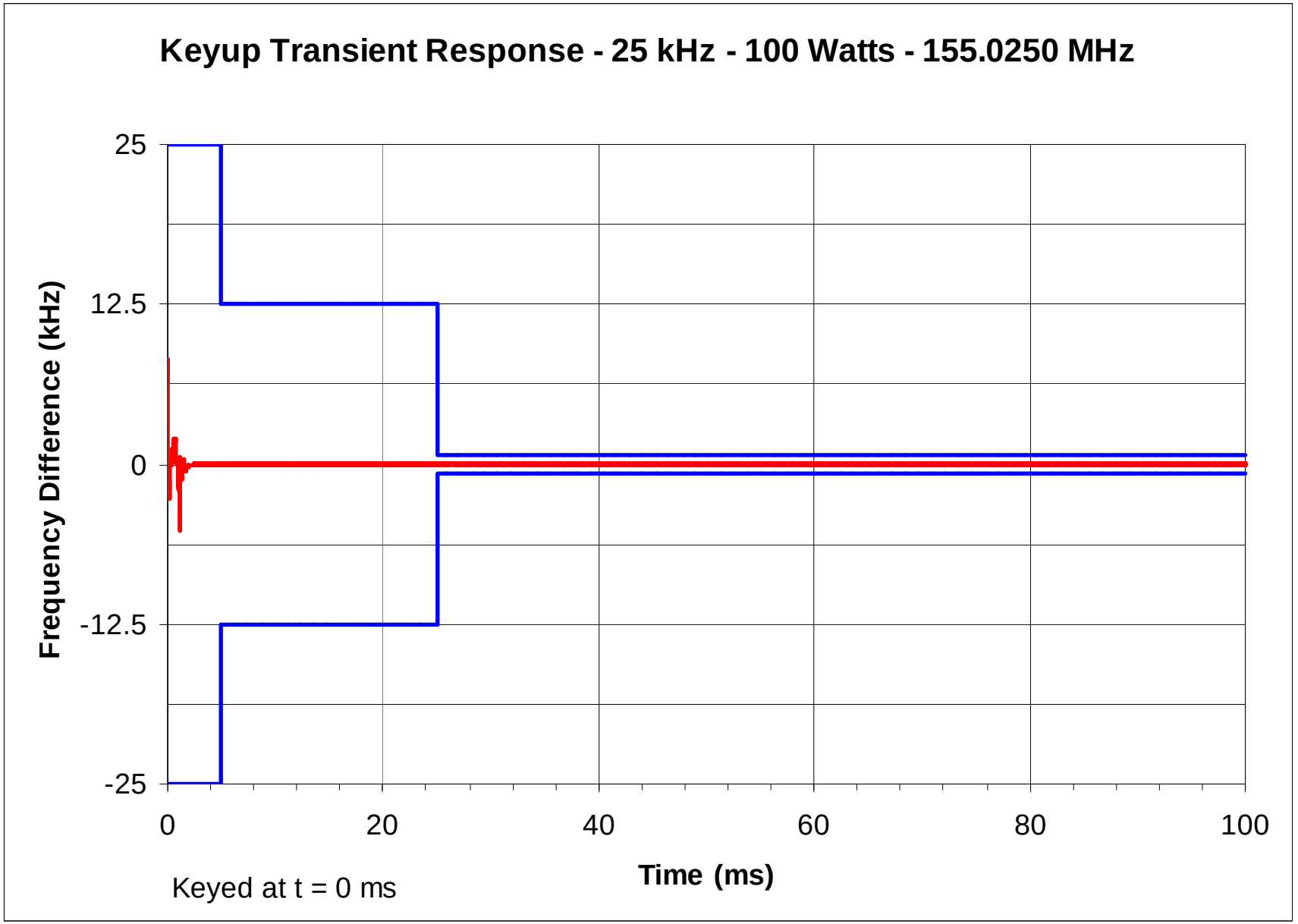
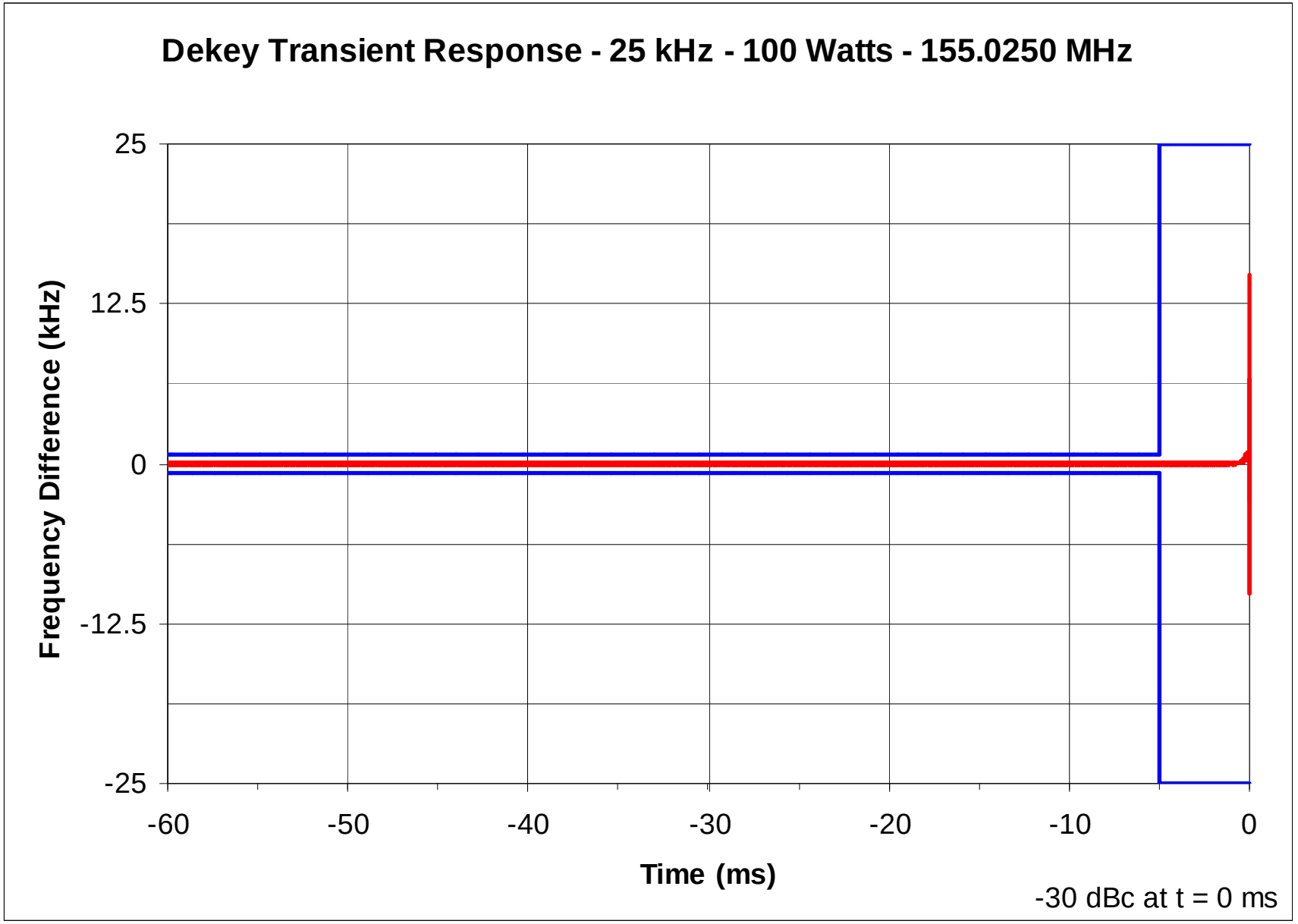
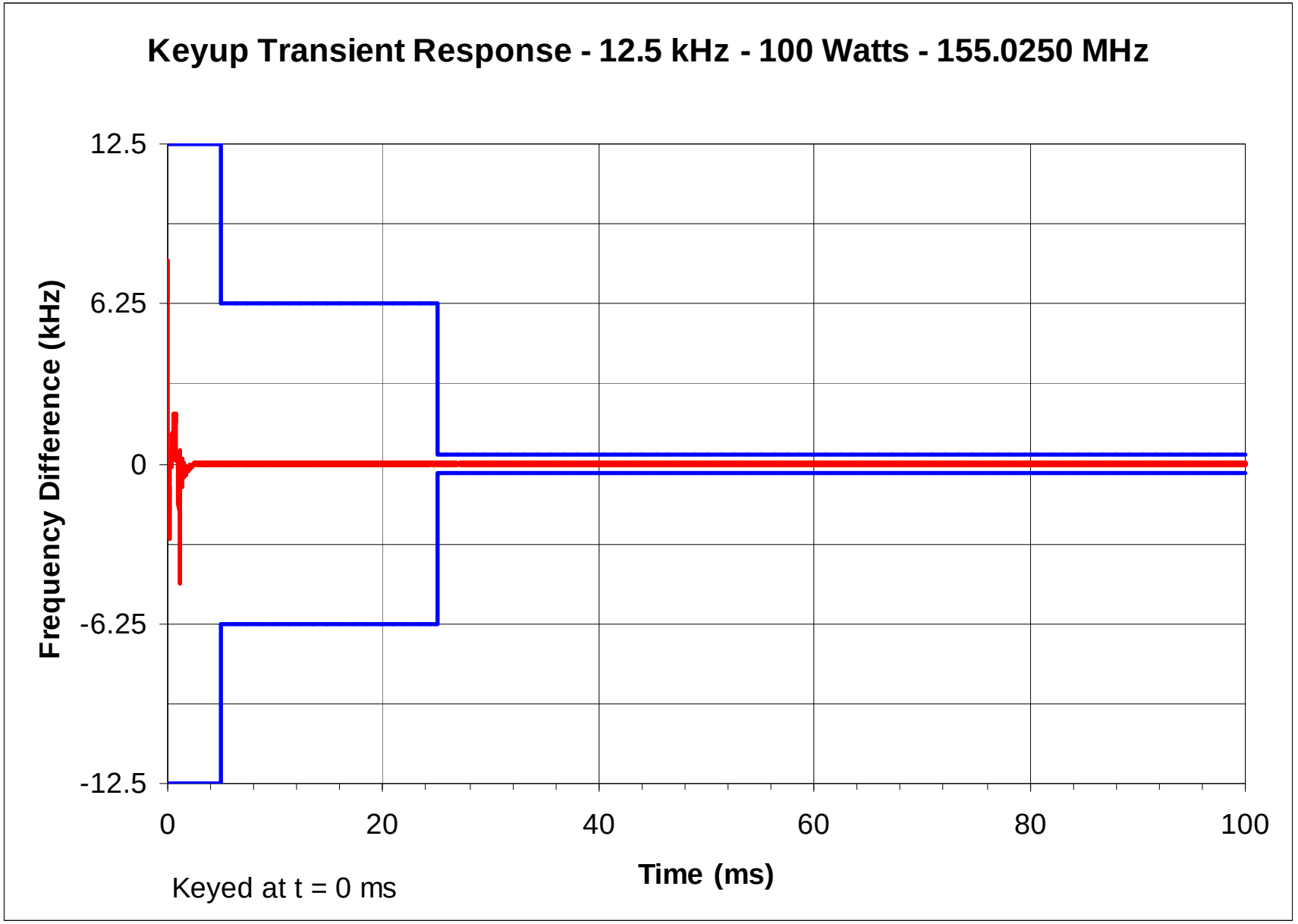


EXHIBIT E1-6.1

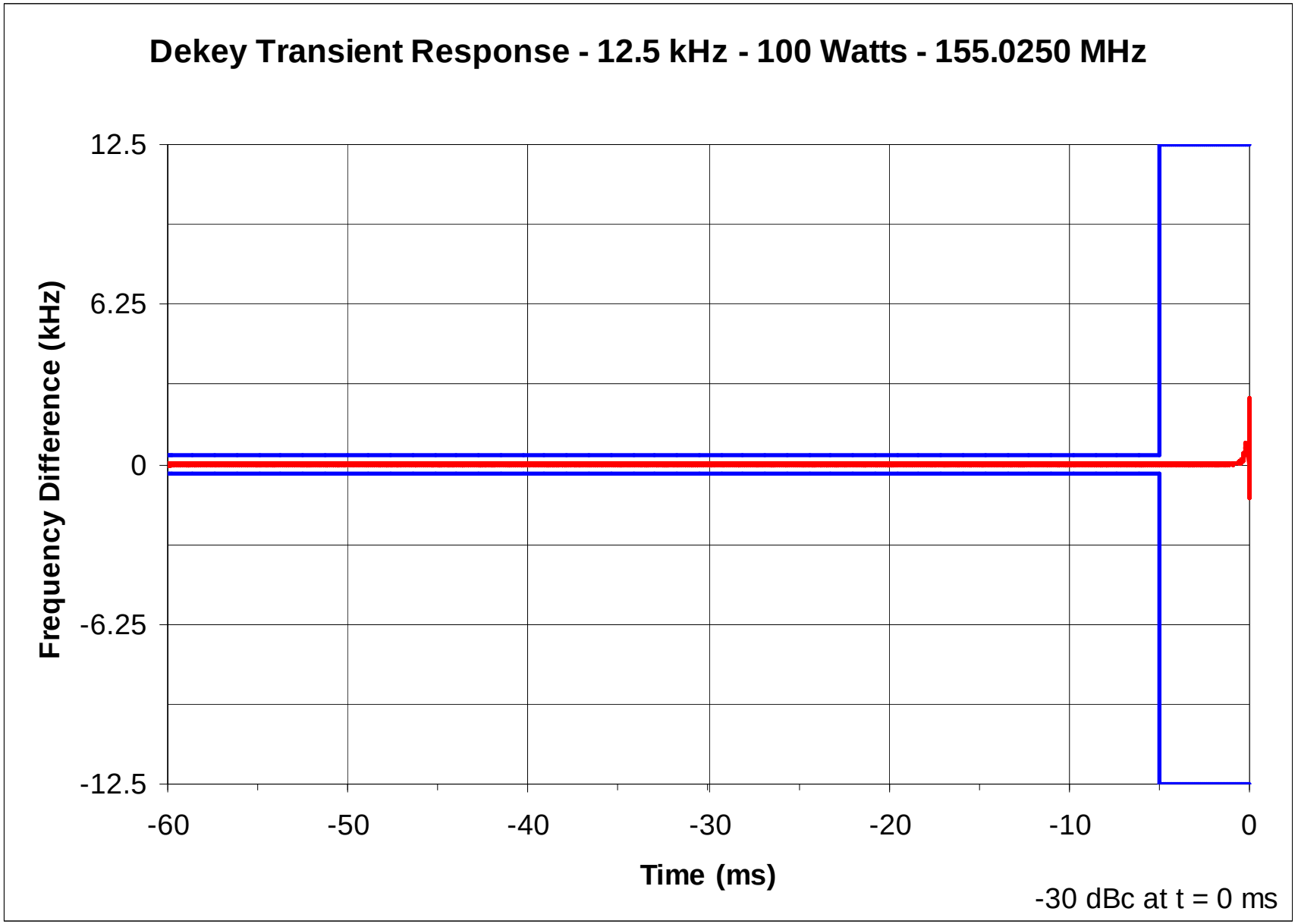
Frequency Transient – De-Key – 25 kHz Channels



Frequency Transient – Key-up – 12.5 kHz Channels



Frequency Transient – De-Key – 12.5 kHz Channels



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: A carrier at 155.0250 MHz was measured. This frequency is near the center of the operating band 136-172 MHz

EXHIBIT	DESCRIPTION
E1-7.1	Audio Frequency Response – Modulation Characteristics, 25 kHz Channels
E1-7.2	Audio Frequency Response – Modulation Characteristics, 12.5 kHz Channels

The specification limit is shown on the response plots

APPLICANT: MOTOROLA **EQUIPMENT TYPE: ABZ89FC3799**

Report on Test Measurements

Audio Frequency Response – 25 kHz Channels

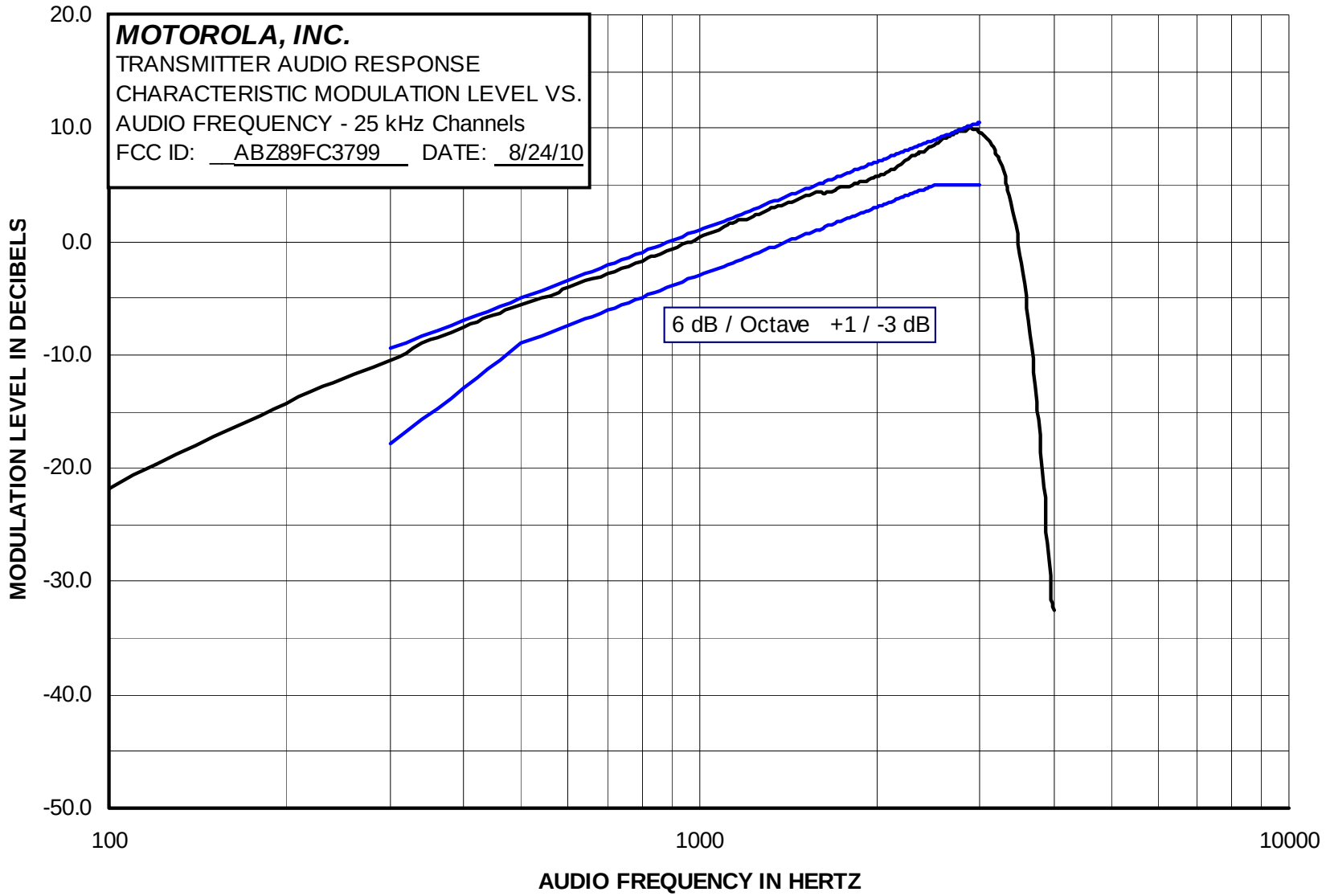


EXHIBIT E1-7.1

APPLICANT: MOTOROLA **EQUIPMENT TYPE: ABZ89FC3799**

Report on Test Measurements

Audio Frequency Response – 12.5 kHz Channels

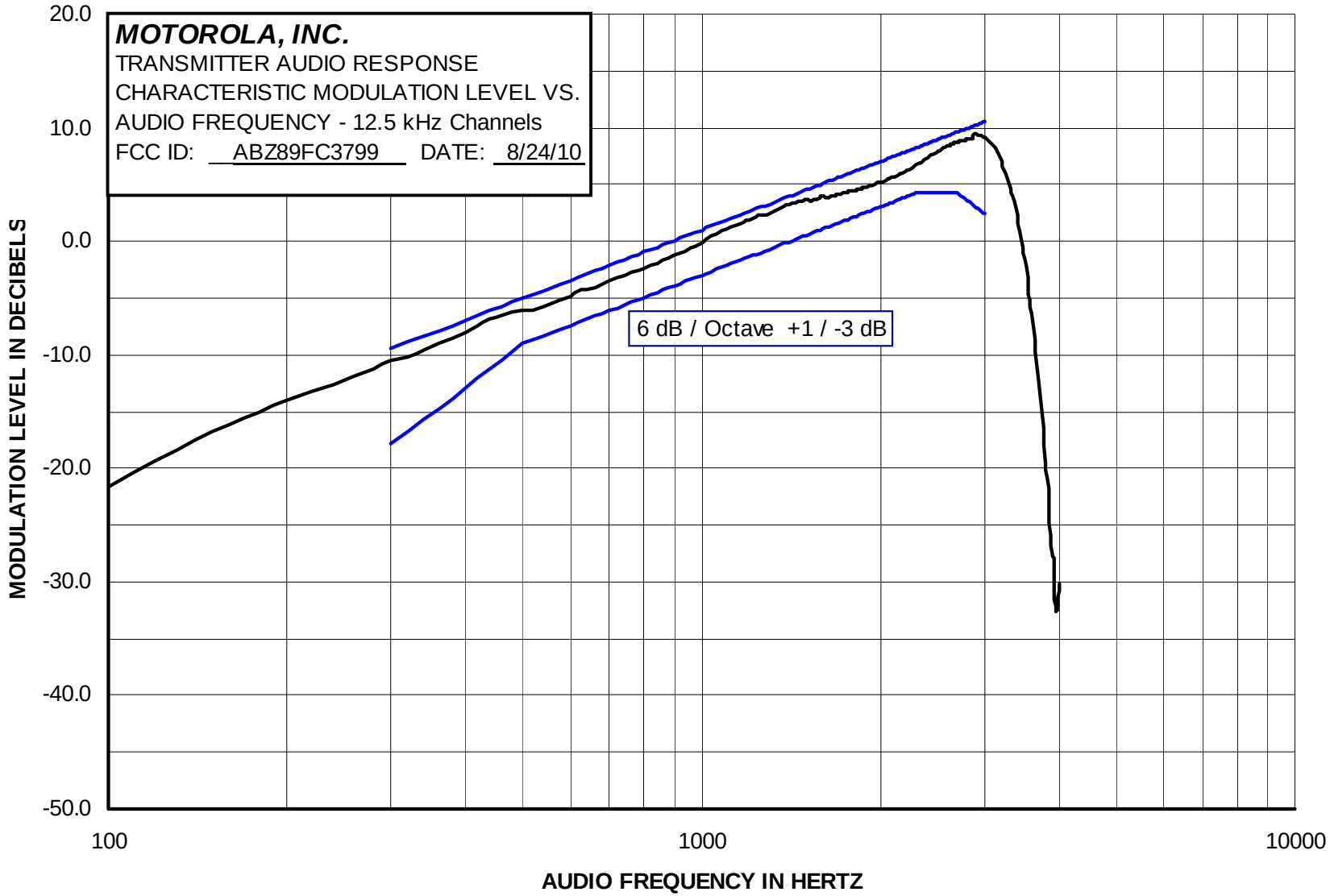


EXHIBIT E1-7.2

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:	A carrier at 155.025 MHz was measured. This frequency is near the center of the operating band 136-172 MHz

Modulation Limiting Response Plots:

EXHIBIT	**DESCRIPTION**
E1-8.1	Modulation Limiting Response – Modulation Characteristics, 25 kHz Channels
E1-8.2	Modulation Limiting Response – Modulation Characteristics, 12.5 kHz Channels

Report on Test Measurements

Modulation Limiting – 25 kHz Channels

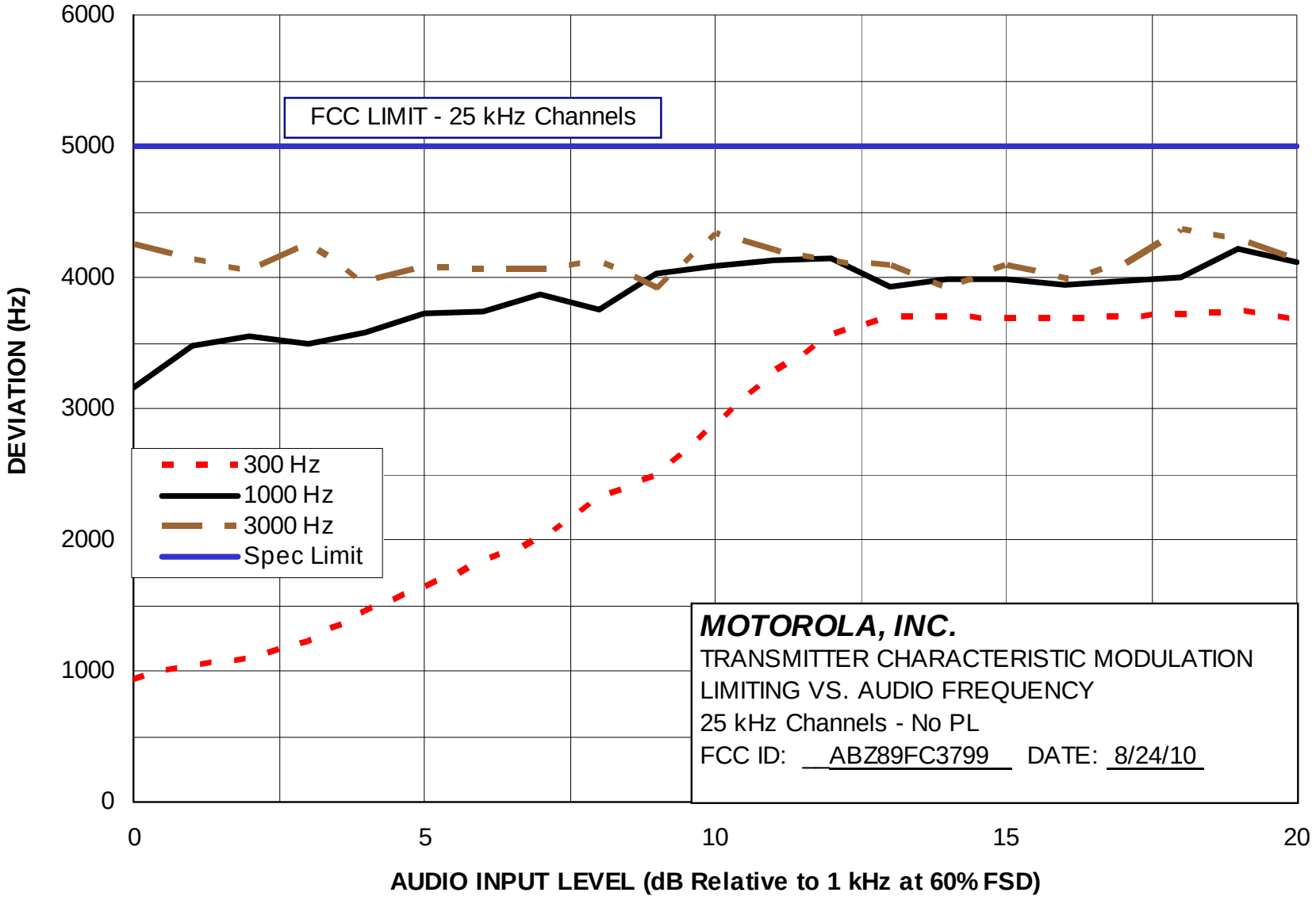
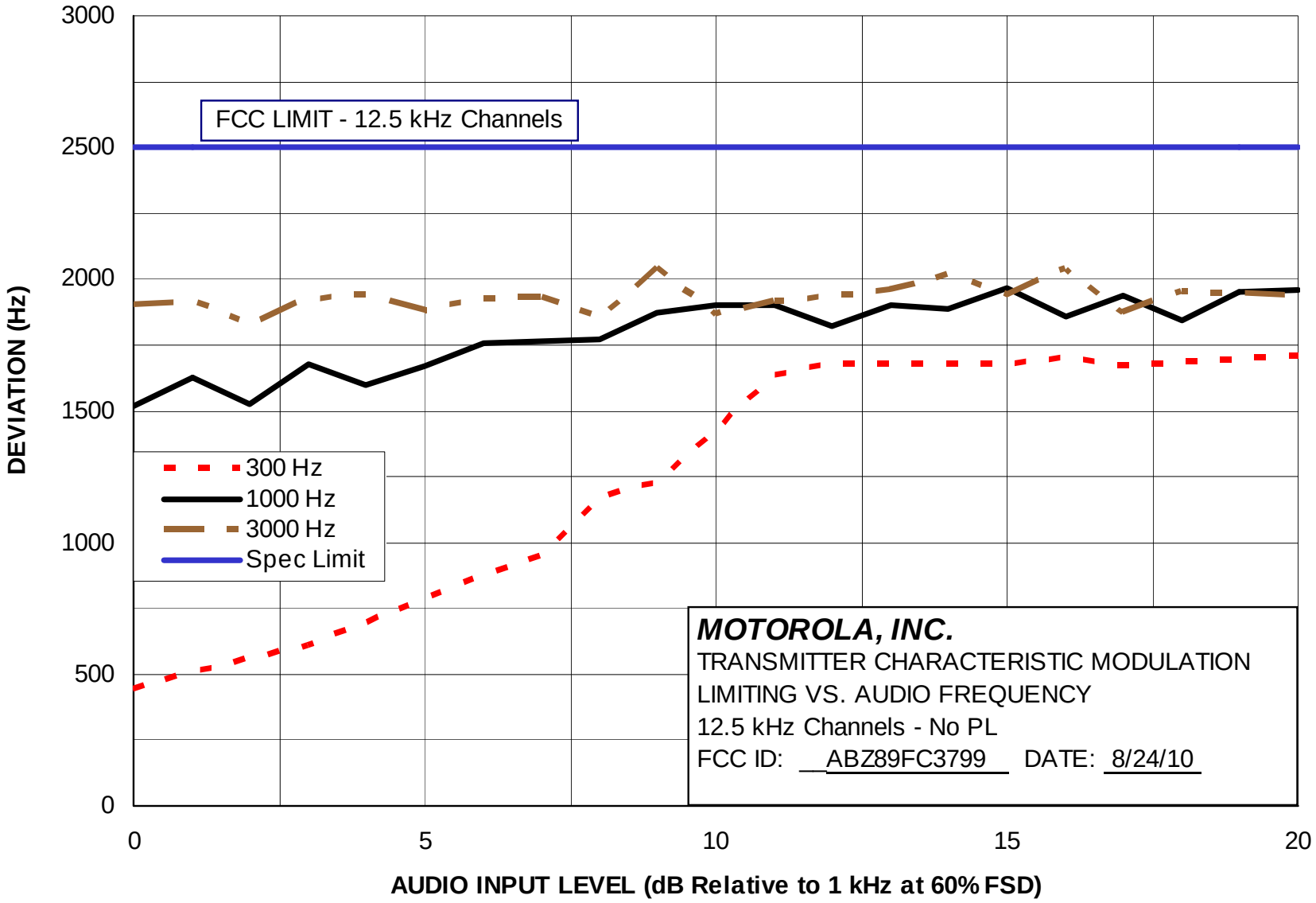


EXHIBIT E1-8.1

Report on Test Measurements

Modulation Limiting – 12.5 kHz Channels



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.

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:	100 Watts

Specification Requirement § 90.210(b) Emission Limits:
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 or 80 dB; (whichever is the lesser attenuation).*

Necessary Bandwidth Calculation:
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	5 kHz	16 kHz	16K0

Emission Measurement Analyzer Settings:

Horizontal:	12.5 kHz per Division	Resolution Bandwidth:	300 Hz
Vertical:	10 dB per Division	Video Bandwidth:	3 kHz
Sweep Time:	72 Seconds (<2000 Hz / Second)	Span:	125 kHz
Detector Mode:	Peak		

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.

EXHIBIT	**DESCRIPTION**
E1-9.1	Carrier with 2500 Hz Audio Tone, 25 kHz Channels
E1-9.2	Carrier with 2500 Hz Audio Tone and Private Line (PL) Signaling, 25 kHz Channels
E1-9.3	Carrier with 2500 Hz Audio Tone and Digital Private Line (DPL) Signaling, 25 kHz Channels

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.

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

Modulation Type:	Analog Voice
Emission Designator:	11K0F3E
Channelization:	12.5 kHz
Deviation Limit:	±5.0 kHz Max
Power Setting:	100 Watts

Specification Requirement § 90.210(d) Emission Limits:
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 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 Bandwidth:	100 Hz
Vertical:	10 dB per Division	Video Bandwidth:	3 kHz
Sweep Time:	72 Seconds (<2000 Hz / Second)	Span:	125 kHz
Detector Mode:	Peak		

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.

EXHIBIT	DESCRIPTION
E1-9.4	Carrier with 2500 Hz Audio Tone, 12.5 kHz Channels
E1-9.5	Carrier with 2500 Hz Audio Tone and Private Line (PL) Signaling, 12.5 kHz Channels
E1-9.6	Carrier with 2500 Hz Audio Tone and Digital Private Line (DPL) Signaling, 12.5 kHz Channels

APPLICANT: MOTOROLA **EQUIPMENT TYPE: ABZ89FC3799**

Report on Test Measurements

Occupied Bandwidth – Carrier with 2500 Hz Audio Tone, 25 kHz Channels

Occupied Bandwidth - 25 kHz Channels - Carrier with 2500 Hz Audio Tone - 16K0F3E

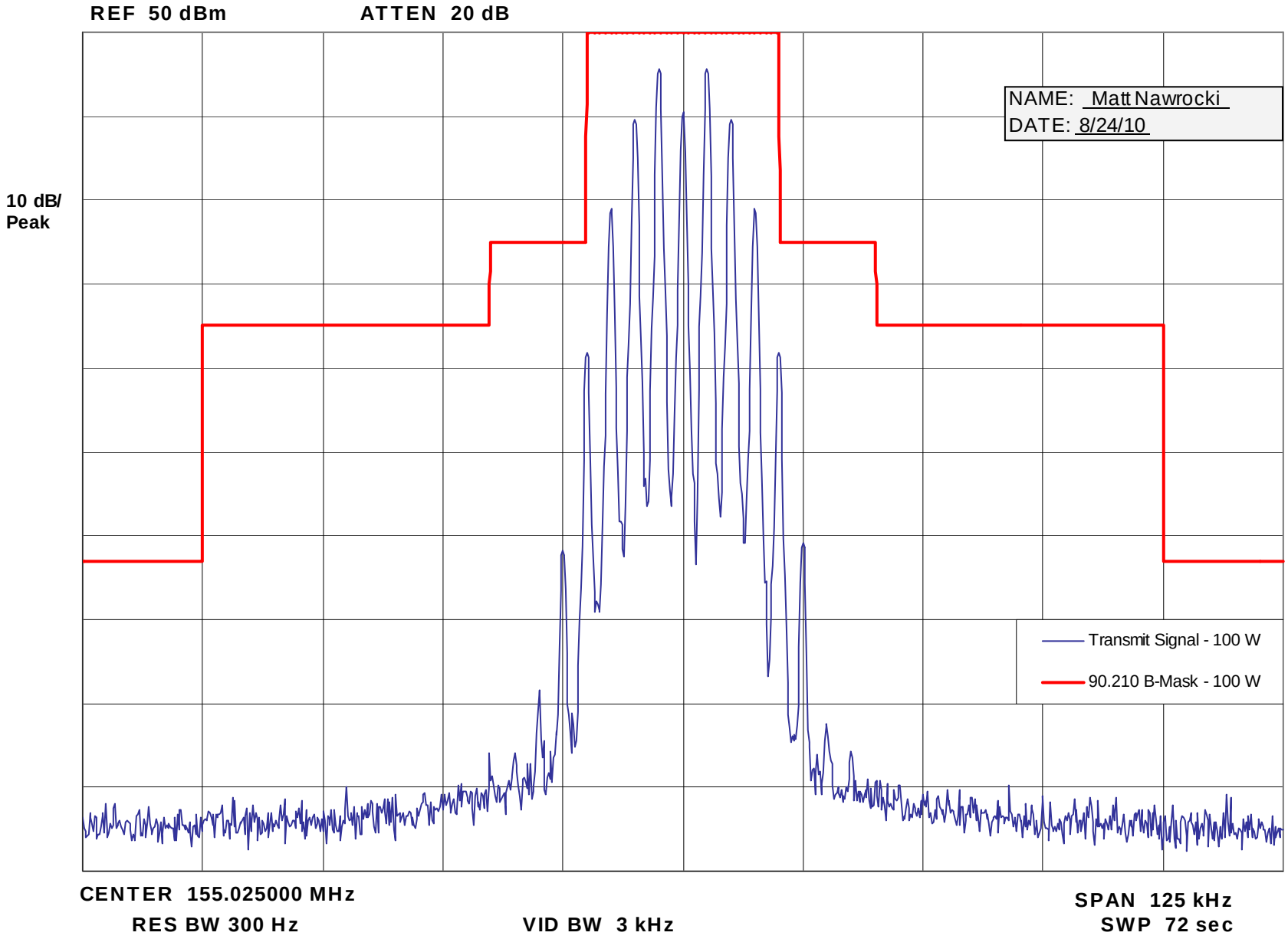


EXHIBIT E1-9.1

Report on Test Measurements

Occupied Bandwidth – Carrier with 2500 Hz Audio Tone and Private Line (PL) Signaling, 25 kHz Channels

Occupied Bandwidth - 25 kHz Channels - Carrier with 2500 Hz Audio and 123 Hz PL - 16K0F3E

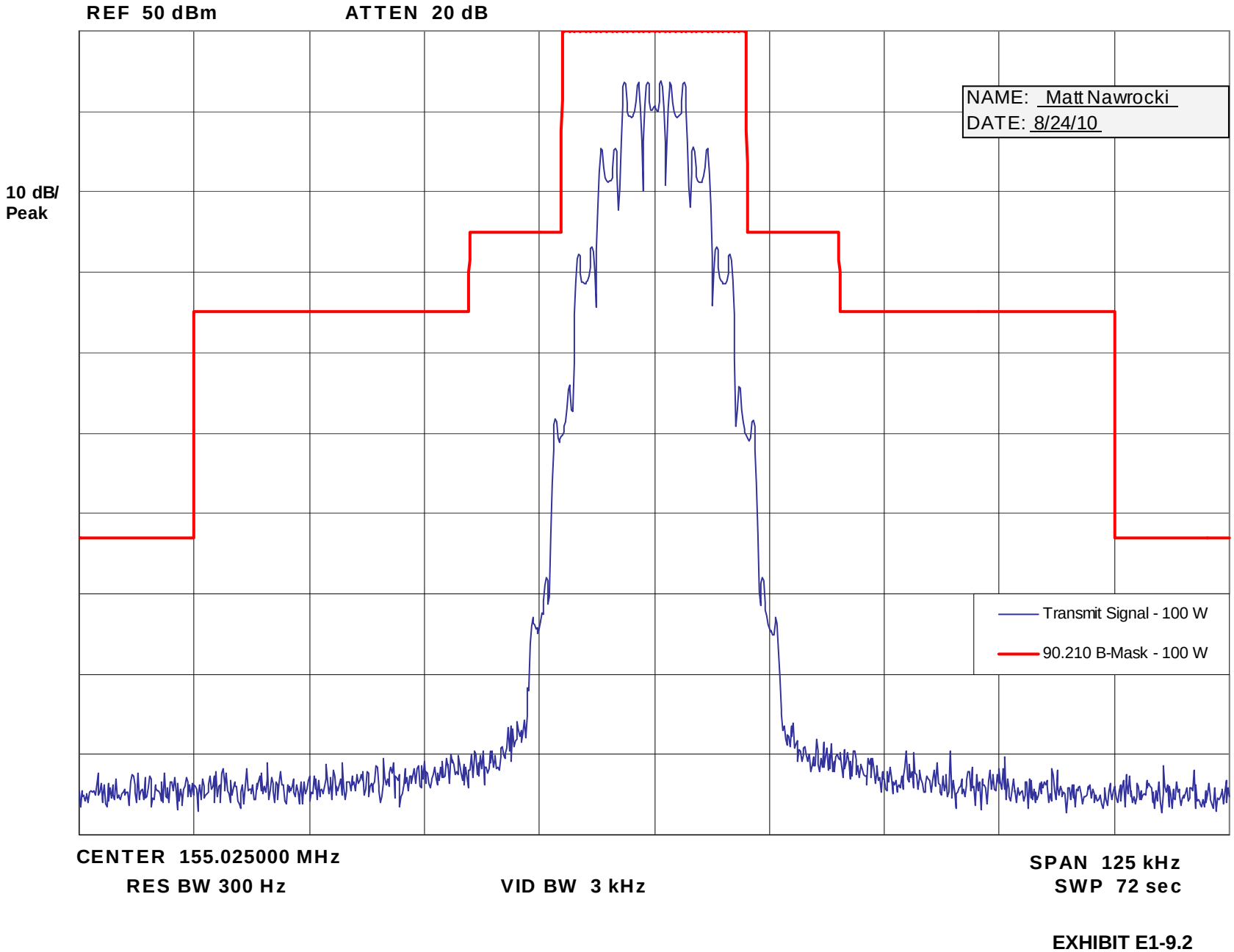


EXHIBIT E1-9.2

Report on Test Measurements

Occupied Bandwidth – Carrier with 2500 Hz Audio Tone and Digital Private Line (DPL) Signaling, 25 kHz Channels

Occupied Bandwidth - 25 kHz Channels - Carrier with 2500 Hz Audio and 627 DPL - 16K0F3E

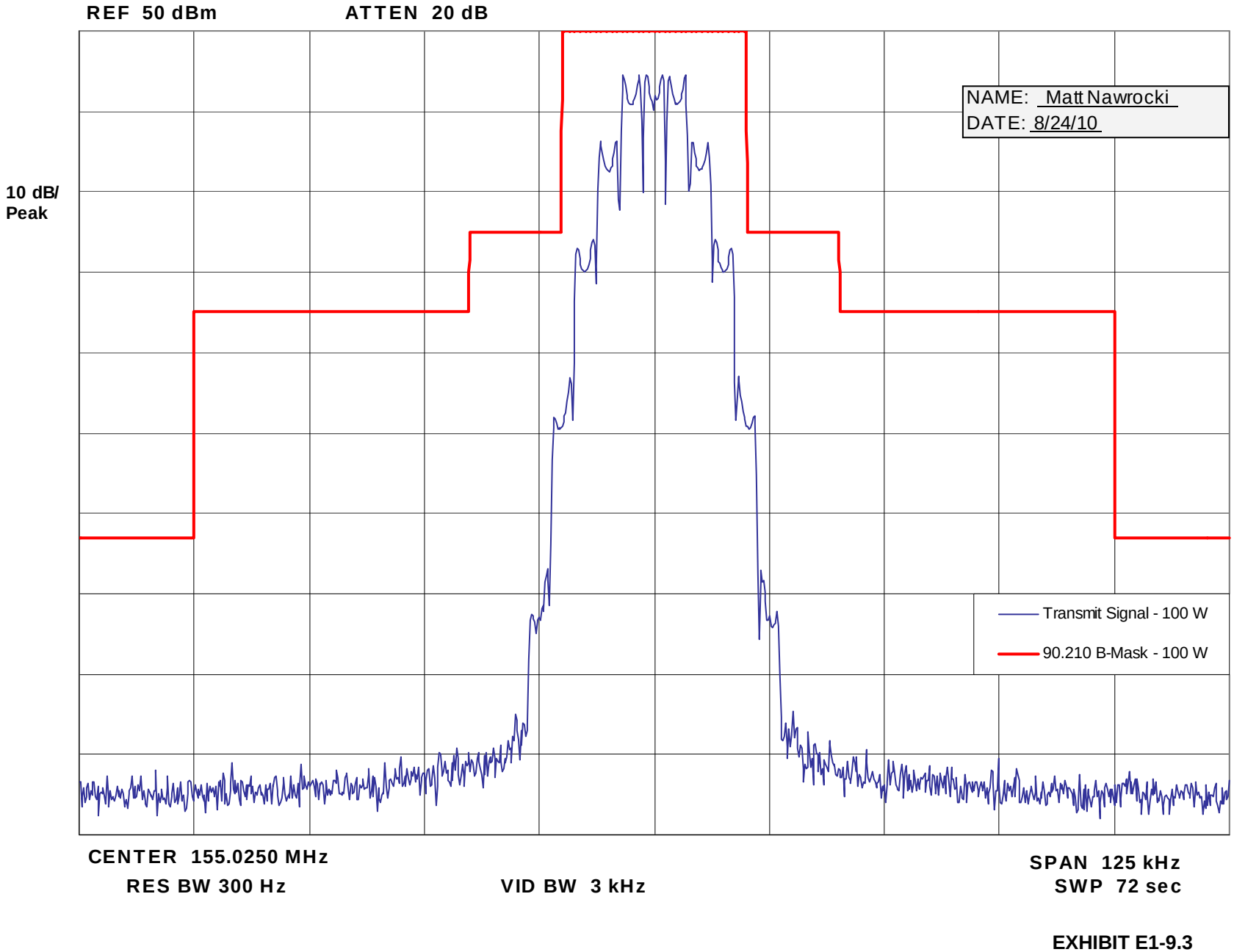


EXHIBIT E1-9.3

Report on Test Measurements

Occupied Bandwidth – Carrier with 2500 Hz Audio Tone, 12.5 kHz Channels

Occupied Bandwidth - 12.5 kHz Channels - Carrier with 2500 Hz Audio Tone - 11K0F3E

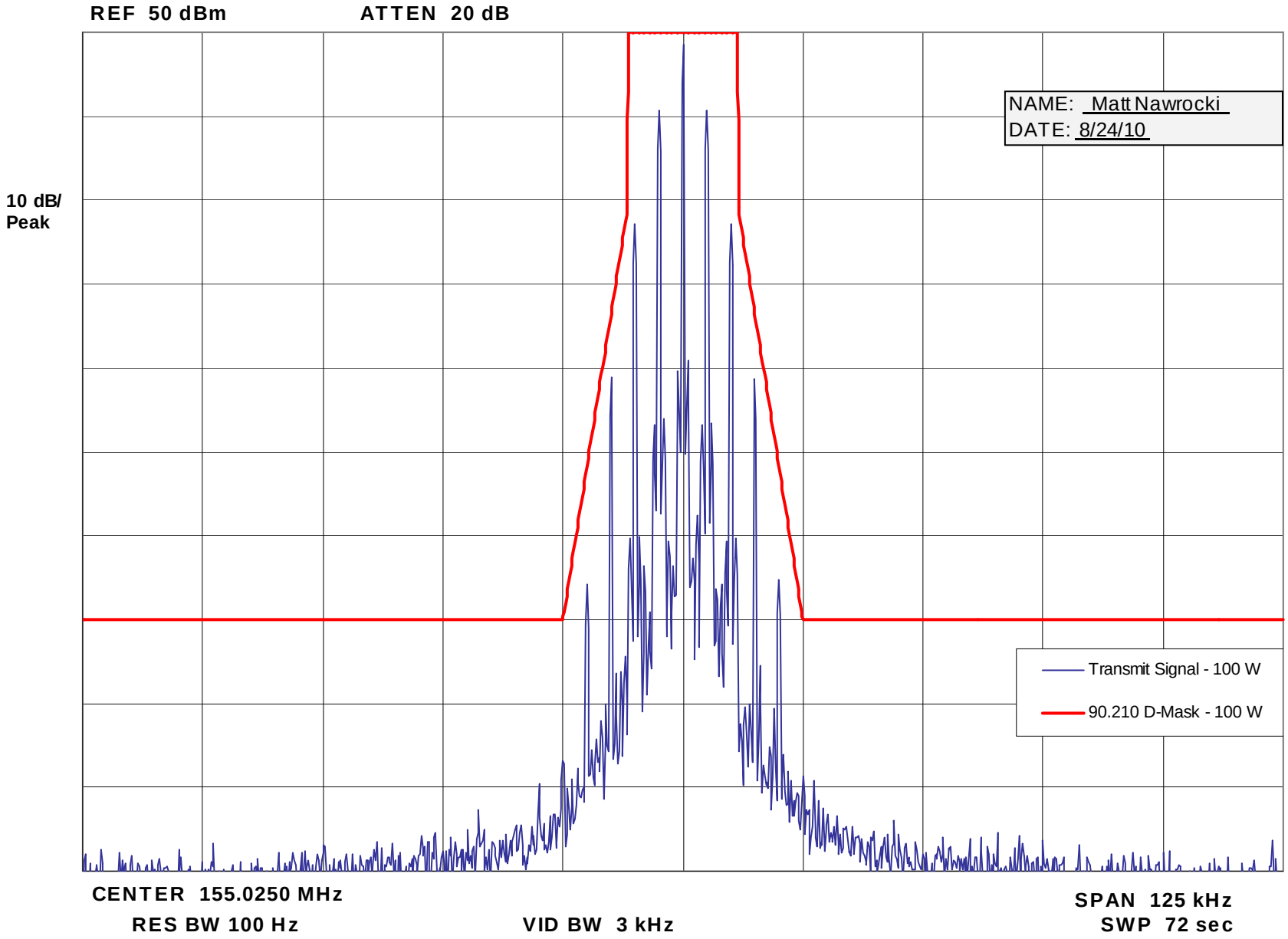


EXHIBIT E1-9.4

APPLICANT: MOTOROLA **EQUIPMENT TYPE: ABZ89FC3799**

Report on Test Measurements

Occupied Bandwidth – Carrier with 2500 Hz Audio Tone and Private Line (PL) Signaling, 12.5 kHz Channels

Occupied Bandwidth - 12.5 kHz Channels - Carrier with 2500 Hz Audio and 123 Hz PL - 11K0F3E

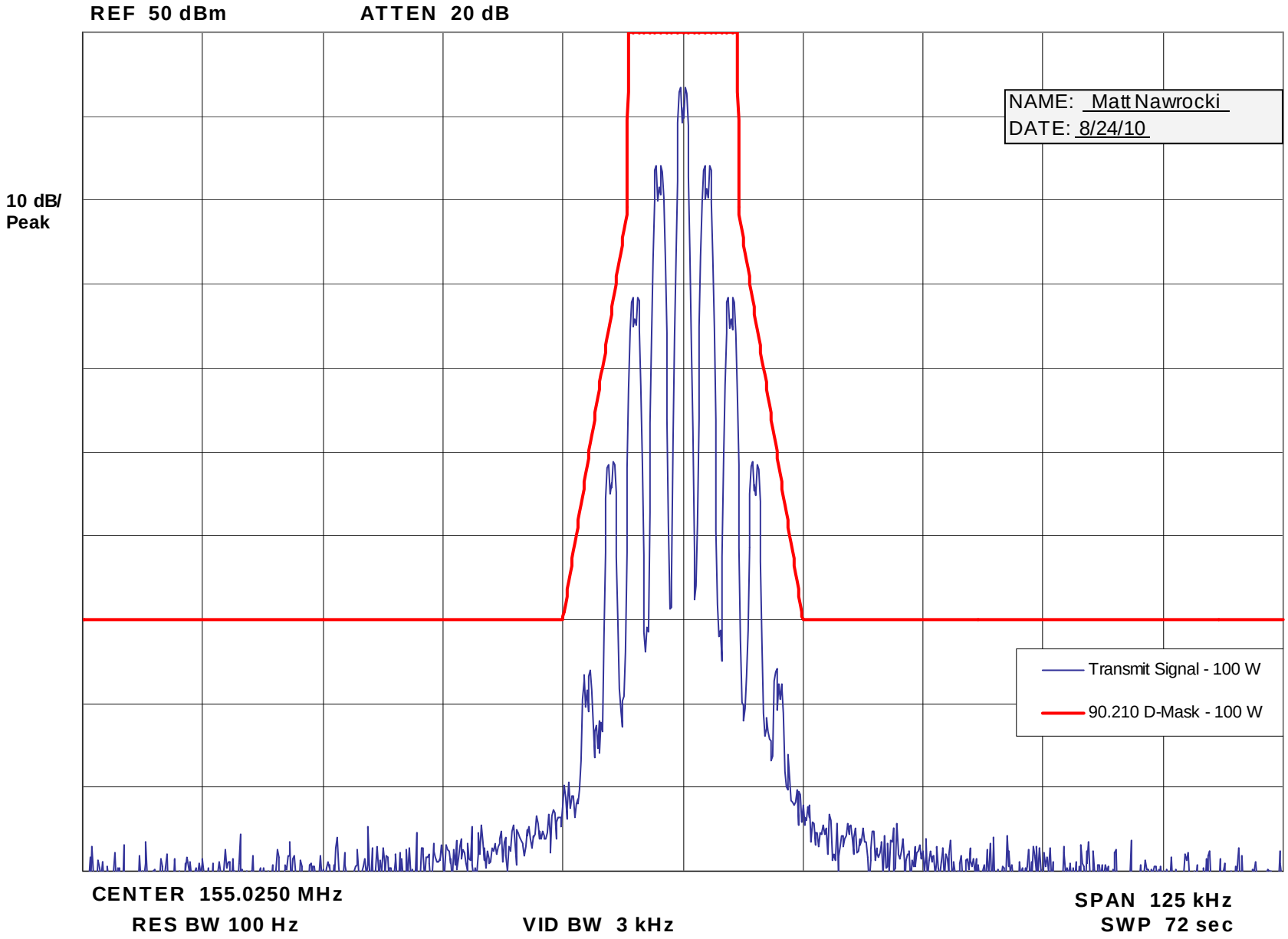


EXHIBIT E1-9.5

Report on Test Measurements

Occupied Bandwidth – Carrier with 2500 Hz Audio Tone and Digital Private Line (DPL) Signaling, 12.5 kHz Channels

Occupied Bandwidth - 12.5 kHz Channels - Carrier with 2500 Hz Audio and 627 DPL - 11K0F3E

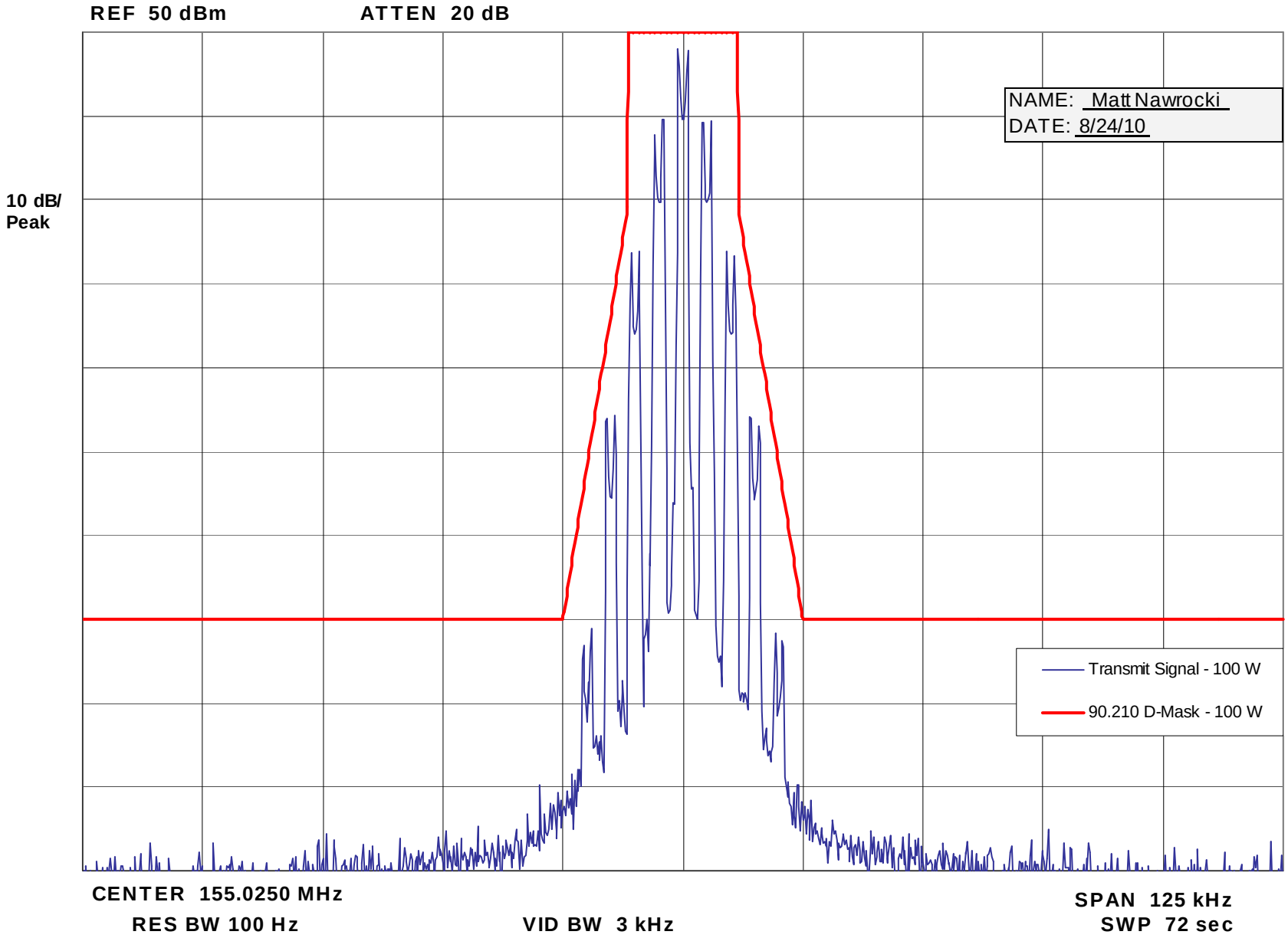


EXHIBIT E1-9.6

Report on Test Measurements

Test Equipment List

MODEL	MANUFACTURER	DESCRIPTION	Serial No.	Last Cal	Next Cal
437B	Hewlett Packard	RF Power Meter	2912A01517	05/13/08	05/13/11
8481A	Hewlett Packard	RF Power Sensor	2702A76706	07/25/08	07/25/11
E4443A	Agilent	Spectrum Analyzer	MY43360090	09/18/09	09/18/12
83712A	Hewlett Packard	Signal Generator	3429A00455	10/27/08	10/27/11
8671B	Hewlett Packard	Signal Generator	2611A00159	10/24/07	10/24/10
85460A	Hewlett Packard	EMI Analyzer, Filter	3704A00467	07/21/07	07/21/10
85462A	Hewlett Packard	EMI Analyzer, RF/Display	3906A00500	07/21/07	07/21/10
8593E	Hewlett Packard	EMI Analyzer	3513A01649	06/12/10	06/12/13
89441A	Agilent	Vector Signal Analyzer	3416A00835	05/27/09	05/27/12
89441A	Agilent	Vector Signal Analyzer	3509A01047	05/13/08	05/13/11
N9030A	Agilent	PXA Signal Analyzer	US49230267	01/17/10	01/17/11
(Various)	Weinschel, Kathrein, Bird	RF Loads	Various	no calibration required	
TWPC-4510-1	Telewave	Cavity	5244	no calibration required	
3020A, etc.	Narda	Directional Coupler	Various	no calibration required	

APPLICANT: MOTOROLA **EQUIPMENT TYPE: ABZ89FC3799**

Report on Test Measurements

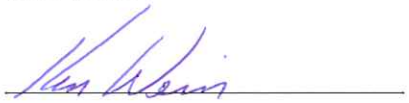
Statement of Certification

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

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

NAME: **Ken Weiss**

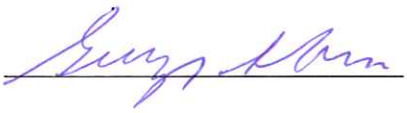
SIGNATURE: 

DATE: **October 14, 2010**

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: **Greg Alms**

SIGNATURE: 

DATE: **October 14, 2010**

POSITION: **Engineering Section Manager**