Engineering Analysis MPE for 5 GHz Transceiver

FCC ID: RAR20001003
BelAir Networks

This analysis was performed as part of the FCC certification requirements for spread spectrum devices, according to the requirements of: FCC part 15, and FCC OET Bulletin 65 “Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields”.

- Module RAR20001003 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 RAR20001003 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 802.11 WLAN 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.

Case I: 5.15 – 5.25 GHz, 4, 10, 15 dBi antennas, 1 x RAR20000003 plus 3 x RAR20001003

Safety distance: 20 cm (7.9 inches)

Case I: 5.15 - 5.25 GHz, 4, 10, 15 dBi antennas

Co-location Compliance for Integrated 802.11b/g & 802.11a Radios								
Safety Distance:	20 cm	(7.9 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]	Result
	RAR20000003			RAR20001003				
35.5	0.706	1	22	0.032	3	0.800	1	Complies

Case II: 5.25 – 5.35 GHz, all antennas, 1 x RAR20000003 plus 3 x RAR20001003

Safety Distance: 25 cm (9.8 inches)

Case II: 5.25 - 5.35 GHz, all antennas

Co-location Compliance for Integrated 802.11b/g & 802.11a Radios								
Safety Distance:	25 cm	(9.8 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]	Result
	RAR20000003			RAR20001003				
35.5	0.452	1	30	0.127	3	0.834	1	Complies

Case III: 5.725 – 5.850 GHz, 4 and 10 dBi antennas, 1 x RAR20000003 plus 3 x RAR20001003

Safety Distance: 25 cm (9.8 inches)

Case III: 5.725 - 5.850 GHz, 4 and 10 dBi antennas

Co-location Compliance for Integrated 802.11b/g & 802.11a Radios								
Safety Distance:	25 cm	(9.8 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]	Result
	RAR20000003			RAR20001003				
35.5	0.452	1	30	0.127	3	0.834	1	Complies

Case IV: 5.725 – 5.850 GHz, 15 dBi antenna, 1 x RAR20000003 plus 3 x RAR20001003

Safety Distance: 33 cm (13 inches)

Case IV: 5.725 - 5.850 GHz, 15 dBi antenna

Co-location Compliance for Integrated 802.11b/g & 802.11a Radios								
Safety Distance:	**33 cm**	(13.0 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]**	**Result**
	RAR20000003			**RAR20001003**				
35.5	**0.259**	**1**	**35**	**0.231**	**3**	**0.953**	**1**	**Complies**

Case V: 5.725 – 5.850 GHz, 23 dBi antenna, 1 x RAR20000003 plus 3 x RAR20001003

Safety Distance: 72 cm (28.3 inches)

Case V: 5.725 - 5.850 GHz, 23 dBi antenna

Co-location Compliance for Integrated 802.11b/g & 802.11a Radios								
Safety Distance:	**72 cm**	(28.3 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]**	**Limit: General Population / Uncontrolled Exposure [mW/cm^2]**	**Result**
	RAR20000003			**RAR20001003**				
35.5	**0.054**	**1**	**43**	**0.306**	**3**	**0.973**	**1**	**Complies**

Case VI: 5.15 – 5.25 GHz, 4, 10, 15 dBi antennas, 1 x RAR20000003 plus 1 x RAR20001003

Safety Distance: 20 cm (7.9 inches)

Case VI: 5.15 - 5.25 GHz, 4, 10, 15 dBi antennas, single BRM

Co-location Compliance for Integrated 802.11b/g & 802.11a Radios								
Safety Distance:	**20 cm**	(7.9 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]**	**Result**
	RAR20000003			**RAR20001003**				
35.5	**0.706**	**1**	**22**	**0.032**	**1**	**0.737**	**1**	**Complies**

Case VII: 5.25 – 5.35 GHz, all antennas, 1 x RAR20000003 plus 1 x RAR20001003

Safety Distance: 20 cm (7.9 inches)

Case VII: 5.25 - 5.35 GHz, all antennas, single BRM

Co-location Compliance for Integrated 802.11b/g & 802.11a Radios								
Safety Distance:	20 cm	(7.9 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]	Result
	RAR20000003			RAR20001003				
35.5	0.706	1	30	0.199	1	0.905	1	Complies

Case VIII: 5.725 – 5.850 GHz, 4 and 10 dBi antennas, 1 x RAR20000003 plus 1 x RAR20001003

Safety Distance: 20 cm (7.9 inches)

Case VIII: 5.725 - 5.850 GHz, 4 and 10 dBi antennas, single BRM

Co-location Compliance for Integrated 802.11b/g & 802.11a Radios								
Safety Distance:	20 cm	(7.9 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]	Result
	RAR20000003			RAR20001003				
35.5	0.706	1	30	0.199	1	0.905	1	Complies

Case IX: 5.725 – 5.850 GHz, 15 dBi antenna, 1 x RAR20000003 plus 1 x RAR20001003

Safety Distance: 25 cm (9.8 inches)

Case IX: 5.725 - 5.850 GHz, 15 dBi antenna, single BRM

Co-location Compliance for Integrated 802.11b/g & 802.11a Radios								
Safety Distance:	25 cm	(9.8 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]	Result
RAR20000003			RAR20001003					
35.5	0.452	1	35	0.403	1	0.854	1	Complies

Case X: 5.725 – 5.850 GHz, 23 dBi antenna, 1 x RAR20000003 plus 1 x RAR20001003

Safety Distance: 44 cm (17.4 inches)

Case X: 5.725 - 5.850 GHz, 23 dBi antenna, single BRM

Co-location Compliance for Integrated 802.11b/g & 802.11a Radios								
Safety Distance:		**44 cm**	(17.3 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]	Limit: General Population / Uncontrolled Exposure [mW/cm^2]	Result
RAR20000003			RAR20001003					
35.5	0.146	1	43	0.820	1	0.966	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 15.247 (b) (4) and FCC Bulletin 65.