Engineering and Testing for EMC and Safety Compliance

# TYPE CERTIFICATION REPORT

**Funktechnik GmbH**
**Zum Handenberg 3**
**Primstal, D-6620**
**Germany**

**MODEL: 70 TX – M1/70 RX – M1**

**FCC ID: PUX-70TX-M1**

***August 3, 2001***

| STANDARDS REFERENCED FOR THIS REPORT | |
|---|---|
| PART 2: 1999 | FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS |
| PART 15: 1999 | §15.109: RADIATED EMISSIONS LIMITS |
| PART 22: 1998 | PUBLIC MOBILES SERVICES |
| PART 74: 1998 | LOW POWER AUXILIARY STATION |
| PART 90: 1998 | PRIVATE LAND MOBILE RADIO SERVICES |
| PART 95 (A): 1998 | GENERAL MOBILE RADIO SERVICES |
| ANSI C63.4-1992 | STANDARD FORMAT MEASUREMENT/TECHNICAL REPORT PERSONAL COMPUTER AND PERIPHERALS |
| ANSI/TIA/EIA603- 1992 | LAND MOBILE FM OR PM COMMUNICATIONS EQUIPMENT MEASUREMENT AND PERFORMANCE STANDARDS |
| ANSI/TIA/EIA 603-1-1998 | ADDENDUM TO ANSI/TIA/EIA 603-1992 |
| RSS-119; Issue 6: 2000 | LAND MOBILE AND FIXED RADIO TRANSMITTERS AND RECEIVERS, 27.41 TO 960 MHZ |
| 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 | Output Power (W) | Freq. Tolerance | Emission Designator |
|---|---|---|---|
| 420-510 | 0.013 | | 16K0F1D |

**REPORT PREPARED BY:**

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*Document Number: 2001218 / QRTL01- 227 / QRTL01-228*



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# 1 GENERAL INFORMATION

The following Report of a Type Certification is prepared on behalf of **HM-Funktechnik GmbH** in accordance with the Federal Communications Commissions and Industry Canada Rules and Regulations. The Equipment Under Test (EUT) was the **70 TX-M1/70 RX-M1, FCC ID: PUX-70TX-M1**. 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 FCC Rules and Regulations CFR 47, Industry Canada RSS-119, and 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. Calibration checks are performed regularly on the instruments, and all accessories including high pass filter, coaxial attenuator, preamplifier and cables.

## 1.1 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 dated March 3, 1994, submitted to and approved by the Federal Communication Commission to perform AC line conducted and radiated emissions testing (ANSI C63.4 1992).

## 1.2 RELATED SUBMITTAL(S)/GRANT(S)

This is an original application report.

## 2 CONFORMANCE STATEMENT

| STANDARDS REFERENCED FOR THIS REPORT | |
|---|---|
| PART 2: 1999 | FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS |
| PART 15: 1999 | §15.109: RADIATED EMISSIONS LIMITS |
| PART 22: 1998 | PUBLIC MOBILES SERVICES |
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| PART 90: 1998 | PRIVATE LAND MOBILE RADIO SERVICES |
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| ANSI/TIA/EIA 603-1-1998 | ADDENDUM TO ANSI/TIA/EIA 603-1992 |
| RSS-119; Issue 6: 2000 | LAND MOBILE AND FIXED RADIO TRANSMITTERS AND RECEIVERS, 27.41 TO 960 MHZ |
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| Frequency Range | Output Power (W) | Freq. Tolerance | Emission Designator |
|---|---|---|---|
| 420-510 | 0.013 | | 16K0F1D |

We, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this attached test record. No modifications were made to the equipment during testing in order to achieve compliance with these standards.

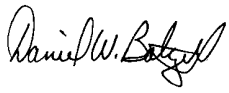
Furthermore, there was no deviation from, additions to or exclusions from the FCC Part 2, FCC Part 90 and Canadian RSS-119 Certification methodology.

Signature: 

Date: August 3, 2001

Typed/Printed Name: Bruno Clavier

Position: Vice President of Operations
(NVLAP Signatory)

Signature: 

Date: August 3, 2001

Typed/Printed Name: Daniel W. Baltzell

Position: Test Engineer

NVLAP *Accredited by the National Voluntary Accreditation Program for the specific scope of accreditation under Lab Code 200061-0.*

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

## 3 TESTED SYSTEM DETAILS

Listed below is the identifiers and descriptions of all equipment, cables, and internal devices used with the EUT for this test, as applicable.

**TABLE 3-1: EQUIPMENT UNDER TEST (EUT)**

| PART | MANUFACTURER | MODEL | SERIAL NUMBER | FCC ID | CABLE DESCRIPTION | RTL BAR CODE |
|---|---|---|---|---|---|---|
| TRANSMITTER WITH BUILT IN WIRE ANTENNA (420.025 MHZ | HM-FUNKTECHNIK GMBH | 70 TX-M1 | 03 | N/A | N/A | 013565 |
| TRANSMITTER | HM-FUNKTECHNIK GMBH | 70 TX-M1 | 02 | N/A | N/A | 013564 |
| TRANSMITTER | HM-FUNKTECHNIK GMBH | 70 TX-M1 | 01 | N/A | N/A | 013563 |
| TRANSMITTER WITH BUILT IN WIRE ANTENNA (420.025 MHZ | HM-FUNKTECHNIK GMBH | 70 TX-M1 | 08 | N/A | N/A | 013571 |
| TRANSMITTER | HM-FUNKTECHNIK GMBH | 70 TX-M1 | 09 | N/A | N/A | 013569 |
| TRANSMITTER | HM-FUNKTECHNIK GMBH | 70 TX-M1 | 07 | N/A | N/A | 013570 |
| TRANSMITTER WITH BUILT IN WIRE ANTENNA (465.000 MHZ | HM-FUNKTECHNIK GMBH | 70 TX-M1 | 04 | N/A | N/A | 013577 |
| TRANSMITTER | HM-FUNKTECHNIK GMBH | 70 TX-M1 | 05 | N/A | N/A | 013576 |
| TRANSMITTER | HM-FUNKTECHNIK GMBH | 70 TX-M1 | 06 | N/A | N/A | 013575 |
| RECEIVER WITH BUILT IN WIRE ANTENNA (509.975 MHZ) | HM-FUNKTECHNIK GMBH | 70 RX-M1 | 03 | N/A | N/A | 013572 |
| RECEIVER | HM-FUNKTECHNIK GMBH | 70 RX-M1 | 02 | N/A | N/A | 013573 |
| RECEIVER | HM-FUNKTECHNIK GMBH | 70 RX-M1 | 01 | N/A | N/A | 013574 |
| RECEIVER WITH BUILT IN WIRE ANTENNA (465.000 MHZ) | HM-FUNKTECHNIK GMBH | 70 RX-M1 | 04 | N/A | N/A | 013568 |
| RECEIVER | HM-FUNKTECHNIK GMBH | 70 RX-M1 | 05 | N/A | N/A | 013567 |
| RECEIVER | HM-FUNKTECHNIK GMBH | 70 RX-M1 | 06 | N/A | N/A | 013566 |
| RECEIVER WITH BUILT IN WIRE ANTENNA (509.975 MHZ) | HM-FUNKTECHNIK GMBH | 70 RX-M1 | 09 | N/A | N/A | 013580 |
| RECEIVER | HM-FUNKTECHNIK GMBH | 70 RX-M1 | 07 | N/A | N/A | 013579 |
| RECEIVER | HM-FUNKTECHNIK GMBH | 70 RX-M1 | 08 | N/A | N/A | 013578 |
| WHIP ANTENNA | HM-FUNKTECHNIK GMBH | N/A | N/A | N/A | N/A | 013582 |
| WHIP ANTENNA | HM-FUNKTECHNIK GMBH | N/A | N/A | N/A | N/A | 013581 |

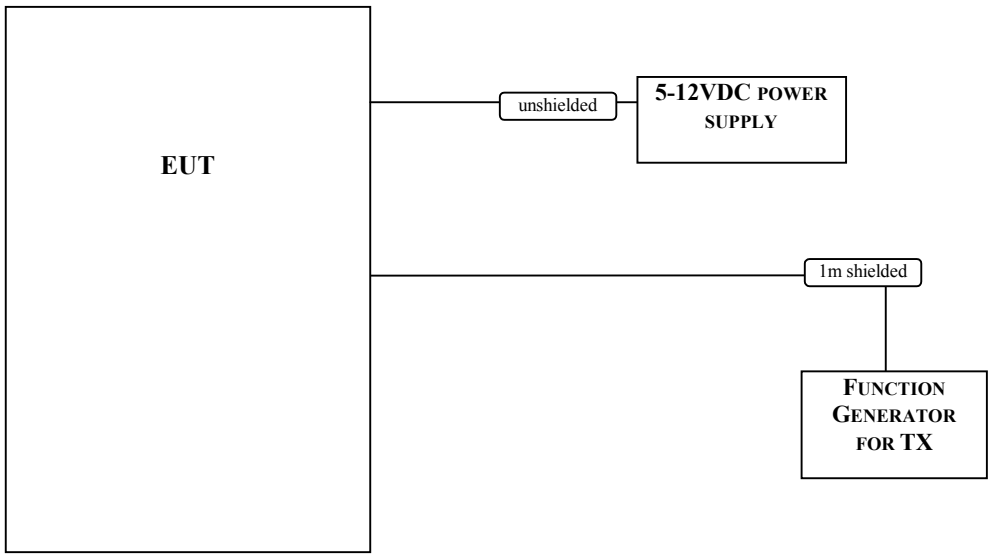



**FIGURE 3-1: CONFIGURATION OF TESTED SYSTEM**

## 4 FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FI(dBuV/m) = SAR(dBuV) + SCF(dB/m)
FI = Field Intensity
SAR = Spectrum Analyzer Reading
SCF = Site Correction Factor

The Site Correction Factor (SCF) used in the above equation is determined empirically, and is expressed in the following equation:

SCF(dB/m) = - PG(dB) + AF(dB/m) + CL(dB)

SCF = Site Correction Factor
PG = Pre-amplifier Gain
AF = Antenna Factor
CL = Cable Loss

The field intensity in microvolts per meter can then be determined according to the following equation:

$$FI(uV/m) = 10^{FI(dBuV/m)/20}$$

For example, assume a signal at a frequency of 125 MHz has a received level measured as 49.3 dBuV. The total Site Correction Factor (antenna factor plus cable loss minus preamplifier gain) for 125 MHz is -11.5 dB/m. The actual radiated field strength is calculated as follows:

49.3 dBuV - 11.5 dB/m = 37.8 dBuV/m

$$10^{37.8/20} = 10^{1.89} = 77.6 \text{ uV/m}$$

# 5 CONDUCTED EMISSIONS

## 5.1 CONDUCTED MEASUREMENT

No conducted measurements are required since the unit is DC battery operated.

# 6 RADIATED EMISSIONS

## 6.1 RADIATED MEASUREMENT

Before final measurements of radiated emissions were made on the open-field three meter range, the EUT was scanned indoors at a three meter distance 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.

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.

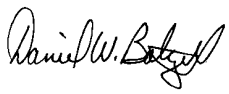
*Note: Rhein Tech Laboratories, Inc. has implemented procedures to minimize errors that occur from test instruments, calibration, procedures, and test setups. Test instrument and calibration errors are documented from the manufacturer or calibration lab. Other errors have been defined and calculated 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.*

## 6.2 TEST DATA: FCC PART 15 §15.109 (A): RADIATED EMISSIONS (CLASS B LIMITS)

**TABLE 6-1: RADIATED EMISSIONS CLASS B LIMITS**

| 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) |
|---|---|---|---|---|---|---|---|---|---|
| 398.625 | Qp | H | 0 | 1.0 | 30.7 | -10.2 | 20.5 | 46.0 | -25.5 |
| 443.600 | Qp | H | 40 | 1.2 | 30.5 | -9.0 | 21.5 | 46.0 | -24.5 |
| 488.575 | Qp | H | 155 | 1.1 | 26.0 | -8.2 | 17.8 | 46.0 | -28.2 |
| 797.250 | Qp | H | 120 | 1.0 | 30.4 | -3.5 | 26.9 | 46.0 | -19.1 |
| 887.200 | Qp | H | 100 | 1.3 | 30.3 | -2.2 | 28.1 | 46.0 | -17.9 |
| 977.150 | Qp | H | 270 | 1.2 | 26.7 | -1.7 | 25.0 | 54.0 | -29.0 |
| 1195.875 | Av | H | 285 | 1.0 | 29.7 | 0.3 | 30.0 | 54.0 | -24.0 |
| 1330.800 | Av | H | 270 | 1.2 | 29.4 | 1.7 | 31.1 | 54.0 | -22.9 |
| 1465.725 | Av | H | 0 | 1.0 | 25.4 | 3.4 | 28.8 | 54.0 | -25.2 |
| 1594.500 | Av | H | 35 | 1.3 | 29.9 | 4.3 | 34.2 | 54.0 | -19.8 |
| 1774.400 | Av | H | 20 | 1.0 | 30.1 | 5.2 | 35.3 | 54.0 | -18.7 |
| 1954.300 | Av | H | 255 | 1.0 | 29.7 | 8.8 | 38.5 | 54.0 | -15.5 |

TEST PERSONNEL:



DANIEL BALTZELL — TEST TECHNICIAN/ENGINEER — SIGNATURE — AUGUST 3, 2001 — DATE OF TEST

**TABLE 6-2: TEST EQUIPMENT USED FOR TESTING (RADIATED EMISSIONS)**

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number | Calibration Due Date |
|---|---|---|---|---|---|
| 900931 | HP | 8566B | Spectrum Analyzer (100Hz – 22 GHz) | 3138A07771 | 03/27/02 |
| 900999 | HP | 8596EM Analyzer | Spectrum Analyzer (9KHz - 12.5GHz) | 3826A00144 | 03/25/02 |
| 901053 | Schaffner@Chase | CBL6112B | Bilog antenna (20 MHz - 2 GHz) | 2648 | 05/24/02 |
| 900321 | EMCO | 3161-03 | Horn Antennas (4-8,2GHz) | 9508-1020 | N/A |
| 900323 | EMCO | 3161-03 | Horn Antennas (4-8,2GHz) | 9508-1020 | N/A |
| 900772 | Electro Metrics | RGA 60 | Horn Antenna | 2310 | 03/25/02 |
| 900889 | HP | 85685A | RF Preselector for HP 8566B or 8568B (20Hz-2GHz) | 3146A01309 | 11/08/01 |
| 900800 | EMCO | 3301B | Active monopole antenna (30 Hz – 50 MHz) | 9809-4071 | 05/02/02 |

# 7 FCC PART 2 §2.1046 (A): RF POWER OUTPUT: CONDUCTED

## 7.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, section 2.2.1

The EUT was connected to a coaxial attenuator having a 50 Ω load impedance.

## 7.2 TEST DATA

The following channels (in MHz) were tested: 450.0125, 460.0125, 470.0125, 489.9875
The worst-case Output Power (highest) levels are shown.

**CARRIER OUTPUT POWER (UNMODULATED)**

**TABLE 7-1: RF POWER OUTPUT**

| Frequency (MHz) | Power measured (dBm) | RF Power measured (mWatt)* |
|---|---|---|
| 420.025 | 11.1 | 13.0 |
| 465.000 | 10.8 | 12.1 |
| 509.975 | 10.4 | 11.1 |

* Measurement accuracy: +/- 3%

**TABLE 7-2: RF POWER OUTPUT (RATED POWER)**

| Rated Power (W) |
|---|
| 0.010 |

TEST PERSONNEL:

DANIEL BALTZELL — TEST TECHNICIAN/ENGINEER — SIGNATURE — AUGUST 3, 2001 — DATE OF TEST

**TABLE 7-3: TEST EQUIPMENT USED FOR TESTING (RF POWER OUTPUT - CONDUCTED)**

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number |
|---|---|---|---|---|
| 900770 | Hewlett Packard | 437B | Power Meter | 2949A02966 |
| 901055 | Hewlett Packard | 8901A Opt. 002-003 | Modulation Analyzer | 2545A04102 |
| 900769 | Hewlett Packard | 8481B | Power Sensor | 2702A05059 |
| 901055 | Hewlett Packard | 8901A Opt. 002-003 | Modulation Analyzer | 2545A04102 |

# 8 FCC PART 2 §2.1046 (A) RF POWER OUTPUT: RADIATED - ERP

## 8.1 TEST PROCEDURE

Substitution Method:

The EUT was setup at an antenna to EUT distance of 3 meters on an open area test site. The EUT was placed on a nonconductive turntable approximately 0.8 meters above the ground plane. The physical arrangement of the EUT and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. 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 worst-case, maximum radiated emission was recorded and used as reference for the ERP measurement. The EUT was then replaced by an ½ wave dipole antenna and polarized in accordance with the EUT's antenna polarization. The ½ wave dipole antenna was connected to a RF signal generator with a coaxial cable. The search antenna height, and search antenna polarity was set to levels that produced the maximum reading obtained in step 3. The signal generator was adjusted to a level that produced the radiated emission level obtained in step 3. The signal generator level was recorded and corrected by the power loss in the cable between the generator and the antenna and further corrected for the gain of the substitution antenna used relative to an ideal ½ wave dipole antenna. The signal generator corrected level is the ERP level

## 8.2 TEST DATA

Settings:

- Power: 0.01 Watt delivered to antenna*
- Radiated power measurements (3 meter)

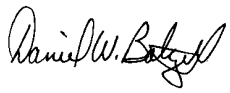
**TABLE 8-1: RADIATED – ERP RF POWER OUTPUT (WHIP ANTENNA)**

| Frequency (MHz) | Signal Generator Level (dBm)* | Cable Loss (dB) | Corrected Antenna Gain (dBi) | Corrected level (dBm) | (Watt) |
|---|---|---|---|---|---|
| 420.025 | 9.7 | 0.6 | -0.6 | 8.5 | 0.007 |
| 465.000 | 4.2 | 0.7 | -0.6 | 2.9 | 0.002 |
| 509.975 | 4.5 | 0.8 | -0.6 | 3.1 | 0.002 |

**TABLE 8-2: RADIATED – ERP RF POWER OUTPUT (WIRE ANTENNA)**

| Frequency (MHz) | Signal Generator Level (dBm)* | Cable Loss (dB) | Corrected Antenna Gain (dBi) | Corrected level (dBm) | (Watt) |
|---|---|---|---|---|---|
| 420.025 | 12.3 | 0.6 | -0.6 | 11.1 | 0.013 |
| 465.000 | 8.1 | 0.7 | -0.6 | 6.8 | 0.005 |
| 509.975 | 6.0 | 0.8 | -0.6 | 4.6 | 0.003 |

TEST PERSONNEL:



DANIEL BALTZELL — TEST TECHNICIAN/ENGINEER — SIGNATURE — AUGUST 3, 2001 — DATE OF TEST

**TABLE 8-3: TEST EQUIPMENT USED FOR TESTING (RADIATED – ERP RF POWER OUTPUT)**

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number |
|---|---|---|---|---|
| 900931 | Hewlett Packard | 8566B | Spectrum Analyzer (100 Hz - 22 GHz) | 3138A07771 |
| 900154 | Compliance Design Inc, | Roberts Dipole | Adjustable Elements Dipole Antenna (30-1000MHz) | - |

# 9 FCC PART 2 §2.1051 AND PART 15 §15.111: SPURIOUS EMISSIONS AT ANTENNA TERMINALS

## 9.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, Section 2.2.13

The transmitter and receiver were terminated with a 50 Ω load and interfaced with a spectrum analyzer.
The transmitter is modulated with a 2,500 Hz sine wave at an input level 16 dB greater than that required to produce 50% of the rated system deviation at 1000 Hz.

## 9.2 TEST DATA

Frequency range of measurement per Part 90.217

The following channels (in MHz) were investigated: 420.025, 465.000, 509.975
The worst case (unwanted emissions) channels are shown. The magnitude of emissions attenuated more than 20 dB below the FCC limit need not be recorded.

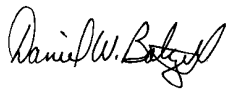
**TABLE 9-1: SPURIOUS EMISSIONS (420.025 MHZ) TRANSMITTER**

| Frequency (MHz) | Level (-dBc) | Limit (-dBc) | Margin(dB) |
|---|---|---|---|
| 393.772 | 80.5 | 30.0 | -50.5 |
| 446.276 | 75.0 | 30.0 | -45.0 |
| 840.050 | 64.5 | 30.0 | -34.5 |
| 1260.075 | 77.5 | 30.0 | -47.5 |
| 1680.100 | 75.7 | 30.0 | -45.7 |
| 2100.125 | 72.9 | 30.0 | -42.9 |
| 2520.150 | 57.2 | 30.0 | -27.2 |
| 2940.175 | 62.3 | 30.0 | -32.3 |
| 3360.200 | 70.2 | 30.0 | -40.2 |
| 3780.225 | 67.0 | 30.0 | -37.0 |
| 4200.250 | 72.9 | 30.0 | -42.9 |

**TABLE 9-2: SPURIOUS EMISSIONS (420.025 MHZ) RECEIVER**

| Frequency (MHz) | Level (dBm) | Limit (2nW) (dBm) | Margin (dB) |
|---|---|---|---|
| 398.625 | -66.7 | -57.0 | -9.7 |
| 797.250 | -80.0 | -57.0 | -23.0 |
| 1195.875 | -85.2 | -57.0 | -28.2 |
| 1594.500 | -84.6 | -57.0 | -27.6 |
| 1993.125 | -92.5 | -57.0 | -35.5 |

TEST PERSONNEL:



DANIEL BALTZELL — TEST TECHNICIAN/ENGINEER

SIGNATURE

AUGUST 3, 2001 — DATE OF TEST

**TABLE 9-3: SPURIOUS EMISSIONS (465.000 MHZ) TRANSMITTER**

| Frequency (MHz) | Level (-dBc) | Limit (-dBc) | Margin(dB) |
|---|---|---|---|
| 435.937 | 88.4 | 30.0 | -58.4 |
| 479.530 | 81.7 | 30.0 | -51.7 |
| 494.062 | 80.2 | 30.0 | -50.2 |
| 930.000 | 77.9 | 30.0 | -47.9 |
| 1395.000 | 87.9 | 30.0 | -57.9 |
| 1860.000 | 88.2 | 30.0 | -58.2 |
| 2325.000 | 75.3 | 30.0 | -45.3 |
| 2790.000 | 72.7 | 30.0 | -42.7 |
| 3255.000 | 84.3 | 30.0 | -54.3 |
| 3720.000 | 86.4 | 30.0 | -56.4 |
| 4185.000 | 94.1 | 30.0 | -64.1 |
| 4650.000 | 78.9 | 30.0 | -48.9 |

**TABLE 9-4: SPURIOUS EMISSIONS ((465.000 MHZ) RECEIVER**

| Frequency (MHz) | Level (dBm) | Limit (2nW) (dBm) | Margin (dB) |
|---|---|---|---|
| 443.600 | -70.2 | -57.0 | -13.2 |
| 887.200 | -89.1 | -57.0 | -32.1 |
| 1330.800 | -80.5 | -57.0 | -23.5 |
| 1774.400 | -88.4 | -57.0 | -31.4 |
| 2218.000 | -80.2 | -57.0 | -23.2 |

TEST PERSONNEL:

DANIEL BALTZELL
TEST TECHNICIAN/ENGINEER

SIGNATURE

AUGUST 3, 2001
DATE OF TEST

**TABLE 9-5: SPURIOUS EMISSIONS (509.975 MHZ) TRANSMITTER**

| Frequency (MHz) | Level (-dBc) | Limit (-dBc) | Margin(dB) |
|---|---|---|---|
| 478.101 | 74.9 | 30.0 | -44.9 |
| 494.038 | 87.6 | 30.0 | -57.6 |
| 525.911 | 90.2 | 30.0 | -60.2 |
| 541.847 | 84.8 | 30.0 | -54.8 |
| 1019.950 | 91.4 | 30.0 | -61.4 |
| 1529.925 | 80.5 | 30.0 | -50.5 |
| 2039.900 | 71.7 | 30.0 | -41.7 |
| 2549.875 | 61.1 | 30.0 | -31.1 |
| 3059.850 | 66.3 | 30.0 | -36.3 |
| 3569.825 | 69.9 | 30.0 | -39.9 |
| 4079.800 | 83.5 | 30.0 | -53.5 |
| 4589.775 | 71.3 | 30.0 | -41.3 |
| 5099.750 | 95.4 | 30.0 | -65.4 |

**TABLE 9-6: SPURIOUS EMISSIONS (509.975 MHZ) RECEIVER**

| Frequency (MHz) | Level (dBm) | Limit (2nW) (dBm) | Margin (dB) |
|---|---|---|---|
| 488.575 | -74.4 | -57.0 | -17.4 |
| 977.150 | -90.0 | -57.0 | -33.0 |
| 1465.725 | -85.5 | -57.0 | -28.5 |
| 1954.300 | -91.3 | -57.0 | -34.3 |
| 2442.875 | -74.0 | -57.0 | -17.0 |

TEST PERSONNEL:

DANIEL BALTZELL — TEST TECHNICIAN/ENGINEER

SIGNATURE

AUGUST 3, 2001 — DATE OF TEST

**TABLE 9-7: TEST EQUIPMENT USED FOR TESTING (RADIATED – ERP RF POWER OUTPUT)**

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

# 10 FCC PART 2 §2.1053 (A): FIELD STRENGTH OF SPURIOUS RADIATION

## 10.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, section 2.2.12

The transmitter is terminated with a 50 Ω load and is modulated with a 2,500 Hz sine wave at an input level 16 dB greater than that required to produce 50% of the rated system deviation at 1000 Hz.

Refer to section "Radiated Measurement" in this report for further information.

## 10.2 TEST DATA

### 10.2.1 CFR 47 PART 90.210 REQUIREMENTS

The worst-case emissions test data are shown. The magnitude of emissions attenuated more than 20 dB below the FCC limit need not be recorded.

**TABLE 10-1: FIELD STRENGTH OF SPURIOUS RADIATION {(420.025 MHZ) SUBSTITUTION METHOD}**

| Frequency | S/G level (dBm) | Cable Loss* | Difference in gain (ref. To 1/2 wave dipole) | Emission level (-dBc) | Limit (-dBc) | Margin (dB) |
|---|---|---|---|---|---|---|
| 840.050 | -52.5 | -1.2 | -1.2 | 66.0 | 30.0 | -36.0 |
| 1260.075 | NF | | | | | |
| 1680.100 | NF | | | | | |
| 2100.125 | NF | | | | | |
| 2520.150 | NF | | | | | |
| 2940.175 | NF | | | | | |
| 3360.200 | NF | | | | | |
| 3780.225 | NF | | | | | |
| 4200.250 | NF | | | | | |

*This insertion loss corresponds to the cable connecting the RF Signal Generator to the ½ wave dipole antenna.
NF is the noise floor of the spectrum analyzer

**TABLE 10-2: FIELD STRENGTH OF SPURIOUS RADIATION {(465.000 MHZ) SUBSTITUTION METHOD}**

| Frequency | S/G level (dBm) | Cable Loss* | Difference in gain (ref. To 1/2 wave dipole) | Emission level (-dBc) | Limit (-dBc) | Margin (dB) |
|---|---|---|---|---|---|---|
| 930.000 | -55.0 | -1.2 | -1.2 | 68.2 | 30.0 | -38.2 |
| 1395.000 | NF | | | | | |
| 1860.000 | NF | | | | | |
| 2325.000 | NF | | | | | |
| 2790.000 | NF | | | | | |
| 3255.000 | NF | | | | | |
| 3720.000 | NF | | | | | |
| 4185.000 | NF | | | | | |
| 4650.000 | NF | | | | | |

*This insertion loss corresponds to the cable connecting the RF Signal Generator to the ½ wave dipole antenna.
NF is the noise floor of the spectrum analyzer

**TABLE 10-3: FIELD STRENGTH OF SPURIOUS RADIATION {(509.975 MHZ) SUBSTITUTION METHOD}**

| Frequency | S/G level (dBm) | Cable Loss* | Difference in gain (ref. To 1/2 wave dipole) | Emission level (-dBc) | Limit (-dBc) Mask D | Margin (dB) |
|---|---|---|---|---|---|---|
| 1019.950 | -56.2 | -1.2 | 0.0 | 67.8 | 30 | -37.8 |
| 1529.925 | NF | | | | | |
| 2039.900 | NF | | | | | |
| 2549.875 | NF | | | | | |
| 3059.850 | NF | | | | | |
| 3569.825 | NF | | | | | |
| 4079.800 | NF | | | | | |
| 4589.775 | NF | | | | | |
| 5099.750 | NF | | | | | |

*This insertion loss corresponds to the cable connecting the RF Signal Generator to the ½ wave dipole antenna.
NF is the noise floor of the spectrum analyzer

TEST PERSONNEL:

DANIEL BALTZELL — TEST TECHNICIAN/ENGINEER

SIGNATURE

AUGUST 3, 2001 — DATE OF TEST

**TABLE 10-4: TEST EQUIPMENT USED FOR TESTING (FIELD STRENGTH OF SPURIOUS RADIATION)**

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number |
|---|---|---|---|---|
| 900791 | Schaffner@Chase | CBL6112 | Antenna (25MHz – 2GHz) | 2099 |
| 900932 | Hewlett Packard | 8449B OPT H02 | Preamplifier (1-26.5 GHz) | 3008A00505 |
| 901020 | Hewlett Packard | 8564E | Portable Spectrum Analyzer (9 kHz - 40 GHz) | 3943A01719 |
| 900917 | Hewlett Packard | 8648C | Synthesized. Signal Generator (9 KHz to 3200 MHz) | 3537A01741 |
| 900928 | Hewlett Packard | 83752A | Synthesized Sweeper, 0.01 to 20 GHz | 3610A00866 |

## 11 FCC PART 90 §90.217 (A): OCCUPIED BANDWIDTH

OCCUPIED BANDWIDTH - COMPLIANCE WITH THE EMISSION MASKS

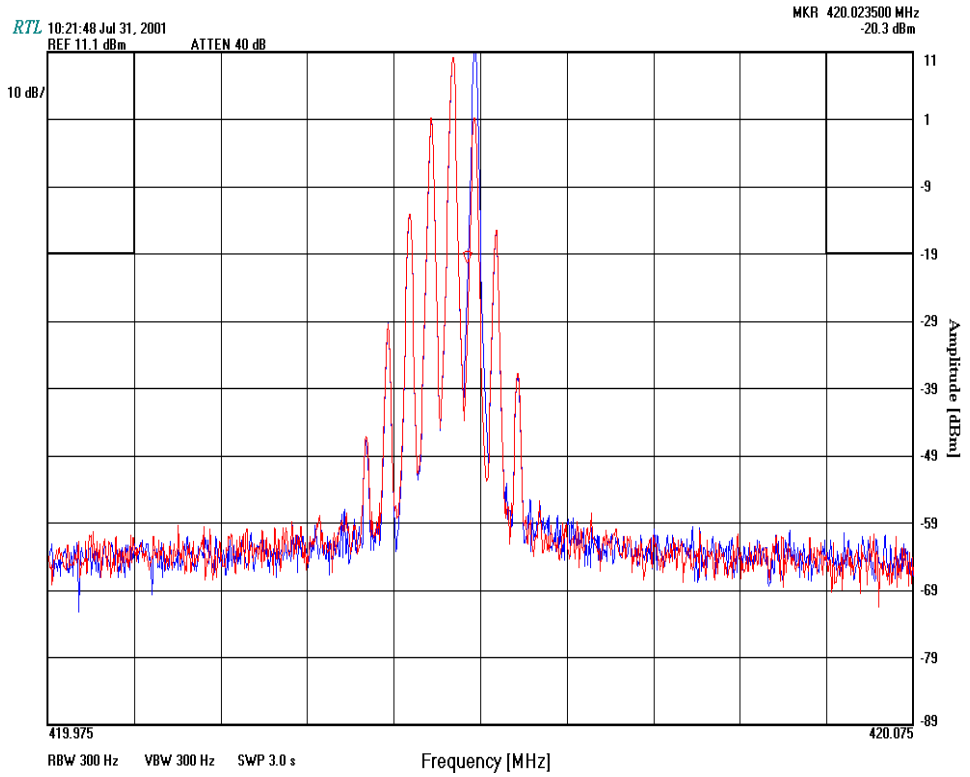
### 11.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, section 2.2.11

Device with audio modulation: Transmitter is modulated with a 2500 Hz sine wave at an input level of 16 dB greater than that required to produce 50% of rated system deviation at 1000 Hz.

### 11.2 TEST DATA

**PLOT 11-1: OCCUPIED BANDWIDTH {25 KHZ CHANNEL BANDWIDTH: MASK (DIGITAL MODULATION: 2,500 HZ)}**




TEST PERSONNEL:

| | | |
|---|---|---|
| DANIEL BALTZELL | | AUGUST 3, 2001 |
| TEST TECHNICIAN/ENGINEER | SIGNATURE | DATE OF TEST |

**TABLE 11-1: TEST EQUIPMENT USED FOR TESTING (OCCUPIED BANDWIDTH)**

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number |
|---|---|---|---|---|
| 901020 | Hewlett Packard | 8564E | Portable Spectrum Analyzer (9 kHz - 40 GHz) | 3943A01719 |

# 12 FCC PART 2 §2.1055: FREQUENCY STABILITY

## 12.1 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.

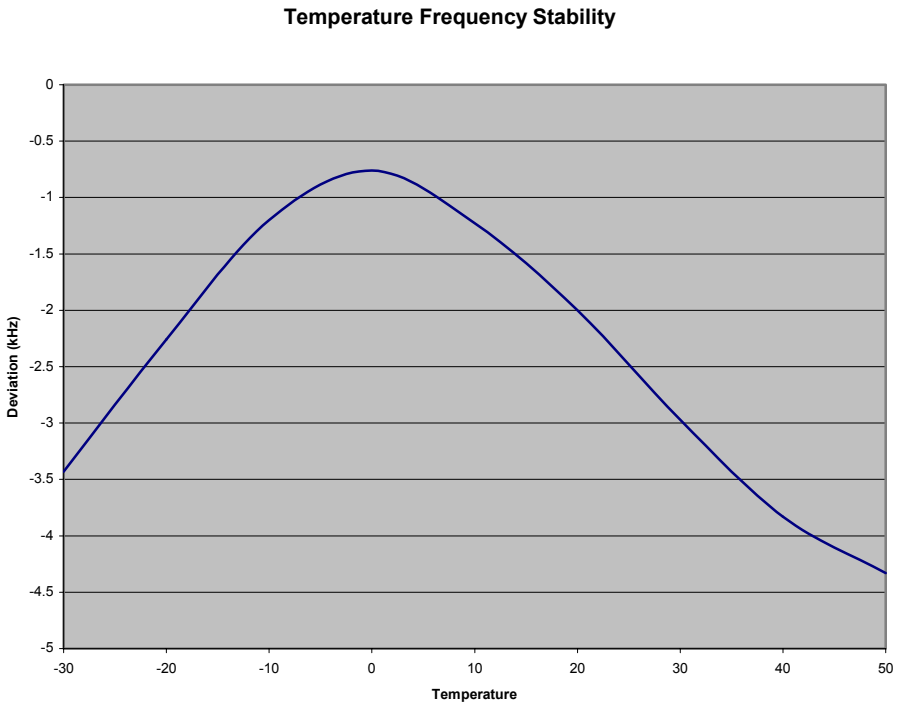
The worst-case test data are shown.

## 12.2 TEST DATA

### 12.2.1 FREQUENCY STABILITY/TEMPERATUARE VARIATION

The worst-case temperature deviation is show below.

**PLOT 12-1: TEMPERATURE FREQUENCY STABILITY**




TEST PERSONNEL:

| | | |
|---|---|---|
| DANIEL BALTZELL | | AUGUST 3, 2001 |
| TEST TECHNICIAN/ENGINEER | SIGNATURE | DATE OF TEST |

**TABLE 12-1: TEMPERATURE FREQUENCY STABILITY**

| Temperature ( C ) | Frequency Measured (MHz) | Deviation (kHz) |
|---|---|---|
| -30 | 420.021570 | -3.43 |
| -20 | 420.022740 | -2.26 |
| -10 | 420.023800 | -1.20 |
| 0 | 420.024240 | -0.76 |
| 10 | 420.023770 | -1.23 |
| 20 | 420.023000 | -2.00 |
| 30 | 420.022030 | -2.97 |
| 40 | 420.021170 | -3.83 |
| 50 | 420.020670 | -4.33 |

TEST PERSONNEL:

DANIEL BALTZELL — TEST TECHNICIAN/ENGINEER

SIGNATURE

AUGUST 3, 2001 — DATE OF TEST

**TABLE 12-2: TEST EQUIPMENT USED FOR TESTING (FREQUENCY STABILITY/TEMPERATURE)**

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number | Calibration Due Date |
|---|---|---|---|---|---|
| 900946 | Tenney Engineering, Inc. | TH65 | Temperature Chamber with Humidity | 11380 | 11/07/01 |
| 901055 | Hewlett Packard | 8901A Opt. 002-003 | Modulation Analyzer | 2545A04102 | 06/08/01 |

**PLOT 12-2: FREQUENCY STABILITY/VOLTAGE VARIATION**

Battery Endpoint = 4.0 VDC

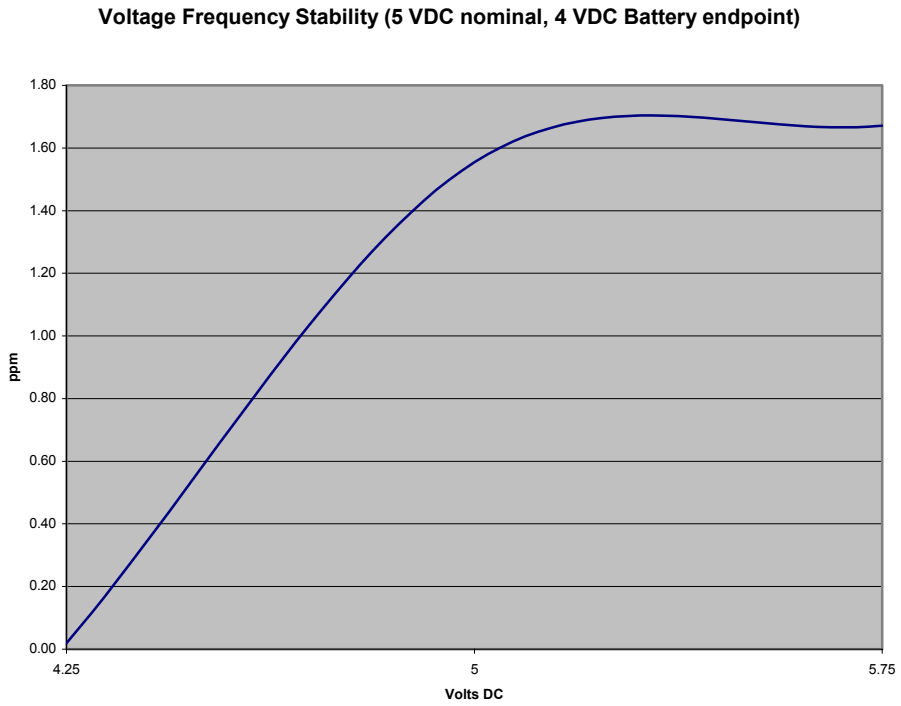



**TABLE 12-3: FREQUENCY STABILITY/VOLTAGE VARIATION**

| Voltage (VDC) | Frequency Measured (MHz) | ppm |
|---|---|---|
| 4.25 | 420.025008 | 0.02 |
| 5.00 | 420.025653 | 1.55 |
| 5.75 | 420.025702 | 1.67 |

TEST PERSONNEL:

DANIEL BALTZELL
TEST TECHNICIAN/ENGINEER

SIGNATURE

AUGUST 3, 2001
DATE OF TEST

**TABLE 12-4: TEST EQUIPMENT USED FOR TESTING (FREQUENCY STABILITY/VOLTAGE)**

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number | Calibration Due Date |
|---|---|---|---|---|---|
| 900946 | Tenney Engineering, Inc. | TH65 | Temperature Chamber with Humidity | 11380 | 11/07/01 |
| 901055 | Hewlett Packard | 8901A Opt. 002-003 | Modulation Analyzer | 2545A04102 | 06/08/01 |

## 13 FCC PART 2 §2.202: NECESSARY BANDWIDTH AND EMISSION BANDWIDTH

Type of Emission: F1D

Necessary Bandwidth and Emission Bandwidth:
25kHz (WB channel): Bn = 16K0F1D

Calculation:
Max modulation(M) in kHz : 3
Max deviation (D) in kHz: 5
Constant factor (K) : 1
Bn = 2xM+2xDK