Engineering and Testing for EMC and Safety Compliance

CERTIFICATION APPLICATION REPORT
FCC PART 95

Test Lab:	Applicant:
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FCC ID:	OJ7901GMR0903	**GRANTEE FRN NUMBER:**	0009634965
PLAT FORM:	N/A	**RTL WORK ORDER NUMBER:**	2003184
MODEL NUMBER / NAME:	VC901 / LF-VC901	**RTL QUOTE NUMBER:**	QRTL03-140A
DATE OF TEST REPORT:	October 16, 2003		

American National Standard Institute:	ANSI C63.4: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
FCC Classification:	FRF -Part 95 Family Radio Face Held Transmitter
FCC Rule Part(s):	Part 95 – Personal Radio Services
Receiver Information	Receiver was found to be compliant - verification report on file

Frequency Range (MHz)	Output Power* (W)	Frequency Tolerance	Emission Designator
462.5625 – 467.7125	0.457	0.00025%	9K0F3E
462.5500 – 462.7250	1.97	0.0005%	9K0F3E

* output power is maximum ERP

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.

Furthermore, there was no deviation from, additions to, or exclusions from the FCC Part 2, FCC Part 15, FCC Part 95, and ANSI C63.4

Signature: _____ Date: October 16, 2003

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

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1 GENERAL INFORMATION

1.1 SCOPE

FCC Rules Part 95: The rules in this subpart govern the licensing and operation of personal radio services.

All measurements contained in this application were conducted in accordance with the FCC Rules and Regulations CFR47 and/or ANSI/TIA-603-B-2002 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 Communications 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 for FCC ID: OJ7901GMR0903. Per FCC 15.101(b), the receiver portion of the EUT is subject to verification; this verification report is on file.

2 EQUIPMENT INFORMATION

2.1 JUSTIFICATION

The EUT operates on Part 95 FRS and GMRS frequencies; four test frequencies were used for testing:

FRS Channel 1 – 462.5625 MHz
FRS Channel 14 – 467.7125 MHz
GMRS Channel 15 – 462.5500 MHz
GMRS Channel 7 – 462.7125 MHz

The EUT is battery powered when used as a transceiver. A power supply is used to charge the EUT when rechargeable batteries are used, but operation of the transceiver is disabled.

2.2 EXERCISING THE EUT

To facilitate intentional radiator testing, the manufacturer programmed the EUT with a continuous transmit mode. This mode is for testing only, and is not available to the end user.

2.3 MODIFICATIONS

No modifications were made to the EUT during testing in order to achieve compliance.

2.4 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
FRS/GMRS Radio	Victory Concept Industries Ltd	VC901 / LF-VC901	901 GMRS #27	OJ7901GMR0903
FRS/GMRS Radio	Victory Concept Industries Ltd	VC901 / LF-VC901	901 GMRS #6	OJ7901GMR0903
FRS/GMRS Radio	Victory Concept Industries Ltd	VC901 / LF-VC901	901 GMRS #9	OJ7901GMR0903
Power Supply	Victory Concept Industries Ltd	U075020D12	N/A	N/A
Ear piece/mic	Victory Concept Industries Ltd	VC901	092503-426/27/28OJ7	N/A

2.5 CONFIGURATION OF TESTED SYSTEM

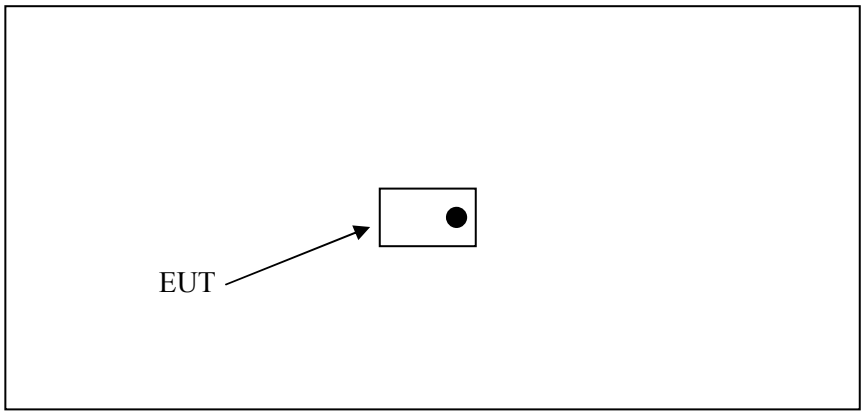


FIGURE 2-1: CONFIGURATION OF TESTED SYSTEM

3 TRANSMITTER CHANNEL FREQUENCIES

FCC 95.621(a) specifies the permitted GMRS transmitter frequencies. The EUT operates on the following GMRS frequencies:

TABLE 3-1: EUT GMRS FREQUENCIES

Channel Number	Frequency (MHz)
15	462.5500
1	462.5625
16	462.5750
2	462.5875
17	462.6000
3	462.6125
18	462.6250
4	462.6375
19	462.6500
5	462.6625
20	462.6750
6	462.6875
21	462.7000
7	462.7125
22	462.7250

FCC 95.627(a) specifies the permitted FRS transmitter frequencies. The EUT operates on the following FRS frequencies:

TABLE 3-2: EUT FRS FREQUENCIES

Channel Number	Frequency (MHz)
1	462.5625
2	462.5875
3	462.6125
4	462.6375
5	462.6625
6	462.6875
7	462.7125
8	467.5625
9	467.5875
10	467.6125
11	467.6375
12	467.6625
13	467.6875
14	467.7125

4 FREQUENCY STABILITY

Per FCC 95.621(b), GMRS transmitters must maintain a frequency tolerance of 0.0005%.

Per FCC 95.627(b), FRS transmitters must maintain a frequency tolerance of 0.00025%.

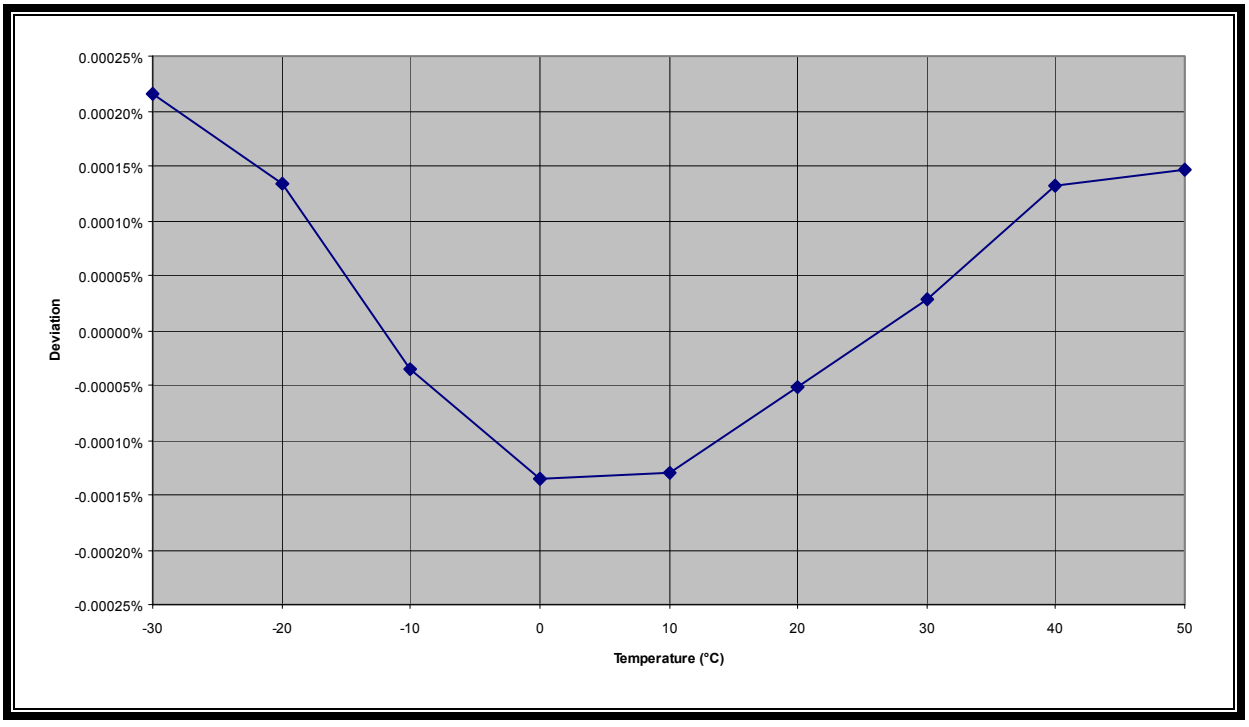
Per FCC 2.1055(a)(1), the frequency stability shall be measured with variation of ambient temperature from –30°C to +50°C.

The EUT was tested at an assigned frequency of 462.5625 MHz. Per the tables and graphs that follow, the EUT meets both the GMRS and FRS frequency stability requirements.

TABLE 4-1: FREQUENCY STABILITY VS TEMPERATURE

Temperature (°C)	Measured Frequency (Hz)	Deviation (%)
-30	462,561,500	0.00022
-20	462,561,880	0.00013
-10	462,562,660	-0.00003
0	462,563,130	-0.00014
10	462,563,100	-0.00013
20	462,562,740	-0.00005
30	462,562,370	0.00003
40	462,561,890	0.00013
50	462,561,820	0.00015

PLOT 4-1: FREQUENCY STABILITY VS TEMPERATURE

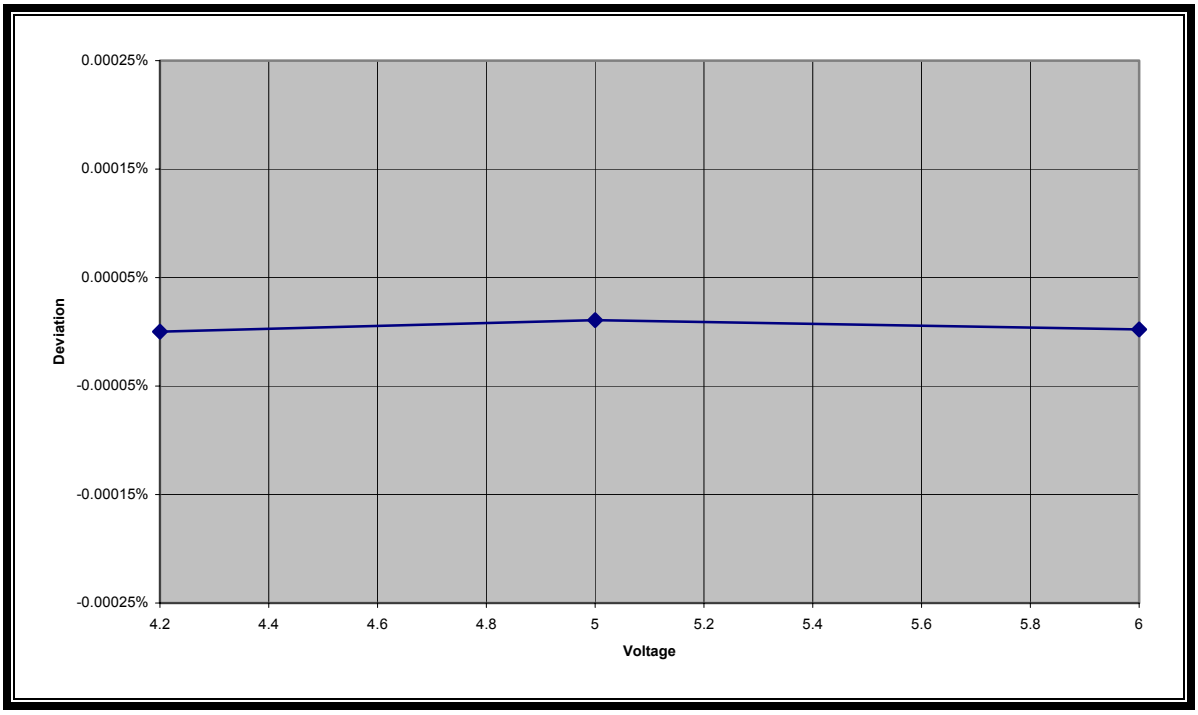


Manufacturer's attested battery end point: 4.2V

TABLE 4-2: FREQUENCY STABILITY VS VOLTAGE

Voltage (V)	Measured Frequency (Hz)	Deviation (%)
4.2	462,562,500	0.00000
5	462,562,450	0.00001
6	462,562,490	0.00000

PLOT 4-2: FREQUENCY STABILITY VS VOLTAGE



TEST PERSONNEL:

Richard B. McMurray, PE	Richard B. McMurray	October 13 and 14, 2003
Test Engineer	Signature	Dates Of Test

TABLE 4-3: FREQUENCY STABILITY TEST EQUIPMENT

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due
900946	Tenney Engineering, Inc.	TH65	Temperature Chamber with Humidity	11380	2/4/04
901020	Hewlett Packard	8564E	Spectrum Analyzer	3943A01719	7/15/04

5 EMISSION TYPES AND BANDWIDTH

FCC 95.631(a) defines the emission types that a GMRS transmitter may utilize. The EUT only uses emission type F3E, and therefore meets this requirement.

FCC 95.631(d) defines the emission types that a FRS transmitter may utilize. The EUT only uses emission type F3E, and therefore meets this requirement.

Per FCC 95.633(a), the authorized bandwidth for a GMRS transmitter using emission type F3E is 20 kHz.

Per FCC 95.633(c), the authorized bandwidth for a FRS transmitter using emission type F3E is 12.5 kHz.

Emission designator calculation:

Per FCC 2.202(e)(2)(i), the necessary bandwidth is calculated as follows:

Bn = 2M +2DK

where

M = maximum modulation frequency in Hz = 2500 Hz
D = peak deviation frequency in Hz = 2000 Hz
K = an overall numerical factor = 1

Bn = 2(2500 Hz) + 2(2000 Hz)(1) = 9000 Hz

Therefore, the emission designator for the EUT is 9K0F3E

6 OCCUPIED BANDWIDTH

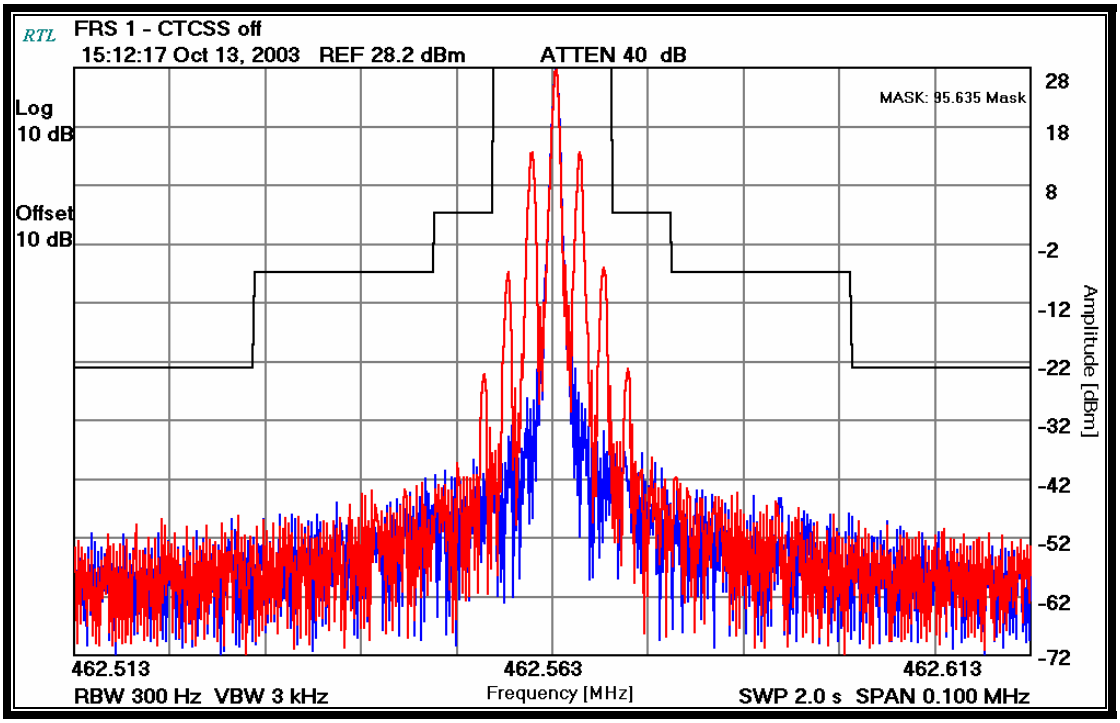
Per FCC 2.1049(c)(1) and for an EUT of this type, the occupied bandwidth should be tested with the EUT modulated by a 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50 percent modulation. The input level was established at the frequency of maximum response of the audio modulating circuit.

The antenna was disconnected from the EUT and a short RF cable was attached. The EUT was then connected to a spectrum analyzer through suitable attenuation. The 4 test frequencies were investigated with CTCSS turned off, set to number 1, and set to number 38. The 12 plots follow.

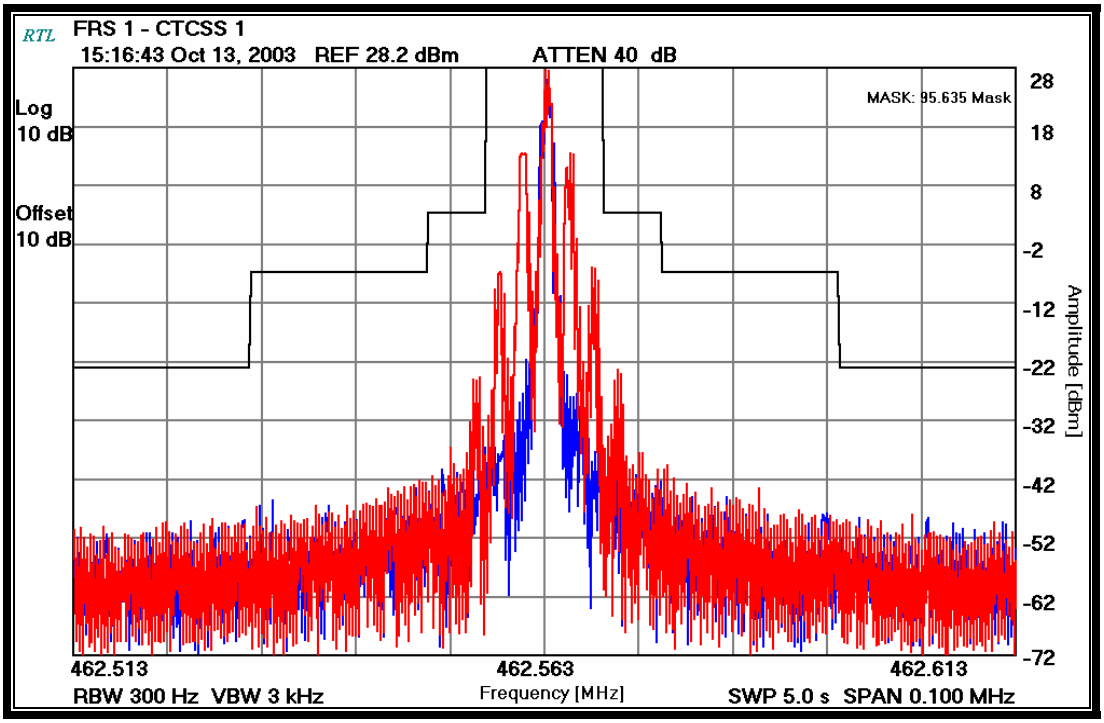
FCC 95.635(b)(1), (3) and (7) specifies the limits for this EUT:

> (1) At least 25 dB (decibels) on any frequency removed from the center of the authorized bandwidth by more than 50% up to and including 100% of the authorized bandwidth.
> (3) At least 35 dB on any frequency removed from the center of the authorized bandwidth by more than 100% up to and including 250% of the authorized bandwidth.
> (7) At least 43 + 10 log10 (T) dB on any frequency removed from the center of the authorized bandwidth by more than 250%.

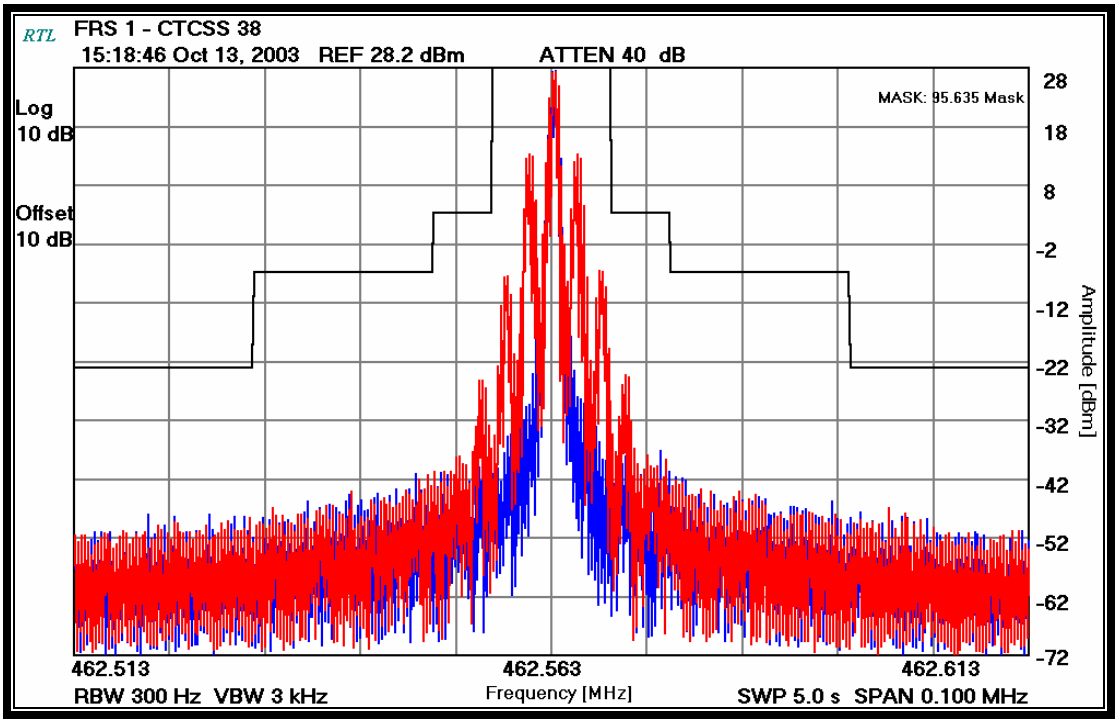
PLOT 6-1: OCCUPIED BANDWIDTH – FRS CHANNEL 1 – CTCSS OFF



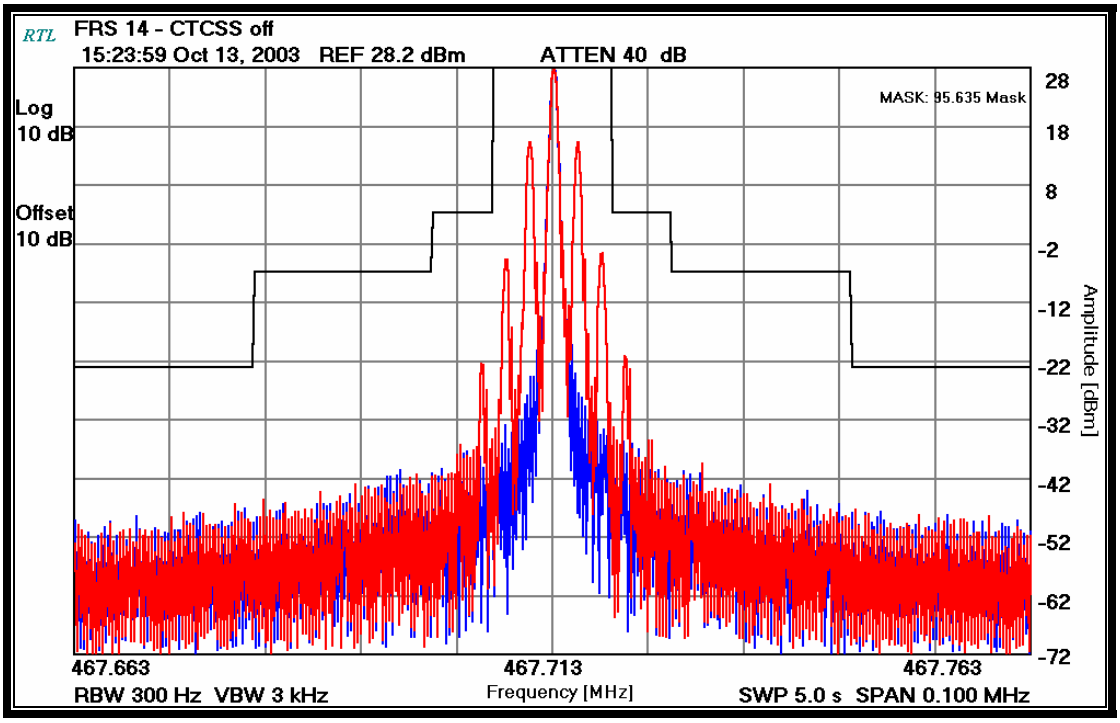
PLOT 6-2: OCCUPIED BANDWIDTH – FRS CHANNEL 1 – CTCSS 1



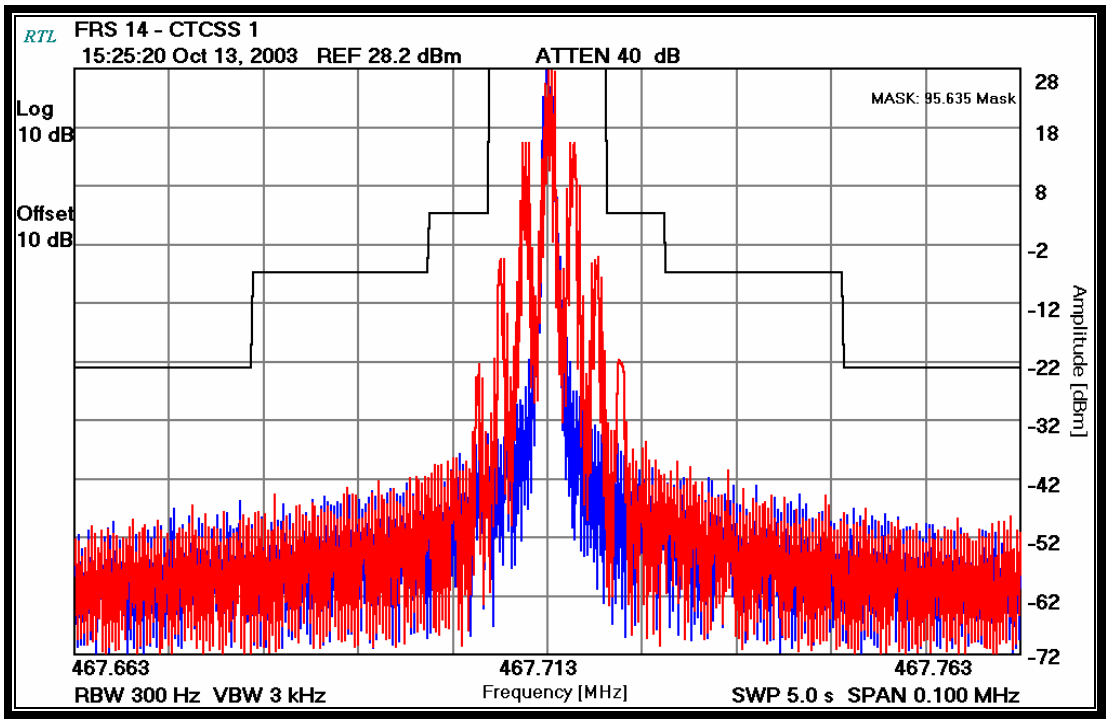
PLOT 6-3: OCCUPIED BANDWIDTH – FRS CHANNEL 1 – CTCSS 38



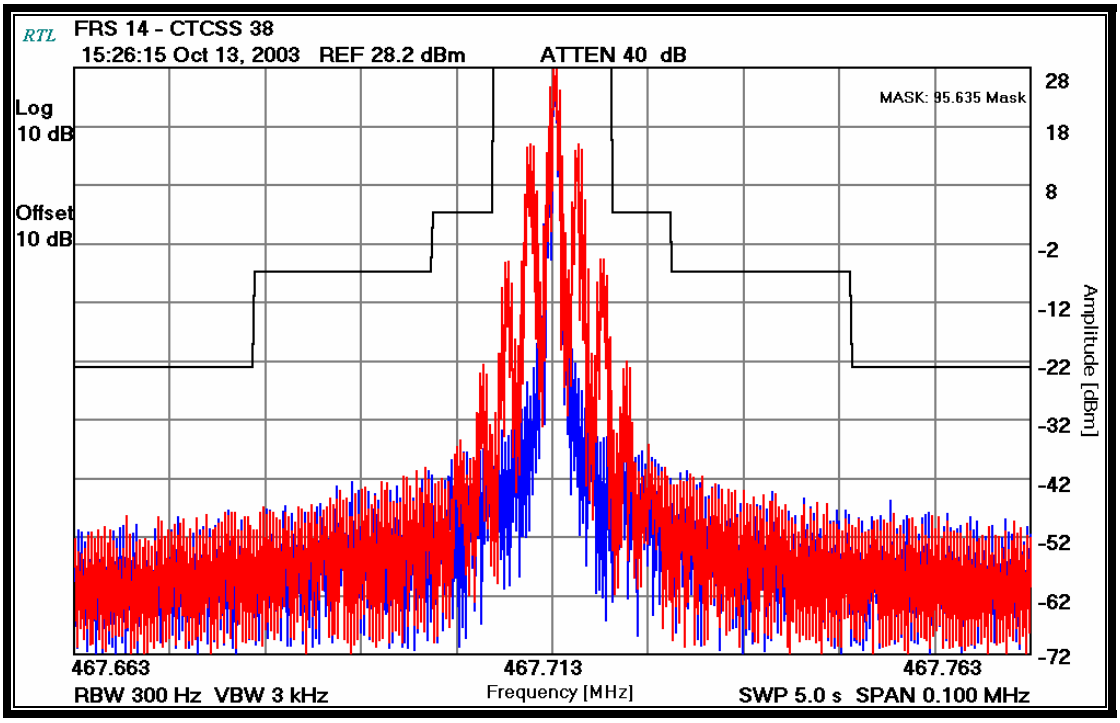
PLOT 6-4: OCCUPIED BANDWIDTH – FRS CHANNEL 14 – CTCSS OFF



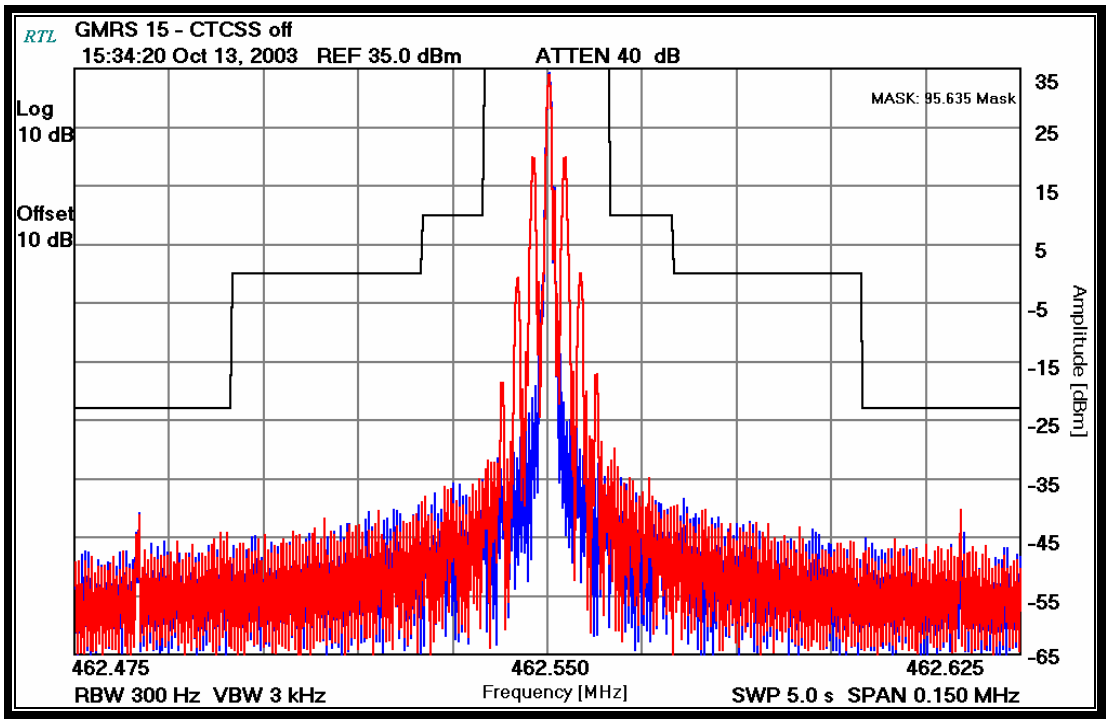
PLOT 6-5: OCCUPIED BANDWIDTH – FRS CHANNEL 14 – CTCSS 1



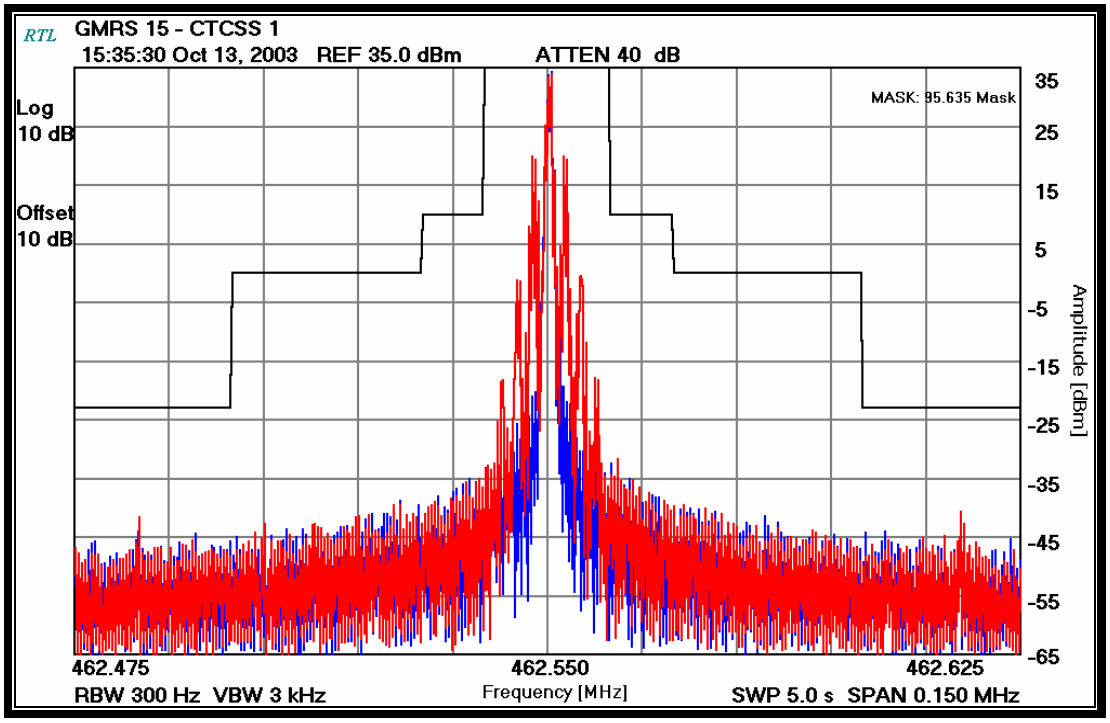
PLOT 6-6: OCCUPIED BANDWIDTH – FRS CHANNEL 14 – CTCSS 38



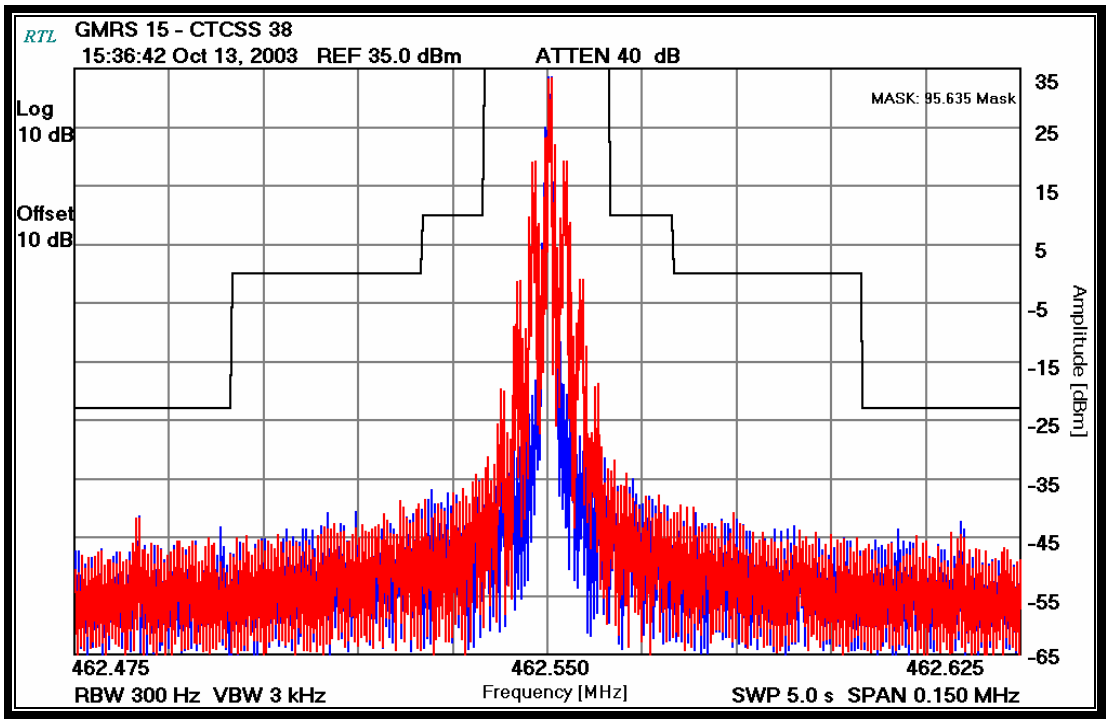
PLOT 6-7: OCCUPIED BANDWIDTH – GMRS CHANNEL 15 – CTCSS OFF



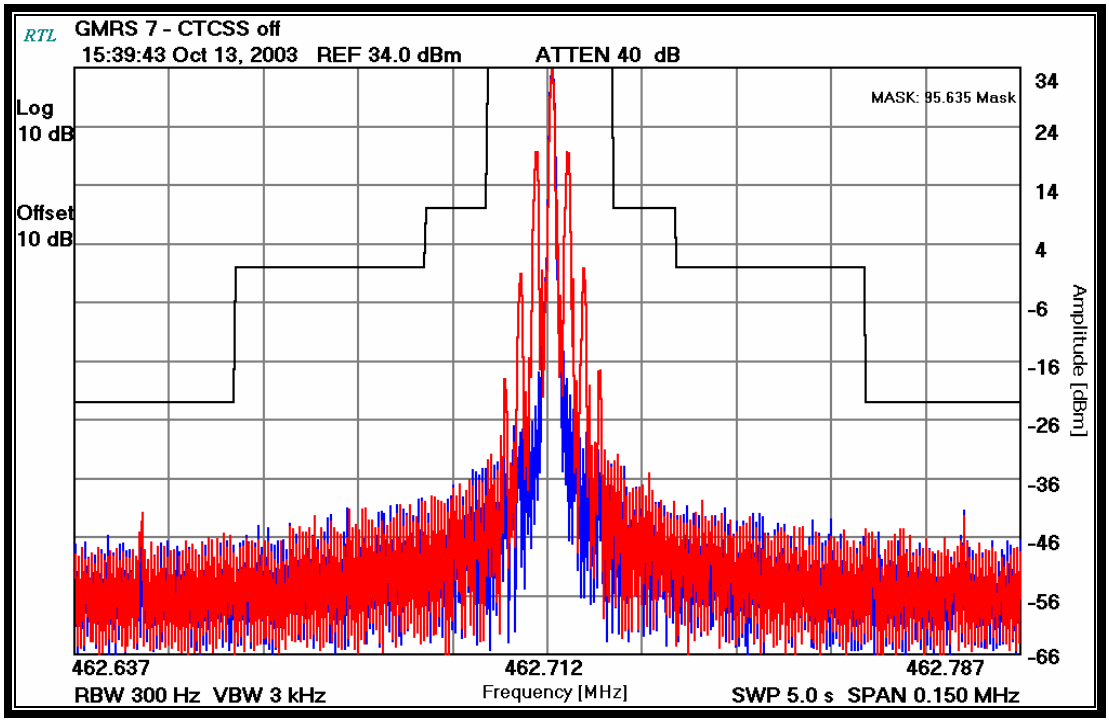
PLOT 6-8: OCCUPIED BANDWIDTH – GMRS CHANNEL 15 – CTCSS 1



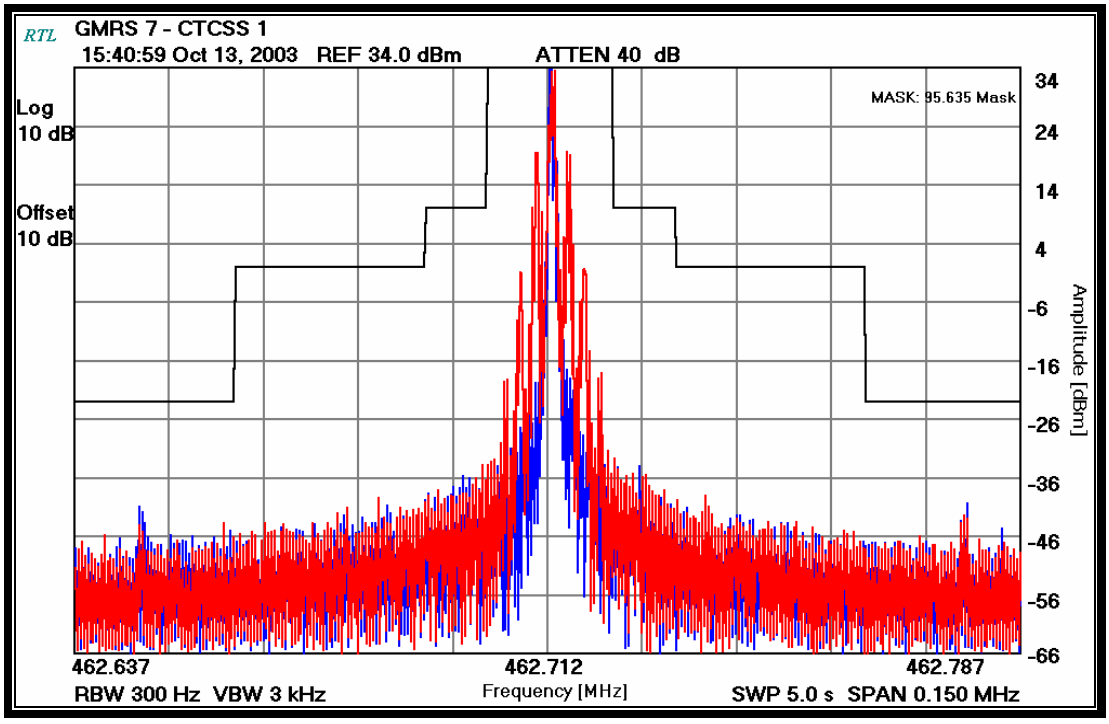
PLOT 6-9: OCCUPIED BANDWIDTH – GMRS CHANNEL 15 – CTCSS 38



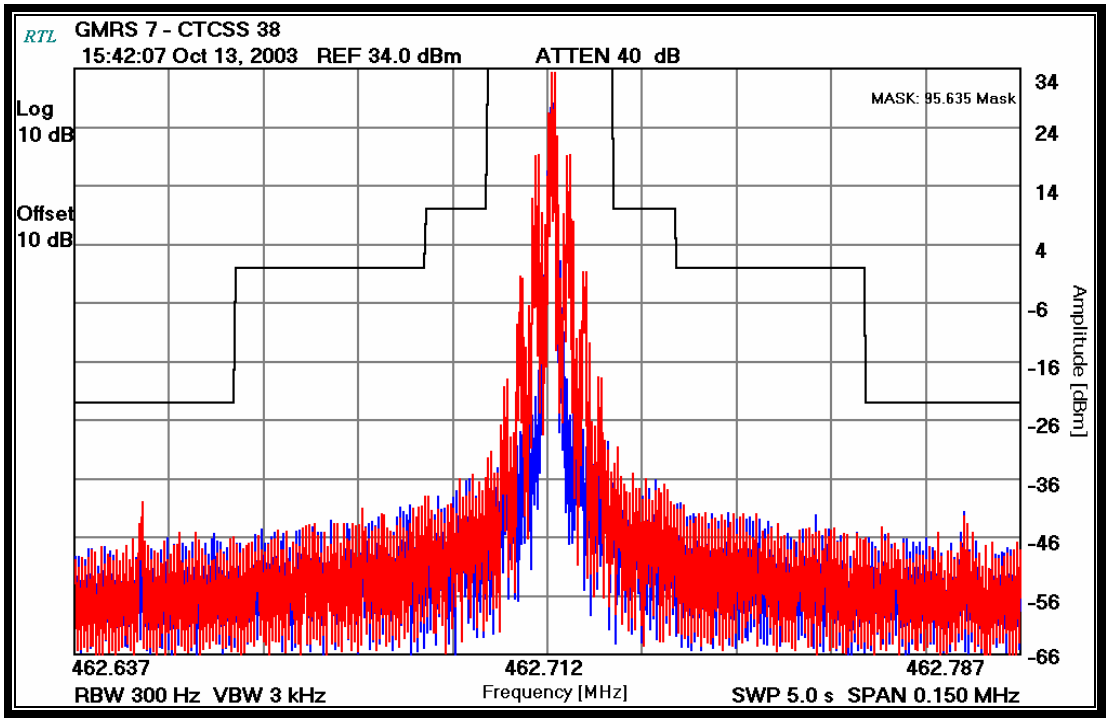
PLOT 6-10: OCCUPIED BANDWIDTH – GMRS CHANNEL 7 – CTCSS OFF



PLOT 6-11: OCCUPIED BANDWIDTH – GMRS CHANNEL 7 – CTCSS 1



PLOT 6-12: OCCUPIED BANDWIDTH – GMRS CHANNEL 15 – CTCSS 38



TEST PERSONNEL:

Richard B. McMurray, PE	Richard B. McMurray	October 13, 2003
Test Engineer	Signature	Date Of Test

TABLE 6-1: OCCUPIED BANDWIDTH TEST EQUIPMENT

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due
901020	Hewlett Packard	8564E	Spectrum Analyzer	3943A01719	7/15/04

7 MODULATION STANDARDS

Per FCC 2.1049(c)(1) and for an EUT of this type, the occupied bandwidth should be tested with the EUT modulated by a 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50 percent modulation. The input level was established at the frequency of maximum response of the audio modulating circuit.

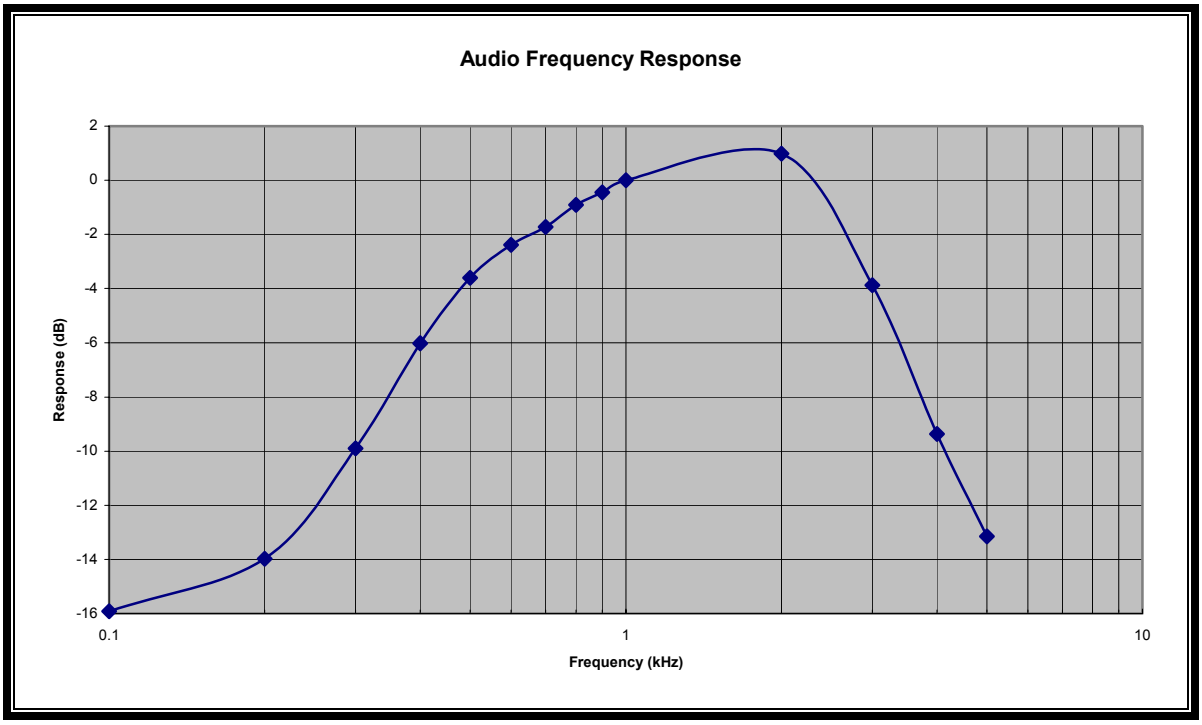
Per FCC 2.1047(a) and for an EUT of this type, a curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all circuitry installed between the modulation limiter and the modulated stage, shall be submitted.

Per FCC 2.1047(b) and for an EUT of this type, a curve or family of curves showing the percentage of modulation versus the modulation input voltage shall be supplied. The information submitted shall be sufficient to show modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed.

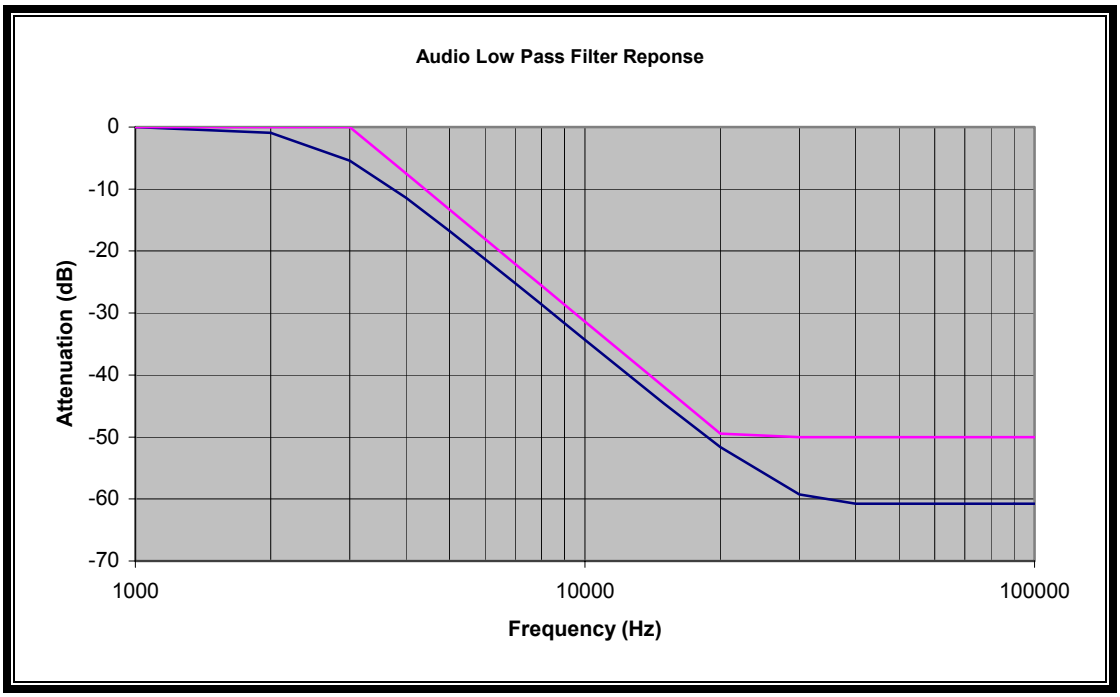
Per FCC 95.637(a) and for an EUT of this type, the GMRS transmitter must not exceed a peak frequency deviation of plus or minus 5 kHz. A FRS unit that transmits emission type F3E must not exceed a peak frequency deviation of plus or minus 2.5 kHz, and the audio frequency response must not exceed 3.125 kHz.

Per FCC 95.637(b) and for an EUT of this type, the GMRS transmitter must include audio frequency low pass filtering. The filter must be between the modulation limiter and the modulated stage of the transmitter. At any frequency (f in kHz) between 3 and 20 kHz, the filter must have an attenuation of at least 60 log10 (f/3) dB greater than the attenuation at 1 kHz. Above 20 kHz, it must have an attenuation of at least 50 dB greater than the attenuation at 1 kHz.

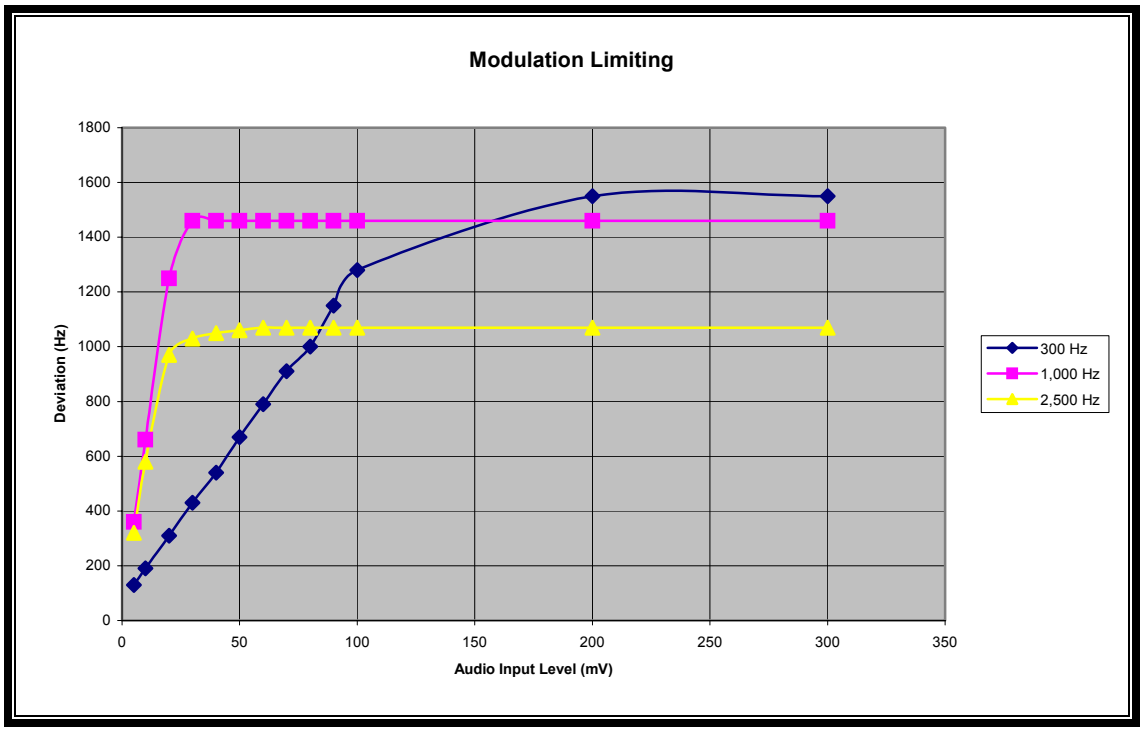
PLOT 7-1: AUDIO FREQUENCY RESPONSE



PLOT 7-2: AUDIO LOW PASS FILTER RESPONSE



PLOT 7-3: MODULATION LIMITING



TEST PERSONNEL:

Richard B. McMurray, PE	Richard B. McMurray	October 8 and 9, 2003
Test Engineer	Signature	Date Of Test

TABLE 7-1: MODULATION CHARACTERISTICS TEST EQUIPMENT

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due
901118	Hewlett Packard	8901B	Modulation Analyzer	2406A00178	6/18/04
901057	Hewlett Packard	3336B	Synthesizer/Level Generator	2514A02585	8/2/04
901067	Hewlett Packard	8903B	Audio Analyzer	2303A00307	4/16/03

8 MAXIMUM TRANSMITTER POWER

Per FCC 95.639(a)(1) and for an EUT of this type, the GMRS transmitter power shall not exceed 50 W.

Per FCC 95.639(d), no FRS transmitter shall exceed 0.5 W ERP.

8.1 TEST PROCEDURE

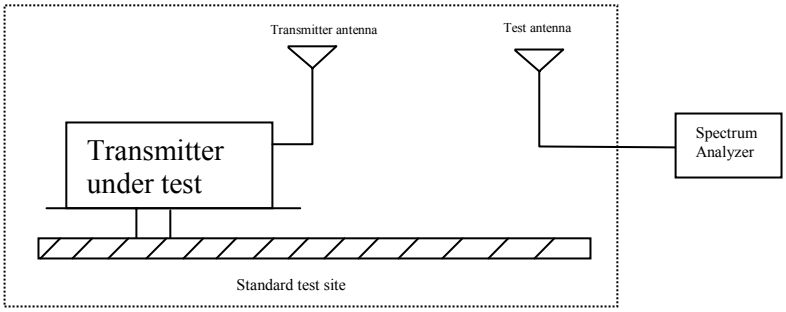


FIGURE 8-1: ILLUSTRATION OF EQUIPMENT SETUP

Connect the equipment as illustrated. Place the transmitter to be tested on the turntable in the standard test site. Raise and lower the test antenna from 1 m to 4 m in both horizontal and vertical polarities. Record the highest received signal with the transmitter rotated 360° and in all 3 polarities.

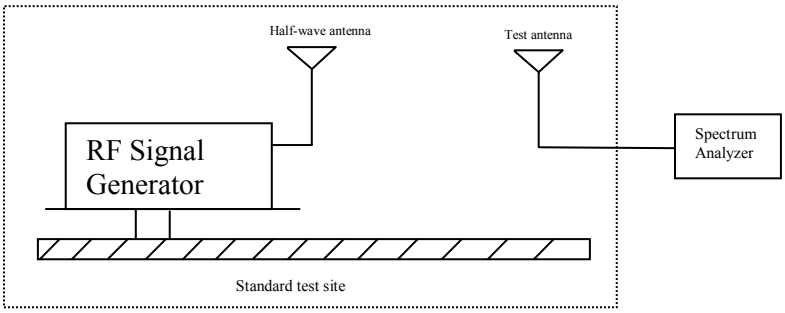


FIGURE 8-2: ILLUSTRATION SUBSTITUTION ANTENNA SETUP

Replace the transmitter under test with a half-wave antenna. The center of the antenna should be at the same location as the transmitter under test. Connect the antenna to a signal generator with a known output power and record the path loss in dB. Reference the antennas used to a half-wave dipole.

8.2 TEST RESULTS

TABLE 8-1: MAXIMUM TRANSMITTER POWER

Channel	Frequency (MHz)	Signal Generator Level (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	ERP of EUT Signal Generator Level - Cable Loss + Dipole Gain	
					(dBm)	(W)
FRS 1	462.5625	25.7	0.9	-0.8	24.05	0.254
FRS 14	467.7125	28.3	1.0	-0.8	26.60	0.457
GMRS 15	462.5500	31.7	0.9	-0.8	30.05	1.01
GMRS 7	462.7125	34.7	1.0	-0.8	32.95	1.97

Notes: ERP Measurements by Substitution Method.

TEST PERSONNEL:

Rachid Sehb		October 10 and 13, 2003
Test Engineer	Signature	Dates Of Test

TABLE 8-2: MAXIMUM TRANSMITTER POWER TEST EQUIPMENT

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due
901020	Hewlett Packard	8564E	Portable Spectrum Analyzer (9 kHz - 40 GHz)	3943A01719	7/15/04
900917	Hewlett Packard	8648C	Synthesized. Signal Generator (9 kHz - 3200 MHz)	3537A01741	5/2/04
901158	Compliance Design, Inc.	Roberts Dipole Antenna	Adjustable Elements Dipole	00401	5/9/04
901053	Schaffner-Chase	CBL6112	Antenna (25 MHz – 2 GHz)	2648	9/3/04

9 RADIATED SPURIOUS AND HARMONIC EMISSIONS – FCC PART 2.1053

9.1 RADIATED SPURIOUS AND HARMONIC EMISSIONS

The EUT was placed on the turntable with the transmitter transmitting. 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. The spectrum analyzer was set to the following settings:

1. Resolution Bandwidth ≤100 kHz
2. Video Bandwidth 10 Hz
3. Sweep Speed 5 Second
4. Detector Mode = Positive Peak

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° 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 half-wave dipole was substituted in place of the EUT. The dipole was fed through a directional coupler and the power at the coupler port was monitored. A signal generator and power amplifier controlled the dipole, and the input level of the dipole was adjusted to the same field strength level as the EUT. The feed point for the dipole was then connected to a calibrated power meter and the power adjusted to read the same as the coupler port previously recorded, to account for any mismatch in impedance which may occur at the dipole antenna. The conducted power at the antenna feed point was recorded. The forward power for the dipole was then determined and the ERP level was determined by adding the forward dipole power and the dipole gain in dB. For readings above 1 GHz, the above method is repeated using standard gain horn antennas.

9.2 RADIATED SPURIOUS TEST EQUIPMENT

TABLE 9-1: RADIATED SPURIOUS TEST EQUIPMENT

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901053	Schaffner-Chase	CBL6112	Antenna (25 MHz – 2 GHz)	2648	9/3/04
900932	Hewlett Packard	8449B OPT H02	Preamplifier (1 - 26.5 GHz)	3008A00505	N/A
901020	Hewlett Packard	8564E	Portable Spectrum Analyzer (9 kHz - 40 GHz)	3943A01719	7/15/04
901158	Compliance Design, Inc.	Roberts Dipole Antenna	Adjustable Elements Dipole	00401	5/9/04
900321	EMCO	3161-03	Horn Antenna (4.0 - 8.2 GHz)	9508-1020	N/A
900772	EMCO	3161-02	Horn Antenna (2 - 4 GHz)	9804-1044	N/A
900814	Electro-Metrics	EM-6961 (RGA-60)	Double Ridges Guide Antenna (1 - 18 GHz)	2310	2/17/04
900917	Hewlett Packard	8648C	Synthesized. Signal Generator (9 kHz - 3200 MHz)	3537A01741	5/2/04

9.3 FIELD STRENGTH OF SPURIOUS RADIATION TEST DATA - §2.1053

TABLE 9-2: RADIATED SPURIOUS EMISSIONS – FRS CHANNEL 1

Frequency (MHz)	Spectrum Analyzer Level (dBuV)	Signal Generator Level (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Corrected Signal Generator Level (dBc)	Margin (dB)
925.13	51.4	-27.5	2.8	-2.0	58.9	-19.2
1387.69	48.8	-14.5	3.4	2.5	42.1	-2.4
1850.25	42.2	-19.4	3.7	3.0	46.9	-7.2
2312.81	60.1	-23.3	4.7	3.2	51.4	-11.7
2775.38	55.2	-21.9	5.6	3.7	50.5	-10.8
3237.94	55.4	-19.2	5.7	4.1	47.5	-7.9
3700.50	47.5	-38.5	6.6	4.0	67.9	-28.2
4163.06	41.1	-35.7	7.0	4.8	64.6	-24.9
4625.63	40.8	-36.8	7.7	6.7	64.5	-24.8

TABLE 9-3: RADIATED SPURIOUS EMISSIONS – FRS CHANNEL 14

Frequency (MHz)	Spectrum Analyzer Level (dBuV)	Signal Generator Level (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Corrected Signal Generator Level (dBc)	Margin (dB)
935.43	53.9	-27.5	2.8	-2.1	60.4	-19.3
1403.14	49.2	-14.5	3.4	2.6	43.4	-2.3
1870.85	42.5	-19.4	3.7	3.0	48.3	-7.2
2338.56	61.7	-23.3	4.7	3.3	52.8	-11.7
2806.28	54.7	-21.9	5.6	3.8	51.8	-10.7
3273.99	57.2	-19.2	5.7	4.1	48.9	-7.8
3741.70	46.9	-38.5	6.6	3.9	69.3	-28.2
4209.41	41.6	-35.7	7.0	5.1	65.7	-24.6
4677.13	40.9	-36.8	7.7	6.7	66.0	-24.9

TABLE 9-4: RADIATED SPURIOUS EMISSIONS – GMRS CHANNEL 15

Frequency (MHz)	Spectrum Analyzer Level (dBuV)	Signal Generator Level (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Corrected Signal Generator Level (dBc)	Margin (dB)
925.10	47.7	-27.5	2.8	-2.0	64.7	-19.2
1387.65	45.5	-14.5	3.4	2.6	47.8	-2.3
1850.20	39.5	-18.4	3.7	3.0	51.7	-6.2
2312.75	55.4	-23.3	4.7	3.2	57.2	-11.7
2775.30	54.3	-21.9	5.6	3.7	56.3	-10.8
3237.85	58.2	-19.2	5.7	4.1	53.3	-7.8
3700.40	42.2	-38.5	6.6	4.0	73.7	-28.2
4162.95	41.1	-35.7	7.0	4.8	70.4	-24.9
4625.50	40.0	-36.8	7.7	6.7	70.3	-24.8

TABLE 9-5: RADIATED SPURIOUS EMISSIONS – GMRS CHANNEL 7

Frequency (MHz)	Spectrum Analyzer Level (dBuV)	Signal Generator Level (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Corrected Signal Generator Level (dBc)	Margin (dB)
925.43	53.5	-27.5	2.8	-2.0	64.8	-19.1
1388.14	54.7	-14.5	3.4	2.5	48.0	-2.2
1850.85	42.2	-19.4	3.7	3.0	52.8	-7.0
2313.56	57.2	-23.3	4.7	3.2	57.3	-11.5
2776.28	56.2	-21.9	5.6	3.7	56.4	-10.6
3238.99	55.5	-19.2	5.7	4.1	53.4	-7.7
3701.70	43.4	-38.5	6.6	4.0	73.8	-28.0
4164.41	41.7	-35.7	7.0	4.8	70.5	-24.8
4627.13	40.5	-36.8	7.7	6.7	70.4	-24.6

10 OTHER REQUIREMENTS

Antenna Requirement

Per FCC 95.647, the antenna of each FRS unit must be an integral part of the transmitter and have no gain (as compared to a half-wave dipole) and must be vertically polarized. The EUT antenna is permanently affixed to the body of the radio, and there is no provision for attaching an external antenna or removing the existing antenna. The gain of the antenna is 0 dBi (-2.15 dBi) and is vertically polarized.

Crystal Requirement

Per FCC 95.651, a GMRS transmitter must be crystal controlled. The frequency determining circuitry of the EUT is crystal controlled (please see the schematic exhibit for details).

Frequency Capability

Per FCC 95.655(b), all frequency-determining circuitry in a GMRS transmitter must be internal to the transmitter and must not be accessible from the exterior of the transmitter operating panel or from the exterior of the transmitter enclosure. The EUT meets this requirement (please see the external photograph exhibit for more information).

11 CONCLUSION

The data in this measurement report shows that the EUT, FCC ID: OJ7901GMR0903, complies with all the requirements of Parts 2 and 95 of the FCC Rules and Regulations.