



## Engineering Analysis MPE for ERM5 Transceiver

FCC ID: RAR20051001

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 RAR20051001 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 RAR20051001 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 IEEE 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 adds together.



The following tables outlines the MPE analysis for various combinations of radios and antenna the RAR20051001 can be used with:

**BelAir200 (Includes BelAir200D) Products**

**Case 1A: Standard Quad ERM5 Only Offering: 4 X RAR20051001 [ERM5] 5.725 - 5.850 GHz : 15 dBi or less antennas**

Co-location Compliance for Integrated ARM3 IEEE 802.11b/g & ERM5 IEEE 802.11an Radios									
Safety Distance: <b>32 cm</b> ( 12.6 inches )									
Worst-case Total EIRP	Max Power Density	Maximum Number of Radios				Total Density for co-located radios	Limit: General Population / Uncontrolled Exposure	Result	
[dBm]	[mW/cm <sup>2</sup> ]		[dBm]	[mW/cm <sup>2</sup> ]		[mW/cm <sup>2</sup> ]	[mW/cm <sup>2</sup> ]		
35	0.246	4				0.983	1	Complies	

**Case 1B: High Gain Quad ERM5 Only Offering: 4 X RAR20051001 [ERM5] 5.725 - 5.850 GHz : 29 dBi or less antennas**

Co-location Compliance for Integrated ARM3 IEEE 802.11b/g & ERM5 IEEE 802.11an Radios									
Safety Distance: <b>160 cm</b> ( 63.0 inches )									
Worst-case Total EIRP	Max Power Density	Maximum Number of Radios				Total Density for co-located radios	Limit: General Population / Uncontrolled Exposure	Result	
[dBm]	[mW/cm <sup>2</sup> ]		[dBm]	[mW/cm <sup>2</sup> ]		[mW/cm <sup>2</sup> ]	[mW/cm <sup>2</sup> ]		
49	0.247	4				0.988	1	Complies	

**Case 2A: Standard ERM5 + ARM3 Offering: 3 X RAR20051001 [ERM5] 5.725 - 5.850 GHz 15 dBi or less antennas-1 X RAR20000003 [ARM3]**

Co-location Compliance for Integrated ARM3 IEEE 802.11b/g & ERM5 IEEE 802.11an Radios									
Safety Distance: <b>33 cm</b> ( 13.0 inches )									
Worst-case Total EIRP	Max Power Density	Maximum Number of Radios	Worst-case Total EIRP	Max Power Density	Maximum Number of Radios	Total Density for co-located radios	Limit: General Population / Uncontrolled Exposure	Result	
[dBm]	[mW/cm <sup>2</sup> ]		[dBm]	[mW/cm <sup>2</sup> ]		[mW/cm <sup>2</sup> ]	[mW/cm <sup>2</sup> ]		
35.5	0.259	1	35	0.231	3	0.953	1	Complies	

**Case 2B: High Gain ERM5 + ARM3 Offering: 3 X RAR20051001 [ERM5] 5.725 - 5.850 GHz with up to 29 dBi antennas and 1 X RAR20000003 [ARM3]**

Co-location Compliance for Integrated ARM3 IEEE 802.11b/g & ERM5 IEEE 802.11an Radios									
Safety Distance: <b>139 cm</b> ( 54.7 inches )									
Worst-case Total EIRP	Max Power Density	Maximum Number of Radios	Worst-case Total EIRP	Max Power Density	Maximum Number of Radios	Total Density for co-located radios	Limit: General Population / Uncontrolled Exposure	Result	
[dBm]	[mW/cm <sup>2</sup> ]		[dBm]	[mW/cm <sup>2</sup> ]		[mW/cm <sup>2</sup> ]	[mW/cm <sup>2</sup> ]		
35.5	0.015	1	49	0.327	3	0.996	1	Complies	

**Case 3A: Standard 2 X RAR20051001 [ERM5] 5.725 - 5.850 GHz with 15 dBi or less antennas and 1 X RAR20000003 [ARM3] and 1 X RAR20021001 [ERM1] at 4.94 GHz with 9 dBi omni**

Co-location Compliance for Integrated IEEE 802.11b/g [ARM3] & Two IEEE 802.11an [ERM5] & One IEEE 802.11a Public Service Radios --> STANDARD GAIN ANTENNAS											
Safety Distance: <b>31 cm</b> ( 12.2 inches )											
Worst-case Total EIRP	Max Power Density	Maximum Number of Radios	Worst-case Total EIRP	Max Power Density	Maximum Number of Radios	Worst-case Total EIRP	Max Power Density	Maximum Number of Radios	Total Density for co-located radios	Limit: General Population / Uncontrolled Exposure	Result
[dBm]	[mW/cm <sup>2</sup> ]		[dBm]	[mW/cm <sup>2</sup> ]		[dBm]	[mW/cm <sup>2</sup> ]		[mW/cm <sup>2</sup> ]	[mW/cm <sup>2</sup> ]	
35.5	0.294	1	35	0.262	2	32	0.131	1	0.949	1	Complies

**Case 3B: High Gain 2 X RAR20051001 [ERM5] 5.725 - 5.850 GHz with 29 dBi or less antennas and 1 X RAR20000003 [ARM3] and 1 X RAR20021001 [ERM1] at 4.94 GHz with 25 dBi or less antenna**

Co-location Compliance for Integrated IEEE 802.11b/g [ARM3] & Two IEEE 802.11an [ERM5] & One IEEE 802.11a Public Service Radios --> HIGH GAIN ANTENNAS											
Safety Distance: <b>89 cm</b> ( 35.0 inches )											
Worst-case Total EIRP	Max Power Density	Maximum Number of Radios	Worst-case Total EIRP	Max Power Density	Maximum Number of Radios	Worst-case Total EIRP	Max Power Density	Maximum Number of Radios	Total Density for co-located radios	Limit: General Population / Uncontrolled Exposure	Result
[dBm]	[mW/cm <sup>2</sup> ]		[dBm]	[mW/cm <sup>2</sup> ]		[dBm]	[mW/cm <sup>2</sup> ]		[mW/cm <sup>2</sup> ]	[mW/cm <sup>2</sup> ]	
35.5	0.036	1	39	0.080	2	49	0.798	1	0.993	1	Complies



**BelAir100 (Includes BelAir100T, BelAir100C, BelAir100D, BelAir100M, BelAir100S)**

Case 4A: Standard Gain BelAir100T: 1 X RAR20051001 [ERM5] 5.725 - 5.850 GHz with 10.5 dBi or less antennas and 1 X RAR20000003 [ARM3] 8 dBi and 1 X RAR20008001 [PSM2] 9 dBi or less

Co-location Compliance for Integrated ARM3 IEEE 802.11b/g & ERM5 IEEE 802.11a/n & PSM2 IEEE 802.11a Public Service Radios --> STANDARD GAIN ANTENNAS											
Safety Distance: 24 cm ( 9.4 inches )											
Worst-case Total EIRP	Max Power Density	Maximum Number of Radios	Worst-case Total EIRP	Max Power Density	Maximum Number of Radios	Worst-case Total EIRP	Max Power Density	Maximum Number of Radios	Total Density for co-located radios	Limit: General Population / Uncontrolled Exposure	Result
[dBm]	[mW/cm <sup>2</sup> ]		[dBm]	[mW/cm <sup>2</sup> ]		[dBm]	[mW/cm <sup>2</sup> ]		[mW/cm <sup>2</sup> ]	[mW/cm <sup>2</sup> ]	
35.5	0.490	1	30.5	0.155	1	33	0.276	1	0.921	1	Complies

Case 4B: High Gain BelAir100T: 1 X RAR20051001 [ERM5] 5.725 - 5.850 GHz with 29 dBi or less antennas and 1 X RAR20000003 [ARM3] 8 dBi and 1 X RAR20008001 [PSM2] 25 dBi or less

Co-location Compliance for Integrated ARM3 IEEE 802.11b/g & ERM5 IEEE 802.11a/n & PSM2 IEEE 802.11a Public Service Radios -- HIGH GAIN ANTENNAS											
Safety Distance: 114 cm ( 44.9 inches )											
Worst-case Total EIRP	Max Power Density	Maximum Number of Radios	Worst-case Total EIRP	Max Power Density	Maximum Number of Radios	Worst-case Total EIRP	Max Power Density	Maximum Number of Radios	Total Density for co-located radios	Limit: General Population / Uncontrolled Exposure	Result
[dBm]	[mW/cm <sup>2</sup> ]		[dBm]	[mW/cm <sup>2</sup> ]		[dBm]	[mW/cm <sup>2</sup> ]		[mW/cm <sup>2</sup> ]	[mW/cm <sup>2</sup> ]	
35.5	0.022	1	49	0.486	1	49	0.486	1	0.994	1	Complies

Case 5A: Standard Gain BelAir100T with Dual ERM5 2X RAR20051001 [ERM5] 5.725 - 5.850 GHz with 15 dBi or less antennas and 1 X RAR20008001 [PSM2] [9 dBi]

Co-location Compliance for Integrated 802.11b/g & 802.11a Radios & 802.11a Public Service Radios											
Safety Distance: 27 cm ( 10.6 inches )											
Worst-case Total EIRP	Max Power Density	Maximum Number of Radios	Worst-case Total EIRP	Max Power Density	Maximum Number of Radios	Worst-case Total EIRP	Max Power Density	Maximum Number of Radios	Total Density for co-located radios	Limit: General Population / Uncontrolled Exposure	Result
[dBm]	[mW/cm <sup>2</sup> ]		[dBm]	[mW/cm <sup>2</sup> ]		[dBm]	[mW/cm <sup>2</sup> ]		[mW/cm <sup>2</sup> ]	[mW/cm <sup>2</sup> ]	
35	0.345	2	34	0.274	1				0.965	1	Complies

Case 5B: High Gain BelAir100T with Dual ERM5 2X RAR20051001 [ERM5] 5.725 - 5.850 GHz with 29 dBi or less antennas and 1 X RAR20008001 [PSM2] [25 dBi]

Co-location Compliance for Integrated 802.11b/g & 802.11a Radios & 802.11a Public Service Radios											
Safety Distance: 138 cm ( 54.3 inches )											
Worst-case Total EIRP	Max Power Density	Maximum Number of Radios	Worst-case Total EIRP	Max Power Density	Maximum Number of Radios	Worst-case Total EIRP	Max Power Density	Maximum Number of Radios	Total Density for co-located radios	Limit: General Population / Uncontrolled Exposure	Result
[dBm]	[mW/cm <sup>2</sup> ]		[dBm]	[mW/cm <sup>2</sup> ]		[dBm]	[mW/cm <sup>2</sup> ]		[mW/cm <sup>2</sup> ]	[mW/cm <sup>2</sup> ]	
49	0.332	2	49	0.332	1				0.996	1	Complies

Case 6: BelAir100S [Pedestal Solution] with 1 X RAR20000003 [ARM3] with 6 dBi Antenna and 1 X RAR20051001 [ERM5] 5.725 - 5.850 GHz with 15 dBi or less antennas

Co-location Compliance for Integrated ARM3 IEEE 802.11b/g & ERM5 IEEE 802.11a/n Radios											
Safety Distance: 20.3 cm ( 8.0 inches )											
Worst-case Total EIRP	Max Power Density	Maximum Number of Radios	Worst-case Total EIRP	Max Power Density	Maximum Number of Radios	Worst-case Total EIRP	Max Power Density	Maximum Number of Radios	Total Density for co-located radios	Limit: General Population / Uncontrolled Exposure	Result
[dBm]	[mW/cm <sup>2</sup> ]		[dBm]	[mW/cm <sup>2</sup> ]		[dBm]	[mW/cm <sup>2</sup> ]		[mW/cm <sup>2</sup> ]	[mW/cm <sup>2</sup> ]	
33	0.385	1	35	0.611	1				0.996	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.



The following worst case summary table will be incorporated in BelAir Networks installation procedures.

Minimum Safety Distances								
Product	Standard Gain Antennas (up to 15 dBi)				High Gain Antennas (up to 29 dBi)			
RF boards: All valid combinations	ERM1	ERM5	ARM3	PSM2	ERM1	ERM5	ARM3	PSM2
BelAir100, BelAir100C, BelAir100T, BelAir100S, BelAir100M, BelAir100D	up to 15 dBi	up to 15 dBi	Any	9 dBi	up to 23 dBi	up to 29 dBi	Any	25 dBi
Distance	( 10.6 inches )				( 54.3 inches )			
BelAir200, BelAir200D	up to 15 dBi	up to 15 dBi	Any	9 dBi	up to 23 dBi	up to 29 dBi	Any	25 dBi
Distance	( 13.0 inches )				( 63.0 inches )			
RAR20000003 (ARM3); RAR20008001 (PSM2); RAR20021001 (ERM1); RAR20051001 (ERM5)								