



FCC & ISED RF Exposure technical brief

Product/Client information:

EUT Name: **A20-Nexus**

EUT Model: 10873

Applicant: Sound Devices LLC

Address: E7556 State Road 23 and 33
Reedsburg, Wisconsin
53959
USA

FCC ID: **2AKLX-10873**

IC ID: **22225-10873**

Product Description:

The **A20-Nexus** is a multi-channel wireless microphone receiver with a Bluetooth Low Energy and a Proprietary long range 2.4GHz FHSS Transmitter. The device is a mobile device that is used in professional program making and special events applications. As such RF exposure distance can be controlled by installation. For the purposes of this exclusion calculation a distance of 200mm has been declared as the worst case, and the power used is either the maximum field strength measured from the device, or maximum conducted power measured of the device. The Bluetooth LE operates using a low channel of 2402 MHz and a High channel of 2480 MHz and with a maximum declared duty cycle of 10%. The proprietary 2.4 GHz FHSS operates using 2400.8 MHz low channel and 2481.6 MHz High channel and with a maximum duty cycle declared of 20%. Each transmitter utilises the same two RF ports via RF switching. The two transmitters do not simultaneously transmit in operation, this is managed in the control software. Therefore, RF exposure is calculated for each transmitter operating individually using the following maximum powers stated from either port A or Port B, including tune up tolerance.

Measured Power values.

FHSS Proprietary 2.4GHz measured Peak radiated field strength:

Low channel 105.9 dBuV/m @3m (Port A) = 10.7 dBm / 11.75 mW

Mid channel 105.7 dBuV/m @3m (Port A) = 10.5 dBm / 11.22 mW

High channel 106.7 dBuV/m @3m (Port A) = 11.5 dBm / 14.13 mW

FHSS Proprietary 2.4GHz measured Peak Conducted Power:

Low channel 7.04 dBm (Port A)

Mid channel 6.67 dBm (Port A)

High channel 7.29 dBm (Port A)

Bluetooth Low Energy 2.4GHz measured Peak radiated field strength:

Low channel 100.3 dBuV/m @3m (Port B) = 5.1 dBm / 3.24 mW

Mid channel 101.8 dBuV/m @3m (Port B) = 6.6 dBm / 4.57 mW

High channel 99.8 dBuV/m @3m (Port B) = 4.6 dBm / 2.88 mW

Bluetooth Low Energy 2.4GHz measured Peak Conducted Power:

Low channel 4.24 dBm (Port B)

Mid channel 4.86 dBm (Port B)

High channel 3.70 dBm (Port B)



FCC RF Exposure.

FCC Evaluation is for exposure potential against the Exclusion limits given in **KDB447498 D01 v06** section 4.3.1.

Exclusion requirements are based upon 10g SAR exclusion for extremities.

Proprietary 2.4GHz transmitter:

Equation of 4.3.1. part 1A Transposed is:

Exclusion in mW = ((Threshold / (\sqrt{F})) * D)

where: Threshold = 7.5 for 10g SAR Extremities

F = Frequency in GHz (2.4008 GHz) & (2.4408 GHz) & (2.4816 GHz)

D = Separation distance in mm (200mm)

Threshold in mW for 2400.8 MHz = 242.021 mW (power allowed at numeric threshold for 50mm) (step a)

Threshold in mW for 2440.8 MHz = 240.029 mW (power allowed at numeric threshold for 50mm) (step a)

Threshold in mW for 2481.6 MHz = 238.048 mW (power allowed at numeric threshold for 50mm) (step a)

Based on channel results above and KDB447498 D01 v06 4.3.1. part b)2):

B2) {[Power allowed at numeric threshold for 50 mm in step a)] + [(test separation distance – 50 mm * 10) mW, for >1500 MHz and <6 GHz frequency range.}

(Using channel frequencies above and separation distance of 200mm) we have

$$= 242.021 \text{ mW} + (200\text{mm}-50\text{mm} * 10)$$

$$= 240.029 \text{ mW} + (200\text{mm}-50\text{mm} * 10)$$

$$= 238.048 \text{ mW} + (200\text{mm}-50\text{mm} * 10)$$

Therefore, exclusion for Proprietary 2.4 GHz transmitter per channel at 200mm distance is:

Low channel 2400.8 MHz = 1742 mW.

Mid channel 2440.8 MHz = 1740 mW.

Top channel 2481.6 MHz = 1738 mW.

Measured maximum peak Radiated value for the EUT in Proprietary 2.4 GHz mode was: 106.7dBuV/m @ 3m (on high channel 2481.6 MHz) which is +11.5 dBm (or 14.13 mW). Adding 2dB for tune up tolerance adjustment gives 13.5dBm / 22.38mW worst case. Antenna gain is included in the field strength measurements. These figures are for a 100% Transmit EUT Duty cycle.

Measured maximum Peak Conducted power was 7.29dBm (5.36 mW) Adding 2dB for tune up tolerance adjustment gives 9.29dBm / 8.49 mW worst case. These figures are for a 100% Transmit EUT Duty cycle.

Maximum Declared duty cycle for proprietary 2.4GHz transmitter operation is 20% and as such, time averaged power would be much lower, however for the purpose of this calculation a 100% duty cycle is used.

Based on the above the EUT in proprietary 2.4GHz mode is excluded from FCC RF Exposure / SAR testing requirements.



Bluetooth 2.4GHz transmitter:

Equation of 4.3.1. part 1A Transposed is:

$$\text{Exclusion in mW} = ((\text{Threshold} / (\sqrt{F})) * D)$$

where: Threshold = 7.5 for 10g SAR Extremities

F = Frequency in GHz (2.402 GHz) & (2.440 GHz) & (2.480 GHz)

D = Separation distance in mm (200mm)

Threshold in mW for 2402MHz = 241.960 mW (power allowed at numeric threshold for 50mm) (step a)

Threshold in mW for 2440 MHz = 240.069 mW (power allowed at numeric threshold for 50mm) (step a)

Threshold in mW for 2480 MHz = 238.125 mW (power allowed at numeric threshold for 50mm) (step a)

Based on channel results above and KDB447498 D01 v06 4.3.1. part b2):

B2) {[Power allowed at numeric threshold for 50 mm in step a)] + [(test separation distance – 50 mm * 10) mW, for >1500 MHz and <6 GHz frequency range.}

(Using channel frequencies above and separation distance of 200mm) we have

$$= 241.960 \text{ mW} + (200\text{mm}-50\text{mm} * 10)$$

$$= 240.069 \text{ mW} + (200\text{mm}-50\text{mm} * 10)$$

$$= 238.125 \text{ mW} + (200\text{mm}-50\text{mm} * 10)$$

Therefore, exclusion for Bluetooth LE 2.4 GHz transmitter per channel at 200mm distance is:

Low channel 2402 MHz = 1742 mW.

Mid channel 2440 MHz = 1740.1 mW.

Top channel 2480 MHz = 1738.1 mW.

Measured maximum peak Radiated value for the EUT in Bluetooth LE 2.4 GHz mode was: 101.8dBuV/m @ 3m (on Middle channel 2440 MHz) which is +6.6 dBm (or 4.57 mW). Adding 2dB for tune up tolerance adjustment gives 8.6dBm / 7.24mW worst case. Antenna gain is included in the field strength measurements. These figures are for a 100% Transmit EUT Duty cycle.

Measured maximum Peak Conducted power was 4.86dBm (3.06 mW) Adding 2dB for tune up tolerance adjustment gives 8.86dBm / 4.85 mW worst case. These figures are for a 100% Transmit EUT Duty cycle.

Maximum Declared duty cycle for Bluetooth LE 2.4GHz transmitter operation is 10% and as such, time averaged power would be much lower, however for the purpose of this calculation a 100% duty cycle is used.

Based on the above the EUT in Bluetooth LE 2.4GHz mode is excluded from FCC RF Exposure / SAR testing requirements.



ISED RF EXPOSURE.

With reference to ISED standard **RSS-102 issue 5** section 2.5.2 Exemption limits for routine evaluation – RF Exposure evaluation.

Bullet point 4) At or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;

Proprietary 2.4GHz transmitter:

$$1.31 \times 10^{-2} \times 2400.8^{0.6834} (\text{W}) = 2.676 \text{ W}$$

$$1.31 \times 10^{-2} \times 2440.8^{0.6834} (\text{W}) = 2.706 \text{ W}$$

$$1.31 \times 10^{-2} \times 2481.6^{0.6834} (\text{W}) = 2.737 \text{ W}$$

Measured maximum peak Radiated value for the EUT in Proprietary 2.4 GHz mode was: 106.7dBuV/m @ 3m (on high channel 2481.6 MHz) which is +11.5 dBm (or 14.13 mW). Adding 2dB for tune up tolerance adjustment gives 13.5dBm / 22.38mW worst case. Antenna gain is included in the field strength measurements. These figures are for a 100% Transmit EUT Duty cycle.

Therefore, the EUT in proprietary 2.4GHz mode meets the exemption limits from routine evaluation, even before the duty cycle of 20% has been taken into consideration.

Bluetooth 2.4GHz transmitter:

$$1.31 \times 10^{-2} \times 2402^{0.6834} (\text{W}) = 2.676 \text{ W}$$

$$1.31 \times 10^{-2} \times 2440^{0.6834} (\text{W}) = 2.705 \text{ W}$$

$$1.31 \times 10^{-2} \times 2480^{0.6834} (\text{W}) = 2.736 \text{ W}$$

Measured maximum peak Radiated value for the EUT in Bluetooth LE 2.4 GHz mode was: 101.8dBuV/m @ 3m (on Middle channel 2440 MHz) which is +6.6 dBm (or 4.57 mW). Adding 2dB for tune up tolerance adjustment gives 8.6dBm / 7.24mW worst case. Antenna gain is included in the field strength measurements. These figures are for a 100% Transmit EUT Duty cycle.

Therefore, the EUT in Bluetooth LE 2.4GHz mode meets the exemption limits from routine evaluation, even before the duty cycle of 10% has been taken into consideration.

This RF exclusion calculation was prepared by Daniel Sims of RN Electronics Ltd acting as Agent for this application.

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