GPS Booster Station Signal Strength Calculation

Reference file # 0250-EX-PL-2006

This GPS booster station re-radiates the GPS L1 (1575.42 MHz) signal. Calculations are performed per Section 8.3.28 of the NTIA regulations, where item 7 states "the maximum equivalent isotropically radiated power must be such that the calculated emissions are no greater than -140 dBm/24 MHz at a distance of 100 feet (30 meters) from the building where the test is being conducted." Additionally, building attenuation has been ignored. This calculation shows that the re-radiated signal strength is in compliance with the regulation.

(1) $P_{sig} = P_{Rec} + G_{rant} + G_{amp} - L_1 + G_{La} - L_2 + G_{rrant} + L_S$

Where:

- P_{sig} = Re-radiated signal strength 30 meters (m) outside the building
- P_{Rec} = Received power from GPS satellites (L1) = -130 dBm
- G_{rant} = Roof active antenna, Antcom PN: 3G1215A-XN-1, antenna gain = 3.5 dBi
- G_{amp} = Roof active antenna amplifier gain = 36 dB
- L_1 = Coaxial cable attenuation, roof antenna to line amplifier
  = 0.35 dB/m x 25 m (cable type: RG213/U)
  = 8.8 dB
- G_{La} = Line amplifier, GPS Networking PN: LA20, gain = 26 dB
- L_2 = N-type plug-to-plug adapter attenuation
  = 0.1 dB
- G_{rrant} = Re-radiating antenna, Antcom PN: 2G1215P-XN-1, antenna gain = -2.3 dBi, at 10° elevation (conservative assumption of worst case gain, since closest wall is behind antenna)
- L_S = Free space loss

(2) $L_S = 20\text{Log}(\lambda/4\pi(D))$

Where:

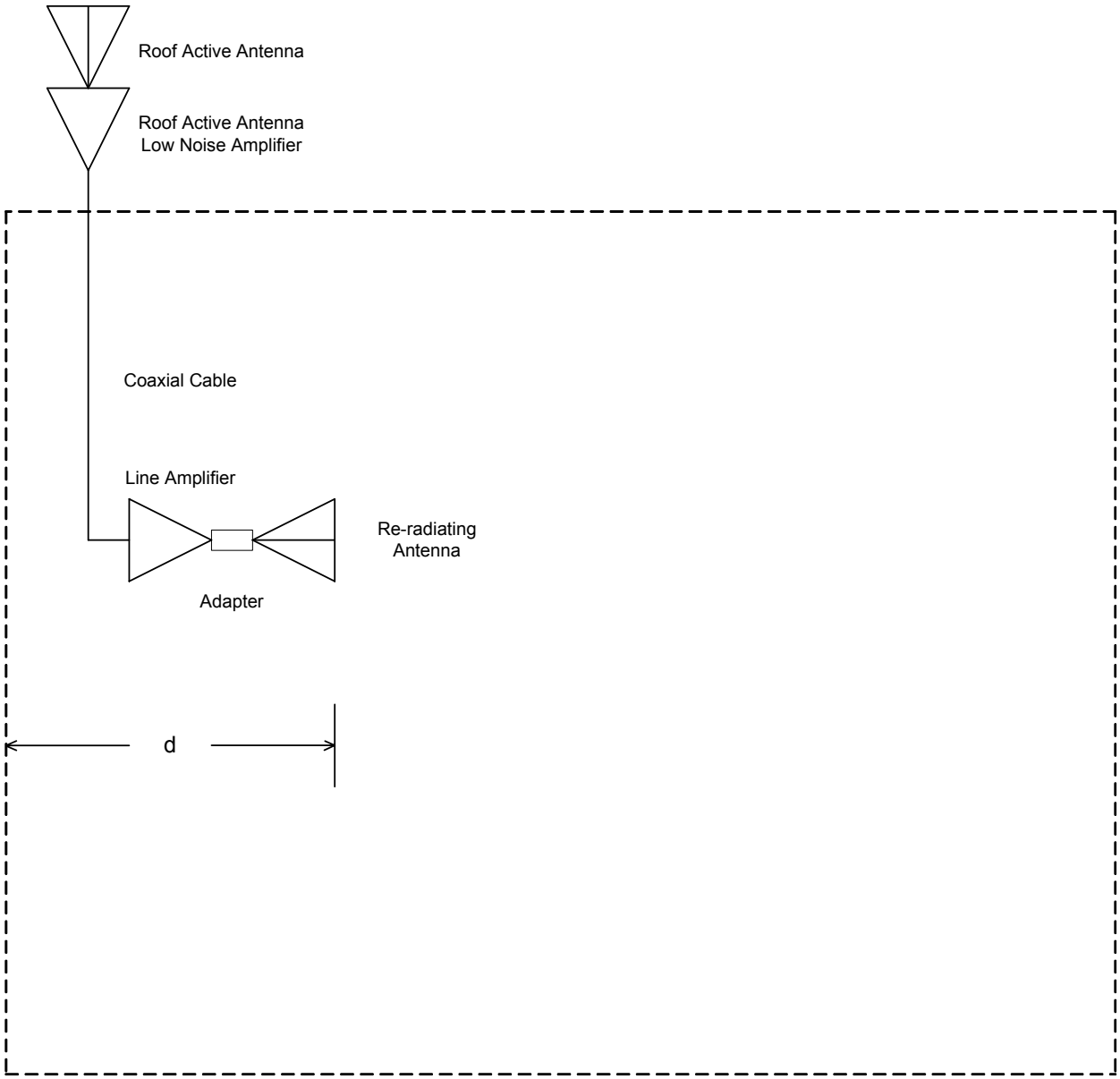
- λ = c/f = 3E8/1575.42E6 = 19.04E-2 m
- D = Distance (d) from antenna to outer wall in meters + 30
  = 0.4 m + 30
  = 30.4 m

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

$L_S = 20\text{Log}(19.04\text{E-}2/4\pi(30.4))$
$= -66.0$ dB

Inserting these values into equation (1) yields

$P_{sig} = -130 + 3.5 + 36 - 8.8 + 26 - 0.1 - 2.3 - 66$
$= -141.7$ dBm


Roof Active Antenna
Roof Active Antenna
Low Noise Amplifier
Coaxial Cable
Line Amplifier
Re-radiating
Antenna
Adapter
d