Appendix A: FCC Part 1.1307, 1.1310, 2.1091, 2.1093; IC RSS-102: RF Exposure

MPE Calculations Including Co-location Considerations

The maximum permissible RF exposure for an uncontrolled environment is specified in FCC 1.1310 table 1B and RSS-102 Issue 5 Table 4.

RF Exposure Limits

Technology	Transmit Frequencies (MHz)	Uncontrolled Exposure		Controlled Exposure	
		FCC Limit (mW/cm^2)	ISED Limit (mW/cm^2)	FCC Limit (mW/cm^2)	ISED Limit (mW/cm^2)
LMR	33 – 48	0.2	0.2	1.0	1.0
LMR	48 – 50	0.2	0.13	1.0	0.65
LMR	136 – 174	0.2	0.13	1.0	0.75
LMR	378 – 522	0.25	0.15	1.3	1.3
LMR	763 – 806	0.51	0.24	2.5	1.8
Bluetooth	2402 – 2480	1.0	0.54	5.0	3.2
2.4 GHz Wi-Fi	2412 – 2462	1.0	0.54	5.0	3.2
5 GHz Wi-Fi	5150 – 5825	1.0	0.90	5.0	4.6

** The lowest frequency of the above frequency ranges produces the most conservative limit (when limit is based on frequency) and was used to calculate the limits above, where applicable.*

Maximum Powers - non-Yagi/non-log periodic antennas

Technology	Transmit Frequencies (MHz)	Duty Cycle (%)	Max Conducted Power (W)	Max Antenna Gain (dBi)	Max EIRP (W)
LMR	33 – 48	50	60	2.15	98.5
LMR	48 – 50	50	60	2.15	98.5
LMR	136 – 174	50	30	5.15	49.2
LMR	378 – 522	50	30	5.15	49.2
LMR	763 – 806	50	18	8.15	117.6
Bluetooth	2402 – 2480	100	0.013	-9	0.002
2.4 GHz Wi-Fi	2412 – 2462	100	0.005	-9	0.001
5 GHz Wi-Fi	5150 – 5825	100	0.003	-9	0.001

** LMR power is based on rated power X 1.20 (per Part 90.205(s)) X 50% duty cycle (for licensed PTT radios)*

Calculated Minimum Safe Distance from LMR Antenna (based on maximum gain of non-Yagi/non-log periodic antennas)

Technology	Transmit Frequencies (MHz)	Uncontrolled Exposure		Controlled Exposure	
		United States (cm)	Canada (cm)	United States (cm)	Canada (cm)
LMR	33 – 48	198	198	89	89
LMR	48 – 50	198	246	89	110
LMR	136 – 174	198	246	89	103
LMR	378 – 522	177	229	78	78
LMR	763 – 806	136	198	62	73

Maximum Powers - Yagi/log periodic antennas

Technology	Transmit Frequencies (MHz)	Duty Cycle (%)	Max Conducted Power (W)	Max Antenna Gain (dBi)	Max EIRP (W)
LMR	136 – 174	50	30	8.15	195.9
LMR	378 – 522	50	30	12.15	492.2
LMR	763 – 806	50	18	12.15	295.3

** LMR power is based on rated power X 1.20 (per Part 90.205(s)) X 50% duty cycle (for licensed PTT radios)*

Calculated Minimum Safe Distance from LMR Antenna (based on maximum gain of Yagi/log periodic antennas) – Mobile Command Center applications

Technology	Transmit Frequencies (MHz)	Uncontrolled Exposure		Controlled Exposure	
		United States (cm)	Canada (cm)	United States (cm)	Canada (cm)
LMR	136 – 174	280	347	125	145
LMR	378 – 522	396	511	174	174
LMR	763 – 806	215	313	97	115

Co-location Considerations

The configuration of this radio consists of a control head and the main body of the radio (VCH). The control head contains the Bluetooth and Wi-Fi transceivers and antenna, and the VCH contains the LMR transceiver circuitry which uses an antenna that is some distance away from both the control head and VCH (such as on the roof or trunk of a vehicle).

Based on the distance between the control head and LMR antenna, one could say that these transceivers are not “co-located”. However, even if these transceivers were considered to be co-located, based upon inspection one can clearly see that the power density contributions of the Bluetooth and Wi-Fi transmitters are negligible compared to the power density of the LMR transmitter.

Both the Bluetooth and Wi-Fi transmitters (considered “stand-alone”) would be exempt from both FCC and ISED RF exposure evaluation. Note that the physical construction of the control head forces a minimum separation distance of at least 15 mm; this distance is used below.

FCC Exemption Calculation

According to KDB 447498 D01 General RF Exposure Guidance v05 4.3.1. Standalone SAR test exclusion considerations, unless specifically required by the published RF exposure KDB procedures, standalone 1-g head or body and 10-g extremity SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when the corresponding SAR Exclusion Threshold condition, listed below, is satisfied.

Limits

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before the calculation
- The result is rounded to one decimal place for comparison

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion

EUT RF Exposure

The max conducted peak output power is 13 mW for the Bluetooth transmitter operating at 2402 MHz.

General RF Exposure = (13 mW / 15 mm) x √2.402GHz = 1.3

Therefore, SAR test is not required since the result is below the ≤ 3.0 1-g SAR limit.

ISED Exemption Statement

The Bluetooth and Wi-Fi output powers (conducted power in this case as it represents worst-case) are below the exemption limits in RSS-102 Issue 5 Table 1 at a separation distance of >= 15 mm.

This report replaces R0.1.