Engineering and Testing for EMC and Safety Compliance

CERTIFICATION APPLICATION REPORT
FCC PART 90 & INDUSTRY CANADA RSS-119

Test Lab:	Applicant:
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FCC ID:	ATH2425111	**FRN NUMBER:**	0005-8136-88
MODEL:	242-51xx	**RTL WORK ORDER NUMBER:**	2004164
EQUIPMENT TYPE:	PTT VHF	**RTL QUOTE NUMBER:**	QRTL04-309
DATE OF TEST REPORT:	November 4, 2004		

FCC Classification:	☒ TNF – Licensed Non-Broadcast Transmitter Held to Face
FCC Rule Part(s):	Part 90: Private Land Mobile Radio Services
Industry Canada Standard:	RSS-119: Land Mobile and Fixed Radio Transmitters and Receivers, 27.41MHz to 960MHz

Frequency Range (MHz)	Output Power (W)	Frequency Tolerance (ppm)	Emission Designator
136 to 174	6.1	0.5	11K0F3E
136 to 174	6.1	0.5	16K0F3E
136 to 174	6.1	0.5	8K00F1E
136 to 174	6.1	0.5	8K00F1D

We, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this test report. No modifications were made to the equipment during testing in order to achieve compliance with these standards.

Furthermore, there was no deviation from, additions to or exclusions from the FCC Part 2, FCC Part 90, Industry Canada RSS-119, ANSI C63.2, ANSI/TIA/EIA603 and ANSI/TIA/EIA 603-1.

Signature:  Date: November 4, 2004

Typed/Printed Name: Desmond A. Fraser Position: President

Signature:  Date: November 4, 2004

Typed/Printed Name: Daniel Baltzell Position: Test Engineer

TABLE OF CONTENTS

FIGURE INDEX

TABLE INDEX

PLOT INDEX

APPENDIX INDEX

PHOTOGRAPH INDEX

1 GENERAL INFORMATION

1.1 SCOPE

FCC Rules Part 90 (Subpart K): This subpart sets forth special requirements applicable to the use of certain frequencies or frequency bands.

Industry Canada RSS-119: This document sets out standards for radio transmitters and receivers for the land mobile and fixed services in bands allocated within the 27.41 MHz to 960 MHz range.

All measurements contained in this application were conducted in accordance with the FCC Rules and Regulations CFR47 Part 90, Industry Canada RSS-119 and ANSI/TIA/EIA603-2002 Land Mobile FM or PM Communications Equipment Measurement and Performance Standards. The measurement instrumentation conforms to the ANSI C63.2; standard for EMI and Field Strength Instrumentation. Calibration checks are performed regularly on the instruments, and all accessories including high pass filter, coaxial attenuator, preamplifier and cables.

1.2 TEST FACILITY

The open area test site and conducted measurement facility used to collect the radiated data is located at 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report and approved by the Federal Communications Commission to perform AC line conducted and radiated emissions testing (ANSI C63.2).

1.3 RELATED SUBMITTAL(S)/GRANT(S)

This is an original application for Certification. The IF, LO and up to the 2nd LO were investigated.

2 EQUIPMENT INFORMATION

2.1 TEST SYSTEM DETAILS

The test sample was received on September 29, 2004. The FCC Identifiers for all equipment, plus descriptions of all cables used in the tested system are:

TABLE 2-1: EQUIPMENT UNDER TEST (EUT)

PART	MANUFACTURER	MODEL	SERIAL NUMBER	FCC ID	CABLE DESCRIPTION	RTL BAR CODE
Portable Radio	EF Johnson	023-5580-042	55840E304A35115	ATH2425111	N/A	16168
Battery	EF Johnson	587-5100-360	N/A	N/A	N/A	16171
Battery	EF Johnson	587-5100-360	N/A	N/A	N/A	16172
Antenna	EF Johnson	501-0017-100	N/A	N/A	N/A	16173
Antenna	EF Johnson	501-0017-101	N/A	N/A	N/A	16174
Antenna	EF Johnson	501-0017-103	N/A	N/A	N/A	16175
Antenna	EF Johnson	501-0017-105	N/A	N/A	N/A	16176

TABLE 2-2: EXTERNAL COMPONENTS IN TEST CONFIGURATION

PART	MANUFACTURER	MODEL	SERIAL NUMBER	FCC ID	CABLE DESCRIPTION	RTL BAR CODE
Charger	Motorola	AA16740	1123335648	N/A	N/A	16170

2.2 WORST CASE CONFIGURATION OF TESTED SYSTEM

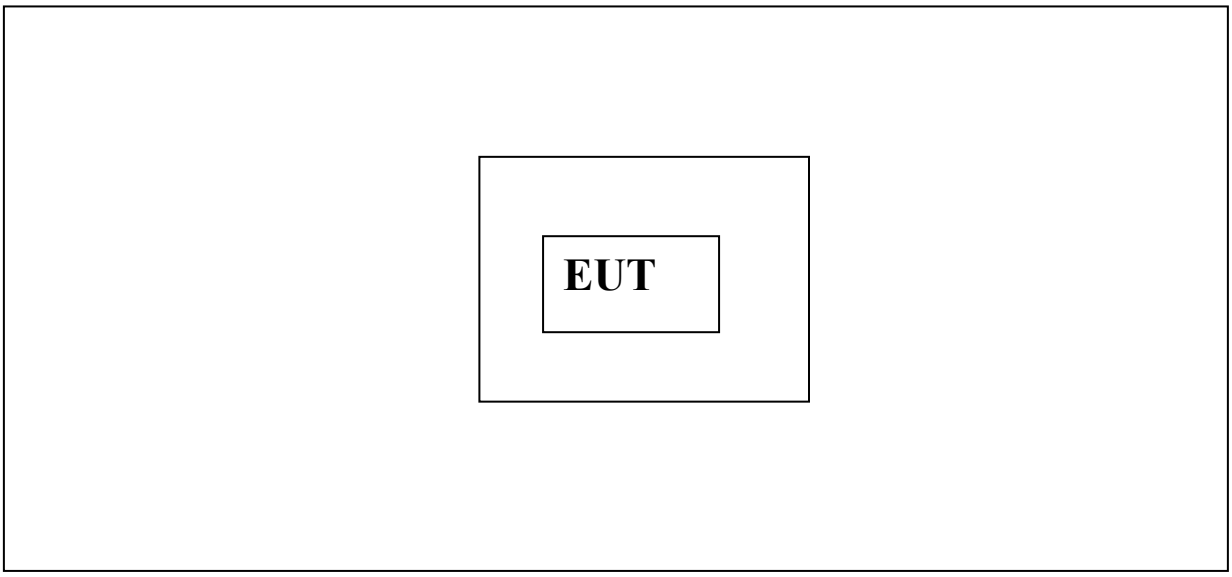


FIGURE 2-1: WORST CASE CONFIGURATION OF SYSTEM UNDER TEST

3 FCC PART 2.1033(C)(8); DC VOLTAGES AND CURRENTS

The DC voltages applied to, and DC currents into, the several elements of the final radio frequency amplifying device for normal operation over the power range were: 7.5 V at 0.78 A

4 RF POWER OUTPUT - §2.1046, RSS-119 §6.2

4.1 ANSI/TIA/EIA-603-2002, SECTION 2.2.1 TEST PROCEDURE

Connect the equipment as illustrated below. Measure the transmitter output power during the defined duty cycle. The EUT was connected to a coaxial attenuator having a 50 Ω load impedance.

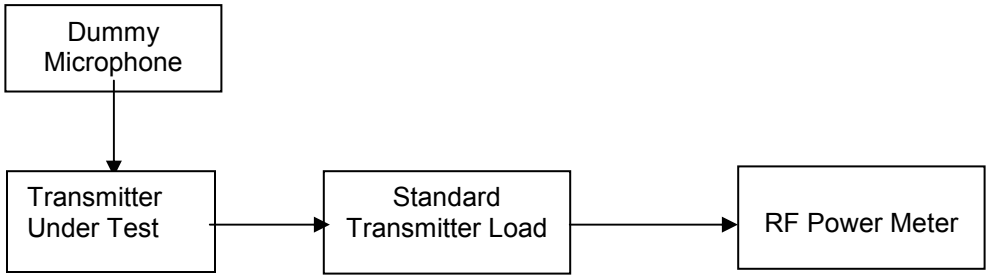


FIGURE 4-1: ILLUSTRATION OF HOW THE EQUIPMENT IS CONNECTED

4.2 RF POWER OUTPUT TEST EQUIPMENT

TABLE 4-1: RF POWER OUTPUT TEST EQUIPMENT

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Cal Due Date
901184	Agilent Technologies	E4416A	EPM-P Power Meter, single channel	GB41050573	08/02/2005
901186	Agilent Technologies	E9323A (50 MHz – 6 GHz)	Peak & Average Power Sensor	US40410380	09/10/2005

4.3 RF POWER OUTPUT TEST DATA

TABLE 4-2: RF POWER OUTPUT TEST DATA

Frequency (MHz)	Channel	Peak Conducted Power (dBm)	Peak Conducted Power (W)
136	1	37.8	6.1
150	2	37.4	5.4
174	3	38.0	6.3

TEST PERSONNEL:

Richard B. McMurray	Richard B. McMurray	October 6, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

5 MODULATION CHARACTERISTICS - §2.1047 TEST PROCEDURE, RSS-119 §6.6

The modulation characteristic tests apply to analog modulation and do not apply to digital modulation.

5.1 MODULATION CHARACTERISTICS TEST EQUIPMENT

TABLE 5-1: MODULATION CHARACTERISTICS TEST EQUIPMENT

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Cal Due Date
901118	Hewlett Packard	HP8901B	Modulation Analyzer (150 kHz – 1300 MHz)	2406A00178	7/7/05
901054	Hewlett Packard	HP 3586B	Selective Level Meter	1928A01892	9/8/05
900915	Hewlett Packard	33120	15 MHz Waveform Generator	US 36029992	3/3/05

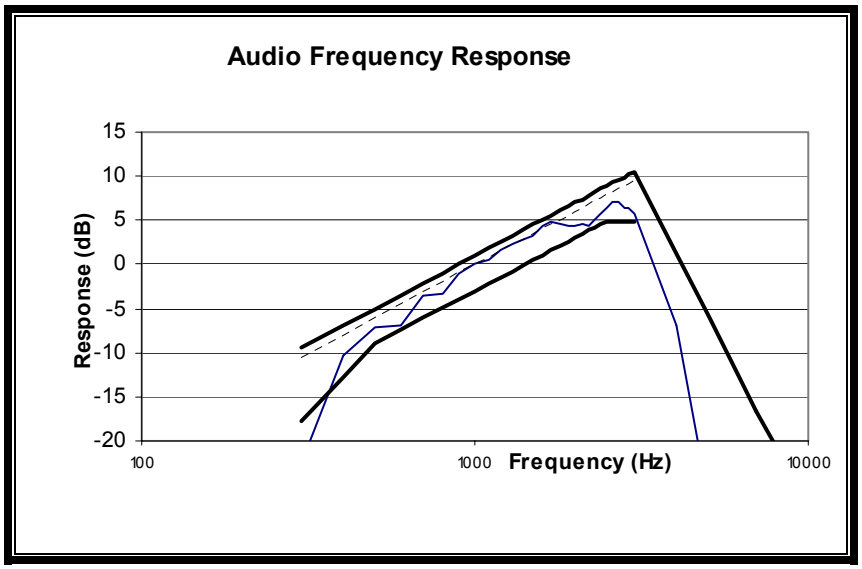
6 FCC PART 2 §2.1047 (A): MODULATION CHARACTERISTICS - AUDIO FREQUENCY RESPONSE

6.1 TEST PROCEDURE

ANSI/TIA/EIA-603-2002, section 2.2.6. The audio frequency response is the degree of closeness to which the frequency deviation of the transmitter follows a prescribed characteristic. The input audio level at 1000 Hz is set to produce 20% of the rated system deviation. This point is shown as the 0 dB reference level, noted DEVref. The audio signal generator was varied from 100Hz to 5kHz with the input level held constant. The deviation in kHz was recorded using a modulation analyzer as DEVfreq. The response in dB relative to 1 kHz was calculated as follows: Audio Frequency Response = 20 LOG (DEVfreq/DEVref)

6.2 TEST DATA

PLOT 6-1: AUDIO FREQUENCY RESPONSE



TEST PERSONNEL:

DANIEL BALTZELL		OCTOBER 20, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

7 FCC PART 2 §2.1047 (A): MODULATION CHARACTERISTICS - AUDIO LOW PASS FILTER RESPONSE

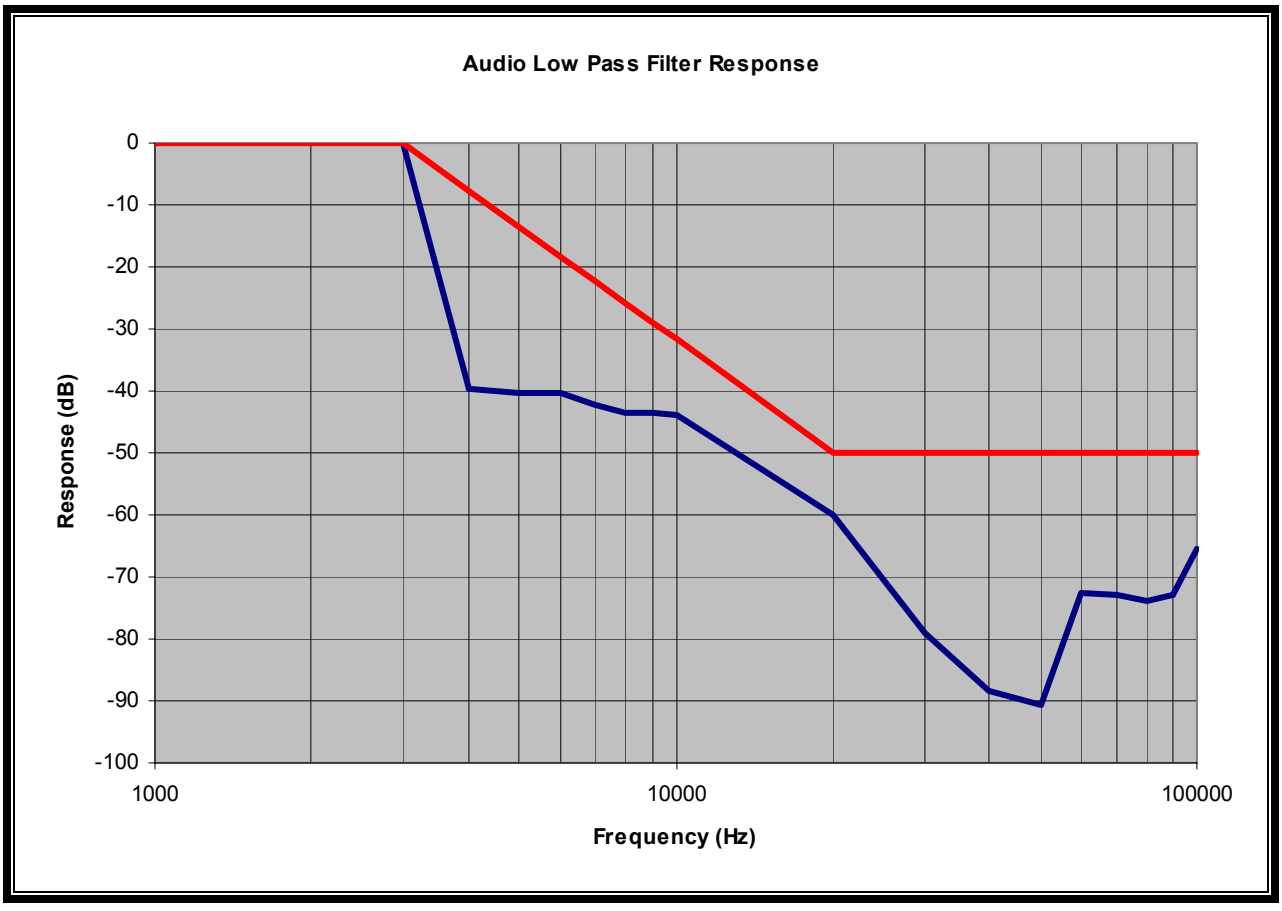
7.1 TEST PROCEDURE

ANSI/TIA/EIA-603-2002, 2.2.15

The Audio Low Pass Filter Response is the frequency response of the post limiter low pass filter circuit above 3000 Hz.

7.2 TEST DATA

PLOT 7-1: AUDIO LOW PASS FILTER RESPONSE



TEST PERSONNEL:

DANIEL BALTZELL		OCTOBER 20, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

8 FCC PART 2 §2.1047 (B): MODULATION CHARACTERISTICS - MODULATION LIMITING

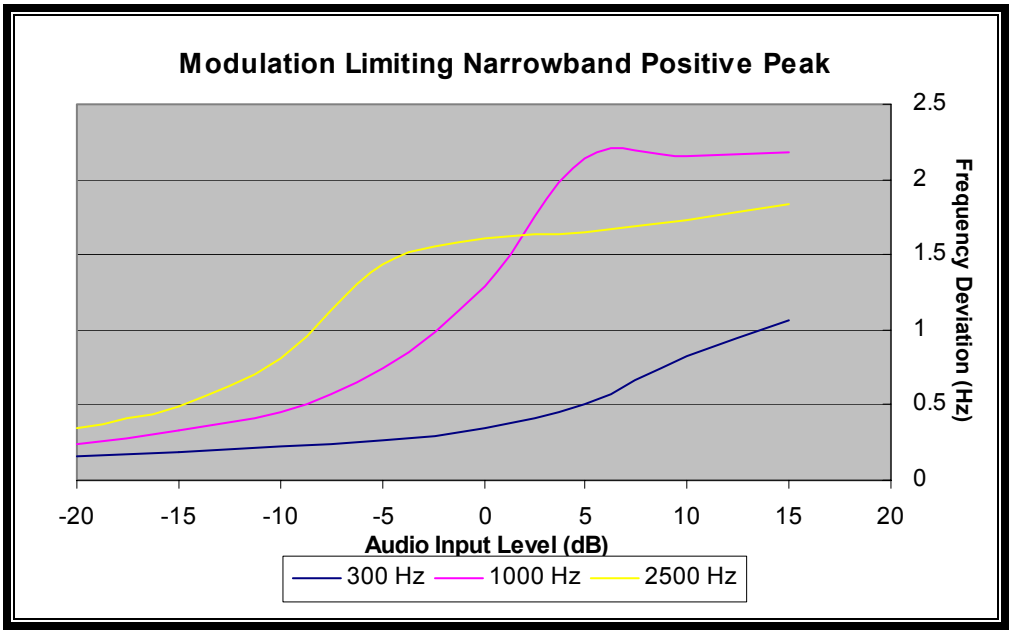
8.1 TEST PROCEDURE

ANSI/TIA/EIA-603-2002, section 2.2.3

The transmitter is adjusted for full rated system deviation. The audio input level is adjusted for 60% of rated system deviation at 1000 Hz. Using this level as a reference (0 dB) the audio input level is varied from the reference to a level +20 dB above it and –20 dB under it, for modulation frequencies of 300 Hz, 1,000 Hz, and 2,500 Hz. The system deviation obtained as a function of the input level is recorded. Both Positive and Negative Peak deviations were recorded.

8.2 TEST DATA

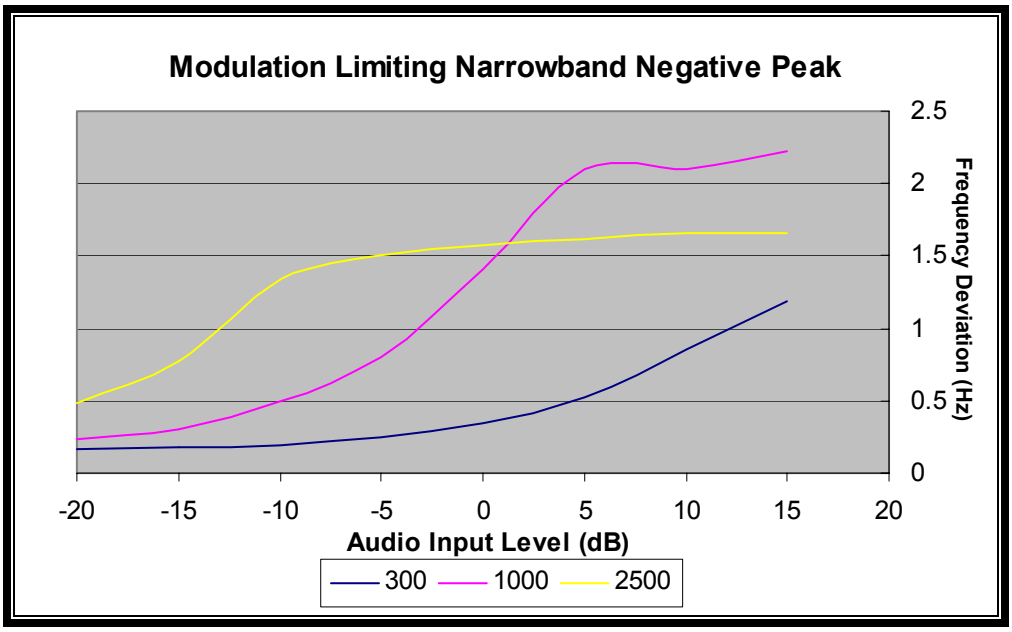
PLOT 8-1: MODULATION LIMITING RESPONSE (POSITIVE PEAK) CHANNEL 2, 150 MHZ; NARROWBAND POSITIVE PEAK



TEST PERSONNEL:

DANIEL BALTZELL		OCTOBER 26, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

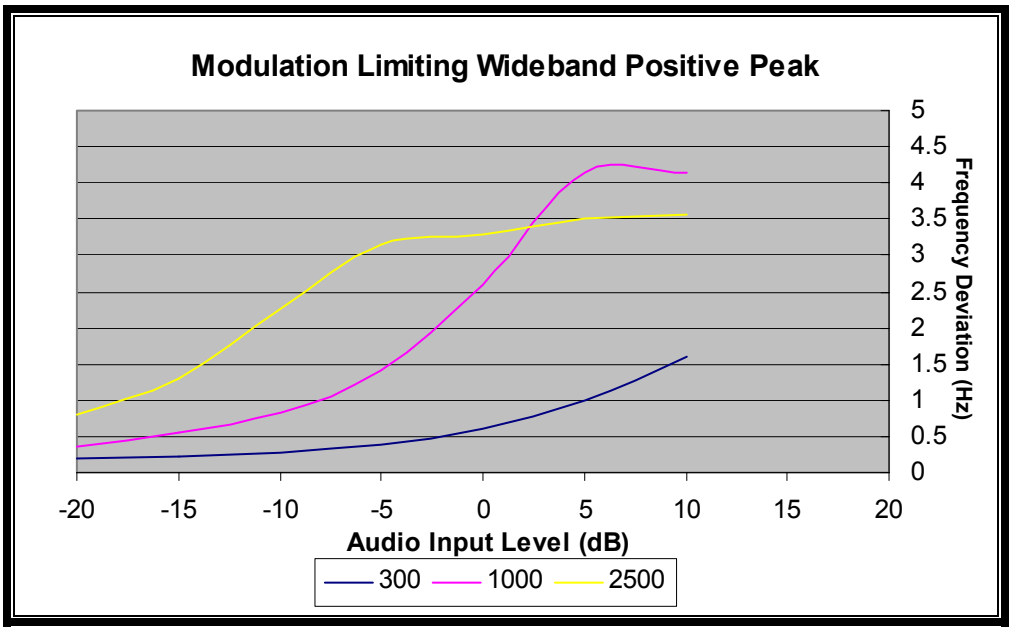
PLOT 8-2: MODULATION LIMITING RESPONSE (NEGATIVE PEAK) CHANNEL 2, 150 MHZ; NARROWBAND NEGATIVE PEAK



TEST PERSONNEL:

DANIEL BALTZELL		OCTOBER 26, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

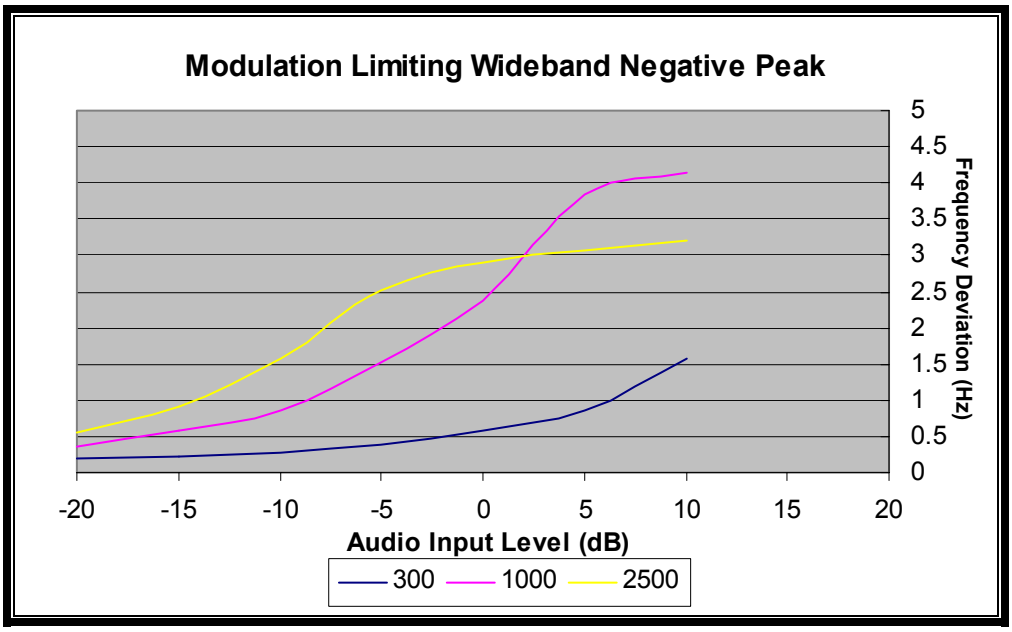
PLOT 8-3: MODULATION LIMITING RESPONSE (POSITIVE PEAK) CHANNEL 2, 150 MHZ; WIDEBAND POSITIVE PEAK



TEST PERSONNEL:

DANIEL BALTZELL		OCTOBER 26, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

PLOT 8-4: MODULATION LIMITING RESPONSE (NEGATIVE PEAK) CHANNEL 2, 150 MHZ; WIDEBAND NEGATIVE PEAK



TEST PERSONNEL:

DANIEL BALTZELL		OCTOBER 26, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

9 OCCUPIED BANDWIDTH - §2.1049, RSS-119 §6.4

9.1 OCCUPIED BANDWIDTH - §2.1049 TEST PROCEDURE

The antenna output terminal of the EUT was connected to the input of a 50W spectrum analyzer through a matched 10 dB attenuator. The radio transmitter was operating at maximum output power with and without internal data modulation. 100% of the in-band modulation was below the specified mask.

(b) *Emission Mask B:* For transmitters that are equipped with an audio low-pass filter pursuant to §90.211(a), the power of any emission must be below the unmodulated carrier power (P) as follows:
(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.
(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.
(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

(d) *Emission Mask D, 12.5 kHz channel bandwidth equipment:* 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 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

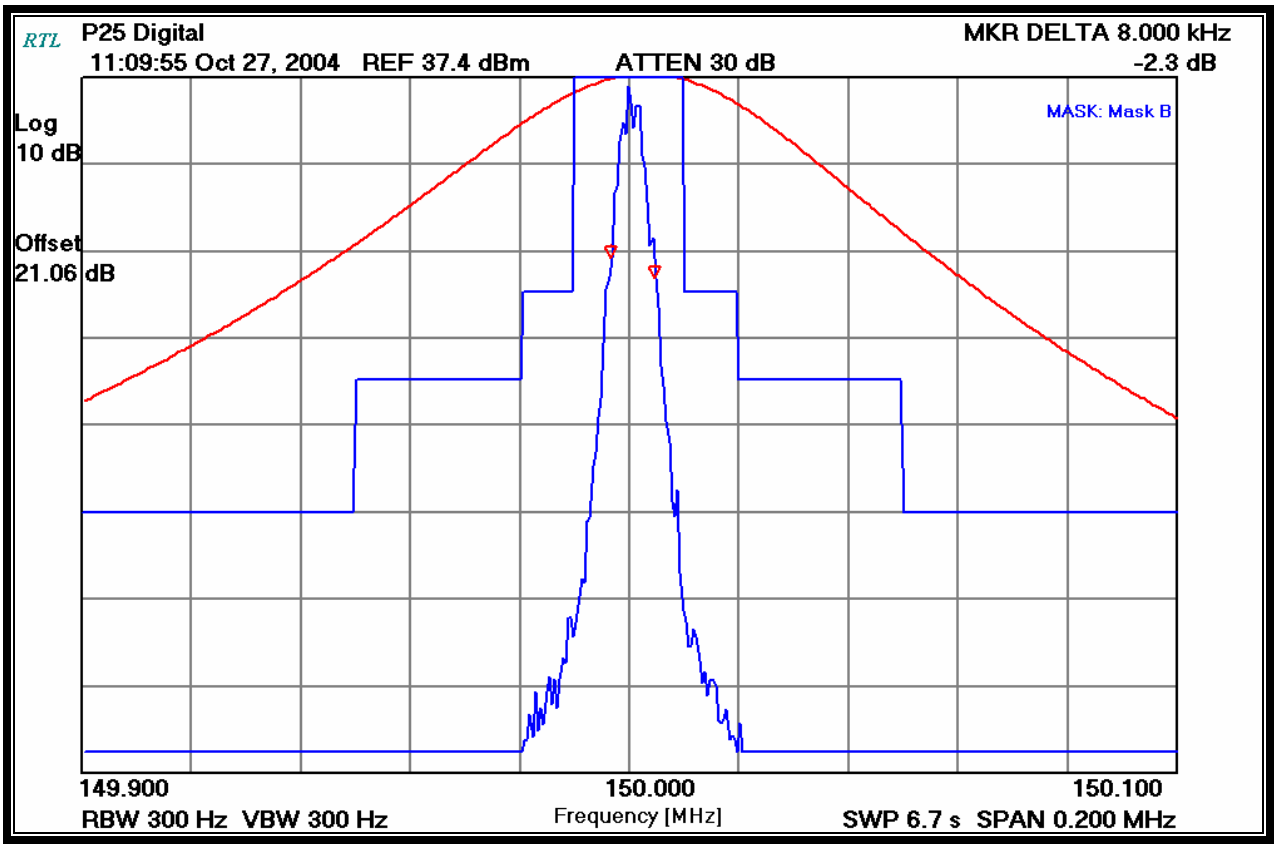
9.2 OCCUPIED BANDWIDTH TEST EQUIPMENT

TABLE 9-1: OCCUPIED BANDWIDTH TEST EQUIPMENT

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Cal Due Date
901215	Hewlett Packard	8596EM	Spectrum Analyzer (9 kHz - 12.8 GHz)	3826A00144	9/8/05
901139	Weinschel Corp.	48-20-34 DC-18GHz	Attenuator, 100W 20 dB	BK5859	5/13/05
900915	Hewlett Packard	33120	15 MHz Waveform Generator	US 36029992	3/3/05

9.3 OCCUPIED BANDWIDTH TEST DATA

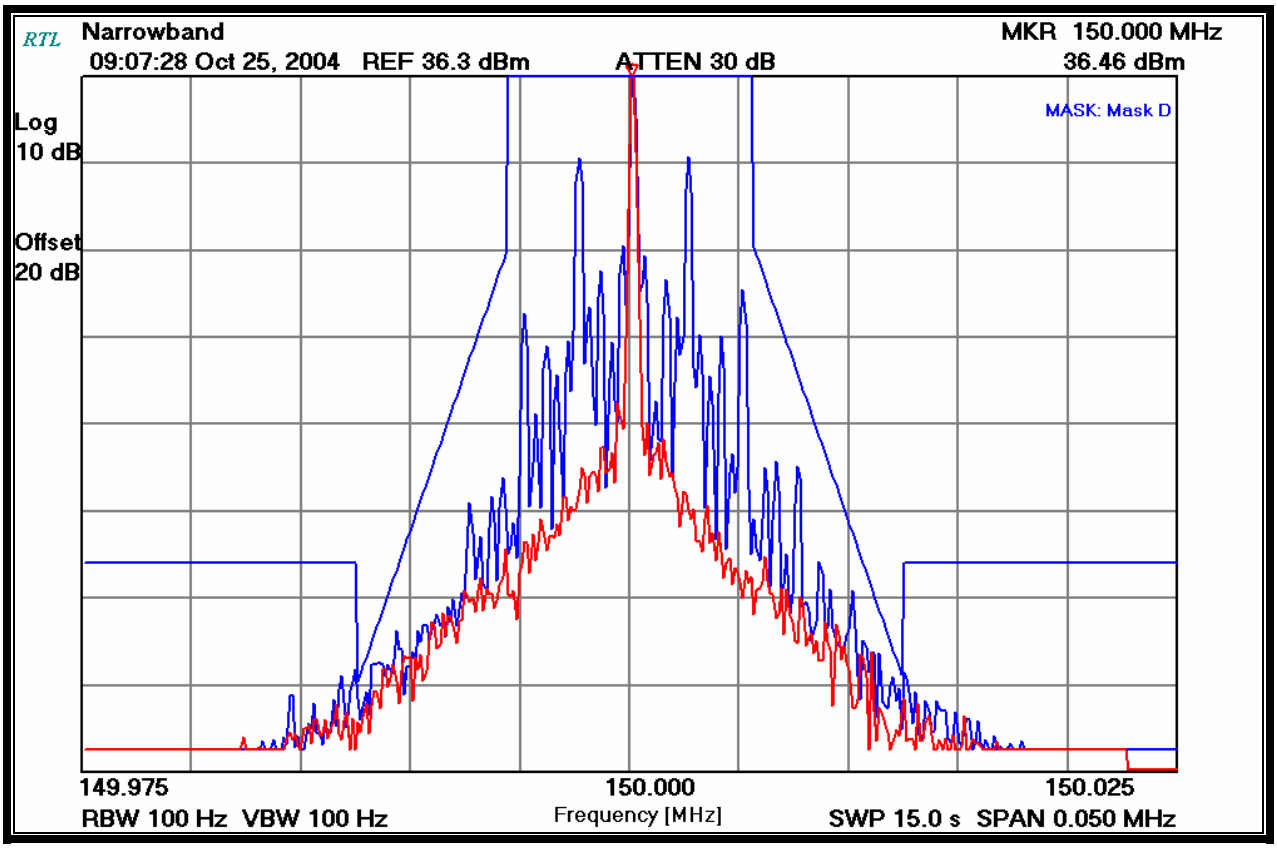
PLOT 9-1: MASK D (150 MHZ; CH 2; P25 DIGITAL)



TEST PERSONNEL:

DANIEL BALTZELL		OCTOBER 27, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

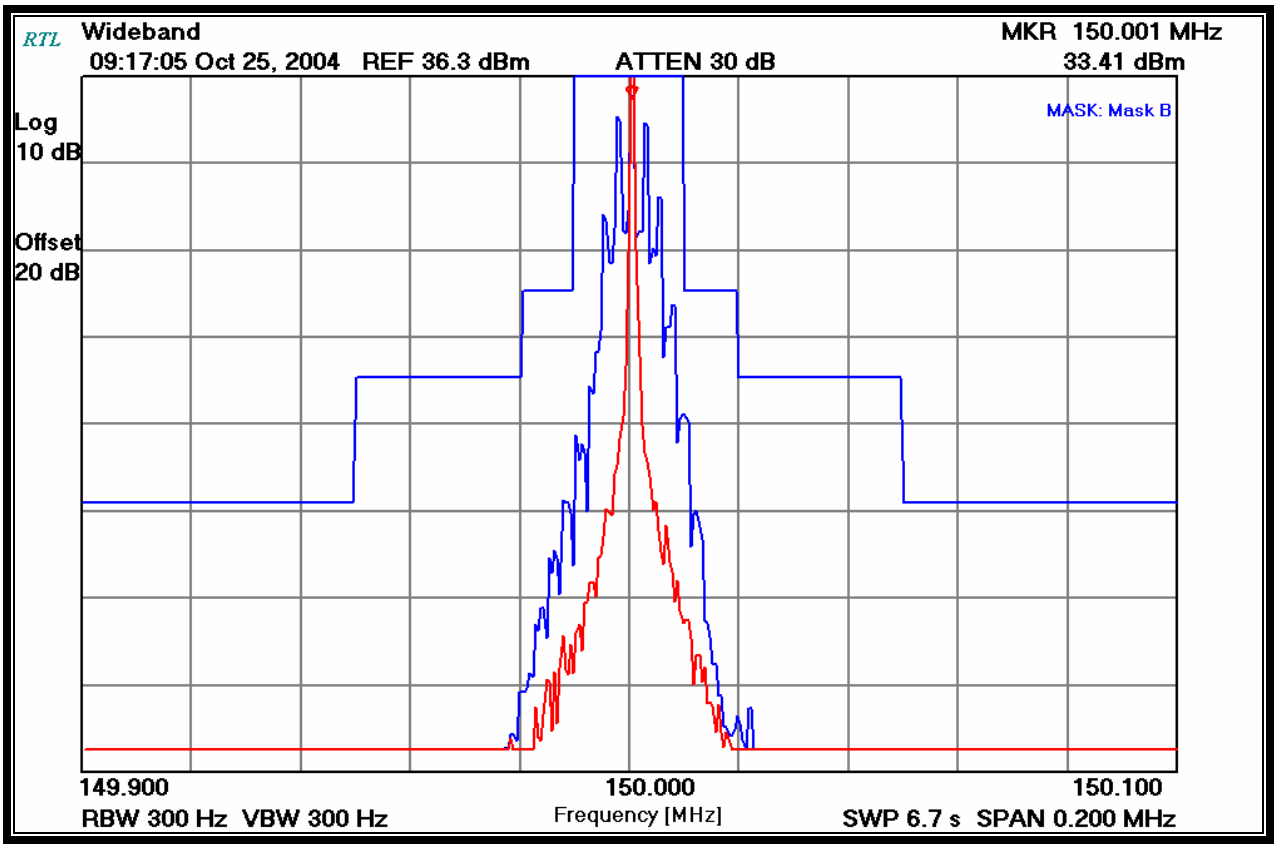
PLOT 9-2: MASK D (150 MHZ; CH. 2; NARROWBAND)



TEST PERSONNEL:

DANIEL BALTZELL		OCTOBER 25, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

PLOT 9-3: MASK B (150 MHZ; CH. 2; WIDEBAND)



TEST PERSONNEL:

DANIEL BALTZELL		OCTOBER 25, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

10 SPURIOUS EMISSIONS AT ANTENNA TERMINAL - §2.1051, RSS-119 §6.3

10.1 SPURIOUS EMISSIONS AT ANTENNA TERMINAL - §2.1051 TEST PROCEDURE

The level of the various conducted spurious frequencies was measured by means of a calibrated spectrum analyzer. The antenna output terminal of the EUT was connected to the input of a 50 Ω spectrum analyzer through a notch filter. The transmitter was operating at maximum power.

10.2 SPURIOUS EMISSIONS AT ANTENNA TERMINAL TEST EQUIPMENT

TABLE 10-1: SPURIOUS EMISSIONS AT ANTENNA TERMINAL TEST EQUIPMENT

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Cal Due Date
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz - 22 GHz)	3138A07771	6/23/05
900915	Hewlett Packard	33120	15 MHz Waveform Generator	US 36029992	3/3/05
901131	Par Electronics	118-174 (25W)	VHF Notch Filter	N/A	5/13/05

10.3 CONDUCTED SPURIOUS EMISSIONS TEST DATA

TABLE 10-2: CONDUCTED SPURIOUS EMISSIONS (CHANNEL 1 AT 136 MHZ)

Operating Frequency (MHz): 136
Channel: 1
Measured Conducted Power (dBm): 37.8
Modulation: Analog
Limit (dBc): 57.8 (50+10LogP)

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Notch Filter Insertion Loss (dB)	Corrected Spectrum Analyzer Level (dBc)	Margin (dB)
272	-52.5	0.5	89.8	-32.0
408	-66.8	0.3	104.3	-46.5
544	-64.1	0.3	101.6	-43.8
680	-71.9	0.4	109.3	-51.5
816	-78.3	0.8	115.3	-57.5
952	-76.3	1.7	112.4	-54.6
1088	-86.6	1.2	123.2	-65.4
1224	-88.1	3.1	122.8	-65.0
1360	-106.1	26.0	117.9	-60.1

TEST PERSONNEL:

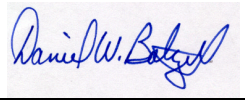
DANIEL BALTZELL		OCTOBER 14, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

TABLE 10-3: CONDUCTED SPURIOUS EMISSIONS (CHANNEL 2 AT 150 MHZ)

Operating Frequency (MHz): 150
Channel: 2
Measured Conducted Power (dBm): 37.4
Modulation: Analog
Limit (dBc): 57.3 (50+10LogP)

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Notch Filter Insertion Loss (dB)	Corrected Spectrum Analyzer Level (dBc)	Margin (dB)
300	-41.3	0.2	78.4	-21.1
450	-84.9	0.3	121.9	-64.6
600	-73.3	0.1	110.5	-53.2
750	-76.2	0.5	113.0	-55.7
900	-93.0	11.5	118.8	-61.5
1050	-82.6	0.9	119.0	-61.7
1200	-85.0	2.7	119.6	-62.3
1350	-104.0	12.4	128.9	-71.6
1500	-114.0	5.8	145.5	-88.2

TEST PERSONNEL:



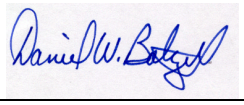
DANIEL BALTZELL		OCTOBER 14, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

TABLE 10-4: CONDUCTED SPURIOUS EMISSIONS (CHANNEL 3 AT 174 MHZ)

Operating Frequency (MHz): 174
Channel: 3
Measured Conducted Power (dBm): 38.0
Modulation: Analog
Limit (dBc): 58.0 (50+10LogP)

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Notch Filter Insertion Loss (dB)	Corrected Spectrum Analyzer Level (dBc)	Margin (dB)
348	-57.7	0.2	95.5	-37.5
522	-70.7	0.1	108.6	-50.6
696	-76.4	0.1	114.3	-56.3
870	-80.2	0.9	117.3	-59.3
1044	-68.3	1.0	105.3	-47.3
1218	-85.1	2.8	120.3	-62.3
1392	-96.5	19.9	114.6	-56.6
1566	-97.1	6.7	128.4	-70.4
1740	-88.5	6.6	119.9	-61.9

TEST PERSONNEL:



DANIEL BALTZELL		OCTOBER 14, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

11 RADIATED SPURIOUS AND HARMONIC EMISSIONS - §2.1053, RSS-119 §6.3

11.1 RADIATED SPURIOUS AND HARMONIC EMISSIONS - §2.1053

ERP Measurements by Substitution Method:

The EUT was placed on a turntable 3 meters from the receive antenna. The EUT was placed on the turntable with the transmitter transmitting into a non-radiating load. The field of maximum intensity was found by rotating the EUT 360 degrees in all 3 orthogonal axes, and changing the height of the receive antenna from 1 to 4 meters. The field strength was recorded from a calibrated spectrum analyzer for each channel being tested. An antenna was substituted in place of the EUT. This antenna was fed by a signal generator, and the input level adjusted to the same field strength level as the EUT. The conducted power from the signal generator was recorded. The level was checked at the antenna input using a splitter to verify no impedance mismatch and corrected. The signal generator level was further corrected by subtracting the connecting cable loss, and further corrected with the transmitting antenna gain referenced to a ½ wave dipole measurement.

The spectrum analyzer was set to the following settings:

Quasi-peak below 1 GHz (120 kHz RBW/VBW); Average above 1 GHz (1 MHz RBW/10 Hz VBW), sweep speed auto.

11.2 RADIATED SPURIOUS TEST EQUIPMENT

TABLE 11-1: RADIATED SPURIOUS TEST EQUIPMENT

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Date
901053	Schaffner Chase	CBL6112B	Bi-Log Antenna (20 MHz - 2 GHz)	2648	9/20/05
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz - 22 GHz)	3138A07771	6/23/05
900928	Hewlett Packard	83752A	Synthesized Sweeper (0.01 - 20 GHz)	3610A00866	9/5/05
900905	Rhein Tech Labs	PR-1040	Pre Amplifier 40dB (10 MHz – 2 GHz)	1006	9/1/05
900814	Electro-Metrics	EM-6961 (RGA-60)	Double Ridged Guide Antenna (1 - 18 GHz)	2310	2/17/06
900154	Compliance Design	Roberts Dipole	Adjustable Elements Dipole Antenna (30 - 1000 MHz)	N/A	10/6/05

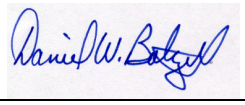
11.3 RADIATED SPURIOUS EMISSIONS TEST DATA - §2.1053

Operating Frequency (MHz): 136
Channel: 1
Measured Conducted Power (dBm): 37.8
Modulation: Analog narrowband
Distance (m): 3
Limit (dBc): 57.8 (50+10LogP)

TABLE 11-2: RADIATED SPURIOUS EMISSIONS DATA CHANNEL 1 §2.1053

Frequency (MHz)	Signal Generator Level (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Corrected Level (dBc)	Margin (dB)
272.0	-60.0	1.9	-0.5	100.2	-42.4
408.0	-70.1	2.5	-0.6	111.0	-53.2
544.0	-74.7	2.8	-0.7	116.0	-58.2
680.0	-65.3	3.2	-1.0	107.3	-49.5
816.0	-64.0	3.5	-1.2	106.5	-48.7
952.0	-76.9	3.8	-1.2	119.7	-61.9
1088.0	-70.9	4.1	0.8	112.0	-54.2
1224.0	-83.9	4.4	2.0	124.1	-66.3
1360.0	-81.5	4.6	3.3	120.6	-62.8

TEST PERSONNEL:



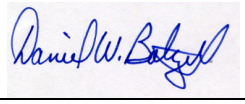
DANIEL BALTZELL		OCTOBER 16, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

Operating Frequency (MHz): 150
Channel: 2
Measured Conducted Power (dBm): 37.4
Modulation: Analog narrowband
Distance (m): 3
Limit (dBc): 57.4 (50+10LogP)

TABLE 11-3: RADIATED SPURIOUS EMISSIONS DATA CHANNEL 2 §2.1053

Frequency (MHz)	Signal Generator Level (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Corrected Level (dBc)	Margin (dB)
300.0	-73.2	2.1	-0.8	113.4	-56.1
450.0	-82.8	2.5	-0.6	123.2	-65.9
600.0	-68.3	3.0	-1.1	109.7	-52.4
750.0	-69.8	3.3	-1.2	111.6	-54.3
900.0	-78.6	3.6	-1.1	120.6	-63.3
1050.0	-75.8	4.2	0.3	117.0	-59.7
1200.0	-79.6	4.3	1.8	119.4	-62.1
1350.0	-86.8	4.6	3.2	125.5	-68.2
1500.0	-90.8	5.0	4.7	128.4	-71.1

TEST PERSONNEL:



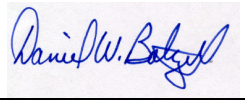
DANIEL BALTZELL		OCTOBER 16, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

Operating Frequency (MHz): 174
Channel: 3
Measured Conducted Power (dBm): 38.0
Modulation: Analog narrowband
Distance (m): 3
Limit (dBc): 58.0 (50+10LogP)

TABLE 11-4: RADIATED SPURIOUS EMISSIONS DATA CHANNEL 3 §2.1053

Frequency (MHz)	Signal Generator Level (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Corrected Level (dBc)	Margin (dB)
348.0	-46.0	2.2	-0.3	86.5	-28.5
522.0	-56.9	2.8	-0.6	98.3	-40.3
696.0	-54.1	3.3	-1.1	96.5	-38.5
870.0	-59.8	3.7	-1.1	102.6	-44.6
1044.0	-44.9	4.2	0.3	86.8	-28.8
1218.0	-77.5	4.4	1.9	118.0	-60.0
1392.0	-71.5	4.7	3.6	110.6	-52.6
1566.0	-72.6	5.0	4.7	110.9	-52.9
1740.0	-78.4	5.4	4.8	117.0	-59.0

TEST PERSONNEL:



DANIEL BALTZELL		OCTOBER 16, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

12 FREQUENCY STABILITY / TEMPERATURE VARIATION - §2.1055, RSS-119 §7

12.1 MEASUREMENT METHOD:

The frequency stability of the transmitter was measured by:

1. Temperature: The temperature was varied from -30°C to +60°C at intervals no more than 10°C throughout the temperature range using an environmental chamber. A period of time sufficient to stabilize all of the components in the equipment shall be allowed prior to each frequency measurement.
2. Primary Supply Voltage: The primary supply voltage was varied from 85% to 115% of the voltage normally at the input to the device or at the power supply terminals if cables are not normally supplied. The EUT was tested down to the battery endpoint.

12.2 TIME PERIOD AND PROCEDURE:

1. The carrier frequency of the transmitter was measured at room temperature (25°C to 27°C, to provide a reference).
2. The equipment was subjected to a period of 1 hour to stabilize at -30°C without any power applied.
3. After the stabilization period at -30°C, the measurement of the carrier frequency of the transmitter was made within a three-minute interval after applying power to the transmitter.
4. Frequency measurements were made at 10°C intervals up to +50°C. A minimum period of 1/2 hour was provided to allow stabilization of the equipment at each temperature level.

12.3 FREQUENCY TOLERANCE:

The minimum frequency stability shall be 5 ppm.

12.4 FREQUENCY STABILITY TEST EQUIPMENT

TABLE 12-1: FREQUENCY STABILITY TEST EQUIPMENT

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Cal Due Date
900946	Tenney Engineering, Inc	TH65	Temperature Chamber with Humidity	11380	2/3/05
901020	Hewlett Packard	8564E	Portable Spectrum Analyzer (9 kHz - 40 GHz)	3943A01719	8/11/05
901247	Wavetek	DM25XT	Multimeter	40804098	3/3/05

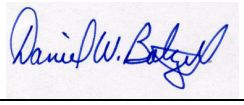
12.5 FREQUENCY STABILITY TEST DATA - §2.1055

Operating Frequency: 150 MHz
Channel: 2 Narrowband
Reference Voltage: 7.5 VDC
Deviation Limit: 5 PPM

TABLE 12-2: FREQUENCY STABILITY DATA - §2.1055: TEMPERATURE

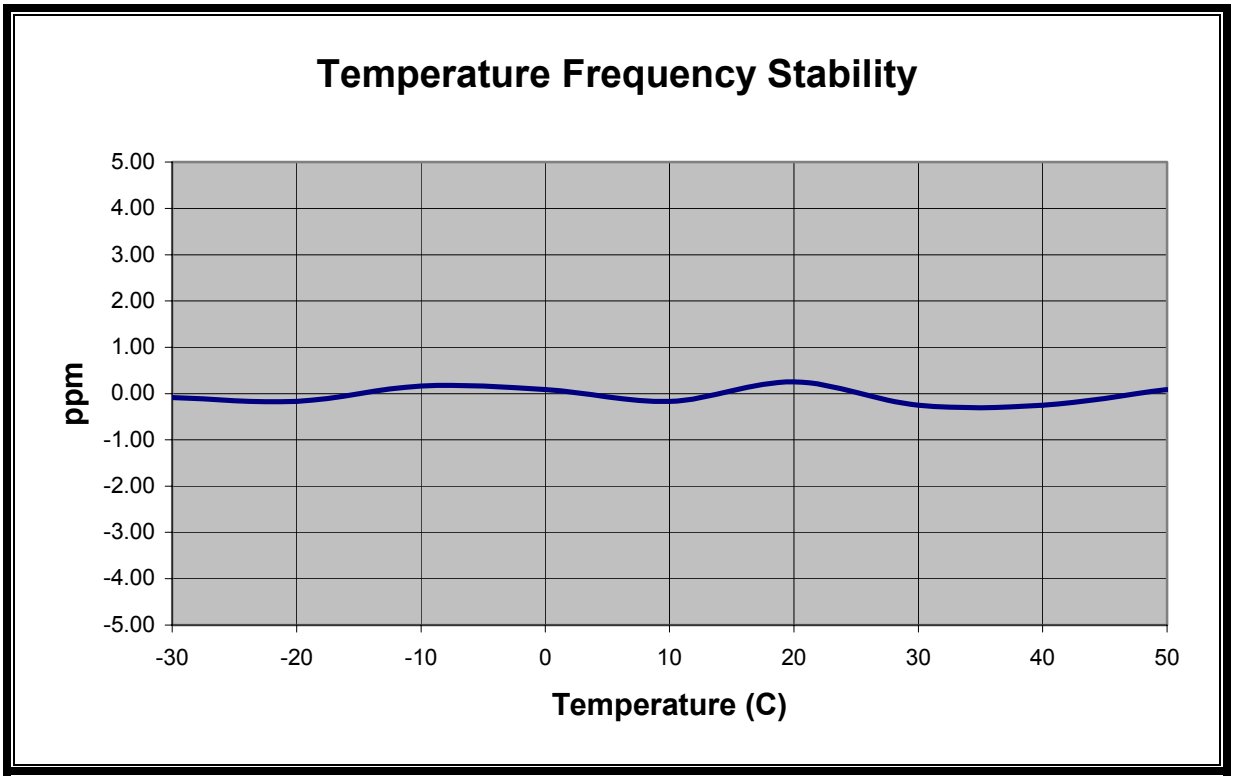
Temperature (ºC)	Measured Frequency (MHz)	ppm
-30	149.999988	-0.08
-20	149.999975	-0.17
-10	150.000025	0.17
0	150.000013	0.09
10	149.999975	-0.17
20	150.000038	0.25
30	149.999963	-0.25
40	149.999963	-0.25
50	150.000013	0.09

TEST PERSONNEL:



DANIEL BALTZELL		OCTOBER 22, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

PLOT 12-1: TEMPERATURE FREQUENCY STABILITY - §2.1055



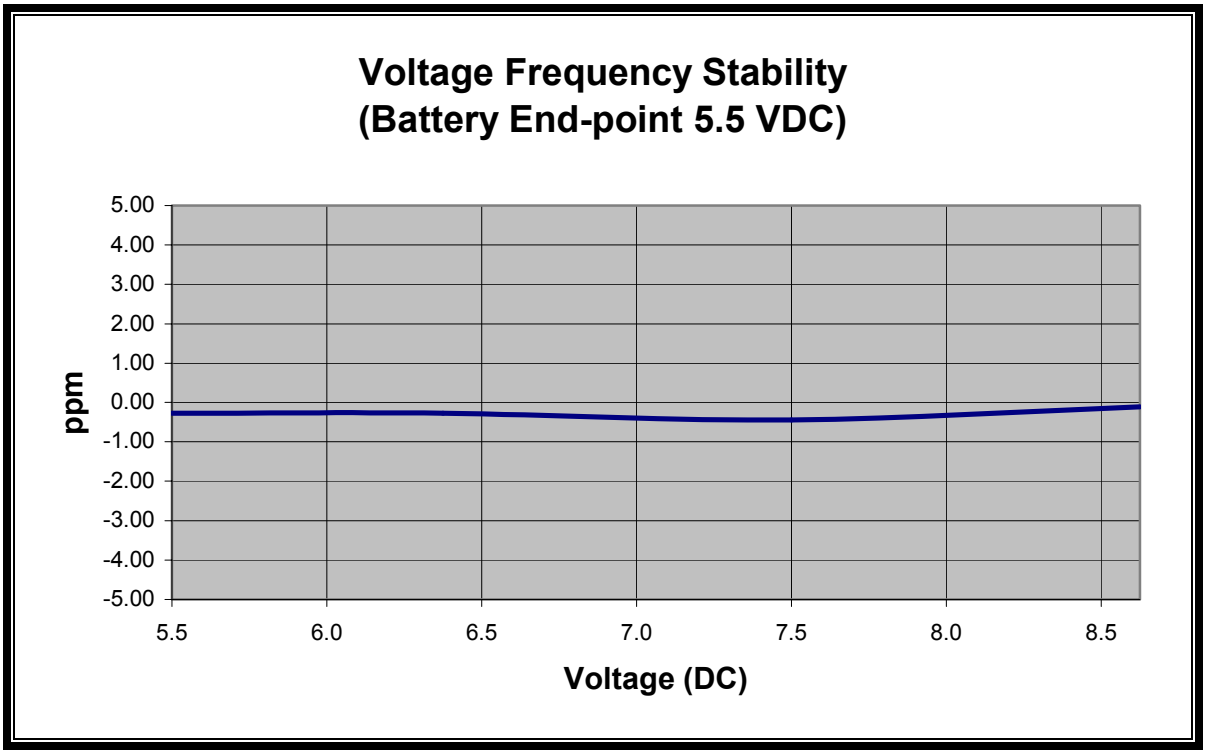
TEST PERSONNEL:

DANIEL BALTZELL		OCTOBER 22, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

TABLE 12-3: FREQUENCY STABILITY DATA - §2.1055: VOLTAGE

Voltage (DC)	Measured Frequency (MHz)	ppm
5.5 (Battery End-point)	149.999958	-0.28
6.375	149.999958	-0.28
7.5	149.999933	-0.45
8.625	149.999983	-0.11

PLOT 12-2: VOLTAGE FREQUENCY STABILITY - §2.1055



TEST PERSONNEL:

DANIEL BALTZELL		OCTOBER 22, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

13 FCC PART 90 §90.214: TRANSIENT FREQUENCY BEHAVIOR, RSS-119 §6.5

13.1 TRANSIENT FREQUENCY BEHAVIOR TEST PROCEDURE

ANSI/TIA/EIA-603-2002, section 2.2.19

13.2 TRANSIENT FREQUENCY BEHAVIOR LIMITS

TABLE 13-1: REQUIREMENTS FOR EUT WITH 25 KHZ CHANNEL SPACING:

Time Intervals (*)(**)	Maximum Frequency Difference (***)	150-174 MHz	421-512 MHz
t1(****)	± 25 kHz	5.0 mSec	10.0 mSec
t2	± 12.5 kHz	20.0 mSec	25.0 mSec
t3(****)	± 25 kHz	5.0 mSec	10.0 mSec

TABLE 13-2: REQUIREMENTS FOR EUT WITH 12.5 KHZ CHANNEL SPACING:

Time Intervals (*)(**)	Maximum Frequency Difference(***)	150-174 MHz	421-512 MHz
T1(****)	± 12.5 kHz	5.0 mSec	10.0 mSec
t2	± 6.25 kHz	20.0 mSec	25.0 mSec
T3(****)	± 12.5 kHz	5.0 mSec	10.0 mSec

(*) t_{on} is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.
t_1 is the time period immediately following t_{on}.
t_2 is the time period immediately following t_1.
t_3 is the time period from the instant when the transmitter is turned off until t_{off}.
t_{off} is the instant when the 1 kHz test signal starts to rise.
(**) 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.
(***) The difference between the actual transmitter frequency and the assigned transmitter frequency.
(****) If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

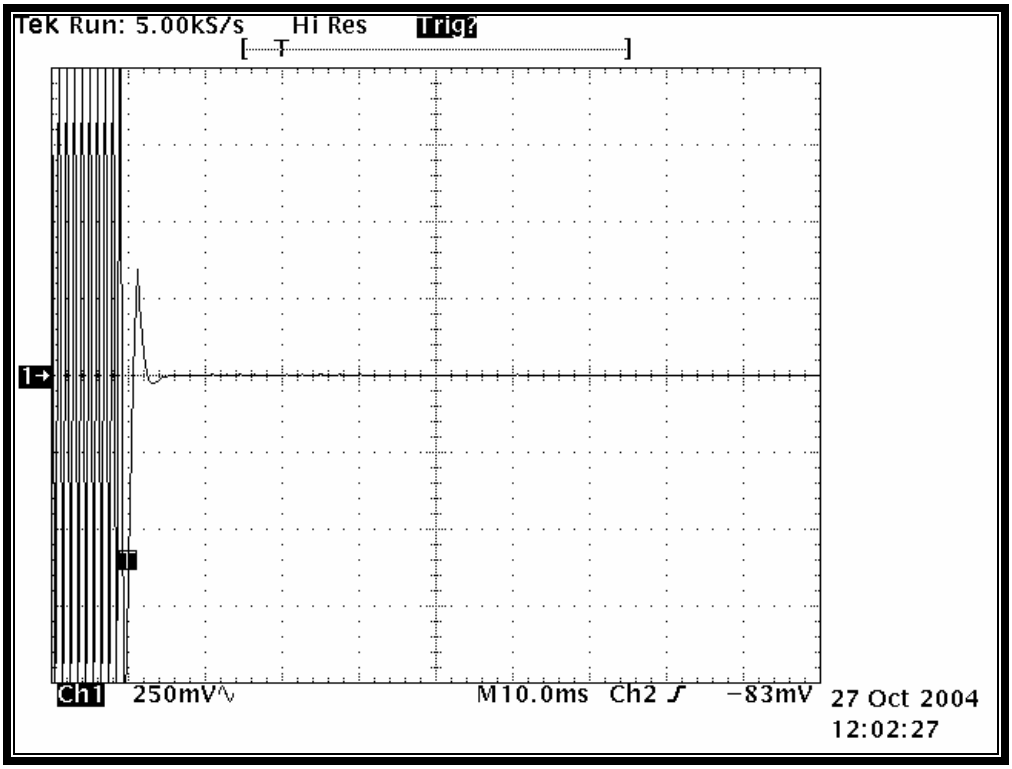
Maximum frequency difference between time T2 and T3: Calculation for Channel 2:
The frequency stability is required to be 5 PPM.
Calculation for Channel 2:
4 div. on scope represents 12.5 kHz for narrow band channel.
Therefore, 150 MHz times 5 PPM times +/- 4 Divisions divided by 12.5kHz equals about +/- 0.24 division. 0.24 Div. corresponds to 0.75 kHz

TABLE 13-3: TRANSIENT FREQUENCY BEHAVIOR TEST EQUIPMENT

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Cal Due Date
900917	Hewlett Packard	8648C	Synthesized Signal Generator (9 kHz - 3200 MHz)	3537A01741	7/6/05
901118	Hewlett Packard	HP8901B	Modulation Analyzer (150 kHz – 1300 MHz	2406A00178	7/7/2005
900561	Tektronix	TDS540A	Oscilloscope	B020129	3/25/05
901214	Hewlett Packard	HP8471D	Detector	2952A19822	Not Required
900352	Werlatone	C1795	Directional Coupler, 100 watt, (1 – 1000 MHz)	4067	7/1/2005
901138	Weinschel Corp.	48-40-34 DC-18GHz	Attenuator, 100W 40 dB	BK5883	5/13/05
901140	Weinschel Corp.	47-10-34 DC-18GHz	Attenuator, 50W 10 dB	BK6203	5/13/05

13.3 TRANSIENT FREQUENCY BEHAVIOR TEST DATA

PLOT 13-1: ON TIME – CHANNEL 2: 150 MHZ; 12.5 KHZ NARROWBAND



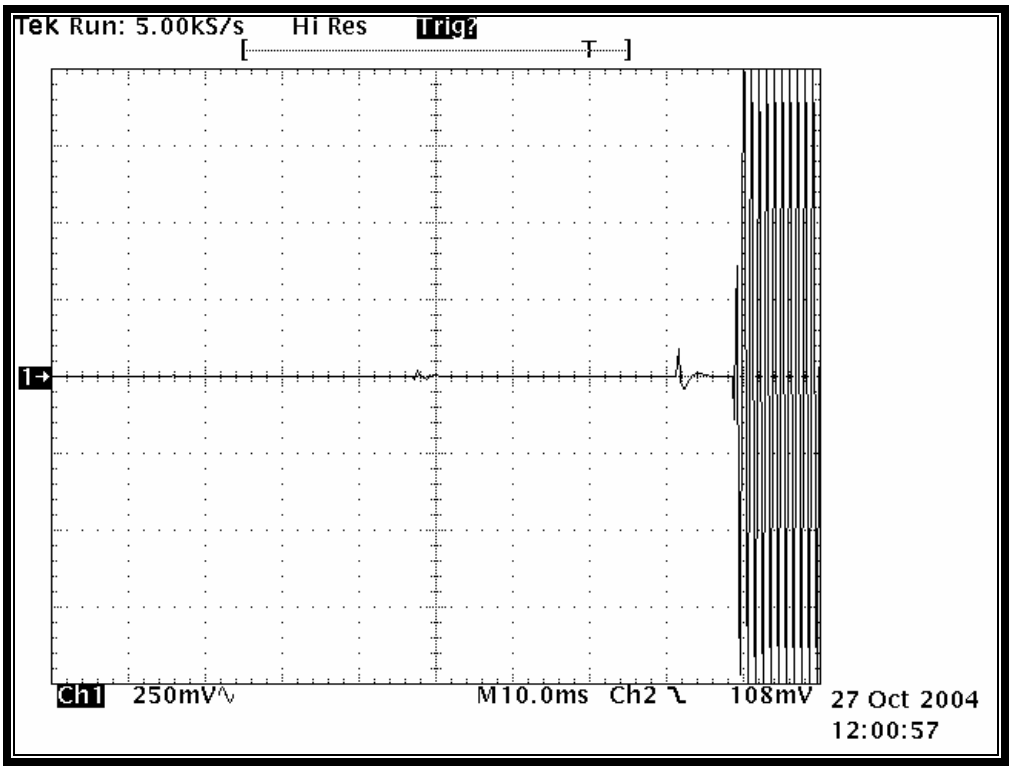
Carrier ON time:
Power: 5.4 W rated
Channel 2: 150 MHz NB (12.5 kHz)
RF Signal Generator: Modulation 12.5 kHz deviation

Timebase: 10 ms/div
Trigger: On positive edge of Ch 2, level -83mV
Ch 1: 250 mV/div, Probe 1.000:1
Vertical scale: +/- 4 div. corresponds to +/- 12.5 kHz

TEST PERSONNEL:

DANIEL BALTZELL		OCTOBER 27, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

PLOT 13-2: OFF TIME – CHANNEL 2: 150 MHZ; 12.5 KHZ NARROWBAND



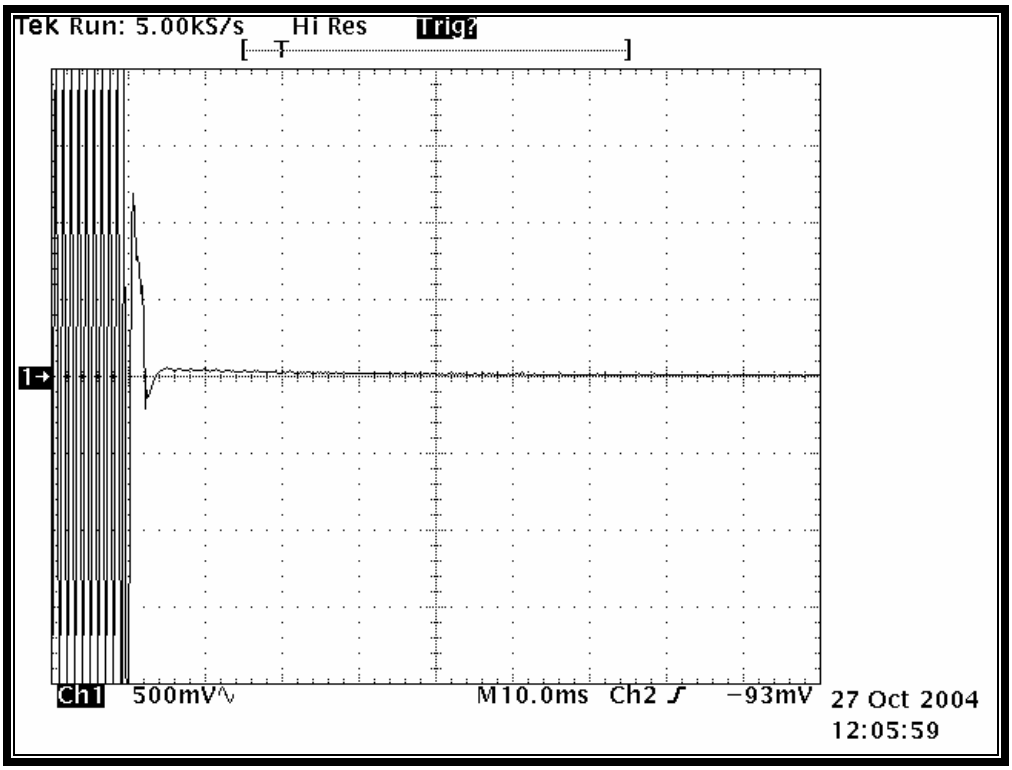
Carrier OFF time:
Power: 5.4 W rated
Channel 2: 150 MHz NB (12.5 kHz)
RF Signal Generator: Modulation 12.5 kHz deviation

Timebase: 10 ms/div
Trigger: On negative edge of Ch 2, level 108 mV
Ch 1: 250mV/div, Probe 1.000:1
Vertical scale: +/- 4 div. corresponds to +/- 12.5 kHz

TEST PERSONNEL:

DANIEL BALTZELL		OCTOBER 27, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

PLOT 13-3: ON TIME – CHANNEL 2: 150 MHZ; 25 KHZ WIDEBAND



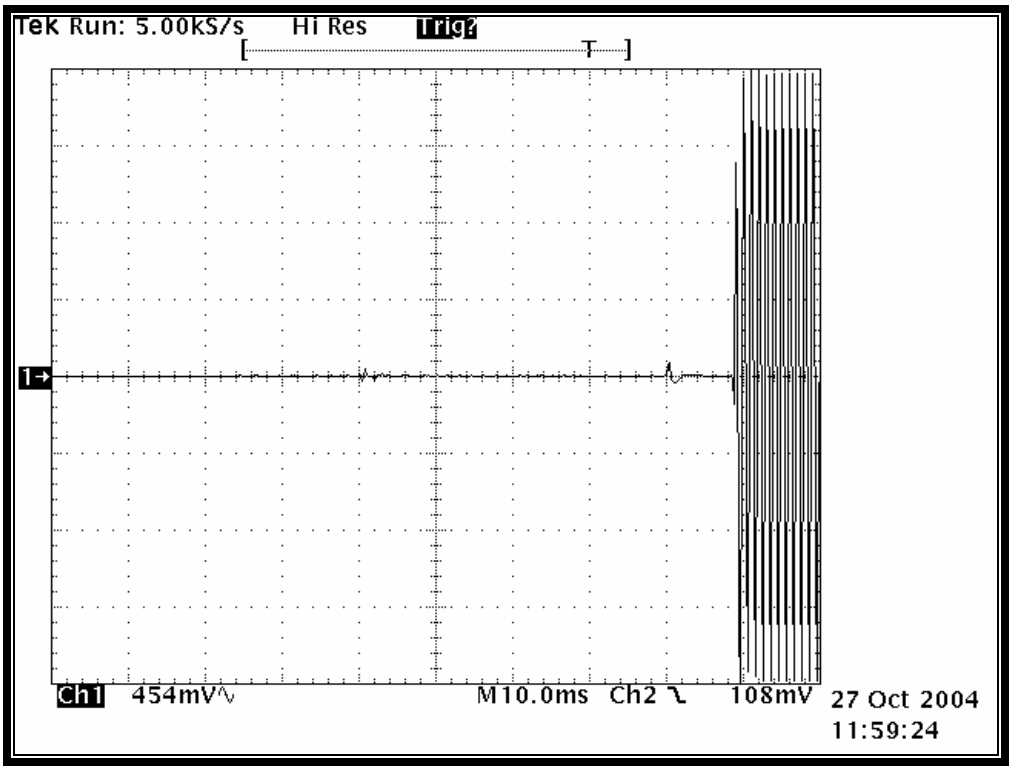
Carrier ON time:
Power: 5.4 W rated
Channel 2: 150 MHz WB (25 kHz)
RF Signal Generator: Modulation 25kHz deviation

Timebase: 10 ms/div
Trigger: On positive edge of Ch2, level -93mV
Ch 1: 500mV/div, Probe 1.000:1
Vertical scale: +/- 4 div. corresponds to +/- 25 kHz

TEST PERSONNEL:

DANIEL BALTZELL		OCTOBER 27, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

PLOT 13-4: OFF TIME – CHANNEL 2: 150 MHZ; 25 KHZ WIDEBAND



Carrier OFF time:
Power: 5.4 W rated
Channel 2: 150 MHz WB (25 kHz)
RF Signal Generator: Modulation 25 kHz deviation

Timebase: 10 ms/div
Trigger: On pnegative edge of Ch 2, level 108mV
Ch 1: 454mV/div, Probe 1.000:1
Vertical scale: +/- 4 div. corresponds to +/- 25 kHz

TEST PERSONNEL:

DANIEL BALTZELL		OCTOBER 27, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

14 FCC PART 2.202: NECESSARY BANDWIDTH AND EMISSION BANDWIDTH

Type of Emission: F3E, F1D, and F1E

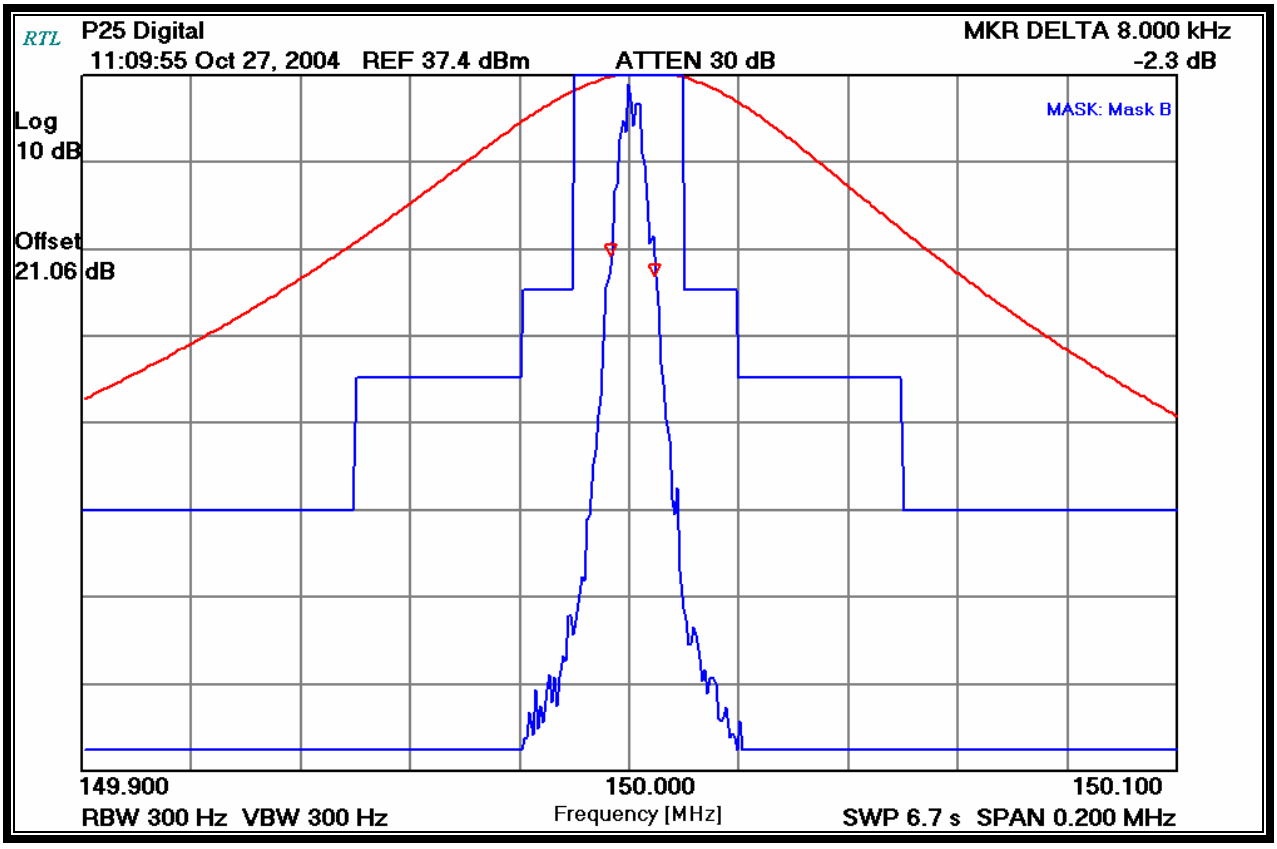
Necessary Bandwidth and Emission Bandwidth calculation:

The 12.5 kHz Analog modulation necessary bandwidth: Bn = 11K0F3E
The 25 kHz Analog modulation necessary bandwidth: Bn = 16K0F3E
The measured digital modulation necessary bandwidth: Bn = 8K00F1D, 8K00F1E

Calculation:

Max modulation (M) in kHz: 3
Max deviation (D) in kHz for (25 KHz channel spacing analog): 5
Max deviation for (D) in kHz for (12.5 KHz channel spacing): 2.5
Constant factor (K): 1
$B_{n(12.5KHz\ analog\ )}$ = 2xM+2xDK = (2x3) + (2x2.5x1) = 11 kHz
$B_{n(25KHz\ analog)}$ = 2xM+2xDK = (2x3) + (2x5x1) = 16 kHz
$B_{n(\ P25\ Digital)}$ = 8.0 kHz

PLOT 14-1: P25 DIGITAL



15 CONCLUSION

The data in this measurement report shows that E.F. Johnson Company Model 242-51xx, FCC ID: ATH2425111, complies with all the requirements of Parts 2 and 90 of the FCC Rules and Industry Canada RSS-119.