Orlando Re-radiated Power Calculations

Note 1: This system re-radiates both L1 (1575.42 MHz) and L2 (1227.6 MHz). Calculations are done for each antenna for the L1 frequency, and for each antenna for the L2 frequency.

Re-radiating Antenna #2 @ 1575.42 MHz

Re-radiated Power at 100 feet beyond the nearest outer wall

(1) $P_{Rerad} = P_{Rec} + G_1 + G_2 + A_1 - C_1 - C_2 - FL$

Where: P_{Rerad} = Re-radiated signal strength 100 ft outside the building
P_{Rec} = Received Power from Satellites (L1) = -130 dBm
G_1 = Roof Antenna Gain = 36 dBi
G_2 = Re-radiating Antenna Gain = 3.5 dBic
A_1 = Amplified Splitter Gain = 20 dB
C_1 = Coax Attenuation, Roof Antenna to Amplifier
= 6.5 dB/100 ft X 80 ft
= 5.2 dB
C_2 = Coax Attenuation, Amplifier to Re-radiating Antenna
= 6.5 dB/100 ft X 7 ft
= 0.455 dB
FL = Freespace Loss

(2) FL = 20LogF + 20LogD + 36.56

Where: F = Frequency in MHz = 1575.42
D = Distance in Miles
= (Distance from antenna to outer wall in feet + 100)/5280
= (5 ft + 100 ft)/5280

Inserting the values for F and D into equation (2) yields

FL = 20Log(1575.42) + 20Log((5+100)/5280) +36.56
= 66.47 dB

Inserting these values into equation (1) then becomes:

P_{Rerad} = -130 + 36 + 3.5 + 20 – 5.2 – 0.455 – 66.47
= - 142.63 dBm

Power radiated from Antenna

(3) $P_{Ant} = P_{Rerad} + FL$

Where: P_{Ant} = power radiated from the antenna

Using values from (1) and (2) above, equation (3) becomes:

P_{Ant} = -142.63 + 66.47 = -76.16 dBm EIRP

(4) P_{ERP} (dB) = P_{EIRP} – 2.148

Convert power expressed in dBm from EIRP to ERP using value from (3) becomes:

P_{Ant} = -76.16 – 2.148
= -78.3 dBm ERP

(5) $P = P_{In}\ [\log^{-1}(P_{Ant}/10)]$

Convert power from dBm to Watts

Where: P = Power in Watts
P_{In} = Input (Reference) Power = 0.001 W

Using values from (3) above, equation (5) becomes:

P_{Ant} = $0.001[\log^{-1}(-76.16/10)]$
= 24.21 pW EIRP

Using value from (4) above, equation (5) becomes:

P_{Ant} = $0.001[\log^{-1}(-78.3/10)]$
= 14.8 pW ERP

Convert power expressed in Watts from EIRP to ERP

(6) P_{ERP} (W) = P_{EIRP} /1.64 (W)

Using values from (5) above, equation (6) becomes:

P_{ERP} = 24.21 pW / 1.64
= 14.8 pW

Power at Transmitter (Radiating Antenna Input)

(7) $P_T = P_{ANT} - G_2$

Where: P_T = Total Power at the Transmitter Output / Radiating Antenna Input (EIRP)

Using values for P_{ANT} expressed in dBm EIRP from (3) above, equation (7) becomes:

P_T = -76.16 – 3.5
= -79.66 dBm EIRP

Convert power from dBm to Watts using equation (5)

P_T = $0.001[\log^{-1}(-79.66/10)]$
= 10.8 pW

Re-radiating Antenna #2 @ 1227.6 MHz

Re-radiated Power at 100 feet beyond the nearest outer wall

(1) $P_{Rerad} = P_{Rec} + G_1 + G_2 + A_1 – C_1 – C_2 – FL$

Where: P_{Rerad} = Re-radiated signal strength 100 ft outside the building
P_{Rec} = Received Power from Satellites (L2) = -136 dBm
G_1 = Roof Antenna Gain = 36 dBi
G_2 = Re-radiating Antenna Gain = 3.5 dBic
A_1 = Amplified Splitter Gain = 20 dB
C_1 = Coax Attenuation, Roof Antenna to Amplifier
= 5.8 dB/100 ft X 80 ft
= 4.64 dB
C_2 = Coax Attenuation, Amplifier to Re-radiating Antenna
= 5.8 dB/100 ft X 7 ft
= 0.406 dB
FL = Freespace Loss

(2) FL = 20LogF + 20LogD + 36.56

Where: F = Frequency in MHz = 1226.7
D = Distance in Miles
= (Distance from antenna to outer wall in feet + 100)/5280
= (5 ft + 100 ft)/5280

Inserting the values for F and D into equation (2) yields

FL = 20Log(1226.7) + 20Log((5+100)/5280) +36.56
= 64.31 dB

Inserting these values into equation (1) then becomes:

P_{Rerad} = -136 + 36 + 3.5 + 20 – 4.64 – 0.406 – 64.31
= - 145.86 dBm

Power radiated from Antenna

(3) $P_{Ant} = P_{Rerad} + FL$

Where: P_{Ant} = power radiated from the antenna

Using values from (1) and (2) above, equation (3) becomes:

P_{Ant} = -145.86 + 64.31 = -81.55 dBm EIRP

(4) P_{ERP} (dB) = P_{EIRP} – 2.148

Convert power expressed in dBm from EIRP to ERP using value from (3) becomes:

P_{Ant} = -81.55 – 2.148
= -83.69 dBm ERP

(5) $P = P_{In}\ [\log^{-1}(P_{Ant}/10)]$

Convert power from dBm to Watts

Where: P = Power in Watts
P_{In} = Input (Reference) Power = 0.001 W

Using values from (3) above, equation (5) becomes:

P_{Ant} = $0.001[\log^{-1}(-81.55/10)]$
= 7.0 pW EIRP

Using value from (4) above, equation (5) becomes:

P_{Ant} = $0.001[\log^{-1}(-83.69/10)]$
= 4.28 pW ERP

Convert power expressed in Watts from EIRP to ERP

(6) P_{ERP} (W) = P_{EIRP} /1.64 (W)

Using values from (5) above, equation (6) becomes:

P_{ERP} = 7.0 pW / 1.64
= 4.27 pW

Power at Transmitter (Radiating Antenna Input)

(7) $P_T = P_{ANT} - G_2$

Where: P_T = Total Power at the Transmitter Output / Radiating Antenna Input (EIRP)

Using values for P_{ANT} expressed in dBm EIRP from (3) above, equation (7) becomes:

P_T = -81.55 – 3.5
= -85.05 dBm EIRP

Convert power from dBm to Watts using equation (5)

P_T = $0.001[\log^{-1}(-79.66/10)]$
= 3.1 pW