

FCC RF Exposure Evaluation

1. Product Information

FCC ID:	2ACEY-TSB-BLE
Product name	TS Smart Deadbolt
Model number	e-Smart 5000-BLE, e-Smart 7000-BLE
Power supply	DC 6V by 4*AA Battery
Modulation Type	GFSK for Bluetooth V4.2 (BT LE) ASK for NFC
Antenna Type	Internal Antenna for BT Coil Antenna for NFC
Antenna Gain	2.23 dBi (maximum) for BT -2.00 dBi (maximum) for NFC
Hardware version	TSB HW V2.0
Software version	TSB FW V2.0
Operation frequency	2402MHz-2480MHz for BT 13.56 MHz for NFC
Exposure category	General population/uncontrolled environment
EUT Type	Production Unit
Device Type	Portable

2. Evaluation Method

According to KDB447498 D01 General RF Exposure Guidance v06 Section 4.3.1 Standalone SAR test exclusion considerations: "Unless specifically required by the published RF exposure KDB procedures, standalone 1-g head or body and 10-g extremity SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when the corresponding SAR Test Exclusion Threshold condition, listed below, is satisfied. These test exclusion conditions are based on source-based time-averaged maximum conducted output power of the RF channel requiring evaluation, adjusted for tune-up tolerance, and the minimum test separation distance required for the exposure conditions.²² The minimum test separation distance is determined by the smallest distance from the antenna and radiating structures or outer surface of the device, according to the host form factor, exposure conditions and platform requirements, to any part of the body or extremity of a user or bystander (see 5) of section 4.1). To qualify for SAR test exclusion, the test separation distances applied must be fully explained and justified by the operating configurations and exposure conditions of the transmitter and applicable host platform requirements, typically in the SAR measurement or SAR analysis report, according to the required published RF exposure KDB procedures. When no other RF exposure testing or reporting is required, a statement of justification and compliance must be included in the equipment approval, in lieu of the SAR report, to qualify for the SAR test exclusion. When required, the device specific conditions described in the other published RF exposure KDB procedures must be satisfied before applying these SAR test exclusion provisions; for example, handheld PTT two-way radios, handsets, laptops & tablets etc."

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

- f (GHz) is the RF channel transmit frequency in GHz
 - Power and distance are rounded to the nearest mW and mm before calculation
 - The result is rounded to one decimal place for comparison
 - 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below
- The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 5) in section 4.1 is applied to determine SAR test exclusion.

For 100 MHz to 6 GHz and test separation distances > 50 mm, the 1-g and 10-g SAR test exclusion

thresholds are determined by the following (also illustrated in Appendix B):

- 1). $\{[\text{Power allowed at numeric threshold for 50 mm in step a)}] + [(\text{test separation distance} - 50 \text{ mm}) \cdot (f(\text{MHz})/150)]\}$ mW, for 100 MHz to 1500 MHz
- 2). $\{[\text{Power allowed at numeric threshold for 50 mm in step a)}] + [(\text{test separation distance} - 50 \text{ mm}) \cdot 10]\}$ mW, for $> 1500 \text{ MHz}$ and $\leq 6 \text{ GHz}$

For frequencies below 100 MHz, the following may be considered for SAR test exclusion (also illustrated in Appendix C)

- 1). For test separation distances $> 50 \text{ mm}$ and $< 200 \text{ mm}$, the power threshold at the corresponding test separation distance at 100 MHz in step b) is multiplied by $[1 + \log(100/f(\text{MHz}))]$
- 2). For test separation distances $\leq 50 \text{ mm}$, the power threshold determined by the equation in c) 1) for 50 mm and 100 MHz is multiplied by $\frac{1}{2}$
- 3). SAR measurement procedures are not established below 100 MHz.

When one of the following test exclusion conditions is satisfied for all combinations of simultaneous transmission configurations, further equipment approval is not required to incorporate transmitter modules in host devices that operate in the mixed mobile and portable host platform exposure conditions. The grantee is responsible for documenting this according to Class I permissive change requirements. Antennas that qualify for standalone SAR test exclusion must apply the estimated standalone SAR to determine simultaneous transmission test exclusion.

- a) The $[\sum \text{ of (the highest measured or estimated SAR for each standalone antenna configuration, adjusted for maximum tune-up tolerance) / } 1.6 \text{ W/kg}] + [\sum \text{ of MPE ratios}] \leq 1.0$.
- b) The SAR to peak location separation ratios of all simultaneously transmitting antenna pairs operating in portable device exposure conditions are all ≤ 0.04 , and the $[\sum \text{ of MPE ratios}] \leq 1.0$.

3. Refer Evaluation Method

[ANSI C95.1-1999](#): IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

[FCC KDB publication 447498 D01 General RF Exposure Guidance v06](#): Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

[FCC CFR 47 part1 1.1310](#): Radiofrequency radiation exposure limits.

[FCC CFR 47 part2 2.1093](#): Radiofrequency radiation exposure evaluation: portable devices

4. Conducted Power Results

[BT LE]

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)
GFSK – BT LE	0	2402	-1.51
	19	2440	-1.55
	39	2480	-1.74

[NFC]

Mode	Channel	Frequency (MHz)	Fundamental Emissions dBuV/m @ 3m
NFC	1	13.56	32.58

5. Manufacturing Tolerance

GFSK – BT LE (Peak)

Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	-1.0	-1.0	-1.0
Tolerance \pm (dB)	1.0	1.0	1.0

6. Evaluation Results

6.1 Standalone Evaluation

[BT LE]

Band/Mode	f (GHz)	Antenna Distance (mm)	RF output power		SAR Test Exclusion Threshold	SAR Test Exclusion
			dBm	mW		
GFSK	2.450	5	0	1.0000	0.3 < 3.0	Yes

Remark:

(1). RF output power including tune up tolerance;

(2). When the minimum test separation distance is < 5 mm, a distance of 5 mm according to f) in section 4.1 of KDB 447498 is applied to determine SAR test exclusion.

[NFC]

According to KDB 412172 D01 Determining ERP and EIRP format;

$$\text{EIRP} = p_t \times g_t = (E \times d)^2 / 30$$

Where:

p_t = transmitter output power in watts,

g_t = numeric gain of the transmitting antenna (unitless),

E = electric field strength in V/m,

d = measurement distance in meters (m).

$$\text{EIRP} = -62.65 \text{ dBm}$$

$$\text{Conducted power} = \text{EIRP} - \text{Antenna Gain} = -60.65 \text{ dBm} < \text{SAR Test Exclusion Threshold (9.96 dBm)}$$

6.2 Simultaneous Transmission for SAR Exclusion

The sample support BT modular and NFC modular, BT and NFC share difference antenna, need consider simultaneous transmission;

Maximum Simultaneous transmission SAR Ratio for BT and NFC;

SAR Ratio _{BT}	SAR Ratio _{NFC}	\sum SAR ratios	Limit	Results
< 0.1	< 0.3	< 0.4	1.0	PASS

7. Conclusion

The measurement results comply with the FCC Limit per 47 CFR 2.1093 for the uncontrolled RF Exposure and SAR Exclusion Threshold per KDB 447498 v06.

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