

RF Exposure- Specific Absorption Rate (SAR)

Project #:	G101122982	Test Area:	Intertek Louisville
Test Method:	FCC CFR47 Part 1.1310	Test Date:	April-2013
EUT Model #:	Lively 1.0		
EUT Serial #:	DVT101		
Manufacturer:	Hamlet, Inc.		
EUT Description:	LivelyHome System Wireless Sensor – Low-Power DSS		
Notes:	Sensor can be body-worn and/or < 20cm from user		

General SAR test reduction and exclusion guidance - KDB 447498 D01 General RF Exposure Guidance, May 28th, 2013

Standalone SAR test exclusion considerations

Unless specifically required by the *published RF exposure KDB procedures*, standalone 1-g head or body and 10-g extremity SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when the corresponding *SAR Test Exclusion Threshold* condition, listed below, is satisfied.

These test exclusion conditions are based on source-based time-averaged maximum conducted output power of the RF channel requiring evaluation, adjusted for tune-up tolerance, and the minimum *test separation distance* required for the exposure conditions. The minimum *test separation distance* is determined by the smallest distance from the antenna and radiating structures or outer surface of the device, according to the host form factor, exposure conditions and platform requirements, to any part of the body or extremity of a user or bystander (see 5) of section 4.1).

To qualify for SAR test exclusion, the *test separation distances* applied must be fully explained and justified by the operating configurations and exposure conditions of the transmitter and applicable host platform requirements, typically in the SAR measurement or SAR analysis report, according to the required *published RF exposure KDB procedures*.

When no other RF exposure testing or reporting is required, a statement of justification and compliance must be included in the equipment approval, in lieu of the SAR report, to qualify for the SAR test exclusion. When required, the device specific conditions described in the other *published RF exposure KDB procedures* must be satisfied before applying these SAR test exclusion provisions; for example, handheld PTT two-way radios, handsets, laptops & tablets etc.

Maximum conducted and radiated power should both be taken into consideration to establish the worst case aggregate maximum output power.

Test exclusion is applied to the required test channels on a channel by channel basis.

Test Methodology

The purpose of this document is to demonstrate the RF Exposure Safety of Radiation harmfulness to the human body for the product.

The Gain of the antenna used in this product has been declared by the manufacturer and/or taken directly from the antenna specification sheet.

EUT Operation

The software provided by Manufacturer enabled the EUT to transmit data at lowest, middle and highest channel individually.

Classification

The antenna of the product, under normal use condition, is minimum 2.1 cm away from the body of the user. A warning statement to the user for keeping at least 2.1 cm or more separation distance with the antenna should be included in users manual. This device is classified as a Portable Device.

SAR Exclusion Limit Criteria – Numeric Threshold

The following limit is from FCC KDB 447498. Refer to Appendix A of this report for details.

- RF Exposure SAR Exclusion Threshold: ≤ 3.0 (1-g head/body)

Determination of SAR Test Exclusion Threshold

Minimum Test Separation Distance

Manufacturer Statement:

"For the low power exclusion calculation here are the dimensions that set the guaranteed minimum separation distance between the user and the TX antenna:

The result of the mechanical team's review of the Lively keyfob assembly was that the smallest nominal distance between the antenna and the exterior surface was:

- 2.14mm of plastic + air gap
- There is typically 0.5mm of gap between antenna and board edge
- So the nominal separation distance is 2.14 mm + 0.5 mm = 2.64 mm
- However, the minimum distance over production variability, if all tolerance stack **worst case the absolute smallest possible distance is 2.1 mm.**"

The following calculation was used to determine compliance to the above limit.

The following is from FCC KDB 447498 D01 General RF Exposure Guidance, May 28th, 2013.

1. The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances ≤ 50 mm* are determined by:

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

Where

- f (GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

The test exclusions are applicable only when the minimum *test separation distance* is \leq 50 mm and for transmission frequencies between 100 MHz and 6 GHz.

Note: When the minimum *test separation distance* is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

$$S = (P/D) * \sqrt{f}$$

Where:

S = SAR test exclusion threshold (1-g or 10-g)

P = max power input to the antenna (mW)

f = frequency (GHz)

D = test separation distance to the center of radiation of the antenna (cm)

Low-Power DSS 2.4GHz Radio

- Maximum conducted output power to antenna = 2.81mW (see test report 101122982DEN-002)
- Lowest Channel: 2.402GHz
- Highest Channel: 2.480GHz
- Minimum Test Separation Distance: 2.1mm

Final Calculations:

Actual minimum test distance = 2.1mm per manufacturer = 2.0mm (rounded to nearest mm). Per guideline above, when minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

Maximum measured conducted output power = 2.81mW = 3.0mW (rounded to nearest mW - per guideline)

Using worst-case 1-g head/body test exclusion limit (numeric threshold) of 3.0

Low Channel

$\{ \text{Max Power of channel mW} / (\text{Min test separation distance}) * \sqrt{f} \text{GHz} \} \leq 3.0$
 $(3\text{mW} / 5\text{mm}) * \sqrt{2.402} = 0.93$

High Channel

$\{ \text{Max Power of channel mW} / (\text{Min test separation distance}) * \sqrt{f} \text{GHz} \} \leq 3.0$
 $(3\text{mW} / 5\text{mm}) * \sqrt{2.480} = 0.94$

Result:

Therefore, SAR test exclusion applies since $0.94 \leq 3.0$

Appendix A

KDB 447498 D01 General RF Exposure Guidance, May 28th, 2013

1. The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances* \leq 50 mm are determined by:

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

Where

- $f(\text{GHz})$ is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

The test exclusions are applicable only when the minimum *test separation distance* is \leq 50 mm and for transmission frequencies between 100 MHz and 6 GHz.

Note: When the minimum *test separation distance* is $<$ 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

2. At 100 MHz to 6 GHz and for *test separation distances* $>$ 50 mm, the SAR test exclusion threshold is determined according to the following, and as illustrated in Appendix B:26

Case 1: [Power allowed at numeric threshold for 50 mm in step 1) + (test separation distance – 50 mm) \cdot ($f(\text{MHz})/150$) mW, at 100 MHz to 1500 MHz

Case 2: [Power allowed at numeric threshold for 50 mm in step 1) + (test separation distance – 50 mm) \cdot 10] mW at $>$ 1500 MHz and \leq 6 GHz

3. At frequencies below 100 MHz, the following may be considered for SAR test exclusion, and as illustrated in Appendix C:27

Case 1: The power threshold at the corresponding test separation distance at 100 MHz in step 2 is multiplied by $[1 + \log(100/f(\text{MHz}))]$ for *test separation distances* $>$ 50 mm and $<$ 200 mm

Case 2: The power threshold determined by the equation in a) for 50 mm and 100 MHz is multiplied by $\frac{1}{2}$ for *test separation distances* \leq 50 mm

Case 3: SAR measurement procedures are not established below 100 MHz. When SAR test exclusion cannot be applied, a KDB inquiry is required to determine SAR evaluation requirements for any test results to be acceptable.

4. For Simultaneous transmission SAR test exclusion considerations, refer to Section 4.3.2