



Engineering and Testing for EMC and Safety Compliance

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

Test Lab: Rhein Tech Laboratories, Inc. Phone: 703-689-0368 360 Herndon Parkway Fax: 703-689-2056 Suite 1400 Web Site: www.rheintech.com Herndon, VA 20170 Contact: ATCBINFO@rheintech.com		Applicant: E F Johnson Phone: 507-835-6276 299 Johnson Ave. Fax: 507-835-6666 P.O. Box 1249 Email: Joblak@efjohnson.com Waseca, MN 56093-0514 Contact: John Oblak	
FCC ID:	ATH2424110	FRN NUMBER:	0005-8136-88
MODEL:	242-41xx	RTL WORK ORDER NUMBER:	2004210
EQUIPMENT TYPE:	PTT VHF	RTL QUOTE NUMBER:	QRTL04-377
DATE OF TEST REPORT:	December 14, 2004		
FCC Classification:	<input checked="" type="checkbox"/> 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 960 MHz		
Frequency Range (MHz)	Output Power (W)	Frequency Tolerance (ppm)	Emission Designator
136 to 174	5.72	3.7	11K0F3E
136 to 174	5.72	3.7	16K0F3E
136 to 174	5.72	3.7	8K10F1D
136 to 174	5.72	3.7	8K10F1E

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.

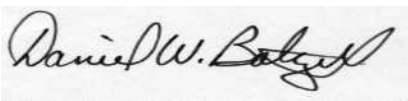
Furthermore, there was no deviation from, additions to or exclusions from the FCC Part 2, FCC Part 90, Industry Canada RSS-119, ANSI/TIA/EIA 603 and ANSI/TIA/EIA 603-1.

Signature: 

Date: December 13, 2004

Typed/Printed Name: Desmond A. Fraser

Position: President

Signature: 

Date: December 13, 2004

Typed/Printed Name: Daniel Baltzell

Position: Test Engineer

TABLE OF CONTENTS

1	GENERAL INFORMATION	5
1.1	SCOPE	5
1.2	TEST FACILITY	5
1.3	RELATED SUBMITTAL(S)/GRANT(S)	5
2	EQUIPMENT INFORMATION.....	6
2.1	TEST SYSTEM DETAILS	6
2.2	WORST CASE CONFIGURATION OF TESTED SYSTEM	7
3	DC VOLTAGES AND CURRENTS FCC PART 2.1033(C)(8)	8
4	RF POWER OUTPUT - §2.1046, RSS-119 §6.2.....	9
4.1	ANSI/TIA/EIA-603-2002, SECTION 2.2.1 TEST PROCEDURE	9
4.2	RF POWER OUTPUT TEST EQUIPMENT	9
4.3	RF POWER OUTPUT TEST DATA	10
5	MODULATION CHARACTERISTICS - §2.1047 TEST PROCEDURE, RSS-119 §6.6	11
5.1	MODULATION CHARACTERISTICS TEST EQUIPMENT	11
6	MODULATION CHARACTERISTICS - AUDIO FREQUENCY RESPONSE FCC PART 2 §2.1047 (A).....	12
6.1	TEST PROCEDURE	12
6.2	TEST DATA	12
7	MODULATION CHARACTERISTICS - AUDIO LOW PASS FILTER RESPONSE FCC PART 2 §2.1047 (A)...	13
7.1	TEST PROCEDURE	13
7.2	TEST DATA	13
8	MODULATION CHARACTERISTICS - MODULATION LIMITING FCC PART 2 §2.1047 (B).....	14
8.1	TEST PROCEDURE	14
8.2	TEST DATA	14
9	OCCUPIED BANDWIDTH - §2.1049, RSS-119 §6.4.....	18
9.1	OCCUPIED BANDWIDTH - §2.1049 TEST PROCEDURE	18
9.2	OCCUPIED BANDWIDTH TEST EQUIPMENT	18
9.3	OCCUPIED BANDWIDTH TEST DATA	19
10	SPURIOUS EMISSIONS AT ANTENNA TERMINAL - §2.1051, RSS-119 §6.3	22
10.1	SPURIOUS EMISSIONS AT ANTENNA TERMINAL - §2.1051 TEST PROCEDURE	22
10.2	SPURIOUS EMISSIONS AT ANTENNA TERMINAL TEST EQUIPMENT	22
10.3	CONDUCTED SPURIOUS EMISSIONS TEST DATA	23
11	RADIATED SPURIOUS AND HARMONIC EMISSIONS - §2.1053, RSS-119 §6.3	26
11.1	RADIATED SPURIOUS AND HARMONIC EMISSIONS - §2.1053	26
11.2	RADIATED SPURIOUS TEST EQUIPMENT	26
11.3	RADIATED SPURIOUS EMISSIONS TEST DATA - §2.1053	27
12	FREQUENCY STABILITY - §2.1055, RSS-119 §7	28
12.1	MEASUREMENT METHOD:	28
12.2	TIME PERIOD AND PROCEDURE:	28
12.3	FREQUENCY TOLERANCE:	28
12.4	FREQUENCY STABILITY TEST EQUIPMENT	28
12.5	FREQUENCY STABILITY TEST DATA - §2.1055	29
13	TRANSIENT FREQUENCY BEHAVIOR FCC PART 90 §90.214, RSS-119 §6.5.....	32
13.1	TRANSIENT FREQUENCY BEHAVIOR TEST PROCEDURE	32
13.2	TRANSIENT FREQUENCY BEHAVIOR LIMITS	32
13.3	TRANSIENT FREQUENCY BEHAVIOR TEST DATA	34
14	NECESSARY BANDWIDTH AND EMISSION BANDWIDTH FCC PART 2.202	38
15	CONCLUSION.....	39

FIGURE INDEX

FIGURE 2-1:	WORST CASE CONFIGURATION OF SYSTEM UNDER TEST	7
FIGURE 4-1:	ILLUSTRATION OF HOW THE EQUIPMENT IS CONNECTED	9

TABLE INDEX

TABLE 2-1:	EQUIPMENT UNDER TEST (EUT)	6
TABLE 2-2:	EXTERNAL COMPONENTS IN TEST CONFIGURATION	6
TABLE 4-1:	RF POWER OUTPUT TEST EQUIPMENT	9
TABLE 4-2:	RF POWER OUTPUT TEST DATA	10
TABLE 5-1:	MODULATION CHARACTERISTICS TEST EQUIPMENT	11
TABLE 9-1:	OCCUPIED BANDWIDTH TEST EQUIPMENT	18
TABLE 10-1:	SPURIOUS EMISSIONS AT ANTENNA TERMINAL TEST EQUIPMENT	22
TABLE 10-2:	CONDUCTED SPURIOUS EMISSIONS (CHANNEL 4 AT 136 MHZ)	23
TABLE 10-3:	CONDUCTED SPURIOUS EMISSIONS (CHANNEL 5 AT 154 MHZ)	24
TABLE 10-4:	CONDUCTED SPURIOUS EMISSIONS (CHANNEL 6 AT 174 MHZ)	25
TABLE 11-1:	RADIATED SPURIOUS TEST EQUIPMENT	26
TABLE 11-2:	RADIATED SPURIOUS EMISSIONS DATA §2.1053	27
TABLE 12-1:	FREQUENCY STABILITY TEST EQUIPMENT	28
TABLE 12-2:	FREQUENCY STABILITY DATA - §2.1055: TEMPERATURE	29
TABLE 12-3:	FREQUENCY STABILITY DATA - §2.1055: VOLTAGE	31
TABLE 13-1:	REQUIREMENTS FOR EUT WITH 25 KHZ CHANNEL SPACING	32
TABLE 13-2:	REQUIREMENTS FOR EUT WITH 12.5 KHZ CHANNEL SPACING	32
TABLE 13-3:	TRANSIENT FREQUENCY BEHAVIOR TEST EQUIPMENT	33
TABLE 15-1:	CONDUCTED TEST DATA NEUTRAL SIDE LINE 1, RX MODE	69
TABLE 15-2:	CONDUCTED TEST DATA HOT SIDE LINE 2, RX MODE	69
TABLE 15-3:	RADIATED TEST DATA MODE: RX/DIGITAL – LIMIT DISTANCE FCC/3M	70

PLOT INDEX

PLOT 6-1:	AUDIO FREQUENCY RESPONSE	12
PLOT 7-1:	AUDIO LOW PASS FILTER RESPONSE	13
PLOT 8-1:	MODULATION LIMITING RESPONSE (POSITIVE PEAK), CHANNEL 5, 154 MHZ,	14
PLOT 8-2:	MODULATION LIMITING RESPONSE (NEGATIVE PEAK), CHANNEL 5, 154 MHZ, NARROWBAND ...	15
PLOT 8-3:	MODULATION LIMITING RESPONSE (POSITIVE PEAK), CHANNEL 2, 154 MHZ, WIDEBAND	16
PLOT 8-4:	MODULATION LIMITING RESPONSE (NEGATIVE PEAK), CHANNEL 2, 154 MHZ, WIDEBAND	17
PLOT 9-1:	MASK D (154 MHZ; CH 8; P25 DIGITAL)	19
PLOT 9-2:	MASK D (154 MHZ; CH. 5; NARROWBAND)	20
PLOT 9-3:	MASK B (154 MHZ; CH. 2; WIDEBAND)	21
PLOT 12-1:	TEMPERATURE FREQUENCY STABILITY - §2.1055	30
PLOT 12-2:	VOLTAGE FREQUENCY STABILITY - §2.1055	31
PLOT 13-1:	ON TIME – CHANNEL 5: 154 MHZ; 12.5 KHZ NARROWBAND	34
PLOT 13-2:	OFF TIME – CHANNEL 5: 154 MHZ; 12.5 KHZ NARROWBAND	35
PLOT 13-3:	ON TIME – CHANNEL 2: 154 MHZ; 25 KHZ WIDEBAND	36
PLOT 13-4:	OFF TIME – CHANNEL 2: 154 MHZ; 25 KHZ WIDEBAND	37

APPENDIX INDEX

APPENDIX A:	RF EXPOSURE.....	40
APPENDIX B:	AGENCY AUTHORIZATION LETTER	41
APPENDIX C:	CONFIDENTIALITY REQUEST LETTER.....	42
APPENDIX D:	ATTESTATION LETTER.....	43
APPENDIX E:	LABEL AND LABEL LOCATION	44
APPENDIX F:	OPERATIONAL DESCRIPTION.....	46
APPENDIX G:	BILL OF MATERIAL (PARTS LIST)	47
APPENDIX H:	SCHEMATICS.....	48
APPENDIX I:	BLOCK DIAGRAMS	49
APPENDIX J:	USER'S MANUAL	50
APPENDIX K:	TEST PHOTOGRAPHS	51
APPENDIX L:	EXTERNAL PHOTOGRAPHS	55
APPENDIX M:	INTERNAL PHOTOGRAPHS.....	60
APPENDIX N:	ADDITIONAL INFORMATION FOR CANADIAN CERTIFICATION.....	69

PHOTOGRAPH INDEX

PHOTOGRAPH 1:	FCC ID / IC ID LABEL AND LOCATION	44
PHOTOGRAPH 2:	RF LABEL AND LOCATION	45
PHOTOGRAPH 3:	RADIATED EMISSIONS FRONT VIEW.....	51
PHOTOGRAPH 4:	RADIATED EMISSIONS BACK VIEW	52
PHOTOGRAPH 5:	CONDUCTED EMISSIONS FRONT VIEW	53
PHOTOGRAPH 6:	CONDUCTED EMISSIONS BACK VIEW.....	54
PHOTOGRAPH 7:	RADIO FRONT	55
PHOTOGRAPH 8:	RADIO BACK.....	56
PHOTOGRAPH 9:	RADIO ACCESSORY CONNECTOR SIDE	57
PHOTOGRAPH 10:	RADIO TOP	58
PHOTOGRAPH 11:	RADIO PTT SIDE.....	59
PHOTOGRAPH 12:	CHASSIS WITH SHIELDS.....	60
PHOTOGRAPH 13:	CHASSIS WITH SHIELDS REMOVED.....	61
PHOTOGRAPH 14:	POWER SUPPLY BOARD TOP	62
PHOTOGRAPH 15:	POWER SUPPLY BOARD BOTTOM.....	63
PHOTOGRAPH 16:	RF BOARD BOTTOM	64
PHOTOGRAPH 17:	RF BOARD TOP	65
PHOTOGRAPH 18:	DIGITAL BOARD IN FRONT COVER.....	66
PHOTOGRAPH 19:	FRONT COVER WITH DIGITAL BOARD AND CONTROL ASSEMBLY	67
PHOTOGRAPH 20:	FRONT COVER WITH DIGITAL BOARD REMOVED	68

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/EIA 603-2002 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.

2 EQUIPMENT INFORMATION

2.1 TEST SYSTEM DETAILS

The test sample was received on November 12, 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	242-4112-410-BA2	41120A394A10103	ATH2424110	N/A	16298
Battery	EF Johnson	N/A	N/A	N/A	N/A	16316
Battery	EF Johnson	N/A	N/A	N/A	N/A	16386
Helical Antenna	EF Johnson	136-174 MHz 501-0017-100	N/A	N/A	N/A	16173
Helical Antenna	EF Johnson	136-151 MHz 501-0017-101	N/A	N/A	N/A	16174
Helical Antenna	EF Johnson	151-166 MHz 501-0017-103	N/A	N/A	N/A	16175
Helical Antenna	EF Johnson	166-174 MHz 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	EF Johnson	N/A	N/A	N/A	N/A	16300
AC Adapter	Ault Inc.	T48240833A300G	0209	N/A	1.6m Unshielded Power	16301

2.2 WORST CASE CONFIGURATION OF TESTED SYSTEM

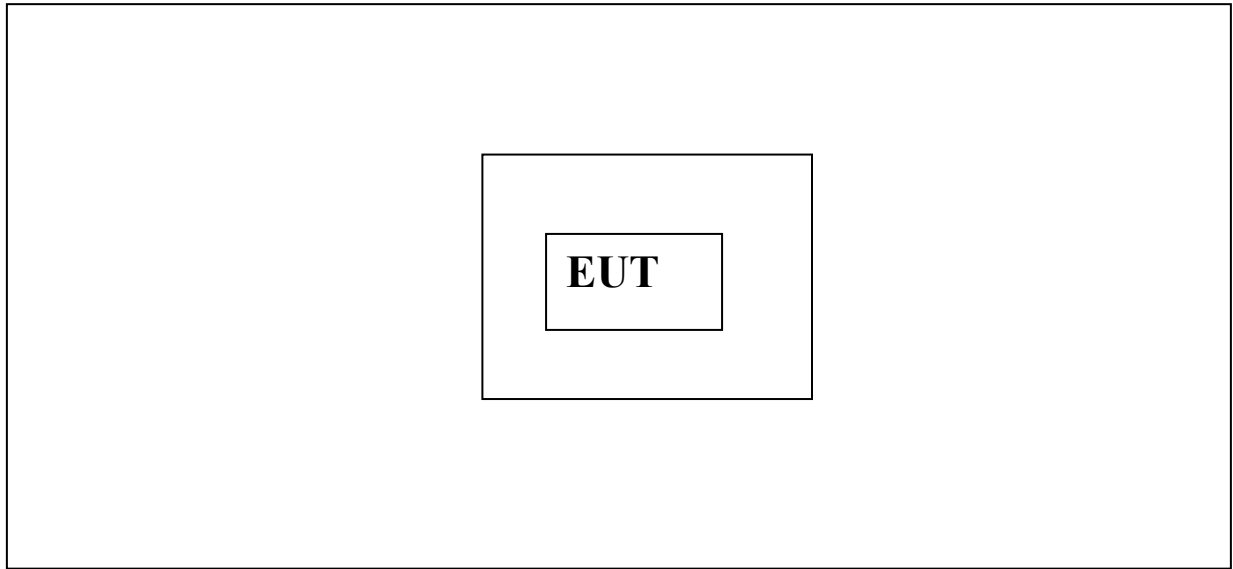


FIGURE 2-1: WORST CASE CONFIGURATION OF SYSTEM UNDER TEST

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

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 1.85 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.

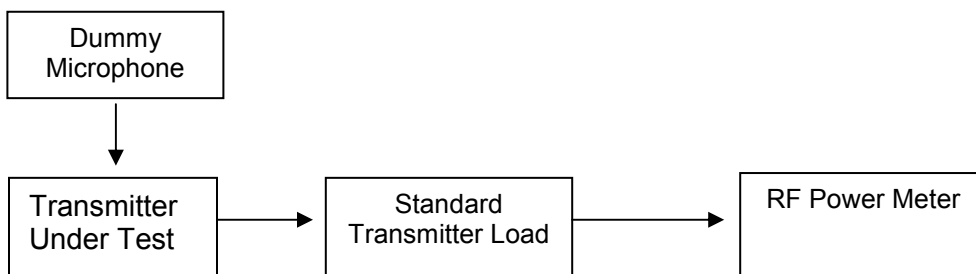


FIGURE 4-1: ILLUSTRATION OF HOW THE EQUIPMENT IS CONNECTED

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

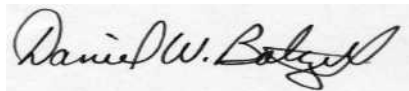
4.3 RF POWER OUTPUT TEST DATA

TABLE 4-2: RF POWER OUTPUT TEST DATA

Frequency (MHz)	Channel	Peak Conducted Power (dBm)	Peak Conducted Power (W)
136	1	37.57	5.715
154	2	37.55	5.689
174	3	36.89	4.887
136	4	37.57	5.715
154	5	37.54	5.675
174	6	36.89	4.887
136	7	37.56	5.702
154	8	37.54	5.675
174	9	36.88	4.875

TEST PERSONNEL:

DANIEL BALTZELL



December 1, 2004
 DATE OF TEST

TEST ENGINEER

SIGNATURE

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 154 kHz – 1300 MHz	2406A00178	7/7/05
901054	Hewlett Packard	HP 3586B	Selective Level Meter	1928A01892	9/8/05
901057	Hewlett Packard	3336B	Synthesizer/Level Generator	2514A02585	9/8/05

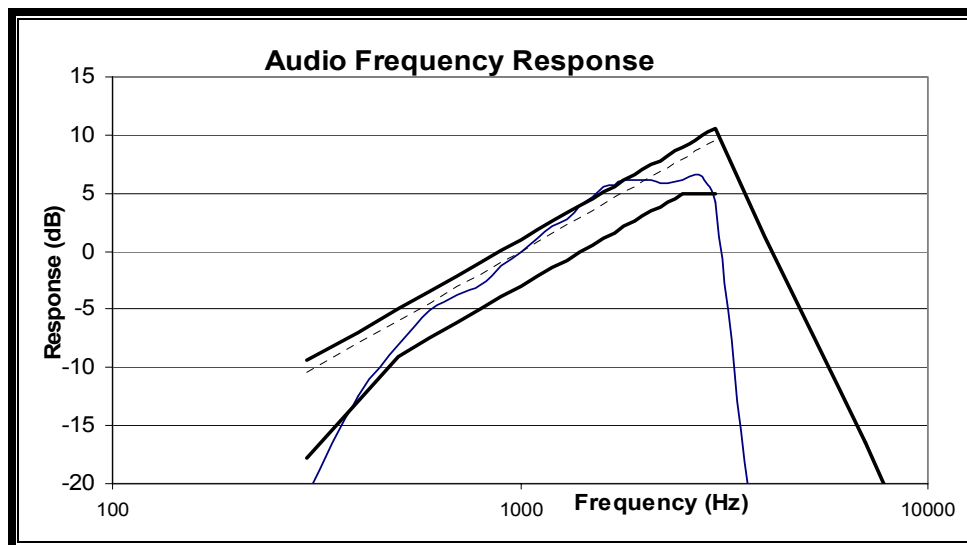
6 MODULATION CHARACTERISTICS - AUDIO FREQUENCY RESPONSE FCC PART 2 §2.1047 (A)

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 100 Hz to 5 kHz 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 = $20 \text{ LOG } (\text{DEVfreq}/\text{DEVref})$

6.2 TEST DATA

PLOT 6-1: AUDIO FREQUENCY RESPONSE



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

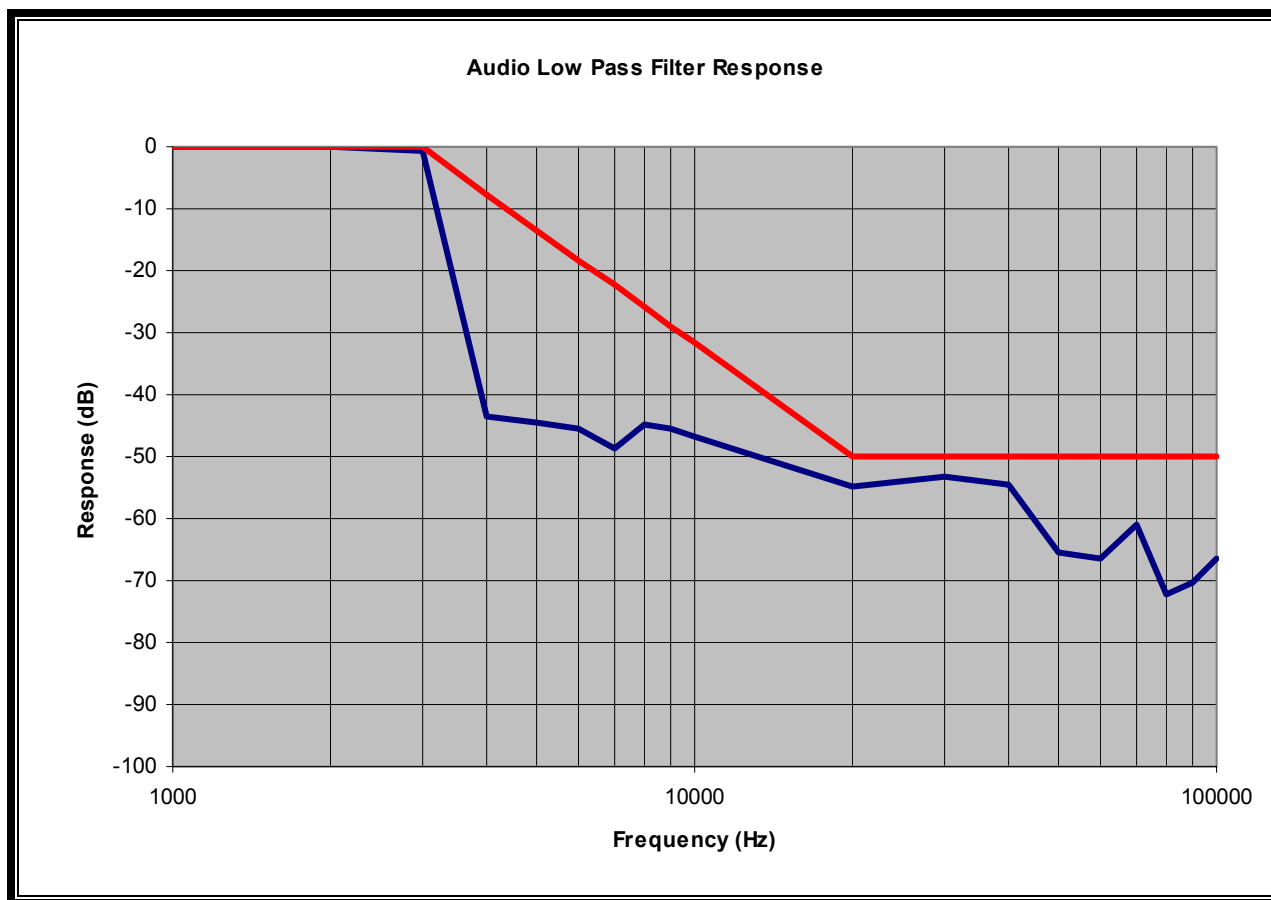
7.1 TEST PROCEDURE

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
TEST ENGINEER

SIGNATURE

NOVEMBER 12, 2004
DATE OF TEST

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

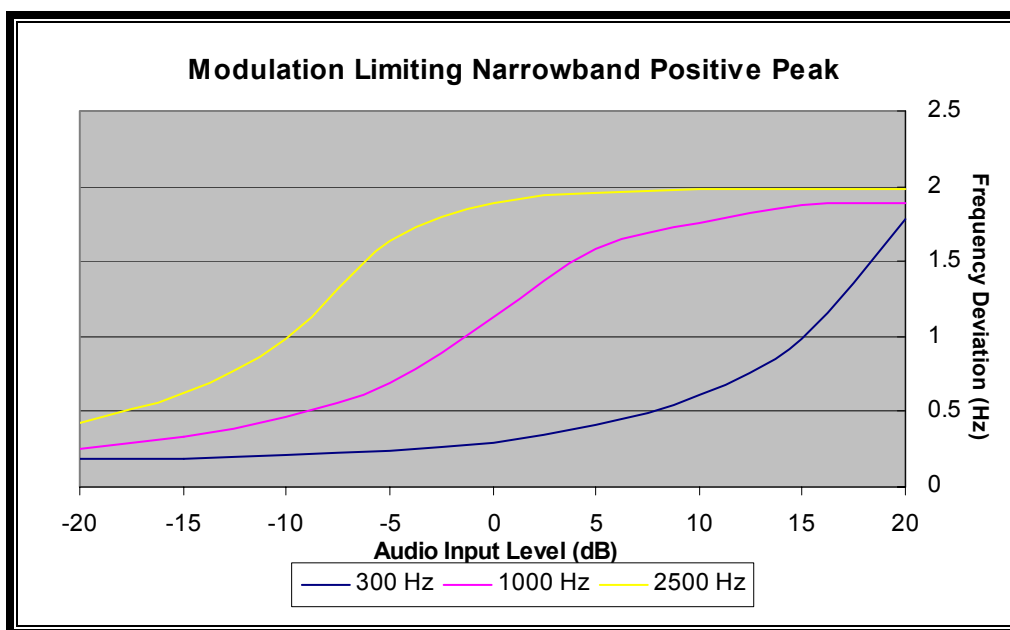
8.1 TEST PROCEDURE

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 5, 154 MHZ, NARROWBAND



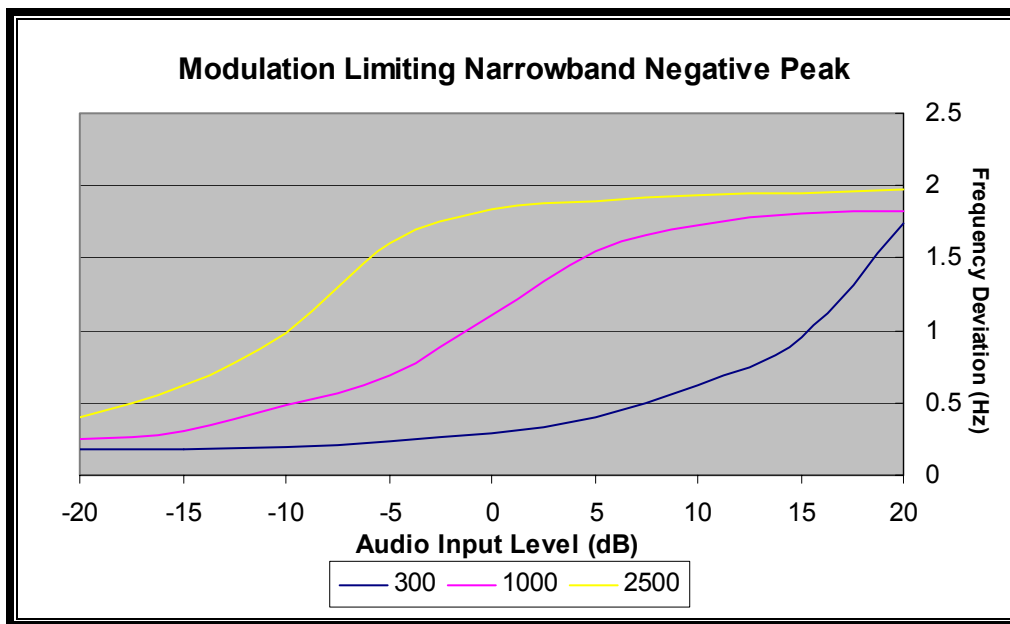
TEST PERSONNEL:

DANIEL BALTZELL
TEST ENGINEER

SIGNATURE

NOVEMBER 12, 2004
DATE OF TEST

PLOT 8-2: MODULATION LIMITING RESPONSE (NEGATIVE PEAK), CHANNEL 5, 154 MHZ, NARROWBAND



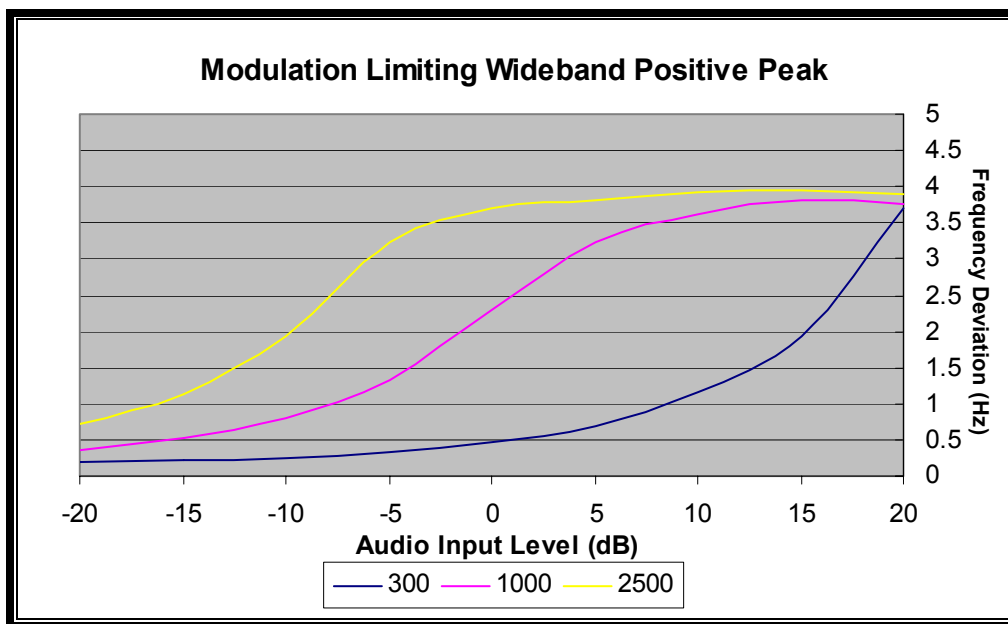
TEST PERSONNEL:

DANIEL BALTZELL
TEST ENGINEER

SIGNATURE

NOVEMBER 12, 2004
DATE OF TEST

PLOT 8-3: MODULATION LIMITING RESPONSE (POSITIVE PEAK), CHANNEL 2, 154 MHZ, WIDEBAND



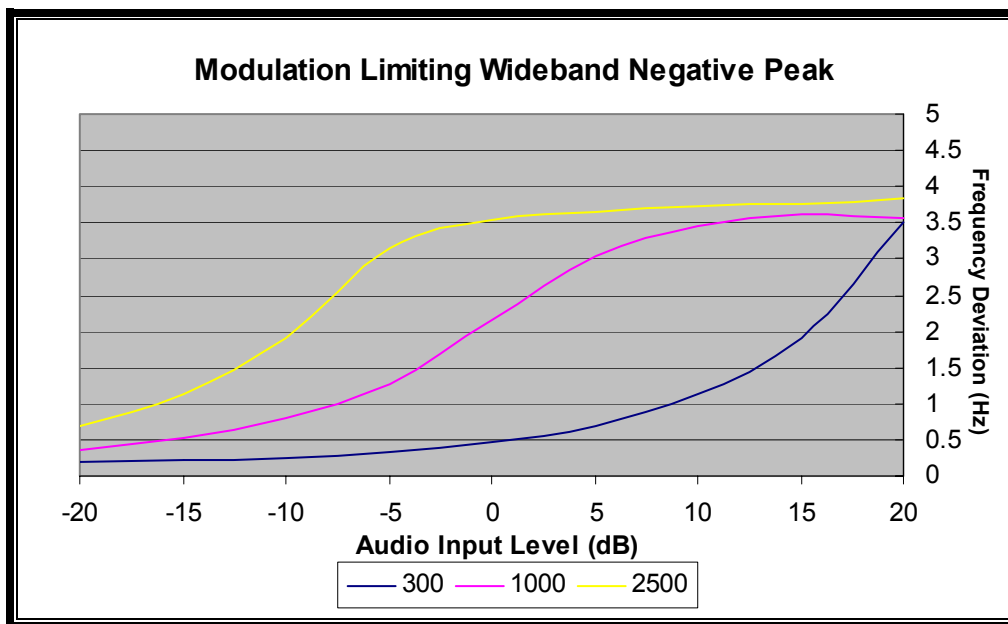
TEST PERSONNEL:

DANIEL BALTZELL
TEST ENGINEER

SIGNATURE

NOVEMBER 12, 2004
DATE OF TEST

PLOT 8-4: MODULATION LIMITING RESPONSE (NEGATIVE PEAK), CHANNEL 2, 154 MHZ, WIDEBAND



TEST PERSONNEL:

DANIEL BALTZELL
TEST ENGINEER

SIGNATURE

NOVEMBER 12, 2004
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 50 ohm 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 per-cent 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 $7.27(f_d - 2.88 \text{ kHz})$ 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.

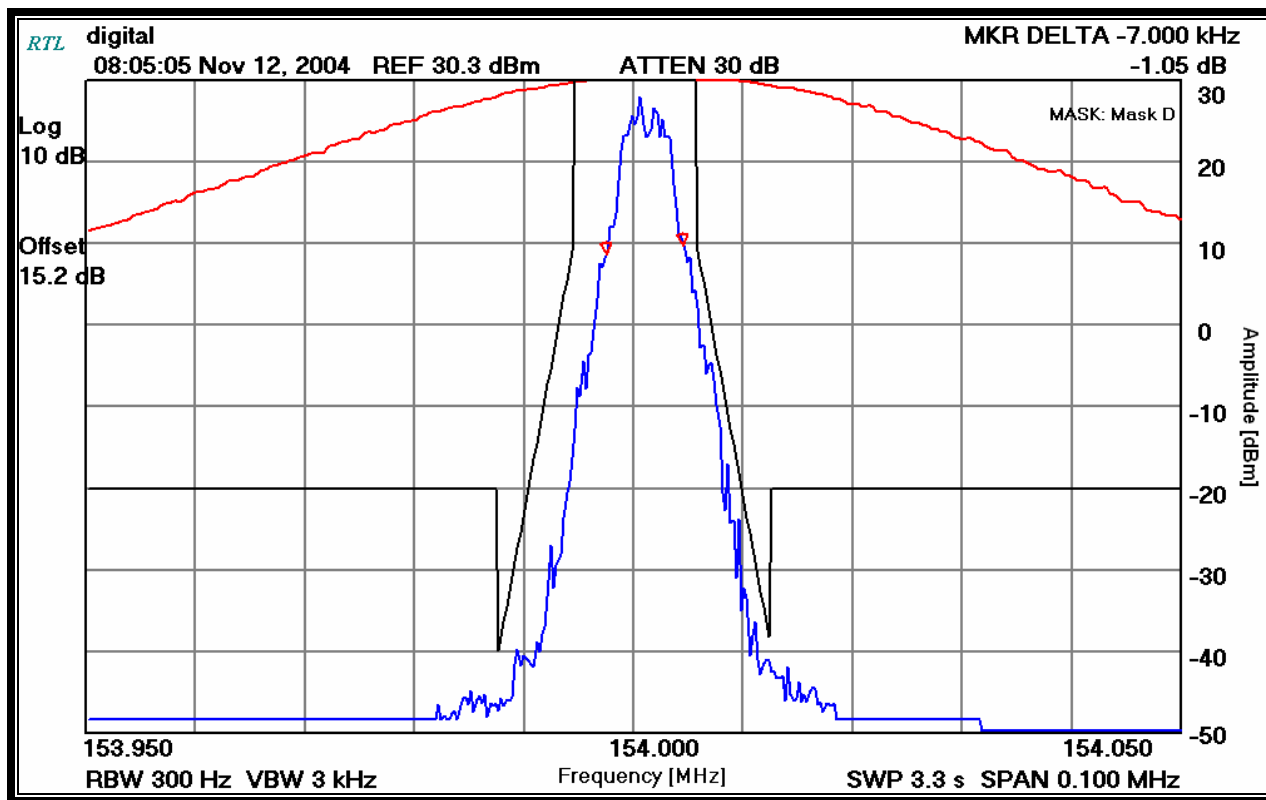
9.2 OCCUPIED BANDWIDTH TEST EQUIPMENT

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 10dB	BK5859	5/13/05
901057	Hewlett Packard	3336B	Synthesizer/Level Generator		9/08/05

9.3 OCCUPIED BANDWIDTH TEST DATA

PLOT 9-1: MASK D (154 MHz; CH 8; P25 DIGITAL)



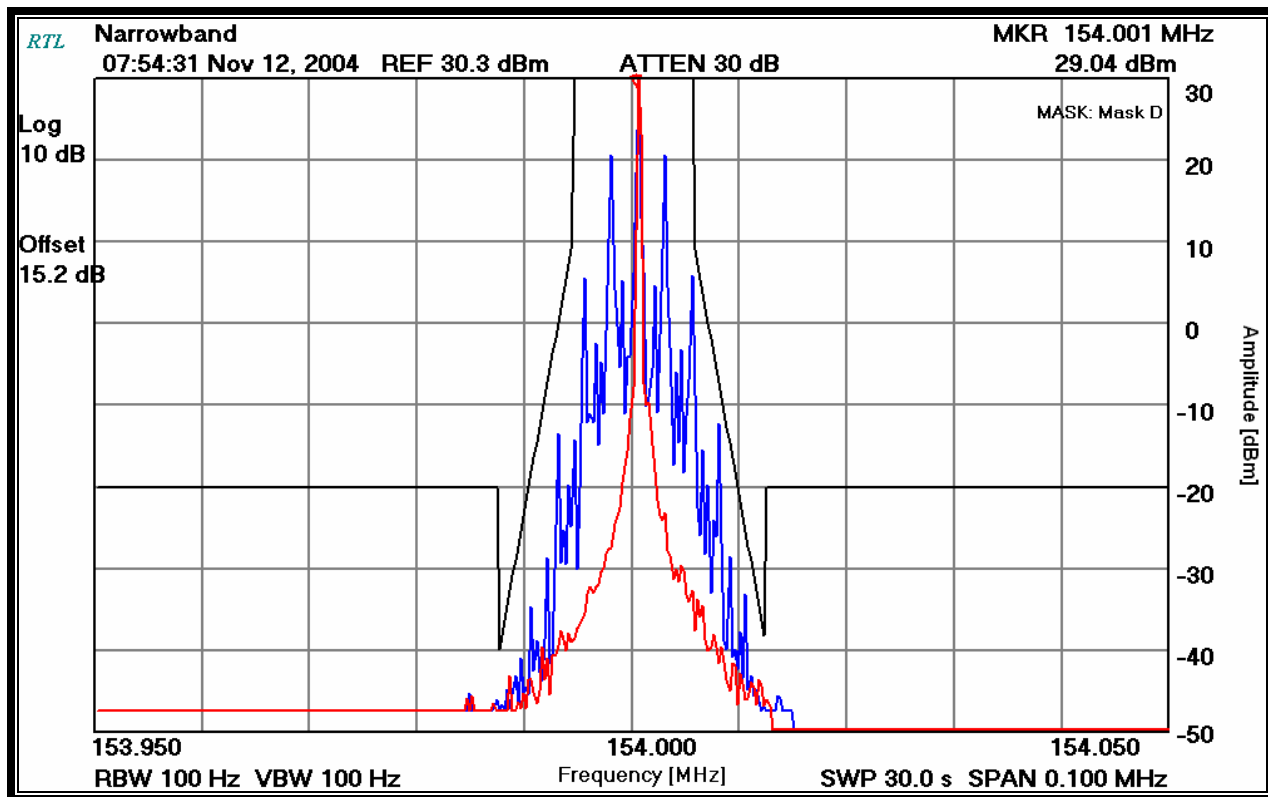
TEST PERSONNEL:

DANIEL BALTZELL
TEST ENGINEER

SIGNATURE

NOVEMBER 12, 2004
DATE OF TEST

PLOT 9-2: MASK D (154 MHZ; CH. 5; NARROWBAND)



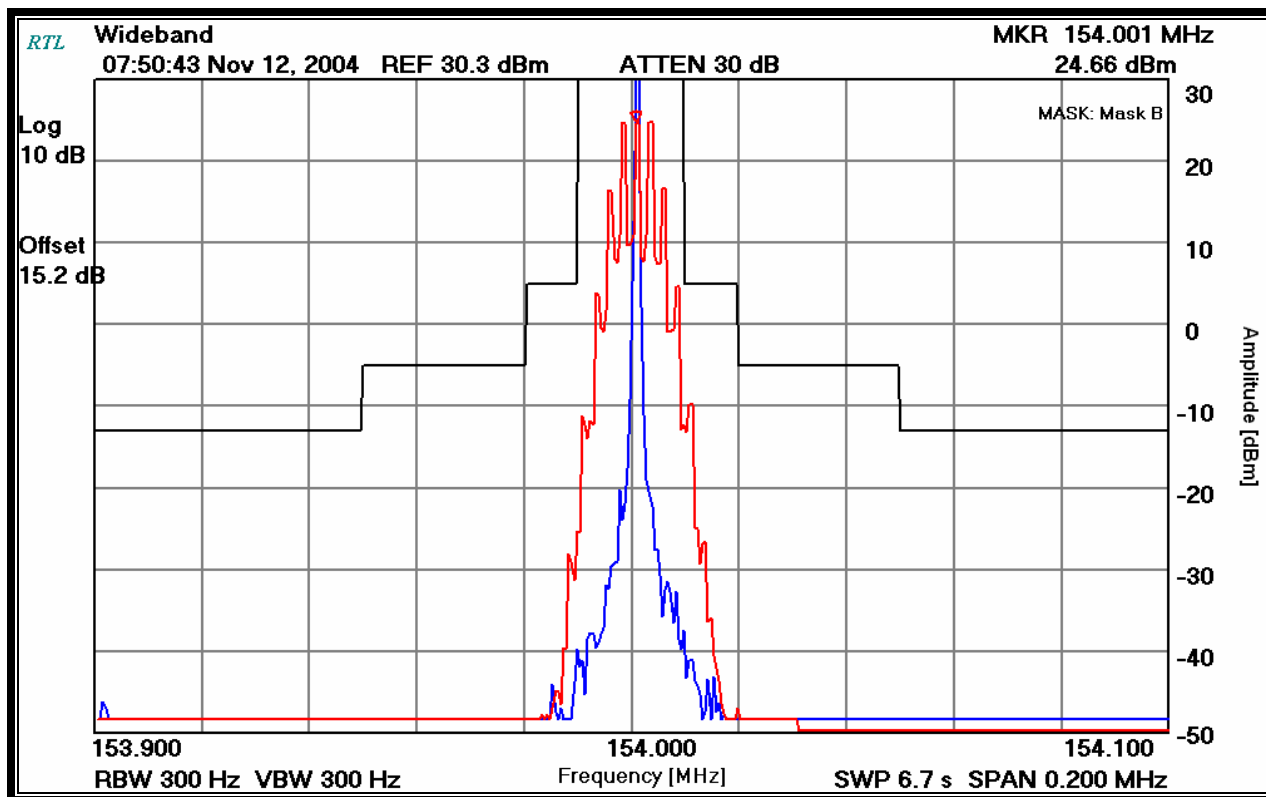
TEST PERSONNEL:

DANIEL BALTZELL
TEST ENGINEER

SIGNATURE

NOVEMBER 12, 2004
DATE OF TEST

PLOT 9-3: MASK B (154 MHZ; CH. 2; WIDEBAND)



TEST PERSONNEL:

DANIEL BALTZELL
TEST ENGINEER

SIGNATURE

NOVEMBER 12, 2004
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
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 4 AT 136 MHZ)

Operating Frequency (MHz): 136
 Channel: 4
 Measured Conducted Power (dBm): 37.5
 Modulation: Analog
 Limit (dBc): 57.5 (50+10LogP)

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Notch Filter Insertion Loss (dB)	Corrected Spectrum Analyzer Level (dBc)	Margin (dB)
272.0	-66.7	-0.5	103.7	-46.2
408.0	-90.4	-0.3	127.6	-70.1
544.0	-96.4	-0.3	133.6	-76.1
680.0	-98.5	-0.4	135.6	-78.1
816.0	-100.7	-0.8	137.4	-79.9
952.0	-98.6	-1.9	134.2	-76.7
1088.0	-99.1	-1.3	135.3	-77.8
1224.0	-98.0	-3.1	132.4	-74.9
1360.0	-98.0	-22.1	113.4	-55.9

TEST PERSONNEL:

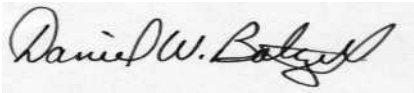
DANIEL BALTZELL TEST ENGINEER	 SIGNATURE	NOVEMBER 17, 2004 DATE OF TEST
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TABLE 10-3: CONDUCTED SPURIOUS EMISSIONS (CHANNEL 5 AT 154 MHZ)

Operating Frequency (MHz): 154
 Channel: 5
 Measured Conducted Power (dBm): 37.5
 Modulation: Analog
 Limit (dBc): 57.5 (50+10LogP)

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Notch Filter Insertion Loss (dB)	Corrected Spectrum Analyzer Level (dBc)	Margin (dB)
308.0	-75.3	-0.3	112.5	-55.0
462.0	-99.1	-0.4	136.2	-78.7
616.0	-95.8	-0.2	133.1	-75.6
770.0	-97.7	-0.8	134.4	-76.9
924.0	-99.5	-11.4	125.6	-68.1
1078.0	-98.2	-1.2	134.5	-77.0
1232.0	-100.2	-3.2	134.5	-77.0
1386.0	-101.6	-17.6	121.5	-64.0
1540.0	-100.9	-6.8	131.6	-74.1

TEST PERSONNEL:

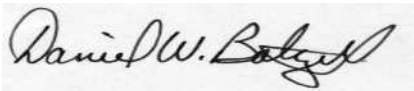
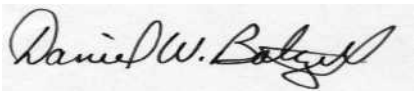
DANIEL BALTZELL TEST ENGINEER	 SIGNATURE	NOVEMBER 17, 2004 DATE OF TEST
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TABLE 10-4: CONDUCTED SPURIOUS EMISSIONS (CHANNEL 6 AT 174 MHZ)

Operating Frequency (MHz): 174
Channel: 6
Measured Conducted Power (dBm): 36.9
Modulation: Analog
Limit (dBc): 56.9 (50+10LogP)

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Notch Filter Insertion Loss (dB)	Corrected Spectrum Analyzer Level (dBc)	Margin (dB)
348.0	-84.1	-0.3	120.7	-63.8
522.0	-97.2	-0.3	133.8	-76.9
696.0	-100.8	-0.4	137.3	-80.4
870.0	-100.1	-1.0	136.0	-79.1
1044.0	-103.5	-1.3	139.1	-82.2
1218.0	-102.1	-3.1	135.9	-79.0
1392.0	-100.6	-15.4	122.1	-65.2
1566.0	-100.0	-7.1	129.8	-72.9
1740.0	-100.4	-6.7	130.6	-73.7

TEST PERSONNEL:

DANIEL BALTZELL TEST ENGINEER	 SIGNATURE	NOVEMBER 17, 2004 DATE OF TEST
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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 (1MHz 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): 154
Channel: 5
Measured Conducted Power (dBm): 37.5
Modulation: Analog narrowband
Distance (m): 3
Limit (dBc): 57.5 (50+10LogP)

TABLE 11-2: RADIATED SPURIOUS EMISSIONS DATA §2.1053

Frequency (MHz)	Signal Generator Level (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Corrected Level (dBc)	Margin (dB)
308.0	-76.3	0.4	-0.6	114.8	-57.3
462.0	-71.5	0.3	-0.5	109.8	-52.3
616.0	-78.0	0.5	-1.1	117.1	-59.6
770.0	-77.6	0.5	-1.2	116.8	-59.3
924.0	-80.5	0.5	-1.1	119.6	-62.1
1078.0	-73.3	0.7	0.6	110.9	-53.4
1232.0	-76.1	0.6	2.1	112.1	-54.6
1386.0	-71.2	0.6	3.6	105.7	-48.2
1540.0	-69.2	0.5	4.7	102.5	-45.0

TEST PERSONNEL:

DANIEL BIGGS TEST ENGINEER	 SIGNATURE	DECEMBER 1, 2004 DATE OF TEST
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12 FREQUENCY STABILITY - §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
901300	Agilent	53131A (225 MHz)	Universal Frequency Counter	MY40001345	11/17/2005
901350	Meterman	33XR	Multimeter	040402802	7/21/2005

12.5 FREQUENCY STABILITY TEST DATA - §2.1055

Operating Frequency: 154 MHz
Channel: 2 Narrowband
Reference Voltage: 7.5 VDC
Deviation Limit: 5 PPM

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

Temperature (°C)	Measured Frequency (MHz)	ppm
-30	153.999809	-1.24
-20	153.999800	-1.30
-10	153.999788	-1.38
0	153.999805	-1.27
10	153.999915	-0.55
20	154.000000	0.00
30	154.000263	1.71
40	154.000529	3.44
50	154.000574	3.73

TEST PERSONNEL:

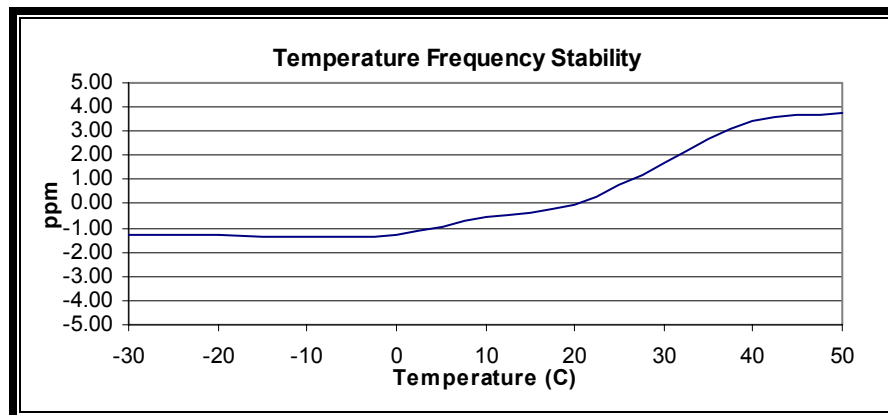
DANIEL BIGGS
TEST ENGINEER



SIGNATURE

DECEMBER 6, 2004
DATE OF TEST

PLOT 12-1: TEMPERATURE FREQUENCY STABILITY - §2.1055



TEST PERSONNEL:

DANIEL BIGGS
TEST ENGINEER

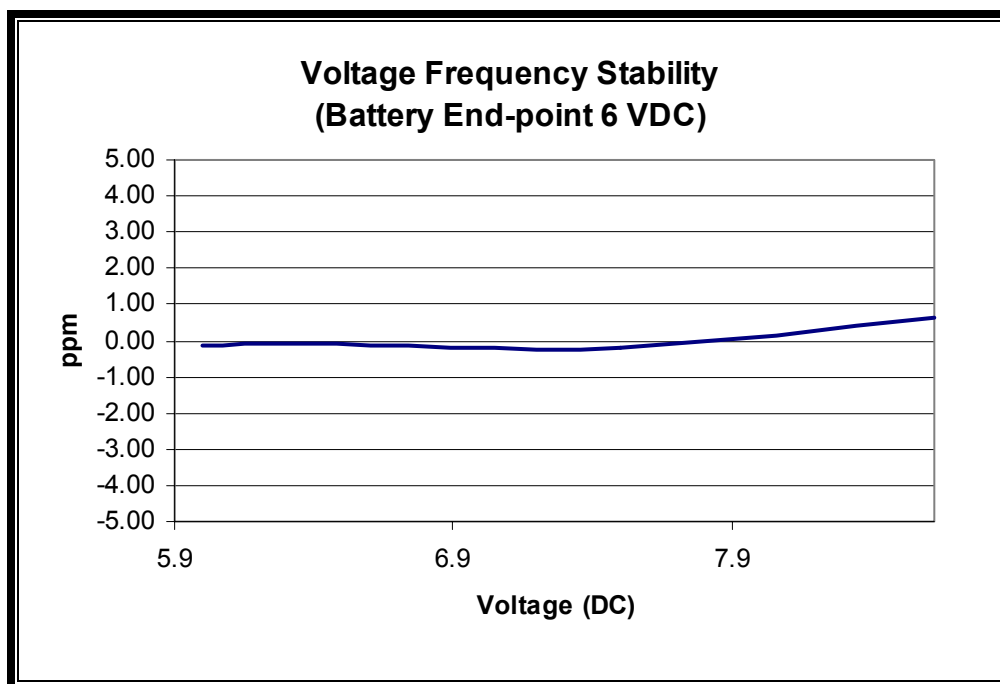
SIGNATURE

DECEMBER 6, 2004
DATE OF TEST

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

Voltage (DC)	Measured Frequency (MHz)	ppm
6.0 (Battery End-point)	153.9999770	-0.15
6.375	153.9999860	-0.09
7.5	153.9999700	-0.19
8.625	154.0000990	0.64

PLOT 12-2: VOLTAGE FREQUENCY STABILITY - §2.1055



TEST PERSONNEL:

DANIEL BALTZELL
TEST ENGINEER

SIGNATURE

DECEMBER 9, 2004
DATE OF TEST

13 TRANSIENT FREQUENCY BEHAVIOR FCC PART 90 §90.214, 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 (***)	154-174 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(***)	154-174 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 5:

The frequency stability is required to be 5 PPM.

Calculation for Channel 5:

4 div. on scope represent 12.5 kHz for narrow band channel.

Therefore, 154 MHz x 5 PPM x +/- 4 Divisions divided by 12.5 kHz = +/- 0.2464 division.

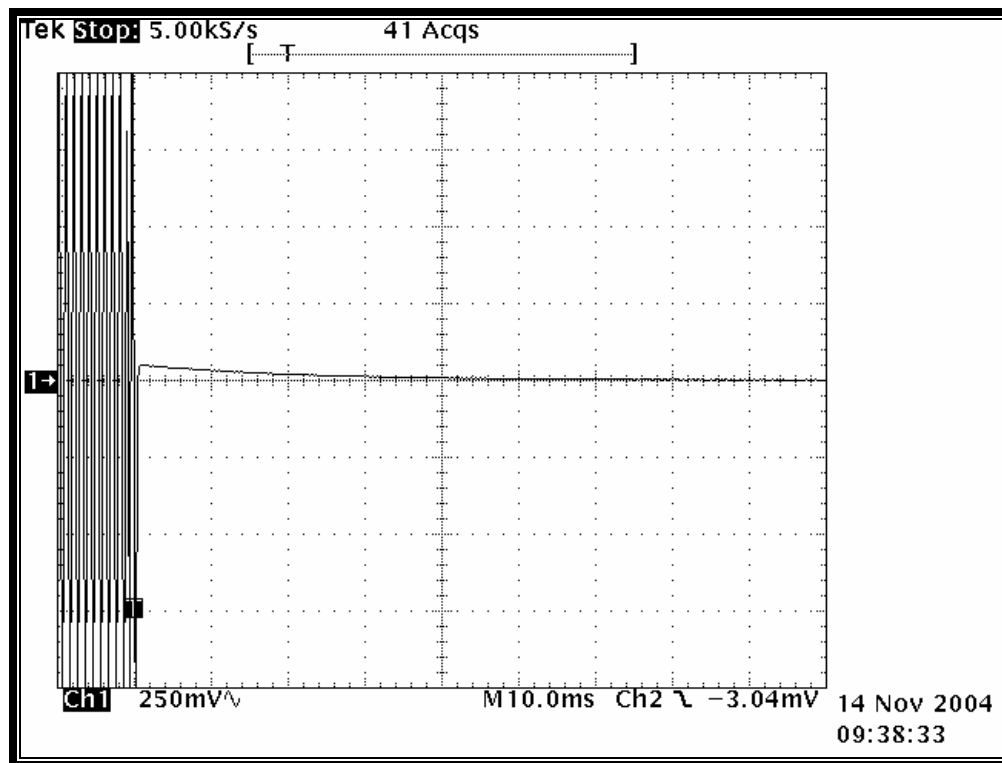
0.2464 Div. corresponds to 770 Hz.

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 (154 kHz – 1300 MHz)	2406A00178	7/7/05
900561	Tektronix	TDS540A	Oscilloscope	B020129	3/25/05
901214	Hewlett Packard	HP8471D	Diode Detector (.0001 - 2 GHz)	2952A-19822	5/13/05
900352	Werlatone	C1795	Directional Coupler, 100 watt, 1 – 1000 MHz	4067	7/1/2005
901138	Weinschel Corp.	48-40-34 DC-18GHz	Attenuator, 100W 40dB	BK5883	5/13/05
901140	Weinschel Corp.	47-10-34 DC-18GHz	Attenuator, 50W 10dB	BK6203	5/13/05

13.3 TRANSIENT FREQUENCY BEHAVIOR TEST DATA

PLOT 13-1: ON TIME – CHANNEL 5: 154 MHZ; 12.5 KHZ NARROWBAND



Carrier ON time:
Power: 1 W rated
Channel 5: 154 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 -3mV
Ch 1: 250 mV/div, Probe 1.000:1
Vertical scale: +/-4 div. corresponds to +/-12.5 kHz

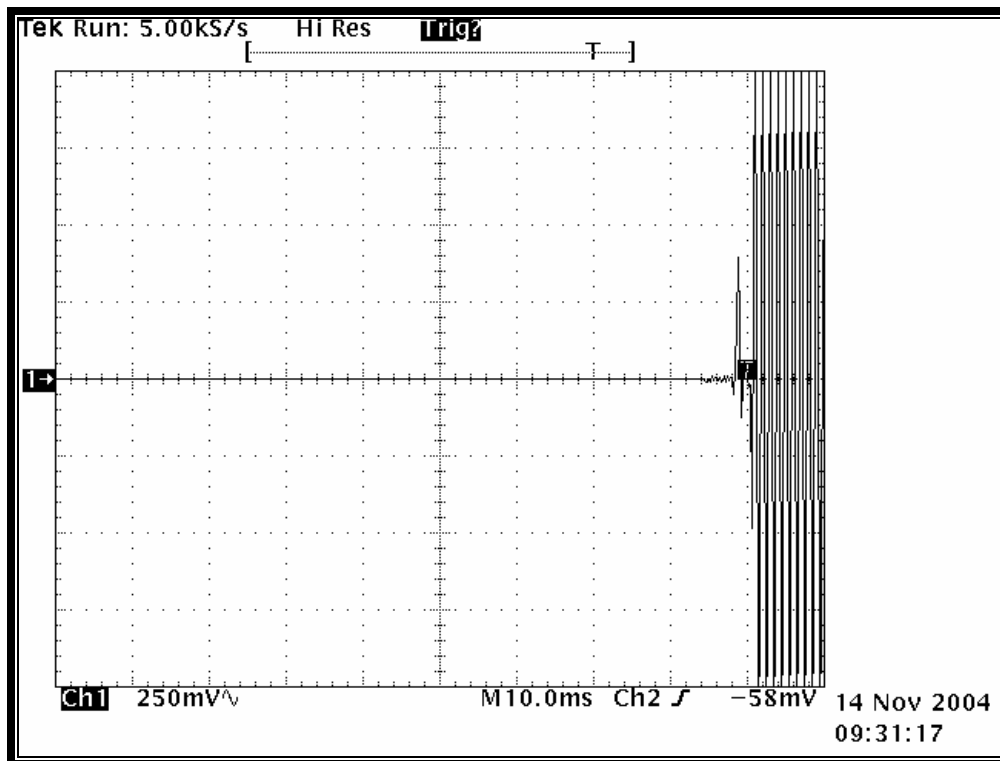
TEST PERSONNEL:

DANIEL BALTZELL
TEST ENGINEER

SIGNATURE

NOVEMBER 14, 2004
DATE OF TEST

PLOT 13-2: OFF TIME – CHANNEL 5: 154 MHZ; 12.5 KHZ NARROWBAND



Carrier OFF time:
Power: 1 W rated
Channel 5: 154 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 -58 mV
Ch 1: 250mV/div, Probe 1.000:1
Vertical scale: +/-4 div. corresponds to +/-12.5 kHz

TEST PERSONNEL:

DANIEL BALTZELL
TEST ENGINEER

SIGNATURE

NOVEMBER 14, 2004
DATE OF TEST

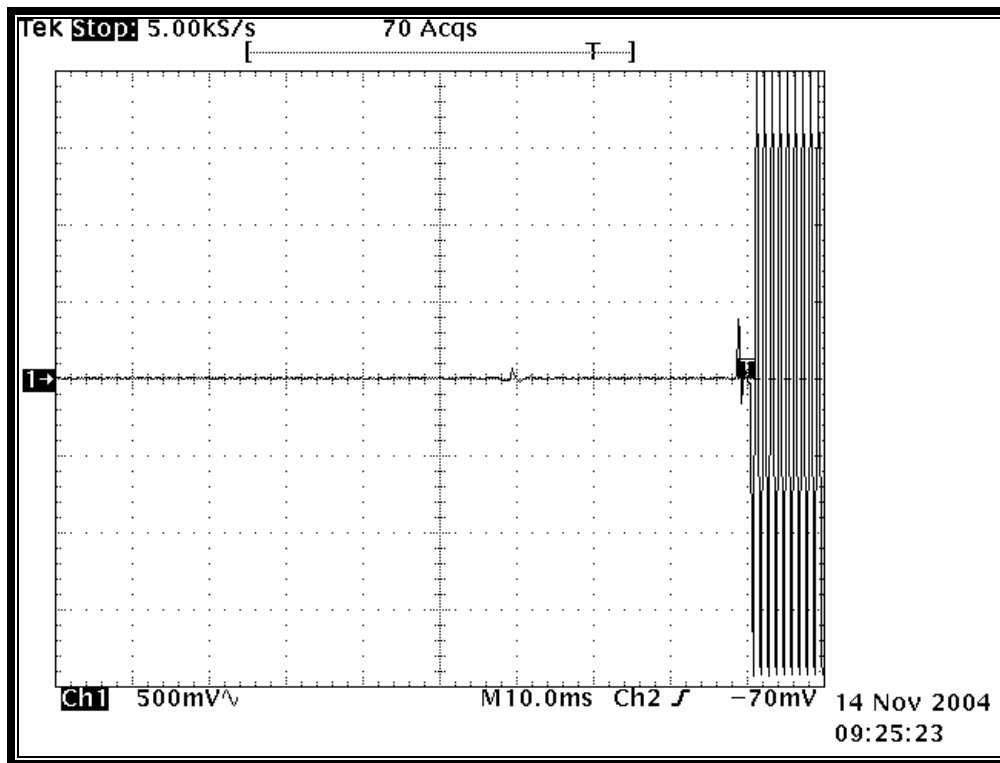
Timebase: 10 ms/div
Trigger: On negative edge of Ch 2, level -99 mV
Ch 1: 500 mV/div, Probe 1.000:1
Vertical scale: +/-4 div. corresponds to +/-25 kHz

DANIEL BALTZELL
TEST ENGINEER

Daniel W. Bolger

NOVEMBER 14, 2004
DATE OF TEST

PLOT 13-4: OFF TIME – CHANNEL 2: 154 MHZ; 25 KHZ WIDEBAND



Carrier OFF time:
Power: 1 W rated
Channel 2: 154 MHz WB (25 kHz)
RF Signal Generator: Modulation 25 kHz deviation

Timebase: 10 ms/div
Trigger: On positive edge of Ch 2, level -70 mV
Ch 1: 500 mV/div, Probe 1.000:1
Vertical scale: +/-4 div. corresponds to +/-25 kHz

TEST PERSONNEL:

DANIEL BALTZELL
TEST ENGINEER

SIGNATURE

NOVEMBER 14, 2004
DATE OF TEST

14 NECESSARY BANDWIDTH AND EMISSION BANDWIDTH FCC PART 2.202

Type of Emission: F3E, F1D, and F1E

Necessary Bandwidth and Emission Bandwidth Calculation:

The 12.5 kHz analog modulation necessary bandwidth: $B_n = 11K0F3E$

The 25 kHz analog modulation necessary bandwidth: $B_n = 16K0F3E$

The measured digital modulation necessary bandwidth: $B_n = 8K10F1D, 8K10F1E$

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

$$B_{n(12.5\text{KHz analog})} = 2 \times M + 2 \times DK = (2 \times 3) + (2 \times 2.5 \times 1) = 11 \text{ kHz}$$

$$B_{n(25\text{KHz analog})} = 2 \times M + 2 \times DK = (2 \times 3) + (2 \times 5 \times 1) = 16 \text{ kHz}$$

$$B_{n(P25 \text{ Digital})} = [9600/\log_2(4)] + 2(1650)(1) = 8.1 \text{ kHz}$$

15 CONCLUSION

The data in this measurement report shows that E.F. Johnson Model 242-41xx, FCC ID: ATH2424110, complies with all the requirements of Parts 2 and 90 of the FCC Rules, and Industry Canada RSS-119.