APPENDIX D: FCC PART 1.1307, 1.1310, 2.1091, 2.1093: RF EXPOSURE

1. General Information:
FCCID: ALH36033110
Environment: Occupational/Controlled Exposure

2. Operating Configurations and Test Conditions:

2.1 Antenna Type(s):

Antenna	Type	Gain (dBi)	Numeric Gain
Half-Wave dipole	Dipole	2.15	1.65

Frequency Range	Frequency Tolerance (ppm)	Emission Designator
450-490 MHz	2.5	16K0F3E
450-490 MHz	2.5	11K0F3E

2.2 dBi Antenna

Output Power (Worst Case)	Time averaging as an inherent property (50.0 % Duty Cycle, -3.0 dB) (W)
Conducted	25.82
Conducted	4.90

3. MPE Calculation:

The maximum distance, from the antenna at which MPE is met or exceeded, is calculated from the equation relating field strength E in V/m, transmit power P in Watts, transmit antenna numeric gain G, and separation distance in meters:

The Electric field generated for a 1mW/cm^2 exposure (S) is calculated as follows:

$$S = \frac{E^2}{Z}$$

where: S = Power density
E = Electric field
Z = Impedance.

$E(V/m) = \sqrt{S \times Z}$ 1.6 mW/cm^2 = 16 W/m^2

The impedance of free space is 337 ohms, where E and H fields are perpendicular.

Thus:

$E(V/m) = \sqrt{16 \times 377}$ = 77.6 V/m

The maximum distance, from the antenna at which MPE is met or exceeded, is calculated from the equation relating field strength E in V/m, transmit power P in Watts, transmit antenna numeric gain G, and separation distance in meters above and solving for d below:

$$E(V/m) = \frac{\sqrt{30 \times P \times G}}{d} \quad \text{and} \quad d = \frac{\sqrt{30 \times P \times G}}{E(V/m)} \quad \text{Power density: } P_d(mW/cm^2) = \frac{E^2}{3770}$$

The limit for general population/uncontrolled exposure environment above 1500MHz is 1 mW/cm^2.

SEPARATION DISTANCE:

Separation Distance [A]	Antenna Gain (dBi)	Duty Cycle (%)
	2.15	
Power[B] (Watt)	(cm)	
25.82	32.0	50.0
25.82	46.0	100.0

Calculations:

50.0% duty cycle = $0.32m = \frac{\sqrt{30 \times 12.9 \times 1.65}}{77.6}$

100% duty cycle = $0.46m = \frac{\sqrt{30 \times 25.8 \times 1.65}}{77.6}$

Notes:
[A] = Distances are calculated for the largest (worst-case) separation distance as applicable.

CONCLUSION:

The device complies with the MPE requirements by providing a safe separation distance between the antenna, including any radiating structure, and any persons.