



Engineering Analysis MPE for WCS 2.3 GHz Transceiver

FCC ID: RAR20006001

BelAir Networks

This analysis was performed as part of the FCC certification requirements for spread spectrum devices, according to the requirements of: FCC part 27, and FCC OET Bulletin 65 "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields".

- Module RAR20006001 will be mounted in BelAir Networks host units and will be professionally installed (Fixed) to provide a minimum separation distance from all persons as detailed in co-location compliance tables below.
- Module RAR20006001 may be co-located with other modules in BelAir Networks products as shown in the co-location compliance tables below. Worst-case configurations are shown below.
- This device will only be operated according to the exposure conditions described in this application.
- End users and installers will be provided with antenna installation and transmitter operating conditions for satisfying RF exposure compliance.

The measured worst-case transmit power yielding the worst-case EIRP were used for the MPE calculations. Calculations were performed based on FCC OET Bulletin 65. The calculations are performed based on the following formula provided in OET 65:

$$S = EIRP / (4\pi R^2).$$

Co-location compliance for multiple frequency exposure criteria to the power density exposure limit is detailed in the table below. This calculation is a worst-case analysis since it assumes all devices are continuously transmitting. The device utilizes the 802.16 protocol which operates in time-division duplex (TDD) mode, so the transmit duty cycle can never be 100% in normal operation. It is also assumed that all directional antennas are aligned to point in the same direction so that power from all radios add.



The following table 1 summarizes the minimum distance covering all configurations of RAR20006001 radios in BelAir Networks products using worst case scenarios.

Table 1

| Node | Minimum Safety Distance cm (inches) | | | |
|---------------------------------------|-------------------------------------|---------------------------|---------------------------|--------------------------------------------------------------|
| | 25 dBi antenna | 18 dBi and 15 dBi antenna | 13, 8.5, 8, 6 dBi antenna | Radios |
| BelAir100 BelAir100S BelAir100C | 80 (31.5 inches) | 36 (14.5 inches) | 24 (9.5 inches) | 2 x RAR20006001 or 1 RAR20000003 and 1 RAR20006001 |
| BelAir200 | 115 (45.5 inches) | 51 (20.5 inches) | 30 (11.8 inches) | 4 x RAR20006001 or 1 RAR20000003 and 3x RAR20006001 |

The following tables outlines the safety distance calculations for the various combinations of antennas and radios, co-located, worst case conditions.

Case I: 2.3 GHz WCS band, 13 dBi or less (6 dBi, 8 dBi), 1 x RAR20006001

| Compliance for one WCS Radio | | | | | | | | |
|------------------------------|-----------------------------|--------------------------|-----------------------------|-----------------------------|--------------------------|-----------------------------------------------|-------------------------------------------------------------|----------|
| Safety Distance: | | 14.5 cm | | (5.7 inches) | | | | |
| Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Total Density for co-located radios [mW/cm^2] | Limit: General Population / Uncontrolled Exposure [mW/cm^2] | |
| RAR20006001 34 | 0.951 | 1 | 0 | 0.000 | 0 | 0.951 | 1 | Complies |

Case II: 2.3 GHz WCS band, 13 dBi or less (6 dBi, 8 dBi), 2 x RAR20006001

| Co-location Compliance for two WCS Radios | | | | | | | | |
|-------------------------------------------|-----------------------------|--------------------------|-----------------------------|-----------------------------|--------------------------|-----------------------------------------------|-------------------------------------------------------------|----------|
| Safety Distance: | | 24 cm | | (9.4 inches) | | | | |
| Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Total Density for co-located radios [mW/cm^2] | Limit: General Population / Uncontrolled Exposure [mW/cm^2] | |
| RAR20006001 34 | 0.347 | 2 | | | | 0.694 | 1 | Complies |



Case III: 2.3 GHz WCS band, 13 dBi or less (6 dBi, 8 dBi), 1 x RAR20006001 and 1 x RAR20000003

| Co-location Compliance for Integrated 802.11b/g & WCS Radios | | | | | | | | | |
|--------------------------------------------------------------|-----------------------------|--------------------------|-----------------------------|-----------------------------|--------------------------|-----------------------------------------------|-------------------------------------------------------------|---|----------|
| Safety Distance: | | 24 cm | | (9.4 inches) | | | | | |
| Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Total Density for co-located radios [mW/cm^2] | Limit: General Population / Uncontrolled Exposure [mW/cm^2] | | |
| RAR20006001 | 34 | 0.347 | 1 | 35.5 | 0.490 | 1 | 0.837 | 1 | Complies |

Case IV: 2.3 GHz WCS band, 13 dBi (Includes 6, 8 dBi), four RAR20006001

| Co-location Compliance for four WCS Radios | | | | | | | | |
|--------------------------------------------|-----------------------------|--------------------------|-----------------------------|-----------------------------|--------------------------|-----------------------------------------------|-------------------------------------------------------------|----------|
| Safety Distance: | | 29 cm | | (11.4 inches) | | | | |
| Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Total Density for co-located radios [mW/cm^2] | Limit: General Population / Uncontrolled Exposure [mW/cm^2] | |
| RAR20006001 | 34 | 0.238 | 4 | | | 0.951 | 1 | Complies |

Case V: 2.3 GHz WCS band, 13 dBi (Includes 6, 8 dBi), three RAR20006001

| Co-location Compliance for four WCS Radios | | | | | | | | | |
|--------------------------------------------|-----------------------------|--------------------------|-----------------------------|-----------------------------|--------------------------|-----------------------------------------------|-------------------------------------------------------------|---|----------|
| Safety Distance: | | 30 cm | | (11.8 inches) | | | | | |
| Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Total Density for co-located radios [mW/cm^2] | Limit: General Population / Uncontrolled Exposure [mW/cm^2] | | |
| RAR20006001 | 34 | 0.222 | 3 | 35.5 | 0.314 | 1 | 0.980 | 1 | Complies |

Case VI: 2.3 GHz WCS band, 25 dBi 1 x RAR20006001

| Compliance for one WCS Radio | | | | | | | | |
|------------------------------|-----------------------------|--------------------------|-----------------------------|-----------------------------|--------------------------|-----------------------------------------------|-------------------------------------------------------------|----------|
| Safety Distance: | | 57 cm | | (22.4 inches) | | | | |
| Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Total Density for co-located radios [mW/cm^2] | Limit: General Population / Uncontrolled Exposure [mW/cm^2] | |
| RAR20006001 | 46 | 0.975 | 1 | | | 0.975 | 1 | Complies |

Case VII: 2.3 GHz WCS band, 25 dBi 2 x RAR20006001

| Co-location Compliance for two WCS Radios | | | | | | | | |
|-------------------------------------------|-----------------------------|--------------------------|-----------------------------|-----------------------------|--------------------------|-----------------------------------------------|-------------------------------------------------------------|----------|
| Safety Distance: | | 80 cm | | (31.5 inches) | | | | |
| Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Total Density for co-located radios [mW/cm^2] | Limit: General Population / Uncontrolled Exposure [mW/cm^2] | |
| RAR20006001 | 46 | 0.495 | 2 | | | 0.990 | 1 | Complies |

Case VIII: 2.3 GHz WCS band, 25 dBi 1 x RAR20006001 and 1 x RAR20000003

| Co-location Compliance for Integrated 802.11b/g & WCS Radios | | | | | | | | | |
|--------------------------------------------------------------|-----------------------------|--------------------------|-----------------------------|-----------------------------|--------------------------|-----------------------------------------------|-------------------------------------------------------------|---|----------|
| Safety Distance: | | 80 cm | | (31.5 inches) | | | | | |
| Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Total Density for co-located radios [mW/cm^2] | Limit: General Population / Uncontrolled Exposure [mW/cm^2] | | |
| RAR20006001 | 46 | 0.495 | 1 | 35.5 | 0.044 | 1 | 0.539 | 1 | Complies |



Case IX: 2.3 GHz WCS band, 25 dBi , 3 x RAR20006001 and RAR20000003

| Co-location Compliance for Integrated 802.11b/g & 3 X WCS Radios | | | | | | | | |
|------------------------------------------------------------------|-----------------------------|--------------------------|-----------------------------|-----------------------------|--------------------------|-----------------------------------------------|---|----------|
| Safety Distance: | | 100 cm | | (39.4 inches) | | | | |
| Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Total Density for co-located radios [mW/cm^2] | | |
| RAR20006001 46 | 0.317 | 3 | RAR20000003 35.5 | 0.028 | 1 | 0.979 | 1 | Complies |

Case X: 2.3 GHz WCS band, 25 dBi , four WCS radios , 4 x RAR20006001

| Co-location Compliance for four WCS Radios | | | | | | | | |
|--------------------------------------------|-----------------------------|--------------------------|-----------------------------|-----------------------------|--------------------------|-----------------------------------------------|---|----------|
| Safety Distance: | | 115 cm | | (45.3 inches) | | | | |
| Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Total Density for co-located radios [mW/cm^2] | | |
| RAR20006001 46 | 0.240 | 4 | | | | 0.958 | 1 | Complies |

Case XI: 2.3 GHz WCS band, 18 dBi (Includes 15 dBi), 1 x RAR20006001

| Compliance for one WCS Radios | | | | | | | | |
|-------------------------------|-----------------------------|--------------------------|-----------------------------|-----------------------------|--------------------------|-----------------------------------------------|---|----------|
| Safety Distance: | | 26 cm | | (10.2 inches) | | | | |
| Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Total Density for co-located radios [mW/cm^2] | | |
| RAR20006001 39 | 0.935 | 1 | | | | 0.935 | 1 | Complies |

Case XII: 2.3 GHz WCS band, 18 dBi (Includes 15 dBi), 2 x RAR20006001

| Co-location Compliance for two WCS Radios | | | | | | | | |
|-------------------------------------------|-----------------------------|--------------------------|-----------------------------|-----------------------------|--------------------------|-----------------------------------------------|---|----------|
| Safety Distance: | | 36 cm | | (14.2 inches) | | | | |
| Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Total Density for co-located radios [mW/cm^2] | | |
| RAR20006001 39 | 0.488 | 2 | | | | 0.975 | 1 | Complies |

Case XIII: 2.3 GHz WCS band, 18 dBi (Includes 15 dBi) , 1 x RAR20000003 and 1x RAR20006001

| Co-location Compliance for Integrated 802.11b/g & WCS Radios | | | | | | | | |
|--------------------------------------------------------------|-----------------------------|--------------------------|-----------------------------|-----------------------------|--------------------------|-----------------------------------------------|---|----------|
| Safety Distance: | | 31 cm | | (12.2 inches) | | | | |
| Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Total Density for co-located radios [mW/cm^2] | | |
| RAR20006001 39 | 0.658 | 1 | RAR20000003 35.5 | 0.294 | 1 | 0.952 | 1 | Complies |

Case XIV: 2.3 GHz WCS band, 18 dBi (Includes 15 dBi) 1 X RAR20000003 and 3 RAR200060001

| Co-location Compliance for Integrated 802.11b/g & 3 X WCS Radios | | | | | | | | |
|------------------------------------------------------------------|-----------------------------|--------------------------|-----------------------------|-----------------------------|--------------------------|-----------------------------------------------|---|----------|
| Safety Distance: | | 47 cm | | (18.5 inches) | | | | |
| Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Total Density for co-located radios [mW/cm^2] | | |
| RAR20006001 39 | 0.286 | 3 | RAR20000003 35.5 | 0.128 | 1 | 0.986 | 1 | Complies |


Case XV: 2.3 GHz WCS band, 18 dBi (Includes 15 dBi), four RAR20006001

| Co-location Compliance for four WCS Radios | | | | | | |
|--------------------------------------------|-----------------------------|--------------------------|-----------------------------|-----------------------------|--------------------------|-----------------------------------------------|
| Safety Distance: | | 51 cm | | (20.1 inches) | | |
| Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Worst-case Total EIRP [dBm] | Max Power Density [mW/cm^2] | Maximum Number of Radios | Total Density for co-located radios [mW/cm^2] |
| 39 | 0.243 | 4 | | | | 0.972 |
| RAR20006001 | | | | | | 1 |
| | | | | | | Complies |

The equipment therefore fulfills the requirements on power density for general population/uncontrolled exposure and therefore complies with the requirements of FCC Part 27.52 and FCC Bulletin 65.