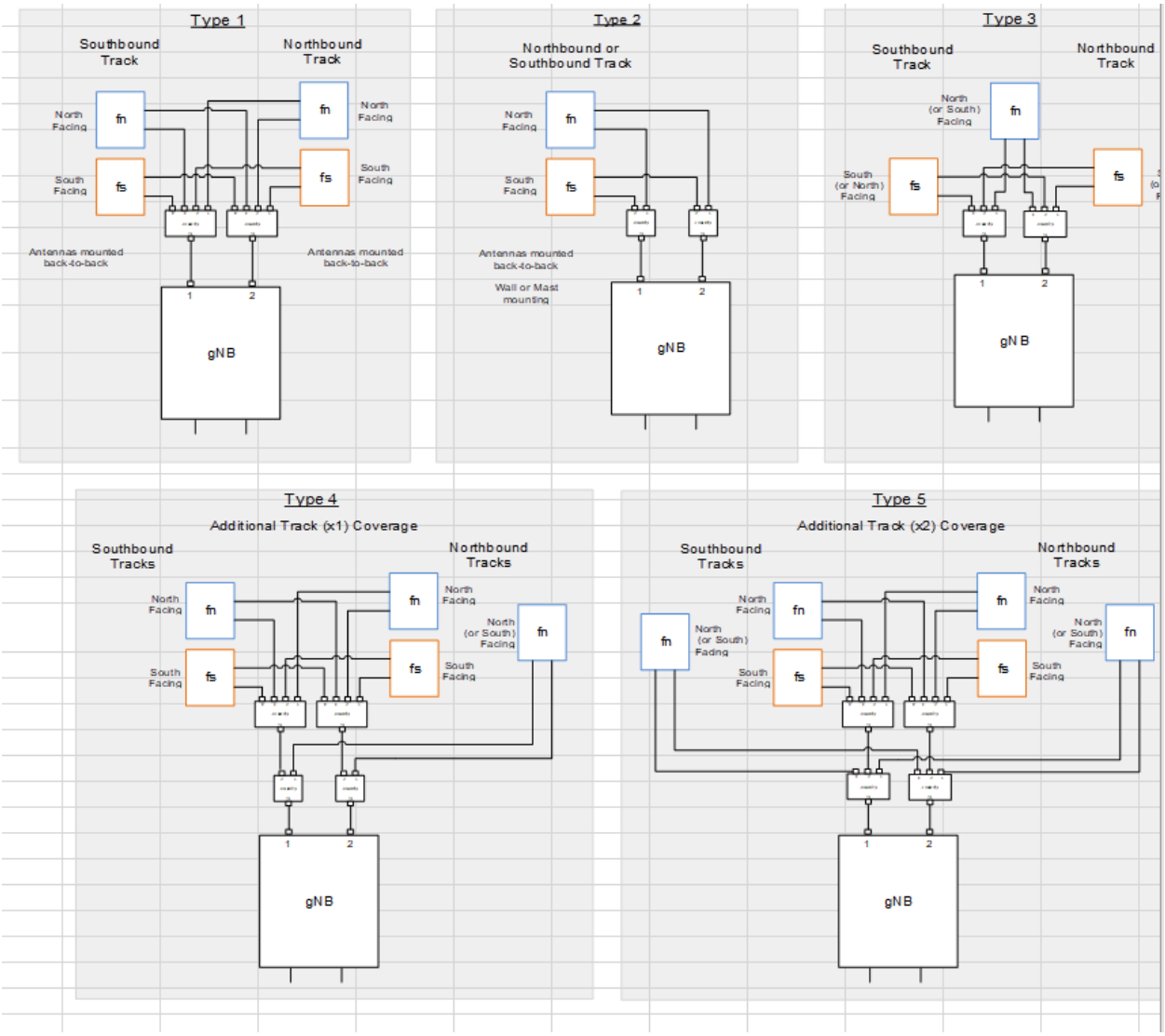
**Environmental evaluation and exposure limit according to FCC CFR 47part 1, §1.1307, §1.1310**

The AirSpeed 1900 (gNB) is classified as mobile device, the calculation was done to confirm a safe distance.

Limit for power density for general population/uncontrolled exposure is 1 mW/cm2 for 1500 -100000 MHz frequency range.

The 5 type of the possible variants of configuration of AirSpeed 1900 (gNB) using 4 RF Antennas and

4:4 RF Splitters:



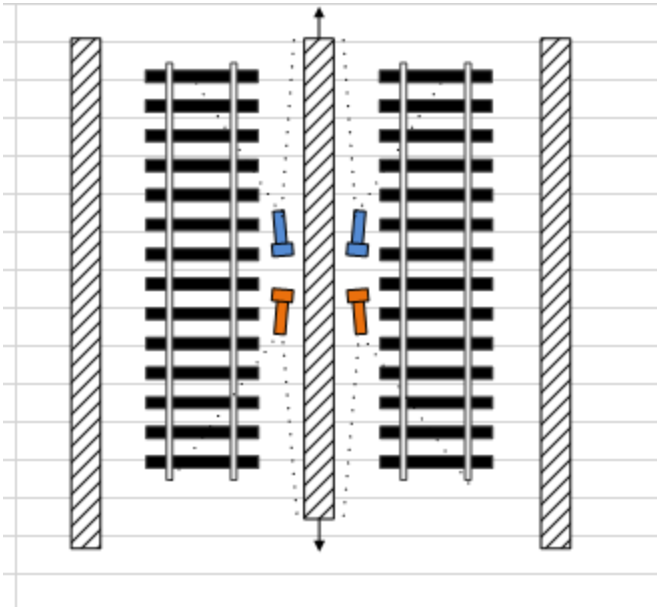
## Type 1:

| 2 Tunnels coverage Scenario where two tunnels require bi-directional coverage. Tunnels separated by concrete walls | | |
|---|---|---|
| Exposure Limit for general Public | 1mw/cm2 | Averaging time 30min |
| Tx1 [dBm] | 29.3 | Rf Power port 1 |
| Tx2[dBm] | 29.3 | RF Power Port2 |
| Power Total[dBm] | 32.3 | |
| RF Cable Loss 1m gNB to RF Splitters | 0.7 | Including connector lossess |
| RF Cable Loss 2.2m RF Splitters to Antennas 1,2,3,4 | 1.1 | Including connector lossess |
| RF Splitter Losses | 7.45 | 1:4 RF Splitter |
| Total loss gNB to Antenna 1,2,3,4[dB] | 9.25 | |
| Conducted RF power to the antenna[dBm] | 23.05 | |
| Antenna Gain [dBi] | 15.3 | KP-45 symmetrical horn |
| EIRP[dBm] | 38.35 | |
| ERP[dBm] | 36.2 | |
| Pt[mW] | 4168.693835 | |
| Duty Cycle | 0.4 | |
| Ptavg Time averaged Power [mW] | 1667.477534 | |
| The minimum safe distance "r", where RF exposure does not exceed FCC permissible limit (cm) | 11.52219381 | Calculated based on 1mw/cm2 limit using duty cycle avergaed RF power* |
| Actual distance between the antenna and train body {cm] | 100 | |

$$\text{Exposure } (mW/cm^2) = \frac{EIRP(mW) * \text{Duty Cycle}}{4*PI* \text{Radius}^2(cm)}$$

## Typical Installation

*Tunnels separated by concrete walls.

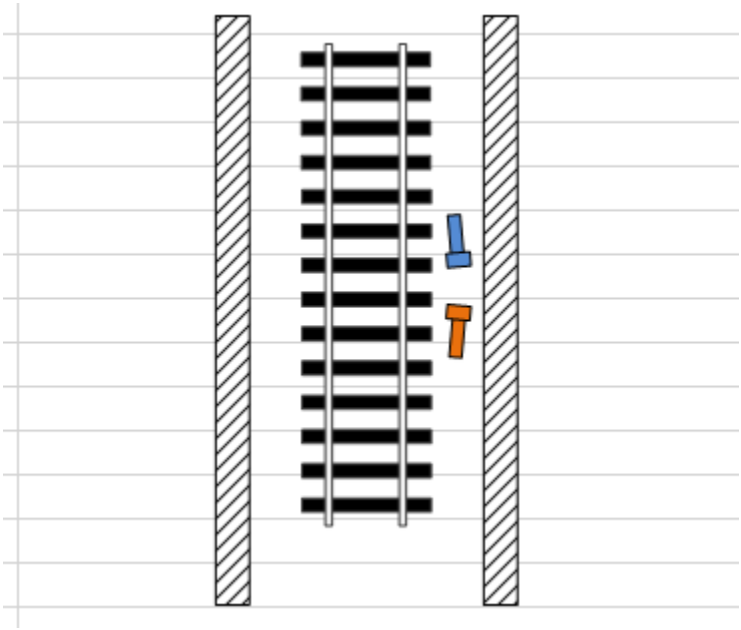


## Type2:

| | | |
|---|---|---|
| Exposure Limit for general Public | 1mw/cm2 | Averaging time 30min |
| Tx1 [dBm] | 27 | Rf Power port 1 |
| Tx2[dBm] | 27 | RF Power Port2 |
| Power Total[dBm] | 30 | |
| RF Cable Loss 1m gNB to RF Splitters | 0.7 | Including connector lossess |
| RF Cable Loss 2.2m RF Splitters to Antennas | 1.1 | Including connector lossess |
| RF Splitter Losses | 3.5 | 1:2 RF Splitter |
| Total loss gNB to Antenna[dB] | 5.3 | |
| Conducted RF power to the antenna 1,2 [dBm] | 24.7 | |
| Antenna Gain [dBi] | 15.3 | KP-45 symmetrical horn |
| EIRP[dBm] | 40 | |
| ERP[dBm] | 37.85 | |
| Pt[mW] | 6095.368972 | |
| Duty Cycle | 0.4 | |
| Ptavg Time averaged Power [mW] | 2438.147589 | |
| The minimum safe distance "r", where RF exposure does not exceed FCC permissible limit (cm) | 13.93269647 | Calculated based on 1mw/cm2 limit using duty cycle avergaed RF power |
| Actual distance between the antenna and train body {cm] | 100 | |

$$\text{Exposure } (mW/cm^2) = \frac{EIRP(mW) * \text{Duty Cycle}}{4*PI* \text{Radius}^2(cm)}$$

## Typical Installation



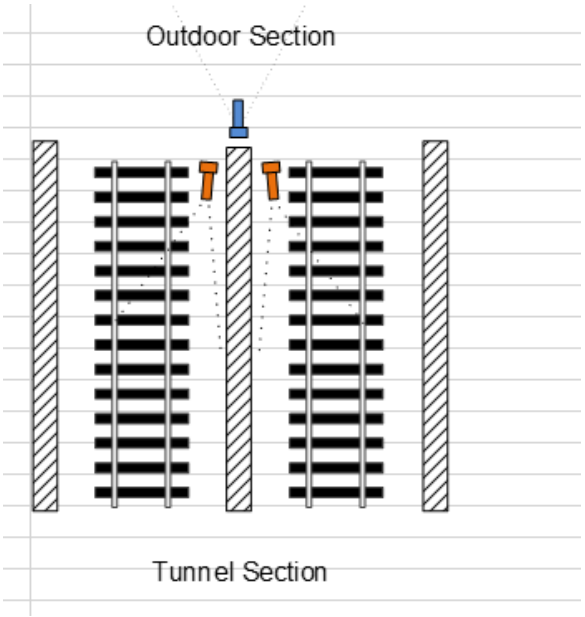
## Type 3:

| | | |
|---|---|---|
| Exposure Limit for general Public | 1mw/cm2 | Averaging time 30min |
| Tx1 [dBm] | 29 | Rf Power port 1 |
| Tx2[dBm] | 29 | RF Power Port2 |
| Power Total[dBm] | 32 | |
| RF Cable Loss 1m gNB to RF Splitters | 0.7 | Including connector lossess |
| RF Cable Loss 2.2m RF Splitters to Antennas | 1.1 | Including connector lossess |
| RF Splitter Losses | 5.7 | 1:3 RF Splitter |
| Total loss gNB to Antenna[dB] | 7.5 | |
| Conducted RF power to the antenna[dBm] | 24.5 | |
| Antenna Gain [dBi] | 15.3 | KP-45 symmetrical horn |
| EIRP[dBm] | 39.8 | |
| ERP[dBm] | 37.65 | |
| Pt[mW] | 5821.032178 | |
| Duty Cycle | 0.4 | |
| Ptavg Time averaged Power [mW] | 2328.412871 | |
| The minimum safe distance "r", where RF exposure does not exceed FCC permissible limit (cm) | 13.61554958 | Calculated based on 1mw/cm2 limit using duty cycle avergaed RF power* |
| Actual distance between the antenna and train body {cm] | 100 | |

$$\text{Exposure } (mW/cm^2) = \frac{EIRP(mW) * \text{Duty Cycle}}{4*PI* \text{Radius}^2(cm)}$$

## Typical Installation

*Tunnels separated by concrete walls.



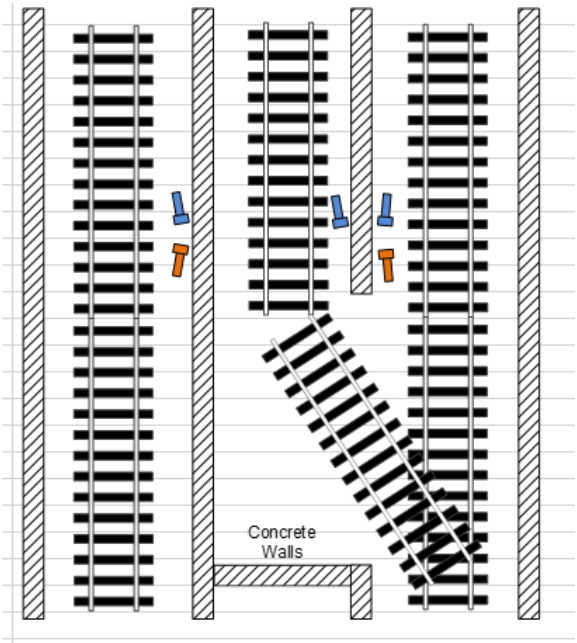
## Type 4:

| | | |
|---|---|---|
| Exposure Limit for general Public | 1mw/cm2 | Averaging time 30min |
| Tx1 [dBm] | 28 | Rf Power port 1 |
| Tx2[dBm] | 28 | RF Power Port2 |
| Power Total[dBm] | 31 | |
| RF Cable Loss 1m gNB to RF Splitter1 | 0.7 | Including connector lossess |
| RF Cable Loss 1m RF Splitter 1 to RF Splitter 2 | 0.7 | Including connector lossess |
| RF Cable Loss 10m RF Splitter 1 to Antenna 5 | 3.1 | Including connector lossess |
| RF Cable Loss 2m RF Splitter 2 to Antenna 1,2,3,4 | 1.1 | Including connector lossess |
| RF Splitter 1 Losses | 3.5 | 1:2 RF Splitter |
| RF Splitter 2 Losses | 6.5 | 1:4 RF Splitter |
| Total loss gNB to Antenna 5[dB] | 7.3 | |
| Total loss gNB to Antenna 1,2,3,4 [dB] | 12.5 | |
| Conducted RF power to the antenna 5[dBm] | 23.7 | |
| Conducted RF power to the antenna 1,2,3,4[dBm] | 18.5 | |
| Antenna Gain [dBi] | 15.3 | KP-45 symmetrical horns |
| EIRP[dBm] Antenna 5 | 39 | |
| EIRP[dBm] Antenna 1,2,3,4 | 33.8 | |
| ERP[dBm] Antenna 5 | 36.85 | |
| ERP[dBm] Antenna 1,2,3,4 | 31.65 | |
| Pt[mW] | 4841.723676 | |
| Duty Cycle | 0.4 | |
| Ptavg Time averaged Power [mW] | 1936.68947 | |
| The minimum safe distance "r", where RF exposure does not exceed FCC permissible limit (cm) | 12.4175288 | Calculated based on 1mw/cm2 limit using duty cycle avergaed RF power* |
| Actual distance between the antenna and train body {cm] | 100 | |

$$\text{Exposure (mW/cm}^2\text{)} = \frac{\text{EIRP(mW) * Duty Cycle}}{4*PI*\text{ Radius}^2\text{(cm)}}$$

## Typical Installation

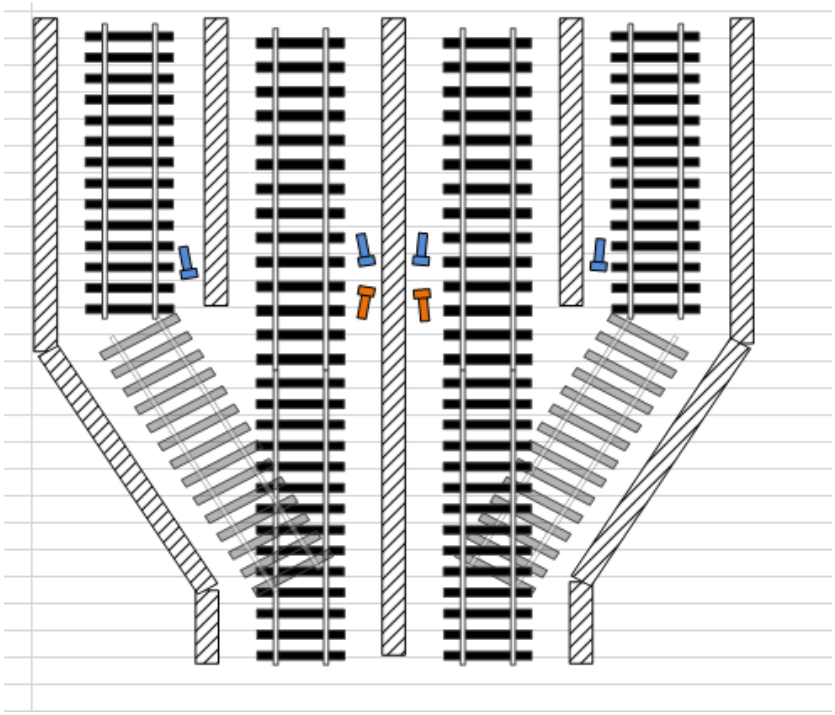
*Tunnels separated by concrete walls.



## Type 5:

| | | |
|---|---|---|
| Exposure Limit for general Public | 1mw/cm2 | Averaging time 30min |
| Tx1 [dBm] | 29 | Rf Power port 1 |
| Tx2[dBm] | 29 | RF Power Port2 |
| Power Total[dBm] | 32 | |
| RF Cable Loss 1m gNB to RF Splitter1 | 0.7 | Including connector lossess |
| RF Cable Loss 1m RF Splitter 1 to RF Splitter 2 | 0.7 | Including connector lossess |
| RF Cable Loss 10m RF Splitter 1 to Antenna 5,6 | 3 | Including connector lossess |
| RF Cable Loss 2m RF Splitter 2 to Antenna 1,2,3,4 | 1.1 | Including connector lossess |
| RF Splitter 1 Losses | 5.7 | 1:3 RF Splitter |
| RF Splitter 2 Losses | 6.5 | 1:4 RF Splitter |
| Total loss gNB to Antenna 5[dB] | 9.4 | |
| Total loss gNB to Antenna 1,2,3,4 [dB] | 14.7 | |
| Conducted RF power to the antenna 5[dBm] | 22.6 | |
| Conducted RF power to the antenna 1,2,3,4[dBm] | 17.3 | |
| Antenna Gain [dBi] | 15.3 | KP-45 symmetrical horns |
| EIRP[dBm] Antenna 5,6 | 37.9 | |
| EIRP[dBm] Antenna 1,2,3,4 | 32.6 | |
| ERP[dBm] Antenna 5,6 | 35.75 | |
| ERP[dBm] Antenna 1,2,3,4 | 30.45 | |
| Pt[mW] | 3758.374043 | |
| Duty Cycle | 0.4 | |
| Ptavg Time averaged Power [mW] | 1503.349617 | |
| The minimum safe distance "r", where RF exposure does not exceed FCC permissible limit (cm) | 10.94044976 | Calculated based on 1mw/cm2 limit using duty cycle avergaed RF power* |
| Actual distance between the antenna and train body [cm] | 100 | |

$$\text{Exposure } (mW/cm^2) = \frac{EIRP(mW) * \text{Duty Cycle}}{4*PI* \text{Radius}^2(cm)}$$

## Typical Installation

*Tunnels separated by concrete walls.