



SAR EVALUATION REPORT

**FCC 47 CFR § 2.1093
IEEE Std 1528-2013**

For
Pulse CO-Oximeter

**FCC ID: VKF-RAD7B
Model Name: Radical-7**

**Report Number: 12229692-S1V1
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Prepared for
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REVISION HISTORY

Rev.	Date	Revisions	Revised By
V1	6/27/2018	Initial Issue	--

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1. Attestation of Test Results

Applicant Name	MASIMO CORP	
FCC ID(s)	VKF-RAD7B	
Model Name(s)	Radical-7	
Applicable Standards	FCC 47 CFR § 2.1093 Published RF exposure KDB procedures IEEE Std 1528-2013	
Exposure Category	SAR Limits (W/Kg)	
	Peak spatial-average (1g of tissue)	Extremities (hands, wrists, ankles, etc.) (10g of tissue)
General population/ Uncontrolled exposure	1.6	4
UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report. Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government (NIST Handbook 150, Annex A). This report is written to support regulatory compliance of the applicable standards stated above.		
Approved & Released By:	Prepared By:	
		
Dave Weaver Operations Leader UL Verification Services Inc.	Coltyce Sanders Test Engineer UL Verification Services Inc.	

2. Test Specification, Methods and Procedures

The tests documented in this report were performed in accordance with FCC 47 CFR § 2.1093, IEEE STD 1528-2013, the following FCC Published RF exposure KDB procedures:

- o 248227 D01 802.11 Wi-Fi SAR v02r02
- o 447498 D01 General RF Exposure Guidance v06
- o 447498 D03 Supplement C Cross-Reference v01
- o 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- o 865664 D02 RF Exposure Reporting v01r02

In addition to the above, the following information was used:

- o [TCB workshop](#) October, 2016; Page 7, RF Exposure Procedures (Bluetooth Duty Factor)

3. Facilities and Accreditation

The test sites and measurement facilities used to collect data are located at

47173 Benicia Street	47266 Benicia Street
SAR Lab A	SAR Lab 1
SAR Lab B	SAR Lab 2
SAR Lab C	SAR Lab 3
SAR Lab D	SAR Lab 4
SAR Lab E	
SAR Lab F	
SAR Lab G	
SAR Lab H	

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0.

4. Device Under Test (DUT) Information

4.1. DUT Description

Device Dimension	Overall (Length x Width): 223.51 mm x 88.64 mm Overall Diagonal: 230 mm Display Diagonal: 109.31 mm The DUT is a Handheld device
Back Cover	Normal Battery Cover
Battery Options	Standard – Lithium-ion battery, Rating 3.7Vdc, 16.2Wh
MCU	1064
Tech Board	7e23
Processor	e 0.8.4.7 i
Docking Station	ASCII IAP Flexport 5127

4.2. Wireless Technologies

Wireless technologies	Frequency bands	Operating mode	Duty Cycle used for SAR testing
Wi-Fi	2.4 GHz	802.11b 802.11g 802.11n (HT20)	N/A ¹
	5 GHz	802.11a 802.11n (HT20) 802.11n (HT40)	N/A ¹
	Does this device support bands 5.60 ~ 5.65 GHz? ☒ Yes ☐ No		
	Does this device support Band gap channel(s)? ☒ Yes ☐ No		
Bluetooth	2.4 GHz	Version 4.2 LE	N/A ¹

Notes:

1. Measured Duty Cycle is not required due to SAR test exemption.

4.3. Duty Cycle Factor Analysis

The radio interface allows wireless connection to *Patient Safety Net* and other wireless systems. The *Radical7 Pro* is only used in a clinic or hospital environment. The hardware design limits wireless transmission to patient telemetry data only. No other type of data transmission is possible. the manufacturer attests that the maximum duty cycle is approximately 6%.

Per Manufacturer: The software sends 120 bytes at 62.5 Hz for 7500 bytes per second, or 60 Kbps. Worst duty cycle will be at the minimum transmission bit rate of 1.1 Mbps. Therefore, the calculated Duty cycle is 0.06 Mbps / 1.1 Mbps, which results in a duty cycle of approximately 6%.

4.4. Maximum Output Power

RF Air interface	Mode	Max. RF Output Power (dBm)
Wi-Fi 2.4 GHz (DTS)	802.11b	19.5
	802.11g	17.5
	802.11n HT20	17.5
	802.11n HT40	17.5
Wi-Fi 5.2 GHz (U-NII I)	802.11a	16.5
	802.11n HT20	16.5
	802.11n HT40	14.5
Wi-Fi 5.3 GHz (U-NII 2A)	802.11a	16.5
	802.11n HT20	16.5
	802.11n HT40	14.5
Wi-Fi 5.6 GHz (U-NII 2C)	802.11a	16.5
	802.11n HT20	16.5
	802.11n HT40	14.5
Wi-Fi 5.8 GHz (U-NII 3)	802.11a	16.5
	802.11n HT20	16.5
	802.11n HT40	14.5
Bluetooth	LE	10.0

4.5. Separation distance

Wireless technologies	RF Exposure Conditions	DUT-to-User Separation
WLAN	Body	0 mm

5. Standalone SAR Test Exclusion Considerations

SAR test exclusion was performed in accordance with KDB 447498 D01 v06.

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:

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

This test exclusion is applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

SAR Test Exclusion Calculation Table for Devices with separation distance < 50 mm:

RF Interface	Frequency (MHz)	Max Output power		Duty Cycle	Max Output Power with Duty factor correction (mW)	Separation distances (mm)	Calculated Threshold Value
		dBm	mW				
Wi-Fi 2.4GHz	2462	19.5	89	6.0%	5	0	1.6
Wi-Fi 5.2GHz	5240	16.5	45	6.0%	3	0	1.4
Wi-Fi 5.3GHz	5320	16.5	45	6.0%	3	0	1.4
Wi-Fi 5.6GHz	5700	16.5	45	6.0%	3	0	1.4
Wi-Fi 5.8GHz	5825	16.5	45	6.0%	3	0	1.4
Bluetooth LE	2480	10.0	10	6.0%	1	0	0.3

Conclusion:

The device operates with a maximum Duty Cycle of 6%. The Calculated Threshold with duty cycle applied is ≤ 3 ; therefore, this device qualifies for Standalone SAR test exclusion. Refer to the Theory of Operation Duty Cycle analysis.

END OF REPORT