# *Exhibit 7. Measurement Procedures-----47 CFR. 2.947*

This exhibit presents a brief summary of how the measurements were made.

## *7.1. RF Power -- Pursuant to 47 CFR 2.947 (C)*

(a) Method of Output Power Measurement: Adaptation of TIA/EIA-603 clause 2.2.1 for Pulsed Measurements

The RF power output is not adjustable except by control from the base station using control channel signals or special radio service software. The transmitter power test procedure in the Service Instruction Manual (EXHIBIT 8) describes the procedure to measure the highest output power via software embedded in the radios. This measurement is made using a special servicing antenna adapter to replace the integral antenna through a 30 dB attenuating load using an RF power meter.

Due to the TDM pulsing, an average reading power meter will not correctly display the pulse average power as it must be corrected for the duty cycle of the pulse train. The Motorola R2660C Service Monitor used for radio servicing provides this compensation. Another instrument which may be used is the Hewlett Packard model 437B which was used to take the data reported herein. To use it requires setting the duty cycle on the RF power meter to 16.667% for 6:1 TDM (this is the test mode default condition), or 33.333% for 3:1 TDM.

(b) Method of Measurement for Effective Radiated Power: Proprietary

The ERP characteristic was measured while a radio was vertically mounted on a non-conducting platform/turntable in a RF Anechoic Chamber. Since the instrumentation for the measurement system RF Anechoic chamber did not support pulsed measurements the radio was set into a test mode which enabled transmission of a continuous wave (CW) signal. The power received at an antenna located at the end of the chamber was recorded on a spectrum analyzer, and scaled upwards to compensate for the calibrated path loss and deviation from normally rated RF output power.

## *7.2. Occupied Bandwidth -- Pursuant to 47 CFR 2.947 (b)*

Method of Measurement: Per TIA/EIA-603-1 clause 2.2.11

1.) Set the radio for measurement of RF output power using the power test procedure in the service manual which employs a pseudo random data sequence per part 2.989 (h), and attach it to a spectrum analyzer through an attenuator. The analyzer is to be set for peak detection with a video bandwidth of 10 times the resolution bandwidth setting, a span of 100 kHz, and a sweep period of 20 seconds.

2.) Using a 30 kHz resolution bandwidth to assure that essentially all of the transmitted energy is measured, obtain a “rainbow” curve and adjust the analyzer setting so that the crest of the curve lies at the 0 dB reference location. This is portrayed as trace 1 on the analyzer display.

3.) Reduce the resolution bandwidth to 300 Hz to characterize the transmitter emission on-channel and adjacent channels spectral performance characteristic. This is portrayed as trace 2 on the analyzer display of Figures 6-1 to 6-8.

4.) Overlay the applicable emission mask on the analyzer display as trace 3.

5) Compare traces 2 and 3 to ensure that trace 2 never exceeds trace 3.

### *7.3. Radiated Spurious Emissions -- Pursuant to 47 CFR 2.947 (b)*

Test Site:

The test site used is the Motorola LMPS OATS (Open Area Test Site) Lab, located at 8000W Sunrise Blvd, Plantation, Florida 33324. This region is reasonably free from RF interference. The Radiated and AC Power line Conducted emissions testing was done for minimum and maximum power.

Method of Measurement: EIA/TIA-603-1 clauses 2.2.12 and 5.2.12

The equipment is placed on the turntable, connected to a dummy RF load and placed in normal operation using the intended power source. A broad-band receiving antenna located 3 meters from the transmitter picks up any signal radiated from the transmitter and its operation accessories. The antenna is adjustable in height and can be rotated for horizontal or vertical polarization. A spectrum analyzer covering the necessary frequency range is used to detect and measure any radiation picked up by the antenna.

The transmitter is modulated with a pseudo random digital signal and 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 this antenna. The spectrum analyzer resolution bandwidth was set to 10kHz for emissions below 1GHz, and 1MHz for higher frequency emissions. To obtain actual radiated signal strength for each spurious and harmonic frequency observed, a standard signal generator with calibrated output is connected to an antenna adjusted to that particular frequency. This antenna is substituted for the transmitter under test. The signal generator output level is adjusted until a reading identical to that obtained with the actual transmitter is observed on the spectrum analyzer. Signal strength is then derived from the generator and appropriate cable losses due to set up. Actual measurements for both maximum and minimum transmit power levels are recorded in tables in exhibit 6.

## 7.4. Frequency Stability -- Pursuant to 47 CFR 2.947 (C)

Measuring the frequency accuracy of the iDEN time division multiplexed (TDM) transmitter needs special procedures for 3 reasons. First is the short (15 ms.) nature of its TDM pulses which preclude the use of an ordinary CW type digital frequency counter. Second, software in the radio prevents the radio from transmitting its TDM pulses unless it is receiving a signal on the trunking system control channel. Third, to maintain the very high stability (greater than that required by part 90 rules) needed for system operation, the radio transmitter frequency is controlled by an automatic frequency control loop in the radio's receiver which locks onto the system forward control channel produced by a Type Accepted part 90 base station. This process results in electronically adjusting the initial frequency of the reference oscillator in the synthesizer section of the radio which is used for both transmission and reception.

As a result, unlike traditional transceivers which do not frequency lock to a remote base station reference frequency, the transmitter frequency accuracy is essentially independent of the voltage and temperature induced variations of the subject transceiver’s frequency reference oscillator. Rather, the transceiver frequency stability is that of the remote base station, but degraded by any inaccuracy in the transceiver frequency locking process. This inaccuracy is primarily attributed to reference oscillator AFC resolution.

By locking onto a base station meeting the requirements of 47 CFR 90.213 which is necessary for the transceiver to function, the transceiver transmitter inherits the inherent 1.5 PPM or better stability of the base station. To assure attainment of the 2.5 PPM accuracy requirement of part 90.213 for this transceiver, the frequency error is measured when locked to ensure that it does not exceed 1.0 PPM.

Method of Measurement: (Proprietary)

Since the transmitter frequency is locked to the frequency of the base station via the receiver in this transceiver, frequency accuracy data was measured with the transceiver locked onto a base station transmitter emulated by a Motorola R2660C Service Monitor as shown in Figure 7-1. This was done using QUAD-16QAM time division duplex (TDD) characteristic of the transceiver wherein it was placed into a TDD mode of transmission as normally used to make a call to a landline phone.

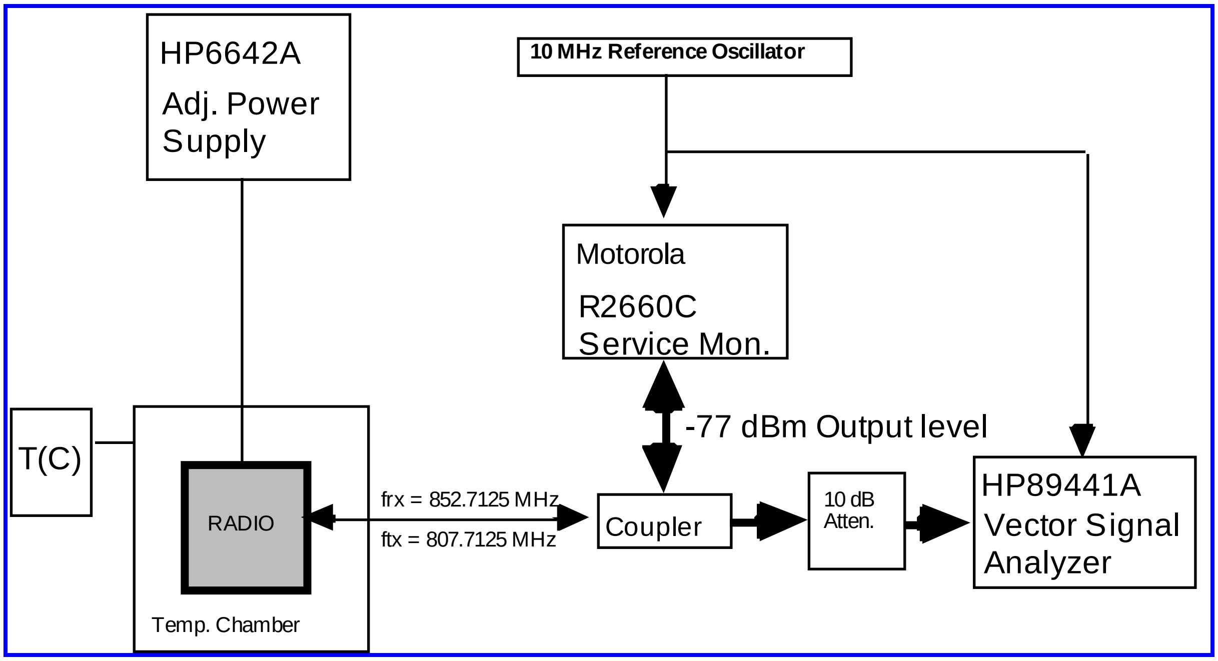


**Figure 7-1: Transmit Frequency Measurement Setup**

During the test the transceiver was receiving a very high accuracy forward control channel frequency signal from the Motorola Base Station, and TDD transmitting a signal on the reverse control channel at a frequency 45.000000 MHz lower corresponding to the normally assigned frequency separation. A Hewlett Packard model 89441A signal analyzer was used to measure the centroid frequency of the emission.

The frequency of the transceiver was measured as operating voltage or temperature was varied, and compared to the frequency of the Motorola Base Station. This produced an error from the expected frequency separation of 45.000000 MHz which was then recorded, and calculated in PPM relative to the expected transmission frequency.

## *7.5 Power Line Conducted Spurious Emissions -- Pursuant 47 CFR 15.107*

Test Site:

The test site is the Motorola LMPS OATS (Open Area Test Site) site, located at, 8000 West Sunrise Blvd., Fort Lauderdale, Florida 33322. This is a region which is reasonably free from RF interference.

Method of Measurement: EIA/TIA-603-1 clauses 2.1.3 and 5.1.3.3

Connect the receiver to the power line through a line stabilization network. A spectrum analyzer of nominal 50 Ω impedance to one terminal (“neutral”) of the line stabilization network. The spectrum analyzer is then tuned to search for spurious outputs from *450kHz to 30 MHz pursuant 47 CFR 15.107*. Record all spurious outputs found. The spectrum analyzer is then connected to the other terminal (“line one”) of the line stabilization network and record all spurious outputs found. The power line conducted spurious emissions is the largest reading obtained.

### *7.6. Measurement Equipment List ---- 47 CFR 2.947 (d)*

1. Spectrum Analyzer
    - A. H.P. 8562E, 30 Hz – 13.2 GHz Spectrum Analyzer
    - B. Rhode & Schwarz FSEM, 20 Hz – 26.5 GHz Spectrum Analyzer
2. Vector Signal Analyzer
    - A. H.P. 89441A, DC - 2650 MHz Vector Signal Analyzer
3. Communications System Analyzer
    - A. Motorola R2660C MIRS Digital Communications System Analyzer
4. Power Meter
    - A. H.P. 437B Power Meter
    - B. H.P. 8482A Power Sensor
5. Multimeter
    - A. Keithley 2001 Multimeter
6. Power Supply
    - A: Motorola 650 mAh 4.8 V Nickel Metal Hydride Battery, Kit #: NTN 8970A
7. RF Load
    - A. Weinschel Associates, Model: 33-30-34, S/N: AZ1096, 25 Watt, 30 dB Attenuator
    - B. Weinschel Associates, Model: 46-10-34, S/N: BD5335, 25 Watt, 10 dB Attenuator
    - C. Narda, Model 768-30, S/N: 9511, 20 Watt, 30 dB Attenuator
    - D. 50 ohm load, Weinschel Associates, Model M1418, S/N BC6736
8. Filter
    - A. Trilithic, Model: X5HX1612-0.75-AA, S/N: 9811186, High Pass Filter
9. Amplifier
    - A. MITEQ ATS5-00101800-60-10P-5, 0.1-18GHz, 25dB Gain Amplifier
10. Antenna
    - A. Watkins -Johnson, Model: WJ48010, S/N: 234, 0.5 GHz - 12.4 GHz, Log - Periodic
    - B. A.H. Systems Inc., Model: SAS-200/571, S/N: 272, 700MHz - 18GHz, Double Ridge Guide Horn
    - C. A.H. Systems Inc., Model: SAS-200/571, S/N: 271, 700MHz - 18GHz, Double Ridge Guide Horn
    - D. EMCO, Model: 3143, S/N: 9403-1019, 20MHz – 1GHz, Biconilog
    - E. EMCO, Model: 3141, S/N: 9403-1047, 20MHz – 1GHz, Biconilog

12. Temperature Chamber
    - A. Thermotron, model S-8
13. LISN
    - A. Solar, Model: 8028-50, Line Impedance Stabilization Network
14. Antenna Positioning Mast
    - A. Sunol Sciences Corp.
15. Computer
    - A. IBM PC Or Compatible, 486 Or Higher, Window 3.1/Window 95 Or Higher.
16. RF Signal Generators
    - A. Rhode & Schwarz SMP22, 10 MHz – 20 GHz
17. Programming Cable

A. DB9 (IBM) - NKN6501A (Motorola)

18. Table

    A. Wood Table

19. Ground plane
20. Output Power Measurement Adaptor
21. A Scientific Atlanta Model 2083A Antenna Measurement System
22. Watkins-Johnson Model AR122
23. Hewlett Packard Model 8566B Spectrum Analyzer
24. Proprietary - Liquid filled human shaped fiberglass phantom
25. Proprietary - Simulated muscle tissues (k = 51.1)
26. Proprietary - Simulated brain tissues ( k = 42.8)
27. Proprietary - Isotropic electric field probe, 3 channel
28. Proprietary - Intelledex Microsmooth Model 660 six-axis robatic arm
29. Proprietary - Test fixturing