360 Herndon Parkway
Suite 1400
Herndon, VA 20170
http://www.rheintech.com

CERTIFICATE OF COMPLIANCE
FCC PART 90 CERTIFICATION & INDUSTRY CANADA CERTIFICATION

Test Lab:	Applicant Information:
Rhein Tech Laboratories, Inc. 360 Herndon Parkway Suite 1400 Herndon, VA 20170 Phone: 703-689-0368 Fax: 703-689-2056 Web Site: www.rheintech.com	E F Johnson 299 Johnson Ave. P.O. Box 1249 Waseca, MN 56093-0514 USA 507-835-6276 (John Oblak)

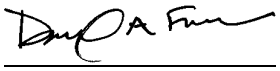
FCC ID:	ATH2425180	**FRN NUMBER:**	0005-8136-88
EQUIPMENT TYPE:	PTT 800 MHz SMR	**MODEL(S):**	242-5180
RTL WORK ORDER NUMBER:	2001338	**RTL QUOTE NUMBER:**	QRTL01-250
DATE OF TEST REPORT:	April 12, 2002		

FCC Classification:	☐ LMS – Part 90 Location & Monitoring Transmitters ☐ TBC – Licensed Broadcast Station Transmitter ☐ TBF – Licensed Broadcast Transmitter Held to Face ☐ TBT – Licensed Broadcast Transmitter Worn on Body ☐ TNB – Licensed Non-Broadcast Station Transmitter ☐ TNE – Licensed Nono-Broadcast Transmitter Held to Ear ☒ TNF – Licensed Non-Broadcast Transmitter Held to Face ☐ TNT – Licensed Non-Broadcast Transmitter Worn on Body
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)	Freq. Tolerance (PPM, %, or Hz)	Emission Designator
806.0125-868.9875	3.4	2.5 PPM	14K0F3E
806.0125-868.9875	3.4	2.5 PPM	16K0F3E
806.0125-868.9875	3.4	2.5 PPM	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 C63.4, ANSI/TIA/EIA603 and ANSI/TIA/EIA 603-1.

Signature: 

Date: April 12, 2002

Typed/Printed Name: Desmond A. Fraser

Position: President

Signature: 

Date: April 12, 2002

Typed/Printed Name: Daniel Baltzell

Position: Test Engineer

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1 GENERAL INFORMATION

1.1 SCOPE

FCC Rules Part 90 (Subpart S): The rules in this subpart govern the licensing and operation of all systems operating in the 806-824/851-869 MHz and 896-901/935-940 MHz 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/EIA603-1992/-1-1998 Land Mobile FM or PM Communications Equipment Measurement and Performance Standards. The instrumentation utilized for the measurements conforms to the ANSI C63.4 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 Communication Commission to perform AC line conducted and radiated emissions testing (ANSI C63.4 1992).

1.3 RELATED SUBMITTAL (S)/GRANT(S)

This is an original application for Certification. A DoC report is on file for the receiver section and digital interface for the EUT. The IF, LO and up to the 2nd LO were investigated.

2 EQUIPMENT INFORMATION

2.1 APPLICANT AND EQUIPMENT INFORMATION

Test Lab:	Applicant Information:
Rhein Tech Laboratories, Inc. 360 Herndon Parkway Suite 1400 Herndon, VA 20170 Phone: 703-689-0368 Fax: 703-689-2056 Web Site: www.rheintech.com	E F Johnson 299 Johnson Ave. P.O. Box 1249 Waseca, MN 56093-0514 USA 507-835-6276 (John Oblak)

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FCC Rule Part(s):	Part 90: Private Land Mobile Radio Services
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Frequency Range (MHz)	Output Power (W)	Freq. Tolerance (ppm, %, or Hz)	Emission Designator
806.0125-868.9875	3.4	2.5 ppm	14K0F3E
806.0125-868.9875	3.4	2.5 ppm	16K0F3E
806.0125-868.9875	3.4	2.5 ppm	8K10F1E

2.2 TEST SYSTEM DETAILS

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	242-5110	51101A361A-10001	ATH2425110	N/A	013673

TABLE 2-2: EXTERNAL COMPONENTS IN TEST CONFIGURATION

PART	MANUFACTURER	MODEL	SERIAL NUMBER	FCC ID	CABLE DESCRIPTION	RTL BAR CODE
BATTERY	EF JOHNSON	7.5V	H8297	N/A	N/A	013879
BATTERY	EF JOHNSON	H8923 XT	006419	N/A	N/A	014117

2.3 WORST CASE CONFIGURATION OF TESTED SYSTEM

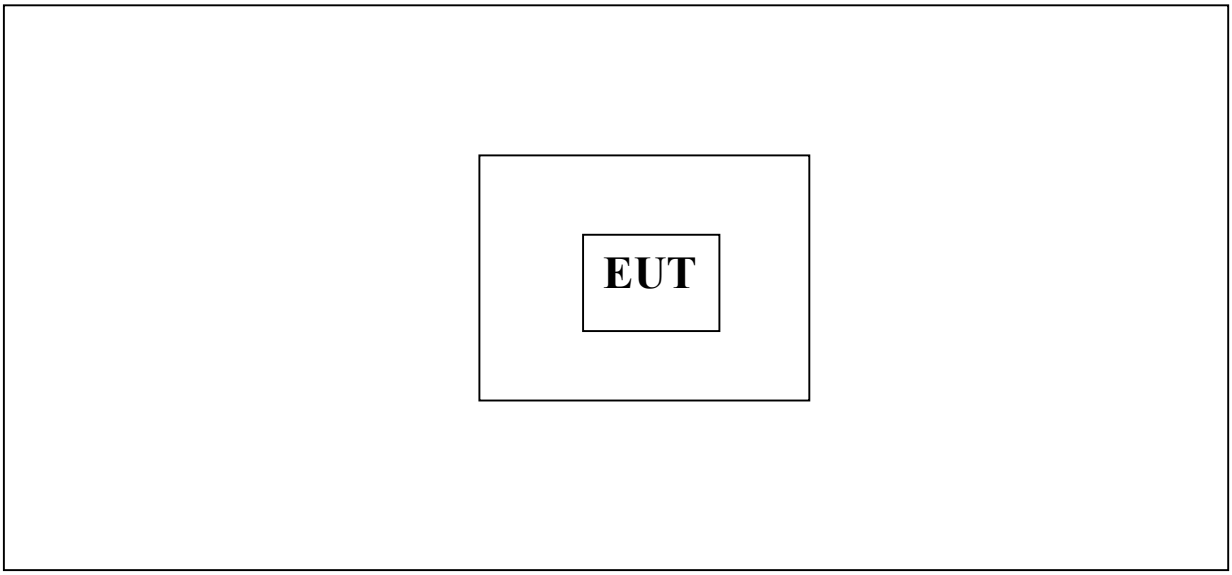


FIGURE 2-1: WORST CASE CONFIGURATION OF SYSTEM UNDER TEST

3 RF POWER OUTPUT - §2.1046

3.1 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.

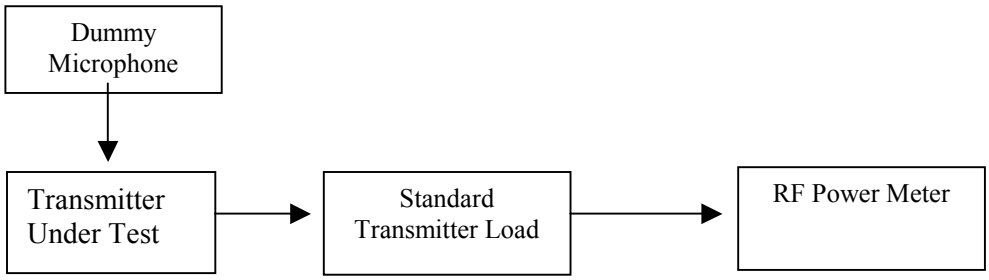


FIGURE 3-1: ILLUSTRATION OF HOW THE EQUIPMENT IS CONNECTED

3.2 RF POWER OUTPUT TEST EQUIPMENT

TABLE 3-1: 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	7/5/02
901186	Agilent Technologies	E9323A (50MHz-6GHz)	Peak & Avg. Power Sensor	US40410380	6/25/02

3.3 RF POWER OUTPUT TEST DATA

Frequency (MHz)	Channel	Power Measured (dBm)	Power (Watt)	Modulation Type
806.0125	1	35.30	3.388	25kHz Analog
815.0125	2	35.35	3.428	25kHz Analog
823.9875	3	35.34	3.420	25kHz Analog
806.0125	4	35.29	3.381	NPSPAC Analog
815.0125	5	35.35	3.428	NPSPAC Analog
823.9875	6	35.33	3.412	NPSPAC Analog
806.0125	7	35.28	3.373	P25 Digital
815.0125	8	35.35	3.428	P25 Digital
823.9875	9	35.32	3.404	P25 Digital
851.0125	10	35.26	3.357	25kHz Analog
860.0125	11	35.32	3.404	25kHz Analog
868.9875	12	35.31	3.396	25kHz Analog
851.0125	13	35.26	3.357	NPSPAC Analog
860.0125	14	35.31	3.396	NPSPAC Analog
868.9875	15	35.31	3.396	NPSPAC Analog
860.0125	16	35.30	3.388	P25 Digital

NOTE: CW measurements used for all power except modulation power for P25 digital.

TEST PERSONNEL:

DANIEL BALTZELL		JANUARY 7, 2002
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

4 MODULATION CHARACTERISTICS - §2.1047

4.1 MODULATION CHARACTERISTICS - §2.1047 TEST PROCEDURE

The modulation characteristic tests do not apply to digital modulation only to those channels with analog modulation.

4.2 MODULATION CHARACTERISTICS TEST EQUIPMENT

TABLE 4-1: MODULATION CHARACTERISTICS TEST EQUIPMENT

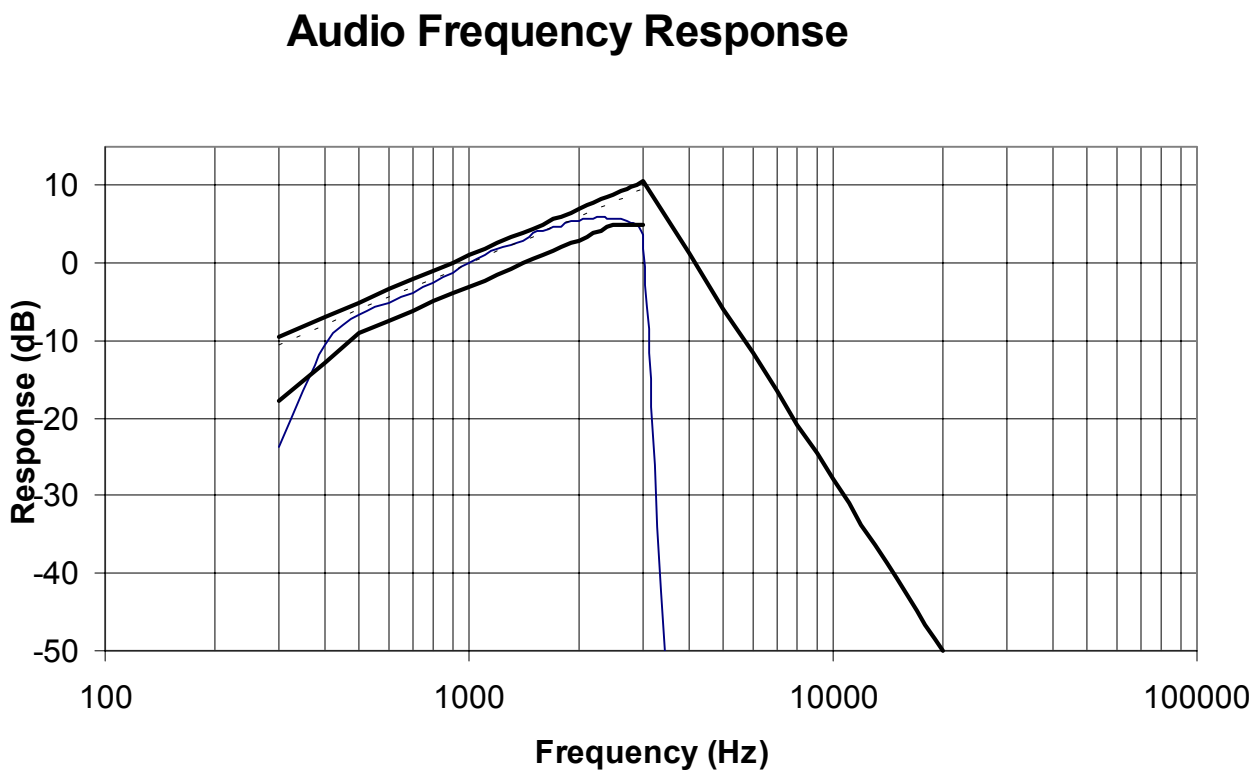
RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Cal Due Date
901055	Hewlett Packard	8901A Opt. 002-003	Modulation Analyzer	2545A04102	7/31/02
901057	Hewlett Packard	3336B	Synthesizer/Level Generator	2514A02585	7/13/02
901054	Hewlett Packard	HP 3586B	Selective Level Meter	1928A01892	7/16/02

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

5.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, 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)

PLOT 5-1: AUDIO FREQUENCY RESPONSE CHANNEL 1 AT 806 MHZ



TEST PERSONNEL:

DANIEL BALTZELL		APRIL 12, 2002
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

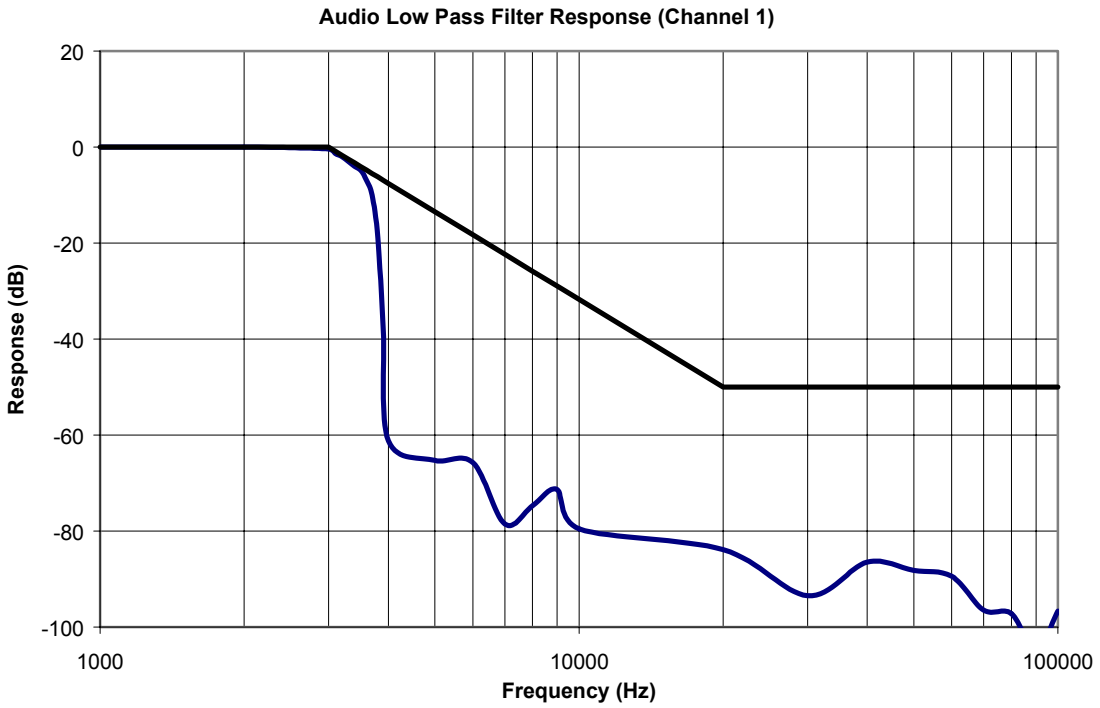
6 FCC PART 2 §2.1047 (A): MODULATION CHARACTERISTICS - AUDIO LOW PASS FILTER RESPONSE

6.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, 2.2.15

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

PLOT 6-1: AUDIO LOW PASS FILTER RESPONSE (CHANNEL 1)



TEST PERSONNEL:

DANIEL BALTZELL		JANUARY 7, 2002
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

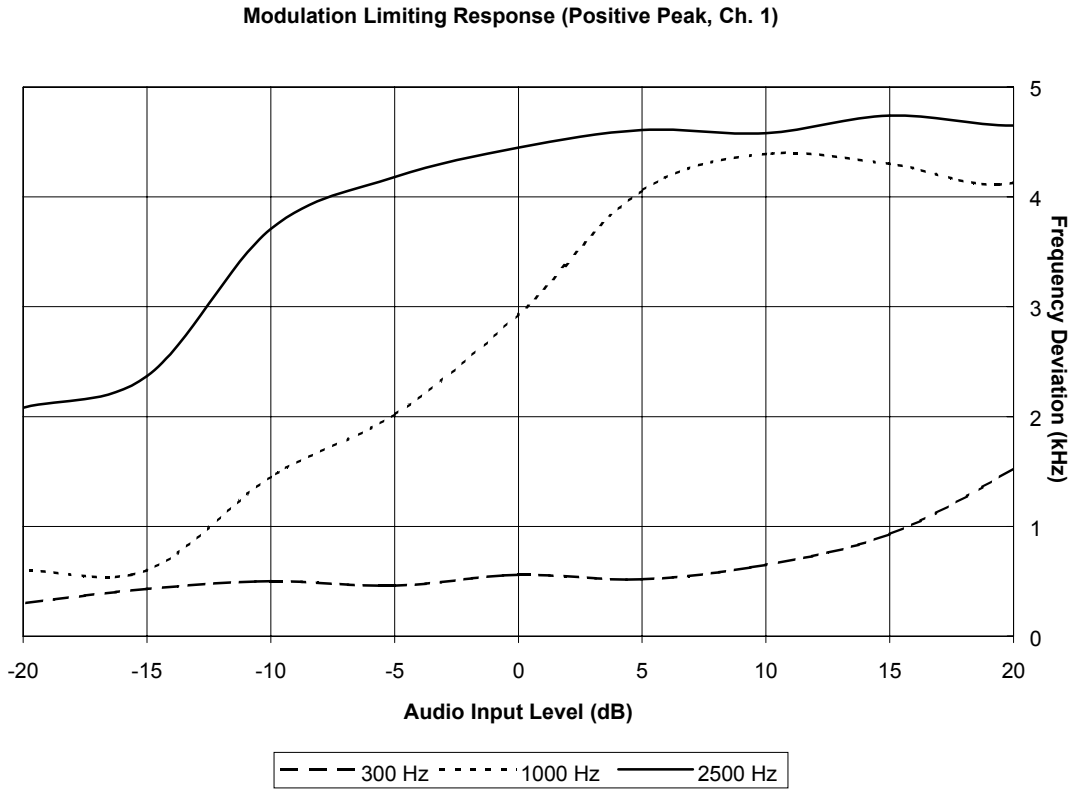
7 FCC PART 2 §2.1047 (B): MODULATION CHARACTERISTICS - MODULATION LIMITING

7.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, 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 1000Hz. Using this level as a reference (0dB) 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 300Hz, 1,000Hz, and 2,500Hz. The system deviation obtained as a function of the input level is recorded. Both Positive and Negative Peak deviations were recorded.

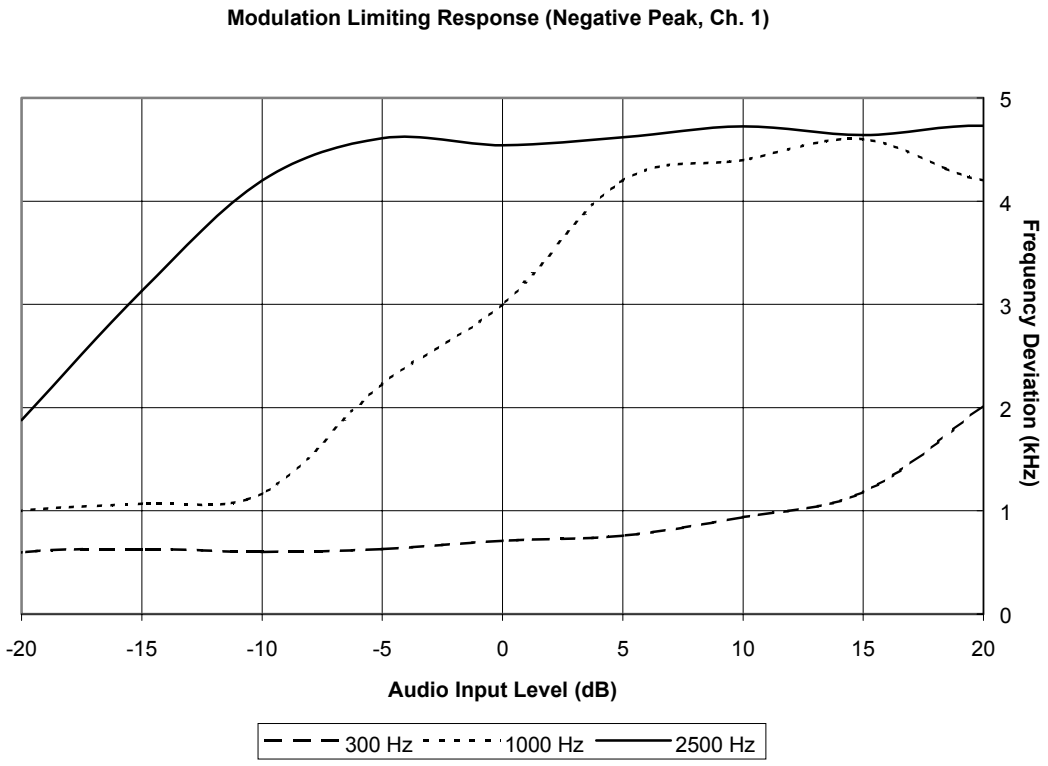
PLOT 7-1: MODULATION LIMITING RESPONSE (POSITIVE PEAK, CHANNEL 1)



TEST PERSONNEL:

DANIEL BALTZELL		JANUARY 7, 2002
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

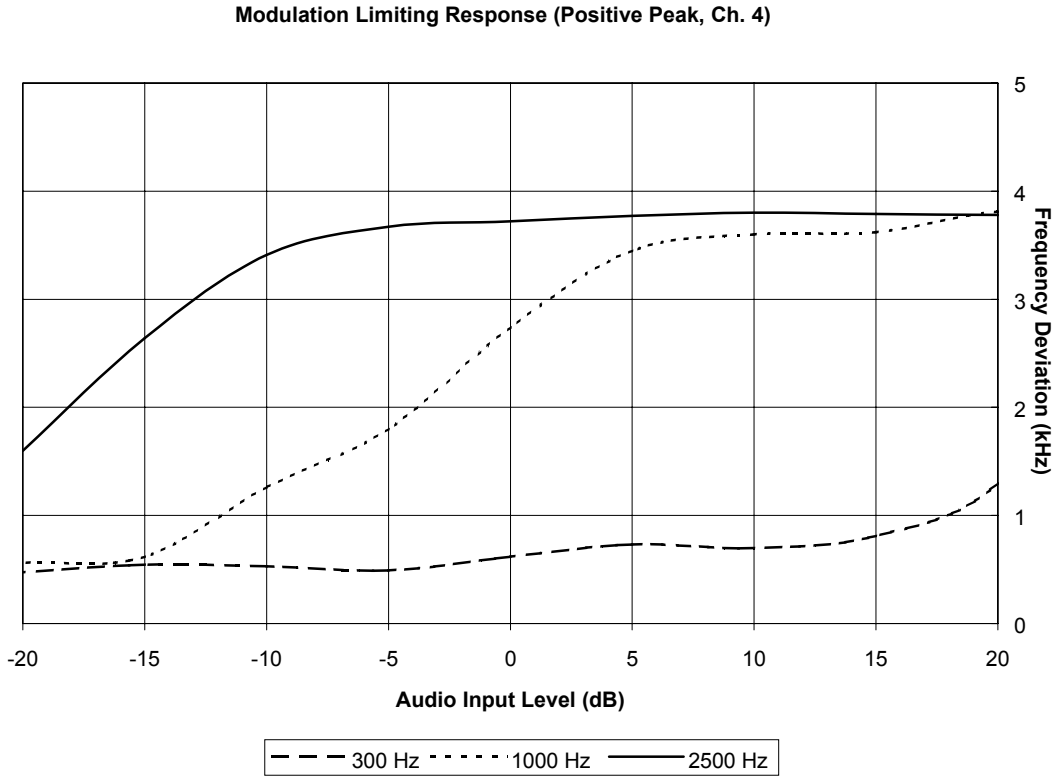
PLOT 7-2: MODULATION LIMITING RESPONSE (NEGATIVE PEAK, CHANNEL 1)



TEST PERSONNEL:

DANIEL BALTZELL		JANUARY 7, 2002
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

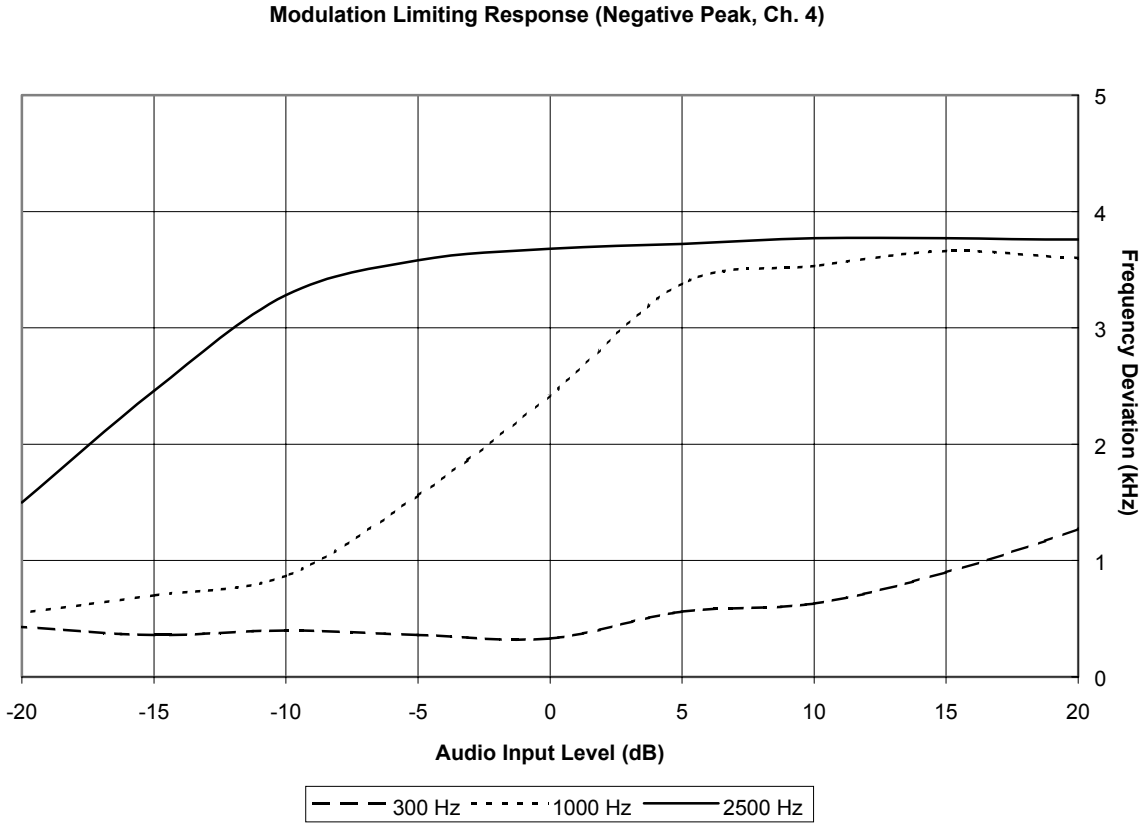
PLOT 7-3: MODULATION LIMITING RESPONSE (POSITIVE PEAK, CHANNEL 4)



TEST PERSONNEL:

DANIEL BALTZELL		JANUARY 7, 2002
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

PLOT 7-4: MODULATION LIMITING RESPONSE (NEGATIVE PEAK, CHANNEL 4)



TEST PERSONNEL:

DANIEL BALTZELL		JANUARY 7, 2002
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

8 OCCUPIED BANDWIDTH - §2.1049

8.1 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 30dB 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. Specified Limits:

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

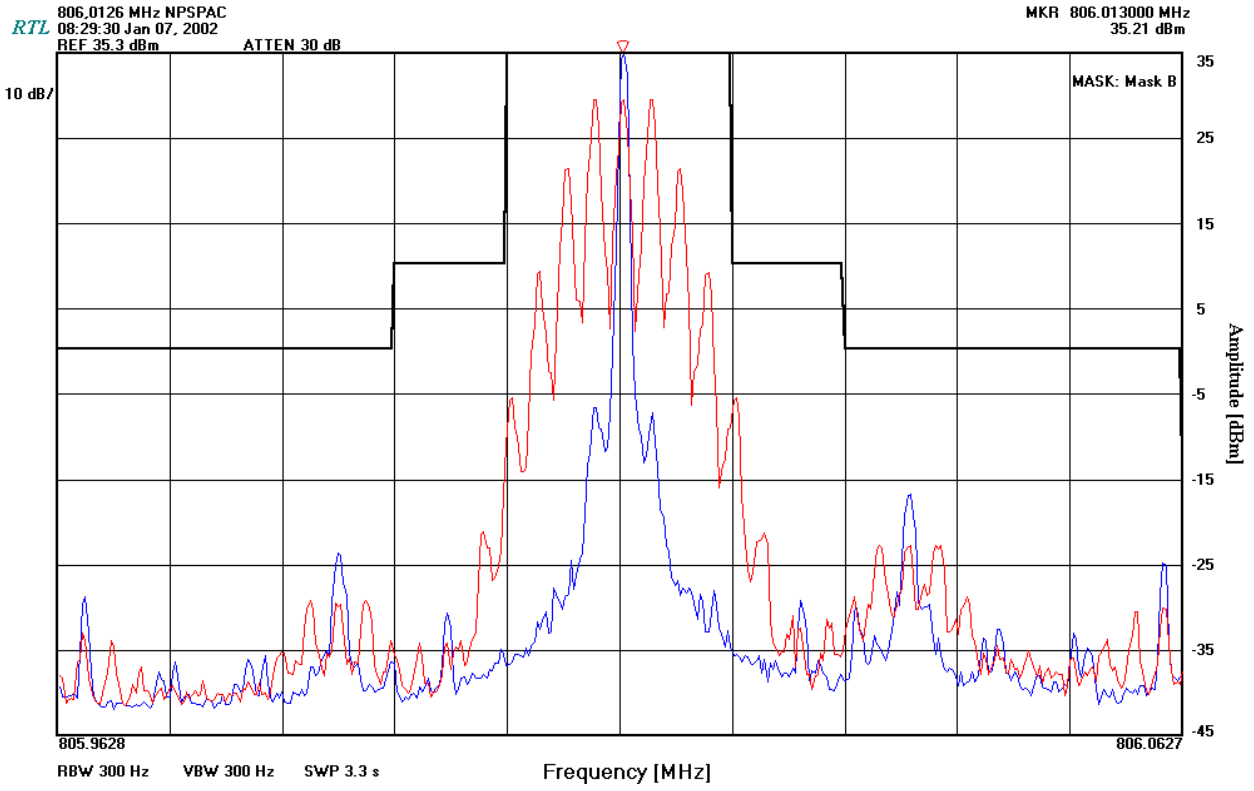
8.2 OCCUPIED BANDWIDTH TEST EQUIPMENT

TABLE 8-1: OCCUPIED BANDWIDTH TEST EQUIPMENT

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Cal Due Date
901020	Hewlett Packard	8564E	Portable Spectrum Analyzer (9kHz – 40 GHz)	3943A01719	6/7/02

8.3 OCCUPIED BANDWIDTH TEST DATA

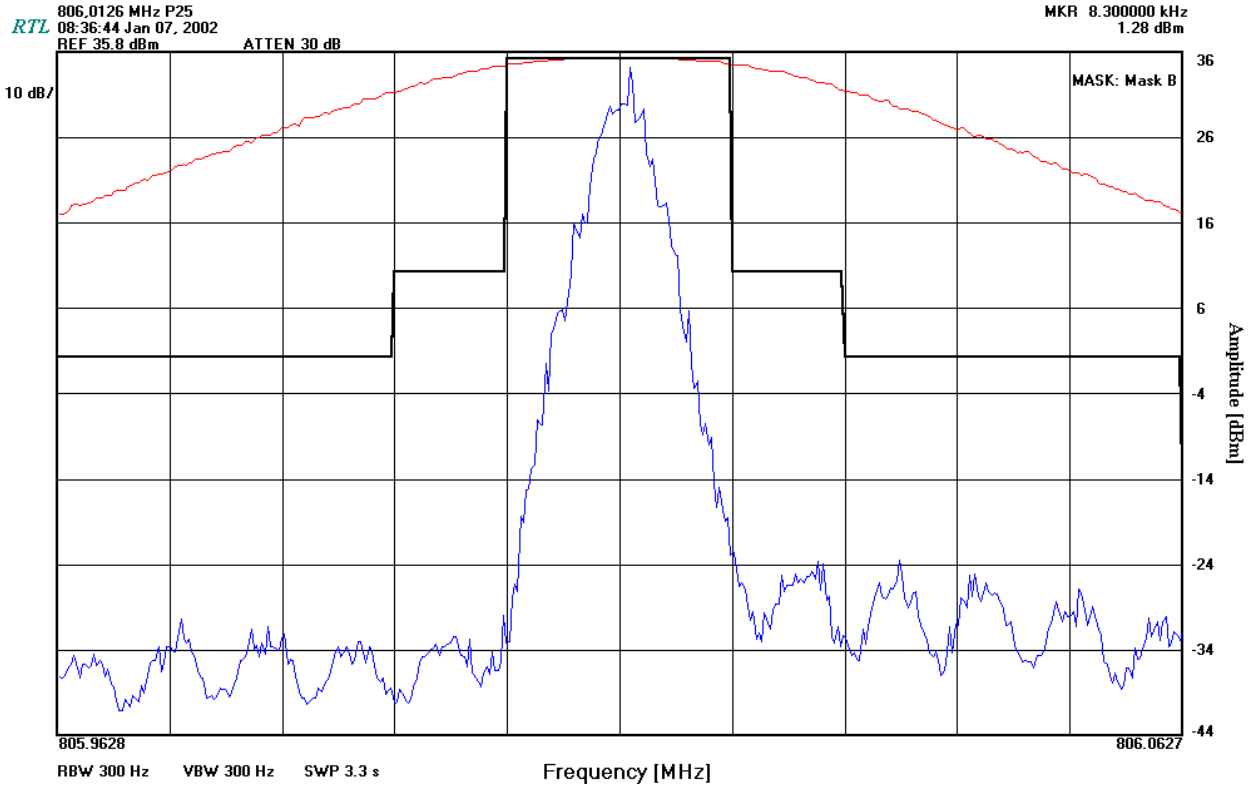
PLOT 8-1: MASK B (806.0125 MHZ; NPSPAC ANALOG CH4)



TEST PERSONNEL:

DANIEL BALTZELL		JANUARY 7, 2002
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

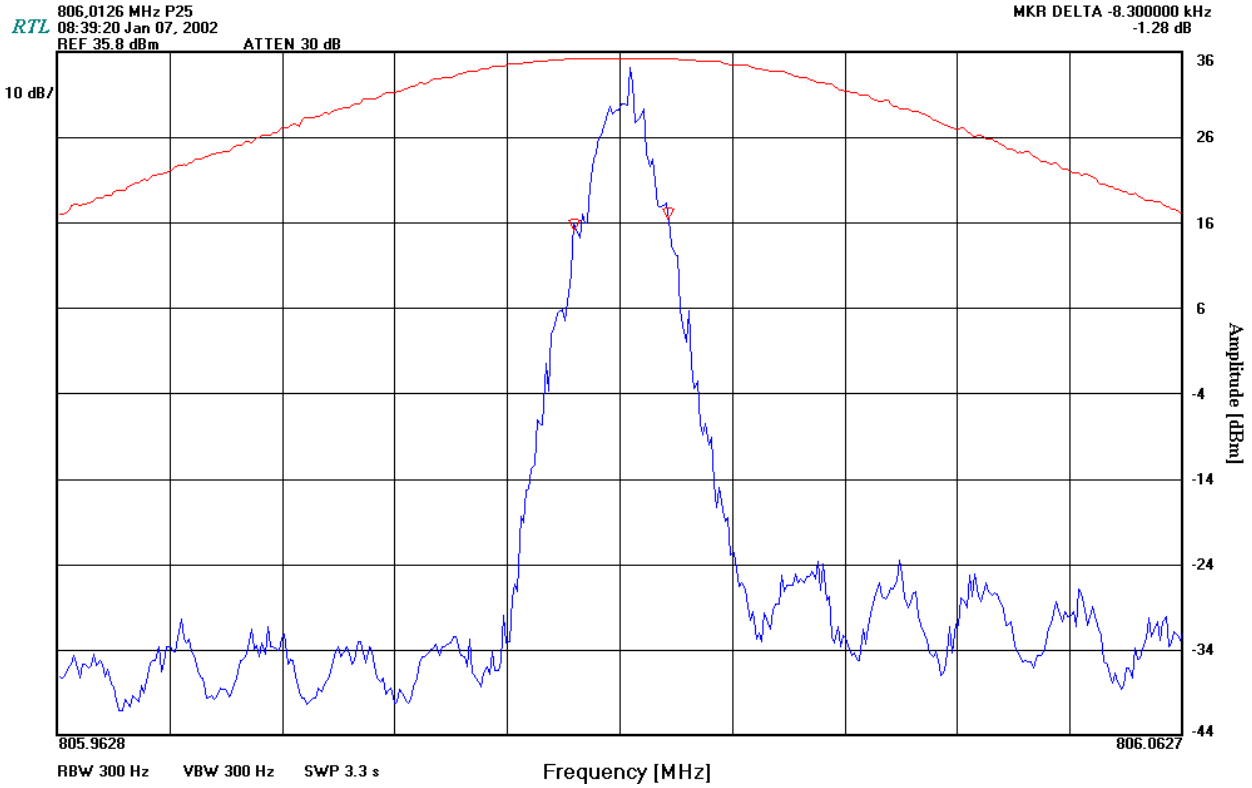
PLOT 8-2: MASK B (806.0125 MHZ; P25 DIGITAL) MASK B



TEST PERSONNEL:

DANIEL BALTZELL		JANUARY 7, 2002
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

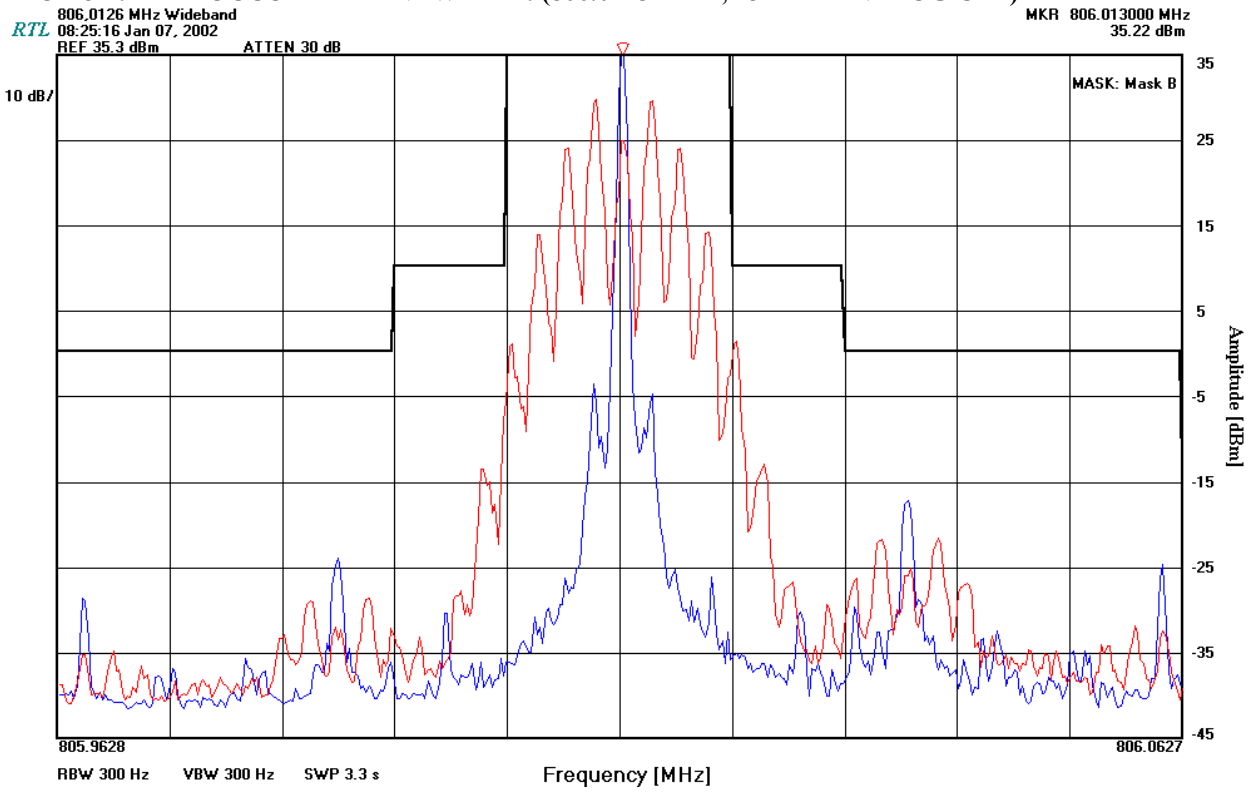
PLOT 8-3: OCCUPIED BANDWIDTH: (806.0125 MHZ, P25 DIGITAL 7): 8.3 KHZ



TEST PERSONNEL:

DANIEL BALTZELL		JANUARY 7, 2002
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

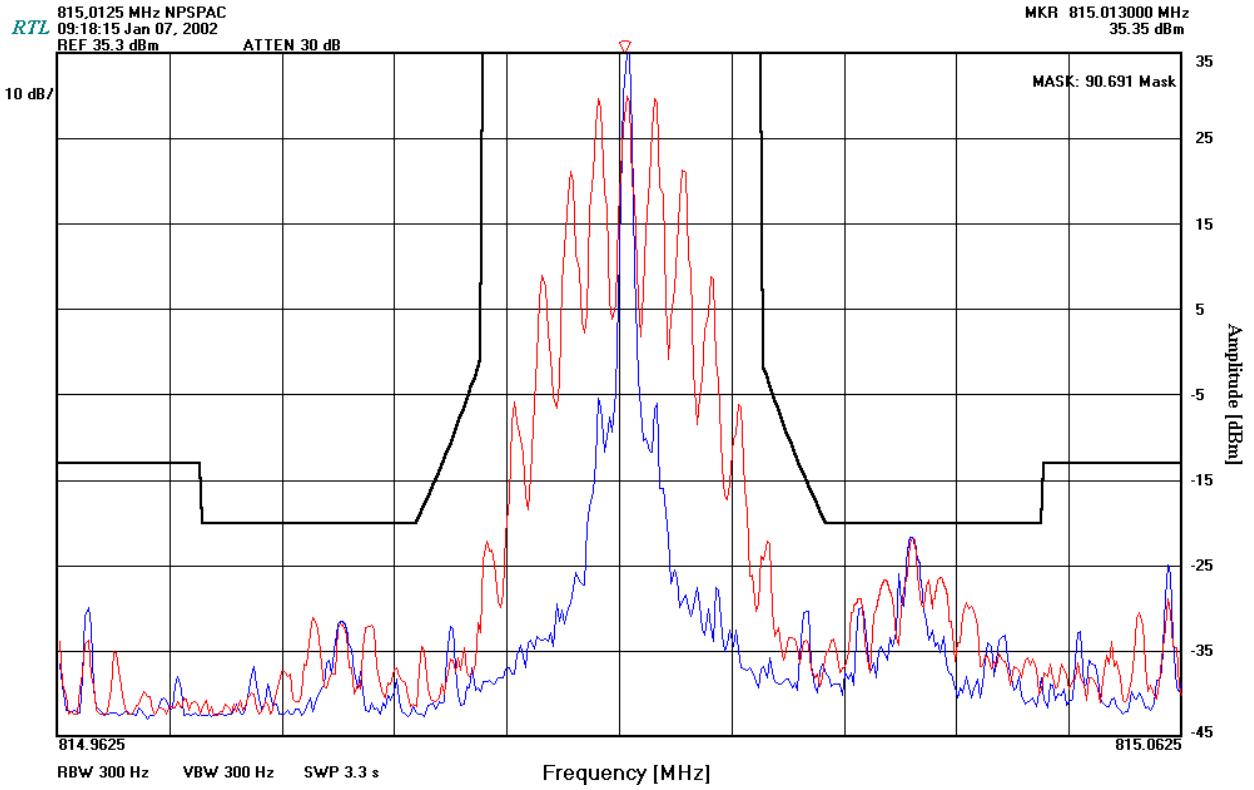
PLOT 8-4: OCCUPIED BANDWIDTH: (806.0125 MHZ, 25 KHZ ANALOG CH1)



TEST PERSONNEL:

DANIEL BALTZELL		JANUARY 7, 2002
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

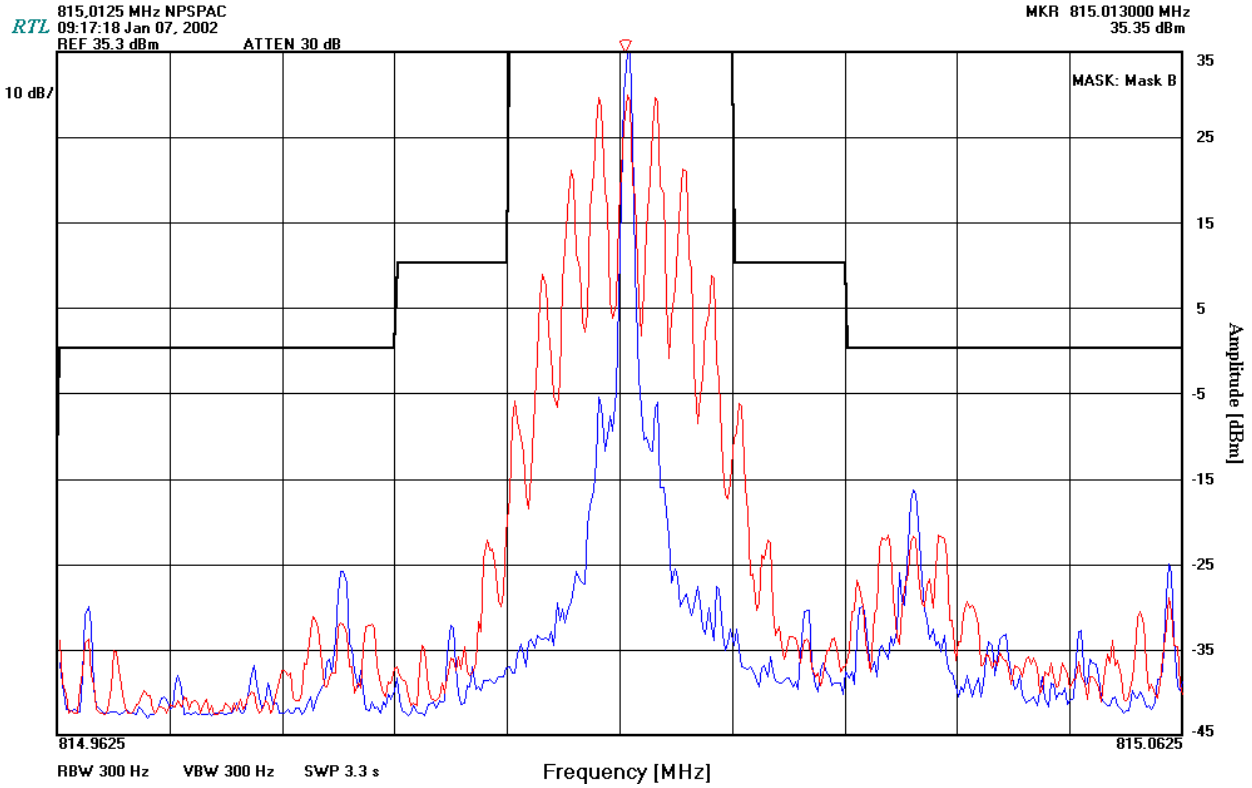
PLOT 8-5: OCCUPIED BANDWIDTH: (815.0125 MHZ, NPSPAC ANALOG CH5) MASK PER PART 90.691



TEST PERSONNEL:

DANIEL BALTZELL		JANUARY 7, 2002
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

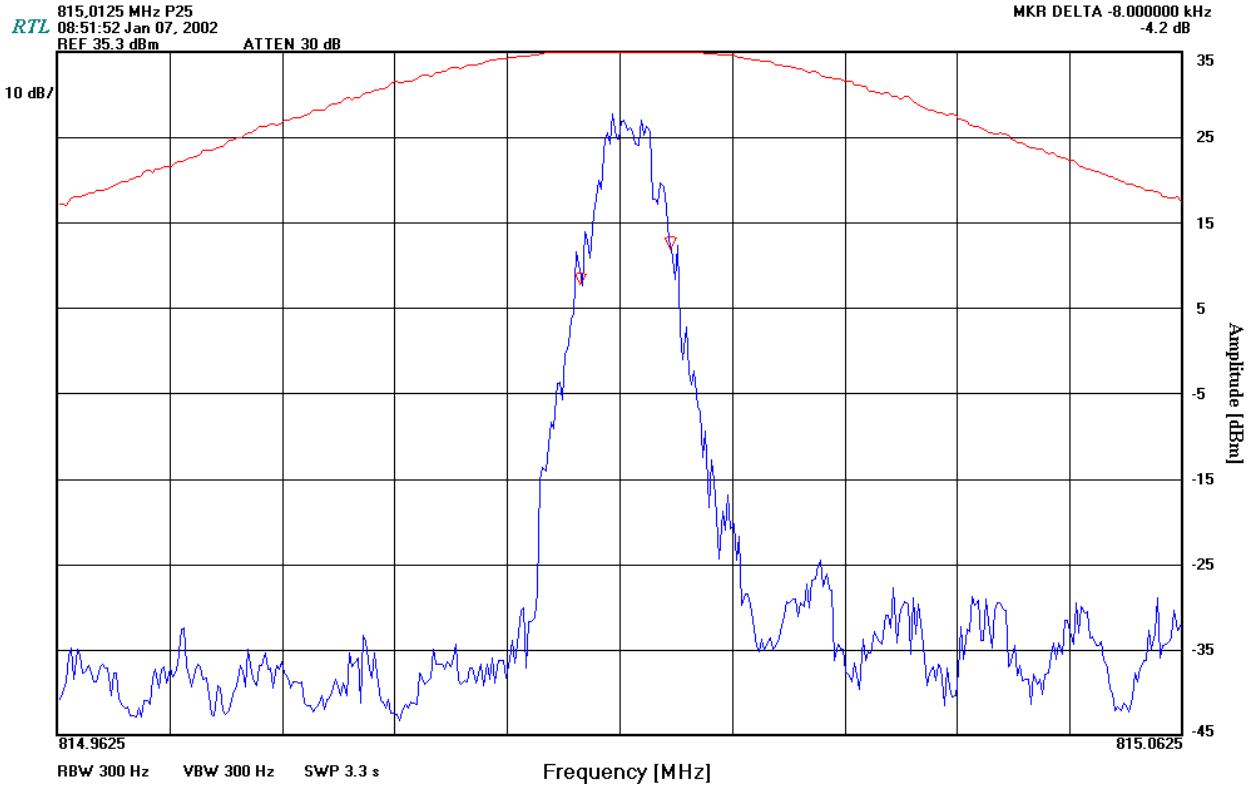
PLOT 8-6: OCCUPIED BANDWIDTH: (815.0125 MHZ, NPSPAC ANALOG CH5); MASK B



TEST PERSONNEL:

DANIEL BALTZELL		JANUARY 7, 2002
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

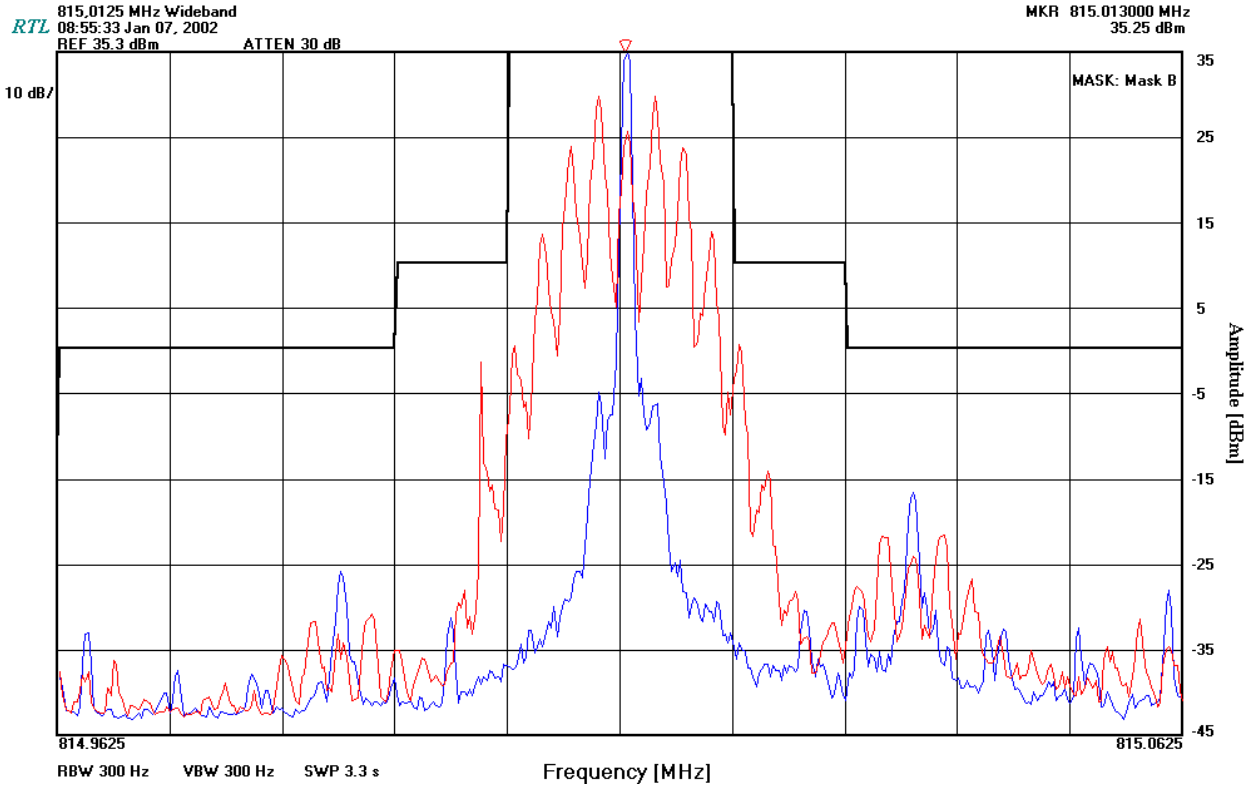
PLOT 8-7: OCCUPIED BANDWIDTH: (815.0125 MHZ; P25 DIGITAL CH8): 8 KHZ



TEST PERSONNEL:

DANIEL BALTZELL		JANUARY 7, 2002
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

PLOT 8-8: OCCUPIED BANDWIDTH: (815.0125 MHZ; 25 KHZ ANALOG CH2): MASK B



TEST PERSONNEL:

DANIEL BALTZELL		JANUARY 7, 2002
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

9 SPURIOUS EMISSIONS AT ANTENNA TERMINAL - §2.1051

9.1 SPURIOUS EMISSIONS AT ANTENNA TERMINAL - §2.1051 TEST PROCEDURE

The level of the carrier and 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 30dB attenuator and coaxial cable. The transmitter was operating at maximum power with internal data modulation.

9.2 SPURIOUS EMISSIONS AT ANTENNA TERMINAL TEST EQUIPMENT

TABLE 9-1: SPURIOUS EMISSIONS AT ANTENNA TERMINAL TEST EQUIPMENT

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Cal Due Date
901020	Hewlett Packard	8564E	Portable Spectrum Analyzer (9 kHz - 40 GHz)	3943A01719	6/7/02
901057	Hewlett Packard	3336B	Synthesizer/Level Generator	2514A02585	7/13/02
901054	Hewlett Packard	HP 3586B	Selective Level Meter	1928A01892	7/16/02
900913	Hewlett Packard	85462A	EMI Receiver RF Section (9 KHz – 6.5 GHz)	3325A00159	12/5/02

9.3 CONDUCTED SPURIOUS EMISSIONS TEST DATA

TABLE 9-2: CONDUCTED SPURIOUS EMISSIONS (CHANNEL 1 AT 806.015 MHZ)

Conducted Antenna Port level measured: 35.3 dBm
Limit = 48.3 dBc

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Notch Filter Insertion Loss (dB)	Corrected Spectrum Analyzer Level (dBc)	Margin (dB)
1612.030	-19.8	0.4	54.7	-6.4
2418.045	-45.5	5.9	74.9	-26.6
3224.060	-53.2	0.2	88.3	-40.0
4030.075	-49.5	0.2	84.6	-36.3
4836.090	-49.0	0.2	84.1	-35.8
5642.105	-68.4	12.9	90.8	-42.5
6448.120	-53.7	0.0	89.0	-40.7
7254.135				<50.0
8060.150				<50.0

TEST PERSONNEL:

DANIEL BALTZELL		FEBRUARY 24, 2002
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

TABLE 9-3: CONDUCTED SPURIOUS EMISSIONS (CHANNEL 4 AT 806.015 MHZ)

Conducted Antenna Port level measured: 35.29 dBm
Limit = 48.29 dBc

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Notch Filter Insertion Loss (dB)	Corrected Spectrum Analyzer Level (dBc)	Margin (dB)
1612.030	-19.9	0.4	54.79	-6.5
2418.045	-45.2	5.9	74.59	-26.3
3224.060	-54.3	0.2	89.39	-41.1
4030.075	-48.2	0.2	83.29	-35.0
4836.090	-48.7	0.2	83.79	-35.5
5642.105	-67.3	12.9	89.69	-41.4
6448.120	-52.3	0.0	87.59	-39.3
7254.135				<50.0
8060.150				<50.0

TEST PERSONNEL:

DANIEL BALTZELL		FEBRUARY 24, 2002
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

10 RADIATED SPURIOUS AND HARMONIC EMISSIONS - §2.1053

10.1 RADIATED SPURIOUS AND HARMONIC EMISSIONS - §2.1053

Radiated and harmonic emissions above 1 GHz were measured at our 3-meter outdoor site. The EUT was placed on the turntable with the transmitter transmitting into a non-radiating load. 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 and the polarization was varied to determine the worst-case emission level.

10.2 RADIATED SPURIOUS TEST EQUIPMENT

TABLE 10-1: 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	5/22/02
900932	Hewlett Packard	8449B OPT H02	Preamplifier 1-26.5 GHz	3008A00505	Not Required
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz – 22 GHz)	3138A07771	5/16/02
900917	Hewlett Packard	8648C	Signal Generator (100kHz – 3200 MHz)	3537A01741	4/19/03
900928	Hewlett Packard	83752A	Syntesized Sweeper (0.01 GHz – 20 GHz)	3610A00866	5/11/02

10.3 RADIATED SPURIOUS EMISSIONS TEST DATA - §2.1053

Operating Frequency (MHz): **815.0125**
Channel: **2**
Measured Cond. Pwr (dBm): **35.33**
Modulation: **25 kHz Analog**
Distance (m): **3**
Limit (dBc): **48.33**

TABLE 10-2: RADIATED SPURIOUS EMISSIONS DATA §2.1053

Frequency (MHz)	Spectrum Analyzer Level (dBuV)	**Signal Generator Level (dBm)**	**Cable Loss (dB)**	**Antenna Gain (dBd)**	**Corrected Level (dBc)**	**Margin (dB)**
1630.025	40.8	4.8	34.7	4.7	60.5	-12.2
2445.038	28.7	-25.6	31.7	5.1	87.5	-39.2
3260.05	23.7	-25.9	29.4	6.1	84.5	-36.2
4075.063	13.9	-31.7	28.6	6.0	89.6	-41.3
4890.075	20.3	-28.7	26.2	7.0	83.3	-35.0
5705.088						<50.0
6520.1						<50.0
7335.113						<50.0
8150.125						<50.0

TEST PERSONNEL:

DANIEL BALTZELL		FEBRUARY 24, 2002
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

The spectrum analyzer was set to the following settings:

1. Resolution Bandwidth 1 MHz
2. Video Bandwidth 10 Hz
3. Sweep Speed 200 ms
4. Detector Mode = Positive Peak

Notes:

ERP Measurements by Substitution Method:

The EUT was placed on a turntable 3-meters from the receive antenna. 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. The field strength was recorded from a calibrated spectrum analyzer for each channel being tested. A horn antenna was substituted in place of the EUT. The horn 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 signal generator level was corrected by subtracting the connecting cable loss, and further corrected with the horn gain referenced to a ½ wave dipole measurement.

Operating Frequency (MHz): **815.0125**
Channel: **5**
Measured Cond. Pwr. (dBm): **35.32**
Modulation: **NPSPAC Analog**
Distance (m): **3**
Limit (dBc): **48.32**

TABLE 10-3: RADIATED SPURIOUS EMISSIONS DATA §2.1053

Frequency (MHz)	Spectrum Analyzer Level (dBuV)	**Signal Generator Level (dBm)**	**Cable Loss (dB)**	**Antenna Gain (dBd)**	**Corrected Level (dBc)**	**Margin (dB)**
1630.025	41.7	5.7	34.7	4.7	59.6	-11.3
2445.038	29.9	-24.4	31.7	5.1	86.3	-38.0
3260.05	24.4	-25.2	29.4	6.1	83.8	-35.5
4075.063	20.4	-25.2	28.6	6.0	83.1	-34.8
4890.075	17.6	-31.4	26.2	7.0	86.0	-37.7
5705.088						<50.0
6520.1						<50.0
7335.113						<50.0
8150.125						<50.0

TEST PERSONNEL:

DANIEL BALTZELL — SIGNATURE — FEBRUARY 24, 2002
TEST TECHNICIAN/ENGINEER — DATE OF TEST

The spectrum analyzer was set to the following settings:

5. Resolution Bandwidth 1 MHz
6. Video Bandwidth 10 Hz
7. Sweep Speed 200 ms
8. Detector Mode = Positive Peak

Notes:

ERP Measurements by Substitution Method:

The EUT was placed on a turntable 3-meters from the receive antenna. 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. The field strength was recorded from a calibrated spectrum analyzer for each channel being tested. A horn antenna was substituted in place of the EUT. The horn 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 signal generator level was corrected by subtracting the connecting cable loss, and further corrected with the horn gain referenced to a ½ wave dipole measurement.

11 FREQUENCY STABILITY / TEMPERATURE VARIATION - §2.1055

11.1 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.

11.2 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 an overnight "soak" at -30°C without any power applied.
3. After the overnight "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 +60°C, then back to room temperature. A minimum period of one hour was provided to allow stabilization of the equipment at each temperature level.

11.3 FREQUENCY TOLERANCE:

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

11.4 FREQUENCY STABILITY TEST EQUIPMENT

TABLE 11-1: 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	11/19/02
901055	Hewlett Packard	8901A Opt. 002-003	Modulation Analyzer	2545A04102	7/31/02

11.5 FREQUENCY STABILITY TEST DATA - §2.1055

Operating Frequency: 806.0125 MHz
Channel: 1
Reference Voltage: 7.5 VDC
Deviation Limit: 0.00025% or 2.5 PPM

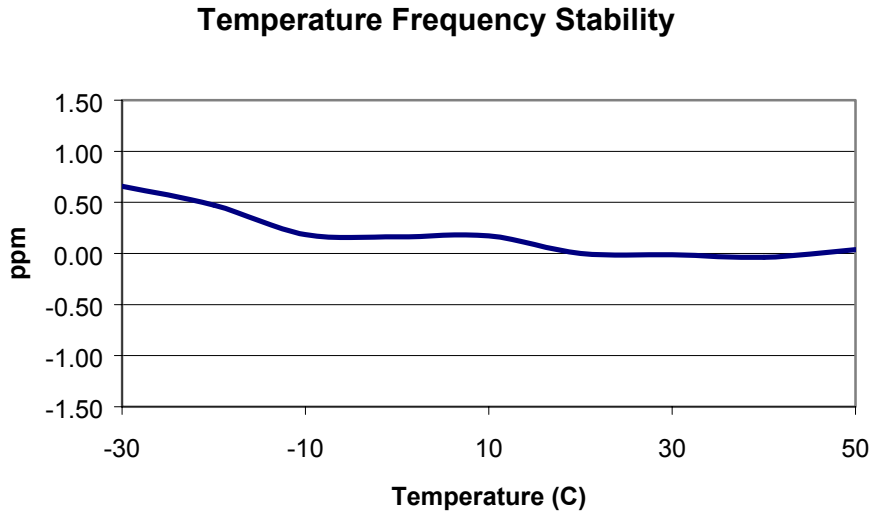
TABLE 11-2: FREQUENCY STABILITY DATA - §2.1055: TEMPERATURE

Temperature (ºC)	Measured Frequency (MHz)	ppm
-30	806.01303	0.66
-20	806.01288	0.47
-10	806.01265	0.19
0	806.01263	0.16
10	806.01264	0.17
20	806.0125	0.00
30	806.01249	-0.01
40	806.01247	-0.04
50	806.01253	0.04

TEST PERSONNEL:

DANIEL BALTZELL		FEBRUARY 24, 2002
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

PLOT 11-1: TEMPERATURE FREQUENCY STABILITY - §2.1055



TEST PERSONNEL:

DANIEL BALTZELL		FEBRUARY 24, 2002
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

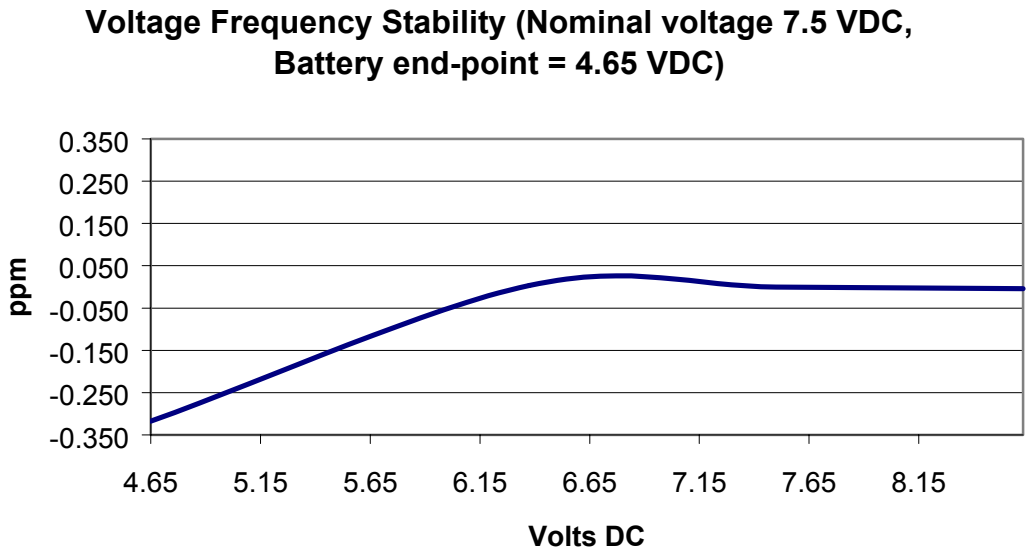
TABLE 11-3: FREQUENCY STABILITY DATA - §2.1055: VOLTAGE

Voltage (DC)	Measured Frequency (MHz)	ppm
4.65	806.012244	-0.318
6.375	806.012503	0.004
7.5	806.01250	0.000
8.625	806.012497	-0.004

TEST PERSONNEL:

DANIEL BALTZELL		FEBRUARY 24, 2002
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

PLOT 11-2: VOLTAGE FREQUENCY STABILITY - §2.1055



TEST PERSONNEL:

DANIEL BALTZELL		FEBRUARY 24, 2002
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

12 FCC PART 90 §90.214: TRANSIENT FREQUENCY BEHAVIOR

12.1 TRANSIENT FREQUENCY BEHAVIOR TEST PROCEDURE

ANSI/TIA/EIA-603-1992, section 2.2.19

12.2 TRANSIENT FREQUENCY BEHAVIOR LIMITS

TABLE 12-1: 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 12-2: 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.

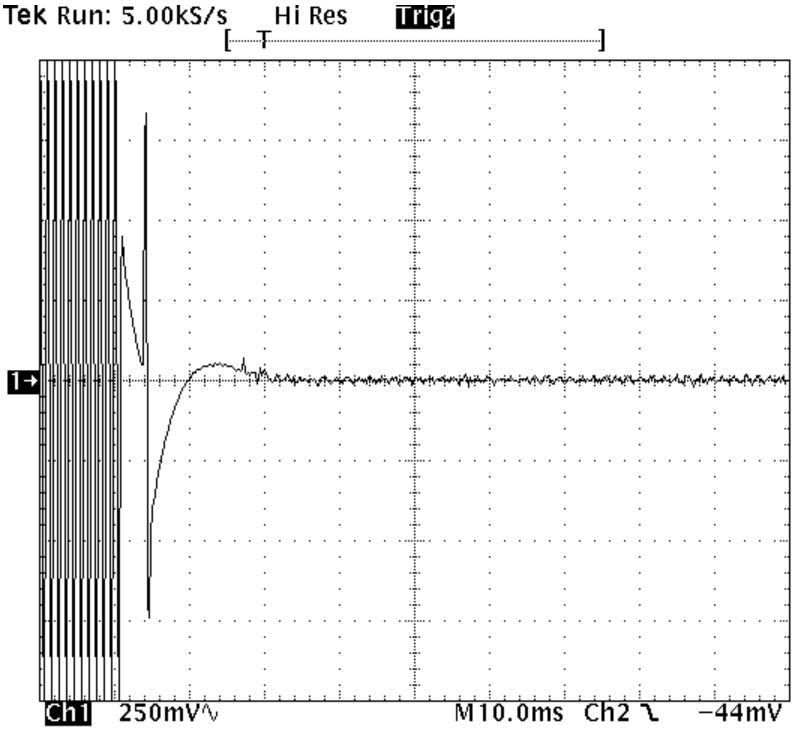
Maximum frequency difference between time T2 and T3: Calculation for Channel 5:
The frequency stability is required to be 2.5 PPM.
Calculation for Channel 5:
4 div. on scope represent 12.5kHz for narrow band channel.
Therefore, 145.525 MHz times 2.5 PPM times +/- 4 Divisions divided by 12.5kHz equals about +/- 0.12 division. 0.12 Div. correspond to 1.213 kHz

TABLE 12-3: 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

12.3 TRANSIENT FREQUENCY BEHAVIOR TEST DATA

PLOT 12-1: (ON TIME) – CHANNEL 1: 806.0125 MHZ {25 KHZ NARROW BAND}



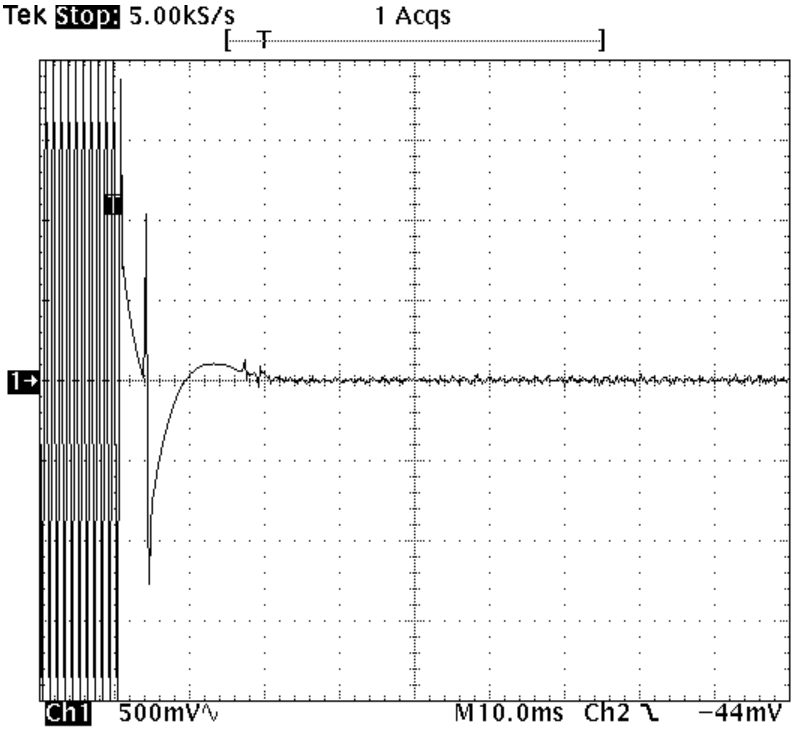
Carrier ON time:
High Power: 3 W rated
Channel 1 : 815.0125 MHz WB(25kHz)
RF Signal Generator: Modulation 25kHz deviation

Timebase: 10 ms/div
Trigger: On negative edge of Ch2, level –44mV
Ch1: 250mV/div, Probe 1.000:1
Vertical scale: +/- 4 div. corresponds to +/- 25 kHz

TEST PERSONNEL:

DANIEL BALTZELL		FEBRUARY 24, 2002
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

PLOT 12-2: (ON TIME) – CHANNEL 1: 806.0125 MHZ {25 KHZ WIDE BAND}



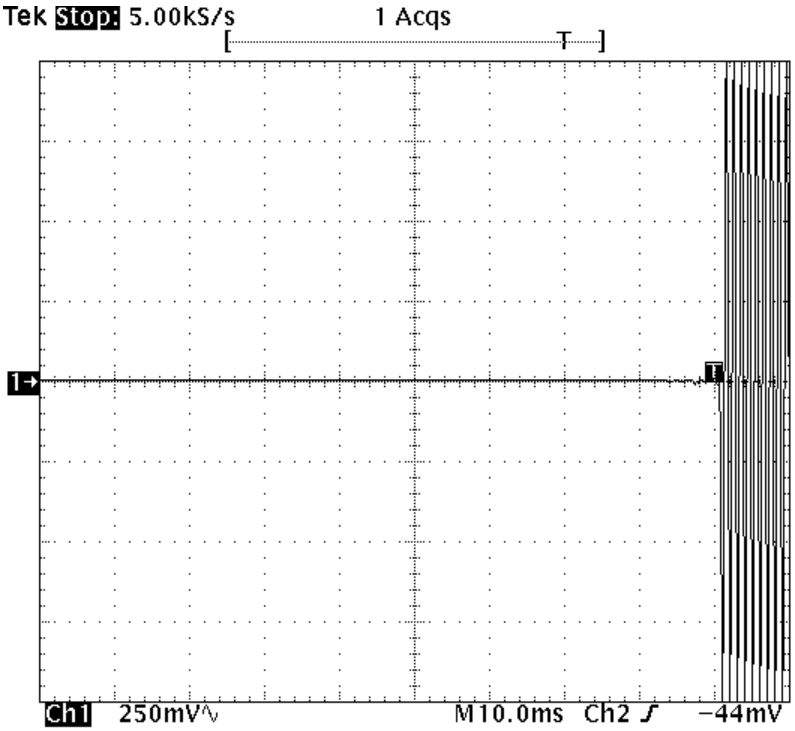
Carrier ON time:
High Power: 5 W rated
Channel 2 : 155.0 MHz WB(25kHz)
RF Signal Generator: Modulation 25kHz deviation to +/- 25 kHz

Timebase: 10 ms/div
Trigger: On negative edge of Ch2, level –44mV
Ch1: 500mV/div, Probe 1.000:1
Vertical scale: +/- 4 div. corresponds

TEST PERSONNEL:

DANIEL BALTZELL		FEBRUARY 24, 2002
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

PLOT 12-3: (OFF TIME) – CHANNEL 5: 155.0 MHZ {12.5 KHZ NARROW BAND}



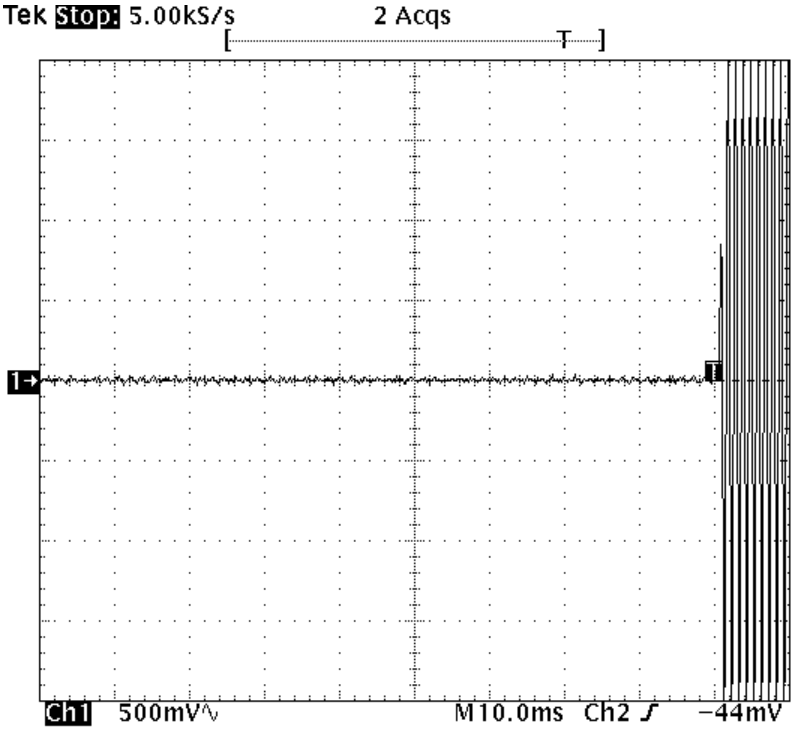
Carrier OFF time:
High Power: 5 W rated
Channel 5 : 155.0 MHz NB(12.5kHz)
RF Signal Generator: Modulation 12.5kHz deviation to +/- 12.5 kHz

Timebase: 10 ms/div
Trigger: On negative edge of Ch2, level -44mV
Ch1: 250 mV/div, Probe 1.000:1
Vertical scale: +/- 4 div. corresponds

TEST PERSONNEL:

DANIEL BALTZELL		FEBRUARY 24, 2002
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

PLOT 12-4: (OFF TIME) – CHANNEL 2: 155.0 MHZ {25 KHZ WIDE BAND}



Carrier OFF time:
High Power: 5 W rated
Channel 2 : 155.0 MHz WB(25kHz)
RF Signal Generator: Modulation 25kHz deviation

Timebase: 10 ms/div
Trigger: On negative edge of Ch2, level –44 mV
Ch1: 500 mV/div, Probe 1.000:1
Vertical scale: +/- 4 div. corresponds to +/- 25 kHz

TEST PERSONNEL:

DANIEL BALTZELL		FEBRUARY 24, 2002
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

13 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 P25 Digital modulation necessary bandwidth: Bn = 8K10F1E
The 25KHz NPSPAC Analog modulation bandwidth = 14K0F3E

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 (25 KHz channel spacing NPSPAC): 4
Constant factor (K): 1
$B_{n(25KHz\ analog)}$ = 2xM+2xDK =(2x3) + (2x5x1) = 16 KHz
$B_{n(P25\ Digital)}$ = 8.1kHz
$B_{n(25KHz\ NPSPAC)}$ = 2xM+2xDK = (2x3) +(2x4x1) = 14 KHz

14 CONCLUSION

The data in this measurement report shows that the above complies with all the requirements of Parts 2 and 90 of the FCC Rules and Industry Canada RSS-119.