

Analysis Report

The Equipment Under Test (EUT), is a 2.4GHz and Bluetooth Classic Transceiver for a Xbox Controller. For the Bluetooth Classic mode, the EUT has 1 antenna and the sample supplied operated on 79 channels, normally at 2402 - 2480MHz. The channels are separated with 1MHz spacing. For the 2.4GHz mode, the EUT has 2 antennas and the sample supplied operated on 40 channels, normally at 2402 - 2480MHz. The channels are separated with 2MHz spacing. The EUT is powered by 1 x 3.7V Lithium-ion battery.

2.4GHz Portion Antenna 1

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

Average Radiated range: 70.4dBμV/m to 80.5dBμV/m

2.4GHz Portion Antenna 2

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

Average Radiated range: 70.9dBμV/m to 83.6dBμV/m

Bluetooth Classic Portion

Frequency Range: 2402MHz to 2480MHz, 1MHz channel spacing, 79 channels

Average Radiated range: 77.5dBμV/m to 83.5dBμV/m

According to the KDB447498 D01 v06:

Radiated Power (maximum)
= 83.6 dBμV/m (0.069183 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.

Simultaneous Transmission SAR exclusion considerations

Since the 2.4GHz and Bluetooth transmitters of this device may operate simultaneously, simultaneous transmission analysis is required. Per KDB447498 D01 v06, 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 2.4GHz Antenna 1 operation,

Maximum Time-averaged Conducted Power of this device = 0.033884 mW (80.5dBμV/m)

Therefore, the Estimated SAR will be determined as follow,

$$\begin{aligned}\text{Estimated SAR} &= (\sqrt{F(\text{GHz})} / 7.5) \times (P_{\text{max}} / TD) \\ &= \mathbf{0.0014229 \text{ W/kg}}\end{aligned}$$

where $P_{\text{max}} = 0.033884 \text{ mW}$, $TD = 5 \text{ mm}$ and $F(\text{GHz}) = 2.480 \text{ GHz}$

For 2.4GHz Antenna 2 operation,

Maximum Time-averaged Conducted Power of this device = 0.069183 mW (83.6dBμV/m)

Therefore, the Estimated SAR will be determined as follow,

$$\begin{aligned}\text{Estimated SAR} &= (\sqrt{F(\text{GHz})} / 7.5) \times (P_{\text{max}} / TD) \\ &= \mathbf{0.0029053 \text{ W/kg}}\end{aligned}$$

where $P_{\text{max}} = 0.069183 \text{ mW}$, $TD = 5 \text{ mm}$ and $F(\text{GHz}) = 2.480 \text{ GHz}$

For Bluetooth Classic operation,

Maximum Time-averaged Conducted Power of this device = 0.067608 mW (83.5dBμV/m)

Therefore, the Estimated SAR will be determined as follow,

$$\begin{aligned}\text{Estimated SAR} &= (\sqrt{F(\text{GHz})} / 7.5) \times (P_{\text{max}} / TD) \\ &= \mathbf{0.0028392 \text{ W/kg}}\end{aligned}$$

where $P_{\text{max}} = 0.067608 \text{ mW}$, $TD = 5 \text{ mm}$ and $F(\text{GHz}) = 2.480 \text{ GHz}$

Simultaneous Transmission Analysis

2.4GHz Antenna 1 SAR (W/kg)	2.4GHz Antenna 2 SAR (W/kg)	Bluetooth Classic SAR (W/kg)	Σ SAR (W/kg)	Simultaneous SAR Required
0.0014229	0.0029053	0.0028392	0.0071674	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 is not required.