

Analysis Report

The Equipment Under Test (EUT), is a portable composite device which contains a 2.4GHz BLE Transceiver and a 13MHz RFID reader for a duck. For the BLE portion, the sample supplied operated on 40 channels, normally at 2402 - 2480MHz. The channels are separated with 2MHz spacing. For the RFID reader, the sample supplied operated on a single channel, 13.56MHz.

The EUT is powered by 3 x 1.5V C batteries. After switching on the EUT, the duck can be paired up with a smartphone and played through a mobile app. The duck will emit different sound and have different actions based on the buttons pressed in the mobile app. The duck will also emit different sound and have different actions based on different "feeling cards" tapped to the duck's chest.

Bluetooth BLE Portion

Antenna Type: Internal, integral

Antenna Gain: 0dBi

Frequency Range: 2402MHz to 2480MHz, 2MHz channel spacing, 40 channels

Nominal rated field strength: 67.7dBμV/m at 3m

Maximum allowed field strength of production tolerance: +/- 3dB

According to the KDB 447498:

Radiated Power (maximum)
= 70.7 dBμV/m (0.0035 mW)

The SAR Exclusion Threshold Level:
= $3.0 * (\text{min. test separation distance, mm}) / \text{sqrt}(\text{freq. in GHz})$
= $3.0 * 5 / \text{sqrt}(2.480)$ mW
= 9.53 mW

Since the above conducted output power is well below the SAR Exclusion threshold level, so the EUT is considered to comply with SAR requirement without testing.

13.56MHz NFC portion (single channel)

Antenna Type: Internal, Integral

Antenna Gain: 0dBi

Nominal rated field strength: 58.4dB μ V/m at 3m

Maximum allowed field strength of production tolerance: +/- 3dB

Radiated Power (maximum)

= 61.4 (0.0004 mW)

The SAR Exclusion Threshold Level for 13.56MHz when minimum test separation distance < 50 mm:

= $[474 * (1 + \log_{10}(100/f(\text{MHz})))]/2$

= 442.7 mW

Since the above conducted output power is well below the SAR Exclusion threshold level, so the EUT is considered to comply with SAR requirement without testing.

Simultaneous Transmission SAR exclusion considerations

Since the NFC 13.56MHz and Bluetooth transmitters of this device may operate simultaneously, simultaneous transmission analysis is required. Per KDB 447498, simultaneous transmission SAR test exclusion can be applied when the sum of 1-g SAR of all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit ($\leq 1.6\text{W/kg}$). When the standalone SAR test exclusion is applied, the standalone 1-g SAR must be estimated according to the following equation,

$$\text{Estimated SAR} = (\sqrt{F(\text{GHz})} / 7.5) \times (P_{\text{max}} / TD)$$

where

$F(\text{GHz})$ is the RF channel transmit frequency in GHz

P_{max} is the max. power of channel, including tune-up tolerance, mW

TD is the min. test separation distance, mm

For NFC operation,

Maximum Time-averaged Conducted Power of this device = 0.0004 mW (**61.4dB μ V/m**)

Therefore, the Estimated SAR will be determined as follow,

$$\begin{aligned}\text{Estimated SAR} &= (\sqrt{F(\text{GHz})} / 7.5) \times (P_{\text{max}} / TD) \\ &= \mathbf{0.0000013 \text{ W/kg}}\end{aligned}$$

where $P_{\text{max}} = 0.0004 \text{ mW}$, $TD = 5 \text{ mm}$ and $F(\text{GHz}) = 0.01356 \text{ GHz}$

For Bluetooth operation,

Maximum Time-averaged Conducted Power of this device = **0.0035 mW (70.7 dB μ V/m)**

Therefore, the Estimated SAR will be determined as follow,

$$\begin{aligned}\text{Estimated SAR} &= (\sqrt{F(\text{GHz})} / 7.5) \times (P_{\text{max}} / TD) \\ &= \mathbf{0.0001480 \text{ W/kg}}\end{aligned}$$

where $P_{\text{max}} = 0.0035 \text{ mW}$, $TD = 5 \text{ mm}$ and $F(\text{GHz}) = 2.480 \text{ GHz}$

Simultaneous Transmission Analysis

NFC SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	Simultaneous SAR Required
0.0000013	0.0001480	0.0001493	No

Conclusion

Since the above summed SAR result for all simultaneous transmission conditions were below the SAR limit (1.6 W/kg), SAR evaluation for simultaneous transmission configuration are not required.