

## Simultaneous Transmission SAR exclusion considerations

Since the 2.4GHz and Bluetooth transceivers 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

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

$TD$  is the min. test separation distance, mm

### For 2.4GHz operation,

**Antenna Type: Internal antenna**

**Antenna Gain: 0dBi**

**Nominal rated field strength: 72.0 dB $\mu$ 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 75.0dB $\mu$ V/m at 3m in frequency 2.4GHz, thus;

$$\text{The EIRP} = [(FS \times D)^2 \times 1000 / 30] = 0.009\text{mW}$$

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

$$\text{Maximum Conducted Power} = 0.009\text{mW}.$$

Therefore (Standalone mode):

The SAR Exclusion Threshold Level:

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

$$= 3.0 \times 5 / \text{sqrt}(2.449) \text{ mW}$$

$$= 9.59 \text{ mW}$$

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.

Therefore (Dual mode):

The Estimated SAR will be determined as follow,

$$\begin{aligned} \text{Estimated SAR} &= (\sqrt{F(\text{GHz})} / 7.5) \times (P_{\text{max}} / TD) \\ &= 0.0003 \text{ W/kg} \end{aligned}$$

where  $P_{\text{max}} = 0.009 \text{ mW}$ ,  $TD = 5 \text{ mm}$  and  $F(\text{GHz}) = 2.449 \text{ GHz}$

**For Bluetooth 4.0 BLE operation,**

BLE Module:

**Antenna Type: Internal antenna**

**Antenna Gain: 0dBi**

**Nominal rated field strength: 89.8 dBµV/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 92.8dBµV/m at 3m in frequency 2.4GHz, thus;

The EIRP = [(FS\*D) ^2\*1000 / 30] = 0.572mW

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

Maximum Conducted Power =0.572mW.

Therefore (Standalone mode):

The SAR Exclusion Threshold Level:  
= 3.0 \* (min. test separation distance, mm) / sqrt(freq. in GHz)  
= 3.0 \* 5 / 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.

Therefore (Dual mode):

The Estimated SAR will be determined as follow,

$$\text{Estimated SAR} = (\sqrt{F(\text{GHz})} / 7.5) \times (P_{\text{max}} / TD) = 0.024 \text{ W/kg}$$

where Pmax = 0.572mW, TD = 5 mm and F(GHz) = 2.480 GHz

**Simultaneous Transmission Analysis**

2.4GHz SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	Simultaneous SAR Required
0.00003	0.024	0.02403	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.