

MEASUREMENT PROCEDURE AND TEST EQUIPMENT USED

Except where otherwise stated, all measurements are made following the Electronic Industries Association (EIA) Minimum Standard for Land Mobile Radio Transceiver - Project 25 Digital Radio Technology (EIA/ TIA-102.CAAB).

This exhibit presents a brief summary of how the measurements were made, the required limits, and the test equipment used.

The following procedures are presented with this application.

- |    |                                      |              |
|----|--------------------------------------|--------------|
| 1. | Test Equipment List                  | <u>  X  </u> |
| 2. | RF Power Output                      | <u>  X  </u> |
| 3. | Occupied Bandwidth                   | <u>  X  </u> |
| 4. | Adjacent Channel Coupled Power Ratio | <u>  X  </u> |
| 5. | Conducted Spurious Emissions         | <u>  X  </u> |
| 6. | Radiated Spurious Emissions          | <u>  X  </u> |
| 7. | 1559-1610 MHz Radiated Emissions     | <u>  X  </u> |
| 8. | Frequency Stability                  | <u>  X  </u> |

**TEST EQUIPMENT LIST**

Pursuant To FCC Rules 2.947 (d)

1. HP 8901B Modulation Analyzer
2. HP 5334B Universal Counter
3. Thermotron 2800 Temperature Chamber
4. Agilent E4438C Frequency Generator
5. HP 6652A DC Power Supply
6. HP 6674A DC Power Supply
7. HP 89441A Vector Signal Analyzer
8. Keithley 2001 Digital Multimeter with temperature sensor
9. JFW Industries 50FHE-030-200 200 Watt 30 dB Attenuator
10. Rohde and Schwarz Model FSEA Spectrum Analyzer
11. Telonic Berkeley Model TTF-750-5-5EE Tunable Bandpass Filter
12. Channel Microwave Corp. Model UL621C Circulator
13. Weinschel Model WA1426-4 RF Terminating Load
14. Weinschel Model WA53 30 dB attenuator (DC - 1.5 GHz)
15. Agilent E4431B ESG - D Series Signal Generator
16. Agilent E4406A VSA Series Transmitter Tester
17. HP 8566B Spectrum Analyzer
18. 7/800 MHz Antenna Set: Quarter Wave, Low Profile, Collinear and Elevated Feed
19. HP 437B Power Meter with 8482H Power Sensor

**RF POWER OUTPUT**

Pursuant to FCC Rules 2.1046 (a)

**Method of Measurement**

The RF power output is measured with the transmitter adjusted in accordance with the tune-up procedure outlined in Exhibit 10 to give the value of voltage and current as specified in Exhibit 6 as required by 2.1033(c)(8). A 50-ohm RF attenuator of proper power rating was used as a load for making these measurements.

The power measurements were made using a Hewlett Packard series 437B power meter with 8482H power sensor and 30 dB attenuator.

**OCCUPIED BANDWIDTH**

Pursuant to FCC Rules 2.1049

**Method of Measurement**

Measured data on occupied bandwidth is presented in the form of a spectrum analyzer photograph, which illustrates the transmitter sidebands. For digital data in High Performance Data (HPD) and Compatible 4-Level Frequency Modulation (C4FM) modes, the reference line for the data plot is that of the peak value of the modulated carrier. In C4FM mode, the carrier is modulated with a Standard Transmitter Test Pattern, which is a continuously repeating 511 bit pseudo-random bit sequence based on ITU-T 0.153. Measurements were conducted per TIA-102.CAAA-B Section 2.2.5.

FCC Limits - Per 47 CFR 90.210(g) for HPD mode and 47 CFR 90.210(d) for C4FM mode.

**ADJACENT CHANNEL COUPLED POWER RATIO**

Pursuant to FCC Rules 90.543

**Method of Measurement**

A reference level of the Unit under Test was obtained by setting the measurement bandwidth of the spectrum analyzer to the channel size and measuring the power in the channel. Measurements were then taken at specified offsets and measurement bandwidths as specified in 90.543(a). For the far-out offsets, the dynamic range of the spectrum analyzer had to be extended. This was accomplished by connecting the output of the Unit Under Test to Port 1 of a circulator, connecting a tunable bandpass filter with a terminating load to Port 2 and connecting Port 3 of the circulator to the spectrum analyzer. With the spectrum analyzer swept over the desired measurement offset, the bandpass filter was slowly tuned from a higher frequency setting toward the current transmitter frequency. As the bandpass filter is tuned, frequencies outside of the filter's bandpass response are reflected back to the circulator where they are then passed to the spectrum analyzer. Frequencies inside the filter's response are passed to the terminating load and thus eliminated from the input of the spectrum analyzer. As the bandpass filter is tuned, the display of the spectrum analyzer is observed. As the center frequency of the filter approaches the current transmitter frequency, the level of the transmitter signal on the display of the spectrum analyzer will drop. The bandpass filter was tuned to the point where sufficient dynamic range of the spectrum analyzer was obtained. Actual measurements are recorded in the attached table.

FCC Limits - Per Rule 90.543(a).

**CONDUCTED SPURIOUS EMISSIONS**

Pursuant to FCC Rule 2.1051

Method of Measurement:

The transmitter is terminated into a 50 ohm load and interfaced with a spectrum analyzer which allows the spurious emission level relative to the carrier level to be measured directly. Measurements shall be made from the lowest radio frequency generated in the equipment to the tenth harmonic of the carrier or as high as the state of the art permits except for that region close to the carrier equal to  $\pm 250\%$  of the authorized bandwidth.

FCC Limits - Per Applicable Rule Parts.

Conducted spurious emissions shall be attenuated below the maximum level of emission of the carrier frequency in accordance with the following formula:

Spurious attenuation in dB =  $43 + 10 \log_{10}$  (Power output in watts) for 25 kHz Channelization.

Spurious attenuation in dB =  $50 + 10 \log_{10}$  (Power output in watts) for 12.5 kHz Channelization.

**RADIATED SPURIOUS EMISSIONS**

Pursuant to FCC Rules 2.1053

Test Site:

The site, located at Plantation, Florida, is in a region, which is reasonably free from RF interference and has been approved by the Commission for Spurious Measurements.

The equipment is placed on the turntable, connected to a dummy RF load and then placed in normal operation using the intended power source. A broadband receiving antenna, located 10 meters from the transmitter-under-test (TUT), picks up any signals radiated from the transmitter and its operation accessories. The antenna is adjustable in height and can be horizontally and vertically polarized. A spectrum analyzer covering the necessary frequency range is used to detect and measure any radiation picked up by the above mentioned receiving antenna.

Method of Measurement:

The equipment is adjusted to obtain peak reading of received signals wherever they occur in the spectrum by:

1. Rotating the transmitter under test.
2. Adjusting the antenna height.

The testing procedure is repeated for both horizontal and vertical polarization of the receiving antenna. Relative signal strength is indicated on the spectrum analyzer connected to the receiving antenna. To obtain actual radiated signal strength for each spurious and harmonic frequency observed, a standard signal generator with calibrated output is connected to a dipole antenna adjusted to that particular frequency. This dipole antenna is substituted for the transmitter under test. The signal generator is adjusted in output level until a reading identical to that obtained with the actual transmitter is observed on the spectrum analyzer. Signal

strength is then read directly from the generator. Actual measurements are recorded on the attached graphs.

FCC Limits -- Per Applicable Rule Parts.

Radiated spurious emissions shall be attenuated below the maximum level of emission of the carrier frequency in accordance with the following formula:

Spurious attenuation in dB =  $43 + 10 \log_{10}$  (Power output in watts) for 25 kHz Channelization.

Spurious attenuation in dB =  $50 + 10 \log_{10}$  (Power output in watts) for 12.5 kHz Channelization.

### **1559-1610 MHz RADIATED EMISSIONS**

Pursuant to FCC Rules 2.1053 & 90.543 (e)

Method of Measurement:

Measurements were conducted per TIA-102.CAAA-B Section 2.2.6.4. The transmitter is terminated into a 50 ohm load and interfaced through a suitable high pass filter to a spectrum analyzer. This allows for the measurement of spurious emission levels in the GNSS band. The transmitter is replaced with a signal generator to determine the loss of the setup at the measurement frequencies. And, the radiated emissions in the GNSS band are calculated as follows:

EIRP (dBm) = Level (dBm) – Loss (dB) + Antenna Gain (dBi)

FCC Limits -- Per 47 CFR 90.543(e).

All emissions including harmonics in the band 1559-1610 MHz shall be limited to –70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and –80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth.

### **FREQUENCY STABILITY**

Pursuant to FCC Rule 2.1055

Method of Measurement:

A. Temperature:

Frequency measurements are made at the extremes of the temperature range -30 to +60 degrees centigrade and at intervals of not more than 10 degrees centigrade throughout the range. Sufficient time is allowed prior to each measurement for the circuit components to stabilize.

A frequency counter is used to record the data in open loop or carrier feed through High Performance Data (HPD) mode. And, a vector signal analyzer is used to record the data in closed or normal HPD mode. In the closed loop HPD mode a signal generator is used as a base station emulator to transmit a very high accuracy forward control channel frequency signal. This forward control channel signal is required for the transceiver to lock onto the base station, to enable transmit.

B. Power Supply Voltage:

The primary voltage was varied from 85% to 115% of the nominal supply voltage. Voltage is measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. In addition, the primary voltage will be reduced to the point where the radio performs a reset (battery operating end point).

FCC Limits -- Per 47 CFR 90.213 and 47 CFR 90.539

Temperature:

Frequency Stability of ± 1.5 ppm from -30 to +60 degrees centigrade in Carrier Feed Through HPD Mode and Compatible 4-Level Frequency Modulation (C4FM) mode.

Frequency Stability of ± 0.4 ppm from -30 to +60 degrees centigrade in normal or closed loop HPD mode.

Power Supply Voltage:

Frequency Stability of ± 1.5 ppm from 85% to 115% of nominal voltage.

**MODEL NUMBERS**

**DESCRIPITON**

M26UGA9PW1AN

HPD 1000 \*  
High Performance Data (HPD) Mode:  
794-824 MHz (1-12 Watt Average)  
Compatible 4-Level Frequency Modulation (C4FM) Mode:  
15 – 36 Watts (764 – 806 MHz)  
15 – 42 Watts (806 – 870 MHz)

\* Does not support low power regional channels and Itinerant channels listed in Sections 90.531(b) 3 and 90.531 (b) 4 respectively.