

1. A control station uses a quarter wave monopole antenna on top of a 15' tower to control an unmanned surveillance aircraft which will be orbiting at an altitude of 3000' AGL. The station broadcasts an 800 W control signal at a frequency of 300 MHz. The receiving antenna on the aircraft has a gain of 3.0. The aircraft needs 3.3 nW of power to process the signal.

(a) Determine the max LOS for this setup.

$R_{LOS} =$

133.5 km

(b) Determine the range at which the antennas have enough power to communicate

$R =$

121.4 km

(c) What is the maximum distance the aircraft can be controlled by the ground station?

$R_{max} =$

121.4 km

2. A search and rescue helicopter is at 450' AGL because of clouds, while the airman they are searching for is on a 50' hill. The downed airman's survival radio transmits 6W of power at 2 MHz, with an antenna with a gain of 3. The helicopter's radio has a gain of 3.2 and requires 3 μ W receive power to accurately communicate.

- (a) Will the airman be able to communicate with the helicopter at 50 km via LOS?

$R_{LOS} =$

64.4 km, Yes

- (b) Will the airman be able to communicate with the helicopter at 50 km via signal power and antenna gain?

$R =$

52.3 km, Yes

- (c) What is the farthest the airman will be able to communicate?

$R_{max} =$

52.3 km

3. A HC-130 is flying a search pattern at 10,000' AGL. Your radio transmits a 4 W signal at 243.0 MHz with an antenna gain of 2.8. The HC-130 has an antenna gain of 3.0 and requires 496.8 aW of power to detect and process the signal.

(a) Determine the max LOS for this setup.

$R_{LOS} =$

227.7 km

(b) Determine the range at which the radio and HC-130 have enough power to communicate

$R =$

25,550 km

(c) What is the maximum distance the aircraft can be controlled by the ground station?

$R_{max} =$

227.7 km

4. A reconnaissance UAS is flying over flat terrain at 800' AGL trying to detect the radio traffic of an insurgent group. The insurgents' camp is on a small plateau, 25' above the surrounding terrain. The insurgents transmit 120 W of power at 24 MHz, using an antenna with a gain of 1.5. The UAS uses an antenna with a gain of 3.0. The UAS requires 80 nW of power to detect and process the transmission.

- (a) If the UAS is 80 km away from the insurgent camp, will it be able to detect the signals?

$R_{LOS} =$

75.78 km, No

- (b) Suppose the UAS moves within 75km. Is the signal power at the receiver adequate?

$P_R =$

83.5 nW, Yes