

Analysis Report

The Equipment Under Test (EUT) is S1801 which is a Bluetooth controlled mobile POS device (point of sale device). It contains an 13MHz RFID module. The RFID portion is for recognize tag function. After placing the tags on the EUT, the EUT will recognize the tags. The Bluetooth can support Bluetooth 2.1 and 4.2 BLE. Bluetooth 2.1 is operating at the frequency range of 2402-2480MHz with 1 MHz channel spacing. Bluetooth 4.2 is operating at the frequency range of 2402-2480MHz with 2 MHz channel spacing. The EUT is powered by 3.7V internal battery or 5.0V through type-C connector.

13.56MHz RFID portion

Antenna Type: Internal integral antenna

Antenna Gain: 0dBi

Nominal rated field strength: 62.0dBμV/m at 3m

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

According to the KDB 447498:

Based on the Maximum allowed field strength of production tolerance was 65.0 dBμV/m at 3m in frequency 13.56MHz, thus;

The EIRP = $[(FS \cdot D)^2 \cdot 1000 / 30] = 0.000948mW$

Conducted power = Radiated Power (EIRP) – Antenna Gain

So;

Conducted Power = 0.000948mW.

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

$$= [474 \cdot (1 + \log_{10}(f(\text{MHz})))]/2$$
$$= 442.7mW$$

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.

Analysis Report

Bluetooth portion

Antenna Type: Internal integral antenna

Antenna Gain: 0dBi

Nominal rated field strength: 86.0dB μ V/m at 3m

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

According to the KDB 447498:

Based on the Maximum allowed field strength of production tolerance was 89.0 dB μ V/m at 3m in frequency 2400-2480MHz, thus;

The EIRP = $[(FS \cdot D)^2 \cdot 1000 / 30] = 0.238298\text{mW}$

Conducted power = Radiated Power (EIRP) – Antenna Gain

So;

Conducted Power = 0.238298mW.

The SAR Exclusion Threshold Level:

= $3.0 \cdot (\text{min. test separation distance, mm}) / \text{sqrt}(\text{freq. in GHz})$

= $3.0 \cdot 5 / \text{sqrt}(2.480) \text{ mW}$

= 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.

Simultaneous Transmission SAR exclusion considerations

Since the RFID 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 = 0.000948 mW

Therefore, the Estimated SAR will be determined as follow,

$$\begin{aligned}\text{Estimated SAR} &= (\sqrt{F(\text{GHz})} / 7.5) \times (P_{\text{max}} / TD) \\ &= 0.00000294 \text{ W/kg}\end{aligned}$$

where $P_{\text{max}} = 0.00024 \text{ mW}$, $TD = 5 \text{ mm}$ and $F(\text{GHz}) = 0.01356 \text{ GHz}$

For Bluetooth 4.2 BLE operation,

Maximum Time-averaged Conducted Power of this device = 0.238298 mW

Therefore, the Estimated SAR will be determined as follow,

$$\begin{aligned}\text{Estimated SAR} &= (\sqrt{F(\text{GHz})} / 7.5) \times (P_{\text{max}} / TD) \\ &= 0.01 \text{ W/kg}\end{aligned}$$

where $P_{\text{max}} = 3.16\text{mW}$, $TD = 5 \text{ mm}$ 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
0.00000294	0.01	0.01000294	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.