MOTOROLA SOLUTIONS

ilac-MRA | STANDARDS MS ISO/IEC 17025 TESTING SAMM No. 0826 | ilac-MRA | A2LA ACCREDITED CERTIFICATE 2518.05

DECLARATION OF COMPLIANCE SAR ASSESSMENT Part 1 of 2

Motorola Solutions, Inc
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Date of Report: 12/12/2019
Report Revision: A

Responsible Engineer:	Lee Kin Kting (EME Engineer)
Report Author:	Lee Kin Kting (EME Engineer)
Date/s Tested:	9/10/2019 - 9/13/2019, 9/18/2019- 9/20/2019, 9/22/2019- 9/28/2019, 9/30/2019-10/4/2019,10/7/2019, 10/9/2019 - 10/14/2019, 11/13/2019, 12/12/2019
Manufacturer:	Motorola Solutions Inc.
Applicant Name:	Motorola Solutions Inc.
DUT Description:	Handheld Portable - 136-174 5W NKP CFS WiFi
Test TX mode(s):	CW (PTT) , Bluetooth, WLAN 802.11 b/g/n
Max. Power output:	6.0 W (LMR 136-174 MHz band), 10.0 mW (Bluetooth), 70.8 mW (WLAN 802.11 b), 20.0 mW (WLAN 802.11g), 12.6 mW (WLAN 802.11n)
Nominal Power:	5.0 W (LMR 136-174 MHz band), 8.9 mW (Bluetooth), 55.0 mW (WLAN 802.11 b), 14.8 mW (WLAN 802.11g), 10.0 mW (WLAN 802.11n)
Tx Frequency Bands:	LMR 136-174 MHz; Bluetooth 2.402-2.480 GHz; WLAN 802.11 b/g/n 2.412-2.462 GHz
Signaling type:	FM (LMR), FHSS (Bluetooth), 802.11 b/g/n (WLAN)
Model(s) Tested:	AAH02JDC9VA1AN (PMUD2629C) / PMUD2629CAANKA
Model(s) Certified:	AAH02JDC9VA1AN (PMUD2629C) / PMUD2629CAANKA, AAH02JDH9VA1AN (PMUD2627C) / PMUD2627CABNKA
Serial Number(s):	446TVPB943
Classification:	Occupational/Controlled
FCC ID:	AZ489FT7126; LMR 150.8-173.4 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-89FT7126; LMR 138-174 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 ISED equipment approval, which are clearly identified
ISED Test Site registration:	24843
FCC Test Firm Registration Number:	823256

The test results clearly demonstrate compliance with FCC Occupational/Controlled RF Exposure limits of 8 W/kg averaged over 1 gram per the requirements of FCC 47 CFR § 2.1093 and RSS-102 (Issue 5).

Based on the information and the testing results provided herein, the undersigned certifies that when used as stated in the operating instructions supplied, said product complies with the national and international reference standards and guidelines listed in section 4.0 of this report (no deviation from standard methods). This report shall not be reproduced without written approval from an officially designated representative of the Motorola Solutions Inc EME Laboratory.

I attest to the accuracy of the data and assume full responsibility for the completeness of these measurements. This reporting format is consistent with the suggested guidelines of the TIA TSB-150 December 2004. The results and statements contained in this report pertain only to the device(s) evaluated.

Tiong Nguk Ing — Digitally signed by Tiong Nguk Ing Date: 2019.12.19 15:46:36 +08'00'

Tiong Nguk Ing
Deputy Technical Manager (Approved Signatory)
Approval Date: 12/19/2019

Part 1 of 2

APPENDICES

Part 2 of 2

APPENDICES

Report Revision History

Date	Revision	Comments
12/12/2019	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 AAH02JDC9VA1AN (PMUD2629C). This device is classified as Occupational/Controlled.

2.0 FCC SAR Summary

Table 1

Equipment Class	Frequency band (MHz)	Max Calc at Body (W/kg)	Max Calc at Face (W/kg)
		1g-SAR	1g-SAR
TNF	150.8-173.4MHz (LMR)	1.74	1.24
*DSS	2402-2480 (Bluetooth)	NA	NA
DTS	2412-2462 (WLAN 802.11 b/g/n)	0.075	0.072
Simultaneous Results		1.82	1.31

*Results not required per KDB (refer to sections 13.6 and 14.0)

3.0 Abbreviations / Definitions

BT: Bluetooth
CNR: Calibration Not Required
CW: Continuous Wave
DPSK: Differential Phase-Shift Keying
DUT: Device Under Test
EDR: Enhanced Data Rate
EME: Electromagnetic Energy
FHSS: Frequency Hopping Spread Spectrum
FM: Frequency Modulation
GFSK: Gaussian Frequency-Shift Keying
LMR: Land Mobile Radio
NA: Not Applicable
PTT: Push to Talk
RSM: Remote Speaker Microphone
SAR: Specific Absorption Rate
TNF: Licensed Non-Broadcast Transmitter Held to Face
WiFi: Wireless Fidelity
WLAN: Wireless Local Area Network
NKP: No Keypad
LKP: Limited Keypad
NiMH: Nickel Metal Hydride
Li-Ion: Lithium-Ion
Li-Mn: Lithium Manganese

Audio accessories: These accessories allow communication while the DUT is worn on the body.

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

4.0 Referenced Standards and Guidelines

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

- IEC62209-1 (2016) 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 v01r01
- FCC KDB – 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r03
- FCC KDB – 865664 D02 RF Exposure Reporting v01r01
- FCC KDB – 447498 D01 General RF Exposure Guidance v05r02
- FCC KDB – 248227 D01 802.11 Wi-Fi SAR v02

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 band using frequency modulation (FM). 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.

The LMR band in these devices operates 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 a Bluetooth v4.0, which include classis Bluetooth, and Bluetooth low energy. It is Class 1 Bluetooth device with Frequency Hopping Spread Spectrum (FHSS) technology. The Bluetooth radio modem is used to wireless link audio accessories. The maximum actual transmission duty cycle is imposed by the Bluetooth standard. The maximum duty cycle for BT is derived from 5-slots packet type operation which consists of receiving on 1-slot and transmitting on 5-slots, and thus maximum duty cycle = 77%.

WLAN 802.11 b/g/n operates using Direct Sequence Spread Spectrum (DSSS) and Orthogonal Frequency-Division Multiplexing (OFDM) accordance with the IEEE 802.11 b/g/n.

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

Technologies	Band (MHz)	Transmission	Duty Cycle (%)	Max Power (W)
LMR	136-174	FM	*50	6.0
BT	2402-2480	FHSS	77.0	0.010
WLAN	2412-2462	802.11b	99.8	0.0708
WLAN	2412-2462	802.11g	99.2	0.0200
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 one internal WLAN/BT antenna offered for this product. The Table below lists their descriptions.

Table 4

Antenna No.	Antenna Models	Description	Selected for test	Tested
1	85012026001	Internal BT/WLAN, 2402-2484 MHz, ¼ wave, 0 dBi	Yes	Yes; for WLAN
2	PMAD4116A	VHF helical (144-165MHz) ½ wave, -12dBi	Yes	Yes
3	PMAD4117A	VHF helical (136-155 MHz) ½ wave, -12dBi	Yes	Yes
4	PMAD4118A	VHF helical (152-174MHz) ½ wave, -12dBi	Yes	Yes
5	PMAD4119A	VHF stubby (136-148MHz) ¼ wave, -9.5dBi	Yes*	Yes*
6	PMAD4120A	VHF stubby (146-160MHz) ¼ wave, -9.5dBi	Yes	Yes
7	PMAD4121B	VHF stubby (160-174MHz) ¼ wave, -9.5dBi	Yes	Yes

*Note: PMAD4119A bandwidth is outside FCC range

7.2 Batteries

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

Table 5

Battery No.	Battery Models	Description	Selected for test	Tested	Comments
1	PMNN4491B	IMPRES Li-Ion IP68 2100 mAh	Yes	Yes	Default battery for body testing
2	PMNN4493A	IMPRES Li-Ion Ultra Hi-Capacity 3000 mAh	Yes	Yes	Default battery for face testing
3	PMNN4406B	Standard IP67 Li-Ion 1500m 1600T mAh	Yes	Yes	
4	PMNN4407B	IMPRES Li-Ion Slim battery 1500 mAh	Yes	Yes	
5	PMNN4409B	IMPRES Hi-Cap Li-Ion non-FM 2150 mAh	Yes	Yes	
6	PMNN4415A	Standard IP56 NiMH 1300m 1400T mAh	Yes	Yes	
7	PMNN4416B	Standard IP56 Li-Ion 1500m 1600T mAh	Yes	Yes	
8	PMNN4417B	IMPRES IP56 Li-Ion1500m 1600T mAh	Yes	Yes	
9	PMNN4418B	IMPRES IP56 Li-Ion 2150m 2250T mAh	Yes	Yes	
10	PMNN4435A	Standard IP57 Li-Ion 1300m 1400T mAh	Yes	Yes	
11	PMNN4463A	Li-Ion IP57 2000 mAh	Yes	Yes	
12	PMNN4488A	Impress Ultra Hi-Capacity 3000 mAh with vibrator	Yes	Yes	Only compatible with body worn PMLN7296A
13	PMNN4490A	IMPRES TIA4950 Hi-Capacity 2900 mAh	Yes	Yes	
14	PMNN4525A	IMPRES Li-ion IP68 1950T mAh	Yes	Yes	
15	PMNN4543A	Li-Ion IP68 2450T mAh	Yes	Yes	
16	PMNN4544A	IMPRES Li-ion IP68 2450T mAh	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	HLN6602A	Universal Chest Pack	Yes	Yes	
2	NTN5243A	Carrying Strap	Yes	Yes	Tested with PMLN5866A, PMLN5864A, PMLN5870A
3	PMLN4651A	2.0 Inch Belt Clip	Yes	Yes	
4	PMLN5863A	Hard Leather Carry Case 3.0 Inch Fixed belt loop- LKP	No	No	By similarity to PMLN5864A
5	PMLN5864A	Hard Leather Carry Case 3.0 Inch Fixed belt loop- NKP	Yes	Yes	Tested with NTN5243A
6	PMLN5865A	Hard Leather Carry Case with 3.0 Inch Swivel belt loop - LKP	No	No	By similarity to PMLN5866A
7	PMLN5866A	Hard Leather Carry Case with 3.0 Inch Swivel belt loop - NKP	Yes	Yes	Tested with NTN5243A with belt loop removed.
8	PMLN5867A	Hard Leather Carry Case with 2.5 Inch Swivel belt loop - LKP	No	No	By similarity to PMLN5866A
9	PMLN5868A	Hard Leather Carry Case with 2.5 Inch Swivel belt loop - NKP	No	No	By similarity to PMLN5866A
10	PMLN5869A	Nylon Carry Case 3.0 Inch Fixed belt loop- LKP	No	No	By similarity to PMLN5870A
11	PMLN5870A	Nylon Carry Case 3.0 Inch Fixed belt loop- NKP	Yes	Yes	Tested with NTN5243A, RLN6487A & RLN6488A
12	PMLN7008A	2.5 Inch Belt Clip	Yes	Yes	
13	PMLN7296A	Vibrating Belt Clip	Yes	Yes	Only applicable for battery with vibrator PMNN4488A
14	RLN4570A	Break-a-way Chest Pack	Yes	Yes	
15	RLN4815A	Radio Pack Radio Utility Case	Yes	Yes	
16	RLN6487A	Leather Radio strap -XL	Yes	Yes	Tested with RLN6488A & PMLN5870A
17	RLN6486A	Leather Radio strap	No	No	By similarity to RLN6487A
18	RLN6488A	Anti Sway strap for leather radio straps	Yes	Yes	Tested with RLN6487A & PMLN5870A

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	PMLN5727A	Earpiece Inline Mic/PTT, Swvl, MagOne	Yes	Yes	Default audio
2	PMMN4076AL	RSM Small with 3.5MM jack	Yes	No	Intended for test. Per KDB provisions test not required.
3	PMMN4073A	IMPRES RSM, small 3.5 jack	Yes	No	Tested with RLN4885B. Intended for test. Per KDB provisions test not required.
4	PMMN4071AL	IMPRES Large RSM, Noise cancelling with 3.5mm jack	Yes	No	Intended for test. Per KDB provisions test not required.
5	PMLN6760A	Behind the head heavy duty headset	Yes	No	Intended for test. Per KDB provisions test not required.
6	PMLN5733A	Earbud with In-Line Mic/PTT, MagOne	Yes	No	Intended for test. Per KDB provisions test not required.
7	PMLN6757A	Earpiece, adjust d-style w/in-line PTT/Mic	Yes	No	Intended for test. Per KDB provisions test not required.
8	PMLN6761A	Ultra-Lite Headset MagOne	Yes	No	Intended for test. Per KDB provisions test not required.
9	PMLN5731A	Heavy duty Headset, Noise Cancellation, Inline PTT	Yes	No	Intended for test. Per KDB provisions test not required.
10	PMLN6759A	Temple transducer	Yes	No	Intended for test. Per KDB provisions test not required.
11	PMLN6754A	3-wire surveillance kit w/ trans tube-black	Yes	No	Intended for test. Per KDB provisions test not required.
12	PMLN5726A	2-Wire Surveillance Kit, Beige	Yes	No	Intended for test. Per KDB provisions test not required.
13	RLN4885B	Receive-only covered earbud with coiled cord	Yes	Yes	Tested with PMMN4073A. Intended for test. Per KDB provisions test not required.
14	PMMN4075A	RSM Small, No Emergency, IP57	No	No	By similarity to PMMN4073A
15	PMMN4076A	RSM Small with 3.5mm Jack	No	No	By similarity to PMMN4073A
16	PMMN4071A	IMPRES RSM large 3.5 jack NC	No	No	By similarity to PMMN4073A
17	PMMN4108A	IMPRES WINDPORTING RSM IP67	No	No	By similarity to PMMN4073A
18	PMLN7269A	2-wire surveillance kit with quick disconnect clear acoustic tube, black	No	No	By similarity to PMLN5726A
19	PMLN7270A	2-wire surveillance kit with quick disconnect clear acoustic tube, beige	No	No	By similarity to PMLN5726A
20	PMLN6755A	3-wire surveillance kit w/ trans tube-beige	No	No	By similarity to PMLN6754A
21	PMLN6635A	Lightweight Headset	No	No	By similarity to PMLN6759A
22	PMLN6763A	Behind the Head Heavy Duty Headset Intrinsically safe TIA	No	No	By similarity to PMLN6760A
23	PMLN7464A	OTTO OTH Headset Slim GCAI Connector (Non-TIA)	No	No	By similarity to PMLN6760A
24	PMLN7465A	OTTO OTH Headset Slim GCAI Connector (TIA)	No	No	By similarity to PMLN6760A
25	PMMN4108AL	IMPRES Wind porting RSM IP67	No	No	By similarity to PMMN4071AL
26	PMMN4073AL	IMPRES Small RSM with 3.5mm jack	No	No	By similarity to PMMN4071AL
27	PMLN5732A	Earset w/ Boom Mic, Mag One	No	No	By similarity to PMLN5727A
28	PMMN4075AL	RSM Small, No emergency, IP57	No	No	By similarity to PMMN4076AL

8.0 Description of Test System

8.1 Descriptions of Robotics/Probes/Readout Electronics

Table 8

Dosimetric System type	System version	DAE type	Probe Type
Schmid & Partner Engineering AG SPEAG DASY 5	52.10.2.1495	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

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

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	150MHz		2450MHz	
	Head	Body	Head	Body
Sugar	55.4	49.7	-	-
Diacetin	-	-	51	34.5
De ionized –Water	38.35	46.2	48.75	65.2
Salt	5.15	3.00	0.15	0.2
HEC	1.0	1	-	-
Bact.	0.1	0.1	0.1	0.1

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	7485	01/23/2019	01/23/2020
SPEAG PROBE	EX3DV4	7364	01/23/2019	01/23/2020
SPEAG DAE	DAE4	688	01/10/2019	01/10/2020
SPEAG DAE	DAE4	1483	01/10/2019	01/10/2020
POWER METER	E4419B	MY45103725	06/10/2019	06/10/2021
POWER METER*	E4418B	GB40206480	09/16/2018	09/16/2019
POWER SENSOR	E9301B	MY55210006	12/19/2018	12/19/2019
POWER SENSOR	E9301B	MY55210003	04/26/2019	04/26/2020
VECTOR SIGNAL GENERATOR	E4438C	MY44270302	03/09/2019	03/09/2020
BI-DIRECTIONAL COUPLER*	3020A	41935	09/15/2018	09/15/2019
BI-DIRECTIONAL COUPLER	3020A	40295	09/12/2019	09/12/2020
BI-DIRECTIONAL COUPLER	3022	77114	08/22/2019	08/22/2020
AMPLIFIER	10W1000C	312859	CNR	CNR
AMPLIFIER	5S1G4	312988	CNR	CNR
POWER METER	E4419B	MY40330364	09/16/2018	09/16/2020
POWER SENSOR	8481B	MY41091170	04/23/2019	04/23/2020
POWER METER	E4416A	MY50001037	08/30/2019	08/30/2021
POWER SENSOR	8481B	MY41091170	04/23/2019	04/23/2020
POWER METER	E4418B	MY45100911	08/30/2019	08/30/2021
POWER SENSOR	E9301B	MY50290001	05/06/2019	05/06/2020
WiFi POWER SENSOR	NRP-Z11	121252	03/11/2018	03/11/2021
TEMPERATURE & HUMINIDITY LOGGER*	TM320	12253047	10/30/2018	10/30/2019
TEMPERATURE & HUMINIDITY LOGGER*	DSB	16326831	11/28/2018	11/28/2019
DIGITAL THERMOMETER	1523	3492108	05/03/2019	05/03/2020
TEMPERATURE PROBE	PR-10-3-100-1/4-6-E	WNWR020579	07/06/2019	07/06/2020
TEMPERATURE PROBE*	80PK-22	06032017	12/05/2018	12/05/2019
THERMOMETER*	HH806AU	080307	12/05/2018	12/05/2019
TEMPERATURE PROBE	80PK-22	05032017	12/26/2018	12/26/2019
THERMOMETER	HH202A	35881	12/26/2018	12/26/2019
NETWORK ANALYZER	E5071B	MY42403147	12/19/2018	12/19/2019
DIELECTRIC ASSESSMENT KIT	DAK-12	1069	01/08/2019	01/08/2020
DIELECTRIC ASSESSMENT KIT	DAK-3.5	1156	01/08/2019	01/08/2020
SPEAG DIPOLE	CLA150	4005	02/09/2018	02/09/2020
SPEAG DIPOLE	D2450V2	781	04/11/2018	04/11/2020
SPEAG DIPOLE	D2450V2	703	10/16/2018	10/16/2020

Note: ‘*’ indicates that the equipment is used for SAR assessment before 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								
03/10/2019	Body	150	7364	0.79	59.1	Pass	Pass	Pass
03/15/2019	Head	150		0.73	50.5	Pass	Pass	Pass
03/20/2019	Body	2450		1.98	48.6	Pass	Pass	Pass
03/20/2019	Head	2450		1.88	35.6	Pass	Pass	Pass
03/08/2019	Body	150	7485	0.81	59.2	Pass	Pass	Pass
03/07/2019	Head	150		0.75	51.2	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
7485	FCC Body	SPEAG CLA 150 / 4005	3.84 +/- 10%	4.20	4.20	09/11/2019#
				4.15	4.15	09/12/2019#
				4.15	4.15	09/13/2019
7364				3.84	3.84	09/18/2019#
				3.97	3.97	09/19/2019#
				3.85	3.85	09/20/2019
				3.77	3.77	09/22/2019
				3.73	3.73	09/23/2019#
				3.62	3.62	09/24/2019#
				3.70	3.70	09/25/2019#
				3.98	3.98	09/26/2019#
				3.80	3.80	09/27/2019#
				3.64	3.64	09/30/2019#
				3.80	3.80	10/01/2019#
				3.78	3.78	10/02/2019
				3.83	3.83	10/04/2019
				3.89	3.89	10/07/2019
	IEEE/IEC Head		3.77 +/- 10%	3.77	3.77	10/03/2019
				3.78	3.78	10/04/2019

Note: '#' indicates that the system verification check covers the next day of testing (within 24 hours)

Table 13 Continued

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
7364	FCC Body	SPEAG D2450V / 781	50.40 +/- 10%	11.6	46.40	10/09/2019#
				11.8	47.20	10/10/2019#
				11.9	47.60	11/13/2019
	IEEE/IEC Head	SPEAG D2450V / 703	52.90 +/- 10%	12.2	48.80	10/11/2019#
				12.0	48.00	10/13/2019
				12.1	48.40	10/14/2019
		SPEAG D2450V / 781	51.30 +/- 10%	12.9	51.60	11/13/2019

Note: '#' indicates that the system verification check covers the next day of testing (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
138	FCC Body	0.79 (0.75-0.83)	62.2 (59.1-65.3)	0.82	59.3	10/02/2019
	IEEE/ IEC Head	0.75 (0.71-0.79)	52.9 (50.2-55.5)	0.72	52.8	10/04/2019
144	FCC Body	0.80 (0.76-0.84)	62.1 (58.9-65.2)	0.83	59.1	10/02/2019
	IEEE/ IEC Head	0.76 (0.72-0.79)	52.6 (49.9-55.2)	0.72	52.5	10/04/2019
146	FCC Body	0.80 (0.76-0.84)	62.0 (58.9-65.1)	0.83	59.1	10/02/2019
	IEEE/ IEC Head	0.76 (0.72-0.8)	52.5 (49.9-55.1)	0.73	52.4	10/04/2019
148	FCC Body	0.80 (0.76-0.84)	62.0 (58.9-65)	0.83	59.0	10/02/2019
	IEEE/ IEC Head	0.76 (0.72-0. 8)	52.4 (49.8-55)	0.73	52.3	10/04/2019
150	FCC Body	0.80 (0.76-0.84)	61.9 (58.8-65.0)	0.77	60.1	09/11/2019#
				0.77	59.9	09/12/2019#
				0.77	59.6	09/13/2019
				0.78	60.2	09/18/2019#
				0.77	59.4	09/19/2019 #
				0.77	59.4	09/20/2019
				0.79	59.2	09/22/2019
				0.80	59.5	09/23/2019#
				0.83	59.3	09/24/2019 #
				0.83	59.9	09/25/2019 #
				0.8	60	09/26/2019 #
				0.77	59.9	09/27/2019 #
				0.83	59.2	09/30/2019 #
				0.78	59.2	10/01/2019 #
				0.83	89.0	10/02/2019
				0.77	59.9	10/04/2019
				0.78	59.8	10/07/2019
	IEEE/ IEC Head	0.76 (0.72-0.80)	52.3 (49.7-54.9)	0.75	51.7	10/03/2019
				0.73	52.2	10/04/2019
				0.75	50.8	10/08/2019

Note: '#' indicates that the tissue covers the next day of testing (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
151	FCC Body	0.8 (0.76-0.84)	61.9 (58.8-65)	0.77	60.0	09/11/2019#
				0.77	59.8	09/12/2019#
				0.77	59.5	09/13/2019
				0.79	59.1	09/22/2019
				0.84	59.3	09/24/2019#
				0.80	59.9	09/26/2019#
				0.83	59.2	09/30/2019
				0.78	59.2	10/01/2019
	IEEE/ IEC Head	0.76 (0.72-0.8)	52.3 (49.6-54.9)	0.75	51.6	10/03/2019
				0.73	52.2	10/04/2019
152	FCC Body	0.8 (0.76-0.84)	61.9 (58.8-64.9)	0.83	58.9	10/02/2019
160	FCC Body	0.81 (0.77-0.85)	61.7 (58.6-64.7)	0.77	59.7	09/11/2019#
				0.78	59.6	09/12/2019#
				0.78	59.3	09/13/2019
				0.79	59.9	09/18/2019#
				0.78	59.1	09/19/2019#
				0.77	59.1	09/20/2019#
				0.79	58.8	09/22/2019
				0.81	59.2	09/23/2019#
				0.84	59.1	09/24/2019#
				0.83	59.6	09/25/2019#
				0.81	59.7	09/26/2019#
				0.78	59.6	09/27/2019#
				0.83	59.0	09/30/2019
				0.78	58.9	10/01/2019
				0.84	58.7	10/02/2019
				0.78	59.6	10/04/2019
	IEEE/ IEC Head	0.77 (0.73-0.81)	51.8 (49.2-54.4)	0.75	51.2	10/03/2019
				0.74	51.8	10/04/2019
165	IEEE/ IEC Head	0.77 (0.73-0.81)	51.6 (49-54.2)	0.74	51.6	10/04/2019
173	FCC Body	0.78 (0.74-0.82)	51.2 (48.7-53.8)	0.84	58.3	10/02/2019
2412	FCC Body	1.91 (1.82-2.01)	52.8 (47.5-58)	2.0	47.9	10/09/2019#
				2.0	48.1	10/10/2019#
	IEEE/ IEC Head	1.77 (1.68-1.86)	39.3 (35.3-43.2)	1.85	35.5	10/11/2019#
				1.81	36.0	10/13/2019
				1.84	35.3	10/14/2019
2437	FCC Body	1.94 (1.84-2.03)	52.7 (47.4-58)	1.98	47.8	11/13/2019
	IEEE/ IEC Head	1.79 (1.7-1.88)	39.2 (35.3-43.1)	1.88	35.5	

Note: '#' indicates that the tissue covers the next day of testing (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
2450	FCC Body	1.95 (1.85-2.05)	52.7 (47.4-58)	2.04	47.7	10/09/2019#
				2.04	47.9	10/10/2019#
				1.99	47.8	11/13/2019
	IEEE/ IEC Head	1.8 (1.71-1.89)	39.2 (35.3-43.1)	1.89	35.4	10/11/2019#
				1.85	35.9	10/13/2019
				1.88	35.3	10/14/2019
				1.89	35.4	11/13/2019
2462	FCC Body	1.97 (1.87-2.07)	52.7 (47.4-58)	2.01	47.7	11/13/2019
	IEEE/ IEC Head	1.81 (1.72-1.9)	39.2 (35.3-43.1)	1.90	35.4	

Note: '#' indicates that the tissue covers the next day of testing (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°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: 18.5 – 23.4˚C Avg. 22 ˚C
Tissue Temperature	18 – 25 ˚C	Range: 20.1-22.˚C Avg. 20.9˚C

Relative humidity target range is a recommended target

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

12.0 DUT Test Setup and Methodology

12.1 Measurements

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

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

Table 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 side 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" in the data Tables is determined by scaling the measured SAR to account for power leveling variations and drift. Appendix F includes a shortened scan to justify SAR scaling for drift. For this device the "Max Calc. 1g-SAR" is scaled using the following formula:

$$Max\_Calc = SAR\_meas \cdot 10^{\frac{-Drift}{10}} \cdot \frac{P\_max}{P\_int} \cdot DC$$

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 50% duty cycle was applied to PTT configurations in the final results.
Standalone and simultaneous BT testing were assessed in sections 13.6 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 150.8-173.4MHz 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 (150.8-173.4MHz) 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). SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 17

Test Freq (MHz)	Power (W)
150.8000	5.880
152.0000	5.850
155.0000	5.790
160.0000	5.990
165.0000	5.900
173.4000	5.760

Assessments at the Body with Body worn PMLN7296A

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

Table 18

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
PMAD4116A	PMNN4488A	PMLN7296A	PMLN5727A	150.800					
				160.000	6.00	-1.01	1.76	1.11	CK-AB-190911-06
				165.000					
PMAD4117A				150.800	5.89	-0.52	1.37	0.79	CK-AB-190911-08
				155.000					
PMAD4118A				152.000					
				160.000	6.00	-0.23	2.68	**1.41**	CK-AB-190911-10
				165.000					
				173.400					
PMAD4120A				150.800					
				155.000					
				160.000	5.97	-0.42	0.94	0.52	AN-AB-190911-11
PMAD4121B				160.000	5.99	-0.28	1.92	1.03	AN-AB-190911-12
				165.000					
				173.400					

Assessments at the Body with Body worn PMLN4651A

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

Table 19

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
PMAD4116A	PMNN4491B	PMLN4651A	PMLN5727A	150.800					
				160.000	6.00	-0.25	1.82	0.96	AN-AB-190911-13
				165.000					
PMAD4117A				150.800	5.90	-0.20	1.43	0.76	AN-AB-190912-01#
				155.000					
PMAD4118A				152.000					
				160.000	5.98	-0.21	2.81	1.48	AN-AB-190912-02#
				165.000					
				173.400					
PMAD4120A				150.800					
				155.000					
				160.000	6.00	-0.56	0.95	0.54	AN-AB-190912-03#
PMAD4121B				160.000	6.00	-0.28	2.05	1.09	AN-AB-190912-04#
				165.000					
				173.400					
Assessment of Additional Batteries									
PMAD4118A	PMNN4435A	PMLN4651A	PMLN5727A	160.000	6.00	-0.46	2.70	1.50	CK-AB-190912-07
	PMNN4417B				6.00	-0.21	2.92	1.53	CK-AB-190912-09
	PMNN4406B				6.00	-0.28	2.97	1.58	CK-AB-190912-11
	PMNN4490A				5.88	-0.31	2.91	1.59	CK-AB-190912-12
	PMNN4418B				6.00	-0.91	2.76	1.70	CK-AB-190912-13
	PMNN4415A				6.00	-0.33	3.04	1.64	CK-AB-190912-14
	PMNN4416B				6.00	-0.98	2.71	1.70	CK-AB-190912-15
	PMNN4409B				6.00	-0.14	2.56	1.32	CK-AB-190912-17
	PMNN4407B				6.00	-0.14	3.09	1.60	AN-AB-190912-19
	PMNN4463A				6.00	-0.34	2.89	1.56	AN-AB-190912-20
	PMNN4543A				6.00	-0.82	2.77	1.67	AN-AB-190912-21
	PMNN4544A				5.98	-1.08	2.70	**1.74**	AN-AB-190912-22
	PMNN4493A				6.00	-1.00	2.74	1.72	AN-AB-190912-23
	PMNN4525A				6.00	-0.38	2.80	1.53	AN-AB-190912-24

Assessment at the Body with Body worn PMLN7008A

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

Table 20

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
PMAD4116A	PMNN4491B	PMLN7008A	PMLN5727A	150.800					
				160.000	6.00	-0.32	2.00	1.08	AN-AB-190913-01#
				165.000					
PMAD4117A				150.800	5.89	-0.31	1.54	0.84	AN-AB-190913-02#
				155.000					
PMAD4118A				152.000					
				160.000	5.99	-0.20	2.95	1.55	AN-AB-190913-03#
				165.000					
				173.400					
PMAD4120A				150.800					
				155.000					
				160.000	6.00	-0.55	0.94	0.54	AN-AB-190913-04#
PMAD4121B				160.000	6.00	-0.33	1.97	1.06	AN-AB-190913-05#
				165.000					
				173.400					
Assessment of Additional Batteries									
PMAD4118A	PMNN4435A	PMLN7008A	PMLN5727A	160.000	6.00	-0.23	2.82	1.49	AN-AB-190913-06#
	PMNN4417B				5.98	-0.35	3.00	1.63	AN-AB-190913-07#
	PMNN4406B				6.00	-0.33	3.06	**1.65**	CK-AB-190913-10
	PMNN4490A				5.87	-0.41	2.88	1.62	CK-AB-190913-11
	PMNN4418B				6.00	-0.29	2.70	1.44	CK-AB-190913-13
	PMNN4415A				6.00	-0.38	2.64	1.44	CK-AB-190913-14
	PMNN4416B				6.00	-0.18	2.48	1.29	AN-AB-190913-16
	PMNN4409B				6.00	-0.44	2.49	1.38	AN-AB-190913-17
	PMNN4407B				5.98	-0.37	2.66	1.45	AN-AB-190913-18
	PMNN4463A				6.00	-0.36	2.56	1.39	AN-AB-190913-19
	PMNN4543A				6.00	-0.75	2.49	1.48	AN-AB-190913-20
	PMNN4544A				5.99	-1.09	2.52	1.62	AN-AB-190913-21
	PMNN4493A				5.97	-1.04	2.52	1.61	AN-AB-190913-22
	PMNN4525A				6.00	-0.35	2.55	1.38	AN-AB-190913-23

Assessment at the Body with Body worn PMLN5870A w/ NTN5243A

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

Table 21

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
PMAD4116A	PMNN4491B	PMLN5870A w/ NTN5243A	PMLN5727A	150.800					
				160.000	6.00	-0.57	0.79	0.45	AN-AB-190913-24
				165.000					
PMAD4117A				150.800	5.90	-1.02	0.54	0.35	AN-AB-190913-25
				155.000					
PMAD4118A				152.000					
				160.000	5.97	-0.34	1.04	0.57	LOH-AB-190918-05
				165.000					
				173.400					
PMAD4120A				150.800					
				155.000					
				160.000	5.90	-0.53	0.32	0.18	ZZ-AB-190918-08
PMAD4121B				160.000	5.92	-0.52	0.77	0.44	ZZ-AB-190918-10
				165.000					
				173.400					
Assessment of Additional Batteries									
PMAD4118A	PMNN4435A	PMLN5870A w/ NTN5243A	PMLN5727A	160.000	5.92	-0.28	1.20	0.65	ZZ-AB-190918-12
	PMNN4417B				5.92	-0.35	1.11	0.61	LOH-AB-190918-16
	PMNN4406B				5.97	-0.37	1.11	0.61	LOH-AB-190919-01#
	PMNN4490A				5.80	-1.08	0.89	0.59	LOH-AB-190919-03
	PMNN4418B				6.00	-0.95	1.45	0.90	LOH-AB-190919-05
	PMNN4415A				5.85	-0.52	1.46	0.84	LOH-AB-190919-16
	PMNN4416B				5.98	-0.39	1.43	0.78	LOH-AB-190920-01#
	PMNN4409B				6.00	-0.40	1.54	0.84	LOH-AB-190920-05
	PMNN4407B				6.00	-0.32	1.38	0.74	ZZ-AB-190920-07
	PMNN4463A				5.95	-1.02	1.78	**1.14**	ZZ-AB-190920-09
	PMNN4543A				5.97	-1.08	0.95	0.61	LOH-AB-190920-13
	PMNN4544A				5.99	-0.37	1.09	0.59	LOH-AB-190920-14
	PMNN4493A				6.00	-0.26	1.35	0.72	LOH-AB-190920-15
	PMNN4525A				6.00	-0.69	1.61	0.94	LOH-AB-190922-03

Assessment at the Body with Body worn PMLN5864A w/ NTN5243A

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

Table 22

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
PMAD4116A	PMNN4491B	PMLN5864A w/ NTN5243A	PMLN5727A	150.800					
				160.000	5.98	-0.49	0.96	0.54	LOH-AB-190922-04
				165.000					
PMAD4117A				150.800	5.84	-0.37	0.98	0.55	LOH-AB-190922-06
				155.000					
PMAD4118A				152.000					
				160.000	5.98	-0.67	1.50	0.88	LOH(NZ)-AB-190923-03
				165.000					
				173.400					
PMAD4120A				150.800					
				155.000					
				160.000	5.98	-0.58	0.28	0.16	ZZ-AB-190923-06
PMAD4121B				160.000	5.95	-0.37	0.77	0.42	ZZ-AB-190923-07
				165.000					
				173.400					
Assessment of Additional Batteries									
PMAD4118A	PMNN4435A	PMLN5864A w/ NTN5243A	PMLN5727A	160.000	5.98	-0.53	1.22	0.69	ZZ-AB-190923-08
	PMNN4417B				5.99	-0.32	1.35	0.73	ZZ-AB-190923-10
	PMNN4406B				5.91	-0.32	1.43	0.78	ZZ-AB-190924-01#
	PMNN4490A				5.96	-0.40	1.27	0.70	ZZ-AB-190924-02#
	PMNN4418B				5.99	-0.40	1.67	0.92	ZZ-AB-190924-04#
	PMNN4415A				5.98	-0.42	0.76	0.42	ZZ-AB-190924-05#
	PMNN4416B				5.95	-0.39	0.91	0.50	ZZ-AB-190924-07
	PMNN4409B				6.00	-0.28	1.44	0.77	ZZ-AB-190924-08
	PMNN4407B				5.99	-0.37	1.12	0.61	ZZ-AB-190924-09
	PMNN4463A				5.98	-0.38	1.34	0.73	ZZ-AB-190925-02#
	PMNN4543A				5.98	-0.48	1.14	0.64	ZZ-AB-190925-04#
	PMNN4544A				5.99	-0.24	0.94	0.50	ZZ-AB-190925-06#
	PMNN4493A				6.00	-0.97	1.27	0.79	LOH-AB-190925-07#
	PMNN4525A				6.00	-0.52	1.75	**0.99**	LOH(NZ)-AB-190925-09#

Assessment at the Body with Body worn PMLN5866A w/ NTN5243A

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

Table 23

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
PMAD4116A	PMNN4491B	PMLN5866A w/ NTN5243A	PMLN5727A	150.800					
				160.000	5.80	-0.44	0.86	0.49	LOH(NZ)-AB-190925-10#
				165.000					
PMAD4117A				150.800	5.81	-0.41	0.40	0.23	LOH(NZ)-AB-190925-11#
				155.000					
PMAD4118A				152.000					
				160.000	5.82	-0.97	1.26	0.81	LOH(NZ)-AB-190925-14
				165.000					
				173.400					
PMAD4120A				150.800					
				155.000					
				160.000	5.79	-0.96	0.30	0.20	LOH(NZ)-AB-190925-15
PMAD4121B				160.000	5.80	-0.33	0.80	0.45	LOH-AB-190925-17
				165.000					
				173.400					
Assessment of Additional Batteries									
PMAD4118A	PMNN4435A	PMLN5866A w/ NTN5243A	PMLN5727A	160.000	5.76	-0.45	1.41	0.81	LOH-AB-190925-18
	PMNN4417B				5.80	-0.47	1.38	0.80	ZZ-AB-190925-19
	PMNN4406B				5.90	-0.47	1.53	0.87	ZZ-AB-190925-20
	PMNN4490A				5.75	-0.12	1.38	0.74	ZZ-AB-190925-21
	PMNN4418B				5.80	-0.54	1.70	**1.00**	ZZ-AB-190925-22
	PMNN4415A				5.83	-0.42	1.42	0.80	ZZ-AB-190925-23
	PMNN4416B				5.90	-0.55	1.18	0.68	ZZ-AB-190925-24
	PMNN4409B				5.95	-0.48	1.52	0.86	ZZ-AB-190926-01#
	PMNN4407B				5.89	-0.45	1.26	0.71	ZZ-AB-190926-02#
	PMNN4463A				5.79	-0.48	1.45	0.84	ZZ-AB-190926-03#
	PMNN4543A				6.00	-0.41	0.86	0.47	ZZ-AB-190926-04#
	PMNN4544A				6.00	-0.81	1.31	0.79	ZZ-AB-190926-05#
	PMNN4493A				5.85	-0.45	1.16	0.66	ZZ-AB-190926-06#
	PMNN4525A				5.95	-0.39	1.53	0.84	LOH(NZ)-AB-190926-07#

Assessment at the Body with Body worn HLN6602A

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

Table 24

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
PMAD4116A	PMNN4491B	HLN6602A	PMLN5727A	150.800					
				160.000	5.76	-0.40	1.11	0.63	LOH(NZ)-AB-190926-08#
				165.000					
PMAD4117A				150.800	5.75	-0.16	1.07	0.58	LOH(NZ)-AB-190926-13
				155.000					
PMAD4118A				152.000					
				160.000	5.75	-0.36	2.45	1.39	LOH(NZ)-AB-190926-10#
				165.000					
				173.400					
PMAD4120A				150.800					
				155.000					
				160.000	5.86	-0.36	0.55	0.31	LOH-AB-190926-14
PMAD4121B				160.000	5.87	-0.30	1.88	1.03	LOH-AB-190926-15
				165.000					
				173.400					
Assessment of Additional Batteries									
PMAD4118A	PMNN4435A	HLN6602A	PMLN5727A	160.000	5.90	-0.36	2.36	1.30	ZZ-AB-190926-16
	PMNN4417B				5.85	-0.30	2.62	1.44	ZZ-AB-190926-17
	PMNN4406B				5.89	-0.36	2.63	**1.46**	ZZ-AB-190926-18
	PMNN4490A				5.93	-0.28	2.47	1.33	ZZ-AB-190926-19
	PMNN4418B				5.90	-0.29	2.43	1.32	ZZ-AB-190926-20
	PMNN4415A				5.89	-0.28	2.13	1.16	ZZ-AB-190926-21
	PMNN4416B				5.95	-0.32	2.66	1.44	ZZ-AB-190927-01#
	PMNN4409B				5.79	-0.32	2.43	1.36	ZZ-AB-190927-02#
	PMNN4407B				5.81	-0.34	2.55	1.42	ZZ-AB-190927-03#
	PMNN4463A				5.82	-0.25	2.27	1.24	ZZ-AB-190927-04#
	PMNN4543A				5.88	-0.28	2.36	1.28	ZZ-AB-190927-05#
	PMNN4544A				5.88	-0.41	1.42	0.80	LOH-AB-190927-06#
	PMNN4493A				5.72	-0.25	2.23	1.29	LOH-AB-190927-07#
	PMNN4525A				5.83	-0.23	2.34	1.27	LOH-AB-190927-08#

Assessment at the Body with Body worn RLN4570A

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

Table 25

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
PMAD4116A	PMNN4491B	RLN4570A	PMLN5727A	150.800					
				160.000	5.78	-0.25	1.10	0.60	LOH-AB-190927-09#
				165.000					
PMAD4117A				150.800	5.85	-0.30	0.54	0.30	LOH-AB-190927-10#
				155.000					
PMAD4118A				152.000					
				160.000	5.87	-0.19	2.62	**1.40**	LOH-AB-190927-12
				165.000					
				173.400					
PMAD4120A				150.800					
				155.000					
				160.000	5.87	-0.37	0.54	0.30	ZZ-AB-190927-13
PMAD4121B				160.000	5.96	-0.36	2.23	1.22	ZZ-AB-190927-14
				165.000					
				173.400					
Assessment of Additional Batteries									
PMAD4118A	PMNN4435A	RLN4570A	PMLN5727A	160.000	5.90	-0.54	2.31	1.33	ZZ-AB-190927-15
	PMNN4417B				5.79	-0.37	2.39	1.35	ZZ-AB-190927-16
	PMNN4406B				5.83	-0.39	2.40	1.35	ZZ-AB-190927-17
	PMNN4490A				5.88	-0.35	2.28	1.26	ZZ-AB-190927-18
	PMNN4418B				5.90	-0.44	2.35	1.32	ZZ-AB-190927-19
	PMNN4415A				5.90	-0.47	1.77	1.00	ZZ-AB-190927-20
	PMNN4416B				5.86	-0.37	2.39	1.33	ZZ-AB-190927-21
	PMNN4409B				5.79	-0.38	2.28	1.29	ZZ-AB-190928-01#
	PMNN4407B				5.84	-0.42	2.32	1.31	ZZ-AB-190928-02#
	PMNN4463A				5.91	-0.49	2.31	1.31	ZZ-AB-190928-03#
	PMNN4543A				5.89	-0.37	2.48	1.34	ZZ-AB-190928-04#
	PMNN4544A				5.91	-0.41	2.48	1.38	ZZ-AB-190928-05#
	PMNN4493A				5.77	-0.34	2.33	1.31	ZZ-AB-190928-06#
	PMNN4525A				5.96	-0.42	2.30	1.28	ZZ-AB-190928-07#

Assessment at the Body with Body worn RLN4815A

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

Table 26

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
PMAD4116A	PMNN4491B	RLN4815A	PMLN5727A	150.800					
				160.000	5.83	-0.36	1.15	0.64	ZZ-AB-190930-09
				165.000					
PMAD4117A				150.800	5.81	-0.48	0.50	0.29	ZZ-AB-190930-05
				155.000					
PMAD4118A				152.000					
				160.000	5.91	-0.30	1.27	0.69	ZZ-AB-190930-06
				165.000					
				173.400					
PMAD4120A				150.800					
				155.000					
				160.000	5.90	-0.41	0.43	0.24	ZZ-AB-190930-07
PMAD4121B				160.000	5.88	-0.44	0.94	0.53	ZZ-AB-190930-08
				165.000					
				173.400					
Assessment of Additional Batteries									
PMAD4118A	PMNN4435A	RLN4815A	PMLN5727A	160.000	5.90	-0.37	1.23	0.68	ZZ-AB-190930-10
	PMNN4417B				5.87	-0.50	1.43	0.82	ZZ-AB-190930-11
	PMNN4406B				5.83	-0.17	1.34	0.72	LOH-AB-190930-12
	PMNN4490A				5.78	-0.26	1.32	0.73	LOH-AB-190930-14
	PMNN4418B				5.86	-0.43	1.30	0.73	LOH-AB-190930-15
	PMNN4415A				5.72	-0.32	1.53	**0.86**	LOH-AB-190930-16
	PMNN4416B				5.84	-0.40	1.20	0.68	LOH-AB-191001-01#
	PMNN4409B				5.87	-0.36	1.24	0.69	LOH-AB-191001-02#
	PMNN4407B				5.80	-0.36	1.27	0.71	LOH-AB-191001-03#
	PMNN4463A				5.92	-0.36	1.29	0.71	LOH-AB-191001-04#
	PMNN4543A				5.96	-0.37	1.13	0.62	LOH-AB-191001-05#
	PMNN4544A				5.95	-0.46	1.12	0.63	LOH-AB-191001-06#
	PMNN4493A				5.89	-0.36	1.17	0.65	LOH-AB-191001-07#
	PMNN4525A				5.79	-0.38	1.23	0.70	ZZ-AB-191001-08#

Assessment at the Body with Body worn PMLN5870A w/ RLN6487A w/RLN6488A
DUT assessment with offered antennas, default battery and above mentioned body worn accessory per KDB 643646. Optional batteries were tested per the requirements of KDB 643646. Refer to Table 17 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 27

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
PMAD4116A	PMNN4491B	PMLN5870A w/ RLN6487A w/ RLN6488A	PMLN5727A	150.800					
				160.000	5.79	-0.72	1.06	0.65	ZZ-AB-191001-10
				165.000					
PMAD4117A				150.800	5.83	-0.67	0.91	0.55	ZZ-AB-191001-11
				155.000					
PMAD4118A				152.000					
				160.000	5.81	-0.69	1.44	0.87	ZZ-AB-191001-12
				165.000					
				173.400					
PMAD4120A				150.800					
				155.000					
				160.000	5.88	-1.08	0.35	0.23	ZZ-AB-191001-13
PMAD4121B				160.000	5.88	-1.05	1.05	0.68	ZZ-AB-191001-14
				165.000					
				173.400					
Assessment of Additional Batteries									
PMAD4118A	PMNN4435A	PMLN5870A w/ RLN6487A w/ RLN6488A	PMLN5727A	160.000	5.91	-0.80	1.58	0.96	ZZ-AB-191001-15
	PMNN4417B				5.83	-0.82	1.57	0.98	ZZ-AB-191001-16
	PMNN4406B				5.90	-0.86	1.49	0.92	ZZ-AB-191001-17
	PMNN4490A				5.95	-0.80	1.25	0.76	ZZ-AB-191001-18
	PMNN4418B				5.82	-0.87	1.47	0.93	LOH-AB-191001-19
	PMNN4415A				5.72	-0.51	1.63	0.96	LOH-AB-191001-20
	PMNN4416B				5.79	-0.84	1.28	0.80	LOH-AB-191001-21
	PMNN4409B				5.85	-1.09	1.37	0.90	LOH-AB-191001-22
	PMNN4407B				5.85	-0.31	1.37	0.75	LOH-AB-191002-01#
	PMNN4463A				5.94	-0.74	1.33	0.80	LOH-AB-191002-02#
	PMNN4543A				5.97	-0.25	0.94	0.50	LOH-AB-191002-03#
	PMNN4544A				5.97	-0.64	0.99	0.58	LOH-AB-191002-04#
	PMNN4493A				5.85	-0.82	1.62	**1.00**	LOH-AB-191002-05#
	PMNN4525A				5.97	-0.39	1.68	0.92	LOH-AB-191002-06#

Assessment at the Body with other audio accessories
Assessment per "KDB 643646 Body SAR Test Consideration for Audio Accessories without Built-in Antenna; Sec 1, A. when overall < 4.0 W/kg, SAR tested for that audio accessory is not necessary." This was applicable to all remaining accessories.

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 E.

Table 28

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
PMAD4118A	PMNN4544A	PMLN4651A	None	152.000					
				160.000	5.92	-0.42	2.97	**1.66**	ZZ-AB-191002-08#
				165.000					
				173.400					

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 802.11 b/g/n for assessment 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 802.11 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 29. 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 E.

SAR testing 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 29

Mode	Channel #	Channel Frequency	Modulation	Battery: PMNN4491B	Antenna Max Power [mW]
				Antenna port[mW]	
802.11b (1Mbps)	1	2412	DSSS	56.60	70.80
	6	2437		56.30	
	11	2462		56.40	
802.11g (6Mbps)	1	2412	OFDM	16.00	20.00
	6	2437		16.40	
	11	2462		14.70	
802.11n (MCS0)	1	2412	OFDM	10.10	12.60
	6	2437		10.30	
	11	2462		9.50	

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

Table 30

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
85012026001 WiFi Ant	PMNN4491B	PMLN4651A	None	2412.000	0.056	-0.04	0.046	0.058	LOH-AB-191009-07
		PMLN7008A			0.056	-0.02	0.035	0.044	LOH-AB-191009-08
		HLN6602A			0.056	-0.26	0.056	**0.075**	ZZ-AB-191009-09
		RLN4570A			0.056	-0.04	0.052	0.066	ZZ-AB-191009-10
		RLN4815A			0.056	-0.05	0.034	0.043	ZZ-AB-191009-11
	PMNN4488A	PMLN7296A			0.056	0.09	0.016	0.019	ZZ-AB-191009-12
	PMNN4491B	PMLN5864A/ NTN5243A			0.056	0.03	0.048	0.060	ZZ-AB-191010-01#
		PMLN5866A/ NTN5243A			0.056	-0.35	0.054	0.073	ZZ-AB-191010-02#
		PMLN5870A/ NTN5243A			0.056	0.36	0.046	0.058	ZZ-AB-191010-03#
		PMLN5870A/ RLN6486A& RLN6488A			0.056	-0.23	0.037	0.049	LOHAB-191010-05#
Assessment of Additional Batteries									
85012026001 WiFi Ant	PMNN4493A	HLN6602A	None	2412.000	0.056	-0.05	0.037	0.047	LOH-AB-191010-06#
	PMNN4435A				0.058	-0.25	0.035	0.045	LOH(NZ)-AB-191010-07#
	PMNN4417B				0.059	-0.28	0.040	0.051	LOH(NZ)-AB-191010-08#
	PMNN4406B				0.059	0.00	0.051	0.061	LOH(NZ)-AB-191010-09#
	PMNN4490A				0.057	-0.25	0.023	0.030	LOH(NZ)-AB-191010-10#
	PMNN4418B				0.060	-0.27	0.033	0.041	LOH(NZ)-AB-191010-11#
	PMNN4415A				0.056	-0.22	0.017	0.023	LOH-AB-191010-13
	PMNN4409B				0.058	-0.05	0.030	0.037	LOH-AB-191010-14
	PMNN4416B				0.056	0.01	0.050	0.062	ZZ-AB-191010-15
	PMNN4407B				0.055	0.04	0.048	0.061	ZZ-AB-191010-16
	PMNN4463A				0.056	0.04	0.042	0.053	ZZ-AB-191010-17
	PMNN4543A				0.056	-0.12	0.058	0.075	ZZ-AB-191010-18
	PMNN4544A				0.056	-0.22	0.036	0.048	ZZ-AB-191011-01#
	PMNN4525A				0.060	0.05	0.035	0.041	ZZ-AB-191011-02#

13.3 LMR assessment at the Face for 150.8-173.4MHz 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 (150.8-173.4MHz) which are listed in Table 31. The channel with the highest conducted power will be identified as the default channel per KDB 643646 (SAR Test for PTT Radios).

Table 31

Test Freq (MHz)	Power (W)
150.8000	5.940
152.0000	5.900
155.0000	5.860
160.0000	6.000
165.0000	5.950
173.4000	5.900

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

Table 32

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
PMAD4116A	PMNN4493A	None, Radio Front	None	150.800					
				160.000	5.94	-0.19	2.23	1.18	LOH-FACE-191003-02
				165.000					
PMAD4117A				150.800	5.85	-0.26	0.93	0.51	LOH-FACE-191003-03
				155.000					
PMAD4118A				152.000					
				160.000	5.93	-0.95	1.35	0.85	LOH-FACE-191003-06
				165.000					
				173.400					
PMAD4120A				150.800					
				155.000					
				160.000	5.85	-0.56	1.07	0.62	LOH-FACE-191003-07
PMAD4121B				160.000	5.84	-1.03	0.78	0.51	ZZ-FACE-191003-08
				165.000					
				173.400					

Continued Table 32

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
Assessment of Additional Batteries									
PMAD4116A	PMNN4435A	None, radio Front	None	160.000	5.77	-0.06	2.23	1.18	ZZ-FACE-191003-09
	PMNN4417B				5.83	-0.61	2.03	1.20	ZZ-FACE-191003-10
	PMNN4406B				5.84	-0.77	2.02	**1.24**	ZZ-FACE-191003-11
	PMNN4490A				5.73	-0.10	2.20	1.18	ZZ-FACE-191003-12
	PMNN4418B				5.85	-0.16	2.20	1.17	ZZ-FACE-191003-13
	PMNN4415A				5.78	-0.33	2.21	1.24	ZZ(NZ)-FACE-191003-15
	PMNN4416B				5.80	-0.73	1.91	1.17	ZZ(NZ)-FACE-191003-16
	PMNN4409B				5.82	-0.80	1.86	1.15	ZZ(NZ)-FACE-191003-17
	PMNN4407B				5.80	-0.88	1.93	1.22	ZZ(NZ)-FACE-191003-19
	PMNN4463A				5.92	-0.17	2.09	1.10	LOH-FACE-191003-20
	PMNN4491A				5.86	-0.17	2.22	1.18	LOH-FACE-191003-21
	PMNN4543A				5.89	-0.53	2.03	1.17	LOH-FACE-191003-22
	PMNN4544A				5.97	-0.75	1.96	1.17	LOH-FACE-191003-23
	PMNN4488A				5.91	-0.17	2.24	1.18	LOH-FACE-191003-24
	PMNN4525A				5.97	-0.13	2.25	1.17	LOH-FACE-191003-25

13.4 WLAN assessment at the Face 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 Face using battery PMNN4493A because it 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 802.11 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 33. 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 E.

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 33

Mode	Channel #	Channel Frequency	Modulation	Battery: PMNN4493A Antenna port[mW]	Antenna Max Power [mW]
802.11b (1Mbps)	1	2412	DSSS	55.10	70.80
	6	2437		54.90	
	11	2462		54.30	
802.11g (6Mbps)	1	2412	OFDM	17.40	20.00
	6	2437		15.70	
	11	2462		15.70	
802.11n (MCS0)	1	2412	OFDM	9.70	12.60
	6	2437		10.20	
	11	2462		10.10	

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

DUT assessment with WLAN internal antenna using all offered batteries with front of the DUT positioned 2.5 cm from the phantom. Refer to Table 33 for highest output power channel.

Table 34

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
85012026001 WiFi Ant	PMNN4493A	None, Radio @ front	None	2412.000	0.055	0.06	0.045	0.058	ZZ-FACE-191011-08
Assessment of Additional Batteries									
85012026001 WiFi Ant	PMNN4491B	None, Radio @ front	None	2412.000	0.057	0.40	0.045	0.056	ZZ-FACE-191011-09
	PMNN4435A				0.059	0.08	0.045	0.054	ZZ-FACE-191011-10
	PMNN4417B				0.059	0.01	0.029	0.035	ZZ-FACE-191012-01#
	PMNN406BR				0.057	0.14	0.042	0.052	ZZ-FACE-191012-02#
	PMNN4490A				0.060	-0.16	0.037	0.045	ZZ-FACE-191012-03#
	PMNN4418B				0.060	-0.37	0.046	0.059	ZZ-FACE-191013-02
	PMNN4415A				0.056	-0.28	0.043	0.058	ZZ-FACE-191013-03
	PMNN4409B				0.058	-0.02	0.048	0.059	ZZ-FACE-191013-04
	PMNN4416B				0.057	0.25	0.044	0.055	ZZ-FACE-191013-05
	PMNN4407B				0.055	-0.15	0.048	**0.064**	ZZ-FACE-191013-06
	PMNN4463A				0.056	0.07	0.045	0.057	ZZ-FACE-191013-07
	PMNN4543A				0.056	0.11	0.029	0.037	ZZ-FACE-191013-08
	PMNN4544A				0.056	0.24	0.044	0.056	ZZ-FACE-191013-09
	PMNN4525A				0.060	0.10	0.045	0.053	ZZ-FACE-191014-02
	PMNN4488A				0.061	-0.05	0.046	0.054	ZZ-FACE-191014-03

13.5 Assessment for ISED, Canada

Based on the assessment results for body and face per KDB643646, additional tests were required for Outside FCC frequency range (138-150.8 MHz). The overall highest test configuration from 150.8-173.4MHz band was chosen to test with frequencies 138, 144, 146 and 148MHz for applicable offered antennas. The SAR results are in Table below.

Table 35

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
Body									
PMAD4116A	PMNN4544A	PMLN4651A	PMLN5727A	144.000	5.78	-0.85	1.78	1.12	ZZ(NZ)-AB-191002-10
PMAD4117A				138.000	5.75	-0.51	1.42	0.83	ZZ(NZ)-AB-191002-11
				144.000	5.74	-0.30	1.67	0.94	ZZ(NZ)-AB-191002-12
PMAD4119A				138.000	5.79	-0.47	0.85	0.49	ZZ-AB-191002-13
				144.000	5.79	-0.38	0.75	0.42	ZZ-AB-191002-14
				148.000	5.81	-0.27	0.63	0.35	ZZ-AB-191002-16
PMAD4120A				146.000	5.83	-0.36	1.02	0.57	ZZ-AB-191002-17
Face									
PMAD4116A	PMNN4406B	None. Radio @ front	None	144.000	5.72	-0.42	1.03	0.60	LOH-FACE-191004-02
PMAD4117A				138.000	5.63	-0.14	1.46	0.80	LOH-FACE-191004-03
				144.000	5.70	-0.46	1.65	0.97	LOH-FACE-191004-04
PMAD4119A				138.000	5.73	-0.05	0.99	0.52	ZZ-FACE-191004-05
				144.000	5.72	-0.39	1.10	0.63	ZZ-FACE-191004-06
				148.000	5.77	-0.28	0.87	0.48	ZZ-FACE-191004-07
PMAD4120A				146.000	5.74	-0.35	0.60	0.34	ZZ(NZ)-FACE-191004-08

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. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 36

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
Body (VHF)									
PMAD4118A	PMNN4544A	PMLN4651A	PMLN5727A	152.000	5.84	-0.46	2.29	1.31	LOH-AB-191002-18
				160.000	5.98	-1.08	2.70	**1.74**	AN-AB-190912-22
				173.400	5.79	-0.32	1.38	0.77	LOH-AB-191002-19
Body (WLAN)									
85012026001 WiFi Ant	PMMN4491B	HLN6602A	None	2412.000	0.056	-0.26	0.056	**0.075**	ZZ-AB-191009-09
				2437.000	0.055	-0.42	0.041	0.058	FD(NZ)-AB-191113-15
				2462.000	0.055	-0.16	0.042	0.056	FD(NZ)-AB-191113-16

Table 37

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
Face (VHF)									
PMAD4116A	PMNN4406BR	None, Radio @ front	None	144.000	5.72	-0.42	1.03	0.60	LOH-FACE-191004-02
				150.800	5.76	-0.46	1.51	**0.87**	ZZ(NZ)-FACE-191004-09
				165.000	5.75	-0.32	1.37	0.77	ZZ(NZ)-FACE-191004-10
Face (WLAN)									
85012026001 WiFi Ant	PMNN4407BR	None, Radio @ front	None	2412.000	0.055	-0.15	0.048	0.064	ZZ-FACE-191013-06
				2437.000	0.057	-0.46	0.052	**0.072**	ZZ-FACE-191113-06
				2462.000	0.056	0.03	0.051	0.065	ZZ-FACE-191113-07

13.6 Assessment at the Bluetooth band

13.6.1 FCC US 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)] *[$\sqrt{F}_{(GHz)}$] = 2.43, which is ≤ 3 for 1-g SAR

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.

13.6.2 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 8.86 dBm

Equivalent isotropically radiated power (EIRP):
= Maximum conducted power, dBm + Antenna gain, dBi
= 8.86 dBm + 0 dBi
= 8.86 dBm or 7.7 mW

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

13.7 Shortened Scan Assessment

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

Table 38

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
PMAD4118A	PMNN4544A	PMLN4651A	PMLN5727A	160.000	5.95	-0.32	2.45	**1.33**	LOH-AB-191007-04

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] = 0.32 W/kg, which is ≤ 0.4 W/kg for 1-g SAR

Where:

X = 7.5 for 1g-SAR
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, 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 70.8mW 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 39

		LMR Bands
	Freq. (MHz)	VHF
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 SAR values found for this filing:

Table 40

Designator	Frequency band (MHz)	Max Calc at Body (W/kg)	Max Calc at Face (W/kg)
		1g-SAR	1g-SAR
FCC			
LMR	150.8-173.4	1.74	1.24
WLAN	2412-2462	0.075	0.072
ISED			
LMR	138-174	1.74	1.24
WLAN	2412-2462	0.075	0.072
Overall			
LMR	136-174	1.74	1.24
WLAN	2412-2462	0.075	0.072

All results are scaled to the maximum output power.

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

Table 40

Designator	Frequency bands	Combined 1g-SAR (W/kg)
Body		
FCC	LMR (150.8-173.4MHz) and WLAN band	1.82
ISED	LMR (138-174MHz) and WLAN band	1.82
Overall	LMR (136-174 MHz) and WLAN band	1.82
Face		
FCC	LMR (150.8-173.4MHz) and WLAN band	1.31
ISED	LMR (138-174MHz) and WLAN band	1.31
Overall	LMR (136-174 MHz) and WLAN band	1.31

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

17.0 Variability Assessment

Per the guidelines in KDB 865664 SAR variability assessment is not required because SAR results are below 4.0W/kg (Occupational)

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

Uncertainty Budget for Device Under Test, for 150 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

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

Uncertainty Budget for System Validation (dipole & flat phantom) for 150 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

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	

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
Servizio svizzero di taratura
S Swiss Calibration Service

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

Accreditation No.: **SCS 0108**

Client **Motorola Solutions MY**

Certificate No: **EX3-7364_Jan19**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:7364
Calibration procedure(s)	QA CAL-01.v9, QA CAL-12.v9, QA CAL-14.v5, QA CAL-23.v5, QA CAL-25.v7 Calibration procedure for dosimetric E-field probes
Calibration date:	January 23, 2019

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

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-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-18 (No. 217-02682)	Apr-19
DAE4	SN: 660	19-Dec-18 (No. DAE4-660_Dec18)	Dec-19
Reference Probe ES3DV2	SN: 3013	31-Dec-18 (No. ES3-3013_Dec18)	Dec-19
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-18)	In house check: Jun-20
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	[signature]
Approved by:	Katja Pokovic	Technical Manager	[signature]

Issued: January 26, 2019

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

Certificate No: EX3-7364_Jan19 Page 1 of 15

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
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, ", "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

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).

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7364

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.46	0.46	0.57	± 10.1 %
DCP (mV)[B]	99.7	97.6	99.3	

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Max dev.	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	114.6	+ 2.7 %	± 4.7 %
		Y	0.0	0.0	1.0		112.4		
		Y	0.0	0.0	1.0		127.7		

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:7364

Sensor Model Parameters

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	129.9
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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7364

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	12.97	12.97	12.97	0.00	1.00	± 13.3 %
300	45.3	0.87	12.05	12.05	12.05	0.09	1.20	± 13.3 %
450	43.5	0.87	10.75	10.75	10.75	0.13	1.30	± 13.3 %
750	41.9	0.89	10.42	10.42	10.42	0.56	0.80	± 12.0 %
835	41.5	0.90	10.23	10.23	10.23	0.30	1.09	± 12.0 %
900	41.5	0.97	9.78	9.78	9.78	0.31	1.08	± 12.0 %
1810	40.0	1.40	8.25	8.25	8.25	0.35	0.87	± 12.0 %
1900	40.0	1.40	8.19	8.19	8.19	0.37	0.85	± 12.0 %
2100	39.8	1.49	8.15	8.15	8.15	0.25	1.09	± 12.0 %
2450	39.2	1.80	7.38	7.38	7.38	0.40	0.85	± 12.0 %
5250	35.9	4.71	5.08	5.08	5.08	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.86	4.86	4.86	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.68	4.68	4.68	0.40	1.80	± 13.1 %
5750	35.4	5.22	4.72	4.72	4.72	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. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. 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.

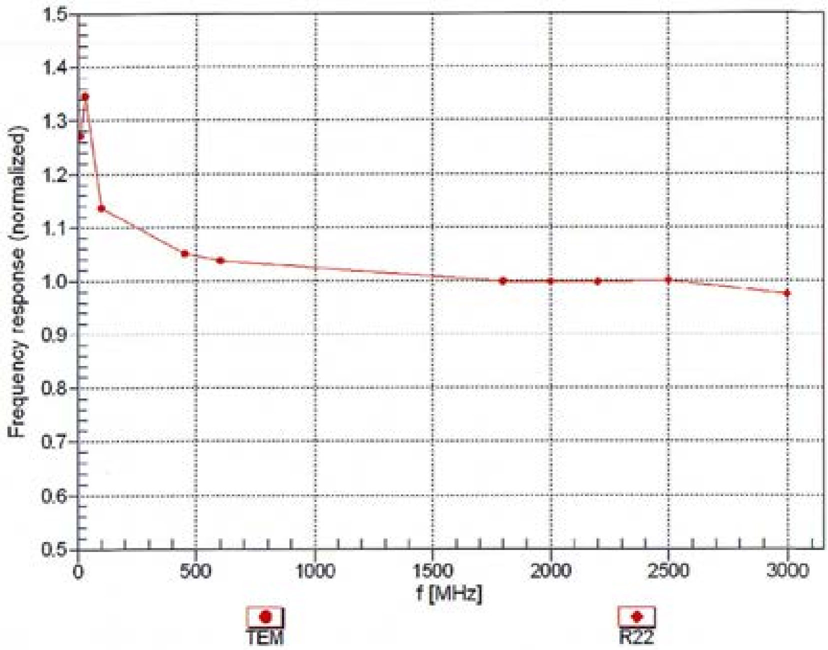
DASY/EASY - Parameters of Probe: EX3DV4 - SN:7364

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	12.37	12.37	12.37	0.00	1.00	± 13.3 %
300	58.2	0.92	11.79	11.79	11.79	0.05	1.20	± 13.3 %
450	56.7	0.94	11.17	11.17	11.17	0.14	1.30	± 13.3 %
750	55.5	0.96	10.24	10.24	10.24	0.50	0.83	± 12.0 %
835	55.2	0.97	9.94	9.94	9.94	0.41	0.90	± 12.0 %
900	55.0	1.05	9.93	9.93	9.93	0.35	0.96	± 12.0 %
1810	53.3	1.52	7.97	7.97	7.97	0.44	0.85	± 12.0 %
1900	53.3	1.52	7.89	7.89	7.89	0.46	0.85	± 12.0 %
2100	53.2	1.62	7.96	7.96	7.96	0.46	0.90	± 12.0 %
2450	52.7	1.95	7.48	7.48	7.48	0.34	0.98	± 12.0 %
5250	48.9	5.36	4.47	4.47	4.47	0.45	1.90	± 13.1 %
5500	48.6	5.65	4.07	4.07	4.07	0.45	1.90	± 13.1 %
5600	48.5	5.77	3.89	3.89	3.89	0.45	1.90	± 13.1 %
5750	48.3	5.94	4.19	4.19	4.19	0.45	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. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. 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.

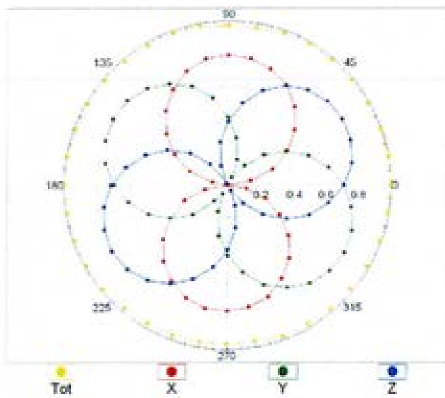
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



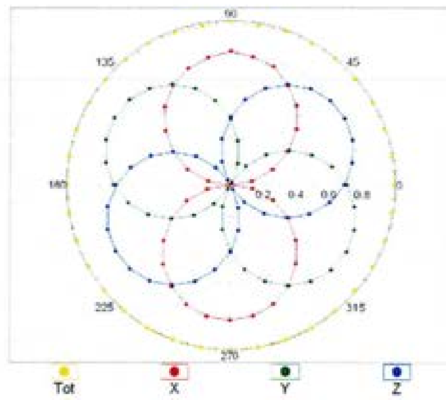
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

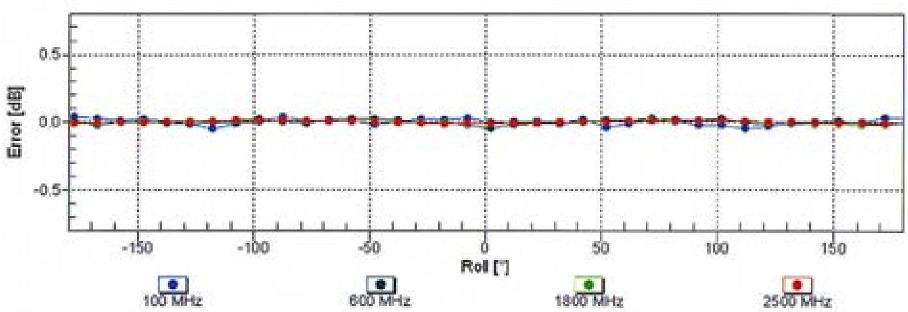
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



f=1800 MHz,R22

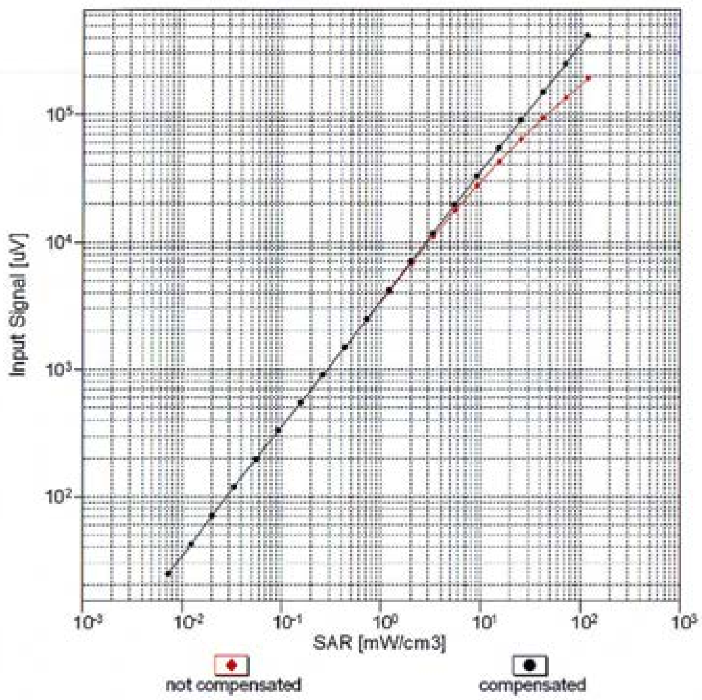


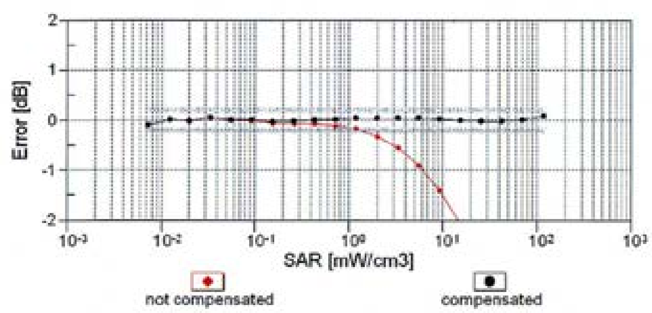


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

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





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

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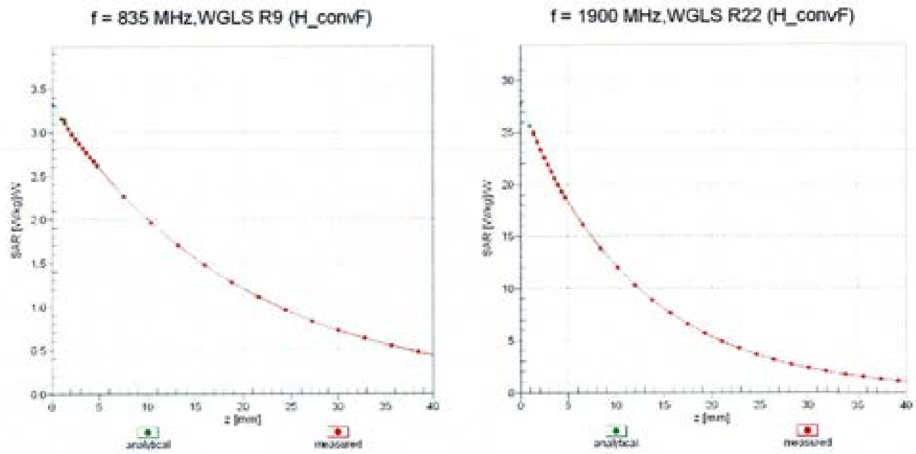
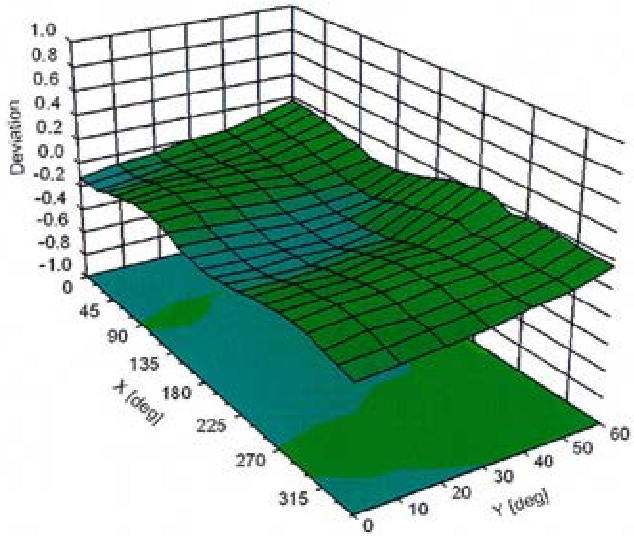
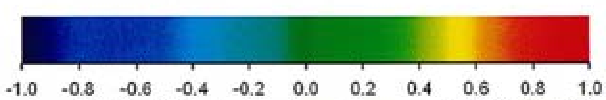
Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz





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

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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	114.6	±2.7 %
		Y	0.0	0.0	1.0		112.4	
		Z	0.0	0.0	1.0		127.7	
10021-DAC	GSM-FDD (TDMA, GMSK)	X	1.72	63.0	12.0	9.39	94.6	±1.9 %
		Y	1.71	65.4	13.2		68.7	
		Z	2.22	65.7	13.5		108.0	
10023-DAC	GPRS-FDD (TDMA, GMSK, TN 0)	X	1.75	63.4	12.3	9.57	91.5	±1.7 %
		Y	1.83	65.6	13.2		67.1	
		Z	2.26	65.5	13.3		104.9	
10024-DAC	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	1.71	64.7	10.9	6.56	147.1	±1.2 %
		Y	4.98	81.5	18.4		127.8	
		Z	2.35	69.4	14.0		131.0	
10025-DAC	EDGE-FDD (TDMA, 8PSK, TN 0)	X	5.28	72.4	25.7	12.62	61.2	±1.2 %
		Y	4.38	68.1	23.6		44.2	
		Z	5.84	75.3	27.6		69.5	
10026-DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1)	X	5.13	74.3	24.8	9.55	140.7	±1.9 %
		Y	4.43	71.4	23.6		100.8	
		Z	5.35	74.8	25.1		128.7	
10027-DAC	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	1.22	62.4	8.8	4.80	140.5	±1.7 %
		Y	29.58	100.0	21.9		130.1	
		Z	34.45	99.7	22.2		118.2	
10028-DAC	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	54.30	99.7	20.4	3.55	116.7	±1.9 %
		Y	0.97	66.1	10.9		148.2	
		Z	43.93	99.7	21.0		131.0	
10029-DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1-2)	X	4.59	72.8	23.2	7.78	137.7	±1.4 %
		Y	3.83	68.9	21.1		125.2	
		Z	5.87	78.6	26.0		118.8	
10039-CAB	CDMA2000 (1xRTT, RC1)	X	4.72	66.7	19.1	4.57	123.7	±0.9 %
		Y	4.44	65.3	18.2		121.2	
		Z	4.88	67.4	19.4		140.2	
10056-CAA	UMTS-TDD (TD-SCDMA, 1.28 Mcps)	X	4.17	68.9	23.5	11.01	89.7	±1.4 %
		Y	3.52	65.8	22.2		64.7	
		Z	4.64	71.3	24.8		101.7	
10058-DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1-2-3)	X	4.77	75.3	23.9	6.52	116.4	±1.4 %
		Y	4.03	71.6	22.1		147.1	
		Z	5.32	76.9	24.4		133.3	
10081-CAB	CDMA2000 (1xRTT, RC3)	X	4.00	66.6	18.9	3.97	120.2	±0.5 %
		Y	3.78	65.2	18.0		118.1	
		Z	4.11	67.0	19.1		136.1	

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10090-DAC	GPRS-FDD (TDMA, GMSK, TN 0-4)	X	1.59	64.6	11.2	6.56	144.9	±1.9 %
		Y	1.86	68.3	12.9		126.4	
		Z	2.87	71.7	14.8		131.1	
10099-DAC	EDGE-FDD (TDMA, 8PSK, TN 0-4)	X	5.33	75.9	25.9	9.55	139.0	±2.2 %
		Y	4.36	71.0	23.4		99.7	
		Z	5.59	76.5	26.3		126.6	
10117-CAC	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	9.95	68.2	21.0	8.07	124.6	±2.2 %
		Y	9.62	67.4	20.5		119.2	
		Z	10.30	69.2	21.6		143.9	
10196-CAC	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.61	68.0	21.0	8.10	119.9	±1.9 %
		Y	9.28	67.1	20.4		114.4	
		Z	9.94	69.0	21.6		137.6	
10290-AAB	CDMA2000, RC1, SO55, Full Rate	X	4.41	67.8	19.3	3.91	123.6	±0.7 %
		Y	4.02	65.7	18.1		120.5	
		Z	4.58	68.5	19.6		139.9	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.79	67.8	19.3	3.46	120.1	±0.5 %
		Y	3.37	65.1	17.7		117.4	
		Z	3.91	68.2	19.5		135.9	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.75	67.9	19.4	3.39	120.3	±0.5 %
		Y	3.35	65.3	17.8		117.1	
		Z	3.86	68.3	19.5		135.5	
10293-AAB	CDMA2000, RC3, SO3, Full Rate	X	3.86	68.0	19.4	3.50	120.3	±0.5 %
		Y	3.44	65.4	17.9		117.0	
		Z	3.91	68.0	19.4		135.8	
10295-AAB	CDMA2000, RC1, SO3, 1/8th Rate 25 fr.	X	5.27	66.0	23.4	12.49	74.0	±1.4 %
		Y	4.56	62.5	21.4		53.0	
		Z	5.70	68.1	24.8		84.1	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	5.20	70.4	19.9	3.76	126.4	±0.5 %
		Y	4.56	67.7	18.4		123.3	
		Z	5.28	70.5	19.9		143.5	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	5.38	71.6	20.6	3.77	124.9	±0.7 %
		Y	4.42	67.3	18.2		121.9	
		Z	5.02	69.8	19.6		142.4	
10406-AAB	CDMA2000, RC3, SO32, SCH0, Full Rate	X	6.70	71.0	20.9	5.22	129.5	±0.7 %
		Y	5.85	67.9	19.2		125.2	
		Z	6.66	70.6	20.7		148.5	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	3.44	72.9	21.1	1.54	126.4	±0.5 %
		Y	2.56	67.0	17.9		123.5	
		Z	3.20	71.3	20.2		142.2	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	9.70	68.1	21.2	8.23	119.3	±1.9 %
		Y	9.38	67.2	20.5		114.1	
		Z	10.02	69.0	21.7		137.1	

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10417-AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 99pc duty cycle)	X	9.70	68.1	21.2	8.23	119.3	±1.9 %
		Y	9.42	67.3	20.6		114.1	
		Z	10.03	69.0	21.7		137.4	
10418-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Long preambule)	X	9.58	68.0	21.1	8.14	118.4	±1.9 %
		Y	9.30	67.2	20.5		113.4	
		Z	9.87	68.9	21.6		136.2	
10458-AAA	CDMA2000 (1xEV-DO, Rev. B, 2 carriers)	X	7.83	67.4	19.9	6.55	108.2	±1.2 %
		Y	7.69	67.0	19.4		104.5	
		Z	8.11	68.2	20.3		124.3	
10459-AAA	CDMA2000 (1xEV-DO, Rev. B, 3 carriers)	X	10.63	69.2	21.7	8.25	130.7	±2.2 %
		Y	10.48	68.9	21.4		123.4	
		Z	10.07	67.8	20.9		101.8	
10515-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps, 99pc duty cycle)	X	3.51	73.4	21.3	1.58	125.8	±0.5 %
		Y	2.68	68.0	18.5		122.8	
		Z	3.41	72.6	20.8		142.5	
10518-AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps, 99pc duty cycle)	X	9.68	68.0	21.1	8.23	118.9	±1.9 %
		Y	9.42	67.3	20.6		114.1	
		Z	10.04	69.1	21.7		137.4	
10525-AAB	IEEE 802.11ac WiFi (20MHz, MCS0, 99pc duty cycle)	X	9.92	68.2	21.3	8.36	120.5	±1.9 %
		Y	9.66	67.6	20.8		116.3	
		Z	10.24	69.2	21.9		139.1	
10526-AAB	IEEE 802.11ac WiFi (20MHz, MCS1, 99pc duty cycle)	X	10.00	68.3	21.4	8.42	120.7	±1.9 %
		Y	9.69	67.5	20.8		116.2	
		Z	10.32	69.3	22.0		139.3	
10534-AAB	IEEE 802.11ac WiFi (40MHz, MCS0, 99pc duty cycle)	X	10.41	68.7	21.5	8.45	125.5	±2.2 %
		Y	10.06	67.8	20.9		120.8	
		Z	10.78	69.7	22.1		145.9	
10535-AAB	IEEE 802.11ac WiFi (40MHz, MCS1, 99pc duty cycle)	X	10.43	68.7	21.5	8.45	126.5	±2.2 %
		Y	10.08	67.9	20.9		121.2	
		Z	10.78	69.7	22.1		146.0	
10544-AAB	IEEE 802.11ac WiFi (80MHz, MCS0, 99pc duty cycle)	X	10.74	69.0	21.5	8.47	130.5	±2.2 %
		Y	10.26	67.9	20.8		123.8	
		Z	10.20	67.7	20.8		101.3	
10545-AAB	IEEE 802.11ac WiFi (80MHz, MCS1, 99pc duty cycle)	X	10.83	69.1	21.6	8.55	130.8	±2.2 %
		Y	10.36	68.1	21.0		124.5	
		Z	10.28	67.8	20.9		101.7	
10564-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 9 Mbps, 99pc duty cycle)	X	9.76	68.2	21.2	8.25	119.0	±1.9 %
		Y	9.46	67.4	20.7		114.6	
		Z	10.08	69.1	21.8		137.5	
10571-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 90pc duty cycle)	X	3.65	73.3	21.4	1.99	123.5	±0.5 %
		Y	2.71	67.4	18.4		120.2	
		Z	3.53	72.6	21.0		138.6	

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10572-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps, 90pc duty cycle)	X	3.80	74.3	21.8	1.99	122.7	±0.5 %
		Y	2.83	68.4	18.9		120.1	
		Z	3.60	73.2	21.2		138.7	
10575-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 90pc duty cycle)	X	9.84	68.2	21.5	8.59	117.1	±1.9 %
		Y	9.55	67.4	20.9		112.7	
		Z	10.17	69.1	22.0		134.4	
10576-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 9 Mbps, 90pc duty cycle)	X	9.84	68.2	21.5	8.60	116.5	±1.9 %
		Y	9.55	67.4	20.9		112.4	
		Z	10.18	69.2	22.1		134.2	
10583-AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 90pc duty cycle)	X	9.87	68.3	21.5	8.59	117.1	±1.9 %
		Y	9.55	67.4	20.9		112.6	
		Z	10.18	69.2	22.1		134.3	
10584-AAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps, 90pc duty cycle)	X	9.87	68.3	21.5	8.60	116.6	±1.9 %
		Y	9.54	67.4	20.9		112.3	
		Z	10.17	69.2	22.1		134.1	
10591-AAB	IEEE 802.11n (HT Mixed, 20MHz, MCS0, 90pc duty cycle)	X	9.98	68.3	21.5	8.63	118.4	±1.9 %
		Y	9.66	67.4	20.9		113.7	
		Z	10.29	69.2	22.1		136.0	
10592-AAB	IEEE 802.11n (HT Mixed, 20MHz, MCS1, 90pc duty cycle)	X	10.14	68.4	21.7	8.79	118.6	±2.2 %
		Y	9.83	67.6	21.1		113.8	
		Z	10.49	69.5	22.3		136.9	
10599-AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS0, 90pc duty cycle)	X	10.57	68.8	21.8	8.79	124.4	±2.2 %
		Y	10.16	67.8	21.1		118.7	
		Z	10.89	69.7	22.4		143.5	
10600-AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS1, 90pc duty cycle)	X	10.65	68.9	21.9	8.88	123.9	±2.2 %
		Y	10.24	67.9	21.2		118.8	
		Z	10.98	69.9	22.5		143.9	
10607-AAB	IEEE 802.11ac WiFi (20MHz, MCS0, 90pc duty cycle)	X	9.99	68.3	21.5	8.64	118.6	±2.2 %
		Y	9.67	67.4	20.9		113.5	
		Z	10.33	69.3	22.1		136.4	
10608-AAB	IEEE 802.11ac WiFi (20MHz, MCS1, 90pc duty cycle)	X	10.13	68.4	21.7	8.77	118.9	±1.9 %
		Y	9.80	67.6	21.1		113.5	
		Z	10.48	69.5	22.3		137.0	
10616-AAB	IEEE 802.11ac WiFi (40MHz, MCS0, 90pc duty cycle)	X	10.58	68.8	21.8	8.82	124.5	±2.2 %
		Y	10.21	67.9	21.2		118.8	
		Z	10.94	69.8	22.4		143.9	
10617-AAB	IEEE 802.11ac WiFi (40MHz, MCS1, 90pc duty cycle)	X	10.59	68.8	21.8	8.81	124.8	±2.2 %
		Y	10.21	67.9	21.2		118.9	
		Z	10.93	69.8	22.4		144.1	
10626-AAB	IEEE 802.11ac WiFi (80MHz, MCS0, 90pc duty cycle)	X	10.89	69.1	21.8	8.83	128.8	±2.2 %
		Y	10.39	68.0	21.1		121.6	
		Z	11.24	70.1	22.4		149.4	

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10627-AAB	IEEE 802.11ac WiFi (80MHz, MCS1, 90pc duty cycle)	X	10.94	69.1	21.9	8.88	129.3	±2.2 %
		Y	10.43	68.0	21.1		121.2	
		Z	11.32	70.2	22.5		149.9	
10648-AAA	CDMA2000 (1x Advanced)	X	3.77	67.8	19.4	3.45	120.1	±0.7 %
		Y	3.51	66.0	18.3		117.6	
		Z	3.94	68.6	19.8		136.8	

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

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Accreditation No.: **SCS 0108**

Client **Motorola Solutions MY**

Certificate No: **EX3-7485_Jan19**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:7485
Calibration procedure(s)	QA CAL-01.v9, QA CAL-12.v9, QA CAL-14.v5, QA CAL-23.v5, QA CAL-25.v7 Calibration procedure for dosimetric E-field probes
Calibration date:	January 23, 2019

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

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-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-18 (No. 217-02682)	Apr-19
DAE4	SN: 660	19-Dec-18 (No. DAE4-660_Dec18)	Dec-19
Reference Probe ES3DV2	SN: 3013	31-Dec-18 (No. ES3-3013_Dec18)	Dec-19
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-18)	In house check: Jun-20
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

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

Issued: January 26, 2019

Calibration Laboratory of
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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, ", "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

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).

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7485

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.46	0.45	0.46	± 10.1 %
DCP (mV)[B]	100.5	94.4	103.1	

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB$\sqrt{\mu V}$	C	D dB	VR mV	Max dev.	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	132.5	+ 3.8 %	± 4.7 %
		Y	0.0	0.0	1.0		129.0		
		Y	0.0	0.0	1.0		131.8		

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:7485

Sensor Model Parameters

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	1.2
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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7485

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	14.29	14.29	14.29	0.00	1.00	± 13.3 %
300	45.3	0.87	13.10	13.10	13.10	0.08	1.10	± 13.3 %
450	43.5	0.87	11.95	11.95	11.95	0.13	1.20	± 13.3 %
750	41.9	0.89	10.90	10.90	10.90	0.42	0.89	± 12.0 %
835	41.5	0.90	10.53	10.53	10.53	0.38	0.97	± 12.0 %
900	41.5	0.97	10.26	10.26	10.26	0.33	1.01	± 12.0 %
1450	40.5	1.20	9.56	9.56	9.56	0.40	0.83	± 12.0 %
1810	40.0	1.40	8.95	8.95	8.95	0.35	0.84	± 12.0 %
1900	40.0	1.40	8.70	8.70	8.70	0.32	0.84	± 12.0 %
2100	39.8	1.49	8.80	8.80	8.80	0.31	0.84	± 12.0 %
2300	39.5	1.67	8.21	8.21	8.21	0.29	0.88	± 12.0 %
2450	39.2	1.80	7.84	7.84	7.84	0.36	0.90	± 12.0 %
2600	39.0	1.96	7.64	7.64	7.64	0.39	0.85	± 12.0 %
3500	37.9	2.91	7.36	7.36	7.36	0.25	1.25	± 13.1 %
3700	37.7	3.12	7.03	7.03	7.03	0.24	1.30	± 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. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. 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.

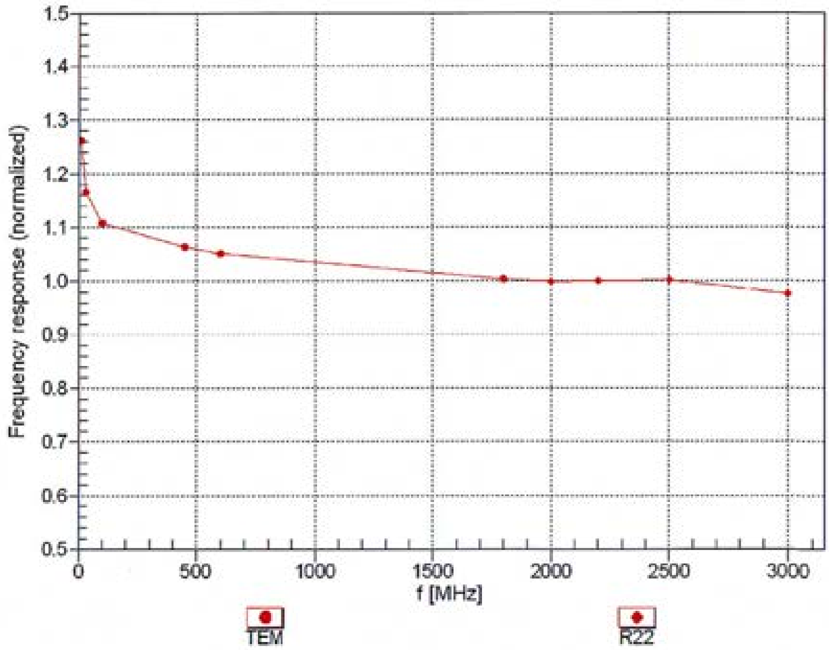
DASY/EASY - Parameters of Probe: EX3DV4 - SN:7485

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	13.55	13.55	13.55	0.00	1.00	± 13.3 %
300	58.2	0.92	12.62	12.62	12.62	0.04	1.10	± 13.3 %
450	56.7	0.94	12.52	12.52	12.52	0.08	1.20	± 13.3 %
750	55.5	0.96	10.75	10.75	10.75	0.27	1.13	± 12.0 %
835	55.2	0.97	10.43	10.43	10.43	0.45	0.84	± 12.0 %
900	55.0	1.05	10.32	10.32	10.32	0.31	0.99	± 12.0 %
1450	54.0	1.30	9.01	9.01	9.01	0.29	0.80	± 12.0 %
1810	53.3	1.52	8.47	8.47	8.47	0.37	0.84	± 12.0 %
1900	53.3	1.52	8.23	8.23	8.23	0.28	0.98	± 12.0 %
2100	53.2	1.62	8.41	8.41	8.41	0.29	0.96	± 12.0 %
2300	52.9	1.81	8.10	8.10	8.10	0.39	0.82	± 12.0 %
2450	52.7	1.95	8.09	8.09	8.09	0.21	1.15	± 12.0 %
2600	52.5	2.16	7.88	7.88	7.88	0.25	0.99	± 12.0 %
3500	51.3	3.31	7.11	7.11	7.11	0.25	1.20	± 13.1 %
3700	51.0	3.55	7.06	7.06	7.06	0.23	1.25	± 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. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. 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.

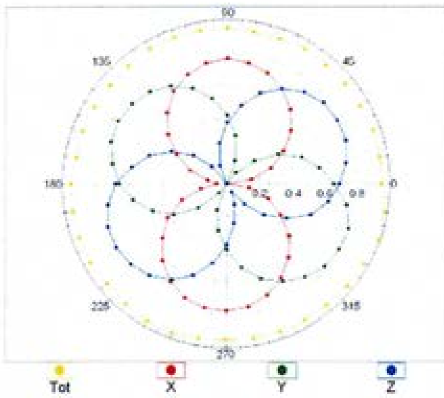
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



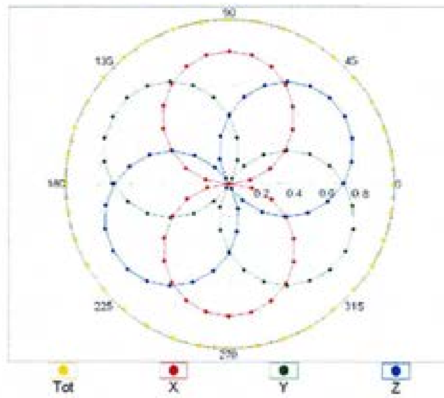
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

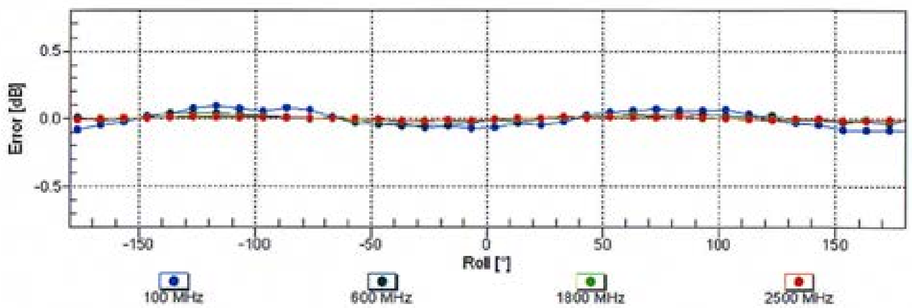
Receiving Pattern (ϕ), $\vartheta = 0°$

f=600 MHz,TEM



f=1800 MHz,R22

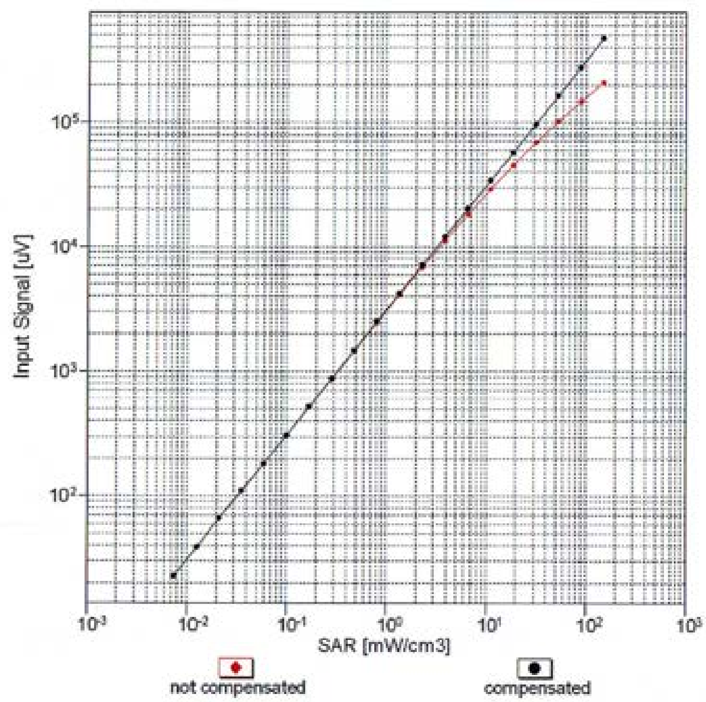


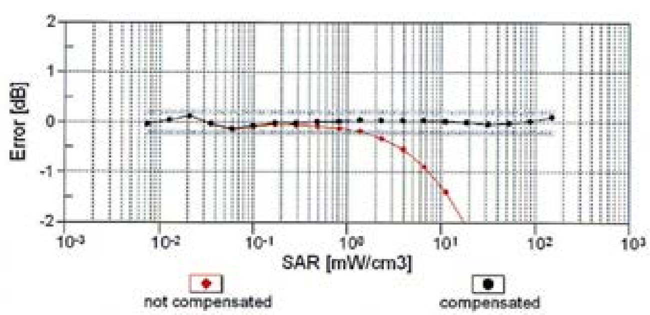


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

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

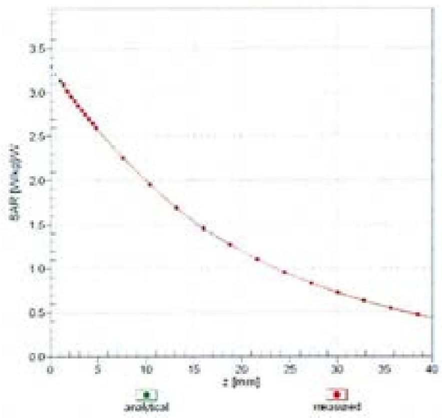




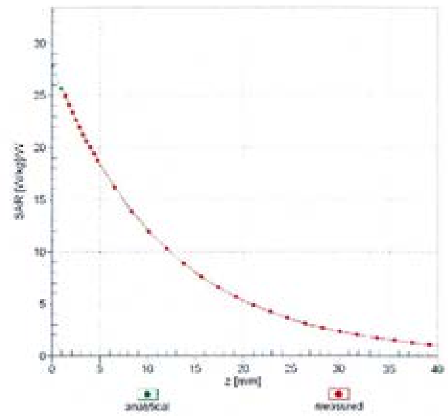
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

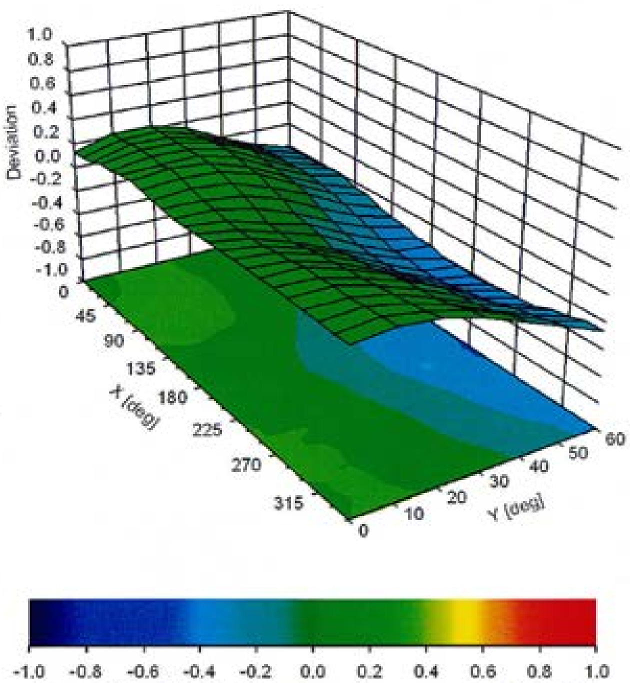


f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

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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	132.5	±3.8 %
		Y	0.0	0.0	1.0		129.0	
		Z	0.0	0.0	1.0		131.8	
10011-CAB	UMTS-FDD (WCDMA)	X	3.27	66.4	17.8	2.91	142.4	±1.7 %
		Y	3.02	64.5	16.8		138.7	
		Z	3.61	69.5	20.0		142.8	
10097-CAB	UMTS-FDD (HSDPA)	X	4.42	65.9	17.9	3.98	127.9	±1.7 %
		Y	4.26	64.8	17.3		146.5	
		Z	4.62	67.5	19.1		128.2	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	4.42	65.9	18.0	3.98	128.1	±1.7 %
		Y	4.29	64.9	17.4		146.2	
		Z	4.62	67.4	19.1		128.2	
10100-CAE	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.11	66.2	18.9	5.67	134.3	±2.2 %
		Y	5.88	65.2	18.4		129.8	
		Z	6.26	67.2	19.7		134.6	
10101-CAE	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM)	X	7.24	67.0	19.6	6.42	142.9	±2.2 %
		Y	7.02	66.2	19.2		137.8	
		Z	7.31	67.5	20.1		143.9	
10108-CAG	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.03	66.1	19.0	5.80	131.6	±1.7 %
		Y	6.09	66.3	19.2		149.4	
		Z	6.12	66.9	19.7		132.1	
10109-CAG	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)	X	6.99	66.9	19.6	6.43	138.2	±2.5 %
		Y	6.85	66.3	19.4		133.8	
		Z	7.07	67.4	20.1		138.7	
10110-CAG	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	5.71	65.7	18.8	5.75	127.7	±2.5 %
		Y	5.77	65.8	19.0		145.1	
		Z	5.84	66.7	19.6		128.5	
10111-CAG	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)	X	6.73	66.8	19.6	6.44	133.1	±1.9 %
		Y	6.57	66.0	19.2		129.1	
		Z	6.81	67.4	20.2		133.7	
10117-CAC	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	9.93	68.4	21.0	8.07	144.8	±3.0 %
		Y	9.73	67.9	20.8		138.9	
		Z	9.98	68.7	21.3		145.4	
10140-CAE	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM)	X	7.42	67.2	19.8	6.49	144.3	±2.2 %
		Y	7.18	66.4	19.4		139.1	
		Z	7.48	67.7	20.3		144.7	
10142-CAE	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, QPSK)	X	5.74	66.5	19.3	5.73	147.7	±1.9 %
		Y	5.58	65.6	18.9		142.1	
		Z	5.83	67.3	20.0		148.4	
10143-CAE	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)	X	6.43	66.7	19.5	6.35	128.7	±2.2 %
		Y	6.51	66.8	19.6		148.1	
		Z	6.55	67.5	20.1		130.0	
10145-CAF	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)	X	5.52	66.7	19.4	5.76	142.0	±1.9 %

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		Y	5.39	65.9	19.0		137.0	
		Z	5.58	67.3	20.0		143.0	
10146-CAF	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM)	X	6.37	67.9	20.1	6.41	144.3	±2.2 %
		Y	6.29	67.4	20.0		140.4	
		Z	6.47	68.5	20.7		145.8	
10149-CAE	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM)	X	6.99	66.8	19.6	6.42	138.3	±1.9 %
		Y	6.83	66.2	19.3		133.5	
		Z	7.05	67.4	20.1		138.4	
10154-CAG	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	5.73	65.8	18.9	5.75	127.6	±2.2 %
		Y	5.79	65.9	19.0		145.4	
		Z	5.82	66.6	19.6		128.0	
10155-CAG	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)	X	6.70	66.7	19.5	6.43	132.8	±2.2 %
		Y	6.60	66.2	19.4		129.3	
		Z	6.81	67.4	20.2		133.7	
10156-CAG	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	X	5.71	66.5	19.3	5.79	146.3	±2.2 %
		Y	5.57	65.7	19.0		140.8	
		Z	5.76	67.1	19.9		146.6	
10157-CAG	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)	X	6.43	66.8	19.6	6.49	127.0	±1.9 %
		Y	6.56	67.1	19.9		145.4	
		Z	6.54	67.5	20.3		127.6	
10160-CAE	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.14	66.3	19.1	5.82	132.4	±1.9 %
		Y	6.03	65.8	18.9		128.5	
		Z	6.23	67.0	19.7		133.1	
10161-CAE	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM)	X	7.01	66.9	19.6	6.43	138.3	±1.9 %
		Y	6.86	66.3	19.4		133.4	
		Z	7.11	67.6	20.2		138.1	
10166-CAF	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK)	X	4.95	66.6	19.3	5.46	136.3	±1.9 %
		Y	4.87	65.9	19.0		132.2	
		Z	5.07	67.5	20.1		136.7	
10167-CAF	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM)	X	5.72	67.5	20.0	6.21	136.4	±2.2 %
		Y	5.66	67.0	19.8		132.4	
		Z	5.93	68.7	20.9		137.5	
10169-CAE	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.75	66.3	19.4	5.73	130.0	±1.7 %
		Y	4.89	66.6	19.6		148.6	
		Z	4.88	67.5	20.3		130.7	
10170-CAE	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	X	5.56	68.0	20.6	6.52	149.7	±2.2 %
		Y	5.49	67.3	20.3		146.3	
		Z	5.48	68.0	20.9		128.0	
10175-CAG	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.74	66.3	19.3	5.72	129.5	±1.9 %
		Y	4.88	66.6	19.6		148.5	
		Z	4.89	67.5	20.4		130.4	
10176-CAG	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	X	5.56	68.0	20.6	6.52	149.7	±2.2 %
		Y	5.47	67.2	20.2		146.3	
		Z	5.47	68.0	20.9		127.7	

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10177-CAI	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	X	4.76	66.4	19.4	5.73	130.1	±1.9 %
		Y	4.88	66.6	19.6		147.9	
		Z	4.91	67.6	20.4		130.5	
10178-CAG	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	X	5.55	68.0	20.6	6.52	149.9	±2.2 %
		Y	5.49	67.2	20.2		146.3	
		Z	5.52	68.2	21.0		127.7	
10181-CAE	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.77	66.4	19.4	5.72	130.0	±1.9 %
		Y	4.88	66.6	19.6		148.3	
		Z	4.92	67.7	20.4		130.7	
10182-CAE	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	X	5.56	68.0	20.6	6.52	149.6	±2.2 %
		Y	5.51	67.4	20.4		146.1	
		Z	5.49	68.1	20.9		127.7	
10184-CAE	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)	X	4.77	66.4	19.4	5.73	129.7	±2.2 %
		Y	4.88	66.6	19.6		148.3	
		Z	4.89	67.5	20.4		130.2	
10185-CAE	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)	X	5.58	68.1	20.7	6.51	149.8	±2.2 %
		Y	5.49	67.3	20.3		146.4	
		Z	5.46	68.0	20.9		127.4	
10187-CAF	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)	X	4.76	66.4	19.4	5.73	129.5	±1.9 %
		Y	4.87	66.4	19.5		148.5	
		Z	4.91	67.6	20.4		130.3	
10188-CAF	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)	X	5.57	68.0	20.6	6.52	149.6	±2.2 %
		Y	5.48	67.2	20.2		146.6	
		Z	5.49	68.1	21.0		127.7	
10196-CAC	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.55	68.3	21.1	8.10	137.2	±2.7 %
		Y	9.39	67.9	20.9		131.6	
		Z	9.60	68.6	21.4		138.2	
10225-CAB	UMTS-FDD (HSPA+)	X	6.77	67.0	19.4	5.97	138.3	±2.2 %
		Y	6.67	66.6	19.2		134.5	
		Z	6.89	67.7	20.0		138.6	
10274-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	5.75	66.7	18.7	4.87	135.3	±0.9 %
		Y	5.54	65.6	18.2		131.4	
		Z	5.92	67.7	19.4		136.5	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.40	66.6	18.5	3.96	145.9	±0.9 %
		Y	4.23	65.6	18.0		140.7	
		Z	4.57	68.1	19.6		145.8	
10297-AAD	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.08	66.3	19.2	5.81	130.5	±1.7 %
		Y	6.25	67.2	19.9		146.9	
		Z	6.19	67.2	19.9		130.9	
10298-AAD	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, QPSK)	X	5.57	66.7	19.4	5.72	143.9	±1.9 %
		Y	5.54	66.5	19.4		138.4	
		Z	5.70	67.7	20.2		144.4	
10299-AAD	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM)	X	6.50	68.0	20.2	6.39	147.5	±1.9 %
		Y	6.41	67.5	20.1		142.6	
		Z	6.60	68.6	20.8		148.1	

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10311-AAD	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.60	66.7	19.4	6.06	136.5	±1.9 %
		Y	6.48	66.3	19.3		131.5	
		Z	6.67	67.4	20.0		136.0	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.93	69.1	18.6	1.54	146.6	±1.7 %
		Y	2.73	67.8	18.0		141.9	
		Z	3.99	76.8	22.9		146.2	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	9.64	68.3	21.1	8.23	137.7	±2.7 %
		Y	9.44	67.8	20.9		131.7	
		Z	9.69	68.7	21.5		138.3	
10418-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Long preambule)	X	9.50	68.2	21.1	8.14	136.1	±2.7 %
		Y	9.32	67.7	20.8		130.9	
		Z	9.55	68.5	21.4		136.7	
10435-AAF	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	5.59	69.0	22.2	7.82	149.8	±2.5 %
		Y	5.34	67.4	21.4		142.3	
		Z	5.47	68.8	22.3		129.6	
10457-AAA	UMTS-FDD (DC-HSDPA)	X	8.03	66.7	19.5	6.62	134.0	±2.2 %
		Y	7.91	66.3	19.3		129.2	
		Z	8.08	67.1	19.9		134.2	
10460-AAA	UMTS-FDD (WCDMA, AMR)	X	3.07	68.6	18.9	2.39	139.3	±1.7 %
		Y	2.84	67.0	18.1		135.5	
		Z	3.70	73.8	22.0		139.1	
10461-AAA	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	5.42	68.1	21.7	7.82	128.9	±1.7 %
		Y	5.36	67.5	21.5		141.9	
		Z	5.50	68.9	22.3		129.2	
10462-AAA	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	6.02	69.9	22.7	8.30	146.8	±1.9 %
		Y	5.73	68.1	21.9		139.1	
		Z	6.08	70.5	23.4		146.9	
10464-AAB	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	5.59	69.0	22.1	7.82	149.3	±1.9 %
		Y	5.30	67.1	21.1		142.3	
		Z	5.66	69.7	22.8		150.0	
10465-AAB	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	6.01	69.7	22.7	8.32	146.1	±1.9 %
		Y	5.73	67.9	21.8		139.2	
		Z	6.14	70.6	23.4		147.9	
10467-AAE	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	5.57	68.9	22.1	7.82	149.2	±1.9 %
		Y	5.30	67.1	21.1		142.1	
		Z	5.46	68.7	22.2		128.9	
10468-AAE	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	6.02	69.8	22.7	8.32	146.5	±1.9 %
		Y	5.72	67.9	21.7		139.4	
		Z	6.13	70.6	23.4		147.0	
10470-AAE	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	5.57	68.9	22.1	7.82	149.1	±2.2 %
		Y	5.31	67.2	21.1		142.3	
		Z	5.45	68.7	22.2		128.8	

10471-AAE	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	6.01	69.7	22.7	8.32	146.6	±1.9 %
		Y	5.71	67.9	21.7		139.6	
		Z	6.11	70.6	23.4		147.5	
10473-AAE	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	5.58	69.0	22.1	7.82	149.2	±2.5 %
		Y	5.30	67.1	21.1		142.7	
		Z	5.47	68.8	22.3		128.8	
10474-AAE	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	6.02	69.8	22.8	8.32	146.4	±2.5 %
		Y	5.71	67.9	21.7		139.4	
		Z	6.10	70.5	23.3		147.8	
10477-AAF	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	6.00	69.7	22.7	8.32	146.7	±2.5 %
		Y	5.71	67.8	21.6		139.8	
		Z	6.11	70.6	23.4		147.7	
10479-AAA	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	5.69	67.7	21.3	7.74	134.3	±2.2 %
		Y	5.57	66.9	20.9		149.5	
		Z	5.72	68.2	21.8		134.7	
10480-AAA	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	6.31	69.0	22.0	8.18	135.9	±2.2 %
		Y	6.13	67.9	21.5		149.8	
		Z	6.38	69.5	22.6		136.7	
10482-AAB	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	6.09	67.7	21.2	7.71	141.8	±2.5 %
		Y	5.76	66.0	20.3		135.6	
		Z	6.11	68.1	21.7		142.5	
10483-AAB	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	7.06	69.0	22.1	8.39	147.0	±2.7 %
		Y	6.68	67.2	21.1		139.8	
		Z	7.10	69.3	22.5		147.6	
10485-AAE	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	6.05	67.4	21.0	7.59	144.1	±2.2 %
		Y	5.75	65.9	20.2		137.6	
		Z	6.09	67.9	21.5		144.7	
10486-AAE	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	6.99	67.9	21.5	8.38	128.4	±2.2 %
		Y	6.84	67.2	21.2		143.1	
		Z	7.05	68.4	22.0		129.3	
10488-AAE	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	6.27	66.8	20.7	7.70	127.9	±2.7 %
		Y	6.10	66.0	20.3		142.8	
		Z	6.33	67.4	21.3		128.7	
10489-AAE	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	7.25	67.7	21.3	8.31	135.3	±2.5 %
		Y	7.07	67.0	21.0		149.8	
		Z	7.29	68.2	21.8		135.8	
10491-AAE	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	6.65	67.2	20.8	7.74	133.4	±2.5 %
		Y	6.43	66.3	20.4		147.9	
		Z	6.71	67.8	21.4		133.7	
10492-AAE	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	7.72	68.0	21.5	8.41	141.6	±2.7 %
		Y	7.35	66.6	20.8		134.4	
		Z	7.74	68.4	21.9		141.9	
10494-AAF	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	6.63	67.2	20.9	7.74	132.7	±2.7 %
		Y	6.39	66.3	20.4		147.1	
		Z	6.67	67.8	21.4		133.2	

10495-AAF	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	7.65	67.9	21.5	8.37	141.2	±2.5 %
		Y	7.27	66.5	20.7		134.2	
		Z	7.66	68.2	21.8		141.8	
10497-AAA	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	6.00	67.8	21.2	7.67	141.2	±2.5 %
		Y	5.69	66.2	20.3		134.7	
		Z	6.05	68.4	21.8		141.5	
10498-AAA	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	6.95	69.1	22.1	8.40	144.1	±1.9 %
		Y	6.61	67.4	21.2		137.4	
		Z	6.99	69.4	22.5		145.3	
10500-AAB	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	6.24	67.5	21.1	7.67	146.1	±2.2 %
		Y	5.92	65.9	20.2		139.9	
		Z	6.29	68.1	21.7		146.9	
10501-AAB	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	7.18	68.0	21.6	8.44	130.5	±2.7 %
		Y	6.98	67.1	21.1		145.4	
		Z	7.22	68.4	22.0		131.6	
10503-AAE	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	6.29	66.9	20.7	7.72	128.0	±2.7 %
		Y	6.10	66.0	20.3		142.7	
		Z	6.35	67.4	21.3		129.0	
10504-AAE	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	7.27	67.8	21.4	8.31	135.4	±1.9 %
		Y	7.06	66.9	21.0		150.0	
		Z	7.32	68.2	21.8		136.2	
10506-AAE	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	6.63	67.2	20.9	7.74	132.8	±2.5 %
		Y	6.42	66.4	20.5		147.8	
		Z	6.67	67.8	21.4		133.2	
10507-AAE	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	7.65	67.9	21.4	8.36	141.2	±2.5 %
		Y	7.28	66.6	20.8		133.9	
		Z	7.67	68.3	21.8		141.9	
10509-AAE	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	7.25	67.8	21.2	7.99	138.9	±2.5 %
		Y	6.82	66.2	20.4		131.6	
		Z	7.29	68.3	21.7		139.1	
10510-AAE	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	8.17	68.3	21.7	8.49	148.7	±2.5 %
		Y	7.71	66.7	20.9		138.9	
		Z	8.16	68.6	22.0		147.6	
10512-AAF	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	6.97	67.7	21.0	7.74	137.5	±2.2 %
		Y	6.56	66.2	20.3		130.3	
		Z	7.01	68.3	21.5		137.7	
10513-AAF	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	8.02	68.1	21.6	8.42	146.5	±2.5 %
		Y	7.60	66.7	20.9		137.7	
		Z	8.03	68.4	21.9		146.8	
10515-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps, 99pc duty cycle)	X	3.03	69.9	19.0	1.58	146.0	±1.4 %
		Y	2.57	66.6	17.3		140.8	
		Z	4.02	77.1	23.0		145.7	

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10564-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 9 Mbps, 99pc duty cycle)	X	9.64	68.3	21.1	8.25	137.0	±2.7 %
		Y	9.51	68.0	21.0		131.9	
		Z	9.72	68.7	21.5		138.2	
10571-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 90pc duty cycle)	X	3.10	69.6	19.1	1.99	142.2	±1.9 %
		Y	2.67	66.9	17.8		137.5	
		Z	4.15	76.9	23.0		142.1	
10572-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps, 90pc duty cycle)	X	3.11	69.9	19.2	1.99	141.9	±1.7 %
		Y	2.68	67.0	17.8		137.4	
		Z	4.00	76.4	22.8		141.9	
10575-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 90pc duty cycle)	X	9.73	68.3	21.4	8.59	134.3	±3.0 %
		Y	9.58	67.9	21.2		128.5	
		Z	9.80	68.7	21.7		135.7	
10576-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 9 Mbps, 90pc duty cycle)	X	9.73	68.4	21.4	8.60	134.1	±3.0 %
		Y	9.53	67.8	21.2		128.1	
		Z	9.81	68.8	21.8		135.2	
10591-AAB	IEEE 802.11n (HT Mixed, 20MHz, MCS0, 90pc duty cycle)	X	9.86	68.4	21.5	8.63	136.2	±3.0 %
		Y	9.66	67.8	21.2		130.3	
		Z	9.93	68.7	21.8		137.4	
10592-AAB	IEEE 802.11n (HT Mixed, 20MHz, MCS1, 90pc duty cycle)	X	10.04	68.6	21.7	8.79	136.6	±3.0 %
		Y	9.83	68.1	21.4		130.4	
		Z	10.09	68.9	21.9		137.9	
10599-AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS0, 90pc duty cycle)	X	10.50	69.0	21.7	8.79	144.3	±3.0 %
		Y	10.20	68.3	21.4		135.9	
		Z	10.52	69.2	22.0		144.8	
10600-AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS1, 90pc duty cycle)	X	10.58	69.1	21.9	8.88	144.7	±3.0 %
		Y	10.29	68.4	21.5		136.9	
		Z	10.61	69.3	22.1		145.0	

[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
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

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

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

Accreditation No.: **SCS 0108**

Client **Motorola Solutions MY**

Certificate No: **CLA150-4005_Feb18**

CALIBRATION CERTIFICATE

Object	CLA150 - SN: 4005
Calibration procedure(s)	QA CAL-15.v8 Calibration procedure for system validation sources below 700 MHz
Calibration date:	February 09, 2018

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5277 (20x)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 3877	30-Dec-17 (No. EX3-3877_Dec17)	Dec-18
DAE4	SN: 654	24-Jul-17 (No. DAE4-654_Jul17)	Jul-18

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (No. 217-02285/02284)	In house check: Jun-18
Power sensor E4412A	SN: MY41498087	06-Apr-16 (No. 217-02285)	In house check: Jun-18
Power sensor E4412A	SN: 000110210	06-Apr-16 (No. 217-02284	In house check: Jun-18
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-16)	In house check: Jun-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-17)	In house check: Oct-18

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

Issued: February 12, 2018

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

Certificate No: CLA150-4005_Feb18 Page 1 of 8

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

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

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

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	ELI4 Flat Phantom	Shell thickness: 2 ± 0.2 mm
EUT Positioning	Touch Position	
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	150 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	52.3	0.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	50.3 ± 6 %	0.76 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	1 W input power	3.80 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**3.77 W/kg ± 18.4 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	1 W input power	2.52 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**2.50 W/kg ± 18.0 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	61.9	0.80 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	62.1 ± 6 %	0.81 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	1 W input power	3.87 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**3.84 W/kg ± 18.4 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	1 W input power	2.57 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**2.55 W/kg ± 18.0 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	41.9 Ω + 2.0 jΩ
Return Loss	- 20.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	42.9 Ω + 0.8 jΩ
Return Loss	- 22.3 dB

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	August 23, 2013

DASY5 Validation Report for Head TSL

Date: 09.02.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: CLA150; Type: CLA150; Serial: CLA150 - SN: 4005

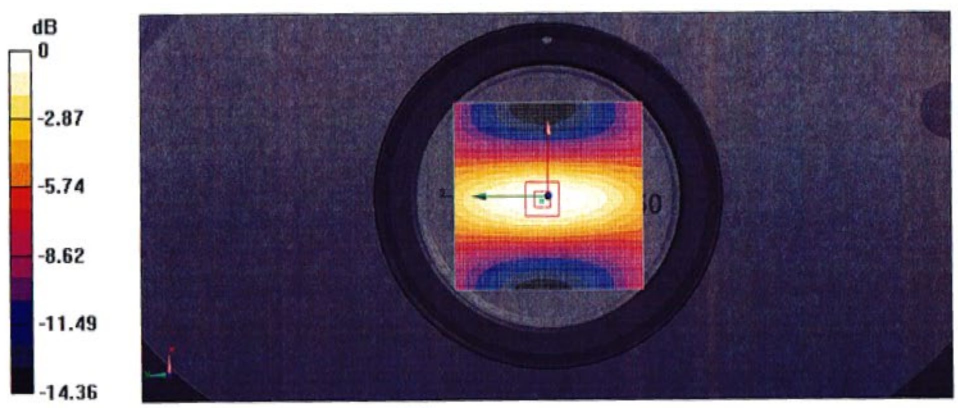
Communication System: UID 0 - CW; Frequency: 150 MHz
Medium parameters used: f = 150 MHz; σ = 0.76 S/m; ε_r = 50.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3877; ConvF(12.12, 12.12, 12.12); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 24.07.2017
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

CLA Calibration for HSL-LF Tissue/CLA150, touch configuration, Pin=1W/Area Scan (81x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 5.37 W/kg

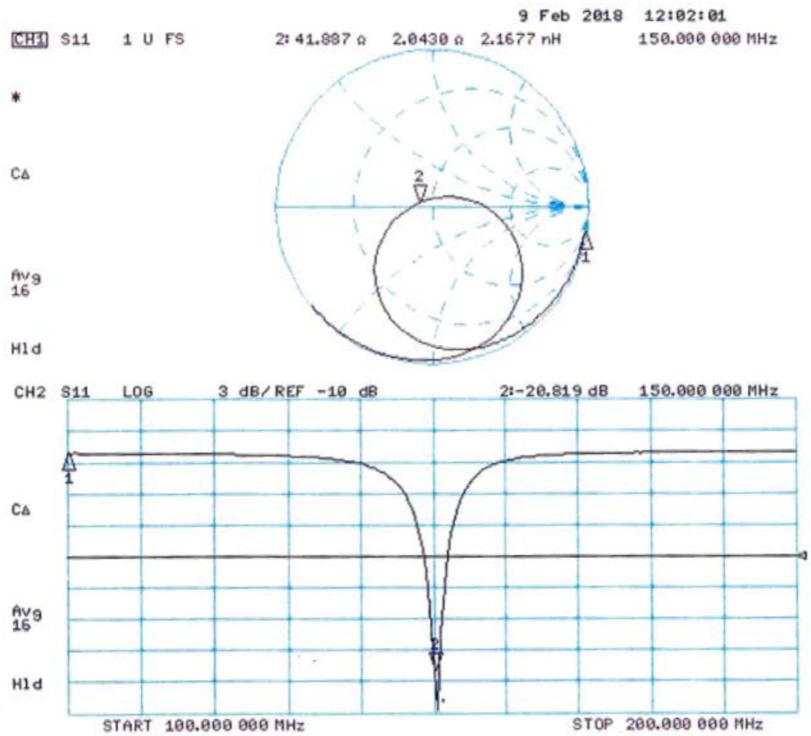
CLA Calibration for HSL-LF Tissue/CLA150, touch configuration, Pin=1W/Zoom Scan, dist=1.4mm (8x10x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 83.36 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 7.14 W/kg
SAR(1 g) = 3.8 W/kg; SAR(10 g) = 2.52 W/kg
Maximum value of SAR (measured) = 5.33 W/kg



0 dB = 5.37 W/kg = 7.30 dBW/kg

Certificate No: CLA150-4005_Feb18 Page 5 of 8

Impedance Measurement Plot for Head TSL



Certificate No: CLA150-4005_Feb18 Page 6 of 8

DASY5 Validation Report for Body TSL

Date: 09.02.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: CLA150; Type: CLA150; Serial: CLA150 - SN: 4005

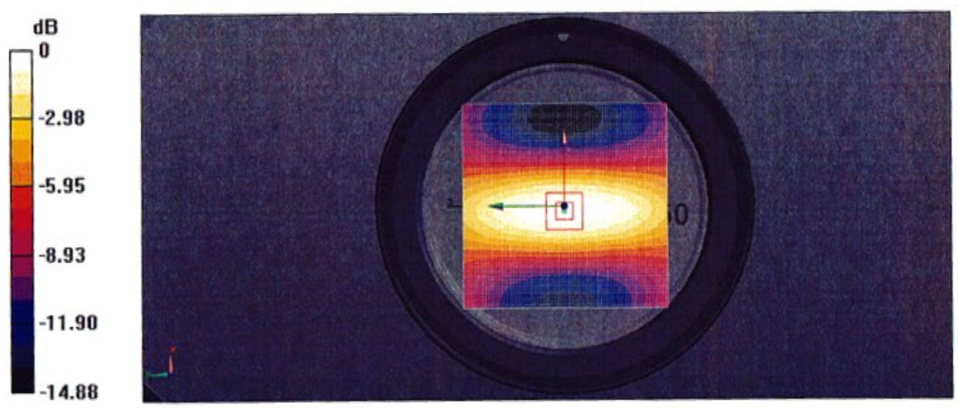
Communication System: UID 0 - CW; Frequency: 150 MHz
Medium parameters used: f = 150 MHz; $\sigma = 0.81$ S/m; $\varepsilon_r = 62.1$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3877; ConvF(11.57, 11.57, 11.57); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 24.07.2017
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

CLA Calibration for MSL-LF Tissue/CLA150, touch configuration, Pin=1W/Area Scan (81x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 5.47 W/kg

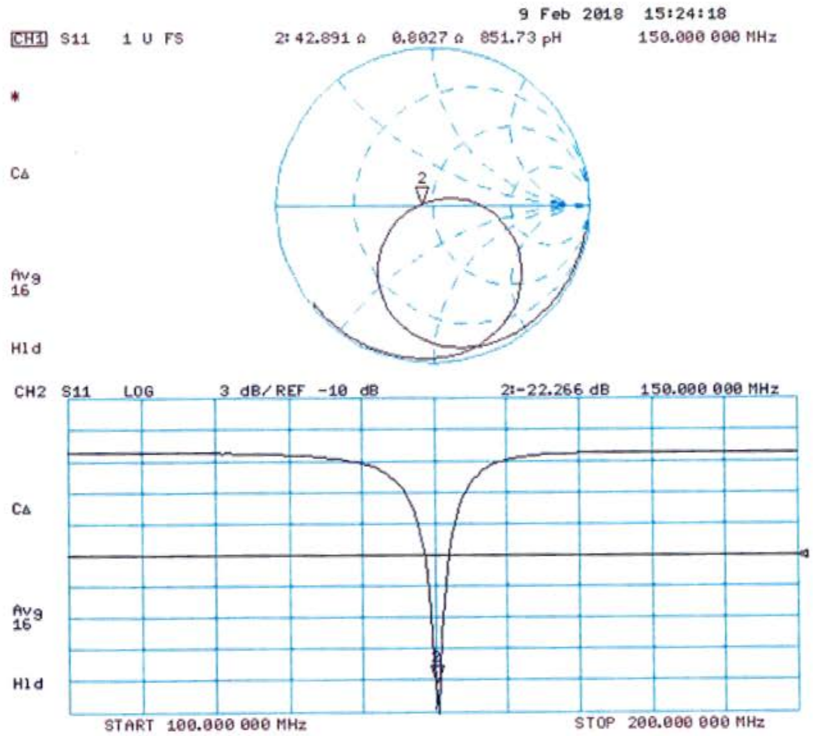
CLA Calibration for MSL-LF Tissue/CLA150, touch configuration, Pin=1W/Zoom Scan, dist=1.4mm (8x10x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 81.25 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 7.26 W/kg
SAR(1 g) = 3.87 W/kg; SAR(10 g) = 2.57 W/kg
Maximum value of SAR (measured) = 5.37 W/kg



0 dB = 5.47 W/kg = 7.38 dBW/kg

Certificate No: CLA150-4005_Feb18 Page 7 of 8

Impedance Measurement Plot for Body TSL



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Accreditation No.: **SCS 0108**

Client **Motorola Solutions MY**

Certificate No: **D2450V2-781_Apr18**

CALIBRATION CERTIFICATE

Object	D2450V2 - SN:781
Calibration procedure(s)	QA CAL-05.v10 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	April 11, 2018

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-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19
Reference Probe EX3DV4	SN: 7349	30-Dec-17 (No. EX3-7349_Dec17)	Dec-18
DAE4	SN: 601	26-Oct-17 (No. DAE4-601_Oct17)	Oct-18

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-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-17)	In house check: Oct-18

	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	M.Weber
Approved by:	Katja Pokovic	Technical Manager	[signature]

Issued: April 12, 2018

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

Certificate No: D2450V2-781_Apr18 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, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
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	38.3 ± 6 %	1.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.1 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**51.3 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.1 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	52.5 ± 6 %	2.01 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.8 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**50.4 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.03 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.9 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.6 Ω + 3.8 jΩ
Return Loss	- 24.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.2 Ω + 6.1 jΩ
Return Loss	- 24.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.152 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: 11.04.2018

Test Laboratory: SPEAG, Zurich, Switzerland

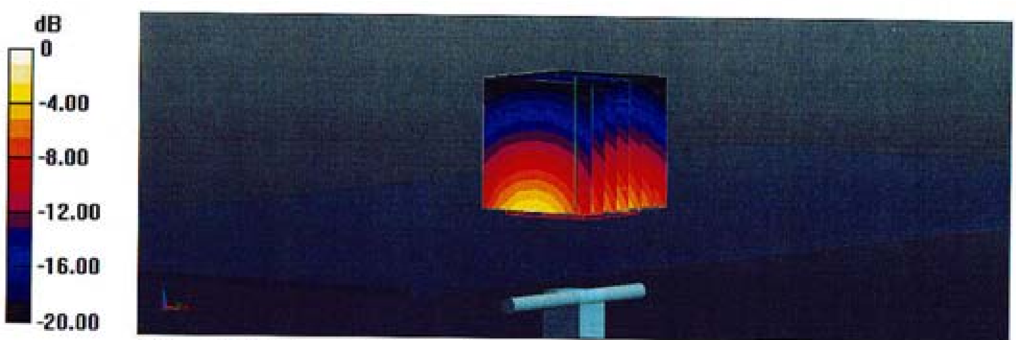
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:781

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.86 S/m; ε_r = 38.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.88, 7.88, 7.88); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

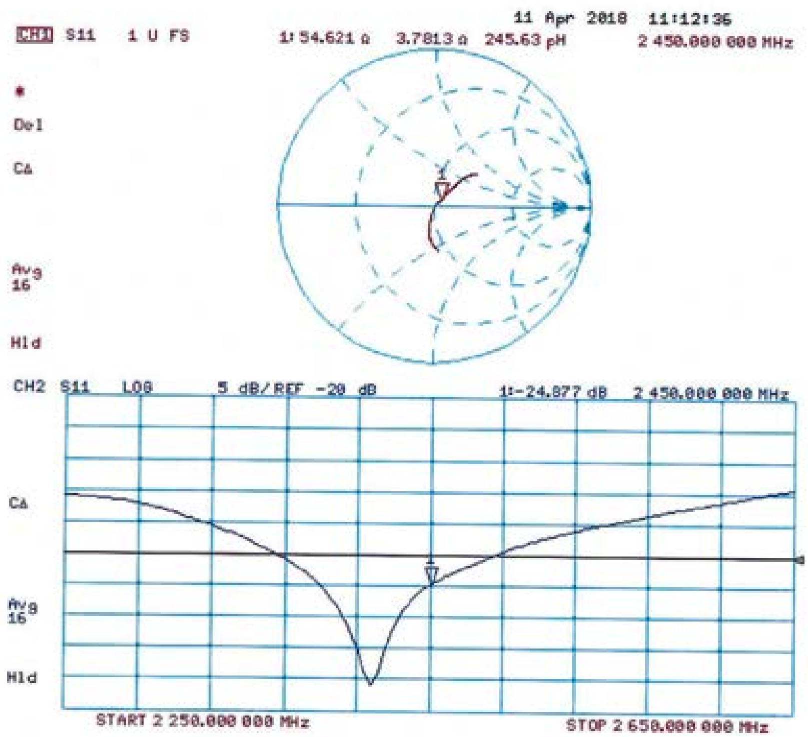
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 115.2 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 25.9 W/kg
SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.09 W/kg
Maximum value of SAR (measured) = 21.4 W/kg



0 dB = 21.4 W/kg = 13.30 dBW/kg

Certificate No: D2450V2-781_Apr18 Page 5 of 8

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 11.04.2018

Test Laboratory: SPEAG, Zurich, Switzerland

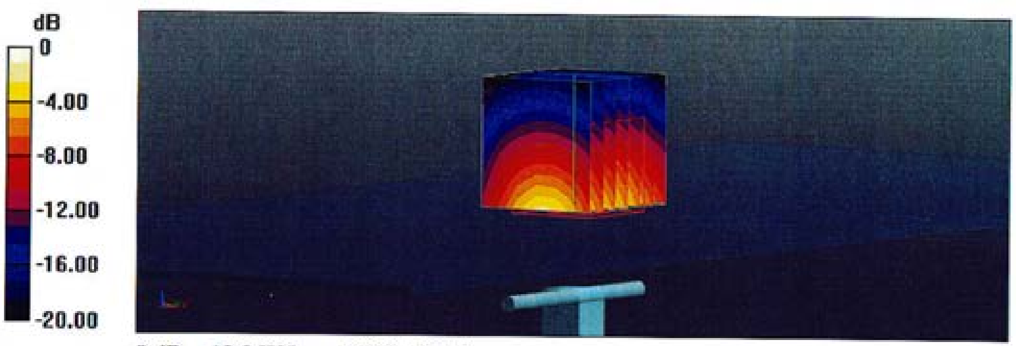
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 781

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.01 S/m; ε_r = 52.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.01, 8.01, 8.01); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

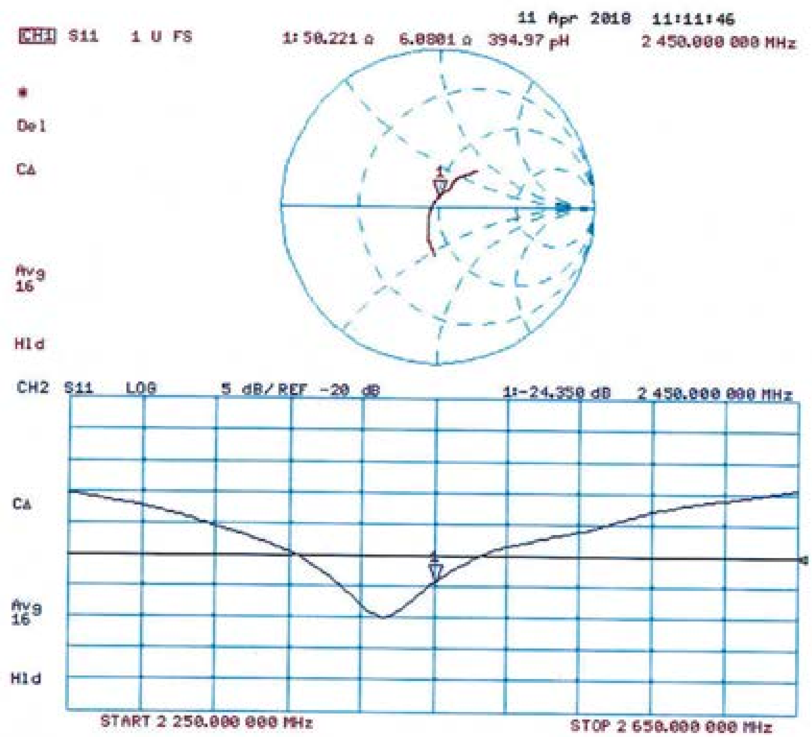
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 105.3 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 25.3 W/kg
SAR(1 g) = 12.8 W/kg; SAR(10 g) = 6.03 W/kg
Maximum value of SAR (measured) = 19.9 W/kg



0 dB = 19.9 W/kg = 12.99 dBW/kg

Certificate No: D2450V2-781_Apr18 Page 7 of 8

Impedance Measurement Plot for Body TSL



Certificate No: D2450V2-781_Apr18 Page 8 of 8

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Accreditation No.: **SCS 0108**

Client **Motorola Solutions MY**

Certificate No: **D2450V2-703_Oct18**

CALIBRATION CERTIFICATE

Object	D2450V2 - SN:703
Calibration procedure(s)	QA CAL-05.v10 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	October 16, 2018

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

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

	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	M.Weber
Approved by:	Katja Pokovic	Technical Manager	

Issued: October 16, 2018

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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, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

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

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.8 ± 6 %	1.85 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	13.5 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**52.9 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.24 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.6 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	51.2 ± 6 %	2.01 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	12.7 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**49.7 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.91 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.3 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.5 Ω + 2.9 jΩ
Return Loss	- 25.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.3 Ω + 6.1 jΩ
Return Loss	- 24.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.146 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	March 22, 2001

DASY5 Validation Report for Head TSL

Date: 16.10.2018

Test Laboratory: SPEAG, Zurich, Switzerland

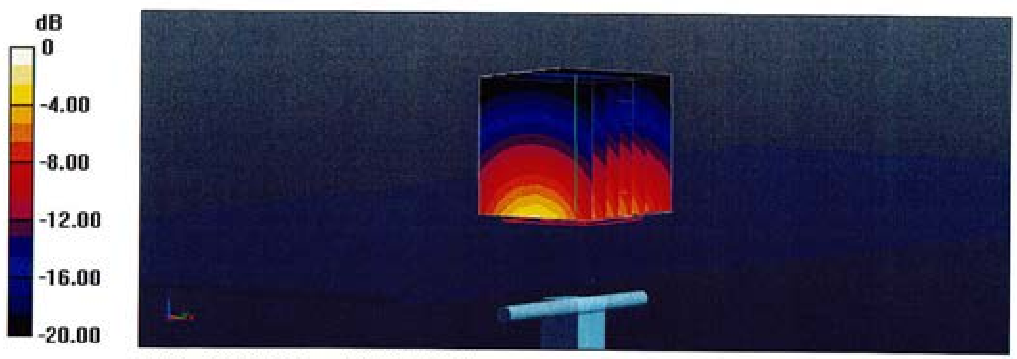
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:703

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.85 S/m; ε_r = 37.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

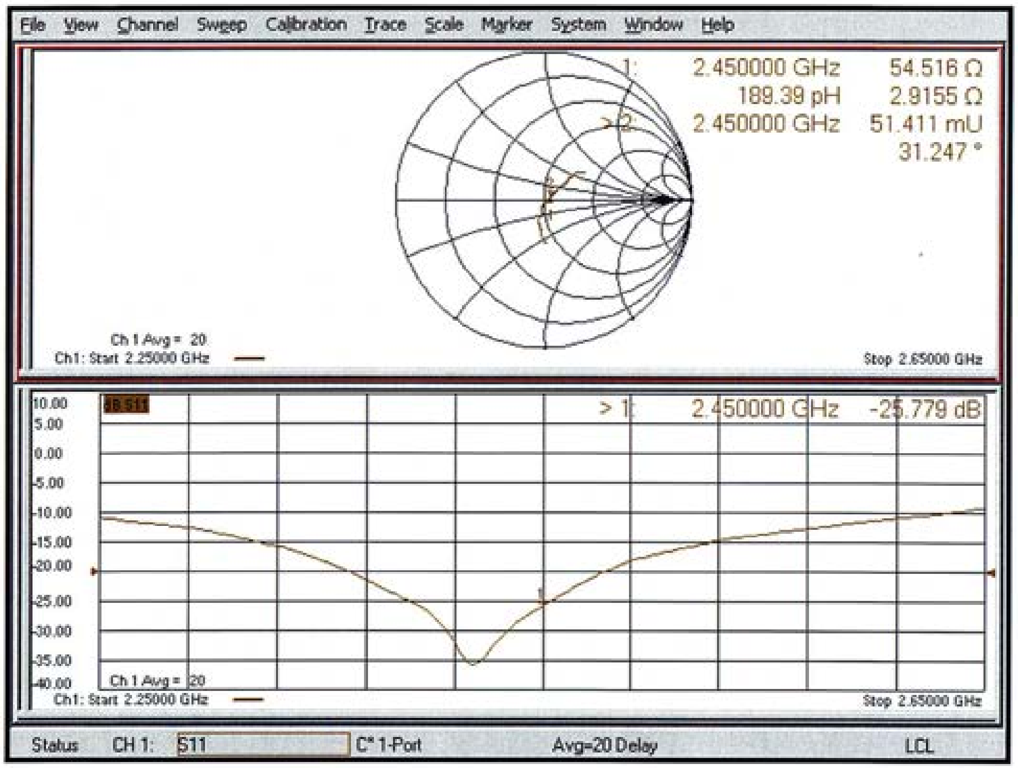
- Probe: EX3DV4 - SN7349; ConvF(7.88, 7.88, 7.88) @ 2450 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 117.8 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 27.1 W/kg
SAR(1 g) = 13.5 W/kg; SAR(10 g) = 6.24 W/kg
Maximum value of SAR (measured) = 22.3 W/kg



0 dB = 22.3 W/kg = 13.48 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 16.10.2018

Test Laboratory: SPEAG, Zurich, Switzerland

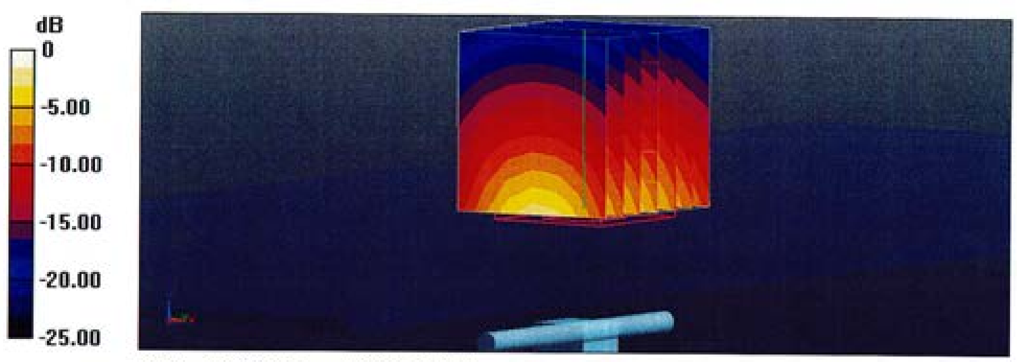
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:703

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.01 S/m; ε_r = 51.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 107.9 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 25.7 W/kg
SAR(1 g) = 12.7 W/kg; SAR(10 g) = 5.91 W/kg
Maximum value of SAR (measured) = 20.9 W/kg



0 dB = 20.9 W/kg = 13.20 dBW/kg

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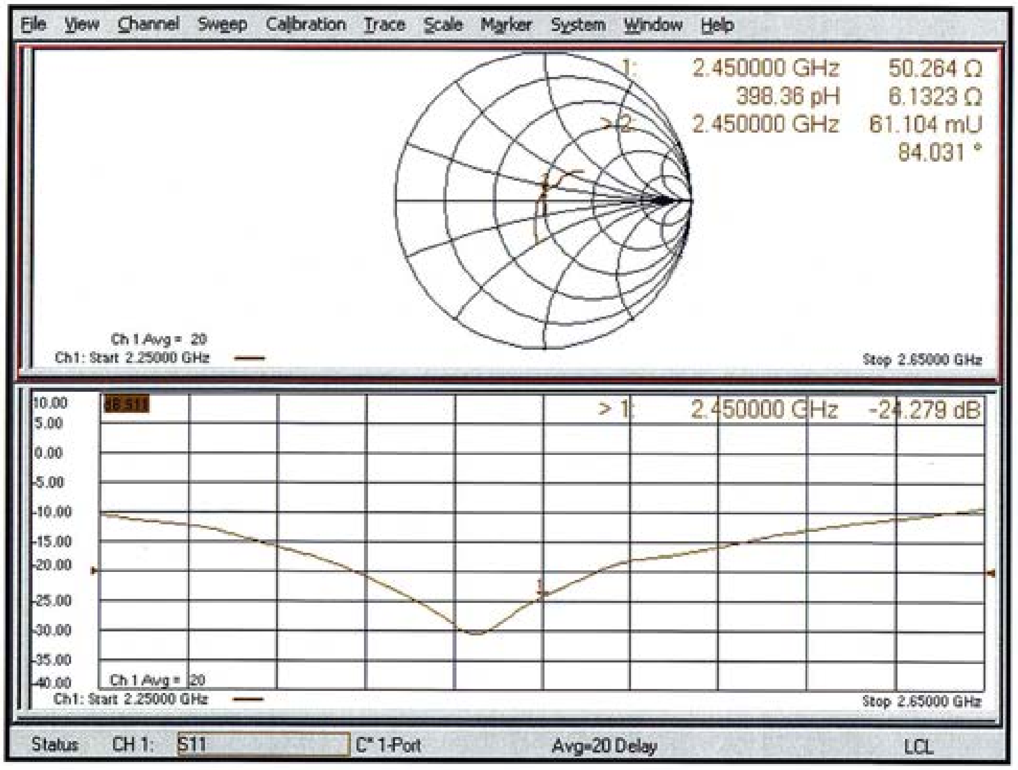
Impedance Measurement Plot for Body TSL



Dipole Data

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

Dipole 2450 (S/N:781 & 703) and CLA-150 (S/N:4005) had exceeded the annual calibration date thus the dipole impedance and return loss measurement data measured by Motorola Solutions' EME lab for all antennas are provided in the table below. The results meet the requirements stated in KDB 865664.

CLA-150 - 4005	Head			Body		
	Impedance		Return Loss	Impedance		Return Loss
Date Measured	real Ω	imag jΩ	dB	real Ω	imag jΩ	dB
02/26/2018	43.11	4.56	-21.01	46.25	-0.63	-28.16
02/09/2019	43.62	5.59	-20.87	46.18	-2.20	-26.77

Dipole 2450-781	Head			Body		
	Impedance		Return Loss	Impedance		Return Loss
Date Measured	real Ω	imag jΩ	dB	real Ω	imag jΩ	dB
05/24/2018	48.07	5.25	-24.89	49.10	4.53	-26.64
04/08/2019	52.92	4.26	-25.99	53.30	5.17	-24.53

Dipole 2450-703	Head			Body		
	Impedance		Return Loss	Impedance		Return Loss
Date Measured	real Ω	imag jΩ	dB	real Ω	imag jΩ	dB
12/20/2018	49.44	3.73	-28.42	48.61	5.62	-24.65
11/11/2019	51.11	3.82	-28.38	48.94	3.93	-28.04