Engineering and Testing for EMC and Safety Compliance

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

Test Lab:	Applicant:
Rhein Tech Laboratories, Inc. 360 Herndon Parkway Suite 1400 Herndon, VA 20170 Contact: ATCBINFO@rheintech.com	Phone:703-689-0368 Fax: 703-689-2056 Web: www.rheintech.com	E. F. Johnson 299 Johnson Ave. P.O. Box 1249 Waseca, MN 56093-0514 Contact: John Oblak	Phone: 507-835-6276 Fax: 507-835-6666 Email: Joblak@efjohnson.com

FCC ID / IC:	ATH2425131 / 933B-2425131	**FRN NUMBER:**	0005-8136-88
MODEL:	242-513x	**RTL WORK ORDER NUMBER:**	2004134
EQUIPMENT TYPE:	PTT 400 MHz	**RTL QUOTE NUMBER:**	QRTL04-279
DATE OF TEST REPORT:	August 23, 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
380-470	5.2	0.9	11K0F3E
380-470	5.2	0.9	16K0F3E
380-470	5.2	0.9	11K8F1E
380-470	5.2	0.9	11K8F1D

* Industry Canada permits a frequency range of 406.1-430 MHz only.

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 FCC Part 2, FCC Part 90, Industry Canada RSS-119, ANSI C61.1; 4.5, ANSI/TIA/EIA603 and ANSI/TIA/EIA 603-1.

Signature: 

Date: August 23, 2004

Typed/Printed Name: Desmond A. Fraser

Position: President

Signature: 

Date: August 23, 2004

Typed/Printed Name: Daniel Baltzell

Position: Test Engineer

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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 C63.7; 1992).

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 FCC Identifiers for all equipment, plus descriptions of all cables used in the tested system are shown in the tables below. There were no deviations from the test standard(s) and/or methods. The test results relate only to the item that was tested.

TABLE 2-1: EQUIPMENT UNDER TEST (EUT)

Part	Manufacturer	Model	Serial Number	FCC ID	Cable Description	Date Sample Received	RTL Bar Code
UHF Portable Radio	E.F. Johnson	242-513x	N/A	ATH2425131	N/A	8/19/04	016130
UHF Portable Radio	E.F. Johnson	023-5170-042	51720E344A 36148	ATH2425131	N/A	8/19/04	016141

TABLE 2-2: EXTERNAL COMPONENTS IN TEST CONFIGURATION

Part	Manufacturer	Model	Serial Number	FCC ID	Cable Description	Date Sample Received	RTL Bar Code
Cable	E.F. Johnson	N/A	N/A	N/A	N/A	4/7/04	015827
Charger	E.F. Johnson	AA16740	1123327073	N/A	N/A	4/7/04	015826
Adapter	E.F. Johnson	Audio Accessory	N/A	N/A	N/A	4/7/04	015825
Headset	E.F. Johnson	5890015059	N/A	N/A	N/A	4/7/04	015824
1/4 wave antenna	E.F. Johnson	501 0105 012	N/A	N/A	N/A	8/19/04	016131
1/2 Wave Antenna	E.F. Johnson	501 0103 013	N/A	N/A	N/A	4/7/04	015822
Microphone	E.F. Johnson	N/A	N/A	N/A	N/A	4/7/04	015821
3600 MAH Battery	E.F. Johnson	587-5100-360	N/A	N/A	N/A	4/7/04	015820
3600 MAH Battery	E.F. Johnson	587-5100-360	N/A	N/A	N/A	4/7/04	015819
3600 MAH Battery	E.F. Johnson	587-5100-360	N/A	N/A	N/A	4/7/04	015818
3600 MAH Battery	E.F. Johnson	587-5100-360	N/A	N/A	N/A	4/7/04	015817
Alkaline Cell Pack	E.F. Johnson	N/A	100803-433ATH	N/A	N/A	4/7/04	015816
Cable for accessory adaptor	E.F. Johnson	N/A	N/A	N/A	N/A	4/7/04	015814
Accessory Adapter	E.F. Johnson	SYS1097-3015	0311214811	N/A	N/A	4/7/04	015813
Charger Kit	E.F. Johnson	585-5100-210	55-65575	N/A	N/A	4/7/04	015812

2.2 WORST CASE CONFIGURATION OF TESTED SYSTEM

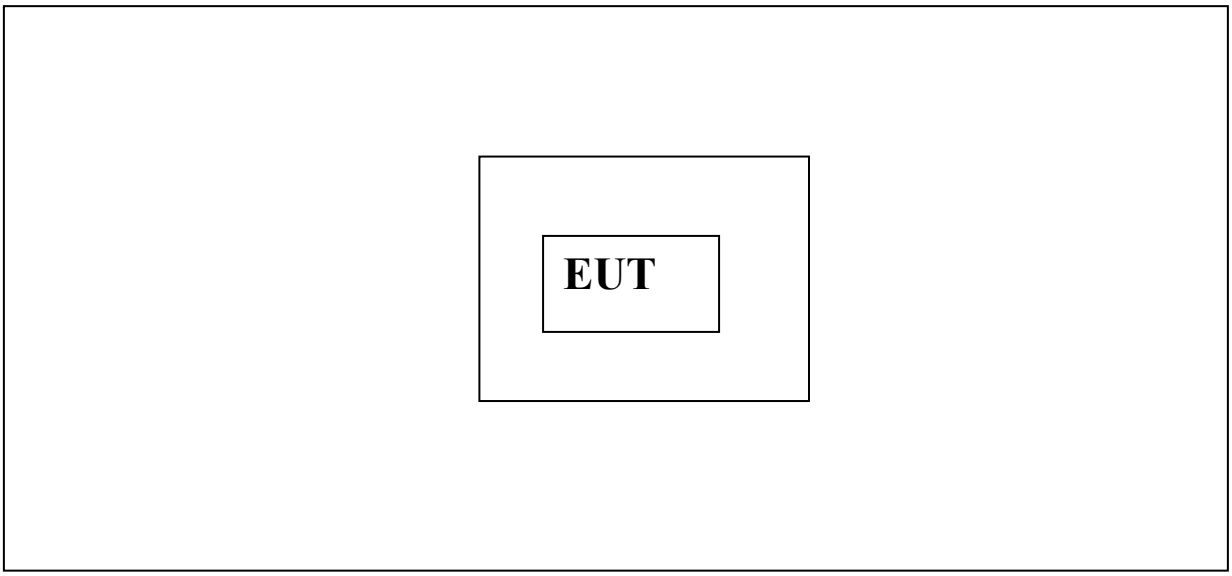


FIGURE 2-1: WORST CASE CONFIGURATION OF SYSTEM UNDER TEST

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 where:

7.5 volts @ 3.6A

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

4.1 ANSI/TIA/EIA-603-1992, 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.

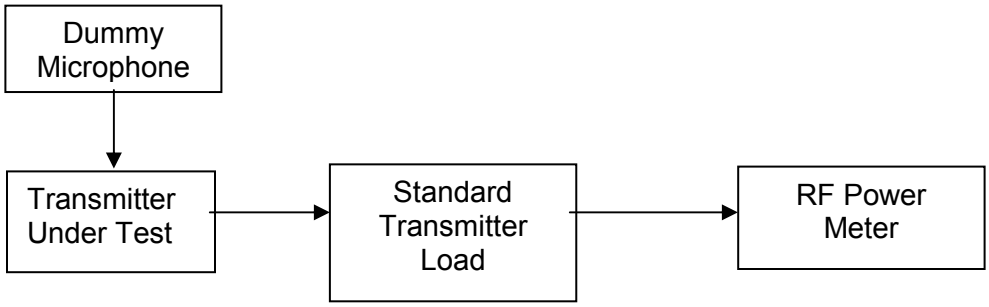


FIGURE 4-1: ILLUSTRATION OF HOW EQUIPMENT IS CONNECTED FOR TEST

4.2 RF POWER OUTPUT TEST EQUIPMENT

TABLE 4-1: RF POWER OUTPUT TEST EQUIPMENT

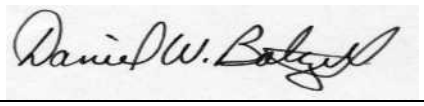
RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Cal Due Date
901184	Agilent Technologies	E4416A	EPM-P Power Meter, single channel	GB41050573	8/2/05
901186	Agilent Technologies	E9323A (50 MHz – 6 GHz)	Peak & Average Power Sensor	US40410380	8/2/05

4.3 RF POWER OUTPUT TEST DATA

TABLE 4-2: RF POWER OUTPUT TEST DATA

Frequency (MHz)	Channel	Power Measured (dBm)	Power (Watt)
380	1	36.68	4.7
425	2	37.14	5.2
470	3	36.73	4.7

TEST PERSONNEL:



DANIEL BALTZELL		AUGUST 21, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

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

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	2406A00178	7/07/05
901057	Hewlett Packard	3336B	Synthesizer/Level Generator	2514A02585	9/08/05
901054	Hewlett Packard	HP 3586B	Selective Level Meter	1928A01892	9/08/05

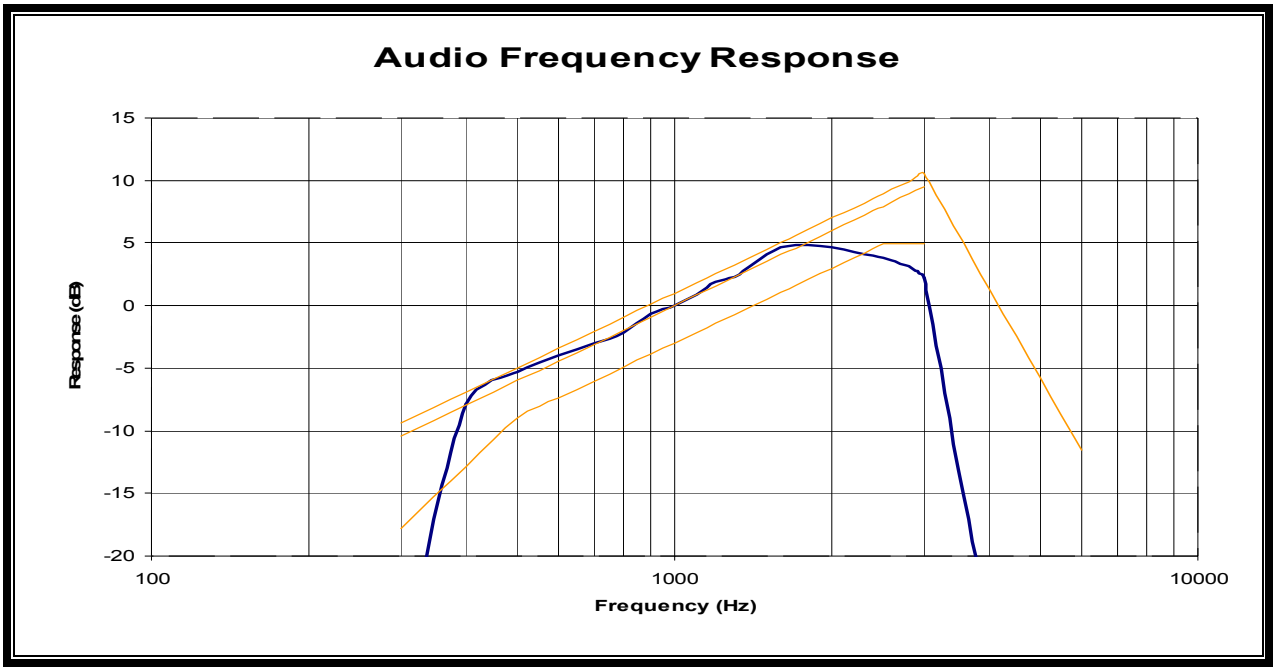
6 FCC PART 2 §2.1047 (A): MODULATION CHARACTERISTICS - AUDIO FREQUENCY RESPONSE

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 300 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 LOG (DEVfreq/DEVref)

6.2 TEST DATA

PLOT 6-1: AUDIO FREQUENCY RESPONSE CHANNEL 2 AT 425 MHZ



TEST PERSONNEL:

DANIEL BALTZELL		SEPTEMBER 11, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

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

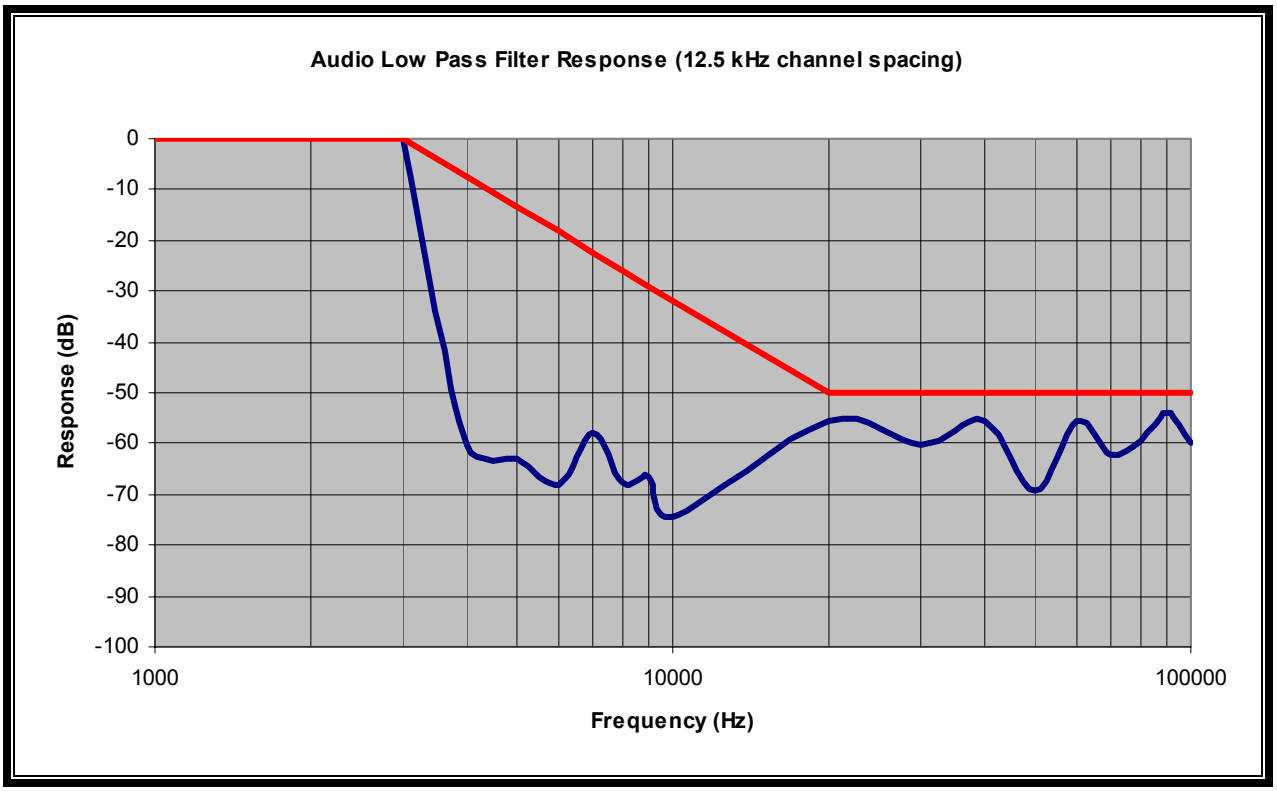
7.1 TEST PROCEDURE

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 (CHANNEL 2)



TEST PERSONNEL:

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

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

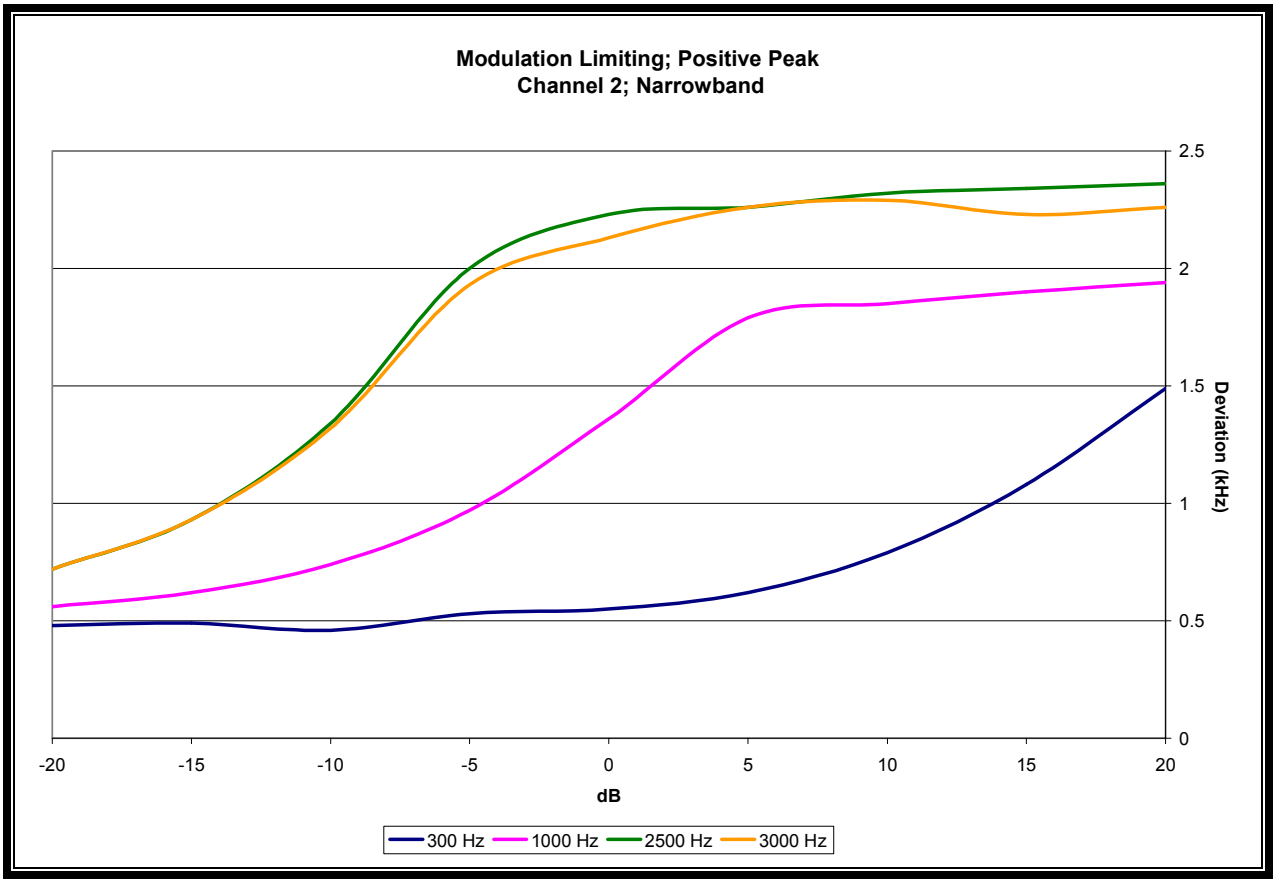
8.1 TEST PROCEDURE

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

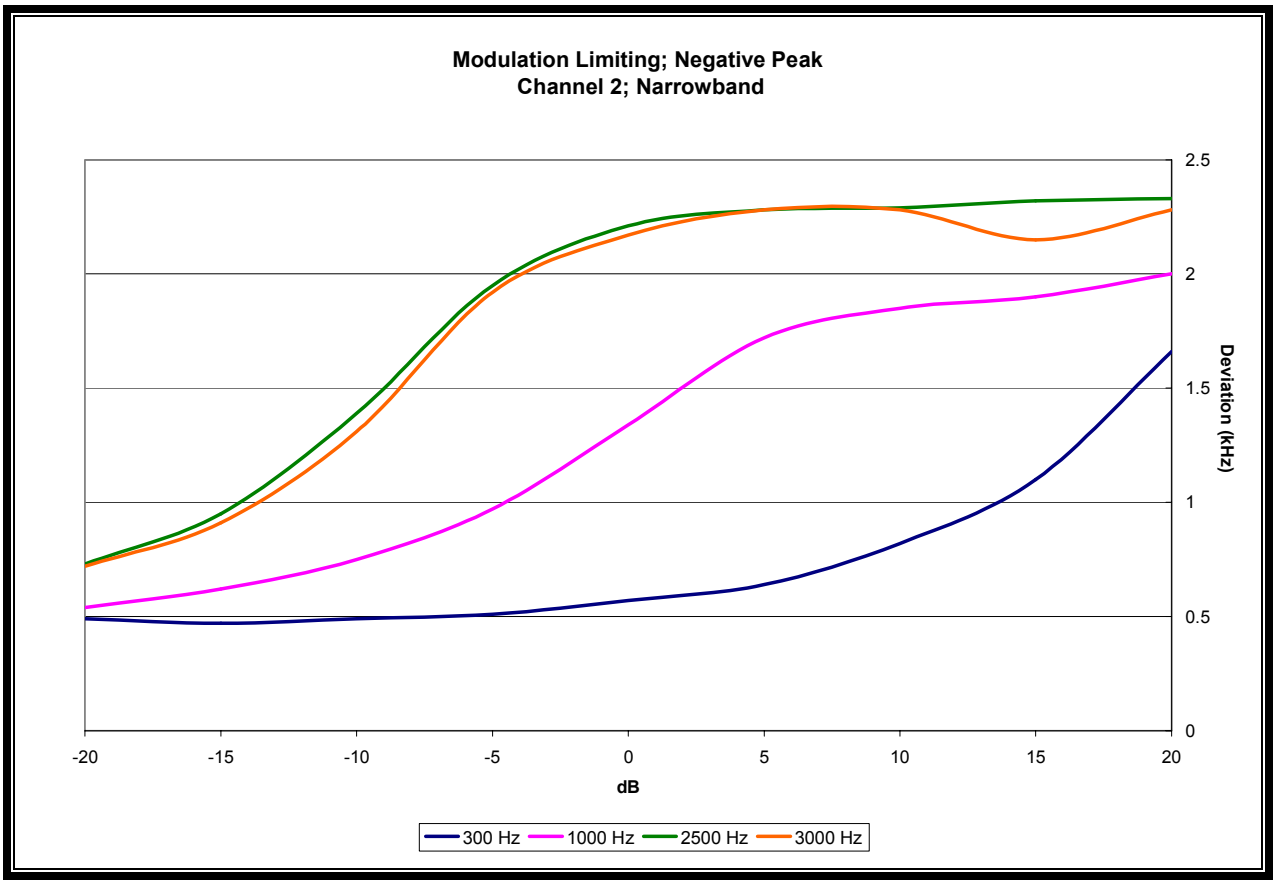
The transmitter is adjusted for full rated system deviation. The audio input level is adjusted for 60% of rated system deviation at 1000 Hz. Using this level as a reference (0 dB), the audio input level is varied from the reference to a level +20 dB above it and –20 dB under it, for modulation frequencies 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

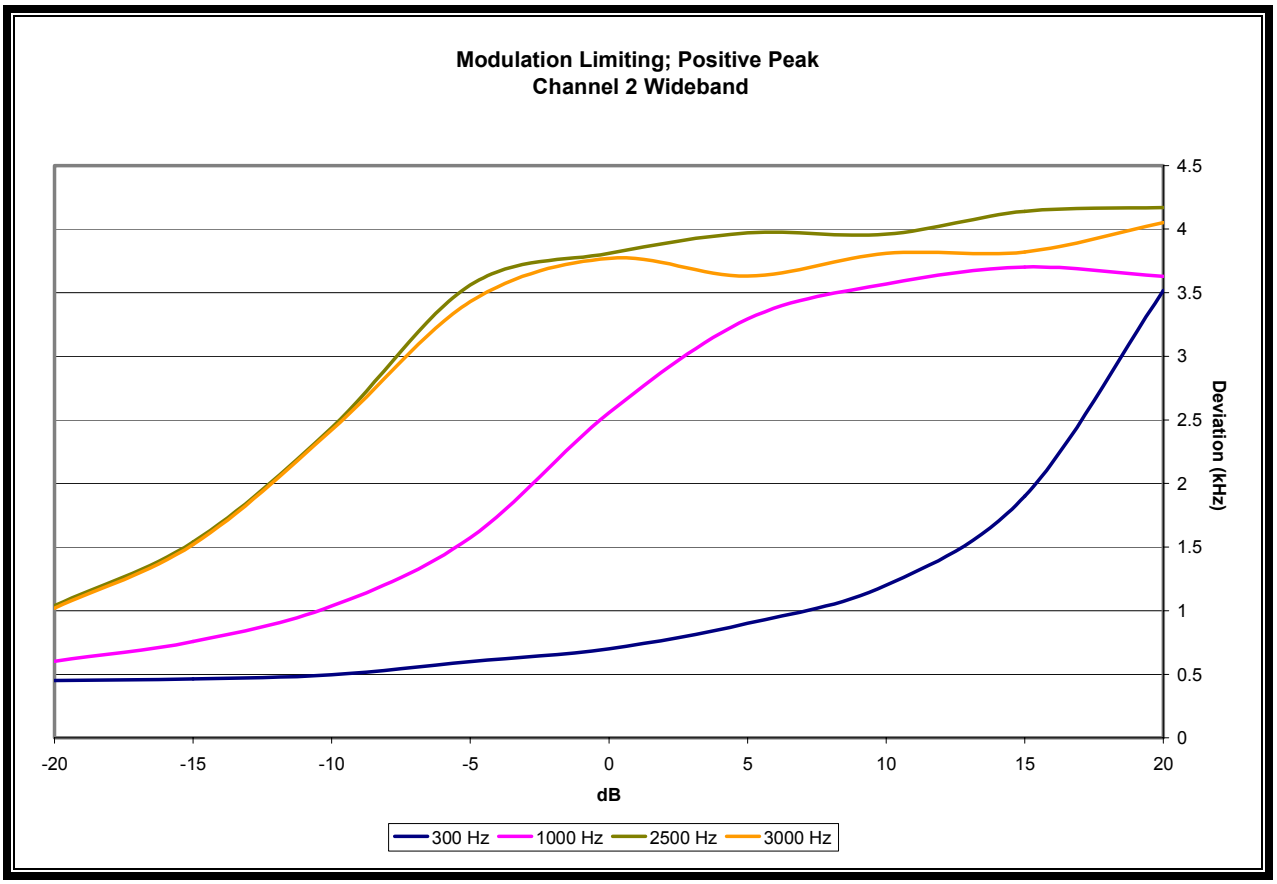
PLOT 8-1: MODULATION LIMITING RESPONSE (POSITIVE PEAK) CHANNEL 2, 425 MHZ NARROWBAND



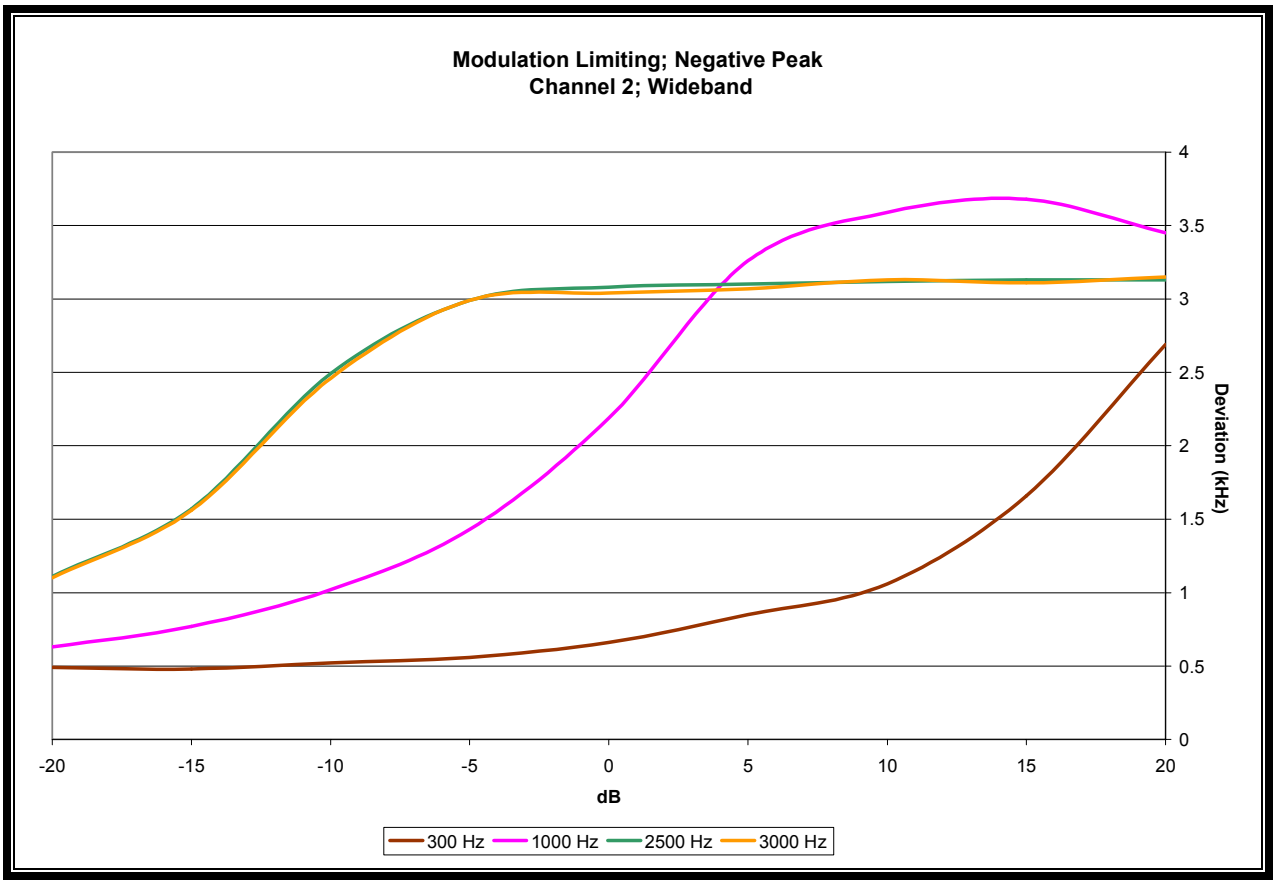
PLOT 8-2: MODULATION LIMITING RESPONSE (NEGATIVE PEAK) CHANNEL 2; 425 MHZ; NARROWBAND



PLOT 8-3: MODULATION LIMITING RESPONSE (POSITIVE PEAK) CHANNEL 2; 425 MHZ; WIDEBAND



PLOT 8-4: MODULATION LIMITING RESPONSE (NEGATIVE PEAK) CHANNEL 2; 425 MHZ; WIDEBAND



TEST PERSONNEL:

DANIEL BALTZELL		SEPTEMBER 11, 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. One hundred percent of the in-band modulation was below the specified mask. Specified Limits:

A. On any frequency removed from the assigned carrier frequency by more than 20 kHz, up to and including 45 kHz, the sideband was at least 26 dB below the carrier.
B. On any frequency removed from the assigned carrier frequency by more than 45 kHz, up to and including 90 kHz, the sideband was at least 45 dB below the carrier.
C. On any frequency removed from the assigned carrier frequency by more than 90 kHz, up to the first multiple of the carrier frequency, the sideband was at least 60 dB below the carrier of 40 + log10 (mean power output in Watts) dB, whichever was the smaller attenuation.

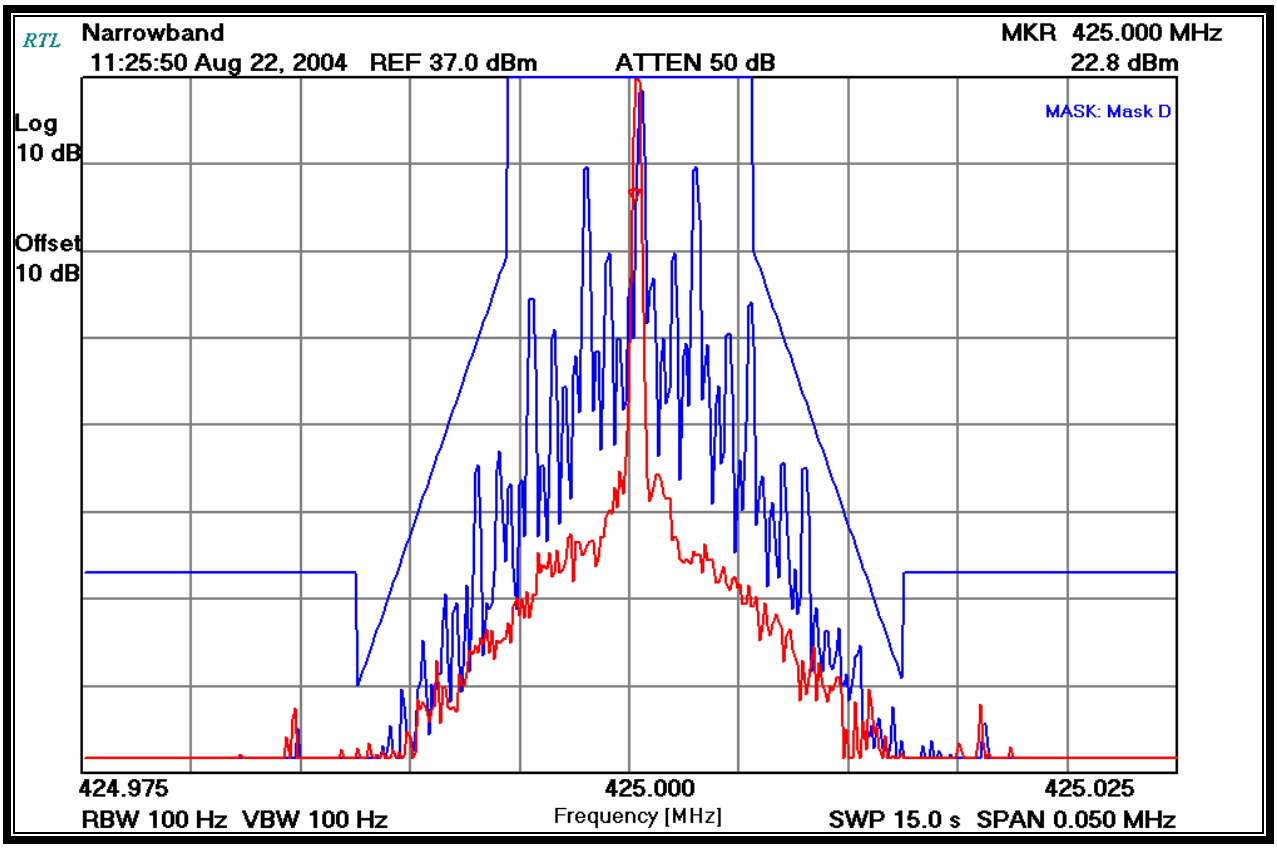
9.2 OCCUPIED BANDWIDTH TEST EQUIPMENT

TABLE 9-1: OCCUPIED BANDWIDTH TEST EQUIPMENT

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Cal Due Date
901215	Hewlett Packard	8596EM (9 kHz - 12.8 GHz)	EMC Analyzer	3826A00144	8/27/04

9.3 OCCUPIED BANDWIDTH TEST DATA

PLOT 9-1: MASK D (425 MHZ; CH 2; NARROWBAND)

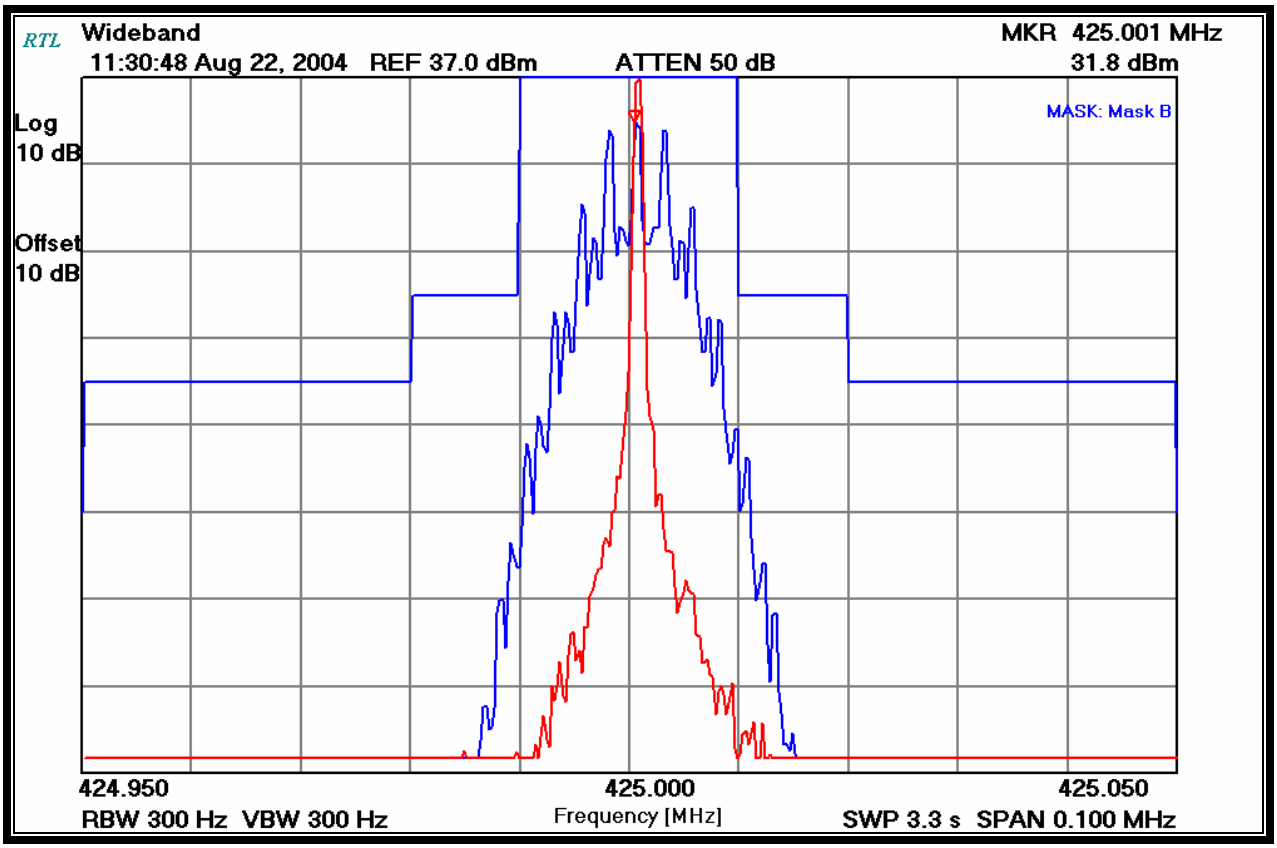


TEST PERSONNEL:

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

9.4 OCCUPIED BANDWIDTH TEST DATA

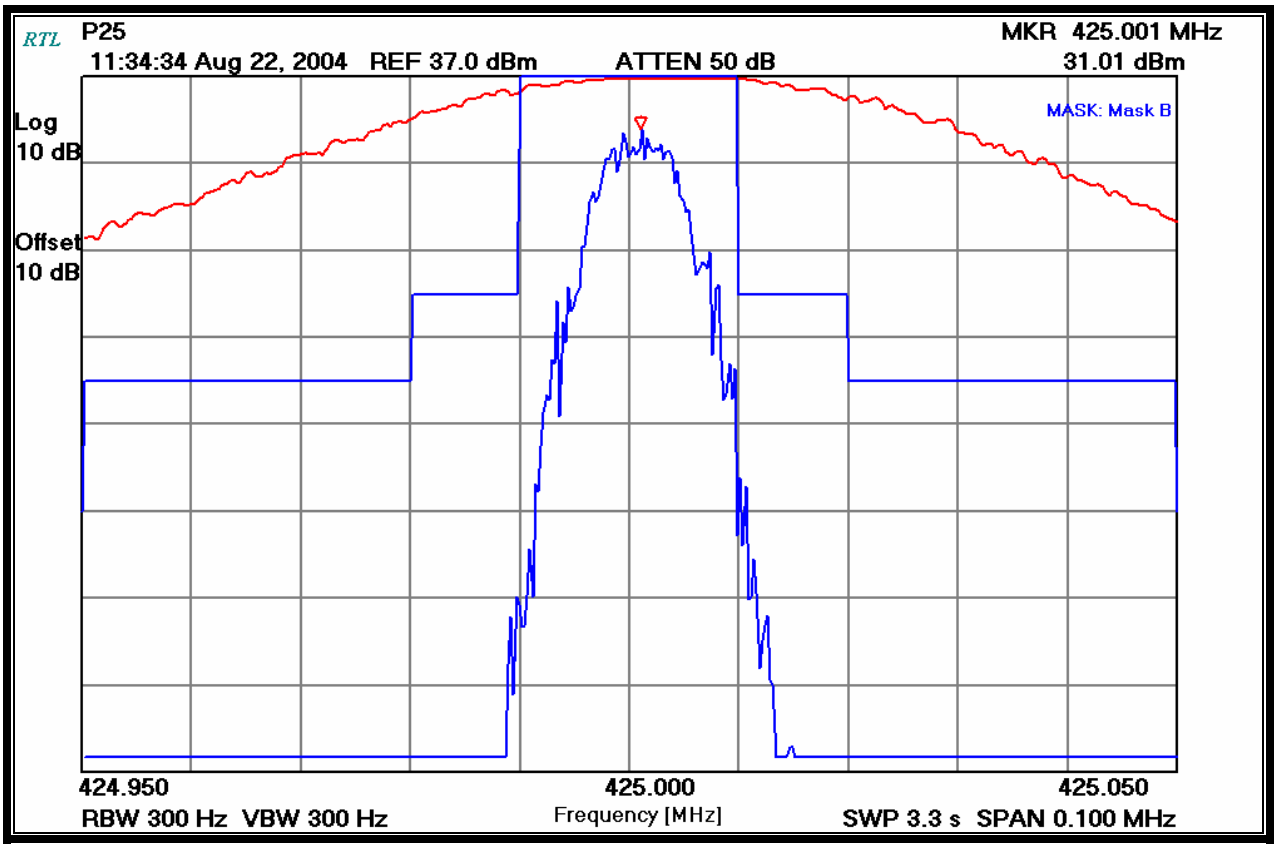
PLOT 9-2: MASK B (425 MHZ; CH 2; WIDEBAND)



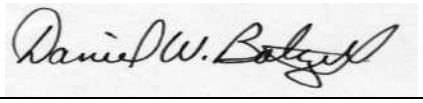
TEST PERSONNEL:

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

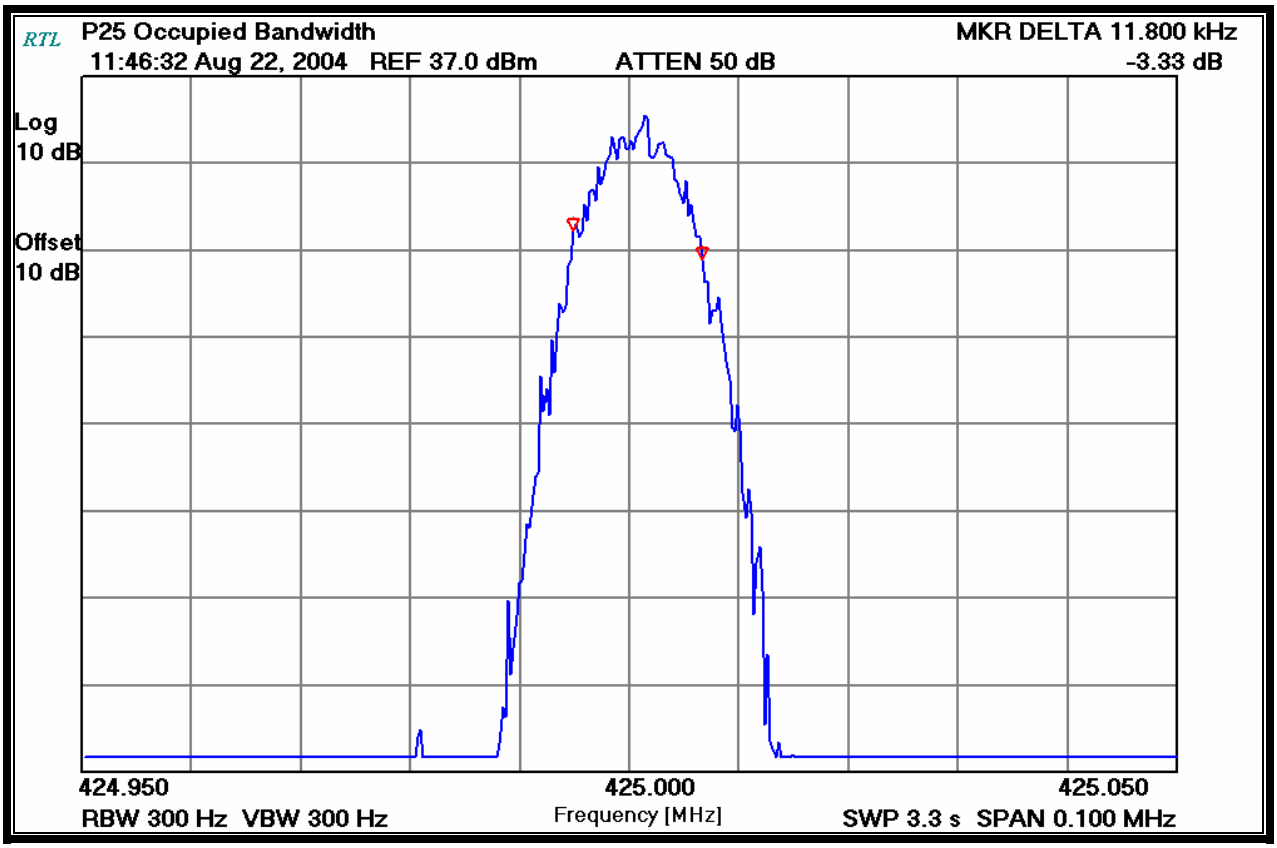
PLOT 9-3: MASK B (425 MHZ; P25 DIGITAL)



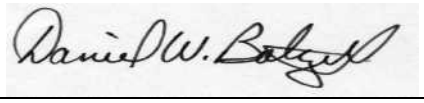
TEST PERSONNEL:

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

PLOT 9-4: OCCUPIED BANDWIDTH: (425 MHZ, P25 DIGITAL): 11.8 KHZ



TEST PERSONNEL:

DANIEL BALTZELL		AUGUST 22, 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 matched 3dB attenuator and 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
901215	Hewlett Packard	8596EM (9 kHz - 12.8 GHz)	EMC Analyzer	3826A00144	8/27/04
901132	Par Electronics	806-902 (25W)	UHF Notch Filter	N/A	5/13/05

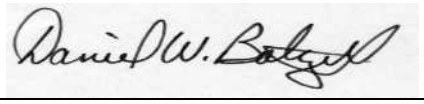
10.3 CONDUCTED SPURIOUS EMISSIONS TEST DATA

TABLE 10-2: CONDUCTED SPURIOUS EMISSIONS (CHANNEL 1 AT 380 MHZ)

Operating Frequency (MHz): 380
Channel: 1
Measured Conducted Power (dBm): 36.7
Modulation: Analog
Limit (dBc): 56.7 (50+10LogP)

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Notch Filter Insertion Loss (dB)	Corrected Spectrum Analyzer Level (dBc)	Margin (dB)
760.0	-50.9	1.2	86.4	-29.7
1140.0	-72.2	0.4	108.5	-51.8
1520.0	-71.8	0.7	107.8	-51.1
1900.0	-72.0	0.6	108.1	-51.4
2280.0	-60.8	0.5	97.0	-40.3
2660.0	-63.9	0.6	100.0	-43.3
3040.0	-53.3	0.3	89.7	-33.0
3420.0	-64.8	1.1	100.4	-43.7
3800.0	-77.1	0.3	113.5	-56.8

TEST PERSONNEL:



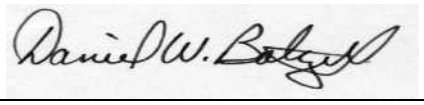
DANIEL BALTZELL		AUGUST 22, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

TABLE 10-3: CONDUCTED SPURIOUS EMISSIONS (CHANNEL 2 AT 425 MHZ)

Operating Frequency (MHz): 425
Channel: 2
Measured Conducted Power (dBm): 37.1
Modulation: Analog
Limit (dBc): 57.1 (50+10LogP)

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Notch Filter Insertion Loss (dB)	Corrected Spectrum Analyzer Level (dBc)	Margin (dB)
850.0	-47.1	0.9	83.3	-26.2
1275.0	-73.0	0.3	109.8	-52.7
1700.0	-63.3	0.3	100.1	-43.0
2125.0	-67.8	1.1	103.8	-46.7
2550.0	-59.9	0.3	96.7	-39.6
2975.0	-71.1	0.2	108.0	-50.9
3400.0	-64.6	1.1	100.6	-43.5
3825.0	-68.9	0.5	105.5	-48.4
4250.0	-83.5	5.1	115.5	-58.4

TEST PERSONNEL:



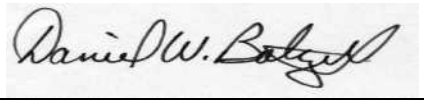
DANIEL BALTZELL		AUGUST 22, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

TABLE 10-4: CONDUCTED SPURIOUS EMISSIONS (CHANNEL 3 AT 470 MHZ)

Operating Frequency (MHz): 470
Channel: 3
Measured Conducted Power (dBm): 36.73
Modulation: Analog
Limit (dBc): 56.73 (50+10LogP)

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Notch Filter Insertion Loss (dB)	Corrected Spectrum Analyzer Level (dBc)	Margin (dB)
940.0	-54.3	1.1	89.9	-32.7
1410.0	-87.7	0.4	124.0	-66.8
1880.0	-70.3	0.8	106.2	-49.0
2350.0	-58.7	1.0	94.4	-37.2
2820.0	-64.9	0.1	101.5	-44.3
3290.0	-50.7	0.9	86.5	-29.3
3760.0	-70.3	0.4	106.6	-49.4
4230.0	-69.1	5.8	100.0	-42.8
4700.0	-68.1	3.2	101.6	-44.4

TEST PERSONNEL:



DANIEL BALTZELL		AUGUST 22, 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

A receiving antenna located 3 meters from the turntable received any signal radiated from the transmitter and its operating accessories. The receiving antenna was varied from 1 to 4 meters

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 approximately 360 degrees and changing the height of the receive antenna from 1 to 4 meters and the polarization was varied to determine the worst-case emission level. The spectrum analyzer level was recorded from a calibrated spectrum analyzer for each channel being tested. A dipole or horn antenna was substituted in place of the EUT and 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 at the point of the antenna using a power splitter to compensate for any impedance mismatch between the 50 ohm signal generator and the transmitting antenna. The signal generator level was corrected by subtracting the connecting cable loss, and further corrected with the antenna gain referenced to a ½ wave dipole measurement.

11.2 RADIATED SPURIOUS TEST EQUIPMENT

TABLE 11-1: RADIATED SPURIOUS TEST EQUIPMENT

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Cal Due Date
901053	Schaffner Chase	CBL6112B	Bi-Log Antenna (20 MHz – 2 GHz)	2648	9/3/04
901215	Hewlett Packard	8596EM	EMC Analyzer (9 kHz - 12.8 GHz)	3826A00144	8/27/04
900928	Hewlett Packard	83752A	Synthesized Sweeper (0.01 GHz – 20 GHz)	3610A00866	8/5/05
900905	Rhein Tech Labs	PR-1040	Amplifier (30 MHz - 2 GHz)	900905	9/10/04
900814	Electro-Metrics	EM-6961 (RGA-60)	Double Ridges Guide Antenna (1 - 18 GHz)	2310	2/17/06
900772	EMCO	3161-02	Horn antenna (2.0 - 4.0 GHz)	9804-1044	5/20/07
900321	EMCO	3161-03	Horn antenna (4.0 - 8.2 GHz)	9508-1020	5/20/07
900932	Hewlett Packard	8449B OPT H02	Preamplifier (1 - 26.5 GHz)	3008A00505	5/5/05
900930	Hewlett Packard	85662A	Spectrum Analyzer Display Section	3144A20839	6/23/05
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz – 22 GHz)	3138A07771	6/23/05
900889	Hewlett Packard	85685A	RF Preselector for HP 8566B (20 Hz - 2 GHz)	3146A01309	3/10/05
900352	Werlatone	C1795	Directional Coupler, 100 watt, (1 – 1000 MHz)	4067	7/1/2005
901341	Narda Microwave Corporation	3003-20-40	Coaxial Directional Coupler	2	7/1/2005
901342	Narda Microwave Corporation	3044-10	Coaxial Directional Coupler	901	7/1/2005
901345	Narda Microwave Corporation	3002-30	Coaxial Directional Coupler	20032	7/1/2005

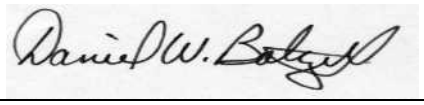
11.3 RADIATED SPURIOUS EMISSIONS TEST DATA - §2.1053

Operating Frequency (MHz): 380
Channel: 1
Measured Conducted Power (dBm): 36.7
Modulation: Analog narrowband
Distance (m): 3
Limit (dBc): 56.7 (50+10LogP)

TABLE 11-2: RADIATED SPURIOUS EMISSIONS DATA §2.1053

Frequency (MHz)	Spectrum Analyzer Peak Level (dBuV)	Spectrum Analyzer Average Level (dBuV)	Signal Generator Level (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Corrected Level (dBc)	Margin (dB)
760.0	54.7	49.5	-67.4	0.7	-1.2	106.0	-49.3
1140.0	53.7	46.7	-59.9	0.9	1.2	96.3	-39.6
1520.0	52.0	42.5	-59.9	1.4	4.7	93.3	-36.6
1900.0	49.6	42.1	-56.8	1.1	4.8	89.8	-33.1
2280.0	38.3	32.1	-60.7	6.5	5.0	98.9	-42.2
2660.0	41.0	32.2	-58.5	7.3	5.5	97.0	-40.3
3040.0	47.7	43.0	-49.0	7.6	6.2	87.1	-30.4
3420.0	31.1	21.4	-70.6	7.6	6.0	108.9	-52.2
3800.0	31.6	26.5	-64.7	8.1	5.9	103.6	-46.9

TEST PERSONNEL:



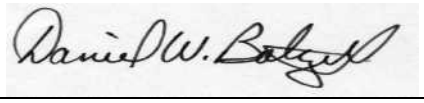
DANIEL BALTZELL		AUGUST 21, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

Operating Frequency (MHz): 425
Channel: 2
Measured Conducted Power (dBm): 37.1
Modulation: Analog narrowband
Distance (m): 3
Limit (dBc): 57.1 (50+10LogP)

TABLE 11-3: RADIATED SPURIOUS EMISSIONS DATA §2.1053

Frequency (MHz)	Spectrum Analyzer Peak Level (dBuV)	Spectrum Analyzer Average Level (dBuV)	Signal Generator Level (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Corrected Level (dBc)	Margin (dB)
850.0	44.3	41.1	-72.4	0.5	-0.2	110.2	-53.1
1275.0	43.6	41.6	-61.9	0.9	2.5	97.4	-40.3
1700.0	53.1	47.2	-54.6	1.2	4.7	88.2	-31.1
2125.0	43.5	33.5	-59.2	6.1	4.9	97.5	-40.4
2550.0	43.4	35.0	-55.5	7.4	5.3	94.7	-37.6
2975.0	43.6	38.9	-53.3	7.5	6.2	91.7	-34.6
3400.0	37.1	27.6	-64.4	7.6	6.0	103.1	-46.0
3825.0	35.5	26.8	-64.0	8.0	5.9	103.2	-46.1
4250.0	31.2	24.8	-63.3	8.2	6.5	102.1	-45.0

TEST PERSONNEL:



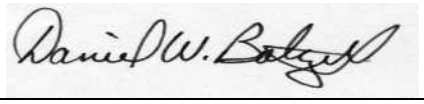
DANIEL BALTZELL		AUGUST 21, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

Operating Frequency (MHz): 470
Channel: 3
Measured Conducted Power (dBm): 36.7
Modulation: Analog narrowband
Distance (m): 3
Limit (dBc): 56.7 (50+10LogP)

TABLE 11-4: RADIATED SPURIOUS EMISSIONS DATA §2.1053

Frequency (MHz)	Spectrum Analyzer Peak Level (dBuV)	Spectrum Analyzer Average Level (dBuV)	Signal Generator Level (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Corrected Level (dBc)	Margin (dB)
940.0	47.2	41.3	-71.4	0.9	-1.2	110.2	-53.5
1410.0	48.7	42.8	-60.6	0.8	3.8	94.3	-37.6
1880.0	53.6	44.7	-54.6	0.7	4.8	87.2	-30.5
2350.0	44.3	33.0	-59.8	6.2	5.1	97.6	-40.9
2820.0	28.8	34.0	-57.8	7.4	5.9	96.0	-39.3
3290.0	41.4	34.2	-57.6	7.8	6.1	96.0	-39.3
3760.0	35.9	27.9	-63.4	7.9	5.9	102.1	-45.4
4230.0	46.3	41.0	-46.9	8.5	6.4	85.7	-29.0
4700.0	44.8	41.7	-46.5	7.8	7.0	84.0	-27.3

TEST PERSONNEL:



DANIEL BALTZELL		AUGUST 21, 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 +50°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 three hour “soak” at -30°C without any power applied.
3. After the “soak” 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, then back to room temperature. A minimum period of one hour was provided to allow stabilization of the equipment at each temperature level.

12.3 FREQUENCY TOLERANCE:

The minimum frequency stability shall be +2.5 ppm referenced to a received carrier frequency from a base station.

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
901247	Wavetek	DM25XT	Multimeter	40804098	3/3/05

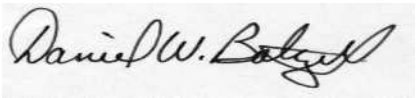
12.5 FREQUENCY STABILITY TEST DATA - §2.1055

Operating Frequency (MHz): 425
Channel: 2
Reference Voltage: 7.5 VDC
Deviation Limit: 2.5 PPM

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

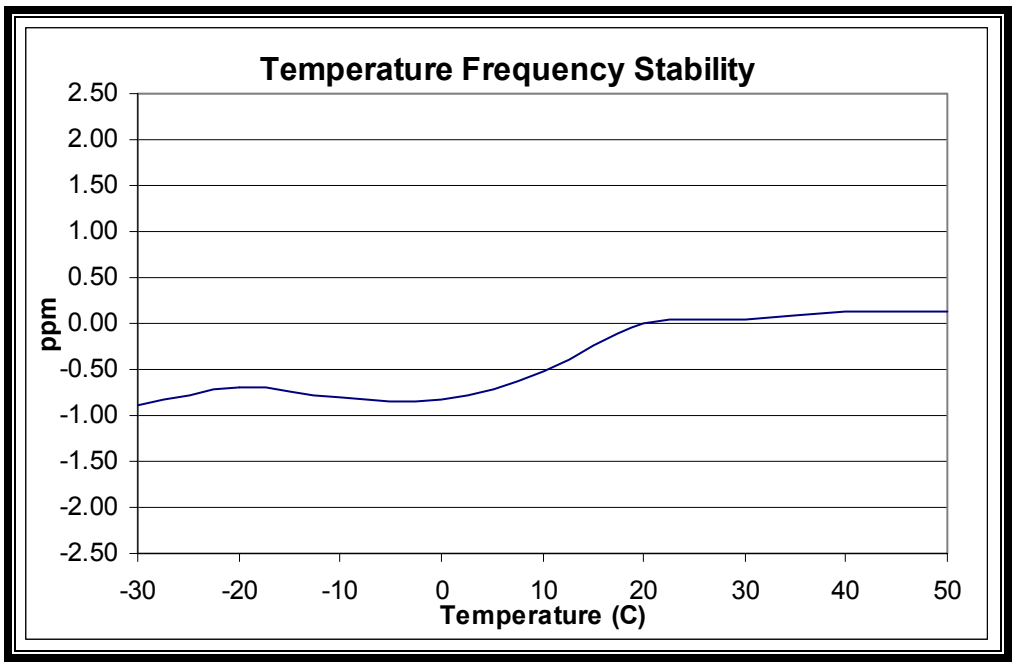
Temperature (ºC)	Measured Frequency (MHz)	ppm
-30	424.999620	-0.89
-20	424.999705	-0.69
-10	424.999655	-0.81
0	424.999650	-0.82
10	424.999780	-0.52
20	425.000000	0.00
30	425.000020	0.05
40	425.000060	0.14
50	425.000060	0.14

TEST PERSONNEL:



DANIEL BALTZELL		SEPTEMBER 10, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

PLOT 12-1: TEMPERATURE FREQUENCY STABILITY - §2.1055



TEST PERSONNEL:

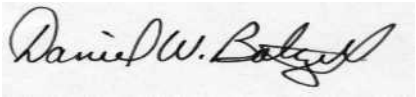
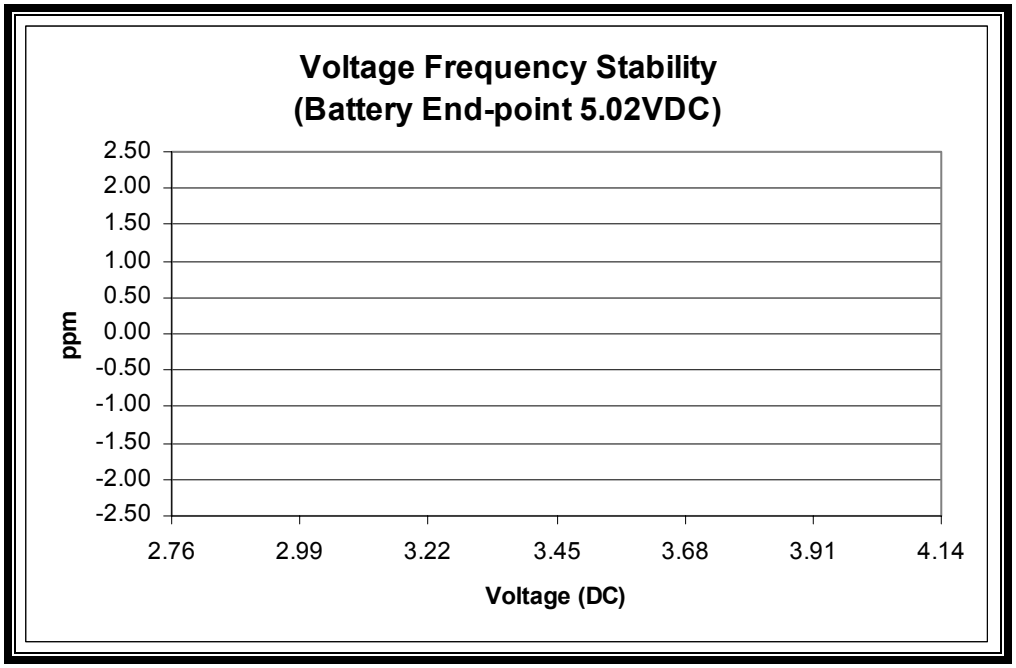
DANIEL BALTZELL		SEPTEMBER 10, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

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

Voltage (DC)	Measured Frequency (MHz)	ppm
5.02 (Battery End-point)	425.000217	0.51
6.375	425.000211	0.50
7.5	425.000205	0.48
8.625	425.000201	0.47

PLOT 12-2: VOLTAGE FREQUENCY STABILITY - §2.1055



TEST PERSONNEL:

DANIEL BALTZELL		SEPTEMBER 10, 2004
TEST ENGINEER	SIGNATURE	DATE OF TEST

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

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 5:
The frequency stability is required to be 2.5 PPM.
Calculation for Channel 5:
4 div. on scope represent 12.5 kHz for narrow band channel.
Therefore, $\frac{481.0125 \text{ MHz} \times 2.5 \text{ PPM} \times +/- 4 \text{ Divisions}}{12.5\text{kHz}} = \approx +/- 0.39$ division

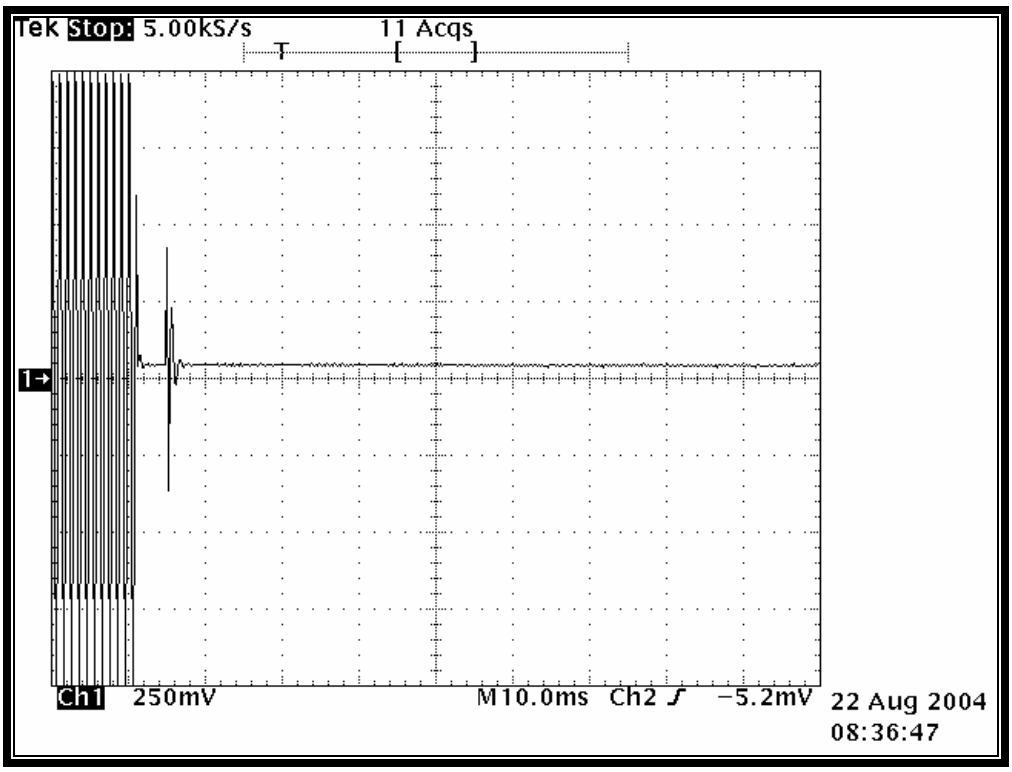
0.39 Div. corresponds to 1.233 kHz

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 To 3200 MHz)	3537A01741	4/19/03
901055	Hewlett Packard	8901A Opt. 002-003	Modulation Analyzer	2545A04102	7/31/02
900561	Tektronix	TDS540A	Oscilloscope	B020129	2/11/03
900913	Hewlett Packard	85462A	EMI Receiver RF Section, (9 kHz - 6.5 GHz)	3325A00159	12/5/02
901214	Hewlett Packard	HP8471D	Detector	2952A19822	Not Required

13.3 TRANSIENT FREQUENCY BEHAVIOR TEST DATA

PLOT 13-1: ON TIME – CHANNEL 2: 425 MHZ; 12.5 KHZ NARROW BAND



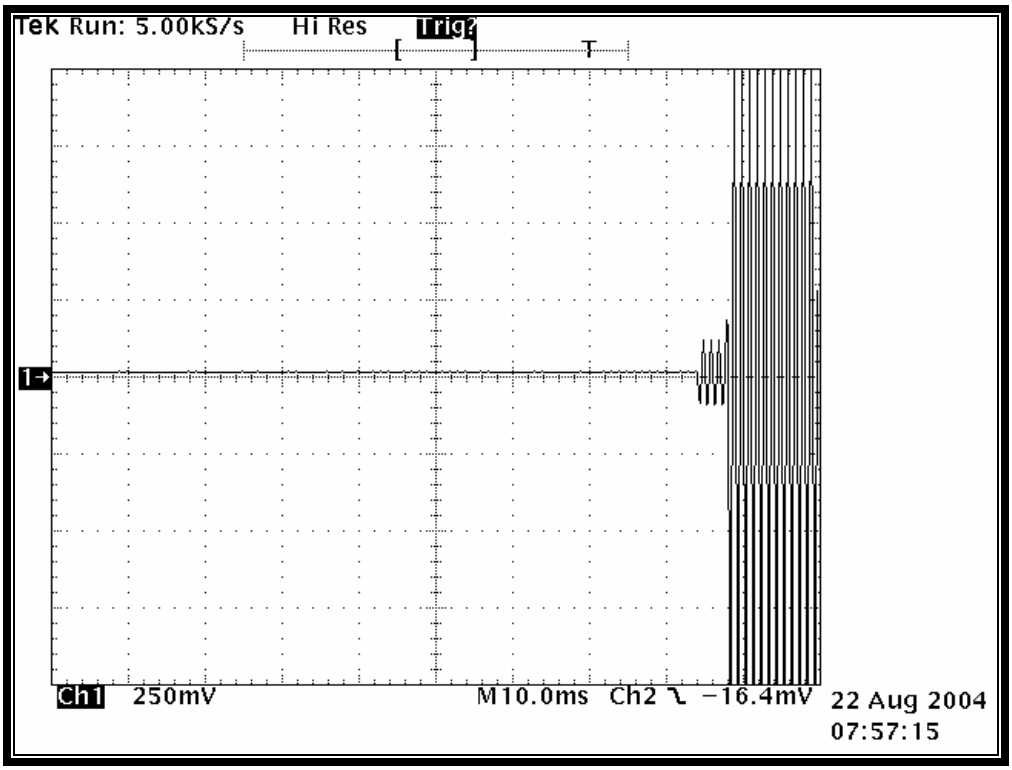
Carrier ON time:
Power: 5.2 W rated
Channel 2: 425 MHz NB (12.5 kHz)
RF Signal Generator: Modulation 12.5 kHz deviation

Timebase: 10 ms/div
Trigger: On negative edge of Ch 2, level –5.2mV
Ch 1: 250 mV/div, Probe 1.000:1
Vertical scale: +/- 4 div. corresponds to +/- 12.5 kHz

TEST PERSONNEL:

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

PLOT 13-2: OFF TIME – CHANNEL 2: 425 MHZ; 12.5 KHZ NARROW BAND



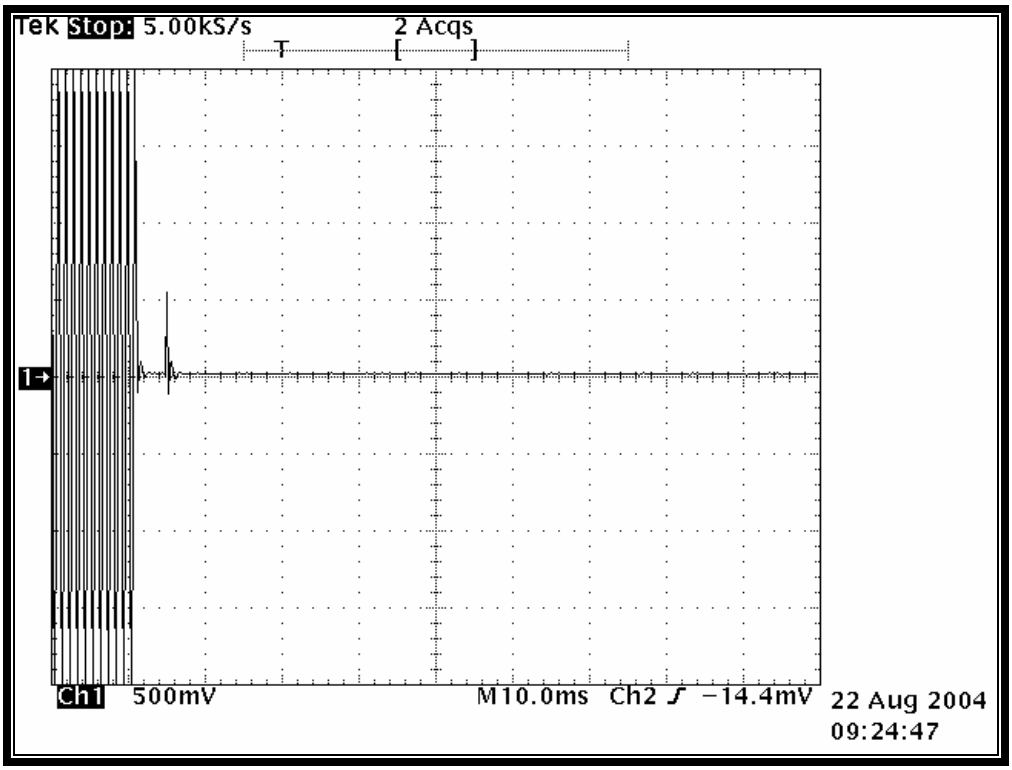
Carrier OFF time:
Power: 5 W rated
Channel 2: 425 MHz NB (12.5 kHz)
RF Signal Generator: Modulation 12.5 kHz deviation

Timebase: 10 ms/div
Trigger: On negative edge of Ch 2, level –16.4 mV
Ch 1: 250 mV/div, Probe 1.000:1
Vertical scale: +/- 4 div. corresponds to +/- 12.5 kHz

TEST PERSONNEL:

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

PLOT 13-3: ON TIME – CHANNEL 2: 425 MHZ; 25 KHZ WIDE BAND



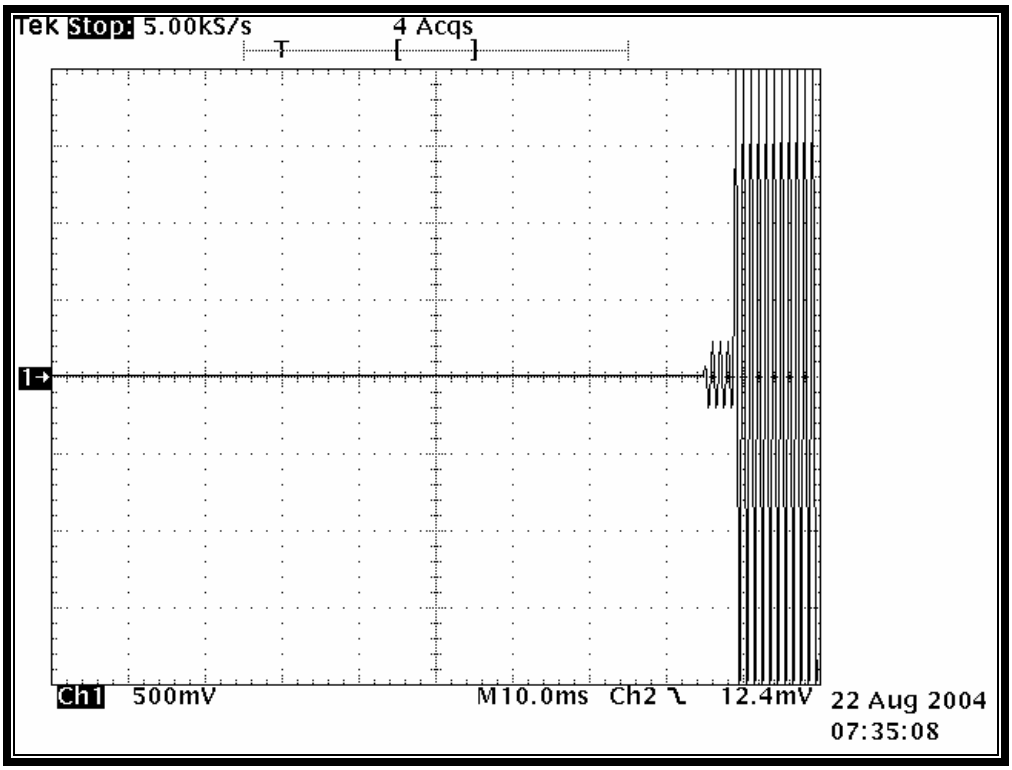
Carrier ON time:
Power: 5 W rated
Channel 2: 425 MHz WB (25 kHz)
RF Signal Generator: Modulation 25 kHz deviation

Timebase: 10 ms/div
Trigger: On negative edge of Ch 2, level –14.4 mV
Ch 1: 500 mV/div, Probe 1.000:1
Vertical scale: +/- 4 div. corresponds to +/- 12.5 kHz

TEST PERSONNEL:

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

PLOT 13-4: OFF TIME – CHANNEL 2: 425 MHZ; 25 KHZ WIDE BAND



Carrier OFF time:
Power: 5 W rated
Channel 2: 425 MHz WB (25 kHz)
RF Signal Generator: Modulation 25 kHz deviation

Timebase: 10 ms/div
Trigger: On positive edge of Ch 2, level 12.4 mV
Ch 1: 500 mV/div, Probe 1.000:1
Vertical scale: +/- 4 div. corresponds to +/- 12.5 kHz

TEST PERSONNEL:

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

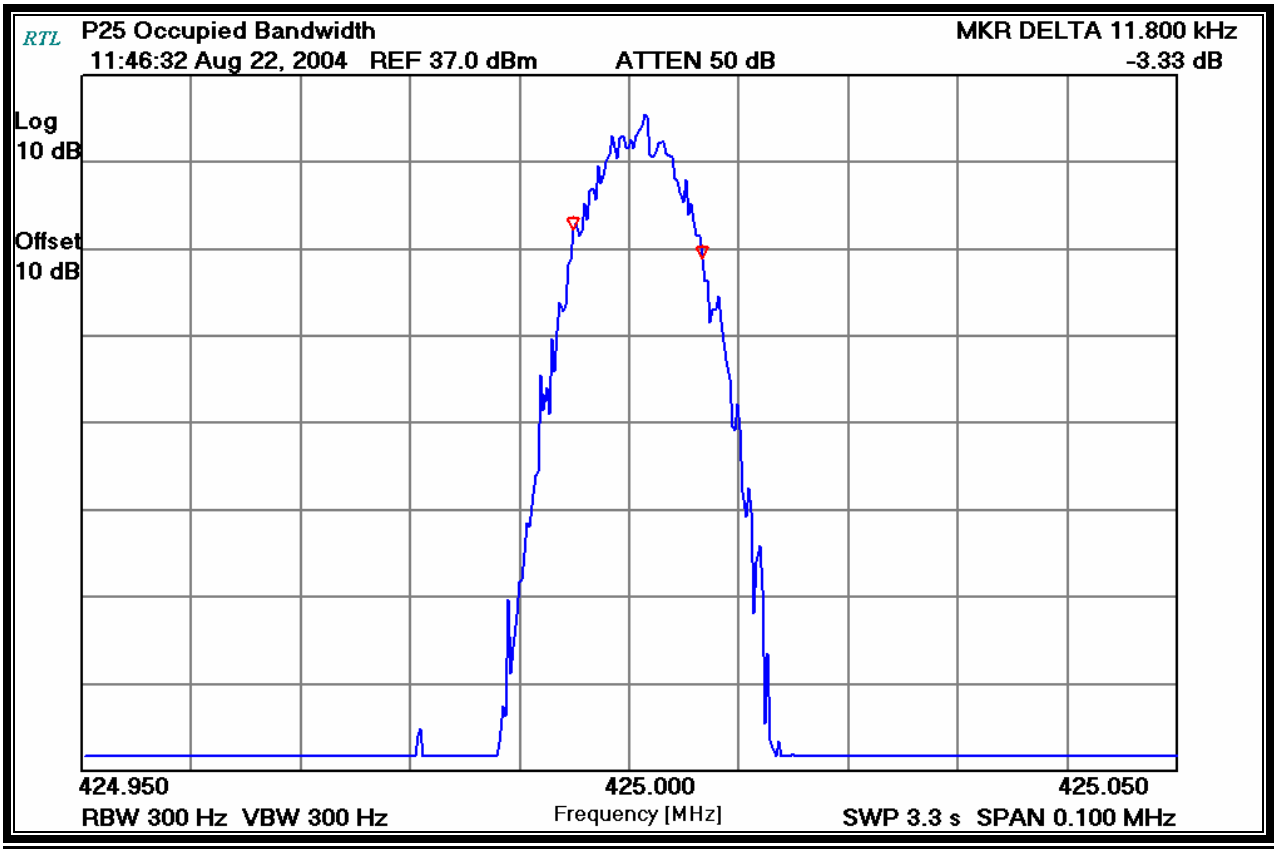
14 FCC PART 2.202: NECESSARY BANDWIDTH AND EMISSION BANDWIDTH

Type of Emission: F3E and F1E

Necessary Bandwidth and Emission Bandwidth calculation

The 25 kHz Analog modulation necessary bandwidth: Bn = 16K0F3E
The measured P25 Digital modulation necessary bandwidth: Bn = 11K8F1E
The 12.5 kHz Analog modulation bandwidth = 11K0F3E

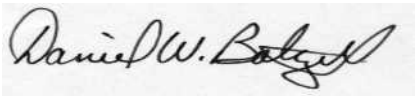
PLOT 14-1: P25 OCCUPIED BANDWIDTH



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
$B_{n(25KHz\ analog)}$ = 2xM+2xDK = (2x3) + (2x5x1) = 16 kHz
$B_{n(P25\ Digital)}$ = 11.8 kHz
$B_{n(12.5KHz\ )}$ = 2xM+2xDK = (2x3) + (2x2.5x1) = 11 kHz

TEST PERSONNEL:

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

15 CONCLUSION

The data in this measurement report shows that E.F. Johnson Model 242-513x, FCC ID: ATH2425131, complies with all the requirements of Parts 2 and 90 of the FCC Rules and Industry Canada RSS-119.