



MOTOROLA SOLUTIONS



MS ISO/IEC 17025
TESTING
SAMM No.0826

DECLARATION OF COMPLIANCE SAR ASSESSMENT Part 1 of 2

Motorola Solutions Inc
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Date of Report: 03/02/2018
Report Revision: A

Responsible Engineer: Veeramani Veerapan
Report Author: Veeramani Veerapan
Date/s Tested: 1/23/2018 – 2/28/2018
Manufacturer: Motorola Solutions Inc.
DUT Description: Handheld Portable: CP200d, 403-470MHz, 4W, Non-Display
Test TX mode(s): CW (PTT)
Max. Power output: 4.8 Watts
Nominal Power: 4.0 Watts
Tx Frequency Bands: 403-470 MHz
Signaling type: FM
Model(s) Tested: AAH01QDC9JA2AN (PMUE4147B)
Model(s) Certified: AAH01QDC9JA2AN (PMUE4147B) / PMUE4147BAANAA,
AAH01QDC9JC2AN (PMUE4147B) / PMUE4147BAANEA
Serial Number(s): 752TTZ7262
Classification: Occupational/Controlled
FCC ID: AZ489FT4948; Rule Part 90 (406.1-470 MHz); This report contains results that are immaterial for FCC equipment approval, which are clearly identified.

IC ID: 109U-89FT4948; (406.1-430 and 450-470 MHz); This report contains results that are immaterial for ISED equipment approval, which are clearly identified.

ISED Test Site Registration: 109AK

FCC Test Firm Registration Number: 823256

The test results clearly demonstrate compliance with FCC Occupational/Controlled RF Exposure limits of 8 W/kg averaged over 1 gram per the requirements of FCC 47 CFR § 2.1093.

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. 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.

Tiong

Tiong Nguk Ing
Deputy Technical Manager
Approval Date: 3/10/2018

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Report Revision History

Date	Revision	Comments
03/02/2018	A	Initial release

1.0 Introduction

This report details the utilization, test setups, test equipments, and test results of the Specific Absorption Rate (SAR) measurements performed at the Motorola Solutions Inc. EME Test Laboratory for handheld portable model number AAH01QDC9JA2AN (PMUE4147B). This device is classified as Occupational/Controlled.

2.0 FCC SAR Summary

Table 1

Equipment Class	Frequency band (MHz)	Max Calc at Body (W/kg)	Max Calc at Face (W/kg)
		1g-SAR	1g-SAR
TNF	406.1- 470	5.93	2.03

3.0 Abbreviations / Definitions

- CNR: Calibration Not Required
- EME: Electromagnetic Energy
- CW: Continuous Wave
- DUT: Device Under Test
- DC: Duty Cycle
- FM: Frequency Modulation
- Li-Ion: Lithium-Ion
- LMR: Land Mobile Radio
- TNF: Licensed Non-Broadcast Transmitter Head on Face
- NA: Not Applicable
- PTT: Push to Talk
- RF: Radio Frequency
- SAR: Specific Absorption Rate

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.

- IEC62209-1 (2005) Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)
- Federal Communications Commission, “Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields”, OET Bulletin 65, FCC, Washington, D.C.: 1997.
- IEEE 1528 (2013), Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
- American National Standards Institute (ANSI) / Institute of Electrical and Electronics Engineers (IEEE) C95. 1-1992
- Institute of Electrical and Electronics Engineers (IEEE) C95.1-2005
- International Commission on Non-Ionizing Radiation Protection (ICNIRP) 1998
- 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. 303 of July 2, 2002 "Regulation of the limitation of exposure to electrical, magnetic, and electromagnetic fields in the radio frequency range between 9 kHz and 300 GHz." and “Attachment to resolution # 303 from July 2, 2002”
- IEC62209-2 Edition 1.0 2010-03, 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).
- 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

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 Devices under Test (DUT)

This device is operates in the LMR band using either frequency modulation (FM) with 100% transmit duty cycle or TDMA signals with maximum of 50% transmit duty cycle. For conservative assessment, FM signal was tested.

The LMR band in this device operates in a half duplex system. A half duplex system only allows the user to transmit or receive. This device cannot transmit and receive simultaneously. The user must stop transmitting in order to receive a signal or listen for a response, regardless of PTT button or use of voice activated audio accessories. This type of operation, along with the RF safety booklet, which instructs the user to transmit no more than 50% of the time, justifies the use of 50% duty factor for this device.

Table 3 below summarizes the bands and maximum output powers. Maximum output powers are defined as upper limit of the production line final test station.

Table 3

Technologies	Band (MHz)	Transmission	Duty Cycle (%)	Max Power (W)
LMR	403-470	FM or TDMA	*50 / *25	4.8

Note - * includes 50% PTT operation

The intended operating positions are “at the face” with the DUT at least 2.5 cm from the mouth, and “at the body” by means of the offered body worn accessories. Body worn audio and PTT operation is accomplished by means of optional remote accessories that are connected 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 section 4.0 to assess compliance of this device. The following sections identify the test criteria and details for each accessory category.

7.1 Antennas

There are five antennas offered for this product. The Table below lists their descriptions.

Table 4

Antenna No.	Antenna Models	Description	Selected for test	Tested
1	8505816K24A	UHF Helical, 403-440MHz, ¼ wave, -1dBi	Yes	Yes
2	NAE6522AR	UHF Stubby, 438-470MHz, ¼ wave, -1dBi	Yes	Yes
3	PMAE4002A	UHF Stubby, 403-433MHz, ¼ wave, -1dBi	Yes	Yes
4	PMAE4003A	UHF Stubby, 430-470MHz, ¼ wave, -1dBi	Yes	Yes
5	PMAE4016A	UHF Whip, 403-520MHz, ¼ wave, 0dBi	Yes	Yes

7.2 Batteries

There are twelve batteries offered for this product. The Table below lists their descriptions.

Table 5

Battery No.	Battery Models	Description	Selected for test	Tested	Comments
1	NNTN4497DR	Battery Li-Ion 2250mAh Typical	Yes	Yes	
2	NNTN4851A	Battery Ni-MH 1400mAh Typical	Yes	Yes	
3	NNTN4970A	Battery Li-Ion 1600mAh	Yes	Yes	Default battery for body
4	PMNN4072A	Battery MagOne Ni-MH 1400mAh Typical	Yes	Yes	
5	PMNN4098A	Battery Ni-MH 1400mAh Typical	Yes	Yes	
6	PMNN4251AR	Battery Ni-MH 1400mAh Typical	Yes	Yes	
7	PMNN4253AR	Battery Li-Ion 1600mAh Typical	Yes	Yes	
8	PMNN4254AR	Battery Li-Ion 2300mAh Typical	Yes	Yes	
9	PMNN4258AR	Battery Li-Ion IP54, 2900mAh Typical	Yes	Yes	
10	PMNN4259AR	Battery MagOne Li-Ion 2075mAh Typical	Yes	Yes	
11	PMNN4450AR	Battery Li-Ion IP54, 2900mAh Typical	Yes	Yes	Default battery for face
12	PMNN4458BR	Battery MagOne Li-Ion 2150mAh Typical	Yes	Yes	

7.3 Body worn Accessories

All body worn accessories were considered. The Table below lists the body worn accessories, and body worn accessory descriptions.

Table 6

Body worn No.	Body worn Models	Description	Selected for test	Tested	Comments
1	HLN8255B	Spring Belt clip, Black	Yes	Yes	
2	RLN5644A	2.0" Belt clip	Yes	Yes	
3	RLN4570A	Breakaway Chest pack	Yes	Yes	
4	HLN6602A	Universal Chest pack	Yes	Yes	
5	RLN4815A	Fanny Pack Carry Accessory	Yes	Yes	
6	HLN9701B	Nylon carry case with fixed belt loop	Yes	Yes	Tested with NTN5243A
7	RLN5383A	Hard Leather carry case with 3" Fixed belt loop	Yes	Yes	Tested with NTN5243A
8	RLN5385B	Hard Leather carry case with 3.0" swivel belt loop	Yes	Yes	Carry case w/o belt loop attached with NTN5243A
9	NTN5243A	Carry strap	Yes	Yes	Tested with HLN9701B, RLN5383A, RLN5385A
10	RLN5384B	Hard Leather carry case with 2.5" swivel belt loop	No	No	By similarity to RLN5385B

7.4 Audio Accessories

All audio accessories were considered. The Table below lists the offered audio accessories and their descriptions. Exhibit 7B illustrates photos of the tested audio accessories.

Table 7

Audio No.	Audio Acc. Models	Description	Selected for test	Tested	Comments
1	PMLN6538A	Lightweight Headset with swivel boom MIC	Yes	Yes	
2	PMLN6539A	Med with over the Head Dual MUFF Headset	Yes	Yes	
3	PMLN6540A	Accessory kit, Heavy duty NC boom MIC headset	Yes	Yes	
4	PMLN6541A	Lightweight Temple Transducer Headset	Yes	Yes	
5	PMMN4013A	Microphone, RSM MIC, Rx-jack (2 pin)	Yes	Yes	Default Audio
6	PMMN4092A	RSM MIC, MAG ONE	Yes	Yes	
7	PMLN6530A	2-Wire with Trans Tube, Black	Yes	Yes	
8	PMLN6531A	Earpiece with In-Line MIC/PTT/VOX, MAGONE	Yes	Yes	
9	PMLN6537A	Earset, Boom MIC, In-Line PTT/VOX, MAGONE	Yes	Yes	
10	PMMN4029A	RSM MIC, IP57	No	No	By similarity to PMMN4092A
11	PMLN6445A	2-Wire with Trans Tube, Black	No	No	By similarity to PMLN6530A
12	PMLN6532A	Swivel earpiece with MIC/PTT, MAGONE	No	No	By similarity to PMLN6531A
13	PMLN6533A	Accessory kit, Earset with combined MIC/PTT	No	No	By similarity to PMLN6530A

Continued Table 8

Audio No.	Audio Acc. Models	Description	Selected for test	Tested	Comments
14	PMLN6534A	Earbud with IN-LINE MIC/PTT/VOX, MAGONE	No	No	By similarity to PMLN6531A
15	PMLN6535A	D-Style earpiece with MIC/PTT	No	No	By similarity to PMLN6530A
16	PMLN6536A	Accessory kit, 2-Wire with Trans Tube, Black	No	No	By similarity to PMLN6530A
17	PMLN6542A	Accessory kit, Breeze headset with Boom MIC & PTT MAGONE	No	No	By similarity to PMLN6537A
18	RLN4941A	Receive only Earpiece with translucent tube & rubber eartip for RSM	No	No	Receive only
19	BDN6720A	Earpiece with GP300 connector	No	No	Receive only
20	AARLN4885B	Receive only covered earbud with Coiled Cord	No	No	Receive only
21	PMLN4620B	D-Shell receive only earpiece (One Size) for Remote Speaker Microphone	No	No	Receive only
22	WADN4190B	Receive only Flexible Earpiece	No	No	Receive only
23	MDPMMN4013A	RSM with Jack, IP 54	No	No	By similarity to PMMN4013A
24	MDPMMN4029A	RSM without Jack, IP57	No	No	By similarity to PMMN4092A
25	MDRLN4885B	Receive only covered earbud with Coiled Cord	No	No	Receive only
26	MDRLN4941A	Receive only Earpiece with translucent tube & rubber eartip for RSM	No	No	Receive only

8.0 Description of Test System



8.1 Descriptions of Robotics/Probes/Readout Electronics

Table 9

Dosimetric System type	System version	DAE type	Probe Type
Schmid & Partner Engineering AG SPEAG DASY 5	52.8.8.1222	DAE4	ES3DV3 (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 10

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	2mm +/- 0.2mm	Wood	< 0.05
SAM	NA	300MHz -6GHz; Er = < 5, Loss Tangent = ≤0.05	Human Model			
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. For Diacetin and similar type simulates, sugar and HEC ingredients are not needed. The solution is mixed thoroughly, covered, and allowed to sit overnight prior to use.

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 11

Ingredients	450 MHz	
	Head	Body
Sugar	56.0	46.5
Diacetin	0	0
De ionized –Water	39.1	50.53
Salt	3.8	1.87
HEC	1	1
Bact.	0.1	0.1

9.0 Additional Test Equipment

The Table below lists additional test equipment used during the SAR assessment.

Table 12

Equipment Type	Model Number	Serial Number	Calibration Date	Calibration Due Date
Speag Probe	ES3DV3	3196	5/17/2017	5/17/2018
Speag DAE	DAE4	684	5/12/2017	5/12/2018
Amplifier	10W1000C	312859	CNR	CNR
Power Meter	E4419B	MY45103725	5/22/2017	5/22/2019
Power Sensor	E9301B	MY50280001	6/23/2017	6/23/2018
Power Meter	E4418B	MY45100911	7/14/2017	7/14/2019
Power Sensor	E9301B	MY41495594	7/20/2017	7/20/2018
Bi-Directional coupler	3020A	40295	9/4/2017	9/4/2018
Signal generator (Vector ESG 250 kHz-6 GHz)	E4438C	MY42081753	4/8/2017	4/8/2018
Dickson Temperature Recorder	TM320	06153216	8/11/2017	8/11/2018
Temperature Probe	JHSS-18U- RSC-6	AGIL700245	10/13/2017	10/13/2018
Thermometer	HH202A	18812	10/13/2017	10/13/2018
Dielectric Assessment Kit	DAK-3.5	1120	3/16/2017	3/16/2018
Network Analyzer	E5071B	MY42403218	8/24/2017	8/24/2018
Speag Dipole	D450V3	1054	10/25/2017	10/25/2019

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 status summary Table is below.

Table 13

Dates	Probe Calibration Point	Probe SN	Measured Tissue Parameters		Validation			
			σ	ϵ_r	Sensitivity	Linearity	Isotropy	
CW								
05/31/2017	Body	450	3196	0.92	54.6	Pass	Pass	Pass
06/01/2017	Head	450	3196	0.89	43.3	Pass	Pass	Pass

10.2 System Verification

System verification checks were conducted each day during the SAR assessment. The results are normalized to 1W. Appendix D includes DASY plots for each day during the SAR assessment. The Table below summarizes the daily system check results used for the SAR assessment.

Table 14

Probe Serial #	Tissue Type	Dipole Kit / Serial #	Ref SAR @ 1W (W/kg)	System Check Results Measured (W/kg)	System Check Test Results when normalized to 1W (W/kg)	Tested Date
3196	FCC Body	SPEAG D450V3 / 1054	4.57 +/- 10%	1.23	4.96	*1/23/2018
				1.24	4.96	1/28/2018
				1.25	5.00	*1/29/2018
				1.25	5.00	*1/30/2018
				1.24	4.96	*1/31/2018
				1.24	4.96	*2/01/2018
				1.24	4.96	2/02/2018
				1.23	4.92	*2/04/2018
				1.22	4.88	*2/05/2018
				1.25	5.00	*2/06/2018
				1.25	5.00	*2/07/2018
				1.20	4.80	2/08/2018
				1.21	4.84	*2/09/2018
				1.19	4.76	*2/11/2018
				1.19	4.76	2/12/2018
				1.24	4.96	2/14/2018
				1.12	4.48	2/21/2018
				1.17	4.72	2/27/2018
	IEEE/IEC Head	4.48 +/- 10%	1.22	4.88	*2/13/2018	
	1.21		4.84	2/15/2018		
1.15	4.60		2/28/2018			

Note: * System performance check cover next testing day (within 24 hrs)

10.3 Equivalent Tissue Test Results

Simulated tissue prepared for SAR measurements is measured daily and within 24 hours prior to actual SAR testing to verify that the tissue is within +/- 5% of target parameters at the center of the transmit band. This measurement is done using the applicable equipment indicated in section 9.0. The Table below summarizes the measured tissue parameters used for the SAR assessment.

Table 15

Frequency (MHz)	Tissue Type	Conductivity Target (S/m)	Dielectric Constant Target	Conductivity Meas. (S/m)	Dielectric Constant Meas.	Tested Date
403	FCC Body	0.93 (0.89-0.98)	57.2 (54.3-60.0)	0.92	55.3	*2/12/2018
	IEEE/IEC Head	0.87 (0.83-0.91)	44.1 (41.9-46.3)	0.84	45.3	*2/13/2018
406	FCC Body	0.93 (0.89-0.98)	57.1 (54.3-60.0)	0.90	55.0	1/23/2018
				0.92	54.9	1/28/2018
				0.92	55.2	*1/30/2018
				0.92	55.1	*1/31/2018
				0.91	54.9	*2/01/2018
				0.91	55.0	2/02/2018
				0.91	55.0	*2/04/2018
				0.91	54.9	*2/05/2018
				0.90	55.0	*2/06/2018
				0.92	55.2	*2/07/2018
	0.90	54.9	2/09/2018			
	IEEE/IEC Head	0.87 (0.83-0.91)	44.0 (41.8-46.2)	0.83	45.3	2/15/2018
420	IEEE/IEC Head	0.87 (0.83-0.91)	43.9 (41.7-46.1)	0.86	44.9	*2/13/2018
425	FCC Body	0.94 (0.89-0.98)	57.0 (54.1-59.8)	0.93	54.9	1/30/2018
				0.93	54.7	2/04/2018
430	FCC Body	0.94 (0.89-0.98)	56.9 (54.1-59.7)	0.92	54.5	*1/23/2018
				0.95	54.4	1/28/2018
				0.94	54.8	*1/29/2018
				0.94	54.8	1/30/2018
				0.94	54.8	*1/31/2018
				0.93	54.5	*2/01/2018
				0.93	54.6	2/02/2018
				0.93	54.6	*2/04/2018
				0.93	54.5	*2/05/2018
				0.92	54.6	*2/06/2018
				0.94	54.8	*2/07/2018
				0.94	54.5	2/08/2018
				0.93	54.5	*2/09/2018
				0.93	54.5	*2/11/2018
	0.94	54.8	2/12/2018			
	IEEE/IEC Head	0.87 (0.83-0.91)	43.7 (41.6-45.9)	0.87	44.4	*2/27/2018

Note: * Tissue sheet date cover next testing day (within 24 hrs)

Continued Table 16

Frequency (MHz)	Tissue Type	Conductivity Target (S/m)	Dielectric Constant Target	Conductivity Meas. (S/m)	Dielectric Constant Meas.	Tested Date
433	FCC Body	0.94 (0.89-0.98)	56.9 (54.0-59.7)	0.94	54.8	*1/30/2018
				0.95	54.7	*1/31/2018
				0.93	54.4	*2/01/2018
				0.93	54.6	2/02/2018
				0.94	54.6	2/04/2018
446	FCC Body	0.94 (0.89-0.98)	56.7 (53.9-59.6)	0.95	54.6	1/30/2018
				0.95	54.4	2/04/2018
450	FCC Body	0.94 (0.89-0.98)	56.7 (53.9-59.5)	0.94	54.2	*1/23/2018
				0.96	54.1	1/28/2018
				0.96	54.4	*1/29/2018
				0.95	54.5	*1/30/2018
				0.96	54.4	*1/31/2018
				0.95	54.2	*2/01/2018
				0.94	54.3	2/02/2018
				0.95	54.3	*2/04/2018
				0.94	54.2	*2/05/2018
				0.93	54.2	*2/06/2018
				0.96	54.5	*2/07/2018
				0.96	54.1	2/08/2018
				0.94	54.1	*2/09/2018
				0.95	54.2	*2/11/2018
				0.96	54.5	*2/12/2018
				0.94	54.4	2/14/2018
				0.96	54.3	*2/20/2018
	0.95	54.0	2/27/2018			
457	IEEE/IEC Head	0.87 (0.83-0.91)	43.5 (41.3-45.7)	0.88	44.2	*2/13/2018
				0.87	44.3	2/15/2018
				0.89	43.9	*2/27/2018
457	FCC Body	0.94 (0.89-0.99)	56.7 (53.8-59.5)	0.96	53.9	2/27/2018
470	FCC Body	0.94 (0.89-0.98)	56.6 (53.8-59.5)	0.96	53.9	1/23/2018
				0.98	53.8	1/28/2018
				0.97	54.2	1/30/2018
				0.98	54.1	1/31/2018
				0.97	54.0	*2/04/2018
				0.95	53.9	*2/06/2018
				0.98	54.2	*2/07/2018
470	FCC Body	0.94 (0.89-0.98)	56.6 (53.8-59.5)	0.96	53.8	2/09/2018
				0.96	54.1	2/14/2018
				0.98	54.0	*2/20/2018
	IEEE/IEC Head	0.87 (0.83-0.91)	43.4 (41.2-45.6)	0.90	43.8	2/13/2018

Note: * Tissue sheet date cover next testing day (within 24 hrs)

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 +/- 2°C 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 15

	Target	Measured
Ambient Temperature	18 – 25 °C	Range: 18.0 – 25.0°C Avg. 21.8 °C
Tissue Temperature	NA	Range: 19.7 -20.4°C Avg. 20.1°C

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 testing.

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

Table 16

Description		≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface		5 ± 1 mm	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location		30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area} , Δy_{Area}		≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
		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.	
Maximum zoom scan spatial resolution: Δx_{Zoom} , Δy_{Zoom}		≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$	≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
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.			

12.2 DUT Configuration(s)

The DUT is a portable device operational at the body 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.

12.3 DUT Positioning Procedures

The positioning of the device for each body location is described below and illustrated in Appendix G.

12.3.1 Body

The DUT was positioned in normal use configuration against the phantom with the offered body worn accessory, battery, and with the offered audio accessories as applicable.

12.3.2 Head

Not applicable.

12.3.3 Face

The DUT was positioned with 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.

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

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 averaged 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:

$$\text{Max_Calc} = \text{SAR_meas} \cdot 10^{\frac{-\text{Drift}}{10}} \cdot \frac{P_{\text{max}}}{P_{\text{int}}} \cdot \text{DC}$$

P_{max} = Maximum Power (W)

P_{int} = Initial Power (W)

Drift = DASY drift results (dB)

SAR_meas = Measured 1-g or 10-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 $P_{\text{int}} > P_{\text{max}}$, then $P_{\text{max}}/P_{\text{int}} = 1$.

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. All tests were performed in CW and 50% duty cycle was applied to PTT configurations in the final results.

13.0 DUT Test Data

13.1 Assessments at the Body

Battery NNTN4970A was selected as default battery for assessment at the Body because it is the thinnest battery (refer to Exhibit 7b for battery illustration). The default battery was used during conducted power measurement for all test channels within FCC allocated frequency range (406.1- 470 MHz) which are listed in Table 17. The channel with highest conducted power will be identified as default channel per KDB 643646 (SAR Test for PTT Radios).

Table 17

Test Freq (MHz)	NNTN44970A
	Power (W)
406.1250	4.76
419.6000	4.72
425.4000	4.67
430.0000	4.64
433.0000	4.64
438.0000	4.60
440.0000	4.60
446.0000	4.59
456.7000	4.56
470.0000	4.61

Assessments at the Body with Body worn HLN8255B

DUT assessment with offered antennas, default battery and, default body worn accessory per KDB 643646. Optional batteries were tested per the requirements of KDB 643646. Refer to Table 17 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 18

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
PMAE4016A	NNTN4970A	HLN8255B	PMMN4013A	406.1250	4.76	-0.13	5.02	2.61	AM-AB-180123-02
				425.4000					
				438.0000					
				456.7000					
				470.0000					
PMAE4003A	NNTN4970A	HLN8255B	PMMN4013A	430.0000	4.65	-0.32	6.94	3.86	AM-AB-180123-03
				446.0000					
				456.7000					
				470.0000	4.60	-0.30	2.85	1.59	AZ(FAZ)-AB-180123-04
PMAE4002A	NNTN4970A	HLN8255B	PMMN4013A	406.1250	4.60	-0.23	3.31	1.82	AZ(FAZ)-AB-180123-05
				419.6000					
				433.0000					
NAE6522AR	NNTN4970A	HLN8255B	PMMN4013A	438.0000					
				446.0000					
				456.7000					
				470.0000	4.61	-0.33	1.99	1.12	AZ(FAZ)-AB-180123-06
8505816K24A	NNTN4970A	HLN8255B	PMMN4013A	406.1250	4.75	-0.33	0.82	0.45	AZ(FAZ)-AB-180123-07
				419.6000					
				425.4000					
				440.0000					
Assessment of Additional Batteries									
PMAE4003A	PMNN4258AR	HLN8255B	PMMN4013A	430.0000	4.80	-0.32	6.87	3.70	AZ(FAZ)-AB-180123-08
	NNTN4497DR				4.78	-0.39	7.52	4.13	AZ(FAZ)-AB-180123-09
	NNTN4851A				4.77	-0.28	7.87	4.22	AZ(FAZ)-AB-180124-01#
	PMNN4072A				4.78	-0.25	7.64	4.06	AZ(FAZ)-AB-180124-03#
	PMNN4098A				4.75	-0.24	7.85	4.19	AZ(FAZ)-AB-180124-04#
	PMNN4251AR				4.71	-0.38	6.95	3.87	AM-AB-180124-05#
	PMNN4253AR				4.69	-0.37	7.25	4.04	AM-AB-180124-06#
	PMNN4254AR				4.77	-0.47	7.33	4.11	AM-AB-180124-07#
	PMNN4259AR				4.77	-0.53	6.96	3.96	FD(FAZ)-AB-180128-03
	PMNN4458BR				4.80	-0.45	7.65	4.24	FD(FAZ)-AB-180128-04
	PMNN4450AR				4.80	-0.31	6.89	3.70	FD(FAZ)-AB-180128-05

Assessments at the Body with Body worn RLN5644A

DUT assessment with offered antennas, default battery and, default body worn accessory per KDB 643646. Optional batteries were tested per the requirements of KDB 643646. Refer to Table 17 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 19

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
PMAE4016A	NNTN4970A	RLN5644A	PMMN4013A	406.1250	4.78	-0.21	4.42	2.33	FD(FAZ)-AB-180128-06
				425.4000					
				438.0000					
				456.7000					
				470.0000					
PMAE4003A	NNTN4970A	RLN5644A	PMMN4013A	430.0000	4.74	-0.24	6.79	3.63	FD(FAZ)-AB-180128-07
				446.0000					
				456.7000					
				470.0000	4.65	-0.31	2.78	1.54	FD(FAZ)-AB-180128-08
PMAE4002A	NNTN4970A	RLN5644A	PMMN4013A	406.1250	4.60	-0.37	2.44	1.39	FD(FAZ)-AB-180128-09
				419.6000					
				433.0000					
NAE6522AR	NNTN4970A	RLN5644A	PMMN4013A	438.0000					
				446.0000					
				456.7000					
				470.0000	4.77	-0.39	2.14	1.18	FD(FAZ)-AB-180128-10
8505816K24A	NNTN4970A	RLN5644A	PMMN4013A	406.1250	4.80	-0.40	0.69	0.38	FD(FAZ)-AB-180128-11
				419.6000					
				425.4000					
				440.0000					
Assessment of Additional Batteries									
PMAE4003A	PMNN4258AR	RLN5644A	PMMN4013A	430.0000	4.71	-0.33	6.57	3.61	FD(FAZ)-AB-180128-12
	NNTN4497DR				4.80	-0.37	7.02	3.82	FD(FAZ)-AB-180128-13
	NNTN4851A				4.79	-0.28	7.76	4.15	FD(FAZ)-AB-180128-14
	PMNN4072A				4.79	-0.42	7.78	4.29	FD(FAZ)-AB-180128-15
	PMNN4098A				4.72	-0.85	6.71	4.15	ZR(FAZ)-AB-180130-01#
	PMNN4251AR				4.80	-0.34	7.00	3.79	ZR(FAZ)-AB-180130-02#

Continued Table 19

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
Assessment of Additional Batteries									
PMAE4003A	PMNN4253AR	RLN5644A	PMMN4013A	430.0000	4.79	-0.25	6.91	3.67	ZR(FAZ)-AB-180130-03#
	PMNN4254AR				4.80	-0.39	6.89	3.77	ZR(FAZ)-AB-180130-04#
	PMNN4259AR				4.80	-0.52	6.54	3.69	ZR(FAZ)-AB-180130-05#
	PMNN4458BR				4.80	-0.50	7.05	3.96	FIE(ZZ)-AB-180130-08
	PMNN4450AR				4.80	-0.33	6.99	3.77	FIE(ZZ)-AB-180130-09

Assessments at the Body with Body worn RLN4570A

DUT assessment with offered antennas, default battery and, default body worn accessory per KDB 643646. Optional batteries were tested per the requirements of KDB 643646. Refer to Table 17 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 20

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
PMAE4016A	NNTN4970A	RLN4570A	PMMN4013A	406.1250	4.80	-0.13	8.85	4.56	ZR(FAZ)-AB-180130-10
				425.4000	4.80	-0.13	8.78	4.52	ZR(FAZ)-AB-180130-11
				438.0000					
				456.7000					
PMAE4003A	NNTN4970A	RLN4570A	PMMN4013A	470.0000	4.60	-0.37	4.32	2.45	AM-AB-180221-06#
				430.0000	4.70	-0.32	9.03	4.96	ZR(FAZ)-AB-180130-13
				446.0000	4.78	-0.34	6.24	3.39	ZR(FAZ)-AB-180130-14
				456.7000					
PMAE4002A	NNTN4970A	RLN4570A	PMMN4013A	470.0000	4.78	-0.30	4.05	2.18	ZR(FAZ)-AB-180130-15
				406.1250	4.80	-0.10	6.96	3.56	ZR(FAZ)-AB-180131-01#
				419.6000					
NAE6522AR	NNTN4970A	RLN4570A	PMMN4013A	433.0000	4.80	-0.22	8.72	4.59	ZR(FAZ)-AB-180131-03#
				438.0000					
				446.0000					
				456.7000					
				470.0000	4.80	-0.42	3.03	1.67	AZ-AB-180131-05

Continued Table 20

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
8505816K24A	NNTN4970A	RLN4570A	PMMN4013A	406.1250	4.80	-0.14	1.31	0.68	ZR(FAZ)-AB-180131-06
				419.6000					
				425.4000					
				440.0000					
Assessment of Additional Batteries									
PM4E4016A	PMNN4258AR	RLN4570A	PMMN4013A	406.1250	4.80	-0.15	7.21	3.73	ZR(FAZ)-AB-180131-07
PM4E4003A				430.0000	4.80	-0.36	7.76	4.22	ZR(FAZ)-AB-180131-09
PM4E4002A				433.0000	4.80	-0.41	7.52	4.13	ZR(FAZ)-AB-180131-10
PM4E4016A	NNTN4497DR	RLN4570A	PMMN4013A	406.1250	4.80	-0.04	7.54	3.80	ZR(FAZ)-AB-180131-11
PM4E4003A				430.0000	4.79	-0.41	8.48	4.67	ZR(FAZ)-AB-180131-12
PM4E4002A				433.0000	4.80	-0.42	8.04	4.43	ZR(FAZ)-AB-180131-13
PM4E4016A	NNTN4851A	RLN4570A	PMMN4013A	406.1250	4.80	-0.10	6.92	3.54	ZR(FAZ)-AB-180201-01#
PM4E4003A				430.0000	4.80	-0.32	9.42	5.07	ZR(FAZ)-AB-180201-02#
PM4E4002A				433.0000	4.80	-0.83	8.54	5.17	ZR(FAZ)-AB-180201-03#
PM4E4016A	PMNN4072A	RLN4570A	PMMN4013A	406.1250	4.80	-0.15	8.50	4.40	ZR(FAZ)-AB-180201-05#
PM4E4003A				430.0000	4.73	-0.44	9.63	5.41	FIE-AB-180201-07#
PM4E4002A				433.0000	4.56	-0.61	8.49	5.14	FIE(ZZ)-AB-180201-10
PM4E4016A	PMNN4098A	RLN4570A	PMMN4013A	406.1250	4.74	-0.10	9.00	4.66	FD(FAZ)-AB-180201-11
PM4E4003A				430.0000	4.80	-0.25	9.64	5.11	FD(FAZ)-AB-180201-12
PM4E4002A				433.0000	4.77	-0.49	9.43	5.31	FD(FAZ)-AB-180201-13
PM4E4016A	PMNN4251AR	RLN4570A	PMMN4013A	406.1250	4.80	-0.13	7.32	3.77	FD(FAZ)-AB-180201-14
PM4E4003A				430.0000	4.80	-0.23	9.33	4.92	FD(FAZ)-AB-180201-15
PM4E4002A				433.0000	4.80	-0.74	7.03	4.17	FD(FAZ)-AB-180201-16
PM4E4016A	PMNN4253AR	RLN4570A	PMMN4013A	406.1250	4.80	-0.22	8.61	4.53	FD(FAZ)-AB-180202-01#
PM4E4003A				430.0000	4.67	-0.15	9.79	5.21	FD(FAZ)-AB-180202-02#
PM4E4002A				433.0000	4.80	-0.39	9.04	4.94	FD(FAZ)-AB-180202-03#
PM4E4016A	PMNN4254AR	RLN4570A	PMMN4013A	406.1250	4.79	-0.12	7.32	3.77	FIE(ZZ)-AB-180202-04#
PM4E4003A				430.0000	4.73	-0.22	7.97	4.25	ZR(FAZ)-AB-180202-06
PM4E4002A				433.0000	4.76	-0.36	7.73	4.23	ZR(FAZ)-AB-180202-08

Continued Table 20

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
Assessment of Additional Batteries									
PMAE4016A	PMNN4259AR	RLN4570A	PMMN4013A	406.1250	4.77	-0.22	7.24	3.83	ZR(FAZ)-AB-180202-10
PMAE4003A				430.0000	4.77	-0.50	8.00	4.52	ZR(FAZ)-AB-180202-11
PMAE4002A				433.0000	4.67	-0.40	7.39	4.16	ZR(FAZ)-AB-180202-12
PMAE4016A	PMNN4458BR	RLN4570A	PMMN4013A	406.1250	4.80	-0.53	6.94	3.92	ZR(FAZ)-AB-180202-13
PMAE4003A				430.0000	4.80	-0.35	8.78	4.76	ZR(FAZ)-AB-180202-14
PMAE4002A				433.0000	4.80	-0.35	8.59	4.66	ZR(FAZ)-AB-180204-03
PMAE4016A	PMNN4450AR	RLN4570A	PMMN4013A	406.1250	4.79	-0.10	7.30	3.74	ZR(FAZ)-AB-180204-04
PMAE4003A				430.0000	4.79	-0.34	9.01	4.88	ZR(FAZ)-AB-180204-05
PMAE4002A				433.0000	4.70	-0.28	7.87	4.29	ZR(FAZ)-AB-180204-06

Assessments at the Body with Body worn HLN6602A

DUT assessment with offered antennas, default battery and, default body worn accessory per KDB 643646. Optional batteries were tested per the requirements of KDB 643646. Refer to Table 17 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 21

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
PMAE4016A	NNTN4970A	HLN6602A	PMMN4013A	406.1250	4.79	-0.16	9.47	4.92	ZR(FAZ)-AB-180204-07
				425.4000	4.74	-0.27	7.11	3.83	ZR(FAZ)-AB-180204-08
				438.0000					
				456.7000					
				470.0000	4.70	-0.31	3.54	1.94	FD(FAZ)-AB-180221-07#
PMAE4003A	NNTN4970A	HLN6602A	PMMN4013A	430.0000	4.74	-0.32	9.00	4.91	AZ-AB-180204-10
				446.0000	4.77	-0.50	6.19	3.49	AZ-AB-180204-11
				456.7000					
				470.0000	4.67	-0.44	3.90	2.22	AZ-AB-180204-12
PMAE4002A	NNTN4970A	HLN6602A	PMMN4013A	406.1250	4.80	-0.24	5.98	3.16	AZ-AB-180204-13
				419.6000					
				433.0000					

Continued Table 21

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
NAE6522AR	NNTN4970A	HLN6602A	PMMN4013A	438.0000					
				446.0000					
				456.7000					
				470.0000	4.78	-0.41	2.70	1.49	AZ-AB-180205-01#
8505816K24A	NNTN4970A	HLN6602A	PMMN4013A	406.1250	4.78	-0.54	1.19	0.68	AZ-AB-180205-02#
				419.6000					
				425.4000					
				440.0000					
Assessment of Additional Batteries									
PM4E4016A	PMNN4258AR	HLN6602A	PMMN4013A	406.1250	4.80	-0.15	8.05	4.17	AZ-AB-180205-03#
PM4E4003A				430.0000	4.80	-0.51	9.26	5.21	AZ-AB-180205-05#
PM4E4016A	NNTN4497DR	HLN6602A	PMMN4013A	406.1250	4.80	-0.56	7.52	4.28	AM-AB-180205-07
PM4E4003A				430.0000	4.80	-0.50	9.74	5.46	AM-AB-180205-08
PM4E4016A	NNTN4851A	HLN6602A	PMMN4013A	406.1250	4.80	-0.16	8.52	4.42	AM-AB-180205-09
PM4E4003A				430.0000	4.80	-0.61	10.20	5.87	AM-AB-180205-10
PM4E4016A	PMNN4072A	HLN6602A	PMMN4013A	406.1250	4.80	-0.15	8.19	4.24	AM-AB-180205-11
PM4E4003A				430.0000	4.80	-0.66	10.10	5.88	AM-AB-180205-12
PM4E4016A	PMNN4098A	HLN6602A	PMMN4013A	406.1250	4.80	-0.09	7.90	4.03	AM-AB-180205-13
PM4E4003A				430.0000	4.80	-0.80	9.87	5.93	AM-AB-180205-14
PM4E4016A	PMNN4251AR	HLN6602A	PMMN4013A	406.1250	4.80	-0.26	6.33	3.36	AM-AB-180205-15
PM4E4003A				430.0000	4.80	-0.43	8.57	4.73	FD(FAZ)-AB-180205-16
PM4E4016A	PMNN4253AR	HLN6602A	PMMN4013A	406.1250	4.80	-0.17	8.70	4.52	FD(FAZ)-AB-180205-17
PM4E4003A				430.0000	4.78	-0.34	9.63	5.23	FD(FAZ)-AB-180205-18
PM4E4016A	PMNN4254AR	HLN6602A	PMMN4013A	406.1250	4.80	-0.09	7.98	4.07	FD(FAZ)-AB-180205-19
PM4E4003A				430.0000	4.80	-0.50	8.71	4.89	FD(FAZ)-AB-180205-20
PM4E4016A	PMNN4259AR	HLN6602A	PMMN4013A	406.1250	4.80	-0.14	8.07	4.17	FD(FAZ)-AB-180205-21
PM4E4003A				430.0000	4.80	-0.64	8.78	5.09	FD(FAZ)-AB-180206-01#
PM4E4016A	PMNN4458BR	HLN6602A	PMMN4013A	406.1250	4.80	-0.10	8.32	4.26	FD(FAZ)-AB-180206-02#
PM4E4003A				430.0000	4.80	-0.53	9.01	5.09	FD(FAZ)-AB-180206-03#
PM4E4016A	PMNN4450AR	HLN6602A	PMMN4013A	406.1250	4.80	-0.12	7.72	3.97	FD(FAZ)-AB-180206-04#
PM4E4003A				430.0000	4.79	-0.46	8.44	4.70	AM-AB-180206-06

Assessments at the Body with Body worn RLN4815A

DUT assessment with offered antennas, default battery and, default body worn accessory per KDB 643646. Optional batteries were tested per the requirements of KDB 643646. Refer to Table 17 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 22

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
PMAE4016A	NNTN4970A	RLN4815A	PMMN4013A	406.1250	4.80	-0.13	3.51	1.81	AM-AB-180206-07
				425.4000					
				438.0000					
				456.7000					
				470.0000					
PMAE4003A	NNTN4970A	RLN4815A	PMMN4013A	430.0000	4.80	-0.39	5.10	2.79	AM-AB-180206-08
				446.0000					
				456.7000					
				470.0000					
PMAE4002A	NNTN4970A	RLN4815A	PMMN4013A	406.1250	4.80	-0.22	2.27	1.19	AM-AB-180206-09
				419.6000					
				433.0000					
NAE6522AR	NNTN4970A	RLN4815A	PMMN4013A	438.0000					
				446.0000					
				456.7000					
				470.0000	4.77	-0.41	1.51	0.83	AM-AB-180206-10
8505816K24A	NNTN4970A	RLN4815A	PMMN4013A	406.1250	4.80	-0.57	0.68	0.39	AM-AB-180206-11
				419.6000					
				425.4000					
				440.0000					
Assessment of Additional Batteries									
PMAE4003A	PMNN4258AR	RLN4815A	PMMN4013A	430.0000	4.80	-0.44	5.12	2.83	AM-AB-180206-12
	NNTN4497DR				4.80	-0.44	5.27	2.92	AM-AB-180206-13
	NNTN4851A				4.80	-0.43	6.13	3.38	AM-AB-180206-14
	PMNN4072A				4.80	-0.41	5.95	3.27	AM-AB-180206-15
	PMNN4098A				4.80	-0.63	5.49	3.17	AM-AB-180206-16
	PMNN4251AR				4.80	-0.39	4.73	2.59	FD(FAZ)-AB-180206-17
	PMNN4253AR				4.77	-0.43	5.35	2.97	FD(FAZ)-AB-180206-18
	PMNN4254AR				4.80	-0.33	4.95	2.67	FD(FAZ)-AB-180206-19
	PMNN4259AR				4.80	-0.43	5.02	2.77	FD(FAZ)-AB-180206-20
	PMNN4458BR				4.80	-0.36	4.96	2.69	FD(FAZ)-AB-180206-21
	PMNN4450AR				4.80	-0.32	5.06	2.72	FD(FAZ)-AB-180206-22

Assessments at the Body with Body worn HLN9701B w/ NTN5243A

DUT assessment with offered antennas, default battery and, default body worn accessory per KDB 643646. Optional batteries were tested per the requirements of KDB 643646. Refer to Table 17 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 23

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
PMAE4016A	NNTN4970A	HLN9701B/NTN5243A	PMMN4013A	406.1250	4.79	-0.04	2.56	1.29	FD(FAZ)-AB-180206-23
				425.4000					
				438.0000					
				456.7000					
				470.0000					
PMAE4003A	NNTN4970A	HLN9701B/NTN5243A	PMMN4013A	430.0000	4.70	-0.37	4.85	2.70	FD(FAZ)-AB-180207-01#
				446.0000					
				456.7000					
				470.0000					
PMAE4002A	NNTN4970A	HLN9701B/NTN5243A	PMMN4013A	406.1250	4.79	-0.22	2.07	1.09	FD(FAZ)-AB-180207-02#
				419.6000					
				433.0000					
NAE6522AR	NNTN4970A	HLN9701B/NTN5243A	PMMN4013A	438.0000					
				446.0000					
				456.7000					
				470.0000	4.75	-0.30	1.40	0.76	FD(FAZ)-AB-180207-03#
8505816K24A	NNTN4970A	HLN9701B/NTN5243A	PMMN4013A	406.1250	4.80	-0.70	0.68	0.40	AM-AB-180207-06
				419.6000					
				425.4000					
				440.0000					
Assessment of Additional Batteries									
PMAE4003A	PMNN4258AR	HLN9701B/NTN5243A	PMMN4013A	430.0000	4.80	-0.61	5.44	3.13	AM-AB-180207-07
	NNTN4497DR				4.80	-0.55	5.99	3.40	AM-AB-180207-08
	NNTN4851A				4.80	-0.45	5.92	3.28	AM-AB-180207-09
	PMNN4072A				4.78	-0.44	5.59	3.11	AM-AB-180207-10
	PMNN4098A				4.78	-0.56	5.57	3.18	AM-AB-180207-11
	PMNN4251AR				4.80	-0.44	5.55	3.07	AM-AB-180207-12
	PMNN4253AR				4.76	-0.33	5.24	2.85	AM-AB-180207-13
	PMNN4254AR				4.80	-0.66	5.40	3.14	AM-AB-180207-14
	PMNN4259AR				4.80	-0.52	4.55	2.56	FD(FAZ)-AB-180207-15
	PMNN4458BR				4.80	-0.41	4.72	2.59	FD(FAZ)-AB-180207-16
	PMNN4450AR				4.80	-0.36	4.77	2.59	FD(FAZ)-AB-180207-17

Assessments at the Body with Body worn RLN5383A w/ NTN5243A

DUT assessment with offered antennas, default battery and, default body worn accessory per KDB 643646. Optional batteries were tested per the requirements of KDB 643646. Refer to Table 17 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 24

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
PMAE4016A	NNTN4970A	RLN5383A/ NTN5243A	PMMN4013A	406.1250	4.78	-0.11	2.07	1.07	FD(FAZ)-AB-180207-18
				425.4000					
				438.0000					
				456.7000					
				470.0000					
PMAE4003A	NNTN4970A	RLN5383A/ NTN5243A	PMMN4013A	430.0000	4.70	-0.16	3.25	1.72	FD(FAZ)-AB-180207-19
				446.0000					
				456.7000					
				470.0000					
PMAE4002A	NNTN4970A	RLN5383A/ NTN5243A	PMMN4013A	406.1250	4.70	-0.19	1.47	0.78	FD(FAZ)-AB-180207-20
				419.6000					
				433.0000					
NAE6522AR	NNTN4970A	RLN5383A/ NTN5243A	PMMN4013A	438.0000					
				446.0000					
				456.7000					
				470.0000	4.72	-0.29	1.09	0.59	FD(FAZ)-AB-180208-01#
8505816K24A	NNTN4970A	RLN5383A/ NTN5243A	PMMN4013A	406.1250	4.77	-0.40	0.32	0.18	FD(FAZ)-AB-180208-02#
				419.6000					
				425.4000					
				440.0000					
Assessment of Additional Batteries									
PMAE4003A	PMNN4258AR	RLN5383A/ NTN5243A	PMMN4013A	430.0000	4.77	-0.34	2.89	1.57	FD(FAZ)-AB-180208-03#
	NNTN4497DR				4.80	-0.37	2.90	1.58	FD(FAZ)-AB-180208-04#
	NNTN4851A				4.80	-0.69	2.94	1.72	AM-AB-180208-06
	PMNN4072A				4.80	-0.51	3.12	1.75	AM-AB-180208-08
	PMNN4098A				4.80	-0.84	3.11	1.89	AM-AB-180208-12
	PMNN4251AR				4.80	-0.46	3.30	1.83	AM-AB-180208-13
	PMNN4253AR				4.80	-0.30	2.92	1.56	AM-AB-180208-14
	PMNN4254AR				4.80	-0.52	2.85	1.61	AM-AB-180208-15
	PMNN4259AR				4.80	-0.62	2.76	1.59	AM-AB-180208-16
	PMNN4458BR				4.80	-0.40	2.83	1.55	FD(FAZ)-AB-180208-17
	PMNN4450AR				4.80	-0.34	2.82	1.52	FD(FAZ)-AB-180208-18

Assessments at the Body with Body worn RLN5385B w/ NTN5243A

DUT assessment with offered antennas, default battery and, default body worn accessory per KDB 643646. Optional batteries were tested per the requirements of KDB 643646. Refer to Table 17 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 25

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
PMAE4016A	NNTN4970A	RLN5385B/NTN5243A	PMMN4013A	406.1250	4.77	-0.14	2.60	1.35	AM-AB-180209-07
				425.4000					
				438.0000					
				456.7000					
				470.0000					
PMAE4003A	NNTN4970A	RLN5385B/NTN5243A	PMMN4013A	430.0000	4.65	-0.35	3.76	2.10	AM-AB-180209-08
				446.0000					
				456.7000					
				470.0000					
PMAE4002A	NNTN4970A	RLN5385B/NTN5243A	PMMN4013A	406.1250	4.73	-0.22	1.73	0.92	AM-AB-180209-09
				419.6000					
				433.0000					
NAE6522AR	NNTN4970A	RLN5385B/NTN5243A	PMMN4013A	438.0000					
				446.0000					
				456.7000					
				470.0000	4.73	-0.36	1.21	0.67	AM-AB-180209-10
8505816K24A	NNTN4970A	RLN5385B/NTN5243A	PMMN4013A	406.1250	4.76	-0.62	0.41	0.24	AM-AB-180209-11
				419.6000					
				425.4000					
				440.0000					
Assessment of Additional Batteries									
PMAE4003A	PMNN4258AR	RLN5385B/NTN5243A	PMMN4013A	430.0000	4.80	-0.44	3.46	1.91	AM-AB-180209-12
	NNTN4497DR				4.80	-0.52	3.78	2.13	AM-AB-180209-13
	NNTN4851A				4.69	-0.36	4.02	2.23	FD(FAZ)-AB-180209-14
	PMNN4072A				4.70	-0.15	3.93	2.08	FD(FAZ)-AB-180209-15
	PMNN4098A				4.78	-0.41	4.00	2.21	FD(FAZ)-AB-180209-16
	PMNN4251AR				4.79	-0.23	3.70	1.95	FD(FAZ)-AB-180209-17
	PMNN4253AR				4.79	-0.21	3.80	2.00	FD(FAZ)-AB-180209-18
	PMNN4254AR				4.80	-0.38	3.78	2.06	FD(FAZ)-AB-180209-19
	PMNN4259AR				4.80	-0.52	3.70	2.09	FD(FAZ)-AB-180209-20
	PMNN4458BR				4.80	-0.41	3.80	2.09	FD(FAZ)-AB-180209-21
	PMNN4450AR				4.80	-0.29	3.42	1.83	FD(FAZ)-AB-180210-01#

Assessment at the Body with other audio accessories

Assessment of additional audio accessories per “KDB 643646 Body SAR Test Consideration for Audio Accessories without Built-in Antenna” Section 1, A. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 26

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
PMAE4003A	PMNN4098A	HLN6602A	PMLN6538A	430.0000	4.80	-0.27	8.53	4.54	FD(FAZ)-AB-180210-02#
			PMLN6539A		4.80	-0.76	9.00	5.36	AM-AB-180211-02
			PMLN6540A		4.80	-0.63	8.91	5.15	AM-AB-180211-03
			PMLN6541A		4.77	-0.62	8.39	4.87	AM-AB-180211-04
			PMLN6537A		4.80	-0.85	8.94	5.44	AM-AB-180212-01#
			PMMN4092A		4.80	-0.63	8.87	5.13	AM-AB-180212-02#
			PMLN6530A		4.80	-0.81	7.85	4.73	AM-AB-180212-03#
			PMLN6531A		4.80	-0.71	9.05	5.33	AM-AB-180212-04#

13.2 Assessments at the Face

Battery PMNN4450AR was selected as default battery for assessment at the Face because it is the highest battery (refer to Exhibit 7b for battery illustration). The default battery was used during conducted power measurement for all test channels within FCC allocated frequency range (406.1- 470 MHz) which are listed in Table 27. The channel with highest conducted power will be identified as default channel per KDB 643646 (SAR Test for PTT Radios).

Table 27

Test Freq (MHz)	PMNN4450AR
	Power (W)
406.1250	4.750
419.6000	4.790
425.4000	4.780
430.0000	4.770
433.0000	4.740
438.0000	4.730
440.0000	4.740
446.0000	4.790
456.7000	4.790
470.0000	4.800

DUT assessment with offered antennas, default battery with front of DUT positioned 2.5cm facing phantom per KDB 643646. Optional batteries were tested per the requirements of KDB 643646. Refer to Table 27 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 28

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
PMAE4016A	PMNN4450AR	NONE	NONE	406.1250					
				425.4000					
				438.0000					
				456.7000					
				470.0000	4.79	-0.21	2.68	1.41	FD(FAZ)-FACE-180213-06
PMAE4003A	PMNN4450AR	NONE	NONE	430.0000					
				446.0000					
				456.7000					
				470.0000	4.80	-0.19	2.65	1.38	FD(FAZ)-FACE-180213-07
PMAE4002A	PMNN4450AR	NONE	NONE	406.1250					
				419.6000	4.80	-0.11	3.50	1.79	FD(FAZ)-FACE-180213-08
				433.0000					
NAE6522AR	PMNN4450AR	NONE	NONE	438.0000					
				446.0000					
				456.7000					
				470.0000	4.80	-0.34	1.87	1.01	FD(FAZ)-FACE-180213-09
8505816K24A	PMNN4450AR	NONE	NONE	406.1250					
				419.6000	4.80	-0.62	0.75	0.43	FD(FAZ)-FACE-180213-10
				425.4000					
				440.0000					
Assessment of Additional Batteries									
PMAE4002A	NNTN4497DR	NONE	NONE	419.6000	4.80	-0.11	3.29	1.69	FD(FAZ)-FACE-180213-11
	NNTN4851A				4.80	-0.11	3.68	1.89	FD(FAZ)-FACE-180213-12
	NNTN4970A				4.61	-0.23	3.70	2.03	AM-FACE-180213-13
	PMMN4072A				4.80	-0.10	3.17	1.62	AM-FACE-180213-14
	PMMN4098A				4.80	-0.11	3.52	1.81	AM-FACE-180213-15
	PMMN4251AR				4.68	-0.12	3.40	1.79	AM-FACE-180213-16
	PMMN4253AR				4.63	-0.19	3.42	1.85	AM-FACE-180213-17
	PMMN4254AR				4.71	-0.12	3.41	1.79	AM-FACE-180213-18
	PMMN4259AR				4.73	-0.08	3.39	1.75	AM-FACE-180214-01#
	PMMN4458BR				4.75	-0.16	2.87	1.50	AM-FACE-180214-02#
	PMMN4258AR				4.74	-0.13	3.22	1.68	AM-FACE-180214-03#

13.3 Assessment for ISED, Canada

Based on the assessment results for body per KDB643646, additional tests were not required for ISED Canada frequency range (406.1- 470 MHz) as testing performed is in compliance with ISED Canada frequency range.

As per ISED Notice 2016-DRS001, additional tests were required for the low, mid and high frequency channels for the configuration with the highest SAR value. The SAR results are in Table 29 below. SAR plot of the highest results per Table (bolded) are presented in Appendix E.

Table 29

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
Body									
PMAE4003A	PMNN4098A	HLN6602A	PMMN4013A	430.0000	4.80	-0.80	9.87	5.93	AM-AB-180205-14
				456.7000	4.75	-0.52	3.82	2.18	AM-AB-180227-10
				470.0000	4.79	-0.38	3.80	2.08	FD(FAZ)-AB-180214-15
Face									
PMAE4002A	NNTN4970A	NONE	NONE	406.1250	4.80	-0.26	2.28	1.21	AM-FACE-180215-12
				419.6000	4.61	-0.23	3.70	2.03	AM-FACE-180213-13
				430.0000	4.75	-0.30	6.96	3.77	AM(ZZ)-FACE-180228-02#

13.4 Assessment outside FCC Part 90

Assessment of outside FCC Part 90 using highest SAR configuration from above. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 30

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
Body									
8505816K24A	PMNN4098A	HLN6602A	PMMN4013A	403.0000	4.67	-0.63	1.34	0.80	AM-AB-180213-01#
PMAE4002A					4.61	-0.02	5.88	3.08	AM-AB-180213-02#
PMAE4016A					4.61	-0.12	8.89	4.76	AM-AB-180213-03#
Face									
8505816K24A	NNTN4970A	NONE	NONE	403.0000	4.66	-0.42	1.09	0.62	AM-FACE-180214-05#
PMAE4002A					4.61	-0.35	2.15	1.21	AM-FACE-180214-06#
PMAE4016A					4.68	-0.24	3.86	2.09	AM-FACE-180214-07#

13.5 Shortened Scan Assessment

A “shortened” scan using the highest SAR configuration overall from above was performed to validate the SAR drift of the full DASY5™ coarse and zoom scans. Note that the shortened scan represents the zoom scan performance result; this is obtained by first running a coarse scan to find the peak area and then, using a newly charged battery, a zoom scan only was performed. The results of the shortened cube scan presented in Appendix D demonstrate that the scaling methodology used to determine the calculated SAR results presented herein are valid. The SAR result from the Table below is provided in Appendix F.

Table 31

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
PMAE4003A	PMNN4098A	HLN6602A	PMMN4013A	430.0000	4.71	-0.73	9.42	5.68	AM-AB-180212-07

14.0 Results Summary

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

Table 32

Designator	Frequency band (MHz)	Max Calc at Body (W/kg)	Max Calc at Face (W/kg)
		1g-SAR	1g-SAR
FCC, US	406.1-470	5.93	2.03
ISED, Canada	406.1-430 & 450-470	5.93	3.77
Overall	403-470	5.93	3.77

The test results clearly demonstrate compliance with FCC Occupational /Controlled RF Exposure limits of 8.0 W/kg averaged over 1 gram per the requirements of FCC 47 CFR § 2.1093.

15.0 Variability Assessment

Per the guidelines in KDB 865664 SAR variability assessment is required because SAR results are above 4.0W/kg (Occupational).

The Table below includes test results of the original measurement(s), the repeated measurement(s), and the ratio (SAR_{high}/SAR_{low}) for the applicable test configuration(s).

Table 33

Run#	Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq. (MHz)	Adj Calc. 1g-SAR (W/kg)	Ratio	Comments
AM-AB-180205-14	PMAE4003A	PMNN4098A	HLN6602A	PMMN4013A	430.0000	5.93	1.06	No additional repeated scans is required due to the Ratio (SAR_{high}/SAR_{low}) < 1.20
AM-AB-180212-07						5.57		

16.0 System Uncertainty

A system uncertainty analysis is not required for this report per KDB 865664 because the highest report SAR value Occupational exposure is less than 7.5W/kg.

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

Appendix A Measurement Uncertainty Budget

Table A.1: Uncertainty Budget for Device Under Test for 450 MHz

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e = f(d,k)</i>	<i>f</i>	<i>g</i>	<i>h = c x f / e</i>	<i>i = c x g / e</i>	<i>k</i>
Uncertainty Component	IEEE 1528 section	Tol. (± %)	Prob Dist	Div.	ci (1 g)	ci (10 g)	1 g u_i (±%)	10 g u_i (±%)	v_i
Measurement System									
Probe Calibration	E.2.1	6.7	N	1.00	1	1	6.7	6.7	∞
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				12	11	482
Expanded Uncertainty (95% CONFIDENCE LEVEL)			<i>k=2</i>				23	23	

FCD-0558 Uncertainty Budget Rev.8

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

Table A.2: Uncertainty Budget for System Validation (dipole & flat phantom) for 450 MHz

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e = f(d,k)</i>	<i>f</i>	<i>g</i>	<i>h = c x f / e</i>	<i>i = c x g / e</i>	<i>k</i>
Uncertainty Component	IEEE 1528 section	Tol. (± %)	Prob Dist	Div.	<i>c_i</i> (1 g)	<i>c_i</i> (10 g)	1 g <i>U_i</i> (±%)	10 g <i>U_i</i> (±%)	<i>v_i</i>
Measurement System									
Probe Calibration	E.2.1	6.7	N	1.00	1	1	6.7	6.7	∞
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				10	9	99999
Expanded Uncertainty (95% CONFIDENCE LEVEL)			<i>k</i> =2				19	18	

FCD-0558 Uncertainty Budget Rev.8

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) *c_i* - sensitivity coefficient that should be applied to convert the variability of the uncertainty component into a variability of SAR.
- g) *u_i* – SAR uncertainty
- h) *v_i* - degrees of freedom for standard uncertainty and effective degrees of freedom for the expanded uncertainty

Appendix B
Probe Calibration Certificate

**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 **Motorola MY**

Certificate No: **ES3-3196_May17**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3196**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-12.v9, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes**

Calibration date: **May 17, 2017**

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. 217-02525)	Apr-18
Reference 20 dB Attenuator	SN: S6277 (20x)	07-Apr-17 (No. 217-02528)	Apr-18
Reference Probe ES3DV2	SN: 3013	31-Dec-16 (No. ES3-3013_Dec16)	Dec-17
DAE4	SN: 660	7-Dec-16 (No. DAE4-660_Dec16)	Dec-17
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-16)	In house check: Jun-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17

	Name	Function	Signature
Calibrated by:	Jeton Kasirati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 18, 2017

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

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



S Schweizerischer Kalibrierdienst
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 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

Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization θ	θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., θ = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

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, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- 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"

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}: Assessed for E-field polarization θ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z} = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters: Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy): in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

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May 17, 2017

Probe ES3DV3

SN:3196

Manufactured: June 16, 2008
Calibrated: May 17, 2017

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

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May 17, 2017

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3196

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.25	1.26	1.30	$\pm 10.1\%$
DCP (mV) ^B	101.5	100.5	99.8	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc (k=2) ^F
0	CW	X	0.0	0.0	1.0	0.00	191.9	$\pm 3.5\%$
		Y	0.0	0.0	1.0		203.8	
		Z	0.0	0.0	1.0		204.9	

Note: For details on UID parameters see Appendix.

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%.

^A The uncertainties of Norm X,Y,Z do not affect the E²-field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter; uncertainty not required.

^F Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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DASY/EASY - Parameters of Probe: ES3DV3 - SN:3196

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [Ⓒ]	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha [Ⓓ]	Depth [Ⓔ] (mm)	Unc (k=2)
150	52.3	0.76	7.46	7.46	7.46	0.08	1.25	± 13.3 %
300	45.3	0.87	7.36	7.36	7.36	0.12	1.60	± 13.3 %
450	43.5	0.87	7.11	7.11	7.11	0.20	1.60	± 13.3 %
750	41.9	0.89	6.82	6.82	6.82	0.71	1.27	± 12.0 %
835	41.5	0.90	6.63	6.63	6.63	0.53	1.40	± 12.0 %
900	41.5	0.97	6.45	6.45	6.45	0.74	1.20	± 12.0 %
1450	40.5	1.20	5.78	5.78	5.78	0.74	1.15	± 12.0 %
1810	40.0	1.40	5.58	5.58	5.58	0.42	1.62	± 12.0 %
1900	40.0	1.40	5.42	5.42	5.42	0.71	1.26	± 12.0 %
2100	39.8	1.49	5.44	5.44	5.44	0.78	1.22	± 12.0 %
2300	39.5	1.67	5.00	5.00	5.00	0.74	1.27	± 12.0 %
2450	39.2	1.80	4.74	4.74	4.74	0.65	1.38	± 12.0 %
2600	39.0	1.96	4.60	4.60	4.60	0.75	1.25	± 12.0 %

[Ⓒ] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.1 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[Ⓓ] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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DASY/EASY - Parameters of Probe: ES3DV3 - SN:3196

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
150	61.9	0.80	7.06	7.06	7.06	0.09	1.25	± 13.3 %
300	58.2	0.92	6.92	6.92	6.92	0.10	1.60	± 13.3 %
450	56.7	0.94	7.00	7.00	7.00	0.13	1.60	± 13.3 %
750	55.5	0.96	6.44	6.44	6.44	0.80	1.13	± 12.0 %
835	55.2	0.97	6.31	6.31	6.31	0.50	1.47	± 12.0 %
900	55.0	1.05	6.27	6.27	6.27	0.52	1.47	± 12.0 %
1450	54.0	1.30	5.40	5.40	5.40	0.71	1.19	± 12.0 %
1810	53.3	1.52	5.11	5.11	5.11	0.40	1.83	± 12.0 %
1900	53.3	1.52	4.91	4.91	4.91	0.60	1.47	± 12.0 %
2100	53.2	1.62	5.24	5.24	5.24	0.60	1.49	± 12.0 %
2300	52.9	1.81	4.72	4.72	4.72	0.80	1.27	± 12.0 %
2450	52.7	1.95	4.58	4.58	4.58	0.80	1.13	± 12.0 %
2600	52.5	2.16	4.40	4.40	4.40	0.80	1.20	± 12.0 %

^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

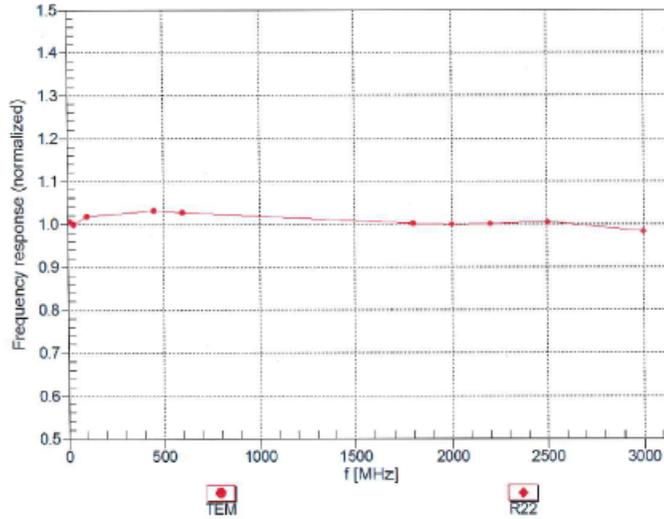
^F At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)

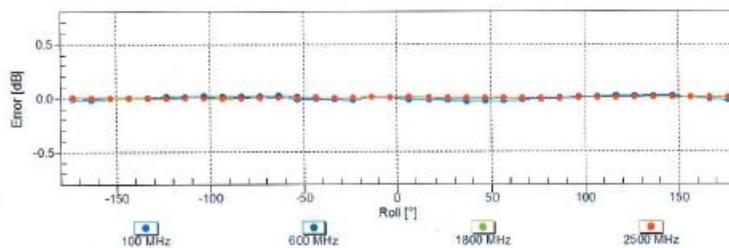
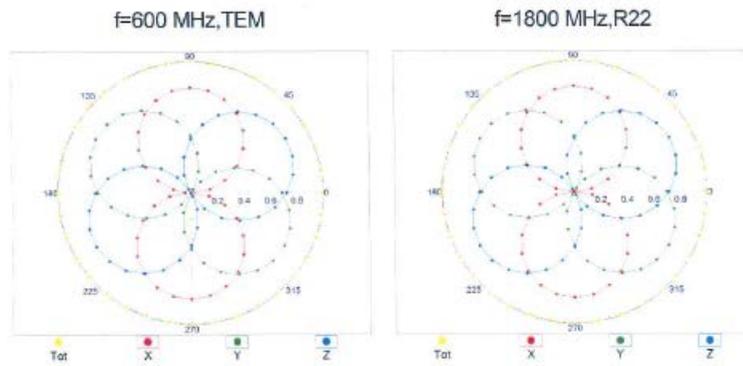


Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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Receiving Pattern (ϕ), $\theta = 0^\circ$

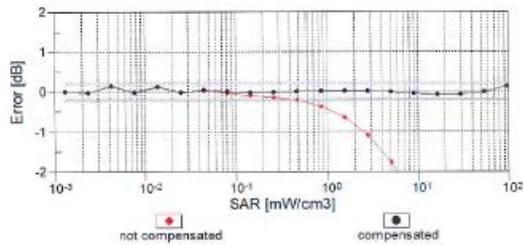
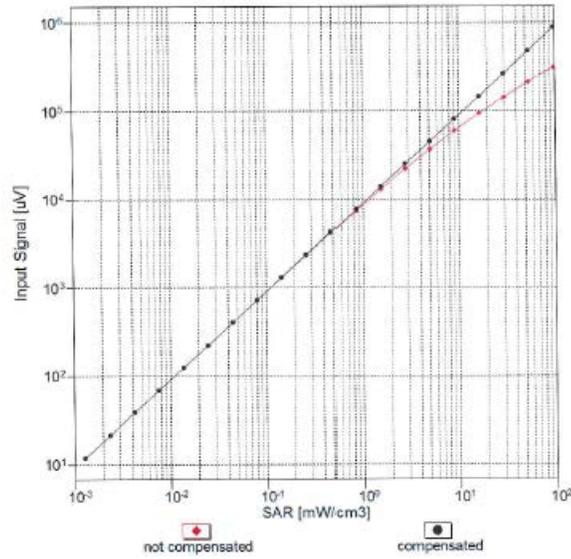


Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

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Dynamic Range f(SAR_{head}) (TEM cell, f_{eval}= 1900 MHz)

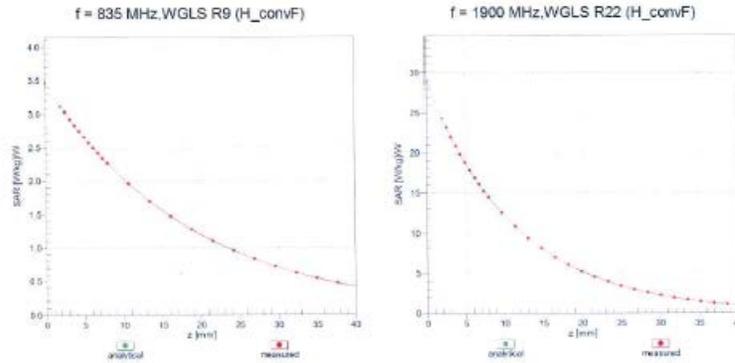


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

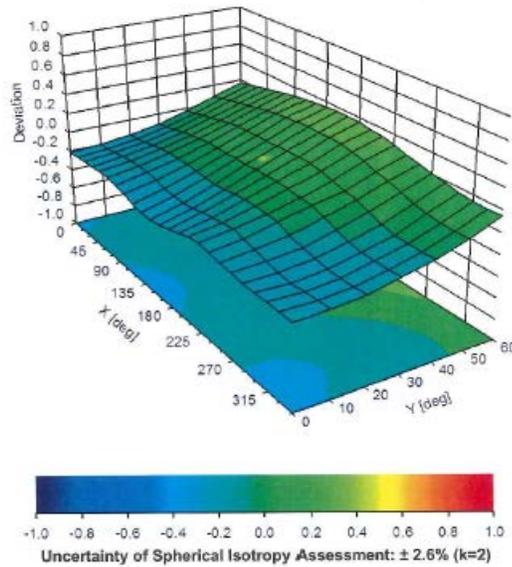
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Conversion Factor Assessment



Deviation from Isotropy in Liquid Error (ϕ, θ), f = 900 MHz



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DASY/EASY - Parameters of Probe: ES3DV3 - SN:3196

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	6.7
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

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May 17, 2017

Appendix: Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu V}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	191.9	$\pm 3.5\%$
		Y	0.0	0.0	1.0		203.8	
		Z	0.0	0.0	1.0		204.9	
10011-CAB	UMTS-FDD (WCDMA)	X	3.15	66.2	18.1	2.91	131.3	$\pm 0.7\%$
		Y	3.25	66.4	17.9		143.9	
		Z	3.34	67.3	18.9		144.4	
10097-CAB	UMTS-FDD (HSDPA)	X	4.57	66.5	18.5	3.98	141.0	$\pm 0.9\%$
		Y	4.44	65.6	17.9		129.2	
		Z	4.57	66.5	18.7		131.2	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	4.63	66.8	18.7	3.98	141.2	$\pm 0.9\%$
		Y	4.48	65.8	18.0		129.6	
		Z	4.56	66.4	18.7		130.5	
10100-CAC	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.64	68.4	20.3	5.67	148.8	$\pm 1.4\%$
		Y	6.31	66.9	19.3		134.7	
		Z	6.47	67.7	20.0		137.4	
10101-CAC	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM)	X	7.41	67.5	20.1	6.42	132.2	$\pm 1.9\%$
		Y	7.45	67.4	19.8		144.4	
		Z	7.62	68.2	20.6		147.4	
10108-CAD	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.50	67.9	20.2	5.80	144.9	$\pm 1.4\%$
		Y	6.20	66.5	19.1		132.7	
		Z	6.38	67.4	20.0		134.5	
10109-CAD	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)	X	7.19	67.3	20.0	6.43	128.8	$\pm 1.7\%$
		Y	7.22	67.1	19.7		141.7	
		Z	7.36	67.8	20.5		143.1	
10110-CAD	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	6.14	67.1	19.8	5.75	140.8	$\pm 1.4\%$
		Y	5.93	66.1	19.0		128.6	
		Z	6.05	66.8	19.7		131.2	
10111-CAD	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)	X	7.21	68.0	20.5	6.44	148.8	$\pm 1.7\%$
		Y	6.96	66.8	19.6		137.4	
		Z	7.09	67.5	20.3		138.9	
10117-CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.47	69.6	21.8	8.07	135.7	$\pm 2.7\%$
		Y	10.30	69.0	21.3		145.6	
		Z	10.27	69.1	21.6		124.4	
10140-CAC	LTE-FDD (SC-FDMA, 100% RB, 15 Mhz, 16-QAM)	X	7.66	67.8	20.3	6.49	133.4	$\pm 1.7\%$
		Y	7.64	67.6	20.0		145.3	
		Z	7.83	68.4	20.7		148.8	
10142-CAD	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, QPSK)	X	5.97	67.0	19.8	5.73	137.4	$\pm 1.7\%$
		Y	5.99	66.8	19.4		149.4	
		Z	5.87	66.5	19.6		128.3	
10143-CAD	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)	X	6.96	67.8	20.4	6.35	145.0	$\pm 1.4\%$
		Y	6.67	66.5	19.4		130.6	
		Z	6.87	67.4	20.3		135.1	

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10145-CAD	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)	X	5.66	66.4	19.5	5.76	132.2	±1.4 %
		Y	5.72	66.4	19.3		145.5	
		Z	5.83	67.1	20.0		146.9	
10146-CAD	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM)	X	6.59	67.3	20.2	6.41	134.3	±1.7 %
		Y	6.70	67.5	20.1		148.7	
		Z	6.57	67.3	20.2		128.0	
10149-CAC	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM)	X	7.42	68.1	20.5	6.42	148.9	±1.7 %
		Y	7.16	66.9	19.7		137.3	
		Z	7.32	67.6	20.4		139.9	
10154-CAD	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.08	66.9	19.7	5.75	135.0	±1.4 %
		Y	5.91	66.0	19.0		128.3	
		Z	6.02	66.6	19.7		129.1	
10155-CAD	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)	X	7.10	67.6	20.3	6.43	144.0	±1.7 %
		Y	6.93	66.7	19.6		135.0	
		Z	7.06	67.4	20.3		136.1	
10156-CAD	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	X	5.86	66.6	19.6	5.79	132.5	±1.4 %
		Y	5.94	66.6	19.4		148.0	
		Z	6.04	67.3	20.1		149.4	
10157-CAD	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)	X	6.88	67.5	20.3	6.49	139.1	±1.4 %
		Y	6.70	66.6	19.6		130.0	
		Z	6.83	67.3	20.3		131.8	
10160-CAC	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.52	67.4	19.9	5.82	139.8	±1.4 %
		Y	6.31	66.4	19.2		131.6	
		Z	6.47	67.2	19.9		134.3	
10161-CAC	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM)	X	7.46	68.0	20.5	6.43	147.9	±1.7 %
		Y	7.28	67.2	19.8		139.9	
		Z	7.40	67.8	20.4		141.3	
10166-CAD	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK)	X	5.26	67.0	19.8	5.46	146.2	±1.2 %
		Y	5.10	65.9	18.9		137.5	
		Z	5.20	66.6	19.7		140.5	
10167-CAD	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM)	X	6.21	68.0	20.5	6.21	147.9	±1.4 %
		Y	6.11	67.3	19.9		141.5	
		Z	6.20	67.9	20.6		145.1	
10169-CAC	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.11	67.1	20.0	5.73	137.1	±1.2 %
		Y	4.97	66.1	19.2		128.7	
		Z	5.09	66.9	20.1		134.8	
10170-CAC	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	X	6.01	68.6	21.2	6.52	140.6	±1.7 %
		Y	5.76	67.1	20.0		128.6	
		Z	5.90	68.0	21.0		135.3	
10175-CAD	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.06	67.0	19.9	5.72	138.1	±1.7 %
		Y	5.19	67.1	19.8		149.2	
		Z	5.09	66.9	20.1		135.6	
10176-CAD	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	X	5.98	68.5	21.1	6.52	139.5	±1.7 %
		Y	5.72	67.0	20.0		127.8	
		Z	5.92	68.1	21.0		136.1	

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10177-CAF	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	X	5.09	67.0	20.0	5.73	137.8	±1.7 %
		Y	5.15	66.9	19.7		149.7	
		Z	5.09	66.9	20.1		135.5	
10178-CAD	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	X	5.96	68.4	21.0	6.52	139.4	±1.4 %
		Y	5.74	67.0	20.0		128.0	
		Z	5.93	68.2	21.1		135.7	
10181-CAC	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	5.08	67.0	20.0	5.72	137.3	±1.4 %
		Y	5.15	66.9	19.7		149.5	
		Z	5.08	66.9	20.0		136.0	
10182-CAC	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	X	5.99	68.5	21.1	6.52	140.2	±1.4 %
		Y	5.75	67.1	20.1		128.3	
		Z	5.92	68.1	21.0		136.0	
10184-CAD	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)	X	5.08	67.0	20.0	5.73	137.5	±1.4 %
		Y	5.13	66.8	19.6		149.7	
		Z	5.08	66.8	20.0		135.5	
10185-CAD	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)	X	5.99	68.5	21.1	6.51	140.4	±1.4 %
		Y	5.77	67.2	20.1		128.7	
		Z	5.95	68.3	21.1		135.9	
10187-CAD	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)	X	5.10	67.0	20.0	5.73	137.7	±1.2 %
		Y	4.94	65.9	19.1		127.3	
		Z	5.11	66.9	20.1		135.0	
10188-CAD	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)	X	5.99	68.5	21.1	6.52	141.3	±1.7 %
		Y	5.75	67.1	20.1		129.1	
		Z	5.94	68.2	21.0		136.0	
10196-CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	10.32	69.9	22.1	8.10	149.3	±2.5 %
		Y	9.93	68.6	21.2		136.9	
		Z	10.25	69.7	22.1		144.6	
10225-CAB	UMTS-FDD (HSPA+)	X	6.96	66.8	19.3	5.97	126.9	±1.4 %
		Y	7.05	67.0	19.4		142.8	
		Z	7.10	67.3	19.9		144.5	
10274-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	6.05	67.2	19.2	4.87	146.9	±1.2 %
		Y	5.88	66.4	18.5		136.3	
		Z	6.02	67.0	19.2		140.4	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.38	66.5	18.7	3.96	128.6	±0.9 %
		Y	4.48	66.7	18.6		141.5	
		Z	4.53	67.1	19.2		146.6	
10297-AAB	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.39	67.4	20.0	5.81	134.6	±1.4 %
		Y	6.16	66.3	19.1		126.6	
		Z	6.34	67.1	19.9		130.2	
10298-AAC	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, QPSK)	X	5.70	66.4	19.5	5.72	128.8	±1.4 %
		Y	5.79	66.5	19.4		144.2	
		Z	5.89	67.2	20.1		146.6	
10299-AAC	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM)	X	6.71	67.5	20.2	6.39	135.5	±1.4 %
		Y	6.54	66.6	19.5		127.4	
		Z	6.64	67.2	20.2		129.0	

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10311-AAB	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	7.01	68.2	20.4	6.06	141.6	±1.7 %
		Y	6.76	67.1	19.6		133.7	
		Z	6.92	67.8	20.3		135.3	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.59	67.8	18.6	1.54	148.4	±0.7 %
		Y	2.50	66.6	17.5		141.3	
		Z	2.62	68.0	19.0		142.7	
10418-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Long preamble)	X	10.26	69.8	22.1	8.14	147.2	±2.5 %
		Y	9.97	68.8	21.4		139.1	
		Z	10.18	69.6	22.1		141.7	
10430-AAA	LTE-FDD (OFDMA, 5 MHz, E-TM 3.1)	X	9.52	69.2	22.0	8.28	133.2	±1.9 %
		Y	9.19	68.0	21.1		124.7	
		Z	9.46	69.0	22.0		127.4	
10431-AAA	LTE-FDD (OFDMA, 10 MHz, E-TM 3.1)	X	10.13	69.7	22.3	8.38	141.6	±2.5 %
		Y	9.84	68.7	21.5		133.3	
		Z	10.08	69.6	22.3		136.1	
10432-AAA	LTE-FDD (OFDMA, 15 MHz, E-TM 3.1)	X	10.35	69.9	22.3	8.34	145.3	±2.5 %
		Y	10.06	68.8	21.5		137.2	
		Z	10.28	69.7	22.3		139.8	
10433-AAA	LTE-FDD (OFDMA, 20 MHz, E-TM 3.1)	X	10.59	70.1	22.4	8.34	149.7	±2.5 %
		Y	10.26	69.0	21.5		139.9	
		Z	10.53	69.9	22.4		144.9	
10434-AAA	W-CDMA (BS Test Model 1, 64 DPCH)	X	9.81	69.7	22.5	8.60	132.3	±2.2 %
		Y	9.51	68.5	21.6		125.0	
		Z	9.78	69.6	22.5		129.2	
10435-AAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	7.19	72.9	24.2	7.82	127.6	±2.2 %
		Y	7.59	73.6	24.4		147.3	
		Z	7.07	72.3	24.1		124.7	
10457-AAA	UMTS-FDD (DC-HSDPA)	X	8.35	67.3	20.1	6.62	139.7	±1.4 %
		Y	8.12	66.5	19.4		128.3	
		Z	8.32	67.2	20.1		135.4	
10460-AAA	UMTS-FDD (WCDMA, AMR)	X	2.90	68.0	19.1	2.39	143.8	±0.9 %
		Y	2.85	67.4	18.5		132.5	
		Z	2.99	68.8	19.7		138.4	
10461-AAA	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	7.38	73.6	24.6	7.82	132.5	±3.0 %
		Y	7.55	73.6	24.3		145.4	
		Z	7.23	72.9	24.4		126.5	
10462-AAA	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	7.72	73.8	24.9	8.30	126.2	±2.7 %
		Y	8.15	74.7	25.1		140.6	
		Z	8.45	76.2	26.4		149.1	
10464-AAA	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	7.27	73.2	24.4	7.82	127.9	±2.5 %
		Y	7.46	73.4	24.2		140.3	
		Z	7.79	75.0	25.6		148.8	

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10465-AAA	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	7.64	73.4	24.7	8.32	124.5	±3.0 %
		Y	8.16	74.7	25.1		140.5	
		Z	8.38	75.9	26.3		147.0	
10467-AAB	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	7.11	72.6	24.1	7.82	125.3	±2.5 %
		Y	7.44	73.3	24.2		139.5	
		Z	7.82	75.2	25.6		149.0	
10466-AAB	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	8.57	76.6	26.4	8.32	149.6	±3.0 %
		Y	8.14	74.6	25.1		140.9	
		Z	8.46	76.3	26.4		149.0	
10470-AAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	7.89	75.4	25.6	7.82	148.3	±2.7 %
		Y	7.51	73.6	24.3		140.6	
		Z	7.81	75.1	25.6		148.1	
10471-AAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	8.51	76.4	26.3	8.32	149.0	±3.0 %
		Y	8.14	74.6	25.1		141.1	
		Z	8.44	76.2	26.4		148.4	
10473-AAB	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	7.86	75.3	25.5	7.82	148.1	±2.7 %
		Y	7.48	73.5	24.3		141.1	
		Z	7.76	74.9	25.5		147.8	
10474-AAB	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	8.51	76.4	26.3	8.32	149.1	±3.0 %
		Y	8.13	74.6	25.1		141.7	
		Z	8.40	76.0	26.3		147.9	
10477-AAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	8.57	76.7	26.5	8.32	148.4	±3.0 %
		Y	8.17	74.7	25.2		142.2	
		Z	8.39	76.0	26.3		148.1	
10479-AAA	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	7.41	72.1	23.7	7.74	130.6	±2.7 %
		Y	7.11	70.5	22.6		126.0	
		Z	7.44	72.1	23.9		130.3	
10480-AAA	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	8.20	73.1	24.4	8.18	136.4	±3.0 %
		Y	7.90	71.6	23.3		130.3	
		Z	8.19	73.0	24.5		134.3	
10482-AAA	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	8.16	73.0	24.1	7.71	142.7	±3.3 %
		Y	7.79	71.3	22.9		136.9	
		Z	8.07	72.6	24.1		140.2	
10483-AAA	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	8.56	71.7	23.7	8.39	127.2	±2.7 %
		Y	9.01	72.7	24.0		148.0	
		Z	9.13	73.5	24.9		148.2	
10485-AAB	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	8.29	73.3	24.2	7.59	148.2	±2.5 %
		Y	7.91	71.7	23.0		140.3	
		Z	8.08	72.6	24.0		141.9	
10486-AAB	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	8.60	71.9	23.9	8.38	130.9	±2.7 %
		Y	9.04	72.2	23.7		149.2	
		Z	8.62	71.3	23.6		125.3	
10488-AAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	8.12	71.6	23.3	7.70	128.9	±2.7 %
		Y	8.42	72.1	23.3		147.2	
		Z	8.65	73.3	24.4		147.8	

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10489-AAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	9.11	72.0	23.9	8.31	137.4	±2.7 %
		Y	8.58	70.0	22.4		127.9	
		Z	8.95	71.5	23.6		130.3	
10491-AAB	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	8.67	72.3	23.5	7.74	135.2	±2.5 %
		Y	8.08	70.0	22.1		125.2	
		Z	8.48	71.6	23.3		128.7	
10492-AAB	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	9.70	72.6	24.1	8.41	144.0	±2.7 %
		Y	9.18	70.6	22.8		135.3	
		Z	9.54	72.0	23.9		138.6	
10494-AAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	8.68	72.5	23.7	7.74	133.9	±2.5 %
		Y	8.08	70.2	22.2		124.5	
		Z	8.51	71.9	23.5		127.7	
10495-AAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	9.60	72.5	24.1	8.37	142.9	±2.7 %
		Y	9.17	70.8	22.9		135.6	
		Z	9.48	72.1	23.9		137.9	
10497-AAA	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	8.00	72.9	24.1	7.67	144.0	±3.0 %
		Y	7.60	71.0	22.7		136.2	
		Z	7.89	72.4	24.0		139.2	
10498-AAA	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	8.34	71.4	23.6	8.40	124.4	±3.0 %
		Y	8.78	72.3	23.8		144.6	
		Z	8.94	73.3	24.8		145.4	
10500-AAA	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	7.79	71.1	23.1	7.67	125.5	±2.5 %
		Y	8.03	71.5	23.0		140.7	
		Z	8.44	73.3	24.4		146.1	
10501-AAA	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	8.98	72.0	24.0	8.44	133.9	±2.7 %
		Y	8.50	70.0	22.6		125.3	
		Z	8.84	71.5	23.8		128.5	
10503-AAB	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	8.11	71.6	23.3	7.72	128.9	±2.5 %
		Y	8.46	72.3	23.4		147.4	
		Z	8.77	73.7	24.6		149.9	
10504-AAB	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	9.12	72.1	23.9	8.31	137.9	±3.0 %
		Y	8.56	69.9	22.4		127.3	
		Z	8.98	71.6	23.7		132.5	
10506-AAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	8.66	72.5	23.7	7.74	133.6	±2.2 %
		Y	8.00	70.0	22.1		122.6	
		Z	8.54	72.0	23.6		129.3	
10507-AAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	9.56	72.4	24.0	8.36	142.4	±3.0 %
		Y	9.00	70.3	22.6		132.3	
		Z	9.54	72.3	24.1		139.8	
10509-AAB	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	9.43	73.2	24.1	7.99	139.9	±2.7 %
		Y	8.75	70.8	22.6		128.7	
		Z	9.34	72.9	24.1		135.9	

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10510-AAB	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	9.51	71.0	23.2	8.49	122.3	±2.7 %
		Y	9.71	71.2	23.1		140.2	
		Z	10.19	72.9	24.4		147.3	
10512-AAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	9.02	72.8	23.7	7.74	135.0	±2.5 %
		Y	8.41	70.7	22.3		126.5	
		Z	9.01	72.8	23.8		133.0	
10513-AAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	10.08	73.0	24.3	8.42	147.1	±2.7 %
		Y	9.44	70.8	22.8		136.6	
		Z	10.02	72.8	24.3		144.2	
10515-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps, 99pc duty cycle)	X	2.69	68.5	18.9	1.58	145.5	±0.7 %
		Y	2.62	67.5	18.1		139.0	
		Z	2.73	68.7	19.3		143.9	
10564-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 9 Mbps, 99pc duty cycle)	X	10.41	69.9	22.3	8.25	146.6	±2.2 %
		Y	10.14	68.9	21.5		138.8	
		Z	10.38	69.8	22.3		142.6	
10571-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 90pc duty cycle)	X	3.47	71.3	20.1	1.99	145.7	±0.7 %
		Y	3.22	69.4	19.0		137.8	
		Z	3.47	71.3	20.4		142.7	
10572-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps, 90pc duty cycle)	X	3.56	71.9	20.4	1.99	144.9	±0.7 %
		Y	3.39	70.5	19.4		138.7	
		Z	3.52	71.7	20.6		142.1	
10575-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 90pc duty cycle)	X	10.83	70.6	22.9	8.59	146.0	±2.7 %
		Y	10.51	69.5	22.0		140.4	
		Z	10.78	70.4	22.9		142.4	
10576-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 9 Mbps, 90pc duty cycle)	X	10.88	70.7	22.9	8.60	147.2	±2.7 %
		Y	10.55	69.6	22.1		139.9	
		Z	10.79	70.5	22.9		141.6	
10591-AAA	IEEE 802.11n (HT Mixed, 20MHz, MCS0, 90pc duty cycle)	X	10.96	70.7	22.9	8.63	148.2	±2.7 %
		Y	10.64	69.6	22.0		142.7	
		Z	10.91	70.5	22.9		144.1	
10592-AAA	IEEE 802.11n (HT Mixed, 20MHz, MCS1, 90pc duty cycle)	X	11.14	70.9	23.1	8.79	147.7	±2.7 %
		Y	10.84	69.8	22.3		143.1	
		Z	11.11	70.8	23.1		144.3	
10599-AAA	IEEE 802.11n (HT Mixed, 40MHz, MCS0, 90pc duty cycle)	X	11.15	70.1	22.5	8.79	126.8	±2.5 %
		Y	10.76	69.0	21.7		121.8	
		Z	11.13	70.1	22.6		124.8	
10600-AAA	IEEE 802.11n (HT Mixed, 40MHz, MCS1, 90pc duty cycle)	X	11.22	70.2	22.6	8.88	126.7	±2.2 %
		Y	10.85	69.1	21.8		122.4	
		Z	11.24	70.2	22.7		124.7	

² Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

Appendix C Dipole Calibration Certificate

**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 **Motorola Solutions MY**

Certificate No: **D450V3-1054_Oct17**

CALIBRATION CERTIFICATE

Object **D450V3 - SN:1054**

Calibration procedure(s) **QA CAL-15.v8
Calibration procedure for dipole validation kits below 700 MHz**

Calibration date: **October 25, 2017**

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: 5277 (20x)	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: 3877	31-Dec-16 (No. EX3-3877_Dec16)	Dec-17
DAE4	SN: 654	24-Jul-17 (No. DAE4-654_Jul17)	Jul-18
Secondary Standards	ID #	Check Date (In house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (No. 217-02285/02284)	In house check: Jun-18
Power sensor E4412A	SN: MY41498087	06-Apr-16 (No. 217-02285)	In house check: Jun-18
Power sensor E4412A	SN: 000110210	06-Apr-16 (No. 217-02284)	In house check: Jun-18
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-16)	In house check: Jun-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:	Jeton Kasrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: October 25, 2017

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

**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**

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	ELI4 Flat Phantom	Shell thickness: 2 ± 0.2 mm
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	43.5	0.87 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	43.5 ± 6 %	0.87 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.12 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	4.48 W/kg ± 18.1 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	0.750 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	3.00 W/kg ± 17.6 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	56.7	0.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.2 ± 6 %	0.93 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	4.57 W/kg ± 18.1 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	0.759 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	3.05 W/kg ± 17.6 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	57.9 Ω - 4.1 jΩ
Return Loss	- 21.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	54.4 Ω - 8.9 jΩ
Return Loss	- 20.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.349 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	December 16, 2005

DASY5 Validation Report for Head TSL

Date: 25.10.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 450 MHz D450V3; Type: D450V3; Serial: D450V3 - SN:1054

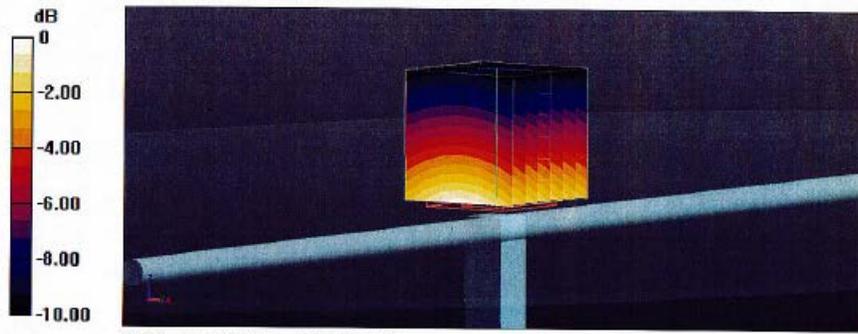
Communication System: UID 0 - CW; Frequency: 450 MHz
 Medium parameters used: $f = 450 \text{ MHz}$; $\sigma = 0.87 \text{ S/m}$; $\epsilon_r = 43.5$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Flat Section
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3877; ConvF(10.5, 10.5, 10.5); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 24.07.2017
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

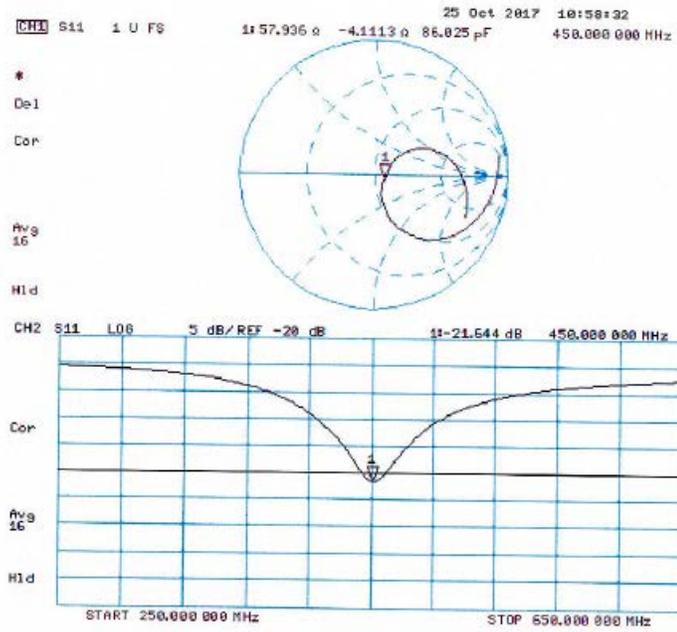
Dipole Calibration for Head Tissue/d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$
 Reference Value = 43.28 V/m; Power Drift = -0.06 dB
 Peak SAR (extrapolated) = 1.74 W/kg
SAR(1 g) = 1.12 W/kg; SAR(10 g) = 0.750 W/kg
 Maximum value of SAR (measured) = 1.52 W/kg



0 dB = 1.52 W/kg = 1.82 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 25.10.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 450 MHz D450V3; Type: D450V3; Serial: D450V3 - SN:1054

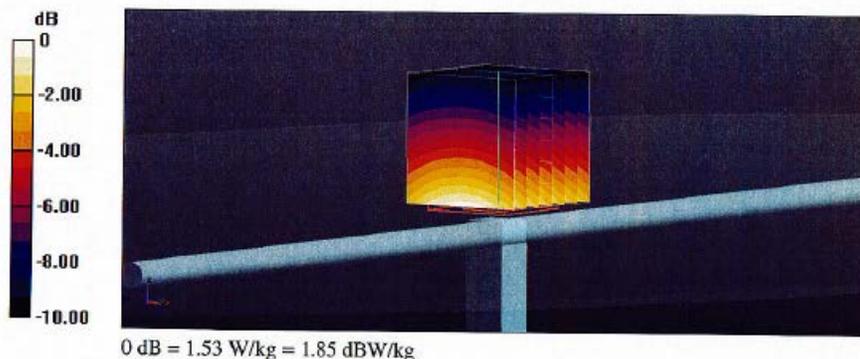
Communication System: UID 0 - CW; Frequency: 450 MHz
Medium parameters used: $f = 450 \text{ MHz}$; $\sigma = 0.93 \text{ S/m}$; $\epsilon_r = 55.2$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

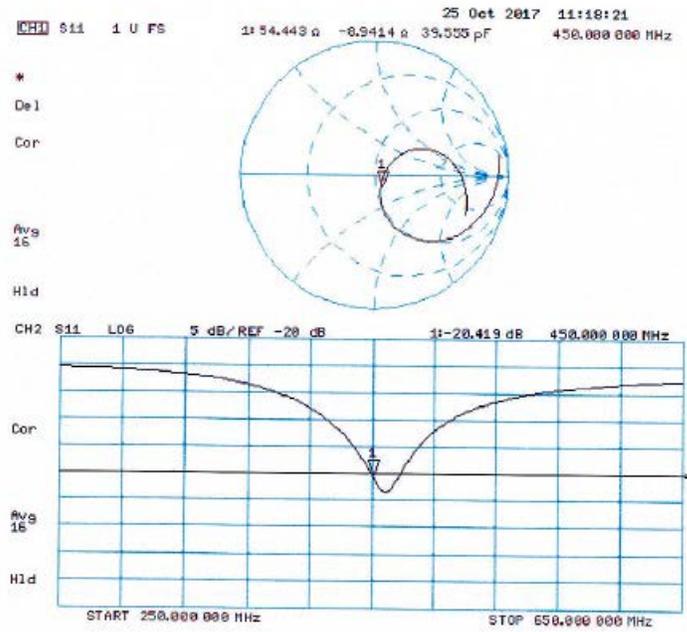
- Probe: EX3DV4 - SN3877; ConvF(10.7, 10.7, 10.7); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 24.07.2017
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

Dipole Calibration for Body Tissue/d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 42.19 V/m; Power Drift = -0.05dB
Peak SAR (extrapolated) = 1.76 W/kg
SAR(1 g) = 1.14 W/kg; SAR(10 g) = 0.759 W/kg
Maximum value of SAR (measured) = 1.53 W/kg



Impedance Measurement Plot for Body TSL



Dipole Data

As stated in KDB 865664, only dipoles used for longer calibration intervals required to provide supporting information and measurement to qualify for extended calibration interval.