

Analysis Report

The Equipment Under Test (EUT) is a Force Link 2 Starter Pack, which contains a 13MHz NFC reader and a Bluetooth 4.0 module. The Bluetooth portion is for update firmware while the NFC portion is for the tag function. After placing the tags on the EUT, the EUT will recognize the tags by sending out different sound effects. The EUT is powered by 3 X 1.5V AAA batteries.

Antenna Type: Internal antenna

Antenna Gain: 0dBi

Maximum allowed field strength of production 73.9 dB μ V/m at 3m

According to the KDB 447498:

Based on the Maximum allowed field strength of production tolerance was 73.9 dB μ V/m at 3m in frequency 13.56MHz, thus;

The EIRP = $[(FS \cdot D)^2 \cdot 1000 / 30] = 0.007\text{mW}$

Conducted power = Radiated Power (EIRP) – Antenna Gain

So;

Conducted Power = 0.007mW.

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

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

= 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.

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Antenna Type: Internal antenna

Antenna Gain: 0dBi

Maximum allowed field strength of production 99.5 dB μ V/m at 3m

According to the KDB 447498:

Based on the Maximum allowed field strength of production tolerance was 99.5dB μ V/m at 3m in frequency 2.4GHz, thus;

The EIRP = $[(FS \cdot D)^2 \cdot 1000 / 30] = 2.67\text{mW}$

Conducted power = Radiated Power (EIRP) – Antenna Gain
So;

Conducted Power = 2.67mW.

The SAR Exclusion Threshold Level:

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

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

= 9.52 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 4.0 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 = **0.007 mW**

Therefore, the Estimated SAR will be determined as follow,

$$\begin{aligned} \text{Estimated SAR} &= (\sqrt{F(\text{GHz})} / 7.5) \times (P_{\text{max}} / TD) \\ &= \mathbf{0.0000217 \text{ W/kg}} \end{aligned}$$

where $P_{\text{max}} = 0.007 \text{ mW}$, $TD = 5 \text{ mm}$ and $F(\text{GHz}) = 0.01356 \text{ GHz}$

For Bluetooth 4.0 BLE operation,

Maximum Time-averaged Conducted Power of this device = **2.67 mW**

Therefore, the Estimated SAR will be determined as follow,

$$\begin{aligned} \text{Estimated SAR} &= (\sqrt{F(\text{GHz})} / 7.5) \times (P_{\text{max}} / TD) \\ &= \mathbf{0.112 \text{ W/kg}} \end{aligned}$$

where $P_{\text{max}} = 2.67\text{mW}$, $TD = 5 \text{ mm}$ 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
0.0000217	0.112	0.1120217	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.