



a Laird Business

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RF Evaluation Exclusion Exhibit For:

Skynet Beacon

Prepared by:

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Product Description:

The Skynet Beacon is a wearable beacon that will be placed in a pendant or wristband. It acts as an un-connectable advertiser that sends an advertising packet once a second. Encoded in the advertising packets are rssi, button status, and battery level.

Statement of compliance:

The Skynet Beacon was evaluated against the requirements and limits of FCC Title 47 part 1.1310 and 2.1091, with the guidance of KDB 447498, the limits of RSS-102 and were found to be compliant.

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Limits:

Per 1-g and 10-g SAR test exclusion from FCC KDB 447498:

For 100 MHz to 6 GHz and *test separation distances* \leq 50 mm, the 1-g and 10-g *SAR test exclusion thresholds* are determined by the following:

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f_{(\text{GHz})}}] \leq 3.0 \text{ for 1-g SAR, and } \leq 7.5 \text{ for 10-g extremity SAR,}^{30} \text{ where}$

- $f_{(\text{GHz})}$ is the RF channel transmit frequency in GHz

Limits per RSS-102 Ed. 5:

Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance^{4,5}

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of \leq 5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

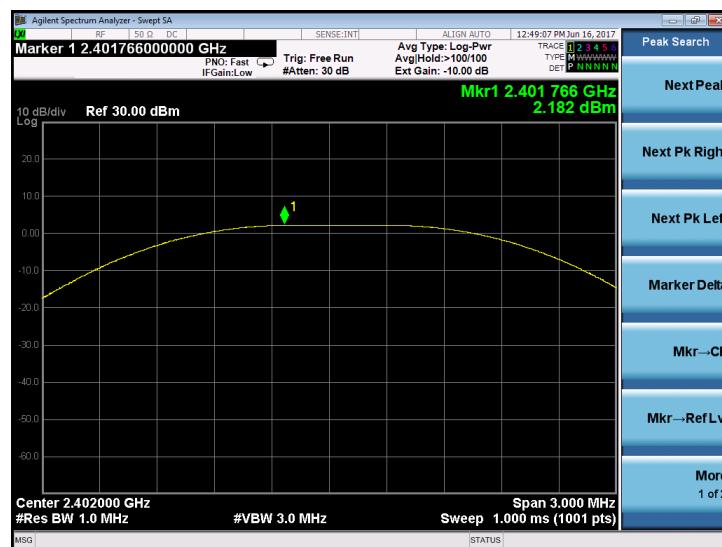
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Data and calculations:

The Published Peak Antenna Gain of the Inverted F PCB Antenna is +5.3 dBi with a tune-up tolerance was of +3 dB per the manufacturer.

Screen Capture of maximum output power at Antenna



Frequency 2402 MHz; GFSK

A. Calculations – BLE

The following calculations are based on a measured conducted RF power of +2.182 dBm at 2402 MHz as presented to the antenna and a +3.0 dB tune-up tolerance. The peak gain of this antenna is +5.3 dBi. The test separation distance will be \leq 5mm in the following calculations since the Equipment is body worn.

Exemption Calculation

Duty Cycle:

The below plots represent the worst case: when a person is in motion while wearing the Beacon



Maximum transmit envelope = 6.021 ms



Minimum separation between adjacent packets = 1531.4 ms



$$\begin{aligned} \text{Duty Cycle correction} &= 10\log \left(\frac{\text{Ton}}{\text{Period}} \right) = 10\log \left(\frac{(6.021\text{ms})}{(1531.4\text{ms}+6.021\text{ms})} \right) \\ &= -24.07 \text{ dB} \end{aligned}$$

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Per FCC KDB 447498 D01 v06:

For 100 MHz to 6 GHz and *test separation distances* \leq 50 mm, the 1-g and 10-g *SAR test exclusion thresholds* are determined by the following:

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f_{(\text{GHz})}}] \leq 3.0 \text{ for 1-g SAR, and } \leq 7.5 \text{ for 10-g extremity SAR,}^{30} \text{ where}$

- $f_{(\text{GHz})}$ is the RF channel transmit frequency in GHz

Calculations:

Conducted output power = 2.182 dBm

Source based time averaged power = 2.182dBm - 24.07dB = -21.89dBm

Frequency/Channel = 2402MHz

Tune-up tolerance = +3 dB

Test separation distance: **< 5mm**

Channel power = Source based time averaged power + tune-up tolerance

= -21.89dBm + 3dB = **-18.89 dBm**

= **0.013 mW**

$$(0.013/5) * (\sqrt{2.402}) = 0.004 < 3.0$$

Conclusion:

The Skynet Beacon is exempt from SAR evaluation when used at a distance of \leq 5mm.

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Per RSS-102:

Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance^{4,5}

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤ 5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤ 300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥ 50 mm
≤ 300	223 mW	254 mW	284 mW	315 mW	345 mW
450	141 mW	159 mW	177 mW	195 mW	213 mW
835	80 mW	92 mW	105 mW	117 mW	130 mW
1900	99 mW	153 mW	225 mW	316 mW	431 mW
2450	83 mW	123 mW	173 mW	235 mW	309 mW
3500	86 mW	124 mW	170 mW	225 mW	290 mW
5800	56 mW	71 mW	85 mW	97 mW	106 mW

For 2402 MHz, at separation distance ≤ 5 mm, using linear interpolation the

Exemption limit = 4.26mW.

Calculations:

Conducted output power = 2.182 dBm

Source based time averaged power = 2.18dBm-24.07dB = -21.89 dBm

Frequency/Channel = 2402MHz

Tune-up tolerance = +3dB

Antenna gain = +5.3 dBi

Test separation distance: < 5mm

EIRP = Source based time averaged power + tune-up tolerance + antenna gain

= -21.89dBm + 3dB + 5.3dBi = -13.59 dBm

= 0.044 mW < 4.26mW

Conclusion:

The Skynet Beacon is exempt from SAR evaluation when used at a distance of ≤ 5 mm.