



***FCC TECHNICAL REPORT  
FOR THE GROUND DATA LINK (GDL)  
AIRCRAFT SEGMENT  
& GROUND SEGMENT***

RF Exposure Information



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**Engineering Analysis of FCC ID: OMLGDL-002  
to  
Federal Communications Commission  
Part 1.1310 Radio Frequency Exposure Limits  
and OET 65 Supplement C**



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## **1 AFFIDAVIT OF COMPLIANCE**

This analysis was performed in order to demonstrate that the subject Part 15.247 spread spectrum transmitter complies with the FCC rules for Radio Frequency Exposure Limits.

The GE Harris Aviation Information Solutions GDL System has been analyzed and found to have a maximum conducted transmit power of 251 mW (+24 dBm). The two omni-directional antennas tested with the system each have a specified maximum antenna gain of 5.15 dBi. Therefore the maximum Effective Isotropic Radiated Power (EIRP) of the system in any direction or frequency is 29.15 dBm.

The formulas and Maximum Permissible Exposure (MPE) limits referenced in this report can be found in FCC Bulletin OET-65 and OET-65, Supplement C, which addresses requirements for low power spread spectrum devices.

All calculations are worst case, assuming the limits for General Population/Uncontrolled Exposure and a transmit duty cycle of 100%. Under normal operating conditions, the duty cycle of the subject transmitter is below 50%.

Based on the calculated Maximum Permissible Exposure (MPE) for the subject transmitter under the worst case operating conditions, the minimum safe distance between antenna and nearby persons is 8.09 cm, or 3.18 inches. Since neither equipment configuration of this professionally installed system exceeds MPE limits when nearby persons are more than 20 cm (8 in) from the antenna, special instructions and warnings are not necessary to ensure compliance.

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## 2 EQUIPMENT UNDER TEST

FCC ID: OMLGDL-002

Type: Part 15.247 Direct Sequence Spread Spectrum Transceiver

Max Power: 251 mW (+24 dBm)

Duty Cycle: N/A

Maximum EIRP for antenna combinations (both antennas have the same maximum gain):

5.15 dBi Omni +29.15 dBm

## 3 EQUIPMENT MPE LIMITS

The Maximum Permissible Exposure (MPE) limits for General Population/Uncontrolled Exposure in the 2400 – 2500 MHz Band is a power density  $S$  of  $1.0 \text{ mW/cm}^2$  averaged over 30 minutes.

A power density of  $1.0 \text{ mW/cm}^2$  is equivalent to a power density of  $10 \text{ W/m}^2$ . The MPE distance at which the power density is equal to  $10 \text{ W/m}^2$  is given by the following equation for an isotropic radiator:

$$S = 1.0 \text{ mW/cm}^2$$

$$S = 10 \text{ W/m}^2 = \text{EIRP}/(4\pi R^2), \text{ where } R = \text{the MPE distance in meters}$$

For this system, the Maximum EIRP is +29.15 dBm. Solving for  $R$ :

$$R^2 = \text{EIRP}/(40\pi)$$

$$R = \sqrt{0.822/(40\pi)}$$

$$R = 0.0809 \text{ m}$$

$$R = 8.09 \text{ cm}$$

$$R = 3.18 \text{ in}$$

Therefore, the maximum distance at which General Population/Uncontrolled Exposure to a power density  $S$  of  $1.0 \text{ mW/cm}^2$  can occur is 8.09 cm, or 3.18 inches.

## 4 FCC TEST RESULTS

The electric field strength,  $E$  in volts/meter, was measured during Spurious Emissions testing at a distance of 3 meters with both the aircraft and ground antennas at 2412, 2442, and 2462 MHz. The highest measured electric field strength with either antenna and at any frequency was 112.57 dB $\mu$ V/m, as shown in Figure 4, using the vertically polarized test system antenna. This measurement was made using a spectrum analyzer with a resolution bandwidth of 1 MHz, which is less than the 6 dB BW (11 MHz) of the emission. Correcting for the BW difference, the true electric field strength at 3 m is:

$$E = 112.57 \text{ dB}\mu\text{V/m} + 10\log(11 \text{ MHz}/1 \text{ MHz})$$

$$E = 112.57 \text{ dB}\mu\text{V/m} + 10.4 \text{ dB}$$

$$E = 122.97 \text{ dB}\mu\text{V/m}$$

$$E = 1.41 \text{ V/m}$$



The EIRP in watts, is given by the following equation:

$$\text{EIRP} = (E \cdot R)^2 / 30, \text{ where } R = \text{the distance in meters}$$

$$\text{EIRP} = (1.41 \text{ V/m} \cdot 3\text{m})^2 / 30$$

$$\text{EIRP} = 0.598 \text{ watts}$$

$$\text{EIRP} = 27.8 \text{ dBm}$$

The maximum peak output power measured using a Peak Power Meter was 0.196 watts, or 22.9 dBm. The antenna gain can therefore be derived as follows:

$$\text{EIRP} = G_t + P_t$$

$$G_t = \text{EIRP} - P_t$$

$$G_t = 27.8 \text{ dBm} - 22.9 \text{ dBm}$$

$$G_t = 4.9 \text{ dBi}$$

The resulting maximum measured antenna gain,  $G_t$  is consistent with the antenna manufacturer's advertised maximum gain of 5.15 dBi.

In summary, the measured EIRP of 27.8 dBm is consistent with the calculated maximum EIRP of 29.15 dBm, as shown in Table 4.

**Table 4: MPE Distance Based on Calculated and Measured Results**

<b>Method</b>	<b>Max Pwr (dBm)</b>	<b>Ant Gain (dBi)</b>	<b>EIRP (dBm)</b>	<b>EIRP (mW)</b>	<b>MPE Dist (cm)</b>
Calculated	24	5.15	29.15	822.24	8.09
Measured	22.9	4.9	27.8	602.56	6.92

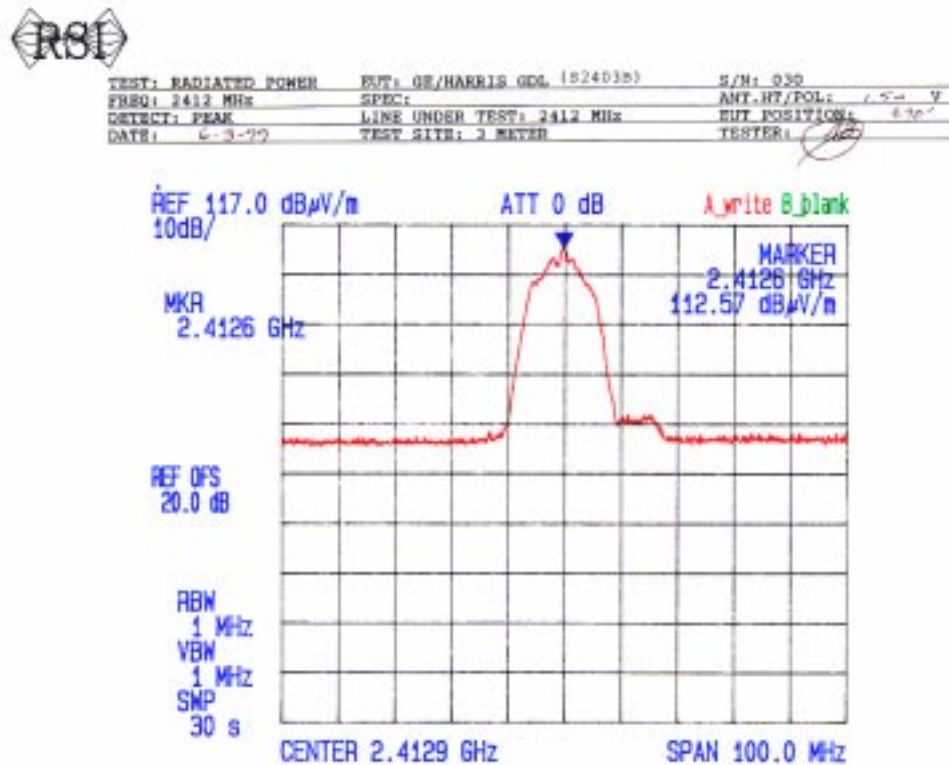


Figure 4: Radiated Emissions Measurement Showing Highest Measured Electric Field Strength of 112.57 dBμV/m

## 5 INSTALLATION SUMMARY

As described earlier, there are two different system configurations, one mobile and one fixed. In the ground based, fixed configuration, the RF Assembly and antenna are physically secured on top of a building or other permanent structure at an airport, as shown in Figure 5.1.

The RF Assembly and Omni Antenna are typically attached to a 10' high mast that extends line of site coverage beyond the edge of the roof to the jet ways, ramp areas, and taxi ways below. They are professionally installed in order to comply with local structural and safety codes. Roof access at these remote locations is restricted to maintenance personnel who are more than 20 cm (8 in) away from the subject equipment while performing maintenance duties. Since the subject ground equipment does not exceed MPE limits when nearby persons are more than 20 cm (8 in) from the antenna, special instructions and warnings are not necessary to ensure compliance for this equipment configuration.

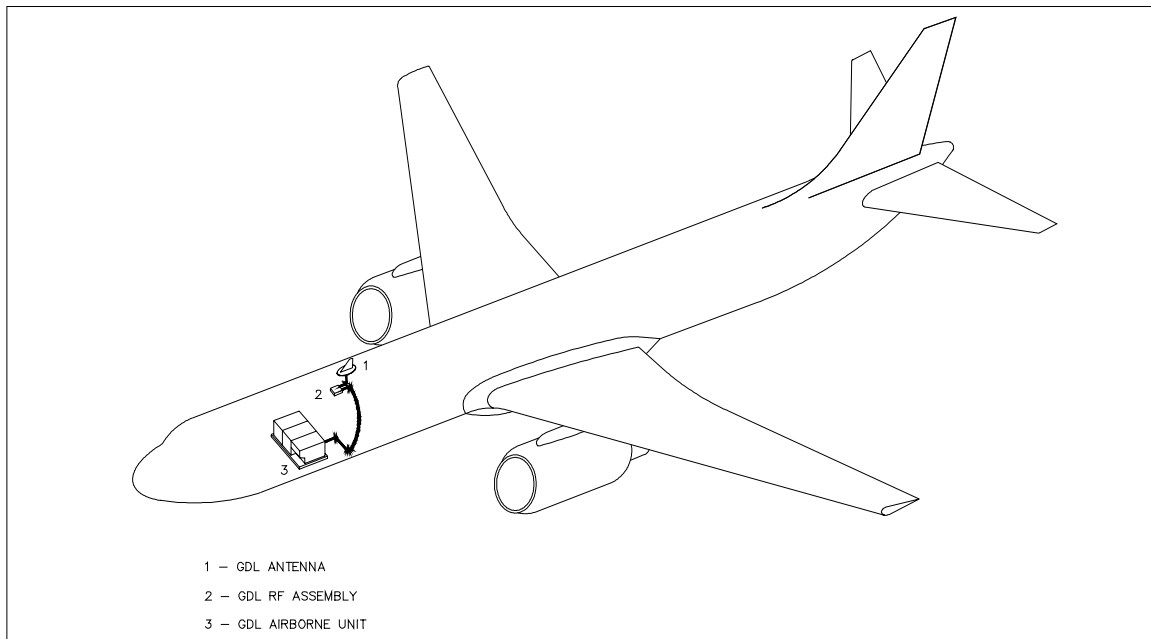


**Figure 5.1: RF Assemblies and Omni Antennas Mounted on Masts at Opposite Ends of Railing**

In the mobile aircraft mounted configuration, the antenna is mounted externally, typically on top of the aircraft, approximately 20' above the ground, depending on the aircraft type. The RF Assembly is mounted inside the aircraft just beneath the antenna, between the fuselage and the passenger cabin ceiling, as shown in Figure .5.2. There is a possibility that in future installations the external antenna may be bottom mounted for air to ground communications. Even in this configuration, ramp personnel such as baggage handlers and fuel truck operators who would be nearest to the antenna, are generally more than 20 cm (8 in) away from the antenna while performing their duties.

In addition, their exposure time is less than 30 minutes. Southwest Airlines' average turn time metric, which is the amount of time an aircraft is parked at the gate between flights, is 20 minutes. During this 20-minute period, ground personnel perform all of their requisite duties while preparing the aircraft for its next flight. The power density that these personnel would be exposed to averaged over a 30-minute period is substantially less than the MPE limit of  $1.0 \text{ mW/cm}^2$ . Since the subject aircraft equipment does not exceed MPE limits when nearby persons are more than 20 cm (8 in) from the antenna, special instructions and warnings are not necessary to ensure compliance for this equipment configuration.





**Figure 5.2: Equipment Installation in Aircraft Mounted Configuration**