## Exhibit No. 2
## Reradiation Analysis
### Approach
The approach taken for this analysis is to meet the NTIA requirements is as follows:
1. Determine the power density required to generate -140 dBm at a GPS input terminal (maximum power allowable) when connected to an isotropic antenna.
2. Determine the power density at 100 ft (~30 m) from our reradiating antenna systems. As each of the antennas will be located near the building wall, this calculation will meet the NTIA requirement showing compliance with the -140 dBm limit 100 feet from the building.
3. Determine the safety margin at 100 ft (~30m) referencing the -140 dBm requirement.
### Maximum Power Allowable
The maximum allowable power at a GPS receiver is -140 dBm when connected to an isotropic antenna.
$-140\ dB_m = 1x10^{-17}\ W$
To determine the maximum allowable power density ($P_d$) at an antenna, it is known that:
$P_d$ x (Effective Area) = Receiver Power
Therefore,
Maximum $P_d$ = Max Allowable Receiver Power / (Antenna Effective Area)
Given that the Antenna Effective Area of an isotropic antenna is $\lambda^2/4\pi$,
Then for **1574.42 MHz (L1):**
Effective Area = $(0.191m)^2/4\pi = 2.90x10^{-3}m^2$
And for **1277.60 MHz (L2):**
Effective Area = $(0.244m)^2/4\pi = 4.74x10^{-3}m^2$
Therefore, the maximum allowable power density for -140 dBm at a GPS receiver is:
At **1574.42 MHz (L1):**
$(P_d)_{max} = 1x10^{-17}\ W / 2.9x10^{-3}m^2 = 3.45x10^{-15}\ W/m^2$
At **1277.60 MHz (L2):**
$(P_d)_{max} = 1x10^{-17}\ W / 4.74x10^{-3}m^2 = 2.11x10^{-15}\ W/m^2$
### AGS LRLAP Lab (Bldg NA) Transmit Power Calculations
The calculations apply to all antenna operating in building NA.
The maximum transmit antenna Gain (G) within 30° of horizontal is:
$G = +0.9\ dB_{ic} = 1.23$ (numeric)
[1]The Measured Power ($T_x$) over 25 MHz at the antenna input is:
For **1574.42 MHz (L1):** $T_{L1} = -99.5\ dB_m = -129.5\ dB_w = 1.122x10^{-13}\ W$
And for **1277.60 MHz (L2):** $T_{L2} = -103.5\ dB_m = -133.5\ dB_w = 4.47x10^{-14}\ W$
The Power Density ($P_d$)is:
$P_d = T_xG/4\pi r^2$
Therefore, the Power Density at 100 ft (~30 m) and within 30° of horizontal is:
At **1574.42 MHz (L1):**
$P_d = (1.122x10^{-13}\ W)(1.23) = 1.22x10^{-17}\ W/m^2$
$4\pi(30)^2$
At **1277.60 MHz (L2):**
$P_d = (4.47x10^{-14}\ W)(1.23) = 4.86x10^{-18}\ W/m^2$
$4\pi(30)^2$

The **worst case** maximum transmit antenna Gain (G) at 90° of horizontal is:

$G = +5.0\ dB_{ic} = 3.16$ (numeric)

Therefore, the **worst case** Power Density at 100 ft (~30 m) and at 90° of horizontal is:

At **1574.42 MHz (L1):**

$P_d = (1.122x10^{-13}\ W)(3.16) = 3.14x10^{-17}\ W/m^2$

$4\pi(30)^2$

At **1277.60 MHz (L2):**

$P_d = (4.47x10^{-14}\ W)(3.16) = 1.25x10^{-17}\ W/m^2$

$4\pi(30)^2$

**Nominal** Power Density

**Worst Case** Power Density

**Note 1:** Power measurements were taken with a spectrum analyzer using a low noise pre-amplifier and are the maximum power across the 25 MHz Bandwidth. These measurements were taken at the coax terminal that connects to the transmit (or reradiating) antenna.

**AGS LRLAP Portable (Dynamics Lab) Transmit Power Calculations**

The maximum transmit antenna Gain (G) within 30° of horizontal is:

$G = +0.9\ dB_{ic} = 1.23$ (numeric)

[1]The Measured Power ($T_x$) over 25 MHz at the antenna input is:

For **1574.42 MHz (L1):** $T_{L1} = -99.5\ dB_m = -129.5\ dB_w = 1.122x10^{-13}\ W$

And for **1277.60 MHz (L2):** $T_{L2} = -101.5\ dB_m = -131.5\ dB_w = 7.08x10^{-14}\ W$

The Power Density ($P_d$)is:

$P_d = T_xG/4\pi r^2$

Therefore, the Power Density at 100 ft (~30 m) and within 30° of horizontal is:

At **1574.42 MHz (L1):**

$P_d = (1.122x10^{-13}\ W)(1.23) = 1.22x10^{-17}\ W/m^2$

$4\pi(30)^2$

At **1277.60 MHz (L2):**

$P_d = (7.08x10^{-14}\ W)(1.23) = 7.70x10^{-18}\ W/m^2$

$4\pi(30)^2$

The **worst case** maximum transmit antenna Gain (G) at 90° of horizontal is:

$G = +5.0\ dB_{ic} = 3.16$ (numeric)

Therefore, the **worst case** Power Density at 100 ft (~30 m) and at 90° of horizontal is:

At **1574.42 MHz (L1):**

$P_d = (1.122x10^{-13}\ W)(3.16) = 3.14x10^{-17}\ W/m^2$

$4\pi(30)^2$

At **1277.60 MHz (L2):**

$P_d = (7.08x10^{-14}\ W)(3.16) = 1.98x10^{-17}\ W/m^2$

$4\pi(30)^2$

**Nominal** Power Density

**Worst Case** Power Density

**Transmit Power Calculation Summary**

From Page 1 of this exhibit, we identified that the Antenna Effective Area of an isotropic antenna is $\lambda^2/4\pi$,

Then for **1574.42 MHz (L1):**

Effective Area = $(0.191m)^2/4\pi = 2.90x10^{-3}m^2$

And for **1277.60 MHz (L2):**

Effective Area = $(0.244m)^2/4\pi = 4.74x10^{-3}m^2$

Therefore, the **worst case** maximum equivalent isotropically radiated power at a distance of 100 feet (30 meters) from the building where the test is being conducted is as follows:

At **1574.42 MHz (L1):**

$(3.14x10^{-17}\ W/m^2)(2.90x10^{-3}m^2) = 9.11x10^{-20}$ W or -190 $dB_w$ => -160 $dB_m$

At **1277.60 MHz (L2):**

$(1.98x10^{-17}\ W/m^2)(4.74x10^{-3}m^2) = 9.39x10^{-20}$ W or -190 $dB_w$ => -160 $dB_m$

Both of which are no greater than the requirement of -140 dBm/24 MHz at a distance of 100 feet (30 meters) from the building where the test is being conducted.