



Engineering Analysis MPE for TRM1, 5.9 GHz Transceiver

FCC ID: RAR20021002

BelAir Networks

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

- Module RAR20021002 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 RAR20021002 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 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 RAR200021002 can be used with. The worst-case RAR200021002 eirp of 33 dBm is used (for 10, 15, or 19 dBi approved antennas).

BelAir200

Case Ia: 1 X RAR20021002 (TRM) 5.850-5.925 GHz and 1 X RAR20000003 (ARM3) and 2 X RAR20006001 (WRM1) or 2 X RAR20007001 (WRM2) (15 dBi)

Co-location Compliance for Integrated 802.11b/g & 802.11a Radios & 802.16 WCS band Radios											
Safety Distance:		33 cm		(13.0 inches)							
									Total Density for co-located radios	Limit: General Population / Uncontrolled Exposure	Result
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	[mW/cm^2]	[mW/cm^2]	
RAR20000003 (ARM3)			RAR20021002 (TRM)			RAR20006001 (WRM1)					
35.5	0.259	1	33	0.146	1	36	0.291	2	0.987	1	Complies

Case Ib: 1 X RAR20021002 (TRM) 5.850-5.925 GHz and 1 X RAR20000003 (ARM3) and 2 X RAR20006001 (WRM1) or 2 X RAR20007001 (WRM2) (25dBi)

Co-location Compliance for Integrated 802.11b/g & 802.11a Radios & 802.16 WCS band Radios												
Safety Distance:		83 cm		(32.7 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
RAR20000003 (ARM3)			RAR20021002 (TRM)			RAR20006001 (WRM1)						
35.5			0.041			1			0.984		1	Complies

**BelAir100**

Case IIa: 1X RAR20021002 (TRM) 5.850-5.925 GHz and 1 X RAR20000003 (ARM3) and 1 X RAR20008001 (PSM2) (10 dBi)

Co-location Compliance for Integrated 802.11b/g & 802.11a Radios & 802.11a Public Service 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	
RAR20000003 (ARM3)			0.418			1			33			0.235			1			RAR20008001 (PSM2)		0.948			1
35.5									34			0.296			1			0.948		1		Complies	

Case IIb: 1X RAR20021002 (TRM) 5.850-5.925 GHz and 1 X RAR20000003 (ARM3) 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:		83 cm		(32.7 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	Density for co- located radios [mW/cm^2]	Limit: General Population / Uncontrolled Exposure [mW/cm^2]	Result
RAR20000003 (ARM3)			RAR20021002 (TRM)			RAR20008001 (PSM2)					
35.5	0.041	1	33	0.023	1	49	0.918	1	0.982	1	Complies

Case IIIa: 1X RAR20021002 (TRM) 5.850 - 5.925 GHz and 1 X RAR20008001 (PSM2) and 1 X RAR20006001 (WRM1) or 1 X RAR20007001 (WRM2) (15 dBi)

Co-location Compliance for Integrated 802.11b/g & 802.11a Radios & 802.16 WCS band Radios

Safety Distance:		26 cm		(10.2 inches)									
									Total Density for co-located radios		Limit: General Population / Uncontrolled Exposure		Result
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	[mW/cm^2]	[mW/cm^2]			
RAR20008001 (PSM2)			RAR20021002 (TRM)			RAR20006001 (WRM1)							
34	0.296	1	33	0.235	1	36	0.469	1	0.999	1	Complies		

Case IIIb: 1X RAR20021002 (TRM) 5.850-5.925 GHz and 1 X RAR20008001 (PSM2) and 1 X RAR20006001 (WRM1) or 1 X RAR20007001 (WRM2) (25 dBi)

Co-location Compliance for Integrated 802.11b/g & 802.11a Radios & 802.16 WCS band Radios

Safety Distance:		60 cm		(23.6 inches)							
									Total Density for co-located radios	Limit: General Population / Uncontrolled Exposure	Result
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	[mW/cm^2]	[mW/cm^2]	
RAR20008001 (PSM2)			RAR20021002 (TRM)			RAR20006001 (WRM1)					
34	0.056	1	33	0.044	1	46	0.880	1	0.980	1	Complies



Case IVa: 1X RAR20021002 (TRM) 5.850-5.925 GHz and 1 X RAR20000003 (ARM3) and 1 X RAR20006001 (WRM1) or 1 X RAR20007001 (WRM2)(15 dBi)

Co-location Compliance for Integrated 802.11b/g & 802.11a Radios & 802.16 WCS band Radios											
Safety Distance:		28 cm		(11.0 inches)							
									Total Density for co-located radios	Limit: General Population / Uncontrolled Exposure	Result
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	[mW/cm^2]	[mW/cm^2]	
RAR20000003 (ARM3)			RAR20021002 (TRM)			RAR20006001 (WRM1)					
35.5	0.360	1	33	0.203	1	36	0.404	1	0.967	1	
Complies											

Case IVb: 1X RAR20021002 (TRM) 5.850-5.925 GHz and 1 X RAR20000003 (ARM3) and 1 X RAR20006001 (WRM1) or 1 X RAR20007001 (WRM2)(25dBi)

Co-location Compliance for Integrated 802.11b/g & 802.11a Radios & 802.16 WCS band Radios											
Safety Distance:		62 cm		(24.4 inches)							
									Total Density for co- located radios	Limit: General Population / Uncontrolled Exposure	Result
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	[mW/cm^2]	[mW/cm^2]	
RAR20000003 (ARM3)			RAR20021002 (TRM)			RAR20006001 (WRM1)					
35.5	0.073	1	33	0.041	1	46	0.824	1	0.939	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 Antennas (up to 19 dBi)				High Gain Antennas (up to 30 dBi)			
RF boards: All valid combinations	TRM1	ARM3C	PSM1 PSM2	WRM1 WRM2	TRM1	ARM3C	PSM1 PSM2	WRM1 WRM2
BelAir100, BelAir100C, BelAir100T, BelAir100S, BelAir100M, BelAir100D, BelAir 200, BelAir200D	Any*	Any	10 dBi	15 dBi	Any*	Any	25 dBi	25 dBi
Distance	33 cm (13 in)				83 cm (33 in)			

* TRM1 with 10, 15, or 19 dBi antennas