

1.0 Maximum Permissible Exposure Evaluation and Co-Location Sum

The results of power measurement and intended use/proximity are compared against the requirements for safety of RF exposure. Includes co-location sum of exposure.

1.2 Criteria

| Section Reference | Date |
|-----------------------------|--------------------|
| 2.1091, FCC OET Bulletin 65 | September 12, 2013 |

1.3 Procedure

Using measurement of peak power and intended application, determine the permissible exposure level or whether additional exposure tests (SAR) are indicated. Justify conclusion for selected exposure area and separation distance.

1.4 Results

The RM01 Radio Module is a modular design intended to be part of a traffic network system. It collects traffic data from remote wireless sensors and shares the information with other nodes in a network. Antennas for this device are one of a selected set of antennas listed in the user manual.

A separation distance of 20 cm was selected for General Public Uncontrolled exposure and applied to limit calculation. The basis for the duty cycle factor is presented in the main test report. The user manual includes instructions forbidding co-location of other transmitters within 20 cm.

Antenna port power was determined from a direct conducted measurement.

| Measured Power Conducted Port | Power Restated in Log Terms | Maximum Antenna Gain | Duty Cycle Factor | ERP | ERP in Linear Terms |
|-------------------------------|-----------------------------|----------------------|-------------------|-----------|---------------------|
| 217.8 mW* | 23.38 dBm | +12 dBi | -5.464 dB | 29.92 dBm | 982 mW |

*This is the peak measurement.

Source-Based Factor for Exposure Calculation

| Transmit Dwell Time | Transmit Time Interval | Limit Imposed on Divisor | Applicable Calculation | Resulting Factor |
|---------------------|------------------------|--------------------------|------------------------------|------------------|
| 17.775 ms | 62.550 ms | Does Not Apply | $10\log_{10}(17.775/62.550)$ | -5.464 dB |

Limit of MPE for SAR Exclusion Threshold for 902 MHz, General Population/Uncontrolled:

$$f_{(\text{MHz})} / 1500 = 902 / 1500 = 0.6013 \text{ mW/cm}^2 \quad \text{Ref. FCC Bulletin OET-65 Table 1(B)}$$

Field density is determined at 20 cm as:

$$S = \text{EIRP} / (4 \pi 20^2) \quad \text{Ref. FCC Bulletin OET-65 Equation (4)}$$

$$S = 982 \text{ mW} / 5026.55 \text{ cm}^2$$

$$S = 0.1954 \text{ mW/cm}^2$$

The power is below the SAR Exclusion Threshold of 0.6013 mW/cm^2 , it therefore meets the criteria for exclusion from SAR testing.

1.5 Co-Location Scenario – Three Identical RM01 Modules

The RM01 Radio Module is specified for co-location of up to 3 modules and simultaneous transmission is possible. The total exposure from the 3 modules must not exceed the allowed limit when operated with the maximum gain antennas. The total exposure is determined by calculating the percent contributed by each module and arriving at a sum:

Limit for operating frequency (determined in 1.4 above): $0.6013 \text{ mW/ mW/cm}^2$

Contribution of one module: 0.1954 mW/cm^2

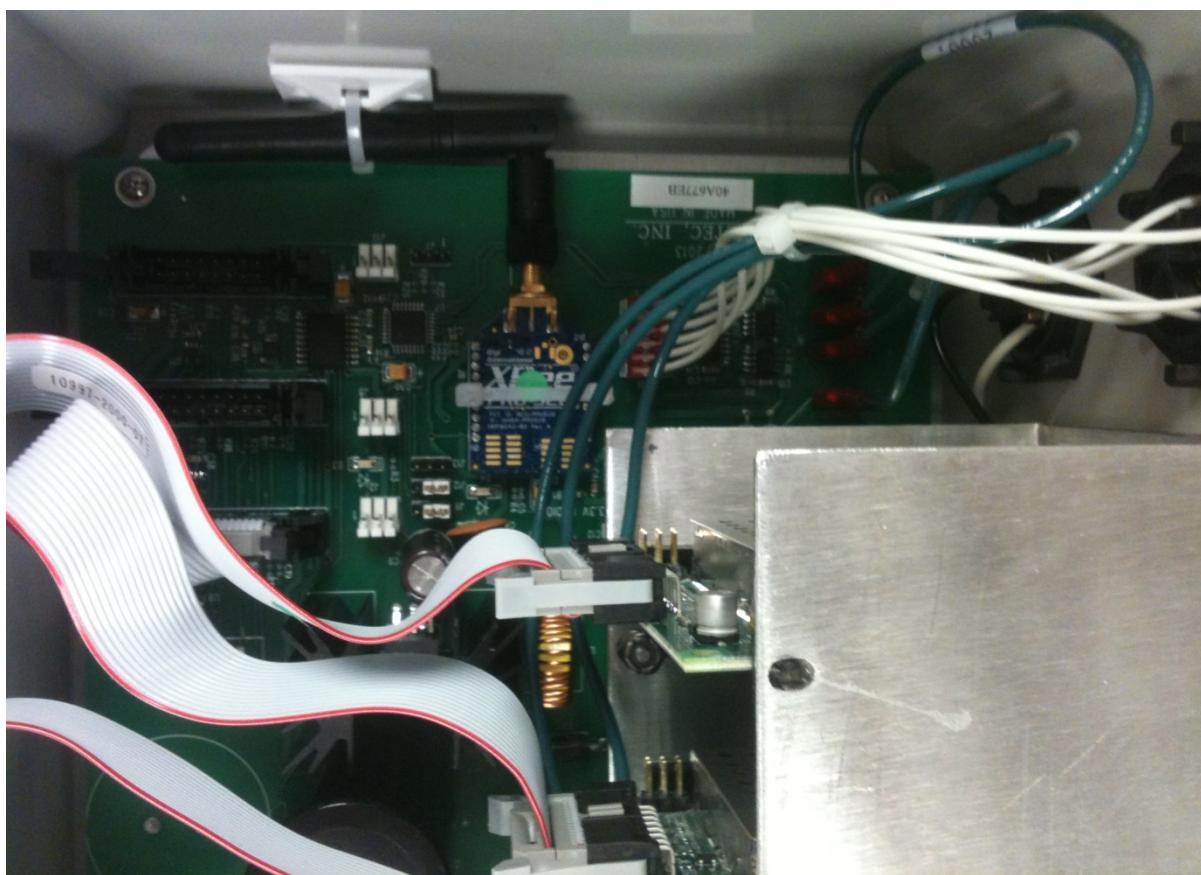
Contribution of one module in percent: $\text{Module / Limit} = 0.1954 \text{ mW/cm}^2 / 0.6013 \text{ mW/cm}^2 = 32.5\%$

Total for specified number of modules. Being identical, the total is simply multiplied: $3 \times 32.5\% = 97.5\%$

97.5% of allowed exposure is calculated when the maximum 12 dBi gain antennas are employed on 3 co-located modules. This satisfies the criteria for co-location.

1.6 Co-Location Scenario – XBee Module FCC ID: MCQ-PROS2B

This module and its antenna are located inside the final host system enclosure of plastic material. The RM01 modules, also in the final enclosure, are connected to their antennas by coax cable at a distance of 3 feet or 91 cm from the enclosure. This amount of spacing between antennas does not require the summation of RM01 exposures with this internal module. A photograph of the installed XBee module appears below.



Photograph 1.6.1 XBee Module (Just left of center.) With Antenna (Upper left.)