BABT TCB
Balfour House,
Churchfield Road,
Walton-on-Thames,
Surrey, KT12 2TD

RF exposure analysis for the equipment TM1Q *(FCC ID: XOGGM12TLTK5)*

The device TM1Q (FCC ID: XOGGM12TLTK5) is designed as module to be installed in other devices. This device is to be used only for fixed and mobile applications. If the final product after integration is intended for portable use, a new application and FCC is required.

The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all the persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

The table below is excerpted from Table 1B of 47 CFR 1.1310 titled Limits for Maximum Permissible Exposure (MPE), Limits for General Population/Uncontrolled Exposure:

Frequency Range (MHz)	Power density (mW/cm^2)	Averaging time (minutes)
300 – 1500	f (MHz) /1500	30
1500 – 100.000	1.0	30

Based on the above table the limits are:

For 850 MHz frequency band device: 0.55 mW/cm^2
For 1900 MHz frequency band device: 1 mW/cm^2

Using the equation from page 19 of OET Bulletin 65, Edition 97-01:

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density (in appropriate units, e.g. mW/cm^2)
          P = power input to the antenna (in appropriate units, e.g., mW)
          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 (appropriate units, e.g., cm)

Compliance with MPE limits can be guaranteed as the calculation below shows:

850 MHz frequency band

Maximum output power considerations:

Mode	Maximum conducted output power (dBm)	Maximum conducted output power (mW)	Duty cycle	Equivalent conducted output power (Maximum conducted output power x duty cycle) (mW)
GPRS	30,61	1150.8	25%	287.7

P	Maximum power input to the antenna:	287,70	mW
R	Distance:	20	cm

| S | MPE limit for uncontrolled exposure: | 0,55 | mW/cm^2 |

| G_1 | Antenna gain (numerical) to comply with MPE limits: | 9,61 | |
| G_1 | Antenna gain (dBi) to comply with MPE limits: | 9,83 | dBi |

| | ERP limit to comply with categorically exclusion of §2.1091(c) | 1,50 | W |

| G_2 | Antenna gain (numerical) to comply with ERP limits: (ERP = Maximum conducted output power x Antenna gain / 1,64) | 8,55 | |
| G_2 | Antenna gain (dBi) to comply with ERP limits: | 9,32 | dBi |

| | ERP power limit according to §22,913 (a): | 7 | W |

| G_3 | Antenna gain (numerical) to comply with ERP limits: (ERP = Maximum conducted output power x Antenna gain / 1,64) | 9,98 | |
| G_3 | Antenna gain (dBi) to comply with ERP limits: | 9,99 | dBi |

| **$G_{850\ MHz\ band}$** | **Min (G_1, G_2, G_3)** | **9,32** | **dBi** |

Therefore the maximum antenna gain to comply with MPE and ERP limits should not exceed **9.32 dBi**.

1900 MHz frequency band

Maximum output power considerations:

Mode	Maximum conducted output power (dBm)	Maximum conducted output power (mW)	Duty cycle	Equivalent conducted output power (Maximum conducted output power x duty cycle) (mW)
GPRS	28,87	770.9	25%	192.73

P	Maximum power input to the antenna:	192,73	mW
R	Distance:	20	cm
S	MPE limit for uncontrolled exposure:	1,00	mW/cm^2

| G_4 | Antenna gain (numerical) to comply with MPE limits: | 26,08 | |
| G_4 | Antenna gain (dBi) to comply with MPE limits: | 14,16 | dBi |

| | EIRP limit to comply with categorically exclusion of §2.1091(c) | 4,92 | W |

| G_5 | Antenna gain (numerical) to comply with EIRP limits: (EIRP = Maximum conducted output power x Antenna gain) | 25,53 | |
| G_5 | Antenna gain (dBi) to comply with EIRP limits: | 14,07 | dBi |

| | EIRP power limit according to §24,232 (b): | 2 | W |

| G_6 | Antenna gain (numerical) to comply with EIRP limits: (EIRP = Maximum conducted output power x Antenna gain) | 10,38 | |

G_6 Antenna gain (dBi) to comply with EIRP limits: 10,16   dBi

$G_{1900\ MHz\ band}$ **Min (G_4, G_5, G_6)**   **10,16   dBi**

Therefore the maximum antenna gain to comply with MPE and EIRP limits should not exceed **10.16 dBi**.