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

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

NAME: Ken Weiss

SIGNATURE: Ken Weiss

DATE: December 02, 2002

POSITION: Lead Electrical 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: Steve Noskowicz

SIGNATURE: Steve Noskowicz

DATE: December 02, 2002

POSITION: Engineering Manager

SUBMITTED MEASURED DATA -- INDEX

EXHIBIT	DESCRIPTION
11A	RF Output Data for Range 2, Range 3, and Range 4 Radios
11F	Occupied Bandwidth: Power Output at 110 Watts, Setup and Specifications
	Occupied BW, 12.5 kHz, Carrier with 9600 BPS Digitized Voice (APCO 25)
11G	Conducted Spurious Emissions: Setup, Specifications, and Index
11G-1	Conducted Spurious Emissions, Harmonics, Power Output at 110 Watts
11G-2	Conducted Spurious Emissions, Harmonics, Power Output at 25 Watts
11G-3	Conducted Spurious Emissions, Close-In, Power Output at 110 Watts, 500 kHz Span
11G-4	Conducted Spurious Emissions, Close-In, Power Output at 110 Watts, 100 MHz Span
11H	Radiated Spurious Emissions: Setup, Specifications, and Index
11H-1	Radiated Spurious Emissions, Harmonics, Power Output at 110 Watts
11H-2	Radiated Spurious Emissions, Harmonics, Power Output at 25 Watts
11J	Frequency Stability: Setup, Specifications, and Index
11J-1	Frequency Stability Vs Temperature
11J-2	Frequency Stability Vs Voltage
11K	Frequency Transient Behavior: Setup, Specifications, Index
11K-1	Frequency Transient Behavior, 12.5 kHz Channel Key-Up
11K-2	Frequency Transient Behavior, 12.5 kHz Channel De-key

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 four parallel power transistors.

Range 2-4 Station:

	R2 (435-470 MHz)		R3 (470-494 MHz)	
Measured RF output	**110**	Watts	**110**	Watts
DC Voltage	**28.0**	Volts	**28.0**	Volts
DC Current	**9.5**	Amperes	**9.5**	Amperes
DC input power for final RF amplifying device(s)	**270**	Watts	**270**	Watts
Primary Supply Voltage	**120**	Volts AC	**120**	Volts AC
Minimum Measured RF output	**25**	Watts	**25**	Watts
Normal DC Voltage	**28.0**	Volts	**28.0**	Volts
Normal DC Current	**4.3**	Amperes	**4.2**	Amperes
DC input power for final RF amplifying device(s)	**120**	Watts	**120**	Watts
Primary Supply Voltage	**120**	Volts AC	**120**	Volts AC

	R4 (494-524 MHz)	
Measured RF output	**100**	Watts
DC Voltage	**28.0**	Volts
DC Current	**9.9**	Amperes
DC input power for final RF amplifying device(s)	**280**	Watts
Primary Supply Voltage	**120**	Volts AC
Minimum Measured RF output	**25**	Watts
Normal DC Voltage	**28.0**	Volts
Normal DC Current	**4.7**	Amperes
DC input power for final RF amplifying device(s)	**130**	Watts
Primary Supply Voltage	**120**	Volts AC

OCCUPIED BANDWIDTH

Modulation Type:	Carrier with 9600 BPS Digitized Voice
Emission Designator:	8K10F1E
Channelization:	12.5 kHz
Power Setting:	110-Watts

SPECIFICATION REQUIREMENT:
§ 90.210(d) Emission Mask Requirements for 12.5 kHz Channel Bandwidth Equipment, 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 f0 to 5.625 kHz removed from f0: Zero dB;

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

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 10 log (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 insure 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.

Reference Calibration Analyzer Settings:

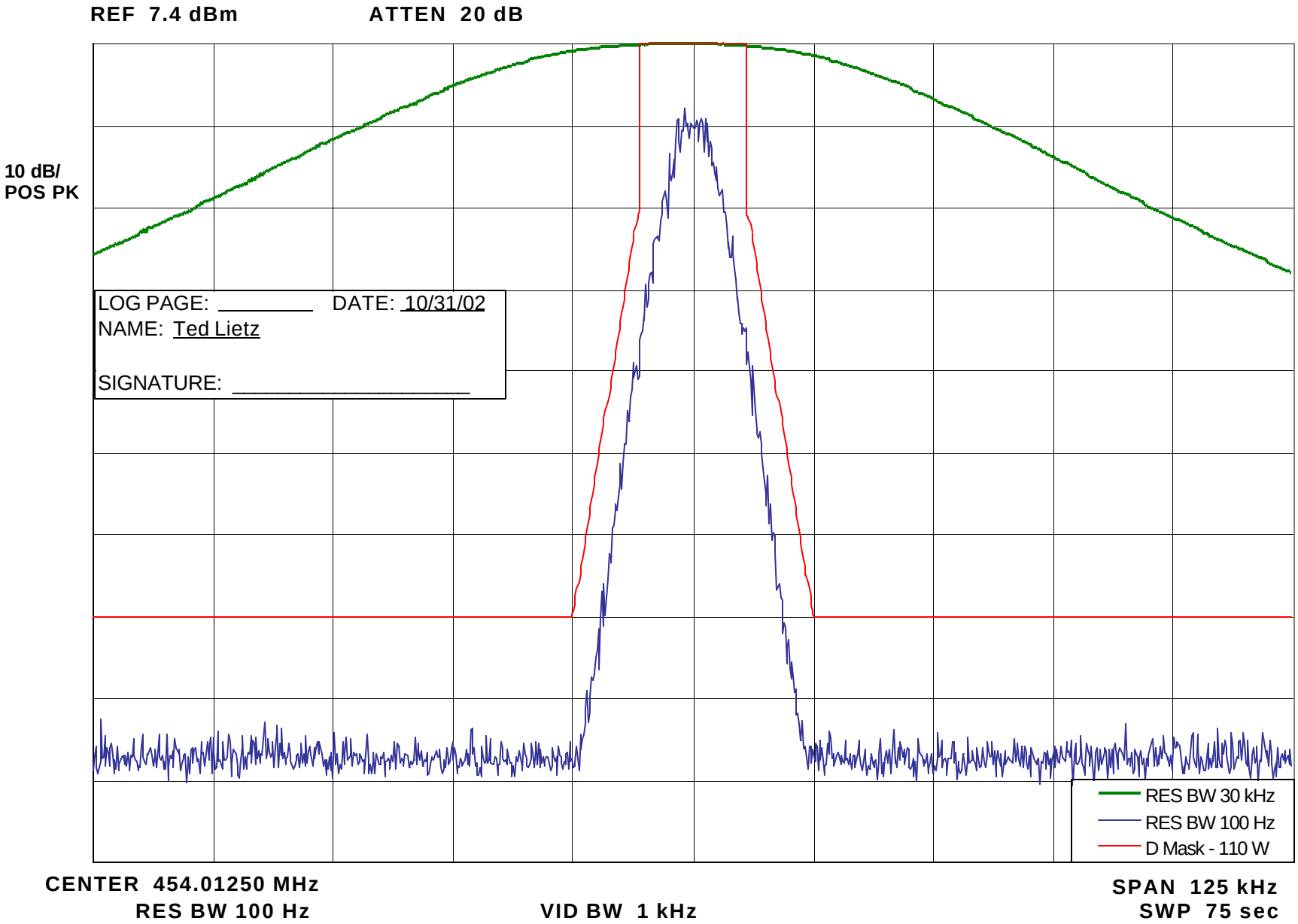
Horizontal:	12.5 kHz per Division	Resolution Bandwidth:	30 kHz
Vertical:	10 dB per Division	Video Bandwidth:	100 kHz
Sweep Time:	75 Seconds (<2000 Hz / Second)	Span:	125 kHz
Detector Mode:	Positive Peak		

Emission Measurement Analyzer Settings:

Horizontal:	12.5 kHz per Division	Resolution Bandwidth:	100 Hz
Vertical:	10 dB per Division	Video Bandwidth:	1 kHz
Sweep Time:	75 Seconds (<2000 Hz / Second)	Span:	125 kHz
Detector Mode:	Positive Peak		

Measurement Procedure:
1) Adjust the spectrum analyzer per the values specified in the Reference Calibration Analyzer Settings.
2) Modulate the transmitter with the appropriate signaling pattern, (psuedorandom data) and key the transmitter at the full carrier 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) Adjust the analyzer per the Emission Measurement Analyzer Settings.
4) Allow the analyzer to sweep, and record the resultant emission levels.
5) Capture / plot the resulting analyzer trace and the emission mask limit. Add labeling as appropriate.

Occupied Bandwidth -- Digitized Voice - 8K10F1E - 110 Watts



APPLICANT: MOTOROLA, INC.

EQUIPMENT TYPE: ABZ89FC4818-D

EXHIBIT 11F (Sheet 2 of 2)

CONDUCTED SPURIOUS EMISSIONS

SPECIFICATION REQUIREMENT:
§ 90.210(d) Emission Mask Requirements for 12.5 kHz Channel Bandwidth Equipment, 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:

On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB (whichever is the lesser attenuation).

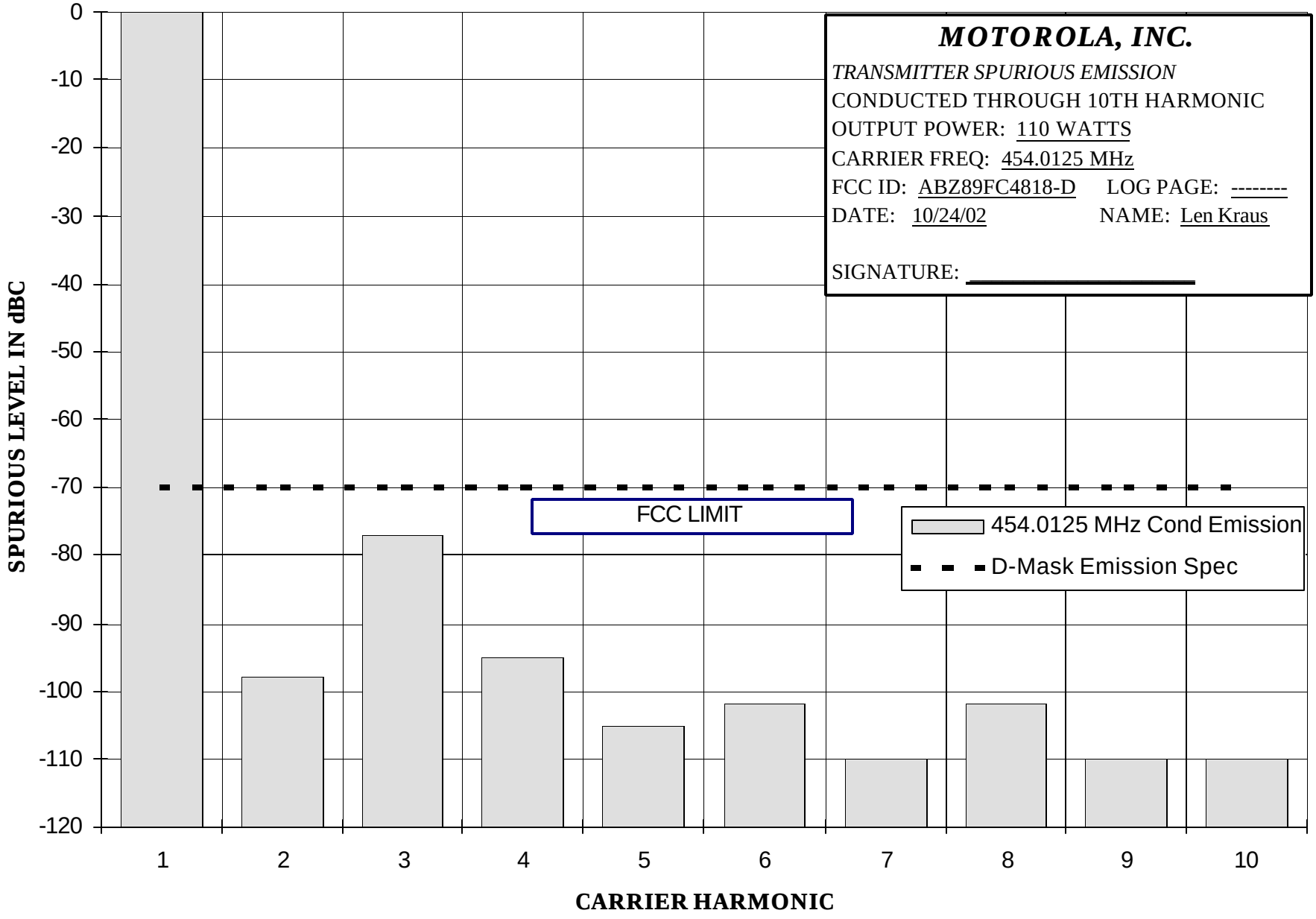
(4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide to capture the true peak emission of the equipment under test. A sufficient number of sweeps must be measured to ensure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, a resolution of at least 10 kHz must be used for frequencies below 1000 MHz. Above 1000 MHz the resolution bandwidth of the instrumentation must be at least 1 MHz. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, then an alternate procedure may be used provided prior Commission approval is obtained.

Modulation: Psuedorandom data

Carrier Frequency: A carrier frequency of 454.0125 MHz was used for conducted spurious emission measurements. This frequency is near the center of the 438-470 MHz Range 2 operating sub-band for this product, and is representative of overall performance within the full 438-512 MHz band.

SPURIOUS EMISSION PLOTS:

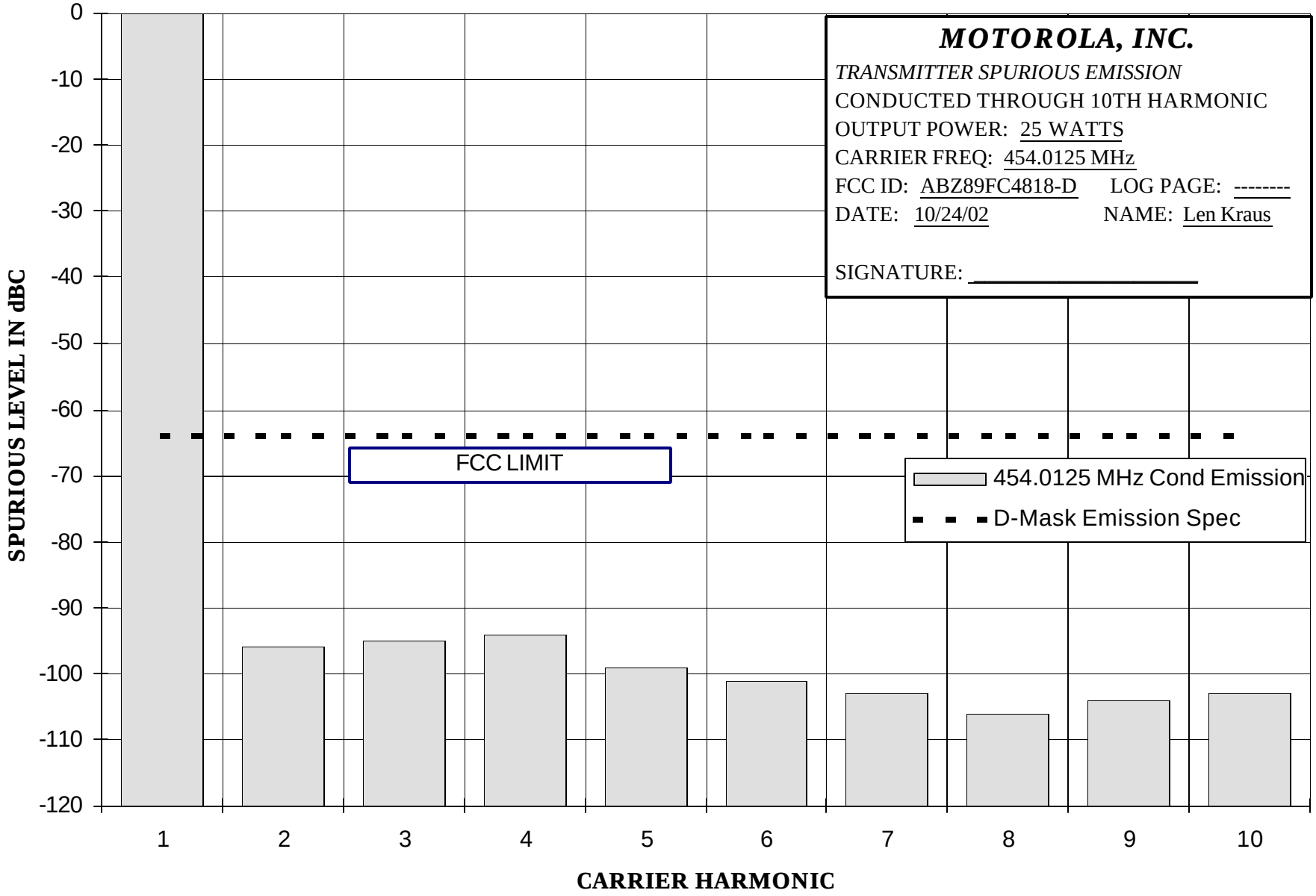
EXHIBIT	DESCRIPTION
11G-1	Conducted Spurious Emissions, Harmonics, Power Output at 110 Watts The specification limit is –70.0 dBC
11G-2	Conducted Spurious Emissions, Harmonics, Power Output at 25 Watts The specification limit is –64.0 dBC
11G-3	Conducted Spurious Emissions, Close-In, Power Output at 110 Watts, 500 kHz Span The specification limit is –70.0 dBC
11G-4	Conducted Spurious Emissions, Close-In, Power Output at 110 Watts, 100 MHz Span The specification limit is –70.0 dBC



APPLICANT: MOTOROLA, INC.

EQUIPMENT TYPE: ABZ89FC4818-D

EXHIBIT 11G-1



APPLICANT: MOTOROLA, INC.

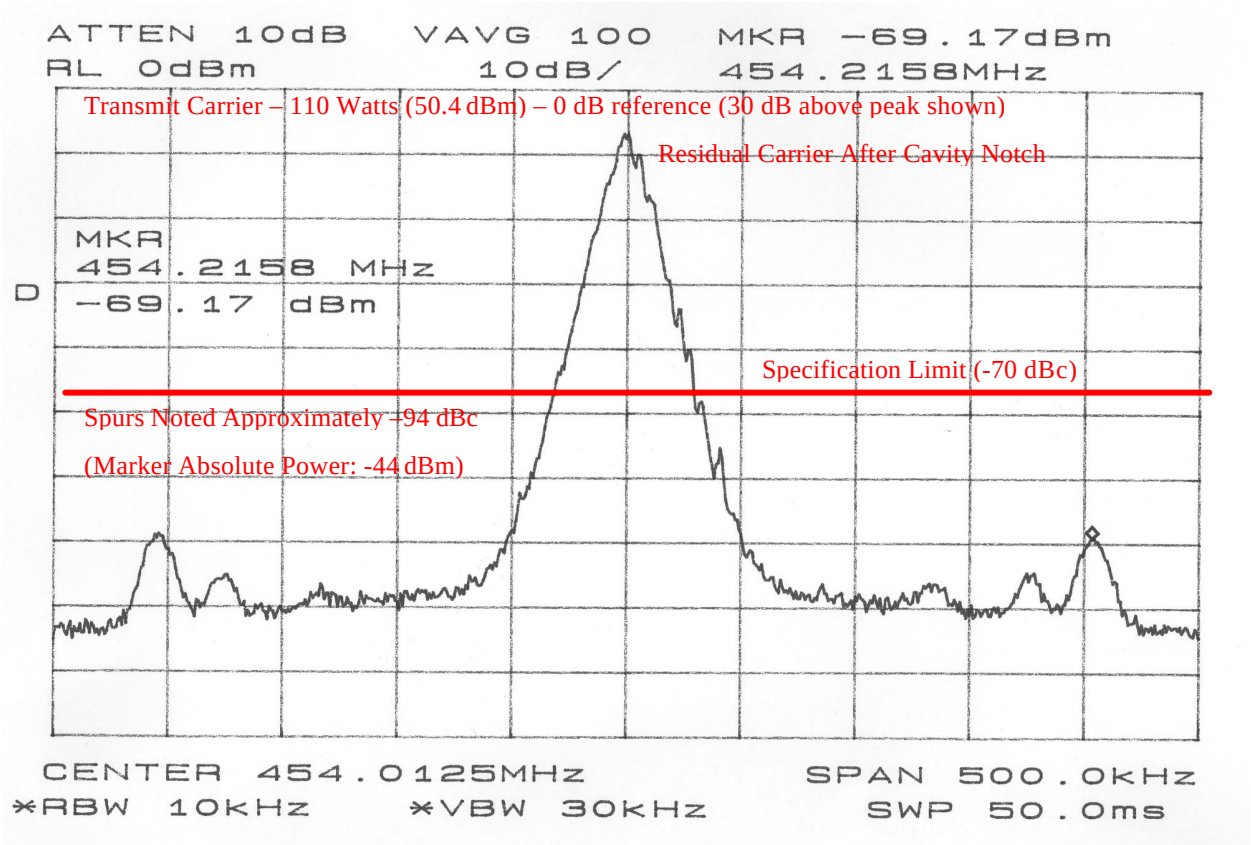
EQUIPMENT TYPE: ABZ89FC4818-D

EXHIBIT 11G-2

MOTOROLA, INC.

TRANSMITTER SPURIOUS EMISSION
CLOSE-IN CONDUCTED
OUTPUT POWER: 110 WATTS
CARRIER FREQ: 454.0125 MHz
FCC ID: ABZ89FC4818-D LOG PAGE: 000764
DATE: 11/7/02 NAME: Tim Mosher

SIGNATURE: _____

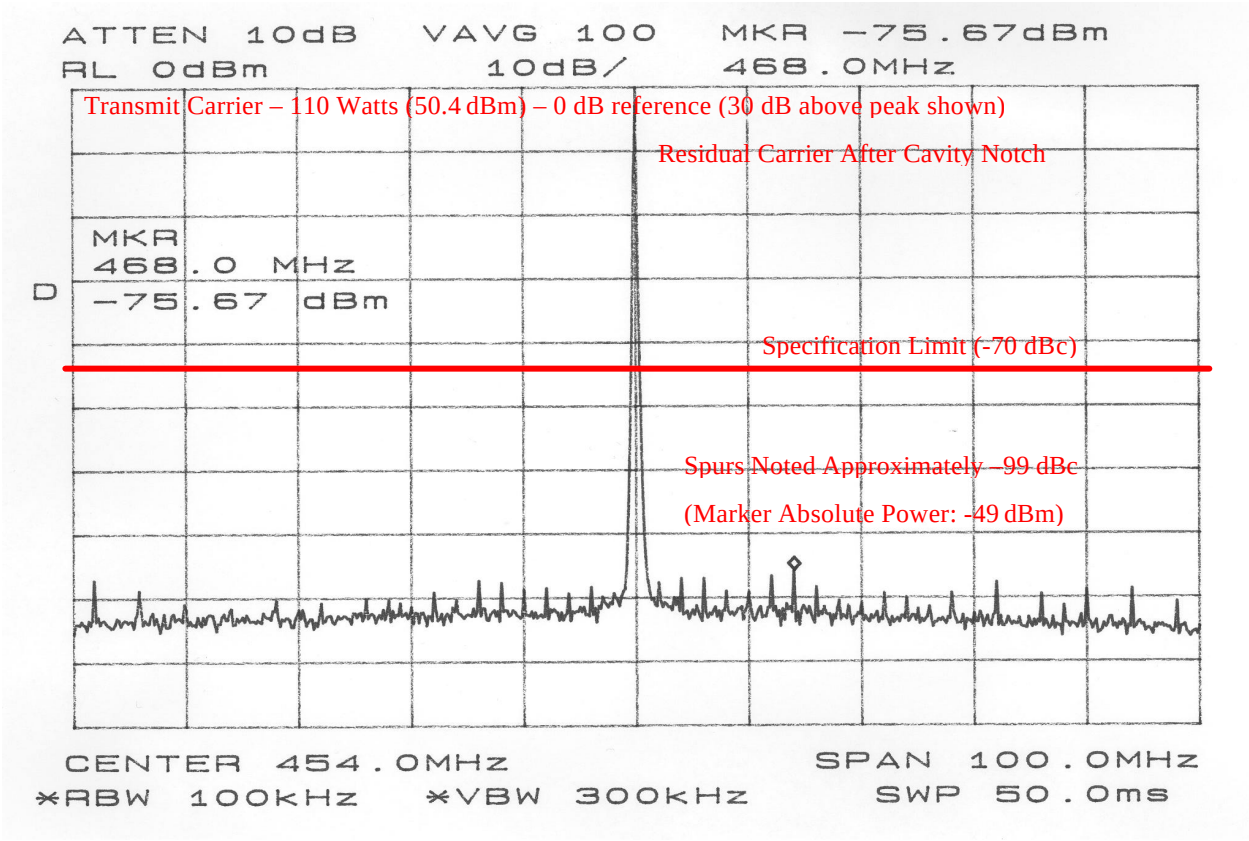


The absolute power of the spur was verified using the substitution method. A signal generator was fed into the same notch test setup as the transmitter. The power level of a 454.2158 MHz signal was adjusted until equivalent power level as the spur shown above (–69.17 dBm) was observed at the spectrum analyzer. This absolute power level was then compared to the power level of the transmitter to obtain the spur power level referenced to the carrier power.

MOTOROLA, INC.

TRANSMITTER SPURIOUS EMISSION
CLOSE-IN CONDUCTED
OUTPUT POWER: 110 WATTS
CARRIER FREQ: 454.0125 MHz
FCC ID: ABZ89FC4818-D LOG PAGE: 000764
DATE: 11/7/02 NAME: Tim Mosher

SIGNATURE: _____



The absolute power of the spur was verified using the substitution method. A signal generator was fed into the same notch test setup as the transmitter. The power level of a 468.0 MHz signal was adjusted until equivalent power level as the spur shown above (–75.67 dBm) was observed at the spectrum analyzer. This absolute power level was then compared to the power level of the transmitter to obtain the spur power level referenced to the carrier power.

RADIATED SPURIOUS EMISSIONS

SPECIFICATION REQUIREMENT:
§ 90.210(d) Emission Mask Requirements for 12.5 kHz Channel Bandwidth Equipment, 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:

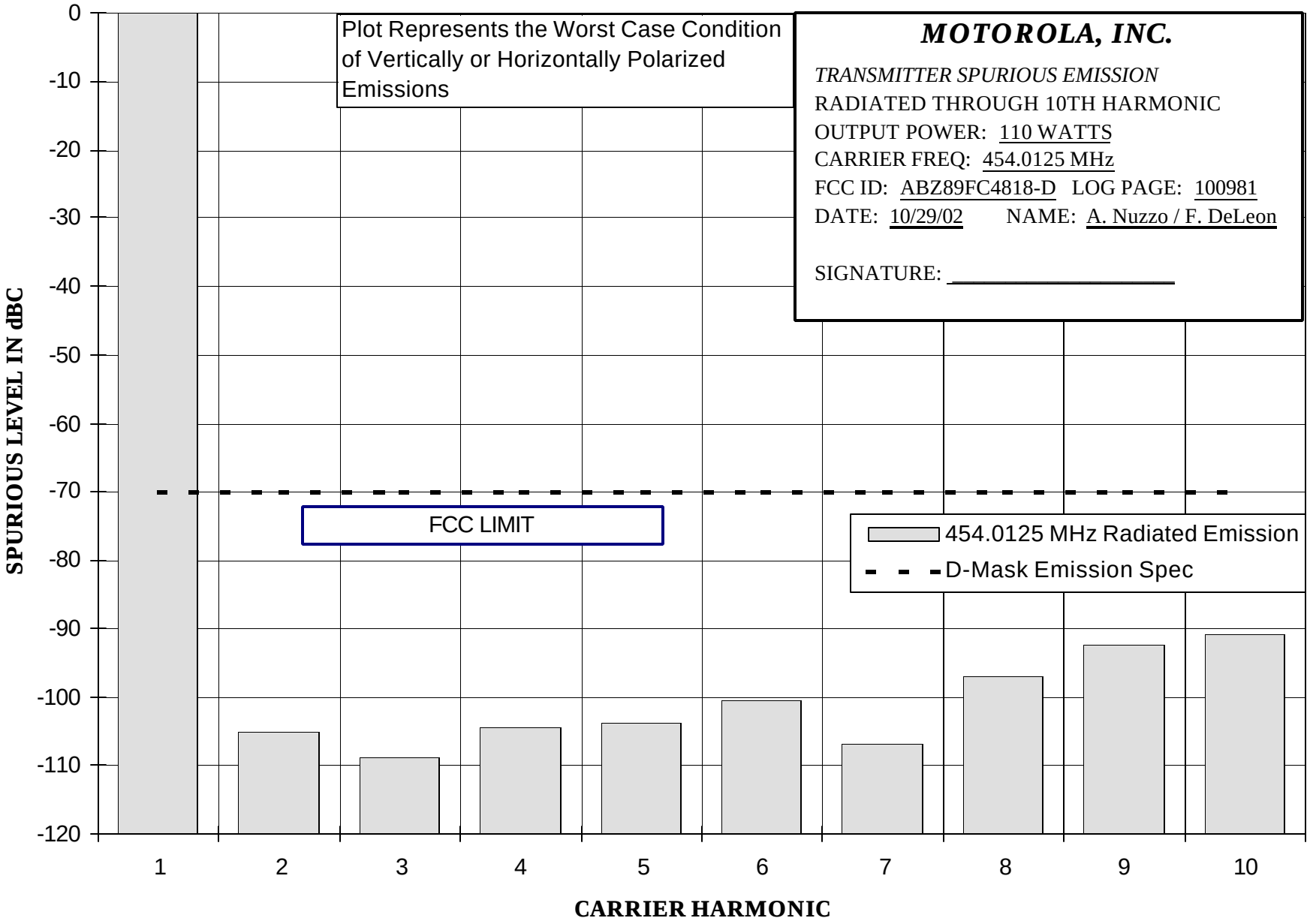
On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB (whichever is the lesser attenuation).

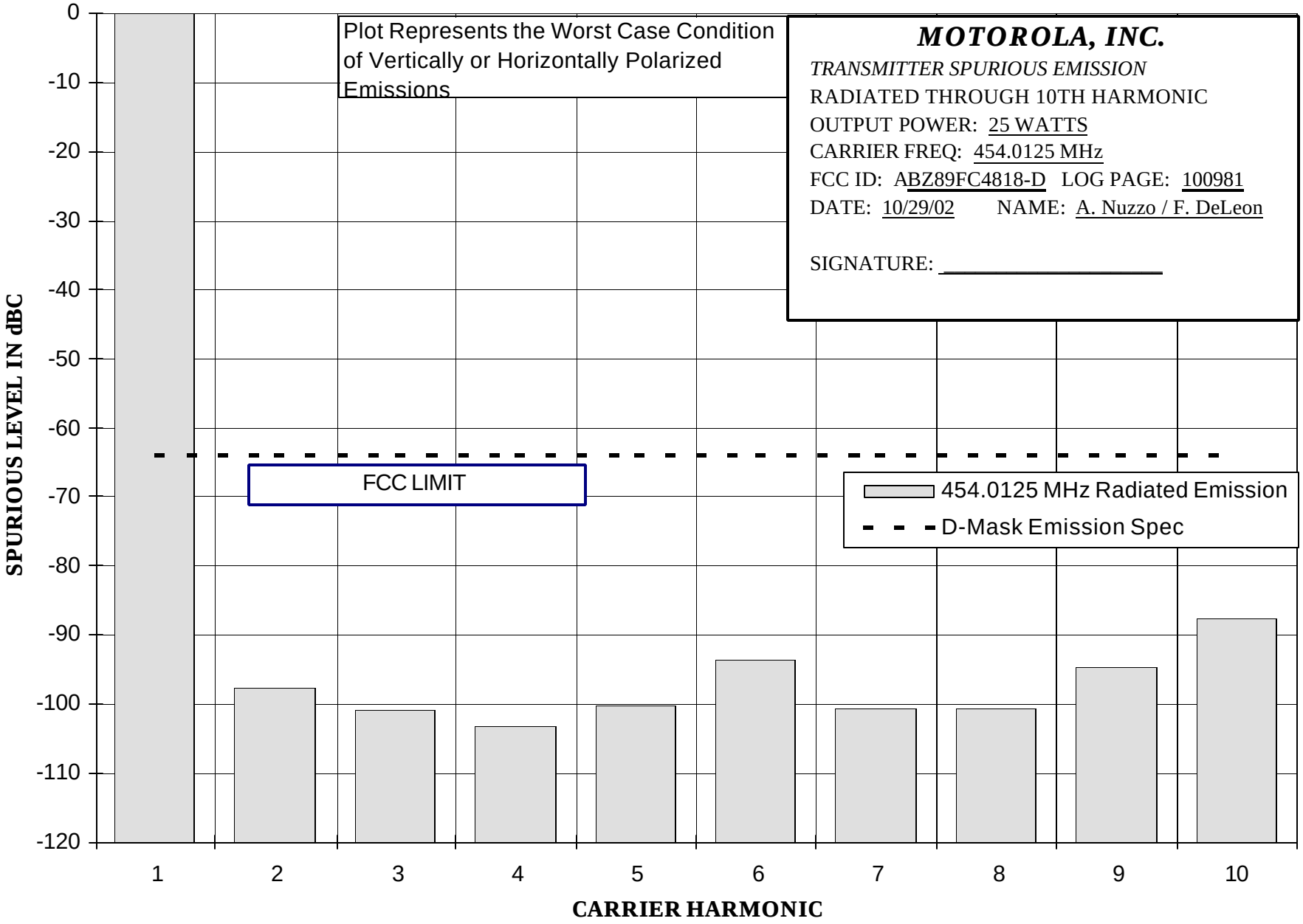
(4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide to capture the true peak emission of the equipment under test. A sufficient number of sweeps must be measured to ensure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, a resolution of at least 10 kHz must be used for frequencies below 1000 MHz. Above 1000 MHz the resolution bandwidth of the instrumentation must be at least 1 MHz. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, then an alternate procedure may be used provided prior Commission approval is obtained.

Modulation:	Psuedorandom data
Carrier Frequency:	A carrier frequency of 454.0125 MHz was used for radiated spurious emission measurements. This frequency is near the center of the 438-470 MHz Range 2 operating sub-band for this product, and is representative of overall performance within the full 438-512 MHz band.

SPURIOUS EMISSION PLOTS:

EXHIBIT	DESCRIPTION
11H-1	Radiated Spurious Emissions, Harmonics, Power Output at 110 Watts The specification limit is –70.0 dBC
11H-2	Radiated Spurious Emissions, Harmonics, Power Output at 25 Watts The specification limit is –64.0 dBC


Plot Represents the Worst Case Condition of Vertically or Horizontally Polarized Emissions
MOTOROLA, INC.
TRANSMITTER SPURIOUS EMISSION
RADIATED THROUGH 10TH HARMONIC
OUTPUT POWER: 110 WATTS
CARRIER FREQ: 454.0125 MHz
FCC ID: ABZ89FC4818-D LOG PAGE: 100981
DATE: 10/29/02 NAME: A. Nuzzo / F. DeLeon
SIGNATURE: _____
FCC LIMIT
454.0125 MHz Radiated Emission
D-Mask Emission Spec
SPURIOUS LEVEL IN dBC
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
1
2
3
4
5
6
7
8
9
10
CARRIER HARMONIC


Plot Represents the Worst Case Condition of Vertically or Horizontally Polarized Emissions
MOTOROLA, INC.
TRANSMITTER SPURIOUS EMISSION
RADIATED THROUGH 10TH HARMONIC
OUTPUT POWER: 25 WATTS
CARRIER FREQ: 454.0125 MHz
FCC ID: ABZ89FC4818-D LOG PAGE: 100981
DATE: 10/29/02 NAME: A. Nuzzo / F. DeLeon
SIGNATURE: _____
FCC LIMIT
454.0125 MHz Radiated Emission
D-Mask Emission Spec
SPURIOUS LEVEL IN dBC
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
1
2
3
4
5
6
7
8
9
10
CARRIER HARMONIC

OSCILLATOR FREQUENCY STABILITY

SPECIFICATION REQUIREMENT:

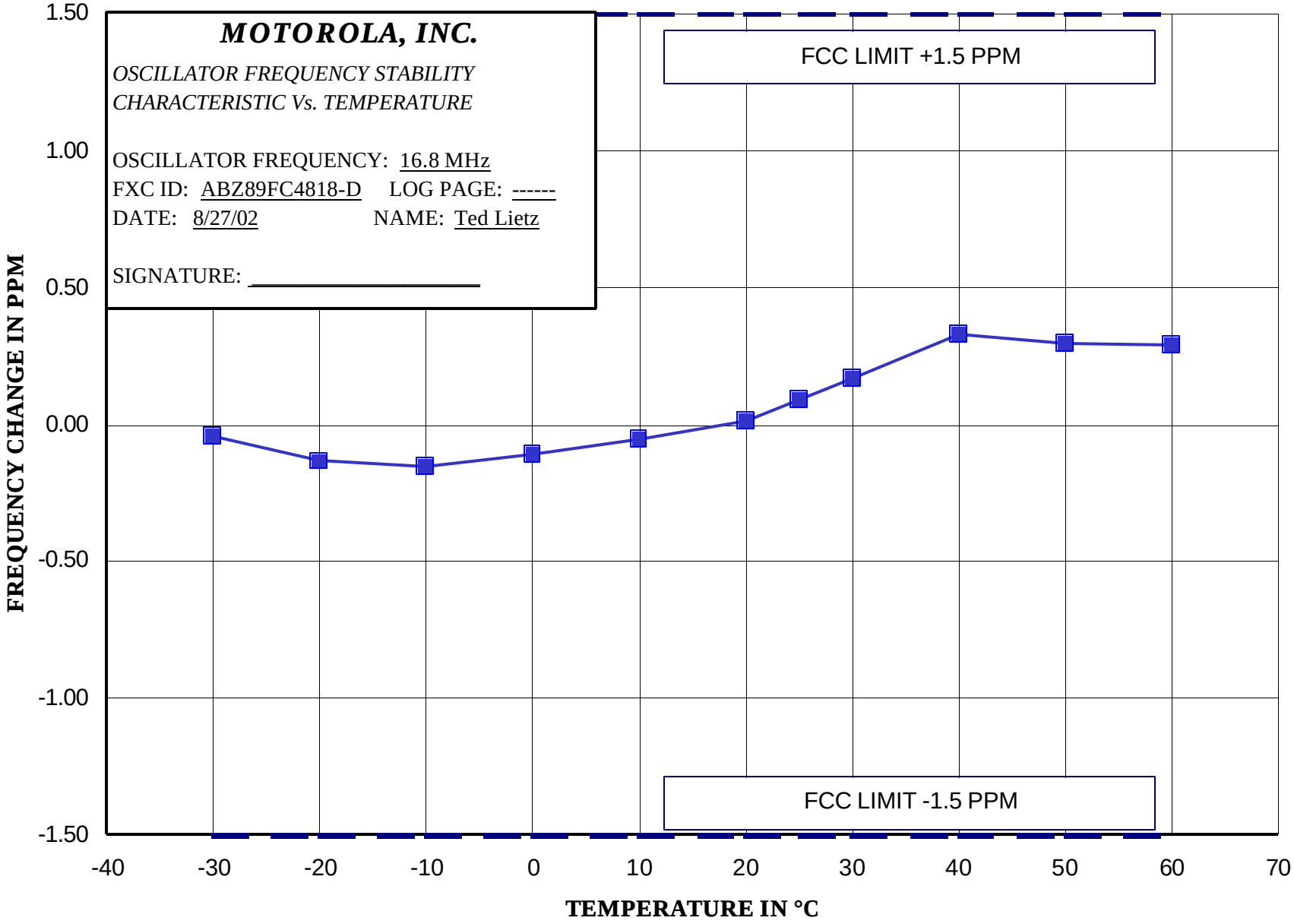
Reference: Part 90.213

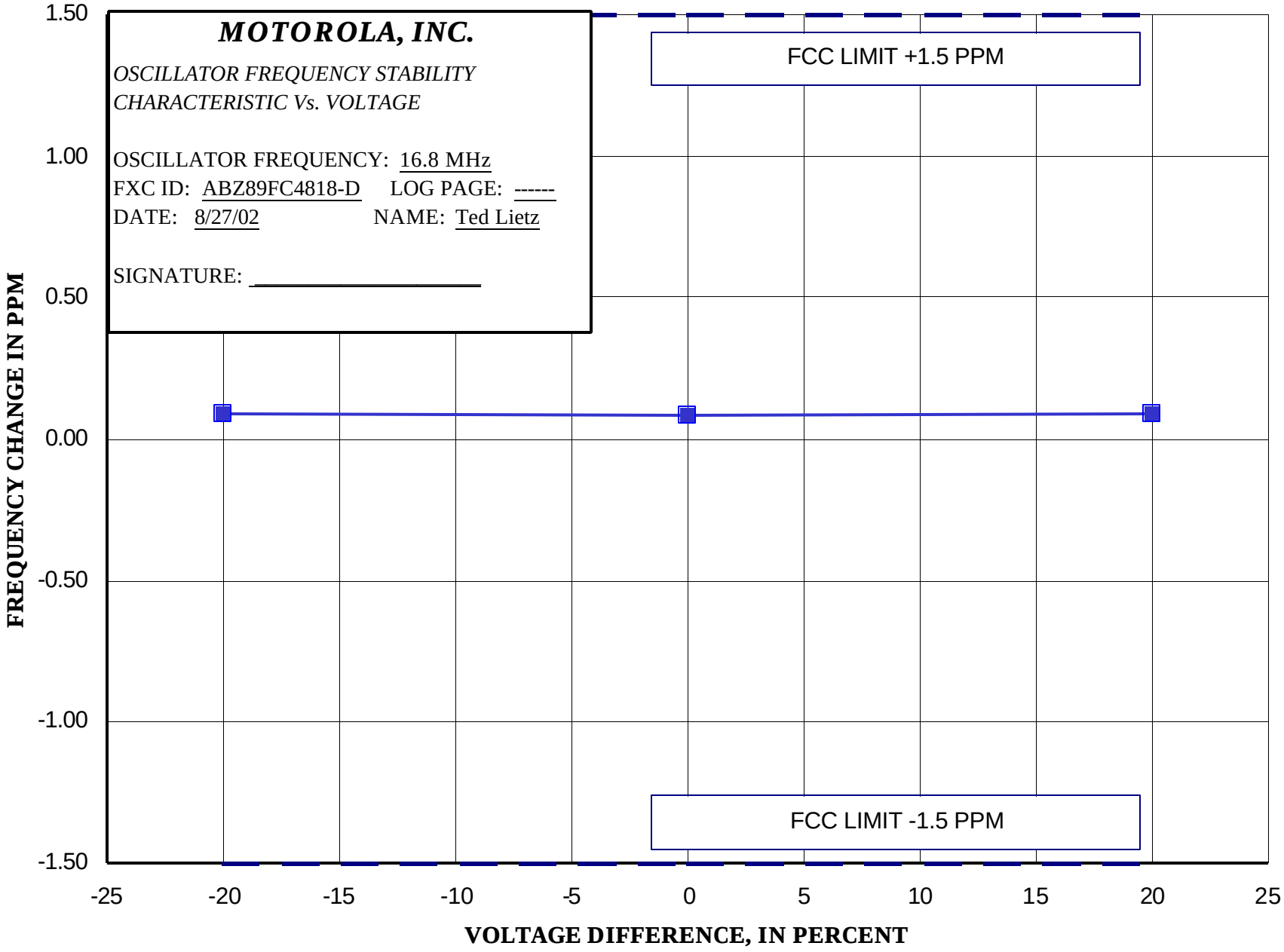
Fixed and Base stations with 25 kHz channel bandwidth, operating at 421-512 MHz, must have a frequency stability of better than 2.5 PPM.

Fixed and Base stations with 12.5 kHz channel bandwidth, operating at 421-512 MHz, must have a frequency stability of better than 1.5 PPM.

FREQUENCY STABILITY PLOTS:

EXHIBIT	DESCRIPTION
11J-1	Frequency Stability Vs Temperature
11J-2	Frequency Stability Vs Voltage


MOTOROLA, INC.
OSCILLATOR FREQUENCY STABILITY
CHARACTERISTIC Vs. TEMPERATURE
OSCILLATOR FREQUENCY: 16.8 MHz
FXC ID: ABZ89FC4818-D LOG PAGE: ------
DATE: 8/27/02 NAME: Ted Lietz
SIGNATURE: _____
FCC LIMIT +1.5 PPM
FCC LIMIT -1.5 PPM
FREQUENCY CHANGE IN PPM
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
-40
-30
-20
-10
0
10
20
30
40
50
60
70
TEMPERATURE IN °C


MOTOROLA, INC.
OSCILLATOR FREQUENCY STABILITY
CHARACTERISTIC Vs. VOLTAGE
OSCILLATOR FREQUENCY: 16.8 MHz
FXC ID: ABZ89FC4818-D LOG PAGE: ------
DATE: 8/27/02 NAME: Ted Lietz
SIGNATURE: _____
FCC LIMIT +1.5 PPM
FCC LIMIT -1.5 PPM
FREQUENCY CHANGE IN PPM
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
-25
-20
-15
-10
-5
0
5
10
15
20
25
VOLTAGE DIFFERENCE, IN PERCENT

TRANSIENT FREQUENCY BEHAVIOR

SPECIFICATION REQUIREMENT

Reference Part 90.214: For transmitters designed to operate in the 421 to 512 MHz frequency band:

SPECIFICATIONS TRANSIENT FREQUENCY BEHAVIOR 25 kHz CHANNELS

For time intervals:

a. t1 =10 ms, Maximum Frequency Difference ±25 kHz

b. t2 = 25 ms Maximum Frequency Difference ±12.5 kHz

c. t3 = 10 ms Maximum Frequency Difference ±25 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.

TRANSIENT FREQUENCY BEHAVIOR 12.5 kHz CHANNELS

For time intervals:

a. t1 =10 ms Maximum Frequency Difference ±12.5 kHz

b. t2 = 25 ms Maximum Frequency Difference ±6.25 kHz

c. t3 = 10 ms Maximum Frequency Difference ±12.5 kHz

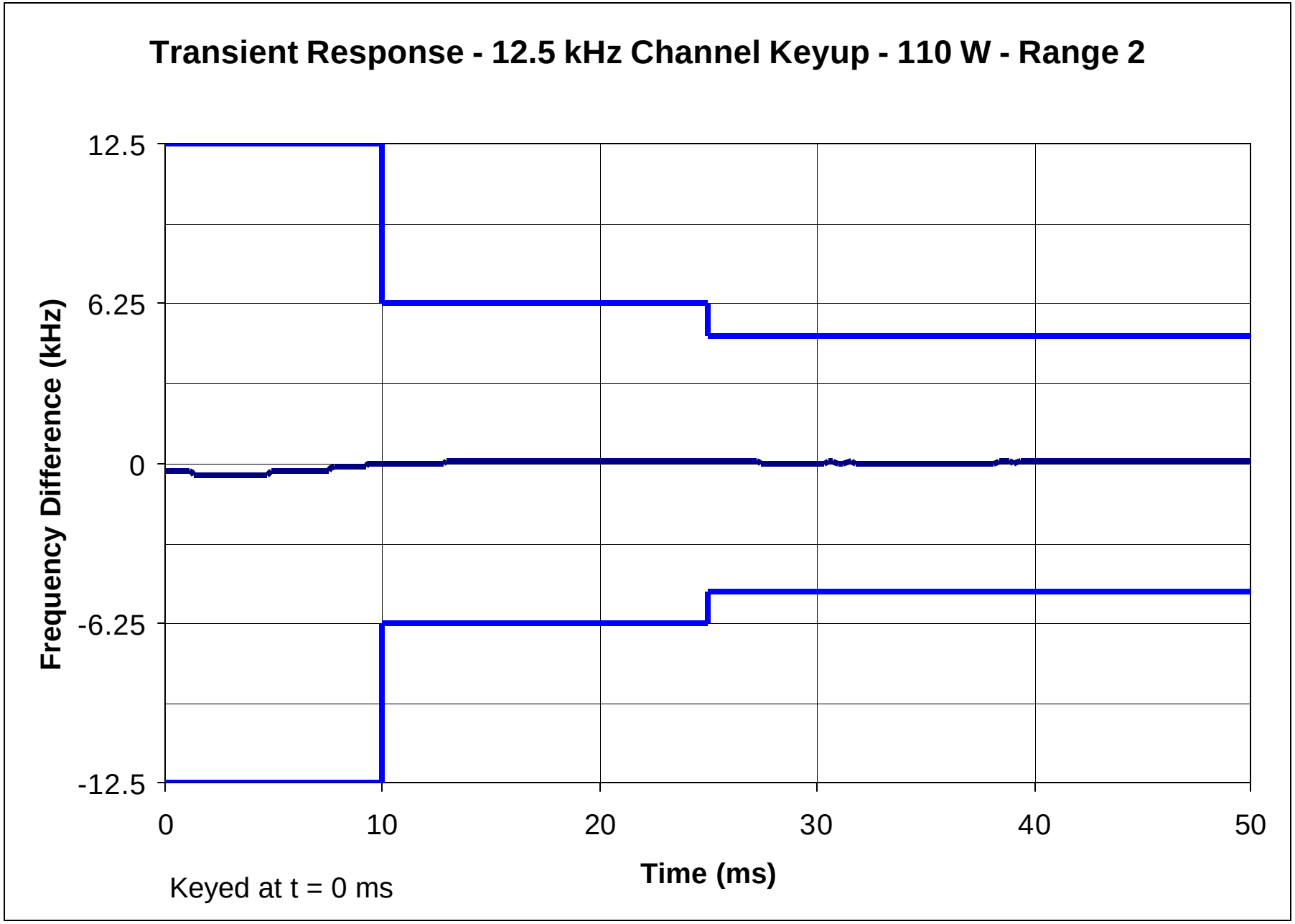
Where t1 and t2 are times immediately following when the transmitter is turned on, and t3 is the time from when the transmitter is turned off.

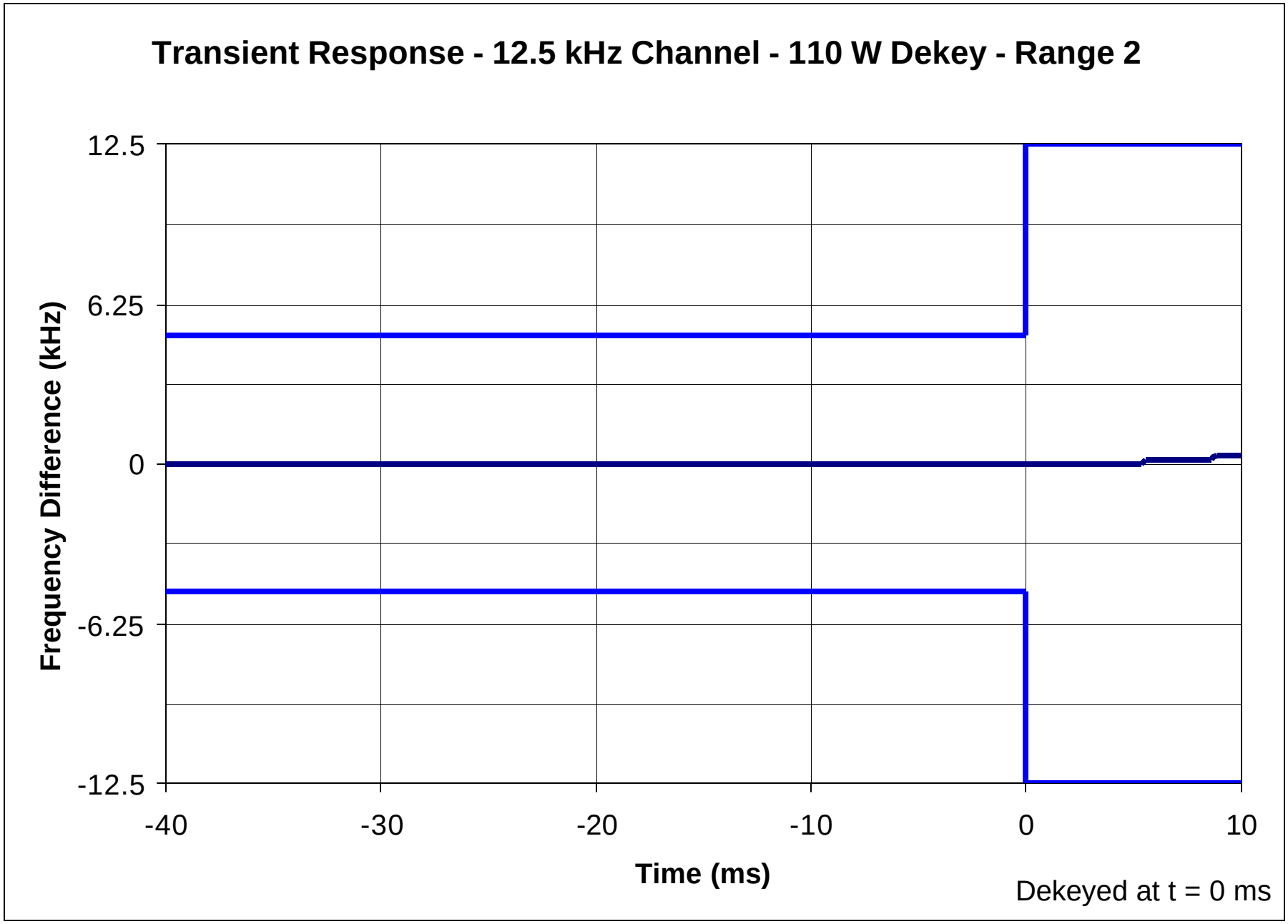
FREQUENCY TRANSIENT BEHAVIOR PLOTS:

EXHIBIT	DESCRIPTION
11K-1	Frequency Transient Behavior, 12.5 kHz Channel Key-Up
11K-2	Frequency Transient Behavior, 12.5 kHz Channel De-key

RADIO SETUP

- A range 2 station was used for this measurement, and had a transmitter frequency of 454.0125 MHz.
- The units were tested at various power levels across the operating range. Power level was found to be irrelevant to performance according to this standard.
- The measurements were taken by using an HP 53310A Modulation Domain Analyzer.


Transient Response - 12.5 kHz Channel Keyup - 110 W - Range 2
Frequency Difference (kHz)
12.5
6.25
0
-6.25
-12.5
0
10
20
30
40
50
Time (ms)
Keyed at t = 0 ms


Transient Response - 12.5 kHz Channel - 110 W Dekey - Range 2
12.5
6.25
0
-6.25
-12.5
Frequency Difference (kHz)
-40
-30
-20
-10
0
10
Time (ms)
Dekeyed at t = 0 ms

TEST EQUIPMENT LIST

MODEL	MANUFACTURER	DESCRIPTION	Serial No.	Last Cal	Next Cal
438A	Hewlett Packard	RF Power Meter	3513U06093	11/05/99	11/05/02
8481A	Hewlett Packard	RF Power Sensor	2702A78679	11/14/01	11/14/04
8568B	Hewlett Packard	Spectrum Analyzer	2841A04405	10/05/00	10/05/03
6071A	Fluke	Signal Generator	3005007	11/17/00	11/17/03
83712A	Hewlett Packard	Signal Generator	3429A00455	no calibration required	
85460A	Hewlett Packard	EMI Analyzer, Filter	3704A00467	10/12/99	10/12/03
85462A	Hewlett Packard	EMI Analyzer, RF/Display	3906A00500	10/12/99	10/12/03
(Various)	Weinschel, Kathrein, Bird	RF Loads	Various	no calibration required	
3020A, etc.	Narda	Directional Coupler	Various	no calibration required	
49441A	Hewlett Packard	Vector Signal Analyzer	3416a00835	06/21/02	06/21/03
53310A	Hewlett Packard	Modulation Domain Analyzer	3121A00479	11/15/01	11/15/04
8566B	Hewlett Packard	Spectrum Analyzer	2140A01273	11/08/01	11/08/02
438A	Hewlett Packard	RF Power Meter	2743A04603	11/15/01	11/15/02
8482A	Hewlett Packard	RF Power Sensor	2652A13844	11/07/01	11/07/02
8561EC	Agilent	Spectrum Analyzer	3946A00224	12/18/00	12/18/03
8753C	Hewlett Packard	Network Analyzer	3029A01510	05/20/00	05/20/03
85047A	Hewlett Packard	S-parameter Test Set	3033A02098	05/20/00	05/20/03
8656B	Hewlett Packard	Signal Generator	3243U11940	06/04/01	06/04/04
(Various)	Weinschel	RF Loads	Various	no calibration required	
ZAPD-21	Mini-Circuits	Combiner/Splitter	None	no calibration required	
7N013	MaCom	Circulator	1928 8750	no calibration required	
S3-02N	MicroLab	Tuner (3 stub)	None	no calibration required	
500-4	Celwave	Cavity Filter	44094	no calibration required	