Project 14393-10

Prepared for:

Prepared for:
SkyGuard TWX, LLC
2121 Legends Parkway
Kingsland, Texas 78639

By

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June 21, 2013

MPE / RF Exposure Report
UAT/ES ADS-B Transceiver
FCC ID: R83UAT1000

Table of Contents

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Applicant: SkyGuardTWX, LLC

Applicant's Address: 2121 Legends Parkway
Kingsland, Texas 78639

FCC ID: R83UAT1000

Project Number: 14393-10

Test Dates: 11/28/2012, 12/21/2012, 1/10/2013, 1/13/2013, 1/15/2013

I, Eric Lifsey, for Professional Testing (EMI), Inc., being familiar with the FCC rules and test procedures have reviewed the test setup, measured data and this report. I believe them to be true and accurate.

Eric Lifsey
EMC Engineer

This report has been reviewed and accepted by SkyGuardTWX, LLC. The undersigned is responsible for ensuring that this device will continue to comply with the FCC rules.

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SkyGuardTWX, LLC., Representative

1.0 Objective

Perform a prediction of MPE using the limit at a given distance and by using equation from Table 1 of 47 CFR 1.1310 Radiofrequency radiation exposure limits.

Table 1—Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*($900/f^2$)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*($180/f^2$)	30
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density.

Note 1 to Table 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

Note 2 to Table 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

1.1 Evaluation Procedure

The power density of the RF field is derived from the following factors: the separation distance, average transmit power, and antenna gain. The field density limit is then determined by the applicable conditions (general vs. occupational) and operating frequency. If applicable the average power is calculated from available peak measured power. The results are compared.

1.2 MPE Prediction – UAT Transmitter

Calculate Average Power (P)

The measured maximum transmit time is divided by the minimum transmit time interval to determine worse case duty cycle factor. Referencing data from the main test report regarding the transmitter timings we have:

Duty Cycle Factor = 10 * Log_{10} (0.234 msec / 475.96 msec) = -33.08 dB

Frequency (MHz)	Measured Peak Output Power (dBm)	Applied Duty Cycle Factor (dB)	Average Power (dBm)	Average Power P (mW)
978	44.24	-33.08	11.16	13*

***Rounded to nearest mW per rules.**

Calculate Power Density (S)

$$S = (PG)/(4\pi R^2)$$

Where: P= power input to antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Averaged Power P (mW)	Max Antenna Gain (dBi)	Max Antenna Gain G (numeric)	Prediction Distance R (cm)	Power Density S at 20.0 cm (mW/cm²)
13	2.0	1.585	20	0.004099

NOTE: Antenna Gain is estimated worst case scenario.

Determine Power Density Limit and Compare

Frequency (MHz)	Applicable Exposure Condition	Density Calculation Method*	Calculated Power Density Limit (mW/cm²)	Calculated Power Density at 20 cm (mW/cm²)	Percent Contribution to MPE (%)
978	General/Uncontrolled	Frequency(MHz) / 1500	0.652	0.004099	0.6

1.3 MPE Prediction – WiFi Transmitter

Calculate Average Power (P)

The maximum programmable power per FCC grant documentation for this device is 67 mW, applying this as worse case below:

Frequency (MHz)	Specified Peak Output Power P (mW)*
2400-2483.5	67

*Rounded to nearest mW per rules.

Calculate Power Density (S)

$S = (PG)/(4\pi R^2)$

Where: P= power input to antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Power P (mW)	Max Antenna Gain (dBi)	Max Antenna Gain G (numeric)	Prediction Distance R (cm)	Power Density S at 20.0 cm (mW/cm²)
67	2.2	1.66	20	0.02213

NOTE: Antenna Gain as specified for Roving Networks model RN-SMA-S-RP.

Determine Power Density Limit and Compare

Frequency (MHz)	Applicable Exposure Condition	Density Calculation Method*	Calculated Power Density Limit (mW/cm^2)	Calculated Power Density at 20 cm (mW/cm^2)	Percent Contribution to MPE (%)
2400-2483.5 (Using 2400)	General/Uncontrolled	Frequency(MHz) / 1500	1.6	0.02213	1.4

1.4 MPE Contributions Summed for Simultaneous Operation

The preceding contributions of RF energy to the individual MPE limits are summed. The total must not exceed 100%.

Percentage from UAT Transmitter	0.6 %
Percentage from WiFi Transmitter	1.4 %
Total Percentage of MPE Exposure Used	**2.0 %**

Conclusion is both transmitters can operate simultaneously and meet the requirements for MPE with 20 cm of minimum spacing between user and antennas.

A user manual warning to maintain minimum 20 cm separation between antennas to user or other persons is required.

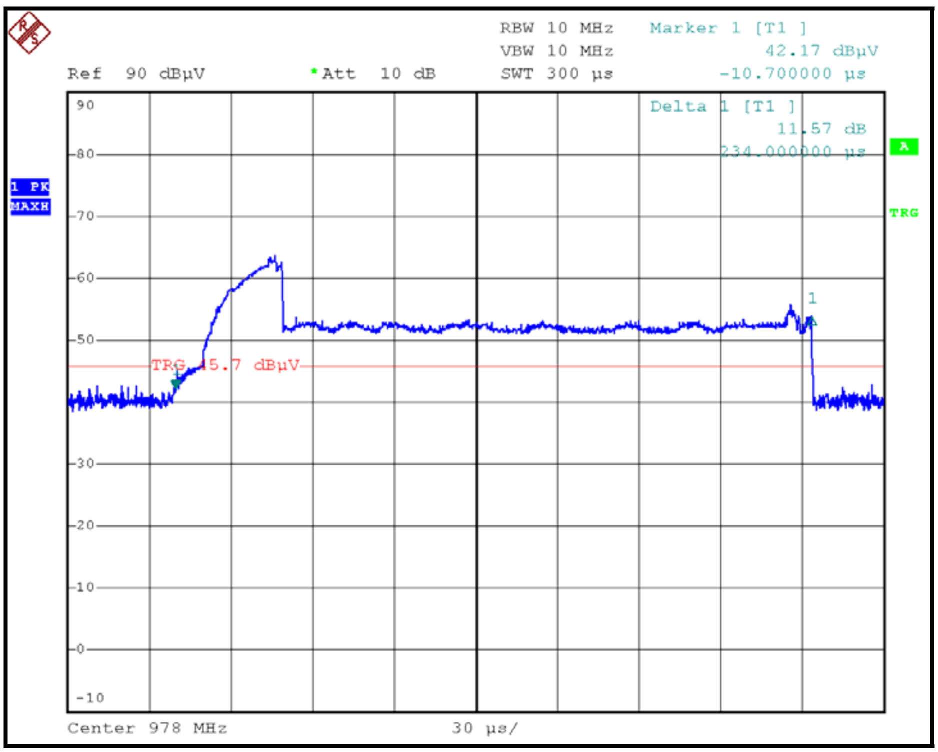
1.5 Transmitter Duty Cycle, UAT Transmitter

The EUT transmit times were measured to determine the duty cycle factor. The objective is to find the longest transmit on time and the shortest time between transmit events/intervals.

For both measurements a max-hold dwell time of at least 1 minute was used to capture worse case timings. This measures the maximum length of transmitting time and the shortest separation in transmit events or intervals.

First the **Transmit On Time** (see plot) is captured with video trigger and max-hold operation. At least 120 transmissions were captured and the markers placed to record the time. The data stream is of a fixed length and little variation was seen. The markers reveal a transmit time of 0.234 msec.

Plot 1.4.1: Transmit On Time

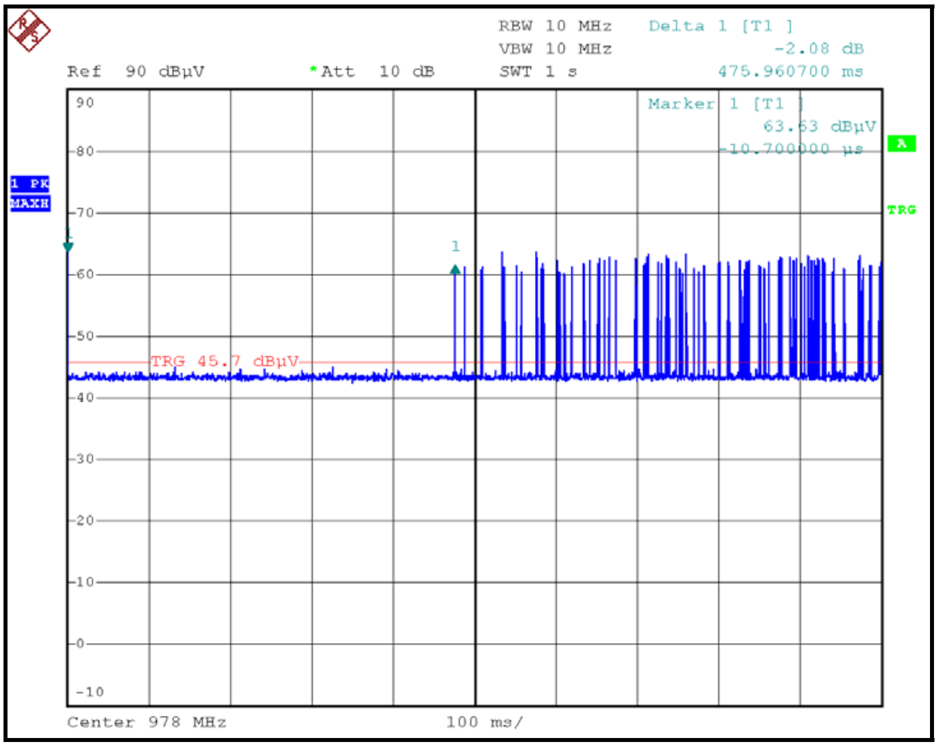


Maximum transmitter on time 0.234 msec.

Next the transmission intervals were measured to find the closest spaced transmission time.

The EUT transmits in GPS-based time slots separated by a required minimum of 475.96 msec (as measured) plus *additional* randomized delays of up to 800 msec to prevent transmit collisions. The randomized intervals can be seen in the **Transmit Intervals** plot below as a large number of transmit events on the right half of the plot. These events were captured in max-hold mode in excess of 1 minute which would capture approximately 120 events or more. Capture was by video trigger, resulting in a first transmit event followed by the next transmit event. For each triggered event, the subsequent next transmit event would appear at random points with none closer than the one recorded at 475.96 msec.

Plot 1.4.2: Transmit Intervals



Minimum interval 475.96 msec. The initial transmit trigger event is at the left edge of the plot.

Using the measurements taken above the factor is calculated as:

Duty Cycle Factor = 10 Log_{10} (0.234 msec / 475.96 msec) = **-38.08 dB**

Measurements performed June 12, 2013.