Maximum Permissible Exposure (MPE)

OVERVIEW

Human exposure to RF emissions from mobile devices (47 CFR §2.1091) may be evaluated based on the MPE limits adopted by the FCC for electric and magnetic field strength and/or power density, as appropriate, since exposures are assumed to occur at distances of 20 cm or more from persons. ANSI C95.1-1992 specifies a minimum separation distance of 20 cm for performing reliable field measurements to determine adherence to MPE limits. If the minimum separation distance between a transmitter and nearby persons is more than 20 cm under normal operating conditions, compliance with MPE limits may be determined at such distance from the transmitter. When applicable, operation instructions and prominent warning labels may be used to alert the exposed persons to maintain a specified distance from the transmitter or to limit their exposure durations and usage conditions to ensure compliance. If the use of warning labels on a transmitter is not effective or desirable, the alternative of performing SAR evaluation with the device at its closest range to persons under normal operating conditions may be used. The field strength and power density limits adopted by the FCC are based on whole-body averaged exposure and the assumption of RF field levels relate most accurately to estimating whole-body averaged SAR. This means some local values of exposures exceeding the stated field strength and power density limits may not necessarily imply non-compliance if the spatial average of spatially averaged RF fields over the exposed portions of a person's body does not exceed the limits.

COMPLIANCE WITH 2.1091

"Mobile devices that operate in the Cellular Radiotelephone Service, the Personal Communications Services, the Satellite Communications Services, the General Wireless Communications Service, the Wireless Communications Service, the Maritime Services and the Specialized Mobile Radio Service authorized under subpart H of part 22 of this chapter, parts 24, 25, 26 and 27 of this chapter, part 80 of this chapter (ship earth stations devices only) and part 90 of this chapter are subject to routine environmental evaluation for RF exposure prior to equipment authorization or use if they operate at frequencies of 1.5 GHz or below and their effective radiated power (ERP) is 1.5 watts or more, or if they operate at frequencies above 1.5 GHz and their ERP is 3 watts or more. Unlicensed personal communications service devices, unlicensed millimeter wave devices and unlicensed NII devices authorized under §§15.253, 15.255, and 15.257, and subparts D and E of part 15 of this chapter are also subject to routine environmental evaluation for RF exposure prior to equipment authorization or use if their ERP is 3 watts or more or if they meet the definition of a portable device as specified in §2.1093(b) requiring evaluation under the provisions of that section.

All other mobile and unlicensed transmitting devices are categorically excluded from routine environmental evaluation for RF exposure prior to equipment authorization or use, except as specified in §§1.1307(c) and 1.1307(d) of this chapter. Applications for equipment authorization of mobile and unlicensed transmitting devices subject to routine environmental evaluation must contain a statement confirming compliance with the limits specified in paragraph (d) of this section as part of their application."

The EUT will only be used with a separation distance of 20 centimeters or greater between the antenna and the body of the user or nearby persons and can therefore be considered a mobile transmitter per 47 CFR 2.1091(b). Per 47 CFR 1.1310, the EUT meets the General Population / Uncontrolled exposure limits listed in Table 1.

COMPLIANCE WITH FCC KDB 447498 D01 Mobile Portable RF Exposure V04

The cellular, WiFi / Bluetooth, and Cirronet radio transceivers are mobile transmitters and are greater than 5 cm from each other and all other simultaneous transmitting antennas.

"KDB 447498 D01 Mobile Portable RF Exposure v04" provides the procedures, requirements, and authorization policies for mobile and portable devices. Item #8 best fits the exosure condition described in this report. Since these mobile devices are categorically excluded from routine evaluation; per footnotes 1 and 32 of KDB 447498, simple calculations may be used to estimate the power density to demonstrate compliance with 47 CFR 1.1310 requirements. The attached estimate shows MPE limits are met for simultaneous transmission at a 20 cm boundary.

FCC LIMITS FOR MPE

Limits for General Population /Uncontrolled Expsoure: 47 CFR 1.1310

Frequency Range (MHz)	Strength (V/m)	Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
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 - 100000			1	30

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

METHOD OF EVALUATION

The exposure level at a 20 cm distance from the EUT's transmitting antenna is calculated using the general equation:

$$S = \frac{P * G}{4 * \pi * R^2}$$

NORTHWEST EMC

Maximum Permissible Exposure (MPE)

XMit 2008.12.29

EUT:	Cellular radio (FCC ID: S9ERGTSC3WN), co-located with: WiFi / Bluetooth radio (FCC ID: S9ERGTSC3BW), Cirronet radio (FCC ID: S9E-RNGR2410)	Work Order:	TRPO0055
Serial Number:	None	Date:	08/31/10
Customer:	Tripod	Temperature:	n/a
Attendees:	None	Humidity:	n/a
Project:	None	Barometric Pres.:	n/a
Evaluated by:	Greg Kiemel	Job Site:	EV06
Power:	n/a		

SPECIFICATIONS	Method
FCC 2.1091:2010	OET Bulletin 65, Supplement C Ed 01-01

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

No Deviations

Signature

MPE Estimates for Individual Devices

Radio	Antenna Type	Antenna Manufacturer	Antenna Part No.	Transmit Frequency (MHz)	Max Peak Output Power (mW)	Duty Cycle	Duty Cycle Corrected Output Power (mW)	Antenna Gain (dBi)	Minimum Antenna Cable Loss (dB)	Power Density @ 20 cm (mW/cm^2)	General Population Exposure Limit from 1.1310 (mW/cm^2)	Ratio of Power Density to the Exposure Limit
Cellular Modem[1]	Isolated Magnetic Dipole	Ethertronics	P522303	824.2	1298.88	Max	1298.88	1.4	0	0.258	0.55	0.47028
				1850.2	885	Max	885	2.6	0	0.176	1	0.17607
WiFi / Bluetooth	Ceramic Chip	Antenna Factor	ANT-2.45-CHP-x	2400	46.7	Max	46.7	0.5	0	0.010	1	0.01042
Cironet	Omini	LM Electronics	PW5S-2400-02-04	2400	47.9	Max	47.9	2	0	0.015	1	0.01510

Note 1: Cellular power listed above is EIRP for both Parts 22 and 24. Antenna gain is for reference only since power is radiated.

Worst Case Co-located Exposure Conditions

All four radios transmitting at the exact same instant

Per Note 24 shown below, the Sum of Worst Case Power Ratios cannot exceed 1.0

Cell Modem Worst Case Ratio of Power Density to the Exposure Limit	**WiFi/ Bluetooth** Worst Case Ratio of Power Density to the Exposure Limit	**Cirronet** Worst Case Ratio of Power Density to the Exposure Limit		**Sum of Worst Case Ratios (Power Density to the Exposure Limit)**	**FCC Limit for Sum of Worst Case Ratios**	
0.47028	0.01042	0.01510		0.49581	1.0	**PASS**

The results shown in the above table are equivalent to the Sum of the EIRP of the Four Co-located Transmitters (EIRP TX1 + EIRP TX2) compared to the exposure limit. The benefit of this method, is that accounts for transmitters operating at different frequencies against different exposure limits.

Excerpts from TCB Training, April 3, 2002, "Mobile Transmitters", Slide 6:

"Devices operating in multiple frequency bands

□ *When RF exposure evaluation is required for TCB approval*
o Separate antennas – estimated minimum separation distances may be considered for the frequency bands that do not require evaluation or TCB approval, however, the estimated distance should take into account the effect of co-located transmitters. (Note 24)

Note 24 According to multiple frequency exposure criteria, the ratio of field strength or power density to the applicable exposure limit at the exposure location should be determined for each transmitter and the sum of these ratios must not exceed 1.0 for the location to be compliant."

The sum of the ratios (power density to the exposure limit) does not exceed 1.0; therefore, the exposure condition is compliant with FCC rules.