

# Section 8

# RF Exposure Information

## Radio Frequency Radiation Exposure Evaluation

FCC Rules: 1.1307, 1.1310, 2.1091, 27.52

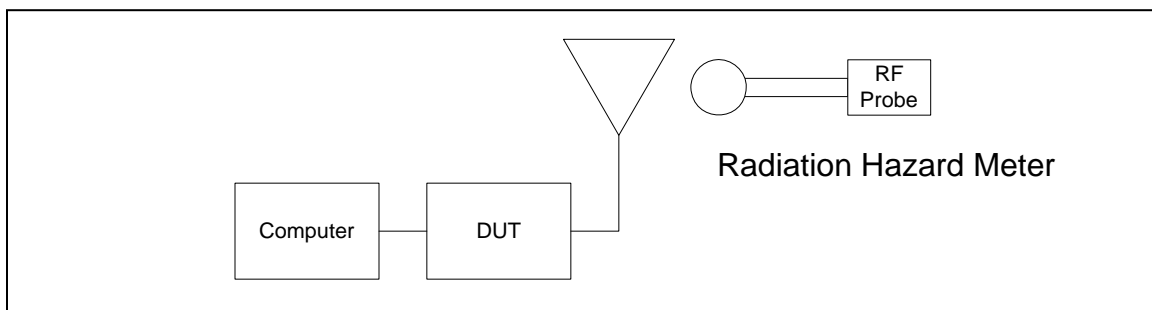
FCC Requirement:  $< 1\text{mW}/\text{cm}^2$  General Population / Uncontrolled Exposure

Standard: IEEE Std C95.3 – 2002  
FCC OET Bulletin 65

Procedure: The Motorola, Inc. Expedience system operates as a Time Division Duplex (TDD) product with a Time Division Multiplex (TDM) frame structure. The RSU-2510-RV and RSU-2510-RH Residential Subscriber Units are able to transmit a time division duplex (TDD) signal up to a maximum 14.29 % transmit duty cycle. To measure the RF Exposure, the RSU transmitter is enabled in test mode and set to the maximum power level. Measurements are performed at the low, mid, and high channels of each channel bandwidth, using the maximum transmitter duty cycle and both antenna polarizations. Modulation was set to 4-QAM.

Conditions: Frequency = 2499, 2593, 2687 MHz  
Temperature = 25°C  
Supply Voltage = 120 VAC / 60 Hz Nominal to DUT Power Supply

Set-Up:



**Radiation Hazard Test Setup Diagram**

## Test Equipment:

Radiation Hazard Meter: General Microwave Corporation RAHAM Model 3  
Calibrated: 10-20-2005 Due: 10-20-2007

Voltmeter: Fluke 87 V True RMS Multimeter  
S/N: 87180024  
Measurement level verified with meter listed below.  
HP 34401A  
S/N: MY45001201  
Calibrated: 4-9-2005 / Calibration due: 4-9-2007

The General Microwave RAHAM Model 3 isotropic broadband electromagnetic radiation hazard meter consists of a model 83A probe and model 481B meter. The model 83A probe employs three orthogonally-oriented thin-film thermoelectric arrays. This type of probe exhibits extremely good adherence to square-law characteristics such that the dc output from the thermocouple is proportional to the square of the electric field strength. The recorder output from the RAHAM meter is applied to the Fluke DVM. The dc level of the Recorder Output is recorded and then converted to the corresponding maximum permissible exposure value. The recorder output at a full scale reading is 124 mV. The measurements performed for this report utilize the 2 mW/cm<sup>2</sup> setting of the RAHAM instrument.

## General Information:

The Motorola, Inc. Expedience RSU-2510-R transmitter can apply 2 watts of RF power, within a channel, to the integral antenna in the 2496-2690 MHz band. The RSU-2510-R has a maximum transmit duty cycle of 14.29 % and is based on a TDM frame (see test information at end of this report).

The vertically polarized antenna has 13 dBi of gain. Therefore, the maximum radiated transmit power would be:

### **14.29% Transmit Duty Cycle:**

$$P_{max} = P_{tx}(dBm) + G(\text{antenna}(dBi)) - 10 \cdot \log(\text{duty cycle})(dB)$$

$$P_{max} = 33 + 13 - 10 \cdot \log(0.1429) = 33 + 13 - 8.45$$

$$P_{max} = 37.55 \text{ dBm EIRP} = 5.688 \text{ Watts EIRP}$$

The horizontally polarized antenna has 12.2 dBi of gain. Therefore, the maximum radiated transmit power would be:

### **14.29% Transmit Duty Cycle:**

$$P_{max} = P_{tx}(dBm) + G(\text{antenna}(dBi)) - 10 \cdot \log(\text{duty cycle})(dB)$$

$$P_{max} = 33 + 12.2 - 10 \cdot \log(0.1429) = 33 + 12.2 - 8.45$$

$$P_{max} = 36.75 \text{ dBm EIRP} = 4.7315 \text{ Watts EIRP}$$

**Calculations:**

The following calculations can be used to determine the distance from the transmitting antenna that must be maintained to ensure that the exposure limit as defined in Table 1 of part 1.1310 (B) Limits for General Population / Uncontrolled Exposure. The formula for the following calculations are found in the OET Bulletin 65, edition 97-01 August 1997, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields".

The maximum power level from the previous calculations will be used.

$$S = \text{EIRP}/4\pi R^2$$

or

$$R = (\text{EIRP}/4\pi S)^{0.5}$$

**2496-2690 MHz Band:**

$$S=1 \text{ mW/cm}^2$$

$$\text{EIRP} = 5.688 \text{ W}$$

$$\text{EIRP} = 5688 \text{ mW}$$

$$S = 1 \text{ mW/cm}^2$$

$$R = (5688/(4*\pi*1))^{0.5}$$

$$R = 21.2753 \text{ cm}$$

$$R=20 \text{ cm}$$

$$\text{EIRP} = 5.688 \text{ W}$$

$$\text{EIRP} = 5688 \text{ mW}$$

$$R = 20 \text{ cm}$$

$$S = 5688/(4*\pi*20^2)$$

$$S = 1.1316 \text{ mW/cm}^2$$

Calculated safe distance from the transmitting antenna is 21.27 cm for a point source radiation element, or the maximum field strength for a point source radiation element at 20 cm would be 1.1316 mW/cm<sup>2</sup>. The Motorola RSU uses a four element patch array antenna. The RF power supplied to each patch is one quarter the total power that would be supplied to a single radiating antenna as described in Bulletin 65. Because the transmitted power is distributed over a larger area, the actual signal at 20 cm will be less than the calculated value. A measurement of the signal strength at 20 cm is detailed below. The measured values of S have been adjusted to include the current calibration factor of the radiation hazard meter.

**Measurement calculations:**

dc voltage recorded = 33.5 mV

Convert dc level to  $S_{dc} = (33.5 \text{ mV} * 2 \text{ mW/cm}^2) / 124 \text{ mV}$   
 $= 67 \text{ mVmW/cm}^2 / 124 \text{ mV}$   
 $= 0.54 \text{ mW/cm}^2$

Apply the calibration factor  $S = S_{dc} * CF$   
 $= 0.54 \text{ mW/cm}^2 * 1.33$

S (MPE level) = 0.72 mW/cm<sup>2</sup>

Test Results:

RSU Vertically Polarized Antenna (20 cm From RSU Case)		
Channel Frequency (MHz)	Channel Bandwidth (MHz)	Max S (mW/cm <sup>2</sup> )
2499	6.0	0.72
2593	6.0	0.61
2687	6.0	0.64
2499	5.5	0.68
2593	5.5	0.64
2687	5.5	0.65

RSU Horizontally Polarized Antenna (20 cm From RSU Case)		
Channel Frequency (MHz)	Channel Bandwidth (MHz)	Max S (mW/cm <sup>2</sup> )
2499	6.0	0.56
2593	6.0	0.60
2687	6.0	0.53
2499	5.5	0.66
2593	5.5	0.67
2687	5.5	0.54

Test Conclusion:

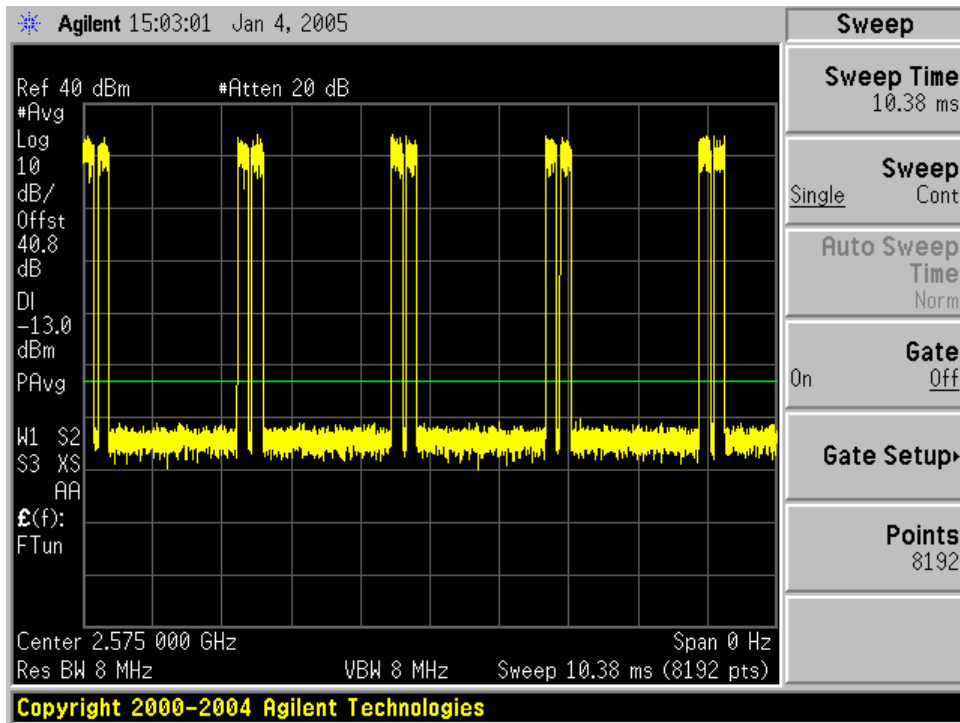
The Motorola, Inc. Expedience, RSU-2510-RV and RSU-2510-RH Residential Subscriber Unit products are below the limit for RF Exposure as detailed in the FCC 47CFR1.1310 requirement for General Population / Uncontrolled Exposure.

***NOTE: Refer to “Section 7: Users Manual and Regulatory Information” for radiation hazard information included in literature shipped with the RSU-2510-R.***

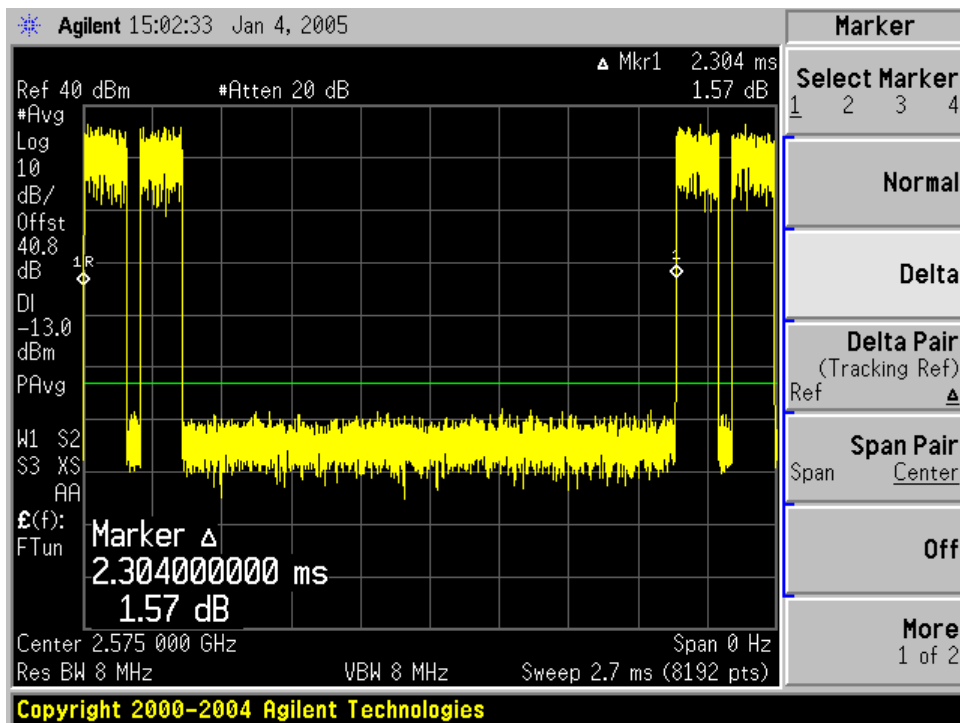
The following information is located on a label on the RSU-2510-R product:

*To comply with FCC radio frequency exposure rules, 47CFR1.1307 and 1.1310, a minimum separation of 20 cm (8 inches) is required between this device and all persons.*

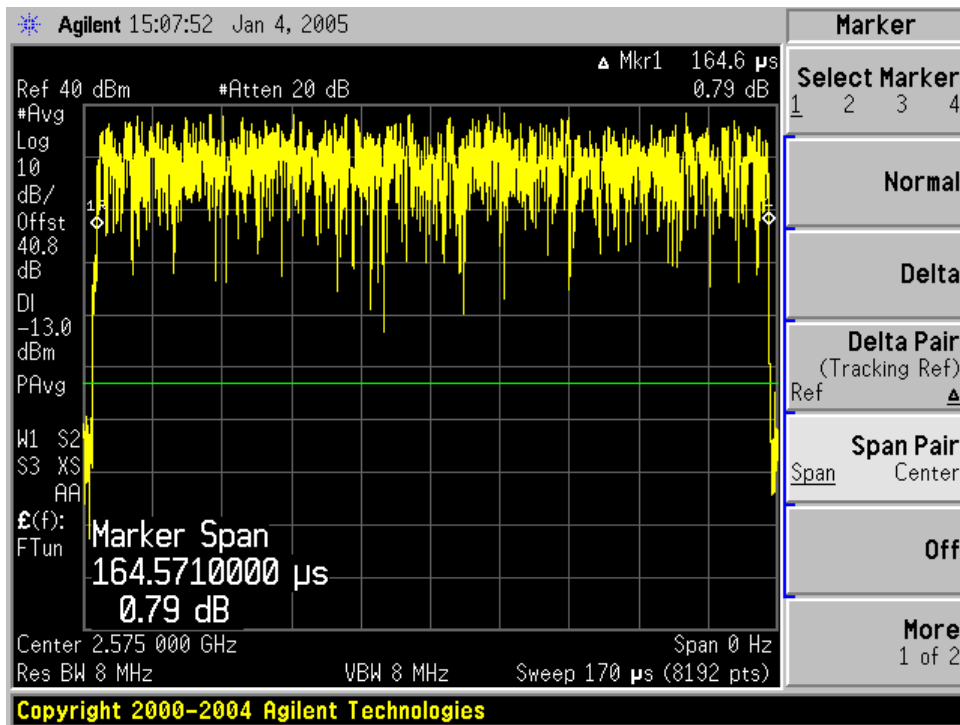
Verification of the Maximum Transmit Duty Cycle is Shown Below.



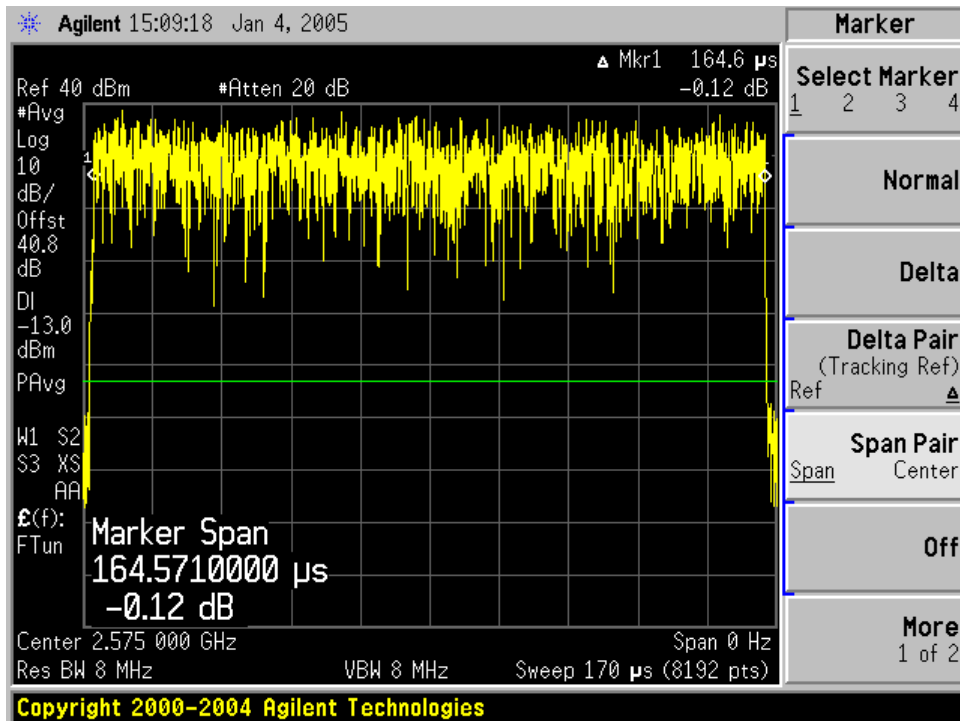
Wide time sweep of transmitter at maximum duty cycle (14.29%)



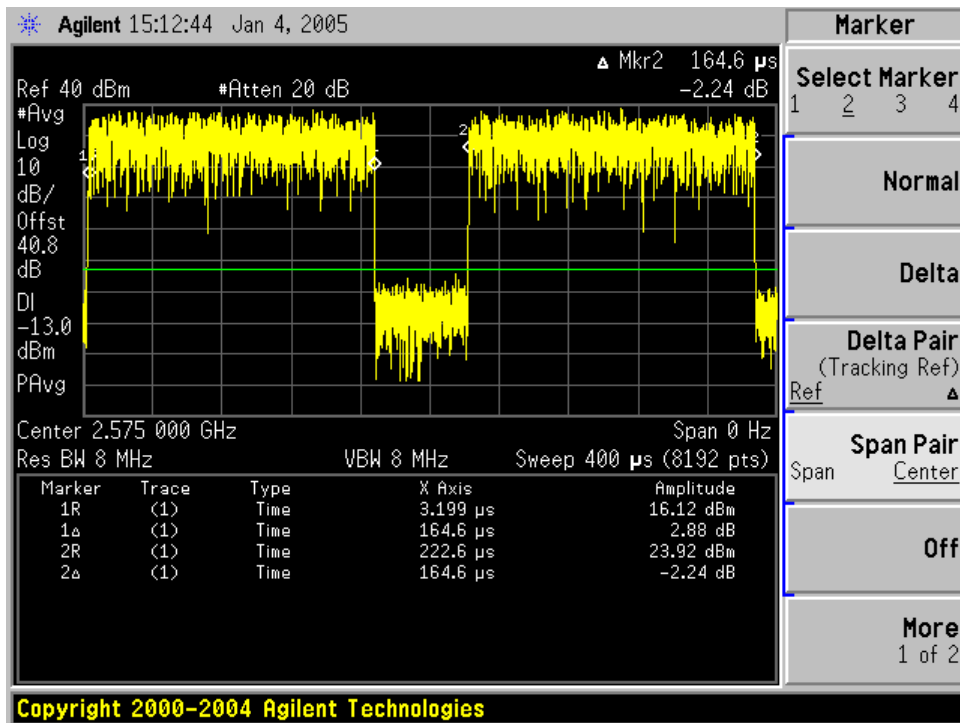
Time measurement between one complete transmit cycle is 2.304 msec.



TX pulse number 1 on time = 164.6 usec.



TX pulse number 2 on time = 164.6 usec



**TX pulse 1 and 2**

Transmit duty cycle = total time transmitting / time between repetition

Transmit duty cycle = (164.6 usec + 164.6 usec) / 2.304 msec

Transmit duty cycle = 329.2 usec / 2.304 msec = .14288 or 14.288 %