CERTIFICATE 2518.05

DECLARATION OF COMPLIANCE SAR ASSESSMENT Part 1 of 2

Motorola Solutions Inc.
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Date of Report: 7/12/2017
Report Revision: A

Responsible Engineer:	Saw Sun Hock (EME Engineer)
Report Author:	Saw Sun Hock (EME Engineer)
Date/s Tested:	6/8/2017-6/9/2017, 6/13/2017 - 6/27/2017, 6/30/2017, 7/12/2017
Manufacturer:	Motorola Solutions Inc.
DUT Description:	Handheld Portable – APX 900 450-520MHz 1-5W, 12.5, 20, 25 KHz, Limited Keypad, Display, WIFI APX 900 450-520MHz 1-5W, 12.5, 20, 25 KHz, Full Keypad, Display, WIFI
Test TX mode(s):	CW (PTT), Bluetooth, and WLAN 802.11b/g/n
Max. Power output:	5.60 W (450-520MHz), 10 mW (Bluetooth), 10 mW (Bluetooth LE), 22.4 mW (802.11b), 8.3 mW (802.11g), 12.6 mW (802.11n)
Nominal Power:	5.00 W (450-520MHz), 8.9 mW (Bluetooth), 8.9 mW (Bluetooth LE), 16.6 mW (802.11b), 6.6 mW (802.11g), 10 mW (802.11n)
Tx Frequency Bands:	LMR 450-520 MHz; Bluetooth 2402-2480 MHz; WLAN 2412-2462 MHz
Signaling type:	FM (LMR), FHSS (Bluetooth), 802.11b/g/n (WLAN)
Model(s) Tested:	H92SDH9PW7AN (PMUE5246A), H92SDF9PW6AN (PMUE5245A)
Model(s) Certified:	H92SDH9PW7AN (PMUE5246A), H92SDF9PW6AN (PMUE5245A)
Serial Number(s):	837TTH0498, 837TTH0506, 837TTH0481, 837TTH0483
Classification:	Occupational/Controlled
FCC ID:	AZ489FT7099; LMR 450-512 MHz, Bluetooth 2.402-2.480 GHz, WLAN 802.11 b/g/n 2.412-2.462 GHz This report contains results that are immaterial for FCC equipment approval, which are clearly identified.
IC:	109U-89FT7099; This report contains results that are immaterial for IC equipment approval, which are clearly identified.
ISED Test Site registration:	109AK

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 OET Bulletin 65. The 10 grams result is not applicable to FCC filing. The test results clearly demonstrate compliance with ICNIRP (1998) Guidelines for limiting exposure in time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz), Health Physics 74, 494-522 RF Exposure limits of 10 W/kg averaged over 10grams of contiguous tissue.

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: 7/13/2017

Tiong Nguk Ing

Digitally signed by Tiong Nguk Ing
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Part 1 of 2

APPENDICES

Part 2 of 2

APPENDICES

Report Revision History

Date	Revision	Comments
7/12/2017	A	Initial release

1.0 Introduction

This report details the utilization, test setup, test equipment, and test results of the Specific Absorption Rate (SAR) measurements performed at the Motorola Solutions Inc. EME Test Laboratory for handheld portable model number H92SDH9PW7AN (PMUE5246A) and H92SDF9PW6AN (PMUE5245A).These devices are 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	10g-SAR	1g-SAR	10g-SAR
TNF	450-512MHz (LMR)	6.45	4.59	4.05	3.06
*DSS	2402-2480MHz	NA	NA	NA	NA
DTS	2412-2462 MHz (WLAN 802.11 b/g/n)	0.0051	0.0023	0.0257	0.0139
**Simultaneous Results		6.46	4.59	4.08	3.07

*Results not required per KDB (refer to sections 13.7 and 14.0)

3.0 Abbreviations / Definitions

BT: Bluetooth
CNR: Calibration Not Required
CW: Continuous Wave
DSSS: Direct Sequence Spread Spectrum
DTS: Digital Transmission System
DUT: Device Under Test
EME: Electromagnetic Energy
FHSS: Frequency Hopping Spread Spectrum
FM: Frequency Modulation
Li-Ion: Lithium-Ion
LMR: Land Mobile Radio
NA: Not Applicable
OFDM: Orthogonal Frequency Division Multiplexing
PTT: Push to Talk
RF: Radio Frequency
SAR: Specific Absorption Rate
DSP: Digital Signal Processor
DSS: Direct Spread Spectrum
GPS: Global Positioning System
MIC: Microphone

RSM: Remote Speaker Microphone
TDMA: Time Division Multiple Access
WLAN: Wireless Local Area Network
TNF: Licensed Non-Broadcast Transmitter Held to Face

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

These products are 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
- FCC KDB – 248227 D01 802.11 Wi-Fi SAR v02r02

5.0 SAR Limits

Table 2

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

6.0 Description of Device Under Test (DUT)

These portable devices operate in the LMR bands using frequency modulation (FM) and TDMA signals incorporating traditional simplex two-way radio transmission protocol. These devices also contain WLAN technology for data capabilities over 802.11 b/g/n wireless networks and Bluetooth technology for short range wireless devices.

Time Division Multiple Access (TDMA) is used to allocate portions of the RF signal by dividing time into two slots. Time allocation enables each unit to transmit its voice information without interference from other transmitting units. Transmission from a unit or base station is accommodated during two time-slot lengths of 15 milliseconds with frame length of 60 milliseconds. The TDMA technique requires sophisticated algorithms and a digital signal processor (DSP) to perform voice compressions/decompressions and RF modulation/demodulation. The maximum duty cycle for TDMA 1:2 is 50%.

The LMR bands in this device operate in a half duplex system. A half duplex system only allows the user to transmit or receive. These devices 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.

These devices also incorporate Class 1 Bluetooth Low energy (LE) device which is a Frequency Hopping Spread Spectrum (FHSS) technology and LE intended to reduce power consumption. The Bluetooth radio modem is used to wireless link audio accessories.
The maximum actual transmission duty cycle is imposing by Bluetooth standard. Packet types varying duty cycles: 1-slot, 3-slots and 5-slots packets. A 5-slot packet type receives on 1-slot and transmits on 5-slots, and thus maximum duty cycle = 76.1%.

WLAN 802.11 b/g/n operate using Direct Sequence Spread Spectrum (DSSS) and Orthogonal Frequency-Division Multiplexing (OFDM) accordance with the IEEE 802.11 b/g/n. With WiFi access, the radio can receive new code plug, firmware and software feature while allow users keep talking without interruption.

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

Table 3

Radio Type	Band (MHz)	Transmission	Duty Cycle (%)	Max Power (W)
LMR	450-520	FM	*50 / *25	5.60
BT	2402-2480	FHSS	77	0.010
BT LE	2402-2480	DSSS	76.1	0.010
WLAN	2412-2462	802.11b	99.8%	0.0224
WLAN	2412-2462	802.11g	99.2%	0.0083
WLAN	2412-2462	802.11n	99.1%	0.0126

Note - * includes 50% PTT operation

The intended operating positions are “at the face” with the DUT at least 1 inch from the mouth, and “at the body” by means of the offered body worn accessories. Body worn audio and PTT operation is accomplished by means of optional remote accessories that are connected to the radio. Operation at the body without an audio accessory attached is possible by means of BT accessories.

7.0 Optional Accessories and Test Criteria

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

7.1 Antennas

There are optional removable antennas and an internal Chip BT/WLAN antenna offered for these models. The Table below lists the antennas and its descriptions.

Table 4

Antenna No.	Antenna Models	Description	Selected for test	Tested
1	PMAE4102A	UHF Stubby Antenna; 450-527MHz; ¼ wave ; 1.7 dBi gain	Yes	Yes
2	PMAE4049A	UHF Whip Antenna; 450-527MHz; ¼ wave ; 1.9 dBd gain	Yes	Yes
3	*AN000151A01	Antenna, Chip, Glonass BT/GPS Antenna Module; 2.400 - 2.484 GHz; ¼ wave; -4 dBi gain	Yes	Yes; only for WLAN

* Refer to sections 13.7 and 14.0 for BT low power exclusion and simultaneous TX for antenna not tested.

7.2 Batteries

There are optional batteries offered for these products. The Table below lists their descriptions.

Table 5

Battery No.	Battery Models	Description	Selected for test	Tested	Comments
1	PMNN4491B	IMPRES 2100 mAH, Li-Ion Battery, Slim High Density Battery-IP68	Yes	Yes	Default battery for Body
2	PMNN4493A	IMPRES 3000 mAH, Li-Ion High Capacity Battery, Low Voltage, IP68	Yes	Yes	Default battery for Face
3	PMNN4448A	IMPRES 2700 mAh Li-Ion Battery	Yes	Yes	
4	PMNN4424A	IMPRES Li-Ion 2300 mAh Slim, IP67	Yes	Yes	
5	PMNN4489A	IMPRES 2900 mAH, Li-Ion High Capacity Battery, Low Voltage	Yes	Yes	
6	NNTN8128B	IMPRES Li-Ion 2000 mAh Slim, IP67	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	PMLN4651A	2 Inch Spring Action Belt Clip	Yes	Yes	
2	PMLN7008A	2.5 Inch Spring Action Belt Clip	Yes	Yes	
3	PMLN5838A	Leather Carry Case with 3-inch Fixed Belt Loop	Yes	Yes	
4	PMLN5840A	Leather Carry Case with 3-inch Swivel Belt Loop	Yes	Yes	.
5	PMLN5842A	Hard Leather Case with 2.5 Inch Swivel Belt Loop	Yes	Yes	
6	PMLN5844A	Nylon Carry Case with 3 Inch Fixed Belt Loop	Yes	Yes	

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	PMMN4062A	Impress Remote Speaker Microphone	Yes	Yes	Default Audio
2	PMLN5102A	Behind-the-head, single muff adjustable headset with in-line push-to-talk	Yes	Yes	
3	PMLN5096B	D-style earpiece with inline push-to-talk.	Yes	Yes	
4	PMLN5275C	Headset with push-to-talk on earcup, noise reduction = 24db, Intrinsically Safe (FM, CSA). May be worn with or without a helmet.	Yes	Yes	
5	PMLN6123A	IMPRES 3-Wire Surveillance Kit with translucent tube, programmable button, black	Yes	Yes	
6	PMLN6129A	IMPRES 2-Wire Surveillance Kit with translucent tube, programmable button, black	Yes	Yes	
7	BDN6783B	3.5mm Threaded Audio Adapter	Yes	Yes	Tested with BDN6732A & RLN5312B
8	RLN5312B	2-Wire Surveillance Kit with Translucent Tube, Black, 3.5mm Threaded.	Yes	Yes	Tested with BDN6783B
9	BDN6732A	3-Wire Surveillance Kit with Extra Loud Earpiece	Yes	Yes	Tested with BDN6783B
10	NNTN7869B	6 Pin Hirose Keyload & Audio Adapter, FM/IS rated	Yes	Yes	Tested with ZMN6038A & ZMN6031A
11	ZMN6031A	3-Wire Surveillance Kit, Beige, Hirose Connector. Requires NNTN7869 Hirose Adapter	Yes	Yes	Tested with NNTN7869B
12	ZMN6038A	2-Wire Surveillance Kit, with Extra Loud Earpiece, Beige, Hirose Connector	Yes	Yes	Tested with NNTN7869B
13	HMN4104B	Features 8-character display, channel knob and rugged, submersible audio jack	Yes	Yes	Tested with RMN5116A
14	RMN5116A	Unique secondary audio accessory that connects to the APX Display RSM and receives audio via bone conduction.	Yes	Yes	Tested with HMN4104B
15	PMLN5653A	D-style receive-only earpiece with 3.5mm plug.	Yes	Yes	
16	BDN6667A	2-Wire Surveillance Kit with Earpiece, Beige, 3.5mm Threaded	No	No	By similarity to RLN5312B

Table 7 continued

Audio No.	Audio Acc. Models	Description	Selected for test	Tested	Comments
17	BDN6668A	3-wire surveillance kit, Beige	No	No	By similarity to BDN6732A
18	BDN6669A	2-wire surveillance kit with an extra-loud earpiece	No	No	By similarity to RLN5312B
19	BDN6670A	This beige, extra-loud (exceeds OHSA standards) earpiece has a separate microphone and Push-to-Talk feature.	No	No	By similarity to BDN6732A
20	BDN6729A	2-Wire Earpiece with Microphone and Push-to-Talk Combined, Black	No	No	By similarity to RLN5312B
21	BDN6730A	3-wire earpiece has a separate microphone and Push-to-Talk feature, Black	No	No	By similarity to BDN6732A
22	BDN6731A	2-Wire Receive-Only Surveillance Kit with Extra-Loud Earpiece, Black, 3.5mm Threaded	No	No	By similarity to RLN5312B
23	HMN4101B	Includes rugged, submersible audio jack	No	No	By similarity to HMN4104B
24	HMN4103B	Features 8-character display and rugged, submersible audio jack	No	No	By similarity to HMN4104B
25	PMLN5101A	IMPRES Temple Transducer with boom microphone and inline PTT	No	No	By similarity to PMLN5275C
26	PMLN6124A	IMPRES 3-Wire Surveillance Kit with translucent tube, programmable button, beige	No	No	By similarity to PMLN6123A
27	PMLN6127A	IMPRES 2-Wire Surveillance Kit, programmable button, black	No	No	By similarity to PMLN6129A
28	PMLN6128A	IMPRES 2-wire beige surveillance kit allows the user to both transmit and receive discreet communications.	No	No	By similarity to PMLN6129A
29	PMLN6130A	IMPRES 2-wire beige surveillance kit allows the user to both transmit and receive discreet communications.	No	No	By similarity to PMLN6129A
30	PMMN4065A	Includes volume control, orange button, and one programmable button.	No	No	By similarity to PMMN4062A
31	PMMN4069A	Windporting microphone with audio jack	No	No	By similarity to PMMN4062A
32	RMN5058A	Single ear, lightweight headset for comfortable, convenient communications.	No	No	By similarity to PMLN5275C
33	ZMN6039A	3-Wire Surveillance Kit, with Extra Loud Earpiece, Beige, Hirose Connector	No	No	By similarity to ZMN6031A
34	ZMN6032A	2-Wire Surveillance Kit, Beige, Hirose Connector	No	No	By similarity to ZMN6038A
35	BDN6666A	Single-wire receive-only surveillance kit with volume control	No	No	Receive Only
36	BDN6728A	1-wire Receive-Only Earpiece with Volume Control and Ear loop, Black.	No	No	Receive Only
37	PMLN6125A	1-wire surveillance kit is a simple, cost-effective solution for users who require discreet communications, Black	No	No	Receive Only
38	PMLN6126A	1-wire surveillance kit is a simple, cost-effective solution for users who require discreet communications, Biege	No	No	Receive Only
39	RLN5313B	1-Wire Receive-Only Surveillance Kit with Translucent Tube, Black, 3.5mm Threaded	No	No	Receive Only
40	RLN5314A	1-Wire Receive-Only Surveillance Kit with Translucent Tube, Beige, 3.5mm Threaded	No	No	Receive Only
41	RLN4941A	Receive-only earpiece with translucent tube and rubber eartip. For Remote Speaker Microphones with 3.5mm audio jack.	No	No	Receive Only
42	AARLN4885B	Receive-only earbud. For Remote Speaker Microphones with 3.5mm audio jack.	No	No	Receive Only
43	WADN4190B	Receive-only flexible earpiece. For Remote Speaker Microphones with 3.5mm audio jack.	No	No	Receive Only

Table 7 continued

Audio No.	Audio Acc. Models	Description	Selected for test	Tested	Comments
44	RLN6424B	Earpiece with translucent tube and rubber eartip.	No	No	Receive Only
45	BDN6781A	Receive-Only Ear pad, Single Wire, Threaded 3.5 mm connector	No	No	Receive Only
46	PMLN4620B	D-Shell Rx-Only Earpiece	No	No	Receive Only
47	BDN6664A	1-Wire Receive-Only Surveillance Kit with Earpiece, Beige, 3.5mm Threaded	No	No	Receive Only
48	BDN6665A	1-Wire Receive-Only Surveillance Kit with Extra-Loud Earpiece, Beige, 3.5mm Threaded	No	No	Receive Only
49	BDN6726A	1-Wire Receive-Only Surveillance Kit with Earpiece, Black, 3.5mm Threaded.	No	No	Receive Only
50	BDN6727A	1-Wire Receive-Only Surveillance Kit with Extra-Loud Earpiece, Black, 3.5mm Threaded	No	No	Receive Only
51	RLN5887A	High Noise kit. Includes clear acoustic tube and foam earplugs.	No	No	Receive Only

8.0 Description of Test System

8.1 Descriptions of Robotics/Probes/Readout Electronics

Table 8

Dosimetric System type	System version	DAE type	Probe Type
Schmid & Partner Engineering AG SPEAG DASY 5	52.8.8.1222	DAE4	EX3DV4 (E-Field)

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

8.2 Description of Phantom(s)

Table 9

Phantom Type	Phantom(s) Used	Material Parameters	Phantom Dimensions LxWxD (mm)	Material Thickness (mm)	Support Structure Material	Loss Tangent (wood)
Triple Flat	NA	200MHz -6GHz; Er = 3-5, Loss Tangent = ≤0.05	280x175x175	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 10

Ingredients	450MHz		2450MHz	
	Head	Body	Head	Body
Sugar	56.00	46.50	0	0
Diacetin	0	0	51.00	34.50
De ionized – Water	39.10	50.53	48.75	65.20
Salt	3.80	1.87	0.15	0.20
HEC	1.00	1.00	0	0
Bact.	0.10	0.10	0.10	0.10

9.0 Additional Test Equipment

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

Table 11

Equipment Type	Model Number	Serial Number	Calibration Date	Calibration Due Date
Speag Probe	EX3DV4	3612	5/17/2017	5/17/2018
Speag Probe	EX3DV4	3735	3/10/2017	3/10/2018
Speag DAE	DAE4	1294	5/23/2017	5/23/2018
Speag DAE	DAE4	729	10/12/2016	10/12/2017
Power Meter	E4418B	MY45107917	5/22/2017	5/22/2019
Power Meter	E4419B	MY45103725	5/22/2017	5/22/2019
Power Meter	E4416A	MY50001037	5/22/2017	5/22/2019
Power Meter	E4419B	MY50000505	9/2/2015	9/2/2017
Power Meter	E4418B	MY45100532	11/4/2015	11/4/2017
Power Sensor	E9301B	MY55210003	7/27/2016	7/27/2017
Power Sensor	E4412A	US37183007	5/19/2017	5/19/2018
Power Sensor	E9301B	MY55210006	11/6/2016	11/6/2017
Power Sensor	8481B	SG41090248	12/16/2016	12/16/2017
*Power Sensor	8482B	2703A04641	6/15/2016	6/15/2017
Power Sensor	E8481B	MY41091170	5/21/2017	5/21/2018
Bi-directional Coupler	3020A	41935	9/2/2016	9/2/2017
Bi-directional Coupler	3022	81640	9/2/2016	9/2/2017
Signal Generator	E4438C	MY42081753	4/8/2017	4/8/2018
Signal Generator	E4438C	MY45091270	7/26/2016	7/26/2018
*Signal Generator	E4438C	MY44270302	6/18/2015	6/18/2017
Broadband Power Sensor	NRP-Z11	121252	2/6/2017	2/6/2019
Amplifier	10W1000C	312859	CNR	CNR
Amplifier	5S1G4	313326	CNR	CNR
Dickson Temperature Recorder	TM320	06153216	8/2/2016	8/2/2017
Temperature Probe	80PK-22	06032017	3/24/2017	3/24/2018
Temperature Probe	80PK-22	05032017	3/24/2017	3/24/2018
Thermometer	HH202A	18801	1/25/2017	1/25/2018
Thermometer	HH202A	35881	12/2/2016	12/2/2017
Dielectric Assessment Kit	DAK-3.5	1156	10/11/2016	10/11/2017
Network Analyzer	E5071B	MY42403147	11/15/2016	11/15/2017
Network Analyzer	E5071B	MY42403218	8/15/2016	8/15/2017
Speag Dipole	D2450V2	782	2/15/2017	2/15/2019
Speag Dipole	D450V3	1077	11/25/2015	11/25/2017

Note: “*”Equipments used for test date prior to calibration due date.

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 12

Dates	Probe Calibration Point		Probe SN	Measured Tissue Parameters		Validation		
				σ	ϵ_r	Sensitivity	Linearity	Isotropy
CW								
6/6/2017	Body	450	3612	0.93	54.7	Pass	Pass	Pass
6/9/2017	Head	450		0.89	43.5	Pass	Pass	Pass
4/23/2017	Body	2450	3735	2.03	53.1	Pass	Pass	Pass
3/22/2017	Head	2450		1.86	36.2	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 13

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
3735	FCC Body	SPEAG D2450V2 / 782	50.50 +/- 10%	13.5	54.00	6/8/2017
				13.0	52.00	6/13/2017
				13.8	55.20	6/14/2017
				12.7	50.80	6/30/2017
	IEEE/IEC Head		53.30 +/- 10%	13.3	53.20	6/9/2017
				13.6	54.40	6/13/2017
3612	FCC Body	SPEAG D450V3 / 1077	4.52 +/- 10%	1.12	4.48	6/16/2017
				1.07	4.28	6/17/2017
				1.08	4.32	*6/18/2017
				1.08	4.32	6/20/2017
				1.09	4.36	6/21/2017
				1.08	4.32	6/22/2017
				1.07	4.28	6/23/2017
				1.06	4.24	6/24/2017
				1.07	4.28	*6/25/2017
				1.09	4.36	7/12/2017
	IEEE/IEC Head		4.57 +/- 10%	1.04	4.16	6/26/2017
				1.06	4.24	6/27/2017

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

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 14

Frequency (MHz)	Tissue Type	Conductivity Target (S/m)	Dielectric Constant Target	Conductivity Meas. (S/m)	Dielectric Constant Meas.	Tested Date
450	FCC Body	0.94 (0.89-0.99)	56.70 (53.90-59.50)	0.92	54.6	6/16/2017
				0.91	54.7	6/17/2017
				0.94	54.7	*6/18/2017
				0.92	54.6	6/20/2017
				0.93	55.0	6/21/2017
				0.92	55.1	6/22/2017
				0.90	54.8	6/23/2017
				0.91	54.9	6/24/2017
				0.90	55.0	*6/25/2017
				0.94	56.8	7/12/2017
	IEEE/ IEC Head	0.87 (0.83-0.91)	43.50 (41.30-45.70)	0.84	43.2	*6/26/2017
466	FCC Body	0.94 (0.89-0.99)	56.60 (53.80-59.50)	0.94	54.3	6/16/2017
				0.92	54.4	6/17/2017
				0.95	54.4	6/18/2017
				0.94	54.8	6/21/2017
				0.93	54.8	6/22/2017
				0.91	54.5	6/23/2017
				0.92	54.7	*6/24/2017
470	FCC Body	0.94 (0.89-0.99)	56.60 (53.80-59.50)	0.96	56.5	7/12/2017
481	FCC Body	0.94 (0.90-0.99)	56.60 (53.80-59.40)	0.95	54.1	6/16/2017
				0.96	54.2	6/18/2017
				0.96	54.6	6/21/2017
				0.95	54.6	6/22/2017
				0.92	54.3	6/23/2017
				0.92	54.7	*6/24/2017
	IEEE/ IEC Head	0.87 (0.83-0.92)	43.30 (41.20-45.50)	0.86	42.5	6/26/2017

Note: * This tissue date covered for next test day (within 24 hours)

Table 14 continued

Frequency (MHz)	Tissue Type	Conductivity Target (S/m)	Dielectric Constant Target	Conductivity Meas. (S/m)	Dielectric Constant Meas.	Tested Date
497	FCC Body	0.94 (0.90-0.99)	56.50 (53.70-59.30)	0.96	53.8	6/16/2017
				0.95	54.0	6/17/2017
				0.98	54.0	*6/18/2017
				0.96	53.9	6/20/2017
				0.97	54.4	6/21/2017
				0.96	54.3	6/22/2017
				0.94	54.1	6/23/2017
				0.95	54.2	*6/24/2017
512	FCC Body	0.94 (0.90-0.99)	56.50 (53.60-59.30)	0.96	53.7	6/17/2017
				0.99	53.8	6/18/2017
				0.98	54.2	6/21/2017
				0.97	54.1	6/22/2017
				0.95	53.9	6/23/2017
				0.96	54.0	6/24/2017
				0.95	54.1	6/25/2017
	IEEE/ IEC Head	0.87 (0.83-0.92)	43.20 (41.00-45.30)	0.89	41.9	6/26/2017
516	FCC Body	0.95 (0.90-0.99)	56.40 (53.60-59.30)	0.96	54.0	6/24/2017
				0.96	54.1	*6/25/2017
	IEEE/ IEC Head	0.87 (0.83-0.92)	43.10 (41.00-45.30)	0.89	41.8	*6/26/2017
520	FCC Body	0.95 (0.90-0.99)	56.40 (53.60-59.20)	0.96	54.0	*6/25/2017
	IEEE/ IEC Head	0.87 (0.83-0.92)	43.10 (41.00-45.30)	0.90	41.8	*6/26/2017
2437	FCC Body	1.94 (1.84-2.03)	52.70 (47.40-58.00)	1.98	50.1	*6/7/2017
				2.00	49.1	6/13/2017
				2.02	48.6	6/14/2017
				2.02	47.9	6/30/2017
	IEEE/ IEC Head	1.79 (1.70-1.88)	39.2 (35.30-43.10)	1.83	35.7	6/9/2017
				1.80	35.6	6/13/2017
2450	FCC Body	1.95 (1.85-2.05)	52.70 (47.40-58.00)	2.00	50.1	*6/7/2017
				2.01	49.1	6/13/2017
				2.03	48.6	6/14/2017
				2.04	47.8	6/30/2017
	IEEE/ IEC Head	1.80 (1.71-1.89)	39.2 (35.30-43.10)	1.84	35.6	6/9/2017
				1.81	35.6	6/13/2017

Note: * This tissue date covered for next test day (within 24 hours)

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^{o}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: 18.8 – 25˚C Avg. 21.3 ˚C
Tissue Temperature	NA	Range: 19.2-21.8˚C Avg. 20.7˚C

Relative humidity target range is a recommended target

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

12.0 DUT Test Setup and Methodology

12.1 Measurements

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

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

Table 16

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

12.2 DUT Configuration(s)

The DUT is a portable device operational at the body and face as described in section 6.0 while using the applicable accessories listed in section 7.0. All accessories listed in section 7.0 of this report were considered when implementing the guidelines specified in KDB 643646.

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 as well as with and without the offered audio accessories as applicable.

12.3.2 Head

Not applicable.

12.3.3 Face

The DUT was positioned with its' front and back sides separated 2.5cm from the phantom.

12.4 DUT Test Channels

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

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

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

12.5 SAR Result Scaling Methodology

The calculated 1-gram and 10-gram averaged SAR results indicated as "Max Calc. 1g-SAR" and "Max Calc.10g-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" and "Max Calc.10g-SAR" are scaled using the following formula:

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

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_int > P_max, then P_max/P_int = 1.
Drift = 1 for positive drift

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

12.6 DUT Test Plan

The guidelines and requirements outlined in section 4.0 were used to assess compliance of this device. All modes of operation identified in section 6.0 were considered during the development of the test plan. All tests were performed in CW and LTE modes and 50% duty cycle was applied to PTT configurations in the final results.

Standalone and simultaneous BT testing were assessed in sections 13.7 and 14.0 per the guidelines of KDB 447498.

WLAN tests were performed in 802.11b mode using a duty cycle of 99.8% with results scaled to 100% as per guidelines of KDB 248227.

13.0 DUT Test Data

13.1 LMR assessments at the Body for 450-512MHz band

Battery PMNN4491B was selected as the default battery for assessments at the Body because it is the thinnest battery (refer to Exhibit 7B for battery illustration). The default battery was used during conducted power measurements for all test channels within FCC allocated frequency range (450-512MHz) which are listed in Table 17. The channel with the highest conducted power will be identified as the default channel per KDB 643646 (SAR Test for PTT Radios).

Table 17

Test Freq (MHz)	Power (W)
450.0000	5.45
465.5000	5.43
481.0000	5.48
496.5000	5.50
512.0000	5.44

Assessments at the Body with Body worn PMLN4651A

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 F.

Table 18

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
PMAE4102A	PMNN4491B	PMLN4651A	PMMN4062A	450.0000	5.45	-0.54	7.94	5.87	4.62	3.42	TLC(FAZ)-AB-170616-02
				465.5000	5.43	-0.74	8.12	5.96	4.96	3.64	TLC(FAZ)-AB-170616-03
				481.0000							
				496.5000	5.60	-0.69	6.57	4.70	3.85	2.75	FD(AN)-AB-170620-17
				512.0000							
PMAE4049A	PMNN4491B	PMLN4651A	PMMN4062A	450.0000	5.45	-0.62	7.17	5.34	4.25	3.16	FIE-AB-170616-08
				465.5000	5.50	-0.57	8.64	6.37	5.02	3.70	FIE-AB-170616-09
				481.0000	5.46	-0.68	7.86	5.76	4.71	3.45	FIE(AN)-AB-170616-10
				496.5000	5.49	-0.67	7.28	5.25	4.33	3.12	FIE(AN)-AB-170616-11
				512.0000	5.58	-0.82	9.42	6.82	5.71	4.13	FIE-AB-170617-02

Table 18 (Continued)

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
Assessment of Additional Batteries											
PMAE4102A	PMNN4448A	PMLN4651A	PMMN4062A	450.0000							
				465.5000	5.37	-0.77	6.55	4.80	4.08	2.99	FIE-AB-170617-03
				481.0000							
				496.5000							
				512.0000							
PMAE4102A	PMNN4424A	PMLN4651A	PMMN4062A	450.0000							
				465.5000	5.38	-0.78	6.50	4.76	4.05	2.96	FIE-AB-170617-05
				481.0000							
				496.5000							
				512.0000							
PMAE4102A	PMNN4493A	PMLN4651A	PMMN4062A	450.0000							
				465.5000	5.52	-0.81	6.18	4.60	3.78	2.81	FIE-AB-170617-07
				481.0000							
				496.5000							
				512.0000							
PMAE4102A	PMNN4489A	PMLN4651A	PMMN4062A	450.0000							
				465.5000	5.30	-0.72	7.23	5.28	4.51	3.29	FIE-AB-170617-09
				481.0000							
				496.5000							
				512.0000							
PMAE4102A	NNTN8128B	PMLN4651A	PMMN4062A	450.0000							
				465.5000	5.54	-0.83	8.73	6.33	5.34	3.87	FD-AB-170617-11
				481.0000							
				496.5000							
				512.0000							

Table 18 (Continued)

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
Assessment of Additional Batteries											
PMAE4049A	PMNN4448A	PMLN4651A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000							
				512.0000	5.47	-0.71	6.53	4.85	3.94	2.92	FIE-AB-170617-04
PMAE4049A	PMNN4424A	PMLN4651A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000							
				512.0000	5.40	-0.87	6.30	4.67	3.99	2.96	FIE-AB-170617-06
PMAE4049A	PMNN4493A	PMLN4651A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000							
				512.0000	5.50	-0.77	7.48	5.47	4.55	3.32	FIE-AB-170617-08
PMAE4049A	PMNN4489A	PMLN4651A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000							
				512.0000	5.30	-0.73	7.76	5.66	4.85	3.54	FD-AB-170617-10
PMAE4102A	NNTN8128B	PMLN4651A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000							
				512.0000	5.58	-0.79	9.90	7.08	**5.96**	**4.26**	FD-AB-170617-12

Assessments at the Body with Body worn PMLN7008A

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 F.

Table 19

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
PMAE4102A	PMNN4491B	PMLN7008A	PMMN4062A	450.0000	5.52	-0.55	7.98	5.89	4.59	3.39	FD-AB-170617-13
				465.5000	5.42	-0.77	8.03	5.92	4.95	3.65	FD-AB-170617-14
				481.0000							
				496.5000	5.57	-0.76	6.38	4.58	3.82	2.74	FD-AB-170617-16
				512.0000							
PMAE4049A	PMNN4491B	PMLN7008A	PMMN4062A	450.0000	5.40	-0.63	7.04	5.17	4.22	3.10	FD-AB-170617-18
				465.5000	5.56	-0.78	7.47	5.48	4.50	3.30	FIE-AB-170618-02
				481.0000	5.53	-0.72	7.54	5.48	4.51	3.28	FIE-AB-170618-03
				496.5000	5.55	-0.68	7.33	5.23	4.32	3.09	FIE-AB-170618-04
				512.0000	5.60	-0.77	9.47	6.83	5.65	4.08	FIE-AB-170618-05
Assessment of Additional Batteries											
PMAE4102A	PMNN4448A	PMLN7008A	PMMN4062A	450.0000							
				465.5000	5.49	-0.77	6.88	5.03	4.19	3.06	FIE-AB-170618-06
				481.0000							
				496.5000							
				512.0000							
PMAE4102A	PMNN4424A	PMLN7008A	PMMN4062A	450.0000							
				465.5000	5.38	-0.76	6.66	4.88	4.13	3.03	FD-AB-170618-08
				481.0000							
				496.5000							
				512.0000							
PMAE4102A	PMNN4493A	PMLN7008A	PMMN4062A	450.0000							
				465.5000	5.56	-0.80	6.48	4.83	3.92	2.92	FD-AB-170618-10
				481.0000							
				496.5000							
				512.0000							
PMAE4102A	PMNN4489A	PMLN7008A	PMMN4062A	450.0000							
				465.5000	5.30	-0.70	7.54	5.49	4.68	3.41	FD-AB-170618-12
				481.0000							
				496.5000							
				512.0000							
PMAE4102A	NNTN8128B	PMLN7008A	PMMN4062A	450.0000							
				465.5000	5.59	-0.81	9.39	6.80	5.67	4.10	FD-AB-170618-14
				481.0000							
				496.5000							
				512.0000							

Table 19 (Continued)

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
Assessment of Additional Batteries											
PMAE4049A	PMNN4448A	PMLN7008A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000							
				512.0000	5.50	-0.59	6.76	5.01	3.94	2.92	FD-AB-170618-07
PMAE4049A	PMNN4424A	PMLN7008A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000							
				512.0000	5.40	-0.83	6.81	5.06	4.27	3.18	FD-AB-170618-09
PMAE4049A	PMNN4493A	PMLN7008A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000							
				512.0000	5.54	-0.77	7.28	5.41	4.39	3.26	FD-AB-170618-11
PMAE4049A	PMNN4489A	PMLN7008A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000							
				512.0000	5.30	-0.72	8.04	5.92	5.01	3.69	FD-AB-170618-13
PMAE4049A	NNTN8128B	PMLN7008A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.75	-0.69	8.10	5.76	4.75	3.38	FD(AN)-AB-170619-01#
				512.0000	5.59	-0.78	10.40	7.45	**6.23**	**4.47**	FD-AB-170618-16

Assessments at the Body with Body worn PMLN5838A

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 F.

Table 20

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
PMAE4102A	PMNN4491B	PMLN5838A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.59	-0.73	3.24	2.43	1.92	1.44	FD(AN)-AB-170620-18
				512.0000							
PMAE4049A	PMNN4491B	PMLN5838A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.57	-0.56	4.02	3.01	**2.30**	**1.72**	ZR(HR)-AB-170620-19
				512.0000							
Assessment of Additional Batteries											
PMAE4049A	PMNN4448A	PMLN5838A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.57	-0.56	2.58	1.94	1.48	1.11	ZR(HR)-AB-170620-20
				512.0000							
PMAE4049A	PMNN4424A	PMLN5838A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.45	-0.63	2.75	2.08	1.63	1.24	ZR(HR)-AB-170620-21
				512.0000							
PMAE4049A	PMNN4493A	PMLN5838A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.57	-0.62	3.12	2.36	1.81	1.37	ZR(HR)-AB-170620-22
				512.0000							
PMAE4049A	PMNN4489A	PMLN5838A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.36	-0.55	3.45	2.60	2.05	1.54	ZR(HR)-AB-170620-23
				512.0000							
PMAE4049A	NNTN8128B	PMLN5838A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.59	-0.58	3.35	2.54	1.92	1.45	ZR(HR)-AB-170621-01#
				512.0000							

Assessments at the Body with Body worn PMLN5840A

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 F.

Table 21

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
PMAE4102A	PMNN4491B	PMLN5840A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.59	-0.67	1.93	1.47	1.13	0.86	ZR(HR)-AB-170621-02#
				512.0000							
PMAE4049A	PMNN4491B	PMLN5840A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.58	-0.54	2.09	1.60	**1.19**	**0.91**	ZR(HR)-AB-170621-03#
				512.0000							
Assessment of Additional Batteries											
PMAE4049A	PMNN4448A	PMLN5840A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.46	-0.53	1.52	1.16	0.88	0.67	ZR(HR)-AB-170621-04#
				512.0000							
PMAE4049A	PMNN4424A	PMLN5840A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.36	-0.53	1.49	1.14	0.88	0.67	ZR(HR)-AB-170621-05#
				512.0000							
PMAE4049A	PMNN4493A	PMLN5840A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.60	-0.54	1.54	1.18	0.87	0.67	ZR(HR)-AB-170621-06#
				512.0000							
PMAE4049A	PMNN4489A	PMLN5840A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.28	-0.44	1.63	1.25	0.96	0.73	FD(AN)-AB-170621-07#
				512.0000							

Table 21 (Continued)

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
Assessment of Additional Batteries											
PMAE4049A	NNTN8128B	PMLN5840A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.59	-0.60	1.96	1.50	1.13	0.86	FD(AN)-AB-170621-08#
				512.0000							

Assessments at the Body with Body worn PMLN5842A

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 F.

Table 22

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
PMAE4102A	PMNN4491B	PMLN5842A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.58	-0.71	2.42	1.60	1.43	0.95	FD(AN)-AB-170621-09#
				512.0000							
PMAE4049A	PMNN4491B	PMLN5842A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.59	-0.66	2.70	1.88	**1.57**	**1.10**	FD(AN)-AB-170621-10#
				512.0000							

Table 22 (Continued)

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
Assessment of Additional Batteries											
PMAE4049A	PMNN4448A	PMLN5842A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.56	-0.63	1.74	1.23	1.01	0.72	FD(AN)-AB-170621-11#
				512.0000							
PMAE4049A	PMNN4424A	PMLN5842A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.50	-0.73	1.82	1.25	1.10	0.75	FD(AN)-AB-170621-13
				512.0000							
PMAE4049A	PMNN4493A	PMLN5842A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.59	-0.84	1.73	1.27	1.05	0.77	FD(AN)-AB-170621-14
				512.0000							
PMAE4049A	PMNN4489A	PMLN5842A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.35	-0.70	2.22	1.52	1.37	0.93	FD(AN)-AB-170621-15
				512.0000							
PMAE4049A	NNTN8128B	PMLN5842A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.59	-0.78	2.27	1.55	1.36	0.93	FD(AN)-AB-170621-16
				512.0000							

Assessments at the Body with Body worn PMLN5844A

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 F.

Table 23

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
PMAE4102A	PMNN4491B	PMLN5844A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.60	-0.76	4.74	3.56	2.82	2.12	FD(AN)-AB-170621-17
				512.0000							
PMAE4049A	PMNN4491B	PMLN5844A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.60	-0.67	5.75	4.31	3.35	2.51	FD(AN)-AB-170621-18
				512.0000							
Assessment of Additional Batteries											
PMAE4049A	PMNN4448A	PMLN5844A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.55	-0.60	4.43	3.32	2.57	1.92	FD(AN)-AB-170621-19
				512.0000							
PMAE4049A	PMNN4424A	PMLN5844A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.43	-0.57	4.60	3.44	2.70	2.02	ZR(HR)-AB-170621-20
				512.0000							
PMAE4049A	PMNN4493A	PMLN5844A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.57	-0.61	4.75	3.55	2.75	2.05	ZR(HR)-AB-170621-21
				512.0000							
PMAE4049A	PMNN4489A	PMLN5844A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.35	-0.54	5.15	3.86	3.05	2.29	ZR(HR)-AB-170621-22
				512.0000							
PMAE4049A	NNTN8128B	PMLN5844A	PMMN4062A	450.0000							
				465.5000							
				481.0000							
				496.5000	5.60	-0.62	5.96	4.46	**3.44**	**2.57**	ZR(HR)-AB-170621-23
				512.0000							

Assessment at the Body with other audio accessories

Assessment per "KDB 643646 Body SAR Test Consideration for Audio Accessories without Built-in Antenna".

Table 24

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
PMAE4049A	NNTN8128B	PMLN7008A	PMLN5102A	450.0000	5.58	-0.47	7.48	5.39	4.18	3.01	FD(AN)-AB-170622-09#
				465.5000	5.45	-0.69	9.13	6.51	5.50	3.92	FD(AN)-AB-170622-10#
				481.0000	5.50	-0.68	8.87	6.29	5.28	3.74	FD(AN)-AB-170622-11#
				496.5000	5.59	-0.51	9.06	6.39	5.10	3.60	FD(AN)-AB-170622-14
				512.0000	5.60	-0.83	9.91	7.03	6.00	4.26	FD(AN)-AB-170622-15
PMAE4049A	NNTN8128B	PMLN7008A	PMLN5096B	450.0000	5.55	-0.53	7.72	5.54	4.40	3.16	FD(AN)-AB-170622-16
				465.5000	5.54	-0.64	9.13	6.48	5.35	3.80	FD(AN)-AB-170622-17
				481.0000	5.59	-0.73	8.99	6.36	5.33	3.77	FD(AN)-AB-170622-18
				496.5000	5.60	-0.65	8.25	5.77	4.79	3.35	ZR(HR)-AB-170622-19
				512.0000	5.60	-0.84	10.20	7.22	6.19	4.38	ZR(HR)-AB-170622-20
PMAE4049A	NNTN8128B	PMLN7008A	PMLN5275C	450.0000	5.60	-0.56	8.40	6.02	4.78	3.42	ZR(HR)-AB-170622-21
				465.5000	5.46	-0.63	9.69	6.93	5.74	4.11	ZR(HR)-AB-170622-22
				481.0000	5.60	-0.66	9.14	6.48	5.32	3.77	ZR(HR)-AB-170622-23
				496.5000	5.60	-0.63	8.70	6.15	5.03	3.56	ZR(HR)-AB-170623-01#
				512.0000	5.60	-0.79	9.77	6.95	5.86	4.17	ZR(HR)-AB-170623-02#
PMAE4049A	NNTN8128B	PMLN7008A	PMLN6123A	450.0000	5.58	-0.47	7.76	5.59	4.34	3.13	ZR(HR)-AB-170623-03#
				465.5000	5.48	-0.65	8.81	6.30	5.23	3.74	ZR(HR)-AB-170623-04#
				481.0000	5.58	-0.66	8.40	5.94	4.91	3.47	ZR(HR)-AB-170623-05#
				496.5000	5.60	-0.65	7.53	5.30	4.37	3.08	ZR(HR)-AB-170623-06#
				512.0000	5.60	-0.79	9.05	6.41	5.43	3.84	ZR(HR)-AB-170623-07#

Table 24 (Continued)

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
PMAE4049A	NNTN8128B	PMLN7008A	PMLN6129A	450.0000	5.58	-0.59	6.84	4.90	3.93	2.82	ZR(HR)-AB-170623-08#
				465.5000	5.56	-0.70	9.17	6.54	5.43	3.87	FD(AN)-AB-170623-09#
				481.0000	5.52	-0.69	8.71	6.16	5.18	3.66	FD(AN)-AB-170623-10#
				496.5000	5.59	-0.65	8.12	5.73	4.72	3.33	FD(AN)-AB-170623-11#
				512.0000	5.60	-0.79	9.39	6.64	5.63	3.98	FD(AN)-AB-170623-12#
PMAE4049A	NNTN8128B	PMLN7008A	RLN5312B w/ BDN6783B	450.0000	5.60	-0.48	7.18	5.14	4.01	2.87	ZR(HR)-AB-170623-14
				465.5000	5.56	-0.63	9.51	6.81	5.54	3.96	ZR(HR)-AB-170623-15
				481.0000	5.52	-0.66	8.56	6.07	5.05	3.58	ZR(HR)-AB-170624-01#
				496.5000	5.60	-0.66	7.47	5.28	4.35	3.07	ZR(HR)-AB-170624-02#
				512.0000	5.60	-0.78	8.69	6.15	5.20	3.68	ZR(HR)-AB-170624-03#
PMAE4049A	NNTN8128B	PMLN7008A	BDN6732A w/ BDN6783B	450.0000	5.60	-0.59	7.00	5.05	4.01	2.89	ZR(HR)-AB-170624-04#
				465.5000	5.59	-0.64	9.01	6.44	5.23	3.74	ZR(HR)-AB-170624-05#
				481.0000	5.56	-0.64	8.22	5.85	4.80	3.41	ZR(HR)-AB-170624-06#
				496.5000	5.56	-0.69	7.03	4.96	4.15	2.93	ZR(HR)-AB-170624-07#
				512.0000	5.53	-0.78	7.83	5.56	4.74	3.37	ZR(HR)-AB-170624-08#
PMAE4049A	NNTN8128B	PMLN7008A	ZMN6031A w/ NNTN7869B	450.0000	5.58	-0.53	7.67	5.49	4.35	3.11	ZR(HR)-AB-170624-09#
				465.5000	5.53	-0.69	9.00	6.39	5.34	3.79	KKL-AB-170624-10#
				481.0000	5.60	-0.69	8.15	5.75	4.78	3.37	KKL-AB-170624-11#
				496.5000	5.60	-0.61	8.03	5.67	4.62	3.26	KKL-AB-170624-12#
				512.0000	5.60	-0.78	9.30	6.58	5.56	3.94	KKL-AB-170624-13#
PMAE4049A	NNTN8128B	PMLN7008A	ZMN6038A w/ NNTN7869B	450.0000	5.54	-0.52	8.23	5.88	4.69	3.35	KKL-AB-170624-14#
				465.5000	5.55	-0.58	9.62	6.85	5.55	3.95	KKL-AB-170624-15#
				481.0000	5.56	-0.66	8.64	6.14	5.07	3.60	KKL-AB-170624-16#
				496.5000	5.60	-0.61	7.97	5.59	4.59	3.22	KKL-AB-170624-17#
				512.0000	5.60	-0.83	9.39	6.64	5.68	4.02	KKL-AB-170624-18#
PMAE4049A	NNTN8128B	PMLN7008A	HMN4104B w/ RMN5116A	450.0000	5.56	-0.55	7.65	5.52	4.37	3.16	KKL-AB-170624-19#
				465.5000	5.60	-0.74	8.84	6.31	5.24	3.74	KKL-AB-170624-20#
				481.0000	5.55	-0.71	7.37	5.16	4.38	3.07	KKL-AB-170624-21#
				496.5000	5.60	-0.63	8.60	6.02	4.97	3.48	KKL-AB-170624-22#
				512.0000	5.60	-0.78	10.50	7.38	**6.28**	**4.42**	KKL-AB-170624-24
PMAE4049A	NNTN8128B	PMLN7008A	PMLN5653A	450.0000	5.60	-0.48	7.49	5.37	4.18	3.00	KKL-AB-170625-02#
				465.5000	5.57	-0.62	9.46	6.75	5.49	3.91	KKL-AB-170625-03#
				481.0000	5.51	-0.65	8.47	6.02	5.00	3.55	KKL-AB-170625-04#
				496.5000	5.60	-0.64	8.35	5.88	4.84	3.41	KKL-AB-170625-05#
				512.0000	5.60	-0.77	9.82	6.94	5.86	4.14	KKL-AB-170625-06#

Assessment of wireless BT configuration

Assessment using the overall highest SAR configuration at the body from above without an audio accessory attached. SAR plots of the highest results per Table (bolded) are presented in Appendix F.

Table 25

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
PMAE4049A	NNTN8128B	PMLN7008A	None	450.0000	5.57	-0.45	8.39	6.13	4.68	3.42	KKL-AB-170625-07#
				465.5000	5.60	-0.63	10.60	7.69	**6.13**	**4.45**	KKL-AB-170625-08#
				481.0000	5.58	-0.60	9.63	6.97	5.55	4.02	KKL-AB-170625-09#
				496.5000	5.60	-0.65	9.27	6.71	5.38	3.90	KKL-AB-170625-10#
				512.0000	5.60	-0.81	9.18	6.78	5.53	4.09	KKL-AB-170625-11#

13.2 WLAN assessment at the Body for 802.11 b/g/n

The tables below represent the output power measurements for WLAN 2.4 GHz 802.11b/g/n for assessments at the Body using battery PMNN4491B because it is the thinnest battery (refer to Exhibit 7B for battery illustration). These power measurements were used to determine the necessary modes for SAR testing according to KDB 248227 D01 SAR Measurement Procedures for 802.11a/b/g/ Transmitters.

The battery was used during conducted power measurements for all test channels within FCC allocated frequency range (2.412-2.462 GHz) which are listed in Table 26. The channel with the highest conducted power will be identified as the default channel per KDB 643646 (SAR Test for PTT Radios). SAR plots of the highest results per Table (bolded) are presented in Appendix F.

SAR is not required for 802.11 g/n when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2W/kg.

Table 26

Mode	Channel #	Channel Frequency	Modulation	Battery: PMNN4491B Antenna port[mW]	Antenna Max Power [mW]
802.11b (1Mbps)	1	2412	DSSS	18.9	22.4
	6	2437		21.0	
	11	2462		20.4	
802.11g (6Mbps)	1	2412	OFDM	7.2	8.3
	6	2437		8.1	
	11	2462		7.0	
802.11n (MCS0)	1	2412	OFDM	11.3	12.6
	6	2437		11.6	
	11	2462		10.8	

802.11b was chosen over 802.11 g & n for testing because it has the highest max power

Assessments at the Body with all offered Body worn

DUT assessment with WLAN internal antenna, all offered batteries without any cable accessory attachment against phantom with all offered body worn. Refer to Table 26 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix F.

Table 27

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
AN000151A01 WiFi Ant	PMNN4491B	PMLN4651A	None	2437.000	0.0210	0.79	0.0028	0.0008	0.0030	0.0009	FD(AN)-AB-170608-04#
AN000151A01 WiFi Ant	PMNN4491B	PMLN7008A	None	2437.000	0.0210	0.11	0.00477	0.00216	**0.0051**	**0.0023**	FD-AB-170614-12
AN000151A01 WiFi Ant	PMNN4491B	PMLN5838A	None	2437.000	0.0210	2.15	0.000271	0.0000305	0.00029	0.00003	ZR-AB-170614-05#
AN000151A01 WiFi Ant	PMNN4491B	PMLN5840A	None	2437.000	0.0210	0.00	0.00003	0.00001	0.00004	0.00001	ZR-AB-170614-06#
AN000151A01 WiFi Ant	PMNN4491B	PMLN5842A	None	2437.000	0.0210	0.00	0.00032	0.00006	0.0003	0.0001	ZR-AB-170614-07#
AN000151A01 WiFi Ant	PMNN4491B	PMLN5844A	None	2437.000	0.0210	-1.01	0.000083	0.000012	0.00011	0.00002	FD-AB-170614-09
Assessment of Additional Batteries											
AN000151A01 WiFi Ant	PMNN4424A	PMLN7008A	None	2437.000	0.0208	0.99	0.00204	0.00063	0.0022	0.0007	TLC-AB-170630-04
AN000151A01 WiFi Ant	PMNN4448A	PMLN7008A	None	2437.000	0.0215	0.63	0.00194	0.00062	0.0020	0.0006	FD(AN)-AB-170613-12
AN000151A01 WiFi Ant	PMNN4489A	PMLN7008A	None	2437.000	0.0224	0.47	0.00212	0.00047	0.0021	0.0005	ZR-AB-170614-02#
AN000151A01 WiFi Ant	NNTN8128B	PMLN7008A	None	2437.000	0.0210	-0.01	0.00244	0.00075	0.0026	0.0008	FD-AB-170614-10
AN000151A01 WiFi Ant	PMNN4493A	PMLN7008A	None	2437.000	0.0224	-0.95	0.00044	0.00005	0.0005	0.0001	ZR-AB-170614-04#

13.3 LMR assessment at the Face for 450-512MHz band

Battery PMNN4493A was selected as the default battery for assessments at the Face because it has the highest capacity (refer to Exhibit 7B for battery illustration). The default battery was used during conducted power measurements for all test channels within FCC allocated frequency range (450-512MHz) which are listed in Table 28. The channel with the highest conducted power will be identified as the default channel per KDB 643646 (SAR Test for PTT Radios). SAR plots of the highest results per Table (bolded) are presented in Appendix F.

Table 28

Test Freq (MHz)	Power (W)
450.0000	5.46
465.5000	5.43
481.0000	5.50
496.5000	5.49
512.0000	5.42

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 28 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix F.

Table 29

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
PMAE4102A	PMNN4493A	Radio @ Front	None	450.0000							
				465.5000							
				481.0000	5.55	-0.62	5.51	4.16	3.21	2.42	KKL-FACE-170626-08
				496.5000							
				512.0000							
PMAE4049A	PMNN4493A	Radio @ Front	None	450.0000	5.46	-0.42	7.17	5.42	**4.05**	**3.06**	KKL-FACE-170627-10
				465.5000							
				481.0000	5.53	-0.47	6.39	4.83	3.61	2.73	KKL-FACE-170626-09
				496.5000							
				512.0000	5.55	-0.55	6.18	4.65	3.54	2.66	KKL-FACE-170626-11
Assessment of Additional Batteries											
PMAE4049A	NNTN8128B	Radio @ Front	None	450.0000	5.60	-0.41	6.73	5.09	3.70	2.80	KKL-FACE-170626-12
				465.5000							
				481.0000							
				496.5000							
				512.0000							

Table 29 (Continued)

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
Assessment of Additional Batteries											
PMAE4049A	PMNN4448A	Radio @ Front	None	450.0000	5.40	-0.41	6.90	5.23	3.93	2.98	KKL-FACE-170626-13
				465.5000							
				481.0000							
				496.5000							
				512.0000							
PMAE4049A	PMNN4424A	Radio @ Front	None	450.0000	5.34	-0.46	6.57	4.99	3.83	2.91	KKL-FACE-170626-14
				465.5000							
				481.0000							
				496.5000							
				512.0000							
PMAE4049A	PMNN4489A	Radio @ Front	None	450.0000	5.24	-0.36	6.61	5.03	3.84	2.92	KKL-FACE-170627-01#
				465.5000							
				481.0000							
				496.5000							
				512.0000							
PMAE4049A	PMNN4491B	Radio @ Front	None	450.0000	5.52	-0.44	6.61	5.03	3.71	2.82	KKL-FACE-170627-02#
				465.5000							
				481.0000							
				496.5000							
				512.0000							

13.4 WLAN assessments at the Face for 802.11b/g/n (2.412 – 2.462 GHz)

The tables below represent the output power measurements for WLAN 2.4 GHz 802.11b/g/n for assessments at the Face using battery PMNN4493A because it is has the highest capacity (refer to Exhibit 7B for battery illustration). These power measurements were used to determine the necessary modes for SAR testing according to KDB 248227 D01 SAR Measurement Procedures for 802.11a/b/g/ Transmitters.

The battery was used during conducted power measurements for all test channels within FCC allocated frequency range (2.412-2.462GHz) which are listed in Table 30. The channel with the highest conducted power will be identified as the default channel per KDB 643646 (SAR Test for PTT Radios).

SAR is not required for 802.11 g/n when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2W/kg.

Table 30

Mode	Channel #	Channel Frequency	Modulation	Battery: PMNN4493A Antenna port[mW]	Antenna Max Power [mW]
802.11b (1Mbps)	1	2412	DSSS	19.0	22.4
	6	2437		21.0	
	11	2462		20.5	
802.11g (6Mbps)	1	2412	OFDM	7.3	8.3
	6	2437		8.1	
	11	2462		7.1	
802.11n (MCS0)	1	2412	OFDM	11.1	12.6
	6	2437		12.3	
	11	2462		10.8	

DUT assessment with WLAN internal antenna with front of the DUT 2.5cm from phantom with all offered batteries. Refer to Table 30 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented 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)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
AN000151A01 WiFi Ant	PMNN4493A	None	None	2437.000	0.0210	0.00	0.02400	0.01300	**0.0257**	**0.0139**	ZR-FACE-170613-07
Assessment of Additional Batteries											
AN000151A01 WiFi Ant	PMNN4424A	None	None	2437.000	0.0208	0.03	0.02100	0.01200	0.0227	0.0129	ZR-FACE-170609-04
AN000151A01 WiFi Ant	PMNN4448A	None	None	2437.000	0.0215	0.05	0.02000	0.01200	0.0209	0.0125	ZR-FACE-170613-02
AN000151A01 WiFi Ant	PMNN4489A	None	None	2437.000	0.0224	0.26	0.02000	0.01200	0.0200	0.0120	ZR-FACE-170613-03
AN000151A01 WiFi Ant	PMNN4491B	None	None	2437.000	0.0210	0.11	0.01900	0.01100	0.0203	0.0118	ZR-FACE-170613-04
AN000151A01 WiFi Ant	NNTN8128B	None	None	2437.000	0.0224	0.07	0.02000	0.01200	0.0200	0.0120	ZR-FACE-170613-05

13.5 Assessment at 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 F.

Table 32

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
Body											
PMAE4102A	NNTN8128B	PMLN7008A	HMN4104B w/ RMN5116A	516.0000	5.60	-0.97	4.49	3.14	2.81	1.96	KKL-AB-170625-13#
				520.0000	5.60	-0.90	4.61	3.27	2.84	2.01	KKL-AB-170625-15
PMAE4049A	NNTN8128B	PMLN7008A	HMN4104B w/ RMN5116A	516.0000	5.60	-0.78	9.77	6.92	**5.85**	**4.14**	KKL-AB-170626-01#
				520.0000	5.60	-0.84	9.63	6.83	5.84	4.14	KKL-AB-170626-02#
Face											
PMAE4102A	PMNN4493A	Radio @ Front	None	516.0000	5.58	-0.59	4.07	3.07	2.34	1.76	KKL-FACE-170627-03#
				520.0000	5.55	-0.71	3.66	2.75	2.17	1.63	KKL-FACE-170627-04#
PMAE4049A	PMNN4493A	Radio @ Front	None	516.0000	5.58	-0.54	6.28	4.74	**3.57**	**2.69**	KKL-FACE-170627-05#
				520.0000	5.55	-0.58	5.99	4.52	3.45	2.61	KKL-FACE-170627-06#

13.6 Assessment for ISED, Canada

Based on the assessment results for body and face per KDB643646, additional tests were not required for ISED Canada frequency range (450-470 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 32 below. SAR plots of the highest results per Table (bolded) are presented in Appendix F.

Table 33

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
Body											
PMAE4049A	NNTN8128B	PMLN7008A	None	450.0000	5.45	-0.48	8.28	6.05	4.75	3.47	ZR(AN)-AB-170712-09
				465.5000	5.60	-0.63	10.60	7.69	6.13	4.45	KKL-AB-170625-08#
				470.0000	5.59	-0.74	10.40	7.57	**6.18**	**4.50**	ZR(AN)-AB-170712-10
Face											
PMAE4049A	PMNN4493A	Radio @ Front	None	450.0000	5.46	-0.42	7.17	5.42	4.05	3.06	KKL-FACE-170627-10
				465.5000	5.52	-0.48	7.29	5.50	**4.13**	**3.12**	KKL-FACE-170627-12
				470.0000	5.48	-0.47	7.07	5.32	4.03	3.03	KKL-FACE-170627-13

13.7 Assessment at the Bluetooth band

13.7.1 FCC Requirement

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

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] *[$\sqrt{F_{(GHz)}}$] = 2.4, which is ≤ 3 for 1-g SAR or 7.5 for 10-g extremity

Where:

Max. power = 7.7mW (10mW*77% duty cycle)
Min. test separation distance = 5mm for actual test separation < 5mm
F(GHz) = 2.48 GHz

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

13.7.2 ISED Canada Requirement

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

Standalone Bluetooth transmitter operates at

Maximum conducted power:
= 10 mW * 77%
= 7.7 mW or 8.87 dBm

Equivalent isotropically radiated power (EIRP):
= Maximum conducted power, dBm + Antenna gain, dBi
= 8.87 dBm – 4.00 dBi
=4.87 dBm or 3.07 mW

Higher output power level, maximum conducted power 7.7 mW was below the threshold power level 20 mW. Hence SAR test was not required for Bluetooth band.

13.8 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 G.

Table 34

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
PMAE4049A	NNTN8128B	PMLN7008A	HMN4104B w/ RMN5116A	512.0000	5.60	-0.46	11.60	8.26	**6.45**	**4.59**	KKL-AB-170626-06#

14.0 Simultaneous Transmission Exclusion for BT

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

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] *[√F(GHz)/X] = 0.32W/kg, which is ≤ 0.4 W/kg (1g)

Where:

X = 7.5 for 1g-SAR; 18.75 for 10g
Max. power = 7.7mW (12mW*77% duty cycle)
Min. test separation distance = 5mm for actual test separation < 5mm
F(GHz) = 2.48 GHz

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

15.0 Simultaneous Transmission between LMR and WLAN

These devices use a single transmitter module and antenna for both WLAN and BT. WLAN and BT cannot transmit simultaneously. Simultaneous transmission for BT had been excluded as mentioned in section 14.0. The maximum sourced-based-time-averaged output power for 802.11 b is 22.4mW while BT is 7.7mW. Therefore the measured SAR from 802.11b is used in conjunction with LMR for simultaneous results.

The Table below summarizes the simultaneous transmissions between LMR and WLAN bands.

Table 35

		LMR Bands
	Freq. (MHz)	450-512 MHz
WLAN Band	2412 - 2462	√

16.0 Results Summary

Based on the test guidelines from section 4.0 and satisfying frequencies within FCC bands and ISED Canada Frequency bands, the highest Operational Maximum Calculated 1-gram and 10-gram average SAR values found for this filing:

Table 36

Technologies	Frequency band (MHz)	Max Calc at Body (W/kg)		Max Calc at Face (W/kg)	
		1g-SAR	10g-SAR	1g-SAR	10g-SAR
FCC					
LMR	450-512	6.45	4.59	4.05	3.06
WLAN	2412-2462	0.0051	0.0023	0.0257	0.0139
ISED Canada					
LMR	450- 470	6.18	4.50	4.13	3.12
WLAN	2412-2462	0.0051	0.0023	0.0257	0.0139
Overall					
LMR	450-520	6.45	4.59	4.13	3.12
WLAN	2412-2462	0.0051	0.0023	0.0257	0.0139

All results are scaled to the maximum output power.

The highest combined 1g-SAR results for simultaneous is indicated in the following Table:

Table 37

Designator	Frequency bands	Combined 1g-SAR (W/kg)	Combined 10g-SAR (W/kg)
Body			
FCC	LMR (450-512MHz) and WLAN band	6.46	4.59
ISED Canada	LMR (450- 470 MHz) and WLAN band	6.19	4.50
Overall	LMR (450-520 MHz) and WLAN band	6.46	4.59
Face			
FCC	LMR (450-512 MHz) and WLAN band	4.08	3.07
ISED Canada	LMR (450- 470 MHz)and WLAN band	4.16	3.13
Overall	LMR (450-520 MHz) and WLAN band	4.16	3.13

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 OET Bulletin 65. The 10 grams result is not applicable to FCC filing.

17.0 Variability Assessment

Per the guidelines in KDB 865664 SAR variability assessment is required because SAR results are above 4.0 W/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 38

Run#	Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq. (MHz)	Adj Calc. 1g-SAR (W/kg)	Ratio	Comments
KKL-AB-170624-24	PMAE4049A	NNTN8128B	PMLN7008A	HMN4104B w/ RMN5116A	512.0000	6.28	0.97	No additional repeated scans is required due to the Ratio (SAR_{high}/SAR_{low}) < 1.20
KKL-AB-170626-06#						6.45		

18.0 System Uncertainty

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

Per the guidelines of ISO 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

a	b	c	d	e = f(d,k)	f	g	h = c x f / e	i = c x g / e	k
Uncertainty Component	IEEE 1528 section	Tol. (± %)	Prob Dist	Div.	c_i (1 g)	c_i (10 g)	1 g u_i (±%)	10 g u_i (±%)	v_i
Measurement System									
Probe Calibration	E.2.1	6.7	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				11	11	477
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k*=2				23	22	

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

Table A.2: Uncertainty Budget for Device Under Test, for 2450 MHz

a	*b*	*c*	*d*	*e = f(d,k)*	*f*	*g*	*h = c x f / e*	*i = c x g / e*	*k*
Uncertainty Component	**IEEE 1528 section**	**Tol. (± %)**	**Prob Dist**	**Div.**	**ci (1 g)**	**ci (10 g)**	**1 g u_i (±%)**	**10 g u_i (±%)**	v_i
Measurement System									
Probe Calibration	E.2.1	6.0	N	1.00	1	1	6.0	6.0	∞
Axial Isotropy	E.2.2	4.7	R	1.73	0.707	0.707	1.9	1.9	∞
Hemispherical Isotropy	E.2.2	9.6	R	1.73	0.707	0.707	3.9	3.9	∞
Boundary Effect	E.2.3	1.0	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	1.1	R	1.73	1	1	0.6	0.6	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mech. Tolerance	E.6.2	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning w.r.t Phantom	E.6.3	1.4	R	1.73	1	1	0.8	0.8	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	3.4	R	1.73	1	1	2.0	2.0	∞
Test sample Related									
Test Sample Positioning	E.4.2	3.2	N	1.00	1	1	3.2	3.2	29
Device Holder Uncertainty	E.4.1	4.0	N	1.00	1	1	4.0	4.0	8
SAR drift	6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity (target)	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	E.3.3	3.3	N	1.00	0.64	0.43	2.1	1.4	∞
Liquid Permittivity (target)	E.3.2	5.0	R	1.73	0.6	0.49	1.7	1.4	∞
Liquid Permittivity (measurement)	E.3.3	1.9	N	1.00	0.6	0.49	1.1	0.9	∞
Combined Standard Uncertainty			RSS				11	11	419
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k*=2				22	22	

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

Table A.3: Uncertainty Budget for System Validation (dipole & flat phantom) for 450 MHz

a	*b*	*c*	*d*	*e = f(d,k)*	*f*	*g*	*h = c x f / e*	*i = c x g / e*	*k*
Uncertainty Component	**IEEE 1528 section**	**Tol. (± %)**	**Prob Dist**	**Div.**	**c_i (1 g)**	**c_i (10 g)**	**1 g U_i (±%)**	**10 g U_i (±%)**	**v_i**
Measurement System									
Probe Calibration	E.2.1	6.7	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)			*k*=2				19	18	

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.4: Uncertainty Budget for System Validation (dipole & flat phantom) for 2450 MHz

a	*b*	*c*	*d*	*e = f(d,k)*	*f*	*g*	*h = c x f / e*	*i = c x g / e*	*k*
Uncertainty Component	**IEEE 1528 section**	**Tol. (± %)**	**Prob Dist**	**Div.**	**c_i (1 g)**	**c_i (10 g)**	**1 g U_i (±%)**	**10 g U_i (±%)**	**v_i**
Measurement System									
Probe Calibration	E.2.1	6.0	N	1.00	1	1	6.0	6.0	∞
Axial Isotropy	E.2.2	4.7	R	1.73	1	1	2.7	2.7	∞
Spherical Isotropy	E.2.2	9.6	R	1.73	0	0	0.0	0.0	∞
Boundary Effect	E.2.3	1.0	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	0.0	R	1.73	1	1	0.0	0.0	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning w.r.t. Phantom	E.6.3	1.4	R	1.73	1	1	0.8	0.8	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	3.4	R	1.73	1	1	2.0	2.0	∞
Dipole									
Dipole Axis to Liquid Distance	8, E.4.2	2.0	R	1.73	1	1	1.2	1.2	∞
Input Power and SAR Drift Measurement	8, 6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity (target)	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	E.3.3	3.3	R	1.73	0.64	0.43	1.2	0.8	∞
Liquid Permittivity (target)	E.3.2	5.0	R	1.73	0.6	0.49	1.7	1.4	∞
Liquid Permittivity (measurement)	E.3.3	1.9	R	1.73	0.6	0.49	0.6	0.5	∞
Combined Standard Uncertainty			RSS				9	9	99999
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k*=2				18	17	

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

Appendix B
Probe Calibration Certificates

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
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: **EX3-3735_Mar17**

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3735

Calibration procedure(s): QA CAL-01.v9, QA CAL-12.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

Calibration date: March 10, 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	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: S5277 (20x)	05-Apr-16 (No. 217-02293)	Apr-17
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 Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: March 14, 2017

Certificate No: EX3-3735_Mar17 Page 1 of 16

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
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,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:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,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*.
- *DCPx,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 *NORMx,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 *NORMx* (no uncertainty required).

Probe EX3DV4

SN:3735

Manufactured: February 15, 2010
Calibrated: March 10, 2017

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3735

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.37	0.39	0.46	± 10.1 %
DCP (mV)[B]	105.5	101.6	100.2	

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	141.9	±3.0 %
		Y	0.0	0.0	1.0		141.6	
		Z	0.0	0.0	1.0		149.0	

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 E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3735

Calibration Parameter Determined in Head 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	52.3	0.76	11.79	11.79	11.79	0.00	1.00	± 13.3 %
300	45.3	0.87	11.08	11.08	11.08	0.08	1.30	± 13.3 %
450	43.5	0.87	10.37	10.37	10.37	0.16	1.30	± 13.3 %
750	41.9	0.89	9.82	9.82	9.82	0.45	0.86	± 12.0 %
835	41.5	0.90	9.44	9.44	9.44	0.50	0.80	± 12.0 %
900	41.5	0.97	9.28	9.28	9.28	0.36	1.00	± 12.0 %
1450	40.5	1.20	8.46	8.46	8.46	0.36	0.80	± 12.0 %
1810	40.0	1.40	7.97	7.97	7.97	0.27	1.01	± 12.0 %
1900	40.0	1.40	7.89	7.89	7.89	0.33	0.85	± 12.0 %
2100	39.8	1.49	7.83	7.83	7.83	0.27	0.80	± 12.0 %
2300	39.5	1.67	7.37	7.37	7.37	0.29	0.88	± 12.0 %
2450	39.2	1.80	7.08	7.08	7.08	0.38	0.86	± 12.0 %
2600	39.0	1.96	6.78	6.78	6.78	0.34	0.89	± 12.0 %
4950	36.3	4.40	5.49	5.49	5.49	0.40	1.80	± 13.1 %
5250	35.9	4.71	4.88	4.88	4.88	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.57	4.57	4.57	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.40	4.40	4.40	0.40	1.80	± 13.1 %
5750	35.4	5.22	4.56	4.56	4.56	0.40	1.80	± 13.1 %

[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.

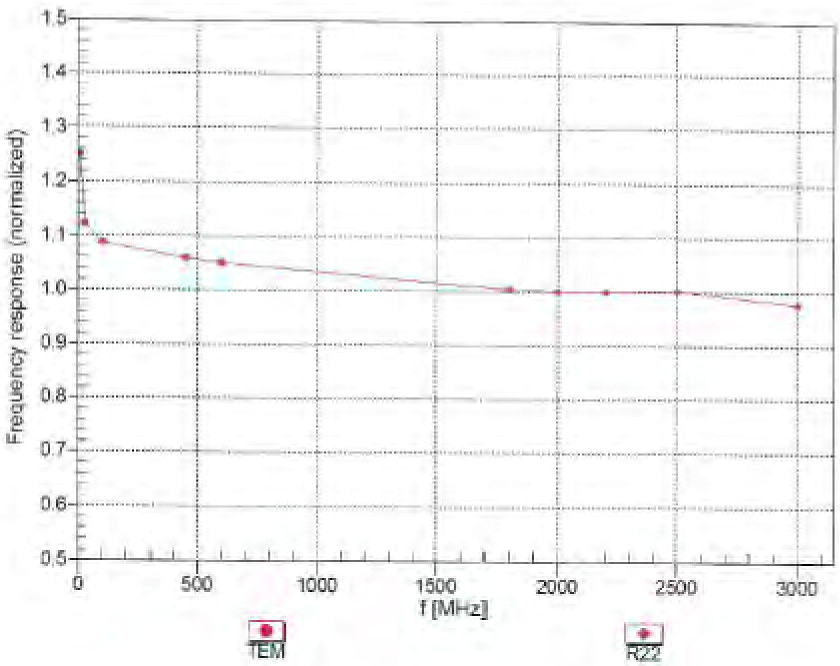
DASY/EASY - Parameters of Probe: EX3DV4 - SN:3735

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	11.23	11.23	11.23	0.00	1.00	± 13.3 %
300	58.2	0.92	10.61	10.61	10.61	0.05	1.20	± 13.3 %
450	56.7	0.94	10.56	10.56	10.56	0.07	1.20	± 13.3 %
750	55.5	0.96	9.52	9.52	9.52	0.30	1.00	± 12.0 %
835	55.2	0.97	9.28	9.28	9.28	0.42	0.87	± 12.0 %
900	55.0	1.05	9.19	9.19	9.19	0.44	0.80	± 12.0 %
1450	54.0	1.30	8.07	8.07	8.07	0.34	0.80	± 12.0 %
1810	53.3	1.52	7.88	7.88	7.88	0.36	0.85	± 12.0 %
1900	53.3	1.52	7.76	7.76	7.76	0.30	0.90	± 12.0 %
2100	53.2	1.62	7.73	7.73	7.73	0.40	0.80	± 12.0 %
2300	52.9	1.81	7.32	7.32	7.32	0.42	0.80	± 12.0 %
2450	52.7	1.95	7.24	7.24	7.24	0.41	0.86	± 12.0 %
2600	52.5	2.16	6.90	6.90	6.90	0.36	0.89	± 12.0 %
4950	49.4	5.01	4.51	4.51	4.51	0.40	1.90	± 13.1 %
5250	48.9	5.36	4.35	4.35	4.35	0.40	1.90	± 13.1 %
5500	48.6	5.65	4.00	4.00	4.00	0.40	1.90	± 13.1 %
5600	48.5	5.77	3.75	3.75	3.75	0.50	1.90	± 13.1 %
5750	48.3	5.94	3.83	3.83	3.83	0.50	1.90	± 13.1 %

[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.

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

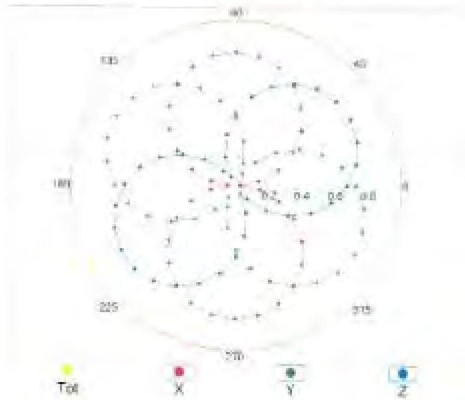


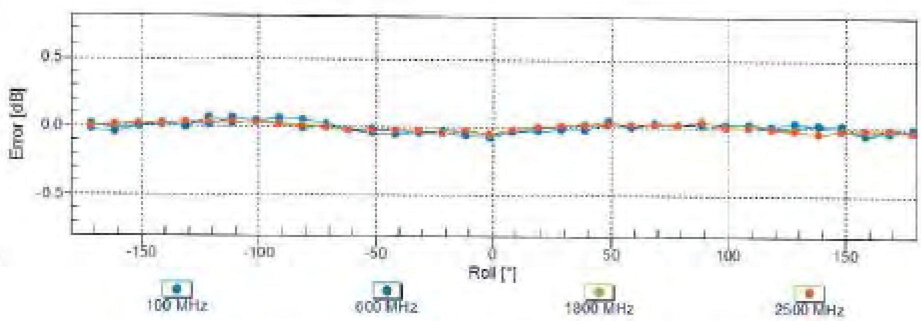
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (φ), $\vartheta = 0°$

f=600 MHz,TEM

f=1800 MHz,R22

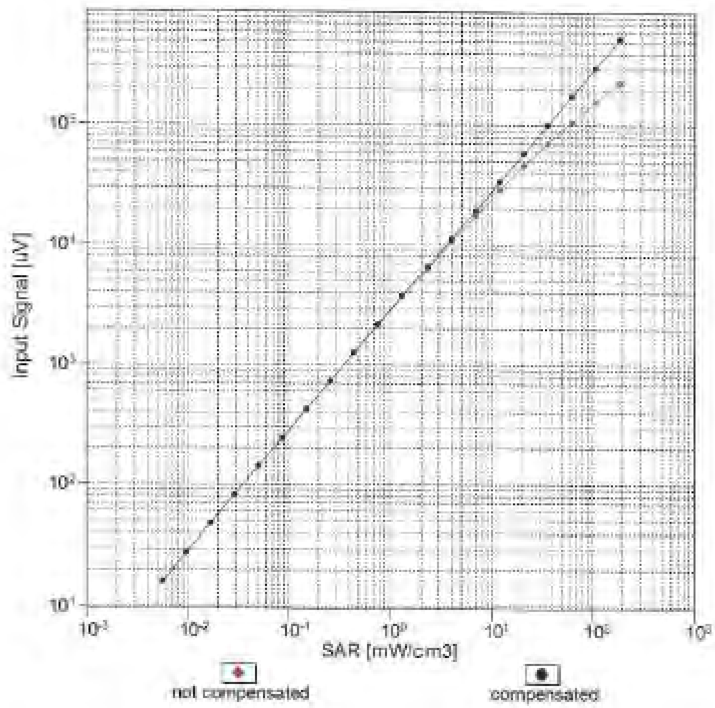


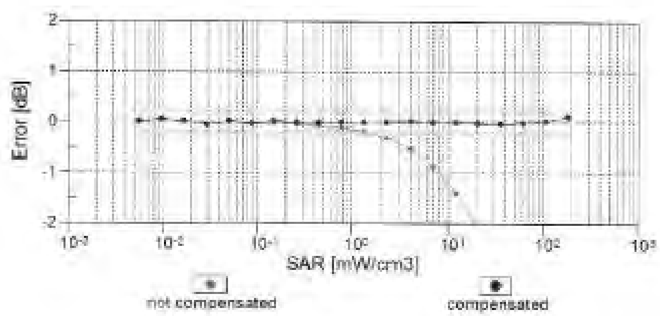


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

(TEM cell , f_{eval}= 1900 MHz)





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

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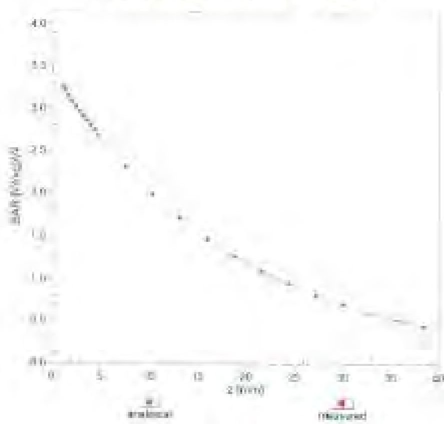
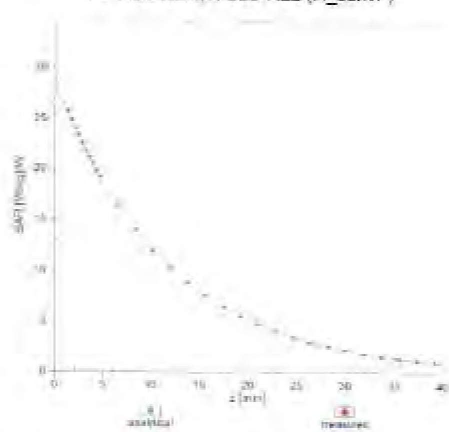
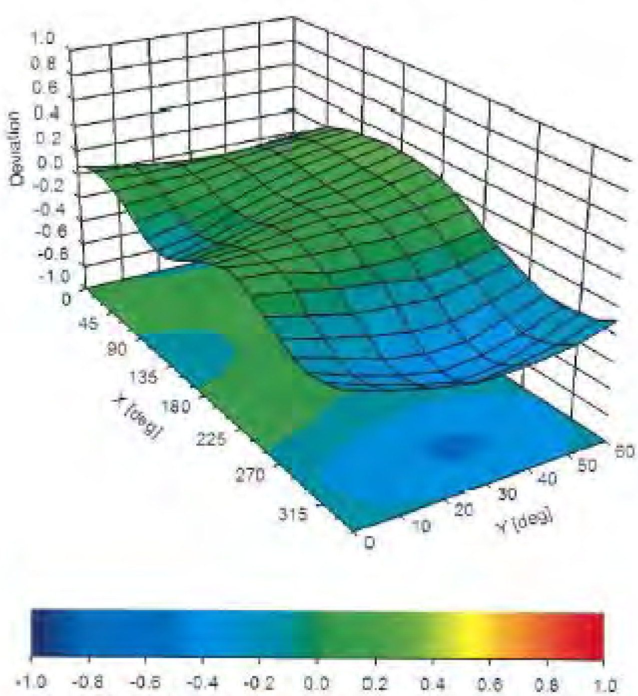
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

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DASY/EASY - Parameters of Probe: EX3DV4 - SN:3735

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-1.5
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

EX3DV4– SN:3735 March 10, 2017

Appendix: Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc (k=2)
0	CW	X	0.0	0.0	1.0	0.00	141.9	±3.0 %
		Y	0.0	0.0	1.0		141.6	
		Z	0.0	0.0	1.0		149.0	
10021-DAC	GSM-FDD (TDMA, GMSK)	X	3.44	68.2	14.9	9.39	118.0	±2.2 %
		Y	3.22	69.4	16.8		85.0	
		Z	12.08	88.1	24.1		147.1	
10023-DAC	GPRS-FDD (TDMA, GMSK, TN 0)	X	4.06	71.2	16.7	9.57	114.5	±2.7 %
		Y	3.01	68.0	16.2		83.3	
		Z	11.22	87.4	24.1		141.6	
10024-DAC	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	5.82	76.3	17.1	6.56	149.2	±2.2 %
		Y	6.09	79.3	19.0		142.0	
		Z	16.49	90.1	22.6		125.8	
10025-DAC	EDGE-FDD (TDMA, 8PSK, TN 0)	X	6.61	75.2	26.4	12.62	77.0	±2.2 %
		Y	5.33	69.5	23.9		56.8	
		Z	7.84	79.0	28.9		89.4	
10026-DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1)	X	7.48	79.8	26.6	9.55	147.0	±2.5 %
		Y	5.75	73.4	23.6		120.4	
		Z	9.68	84.4	28.7		127.8	
10027-DAC	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	40.65	99.8	23.0	4.80	145.4	±1.7 %
		Y	23.67	96.2	22.9		147.6	
		Z	47.87	100.0	23.5		143.2	
10028-DAC	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	43.00	100.0	22.3	3.55	130.4	±1.7 %
		Y	36.95	99.6	22.6		133.5	
		Z	60.81	99.8	22.1		126.2	
10029-DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1-2)	X	7.59	81.3	26.3	7.78	145.1	±2.7 %
		Y	5.99	75.7	23.9		143.3	
		Z	9.66	84.1	27.1		146.1	
10039-CAB	CDMA2000 (1xRTT, RC1)	X	5.02	67.8	19.4	4.57	149.2	±0.9 %
		Y	4.68	66.2	18.6		129.2	
		Z	4.84	66.4	18.5		138.5	
10056-CAA	UMTS-TDD (TD-SCDMA, 1.28 Mcps)	X	6.17	75.3	25.9	11.01	118.9	±3.0 %
		Y	4.85	69.1	23.0		86.4	
		Z	9.69	85.3	30.7		147.5	
10058-DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1-2-3)	X	6.02	76.9	23.7	6.52	133.6	±2.2 %
		Y	5.32	73.9	22.4		136.6	
		Z	7.69	79.7	24.5		131.6	
10061-CAB	CDMA2000 (1xRTT, RC3)	X	4.24	67.6	19.3	3.97	142.4	±0.7 %
		Y	3.86	66.1	18.4		145.9	
		Z	3.98	65.7	18.0		133.7	

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10090-DAC	GPRS-FDD (TDMA, GMSK, TN 0-4)	X	5.59	77.4	18.0	6.56	143.9	±2.5 %
		Y	5.36	77.6	18.0		139.4	
		Z	14.11	87.2	21.4		126.1	
10099-DAC	EDGE-FDD (TDMA, 8PSK, TN 0-4)	X	7.91	81.7	27.6	9.55	141.4	±2.2 %
		Y	6.07	75.0	24.6		116.8	
		Z	9.76	84.6	28.7		126.1	
10117-CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	9.99	68.2	20.8	8.07	124.1	±2.7 %
		Y	10.02	68.1	20.7		128.3	
		Z	10.36	68.9	21.1		144.0	
10196-CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	10.14	69.3	21.5	8.10	147.6	±3.0 %
		Y	9.66	67.9	20.6		124.3	
		Z	10.02	68.7	21.1		140.2	
10290-AAB	CDMA2000, RC1, SO55, Full Rate	X	4.76	69.1	19.8	3.91	148.6	±0.7 %
		Y	4.37	67.2	18.8		127.1	
		Z	4.48	67.1	18.6		141.7	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	4.23	69.8	20.2	3.46	141.9	±0.7 %
		Y	3.74	67.0	18.7		144.4	
		Z	3.66	66.0	17.9		134.6	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	4.06	69.2	19.8	3.39	141.8	±0.7 %
		Y	3.68	67.1	18.7		143.8	
		Z	3.63	66.3	18.0		133.7	
10293-AAB	CDMA2000, RC3, SO3, Full Rate	X	4.15	69.1	19.6	3.50	140.6	±0.7 %
		Y	3.76	67.0	18.7		142.9	
		Z	3.72	66.3	18.2		133.4	
10295-AAB	CDMA2000, RC1, SO3, 1/8th Rate 25 fr.	X	7.03	71.7	25.9	12.49	95.3	±2.7 %
		Y	5.88	66.3	22.9		68.6	
		Z	9.34	78.7	29.6		118.5	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	6.00	72.8	20.9	3.76	128.4	±0.7 %
		Y	4.95	68.7	18.9		133.1	
		Z	4.96	68.0	18.5		142.1	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	5.91	72.6	20.9	3.77	127.8	±0.7 %
		Y	4.93	68.9	19.0		130.8	
		Z	4.87	68.0	18.5		141.9	
10406-AAB	CDMA2000, RC3, SO32, SCH0, Full Rate	X	6.96	71.2	20.9	5.22	134.2	±0.9 %
		Y	6.30	69.1	19.8		136.9	
		Z	6.47	68.7	19.5		125.4	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	4.22	76.7	22.6	1.54	149.3	±1.2 %
		Y	3.68	73.6	20.9		128.1	
		Z	2.62	68.3	16.2		138.3	
10417-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 99pc duty cycle)	X	10.18	69.2	21.6	8.23	145.8	±3.0 %
		Y	10.09	68.6	21.2		148.6	
		Z	10.04	68.6	21.1		136.8	

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10418-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Long preambule)	X	10.12	69.4	21.6	8.14	146.6	±2.7 %
		Y	9.97	68.7	21.2		147.5	
		Z	9.96	68.8	21.1		137.7	
10419-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Short preambule)	X	10.24	69.5	21.7	8.19	148.0	±3.0 %
		Y	10.04	68.8	21.2		149.3	
		Z	10.07	68.7	21.2		140.0	
10458-AAA	CDMA2000 (1xEV-DO, Rev. B, 2 carriers)	X	8.54	69.2	20.7	6.55	135.8	±1.9 %
		Y	8.28	68.3	20.1		137.1	
		Z	8.19	67.8	19.7		129.9	
10459-AAA	CDMA2000 (1xEV-DO, Rev. B, 3 carriers)	X	10.88	69.8	21.8	8.25	136.2	±3.0 %
		Y	10.86	69.4	21.5		138.8	
		Z	10.77	68.6	21.1		133.1	
10515-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps, 99pc duty cycle)	X	5.92	82.8	24.9	1.58	128.2	±0.7 %
		Y	3.52	73.0	20.8		130.5	
		Z	2.89	68.7	18.4		143.9	
10518-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps, 99pc duty cycle)	X	10.26	69.5	21.7	8.23	145.6	±3.0 %
		Y	10.10	68.8	21.2		147.6	
		Z	10.16	68.9	21.3		140.0	
10525-AAA	IEEE 802.11ac WiFi (20MHz, MCS0, 99pc duty cycle)	X	10.03	68.5	21.2	8.36	122.7	±3.0 %
		Y	10.00	68.2	21.0		124.0	
		Z	10.40	69.1	21.5		142.7	
10526-AAA	IEEE 802.11ac WiFi (20MHz, MCS1, 99pc duty cycle)	X	10.10	68.5	21.3	8.42	123.6	±2.7 %
		Y	10.05	68.2	21.0		123.9	
		Z	10.48	69.2	21.5		143.3	
10534-AAA	IEEE 802.11ac WiFi (40MHz, MCS0, 99pc duty cycle)	X	10.58	69.0	21.4	8.45	129.5	±2.7 %
		Y	10.49	68.6	21.2		129.9	
		Z	10.47	68.5	21.1		123.7	
10535-AAA	IEEE 802.11ac WiFi (40MHz, MCS1, 99pc duty cycle)	X	10.58	69.0	21.4	8.45	129.7	±2.7 %
		Y	10.52	68.7	21.2		132.0	
		Z	10.49	68.5	21.1		124.1	
10544-AAA	IEEE 802.11ac WiFi (80MHz, MCS0, 99pc duty cycle)	X	11.04	69.5	21.5	8.47	134.3	±2.7 %
		Y	10.75	68.7	21.0		133.9	
		Z	10.88	69.0	21.1		127.7	
10545-AAA	IEEE 802.11ac WiFi (80MHz, MCS1, 99pc duty cycle)	X	11.10	69.6	21.5	8.55	134.0	±2.7 %
		Y	10.82	68.8	21.1		134.4	
		Z	10.97	69.0	21.2		127.9	
10564-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 9 Mbps, 99pc duty cycle)	X	9.90	68.5	21.2	8.25	122.7	±3.0 %
		Y	9.89	68.3	21.0		124.9	
		Z	10.26	69.1	21.4		142.4	
10571-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 90pc duty cycle)	X	6.11	82.4	24.9	1.99	129.0	±0.7 %
		Y	3.46	71.4	20.1		149.7	
		Z	3.49	70.6	19.3		141.5	

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10572-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps, 90pc duty cycle)	X	6.14	82.6	25.0	1.99	127.7	±0.9 %
		Y	3.59	72.3	20.6		148.0	
		Z	3.56	71.0	19.5		140.0	
10575-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 90pc duty cycle)	X	10.06	68.6	21.5	8.59	122.5	±3.0 %
		Y	10.34	69.1	21.6		147.4	
		Z	10.50	69.3	21.8		139.6	
10576-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 9 Mbps, 90pc duty cycle)	X	10.61	70.0	22.2	8.60	149.8	±2.7 %
		Y	10.38	69.2	21.7		148.3	
		Z	10.55	69.4	21.8		140.6	
10583-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 90pc duty cycle)	X	10.11	68.7	21.5	8.59	124.6	±2.7 %
		Y	10.35	69.1	21.6		148.8	
		Z	10.51	69.4	21.8		140.5	
10584-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps, 90pc duty cycle)	X	10.11	68.7	21.5	8.60	123.0	±3.0 %
		Y	10.07	68.4	21.2		123.3	
		Z	10.56	69.5	21.8		141.6	
10591-AAA	IEEE 802.11n (HT Mixed, 20MHz, MCS0, 90pc duty cycle)	X	10.23	68.8	21.6	8.63	125.2	±3.0 %
		Y	10.15	68.4	21.2		124.7	
		Z	10.65	69.4	21.6		142.5	
10592-AAA	IEEE 802.11n (HT Mixed, 20MHz, MCS1, 90pc duty cycle)	X	10.40	69.0	21.8	8.79	125.2	±2.7 %
		Y	10.34	68.5	21.4		126.6	
		Z	10.85	69.7	22.1		144.2	
10599-AAA	IEEE 802.11n (HT Mixed, 40MHz, MCS0, 90pc duty cycle)	X	10.88	69.4	21.6	8.79	132.6	±3.0 %
		Y	10.78	69.0	21.5		132.8	
		Z	10.78	68.8	21.5		124.2	
10600-AAA	IEEE 802.11n (HT Mixed, 40MHz, MCS1, 90pc duty cycle)	X	10.94	69.4	21.9	8.88	131.7	±3.0 %
		Y	10.84	69.0	21.6		132.9	
		Z	10.86	68.9	21.6		124.4	
10607-AAA	IEEE 802.11ac WiFi (20MHz, MCS0, 90pc duty cycle)	X	10.26	68.8	21.6	8.64	125.4	±3.0 %
		Y	10.24	68.5	21.3		126.7	
		Z	10.71	69.6	21.9		144.0	
10608-AAA	IEEE 802.11ac WiFi (20MHz, MCS1, 90pc duty cycle)	X	10.40	69.0	21.7	8.77	125.8	±3.3 %
		Y	10.36	68.6	21.4		127.2	
		Z	10.87	69.8	22.1		145.4	
10616-AAA	IEEE 802.11ac WiFi (40MHz, MCS0, 90pc duty cycle)	X	10.90	69.4	21.9	8.82	131.8	±3.0 %
		Y	10.79	68.9	21.5		132.7	
		Z	10.83	68.9	21.5		123.8	
10617-AAA	IEEE 802.11ac WiFi (40MHz, MCS1, 90pc duty cycle)	X	10.91	69.4	21.9	8.81	132.1	±3.0 %
		Y	10.78	69.0	21.5		133.1	
		Z	10.83	68.9	21.5		124.0	
10626-AAA	IEEE 802.11ac WiFi (80MHz, MCS0, 90pc duty cycle)	X	11.37	69.8	21.9	8.83	136.7	±3.0 %
		Y	11.05	69.1	21.4		134.9	
		Z	11.27	69.5	21.6		128.1	

10627-AAA	IEEE 802.11ac WiFi (80MHz, MCS1, 90pc duty cycle)	X	11.44	70.0	22.0	8.88	137.5	±3.0 %
		Y	11.10	69.1	21.5		135.1	
		Z	11.35	69.5	21.7		128.9	
10646-AAA	CDMA2000 (1x Advanced)	X	4.39	70.8	20.9	3.45	148.1	±0.9 %
		Y	3.84	67.8	19.3		148.6	
		Z	3.78	66.9	18.5		139.2	

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

Calibration Laboratory of
Schmid & Partner
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Accreditation No.: **SCS 0108**

Client **Motorola MY**

Certificate No: **EX3-3612_May17**

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3612

Calibration procedure(s): QA CAL-01.v9, QA CAL-12.v9, QA CAL-14.v4, 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: S5277 (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 Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 18, 2017

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

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Accreditation No.: **SCS 0108**

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,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:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,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*.
- *DCPx,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 *NORMx,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 *NORMx* (no uncertainty required).

Probe EX3DV4

SN:3612

Manufactured: March 23, 2007
Calibrated: May 17, 2017

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3612

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.43	0.48	0.39	± 10.1 %
DCP (mV)[B]	94.2	96.8	97.5	

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	140.4	±2.7 %
		Y	0.0	0.0	1.0		140.7	
		Z	0.0	0.0	1.0		141.7	

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 E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3612

Calibration Parameter Determined in Head 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	52.3	0.76	10.17	10.17	10.17	0.00	1.00	± 13.3 %
300	45.3	0.87	9.87	9.87	9.87	0.09	1.20	± 13.3 %
450	43.5	0.87	9.25	9.25	9.25	0.16	1.20	± 13.3 %
750	41.9	0.89	8.71	8.71	8.71	0.46	0.93	± 12.0 %
835	41.5	0.90	8.45	8.45	8.45	0.46	0.90	± 12.0 %
900	41.5	0.97	8.27	8.27	8.27	0.48	0.84	± 12.0 %
1450	40.5	1.20	7.78	7.78	7.78	0.39	0.80	± 12.0 %
1810	40.0	1.40	7.18	7.18	7.18	0.33	0.85	± 12.0 %
1900	40.0	1.40	7.16	7.16	7.16	0.25	0.86	± 12.0 %
2100	39.8	1.49	7.17	7.17	7.17	0.33	0.80	± 12.0 %
2300	39.5	1.67	6.88	6.88	6.88	0.32	0.80	± 12.0 %
2450	39.2	1.80	6.59	6.59	6.59	0.35	0.80	± 12.0 %
2600	39.0	1.96	6.49	6.49	6.49	0.37	0.80	± 12.0 %
4950	36.3	4.40	5.12	5.12	5.12	0.35	1.80	± 13.1 %
5250	35.9	4.71	4.76	4.76	4.76	0.35	1.80	± 13.1 %
5500	35.6	4.96	4.56	4.56	4.56	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.36	4.36	4.36	0.40	1.80	± 13.1 %
5750	35.4	5.22	4.85	4.85	4.85	0.40	1.80	± 13.1 %

[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.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3612

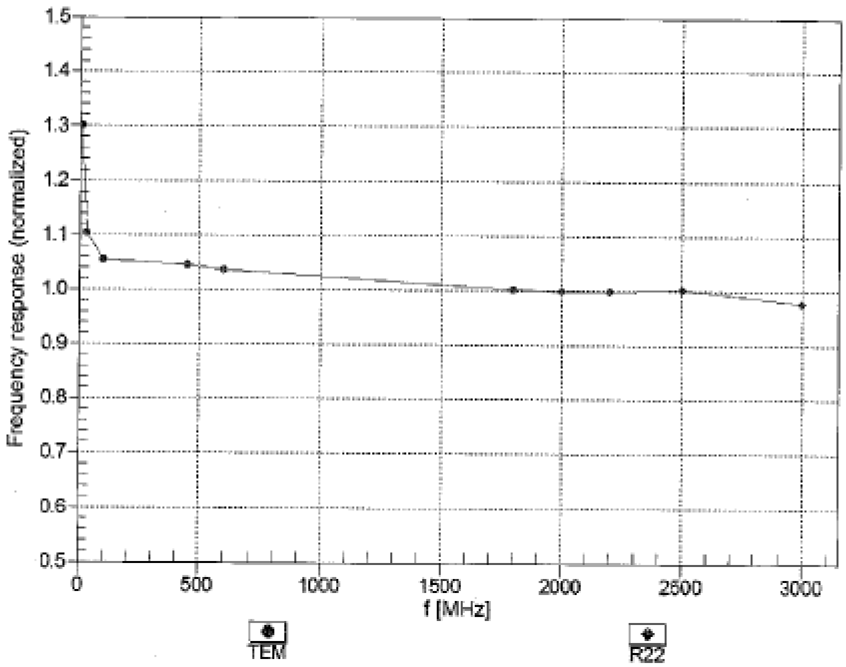
Calibration Parameter Determined in Body Tissue Simulating Media

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	9.82	9.82	9.82	0.00	1.00	± 13.3 %
300	58.2	0.92	9.51	9.51	9.51	0.05	1.25	± 13.3 %
450	56.7	0.94	9.35	9.35	9.35	0.09	1.25	± 13.3 %
750	55.5	0.96	8.62	8.62	8.62	0.44	0.80	± 12.0 %
835	55.2	0.97	8.41	8.41	8.41	0.52	0.84	± 12.0 %
900	55.0	1.05	8.38	8.38	8.38	0.27	1.11	± 12.0 %
1450	54.0	1.30	7.39	7.39	7.39	0.32	0.80	± 12.0 %
1810	53.3	1.52	7.13	7.13	7.13	0.34	0.94	± 12.0 %
1900	53.3	1.52	7.07	7.07	7.07	0.40	0.80	± 12.0 %
2100	53.2	1.62	7.27	7.27	7.27	0.42	0.80	± 12.0 %
2300	52.9	1.81	6.86	6.86	6.86	0.40	0.80	± 12.0 %
2450	52.7	1.95	6.82	6.82	6.82	0.27	0.92	± 12.0 %
2600	52.5	2.16	6.58	6.58	6.58	0.29	0.90	± 12.0 %
4950	49.4	5.01	4.39	4.39	4.39	0.40	1.90	± 13.1 %
5250	48.9	5.36	4.31	4.31	4.31	0.40	1.90	± 13.1 %
5500	48.6	5.65	3.89	3.89	3.89	0.45	1.90	± 13.1 %
5600	48.5	5.77	3.80	3.80	3.80	0.45	1.90	± 13.1 %
5750	48.3	5.94	4.00	4.00	4.00	0.50	1.90	± 13.1 %

[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.

Frequency Response of E-Field

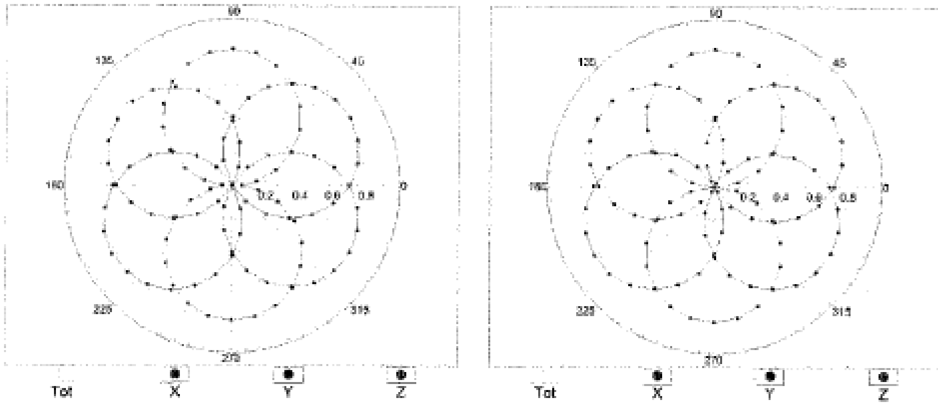
(TEM-Cell:ifi110 EXX, Waveguide: R22)

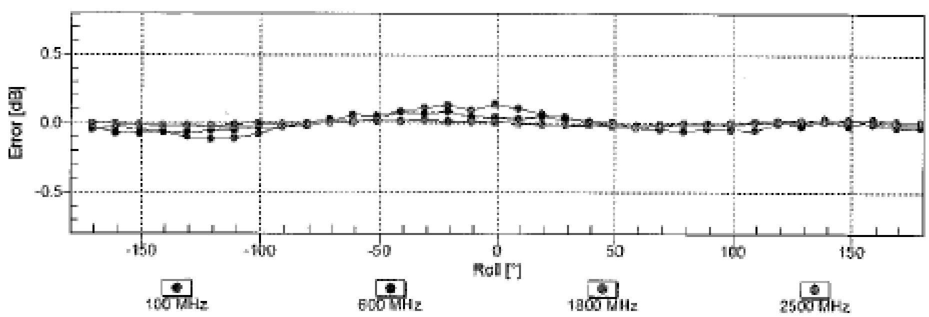


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (ϕ), $\vartheta = 0°$

f=600 MHz,TEM f=1800 MHz,R22

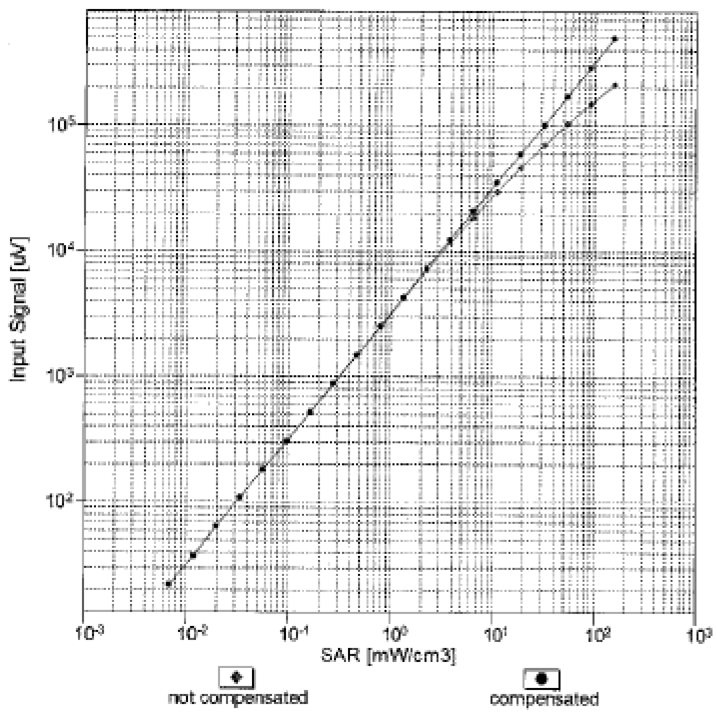


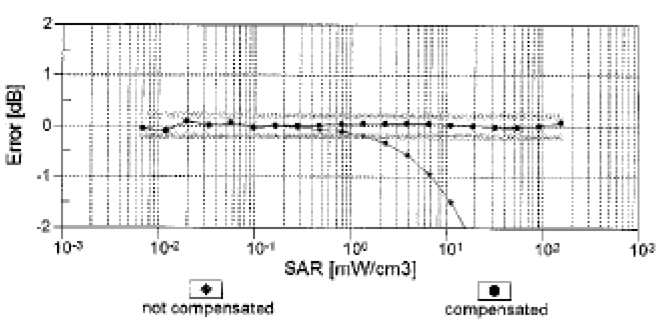


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

(TEM cell , f_{eval}= 1900 MHz)

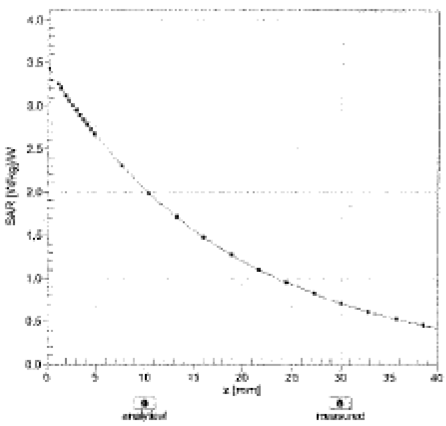




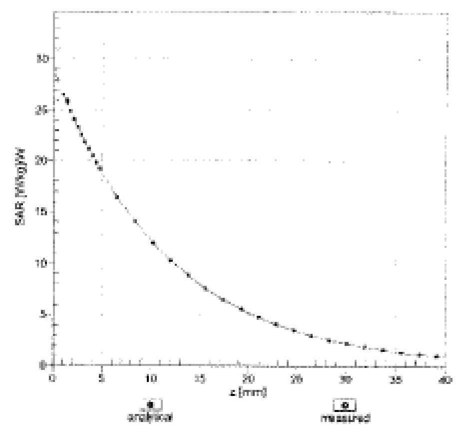
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

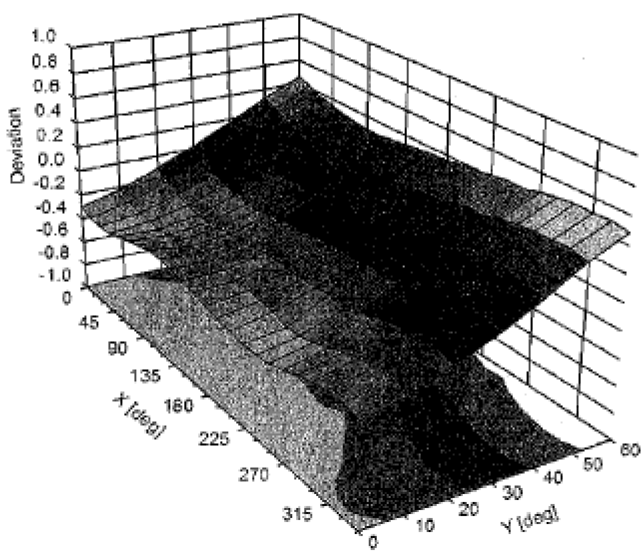


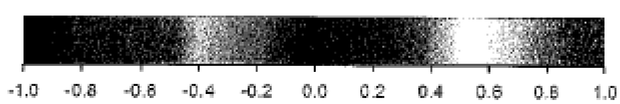
f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz





Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3612

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	78.9
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

Appendix: Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	140.4	±2.7 %
		Y	0.0	0.0	1.0		140.7	
		Z	0.0	0.0	1.0		141.7	
10021-DAC	GSM-FDD (TDMA, GMSK)	X	2.13	66.5	13.8	9.39	117.9	±1.9 %
		Y	1.67	63.5	12.5		76.9	
		Z	2.34	68.1	14.8		107.2	
10023-DAC	GPRS-FDD (TDMA, GMSK, TN 0)	X	2.14	66.8	14.2	9.57	111.5	±3.8 %
		Y	1.63	62.7	12.1		76.2	
		Z	2.63	70.4	16.4		103.6	
10024-DAC	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	1.99	68.1	13.5	6.56	145.4	±1.7 %
		Y	3.88	78.0	17.9		140.9	
		Z	4.74	79.7	18.3		133.7	
10025-DAC	EDGE-FDD (TDMA, 8PSK, TN 0)	X	5.57	74.0	27.0	12.62	79.2	±1.9 %
		Y	4.98	70.0	24.6		53.4	
		Z	5.49	73.8	27.0		72.1	
10026-DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1)	X	5.37	75.0	25.5	9.55	146.2	±1.7 %
		Y	4.77	71.4	23.6		110.0	
		Z	5.63	76.6	26.4		133.4	
10027-DAC	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	5.36	81.3	17.6	4.80	147.9	±1.9 %
		Y	23.73	100.0	23.3		131.0	
		Z	24.58	99.7	23.1		133.0	
10028-DAC	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	39.40	99.8	21.2	3.55	136.7	±1.4 %
		Y	31.48	99.6	21.6		141.3	
		Z	28.30	99.9	22.2		145.2	
10029-DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1-2)	X	5.33	76.0	24.9	7.78	148.8	±1.4 %
		Y	4.63	71.9	22.8		147.6	
		Z	5.44	76.7	25.3		134.9	
10039-CAB	CDMA2000 (1xRTT, RC1)	X	4.85	66.6	18.9	4.57	141.0	±1.2 %
		Y	4.94	67.2	19.4		149.5	
		Z	5.04	68.2	20.1		149.8	
10056-CAA	UMTS-TDD (TD-SCDMA, 1.28 Mcps)	X	4.53	70.5	24.5	11.01	117.8	±1.7 %
		Y	4.00	67.1	22.6		80.0	
		Z	4.65	71.8	25.4		108.8	
10058-DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1-2-3)	X	4.64	73.1	22.6	6.52	141.0	±1.4 %
		Y	4.57	72.9	22.7		147.2	
		Z	4.81	75.0	24.0		129.0	
10061-CAB	CDMA2000 (1xRTT, RC3)	X	3.96	65.7	18.3	3.97	135.8	±0.9 %
		Y	4.08	66.6	19.0		143.5	
		Z	4.22	67.9	19.8		145.3	
10090-DAC	GPRS-FDD (TDMA, GMSK, TN 0-4)	X	2.01	68.4	13.4	6.56	142.9	±2.2 %
		Y	2.59	71.6	15.0		138.5	
		Z	11.30	91.6	22.2		133.5	

10099-DAC	EDGE-FDD (TDMA, 8PSK, TN 0-4)	X	5.86	77.8	26.9	9.55	141.6	±2.5 %
		Y	5.01	72.9	24.3		106.0	
		Z	6.21	79.8	28.0		149.0	
10117-CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.60	69.2	21.5	8.07	149.0	±3.0 %
		Y	10.31	68.4	21.0		129.5	
		Z	10.46	69.1	21.5		133.8	
10196-CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	10.22	69.0	21.5	8.10	145.1	±3.0 %
		Y	10.01	68.3	21.0		125.8	
		Z	10.02	68.7	21.4		129.7	
10290-AAB	CDMA2000, RC1, SO55, Full Rate	X	4.45	67.2	18.8	3.91	144.2	±0.9 %
		Y	4.55	67.9	19.5		127.3	
		Z	4.73	69.3	20.4		130.2	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.70	66.4	18.4	3.46	138.0	±0.7 %
		Y	3.88	67.9	19.6		141.5	
		Z	4.05	69.3	20.4		146.1	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.62	66.4	18.3	3.39	139.1	±0.7 %
		Y	3.90	68.4	19.8		142.7	
		Z	4.08	70.0	20.7		145.6	
10293-AAB	CDMA2000, RC3, SO3, Full Rate	X	3.72	66.4	18.4	3.50	138.6	±0.7 %
		Y	3.90	67.8	19.6		141.4	
		Z	4.07	69.3	20.4		146.0	
10295-AAB	CDMA2000, RC1, SO3, 1/8th Rate 25 fr.	X	5.79	67.9	24.6	12.49	96.8	±1.7 %
		Y	5.20	64.3	22.3		64.1	
		Z	5.69	67.9	24.7		87.8	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.97	68.6	18.9	3.76	146.2	±0.7 %
		Y	5.26	69.9	19.9		132.8	
		Z	5.62	72.1	20.9		144.9	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.91	68.7	19.0	3.77	146.5	±0.9 %
		Y	5.19	70.0	20.0		130.3	
		Z	5.50	72.0	21.0		143.3	
10406-AAB	CDMA2000, RC3, SO32, SCH0, Full Rate	X	6.36	68.9	19.8	5.22	129.3	±1.2 %
		Y	6.53	69.3	20.1		136.2	
		Z	6.83	71.2	21.2		149.8	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.71	67.5	18.2	1.54	144.4	±0.7 %
		Y	3.45	73.1	21.5		128.2	
		Z	3.71	75.0	22.4		141.4	
10417-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 99pc duty cycle)	X	10.31	69.0	21.6	8.23	145.7	±3.0 %
		Y	10.10	68.4	21.2		125.0	
		Z	10.29	69.3	21.9		139.9	
10418-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Long preambule)	X	10.22	69.1	21.6	8.14	146.2	±3.0 %
		Y	10.02	68.4	21.2		125.4	
		Z	10.15	69.2	21.7		139.0	

10458-AAA	CDMA2000 (1xEV-DO, Rev. B, 2 carriers)	X	8.26	68.0	20.1	6.55	134.0	±1.7 %
		Y	8.55	68.6	20.5		140.6	
		Z	8.23	68.4	20.5		125.9	
10459-AAA	CDMA2000 (1xEV-DO, Rev. B, 3 carriers)	X	10.79	68.9	21.5	8.25	137.1	±3.0 %
		Y	11.20	69.7	21.9		143.6	
		Z	10.71	69.2	21.8		127.5	
10515-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps, 99pc duty cycle)	X	2.74	67.8	18.4	1.58	148.0	±0.7 %
		Y	3.62	74.2	22.0		129.4	
		Z	3.89	76.1	22.9		140.5	
10518-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps, 99pc duty cycle)	X	10.45	69.4	21.8	8.23	149.5	±2.5 %
		Y	10.13	68.4	21.2		126.1	
		Z	10.29	69.3	21.8		139.5	
10525-AAA	IEEE 802.11ac WiFi (20MHz, MCS0, 99pc duty cycle)	X	10.21	68.4	21.3	8.36	126.0	±3.0 %
		Y	10.41	68.7	21.5		129.4	
		Z	10.50	69.4	22.0		142.0	
10526-AAA	IEEE 802.11ac WiFi (20MHz, MCS1, 99pc duty cycle)	X	10.32	68.5	21.4	8.42	126.6	±3.0 %
		Y	10.47	68.8	21.5		130.1	
		Z	10.61	69.6	22.1		142.2	
10534-AAA	IEEE 802.11ac WiFi (40MHz, MCS0, 99pc duty cycle)	X	10.83	69.1	21.6	8.45	133.9	±2.7 %
		Y	10.87	69.1	21.6		135.0	
		Z	10.65	68.9	21.6		123.6	
10535-AAA	IEEE 802.11ac WiFi (40MHz, MCS1, 99pc duty cycle)	X	10.84	69.1	21.6	8.45	134.6	±3.0 %
		Y	10.89	69.1	21.6		135.1	
		Z	10.73	69.1	21.7		125.5	
10544-AAA	IEEE 802.11ac WiFi (80MHz, MCS0, 99pc duty cycle)	X	11.29	69.6	21.7	8.47	138.9	±3.0 %
		Y	11.10	69.2	21.5		136.9	
		Z	11.14	69.5	21.7		128.7	
10545-AAA	IEEE 802.11ac WiFi (80MHz, MCS1, 99pc duty cycle)	X	11.46	69.9	21.9	8.55	141.1	±3.0 %
		Y	11.21	69.3	21.6		138.1	
		Z	11.26	69.7	21.9		129.9	
10564-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 9 Mbps, 99pc duty cycle)	X	10.12	68.5	21.3	8.25	127.9	±2.7 %
		Y	10.22	68.6	21.3		127.3	
		Z	10.39	69.5	22.0		142.2	
10571-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 90pc duty cycle)	X	2.82	67.6	18.5	1.99	147.5	±0.9 %
		Y	3.44	72.5	21.5		148.6	
		Z	3.68	73.9	21.9		138.7	
10572-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps, 90pc duty cycle)	X	2.93	68.4	18.8	1.99	146.0	±0.7 %
		Y	3.53	73.1	21.7		145.7	
		Z	4.04	76.1	22.9		137.5	
10575-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 90pc duty cycle)	X	10.18	68.4	21.5	8.59	124.0	±3.0 %
		Y	10.32	68.6	21.6		123.8	
		Z	10.48	69.5	22.2		139.0	
10576-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 9 Mbps, 90pc duty cycle)	X	10.20	68.4	21.5	8.60	123.9	±3.0 %
		Y	10.35	68.7	21.6		123.7	
		Z	10.53	69.6	22.3		140.0	

10583-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 90pc duty cycle)	X	10.63	69.6	22.2	8.59	149.6	±2.7 %
		Y	10.33	68.6	21.6		124.0	
		Z	10.48	69.5	22.2		139.5	
10584-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps, 90pc duty cycle)	X	10.22	68.5	21.5	8.60	124.2	±3.0 %
		Y	10.35	68.6	21.6		124.1	
		Z	10.52	69.6	22.3		139.8	
10591-AAA	IEEE 802.11n (HT Mixed, 20MHz, MCS0, 90pc duty cycle)	X	10.34	68.5	21.6	8.63	125.6	±3.0 %
		Y	10.51	68.8	21.7		127.7	
		Z	10.66	69.7	22.3		143.1	
10592-AAA	IEEE 802.11n (HT Mixed, 20MHz, MCS1, 90pc duty cycle)	X	10.51	68.7	21.7	8.79	126.2	±3.0 %
		Y	10.66	68.9	21.8		128.2	
		Z	10.82	69.8	22.5		143.2	
10599-AAA	IEEE 802.11n (HT Mixed, 40MHz, MCS0, 90pc duty cycle)	X	11.01	69.2	21.9	8.79	133.1	±3.0 %
		Y	11.06	69.3	21.9		134.2	
		Z	10.85	69.1	21.9		123.7	
10600-AAA	IEEE 802.11n (HT Mixed, 40MHz, MCS1, 90pc duty cycle)	X	11.07	69.3	22.0	8.88	132.7	±3.0 %
		Y	11.11	69.3	21.9		134.8	
		Z	10.95	69.2	22.1		124.9	
10607-AAA	IEEE 802.11ac WiFi (20MHz, MCS0, 90pc duty cycle)	X	10.30	68.4	21.5	8.64	124.6	±3.0 %
		Y	10.51	68.8	21.7		129.3	
		Z	10.65	69.6	22.3		142.8	
10608-AAA	IEEE 802.11ac WiFi (20MHz, MCS1, 90pc duty cycle)	X	10.49	68.7	21.7	8.77	125.7	±2.7 %
		Y	10.67	69.0	21.8		130.0	
		Z	10.83	69.9	22.5		143.9	
10616-AAA	IEEE 802.11ac WiFi (40MHz, MCS0, 90pc duty cycle)	X	11.01	69.2	21.9	8.82	132.0	±2.7 %
		Y	11.09	69.3	21.9		136.2	
		Z	11.34	70.3	22.6		149.7	
10617-AAA	IEEE 802.11ac WiFi (40MHz, MCS1, 90pc duty cycle)	X	10.98	69.1	21.8	8.81	131.8	±3.0 %
		Y	11.09	69.3	21.9		135.7	
		Z	10.85	69.0	21.9		123.4	
10626-AAA	IEEE 802.11ac WiFi (80MHz, MCS0, 90pc duty cycle)	X	11.48	69.8	22.0	8.83	136.8	±3.0 %
		Y	11.33	69.4	21.8		138.3	
		Z	11.32	69.6	22.0		127.1	
10627-AAA	IEEE 802.11ac WiFi (80MHz, MCS1, 90pc duty cycle)	X	11.56	69.9	22.1	8.88	136.8	±3.0 %
		Y	11.40	69.5	21.9		138.3	
		Z	11.37	69.7	22.1		127.3	
10648-AAA	CDMA2000 (1x Advanced)	X	3.75	66.8	18.7	3.45	142.8	±0.7 %
		Y	4.06	69.0	20.3		148.6	
		Z	4.02	69.3	20.5		135.3	

[E] 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 Certificates

Calibration Laboratory of
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Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

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Accreditation No.: SCS 0108

Client **Motorola Solutions MY**

Certificate No: **D2450V2-782_Feb17**

CALIBRATION CERTIFICATE

Object: D2450V2 - SN:782

Calibration procedure(s): QA CAL-05.v9
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: February 15, 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	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 7349	31-Dec-16 (No. EX3-7349_Dec16)	Dec-17
DAE4	SN: 601	04-Jan-17 (No. DAE4-601_Jan17)	Jan-18

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17

	Name	Function	Signature
Calibrated by:	Johannes Kurikka	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: February 15, 2017

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Certificate No: D2450V2-782_Feb17 Page 1 of 8

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Accredited by the Swiss Accreditation Service (SAS)
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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, "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"

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	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.5 ± 6 %	1.87 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	13.7 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**53.3 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.8 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.6 ± 6 %	2.02 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	12.9 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**50.5 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.94 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.5 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.9 Ω + 4.0 jΩ
Return Loss	- 27.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.3 Ω + 5.7 jΩ
Return Loss	- 24.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.151 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	May 06, 2005

DASY5 Validation Report for Head TSL

Date: 15.02.2017

Test Laboratory: SPEAG, Zurich, Switzerland

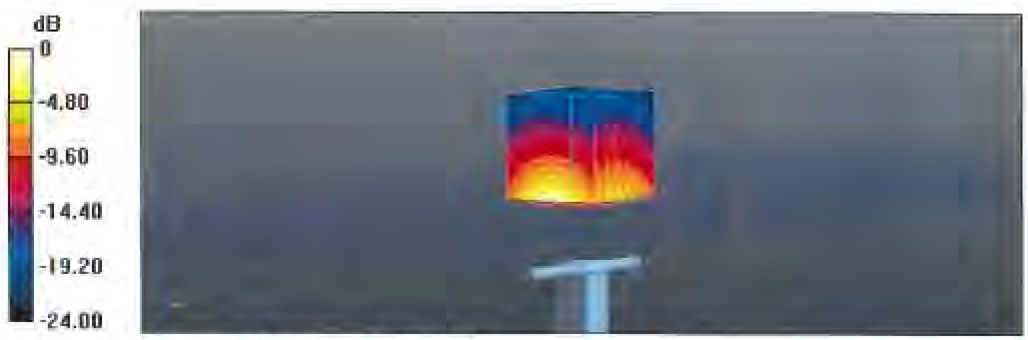
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:782

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.87 S/m; ε_r = 37.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

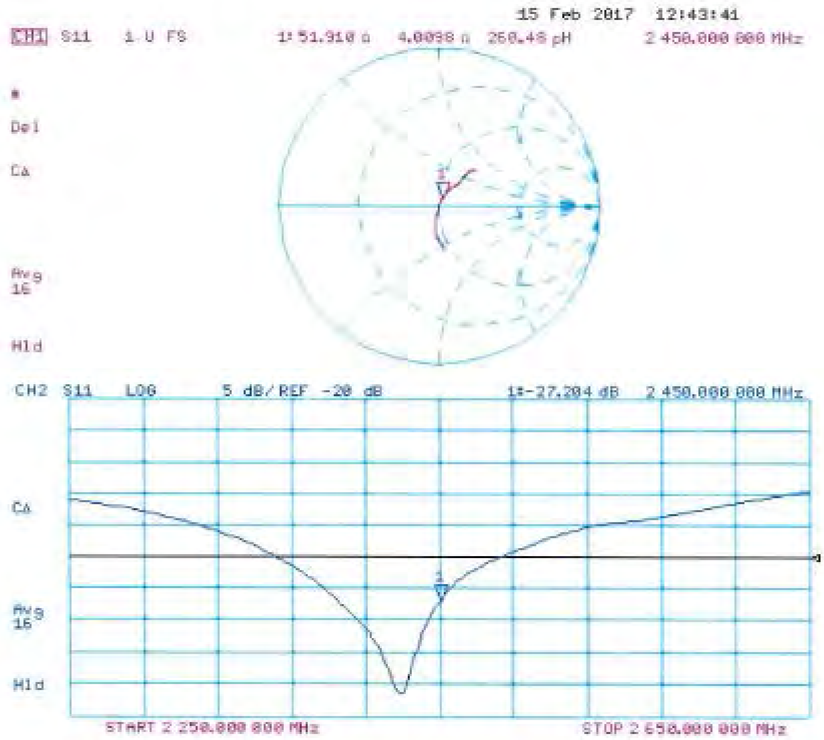
- Probe: EX3DV4 - SN7349; ConvF(7.72, 7.72, 7.72); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.01.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7331)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 115.0 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 28.4 W/kg
SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.3 W/kg
Maximum value of SAR (measured) = 22.8 W/kg



0 dB = 22.8 W/kg = 13.58 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 15.02.2017

Test Laboratory: SPEAG, Zurich, Switzerland

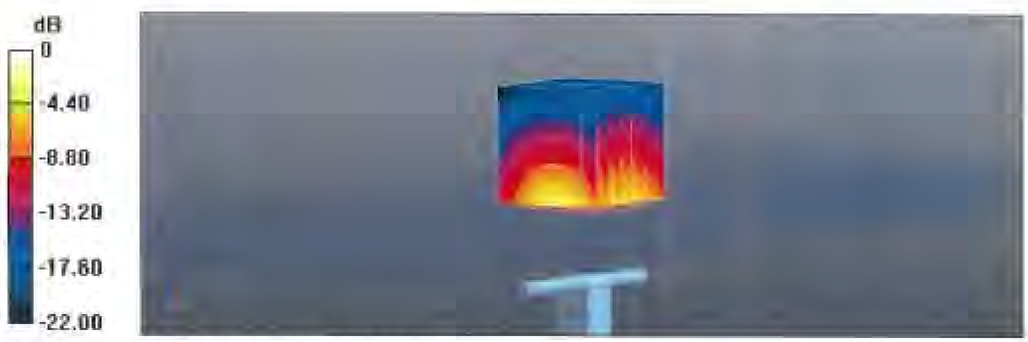
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:782

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.02 S/m; ε_r = 51.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.79, 7.79, 7.79); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.01.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7331)

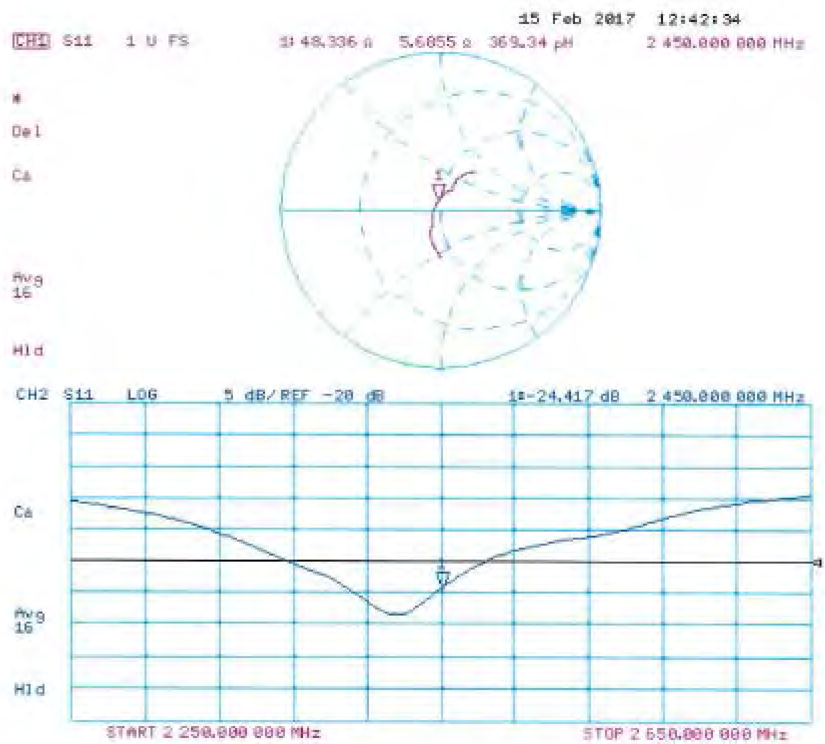
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 105.4 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 26.6 W/kg
SAR(1 g) = 12.9 W/kg; SAR(10 g) = 5.94 W/kg
Maximum value of SAR (measured) = 20.6 W/kg



0 dB = 20.6 W/kg = 13.14 dBW/kg

Certificate No: D2450V2-782_Feb17 Page 7 of 8

Impedance Measurement Plot for Body TSL



Certificate No: D2450V2-782_Feb17 Page 8 of 8

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Accreditation No.: **SCS 0108**

Client Motorola EME

Certificate No: D450V3-1077_Nov15

CALIBRATION CERTIFICATE

Object	D450V3 - SN: 1077
Calibration procedure(s)	QA CAL-15.v8 Calibration procedure for dipole validation kits below 700 MHz
Calibration date:	November 25, 2015

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 E4419B	GB41293874	01-Apr-15 (No. 217-02128)	Mar-16
Power sensor E4412A	MY41498087	01-Apr-15 (No. 217-02128)	Mar-16
Reference 3 dB Attenuator	SN: S5054 (3c)	01-Apr-15 (No. 217-02129)	Mar-16
Reference 20 dB Attenuator	SN: S5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe ET3DV6	SN: 1507	30-Dec-14 (No. ET3-1507_Dec14)	Dec-15
DAE4	SN: 654	08-Jul-15 (No. DAE4-654_Jul15)	Jul-16

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	04-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

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

Issued: November 25, 2015

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Certificate No: D450V3-1077_Nov15 Page 1 of 8

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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, "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"

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%.

Certificate No: D450V3-1077_Nov15 Page 2 of 8

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
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	44.0 ± 6 %	0.89 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	1.16 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**4.57 W/kg ± 18.1 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	0.777 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**3.07 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	56.3 ± 6 %	0.95 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	**4.52 W/kg ± 18.1 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	0.749 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**2.97 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	58.1 Ω - 2.3 jΩ
Return Loss	- 22.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	55.0 Ω - 6.8 jΩ
Return Loss	- 21.9 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	June 24, 2010

DASY5 Validation Report for Head TSL

Date: 25.11.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN: 1077

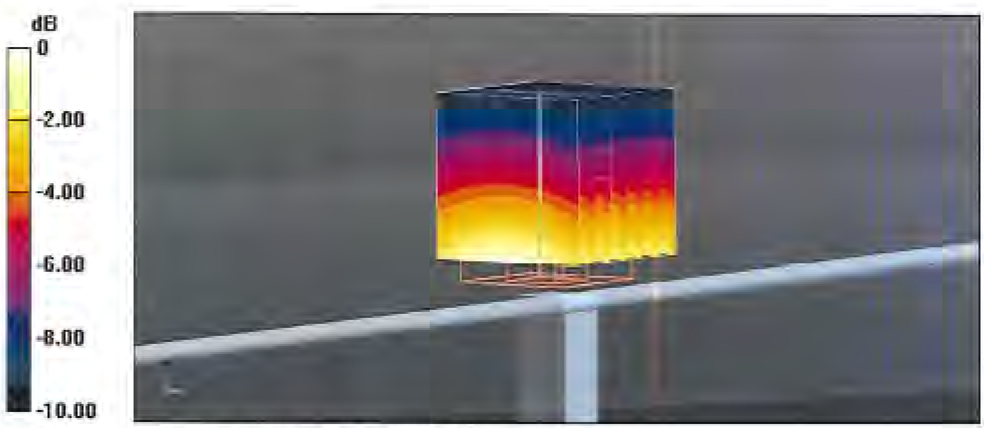
Communication System: UID 0 - CW; Frequency: 450 MHz
Medium parameters used: f = 450 MHz; σ = 0.89 S/m; ε_r = 44; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(6.58, 6.58, 6.58); Calibrated: 30.12.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 08.07.2015
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

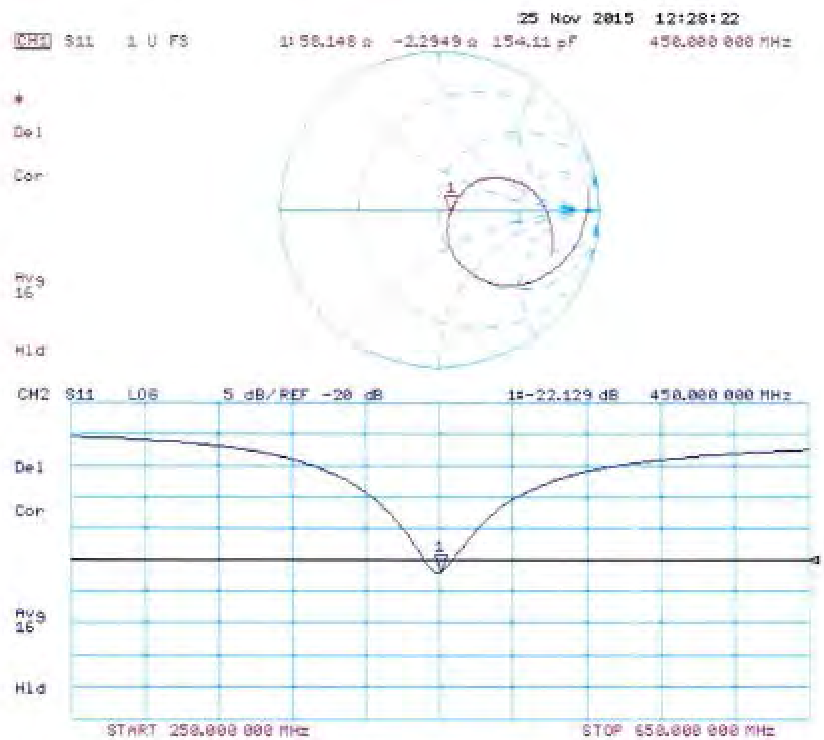
Dipole Calibration for Head Tissue/d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 39.43 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 1.67 W/kg
SAR(1 g) = 1.16 W/kg; SAR(10 g) = 0.777 W/kg
Maximum value of SAR (measured) = 1.25 W/kg



0 dB = 1.25 W/kg = 0.97 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 25.11.2015

Test Laboratory: SPEAG, Zurich, Switzerland

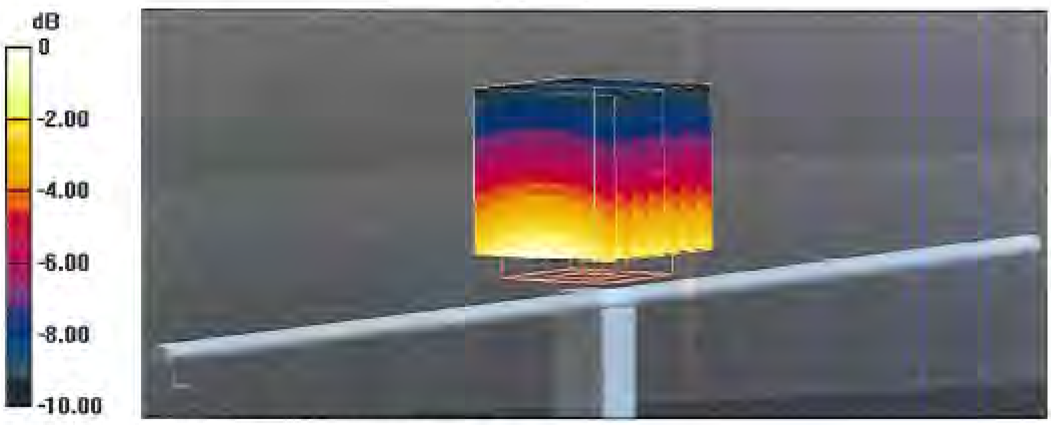
DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN: 1077

Communication System: UID 0 - CW; Frequency: 450 MHz
Medium parameters used: f = 450 MHz; σ = 0.95 S/m; ε_r = 56.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(7.05, 7.05, 7.05); Calibrated: 30.12.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 08.07.2015
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Body Tissue/d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 36.74 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 1.80 W/kg
SAR(1 g) = 1.14 W/kg; SAR(10 g) = 0.749 W/kg
Maximum value of SAR (measured) = 1.22 W/kg



0 dB = 1.22 W/kg = 0.86 dBW/kg

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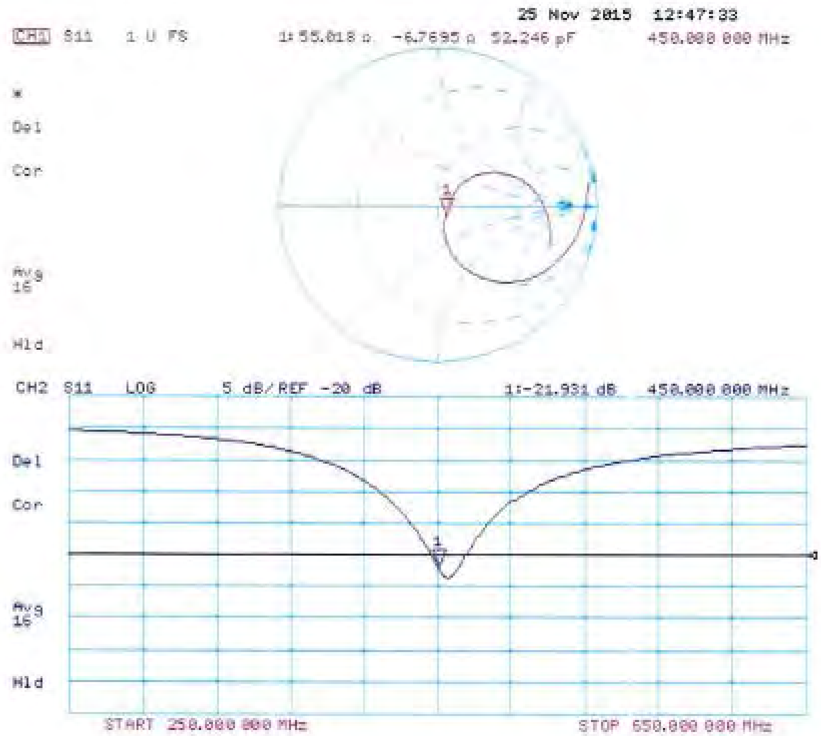
Impedance Measurement Plot for Body TSL



Dipole Data

As stated in KDB 865664, only Dipole D450V3 (serial number 1077) exceed annual calibration, the test laboratory must ensure that the required supporting information and documentation are included in report to qualify for extended calibration interval.

The table below includes dipoles impedance and return loss measurement data measured by Motorola Solutions' EME lab. The results meet requirements stated in KDB 865664.

Dipole D450V3 (SN 1077)	Head			Body		
Date Measured	Impedance		Return Loss	Impedance		Return Loss
	real Ω	imag jΩ	dB	real Ω	imag jΩ	dB
06/28/2016	58.87	-2.93	-22.48	50.59	-6.61	-22.25
12/01/2016	59.08	-2.93	-22.65	51.05	-7.45	-22.63

Appendix D
SAR Summary Results Table for FCC PAG review

Table D.1 Body configuration 450-512MHz LMR band SAR Summary Result

Table #	Body / Head / Face	Antenna No.	Battery No.	Body Worn No.	Audio No.	Front / Back	F1 450 MHz	F2 465.5 MHz	F3 481 MHz	F4 496.5 MHz	F5 512 MHz
18	Body	1	1	1	1	Back	4.62	4.96		3.85	
18	Body	2	1	1	1	Back	4.25	5.02	4.71	4.33	5.71
18	Body	1	3	1	1	Back		4.08			
18	Body	1	4	1	1	Back		4.05			
18	Body	1	2	1	1	Back		3.78			
18	Body	1	5	1	1	Back		4.51			
18	Body	1	6	1	1	Back		5.34			
18	Body	2	3	1	1	Back					3.94
18	Body	2	4	1	1	Back					3.99
18	Body	2	2	1	1	Back					4.55
18	Body	2	5	1	1	Back					4.85
18	Body	2	6	1	1	Back					5.96
19	Body	1	1	2	1	Back	4.59	4.95		3.82	
19	Body	2	1	2	1	Back	4.22	4.50	4.51	4.32	5.65
19	Body	1	3	2	1	Back		4.19			
19	Body	1	4	2	1	Back		4.13			
19	Body	1	2	2	1	Back		3.92			
19	Body	1	5	2	1	Back		4.68			
19	Body	1	6	2	1	Back		5.67			
19	Body	2	3	2	1	Back					3.94
19	Body	2	4	2	1	Back					4.27
19	Body	2	2	2	1	Back					4.39
19	Body	2	5	2	1	Back					5.01
19	Body	2	6	2	1	Back				4.75	6.23
20	Body	1	1	3	1	Back				1.92	
20	Body	2	1	3	1	Back				2.30	
20	Body	2	3	3	1	Back				1.48	
20	Body	2	4	3	1	Back				1.63	
20	Body	2	2	3	1	Back				1.81	
20	Body	2	5	3	1	Back				2.05	
20	Body	2	6	3	1	Back				1.92	
21	Body	1	1	4	1	Back				1.13	
21	Body	2	1	4	1	Back				1.19	
21	Body	2	3	4	1	Back				0.88	
21	Body	2	4	4	1	Back				0.88	
21	Body	2	2	4	1	Back				0.87	
21	Body	2	5	4	1	Back				0.96	
21	Body	2	6	4	1	Back				1.13	
22	Body	1	1	5	1	Back				1.43	
22	Body	2	1	5	1	Back				1.57	
22	Body	2	3	5	1	Back				1.01	
22	Body	2	4	5	1	Back				1.10	
22	Body	2	2	5	1	Back				1.05	
22	Body	2	5	5	1	Back				1.37	
22	Body	2	6	5	1	Back				1.36	

Table D.1 (Continued)

Table #	Body / Head / Face	Antenna No.	Battery No.	Body Worn No.	Audio No.	Front / Back	F1	F2	F3	F4	F5
							450 MHz	465.5 MHz	481 MHz	496.5 MHz	512 MHz
23	Body	1	1	6	1	Back				2.82	
23	Body	2	1	6	1	Back				3.35	
23	Body	2	3	6	1	Back				2.57	
23	Body	2	4	6	1	Back				2.70	
23	Body	2	2	6	1	Back				2.75	
23	Body	2	5	6	1	Back				3.05	
23	Body	2	6	6	1	Back				3.44	
24	Body	2	6	2	2	Back	4.18	5.50	5.28	5.10	6.00
24	Body	2	6	2	3	Back	4.40	5.35	5.33	4.79	6.19
24	Body	2	6	2	4	Back	4.78	5.74	5.32	5.03	5.86
24	Body	2	6	2	5	Back	4.34	5.23	4.91	4.37	5.43
24	Body	2	6	2	6	Back	3.93	5.43	5.18	4.72	5.63
24	Body	2	6	2	7&8	Back	4.01	5.54	5.05	4.35	5.20
24	Body	2	6	2	7&9	Back	4.01	5.23	4.80	4.15	4.74
24	Body	2	6	2	10&11	Back	4.35	5.34	4.78	4.62	5.56
24	Body	2	6	2	10&12	Back	4.69	5.55	5.07	4.59	5.68
24	Body	2	6	2	13&14	Back	4.37	5.24	4.38	4.97	6.28
24	Body	2	6	2	15	Back	4.18	5.49	5.00	4.84	5.86
25	Body	2	6	2	None	Back	4.68	6.13	5.55	5.38	5.53

Table D.2 Body Configuration 2412-2462MHz WLAN band SAR Summary Result

Table #	Body / Head / Face	Antenna No.	Battery No.	Body Worn No.	Audio No.	Front / Back	F1	F2	F3
							2412.000 MHz	2437.000 MHz	2462.000 MHz
27	Body	3	1	1	None	Back		0.0030	
27	Body	3	1	2	None	Back		0.0051	
27	Body	3	1	3	None	Back		0.00029	
27	Body	3	1	4	None	Back		0.00004	
27	Body	3	1	5	None	Back		0.0003	
27	Body	3	1	6	None	Back		0.00011	
27	Body	3	4	2	None	Back		0.0022	
27	Body	3	3	2	None	Back		0.0020	
27	Body	3	5	2	None	Back		0.0021	
27	Body	3	6	2	None	Back		0.0026	
27	Body	3	2	2	None	Back		0.0005	

Table D.3 Face Configuration 450-512 MHz LMR band SAR Summary Result

Table #	Body / Head / Face	Antenna No.	Battery No.	Body Worn No.	Audio No.	Front / Back	F1	F2	F3	F4	F5
							450 MHz	465.5 MHz	481 MHz	496.5 MHz	512 MHz
29	Face	1	2	None	None	Back			3.21		
29	Face	2	2	None	None	Back	4.05		3.61		3.54
29	Face	2	6	None	None	Back	3.70				
29	Face	2	3	None	None	Back	3.93				
29	Face	2	4	None	None	Back	3.83				
29	Face	2	5	None	None	Back	3.84				
29	Face	2	1	None	None	Back	3.71				

Table D.4 Face Configuration 2412-2462MHz WLAN band SAR Summary Result

Table #	Body / Head / Face	Antenna No.	Battery No.	Body Worn No.	Audio No.	Front / Back	F1 2412.000 MHz	F2 2437.000 MHz	F3 2462.000 MHz
30	Face	3	2	None	None	Back		0.0257	
30	Face	3	4	None	None	Back		0.0227	
30	Face	3	3	None	None	Back		0.0209	
30	Face	3	5	None	None	Back		0.0200	
30	Face	3	1	None	None	Back		0.0203	
30	Face	3	6	None	None	Back		0.02000	