

**TEST SET-UP PROCEDURES AND TEST EQUIPMENT USED**

Pursuant to 47 CFR 2.947

Except where otherwise stated, all measurements are made following the Telecommunications Industries Association/Electronic Industries Association (TIA/EIA) "Land Mobile FM or PM Communications Equipment Measurement and Performance Standards" (TIA/EIA-603).

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
- 2) RF Power Output
- 3) Audio Frequency Response
- 4) Post Limiter Lowpass Filter Response
- 5) Modulation Limiting Characteristic
- 6) Occupied Bandwidth
- 7) Conducted Spurious Emissions
- 8) Radiated Spurious Emissions
- 9) Frequency Stability vs. Temperature and Voltage
- 10) 1559 – 1610 MHz Radiated Emissions
- 11) Adjacent Channel Power Ratio (ACPR)

**Test Equipment List**

Pursuant to 47 CFR 2.1033(c)

The following test equipment was used to perform the measurements of the submitted data. The calibration of this equipment is performed at regular intervals.

**Transmitter Frequency:**

HP 5385A Frequency Counter with High-Stability Reference

**Temperature Measurement:**

HP 2804A Quartz Thermometer

**Transmitter RF Power:**

HP 435A Power Meter with HP 8482A Power Sensor

**DC Voltages and Currents:**

Fluke 8010A Digital Voltmeter

**Audio Responses:**

HP 8903B Audio Analyzer

**Deviation:**

HP 8901B Modulation Analyzer

**Transmitter Conducted Spurious and Harmonic Emissions:**

HP 8566B Spectrum Analyzer with HP 85685A Preselector

**Transmitter Occupied Bandwidth:**

HP 8591A Spectrum Analyzer

**Radiated Spurious and Harmonic Emissions:**

Radiated Spurious and Harmonic Emissions were performed by:

Motorola Plantation OATS (Open Area Test Site) Lab  
8000 West Sunrise Blvd.  
Plantation, Florida 33322

FCC Registration: 91932  
Industry of Canada: IC3679  
ISO 25 certified

**Measurement Procedures Used for Submitted Data****EXHIBIT 6A - RF Power Output vs. DC Power Input – Pursuant to 47 CFR 2.1046**

The transmitter is operated under normal conditions at the specified nominal dc input voltage. The antenna output is terminated in 50  $\Omega$ . The DC supply path to the final stage only is interrupted to allow insertion of a DC ammeter in series with the DC supply. The DC voltage drop of the ammeter is negligible. A DC voltmeter is used to measure the DC voltage applied to the final stage. The DC input power to the final stage (in watts) is computed as the product of the DC current (in amperes) times the DC voltage (in volts). This measurement is performed at the lowest, the middle and the highest operating frequencies of the operating bandwidth of the equipment.

**EXHIBIT 6B - Transmitter Audio Frequency Response – Pursuant to 47 CFR 2.1047(a)**

The transmitter output is monitored with an HP8901B modulation analyzer, whose FM demodulator output is fed to an HP8903B audio analyzer. De-emphasis or filtering within the test equipment is not used. An audio oscillator signal, derived from the HP8903B Audio Analyzer, is connected to the microphone audio input of the transmitter. At a frequency of 1 kHz, the level is adjusted to obtain 20% of full system deviation, to ensure that limiting does not occur at any frequency in the range of 300 - 3000 Hz. A constant input level is then maintained and the oscillator frequency is varied between the range of 100 Hz to 5000 Hz. The frequency response is plotted, using a reference of 0 dB at 1 kHz.

**EXHIBIT 6C - Transmitter Audio Post Limiter Lowpass Filter Response – Pursuant to 47 CFR 2.1047(a)**

The audio oscillator portion of an HP8903B audio analyzer is connected to the input of the post limiter lowpass filter. The output of the lowpass filter is measured with the HP8903B audio analyzer. The response is swept between the limits of 100 Hz and 100 kHz. Oscillator level is chosen to be the as high as possible that will not cause limiting at any frequency, and is maintained constant vs. frequency.

**EXHIBIT 6D - Modulation Limiting Characteristic – Pursuant to 47 CFR 2.1047(b)**

An audio oscillator is connected to the microphone audio input. The transmitter output is monitored with an HP8901B modulation analyzer. The flat frequency response FM demodulator output of the HP8901B is fed to an HP8903B audio analyzer. The 20 kHz lowpass filter of the Modulation Analyzer is used to reduce the level of residual high frequency noise. The oscillator level is adjusted, at 1 kHz, to obtain 60% of full system deviation. The oscillator level is then varied over a range of  $\pm 25$  dB in 5 dB increments, and the resulting deviation is plotted. This measurement is repeated at 300 Hz and 3 kHz. The above procedure is performed four times, for conditions with Tone Private Line, Digital Private Line, Trunking (these are continuous subaudible signaling formats), and without subaudible signalling (referred to as "carrier squelch mode.")

**Measurement Procedures Used for Submitted Data (continued)****EXHIBIT 6E - Occupied Bandwidth – Pursuant to 47 CFR 2.1049(c)(1)****Procedure for Occupied Bandwidth for Voice Transmission**

An audio oscillator is connected to the microphone audio input. The frequency is set to 2500 Hz and the amplitude is adjusted to a level 16 dB above that required to produce 50% of full system deviation at the frequency of maximum response of the audio modulation circuit, in accordance with FCC rules Part 2.1049(c)(1).

The transmitter output is connected, via a suitable attenuator, to an HP8593A spectrum analyzer that outputs to an HP7470A plotter. Spectrum analysis of the transmitter output is performed to at least  $\pm 2.5$  times the channel spacing. The unmodulated carrier is used to establish a 0-dB reference, then with the modulating signal is applied. This measurement is repeated with Tone Private Line continuous subaudible signaling added (250.3 Hz at 15% full system deviation), again with Digital Private Line (code 131 at 15% of full system deviation), and again with Trunking modulation (297 BPS at 32% of full system deviation). These measurements are then repeated for all types of signaling or data transmission that are not used simultaneously with voice. In these cases, the signaling or data modulation replaces the 2500 Hz tone modulation. The repeated measurements are performed separately for conditions with Tone Private Line, Digital Private Line, Trunking, and without subaudible signaling.

**Procedure for Occupied Bandwidth for Data Transmission**

An audio function generator capable of voltage control of frequency is connected to the flat (non pre-emphasized) transmit audio input of the equipment under test. A second function generator producing a square wave output at a frequency of 1200 Hz is connected to the voltage control input of the first generator. The first generator is set to produce a sine wave signal at a center frequency of 2500 Hz, and the amplitude of the square wave from the second generator is adjusted so that the frequency of the first generator is varied  $\pm 500$  Hz. The resulting output of the first generator is an AFSK sine wave signal that shifts between two discrete frequencies, 2000 Hz and 3000 Hz, at a rate of 1200 Hz. The amplitude of the first generator, which modulates the transmitter, is adjusted for full system deviation.

The transmitter output is connected, via a suitable attenuator, to an HP8593A spectrum analyzer that outputs to an HP7470A plotter. Spectrum analysis of the transmitter output is performed to at least  $\pm 2.5$  times the channel spacing. The unmodulated carrier is used to establish a 0-dB reference, and then the modulating signal is applied. This measurement is repeated with Tone Private Line continuous subaudible signaling added (250.3 Hz at 15% full system deviation) again with Digital Private Line (code 131 at 15% of full system deviation), and again with Trunking modulation (297 BPS at 32% of full system deviation). In each case, the amplitude of the modulating signal is adjusted so that the total deviation level, including the TPL or DPL modulation, is the full system deviation.

**Measurement Procedures Used for Submitted Data (continued)****EXHIBIT 6F - Conducted Spurious Emissions – Pursuant to 47 CFR 2.1051**

The output of the transmitter is connected, via a suitable attenuator, to the input of an HP8593A spectrum analyzer. After a carrier reference level has been established, a tunable notch filter is inserted between the attenuator and the spectrum analyzer to allow suppression of the carrier level. The effects of the notch filter on other frequencies, if any, are taken into account. The level of spurious emissions, in dB relative to the carrier, is plotted. This data is measured at the upper and lower frequency limits of the frequency range. If transmit power is adjustable, the measurement is repeated at various power levels including minimum and maximum.

**EXHIBIT 6G - Radiated Spurious Emissions – Pursuant to 47 CFR 2.1053**

Transmitter radiated spurious emissions were measured by the Motorola Plantation OATS (Open Area Test Site) Lab, located at 8000 West Sunrise Blvd, Plantation, Florida 33322. Measurements were made at an approved open field test site constructed in accordance with Appendix B, FCC/OST 55 (1982), and were performed in accordance with the Code of Federal Regulations, Title 47, Part 2, paragraph 2.1053. The data is plotted as "Radiated Spurious and Harmonic Emissions (Horizontal and Vertical)" on the graphs comprising EXHIBIT 6G. The specification limit corresponding to a level of 43 dB + 10 log (Pout) below the fundamental carrier power of the transmitter is indicated on each graph for reference.

The following additional instruments are used in performing the radiated field strength measurements:

- Hewlett Packard model 8566A spectrum analyzer
- Hewlett Packard model 8350B sweep oscillator
- Empire Devices DM-105/T3 tuned dipole antenna (400-1000 MHz)
- EMCO 3121C-DB4 tuned dipole antenna (400-1000 MHz)
- EMCO 3105 ridged W.G. antennas (1-12.4 GHz)
- Bird model 8130 50  $\Omega$ , 50 Watt load

**EXHIBIT 6H-1 and 7H-2 - Frequency Stability vs. Temperature and vs. Voltage – Pursuant to 47 CFR 2.1055(a)(b) and (d)**

Frequency Stability vs. Temperature data is measured in accordance with FCC Rules Part 2.1055(a)(1). An HP5061A Cesium Beam Frequency Standard is used as a reference for frequency measurements. The calibration of the temperature measurements of the environmental chamber is referenced to an HP2804A Quartz Thermometer.

Frequency Stability vs. Voltage data is measured in accordance with FCC Rules Part 2.1055(d). An HP5061A Cesium Beam Frequency Standard is used as a reference for frequency measurements.

**Measurement Procedures Used for Submitted Data (continued)****EXHIBIT 6I – 1559-1610 MHz Radiated Emissions – Pursuant to 47 CFR 2.1051 & 27.53(e)**Test Site:

The test site used is the Motorola Plantation OATS (Open Area Test Site) Lab, located at 8000 West Sunrise Blvd, Plantation, Florida 33322. This region is reasonably free from RF interference and has been approved by the Commission for Spurious Measurements (FCC Registration: 91932 / Industry of Canada: IC3679 / ISO 25 certified).

The equipment is placed on the turn table, connected to the applicable radio antenna and then placed in normal operation using the intended power source. A broadband receiving antenna, located 3 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 or 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 GNSS spectrum (1559-1610 MHz) 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 response and harmonic frequency observed, a standard signal generator with calibrated output is connected to a dipole antenna adjusted to that particular frequency. The 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 tables of Exhibit 6I.

FCC Limits – Per 47 CFR 27.53(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.

**EXHIBIT 6J – Adjacent Channel Coupled Power Ratios – Pursuant to 47 CFR 27.53(d)(1)**Method of Measurement:

The signal from the Unit Under Test is mixed down, bandpass filtered and input into a vector signal analyzer (VSA). This method increases the dynamic range of the set-up. A reference level of the Unit Under Test was obtained by setting the measurement bandwidth of the VSA to the channel size and measuring the power in the channel.

**Measurement Procedures Used for Submitted Data (continued)**

Measurements were then taken at specified offsets and measurement bandwidths as specified in 47 CFR 27.53(d)(1). Actual measurements are recorded in the attached table of Exhibit 6J.

FCC Limits: -- Per 47 CFR 27.53(d)(1)