PCTEST
18855 Adams Ct, Morgan Hill, CA 95037 USA
Tel. +1.410.290.6652 / Fax +1.410.290.6654
http://www.pctest.com

SAR EVALUATION REPORT

Applicant Name:
Apple Inc.
One Apple Park Way
Cupertino, CA 95014

Date of Testing:
02/04/2021 – 02/08/2021
Test Site/Location:
PCTEST Lab, Morgan Hill, CA, USA
Document Serial No.:
1C2101020001-01.BCG (Rev 2)

FCC ID:	**BCGA2377**
APPLICANT:	**APPLE, INC.**

DUT Type:	Tablet Device
Application Type:	Certification
FCC Rule Part(s):	CFR §2.1093
Model:	A2377

Equipment Class	Band & Mode	Tx Frequency	SAR
			1g Body (W/kg)
DTS	2.4 GHz WLAN	2412 - 2472 MHz	1.19
NII	U-NII-1	5180 - 5240 MHz	1.08
NII	U-NII-2A	5260 - 5320 MHz	1.01
NII	U-NII-2C	5500 - 5720 MHz	1.05
NII	U-NII-3	5745 - 5825 MHz	1.04
DSS/DTS	Bluetooth	2402 - 2480 MHz	1.17
Simultaneous SAR per KDB 690783 D01v01r03:			1.46

Note: This revised Test Report 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.

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE C95.1-1992 and has been tested in accordance with the measurement procedures specified in Section 1.7 of this report; for North American frequency bands only.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them. Test results reported herein relate only to the item(s) tested.

Randy Ortanez
President

The SAR Tick is an initiative of the Mobile & Wireless Forum (MWF). While a product may be considered eligible, use of the SAR Tick logo requires an agreement with the MWF. Further details can be obtained by emailing: sartick@mwfai.info.

TABLE OF CONTENTS

1 DEVICE UNDER TEST 3

2 INTRODUCTION 15

3 DOSIMETRIC ASSESSMENT 16

4 TEST CONFIGURATION POSITIONS 17

5 RF EXPOSURE LIMITS 18

6 FCC MEASUREMENT PROCEDURES 19

7 RF CONDUCTED POWERS 22

8 SYSTEM VERIFICATION 33

9 SAR DATA SUMMARY 35

10 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS 40

11 SAR MEASUREMENT VARIABILITY 44

12 EQUIPMENT LIST 45

13 MEASUREMENT UNCERTAINTIES 46

14 CONCLUSION 47

15 REFERENCES 48

APPENDIX A: SAR TEST PLOTS

APPENDIX B: SAR DIPOLE VERIFICATION PLOTS

APPENDIX C: SAR TISSUE SPECIFICATIONS

APPENDIX D: SAR SYSTEM VALIDATION

APPENDIX E: DUT ANTENNA DIAGRAM & SAR TEST SETUP PHOTOGRAPHS

APPENDIX F: IEEE 802.11AX RU SAR EXCLUSION

APPENDIX G: WIFI TIME-AVERAGED SAR VERIFICATION

APPENDIX H: PROBE AND DIPOLE CALIBRATION CERTIFICATES

1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
2.4 GHz WLAN	Voice/Data	2412 - 2472 MHz
U-NII-1	Voice/Data	5180 - 5240 MHz
U-NII-2A	Voice/Data	5260 - 5320 MHz
U-NII-2C	Voice/Data	5500 - 5720 MHz
U-NII-3	Voice/Data	5745 - 5825 MHz
Bluetooth	Data	2402 - 2480 MHz

1.2 Power Reduction for SAR

There is no power reduction used for any band/mode implemented in this device for SAR purposes.

This device used an independent mechanism that limits WIFI powers to a time-averaged output power. For the purposes of this test report, all SAR measurements were performed with the algorithm disabled at the maximum time-averaged output power level. Appendix G includes verification data for this time-averaged SAR mechanism.

1.3 Nominal and Maximum Output Power Specifications

This device operates using the following maximum and nominal output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB Publication 447498 D01v06.

1.3.1 Maximum Time-Averaged Output Power

Note: Targets for 802.11ax RU operations can be found in Appendix F.

Mode/ Band			IEEE 802.11b (2.4 GHz)		IEEE 802.11g (2.4 GHz)		IEEE 802.11n (2.4 GHz)		IEEE 802.11ax SU (2.4 GHz)	
		Channel	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
Modulated Average - Single Tx Chain (dBm) - Antenna WF8	20 MHz Bandwidth	1	17.00	15.50	14.50	13.00	14.50	13.00	14.50	13.00
		2	17.00	15.50	17.00	15.50	17.00	15.50	17.00	15.50
		3	17.00	15.50	17.00	15.50	17.00	15.50	17.00	15.50
		4	17.00	15.50	17.00	15.50	17.00	15.50	17.00	15.50
		5	17.00	15.50	17.00	15.50	17.00	15.50	17.00	15.50
		6	17.00	15.50	17.00	15.50	17.00	15.50	17.00	15.50
		7	17.00	15.50	17.00	15.50	17.00	15.50	17.00	15.50
		8	17.00	15.50	17.00	15.50	17.00	15.50	17.00	15.50
		9	17.00	15.50	17.00	15.50	17.00	15.50	17.00	15.50
		10	17.00	15.50	17.00	15.50	17.00	15.50	17.00	15.50
		11	17.00	15.50	15.50	14.00	15.50	14.00	14.50	13.00
		12	17.00	15.50	13.00	11.50	13.00	11.50	13.00	11.50
		13	17.00	15.50	9.00	7.50	9.00	7.50	N/A	N/A

Mode/ Band			IEEE 802.11g (2.4 GHz)		IEEE 802.11n (2.4 GHz)		IEEE 802.11ax SU (2.4 GHz)	
		Channel	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
Modulated Average - 2 Tx Chain (dBm) - Antenna WF8	20 MHz Bandwidth	1	12.75	11.25	12.75	11.25	12.75	11.25
		2	17.00	15.50	17.00	15.50	17.00	15.50
		3	17.00	15.50	17.00	15.50	17.00	15.50
		4	17.00	15.50	17.00	15.50	17.00	15.50
		5	17.00	15.50	17.00	15.50	17.00	15.50
		6	17.00	15.50	17.00	15.50	17.00	15.50
		7	17.00	15.50	17.00	15.50	17.00	15.50
		8	17.00	15.50	17.00	15.50	17.00	15.50
		9	17.00	15.50	17.00	15.50	17.00	15.50
		10	17.00	15.50	17.00	15.50	17.00	15.50
		11	12.00	10.50	12.00	10.50	12.00	10.50
		12	11.00	9.50	11.00	9.50	10.00	8.50
		13	6.50	5.00	6.50	5.00	N/A	N/A

Note: In MIMO operations, each antenna transmits at maximum allowed powers as indicated above.

Mode/ Band			IEEE 802.11b (2.4 GHz)		IEEE 802.11g (2.4 GHz)		IEEE 802.11n (2.4 GHz)		IEEE 802.11ax SU (2.4 GHz)	
		Channel	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
Modulated Average - Single Tx Chain (dBm) - Antenna WF7	20 MHz Bandwidth	1	16.25	14.75	14.50	13.00	14.50	13.00	14.50	13.00
		2	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		3	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		4	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		5	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		6	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		7	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		8	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		9	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		10	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		11	16.25	14.75	15.50	14.00	15.50	14.00	14.50	13.00
		12	16.25	14.75	13.00	11.50	13.00	11.50	13.00	11.50
		13	16.25	14.75	9.00	7.50	9.00	7.50	N/A	N/A

Mode/ Band			IEEE 802.11g (2.4 GHz)		IEEE 802.11n (2.4 GHz)		IEEE 802.11ax SU (2.4 GHz)	
		Channel	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
Modulated Average - 2 Tx Chain (dBm) - Antenna WF7	20 MHz Bandwidth	1	12.75	11.25	12.75	11.25	12.75	11.25
		2	16.25	14.75	16.25	14.75	16.25	14.75
		3	16.25	14.75	16.25	14.75	16.25	14.75
		4	16.25	14.75	16.25	14.75	16.25	14.75
		5	16.25	14.75	16.25	14.75	16.25	14.75
		6	16.25	14.75	16.25	14.75	16.25	14.75
		7	16.25	14.75	16.25	14.75	16.25	14.75
		8	16.25	14.75	16.25	14.75	16.25	14.75
		9	16.25	14.75	16.25	14.75	16.25	14.75
		10	16.25	14.75	16.25	14.75	16.25	14.75
		11	12.00	10.50	12.00	10.50	12.00	10.50
		12	11.00	9.50	11.00	9.50	10.00	8.50
		13	6.50	5.00	6.50	5.00	N/A	N/A

Note: In MIMO operations, each antenna transmits at maximum allowed powers as indicated above.

Mode/ Band			IEEE 802.11a (5 GHz)		IEEE 802.11n (5 GHz)		IEEE 802.11ac (5 GHz)		IEEE 802.11ax SU (5 GHz)	
		Channel	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
Modulated Average - Single Tx Chain (dBm) - Antenna 5T	20 MHz Bandwidth	36	18.00	16.50	18.00	16.50	18.00	16.50	17.50	16.00
		40	18.00	16.50	18.00	16.50	18.00	16.50	18.00	16.50
		44	18.00	16.50	18.00	16.50	18.00	16.50	18.00	16.50
		48	18.00	16.50	18.00	16.50	18.00	16.50	18.00	16.50
		52	17.25	15.75	17.25	15.75	17.25	15.75	17.25	15.75
		56	17.25	15.75	17.25	15.75	17.25	15.75	17.25	15.75
		60	17.25	15.75	17.25	15.75	17.25	15.75	17.25	15.75
		64	17.25	15.75	17.25	15.75	17.25	15.75	17.25	15.75
		100	16.50	15.00	16.50	15.00	16.50	15.00	16.50	15.00
		104	16.50	15.00	16.50	15.00	16.50	15.00	16.50	15.00
		108	16.50	15.00	16.50	15.00	16.50	15.00	16.50	15.00
		112	16.50	15.00	16.50	15.00	16.50	15.00	16.50	15.00
		116	16.50	15.00	16.50	15.00	16.50	15.00	16.50	15.00
		120	16.50	15.00	16.50	15.00	16.50	15.00	16.50	15.00
		124	16.50	15.00	16.50	15.00	16.50	15.00	16.50	15.00
		128	16.50	15.00	16.50	15.00	16.50	15.00	16.50	15.00
		132	16.50	15.00	16.50	15.00	16.50	15.00	16.50	15.00
		136	16.50	15.00	16.50	15.00	16.50	15.00	16.50	15.00
		140	16.50	15.00	16.50	15.00	16.50	15.00	13.50	12.00
		144	16.50	15.00	16.50	15.00	16.50	15.00	16.50	15.00
		149	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25
		153	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25
		157	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25
		161	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25
		165	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25
	40 MHz Bandwidth	38			17.00	15.50	17.00	15.50	17.00	15.50
		46			18.00	16.50	18.00	16.50	18.00	16.50
		54			17.25	15.75	17.25	15.75	17.25	15.75
		62			16.00	14.50	16.00	14.50	15.00	13.50
		102			16.50	15.00	16.50	15.00	16.00	14.50
		110			16.50	15.00	16.50	15.00	16.50	15.00
		118			16.50	15.00	16.50	15.00	16.50	15.00
		126			16.50	15.00	16.50	15.00	16.50	15.00
		134			16.50	15.00	16.50	15.00	16.50	15.00
		142			16.50	15.00	16.50	15.00	16.50	15.00
		151			15.75	14.25	15.75	14.25	15.75	14.25
		159			15.75	14.25	15.75	14.25	15.75	14.25
	80 MHz Bandwidth	42					17.00	15.50	13.50	12.00
		58					15.00	13.50	13.50	12.00
		106					16.00	14.50	13.50	12.00
		122					16.50	15.00	16.50	15.00
		138					16.50	15.00	16.50	15.00
		155					15.75	14.25	15.75	14.25

Mode/ Band			IEEE 802.11a (5 GHz)		IEEE 802.11n (5 GHz)		IEEE 802.11ac (5 GHz)		IEEE 802.11ax SU (5 GHz)	
		Channel	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
Modulated Average - 2 Tx Chain (dBm) CDD - Antenna 5T	20 MHz Bandwidth	36	15.50	14.00	15.50	14.00	15.50	14.00	15.50	14.00
		40	15.50	14.00	15.50	14.00	15.50	14.00	15.50	14.00
		44	15.50	14.00	15.50	14.00	15.50	14.00	15.50	14.00
		48	15.50	14.00	15.50	14.00	15.50	14.00	15.50	14.00
		52	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		56	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		60	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		64	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		100	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		104	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		108	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		112	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		116	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		120	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		124	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		128	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		132	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		136	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		140	14.50	13.00	14.50	13.00	14.50	13.00	13.50	12.00
		144	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		149	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25
		153	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25
		157	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25
		161	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25
		165	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25
	40 MHz Bandwidth	38			14.50	13.00	14.50	13.00	14.50	13.00
		46			18.00	16.50	18.00	16.50	18.00	16.50
		54			17.25	15.75	17.25	15.75	17.25	15.75
		62			13.00	11.50	13.00	11.50	13.00	11.50
		102			14.50	13.00	14.50	13.00	13.50	12.00
		110			16.50	15.00	16.50	15.00	16.50	15.00
		118			16.50	15.00	16.50	15.00	16.50	15.00
		126			16.50	15.00	16.50	15.00	16.50	15.00
		134			16.25	14.75	16.25	14.75	15.00	13.50
		142			16.50	15.00	16.50	15.00	16.50	15.00
		151			15.75	14.25	15.75	14.25	15.75	14.25
		159			15.75	14.25	15.75	14.25	15.75	14.25
	80 MHz Bandwidth	42					12.50	11.00	12.00	10.50
		58					12.50	11.00	12.00	10.50
		106					13.00	11.50	12.00	10.50
		122					16.50	15.00	16.50	15.00
		138					16.50	15.00	16.50	15.00
		155					15.75	14.25	15.75	14.25

Note: In MIMO operations, each antenna transmits at maximum allowed powers as indicated above.

Mode/ Band			IEEE 802.11n (5 GHz)		IEEE 802.11ac (5 GHz)		IEEE 802.11ax SU (5 GHz)	
		Channel	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
Modulated Average - 2 Tx Chain (dBm) SDM - Antenna 5T	20 MHz Bandwidth	36	17.00	15.50	17.00	15.50	16.00	14.50
		40	17.00	15.50	17.00	15.50	17.00	15.50
		44	17.00	15.50	17.00	15.50	17.00	15.50
		48	17.00	15.50	17.00	15.50	17.00	15.50
		52	17.00	15.50	17.00	15.50	17.00	15.50
		56	17.00	15.50	17.00	15.50	17.00	15.50
		60	17.00	15.50	17.00	15.50	17.00	15.50
		64	17.00	15.50	17.00	15.50	16.00	14.50
		100	16.50	15.00	16.50	15.00	16.50	15.00
		104	16.50	15.00	16.50	15.00	16.50	15.00
		108	16.50	15.00	16.50	15.00	16.50	15.00
		112	16.50	15.00	16.50	15.00	16.50	15.00
		116	16.50	15.00	16.50	15.00	16.50	15.00
		120	16.50	15.00	16.50	15.00	16.50	15.00
		124	16.50	15.00	16.50	15.00	16.50	15.00
		128	16.50	15.00	16.50	15.00	16.50	15.00
		132	16.50	15.00	16.50	15.00	16.50	15.00
		136	16.50	15.00	16.50	15.00	16.50	15.00
		140	15.00	13.50	15.00	13.50	12.00	10.50
		144	16.50	15.00	16.50	15.00	16.50	15.00
		149	15.75	14.25	15.75	14.25	15.75	14.25
		153	15.75	14.25	15.75	14.25	15.75	14.25
		157	15.75	14.25	15.75	14.25	15.75	14.25
		161	15.75	14.25	15.75	14.25	15.75	14.25
		165	15.75	14.25	15.75	14.25	15.75	14.25
	40 MHz Bandwidth	38	14.50	13.00	14.50	13.00	14.50	13.00
		46	18.00	16.50	18.00	16.50	18.00	16.50
		54	17.25	15.75	17.25	15.75	17.25	15.75
		62	13.00	11.50	13.00	11.50	13.00	11.50
		102	14.50	13.00	14.50	13.00	13.50	12.00
		110	16.50	15.00	16.50	15.00	16.50	15.00
		118	16.50	15.00	16.50	15.00	16.50	15.00
		126	16.50	15.00	16.50	15.00	16.50	15.00
		134	16.25	14.75	16.25	14.75	15.00	13.50
		142	16.50	15.00	16.50	15.00	16.50	15.00
		151	15.75	14.25	15.75	14.25	15.75	14.25
		159	15.75	14.25	15.75	14.25	15.75	14.25
	80 MHz Bandwidth	42	[redacted]		12.50	11.00	12.00	10.50
		58			12.50	11.00	12.00	10.50
		106			13.00	11.50	12.00	10.50
		122			16.50	15.00	16.50	15.00
		138			16.50	15.00	16.50	15.00
		155			15.75	14.25	15.75	14.25

Note: In MIMO operations, each antenna transmits at maximum allowed powers as indicated above.

Mode/ Band			IEEE 802.11a (5 GHz)		IEEE 802.11n (5 GHz)		IEEE 802.11ac (5 GHz)		IEEE 802.11ax SU (5 GHz)	
		Channel	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
Modulated Average - Single Tx Chain (dBm) -Antenna 5B	20 MHz Bandwidth	36	16.50	15.00	16.50	15.00	16.50	15.00	16.50	15.00
		40	16.50	15.00	16.50	15.00	16.50	15.00	16.50	15.00
		44	16.50	15.00	16.50	15.00	16.50	15.00	16.50	15.00
		48	16.50	15.00	16.50	15.00	16.50	15.00	16.50	15.00
		52	17.25	15.75	17.25	15.75	17.25	15.75	17.25	15.75
		56	17.25	15.75	17.25	15.75	17.25	15.75	17.25	15.75
		60	17.25	15.75	17.25	15.75	17.25	15.75	17.25	15.75
		64	17.25	15.75	17.25	15.75	17.25	15.75	17.25	15.75
		100	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		104	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		108	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		112	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		116	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		120	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		124	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		128	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		132	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		136	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		140	16.25	14.75	16.25	14.75	16.25	14.75	13.50	12.00
		144	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		149	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00
		153	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00
		157	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00
		161	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00
		165	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00
	40 MHz Bandwidth	38			16.50	15.00	16.50	15.00	16.50	15.00
		46			16.50	15.00	16.50	15.00	16.50	15.00
		54			17.25	15.75	17.25	15.75	17.25	15.75
		62			16.00	14.50	16.00	14.50	15.00	13.50
		102			16.25	14.75	16.25	14.75	16.00	14.50
		110			16.25	14.75	16.25	14.75	16.25	14.75
		118			16.25	14.75	16.25	14.75	16.25	14.75
		126			16.25	14.75	16.25	14.75	16.25	14.75
		134			16.25	14.75	16.25	14.75	16.25	14.75
		142			16.25	14.75	16.25	14.75	16.25	14.75
		151			17.50	16.00	17.50	16.00	17.50	16.00
		159			17.50	16.00	17.50	16.00	17.50	16.00
	80 MHz Bandwidth	42					16.50	15.00	13.50	12.00
		58					15.00	13.50	13.50	12.00
		106					16.00	14.50	13.50	12.00
		122					16.25	14.75	16.25	14.75
		138					16.25	14.75	16.25	14.75
		155					17.50	16.00	17.00	15.50

Mode/ Band			IEEE 802.11a (5 GHz)		IEEE 802.11n (5 GHz)		IEEE 802.11ac (5 GHz)		IEEE 802.11ax SU (5 GHz)	
		Channel	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
Modulated Average - 2 Tx Chain (dBm) CDD - Antenna 5B	20 MHz Bandwidth	36	15.50	14.00	15.50	14.00	15.50	14.00	15.50	14.00
		40	15.50	14.00	15.50	14.00	15.50	14.00	15.50	14.00
		44	15.50	14.00	15.50	14.00	15.50	14.00	15.50	14.00
		48	15.50	14.00	15.50	14.00	15.50	14.00	15.50	14.00
		52	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		56	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		60	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		64	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		100	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		104	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		108	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		112	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		116	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		120	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		124	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		128	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		132	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		136	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		140	14.50	13.00	14.50	13.00	14.50	13.00	13.50	12.00
		144	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00
		149	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00
		153	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00
		157	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00
		161	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00
		165	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00
	40 MHz Bandwidth	38			14.50	13.00	14.50	13.00	14.50	13.00
		46			16.50	15.00	16.50	15.00	16.50	15.00
		54			17.25	15.75	17.25	15.75	17.25	15.75
		62			13.00	11.50	13.00	11.50	13.00	11.50
		102			14.50	13.00	14.50	13.00	13.50	12.00
		110			16.25	14.75	16.25	14.75	16.25	14.75
		118			16.25	14.75	16.25	14.75	16.25	14.75
		126			16.25	14.75	16.25	14.75	16.25	14.75
		134			16.25	14.75	16.25	14.75	15.00	13.50
		142			16.25	14.75	16.25	14.75	16.25	14.75
		151			17.50	16.00	17.50	16.00	17.50	16.00
		159			17.50	16.00	17.50	16.00	17.50	16.00
	80 MHz Bandwidth	42					12.50	11.00	12.00	10.50
		58					12.50	11.00	12.00	10.50
		106					13.00	11.50	12.00	10.50
		122					16.25	14.75	16.25	14.75
		138					16.25	14.75	16.25	14.75
		155					17.00	15.50	16.50	15.00

Note: In MIMO operations, each antenna transmits at maximum allowed powers as indicated above.

Mode/ Band			IEEE 802.11n (5 GHz)		IEEE 802.11ac (5 GHz)		IEEE 802.11ax SU (5 GHz)	
		Channel	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
Modulated Average - 2 Tx Chain (dBm) SDM - Antenna 5B	20 MHz Bandwidth	36	16.50	15.00	16.50	15.00	16.00	14.50
		40	16.50	15.00	16.50	15.00	16.50	15.00
		44	16.50	15.00	16.50	15.00	16.50	15.00
		48	16.50	15.00	16.50	15.00	16.50	15.00
		52	17.00	15.50	17.00	15.50	17.00	15.50
		56	17.00	15.50	17.00	15.50	17.00	15.50
		60	17.00	15.50	17.00	15.50	17.00	15.50
		64	17.00	15.50	17.00	15.50	16.00	14.50
		100	16.25	14.75	16.25	14.75	16.25	14.75
		104	16.25	14.75	16.25	14.75	16.25	14.75
		108	16.25	14.75	16.25	14.75	16.25	14.75
		112	16.25	14.75	16.25	14.75	16.25	14.75
		116	16.25	14.75	16.25	14.75	16.25	14.75
		120	16.25	14.75	16.25	14.75	16.25	14.75
		124	16.25	14.75	16.25	14.75	16.25	14.75
		128	16.25	14.75	16.25	14.75	16.25	14.75
		132	16.25	14.75	16.25	14.75	16.25	14.75
		136	16.25	14.75	16.25	14.75	16.25	14.75
		140	15.00	13.50	15.00	13.50	12.00	10.50
		144	16.25	14.75	16.25	14.75	16.25	14.75
		149	17.50	16.00	17.50	16.00	17.50	16.00
		153	17.50	16.00	17.50	16.00	17.50	16.00
		157	17.50	16.00	17.50	16.00	17.50	16.00
		161	17.50	16.00	17.50	16.00	17.50	16.00
		165	17.50	16.00	17.50	16.00	17.50	16.00
	40 MHz Bandwidth	38	14.50	13.00	14.50	13.00	14.50	13.00
		46	16.50	15.00	16.50	15.00	16.50	15.00
		54	17.25	15.75	17.25	15.75	17.25	15.75
		62	13.00	11.50	13.00	11.50	13.00	11.50
		102	14.50	13.00	14.50	13.00	13.50	12.00
		110	16.25	14.75	16.25	14.75	16.25	14.75
		118	16.25	14.75	16.25	14.75	16.25	14.75
		126	16.25	14.75	16.25	14.75	16.25	14.75
		134	16.25	14.75	16.25	14.75	15.00	13.50
		142	16.25	14.75	16.25	14.75	16.25	14.75
		151	17.50	16.00	17.50	16.00	17.50	16.00
		159	17.50	16.00	17.50	16.00	17.50	16.00
	80 MHz Bandwidth	42	[redacted]		12.50	11.00	12.00	10.50
		58			12.50	11.00	12.00	10.50
		106			13.00	11.50	12.00	10.50
		122			16.25	14.75	16.25	14.75
		138			16.25	14.75	16.25	14.75
		155			17.00	15.50	16.50	15.00

Note: In MIMO operations, each antenna transmits at maximum allowed powers as indicated above.

1.3.2 Bluetooth Maximum Output Power

Mode / Band		Modulated Average - Single Tx Chain (dBm) - Antenna WF8
Bluetooth BDR/LE	Maximum	**16.50**
	Nominal	**15.00**
Bluetooth EDR	Maximum	**14.00**
	Nominal	**12.50**
Bluetooth HDR	Maximum	**12.00**
	Nominal	**10.50**

Mode / Band		Modulated Average - TXBF (dBm) - Antenna WF8
Bluetooth BDR	Maximum	**14.00**
	Nominal	**12.50**
Bluetooth EDR	Maximum	**12.00**
	Nominal	**10.50**
Bluetooth HDR	Maximum	**12.00**
	Nominal	**10.50**
Bluetooth LE	Maximum	**4.50**
	Nominal	**3.00**

Note: In TxBF operations, each antenna transmits at maximum allowed powers as indicated above.

Mode / Band		Modulated Average - Single Tx Chain (dBm) - Antenna WF7
Bluetooth BDR/LE	Maximum	**16.50**
	Nominal	**15.00**
Bluetooth EDR	Maximum	**14.00**
	Nominal	**12.50**
Bluetooth HDR	Maximum	**12.00**
	Nominal	**10.50**

Mode / Band		Modulated Average - TXBF (dBm) - Antenna WF7
Bluetooth BDR	Maximum	**14.00**
	Nominal	**12.50**
Bluetooth EDR	Maximum	**12.00**
	Nominal	**10.50**
Bluetooth HDR	Maximum	**12.00**
	Nominal	**10.50**
Bluetooth LE	Maximum	**4.50**
	Nominal	**3.00**

Note: In TxBF operations, each antenna transmits at maximum allowed powers as indicated above.

1.4 DUT Antenna Locations

The overall diagonal dimension of the device is > 200 cm. A diagram showing the location of the device antennas can be found in Appendix E. Exact antenna dimensions and separation distances are shown in the Technical Descriptions in the FCC filings.

Table 1-1
Device Edges/Sides for SAR Testing

Device Sides/Edges for SAR Testing						
Mode	Back	Front	Top	Bottom	Right	Left
2.4 GHz WLAN Antenna WF8	Yes	No	Yes	No	Yes	No
2.4 GHz WLAN Antenna WF7	Yes	No	Yes	No	No	Yes
5 GHz WLAN Antenna 5T	Yes	No	No	No	Yes	No
5 GHz WLAN Antenna 5B	Yes	No	No	No	Yes	No
Bluetooth Antenna WF8	Yes	No	Yes	No	Yes	No
Bluetooth Antenna WF7	Yes	No	Yes	No	No	Yes

Note: Per FCC KDB Publication 616217 D04v01r01, particular DUT edges were not required to be evaluated for SAR based on the SAR exclusion threshold in KDB 447498 D01v06. Additional edges may have been evaluated for simultaneous transmission analysis.

1.5 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D01v06, transmitters are considered to be operating simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds.

This device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneous transmission analysis according to FCC KDB Publication 447498 D01v06 4.3.2 procedures.

Table 1-2
Simultaneous Transmission Scenarios

No.	Capable Transmit Configuration	Body
1	2.4 GHz Wi-Fi MIMO	Yes
2	2.4 GHz Bluetooth (TXBF)	Yes
3	5 GHz Wi-Fi MIMO	Yes
4	2.4 GHz Bluetooth + 5 GHz Wi-Fi	Yes
5	2.4 GHz Bluetooth + 5 GHz Wi-Fi MIMO	Yes
6	2.4 GHz Bluetooth (TXBF) + 5 GHz Wi-Fi	Yes
7	2.4 GHz Bluetooth (TXBF) + 5 GHz Wi-Fi MIMO	Yes

1. 2.4 GHz WLAN and 2.4 GHz Bluetooth share the same antenna path and cannot transmit simultaneously on any antenna (Antenna WF8, Antenna WF7).
2. 2.4 GHz WLAN and 5 GHz WLAN cannot transmit simultaneously.
3. This device supports 2x2 MIMO Tx for WLAN 802.11a/g/n/ac/ax. 802.11a/g/n/ac/ax supports CDD and STBC and 802.11n/ac/ax additionally supports SDM. Each WLAN antenna can transmit independently or together when operating with MIMO.
4. This device supports VOWIFI.

1.6 Miscellaneous SAR Test Considerations

(A) WIFI/BT

Based on the maximum allowed power for the respective antennas, U-NII-1 was evaluated for Antenna 5T and U-NII-2A was evaluated for Antenna 5B. Additional testing for U-NII-1 Antenna 5B and U-NII-2A Antenna 5T were not required since all reported SAR was less than 1.2 W/kg per FCC KDB Publication 248227 D01v02r02.

The WLAN/Bluetooth chipset in this device is produced by two different suppliers. The electrically identical modules are manufactured with the identical mechanical structure to meet the same specifications and functions. Two device variants are referenced as Variant 1 and Variant 2 in this report. WLAN/Bluetooth SAR worst case configuration was spotchecked on Variant 1 and Variant 2. The Variant with the highest reported SAR values was evaluated for the remaining WLAN/Bluetooth configurations.

This device supports channel 1-13 for 2.4 GHZ WLAN. However, because channel 12/13 targets are not higher than that of channels 1-11, default channels for SAR testing are determined per FCC KDB 248227 D01v02r02.

This device supports IEEE 802.11ac with the following features:

a) Up to 80 MHz Bandwidth only
b) No aggregate channel configurations
c) 2 Tx antenna output
d) 256 QAM is supported
e) TDWR and Band gap channels are supported

This device supports IEEE 802.11ax with the following features:

a) Up to 80 MHz Bandwidth only for 5 GHz
b) Up to 20 MHz Bandwidth only for 2.4 GHz
c) No aggregate channel configurations
d) 2 Tx antenna output
e) Up to 1024 QAM is supported
f) TDWR and Band gap channels are supported for 5 GHz
g) MU-MIMO UL Operations are not supported

Per April 2019 TCB Workshop Notes, SAR testing was not required for 802.11ax when applying the initial test configuration procedures of KDB 248227, with 802.11ax considered a higher order 802.11 mode.

1.7 Guidance Applied

- FCC KDB Publication 248227 D01v02r02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01v06 (General SAR Guidance)
- FCC KDB Publication 865664 D01v01r04, D02v01r02 (SAR Measurements up to 6 GHz)
- FCC KDB Publication 616217 D04v01r02 (Tablet)
- April 2019 TCB Workshop Notes (IEEE 802.11ax)

1.8 Device Serial Numbers

Several samples with identical hardware 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. The serial numbers used for each test are indicated alongside the results in Section 9.

2 INTRODUCTION

The FCC and Innovation, Science, and Economic Development Canada have adopted the guidelines for evaluating the environmental effects of radio frequency (RF) radiation in ET Docket 93-62 on Aug. 6, 1996 and Health Canada Safety Code 6 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices. [1]

The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz [3] and Health Canada RF Exposure Guidelines Safety Code 6 [22]. The measurement procedure described in IEEE/ANSI C95.3-2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave [4] is used for guidance in measuring the Specific Absorption Rate (SAR) due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the International Committee for Non-Ionizing Radiation Protection (ICNIRP) in Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," Report No. Vol 74. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

2.1 SAR Definition

Specific Absorption Rate is defined as the time derivative (rate) of the incremental energy (dU) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (ρ). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Equation 2-1).

Equation 2-1
SAR Mathematical Equation

$$SAR = \frac{d}{dt}\left(\frac{dU}{dm}\right) = \frac{d}{dt}\left(\frac{dU}{\rho dv}\right)$$

SAR is expressed in units of Watts per Kilogram (W/kg).

$$SAR = \frac{\sigma \cdot E^2}{\rho}$$

where:

σ = conductivity of the tissue-simulating material (S/m)
ρ = mass density of the tissue-simulating material (kg/m^3)
E = Total RMS electric field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relation to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.[6]

3 DOSIMETRIC ASSESSMENT

3.1 Measurement Procedure

The evaluation was performed using the following procedure compliant to FCC KDB Publication 865664 D01v01r04 and IEEE 1528-2013:

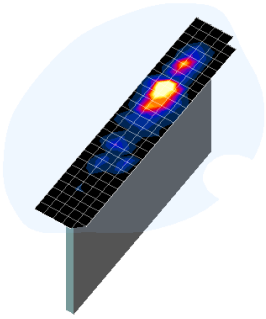


Figure 3-1
Sample SAR Area Scan

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01r04 (See Table 3-1) and IEEE 1528-2013.
2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1g/10g cube evaluation. SAR at this fixed point was measured and used as a reference value.
3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01r04 (See Table 3-1) and IEEE 1528-2013. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online for more details):

   a. SAR values at the inner surface of the phantom are extrapolated from the measured values along the line away from the surface with spacing no greater than that in Table 3-1. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).

   b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.

   c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

Table 3-1
Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01r04*

Frequency	Maximum Area Scan Resolution (mm) (Δx_{area}, Δy_{area})	Maximum Zoom Scan Resolution (mm) (Δx_{zoom}, Δy_{zoom})	Maximum Zoom Scan Spatial Resolution (mm)			Minimum Zoom Scan Volume (mm) (x,y,z)
			Uniform Grid	Graded Grid		
			$\Delta z_{zoom}(n)$	$\Delta z_{zoom}(1)$*	$\Delta z_{zoom}(n>1)$*	
≤ 2 GHz	≤ 15	≤ 8	≤ 5	≤ 4	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 30
2-3 GHz	≤ 12	≤ 5	≤ 5	≤ 4	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 30
3-4 GHz	≤ 12	≤ 5	≤ 4	≤ 3	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 28
4-5 GHz	≤ 10	≤ 4	≤ 3	≤ 2.5	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 25
5-6 GHz	≤ 10	≤ 4	≤ 2	≤ 2	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 22

*Also compliant to IEEE 1528-2013 Table 6

4 TEST CONFIGURATION POSITIONS

4.1 Device Holder

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

4.2 SAR Testing for Tablet per KDB Publication 616217 D04v01r02

Per FCC KDB Publication 616217 D04v01r02, the back surface and edges of the tablet should be tested for SAR compliance with the tablet touching the phantom. The SAR Exclusion Threshold in KDB 447498 D01v06 can be applied to determine SAR test exclusion for adjacent edge configurations. The closest distance from the antenna to an adjacent tablet edge is used to determine if SAR testing is required for the adjacent edges, with the adjacent edge positioned against the phantom and the edge containing the antenna positioned perpendicular to the phantom.

5 RF EXPOSURE LIMITS

5.1 Uncontrolled Environment

UNCONTROLLED ENVIRONMENTS are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

5.2 Controlled Environment

CONTROLLED ENVIRONMENTS are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Table 5-1
SAR Human Exposure Specified in ANSI/IEEE C95.1-1992 and Health Canada Safety Code 6

HUMAN EXPOSURE LIMITS		
	UNCONTROLLED ENVIRONMENT *General Population* (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT *Occupational* (W/kg) or (mW/g)
Peak Spatial Average SAR Head	1.6	8.0
Whole Body SAR	0.08	0.4
Peak Spatial Average SAR Hands, Feet, Ankle, Wrists, etc.	4.0	20

1. The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
2. The Spatial Average value of the SAR averaged over the whole body.
3. The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

6 FCC MEASUREMENT PROCEDURES

6.1 Measured and Reported SAR

Per FCC KDB Publication 447498 D01v06, when SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance. For simultaneous transmission, the measured aggregate SAR must be scaled according to the sum of the differences between the maximum tune-up tolerance and actual power used to test each transmitter. When SAR is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as *reported* SAR. The highest *reported* SAR results are identified on the grant of equipment authorization according to procedures in KDB 690783 D01v01r03.

6.2 SAR Testing with 802.11 Transmitters

The normal network operating configurations of 802.11 transmitters are not suitable for SAR measurements. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure the results are consistent and reliable. See KDB Publication 248227 D01v02r02 for more details.

6.2.1 General Device Setup

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters.

A periodic duty factor is required for current generation SAR systems to measure SAR. When 802.11 frame gaps are accounted for in the transmission, a maximum transmission duty factor of 92 - 96% is typically achievable in most test mode configurations. A minimum transmission duty factor of 85% is required to avoid certain hardware and device implementation issues related to wide range SAR scaling. The reported SAR is scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit.

6.2.2 U-NII-1 and U-NII-2A

For devices that operate in both U-NII-1 and U-NII-2A bands, when the same maximum output power is specified for both bands, SAR measurement using OFDM SAR test procedures is not required for U-NII-1 unless the highest reported SAR for U-NII-2A is > 1.2 W/kg. When different maximum output powers are specified for the bands, SAR measurement for the U-NII band with the lower maximum output power is not required unless the highest reported SAR for the U-NII band with the higher maximum output power, adjusted by the ratio of lower to higher specified maximum output power for the two bands, is > 1.2 W/kg.

6.2.3 U-NII-2C and U-NII-3

The frequency range covered by U-NII-2C and U-NII-3 is 380 MHz (5.47 – 5.85 GHz), which requires a minimum of at least two SAR probe calibration frequency points to support SAR measurements. When Terminal Doppler Weather Radar (TDWR) restriction applies, the channels at 5.60 – 5.65 GHz in U-NII-2C band must be disabled with acceptable mechanisms and documented in the equipment certification. Unless band gap channels are permanently disabled, SAR must be considered for these channels. Each band is tested independently according to the normally required OFDM SAR measurement and probe calibration frequency points requirements.

6.2.4 2.4 GHz SAR Test Requirements

SAR is measured for 2.4 GHz 802.11b DSSS using either the fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following:

1) When the reported SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.

2) When the reported SAR is > 0.8 W/kg, SAR is required for that position using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing.

2.4 GHz 802.11 g/n/ax OFDM are additionally evaluated for SAR if the highest reported SAR for 802.11b, adjusted by the ratio of the OFDM to DSSS specified maximum output power, is > 1.2 W/kg. When SAR is required for OFDM modes in 2.4 GHz band, the Initial Test Configuration Procedures should be followed.

6.2.5 OFDM Transmission Mode and SAR Test Channel Selection

When the same maximum output power was specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration with the largest channel bandwidth, lowest order modulation and lowest data rate. When the maximum output power of a channel is the same for equivalent OFDM configurations; for example, 802.11a, 802.11n and 802.11ac or 802.11g and 802.11n with the same channel bandwidth, modulation and data rate etc., the lower order 802.11 mode i.e., 802.11a, then 802.11n and 802.11ac or 802.11g then 802.11n, is used for SAR measurement. Per April 2019 TCB Workshop guidance, 802.11ax was considered the highest order 802.11 mode. When the maximum output power are the same for multiple test channels, either according to the default or additional power measurement requirements, SAR is measured using the channel closest to the middle of the frequency band or aggregated band. When there are multiple channels with the same maximum output power, SAR is measured using the higher number channel.

6.2.6 Initial Test Configuration Procedure

For OFDM, an initial test configuration is determined for each frequency band and aggregated band, according to the transmission mode with the highest maximum output power specified for SAR measurements. When the same maximum output power is specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration(s) with the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order IEEE 802.11 mode. The channel of the transmission mode with the highest average RF output conducted power will be the initial test configuration.

When the reported SAR is ≤ 0.8 W/kg, no additional measurements on other test channels are required. Otherwise, SAR is evaluated using the subsequent highest average RF output channel until the reported SAR result is ≤ 1.2 W/kg or all channels are measured. When there are multiple untested channels having the same subsequent highest average RF output power, the channel with higher frequency from the lowest 802.11 mode is considered for SAR measurements (See Section 6.2.5).

6.2.7 Subsequent Test Configuration Procedures

For OFDM configurations in each frequency band and aggregated band, SAR is evaluated for initial test configuration using the fixed test position or the initial test position procedure. When the highest reported SAR (for the initial test configuration), adjusted by the ratio of the specified maximum output power of the subsequent test configuration to initial test configuration, is ≤ 1.2 W/kg, no additional SAR tests for the subsequent test configurations are required.

6.2.8 MIMO SAR considerations

Per KDB Publication 248227 D01v02r02, the simultaneous SAR provisions in KDB Publication 447498 D01v06 should be applied to determine simultaneous transmission SAR test exclusion for WIFI MIMO. If the sum of 1g single transmission chain SAR measurements is <1.6 W/kg, no additional SAR measurements for MIMO are required. Alternatively, SAR for MIMO can be measured with all antennas transmitting simultaneously at the specified maximum output power of MIMO operation.

7 RF CONDUCTED POWERS

7.1 WLAN Conducted Powers

Table 7-1
2.4 GHz WLAN Maximum Time-Averaged RF Power – Antenna WF8, Variant 1

2.4GHz Conducted Power [dBm]					
Freq [MHz]	Channel	IEEE Transmission Mode			
		802.11b	802.11g	802.11n	802.11ax (SU)
		Average	Average	Average	Average
2412	1	16.06	13.42	13.61	13.55
2417	2		15.97	16.03	15.93
2437	6	16.05	16.06	15.97	15.99
2457	10		16.11	15.91	15.97
2462	11	16.09	14.45	14.43	13.57

Table 7-2
2.4 GHz WLAN Maximum Time-Averaged RF Power – Antenna WF8, Variant 2

2.4GHz Conducted Power [dBm]					
Freq [MHz]	Channel	IEEE Transmission Mode			
		802.11b	802.11g	802.11n	802.11ax (SU)
		Average	Average	Average	Average
2412	1	16.03	13.61	13.62	13.62
2417	2		16.05	16.10	16.07
2437	6	16.06	16.12	16.12	16.13
2457	10		16.07	16.04	15.93
2462	11	16.07	14.54	14.49	13.61

Table 7-3
2.4 GHz WLAN Maximum Time-Averaged RF Power – Antenna WF7, Variant 1

2.4GHz Conducted Power [dBm]					
Freq [MHz]	Channel	IEEE Transmission Mode			
		802.11b	802.11g	802.11n	802.11ax (SU)
		Average	Average	Average	Average
2412	1	15.26	13.58	13.48	13.42
2417	2		15.32	15.23	15.21
2437	6	15.18	15.27	15.25	15.32
2457	10		15.33	15.36	15.19
2462	11	15.39	14.61	14.35	13.59

Table 7-4
2.4 GHz WLAN Maximum Time-Averaged RF Power – Antenna WF7, Variant 2

2.4GHz Conducted Power [dBm]					
Freq [MHz]	Channel	IEEE Transmission Mode			
		802.11b	802.11g	802.11n	802.11ax (SU)
		Average	Average	Average	Average
2412	1	15.13	13.39	13.39	13.52
2417	2		15.30	15.27	15.28
2437	6	15.15	15.28	15.37	15.22
2457	10		15.19	15.20	15.19
2462	11	15.31	14.51	14.40	13.59

Table 7-5
5 GHz WLAN Maximum Time-Averaged RF Power – Antenna 5T, Variant 1

5GHz (40MHz) Conducted Power [dBm]				
Freq [MHz]	Channel	IEEE Transmission Mode		
		802.11n	802.11ac	802.11ax (SU)
		Average	Average	Average
5190	38	15.59	15.91	15.99
5230	46	17.05	17.15	16.91
5270	54	16.23	16.23	16.21
5310	62	14.61	15.09	14.05

5GHz (80MHz) Conducted Power [dBm]			
Freq [MHz]	Channel	IEEE Transmission Mode	
		802.11ac	802.11ax (SU)
		Average	Average
5530	106	14.10	12.47
5610	122	15.32	15.37
5690	138	15.28	15.46
5775	155	14.77	14.66

Table 7-6
5 GHz WLAN Maximum Time-Averaged RF Power – Antenna 5T, Variant 2

5GHz (40MHz) Conducted Power [dBm]				
Freq [MHz]	Channel	IEEE Transmission Mode		
		802.11n	802.11ac	802.11ax (SU)
		Average	Average	Average
5190	38	15.66	15.92	15.96
5230	46	16.95	16.98	17.02
5270	54	16.12	16.28	16.22
5310	62	14.46	15.12	14.07

5GHz (80MHz) Conducted Power [dBm]			
Freq [MHz]	Channel	IEEE Transmission Mode	
		802.11ac	802.11ax (SU)
		Average	Average
5530	106	14.12	12.56
5610	122	15.51	15.44
5690	138	15.62	15.54
5775	155	14.72	14.82

Table 7-7
5 GHz WLAN Maximum Time-Averaged RF Power – Antenna 5B, Variant 1

5GHz (40MHz) Conducted Power [dBm]				
Freq [MHz]	Channel	IEEE Transmission Mode		
		802.11n	802.11ac	802.11ax (SU)
		Average	Average	Average
5190	38	15.54	15.51	15.43
5230	46	15.48	15.45	15.36
5270	54	15.72	16.22	16.30
5310	62	14.51	14.04	13.92

5GHz (80MHz) Conducted Power [dBm]			
Freq [MHz]	Channel	IEEE Transmission Mode	
		802.11ac	802.11ax (SU)
		Average	Average
5530	106	14.32	12.43
5610	122	15.00	15.20
5690	138	15.04	15.31
5775	155	16.47	15.97

Table 7-8
5 GHz WLAN Maximum Time-Averaged RF Power – Antenna 5B, Variant 2

5GHz (40MHz) Conducted Power [dBm]				
Freq [MHz]	Channel	IEEE Transmission Mode		
		802.11n	802.11ac	802.11ax (SU)
		Average	Average	Average
5190	38	15.42	15.48	15.44
5230	46	15.52	15.42	15.57
5270	54	15.55	16.22	16.30
5310	62	14.65	15.11	14.06

5GHz (80MHz) Conducted Power [dBm]			
Freq [MHz]	Channel	IEEE Transmission Mode	
		802.11ac	802.11ax (SU)
		Average	Average
5530	106	14.25	12.56
5610	122	15.05	15.24
5690	138	15.12	15.32
5775	155	16.53	16.03

7.1.1 Notes for WLAN

Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02:

- Power measurements were performed for the transmission mode configuration with the highest maximum output power specified for production units.
- For transmission modes with the same maximum output power specification, powers were measured for the largest channel bandwidth, lowest order modulation and lowest data rate.
- For transmission modes with identical maximum specified output power, channel bandwidth, modulation and data rates, power measurements were required for all identical configurations.
- For each transmission mode configuration, powers were measured for the highest and lowest channels; and at the mid-band channel(s) when there were at least 3 channels supported. For configurations with multiple mid-band channels, due to an even number of channels, both channels were measured.
- The WLAN chipset in this device is produced by two different suppliers. The electrically identical modules are manufactured with the identical mechanical structure to meet the same specifications and functions. Two device variants are referenced as Variant 1 and Variant 2 in this report.
- WLAN SAR worst case configuration was spotchecked on Variant 1 and Variant 2. The Variant with the highest reported SAR value was evaluated for the remaining WLAN configurations.
- Full power measurements were performed for Variant 1 and Variant 2 per FCC KDB Procedures 248227.
- The time-averaged mechanism for WLAN operations was disabled for the above power measurements.
- The device was configured by manufacturer's software to transmit continuously at the maximum time-averaged output power levels.

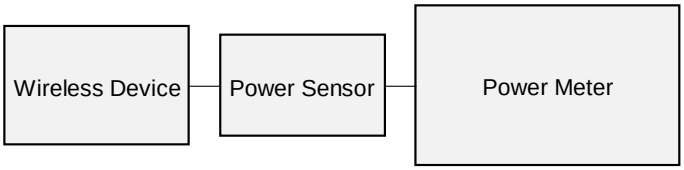


Figure 7-1
Power Measurement Setup

7.2 Bluetooth Conducted Powers

Table 7-9
Maximum Bluetooth Average RF Power – Antenna WF8, Variant 1

Frequency [MHz]	Modulation	Data Rate [Mbps]	Channel No.	Avg Conducted Power	
				[dBm]	[mW]
2402	GFSK	1.0	0	15.02	31.769
2441	GFSK	1.0	39	15.40	34.674
2480	GFSK	1.0	78	15.60	36.308

Table 7-10
Maximum Bluetooth Average RF Power – Antenna WF8, Variant 2

Frequency [MHz]	Modulation	Data Rate [Mbps]	Channel No.	Avg Conducted Power	
				[dBm]	[mW]
2402	GFSK	1.0	0	15.60	36.308
2441	GFSK	1.0	39	15.56	35.975
2480	GFSK	1.0	78	15.44	34.995

Table 7-11
Maximum Bluetooth Average RF Power – Antenna WF7, Variant 1

Frequency [MHz]	Modulation	Data Rate [Mbps]	Channel No.	Avg Conducted Power	
				[dBm]	[mW]
2402	GFSK	1.0	0	15.38	34.514
2441	GFSK	1.0	39	15.26	33.574
2480	GFSK	1.0	78	15.40	34.674

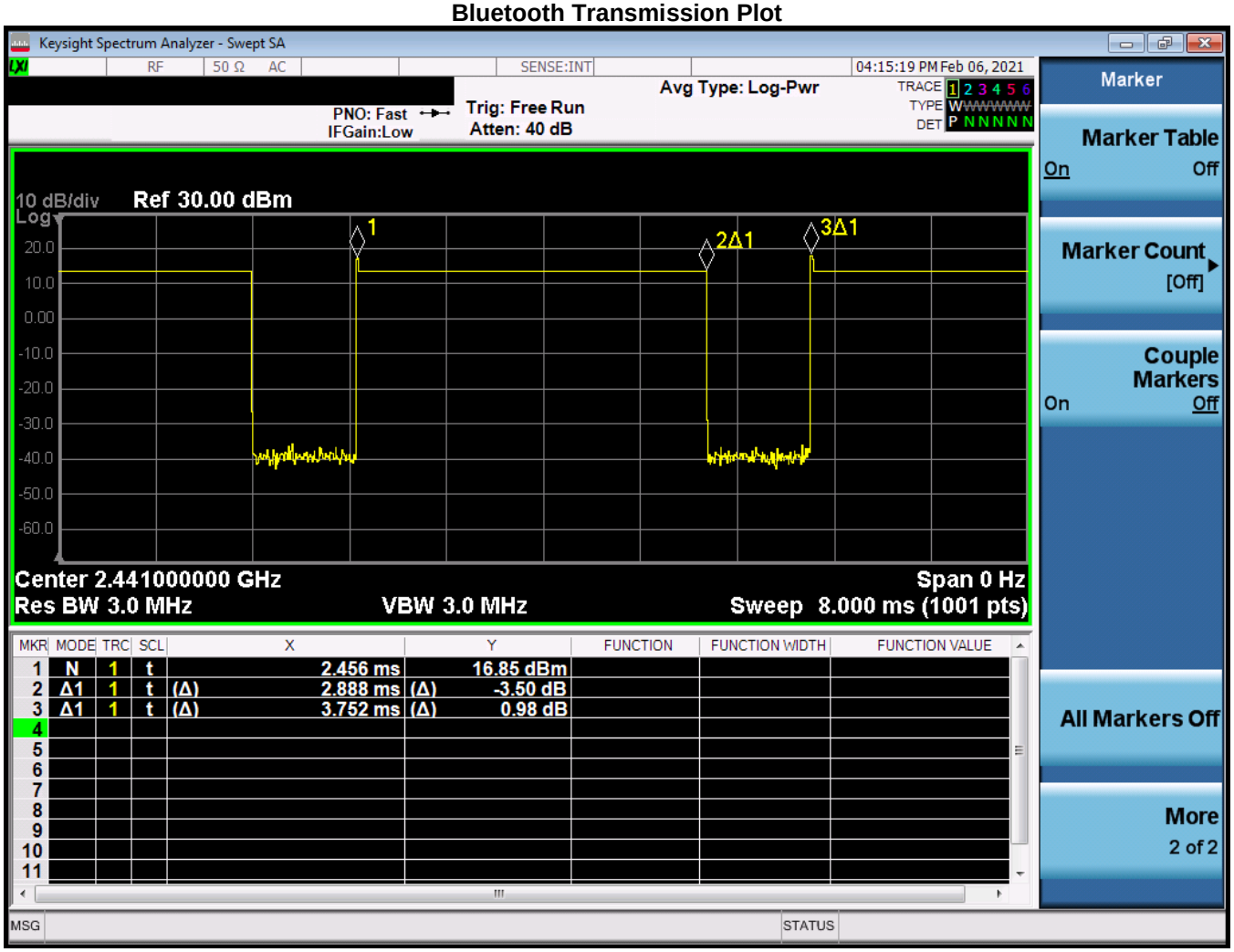
Table 7-12
Maximum Bluetooth Average RF Power – Antenna WF7, Variant 2

Frequency [MHz]	Modulation	Data Rate [Mbps]	Channel No.	Avg Conducted Power	
				[dBm]	[mW]
2402	GFSK	1.0	0	15.24	33.420
2441	GFSK	1.0	39	15.30	33.884
2480	GFSK	1.0	78	15.50	35.481

7.3 Bluetooth Duty Cycle

7.3.1 Maximum Bluetooth Transmission Antenna WF8 Variant 1

Figure 7-2
Bluetooth Transmission Plot

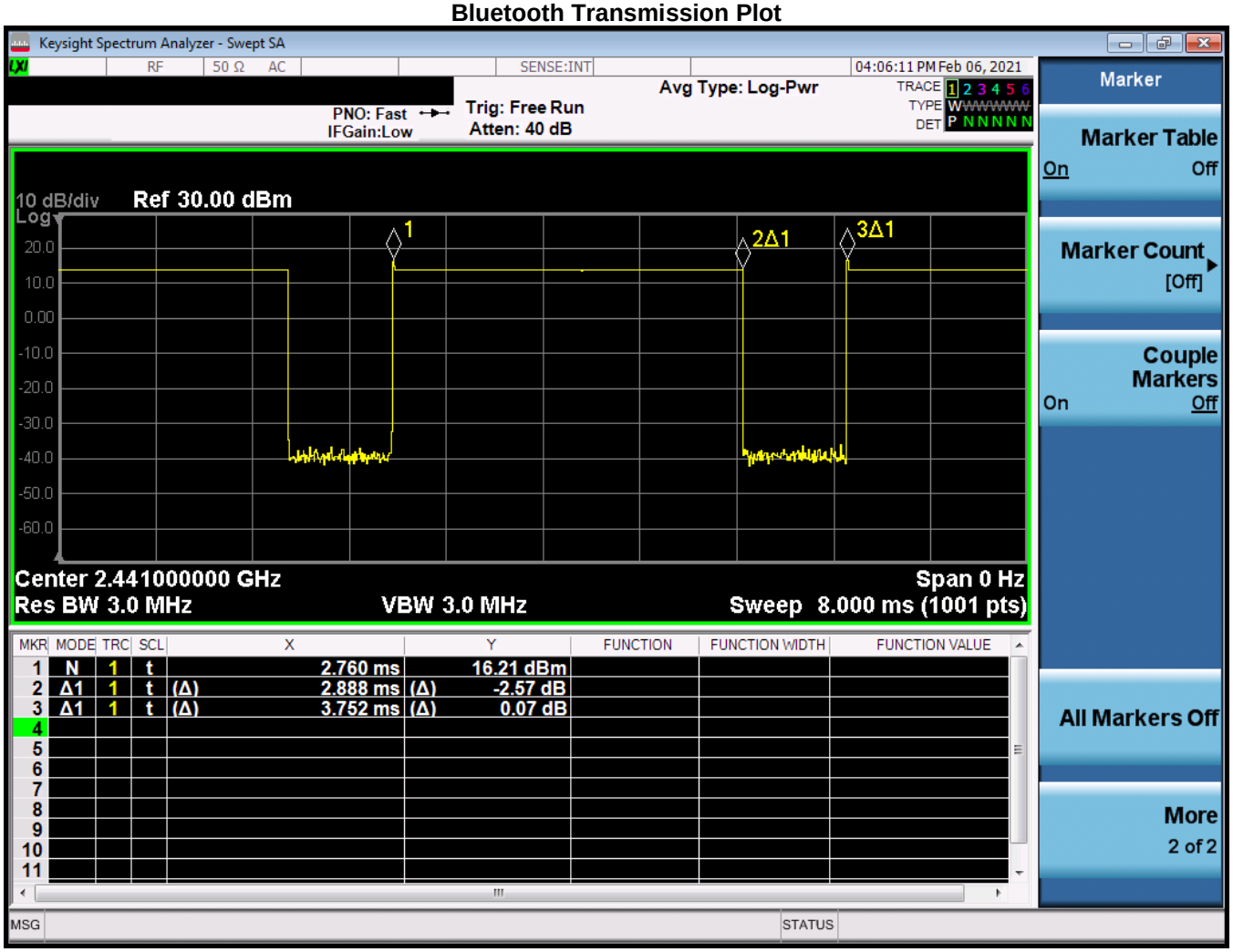


Equation 7-1
Bluetooth Duty Cycle Calculation

$$Duty\ Cycle = \frac{Pulse\ Width}{Period} * 100\% = \frac{2.888\ ms}{3.752\ ms} * 100\% = 77.0\%$$

7.3.2 Maximum Bluetooth Transmission Antenna WF8 Variant 2

Figure 7-3
Bluetooth Transmission Plot

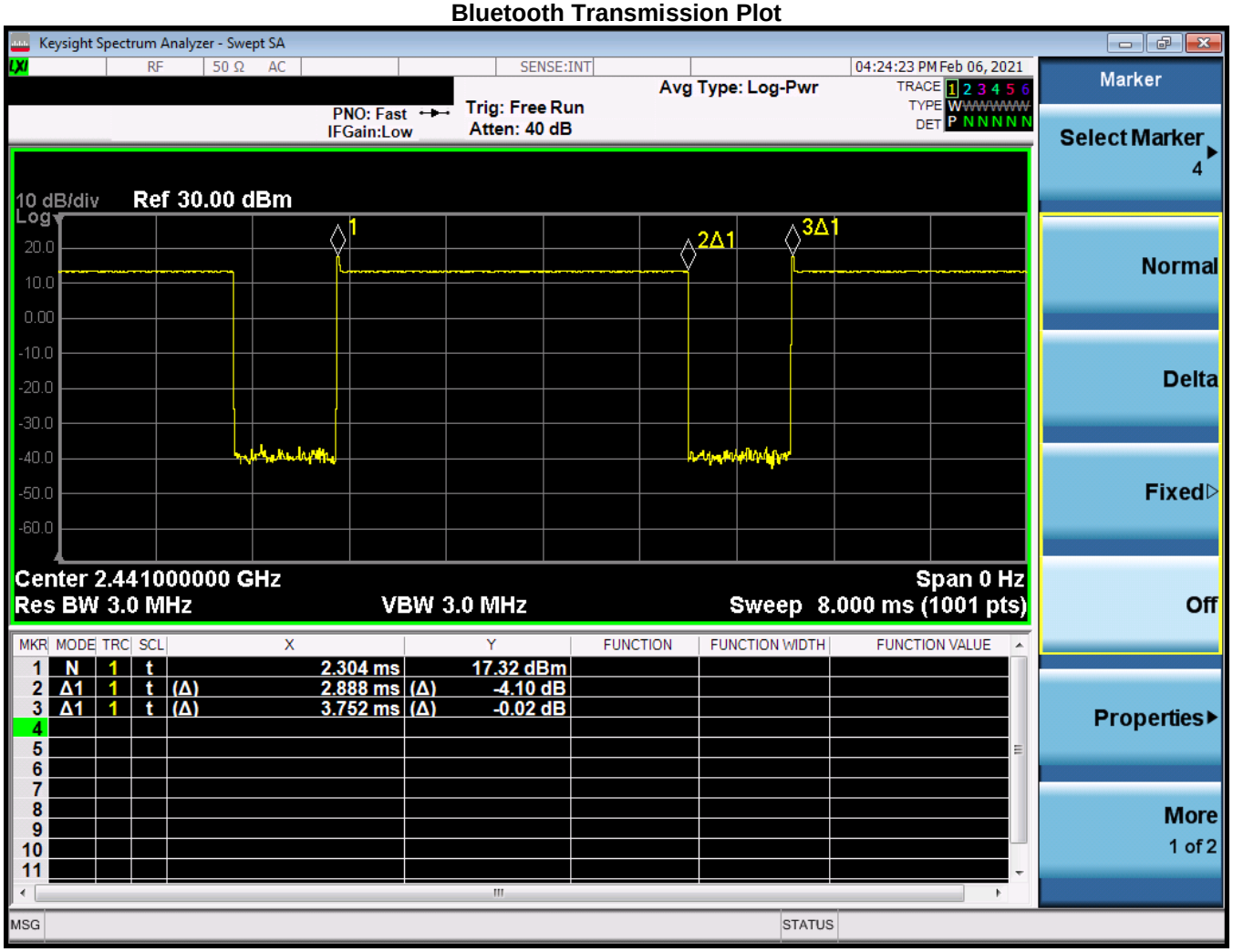


Equation 7-2
Bluetooth Duty Cycle Calculation

$$Duty\ Cycle = \frac{Pulse\ Width}{Period} * 100\% = \frac{2.888\ ms}{3.752\ ms} * 100\% = 77.0\%$$

7.3.3 Maximum Bluetooth Transmission Antenna WF7 Variant 1

Figure 7-4
Bluetooth Transmission Plot

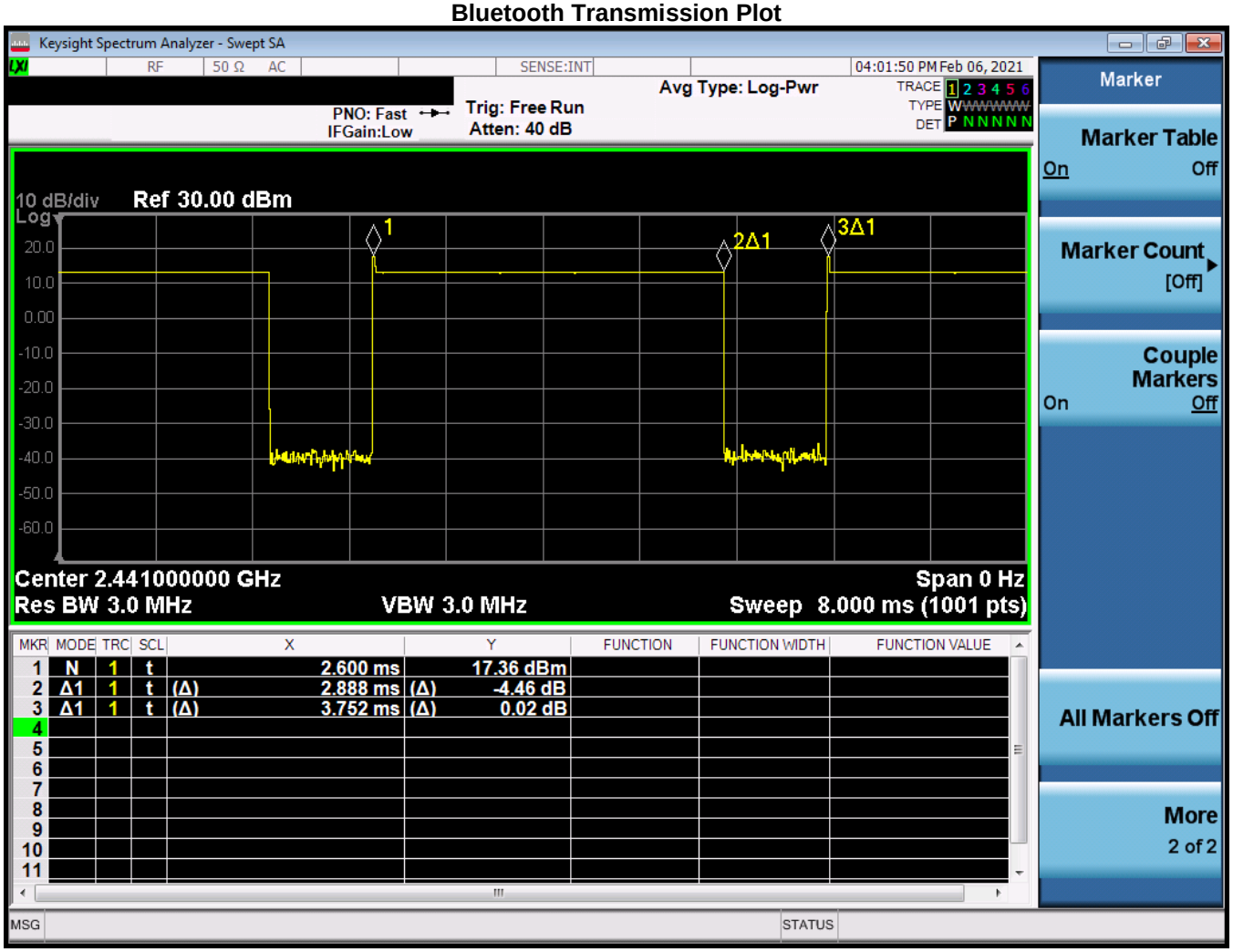


Equation 7-3
Bluetooth Duty Cycle Calculation

$$Duty\ Cycle = \frac{Pulse\ Width}{Period} * 100\% = \frac{2.888\ ms}{3.752\ ms} * 100\% = 77.0\%$$

7.3.4 Maximum Bluetooth Transmission Antenna WF7 Variant 2

Figure 7-5
Bluetooth Transmission Plot



Equation 7-4
Bluetooth Duty Cycle Calculation

$$Duty\ Cycle = \frac{Pulse\ Width}{Period} * 100\% = \frac{2.888\ ms}{3.752\ ms} * 100\% = 77.0\%$$

7.4 Notes for Bluetooth

- The Bluetooth chipset in this device is produced by two different suppliers. The electrically identical modules are manufactured with the identical mechanical structure to meet the same specifications and functions. Two device variants are referenced as Variant 1 and Variant 2 in this report.
- Bluetooth SAR worst case configuration was spotchecked on Variant 1 and Variant 2. The Variant with the highest reported SAR value was evaluated for the remaining Bluetooth configurations.
- Full power measurements were performed for Variant 1 and Variant 2 per FCC KDB Procedures 248227.
- Bluetooth operations are reduced in output power when it is operating simultaneously with 5 GHz WLAN. Detailed description of the power reduction mechanism is included in the operational description.

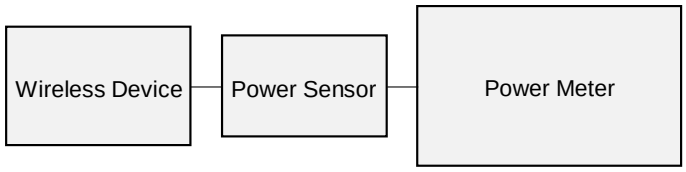


Figure 7-6
Power Measurement Setup

8 SYSTEM VERIFICATION

8.1 Tissue Verification

Table 8-1
Measured Tissue Properties

Calibrated for Tests Performed on:	Tissue Type	Tissue Temp During Calibration (°C)	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
02/08/2021	2450B	21.1	2400	1.980	51.296	1.902	52.767	*4.10%*	*-2.79%*
			2450	2.025	51.225	1.950	52.700	*3.85%*	*-2.80%*
			2500	2.072	51.149	2.021	52.636	*2.52%*	*-2.83%*
02/04/2021	5200B-5800B	22.8	5180	5.364	48.157	5.276	49.041	*1.67%*	*-1.80%*
			5200	5.396	48.114	5.299	49.014	*1.83%*	*-1.84%*
			5220	5.413	48.087	5.323	48.987	*1.69%*	*-1.84%*
			5240	5.438	48.064	5.346	48.960	*1.72%*	*-1.83%*
			5260	5.464	48.026	5.369	48.933	*1.77%*	*-1.85%*
			5280	5.493	47.966	5.393	48.906	*1.85%*	*-1.92%*
			5300	5.522	47.915	5.416	48.879	*1.96%*	*-1.97%*
			5320	5.542	47.900	5.439	48.851	*1.89%*	*-1.95%*
			5500	5.777	47.582	5.650	48.607	*2.25%*	*-2.11%*
			5520	5.809	47.557	5.673	48.580	*2.40%*	*-2.11%*
			5540	5.838	47.529	5.696	48.553	*2.49%*	*-2.11%*
			5560	5.866	47.500	5.720	48.526	*2.55%*	*-2.11%*
			5580	5.890	47.464	5.743	48.499	*2.56%*	*-2.13%*
			5600	5.915	47.425	5.766	48.471	*2.58%*	*-2.16%*
			5620	5.953	47.364	5.790	48.444	*2.82%*	*-2.23%*
			5640	5.980	47.347	5.813	48.417	*2.87%*	*-2.21%*
			5660	6.010	47.327	5.837	48.390	*2.96%*	*-2.20%*
			5680	6.034	47.300	5.860	48.363	*2.97%*	*-2.20%*
			5700	6.056	47.252	5.883	48.336	*2.94%*	*-2.24%*
			5745	6.125	47.154	5.936	48.275	*3.18%*	*-2.32%*
			5765	6.156	47.139	5.959	48.248	*3.31%*	*-2.30%*
			5785	6.188	47.103	5.982	48.220	*3.44%*	*-2.32%*
			5800	6.203	47.078	6.000	48.200	*3.38%*	*-2.33%*
			5805	6.209	47.069	6.006	48.193	*3.38%*	*-2.33%*
			5825	6.236	47.025	6.029	48.166	*3.43%*	*-2.37%*

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.

8.2 Test System Verification

Prior to SAR assessment, the system is verified to ±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 D.

Table 8-2
System Verification Results – 1g

System Verification TARGET & MEASURED												
SAR System #	**Tissue Frequency (MHz)**	**Tissue Type**	**Date**	**Amb. Temp (°C)**	**Liquid Temp (°C)**	**Input Power (W)**	**Source SN**	**Probe SN**	**Measured SAR_{1g} (W/kg)**	**1 W Target SAR_{1g} (W/kg)**	**1 W Normalized SAR_{1g} (W/kg)**	**$Deviation_{1g}$ (%)**
AM6	2450	BODY	02/08/2021	22.9	21.2	0.100	921	7546	5.380	50.800	53.800	5.91%
AM2	5250	BODY	02/04/2021	22.4	21.0	0.050	1123	7416	3.440	74.000	68.800	-7.03%
AM2	5600	BODY	02/04/2021	22.4	21.0	0.050	1123	7416	3.810	77.600	76.200	-1.80%
AM2	5750	BODY	02/04/2021	22.4	21.0	0.050	1123	7416	3.930	74.700	78.600	5.22%

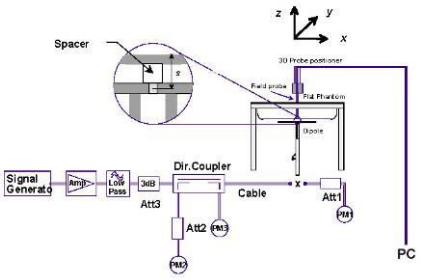


Figure 8-1
System Verification Setup Diagram

Figure 8-2
System Verification Setup Photo

9 SAR DATA SUMMARY

9.1 Standalone Body SAR Data

Table 9-1
2.4 GHz WLAN Body SAR Data – Antenna WF8

MEASUREMENT RESULTS																					
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna Config.	Variant	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	SAR (10g)	Reported SAR (10g)	Plot #
MHz	Ch.														(W/kg)			(W/kg)	(W/kg)	(W/kg)	
2412	1	802.11b	DSSS	22	17.00	16.06	-0.20	0 mm	Antenna WF8	V1	QVWYQ20QD4	1	back	100.0	0.890	1.242	1.000	1.105	0.351	0.436	
2412	1	802.11b	DSSS	22	17.00	16.03	-0.15	0 mm	Antenna WF8	V2	HKJJY7D02G	1	back	100.0	0.949	1.250	1.000	**1.186**	0.375	0.469	A1
2437	6	802.11b	DSSS	22	17.00	16.06	-0.18	0 mm	Antenna WF8	V2	HKJJY7D02G	1	back	100.0	0.948	1.242	1.000	1.177	0.371	0.461	
2462	11	802.11b	DSSS	22	17.00	16.07	-0.17	0 mm	Antenna WF8	V2	HKJJY7D02G	1	back	100.0	0.838	1.239	1.000	1.038	0.331	0.410	
2462	11	802.11b	DSSS	22	17.00	16.07	0.04	0 mm	Antenna WF8	V2	HKJJY7D02G	1	top	100.0	0.404	1.239	1.000	0.501	0.162	0.201	
2462	11	802.11b	DSSS	22	17.00	16.07	0.20	0 mm	Antenna WF8	V2	HKJJY7D02G	1	bottom	100.0	0.024	1.239	1.000	0.030	0.011	0.014	
2462	11	802.11b	DSSS	22	17.00	16.07	0.01	0 mm	Antenna WF8	V2	HKJJY7D02G	1	right	100.0	0.062	1.239	1.000	0.077	0.026	0.032	
2462	11	802.11b	DSSS	22	17.00	16.07	0.15	0 mm	Antenna WF8	V2	HKJJY7D02G	1	left	100.0	0.000	1.239	1.000	0.000	0.000	0.000	
2412	1	802.11b	DSSS	22	17.00	16.03	-0.14	0 mm	Antenna WF8	V2	HKJJY7D02G	1	back	100.0	0.928	1.250	1.000	1.160	0.367	0.459	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population															Body 1.6 W/kg (mW/g) averaged over 1 gram						

Note: Blue entry indicates variability measurement.

Table 9-2
2.4 GHz WLAN Body SAR Data – Antenna WF7

MEASUREMENT RESULTS																					
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna Config.	Variant	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	SAR (10g)	Reported SAR (10g)	Plot #
MHz	Ch.														(W/kg)			(W/kg)	(W/kg)	(W/kg)	
2412	1	802.11b	DSSS	22	16.25	15.13	-0.10	0 mm	Antenna WF7	V2	HDXNP06NN9	1	back	100.0	0.750	1.294	1.000	0.971	0.344	0.445	
2437	6	802.11b	DSSS	22	16.25	15.15	-0.05	0 mm	Antenna WF7	V2	HDXNP06NN9	1	back	100.0	0.787	1.288	1.000	1.014	0.366	0.471	
2437	6	802.11b	DSSS	22	16.25	15.18	0.01	0 mm	Antenna WF7	V1	HXK21776F9	1	back	100.0	0.779	1.279	1.000	0.996	0.360	0.460	
2462	11	802.11b	DSSS	22	16.25	15.31	0.10	0 mm	Antenna WF7	V2	HDXNP06NN9	1	back	100.0	0.807	1.242	1.000	1.002	0.377	0.468	
2462	11	802.11b	DSSS	22	16.25	15.31	-0.05	0 mm	Antenna WF7	V2	HDXNP06NN9	1	top	100.0	0.432	1.242	1.000	0.537	0.202	0.251	
2462	11	802.11b	DSSS	22	16.25	15.31	0.20	0 mm	Antenna WF7	V2	HDXNP06NN9	1	bottom	100.0	0.045	1.242	1.000	0.056	0.019	0.024	
2462	11	802.11b	DSSS	22	16.25	15.31	0.17	0 mm	Antenna WF7	V2	HDXNP06NN9	1	right	100.0	0.001	1.242	1.000	0.001	0.001	0.001	
2462	11	802.11b	DSSS	22	16.25	15.31	-0.19	0 mm	Antenna WF7	V2	HDXNP06NN9	1	left	100.0	0.361	1.242	1.000	0.448	0.133	0.165	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population															Body 1.6 W/kg (mW/g) averaged over 1 gram						

Table 9-3
5 GHz WLAN Body SAR Data – Antenna 5T

MEASUREMENT RESULTS																					
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna Config.	Variant	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	SAR (10g)	Reported SAR (10g)	Plot #
MHz	Ch.														(W/kg)			(W/kg)	(W/kg)	(W/kg)	
5230	46	802.11n	OFDM	40	18.00	17.05	-0.18	0 mm	Antenna 5T	V1	QWYQ20QD4	13.5	back	98.0	0.126	1.245	1.020	0.160	0.052	0.066	
5230	46	802.11n	OFDM	40	18.00	17.05	0.13	0 mm	Antenna 5T	V1	QWYQ20QD4	13.5	top	98.0	0.010	1.245	1.020	0.013	0.002	0.003	
5230	46	802.11n	OFDM	40	18.00	17.05	0.12	0 mm	Antenna 5T	V1	QWYQ20QD4	13.5	bottom	98.0	0.000	1.245	1.020	0.000	0.000	0.000	
5190	38	802.11n	OFDM	40	17.00	15.59	-0.01	0 mm	Antenna 5T	V1	QWYQ20QD4	13.5	right	98.0	0.589	1.384	1.020	0.831	0.205	0.289	
5230	46	802.11n	OFDM	40	18.00	17.05	-0.19	0 mm	Antenna 5T	V1	QWYQ20QD4	13.5	right	98.0	0.851	1.245	1.020	1.081	0.296	0.376	A2
5230	46	802.11n	OFDM	40	18.00	16.95	-0.10	0 mm	Antenna 5T	V2	CP9Q23HXJF	13.5	right	97.8	0.684	1.274	1.022	0.891	0.233	0.303	
5230	46	802.11n	OFDM	40	18.00	17.05	-0.15	0 mm	Antenna 5T	V1	QWYQ20QD4	13.5	left	98.0	0.012	1.245	1.020	0.015	0.005	0.006	
5230	46	802.11n	OFDM	40	18.00	17.05	-0.20	0 mm	Antenna 5T	V1	QWYQ20QD4	13.5	right	98.0	0.824	1.245	1.020	1.046	0.294	0.373	
5610	122	802.11ac	OFDM	80	16.50	15.32	-0.06	0 mm	Antenna 5T	V1	QWYQ20QD4	29.3	back	96.0	0.107	1.312	1.042	0.146	0.041	0.056	
5610	122	802.11ac	OFDM	80	16.50	15.32	-0.18	0 mm	Antenna 5T	V1	QWYQ20QD4	29.3	top	96.0	0.012	1.312	1.042	0.016	0.003	0.004	
5610	122	802.11ac	OFDM	80	16.50	15.32	0.00	0 mm	Antenna 5T	V1	QWYQ20QD4	29.3	bottom	96.0	0.000	1.312	1.042	0.000	0.000	0.000	
5530	106	802.11ac	OFDM	80	16.00	14.10	-0.19	0 mm	Antenna 5T	V1	QWYQ20QD4	29.3	right	96.0	0.476	1.549	1.042	0.768	0.160	0.258	
5610	122	802.11ac	OFDM	80	16.50	15.32	0.03	0 mm	Antenna 5T	V1	QWYQ20QD4	29.3	right	96.0	0.730	1.312	1.042	0.998	0.240	0.328	
5690	138	802.11ac	OFDM	80	16.50	15.28	-0.05	0 mm	Antenna 5T	V1	QWYQ20QD4	29.3	right	96.0	0.761	1.324	1.042	1.050	0.248	0.342	
5690	138	802.11ac	OFDM	80	16.50	15.62	0.07	0 mm	Antenna 5T	V2	HDXNP06NN9	29.3	right	95.9	0.771	1.225	1.043	0.985	0.253	0.323	
5610	122	802.11ac	OFDM	80	16.50	15.32	0.17	0 mm	Antenna 5T	V1	QWYQ20QD4	29.3	left	96.0	0.014	1.312	1.042	0.019	0.006	0.008	
5775	155	802.11ac	OFDM	80	15.75	14.72	-0.05	0 mm	Antenna 5T	V2	HDXNP06NN9	29.3	back	95.9	0.076	1.268	1.043	0.101	0.029	0.038	
5775	155	802.11ac	OFDM	80	15.75	14.72	0.13	0 mm	Antenna 5T	V2	HDXNP06NN9	29.3	top	95.9	0.001	1.268	1.043	0.001	0.000	0.000	
5775	155	802.11ac	OFDM	80	15.75	14.72	0.00	0 mm	Antenna 5T	V2	HDXNP06NN9	29.3	bottom	95.9	0.000	1.268	1.043	0.000	0.000	0.000	
5775	155	802.11ac	OFDM	80	15.75	14.77	0.07	0 mm	Antenna 5T	V1	QWYQ20QD4	29.3	right	96.0	0.706	1.253	1.042	0.922	0.230	0.300	
5775	155	802.11ac	OFDM	80	15.75	14.72	0.03	0 mm	Antenna 5T	V2	HDXNP06NN9	29.3	right	95.9	0.786	1.268	1.043	1.040	0.259	0.343	
5775	155	802.11ac	OFDM	80	15.75	14.72	0.17	0 mm	Antenna 5T	V2	HDXNP06NN9	29.3	left	95.9	0.012	1.268	1.043	0.016	0.005	0.007	

ANSI / IEEE C95.1 1992 - SAFETY LIMIT	Body
Spatial Peak	1.6 W/kg (mW/g)
Uncontrolled Exposure/General Population	averaged over 1 gram

Note: Blue entry indicates variability measurement.

Table 9-4
5 GHz WLAN Body SAR Data – Antenna 5B

MEASUREMENT RESULTS																					
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna Config.	Variant	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	SAR (10g)	Reported SAR (10g)	Plot #
MHz	Ch.														(W/kg)			(W/kg)	(W/kg)	(W/kg)	
5270	54	802.11n	OFDM	40	17.25	15.55	0.08	0 mm	Antenna 5B	V2	YLXLR4V03R	13.5	back	97.8	0.088	1.479	1.022	0.133	0.036	0.054	
5270	54	802.11n	OFDM	40	17.25	15.55	0.00	0 mm	Antenna 5B	V2	YLXLR4V03R	13.5	top	97.8	0.000	1.479	1.022	0.000	0.000	0.000	
5270	54	802.11n	OFDM	40	17.25	15.55	-0.20	0 mm	Antenna 5B	V2	YLXLR4V03R	13.5	bottom	97.8	0.045	1.479	1.022	0.068	0.012	0.018	
5270	54	802.11n	OFDM	40	17.25	15.72	-0.06	0 mm	Antenna 5B	V1	HXK21776F9	13.5	right	98.0	0.657	1.422	1.020	0.953	0.193	0.280	
5270	54	802.11n	OFDM	40	17.25	15.55	0.20	0 mm	Antenna 5B	V2	YLXLR4V03R	13.5	right	97.8	0.669	1.479	1.022	1.011	0.196	0.296	
5310	62	802.11n	OFDM	40	16.00	14.65	0.01	0 mm	Antenna 5B	V2	YLXLR4V03R	13.5	right	97.8	0.513	1.365	1.022	0.716	0.150	0.209	
5270	54	802.11n	OFDM	40	17.25	15.55	-0.15	0 mm	Antenna 5B	V2	YLXLR4V03R	13.5	left	97.8	0.010	1.479	1.022	0.015	0.004	0.006	
5690	138	802.11ac	OFDM	80	16.25	15.04	-0.19	0 mm	Antenna 5B	V1	QWYQ20QD4	29.3	back	96.0	0.074	1.321	1.042	0.102	0.030	0.041	
5690	138	802.11ac	OFDM	80	16.25	15.04	0.00	0 mm	Antenna 5B	V1	QWYQ20QD4	29.3	top	96.0	0.000	1.321	1.042	0.000	0.000	0.000	
5690	138	802.11ac	OFDM	80	16.25	15.04	0.14	0 mm	Antenna 5B	V1	QWYQ20QD4	29.3	bottom	96.0	0.034	1.321	1.042	0.047	0.009	0.012	
5530	106	802.11ac	OFDM	80	16.00	14.32	0.20	0 mm	Antenna 5B	V1	QWYQ20QD4	29.3	right	96.0	0.418	1.472	1.042	0.641	0.127	0.195	
5610	122	802.11ac	OFDM	80	16.25	15.00	-0.16	0 mm	Antenna 5B	V1	QWYQ20QD4	29.3	right	96.0	0.740	1.334	1.042	1.029	0.216	0.300	
5610	122	802.11ac	OFDM	80	16.25	15.05	-0.20	0 mm	Antenna 5B	V2	HDXNP06NN9	29.3	right	95.8	0.631	1.318	1.044	0.868	0.192	0.264	
5690	138	802.11ac	OFDM	80	16.25	15.04	-0.12	0 mm	Antenna 5B	V1	QWYQ20QD4	29.3	right	96.0	0.622	1.321	1.042	0.856	0.186	0.256	
5690	138	802.11ac	OFDM	80	16.25	15.04	0.17	0 mm	Antenna 5B	V1	QWYQ20QD4	29.3	left	96.0	0.010	1.321	1.042	0.014	0.004	0.006	
5775	155	802.11ac	OFDM	80	17.50	16.47	-0.20	0 mm	Antenna 5B	V1	HXK21776F9	29.3	back	96.0	0.081	1.268	1.042	0.107	0.031	0.041	
5775	155	802.11ac	OFDM	80	17.50	16.47	0.00	0 mm	Antenna 5B	V1	HXK21776F9	29.3	top	96.0	0.000	1.268	1.042	0.000	0.000	0.000	
5775	155	802.11ac	OFDM	80	17.50	16.47	0.11	0 mm	Antenna 5B	V1	HXK21776F9	29.3	bottom	96.0	0.019	1.268	1.042	0.025	0.003	0.004	
5775	155	802.11ac	OFDM	80	17.50	16.47	-0.06	0 mm	Antenna 5B	V1	HXK21776F9	29.3	right	96.0	0.765	1.268	1.042	1.011	0.240	0.317	
5775	155	802.11ac	OFDM	80	17.50	16.53	-0.08	0 mm	Antenna 5B	V2	YLXLR4V03R	29.3	right	95.8	0.753	1.250	1.044	0.983	0.237	0.309	
5775	155	802.11ac	OFDM	80	17.50	16.47	0.00	0 mm	Antenna 5B	V1	HXK21776F9	29.3	left	96.0	0.000	1.268	1.042	0.000	0.000	0.000	

ANSI / IEEE C95.1 1992 - SAFETY LIMIT	Body
Spatial Peak	1.6 W/kg (mW/g)
Uncontrolled Exposure/General Population	averaged over 1 gram

Table 9-5
Bluetooth Body SAR Data – Antenna WF8

MEASUREMENT RESULTS																				
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna Config.	Variant	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	SAR (1g)	Scaling Factor (Cond Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	SAR (10g)	Reported SAR (10g)	Plot #
MHz	Ch.													(W/kg)			(W/kg)	(W/kg)	(W/kg)	
2402	0	Bluetooth	FHSS	16.50	15.02	-0.15	0 mm	Antenna WF8	V1	WXJQH56YW5	1	back	77.0	0.682	1.406	1.006	0.965	0.263	0.372	
2402	0	Bluetooth	FHSS	16.50	15.60	-0.20	0 mm	Antenna WF8	V2	HDXNP06NN9	1	back	77.0	0.946	1.230	1.006	**1.171**	0.381	0.471	A3
2441	39	Bluetooth	FHSS	16.50	15.56	-0.20	0 mm	Antenna WF8	V2	HDXNP06NN9	1	back	77.0	0.935	1.242	1.006	**1.168**	0.364	0.455	
2480	78	Bluetooth	FHSS	16.50	15.44	-0.03	0 mm	Antenna WF8	V2	HDXNP06NN9	1	back	77.0	0.823	1.276	1.006	1.056	0.322	0.413	
2402	0	Bluetooth	FHSS	16.50	15.60	-0.08	0 mm	Antenna WF8	V2	HDXNP06NN9	1	top	77.0	0.537	1.230	1.006	0.664	0.216	0.267	
2402	0	Bluetooth	FHSS	16.50	15.60	0.12	0 mm	Antenna WF8	V2	HDXNP06NN9	1	bottom	77.0	0.002	1.230	1.006	0.002	0.001	0.001	
2402	0	Bluetooth	FHSS	16.50	15.60	0.03	0 mm	Antenna WF8	V2	HDXNP06NN9	1	right	77.0	0.069	1.230	1.006	0.085	0.028	0.035	
2402	0	Bluetooth	FHSS	16.50	15.60	0.12	0 mm	Antenna WF8	V2	HDXNP06NN9	1	left	77.0	0.000	1.230	1.006	0.000	0.000	0.000	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population**							**Body** **1.6 W/kg (mW/g)** averaged over 1 gram													

Note: The reported SAR was scaled to the 77.5% transmission duty factor to determine compliance since the duty factor of the device is permanently limited to 77.5% per the manufacturer.

Table 9-6
Bluetooth Body SAR Data – Antenna WF7

MEASUREMENT RESULTS																				
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna Config.	Variant	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	SAR (1g)	Scaling Factor (Cond Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	SAR (10g)	Reported SAR (10g)	Plot #
MHz	Ch.													(W/kg)			(W/kg)	(W/kg)	(W/kg)	
2402	0	Bluetooth	FHSS	16.50	15.24	0.00	0 mm	Antenna WF7	V2	HDXNP06NN9	1	back	77.0	0.758	1.337	1.006	1.020	0.362	0.487	
2441	39	Bluetooth	FHSS	16.50	15.30	0.07	0 mm	Antenna WF7	V2	HDXNP06NN9	1	back	77.0	0.695	1.318	1.006	0.922	0.326	0.432	
2480	78	Bluetooth	FHSS	16.50	15.50	0.03	0 mm	Antenna WF7	V2	HDXNP06NN9	1	back	77.0	0.842	1.259	1.006	1.066	0.398	0.504	
2480	78	Bluetooth	FHSS	16.50	15.40	0.12	0 mm	Antenna WF7	V1	WXJQH56YW5	1	back	77.0	0.687	1.288	1.006	0.890	0.318	0.412	
2480	78	Bluetooth	FHSS	16.50	15.50	0.04	0 mm	Antenna WF7	V2	HDXNP06NN9	1	top	77.0	0.360	1.259	1.006	0.456	0.160	0.203	
2480	78	Bluetooth	FHSS	16.50	15.50	0.01	0 mm	Antenna WF7	V2	HDXNP06NN9	1	bottom	77.0	0.027	1.259	1.006	0.034	0.011	0.014	
2480	78	Bluetooth	FHSS	16.50	15.50	0.00	0 mm	Antenna WF7	V2	HDXNP06NN9	1	right	77.0	0.000	1.259	1.006	0.000	0.000	0.000	
2480	78	Bluetooth	FHSS	16.50	15.50	0.04	0 mm	Antenna WF7	V2	HDXNP06NN9	1	left	77.0	0.194	1.259	1.006	0.246	0.079	0.100	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population**							**Body** **1.6 W/kg (mW/g)** averaged over 1 gram													

Note: The reported SAR was scaled to the 77.5% transmission duty factor to determine compliance since the duty factor of the device is permanently limited to 77.5% per the manufacturer.

9.2 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in FCC KDB Publication 616217 D04v01r02 and FCC KDB Publication 447498 D01v06.
2. Batteries are fully charged at the beginning of the SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. 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.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v06.
6. Per FCC KDB 865664 D01v01r04, variability SAR tests were performed when the measured SAR results for a frequency band were greater than or equal to 0.8 W/kg. Repeated SAR measurements are highlighted in the tables above for clarity. Please see Section 11.1 for variability analysis.
7. FCC KDB Publication 616217 D04v01r02 Section 4.3, SAR tests are required for the back surface and edges of the tablet with the tablet touching the phantom. The SAR Exclusion Threshold in FCC KDB 447498 D01v06 was applied to determine SAR test exclusion for adjacent edge configurations.

WLAN Notes:

1. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 2.4 GHz WIFI single transmission chain operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4 GHz 802.11g/n/ax) was not required due to the maximum allowed powers and the highest reported DSSS SAR. See Section 6.2.4 for more information.
2. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 5 GHz WIFI single transmission chain operations, the initial test configuration was selected according to the transmission mode with the highest maximum allowed powers. Other transmission modes were not investigated since the highest reported SAR for initial test configuration adjusted by the ratio of maximum output powers is less than 1.2 W/kg for 1g evaluations. See Section 6.2.5 for more information.
3. Per KDB Publication 248227 D01v02r02, SAR for MIMO was evaluated by following the simultaneous SAR provisions from KDB Publication 447498 D01v06 by either evaluating the sum of the 1g SAR values of each antenna transmitting independently or making a SAR measurement with both antennas transmitting simultaneously. Please see Section 10 for complete analysis.
4. When the maximum reported 1g averaged SAR is ≤0.8 W/kg, SAR testing on additional channels was not required. Otherwise, SAR for the next highest output power channel was required until the reported SAR result was ≤ 1.20 W/kg for 1g evaluations or all test channels were measured.
5. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools. The reported SAR was scaled to the 100% transmission duty factor to determine compliance. Procedures used to measure the duty factor are identical to that in the associated EMC test reports. The reported SAR was scaled to the 100% transmission duty factor to determine compliance. The maximum achievable duty cycles for all modes were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8 MHz, VBW = 50 MHz, and detector = peak per guidance of Section 6.0 b) of ANSI C63. 10-2013 and KDB 558074 D01v04. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100.
6. The time-averaged mechanism for WLAN operations was disabled for the above SAR measurements. The SAR was scaled to the maximum time-averaged output power.

Bluetooth Notes

1. Bluetooth SAR was measured with the device connected to a call box with hopping disabled with DH5 operation and Tx Tests test mode type. Per October 2016 TCB Workshop Notes, the reported SAR was scaled to the 77.5% transmission duty factor to determine compliance. See Section 7.3 for the time domain plot and calculation for the duty factor of the device.

10 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

10.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D01v06 are applicable to devices with built-in unlicensed transmitters such as 802.11 and Bluetooth devices which may simultaneously transmit together.

10.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore, simultaneous transmission analysis is required. Per FCC KDB Publication 447498 D01v06 4.3.2 and IEEE 1528-2013 Section 6.3.4.1.2, simultaneous transmission SAR test exclusion may be applied when the sum of the 1g SAR for all the simultaneous transmitting antennas in a specific a physical test configuration is ≤1.6 W/kg. The different test positions in an exposure condition may be considered collectively to determine SAR test exclusion according to the sum of 1g SAR.

Note:

*The SAR distributions for at least one of the antennas are spatially separated from the other antennas per FCC KDB Publication 248227 Section 6.1 procedures. Therefore, the simultaneous transmission were treated independently for this configuration. See section 10.4 for more information about the Spatial Separation Analysis.

10.3 Body SAR Simultaneous Transmission Analysis

Table 10-1
Simultaneous Transmission Scenario with 2.4 GHz WLAN

Simult Tx	Configuration	2.4 GHz WLAN Antenna WF8 SAR (W/kg)	2.4 GHz WLAN Antenna WF7 SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body SAR	Back	1.186	1.014	1.186*
	Top	0.501	0.537	**1.038**
	Bottom	0.030	0.056	0.086
	Right	0.077	0.001	0.078
	Left	0.000	0.448	0.448

Table 10-2
Simultaneous Transmission Scenario with 2.4 GHz Bluetooth

Simult Tx	Configuration	Bluetooth Antenna WF8 SAR (W/kg)	Bluetooth Antenna WF7 SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body SAR	Back	1.171	1.066	1.171*
	Top	0.664	0.456	**1.120**
	Bottom	0.002	0.034	0.036
	Right	0.085	0.000	0.085
	Left	0.000	0.246	0.246

Table 10-3
Simultaneous Transmission Scenario with 5 GHz WLAN

Simult Tx	Configuration	5 GHz WLAN Antenna 5T SAR (W/kg)	5 GHz WLAN Antenna 5B SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body SAR	Back	0.160	0.133	**0.293**
	Top	0.016	0.000	0.016
	Bottom	0.000	0.068	0.068
	Right	1.081	1.029	1.081*
	Left	0.019	0.015	0.034

Table 10-4
Simultaneous Transmission Scenario with 2.4 GHz Bluetooth (TXBF) and 5 GHz MIMO

Simult Tx	Configuration	Bluetooth Antenna WF8 SAR (W/kg)	Bluetooth Antenna WF7 SAR (W/kg)	5 GHz WLAN Antenna 5T SAR (W/kg)	5 GHz WLAN Antenna 5B SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	4	1+2+3+4
Body SAR	Back	1.171	1.066	0.160	0.133	1.464*
	Top	0.664	0.456	0.016	0.000	**1.136**
	Bottom	0.002	0.034	0.000	0.068	0.104
	Right	0.085	0.000	1.081	1.029	1.166*
	Left	0.000	0.246	0.019	0.015	0.280

10.4 Spatial Separation Analysis

Per FCC KDB Publication 248227, antennas may be considered spatially separated when the aggregate SAR from multiple antennas at any location in the combined SAR distribution is either ≤ 1.2 W/kg where at least 90% of the SAR is attributed to a single SAR distribution or ≤ 0.4 W/kg where no more than one SAR distribution is contributing > 0.1 W/kg.

Spatial separation was determined by inspection of the area scan SAR distributions to confirm that at all locations, SAR was <1.2 W/kg, where at least 90% of the SAR is attributed to a single SAR distribution. See below for illustrations of the spatial antennas considered.

10.4.1 Back Side Spatial Separation Analysis

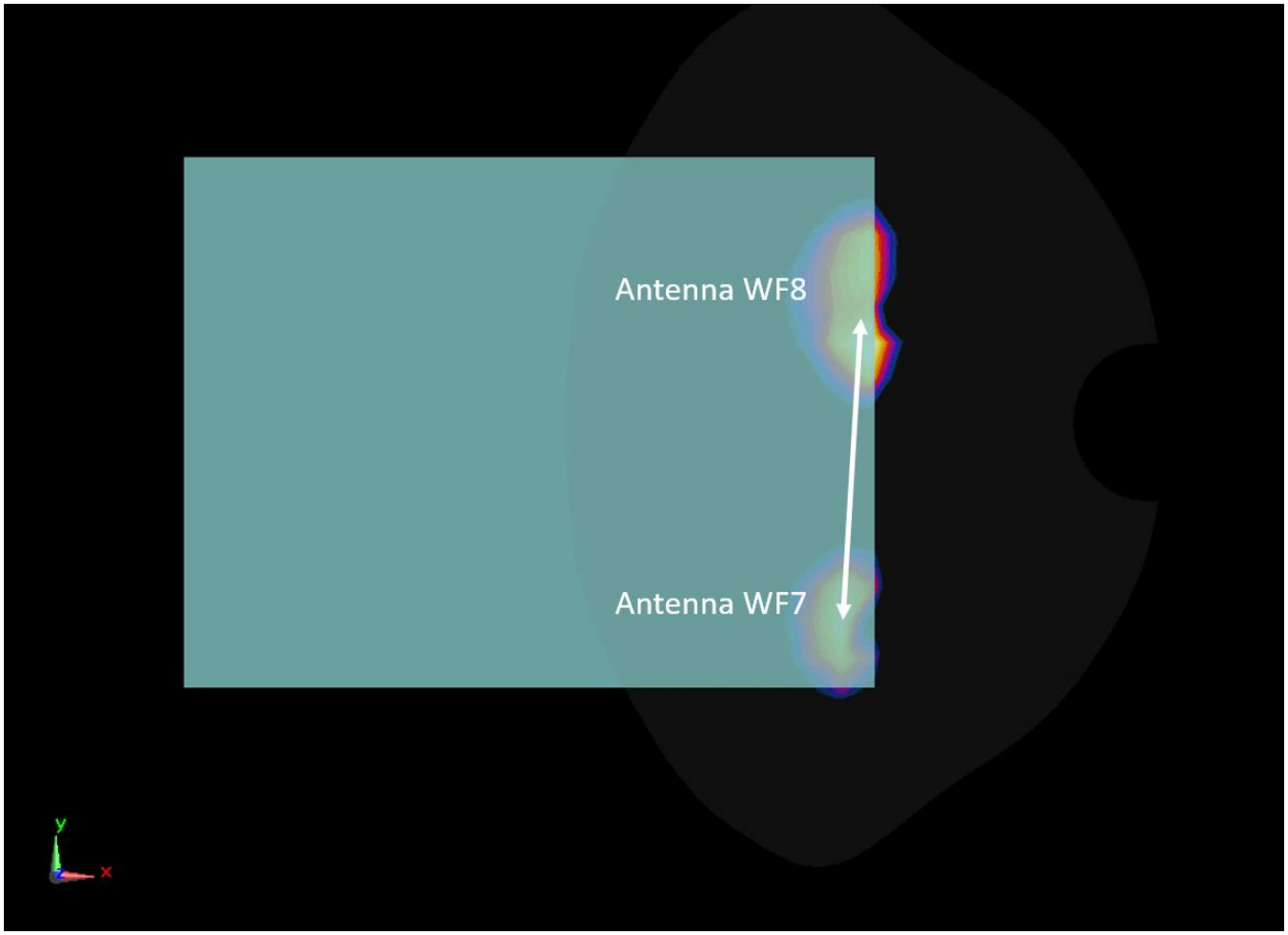


Figure 10-1
Back Side Spatial Separation for Antenna WF8 and Antenna WF7

10.4.2 Right Edge Spatial Separation Analysis

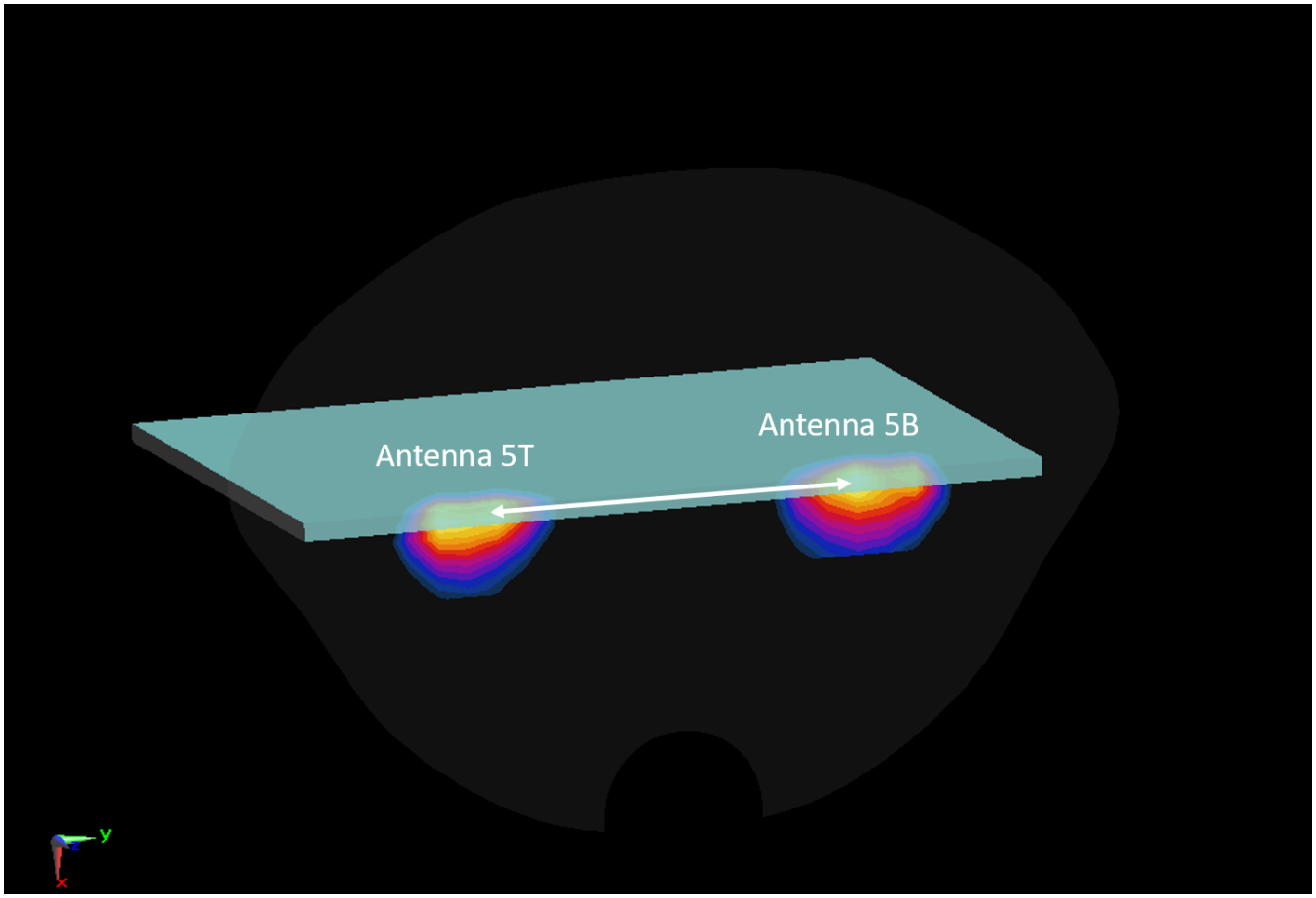


Figure 10-2
Right Edge Spatial Separation for Antenna 5T and Antenna 5B

10.5 Simultaneous Transmission Conclusion

The above numerical summed SAR results and spatial separation analysis for all the worst-case simultaneous transmission conditions were below the SAR limit. Therefore, the above analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit and therefore no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D01v06 and IEEE 1528-2013 Section 6.3.4.1.2.

11 SAR MEASUREMENT VARIABILITY

11.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01r04, SAR measurement variability was assessed for each frequency band, which was determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media were required for SAR measurements in a frequency band, the variability measurement procedures were applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. These additional measurements were repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device was returned to ambient conditions (normal room temperature) with the battery fully charged before it was re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

SAR Measurement Variability was assessed using the following procedures for each frequency band:

1) When the original highest measured SAR is ≥ 0.80 W/kg, the measurement was repeated once.
2) A second repeated measurement was performed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg (~ 10% from the 1g SAR limit).
3) A third repeated measurement was performed only if the original, first or second repeated measurement was ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.
4) Repeated measurements are not required when the original highest measured SAR is < 0.80 W/kg

Table 11-1
Body SAR Measurement Variability Results

BODY VARIABILITY RESULTS														
Band	FREQUENCY		Mode	Service	Data Rate (Mbps)	Side	Spacing	Measured SAR (1g)	1st Repeated SAR (1g)	Ratio	2nd Repeated SAR (1g)	Ratio	3rd Repeated SAR (1g)	Ratio
	MHz	Ch.						(W/kg)	(W/kg)		(W/kg)		(W/kg)	
2450	2412.00	1	802.11b, 22 MHz Bandwidth	DSSS , Antenna WF8	1	back	0 mm	0.949	0.928	1.02	N/A	N/A	N/A	N/A
5250	5230.00	46	802.11n, 40 MHz Bandwidth	OFDM , Antenna 5T	13.5	right	0 mm	0.851	0.824	1.03	N/A	N/A	N/A	N/A
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram						

11.2 Measurement Uncertainty

The measured SAR was <1.5 W/kg for 1g and <3.75 W/kg for 10g for all frequency bands. Therefore, per KDB Publication 865664 D01v01r04, the extended measurement uncertainty analysis per IEEE 1528-2013 was not required.

12 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	N5182A	MXG Vector Signal Generator	9/25/2020	Annual	9/25/2021	US46240505
Agilent	N5182A	MXG Vector Signal Generator	12/1/2020	Annual	12/1/2021	MY47420837
Agilent	8753ES	S-Parameter Network Analyzer	9/16/2020	Annual	9/16/2021	MY40000670
Agilent	E4438C	ESG Vector Signal Generator	9/29/2020	Annual	9/29/2021	MY45093852
Agilent	N9020A	MXA Signal Analyzer	12/21/2020	Annual	12/21/2021	MY50200571
Agilent	85033E	3.5mm Standard Calibration Kit	6/6/2020	Annual	6/6/2021	MY53402352
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	343971
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	343972
Amplifier Research	150A100C	Amplifier	CBT	N/A	CBT	350132
Anritsu	ML2495A	Power Meter	11/3/2020	Annual	11/3/2021	1039008
Anritsu	MA24106A	USB Power Sensor	6/8/2020	Annual	6/8/2021	2018534
Anritsu	MA24106A	USB Power Sensor	6/3/2020	Annual	6/3/2021	2018527
Anritsu	MA24106A	USB Power Sensor	9/15/2020	Annual	9/15/2021	1248508
Anritsu	MA24106A	USB Power Sensor	9/15/2020	Annual	9/15/2021	1244515
Anritsu	MA2411B	Pulse Power Sensor	12/18/2020	Annual	12/18/2021	1027293
Anritsu	MA2411B	Pulse Power Sensor	12/9/2020	Annual	12/9/2021	1726262
Control Company	4040	Therm./Clock/Humidity Monitor	6/29/2019	Biennial	6/29/2021	192291470
Control Company	4040	Therm./Clock/Humidity Monitor	6/29/2019	Biennial	6/29/2021	192291455
Control Company	4040	Therm./Clock/Humidity Monitor	6/29/2019	Biennial	6/29/2021	192291460
Control Company	4353	Long Stem Thermometer	10/28/2020	Biennial	10/28/2022	200670633
Control Company	4353	Long Stem Thermometer	10/28/2020	Biennial	10/28/2022	200670623
Insize	1108-150	Digital Caliper	1/17/2020	Biennial	1/17/2022	409193536
KEYSIGHT	E4438C	VECTOR SIGNAL GENERATOR	6/22/2020	Annual	6/22/2021	MY45092078
MCL	BW-N10W5+	10dB Attenuator	CBT	N/A	CBT	1611
MCL	BW-N3W5+	3dB Attenuator	CBT	N/A	CBT	1812
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1311
Mini-Circuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	ZHDC-16-63-S+	50-6000MHz Bidirectional Coupler	CBT	N/A	CBT	N/A
Rohde & Schwarz	FSP-7	Spectrum Analyzer	1/9/2020	Biennial	1/9/2022	100288
Rosenberger	32W1006-016	Torque Wrench	12/1/2020	Annual	12/1/2021	N/A
SPEAG	D2450V2	2450 MHz SAR Dipole	11/12/2018	Triennial	11/12/2021	921
SPEAG	D5GHzV2	5 GHz SAR Dipole	3/13/2018	Triennial	3/13/2021	1123
SPEAG	DAE4	Dasy Data Acquisition Electronics	6/11/2020	Annual	6/11/2021	701
SPEAG	DAE4	Data Acquisition Electronics	4/14/2020	Annual	4/14/2021	1532
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/12/2020	Annual	5/12/2021	1070
SPEAG	EX3DV4	SAR Probe	7/16/2020	Annual	7/16/2021	7546
SPEAG	EX3DV4	SAR Probe	6/22/2020	Annual	6/22/2021	7416

Note: 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.

13 MEASUREMENT UNCERTAINTIES

a	b	c	d	e= f(d,k)	f	g	h = c x f/e	i = c x g/e	k
Uncertainty Component	IEEE 1528 Sec.	Tol. (± %)	Prob. Dist.	Div.	c_i 1gm	c_i 10 gms	1gm u_i (± %)	10gms u_i (± %)	v_i
Measurement System									
Probe Calibration	E.2.1	6.55	N	1	1	1	6.6	6.6	∞
Axial Isotropy	E.2.2	0.25	N	1	0.7	0.7	0.2	0.2	∞
Hemishperical Isotropy	E.2.2	1.3	N	1	0.7	0.7	0.9	0.9	∞
Boundary Effect	E.2.3	2	R	1.732	1	1	1.2	1.2	∞
Linearity	E.2.4	0.3	N	1	1	1	0.3	0.3	∞
System Detection Limits	E.2.4	0.25	R	1.732	1	1	0.1	0.1	∞
Readout Electronics	E.2.6	0.3	N	1	1	1	0.3	0.3	∞
Response Time	E.2.7	0.8	R	1.732	1	1	0.5	0.5	∞
Integration Time	E.2.8	2.6	R	1.732	1	1	1.5	1.5	∞
RF Ambient Conditions - Noise	E.6.1	3	R	1.732	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	3	R	1.732	1	1	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.8	R	1.732	1	1	0.5	0.5	∞
Probe Positioning w/ respect to Phantom	E.6.3	6.7	R	1.732	1	1	3.9	3.9	∞
Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation	E.5	4	R	1.732	1	1	2.3	2.3	∞
Test Sample Related									
Test Sample Positioning	E.4.2	3.12	N	1	1	1	3.1	3.1	35
Device Holder Uncertainty	E.4.1	1.67	N	1	1	1	1.7	1.7	5
Output Power Variation - SAR drift measurement	E.2.9	5	R	1.732	1	1	2.9	2.9	∞
SAR Scaling	E.6.5	0	R	1.732	1	1	0.0	0.0	∞
Phantom & Tissue Parameters									
Phantom Uncertainty (Shape & Thickness tolerances)	E.3.1	7.6	R	1.73	1.0	1.0	4.4	4.4	∞
Liquid Conductivity - measurement uncertainty	E.3.3	4.3	N	1	0.78	0.71	3.3	3.0	76
Liquid Permittivity - measurement uncertainty	E.3.3	4.2	N	1	0.23	0.26	1.0	1.1	75
Liquid Conductivity - Temperature Uncertainty	E.3.4	3.4	R	1.732	0.78	0.71	1.5	1.4	∞
Liquid Permittivity - Temperature Unceritainty	E.3.4	0.6	R	1.732	0.23	0.26	0.1	0.1	∞
Liquid Conductivity - deviation from target values	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Permittivity - deviation from target values	E.3.2	5.0	R	1.73	0.60	0.49	1.7	1.4	∞
Combined Standard Uncertainty (k=1)			RSS				11.6	11.4	191
Expanded Uncertainty (95% CONFIDENCE LEVEL)			k=2				23.2	22.8	

The above measurement uncertainties are according to IEEE Std. 1528-2013

14 CONCLUSION

14.1 Measurement Conclusion

The SAR evaluation indicates that the EUT complies with the RF radiation exposure limits of the FCC and Innovation, Science, and Economic Development Canada, with respect to all parameters subject to this test. These measurements were taken to simulate the RF effects of RF exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The results and statements relate only to the item(s) tested.

Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables. [3]

15 REFERENCES

[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.

[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 Hoschschule Zürich, Dosimetric Evaluation of the Cellular Phone.

[20] IEC 62209-1, Measurement procedure for the assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Part 1: Devices used next to the ear (Frequency range of 300 MHz to 6 GHz), July 2016.

[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 Septembro 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.

APPENDIX A: SAR TEST DATA

PCTEST

DUT: BCGA2377; Type: Tablet Device; Serial: HKJJY7D02G

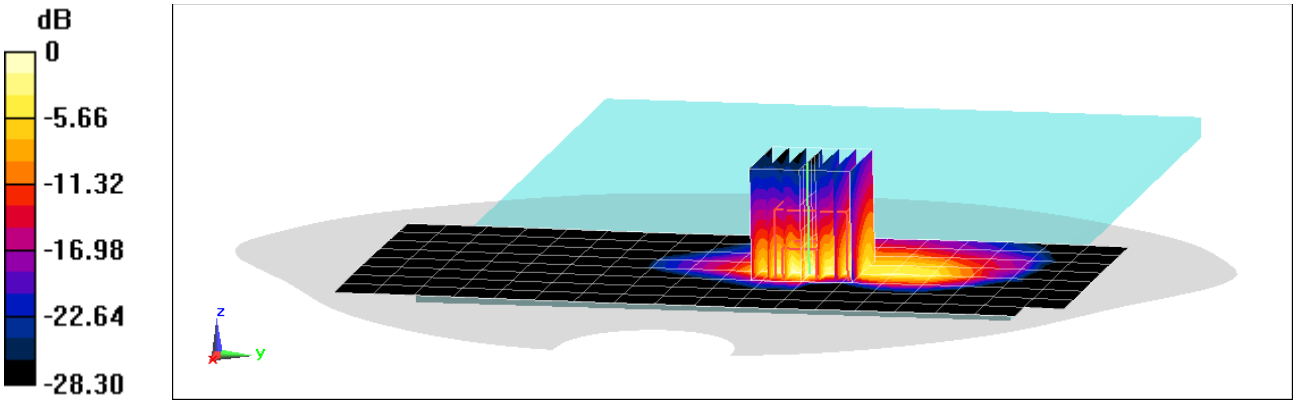
Communication System: UID 0, IEEE 802.11b; 2412 MHz; Duty Cycle: 1:1
Medium: 2450 MHz Body; Medium parameters used (interpolated):
f = 2412 MHz; σ = 1.991 S/m; ε_r = 51.279; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 02-08-2021; Ambient Temp: 22.9°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN7546; ConvF(7.32, 7.32, 7.32) @ 2412 MHz; Calibrated: 7/16/2020
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1532; Calibrated: 4/14/2020
Phantom: Twin-SAM V4.0 Main; Type: QD 000 P40 CC; Serial: 1114
Measurement SW: DASY52, Version 52.10 (4);SEMCAD X Version 14.6.14 (7483)

Mode: IEEE 802.11b, Antenna WF8, Variant 2, 22 MHz Bandwidth, Body SAR, Ch 1, 1 Mbps, Back Side

Area Scan (9x19x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x8)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=1.4mm; Graded Ratio: 1.4
Reference Value = 20.66 V/m; Power Drift = -0.15 dB
Peak SAR (extrapolated) = 3.50 W/kg
SAR(1 g) = 0.949 W/kg; SAR(10 g) = 0.375 W/kg



0 dB = 2.18 W/kg = 3.38 dBW/kg

PCTEST

DUT: BCGA2377; Type: Tablet Device; Serial: QVWYQ20QD4

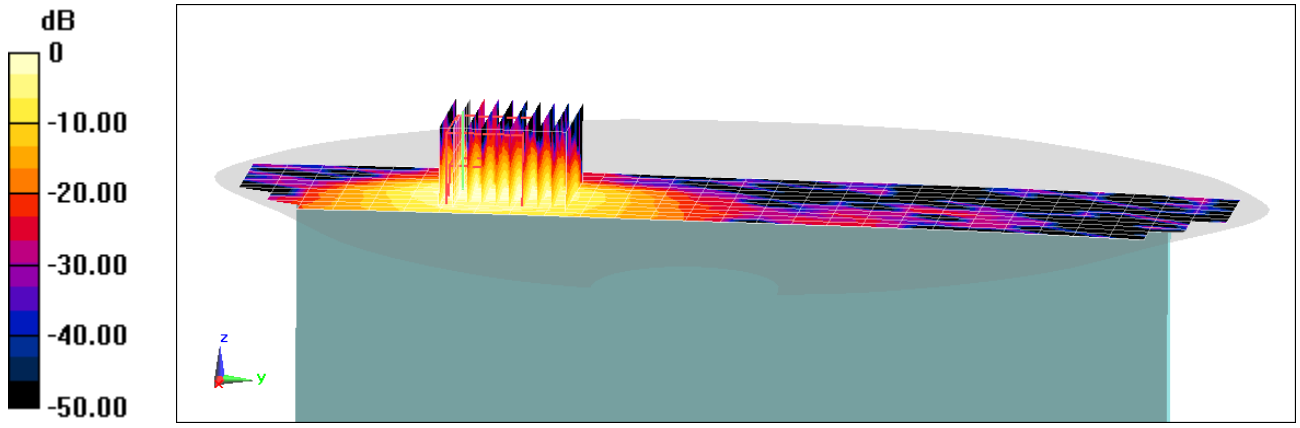
Communication System: UID 0, IEEE 802.11n; Frequency: 5230 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used (interpolated):
f = 5230 MHz; σ = 5.425 S/m; ε_r = 48.075; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 02-04-2021; Ambient Temp: 22.4°C; Tissue Temp: 21.0°C

Probe: EX3DV4 - SN7416; ConvF(4.61, 4.61, 4.61) @ 5230 MHz; Calibrated: 6/22/2020
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn701; Calibrated: 6/11/2020
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CA; Serial: 1275
Measurement SW: DASY52, Version 52.10 (4);SEMCAD X Version 14.6.14 (7483)

Mode: IEEE 802.11n, Antenna 5T, Variant 1, U-NII-1, 40 MHz Bandwidth, Body SAR, Ch 46, 13.5 Mbps, Right Edge

Area Scan (12x29x1): Measurement grid: dx=5mm, dy=10mm
Zoom Scan (10x10x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Reference Value = 13.12 V/m; Power Drift = -0.19 dB
Peak SAR (extrapolated) = 4.03 W/kg
SAR(1 g) = 0.851 W/kg; SAR(10 g) = 0.296 W/kg



0 dB = 2.31 W/kg = 3.64 dBW/kg

PCTEST

DUT: BCGA2377; Type: Tablet Device; Serial: HDXNP06NN9

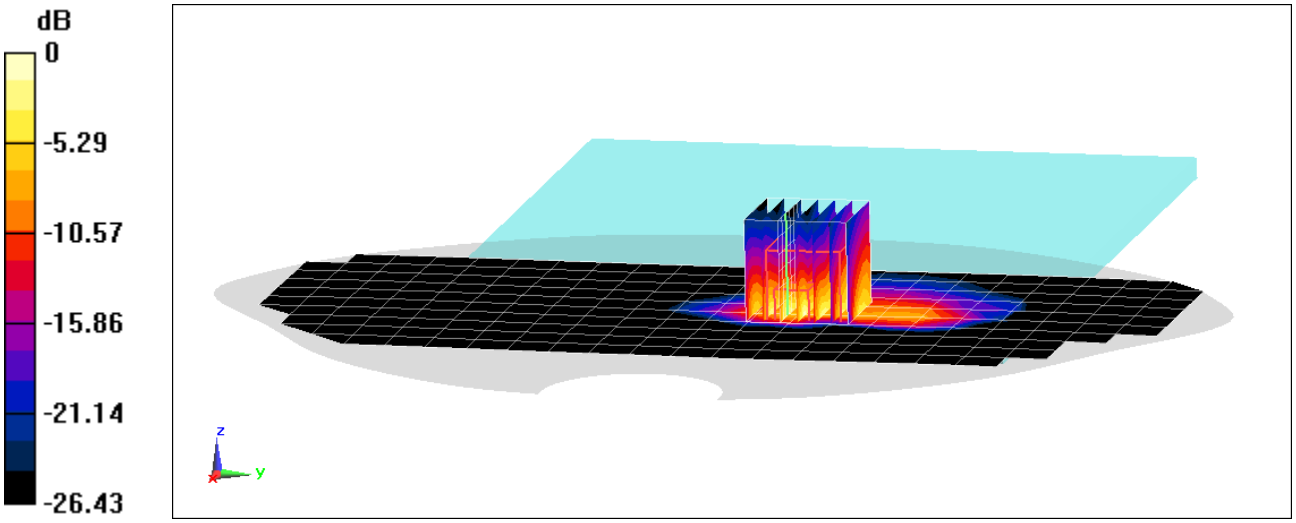
Communication System: UID 0, Bluetooth; Frequency: 2402 MHz; Duty Cycle: 1:1.29867
Medium: 2450 MHz Body; Medium parameters used (interpolated):
f = 2402 MHz; σ = 1.982 S/m; ε_r = 51.293; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 02-08-2021; Ambient Temp: 22.9°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN7546; ConvF(7.32, 7.32, 7.32) @ 2402 MHz; Calibrated: 7/16/2020
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1532; Calibrated: 4/14/2020
Phantom: Twin-SAM V4.0 Main; Type: QD 000 P40 CC; Serial: 1114
Measurement SW: DASY52, Version 52.10 (4);SEMCAD X Version 14.6.14 (7483)

Mode: Bluetooth, Antenna WF8, Variant 2, Body SAR, Ch 0, 1 Mbps, Back Side

Area Scan (11x23x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 17.99 V/m; Power Drift = -0.2 dB
Peak SAR (extrapolated) = 3.32 W/kg
SAR(1 g) = 0.946 W/kg; SAR(10 g) = 0.381 W/kg



0 dB = 2.28 W/kg = 3.58 dBW/kg

APPENDIX B: SYSTEM VERIFICATION

PCTEST

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 921

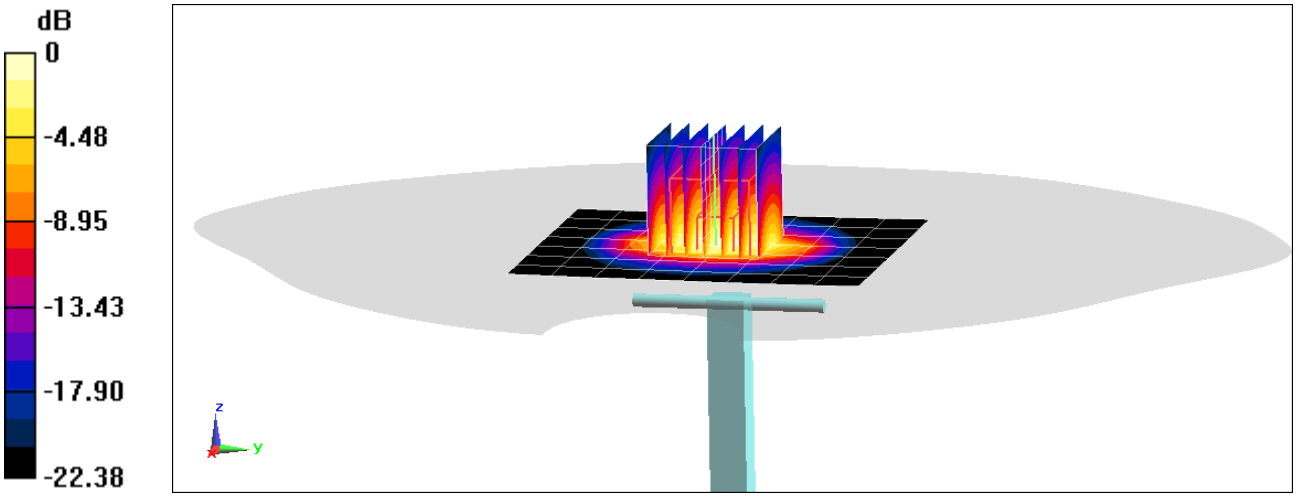
Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1
2450 MHz Body Medium parameters used:
f = 2450 MHz; σ = 2.025 S/m; ε_r = 51.225; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 02-08-2021; Ambient Temp: 22.9°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN7546; ConvF(7.32, 7.32, 7.32) @ 2450 MHz; Calibrated: 7/16/2020
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1532; Calibrated: 4/14/2020
Phantom: Twin-SAM V4.0 Main; Type: QD 000 P40 CC; Serial: 1114
Measurement SW: DASY52, Version 52.10 (4);SEMCAD X Version 14.6.14 (7483)

2450 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 11.2 W/kg
SAR(1 g) = 5.38 W/kg; SAR(10 g) = 2.49 W/kg
Deviation(1 g) = 5.91%



0 dB = 8.88 W/kg = 9.48 dBW/kg

DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1123

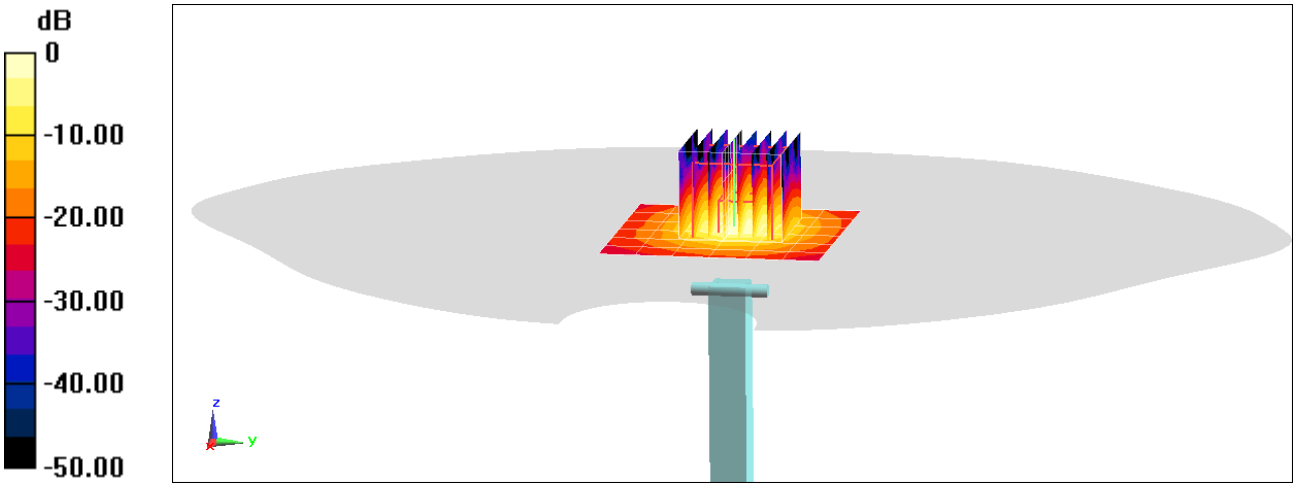
Communication System: UID 0, CW; Frequency: 5250 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used (interpolated):
f = 5250 MHz; σ = 5.451 S/m; ε_r = 48.045; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 02-04-2021; Ambient Temp: 22.4°C; Tissue Temp: 21.0°C

Probe: EX3DV4 - SN7416; ConvF(4.61, 4.61, 4.61) @ 5250 MHz; Calibrated: 6/22/2020
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn701; Calibrated: 6/11/2020
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CA; Serial: 1275
Measurement SW: DASY52, Version 52.10 (4);SEMCAD X Version 14.6.14 (7483)

5250 MHz System Verification at 17.0 dBm (50 mW)

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Peak SAR (extrapolated) = 14.0 W/kg
SAR(1 g) = 3.44 W/kg; SAR(10 g) = 0.951 W/kg
Deviation(1 g) = -7.03%



0 dB = 8.02 W/kg = 9.04 dBW/kg

PCTEST

DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1123

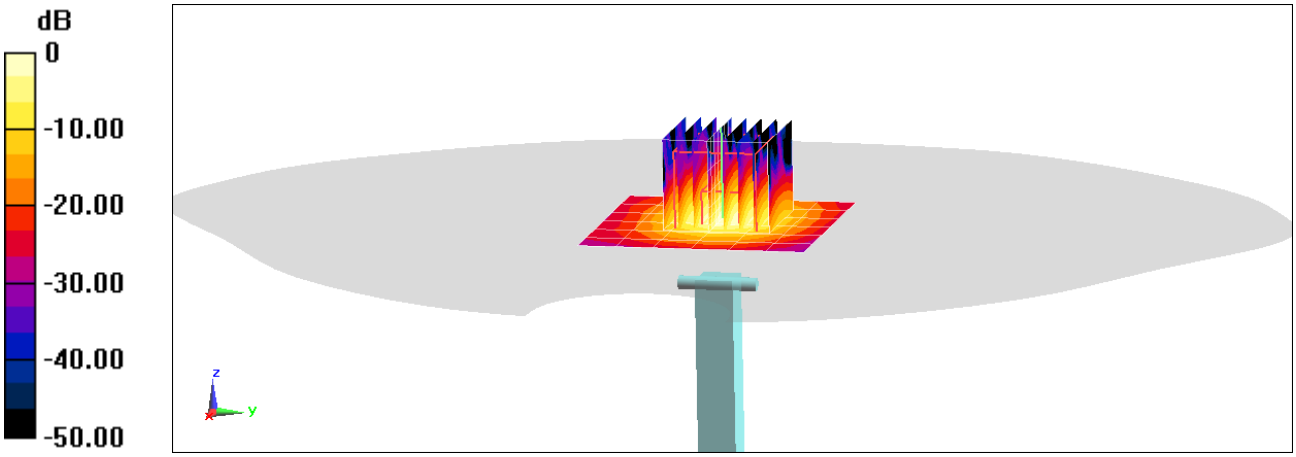
Communication System: UID 0, CW; Frequency: 5600 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5600 MHz; σ = 5.915 S/m; ε_r = 47.425; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 02-04-2021; Ambient Temp: 22.4°C; Tissue Temp: 21.0°C

Probe: EX3DV4 - SN7416; ConvF(4.09, 4.09, 4.09) @ 5600 MHz; Calibrated: 6/22/2020
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn701; Calibrated: 6/11/2020
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CA; Serial: 1275
Measurement SW: DASY52, Version 52.10 (4);SEMCAD X Version 14.6.14 (7483)

5600 MHz System Verification at 17.0 dBm (50 mW)

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Peak SAR (extrapolated) = 16.9 W/kg
SAR(1 g) = 3.81 W/kg; SAR(10 g) = 1.06 W/kg
Deviation(1 g) = -1.80%



0 dB = 9.37 W/kg = 9.72 dBW/kg

DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1123

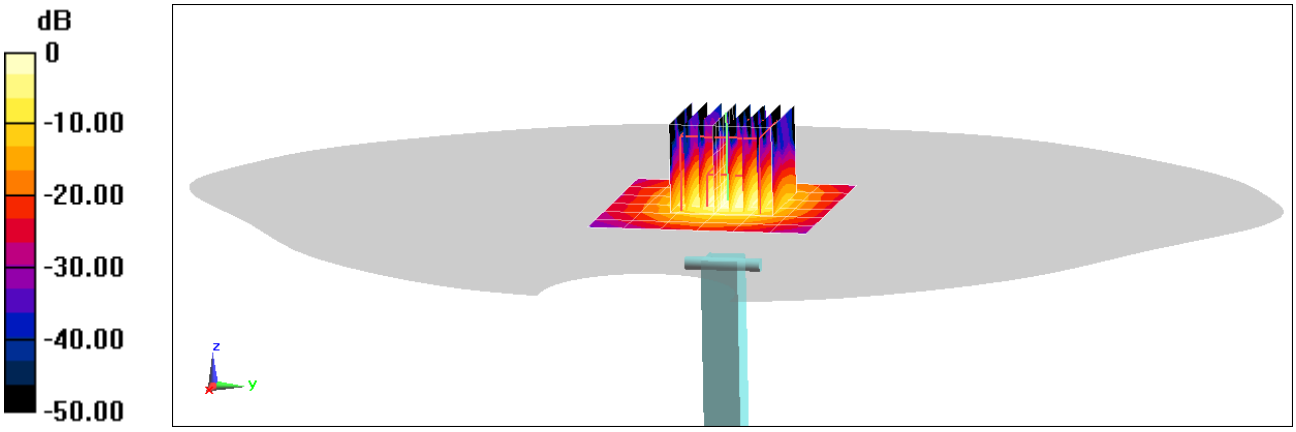
Communication System: UID 0, CW; Frequency: 5750 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used (interpolated):
f = 5750 MHz; σ = 6.133 S/m; ε_r = 47.15; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 02-04-2021; Ambient Temp: 22.4°C; Tissue Temp: 21.0°C

Probe: EX3DV4 - SN7416; ConvF(4.14, 4.14, 4.14) @ 5750 MHz; Calibrated: 6/22/2020
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn701; Calibrated: 6/11/2020
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CA; Serial: 1275
Measurement SW: DASY52, Version 52.10 (4);SEMCAD X Version 14.6.14 (7483)

5750 MHz System Verification at 17.0 dBm (50 mW)

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Peak SAR (extrapolated) = 17.4 W/kg
SAR(1 g) = 3.93 W/kg; SAR(10 g) = 1.09 W/kg
Deviation(1 g) = 5.22%



0 dB = 9.54 W/kg = 9.80 dBW/kg

APPENDIX C: SAR TISSUE SPECIFICATIONS

Measurement Procedure for Tissue verification:

1) The network analyzer and probe system was configured and calibrated.
2) The probe was immersed in the tissue. The tissue was placed in a nonmetallic container. Trapped air bubbles beneath the flange were minimized by placing the probe at a slight angle.
3) The complex admittance with respect to the probe aperture was measured
4) The complex relative permittivity ε' can be calculated from the below equation (Pournaropoulos and Misra):

$$Y = \frac{j2\omega\varepsilon_r\varepsilon_0}{\left[\ln(b/a)\right]^2}\int_a^b\int_a^b\int_0^\pi \cos\phi' \frac{\exp\left[-j\omega r(\mu_0\varepsilon_r'\varepsilon_0)^{1/2}\right]}{r} d\phi' d\rho' d\rho$$

where *Y* is the admittance of the probe in contact with the sample, the primed and unprimed coordinates refer to source and observation points, respectively, $r^2 = \rho^2 + \rho'^2 - 2\rho\rho'\cos\phi'$, ω is the angular frequency, and $j = \sqrt{-1}$.

3 Composition / Information on ingredients

3.2 Mixtures
Description: Aqueous solution with surfactants and inhibitors
Declarable, or hazardous components:

CAS: 107-21-1 EINECS: 203-473-3 Reg.nr.: 01-2119456816-28-0000	**Ethanediol** STOT RE 2, H373; Acute Tox. 4, H302	>1.0-4.9%
CAS: 68608-26-4 EINECS: 271-781-5 Reg.nr.: 01-2119527859-22-0000	**Sodium petroleum sulfonate** Eye Irrit. 2, H319	< 2.9%
CAS: 107-41-5 EINECS: 203-489-0 Reg.nr.: 01-2119539582-35-0000	**Hexylene Glycol / 2-Methyl-pentane-2,4-diol** Skin Irrit. 2, H315; Eye Irrit. 2, H319	< 2.9%
CAS: 68920-66-1 NLP: 500-236-9 Reg.nr.: 01-2119489407-26-0000	**Alkoxylated alcohol, > C_{16}** Aquatic Chronic 2, H411; Skin Irrit. 2, H315; Eye Irrit. 2, H319	< 2.0%

Additional information:
For the wording of the listed risk phrases refer to section 16.
Not mentioned CAS-, EINECS- or registration numbers are to be regarded as Proprietary/Confidential.
The specific chemical identity and/or exact percentage concentration of proprietary components is withheld as a trade secret.

Figure C-1

Note: Liquid recipes are proprietary SPEAG. Since the composition is approximate to the actual liquids utilized, the manufacturer tissue-equivalent liquid data sheets are provided below.

Schmid & Partner Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 44 245 9700, Fax +41 44 245 9779
info@speag.com, http://www.speag.com

Measurement Certificate / Material Test

Item Name	**Body Tissue Simulating Liquid (MBBL600-6000V6)**
Product No.	SL AAM U16 BC (Batch: 200803-1)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated DAK probe.

Target Parameters

Target parameters as defined in the KDB 865664 compliance standard.

Test Condition

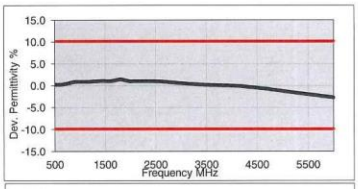
Ambient Condition	22°C ; 30% humidity
TSL Temperature	22°C
Test Date	6-Aug-20
Operator	CL

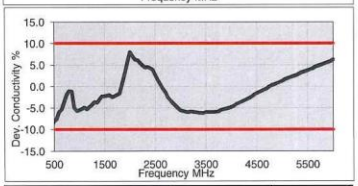
Additional Information

TSL Density
TSL Heat-capacity

Results

	Measured			Target		Diff.to Target [%]	
f [MHz]	e'	e''	sigma	eps	sigma	Δ-eps	Δ-sigma
600	56.3	26.8	0.89	56.1	0.95	0.3	-6.3
750	55.8	22.6	0.94	55.5	0.96	0.5	-2.1
800	55.7	21.6	0.96	55.3	0.97	0.7	-1.0
825	55.7	21.1	0.97	55.2	0.98	0.8	-1.0
835	55.7	20.9	0.98	55.1	0.99	1.0	-0.5
850	55.6	20.7	0.98	55.2	0.99	0.8	-1.0
900	55.5	19.9	1.00	55.0	1.05	0.9	-4.8
1400	54.7	15.9	1.24	54.1	1.28	1.1	-3.1
1450	54.6	15.8	1.27	54.0	1.30	1.1	-2.3
1600	54.4	15.3	1.36	53.8	1.39	1.1	-2.2
1625	54.4	15.3	1.38	53.8	1.41	1.2	-2.1
1640	54.4	15.2	1.39	53.7	1.42	1.3	-2.1
1650	54.3	15.2	1.39	53.7	1.43	1.1	-2.8
1700	54.2	15.1	1.43	53.6	1.46	1.2	-2.1
1750	54.2	15.0	1.46	53.4	1.49	1.4	-2.0
1800	54.1	14.9	1.50	53.3	1.52	1.5	-1.3
1810	54.1	14.9	1.51	53.3	1.52	1.5	-0.7
1825	54.1	14.9	1.52	53.3	1.52	1.5	0.0
1850	54.0	14.9	1.53	53.3	1.52	1.3	0.7
1900	54.0	14.8	1.57	53.3	1.52	1.3	3.3
1950	53.9	14.8	1.60	53.3	1.52	1.1	5.3
2000	53.8	14.8	1.64	53.3	1.52	0.9	7.9
2050	53.8	14.7	1.68	53.2	1.57	1.1	7.0
2100	53.7	14.7	1.72	53.2	1.62	1.0	6.2
2150	53.7	14.7	1.76	53.1	1.66	1.1	6.0
2200	53.6	14.7	1.80	53.0	1.71	1.1	5.3
2250	53.5	14.8	1.85	53.0	1.76	1.0	5.1
2300	53.5	14.8	1.89	52.9	1.81	1.1	4.4
2350	53.4	14.8	1.94	52.8	1.85	1.1	4.9
2400	53.3	14.8	1.98	52.8	1.90	1.0	4.2
2450	53.3	14.9	2.03	52.7	1.95	1.1	4.1
2500	53.2	14.9	2.07	52.6	2.02	1.1	2.5
2550	53.1	15.0	2.12	52.6	2.09	1.0	1.4
2600	53.0	15.0	2.17	52.5	2.16	0.9	0.5





3500	51.4	16.0	3.11	51.3	3.31	0.2	-6.0
3700	51.1	16.2	3.34	51.1	3.55	0.1	-5.9
5200	48.3	18.7	5.42	49.0	5.30	-1.5	2.3
5250	48.2	18.8	5.50	49.0	5.36	-1.6	2.5
5300	48.1	18.9	5.57	48.9	5.42	-1.7	2.8
5500	47.7	19.2	5.86	48.6	5.65	-2.0	3.8
5600	47.5	19.3	6.01	48.5	5.77	-2.1	4.2
5700	47.3	19.4	6.16	48.3	5.88	-2.3	4.8
5800	47.0	19.6	6.32	48.2	6.00	-2.4	5.3
6000	46.6	19.8	6.62	47.9	6.23	-2.7	6.3
6500							
7000							
7500							
8000							
8500							
9000							
9500							
10000							

Figure C-2
600 – 5800 MHz Body Tissue Equivalent Matter

APPENDIX D: SAR SYSTEM VALIDATION

Per FCC KDB Publication 865664 D02v01r02, SAR system validation status should be documented to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the required tissue- equivalent media for system validation, according to the procedures outlined in FCC KDB Publication 865664 D01v01r04 and IEEE 1528-2013. Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters has been included.

Table D-1
SAR System Validation Summary – 1g

SAR System	Freq. (MHz)	Date	Probe SN	Probe Cal Point		Cond. (σ)	Perm. (εr)	CW VALIDATION			MOD. VALIDATION		
								SENSITIVITY	PROBE LINEARITY	PROBE ISOTROPY	MOD. TYPE	DUTY FACTOR	PAR
AM6	2450	11/12/2020	7546	2450	Body	2.015	50.580	PASS	PASS	PASS	OFDM/TDD	PASS	PASS
AM2	5250	10/14/2020	7416	5250	Body	5.451	46.990	PASS	PASS	PASS	OFDM	N/A	PASS
AM2	5600	10/14/2020	7416	5600	Body	5.956	46.310	PASS	PASS	PASS	OFDM	N/A	PASS
AM2	5750	10/14/2020	7416	5750	Body	6.181	46.014	PASS	PASS	PASS	OFDM	N/A	PASS

NOTE: While the probes have been calibrated for both CW and modulated signals, all measurements were performed using communication systems calibrated for CW signals only. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01v01r04 for scenarios when CW probe calibrations are used with other signal types. SAR systems were validated for modulated signals with a periodic duty cycle, such as GMSK, or with a high peak to average ratio (>5 dB), such as OFDM according to FCC KDB Publication 865664 D01v01r04.

APPENDIX F: IEEE 802.11AX RU SAR EXCLUSION

1.1 IEEE 802.11ax RU SAR Exclusion

To make the most efficient use of the additional available subcarriers (data tones), IEEE 802.11ax can utilize Orthogonal Frequency-Division Multiple Access (OFDMA) which divides the existing 802.11 channels into smaller subchannels called Resource Units (RUs). Possible RU sizes are: 26T, 52T, 106T, 242T, 484T and 996T.

Per FCC Guidance, 802.11ax was considered a higher order 802.11 mode when compared to a/b/g/n/ac to apply KDB Publication 248227 D01v02r02 for OFDM mode selection. Therefore, SAR tests were not required for 802.11ax based on the maximum allowed output powers of OFDM modes and the reported SAR values. Per FCC Guidance, maximum conducted powers were performed for each RU size to demonstrate that the output powers would not be higher than the other OFDM 802.11 modes.

1.2 IEEE 802.11ax RU Target Powers

1.2.1 Maximum Time-Averaged 802.11ax RU Output Power

Mode/ Band		Tones	26T		52T		106T		242T	
		Channel	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
Modulated Average - Single Tx Chain (dBm) - Antenna WF8	20 MHz Bandwidth	1	12.50	11.00	12.50	11.00	12.50	11.00	12.50	11.00
		2	16.00	14.50	16.00	14.50	16.00	14.50	16.00	14.50
		3	17.00	15.50	17.00	15.50	17.00	15.50	17.00	15.50
		4	17.00	15.50	17.00	15.50	17.00	15.50	17.00	15.50
		5	17.00	15.50	17.00	15.50	17.00	15.50	17.00	15.50
		6	17.00	15.50	17.00	15.50	17.00	15.50	17.00	15.50
		7	17.00	15.50	17.00	15.50	17.00	15.50	17.00	15.50
		8	17.00	15.50	17.00	15.50	17.00	15.50	17.00	15.50
		9	17.00	15.50	17.00	15.50	17.00	15.50	17.00	15.50
		10	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25
		11	13.00	11.50	13.00	11.50	13.00	11.50	13.00	11.50
		12	11.00	9.50	11.00	9.50	11.00	9.50	11.00	9.50
		13	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Mode/ Band		Tones	26T		52T		106T		242T	
		Channel	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
Modulated Average - 2 Tx Chain (dBm) - Antenna WF8	20 MHz Bandwidth	1	11.00	9.50	11.00	9.50	11.00	9.50	11.00	9.50
		2	14.00	12.50	14.00	12.50	14.00	12.50	14.00	12.50
		3	17.00	15.50	17.00	15.50	17.00	15.50	17.00	15.50
		4	17.00	15.50	17.00	15.50	17.00	15.50	17.00	15.50
		5	17.00	15.50	17.00	15.50	17.00	15.50	17.00	15.50
		6	17.00	15.50	17.00	15.50	17.00	15.50	17.00	15.50
		7	17.00	15.50	17.00	15.50	17.00	15.50	17.00	15.50
		8	17.00	15.50	17.00	15.50	17.00	15.50	17.00	15.50
		9	16.50	15.00	16.50	15.00	16.50	15.00	16.50	15.00
		10	14.00	12.50	14.00	12.50	14.00	12.50	14.00	12.50
		11	11.50	10.00	11.50	10.00	11.50	10.00	11.50	10.00
		12	9.00	7.50	9.00	7.50	9.00	7.50	9.00	7.50
		13	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Note: In MIMO operations, each antenna transmits at maximum allowed powers as indicated above.

Mode/ Band		Tones	26T		52T		106T		242T	
		Channel	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
Modulated Average - Single Tx Chain (dBm) - Antenna WF7	20 MHz Bandwidth	1	12.50	11.00	12.50	11.00	12.50	11.00	12.50	11.00
		2	16.00	14.50	16.00	14.50	16.00	14.50	16.00	14.50
		3	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		4	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		5	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		6	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		7	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		8	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		9	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		10	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25
		11	13.00	11.50	13.00	11.50	13.00	11.50	13.00	11.50
		12	11.00	9.50	11.00	9.50	11.00	9.50	11.00	9.50
		13	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Mode/ Band		Tones	26T		52T		106T		242T	
		Channel	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
Modulated Average - 2 Tx Chain (dBm) - Antenna WF7	20 MHz Bandwidth	1	11.00	9.50	11.00	9.50	11.00	9.50	11.00	9.50
		2	14.00	12.50	14.00	12.50	14.00	12.50	14.00	12.50
		3	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		4	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		5	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		6	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		7	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		8	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		9	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		10	14.00	12.50	14.00	12.50	14.00	12.50	14.00	12.50
		11	11.50	10.00	11.50	10.00	11.50	10.00	11.50	10.00
		12	9.00	7.50	9.00	7.50	9.00	7.50	9.00	7.50
		13	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Note: In MIMO operations, each antenna transmits at maximum allowed powers as indicated above.

Mode/ Band		Tones	26T		52T		106T		242T		484T		996T	
		Channel	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
Modulated Average - Single Tx Chain (dBm) - Antenna 5T	20 MHz Bandwidth	36	12.00	10.50	15.00	13.50	16.00	14.50	16.00	14.50				
		40	12.00	10.50	15.00	13.50	18.00	16.50	18.00	16.50				
		44	12.00	10.50	15.00	13.50	18.00	16.50	18.00	16.50				
		48	12.00	10.50	15.00	13.50	18.00	16.50	18.00	16.50				
		52	12.00	10.50	15.00	13.50	17.25	15.75	17.25	15.75				
		56	12.00	10.50	15.00	13.50	17.25	15.75	17.25	15.75				
		60	12.00	10.50	15.00	13.50	17.25	15.75	17.25	15.75				
		64	12.00	10.50	15.00	13.50	16.00	14.50	16.00	14.50				
		100	12.00	10.50	15.00	13.50	15.50	14.00	15.50	14.00				
		104	12.00	10.50	15.00	13.50	16.50	15.00	16.50	15.00				
		108	12.00	10.50	15.00	13.50	16.50	15.00	16.50	15.00				
		112	12.00	10.50	15.00	13.50	16.50	15.00	16.50	15.00				
		116	12.00	10.50	15.00	13.50	16.50	15.00	16.50	15.00				
		120	12.00	10.50	15.00	13.50	16.50	15.00	16.50	15.00				
		124	12.00	10.50	15.00	13.50	16.50	15.00	16.50	15.00				
		128	12.00	10.50	15.00	13.50	16.50	15.00	16.50	15.00				
		132	12.00	10.50	15.00	13.50	16.50	15.00	16.50	15.00				
		136	12.00	10.50	15.00	13.50	16.50	15.00	16.50	15.00				
		140	12.00	10.50	12.50	11.00	12.50	11.00	12.50	11.00				
		144	12.00	10.50	15.00	13.50	16.50	15.00	16.50	15.00				
		149	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25				
		153	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25				
		157	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25				
		161	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25				
		165	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25				
	40 MHz Bandwidth	38	12.00	10.50	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00		
		46	12.00	10.50	15.00	13.50	18.00	16.50	18.00	16.50	18.00	16.50		
		54	12.00	10.50	15.00	13.50	17.25	15.75	17.25	15.75	17.25	15.75		
		62	12.00	10.50	14.00	12.50	14.00	12.50	14.00	12.50	14.00	12.50		
		102	12.00	10.50	13.50	12.00	13.50	12.00	13.50	12.00	13.50	12.00		
		110	12.00	10.50	15.00	13.50	16.50	15.00	16.50	15.00	16.50	15.00		
		118	12.00	10.50	15.00	13.50	16.50	15.00	16.50	15.00	16.50	15.00		
		126	12.00	10.50	15.00	13.50	16.50	15.00	16.50	15.00	16.50	15.00		
		134	12.00	10.50	15.00	13.50	15.00	13.50	15.00	13.50	15.00	13.50		
		142	12.00	10.50	15.00	13.50	16.50	15.00	12.50	11.00	16.50	15.00		
		151	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25		
		159	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25		
	80 MHz Bandwidth	42	11.50	10.00	12.50	11.00	12.50	11.00	12.50	11.00	12.50	11.00	12.50	11.00
		58	10.00	8.50	12.50	11.00	12.50	11.00	12.50	11.00	12.50	11.00	12.50	11.00
		106	12.00	10.50	12.00	10.50	12.00	10.50	12.00	10.50	12.00	10.50	12.00	10.50
		122	12.00	10.50	15.00	13.50	16.50	15.00	16.50	15.00	16.50	15.00	16.50	15.00
		138	12.00	10.50	15.00	13.50	16.50	15.00	12.50	11.00	15.00	13.50	16.50	15.00
		155	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25

Mode/ Band		Tones	26T		52T		106T		242T		484T		996T	
		Channel	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
Modulated Average - 2 Tx Chain (dBm) CDD - Antenna 5T	20 MHz Bandwidth	36	7.50	6.00	10.50	9.00	13.50	12.00	15.00	13.50				
		40	7.50	6.00	10.50	9.00	13.50	12.00	15.50	14.00				
		44	7.50	6.00	10.50	9.00	13.50	12.00	15.50	14.00				
		48	7.50	6.00	10.50	9.00	13.50	12.00	15.50	14.00				
		52	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		56	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		60	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		64	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		100	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		104	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		108	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		112	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		116	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		120	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		124	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		128	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		132	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		136	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		140	6.50	5.00	9.50	8.00	11.00	9.50	11.00	9.50				
		144	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		149	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25				
		153	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25				
		157	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25				
		161	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25				
		165	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25				
	40 MHz Bandwidth	38	7.50	6.00	10.50	9.00	13.00	11.50	13.00	11.50	13.00	11.50		
		46	7.50	6.00	10.50	9.00	13.50	12.00	15.50	14.00	18.00	16.50		
		54	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00	17.25	15.75		
		62	6.50	5.00	9.50	8.00	12.00	10.50	12.00	10.50	12.00	10.50		
		102	6.50	5.00	9.50	8.00	12.00	10.50	12.00	10.50	12.00	10.50		
		110	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00	16.50	15.00		
		118	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00	16.50	15.00		
		126	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00	16.50	15.00		
		134	6.50	5.00	9.50	8.00	12.50	11.00	14.00	12.50	14.00	12.50		
		142	6.50	5.00	9.50	8.00	12.50	11.00	12.00	10.50	16.50	15.00		
		151	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25		
		159	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25		
	80 MHz Bandwidth	42	7.50	6.00	10.50	9.00	11.00	9.50	11.00	9.50	11.00	9.50	11.00	9.50
		58	6.50	5.00	9.50	8.00	11.00	9.50	11.00	9.50	11.00	9.50	11.00	9.50
		106	6.50	5.00	9.50	8.00	11.00	9.50	11.00	9.50	11.00	9.50	11.00	9.50
		122	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00	15.00	13.50	15.00	13.50
		138	6.50	5.00	9.50	8.00	12.50	11.00	12.00	10.50	14.00	12.50	16.50	15.00
		155	15.50	14.00	15.50	14.00	15.50	14.00	15.50	14.00	15.50	14.00	15.50	14.00

Note: In MIMO operations, each antenna transmits at maximum allowed powers as indicated above.

Mode/ Band		Tones	26T		52T		106T		242T		484T		996T	
		Channel	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
Modulated Average - 2 Tx Chain (dBm) SDM - Antenna 5T	20 MHz Bandwidth	36	9.00	7.50	12.00	10.50	15.00	13.50	15.00	13.50				
		40	9.00	7.50	12.00	10.50	15.00	13.50	17.00	15.50				
		44	9.00	7.50	12.00	10.50	15.00	13.50	17.00	15.50				
		48	9.00	7.50	12.00	10.50	15.00	13.50	17.00	15.50				
		52	9.00	7.50	12.00	10.50	15.00	13.50	17.00	15.50				
		56	9.00	7.50	12.00	10.50	15.00	13.50	17.00	15.50				
		60	9.00	7.50	12.00	10.50	15.00	13.50	17.00	15.50				
		64	9.00	7.50	12.00	10.50	15.00	13.50	15.00	13.50				
		100	9.00	7.50	12.00	10.50	15.00	13.50	15.25	13.75				
		104	9.00	7.50	12.00	10.50	15.00	13.50	16.50	15.00				
		108	9.00	7.50	12.00	10.50	15.00	13.50	16.50	15.00				
		112	9.00	7.50	12.00	10.50	15.00	13.50	16.50	15.00				
		116	9.00	7.50	12.00	10.50	15.00	13.50	16.50	15.00				
		120	9.00	7.50	12.00	10.50	15.00	13.50	16.50	15.00				
		124	9.00	7.50	12.00	10.50	15.00	13.50	16.50	15.00				
		128	9.00	7.50	12.00	10.50	15.00	13.50	16.50	15.00				
		132	9.00	7.50	12.00	10.50	15.00	13.50	16.50	15.00				
		136	9.00	7.50	12.00	10.50	15.00	13.50	16.50	15.00				
		140	9.00	7.50	11.00	9.50	11.00	9.50	11.00	9.50				
		144	9.00	7.50	12.00	10.50	15.00	13.50	16.50	15.00				
		149	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25				
		153	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25				
		157	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25				
		161	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25				
		165	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25				
	40 MHz Bandwidth	38	9.00	7.50	12.00	10.50	13.00	11.50	13.00	11.50	13.00	11.50		
		46	9.00	7.50	12.00	10.50	15.00	13.50	17.00	15.50	18.00	16.50		
		54	9.00	7.50	12.00	10.50	15.00	13.50	17.00	15.50	17.25	15.75		
		62	9.00	7.50	12.00	10.50	12.00	10.50	12.00	10.50	12.00	10.50		
		102	9.00	7.50	12.00	10.50	12.00	10.50	12.00	10.50	12.00	10.50		
		110	9.00	7.50	12.00	10.50	15.00	13.50	16.50	15.00	16.50	15.00		
		118	9.00	7.50	12.00	10.50	15.00	13.50	16.50	15.00	16.50	15.00		
		126	9.00	7.50	12.00	10.50	15.00	13.50	16.50	15.00	16.50	15.00		
		134	9.00	7.50	12.00	10.50	14.00	12.50	14.00	12.50	14.00	12.50		
		142	9.00	7.50	12.00	10.50	15.00	13.50	11.00	9.50	16.50	15.00		
		151	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25		
		159	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25	15.75	14.25		
	80 MHz Bandwidth	42	9.00	7.50	11.00	9.50	11.00	9.50	11.00	9.50	11.00	9.50	11.00	9.50
		58	8.50	7.00	11.00	9.50	11.00	9.50	11.00	9.50	11.00	9.50	11.00	9.50
		106	9.00	7.50	11.00	9.50	11.00	9.50	11.00	9.50	11.00	9.50	11.00	9.50
		122	9.00	7.50	12.00	10.50	15.00	13.50	15.00	13.50	15.00	13.50	15.00	13.50
		138	9.00	7.50	12.00	10.50	15.00	13.50	11.00	9.50	14.00	12.50	16.50	15.00
		155	15.50	14.00	15.50	14.00	15.50	14.00	15.50	14.00	15.50	14.00	15.50	14.00

Note: In MIMO operations, each antenna transmits at maximum allowed powers as indicated above.

Mode/ Band		Tones	26T		52T		106T		242T		484T		996T	
		Channel	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
Modulated Average - Single Tx Chain (dBm) - Antenna 5B	20 MHz Bandwidth	36	12.00	10.50	15.00	13.50	16.00	14.50	16.00	14.50				
		40	12.00	10.50	15.00	13.50	16.50	15.00	16.50	15.00				
		44	12.00	10.50	15.00	13.50	16.50	15.00	16.50	15.00				
		48	12.00	10.50	15.00	13.50	16.50	15.00	16.50	15.00				
		52	12.00	10.50	15.00	13.50	17.25	15.75	17.25	15.75				
		56	12.00	10.50	15.00	13.50	17.25	15.75	17.25	15.75				
		60	12.00	10.50	15.00	13.50	17.25	15.75	17.25	15.75				
		64	12.00	10.50	15.00	13.50	16.00	14.50	16.00	14.50				
		100	12.00	10.50	15.00	13.50	15.50	14.00	15.50	14.00				
		104	12.00	10.50	15.00	13.50	16.25	14.75	16.25	14.75				
		108	12.00	10.50	15.00	13.50	16.25	14.75	16.25	14.75				
		112	12.00	10.50	15.00	13.50	16.25	14.75	16.25	14.75				
		116	12.00	10.50	15.00	13.50	16.25	14.75	16.25	14.75				
		120	12.00	10.50	15.00	13.50	16.25	14.75	16.25	14.75				
		124	12.00	10.50	15.00	13.50	16.25	14.75	16.25	14.75				
		128	12.00	10.50	15.00	13.50	16.25	14.75	16.25	14.75				
		132	12.00	10.50	15.00	13.50	16.25	14.75	16.25	14.75				
		136	12.00	10.50	15.00	13.50	16.25	14.75	16.25	14.75				
		140	12.00	10.50	12.50	11.00	12.50	11.00	12.50	11.00				
		144	12.00	10.50	15.00	13.50	16.25	14.75	16.25	14.75				
		149	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00				
		153	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00				
		157	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00				
		161	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00				
		165	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00				
	40 MHz Bandwidth	38	12.00	10.50	14.50	13.00	14.50	13.00	14.50	13.00	14.50	13.00		
		46	12.00	10.50	15.00	13.50	16.50	15.00	16.50	15.00	16.50	15.00		
		54	12.00	10.50	15.00	13.50	17.25	15.75	17.25	15.75	17.25	15.75		
		62	12.00	10.50	14.00	12.50	14.00	12.50	14.00	12.50	14.00	12.50		
		102	12.00	10.50	13.50	12.00	13.50	12.00	13.50	12.00	13.50	12.00		
		110	12.00	10.50	15.00	13.50	16.25	14.75	16.25	14.75	16.25	14.75		
		118	12.00	10.50	15.00	13.50	16.25	14.75	16.25	14.75	16.25	14.75		
		126	12.00	10.50	15.00	13.50	16.25	14.75	16.25	14.75	16.25	14.75		
		134	12.00	10.50	15.00	13.50	15.00	13.50	15.00	13.50	15.00	13.50		
		142	12.00	10.50	15.00	13.50	16.25	14.75	12.50	11.00	16.25	14.75		
		151	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00		
		159	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00		
	80 MHz Bandwidth	42	11.50	10.00	12.50	11.00	12.50	11.00	12.50	11.00	12.50	11.00	12.50	11.00
		58	10.00	8.50	12.50	11.00	12.50	11.00	12.50	11.00	12.50	11.00	12.50	11.00
		106	12.00	10.50	12.00	10.50	12.00	10.50	12.00	10.50	12.00	10.50	12.00	10.50
		122	12.00	10.50	15.00	13.50	16.25	14.75	16.25	14.75	16.25	14.75	16.25	14.75
		138	12.00	10.50	15.00	13.50	16.25	14.75	12.50	11.00	15.00	13.50	16.25	14.75
		155	16.00	14.50	16.00	14.50	16.00	14.50	16.00	14.50	16.00	14.50	16.00	14.50

Mode/ Band		Tones	26T		52T		106T		242T		484T		996T	
		Channel	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
Modulated Average - 2 Tx Chain (dBm) CDD - Antenna 5B	20 MHz Bandwidth	36	7.50	6.00	10.50	9.00	13.50	12.00	15.00	13.50				
		40	7.50	6.00	10.50	9.00	13.50	12.00	15.50	14.00				
		44	7.50	6.00	10.50	9.00	13.50	12.00	15.50	14.00				
		48	7.50	6.00	10.50	9.00	13.50	12.00	15.50	14.00				
		52	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		56	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		60	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		64	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		100	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		104	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		108	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		112	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		116	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		120	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		124	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		128	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		132	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		136	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		140	6.50	5.00	9.50	8.00	11.00	9.50	11.00	9.50				
		144	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00				
		149	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00				
		153	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00				
		157	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00				
		161	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00				
		165	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00				
	40 MHz Bandwidth	38	7.50	6.00	10.50	9.00	13.00	11.50	13.00	11.50	13.00	11.50		
		46	7.50	6.00	10.50	9.00	13.50	12.00	15.50	14.00	16.50	15.00		
		54	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00	17.25	15.75		
		62	6.50	5.00	9.50	8.00	12.00	10.50	12.00	10.50	12.00	10.50		
		102	6.50	5.00	9.50	8.00	12.00	10.50	12.00	10.50	12.00	10.50		
		110	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00	16.25	14.75		
		118	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00	16.25	14.75		
		126	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00	16.25	14.75		
		134	6.50	5.00	9.50	8.00	12.50	11.00	14.00	12.50	14.00	12.50		
		142	6.50	5.00	9.50	8.00	12.50	11.00	12.00	10.50	16.25	14.75		
		151	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00		
		159	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00		
	80 MHz Bandwidth	42	7.50	6.00	10.50	9.00	11.00	9.50	11.00	9.50	11.00	9.50	11.00	9.50
		58	6.50	5.00	9.50	8.00	11.00	9.50	11.00	9.50	11.00	9.50	11.00	9.50
		106	6.50	5.00	9.50	8.00	11.00	9.50	11.00	9.50	11.00	9.50	11.00	9.50
		122	6.50	5.00	9.50	8.00	12.50	11.00	14.50	13.00	15.00	13.50	15.00	13.50
		138	6.50	5.00	9.50	8.00	12.50	11.00	12.00	10.50	14.00	12.50	16.25	14.75
		155	15.50	14.00	15.50	14.00	15.50	14.00	15.50	14.00	15.50	14.00	15.50	14.00

Note: In MIMO operations, each antenna transmits at maximum allowed powers as indicated above.

Mode/ Band		Tones	26T		52T		106T		242T		484T		996T	
		Channel	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
Modulated Average - 2 Tx Chain (dBm) SDM - Antenna 5B	20 MHz Bandwidth	36	9.00	7.50	12.00	10.50	15.00	13.50	15.00	13.50				
		40	9.00	7.50	12.00	10.50	15.00	13.50	16.50	15.00				
		44	9.00	7.50	12.00	10.50	15.00	13.50	16.50	15.00				
		48	9.00	7.50	12.00	10.50	15.00	13.50	16.50	15.00				
		52	9.00	7.50	12.00	10.50	15.00	13.50	17.00	15.50				
		56	9.00	7.50	12.00	10.50	15.00	13.50	17.00	15.50				
		60	9.00	7.50	12.00	10.50	15.00	13.50	17.00	15.50				
		64	9.00	7.50	12.00	10.50	15.00	13.50	15.00	13.50				
		100	9.00	7.50	12.00	10.50	15.00	13.50	15.25	13.75				
		104	9.00	7.50	12.00	10.50	15.00	13.50	16.25	14.75				
		108	9.00	7.50	12.00	10.50	15.00	13.50	16.25	14.75				
		112	9.00	7.50	12.00	10.50	15.00	13.50	16.25	14.75				
		116	9.00	7.50	12.00	10.50	15.00	13.50	16.25	14.75				
		120	9.00	7.50	12.00	10.50	15.00	13.50	16.25	14.75				
		124	9.00	7.50	12.00	10.50	15.00	13.50	16.25	14.75				
		128	9.00	7.50	12.00	10.50	15.00	13.50	16.25	14.75				
		132	9.00	7.50	12.00	10.50	15.00	13.50	16.25	14.75				
		136	9.00	7.50	12.00	10.50	15.00	13.50	16.25	14.75				
		140	9.00	7.50	11.00	9.50	11.00	9.50	11.00	9.50				
		144	9.00	7.50	12.00	10.50	15.00	13.50	16.25	14.75				
		149	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00				
		153	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00				
		157	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00				
		161	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00				
		165	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00				
	40 MHz Bandwidth	38	9.00	7.50	12.00	10.50	13.00	11.50	13.00	11.50	13.00	11.50		
		46	9.00	7.50	12.00	10.50	15.00	13.50	16.50	15.00	16.50	15.00		
		54	9.00	7.50	12.00	10.50	15.00	13.50	17.00	15.50	17.25	15.75		
		62	9.00	7.50	12.00	10.50	12.00	10.50	12.00	10.50	12.00	10.50		
		102	9.00	7.50	12.00	10.50	12.00	10.50	12.00	10.50	12.00	10.50		
		110	9.00	7.50	12.00	10.50	15.00	13.50	16.25	14.75	16.25	14.75		
		118	9.00	7.50	12.00	10.50	15.00	13.50	16.25	14.75	16.25	14.75		
		126	9.00	7.50	12.00	10.50	15.00	13.50	16.25	14.75	16.25	14.75		
		134	9.00	7.50	12.00	10.50	14.00	12.50	14.00	12.50	14.00	12.50		
		142	9.00	7.50	12.00	10.50	15.00	13.50	11.00	9.50	16.25	14.75		
		151	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00		
		159	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00	17.50	16.00		
	80 MHz Bandwidth	42	9.00	7.50	11.00	9.50	11.00	9.50	11.00	9.50	11.00	9.50	11.00	9.50
		58	8.50	7.00	11.00	9.50	11.00	9.50	11.00	9.50	11.00	9.50	11.00	9.50
		106	9.00	7.50	11.00	9.50	11.00	9.50	11.00	9.50	11.00	9.50	11.00	9.50
		122	9.00	7.50	12.00	10.50	15.00	13.50	15.00	13.50	15.00	13.50	15.00	13.50
		138	9.00	7.50	12.00	10.50	15.00	13.50	11.00	9.50	14.00	12.50	16.25	14.75
		155	15.50	14.00	15.50	14.00	15.50	14.00	15.50	14.00	15.50	14.00	15.50	14.00

Note: In MIMO operations, each antenna transmits at maximum allowed powers as indicated above.

1.3 IEEE 802.11ax Measured Powers

Table 1
Maximum 2.4 GHz 802.11ax RU Time-Averaged WLAN Output Power – Antenna WF8

Freq [MHz]	Channel	Tones	RU Index	Avg Conducted Powers (dBm)
2412	1	26T	0	11.62
			4	11.48
			8	11.57
2422	3	26T	0	16.16
			4	15.92
			8	16.17
2437	6	26T	0	15.96
			4	16.07
			8	16.15
2452	9	26T	0	16.14
			4	16.12
			8	16.11
2462	11	26T	0	12.04
			4	12.12
			8	12.05

Freq [MHz]	Channel	Tones	RU Index	Avg Conducted Powers (dBm)
2412	1	52T	37	11.61
			38	11.57
			40	11.60
2422	3	52T	37	16.07
			38	16.03
			40	16.05
2437	6	52T	37	16.08
			38	16.12
			40	16.19
2452	9	52T	37	16.15
			38	16.14
			40	16.13
2462	11	52T	37	12.06
			38	12.04
			40	11.98

Freq [MHz]	Channel	Tones	RU Index	Avg Conducted Powers (dBm)
2412	1	106T	53	11.64
			54	11.42
2422	3	106T	53	16.11
			54	15.98
2437	6	106T	53	16.10
			54	15.93
2452	9	106T	53	16.11
			54	15.94
2462	11	106T	53	12.17
			54	11.99

Freq [MHz]	Channel	Tones	RU Index	Avg Conducted Powers (dBm)
2412	1	242T	61	11.57
2422	3	242T	61	15.98
2437	6	242T	61	16.13
2452	9	242T	61	16.11
2462	11	242T	61	12.12

Table 2
Maximum 2.4 GHz 802.11ax RU Time-Averaged WLAN Output Power – Antenna WF7

Freq [MHz]	Channel	Tones	RU Index	Avg Conducted Powers (dBm)
2412	1	26T	0	11.62
			4	11.38
			8	11.43
2422	3	26T	0	15.23
			4	15.32
			8	15.21
2437	6	26T	0	15.34
			4	15.35
			8	15.33
2452	9	26T	0	15.36
			4	15.28
			8	15.27
2462	11	26T	0	12.07
			4	12.06
			8	12.10

Freq [MHz]	Channel	Tones	RU Index	Avg Conducted Powers (dBm)
2412	1	52T	37	11.61
			38	11.56
			40	11.30
2422	3	52T	37	15.07
			38	15.17
			40	15.16
2437	6	52T	37	15.36
			38	15.21
			40	15.33
2452	9	52T	37	15.35
			38	15.31
			40	15.27
2462	11	52T	37	12.12
			38	11.97
			40	12.09

Freq [MHz]	Channel	Tones	RU Index	Avg Conducted Powers (dBm)
2412	1	106T	53	11.57
			54	11.52
2422	3	106T	53	15.12
			54	15.22
2437	6	106T	53	15.05
			54	15.28
2452	9	106T	53	15.16
			54	15.18
2462	11	106T	53	12.01
			54	12.00

Freq [MHz]	Channel	Tones	RU Index	Avg Conducted Powers (dBm)
2412	1	242T	61	11.36
2422	3	242T	61	15.31
2437	6	242T	61	15.26
2452	9	242T	61	15.16
2462	11	242T	61	12.08

Table 3
Maximum 5 GHz 802.11ax RU Time-Averaged WLAN Output Power – Antenna 5T

	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					0	4	8
20MHz BW	1	5180	36	26T	11.12	11.68	11.28
		5200	40	26T	10.95	11.54	11.04
		5220	44	26T	10.97	11.56	11.08
		5240	48	26T	10.98	11.59	11.12
	2A	5260	52	26T	11.00	11.62	11.11
		5280	56	26T	11.08	11.67	11.25
		5300	60	26T	10.89	11.61	11.08
		5320	64	26T	10.98	11.57	11.11
	2C	5500	100	26T	10.85	11.40	10.91
		5600	120	26T	10.96	11.55	11.01
		5620	124	26T	11.02	11.58	11.13
		5720	144	26T	10.98	11.53	11.01
	3	5745	149	26T	14.85	15.35	14.91
		5785	157	26T	14.71	15.26	14.81
		5825	165	26T	14.82	15.31	14.85

	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					37	39	40
20MHz BW	1	5180	36	52T	14.10	14.46	14.21
		5200	40	52T	14.00	14.35	14.05
		5220	44	52T	14.03	14.49	14.18
		5240	48	52T	14.06	14.42	14.17
	2A	5260	52	52T	14.06	14.61	14.18
		5280	56	52T	14.09	14.52	14.24
		5300	60	52T	14.11	14.51	14.27
		5320	64	52T	14.05	14.43	14.18
	2C	5500	100	52T	14.09	14.45	14.19
		5600	120	52T	13.85	14.18	13.89
		5620	124	52T	14.09	14.44	14.16
		5720	144	52T	14.04	14.36	14.01
	3	5745	149	52T	14.69	15.02	14.75
		5785	157	52T	14.78	15.12	14.86
		5825	165	52T	14.61	14.96	14.65

	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					53	54	N/A
20MHz BW	1	5180	36	106T	14.93	15.01	
		5200	40	106T	16.99	17.14	
		5220	44	106T	17.03	17.14	
		5240	48	106T	17.08	17.16	
	2A	5260	52	106T	16.28	16.38	
		5280	56	106T	16.22	16.34	
		5300	60	106T	16.37	16.52	
		5320	64	106T	15.06	15.12	
	2C	5500	100	106T	14.52	14.55	
		5520	104	106T	15.51	15.54	
		5600	120	106T	15.56	15.53	
		5620	124	106T	15.52	15.56	
		5720	144	106T	15.49	15.52	
	3	5745	149	106T	14.61	14.64	
		5785	157	106T	14.75	14.76	
		5825	165	106T	14.78	14.79	

	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					61	N/A	N/A
20MHz BW	1	5180	36	242T	15.08		
		5200	40	242T	17.07		
		5220	44	242T	17.05		
		5240	48	242T	16.98		
	2A	5260	52	242T	16.19		
		5280	56	242T	16.36		
		5300	60	242T	16.25		
		5320	64	242T	14.92		
	2C	5500	100	242T	14.41		
		5520	104	242T	15.51		
		5600	120	242T	15.49		
		5620	124	242T	15.47		
		5720	144	242T	15.57		
	3	5745	149	242T	14.69		
		5785	157	242T	14.65		
		5825	165	242T	14.69		

	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					0	8	17
40MHz BW	1	5190	38	26T	10.44	11.75	10.98
		5230	46	26T	10.62	11.89	10.95
	2A	5270	54	26T	10.55	11.79	10.87
		5310	62	26T	10.59	11.70	10.78
	2C	5510	102	26T	10.57	11.62	10.70
		5590	118	26T	10.54	11.68	10.79
		5630	126	26T	10.55	11.65	10.71
		5710	142	26T	10.59	11.72	10.67
	3	5755	151	26T	14.38	15.57	14.51
		5795	159	26T	14.38	15.45	14.47

	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					37	40	44
40MHz BW	1	5190	38	52T	13.44	14.42	13.70
		5230	46	52T	13.65	14.63	13.93
	2A	5270	54	52T	13.72	14.71	14.01
		5310	62	52T	12.87	13.92	13.30
	2C	5510	102	52T	12.33	13.23	12.58
		5550	110	52T	13.85	14.78	14.01
		5590	118	52T	13.91	14.80	14.05
		5630	126	52T	13.83	14.79	14.00
		5710	142	52T	13.76	14.71	13.97
	3	5755	151	52T	14.65	15.57	14.71
		5795	159	52T	14.61	15.49	14.75

40MHz BW	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					53	54	56
	1	5190	38	106T	13.40	14.17	13.77
		5230	46	106T	17.00	17.87	17.45
	2A	5270	54	106T	16.21	16.91	16.47
		5310	62	106T	13.02	13.74	13.25
	2C	5510	102	106T	12.56	13.24	12.88
		5550	110	106T	15.55	16.17	15.70
		5590	118	106T	15.45	16.13	15.74
		5630	126	106T	15.65	16.28	15.86
		5710	142	106T	15.54	16.13	15.61
	3	5755	151	106T	14.65	15.32	14.76
		5795	159	106T	14.82	15.46	14.93

40MHz BW	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					61	62	N/A
	1	5190	38	242T	13.53	13.90	
		5230	46	242T	16.95	17.07	
	2A	5270	54	242T	16.28	16.50	
		5310	62	242T	12.93	13.12	
	2C	5510	102	242T	12.63	12.75	
		5550	110	242T	15.55	15.75	
		5590	118	242T	15.41	15.43	
		5630	126	242T	15.55	15.77	
		5710	142	242T	11.53	11.73	
	3	5755	151	242T	14.74	14.82	
		5795	159	242T	14.71	14.63	

40MHz BW	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					65	N/A	N/A
	1	5190	38	484T	13.62		
		5230	46	484T	17.03		
	2A	5270	54	484T	16.36		
		5310	62	484T	13.13		
	2C	5510	102	484T	12.52		
		5550	110	484T	15.55		
		5590	118	484T	15.65		
		5630	126	484T	15.57		
		5710	142	484T	15.53		
	3	5755	151	484T	14.76		
		5795	159	484T	14.68		

80MHz BW	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					0	18	36
	1	5210	42	26T	10.17	11.37	10.58
	2A	5290	58	26T	8.92	9.41	8.96
	2C	5530	106	26T	10.91	11.74	11.06
		5610	122	26T	11.05	11.47	10.96
		5690	138	26T	11.00	11.62	10.88
	3	5775	155	26T	14.75	15.28	14.73

80MHz BW	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					37	44	52
	1	5210	42	52T	11.58	12.35	11.96
	2A	5290	58	52T	11.44	12.17	11.61
	2C	5530	106	52T	11.10	11.79	11.27
		5610	122	52T	14.00	14.64	14.08
		5690	138	52T	13.93	14.38	13.83
	3	5775	155	52T	14.65	15.14	14.65

80MHz BW	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					53	56	60
	1	5210	42	106T	11.51	11.96	11.84
	2A	5290	58	106T	11.45	12.00	11.53
	2C	5530	106	106T	11.12	11.61	11.23
		5610	122	106T	15.45	15.87	15.41
		5690	138	106T	15.43	15.82	15.30
	3	5775	155	106T	14.78	15.18	14.78

80MHz BW	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					61	62	64
	1	5210	42	242T	11.43	12.02	11.58
	2A	5290	58	242T	11.41	11.80	11.44
	2C	5530	106	242T	10.96	11.36	11.08
		5610	122	242T	15.55	15.61	15.65
		5690	138	242T	11.61	11.73	11.45
	3	5775	155	242T	14.95	15.14	15.02

80MHz BW	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					65	66	N/A
	1	5210	42	484T	11.45	11.61	
	2A	5290	58	484T	11.50	11.61	
	2C	5530	106	484T	10.91	11.12	
		5610	122	484T	15.38	15.41	
		5690	138	484T	14.01	14.03	
	3	5775	155	484T	14.71	14.58	

80MHz BW	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					67	N/A	N/A
	1	5210	42	996T	11.60		
	2A	5290	58	996T	11.53		
	2C	5530	106	996T	11.01		
		5610	122	996T	15.40		
		5690	138	996T	15.53		
	3	5775	155	996T	14.76		

Table 4
Maximum 5 GHz 802.11ax RU Time-Averaged WLAN Output Power – Antenna 5B

20MHz BW	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					0	4	8
	1	5180	36	26T	10.91	11.44	11.05
		5200	40	26T	10.93	11.55	11.07
		5220	44	26T	10.96	11.55	11.12
		5240	48	26T	11.12	11.75	11.25
	2A	5260	52	26T	11.08	11.77	11.28
		5280	56	26T	11.12	11.75	11.35
		5300	60	26T	11.01	11.65	11.15
		5320	64	26T	10.92	11.45	10.96
	2C	5500	100	26T	11.01	11.59	11.10
		5600	120	26T	10.98	11.58	11.07
		5620	124	26T	11.00	11.61	11.10
		5720	144	26T	10.92	11.56	11.22
	3	5745	149	26T	16.38	16.97	16.65
		5785	157	26T	16.47	17.25	16.99
		5825	165	26T	16.49	17.14	16.86

20MHz BW	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					37	39	40
	1	5180	36	52T	13.90	14.31	14.01
		5200	40	52T	14.08	14.55	14.22
		5220	44	52T	14.17	14.61	14.34
		5240	48	52T	14.10	14.49	14.19
	2A	5260	52	52T	13.93	14.27	14.02
		5280	56	52T	14.09	14.50	14.22
		5300	60	52T	13.99	14.34	14.09
		5320	64	52T	13.94	14.27	14.02
	2C	5500	100	52T	13.96	14.27	14.00
		5600	120	52T	14.09	14.42	14.18
		5620	124	52T	14.15	14.52	14.26
		5720	144	52T	14.01	14.47	14.26
	3	5745	149	52T	16.48	16.92	16.68
		5785	157	52T	16.79	17.30	17.06
		5825	165	52T	16.67	17.15	16.89

20MHz BW	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					53	54	N/A
	1	5180	36	106T	15.01	15.06	
		5200	40	106T	15.63	15.68	
		5220	44	106T	15.57	15.71	
		5240	48	106T	15.51	15.60	
	2A	5260	52	106T	16.17	16.21	
		5280	56	106T	16.16	16.25	
		5300	60	106T	16.27	16.34	
		5320	64	106T	15.07	15.16	
	2C	5500	100	106T	14.46	14.49	
		5520	104	106T	15.26	15.30	
		5600	120	106T	15.31	15.34	
		5620	124	106T	15.32	15.35	
		5720	144	106T	15.21	15.41	
	3	5745	149	106T	16.36	16.52	
		5785	157	106T	16.46	16.68	
		5825	165	106T	16.45	16.58	

20MHz BW	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					61	N/A	N/A
	1	5180	36	242T	15.05		
		5200	40	242T	15.37		
		5220	44	242T	15.45		
		5240	48	242T	15.56		
	2A	5260	52	242T	16.27		
		5280	56	242T	16.23		
		5300	60	242T	16.32		
		5320	64	242T	15.15		
	2C	5500	100	242T	14.51		
		5520	104	242T	15.26		
		5600	120	242T	15.32		
		5620	124	242T	15.34		
		5720	144	242T	15.34		
	3	5745	149	242T	16.65		
		5785	157	242T	16.56		
		5825	165	242T	16.54		

40MHz BW	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					0	8	17
	1	5190	38	26T	10.64	11.91	11.02
		5230	46	26T	10.62	11.89	11.04
	2A	5270	54	26T	10.55	11.76	10.77
		5310	62	26T	10.53	11.80	10.90
	2C	5510	102	26T	10.71	11.79	10.85
		5590	118	26T	10.75	11.91	11.00
		5630	126	26T	10.60	11.80	10.97
		5710	142	26T	10.57	11.92	10.91
	3	5755	151	26T	16.00	17.31	16.29
		5795	159	26T	15.91	17.25	16.28

40MHz BW	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					37	40	44
	1	5190	38	52T	13.00	14.23	13.49
		5230	46	52T	13.71	14.91	14.19
	2A	5270	54	52T	13.82	14.84	14.06
		5310	62	52T	12.92	13.88	13.15
	2C	5510	102	52T	12.55	13.42	12.76
		5550	110	52T	13.80	14.73	14.01
		5590	118	52T	13.86	14.76	14.16
		5630	126	52T	13.85	14.87	14.26
		5710	142	52T	13.79	14.83	14.08
	3	5755	151	52T	16.21	17.28	16.45
		5795	159	52T	16.11	17.41	16.53

40MHz BW	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					53	54	56
	1	5190	38	106T	13.55	14.18	13.72
		5230	46	106T	15.49	16.14	15.70
	2A	5270	54	106T	16.24	16.91	16.61
		5310	62	106T	12.84	13.60	13.13
	2C	5510	102	106T	12.50	13.07	12.80
		5550	110	106T	15.00	15.57	15.23
		5590	118	106T	15.19	15.76	15.36
		5630	126	106T	15.22	15.85	15.54
		5710	142	106T	15.31	16.00	15.47
	3	5755	151	106T	16.51	17.20	16.68
		5795	159	106T	16.45	17.17	16.71

40MHz BW	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					61	62	N/A
	1	5190	38	242T	13.49	13.68	
		5230	46	242T	15.61	15.76	
	2A	5270	54	242T	16.31	16.50	
		5310	62	242T	12.91	12.97	
	2C	5510	102	242T	12.45	12.65	
		5550	110	242T	15.32	15.58	
		5590	118	242T	15.08	15.33	
		5630	126	242T	15.22	15.52	
		5710	142	242T	11.57	11.75	
	3	5755	151	242T	16.44	16.58	
		5795	159	242T	16.56	16.61	

40MHz BW	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					65	N/A	N/A
	1	5190	38	484T	13.50		
		5230	46	484T	15.50		
	2A	5270	54	484T	16.27		
		5310	62	484T	12.95		
	2C	5510	102	484T	12.41		
		5550	110	484T	15.26		
		5590	118	484T	15.35		
		5630	126	484T	15.29		
		5710	142	484T	15.20		
	3	5755	151	484T	16.57		
		5795	159	484T	16.41		

80MHz BW	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					0	18	36
	1	5210	42	26T	10.34	11.41	10.62
	2A	5290	58	26T	8.95	9.81	9.10
	2C	5530	106	26T	11.09	11.81	11.23
		5610	122	26T	10.92	11.62	11.00
		5690	138	26T	10.89	11.67	11.28
	3	5775	155	26T	14.95	15.67	15.12

80MHz BW	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					37	44	52
	1	5210	42	52T	11.43	12.21	11.84
	2A	5290	58	52T	11.43	12.00	11.53
	2C	5530	106	52T	10.92	11.55	11.11
		5610	122	52T	13.94	14.40	14.01
		5690	138	52T	13.97	14.67	14.13
	3	5775	155	52T	15.09	15.86	15.26

80MHz BW	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					53	56	60
	1	5210	42	106T	11.42	12.05	11.86
	2A	5290	58	106T	11.44	11.94	11.52
	2C	5530	106	106T	10.96	11.33	11.12
		5610	122	106T	15.21	15.73	15.33
		5690	138	106T	15.41	15.79	15.47
	3	5775	155	106T	15.11	15.67	15.25

80MHz BW	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					61	62	64
	1	5210	42	242T	11.58	12.09	11.64
	2A	5290	58	242T	11.43	11.71	11.49
	2C	5530	106	242T	10.94	11.27	11.20
		5610	122	242T	15.32	15.45	15.50
		5690	138	242T	11.50	11.56	11.48
	3	5775	155	242T	15.01	15.30	14.96

80MHz BW	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					65	66	N/A
	1	5210	42	484T	11.60	11.78	
	2A	5290	58	484T	11.45	11.67	
	2C	5530	106	484T	11.00	11.25	
		5610	122	484T	15.25	15.57	
		5690	138	484T	14.13	14.15	
	3	5775	155	484T	15.02	15.04	

80MHz BW	Band	Freq [MHz]	Channel	Tones	Avg Conducted Power (dBm)		
					RU Index		
					67	N/A	N/A
	1	5210	42	996T	11.43		
	2A	5290	58	996T	11.60		
	2C	5530	106	996T	10.12		
		5610	122	996T	15.27		
		5690	138	996T	15.34		
	3	5775	155	996T	15.02		

APPENDIX G: WIFI TIME-AVERAGED SAR VERIFICATION

1.1 WIFI Time-Averaged SAR Verification Summary

This device supports the manufacturer's time-averaged SAR (TAS) mechanism for WLAN operations. The output power is controlled in real-time so that the power averaged over any 60 second window does not exceed the level tested for SAR in this report. The time-averaged SAR algorithm tracks the energy contribution relative to the available energy budget for each transmitter, defined as the "utilization ratio." Once the utilization ratios for each of the individual WLAN transmitters are calculated, they are summed to derive the overall WLAN system power utilization ratio. This metric is used by the WLAN chipset to manage power levels over time and ensure that SAR limits are never exceeded.

Per FCC Guidance, the following test scenarios were defined to validate the TAS mechanism. The specific scenarios are constructed to validate the operation of the algorithm in all operational states, including transitions between states/antennas:

- Change in channel/band
- Change in antenna (includes connection drop scenario)

Predefined transmit profiles for each test scenario are provided by the manufacturer's test automation software to control the operation of the DUT while synchronized operational data was recorded from internal firmware and external power monitors. The data was plotted over time relative to the utilization limit to demonstrate that the maximum time-averaged power is never exceeded. "Reported" values were output and captured directly from DUT firmware, while "Measured" results were obtained from external power metering. The uncertainty budget applied to the WLAN power control functions for this device is 1.5 dB. In all test cases, WLAN radios were configured to operate at 100% duty cycle.

Table 1-1
Test Configurations for WIFI Time-Averaged SAR Verification

Mode	Antenna	Channel	Plim (dBm)	Plim (mW)
802.11b, 22 MHz Bandwidth	WF8	7	17.00	50
802.11b, 22 MHz Bandwidth	WF7	7	16.25	42
802.11a, 20 MHz Bandwidth	5T	149	15.75	38
802.11a, 20 MHz Bandwidth	5B	149	17.50	56

Plim is the maximum time-averaged output power evaluated for SAR compliance

1.2 Verification Summary

Scenario 1: Change in Antenna

For this test, the effect on the time-averaging algorithm from a change in the active transmit antenna was evaluated. Figures G-1 and G-2 show a switch of 2.4 GHz transmissions from antenna WF8 to antenna WF7 at Time = 120 s, while Figures G-3 and G-4 show a comparable transition for antenna 5T to antenna 5B 5 GHz transmissions. In both cases the test automation is controlling the WLAN radios to operate at 100% duty cycle. In both cases the utilization ratio never exceeds 100% and the average transmit power never exceeds the Plim of each respective antenna.

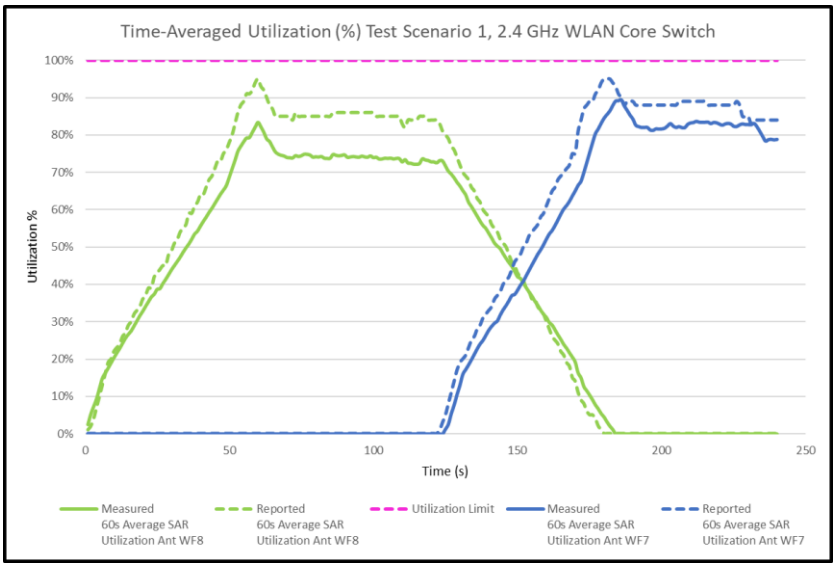


Figure G-1
60s Average SAR Utilization vs. Time, 2.4 GHz

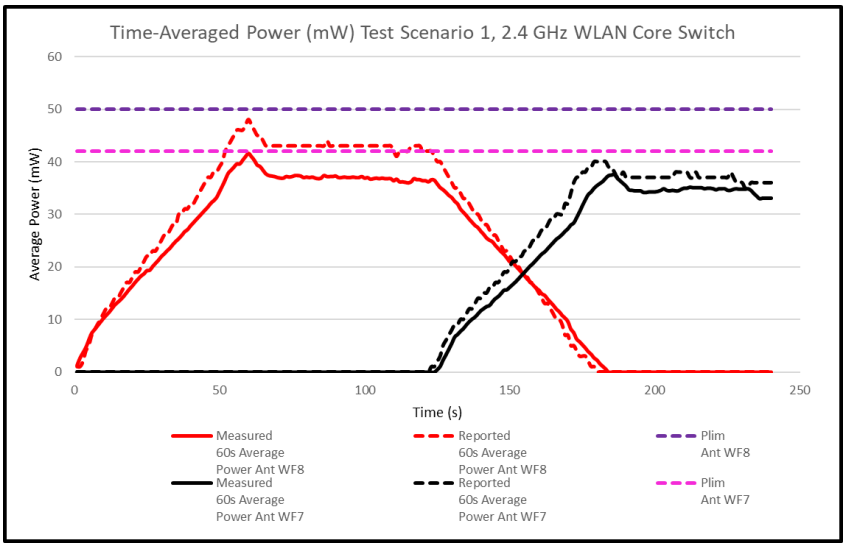


Figure G-2
60s Average Power vs. Time, 2.4 GHz

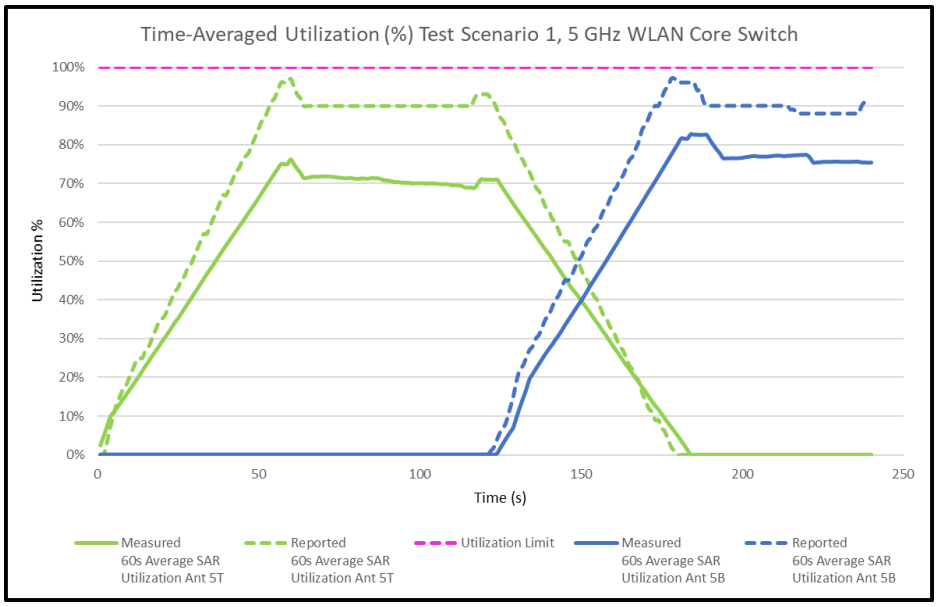


Figure G-3
60s Average SAR Utilization vs. Time, 5 GHz

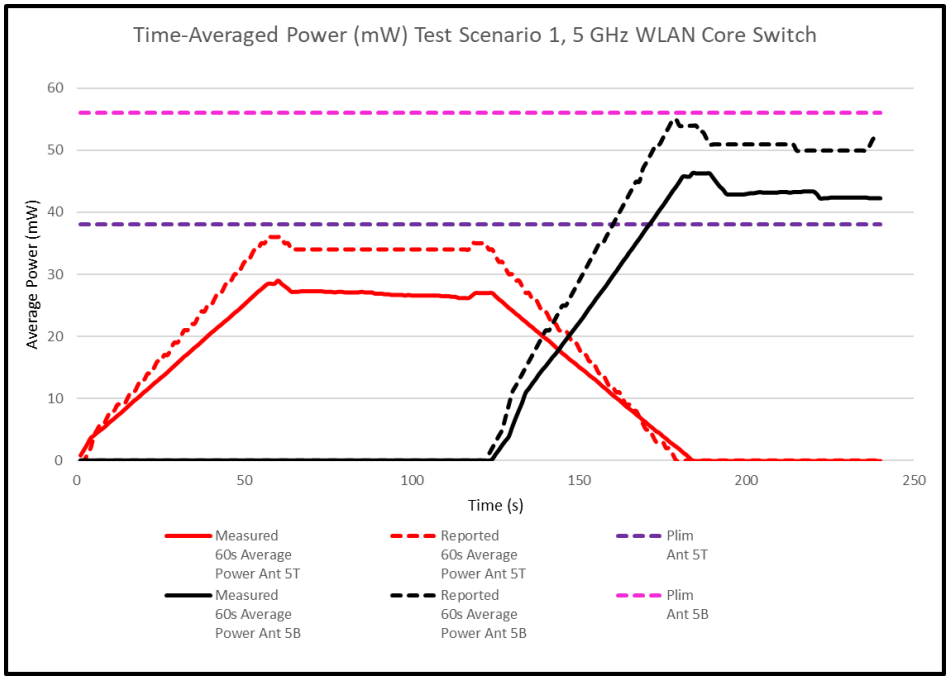


Figure G-4
60s Average Power vs. Time, 5 GHz

Scenario 2: Change in Channel/Band Test Case

This test demonstrates the efficacy of the time-averaged SAR algorithm while switching between 2.4 GHz and 5 GHz WLAN bands. In addition, it shows that the algorithm tracks time-averaged power and system utilization when the active transmitter is disabled and then reconnects.

The 2.4 GHz Ant WF8 transmitter is active at 100% duty cycle until Time = 120 s. When 2.4 GHz transmissions case, the 5 GHz Ant 5T transmitter is activated and begins to negotiate a new connection. The connection is established and the increase in average transmit power and utilization can clearly be seen. In this case the utilization ratio never exceeds 100% and the average transmit power never exceeds the Plim of each respective antenna.

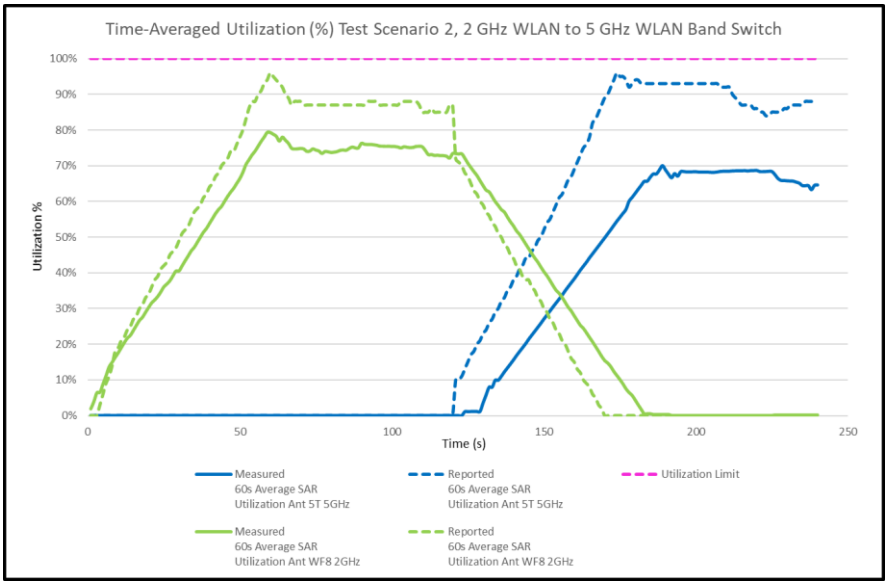


Figure G-5
60s Average Utilization vs. Time during Band Switch

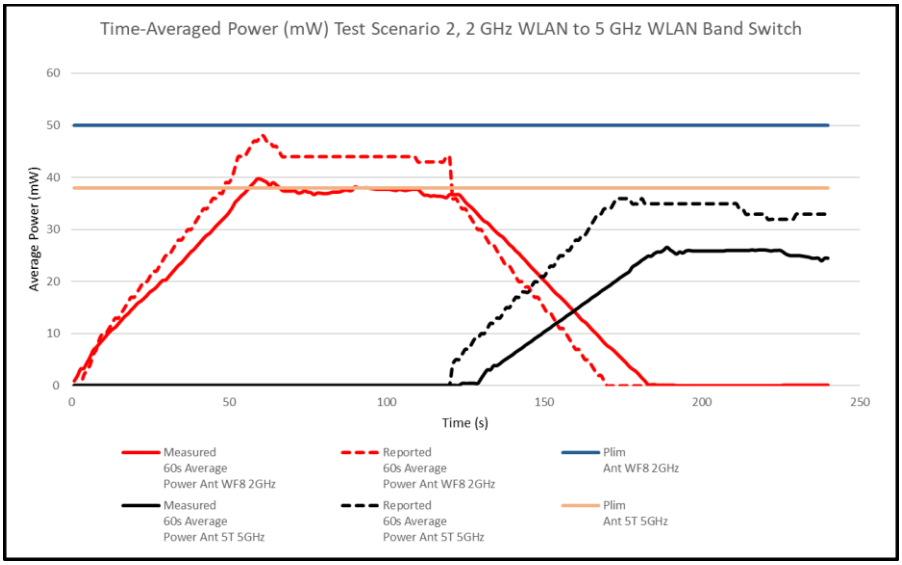


Figure G-6
60s Average Power vs. Time during Band Switch

APPENDIX H: PROBE AND DIPOLE CALIBRATION CERTIFICATES

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client **PC Test**

Certificate No: **D2450V2-921_Nov18**

CALIBRATION CERTIFICATE

Object D2450V2 - SN:921

Calibration procedure(s) QA CAL-05.v10
Calibration procedure for dipole validation kits above 700 MHz

SC ✓ 12/4/2018 BN ✓

Calibration date: November 12, 2018 12/31/2019

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

ATM ✓

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

11/12/20

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19
Reference Probe EX3DV4	SN: 7349	30-Dec-17 (No. EX3-7349_Dec17)	Dec-18
DAE4	SN: 601	04-Oct-18 (No. DAE4-601_Oct18)	Oct-19

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

	Name	Function	Signature
Calibrated by:	Manu Seitz	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: November 12, 2018

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "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)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.9 ± 6 %	1.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.6 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**53.1 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.8 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.4 ± 6 %	2.02 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**50.8 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.03 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.8 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.7 Ω + 6.5 jΩ
Return Loss	- 22.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.7 Ω + 7.8 jΩ
Return Loss	- 22.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.157 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 26, 2013

DASY5 Validation Report for Head TSL

Date: 12.11.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:921

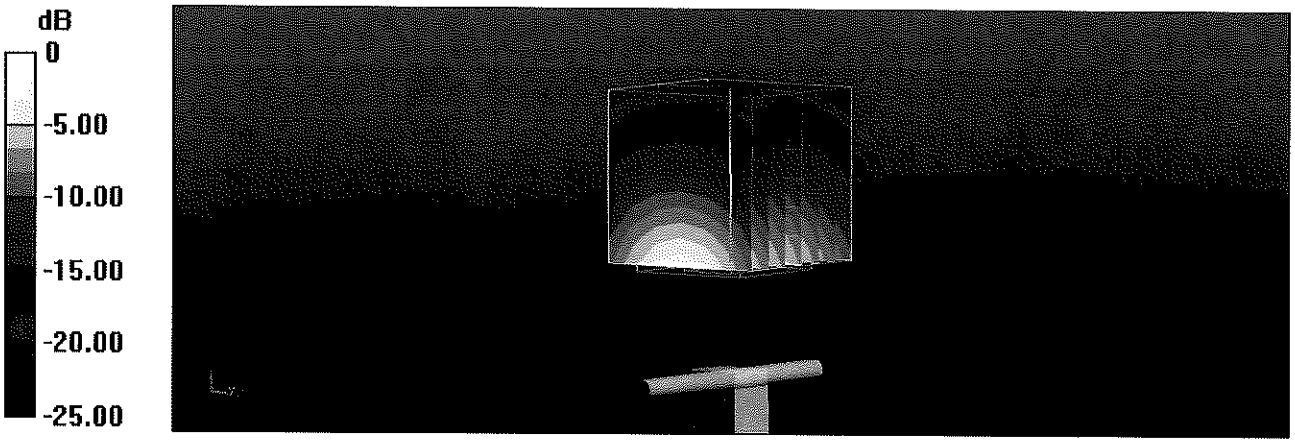
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.86 S/m; ε_r = 37.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.88, 7.88, 7.88) @ 2450 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

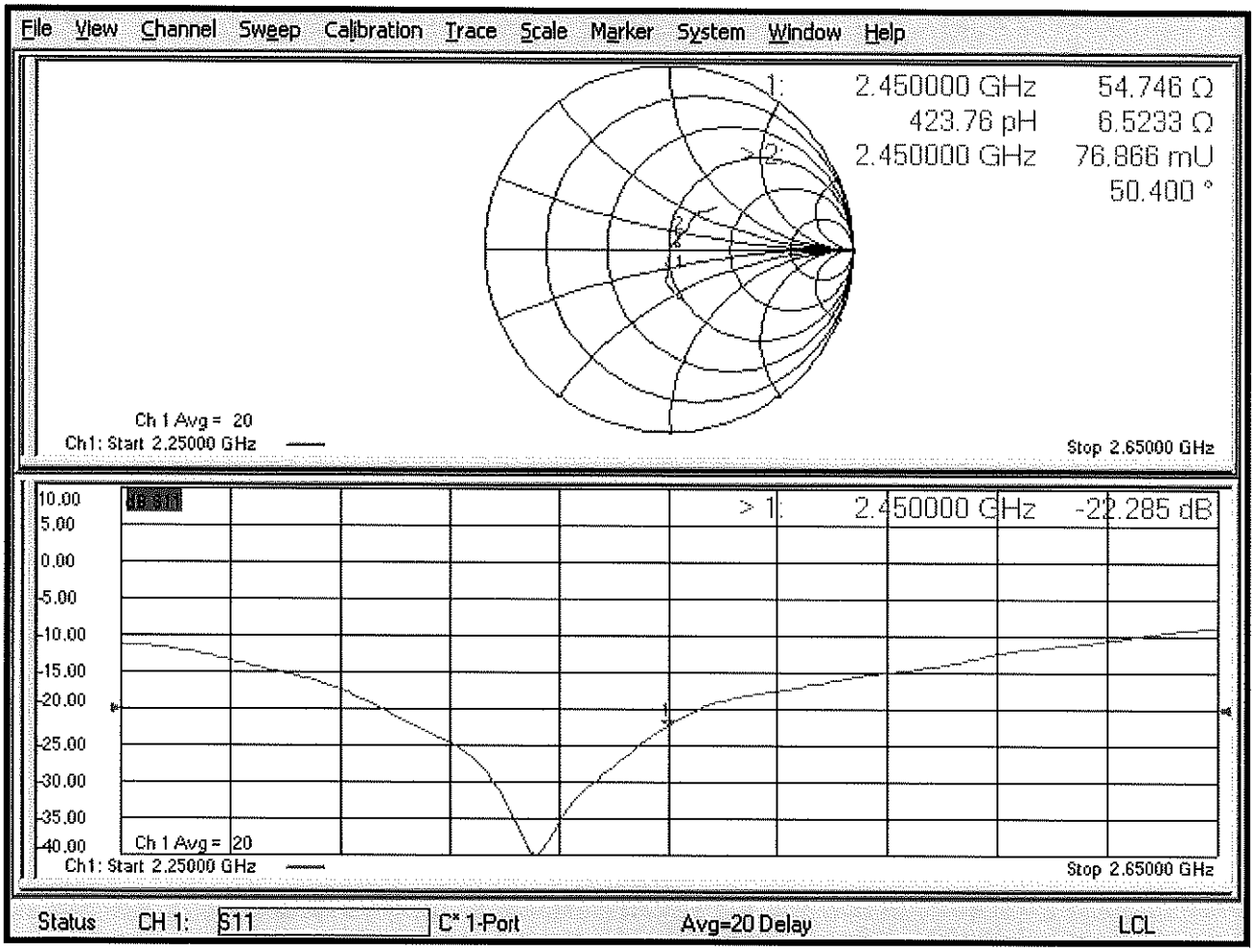
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 117.7 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 27.4 W/kg
SAR(1 g) = 13.6 W/kg; SAR(10 g) = 6.28 W/kg
Maximum value of SAR (measured) = 22.4 W/kg



0 dB = 22.4 W/kg = 13.50 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 12.11.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:921

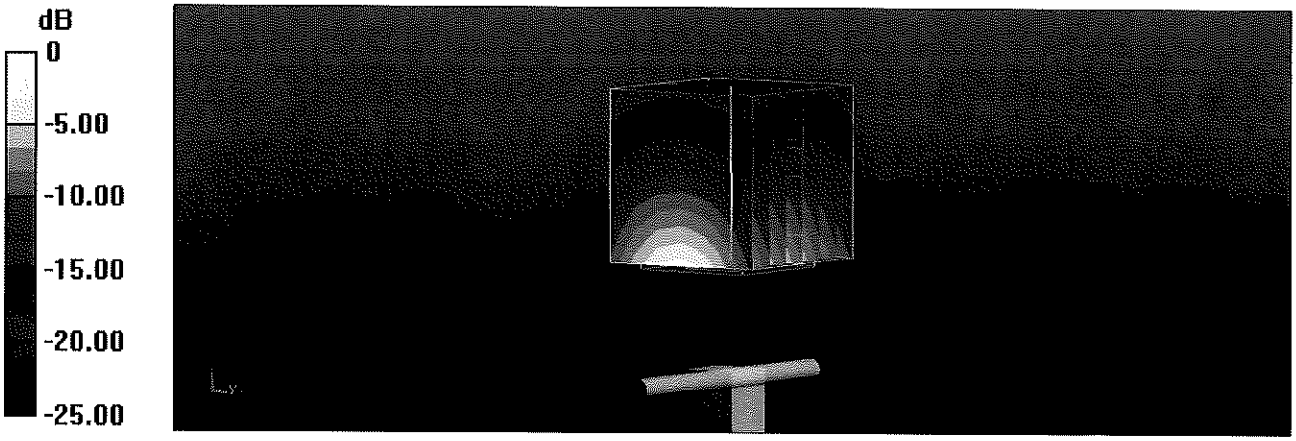
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.02 S/m; ε_r = 51.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.01, 8.01, 8.01) @ 2450 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

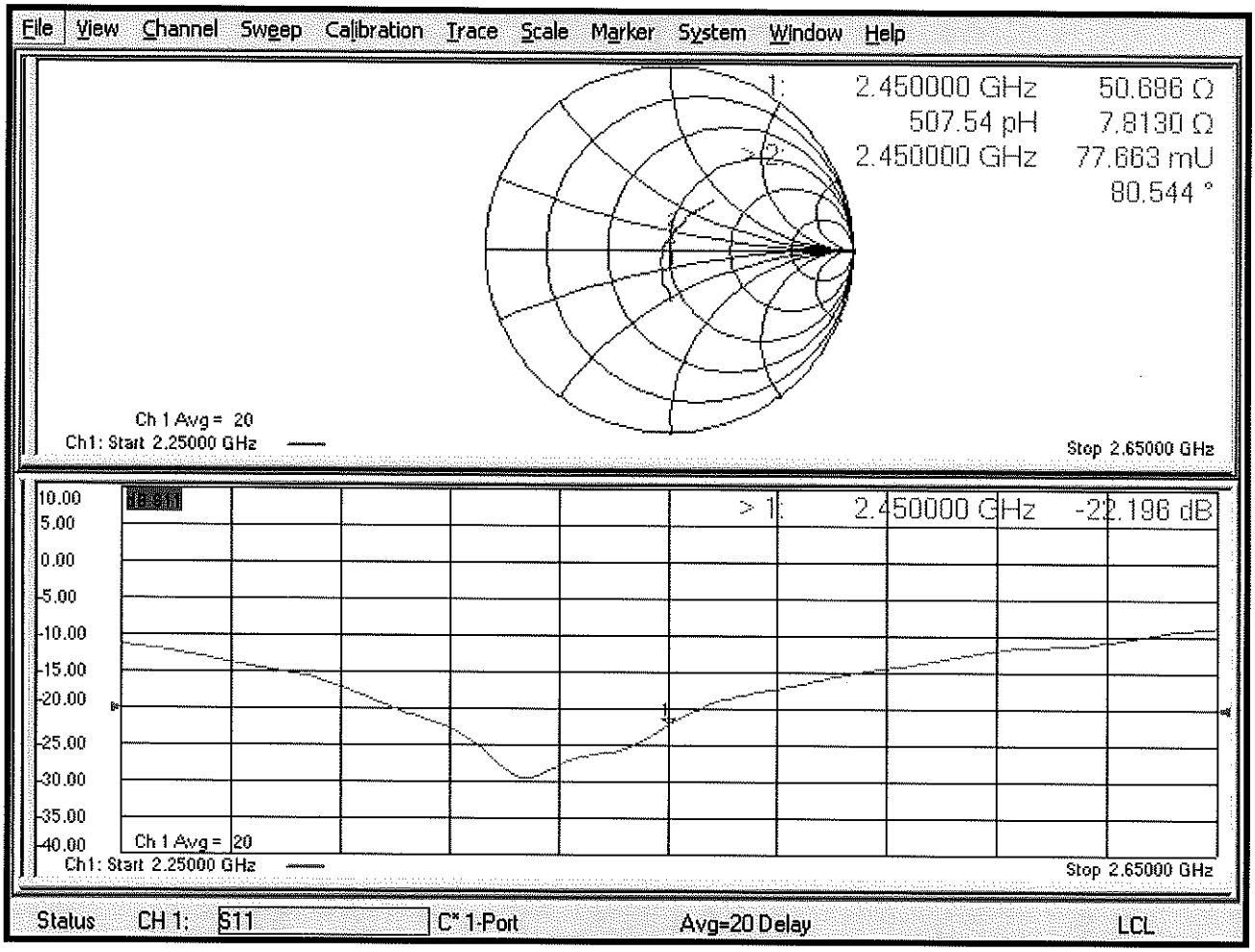
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 108.6 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 26.1 W/kg
SAR(1 g) = 13 W/kg; SAR(10 g) = 6.03 W/kg
Maximum value of SAR (measured) = 21.3 W/kg



0 dB = 21.3 W/kg = 13.28 dBW/kg

Impedance Measurement Plot for Body TSL



Certification of Calibration

Object	D2450V2 – SN: 921
Calibration procedure(s)	Procedure for Calibration Extension for SAR Dipoles.
Extended Calibration date:	November 11, 2019
Description:	SAR Validation Dipole at 2450 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Network Analyzer	8/26/2019	Annual	8/26/2020	MY40000670
Agilent	E4438C	ESG Vector Signal Generator	6/27/2019	Annual	6/27/2020	MY45093852
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	343972
Anritsu	ML2495A	Power Meter	11/20/2018	Annual	11/20/2019	1039008
Anritsu	MA2411B	Pulse Power Sensor	11/20/2018	Annual	11/20/2019	1027293
Anritsu	MA2411B	Pulse Power Sensor	11/20/2018	Annual	11/20/2019	1339007
Control Company	4040	Temperature / Humidity Monitor	2/28/2018	Biennial	2/28/2020	150761911
Control Company	4352	Ultra Long Stem Thermometer	2/28/2018	Biennial	2/28/2020	170330160
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	7/2/2019	Annual	7/2/2020	MY53401181
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Seekonk	NC-100	Torque Wrench	5/4/2018	Biennial	5/4/2020	22216
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/7/2019	Annual	5/7/2020	1070
SPEAG	EX3DV4	SAR Probe	1/24/2019	Annual	1/24/2020	7490
SPEAG	DAE4	Data Acquisition Electronics	1/15/2019	Annual	1/15/2020	1532

Measurement Uncertainty = ±23% (k=2)

	Name	Function	Signature
Calibrated By:	Parker Jones	Team Lead Engineer	Parker Jones
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	

DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

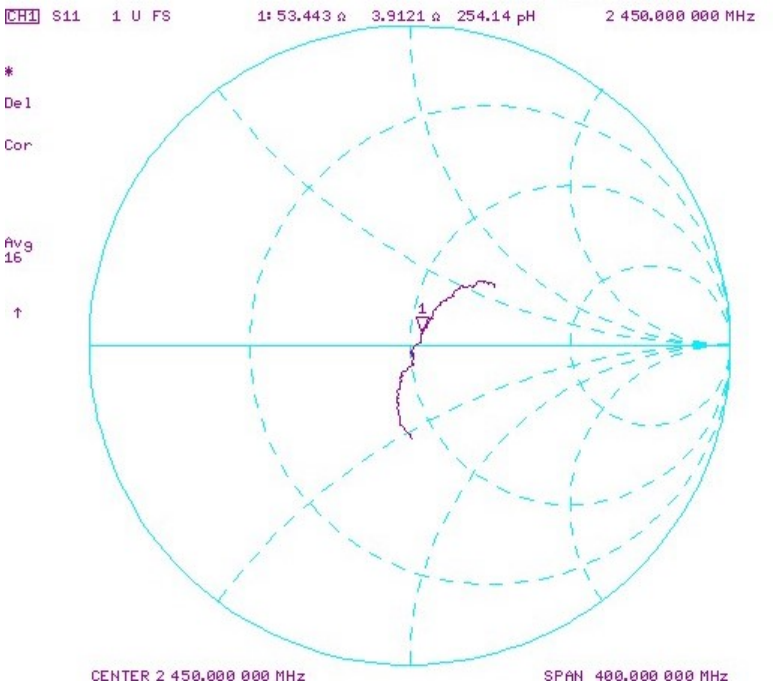
1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

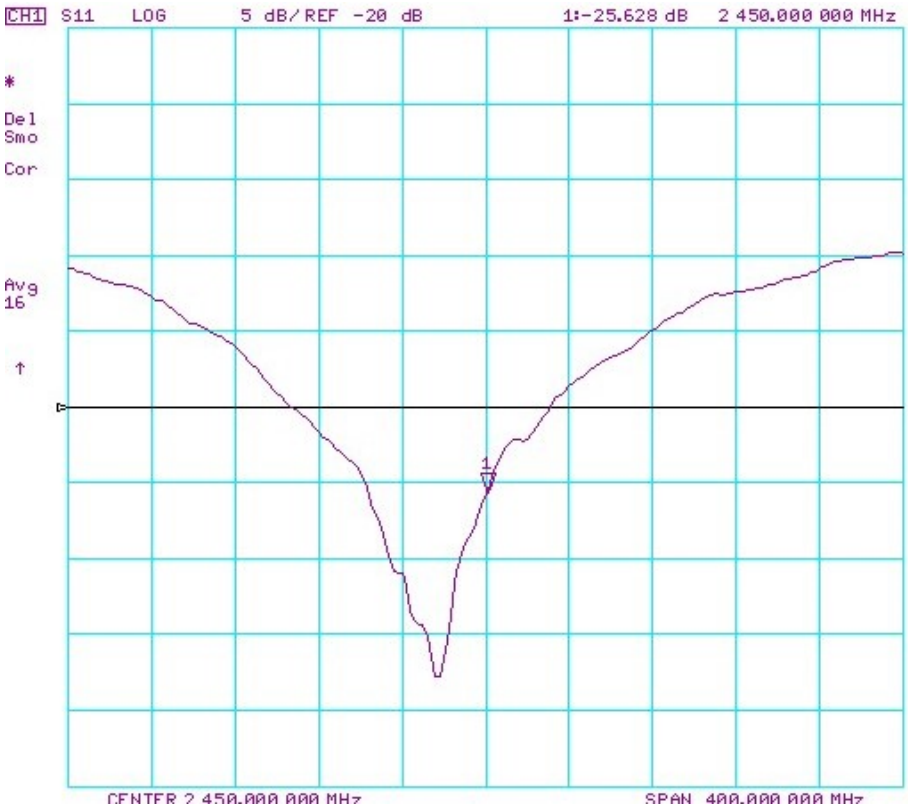
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 20.0 dBm	Measured Head SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 20.0 dBm	Measured Head SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
11/12/2018	11/11/2019	1.157	5.31	5.28	-0.56%	2.48	2.38	-4.03%	54.7	53.4	1.3	6.5	3.9	2.6	-22.3	-25.6	-14.80%	PASS

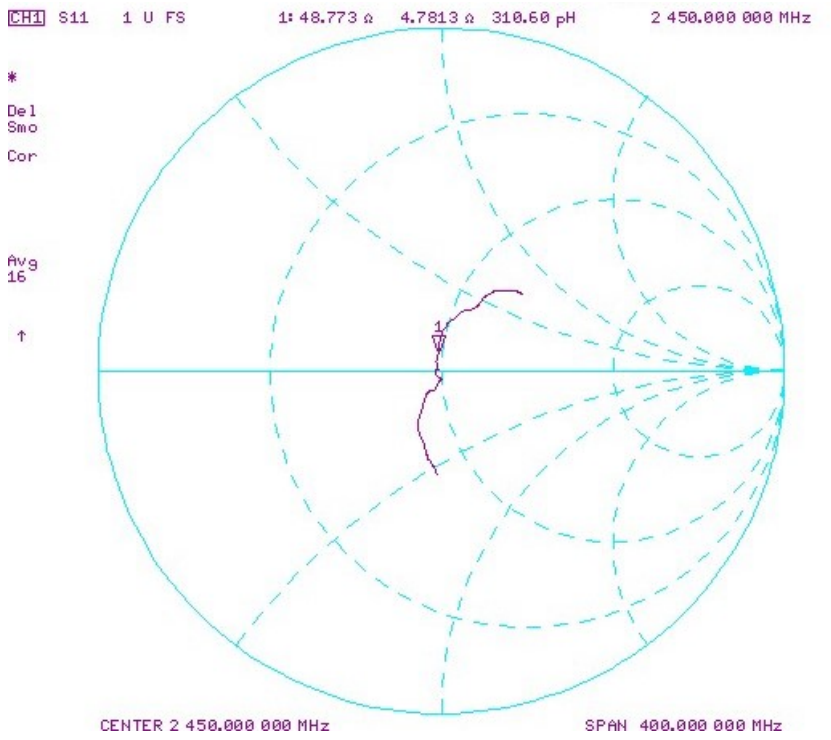
Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 20.0 dBm	Measured Body SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 20.0 dBm	Measured Body SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured Impedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
11/12/2018	11/11/2019	1.157	5.08	5.41	6.50%	2.38	2.47	3.78%	50.7	48.8	1.9	7.8	4.8	3	-22.2	-26.2	-18.00%	PASS

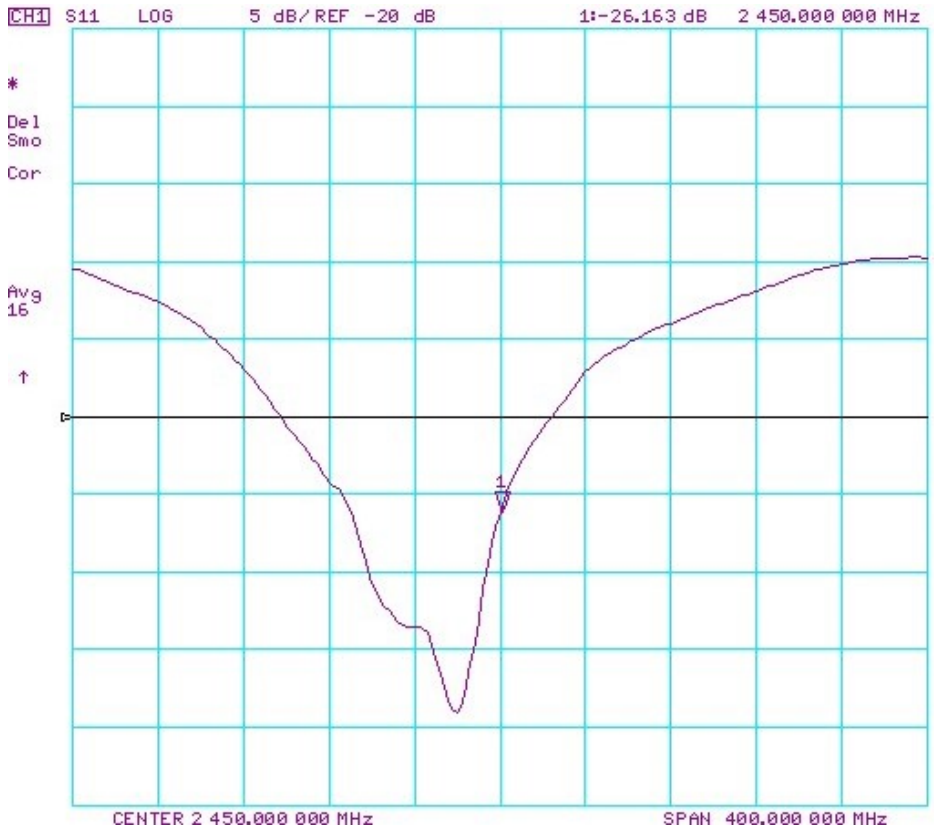
Impedance & Return-Loss Measurement Plot for Head TSL





Impedance & Return-Loss Measurement Plot for Body TSL





Certification of Calibration

Object	D2450V2 – SN: 921
Calibration procedure(s)	Procedure for Calibration Extension for SAR Dipoles.
Extended Calibration date:	November 12, 2020
Description:	SAR Validation Dipole at 2450 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Network Analyzer	1/16/2020	Annual	1/16/2021	US39170118
Agilent	E4438C	ESG Vector Signal Generator	8/10/2020	Annual	8/10/2021	MY47270002
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	343972
Anritsu	ML2495A	Power Meter	12/17/2019	Annual	12/17/2020	1138001
Anritsu	MA2411B	Pulse Power Sensor	12/4/2019	Annual	12/4/2020	0846215
Anritsu	MA2411B	Pulse Power Sensor	9/22/2020	Annual	9/22/2021	1339008
Control Company	4040	Temperature / Humidity Monitor	2/17/2020	Biennial	2/17/2022	200113269
Control Company	4352	Long Stem Thermometer	6/26/2019	Biennial	6/26/2021	192282744
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	9/1/2020	Annual	9/1/2021	MY53401181
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Seekonk	NC-100	Torque Wrench	9/24/2020	Biennial	9/24/2022	022216
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/12/2020	Annual	5/12/2021	1070
SPEAG	EX3DV4	SAR Probe	1/20/2020	Annual	1/20/2021	3837
SPEAG	DAE4	Data Acquisition Electronics	1/14/2020	Annual	1/14/2021	793

Measurement Uncertainty = ±23% (k=2)

	Name	Function	Signature
Calibrated By:	Parker Jones	Team Lead Engineer	Parker Jones
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	KOK

DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

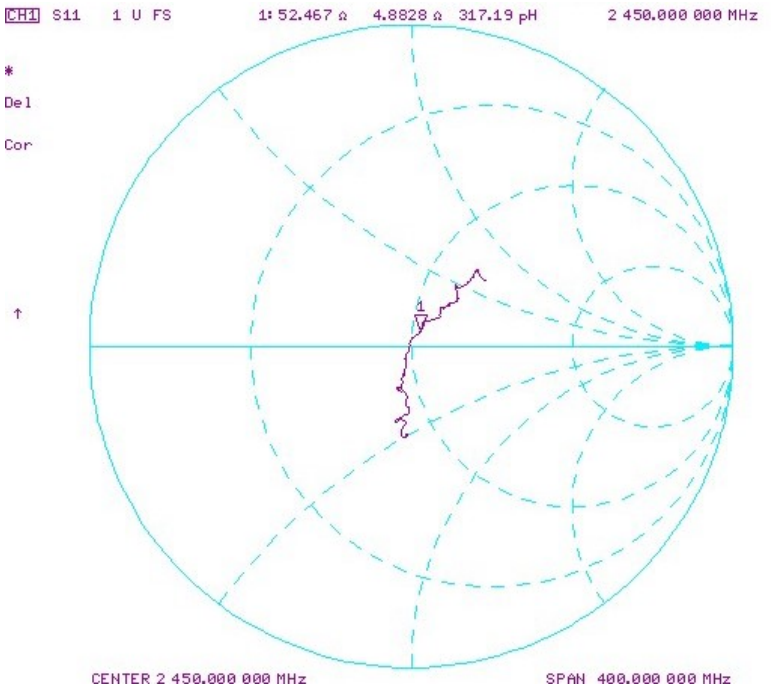
1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

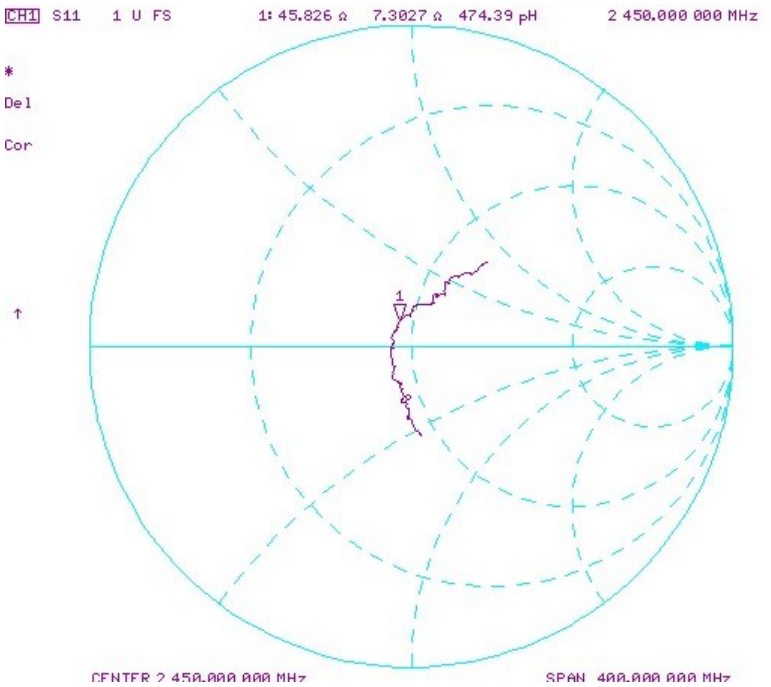
Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 20.0 dBm	Measured Head SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 20.0 dBm	Measured Head SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
11/12/2018	11/12/2020	1.157	5.31	5.51	3.77%	2.48	2.55	2.82%	54.7	52.5	2.2	6.5	4.9	1.6	-22.3	-26	-16.40%	PASS

Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 20.0 dBm	Measured Body SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 20.0 dBm	Measured Body SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured Impedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
11/12/2018	11/12/2020	1.157	5.08	5.35	5.31%	2.38	2.48	4.20%	50.7	45.8	4.9	7.8	7.3	0.5	-22.2	-20.9	5.80%	PASS

Impedance & Return-Loss Measurement Plot for Head TSL



Impedance & Return-Loss Measurement Plot for Body TSL



Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client PC Test

Certificate No: D5GHzV2-1123_Mar18

CALIBRATION CERTIFICATE

Object: D5GHzV2 - SN:1123

Calibration procedure(s): QA CAL-22.v2
Calibration procedure for dipole validation kits between 3-6 GHz

SC ✓ 3/21/18

Calibration date: March 13, 2018

SC ✓ 3/12/19 ATM ✓ 6/10/2020

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 3503	30-Dec-17 (No. EX3-3503_Dec17)	Dec-18
DAE4	SN: 601	26-Oct-17 (No. DAE4-601_Oct17)	Oct-18

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-16 (No. 217-02222)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-16 (No. 217-02222)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-16 (No. 217-02223)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (In house check Oct-16)	In house check: Oct-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (In house check Oct-17)	In house check: Oct-18

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: March 14, 2018

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "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)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz	

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.2 ± 6 %	4.58 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.15 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**81.6 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.35 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.5 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.7 ± 6 %	4.94 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.51 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**85.1 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.43 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.3 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.5 ± 6 %	5.10 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.06 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**80.6 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.29 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.9 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.36 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.1 ± 6 %	5.49 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5250 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.45 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**74.0 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.08 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.6 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.4 ± 6 %	5.97 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.82 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**77.6 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.19 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.7 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.3	5.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.2 ± 6 %	6.18 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.52 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**74.7 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.10 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.8 W/kg ± 19.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	53.2 Ω - 5.2 jΩ
Return Loss	- 24.6 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	57.2 Ω - 0.4 jΩ
Return Loss	- 23.4 dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	56.7 Ω + 0.9 jΩ
Return Loss	- 23.9 dB

Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	51.6 Ω - 4.3 jΩ
Return Loss	- 26.9 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	59.0 Ω - 0.3 jΩ
Return Loss	- 21.7 dB

Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	57.8 Ω + 1.0 jΩ
Return Loss	- 22.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.205 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 08, 2011

DASY5 Validation Report for Head TSL

Date: 13.03.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1123

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz
Medium parameters used: f = 5250 MHz; σ = 4.58 S/m; ε_r = 36.2; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5600 MHz; σ = 4.94 S/m; ε_r = 35.7; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5750 MHz; σ = 5.1 S/m; ε_r = 35.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

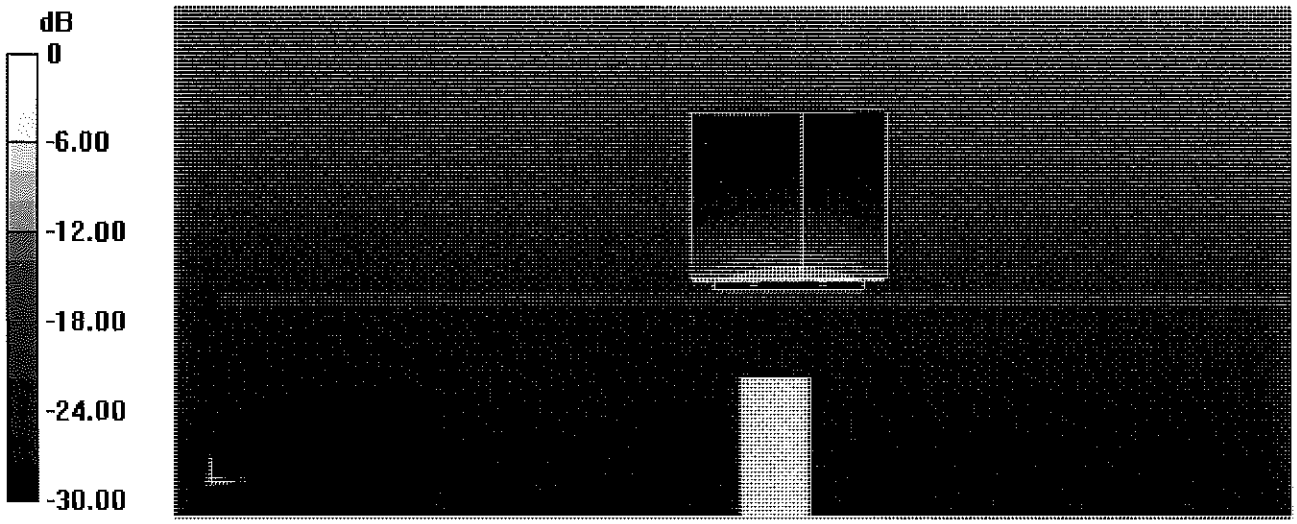
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.51, 5.51, 5.51); Calibrated: 30.12.2017, ConvF(5.05, 5.05, 5.05); Calibrated: 30.12.2017, ConvF(4.98, 4.98, 4.98); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 73.12 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 28.1 W/kg
SAR(1 g) = 8.15 W/kg; SAR(10 g) = 2.35 W/kg
Maximum value of SAR (measured) = 18.4 W/kg

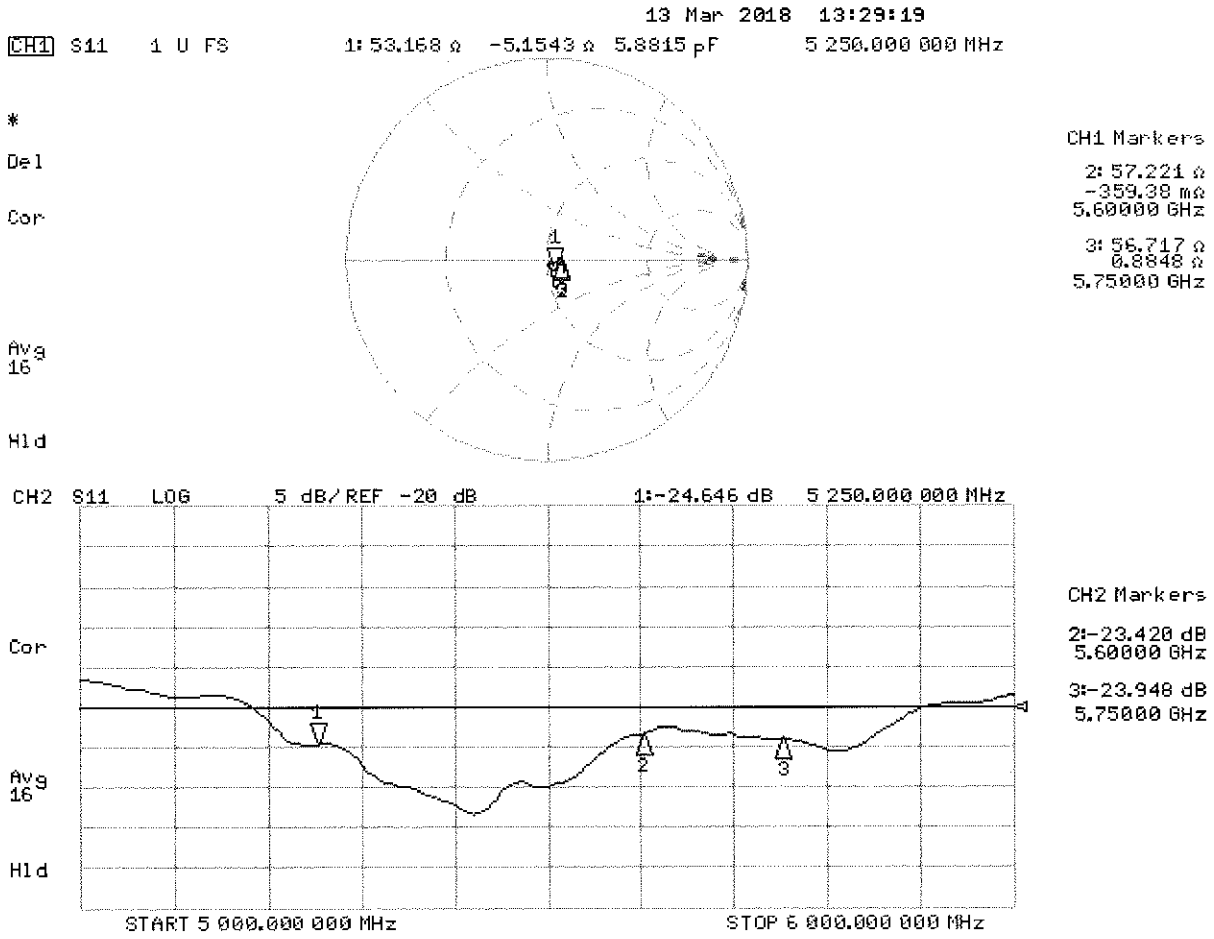
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 72.34 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 32.4 W/kg
SAR(1 g) = 8.51 W/kg; SAR(10 g) = 2.43 W/kg
Maximum value of SAR (measured) = 19.8 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 70.38 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 31.4 W/kg
SAR(1 g) = 8.06 W/kg; SAR(10 g) = 2.29 W/kg
Maximum value of SAR (measured) = 19.1 W/kg



0 dB = 19.1 W/kg = 12.81 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 12.03.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1123

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz
Medium parameters used: f = 5250 MHz; σ = 5.49 S/m; ε_r = 47.1; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5600 MHz; σ = 5.97 S/m; ε_r = 46.4; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5750 MHz; σ = 6.18 S/m; ε_r = 46.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

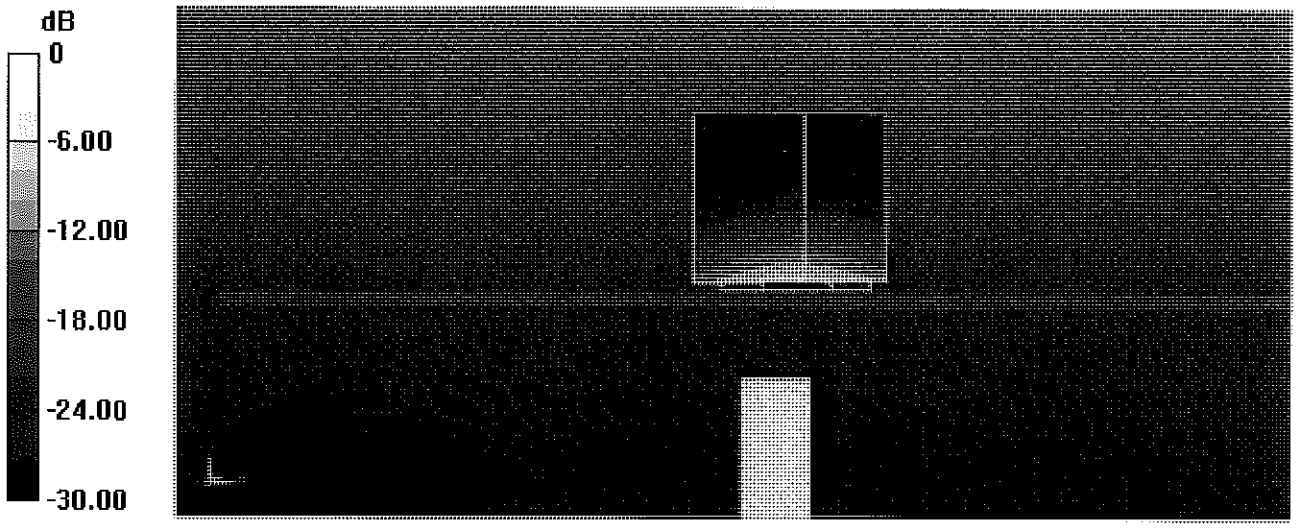
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.26, 5.26, 5.26); Calibrated: 30.12.2017, ConvF(4.65, 4.65, 4.65); Calibrated: 30.12.2017, ConvF(4.57, 4.57, 4.57); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.35 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 28.3 W/kg
SAR(1 g) = 7.45 W/kg; SAR(10 g) = 2.08 W/kg
Maximum value of SAR (measured) = 17.6 W/kg

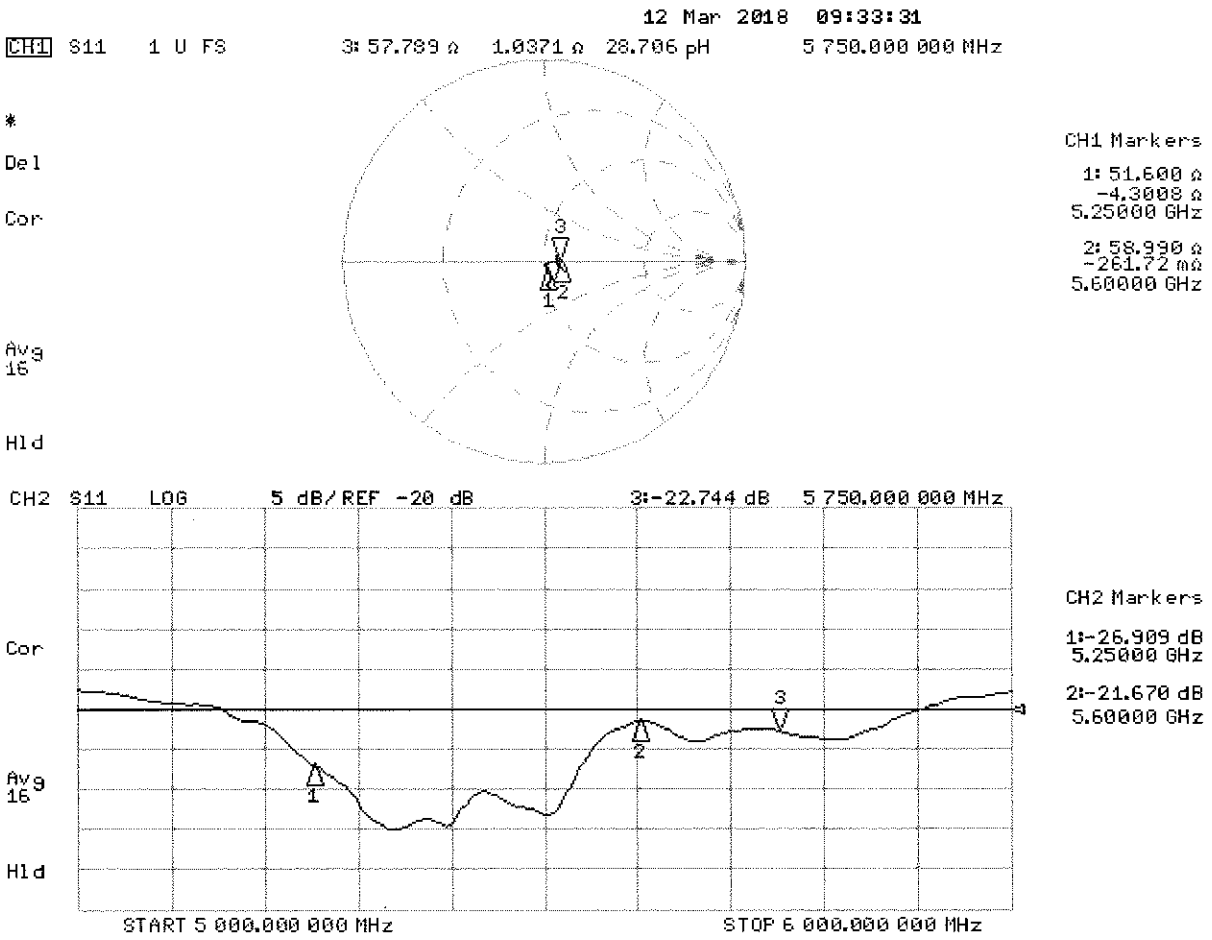
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.20 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 32.5 W/kg
SAR(1 g) = 7.82 W/kg; SAR(10 g) = 2.19 W/kg
Maximum value of SAR (measured) = 19.0 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 61.74 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 31.8 W/kg
SAR(1 g) = 7.52 W/kg; SAR(10 g) = 2.1 W/kg
Maximum value of SAR (measured) = 18.5 W/kg



0 dB = 18.5 W/kg = 12.67 dBW/kg

Impedance Measurement Plot for Body TSL



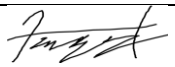
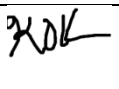
Certification of Calibration

Object	D5GHzV2 – SN: 1123
Calibration procedure(s)	Procedure for Calibration Extension for SAR Dipoles.
Extension Calibration date:	3/12/2019
Description:	SAR Validation Dipole at 5250, 5600, and 5750 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Network Analyzer	10/2/2018	Annual	10/2/2019	US39170118
Agilent	N5182A	MXG Vector Signal Generator	6/15/2018	Annual	6/15/2019	MY47420837
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	343972
Anritsu	MA2411B	Pulse Power Sensor	10/30/2018	Annual	10/30/2019	1207470
Anritsu	MA2411B	Pulse Power Sensor	11/20/2018	Annual	11/20/2019	1339007
Anritsu	ML2495A	Power Meter	10/21/2018	Annual	10/21/2019	941001
Control Company	4040	Temperature / Humidity Monitor	2/28/2018	Biennial	2/28/2020	150761911
Control Company	4352	Ultra Long Stem Thermometer	5/2/2017	Biennial	5/2/2019	170330158
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	6/4/2018	Annual	6/4/2019	MY53401181
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Seekonk	NC-100	Torque Wrench	7/11/2018	Annual	7/11/2019	N/A
SPEAG	DAE4	Dasy Data Acquisition Electronics	7/10/2018	Annual	7/10/2019	1402
SPEAG	DAE4	Dasy Data Acquisition Electronics	10/18/2018	Annual	10/18/2019	1364
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/15/2018	Annual	5/15/2019	1070
SPEAG	EX3DV4	SAR Probe	7/20/2018	Annual	7/20/2019	7416
SPEAG	EX3DV4	SAR Probe	7/20/2018	Annual	7/20/2019	7491

Measurement Uncertainty = ±23% (k=2)

	Name	Function	Signature
Calibrated By:	Sangmin Cha	Team Lead Engineer	
Approved By:	Kaitlin O'Keefe	Managing Director	

DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

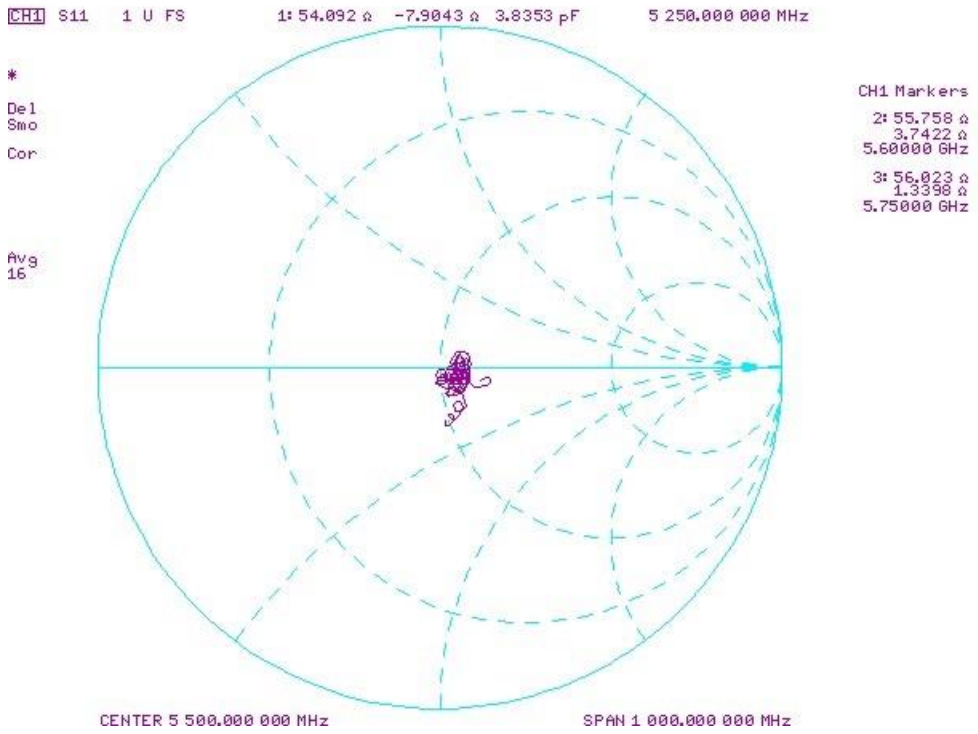
1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

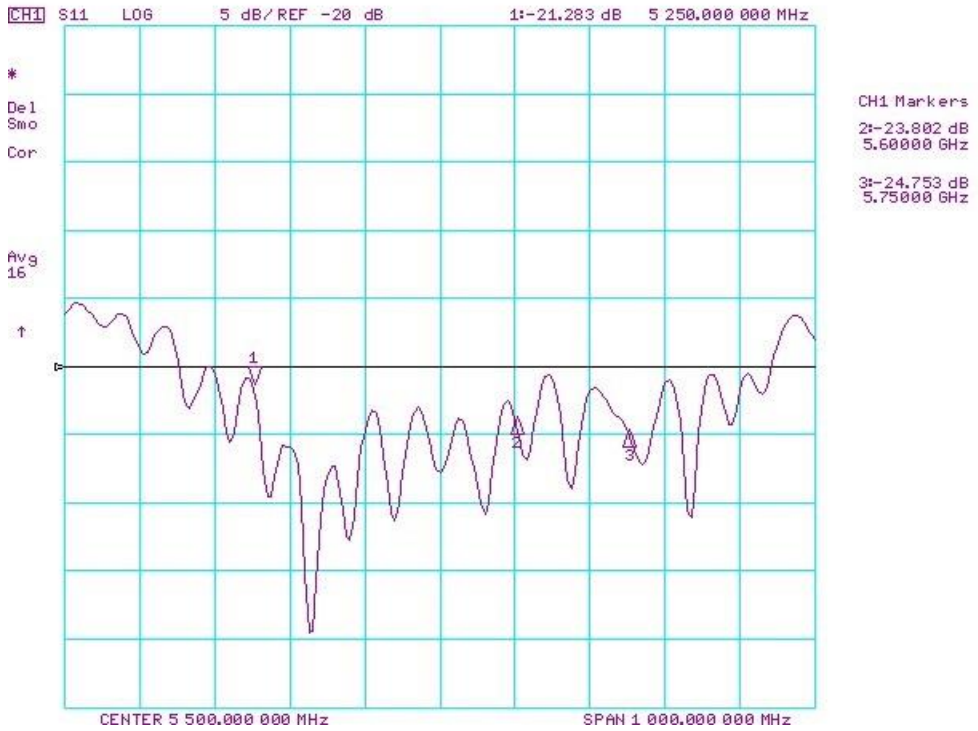
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

Frequency (MHz)	Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 17.0 dBm	Measured Head SAR (1g) W/kg @ 17.0 dBm	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 17.0 dBm	Measured Head SAR (10g) W/kg @ 17.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
5250	3/13/2018	3/12/2019	1.205	4.08	3.84	-5.88%	1.18	1.09	-7.63%	53.2	54.1	0.9	-5.2	-7.9	2.7	-24.6	-21.3	13.40%	PASS
5600	3/13/2018	3/12/2019	1.205	4.26	4	-6.10%	1.22	1.13	-7.38%	57.2	55.8	1.4	-0.4	3.7	4.1	-23.4	-23.8	-1.70%	PASS
5750	3/13/2018	3/12/2019	1.205	4.03	3.73	-7.44%	1.15	1.06	-7.83%	56.7	56	0.7	0.9	1.3	0.4	-23.9	-24.8	-3.80%	PASS

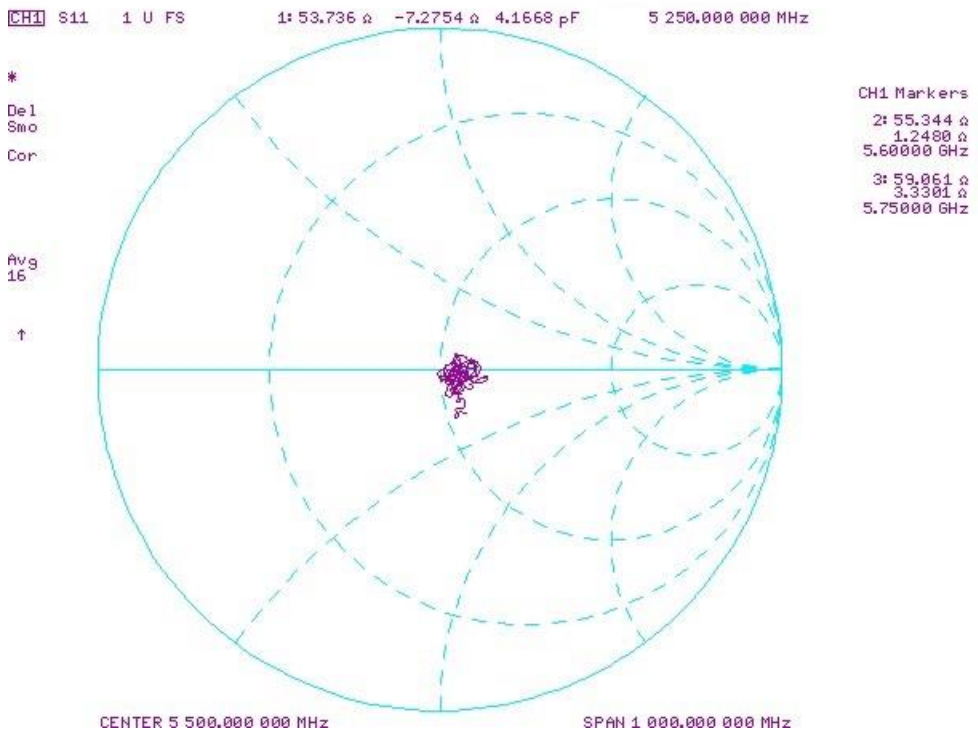
Frequency (MHz)	Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 17.0 dBm	Measured Body SAR (1g) W/kg @ 17.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 17.0 dBm	Measured Body SAR (10g) W/kg @ 17.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured Impedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
5250	3/13/2018	3/12/2019	1.205	3.7	3.83	3.51%	1.03	1.07	3.88%	51.6	53.7	2.1	-4.3	-7.3	3	-26.9	-22.1	17.80%	PASS
5600	3/13/2018	3/12/2019	1.205	3.88	3.97	2.32%	1.09	1.09	0.00%	59	55.3	3.7	-0.3	1.2	1.5	-21.7	-25.5	-17.50%	PASS
5750	3/13/2018	3/12/2019	1.205	3.74	3.76	0.53%	1.04	1.03	-0.96%	57.8	59.1	1.3	1	3.3	2.3	-22.7	-21.1	7.00%	PASS

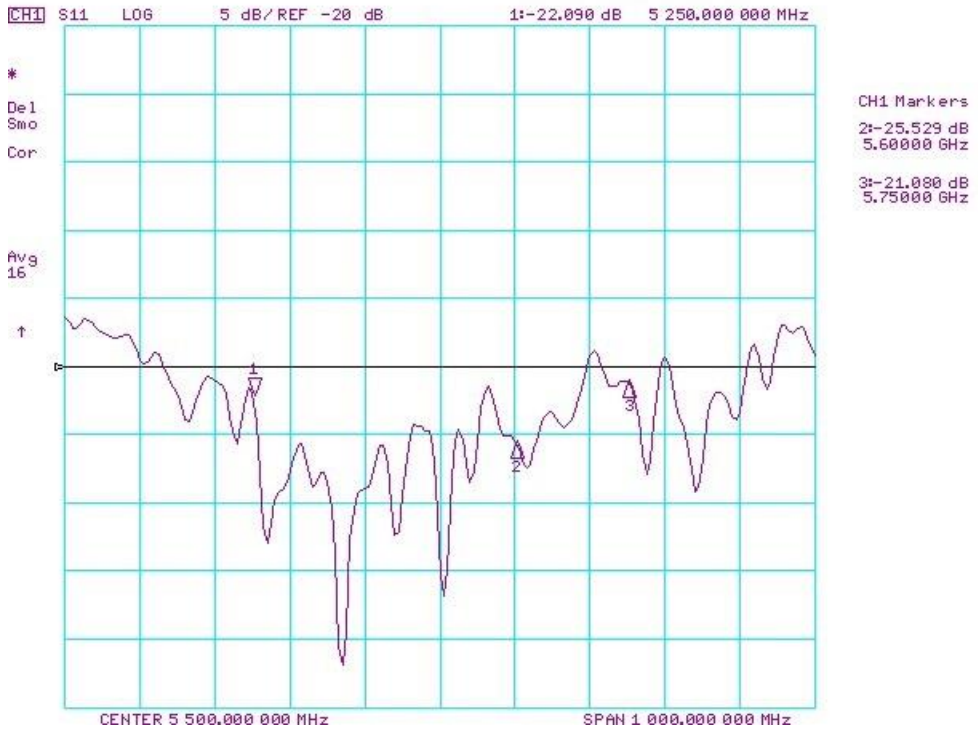
Impedance & Return-Loss Measurement Plot for Head TSL





Impedance & Return-Loss Measurement Plot for Body TSL





Certification of Calibration

Object	D5GHzV2 – SN: 1123
Calibration procedure(s)	Procedure for Calibration Extension for SAR Dipoles.
Extension Calibration date:	3/12/2020
Description:	SAR Validation Dipole at 5250, 5600, and 5750 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Network Analyzer	1/16/2020	Annual	1/16/2021	US39170118
Agilent	N5182A	MXG Vector Signal Generator	8/19/2019	Annual	8/19/2020	MY47420837
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	343972
Anritsu	MA2411B	Pulse Power Sensor	1/21/2020	Annual	1/21/2021	1207470
Anritsu	MA2411B	Pulse Power Sensor	1/21/2020	Annual	1/21/2021	1339007
Anritsu	ML2495A	Power Meter	1/15/2020	Annual	1/15/2021	1328004
Control Company	62344-734	Therm./ Clock/ Humidity Monitor	3/18/2019	Biennial	3/18/2021	192038436
Control Company	4352	Ultra Long Stem Thermometer	8/2/2018	Biennial	8/2/2020	181292000
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	7/2/2019	Annual	7/2/2020	MY53401181
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Seekonk	NC-100	Torque Wrench	5/9/2018	Biennial	5/9/2020	22217
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/7/2019	Annual	5/7/2020	1070
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/13/2020	Annual	2/13/2021	1403
SPEAG	EX3DV4	SAR Probe	2/19/2020	Annual	2/19/2021	7427

Measurement Uncertainty = ±23% (k=2)

	Name	Function	Signature
Calibrated By:	Parker Jones	Team Lead Engineer	Parker Jones
Approved By:	Kaitlin O'Keefe	Managing Director	

DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

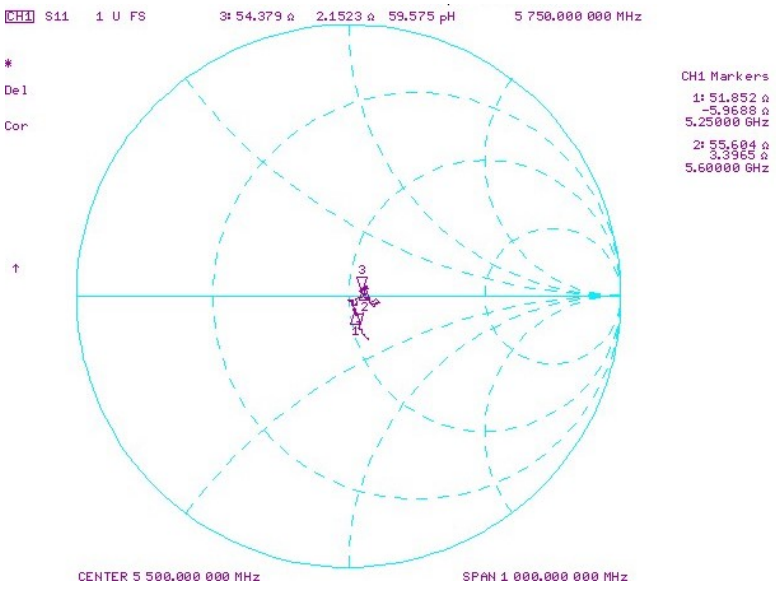
1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have 3-year calibration period from the calibration date:

Frequency (MHz)	Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 17.0 dBm	Measured Head SAR (1g) W/kg @ 17.0 dBm	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 17.0 dBm	Measured Head SAR (10g) W/kg @ 17.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
5250	3/13/2018	3/12/2020	1.205	4.080	3.87	-5.15%	1.175	1.09	-7.23%	53.2	51.9	1.3	-5.2	-6.0	0.8	-24.6	-24.0	2.40%	PASS
5600	3/13/2018	3/12/2020	1.205	4.255	4.13	-2.94%	1.215	1.16	-4.53%	57.2	55.6	1.6	-0.4	3.4	3.8	-23.4	-24.2	-3.40%	PASS
5750	3/13/2018	3/12/2020	1.205	4.030	3.84	-4.71%	1.145	1.07	-6.55%	56.7	54.4	2.3	0.9	2.2	1.3	-23.9	-26.5	-10.90%	PASS

Frequency (MHz)	Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 17.0 dBm	Measured Body SAR (1g) W/kg @ 17.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 17.0 dBm	Measured Body SAR (10g) W/kg @ 17.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured Impedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
5250	3/13/2018	3/12/2020	1.205	3.700	3.55	-4.05%	1.030	0.99	-4.17%	51.6	49.5	2.1	-4.3	-6.0	1.7	-26.9	-27.0	-0.40%	PASS
5600	3/13/2018	3/12/2020	1.205	3.880	3.87	-0.26%	1.085	1.06	-2.30%	59.0	54.1	4.9	-0.3	1.0	1.3	-21.7	-24.0	-10.60%	PASS
5750	3/13/2018	3/12/2020	1.205	3.735	3.62	-3.08%	1.040	0.99	-4.62%	57.8	55.3	2.5	1.0	2.9	1.9	-22.7	-23.8	-4.80%	PASS

Impedance & Return-Loss Measurement Plot for Head TSL



Impedance & Return-Loss Measurement Plot for Body TSL