Bay Area Compliance Labs Corp.
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MPE ENGINEERING ANALYSIS

This analysis was performed as part of FCC certification requirements for Coulomb Technologies Inc modules, according to the requirements of FCC Part 1.1310, and OET Bulletin 65 "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields"

Zigbee Module (FCC ID: W38-17-001002-01) and GSM/GPRS Module (FCC ID: W38-17-001004-01) will be built into a Coulomb Host, two Hosts will be mounted back to back that allow Zigbee and GSM/GPRS modules transmit simultaneously.

According to §1.1310 and §2.1091 (Mobile Devices) RF exposure is calculated.

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

Note: f = frequency in MHz, * = Plane-wave equivalent power density

The MPE calculations were performed based on FCC OET-65 with the following formula:

$$S = PG/4\pi R^2$$

Where: S = power density
P = power input to antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

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Radio/FCC ID	Freq. (MHz)	MPE Limit (mW/cm^2)	Output Power (mW)	Duty Cycle	Antenna Gain (dBi)	Antenna Gain (Number)	Power Density at 20 cm	% of MPE at 20 cm	MPE Distance in cm
Zigbee FCC ID: W38-17-001002-01	2405	1.0	72	100%	1.09	1.29	0.02	1.8%	2.71
GSM/GPRS Modem FCC ID: W38-17-001004-01	824	0.549	1514	24%	3.0	2.0	0.14	26.3%	10.25
	1850	1.0	978	24%	1.4	1.38	0.06	6.4%	5.08
Zigbee Radio Co-located with GSM/GPRS Radio									
Zigbee with GSM/GPRS Modem	2405 824							28.1%	10.6
	2405 1850							8.2%	5.76

The MPE calculations in the spreadsheet above demonstrates that the combination of the Zigbee module (FCC ID: W38-17-001002-01) with the GSM/GPRS modem (FCC ID: W38-17-001004-01) defined meets the MPE requirement stated in FCC Part 1.1310 at the 20 cm distance required for mobile exposure conditions.

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Zigbee Module (FCC ID: W38-17-001002-01) and CDMA Module (FCC ID: W38-17-001008-01) will be built into a Coulomb Host, two Hosts will be mounted back to back that allow Zigbee and CDMA modules transmit simultaneously.

According to §1.1310 and §2.1091 (Mobile Devices) RF exposure is calculated.

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

Note: f = frequency in MHz, * = Plane-wave equivalent power density

The MPE calculations were performed based on FCC OET-65 with the following formula:

$$S = PG/4\pi R^2$$

Where: S = power density
P = power input to antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

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Radio/FCC ID	Freq. (MHz)	MPE Limit (mW/cm^2)	Output Power (mW)	Duty Cycle	Antenna Gain (dBi)	Antenna Gain (Number)	Power Density at 20 cm	% of MPE at 20 cm	MPE Distance in cm
Zigbee FCC ID: W38-17-001002-01	2405	1.0	72	100%	1.09	1.29	0.02	1.8%	2.71
CDMA Modem FCC ID: W38-17-001008-01	824	0.549	897	100%	0	1.0	0.18	32.5%	4.61
	1850	1.0	432	100%	0	1.0	0.09	8.6%	2.54
Zigbee Radio Co-located with CDMA Radio									
Zigbee with CDMA Modem	2405 824							34.3%	11.72
	2405 1850							10.4%	6.46

The MPE calculations in the spreadsheet above demonstrates that the combination of the Zigbee module (FCC ID: W38-17-001002-01) with the CDMA modem (FCC ID: W38-17-001008-01) defined meets the MPE requirement stated in FCC Part 1.1310 at the 20 cm distance required for mobile exposure conditions.