

Simultaneous Transmission SAR exclusion considerations

Since there are 2 identical 2.4GHz RF transceivers (Ti CC2510) into this device that 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 Control Radio operation (20FSK),

Antenna Type: Internal antenna

Antenna Gain: +2dBi

Nominal rated field strength: 88.9 dB 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 91.9dB μ V/m at 3m in frequency 2.4GHz, thus;

$$\text{The EIRP} = [(FS \times D)^2 \times 1000 / 30] = 0.465\text{mW}$$

Conducted power = Radiated Power (EIRP) – Antenna Gain

So;

$$\text{Maximum Conducted Power} = 0.293\text{mW}.$$

Therefore, the Estimated SAR will be determined as follow,

$$\begin{aligned} \text{Estimated SAR} &= (\sqrt{F(\text{GHz})} / 7.5) \times (P_{\text{max}} / TD) \\ &= 0.012 \text{ W/kg} \end{aligned}$$

where $P_{\text{max}} = 0.293\text{mW}$, $TD = 5 \text{ mm}$ and $F(\text{GHz}) = 2.4822 \text{ GHz}$

For Announce Radio operation (20FSK),

Antenna Type: Internal antenna

Antenna Gain: +2dBi

Nominal rated field strength: 87.8 dB 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 90.8dB μ V/m at 3m in frequency 2.4GHz, thus;

$$\text{The EIRP} = [(FS \cdot D)^2 \cdot 1000 / 30] = 0.361\text{mW}$$

Conducted power = Radiated Power (EIRP) – Antenna Gain

So;

$$\text{Conducted Power} = 0.228\text{mW}.$$

Maximum Time-averaged Conducted Power of this device = **0.228 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 $P_{\text{max}} = 0.228\text{mW}$, $TD = 5 \text{ mm}$ and $F(\text{GHz}) = 2.452 \text{ GHz}$

For Announce Radio operation (500FSK),

Antenna Type: Internal antenna

Antenna Gain: +2dBi

Nominal rated field strength: 86.5 dB 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 89.5 dB μ V/m at 3m in frequency 2.4GHz, thus;

$$\text{The EIRP} = [(FS \cdot D)^2 \cdot 1000 / 30] = 0.267\text{mW}$$

Conducted power = Radiated Power (EIRP) – Antenna Gain

So;

$$\text{Conducted Power} = 0.169\text{mW}.$$

Maximum Time-averaged Conducted Power of this device = **0.169 mW**

Therefore, the Estimated SAR will be determined as follow,

$$\text{Estimated SAR} = (\sqrt{F(\text{GHz}) / 7.5}) \times (P_{\text{max}} / TD) \\ = 0.007 \text{ W/kg}$$

where $P_{\text{max}} = 0.169\text{mW}$, $TD = 5 \text{ mm}$ and $F(\text{GHz}) = 2.481121 \text{ GHz}$

Simultaneous Transmission Analysis

Control Radio (20FSK) SAR (W/kg)	Announce Radio (20FSK) SAR (W/kg)	Announce Radio (500FSK) SAR (W/kg)	Σ SAR (W/kg)	Simultaneous SAR Required
0.012	0.01	0.007	0.029	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.