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 #1 @ 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 50 ft
= 3.25 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
= (2 ft + 100 ft)/5280

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

FL = 20Log(1575.42) + 20Log((2+100)/5280) +36.56
= 66.23 dB

Inserting these values into equation (1) then becomes:

P_{Rerad} = -130 + 36 + 3.5 + 20 – 5.2 – 3.25 – 66.23
= - 145.18 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} = -145.18 + 66.23 = -78.95 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} = -78.95 – 2.148
= -81.1 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} = $0.001[\log^{-1}(-78.95/10)]$
= 12.74 pW EIRP

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

P_{Ant} = $0.001[\log^{-1}(-81.1/10)]$
= 7.77 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} = 12.74 pW / 1.64
= 7.77 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 = -78.95 – 3.5
= -82.45 dBm EIRP

Convert power from dBm to Watts using equation (5)

P_T = $0.001[\log^{-1}(-82.45/10)]$
= 5.69 pW

Re-radiating Antenna #1 @ 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 50 ft
= 2.9 dB
FL = Freespace Loss

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

Where: F = Frequency in MHz = 1227.6
D = Distance in Miles
= (Distance from antenna to outer wall in feet + 100)/5280
= (2 ft + 100 ft)/5280

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

FL = 20Log(1227.6) + 20Log((2+100)/5280) +36.56
= 64.06 dB

Inserting these values into equation (1) then becomes:

P_{Rerad} = -136 + 36 + 3.5 + 20 – 4.64 – 2.9 – 64.06
= - 148.1 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} = -148.1 + 64.06 = -84.04 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} = -84.04 – 2.148

= -86.19 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} = $0.001[\log^{-1}(-84.04/10)]$
= 3.9 pW EIRP

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

P_{Ant} = $0.001[\log^{-1}(-86.19/10)]$
= 2.4 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} = 3.9 pW / 1.64
= 2.4 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 = -84.04 – 3.5
= -87.54 dBm EIRP

Convert power from dBm to Watts using equation (5)

P_T = $0.001[\log^{-1}(-79.66/10)]$
= 1.76 pW