Engineering and Testing for EMC and Safety Compliance

APPLICATION CERTIFICATION FOR A

FRS DEVICE

Maxon Telecom Ltd
459-23 Kasan-Dong
Kumchon-Ku, Seoul / Korea

MODEL: FRS-1400

FCC ID: AWWFRS1400

July 13, 2001

STANDARDS REFERENCED FOR THIS REPORT	
PART 2; 1999	FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS
PART 15; 1999	RADIO FREQUENCIES DEVICES
PART 95; 1998	PERSONAL RADIO SERVICES
OET BULLETIN NO. 43; 1994	PEAK ENVELOPE POWER AND OUTPUT LIMITING IN THE CITIZENS BAND (CB) RADIO SERVICE
ANSI C63.4-1992	STANDARD FORMAT MEASUREMENT/TECHNICAL REPORT PERSONAL COMPUTER AND PERIPHERALS
ANSI/TIA/EIA 603-1; 1998	ADDENDUM TO ANSI/TIA/EIA 603-1992
RSS-210; Issue 5; Draft 3	LOW POWER LICENCE-EXEMPT RADIOCOMMUNICATION DEVICES (ALL FREQUENCY BANDS)
RSS-102; Issue 1; 1999	EVALUATION PROCEDURE FOR MOBILE AND PORTABLE RADIO TRANSMITTERS WITH RESPECT TO HEALTH CANADA'S SAFETY CODE 6 FOR EXPOSURE OF HUMANS TO RADIO FREQUENCY FIELDS

FREQUENCY RANGE MHZ	OUTPUT POWER (W) ERP	FREQUENCY TOLERANCE	EMISSION DESIGNATOR
462.5625-467.7125	0.038	0.00025%	10K4F3E

REPORT PREPARED BY:

EMI Technician: **Daniel Baltzell**
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1 GENERAL INFORMATION

The following Application for FCC Type Certification of a FRS Device is prepared on behalf of ***Maxon*** in accordance with Part 2, and Part 15, Subparts A and B of the Federal Communications Commissions rules and regulations and Industry Canada RSS-210. The Equipment Under Test (EUT) was the ***FRS-1400, FCC ID: AWWFRS1400.*** The test results reported in this document relate only to the item that was tested.

All measurements contained in this Application were conducted in accordance with ANSI C63.4 Methods of Measurement of Radio Noise Emissions, 1992. The instrumentation utilized for the measurements conforms to the ANSI C63.4 standard for EMI and Field Strength Instrumentation. Some accessories are used to increase sensitivity and prevent overloading of the measuring instrument. These are explained in this report. Calibration checks are performed regularly on the instruments, and all accessories including the high pass filter, preamplifier and cables.

1.1 MODIFICATIONS

No modifications were made to the EUT during testing.

1.2 RELATED SUBMITTAL(S)/GRANT(S)

This is an original certification submission.

1.3 TEST METHODOLOGY

Radiated testing was performed according to the procedures in ANSI C63.4 1992. Radiated testing was performed at an antenna to EUT distance of 3 meters.

1.4 TEST FACILITY

The open area test site and conducted measurement facility used to collect the radiated data is located on the parking lot of Rhein Tech Laboratories, Inc. 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report, submitted to and approved by the Federal Communication Commission to perform AC line conducted and radiated emissions testing (ANSI C63.4 1992).

2 SYSTEM TEST CONFIGURATION

2.1 JUSTIFICATION

To complete the test configuration required by the FCC, the receiver's external antenna received a signal from a signal generator output connector to an antenna, the receiver indicator displayed optimal reception. The EUT's IF, local oscillators, and crystal oscillators and harmonics of each were investigated. All modes were investigated and tested including idle mode. The final radiated data was taken with the EUT locked to a set frequency.

2.2 EXERCISING THE EUT

The EUT was exercised using a Hewlett Packard Signal Generator to generate a continuous wave frequency, which was received by and activated the EUT receiver portion under test.

2.3 POWER CAPABILITY

The EUT cannot be increased in excess of the limit specified in the FCC Rules and Regulations §95.639

3 CONFORMANCE STATEMENT

STANDARDS REFERENCED FOR THIS REPORT	
PART 2; 1999	FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS
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FREQUENCY RANGE MHZ	**OUTPUT POWER (W) ERP**	**FREQUENCY TOLERANCE**	**EMISSION DESIGNATOR**
462.5625-467.7125	0.038	0.00025%	10K4F3E

I, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described above. Modifications were not made during testing to the equipment in order to achieve compliance with these standards.

Furthermore, there was no deviation from, additions to or exclusions from the ANSI C63.4 test methodology.

Signature: ______________ Date: July 13, 2001

Typed/Printed Name: Desmond A. Fraser Position: President
(NVLAP Signatory)

NVLAP *Accredited by the National Voluntary Accreditation Program for the specific scope of accreditation under Lab Code 20061-0.*

Note: This report may not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government.

4 EMISSIONS EQUIPMENT LIST

RTL Asset Number	Manufacturer	Model	Part Type	Serial Number
900969	Hewlett Packard	85650A	Quasi-Peak Adapter (30 Hz – 40 GHz)	2412A00414
900929	Hewlett Packard	85650A	Quasi-Peak Adapter (30 Hz – 40 GHz)	2811A01276
900901	Hewlett Packard	85650A	Quasi-Peak Adapter (30 Hz – 40 GHz)	3145A01599
900339	Hewlett Packard	85650A	Quasi-Peak Adapter (30 Hz – 40 GHz)	2521A00743
900042	Hewlett Packard	85650A	Quasi-Peak Adapter (30 Hz – 40 GHz)	2521A01032
900924	Amplifier Research	75A220	Amplifier (10 kHz – 220 MHz)	
900933	Hewlett Packard	11975A	Power Amplifier (2 - 8 GHz)	2304A00348
901067	Hewlett Packard	8903B	Audio Analyzer	2303A00307
901055	Hewlett Packard	8901A Opt. 002-003	Modulation Analyzer	2545A04102
900926	Hewlett Packard	8753D	RF Vector Network Analyzer	3410A09659
901089	Hewlett Packard	HP875ET	Transmission/Reflection Network Analyzer	US39170052
900968	Hewlett Packard	8567A	Spectrum Analyzer (10 kHz – 1.5 GHz)	2602A00160
900903	Hewlett Packard	8567A	Spectrum Analyzer (10 kHz – 1.5 GHz)	2841A00614
900897	Hewlett Packard	8567A	Spectrum Analyzer (10 kHz – 1.5 GHz)	2727A00535
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz – 22 GHz)	3138A07771
900912	Hewlett Packard	8568A	RF Spectrum Analyzer (100 Hz – 1.5 GHz)	2634A02704
900824	Hewlett Packard	8591E	RF Spectrum Analyzer (9 KHz – 1.8 GHz)	3710A06135
900724	ARA	LPB-2520	Log Periodic / Biconical Antenna (25-1000 MHz)	1037
900725	ARA	LPB-2520	Log Periodic / Biconical Antenna (25-1000 MHz)	1036
900967	A.H. Systems	TDS-206/535-1 through TDS-206/535-4	Tuned Dipole set (30 – 1000 MHz)	126, 128, 129, 132
900154	Compliance Design	Roberts Dipole	Adjustable Elements Dipole antenna (30-1000MHz)	N/A
900814	Electro-Metrics	RGA-60	Double Ridges Guide Antenna (1-18 GHz)	2310
900081	EMCO	3146	Log-Periodic Antenna (200-1000 MHz)	1850
900800	EMCO	3301B	Active Monopole (Rod antenna) (30 Hz – 50 MHz)	9809-4071
900151	Rohde and Schwarz	HFH2-Z2	Loop Antenna (9kHz-30 MHz)	82825/019
900791	Schaffner –Chase	CSL6112	Bilog antenna (30 MHz – 2GHz)	2099
901053	Schaffner –Chase	CBL6112B	Bilog Chase antenna (200 MHz – 2 GHz)	2648
900060	Hewlett Packard	86634B	Auxiliary Section for External Pulse Modulator	1314A02913
901041	ACO Pacific	511E	Sound Level Calibrator	028751
900970	Hewlett Packard	85662A	Spectrum Analyzer Display	254211239
900930	Hewlett Packard	85662A	Spectrum Analyzer Display	3144A20839
900911	Hewlett Packard	85662A	Spectrum Analyzer Display	2542A12739
900902	Hewlett Packard	85662A	Spectrum Analyzer Display	2848A17585
900896	Hewlett Packard	85662A	Spectrum Analyzer Display	2816A16471
900914	Hewlett Packard	8546OA	RF Filter Section, (100 KHz to 6.5 GHz)	3330A00107
901057	Hewlett Packard	3336B	Synthesizer/Level Generator	2514A02585
900059	Hewlett Packard	8660C	Signal Generator (9 KHz – 3200 MHz)	1947A02956
900960	Hewlett Packard	8444A	Tracking Generator (0.5 –1500MHz)	2325A07827
900917	Hewlett Packard	8648C	Synthesized. Signal Generator (9 KHz – 3200 MHz)	3537A01741

RTL Asset Number	Manufacturer	Model	Part Type	Serial Number	Calibration due date
900821	Hewlett Packard	33120A	15 MHz Function / Arbitrary Waveform Generator	US36029992	11/14/01
900059	Hewlett Packard	8660C	Synthesized. Signal Generator (9 kHz –3200 MHz)	1947A02956	11/08/01
900195	Tektronix	CFG280	Function Generator (0.1 Hz – 11 MHz)	TW12167	N/A
900927	Tektronix	ASG 100	Audio Signal Generator	B03274 V2.3	N/A
900268	Taylor	5565	Hygrometer / Thermometer	N/A	09/05/01
901056	Hewlett Packard	8954A, Opt.H03	Transceiver Interface	2924A00830	06/02/01
901088	Hewlett Packard	8954A	Transceiver Interface	2146A00139	07/28/01
901082	AFJ International	AFJ LS16	LISN (9 kHz – 30 MHz)	16010020081	06/16/01
901083	AFJ International	AFJ LS16	LISN (9 kHz – 30 MHz)	16010020082	06/16/01
901084	AFJ International	AFJ LS16	LISN (9 kHz – 30 MHz)	16010020080	06/16/01
901090	Bajog electronic	4V-100/200	LISN (150 kHz – 30 MHz)	00-44-007	08/03/01
900726	Solar	7225-1	LISN	N/A	03/29/01
900727	Solar	7225-1	LISN	N/A	03/29/01
900078	Solar	7225-1	LISN	N/A	03/29/01
900077	Solar	7225-1	LISN	N/A	03/29/01
901054	Hewlett Packard	HP 3586B	Selective Level Meter	1928A01892	06/08/01
900793	Hewlett Packard	432A	Thermistor Power Meter	1848a22632	N/A
900721	Hewlett Packard	8447D	Preamplifier (0.1-1300 MHz)	2727A05397	N/A
900889	Hewlett Packard	85685A	RF Preselector for HP 8566B or 8568B (20Hz-2GHz)	3146A01309	11/14/01
900566	Amplifier Research	FP 2000	Isotropic Field Probe	20760	08/29/01
900854	Solar Electronics Co	9119-IN	RF Current Probe	972501	
900849	Solar Electronics Co	9121-IN	Injection Probe (10 MHz – 1 GHz)	953501	
900848	Solar Electronics Co	9320-IN	RF Current Probe	990521	
900913	Hewlett Packard	85462A	EMI Receiver RF Section (9 KHz – 6.5 GHz)	3325A00159	03/29/01

5 CONDUCTED EMISSIONS

Conducted line emissions are not required since this device is battery operated.

6 RADIATED EMISSIONS MEASUREMENTS

Before final measurements of radiated emissions were made on the open-field three/ten meter range, the EUT was scanned indoors at one meter and three meter distances, in order to determine its emissions spectrum signature. The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. This process was repeated during final radiated emissions measurements on the open-field range, at each frequency, in order to insure that maximum emission amplitudes were attained.

Final radiated emissions measurements were made on the three-meter, open-field test site. The EUT was placed on a nonconductive turntable approximately 0.8 meters above the ground plane. The spectrum was examined from 30 MHz to 1000 MHz using a Hewlett Packard 8566B spectrum analyzer, a Hewlett Packard 85650A quasi-peak adapter, and EMCO log periodic and biconical antenna. In order to gain sensitivity, a HP8447 preamplifier was connected in series between the antenna and the input of the spectrum analyzer.

At each frequency, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters in order to determine the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarizations. The spectrum analyzer's 6 dB bandwidth was set to 120 kHz, and the analyzer was operated in the CISPR quasi-peak detection mode. No video filter less than 10 times the resolution bandwidth was used. When any clock exceeds 108 MHz, the EUT was tested between 1 to 2 Gigahertz in peak mode with the resolution bandwidth set at 1 MHz as stated in ANSI C63.4. The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report.

Note: Rhein Tech Laboratories, Inc. has implemented procedures to minimize errors that occur from test instruments, calibration, procedures, and test setups. Test instrument and calibration errors are documented from the manufacturer or calibration lab. Other errors have been defined and calculated within the Rhein Tech quality manual, section 6.1. Rhein Tech implements the following procedures to minimize errors that may occur: yearly as well as daily calibration methods, technician training, and emphasis to employees on avoiding error.

6.1 FCC PART 2 §2.1046 RF POWER OUTPUT

6.1.1 FCC PART 95 §95.639 MAXIMUM TRANSMITTER POWER

TABLE 6-1: Effective Radiated Power {FCC §95.639}

Emission Frequency (MHz)	Signal Generator Reading (dBm)	Cable Loss and TX Antenna Gain Correction (dB)	Corrected Signal Generator Level (dBm) ERP	ERP (mW)	Limit 95.639 (d) Watt
462.5625	29.3	-13.5	15.8	37.7	0.5
462.7125	28.5	-13.9	14.6	29.0	0.5
467.7125	29.5	-14.4	15.1	32.6	0.5

Measurement uncertainty=0.5 dB

6.1.2 §15.109: RADIATED EMISSIONS

TABLE 6-2: RADIATED EMISSION (RECEIVER/DIGITAL) {FCC §15.109}

Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
39.770	Qp	V	0	1.0	35.2	-13.2	22.0	40.0	-18.0
45.270	Qp	V	0	1.0	30.2	-15.9	14.3	40.0	-25.7
53.130	Qp	V	0	1.0	33.6	-17.9	15.7	40.0	-24.3
54.070	Qp	V	0	1.0	36.4	-18.0	18.4	40.0	-21.6
446.313	Qp	V	90	1.0	46.1	-1.6	44.5	46.0	-1.5
1338.938	Av	V	120	1.0	30.9	0.5	31.4	54.0	-22.6

**All readings are quasi-peak, unless stated otherwise.*

TEST PERSONNEL:

Signature: ____________________ Date: July 13, 2001

Typed/Printed Name: Daniel Baltzell

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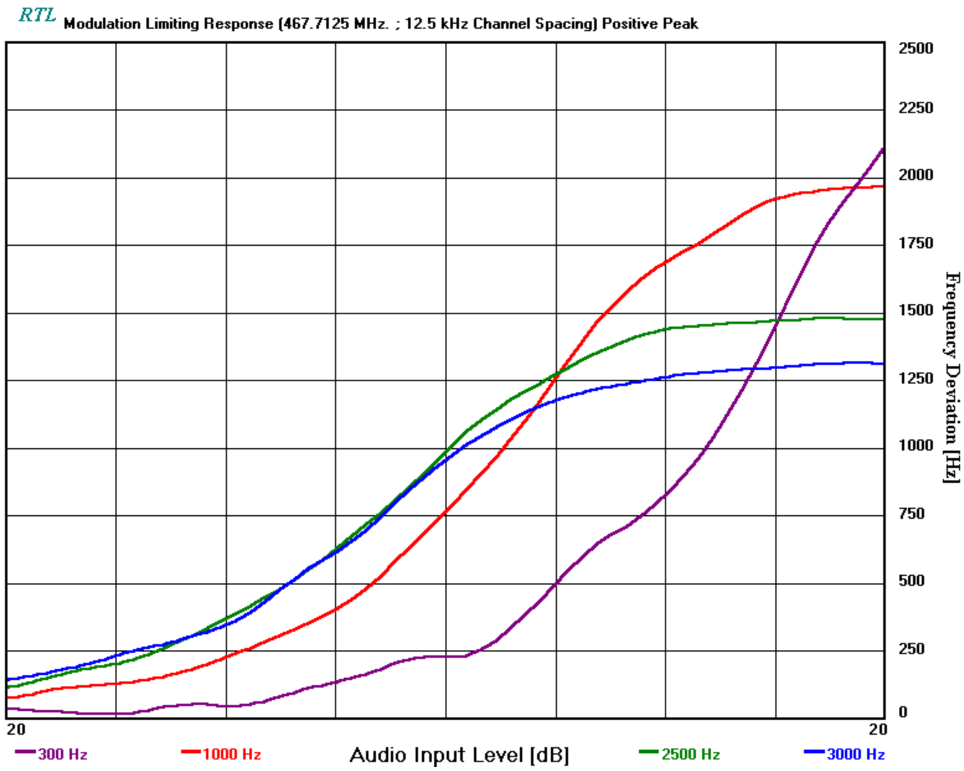
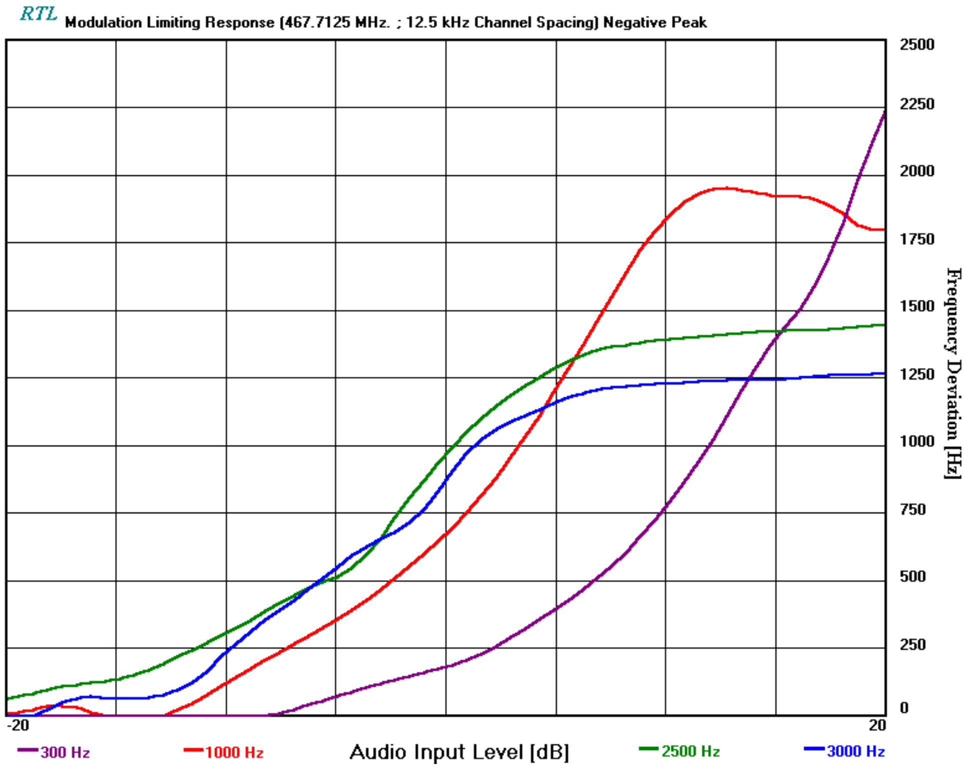
7 PART 2 §2.1047 MODULATION CHARATERISTICS

7.1 §95.637: MODULATION STANDARDS

PLOT 7-1: MODULATION LIMITING POSITIVE PEAK (-47.14 DBM = 0 REF.)

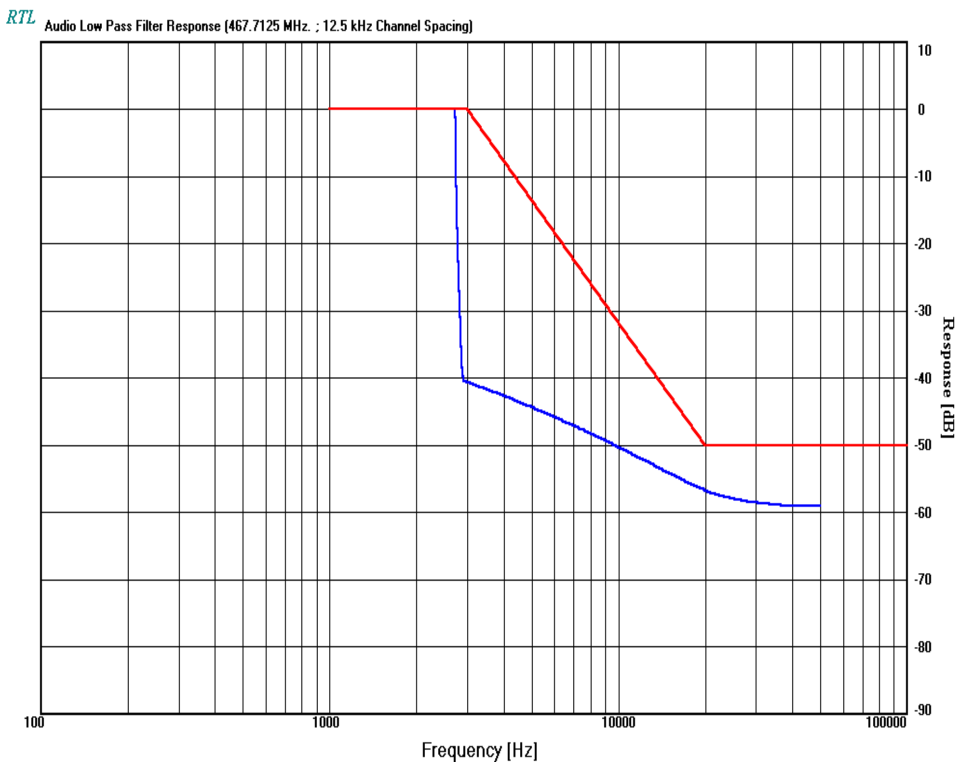


PLOT 7-2: MODULATION LIMITING NEGATIVE PEAK (-47.14 DBM = 0 REF.)

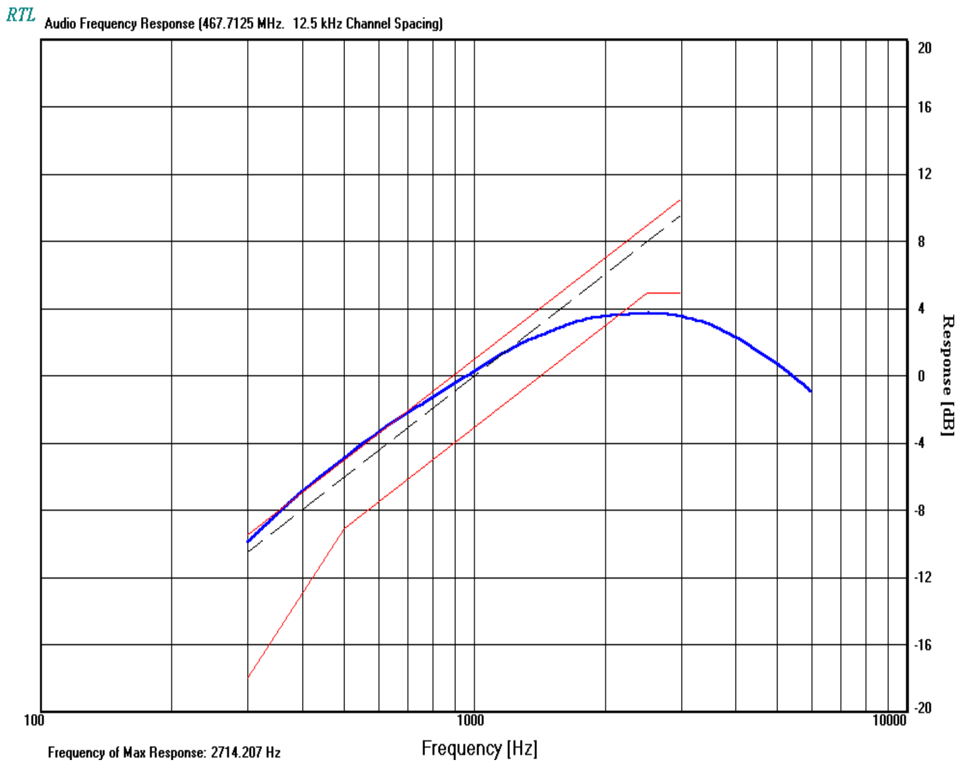


7.2 §95.655: FREQUENCY CAPABILITY

PLOT 7-3: AUDIO LOW PASS FILTER RESPONSE



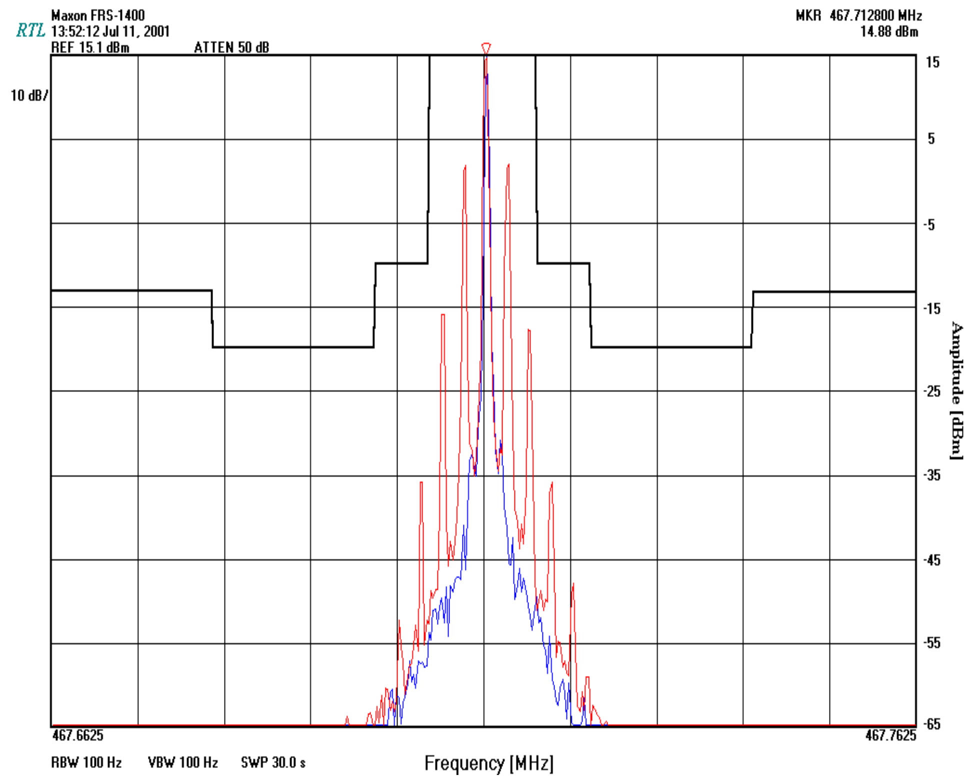
PLOT 7-4: AUDIO FREQUENCY RESPONSE (0.3 KHZ DEV. REF.)



8 FCC PART 2 §2.1049 OCCUPIED BANDWIDTH

8.1 §95.633: EMISSION BANDWIDTH

PLOT 8-1: EMISSION BANDWIDTH {FCC PART 95 §95.633}



9 FCC RULES AND REGULATIONS PART 2 §2.202: NECESSARY BANDWIDTH AND EMISSION BANDWIDTH

FCC Part 95.631 and FCC 95.193:

FCC Part 95.631 (d): Emission Types

"An FRS unit may transmit only emission type F3E."

Type of Emission: F3E

Necessary Bandwidth and Emission Bandwidth:
12.5kHz (NB channel) : Bn = 10K4F3E

Calculation:
Max modulation(M) in kHz : 2.706
Max deviation (D) in kHz: 2.5 (NB)
Constant factor (K) : 1
Bn = 2xM+2xDK

FCC Part 95.633 (c) Emission Bandwidth

"The authorized bandwidth for emission type F3E transmitted by a FRS unit is 12.5 kHz."

10 FCC PART 2 §2.1051 AND §2.1053 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

10.1 §95.635: UNWANTED RADIATION

TABLE 10-1: RADIATED SPURIOUS EMISSIONS

Frequency (MHz)	dBuV @ 3 m	Signal Generator (dBm)	Cable Loss (dB)	Corrected Antenna Gain	Corrected Signal Generator Level (-dBc)	Limit (-dBc)	Margin (dB)
935.4250	56.2	17.5	-39.2	-1.2	-38.0	-28.1	-9.9
1403.1375	54.5	2.7	-39.8	5.9	-46.4	-28.1	-18.3
1870.8500	47.0	2.8	-40.0	6.9	-45.3	-28.1	-17.2
2338.5625	65.5	3.2	-40.3	7.2	-45.0	-28.1	-16.9
2806.2750	62.3	-1.9	-40.5	8.0	-49.5	-28.1	-21.4
3273.9875	73.7	11.0	-42.0	6.2	-40.0	-28.1	-11.9
3741.7000	62.2	-1.6	-42.2	8.1	-50.8	-28.1	-22.7
4209.4125	52.8	-1.2	-41.8	8.5	-49.6	-28.1	-21.5
4677.1250	51.7	-2.8	-41.7	7.0	-52.6	-28.1	-24.5

11 FCC PART 2 §2.1055 FRQUENCY STABILITY

11.1 §95.625: FREQUENCY TOLERANCE

11.2 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, section 2.2.2

The carrier frequency stability is the ability of the transmitter to maintain an assigned carrier frequency.

The EUT was evaluated over the temperature range -30°C to +50°C.

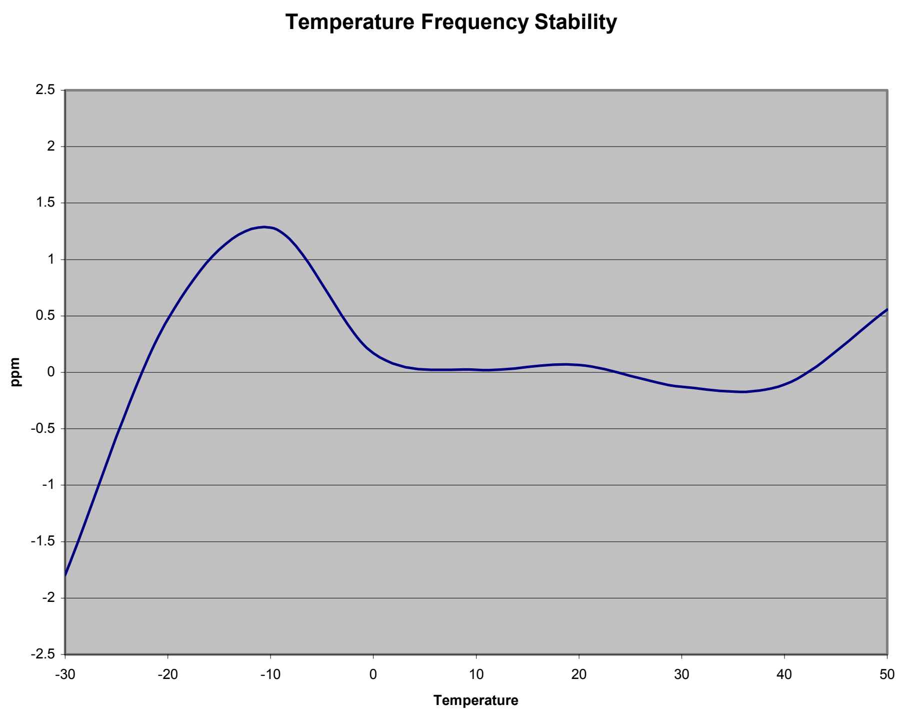
The temperature was initially set to -30°C and a 2-hour period was observed for stabilization of the EUT.
The frequency stability was measured within one minute after application of primary power to the transmitter. The temperature was raised at intervals of 10 degrees centigrade through the range. A ½ an hour period was observed to stabilize the EUT at each measurement step and the frequency stability was measured within one minute after application of primary power to the transmitter.
Additionally, the power supply voltage of the EUT was varied from 85% to 115% of the nominal voltage.

The worst-case test data are shown.

PLOT 11-1: TEMPERATURE FREQUENCY STABILITY

Limit 0.00025 % = 2.5 ppm

Channel 14 (467.7125 MHz) –1.8 ppm at –30 C



PLOT 11-2: VOLTAGE FREQUENCY STABILITY

Battery end-point 3.0 VDC