

Analysis Report

Report No.: 21061501HKG-001

The Equipment Under Test (EUT) is Versa Ex. The EUT has 125kHz RFID reader and 2.4GHz Zigbee transceiver for wireless connectivity.

2.4GHz Zigbee portion

Antenna Type: Internal, Integral

Antenna Gain: -1 dBi

Peak Conducted output power: 4 dBm

Frequency range: 2405MHz to 2480MHz, channel spacing 5MHz (16 channels)

125kHz RFID portion

Antenna Type: Internal, Integral

Antenna Gain: 0dBi

Maximum Field Strength: 73 dBμV/m@3m

Frequency range: 125kHz (single channel)

According to the KDB 447498:

2.4GHz Zigbee portion

Conducted Power (max) = 4 dBm (2.51 mW)

The SAR Exclusion Threshold Level:

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

= $3.0 * 5 / \sqrt{2.480}$ 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.

125kHz RFID reader portion

Based on the Maximum allowed field strength of production tolerance was 73 dBμV/m at 3m in frequency 125kHz, thus;

The EIRP = $[(FS*D)^2 * 1000 / 30] = 0.006 \text{ mW} (-22.2 \text{ dBm})$

Conducted power = Radiated Power (EIRP) – Antenna Gain = $(-22.2 \text{ dBm} - 0 \text{ dBi})$

So;

Conducted Power = 0.006 mW (-22.2 dBm).

The SAR Exclusion Threshold Level for 125kHz when the minimum test separation distance is < 50mm:

= $[948 * (1 + \log_{10}(f(\text{MHz})))]/2$

= 1850 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 Zigbee transceiver and 125kHz RFID reader 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 2.4GHz Zigbee operation,

Maximum Time-averaged Conducted Power of this device = **2.51 mW**

Therefore, the Estimated SAR will be determined as follow,

$$\begin{aligned}\text{Estimated SAR} &= (\sqrt{F(\text{GHz})} / 7.5) \times (P_{\text{max}} / TD) \\ &= \mathbf{0.1054 \text{ W/kg}}\end{aligned}$$

where $P_{\text{max}} = 2.51 \text{ mW}$, $TD = 5 \text{ mm}$ and $F(\text{GHz}) = 2.480 \text{ GHz}$

For 125kHz RFID reader operation,

Maximum Time-averaged Conducted Power of this device = **0.006 mW**

Therefore, the Estimated SAR will be determined as follow,

$$\begin{aligned}\text{Estimated SAR} &= (\sqrt{F(\text{GHz})} / 7.5) \times (P_{\text{max}} / TD) \\ &= \mathbf{0.000001788 \text{ W/kg}}\end{aligned}$$

where $P_{\text{max}} = 0.006 \text{ mW}$, $TD = 5 \text{ mm}$ and $F(\text{GHz}) = 0.000125 \text{ GHz}$

Simultaneous Transmission Analysis

2.4GHz Zigbee SAR (W/kg)	125kHz RFID reader SAR (W/kg)	Σ SAR (W/kg)	Simultaneous SAR Required
0.1054	0.000001788	0.105401788	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.