

**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: 110 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<sub>10</sub>(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.

<b>EXHIBIT</b>	<b>DESCRIPTION</b>
E1-2.9	H-DQPSK P25 Two Slot TDMA Digital Modulation

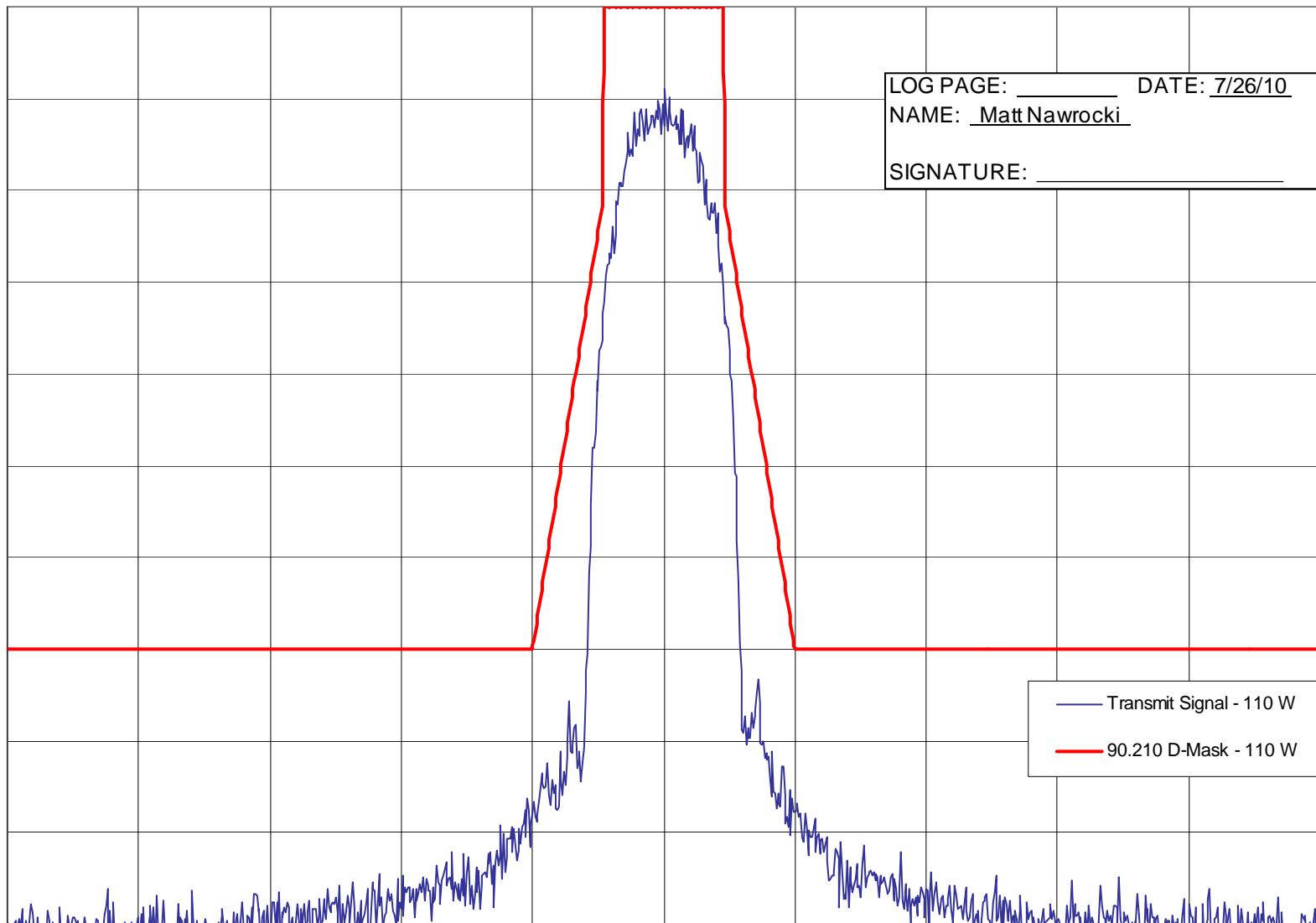
## Report on Test Measurements

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

## Occupied Bandwidth -- H-DQPSK P25 Two Slot TDMA Digital Modulation - 9K80D7W - 110 Watts

REF 50.4 dBm

ATTEN 20 dB

10 dB/  
Peak

CENTER 420.01250 MHz

RES BW 100 Hz

VID BW 10 kHz

SPAN 125 kHz

SWP 72 sec

EXHIBIT E1-2.9  
(Permissive Change)

## 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 roll off 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 420.0125 MHz was measured. This frequency is near the center of the operating band 406.1-435 MHz

<b>EXHIBIT</b>	<b>DESCRIPTION</b>
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: ABZ89FC4821

Report on Test Measurements

Audio Frequency Response – 25 kHz Channels

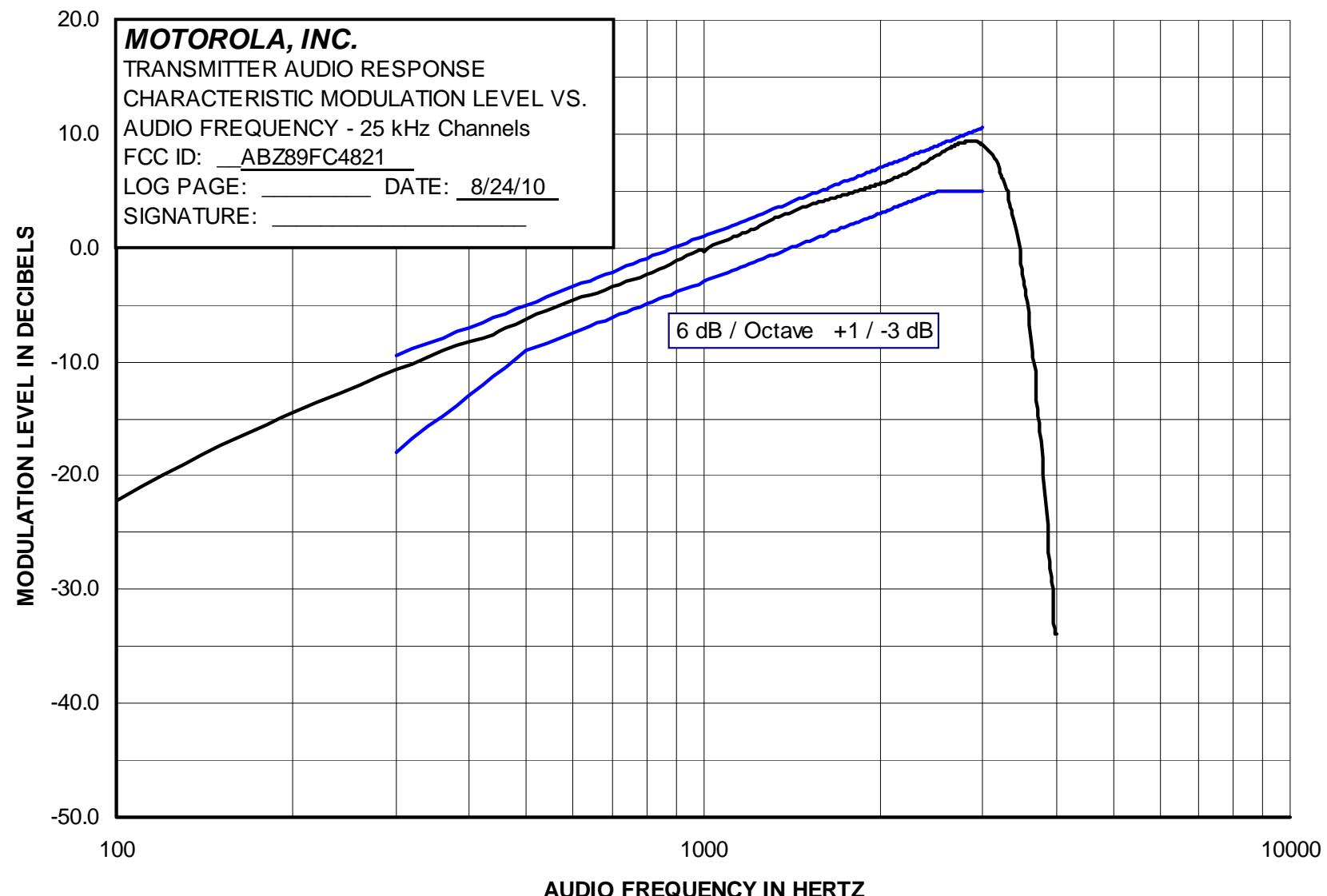


EXHIBIT E1-7.1  
(Permissive Change)

APPLICANT: MOTOROLA

EQUIPMENT TYPE: ABZ89FC4821

Report on Test Measurements

Audio Frequency Response – 12.5 kHz Channels

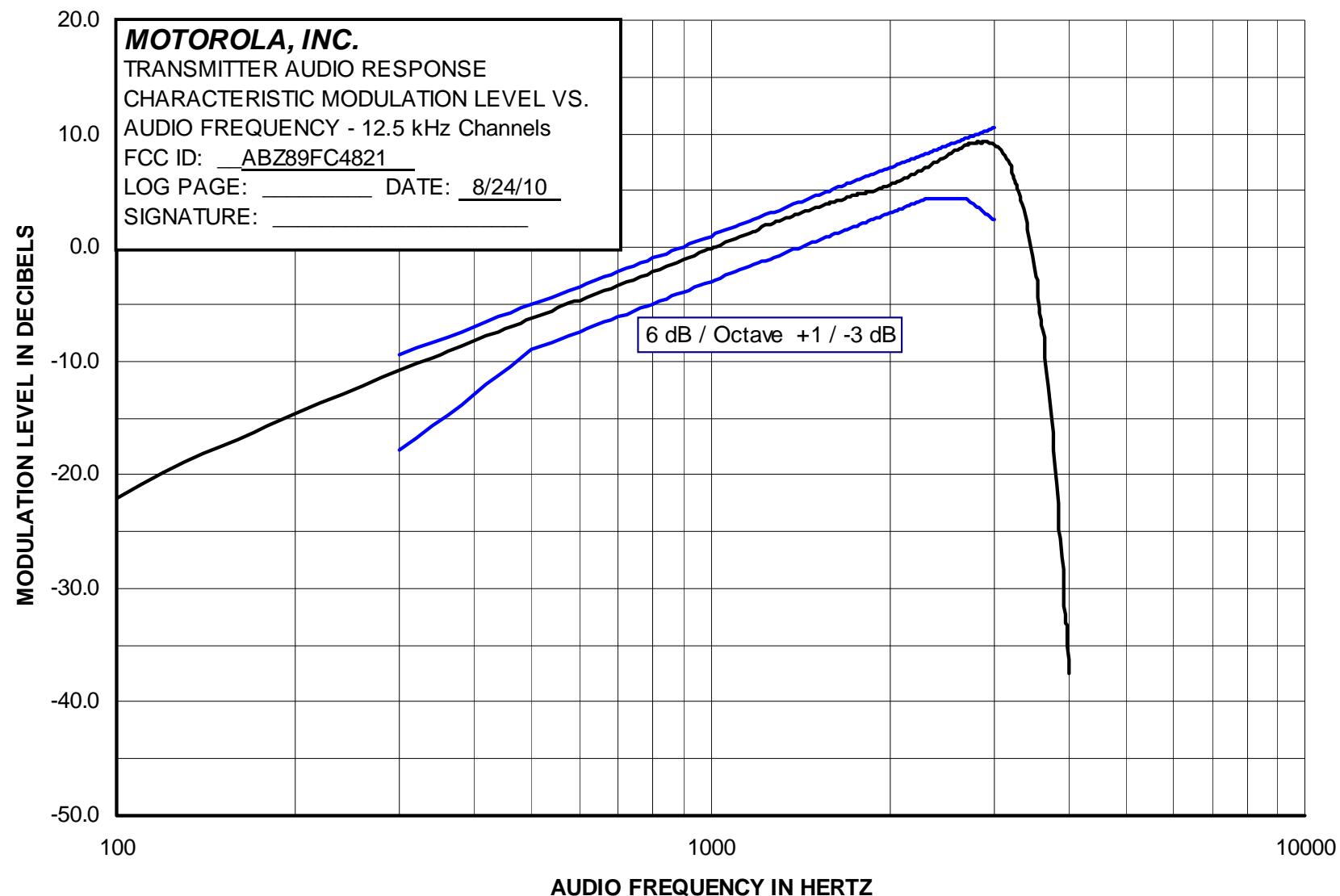


EXHIBIT E1-7.2  
(Permissive Change)

**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

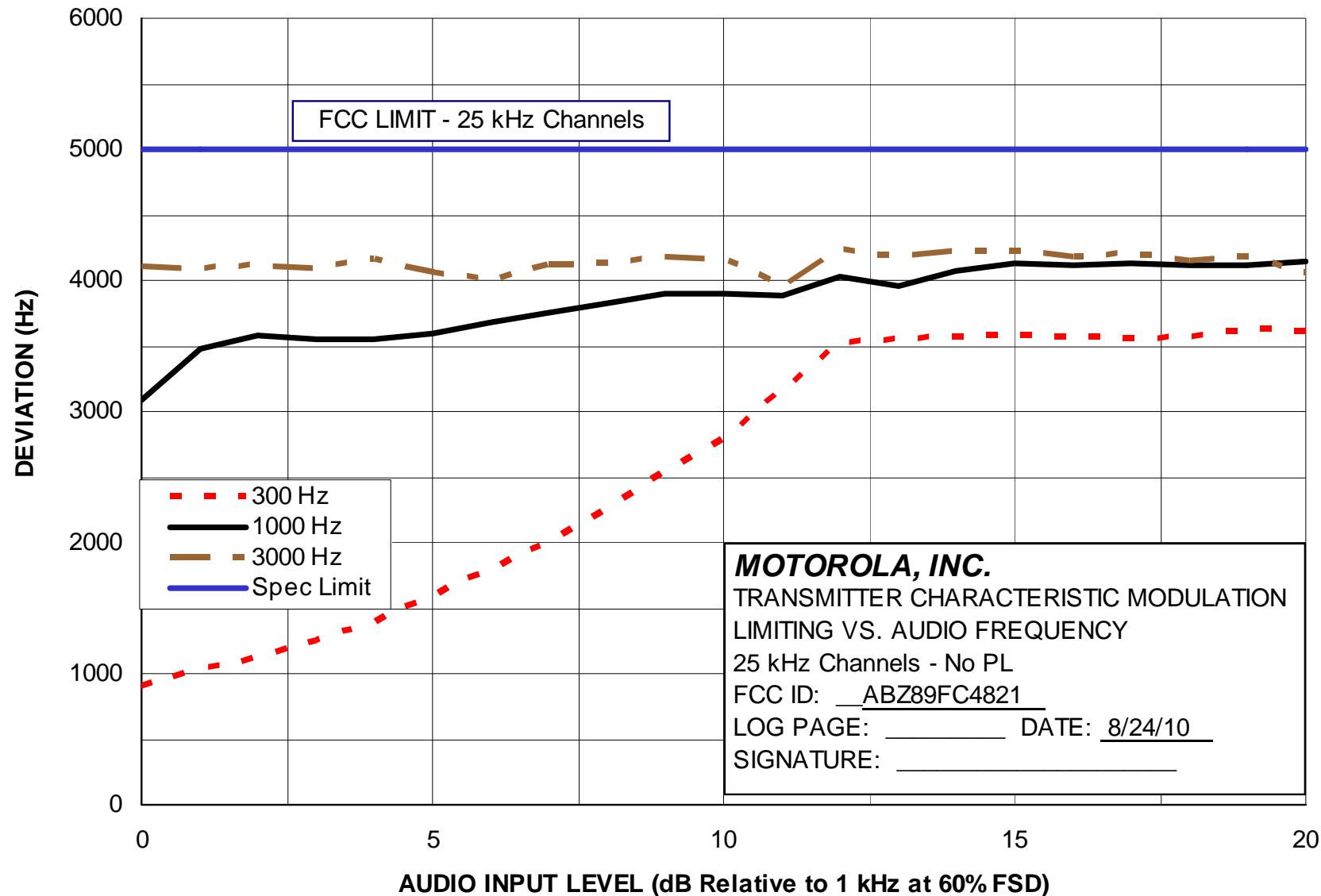
Carrier Frequency: A carrier at 420.0125 MHz was measured. This frequency is near the center of the operating band 406.1-435 MHz

**Modulation Limiting Response Plots:****EXHIBIT      DESCRIPTION**

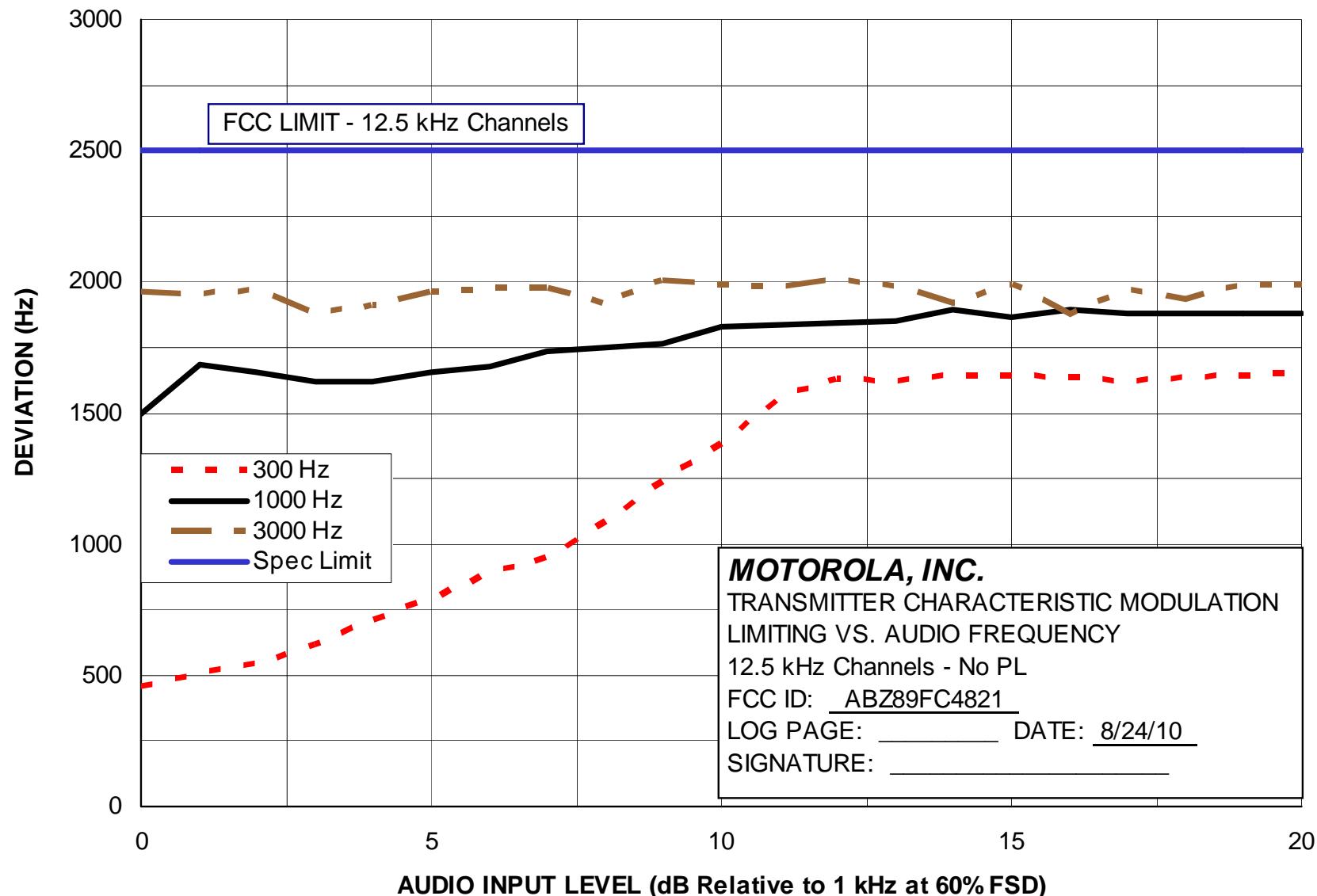
E1-8.1      Modulation Limiting Response – Modulation Characteristics, 25 kHz Channels

E1-8.2      Modulation Limiting Response – Modulation Characteristics, 12.5 kHz Channels

## Report on Test Measurements

*Modulation Limiting – 25 kHz Channels*

## 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:  $\pm 5.0$  kHz Max  
 Power Setting: 110 Watts

#### 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 *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:

<i>Max Mod Freq, M</i>	<i>Max Deviation, D</i>	<i>2*(M+D)</i>	<i>Nec BW</i>
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.

<b>EXHIBIT</b>	<b>DESCRIPTION</b>
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:  $\pm 2.5$  kHz Max  
 Power Setting: 110 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 (Analog Emission):

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

<i>Max Mod Freq, M</i>	<i>Max Deviation, D</i>	<i>2*(M+D)</i>	<i>Nec BW</i>
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.

<b>EXHIBIT</b>	<b>DESCRIPTION</b>
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: ABZ89FC4821

Report on Test Measurements

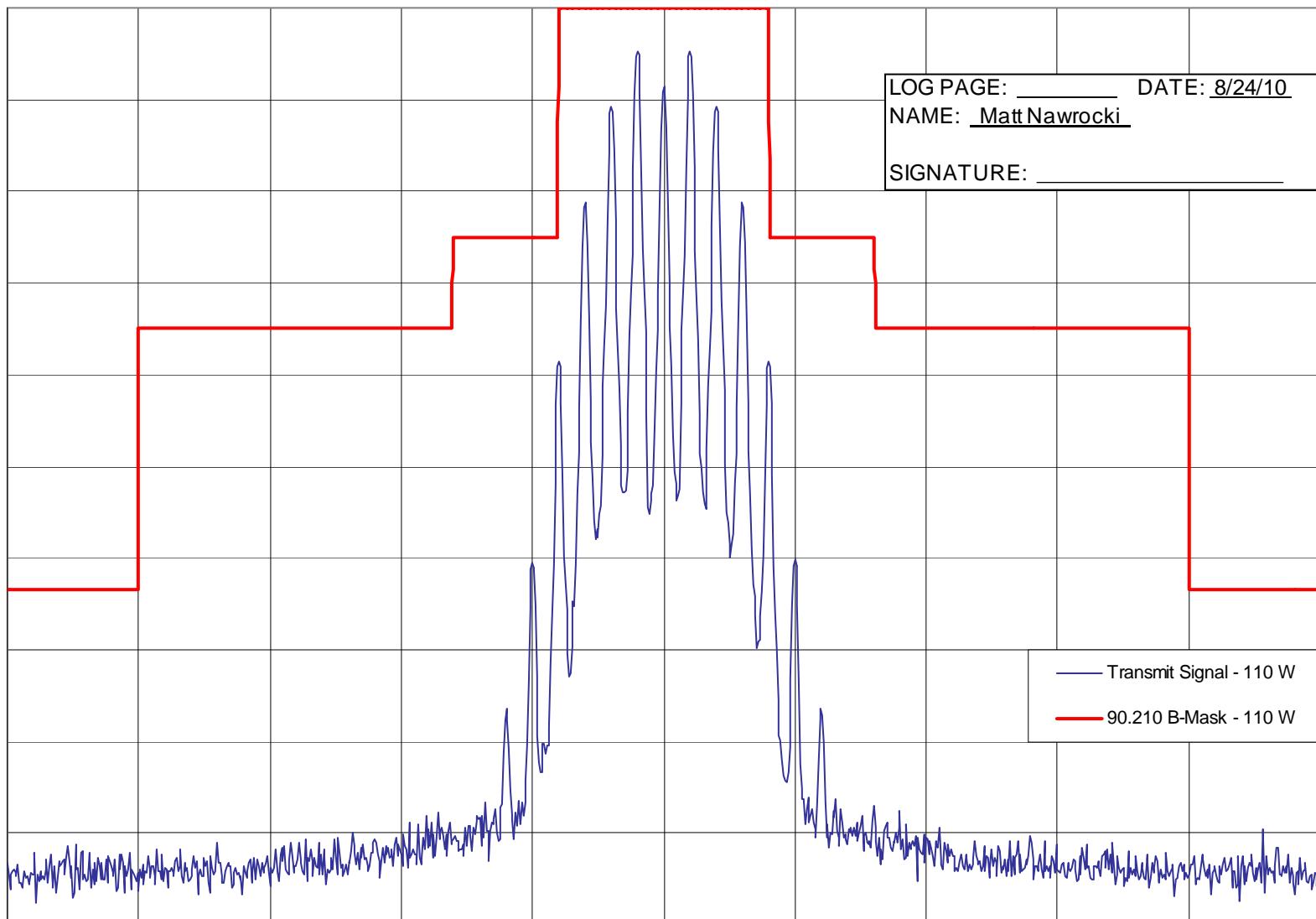
Occupied Bandwidth – Carrier with 2500 Hz Audio Tone, 25 kHz Channels

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

REF 50.4 dBm

ATTEN 20 dB

10 dB/  
Peak



CENTER 420.0125000 MHz

RES BW 300 Hz

VID BW 3 kHz

SPAN 125 kHz

SWP 72 sec

EXHIBIT E1-9.1  
(Permissive Change)

APPLICANT: MOTOROLA

EQUIPMENT TYPE: ABZ89FC4821

Report on Test Measurements

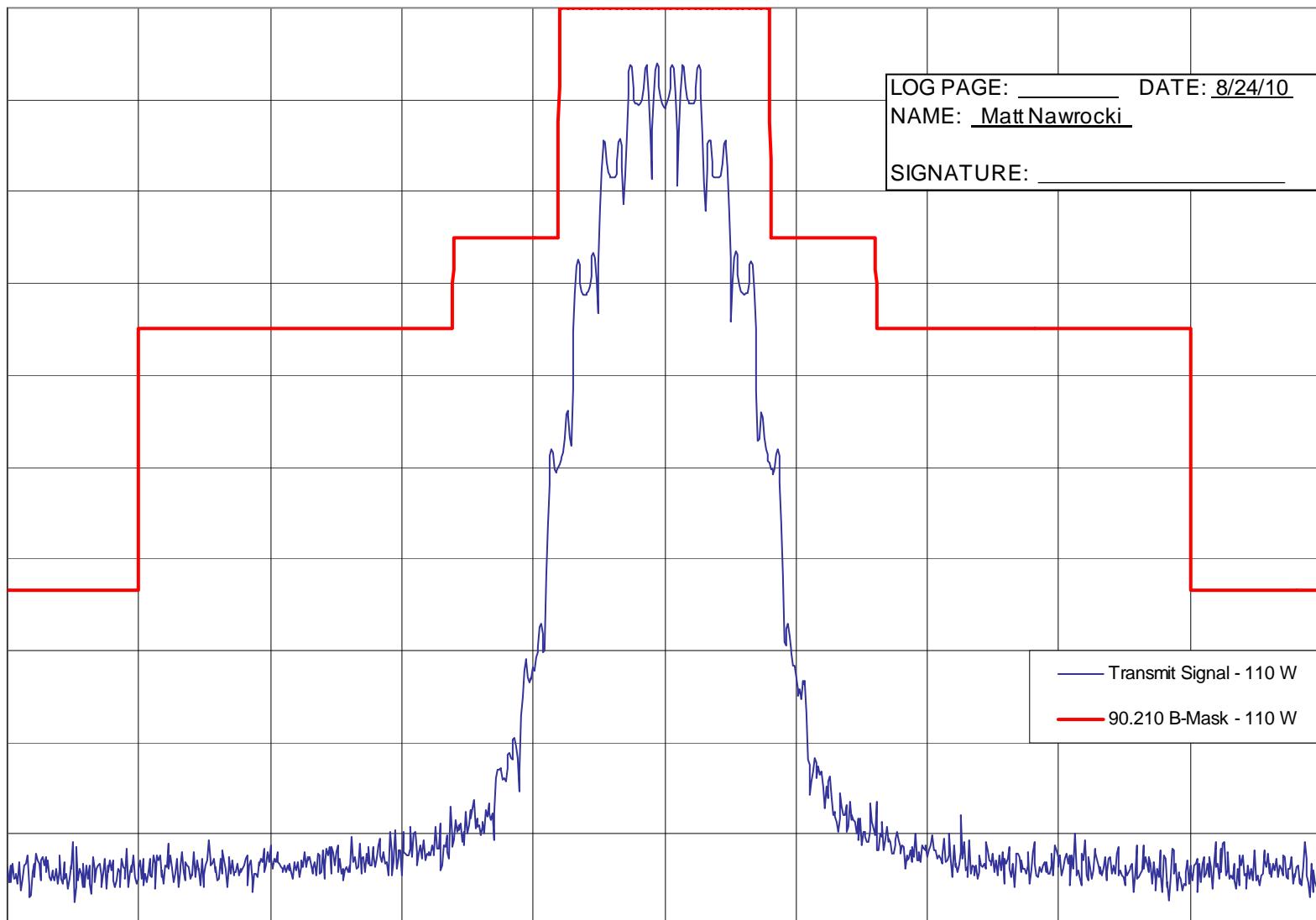
Occupied Bandwidth – Carrier with 2500 Hz Audio Tone and Private Line (PL) Signaling, 25 kHz Channels

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

REF 50.4 dBm

ATTEN 20 dB

10 dB/  
Peak



CENTER 420.0125000 MHz

RES BW 300 Hz

VID BW 3 kHz

SPAN 125 kHz

SWP 72 sec

EXHIBIT E1-9.2  
(Permissive Change)

APPLICANT: MOTOROLA

EQUIPMENT TYPE: ABZ89FC4821

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

REF 50.4 dBm

ATTEN 20 dB

10 dB/  
Peak

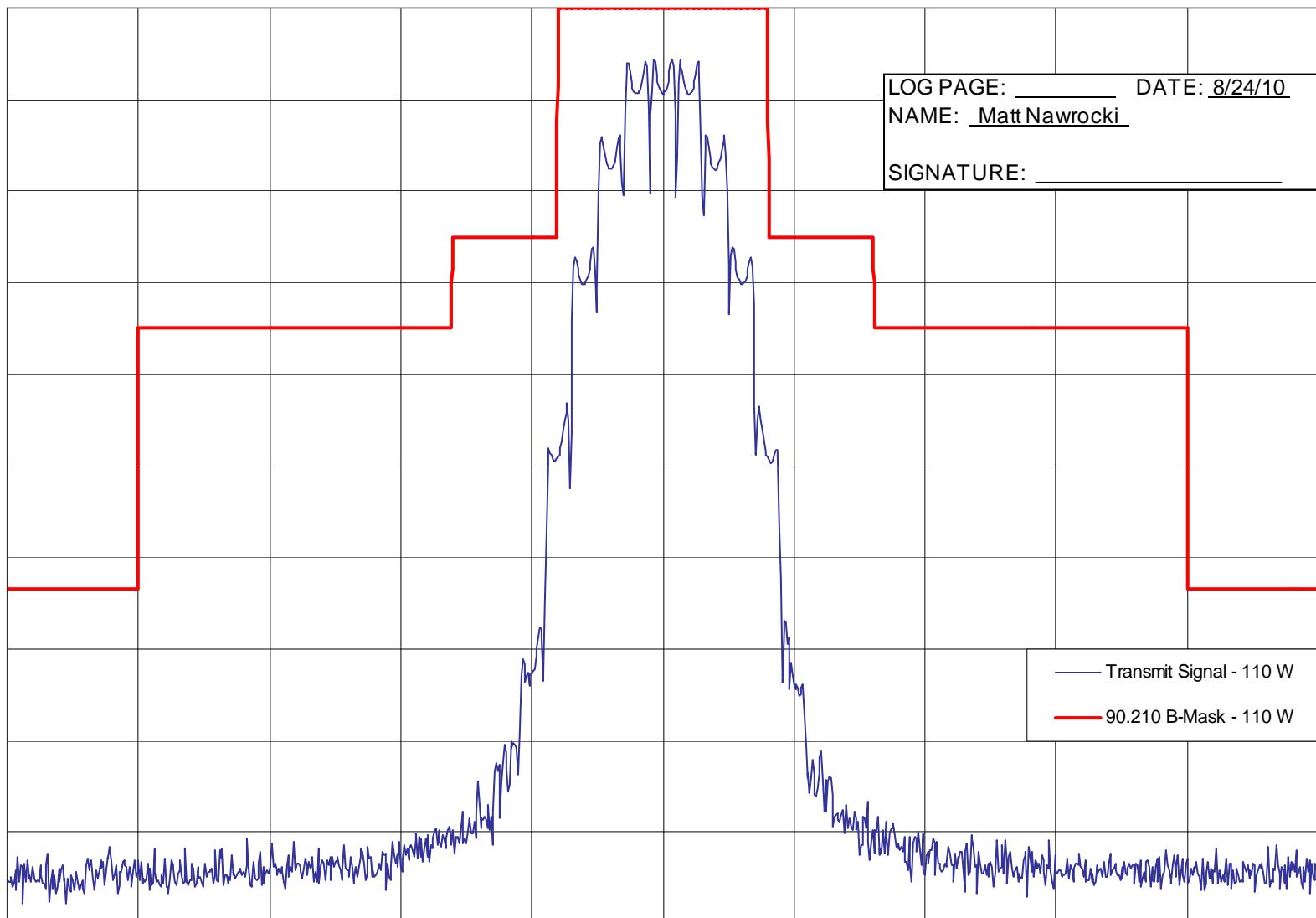


EXHIBIT E1-9.3  
(Permissive Change)

APPLICANT: MOTOROLA

EQUIPMENT TYPE: ABZ89FC4821

Report on Test Measurements

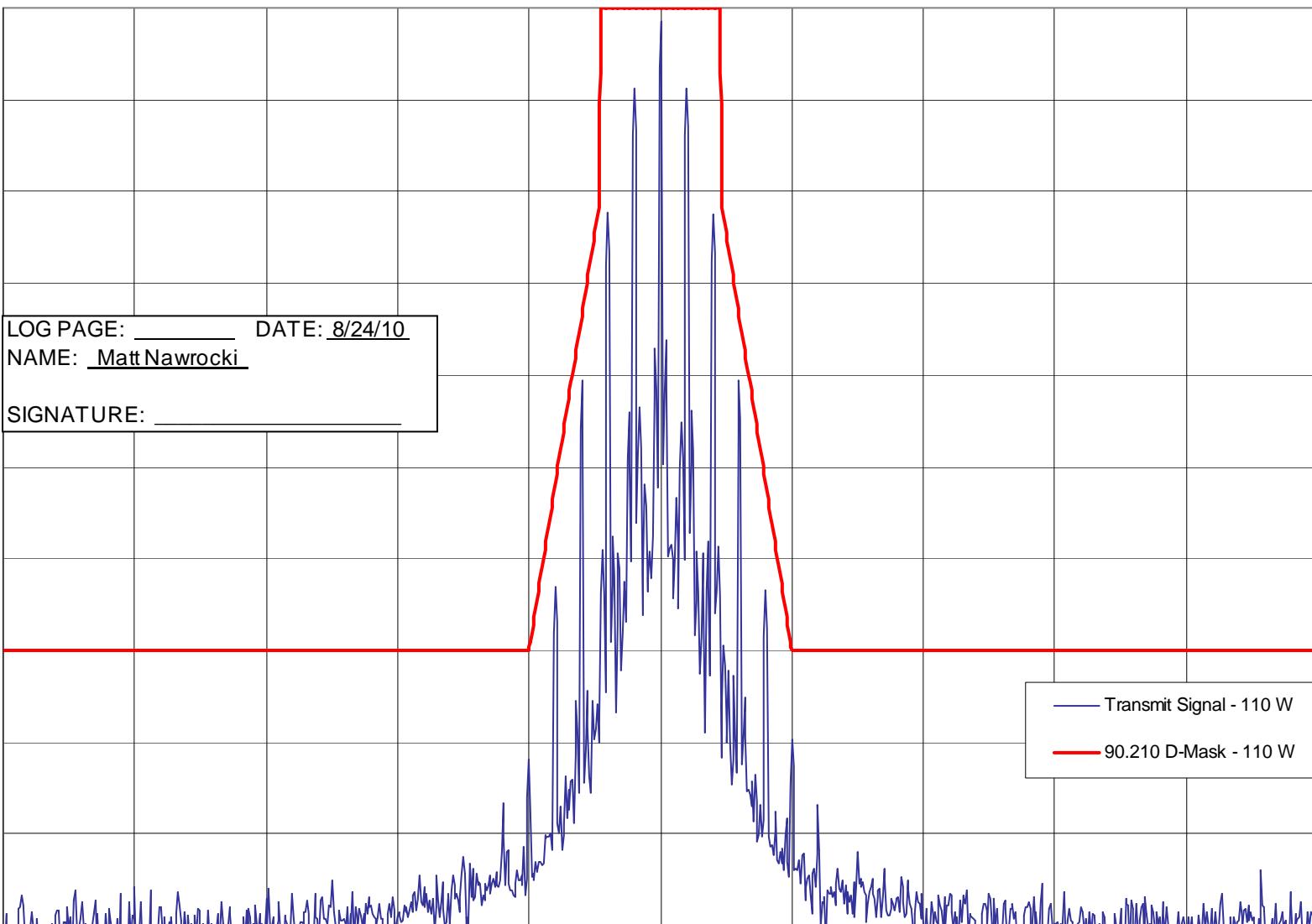
Occupied Bandwidth – Carrier with 2500 Hz Audio Tone, 12.5 kHz Channels

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

REF 50.4 dBm

ATTEN 20 dB

10 dB/  
Peak



CENTER 420.01250 MHz

RES BW 100 Hz

VID BW 3 kHz

SPAN 125 kHz

SWP 72 sec

EXHIBIT E1-9.4  
(Permissive Change)

APPLICANT: MOTOROLA

EQUIPMENT TYPE: ABZ89FC4821

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

REF 50.4 dBm

ATTEN 20 dB

10 dB/  
Peak

LOG PAGE: \_\_\_\_\_ DATE: 8/24/10  
NAME: Matt Nawrocki

SIGNATURE: \_\_\_\_\_

CENTER 420.01250 MHz

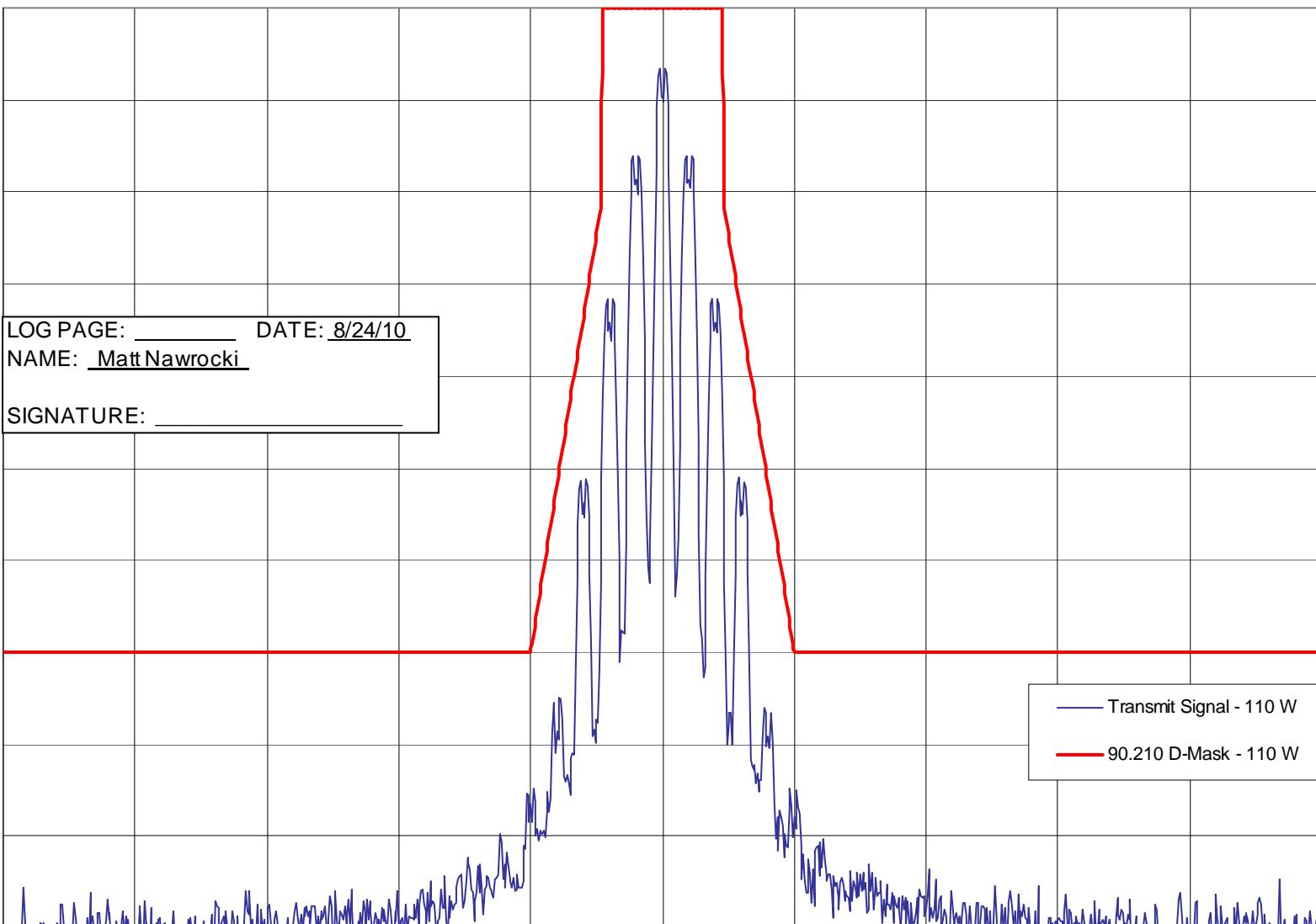
RES BW 100 Hz

VID BW 3 kHz

SPAN 125 kHz

SWP 72 sec

EXHIBIT E1-9.5  
(Permissive Change)



APPLICANT: MOTOROLA

EQUIPMENT TYPE: ABZ89FC4821

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

REF 50.4 dBm

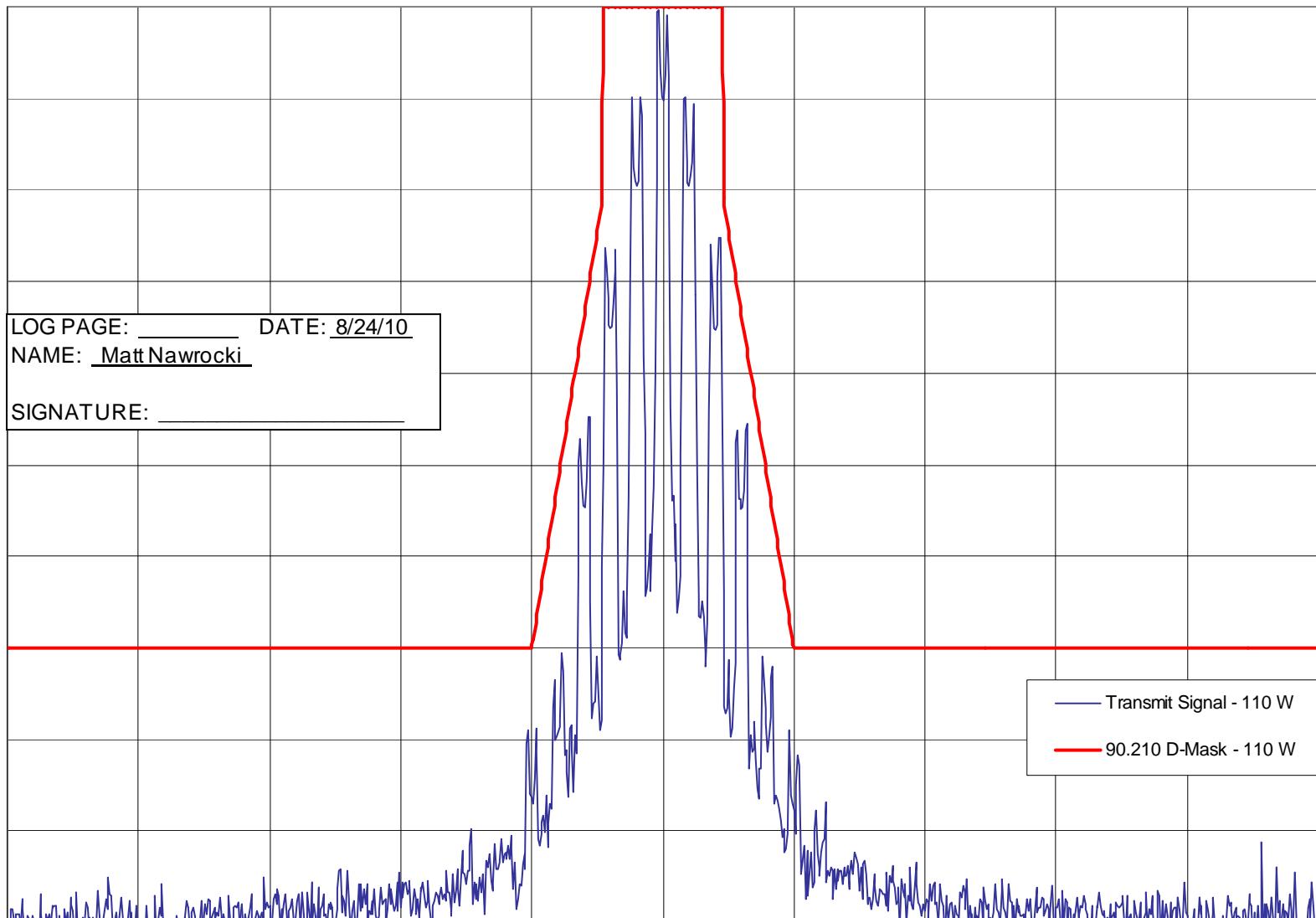
ATTEN 20 dB

10 dB/  
Peak

LOG PAGE: \_\_\_\_\_ DATE: 8/24/10

NAME: Matt Nawrocki

SIGNATURE: \_\_\_\_\_



CENTER 420.01250 MHz

RES BW 100 Hz

VID BW 3 kHz

SPAN 125 kHz

SWP 72 sec

EXHIBIT E1-9.6  
(Permissive Change)