MOTOROLA SOLUTIONS

ilac-MRA STANDARDS MALAYSIA ACCREDITED SAMM 826

ilac-MRA A2LA ACCREDITED CERTIFICATE 2518.05

DECLARATION OF COMPLIANCE SAR ASSESSMENT Part 1 of 4

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Date of Report: **01/30/2023**
Report Revision: **I**

Responsible Engineer:	Saw Sun Hock (EME Engineer)
Report Author:	Kin Kting Lee (EME Technician)
Date/s Tested:	8/24/2022-8/30/2022, 9/4/2022-9/13/2022, 11/13/2022 – 11/25/2022
Manufacturer:	Motorola Solutions Inc.
DUT Description:	Handheld Portable – WAVE PTX TWO WAY RADIO
Test TX mode(s):	LTE, WCDMA, WLAN, BT / BT LE
Max. Power output:	Refer table 3 (Part 1 of 4)
Nominal Power output:	Refer table 3 (Part 1 of 4)
Tx Frequency Bands:	Refer table 3 (Part 1 of 4)
Signaling type:	QPSK, 16QAM, 64QAM, QPSK, DSSS, OFDM, SC-FDMA, RMC/AMR 12.2Kbps, HSDPA, HSUPA
Model(s) Tested:	HK2183A [HKUN4243A]
Model(s) Certified:	HK2183A [HKUN4243A], HK2184A [HKUN4245A]
Serial Number(s):	642QYQ0178, 642QYQ0141, 642QYU0102 and 642QYU0031
Firmware Version:	TAURUS_BASE_D00.00.02_APP_D00.01.63
Classification:	General Population / Uncontrolled Environment
Applicant Name:	Motorola Solutions Inc.
Applicant Address:	8000 West Sunrise Boulevard, Fort Lauderdale, Florida 33322
FCC ID:	AZ489FT7166
FCC Test Firm Registration Number:	823256
IC:	109U-89FT7166
ISED Test Site registration:	24843

The test results clearly demonstrate compliance with General Population / Uncontrolled RF Exposure limits of 1.6 W/kg averaged over 1 gram per the requirements of FCC 47 CFR § 2.1093 and RSS-102 (Issue 5)

Based on the information and the testing results provided herein, the undersigned certifies that when used as stated in the operating instructions supplied, said product complies with the national and international reference standards and guidelines listed in section 4.0 of this report (no deviation from standard methods).
This report shall not be reproduced without written approval from an officially designated representative of the Motorola Solutions Inc EME Laboratory.
I attest to the accuracy of the data and assume full responsibility for the completeness of these measurements. This reporting format is consistent with the suggested guidelines of the TIA TSB-150 December 2004. The results and statements contained in this report pertain only to the device(s) evaluated.

Saw Sun Hock (Approval Signatory)
Approval Date: 01/30/2023

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DUT, Body worn and Audio accessories photos

Report Revision History

Date	Revision	Comments
10/21/2022	A	Initial release
11/23/2022	B	Update the cover page DUT description
12/19/2022	C	Update the test data
12/27/2022	D	Update the firmware version and WLAN 5GHz power
01/03/2023	E	Update the WLAN 2.4GHz power
01/09/2023	F	Update Antenna Gain
01/14/2023	G	Update the word “dbi to dBi”
01/27/2023	H	Amend the cover page, session 14.0, 16.0 and 17.0
01/30/2023	I	Revise section 14 & 16 on for the BT SAR exclusions

1.0 Introduction

This report details the utilization, test setup, test equipment, and test results of the Specific Absorption Rate (SAR) measurements performed at the Motorola Solutions Inc. EME Test Laboratory for handheld portable model HK2183A [HKUN4243A]. This device is classified as General Population / Uncontrolled Environment.

2.0 FCC SAR Summary

Table 2

Equipment Class	Frequency band (MHz)	Max Calc at Body (W/kg)	Max Calc at Face (W/kg)
		1g-SAR	1g-SAR
PCF	LTE B2	0.484	0.322
	LTE B4	0.477	0.253
	LTE B5	0.448	0.303
	LTE B7	0.287	0.288
	LTE B12	0.396	0.272
	LTE B13	0.617	0.362
	LTE B25	0.466	0.349
	LTE B26	0.379	0.346
	LTE B41	0.191	0.172
	LTE B66	0.521	0.324
	WCDMA B2	0.448	0.365
	WCDMA B4	0.491	0.380
	WCDMA B5	0.569	0.295
*DSS	BT	NA	NA
DTS	WLAN 2.4GHz	0.250	0.016
NII	WLAN 5.0GHz	0.799	0.080
Highest SAR Results		0.799	0.380

Notes:
1) "*"Results not required per KDB (refer to sections 14.0 and 16.0)
2) LTE Band 17 covered within band 12 (refer to report Part 4 of 4)

3.0 Abbreviations / Definitions

BT:	Bluetooth
CNR:	Calibration Not Required
CW:	Continuous Wave
DSS	Part 15 Spread Spectrum Transmitter
DSSS:	Direct Sequence Spread Spectrum
DTS:	Digital Transmissions System
DUT:	Device Under Test
EME:	Electromagnetic Energy
FHSS:	Frequency Hopping Spread Spectrum
GFSK:	Gaussian Frequency-Shift Keying
LTE:	Long Term Evolution
NA:	Not Applicable
OFDM:	Orthogonal Frequency Division Multiplexing
PTT:	Push to Talk
QPSK:	Quadrature Pulse Shift Key
SAR:	Specific Absorption Rate
16QAM:	16 State Quadrature Amplitude Modulation

Audio accessories: These accessories allow communication while the DUT is worn on the body.
Body worn accessories: These accessories allow the DUT to be worn on the body of the user.
Maximum Power: Defined as the upper limit of the production line final test station

4.0 Referenced Standards and Guidelines

This product is designed to comply with the following applicable national and international standards and guidelines.

- Federal Communications Commission, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields", OET Bulletin 65, FCC, Washington, D.C.: 1997.
- Institute of Electrical and Electronics Engineers (IEEE) C95.1-2019
- International Commission on Non-Ionizing Radiation Protection (ICNIRP) 2020
- Ministry of Health (Canada) Safety Code 6 (2015), Limits of Human Exposure to Radio frequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz
- RSS-102 (Issue 5) – Radio Frequency (RF) Exposure Compliance of Radio communication Apparatus (All Frequency Bands)
- Australian Communications Authority Radio communications (Electromagnetic Radiation - Human Exposure) Standard (2014)
- ANATEL, Brazil Regulatory Authority, Resolution No 700 of September 28, 2018 "Approves the Regulation on the Assessment of Human Exposure to Electric, Magnetic and Electromagnetic Fields Associated with the Operation of Radio communication Transmitting Stations.
- IEC/IEEE 62209-1528-2020- 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 1528: Human models, instrumentation, and procedures (Frequency range of 4 MHz to 10 GHz)

- FCC KDB – 643646 D01 SAR Test for PTT Radios v01r03
- FCC KDB – 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB – 865664 D02 RF Exposure Reporting v01r02
- FCC KDB – 447498 D01 General RF Exposure Guidance v06
- FCC KDB – 941225 D05 SAR for LTE Devices v02r05
- FCC KDB – 941225 D01 3G SAR Procedures v03r01
- FCC KDB – 248227 D01 802.11 Wi-Fi SAR v02r02
- FCC KDB - 648474 D04 Handset SAR v01r03

5.0 SAR Limits

Table 2

EXPOSURE LIMITS	SAR (W/kg)	
	(General Population / Uncontrolled Exposure Environment)	(Occupational / Controlled Exposure Environment)
Spatial Average - ANSI - (averaged over the whole body)	0.08	0.4
Spatial Peak - ANSI - (averaged over any 1-g of tissue)	1.6	8.0
Spatial Peak – ICNIRP/ANSI - (hands/wrists/feet/ankles averaged over 10-g)	4.0	20.0
Spatial Peak - ICNIRP - (Head and Trunk 10-g)	2.0	10.0

6.0 Description of Device Under Test (DUT)

This device includes LTE technology, which is capable of OFDM (Orthogonal Frequency Division Multiplexing) on the downlink and SC-FDMA (Single Carrier Frequency Division Multiple Access) on the uplink. Depending upon the packet size of the data being sent the uplink Bandwidth can vary from 1MHz to 10MHz. They also cover one slot in the time frame. This means that different LTE signal bandwidths will have different numbers of resource blocks in which the maximum of 10 MHz frequency correlates to 50 resource blocks or (50RB x 12) 600 subcarriers.

This device includes a Class 1 Bluetooth device which is a Frequency Hopping Spread Spectrum (FHSS) technology. The Bluetooth radio modem is used to wireless link audio accessories. The maximum actual transmission duty cycle is imposed by the Bluetooth standard. The maximum duty cycle for BT is 76.79%.

This device includes WCDMA technology which operates in Wideband Code Division Multiple Access. The device supports HSPA+ (QPSK only on the uplink) the maximum duty cycles and output powers are defined in Table 3.

This device includes WLAN 2.4 GHz 802.11 b/g/n operate using Direct Sequence Spread Spectrum (DSSS) and Orthogonal Frequency-Division Multiplexing (OFDM) with channel bandwidth of 20 MHz. WLAN 5GHz 802.11 a/ac/n operate using Orthogonal Frequency-Division Multiplexing(OFDM) with channel bandwidth of 20MHz, 40MHz, 80MHz.

Table 3 below summarizes the technologies, bands, maximum duty cycles and maximum output powers. Declared maximum output powers are defined as upper limit of the production line final test station.

Table 3

Technologies	Band (MHz)	Transmission	Duty Cycle (%)	Nominal Power (W)	Declared Max Power (W)
(1)LTE Band 2	1850-1910	QPSK, 16QAM. 64QAM(8)	100	0.1995	0.2818
(2)LTE Band 4	1710-1755	QPSK, 16QAM. 64QAM(8)	100	0.1995	0.2818
(3)LTE Band 5	824-849	QPSK, 16QAM. 64QAM(8)	100	0.1995	0.2818
LTE Band 7	2500-2570	QPSK, 16QAM. 64QAM(8)	100	0.1995	0.2511
LTE Band 12	699-716	QPSK, 16QAM. 64QAM(8)	100	0.1995	0.2511
(4)LTE Band 13	777-787	QPSK, 16QAM. 64QAM(8)	100	0.1995	0.2818
LTE Band 17	704-716	QPSK, 16QAM. 64QAM(8)	100	0.1995	0.2511
LTE Band 25	1850-1915	QPSK, 16QAM. 64QAM(8)	100	0.1995	0.2511
LTE Band 26	814-849	QPSK, 16QAM. 64QAM(8)	100	0.1995	0.2511
LTE Band 41	2496-2690	QPSK, 16QAM. 64QAM(8)	100	0.1995	0.2511
LTE Band 66	1710-1780	QPSK, 16QAM. 64QAM(8)	100	0.1995	0.2511
(5)WCDMA Band 2	1850- 1910	RMC/AMR 12.2Kbps	100	0.2339	0.2818
(6)WCDMA Band 4	1710 to 1755	RMC/AMR 12.2Kbps	100	0.2339	0.2818
(7)WCDMA Band 5	824 to 849	RMC/AMR 12.2Kbps	100	0.2339	0.2818

(1) EME tested LTE Band 2 at 0.2818 W (Highest max conducted average power as stated in the table above). The new power of LTE Band 2 will be implement in Production unit for all channels are 0.2511 W.

(2) EME tested LTE Band 4 at 0.2818 W (Highest max conducted average power as stated in the table above). The new power of LTE Band 4 will be implement in Production unit for all channels are 0.2511 W.

(3) EME tested LTE Band 5 at 0.2818 W (Highest max conducted average power as stated in the table above). The new power of LTE Band 5 will be implement in Production unit for all channels are 0.2511 W.

(4) EME tested LTE Band 13 at 0.2818 W (Highest max conducted average power as stated in the table above). The new power of LTE Band 7 will be implement in Production unit for all channels are 0.2511 W.

(5) EME tested WCDMA Band 2 at 0.2818 W (Highest max conducted average power as stated in the table above). The new power of WCDMA Band 2 will be implement in Production unit for all channels are 0.2511 W.

(6) EME tested WCDMA Band 4 at 0.2818 W (Highest max conducted average power as stated in the table above). The new power of WCDMA Band 4 will be implement in Production unit for all channels are 0.2511 W.

(7) EME tested WCDMA Band 5 at 0.2818 W (Highest max conducted average power as stated in the table above). The new power of WCDMA Band 5 will be implement in Production unit for all channels are 0.2511 W.

(8) EME tested WLAN 802.11g channel11 at 0.0158 W (Highest max conducted average power as stated in the table above). The new power of WLAN 802.11g channel11 will be implement in Production unit for all channels are 0.0126W.

(9) EME tested WLAN 802.11n channel11 at 0.0126 W (Highest max conducted average power as stated in the table above). The new power of WLAN 802.11n channel11 will be implement in Production unit for all channels are 0.0100W.

(10) EME tested WLAN 802.11a channel 140 at 0.0631 W (Highest max conducted average power as stated in the table above). The new power of WLAN 802.11a channel 140 will be implement in Production unit for all channels are 0.0501W.

(11) EME tested WLAN 802.11ac channel 140 at 0.0562 W (Highest max conducted average power as stated in the table above). The new power of WLAN 802.11ac channel 140 will be implement in Production unit for all channels are 0.0501W.

(12) 64QAM for receive only.

Table 3 (Continued)

Technologies	Band (MHz)	Transmission	Duty Cycle (%)	Nominal Power (W)	Declared Max Power (W)
WLAN 802.11 b (22 MHz)	2412-2462	DSSS	99.45	0.0501	0.0708
(8)WLAN 802.11 g (20 MHz)		OFDM	99.45	CH 01 - 0.0282, CH 06 - 0.0282, CH11 - 0.0100,	CH 01 - 0.0398, CH 06 - 0.0398, CH11 - 0.0158,
(9)WLAN 802.11 n (20 MHz)		OFDM	99.42	CH 01 - 0.0178, CH 06 - 0.0178, CH11 - 0.0079,	CH 01 - 0.0251, CH 06 - 0.0251, CH11 - 0.0126,
(10)WLAN 802.11 a (20 MHz)	5180-5825	OFDM	99.27	Others channels 0.0282 except: CH36 - 0.0501 CH64 - 0.0282, CH100 - 0.0398, CH140 - 0.0501, CH165 - 0.0562	Others channels 0.0398 except: CH 36 - 0.0708 CH64 - 0.0398, CH100 - 0.0562, CH140 - 0.0631, CH165 - 0.0708
WLAN 802.11 n (20 MHz)			99.42	Others channels 0.0178 except: CH36 - 0.0354 CH64 - 0.0178, CH100 - 0.0316, CH140 - 0.0316, CH165 - 0.0354	Others channels 0.0251 except: CH 36 - 0.0501 CH64 - 0.0251 CH100 - 0.0354 CH140 - 0.0446 CH165 - 0.0501
WLAN 802.11 n (40 MHz)			98.29	Others channels 0.0126 except: CH38 - 0.0251 CH62 - 0.0126, CH102 - 0.0178, CH134 - 0.0251, CH159 - 0.0282	Others channels 0.020 except: CH 38 - 0.0354 CH62 - 0.0200 CH102 - 0.0251 CH134 - 0.0354 CH159 - 0.0398
(11)WLAN 802.11 ac (20 MHz)			99.24	Others channels 0.0200 except: CH36 - 0.0354 CH64 - 0.0200, CH100 - 0.0251, CH140 - 0.0398, CH165 - 0.0354	Others channels 0.0282 except: CH 36 - 0.0501 CH64 - 0.0282 CH100 - 0.0354 CH140 - 0.0562 CH165 - 0.0501
WLAN 802.11 ac (40 MHz)			98.30	Others channels 0.0126 except: CH38 - 0.0251 CH62 - 0.0126, CH102 - 0.0178, CH134 - 0.0224, CH159 - 0.0282	Other channels 0.0178 except: CH 38 - 0.0354 CH62 - 0.0178 CH102 - 0.0251 CH134 - 0.0316 CH159 - 0.0354
WLAN 802.11 ac (80 MHz)			96.31	Others channels 0.0158 except: CH42 - 0.0158 CH58 - 0.0112, CH106 - 0.0126, CH138 - 0.0158, CH155 - 0.0158	Other channels 0.0158 except: CH 42 - 0.0223 CH58 - 0.0158 CH106 - 0.0178 CH138 - 0.0223 CH155 - 0.0223
*Bluetooth	2402-2480	FHSS	76.79	Other channels 0.0080 except: CH0 - 0.0100 CH39 -0.0100 CH78 - 0.0080	Other channels 0.0100 except: CH0 - 0.0125 CH39 -0.0125 CH78 - 0.0100
*Bluetooth LE			65.28	0.0012	CH0 - 0.0014 CH19 -0.0016 CH39 - 0.0011

Note: * Conducted (Average Detector) Power

The intended operating positions are “at the face” with the DUT at least 1 inch from the mouth, and “at the body” by means of the offered body worn accessories. Body worn audio and PTT operation is accomplish by means of optional remote accessories that are connect to the radio.

7.0 Optional Accessories and Test Criteria

This device is offered with optional accessories. All accessories were individually evaluated during the test plan creation to determine if testing was required per the guidelines outlined in "SAR Test Reduction Considerations for Occupational PTT Radios" FCC KDB 643646 to assess compliance of this device. The following sections identify the test criteria and details for each accessory category. Refer to Exhibit 7B for antenna separation distances.

7.1 Antennas

There are internal LTE/WCDMA and WLAN/BT antennas in this product. The Table below lists their descriptions.

Table 4

Antenna No.	Antenna Models	Description	Selected for test	Tested
1	AS1000215	BT/BTLE/WIFI antenna 2402 - 2482 MHz 1⁄4 wave, (1.14dBi), WIFI 5G UNII-1 5150-5250MHz 1⁄4 wave, (1.37dBi), UNII-2A 5250-5350MHz 1⁄4 wave, (1.96dBi), UNII-2C 5470-5725MHz 1⁄4 wave, (3.53dBi), UNII-3 5725-5850MHz 1⁄4 wave, (4.1dBi)	Yes	Yes
2	HKAN4005A	LTE/WCDMA STUBBY ANTENNA 698MHz-960MHz, 1710MHz-2170MHz, 2300MHz-2700MHz, 1⁄4 wave, WCDMA B2 (4.37dBi), B4 (4.69dBi), B5 (1.11dBi), LTE B2 (4.37 dBi), B4 (4.69 dBi), B5(1.11dBi), B7 (2.49dBi), B12(-0.38dBi), B13 (0.28dBi), B17 (-0.38dBi), B25 (4.37dBi), B26 (1.11dBi), B41 (2.56dBi), B66 (4.69dBi)	Yes	Yes

7.2 Battery

Only one battery applicable for this product. The Table below lists their descriptions.

Table 5

Battery No.	Battery Models	Description	Selected for test	Tested	Comments
1	PMNN4578A	Battery Pack, Battery Pack, Batt Li-Ion 2500T	Yes	Yes	

7.3 Body worn Accessories

All applicable body worn is evaluate for this product. The Table below lists their descriptions.

Table 6

Body worn No.	Body worn Models	Description	Selected for test	Tested	Comments
1	PMLN6074A	Wrist Strap.	No	No	Not for body intended use
2	PMLN7128A	Carry Accessory-Belt Clip, Heavy-Duty Swivel Belt Clip.	Yes	Yes	
3	PMLN8439A	Carry Accessory-Holster, Carry Holster	Yes	Yes	

7.4 Audio Accessories

All applicable audio is evaluated for this product. The Table below lists their descriptions.

Table 7

Audio No.	Audio Acc. Models	Description	Selected for test	Tested	Comments
1	PMLN7156A	Mag One Ear bud With In-Line Microphone And PTT	Yes	No*	
2	PMLN7157A	2-Wire Surveillance Kit With Translucent Tube, Black	Yes	No*	
3	PMLN7158A	1-Wire Surveillance Kit With In-Line Mic And PTT, Black.	Yes	No*	
4	PMLN7159A	Adjustable Earpiece With In-Line Mic And PTT, Black	Yes	No*	
5	PMLN7189A	Swivel Earpiece With In-Line Microphone And PTT	Yes	No*	
6	PMLN8191A	Audio Accessory-Earpiece,1-Wire Enh Clear Tube Earpiece, 2.5mm Single Pin, Angled	Yes	No*	
7	PMMN4125B	Audio Accessory-Remote Speaker Microphone	Yes	No*	

Note - * Intended for test. Per KDB provision tests not required.

8.0 Description of Test System

8.1 Descriptions of Robotics/Probes/Readout Electronics

Table 8

Dosimetric System type	System version	DAE type	Probe Type
Schmid & Partner Engineering AG SPEAG DASY 5	52.10.2.1527	DAE4	EX3DV4 (E-Field)

The DASY5™ system is operated per the instructions in the DASY5™ Users Manual. The complete manual is available directly from SPEAG™. All measurement equipment used to assess SAR compliance was calibrated according to ISO/IEC 17025 A2LA guidelines. Section 9.0 presents additional test equipment information. Appendices B and C present the applicable calibration certificates. The E-field probe first scans a coarse grid over a large area inside the phantom in order to locate the interpolated maximum SAR distribution. After the coarse scan measurement, the probe is automatically moved to a position at the interpolated maximum. The subsequent scan can directly use this position as reference for the cube evaluations.

8.2 Description of Phantom(s)

Table 9

Phantom Type	Phantom(s) Used	Material Parameters	Phantom Dimensions LxWxD (mm)	Material Thickness (mm)	Support Structure Material	Loss Tangent (wood)
Triple Flat	NA	200MHz -6GHz; Er = 3-5, Loss Tangent = ≤0.05	280x175x175			
SAM	NA	300MHz -6GHz; Er = < 5, Loss Tangent = ≤0.05	Human Model	2mm +/- 0.2mm	Wood	< 0.05
Oval Flat	√	300MHz -6GHz; Er = 4+/- 1, Loss Tangent = ≤0.05	600x400x190			

8.3 Description of Simulated Tissue

The sugar based simulate tissue is produced by placing the correct measured amount of De-ionized water into a large container. Each of the dried ingredients are weighed and added to the water carefully to avoid clumping. If the solution has a high sugar concentration the water is pre-heated to aid in dissolving the ingredients.

The simulated tissue mixture was mixed based on the Simulated Tissue Composition indicated in Table 10. During the daily testing of this product, the applicable mixture was used to measure the Di-electric parameters at each of the tested frequencies to verify that the Di-electric parameters were within the tolerance of the tissue specifications.

Simulated Tissue Composition (percent by mass)

Table 10

Ingredients	750MHz	835MHz	1800MHz	1900MHz	2450MHz	2600MHz
	Head					
Sugar	NA	NA	NA	NA	NA	NA
Diacetin	NA	NA	NA	NA	NA	NA
De-ionized - Water	NA	NA	NA	NA	NA	NA
Salt	NA	NA	NA	NA	NA	NA
HEC	NA	NA	NA	NA	NA	NA
Bact.	NA	NA	NA	NA	NA	NA

Note: SPEAG provides Motorola proprietary stimulant ingredients for the 750MHz, 835MHz, 1800MHz, 1900MHz, 2450MHz & 2600MHz band.

Table 10 (Continue)

Ingredients	5250MHz	5600MHz	5750MHz
	Head		
Sugar	NA	NA	NA
Diacetin	NA	NA	NA
De-ionized - Water	NA	NA	NA
Salt	NA	NA	NA
HEC	NA	NA	NA
Bact.	NA	NA	NA

Note: SPEAG provides Motorola proprietary stimulant ingredients for the 5GHz band.

9.0 Additional Test Equipment

The Table below lists additional test equipment used during the SAR assessment for testing period 8/24/2022-8/30/2022, 9/4/2022-9/13/2022

Table 11

Equipment Type	Model Number	Serial Number	Calibration Date	Calibration Due Date
SPEAG PROBE	EX3DV4	7519	2/28/2022	2/28/2025
SPEAG PROBE	EX3DV4	7364	2/28/2022	2/28/2025
SPEAG PROBE	EX3DV4	7485	4/25/2022	4/25/2025
SPEAG DAE	DAE4	1294	2/22/2022	2/22/2025
SPEAG DAE	DAE4	684	2/22/2022	2/22/2025
SPEAG DAE	DAE4	850	4/14/2022	4/14/2025
POWER AMPLIFIER	50W100D	0357646	CNR	CNR
POWER AMPLIFIER	50W 1000A	14715	CNR	CNR
POWER AMPLIFIER	5S4G11	312664	CNR	CNR
POWER AMPLIFIER	5S4G11	312663	CNR	CNR
POWER AMPLIFIER	5S1G4	312988	CNR	CNR
VECTOR SIGNAL GENERATOR	E4438C	MY45091270	9/9/2021	9/9/2022
VECTOR SIGNAL GENERATOR	E4438C	MY42081753	8/14/2022	8/14/2023
VECTOR SIGNAL GENERATOR	E4438C	MY47272101	10/27/2021	10/27/2022
POWER METER	E4419B	MY45103725	6/12/2022	6/12/2023
POWER METER	E4418B	MY45107917	7/13/2022	7/13/2023
POWER METER	E4417A	GB41292245	11/24/2021	11/24/2022
POWER METER	E4418B	MY45100739	12/8/2021	12/8/2022
POWER METER	E4419B	MY45103725	6/12/2022	6/12/2023
POWER METER	E4418B	MY45100739	12/8/2021	12/8/2022
POWER SENSOR	E4412A	MY61050006	4/7/2022	4/7/2023
POWER SENSOR	E4412A	MY61060011	4/7/2022	4/7/2023
POWER SENSOR	E9301B	MY55210003	6/8/2022	6/8/2023
POWER SENSOR	E9301B	MY41495733	6/8/2022	6/8/2023
POWER SENSOR	E9301B	MY50280001	5/26/2022	5/26/2023
POWER SENSOR	E4412A	MY61060011	4/7/2022	4/7/2023
POWER SENSOR	NRP-Z11	121252	6/18/2021	6/18/2023
BI-DIRECTIONAL COUPLER	3022	81639	9/7/2021	9/7/2022
BI-DIRECTIONAL COUPLER	3024	61136	7/20/2022	7/20/2023
BI-DIRECTIONAL COUPLER	3024	61178	11/25/2021	11/25/2022
BI-DIRECTIONAL COUPLER	3020A	40295	6/30/2022	6/30/2023
BI-DIRECTIONAL COUPLER	3022	81640	6/29/2022	6/29/2023
DATA LOGGER	DSB	16398050	8/13/2022	8/13/2023
DATA LOGGER	DSB	16326820	11/26/2021	11/26/2022
DIELECTRIC ASSESSMENT KIT	DAK-3.5	1120	10/6/2021	10/6/2022
THERMOMETER	HH806AU	080307	11/26/2021	11/26/2022
DIGITAL THERMOMETER	1523	3492108	9/28/2021	9/28/2022
TEMPERATURE PROBE	80PK-22	06032017	11/26/2021	11/26/2022
TEMPERATURE PROBE	PR-10L-4-100-1/4-6-BX	WNWR037791	9/17/2021	9/17/2022
NETWORK ANALYZER	E5071B	MY42403218	9/13/2021	9/13/2022

Table 11 (Continued)

Equipment Type	Model Number	Serial Number	Calibration Date	Calibration Due Date
SPEAG DIPOLE	D750V3	1098	10/8/2021	10/8/2024
SPEAG DIPOLE	D835V2	4D029	8/27/2021	8/27/2024
SPEAG DIPOLE	D1800V2	2D120	4/20/2020	4/20/2023
SPEAG DIPOLE	D1900V2	5D065	10/30/2019	10/30/2022
SPEAG DIPOLE	D2600V2	1011	4/20/2020	4/20/2023
SPEAG DIPOLE	D2450V2	782	2/20/2020	2/20/2023
SPEAG DIPOLE	D5GHzV2	1022	7/16/2021	7/16/2024
WIDEBAND RADIO COMMUNICATION TESTER	CMW500	153170	11/10/2020	11/10/2022
WIDEBAND RADIO COMMUNICATION TESTER	CMW500	153169	8/28/2020	8/28/2022

The Table below lists additional test equipment used during the SAR assessment for testing period 11/13/2022 – 11/14/2022, 11/17/2022- 11/20/2022, 11/25/2022

Table 11 (Continued)

Equipment Type	Model Number	Serial Number	Calibration Date	Calibration Due Date
SPEAG PROBE	EX3DV4	7519	2/28/2022	2/28/2025
SPEAG DAE	DAE4	684	2/22/2022	2/22/2025
POWER AMPLIFIER	50W100D	0357646	CNR	CNR
BI-DIRECTIONAL COUPLER	3020A	40295	6/30/2022	6/30/2023
BI-DIRECTIONAL COUPLER	3024	61182	6/30/2022	6/30/2023
VECTOR SIGNAL GENERATOR	E4438C	MY45091270	9/21/2022	9/21/2023
POWER SUORCE	SE UMS 160 CA	4251	4/13/2022	4/13/2023
POWER SENSOR	E4412A	MY61050006	4/7/2022	4/7/2023
POWER SENSOR	E4412A	MY61060011	4/7/2022	4/7/2023
POWER METER	E4419B	MY45103725	6/12/2022	6/12/2023
POWER METER	E4418B	MY45107917	7/13/2022	7/13/2023
DATA LOGGER	DSB	16326820	11/26/2021	11/26/2022
THERMOMETER	HH806AU	080307	11/26/2021	11/26/2022
TEMPERATURE PROBE	80PK-22	05032017	12/10/2021	12/10/2022
NETWORK ANALYZER	E5071B	MY42403147	2/14/2022	2/14/2023
DIELECTRIC ASSESSMENT KIT	DAK-3.5	1156	4/11/2022	4/11/2023
THERMOMETER	HH202A	35881	12/10/2021	12/10/2022
TEMPERATURE PROBE	80PK-22	6032017	11/26/2021	11/26/2022
WIDEBAND RADIO COMMUNICATION TESTER	CMW500	171180	5/4/2022	5/4/2024
WIDEBAND RADIO COMMUNICATION TESTER	CMW500	153170	8/13/2022	8/13/2023
SPEAG DIPOLE	D835V2	4D029	8/27/2021	8/27/2024
SPEAG DIPOLE	D1800V2	2D119	7/12/2021	7/12/2024
SPEAG DIPOLE	D2450V2	782	2/20/2020	2/20/2023
SPEAG DIPOLE	D5GHZV2	1026	9/24/2021	9/24/2024

10.0 SAR Measurement System Validation and Verification

DASY output files of the probe/dipole calibration certificates and system verification test results are included in appendices B, C & D respectively.

10.1 System Validation

The SAR measurement system was validated according to procedures in KDB 865664. The validation results are summarized in the following reports:

Part 2 for WCDMA (Band 2, 4 & 5)
Part 3 for WLAN (2.4GHz and 5GHz)
Part 4 for LTE (Band 2,4,5,7,12,13,17,25,26,41 & 66)

10.2 System Verification

System verification was conducted each day during the SAR assessment. The system verification results are summarized in the following reports:

Part 2 for WCDMA (Band 2, 4 & 5)
Part 3 for WLAN (2.4GHz and 5GHz)
Part 4 for LTE (Band 2,4,5,7,12,13,17,25,26,41 & 66)

10.3 Equivalent Tissue Test Results

Measured dielectric properties for simulated tissue results are summarized in the following reports:

Part 2 for WCDMA (Band 2, 4 & 5)
Part 3 for WLAN (2.4GHz and 5GHz)
Part 4 for LTE (Band 2,4,5,7,12,13,17,25,26,41 & 66)

11.0 Environmental Test Conditions

The EME Laboratory's ambient environment is well controlled resulting in very stable simulated tissue temperature and therefore stable dielectric properties. Simulated tissue temperature is measured prior to each scan to insure it is within +/ - 2ºC of the temperature at which the dielectric properties were determined. The liquid depth within the phantom used for measurements was at least 15cm. Additional precautions are routinely taken to ensure the stability of the simulated tissue such as covering the phantoms when scans are not actively in process in order to minimize evaporation. The lab environment is continuously monitored. The Table below presents the range and average environmental conditions during the SAR tests reported herein:

Table 12

	Target	Measured
Ambient Temperature	18 – 25 ˚C	Range: 21.1 – 24.9˚C Avg. 22.75 ˚C
Tissue Temperature	18 – 25 ˚C	Range: 19.2-22.8˚C Avg. 21.6˚C

Relative humidity target range is a recommended target

The EME Lab RF environment uses a Spectrum Analyzer to monitor for extraneous large signal RF contaminants that could possibly affect the test results. If such unwanted signals are discovered the SAR scans are repeated.

12.0 DUT Test Setup and Methodology

12.1 Measurements

SAR measurements were performed using the DASY system described in section 8.0 using zoom scans. Oval flat phantoms filled with applicable simulated tissue were used for body and face testing.

The Table below includes the step sizes and resolution of area and zoom scans per KDB 865664 requirements

Table 13

<table>
<tr><th colspan="2">Description</th><th>≤ 3 GHz</th><th>> 3 GHz</th></tr>
<tr><td colspan="2">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 ± 1 mm</td><td>½·δ·ln(2) ± 0.5 mm</td></tr>
<tr><td colspan="2">Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td colspan="2" rowspan="2">Maximum area scan spatial resolution: ΔxArea, ΔyArea</td><td>≤ 2 GHz: ≤ 15 mm
2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm
4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
<tr><td colspan="2">Maximum zoom scan spatial resolution: ΔxZoom, ΔyZoom</td><td>≤ 2 GHz: ≤ 8 mm
2 – 3 GHz: ≤ 5 mm*</td><td>3 – 4 GHz: ≤ 5 mm*
4 – 6 GHz: ≤ 4 mm*</td></tr>
<tr><td>Maximum zoom scan spatial resolution, normal to phantom surface</td><td>uniform grid: ΔzZoom(n)</td><td>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm
4 – 5 GHz: ≤ 3 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td colspan="4">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.
* When zoom scan is required and the reported SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

12.2 DUT Configuration(s)

The DUT is a portable device operational at the body and face as described in section 6.0 while using the applicable accessories listed in section 7.0. All accessories listed in section 7.0 of this report were considered when implementing the standards and guidelines specified in section 4.0.

12.3 DUT Positioning Procedures

The positioning of the device for each body location is described below and illustrated in Exhibit 7b.

Body

The DUT was positioned in normal use configuration against the phantom
With the offered body worn accessory as well as without the offered audio accessories as applicable.

Head

Not Applicable

Face

The DUT was positioned with its' front sides separated 2.5cm from the Phantom.

12.4 DUT Test Channels

The number of test channels was determined by using the following IEEE 1528 equation. The use of this equation produces the same or more test channels compared to the FCC KDB 447498 number of test channels formula.

$$N_c = 2 * roundup[10 * (f_{high} - f_{low}) / f_c] + 1$$

Where
N_c = Number of channels
F_{high} = Upper channel
F_{low} = Lower channel
F_c = Center channel

12.5 SAR Result Scaling Methodology

The calculated 1-gram SAR results indicated as “Max Calc. 1g-SAR in the data Tables is determined by scaling the measured SAR to account for power leveling variations and drift. Appendix F includes a shortened scan to justify SAR scaling for drift. For this device the “Max Calc. 1g-SAR” is scaled using the following formula:

$$Max\_Calc = SAR\_meas \cdot 10^{\frac{-Drift}{10}} \cdot \frac{P\_\max}{P\_\mathrm{int}} \cdot DC$$

P_max = Maximum Power (W)
P_int = Initial Power (W)
Drift = DASY drift results (dB)
SAR_meas = Measured 1-g Avg. SAR (W/kg)
DC = Transmission mode duty cycle in % where applicable
50% duty cycle is applied for PTT operation

Note: for conservative results, the following are applied:
If P_int > P_max, then P_max/P_int = 1.
Drift = 1 for positive drift

Additional SAR scaling was applied using the methodologies outlined in FCC KDB 865664 using tissue sensitivity values. SAR was scaled for conditions where the tissue permittivity was measured above the nominal target and for tissue conductivity that was measured below the nominal target. Negative or reduced SAR scaling is not permitted.

12.6 DUT Test Plan

The guidelines and requirements outlined in section 4.0 were used to assess compliance of this device. All modes of operation identified in section 6.0 were considered during the development of the test plan.

Standalone and simultaneous BT testing were assessed in sections 13.2 and 14.0 per the guidelines of KDB 447498.

13.0 DUT Test Data

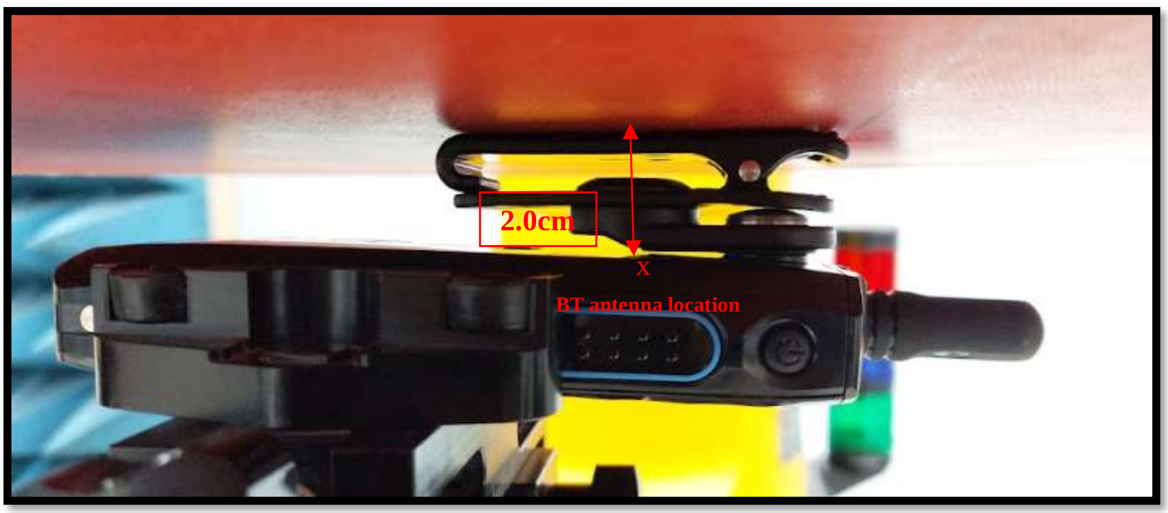
13.1 SAR Data

Refer to the following report:

Part 2 for WCDMA (Band 2, 4 & 5)
Part 3 for WLAN (2.4GHz and 5GHz)
Part 4 for LTE (Band 2,4,5,7,12,13,17,25,26,41 & 66)

14.0 Assessment test exclusions for BT

The closest separation distance from the outer housing (location of the BT antenna will be indicated in Ex7B) to the phantom is 2.0 cm with a belt clip, as indicated in the picture below.



14.1 FCC Requirement

SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and ≤ 50 mm

MHz	5	10	15	20	25	mm
150	39	77	116	155	194	*SAR Test Exclusion Threshold* (mW)
300	27	55	82	110	137	
450	22	45	67	89	112	
835	16	33	49	66	82	
900	16	32	47	63	79	
1500	12	24	37	49	61	
1900	11	22	33	44	54	
2450	10	19	29	38	48	
3600	8	16	24	32	40	
5200	7	13	20	26	33	
5400	6	13	19	26	32	
5800	6	12	19	25	31	

Per guidelines in KDB 447498, the following formula was used to determine the test exclusion for standalone Bluetooth transmitter;

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] *[$\sqrt{F_{(GHz)}}$] = 0.8 W/kg, which is ≤ 3 W/kg (1g)

Where:

Max. Power = 9.60mW (12.5mW*76.79 % duty cycle)
Min. test separation distance = 20mm for actual test separation
F(GHz) = 2.48 GHz

Per the result from the calculation above, the standalone SAR assessment was not required for Bluetooth band. Therefore, SAR results for Bluetooth are not reported herein.

14.2 ISED Canada Requirement

Based on RSS-102 Issue 5, exclusions limits for SAR evaluation for devices at Bluetooth frequency band with separation distance ≤ 20mm was 30 mW.

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Standalone Bluetooth transmitter operates at Maximum conducted power:

= 12.5 mW * 76.79 %

= 9.60 mW or 9.82 dBm

Equivalent isotropically radiated power (EIRP):

= Maximum conducted power, dBm + Antenna gain, dBi

= 9.82 dBm + 1.14 dBi

= 10.96 dBm or 12.50 mW

Higher output power level, Equivalent isotropically radiated power (EIRP)

12.50 mW was below the threshold power level 30 mW. Hence SAR test was not required for Bluetooth band.

15.0 Simultaneous Transmission

The Table below summarizes the simultaneous transmission conditions for this device.

Table 14

Exposure Conditions	Item	Capable Simultaneous Transmit Configurations
Body-Worn	1	WWAN + BT
Face	1	WWAN + BT

Note:
1. WLAN 2.4GHz and BT share the same RF path in the chipset. Only one technology can make its way to the RF path at a time.
2. This device is an android device which allows only one data pipe to the network. Either WWAN or WLAN only can exist at a time, hence simultaneous transmit for WWAN+ WLAN is not applicable.
3. BT connection is between the device and accessory only, hence simultaneous transmit for WWAN+ BT is applicable.
4. WLAN 2.4GHz + BT and WLAN 5GHz + BT cannot be simultaneous transmit but will be time multiplexed.

16.0 Simultaneous Transmission Exclusions for BT

Per guidelines in KDB 447498, the following formula was used to determine the test exclusion to an antenna that transmits simultaneously with other antennas for test distances ≤ 50mm:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] *[√F(GHz)/X] = 0.1 W/kg, which is ≤ 0.4 W/kg (1g)

Where:

X = 7.5 for 1g-SAR; 18.75 for 10g
Max. Power = 9.60mW (12.5mW*76.79% duty cycle)
Min. test separation distance = 20mm for actual test separation
F(GHz) = 2.48 GHz

Per the result from the calculation above, simultaneous exclusion is applied and therefore SAR results are not reported herein.

17.0 Results Summary

Based on the test guidelines from section 4.0 and satisfying frequencies within FCC bands and ISED Canada Frequency bands, the highest Operational Maximum Calculated 1-gram average SAR values found for this filing:

Table 15

Designator	Frequency band (MHz)	Max Calc at Body (W/kg)	Max Calc at Face (W/kg)
		1g-SAR	1g-SAR
LTE	LTE B2	0.484	0.322
	LTE B4	0.477	0.253
	LTE B5	0.448	0.303
	LTE B7	0.287	0.288
	LTE B12	0.396	0.272
	LTE B13	0.617	0.362
	LTE B25	0.466	0.349
	LTE B26	0.379	0.346
	LTE B41	0.191	0.172
	LTE B66	0.521	0.324
WCDMA	WCDMA B2	0.448	0.365
	WCDMA B4	0.491	0.380
	WCDMA B5	0.569	0.295
BT	2400-2485	NA	NA
WLAN 2.4GHz	2412-2462	0.250	0.016
WLAN 5.0GHz	5180-5825	0.799	0.080
Highest SAR Results		0.799	0.380

All results are scaled to the maximum output power

The test results clearly demonstrate compliance with FCC General Population / Uncontrolled RF Exposure limits of 1.6 W/kg averaged over 1 gram per the requirements of FCC 47 CFR § 2.1093 and ISED RSS-102 (Issue 5)

18.0 Variability Assessment

Per the guidelines in KDB 865664 SAR variability assessment is not required because SAR results are below 0.8W/kg (General Population).

19.0 System Uncertainty

A system uncertainty analysis is not required for this report per KDB 865664 because the highest report SAR value for General Population exposure is less than 1.5W/kg

Per the guidelines of ISO/IEC 17025 a reported system uncertainty is required and therefore measurement uncertainty budget is included in 20.0 measurement uncertainty budget.

20.0 Measurement Uncertainty Budget

Uncertainty Budget for System Validation (dipole & flat phantom) for 700 MHz to 800 MHz

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 section	**Tol. (± %)**	**Prob. Dist.**	**Div.**	c_i (1 g)	c_i (10 g)	**1 g** u_i (±%)	**10 g** u_i (±%)	v_i
Measurement System									
Probe Calibration	E.2.1	6.0	N	1.00	1	1	6.0	6.0	∞
Axial Isotropy	E.2.2	4.7	R	1.73	1	1	2.7	2.7	∞
Spherical Isotropy	E.2.2	9.6	R	1.73	0	0	0.0	0.0	∞
Boundary Effect	E.2.3	1.0	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	0.0	R	1.73	1	1	0.0	0.0	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning w.r.t. Phantom	E.6.3	1.4	R	1.73	1	1	0.8	0.8	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	3.4	R	1.73	1	1	2.0	2.0	∞
Dipole									
Dipole Axis to Liquid Distance	8, E.4.2	2.0	R	1.73	1	1	1.2	1.2	∞
Input Power and SAR Drift Measurement	8, 6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity (target)	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	E.3.3	3.3	R	1.73	0.64	0.43	1.2	0.8	∞
Liquid Permittivity (target)	E.3.2	5.0	R	1.73	0.6	0.49	1.7	1.4	∞
Liquid Permittivity (measurement)	E.3.3	1.9	R	1.73	0.6	0.49	0.6	0.5	∞
Combined Standard Uncertainty			RSS				9	9	99999
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k*=2				18	17	

Notes for uncertainty budget Tables:
a) Column headings *a*-*k* are given for reference.
b) Tol. - tolerance in influence quantity.
c) Prob. Dist. – Probability distribution
d) N, R - normal, rectangular probability distributions
e) Div. - divisor used to translate tolerance into normally distributed standard uncertainty
f) *ci* - sensitivity coefficient that should be applied to convert the variability of the uncertainty component into a variability of SAR.
g) *ui* – SAR uncertainty
h) *vi* - degrees of freedom for standard uncertainty and effective degrees of freedom for the expanded uncertainty

Uncertainty Budget for System Validation (dipole & flat phantom) for 800 MHz to 3 GHz

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 section	**Tol. (± %)**	**Prob. Dist.**	**Div.**	**c_i (1 g)**	**c_i (10 g)**	**1 g u_i (±%)**	**10 g u_i (±%)**	**v_i**
Measurement System									
Probe Calibration	E.2.1	6.0	N	1.00	1	1	6.0	6.0	∞
Axial Isotropy	E.2.2	4.7	R	1.73	1	1	2.7	2.7	∞
Spherical Isotropy	E.2.2	9.6	R	1.73	0	0	0.0	0.0	∞
Boundary Effect	E.2.3	1.0	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	0.0	R	1.73	1	1	0.0	0.0	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning w.r.t. Phantom	E.6.3	1.4	R	1.73	1	1	0.8	0.8	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	3.4	R	1.73	1	1	2.0	2.0	∞
Dipole									
Dipole Axis to Liquid Distance	8, E.4.2	2.0	R	1.73	1	1	1.2	1.2	∞
Input Power and SAR Drift Measurement	8, 6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity (target)	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	E.3.3	3.3	R	1.73	0.64	0.43	1.2	0.8	∞
Liquid Permittivity (target)	E.3.2	5.0	R	1.73	0.6	0.49	1.7	1.4	∞
Liquid Permittivity (measurement)	E.3.3	1.9	R	1.73	0.6	0.49	0.6	0.5	∞
Combined Standard Uncertainty			RSS				9	9	99999
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k*=2				18	17	

Notes for uncertainty budget Tables:
a) Column headings *a*-*k* are given for reference.
b) Tol. - tolerance in influence quantity.
c) Prob. Dist. – Probability distribution
d) N, R - normal, rectangular probability distributions
e) Div. - divisor used to translate tolerance into normally distributed standard uncertainty
f) *ci* - sensitivity coefficient that should be applied to convert the variability of the uncertainty component into a variability of SAR.
g) *ui* – SAR uncertainty
h) *vi* - degrees of freedom for standard uncertainty and effective degrees of freedom for the expanded uncertainty

Uncertainty Budget for System Validation (dipole & flat phantom) for 3 to 6 GHz

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 section	Tol. (± %)	Prob. Dist.	Div.	c_i (1 g)	c_i (10 g)	1 g u_i (±%)	10 g u_i (±%)	v_i
Measurement System									
Probe Calibration	E.2.1	7.0	N	1.00	1	1	7.0	7.0	∞
Axial Isotropy	E.2.2	4.7	R	1.73	1	1	2.7	2.7	∞
Spherical Isotropy	E.2.2	9.6	R	1.73	0	0	0.0	0.0	∞
Boundary Effect	E.2.3	2.0	R	1.73	1	1	1.2	1.2	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	0.0	R	1.73	1	1	0.0	0.0	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mechanical Tolerance	E.6.2	1.0	R	1.73	1	1	0.6	0.6	∞
Probe Positioning w.r.t. Phantom	E.6.3	4.0	R	1.73	1	1	2.3	2.3	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	2.1	R	1.73	1	1	1.2	1.2	∞
Dipole									
Dipole Axis to Liquid Distance	8, E.4.2	2.0	R	1.73	1	1	1.2	1.2	∞
Input Power and SAR Drift Measurement	8, 6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Dielectric Parameter Correction	--	1.4	N	1.00	1	0.79	1.4	1.1	∞
Liquid Conductivity (measurement)	E.3.3	3.3	R	1.73	0.64	0.43	1.2	0.8	∞
Liquid Permittivity (measurement)	E.3.3	1.9	R	1.73	0.6	0.49	0.6	0.5	∞
Combined Standard Uncertainty			RSS				10	10	99999
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k*=2				19	19	

Notes for uncertainty budget Tables:
a) Column headings *a*-*k* are given for reference.
b) Tol. - tolerance in influence quantity.
c) Prob. Dist. – Probability distribution
d) N, R - normal, rectangular probability distributions
e) Div. - divisor used to translate tolerance into normally distributed standard uncertainty
f) *ci* - sensitivity coefficient that should be applied to convert the variability of the uncertainty component into a variability of SAR.
g) *ui* – SAR uncertainty
h) *vi* - degrees of freedom for standard uncertainty and effective degrees of freedom for the expanded uncertainty

Uncertainty Budget for Device Under Test, for 700 MHz to 800 MHz

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 section	**Tol. (± %)**	**Prob Dist**	**Div.**	c_i (1 g)	c_i (10 g)	**1 g** u_i (±%)	**10 g** u_i (±%)	v_i
Measurement System									
Probe Calibration	E.2.1	6.0	N	1.00	1	1	6.0	6.0	∞
Axial Isotropy	E.2.2	4.7	R	1.73	0.707	0.707	1.9	1.9	∞
Hemispherical Isotropy	E.2.2	9.6	R	1.73	0.707	0.707	3.9	3.9	∞
Boundary Effect	E.2.3	1.0	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	1.1	R	1.73	1	1	0.6	0.6	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mech. Tolerance	E.6.2	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning w.r.t Phantom	E.6.3	1.4	R	1.73	1	1	0.8	0.8	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	3.4	R	1.73	1	1	2.0	2.0	∞
Test sample Related									
Test Sample Positioning	E.4.2	3.2	N	1.00	1	1	3.2	3.2	29
Device Holder Uncertainty	E.4.1	4.0	N	1.00	1	1	4.0	4.0	8
SAR drift	6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity (target)	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	E.3.3	3.3	N	1.00	0.64	0.43	2.1	1.4	∞
Liquid Permittivity (target)	E.3.2	5.0	R	1.73	0.6	0.49	1.7	1.4	∞
Liquid Permittivity (measurement)	E.3.3	1.9	N	1.00	0.6	0.49	1.1	0.9	∞
Combined Standard Uncertainty			RSS				11	11	419
Expanded Uncertainty (95% CONFIDENCE LEVEL)			k=2				22	22	

Notes for uncertainty budget Tables:
a) Column headings *a*-*k* are given for reference.
b) Tol. - tolerance in influence quantity.
c) Prob. Dist. – Probability distribution
d) N, R - normal, rectangular probability distributions
e) Div. - divisor used to translate tolerance into normally distributed standard uncertainty
f) *ci* - sensitivity coefficient that should be applied to convert the variability of the uncertainty component into a variability of SAR.
g) *ui* – SAR uncertainty
h) *vi* - degrees of freedom for standard uncertainty and effective degrees of freedom for the expanded uncertainty

Uncertainty Budget for Device Under Test, for 800 MHz to 3 GHz

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 section	**Tol. (± %)**	**Prob Dist**	**Div.**	**c_i (1 g)**	**c_i (10 g)**	**1 g u_i (±%)**	**10 g u_i (±%)**	v_i
Measurement System									
Probe Calibration	E.2.1	6.0	N	1.00	1	1	6.0	6.0	∞
Axial Isotropy	E.2.2	4.7	R	1.73	0.707	0.707	1.9	1.9	∞
Hemispherical Isotropy	E.2.2	9.6	R	1.73	0.707	0.707	3.9	3.9	∞
Boundary Effect	E.2.3	1.0	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	1.1	R	1.73	1	1	0.6	0.6	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mech. Tolerance	E.6.2	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning w.r.t Phantom	E.6.3	1.4	R	1.73	1	1	0.8	0.8	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	3.4	R	1.73	1	1	2.0	2.0	∞
Test sample Related									
Test Sample Positioning	E.4.2	3.2	N	1.00	1	1	3.2	3.2	29
Device Holder Uncertainty	E.4.1	4.0	N	1.00	1	1	4.0	4.0	8
SAR drift	6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity (target)	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	E.3.3	3.3	N	1.00	0.64	0.43	2.1	1.4	∞
Liquid Permittivity (target)	E.3.2	5.0	R	1.73	0.6	0.49	1.7	1.4	∞
Liquid Permittivity (measurement)	E.3.3	1.9	N	1.00	0.6	0.49	1.1	0.9	∞
Combined Standard Uncertainty			RSS				11	11	419
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k*=2				22	22	

Notes for uncertainty budget Tables:
a) Column headings *a*-*k* are given for reference.
b) Tol. - tolerance in influence quantity.
c) Prob. Dist. – Probability distribution
d) N, R - normal, rectangular probability distributions
e) Div. - divisor used to translate tolerance into normally distributed standard uncertainty
f) *ci* - sensitivity coefficient that should be applied to convert the variability of the uncertainty component into a variability of SAR.
g) *ui* – SAR uncertainty
h) *vi* - degrees of freedom for standard uncertainty and effective degrees of freedom for the expanded uncertainty

Uncertainty Budget for Device Under Test for 3 to 6 GHz

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 section**	**Tol. (± %)**	**Prob Dist**	**Div.**	**c_i (1 g)**	**c_i (10 g)**	**1 g u_i (±%)**	**10 g u_i (±%)**	**v_i**
Measurement System									
Probe Calibration	E.2.1	7.0	N	1.00	1	1	7.0	7.0	∞
Axial Isotropy	E.2.2	4.7	R	1.73	0.707	0.707	1.9	1.9	∞
Hemispherical Isotropy	E.2.2	9.6	R	1.73	0.707	0.707	3.9	3.9	∞
Boundary Effect	E.2.3	2.0	R	1.73	1	1	1.2	1.2	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	1.1	R	1.73	1	1	0.6	0.6	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mech. Tolerance	E.6.2	1.0	R	1.73	1	1	0.6	0.6	∞
Probe Positioning w.r.t Phantom	E.6.3	4.0	R	1.73	1	1	2.3	2.3	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	2.1	R	1.73	1	1	1.2	1.2	∞
Test sample Related									
Test Sample Positioning	E.4.2	3.2	N	1.00	1	1	3.2	3.2	29
Device Holder Uncertainty	E.4.1	4.0	N	1.00	1	1	4.0	4.0	8
SAR drift	6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Dielectric Parameter Correction	--	1.4	N	1.00	1	0.79	1.4	1.1	∞
Liquid Conductivity (measurement)	E.3.3	3.3	N	1.00	0.64	0.43	2.1	1.4	∞
Liquid Permittivity (measurement)	E.3.3	1.9	N	1.00	0.6	0.49	1.1	0.9	∞
Combined Standard Uncertainty			RSS				12	12	504
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k*=2				23	23	

Notes for uncertainty budget Tables:
a) Column headings *a*-*k* are given for reference.
b) Tol. - tolerance in influence quantity.
c) Prob. Dist. – Probability distribution
d) N, R - normal, rectangular probability distributions
e) Div. - divisor used to translate tolerance into normally distributed standard uncertainty
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