



RF Exposure Evaluation for MC7700 Wireless Modem as a Mobile Device

In this application we seek modular approval to the MC7700 wireless modem for use in mobile configuration. Based on the FCC OET Bulletin 65 Supplement C and 47 CFR §2.1091, we have concluded that the MC7700 will comply with the FCC rules on RF exposure for mobile devices if the antenna gain does not exceed 7.5 dBi in cellular band, 3 dBi in PCS band, 5.5 dBi in LTE Band 4 and 9 dBi in LTE Band 17. The following analysis will demonstrate such compliance. The analysis will be done in US bands only.

Operation in cellular band (824 – 849 MHz)

The maximum conducted output power of MC7700 in Cellular band is 32.5 dBm. Take the worst case as an example, in which an antenna with 7.5 dBi gain is used. The resulted power density at a distance of 20 cm can be deducted as follows:

$$\begin{aligned} \text{EIRP} &= P_{\text{cond}} + 7.5 \\ \text{Power Density} &= \text{EIRP} * \text{DutyCycle} / (4\pi R^2) \end{aligned}$$

The table below shows the different MPE levels in different time slot configurations:

	Max Pcond (dBm)	Max EIRP (dBm)	Max EIRP (mW)	MPE (mW/cm ²)
1 Time Slot	32.5	40	10000.00	0.249
2 Time Slots	32.5	40	10000.00	0.497
3 Time Slots	28.5	36	3981.07	0.297
4 Time Slots	28.5	36	3981.07	0.396

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and can be calculated as follows:

$$\text{MPE limit} = 824/1500 = 0.55 \text{ mW/cm}^2$$

As we can see the resulted power density is below the MPE limit, therefore MC7700 in Cellular band is compliant with the FCC rules on RF exposure.

Operation in PCS band (1850 – 1910 MHz)

The maximum conducted output power of MC7700 in PCS band is 29.7 dBm. Take the worst case as an example, in which an antenna with 3 dBi gain is used. The resulted ERP can be expressed as follows:

$$\text{ERP} = 29.7 + 3 - 2.15 = 30.55 \text{ dBm (1.14 W)} < 3 \text{ W}$$

The FCC OET Bulletin 65 Supplement C states that mobile devices identified in 47 CFR §2.1091 that operate at frequencies above 1.5 GHz with an ERP of 3.0 watts or more are required to perform routine environmental evaluation for RF exposure prior to equipment authorization or use; otherwise, they are categorically excluded.

As we can see this resulted ERP is below 3 W, therefore routine environmental evaluation for RF exposure prior to equipment authorization or use for MC7700 in PCS band is categorically excluded.

Operation in LTE Band 4 (1710 – 1755 MHz)

The maximum conducted output power of MC7700 in PCS band is 24.5 dBm. Take the worst case as an example, in which an antenna with 5.5 dBi gain is used. The resulted ERP can be expressed as follows:

$$\text{ERP} = 24.5 + 5.5 - 2.15 = 27.85 \text{ dBm} (0.61 \text{ W}) < 3 \text{ W}$$

The FCC OET Bulletin 65 Supplement C states that mobile devices identified in 47 CFR §2.1091 that operate at frequencies above 1.5 GHz with an ERP of 3.0 watts or more are required to perform routine environmental evaluation for RF exposure prior to equipment authorization or use; otherwise, they are categorically excluded.

As we can see this resulted ERP is below 3 W, therefore routine environmental evaluation for RF exposure prior to equipment authorization or use for MC7700 in PCS band is categorically excluded.

Operation in LTE Band 17 (704 – 716 MHz)

The maximum conducted output power of MC7700 in Cellular band is 24.2 dBm. Take the worst case as an example, in which an antenna with 9 dBi gain is used. The resulted power density at a distance of 20 cm can be deducted as follows:

$$\begin{aligned} \text{EIRP} &= P_{\text{cond}} + 9 \\ \text{Power Density} &= \text{EIRP} / (4\pi R^2) = 0.42 \text{ mW/cm}^2 \end{aligned}$$

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and can be calculated as follows:

$$\text{MPE limit} = 704/1500 = 0.469 \text{ mW/cm}^2$$

As we can see the resulted power density is below the MPE limit, therefore MC7700 in Cellular band is compliant with the FCC rules on RF exposure.