

Product: TAGSMYTH RangeTRACKER
Model Number: TS1-RTKR101
FCC ID: 2ADS3-TS1RTKR101
IC: 12618A- TS1RTKR101
Document Revision: 1.2

RF Exposure Analysis

Summary

The TAGSMYTH RangeTRACKER meets all SAR test exclusion guidelines and SAR testing is not required.

Introduction

The RangeTRACKER contains 3 intentional radiators, transmitting at 150 kHz, 917.4 Mhz, and 2.4 GHz as shown below:

- Bluetooth Low-Energy Module: 2.4 Ghz, modular id QOQBLE113
- Near-field wake: 150 kHz
- Long-range wake: 917.4 Mhz

The Bluetooth module is always enabled when the device is turned on. Software restricts the other two transmitters so that only one of them may be enabled at any time. This yields three possible transmitter operating modes:

1. Bluetooth enabled, all other transmitters disabled
2. Bluetooth enabled, long-range wake enabled
3. Bluetooth enabled, near-field wake enabled

For standalone transmitters, SAR test exclusion guidelines are given in KDB 447498 Chapter 4.3.1-1:

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

$$\left[\frac{(\text{max. power of channel, including tune-up tolerance, mW})}{(\text{min. test separation distance, mm})} \cdot \sqrt{f(\text{GHz})} \right] \leq 3.0 \text{ for 1-g SAR and } \leq 7.5 \text{ for 10-g extremity SAR, where}$$

- *$f(\text{GHz})$ is the RF channel transmit frequency in GHz, Power and distance are rounded to the nearest mW and mm before calculation, and the result is rounded to one decimal place for comparison*

SAR test exclusion for simultaneous transmission is defined in KDB 447498 Chapter 4.3.2. To wit,

“Simultaneous transmission SAR test exclusion is determined for each operating configuration and exposure condition according to the reported standalone SAR of each applicable simultaneous transmitting antenna. When the sum of 1-g or 10-g SAR of all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit, SAR test exclusion applies to that simultaneous transmission configuration.”

Test exclusions for each transmitter will be analyzed independently using standard SAR exclusion thresholds as defined in KDB 447498 Chapter 4.3.1-1. The standalone estimates are then added to determine simultaneous transmission SAR test exclusion. All tests are performed for 1-g exposure limits.

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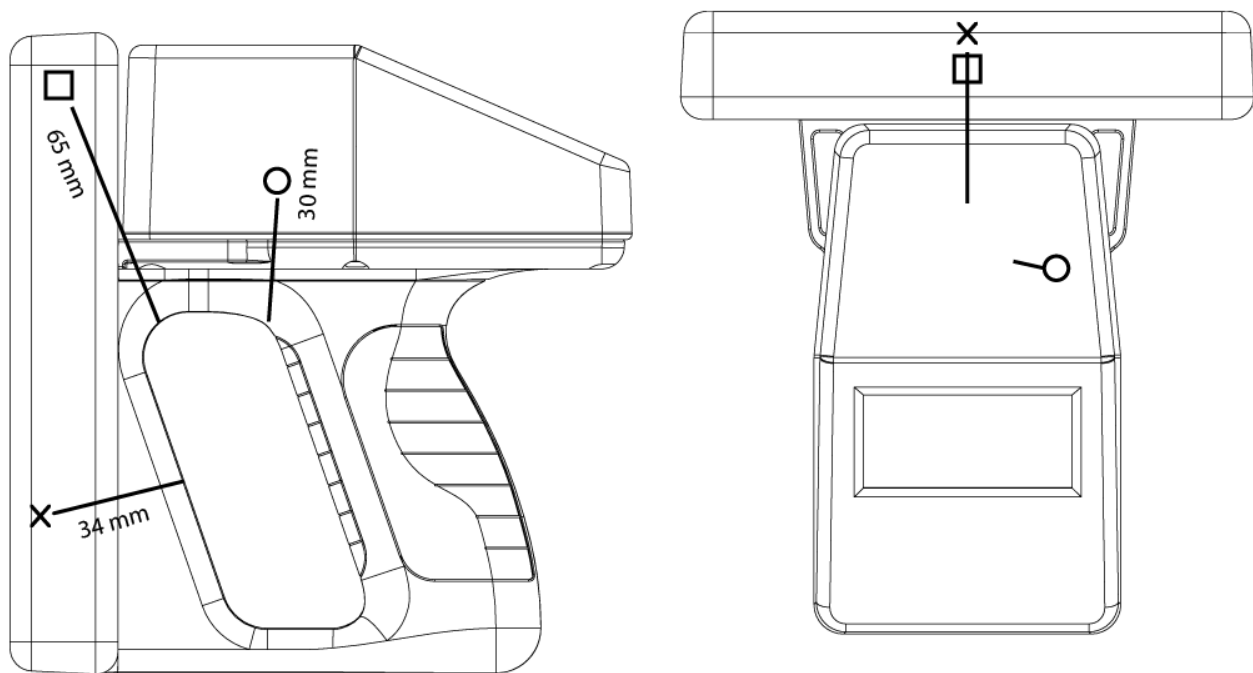
All transmissions on the RangeTRACKER are pulsed, reducing effective exposure based on the on-time of each transmitter. However, in the interest of simplicity and to provide a worst-case exposure analysis, duty-cycle based exposure reduction is ignored and exposure with 100% duty cycle is considered.

The minimum test separation distance is the minimum distance from the user's hand to the center-feed of the antenna at any time during normal operation. During normal operation, the user's hand is the closest part of the user's body to the radiating element, as shown in the drawing below:

✕ = 915 Mhz Antenna Center-Feed Location

○ = Bluetooth Antenna Center-Feed Location

□ = 150 kHz Ferrite Antenna Location



During normal operation, the minimum distance between the user and the 915 Mhz antenna's center feed is 34 mm. The minimum distance between the user and the Bluetooth antenna is 30 mm. The minimum distance between the ferrite antenna and the user is 65 mm.

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Long-range wake – 917.4 Mhz

Conducted Output Power: 14.4 dBm

Antenna Gain: 4.5 dBi

Effective EIRP (mW), with 100% duty-cycle: 18.9 dBm, or **77.6 mW**

Min. test separation distance, hand to antenna center-feed: **3.4cm**

Analysis for FCC

Using the formula for standalone transmitters given in KDB 447498 Chapter 4.3.1-1:

$$\frac{77.6 \text{ mW}}{34 \text{ mm}} \sqrt{0.9174 \text{ Ghz}} = 2.19 < 3.0$$

Thus the SAR exclusion condition is fulfilled and SAR evaluation is not required for this transmitter.

Analysis for IC

For a minimum separation distance of 34mm, the SAR exemption limit given for 917.5 Mhz in Table 1 of RSS-102 Section 2.5.1 is 81 mW. The EIRP assuming 100% duty-cycle 77.6 mW. The device therefore meets the SAR exemption limit and SAR testing is not required.

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Short-range wake – 150 kHz

The short-range wake transmission at 150 kHz has a maximum EIRP of 0.13mW. The minimum separation distance between the ferrite antenna and the user's hand during normal operation is 6.5cm.

Analysis for FCC

The effective 0.13 mW output power of the 150 kHz transmission falls well within the SAR exclusion conditions in KDB 447498 Section 4.3.1-3 for transmitters at less than 100 Mhz, and SAR testing is not required.

Analysis for IC

For a separation of more than 50mm, the SAR exemption limit given for frequencies under 300 Mhz in Table 1 of RSS-102 Section 2.5.1 is 345 mW. The EIRP of the 150 kHz transmitter 0.13mW. The device therefore meets the SAR exemption limit and SAR testing is not required.

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Bluetooth LE – 2.4 Ghz

The analysis for the Bluetooth LE module uses data submitted to the FCC for module ID QQQBLE113.

For the BLE113, the maximum TX power including tolerances is 1.5mW, with a maximum TX frequency of 2.48 Ghz. The minimum separation distance between the Bluetooth module's antenna and the user's hand during normal operation is 3cm.

Analysis for FCC

$$\frac{1.5 \text{ mW}}{30 \text{ mm}} \sqrt{2.48 \text{ Ghz}} = 0.079 < 3.0$$

Thus the SAR exclusion condition is fulfilled and SAR evaluation is not required for this transmitter.

Analysis for IC

For a separation of 30mm, the SAR exemption limit given for 2450 Mhz in Table 1 of RSS-102 Section 2.5.1 is 30 mW. The EIRP of the Bluetooth module is 1.5mW. The device therefore meets the SAR exemption limit and SAR testing is not required.

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Simultaneous Transmission SAR Evaluation

As specified in KDB 447498 Chapter 4.3.2, SAR exclusion for multiple transmitters requires that the sum of all individual SAR estimates remain under the threshold to qualify for SAR exclusion. Individual transmitter SAR estimates were considered in previous sections.

The RangeTRACKER can operate in one of three transmit modes, outlined below:

Bluetooth LE Only

Bluetooth SAR: 0.079

Total: **0.079 < 3.0**

Bluetooth and Long-Range Wake

Bluetooth SAR: 0.079

Long-range Wake SAR: 2.19

Total: $0.079 + 2.19 = \mathbf{2.269 < 3.0}$

Bluetooth and Short-Range Wake

Bluetooth SAR: 0.079

Short-range Wake SAR: 0.13

Total: $0.079 + 0.13 = \mathbf{0.209 < 3.0}$

In all three cases, the SAR exclusion condition is met and SAR evaluation is not required for this transmitter.