RF Exposure requirements

Product name	SMART KEY READER
Model number	SMK-HWF-01
FCC ID	ZE8-SMK-HWF-01
Radio specification	2.4 GHz ZigBee transceiver, 125 kHz transmitter
Antenna	2.4 GHz: integral SMD chip antenna, 125 kHz: integral loop coil antenna
Power source	DC 12 V or 24 V battery in a vehicle
RF output power	2.4 GHz: -3.89 dBm (0.41 mW) (PEAK) 125 kHz: 84.1 dBμV/m (measured at 3 m distance)

According to the KDB 447498 D01 General RF Exposure Guidance v06, the equation and threshold in 4.3.1 were applied to determine SAR test exclusion, and the equation and threshold in 4.3.2 b) were applied to determine the estimated SAR for Simultaneous Transmission SAR Test Exclusion.

4.3.1 Standalone SAR test exclusion consideration

a) For 100 MHz to 6 GHz and the test separation distances ≤ 50mm, the 1-g SAR test exclusion thresholds are determined by the following:

[(maximum power, mW) / (min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0

b) For 100 MHz to 6 GHz and test separation distances > 50 mm, the 1-g SAR test exclusion thresholds are determined by the following:

1) {[Power allowed at numeric threshold for 50 mm in step a)] + [(test separation distance - 50 mm)·(f(MHz)/150)]} mW, for 100 MHz to 1500 MHz

c) For frequencies below 100 MHz, the following may be considered for SAR test exclusion

1) For test separation distances > 50 mm and < 200 mm, the power threshold at the corresponding test separation distance at 100 MHz in step b) is multiplied by [1 + log(100/f(MHz))]

2) For test separation distances ≤ 50 mm, the power threshold determined by the equation in c) 1) for 50 mm and 100 MHz is multiplied by ½

(SAR test exclusion thresholds for 2.4 GHz ZigBee Transceiver)

(0.41 / 5) × √2.405 = 0.13 (< 3.0)

The RF output power was 0.41 mW and satisfied the SAR test exclusion thresholds when the distance of 5 mm was applied.

(SAR test exclusion power thresholds for 125 kHz Transmitter)

1/2 × {(3 × 50 /√0.1) × [1 + log(100/0.125)]} = 925 mW (for test separation ≤ 50 mm)

The electric field strength was 84.4 dBμV/m (PEAK value) measured at 3-m distance, and satisfied the SAR test exclusion power thresholds. Although the conducted RF output power was unknown, the maximum average

power could be assumed as the below:

(1) The product used MOSFET driver (IC6, IRF7509PbF) to generator 125 kHz RF signals. The maximum power dissipation of MOSFET was 1.25 W, and therefore the product cannot generate RF signals more than 1.25 W.
(2) The product repeatedly emitted 125 kHz RF signals. The duration was less than 18 ms and the period was 1 second. The duty cycle factor for the calculation of the average power was 0.018.
(3) The source-based time-averaged maximum conducted output power was assumed as the maximum 22.5 mW (=1.25 × 18), and satisfied the SAR test exclusion power thresholds.

4.3.2 Simultaneous transmission SAR test exclusion

When an antenna qualifies for the standalone SAR test exclusion of 4.3.1 and also transmits simultaneously with other antennas, the standalone SAR value must be estimated according to the following to determine the simultaneous transmission SAR test exclusion criteria:

[(maximum power, mW) / (min. test separation distance, mm)]·[√f(GHz)/x] W/kg; x = 7.5 for 1-g SAR

(standalone SAR value estimation for 2.4 GHz ZigBee Transceiver)

(0.41 / 5) × (√2.405 / 7.5) = 0.017 W/kg

(standalone SAR value estimation for 125 kHz Transmitter)

(22.5 / 5) × (√(0.125 × 10-3) / 7.5) = 0.007 W/kg

The sum of the estimated SAR values was less than ≤ 0.4 W/kg when the test separation distance of 5 mm was applied.