

**MEASUREMENT TECHNIQUES**2.991 **Measurements Required:** Conducted Spurious and Harmonic Emissions at Antenna Terminals (Analog Mode)

Graph attached  
EXHIBIT 9G

**Definition** - (as used herein) Spurious radiations are the radio frequency voltages or power generated within the equipment and appearing at the equipment's output terminals when properly loaded with its characteristic non-radiating artificial load.

**Minimum standard** - The magnitude of each spurious and harmonic emission that can be detected when the equipment is operated under the conditions specified in the alignment procedure, EXHIBIT 8B, shall be attenuated 43dB below the mean power output. In the range of frequencies between 869.04MHz and 893.97MHz, no spur shall exceed -80dBm.

**Method of Measurement** - The transmitter was modulated with a 2500Hz tone at a level 16dB greater than that required to provide 50% modulation. The spectrum was scanned from the lowest frequency generated in the equipment to the tenth harmonic of the carrier. The level of the carrier and the various conducted spurious and harmonic frequencies shall be measured by means of a calibrated receiving system used to compare the output of the transmitter with that of a standard signal generator at the spurious frequency.

2.991 **Measurements Required:** Conducted Spurious and Harmonic Emissions at Antenna Terminals (Digital Mode)

Graph Attached  
EXHIBIT 9G

**Definition** - (as used herein) Spurious radiations are the radio frequency voltages or power generated within the equipment and appearing at the equipment's output terminals when properly loaded with its characteristic non-radiating artificial load.

**Minimum Standard** - The magnitude of each spurious and harmonic emission that can be detected when the equipment is operated under the conditions specified in the alignment procedure, EXHIBIT 8B, shall be attenuated 43dB below the mean power output. In the range of frequencies between 869.04MHz and 893.97MHz, no spur shall exceed -80dBm.

**Method of Measurement** - The transmitter was modulated with OQPSK modulation using pseudo random data. The spectrum was scanned from the lowest frequency generated in the equipment to the tenth harmonic of the carrier. The level of the carrier and the various conducted spurious and harmonic frequencies shall be measured by means of a calibrated receiving system used to compare the output of the transmitter with that of a standard signal generator at the spurious frequency.

2.993 **Measurements Required:** Radiated Spurious and Harmonic Radiation (Analog and Digital Modes)

Graph attached  
EXHIBIT 9H

**Definition** - Radiated spurious and harmonic emissions are frequencies from the equipment when loaded into a non-radiating load on a frequency or frequencies which are

outside an occupied band sufficient to insure transmission of information of required quality for the class of communications desired. The reduction in the level of these spurious emissions will not effect the quality of the information being transmitted.

Minimum standard - Radiated spurious emissions shall be attenuated 43dB below the mean power output. In the range of frequencies between 869.04MHz and 893.97MHz, no spur shall exceed -80dBm.

Method of Measurement:

Test Site - Schaumburg, Illinois, a region which is reasonably free from RF interference. A non-metallic building has been constructed to a special design which minimizes disturbances to RF radiation patterns. The building houses both the equipment under test and all the control and measurement equipment.

Installation of Equipment:

The equipment under test is placed on the turntable, connected to a dummy RF load, and then placed in normal operation using the intended power source. A receiving antenna located 3 meters from the turntable picks up any signal radiated from the transmitter and its operating accessories. The antenna is adjustable in height and can be horizontally and vertically polarized. Tunable receivers covering the necessary frequency range are used to detect and measure any radiation picked up by the antenna.

Measurement Procedure

The equipment is adjustable to obtain peak readings 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 meters built into the receiver. To obtain actual radiated signal strength, a standard signal generator with calibrated output is substituted for the transmitter under test. The signal generator is adjusted in output until a reading identical to that obtained with the actual transmitter is obtained at the receiver. Signal strength is then read directly from the generator. Actual measurements are recorded on the attached graph.

2.995 Measurements Required: Frequency Stability (Analog and Digital Modes)

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

Minimum standard - In the analog modes, the minimum frequency stability shall be  $\pm 0.000075\%$  referenced to a received carrier frequency from a base station. This meets the requirement for operational accuracy of 0.00025% in wide mode and 0.00010% in narrow mode. In digital mode, the minimum frequency stability shall be  $\pm 300$  Hz referenced to a received carrier frequency from a base station. This meets the requirement for operational accuracy of 0.00005% in digital mode.

Method of Measurement - Frequency measurements shall be made at the extremes of the

temperature range  $-30^{\circ}$  to  $+60^{\circ}\text{C}$  and at intervals of not more than  $10^{\circ}\text{C}$  throughout the range. A period of time sufficient to stabilize all of the components in the equipment shall be allowed prior to each frequency measurement. The frequency of the transmitter shall be measured by extracting a sample of the carrier and measuring its center frequency by equipment having a degree of accuracy of at least 10 times that of the minimum to be measured.

The frequency stability of transmitting equipment shall be checked with variations in:

- (a) Temperature: Vary the ambient from  $-30^{\circ}\text{C}$  to  $+60^{\circ}\text{C}$ .

Graphs attached EXHIBITS 9J-1, 2 & 3.

- (b) Primary Supply Voltage:

Vary the primary supply voltage over the specified battery voltage range.

Graphs attached EXHIBITS 9K-1, 2 & 3.

#### Timing Period and Procedure for Frequency Stability Measurements

1. The carrier frequency of the transmitter was measured at room temperature (usually between  $25^{\circ}$  and  $27^{\circ}\text{C}$ ) to provide a reference.
2. The equipment was then subjected to an overnight soak at  $-30^{\circ}\text{C}$  without any power applied.
3. After an overnight soak at  $-30^{\circ}\text{C}$ , measurement of the carrier frequency of the transmitter was made within a three minute interval after applying power to the transmitter.
4. Frequency measurements were made at each  $10^{\circ}\text{C}$  interval ( $-30^{\circ}$ ,  $-20^{\circ}$ ,  $-10^{\circ}$ ,  $0^{\circ}$ ,  $+10^{\circ}$ ,  $+20^{\circ}$ ,  $+30^{\circ}$ ,  $+40^{\circ}$ ,  $+50^{\circ}$ ,  $+60^{\circ}$ ). A period of at least one hour was provided to allow stabilization of the equipment at each temperature level.
5. In all measurements, at the various temperature intervals, the temperature was held to  $\pm 1^{\circ}\text{C}$  from the temperature level.
6. The artificial load was mounted external to the temperature chamber.

Addendum to Section 2.991 and 2.993: Measurement of Conducted and Radiated Spurious and Harmonic Emissions in the Frequency Range of 869 to 894MHz.

Minimum Standard: The magnitude of each spurious and harmonic emission and the spectrum noise floor (side-band noise) that can be detected when the equipment is operated under the conditions specified in the alignment procedure shall not be more than  $-80\text{dBm}$  (or equivalently not more than  $-115\text{dB}$  below the maximum mean carrier output).

Method of Measurement: Using the methods called out in parts 2.991 and 2.993 the following addition to the test set up is required.

1. At the input terminals of the frequency selectable receiver (spectrum analyzer) an isolator (RF circulator with one port terminated in 50) and an 869 to 894MHz bandpass filter is connected between the test transceiver (for conducted tests) or the receiver

antenna (for radiated tests) and the analyzer. The rejection of the bandpass filter to signals in the 824 to 849MHz range must be adequate to limit the transmit energy from the test transceiver which appears at the analyzer to a level which will allow the analyzer to measure signals less than -90dBm.

2. Calibration of the test receiver must be performed with this set up at enough frequencies in the 869 to 894MHz range to insure accuracy before measurements are made (thus allowing variations in the passband filter insertion loss to be calibrated out).