

**MEASUREMENT PROCEDURE AND TEST EQUIPMENT USED**

Except where otherwise stated, all measurements are made following the Electronic Industries Association (EIA) Minimum Standard for Portable/Personal Land Mobile Communications FM or PM Equipment 25-1000 MHz-(EIA/TIA-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                       | <u>    x    </u> |
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### Test Equipment List

Pursuant To FCC Rules 2.947 (d)

1. HP 8566A Spectrum Analyzer.
2. Rohde & Schwarz FSEA Spectrum Analyzer.
3. HP 8657B RF Signal Generator.
4. Rohde & Schwarz SMP22 Signal Generator.
5. Antenna Set:
  - A. A.H. Systems, Inc. SAS-200/571 (0.7-18GHz).
  - B. EMCO 3143 (< 1GHz).
  - C. Watkins Johnson 272 (> 1 GHz).
  - D. Schaffner-Chase CBL6112B Bilog (30MHz – 3GHz).
6. Agilent E4419B RF Power Meter.
7. HP 8901B Modulation Analyzer.
8. Tenney (Series 942) Temperature Chamber.
9. HP 6623A System DC Power Supply.
10. HP 89441A Vector Signal Analyzer
11. HP 8903B Audio Analyzer.
12. Rohde & Schwarz UPD Audio Analyzer.
13. HP 34401A Digital Multimeter.
14. Tektronics TDS-754A Oscilloscope.
15. HP 8902A Measuring Receiver.
16. Rohde & Schwarz ESI26 Receiver / Analyzer
17. Weinschel Model 33 30dB attenuator
18. Telonic Berkeley Model TTF-750-5-5EE Tunable Bandpass Filter
19. Channel Microwave Corp. Model UL621C Circulator.
20. Weinschel Model WA1426-4 RF Terminating load.
21. EMCO 3810/2NM LISN

### **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 12 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 are made using an Agilent series E4419B RF power meter and 30 dB attenuator.

### **Audio Frequency Response**

Pursuant FCC Rules 2.1047 (a)

#### **Method of Measurement**

Operate the transmitter under standard test conditions and monitor the output with a frequency deviation meter or calibrated test receiver. With 1000 Hz sine wave audio input applied through a dummy microphone circuit, adjust the audio input to give 20% of full rated system deviation. Maintaining a constant input voltage, vary the input frequency from 300 to 3000 Hz, and observe the deviation.

#### **Minimum Standard**

The audio frequency response shall not vary more than +1 or -3 dB from 300 to 3000 Hz from a true 6 dB per octave pre-emphasis characteristic as referenced to 1000 Hz level, with the exception of a permissible 6 dB/octave roll off below 500 Hz. Equivalent to TIA/EIA 603 Section 5.2.6.2 mask.

### **Low Pass Filter Response**

Pursuant FCC Rules 2.1047 (a)

#### **Method of Measurement**

A Dynamic Signal Analyzer is used to sweep the response from 1kHz to 25kHz. The source of the analyzer is connected to the AUDIO IN port of the radio interface box. The audio input level is adjusted to produce a standard test modulation. The transmitter is operated under standard test conditions and the output of the Switch Cap Filter is monitored, with the post limiter low pass filter within the lineup. The output is connected to channel 2 of the analyzer and referenced to its input signal. A sinusoidal sweep from 1K to 25KHz will produce the frequency response of the low pass filter during TX mode.

**FCC Limits** -- Per applicable rule parts.

450 to 869 MHz & VHF Marine.

Frequencies between 3 kHz and 20 kHz shall be attenuated greater than the attenuation at 1 kHz by  $60 \log_{10} (f/3)$  dB.

Frequencies above 20 kHz shall be attenuated at least 50 dB.

**Modulation Limiting**

Pursuant FCC Rules 2.1047 (b)

**Method of Measurement**

The transmitter shall be adjusted for full rated system deviation. Adjust the audio input for 60% of rated system deviation at 1000 Hz. Using this level as a reference (0 dB) vary the audio input level from the reference to a level 20 dB above it for modulation frequencies of 300, 1000 and 3000 Hz. Record the system deviation obtained as a function of the input level.

**FCC Limits**

Minimum Standard - The transmitter modulation must not exceed rated system deviation at any audio frequency input or reasonable change in input level.

**Occupied Bandwidth**

Pursuant to FCC Rules 2.1049

**Method of Measurement**

Data on occupied bandwidth is presented in the form of a spectrum analyzer photograph, which illustrates the transmitter sidebands. For analog signals, the reference line for the data plot is taken of the unmodulated carrier, to which is superimposed the sideband display generated by modulating the carrier with a 2500 Hz tone at a level 16 dB greater than that required to produce 50 percent modulation. For digital voice and data, the reference line for the data plot is that of the peak value of the modulated carrier. For digital data, the Standard Transmitter Test Pattern is a continuously repeating 511 bit pseudo-random bit sequence based on ITU-T 0.153. If tone or digital coded squelch is indicated, photographs using both the 2500 Hz tone and the indicated squelch signal are used to modulate the transmitter. During these measurements, the instantaneous Deviation Control is set for a maximum of +5 kHz.

**FCC Limits** - Per Applicable Rule Parts.

Measured Data: At least +25 dB down on any frequency removed from the assigned frequency by more than 50 % and up to and including 100% of the authorized bandwidth. At least +35 dB down on any frequency removed from the assigned frequency by more than 100% up to and including 250% of the authorized bandwidth; at least 43 plus  $10 \log_{10}$  (mean output power in watts) decibels or 70 decibels, whichever is the lesser attenuation.

**ADJACENT CHANNEL POWER**

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. The resulting data is tabularized in Exhibit 6F.

FCC Limits - Per Rule 90.543(a).

### **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 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 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 =  $43 + 10 \log_{10}(\text{Power output in watts})$

**1559-1610MHz Radiated Emissions (GNSS)**

Pursuant to FCC Rules 2.1053 &amp; 90.543e

**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 turntable, 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 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 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 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 tables.

**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.

**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. Modulate the transmitter with a 2500 Hz sine wave at an input level 16 dB greater than that required to produce 50% of rated system deviation at 1000 Hz. 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.

### **Power Line Conducted Spurious Emissions**

Pursuant to FCC Rule 15.107

#### **Method of Measurement:**

Connect the equipment to the power line through a line stabilization network. A spectrum analyzer of nominal 50Ω impedance to one terminal of the line stabilization network. The spectrum analyzer is then tuned to search for spurious outputs from 450kHz to 30MHz. Record all spurious outputs found. The spectrum analyzer is then connected to the other terminal of the line stabilization network and record all spurious outputs found. The power line conducted spurious emissions is the largest reading obtained.

### **Frequency Stability**

Pursuant to FCC Rule 2.1055

#### **Method of Measurement:**

##### **A. Temperature (Non-heated type crystal oscillators):**

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.

##### **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.

FCC Limits -- Per FCC Rule 90.213

Temperature - Frequency Stability of  $\pm 1.5$  ppm from -30 to +60 degrees centigrade.

Power Supply Voltage - Frequency Stability of  $\pm 1.5$  ppm from 85% to 115% of nominal voltage.

#### **MODEL NUMBERS**

#### **DESCRIPITON**

H46UCC9PW5AN

764-870 MHz, 1.0 - 3.0 Watt Digital XTS2500  
48 Channels, No Keypad, No Display

H46UCF9PW6AN

764-870 MHz, 1.0 - 3.0 Watt Digital XTS2500  
160 Channels, 3x2 Keypad, 6-line Display

H46UCH9PW7AN

764-870 MHz, 1.0 - 3.0 Watt Digital XTS2500  
160 Channels, 3x6 Keypad, 6-line Display