

INTERTEK TESTING SERVICES

RF Exposure

The equipment under test (EUT) is Bluetooth Adapter for Switch-BLK with Bluetooth function operating at 2.4G Band. The EUT can be powered by DC 5.0V: Powered by SWITCH. For more detail information pls. refer to the user manual.

BT function:

Antenna Type: Integral antenna.

Antenna Gain: 0dBi.

The normal radiated output power (e.i.r.p) is: -0.5dBm (tolerance: +/- 2dB).

The normal conducted output power is -0.5dBm (tolerance: +/- 2dB).

Modulation Type: GFSK, $\pi/4$ -DQPSK, 8-DPSK.

According to the KDB 447498:

The Maximum peak radiated emission for the EUT is 96.3 dB μ V/m at 3m in the frequency 2441MHz

The EIRP = $[(FS \cdot D)^2 / 30]$ mW = 1.07dBm

which is within the production variation.

The Minimum peak radiated emission for the EUT is 93.3 dB μ V/m at 3m in the frequency 2402MHz

The EIRP = $[(FS \cdot D)^2 / 30]$ mW = -1.93dBm

which is within the production variation.

The maximum conducted output power specified is 1.5dBm= 1.413mW

The source- based time-averaging conducted output power

=1.413* Duty cycle mW

=1.413 *83.33% mW

=1.18mW

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 source-based time-averaging conducted output power is well below the SAR low threshold level, so the EUT is considered to comply with SAR requirement without testing.

Worst Duty cycle on DH5 mode = 5/6 = 83.33%

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BLE function:

Antenna Type: Integral antenna.

Antenna Gain: 0dBi.

The normal radiated output power (e.i.r.p) is: -2.0dBm (tolerance: +/- 2dB).

The normal conducted output power is -2.0dBm (tolerance: +/- 2dB).

Modulation Type: GFSK.

According to the KDB 447498:

The Maximum peak radiated emission for the EUT is 94.6 dB μ V/m at 3m in the frequency 2480MHz

The EIRP = $[(FS \cdot D)^2 / 30]$ mW = -0.63dBm

which is within the production variation.

The Minimum peak radiated emission for the EUT is 92.4 dB μ V/m at 3m in the frequency 2402MHz

The EIRP = $[(FS \cdot D)^2 / 30]$ mW = -2.83dBm

which is within the production variation.

The maximum conducted output power specified is 0.0dBm=1.0mW

The source- based time-averaging conducted output power
= $1.0 \cdot \text{Duty cycle}$ mW = 1.0mW (Duty cycle =100%)

The SAR Exclusion Threshold Level:

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

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

= 9.53 mW

Since the source-based time-averaging conducted output power is well below the SAR low threshold level, so the EUT is considered to comply with SAR requirement without testing.

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Simultaneous SAR Considerations:

The EUT can work with SWITCH console which has WIFI and Bluetooth functions. According to KDB 447498 D01, section 4.3.2 b), When an antenna qualifies for the standalone SAR test exclusion of 4.3.1 and also transmits simultaneously with other antennas, the standalone SAR value must be estimated according to the following to determine the simultaneous transmission SAR test exclusion criteria:

$$\left[\frac{\text{(max. power of channel, including tune-up tolerance, mW)}}{\text{(min. test separation distance, mm)}} \right] \cdot \left[\frac{\sqrt{f(\text{GHz})}}{x} \right] \text{ W/kg, for test separation distances } \leq 50 \text{ mm; where } x = 7.5 \text{ for 1-g SAR and } x = 18.75 \text{ for 10-g SAR.}$$

The estimated 1-g SAR value of the EUT
$$= (1.18 \text{ mW}/5 \text{ mm}) \cdot (2.48^{0.5})/7.5 \text{ W/kg} = 0.0496 \text{ W/kg}$$

Based on FCC ID:BKEHAC001 test report, the sum SAR value of simultaneous transmission for the SWITCH console and EUT can be calculated as below:

Simultaneous transmission for WLAN ANT0 and EUT ANT_{EUT}:

The sum SAR value = $1.55 \text{ W/Kg} + 0.0496 \text{ W/kg} = 1.5996 \text{ W/Kg}$

Simultaneous transmission for WLAN ANT1 and EUT ANT_{EUT}:

The sum SAR value = $0.503 \text{ W/Kg} + 0.0496 \text{ W/kg} = 0.5526 \text{ W/Kg}$

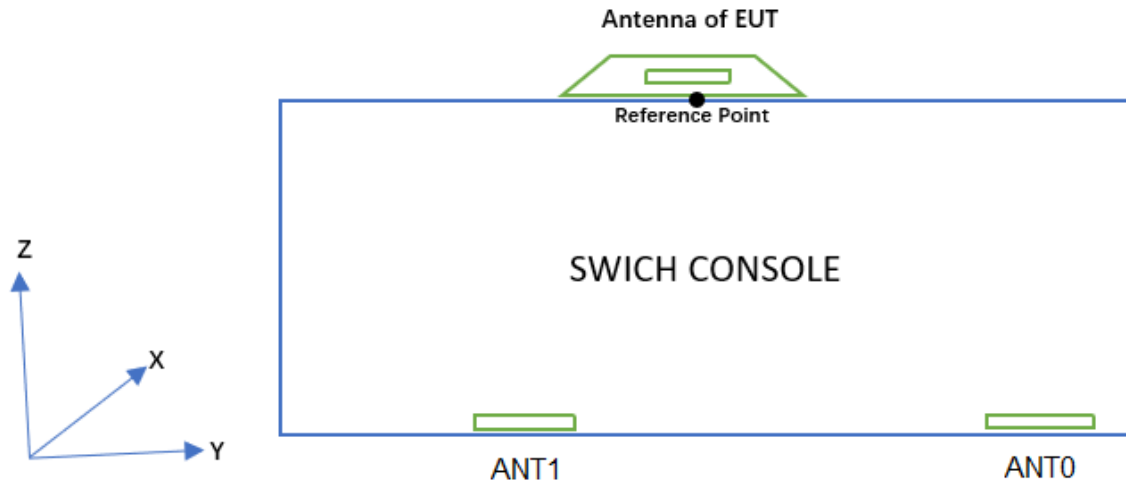
Simultaneous transmission for WLAN ANT0, WLAN ANT1 and EUT ANT_{EUT}:

The sum SAR value = $0.0496 \text{ W/Kg} + 1.55 \text{ W/Kg} + 0.166 = 1.7656 \text{ W/Kg} \geq 1.6 \text{ W/Kg}$

According to the KDB 447498 D01, When the sum of SAR value exceeded 1.6 W/kg , SPLSR evaluation is required. The simultaneously transmitting antennas in each operating mode and exposure condition combination must be considered one pair at a time to determine the SAR to peak location separation ratio to qualify for test exclusion.

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Antenna Location



	X(mm)	Y(mm)	Z(mm)
ANT0	2	71	-177
ANT1	3	-33	-178
ANT _{EUT}	9	-2	7

- 1) The x, y, z coordinates of ANT0 and ANT1 which located within the SWICH console and the SPLSR estimated result can be found in the FCC ID:BKEHAC001 test report.
- 2) SPLSR evaluation for ANT0 located in the SWICH console and ANT_{EUT} located in the EUT are shown as below:

Coordinates of the transmitting antennas

	x(mm)	y(mm)	z(mm)
ANT0	2	71	-177
ANT _{EUT}	9	-2	7

Note: $R_i = \text{SQRT}[(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2]$

SPLSR estimated Result

WLAN ANT0 SAR1(W/kg)	EUT ANT _{EUT} SAR2(W/kg)	$\sum 1\text{-g SAR}$ (W/kg)	Calculated Distance R _i (mm)	SPLSR (≤ 0.04)
1.550	0.0496	1.5996	198	0.01

Note: $\text{SPLSR} = (\text{SAR1} + \text{SAR2})^{1.5} / R_i$

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- 3) SPLSR evaluation for ANT1 located in the SWITCH console and ANT_{EUT} located in the EUT are shown as below:

Coordinates of the transmitting antennas

	x(mm)	y(mm)	z(mm)
WLAN ANT1	3	-33	-178
ANT _{EUT}	9	-2	7

Note: $R_i = \text{SQRT}[(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2]$

SPLSR estimated Result

WLAN ANT1 SAR1(W/kg)	EUT ANT _{EUT} SAR2(W/kg)	$\sum 1\text{-g SAR}$ (W/kg)	Calculated Distance R_i (mm)	SPLSR (≤ 0.04)
0.503	0.0496	0.5526	188	0.002

Note: $\text{SPLSR} = (\text{SAR1} + \text{SAR2})^{1.5}/R_i$

Conclusion:

Simultaneous transmission SAR measurement is not required because the either sum of the 1-g SAR is <1.6W/kg or SPLSR is <0.04 for all circumstances that require SPLSR calculation.