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# SAR EVALUATION REPORT

**Applicant Name:**
Samsung Electronics Co., Ltd.
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Yeongtong-gu, Suwon-si
Gyeonggi-do, 16677, Korea

**Date of Testing:**
12/12/16 - 02/13/17
**Test Site/Location:**
PCTEST Lab, Columbia, MD, USA
**Document Serial No.:**
1M1702020048-01.A3L

**FCC ID:** **A3LSMT825N0**

**APPLICANT:** **SAMSUNG ELECTRONICS CO., LTD.**

**DUT Type:** Portable Tablet
**Application Type:** Certification
**FCC Rule Part(s):** CFR §2.1093
**Model:** SM-T825N0

| Equipment Class | Band & Mode | Tx Frequency | SAR 1 gm Body W/kg |
|---|---|---|---|
| PCB | GSM/GPRS/EDGE 1900 | 1850.20 - 1909.80 MHz | 1.07 |
| PCB | UMTS 850 | 826.40 - 846.60 MHz | 1.07 |
| PCB | UMTS 1900 | 1852.4 - 1907.6 MHz | 0.96 |
| PCB | LTE Band 17 | 706.5 - 713.5 MHz | 1.09 |
| PCB | LTE Band 5 (Cell) | 824.7 - 848.3 MHz | 0.91 |
| PCB | LTE Band 4 (AWS) | 1710.7 - 1754.3 MHz | 1.09 |
| PCB | LTE Band 2 (PCS) | 1850.7 - 1909.3 MHz | 0.74 |
| DTS | 2.4 GHz WLAN | 2412 - 2472 MHz | 0.96 |
| NII | U-NII-1 | 5180 - 5240 MHz | N/A |
| NII | U-NII-2A | 5260 - 5320 MHz | 1.08 |
| NII | U-NII-2C | 5500 - 5720 MHz | 1.09 |
| NII | U-NII-3 | 5745 - 5825 MHz | 0.78 |
| DSS | Bluetooth | 2402 - 2480 MHz | 0.34 |
| **Simultaneous SAR per KDB 690783 D01v01r03:** | | | 1.49 |

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE C95.1-1992 and has been tested in accordance with the measurement procedures specified in Section 1.7 of this report; for North American frequency bands only.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them. Test results reported herein relate only to the item(s) tested.

Randy Ortanez
President

The SAR Tick is an initiative of the Mobile Manufacturers Forum (MMF). While a product may be considered eligible, use of the SAR Tick logo requires an agreement with the MMF. Further details can be obtained by emailing: sartick@mmfai.info.

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# 1 DEVICE UNDER TEST

## 1.1 Device Overview

| Band & Mode | Operating Modes | Tx Frequency |
|---|---|---|
| GSM/GPRS/EDGE 1900 | Voice/Data | 1850.20 - 1909.80 MHz |
| UMTS 850 | Voice/Data | 826.40 - 846.60 MHz |
| UMTS 1900 | Voice/Data | 1852.4 - 1907.6 MHz |
| LTE Band 17 | Data | 706.5 - 713.5 MHz |
| LTE Band 5 (Cell) | Data | 824.7 - 848.3 MHz |
| LTE Band 4 (AWS) | Data | 1710.7 - 1754.3 MHz |
| LTE Band 2 (PCS) | Data | 1850.7 - 1909.3 MHz |
| 2.4 GHz WLAN | Data | 2412 - 2472 MHz |
| U-NII-1 | Data | 5180 - 5240 MHz |
| U-NII-2A | Data | 5260 - 5320 MHz |
| U-NII-2C | Data | 5500 - 5720 MHz |
| U-NII-3 | Data | 5745 - 5825 MHz |
| Bluetooth | Data | 2402 - 2480 MHz |
| ANT+ | Data | 2402 - 2480 MHz |

## 1.2 Power Reduction for SAR

This device uses a power reduction mechanism for SAR compliance. The power reduction mechanism is activated when the device is used in close proximity to the user's body. FCC KDB Publication 616217 D04v01r02 Section 6 was used as a guideline for selecting SAR test distances for this device. Detailed descriptions of the power reduction mechanism are included in the operational description.

## 1.3 Nominal and Maximum Output Power Specifications

This device operates using the following maximum and nominal output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB Publication 447498 D01v06.

### 1.3.1 Maximum Output Powers

| Mode / Band | | Voice (dBm) | Burst Average GMSK (dBm) | | | | Burst Average 8-PSK (dBm) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 TX Slot | *1 TX Slots* | *2 TX Slots* | *3 TX Slots* | *4 TX Slots* | *1 TX Slots* | *2 TX Slots* | *3 TX Slots* | *4 TX Slots* |
| GSM/GPRS/EDGE 1900 | Maximum | **30.5** | **30.5** | **29.0** | **27.0** | **25.0** | **26.5** | **25.0** | **23.5** | **22.0** |
| | Nominal | **30.0** | **30.0** | **28.5** | **26.5** | **24.5** | **26.0** | **24.5** | **23.0** | **21.5** |

| Mode / Band | | Modulated Average (dBm) | | |
|---|---|---|---|---|
| | | *3GPP WCDMA* | *3GPP HSDPA* | *3GPP HSUPA* |
| UMTS Band 5 (850 MHz) | Maximum | **24.5** | **23.5** | **23.5** |
| | Nominal | **24.0** | **23.0** | **23.0** |
| UMTS Band 2 (1900 MHz) | Maximum | **24.0** | **23.0** | **23.0** |
| | Nominal | **23.5** | **22.5** | **22.5** |

| Mode / Band | | Modulated Average (dBm) |
|---|---|---|
| LTE Band 17 | Maximum | **23.5** |
| | Nominal | **23.0** |
| LTE Band 5 (Cell) | Maximum | **24.5** |
| | Nominal | **24.0** |
| LTE Band 4 (AWS) | Maximum | **24.1** |
| | Nominal | **23.6** |
| LTE Band 2 (PCS) | Maximum | **24.0** |
| | Nominal | **23.5** |

| Mode / Band | | Modulated Average - Single Tx Chain (dBm) | | |
|---|---|---|---|---|
| | | Ch. 1-11 | Ch. 12 | Ch. 13 |
| IEEE 802.11b (2.4 GHz) | Maximum | **14.0** | **5.5** | **5.5** |
| | Nominal | **13.5** | **5.0** | **5.0** |
| IEEE 802.11g (2.4 GHz) | Maximum | **14.0** | **5.5** | **5.5** |
| | Nominal | **13.5** | **5.0** | **5.0** |
| IEEE 802.11n (2.4 GHz) | Maximum | **14.0** | **5.5** | **5.5** |
| | Nominal | **13.5** | **5.0** | **5.0** |

| Mode / Band | | Modulated Average - Single Tx Chain (dBm) | | |
|---|---|---|---|---|
| | | 20 MHz Bandwidth | 40 MHz Bandwidth | 80 MHz Bandwidth |
| IEEE 802.11a (5 GHz) | Maximum | **11.0** | | |
| | Nominal | **10.5** | | |
| IEEE 802.11n (5 GHz) | Maximum | **11.0** | **11.0** | |
| | Nominal | **10.5** | **10.5** | |
| IEEE 802.11ac (5 GHz) | Maximum | **11.0** | **11.0** | **11.0** |
| | Nominal | **10.5** | **10.5** | **10.5** |

| Mode / Band | | Modulated Average - MIMO (dBm) | | |
|---|---|---|---|---|
| | | Ch. 1-11 | Ch. 12 | Ch. 13 |
| IEEE 802.11g (2.4 GHz) | Maximum | **17.0** | **8.5** | **8.5** |
| | Nominal | **16.5** | **8.0** | **8.0** |
| IEEE 802.11n (2.4 GHz) | Maximum | **17.0** | **8.5** | **8.5** |
| | Nominal | **16.5** | **8.0** | **8.0** |

| Mode / Band | | Modulated Average - MIMO (dBm) | | |
|---|---|---|---|---|
| | | 20 MHz Bandwidth | 40 MHz Bandwidth | 80 MHz Bandwidth |
| IEEE 802.11a (5 GHz) | Maximum | **14.0** | | |
| | Nominal | **13.5** | | |
| IEEE 802.11n (5 GHz) | Maximum | **14.0** | **14.0** | |
| | Nominal | **13.5** | **13.5** | |
| IEEE 802.11ac (5 GHz) | Maximum | **14.0** | **14.0** | **14.0** |
| | Nominal | **13.5** | **13.5** | **13.5** |

| Mode / Band | | Modulated Average (dBm) |
|---|---|---|
| Bluetooth | Maximum | **11.0** |
| | Nominal | **10.5** |
| Bluetooth LE | Maximum | **3.0** |
| | Nominal | **2.5** |

### 1.3.2 Reduced Output Powers

| Mode / Band | | Voice (dBm) | Burst Average GMSK (dBm) | | | | Burst Average 8-PSK (dBm) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 TX Slot | *1 TX Slots* | *2 TX Slots* | *3 TX Slots* | *4 TX Slots* | *1 TX Slots* | *2 TX Slots* | *3 TX Slots* | *4 TX Slots* |
| GSM/GPRS/EDGE 1900 | Maximum | **22.0** | **22.0** | **20.5** | **18.5** | **18.5** | **18.5** | **17.0** | **15.5** | **15.5** |
| | Nominal | **21.5** | **21.5** | **20.0** | **18.0** | **18.0** | **18.0** | **16.5** | **15.0** | **15.0** |

| Mode / Band | | Modulated Average (dBm) | | |
|---|---|---|---|---|
| | | *3GPP WCDMA* | *3GPP HSDPA* | *3GPP HSUPA* |
| UMTS Band 5 (850 MHz) | Maximum | **17.0** | **16.5** | **16.5** |
| | Nominal | **16.5** | **16.0** | **16.0** |
| UMTS Band 2 (1900 MHz) | Maximum | **14.0** | **13.5** | **13.5** |
| | Nominal | **13.5** | **13.0** | **13.0** |

| Mode / Band | | Modulated Average (dBm) |
|---|---|---|
| LTE Band 17 | Maximum | **17.0** |
| | Nominal | **16.5** |
| LTE Band 5 (Cell) | Maximum | **16.0** |
| | Nominal | **15.5** |
| LTE Band 4 (AWS) | Maximum | **14.0** |
| | Nominal | **13.5** |
| LTE Band 2 (PCS) | Maximum | **14.0** |
| | Nominal | **13.5** |

## 1.4 DUT Antenna Locations

The overall diagonal dimension of the device is > 200 mm. A diagram showing the location of the device antennas can be found in Appendix F. Exact antenna dimensions and separation distances are shown in the Technical Descriptions in the FCC filings.

**Table 1-1**
**Device Edges/Sides for SAR Testing**

| Device Sides/Edges for SAR Testing | | | | | |
|---|---|---|---|---|---|
| Mode | Back | Top | Bottom | Right | Left |
| GPRS 1900 | Yes | Yes | No | Yes | Yes |
| UMTS 850 | Yes | Yes | No | Yes | Yes |
| UMTS 1900 | Yes | Yes | No | Yes | Yes |
| LTE Band 17 | Yes | Yes | No | Yes | Yes |
| LTE Band 5 (Cell) | Yes | Yes | No | Yes | Yes |
| LTE Band 4 (AWS) | Yes | Yes | No | Yes | Yes |
| LTE Band 2 (PCS) | Yes | Yes | No | Yes | Yes |
| 2.4 GHz WLAN Ant 1 | Yes | No | Yes | Yes | No |
| 2.4 GHz WLAN Ant 2 | Yes | No | Yes | No | Yes |
| 5 GHz WLAN Ant 1 | Yes | No | Yes | Yes | No |
| 5 GHz WLAN Ant 2 | Yes | No | Yes | No | Yes |
| Bluetooth | Yes | No | Yes | Yes | No |

Note: Per FCC KDB Publication 616217 D04v01r01, particular edges were not required to be evaluated for SAR based on the SAR exclusion threshold in KDB 447498 D01V06. Additional edges may have been evaluated for simultaneous transmission analysis.

## 1.5 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D01v06, transmitters are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds. Possible transmission paths for the DUT are shown in Figure 1-1 and are color-coded to indicate communication modes which share the same path. Modes which share the same transmission path cannot transmit simultaneously with one another.


**Figure 1-1**
**Simultaneous Transmission Paths**

This device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneous transmission analysis according to FCC KDB Publication 447498 D01v06 4.3.2 procedures.

**Table 1-2**
**Simultaneous Transmission Scenarios**

| No. | Capable Transmit Configuration | Body |
|---|---|---|
| 1 | GSM/GPRS/EDGE + 2.4 GHz WI-FI | Yes |
| 2 | GSM/GPRS/EDGE + 5 GHz WI-FI | Yes |
| 3 | GSM/GPRS/EDGE + 2.4 GHz Bluetooth | Yes |
| 4 | GSM/GPRS/EDGE + 2.4 GHz WI-FI MIMO | Yes |
| 5 | GSM/GPRS/EDGE + 5 GHz WI-FI MIMO | Yes |
| 6 | UMTS + 2.4 GHz WI-FI | Yes |
| 7 | UMTS + 5 GHz WI-FI | Yes |
| 8 | UMTS + 2.4 GHz Bluetooth | Yes |
| 9 | UMTS + 2.4 GHz WI-FI MIMO | Yes |
| 10 | UMTS + 5 GHz WI-FI MIMO | Yes |
| 11 | LTE + 2.4 GHz WI-FI | Yes |
| 12 | LTE + 5 GHz WI-FI | Yes |
| 13 | LTE + 2.4 GHz Bluetooth | Yes |
| 14 | LTE + 2.4 GHz WI-FI MIMO | Yes |
| 15 | LTE + 5 GHz WI-FI MIMO | Yes |

1. All licensed modes share the same antenna path and cannot transmit simultaneously.
2. When the user utilizes multiple services in UMTS 3G mode it uses multi-Radio Access Bearer or multi-RAB. The power control is based on a physical control channel (Dedicated Physical Control Channel [DPCCH]) and power control will be adjusted to meet the needs of both services. Therefore, the UMTS+WLAN scenario also represents the UMTS Voice/DATA + WLAN Hotspot scenario.
3. This device supports 2x2 MIMO Tx for WLAN 802.11a/gn/ac. Each WLAN antenna can transmit independently or together when operating with MIMO.

## 1.6 Miscellaneous SAR Test Considerations

### (A) WIFI/BT

Since U-NII-1 and U-NII-2A bands have the same maximum output power and the highest reported SAR for U-NII-2A is less than 1.2 W/kg, SAR is not required for U-NII-1 band according to FCC KDB Publication 248227 D01v02r02.

This device supports IEEE 802.11ac with the following features:
a) Up to 80 MHz Bandwidth only
b) No aggregate channel configurations
c) 2 Tx antenna output
d) 256 QAM is supported
e) TDWR and Band gap channels are supported

This device supports channel 1-13 for 2.4 GHz WLAN. However, due to the reduced output power for channels 12 and 13, channels 1, 6, and 11 were considered for SAR testing per KDB 248227 D01v02r02.

**(B) Licensed Transmitter(s)**

GSM/GPRS/EDGE DTM is not supported for US bands. Therefore, the GSM Voice modes in this report do not transmit simultaneously with GPRS/EDGE Data.

This device is only capable of QPSK HSUPA in the uplink. Therefore, no additional SAR tests are required beyond that described for devices with HSUPA in KDB 941225 D01v03r01.

LTE SAR for the higher modulations and lower bandwidths were not tested since the maximum average output power of all required channels and configurations was not more than 0.5 dB higher than the highest bandwidth; and the reported LTE SAR for the highest bandwidth was less than 1.45 W/kg for all configurations according to FCC KDB 941225 D05v02r04.

## 1.7 Guidance Applied

- FCC KDB Publication 616217 D04v01r02 (SAR for laptop and tablets)
- FCC KDB Publication 941225 D01v03r01, D05v02r04 (2G/3G/4G)
- FCC KDB Publication 248227 D01v02r02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01v06 (General SAR Guidance)
- FCC KDB Publication 865664 D01v01r04, D02v01r02 (SAR Measurements up to 6 GHz)
- October 2013 TCB Workshop Notes (GPRS Testing Considerations)

## 1.8 Device Serial Numbers

Several samples with identical hardware were used to support SAR testing. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units. Power level was configured for tested via software only available to the manufacturer (end user cannot control power level) per KDB 616217.

| | Maximum Power Serial Number | Reduced Power Serial Number |
|---|---|---|
| GSM/GPRS/EDGE 1900 | 09999 | 09999 |
| UMTS 850 | 09999 | 09999 |
| UMTS 1900 | 09999 | 09999 |
| LTE Band 17 | 09999 | 09999 |
| LTE Band 5 (Cell) | 02212 | 05286 |
| LTE Band 4 (AWS) | 05260 | 05260 |
| LTE Band 2 (PCS) | 14379 | 09999 |
| 2.4 GHz WLAN | 05260 | - |
| 5 GHz WLAN | 05211 | - |
| Bluetooth | 02220 | - |

# 2 LTE INFORMATION

| LTE Information | | | |
|---|---|---|---|
| **FCC ID** | **A3LSMT825N0** | | |
| Form Factor | Portable Tablet | | |
| Frequency Range of each LTE transmission band | LTE Band 17 (706.5 - 713.5 MHz) | | |
| | LTE Band 5 (Cell) (824.7 - 848.3 MHz) | | |
| | LTE Band 4 (AWS) (1710.7 - 1754.3 MHz) | | |
| | LTE Band 2 (PCS) (1850.7 - 1909.3 MHz) | | |
| Channel Bandwidths | LTE Band 17: 5 MHz, 10 MHz | | |
| | LTE Band 5 (Cell): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz | | |
| | LTE Band 4 (AWS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz | | |
| | LTE Band 2 (PCS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz | | |
| Channel Numbers and Frequencies (MHz) | Low | Mid | High |
| LTE Band 17: 5 MHz | 706.5 (23755) | 710 (23790) | 713.5 (23825) |
| LTE Band 17: 10 MHz | 709 (23780) | 710 (23790) | 711 (23800) |
| LTE Band 5 (Cell): 1.4 MHz | 824.7 (20407) | 836.5 (20525) | 848.3 (20643) |
| LTE Band 5 (Cell): 3 MHz | 825.5 (20415) | 836.5 (20525) | 847.5 (20635) |
| LTE Band 5 (Cell): 5 MHz | 826.5 (20425) | 836.5 (20525) | 846.5 (20625) |
| LTE Band 5 (Cell): 10 MHz | 829 (20450) | 836.5 (20525) | 844 (20600) |
| LTE Band 4 (AWS): 1.4 MHz | 1710.7 (19957) | 1732.5 (20175) | 1754.3 (20393) |
| LTE Band 4 (AWS): 3 MHz | 1711.5 (19965) | 1732.5 (20175) | 1753.5 (20385) |
| LTE Band 4 (AWS): 5 MHz | 1712.5 (19975) | 1732.5 (20175) | 1752.5 (20375) |
| LTE Band 4 (AWS): 10 MHz | 1715 (20000) | 1732.5 (20175) | 1750 (20350) |
| LTE Band 4 (AWS): 15 MHz | 1717.5 (20025) | 1732.5 (20175) | 1747.5 (20325) |
| LTE Band 4 (AWS): 20 MHz | 1720 (20050) | 1732.5 (20175) | 1745 (20300) |
| LTE Band 2 (PCS): 1.4 MHz | 1850.7 (18607) | 1880 (18900) | 1909.3 (19193) |
| LTE Band 2 (PCS): 3 MHz | 1851.5 (18615) | 1880 (18900) | 1908.5 (19185) |
| LTE Band 2 (PCS): 5 MHz | 1852.5 (18625) | 1880 (18900) | 1907.5 (19175) |
| LTE Band 2 (PCS): 10 MHz | 1855 (18650) | 1880 (18900) | 1905 (19150) |
| LTE Band 2 (PCS): 15 MHz | 1857.5 (18675) | 1880 (18900) | 1902.5 (19125) |
| LTE Band 2 (PCS): 20 MHz | 1860 (18700) | 1880 (18900) | 1900 (19100) |
| UE Category | 4 | | |
| Modulations Supported in UL | QPSK, 16QAM | | |
| LTE MPR Permanently implemented per 3GPP TS 36.101 section 6.2.3~6.2.5? (manufacturer attestation to be provided) | YES | | |
| A-MPR (Additional MPR) disabled for SAR Testing? | YES | | |
| LTE Release 10 Additional Information | This device does not support full CA features on 3GPP Release 10. All uplink communications are identical to the Release 8 Specifications. The following LTE Release 10 Features are not supported: Carrier Aggregation, Relay, HetNet, Enhanced MIMO, eICIC, WIFI Offloading, MDH, eMBMS, Cross-Carrier Scheduling, Enhanced SC-FDMA. | | |

# 3 INTRODUCTION

The FCC and Innovation, Science, and Economic Development Canada have adopted the guidelines for evaluating the environmental effects of radio frequency (RF) radiation in ET Docket 93-62 on Aug. 6, 1996 and Health Canada Safety Code 6 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices. [1]

The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz [3] and Health Canada RF Exposure Guidelines Safety Code 6 [22]. The measurement procedure described in IEEE/ANSI C95.3-2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave [4] is used for guidance in measuring the Specific Absorption Rate (SAR) due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the International Committee for Non-Ionizing Radiation Protection (ICNIRP) in Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," Report No. Vol 74. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

## 3.1 SAR Definition

Specific Absorption Rate is defined as the time derivative (rate) of the incremental energy (dU) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density ($\rho$). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Equation 3-1).

**Equation 3-1**
**SAR Mathematical Equation**

$$SAR = \frac{d}{dt}\left(\frac{dU}{dm}\right) = \frac{d}{dt}\left(\frac{dU}{\rho dv}\right)$$

**SAR is expressed in units of Watts per Kilogram (W/kg).**

$$SAR = \frac{\sigma \cdot E^2}{\rho}$$

where:

$\sigma$ = conductivity of the tissue-simulating material (S/m)
$\rho$ = mass density of the tissue-simulating material (kg/m$^3$)
E = Total RMS electric field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relation to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.[6]

# 4 DOSIMETRIC ASSESSMENT

## 4.1 Measurement Procedure

The evaluation was performed using the following procedure compliant to FCC KDB Publication 865664 D01v01r04 and IEEE 1528-2013:

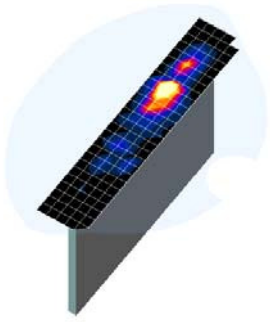


**Figure 4-1**
**Sample SAR Area Scan**

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01r04 (See Table 4-1) and IEEE 1528-2013.
2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1g/10g cube evaluation. SAR at this fixed point was measured and used as a reference value.
3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01r04 (See Table 4-1) and IEEE 1528-2013. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online for more details):

   a. SAR values at the inner surface of the phantom are extrapolated from the measured values along the line away from the surface with spacing no greater than that in Table 4-1. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).

   b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.

   c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

**Table 4-1**
**Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01r04***

| Frequency | Maximum Area Scan Resolution (mm) ($\Delta x_{area}$, $\Delta y_{area}$) | Maximum Zoom Scan Resolution (mm) ($\Delta x_{zoom}$, $\Delta y_{zoom}$) | Maximum Zoom Scan Spatial Resolution (mm) | | | Minimum Zoom Scan Volume (mm) (x,y,z) |
|---|---|---|---|---|---|---|
| | | | Uniform Grid | Graded Grid | | |
| | | | $\Delta z_{zoom}(n)$ | $\Delta z_{zoom}(1)$* | $\Delta z_{zoom}(n>1)$* | |
| ≤ 2 GHz | ≤ 15 | ≤ 8 | ≤ 5 | ≤ 4 | ≤ 1.5*$\Delta z_{zoom}(n-1)$ | ≥ 30 |
| 2-3 GHz | ≤ 12 | ≤ 5 | ≤ 5 | ≤ 4 | ≤ 1.5*$\Delta z_{zoom}(n-1)$ | ≥ 30 |
| 3-4 GHz | ≤ 12 | ≤ 5 | ≤ 4 | ≤ 3 | ≤ 1.5*$\Delta z_{zoom}(n-1)$ | ≥ 28 |
| 4-5 GHz | ≤ 10 | ≤ 4 | ≤ 3 | ≤ 2.5 | ≤ 1.5*$\Delta z_{zoom}(n-1)$ | ≥ 25 |
| 5-6 GHz | ≤ 10 | ≤ 4 | ≤ 2 | ≤ 2 | ≤ 1.5*$\Delta z_{zoom}(n-1)$ | ≥ 22 |

*Also compliant to IEEE 1528-2013 Table 6

# 5 TEST CONFIGURATION POSITIONS

## 5.1 Device Holder

The device holder is made out of low-loss POM material having the following dielectric parameters: relative permittivity ε = 3 and loss tangent δ = 0.02.

## 5.2 SAR Testing for Tablet per KDB Publication 616217 D04v01r02

Per FCC KDB Publication 616217 D04v01r02, the back surface and edges of the tablet should be tested for SAR compliance with the tablet touching the phantom. The SAR Exclusion Threshold in KDB 447498 D01v06 can be applied to determine SAR test exclusion for adjacent edge configurations. The closest distance from the antenna to an adjacent tablet edge is used to determine if SAR testing is required for the adjacent edges, with the adjacent edge positioned against the phantom and the edge containing the antenna positioned perpendicular to the phantom.

## 5.3 Proximity Sensor Considerations

This device uses a power reduction mechanism to reduce output powers in certain use conditions when the device is used close the user's body.

When the device's antenna is within a certain distance of the user, the sensor activates and reduces the maximum allowed output power. However, the sensor is not active when the device is moved beyond the sensor triggering distance and the maximum output power is no longer limited. Therefore, additional evaluation is needed in the vicinity of the triggering distance to ensure SAR is compliant when the device is allowed to operate at a non-reduced output power level. FCC KDB Publication 616217 D04v01r02 Section 6 was used as a guideline for selecting SAR test distances for this device at these additional test positions. Sensor triggering distance summary data is included in Appendix G.

The sensor is designed to support sufficient detection range and sensitivity to cover regions of the sensors in all applicable directions since the sensor entirely covers the antennas.

# 6 RF EXPOSURE LIMITS

## 6.1 Uncontrolled Environment

UNCONTROLLED ENVIRONMENTS are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

## 6.2 Controlled Environment

CONTROLLED ENVIRONMENTS are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

**Table 6-1**
**SAR Human Exposure Specified in ANSI/IEEE C95.1-1992 and Health Canada Safety Code 6**

| HUMAN EXPOSURE LIMITS | | |
|---|---|---|
| | UNCONTROLLED ENVIRONMENT *General Population* (W/kg) or (mW/g) | CONTROLLED ENVIRONMENT *Occupational* (W/kg) or (mW/g) |
| **Peak Spatial Average SAR** Head | 1.6 | 8.0 |
| **Whole Body SAR** | 0.08 | 0.4 |
| **Peak Spatial Average SAR** Hands, Feet, Ankle, Wrists, etc. | 4.0 | 20 |

1. The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
2. The Spatial Average value of the SAR averaged over the whole body.
3. The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

# 7 FCC MEASUREMENT PROCEDURES

Power measurements for licensed transmitters are performed using a base station simulator under digital average power.

## 7.1 Measured and Reported SAR

Per FCC KDB Publication 447498 D01v06, when SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance. For simultaneous transmission, the measured aggregate SAR must be scaled according to the sum of the differences between the maximum tune-up tolerance and actual power used to test each transmitter. When SAR is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as *reported* SAR. The highest *reported* SAR results are identified on the grant of equipment authorization according to procedures in KDB 690783 D01v01r03.

## 7.2 3G SAR Test Reduction Procedure

In FCC KDB Publication 941225 D01v03r01, certain transmission modes within a frequency band and wireless mode evaluated for SAR are defined as primary modes. The equivalent modes considered for SAR test reduction are denoted as secondary modes. When the maximum output power including tune-up tolerance specified for production units in a secondary mode is $\leq$ 0.25 dB higher than the primary mode or when the highest reported SAR of the primary mode, scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode, is $\leq$ 1.2 W/kg, SAR measurements are not required for the secondary mode. These criteria are referred to as the 3G SAR test reduction procedure. When the 3G SAR test reduction procedure is not satisfied, SAR measurements are additionally required for the secondary mode.

## 7.3 Procedures Used to Establish RF Signal for SAR

The following procedures are according to FCC KDB Publication 941225 D01v03r01 “3G SAR Measurement Procedures.”

The device is placed into a simulated call using a base station simulator in a RF shielded chamber. Establishing connections in this manner ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. Devices under test are evaluated prior to testing, with a fully charged battery and were configured to operate at maximum output power. In order to verify that the device is tested throughout the SAR test at maximum output power, the SAR measurement system measures a “point SAR” at an arbitrary reference point at the start and end of the 1 gram SAR evaluation, to assess for any power drifts during the evaluation. If the power drift deviates by more than 5%, the SAR test and drift measurements are repeated.

## 7.4 SAR Measurement Conditions for UMTS

### 7.4.1 Output Power Verification

Maximum output power is verified on the High, Middle and Low channels according to the general descriptions in section 5.2 of 3GPP TS 34.121, using the appropriate RMC with TPC (transmit power control) set to all “1s” or applying the required inner loop power control procedures to maintain maximum output power while HSUPA is active. Results for all applicable physical channel configurations (DPCCH, DPDCHn and spreading codes, HS-DPCCH etc) are tabulated in this test report. All configurations that are not supported by the DUT or cannot be measured due to technical or equipment limitations are identified.

### 7.4.2 Body SAR Measurements

SAR for body exposure configurations is measured using the 12.2 kbps RMC with the TPC bits all "1s". The 3G SAR test reduction procedure is applied to other spreading codes and multiple $DPDCH_n$ configurations supported by the handset with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured using an applicable RMC configuration with the corresponding spreading code or $DPDCH_n$, for the highest reported SAR configuration in 12.2 kbps RMC.

### 7.4.3 SAR Measurements with Rel 5 HSDPA

The 3G SAR test reduction procedure is applied to HSDPA body configurations with 12.2 kbps RMC as the primary mode. Otherwise, Body SAR for HSDPA is measured using an FRC with H-Set 1 in Sub-test 1 and a 12.2 kbps RMC configured in Test Loop Mode 1, for the highest reported SAR configuration in 12.2 kbps RMC without HSDPA. Handsets with both HSDPA and HSUPA are tested according to Release 6 HSPA test procedures.

### 7.4.4 SAR Measurements with Rel 6 HSUPA

The 3G SAR test reduction procedure is applied to HSPA (HSUPA/HSDPA with RMC) body configurations with 12.2 kbps RMC as the primary mode. Otherwise, Body SAR for HSPA is measured with E-DCH Sub-test 5, using H-Set 1 and QPSK for FRC and a 12.2 kbps RMC configured in Test Loop Mode 1 and power control algorithm 2, according to the highest reported body SAR configuration in 12.2 kbps RMC without HSPA.

When VOIP applies to head exposure, the 3G SAR test reduction procedure is applied with 12.2 kbps RMC as the primary mode; otherwise, the same HSPA configuration used for body SAR measurements are applied to head exposure testing.

### 7.4.5 SAR Measurement Conditions for DC-HSDPA

SAR is required for Rel. 8 DC-HSDPA when SAR is required for Rel. 5 HSDPA; otherwise, the 3G SAR test reduction procedure is applied to DC-HSDPA with 12.2 kbps RMC as the primary mode. Power is measured for DC-HSDPA according to the H-Set 12, FRC configuration in Table C.8.1.12 of 3GPP TS 34.121-1 to determine SAR test reduction. A primary and a secondary serving HS-DSCH Cell are required to perform the power measurement and for the results to be acceptable.

## 7.5 SAR Measurement Conditions for LTE

LTE modes are tested according to FCC KDB 941225 D05v02r04 publication. Establishing connections with base station simulators ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. The R&S CMW500 or Anritsu MT8820C simulators are used for LTE output power measurements and SAR testing. Closed loop power control was used so the UE transmits with maximum output power during SAR testing. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

### 7.5.1 Spectrum Plots for RB Configurations

A properly configured base station simulator was used for SAR tests and power measurements. Therefore, spectrum plots for RB configurations were not required to be included in this report.

### 7.5.2 MPR

MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.

### 7.5.3 A-MPR

A-MPR (Additional MPR) has been disabled for all SAR tests by setting NS=01 on the base station simulator.

### 7.5.4 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 D05v02r04:

a. Per Section 5.2.1, SAR is required for QPSK 1 RB Allocation for the largest bandwidth
   i. The required channel and offset combination with the highest maximum output power is required for SAR.
   ii. When the reported SAR is ≤ 0.8 W/kg, testing of the remaining RB offset configurations and required test channels is not required. Otherwise, SAR is required for the remaining required test channels using the RB offset configuration with highest output power for that channel.
   iii. When the reported SAR for a required test channel is > 1.45 W/kg, SAR is required for all RB offset configurations for that channel.
b. Per Section 5.2.2, SAR is required for 50% RB allocation using the largest bandwidth following the same procedures outlined in Section 5.2.1.
c. Per Section 5.2.3, QPSK SAR is not required for the 100% allocation when the highest maximum output power for the 100% allocation is less than the highest maximum output power of the 1 RB and 50% RB allocations and the reported SAR for the 1 RB and 50% RB allocations is < 0.8 W/kg.
d. Per Section 5.2.4 and 5.3, SAR tests for higher order modulations and lower bandwidths configurations are not required when the conducted power of the required test configurations determined by Sections 5.2.1 through 5.2.3 is less than or equal to ½ dB higher than the equivalent configuration using QPSK modulation and when the QPSK SAR for those configurations is <1.45 W/kg.

### 7.5.5 Downlink Only Carrier Aggregation

Conducted power measurements with LTE Carrier Aggregation (CA) (downlink only) active are made in accordance to KDB Publication 941225 D05Av01r02. The RRC connection is only handled by one cell, the primary component carrier (PCC) for downlink and uplink communications. After making a data connection to the PCC, the UE device adds secondary component carrier(s) (SCC) on the downlink only. All uplink communications and acknowledgements remain identical to specifications when downlink carrier aggregation is inactive on the PCC. For every supported combination of downlink only carrier aggregation, additional conducted output powers are measured with the downlink carrier aggregation active for the configuration with highest measured maximum conducted power with downlink carrier aggregation inactive measured among the channel bandwidth, modulation, and RB combinations in each frequency band. Per FCC KDB Publication 941225 D05Av01r02, no SAR measurements are required for carrier aggregation configurations when the average output power with downlink only carrier aggregation active is not more than 0.25 dB higher than the average output power with downlink only carrier aggregation inactive.

## 7.6 SAR Testing with 802.11 Transmitters

The normal network operating configurations of 802.11 transmitters are not suitable for SAR measurements. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure the results are consistent and reliable. See KDB Publication 248227 D01v02r02 for more details.

### 7.6.1 General Device Setup

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters.

A periodic duty factor is required for current generation SAR systems to measure SAR. When 802.11 frame gaps are accounted for in the transmission, a maximum transmission duty factor of 92 - 96% is typically achievable in most test mode configurations. A minimum transmission duty factor of 85% is required to avoid certain hardware and device implementation issues related to wide range SAR scaling. The reported SAR is scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit.

### 7.6.2 U-NII-1 and U-NII-2A

For devices that operate in both U-NII-1 and U-NII-2A bands, when the same maximum output power is specified for both bands, SAR measurement using OFDM SAR test procedures is not required for U-NII-1 unless the highest reported SAR for U-NII-2A is > 1.2 W/kg. When different maximum output powers are specified for the bands, SAR measurement for the U-NII band with the lower maximum output power is not required unless the highest reported SAR for the U-NII band with the higher maximum output power, adjusted by the ratio of lower to higher specified maximum output power for the two bands, is > 1.2 W/kg.

### 7.6.3 U-NII-2C and U-NII-3

The frequency range covered by U-NII-2C and U-NII-3 is 380 MHz (5.47 – 5.85 GHz), which requires a minimum of at least two SAR probe calibration frequency points to support SAR measurements. When Terminal Doppler Weather Radar (TDWR) restriction applies, the channels at 5.60 – 5.65 GHz in U-NII-2C band must be disabled with acceptable mechanisms and documented in the equipment certification. Unless band gap channels are permanently disabled, SAR must be considered for these channels. Each band is tested independently according to the normally required OFDM SAR measurement and probe calibration frequency points requirements.

### 7.6.4 2.4 GHz SAR Test Requirements

SAR is measured for 2.4 GHz 802.11b DSSS using either the fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following:

1) When the reported SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.

2) When the reported SAR is > 0.8 W/kg, SAR is required for that position using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing.

2.4 GHz 802.11 g/n OFDM are additionally evaluated for SAR if the highest reported SAR for 802.11b, adjusted by the ratio of the OFDM to DSSS specified maximum output power, is › 1.2 W/kg. When SAR is required for OFDM modes in 2.4 GHz band, the Initial Test Configuration Procedures should be followed.

### 7.6.5 OFDM Transmission Mode and SAR Test Channel Selection

When the same maximum output power was specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration with the largest channel bandwidth, lowest order modulation and lowest data rate. When the maximum output power of a channel is the same for equivalent OFDM configurations; for example, 802.11a, 802.11n and 802.11ac or 802.11g and 802.11n with the same channel bandwidth, modulation and data rate etc., the lower order 802.11 mode i.e.,

802.11a, then 802.11n and 802.11ac or 802.11g then 802.11n, is used for SAR measurement. When the maximum output power are the same for multiple test channels, either according to the default or additional power measurement requirements, SAR is measured using the channel closest to the middle of the frequency band or aggregated band. When there are multiple channels with the same maximum output power, SAR is measured using the higher number channel.

### 7.6.6 Initial Test Configuration Procedure

For OFDM, an initial test configuration is determined for each frequency band and aggregated band, according to the transmission mode with the highest maximum output power specified for SAR measurements. When the same maximum output power is specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration(s) with the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order IEEE 802.11 mode. The channel of the transmission mode with the highest average RF output conducted power will be the initial test configuration.

When the reported SAR is ≤ 0.8 W/kg, no additional measurements on other test channels are required. Otherwise, SAR is evaluated using the subsequent highest average RF output channel until the reported SAR result is ≤ 1.2 W/kg or all channels are measured. When there are multiple untested channels having the same subsequent highest average RF output power, the channel with higher frequency from the lowest 802.11 mode is considered for SAR measurements (See Section 7.6.5).

### 7.6.7 Subsequent Test Configuration Procedures

For OFDM configurations in each frequency band and aggregated band, SAR is evaluated for initial test configuration using the fixed test position or the initial test position procedure. When the highest reported SAR (for the initial test configuration), adjusted by the ratio of the specified maximum output power of the subsequent test configuration to initial test configuration, is ≤ 1.2 W/kg, no additional SAR tests for the subsequent test configurations are required.

### 7.6.8 MIMO SAR considerations

Per KDB Publication 248227 D01v02r02, the simultaneous SAR provisions in KDB Publication 447498 D01v06 should be applied to determine simultaneous transmission SAR test exclusion for WIFI MIMO. If the sum of 1g single transmission chain SAR measurements is <1.6 W/kg, no additional SAR measurements for MIMO are required. Alternatively, SAR for MIMO can be measured with all antennas transmitting simultaneously at the specified maximum output power of MIMO operation.

# 8 RF CONDUCTED POWERS

## 8.1 GSM Conducted Powers

**Table 8-1**
**Maximum Conducted Powers**

| Maximum Burst-Averaged Output Power | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *Voice* | *GPRS/EDGE Data (GMSK)* | | | | *EDGE Data (8-PSK)* | | | |
| **Band** | **Channel** | **GSM [dBm] CS (1 Slot)** | **GPRS [dBm] 1 Tx Slot** | **GPRS [dBm] 2 Tx Slot** | **GPRS [dBm] 3 Tx Slot** | **GPRS [dBm] 4 Tx Slot** | **EDGE [dBm] 1 Tx Slot** | **EDGE [dBm] 2 Tx Slot** | **EDGE [dBm] 3 Tx Slot** | **EDGE [dBm] 4 Tx Slot** |
| **GSM 1900** | 512 | 29.41 | 29.30 | 28.15 | **25.93** | 24.31 | 25.07 | 23.90 | 22.37 | 20.99 |
| | 661 | 28.67 | 28.55 | 27.47 | **25.43** | 23.66 | 24.50 | 23.28 | 21.70 | 20.20 |
| | 810 | 29.46 | 29.40 | 28.29 | **26.00** | 24.37 | 25.14 | 23.90 | 22.35 | 20.98 |

| Calculated Maximum Frame-Averaged Output Power | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *Voice* | *GPRS/EDGE Data (GMSK)* | | | | *EDGE Data (8-PSK)* | | | |
| **Band** | **Channel** | **GSM [dBm] CS (1 Slot)** | **GPRS [dBm] 1 Tx Slot** | **GPRS [dBm] 2 Tx Slot** | **GPRS [dBm] 3 Tx Slot** | **GPRS [dBm] 4 Tx Slot** | **EDGE [dBm] 1 Tx Slot** | **EDGE [dBm] 2 Tx Slot** | **EDGE [dBm] 3 Tx Slot** | **EDGE [dBm] 4 Tx Slot** |
| **GSM 1900** | 512 | 20.38 | 20.27 | 22.13 | **21.67** | 21.30 | 16.04 | 17.88 | 18.11 | 17.98 |
| | 661 | 19.64 | 19.52 | 21.45 | **21.17** | 20.65 | 15.47 | 17.26 | 17.44 | 17.19 |
| | 810 | 20.43 | 20.37 | 22.27 | **21.74** | 21.36 | 16.11 | 17.88 | 18.09 | 17.97 |
| **GSM 1900** | **Frame Avg.Targets:** | 20.97 | 20.97 | 22.48 | **22.24** | 21.49 | 16.97 | 18.48 | 18.74 | 18.49 |

**Table 8-2**
**Reduced Conducted Powers**

| Maximum Burst-Averaged Output Power | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *Voice* | *GPRS/EDGE Data (GMSK)* | | | | *EDGE Data (8-PSK)* | | | |
| **Band** | **Channel** | **GSM [dBm] CS (1 Slot)** | **GPRS [dBm] 1 Tx Slot** | **GPRS [dBm] 2 Tx Slot** | **GPRS [dBm] 3 Tx Slot** | **GPRS [dBm] 4 Tx Slot** | **EDGE [dBm] 1 Tx Slot** | **EDGE [dBm] 2 Tx Slot** | **EDGE [dBm] 3 Tx Slot** | **EDGE [dBm] 4 Tx Slot** |
| **GSM 1900** | 512 | 21.62 | 21.70 | 20.10 | 18.38 | **18.20** | 18.31 | 16.74 | 15.36 | 15.21 |
| | 661 | 20.92 | 21.01 | 19.40 | 17.73 | **17.57** | 17.53 | 16.13 | 14.77 | 14.62 |
| | 810 | 21.68 | 21.77 | 20.12 | 18.37 | **18.34** | 18.29 | 16.87 | 15.37 | 15.38 |

| Calculated Maximum Frame-Averaged Output Power | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *Voice* | *GPRS/EDGE Data (GMSK)* | | | | *EDGE Data (8-PSK)* | | | |
| **Band** | **Channel** | **GSM [dBm] CS (1 Slot)** | **GPRS [dBm] 1 Tx Slot** | **GPRS [dBm] 2 Tx Slot** | **GPRS [dBm] 3 Tx Slot** | **GPRS [dBm] 4 Tx Slot** | **EDGE [dBm] 1 Tx Slot** | **EDGE [dBm] 2 Tx Slot** | **EDGE [dBm] 3 Tx Slot** | **EDGE [dBm] 4 Tx Slot** |
| **GSM 1900** | 512 | 12.59 | 12.67 | 14.08 | 14.12 | **15.19** | 9.28 | 10.72 | 11.10 | 12.20 |
| | 661 | 11.89 | 11.98 | 13.38 | 13.47 | **14.56** | 8.50 | 10.11 | 10.51 | 11.61 |
| | 810 | 12.65 | 12.74 | 14.10 | 14.11 | **15.33** | 9.26 | 10.85 | 11.11 | 12.37 |
| **GSM 1900** | **Frame Avg.Targets:** | 12.47 | 12.47 | 13.98 | 13.74 | **14.99** | 8.97 | 10.48 | 10.74 | 11.99 |

Note:

1. Both burst-averaged and calculated frame-averaged powers are included. Frame-averaged power was calculated from the measured burst-averaged power by converting the slot powers into linear units and calculating the energy over 8 timeslots.
2. GPRS/EDGE (GMSK) output powers were measured with coding scheme setting of 1 (CS1) on the base station simulator. CS1 was configured to measure GPRS output power measurements and SAR to ensure GMSK modulation in the signal. Our Investigation has shown that CS1 - CS4 settings do not have any impact on the output levels or modulation in the GPRS modes.
3. EDGE (8-PSK) output powers were measured with MCS7 on the base station simulator. MCS7 coding scheme was used to measure the output powers for EDGE since investigation has shown that choosing MCS7 coding scheme will ensure 8-PSK modulation. It has been shown that MCS levels that produce 8PSK modulation do not have an impact on output power.

**GSM Class:** B
**GPRS Multislot class:** 33 (Max 4 Tx uplink slots)
**EDGE Multislot class:** 33 (Max 4 Tx uplink slots)
**DTM Multislot Class:** N/A


**Figure 8-1**
**Power Measurement Setup**

## 8.2 UMTS Conducted Powers

**Table 8-3**
**Maximum Conducted Powers**

| 3GPP Release Version | Mode | 3GPP 34.121 Subtest | Cellular Band [dBm] | | | PCS Band [dBm] | | | 3GPP MPR [dB] |
|---|---|---|---|---|---|---|---|---|---|
| | | | 4132 | 4183 | 4233 | 9262 | 9400 | 9538 | |
| 99 | WCDMA | 12.2 kbps RMC | 22.84 | 22.76 | 22.85 | 23.05 | 22.30 | **23.14** | - |
| 99 | | 12.2 kbps AMR | 22.80 | 22.75 | 22.87 | 22.76 | 22.28 | 22.82 | - |
| 6 | HSDPA | Subtest 1 | 21.88 | 21.85 | 22.03 | 22.02 | 21.28 | 22.09 | 0 |
| 6 | | Subtest 2 | 21.92 | 21.89 | 21.99 | 22.06 | 21.24 | 22.13 | 0 |
| 6 | | Subtest 3 | 21.48 | 21.36 | 21.49 | 21.53 | 20.82 | 21.64 | 0.5 |
| 6 | | Subtest 4 | 21.44 | 21.39 | 21.52 | 21.57 | 20.83 | 21.61 | 0.5 |
| 6 | HSUPA | Subtest 1 | 21.67 | 21.87 | 21.66 | 22.05 | 21.34 | 22.16 | 0 |
| 6 | | Subtest 2 | 19.97 | 19.91 | 20.02 | 20.08 | 19.37 | 20.14 | 2 |
| 6 | | Subtest 3 | 20.89 | 20.91 | 21.01 | 21.07 | 20.33 | 21.16 | 1 |
| 6 | | Subtest 4 | 19.93 | 19.89 | 20.02 | 20.08 | 19.34 | 20.13 | 2 |
| 6 | | Subtest 5 | 21.89 | 21.91 | 22.04 | 22.08 | 21.33 | 22.12 | 0 |

**Table 8-4**
**Reduced Conducted Powers**

| 3GPP Release Version | Mode | 3GPP 34.121 Subtest | Cellular Band [dBm] | | | PCS Band [dBm] | | | 3GPP MPR [dB] |
|---|---|---|---|---|---|---|---|---|---|
| | | | 4132 | 4183 | 4233 | 9262 | 9400 | 9538 | |
| 99 | WCDMA | 12.2 kbps RMC | 16.02 | 16.01 | 16.03 | 13.22 | 12.51 | 13.31 | - |
| 99 | | 12.2 kbps AMR | 16.00 | 15.96 | 16.02 | 13.21 | 12.48 | 13.30 | - |
| 6 | HSDPA | Subtest 1 | 15.07 | 15.04 | 15.09 | 12.18 | 11.51 | 12.28 | 0 |
| 6 | | Subtest 2 | 15.09 | 15.07 | 15.12 | 12.22 | 11.50 | 12.29 | 0 |
| 6 | | Subtest 3 | 14.63 | 14.58 | 14.62 | 11.73 | 11.04 | 11.77 | 0.5 |
| 6 | | Subtest 4 | 14.61 | 14.57 | 14.64 | 11.74 | 11.03 | 11.79 | 0.5 |
| 6 | HSUPA | Subtest 1 | 15.13 | 15.07 | 14.85 | 12.25 | 11.53 | 11.77 | 0 |
| 6 | | Subtest 2 | 13.03 | 13.09 | 13.15 | 10.21 | 9.53 | 10.29 | 2 |
| 6 | | Subtest 3 | 14.01 | 14.09 | 14.13 | 11.19 | 10.52 | 11.29 | 1 |
| 6 | | Subtest 4 | 13.14 | 13.08 | 13.12 | 10.21 | 9.51 | 10.07 | 2 |
| 6 | | Subtest 5 | 15.02 | 15.09 | 15.14 | 11.92 | 11.50 | 12.02 | 0 |

This device does not support DC-HSDPA.

It is expected by the manufacturer that MPR for some HSPA subtests may be up to 1 dB more than specified by 3GPP, but also as low as 0 dB according to the chipset implementation in this model.


**Figure 8-2**
**Power Measurement Setup**

## 8.3 LTE Conducted Powers

### 8.3.1 LTE Band 17

**Table 8-5**
**LTE Band 17 Maximum Conducted Powers - 10 MHz Bandwidth**

| LTE Band 17 10 MHz Bandwidth | | | | | |
|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Mid Channel 23790 (710.0 MHz) Conducted Power [dBm] | MPR Allowed per 3GPP [dB] | MPR [dB] |
| QPSK | 1 | 0 | 22.30 | 0 | 0 |
| | 1 | 25 | **22.34** | | 0 |
| | 1 | 49 | 22.20 | | 0 |
| | 25 | 0 | 21.43 | 0-1 | 1 |
| | 25 | 12 | **21.44** | | 1 |
| | 25 | 25 | 21.40 | | 1 |
| | 50 | 0 | 21.38 | | 1 |
| 16QAM | 1 | 0 | 21.36 | 0-1 | 1 |
| | 1 | 25 | 21.37 | | 1 |
| | 1 | 49 | 21.27 | | 1 |
| | 25 | 0 | 20.37 | 0-2 | 2 |
| | 25 | 12 | 20.37 | | 2 |
| | 25 | 25 | 20.33 | | 2 |
| | 50 | 0 | 20.35 | | 2 |

Note: LTE Band 17 at 10 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

**Table 8-6**
**LTE Band 17 Maximum Conducted Powers - 5 MHz Bandwidth**

| LTE Band 17 5 MHz Bandwidth | | | | | |
|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Mid Channel 23790 (710.0 MHz) Conducted Power [dBm] | MPR Allowed per 3GPP [dB] | MPR [dB] |
| QPSK | 1 | 0 | 22.55 | 0 | 0 |
| | 1 | 12 | 22.51 | | 0 |
| | 1 | 24 | 22.46 | | 0 |
| | 12 | 0 | 21.75 | 0-1 | 1 |
| | 12 | 6 | 21.68 | | 1 |
| | 12 | 13 | 21.63 | | 1 |
| | 25 | 0 | 21.66 | | 1 |
| 16QAM | 1 | 0 | 22.02 | 0-1 | 1 |
| | 1 | 12 | 21.97 | | 1 |
| | 1 | 24 | 21.92 | | 1 |
| | 12 | 0 | 20.76 | 0-2 | 2 |
| | 12 | 6 | 20.75 | | 2 |
| | 12 | 13 | 20.66 | | 2 |
| | 25 | 0 | 20.68 | | 2 |

Note: LTE Band 17 at 5 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

## Table 8-7
## LTE Band 17 Reduced Conducted Powers - 10 MHz Bandwidth

| LTE Band 17<br>10 MHz Bandwidth | | | | | |
|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Mid Channel<br>23790<br>(710.0 MHz)<br>Conducted Power<br>[dBm] | MPR Allowed per 3GPP [dB] | MPR [dB] |
| QPSK | 1 | 0 | 16.06 | 0 | 0 |
| | 1 | 25 | **16.21** | | 0 |
| | 1 | 49 | 16.00 | | 0 |
| | 25 | 0 | **16.20** | 0-1 | 0 |
| | 25 | 12 | 16.19 | | 0 |
| | 25 | 25 | 16.17 | | 0 |
| | 50 | 0 | 16.18 | | 0 |
| 16QAM | 1 | 0 | 16.35 | 0-1 | 0 |
| | 1 | 25 | 16.41 | | 0 |
| | 1 | 49 | 16.27 | | 0 |
| | 25 | 0 | 16.25 | 0-2 | 0 |
| | 25 | 12 | 16.24 | | 0 |
| | 25 | 25 | 16.22 | | 0 |
| | 50 | 0 | 16.18 | | 0 |

Note: LTE Band 17 at 10 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

## Table 8-8
## LTE Band 17 Reduced Conducted Powers - 5 MHz Bandwidth

| LTE Band 17<br>5 MHz Bandwidth | | | | | |
|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Mid Channel<br>23790<br>(710.0 MHz)<br>Conducted Power<br>[dBm] | MPR Allowed per 3GPP [dB] | MPR [dB] |
| QPSK | 1 | 0 | 16.66 | 0 | 0 |
| | 1 | 12 | 16.61 | | 0 |
| | 1 | 24 | 16.57 | | 0 |
| | 12 | 0 | 16.81 | 0-1 | 0 |
| | 12 | 6 | 16.75 | | 0 |
| | 12 | 13 | 16.70 | | 0 |
| | 25 | 0 | 16.69 | | 0 |
| 16QAM | 1 | 0 | 16.53 | 0-1 | 0 |
| | 1 | 12 | 16.59 | | 0 |
| | 1 | 24 | 16.65 | | 0 |
| | 12 | 0 | 16.80 | 0-2 | 0 |
| | 12 | 6 | 16.79 | | 0 |
| | 12 | 13 | 16.77 | | 0 |
| | 25 | 0 | 16.68 | | 0 |

Note: LTE Band 17 at 5 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

## 8.3.2 LTE Band 5 (Cell)

**Table 8-9**
**LTE Band 5 (Cell) Maximum Conducted Powers - 10 MHz Bandwidth**

| LTE Band 5 (Cell) 10 MHz Bandwidth | | | | | |
|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Mid Channel 20525 (836.5 MHz) Conducted Power [dBm] | MPR Allowed per 3GPP [dB] | MPR [dB] |
| QPSK | 1 | 0 | 22.94 | 0 | 0 |
| | 1 | 25 | **22.99** | | 0 |
| | 1 | 49 | 22.87 | | 0 |
| | 25 | 0 | 22.10 | 0-1 | 1 |
| | 25 | 12 | **22.11** | | 1 |
| | 25 | 25 | 22.07 | | 1 |
| | 50 | 0 | 22.08 | | 1 |
| 16QAM | 1 | 0 | 22.06 | 0-1 | 1 |
| | 1 | 25 | 22.08 | | 1 |
| | 1 | 49 | 22.04 | | 1 |
| | 25 | 0 | 21.08 | 0-2 | 2 |
| | 25 | 12 | 21.07 | | 2 |
| | 25 | 25 | 21.05 | | 2 |
| | 50 | 0 | 21.00 | | 2 |

Note: LTE Band 5 (Cell) at 10 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

**Table 8-10**
**LTE Band 5 (Cell) Maximum Conducted Powers - 5 MHz Bandwidth**

| LTE Band 5 (Cell) 5 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 20425 (826.5 MHz) | Mid Channel 20525 (836.5 MHz) | High Channel 20625 (846.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 22.86 | 22.91 | 22.79 | 0 | 0 |
| | 1 | 12 | 22.94 | 22.99 | 22.76 | | 0 |
| | 1 | 24 | 22.93 | 22.84 | 22.62 | | 0 |
| | 12 | 0 | 21.92 | 22.02 | 21.88 | 0-1 | 1 |
| | 12 | 6 | 21.97 | 22.06 | 21.92 | | 1 |
| | 12 | 13 | 21.92 | 22.01 | 21.91 | | 1 |
| | 25 | 0 | 21.91 | 21.98 | 21.89 | | 1 |
| 16QAM | 1 | 0 | 22.24 | 22.26 | 22.24 | 0-1 | 1 |
| | 1 | 12 | 22.34 | 22.29 | 22.21 | | 1 |
| | 1 | 24 | 22.27 | 22.19 | 22.12 | | 1 |
| | 12 | 0 | 20.98 | 20.98 | 20.93 | 0-2 | 2 |
| | 12 | 6 | 20.97 | 21.04 | 20.97 | | 2 |
| | 12 | 13 | 20.95 | 20.99 | 20.92 | | 2 |
| | 25 | 0 | 20.86 | 21.01 | 20.92 | | 2 |

## Table 8-11
## LTE Band 5 (Cell) Maximum Conducted Powers - 3 MHz Bandwidth

| LTE Band 5 (Cell) 3 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 20415 (825.5 MHz) | Mid Channel 20525 (836.5 MHz) | High Channel 20635 (847.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 22.67 | 22.84 | 22.79 | 0 | 0 |
| | 1 | 7 | 22.82 | 22.95 | 22.89 | | 0 |
| | 1 | 14 | 22.65 | 22.80 | 22.72 | | 0 |
| | 8 | 0 | 21.91 | 21.91 | 21.84 | 0-1 | 1 |
| | 8 | 4 | 21.93 | 21.99 | 21.92 | | 1 |
| | 8 | 7 | 21.86 | 21.89 | 21.82 | | 1 |
| | 15 | 0 | 21.87 | 21.97 | 21.89 | | 1 |
| 16QAM | 1 | 0 | 21.95 | 22.14 | 21.96 | 0-1 | 1 |
| | 1 | 7 | 21.97 | 22.30 | 22.05 | | 1 |
| | 1 | 14 | 21.86 | 22.16 | 21.79 | | 1 |
| | 8 | 0 | 20.90 | 20.82 | 20.70 | 0-2 | 2 |
| | 8 | 4 | 20.94 | 20.92 | 20.78 | | 2 |
| | 8 | 7 | 20.92 | 20.84 | 20.68 | | 2 |
| | 15 | 0 | 20.81 | 20.98 | 20.79 | | 2 |

## Table 8-12
## LTE Band 5 (Cell) Maximum Conducted Powers -1.4 MHz Bandwidth

| LTE Band 5 (Cell) 1.4 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 20407 (824.7 MHz) | Mid Channel 20525 (836.5 MHz) | High Channel 20643 (848.3 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 22.61 | 22.97 | 22.68 | 0 | 0 |
| | 1 | 2 | 22.69 | 23.02 | 22.75 | | 0 |
| | 1 | 5 | 22.64 | 22.97 | 22.67 | | 0 |
| | 3 | 0 | 22.78 | 22.89 | 22.74 | | 0 |
| | 3 | 2 | 22.83 | 22.93 | 22.81 | | 0 |
| | 3 | 3 | 22.77 | 22.83 | 22.77 | | 0 |
| | 6 | 0 | 21.81 | 21.88 | 21.73 | 0-1 | 1 |
| 16QAM | 1 | 0 | 21.89 | 21.86 | 21.83 | 0-1 | 1 |
| | 1 | 2 | 21.98 | 21.87 | 21.86 | | 1 |
| | 1 | 5 | 21.91 | 21.76 | 21.79 | | 1 |
| | 3 | 0 | 21.77 | 21.91 | 21.95 | | 1 |
| | 3 | 2 | 21.82 | 21.93 | 21.97 | | 1 |
| | 3 | 3 | 21.75 | 21.84 | 21.92 | | 1 |
| | 6 | 0 | 20.77 | 20.96 | 20.77 | 0-2 | 2 |

## Table 8-13
## LTE Band 5 (Cell) Reduced Conducted Powers - 10 MHz Bandwidth

| LTE Band 5 (Cell) 10 MHz Bandwidth | | | | | |
|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Mid Channel 20525 (836.5 MHz) Conducted Power [dBm] | MPR Allowed per 3GPP [dB] | MPR [dB] |
| QPSK | 1 | 0 | 14.84 | 0 | 0 |
| | 1 | 25 | **14.92** | | 0 |
| | 1 | 49 | 14.82 | | 0 |
| | 25 | 0 | 15.02 | 0-1 | 0 |
| | 25 | 12 | **15.08** | | 0 |
| | 25 | 25 | 14.96 | | 0 |
| | 50 | 0 | **15.07** | | 0 |
| 16QAM | 1 | 0 | 15.39 | 0-1 | 0 |
| | 1 | 25 | 15.42 | | 0 |
| | 1 | 49 | 15.37 | | 0 |
| | 25 | 0 | 15.03 | 0-2 | 0 |
| | 25 | 12 | 15.12 | | 0 |
| | 25 | 25 | 14.96 | | 0 |
| | 50 | 0 | 15.07 | | 0 |

Note: LTE Band 5 (Cell) at 10 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

## Table 8-14
## LTE Band 5 (Cell) Reduced Conducted Powers - 5 MHz Bandwidth

| LTE Band 5 (Cell) 5 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 20425 (826.5 MHz) | Mid Channel 20525 (836.5 MHz) | High Channel 20625 (846.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 14.82 | 14.94 | 14.99 | 0 | 0 |
| | 1 | 12 | 14.77 | 14.99 | 14.92 | | 0 |
| | 1 | 24 | 14.80 | 14.91 | 14.87 | | 0 |
| | 12 | 0 | 14.93 | 15.05 | 14.90 | 0-1 | 0 |
| | 12 | 6 | 14.98 | 15.07 | 14.96 | | 0 |
| | 12 | 13 | 14.96 | 15.04 | 14.93 | | 0 |
| | 25 | 0 | 14.94 | 15.03 | 14.91 | | 0 |
| 16QAM | 1 | 0 | 15.00 | 15.22 | 15.29 | 0-1 | 0 |
| | 1 | 12 | 15.04 | 15.21 | 15.23 | | 0 |
| | 1 | 24 | 15.00 | 15.14 | 15.17 | | 0 |
| | 12 | 0 | 14.96 | 15.03 | 14.96 | 0-2 | 0 |
| | 12 | 6 | 15.03 | 15.09 | 14.98 | | 0 |
| | 12 | 13 | 14.97 | 15.03 | 14.94 | | 0 |
| | 25 | 0 | 14.97 | 15.06 | 14.90 | | 0 |

## Table 8-15
## LTE Band 5 (Cell) Reduced Conducted Powers - 3 MHz Bandwidth

| LTE Band 5 (Cell) 3 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 20415 (825.5 MHz) | Mid Channel 20525 (836.5 MHz) | High Channel 20635 (847.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 14.83 | 14.93 | 14.83 | 0 | 0 |
| | 1 | 7 | 14.95 | 15.03 | 14.91 | | 0 |
| | 1 | 14 | 14.82 | 14.88 | 14.70 | | 0 |
| | 8 | 0 | 14.93 | 14.96 | 14.89 | 0-1 | 0 |
| | 8 | 4 | 14.97 | 15.05 | 14.95 | | 0 |
| | 8 | 7 | 14.93 | 14.97 | 14.86 | | 0 |
| | 15 | 0 | 14.96 | 15.00 | 14.88 | | 0 |
| 16QAM | 1 | 0 | 14.99 | 15.40 | 15.33 | 0-1 | 0 |
| | 1 | 7 | 15.11 | 15.42 | 15.40 | | 0 |
| | 1 | 14 | 14.91 | 15.41 | 15.26 | | 0 |
| | 8 | 0 | 14.89 | 15.07 | 14.98 | 0-2 | 0 |
| | 8 | 4 | 14.93 | 15.12 | 15.04 | | 0 |
| | 8 | 7 | 14.91 | 15.06 | 14.98 | | 0 |
| | 15 | 0 | 14.97 | 15.07 | 15.01 | | 0 |

## Table 8-16
## LTE Band 5 (Cell) Reduced Conducted Powers -1.4 MHz Bandwidth

| LTE Band 5 (Cell) 1.4 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 20407 (824.7 MHz) | Mid Channel 20525 (836.5 MHz) | High Channel 20643 (848.3 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 14.77 | 14.98 | 14.64 | 0 | 0 |
| | 1 | 2 | 14.82 | 15.00 | 14.68 | | 0 |
| | 1 | 5 | 14.78 | 14.97 | 14.61 | | 0 |
| | 3 | 0 | 14.80 | 14.93 | 14.79 | | 0 |
| | 3 | 2 | 14.84 | 14.99 | 14.80 | | 0 |
| | 3 | 3 | 14.79 | 14.91 | 14.76 | | 0 |
| | 6 | 0 | 14.82 | 14.94 | 14.82 | 0-1 | 0 |
| 16QAM | 1 | 0 | 14.90 | 14.88 | 14.99 | 0-1 | 0 |
| | 1 | 2 | 14.99 | 14.92 | 15.03 | | 0 |
| | 1 | 5 | 14.89 | 14.82 | 14.98 | | 0 |
| | 3 | 0 | 14.83 | 15.03 | 14.76 | | 0 |
| | 3 | 2 | 14.88 | 15.02 | 14.80 | | 0 |
| | 3 | 3 | 14.85 | 15.00 | 14.72 | | 0 |
| | 6 | 0 | 14.95 | 15.12 | 14.89 | 0-2 | 0 |

### 8.3.3 LTE Band 4 (AWS)

**Table 8-17**
**LTE Band 4 (AWS) Maximum Conducted Powers - 20 MHz Bandwidth**

| LTE Band 4 (AWS) 20 MHzBandwidth | | | | | |
|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Mid Channel 20175 (1732.5 MHz) Conducted Power [dBm] | MPR Allowed per 3GPP [dB] | MPR [dB] |
| QPSK | 1 | 0 | **23.65** | 0 | 0 |
| | 1 | 50 | 22.72 | | 0 |
| | 1 | 99 | 22.78 | | 0 |
| | 50 | 0 | **22.20** | 0-1 | 1 |
| | 50 | 25 | 21.87 | | 1 |
| | 50 | 50 | 21.82 | | 1 |
| | 100 | 0 | 21.99 | | 1 |
| 16QAM | 1 | 0 | 22.70 | 0-1 | 1 |
| | 1 | 50 | 21.79 | | 1 |
| | 1 | 99 | 21.91 | | 1 |
| | 50 | 0 | 21.13 | 0-2 | 2 |
| | 50 | 25 | 20.84 | | 2 |
| | 50 | 50 | 20.75 | | 2 |
| | 100 | 0 | 20.95 | | 2 |

Note: LTE Band 4 (AWS) at 20 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

**Table 8-18**
**LTE Band 4 (AWS) Maximum Conducted Powers - 15 MHz Bandwidth**

| LTE Band 4 (AWS) 15 MHzBandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 20025 (1717.5 MHz) | Mid Channel 20175 (1732.5 MHz) | High Channel 20325 (1747.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 23.65 | 23.45 | 23.25 | 0 | 0 |
| | 1 | 36 | 22.97 | 22.95 | 22.63 | | 0 |
| | 1 | 74 | 23.07 | 22.93 | 22.58 | | 0 |
| | 36 | 0 | 22.38 | 22.31 | 21.96 | 0-1 | 1 |
| | 36 | 18 | 22.16 | 22.01 | 21.75 | | 1 |
| | 36 | 37 | 22.01 | 21.90 | 21.65 | | 1 |
| | 75 | 0 | 22.20 | 22.06 | 21.79 | | 1 |
| 16QAM | 1 | 0 | 22.87 | 22.71 | 22.56 | 0-1 | 1 |
| | 1 | 36 | 22.32 | 21.99 | 21.84 | | 1 |
| | 1 | 74 | 22.33 | 22.05 | 21.84 | | 1 |
| | 36 | 0 | 21.33 | 21.20 | 20.86 | 0-2 | 2 |
| | 36 | 18 | 21.15 | 20.95 | 20.70 | | 2 |
| | 36 | 37 | 20.98 | 20.82 | 20.57 | | 2 |
| | 75 | 0 | 21.31 | 21.00 | 20.76 | | 2 |

## Table 8-19
## LTE Band 4 (AWS) Maximum Conducted Powers - 10 MHz Bandwidth

| LTE Band 4 (AWS) 10 MHzBandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 20000 (1715.0 MHz) | Mid Channel 20175 (1732.5 MHz) | High Channel 20350 (1750.0 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 23.58 | 23.44 | 23.15 | 0 | 0 |
| | 1 | 25 | 23.39 | 23.08 | 22.83 | | 0 |
| | 1 | 49 | 23.26 | 22.99 | 22.78 | | 0 |
| | 25 | 0 | 22.69 | 22.32 | 22.06 | 0-1 | 1 |
| | 25 | 12 | 22.55 | 22.20 | 21.97 | | 1 |
| | 25 | 25 | 22.43 | 22.09 | 21.99 | | 1 |
| | 50 | 0 | 22.62 | 22.20 | 21.96 | | 1 |
| 16QAM | 1 | 0 | 22.76 | 22.52 | 22.35 | 0-1 | 1 |
| | 1 | 25 | 22.59 | 22.31 | 22.05 | | 1 |
| | 1 | 49 | 22.51 | 22.21 | 22.02 | | 1 |
| | 25 | 0 | 21.58 | 21.27 | 21.00 | 0-2 | 2 |
| | 25 | 12 | 21.49 | 21.14 | 20.93 | | 2 |
| | 25 | 25 | 21.41 | 21.05 | 20.82 | | 2 |
| | 50 | 0 | 21.55 | 21.13 | 20.93 | | 2 |

## Table 8-20
## LTE Band 4 (AWS) Maximum Conducted Powers - 5 MHz Bandwidth

| LTE Band 4 (AWS) 5 MHzBandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 19975 (1712.5 MHz) | Mid Channel 20175 (1732.5 MHz) | High Channel 20375 (1752.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 23.56 | 23.35 | 23.05 | 0 | 0 |
| | 1 | 12 | 23.46 | 23.13 | 22.89 | | 0 |
| | 1 | 24 | 23.38 | 23.09 | 22.84 | | 0 |
| | 12 | 0 | 22.65 | 22.29 | 22.02 | 0-1 | 1 |
| | 12 | 6 | 22.57 | 22.23 | 21.98 | | 1 |
| | 12 | 13 | 22.53 | 22.19 | 21.96 | | 1 |
| | 25 | 0 | 22.52 | 22.19 | 21.98 | | 1 |
| 16QAM | 1 | 0 | 22.78 | 22.59 | 22.21 | 0-1 | 1 |
| | 1 | 12 | 22.67 | 22.31 | 22.13 | | 1 |
| | 1 | 24 | 22.62 | 22.29 | 22.01 | | 1 |
| | 12 | 0 | 21.60 | 21.25 | 20.99 | 0-2 | 2 |
| | 12 | 6 | 21.58 | 21.28 | 20.99 | | 2 |
| | 12 | 13 | 21.53 | 21.19 | 20.91 | | 2 |
| | 25 | 0 | 21.51 | 21.17 | 20.93 | | 2 |

## Table 8-21
## LTE Band 4 (AWS) Maximum Conducted Powers - 3 MHz Bandwidth

| LTE Band 4 (AWS) 3 MHzBandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 19965 (1711.5 MHz) | Mid Channel 20175 (1732.5 MHz) | High Channel 20385 (1753.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 23.59 | 23.15 | 22.92 | 0 | 0 |
| | 1 | 7 | 23.66 | 23.17 | 22.95 | | 0 |
| | 1 | 14 | 23.40 | 23.08 | 22.86 | | 0 |
| | 8 | 0 | 22.53 | 22.19 | 21.95 | 0-1 | 1 |
| | 8 | 4 | 22.65 | 22.21 | 21.99 | | 1 |
| | 8 | 7 | 22.45 | 22.16 | 21.98 | | 1 |
| | 15 | 0 | 22.53 | 22.17 | 22.05 | | 1 |
| 16QAM | 1 | 0 | 22.70 | 22.31 | 22.15 | 0-1 | 1 |
| | 1 | 7 | 22.81 | 22.41 | 22.20 | | 1 |
| | 1 | 14 | 22.60 | 22.28 | 22.16 | | 1 |
| | 8 | 0 | 21.54 | 21.22 | 21.08 | 0-2 | 2 |
| | 8 | 4 | 21.62 | 21.21 | 21.08 | | 2 |
| | 8 | 7 | 21.52 | 21.21 | 21.03 | | 2 |
| | 15 | 0 | 21.55 | 21.13 | 20.96 | | 2 |

## Table 8-22
## LTE Band 4 (AWS) Maximum Conducted Powers -1.4 MHz Bandwidth

| LTE Band 4 (AWS) 1.4 MHzBandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 19957 (1710.7 MHz) | Mid Channel 20175 (1732.5 MHz) | High Channel 20393 (1754.3 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 23.46 | 23.17 | 22.87 | 0 | 0 |
| | 1 | 2 | 23.43 | 23.24 | 22.89 | | 0 |
| | 1 | 5 | 23.39 | 23.11 | 22.86 | | 0 |
| | 3 | 0 | 23.53 | 23.12 | 22.87 | | 0 |
| | 3 | 2 | 23.41 | 23.16 | 22.91 | | 0 |
| | 3 | 3 | 23.39 | 23.09 | 22.83 | | 0 |
| | 6 | 0 | 22.54 | 22.21 | 21.96 | 0-1 | 1 |
| 16QAM | 1 | 0 | 22.76 | 22.35 | 22.05 | 0-1 | 1 |
| | 1 | 2 | 22.72 | 22.42 | 22.08 | | 1 |
| | 1 | 5 | 22.61 | 22.31 | 22.03 | | 1 |
| | 3 | 0 | 22.65 | 22.29 | 22.05 | | 1 |
| | 3 | 2 | 22.69 | 22.29 | 22.06 | | 1 |
| | 3 | 3 | 22.66 | 22.23 | 22.00 | | 1 |
| | 6 | 0 | 21.61 | 21.30 | 21.01 | 0-2 | 2 |

## Table 8-23
## LTE Band 4 (AWS) Reduced Conducted Powers - 20 MHz Bandwidth

| LTE Band 4 (AWS) 20 MHzBandwidth | | | | | |
|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Mid Channel 20175 (1732.5 MHz) Conducted Power [dBm] | MPR Allowed per 3GPP [dB] | MPR [dB] |
| QPSK | 1 | 0 | **13.20** | 0 | 0 |
| | 1 | 50 | 12.40 | | 0 |
| | 1 | 99 | 12.42 | | 0 |
| | 50 | 0 | **12.80** | 0-1 | 0 |
| | 50 | 25 | 12.46 | | 0 |
| | 50 | 50 | 12.44 | | 0 |
| | 100 | 0 | 12.61 | | 0 |
| 16QAM | 1 | 0 | 13.30 | 0-1 | 0 |
| | 1 | 50 | 12.61 | | 0 |
| | 1 | 99 | 12.65 | | 0 |
| | 50 | 0 | 12.78 | 0-2 | 0 |
| | 50 | 25 | 12.47 | | 0 |
| | 50 | 50 | 12.39 | | 0 |
| | 100 | 0 | 12.60 | | 0 |

Note: LTE Band 4 (AWS) at 20 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

## Table 8-24
## LTE Band 4 (AWS) Reduced Conducted Powers - 15 MHz Bandwidth

| LTE Band 4 (AWS) 15 MHzBandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 20025 (1717.5 MHz) | Mid Channel 20175 (1732.5 MHz) | High Channel 20325 (1747.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 13.16 | 13.12 | 12.93 | 0 | 0 |
| | 1 | 36 | 12.64 | 12.54 | 12.27 | | 0 |
| | 1 | 74 | 12.71 | 12.55 | 12.25 | | 0 |
| | 36 | 0 | 13.09 | 12.94 | 12.65 | 0-1 | 0 |
| | 36 | 18 | 12.86 | 12.71 | 12.45 | | 0 |
| | 36 | 37 | 12.72 | 12.61 | 12.34 | | 0 |
| | 75 | 0 | 12.91 | 12.75 | 12.45 | | 0 |
| 16QAM | 1 | 0 | 13.48 | 13.40 | 13.21 | 0-1 | 0 |
| | 1 | 36 | 12.98 | 12.83 | 12.61 | | 0 |
| | 1 | 74 | 13.00 | 12.83 | 12.56 | | 0 |
| | 36 | 0 | 13.01 | 12.98 | 12.64 | 0-2 | 0 |
| | 36 | 18 | 12.83 | 12.73 | 12.47 | | 0 |
| | 36 | 37 | 12.71 | 12.60 | 12.36 | | 0 |
| | 75 | 0 | 12.89 | 12.74 | 12.51 | | 0 |

## Table 8-25
## LTE Band 4 (AWS) Reduced Conducted Powers - 10 MHz Bandwidth

| LTE Band 4 (AWS) 10 MHzBandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 20000 (1715.0 MHz) | Mid Channel 20175 (1732.5 MHz) | High Channel 20350 (1750.0 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 13.12 | 12.78 | 12.59 | 0 | 0 |
| | 1 | 25 | 12.79 | 12.53 | 12.31 | | 0 |
| | 1 | 49 | 12.72 | 12.46 | 12.26 | | 0 |
| | 25 | 0 | 13.12 | 12.79 | 12.54 | 0-1 | 0 |
| | 25 | 12 | 12.98 | 12.65 | 12.46 | | 0 |
| | 25 | 25 | 12.88 | 12.61 | 12.36 | | 0 |
| | 50 | 0 | 13.01 | 12.65 | 12.48 | | 0 |
| 16QAM | 1 | 0 | 13.29 | 13.00 | 12.78 | 0-1 | 0 |
| | 1 | 25 | 13.13 | 12.75 | 12.52 | | 0 |
| | 1 | 49 | 12.94 | 12.66 | 12.54 | | 0 |
| | 25 | 0 | 13.04 | 12.78 | 12.50 | 0-2 | 0 |
| | 25 | 12 | 12.92 | 12.65 | 12.43 | | 0 |
| | 25 | 25 | 12.85 | 12.60 | 12.33 | | 0 |
| | 50 | 0 | 13.00 | 12.66 | 12.48 | | 0 |

## Table 8-26
## LTE Band 4 (AWS) Reduced Conducted Powers - 5 MHz Bandwidth

| LTE Band 4 (AWS) 5 MHzBandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 19975 (1712.5 MHz) | Mid Channel 20175 (1732.5 MHz) | High Channel 20375 (1752.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 12.99 | 12.66 | 12.38 | 0 | 0 |
| | 1 | 12 | 12.83 | 12.45 | 12.30 | | 0 |
| | 1 | 24 | 12.74 | 12.43 | 12.23 | | 0 |
| | 12 | 0 | 12.96 | 12.61 | 12.38 | 0-1 | 0 |
| | 12 | 6 | 12.94 | 12.65 | 12.39 | | 0 |
| | 12 | 13 | 12.89 | 12.58 | 12.32 | | 0 |
| | 25 | 0 | 12.93 | 12.61 | 12.35 | | 0 |
| 16QAM | 1 | 0 | 13.18 | 12.89 | 12.59 | 0-1 | 0 |
| | 1 | 12 | 13.04 | 12.69 | 12.52 | | 0 |
| | 1 | 24 | 13.02 | 12.75 | 12.35 | | 0 |
| | 12 | 0 | 13.00 | 12.62 | 12.40 | 0-2 | 0 |
| | 12 | 6 | 13.01 | 12.63 | 12.43 | | 0 |
| | 12 | 13 | 12.89 | 12.58 | 12.32 | | 0 |
| | 25 | 0 | 12.90 | 12.60 | 12.33 | | 0 |

## Table 8-27
## LTE Band 4 (AWS) Reduced Conducted Powers - 3 MHz Bandwidth

| LTE Band 4 (AWS) 3 MHzBandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 19965 (1711.5 MHz) | Mid Channel 20175 (1732.5 MHz) | High Channel 20385 (1753.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 12.87 | 12.50 | 12.32 | 0 | 0 |
| | 1 | 7 | 12.95 | 12.58 | 12.46 | | 0 |
| | 1 | 14 | 12.78 | 12.42 | 12.33 | | 0 |
| | 8 | 0 | 12.86 | 12.56 | 12.37 | 0-1 | 0 |
| | 8 | 4 | 12.96 | 12.58 | 12.38 | | 0 |
| | 8 | 7 | 12.82 | 12.55 | 12.31 | | 0 |
| | 15 | 0 | 12.92 | 12.59 | 12.29 | | 0 |
| 16QAM | 1 | 0 | 12.87 | 12.70 | 12.28 | 0-1 | 0 |
| | 1 | 7 | 12.90 | 12.76 | 12.26 | | 0 |
| | 1 | 14 | 12.78 | 12.62 | 12.23 | | 0 |
| | 8 | 0 | 12.86 | 12.66 | 12.38 | 0-2 | 0 |
| | 8 | 4 | 12.96 | 12.65 | 12.36 | | 0 |
| | 8 | 7 | 12.83 | 12.63 | 12.30 | | 0 |
| | 15 | 0 | 12.91 | 12.58 | 12.31 | | 0 |

## Table 8-28
## LTE Band 4 (AWS) Reduced Conducted Powers -1.4 MHz Bandwidth

| LTE Band 4 (AWS) 1.4 MHzBandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 19957 (1710.7 MHz) | Mid Channel 20175 (1732.5 MHz) | High Channel 20393 (1754.3 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 12.78 | 12.40 | 12.11 | 0 | 0 |
| | 1 | 2 | 12.72 | 12.42 | 12.18 | | 0 |
| | 1 | 5 | 12.64 | 12.35 | 12.12 | | 0 |
| | 3 | 0 | 12.81 | 12.36 | 12.20 | | 0 |
| | 3 | 2 | 12.72 | 12.38 | 12.23 | | 0 |
| | 3 | 3 | 12.71 | 12.40 | 12.13 | | 0 |
| | 6 | 0 | 12.78 | 12.49 | 12.26 | 0-1 | 0 |
| 16QAM | 1 | 0 | 13.00 | 12.39 | 12.30 | 0-1 | 0 |
| | 1 | 2 | 12.93 | 12.38 | 12.41 | | 0 |
| | 1 | 5 | 12.92 | 12.34 | 12.40 | | 0 |
| | 3 | 0 | 12.89 | 12.43 | 12.30 | | 0 |
| | 3 | 2 | 12.88 | 12.40 | 12.36 | | 0 |
| | 3 | 3 | 12.84 | 12.41 | 12.29 | | 0 |
| | 6 | 0 | 12.87 | 12.49 | 12.34 | 0-2 | 0 |

## 8.3.4 LTE Band 2 (PCS)

**Table 8-29**
**LTE Band 2 (PCS) Maximum Conducted Powers - 20 MHz Bandwidth**

| LTE Band 2 (PCS) 20 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 18700 (1860.0 MHz) | Mid Channel 18900 (1880.0 MHz) | High Channel 19100 (1900.0 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | **23.80** | 23.23 | 23.47 | 0 | 0 |
| | 1 | 50 | 22.80 | 22.33 | 23.04 | | 0 |
| | 1 | 99 | 22.81 | 22.70 | 23.45 | | 0 |
| | 50 | 0 | **22.25** | 21.75 | 22.14 | 0-1 | 1 |
| | 50 | 25 | 21.84 | 21.34 | 22.08 | | 1 |
| | 50 | 50 | 21.81 | 21.50 | 22.20 | | 1 |
| | 100 | 0 | 21.99 | 21.51 | 22.24 | | 1 |
| 16QAM | 1 | 0 | 22.80 | 22.29 | 22.49 | 0-1 | 1 |
| | 1 | 50 | 21.86 | 21.30 | 21.98 | | 1 |
| | 1 | 99 | 21.84 | 21.72 | 22.41 | | 1 |
| | 50 | 0 | 21.20 | 20.71 | 21.08 | 0-2 | 2 |
| | 50 | 25 | 20.85 | 20.33 | 21.03 | | 2 |
| | 50 | 50 | 20.80 | 20.45 | 21.15 | | 2 |
| | 100 | 0 | 20.95 | 20.47 | 21.17 | | 2 |

**Table 8-30**
**LTE Band 2 (PCS) Maximum Conducted Powers - 15 MHz Bandwidth**

| LTE Band 2 (PCS) 15 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 18675 (1857.5 MHz) | Mid Channel 18900 (1880.0 MHz) | High Channel 19125 (1902.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 23.77 | 23.19 | 23.70 | 0 | 0 |
| | 1 | 36 | 22.94 | 22.46 | 23.19 | | 0 |
| | 1 | 74 | 22.77 | 22.82 | 23.66 | | 0 |
| | 36 | 0 | 22.41 | 21.86 | 22.39 | 0-1 | 1 |
| | 36 | 18 | 22.11 | 21.55 | 22.25 | | 1 |
| | 36 | 37 | 21.95 | 21.54 | 22.30 | | 1 |
| | 75 | 0 | 22.11 | 21.56 | 22.29 | | 1 |
| 16QAM | 1 | 0 | 22.74 | 22.45 | 22.92 | 0-1 | 1 |
| | 1 | 36 | 22.13 | 21.93 | 22.53 | | 1 |
| | 1 | 74 | 22.00 | 22.16 | 22.70 | | 1 |
| | 36 | 0 | 21.34 | 20.85 | 21.34 | 0-2 | 2 |
| | 36 | 18 | 21.15 | 20.60 | 21.24 | | 2 |
| | 36 | 37 | 20.93 | 20.57 | 21.32 | | 2 |
| | 75 | 0 | 21.13 | 20.59 | 21.23 | | 2 |

## Table 8-31
## LTE Band 2 (PCS) Maximum Conducted Powers - 10 MHz Bandwidth

| LTE Band 2 (PCS) 10 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 18650 (1855.0 MHz) | Mid Channel 18900 (1880.0 MHz) | High Channel 19150 (1905.0 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 23.33 | 22.68 | 23.29 | 0 | 0 |
| | 1 | 25 | 22.95 | 22.31 | 23.22 | | 0 |
| | 1 | 49 | 22.80 | 22.45 | 23.34 | | 0 |
| | 25 | 0 | 22.30 | 21.62 | 22.55 | 0-1 | 1 |
| | 25 | 12 | 22.05 | 21.48 | 22.46 | | 1 |
| | 25 | 25 | 22.02 | 21.50 | 22.50 | | 1 |
| | 50 | 0 | 22.08 | 21.46 | 22.47 | | 1 |
| 16QAM | 1 | 0 | 22.52 | 22.23 | 22.55 | 0-1 | 1 |
| | 1 | 25 | 22.07 | 21.87 | 22.44 | | 1 |
| | 1 | 49 | 21.88 | 22.01 | 22.53 | | 1 |
| | 25 | 0 | 21.28 | 20.64 | 21.54 | 0-2 | 2 |
| | 25 | 12 | 21.10 | 20.50 | 21.45 | | 2 |
| | 25 | 25 | 21.03 | 20.53 | 21.46 | | 2 |
| | 50 | 0 | 21.05 | 20.48 | 21.43 | | 2 |

## Table 8-32
## LTE Band 2 (PCS) Maximum Conducted Powers - 5 MHz Bandwidth

| LTE Band 2 (PCS) 5 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 18625 (1852.5 MHz) | Mid Channel 18900 (1880.0 MHz) | High Channel 19175 (1907.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 23.21 | 22.55 | 23.36 | 0 | 0 |
| | 1 | 12 | 23.13 | 22.34 | 23.41 | | 0 |
| | 1 | 24 | 22.95 | 22.39 | 23.44 | | 0 |
| | 12 | 0 | 22.19 | 21.48 | 22.44 | 0-1 | 1 |
| | 12 | 6 | 22.16 | 21.43 | 22.49 | | 1 |
| | 12 | 13 | 22.07 | 21.47 | 22.43 | | 1 |
| | 25 | 0 | 22.14 | 21.45 | 22.45 | | 1 |
| 16QAM | 1 | 0 | 22.56 | 21.71 | 22.65 | 0-1 | 1 |
| | 1 | 12 | 22.44 | 21.49 | 22.66 | | 1 |
| | 1 | 24 | 22.28 | 21.59 | 22.60 | | 1 |
| | 12 | 0 | 21.12 | 20.50 | 21.42 | 0-2 | 2 |
| | 12 | 6 | 21.11 | 20.48 | 21.48 | | 2 |
| | 12 | 13 | 21.08 | 20.49 | 21.38 | | 2 |
| | 25 | 0 | 21.06 | 20.45 | 21.44 | | 2 |

## Table 8-33
## LTE Band 2 (PCS) Maximum Conducted Powers - 3 MHz Bandwidth

| LTE Band 2 (PCS) 3 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 18615 (1851.5 MHz) | Mid Channel 18900 (1880.0 MHz) | High Channel 19185 (1908.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 23.05 | 22.36 | 23.32 | 0 | 0 |
| | 1 | 7 | 23.10 | 22.43 | 23.34 | | 0 |
| | 1 | 14 | 22.98 | 22.30 | 23.23 | | 0 |
| | 8 | 0 | 22.12 | 21.44 | 22.48 | 0-1 | 1 |
| | 8 | 4 | 22.12 | 21.45 | 22.46 | | 1 |
| | 8 | 7 | 22.08 | 21.36 | 22.39 | | 1 |
| | 15 | 0 | 22.13 | 21.40 | 22.45 | | 1 |
| 16QAM | 1 | 0 | 22.21 | 21.86 | 22.59 | 0-1 | 1 |
| | 1 | 7 | 22.30 | 21.92 | 22.64 | | 1 |
| | 1 | 14 | 22.07 | 21.82 | 22.48 | | 1 |
| | 8 | 0 | 21.05 | 20.50 | 21.48 | 0-2 | 2 |
| | 8 | 4 | 21.06 | 20.49 | 21.48 | | 2 |
| | 8 | 7 | 21.02 | 20.46 | 21.47 | | 2 |
| | 15 | 0 | 21.08 | 20.45 | 21.43 | | 2 |

## Table 8-34
## LTE Band 2 (PCS) Maximum Conducted Powers -1.4 MHz Bandwidth

| LTE Band 2 (PCS) 1.4 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 18607 (1850.7 MHz) | Mid Channel 18900 (1880.0 MHz) | High Channel 19193 (1909.3 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | | | | | |
| QPSK | 1 | 0 | 22.95 | 22.38 | 23.13 | 0 | 0 |
| | 1 | 2 | 23.00 | 22.40 | 23.28 | | 0 |
| | 1 | 5 | 22.97 | 22.39 | 23.18 | | 0 |
| | 3 | 0 | 23.00 | 22.33 | 23.36 | | 0 |
| | 3 | 2 | 23.05 | 22.37 | 23.40 | | 0 |
| | 3 | 3 | 22.99 | 22.28 | 23.36 | | 0 |
| | 6 | 0 | 21.98 | 21.32 | 22.38 | 0-1 | 1 |
| 16QAM | 1 | 0 | 22.06 | 21.23 | 22.41 | 0-1 | 1 |
| | 1 | 2 | 22.12 | 21.29 | 22.52 | | 1 |
| | 1 | 5 | 22.05 | 21.20 | 22.46 | | 1 |
| | 3 | 0 | 22.02 | 21.38 | 22.29 | | 1 |
| | 3 | 2 | 22.05 | 21.42 | 22.33 | | 1 |
| | 3 | 3 | 22.03 | 21.41 | 22.26 | | 1 |
| | 6 | 0 | 21.06 | 20.51 | 21.46 | 0-2 | 2 |

## Table 8-35
## LTE Band 2 (PCS) Reduced Conducted Powers - 20 MHz Bandwidth

| LTE Band 2 (PCS) 20 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 18700 (1860.0 MHz) | Mid Channel 18900 (1880.0 MHz) | High Channel 19100 (1900.0 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | **13.70** | 13.24 | 13.32 | 0 | 0 |
| | 1 | 50 | 12.79 | 12.30 | 12.87 | | 0 |
| | 1 | 99 | 12.78 | 12.58 | 13.27 | | 0 |
| | 50 | 0 | **13.27** | 12.78 | 13.16 | 0-1 | 0 |
| | 50 | 25 | 12.88 | 12.37 | 13.07 | | 0 |
| | 50 | 50 | 12.78 | 12.46 | 13.20 | | 0 |
| | 100 | 0 | 13.00 | 12.49 | 13.26 | | 0 |
| 16QAM | 1 | 0 | 13.75 | 13.23 | 13.52 | 0-1 | 0 |
| | 1 | 50 | 12.84 | 12.34 | 13.04 | | 0 |
| | 1 | 99 | 12.78 | 12.76 | 13.47 | | 0 |
| | 50 | 0 | 13.25 | 12.72 | 13.14 | 0-2 | 0 |
| | 50 | 25 | 12.88 | 12.34 | 13.08 | | 0 |
| | 50 | 50 | 12.82 | 12.45 | 13.16 | | 0 |
| | 100 | 0 | 12.97 | 12.49 | 13.22 | | 0 |

## Table 8-36
## LTE Band 2 (PCS) Reduced Conducted Powers - 15 MHz Bandwidth

| LTE Band 2 (PCS) 15 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 18675 (1857.5 MHz) | Mid Channel 18900 (1880.0 MHz) | High Channel 19125 (1902.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 13.75 | 13.27 | 13.83 | 0 | 0 |
| | 1 | 36 | 13.15 | 12.71 | 13.35 | | 0 |
| | 1 | 74 | 12.93 | 12.80 | 13.56 | | 0 |
| | 36 | 0 | 13.52 | 12.95 | 13.46 | 0-1 | 0 |
| | 36 | 18 | 13.23 | 12.69 | 13.35 | | 0 |
| | 36 | 37 | 13.06 | 12.67 | 13.37 | | 0 |
| | 75 | 0 | 13.19 | 12.68 | 13.38 | | 0 |
| 16QAM | 1 | 0 | 13.83 | 13.46 | 13.82 | 0-1 | 0 |
| | 1 | 36 | 13.33 | 12.78 | 13.44 | | 0 |
| | 1 | 74 | 13.05 | 13.00 | 13.62 | | 0 |
| | 36 | 0 | 13.43 | 12.94 | 13.50 | 0-2 | 0 |
| | 36 | 18 | 13.19 | 12.70 | 13.37 | | 0 |
| | 36 | 37 | 13.00 | 12.67 | 13.43 | | 0 |
| | 75 | 0 | 13.25 | 12.71 | 13.31 | | 0 |

## Table 8-37
## LTE Band 2 (PCS) Reduced Conducted Powers - 10 MHz Bandwidth

| LTE Band 2 (PCS) 10 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 18650 (1855.0 MHz) | Mid Channel 18900 (1880.0 MHz) | High Channel 19150 (1905.0 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 13.33 | 12.75 | 13.35 | 0 | 0 |
| | 1 | 25 | 12.96 | 12.40 | 13.21 | | 0 |
| | 1 | 49 | 12.87 | 12.53 | 13.27 | | 0 |
| | 25 | 0 | 13.26 | 12.68 | 13.49 | 0-1 | 0 |
| | 25 | 12 | 13.10 | 12.51 | 13.40 | | 0 |
| | 25 | 25 | 13.01 | 12.56 | 13.42 | | 0 |
| | 50 | 0 | 13.09 | 12.54 | 13.44 | | 0 |
| 16QAM | 1 | 0 | 13.45 | 13.23 | 13.67 | 0-1 | 0 |
| | 1 | 25 | 13.06 | 12.85 | 13.47 | | 0 |
| | 1 | 49 | 12.96 | 12.99 | 13.55 | | 0 |
| | 25 | 0 | 13.29 | 12.73 | 13.51 | 0-2 | 0 |
| | 25 | 12 | 13.10 | 12.57 | 13.44 | | 0 |
| | 25 | 25 | 13.04 | 12.63 | 13.47 | | 0 |
| | 50 | 0 | 13.07 | 12.54 | 13.42 | | 0 |

## Table 8-38
## LTE Band 2 (PCS) Reduced Conducted Powers - 5 MHz Bandwidth

| LTE Band 2 (PCS) 5 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 18625 (1852.5 MHz) | Mid Channel 18900 (1880.0 MHz) | High Channel 19175 (1907.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 13.23 | 12.53 | 13.41 | 0 | 0 |
| | 1 | 12 | 13.15 | 12.34 | 13.43 | | 0 |
| | 1 | 24 | 13.08 | 12.41 | 13.40 | | 0 |
| | 12 | 0 | 13.20 | 12.49 | 13.43 | 0-1 | 0 |
| | 12 | 6 | 13.19 | 12.46 | 13.46 | | 0 |
| | 12 | 13 | 13.13 | 12.50 | 13.38 | | 0 |
| | 25 | 0 | 13.15 | 12.45 | 13.42 | | 0 |
| 16QAM | 1 | 0 | 13.55 | 12.72 | 13.59 | 0-1 | 0 |
| | 1 | 12 | 13.48 | 12.55 | 13.61 | | 0 |
| | 1 | 24 | 13.34 | 12.65 | 13.60 | | 0 |
| | 12 | 0 | 13.22 | 12.52 | 13.40 | 0-2 | 0 |
| | 12 | 6 | 13.19 | 12.50 | 13.45 | | 0 |
| | 12 | 13 | 13.15 | 12.49 | 13.38 | | 0 |
| | 25 | 0 | 13.13 | 12.48 | 13.42 | | 0 |

## Table 8-39
## LTE Band 2 (PCS) Reduced Conducted Powers - 3 MHz Bandwidth

| LTE Band 2 (PCS) 3 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 18615 (1851.5 MHz) | Mid Channel 18900 (1880.0 MHz) | High Channel 19185 (1908.5 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 13.12 | 12.43 | 13.31 | 0 | 0 |
| | 1 | 7 | 13.15 | 12.46 | 13.40 | | 0 |
| | 1 | 14 | 13.06 | 12.36 | 13.24 | | 0 |
| | 8 | 0 | 13.16 | 12.46 | 13.46 | 0-1 | 0 |
| | 8 | 4 | 13.17 | 12.45 | 13.48 | | 0 |
| | 8 | 7 | 13.13 | 12.39 | 13.40 | | 0 |
| | 15 | 0 | 13.20 | 12.47 | 13.44 | | 0 |
| 16QAM | 1 | 0 | 13.24 | 12.88 | 13.68 | 0-1 | 0 |
| | 1 | 7 | 13.33 | 12.87 | 13.70 | | 0 |
| | 1 | 14 | 13.14 | 12.85 | 13.55 | | 0 |
| | 8 | 0 | 13.15 | 12.59 | 13.46 | 0-2 | 0 |
| | 8 | 4 | 13.18 | 12.58 | 13.49 | | 0 |
| | 8 | 7 | 13.13 | 12.51 | 13.44 | | 0 |
| | 15 | 0 | 13.20 | 12.49 | 13.43 | | 0 |

## Table 8-40
## LTE Band 2 (PCS) Reduced Conducted Powers -1.4 MHz Bandwidth

| LTE Band 2 (PCS) 1.4 MHz Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|
| Modulation | RB Size | RB Offset | Low Channel 18607 (1850.7 MHz) | Mid Channel 18900 (1880.0 MHz) | High Channel 19193 (1909.3 MHz) | MPR Allowed per 3GPP [dB] | MPR [dB] |
| | | | Conducted Power [dBm] | | | | |
| QPSK | 1 | 0 | 12.97 | 12.46 | 13.20 | 0 | 0 |
| | 1 | 2 | 13.04 | 12.49 | 13.24 | | 0 |
| | 1 | 5 | 12.98 | 12.47 | 13.19 | | 0 |
| | 3 | 0 | 13.00 | 12.39 | 13.29 | | 0 |
| | 3 | 2 | 13.06 | 12.44 | 13.35 | | 0 |
| | 3 | 3 | 13.01 | 12.32 | 13.29 | | 0 |
| | 6 | 0 | 13.04 | 12.38 | 13.34 | 0-1 | 0 |
| 16QAM | 1 | 0 | 13.14 | 12.24 | 13.49 | 0-1 | 0 |
| | 1 | 2 | 13.19 | 12.34 | 13.56 | | 0 |
| | 1 | 5 | 13.10 | 12.27 | 13.50 | | 0 |
| | 3 | 0 | 13.09 | 12.42 | 13.23 | | 0 |
| | 3 | 2 | 13.12 | 12.50 | 13.21 | | 0 |
| | 3 | 3 | 13.09 | 12.44 | 13.23 | | 0 |
| | 6 | 0 | 13.13 | 12.52 | 13.41 | 0-2 | 0 |

## 8.4 WLAN Conducted Powers

**Table 8-41**
**2.4 GHz WLAN Antenna 1 Average RF Power**

| 2.4GHz Conducted Power [dBm] | | | | |
|---|---|---|---|---|
| Freq [MHz] | Channel | IEEE Transmission Mode | | |
| | | 802.11b | 802.11g | 802.11n |
| 2412 | 1 | **13.56** | 13.87 | 13.68 |
| 2437 | 6 | 13.53 | 13.58 | 13.86 |
| 2462 | 11 | 13.30 | 13.77 | 13.63 |

**Table 8-42**
**2.4 GHz WLAN Antenna 2 Average RF Power**

| 2.4GHz Conducted Power [dBm] | | | | |
|---|---|---|---|---|
| Freq [MHz] | Channel | IEEE Transmission Mode | | |
| | | 802.11b | 802.11g | 802.11n |
| 2412 | 1 | **13.22** | 13.14 | 13.03 |
| 2437 | 6 | 13.18 | 13.22 | 13.33 |
| 2462 | 11 | 13.15 | 13.20 | 12.98 |

**Table 8-43**
**5 GHz WLAN Antenna 1 Average RF Power**

| 5GHz (80MHz) Conducted Power [dBm] | | |
|---|---|---|
| Freq [MHz] | Channel | IEEE Transmission Mode |
| | | 802.11ac |
| 5210 | 42 | 10.19 |
| 5290 | 58 | **10.98** |
| 5530 | 106 | **10.79** |
| 5610 | 122 | 10.76 |
| 5690 | 138 | 10.33 |
| 5775 | 155 | **10.63** |

**Table 8-44**
**5 GHz WLAN Antenna 2 Average RF Power**

| 5GHz (80MHz) Conducted Power [dBm] | | |
|---|---|---|
| Freq [MHz] | Channel | IEEE Transmission Mode |
| | | 802.11ac |
| 5210 | 42 | 10.48 |
| 5290 | 58 | **10.37** |
| 5530 | 106 | 10.17 |
| 5610 | 122 | 10.13 |
| 5690 | 138 | **10.94** |
| 5775 | 155 | **10.83** |

**Table 8-45**
**5 GHz WLAN MIMO Average RF Power**

| 5GHz (80MHz) Conducted Power [dBm] | | | | |
|---|---|---|---|---|
| Freq [MHz] | Channel | ANT1 | ANT2 | MIMO |
| 5210 | 42 | 10.19 | 10.48 | 13.35 |
| 5290 | 58 | 10.98 | 10.37 | 13.70 |
| 5530 | 106 | 10.79 | 10.17 | 13.50 |
| 5610 | 122 | 10.76 | 10.13 | 13.47 |
| 5690 | 138 | 10.33 | 10.94 | 13.66 |
| 5775 | 155 | 10.63 | 10.83 | 13.74 |

Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02:

- Power measurements were performed for the transmission mode configuration with the highest maximum output power specified for production units.
- For transmission modes with the same maximum output power specification, powers were measured for the largest channel bandwidth, lowest order modulation and lowest data rate.
- For transmission modes with identical maximum specified output power, channel bandwidth, modulation and data rates, power measurements were required for all identical configurations.
- For each transmission mode configuration, powers were measured for the highest and lowest channels; and at the mid-band channel(s) when there were at least 3 channels supported. For configurations with multiple mid-band channels, due to an even number of channels, both channels were measured.
- The bolded data rate and channel above were tested for SAR.

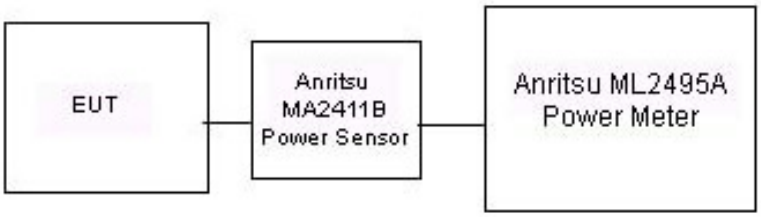



**Table 8-46**
**Power Measurement Setup for Bandwidths < 50 MHz**

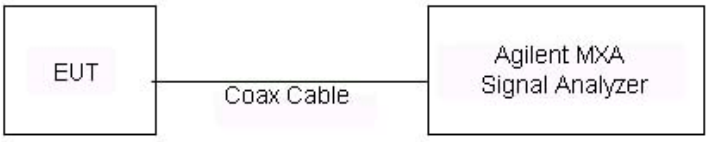



**Table 8-47**
**Power Measurement Setup for Bandwidths > 50 MHz**

## 8.5 Bluetooth Conducted Powers

**Table 8-48**
**Bluetooth Average RF Power**

| Frequency [MHz] | Data Rate [Mbps] | Channel No. | Avg Conducted Power | |
|---|---|---|---|---|
| | | | [dBm] | [mW] |
| 2402 | 1.0 | 0 | 9.31 | 8.539 |
| 2441 | 1.0 | 39 | **10.55** | 11.350 |
| 2480 | 1.0 | 78 | 10.13 | 10.313 |
| 2402 | 2.0 | 0 | 6.11 | 4.087 |
| 2441 | 2.0 | 39 | 7.32 | 5.398 |
| 2480 | 2.0 | 78 | 6.92 | 4.915 |
| 2402 | 3.0 | 0 | 6.18 | 4.153 |
| 2441 | 3.0 | 39 | 7.37 | 5.461 |
| 2480 | 3.0 | 78 | 6.98 | 4.984 |

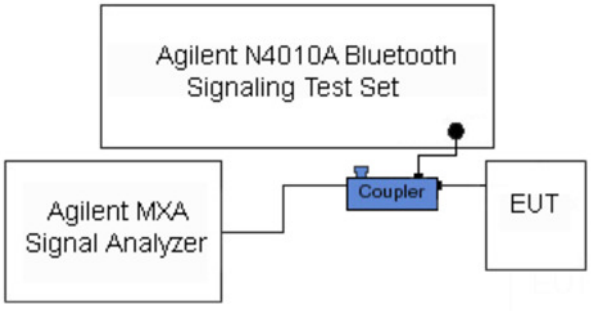



**Figure 8-3**
**Power Measurement Setup**

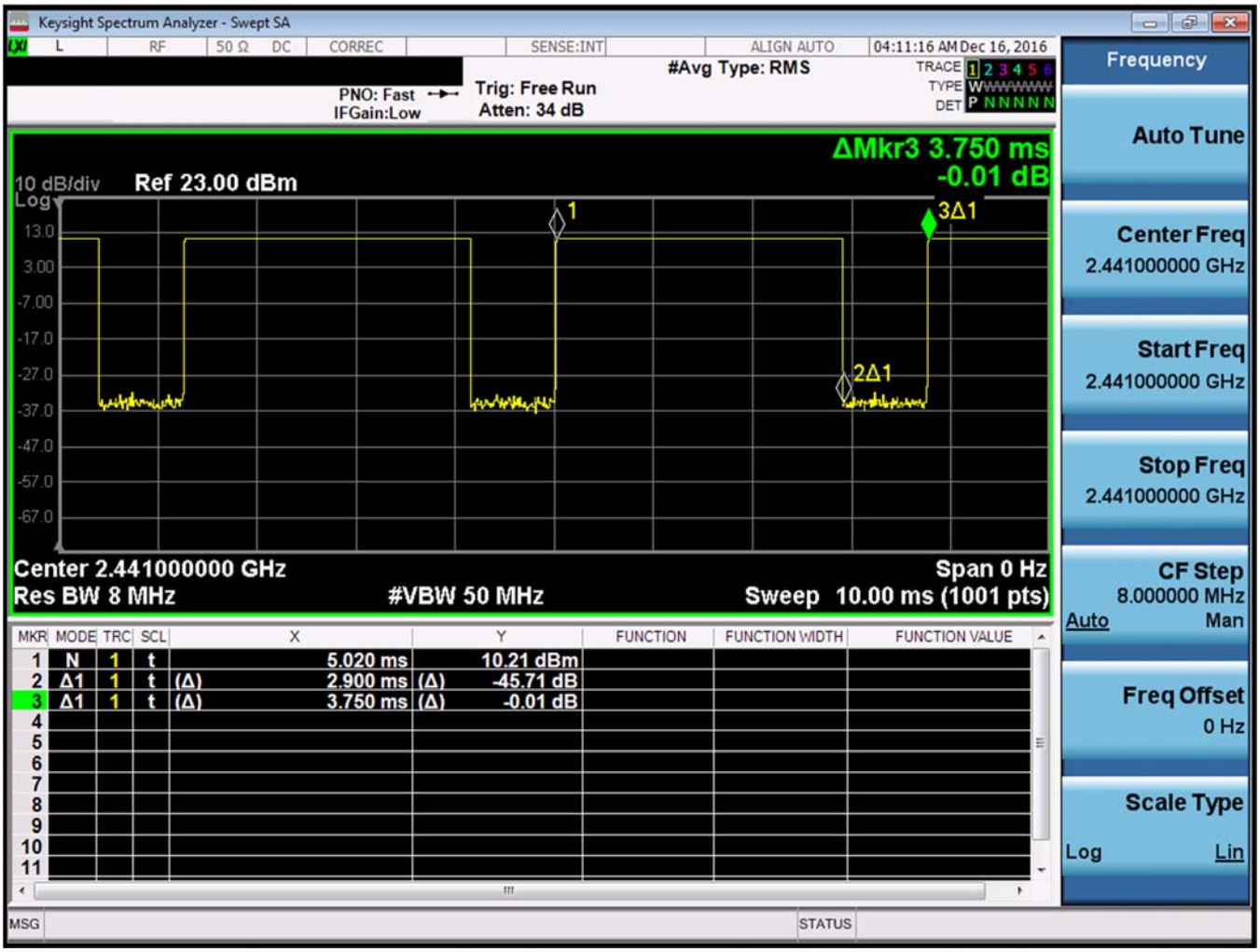



**Figure 8-4**
**Bluetooth Transmission Plot**

**Equation 8-1**
**Bluetooth Duty Cycle Calculation**

$$Duty\ Cycle = \frac{Pulse\ Width}{Period} * 100\% = \frac{2.900\ ms}{3.750\ ms} * 100\% = 77.3\%$$

# 9 SYSTEM VERIFICATION

## 9.1 Tissue Verification

**Table 9-1**
**Measured Tissue Properties**

| Calibrated for Tests Performed on: | Tissue Type | Tissue Temp During Calibration (°C) | Measured Frequency (MHz) | Measured Conductivity, σ (S/m) | Measured Dielectric Constant, ε | TARGET Conductivity, σ (S/m) | TARGET Dielectric Constant, ε | %dev σ | %dev ε |
|---|---|---|---|---|---|---|---|---|---|
| 12/13/2016 | 750B | 21.3 | 710 | 0.928 | 56.219 | 0.960 | 55.687 | -3.33% | 0.96% |
| | | | 740 | 0.956 | 55.951 | 0.963 | 55.570 | -0.73% | 0.69% |
| | | | 755 | 0.969 | 55.775 | 0.964 | 55.512 | 0.52% | 0.47% |
| 12/12/2016 | 835B | 20.8 | 820 | 0.980 | 54.215 | 0.969 | 55.258 | 1.14% | -1.89% |
| | | | 835 | 0.995 | 54.078 | 0.970 | 55.200 | 2.58% | -2.03% |
| | | | 850 | 1.009 | 53.922 | 0.988 | 55.154 | 2.13% | -2.23% |
| 02/13/2017 | 835B | 20.2 | 820 | 0.973 | 54.367 | 0.969 | 55.258 | 0.41% | -1.61% |
| | | | 835 | 0.988 | 54.224 | 0.970 | 55.200 | 1.86% | -1.77% |
| | | | 850 | 1.002 | 54.082 | 0.988 | 55.154 | 1.42% | -1.94% |
| 12/13/2016 | 1750B | 22.5 | 1710 | 1.433 | 52.386 | 1.463 | 53.537 | -2.05% | -2.15% |
| | | | 1750 | 1.481 | 52.208 | 1.488 | 53.432 | -0.47% | -2.29% |
| | | | 1790 | 1.526 | 52.053 | 1.514 | 53.326 | 0.79% | -2.39% |
| 12/14/2016 | 1900B | 22.1 | 1850 | 1.522 | 52.165 | 1.520 | 53.300 | 0.13% | -2.13% |
| | | | 1880 | 1.555 | 52.111 | 1.520 | 53.300 | 2.30% | -2.23% |
| | | | 1910 | 1.588 | 52.015 | 1.520 | 53.300 | 4.47% | -2.41% |
| 12/12/2016 | 2450B | 23.3 | 2400 | 1.900 | 52.340 | 1.902 | 52.767 | -0.11% | -0.81% |
| | | | 2450 | 1.971 | 52.158 | 1.950 | 52.700 | 1.08% | -1.03% |
| | | | 2500 | 2.040 | 51.932 | 2.021 | 52.636 | 0.94% | -1.34% |
| 02/06/2017 | 2450B | 22.3 | 2400 | 1.967 | 51.022 | 1.902 | 52.767 | 3.42% | -3.31% |
| | | | 2450 | 2.036 | 50.834 | 1.950 | 52.700 | 4.41% | -3.54% |
| | | | 2500 | 2.104 | 50.627 | 2.021 | 52.636 | 4.11% | -3.82% |
| 12/26/2016 | 5200B-5800B | 21.2 | 5240 | 5.511 | 47.075 | 5.346 | 48.960 | 3.09% | -3.85% |
| | | | 5260 | 5.534 | 47.034 | 5.369 | 48.933 | 3.07% | -3.88% |
| | | | 5280 | 5.545 | 46.970 | 5.393 | 48.906 | 2.82% | -3.96% |
| | | | 5300 | 5.581 | 46.888 | 5.416 | 48.879 | 3.05% | -4.07% |
| | | | 5320 | 5.605 | 46.935 | 5.439 | 48.851 | 3.05% | -3.92% |
| | | | 5520 | 5.866 | 46.575 | 5.673 | 48.580 | 3.40% | -4.13% |
| | | | 5540 | 5.888 | 46.552 | 5.696 | 48.553 | 3.37% | -4.12% |
| | | | 5600 | 5.989 | 46.456 | 5.766 | 48.471 | 3.87% | -4.16% |
| | | | 5620 | 6.016 | 46.437 | 5.790 | 48.444 | 3.90% | -4.14% |
| | | | 5680 | 6.081 | 46.311 | 5.860 | 48.363 | 3.77% | -4.24% |
| | | | 5700 | 6.124 | 46.243 | 5.883 | 48.336 | 4.10% | -4.33% |
| | | | 5745 | 6.193 | 46.245 | 5.936 | 48.275 | 4.33% | -4.21% |
| | | | 5765 | 6.211 | 46.222 | 5.959 | 48.248 | 4.23% | -4.20% |
| | | | 5785 | 6.222 | 46.181 | 5.982 | 48.220 | 4.01% | -4.23% |
| | | | 5825 | 6.300 | 46.060 | 6.029 | 48.166 | 4.49% | -4.37% |

The above measured tissue parameters were used in the DASY software. The DASY software was used to perform interpolation to determine the dielectric parameters at the SAR test device frequencies (per KDB Publication 865664 D01v01r04 and IEEE 1528-2013 6.6.1.2). The tissue parameters listed in the SAR test plots may slightly differ from the table above due to significant digit rounding in the software.

## 9.2 Test System Verification

Prior to SAR assessment, the system is verified to ±10% of the SAR measurement on the reference dipole at the time of calibration by the calibration facility. Full system validation status and result summary can be found in Appendix E.

**Table 9-2**
**System Verification Results**

| System Verification<br>TARGET & MEASURED | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAR System # | Tissue Frequency (MHz) | Tissue Type | Date: | Amb. Temp (°C) | Liquid Temp (°C) | Input Power (W) | Dipole SN | Probe SN | Measured $SAR_{1g}$ (W/kg) | 1 W Target $SAR_{1g}$ (W/kg) | 1 W Normalized $SAR_{1g}$ (W/kg) | $Deviation_{1g}$ (%) |
| K | 750 | BODY | 12/13/2016 | 22.3 | 21.3 | 0.200 | 1161 | 7409 | 1.660 | 8.430 | 8.300 | -1.54% |
| H | 835 | BODY | 12/12/2016 | 21.2 | 21.8 | 0.200 | 4d047 | 3319 | 2.050 | 9.570 | 10.250 | 7.11% |
| H | 835 | BODY | 02/13/2017 | 21.6 | 20.6 | 0.200 | 4d047 | 3319 | 2.060 | 9.570 | 10.300 | 7.63% |
| A | 1750 | BODY | 12/13/2016 | 24.5 | 22.5 | 0.100 | 1150 | 3022 | 3.690 | 36.500 | 36.900 | 1.10% |
| K | 1900 | BODY | 12/14/2016 | 23.1 | 22.3 | 0.100 | 5d080 | 7409 | 3.950 | 39.100 | 39.500 | 1.02% |
| C | 2450 | BODY | 12/12/2016 | 24.0 | 23.3 | 0.100 | 719 | 7410 | 5.010 | 51.500 | 50.100 | -2.72% |
| E | 2450 | BODY | 02/06/2017 | 22.2 | 21.2 | 0.100 | 981 | 7406 | 5.070 | 50.800 | 50.700 | -0.20% |
| D | 5250 | BODY | 12/26/2016 | 20.9 | 20.1 | 0.050 | 1237 | 3914 | 3.480 | 74.800 | 69.600 | -6.95% |
| D | 5600 | BODY | 12/26/2016 | 20.9 | 20.1 | 0.050 | 1237 | 3914 | 3.590 | 77.000 | 71.800 | -6.75% |
| D | 5750 | BODY | 12/26/2016 | 20.9 | 20.1 | 0.050 | 1237 | 3914 | 3.580 | 75.400 | 71.600 | -5.04% |

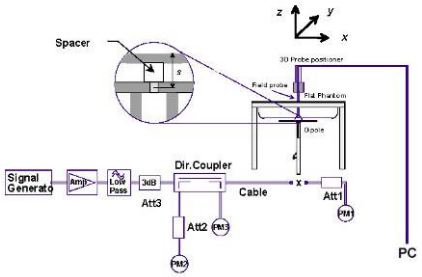



**Figure 9-1**
**System Verification Setup Diagram**

**Figure 9-2**
**System Verification Setup Photo**

# 10 SAR DATA SUMMARY

## 10.1 Standalone Body SAR Data

**Table 10-1**
**GPRS Body SAR Data**

| MEASUREMENT RESULTS | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | Mode | Service | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Power Drift [dB] | Spacing | Device Serial Number | # of GPRS Slots | Duty Cycle | Side | SAR (1g) | Scaling Factor | Reported SAR (1g) | Plot # |
| MHz | Ch. | | | | | | | | | | | (W/kg) | | (W/kg) | |
| 1909.80 | 810 | GSM 1900 | GPRS | 27.0 | 26.00 | -0.03 | 13 mm | 09999 | 3 | 1:2.76 | back | 0.253 | 1.259 | 0.319 | |
| 1909.80 | 810 | GSM 1900 | GPRS | 27.0 | 26.00 | 0.01 | 19 mm | 09999 | 3 | 1:2.76 | top | 0.185 | 1.259 | 0.233 | |
| 1909.80 | 810 | GSM 1900 | GPRS | 27.0 | 26.00 | 0.17 | 0 mm | 09999 | 3 | 1:2.76 | right | 0.113 | 1.259 | 0.142 | |
| 1850.20 | 512 | GSM 1900 | GPRS | 27.0 | 25.93 | -0.04 | 0 mm | 09999 | 3 | 1:2.76 | left | 0.615 | 1.279 | 0.787 | |
| 1880.00 | 661 | GSM 1900 | GPRS | 27.0 | 25.43 | -0.18 | 0 mm | 09999 | 3 | 1:2.76 | left | 0.685 | 1.435 | 0.983 | |
| 1909.80 | 810 | GSM 1900 | GPRS | 27.0 | 26.00 | -0.01 | 0 mm | 09999 | 3 | 1:2.76 | left | 0.735 | 1.259 | 0.925 | |
| 1850.20 | 512 | GSM 1900 | GPRS | 18.5 | 18.20 | -0.10 | 0 mm | 09999 | 4 | 1:2.076 | back | 0.930 | 1.072 | 0.997 | A1 |
| 1880.00 | 661 | GSM 1900 | GPRS | 18.5 | 17.57 | -0.14 | 0 mm | 09999 | 4 | 1:2.076 | back | 0.866 | 1.239 | 1.073 | |
| 1909.80 | 810 | GSM 1900 | GPRS | 18.5 | 18.34 | -0.21 | 0 mm | 09999 | 4 | 1:2.076 | back | 0.819 | 1.038 | 0.850 | |
| 1909.80 | 810 | GSM 1900 | GPRS | 18.5 | 18.34 | -0.04 | 0 mm | 09999 | 4 | 1:2.076 | top | 0.428 | 1.038 | 0.444 | |
| 1850.20 | 512 | GSM 1900 | GPRS | 18.5 | 18.20 | -0.17 | 0 mm | 09999 | 4 | 1:2.076 | back | 0.918 | 1.072 | 0.984 | |
| ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | | Body<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | | | |

Note: Blue entries indicate variability measurements.

## Table 10-2
## UMTS Body SAR Data

| MEASUREMENT RESULTS | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | Mode | Service | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Power Drift [dB] | Spacing | Device Serial Number | Duty Cycle | Side | SAR (1g) | Scaling Factor | Reported SAR (1g) | Plot # |
| MHz | Ch. | | | | | | | | | | (W/kg) | | (W/kg) | |
| 826.40 | 4132 | UMTS 850 | RMC | 24.5 | 22.84 | -0.04 | 13 mm | 09999 | 1:1 | back | 0.732 | 1.466 | 1.073 | |
| 836.60 | 4183 | UMTS 850 | RMC | 24.5 | 22.76 | -0.02 | 13 mm | 09999 | 1:1 | back | 0.717 | 1.493 | 1.070 | |
| 846.60 | 4233 | UMTS 850 | RMC | 24.5 | 22.85 | -0.03 | 13 mm | 09999 | 1:1 | back | 0.713 | 1.462 | 1.042 | |
| 836.60 | 4183 | UMTS 850 | RMC | 24.5 | 22.76 | 0.00 | 19 mm | 09999 | 1:1 | top | 0.511 | 1.493 | 0.763 | |
| 836.60 | 4183 | UMTS 850 | RMC | 24.5 | 22.76 | -0.06 | 0 mm | 09999 | 1:1 | right | 0.126 | 1.493 | 0.188 | |
| 836.60 | 4183 | UMTS 850 | RMC | 24.5 | 22.76 | -0.04 | 0 mm | 09999 | 1:1 | left | 0.144 | 1.493 | 0.215 | |
| 826.40 | 4132 | UMTS 850 | RMC | 17.0 | 16.02 | -0.01 | 0 mm | 09999 | 1:1 | back | 0.732 | 1.253 | 0.917 | |
| 836.60 | 4183 | UMTS 850 | RMC | 17.0 | 16.01 | 0.00 | 0 mm | 09999 | 1:1 | back | 0.719 | 1.256 | 0.903 | |
| 846.60 | 4233 | UMTS 850 | RMC | 17.0 | 16.03 | 0.01 | 0 mm | 09999 | 1:1 | back | 0.726 | 1.250 | 0.908 | |
| 826.40 | 4132 | UMTS 850 | RMC | 17.0 | 16.02 | -0.04 | 0 mm | 09999 | 1:1 | top | 0.751 | 1.253 | 0.941 | |
| 836.60 | 4183 | UMTS 850 | RMC | 17.0 | 16.01 | -0.03 | 0 mm | 09999 | 1:1 | top | 0.745 | 1.256 | 0.936 | |
| 846.60 | 4233 | UMTS 850 | RMC | 17.0 | 16.03 | -0.05 | 0 mm | 09999 | 1:1 | top | 0.763 | 1.250 | 0.954 | A2 |
| 1907.60 | 9538 | UMTS 1900 | RMC | 24.0 | 23.14 | -0.01 | 13 mm | 09999 | 1:1 | back | 0.603 | 1.219 | 0.735 | |
| 1907.60 | 9538 | UMTS 1900 | RMC | 24.0 | 23.14 | 0.01 | 19 mm | 09999 | 1:1 | top | 0.288 | 1.219 | 0.351 | |
| 1907.60 | 9538 | UMTS 1900 | RMC | 24.0 | 23.14 | 0.05 | 0 mm | 09999 | 1:1 | right | 0.161 | 1.219 | 0.196 | |
| 1852.40 | 9262 | UMTS 1900 | RMC | 24.0 | 23.05 | 0.06 | 0 mm | 09999 | 1:1 | left | 0.606 | 1.245 | 0.754 | |
| 1880.00 | 9400 | UMTS 1900 | RMC | 24.0 | 22.30 | 0.08 | 0 mm | 09999 | 1:1 | left | 0.563 | 1.479 | 0.833 | |
| 1907.60 | 9538 | UMTS 1900 | RMC | 24.0 | 23.14 | -0.03 | 0 mm | 09999 | 1:1 | left | 0.791 | 1.219 | 0.964 | A3 |
| 1907.60 | 9538 | UMTS 1900 | RMC | 14.0 | 13.31 | 0.04 | 0 mm | 09999 | 1:1 | back | 0.571 | 1.172 | 0.669 | |
| 1907.60 | 9538 | UMTS 1900 | RMC | 14.0 | 13.31 | -0.01 | 0 mm | 09999 | 1:1 | top | 0.303 | 1.172 | 0.355 | |
| ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | | Body<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | | |

## Table 10-3
## LTE Band 17 Body SAR Data

| MEASUREMENT RESULTS | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | | Mode | Bandwidth [MHz] | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Power Drift [dB] | MPR [dB] | Device Serial Number | Modulation | RB Size | RB Offset | Spacing | Side | Duty Cycle | SAR (1g) | Scaling Factor | Reported SAR (1g) | Plot # |
| MHz | Ch. | | | | | | | | | | | | | | | (W/kg) | | (W/kg) | |
| 710.00 | 23790 | Mid | LTE Band 17 | 10 | 23.5 | 22.34 | 0.01 | 0 | 09999 | QPSK | 1 | 25 | 13 mm | back | 1:1 | 0.752 | 1.306 | 0.982 | |
| 710.00 | 23790 | Mid | LTE Band 17 | 10 | 22.5 | 21.44 | 0.03 | 1 | 09999 | QPSK | 25 | 12 | 13 mm | back | 1:1 | 0.611 | 1.276 | 0.780 | |
| 710.00 | 23790 | Mid | LTE Band 17 | 10 | 22.5 | 21.38 | 0.03 | 1 | 09999 | QPSK | 50 | 0 | 13 mm | back | 1:1 | 0.615 | 1.294 | 0.796 | |
| 710.00 | 23790 | Mid | LTE Band 17 | 10 | 23.5 | 22.34 | -0.01 | 0 | 09999 | QPSK | 1 | 25 | 19 mm | top | 1:1 | 0.337 | 1.306 | 0.440 | |
| 710.00 | 23790 | Mid | LTE Band 17 | 10 | 22.5 | 21.44 | 0.10 | 1 | 09999 | QPSK | 25 | 12 | 19 mm | top | 1:1 | 0.285 | 1.276 | 0.364 | |
| 710.00 | 23790 | Mid | LTE Band 17 | 10 | 23.5 | 22.34 | 0.12 | 0 | 09999 | QPSK | 1 | 25 | 0 mm | right | 1:1 | 0.139 | 1.306 | 0.182 | |
| 710.00 | 23790 | Mid | LTE Band 17 | 10 | 22.5 | 21.44 | 0.05 | 1 | 09999 | QPSK | 25 | 12 | 0 mm | right | 1:1 | 0.128 | 1.276 | 0.163 | |
| 710.00 | 23790 | Mid | LTE Band 17 | 10 | 23.5 | 22.34 | 0.05 | 0 | 09999 | QPSK | 1 | 25 | 0 mm | left | 1:1 | 0.237 | 1.306 | 0.310 | |
| 710.00 | 23790 | Mid | LTE Band 17 | 10 | 22.5 | 21.44 | -0.07 | 1 | 09999 | QPSK | 25 | 12 | 0 mm | left | 1:1 | 0.181 | 1.276 | 0.231 | |
| 710.00 | 23790 | Mid | LTE Band 17 | 10 | 17.0 | 16.21 | 0.05 | 0 | 09999 | QPSK | 1 | 25 | 0 mm | back | 1:1 | 0.858 | 1.199 | 1.029 | |
| 710.00 | 23790 | Mid | LTE Band 17 | 10 | 17.0 | 16.20 | 0.05 | 0 | 09999 | QPSK | 25 | 0 | 0 mm | back | 1:1 | 0.880 | 1.202 | 1.058 | |
| 710.00 | 23790 | Mid | LTE Band 17 | 10 | 17.0 | 16.18 | 0.07 | 0 | 09999 | QPSK | 50 | 0 | 0 mm | back | 1:1 | 0.891 | 1.208 | 1.076 | |
| 710.00 | 23790 | Mid | LTE Band 17 | 10 | 17.0 | 16.21 | -0.09 | 0 | 09999 | QPSK | 1 | 25 | 0 mm | top | 1:1 | 0.695 | 1.199 | 0.833 | |
| 710.00 | 23790 | Mid | LTE Band 17 | 10 | 17.0 | 16.20 | -0.09 | 0 | 09999 | QPSK | 25 | 0 | 0 mm | top | 1:1 | 0.723 | 1.202 | 0.869 | |
| 710.00 | 23790 | Mid | LTE Band 17 | 10 | 17.0 | 16.18 | -0.08 | 0 | 09999 | QPSK | 50 | 0 | 0 mm | top | 1:1 | 0.760 | 1.208 | 0.918 | |
| 710.00 | 23790 | Mid | LTE Band 17 | 10 | 17.0 | 16.18 | 0.20 | 0 | 09999 | QPSK | 50 | 0 | 0 mm | back | 1:1 | 0.899 | 1.208 | **1.086** | A4 |
| ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | | | | | | | Body<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | | | |

Note: Blue entry indicates variability measurement.

## Table 10-4
## LTE Band 5 (Cell.) Body SAR Data

| MEASUREMENT RESULTS | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | | Mode | Bandwidth [MHz] | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Power Drift [dB] | MPR [dB] | Device Serial Number | Modulation | RB Size | RB Offset | Spacing | Side | Duty Cycle | SAR (1g) | Scaling Factor | Reported SAR (1g) | Plot # |
| MHz | Ch. | | | | | | | | | | | | | | | (W/kg) | | (W/kg) | |
| 836.50 | 20525 | Mid | LTE Band 5 (Cell) | 10 | 24.5 | 22.99 | 0.00 | 0 | 02212 | QPSK | 1 | 25 | 13 mm | back | 1:1 | 0.643 | 1.416 | 0.910 | A5 |
| 836.50 | 20525 | Mid | LTE Band 5 (Cell) | 10 | 23.5 | 22.11 | 0.00 | 1 | 02212 | QPSK | 25 | 12 | 13 mm | back | 1:1 | 0.533 | 1.377 | 0.734 | |
| 836.50 | 20525 | Mid | LTE Band 5 (Cell) | 10 | 23.5 | 22.08 | -0.02 | 1 | 02212 | QPSK | 50 | 0 | 10 mm | back | 1:1 | 0.528 | 1.387 | 0.732 | |
| 836.50 | 20525 | Mid | LTE Band 5 (Cell) | 10 | 24.5 | 22.99 | -0.06 | 0 | 02212 | QPSK | 1 | 25 | 19 mm | top | 1:1 | 0.615 | 1.416 | 0.871 | |
| 836.50 | 20525 | Mid | LTE Band 5 (Cell) | 10 | 23.5 | 22.11 | 0.01 | 1 | 02212 | QPSK | 25 | 12 | 19 mm | top | 1:1 | 0.485 | 1.377 | 0.668 | |
| 836.50 | 20525 | Mid | LTE Band 5 (Cell) | 10 | 23.5 | 22.08 | -0.01 | 1 | 02212 | QPSK | 50 | 0 | 19 mm | top | 1:1 | 0.480 | 1.387 | 0.666 | |
| 836.50 | 20525 | Mid | LTE Band 5 (Cell) | 10 | 24.5 | 22.99 | 0.00 | 0 | 02212 | QPSK | 1 | 25 | 0 mm | right | 1:1 | 0.082 | 1.416 | 0.116 | |
| 836.50 | 20525 | Mid | LTE Band 5 (Cell) | 10 | 23.5 | 22.11 | 0.00 | 1 | 02212 | QPSK | 25 | 12 | 0 mm | right | 1:1 | 0.064 | 1.377 | 0.088 | |
| 836.50 | 20525 | Mid | LTE Band 5 (Cell) | 10 | 24.5 | 22.99 | 0.02 | 0 | 02212 | QPSK | 1 | 25 | 0 mm | left | 1:1 | 0.137 | 1.416 | 0.194 | |
| 836.50 | 20525 | Mid | LTE Band 5 (Cell) | 10 | 23.5 | 22.11 | 0.07 | 1 | 02212 | QPSK | 25 | 12 | 0 mm | left | 1:1 | 0.121 | 1.377 | 0.167 | |
| 836.50 | 20525 | Mid | LTE Band 5 (Cell) | 10 | 16.0 | 14.92 | -0.04 | 0 | 05286 | QPSK | 1 | 25 | 0 mm | back | 1:1 | 0.491 | 1.282 | 0.629 | |
| 836.50 | 20525 | Mid | LTE Band 5 (Cell) | 10 | 16.0 | 15.08 | -0.03 | 0 | 05286 | QPSK | 25 | 12 | 0 mm | back | 1:1 | 0.510 | 1.236 | 0.630 | |
| 836.50 | 20525 | Mid | LTE Band 5 (Cell) | 10 | 16.0 | 15.07 | -0.04 | 0 | 05286 | QPSK | 50 | 0 | 0 mm | back | 1:1 | 0.509 | 1.239 | 0.631 | |
| 836.50 | 20525 | Mid | LTE Band 5 (Cell) | 10 | 16.0 | 14.92 | -0.05 | 0 | 05286 | QPSK | 1 | 25 | 0 mm | top | 1:1 | 0.551 | 1.282 | 0.706 | |
| 836.50 | 20525 | Mid | LTE Band 5 (Cell) | 10 | 16.0 | 15.08 | -0.02 | 0 | 05286 | QPSK | 25 | 12 | 0 mm | top | 1:1 | 0.576 | 1.236 | 0.712 | |
| 836.50 | 20525 | Mid | LTE Band 5 (Cell) | 10 | 16.0 | 15.07 | -0.03 | 0 | 05286 | QPSK | 50 | 0 | 0 mm | top | 1:1 | 0.571 | 1.239 | 0.707 | |
| ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | | | | | | | Body<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | | | |

## Table 10-5
## LTE Band 4 (AWS) Body SAR Data

| MEASUREMENT RESULTS | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | | Mode | Bandwidth [MHz] | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Power Drift [dB] | MPR [dB] | Device Serial Number | Modulation | RB Size | RB Offset | Spacing | Side | Duty Cycle | SAR (1g) | Scaling Factor | Reported SAR (1g) | Plot # |
| MHz | Ch. | | | | | | | | | | | | | | | (W/kg) | | (W/kg) | |
| 1732.50 | 20175 | Mid | LTE Band 4 (AWS) | 20 | 24.1 | 23.65 | -0.03 | 0 | 05260 | QPSK | 1 | 0 | 13 mm | back | 1:1 | 0.982 | 1.109 | **1.089** | A6 |
| 1732.50 | 20175 | Mid | LTE Band 4 (AWS) | 20 | 23.1 | 22.20 | 0.08 | 1 | 05260 | QPSK | 50 | 0 | 13 mm | back | 1:1 | 0.677 | 1.230 | 0.833 | |
| 1732.50 | 20175 | Mid | LTE Band 4 (AWS) | 20 | 23.1 | 21.99 | 0.03 | 1 | 05260 | QPSK | 100 | 0 | 13 mm | back | 1:1 | 0.663 | 1.291 | 0.856 | |
| 1732.50 | 20175 | Mid | LTE Band 4 (AWS) | 20 | 24.1 | 23.65 | -0.04 | 0 | 05260 | QPSK | 1 | 0 | 19 mm | top | 1:1 | 0.394 | 1.109 | 0.437 | |
| 1732.50 | 20175 | Mid | LTE Band 4 (AWS) | 20 | 23.1 | 22.20 | 0.00 | 1 | 05260 | QPSK | 50 | 0 | 19 mm | top | 1:1 | 0.283 | 1.230 | 0.348 | |
| 1732.50 | 20175 | Mid | LTE Band 4 (AWS) | 20 | 24.1 | 23.65 | 0.06 | 0 | 05260 | QPSK | 1 | 0 | 0 mm | right | 1:1 | 0.185 | 1.109 | 0.205 | |
| 1732.50 | 20175 | Mid | LTE Band 4 (AWS) | 20 | 23.1 | 22.20 | -0.01 | 1 | 05260 | QPSK | 50 | 0 | 0 mm | right | 1:1 | 0.135 | 1.230 | 0.166 | |
| 1732.50 | 20175 | Mid | LTE Band 4 (AWS) | 20 | 24.1 | 23.65 | -0.05 | 0 | 05260 | QPSK | 1 | 0 | 0 mm | left | 1:1 | 0.457 | 1.109 | 0.507 | |
| 1732.50 | 20175 | Mid | LTE Band 4 (AWS) | 20 | 23.1 | 22.20 | 0.03 | 1 | 05260 | QPSK | 50 | 0 | 0 mm | left | 1:1 | 0.331 | 1.230 | 0.407 | |
| 1732.50 | 20175 | Mid | LTE Band 4 (AWS) | 20 | 14.0 | 13.20 | 0.00 | 0 | 05260 | QPSK | 1 | 0 | 0 mm | back | 1:1 | 0.603 | 1.202 | 0.725 | |
| 1732.50 | 20175 | Mid | LTE Band 4 (AWS) | 20 | 14.0 | 12.80 | -0.01 | 0 | 05260 | QPSK | 50 | 0 | 0 mm | back | 1:1 | 0.544 | 1.318 | 0.717 | |
| 1732.50 | 20175 | Mid | LTE Band 4 (AWS) | 20 | 14.0 | 13.20 | -0.10 | 0 | 05260 | QPSK | 1 | 0 | 0 mm | top | 1:1 | 0.370 | 1.202 | 0.445 | |
| 1732.50 | 20175 | Mid | LTE Band 4 (AWS) | 20 | 14.0 | 12.80 | -0.02 | 0 | 05260 | QPSK | 50 | 0 | 0 mm | top | 1:1 | 0.321 | 1.318 | 0.423 | |
| 1732.50 | 20175 | Mid | LTE Band 4 (AWS) | 20 | 24.1 | 23.65 | -0.01 | 0 | 05260 | QPSK | 1 | 0 | 13 mm | back | 1:1 | 0.914 | 1.109 | 1.014 | |
| ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | | | | | | | | | | Body<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | |

Note: Blue entry indicates variability measurement.

## Table 10-6
## LTE Band 2 (PCS) Body SAR Data

| MEASUREMENT RESULTS | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | | Mode | Bandwidth [MHz] | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Power Drift [dB] | MPR [dB] | Device Serial Number | Modulation | RB Size | RB Offset | Spacing | Side | Duty Cycle | SAR (1g) | Scaling Factor | Reported SAR (1g) | Plot # |
| MHz | Ch. | | | | | | | | | | | | | | | (W/kg) | | (W/kg) | |
| 1860.00 | 18700 | Low | LTE Band 2 (PCS) | 20 | 24.0 | 23.80 | -0.03 | 0 | 14379 | QPSK | 1 | 0 | 13 mm | back | 1:1 | 0.518 | 1.047 | 0.542 | |
| 1860.00 | 18700 | Low | LTE Band 2 (PCS) | 20 | 23.0 | 22.25 | -0.19 | 1 | 14379 | QPSK | 50 | 0 | 13 mm | back | 1:1 | 0.370 | 1.189 | 0.440 | |
| 1860.00 | 18700 | Low | LTE Band 2 (PCS) | 20 | 24.0 | 23.80 | -0.09 | 0 | 14379 | QPSK | 1 | 0 | 19 mm | top | 1:1 | 0.405 | 1.047 | 0.424 | |
| 1860.00 | 18700 | Low | LTE Band 2 (PCS) | 20 | 23.0 | 22.25 | -0.01 | 1 | 14379 | QPSK | 50 | 0 | 19 mm | top | 1:1 | 0.290 | 1.189 | 0.345 | |
| 1860.00 | 18700 | Low | LTE Band 2 (PCS) | 20 | 24.0 | 23.80 | -0.01 | 0 | 14379 | QPSK | 1 | 0 | 0 mm | right | 1:1 | 0.165 | 1.047 | 0.173 | |
| 1860.00 | 18700 | Low | LTE Band 2 (PCS) | 20 | 23.0 | 22.25 | 0.02 | 1 | 14379 | QPSK | 50 | 0 | 0 mm | right | 1:1 | 0.118 | 1.189 | 0.140 | |
| 1860.00 | 18700 | Low | LTE Band 2 (PCS) | 20 | 24.0 | 23.80 | -0.12 | 0 | 14379 | QPSK | 1 | 0 | 0 mm | left | 1:1 | 0.538 | 1.047 | 0.563 | |
| 1860.00 | 18700 | Low | LTE Band 2 (PCS) | 20 | 23.0 | 22.25 | -0.01 | 1 | 14379 | QPSK | 50 | 0 | 0 mm | left | 1:1 | 0.401 | 1.189 | 0.477 | |
| 1860.00 | 18700 | Low | LTE Band 2 (PCS) | 20 | 14.0 | 13.70 | -0.17 | 0 | 09999 | QPSK | 1 | 0 | 0 mm | back | 1:1 | 0.685 | 1.072 | 0.734 | A7 |
| 1860.00 | 18700 | Low | LTE Band 2 (PCS) | 20 | 14.0 | 13.27 | -0.15 | 0 | 09999 | QPSK | 50 | 0 | 0 mm | back | 1:1 | 0.623 | 1.183 | 0.737 | |
| 1860.00 | 18700 | Low | LTE Band 2 (PCS) | 20 | 14.0 | 13.70 | 0.02 | 0 | 09999 | QPSK | 1 | 0 | 0 mm | top | 1:1 | 0.443 | 1.072 | 0.475 | |
| 1860.00 | 18700 | Low | LTE Band 2 (PCS) | 20 | 14.0 | 13.27 | 0.00 | 0 | 09999 | QPSK | 50 | 0 | 0 mm | top | 1:1 | 0.400 | 1.183 | 0.473 | |
| ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | | | | | | | | | | Body<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | |

## Table 10-7
## 2.4 GHz WLAN Body SAR Data

| MEASUREMENT RESULTS | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | Mode | Service | Bandwidth [MHz] | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Power Drift [dB] | Spacing | Antenna Config. | Device Serial Number | Data Rate (Mbps) | Side | Duty Cycle (%) | Peak SAR of Area Scan | SAR (1g) | Scaling Factor (Power) | Scaling Factor (Duty Cycle) | Reported SAR (1g) | Plot # |
| MHz | Ch. | | | | | | | | | | | | | W/kg | (W/kg) | | | (W/kg) | |
| 2412 | 1 | 802.11b | DSSS | 22 | 14.0 | 13.56 | -0.12 | 0 mm | 1 | 05260 | 1 | back | 99.2 | 1.091 | 0.827 | 1.107 | 1.008 | 0.923 | |
| 2437 | 6 | 802.11b | DSSS | 22 | 14.0 | 13.53 | -0.09 | 0 mm | 1 | 05260 | 1 | back | 99.2 | 1.129 | 0.855 | 1.114 | 1.008 | **0.960** | A8 |
| 2412 | 1 | 802.11b | DSSS | 22 | 14.0 | 13.56 | -0.03 | 0 mm | 1 | 05260 | 1 | top | 99.2 | 0.043 | 0.026 | 1.107 | 1.008 | 0.029 | |
| 2412 | 1 | 802.11b | DSSS | 22 | 14.0 | 13.56 | 0.02 | 0 mm | 1 | 05260 | 1 | bottom | 99.2 | 0.585 | 0.437 | 1.107 | 1.008 | 0.488 | |
| 2412 | 1 | 802.11b | DSSS | 22 | 14.0 | 13.56 | 0.08 | 0 mm | 1 | 05260 | 1 | right | 99.2 | 0.205 | 0.118 | 1.107 | 1.008 | 0.132 | |
| 2412 | 1 | 802.11b | DSSS | 22 | 14.0 | 13.22 | -0.10 | 0 mm | 2 | 05260 | 1 | back | 98.8 | 0.550 | 0.462 | 1.197 | 1.012 | 0.560 | |
| 2412 | 1 | 802.11b | DSSS | 22 | 14.0 | 13.22 | -0.20 | 0 mm | 2 | 05260 | 1 | top | 98.8 | 0.029 | 0.016 | 1.197 | 1.012 | 0.019 | |
| 2412 | 1 | 802.11b | DSSS | 22 | 14.0 | 13.22 | -0.09 | 0 mm | 2 | 05260 | 1 | bottom | 98.8 | 0.542 | 0.367 | 1.197 | 1.012 | 0.445 | |
| 2412 | 1 | 802.11b | DSSS | 22 | 14.0 | 13.22 | 0.16 | 0 mm | 2 | 05260 | 1 | left | 98.8 | 0.142 | 0.086 | 1.197 | 1.012 | 0.104 | |
| 2437 | 6 | 802.11b | DSSS | 22 | 14.0 | 13.53 | -0.05 | 0 mm | 1 | 05260 | 1 | back | 99.2 | 1.008 | 0.847 | 1.114 | 1.008 | 0.951 | |
| ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | | | | | | | | Body<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | |

Note: Blue entry indicates variability measurement.

# Table 10-8
# 5 GHz WLAN Body SAR Data

| MEASUREMENT RESULTS | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | Mode | Service | Bandwidth [MHz] | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Power Drift [dB] | Spacing | Antenna Config. | Device Serial Number | Data Rate (Mbps) | Side | Duty Cycle (%) | Peak SAR of Area Scan | SAR (1g) | Scaling Factor (Power) | Scaling Factor (Duty Cycle) | Reported SAR (1g) | Plot # |
| MHz | Ch. | | | | | | | | | | | | | W/kg | (W/kg) | | | (W/kg) | |
| 5290 | 58 | 802.11ac | OFDM | 80 | 11.0 | 10.98 | -0.11 | 0 mm | 1 | 05211 | 29.3 | back | 86.9 | 1.370 | 0.739 | 1.005 | 1.151 | 0.855 | |
| 5290 | 58 | 802.11ac | OFDM | 80 | 11.0 | 10.98 | 0.13 | 0 mm | 1 | 05211 | 29.3 | top | 86.9 | 0.081 | 0.019 | 1.005 | 1.151 | 0.022 | |
| 5290 | 58 | 802.11ac | OFDM | 80 | 11.0 | 10.98 | -0.17 | 0 mm | 1 | 05211 | 29.3 | bottom | 86.9 | 1.945 | 0.737 | 1.005 | 1.151 | 0.853 | |
| 5290 | 58 | 802.11ac | OFDM | 80 | 11.0 | 10.98 | 0.17 | 0 mm | 1 | 05211 | 29.3 | right | 86.9 | 0.939 | 0.298 | 1.005 | 1.151 | 0.345 | |
| 5290 | 58 | 802.11ac | OFDM | 80 | 11.0 | 10.98 | 0.14 | 0 mm | 1 | 05211 | 29.3 | left | 86.9 | 0.075 | 0.033 | 1.005 | 1.151 | 0.038 | |
| 5290 | 58 | 802.11ac | OFDM | 80 | 11.0 | 10.37 | -0.17 | 0 mm | 2 | 05211 | 29.3 | back | 86.9 | 1.539 | 0.814 | 1.156 | 1.151 | 1.083 | |
| 5290 | 58 | 802.11ac | OFDM | 80 | 11.0 | 10.37 | 0.10 | 0 mm | 2 | 05211 | 29.3 | top | 86.9 | 0.037 | 0.012 | 1.156 | 1.151 | 0.016 | |
| 5290 | 58 | 802.11ac | OFDM | 80 | 11.0 | 10.37 | -0.10 | 0 mm | 2 | 05211 | 29.3 | bottom | 86.9 | 1.545 | 0.568 | 1.156 | 1.151 | 0.756 | |
| 5290 | 58 | 802.11ac | OFDM | 80 | 11.0 | 10.37 | 0.19 | 0 mm | 2 | 05211 | 29.3 | left | 86.9 | 0.613 | 0.184 | 1.156 | 1.151 | 0.245 | |
| 5290 | 58 | 802.11ac | OFDM | 80 | 14.0 | 13.70 | 0.18 | 0 mm | MIMO | 05211 | 58.5 | bottom | 85.9 | 1.198 | 0.680 | 1.156 | 1.164 | 0.915 | |
| 5530 | 106 | 802.11ac | OFDM | 80 | 11.0 | 10.79 | 0.20 | 0 mm | 1 | 05211 | 29.3 | back | 86.9 | 3.005 | 0.893 | 1.050 | 1.151 | 1.079 | |
| 5610 | 122 | 802.11ac | OFDM | 80 | 11.0 | 10.76 | -0.13 | 0 mm | 1 | 05211 | 29.3 | back | 86.9 | 0.836 | 0.812 | 1.057 | 1.151 | 0.988 | |
| 5530 | 106 | 802.11ac | OFDM | 80 | 11.0 | 10.79 | 0.19 | 0 mm | 1 | 05211 | 29.3 | top | 86.9 | 0.010 | 0.000 | 1.050 | 1.151 | 0.000 | |
| 5530 | 106 | 802.11ac | OFDM | 80 | 11.0 | 10.79 | 0.19 | 0 mm | 1 | 05211 | 29.3 | bottom | 86.9 | 1.526 | 0.486 | 1.050 | 1.151 | 0.587 | |
| 5530 | 106 | 802.11ac | OFDM | 80 | 11.0 | 10.79 | 0.10 | 0 mm | 1 | 05211 | 29.3 | right | 86.9 | 0.378 | 0.128 | 1.050 | 1.151 | 0.155 | |
| 5530 | 106 | 802.11ac | OFDM | 80 | 11.0 | 10.79 | 0.06 | 0 mm | 1 | 05211 | 29.3 | left | 86.9 | 0.014 | 0.017 | 1.050 | 1.151 | 0.021 | |
| 5690 | 138 | 802.11ac | OFDM | 80 | 11.0 | 10.94 | -0.17 | 0 mm | 2 | 05211 | 29.3 | back | 86.9 | 0.934 | 0.456 | 1.014 | 1.151 | 0.532 | |
| 5690 | 138 | 802.11ac | OFDM | 80 | 11.0 | 10.94 | 0.10 | 0 mm | 2 | 05211 | 29.3 | top | 86.9 | 0.029 | 0.006 | 1.014 | 1.151 | 0.007 | |
| 5690 | 138 | 802.11ac | OFDM | 80 | 11.0 | 10.94 | -0.04 | 0 mm | 2 | 05211 | 29.3 | bottom | 86.9 | 1.066 | 0.373 | 1.014 | 1.151 | 0.435 | |
| 5690 | 138 | 802.11ac | OFDM | 80 | 11.0 | 10.94 | 0.10 | 0 mm | 2 | 05211 | 29.3 | left | 86.9 | 0.162 | 0.060 | 1.014 | 1.151 | 0.070 | |
| 5690 | 138 | 802.11ac | OFDM | 80 | 14.0 | 13.66 | 0.14 | 0 mm | MIMO | 05211 | 58.5 | bottom | 85.9 | 0.699 | 0.402 | 1.167 | 1.164 | 0.546 | |
| 5775 | 155 | 802.11ac | OFDM | 80 | 11.0 | 10.63 | -0.13 | 0 mm | 1 | 05211 | 29.3 | back | 86.9 | 1.548 | 0.623 | 1.089 | 1.151 | 0.781 | |
| 5775 | 155 | 802.11ac | OFDM | 80 | 11.0 | 10.63 | 0.10 | 0 mm | 1 | 05211 | 29.3 | top | 86.9 | 0.017 | 0.001 | 1.089 | 1.151 | 0.001 | |
| 5775 | 155 | 802.11ac | OFDM | 80 | 11.0 | 10.63 | -0.10 | 0 mm | 1 | 05211 | 29.3 | bottom | 86.9 | 0.733 | 0.271 | 1.089 | 1.151 | 0.340 | |
| 5775 | 155 | 802.11ac | OFDM | 80 | 11.0 | 10.63 | 0.19 | 0 mm | 1 | 05211 | 29.3 | right | 86.9 | 0.250 | 0.093 | 1.089 | 1.151 | 0.117 | |
| 5775 | 155 | 802.11ac | OFDM | 80 | 11.0 | 10.63 | 0.10 | 0 mm | 1 | 05211 | 29.3 | left | 86.9 | 0.014 | 0.017 | 1.089 | 1.151 | 0.021 | |
| 5775 | 155 | 802.11ac | OFDM | 80 | 11.0 | 10.83 | 0.05 | 0 mm | 2 | 05211 | 29.3 | back | 86.9 | 0.831 | 0.471 | 1.040 | 1.151 | 0.564 | |
| 5775 | 155 | 802.11ac | OFDM | 80 | 11.0 | 10.83 | 0.13 | 0 mm | 2 | 05211 | 29.3 | top | 86.9 | 0.031 | 0.009 | 1.040 | 1.151 | 0.011 | |
| 5775 | 155 | 802.11ac | OFDM | 80 | 11.0 | 10.83 | -0.15 | 0 mm | 2 | 05211 | 29.3 | bottom | 86.9 | 1.069 | 0.348 | 1.040 | 1.151 | 0.417 | |
| 5775 | 155 | 802.11ac | OFDM | 80 | 11.0 | 10.83 | 0.17 | 0 mm | 2 | 05211 | 29.3 | left | 86.9 | 0.177 | 0.067 | 1.040 | 1.151 | 0.080 | |
| 5775 | 155 | 802.11ac | OFDM | 80 | 14.0 | 13.74 | -0.13 | 0 mm | MIMO | 05211 | 58.5 | bottom | 85.9 | 0.491 | 0.269 | 1.089 | 1.164 | 0.341 | |
| 5290 | 58 | 802.11ac | OFDM | 80 | 11.0 | 10.37 | -0.13 | 0 mm | 2 | 05211 | 29.3 | back | 86.9 | 1.843 | 0.813 | 1.156 | 1.151 | 1.082 | |
| 5530 | 106 | 802.11ac | OFDM | 80 | 11.0 | 10.79 | -0.14 | 0 mm | 1 | 05211 | 29.3 | back | 86.9 | 1.081 | 0.900 | 1.050 | 1.151 | **1.088** | A9 |
| ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | | | | | | | | Body<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | |

Note: Blue entries indicate variability measurements.

**Table 10-9**
**Bluetooth Body SAR Data**

| MEASUREMENT RESULTS | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | Mode | Service | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Power Drift [dB] | Spacing | Device Serial Number | Data Rate (Mbps) | Side | Duty Cycle (%) | SAR (1g) | Scaling Factor (Power) | Scaling Factor (Duty Cycle) | Reported SAR (1g) | Plot # |
| MHz | Ch. | | | | | | | | | | | (W/kg) | | | (W/kg) | |
| 2441 | 39 | Bluetooth | FHSS | 11.0 | 10.55 | -0.12 | 0 mm | 02220 | 1 | back | 77.3 | 0.237 | 1.109 | 1.294 | **0.340** | A10 |
| 2441 | 39 | Bluetooth | FHSS | 11.0 | 10.55 | 0.06 | 0 mm | 02220 | 1 | bottom | 77.3 | 0.204 | 1.109 | 1.294 | 0.292 | |
| 2441 | 39 | Bluetooth | FHSS | 11.0 | 10.55 | -0.06 | 0 mm | 02220 | 1 | right | 77.3 | 0.028 | 1.109 | 1.294 | 0.040 | |
| ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | | | Body<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | | | |

## 10.2 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in FCC KDB Publication 616217 D04v01r02 and FCC KDB Publication 447498 D01v06.
2. Batteries are fully charged at the beginning of the SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v06.
6. Per FCC KDB 865664 D01v01r04, variability SAR tests were performed when the measured SAR results for a frequency band were greater than or equal to 0.8 W/kg. Repeated SAR measurements are highlighted in the tables above for clarity. Please see Section 12 for variability analysis.
7. FCC KDB Publication 616217 D04v01r02 Section 4.3, SAR tests are required for the back surface and edges of the tablet with the tablet touching the phantom. The SAR Exclusion Threshold in FCC KDB 447498 D01v06 was applied to determine SAR test exclusion for adjacent edge configurations.

GSM Test Notes:

1. Justification for reduced test configurations per KDB Publication 941225 D01v03r01 and October 2013 TCB Workshop Notes: The source-based frame-averaged output power was evaluated for all GPRS/EDGE slot configurations. The configuration with the highest target frame averaged output power was evaluated for hotspot SAR. When the maximum frame-averaged powers are equivalent across two or more slots (within 0.25 dB), the configuration with the most number of time slots was tested.
2. Per FCC KDB Publication 447498 D01v06, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel was used.

UMTS Notes:

1. UMTS mode in was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01v03r01. AMR and HSPA SAR was not required per the 3G Test Reduction Procedure in KDB Publication 941225 D01v03r01.
2. Per FCC KDB Publication 447498 D01v06, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel was used.

LTE Notes:

1. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Considerations for LTE Devices in FCC KDB Publication 941225 D05v02r04. The general test procedures used for testing can be found in Section 7.5.4.
2. MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.
3. A-MPR was disabled for all SAR tests by setting NS=01 on the base station simulator. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

WLAN Notes:

1. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 2.4 GHz WIFI single transmission chain operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4 GHz 802.11g/n) was not required due to the maximum allowed powers and the highest reported DSSS SAR. See Section 7.6.4 for more information.
2. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 5 GHz WIFI single transmission chain operations, the initial test configuration was selected according to the transmission mode with the highest maximum allowed powers. Other transmission modes were not investigated since the highest reported SAR for initial test configuration adjusted by the ratio of maximum output powers is less than 1.2 W/kg. See Section 7.6.5 for more information.
3. Per KDB Publication 248227 D01v02r02, SAR for MIMO was evaluated by following the simultaneous SAR provisions from KDB Publication 447498 D01v06. Please see Section 11 for complete analysis.
4. When the maximum reported 1g averaged SAR is ≤0.8 W/kg, SAR testing on additional channels was not required. Otherwise, SAR for the next highest output power channel was required until the reported SAR result was ≤ 1.20 W/kg or all test channels were measured.
5. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools. The reported SAR was scaled to the 100% transmission duty factor to determine compliance. Procedures used to measure the duty factor are identical to that in the associated EMC test reports.

Bluetooth Notes:

1. Bluetooth SAR was measured with the device connected to a call box with hopping disabled with DH5 operation and Tx Tests test mode type. Per October 2016 TCB Workshop Notes, the reported SAR was scaled to the 100% transmission duty factor to determine compliance. See Section 8.5 for the time-domain plot and calculation for the duty factor of the device.

# 11 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

## 11.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D01v06 are applicable to devices with built-in unlicensed transmitters such as 802.11 and Bluetooth devices which may simultaneously transmit with the licensed transmitter.

## 11.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore simultaneous transmission analysis is required. Per FCC KDB Publication 447498 D01v06 4.3.2 and IEEE 1528-2013 Section 6.3.4.1.2, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the simultaneous transmitting antennas in a specific a physical test configuration is ≤1.6 W/kg. The different test positions in an exposure condition may be considered collectively to determine SAR test exclusion according to the sum of 1-g or 10-g SAR.

## 11.3 Body SAR Simultaneous Transmission Analysis

**Table 11-1**
**Simultaneous Transmission Scenario with 2.4 GHz WLAN**

| Simult Tx | Configuration | GPRS 1900 SAR (W/kg) | 2.4 GHz WLAN Ant 1 SAR (W/kg) | 2.4 GHz WLAN Ant 2 SAR (W/kg) | Σ SAR (W/kg) | | | SPLSR | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 1+2 | 1+3 | 1+2+3 | 1+2 | 1+3 | 2+3 |
| Body SAR | Back | 1.073 | 0.960 | 0.560 | See Note 1 | See Note 1 | See Note 1 | 0.01 | 0.01 | 0.02 |
| | Top | 0.444 | 0.029 | 0.019 | 0.473 | 0.463 | 0.492 | N/A | N/A | N/A |
| | Bottom | 0.400 | 0.488 | 0.445 | 0.888 | 0.845 | 1.333 | N/A | N/A | N/A |
| | Right | 0.142 | 0.132 | 0.400 | 0.274 | 0.542 | 0.674 | N/A | N/A | N/A |
| | Left | 0.983 | 0.400 | 0.104 | 1.383 | 1.087 | **1.487** | N/A | N/A | N/A |

| Simult Tx | Configuration | UMTS 850 SAR (W/kg) | 2.4 GHz WLAN Ant 1 SAR (W/kg) | 2.4 GHz WLAN Ant 2 SAR (W/kg) | Σ SAR (W/kg) | | | SPLSR | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 1+2 | 1+3 | 1+2+3 | 1+2 | 1+3 | 2+3 |
| Body SAR | Back | 1.073 | 0.960 | 0.560 | See Note 1 | See Note 1 | See Note 1 | 0.01 | 0.01 | 0.02 |
| | Top | 0.954 | 0.029 | 0.019 | 0.983 | 0.973 | 1.002 | N/A | N/A | N/A |
| | Bottom | 0.400 | 0.488 | 0.445 | 0.888 | 0.845 | **1.333** | N/A | N/A | N/A |
| | Right | 0.188 | 0.132 | 0.400 | 0.320 | 0.588 | 0.720 | N/A | N/A | N/A |
| | Left | 0.215 | 0.400 | 0.104 | 0.615 | 0.319 | 0.719 | N/A | N/A | N/A |

| Simult Tx | Configuration | UMTS 1900 SAR (W/kg) | 2.4 GHz WLAN Ant 1 SAR (W/kg) | 2.4 GHz WLAN Ant 2 SAR (W/kg) | Σ SAR (W/kg) | | | SPLSR | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 1+2 | 1+3 | 1+2+3 | 1+2 | 1+3 | 2+3 |
| Body SAR | Back | 0.735 | 0.960 | 0.560 | See Note 1 | 1.295 | See Note 1 | 0.01 | 0.01 | 0.02 |
| | Top | 0.355 | 0.029 | 0.019 | 0.384 | 0.374 | 0.403 | N/A | N/A | N/A |
| | Bottom | 0.400 | 0.488 | 0.445 | 0.888 | 0.845 | 1.333 | N/A | N/A | N/A |
| | Right | 0.196 | 0.132 | 0.400 | 0.328 | 0.596 | 0.728 | N/A | N/A | N/A |
| | Left | 0.964 | 0.400 | 0.104 | 1.364 | 1.068 | **1.468** | N/A | N/A | N/A |

| Simult Tx | Configuration | LTE Band 17 SAR (W/kg) | 2.4 GHz WLAN Ant 1 SAR (W/kg) | 2.4 GHz WLAN Ant 2 SAR (W/kg) | Σ SAR (W/kg) | | | SPLSR | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 1+2 | 1+3 | 1+2+3 | 1+2 | 1+3 | 2+3 |
| Body SAR | Back | 1.086 | 0.960 | 0.560 | See Note 1 | See Note 1 | See Note 1 | 0.01 | 0.01 | 0.02 |
| | Top | 0.918 | 0.029 | 0.019 | 0.947 | 0.937 | 0.966 | N/A | N/A | N/A |
| | Bottom | 0.400 | 0.488 | 0.445 | 0.888 | 0.845 | **1.333** | N/A | N/A | N/A |
| | Right | 0.182 | 0.132 | 0.400 | 0.314 | 0.582 | 0.714 | N/A | N/A | N/A |
| | Left | 0.310 | 0.400 | 0.104 | 0.710 | 0.414 | 0.814 | N/A | N/A | N/A |

| Simult Tx | Configuration | LTE Band 5 (Cell) SAR (W/kg) | 2.4 GHz WLAN Ant 1 SAR (W/kg) | 2.4 GHz WLAN Ant 2 SAR (W/kg) | Σ SAR (W/kg) | | | SPLSR | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 1+2 | 1+3 | 1+2+3 | 1+2 | 1+3 | 2+3 |
| Body SAR | Back | 0.910 | 0.960 | 0.560 | See Note 1 | **1.470** | See Note 1 | 0.01 | 0.01 | 0.02 |
| | Top | 0.871 | 0.029 | 0.019 | 0.900 | 0.890 | 0.919 | N/A | N/A | N/A |
| | Bottom | 0.400 | 0.488 | 0.445 | 0.888 | 0.845 | 1.333 | N/A | N/A | N/A |
| | Right | 0.116 | 0.132 | 0.400 | 0.248 | 0.516 | 0.648 | N/A | N/A | N/A |
| | Left | 0.194 | 0.400 | 0.104 | 0.594 | 0.298 | 0.698 | N/A | N/A | N/A |

| Simult Tx | Configuration | LTE Band 4 (AWS) SAR (W/kg) | 2.4 GHz WLAN Ant 1 SAR (W/kg) | 2.4 GHz WLAN Ant 2 SAR (W/kg) | Σ SAR (W/kg) | | | SPLSR | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 1+2 | 1+3 | 1+2+3 | 1+2 | 1+3 | 2+3 |
| Body SAR | Back | 1.089 | 0.960 | 0.560 | See Note 1 | See Note 1 | See Note 1 | 0.01 | 0.01 | 0.02 |
| | Top | 0.445 | 0.029 | 0.019 | 0.474 | 0.464 | 0.493 | N/A | N/A | N/A |
| | Bottom | 0.400 | 0.488 | 0.445 | 0.888 | 0.845 | **1.333** | N/A | N/A | N/A |
| | Right | 0.205 | 0.132 | 0.400 | 0.337 | 0.605 | 0.737 | N/A | N/A | N/A |
| | Left | 0.507 | 0.400 | 0.104 | 0.907 | 0.611 | 1.011 | N/A | N/A | N/A |

| Simult Tx | Configuration | LTE Band 2 (PCS) SAR (W/kg) | 2.4 GHz WLAN Ant 1 SAR (W/kg) | 2.4 GHz WLAN Ant 2 SAR (W/kg) | Σ SAR (W/kg) | | | SPLSR | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 1+2 | 1+3 | 1+2+3 | 1+2 | 1+3 | 2+3 |
| Body SAR | Back | 0.737 | 0.960 | 0.560 | See Note 1 | 1.297 | See Note 1 | 0.01 | 0.01 | 0.02 |
| | Top | 0.475 | 0.029 | 0.019 | 0.504 | 0.494 | 0.523 | N/A | N/A | N/A |
| | Bottom | 0.400 | 0.488 | 0.445 | 0.888 | 0.845 | **1.333** | N/A | N/A | N/A |
| | Right | 0.173 | 0.132 | 0.400 | 0.305 | 0.573 | 0.705 | N/A | N/A | N/A |
| | Left | 0.563 | 0.400 | 0.104 | 0.963 | 0.667 | 1.067 | N/A | N/A | N/A |

## Table 11-2
## Simultaneous Transmission Scenario with 5 GHz WLAN

| Simult Tx | Configuration | GPRS 1900 SAR (W/kg) | 5 GHz WLAN Ant 1 SAR (W/kg) | 5 GHz WLAN Ant 2 SAR (W/kg) | Σ SAR (W/kg) | | | SPLSR | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 1+2 | 1+3 | 1+2+3 | 1+2 | 1+3 | 2+3 |
| Body SAR | Back | 1.073 | 1.088 | 1.083 | See Note 1 | See Note 1 | See Note 1 | 0.01 | 0.01 | 0.04 |
| | Top | 0.444 | 0.022 | 0.016 | 0.466 | 0.460 | 0.482 | N/A | N/A | N/A |
| | Bottom | 0.400 | 0.853 | 0.756 | 1.253 | 1.156 | See Table 11-3 | N/A | N/A | N/A |
| | Right | 0.142 | 0.345 | 0.400 | 0.487 | 0.542 | 0.887 | N/A | N/A | N/A |
| | Left | 0.983 | 0.038 | 0.245 | 1.021 | 1.228 | **1.266** | N/A | N/A | N/A |

| Simult Tx | Configuration | UMTS 850 SAR (W/kg) | 5 GHz WLAN Ant 1 SAR (W/kg) | 5 GHz WLAN Ant 2 SAR (W/kg) | Σ SAR (W/kg) | | | SPLSR | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 1+2 | 1+3 | 1+2+3 | 1+2 | 1+3 | 2+3 |
| Body SAR | Back | 1.073 | 1.088 | 1.083 | See Note 1 | See Note 1 | See Note 1 | 0.01 | 0.01 | 0.04 |
| | Top | 0.954 | 0.022 | 0.016 | 0.976 | 0.970 | 0.992 | N/A | N/A | N/A |
| | Bottom | 0.400 | 0.853 | 0.756 | **1.253** | 1.156 | See Table 11-3 | N/A | N/A | N/A |
| | Right | 0.188 | 0.345 | 0.400 | 0.533 | 0.588 | 0.933 | N/A | N/A | N/A |
| | Left | 0.215 | 0.038 | 0.245 | 0.253 | 0.460 | 0.498 | N/A | N/A | N/A |

| Simult Tx | Configuration | UMTS 1900 SAR (W/kg) | 5 GHz WLAN Ant 1 SAR (W/kg) | 5 GHz WLAN Ant 2 SAR (W/kg) | Σ SAR (W/kg) | | | SPLSR | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 1+2 | 1+3 | 1+2+3 | 1+2 | 1+3 | 2+3 |
| Body SAR | Back | 0.735 | 1.088 | 1.083 | See Note 1 | See Note 1 | See Note 1 | 0.01 | 0.01 | 0.04 |
| | Top | 0.355 | 0.022 | 0.016 | 0.377 | 0.371 | 0.393 | N/A | N/A | N/A |
| | Bottom | 0.400 | 0.853 | 0.756 | **1.253** | 1.156 | See Table 11-3 | N/A | N/A | N/A |
| | Right | 0.196 | 0.345 | 0.400 | 0.541 | 0.596 | 0.941 | N/A | N/A | N/A |
| | Left | 0.964 | 0.038 | 0.245 | 1.002 | 1.209 | 1.247 | N/A | N/A | N/A |

| Simult Tx | Configuration | LTE Band 17 SAR (W/kg) | 5 GHz WLAN Ant 1 SAR (W/kg) | 5 GHz WLAN Ant 2 SAR (W/kg) | Σ SAR (W/kg) | | | SPLSR | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 1+2 | 1+3 | 1+2+3 | 1+2 | 1+3 | 2+3 |
| Body SAR | Back | 1.086 | 1.088 | 1.083 | See Note 1 | See Note 1 | See Note 1 | 0.01 | 0.01 | 0.04 |
| | Top | 0.918 | 0.022 | 0.016 | 0.940 | 0.934 | 0.956 | N/A | N/A | N/A |
| | Bottom | 0.400 | 0.853 | 0.756 | **1.253** | 1.156 | See Table 11-3 | N/A | N/A | N/A |
| | Right | 0.182 | 0.345 | 0.400 | 0.527 | 0.582 | 0.927 | N/A | N/A | N/A |
| | Left | 0.310 | 0.038 | 0.245 | 0.348 | 0.555 | 0.593 | N/A | N/A | N/A |

| Simult Tx | Configuration | LTE Band 5 (Cell) SAR (W/kg) | 5 GHz WLAN Ant 1 SAR (W/kg) | 5 GHz WLAN Ant 2 SAR (W/kg) | Σ SAR (W/kg) | | | SPLSR | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 1+2 | 1+3 | 1+2+3 | 1+2 | 1+3 | 2+3 |
| Body SAR | Back | 0.910 | 1.088 | 1.083 | See Note 1 | See Note 1 | See Note 1 | 0.01 | 0.01 | 0.04 |
| | Top | 0.871 | 0.022 | 0.016 | 0.893 | 0.887 | 0.909 | N/A | N/A | N/A |
| | Bottom | 0.400 | 0.853 | 0.756 | **1.253** | 1.156 | See Table 11-3 | N/A | N/A | N/A |
| | Right | 0.116 | 0.345 | 0.400 | 0.461 | 0.516 | 0.861 | N/A | N/A | N/A |
| | Left | 0.194 | 0.038 | 0.245 | 0.232 | 0.439 | 0.477 | N/A | N/A | N/A |

| Simult Tx | Configuration | LTE Band 4 (AWS) SAR (W/kg) | 5 GHz WLAN Ant 1 SAR (W/kg) | 5 GHz WLAN Ant 2 SAR (W/kg) | Σ SAR (W/kg) | | | SPLSR | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 1+2 | 1+3 | 1+2+3 | 1+2 | 1+3 | 2+3 |
| Body SAR | Back | 1.089 | 1.088 | 1.083 | See Note 1 | See Note 1 | See Note 1 | 0.01 | 0.01 | 0.04 |
| | Top | 0.445 | 0.022 | 0.016 | 0.467 | 0.461 | 0.483 | N/A | N/A | N/A |
| | Bottom | 0.400 | 0.853 | 0.756 | **1.253** | 1.156 | See Table 11-3 | N/A | N/A | N/A |
| | Right | 0.205 | 0.345 | 0.400 | 0.550 | 0.605 | 0.950 | N/A | N/A | N/A |
| | Left | 0.507 | 0.038 | 0.245 | 0.545 | 0.752 | 0.790 | N/A | N/A | N/A |

| Simult Tx | Configuration | LTE Band 2 (PCS) SAR (W/kg) | 5 GHz WLAN Ant 1 SAR (W/kg) | 5 GHz WLAN Ant 2 SAR (W/kg) | Σ SAR (W/kg) | | | SPLSR | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 1+2 | 1+3 | 1+2+3 | 1+2 | 1+3 | 2+3 |
| Body SAR | Back | 0.737 | 1.088 | 1.083 | See Note 1 | See Note 1 | See Note 1 | 0.01 | 0.01 | 0.04 |
| | Top | 0.475 | 0.022 | 0.016 | 0.497 | 0.491 | 0.513 | N/A | N/A | N/A |
| | Bottom | 0.400 | 0.853 | 0.756 | **1.253** | 1.156 | See Table 11-3 | N/A | N/A | N/A |
| | Right | 0.173 | 0.345 | 0.400 | 0.518 | 0.573 | 0.918 | N/A | N/A | N/A |
| | Left | 0.563 | 0.038 | 0.245 | 0.601 | 0.808 | 0.846 | N/A | N/A | N/A |

**Table 11-3**
**Bottom Edge Simultaneous Transmission Scenario with 5 GHz WLAN**

| Configuration | Mode | 2G/3G/4G SAR (W/kg) | 5 GHz WLAN MIMO SAR (W/kg) | Σ SAR (W/kg) |
|---|---|---|---|---|
| Bottom Edge | GSM 1900 | 0.400 | 0.915 | 1.315 |
| Bottom Edge | UMTS 850 | 0.400 | 0.915 | 1.315 |
| Bottom Edge | UMTS 1900 | 0.400 | 0.915 | 1.315 |
| Bottom Edge | LTE Band 17 | 0.400 | 0.915 | 1.315 |
| Bottom Edge | LTE Band 5 (Cell) | 0.400 | 0.915 | 1.315 |
| Bottom Edge | LTE Band 4 (AWS) | 0.400 | 0.915 | 1.315 |
| Bottom Edge | LTE Band 2 (PCS) | 0.400 | 0.915 | 1.315 |

## Table 11-4
## Simultaneous Transmission Scenario with Bluetooth

| Simult Tx | Configuration | GPRS 1900 SAR (W/kg) | Bluetooth SAR (W/kg) | Σ SAR (W/kg) |
|---|---|---|---|---|
| Body SAR | Back | 1.073 | 0.340 | **1.413** |
| | Top | 0.444 | 0.400 | 0.844 |
| | Bottom | 0.400 | 0.292 | 0.692 |
| | Right | 0.142 | 0.040 | 0.182 |
| | Left | 0.983 | 0.400 | 1.383 |

| Simult Tx | Configuration | UMTS 850 SAR (W/kg) | Bluetooth SAR (W/kg) | Σ SAR (W/kg) |
|---|---|---|---|---|
| Body SAR | Back | 1.073 | 0.340 | **1.413** |
| | Top | 0.954 | 0.400 | 1.354 |
| | Bottom | 0.400 | 0.292 | 0.692 |
| | Right | 0.188 | 0.040 | 0.228 |
| | Left | 0.215 | 0.400 | 0.615 |

| Simult Tx | Configuration | UMTS 1900 SAR (W/kg) | Bluetooth SAR (W/kg) | Σ SAR (W/kg) |
|---|---|---|---|---|
| Body SAR | Back | 0.735 | 0.340 | 1.075 |
| | Top | 0.355 | 0.400 | 0.755 |
| | Bottom | 0.400 | 0.292 | 0.692 |
| | Right | 0.196 | 0.040 | 0.236 |
| | Left | 0.964 | 0.400 | **1.364** |

| Simult Tx | Configuration | LTE Band 17 SAR (W/kg) | Bluetooth SAR (W/kg) | Σ SAR (W/kg) |
|---|---|---|---|---|
| Body SAR | Back | 1.086 | 0.340 | **1.426** |
| | Top | 0.918 | 0.400 | 1.318 |
| | Bottom | 0.400 | 0.292 | 0.692 |
| | Right | 0.182 | 0.040 | 0.222 |
| | Left | 0.310 | 0.400 | 0.710 |

| Simult Tx | Configuration | LTE Band 5 (Cell) SAR (W/kg) | Bluetooth SAR (W/kg) | Σ SAR (W/kg) |
|---|---|---|---|---|
| Body SAR | Back | 0.910 | 0.340 | 1.250 |
| | Top | 0.871 | 0.400 | **1.271** |
| | Bottom | 0.400 | 0.292 | 0.692 |
| | Right | 0.116 | 0.040 | 0.156 |
| | Left | 0.194 | 0.400 | 0.594 |

| Simult Tx | Configuration | LTE Band 4 (AWS) SAR (W/kg) | Bluetooth SAR (W/kg) | Σ SAR (W/kg) |
|---|---|---|---|---|
| Body SAR | Back | 1.089 | 0.340 | **1.429** |
| | Top | 0.445 | 0.400 | 0.845 |
| | Bottom | 0.400 | 0.292 | 0.692 |
| | Right | 0.205 | 0.040 | 0.245 |
| | Left | 0.507 | 0.400 | 0.907 |

| Simult Tx | Configuration | LTE Band 2 (PCS) SAR (W/kg) | Bluetooth SAR (W/kg) | Σ SAR (W/kg) |
|---|---|---|---|---|
| Body SAR | Back | 0.737 | 0.340 | **1.077** |
| | Top | 0.475 | 0.400 | 0.875 |
| | Bottom | 0.400 | 0.292 | 0.692 |
| | Right | 0.173 | 0.040 | 0.213 |
| | Left | 0.563 | 0.400 | 0.963 |

Notes:

1. No evaluation was performed to determine the aggregate 1g SAR for these configurations as the SPLS ratio between the antenna pairs was not greater than 0.04 per FCC KDB 447498 D01v06. See Section 11.4 for detailed SPLS ratio analysis.
2. For SAR summation, the highest reported SAR across all test distances was used as the most conservative evaluation for simultaneous transmission analysis for each device edge.
3. When the antenna separation distance was > 50 mm, an estimated SAR of 0.4 W/kg was used to determine the simultaneous transmission SAR exclusion for test positions excluded per FCC KDB Publication 447498 D01v06.

## 11.4 SPLSR Evaluation and Analysis

Per FCC KDB Publication 447498 D01v06, when the sum of the standalone transmitters is more than 1.6 W/kg for 1g, the SAR sum to peak locations can be analyzed to determine SAR distribution overlaps. When the SAR peak to location ratio (shown below) for each pair of antennas is ≤ 0.04 for 1g, simultaneous SAR evaluation is not required. The distance between the transmitters was calculated using the following formula.

$$\text{Distance}_{Tx1-Tx2} = R_i = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

$$\text{SPLS Ratio} = \frac{(SAR_1 + SAR_2)^{1.5}}{R_i}$$

### 11.4.1 Back Side SPLSR Evaluation and Analysis

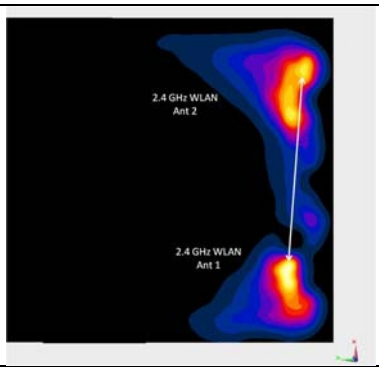
**Table 11-5**
**Peak SAR Locations for Body Back Side**

| Mode/Band | x (mm) | y (mm) | Reported SAR (W/kg) |
|---|---|---|---|
| 2.4 GHz WLAN Ant 1 | -65.80 | -104.40 | 0.960 |
| 2.4 GHz WLAN Ant 2 | 41.60 | -106.80 | 0.560 |
| 5 GHz WLAN Ant 1 | -63.00 | -108.00 | 1.088 |
| 5 GHz WLAN Ant 2 | 9.00 | -110.00 | 1.083 |
| GPRS 1900 | 8.50 | 111.00 | 1.073 |
| UMTS 850 | -15.50 | 120.00 | 1.073 |
| UMTS 1900 | -3.50 | 112.50 | 0.735 |
| LTE Band 17 | -19.50 | 121.50 | 1.086 |
| LTE Band 5 (Cell) | -14.00 | 120.00 | 0.910 |
| LTE Band 4 (AWS) | 1.00 | 112.50 | 1.089 |
| LTE Band 2 (PCS) | 10.00 | 111.00 | 0.737 |

## Table 11-6
## Back Side SAR to Peak Location Separation Ratio Calculations

| Antenna Pair | | Standalone 1g SAR (W/kg) | | Standalone SAR Sum (W/kg) | Peak SAR Separation Distance | SPLS Ratio | Plot Number |
|---|---|---|---|---|---|---|---|
| Ant "a" | Ant "b" | a | b | a+b | $D_{a-b}$ | $(a+b)^{1.5}/D_{a-b}$ | |
| 2.4 GHz WLAN Ant 1 | 2.4 GHz WLAN Ant 2 | 0.960 | 0.560 | 1.520 | 107.43 | 0.02 | 1 |
| GPRS 1900 | 2.4 GHz WLAN Ant 1 | 1.073 | 0.960 | 2.033 | 227.85 | 0.01 | 2 |
| GPRS 1900 | 2.4 GHz WLAN Ant 2 | 1.073 | 0.560 | 1.633 | 220.30 | 0.01 | 3 |
| UMTS 850 | 2.4 GHz WLAN Ant 1 | 1.073 | 0.960 | 2.033 | 229.97 | 0.01 | 4 |
| UMTS 850 | 2.4 GHz WLAN Ant 2 | 1.073 | 0.560 | 1.633 | 233.88 | 0.01 | 5 |
| UMTS 1900 | 2.4 GHz WLAN Ant 1 | 0.735 | 0.960 | 1.695 | 225.67 | 0.01 | 6 |
| UMTS 1900 | 2.4 GHz WLAN Ant 2 | 0.735 | 0.560 | 1.295 | 223.89 | 0.01 | 7 |
| LTE Band 17 | 2.4 GHz WLAN Ant 1 | 1.086 | 0.960 | 2.046 | 230.60 | 0.01 | 8 |
| LTE Band 17 | 2.4 GHz WLAN Ant 2 | 1.086 | 0.560 | 1.646 | 236.33 | 0.01 | 9 |
| LTE Band 5 (Cell) | 2.4 GHz WLAN Ant 1 | 0.910 | 0.960 | 1.870 | 230.30 | 0.01 | 10 |
| LTE Band 5 (Cell) | 2.4 GHz WLAN Ant 2 | 0.910 | 0.560 | 1.470 | 233.52 | 0.01 | 11 |
| LTE Band 4 (AWS) | 2.4 GHz WLAN Ant 1 | 1.089 | 0.960 | 2.049 | 226.95 | 0.01 | 12 |
| LTE Band 4 (AWS) | 2.4 GHz WLAN Ant 2 | 1.089 | 0.560 | 1.649 | 223.03 | 0.01 | 13 |
| LTE Band 2 (PCS) | 2.4 GHz WLAN Ant 1 | 0.737 | 0.960 | 1.697 | 228.35 | 0.01 | 14 |
| LTE Band 2 (PCS) | 2.4 GHz WLAN Ant 2 | 0.737 | 0.560 | 1.297 | 220.08 | 0.01 | 15 |
| 5 GHz WLAN Ant 1 | 5 GHz WLAN Ant 2 | 1.088 | 1.083 | 2.171 | 72.03 | 0.04 | 16 |
| GPRS 1900 | 5 GHz WLAN Ant 1 | 1.073 | 1.088 | 2.161 | 230.38 | 0.01 | 17 |
| GPRS 1900 | 5 GHz WLAN Ant 2 | 1.073 | 1.083 | 2.156 | 221.00 | 0.01 | 18 |
| UMTS 850 | 5 GHz WLAN Ant 1 | 1.073 | 1.088 | 2.161 | 232.90 | 0.01 | 19 |
| UMTS 850 | 5 GHz WLAN Ant 2 | 1.073 | 1.083 | 2.156 | 231.30 | 0.01 | 20 |
| UMTS 1900 | 5 GHz WLAN Ant 1 | 0.735 | 1.088 | 1.823 | 228.39 | 0.01 | 21 |
| UMTS 1900 | 5 GHz WLAN Ant 2 | 0.735 | 1.083 | 1.818 | 222.85 | 0.01 | 22 |
| LTE Band 17 | 5 GHz WLAN Ant 1 | 1.086 | 1.088 | 2.174 | 233.59 | 0.01 | 23 |
| LTE Band 17 | 5 GHz WLAN Ant 2 | 1.086 | 1.083 | 2.169 | 233.25 | 0.01 | 24 |
| LTE Band 5 (Cell) | 5 GHz WLAN Ant 1 | 0.910 | 1.088 | 1.998 | 233.21 | 0.01 | 25 |
| LTE Band 5 (Cell) | 5 GHz WLAN Ant 2 | 0.910 | 1.083 | 1.993 | 231.15 | 0.01 | 26 |
| LTE Band 4 (AWS) | 5 GHz WLAN Ant 1 | 1.089 | 1.088 | 2.177 | 229.60 | 0.01 | 27 |
| LTE Band 4 (AWS) | 5 GHz WLAN Ant 2 | 1.089 | 1.083 | 2.172 | 222.64 | 0.01 | 28 |
| LTE Band 2 (PCS) | 5 GHz WLAN Ant 1 | 0.737 | 1.088 | 1.825 | 230.85 | 0.01 | 29 |
| LTE Band 2 (PCS) | 5 GHz WLAN Ant 2 | 0.737 | 1.083 | 1.820 | 221.00 | 0.01 | 30 |

## Table 11-7
## Back Side SAR to Peak Location Separation Ratio Plots

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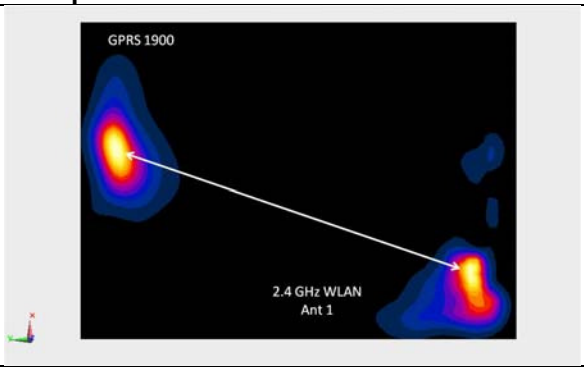


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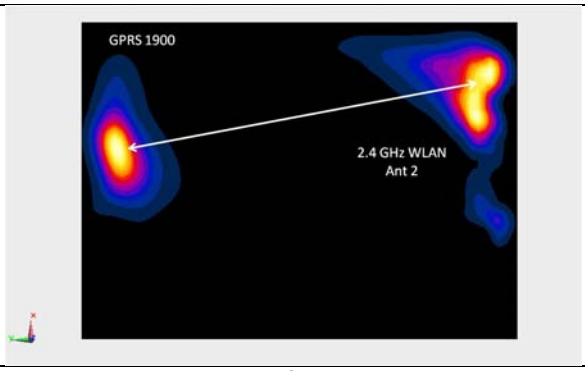


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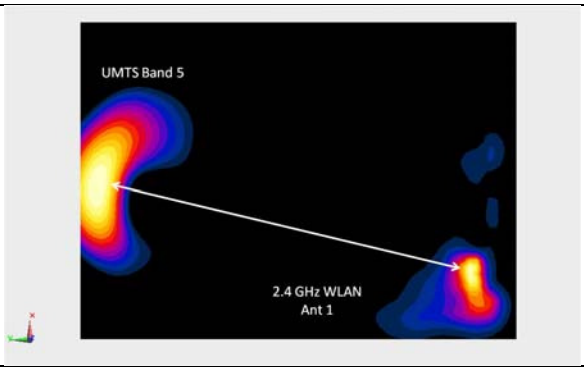


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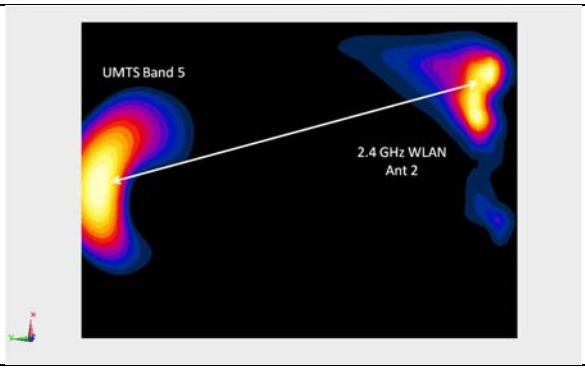


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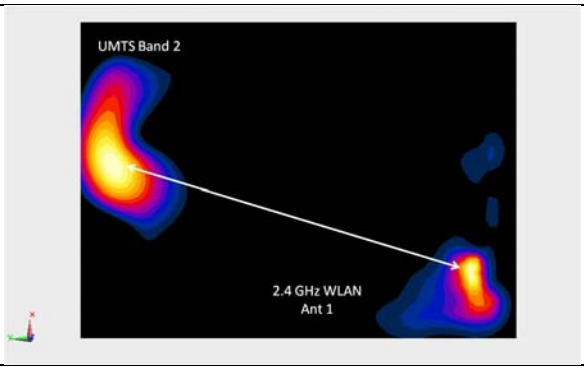


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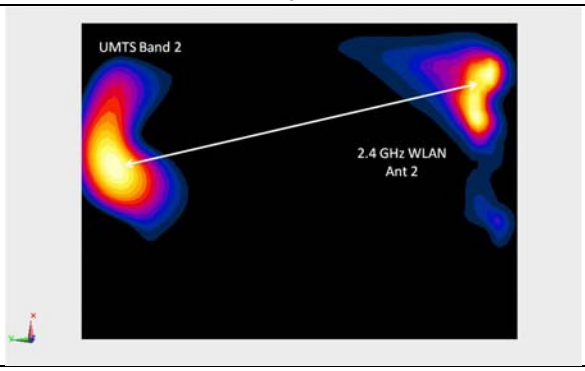


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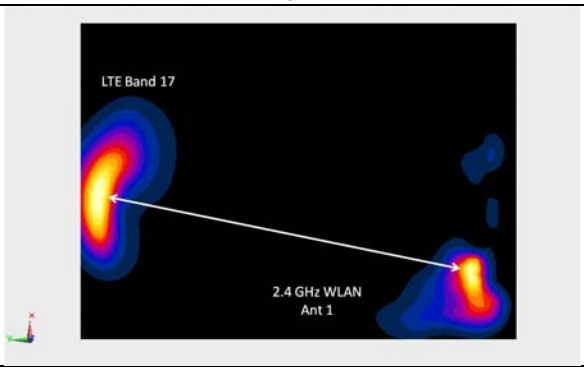


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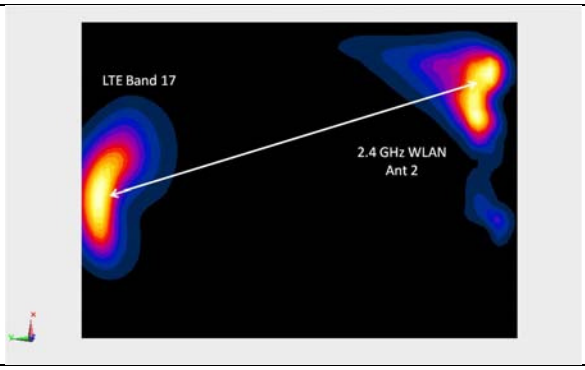


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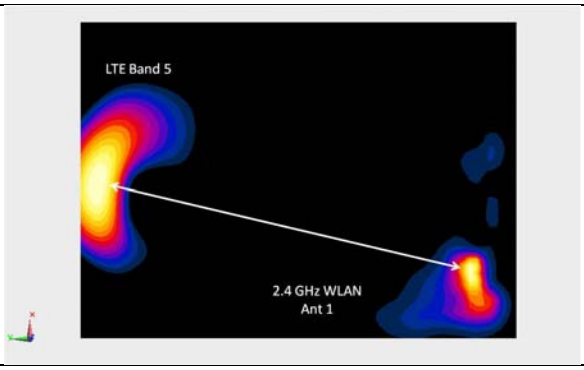


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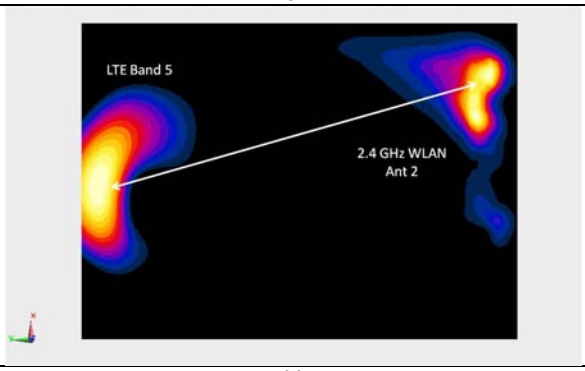


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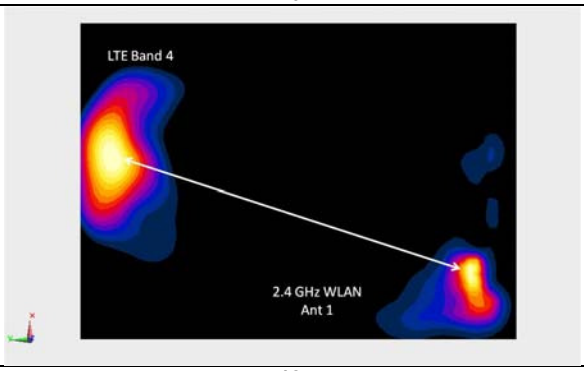


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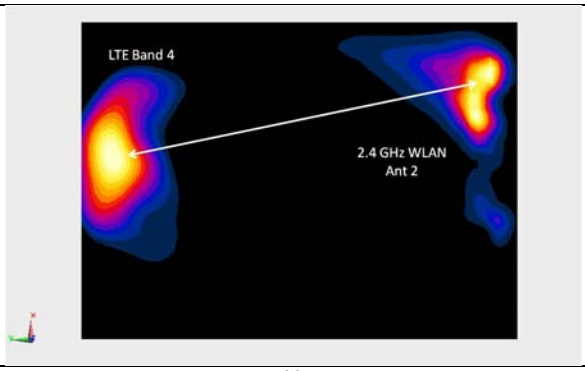


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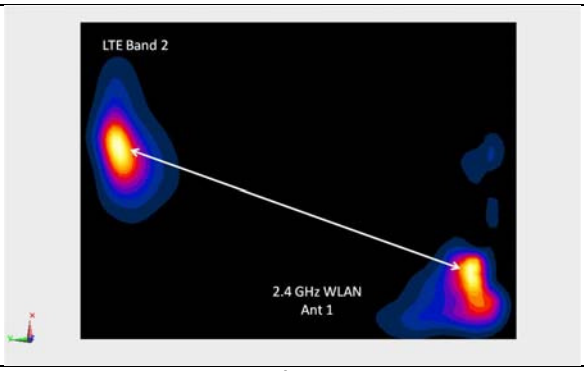


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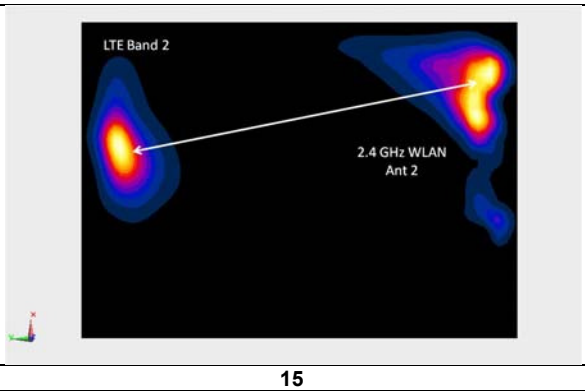


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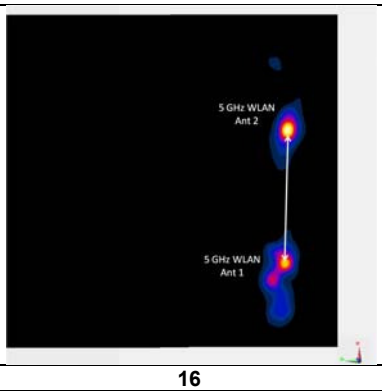


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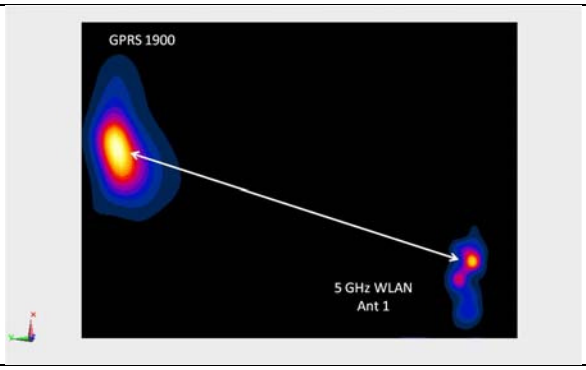


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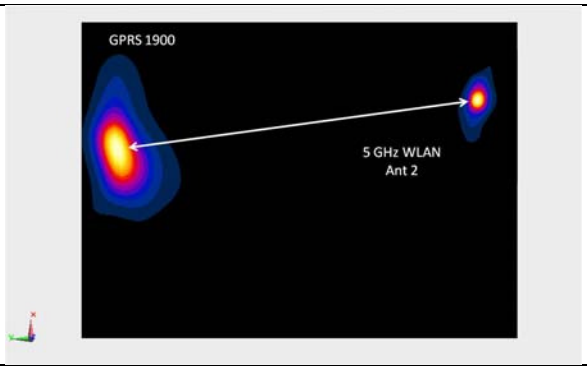


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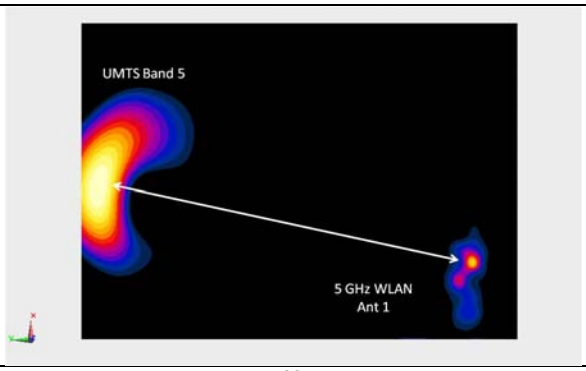


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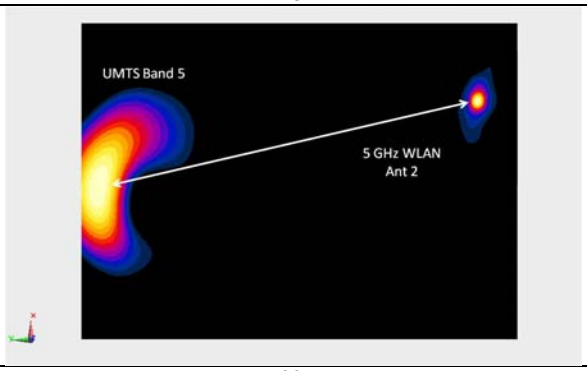


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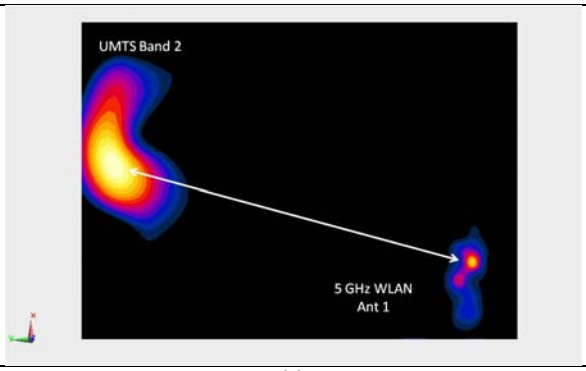


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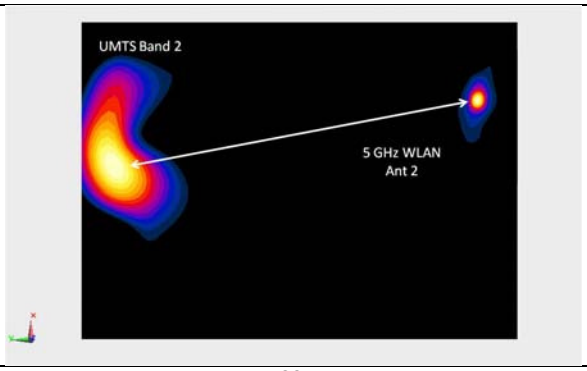


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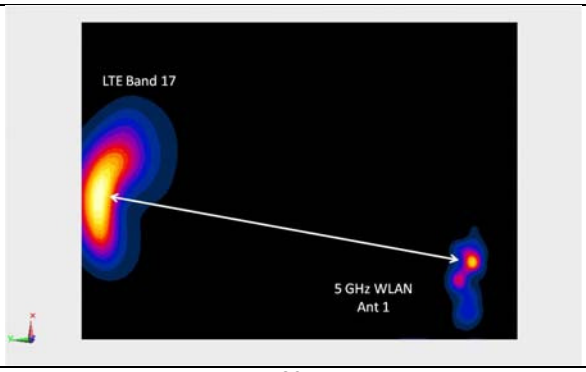


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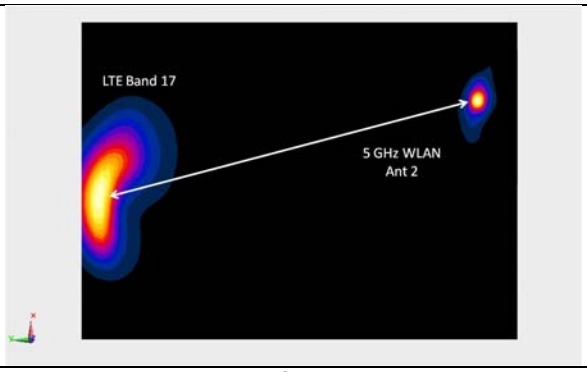


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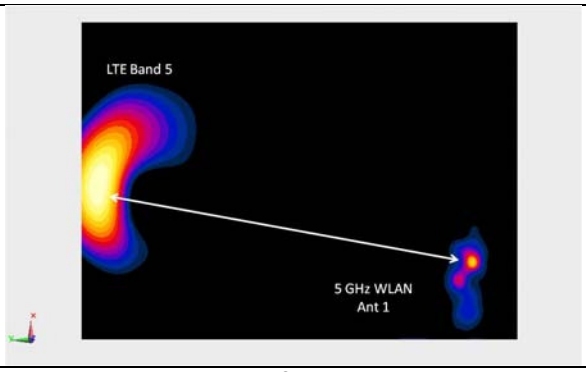
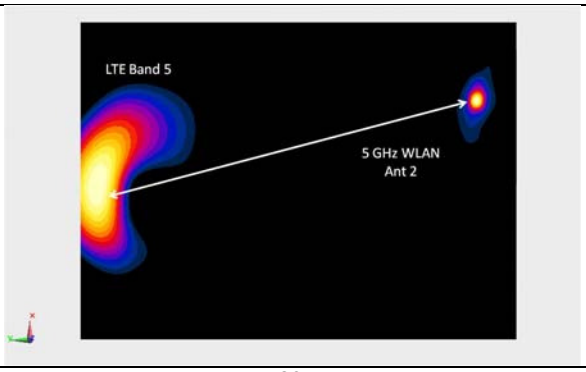
|  |  |
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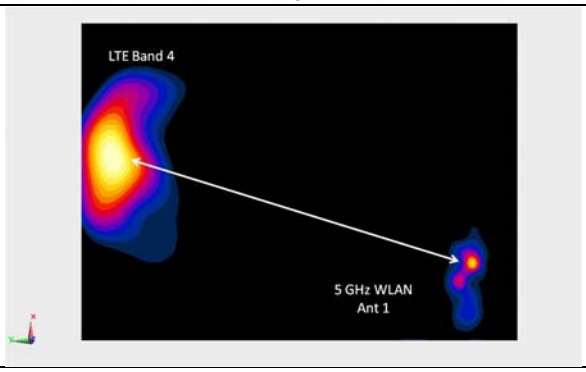
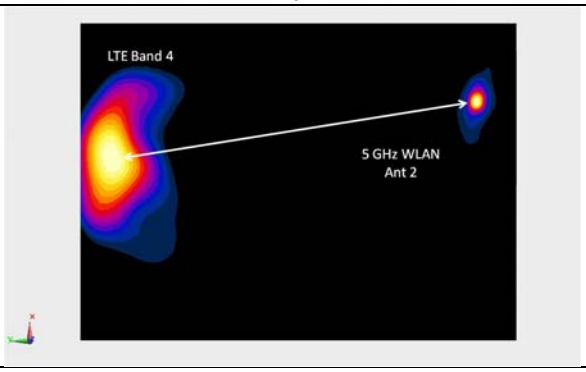
|  |  |
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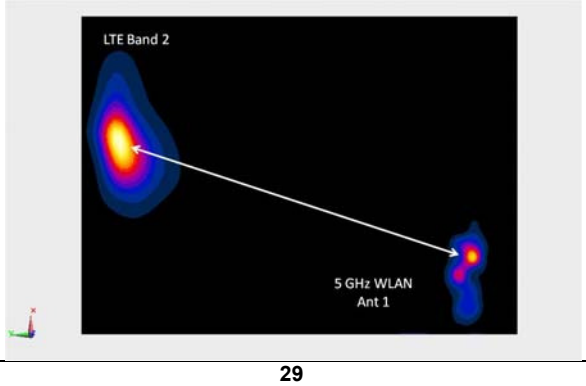
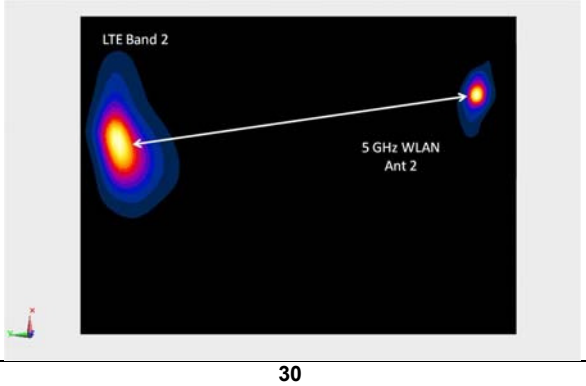
|  |  |
| **29** | **30** |

## 11.5 Simultaneous Transmission Conclusion

The above numerical summed SAR results and SPLSR analysis are sufficient to determine that simultaneous transmission cases will not exceed the SAR limit and therefore no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D01v06 and IEEE 1528- 2013 Section 6.3.4.1.

# 12 SAR MEASUREMENT VARIABILITY

## 12.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01r04, SAR measurement variability was assessed for each frequency band, which was determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media were required for SAR measurements in a frequency band, the variability measurement procedures were applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. These additional measurements were repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device was returned to ambient conditions (normal room temperature) with the battery fully charged before it was re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

SAR Measurement Variability was assessed using the following procedures for each frequency band:

1) When the original highest measured SAR is ≥ 0.80 W/kg, the measurement was repeated once.
2) A second repeated measurement was preformed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).
3) A third repeated measurement was performed only if the original, first or second repeated measurement was ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.
4) Repeated measurements are not required when the original highest measured SAR is < 0.80 W/kg

**Table 12-1**
**Body SAR Measurement Variability Results**

| BODY VARIABILITY RESULTS | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Band | FREQUENCY | | Mode | Service | # of Time Slots | Data Rate (Mbps) | Side | Spacing | Measured SAR (1g) | 1st Repeated SAR (1g) | Ratio | 2nd Repeated SAR (1g) | Ratio | 3rd Repeated SAR (1g) | Ratio |
| | MHz | Ch. | | | | | | | (W/kg) | (W/kg) | | (W/kg) | | (W/kg) | |
| 750 | 710.00 | 23790 | LTE Band 17, 10 MHz Bandwidth | QPSK, 50 RB, 0 RB Offset | N/A | N/A | back | 0 mm | 0.891 | 0.899 | 1.01 | N/A | N/A | N/A | N/A |
| 1750 | 1732.50 | 20175 | LTE Band 4 (AWS), 20 MHz Bandwidth | QPSK, 1 RB, 0 RB Offset | N/A | N/A | back | 13 mm | 0.982 | 0.914 | 1.07 | N/A | N/A | N/A | N/A |
| 1900 | 1850.20 | 512 | GSM 1900 | GPRS | 4 | N/A | back | 0 mm | 0.930 | 0.918 | 1.01 | N/A | N/A | N/A | N/A |
| 2450 | 2437.00 | 6 | 802.11b, 22 MHz Bandwidth | DSSS, ANT 1 | N/A | 1 | back | 0 mm | 0.855 | 0.847 | 1.01 | N/A | N/A | N/A | N/A |
| 5250 | 5290.00 | 58 | 802.11ac, 80 MHz Bandwidth | OFDM, ANT 2 | N/A | 29.3 | back | 0 mm | 0.814 | 0.813 | 1.00 | N/A | N/A | N/A | N/A |
| 5600 | 5530.00 | 106 | 802.11ac, 80 MHz Bandwidth | OFDM, ANT 1 | N/A | 29.3 | back | 0 mm | 0.893 | 0.900 | 1.01 | N/A | N/A | N/A | N/A |
| ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | Body<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | | | | | |

## 12.2 Measurement Uncertainty

The measured SAR was <1.5 W/kg for all frequency bands. Therefore, per KDB Publication 865664 D01v01r04, the extended measurement uncertainty analysis per IEEE 1528-2013 was not required.

# 13 EQUIPMENT LIST

| Manufacturer | Model | Description | Cal Date | Cal Interval | Cal Due | Serial Number |
|---|---|---|---|---|---|---|
| Agilent | 8594A | (9kHz-2.9GHz) Spectrum Analyzer | N/A | N/A | N/A | 3051A00187 |
| Agilent | 8753E | (30kHz-6GHz) Network Analyzer | 3/2/2016 | Annual | 3/2/2017 | JP38020182 |
| Agilent | 8753ES | S-Parameter Network Analyzer | 6/28/2016 | Annual | 6/28/2017 | MY40000670 |
| Agilent | 8753ES | S-Parameter Vector Network Analyzer | 8/19/2016 | Annual | 8/19/2017 | MY40003841 |
| Agilent | 8753ES | S-Parameter Network Analyzer | 10/26/2016 | Annual | 10/26/2017 | US39170118 |
| Agilent | E4432B | ESG-D Series Signal Generator | 3/5/2016 | Annual | 3/5/2017 | US40053896 |
| Agilent | E4438C | ESG Vector Signal Generator | 3/13/2015 | Biennial | 3/13/2017 | MY42082385 |
| Agilent | E5515C | Wireless Communications Test Set | 6/18/2015 | Biennial | 6/18/2017 | GB41450275 |
| Agilent | E5515C | Wireless Communications Test Set | 10/23/2015 | Biennial | 10/23/2017 | GB43193563 |
| Agilent | E8257D | (250kHz-20GHz) Signal Generator | 3/2/2016 | Annual | 3/2/2017 | MY45470194 |
| Agilent | N4010A | Wireless Connectivity Test Set | N/A | N/A | N/A | GB46170464 |
| Agilent | N5182A | MXG Vector Signal Generator | 10/27/2016 | Annual | 10/27/2017 | MY47420603 |
| Agilent | N9020A | MXA Signal Analyzer | 10/28/2016 | Annual | 10/28/2017 | US46470561 |
| Amplifier Research | 15S1G6 | Amplifier | CBT | N/A | CBT | 433971 |
| Anritsu | MA24106A | USB Power Sensor | 6/2/2016 | Annual | 6/2/2017 | 1231535 |
| Anritsu | MA24106A | USB Power Sensor | 6/2/2016 | Annual | 6/2/2017 | 1231538 |
| Anritsu | MA2411B | Pulse Power Sensor | 8/18/2016 | Annual | 8/18/2017 | 1126066 |
| Anritsu | MA2411B | Pulse Power Sensor | 8/18/2016 | Annual | 8/18/2017 | 1207470 |
| Anritsu | ML2495A | Power Meter | 10/16/2015 | Biennial | 10/16/2017 | 941001 |
| Anritsu | ML2495A | Power Meter | 10/16/2015 | Biennial | 10/16/2017 | 1039008 |
| Anritsu | MT8820C | Radio Communication Analyzer | 9/15/2016 | Annual | 9/15/2017 | 6200901190 |
| Anritsu | MT8820C | Radio Communication Analyzer | 11/4/2016 | Annual | 11/4/2017 | 6201144418 |
| COMTech | AR85729-5 | Solid State Amplifier | CBT | N/A | CBT | M1S5A00-009 |
| Control Company | 4040 | Digital Thermometer | 3/18/2015 | Biennial | 3/18/2017 | 150194895 |
| Control Company | 4352 | Ultra Long Stem Thermometer | 3/8/2016 | Biennial | 3/8/2018 | 160261694 |
| Keysight | 772D | Dual Directional Coupler | CBT | N/A | CBT | MY52180215 |
| MCL | BW-N6W5+ | 6dB Attenuator | CBT | N/A | CBT | 1139 |
| MiniCircuits | SLP-2400+ | Low Pass Filter | CBT | N/A | CBT | R8979500903 |
| MiniCircuits | VLF-6000+ | Low Pass Filter | CBT | N/A | CBT | N/A |
| Mini-Circuits | BW-N20W5 | Power Attenuator | CBT | N/A | CBT | 1226 |
| Mini-Circuits | BW-N20W5+ | DC to 18 GHz Precision Fixed 20 dB Attenuator | CBT | N/A | CBT | N/A |
| Mini-Circuits | NLP-1200+ | Low Pass Filter DC to 1000 MHz | CBT | N/A | CBT | N/A |
| Mini-Circuits | NLP-2950+ | Low Pass Filter DC to 2700 MHz | CBT | N/A | CBT | N/A |
| Mitutoyo | CD-6"CSX | Digital Caliper | 3/2/2016 | Biennial | 3/2/2018 | 13264162 |
| Narda | 4014C-6 | 4 - 8 GHz SMA 6 dB Directional Coupler | CBT | N/A | CBT | N/A |
| Narda | 4772-3 | Attenuator (3dB) | CBT | N/A | CBT | 9406 |
| Narda | BW-S3W2 | Attenuator (3dB) | CBT | N/A | CBT | 120 |
| Pasternack | NC-100 | Torque Wrench | 11/6/2015 | Biennial | 11/6/2017 | N/A |
| Pasternack | PE2208-6 | Bidirectional Coupler | CBT | N/A | CBT | N/A |
| Pasternack | PE2209-10 | Bidirectional Coupler | CBT | N/A | CBT | N/A |
| Rohde & Schwarz | CMU200 | Base Station Simulator | 3/29/2016 | Annual | 3/29/2017 | 836371/0079 |
| Rohde & Schwarz | CMW500 | Radio Communication Tester | 10/20/2016 | Annual | 10/20/2017 | 100976 |
| Rohde & Schwarz | CMW500 | Radio Communication Tester | 4/13/2016 | Annual | 4/13/2017 | 140148 |
| Seekonk | NC-100 | Torque Wrench (8" lb) | 9/1/2016 | Biennial | 9/1/2018 | 21053 |
| SPEAG | D750V3 | 750 MHz SAR Dipole | 7/13/2016 | Annual | 7/13/2017 | 1161 |
| SPEAG | D835V2 | 835 MHz SAR Dipole | 7/13/2016 | Annual | 7/13/2017 | 4d047 |
| SPEAG | D1750V2 | 1750 MHz SAR Dipole | 7/14/2016 | Annual | 7/14/2017 | 1150 |
| SPEAG | D1900V2 | 1900 MHz SAR Dipole | 7/8/2016 | Annual | 7/8/2017 | 5d080 |
| SPEAG | D2450V2 | 2450 MHz SAR Dipole | 8/18/2016 | Annual | 8/18/2017 | 719 |
| SPEAG | D2450V2 | 2450 MHz SAR Dipole | 7/25/2016 | Annual | 7/25/2017 | 981 |
| SPEAG | D5GHzV2 | 5 GHz SAR Dipole | 8/2/2016 | Annual | 8/2/2017 | 1237 |
| SPEAG | DAE4 | Dasy Data Acquisition Electronics | 5/11/2016 | Annual | 5/11/2017 | 859 |
| SPEAG | DAE4 | Dasy Data Acquisition Electronics | 2/18/2016 | Annual | 2/18/2017 | 1272 |
| SPEAG | DAE4 | Dasy Data Acquisition Electronics | 7/12/2016 | Annual | 7/12/2017 | 1322 |
| SPEAG | DAE4 | Dasy Data Acquisition Electronics | 3/14/2016 | Annual | 3/14/2017 | 1368 |
| SPEAG | DAE4 | Dasy Data Acquisition Electronics | 4/14/2016 | Annual | 4/14/2017 | 1407 |
| SPEAG | DAE4 | Dasy Data Acquisition Electronics | 1/15/2016 | Annual | 1/15/2017 | 1466 |
| SPEAG | DAK-3.5 | Dielectric Assessment Kit | 5/10/2016 | Annual | 5/10/2017 | 1070 |
| SPEAG | ES3DV2 | SAR Probe | 7/19/2016 | Annual | 7/19/2017 | 3022 |
| SPEAG | ES3DV3 | SAR Probe | 3/18/2016 | Annual | 3/18/2017 | 3319 |
| SPEAG | EX3DV4 | SAR Probe | 2/22/2016 | Annual | 2/22/2017 | 3914 |
| SPEAG | EX3DV4 | SAR Probe | 4/19/2016 | Annual | 4/19/2017 | 7406 |
| SPEAG | EX3DV4 | SAR Probe | 5/17/2016 | Annual | 5/17/2017 | 7409 |
| SPEAG | EX3DV4 | SAR Probe | 7/25/2016 | Annual | 7/25/2017 | 7410 |

Note:

1. CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.
2. Each equipment was used solely within its calibration period.

# 14 MEASUREMENT UNCERTAINTIES

| a | c | d | e= f(d,k) | f | g | h = c x f/e | i = c x g/e | k |
|---|---|---|---|---|---|---|---|---|
| **Uncertainty Component** | **Tol. (± %)** | **Prob. Dist.** | **Div.** | **$c_i$ 1gm** | **$c_i$ 10 gms** | **1gm $u_i$ (± %)** | **10gms $u_i$ (± %)** | **$v_i$** |
| **Measurement System** | | | | | | | | |
| Probe Calibration | 6.55 | N | 1 | 1.0 | 1.0 | 6.6 | 6.6 | ∞ |
| Axial Isotropy | 0.25 | N | 1 | 0.7 | 0.7 | 0.2 | 0.2 | ∞ |
| Hemishperical Isotropy | 1.3 | N | 1 | 0.7 | 0.7 | 0.9 | 0.9 | ∞ |
| Boundary Effect | 2.0 | R | 1.73 | 1.0 | 1.0 | 1.2 | 1.2 | ∞ |
| Linearity | 0.3 | N | 1 | 1.0 | 1.0 | 0.3 | 0.3 | ∞ |
| System Detection Limits | 0.25 | R | 1.73 | 1.0 | 1.0 | 0.1 | 0.1 | ∞ |
| Readout Electronics | 0.3 | N | 1 | 1.0 | 1.0 | 0.3 | 0.3 | ∞ |
| Response Time | 0.8 | R | 1.73 | 1.0 | 1.0 | 0.5 | 0.5 | ∞ |
| Integration Time | 2.6 | R | 1.73 | 1.0 | 1.0 | 1.5 | 1.5 | ∞ |
| RF Ambient Conditions - Noise | 3.0 | R | 1.73 | 1.0 | 1.0 | 1.7 | 1.7 | ∞ |
| RF Ambient Conditions - Reflections | 3.0 | R | 1.73 | 1.0 | 1.0 | 1.7 | 1.7 | ∞ |
| Probe Positioner Mechanical Tolerance | 0.4 | R | 1.73 | 1.0 | 1.0 | 0.2 | 0.2 | ∞ |
| Probe Positioning w/ respect to Phantom | 6.7 | R | 1.73 | 1.0 | 1.0 | 3.9 | 3.9 | ∞ |
| Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation | 4.0 | R | 1.73 | 1.0 | 1.0 | 2.3 | 2.3 | ∞ |
| **Test Sample Related** | | | | | | | | |
| Test Sample Positioning | 2.7 | N | 1 | 1.0 | 1.0 | 2.7 | 2.7 | 35 |
| Device Holder Uncertainty | 1.67 | N | 1 | 1.0 | 1.0 | 1.7 | 1.7 | 5 |
| Output Power Variation - SAR drift measurement | 5.0 | R | 1.73 | 1.0 | 1.0 | 2.9 | 2.9 | ∞ |
| SAR Scaling | 0.0 | R | 1.73 | 1.0 | 1.0 | 0.0 | 0.0 | ∞ |
| **Phantom & Tissue Parameters** | | | | | | | | |
| Phantom Uncertainty (Shape & Thickness tolerances) | 7.6 | R | 1.73 | 1.0 | 1.0 | 4.4 | 4.4 | ∞ |
| Liquid Conductivity - measurement uncertainty | 4.2 | N | 1 | 0.78 | 0.71 | 3.3 | 3.0 | 10 |
| Liquid Permittivity - measurement uncertainty | 4.1 | N | 1 | 0.23 | 0.26 | 1.0 | 1.1 | 10 |
| Liquid Conductivity - Temperature Uncertainty | 3.4 | R | 1.73 | 0.78 | 0.71 | 1.5 | 1.4 | ∞ |
| Liquid Permittivity - Temperature Unceritainty | 0.6 | R | 1.73 | 0.23 | 0.26 | 0.1 | 0.1 | ∞ |
| Liquid Conductivity - deviation from target values | 5.0 | R | 1.73 | 0.64 | 0.43 | 1.8 | 1.2 | ∞ |
| Liquid Permittivity - deviation from target values | 5.0 | R | 1.73 | 0.60 | 0.49 | 1.7 | 1.4 | ∞ |
| **Combined Standard Uncertainty (k=1)** | | RSS | | | | 11.5 | 11.3 | 60 |
| **Expanded Uncertainty** (95% CONFIDENCE LEVEL) | | k=2 | | | | 23.0 | 22.6 | |

# 15 CONCLUSION

## 15.1 Measurement Conclusion

The SAR evaluation indicates that the EUT complies with the RF radiation exposure limits of the FCC and Innovation, Science, and Economic Development Canada, with respect to all parameters subject to this test. These measurements were taken to simulate the RF effects of RF exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The results and statements relate only to the item(s) tested.

Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables. [3]

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# APPENDIX A: SAR TEST DATA

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: A3LSMT825N0; Type: Portable Tablet; Serial: 09999**

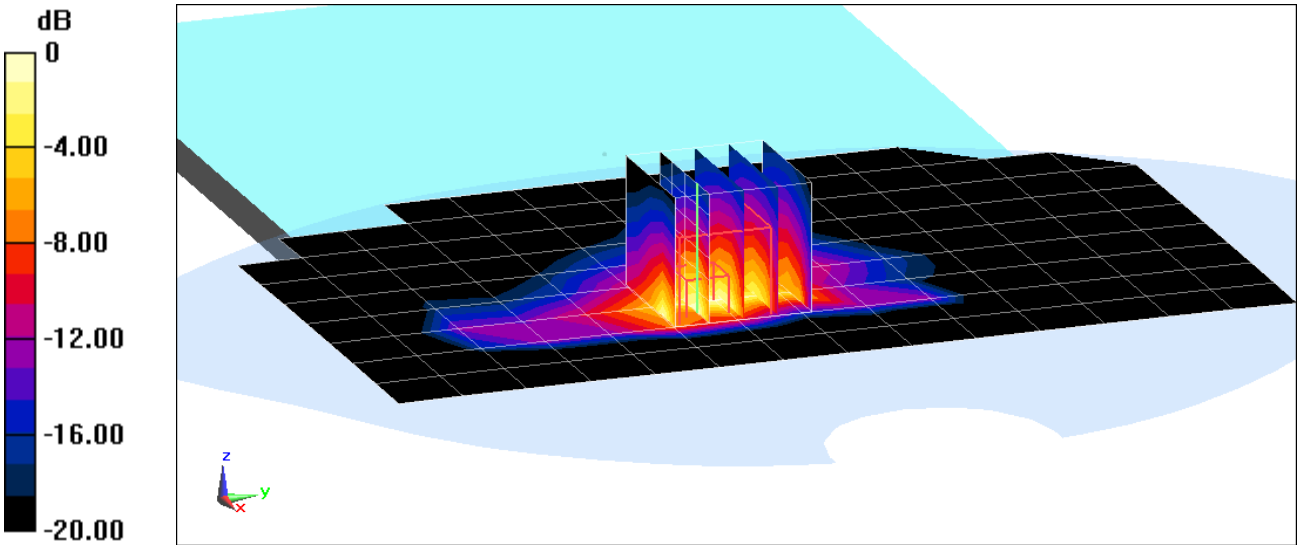
Communication System: UID 0, GSM GPRS; 4 Tx slots; Frequency: 1850.2 MHz; Duty Cycle: 1:2.076
Medium: 1900 Body; Medium parameters used (interpolated):
f = 1850.2 MHz; $\sigma$ = 1.522 S/m; $\varepsilon_r$ = 52.165; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 12-14-2016; Ambient Temp: 23.1°C; Tissue Temp: 22.3°C

Probe: EX3DV4 - SN7409; ConvF(7.47, 7.47, 7.47); Calibrated: 5/17/2016;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/11/2016
Phantom: SAM Left; Type: QD000P40CC; Serial: TP: 1375
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

## Mode: GPRS 1900, Body SAR, Back Side, Low.ch, 4 Tx Slots

**Area Scan (10x15x1):** Measurement grid: dx=15mm, dy=15mm
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 22.74 V/m; Power Drift = -0.10 dB
Peak SAR (extrapolated) = 2.08 W/kg
**SAR(1 g) = 0.930 W/kg**




0 dB = 1.56 W/kg = 1.93 dBW/kg

**DUT: A3LSMT825N0; Type: Portable Tablet; Serial: 09999**

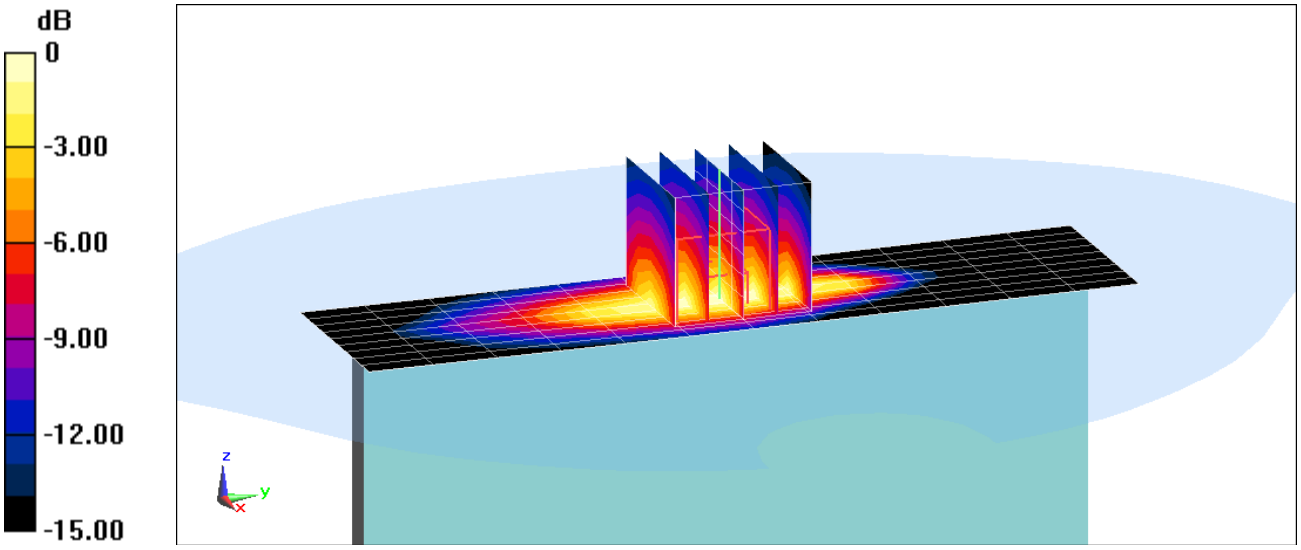
Communication System: UID 0, UMTS; Frequency: 846.6 MHz; Duty Cycle: 1:1
Medium: 835 Body; Medium parameters used (interpolated):
f = 846.6 MHz; $\sigma$ = 1.006 S/m; $\varepsilon_r$ = 53.957; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 12-12-2016; Ambient Temp: 21.2°C; Tissue Temp: 21.8°C

Probe: ES3DV3 - SN3319; ConvF(6.04, 6.04, 6.04); Calibrated: 3/18/2016;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 3/14/2016
Phantom: SAM with CRP (Left); Type: SAM; Serial: 1715
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Mode: UMTS 850, Body SAR, Top Edge, High.ch**

**Area Scan (10x13x1):** Measurement grid: dx=5mm, dy=15mm
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 29.98 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 1.56 W/kg
**SAR(1 g) = 0.763 W/kg**




0 dB = 1.03 W/kg = 0.13 dBW/kg

**DUT: A3LSMT825N0; Type: Portable Tablet; Serial: 09999**

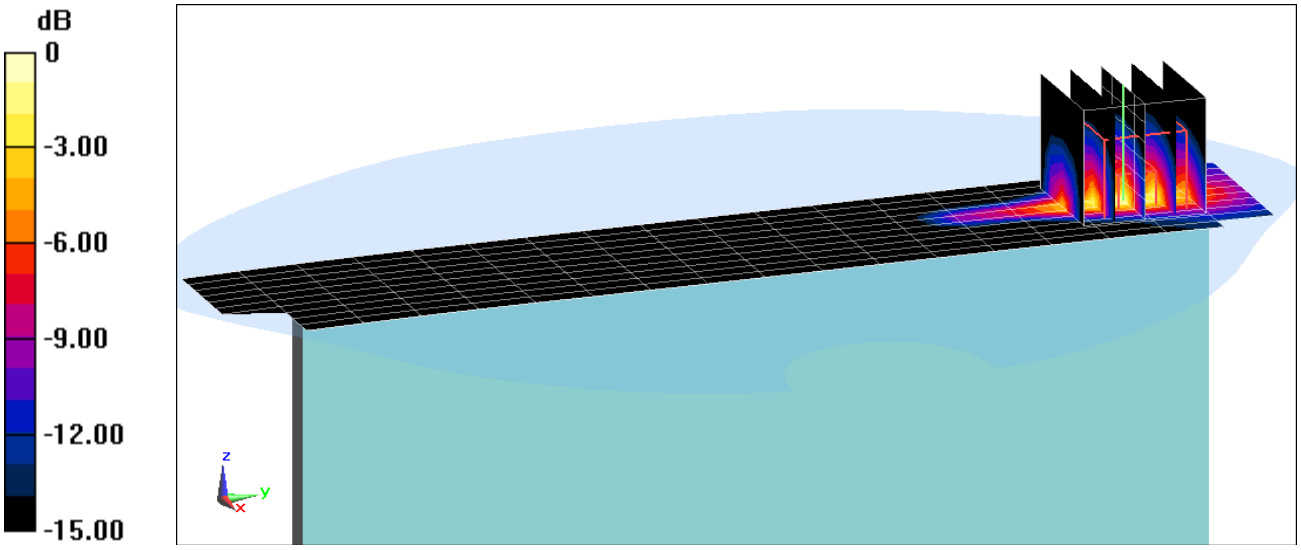
Communication System: UID 0, UMTS; Frequency: 1907.6 MHz; Duty Cycle: 1:1
Medium: 1900 Body; Medium parameters used (interpolated):
f = 1907.6 MHz; $\sigma$ = 1.585 S/m; $\varepsilon_r$ = 52.023; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 12-14-2016; Ambient Temp: 23.1°C; Tissue Temp: 22.3°C

Probe: EX3DV4 - SN7409; ConvF(7.47, 7.47, 7.47); Calibrated: 5/17/2016;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/11/2016
Phantom: SAM Left; Type: QD000P40CC; Serial: TP: 1375
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Mode: UMTS 1900, Body SAR, Left Edge, High.ch**

**Area Scan (11x19x1):** Measurement grid: dx=5mm, dy=15mm
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 24.34 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 2.12 W/kg
**SAR(1 g) = 0.791 W/kg**




0 dB = 1.73 W/kg = 2.38 dBW/kg

**DUT: A3LSMT825N0; Type: Portable Tablet; Serial: 09999**

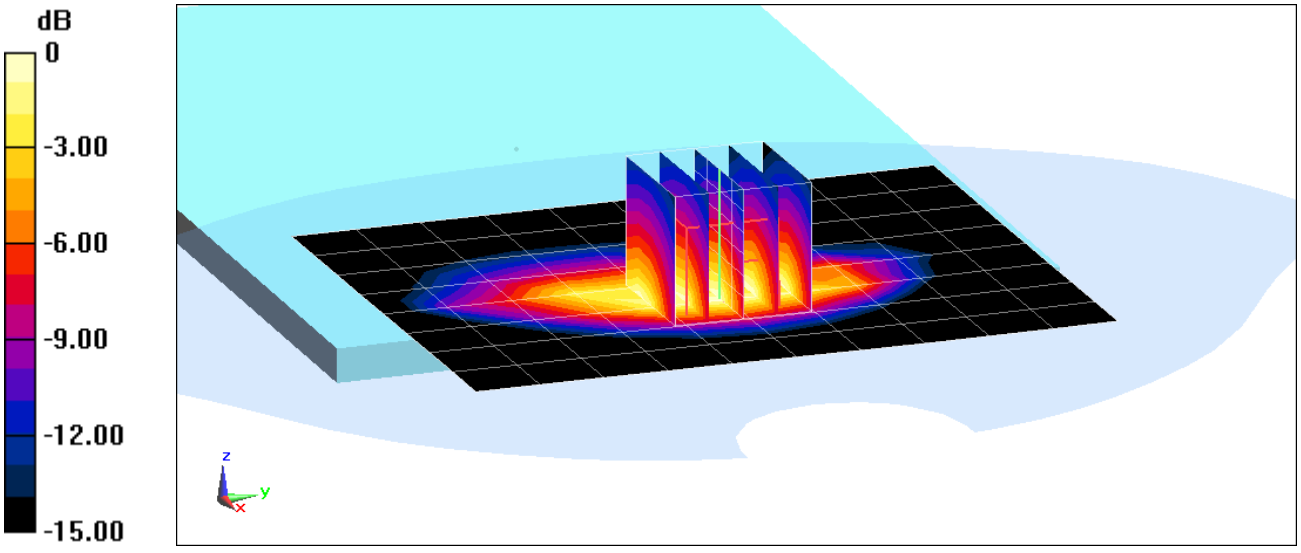
Communication System: UID 0, LTE Band 17; Frequency: 710 MHz; Duty Cycle: 1:1
Medium: 750 Body; Medium parameters used:
f = 710 MHz; $\sigma$ = 0.928 S/m; $\varepsilon_r$ = 56.219; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 12-13-2016; Ambient Temp: 22.3°C; Tissue Temp: 21.3°C

Probe: EX3DV4 - SN7409; ConvF(9.46, 9.46, 9.46); Calibrated: 5/17/2016;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/11/2016
Phantom: SAM Right; Type: QD000P40CD; Serial: TP:7535
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Mode: LTE Band 17, Body SAR, Back Side, Mid.ch, 10 MHz Bandwidth, QPSK, 50 RB, 0 RB Offset**

**Area Scan (9x11x1):** Measurement grid: dx=15mm, dy=15mm
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 31.48 V/m; Power Drift = 0.20 dB
Peak SAR (extrapolated) = 2.04 W/kg
**SAR(1 g) = 0.899 W/kg**




0 dB = 1.30 W/kg = 1.14 dBW/kg

**DUT: A3LSMT825N0; Type: Portable Tablet; Serial: 02212**

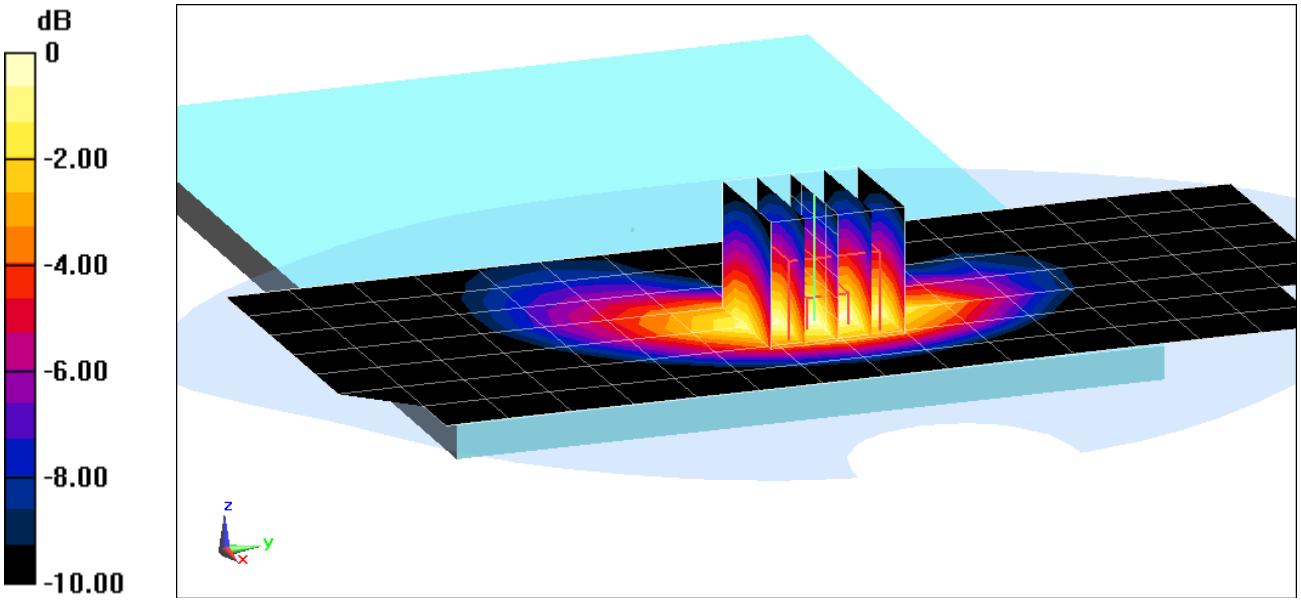
Communication System: UID 0, LTE Band 5 (Cell.); Frequency: 836.5 MHz; Duty Cycle: 1:1
Medium: 835 Body Medium parameters used (interpolated):
f = 836.5 MHz; $\sigma$ = 0.989 S/m; $\varepsilon_r$ = 54.21; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 1.3 cm

Test Date: 02-13-2017; Ambient Temp: 21.6°C; Tissue Temp: 20.6°C

Probe: ES3DV3 - SN3319; ConvF(6.04, 6.04, 6.04); Calibrated: 3/18/2016;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 3/14/2016
Phantom: SAM with CRP (Left); Type: SAM; Serial: 1715
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Mode: LTE Band 5 (Cell.), Body SAR, Back Side, Mid.ch, 10 MHz Bandwidth, QPSK, 1 RB, 25 RB Offset**

**Area Scan (8x17x1):** Measurement grid: dx=15mm, dy=15mm
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 26.74 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 0.956 W/kg
**SAR(1 g) = 0.643 W/kg**




0 dB = 0.747 W/kg = -1.27 dBW/kg

**DUT: A3LSMT825N0; Type: Portable Tablet; Serial: 05260**

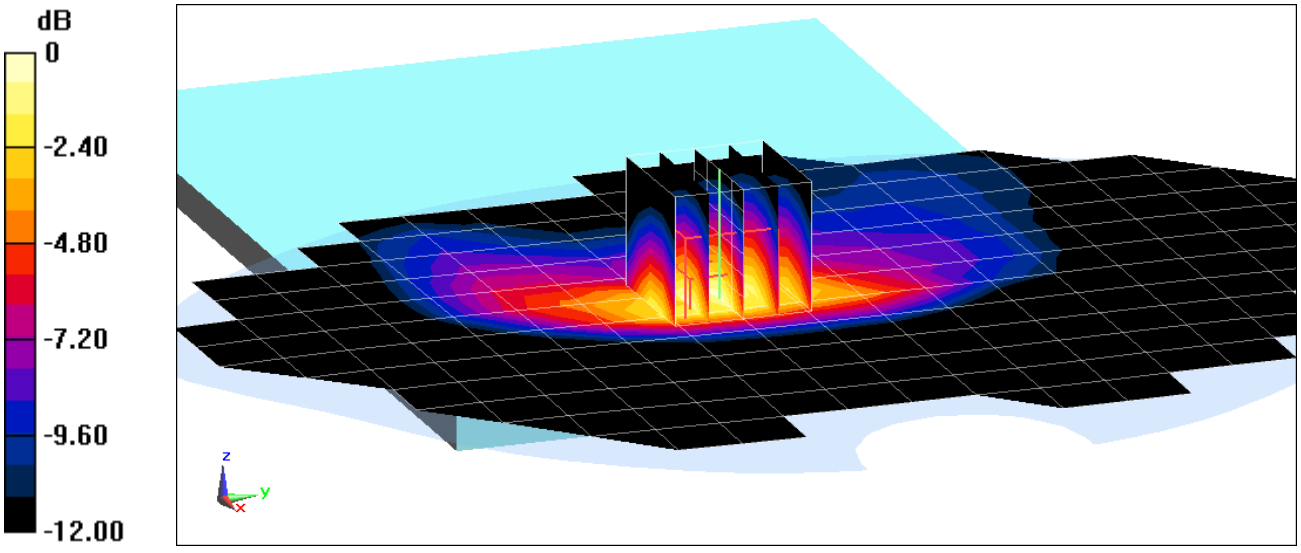
Communication System: UID 0, LTE Band 4 (AWS); Frequency: 1732.5 MHz; Duty Cycle: 1:1
Medium: 1750 Body; Medium parameters used (interpolated):
f = 1732.5 MHz; $\sigma$ = 1.46 S/m; $\varepsilon_r$ = 52.286; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 1.3 cm

Test Date: 12-13-2016; Ambient Temp: 24.5°C; Tissue Temp: 22.5°C

Probe: ES3DV2 - SN3022; ConvF(4.78, 4.78, 4.78); Calibrated: 7/19/2016;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1466; Calibrated: 1/15/2016
Phantom: SAM Main; Type: QD000P40CC; Serial: TP 1114
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Mode: LTE Band 4 (AWS), Body SAR, Back Side, Mid.ch, 20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset**

**Area Scan (15x19x1):** Measurement grid: dx=15mm, dy=15mm
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 27.67 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 1.61 W/kg
**SAR(1 g) = 0.982 W/kg**




0 dB = 1.17 W/kg = 0.68 dBW/kg

**DUT: A3LSMT825N0; Type: Portable Tablet; Serial: 09999**

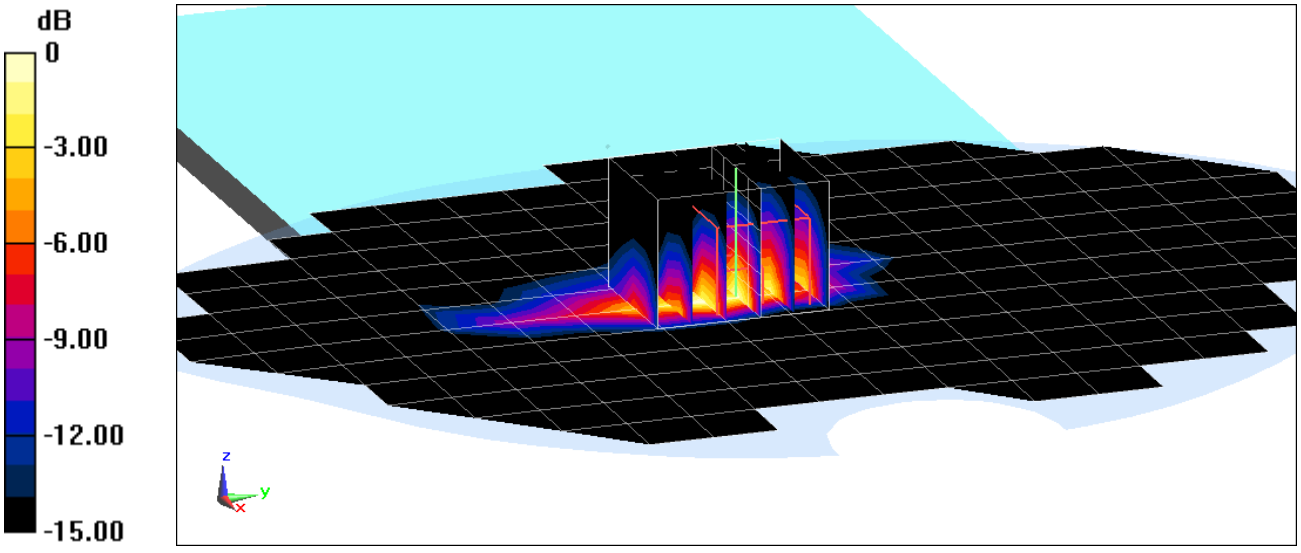
Communication System: UID 0, LTE Band 2 (PCS); Frequency: 1860 MHz; Duty Cycle: 1:1
Medium: 1900 Body; Medium parameters used (interpolated):
f = 1860 MHz; $\sigma$ = 1.533 S/m; $\varepsilon_r$ = 52.147; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 12-14-2016; Ambient Temp: 23.1°C; Tissue Temp: 22.3°C

Probe: EX3DV4 - SN7409; ConvF(7.47, 7.47, 7.47); Calibrated: 5/17/2016;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/11/2016
Phantom: SAM Left; Type: QD000P40CC; Serial: TP: 1375
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Mode: LTE Band 2 (PCS), Body SAR, Back Side, Low.ch, 20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset**

**Area Scan (15x19x1):** Measurement grid: dx=15mm, dy=15mm
**Zoom Scan (5x6x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 21.53 V/m; Power Drift = -0.17 dB
Peak SAR (extrapolated) = 1.53 W/kg
**SAR(1 g) = 0.685 W/kg**




0 dB = 1.23 W/kg = 0.90 dBW/kg

**DUT: A3LSMT825N0; Type: Portable Tablet; Serial: 05260**

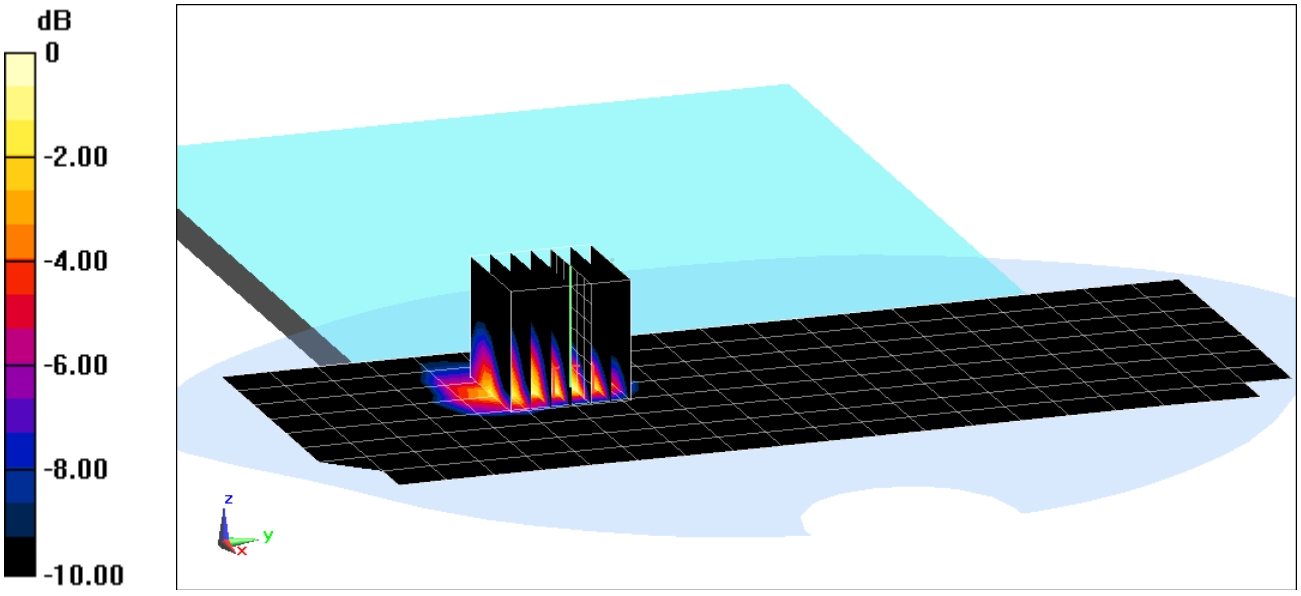
Communication System: UID 0, IEEE 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium: 2450 Body; Medium parameters used (interpolated):
f = 2437 MHz; $\sigma$ = 1.998 S/m; $\varepsilon_r$ = 51.907; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 01-24-2017; Ambient Temp: 22.4°C; Tissue Temp: 22.7°C

Probe: ES3DV3 - SN3319; ConvF(4.2, 4.2, 4.2); Calibrated: 3/18/2016;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 3/14/2016
Phantom: SAM with CRP (Left); Type: SAM; Serial: 1715
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Mode: IEEE 802.11b, Antenna 1, 22 MHz Bandwidth, Body SAR, Back Side, Ch 6, 1 Mbps**

**Area Scan (9x21x1):** Measurement grid: dx=12mm, dy=12mm
**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 22.46 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 2.36 W/kg
**SAR(1 g) = 0.855 W/kg**




0 dB = 1.14 W/kg = 0.57 dBW/kg

**DUT: A3LSMT825N0; Type: Portable Tablet; Serial: 05211**

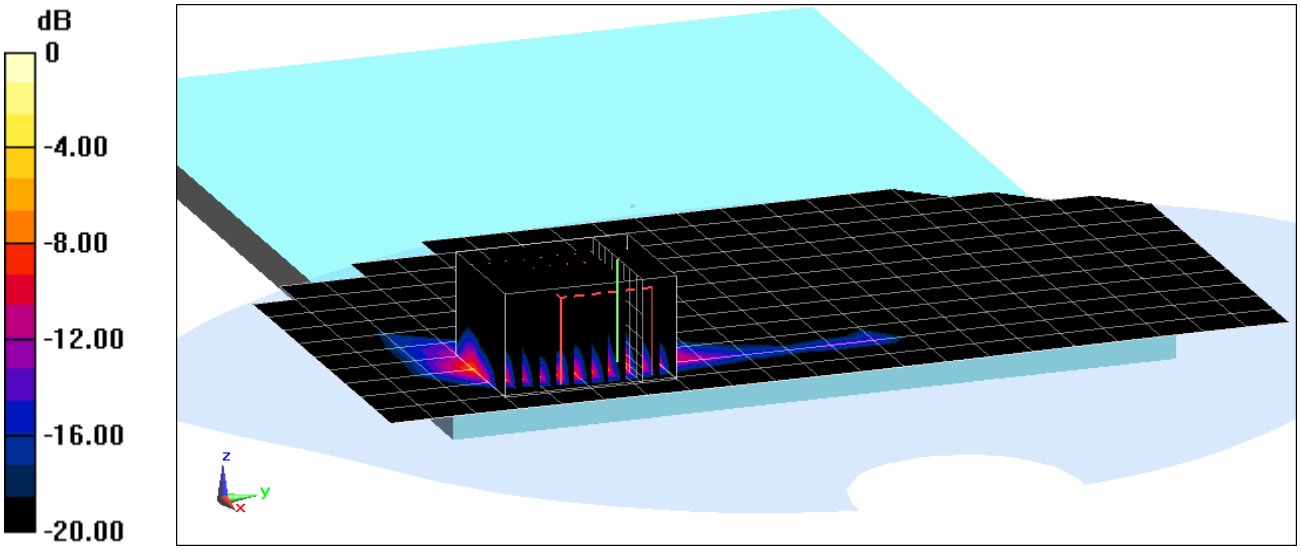
Communication System: UID 0, IEEE 802.11ac; Frequency: 5530 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used (interpolated):
f = 5530 MHz; $\sigma$ = 5.877 S/m; $\varepsilon_r$ = 46.563; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 12-26-2016; Ambient Temp: 20.9°C; Tissue Temp: 20.1°C

Probe: EX3DV4 - SN3914; ConvF(3.63, 3.63, 3.63); Calibrated: 2/22/2016;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 2/18/2016
Phantom: SAM with CRP v5.0 Front; Type: QD000P40CD; Serial: 1646
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Mode: IEEE 802.11ac, Antenna 1, U-NII-2C, 80 MHz Bandwidth, Body SAR, Back Side, Ch 106, 29.3 Mbps**

**Area Scan (14x22x1):** Measurement grid: dx=10mm, dy=10mm
**Zoom Scan (9x11x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Reference Value = 10.38 V/m; Power Drift = -0.14 dB
Peak SAR (extrapolated) = 7.29 W/kg
**SAR(1 g) = 0.900 W/kg**




0 dB = 4.26 W/kg = 6.29 dBW/kg

**DUT: A3LSMT825N0; Type: Portable Tablet; Serial: 02220**

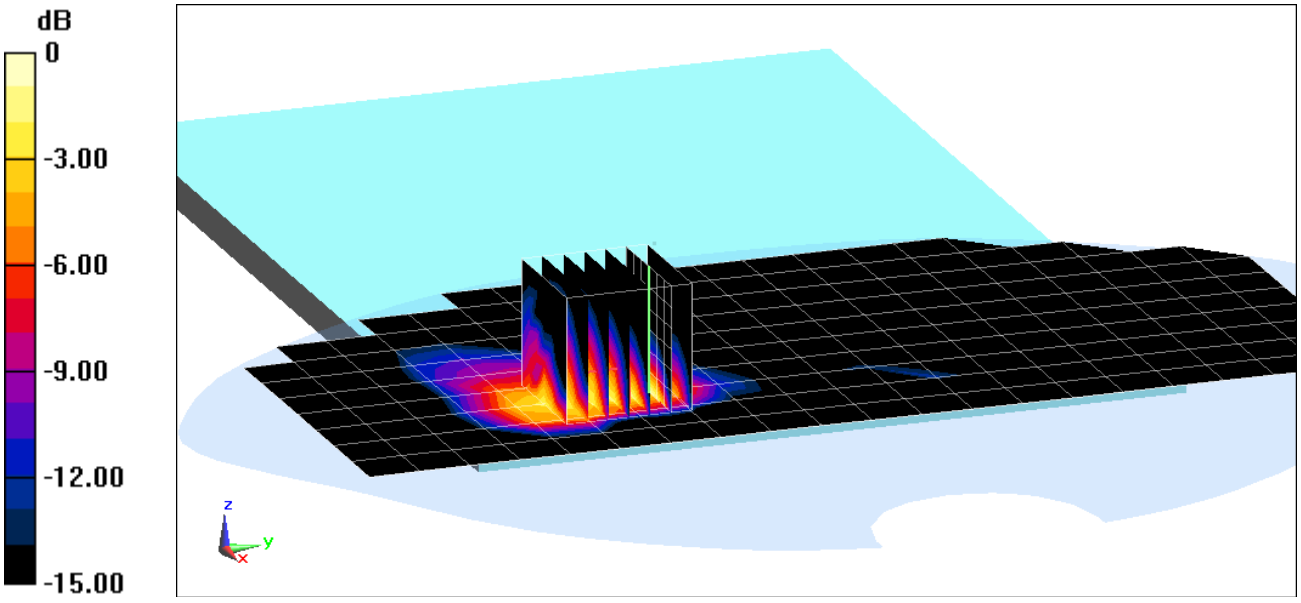
Communication System: UID 0, Bluetooth; Frequency: 2441 MHz; Duty Cycle: 1:1.294
Medium: 2450 Body Medium parameters used (interpolated):
f = 2441 MHz; $\sigma$ = 2.024 S/m; $\varepsilon_r$ = 50.868; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 02-06-2017; Ambient Temp: 22.2°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN7406; ConvF(7.24, 7.24, 7.24); Calibrated: 4/19/2016;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1407; Calibrated: 4/14/2016
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Mode: Bluetooth, Body SAR, Back Side, Ch 39, 1 Mbps**

**Area Scan (13x21x1):** Measurement grid: dx=12mm, dy=12mm
**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 11.55 V/m; Power Drift = -0.12 dB
Peak SAR (extrapolated) = 0.703 W/kg
**SAR(1 g) = 0.237 W/kg**




0 dB = 0.472 W/kg = -3.26 dBW/kg

# APPENDIX B: SYSTEM VERIFICATION

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 750 MHz; Type: D750V3; Serial: 1161**

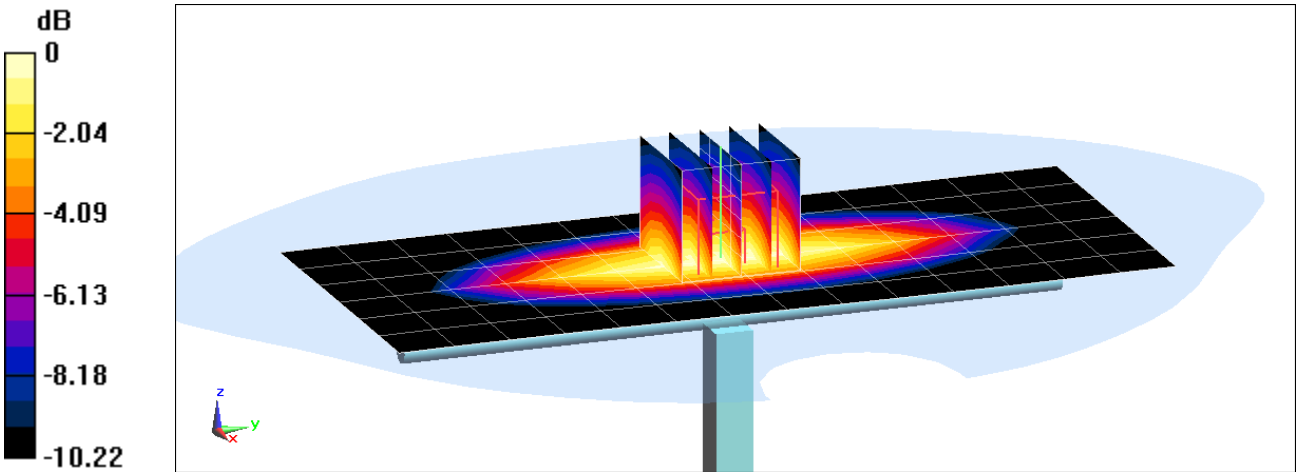
Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1
Medium: 750 Body; Medium parameters used (interpolated):
$f = 750$ MHz; $\sigma = 0.965$ S/m; $\varepsilon_r = 55.834$; $\rho = 1000$ kg/m$^3$
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 12-13-2016; Ambient Temp: 22.3°C; Tissue Temp: 21.3°C

Probe: EX3DV4 - SN7409; ConvF(9.46, 9.46, 9.46); Calibrated: 5/17/2016;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/11/2016
Phantom: SAM Right; Type: QD000P40CD; Serial: TP:7535
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

## 750 MHz System Verification at 23.0 dBm (200 mW)

**Area Scan (7x15x1):** Measurement grid: dx=15mm, dy=15mm
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 2.51 W/kg
**SAR(1 g) = 1.66 W/kg**
Deviation(1 g) = -1.54%




0 dB = 2.22 W/kg = 3.46 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d047**

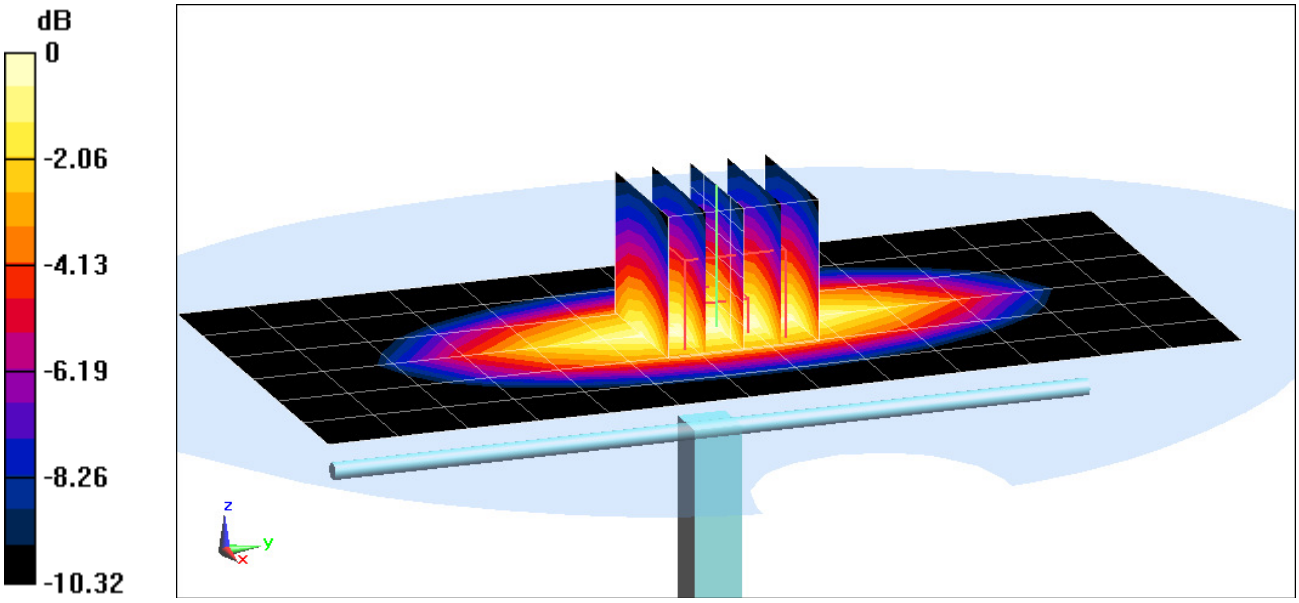
Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: 835 Body; Medium parameters used:
f = 835 MHz; $\sigma$ = 0.988 S/m; $\varepsilon_r$ = 54.224; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 02-13-2017; Ambient Temp: 21.6°C; Tissue Temp: 20.6°C

Probe: ES3DV3 - SN3319; ConvF(6.04, 6.04, 6.04); Calibrated: 3/18/2016;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 3/14/2016
Phantom: SAM with CRP (Left); Type: SAM; Serial: 1715
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

## 835 MHz System Verification at 23.0 dBm (200 mW)

**Area Scan (7x14x1):** Measurement grid: dx=15mm, dy=15mm
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 3.02 W/kg
**SAR(1 g) = 2.06 W/kg**
Deviation(1 g) = 7.63%




0 dB = 2.41 W/kg = 3.82 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: 1150**

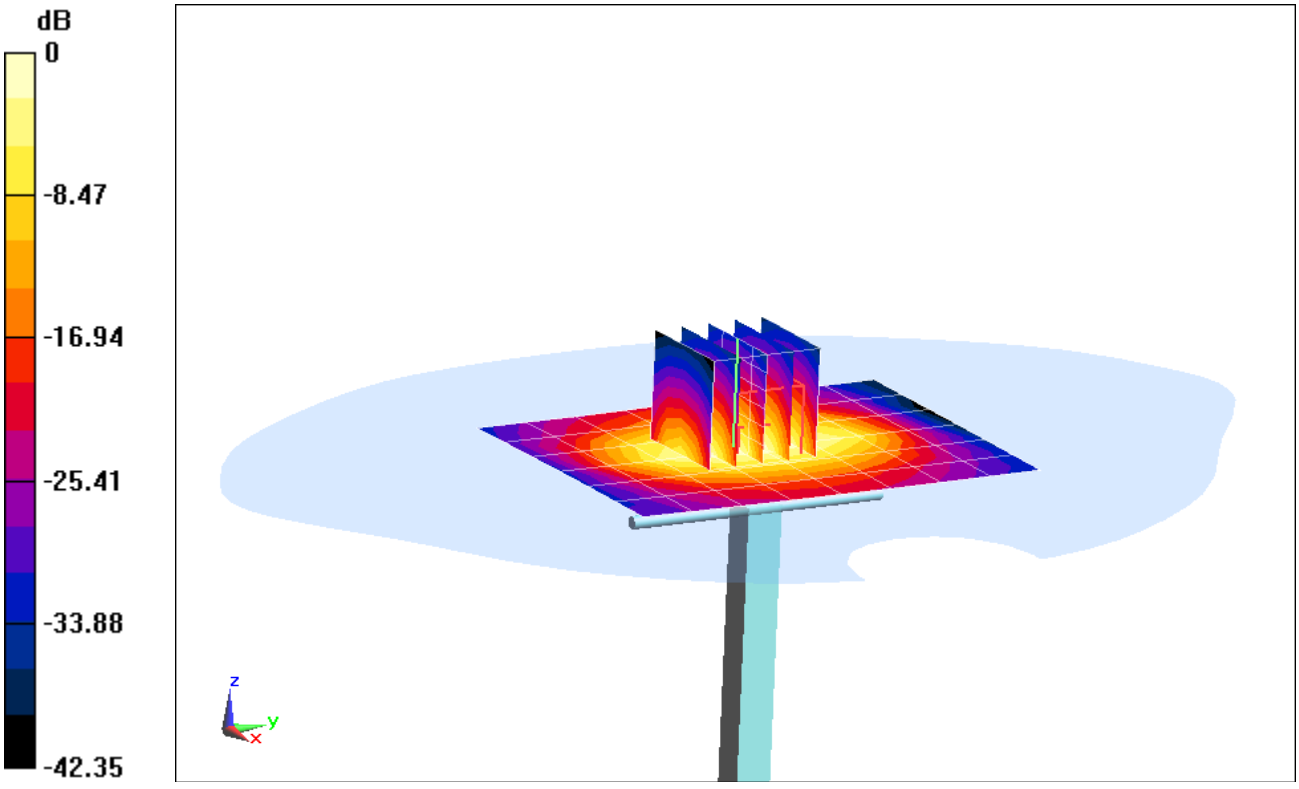
Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1
Medium: 1750 Body; Medium parameters used:
f = 1750 MHz; $\sigma$ = 1.481 S/m; $\varepsilon_r$ = 52.208; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 12-13-2016; Ambient Temp: 24.5°C; Tissue Temp: 22.5°C

Probe: ES3DV2 - SN3022; ConvF(4.78, 4.78, 4.78); Calibrated: 7/19/2016;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1466; Calibrated: 1/15/2016
Phantom: SAM Main; Type: QD000P40CC; Serial: TP 1114
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**1750 MHz System Verification at 20.0 dBm (100 mW)**

**Area Scan (7x9x1):** Measurement grid: dx=15mm, dy=15mm
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 6.44 W/kg
**SAR(1 g) = 3.69 W/kg**
Deviation(1 g) = 1.10%




0 dB = 4.33 W/kg = 6.36 dBW/kg

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d080**

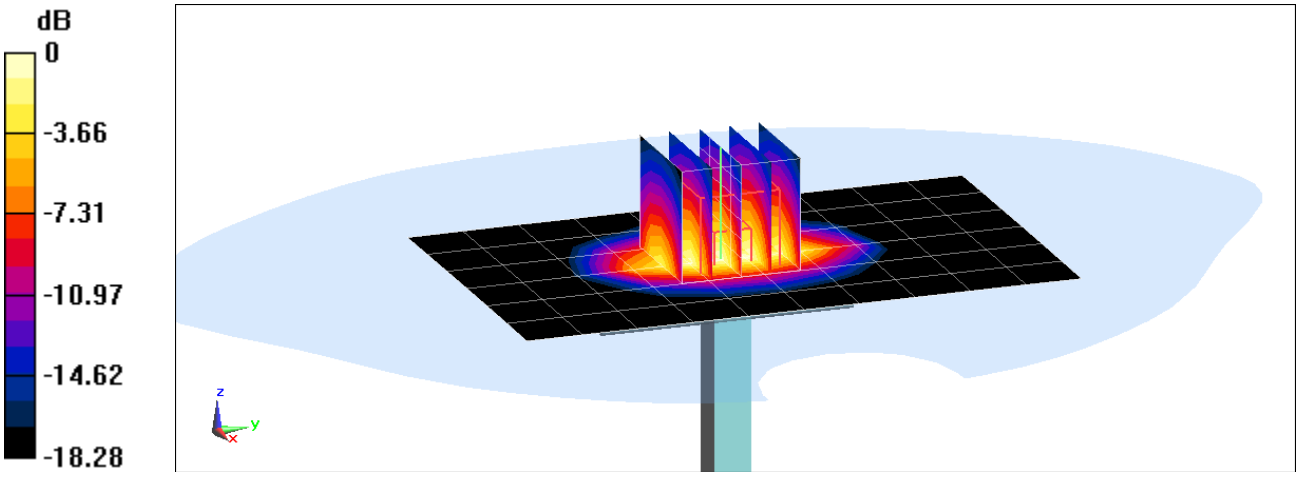
Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Body; Medium parameters used (interpolated):
f = 1900 MHz; $\sigma$ = 1.577 S/m; $\varepsilon_r$ = 52.047; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 12-14-2016; Ambient Temp: 23.1°C; Tissue Temp: 22.3°C

Probe: EX3DV4 - SN7409; ConvF(7.47, 7.47, 7.47); Calibrated: 5/17/2016;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/11/2016
Phantom: SAM Left; Type: QD000P40CC; Serial: TP: 1375
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**1900 MHz System Verification at 20.0 dBm (100 mW)**

**Area Scan (7x11x1):** Measurement grid: dx=15mm, dy=15mm
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 7.26 W/kg
**SAR(1 g) = 3.95 W/kg**
Deviation(1 g) = 1.02%




0 dB = 6.09 W/kg = 7.85 dBW/kg

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 719**

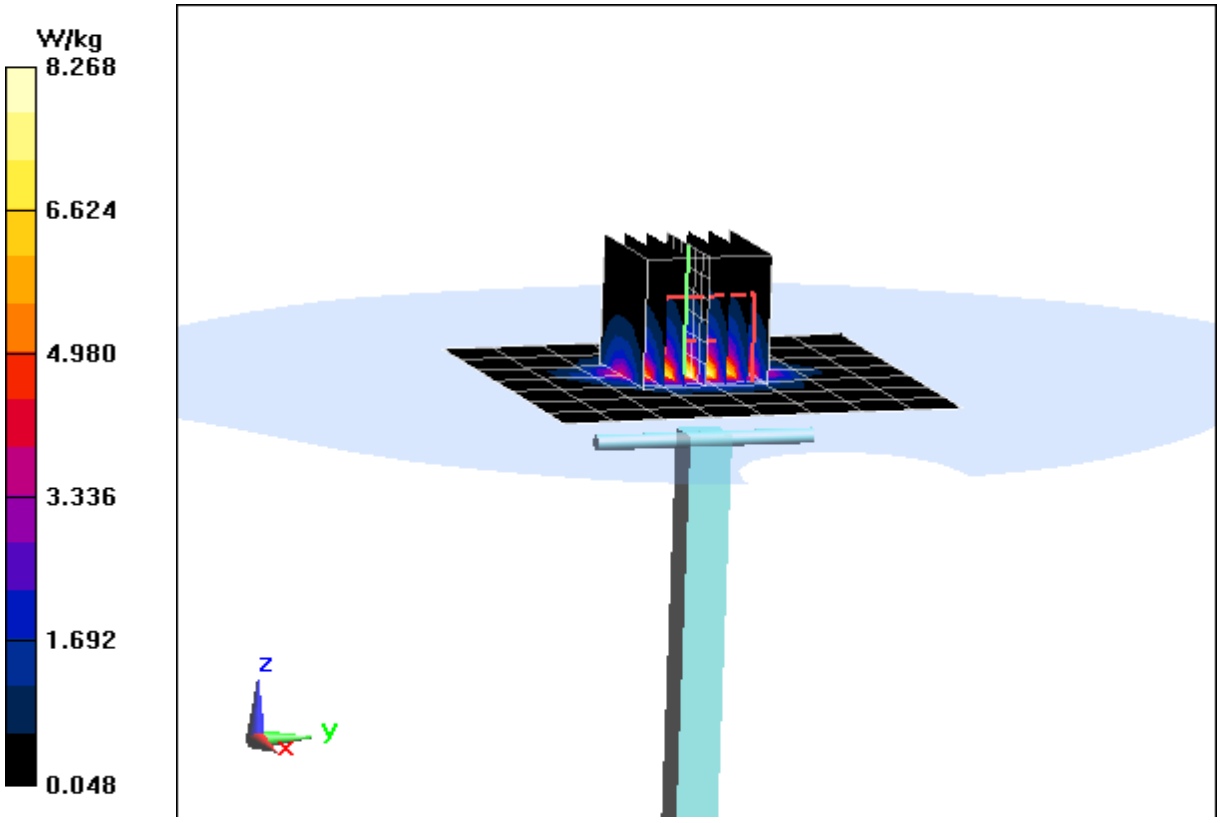
Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: 2450 Body; Medium parameters used:
f = 2450 MHz; $\sigma$ = 1.971 S/m; $\varepsilon_r$ = 52.158; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 12-12-2016; Ambient Temp: 24.0°C; Tissue Temp: 23.3°C

Probe: EX3DV4 - SN7410; ConvF(7.4, 7.4, 7.4); Calibrated: 7/25/2016;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 7/12/2016
Phantom: Sub TWIN SAM; Type: QD000P40CC; Serial: TP-1357
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**2450 MHz System Verification at 20.0 dBm (100 mW)**

**Area Scan (8x9x1):** Measurement grid: dx=12mm, dy=12mm
**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 11.5 W/kg
**SAR(1 g) = 5.01 W/kg**
Deviation(1 g) = -2.72%



**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 981**

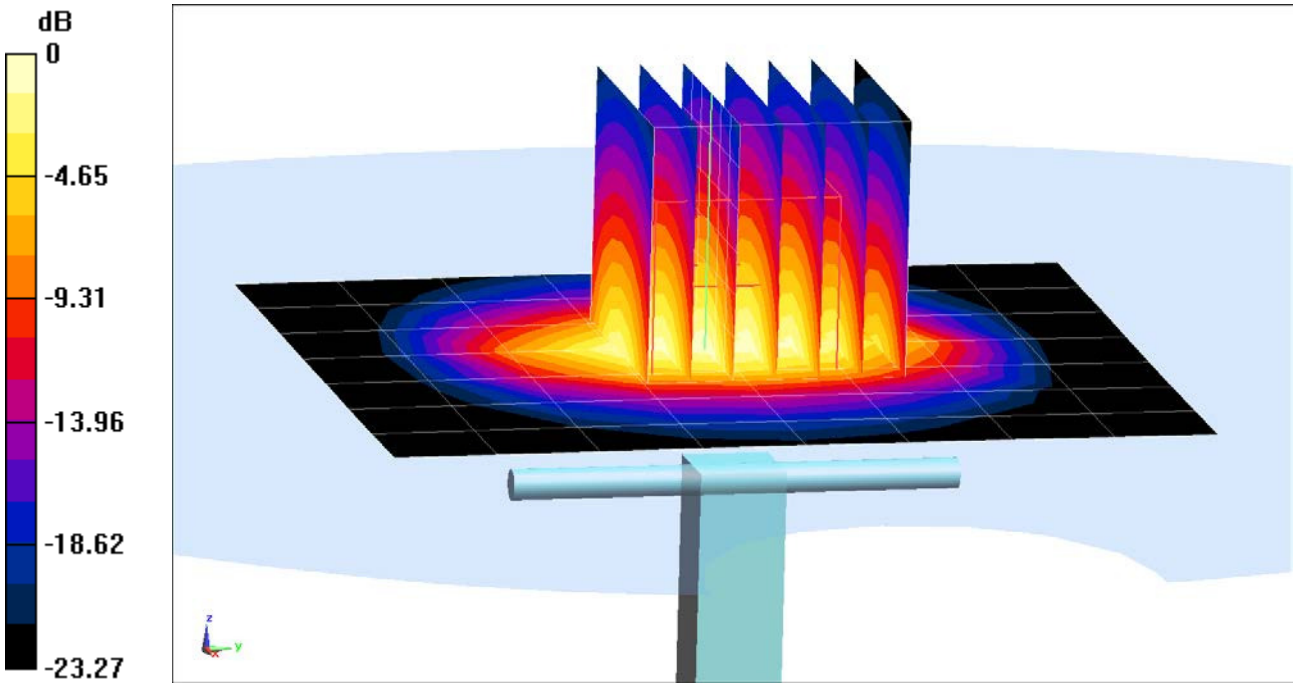
Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: 2450 Body; Medium parameters used:
f = 2450 MHz; $\sigma$ = 2.036 S/m; $\varepsilon_r$ = 50.834; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 02-06-2017; Ambient Temp: 22.2°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN7406; ConvF(7.24, 7.24, 7.24); Calibrated: 4/19/2016;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1407; Calibrated: 4/14/2016
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**2450 MHz System Verification at 20.0 dBm (100 mW)**

**Area Scan (8x9x1):** Measurement grid: dx=12mm, dy=12mm
**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 10.7 W/kg
**SAR(1 g) = 5.07 W/kg**
Deviation(1 g) = -0.20%




0 dB = 8.53 W/kg = 9.31 dBW/kg

**DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1237**

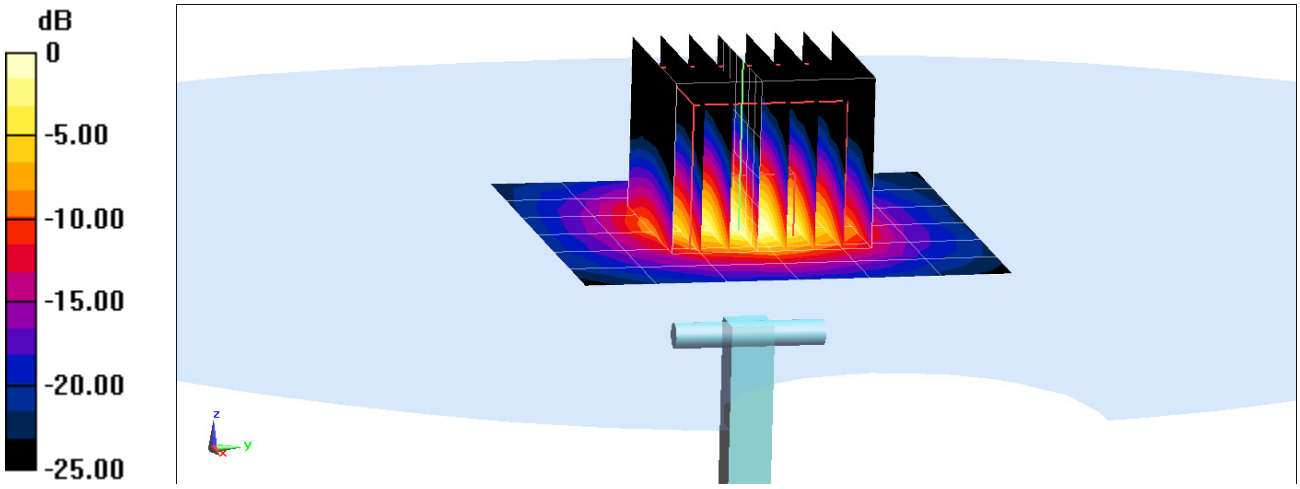
Communication System: UID 0, CW; Frequency: 5250 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body; Medium parameters used (interpolated):
f = 5250 MHz; $\sigma$ = 5.522 S/m; $\varepsilon_r$ = 47.054; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 12-26-2016; Ambient Temp: 20.9°C; Tissue Temp: 20.1°C

Probe: EX3DV4 - SN3914; ConvF(4.32, 4.32, 4.32); Calibrated: 2/22/2016;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 2/18/2016
Phantom: SAM with CRP v5.0 Front; Type: QD000P40CD; Serial: 1646
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**5250 MHz System Verification at 17.0 dBm (50 mW)**

**Area Scan (7x7x1):** Measurement grid: dx=10mm, dy=10mm
**Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Peak SAR (extrapolated) = 14.5 W/kg
**SAR(1 g) = 3.48 W/kg**
Deviation(1 g) = -6.95%




0 dB = 8.16 W/kg = 9.12 dBW/kg

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1237**

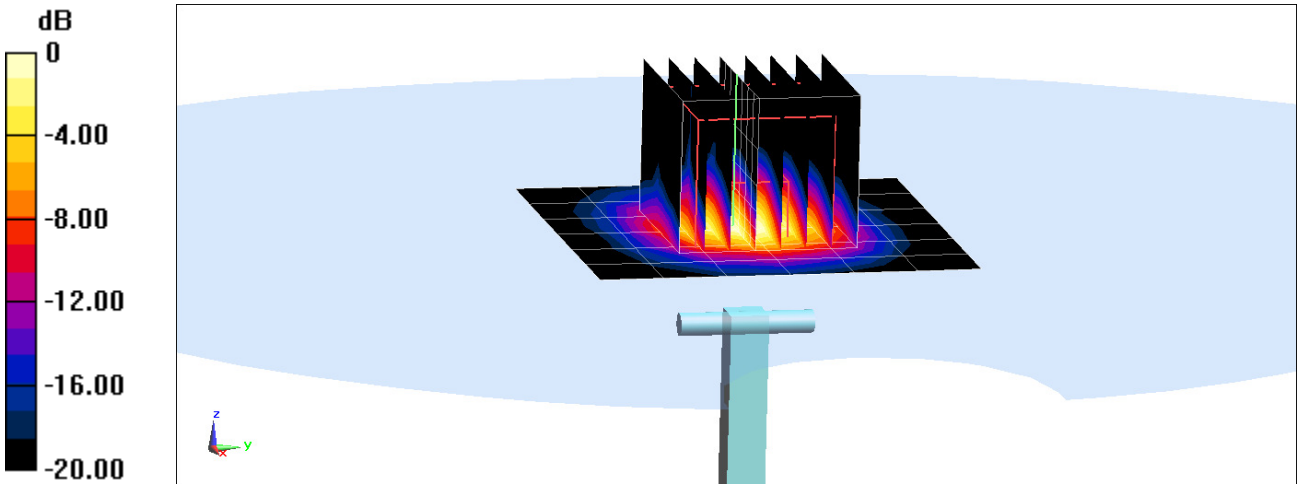
Communication System: UID 0, CW; Frequency: 5600 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body; Medium parameters used:
f = 5600 MHz; $\sigma$ = 5.989 S/m; $\varepsilon_r$ = 46.456; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 12-26-2016; Ambient Temp: 20.9°C; Tissue Temp: 20.1°C

Probe: EX3DV4 - SN3914; ConvF(3.63, 3.63, 3.63); Calibrated: 2/22/2016;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 2/18/2016
Phantom: SAM with CRP v5.0 Front; Type: QD000P40CD; Serial: 1646
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

## 5600 MHz System Verification at 17.0 dBm (50 mW)

**Area Scan (7x7x1):** Measurement grid: dx=10mm, dy=10mm
**Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Peak SAR (extrapolated) = 15.4 W/kg
**SAR(1 g) = 3.59 W/kg**
Deviation(1 g) = -6.75%




0 dB = 8.62 W/kg = 9.36 dBW/kg

**DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1237**

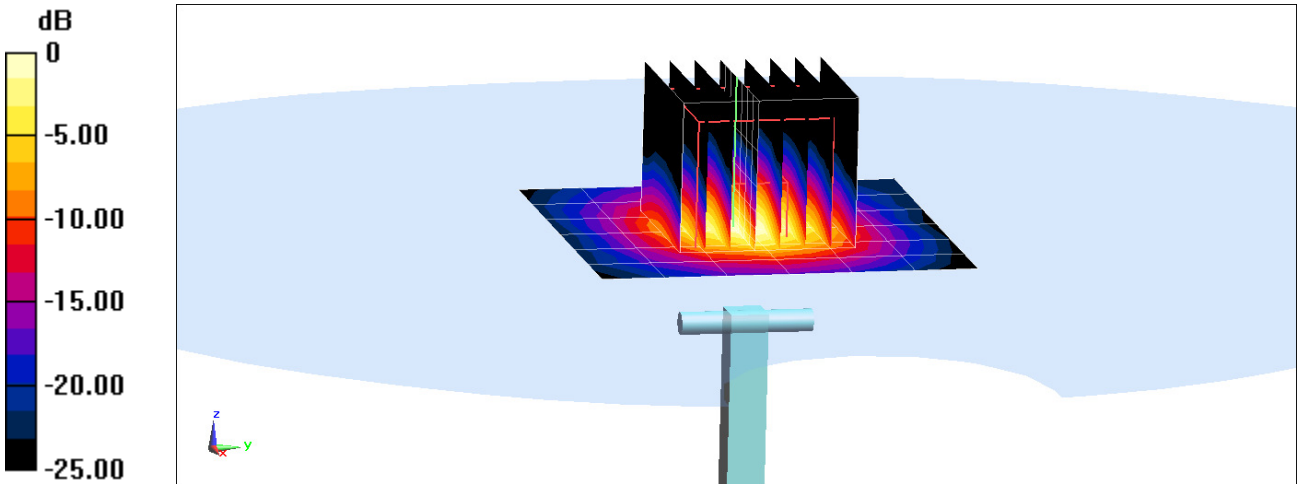
Communication System: UID 0, CW; Frequency: 5750 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body; Medium parameters used (interpolated):
f = 5750 MHz; $\sigma$ = 6.197 S/m; $\varepsilon_r$ = 46.239; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 12-26-2016; Ambient Temp: 20.9°C; Tissue Temp: 20.1°C

Probe: EX3DV4 - SN3914; ConvF(3.86, 3.86, 3.86); Calibrated: 2/22/2016;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 2/18/2016
Phantom: SAM with CRP v5.0 Front; Type: QD000P40CD; Serial: 1646
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**5750 MHz System Verification at 17.0 dBm (50 mW)**

**Area Scan (7x7x1):** Measurement grid: dx=10mm, dy=10mm
**Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Peak SAR (extrapolated) = 15.7 W/kg
**SAR(1 g) = 3.58 W/kg**
Deviation(1 g) = -5.04%




0 dB = 8.56 W/kg = 9.32 dBW/kg

# APPENDIX C: PROBE CALIBRATION

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

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

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

**Accreditation No.: SCS 0108**

**Client** **PC Test**

**Certificate No: D750V3-1161_Jul16**

# CALIBRATION CERTIFICATE

Object D750V3 - SN:1161

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

Calibration date: July 13, 2016

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter NRP | SN: 104778 | 06-Apr-16 (No. 217-02288/02289) | Apr-17 |
| Power sensor NRP-Z91 | SN: 103244 | 06-Apr-16 (No. 217-02288) | Apr-17 |
| Power sensor NRP-Z91 | SN: 103245 | 06-Apr-16 (No. 217-02289) | Apr-17 |
| Reference 20 dB Attenuator | SN: 5058 (20k) | 05-Apr-16 (No. 217-02292) | Apr-17 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 05-Apr-16 (No. 217-02295) | Apr-17 |
| Reference Probe EX3DV4 | SN: 7349 | 15-Jun-16 (No. EX3-7349_Jun16) | Jun-17 |
| DAE4 | SN: 601 | 30-Dec-15 (No. DAE4-601_Dec15) | Dec-16 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Power meter EPM-442A | SN: GB37480704 | 07-Oct-15 (No. 217-02222) | In house check: Oct-16 |
| Power sensor HP 8481A | SN: US37292783 | 07-Oct-15 (No. 217-02222) | In house check: Oct-16 |
| Power sensor HP 8481A | SN: MY41092317 | 07-Oct-15 (No. 217-02223) | In house check: Oct-16 |
| RF generator R&S SMT-06 | SN: 100972 | 15-Jun-15 (in house check Jun-15) | In house check: Oct-16 |
| Network Analyzer HP 8753E | SN: US37390585 | 18-Oct-01 (in house check Oct-15) | In house check: Oct-16 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Claudio Leubler | Laboratory Technician | |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: July 13, 2016

## Glossary:

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

## Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

## Additional Documentation:

e) DASY4/5 System Handbook

## Methods Applied and Interpretation of Parameters:

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

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

## Measurement Conditions

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

| | | |
|---|---|---|
| **DASY Version** | DASY5 | V52.8.8 |
| **Extrapolation** | Advanced Extrapolation | |
| **Phantom** | Modular Flat Phantom | |
| **Distance Dipole Center - TSL** | 15 mm | with Spacer |
| **Zoom Scan Resolution** | dx, dy, dz = 5 mm | |
| **Frequency** | 750 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 41.9 | 0.89 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 40.9 ± 6 % | 0.91 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 | 2.09 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **8.17 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 1.37 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **5.39 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 | 55.5 | 0.96 mho/m |
| **Measured Body TSL parameters** | (22.0 ± 0.2) °C | 55.1 ± 6 % | 0.99 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 | 2.16 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **8.43 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 1.41 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **5.53 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 | 55.6 Ω - 0.9 jΩ |
| Return Loss | - 25.4 dB |

### Antenna Parameters with Body TSL

| | |
|---|---|
| Impedance, transformed to feed point | 50.2 Ω - 4.0 jΩ |
| Return Loss | - 28.0 dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.033 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 | November 19, 2015 |

## DASY5 Validation Report for Head TSL

Date: 13.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1161**

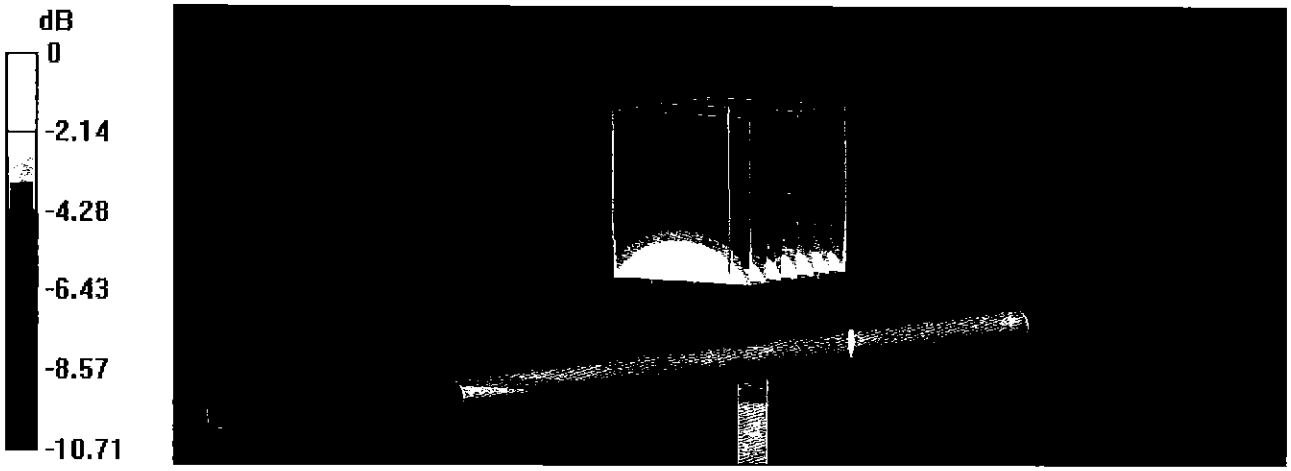
Communication System: UID 0 - CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; $\sigma$ = 0.91 S/m; $\varepsilon_r$ = 40.9; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.07, 10.07, 10.07); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

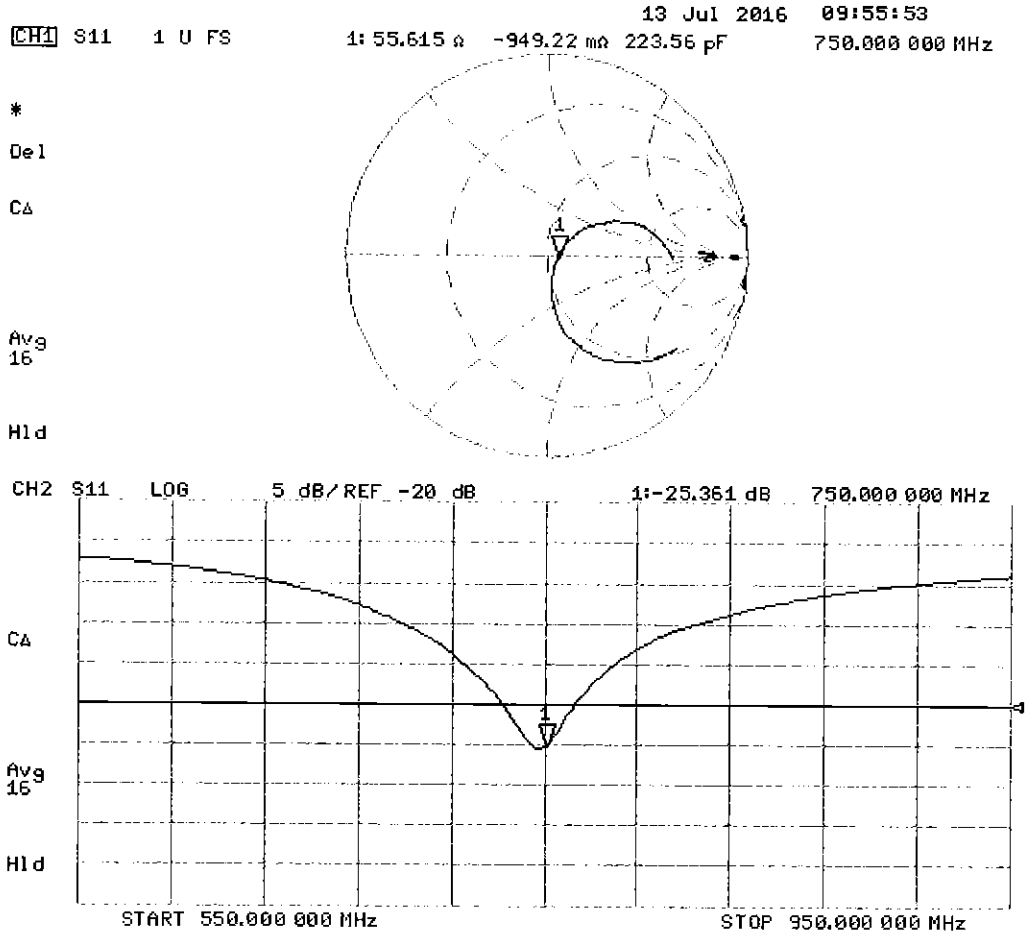
### Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 58.07 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 3.13 W/kg
**SAR(1 g) = 2.09 W/kg; SAR(10 g) = 1.37 W/kg**
Maximum value of SAR (measured) = 2.80 W/kg




0 dB = 2.80 W/kg = 4.47 dBW/kg

## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 13.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1161**

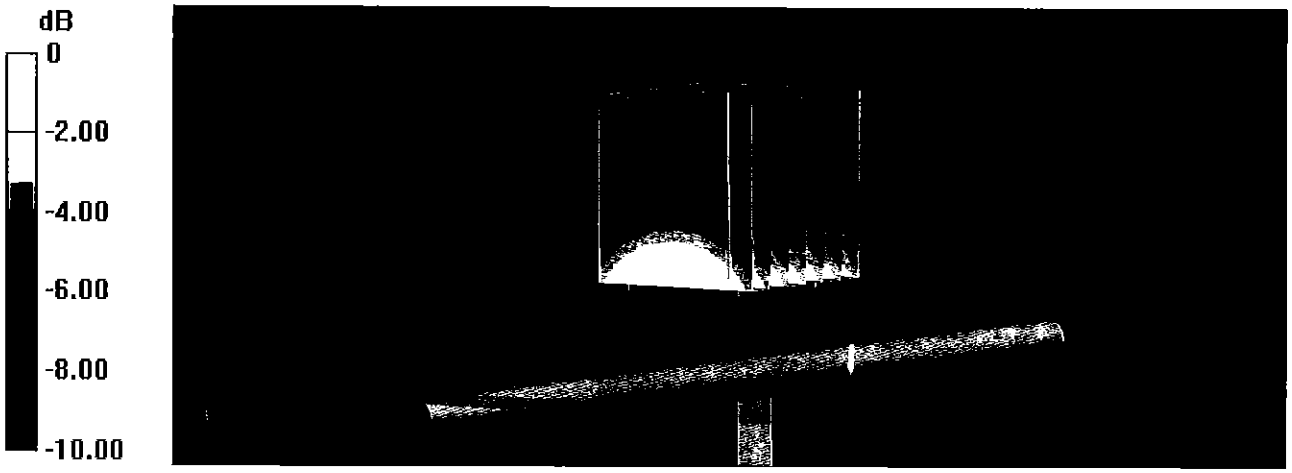
Communication System: UID 0 - CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; $\sigma$ = 0.99 S/m; $\varepsilon_r$ = 55.1; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(9.99, 9.99, 9.99); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

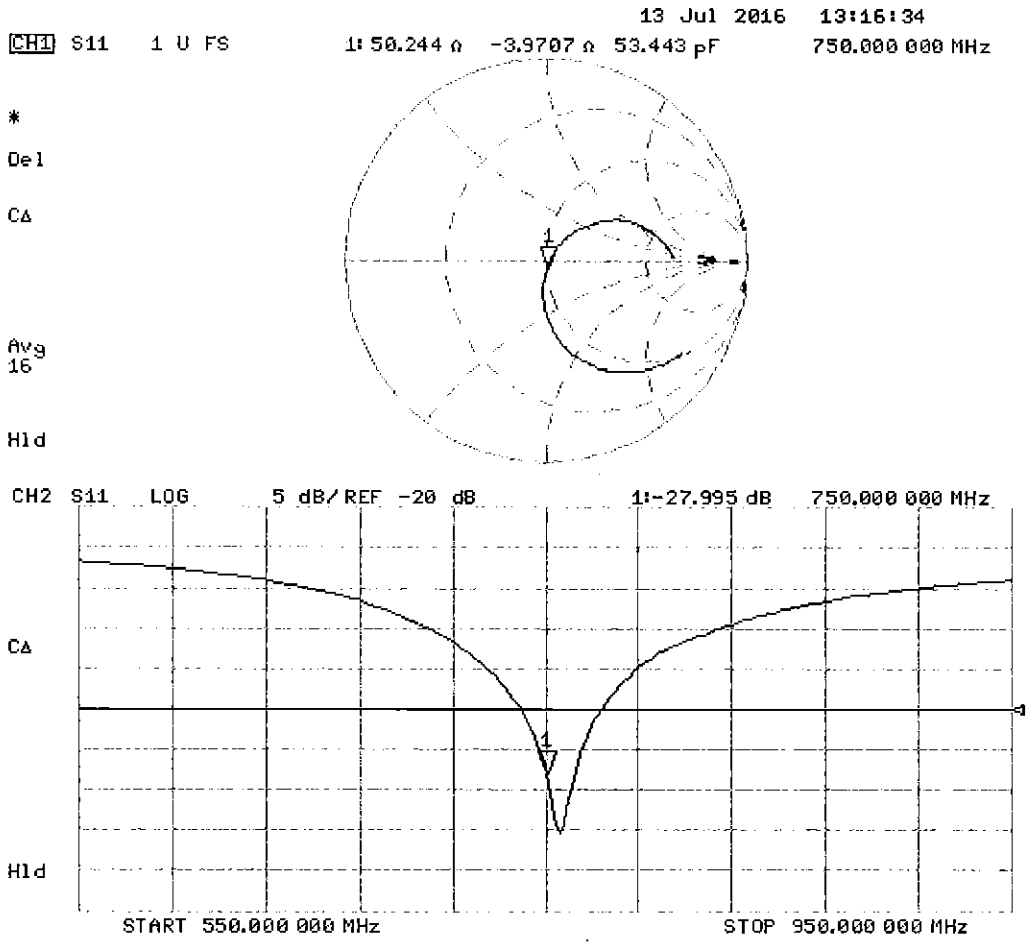
### Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.33 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 3.22 W/kg
**SAR(1 g) = 2.16 W/kg; SAR(10 g) = 1.41 W/kg**
Maximum value of SAR (measured) = 2.87 W/kg




0 dB = 2.87 W/kg = 4.58 dBW/kg

## Impedance Measurement Plot for Body TSL



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**C** Service suisse d'étalonnage
**S** Servizio svizzero di taratura
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**Accreditation No.: SCS 0108**

**Client** **PC Test**

**Certificate No: D835V2-4d047_Jul16**

# CALIBRATION CERTIFICATE

Object D835V2 - SN:4d047

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

BN✓
7/16/2016

Calibration date: July 13, 2016

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter NRP | SN: 104778 | 06-Apr-16 (No. 217-02288/02289) | Apr-17 |
| Power sensor NRP-Z91 | SN: 103244 | 06-Apr-16 (No. 217-02288) | Apr-17 |
| Power sensor NRP-Z91 | SN: 103245 | 06-Apr-16 (No. 217-02289) | Apr-17 |
| Reference 20 dB Attenuator | SN: 5058 (20k) | 05-Apr-16 (No. 217-02292) | Apr-17 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 05-Apr-16 (No. 217-02295) | Apr-17 |
| Reference Probe EX3DV4 | SN: 7349 | 15-Jun-16 (No. EX3-7349_Jun16) | Jun-17 |
| DAE4 | SN: 601 | 30-Dec-15 (No. DAE4-601_Dec15) | Dec-16 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Power meter EPM-442A | SN: GB37480704 | 07-Oct-15 (No. 217-02222) | In house check: Oct-16 |
| Power sensor HP 8481A | SN: US37292783 | 07-Oct-15 (No. 217-02222) | In house check: Oct-16 |
| Power sensor HP 8481A | SN: MY41092317 | 07-Oct-15 (No. 217-02223) | In house check: Oct-16 |
| RF generator R&S SMT-06 | SN: 100972 | 15-Jun-15 (in house check Jun-15) | In house check: Oct-16 |
| Network Analyzer HP 8753E | SN: US37390585 | 18-Oct-01 (in house check Oct-15) | In house check: Oct-16 |

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

Issued: July 13, 2016

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

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**Accreditation No.: SCS 0108**

## Glossary:

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

## Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

## Additional Documentation:

e) DASY4/5 System Handbook

## Methods Applied and Interpretation of Parameters:

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

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

## Measurement Conditions

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

| | | |
|---|---|---|
| **DASY Version** | DASY5 | V52.8.8 |
| **Extrapolation** | Advanced Extrapolation | |
| **Phantom** | Modular Flat Phantom | |
| **Distance Dipole Center - TSL** | 15 mm | with Spacer |
| **Zoom Scan Resolution** | dx, dy, dz = 5 mm | |
| **Frequency** | 835 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 41.5 | 0.90 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 40.6 ± 6 % | 0.94 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 | 2.37 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **9.13 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 cm$^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 1.53 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **5.95 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 | 55.2 | 0.97 mho/m |
| **Measured Body TSL parameters** | (22.0 ± 0.2) °C | 54.9 ± 6 % | 1.01 mho/m ± 6 % |
| **Body TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Body TSL

| **SAR averaged over 1 cm$^3$ (1 g) of Body TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 2.47 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **9.57 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 cm$^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 1.60 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **6.24 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 | 49.8 Ω - 5.9 jΩ |
| Return Loss | - 24.5 dB |

### Antenna Parameters with Body TSL

| | |
|---|---|
| Impedance, transformed to feed point | 45.8 Ω - 8.2 jΩ |
| Return Loss | - 20.3 dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | None 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 | August 16, 2006 |

## DASY5 Validation Report for Head TSL

Date: 13.07.201

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz D835V2; Type: D835V2; Serial: D835V2 - SN:4d047**

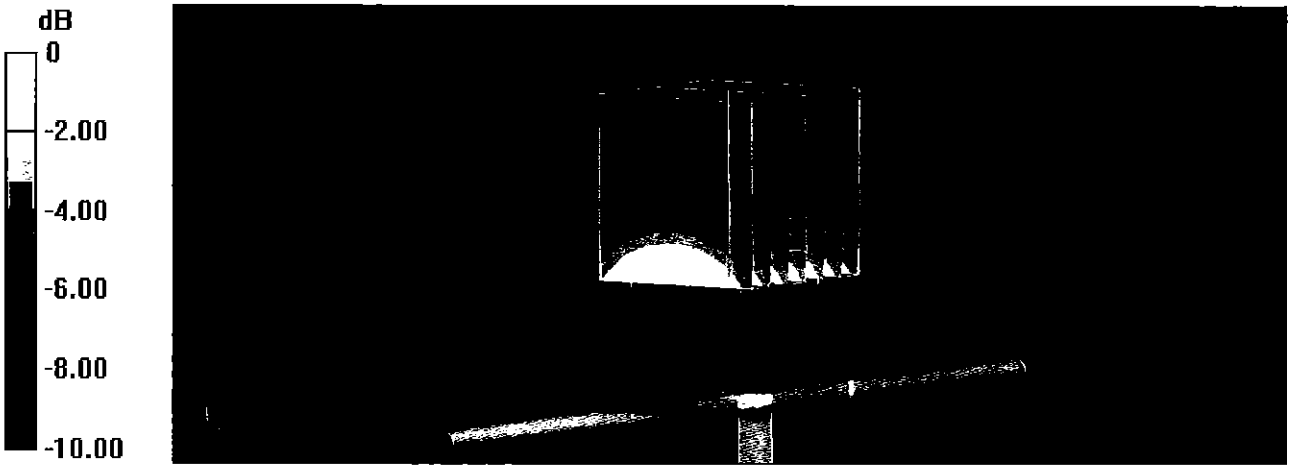
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; $\sigma$ = 0.94 S/m; $\varepsilon_r$ = 40.6; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(9.72, 9.72, 9.72); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

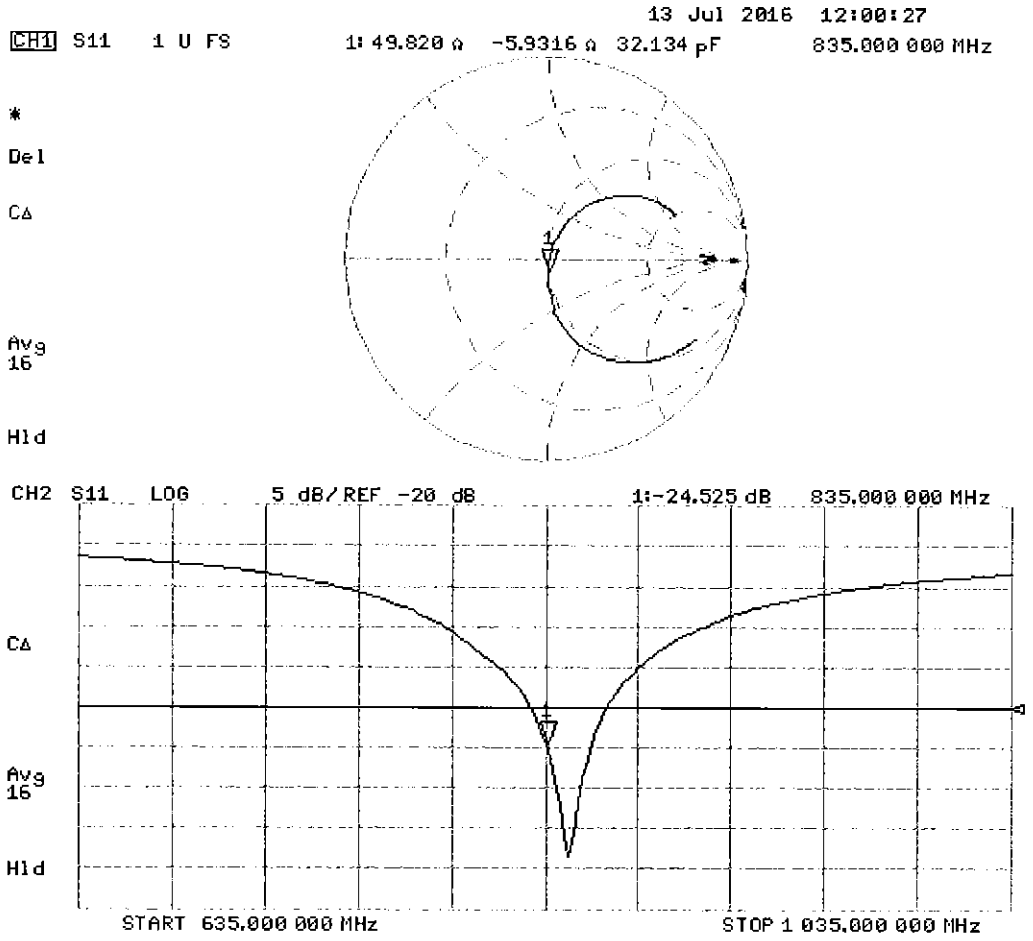
### Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 60.98 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 3.56 W/kg
**SAR(1 g) = 2.37 W/kg; SAR(10 g) = 1.53 W/kg**
Maximum value of SAR (measured) = 3.17 W/kg




0 dB = 3.17 W/kg = 5.01 dBW/kg

## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 13.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz D835V2; Type: D835V2; Serial: D835V2 - SN:4d047**

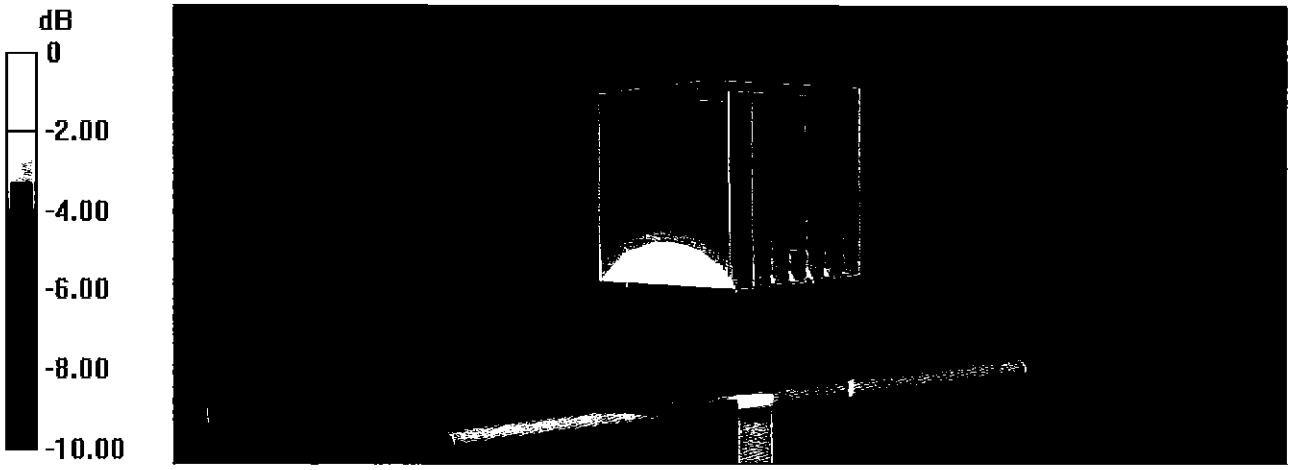
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; $\sigma$ = 1.01 S/m; $\varepsilon_r$ = 54.9; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(9.73, 9.73, 9.73); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

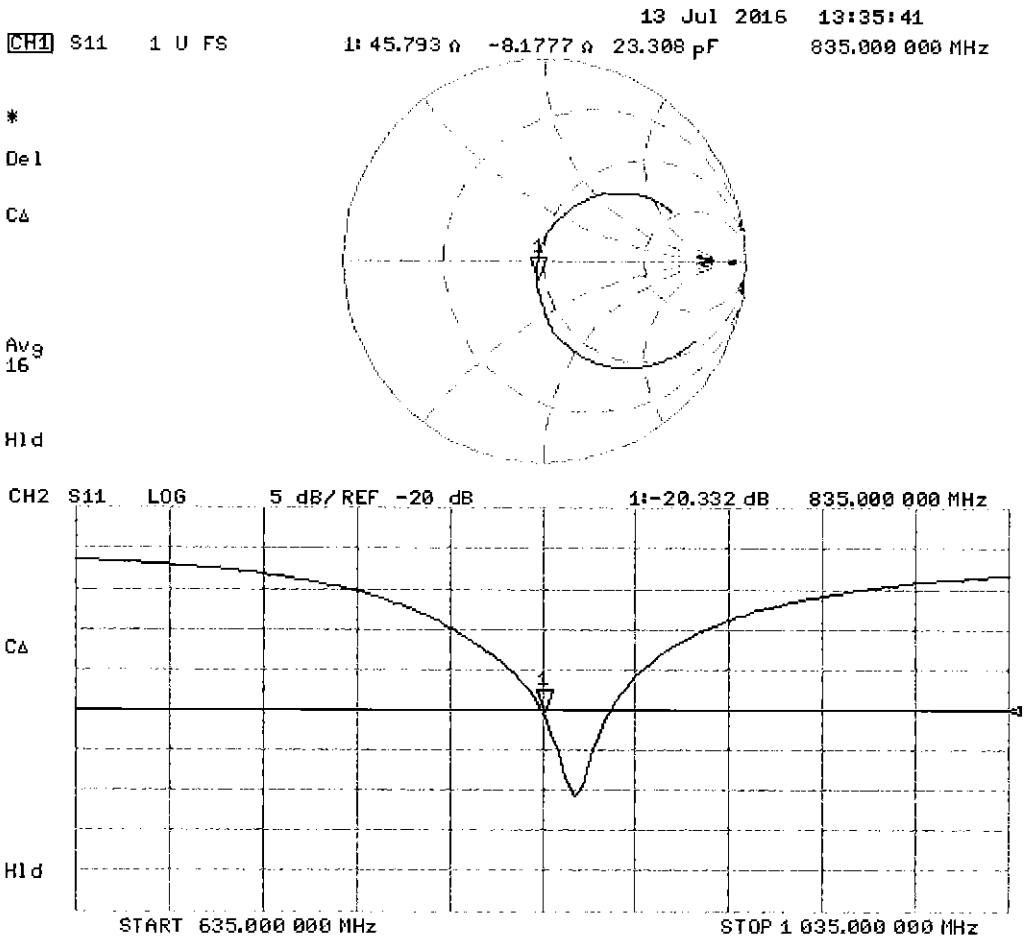
### Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 59.88 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 3.67 W/kg
**SAR(1 g) = 2.47 W/kg; SAR(10 g) = 1.6 W/kg**
Maximum value of SAR (measured) = 3.27 W/kg




0 dB = 3.27 W/kg = 5.15 dBW/kg

## Impedance Measurement Plot for Body TSL



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**Accreditation No.: SCS 0108**

**Client** **PC Test**

**Certificate No: D1750V2-1150_Jul16**

# CALIBRATION CERTIFICATE

Object D1750V2 - SN:1150

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

✓PM 8/9/16

Calibration date: July 14, 2016

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter NRP | SN: 104778 | 06-Apr-16 (No. 217-02288/02289) | Apr-17 |
| Power sensor NRP-Z91 | SN: 103244 | 06-Apr-16 (No. 217-02288) | Apr-17 |
| Power sensor NRP-Z91 | SN: 103245 | 06-Apr-16 (No. 217-02289) | Apr-17 |
| Reference 20 dB Attenuator | SN: 5058 (20k) | 05-Apr-16 (No. 217-02292) | Apr-17 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 05-Apr-16 (No. 217-02295) | Apr-17 |
| Reference Probe EX3DV4 | SN: 7349 | 15-Jun-16 (No. EX3-7349_Jun16) | Jun-17 |
| DAE4 | SN: 601 | 30-Dec-15 (No. DAE4-601_Dec15) | Dec-16 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Power meter EPM-442A | SN: GB37480704 | 07-Oct-15 (No. 217-02222) | In house check: Oct-16 |
| Power sensor HP 8481A | SN: US37292783 | 07-Oct-15 (No. 217-02222) | In house check: Oct-16 |
| Power sensor HP 8481A | SN: MY41092317 | 07-Oct-15 (No. 217-02223) | In house check: Oct-16 |
| RF generator R&S SMT-06 | SN: 100972 | 15-Jun-15 (in house check Jun-15) | In house check: Oct-16 |
| Network Analyzer HP 8753E | SN: US37390585 | 18-Oct-01 (in house check Oct-15) | In house check: Oct-16 |

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

Issued: July 14, 2016

## Glossary:

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

## Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

## Additional Documentation:

e) DASY4/5 System Handbook

## Methods Applied and Interpretation of Parameters:

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

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

## Measurement Conditions

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

| | | |
|---|---|---|
| **DASY Version** | DASY5 | V52.8.8 |
| **Extrapolation** | Advanced Extrapolation | |
| **Phantom** | Modular Flat Phantom | |
| **Distance Dipole Center - TSL** | 10 mm | with Spacer |
| **Zoom Scan Resolution** | dx, dy, dz = 5 mm | |
| **Frequency** | 1750 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 40.1 | 1.37 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 38.8 ± 6 % | 1.36 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 | 9.06 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **36.1 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 4.80 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **19.2 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 | 53.4 | 1.49 mho/m |
| **Measured Body TSL parameters** | (22.0 ± 0.2) °C | 53.4 ± 6 % | 1.48 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 | 9.09 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **36.5 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 4.85 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **19.5 W/kg ± 16.5 % (k=2)** |

## Appendix (Additional assessments outside the scope of SCS 0108)

### Antenna Parameters with Head TSL

| | |
|---|---|
| Impedance, transformed to feed point | 50.9 Ω + 0.4 jΩ |
| Return Loss | - 40.2 dB |

### Antenna Parameters with Body TSL

| | |
|---|---|
| Impedance, transformed to feed point | 46.4 Ω - 0.5 jΩ |
| Return Loss | - 28.5 dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.218 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 | April 10, 2015 |

## DASY5 Validation Report for Head TSL

Date: 14.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1750 MHz D1750V2; Type: D1750V2; Serial: D1750V2 - SN:1150**

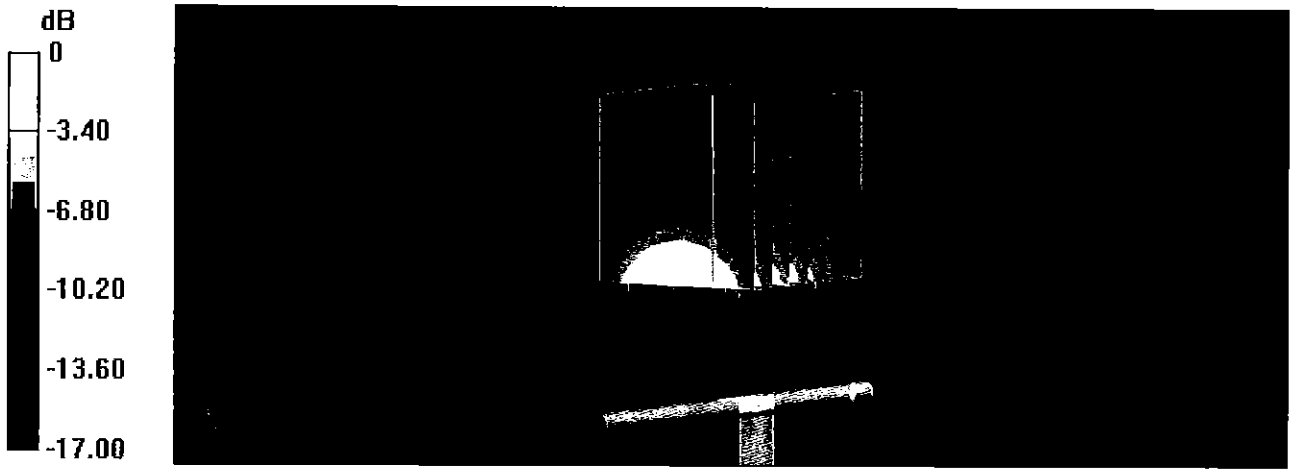
Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; $\sigma$ = 1.36 S/m; $\varepsilon_r$ = 38.8; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.46, 8.46, 8.46); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

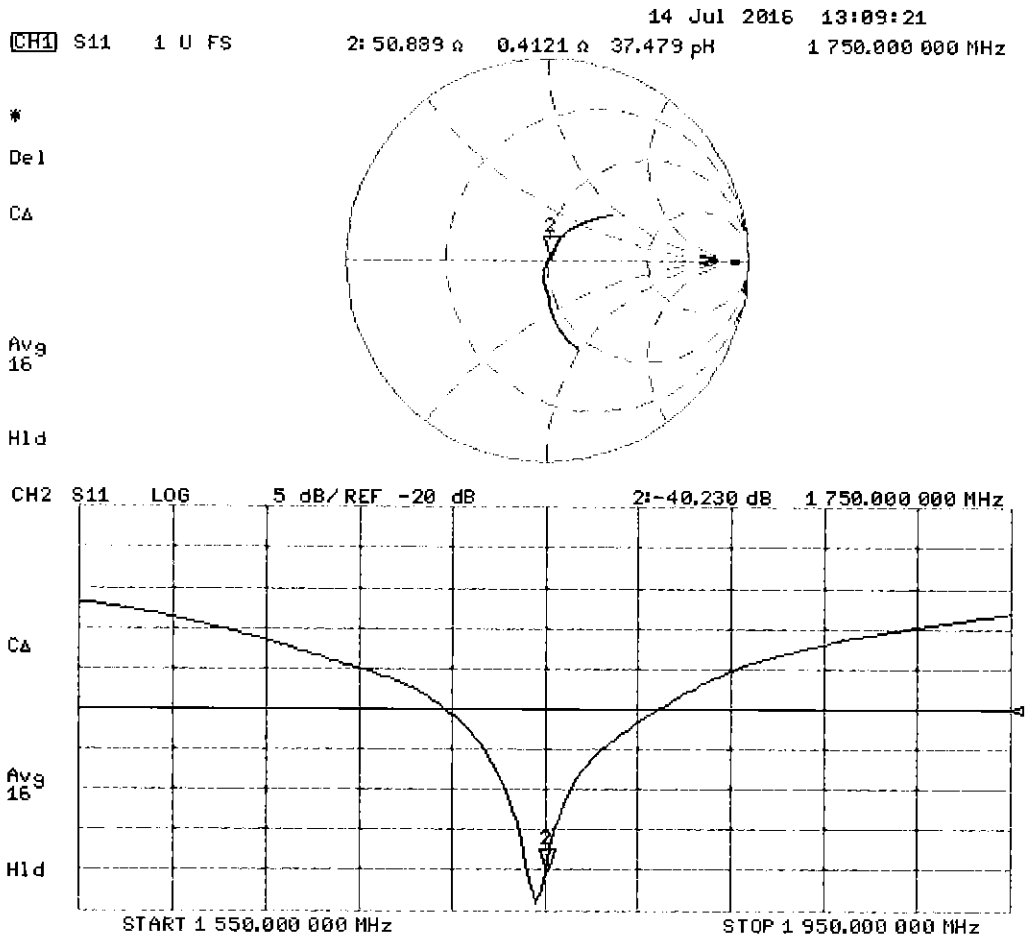
### Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 104.4 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 16.6 W/kg
**SAR(1 g) = 9.06 W/kg; SAR(10 g) = 4.8 W/kg**
Maximum value of SAR (measured) = 13.9 W/kg




0 dB = 13.9 W/kg = 11.43 dBW/kg

## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 14.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1750 MHz D1750V2; Type: D1750V2; Serial: D1750V2 - SN:1150**

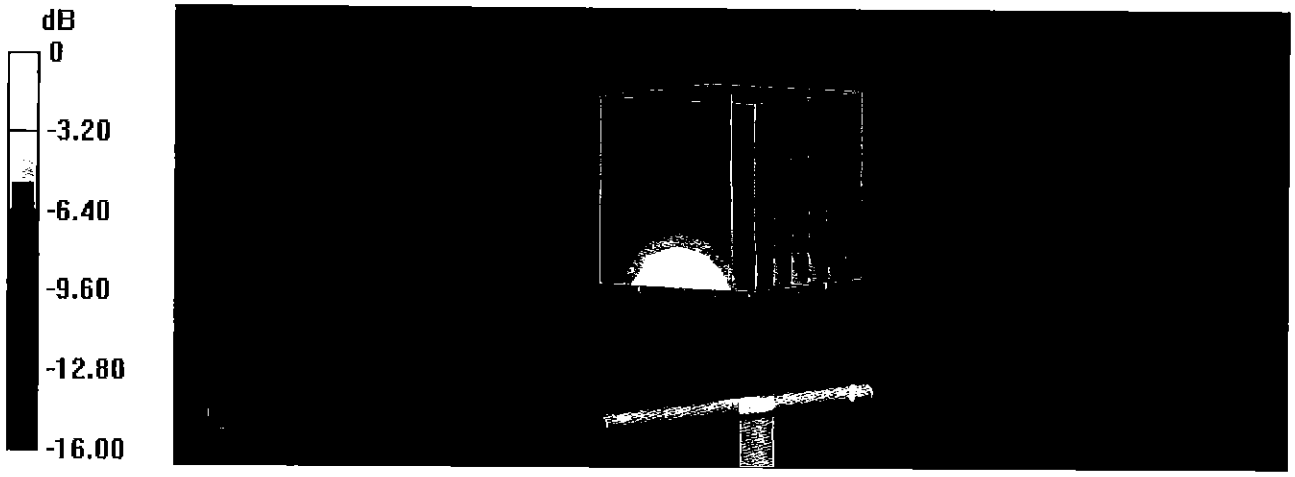
Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; $\sigma$ = 1.48 S/m; $\varepsilon_r$ = 53.4; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.25, 8.25, 8.25); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

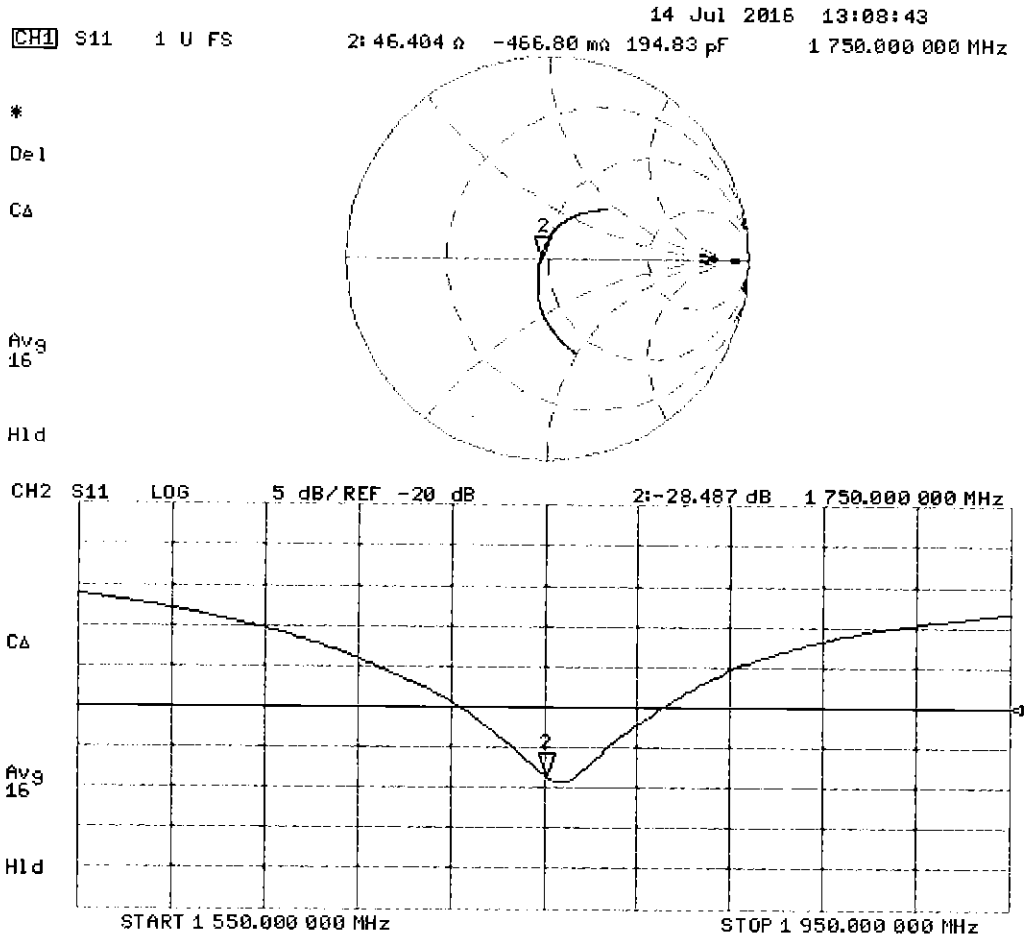
### Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 100.4 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 16.0 W/kg
**SAR(1 g) = 9.09 W/kg; SAR(10 g) = 4.85 W/kg**
Maximum value of SAR (measured) = 13.7 W/kg




0 dB = 13.7 W/kg = 11.37 dBW/kg

## Impedance Measurement Plot for Body TSL



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

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

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

**Accreditation No.: SCS 0108**

**Client** **PC Test**

**Certificate No: D1900V2-5d080_Jul16**

# CALIBRATION CERTIFICATE

Object D1900V2 - SN:5d080

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

BN ✓ 7/16/2016

Calibration date: July 08, 2016

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter NRP | SN: 104778 | 06-Apr-16 (No. 217-02288/02289) | Apr-17 |
| Power sensor NRP-Z91 | SN: 103244 | 06-Apr-16 (No. 217-02288) | Apr-17 |
| Power sensor NRP-Z91 | SN: 103245 | 06-Apr-16 (No. 217-02289) | Apr-17 |
| Reference 20 dB Attenuator | SN: 5058 (20k) | 05-Apr-16 (No. 217-02292) | Apr-17 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 05-Apr-16 (No. 217-02295) | Apr-17 |
| Reference Probe EX3DV4 | SN: 7349 | 15-Jun-16 (No. EX3-7349_Jun16) | Jun-17 |
| DAE4 | SN: 601 | 30-Dec-15 (No. DAE4-601_Dec15) | Dec-16 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Power meter EPM-442A | SN: GB37480704 | 07-Oct-15 (No. 217-02222) | In house check: Oct-16 |
| Power sensor HP 8481A | SN: US37292783 | 07-Oct-15 (No. 217-02222) | In house check: Oct-16 |
| Power sensor HP 8481A | SN: MY41092317 | 07-Oct-15 (No. 217-02223) | In house check: Oct-16 |
| RF generator R&S SMT-06 | SN: 100972 | 15-Jun-15 (in house check Jun-15) | In house check: Oct-16 |
| Network Analyzer HP 8753E | SN: US37390585 | 18-Oct-01 (in house check Oct-15) | In house check: Oct-16 |

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

Issued: July 13, 2016

## Glossary:

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

## Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

## Additional Documentation:

e) DASY4/5 System Handbook

## Methods Applied and Interpretation of Parameters:

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

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

## Measurement Conditions

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

| | | |
|---|---|---|
| **DASY Version** | DASY5 | V52.8.8 |
| **Extrapolation** | Advanced Extrapolation | |
| **Phantom** | Modular Flat Phantom | |
| **Distance Dipole Center - TSL** | 10 mm | with Spacer |
| **Zoom Scan Resolution** | dx, dy, dz = 5 mm | |
| **Frequency** | 1900 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 40.0 | 1.40 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 39.8 ± 6 % | 1.38 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 | 9.76 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **39.3 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 cm$^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 5.10 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **20.5 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 | 53.3 | 1.52 mho/m |
| **Measured Body TSL parameters** | (22.0 ± 0.2) °C | 52.7 ± 6 % | 1.51 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 | 9.75 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **39.1 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 cm$^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 5.17 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **20.7 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 | 52.1 Ω + 5.3 jΩ |
| Return Loss | - 25.1 dB |

### Antenna Parameters with Body TSL

| | |
|---|---|
| Impedance, transformed to feed point | 47.4 Ω + 6.8 jΩ |
| Return Loss | - 22.6 dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.192 ns |

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

| | |
|---|---|
| Manufactured by | SPEAG |
| Manufactured on | June 28, 2006 |

## DASY5 Validation Report for Head TSL

Date: 08.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d080**

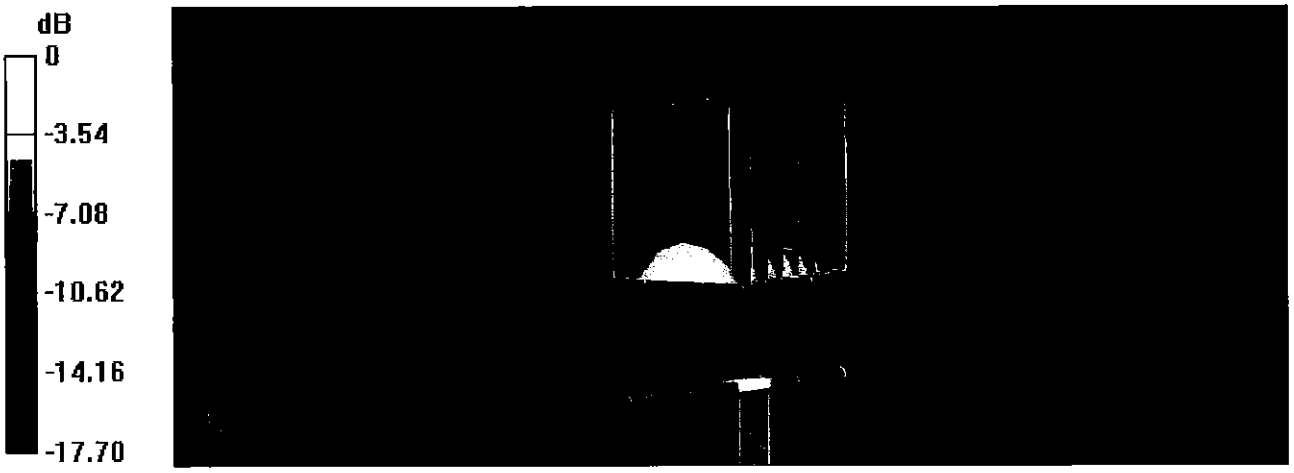
Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; $\sigma$ = 1.38 S/m; $\varepsilon_r$ = 39.8; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.99, 7.99, 7.99); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

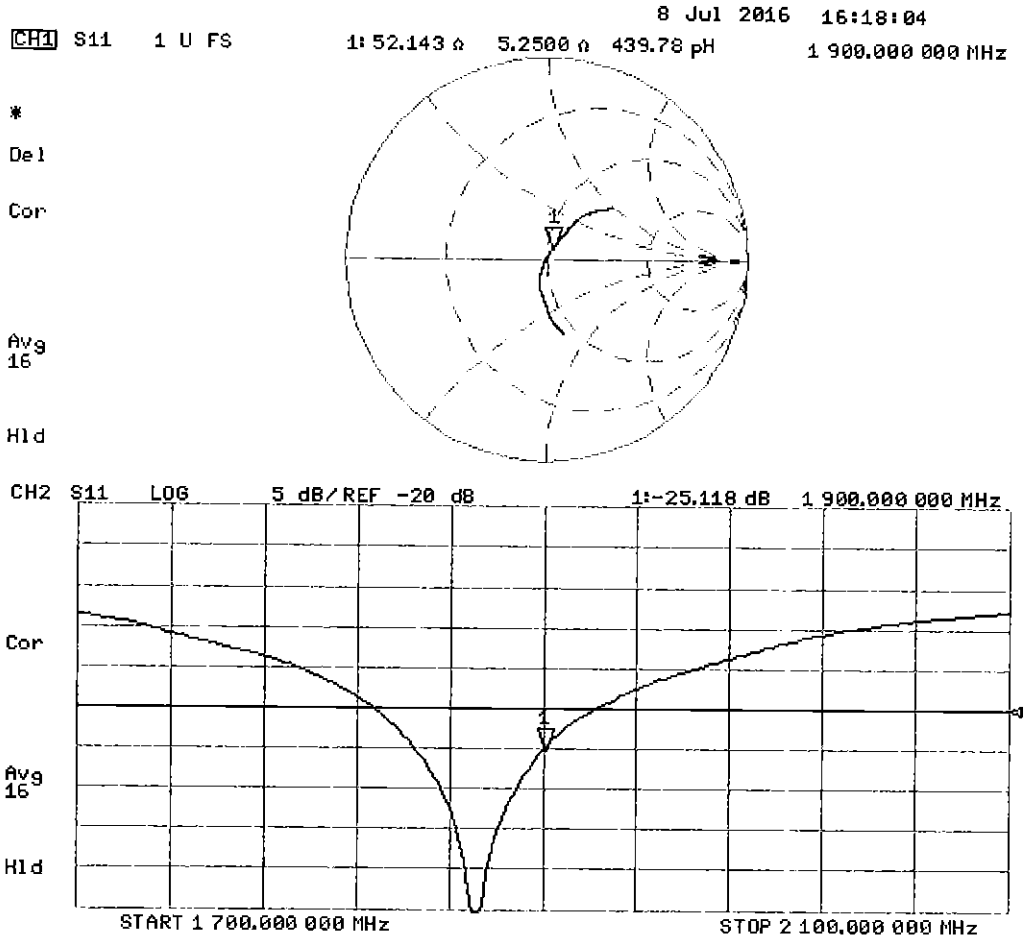
### Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 106.6 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 18.4 W/kg
**SAR(1 g) = 9.76 W/kg; SAR(10 g) = 5.1 W/kg**
Maximum value of SAR (measured) = 15.0 W/kg




0 dB = 15.0 W/kg = 11.76 dBW/kg

## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 08.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d080**

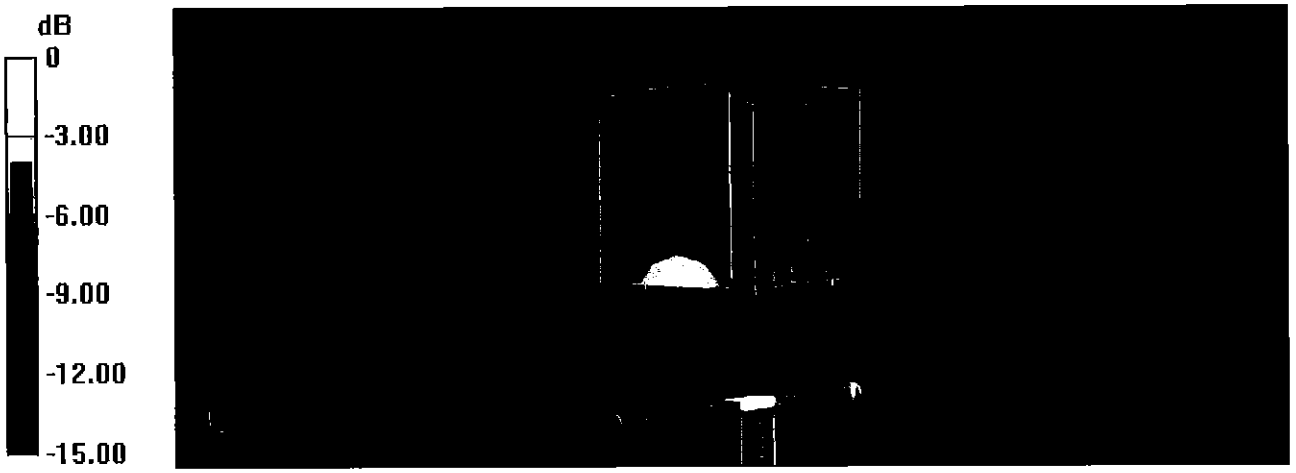
Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; $\sigma$ = 1.51 S/m; $\varepsilon_r$ = 52.7; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.03, 8.03, 8.03); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

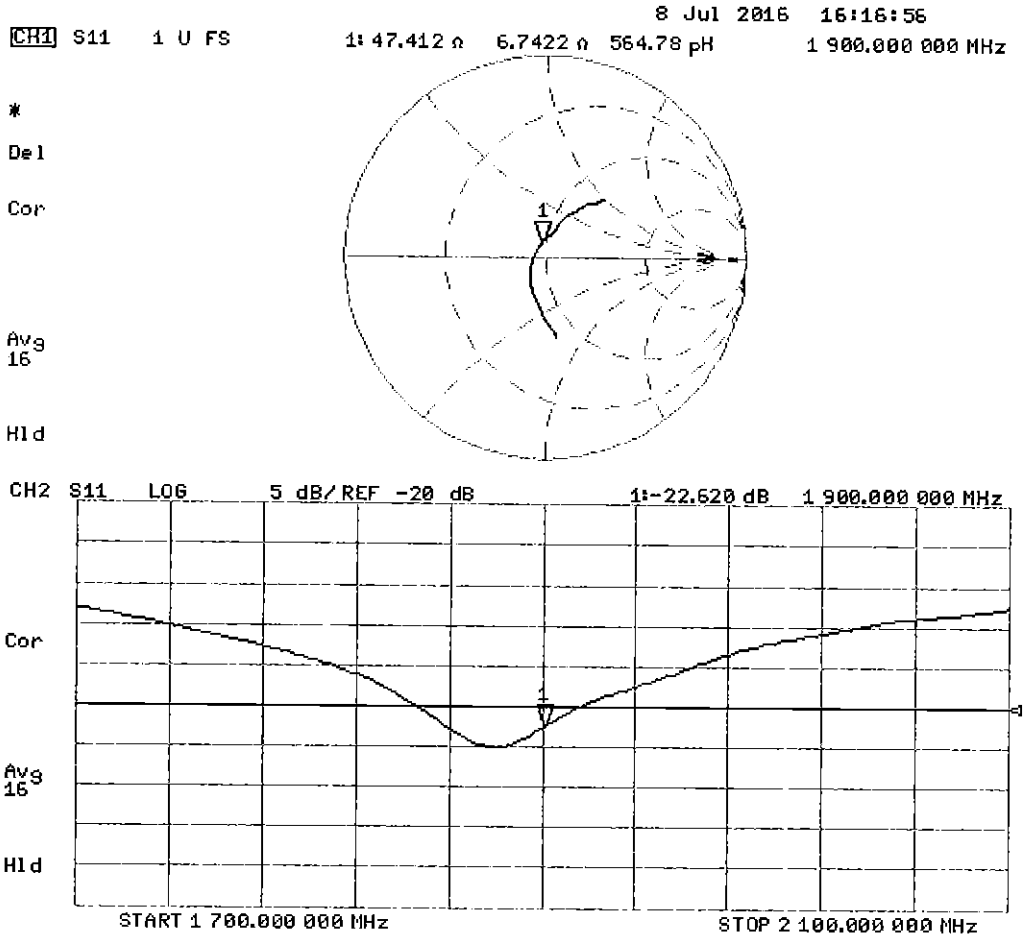
### Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 103.1 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 17.1 W/kg
**SAR(1 g) = 9.75 W/kg; SAR(10 g) = 5.17 W/kg**
Maximum value of SAR (measured) = 14.7 W/kg




0 dB = 14.7 W/kg = 11.67 dBW/kg

## Impedance Measurement Plot for Body TSL



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

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

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

**Accreditation No.: SCS 0108**

**Client** **PC Test**

**Certificate No: D2450V2-719_Aug16**

# CALIBRATION CERTIFICATE

Object D2450V2 - SN:719

BNN
09-01-2016

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

Calibration date: August 18, 2016

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter NRP | SN: 104778 | 06-Apr-16 (No. 217-02288/02289) | Apr-17 |
| Power sensor NRP-Z91 | SN: 103244 | 06-Apr-16 (No. 217-02288) | Apr-17 |
| Power sensor NRP-Z91 | SN: 103245 | 06-Apr-16 (No. 217-02289) | Apr-17 |
| Reference 20 dB Attenuator | SN: 5058 (20k) | 05-Apr-16 (No. 217-02292) | Apr-17 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 05-Apr-16 (No. 217-02295) | Apr-17 |
| Reference Probe EX3DV4 | SN: 7349 | 15-Jun-16 (No. EX3-7349_Jun16) | Jun-17 |
| DAE4 | SN: 601 | 30-Dec-15 (No. DAE4-601_Dec15) | Dec-16 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Power meter EPM-442A | SN: GB37480704 | 07-Oct-15 (No. 217-02222) | In house check: Oct-16 |
| Power sensor HP 8481A | SN: US37292783 | 07-Oct-15 (No. 217-02222) | In house check: Oct-16 |
| Power sensor HP 8481A | SN: MY41092317 | 07-Oct-15 (No. 217-02223) | In house check: Oct-16 |
| RF generator R&S SMT-06 | SN: 100972 | 15-Jun-15 (in house check Jun-15) | In house check: Oct-16 |
| Network Analyzer HP 8753E | SN: US37390585 | 18-Oct-01 (in house check Oct-15) | In house check: Oct-16 |

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

Issued: August 18, 2016

## Glossary:

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

## Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

## Additional Documentation:

e) DASY4/5 System Handbook

## Methods Applied and Interpretation of Parameters:

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

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

## Measurement Conditions

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

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

## Head TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 39.2 | 1.80 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 38.2 ± 6 % | 1.88 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 mW input power | 13.9 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **54.1 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 cm$^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 6.47 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **25.5 W/kg ± 16.5 % (k=2)** |

## Body TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Body TSL parameters** | 22.0 °C | 52.7 | 1.95 mho/m |
| **Measured Body TSL parameters** | (22.0 ± 0.2) °C | 52.0 ± 6 % | 2.04 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 | 13.2 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **51.5 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 cm$^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 6.20 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **24.5 W/kg ± 16.5 % (k=2)** |

## Appendix (Additional assessments outside the scope of SCS 0108)

### Antenna Parameters with Head TSL

| | |
|---|---|
| Impedance, transformed to feed point | 53.9 Ω + 5.5 jΩ |
| Return Loss | - 23.8 dB |

### Antenna Parameters with Body TSL

| | |
|---|---|
| Impedance, transformed to feed point | 50.5 Ω + 7.6 jΩ |
| Return Loss | - 22.5 dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.150 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 | September 10, 2002 |

## DASY5 Validation Report for Head TSL

Date: 18.08.2016

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:719**

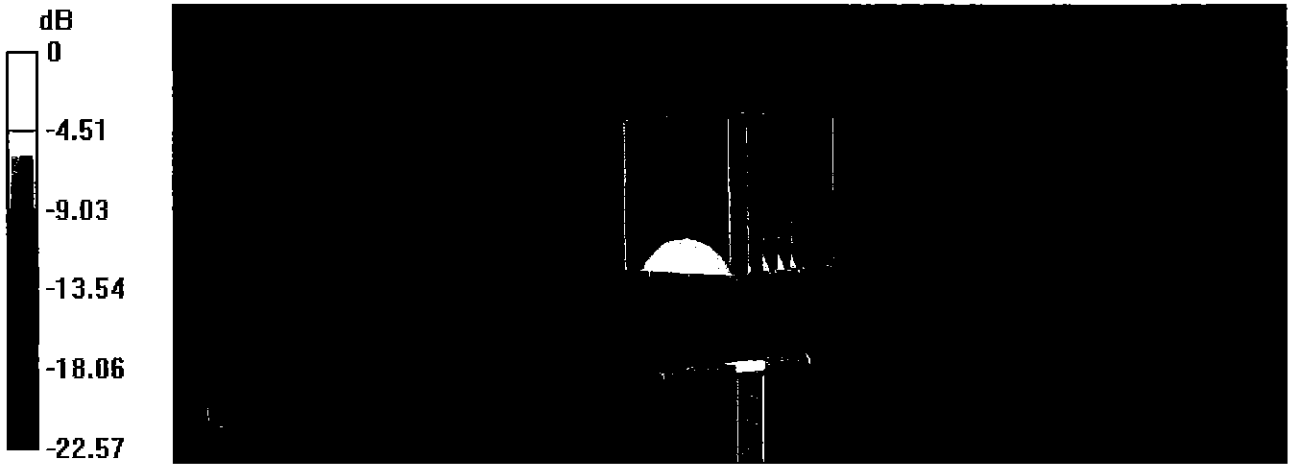
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma$ = 1.88 S/m; $\varepsilon_r$ = 38.2; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.72, 7.72, 7.72); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

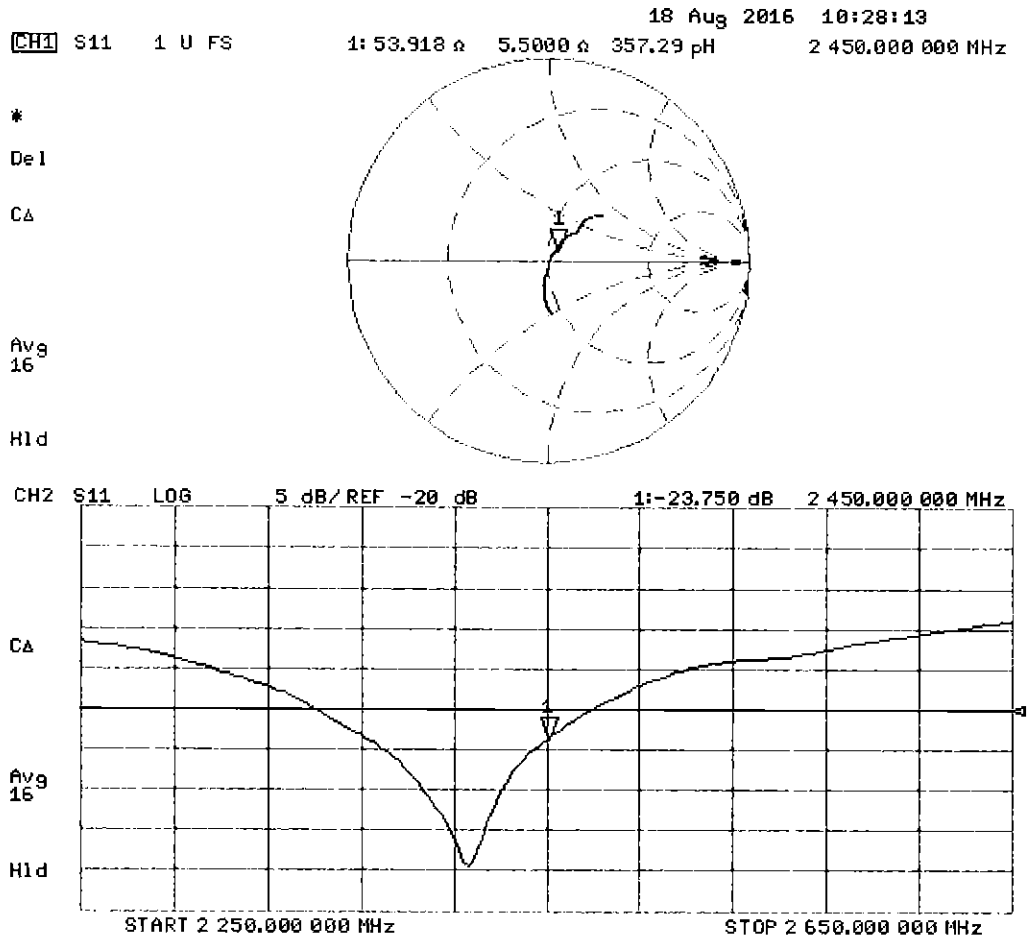
### Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 116.1 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 27.9 W/kg
**SAR(1 g) = 13.9 W/kg; SAR(10 g) = 6.47 W/kg**
Maximum value of SAR (measured) = 22.8 W/kg




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

## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 18.08.2016

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:719**

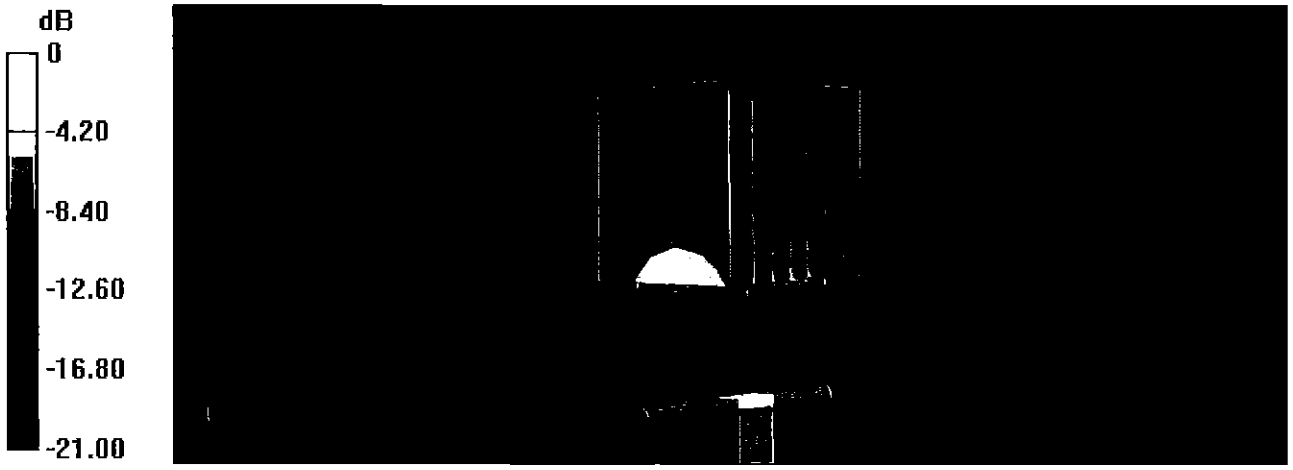
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma$ = 2.04 S/m; $\varepsilon_r$ = 52; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.79, 7.79, 7.79); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

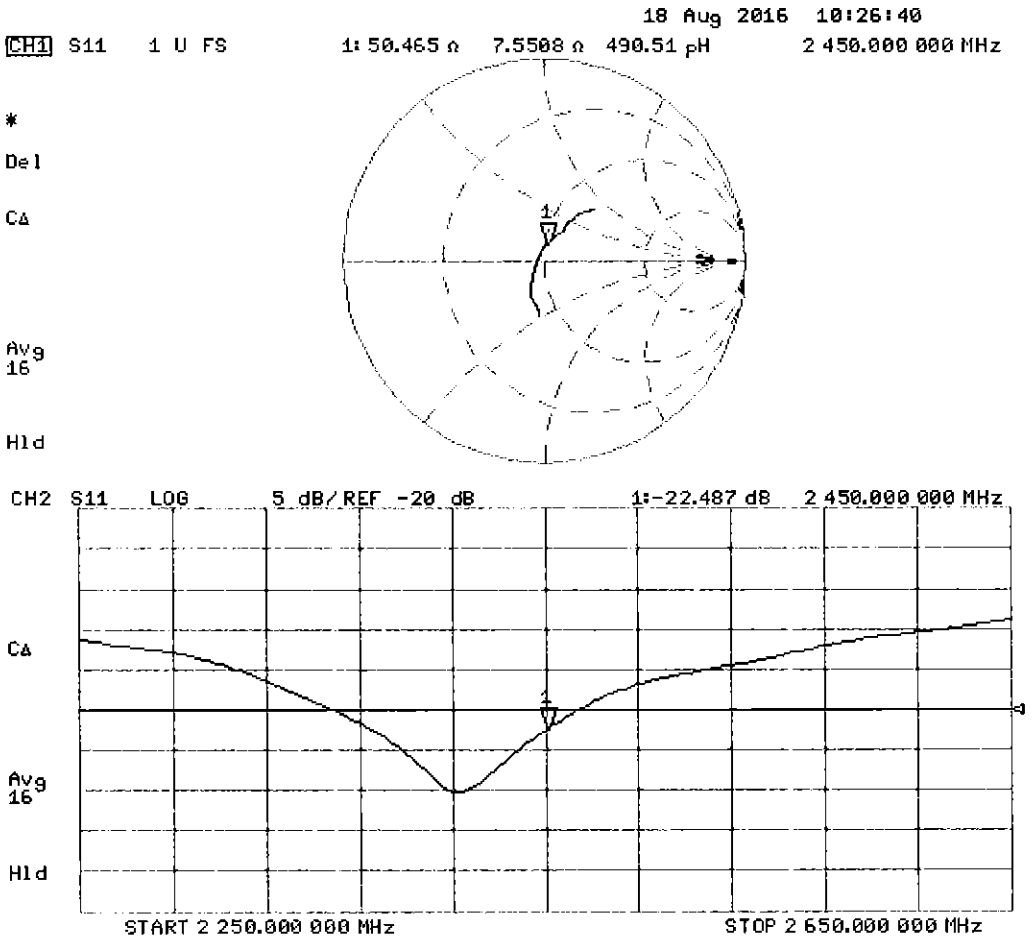
### Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 106.9 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 26.1 W/kg
**SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.2 W/kg**
Maximum value of SAR (measured) = 21.5 W/kg




0 dB = 21.5 W/kg = 13.32 dBW/kg

## Impedance Measurement Plot for Body TSL



**Calibration Laboratory of**
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**S** Schweizerischer Kalibrierdienst
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**S** Servizio svizzero di taratura
**S** Swiss Calibration Service

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**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** **PC Test**

**Certificate No: D2450V2-981_Jul16**

# CALIBRATION CERTIFICATE

Object D2450V2 - SN:981

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

VPH
8/9/16

Calibration date: July 25, 2016

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter NRP | SN: 104778 | 06-Apr-16 (No. 217-02288/02289) | Apr-17 |
| Power sensor NRP-Z91 | SN: 103244 | 06-Apr-16 (No. 217-02288) | Apr-17 |
| Power sensor NRP-Z91 | SN: 103245 | 06-Apr-16 (No. 217-02289) | Apr-17 |
| Reference 20 dB Attenuator | SN: 5058 (20k) | 05-Apr-16 (No. 217-02292) | Apr-17 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 05-Apr-16 (No. 217-02295) | Apr-17 |
| Reference Probe EX3DV4 | SN: 7349 | 15-Jun-16 (No. EX3-7349_Jun16) | Jun-17 |
| DAE4 | SN: 601 | 30-Dec-15 (No. DAE4-601_Dec15) | Dec-16 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Power meter EPM-442A | SN: GB37480704 | 07-Oct-15 (No. 217-02222) | In house check: Oct-16 |
| Power sensor HP 8481A | SN: US37292783 | 07-Oct-15 (No. 217-02222) | In house check: Oct-16 |
| Power sensor HP 8481A | SN: MY41092317 | 07-Oct-15 (No. 217-02223) | In house check: Oct-16 |
| RF generator R&S SMT-06 | SN: 100972 | 15-Jun-15 (in house check Jun-15) | In house check: Oct-16 |
| Network Analyzer HP 8753E | SN: US37390585 | 18-Oct-01 (in house check Oct-15) | In house check: Oct-16 |

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

Issued: July 27, 2016

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

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

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

**Accreditation No.: SCS 0108**

## Glossary:

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

## Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

## Additional Documentation:

e) DASY4/5 System Handbook

## Methods Applied and Interpretation of Parameters:

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

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

## Measurement Conditions

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

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

## Head TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 39.2 | 1.80 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 38.0 ± 6 % | 1.86 mho/m ± 6 % |
| **Head TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Head TSL

| **SAR averaged over 1 cm$^3$ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 13.5 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **52.8 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 cm$^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 6.26 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **24.7 W/kg ± 16.5 % (k=2)** |

## Body TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Body TSL parameters** | 22.0 °C | 52.7 | 1.95 mho/m |
| **Measured Body TSL parameters** | (22.0 ± 0.2) °C | 51.8 ± 6 % | 2.03 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 | 13.0 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **50.8 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 cm$^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 6.04 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **23.8 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 | 53.2 Ω + 3.4 jΩ |
| Return Loss | - 26.9 dB |

### Antenna Parameters with Body TSL

| | |
|---|---|
| Impedance, transformed to feed point | 50.2 Ω + 4.5 jΩ |
| Return Loss | - 27.0 dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.162 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 30, 2014 |

## DASY5 Validation Report for Head TSL

Date: 13.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: D2450V2 - SN:981**

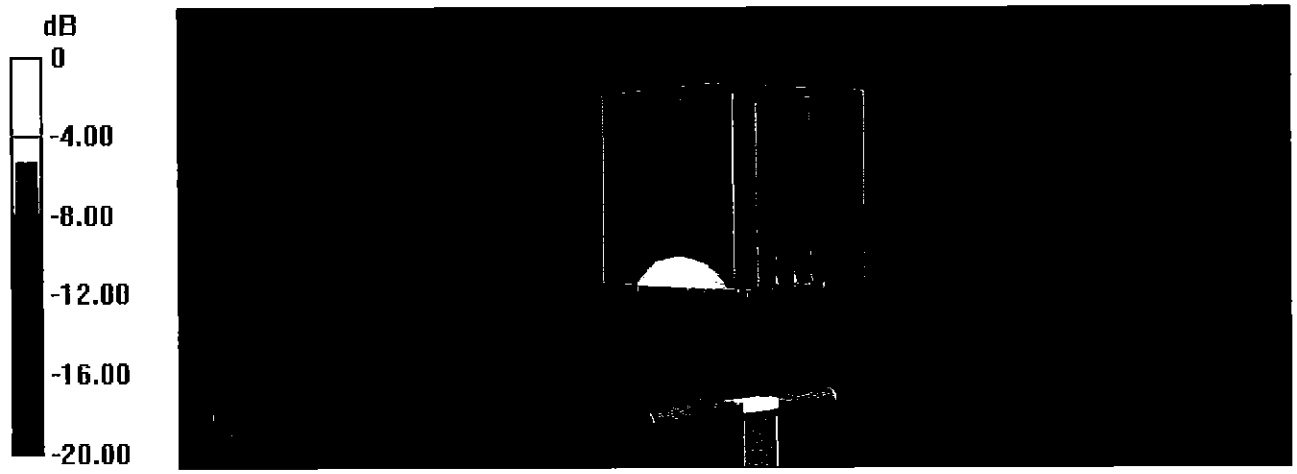
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma$ = 1.86 S/m; $\varepsilon_r$ = 38; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.72, 7.72, 7.72); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

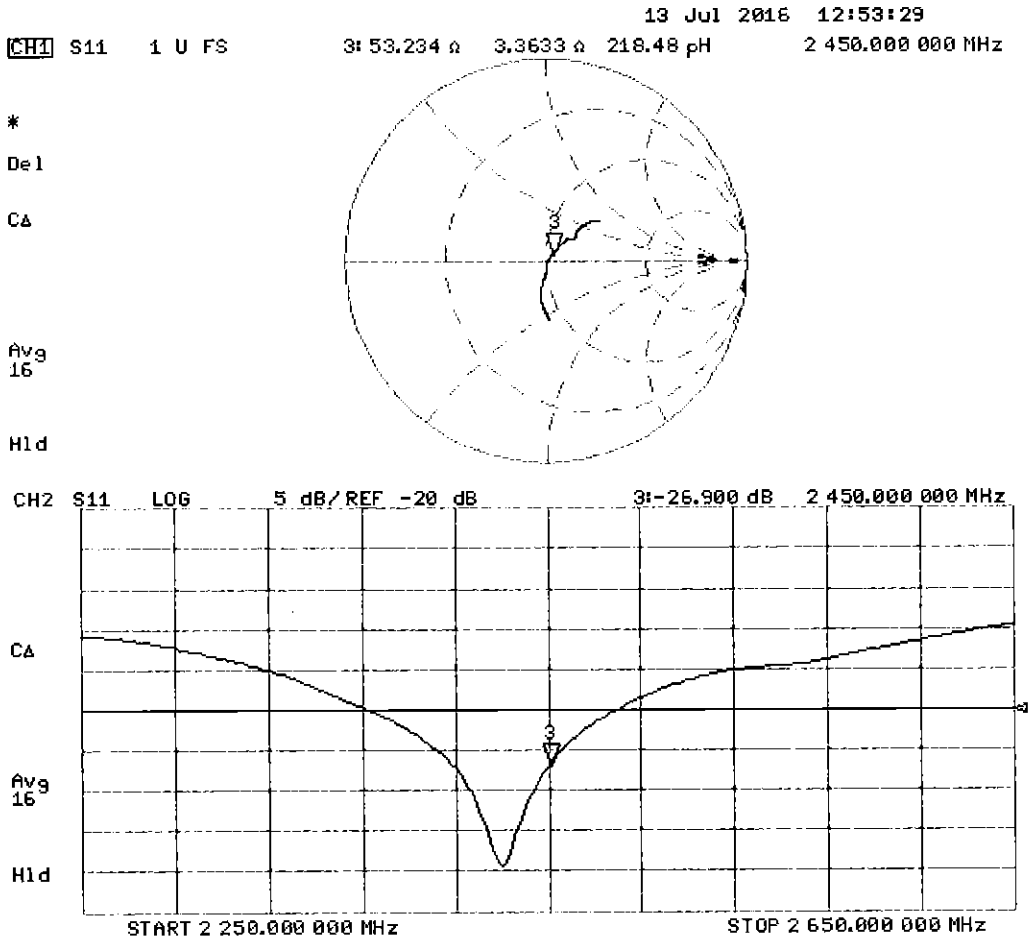
### Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 115.8 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 27.4 W/kg
**SAR(1 g) = 13.5 W/kg; SAR(10 g) = 6.26 W/kg**
Maximum value of SAR (measured) = 22.5 W/kg




0 dB = 22.5 W/kg = 13.52 dBW/kg

## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 25.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: D2450V2 - SN:981**

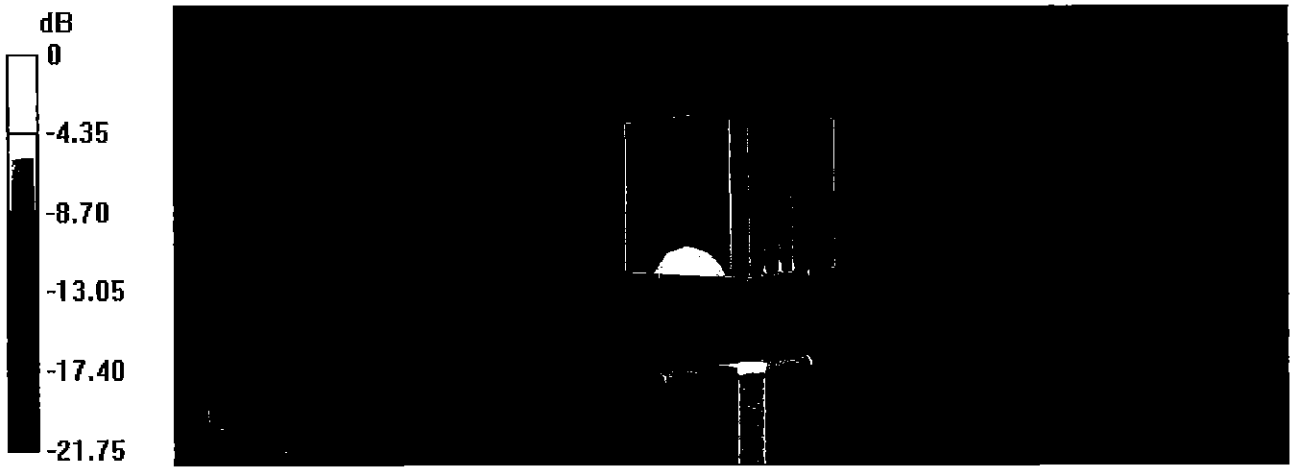
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma$ = 2.03 S/m; $\varepsilon_r$ = 51.8; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.79, 7.79, 7.79); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 107.1 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 26.0 W/kg
**SAR(1 g) = 13 W/kg; SAR(10 g) = 6.04 W/kg**
Maximum value of SAR (measured) = 21.4 W/kg




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

## Impedance Measurement Plot for Body TSL