



PCTEST ENGINEERING LABORATORY, INC.

7185 Oakland Mills Road, Columbia, MD 21046 USA
Tel. +1.410.290.6652 / Fax +1.410.290.6654
<http://www.pctestlab.com>



RF EXPOSURE FCC KDB 447498 CALCULATIONS

Applicant Name:
Owlet Baby Care Inc.
32 W. Center Street
Suite 201
Provo, UT 84601

Date of Testing:
08/08/2016
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Document Serial No.:
0Y1608121326.2AIEP-R1

FCC ID: 2AIEP-OSS1B
APPLICANT: OWLET BABY CARE INC.

DUT Type: Wearable Sensor
Test Methods Applied: FCC KDB 447498, 865664
Model(s): OSS 1.1

According to FCC KDB 447498 D01 4.3, SAR evaluation is not required for this device as the SAR Test Exclusion Threshold condition is satisfied as below:

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

Where,

$$f(\text{GHz}) = 2.5 \text{ GHz}$$

$$\text{max. power of channel, including tune-up tolerance, mW} = 13.5 \text{ dBm} \rightarrow 10.522 \text{ mW}$$

$$\text{Duty Factor} = 47\%$$



$$\text{min. test separation distance} = 5\text{mm}$$

Note: Power and distance are rounded to the nearest mW and mm before calculation

$$\text{FCC 447498 D01 4.3 Formula} = 11.0/5.0 * \text{sqrt}(2.5) = 3.4785 \leq 7.5$$



Therefore, Extremity SAR testing is not required to be tested for this device per FCC KDB 447498.

Note: This revised Test Report (S/N: 0Y1608121326.2AIEP-R1) supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

FCC ID: 2AIEP-OSS1B		RF EXPOSURE REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1608121326.2AIEP-R1	Test Dates: 08/08/2016	DUT Type: Wearable Sensor	Page 1 of 9	

A1. SAR TEST RESULTS (INFORMATION ONLY)

The following annex describes the SAR testing voluntarily performed by the applicant, although excluded for FCC Testing, according to FCC KDB 447498.

FCC ID: 2AIEP-OSS1B	 PCTEST RF EXPOSURE REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1608121326.2AIEP-R1	Test Dates: 08/08/2016	DUT Type: Wearable Sensor	Page 2 of 9

1 DEVICE UNDER TEST (INFORMATIVE ONLY)

1.1 Device Overview

This device is a wearable sensor intended only to be used with the back of the device to be used in close contact (0 mm) with feet. Therefore, this device was evaluated for extremity SAR.

Band & Mode	Operating Modes	Tx Frequency
Bluetooth LE	Data	2402 - 2480 MHz

1.2 Device Serial Numbers

Several samples that are programmed to transmit at one of 3 frequencies (2402, 2440 & 2480 MHz) were used to support SAR testing. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.



Mode	Extremity Serial Number
Bluetooth LE	000B8 / 0008E / 000B2

1.3 Device Holder

The device holder is made out of low-loss POM material having the following dielectric parameters: relative permittivity $\epsilon = 3$ and loss tangent $\delta = 0.02$.

1.4 Extremity Exposure Configurations

The device is evaluated with the back in direct contact against a flat phantom filled with body tissue-equivalent medium, although the 10-g extremity SAR Exclusion Thresholds in KDB Publication 447498 D01v06 show that SAR testing is not required.

FCC ID: 2AIEP-OSS1B	 PCTEST RF EXPOSURE REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1608121326.2AIEP-R1	Test Dates: 08/08/2016	DUT Type: Wearable Sensor	Page 3 of 9

2 SYSTEM VERIFICATION (INFORMATIVE ONLY)

2.1 Tissue Verification

**Table 2-1
Measured Tissue Properties**

			Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ϵ	TARGET Conductivity, σ (S/m)	TARGET Dielectric Constant, ϵ	% dev σ	% dev ϵ
8/8/2016	2450B	22.6	2400	1.975	51.618	1.902	52.767	3.84%	-2.18%
			2450	2.025	51.379	1.950	52.700	3.85%	-2.51%
			2500	2.108	51.169	2.021	52.636	4.30%	-2.79%

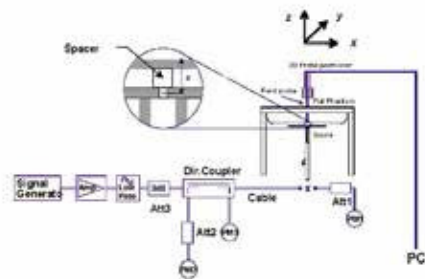
The above measured tissue parameters were used in the DASY software. The DASY software was used to perform interpolation to determine the dielectric parameters at the SAR test device frequencies (per KDB Publication 865664 D01v01r04 and IEEE 1528-2013 6.6.1.2). The tissue parameters listed in the SAR test plots may slightly differ from the table above due to significant digit rounding in the software.

2.2 Test System Verification

Prior to SAR assessment, the system is verified to $\pm 10\%$ of the SAR measurement on the reference dipole at the time of calibration by the calibration facility. Full system validation status and result summary can be found in Appendix E.

**Table 2-2
System Verification Results – 10g**

SAR System #	Tissue Frequency (MHz)	Tissue Type	Date:	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Dipole SN	Probe SN	Measured SAR _{10g} (W/kg)	(I/I)	(I/I)	(%)
E	2450	BODY	08/08/2016	21.7	22.0	0.100	719	7406	2.270	24.300	22.700	-6.58%



**Figure 2-1
System Verification Setup Diagram**



**Figure 2-2
System Verification Setup Photo**

FCC ID: 2AIEP-OSS1B	PCTEST	RF EXPOSURE REPORT	Owint	Reviewed by: Quality Manager
Document S/N: 0Y1608121326.2AIEP-R1	Test Dates: 08/08/2016	DUT Type: Wearable Sensor		Page 4 of 9

3 SAR DATA (INFORMATIVE ONLY)

3.1 Standalone Extremity SAR Data



**Table 3-1
Bluetooth LE Extremity SAR**

MEASUREMENT RESULTS																
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	(10g)	Scaling Factor (Cond. Power)	Scaling Factor (Duty Cycle)	Reported SAR (10g)	Plot #
MHz	Ch.											(W/kg)			(W/kg)	
2402	0	Bluetooth LE	GFSK	13.5	10.97	0.00	0 mm	000B8	1	back	47.0	0.193	1.791	2.128	0.735	A1
2440	19	Bluetooth LE	GFSK	13.5	11.89	-0.02	0 mm	0008E	1	back	47.0	0.109	1.449	2.128	0.336	
2480	39	Bluetooth LE	GFSK	13.5	12.54	0.08	0 mm	000B2	1	back	47.0	0.121	1.247	2.128	0.321	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Extremity 4.0 W/kg (mW/g) averaged over 10 grams									

3.2 SAR Test Notes

General Notes:

1. The Test results show the 10g measured SAR below the 4.0 W/kg Extremity FCC Limit
2. The test data reported are the worst-case SAR values according to test procedures specified in FCC KDB Publication 447498 D01v06.
3. Batteries are fully charged at the beginning of the SAR measurements.
4. Liquid tissue depth was at least 15.0 cm for all frequencies.
5. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
6. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v06.
7. Per FCC KDB 865664 D01v01r04, variability SAR tests were not required since the measured SAR results were less than 2.0 W/kg for 10g SAR. Please see Section **Error! Reference source not found.** for more information.
8. This device was tested at a low duty cycle so that the components and transmitter would operate as expected throughout the duration of the SAR test. The reported SAR was scaled to the 100% transmission duty factor to determine compliance. The EMC Reports contain the calculations and procedures for measuring the duty factor of the device.



FCC ID: 2AIEP-OSS1B		RF EXPOSURE REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1608121326.2AIEP-R1	Test Dates: 08/08/2016	DUT Type: Wearable Sensor		Page 5 of 9

4 EQUIPMENT LIST (INFORMATIVE ONLY)

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Gigatronics	80701A	(0.05-18GHz) Power Sensor	11/4/2015	Annual	11/4/2016	1833460
Agilent	E8257D	(250kHz-20GHz) Signal Generator	3/2/2016	Annual	3/2/2017	MY45470194
Agilent	8753E	(30kHz-6GHz) Network Analyzer	3/2/2016	Annual	3/2/2017	JP38020182
Agilent	8594A	(9kHz-2.9GHz) Spectrum Analyzer	N/A	N/A	N/A	3051A00187
Anritsu	MT8820C	Radio Communication Analyzer	4/14/2016	Annual	4/14/2017	6201240328
Agilent	N9020A	MXA Signal Analyzer	11/5/2015	Annual	11/5/2016	US46470561
Rohde & Schwarz	CMU200	Base Station Simulator	12/2/2015	Annual	12/2/2016	833855/0010
Agilent	E5515C	Wireless Communications Test Set	11/4/2014	Biennial	11/4/2016	GB43193563
Agilent	N4010A	Wireless Connectivity Test Set	N/A	N/A	N/A	GB46170464
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433978
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/10/2016	Annual	5/10/2017	1070
Mitutoyo	CD-6"CSX	Digital Caliper	3/2/2016	Biennial	3/2/2018	13264165
Control Company	4040	Digital Thermometer	3/18/2015	Biennial	3/18/2017	150194896
Control Company	4353	Long Stem Thermometer	3/5/2015	Biennial	3/5/2017	150149565
Seekonk	NC-100	Torque Wrench	11/6/2015	Biennial	11/6/2017	22313
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	CBT	120
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Anritsu	MA2481A	Power Sensor	3/3/2016	Annual	3/3/2017	5318
Anritsu	MA2411B	Pulse Power Sensor	12/7/2015	Annual	12/7/2016	1339018
Anritsu	MA24106A	USB Power Sensor	6/2/2016	Annual	6/2/2017	1244512
Anritsu	MA24106A	USB Power Sensor	6/2/2016	Annual	6/2/2017	1248508
SPEAG	EX3DV4	SAR Probe	4/19/2016	Annual	4/19/2017	7406
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/14/2016	Annual	4/14/2017	1407
SPEAG	D2450V2	2450 MHz SAR Dipole	8/20/2015	Annual	8/20/2016	719



Note:

1. All equipment was used solely within its calibration period.
2. CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.

FCC ID: 2AIEP-OSS1B	 PCTEST Engineering Laboratory, Inc.	RF EXPOSURE REPORT	 Owint Data Solutions	Reviewed by: Quality Manager
Document S/N: 0Y1608121326.2AIEP-R1	Test Dates: 08/08/2016	DUT Type: Wearable Sensor	Page 6 of 9	

5 MEASUREMENT UNCERTAINTIES (INFORMATIVE ONLY)



a	c	d	e= f(d,k)	f	g	h = c x f/e	i = c x g/e	k
Uncertainty Component	$\square\square$ (\pm %)	Prob. Dist.	Div.	c_i 1gm	c_i 10 gms	1gm u_i (\pm %)	10gms u_i (\pm %)	v_i
Measurement System								
Probe Calibration	6.55	N	1	1.0	1.0	6.6	6.6	∞
Axial Isotropy	0.25	N	1	0.7	0.7	0.2	0.2	∞
Hemishperical Isotropy	1.3	N	1	0.7	0.7	0.9	0.9	∞
Boundary Effect	2.0	R	1.73	1.0	1.0	1.2	1.2	∞
Linearity	0.3	N	1	1.0	1.0	0.3	0.3	∞
System Detection Limits	0.25	R	1.73	1.0	1.0	0.1	0.1	∞
Readout Electronics	0.3	N	1	1.0	1.0	0.3	0.3	∞
Response Time	0.8	R	1.73	1.0	1.0	0.5	0.5	∞
Integration Time	2.6	R	1.73	1.0	1.0	1.5	1.5	∞
RF Ambient Conditions - Noise	3.0	R	1.73	1.0	1.0	1.7	1.7	∞
RF Ambient Conditions - Reflections	3.0	R	1.73	1.0	1.0	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	0.4	R	1.73	1.0	1.0	0.2	0.2	∞
Probe Positioning w/ respect to Phantom	6.7	R	1.73	1.0	1.0	3.9	3.9	∞
Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation	4.0	R	1.73	1.0	1.0	2.3	2.3	∞
Test Sample Related								
Test Sample Positioning	2.7	N	1	1.0	1.0	2.7	2.7	35
Device Holder Uncertainty	1.67	N	1	1.0	1.0	1.7	1.7	5
Output Power Variation - SAR drift measurement	5.0	R	1.73	1.0	1.0	2.9	2.9	∞
SAR Scaling	0.0	R	1.73	1.0	1.0	0.0	0.0	∞
Phantom & Tissue Parameters								
Phantom Uncertainty (Shape & Thickness tolerances)	7.6	R	1.73	1.0	1.0	4.4	4.4	∞
Liquid Conductivity - measurement uncertainty	4.2	N	1	0.78	0.71	3.3	3.0	10
Liquid Permittivity - measurement uncertainty	4.1	N	1	0.23	0.26	1.0	1.1	10
Liquid Conductivity - Temperature Uncertainty	3.4	R	1.73	0.78	0.71	1.5	1.4	∞
Liquid Permittivity - Temperature Uncertainty	0.6	R	1.73	0.23	0.26	0.1	0.1	∞
Liquid Conductivity - deviation from target values	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Permittivity - deviation from target values	5.0	R	1.73	0.60	0.49	1.7	1.4	∞
Combined Standard Uncertainty (k=1)	RSS					11.5	11.3	60
Expanded Uncertainty (95% CONFIDENCELEVEL)	k=2					23.0	22.6	

FCC ID: 2AIEP-OSS1B	 RF EXPOSURE REPORT 		Reviewed by: Quality Manager
Document S/N: 0Y1608121326.2AIEP-R1	Test Dates: 08/08/2016	DUT Type: Wearable Sensor	Page 7 of 9



6

REFERENCES (INFORMATIVE ONLY)

- [1] Federal Communications Commission, ET Docket 93-62, Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation, Aug. 1996.
- [2] ANSI/IEEE C95.1-2005, American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 3kHz to 300GHz, New York: IEEE, 2006.
- [3] ANSI/IEEE C95.1-1992, American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 3kHz to 300GHz, New York: IEEE, Sept. 1992.
- [4] ANSI/IEEE C95.3-2002, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave, New York: IEEE, December 2002.
- [5] IEEE Standards Coordinating Committee 39 –Standards Coordinating Committee 34 – IEEE Std. 1528-2013, IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.
- [6] NCRP, National Council on Radiation Protection and Measurements, Biological Effects and Exposure Criteria for RadioFrequency Electromagnetic Fields, NCRP Report No. 86, 1986. Reprinted Feb. 1995.
- [7] T. Schmid, O. Egger, N. Kuster, Automated E-field scanning system for dosimetric assessments, IEEE Transaction on Microwave Theory and Techniques, vol. 44, Jan. 1996, pp. 105-113.
- [8] K. Pokovic, T. Schmid, N. Kuster, Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequencies, ICECOM97, Oct. 1997, pp. 1 -124.
- [9] K. Pokovic, T. Schmid, and N. Kuster, E-field Probe with improved isotropy in brain simulating liquids, Proceedings of the ELMAR, Zadar, Croatia, June 23-25, 1996, pp. 172-175.
- [10] Schmid & Partner Engineering AG, Application Note: Data Storage and Evaluation, June 1998, p2.
- [11] V. Hombach, K. Meier, M. Burkhardt, E. Kuhn, N. Kuster, The Dependence of EM Energy Absorption upon Human Modeling at 900 MHz, IEEE Transaction on Microwave Theory and Techniques, vol. 44 no. 10, Oct. 1996, pp. 1865-1873.
- [12] N. Kuster and Q. Balzano, Energy absorption mechanism by biological bodies in the near field of dipole antennas above 300MHz, IEEE Transaction on Vehicular Technology, vol. 41, no. 1, Feb. 1992, pp. 17-23.
- [13] G. Hartsgrove, A. Kraszewski, A. Surowiec, Simulated Biological Materials for Electromagnetic Radiation Absorption Studies, University of Ottawa, Bioelectromagnetics, Canada: 1987, pp. 29-36.
- [14] Q. Balzano, O. Garay, T. Manning Jr., Electromagnetic Energy Exposure of Simulated Users of Portable Cellular Telephones, IEEE Transactions on Vehicular Technology, vol. 44, no.3, Aug. 1995.
- [15] W. Gander, Computermathematick, Birkhaeuser, Basel, 1992.
- [16] W.H. Press, S.A. Teukolsky, W.T. Vetterling, and B.P. Flannery, Numerical Recipes in C, The Art of Scientific Computing, Second edition, Cambridge University Press, 1992.
- [17] N. Kuster, R. Kastle, T. Schmid, Dosimetric evaluation of mobile communications equipment with known precision, IEEE Transaction on Communications, vol. E80-B, no. 5, May 1997, pp. 645-652.



FCC ID: 2AIEP-OSS1B	 PCTEST Engineering Laboratory, Inc.	RF EXPOSURE REPORT	 Owint Engineering	Reviewed by: Quality Manager
Document S/N: 0Y1608121326.2AIEP-R1	Test Dates: 08/08/2016	DUT Type: Wearable Sensor		Page 8 of 9

- [18] CENELEC CLC/SC111B, European Prestandard (prENV 50166-2), Human Exposure to Electromagnetic Fields High-frequency: 10kHz-300GHz, Jan. 1995.
- [19] Prof. Dr. Niels Kuster, ETH, Eidgenössische Technische Hochschule Zürich, Dosimetric Evaluation of the Cellular Phone.
- [20] IEC 62209-1, Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 1: Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz), Feb. 2005.
- [21] Innovation, Science, Economic Development Canada RSS-102 Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands) Issue 5, March 2015.
- [22] Health Canada Safety Code 6 Limits of Human Exposure to Radio Frequency Electromagnetic Fields in the Frequency Range from 3 kHz – 300 GHz, 2015
- [23] FCC SAR Test Procedures for 2G-3G Devices, Mobile Hotspot and UMPC Devices KDB Publications 941225, D01-D07
- [24] SAR Measurement Guidance for IEEE 802.11 Transmitters, KDB Publication 248227 D01
- [25] FCC SAR Considerations for Handsets with Multiple Transmitters and Antennas, KDB Publications 648474 D03-D04
- [26] FCC SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers, FCC KDB Publication 616217 D04
- [27] FCC SAR Measurement and Reporting Requirements for 100MHz – 6 GHz, KDB Publications 865664 D01-D02
- [28] FCC General RF Exposure Guidance and SAR Procedures for Dongles, KDB Publication 447498, D01-D02
- [29] Anexo à Resolução No. 533, de 10 de Setembro de 2009.
- [30] IEC 62209-2, Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz), Mar. 2010.

FCC ID: 2AIEP-OSS1B	 RF EXPOSURE REPORT 		Reviewed by: Quality Manager
Document S/N: 0Y1608121326.2AIEP-R1	Test Dates: 08/08/2016	DUT Type: Wearable Sensor	Page 9 of 9



7

SAR TEST SETUP PHOTOGRAPHS

FCC ID: 2AIEP-OSS1B	 PCTEST Engineering Laboratory, Inc.	SAR EVALUATION REPORT	 Owlet Test Systems	Reviewed by: Quality Manager
Test Dates: 08/08/2016	DUT Type: Wearable Sensor			Photos Page 1 of 2



SAR Test Setup Photo 1 - Back side at 0.0 cm

FCC ID: 2AIEP-OSS1B		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 08/08/2016	DUT Type: Wearable Sensor		Photos Page 2 of 2	