



Engineering Analysis MPE for RAR20100520, 2.3 GHz Transceiver

FCC ID: RAR20100520
BelAir Networks

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

- Module RAR20100520 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 RAR20100520 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:

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

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 will be less than 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, which is the worst-case condition.



The following table summarizes the results of MPE calculations for various products and antenna configurations (“Any” indicates any antenna certified for use with that radio). The detailed calculations are provided below.

Radio and Antenna Combinations					
	RAR20100520 (2.3 GHz)	RAR20180001 (2.4 GHz)	RAR20180002 (5.2, 5.6, 5.8 GHz)	RAR20000003 (2.4 GHz)	RAR20021001 / RAR20031001 (5.8 GHz)
BelAir20 Safety Distance	up to 15.5 dBi	n/a	n/a	n/a	n/a
	15 cm (6 inches)				
BelAir20 Safety Distance	up to 15.5 dBi	4 dBi	5 dBi	n/a	n/a
	16.5 cm (6.5 inches)				
BelAir100T Safety Distance	up to 15.5 dBi	n/a	n/a	Any	n/a
	21 cm (8.3 inches)				
BelAir100T Safety Distance	up to 15.5 dBi	n/a	n/a	Any	up to 15 dBi
	26 cm (10.2 inches)				
BelAir100T Safety Distance	up to 15.5 dBi	n/a	n/a	Any	up to 19 dBi
	33 cm (13.0 inches)				
BelAir100T Safety Distance	up to 15.5 dBi	n/a	n/a	Any	up to 23 dBi
	45 cm (17.7 inches)				

The following calculation shows the safety distance for an RAR20100520 module with its maximum antenna gain of 15.5 dBi:

Case I: RAR20100520 (2.3 GHz) with 15.5 dBi antenna

Safety Distance: 15 (5.9 inches)					
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
32.46	RAR20100520 0.623	1	0.623	1	Complies



The following tables outline the MPE analysis for various combinations of radios and antenna the RAR20100520 may be used with:

Case Ia: BA20: RAR20100520 (2.3 GHz) wth 15.5 dBi antenna, RAR20180001 (2.4 GHz) with 4 dBi Antenna

Safety Distance:		16.5 cm		(6.5 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]	Result			
32.46	0.515	1	32.0483	0.468	1	0.983	1	Complies			

Case Ib: BA20: RAR20100520 (2.3 GHz) wth 15.5 dBi antenna, RAR20180002 (5 GHz) with 5 dBi Antenna

Safety Distance:		15 cm		(5.9 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			
32.46	0.623	1	30.11	0.363	1	0.986	1	Complies			

Case IIa: BA100: RAR20100520 (2.3 GHz) with 15.5 dBi antenna, RAR20000003 (2.4 GHz) with all antennas

Safety Distance:		21 cm		(8.3 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			
32.46	0.318	1	35.5	0.640	1	0.958	1	Complies			

Case IIb: BA100: RAR20100520 (2.3 GHz) with 15.5 dBi antenna, RAR20000003 (2.4 GHz) with all antennas, RAR20021001 (5.8 GHz) with 15dBi or less antenna

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	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	
32.46	0.207	1	35.5	0.418	1	35	0.372	1	0.997	1	Complies	

Case IIc: BA100: RAR20100520 (2.3 GHz) with 15.5 dBi antenna, RAR20000003 (2.4 GHz) with all antennas, RAR20021001 (5.8 GHz) with 19dBi or less antenna

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	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	
32.46	0.129	1	35.5	0.259	1	39	0.580	1	0.968	1	Complies	

Case IIId: BA100: RAR20100520 (2.3 GHz) with 15.5 dBi antenna, RAR20000003 (2.4 GHz) with all antennas, RAR20021001 (5.8 GHz) with 23 dBi antenna

Safety Distance:		45 cm		(17.7 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	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	
32.46	0.069	1	35.5	0.139	1	43	0.784	1	0.993	1	Complies	

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