

DECLARATION OF COMPLIANCE SAR ASSESSMENT Part 1 of 2

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Report Author: Tiong Nguk Ing (EME Engineer)
Date/s Tested: 9/23/2015- 9/28/2015,10/15/2015- 10/19/2015
Manufacturer: Motorola Solutions Inc.
DUT Description: Handheld Portable 450-527 MHz 3W ENG FKP WiFi GOB
Test TX mode(s): TDMA (PTT) , Bluetooth, WLAN 802.11 b/g/n
Max. Power output: 3.6 W (LMR 450-527 MHz band), 7.9 mW (Bluetooth), 22.4 mW (WLAN 802.11 b), 7.9 mW (WLAN 802.11g), 7.9 mW (WLAN 802.11n)
Nominal Power: 3.0 W (LMR 450-527 MHz band), 6.3 mW (Bluetooth), 17.8 mW (WLAN 802.11 b), 6.3 mW (WLAN 802.11g), 6.3 mW (WLAN 802.11n)
Tx Frequency Bands: LMR 450-527 MHz; Bluetooth 2.402-2.480 GHz; WLAN 802.11 b/g/n 2.412-2.484 GHz
Signaling type: TDMA (LMR), FHSS (Bluetooth), 802.11 b/g/n (WLAN)
Model(s) Tested: PMUE4402B
Model(s) Certified: PMUE4402B
Serial Number(s): 682TRT0041, 682TRT0043, 682TRT0045 & 682TRT0048
Classification: Occupational/Controlled
FCC ID: AZ489FT7073; LMR 450-512 MHz, Bluetooth 2.402-2.480 GHz, WLAN 802.11 b/g/n 2.412-2.462 GHz
IC: 109U-89FT7073; This report contains results that are immaterial for IC equipment approval, which are clearly identified.

The test results clearly demonstrate compliance with FCC Occupational/Controlled RF Exposure limits of 8 W/kg averaged over 1 gram per the requirements of OET Bulletin 65. The 10 grams result is not applicable to FCC filing. The test results clearly demonstrate compliance with ICNIRP (1998) Guidelines for limiting exposure in time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz), Health Physics 74, 494-522 RF Exposure limits of 10 W/kg averaged over 10grams of contiguous tissue.

Based on the information and the testing results provided herein, the undersigned certifies that when used as stated in the operating instructions supplied, said product complies with the national and international reference standards and guidelines listed in section 4.0 of this report. This report shall not be reproduced without written approval from an officially designated representative of the Motorola Solutions Inc EME Laboratory. I attest to the accuracy of the data and assume full responsibility for the completeness of these measurements. This reporting format is consistent with the suggested guidelines of the TIA TSB-150 December 2004. The results and statements contained in this report pertain only to the device(s) evaluated.

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| <p><i>Deanna Zakharia</i> Deanna Zakharia EME Lab Senior Resource Manager, Laboratory Director Approval Date: 1/5/2016</p> | <p>Certification Date: 11/9/2015 Certification No.: L1151088P</p> |
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Report Revision History

| Date | Revision | Comments |
|------------|----------|---|
| 11/09/2015 | A | Initial release |
| 12/29/2015 | B | Update BT/WLAN antenna gain from dBd to dBi |

1.0 Introduction

This report details the utilization, test setups, test equipments, and test results of the Specific Absorption Rate (SAR) measurements performed at the Motorola Solutions Inc. EME Test Laboratory for handheld portable model number PMUE4402B. 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 | 10g-SAR | 1g-SAR | 10g-SAR |
| TNF | 450-512 (LMR) | 1.23 | 0.90 | 0.95 | 0.69 |
| *DSS | 2402-2480 MHz (Bluetooth) | NA | NA | NA | NA |
| DTS | 2412-2483.5 MHz (WLAN 802.11 b/g/n) | 0.0200 | 0.0070 | 0.0893 | 0.0673 |
| **Simultaneous Results | | 1.25 | 0.91 | 1.04 | 0.76 |

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

3.0 Abbreviations / Definitions

BT: Bluetooth
 CNR: Calibration Not Required
 4FSK: 4 Level Frequency Shift Keying
 DSS: Direct Spread Spectrum
 DTS: Digital Transmission System
 DUT: Device Under Test
 EME: Electromagnetic Energy
 FHSS: Frequency Hopping Spread Spectrum
 Li-ion: Lithium-Ion
 LMR: Land Mobile Radio
 NA: Not Applicable
 OFDM: Orthogonal Frequency Division Multiplexing
 PTT: Push to Talk
 RF: Radio Frequency
 SAR: Specific Absorption Rate
 TDMA: Time Division Multiple Access
 TNF: Licensed Non-Broadcast Transmitter Held to Face
 WLAN: Wireless Local Area Network

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

Body worn accessories: These accessories allow the DUT to be worn on the body of the user.

Maximum Power: Defined as the upper limit of the production line final test station.

4.0 Referenced Standards and Guidelines

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

- IEC62209-1 (2005) Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)
- Federal Communications Commission, “Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields”, OET Bulletin 65, FCC, Washington, D.C.: 1997.
- IEEE 1528 (2003), 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 Radiocommunication 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 Devices Under Test (DUT)

This portable device operates in the LMR bands using 4-level frequency Shift Keying (4FSK) modulation and Time Division Multiple Access (TDMA). This device also contains WLAN technology for data capabilities over 802.11 b/g/n wireless networks and Bluetooth technology for short range wireless devices.

Time Division Multiple Access (TDMA) is used to allocate portions of the RF signal by dividing time into two slots. Time allocation enables each unit to transmit its voice information without interference from other transmitting units. Transmission from a unit or base station is accommodated during two time-slot lengths of 30 milliseconds with frame length of 60 milliseconds. The maximum duty cycle for TDMA 1:2 is 50%.

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

This device also incorporates a Bluetooth v4.0, which includes classis Bluetooth, Bluetooth high speed 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 = 77.01%.

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

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 | 450-527 | TDMA | *25 | 3.60 |
| BT | 2402-2480 | FHSS | 77.01 | 0.0079 |
| WLAN | 2412-2484 | 802.11b | 100 | 0.0224 |
| WLAN | 2412-2484 | 802.11g | 100 | 0.0079 |
| WLAN | 2412-2484 | 802.11n | 100 | 0.0079 |

Note - * includes 50% PTT operation

The intended operating positions are “at the face” with the DUT at least 2.5cm 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

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

7.1 Antennas

This device offered optional LMR integral antennas and one internal BT/WLAN antenna. The Table below lists their descriptions.

Table 4

| Antenna Models | Description | Selected for test | Tested |
|----------------|--|-------------------|--------------------|
| PMAE4077B | Stubby, 438-470 MHz, ¼ Wave, -1.5 dBi | Yes | Yes |
| PMAE4091A | Stubby, 450-490 MHz, ¼ Wave, -1.5 dBi | Yes | Yes |
| PMAE4092A | Stubby, 480-527 MHz, ¼ Wave, -1.5 dBi | Yes | Yes |
| PMLE5102A | Internal BT/WLAN, 2400-2500 MHz, ¼ Wave, 0.5 dBi | Yes | Yes; for WLAN only |

7.2 Batteries

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

Table 5

| Battery Models | Description | Selected for test | Tested | Comments |
|----------------|------------------------------------|-------------------|--------|--|
| HKNN4013A | BT90 Battery pack, Li-ion 1800 mAh | Yes | Yes | Default battery for body testing |
| PMNN4468A | BT100X Li-ion 2300 mAh | Yes | Yes | Default battery for face testing; Not able to support body worn PMLN5956B with radio face out. |

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 Models | Description | Selected for test | Tested | Comments |
|------------------|---|-------------------|--------|--|
| PMLN6074A | Wrist Strap | No | No | For convenient carry DUT purpose only. No PTT operation with this wrist strap. |
| PMLN7040A | Soft Leather Carry Case with 1.5 inch Swivel clip | Yes | Yes | |
| PMLN5956B | Carry Holder | Yes | Yes | Allow DUT face in or face out. Not able to support battery PMNN4468A for radio face out. |

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 Acc. Models | Description | Selected for test | Tested | Comments |
|-------------------|---|-------------------|--------|---|
| PMLN5958B | Swivel Earpiece, In-Line Microphone & PTT | Yes | Yes | Default audio |
| PMLN5957B | Surveillance Earpiece with in-line microphone and PTT | Yes | No | SAR \leq 4.0 W/kg, test not require as per KDB 643646 D01 |
| PMLN7158A | 1-Wire Surveillance Kit with in-line microphone and push-to-talk, black | Yes | No | SAR \leq 4.0 W/kg, test not require as per KDB 643646 D01 |
| PMLN7189A | Swivel Earpiece With In-Line Microphone And Push-To-Talk | Yes | No | SAR \leq 4.0 W/kg, test not require as per KDB 643646 D01 |
| PMLN7157A | 2-Wire Surveillance Kit With Translucent Tube, Black | Yes | No | SAR \leq 4.0 W/kg, test not require as per KDB 643646 D01 |
| PMLN7159A | Adjustable D-style earpiece with in-line microphone and push-to-talk, black | Yes | No | SAR \leq 4.0 W/kg, test not require as per KDB 643646 D01 |
| PMLN7156A | Mag One Earbud with in-line microphone and push-to-talk | Yes | No | SAR \leq 4.0 W/kg, test not require as per KDB 643646 D01 |

8.0 Description of Test System



8.1 Descriptions of Robotics/Probes/Readout Electronics

Table 8

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

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

8.2 Description of Phantom(s)

Table 9

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

8.3 Description of Simulated Tissue

The sugar based simulate tissue is produced by placing the correct measured amount of De-ionized water into a large container. Each of the dried ingredients are weighed and added to the water carefully to avoid clumping. If the solution has a high sugar concentration the water is pre-heated to aid in dissolving the ingredients. For Diacetin and similar type simulates, sugar and HEC ingredients are not needed. The solution is mixed thoroughly, covered, and allowed to sit overnight prior to use.

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

Simulated Tissue Composition (percent by mass)

Table 10

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

9.0 Additional Test Equipment

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

Table 11

| Equipment Type | Model Number | Serial Number | Calibration Date | Calibration Due Date |
|------------------------------|--------------|---------------|------------------|----------------------|
| Speag Probe | EX3DV4 | 3568 | 2/27/2015 | 2/27/2016 |
| Speag Probe | EX3DV4 | 7364 | 6/23/2015 | 6/23/2016 |
| Speag DAE | DAE4 | 688 | 2/23/2015 | 2/23/2016 |
| Speag DAE | DAE4 | 684 | 11/5/2014 | 11/5/2015 |
| Signal Generator | E4438C | MY45091270 | 7/9/2014 | 7/9/2016 |
| Power Meter | E4418B | MY45101014 | 10/21/2014 | 10/21/2015 |
| Power Sensor | 8481B | MY41091170 | 10/25/2014 | 10/25/2015 |
| Power Meter | E4418B | MY45100739 | 5/29/2015 | 5/29/2017 |
| Power Sensor | 8481B | MY41091243 | 6/3/2015 | 6/3/2016 |
| Bi-directional Coupler | 3020A | 41931 | 7/6/2015 | 7/6/2016 |
| Bi-directional Coupler | 3022 | 81639 | 7/6/2015 | 7/6/2016 |
| Amplifier | 10W1000C | 312858 | CNR | CNR |
| Amplifier | 5S1G4 | 313326 | CNR | CNR |
| Power Meter | E4416A | MY50001037 | 2/16/2015 | 2/16/2016 |
| Power Sensor | N8481B | MY51450002 | 2/23/2015 | 2/23/2016 |
| Broadband Power Sensor | NRP-Z11 | 120907 | 2/11/2015 | 2/11/2016 |
| Thermometer | HH806AU | 080307 | 11/12/2014 | 11/12/2015 |
| Thermometer | DTM3000 | 3257 | 8/28/2015 | 8/28/2016 |
| Dickson Temperature Recorder | TM320 | 12253047 | 11/11/2014 | 11/11/2015 |
| Temperature Probe | 80PK-25 | 080428.01 | 7/22/2015 | 7/22/2016 |
| Dielectric Assessment Kit | DAK-12 | 1069 | 5/12/2015 | 5/12/2016 |
| Network Analyzer | E5071B | MY42403218 | 8/4/2015 | 8/4/2016 |
| Speag Dipole | D450V3 | 1053 | 3/17/2015 | 3/17/2017 |
| Speag Dipole | D2450V2 | 781 | 3/20/2015 | 3/20/2017 |

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 |
| Signaling | | | | | | | | |
| 04/06/2015 | Body | 450 | 3568 | 0.95 | 54.2 | Pass | Pass | Pass |
| 04/29/2015 | Head | 450 | | 0.88 | 44.6 | Pass | Pass | Pass |
| CW | | | | | | | | |
| 07/15/2015 | Body | 2450 | 7364 | 1.86 | 48.9 | Pass | Pass | Pass |
| 07/15/2015 | Head | 2450 | | 1.77 | 36.4 | 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 |
|----------------|----------------|-----------------------|---------------------|--------------------------------------|--|-------------|
| 3568 | FCC Body | SPEAG D450V3 / 1053 | 4.41 +/- 10% | 1.19 | 4.76 | 9/23/2015 |
| | IIEEE/IEC Head | | | 1.16 | 4.64 | 9/25/2015 |
| | IIEEE/IEC Head | | 4.45 +/- 10% | 1.11 | 4.44 | 9/28/2015 |
| 7364 | FCC Body | SPEAG D2450V2 / 781 | 51.90 +/- 10% | 12.70 | 50.80 | 10/16/2015 |
| | IIEEE/IEC Head | | 52.30 +/- 10% | 13.50 | 54.00 | 10/19/2015 |

10.3 Equivalent Tissue Test Results

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

Table 14

| Frequency (MHz) | Tissue Type | Conductivity Target (S/m) | Dielectric Constant Target | Conductivity Meas. (S/m) | Dielectric Constant Meas. | Tested Date |
|-----------------|---------------|---------------------------|----------------------------|--------------------------|---------------------------|-------------|
| 450 | FCC Body | 0.94 (0.89-0.99) | 56.7 (53.9-59.5) | 0.90 | 55.70 | 9/23/2015 |
| | | | | 0.90 | 55.40 | 9/25/2015 |
| 450 | IEEE/IEC Head | 0.87 (0.83-0.91) | 43.5 (41.3-45.7) | 0.85 | 43.70 | 9/28/2015 |
| 460 | FCC Body | 0.94 (0.89-0.99) | 56.7 (53.8-59.5) | 0.91 | 55.50 | 9/23/2015 |
| | | | | 0.91 | 55.30 | 9/25/2015 |
| 480 | IEEE/IEC Head | 0.87 (0.83-0.92) | 43.3 (41.2-45.5) | 0.88 | 43.10 | 9/28/2015 |
| 496 | FCC Body | 0.94 (0.9-0.99) | 56.5 (53.7-59.3) | 0.94 | 55.00 | 9/23/2015 |
| | | | | 0.94 | 54.70 | 9/25/2015 |
| 520 | FCC Body | 0.95 (0.9-0.99) | 56.4 (53.6-59.2) | 0.96 | 54.40 | 9/25/2015 |
| 520 | IEEE/IEC Head | 0.87 (0.83-0.92) | 43.1 (41-45.3) | 0.91 | 42.40 | 9/28/2015 |
| 527 | FCC Body | 0.95 (0.9-0.99) | 56.4 (53.6-59.2) | 0.96 | 54.30 | 9/25/2015 |
| 527 | IEEE/IEC Head | 0.88 (0.83-0.92) | 43.1 (40.9-45.2) | 0.92 | 42.30 | 9/28/2015 |
| 2412 | FCC Body | 1.91 (1.82-2.01) | 52.8 (47.5-58) | 1.95 | 47.8 | 10/16/2015 |
| 2412 | IEEE/IEC Head | 1.77 (1.68-1.86) | 39.3 (35.3-43.2) | 1.84 | 35.7 | 10/19/2015 |
| 2450 | FCC Body | 1.95 (1.85-2.05) | 52.7 (47.4-58) | 2.00 | 47.70 | 10/16/2015 |
| 2450 | IEEE/IEC Head | 1.80 (1.71-1.89) | 39.2 (35.3-43.1) | 1.88 | 35.50 | 10/19/2015 |

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: 19.9 – 23.3°C Avg. 21.5 °C |
| Tissue Temperature | NA | Range: 19.2 -20.6°C Avg. 20.0°C |

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

12.0 DUT Test Setup and Methodology

12.1 Measurements

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

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

Table 16

| Description | | ≤ 3 GHz | > 3 GHz |
|---|------------------------------------|---|---|
| Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface | | 5 ± 1 mm | $\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm |
| Maximum probe angle from probe axis to phantom surface normal at the measurement location | | 30° ± 1° | 20° ± 1° |
| Maximum area scan spatial resolution: Δx_{Area} , Δy_{Area} | | ≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm | 3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm |
| | | When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device. | |
| Maximum zoom scan spatial resolution: Δx_{Zoom} , Δy_{Zoom} | | ≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm* | 3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm* |
| Maximum zoom scan spatial resolution, normal to phantom surface | uniform grid: $\Delta z_{Zoom}(n)$ | ≤ 5 mm | 3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm |
| Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details. | | | |
| * When zoom scan is required and the reported SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz. | | | |

12.2 DUT Configuration(s)

The DUT is a portable device operational at the body 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 sides separated 2.5cm from the phantom.

12.4 DUT Test Channels

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

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

Where

N_c = Number of channels

F_{high} = Upper channel

F_{low} = Lower channel

F_c = Center channel

12.5 SAR Result Scaling Methodology

The calculated 1-gram and 10-gram averaged SAR results indicated as “Max Calc. 1g-SAR” and “Max Calc.10g-SAR” in the data Tables is determined by scaling the measured SAR to account for power leveling variations and drift. Appendix F includes a shortened scan to justify SAR scaling for drift. For this device the “Max Calc. 1g-SAR” and “Max Calc.10g-SAR” are scaled using the following formula:

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

P_{max} = Maximum Power (W)

P_{int} = Initial Power (W)

Drift = DASY drift results (dB)

SAR_meas = Measured 1-g or 10-g Avg. SAR (W/kg)

DC = Transmission mode duty cycle in % where applicable

50% duty cycle is applied for PTT operation

Note: for conservative results, the following are applied:

If $P_{\text{int}} > P_{\text{max}}$, then $P_{\text{max}}/P_{\text{int}} = 1$.

Drift = 1 for positive drift

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

12.6 DUT Test Plan

The guidelines and requirements outlined in section 4.0 were used to assess compliance of this device. All modes of operation identified in section 6.0 were considered during the development of the test plan. All tests were performed in TDMA and 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 99.87% with results scaled to 100% as per guidelines of KDB 248227.

13.0 DUT Test Data

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

Battery HKNN4013A was selected as the default battery for assessments at the Body because it is the thinnest battery (refer to Exhibit 7B for battery illustration). The default battery was used during conducted power measurements for all test channels within FCC allocated frequency range (450-512 MHz) 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) |
|---|-----------|
| Serial Number 682TRT0041 w/antenna PMAE4077B (438-470 MHz) | |
| 450 | 3.60 |
| 460 | 3.60 |
| 470 | 3.60 |
| Serial Number 682TRT0043 w/antenna PMAE4091A (450-490 MHz) | |
| 450 | 3.58 |
| 460 | 3.59 |
| 470 | 3.58 |
| 490 | 3.57 |
| Serial Number 682TRT0048 w/antenna PMAE4092A (480-527 MHz) | |
| 480 | 3.59 |
| 496 | 3.60 |
| 512 | 3.58 |

Assessments at the Body with Body worn PMLN5956B w/ DUT face out
 DUT assessment with offered antenna, default battery and, default body worn accessory per KDB 643646. No optional battery offered for this body worn configuration. 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) | Meas. 10g-SAR (W/kg) | Max Calc. 1g-SAR (W/kg) | Max Calc. 10g-SAR (W/kg) | Run# |
|-----------|-----------|---------------------------|-----------------|-----------------|--------------|----------------|---------------------|----------------------|-------------------------|--------------------------|------------------|
| PMAE4077B | HKNN4013A | PMLN5956B w/ DUT face out | PMLN5958B | 450.000 | 3.60 | -0.35 | 1.18 | 0.86 | 0.64 | 0.46 | TLC-AB-150923-14 |
| | | | | 460.000 | | | | | | | |
| | | | | 470.000 | | | | | | | |
| PMAE4091A | HKNN4013A | PMLN5956B w/ DUT face out | PMLN5958B | 450.000 | | | | | | | |
| | | | | 460.000 | 3.60 | -0.37 | 1.98 | 1.43 | 1.08 | 0.78 | TLC-AB-150923-15 |
| | | | | 470.000 | | | | | | | |
| | | | | 490.000 | | | | | | | |
| PMAE4092A | HKNN4013A | PMLN5956B w/ DUT face out | PMLN5958B | 480.000 | | | | | | | |
| | | | | 496.000 | 3.60 | -0.54 | 1.81 | 1.32 | 1.02 | 0.75 | TLC-AB-150925-02 |
| | | | | 512.000 | | | | | | | |

Assessments at the Body with Body worn PMLN5956B w/ DUT face in
 DUT assessment with offered antenna, default battery and, optional body worn accessory per KDB 643646. Optional battery was 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) | Meas. 10g-SAR (W/kg) | Max Calc. 1g-SAR (W/kg) | Max Calc. 10g-SAR (W/kg) | Run# |
|----------------------------------|-----------|--------------------------|-----------------|-----------------|--------------|----------------|---------------------|----------------------|-------------------------|--------------------------|------------------|
| PMAE4077B | HKNN4013A | PMLN5956B w/ DUT face in | PMLN5958B | 450.000 | 3.60 | -0.27 | 0.78 | 0.56 | 0.41 | 0.30 | TLC-AB-150923-08 |
| | | | | 460.000 | | | | | | | |
| | | | | 470.000 | | | | | | | |
| PMAE4091A | HKNN4013A | PMLN5956B w/ DUT face in | PMLN5958B | 450.000 | | | | | | | |
| | | | | 460.000 | 3.60 | -0.11 | 1.79 | 1.31 | 0.92 | 0.67 | TLC-AB-150923-09 |
| | | | | 470.000 | | | | | | | |
| | | | | 490.000 | | | | | | | |
| PMAE4092A | HKNN4013A | PMLN5956B w/ DUT face in | PMLN5958B | 480.000 | | | | | | | |
| | | | | 496.000 | 3.60 | -0.36 | 1.59 | 1.17 | 0.86 | 0.64 | TLC-AB-150923-12 |
| | | | | 512.000 | | | | | | | |
| Assessment of Additional Battery | | | | | | | | | | | |
| PMAE4091A | PMNN4468A | PMLN5956B w/ DUT face in | PMLN5958B | 450.000 | | | | | | | |
| | | | | 460.000 | 3.60 | -0.18 | 1.84 | 1.34 | 0.96 | 0.70 | TLC-AB-150923-13 |
| | | | | 470.000 | | | | | | | |
| | | | | 490.000 | | | | | | | |

Assessments at the Body with Body worn PMLN7040A

DUT assessment with offered antenna, default battery and, optional body worn accessory per KDB 643646. Optional battery was 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) | Meas. 10g-SAR (W/kg) | Max Calc. 1g-SAR (W/kg) | Max Calc. 10g-SAR (W/kg) | Run# |
|----------------------------------|-----------|-----------------|-----------------|-----------------|--------------|----------------|---------------------|----------------------|-------------------------|--------------------------|------------------|
| PMAE4077B | HKNN4013A | PMLN7040A | PMLN5958B | 450.000 | 3.60 | -0.41 | 1.24 | 0.92 | 0.68 | 0.50 | FIE-AB-150923-02 |
| | | | | 460.000 | | | | | | | |
| | | | | 470.000 | | | | | | | |
| PMAE4091A | HKNN4013A | PMLN7040A | PMLN5958B | 450.000 | | | | | | | |
| | | | | 460.000 | 3.60 | -0.37 | 1.73 | 1.28 | 0.94 | 0.70 | FIE-AB-150923-03 |
| | | | | 470.000 | | | | | | | |
| | | | | 490.000 | | | | | | | |
| PMAE4092A | HKNN4013A | PMLN7040A | PMLN5958B | 480.000 | | | | | | | |
| | | | | 496.000 | 3.60 | -0.38 | 1.62 | 1.20 | 0.88 | 0.65 | TLC-AB-150923-10 |
| | | | | 512.000 | | | | | | | |
| Assessment of Additional Battery | | | | | | | | | | | |
| PMAE4091A | PMNN4468A | PMLN7040A | PMLN5958B | 450.000 | | | | | | | |
| | | | | 460.000 | 3.60 | -0.35 | 1.90 | 1.41 | 1.03 | 0.76 | TLC-AB-150923-11 |
| | | | | 470.000 | | | | | | | |
| | | | | 490.000 | | | | | | | |

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 21

| Antenna | Battery | Carry Accessory | Cable Accessory | Test Freq (MHz) | Init Pwr (W) | SAR Drift (dB) | Meas. 1g-SAR (W/kg) | Meas. 10g-SAR (W/kg) | Max Calc. 1g-SAR (W/kg) | Max Calc. 10g-SAR (W/kg) | Run# |
|-----------|-----------|--------------------------|-----------------|-----------------|--------------|----------------|---------------------|----------------------|-------------------------|--------------------------|------------------|
| PMAE4091A | HKNN4013A | PMLN5956B w/DUT face out | None | 450.000 | | | | | | | |
| | | | | 460.000 | 3.60 | -0.45 | 2.19 | 1.60 | 1.21 | 0.89 | TLC-AB-150925-04 |
| | | | | 470.000 | | | | | | | |
| | | | | 490.000 | | | | | | | |

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

The tables below represent the output power measurements for WLAN 2.4 GHz 802.11b/g/n for assessments at the Body using battery HKNN4013A because it is the thinnest battery (refer to Exhibit 7B for battery illustration). These power measurements were used to determine the necessary modes for SAR testing according to KDB 248227 D01 SAR Measurement Procedures for 802.11a/b/g/Transmitters.

The battery was used during conducted power measurements for all test channels within FCC allocated frequency range (2.412-2.462 GHz) which are listed in Table 22. 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 22

| Mode | Channel # | Channel Frequency | Modulation | Battery: HKNN4013A | Antenna Max Power [mW] |
|-----------------|-----------|-------------------|------------|--------------------|------------------------|
| | | | | Antenna port[mW] | |
| 802.11b (1Mbps) | 1 | 2412 | DSSS | 17.36 | 22.40 |
| | 6 | 2437 | | 15.82 | |
| | 11 | 2462 | | 15.79 | |
| 802.11g (6Mbps) | 1 | 2412 | OFDM | 6.56 | 7.90 |
| | 6 | 2437 | | 5.98 | |
| | 11 | 2462 | | 5.31 | |
| 802.11n (MCS0) | 1 | 2412 | OFDM | 6.61 | 7.90 |
| | 6 | 2437 | | 6.01 | |
| | 11 | 2462 | | 5.28 | |

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 22 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) | Meas. 10g-SAR (W/kg) | Max Calc. 1g-SAR (W/kg) | Max Calc. 10g-SAR (W/kg) | Run# |
|--|-----------|---------------------------------|-----------------|-----------------|--------------|----------------|---------------------|----------------------|-------------------------|--------------------------|------------------|
| PMLE5102A WLAN Internal Antenna | HKNN4013A | PMLN5956B w/ DUT face out | None | 2412.000 | 0.0173 | -0.55 | 0.010 | 0.005 | 0.0143 | 0.0077 | KKL-AB-151016-02 |
| | | PMLN5956B w/ DUT face in | | 2412.000 | 0.0173 | 0.03 | 0.0017 | 0.0003 | 0.0022 | 0.0003 | KKL-AB-151016-03 |
| | | PMLN7040A | | 2412.000 | 0.0173 | -0.75 | 0.013 | 0.005 | 0.0200 | 0.0070 | TLC-AB-151016-04 |
| Assessment of Additional Battery | | | | | | | | | | | |
| PMLE5102A WLAN Internal Antenna | PMNN4468A | PMLN7040A | None | 2412.000 | 0.0171 | 0.18 | 0.000031 | 0.000003 | 0.000040 | 0.000004 | TLC-AB-151016-06 |

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

Battery PMNN4468A was selected as the default battery for assessments at the Face because it has the highest capacity (refer to Exhibit 7B for battery illustration). The default battery was used during conducted power measurements for all test channels within FCC allocated frequency range (450-512 MHz) which are listed in Table 24. 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 24

| Test Freq (MHz) | Power (W) |
|---|------------------|
| Serial Number 682TRT0041 w/antenna PMAE4077B (438-470 MHz) | |
| 450 | 3.57 |
| 460 | 3.57 |
| 470 | 3.56 |
| Serial Number 682TRT0043 w/antenna PMAE4091A (450-490 MHz) | |
| 450 | 3.58 |
| 460 | 3.56 |
| 470 | 3.56 |
| 490 | 3.52 |
| Serial Number 682TRT0048 w/antenna PMAE4092A (480-527 MHz) | |
| 480 | 3.56 |
| 496 | 3.56 |
| 512 | 3.55 |

DUT assessment with offered antenna, default battery with front of DUT positioned 2.5cm facing phantom per KDB 643646. Optional battery was tested per the requirements of KDB 643646. Refer to Table 24 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) | Meas. 10g-SAR (W/kg) | Max Calc. 1g-SAR (W/kg) | Max Calc. 10g-SAR (W/kg) | Run# |
|----------------------------------|-----------|-----------------|-----------------|-----------------|--------------|----------------|---------------------|----------------------|-------------------------|--------------------------|--------------------|
| PMAE4077B | PMNN4468A | None | None | 450.000 | 3.58 | -0.23 | 1.24 | 0.90 | 0.66 | 0.48 | TLC-FACE-150928-02 |
| | | | | 460.000 | | | | | | | |
| | | | | 470.000 | | | | | | | |
| PMAE4091A | PMNN4468A | None | None | 450.000 | 3.54 | -0.25 | 1.58 | 1.15 | 0.85 | 0.62 | TLC-FACE-150928-03 |
| | | | | 460.000 | | | | | | | |
| | | | | 470.000 | | | | | | | |
| | | | | 490.000 | | | | | | | |
| PMAE4092A | PMNN4468A | None | None | 480.000 | 3.48 | -0.12 | 1.79 | 1.30 | 0.952 | 0.691 | TLC-FACE-150928-04 |
| | | | | 496.000 | | | | | | | |
| | | | | 512.000 | | | | | | | |
| Assessment of Additional Battery | | | | | | | | | | | |
| PMAE4092A | HKNN4013A | None | None | 480.000 | 3.48 | -0.24 | 1.74 | 1.26 | 0.951 | 0.689 | TLC-FACE-150928-05 |
| | | | | 496.000 | | | | | | | |
| | | | | 512.000 | | | | | | | |

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 PMNN4468A 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 802.11a/b/g/Transmitters.

The battery was used during conducted power measurements for all test channels within FCC allocated frequency range (2.412-2.462GHz) which are listed in Table 26. The channel with the highest conducted power will be identified as the default channel per KDB 643646 (SAR Test for PTT Radios). SAR plots of the highest results per Table (bolded) are presented in Appendix 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 $\leq 1.2W/kg$.

Table 26

| Mode | Channel # | Channel Frequency | Modulation | Battery: PMNN4468A | Antenna Max Power [mW] |
|-----------------|-----------|-------------------|------------|--------------------|------------------------|
| | | | | Antenna port[mW] | |
| 802.11b (1Mbps) | 1 | 2412 | DSSS | 17.08 | 22.4 |
| | 6 | 2437 | | 15.56 | |
| | 11 | 2462 | | 15.45 | |
| 802.11g (6Mbps) | 1 | 2412 | OFDM | 6.53 | 7.90 |
| | 6 | 2437 | | 5.98 | |
| | 11 | 2462 | | 5.29 | |
| 802.11n (MCS0) | 1 | 2412 | OFDM | 6.56 | 7.90 |
| | 6 | 2437 | | 5.92 | |
| | 11 | 2462 | | 5.26 | |

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 2.5 cm from phantom. Refer to Table 26 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) | Meas. 10g-SAR (W/kg) | Max Calc. 1g-SAR (W/kg) | Max Calc. 10g-SAR (W/kg) | Run# |
|--|-----------|-----------------|-----------------|-----------------|--------------|----------------|---------------------|----------------------|-------------------------|--------------------------|--------------------|
| PMLE5102A WLAN Internal Antenna | PMNN4468A | None | None | 2412.000 | 0.0171 | 2.16 | 0.0390 | 0.0250 | 0.0513 | 0.0329 | TLC-FACE-151019-06 |
| Assessment of Additional Battery | | | | | | | | | | | |
| PMLE5102A WLAN Internal Antenna | HKNN4013A | None | None | 2412.000 | 0.0173 | 1.11 | 0.0690 | 0.0520 | 0.0893 | 0.0673 | TLC-FACE-151019-08 |

13.5 Assessment for Industry Canada

Based on the assessment results for body and face per KDB643646, additional tests were not required for Industry Canada frequency range (450-470 MHz) as testing performed is in compliance with Industry Canada frequency range.

13.6 Assessment at the Bluetooth band

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

$$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] * [\sqrt{F_{(\text{GHz})}}] = 1.92 \text{ W/kg, which is } \leq 3 \text{ W/kg (1g)}$$

Where:

Max. Power = 6.08mW (7.9mW*77.01% duty cycle)

Min. test separation distance = 5mm for actual test separation < 5mm

F (GHz) = 2.48 GHz

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

13.7 Assessment outside FCC Part 90

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

Table 28

| Antenna | Battery | Carry Accessory | Cable Accessory | Test Freq (MHz) | Init Pwr (W) | SAR Drift (dB) | Meas. 1g-SAR (W/kg) | Meas. 10g-SAR (W/kg) | Max Calc. 1g-SAR (W/kg) | Max Calc. 10g-SAR (W/kg) | Run# |
|-------------|-----------|--------------------------|-----------------|-----------------|--------------|----------------|---------------------|----------------------|-------------------------|--------------------------|--------------------|
| Body | | | | | | | | | | | |
| PMAE4092A | HKNN4013A | PMLN5956B w/DUT face Out | None | 519.500 | 3.57 | -0.73 | 1.35 | 0.99 | 0.81 | 0.59 | TLC-AB-150925-05 |
| | | | | 527.000 | 3.57 | -0.63 | 1.47 | 1.06 | 0.86 | 0.62 | TLC-AB-150925-06 |
| Face | | | | | | | | | | | |
| PMAE4092A | PMNN4468A | None | None | 519.500 | 3.58 | -0.43 | 1.39 | 1.00 | 0.77 | 0.56 | TLC-FACE-150928-07 |
| | | | | 527.000 | 3.53 | -0.22 | 1.52 | 1.09 | 0.82 | 0.58 | FIE-FACE-150928-08 |

13.8 Shortened Scan Assessment

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

Table 29

| Antenna | Battery | Carry Accessory | Cable Accessory | Test Freq (MHz) | Init Pwr (W) | SAR Drift (dB) | Meas. 1g-SAR (W/kg) | Meas. 10g-SAR (W/kg) | Max Calc. 1g-SAR (W/kg) | Max Calc. 10g-SAR (W/kg) | Run# |
|-----------|-----------|--------------------------|-----------------|-----------------|--------------|----------------|---------------------|----------------------|-------------------------|--------------------------|------------------|
| PMAE4091A | HKNN4013A | PMLN5956B w/DUT face Out | None | 460.0000 | 3.60 | -0.23 | 2.33 | 1.70 | 1.23 | 0.90 | TLC-AB-150925-07 |

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 $\leq 50\text{mm}$:

$$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] * [\sqrt{F(\text{GHz})}/X] = 0.26 \text{ W/kg, which is } \leq 0.4 \text{ W/kg (1g)}$$

Where:

$$X = 7.5 \text{ for 1g-SAR; } 18.75 \text{ for 10g}$$

$$\text{Max. Power} = 6.08\text{mW (7.9mW*77.01\% duty cycle)}$$

$$\text{Min. test separation distance} = 5\text{mm for actual test separation} < 5\text{mm}$$

$$F(\text{GHz}) = 2.48 \text{ GHz}$$

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, WLAN and BT

This device uses a single transmitter module and antenna for both WLAN and BT. WLAN and BT cannot transmit simultaneously. Simultaneous transmission for BT had been excluded as mentioned in section 14.0. The maximum sourced-based-time-averaged output power for 802.11 b is 22.4 mW while BT is 6.08mW. 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 30

| | | LMR Bands |
|------------------|--------------------|------------------|
| | Freq. (MHz) | 450-512 MHz |
| WLAN Band | 2412 - 2484 | √ |

16.0 Results Summary

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

Table 31

| Technologies | Frequency band (MHz) | Max Calc at Body (W/kg) | | Max Calc at Face (W/kg) | |
|------------------------|-----------------------------|--------------------------------|----------------|--------------------------------|----------------|
| | | 1g-SAR | 10g-SAR | 1g-SAR | 10g-SAR |
| FCC | | | | | |
| LMR | 450-512 | 1.23 | 0.90 | 0.95 | 0.69 |
| WLAN | 2412-2483.5 | 0.0200 | 0.0070 | 0.0893 | 0.0673 |
| Industry Canada | | | | | |
| LMR | 450-470 | 1.23 | 0.90 | 0.85 | 0.62 |
| WLAN | 2412-2483.5 | 0.0200 | 0.0070 | 0.0893 | 0.0673 |
| Overall | | | | | |
| LMR | 450-527 | 1.23 | 0.90 | 0.95 | 0.69 |
| WLAN | 2412-2484 | 0.0200 | 0.0070 | 0.0893 | 0.0673 |

All results are scaled to the maximum output power.

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

Table 32

| Designator | Frequency bands | Combined 1g-SAR (W/kg) | Combined 10g-SAR (W/kg) |
|-------------------|----------------------------------|---------------------------------------|--|
| Body | | | |
| FCC | LMR (450-512 MHz) and WLAN band | 1.25 | 0.91 |
| IC | LMR (450-470 MHz) and WLAN band | 1.25 | 0.91 |
| Overall | LMR (450-527 MHz) and WLAN band | 1.25 | 0.91 |
| Face | | | |
| FCC | LMR (450-512 MHz) and WLAN band | 1.04 | 0.76 |
| IC | LMR (450-470 MHz) and WLAN band | 0.94 | 0.69 |
| Overall | LMR (450-527 MHz) and WLAN band | 1.04 | 0.76 |

The test results clearly demonstrate compliance with FCC Occupational/Controlled RF Exposure limits of 8 W/kg averaged over 1 gram per the requirements of OET Bulletin 65. The 10 grams result is not applicable to FCC filing.

17.0 Variability Assessment

Per the guidelines in KDB 865664 SAR variability assessment is 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 Occupational exposure is less than 7.5W/kg.

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

Appendix A Measurement Uncertainty Budget

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

| <i>a</i> | <i>b</i> | <i>c</i> | <i>d</i> | <i>e = f(d,k)</i> | <i>f</i> | <i>g</i> | <i>h = c x f / e</i> | <i>i = c x g / e</i> | <i>k</i> |
|--|-------------------|------------|-----------|-----------------------|----------|-----------|------------------------------|------------------------------|----------|
| Uncertainty Component | IEEE 1528 section | Tol. (± %) | Prob Dist | Div. | ci (1 g) | ci (10 g) | 1 g u_i (±%) | 10 g u_i (±%) | ν_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) ν_i - degrees of freedom for standard uncertainty and effective degrees of freedom for the expanded uncertainty

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

| <i>a</i> | <i>b</i> | <i>c</i> | <i>d</i> | <i>e = f(d,k)</i> | <i>f</i> | <i>g</i> | <i>h = c x f / e</i> | <i>i = c x g / e</i> | <i>k</i> |
|--|----------------------------------|-----------------------|----------------------|-----------------------|---------------------|----------------------|---------------------------------------|--|----------------------|
| Uncertainty Component | IEEE 1528 section | Tol. (± %) | Prob Dist | Div. | ci (1 g) | ci (10 g) | 1 g u_i (±%) | 10 g u_i (±%) | v_i |
| Measurement System | | | | | | | | | |
| Probe Calibration | E.2.1 | 6.0 | 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) | | | <i>k</i> =2 | | | | 22 | 22 | |

Notes for uncertainty budget Tables:

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

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

| <i>a</i> | <i>b</i> | <i>c</i> | <i>d</i> | <i>e = f(d,k)</i> | <i>f</i> | <i>g</i> | <i>h = c x f / e</i> | <i>i = c x g / e</i> | <i>k</i> |
|--|-------------------|------------|-------------|-----------------------|----------------------------|-----------------------------|-------------------------------|--------------------------------|----------------------|
| Uncertainty Component | IEEE 1528 section | Tol. (± %) | Prob Dist | Div. | <i>c_i</i> (1 g) | <i>c_i</i> (10 g) | 1 g <i>U_i</i> (±%) | 10 g <i>U_i</i> (±%) | <i>v_i</i> |
| Measurement System | | | | | | | | | |
| Probe Calibration | E.2.1 | 6.7 | N | 1.00 | 1 | 1 | 6.7 | 6.7 | ∞ |
| Axial Isotropy | E.2.2 | 4.7 | R | 1.73 | 1 | 1 | 2.7 | 2.7 | ∞ |
| Spherical Isotropy | E.2.2 | 9.6 | R | 1.73 | 0 | 0 | 0.0 | 0.0 | ∞ |
| Boundary Effect | E.2.3 | 1.0 | R | 1.73 | 1 | 1 | 0.6 | 0.6 | ∞ |
| Linearity | E.2.4 | 4.7 | R | 1.73 | 1 | 1 | 2.7 | 2.7 | ∞ |
| System Detection Limits | E.2.5 | 1.0 | R | 1.73 | 1 | 1 | 0.6 | 0.6 | ∞ |
| Readout Electronics | E.2.6 | 0.3 | N | 1.00 | 1 | 1 | 0.3 | 0.3 | ∞ |
| Response Time | E.2.7 | 1.1 | R | 1.73 | 1 | 1 | 0.6 | 0.6 | ∞ |
| Integration Time | E.2.8 | 0.0 | R | 1.73 | 1 | 1 | 0.0 | 0.0 | ∞ |
| RF Ambient Conditions - Noise | E.6.1 | 3.0 | R | 1.73 | 1 | 1 | 1.7 | 1.7 | ∞ |
| RF Ambient Conditions - Reflections | E.6.1 | 0.0 | R | 1.73 | 1 | 1 | 0.0 | 0.0 | ∞ |
| Probe Positioner Mechanical Tolerance | E.6.2 | 0.4 | R | 1.73 | 1 | 1 | 0.2 | 0.2 | ∞ |
| Probe Positioning w.r.t. Phantom | E.6.3 | 1.4 | R | 1.73 | 1 | 1 | 0.8 | 0.8 | ∞ |
| Max. SAR Evaluation (ext., int., avg.) | E.5 | 3.4 | R | 1.73 | 1 | 1 | 2.0 | 2.0 | ∞ |
| Dipole | | | | | | | | | |
| Dipole Axis to Liquid Distance | 8, E.4.2 | 2.0 | R | 1.73 | 1 | 1 | 1.2 | 1.2 | ∞ |
| Input Power and SAR Drift Measurement | 8, 6.6.2 | 5.0 | R | 1.73 | 1 | 1 | 2.9 | 2.9 | ∞ |
| Phantom and Tissue Parameters | | | | | | | | | |
| Phantom Uncertainty | E.3.1 | 4.0 | R | 1.73 | 1 | 1 | 2.3 | 2.3 | ∞ |
| Liquid Conductivity (target) | E.3.2 | 5.0 | R | 1.73 | 0.64 | 0.43 | 1.8 | 1.2 | ∞ |
| Liquid Conductivity (measurement) | E.3.3 | 3.3 | R | 1.73 | 0.64 | 0.43 | 1.2 | 0.8 | ∞ |
| Liquid Permittivity (target) | E.3.2 | 5.0 | R | 1.73 | 0.6 | 0.49 | 1.7 | 1.4 | ∞ |
| Liquid Permittivity (measurement) | E.3.3 | 1.9 | R | 1.73 | 0.6 | 0.49 | 0.6 | 0.5 | ∞ |
| Combined Standard Uncertainty | | | RSS | | | | 10 | 9 | 99999 |
| Expanded Uncertainty (95% CONFIDENCE LEVEL) | | | <i>k</i> =2 | | | | 19 | 18 | |

Notes for uncertainty budget Tables:

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

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

| <i>a</i> | <i>b</i> | <i>c</i> | <i>d</i> | <i>e = f(d,k)</i> | <i>f</i> | <i>g</i> | <i>h = c x f / e</i> | <i>i = c x g / e</i> | <i>k</i> |
|--|-------------------|------------|-------------|-----------------------|----------------------------|-----------------------------|-------------------------------|--------------------------------|----------------------|
| Uncertainty Component | IEEE 1528 section | Tol. (± %) | Prob Dist | Div. | <i>c_i</i> (1 g) | <i>c_i</i> (10 g) | 1 g <i>U_i</i> (±%) | 10 g <i>U_i</i> (±%) | <i>v_i</i> |
| Measurement System | | | | | | | | | |
| Probe Calibration | E.2.1 | 6.0 | 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) | | | <i>k</i> =2 | | | | 18 | 17 | |

Notes for uncertainty budget Tables:

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

Appendix B

Probe Calibration Certificates

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



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

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

Accreditation No.: **SCS 0108**

Client: **Motorola Solutions MY**

Certificate No: **EX3-3568_Feb15**

CALIBRATION CERTIFICATE

Object: **EX3DV4 - SN:3568**

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

Calibration date: **February 27, 2015**

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID | Cal Date (Certificate No.) | Scheduled Calibration |
|----------------------------|-----------------|-----------------------------------|------------------------|
| Power meter E4419B | GB41293874 | 03-Apr-14 (No. 217-01911) | Apr-15 |
| Power sensor E4412A | MY41498087 | 03-Apr-14 (No. 217-01911) | Apr-15 |
| Reference 3 dB Attenuator | SN: S5054 (3c) | 03-Apr-14 (No. 217-01915) | Apr-15 |
| Reference 20 dB Attenuator | SN: S5277 (20x) | 03-Apr-14 (No. 217-01919) | Apr-15 |
| Reference 30 dB Attenuator | SN: S5128 (30x) | 03-Apr-14 (No. 217-01920) | Apr-15 |
| Reference Probe E53DV2 | SN: 3013 | 30-Dec-14 (No. ES3-3013_Dec14) | Dec-15 |
| DAE4 | SN: 660 | 14-Jan-15 (No. DAE4-600_Jan15) | Jan-16 |
| Secondary Standards | ID | Check Date (in house) | Scheduled Check |
| RF generator HP 8648C | US3642U01700 | 4-Aug-99 (in house check Apr-13) | In house check: Apr-16 |
| Network Analyzer HP 8753E | US37390585 | 18-Oct-01 (in house check Oct-14) | In house check: Oct-15 |

| | | | |
|----------------|------------------------------|--|------------|
| Calibrated by: | Name: Claudia Leubler | Function: Laboratory Technician | Signature: |
| Approved by: | Name: Kalja Pokovic | Function: Technical Manager | Signature: |

Issued: February 27, 2015

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

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



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

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

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

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

EX3DV4 - SN:3568

February 27, 2015

Probe EX3DV4

SN:3568

Manufactured: July 15, 2005
Calibrated: February 27, 2015

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

EX3DV4- SN:3568

February 27, 2015

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3568

Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|--------------------------|----------|----------|----------|--------------|
| Norm $(\mu V/(V/m)^2)^A$ | 0.54 | 0.51 | 0.49 | $\pm 10.1\%$ |
| DCP (mV) ^B | 99.3 | 101.3 | 101.0 | |

Modulation Calibration Parameters

| UID | Communication System Name | | A dB | B dB $\sqrt{\mu V}$ | C | D dB | VR mV | Unc (k=2) |
|-----------|--|---|---------|------------------------|------|---------|----------|--------------|
| 0 | CW | X | 0.0 | 0.0 | 1.0 | 0.00 | 192.0 | $\pm 3.5\%$ |
| | | Y | 0.0 | 0.0 | 1.0 | | 175.3 | |
| | | Z | 0.0 | 0.0 | 1.0 | | 190.8 | |
| 10012-CAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps) | X | 2.65 | 65.7 | 16.6 | 1.87 | 148.3 | $\pm 0.7\%$ |
| | | Y | 2.97 | 68.9 | 18.7 | | 137.2 | |
| | | Z | 2.96 | 68.8 | 18.6 | | 147.9 | |
| 10013-CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps) | X | 10.70 | 69.3 | 22.2 | 9.46 | 139.2 | $\pm 3.8\%$ |
| | | Y | 10.51 | 69.3 | 22.4 | | 129.1 | |
| | | Z | 10.53 | 69.3 | 22.3 | | 137.1 | |
| 10059-CAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps) | X | 2.80 | 66.3 | 16.9 | 2.12 | 146.6 | $\pm 0.5\%$ |
| | | Y | 3.31 | 70.7 | 19.6 | | 137.1 | |
| | | Z | 3.06 | 69.1 | 18.8 | | 145.2 | |
| 10060-CAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps) | X | 3.05 | 70.6 | 18.9 | 2.83 | 128.5 | $\pm 0.5\%$ |
| | | Y | 5.39 | 83.1 | 24.8 | | 144.2 | |
| | | Z | 4.17 | 78.5 | 23.1 | | 126.7 | |
| 10061-CAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps) | X | 3.87 | 70.8 | 19.3 | 3.60 | 130.1 | $\pm 0.7\%$ |
| | | Y | 5.34 | 78.6 | 23.3 | | 143.9 | |
| | | Z | 4.50 | 75.6 | 22.1 | | 129.6 | |
| 10071-CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 9 Mbps) | X | 10.81 | 69.5 | 22.5 | 9.83 | 135.7 | $\pm 3.5\%$ |
| | | Y | 10.59 | 69.4 | 22.7 | | 126.5 | |
| | | Z | 10.58 | 69.3 | 22.5 | | 132.2 | |
| 10072-CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 12 Mbps) | X | 10.33 | 69.1 | 22.2 | 9.62 | 129.8 | $\pm 3.8\%$ |
| | | Y | 10.63 | 70.5 | 23.3 | | 149.0 | |
| | | Z | 10.12 | 69.0 | 22.3 | | 128.4 | |
| 10073-CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 18 Mbps) | X | 10.30 | 69.1 | 22.4 | 9.94 | 125.1 | $\pm 3.5\%$ |
| | | Y | 10.65 | 70.7 | 23.6 | | 144.4 | |
| | | Z | 10.41 | 70.0 | 23.1 | | 148.6 | |
| 10074-CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 24 Mbps) | X | 10.74 | 70.3 | 23.4 | 10.30 | 145.6 | $\pm 3.8\%$ |
| | | Y | 10.72 | 70.9 | 24.0 | | 139.7 | |
| | | Z | 10.44 | 70.0 | 23.4 | | 143.8 | |
| 10075-CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 36 Mbps) | X | 10.83 | 70.5 | 23.9 | 10.77 | 141.4 | $\pm 4.6\%$ |
| | | Y | 10.78 | 71.0 | 24.5 | | 134.7 | |
| | | Z | 10.52 | 70.2 | 23.9 | | 139.3 | |

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| | | | | | | | | |
|-----------|--|---|-------|------|------|-------|-------|--------|
| 10076-CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 48 Mbps) | X | 10.76 | 70.4 | 23.9 | 10.94 | 138.3 | ±4.1 % |
| | | Y | 10.73 | 71.0 | 24.6 | | 130.1 | |
| | | Z | 10.44 | 70.0 | 23.9 | | 136.2 | |
| 10077-CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps) | X | 10.75 | 70.4 | 24.0 | 11.00 | 138.0 | ±4.4 % |
| | | Y | 10.70 | 71.0 | 24.6 | | 129.2 | |
| | | Z | 10.40 | 70.0 | 23.9 | | 134.9 | |
| 10114-CAB | IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK) | X | 9.90 | 67.7 | 20.4 | 8.10 | 124.1 | ±2.7 % |
| | | Y | 10.24 | 68.9 | 21.2 | | 142.9 | |
| | | Z | 9.95 | 68.2 | 20.8 | | 126.2 | |
| 10115-CAB | IEEE 802.11n (HT Greenfield, 81 Mbps, 16-QAM) | X | 10.36 | 68.1 | 20.7 | 8.46 | 126.5 | ±3.0 % |
| | | Y | 10.78 | 69.4 | 21.7 | | 147.2 | |
| | | Z | 10.37 | 68.5 | 21.1 | | 127.1 | |
| 10118-CAB | IEEE 802.11n (HT Greenfield, 135 Mbps, 64-QAM) | X | 10.31 | 68.8 | 21.0 | 8.15 | 149.8 | ±3.0 % |
| | | Y | 10.32 | 69.0 | 21.3 | | 145.2 | |
| | | Z | 9.97 | 68.2 | 20.8 | | 126.4 | |
| 10117-CAB | IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK) | X | 9.89 | 67.7 | 20.3 | 8.07 | 124.4 | ±3.0 % |
| | | Y | 10.32 | 69.1 | 21.3 | | 146.0 | |
| | | Z | 9.93 | 68.1 | 20.7 | | 127.1 | |
| 10118-CAB | IEEE 802.11n (HT Mixed, 81 Mbps, 16-QAM) | X | 10.50 | 68.3 | 20.9 | 8.59 | 127.7 | ±3.3 % |
| | | Y | 10.90 | 69.6 | 21.8 | | 148.8 | |
| | | Z | 10.50 | 68.6 | 21.2 | | 129.1 | |
| 10119-CAB | IEEE 802.11n (HT Mixed, 135 Mbps, 64-QAM) | X | 8.86 | 67.7 | 20.4 | 8.13 | 124.0 | ±3.0 % |
| | | Y | 10.33 | 69.1 | 21.3 | | 146.1 | |
| | | Z | 9.96 | 68.2 | 20.8 | | 125.7 | |
| 10193-CAB | IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK) | X | 9.95 | 68.6 | 20.9 | 8.09 | 146.0 | ±3.0 % |
| | | Y | 9.85 | 68.7 | 21.2 | | 138.9 | |
| | | Z | 9.96 | 69.0 | 21.3 | | 146.8 | |
| 10194-CAB | IEEE 802.11n (HT Greenfield, 39 Mbps, 16-QAM) | X | 9.93 | 68.5 | 20.9 | 8.12 | 143.4 | ±3.0 % |
| | | Y | 9.86 | 68.7 | 21.2 | | 137.8 | |
| | | Z | 9.95 | 68.9 | 21.2 | | 145.1 | |
| 10195-CAB | IEEE 802.11n (HT Greenfield, 65 Mbps, 64-QAM) | X | 10.08 | 68.7 | 21.0 | 8.21 | 144.9 | ±3.0 % |
| | | Y | 9.98 | 68.8 | 21.3 | | 138.7 | |
| | | Z | 10.07 | 69.0 | 21.3 | | 146.2 | |
| 10196-CAB | IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK) | X | 9.90 | 68.5 | 20.9 | 8.10 | 143.5 | ±2.7 % |
| | | Y | 9.82 | 68.7 | 21.2 | | 137.2 | |
| | | Z | 9.90 | 68.8 | 21.2 | | 144.7 | |
| 10197-CAB | IEEE 802.11n (HT Mixed, 39 Mbps, 16-QAM) | X | 9.98 | 68.6 | 20.9 | 8.13 | 144.3 | ±3.0 % |
| | | Y | 9.88 | 68.7 | 21.2 | | 138.3 | |
| | | Z | 9.95 | 68.8 | 21.2 | | 144.6 | |
| 10198-CAB | IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM) | X | 10.10 | 68.6 | 21.0 | 8.27 | 144.1 | ±3.0 % |
| | | Y | 10.06 | 68.9 | 21.4 | | 138.6 | |
| | | Z | 10.10 | 69.0 | 21.4 | | 145.7 | |

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| | | | | | | | | |
|-----------|--|---|-------|------|------|------|-------|--------|
| 10219-CAB | IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK) | X | 9.78 | 68.4 | 20.8 | 8.03 | 141.7 | ±2.7 % |
| | | Y | 9.89 | 68.5 | 21.1 | | 136.2 | |
| | | Z | 9.81 | 68.8 | 21.2 | | 143.5 | |
| 10220-CAB | IEEE 802.11n (HT Mixed, 43.3 Mbps, 16-QAM) | X | 9.94 | 68.5 | 20.9 | 8.13 | 142.5 | ±2.7 % |
| | | Y | 9.88 | 68.7 | 21.2 | | 137.6 | |
| | | Z | 9.95 | 68.9 | 21.2 | | 144.6 | |
| 10221-CAB | IEEE 802.11n (HT Mixed, 72.2 Mbps, 64-QAM) | X | 10.11 | 68.6 | 21.0 | 8.27 | 144.3 | ±3.0 % |
| | | Y | 10.05 | 68.9 | 21.4 | | 138.6 | |
| | | Z | 10.13 | 69.0 | 21.4 | | 146.4 | |
| 10222-CAB | IEEE 802.11n (HT Mixed, 15 Mbps, BPSK) | X | 10.24 | 68.7 | 20.9 | 8.06 | 149.8 | ±3.0 % |
| | | Y | 10.24 | 68.9 | 21.2 | | 145.0 | |
| | | Z | 9.87 | 68.0 | 20.7 | | 124.7 | |
| 10223-CAB | IEEE 802.11n (HT Mixed, 90 Mbps, 16-QAM) | X | 10.35 | 68.1 | 20.8 | 8.48 | 125.5 | ±3.3 % |
| | | Y | 10.82 | 69.5 | 21.7 | | 149.4 | |
| | | Z | 10.40 | 68.5 | 21.1 | | 127.9 | |
| 10224-CAB | IEEE 802.11n (HT Mixed, 150 Mbps, 64-QAM) | X | 10.21 | 68.6 | 20.9 | 8.08 | 148.2 | ±3.0 % |
| | | Y | 10.27 | 69.1 | 21.3 | | 145.7 | |
| | | Z | 9.88 | 68.1 | 20.7 | | 125.1 | |
| 10315-AAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle) | X | 2.54 | 65.4 | 16.4 | 1.71 | 146.8 | ±0.7 % |
| | | Y | 2.94 | 69.2 | 18.8 | | 142.3 | |
| | | Z | 3.08 | 70.2 | 19.4 | | 149.1 | |
| 10316-AAB | IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle) | X | 10.02 | 68.5 | 21.0 | 8.36 | 139.3 | ±3.0 % |
| | | Y | 9.93 | 68.7 | 21.3 | | 135.2 | |
| | | Z | 10.06 | 68.9 | 21.4 | | 142.0 | |
| 10415-AAA | IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle) | X | 2.45 | 65.2 | 16.4 | 1.54 | 146.0 | ±0.7 % |
| | | Y | 3.04 | 70.1 | 19.2 | | 141.8 | |
| | | Z | 2.90 | 69.4 | 19.0 | | 148.8 | |
| 10416-AAA | IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle) | X | 9.90 | 68.3 | 20.8 | 8.23 | 138.6 | ±3.0 % |
| | | Y | 9.84 | 68.5 | 21.2 | | 135.4 | |
| | | Z | 9.93 | 68.7 | 21.2 | | 140.8 | |
| 10418-AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Long preamble) | X | 9.79 | 68.3 | 20.8 | 8.14 | 138.4 | ±2.7 % |
| | | Y | 9.74 | 68.5 | 21.2 | | 135.3 | |
| | | Z | 9.79 | 68.6 | 21.1 | | 140.4 | |
| 10419-AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Short preamble) | X | 9.86 | 68.3 | 20.8 | 8.19 | 140.0 | ±2.7 % |
| | | Y | 9.82 | 68.6 | 21.2 | | 135.6 | |
| | | Z | 9.89 | 68.7 | 21.2 | | 141.3 | |
| 10422-AAA | IEEE 802.11n (HT Greenfield, 7.2 Mbps, BPSK) | X | 10.14 | 68.6 | 21.1 | 8.32 | 143.5 | ±3.0 % |
| | | Y | 10.08 | 68.9 | 21.4 | | 138.4 | |
| | | Z | 10.12 | 68.9 | 21.4 | | 145.2 | |
| 10423-AAA | IEEE 802.11n (HT Greenfield, 43.3 Mbps, 16-QAM) | X | 10.29 | 68.8 | 21.2 | 8.47 | 144.1 | ±3.0 % |
| | | Y | 10.22 | 69.0 | 21.5 | | 138.5 | |
| | | Z | 10.29 | 69.1 | 21.5 | | 145.6 | |

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| | | | | | | | | |
|-----------|---|---|-------|------|------|------|-------|--------|
| 10424-AAA | IEEE 802.11n (HT Greenfield, 72.2 Mbps, 64-QAM) | X | 10.17 | 68.6 | 21.1 | 8.40 | 142.9 | ±3.3 % |
| | | Y | 10.12 | 68.9 | 21.5 | | 137.8 | |
| | | Z | 10.19 | 69.1 | 21.5 | | 144.9 | |
| 10425-AAA | IEEE 802.11n (HT Greenfield, 15 Mbps, BPSK) | X | 10.23 | 68.0 | 20.6 | 8.41 | 123.3 | ±3.0 % |
| | | Y | 10.71 | 69.5 | 21.7 | | 147.2 | |
| | | Z | 10.28 | 68.4 | 21.0 | | 125.5 | |
| 10426-AAA | IEEE 802.11n (HT Greenfield, 90 Mbps, 16-QAM) | X | 10.28 | 68.1 | 20.7 | 8.45 | 124.6 | ±3.0 % |
| | | Y | 10.74 | 69.5 | 21.7 | | 146.3 | |
| | | Z | 10.33 | 68.5 | 21.1 | | 126.3 | |
| 10427-AAA | IEEE 802.11n (HT Greenfield, 150 Mbps, 64-QAM) | X | 10.24 | 68.0 | 20.7 | 8.41 | 125.1 | ±3.3 % |
| | | Y | 10.71 | 68.4 | 21.6 | | 148.5 | |
| | | Z | 10.31 | 68.5 | 21.1 | | 126.6 | |

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

^a The uncertainties of Norm X,Y,Z do not affect the E²-field uncertainty inside TSL (see Pages 8 and 9).
^b Numerical linearization parameter: uncertainty not required.
^c 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:3568

Calibration Parameter Determined in Head Tissue Simulating Media

| f (MHz) ^c | Relative Permittivity ^e | Conductivity (S/m) ^f | ConvF X | ConvF Y | ConvF Z | Alpha ^g | Depth ^g (mm) | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|--------------------|-------------------------|-------------|
| 150 | 52.3 | 0.76 | 10.26 | 10.26 | 10.26 | 0.00 | 1.00 | ± 13.3 % |
| 300 | 45.3 | 0.87 | 9.57 | 9.57 | 9.57 | 0.12 | 1.00 | ± 13.3 % |
| 450 | 43.5 | 0.87 | 8.92 | 8.92 | 8.92 | 0.17 | 2.21 | ± 13.3 % |
| 750 | 41.9 | 0.89 | 8.48 | 8.48 | 8.48 | 0.31 | 1.01 | ± 12.0 % |
| 900 | 41.5 | 0.97 | 8.26 | 8.26 | 8.26 | 0.38 | 0.87 | ± 12.0 % |
| 2450 | 39.2 | 1.80 | 6.38 | 6.38 | 6.38 | 0.37 | 0.86 | ± 12.0 % |

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

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

^e 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 3-8 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3568

Calibration Parameter Determined in Body Tissue Simulating Media

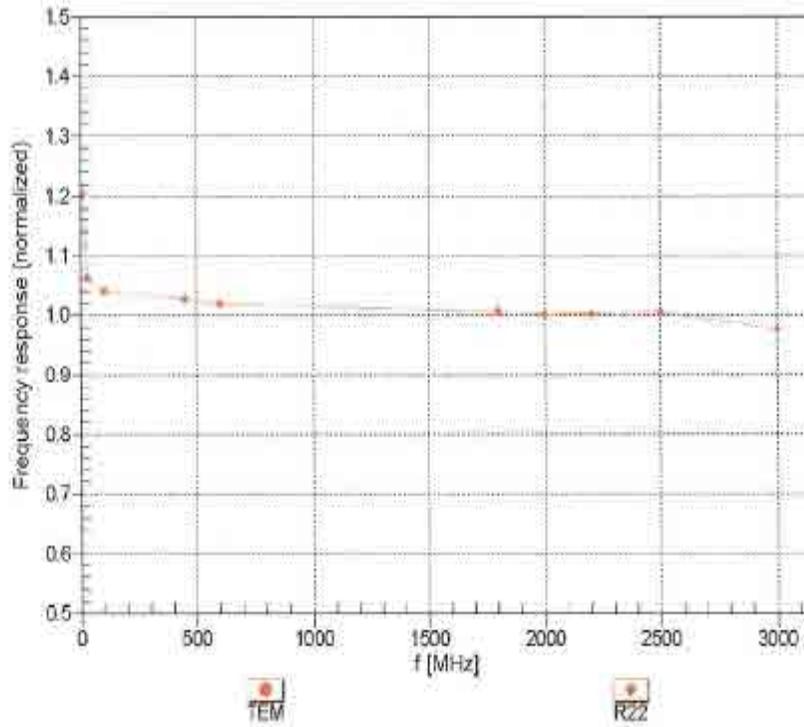
| f (MHz) ^c | Relative Permittivity ^f | Conductivity (S/m) ^f | ConvF X | ConvF Y | ConvF Z | Alpha ^g | Depth (mm) ^h | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|--------------------|-------------------------|-------------|
| 150 | 81.9 | 0.80 | 10.08 | 10.08 | 10.08 | 0.00 | 1.00 | ± 13.3 % |
| 300 | 58.2 | 0.92 | 11.07 | 11.07 | 11.07 | 0.08 | 1.00 | ± 13.3 % |
| 450 | 56.7 | 0.94 | 8.93 | 8.93 | 8.93 | 0.10 | 1.00 | ± 13.3 % |
| 750 | 55.5 | 0.96 | 8.33 | 8.33 | 8.33 | 0.33 | 0.99 | ± 12.0 % |
| 900 | 55.0 | 1.05 | 8.09 | 8.09 | 8.09 | 0.30 | 1.09 | ± 12.0 % |
| 2450 | 52.7 | 1.95 | 6.63 | 6.63 | 6.63 | 0.80 | 0.59 | ± 12.0 % |

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

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

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

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



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

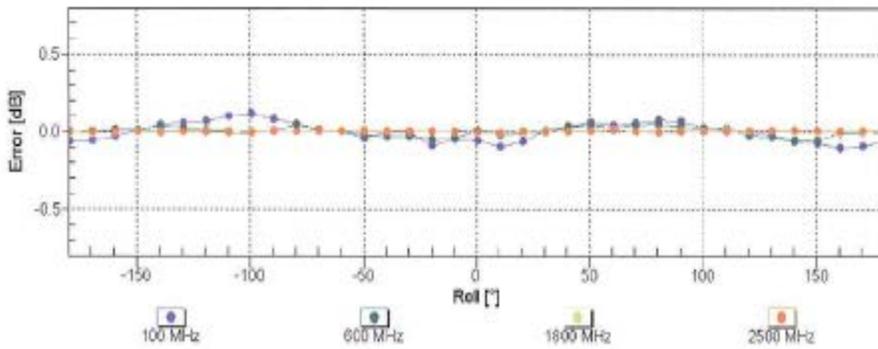
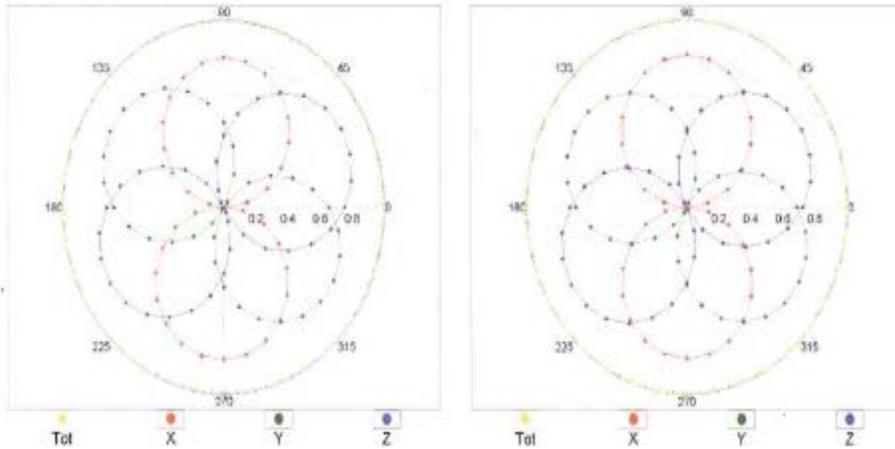
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Receiving Pattern (ϕ), $\theta = 0^\circ$

f=600 MHz, TEM

f=1800 MHz, R22

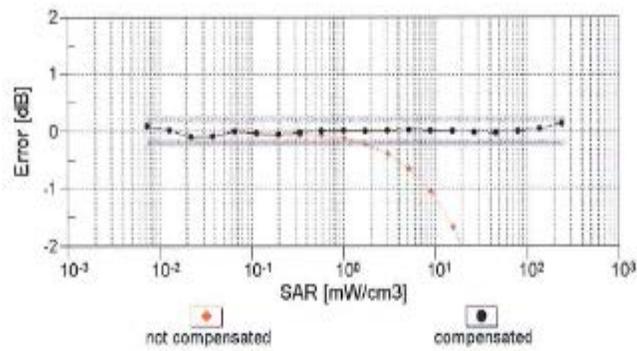
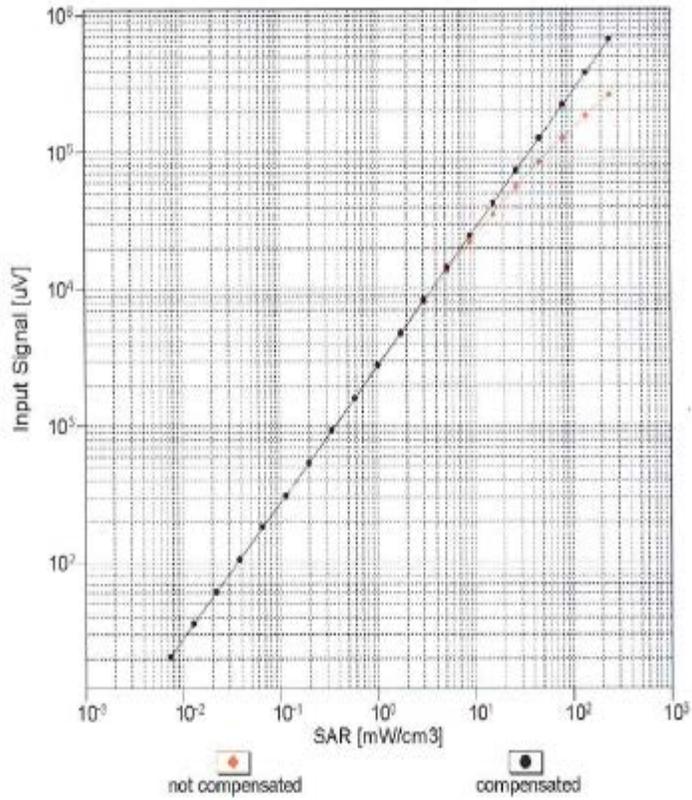


Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

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Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell, $f_{\text{eval}} = 1900 \text{ MHz}$)

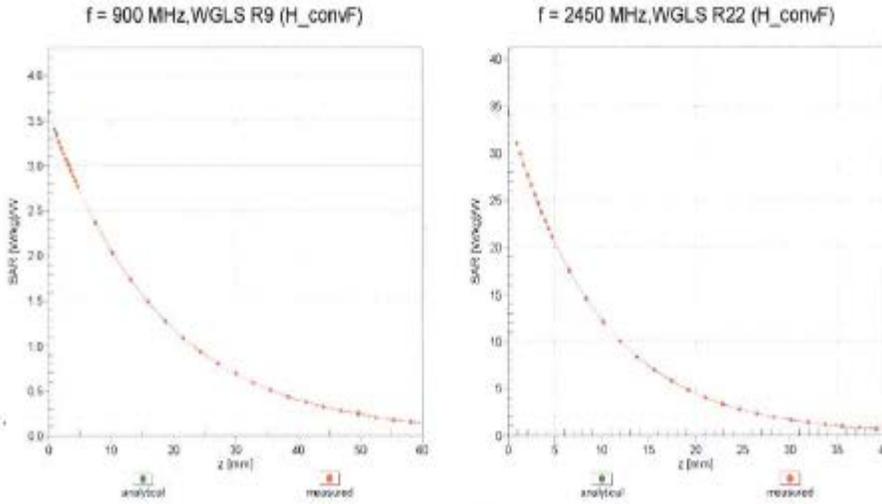


Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

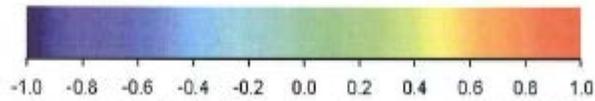
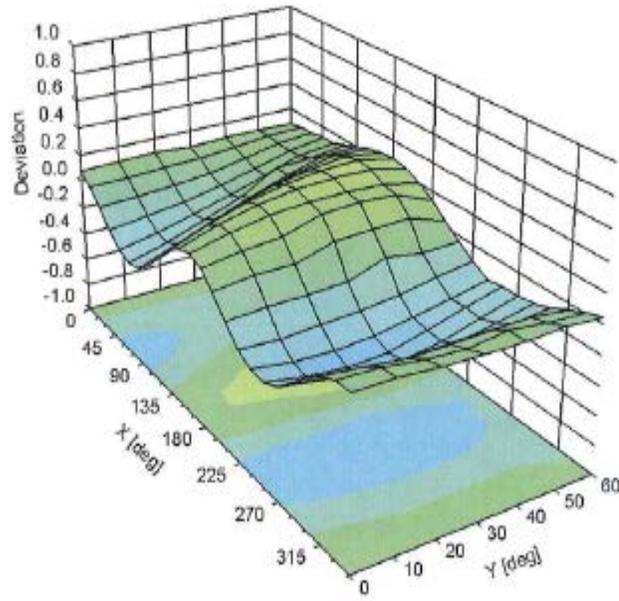
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Conversion Factor Assessment



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



Uncertainty of Spherical Isotropy Assessment: $\pm 2.6\%$ (k=2)

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DASY/EASY - Parameters of Probe: EX3DV4 - SN:3568

Other Probe Parameters

| | |
|---|------------|
| Sensor Arrangement | Triangular |
| Connector Angle (°) | -119.5 |
| Mechanical Surface Detection Mode | enabled |
| Optical Surface Detection Mode | disabled |
| Probe Overall Length | 337 mm |
| Probe Body Diameter | 10 mm |
| Tip Length | 9 mm |
| Tip Diameter | 2.5 mm |
| Probe Tip to Sensor X Calibration Point | 1 mm |
| Probe Tip to Sensor Y Calibration Point | 1 mm |
| Probe Tip to Sensor Z Calibration Point | 1 mm |
| Recommended Measurement Distance from Surface | 1.4 mm |

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



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

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

Accreditation No.: **SCS 0108**

Client **Motorola Solutions MY**

Certificate No: **EX3-7364_Jun15**

CALIBRATION CERTIFICATE

Object: **EX3DV4 - SN:7364**

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

Calibration date: **June 23, 2015**

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID | Cal Date (Certificate No.) | Scheduled Calibration |
|----------------------------|-----------------|-----------------------------------|------------------------|
| Power meter E4419B | GB41293874 | 01-Apr-15 (No. 217-02128) | Mar-16 |
| Power sensor E4412A | MY41498087 | 01-Apr-15 (No. 217-02128) | Mar-16 |
| Reference 3 dB Attenuator | SN: S5054 (3c) | 01-Apr-15 (No. 217-02129) | Mar-16 |
| Reference 20 dB Attenuator | SN: S5277 (20x) | 01-Apr-15 (No. 217-02132) | Mar-16 |
| Reference 30 dB Attenuator | SN: S5129 (30b) | 01-Apr-15 (No. 217-02133) | Mar-16 |
| Reference Probe ES3DV2 | SN: 3013 | 30-Dec-14 (No. ES3-3013_Dec14) | Dec-15 |
| DAE4 | SN: 660 | 14-Jan-15 (No. DAE4-660_Jan15) | Jan-16 |
| Secondary Standards | ID | Check Date (in house) | Scheduled Check |
| RF generator HP 8648C | US3642U01700 | 4-Aug-99 (in house check Apr-13) | In house check: Apr-15 |
| Network Analyzer HP 8753E | US37390585 | 18-Oct-01 (in house check Oct-14) | In house check: Oct-15 |

| | | | |
|----------------|-------------------------------|-----------------------------------|---------------|
| Calibrated by: | Name Claudio Lauber | Function Laboratory Technician | Signature |
| Approved by: | Name Katja Piskovic | Function Technical Manager | |

Issued: June 24, 2015

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

**Calibration Laboratory of
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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

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

EX3DV4 – SN:7364

June 23, 2015

Probe EX3DV4

SN:7364

Manufactured: February 5, 2015

Calibrated: June 23, 2015

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

EX3DV4- SN:7364

June 23, 2015

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

Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|----------|----------|----------|--------------|
| Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A | 0.48 | 0.46 | 0.59 | $\pm 10.1\%$ |
| DCP (mV) ^B | 97.7 | 96.3 | 97.3 | |

Modulation Calibration Parameters

| UID | Communication System Name | | A dB | B dB/ μV | C | D dB | VR mV | Unc ^C (k=2) |
|-----------|---|---|---------|------------------------|------|---------|----------|---------------------------|
| 0 | CW | X | 0.0 | 0.0 | 1.0 | 0.00 | 115.0 | $\pm 3.5\%$ |
| | | Y | 0.0 | 0.0 | 1.0 | | 110.5 | |
| | | Z | 0.0 | 0.0 | 1.0 | | 124.6 | |
| 10011-CAB | UMTS-FDD (WCDMA) | X | 3.42 | 67.2 | 18.6 | 2.91 | 122.6 | $\pm 0.5\%$ |
| | | Y | 3.14 | 64.8 | 18.9 | | 117.5 | |
| | | Z | 3.48 | 67.3 | 18.5 | | 135.3 | |
| 10012-CAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps) | X | 2.86 | 68.1 | 18.5 | 1.87 | 122.4 | $\pm 0.5\%$ |
| | | Y | 2.39 | 63.9 | 15.8 | | 117.3 | |
| | | Z | 3.01 | 69.0 | 18.8 | | 135.0 | |
| 10013-CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps) | X | 10.47 | 68.7 | 22.2 | 9.46 | 115.4 | $\pm 2.7\%$ |
| | | Y | 10.30 | 68.1 | 21.6 | | 107.3 | |
| | | Z | 10.58 | 69.3 | 22.6 | | 126.2 | |
| 10059-CAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps) | X | 3.03 | 69.0 | 19.0 | 2.12 | 120.5 | $\pm 0.5\%$ |
| | | Y | 2.58 | 65.1 | 16.6 | | 115.0 | |
| | | Z | 2.93 | 68.2 | 18.4 | | 133.3 | |
| 10080-CAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps) | X | 3.74 | 77.3 | 22.8 | 2.83 | 148.9 | $\pm 0.5\%$ |
| | | Y | 2.75 | 70.3 | 19.2 | | 141.7 | |
| | | Z | 3.40 | 75.1 | 21.8 | | 118.0 | |
| 10061-CAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps) | X | 3.83 | 73.4 | 21.4 | 3.60 | 145.6 | $\pm 0.7\%$ |
| | | Y | 3.06 | 68.2 | 18.5 | | 139.1 | |
| | | Z | 3.96 | 74.0 | 21.7 | | 117.9 | |
| 10062-CAB | IEEE 802.11a/b WiFi 5 GHz (OFDM, 6 Mbps) | X | 10.17 | 68.5 | 21.5 | 8.68 | 116.8 | $\pm 2.5\%$ |
| | | Y | 9.91 | 67.6 | 20.8 | | 107.4 | |
| | | Z | 10.39 | 69.3 | 22.0 | | 132.5 | |
| 10063-CAB | IEEE 802.11a/b WiFi 5 GHz (OFDM, 9 Mbps) | X | 10.01 | 68.4 | 21.4 | 8.63 | 116.3 | $\pm 2.5\%$ |
| | | Y | 9.85 | 67.7 | 20.9 | | 108.8 | |
| | | Z | 10.24 | 69.2 | 22.0 | | 131.7 | |
| 10064-CAB | IEEE 802.11a/b WiFi 5 GHz (OFDM, 12 Mbps) | X | 10.46 | 68.7 | 21.9 | 9.09 | 117.4 | $\pm 2.7\%$ |
| | | Y | 10.34 | 68.2 | 21.3 | | 110.7 | |
| | | Z | 10.69 | 69.6 | 22.5 | | 132.1 | |
| 10065-CAB | IEEE 802.11a/b WiFi 5 GHz (OFDM, 18 Mbps) | X | 10.10 | 68.4 | 21.7 | 9.00 | 113.5 | $\pm 2.5\%$ |
| | | Y | 10.01 | 68.0 | 21.2 | | 107.5 | |
| | | Z | 10.29 | 69.2 | 22.2 | | 127.6 | |
| 10066-CAB | IEEE 802.11a/b WiFi 5 GHz (OFDM, 24 Mbps) | X | 10.32 | 68.7 | 22.1 | 9.38 | 113.2 | $\pm 2.5\%$ |
| | | Y | 10.20 | 68.1 | 21.6 | | 106.0 | |
| | | Z | 10.49 | 69.4 | 22.6 | | 125.8 | |

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| | | | | | | | | |
|-----------|--|---|-------|------|------|-------|-------|--------|
| 10067-CAB | IEEE 802.11a/n WiFi 5 GHz (OFDM, 36 Mbps) | X | 10.83 | 69.1 | 22.8 | 10.12 | 111.9 | ±3.0 % |
| | | Y | 10.70 | 68.6 | 22.3 | | 105.5 | |
| | | Z | 11.04 | 70.0 | 23.5 | | 125.5 | |
| 10068-CAB | IEEE 802.11a/n WiFi 5 GHz (OFDM, 48 Mbps) | X | 10.64 | 69.0 | 22.9 | 10.24 | 108.5 | ±3.3 % |
| | | Y | 11.07 | 70.0 | 23.2 | | 145.3 | |
| | | Z | 10.83 | 69.9 | 23.5 | | 121.7 | |
| 10069-CAB | IEEE 802.11a/n WiFi 5 GHz (OFDM, 54 Mbps) | X | 10.95 | 69.2 | 23.2 | 10.56 | 109.6 | ±3.5 % |
| | | Y | 11.38 | 70.3 | 23.6 | | 146.1 | |
| | | Z | 11.13 | 70.1 | 23.8 | | 122.0 | |
| 10071-CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 9 Mbps) | X | 10.46 | 68.7 | 22.4 | 9.83 | 110.6 | ±2.5 % |
| | | Y | 10.36 | 68.2 | 21.9 | | 105.8 | |
| | | Z | 10.71 | 69.6 | 23.1 | | 124.2 | |
| 10072-CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 12 Mbps) | X | 10.01 | 68.4 | 22.2 | 9.62 | 106.7 | ±3.0 % |
| | | Y | 10.38 | 69.2 | 22.4 | | 144.1 | |
| | | Z | 10.18 | 69.1 | 22.7 | | 119.4 | |
| 10073-CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 18 Mbps) | X | 10.78 | 70.9 | 23.9 | 9.94 | 149.7 | ±3.0 % |
| | | Y | 10.27 | 69.1 | 22.6 | | 139.1 | |
| | | Z | 10.17 | 69.3 | 23.1 | | 115.9 | |
| 10074-CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 24 Mbps) | X | 10.82 | 71.0 | 24.2 | 10.30 | 144.0 | ±3.3 % |
| | | Y | 10.30 | 69.2 | 22.9 | | 133.6 | |
| | | Z | 10.22 | 69.5 | 23.4 | | 111.6 | |
| 10075-CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 36 Mbps) | X | 10.91 | 71.3 | 24.8 | 10.77 | 136.9 | ±3.3 % |
| | | Y | 10.34 | 69.2 | 23.3 | | 129.4 | |
| | | Z | 10.31 | 69.7 | 23.9 | | 108.0 | |
| 10076-CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 48 Mbps) | X | 10.84 | 71.1 | 24.9 | 10.94 | 134.9 | ±3.3 % |
| | | Y | 10.25 | 69.0 | 23.3 | | 125.9 | |
| | | Z | 10.28 | 69.7 | 24.1 | | 106.3 | |
| 10077-CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps) | X | 10.61 | 71.1 | 24.9 | 11.00 | 133.2 | ±3.5 % |
| | | Y | 10.23 | 69.1 | 23.4 | | 124.7 | |
| | | Z | 11.06 | 72.3 | 25.6 | | 148.3 | |
| 10097-CAB | UMTS-FDD (HSDPA) | X | 4.64 | 66.4 | 18.3 | 3.98 | 129.4 | ±0.7 % |
| | | Y | 4.47 | 65.1 | 17.4 | | 126.4 | |
| | | Z | 4.82 | 67.2 | 18.8 | | 144.7 | |
| 10096-CAB | UMTS-FDD (HSUPA, Subtest 2) | X | 4.66 | 66.5 | 18.4 | 3.98 | 130.1 | ±0.7 % |
| | | Y | 4.50 | 65.3 | 17.5 | | 126.7 | |
| | | Z | 4.78 | 67.0 | 18.7 | | 145.5 | |
| 10100-CAB | LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK) | X | 6.59 | 67.6 | 19.7 | 5.67 | 136.1 | ±1.4 % |
| | | Y | 6.37 | 66.4 | 18.8 | | 131.7 | |
| | | Z | 6.14 | 66.0 | 18.9 | | 107.5 | |
| 10101-CAB | LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM) | X | 7.68 | 67.9 | 20.1 | 6.42 | 146.1 | ±1.7 % |
| | | Y | 7.50 | 67.0 | 19.4 | | 140.3 | |
| | | Z | 7.24 | 66.6 | 19.5 | | 115.2 | |
| 10102-CAB | LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) | X | 8.00 | 68.2 | 20.4 | 6.60 | 148.5 | ±1.7 % |
| | | Y | 7.78 | 67.2 | 19.6 | | 141.8 | |
| | | Z | 7.54 | 66.9 | 19.7 | | 117.4 | |

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|-----------|--|---|-------|------|------|------|-------|--------|
| 10108-CAC | LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK) | X | 8.41 | 67.0 | 19.5 | 5.80 | 133.0 | ±1.2 % |
| | | Y | 6.24 | 66.1 | 18.8 | | 128.4 | |
| | | Z | 6.04 | 65.7 | 18.9 | | 106.2 | |
| 10109-CAC | LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM) | X | 7.40 | 67.6 | 20.0 | 6.43 | 141.0 | ±1.7 % |
| | | Y | 7.23 | 66.7 | 19.3 | | 135.5 | |
| | | Z | 8.98 | 66.3 | 19.4 | | 111.0 | |
| 10110-CAC | LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK) | X | 6.05 | 66.5 | 19.2 | 5.75 | 129.1 | ±1.4 % |
| | | Y | 5.89 | 65.5 | 18.5 | | 124.3 | |
| | | Z | 6.26 | 67.4 | 19.8 | | 145.9 | |
| 10111-CAC | LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM) | X | 7.12 | 67.4 | 20.0 | 6.44 | 136.5 | ±1.4 % |
| | | Y | 6.94 | 66.5 | 19.2 | | 130.6 | |
| | | Z | 6.69 | 66.0 | 19.3 | | 107.3 | |
| 10112-CAC | LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM) | X | 7.64 | 67.8 | 20.2 | 6.59 | 142.4 | ±1.7 % |
| | | Y | 7.46 | 66.9 | 19.5 | | 136.7 | |
| | | Z | 7.21 | 66.5 | 19.6 | | 111.3 | |
| 10113-CAC | LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM) | X | 7.32 | 67.5 | 20.1 | 6.62 | 137.7 | ±1.7 % |
| | | Y | 7.15 | 66.6 | 19.4 | | 131.4 | |
| | | Z | 6.92 | 66.2 | 19.4 | | 108.9 | |
| 10114-CAB | IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK) | X | 10.23 | 68.5 | 21.0 | 8.10 | 124.2 | ±2.5 % |
| | | Y | 10.04 | 67.9 | 20.5 | | 117.0 | |
| | | Z | 10.56 | 69.5 | 21.7 | | 142.7 | |
| 10115-CAB | IEEE 802.11n (HT Greenfield, 81 Mbps, 16-QAM) | X | 10.80 | 69.1 | 21.5 | 8.46 | 128.6 | ±2.5 % |
| | | Y | 10.61 | 68.5 | 21.0 | | 120.9 | |
| | | Z | 11.08 | 70.0 | 22.1 | | 145.6 | |
| 10116-CAB | IEEE 802.11n (HT Greenfield, 135 Mbps, 64-QAM) | X | 10.31 | 68.7 | 21.1 | 8.15 | 125.0 | ±2.5 % |
| | | Y | 10.13 | 68.1 | 20.6 | | 118.2 | |
| | | Z | 10.59 | 69.6 | 21.7 | | 142.4 | |
| 10117-CAB | IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK) | X | 10.27 | 68.6 | 21.1 | 8.07 | 125.9 | ±2.5 % |
| | | Y | 10.08 | 68.0 | 20.5 | | 119.0 | |
| | | Z | 10.52 | 69.4 | 21.6 | | 142.8 | |
| 10118-CAB | IEEE 802.11n (HT Mixed, 81 Mbps, 16-QAM) | X | 10.91 | 69.2 | 21.7 | 8.59 | 128.3 | ±2.5 % |
| | | Y | 10.70 | 68.6 | 21.1 | | 121.2 | |
| | | Z | 11.21 | 70.2 | 22.3 | | 146.3 | |
| 10119-CAB | IEEE 802.11n (HT Mixed, 135 Mbps, 64-QAM) | X | 10.27 | 68.6 | 21.1 | 8.13 | 125.1 | ±2.5 % |
| | | Y | 10.10 | 68.0 | 20.5 | | 118.1 | |
| | | Z | 10.57 | 69.6 | 21.7 | | 142.8 | |
| 10140-CAB | LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM) | X | 7.93 | 68.3 | 20.4 | 6.49 | 147.7 | ±1.7 % |
| | | Y | 7.73 | 67.4 | 19.6 | | 142.8 | |
| | | Z | 7.42 | 66.8 | 19.6 | | 116.6 | |
| 10141-CAB | LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM) | X | 8.04 | 68.2 | 20.3 | 6.53 | 149.1 | ±1.7 % |
| | | Y | 7.84 | 67.4 | 19.6 | | 143.2 | |
| | | Z | 7.58 | 66.9 | 19.7 | | 117.6 | |
| 10142-CAC | LTE-FDD (SC-FDMA, 100% RB, 3 MHz, QPSK) | X | 5.83 | 66.2 | 19.1 | 5.73 | 125.7 | ±1.2 % |
| | | Y | 5.68 | 65.2 | 18.4 | | 121.2 | |
| | | Z | 6.04 | 67.0 | 19.6 | | 142.9 | |

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|-----------|---|---|------|------|------|------|-------|--------|
| 10143-CAC | LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM) | X | 6.82 | 67.3 | 19.9 | 6.35 | 131.4 | ±1.4 % |
| | | Y | 6.65 | 66.3 | 19.1 | | 126.5 | |
| | | Z | 7.04 | 68.1 | 20.4 | | 148.1 | |
| 10144-CAC | LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 64-QAM) | X | 7.15 | 67.5 | 20.1 | 6.65 | 132.6 | ±1.4 % |
| | | Y | 6.96 | 66.6 | 19.4 | | 127.2 | |
| | | Z | 7.36 | 68.4 | 20.7 | | 149.1 | |
| 10145-CAC | LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK) | X | 5.54 | 65.9 | 19.0 | 5.76 | 120.5 | ±1.2 % |
| | | Y | 5.42 | 65.1 | 18.3 | | 116.1 | |
| | | Z | 5.76 | 66.9 | 19.6 | | 135.7 | |
| 10146-CAC | LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM) | X | 6.48 | 67.3 | 19.9 | 6.41 | 124.0 | ±1.4 % |
| | | Y | 6.28 | 66.2 | 19.1 | | 119.2 | |
| | | Z | 6.70 | 68.1 | 20.4 | | 140.0 | |
| 10147-CAC | LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 64-QAM) | X | 6.74 | 67.4 | 20.1 | 6.72 | 124.3 | ±1.7 % |
| | | Y | 6.55 | 66.4 | 19.4 | | 119.3 | |
| | | Z | 6.97 | 68.3 | 20.7 | | 140.2 | |
| 10149-CAB | LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM) | X | 7.35 | 67.4 | 19.9 | 6.42 | 138.2 | ±1.4 % |
| | | Y | 7.17 | 66.5 | 19.2 | | 133.3 | |
| | | Z | 6.97 | 66.3 | 19.4 | | 109.6 | |
| 10150-CAB | LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM) | X | 7.61 | 67.7 | 20.1 | 6.60 | 140.5 | ±1.4 % |
| | | Y | 7.45 | 66.9 | 19.5 | | 135.0 | |
| | | Z | 7.22 | 66.5 | 19.6 | | 112.4 | |
| 10154-CAC | LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK) | X | 6.03 | 66.4 | 19.2 | 5.75 | 127.0 | ±1.4 % |
| | | Y | 5.85 | 65.3 | 18.4 | | 122.3 | |
| | | Z | 6.24 | 67.3 | 19.8 | | 145.2 | |
| 10155-CAC | LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM) | X | 7.06 | 67.2 | 19.8 | 6.43 | 134.1 | ±1.4 % |
| | | Y | 6.91 | 66.4 | 19.2 | | 128.7 | |
| | | Z | 6.69 | 66.1 | 19.3 | | 107.1 | |
| 10156-CAC | LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK) | X | 5.76 | 66.0 | 19.1 | 5.79 | 123.3 | ±1.2 % |
| | | Y | 5.63 | 65.1 | 18.3 | | 118.7 | |
| | | Z | 5.97 | 67.0 | 19.7 | | 139.3 | |
| 10157-CAC | LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM) | X | 6.80 | 67.2 | 19.9 | 6.49 | 128.7 | ±1.4 % |
| | | Y | 6.62 | 66.3 | 19.2 | | 123.2 | |
| | | Z | 6.99 | 68.0 | 20.4 | | 144.9 | |
| 10158-CAC | LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM) | X | 7.30 | 67.4 | 20.0 | 6.62 | 134.5 | ±1.4 % |
| | | Y | 7.12 | 66.5 | 19.3 | | 129.0 | |
| | | Z | 6.91 | 66.3 | 19.5 | | 107.5 | |
| 10159-CAC | LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM) | X | 6.91 | 67.4 | 20.0 | 6.56 | 129.3 | ±1.4 % |
| | | Y | 6.69 | 66.3 | 19.2 | | 123.1 | |
| | | Z | 7.12 | 68.2 | 20.5 | | 145.9 | |
| 10160-CAB | LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK) | X | 6.54 | 67.1 | 19.6 | 5.82 | 132.9 | ±1.4 % |
| | | Y | 6.29 | 65.9 | 18.7 | | 126.6 | |
| | | Z | 6.71 | 67.9 | 20.0 | | 149.3 | |
| 10161-CAB | LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM) | X | 7.41 | 67.6 | 20.0 | 6.43 | 139.7 | ±1.7 % |
| | | Y | 7.22 | 66.6 | 19.3 | | 133.2 | |
| | | Z | 6.97 | 66.2 | 19.3 | | 110.0 | |

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|-----------|--|---|------|------|------|------|-------|--------|
| 10162-CAB | LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM) | X | 7.66 | 67.9 | 20.2 | 6.58 | 141.5 | ±1.7 % |
| | | Y | 7.48 | 67.0 | 19.5 | | 134.6 | |
| | | Z | 7.18 | 66.4 | 19.5 | | 112.1 | |
| 10166-CAC | LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK) | X | 4.96 | 65.8 | 18.8 | 5.46 | 115.4 | ±0.9 % |
| | | Y | 4.76 | 64.5 | 17.9 | | 110.2 | |
| | | Z | 5.13 | 66.5 | 19.3 | | 130.4 | |
| 10167-CAC | LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM) | X | 5.82 | 66.9 | 19.6 | 6.21 | 117.4 | ±1.2 % |
| | | Y | 5.60 | 65.7 | 18.8 | | 109.9 | |
| | | Z | 6.07 | 67.9 | 20.3 | | 132.7 | |
| 10168-CAC | LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 64-QAM) | X | 6.28 | 67.1 | 20.0 | 6.79 | 117.2 | ±1.4 % |
| | | Y | 6.06 | 66.0 | 19.2 | | 111.0 | |
| | | Z | 6.49 | 67.9 | 20.6 | | 132.0 | |
| 10169-CAB | LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK) | X | 4.78 | 65.8 | 19.1 | 5.73 | 109.6 | ±1.2 % |
| | | Y | 4.92 | 66.1 | 19.0 | | 145.3 | |
| | | Z | 4.94 | 66.5 | 19.6 | | 123.2 | |
| 10170-CAB | LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM) | X | 5.36 | 66.3 | 19.7 | 6.52 | 107.4 | ±1.4 % |
| | | Y | 5.59 | 67.0 | 19.8 | | 142.7 | |
| | | Z | 5.61 | 67.4 | 20.4 | | 121.7 | |
| 10171-AAB | LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM) | X | 5.38 | 66.5 | 19.7 | 6.49 | 107.3 | ±1.4 % |
| | | Y | 5.59 | 67.1 | 19.8 | | 144.6 | |
| | | Z | 5.64 | 67.6 | 20.4 | | 121.5 | |
| 10175-CAC | LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK) | X | 4.71 | 65.4 | 18.6 | 5.72 | 107.7 | ±1.2 % |
| | | Y | 4.91 | 66.0 | 18.9 | | 144.8 | |
| | | Z | 4.91 | 66.3 | 19.4 | | 122.3 | |
| 10176-CAC | LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM) | X | 5.78 | 68.1 | 20.6 | 6.52 | 149.6 | ±1.4 % |
| | | Y | 5.57 | 66.9 | 19.7 | | 142.9 | |
| | | Z | 5.65 | 67.6 | 20.5 | | 121.7 | |
| 10177-CAE | LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK) | X | 5.05 | 67.1 | 19.7 | 5.73 | 150.0 | ±1.2 % |
| | | Y | 4.91 | 66.0 | 18.9 | | 144.6 | |
| | | Z | 4.93 | 66.5 | 19.5 | | 122.4 | |
| 10178-CAC | LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM) | X | 5.80 | 68.2 | 20.7 | 6.52 | 149.3 | ±1.4 % |
| | | Y | 5.59 | 67.0 | 19.8 | | 142.5 | |
| | | Z | 5.63 | 67.5 | 20.4 | | 121.7 | |
| 10179-CAC | LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM) | X | 5.80 | 68.3 | 20.7 | 6.50 | 149.2 | ±1.4 % |
| | | Y | 5.62 | 67.2 | 19.9 | | 144.8 | |
| | | Z | 5.61 | 67.5 | 20.4 | | 121.4 | |
| 10180-CAC | LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM) | X | 5.80 | 68.3 | 20.7 | 6.50 | 148.6 | ±1.4 % |
| | | Y | 5.60 | 67.1 | 19.8 | | 144.4 | |
| | | Z | 5.63 | 67.5 | 20.4 | | 121.6 | |
| 10181-CAB | LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK) | X | 5.04 | 67.0 | 19.7 | 5.72 | 149.4 | ±1.2 % |
| | | Y | 4.94 | 66.2 | 19.1 | | 145.5 | |
| | | Z | 4.92 | 66.4 | 19.5 | | 122.1 | |
| 10182-CAB | LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM) | X | 5.79 | 68.2 | 20.7 | 6.52 | 148.9 | ±1.4 % |
| | | Y | 5.57 | 66.9 | 19.7 | | 142.2 | |
| | | Z | 5.63 | 67.5 | 20.5 | | 121.0 | |

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| | | | | | | | | |
|-----------|---|---|-------|------|------|------|-------|--------|
| 10183-AAA | LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM) | X | 5.81 | 68.4 | 20.8 | 6.50 | 148.4 | ±1.4 % |
| | | Y | 5.62 | 67.2 | 19.9 | | 144.3 | |
| | | Z | 5.62 | 67.5 | 20.4 | | 121.1 | |
| 10184-CAC | LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK) | X | 5.06 | 67.1 | 19.8 | 5.73 | 149.2 | ±1.2 % |
| | | Y | 4.91 | 66.0 | 18.9 | | 144.9 | |
| | | Z | 4.94 | 66.5 | 19.5 | | 122.0 | |
| 10185-CAC | LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM) | X | 5.77 | 68.1 | 20.6 | 6.51 | 148.4 | ±1.4 % |
| | | Y | 5.57 | 66.9 | 19.8 | | 142.5 | |
| | | Z | 5.62 | 67.5 | 20.4 | | 121.5 | |
| 10186-AAC | LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM) | X | 5.81 | 68.4 | 20.8 | 6.50 | 148.0 | ±1.7 % |
| | | Y | 5.63 | 67.3 | 19.9 | | 144.7 | |
| | | Z | 5.60 | 67.5 | 20.3 | | 121.0 | |
| 10187-CAC | LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK) | X | 5.07 | 67.1 | 19.8 | 5.73 | 149.3 | ±1.2 % |
| | | Y | 4.94 | 66.2 | 19.0 | | 145.6 | |
| | | Z | 4.91 | 66.3 | 19.4 | | 122.3 | |
| 10188-CAC | LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM) | X | 5.79 | 68.2 | 20.7 | 6.52 | 148.1 | ±1.7 % |
| | | Y | 5.57 | 66.9 | 19.7 | | 142.5 | |
| | | Z | 5.61 | 67.4 | 20.4 | | 121.2 | |
| 10189-AAC | LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM) | X | 5.83 | 68.5 | 20.8 | 6.50 | 148.1 | ±1.4 % |
| | | Y | 5.60 | 67.1 | 19.8 | | 144.5 | |
| | | Z | 5.64 | 67.6 | 20.4 | | 121.5 | |
| 10193-CAB | IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK) | X | 9.64 | 67.7 | 20.6 | 8.09 | 112.5 | ±2.2 % |
| | | Y | 9.63 | 67.5 | 20.3 | | 109.6 | |
| | | Z | 10.04 | 68.9 | 21.4 | | 132.4 | |
| 10194-CAB | IEEE 802.11n (HT Greenfield, 39 Mbps, 16-QAM) | X | 9.78 | 68.0 | 20.9 | 8.12 | 116.1 | ±2.2 % |
| | | Y | 9.67 | 67.5 | 20.4 | | 110.9 | |
| | | Z | 10.06 | 68.9 | 21.5 | | 131.8 | |
| 10195-CAB | IEEE 802.11n (HT Greenfield, 65 Mbps, 64-QAM) | X | 9.93 | 68.3 | 21.0 | 8.21 | 117.1 | ±2.5 % |
| | | Y | 9.81 | 67.7 | 20.5 | | 112.3 | |
| | | Z | 10.19 | 69.1 | 21.5 | | 134.2 | |
| 10196-CAB | IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK) | X | 9.73 | 68.0 | 20.8 | 8.10 | 116.3 | ±2.2 % |
| | | Y | 9.62 | 67.5 | 20.3 | | 111.7 | |
| | | Z | 10.01 | 68.9 | 21.4 | | 132.6 | |
| 10197-CAB | IEEE 802.11n (HT Mixed, 39 Mbps, 16-QAM) | X | 9.77 | 68.0 | 20.8 | 8.13 | 116.4 | ±2.2 % |
| | | Y | 9.75 | 67.7 | 20.5 | | 111.4 | |
| | | Z | 10.10 | 69.0 | 21.5 | | 132.9 | |
| 10198-CAB | IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM) | X | 9.96 | 68.2 | 21.0 | 8.27 | 117.4 | ±2.5 % |
| | | Y | 9.88 | 67.8 | 20.6 | | 112.8 | |
| | | Z | 10.29 | 69.3 | 21.7 | | 135.1 | |
| 10219-CAB | IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK) | X | 9.62 | 67.9 | 20.8 | 8.03 | 116.5 | ±2.2 % |
| | | Y | 9.53 | 67.4 | 20.3 | | 111.0 | |
| | | Z | 9.94 | 68.9 | 21.4 | | 132.9 | |
| 10220-CAB | IEEE 802.11n (HT Mixed, 43.3 Mbps, 16-QAM) | X | 9.81 | 68.1 | 20.9 | 8.13 | 117.2 | ±2.2 % |
| | | Y | 9.70 | 67.6 | 20.4 | | 111.6 | |
| | | Z | 10.10 | 69.0 | 21.5 | | 134.0 | |

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| | | | | | | | | |
|-----------|---|---|-------|------|------|------|-------|--------|
| 10221-CAB | IEEE 802.11n (HT Mixed, 72.2 Mbps, 64-QAM) | X | 9.97 | 68.2 | 21.0 | 8.27 | 118.3 | ±2.5 % |
| | | Y | 9.89 | 67.8 | 20.6 | | 112.7 | |
| | | Z | 10.29 | 69.2 | 21.7 | | 135.4 | |
| 10222-CAB | IEEE 802.11n (HT Mixed, 15 Mbps, BPSK) | X | 10.14 | 68.4 | 20.9 | 8.06 | 122.8 | ±2.5 % |
| | | Y | 10.02 | 67.9 | 20.5 | | 116.9 | |
| | | Z | 10.48 | 69.4 | 21.6 | | 140.6 | |
| 10223-CAB | IEEE 802.11n (HT Mixed, 90 Mbps, 16-QAM) | X | 10.72 | 69.0 | 21.4 | 8.48 | 126.2 | ±2.5 % |
| | | Y | 10.54 | 68.3 | 20.9 | | 119.3 | |
| | | Z | 11.04 | 69.9 | 22.1 | | 143.9 | |
| 10224-CAB | IEEE 802.11n (HT Mixed, 150 Mbps, 64-QAM) | X | 10.13 | 68.4 | 20.9 | 8.08 | 123.4 | ±2.5 % |
| | | Y | 10.01 | 68.0 | 20.5 | | 115.7 | |
| | | Z | 10.44 | 69.3 | 21.5 | | 140.3 | |
| 10225-CAB | UMTS-FDD (HSPA+) | X | 7.19 | 67.5 | 19.6 | 5.97 | 143.8 | ±1.4 % |
| | | Y | 7.05 | 66.7 | 19.0 | | 138.4 | |
| | | Z | 6.78 | 66.2 | 19.0 | | 112.5 | |
| 10274-CAB | UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10) | X | 6.03 | 66.9 | 18.8 | 4.87 | 136.9 | ±1.2 % |
| | | Y | 5.89 | 66.1 | 18.1 | | 131.5 | |
| | | Z | 5.76 | 66.1 | 18.5 | | 109.1 | |
| 10275-CAB | UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4) | X | 4.32 | 65.7 | 18.0 | 3.96 | 119.3 | ±0.9 % |
| | | Y | 4.16 | 64.5 | 17.1 | | 112.7 | |
| | | Z | 4.57 | 66.9 | 18.7 | | 136.2 | |
| 10297-AAA | LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK) | X | 6.29 | 66.6 | 19.2 | 5.81 | 126.9 | ±1.4 % |
| | | Y | 6.12 | 65.6 | 18.5 | | 120.7 | |
| | | Z | 6.52 | 67.5 | 19.8 | | 142.9 | |
| 10298-AAB | LTE-FDD (SC-FDMA, 50% RB, 3 MHz, QPSK) | X | 5.62 | 66.1 | 19.1 | 5.72 | 120.8 | ±1.2 % |
| | | Y | 5.44 | 65.0 | 18.3 | | 115.1 | |
| | | Z | 5.80 | 66.9 | 19.6 | | 136.0 | |
| 10299-AAB | LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM) | X | 6.55 | 67.1 | 19.8 | 6.39 | 125.4 | ±1.4 % |
| | | Y | 6.35 | 66.1 | 19.0 | | 119.2 | |
| | | Z | 6.82 | 68.2 | 20.5 | | 140.5 | |
| 10300-AAB | LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 64-QAM) | X | 6.73 | 67.3 | 20.0 | 6.60 | 125.1 | ±1.4 % |
| | | Y | 6.53 | 66.3 | 19.2 | | 118.8 | |
| | | Z | 6.99 | 68.2 | 20.6 | | 140.9 | |
| 10311-AAA | LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK) | X | 6.94 | 67.4 | 19.7 | 6.06 | 135.3 | ±1.4 % |
| | | Y | 6.75 | 66.4 | 19.0 | | 129.1 | |
| | | Z | 6.55 | 66.2 | 19.2 | | 106.3 | |
| 10315-AAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle) | X | 2.71 | 67.3 | 17.7 | 1.71 | 120.4 | ±0.5 % |
| | | Y | 2.36 | 64.0 | 15.7 | | 114.8 | |
| | | Z | 2.97 | 68.9 | 18.7 | | 133.5 | |
| 10316-AAB | IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle) | X | 9.89 | 68.1 | 21.1 | 8.36 | 116.2 | ±2.5 % |
| | | Y | 9.75 | 67.5 | 20.5 | | 108.9 | |
| | | Z | 10.15 | 69.0 | 21.6 | | 131.4 | |
| 10317-AAB | IEEE 802.11a WiFi 5 GHz (OFDM, 6 Mbps, 96pc duty cycle) | X | 9.89 | 68.1 | 21.1 | 8.36 | 116.7 | ±2.5 % |
| | | Y | 9.76 | 67.6 | 20.6 | | 110.0 | |
| | | Z | 10.16 | 69.0 | 21.7 | | 132.3 | |

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|-----------|--|---|-------|------|------|------|-------|--------|
| 10415-AAA | IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle) | X | 2.58 | 66.6 | 17.4 | 1.54 | 122.6 | ±0.5 % |
| | | Y | 2.36 | 64.2 | 15.8 | | 117.2 | |
| | | Z | 2.79 | 68.0 | 18.2 | | 136.1 | |
| 10416-AAA | IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle) | X | 9.83 | 68.1 | 21.0 | 8.23 | 117.6 | ±2.2 % |
| | | Y | 9.72 | 67.6 | 20.5 | | 110.8 | |
| | | Z | 10.12 | 69.0 | 21.6 | | 132.8 | |
| 10417-AAA | IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 99pc duty cycle) | X | 9.82 | 68.1 | 20.9 | 8.23 | 117.7 | ±2.2 % |
| | | Y | 9.76 | 67.7 | 20.5 | | 111.5 | |
| | | Z | 10.11 | 69.0 | 21.6 | | 133.6 | |
| 10418-AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Long preamble) | X | 9.69 | 68.0 | 20.9 | 8.14 | 116.6 | ±2.2 % |
| | | Y | 9.59 | 67.5 | 20.4 | | 110.3 | |
| | | Z | 9.95 | 68.8 | 21.4 | | 131.4 | |
| 10419-AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Short preamble) | X | 9.76 | 68.1 | 20.9 | 8.19 | 117.3 | ±2.2 % |
| | | Y | 9.70 | 67.6 | 20.5 | | 111.1 | |
| | | Z | 10.04 | 68.9 | 21.5 | | 132.4 | |
| 10422-AAA | IEEE 802.11n (HT Greenfield, 7.2 Mbps, BPSK) | X | 10.03 | 68.4 | 21.1 | 8.32 | 119.6 | ±2.5 % |
| | | Y | 9.90 | 67.7 | 20.6 | | 112.8 | |
| | | Z | 10.29 | 69.2 | 21.7 | | 133.6 | |
| 10423-AAA | IEEE 802.11n (HT Greenfield, 43.3 Mbps, 16-QAM) | X | 10.19 | 68.5 | 21.3 | 8.47 | 120.0 | ±2.5 % |
| | | Y | 10.08 | 68.0 | 20.8 | | 112.9 | |
| | | Z | 10.43 | 69.3 | 21.6 | | 134.2 | |
| 10424-AAA | IEEE 802.11n (HT Greenfield, 72.2 Mbps, 64-QAM) | X | 10.08 | 68.4 | 21.2 | 8.40 | 119.6 | ±2.5 % |
| | | Y | 9.96 | 67.8 | 20.7 | | 112.6 | |
| | | Z | 10.33 | 69.2 | 21.6 | | 133.7 | |
| 10425-AAA | IEEE 802.11n (HT Greenfield, 15 Mbps, BPSK) | X | 10.62 | 68.9 | 21.4 | 8.41 | 126.1 | ±2.7 % |
| | | Y | 10.42 | 68.2 | 20.8 | | 117.7 | |
| | | Z | 10.92 | 69.8 | 22.0 | | 142.2 | |
| 10426-AAA | IEEE 802.11n (HT Greenfield, 90 Mbps, 16-QAM) | X | 10.66 | 69.0 | 21.5 | 8.45 | 126.5 | ±2.7 % |
| | | Y | 10.43 | 68.2 | 20.8 | | 118.2 | |
| | | Z | 10.95 | 69.8 | 22.0 | | 142.5 | |
| 10427-AAA | IEEE 802.11n (HT Greenfield, 150 Mbps, 64-QAM) | X | 10.65 | 69.0 | 21.4 | 8.41 | 126.9 | ±2.7 % |
| | | Y | 10.40 | 68.2 | 20.8 | | 118.2 | |
| | | Z | 10.92 | 69.8 | 22.0 | | 142.7 | |
| 10434-AAA | W-CDMA (BS Test Model 1, 64 DPCH) | X | 9.04 | 67.7 | 21.1 | 8.60 | 103.3 | ±2.7 % |
| | | Y | 9.68 | 69.3 | 21.7 | | 143.5 | |
| | | Z | 9.37 | 68.8 | 21.8 | | 116.7 | |

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

^a The uncertainties of Norm X, Y, Z do not affect the E² field uncertainty inside TSL (see Pages 12 and 13).

^b Numerical linearization parameter; uncertainty not required.

^c 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

Calibration Parameter Determined in Head Tissue Simulating Media

| f (MHz) ^c | Relative Permittivity ^e | Conductivity (S/m) ^e | ConvF X | ConvF Y | ConvF Z | Alpha ^d | Depth (mm) | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|--------------------|------------|-------------|
| 150 | 52.3 | 0.76 | 12.95 | 12.95 | 12.95 | 0.00 | 1.00 | ± 13.3 % |
| 300 | 45.3 | 0.87 | 11.95 | 11.95 | 11.95 | 0.10 | 1.10 | ± 13.3 % |
| 450 | 43.5 | 0.87 | 10.72 | 10.72 | 10.72 | 0.15 | 1.10 | ± 13.3 % |
| 750 | 41.9 | 0.89 | 10.01 | 10.01 | 10.01 | 0.29 | 1.06 | ± 12.0 % |
| 900 | 41.5 | 0.97 | 9.26 | 9.26 | 9.26 | 0.24 | 1.23 | ± 12.0 % |
| 1810 | 40.0 | 1.40 | 7.93 | 7.93 | 7.93 | 0.33 | 0.80 | ± 12.0 % |
| 1900 | 40.0 | 1.40 | 7.93 | 7.93 | 7.93 | 0.35 | 0.80 | ± 12.0 % |
| 2450 | 39.2 | 1.80 | 7.18 | 7.18 | 7.18 | 0.27 | 0.98 | ± 12.0 % |
| 2600 | 39.0 | 1.96 | 6.93 | 6.93 | 6.93 | 0.34 | 0.93 | ± 12.0 % |
| 5200 | 36.0 | 4.66 | 5.22 | 5.22 | 5.22 | 0.35 | 1.80 | ± 13.1 % |
| 5300 | 35.9 | 4.76 | 5.00 | 5.00 | 5.00 | 0.35 | 1.80 | ± 13.1 % |
| 5500 | 35.6 | 4.96 | 4.75 | 4.75 | 4.75 | 0.40 | 1.80 | ± 13.1 % |
| 5600 | 35.5 | 5.07 | 4.64 | 4.64 | 4.64 | 0.40 | 1.80 | ± 13.1 % |
| 5800 | 35.3 | 5.27 | 4.52 | 4.52 | 4.52 | 0.40 | 1.80 | ± 13.1 % |

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

^e 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.

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

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

Calibration Parameter Determined in Body Tissue Simulating Media

| f (MHz) ^c | Relative Permittivity ^e | Conductivity (S/m) ^f | ConvF X | ConvF Y | ConvF Z | Alpha ^g | Depth ^h (mm) | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|--------------------|-------------------------|-------------|
| 150 | 61.9 | 0.80 | 12.28 | 12.28 | 12.28 | 0.00 | 1.00 | ± 13.3 % |
| 300 | 58.2 | 0.92 | 11.24 | 11.24 | 11.24 | 0.08 | 1.10 | ± 13.3 % |
| 450 | 56.7 | 0.94 | 11.02 | 11.02 | 11.02 | 0.09 | 1.10 | ± 13.3 % |
| 750 | 55.5 | 0.96 | 9.42 | 9.42 | 9.42 | 0.27 | 1.06 | ± 12.0 % |
| 900 | 55.0 | 1.05 | 9.20 | 9.20 | 9.20 | 0.27 | 1.22 | ± 12.0 % |
| 1810 | 53.3 | 1.52 | 7.75 | 7.75 | 7.75 | 0.43 | 0.85 | ± 12.0 % |
| 1900 | 53.3 | 1.52 | 7.57 | 7.57 | 7.57 | 0.47 | 0.80 | ± 12.0 % |
| 2450 | 52.7 | 1.95 | 7.33 | 7.33 | 7.33 | 0.35 | 0.90 | ± 12.0 % |
| 2600 | 52.5 | 2.16 | 7.17 | 7.17 | 7.17 | 0.31 | 0.95 | ± 12.0 % |
| 5200 | 49.0 | 5.30 | 4.52 | 4.52 | 4.52 | 0.45 | 1.90 | ± 13.1 % |
| 5300 | 48.9 | 5.42 | 4.29 | 4.29 | 4.29 | 0.45 | 1.90 | ± 13.1 % |
| 5500 | 48.6 | 5.65 | 3.92 | 3.92 | 3.92 | 0.50 | 1.90 | ± 13.1 % |
| 5600 | 48.5 | 5.77 | 3.74 | 3.74 | 3.74 | 0.50 | 1.90 | ± 13.1 % |
| 5800 | 48.2 | 6.00 | 4.06 | 4.06 | 4.06 | 0.50 | 1.90 | ± 13.1 % |

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

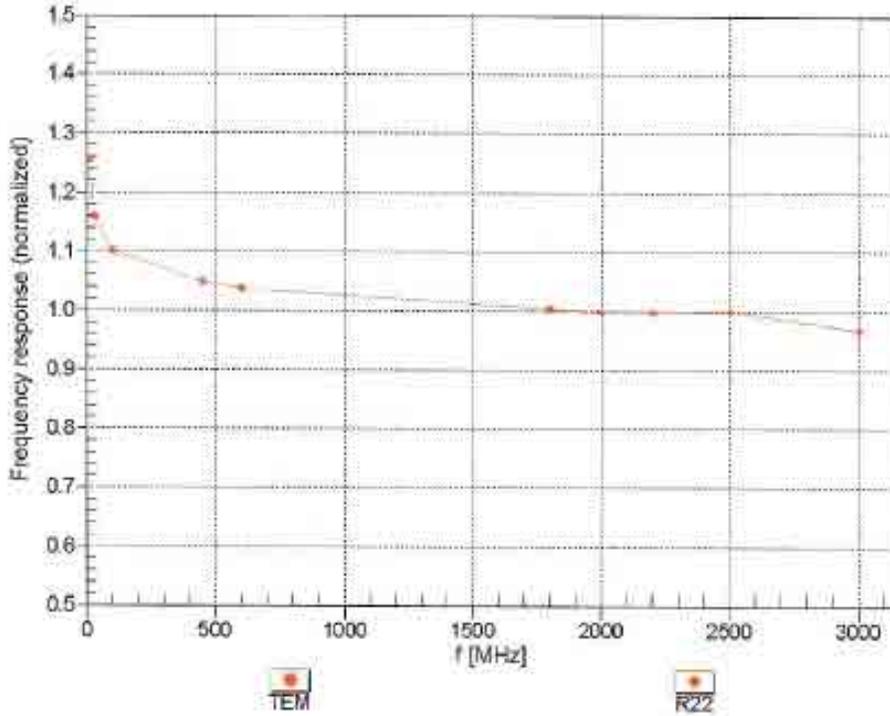
^e At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty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

EX3DV4-SN:7364

June 23, 2015

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



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

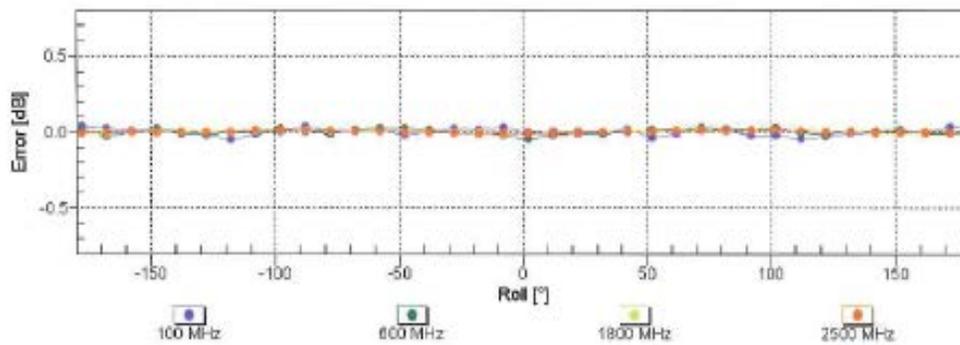
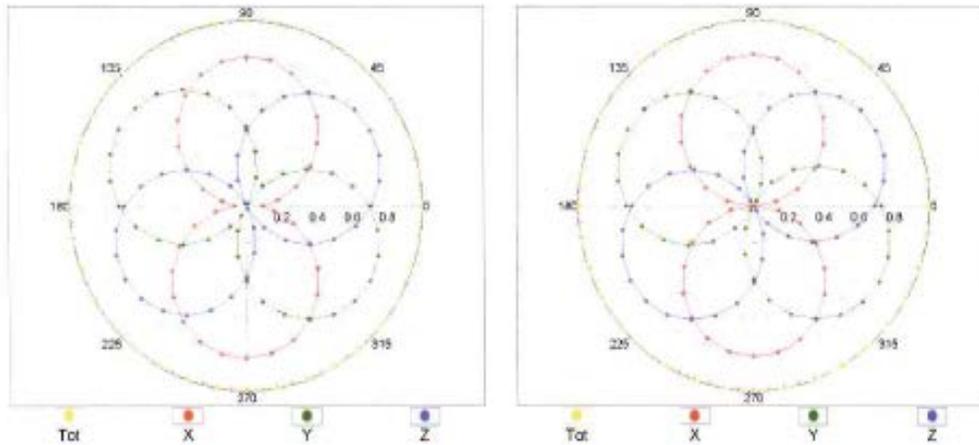
EX3DV4-SN:7364

June 23, 2015

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

f=600 MHz,TEM

f=1800 MHz,R22

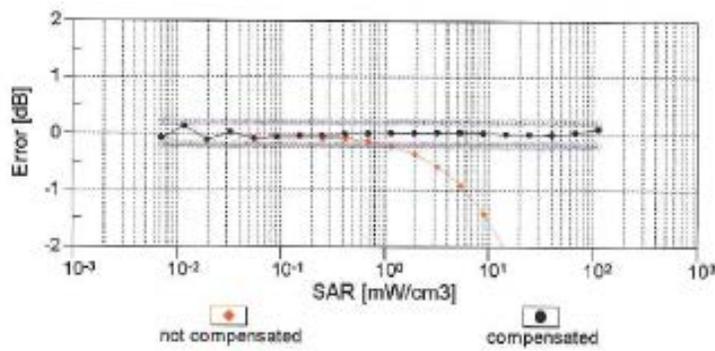
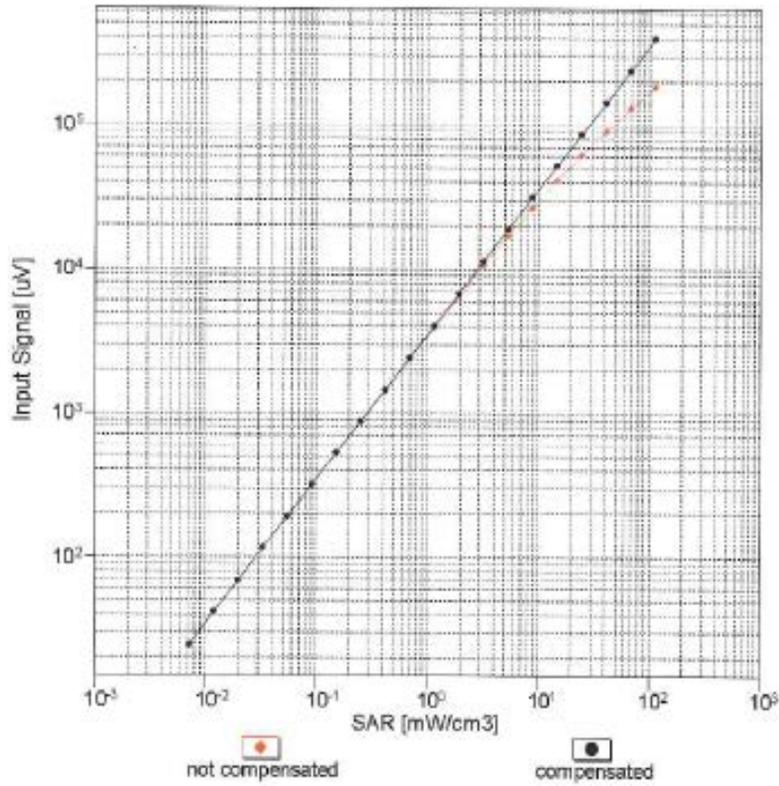


Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

EX3DV4- SN:7364

June 23, 2015

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

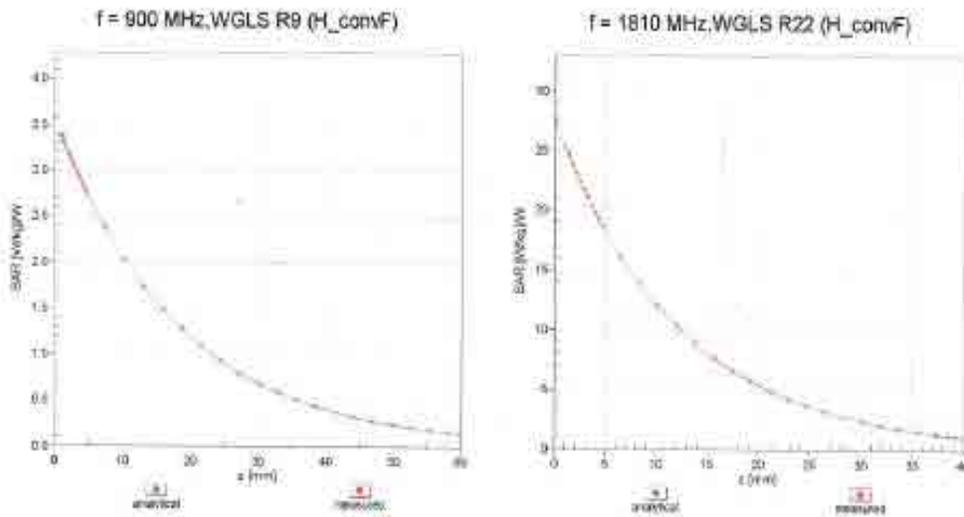


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

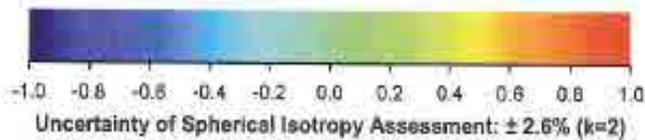
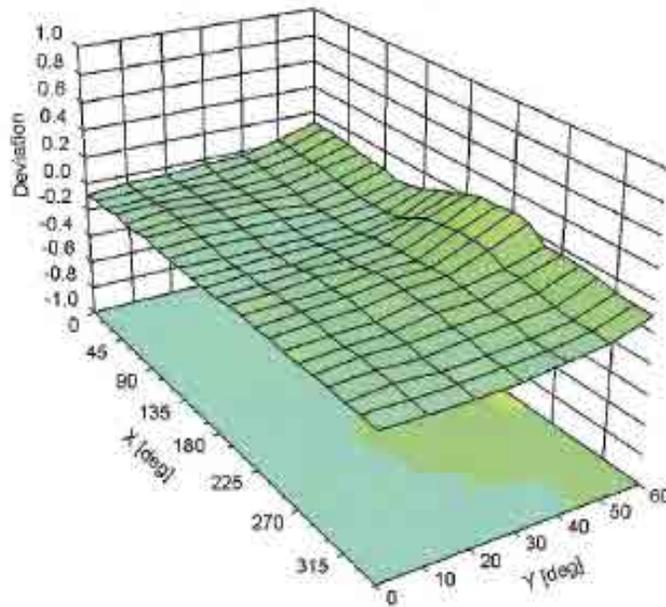
EX3DV4- SN:7364

June 23, 2015

Conversion Factor Assessment



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



EX3DV4- SN:7364

June 23, 2015

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

Other Probe Parameters

| | |
|---|------------|
| Sensor Arrangement | Triangular |
| Connector Angle (°) | 132.1 |
| Mechanical Surface Detection Mode | enabled |
| Optical Surface Detection Mode | disabled |
| Probe Overall Length | 337 mm |
| Probe Body Diameter | 10 mm |
| Tip Length | 9 mm |
| Tip Diameter | 2.5 mm |
| Probe Tip to Sensor X Calibration Point | 1 mm |
| Probe Tip to Sensor Y Calibration Point | 1 mm |
| Probe Tip to Sensor Z Calibration Point | 1 mm |
| Recommended Measurement Distance from Surface | 1.4 mm |

Appendix C

Dipole Calibration Certificates

**Calibration Laboratory of
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Zeughausstrasse 43, 8004 Zurich, Switzerland



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Accreditation No.: **SCS 0108**

Client **Motorola Solutions MY**

Certificate No: **D450V3-1053_Mar15**

CALIBRATION CERTIFICATE

Object: **D450V3 - SN:1053**

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

Calibration date: **March 17, 2015**

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|-----------------------------|--------------------|-----------------------------------|------------------------|
| Power meter E4419B | GB41293374 | 03-Apr-14 (No. 217-01911) | Apr-15 |
| Power sensor E4412A | MY41498267 | 03-Apr-14 (No. 217-01911) | Apr-15 |
| Reference 3 dB Attenuator | SN: S5054 (3c) | 03-Apr-14 (No. 217-01915) | Apr-15 |
| Reference 20 dB Attenuator | SN: S5058 (20k) | 03-Apr-14 (No. 217-01918) | Apr-15 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 03-Apr-14 (No. 217-01921) | Apr-15 |
| Reference Probe ET3DV8 | SN: 1507 | 30-Dec-14 (No. ET3-1507_Dec14) | Dec-15 |
| DAE4 | SN: 654 | 30-Jun-14 (No. DAE4-654_Jun14) | Jun-15 |
| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
| RF generator HP 8648C | US3642U01700 | 04-Aug-09 (in house check Apr-13) | In house check: Apr-16 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-14) | In house check: Oct-16 |

| | | | |
|----------------|-----------------------|-----------------------------------|---------------|
| Calibrated by: | Name Jeton Kasrati | Function Laboratory Technician | Signature |
| Approved by: | Name Katja Pokovic | Function Technical Manager | Signature |

Issued: March 17, 2015

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- c) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

| | | |
|------------------------------|------------------------|-----------------------------|
| DASY Version | DASY5 | V52.8.8 |
| Extrapolation | Advanced Extrapolation | |
| Phantom | ELI4 Flat Phantom | Shell thickness: 2 ± 0.2 mm |
| Distance Dipole Center - TSL | 15 mm | with Spacer |
| Zoom Scan Resolution | dx, dy, dz = 5 mm | |
| Frequency | 450 MHz ± 1 MHz | |

Head TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters | 22.0 °C | 43.5 | 0.87 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 43.9 ± 6 % | 0.88 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 W input power | 1.12 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 4.45 W/kg ± 18.1 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
|---|-------------------|---------------------------------|
| SAR measured | 250 W input power | 0.747 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 2.97 W/kg ± 17.6 % (k=2) |

Body TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Body TSL parameters | 22.0 °C | 56.7 | 0.94 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 56.7 ± 6 % | 0.97 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 W input power | 1.13 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 4.41 W/kg ± 18.1 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Body TSL | condition | |
|---|-------------------|---------------------------------|
| SAR measured | 250 W input power | 0.746 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 2.92 W/kg ± 17.6 % (k=2) |

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

| | |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 57.2 Ω - 2.2 j Ω |
| Return Loss | - 23.1 dB |

Antenna Parameters with Body TSL

| | |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 55.2 Ω - 5.3 j Ω |
| Return Loss | - 23.0 dB |

General Antenna Parameters and Design

| | |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1,350 ns |
|----------------------------------|----------|

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

| | |
|-----------------|-------------------|
| Manufactured by | SPEAG |
| Manufactured on | December 16, 2005 |

DASY5 Validation Report for Head TSL

Date: 17.03.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN:1053

Communication System: UID 0 - CW; Frequency: 450 MHz

Medium parameters used: $f = 450 \text{ MHz}$; $\sigma = 0.88 \text{ S/m}$; $\epsilon_r = 43.9$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(6.58, 6.58, 6.58); Calibrated: 30.12.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 30.06.2014
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

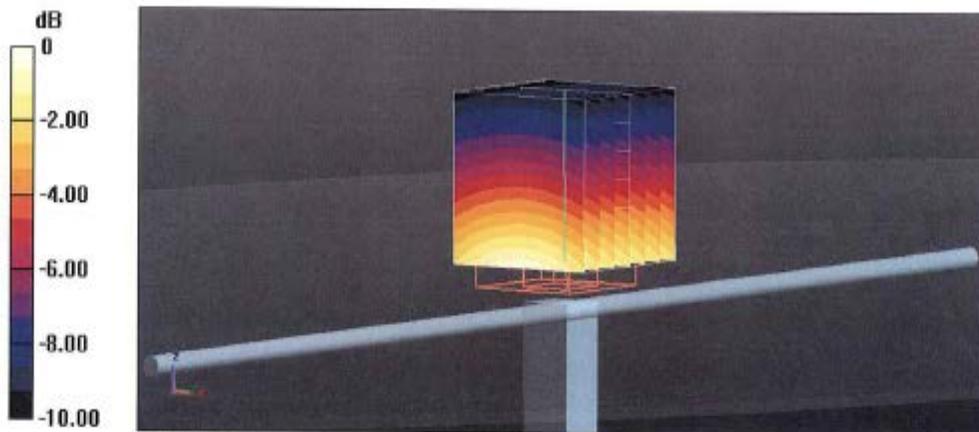
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 38.88 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 1.61 W/kg

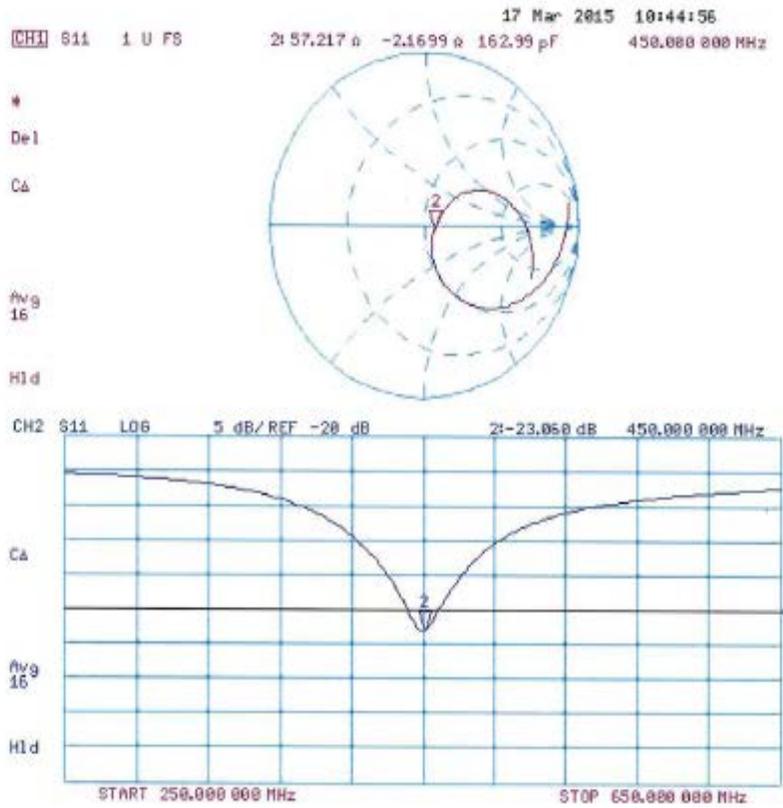
SAR(1 g) = 1.12 W/kg; SAR(10 g) = 0.747 W/kg

Maximum value of SAR (measured) = 1.20 W/kg



0 dB = 1.20 W/kg = 0.79 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 17.03.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN:1053

Communication System: UID 0 - CW; Frequency: 450 MHz

Medium parameters used: $f = 450 \text{ MHz}$; $\sigma = 0.97 \text{ S/m}$; $\epsilon_r = 56.7$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(7.05, 7.05, 7.05); Calibrated: 30.12.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 30.06.2014
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

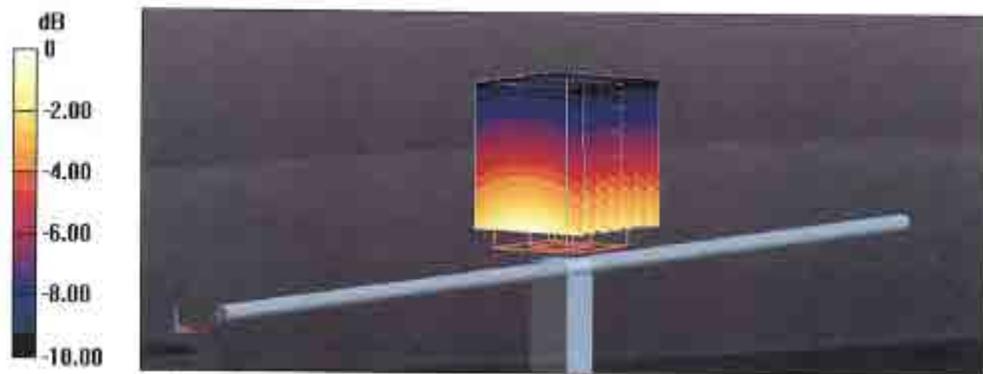
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 36.35 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 1.81 W/kg

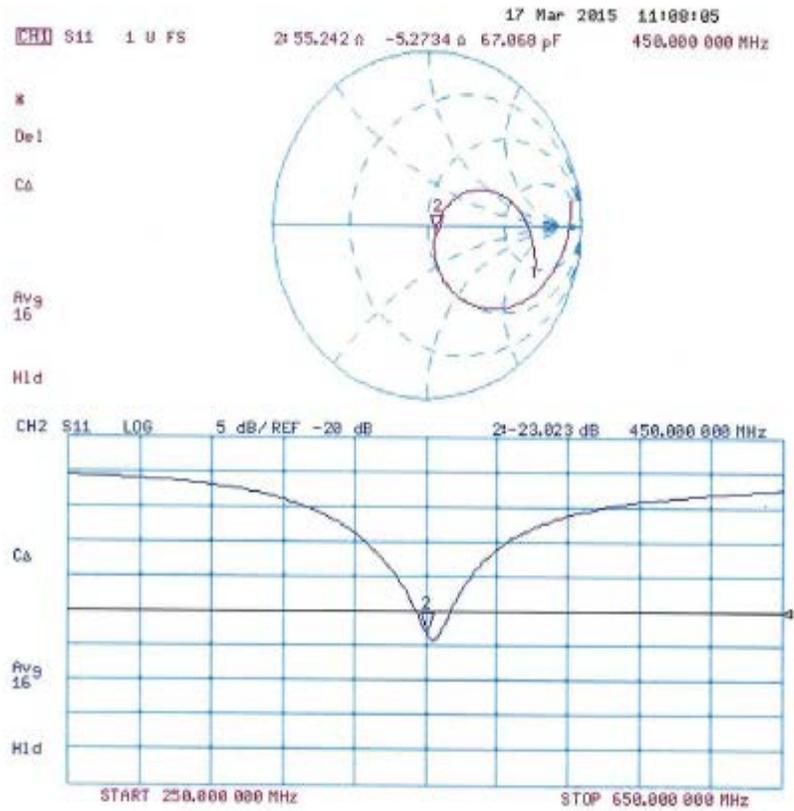
SAR(1 g) = 1.13 W/kg; SAR(10 g) = 0.746 W/kg

Maximum value of SAR (measured) = 1.21 W/kg



0 dB = 1.21 W/kg = 0.83 dBW/kg

Impedance Measurement Plot for Body TSL



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Accreditation No.: **SCS 0108**

Client **Motorola Solutions MY**

Certificate No: **D2450V2-781_Mar15**

CALIBRATION CERTIFICATE

Object: **D2450V2 - SN:781**

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

Calibration date: **March 20, 2015**

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|-----------------------------|--------------------|-----------------------------------|------------------------|
| Power meter EPM-442A | GB37480704 | 07-Oct-14 (No. 217-02020) | Oct-15 |
| Power sensor HP 8481A | LIS37292783 | 07-Oct-14 (No. 217-02020) | Oct-15 |
| Power sensor HP 8481A | MY41092317 | 07-Oct-14 (No. 217-02021) | Oct-15 |
| Reference 20 dB Attenuator | SN: 5058 (20k) | 03-Apr-14 (No. 217-01919) | Apr-15 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 03-Apr-14 (No. 217-01921) | Apr-15 |
| Reference Probe ES3DV3 | SN: 3205 | 30-Dec-14 (No. ES3-3205_Dec14) | Dec-15 |
| D4E4 | SN: 601 | 18-Aug-14 (No. D4E4-601_Aug14) | Aug-15 |
| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
| RF generator R&S SM1-05 | 100005 | 04-Aug-09 (in house check Oct-13) | In house check: Oct-16 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-14) | In house check: Oct-15 |

Calibrated by: **Israa Elneouq** (Name) / **Laboratory Technician** (Function) / *Israa Elneouq* (Signature)

Approved by: **Katja Pokovic** (Name) / **Technical Manager** (Function) / *Katja Pokovic* (Signature)

Issued: March 20, 2015

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- c) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

| | | |
|------------------------------|------------------------|-------------|
| DASY Version | DASY5 | V52.8.8 |
| Extrapolation | Advanced Extrapolation | |
| Phantom | Modular Flat Phantom | |
| Distance Dipole Center - TSL | 10 mm | with Spacer |
| Zoom Scan Resolution | dx, dy, dz = 5 mm | |
| Frequency | 2450 MHz ± 1 MHz | |

Head TSL parameters

The following parameters and calculations were applied:

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters | 22.0 °C | 39.2 | 1.80 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 37.8 ± 6 % | 1.83 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 | 13.3 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 52.3 W/kg ± 17.0 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
|---|--------------------|---------------------------------|
| SAR measured | 250 mW input power | 6.16 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 24.4 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 | 50.8 ± 6 % | 2.02 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C | ---- | ---- |

SAR result with Body TSL

| SAR averaged over 1 cm ³ (1 g) of Body TSL | Condition | |
|---|--------------------|---------------------------------|
| SAR measured | 250 mW input power | 13.3 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 51.9 W/kg ± 17.0 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Body TSL | condition | |
|---|--------------------|---------------------------------|
| SAR measured | 250 mW input power | 6.15 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 24.2 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 | 53.9 Ω + 1.2 jΩ |
| Return Loss | -29.2 dB |

Antenna Parameters with Body TSL

| | |
|--------------------------------------|-----------------|
| Impedance, transformed to feed point | 49.9 Ω + 3.2 jΩ |
| Return Loss | -30.0 dB |

General Antenna Parameters and Design

| | |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.155 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: 20.03.2015

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: $f = 2450 \text{ MHz}$; $\sigma = 1.83 \text{ S/m}$; $\epsilon_r = 37.8$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.54, 4.54, 4.54); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

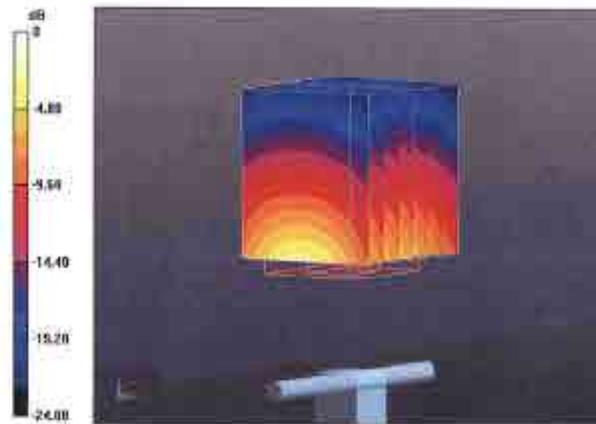
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 101.2 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 27.9 W/kg

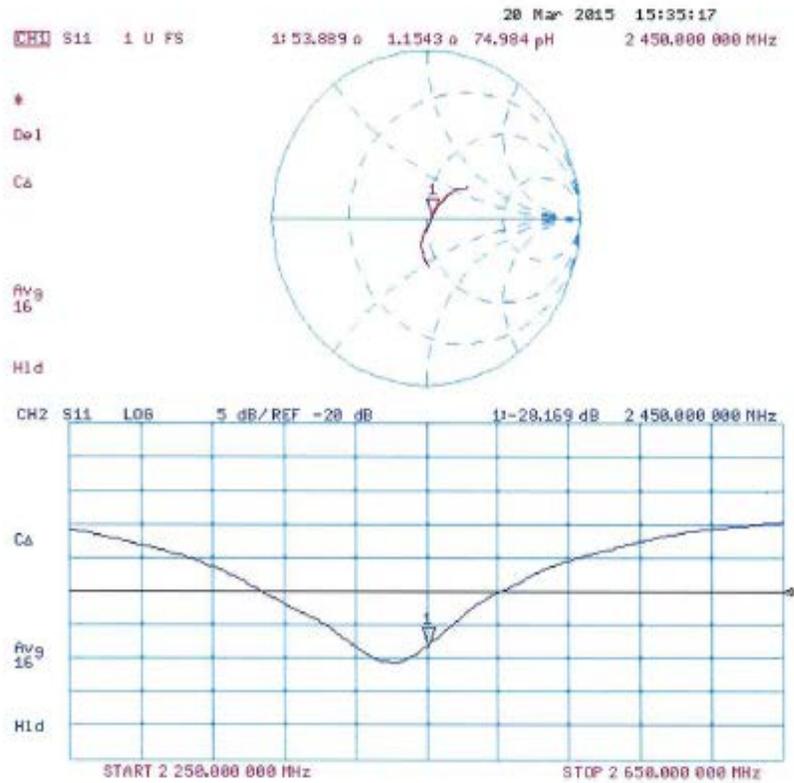
SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.16 W/kg

Maximum value of SAR (measured) = 17.4 W/kg



0 dB = 17.4 W/kg = 12.41 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 19.03.2015

Test Laboratory: SPEAG, Zurich, Switzerland

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

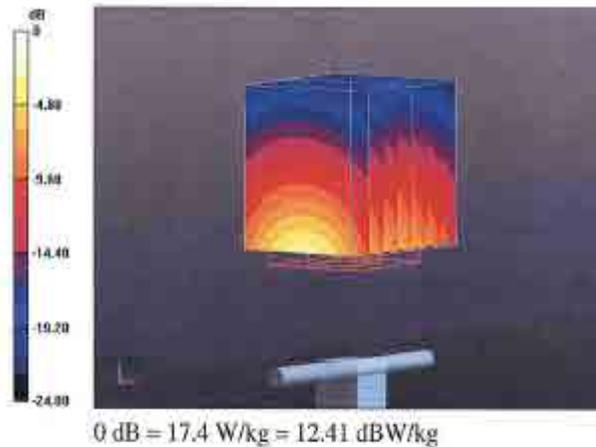
Communication System: UID 0 - CW; Frequency: 2450 MHz
 Medium parameters used: $f = 2450$ MHz; $\sigma = 2.02$ S/m; $\epsilon_r = 50.8$; $\rho = 1000$ kg/m³
 Phantom section: Flat Section
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

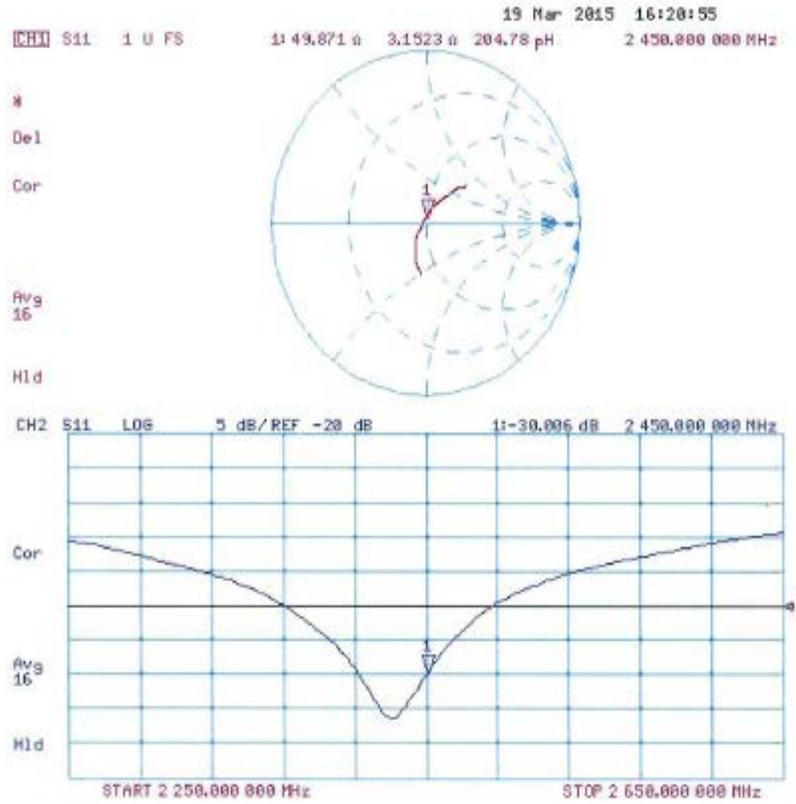
- Probe: ES3DV3 - SN3205; ConvF(4.32, 4.32, 4.32); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm
 Reference Value = 95.66 V/m; Power Drift = 0.03 dB
 Peak SAR (extrapolated) = 28.0 W/kg
SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.15 W/kg
 Maximum value of SAR (measured) = 17.4 W/kg



Impedance Measurement Plot for Body TSL



Dipole Data

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

Dipole D450V3 (serial number 1053) and D2450V2 (serial number 781) do not exceed annual calibration date, therefore further justification and validation for impedance and return loss are not required.