



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:

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

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 802.16 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]	Result
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]	Result
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]	Result
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]	Result
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]	Result
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]	Result
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]	Result
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]	Result
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]	Limit: General Population / Uncontrolled Exposure [mW/cm ²]	Result
46	0.317	3	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]	Limit: General Population / Uncontrolled Exposure [mW/cm ²]	Result
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]	Limit: General Population / Uncontrolled Exposure [mW/cm ²]	Result
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]	Limit: General Population / Uncontrolled Exposure [mW/cm ²]	Result
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]	Limit: General Population / Uncontrolled Exposure [mW/cm ²]	Result
39	0.658	1	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]	Limit: General Population / Uncontrolled Exposure [mW/cm ²]	Result
39	0.286	3	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]	Limit: General Population / Uncontrolled Exposure [mW/cm ²]	Result
39	0.243	4				0.972	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.