W66 N220 Commerce Court ● Cedarburg, WI 53012
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RF Evaluation Exclusion Exhibit For:

X3 Pak Alert SE7

Prepared by:

Coty Hammerer, EMC Engineer

9/17/17

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Product Description:

The SCOTT PAK-TRACKER Locator System is a two part electronic system consisting of a PAK-TRACKER Transmitter, which is integrated into the PAK- ALERT SE + distress alarm, and a PAK-TRACKER Hand Held Receiver, which is a directional receiver or “sniffer” used to locate the signal coming from the PAK-TRACKER Transmitter.

The PAK-TRACKER Transmitter works in conjunction with the PAK-ALERT SE + distress alarm. A short time after activation of the full alarm, the unit begins transmitting a signal with a unique ID number that can be received by the PAK-TRACKER Hand Held Receiver.

The PAK-TRACKER Hand Held Receiver is then used as a directional sensor to lead the rescue crew to the downed user. By pointing the PAK-TRACKER Hand Held Receiver in the direction of the strongest signal, the rescue crew can follow the signal to the downed user.

A BLE radio transceiver is provided as a tunnel for accessing stored data concerning PAK operation.

Statement of compliance:

The Tyco/ Scott Health and Safety X3 Pak Alert SE7 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* ≤ 50 mm, the 1-g and 10-g *SAR test exclusion thresholds* are determined by the following:

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

- $f_{(GHz)}$ 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 ≤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 AT3216-B2R7HAA_S-R00-N198 BLE Chip Antenna is +0.5 dBi and the Peak Antenna Gain of the Custom Model 200764 MICROSTRIP Proprietary Antenna was calculated to be +2.1 dBi. The tune-up tolerance was calculated to be +3 dB.

A. Calculations – BLE

The following calculations are based on a measured conducted RF power of +3.75 dBm at 2440 MHz as presented to the antenna and a +3.0 dB tune-up tolerance. The peak gain of this antenna is +0.5 dBi. The test separation distance will be 10mm in the following calculations. Refer to photos on page 13, distance from antennas to body is 25mm.

RF power at the Antenna + Tune-Up Tolerance = 3.75 dBm + 3.0dB = 6.75 dBm = 4.73 mW

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

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

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

[4.73/10]*[$\sqrt{2.440}$] ≤ 3

0.74 ≤ 3

Therefore, per KDB 447498 D01 v06, since 0.33 < 3 the X3 Pak Alert SE7 complies.

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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
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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 2440MHz, at separation distance ≤ 10mm, using linear interpolation the

Exemption limit = **7.05mW**

Calculations:

Conducted output power = 3.75 dBm
Frequency/Channel = 2440MHz
Tune-up tolerance = 3dB
Antenna gain = 0.5dBi
Test separation distance: **< 10mm**

EIRP = Source based time averaged power + tune-up tolerance + antenna gain
= 3.75dBm + 3dB + 0.5dBi = **7.25dBm = 5.31mW**
= **5.31 mW < 7.05mW**

Conclusion: The X3 Pak Alert SE7 is exempt from SAR evaluation when used at a distance of ≤10mm.

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The X3 Pak Alert SE7 is exempt from SAR evaluation when used at a distance of ≤ 10mm.

B. Calculations – 802.15.4

The following calculations are based on a measured conducted RF power of +19.0 dBm at 2425 MHz as presented to the antenna and a +3.0 dB tune-up tolerance. The peak gain of this antenna is +2.1 dBi. The test separation distance will be 25mm or 5mm to show worst case if compliant at 5mm.

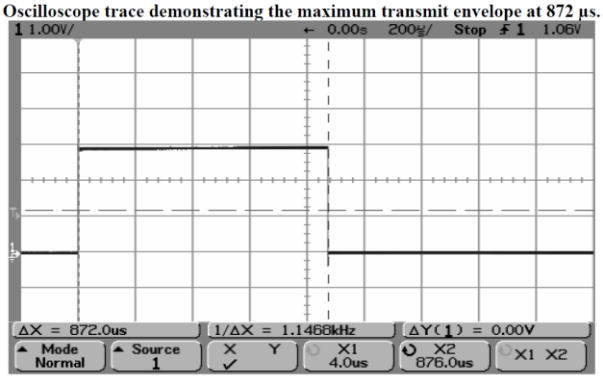
Exemption Calculation

Duty Cycle:

Per theory of operation:

"The device operates in a packet mode only. No continuous RF carrier is possible. Each packet is 872 µs long and is repeated at a rate of 4 times per second. The average time between packets is ¼ second but they will dither in time. The shortest repetition between two adjacent packets is 173 ms."

Oscilloscope trace demonstrating the maximum transmit envelope at 872 µs.



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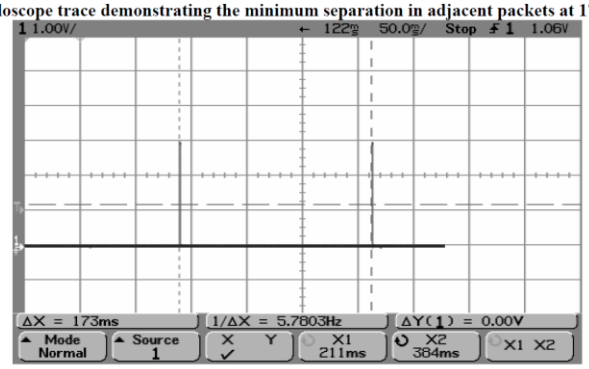
Oscilloscope trace demonstrating the minimum separation in adjacent packets at 173 ms.



Duty Cycle correction = 10log (Ton/Period) = 10log ((0.872ms)/(173.0ms+0.872ms)) = -23.0dB

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

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

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

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

Calculations:

Conducted output power = 19.0 dBm
Source based time averaged power = 19.0dBm-23.0dB = -4.0dBm
Frequency/Channel = 2425MHz
Tune-up tolerance = 3 dB
Test separation distance: **< 5mm**

Channel power = Source based time averaged power + tune-up tolerance
= -4.0dBm + 3dB = **-1.0 dBm**
= **0.79 mW**

(0.79/5)*(√(2.425)) = 0.25 < 3.0

Conclusion:

The X3 Pak Alert SE7 is exempt from SAR evaluation when used at a distance of ≤ 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
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For 2425MHz, at separation distance ≤ 5mm, using linear interpolation the

Exemption limit = **4.1mW**

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Calculations:

Conducted output power = 19.0 dBm
Source based time averaged power = 19.0dBm-23.0dB = -4.0dBm
Frequency/Channel = 2425MHz
Tune-up tolerance = 3dB
Antenna gain = 2.1dBi
Test separation distance: **≤ 5mm**

EIRP = Source based time averaged power + tune-up tolerance + antenna gain
= -4.0dBm + 3dB + 2.1dBi = **1.1dBm**
= **1.29 mW < 4.1mW**

Conclusion:

The X3 Pak Alert SE7 is exempt from SAR evaluation when used at a distance of ≤ 5mm.

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Simultaneous Transmission with BLE + Proprietary Radios

BLE threshold from + 802.15.4 threshold ≤ 3.0, assuming a 10 cm distance:

[4.73/10]*[$\sqrt{2.440}$] + [(0.79/10)*(√(2.425))] ≤ 3, Here 0.74 +0.12 = 0.86 ≤ 3 assuming a 10mm distance with both radios simultaneously transmitting.

Max BLE power at antenna terminal (adjusted for tune-up tolerance and Antenna Gain) + Max 802.15.4 power at antenna terminal (adjusted for tune-up tolerance and Antenna Gain) ≤ 7.05 mW

7.25dBm + 1.1dBm = 8.35 dBm =6.84 mW ≤ 7.05 mW at a 10mm separation distance.

Therefore, the value calculated for Simultaneous transmission in this case meets the requirement of RSS-102 using the methods of KDB 447498.

The Antennas will be a distance of 25mm from the closest point of the human body, refer to pg. 13 of this document.

The calculations above show compliance can be met at a distance of ≤ 10cm and therefore SAR Testing is not required.

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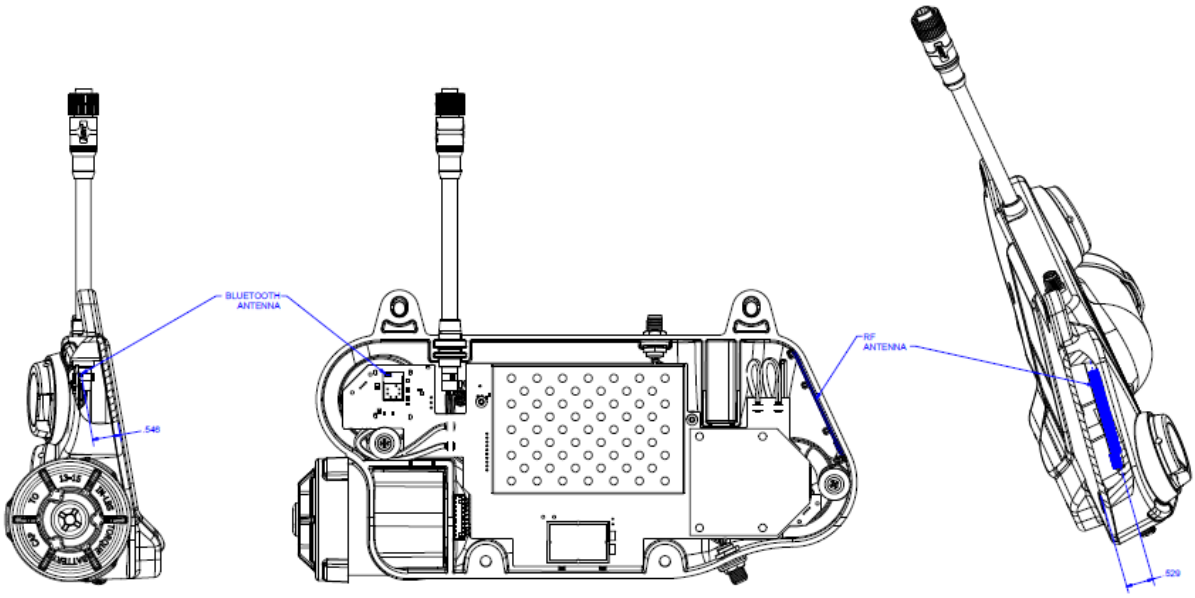
Radio Locations



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Photos of EUT on A Person