Porsche eBike Performance

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With regard to the BLE module BC840M (with FCC ID X8WBC840M) and its antenna position with a minimum distance of 20 cm from people and other transmitters, the following are our explanations of the installation situation.

To meet the requirements for the position of the BLE module BC840M (with FCC ID X8WBC840M), which is located inside the display LED HUB, it was deliberately positioned at the very beginning of the frame triangle, next to the head tube, in order to have the greatest possible distance from all body extremities.

Calculations of RF safety distance acc. to worst case at uncontrolled exposure:

Maximum Permissible Exposure (MPE) calculation

https://fcc.report/FCC-ID/X8WBC840M/4193123.pdf

Maximum Permissible Exposure (MPE) Evaluation

PCB Antenna

Maximum output power at antenna input terminal:	15.38	(dBm)
Maximum output power at antenna input terminal:	34.51437393	(mW)
Tune-Up power Tolerance:	1	dB
Duty cycle:	100	(%)
Maximum Pav :	43.45102242	(mW)
Antenna gain (typical):	-3.58	(dBi)
Maximum antenna gain:	0.438530698	(numeric)
Prediction distance:	20	(cm)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm^2)
Power density at predication frequency at 20 (cm)	0.0037927	(mW/cm^2)

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

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

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

Measurement Result:

The predicted power density level at 20 cm is 0.0037927 mW/cm². This is below the uncontrolled exposure limit of 1 mW/cm².

Maximum output power at antenna input terminal

$P_{in,max,dBm} := 16,38$

$P := (10)^{\frac{P_{in,max,dBm}}{10}} \cdot 1 \, mM = 43,451 \, mW$

$G := -3,58 \, dB$

$G_{lin} := (10)^{0,1 \cdot \frac{G}{dB}}$ dB does not work in smath, so we have to convert it

$r := 2 \, cm$

$$S := P \cdot \frac{G_{lin}}{4 \cdot \pi \cdot r^2} = 0,3791 \; \frac{mW}{cm^2}$$

Exposure limit: 1mW/cm²

$$S_{lim} := 1 \; \frac{mW}{cm^2}$$

$$r_{lim} := \sqrt{P \cdot \frac{G_{lin}}{4 \cdot \pi \cdot S_{lim}}} = 1,2314 \; cm$$

The FCC report for our BC840M calculated the power density at a distance of 20 cm and said that this power density is below the required limit. The MPE limit for uncontrolled exposure is here 1 mW/cm².

If we change the formula, we can calculate the minimum distance needed to meet the limit. And this distance is **1.24 cm**.

The following pictures show various distances to the positioned display LED HUB L (AN 30A 102 200 A) with integrated BLE module BC840M.

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Position display LED HUB with BLE module BC840M.