# SAR TEST REPORT

## No. I20Z70178-SEM03

**For**

**SAMSUNG Electronics Co., Ltd.**

**Tablet with Bluetooth, WLAN**

**Model Name: SM-T500**

**With**

**Hardware Version: REV1.0**

**Software Version: T500.001**

**FCC ID: ZCASMT500**

**Issued Date: 2020-7-30**

**Note:**

The test results in this test report relate only to the devices specified in this report. This report shall not be reproduced except in full without the written approval of CTTL.

The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S.Government.

**Test Laboratory:**

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## REPORT HISTORY

| Report Number | Revision | Issue Date | Description |
|---|---|---|---|
| I20Z70178-SEM03 | Rev.0 | 2020-7-28 | Initial creation of test report |
| I20Z70178-SEM03 | Rev.1 | 2020-7-30 | Change device type from mobile phone to tablet on page6. |

# TABLE OF CONTENT



# 1 Test Laboratory

## 1.1 Testing Location

| | |
|---|---|
| Company Name: | CTTL(Shouxiang) |
| Address: | No. 51 Shouxiang Science Building, Xueyuan Road, Haidian District, Beijing, P. R. China100191 |
| (if applicable)<br>SAR test lab number | 12389A-1 |

## 1.2 Testing Environment

| | |
|---|---|
| Temperature: | 18°C~25 °C, |
| Relative humidity: | 30%~ 70% |
| Ground system resistance: | < 0.5 Ω |
| Ambient noise & Reflection: | < 0.012 W/kg |

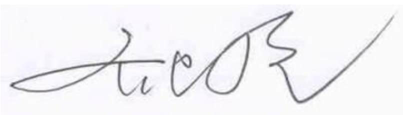
## 1.3 Project Data

| | |
|---|---|
| Project Leader: | Qi Dianyuan |
| Test Engineer: | Lin Xiaojun |
| Testing Start Date: | July 23, 2020 |
| Testing End Date: | July 26, 2020 |

## 1.4 Signature

**Lin Xiaojun**

**(Prepared this test report)**



**Qi Dianyuan**

**(Reviewed this test report)**

**Lu Bingsong**

**Deputy Director of the laboratory**

**(Approved this test report)**

## 2 Statement of Compliance

The maximum results of SAR found during testing for SAMSUNG Electronics Co., Ltd. Tablet with Bluetooth, WLAN SM-T500 is as follows:

**Table 2.1: Highest Reported SAR (1g)**

| Mode | Body 1g SAR(W/Kg) | Equipment Class | 1g SAR Limits (W/kg) |
|---|---|---|---|
| WLAN 2.4GHz | **1.38** | DTS | 1.6 |
| WLAN 5GHz | 1.25 | | |

The SAR values found for the Tablet are below the maximum recommended levels of 1.6 W/kg as averaged over any 1g tissue according to the ANSI C95.1-1992.

For body worn operation, this device has been tested and meets FCC RF exposure guidelines when used with any accessory that contains no metal and which provides a minimum separation distance from 0/18 mm between this device and the body of the user. Use of other accessories may not ensure compliance with FCC RF exposure guidelines.

The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power output.

The measurement together with the test system set-up is described in annex C of this test report. A detailed description of the equipment under test can be found in chapter 4 of this test report.

The highest reported SAR value is obtained at the case of **(Table 2.1),** and the values are**: 1.38 W/kg (1g).**

# 3 Client Information

## 3.1 Applicant Information

| | |
|---|---|
| Company Name: | SAMSUNG Electronics Co., Ltd. |
| Address /Post: | 19 Chapin Road, Building D, Pine Brook New Jersey United States, 07058 |
| Contact Person: | Jenni Chun |
| E-mail: | j1.chun@samsung.com |
| Telephone: | 1-973-808-6375 |
| Fax: | N/A |

## 3.2 Manufacturer Information

| | |
|---|---|
| Company Name: | SAMSUNG Electronics Co., Ltd. |
| Address /Post: | Samsung R5, Maetan dong 129, Samsung ro<br>Youngtong gu, Suwon city 443 742, Korea |
| Contact Person: | Kobe Cho |
| E-mail: | ggobi.cho@samsung.com |
| Telephone: | +82 - 10 - 2722 - 4159 |
| Fax: | N/A |

# 4 Equipment Under Test (EUT) and Ancillary Equipment (AE)

## 4.1 About EUT

| | |
|---|---|
| Description: | Tablet with Bluetooth, WLAN |
| Model name: | SM-T500 |
| Operating mode(s): | BT, WLAN(Wi-Fi2.4G&5G) |
| Tested Tx Frequency: | 2412 – 2462 MHz (Wi-Fi 2.4G)<br>5.15 – 5.35 GHz  5.47 – 5.85 GHz(Wi-Fi 5G) |
| GPRS/EGPRS Multislot Class: | / |
| Device type: | Tablet |
| Antenna type: | Embedded |
| Hotspot mode: | / |
| Product dimension | Long 247.6mm ;Wide 157.36mm ; Diagonal 293.37mm |

## 4.2 Internal Identification of EUT used during the test

| EUT ID* | IMEI/SN | HW Version | SW Version |
|---|---|---|---|
| UT01a | 2070178UT08a | REV1.0 | T500.001 |
| UT02a | 2070178UT17a | REV1.0 | T500.001 |

*EUT ID: is used to identify the test sample in the lab internally.

**Note:** It is performed to test SAR with the UT01a and conducted power with the UT02a.

## 4.3 Internal Identification of AE used during the test

| AE ID | Description | Model | SN | Manufactory |
|---|---|---|---|---|
| AE1 | Battery | SCUD-WT-N19 | / | SCUD(Fujian)Electronics Co.,Ltd. |
| AE2 | Headset | GH59-15060A | / | ALMUS CO.,LTD |

*AE ID: is used to identify the test sample in the lab internally.

# 5 TEST METHODOLOGY

## 5.1 Applicable Limit Regulations

**ANSI C95.1–1992:** IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

It specifies the maximum exposure limit of **1.6 W/kg** as averaged over any 1 gram of tissue for portable devices being used within 20 cm of the user in the uncontrolled environment.

## 5.2 Applicable Measurement Standards

**IEEE 1528–2013:** Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.

**KDB447498 D01 General RF Exposure Guidance v06:** Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

**KDB616217 D04 SAR for laptop and tablets v01r02** SAR Evaluation Considerations for Laptop, Notebook, Notebook and Tablet Computers.

**KDB648474 D04 Handset SAR v01r03:** SAR Evaluation Considerations for Wireless Handsets.

**KDB941225 D01 SAR test for 3G devices v03r01:** SAR Measurement Procedures for 3G Devices

**KDB941225 D05 SAR for LTE Devices v02r05:** SAR Evaluation Considerations for LTE Devices

**KDB248227 D01 802.11 Wi-Fi SAR v02r02:** SAR GUIDANCE FOR IEEE 802.11 (Wi-Fi) TRANSMITTERS

**KDB865664 D01SAR measurement 100 MHz to 6 GHz v01r04:** SAR Measurement Requirements for 100 MHz to 6 GHz.

**KDB865664 D02 RF Exposure Reporting v01r02:** RF Exposure Compliance Reporting and Documentation Considerations

# 6 Specific Absorption Rate (SAR)

## 6.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

## 6.2 SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy ( $dW$ ) absorbed by (dissipated in) an incremental mass ( $dm$ ) contained in a volume element ( $dv$ ) of a given density ( $\rho$ ) . The equation description is as below:

$$SAR = \frac{d}{dt}(\frac{dW}{dm}) = \frac{d}{dt}(\frac{dW}{\rho dv})$$

SAR is expressed in units of Watts per kilogram (W/kg)

SAR measurement can be either related to the temperature elevation in tissue by

$$SAR = c(\frac{\delta T}{\delta t})$$

Where: C is the specific head capacity, $\delta T$ is the temperature rise and $\delta t$ is the exposure duration, or related to the electrical field in the tissue by

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

Where: $\sigma$ is the conductivity of the tissue, $\rho$ is the mass density of tissue and $E$ is the RMS electrical field strength.

However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

# 7 Tissue Simulating Liquids

## 7.1 Targets for tissue simulating liquid

**Table 7.1: Targets for tissue simulating liquid**

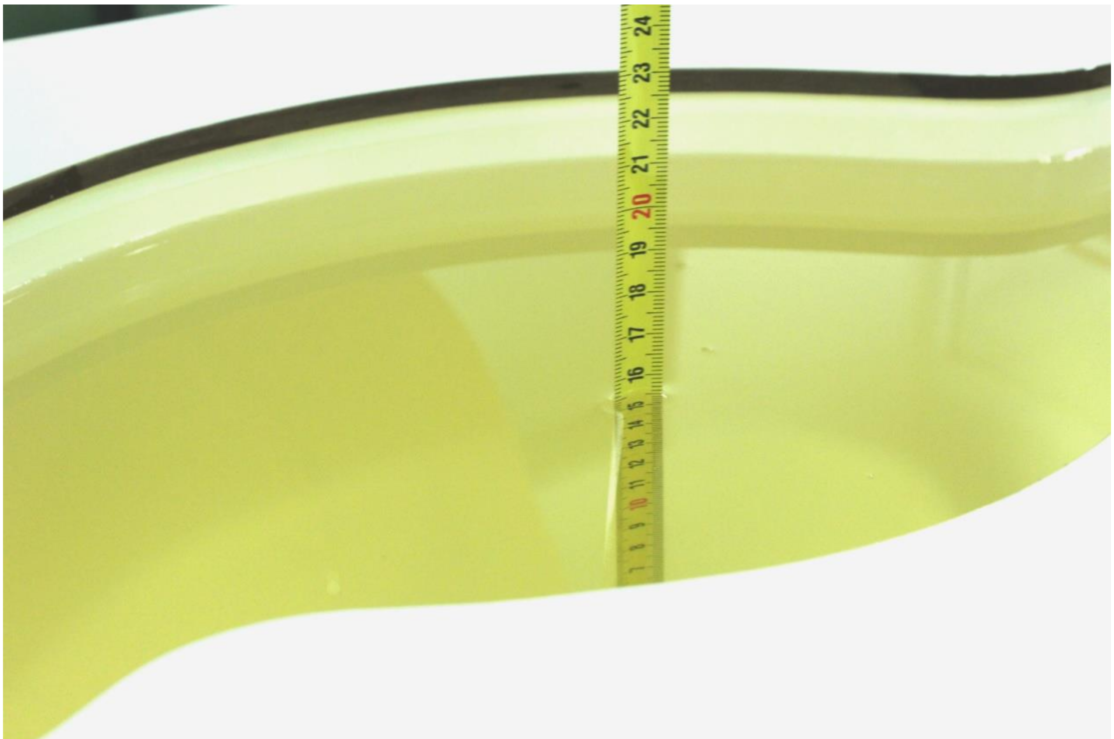
| Frequency(MHz) | Liquid Type | Conductivity(σ) | ± 5% Range | Permittivity(ε) | ± 5% Range |
|---|---|---|---|---|---|
| 2450 | Head | 1.80 | 1.71～1.89 | 39.2 | 37.2～41.2 |
| 5250 | Head | 4.71 | 4.47～4.95 | 35.93 | 34.13～37.73 |
| 5600 | Head | 5.07 | 4.82～5.32 | 35.53 | 33.8～37.3 |
| 5750 | Head | 5.22 | 4.96～5.48 | 35.36 | 33.59～37.13 |

## 7.2 Dielectric Performance

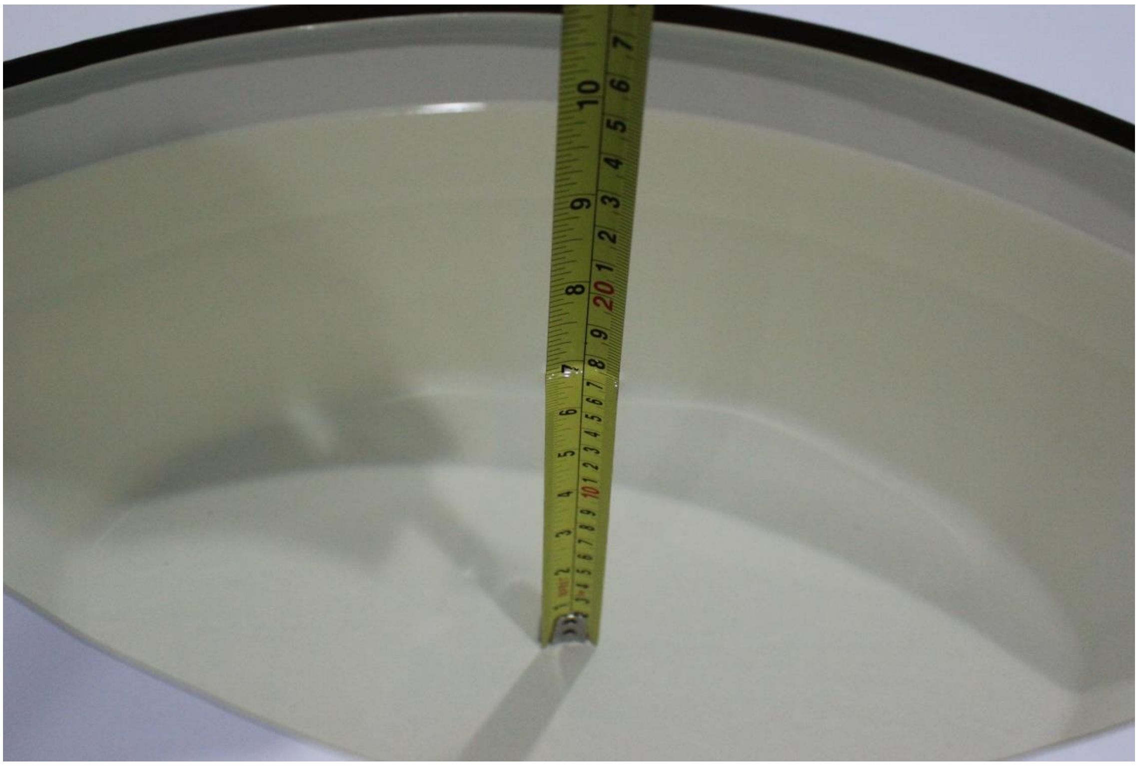
**Table 7.2: Dielectric Performance of Tissue Simulating Liquid**

| Measurement Date yyyy/mm/dd | Frequency | Type | Permittivity ε | Drift (%) | Conductivity σ (S/m) | Drift (%) |
|---|---|---|---|---|---|---|
| 2020/7/23 | 2450MHz | Head | 38.82 | -0.97 | 1.767 | -1.83 |
| 2020/7/24 | 5200 MHz | Head | 35.35 | -1.78 | 4.692 | 0.69 |
| 2020/7/25 | 5600 MHz | Head | 36.1 | 1.60 | 5.082 | 0.24 |
| 2020/7/26 | 5800 MHz | Head | 35.06 | -0.68 | 5.323 | 1.01 |

Note: The liquid temperature is 22.0℃



**Picture 7-1 Liquid depth in the Flat Phantom (2450MHz)**

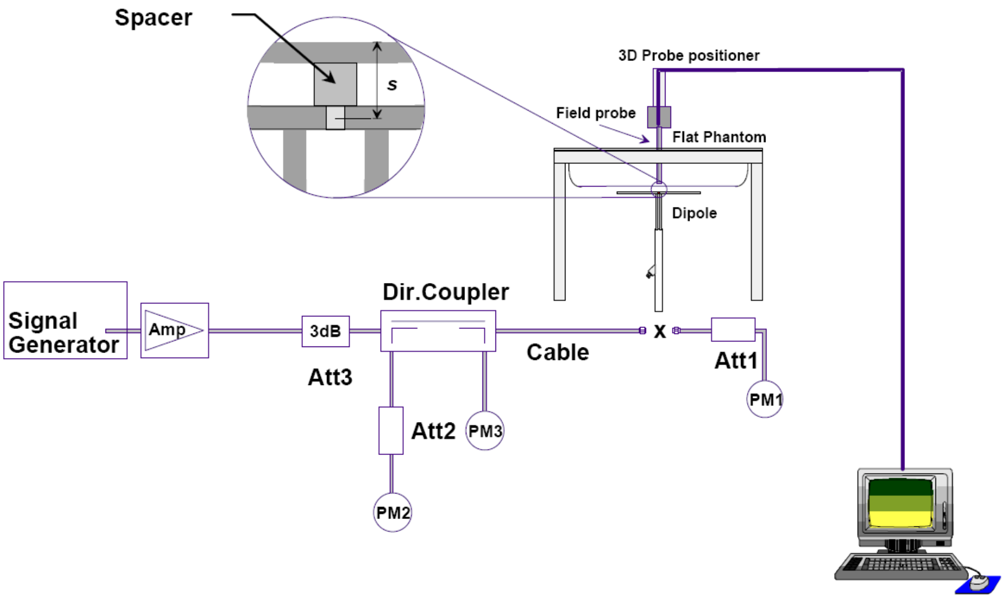


**Picture 7-2 Liquid depth in the Flat Phantom (5GHz)**

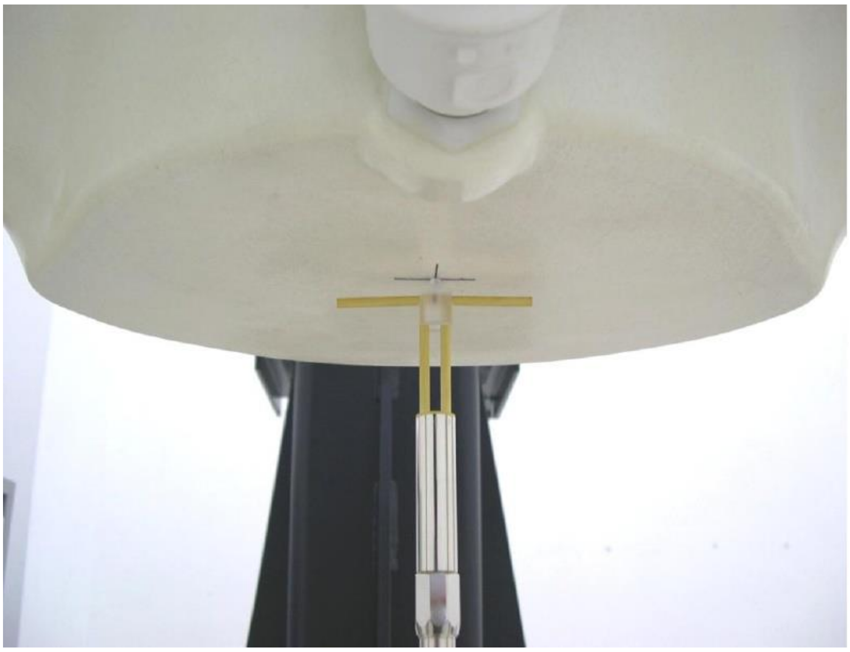
# 8 System verification

## 8.1 System Setup

In the simplified setup for system evaluation, the DUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave that comes from a signal generator. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The equipment setup is shown below:




**Picture 8.1 System Setup for System Evaluation**



**Picture 8.2 Photo of Dipole Setup**

## 8.2 System Verification

SAR system verification is required to confirm measurement accuracy, according to the tissue dielectric media, probe calibration points and other system operating parameters required for measuring the SAR of a test device. The system verification must be performed for each frequency band and within the valid range of each probe calibration point required for testing the device.

The system verification results are required that the area scan estimated 1-g SAR is within 3% of the zoom scan 1-g SAR. The details are presented in annex B.

**Table 8.1: System Verification of Body**

| Measurement Date (yyyy-mm-dd) | Frequency | Target value (W/kg) | | Measured value (W/kg) | | Deviation | |
|---|---|---|---|---|---|---|---|
| | | 10 g Average | 1 g Average | 10 g Average | 1 g Average | 10 g Average | 1 g Average |
| 2020/7/23 | 2450MHz | 5.98 | 13.1 | 6.02 | 13.18 | 0.67% | 0.61% |
| 2020/7/24 | 5200 MHz | 2.17 | 7.59 | 2.1 | 7.6 | -1.38% | 0.40% |
| 2020/7/25 | 5600 MHz | 2.3 | 8.07 | 2.3 | 8.0 | 1.74% | -0.74% |
| 2020/7/26 | 5800 MHz | 2.28 | 7.94 | 2.3 | 8.1 | 2.19% | 1.51% |

# 9 Measurement Procedures

## 9.1 Tests to be performed

In order to determine the highest value of the peak spatial-average SAR of a handset, all device positions, configurations and operational modes shall be tested for each frequency band according to steps 1 to 3 below. A flowchart of the test process is shown in picture 9.1.

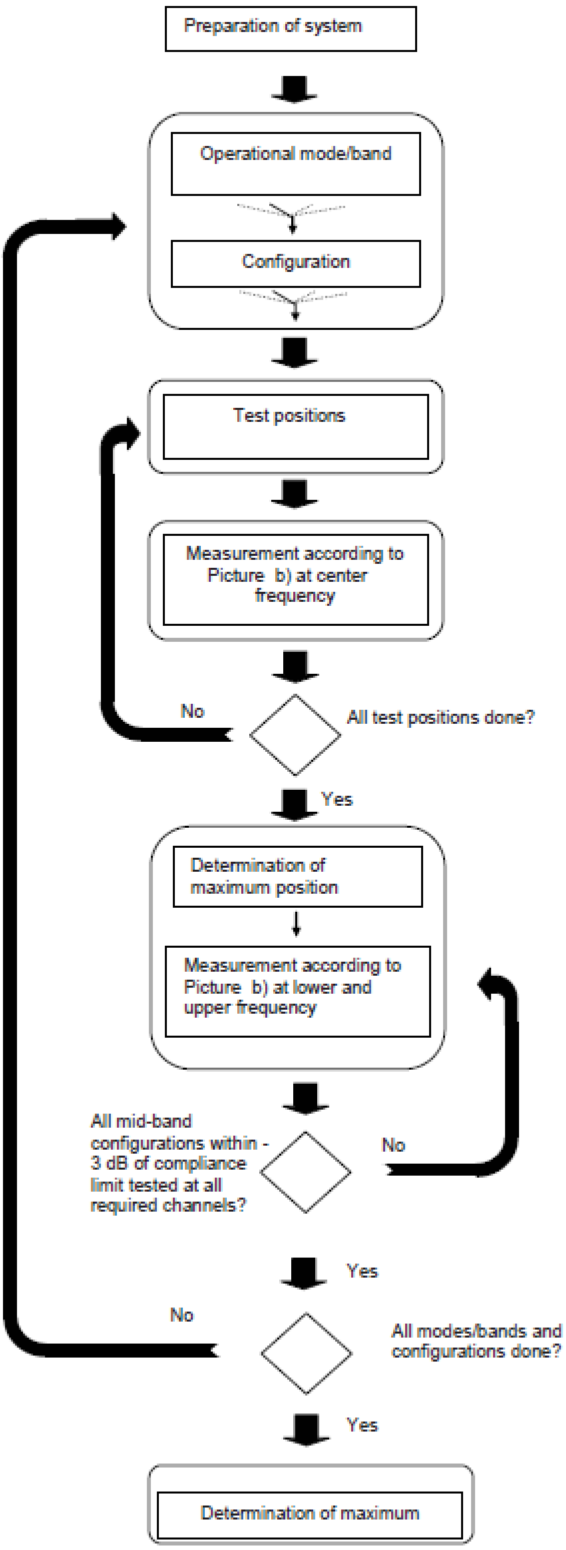
**Step 1**: The tests described in 9.2 shall be performed at the channel that is closest to the center of the transmit frequency band ( $f_c$) for:

a) all device positions (cheek and tilt, for both left and right sides of the SAM phantom, as described in annex D),
b) all configurations for each device position in a), e.g., antenna extended and retracted, and
c) all operational modes, e.g., analogue and digital, for each device position in a) and configuration in b) in each frequency band.

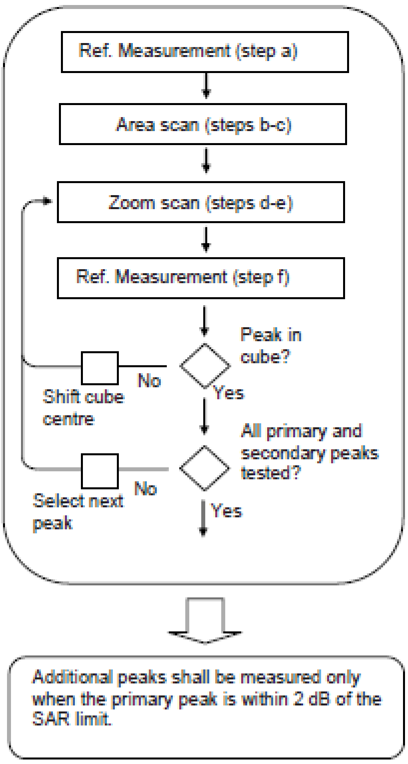
If more than three frequencies need to be tested according to 11.1 (i.e., $N_c$ > 3), then all frequencies, configurations and modes shall be tested for all of the above test conditions.

**Step 2**: For the condition providing highest peak spatial-average SAR determined in Step 1, perform all tests described in 9.2 at all other test frequencies, i.e., lowest and highest frequencies. In addition, for all other conditions (device position, configuration and operational mode) where the peak spatial-average SAR value determined in Step 1 is within 3 dB of the applicable SAR limit, it is recommended that all other test frequencies shall be tested as well.

**Step 3**: Examine all data to determine the highest value of the peak spatial-average SAR found in Steps 1 to 2.




Picture a – Tests to be performed




Picture b – General procedure

**Picture 9.1 Block diagram of the tests to be performed**

## 9.2 General Measurement Procedure

The area and zoom scan resolutions specified in the table below must be applied to the SAR measurements and fully documented in SAR reports to qualify for TCB approval. Probe boundary effect error compensation is required for measurements with the probe tip closer than half a probe tip diameter to the phantom surface. Both the probe tip diameter and sensor offset distance must satisfy measurement protocols; to ensure probe boundary effect errors are minimized and the higher fields closest to the phantom surface can be correctly measured and extrapolated to the phantom surface for computing 1-g SAR. Tolerances of the post-processing algorithms must be verified by the test laboratory for the scan resolutions used in the SAR measurements, according to the reference distribution functions specified in IEEE Std 1528-2013. The results should be documented as part of the system validation records and may be requested to support test results when all the measurement parameters in the following table are not satisfied.

<table>
<tr><td colspan="3"></td><td>≤ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td colspan="3">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 ± 1 mm</td><td>½·δ·ln(2) ± 0.5 mm</td></tr>
<tr><td colspan="3">Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td colspan="3" rowspan="2">Maximum area scan spatial resolution: $\Delta x_{Area}$, $\Delta y_{Area}$</td><td>≤ 2 GHz: ≤ 15 mm<br>2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm<br>4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: $\Delta x_{Zoom}$, $\Delta y_{Zoom}$</td><td>≤ 2 GHz: ≤ 8 mm<br>2 – 3 GHz: ≤ 5 mm*</td><td>3 – 4 GHz: ≤ 5 mm*<br>4 – 6 GHz: ≤ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm<br>4 – 5 GHz: ≤ 3 mm<br>5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>≤ 4 mm</td><td>3 – 4 GHz: ≤ 3 mm<br>4 – 5 GHz: ≤ 2.5 mm<br>5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">≤ 1.5·$\Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>≥ 30 mm</td><td>3 – 4 GHz: ≥ 28 mm<br>4 – 5 GHz: ≥ 25 mm<br>5 – 6 GHz: ≥ 22 mm</td></tr>
<tr><td colspan="5">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.<br>* When zoom scan is required and the <u>reported</u> SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

## 9.3 WCDMA Measurement Procedures for SAR

The following procedures are applicable to WCDMA handsets operating under 3GPP Release99, Release 5 and Release 6. The default test configuration is to measure SAR with an established radio link between the DUT and a communication test set using a 12.2kbps RMC (reference measurement channel) configured in Test Loop Mode 1. SAR is selectively confirmed for other physical channel configurations (DPCCH & $DPDCH_n$), HSDPA and HSPA (HSUPA/HSDPA) modes according to output power, exposure conditions and device operating capabilities. Both uplink and downlink should be configured with the same RMC or AMR, when required. SAR for Release 5 HSDPA and Release 6 HSPA are measured using the applicable FRC (fixed reference channel) and E-DCH reference channel configurations. Maximum output power is verified according to applicable versions of 3GPP TS 34.121 and SAR must be measured according to these maximum output conditions. When Maximum Power Reduction (MPR) is not implemented according to Cubic Metric (CM) requirements for Release 6 HSPA, the following procedures do not apply.

**For Release 5 HSDPA Data Devices:**

| Sub-test | $\beta_c$ | $\beta_d$ | $\beta_d$ (SF) | $\beta_c/\beta_d$ | $\beta_{hs}$ | CM/dB |
|---|---|---|---|---|---|---|
| 1 | 2/15 | 15/15 | 64 | 2/15 | 4/15 | 0.0 |
| 2 | 12/15 | 15/15 | 64 | 12/15 | 24/25 | 1.0 |
| 3 | 15/15 | 8/15 | 64 | 15/8 | 30/15 | 1.5 |
| 4 | 15/15 | 4/15 | 64 | 15/4 | 30/15 | 1.5 |

**For Release 6 HSPA Data Devices**

| Sub-test | $\beta_c$ | $\beta_d$ | $\beta_d$ (SF) | $\beta_c/\beta_d$ | $\beta_{hs}$ | $\beta_{ec}$ | $\beta_{ed}$ | $\beta_{ed}$ (SF) | $\beta_{ed}$ (codes) | CM (dB) | MPR (dB) | AG Index | E-TFCI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 11/15 | 15/15 | 64 | 11/15 | 22/15 | 209/225 | 1039/225 | 4 | 1 | 1.5 | 1.5 | 20 | 75 |
| 2 | 6/15 | 15/15 | 64 | 6/15 | 12/15 | 12/15 | 12/15 | 4 | 1 | 1.5 | 1.5 | 12 | 67 |
| 3 | 15/15 | 9/15 | 64 | 15/9 | 30/15 | 30/15 | $\beta_{ed1}$:47/15<br>$\beta_{ed2}$:47/15 | 4 | 2 | 1.5 | 1.5 | 15 | 92 |
| 4 | 2/15 | 15/15 | 64 | 2/15 | 4/15 | 4/15 | 56/75 | 4 | 1 | 1.5 | 1.5 | 17 | 71 |
| 5 | 15/15 | 15/15 | 64 | 15/15 | 24/15 | 30/15 | 134/15 | 4 | 1 | 1.5 | 1.5 | 21 | 81 |

**Rel.8 DC-HSDPA (Cat 24)**

SAR test exclusion for Rel.8 DC-HSDPA must satisfy the SAR test exclusion requirements of Rel.5 HSDPA. SAR test exclusion for DC-HSDPA devices is determined by power measurements according to the H-Set 12, Fixed Reference Channel (FRC) configuration in Table C.8.1.12 of 3GPP TS 34.121-1. A primary and a secondary serving HS-DSCH Cell are required to perform the power measurement and for the results to qualify for SAR test exclusion.

## 9.4 SAR Measurement for LTE

SAR tests for LTE are performed with a base station simulator, Rohde & Rchwarz CMW500. Closed loop power control was used so the UE transmits with maximum output power during SAR testing.
All powers were measured with the CMW 500.
It is performed for conducted power and SAR based on the KDB941225 D05.
SAR is evaluated separately according to the following procedures for the different test positions in each exposure condition – head, body, body-worn accessories and other use conditions. The procedures in the following subsections are applied separately to test each LTE frequency band.

1) QPSK with 1 RB allocation

   Start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power among RB offsets at the upper edge, middle and lower edge of each required test channel. When the reported SAR is ≤ 0.8 W/kg, testing of the remaining RB offset configurations and required test channels is not required for 1 RB allocation; otherwise, SAR is required for the remaining required test channels and only for the RB offset configuration with the highest output power for that channel. When the reported SAR of a required test channel is > 1.45 W/kg, SAR is required for all three RB offset configurations for that required test channel.

2) QPSK with 50% RB allocation

   The procedures required for 1 RB allocation in 1) are applied to measure the SAR for QPSK with 50% RB allocation.

3) QPSK with 100% RB allocation

   For QPSK with 100% RB allocation, SAR is not required when the highest maximum output power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation in 1) and 2) are ≤ 0.8 W/kg. Otherwise, SAR is measured for the highest output power channel; and if the reported SAR is > 1.45 W/kg, the remaining required test channels must also be tested.

## 9.5 Bluetooth & Wi-Fi Measurement Procedures for SAR

Normal network operating configurations are not suitable for measuring the SAR of 802.11 transmitters in general. 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 that the results are consistent and reliable.
Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in a 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. The test frequencies should correspond to actual channel frequencies defined for domestic use. SAR for devices with switched diversity should be measured with only one antenna transmitting at a time during each SAR measurement, according to a fixed modulation and data rate. The same data pattern should be used for all measurements.

## 9.6 Power Drift

To control the output power stability during the SAR test, DASY4 system calculates the power drift by measuring the E-field at the same location at the beginning and at the end of the measurement for each test position. These drift values can be found in section 14 labeled as: (Power Drift [dB]). This ensures that the power drift during one measurement is within 5%.

# 10 Area Scan Based 1-g SAR

## 10.1 Requirement of KDB

According to the KDB447498 D01 v05, when the implementation is based the specific polynomial fit
algorithm as presented at the 29th Bioelectromagnetics Society meeting (2007) and the estimated 1-g SAR is ≤ 1.2 W/kg, a zoom scan measurement is not required provided it is also not needed for any other purpose; for example, if the peak SAR location required for simultaneous transmission SAR test exclusion can be determined accurately by the SAR system or manually to discriminate between distinctive peaks and scattered noisy SAR distributions from area scans.

There must not be any warning or alert messages due to various measurement concerns identified by the SAR system; for example, noise in measurements, peaks too close to scan boundary, peaks are too sharp, spatial resolution and uncertainty issues etc. The SAR system verification must also demonstrate that the area scan estimated 1-g SAR is within 3% of the zoom scan 1-g SAR (See Annex B). When all the SAR results for each exposure condition in a frequency band and wireless mode are based on estimated 1-g SAR, the 1-g SAR for the highest SAR configuration must be determined by a zoom scan.

## 10.2 Fast SAR Algorithms

The approach is based on the area scan measurement applying a frequency dependent attenuation parameter. This attenuation parameter was empirically determined by analyzing a large number of phones. The MOTOROLA FAST SAR was developed and validated by the MOTOROLA Research Group in Ft. Lauderdale.

In the initial study, an approximation algorithm based on Linear fit was developed. The accuracy of the algorithm has been demonstrated across a broad frequency range (136-2450 MHz) and for both 1- and 10-g averaged SAR using a sample of 264 SAR measurements from 55 wireless handsets. For the sample size studied, the root-mean-squared errors of the algorithm are 1.2% and 5.8% for 1- and 10-g averaged SAR, respectively. The paper describing the algorithm in detail is expected to be published in August 2004 within the Special Issue of Transactions on MTT.

In the second step, the same research group optimized the fitting algorithm to an Polynomial fit whereby the frequency validity was extended to cover the range 30-6000MHz. Details of this study can be found in the BEMS 2007 Proceedings.
Both algorithms are implemented in DASY software.

# 11 Conducted Output Power

There are two sets of tune-up power, Normal power and Low power, for Wi-Fi2.4G and Wi-Fi5G by proximity sensor. The detail of proximity sensor is presented in annex I.

## 11.1 Wi-Fi and BT Measurement result

The maximum output power of BT is 9.07dBm.
The maximum tune up of BT is 9.7dBm.

WiFi 2.4G-Normal power

| **802.11b** | | | | |
|---|---|---|---|---|
| Channel\data rate | 1Mbps | 2Mbps | 5.5Mbps | 11Mbps |
| 11(2462MHz) | 18.60 | 18.69 | / | / |
| 6(2437(MHz) | 18.84 | 18.90 | 18.83 | 18.85 |
| 1(2412MHz) | 18.65 | 18.82 | / | / |
| Tune up | 19.50 | 19.50 | 19.50 | 19.50 |

| **802.11g** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Channel\data rate | 6Mbps | 9Mbps | 12Mbps | 18Mbps | 24Mbps | 36Mbps | 48Mbps | 54Mbps |
| 11(2462MHz) | 17.09 | / | / | / | / | / | / | / |
| 6(2437(MHz) | 17.32 | 16.81 | 16.26 | 16.50 | 16.30 | 15.74 | 15.32 | 14.75 |
| 1(2412MHz) | 17.11 | / | / | / | / | / | / | / |
| Tune up | 18.00 | 17.50 | 17.00 | 17.00 | 17.00 | 16.50 | 16.00 | 15.50 |
| **802.11n-20MHz** | | | | | | | | |
| Channel\data rate | MCS0 | MCS1 | MCS2 | MCS3 | MCS4 | MCS5 | MCS6 | MCS7 |
| 11(2462MHz) | 16.95 | / | / | / | / | / | / | / |
| 6(2437(MHz) | 17.15 | 16.49 | 16.35 | 16.30 | 16.24 | 15.70 | 15.25 | 14.57 |
| 1(2412MHz) | 16.85 | / | / | / | / | / | / | / |
| Tune up | 18.00 | 17.50 | 17.00 | 17.00 | 17.00 | 16.50 | 16.00 | 15.00 |

WiFi 2.4G-Low power

| 802.11b | | | | |
|---|---|---|---|---|
| Channel\data rate | 1Mbps | 2Mbps | 5.5Mbps | 11Mbps |
| 11(2462MHz) | 13.52 | 13.55 | 13.54 | 13.53 |
| 6(2437(MHz) | 13.45 | 13.48 | / | / |
| 1(2412MHz) | 13.50 | 13.51 | / | / |
| Tune up | 14.00 | 14.00 | 14.00 | 14.00 |

| 802.11g | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Channel\data rate | 6Mbps | 9Mbps | 12Mbps | 18Mbps | 24Mbps | 36Mbps | 48Mbps | 54Mbps |
| 11(2462MHz) | 13.60 | 13.57 | 13.62 | 13.70 | 13.77 | 13.69 | 13.62 | 13.63 |
| 6(2437(MHz) | 13.57 | / | / | / | 13.65 | / | / | / |
| 1(2412MHz) | 13.42 | / | / | / | 13.59 | / | / | / |
| Tune up | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 |
| **802.11n-20MHz** | | | | | | | | |
| Channel\data rate | MCS0 | MCS1 | MCS2 | MCS3 | MCS4 | MCS5 | MCS6 | MCS7 |
| 11(2462MHz) | 13.40 | 13.45 | 13.59 | 13.54 | 13.55 | 13.46 | 13.53 | 13.46 |
| 6(2437(MHz) | 13.34 | / | 13.52 | / | / | / | / | / |
| 1(2412MHz) | 13.23 | / | 13.45 | / | / | / | / | / |
| Tune up | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 |

WiFi 5G- Normal power

| 802.11a(dBm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Channel\data rate | 6Mbps | 9Mbps | 12Mbps | 18Mbps | 24Mbps | 36Mbps | 48Mbps | 54Mbps |
| 36(5180 MHz) | 17.81 | 17.29 | 16.89 | 16.29 | 15.98 | 15.54 | 15.14 | 14.65 |
| 40(5200 MHz) | 17.68 | / | / | / | / | / | / | / |
| 44(5220 MHz) | 17.54 | / | / | / | / | / | / | / |
| 48(5240 MHz) | 17.79 | / | / | / | / | / | / | / |
| 52(5260 MHz) | 18.25 | / | / | / | / | / | / | / |
| 56(5280 MHz) | 18.56 | / | / | / | / | / | / | / |
| 60(5300 MHz) | 18.65 | 17.96 | 17.59 | 16.94 | 16.69 | 16.26 | 15.80 | 15.29 |
| 64(5320 MHz) | 18.38 | / | / | / | / | / | / | / |
| Tune up | 19.00 | 18.50 | 18.00 | 17.50 | 17.00 | 16.50 | 16.00 | 15.50 |
| 100(5500 MHz) | 17.68 | / | / | / | / | / | / | / |
| 104(5520 MHz) | 17.42 | / | / | / | / | / | / | / |
| 108(5540 MHz) | 17.44 | / | / | / | / | / | / | / |
| 112(5560 MHz) | 17.38 | / | / | / | / | / | / | / |
| 116(5580 MHz) | 17.79 | / | / | / | / | / | / | / |
| 120(5600 MHz) | 18.31 | / | / | / | / | / | / | / |
| 124(5620 MHz) | 18.46 | / | / | / | / | / | / | / |
| 128(5640 MHz) | 18.70 | 18.13 | 17.74 | 17.14 | 16.87 | 16.43 | 15.96 | 15.46 |
| 132(5660 MHz) | 18.42 | / | / | / | / | / | / | / |
| 136(5680 MHz) | 17.49 | / | / | / | / | / | / | / |
| 140(5700 MHz) | 16.70 | / | / | / | / | / | / | / |
| 144(5720 MHz) | 17.60 | / | / | / | / | / | / | / |
| Tune up | 19.00 | 18.50 | 18.00 | 17.50 | 17.00 | 16.50 | 16.00 | 15.50 |
| 149(5745 MHz) | 17.47 | / | / | / | / | / | / | / |
| 153(5765 MHz) | 17.93 | / | / | / | / | / | / | / |
| 157(5785 MHz) | 18.78 | / | / | / | / | / | / | / |
| 161(5805 MHz) | 18.83 | 18.33 | 17.80 | 17.15 | 16.79 | 16.21 | 15.75 | 15.17 |
| 165(5825 MHz) | 18.42 | / | / | / | / | / | / | / |
| Tune up | 19.00 | 18.50 | 18.00 | 17.50 | 17.00 | 16.50 | 16.00 | 15.50 |

Note: The tune up of CH140(5700 MHz) is 18dBm.

WiFi 5G- Low power

| 802.11n(dBm)-40MHz | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Channel\data rate | MCS0 | MCS1 | MCS2 | MCS3 | MCS4 | MCS5 | MCS6 | MCS7 |
| 38(5190 MHz) | 7.83 | 7.80 | 7.82 | 7.81 | 7.11 | 7.05 | 6.99 | 6.97 |
| 46(5230 MHz) | 7.49 | / | / | / | / | / | / | / |
| 54(5270 MHz) | 8.37 | / | / | / | / | / | / | / |
| 62(5310 MHz) | 8.89 | 8.84 | 8.82 | 8.85 | 8.10 | 8.04 | 7.99 | 7.92 |
| Tune up | 9.40 | 9.40 | 9.40 | 9.40 | 9.00 | 9.00 | 8.90 | 8.90 |
| 102(5510 MHz) | 7.51 | / | / | / | / | / | / | / |
| 110(5550 MHz) | 7.39 | / | / | / | / | / | / | / |
| 118(5590 MHz) | 7.95 | / | / | / | / | / | / | / |
| 126(5630 MHz) | 8.65 | 8.62 | 8.63 | 8.60 | 7.95 | 7.85 | 7.82 | 7.77 |
| 134(5670 MHz) | 7.95 | / | / | / | / | / | / | / |
| 142(5710 MHz) | 7.21 | / | / | / | / | / | / | / |
| Tune up | 9.20 | 9.20 | 9.20 | 9.20 | 9.00 | 9.00 | 8.90 | 8.90 |
| 151(5755 MHz) | 7.39 | / | / | / | / | / | / | / |
| 159(5795 MHz) | 8.32 | 8.31 | 8.27 | 8.28 | 7.43 | 7.39 | 7.35 | 7.27 |
| Tune up | 9.30 | 9.30 | 9.30 | 9.30 | 9.00 | 9.00 | 8.90 | 8.90 |

| 802.11ac(dBm)-40MHz | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Channel\data rate | MCS0 | MCS1 | MCS2 | MCS3 | MCS4 | MCS5 | MCS6 | MCS7 | MCS8 | MCS9 |
| 38(5190 MHz) | 7.84 | 7.86 | 7.85 | 7.83 | 7.14 | 7.08 | 7.03 | 6.97 | 6.07 | 6.82 |
| 46(5230 MHz) | 7.54 | 7.57 | / | / | / | / | / | / | / | / |
| 54(5270 MHz) | 8.42 | 8.44 | / | / | / | / | / | / | / | / |
| 62(5310 MHz) | 8.84 | 8.89 | 8.88 | 8.85 | 8.13 | 8.06 | 8.01 | 7.96 | 7.87 | 7.83 |
| Tune up | 9.50 | 9.50 | 9.50 | 9.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 |
| 102(5510 MHz) | 7.57 | 7.60 | / | / | / | / | / | / | / | / |
| 110(5550 MHz) | 7.38 | 7.42 | / | / | / | / | / | / | / | / |
| 118(5590 MHz) | 7.98 | 8.01 | / | / | / | / | / | / | / | / |
| 126(5630 MHz) | 8.67 | 8.68 | 8.66 | 8.65 | 7.96 | 7.86 | 7.84 | 7.80 | 7.75 | 7.66 |
| 134(5670 MHz) | 8.02 | 8.04 | / | / | / | / | / | / | / | / |
| 142(5710 MHz) | 7.23 | 7.24 | / | / | / | / | / | / | / | / |
| Tune up | 9.20 | 9.20 | 9.20 | 9.20 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 |
| 151(5755 MHz) | 7.44 | 7.49 | / | / | / | / | / | / | / | / |
| 159(5795 MHz) | 8.36 | 8.37 | 8.31 | 8.29 | 7.48 | 7.39 | 7.37 | 7.29 | 7.24 | 7.22 |
| Tune up | 9.40 | 9.40 | 9.40 | 9.40 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 |

| 802.11ac(dBm)-80MHz | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Channel\data rate | MCS0 | MCS1 | MCS2 | MCS3 | MCS4 | MCS5 | MCS6 | MCS7 | MCS8 | MCS9 |
| 42(5210 MHz) | 7.59 | 7.52 | 8.21 | 8.07 | 7.47 | 7.27 | 7.20 | 7.13 | 6.96 | 6.95 |
| 58(5290 MHz) | 8.60 | 8.52 | 9.18 | 9.08 | 8.38 | 8.23 | 8.16 | 8.09 | 7.93 | 7.87 |
| Tune up | 9.50 | 9.50 | 9.50 | 9.50 | 9.00 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 |
| 106(5530 MHz) | 7.41 | 7.39 | 8.05 | 7.97 | 7.26 | 7.17 | 7.11 | 7.00 | 6.88 | 6.80 |
| 122(5610 MHz) | 7.29 | / | 7.79 | / | / | / | / | / | / | / |
| 138(5690 MHz) | 7.36 | / | 7.91 | / | / | / | / | / | / | / |
| Tune up | 9.20 | 9.20 | 9.20 | 9.20 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 |
| 155(5775 MHz) | 7.47 | 7.36 | 8.09 | 8.04 | 7.26 | 7.15 | 7.10 | 6.95 | 6.83 | 6.81 |
| Tune up | 9.40 | 9.40 | 9.40 | 9.40 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 | 8.50 |

# 12 Simultaneous TX SAR Considerations

## 12.1 Introduction

The following procedures adopted from “FCC SAR Considerations for Cell Phones with Multiple Transmitters” are applicable to handsets with built-in unlicensed transmitters such as 802.11 a/b/g and Bluetooth devices which may simultaneously transmit with the licensed transmitter.
For this device, the BT and Wi-Fi can transmit simultaneous with other transmitters.

## 12.2 Transmit Antenna Separation Distances

Please refer to the picture of antenna locations in the document: “The Photos of SAR test - I20Z70178”

## 12.3 Standalone SAR Test Exclusion Considerations

Standalone 1-g head or body SAR evaluation by measurement or numerical simulation is not required when the corresponding SAR Exclusion Threshold condition, listed below, is satisfied.
The 1-g SAR test exclusion threshold for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:
[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR, where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

**Table 12.1: Standalone SAR test exclusion considerations**

| Band/Mode | F(GHz) | Position | SAR test exclusion threshold(mW) | RF output power | | SAR test exclusion |
|---|---|---|---|---|---|---|
| | | | | dBm | mW | |
| Bluetooth | 2.441 | Body | 9.60 | 9.7 | 9.33 | YES |
| 2.4GHz WLAN | 2.45 | Body | 9.58 | 19.5 | 89.13 | NO |
| 5GHz WLAN | 5.2 | Body | 6.58 | 19 | 79.43 | NO |
| | 5.3 | Body | 6.52 | 19 | 79.43 | NO |
| | 5.6 | Body | 6.34 | 19 | 79.43 | NO |
| | 5.8 | Body | 6.23 | 19 | 79.43 | NO |

# 13 Evaluation of Simultaneous

N/A

## 14 SAR Test Result

It is determined by user manual for the distance between the EUT and the phantom bottom.

The distance are 0mm, 9mm, 10mm, 12mm and 14mm, and just applied to the condition of body worn accessory.

It is performed for all SAR measurements with area scan based 1-g SAR estimation (Fast SAR). A zoom scan measurement is added when the estimated 1-g SAR is the highest measured SAR in each exposure configuration, wireless mode and frequency band combination or more than 1.2W/kg.

The calculated SAR is obtained by the following formula:

$$\text{Reported SAR} = \text{Measured SAR} \times 10^{(P_{Target} - P_{Measured})/10}$$

Where $P_{Target}$ is the power of manufacturing upper limit;

$P_{Measured}$ is the measured power in chapter 11.

## 14.1 WLAN Evaluation for 2.4G

According to the KDB248227 D01, SAR is measured for 2.4GHz 802.11b DSSS using the initial test position procedure.

**Body Evaluation for 802.11b**

**Table 14.1-1: SAR Values (WLAN - Body)– 802.11b (Fast SAR)**

| Ambient Temperature: 22.9 °C Liquid Temperature: 22.5°C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | Test Position | Figure No./ Note | Conducted Power (dBm) | Max. tune-up Power (dBm) | Measured SAR(10g) (W/kg) | Reported SAR(10g)(W/kg) | Measured SAR(1g) (W/kg) | Reported SAR(1g) (W/kg) | Power Drift (dB) |
| MHz | Ch. | | | | | | | | | |
| 6 | 2437 | Rear | Note1 | 18.9 | 19.5 | 0.066 | **0.08** | 0.124 | **0.14** | 0.08 |
| 6 | 2437 | Top | Note1 | 18.9 | 19.5 | 0.093 | **0.11** | 0.179 | **0.21** | 0.03 |
| 11 | 2462 | Rear | Note2 | 13.55 | 14 | 0.322 | **0.36** | 0.9 | **1.00** | 0.08 |
| 6 | 2437 | Rear | Note2 | 13.48 | 14 | 0.274 | **0.31** | 0.76 | **0.86** | -0.12 |
| 1 | 2412 | Rear | Note2 | 13.51 | 14 | 0.416 | **0.47** | 1.13 | **1.26** | -0.02 |
| 11 | 2462 | Top | Note2 | 13.55 | 14 | 0.236 | **0.26** | 0.512 | **0.57** | 0.01 |
| 1 | 2412 | Rear | Note2/Headset | 13.51 | 14 | 0.401 | **0.45** | 1.08 | **1.21** | -0.06 |

Note1: The distance between the EUT and the phantom bottom is 18mm.

Note2: The distance between the EUT and the phantom bottom is 0mm

As shown above table, the initial test position for body is “Rear 0mm”. So the body SAR of WLAN is presented as below:

**Table 14.1-2: SAR Values (WLAN - Body)– 802.11b (Full SAR)**

| Ambient Temperature: 22.9 °C Liquid Temperature: 22.5°C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | Test Position | Figure No./ Note | Conducted Power (dBm) | Max. tune-up Power (dBm) | Measured SAR(10g) (W/kg) | Reported SAR(10g) (W/kg) | Measured SAR(1g) (W/kg) | Reported SAR(1g)( W/kg) | Power Drift (dB) |
| MHz | Ch. | | | | | | | | | |
| 6 | 2437 | Rear | / | 13.55 | 14 | 0.321 | **0.36** | 0.891 | **0.99** | 0.08 |
| 11 | 2462 | Rear | / | 13.48 | 14 | 0.275 | **0.31** | 0.758 | **0.85** | -0.12 |
| 6 | 2437 | Rear | FigA.1 | 13.51 | 14 | 0.415 | **0.46** | 1.14 | **1.28** | -0.02 |
| 1 | 2412 | Top | / | 13.55 | 14 | 0.234 | **0.26** | 0.51 | **0.57** | 0.01 |
| 11 | 2462 | Rear | Headset | 13.51 | 14 | 0.398 | **0.45** | 1.06 | **1.19** | -0.06 |

Note: The distance between the EUT and the phantom bottom is 0mm.

Note1: When the reported SAR of the initial test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position using subsequent highest estimated 1-g SAR conditions determined by area scans, on the highest maximum output power channel, until the reported SAR is ≤ 0.8 W/kg.

Note2: For all positions/configurations tested using the initial test position and subsequent test positions, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.

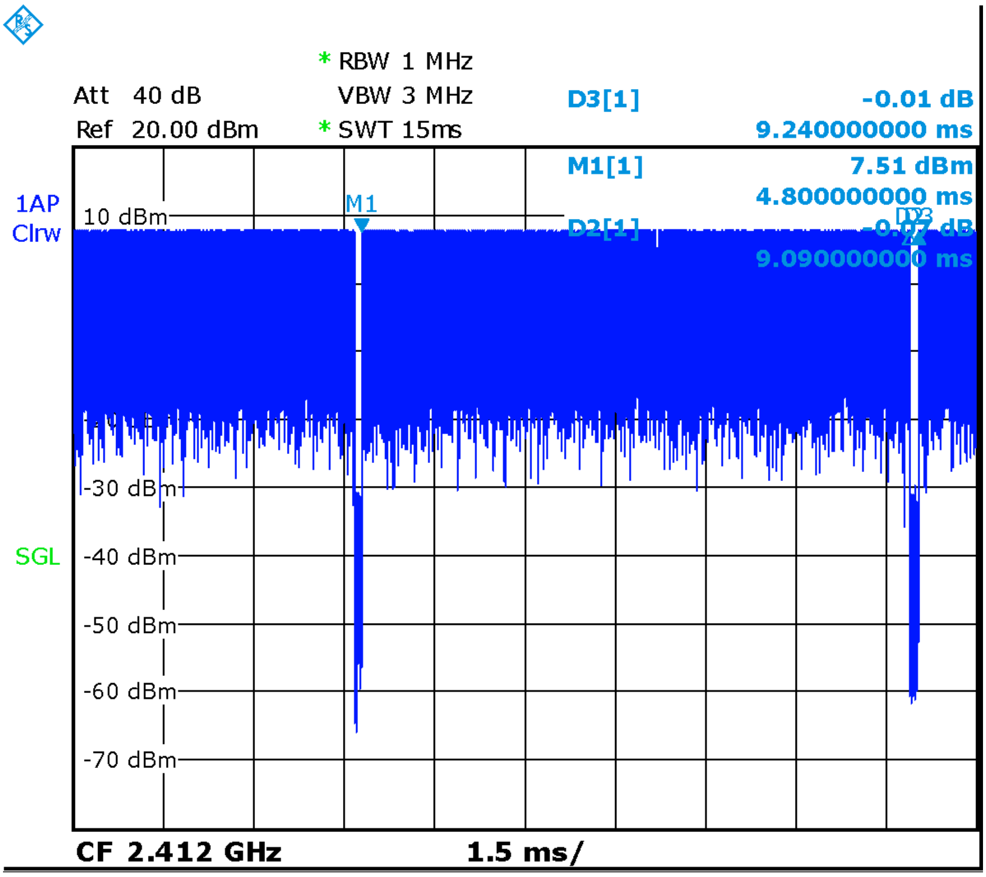
 

According to the KDB248227 D01, The reported SAR must be scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit. The scaled reported SAR is presented as below.

**Table 14.1-3: SAR Values (WLAN - Body) – 802.11b (Scaled Reported SAR)**

| Ambient Temperature: 22.9 ℃ Liquid Temperature: 22.5℃ | | | | | | |
|---|---|---|---|---|---|---|
| Frequency | | Test Position | Actual duty factor | maximum duty factor | Reported SAR (1g)(W/kg) | Scaled reported SAR (1g)(W/kg) |
| MHz | Ch. | | | | | |
| 2412 | 1 | Rear | 98.4% | 100% | **1.28** | **1.30** |

Additional SAR is required for OFDM because the 802.11b adjusted SAR > 1.2 W/kg.




**Picture 14.1 Duty factor plot**

According to the KDB248227 D01, SAR is measured for 2.4GHz 802.11g OFDM using the initial test position procedure.

**Body Evaluation for 802.11g**

**Table 14.1-4: SAR Values (WLAN - Body)– 802.11g (Fast SAR)**

| Ambient Temperature: 22.9 °C Liquid Temperature: 22.5°C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | Test Position | Figure No./ Note | Conducted Power (dBm) | Max. tune-up Power (dBm) | Measured SAR(10g) (W/kg) | Reported SAR(10g)(W/kg) | Measured SAR(1g) (W/kg) | Reported SAR(1g) (W/kg) | Power Drift (dB) |
| MHz | Ch. | | | | | | | | | |
| 11 | 2462 | Rear | / | 13.77 | 14 | 0.345 | **0.36** | 1.03 | **1.09** | -0.06 |
| 6 | 2437 | Rear | / | 13.65 | 14 | 0.338 | **0.37** | 1.01 | **1.09** | 0.07 |
| 1 | 2412 | Rear | / | 13.59 | 14 | 0.457 | **0.50** | 1.22 | **1.34** | -0.13 |
| 11 | 2462 | Top | / | 13.77 | 14 | 0.256 | **0.27** | 0.728 | **0.77** | -0.11 |
| 1 | 2412 | Rear | Headset | 13.59 | 14 | 0.425 | **0.47** | 1.14 | **1.25** | 0.08 |

Note: The distance between the EUT and the phantom bottom is 0mm

As shown above table, the initial test position for body is “Rear”. So the body SAR of WLAN is presented as below:

**Table 14.1-5: SAR Values (WLAN - Body)– 802.11g (Full SAR)**

| Ambient Temperature: 22.9 °C Liquid Temperature: 22.5°C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | Test Position | Figure No./ Note | Conducted Power (dBm) | Max. tune-up Power (dBm) | Measured SAR(10g) (W/kg) | Reported SAR(10g) (W/kg) | Measured SAR(1g) (W/kg) | Reported SAR(1g)(W/kg) | Power Drift (dB) |
| MHz | Ch. | | | | | | | | | |
| 11 | 2462 | Rear | / | 13.77 | 14 | 0.35 | **0.37** | 1.06 | **1.12** | -0.06 |
| 6 | 2437 | Rear | / | 13.65 | 14 | 0.34 | **0.37** | 1.02 | **1.11** | 0.07 |
| 1 | 2412 | Rear | FigA.2 | 13.59 | 14 | 0.463 | **0.51** | 1.24 | **1.36** | -0.13 |
| 11 | 2462 | Top | / | 13.77 | 14 | 0.261 | **0.28** | 0.731 | **0.77** | -0.11 |
| 1 | 2412 | Rear | Headset | 13.59 | 14 | 0.436 | **0.48** | 1.18 | **1.30** | 0.08 |

Note: The distance between the EUT and the phantom bottom is 0mm.

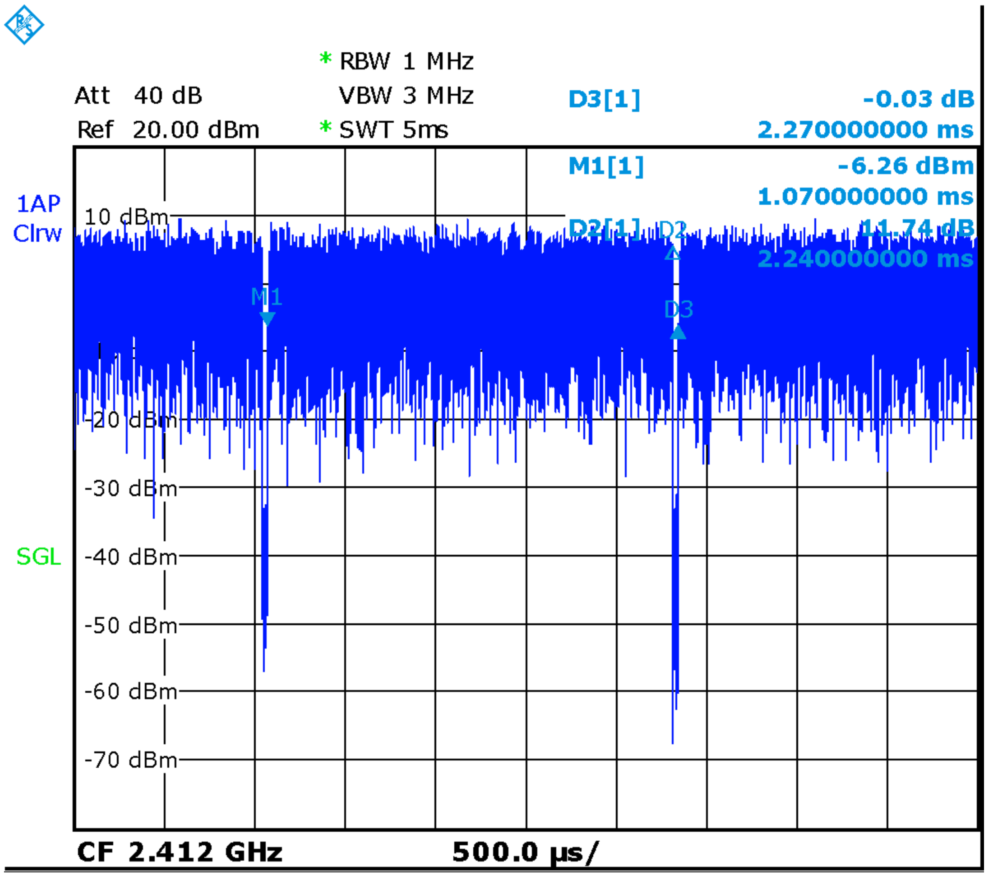
Note1: When the reported SAR of the initial test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position using subsequent highest estimated 1-g SAR conditions determined by area scans, on the highest maximum output power channel, until the reported SAR is ≤ 0.8 W/kg.

Note2: For all positions/configurations tested using the initial test position and subsequent test positions, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.

According to the KDB248227 D01, The reported SAR must be scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit. The scaled reported SAR is presented as below.

**Table 14.1-6: SAR Values (WLAN - Body) – 802.11g (Scaled Reported SAR)**

| Ambient Temperature: 22.9 ℃ Liquid Temperature: 22.5℃ | | | | | | |
|---|---|---|---|---|---|---|
| Frequency | | Test Position | Actual duty factor | maximum duty factor | Reported SAR (1g)(W/kg) | Scaled reported SAR (1g)(W/kg) |
| MHz | Ch. | | | | | |
| 2412 | 1 | Rear | 98.7% | 100% | **1.36** | **1.38** |




**Picture 14.2 Duty factor plot**

**Body Evaluation for 802.11n**

**Table 14.1-7: SAR Values (WLAN - Body)– 802.11n (Fast SAR)**

| Ambient Temperature: 22.9 °C Liquid Temperature: 22.5°C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | Test Position | Figure No./ Note | Conducted Power (dBm) | Max. tune-up Power (dBm) | Measured SAR(10g) (W/kg) | Reported SAR(10g)(W/kg) | Measured SAR(1g) (W/kg) | Reported SAR(1g) (W/kg) | Power Drift (dB) |
| MHz | Ch. | | | | | | | | | |
| 11 | 2462 | Rear | / | 13.77 | 14 | 0.328 | **0.36** | 0.874 | **0.96** | 0.03 |
| 6 | 2437 | Rear | / | 13.65 | 14 | 0.321 | **0.36** | 0.813 | **0.91** | -0.03 |
| 1 | 2412 | Rear | / | 13.59 | 14 | 0.447 | **0.51** | 1.18 | **1.34** | -0.15 |
| 11 | 2462 | Top | / | 13.77 | 14 | 0.245 | **0.27** | 0.71 | **0.78** | 0.12 |
| 1 | 2412 | Rear | Headset | 13.59 | 14 | 0.429 | **0.49** | 1.08 | **1.23** | 0.08 |

Note: The distance between the EUT and the phantom bottom is 0mm

As shown above table, the initial test position for body is “Rear”. So the body SAR of WLAN is presented as below:

**Table 14.1-8: SAR Values (WLAN - Body)– 802.11n (Full SAR)**

| Ambient Temperature: 22.9 °C Liquid Temperature: 22.5°C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | | Test Position | Figure No./ Note | Conducted Power (dBm) | Max. tune-up Power (dBm) | Measured SAR(10g) (W/kg) | Reported SAR(10g) (W/kg) | Measured SAR(1g) (W/kg) | Reported SAR(1g)( W/kg) | Power Drift (dB) |
| MHz | Ch. | | | | | | | | | |
| 11 | 2462 | Rear | / | 13.59 | 14 | 0.331 | **0.36** | 0.879 | **0.97** | 0.03 |
| 6 | 2437 | Rear | / | 13.52 | 14 | 0.324 | **0.36** | 0.826 | **0.92** | -0.03 |
| 1 | 2412 | Rear | FigA.3 | 13.45 | 14 | 0.45 | **0.51** | 1.2 | **1.36** | -0.15 |
| 11 | 2462 | Top | / | 13.59 | 14 | 0.248 | **0.27** | 0.717 | **0.79** | 0.12 |
| 1 | 2412 | Rear | Headset | 13.45 | 14 | 0.439 | **0.50** | 1.12 | **1.27** | 0.08 |

Note: The distance between the EUT and the phantom bottom is 0mm.

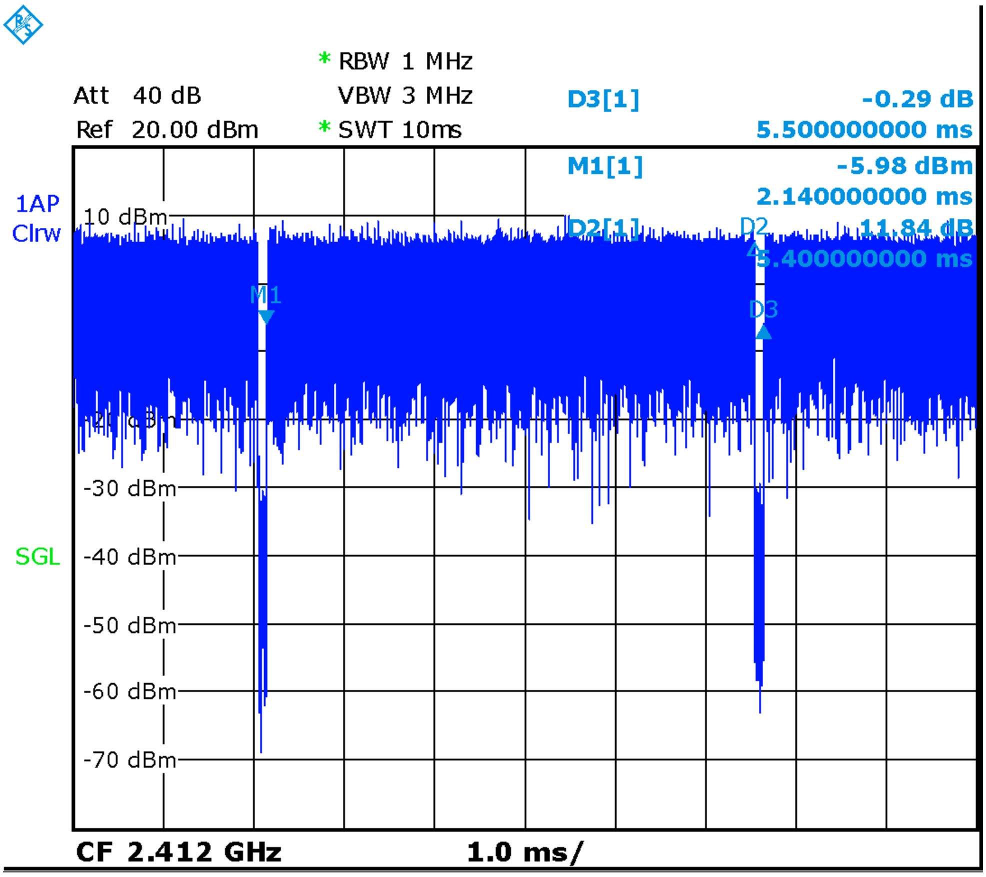
Note1: When the reported SAR of the initial test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position using subsequent highest estimated 1-g SAR conditions determined by area scans, on the highest maximum output power channel, until the reported SAR is ≤ 0.8 W/kg.

Note2: For all positions/configurations tested using the initial test position and subsequent test positions, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.

According to the KDB248227 D01, The reported SAR must be scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit. The scaled reported SAR is presented as below.

**Table 14.1-9: SAR Values (WLAN - Body) – 802.11g (Scaled Reported SAR)**

| Ambient Temperature: 22.9 ℃ Liquid Temperature: 22.5℃ | | | | | | |
|---|---|---|---|---|---|---|
| Frequency | | Test Position | Actual duty factor | maximum duty factor | Reported SAR (1g)(W/kg) | Scaled reported SAR (1g)(W/kg) |
| MHz | Ch. | | | | | |
| 2412 | 1 | Rear | 98.2% | 100% | **1.36** | **1.38** |




**Picture 14.3 Duty factor plot**

## 14.2 WLAN Evaluation For 5G

**Table 14.2-1: OFDM mode specified maximum output power of WLAN antenna**

| 802.11 mode | a | g | n | | ac | | | |
|---|---|---|---|---|---|---|---|---|
| Ch. BW(MHz) | 20 | 20 | 20 | 40 | 20 | 40 | 80 | 160 |
| U-NII-1 | X | | X | X | X | X | X | |
| U-NII-2A | X | | X | X | X | X | X | |
| U-NII-2C | X | | X | X | X | X | X | |
| U-NII-3 | X | | X | X | X | X | X | |
| § 15.247 (5.8 GHz) | | | | | | | | |
| X: maximum(conducted) output power(mW), including tolerance, specified for production units | | | | | | | | |

**Table 14.2-2: Maximum output power specified of WLAN antenna – Body-Normal power**

| 802.11 mode | a | g | n | | ac | | | |
|---|---|---|---|---|---|---|---|---|
| Ch. BW(MHz) | 20 | 20 | 20 | 40 | 20 | 40 | 80 | 160 |
| U-NII-1 | 79 | | 63 | 50 | 63 | 56 | 45 | |
| U-NII-2A | 79 | | 63 | 50 | 63 | 56 | 45 | |
| U-NII-2C | 79 | | 63 | 50 | 63 | 56 | 45 | |
| U-NII-3 | 79 | | 63 | 50 | 63 | 56 | 45 | |
| § 15.247 (5.8 GHz) | | | | | | | | |

- The maximum output power specified for production units is the same for all channels, modulations and data rates in each channel bandwidth configuration of the 802.11a/g/n/ac modes.
- The blue highlighted cells represent highest output configurations in each standalone or aggregated frequency band, with tune-up tolerance included.

**Table 14.2-3: Maximum output power specified of WLAN antenna – Body-Low power**

| 802.11 mode | a | g | n | | ac | | | |
|---|---|---|---|---|---|---|---|---|
| Ch. BW(MHz) | 20 | 20 | 20 | 40 | 20 | 40 | 80 | 160 |
| U-NII-1 | 8 | | 8 | 9 | 8 | 9 | 9 | |
| U-NII-2A | 8 | | 8 | 9 | 8 | 9 | 9 | |
| U-NII-2C | 7 | | 7 | 8 | 7 | 8 | 8 | |
| U-NII-3 | 8 | | 7 | 9 | 7 | 9 | 9 | |
| § 15.247 (5.8 GHz) | | | | | | | | |

- The maximum output power specified for production units is the same for all channels, modulations and data rates in each channel bandwidth configuration of the 802.11a/g/n/ac modes.
- The blue highlighted cells represent highest output configurations in each standalone or aggregated frequency band, with tune-up tolerance included.

**Table 14.2-4: Maximum output power measured of WLAN antenna, for the applicable OFDM configurations according to the default power measurement procedures for selection initial test configurations – Body-Normal power**

| 802.11 mode | a | n | | ac | | |
|---|---|---|---|---|---|---|
| BW(MHz) | 20 | 20 | 40 | 20 | 40 | 80 |
| U-NII-1 | 36/40/44/48<br>60/59/57/60 | 36/40/44/48<br>Lower power | 38/46<br>Lower power | 36/40/44/48<br>Lower power | 38/46<br>Lower power | 42<br>Lower power |
| U-NII-2A | 52/56/60/64<br>67/72/73/69 | 52/56/60/64<br>Lower power | 54/62<br>Lower power | 52/56/60/64<br>Lower power | 54/62<br>Lower power | 58<br>Lower power |
| U-NII-2C | 100/104/108/112/116/120/124/128/132/136/140/144/<br>59/55/55/55/60/68/70/74/70/56/47/58 | 100/104/108/112/116/120/124/128/132/136/140/144<br>Lower power | 102/110/118/126/134/142<br>Lower power | 100/104/108/112/116/120/124/128/132/136/140/144<br>Lower power | 102/110/118/126/134/142<br>Lower power | 106/122/138<br>Lower power |
| U-NII-3 | 149/153/157/161/165<br>56/62/76/76/70 | 149/153/157/161/165<br>Lower power | 151/159<br>Lower power | 149/153/157/161/165<br>Lower power | 151/159<br>Lower power | 155<br>Lower power |

- The **bold numbers** is the maximum output measured power (mW).
- Channels with measured maximum power within 0.25dB are considered to have the same measured output.
- Channels selected for initial test configuration are highlighted in yellow.

**Table 14.2-5: Maximum output power measured of WLAN antenna, for the applicable OFDM configurations according to the default power measurement procedures for selection initial test configurations – Body-Low power**

| 802.11 mode | a | n | | ac | | |
|---|---|---|---|---|---|---|
| BW(MHz) | 20 | 20 | 40 | 20 | 40 | 80 |
| U-NII-1 | 36/40/44/48<br>Lower power | 36/40/44/48<br>Lower power | 38/46<br>Lower power | 36/40/44/48<br>Lower power | 38/46<br>Lower power | 42<br>7 |
| U-NII-2A | 52/56/60/64<br>Lower power | 52/56/60/64<br>Lower power | 54/62<br>Lower power | 52/56/60/64<br>Lower power | 54/62<br>Lower power | 58<br>8 |
| U-NII-2C | 100/104/108/112/116/120/124/128/132/136/140/144/<br>Lower power | 100/104/108/112/116/120/124/128/132/136/140/144<br>Lower power | 102/110/118/126/134/142<br>Lower power | 100/104/108/112/116/120/124/128/132/136/140/144<br>Lower power | 102/110/118/126/134/142<br>Lower power | 106/122/138<br>6/6/6 |
| U-NII-3 | 149/153/157/16<br>Lower power | 149/153/157/161/165<br>Lower power | 151/159<br>Lower power | 149/153/157/161/165<br>Lower power | 151/159<br>Lower power | 155<br>6 |

- The **bold numbers** is the maximum output measured power (mW).
- Channels with measured maximum power within 0.25dB are considered to have the same measured output.
- Channels selected for initial test configuration are highlighted in yellow.

**Table 14.2-6: Reported SAR of initial test configuration for Body-Normal power 18mm**

| 802.11 mode | a | n | | ac | | |
|---|---|---|---|---|---|---|
| BW(MHz) | 20 | 20 | 40 | 20 | 40 | 80 |
| U-NII-1 | 36/40/44/48<br>UNII-2A exclusion applied | 36/40/44/48 | 38/46 | 36/40/44/48 | 38/46 | 42 |
| U-NII-2A | 52/56/60/64<br>**0.75** | 52/56/60/64 | 54/62 | 52/56/60/64 | 54/62 | 58 |
| U-NII-2C | 100/104/108/112/116/120/124/128/132/136/140/144<br>**0.50** | 100/104/108/112/116/120/124/128/132/136/140/144 | 102/110/118/126/134/142 | 100/104/108/112/116/120/124/128/132/136/140/144 | 102/110/118/126/134/142 | 106/122/138 |
| U-NII-3 | 149/153/157/161/165<br>**0.32** | 149/153/157/161/165 | 151/159 | 149/153/157/161/165 | 151/159 | 155 |
| Highest measured output power channel tested initially are in yellow highlight. | | | | | | |

**Table 14.2-7: Reported SAR of initial test configuration for Body-Low power 0mm**

| 802.11 mode | a | n | | ac | | |
|---|---|---|---|---|---|---|
| BW(MHz) | 20 | 20 | 40 | 20 | 40 | 80 |
| U-NII-1 | 36/40/44/48 | 36/40/44/48 | 38/46 | 36/40/44/48 | 38/46 | 42<br>UNII-2A exclusion applied |
| U-NII-2A | 52/56/60/64 | 52/56/60/64 | 54/62 | 52/56/60/64 | 54/62 | 58<br>0.84 |
| U-NII-2C | 100/104/108/112/116/120/124/128/132/136/140/144 | 100/104/108/112/116/120/124/128/132/136/140/144 | 102/110/118/126/134/142 | 100/104/108/112/116/120/124/128/132/136/140/144 | 102/110/118/126/134/142 | 106/122/138<br>0.93/1.18 |
| U-NII-3 | 149/153/157/161/165 | 149/153/157/161/165 | 151/159 | 149/153/157/161/165 | 151/159 | 155<br>1.22 |
| The green highlighted channels are next highest measured output channel in the initial test configuration.<br>Highest measured output power channel tested initially are in yellow highlight. | | | | | | |

**Table 14.2-8: SAR Values (WLAN 5G - Body)**

| Frequency | | Test Position | Figure No. | Conducted Power (dBm) | Max. tune-up Power (dBm) | Measured SAR(10g) (W/kg) | Reported SAR(10g) (W/kg) | Measured SAR(1g) (W/kg) | Reported SAR(1g) (W/kg) | Power Drift (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| Ch. | MHz | | | | | | | | | |
| 58 | 5290 | Rear | Note1 | 18.65 | 19 | 0.695 | **0.75** | 0.151 | **0.16** | 0.01 |
| 58 | 5290 | Top | Note1 | 18.65 | 19 | 0.651 | **0.71** | 0.171 | **0.19** | -0.08 |
| 106 | 5530 | Rear | Note1 | 18.7 | 19 | 0.454 | **0.49** | 0.165 | **0.18** | -0.08 |
| 138 | 5690 | Top | Note1 | 18.7 | 19 | 0.462 | **0.50** | 0.177 | **0.19** | 0.07 |
| 106 | 5530 | Rear | Note1 | 18.83 | 19 | 0.247 | **0.26** | 0.106 | **0.11** | 0.1 |
| 155 | 5775 | Top | Note1 | 18.83 | 19 | 0.312 | **0.32** | 0.131 | **0.14** | -0.03 |
| 58 | 5290 | Rear | / | 9.18 | 9.5 | 0.669 | **0.72** | 0.149 | **0.16** | 0.00 |
| 58 | 5290 | Top | / | 9.18 | 9.5 | 0.779 | **0.84** | 0.144 | **0.16** | 0.15 |
| 106 | 5530 | Rear | | 8.05 | 9.2 | 0.712 | **0.93** | 0.159 | **0.21** | 0.01 |
| 138 | 5690 | Rear | / | 7.91 | 9.2 | 0.876 | **1.18** | 0.209 | **0.28** | -0.09 |
| 106 | 5530 | Top | / | 8.05 | 9.2 | 0.445 | **0.58** | 0.087 | **0.11** | -0.09 |
| 155 | 5775 | Rear | FigA.4 | 8.09 | 9.4 | 0.905 | **1.22** | 0.194 | **0.26** | 0.05 |
| 155 | 5775 | Top | / | 8.09 | 9.4 | 0.513 | **0.69** | 0.110 | **0.15** | -0.08 |
| 155 | 5775 | Rear | / | 8.09 | 9.4 | 0.866 | **1.17** | 0.185 | **0.25** | -0.10 |

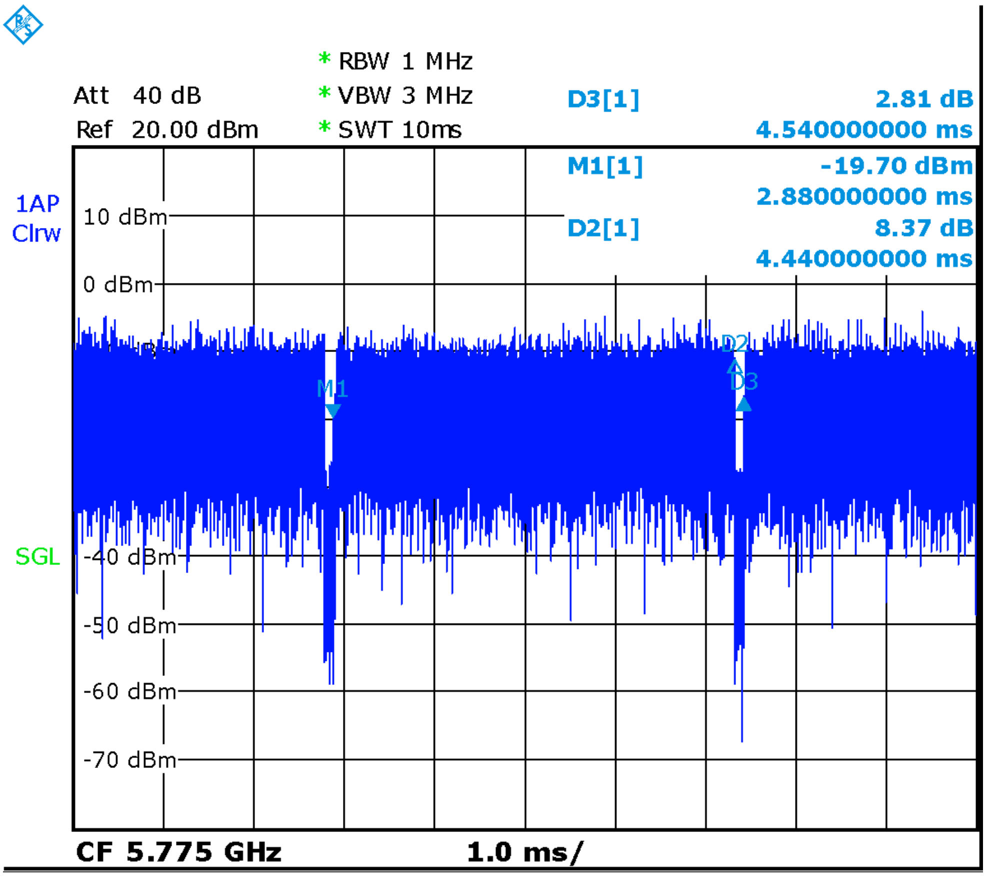
Note: The distance between the EUT and the phantom bottom is 0mm.

Note1: The distance between the EUT and the phantom bottom is 18mm.

According to the KDB248227 D01, The reported SAR must be scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit. The scaled reported SAR is presented as below.

**Table 14.2-9 SAR Values (WLAN 5G - Body) (Scaled Reported SAR)**

| Frequency | | Test Position | D (mm) | Actual duty factor | maximum duty factor | Reported SAR (1g) (W/kg) | Scaled reported SAR (1g) (W/kg) |
|---|---|---|---|---|---|---|---|
| Ch. | MHz | | | | | | |
| 155 | 5775 | Rear | 0 | 97.8% | 100% | **1.22** | **1.25** |




**Picture 14.4 The plot of duty factor**

## 15 SAR Measurement Variability

SAR measurement variability must be assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media are required for SAR measurements in a frequency band, the variability measurement procedures should be applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium.

The following procedures are applied to determine if repeated measurements are required.

1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.

2) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.

3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).

4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

| Mode | CH | Freq | Test Poisition | Original SAR (W/kg) | First Repeated SAR(W/kg) | The Ratio |
|---|---|---|---|---|---|---|
| Wi-Fi 2.4G 802.11b | 1 | 2412MHz | Rear 0mm | 1.13 | 1.11 | 1.02 |
| Wi-Fi 2.4G 802.11g | 1 | 2412MHz | Rear 0mm | 1.14 | 1.12 | 1.02 |
| Wi-Fi 2.4G 802.11n | 1 | 2412MHz | Rear 0mm | 1.22 | 1.18 | 1.03 |
| Wi-Fi 5G 802.11ac | 138 | 5690MHz | Rear 0mm | 0.876 | 0.871 | 1.01 |
| Wi-Fi 5G 802.11ac | 155 | 5775MHz | Rear 0mm | 0.905 | 0.895 | 1.01 |

# 16 Measurement Uncertainty

## 16.1 Measurement Uncertainty for Normal SAR Tests (300MHz~3GHz)

| No. | Error Description | Type | Uncertainty value | Probably Distribution | Div. | (Ci) 1g | (Ci) 10g | Std. Unc. (1g) | Std. Unc. (10g) | Degree of freedom |
|---|---|---|---|---|---|---|---|---|---|---|
| **Measurement system** | | | | | | | | | | |
| 1 | Probe calibration | B | 6.0 | N | 1 | 1 | 1 | 6.0 | 6.0 | ∞ |
| 2 | Isotropy | B | 4.7 | R | $\sqrt{3}$ | 0.7 | 0.7 | 1.9 | 1.9 | ∞ |
| 3 | Boundary effect | B | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.6 | 0.6 | ∞ |
| 4 | Linearity | B | 4.7 | R | $\sqrt{3}$ | 1 | 1 | 2.7 | 2.7 | ∞ |
| 5 | Detection limit | B | 1.0 | N | 1 | 1 | 1 | 0.6 | 0.6 | ∞ |
| 6 | Readout electronics | B | 0.3 | R | $\sqrt{3}$ | 1 | 1 | 0.3 | 0.3 | ∞ |
| 7 | Response time | B | 0.8 | R | $\sqrt{3}$ | 1 | 1 | 0.5 | 0.5 | ∞ |
| 8 | Integration time | B | 2.6 | R | $\sqrt{3}$ | 1 | 1 | 1.5 | 1.5 | ∞ |
| 9 | RF ambient conditions-noise | B | 0 | R | $\sqrt{3}$ | 1 | 1 | 0 | 0 | ∞ |
| 10 | RFambient conditions-reflection | B | 0 | R | $\sqrt{3}$ | 1 | 1 | 0 | 0 | ∞ |
| 11 | Probe positioned mech. restrictions | B | 0.4 | R | $\sqrt{3}$ | 1 | 1 | 0.2 | 0.2 | ∞ |
| 12 | Probe positioning with respect to phantom shell | B | 2.9 | R | $\sqrt{3}$ | 1 | 1 | 1.7 | 1.7 | ∞ |
| 13 | Post-processing | B | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.6 | 0.6 | ∞ |
| **Test sample related** | | | | | | | | | | |
| 14 | Test sample positioning | A | 3.3 | N | 1 | 1 | 1 | 3.3 | 3.3 | 71 |
| 15 | Device holder uncertainty | A | 3.4 | N | 1 | 1 | 1 | 3.4 | 3.4 | 5 |
| 16 | Drift of output power | B | 5.0 | R | $\sqrt{3}$ | 1 | 1 | 2.9 | 2.9 | ∞ |
| **Phantom and set-up** | | | | | | | | | | |
| 17 | Phantom uncertainty | B | 4.0 | R | $\sqrt{3}$ | 1 | 1 | 2.3 | 2.3 | ∞ |
| 18 | Liquid conductivity (target) | B | 5.0 | R | $\sqrt{3}$ | 0.64 | 0.43 | 1.8 | 1.2 | ∞ |
| 19 | Liquid conductivity (meas.) | A | 2.06 | N | 1 | 0.64 | 0.43 | 1.32 | 0.89 | 43 |
| 20 | Liquid permittivity (target) | B | 5.0 | R | $\sqrt{3}$ | 0.6 | 0.49 | 1.7 | 1.4 | ∞ |
| 21 | Liquid permittivity (meas.) | A | 1.6 | N | 1 | 0.6 | 0.49 | 1.0 | 0.8 | 521 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Combined standard uncertainty | $u_c^{'} = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$ | | | | | | 9.55 | 9.43 | 257 |
| Expanded uncertainty (confidence interval of 95 %) | $u_e = 2u_c$ | | | | | | 19.1 | 18.9 | |

## 16.2 Measurement Uncertainty for Normal SAR Tests (3~6GHz)

| No. | Error Description | Type | Uncertainty value | Probably Distribution | Div. | (Ci) 1g | (Ci) 10g | Std. Unc. (1g) | Std. Unc. (10g) | Degree of freedom |
|---|---|---|---|---|---|---|---|---|---|---|
| **Measurement system** | | | | | | | | | | |
| 1 | Probe calibration | B | 6.55 | N | 1 | 1 | 1 | 6.55 | 6.55 | ∞ |
| 2 | Isotropy | B | 4.7 | R | $\sqrt{3}$ | 0.7 | 0.7 | 1.9 | 1.9 | ∞ |
| 3 | Boundary effect | B | 2.0 | R | $\sqrt{3}$ | 1 | 1 | 1.2 | 1.2 | ∞ |
| 4 | Linearity | B | 4.7 | R | $\sqrt{3}$ | 1 | 1 | 2.7 | 2.7 | ∞ |
| 5 | Detection limit | B | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.6 | 0.6 | ∞ |
| 6 | Readout electronics | B | 0.3 | R | $\sqrt{3}$ | 1 | 1 | 0.3 | 0.3 | ∞ |
| 7 | Response time | B | 0.8 | R | $\sqrt{3}$ | 1 | 1 | 0.5 | 0.5 | ∞ |
| 8 | Integration time | B | 2.6 | R | $\sqrt{3}$ | 1 | 1 | 1.5 | 1.5 | ∞ |
| 9 | RF ambient conditions-noise | B | 0 | R | $\sqrt{3}$ | 1 | 1 | 0 | 0 | ∞ |
| 10 | RF ambient conditions-reflection | B | 0 | R | $\sqrt{3}$ | 1 | 1 | 0 | 0 | ∞ |
| 11 | Probe positioned mech. restrictions | B | 0.8 | R | $\sqrt{3}$ | 1 | 1 | 0.5 | 0.5 | ∞ |
| 12 | Probe positioning with respect to phantom shell | B | 6.7 | R | $\sqrt{3}$ | 1 | 1 | 3.9 | 3.9 | ∞ |
| 13 | Post-processing | B | 4.0 | R | $\sqrt{3}$ | 1 | 1 | 2.3 | 2.3 | ∞ |
| **Test sample related** | | | | | | | | | | |
| 14 | Test sample positioning | A | 3.3 | N | 1 | 1 | 1 | 3.3 | 3.3 | 71 |
| 15 | Device holder uncertainty | A | 3.4 | N | 1 | 1 | 1 | 3.4 | 3.4 | 5 |
| 16 | Drift of output power | B | 5.0 | R | $\sqrt{3}$ | 1 | 1 | 2.9 | 2.9 | ∞ |
| **Phantom and set-up** | | | | | | | | | | |
| 17 | Phantom uncertainty | B | 4.0 | R | $\sqrt{3}$ | 1 | 1 | 2.3 | 2.3 | ∞ |
| 18 | Liquid conductivity (target) | B | 5.0 | R | $\sqrt{3}$ | 0.64 | 0.43 | 1.8 | 1.2 | ∞ |
| 19 | Liquid conductivity (meas.) | A | 2.06 | N | 1 | 0.64 | 0.43 | 1.32 | 0.89 | 43 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 20 | Liquid permittivity (target) | B | 5.0 | R | $\sqrt{3}$ | 0.6 | 0.49 | 1.7 | 1.4 | ∞ |
| 21 | Liquid permittivity (meas.) | A | 1.6 | N | 1 | 0.6 | 0.49 | 1.0 | 0.8 | 521 |
| Combined standard uncertainty | | $u_c' = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$ | | | | | | 10.7 | 10.6 | 257 |
| Expanded uncertainty (confidence interval of 95 %) | | $u_e = 2u_c$ | | | | | | 21.4 | 21.1 | |

## 16.3 Measurement Uncertainty for Fast SAR Tests (300MHz~3GHz)

| No. | Error Description | Type | Uncertainty value | Probably Distribution | Div. | (Ci) 1g | (Ci) 10g | Std. Unc. (1g) | Std. Unc. (10g) | Degree of freedom |
|---|---|---|---|---|---|---|---|---|---|---|
| **Measurement system** | | | | | | | | | | |
| 1 | Probe calibration | B | 6.0 | N | 1 | 1 | 1 | 6.0 | 6.0 | ∞ |
| 2 | Isotropy | B | 4.7 | R | $\sqrt{3}$ | 0.7 | 0.7 | 1.9 | 1.9 | ∞ |
| 3 | Boundary effect | B | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.6 | 0.6 | ∞ |
| 4 | Linearity | B | 4.7 | R | $\sqrt{3}$ | 1 | 1 | 2.7 | 2.7 | ∞ |
| 5 | Detection limit | B | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.6 | 0.6 | ∞ |
| 6 | Readout electronics | B | 0.3 | R | $\sqrt{3}$ | 1 | 1 | 0.3 | 0.3 | ∞ |
| 7 | Response time | B | 0.8 | R | $\sqrt{3}$ | 1 | 1 | 0.5 | 0.5 | ∞ |
| 8 | Integration time | B | 2.6 | R | $\sqrt{3}$ | 1 | 1 | 1.5 | 1.5 | ∞ |
| 9 | RF ambient conditions-noise | B | 0 | R | $\sqrt{3}$ | 1 | 1 | 0 | 0 | ∞ |
| 10 | RF ambient conditions-reflection | B | 0 | R | $\sqrt{3}$ | 1 | 1 | 0 | 0 | ∞ |
| 11 | Probe positioned mech. Restrictions | B | 0.4 | R | $\sqrt{3}$ | 1 | 1 | 0.2 | 0.2 | ∞ |
| 12 | Probe positioning with respect to phantom shell | B | 2.9 | R | $\sqrt{3}$ | 1 | 1 | 1.7 | 1.7 | ∞ |
| 13 | Post-processing | B | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.6 | 0.6 | ∞ |
| 14 | Fast SAR z-Approximation | B | 7.0 | R | $\sqrt{3}$ | 1 | 1 | 4.0 | 4.0 | ∞ |
| **Test sample related** | | | | | | | | | | |
| 15 | Test sample positioning | A | 3.3 | N | 1 | 1 | 1 | 3.3 | 3.3 | 71 |
| 16 | Device holder uncertainty | A | 3.4 | N | 1 | 1 | 1 | 3.4 | 3.4 | 5 |
| 17 | Drift of output power | B | 5.0 | R | $\sqrt{3}$ | 1 | 1 | 2.9 | 2.9 | ∞ |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Phantom and set-up** | | | | | | | | | | |
| 18 | Phantom uncertainty | B | 4.0 | R | $\sqrt{3}$ | 1 | 1 | 2.3 | 2.3 | ∞ |
| 19 | Liquid conductivity (target) | B | 5.0 | R | $\sqrt{3}$ | 0.64 | 0.43 | 1.8 | 1.2 | ∞ |
| 20 | Liquid conductivity (meas.) | A | 2.06 | N | 1 | 0.64 | 0.43 | 1.32 | 0.89 | 43 |
| 21 | Liquid permittivity (target) | B | 5.0 | R | $\sqrt{3}$ | 0.6 | 0.49 | 1.7 | 1.4 | ∞ |
| 22 | Liquid permittivity (meas.) | A | 1.6 | N | 1 | 0.6 | 0.49 | 1.0 | 0.8 | 521 |
| Combined standard uncertainty | | $u_c^{'} = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$ | | | | | | 10.4 | 10.3 | 257 |
| Expanded uncertainty (confidence interval of 95 %) | | $u_e = 2u_c$ | | | | | | 20.8 | 20.6 | |

## 16.4 Measurement Uncertainty for Fast SAR Tests (3~6GHz)

| No. | Error Description | Type | Uncertainty value | Probably Distribution | Div. | (Ci) 1g | (Ci) 10g | Std. Unc. (1g) | Std. Unc. (10g) | Degree of freedom |
|---|---|---|---|---|---|---|---|---|---|---|
| **Measurement system** | | | | | | | | | | |
| 1 | Probe calibration | B | 6.55 | N | 1 | 1 | 1 | 6.55 | 6.55 | ∞ |
| 2 | Isotropy | B | 4.7 | R | $\sqrt{3}$ | 0.7 | 0.7 | 1.9 | 1.9 | ∞ |
| 3 | Boundary effect | B | 2.0 | R | $\sqrt{3}$ | 1 | 1 | 1.2 | 1.2 | ∞ |
| 4 | Linearity | B | 4.7 | R | $\sqrt{3}$ | 1 | 1 | 2.7 | 2.7 | ∞ |
| 5 | Detection limit | B | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.6 | 0.6 | ∞ |
| 6 | Readout electronics | B | 0.3 | R | $\sqrt{3}$ | 1 | 1 | 0.3 | 0.3 | ∞ |
| 7 | Response time | B | 0.8 | R | $\sqrt{3}$ | 1 | 1 | 0.5 | 0.5 | ∞ |
| 8 | Integration time | B | 2.6 | R | $\sqrt{3}$ | 1 | 1 | 1.5 | 1.5 | ∞ |
| 9 | RF ambient conditions-noise | B | 0 | R | $\sqrt{3}$ | 1 | 1 | 0 | 0 | ∞ |
| 10 | RF ambient conditions-reflection | B | 0 | R | $\sqrt{3}$ | 1 | 1 | 0 | 0 | ∞ |
| 11 | Probe positioned mech. Restrictions | B | 0.8 | R | $\sqrt{3}$ | 1 | 1 | 0.5 | 0.5 | ∞ |
| 12 | Probe positioning with respect to phantom shell | B | 6.7 | R | $\sqrt{3}$ | 1 | 1 | 3.9 | 3.9 | ∞ |
| 13 | Post-processing | B | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.6 | 0.6 | ∞ |
| 14 | Fast SAR z-Approximation | B | 14.0 | R | $\sqrt{3}$ | 1 | 1 | 8.1 | 8.1 | ∞ |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Test sample related** | | | | | | | | | | |
| 15 | Test sample positioning | A | 3.3 | N | 1 | 1 | 1 | 3.3 | 3.3 | 71 |
| 16 | Device holder uncertainty | A | 3.4 | N | 1 | 1 | 1 | 3.4 | 3.4 | 5 |
| 17 | Drift of output power | B | 5.0 | R | $\sqrt{3}$ | 1 | 1 | 2.9 | 2.9 | ∞ |
| **Phantom and set-up** | | | | | | | | | | |
| 18 | Phantom uncertainty | B | 4.0 | R | $\sqrt{3}$ | 1 | 1 | 2.3 | 2.3 | ∞ |
| 19 | Liquid conductivity (target) | B | 5.0 | R | $\sqrt{3}$ | 0.64 | 0.43 | 1.8 | 1.2 | ∞ |
| 20 | Liquid conductivity (meas.) | A | 2.06 | N | 1 | 0.64 | 0.43 | 1.32 | 0.89 | 43 |
| 21 | Liquid permittivity (target) | B | 5.0 | R | $\sqrt{3}$ | 0.6 | 0.49 | 1.7 | 1.4 | ∞ |
| 22 | Liquid permittivity (meas.) | A | 1.6 | N | 1 | 0.6 | 0.49 | 1.0 | 0.8 | 521 |
| Combined standard uncertainty | | $u_c' = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$ | | | | | | 13.5 | 13.4 | 257 |
| Expanded uncertainty (confidence interval of 95 %) | | $u_e = 2u_c$ | | | | | | 27.0 | 26.8 | |

## 17 MAIN TEST INSTRUMENTS

| No. | Name | Type | Serial Number | Calibration Date | Valid Period |
|---|---|---|---|---|---|
| 01 | Network analyzer | N5239A | MY46110673 | January 24, 2020 | One year |
| 02 | Power meter | NRP2 | 106277 | September 4, 2019 | One year |
| 03 | Power sensor | NRP8S | 104291 | | |
| 04 | Signal Generator | E4438C | MY49070393 | January 4, 2020 | One Year |
| 05 | Amplifier | 60S1G4 | 0331848 | No Calibration Requested | |
| 07 | E-field Probe | SPEAG EX3DV4 | 3617 | Jan 30, 2020 | One year |
| 08 | DAE | SPEAG DAE4 | 777 | Jan 8, 2020 | One year |
| 09 | Dipole Validation Kit | SPEAG D2450V2 | 735 | December 17,2019 | One year |
| 10 | Dipole Validation Kit | SPEAG D5GHzV2 | 1040 | June 23, 2020 | One year |

***END OF REPORT BODY***

## ANNEX A Graph Results

**WLAN2450_CH1 Rear 0mm_802.11b**
Date: 7/22/2020
Electronics: DAE4 Sn777
Medium: head 2450 MHz
Medium parameters used: f = 2412; σ = 1.748 mho/m; εr = 39.1; ρ = 1000 kg/m$^3$
Ambient Temperature: 22.5°C, Liquid Temperature: 22.3°C
Communication System: WLAN2450 2412 Duty Cycle: 1:1
Probe: EX3DV4 – SN3617 ConvF(7.65,7.65,7.65)

**Area Scan (71x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.96 W/kg

**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 0 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 3.43 W/kg
**SAR(1 g) = 1.15 W/kg; SAR(10 g) = 0.416 W/kg**
Maximum value of SAR (measured) = 2.33 W/kg

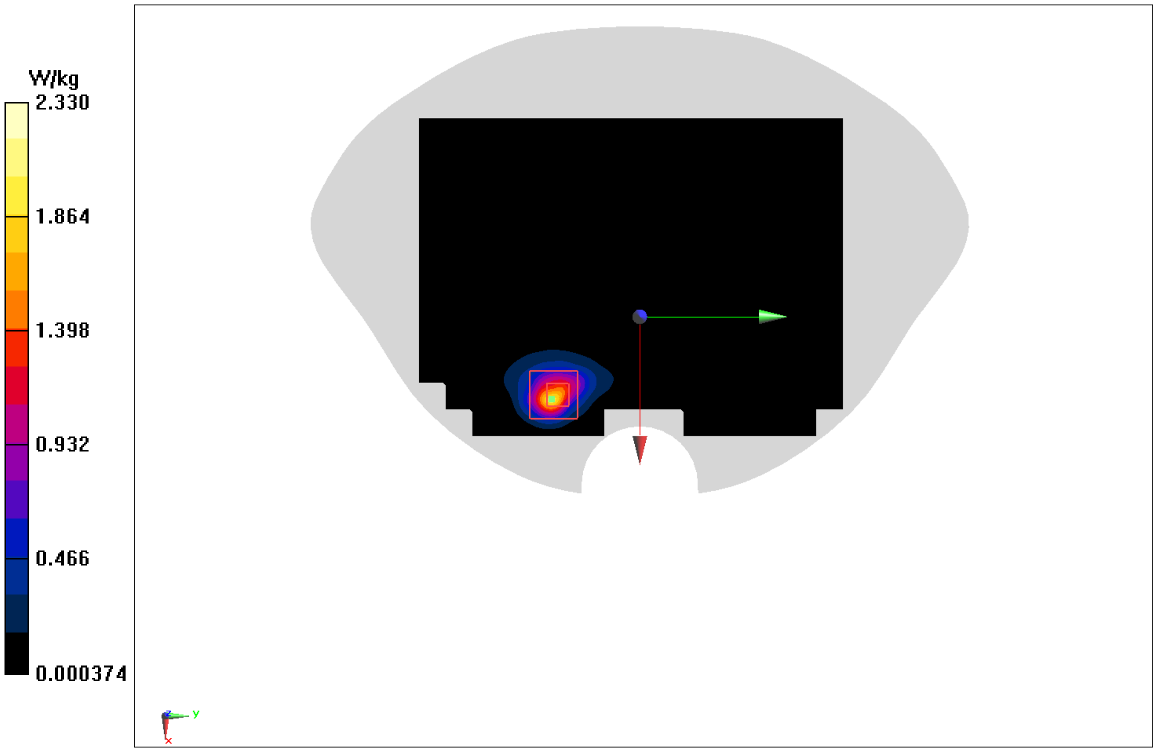



**Fig A.1**

**WLAN2450_CH1 Rear 0mm_802.11g**
Date: 7/22/2020
Electronics: DAE4 Sn777
Medium: head 2450 MHz
Medium parameters used: f = 2412; σ = 1.748 mho/m; εr = 39.1; ρ = 1000 kg/$m^3$
Ambient Temperature: 22.5°C, Liquid Temperature: 22.3°C
Communication System: WLAN2450 2412 Duty Cycle: 1:1
Probe: EX3DV4 – SN3617 ConvF(7.65,7.65,7.65)

**Area Scan (71x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 2.54 W/kg

**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.413 V/m; Power Drift = -0.13 dB
Peak SAR (extrapolated) = 3.57 W/kg
**SAR(1 g) = 1.24 W/kg; SAR(10 g) = 0.463 W/kg**
Maximum value of SAR (measured) = 2.55 W/kg

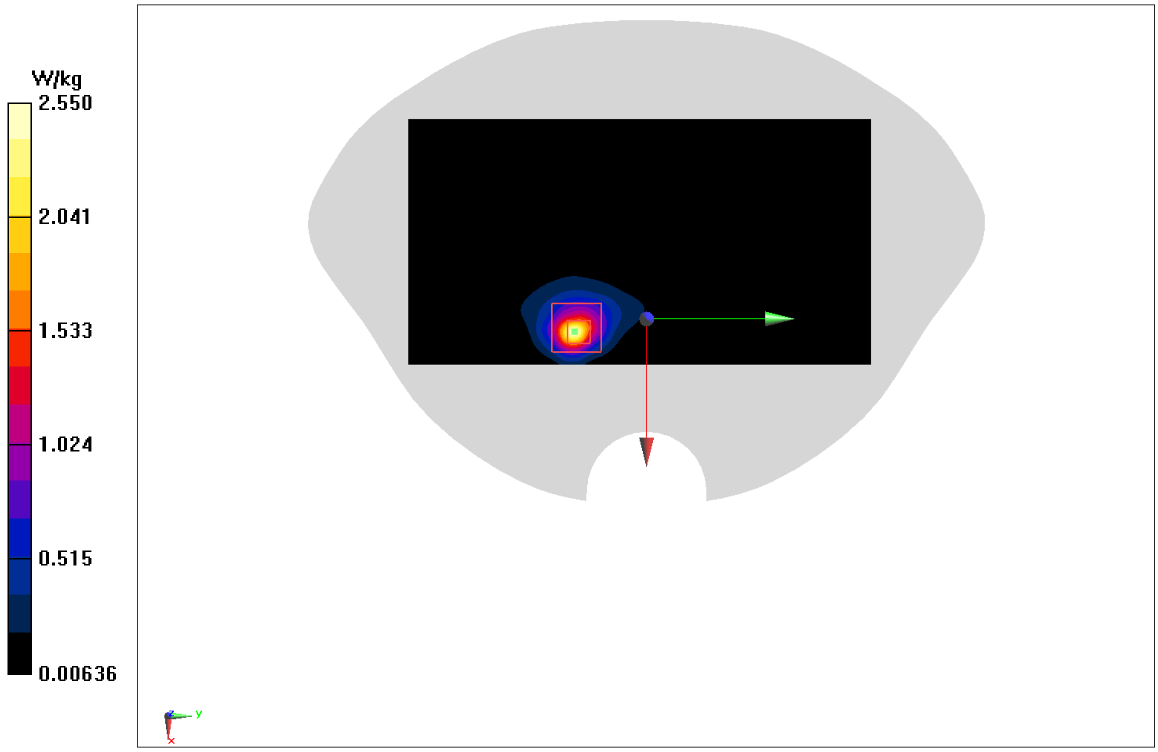



**Fig A.2**

**WLAN2450_CH1_Rear 0mm_802.11n**
Date: 7/22/2020
Electronics: DAE4 Sn777
Medium: Head 2450 MHz
Medium parameters used: f = 2412; σ = 1.748 mho/m; εr = 39.1; ρ = 1000 kg/m$^3$
Ambient Temperature: 22.5°C, Liquid Temperature: 22.3°C
Communication System: WLAN2450 2412 Duty Cycle: 1:1
Probe: EX3DV4 – SN3617 ConvF(7.65,7.65,7.65)

**Area Scan (71x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 2.26 W/kg

**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 5.833 V/m; Power Drift = -0.15 dB
Peak SAR (extrapolated) = 3.43 W/kg
**SAR(1 g) = 1.2 W/kg; SAR(10 g) = 0.45 W/kg**
Maximum value of SAR (measured) = 2.17 W/kg

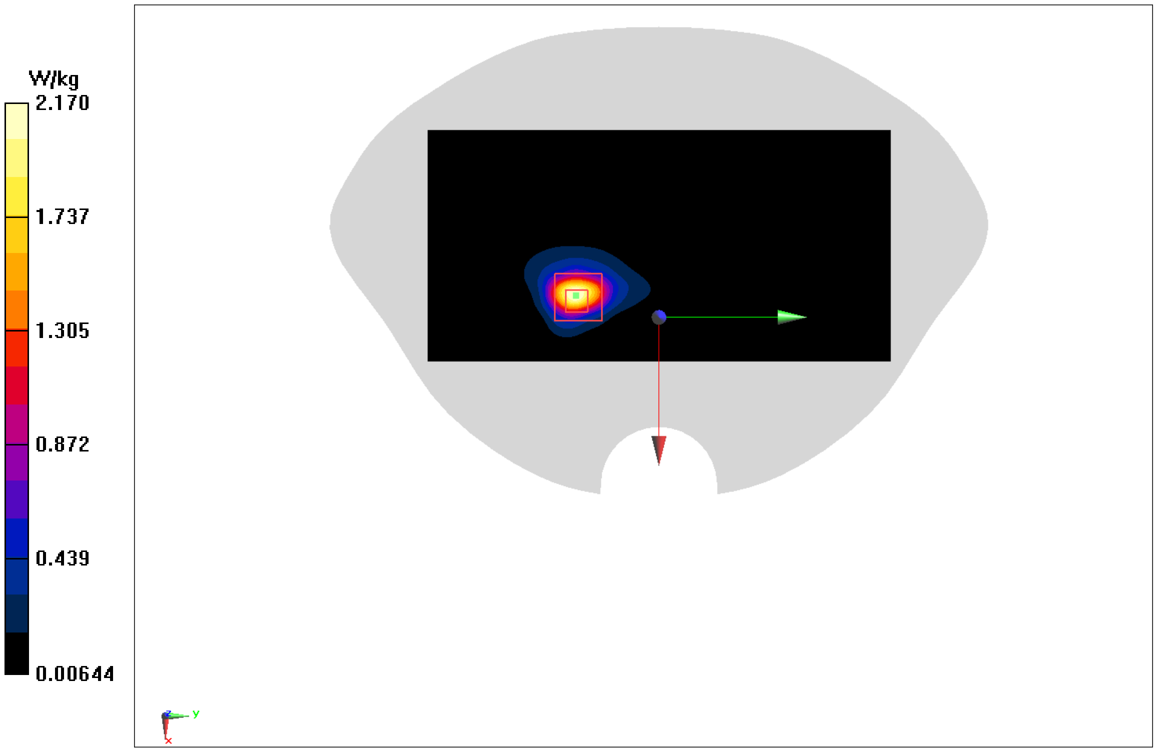



**Fig A.3**

**WLAN5G_802.11ac-80M MCS2_CH155 Rear 0mm**
Date: 7/22/2020
Electronics: DAE4 Sn777
Medium: Head 5GHz
Medium parameters used: f = 5775; σ = 5.07 mho/m; εr = 33.21; ρ = 1000 kg/m$^3$
Ambient Temperature: 22.5°C, Liquid Temperature: 22.3°C
Communication System: WLAN5G 5775 Duty Cycle: 1:1
Probe: EX3DV4 – SN3617 ConvF(5.0,5.0,5.0)

**Area Scan (71x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 2.95 W/kg

**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.115 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 6.59 W/kg
**SAR(1 g) = 0.905 W/kg; SAR(10 g) = 0.194 W/kg**
Maximum value of SAR (measured) = 3.1 W/kg

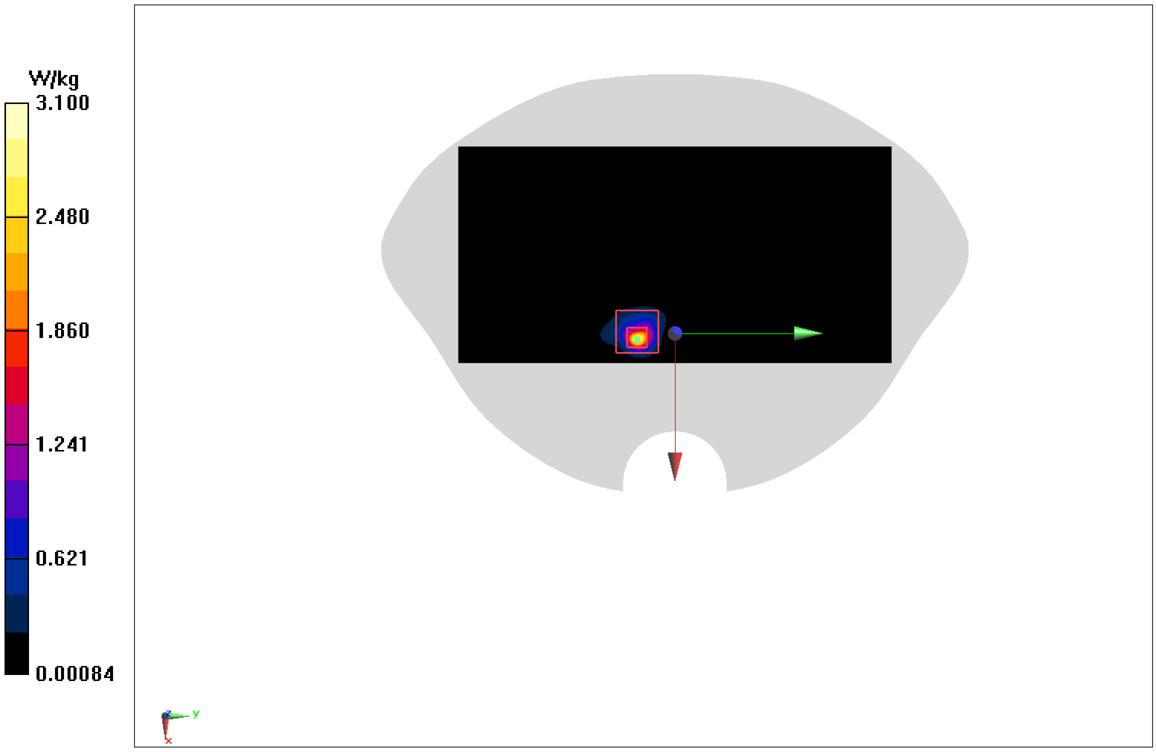



**Fig A.4**

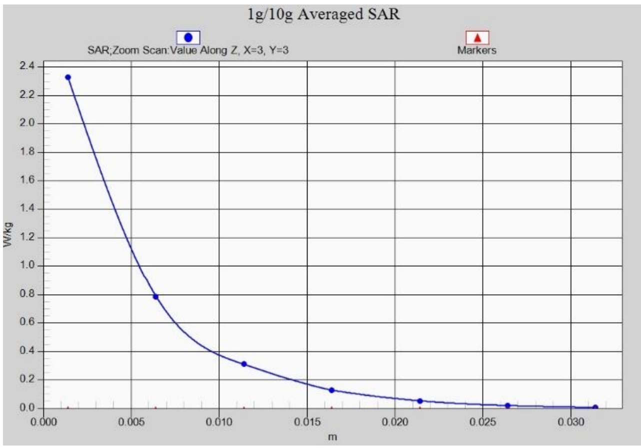



Fig.A.5 Z-Scan at power reference point (WIFI2.4G 802.11b)

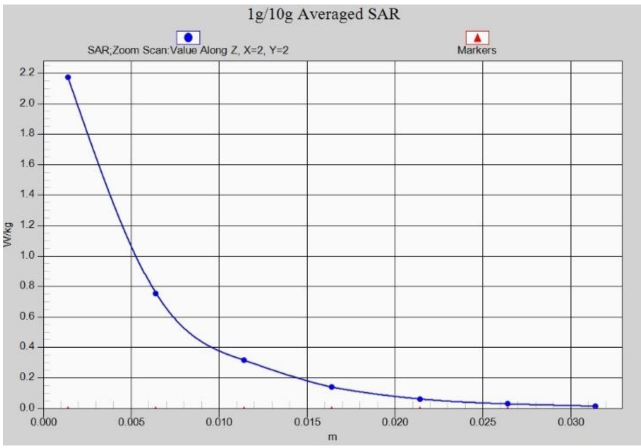



Fig.A.6 Z-Scan at power reference point (WIFI2.4G 802.11g)

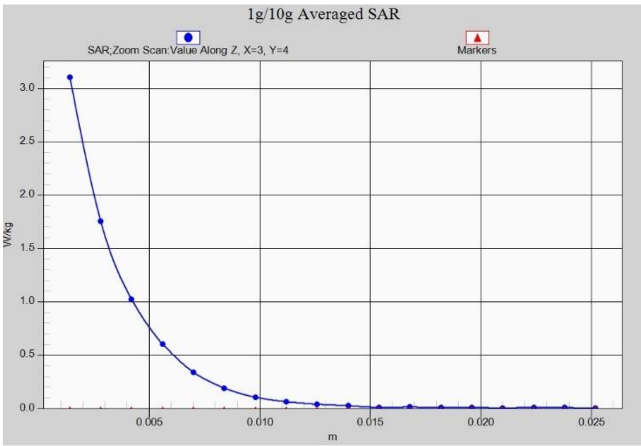



Fig.A.7 Z-Scan at power reference point (WIFI2.4G 802.11n)

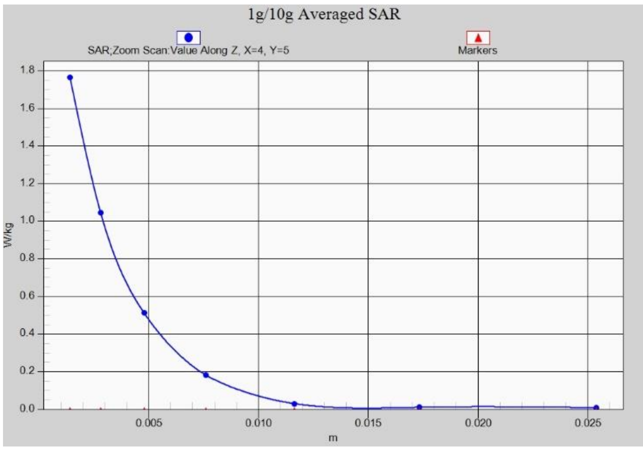



**Fig.A.8 Z-Scan at power reference point (WIFI5G 802.11ac)**

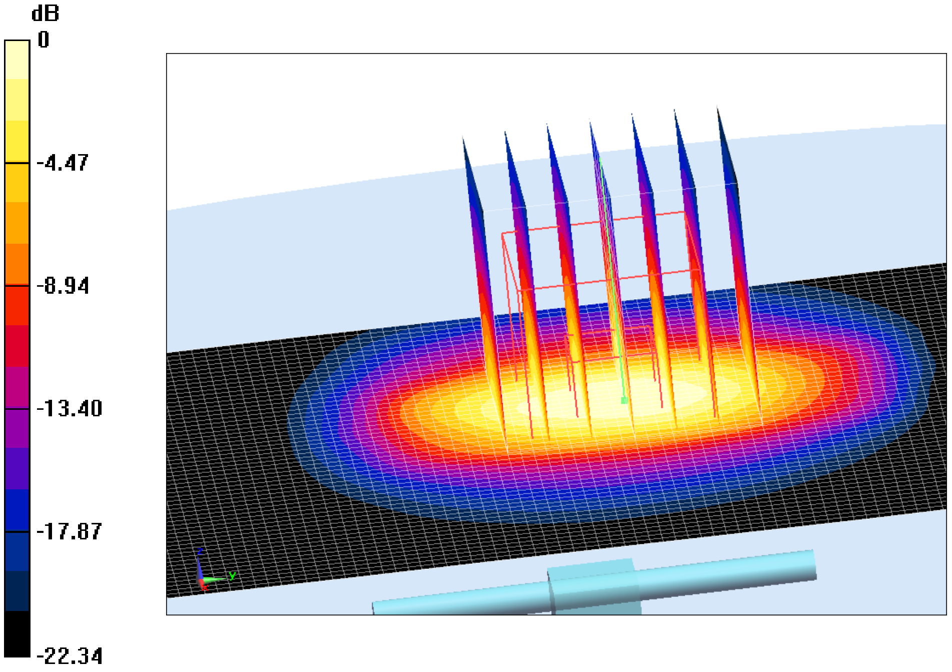
## ANNEX B System Verification Results

### 2450MHz

Date: 7/23/2020
Electronics: DAE4 Sn777
Medium: Head 2450MHz
Medium parameters used: f = 2450MHz; σ =1.767 mho/m; $\varepsilon_r$ = 38.82; ρ = 1000 kg/m$^3$
Ambient Temperature: 22.2ºC Liquid Temperature: 22ºC
Communication System: CW Frequency: 2450MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN3617 ConvF(7.65,7.65,7.65)

**System Validation /Area Scan (81x191x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 101.59 V/m; Power Drift = 0.02
**Fast SAR: SAR(1 g) = 13.25 W/kg; SAR(10 g) = 5.91 W/kg**
Maximum value of SAR (interpolated) = 21.68 W/kg

**System Validation /Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value =101.59 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 27.65 W/kg
**SAR(1 g) = 13.18 W/kg; SAR(10 g) = 6.02 W/kg**
Maximum value of SAR (measured) = 21.98 W/kg




0 dB = 21.98 W/kg = 13.42 dB W/kg

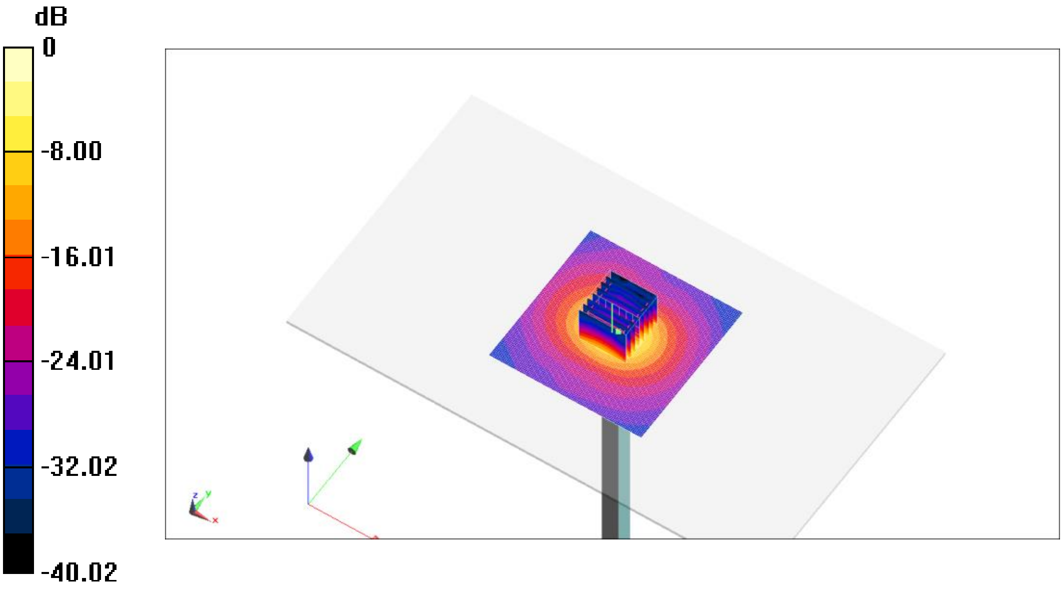
**Fig.B.1 validation 2450MHz 250mW**

## 5200 MHz

Date: 7/24/2020
Electronics: DAE4 Sn777
Medium: Head 5200 MHz
Medium parameters used: f = 5200 MHz; σ =4.692 mho/m; $\varepsilon_r$ = 35.35; ρ = 1000 kg/m$^3$
Ambient Temperature: 22.2°C Liquid Temperature: 22°C
Communication System: CW Frequency: 5200 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN3617 ConvF(5.49, 5.49, 5.49)

**System Validation /Area Scan (81x191x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 17.72 W/kg

**System Validation /Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value =65 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 30.31 W/kg
**SAR(1 g) = 7.62 W/kg; SAR(10 g) = 2.14 W/kg**
Maximum value of SAR (measured) = 18.09 W/kg




0 dB = 18.09 W/kg = 12.57 dB W/kg

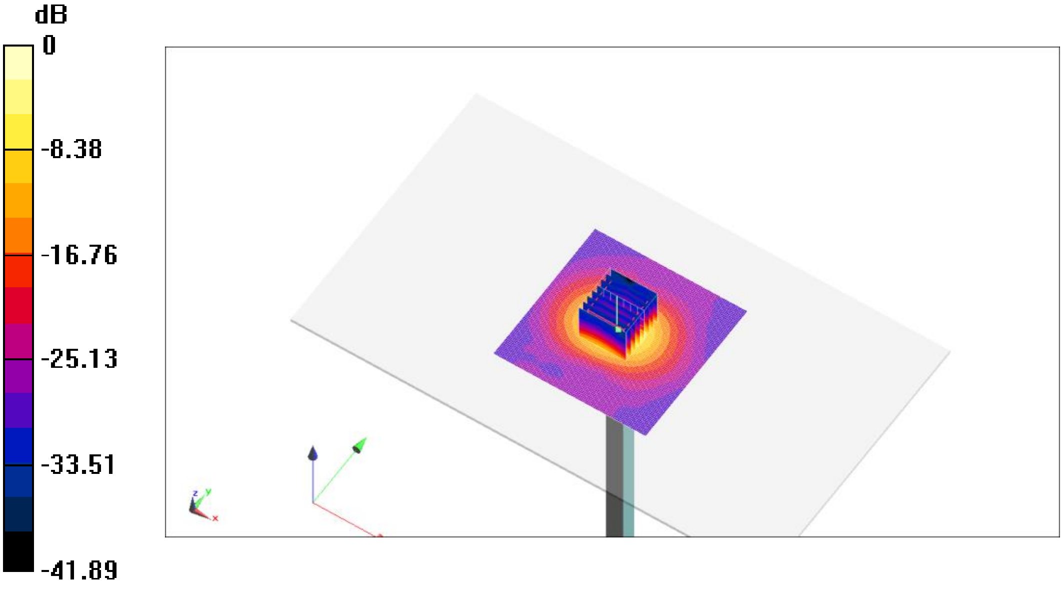
**Fig.B.2 validation 5200 MHz 100mW**

## 5600 MHz

Date: 7/25/2020
Electronics: DAE4 Sn777
Medium: Head 5600 MHz
Medium parameters used: f = 5600 MHz; σ =5.082 mho/m; $\varepsilon_r$ = 36.1; ρ = 1000 kg/m$^3$
Ambient Temperature: 22.2ºC Liquid Temperature: 22ºC
Communication System: CW Frequency: 5600 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN3617 ConvF(4.99,4.99,4.99)

**System Validation /Area Scan (81x191x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 20 W/kg

**System Validation /Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value =65.9 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 35.7 W/kg
**SAR(1 g) = 8.01 W/kg; SAR(10 g) = 2.34 W/kg**
Maximum value of SAR (measured) = 19.66 W/kg




0 dB = 19.66 W/kg = 12.94 dB W/kg

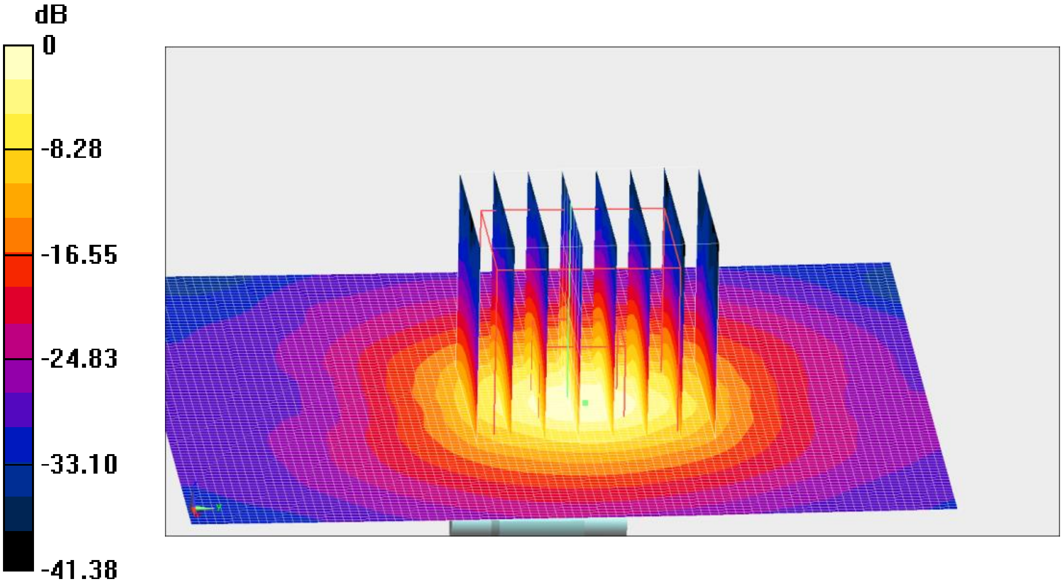
**Fig.B.3 validation 5600 MHz 250mW**

## 5800 MHz

Date: 7/26/2020
Electronics: DAE4 Sn777
Medium: Head 5800 MHz
Medium parameters used: f = 5800 MHz; σ =5.323 mho/m; $\varepsilon_r$ = 35.06; ρ = 1000 kg/m$^3$
Ambient Temperature: 22.2°C Liquid Temperature: 22°C
Communication System: CW Frequency: 5800 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN3617 ConvF(5.00,5.00,5.00)

**System Validation /Area Scan (81x191x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 69.38 V/m; Power Drift = 0.02
**Fast SAR: SAR(1 g) = 7.98 W/kg; SAR(10 g) = 2.31 W/kg**
Maximum value of SAR (interpolated) = 19.1 W/kg

**System Validation /Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value =69.38 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 33.38 W/kg
**SAR(1 g) = 8.06 W/kg; SAR(10 g) = 2.33 W/kg**
Maximum value of SAR (measured) = 19.3 W/kg




0 dB = 19.3 W/kg = 12.86 dB W/kg

**Fig.B.4 validation 5800 MHz 250mW**

The SAR system verification must be required that the area scan estimated 10-g SAR is within 3% of the zoom scan 10-g SAR.

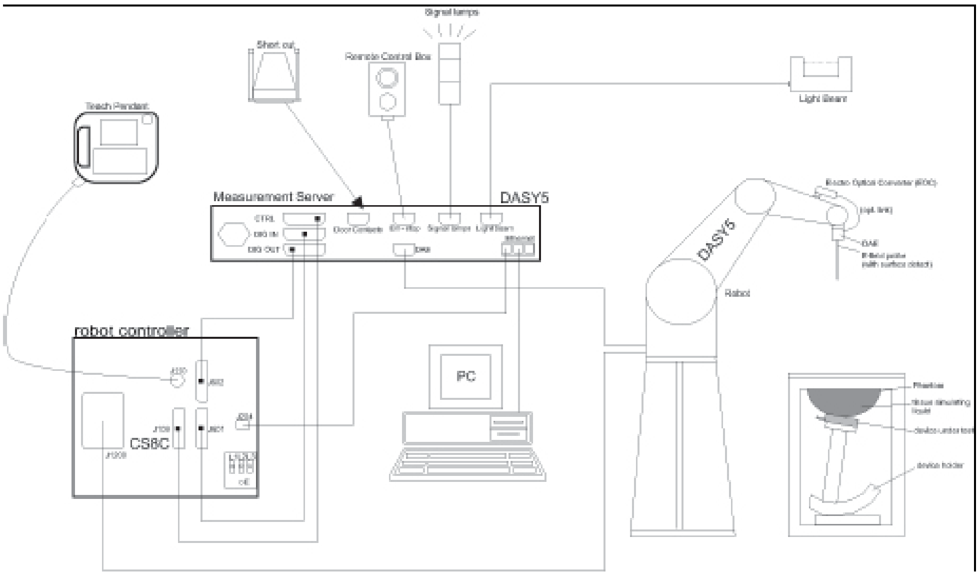
**Table B.1 Comparison between area scan and zoom scan for system verification**

| Date | Band | Position | Area scan (10g) | Zoom scan (10g) | Drift (%) |
|---|---|---|---|---|---|
| 2020/7/23 | 2450MHz | Head | 13.25 | 13.18 | 0.53 |

# ANNEX C　SAR Measurement Setup

## C.1 Measurement Set-up

The Dasy4 or DASY5 system for performing compliance tests is illustrated above graphically. This system consists of the following items:




**Picture C.1 SAR Lab Test Measurement Set-up**

- A standard high precision 6-axis robot (Stäubli TX=RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP and the DASY4 or DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as
- warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

## C.2 Dasy4 or DASY5 E-field Probe System

The SAR measurements were conducted with the dosimetric probe designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multifiber line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY4 or DASY5 software reads the reflection durning a software approach and looks for the maximum using 2$^{nd}$ ord curve fitting. The approach is stopped at reaching the maximum.

**Probe Specifications:**

**Model:** ES3DV3, EX3DV4

**Frequency Range:** 10MHz — 6.0GHz(EX3DV4)
10MHz — 4GHz(ES3DV3)

**Calibration:** In head and body simulating tissue at Frequencies from 835 up to 5800MHz

**Linearity:** ± 0.2 dB(30 MHz to 6 GHz) for EX3DV4
± 0.2 dB(30 MHz to 4 GHz) for ES3DV3

**Dynamic Range:** 10 mW/kg — 100W/kg

**Probe Length:** 330 mm

**Probe Tip Length:** 20 mm

**Body Diameter:** 12 mm

**Tip Diameter:** 2.5 mm (3.9 mm for ES3DV3)

**Tip-Center:** 1 mm (2.0mm for ES3DV3)

**Application:** SAR Dosimetry Testing
Compliance tests of mobile phones
Dosimetry in strong gradient fields

**Picture C.2 Near-field Probe**

**Picture C.3 E-field Probe**

## C.3 E-field Probe Calibration

Each E-Probe/Probe Amplifier combination has unique calibration parameters. A TEM cell calibration procedure is conducted to determine the proper amplifier settings to enter in the probe parameters. The amplifier settings are determined for a given frequency by subjecting the probe to a known E-field density (1 mW/cm$^2$) using an RF Signal generator, TEM cell, and RF Power Meter.

The free space E-field from amplified probe outputs is determined in a test chamber. This calibration can be performed in a TEM cell if the frequency is below 1 GHz and inn a waveguide or other methodologies above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is then rotated 360 degrees until the three channels show the maximum reading. The power density readings equates to 1 mW/ $cm^2$.
E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The E-field in the medium correlates with the temperature rise in the dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

$$SAR = C\frac{\Delta T}{\Delta t}$$

Where:
$\Delta t$ = Exposure time (30 seconds),
C = Heat capacity of tissue (brain or muscle),
$\Delta T$ = Temperature increase due to RF exposure.

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

Where:
$\sigma$ = Simulated tissue conductivity,
$\rho$ = Tissue density ($kg/m^3$).

## C.4 Other Test Equipment

### C.4.1 Data Acquisition Electronics(DAE)

The data acquisition electronics consist of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder with a control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information, as well as an optical uplink for commands and the clock.
The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection.
The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

**PictureC.4: DAE**

## C.4.2 Robot

The SPEAG DASY system uses the high precision robots (DASY4: RX90XL; DASY5: RX160L) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version from Stäubli is used. The Stäubli robot series have many features that are important for our application:

- High precision (repeatability 0.02mm)
- High reliability (industrial design)
- Low maintenance costs (virtually maintenance free due to direct drive gears; no belt drives)
- Jerk-free straight movements (brushless synchron motors; no stepper motors)
- Low ELF interference (motor control fields shielded via the closed metallic construction shields)

**Picture C.5 DASY 4**


**Picture C.6 DASY 5**

## C.4.3 Measurement Server

The Measurement server is based on a PC/104 CPU broad with CPU (dasy4: 166 MHz, Intel Pentium; DASY5: 400 MHz, Intel Celeron), chipdisk (DASY4: 32 MB; DASY5: 128MB), RAM (DASY4: 64 MB, DASY5: 128MB). The necessary circuits for communication with the DAE electronic box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY I/O broad, which is directly connected to the PC/104 bus of the CPU broad.

The measurement server performs all real-time data evaluation of field measurements and surface detection, controls robot movements and handles safety operation. The PC operating system cannot interfere with these time critical processes. All connections are supervised by a watchdog, and disconnection of any of the cables to the measurement server will automatically disarm the robot and disable all program-controlled robot movements. Furthermore, the measurement server is equipped with an expansion port which is reserved for future applications. Please note that this expansion port does not have a standardized pinout, and therefore only devices provided by SPEAG can be connected. Devices from any other supplier could seriously damage the measurement server.


Picture C.7 Server for DASY 4


Picture C.8 Server for DASY 5

### C.4.4 Device Holder for Phantom

The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source at 5mm distance, a positioning uncertainty of ±0.5mm would produce a SAR uncertainty of ±20%. Accurate device positioning is therefore crucial for accurate and repeatable measurements. The positions in which the devices must be measured are defined by the standards.

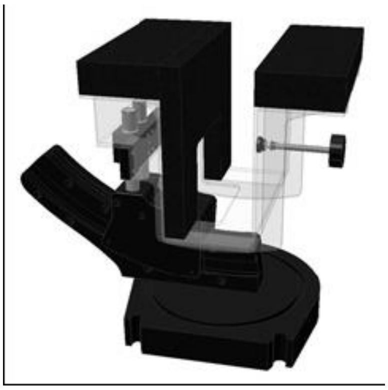
The DASY device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.

The DASY device holder is constructed of low-loss POM material having the following dielectric parameters: relative permittivity $\varepsilon$ =3 and loss tangent $\delta$ =0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

<Laptop Extension Kit>

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the Mounting Device in place of the phone positioner. The extension is fully compatible with the Twin-SAM and ELI phantoms.

**Picture C.9-1: Device Holder**



**Picture C.9-2: Laptop Extension Kit**

### C.4.5 Phantom

The SAM Twin Phantom V4.0 is constructed of a fiberglass shell integrated in a table. The shape of the shell is based on data from an anatomical study designed to

Represent the 90th percentile of the population. The phantom enables the dissymmetric evaluation of SAR for both left and right handed handset usage, as well as body-worn usage using the flat phantom region. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. The shell phantom has a 2mm shell thickness (except the ear region where shell thickness increases to 6 mm).

Shell Thickness: 2 ± 0. 2 mm

Filling Volume: Approx. 25 liters

Dimensions: 810 x l000 x 500 mm (H x L x W)

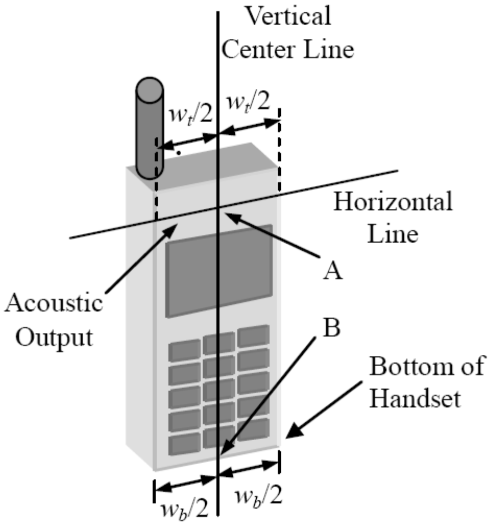
Available: Special

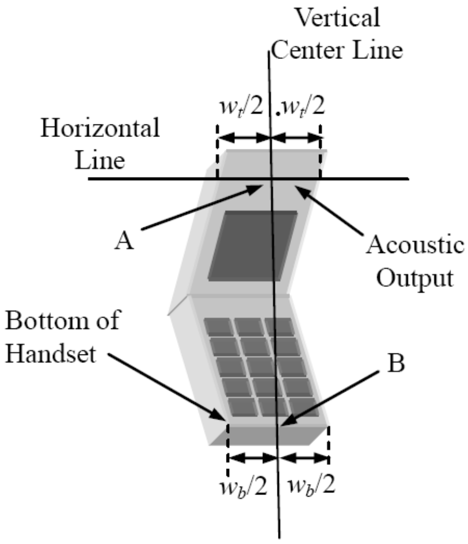
**Picture C.10: SAM Twin Phantom**

# ANNEX D Position of the wireless device in relation to the phantom

## D.1 General considerations

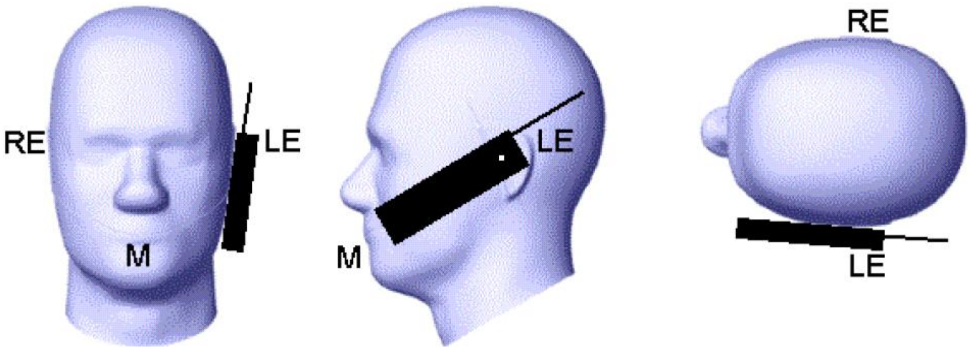
This standard specifies two handset test positions against the head phantom – the “cheek” position and the “tilt” position.



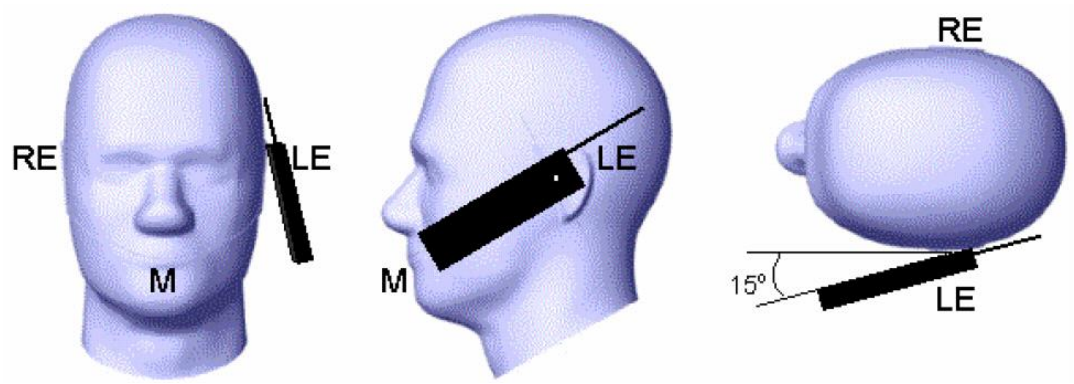




| | |
|---|---|
| $w_t$ | Width of the handset at the level of the acoustic |
| $w_b$ | Width of the bottom of the handset |
| A | Midpoint of the width $w_t$ of the handset at the level of the acoustic output |
| B | Midpoint of the width $w_b$ of the bottom of the handset |

**Picture D.1-a Typical “fixed” case handset Picture D.1-b Typical “clam-shell” case handset**



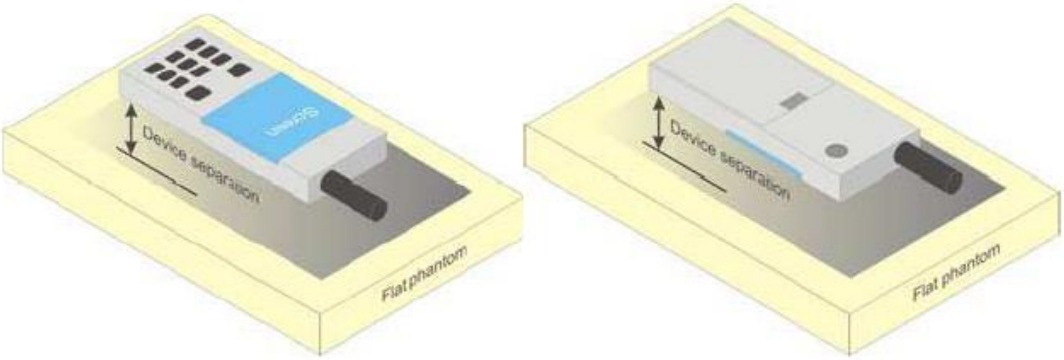

**Picture D.2 Cheek position of the wireless device on the left side of SAM**




**Picture D.3 Tilt position of the wireless device on the left side of SAM**

## D.2 Body-worn device

A typical example of a body-worn device is a mobile phone, wireless enabled PDA or other battery operated wireless device with the ability to transmit while mounted on a person's body using a carry accessory approved by the wireless device manufacturer.

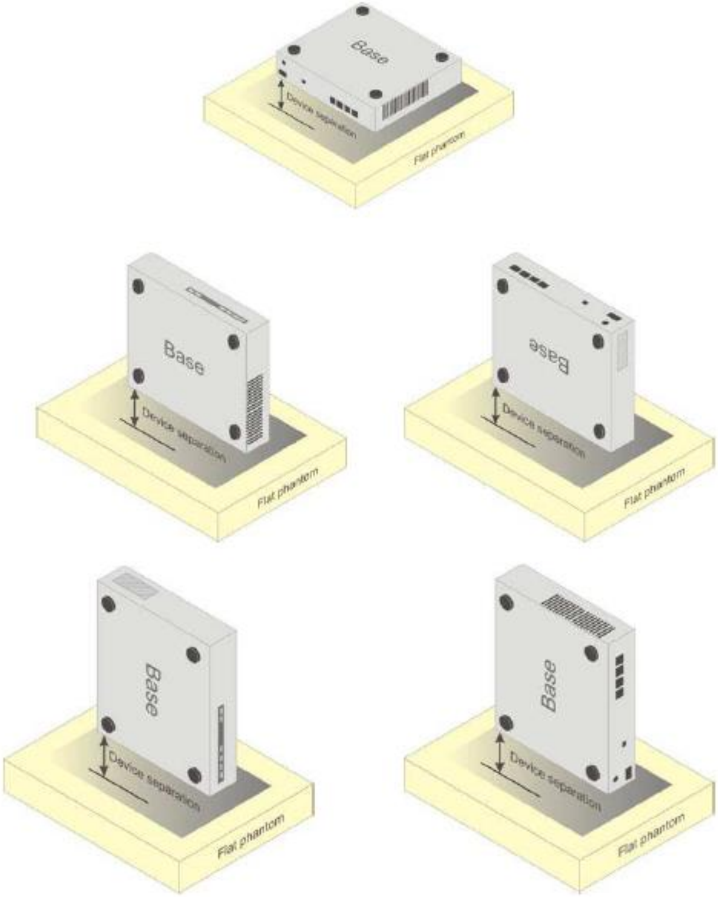



**Picture D.4 Test positions for body-worn devices**

## D.3 Desktop device

A typical example of a desktop device is a wireless enabled desktop computer placed on a table or desk when used.

The DUT shall be positioned at the distance and in the orientation to the phantom that corresponds to the intended use as specified by the manufacturer in the user instructions. For devices that employ an external antenna with variable positions, tests shall be performed for all antenna positions specified. Picture 8.5 show positions for desktop device SAR tests. If the intended use is not specified, the device shall be tested directly against the flat phantom.




**Picture D.5 Test positions for desktop devices**

## D.4 DUT Setup Photos

**Picture D.6**

# ANNEX E Equivalent Media Recipes

The liquid used for the frequency range of 800-3000 MHz consisted of water, sugar, salt, preventol, glycol monobutyl and Cellulose. The liquid has been previously proven to be suited for worst-case. The Table E.1 shows the detail solution. It's satisfying the latest tissue dielectric parameters requirements proposed by the IEEE 1528 and IEC 62209.

**Table E.1: Composition of the Tissue Equivalent Matter**

| Frequency (MHz) | 835 Head | 835 Body | 1900 Head | 1900 Body | 2450 Head | 2450 Body | 5800 Head | 5800 Body |
|---|---|---|---|---|---|---|---|---|
| Ingredients (% by weight) | | | | | | | | |
| Water | 41.45 | 52.5 | 55.242 | 69.91 | 58.79 | 72.60 | 65.53 | 65.53 |
| Sugar | 56.0 | 45.0 | \ | \ | \ | \ | \ | \ |
| Salt | 1.45 | 1.4 | 0.306 | 0.13 | 0.06 | 0.18 | \ | \ |
| Preventol | 0.1 | 0.1 | \ | \ | \ | \ | \ | \ |
| Cellulose | 1.0 | 1.0 | \ | \ | \ | \ | \ | \ |
| Glycol Monobutyl | \ | \ | 44.452 | 29.96 | 41.15 | 27.22 | \ | \ |
| Diethylenglycol monohexylether | \ | \ | \ | \ | \ | \ | 17.24 | 17.24 |
| Triton X-100 | \ | \ | \ | \ | \ | \ | 17.24 | 17.24 |
| Dielectric Parameters Target Value | ε=41.5 σ=0.90 | ε=55.2 σ=0.97 | ε=40.0 σ=1.40 | ε=53.3 σ=1.52 | ε=39.2 σ=1.80 | ε=52.7 σ=1.95 | ε=35.3 σ=5.27 | ε=48.2 σ=6.00 |

**Note: There are a little adjustment respectively for 750, 1750, 2600, 5200, 5300 and 5600 based on the recipe of closest frequency in table E.1.**

## ANNEX F System Validation

The SAR system must be validated against its performance specifications before it is deployed. When SAR probes, system components or software are changed, upgraded or recalibrated, these must be validated with the SAR system(s) that operates with such components.

**Table F.1: System Validation for 3617**

| Probe SN. | Liquid name | Validation date | Frequency point | Status (OK or Not) |
|---|---|---|---|---|
| 3617 | Head 750MHz | January 30,2020 | 750 MHz | OK |
| 3617 | Head 850MHz | January 30,2020 | 835 MHz | OK |
| 3617 | Head 900MHz | January 30,2020 | 900 MHz | OK |
| 3617 | Head 1750MHz | January 30,2020 | 1750 MHz | OK |
| 3617 | Head 1810MHz | January 30,2020 | 1810 MHz | OK |
| 3617 | Head 1900MHz | January 30,2020 | 1900 MHz | OK |
| 3617 | Head 2000MHz | January 30,2020 | 2000 MHz | OK |
| 3617 | Head 2100MHz | January 30,2020 | 2100 MHz | OK |
| 3617 | Head 2300MHz | January 30,2020 | 2300 MHz | OK |
| 3617 | Head 2450MHz | January 30,2020 | 2450 MHz | OK |
| 3617 | Head 2600MHz | January 30,2020 | 2600 MHz | OK |
| 3617 | Head 3500MHz | January 30,2020 | 3500 MHz | OK |
| 3617 | Head 3700MHz | January 30,2020 | 3700 MHz | OK |
| 3617 | Head 5200MHz | January 30,2020 | 5250 MHz | OK |
| 3617 | Head 5500MHz | January 30,2020 | 5600 MHz | OK |
| 3617 | Head 5800MHz | January 30,2020 | 5800 MHz | OK |
| 3617 | Body 750MHz | January 30,2020 | 750 MHz | OK |
| 3617 | Body 850MHz | January 30,2020 | 835 MHz | OK |
| 3617 | Body 900MHz | January 30,2020 | 900 MHz | OK |
| 3617 | Body 1750MHz | January 30,2020 | 1750 MHz | OK |
| 3617 | Body 1810MHz | January 30,2020 | 1810 MHz | OK |
| 3617 | Body 1900MHz | January 30,2020 | 1900 MHz | OK |
| 3617 | Body 2000MHz | January 30,2020 | 2000 MHz | OK |
| 3617 | Body 2100MHz | January 30,2020 | 2100 MHz | OK |
| 3617 | Body 2300MHz | January 30,2020 | 2300 MHz | OK |
| 3617 | Body 2450MHz | January 30,2020 | 2450 MHz | OK |
| 3617 | Body 2600MHz | January 30,2020 | 2600 MHz | OK |
| 3617 | Body 3500MHz | January 30,2020 | 3500 MHz | OK |
| 3617 | Body 3700MHz | January 30,2020 | 3700 MHz | OK |
| 3617 | Body 5200MHz | January 30,2020 | 5250 MHz | OK |
| 3617 | Body 5500MHz | January 30,2020 | 5600 MHz | OK |
| 3617 | Body 5800MHz | January 30,2020 | 5800 MHz | OK |

## ANNEX G Probe Calibration Certificate

### Probe 3617 Calibration Certificate

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
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 **CTTL (Auden)**

Certificate No: **EX3-3617_Jan20/2**

## CALIBRATION CERTIFICATE (Replacement of No: EX3-3617_Jan20)

| | |
|---|---|
| Object | EX3DV4 - SN:3617 |
| Calibration procedure(s) | QA CAL-01.v9, QA CAL-12.v9, QA CAL-14.v5, QA CAL-23.v5, QA CAL-25.v7<br>Calibration procedure for dosimetric E-field probes |
| Calibration date: | January 30, 2020 |

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 | 03-Apr-19 (No. 217-02892/02893) | Apr-20 |
| Power sensor NRP-Z91 | SN: 103244 | 03-Apr-19 (No. 217-02892) | Apr-20 |
| Power sensor NRP-Z91 | SN: 103245 | 03-Apr-19 (No. 217-02893) | Apr-20 |
| Reference 20 dB Attenuator | SN: S5277 (20x) | 04-Apr-19 (No. 217-02894) | Apr-20 |
| DAE4 | SN: 660 | 27-Dec-19 (No. DAE4-660_Dec19) | Dec-20 |
| Reference Probe ES3DV2 | SN: 3013 | 31-Dec-19 (No. ES3-3013_Dec19) | Dec-20 |
| | | | |
| Secondary Standards | ID | Check Date (in house) | Scheduled Check |
| Power meter E4419B | SN: GB41293874 | 06-Apr-16 (in house check Jun-18) | In house check: Jun-20 |
| Power sensor E4412A | SN: MY41498087 | 06-Apr-16 (in house check Jun-18) | In house check: Jun-20 |
| Power sensor E4412A | SN: 000110210 | 06-Apr-16 (in house check Jun-18) | In house check: Jun-20 |
| RF generator HP 8648C | SN: US3642U01700 | 04-Aug-99 (in house check Jun-18) | In house check: Jun-20 |
| Network Analyzer E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-19) | In house check: Oct-20 |

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

Issued: April 7, 2020

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

Certificate No: EX3-3617_Jan20/2 Page 1 of 23

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

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

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

Accreditation No.: **SCS 0108**

## Glossary:

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

## Calibration is Performed According to the Following Standards:

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

## Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the $E^2$-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset:* The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle:* The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Certificate No: EX3-3617_Jan20/2 Page 2 of 23

# DASY/EASY - Parameters of Probe: EX3DV4 - SN:3617

## Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|---|---|---|---|
| Norm ($\mu V/(V/m)^2$)[A] | 0.35 | 0.21 | 0.32 | ± 10.1 % |
| DCP (mV)[B] | 104.3 | 93.8 | 97.1 | |

## Calibration Results for Modulation Response

| UID | Communication System Name | | A dB | B dB√μV | C | D dB | VR mV | Max dev. | Max Unc[E] (k=2) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | CW | X | 0.00 | 0.00 | 1.00 | 0.00 | 130.5 | ± 3.5 % | ± 4.7 % |
| | | Y | 0.00 | 0.00 | 1.00 | | 137.4 | | |
| | | Z | 0.00 | 0.00 | 1.00 | | 129.2 | | |
| 10352-AAA | Pulse Waveform (200Hz, 10%) | X | 5.74 | 74.31 | 15.16 | 10.00 | 60.0 | ± 2.6 % | ± 9.6 % |
| | | Y | 20.00 | 84.63 | 18.23 | | 60.0 | | |
| | | Z | 20.00 | 90.64 | 20.98 | | 60.0 | | |
| 10353-AAA | Pulse Waveform (200Hz, 20%) | X | 11.18 | 82.57 | 16.62 | 6.99 | 80.0 | ± 1.6 % | ± 9.6 % |
| | | Y | 11.60 | 81.13 | 15.97 | | 80.0 | | |
| | | Z | 20.00 | 91.54 | 20.06 | | 80.0 | | |
| 10354-AAA | Pulse Waveform (200Hz, 40%) | X | 20.00 | 88.75 | 16.93 | 3.98 | 95.0 | ± 1.0 % | ± 9.6 % |
| | | Y | 1.22 | 64.13 | 8.17 | | 95.0 | | |
| | | Z | 20.00 | 94.77 | 20.04 | | 95.0 | | |
| 10355-AAA | Pulse Waveform (200Hz, 60%) | X | 20.00 | 90.94 | 16.71 | 2.22 | 120.0 | ± 1.3 % | ± 9.6 % |
| | | Y | 0.41 | 60.00 | 4.32 | | 120.0 | | |
| | | Z | 20.00 | 99.77 | 20.92 | | 120.0 | | |
| 10387-AAA | QPSK Waveform, 1 MHz | X | 0.73 | 63.23 | 9.65 | 0.00 | 150.0 | ± 4.1 % | ± 9.6 % |
| | | Y | 0.47 | 60.00 | 5.82 | | 150.0 | | |
| | | Z | 0.73 | 63.00 | 9.63 | | 150.0 | | |
| 10388-AAA | QPSK Waveform, 10 MHz | X | 2.46 | 70.66 | 17.17 | 0.00 | 150.0 | ± 1.7 % | ± 9.6 % |
| | | Y | 2.10 | 68.37 | 15.67 | | 150.0 | | |
| | | Z | 2.45 | 70.34 | 17.05 | | 150.0 | | |
| 10396-AAA | 64-QAM Waveform, 100 kHz | X | 3.34 | 72.82 | 19.20 | 3.01 | 150.0 | ± 1.6 % | ± 9.6 % |
| | | Y | 3.57 | 72.45 | 19.52 | | 150.0 | | |
| | | Z | 3.45 | 73.00 | 19.94 | | 150.0 | | |
| 10399-AAA | 64-QAM Waveform, 40 MHz | X | 3.61 | 68.21 | 16.41 | 0.00 | 150.0 | ± 3.8 % | ± 9.6 % |
| | | Y | 3.40 | 67.13 | 15.82 | | 150.0 | | |
| | | Z | 3.62 | 68.06 | 16.39 | | 150.0 | | |
| 10414-AAA | WLAN CCDF, 64-QAM, 40MHz | X | 4.88 | 66.26 | 15.89 | 0.00 | 150.0 | ± 6.6 % | ± 9.6 % |
| | | Y | 4.57 | 64.95 | 15.35 | | 150.0 | | |
| | | Z | 4.92 | 66.18 | 15.92 | | 150.0 | | |

Note: For details on UID parameters see Appendix

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

[A] The uncertainties of Norm X,Y,Z do not affect the $E^2$-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.



# DASY/EASY - Parameters of Probe: EX3DV4 - SN:3617

## Sensor Model Parameters

| | C1 fF | C2 fF | α $V^{-1}$ | T1 $ms.V^{-2}$ | T2 $ms.V^{-1}$ | T3 ms | T4 $V^{-2}$ | T5 $V^{-1}$ | T6 |
|---|---|---|---|---|---|---|---|---|---|
| X | 41.2 | 299.64 | 34.06 | 12.13 | 0.82 | 5.00 | 1.88 | 0.20 | 1.00 |
| Y | 42.0 | 334.64 | 39.96 | 9.91 | 1.46 | 5.06 | 0.00 | 0.82 | 1.01 |
| Z | 42.8 | 318.14 | 35.45 | 11.95 | 0.73 | 5.04 | 1.02 | 0.40 | 1.01 |

## Other Probe Parameters

| | |
|---|---|
| Sensor Arrangement | Triangular |
| Connector Angle (°) | 13 |
| Mechanical Surface Detection Mode | enabled |
| Optical Surface Detection Mode | disabled |
| Probe Overall Length | 337 mm |
| Probe Body Diameter | 10 mm |
| Tip Length | 9 mm |
| Tip Diameter | 2.5 mm |
| Probe Tip to Sensor X Calibration Point | 1 mm |
| Probe Tip to Sensor Y Calibration Point | 1 mm |
| Probe Tip to Sensor Z Calibration Point | 1 mm |
| Recommended Measurement Distance from Surface | 1.4 mm |



# DASY/EASY - Parameters of Probe: EX3DV4 - SN:3617

## Calibration Parameter Determined in Head Tissue Simulating Media

| f (MHz) [C] | Relative Permittivity [F] | Conductivity (S/m) [F] | ConvF X | ConvF Y | ConvF Z | Alpha [G] | Depth [G] (mm) | Unc (k=2) |
|---|---|---|---|---|---|---|---|---|
| 64 | 54.2 | 0.75 | 12.37 | 12.37 | 12.37 | 0.00 | 1.00 | ± 13.3 % |
| 150 | 52.3 | 0.76 | 11.63 | 11.63 | 11.63 | 0.00 | 1.00 | ± 13.3 % |
| 300 | 45.3 | 0.87 | 11.41 | 11.41 | 11.41 | 0.08 | 1.20 | ± 13.3 % |
| 450 | 43.5 | 0.87 | 10.84 | 10.84 | 10.84 | 0.12 | 1.40 | ± 13.3 % |
| 750 | 41.9 | 0.89 | 10.07 | 10.07 | 10.07 | 0.61 | 0.80 | ± 12.0 % |
| 835 | 41.5 | 0.90 | 9.66 | 9.66 | 9.66 | 0.54 | 0.84 | ± 12.0 % |
| 900 | 41.5 | 0.97 | 9.56 | 9.56 | 9.56 | 0.54 | 0.80 | ± 12.0 % |
| 1450 | 40.5 | 1.20 | 8.72 | 8.72 | 8.72 | 0.45 | 0.80 | ± 12.0 % |
| 1640 | 40.2 | 1.31 | 8.50 | 8.50 | 8.50 | 0.25 | 0.80 | ± 12.0 % |
| 1750 | 40.1 | 1.37 | 8.41 | 8.41 | 8.41 | 0.30 | 0.80 | ± 12.0 % |
| 1810 | 40.0 | 1.40 | 8.20 | 8.20 | 8.20 | 0.15 | 1.26 | ± 12.0 % |
| 1900 | 40.0 | 1.40 | 8.14 | 8.14 | 8.14 | 0.31 | 0.80 | ± 12.0 % |
| 2000 | 40.0 | 1.40 | 8.25 | 8.25 | 8.25 | 0.40 | 0.81 | ± 12.0 % |
| 2100 | 39.8 | 1.49 | 8.16 | 8.16 | 8.16 | 0.28 | 0.80 | ± 12.0 % |
| 2300 | 39.5 | 1.67 | 7.95 | 7.95 | 7.95 | 0.35 | 0.86 | ± 12.0 % |
| 2450 | 39.2 | 1.80 | 7.65 | 7.65 | 7.65 | 0.33 | 0.90 | ± 12.0 % |
| 2600 | 39.0 | 1.96 | 7.52 | 7.52 | 7.52 | 0.38 | 0.90 | ± 12.0 % |
| 3300 | 38.2 | 2.71 | 7.07 | 7.07 | 7.07 | 0.30 | 1.20 | ± 13.1 % |
| 3500 | 37.9 | 2.91 | 7.02 | 7.02 | 7.02 | 0.35 | 1.30 | ± 13.1 % |
| 3700 | 37.7 | 3.12 | 6.77 | 6.77 | 6.77 | 0.35 | 1.30 | ± 13.1 % |
| 3900 | 37.5 | 3.32 | 6.62 | 6.62 | 6.62 | 0.40 | 1.60 | ± 13.1 % |
| 4100 | 37.2 | 3.53 | 6.60 | 6.60 | 6.60 | 0.40 | 1.60 | ± 13.1 % |
| 4200 | 37.1 | 3.63 | 6.50 | 6.50 | 6.50 | 0.40 | 1.60 | ± 13.1 % |
| 4400 | 36.9 | 3.84 | 6.35 | 6.35 | 6.35 | 0.40 | 1.60 | ± 13.1 % |
| 4600 | 36.7 | 4.04 | 6.30 | 6.30 | 6.30 | 0.40 | 1.60 | ± 13.1 % |
| 4800 | 36.4 | 4.25 | 6.25 | 6.25 | 6.25 | 0.40 | 1.80 | ± 13.1 % |
| 4950 | 36.3 | 4.40 | 6.10 | 6.10 | 6.10 | 0.40 | 1.80 | ± 13.1 % |
| 5200 | 36.0 | 4.66 | 5.49 | 5.49 | 5.49 | 0.40 | 1.80 | ± 13.1 % |
| 5250 | 35.9 | 4.71 | 5.39 | 5.39 | 5.39 | 0.40 | 1.80 | ± 13.1 % |
| 5300 | 35.9 | 4.76 | 5.29 | 5.29 | 5.29 | 0.40 | 1.80 | ± 13.1 % |
| 5500 | 35.6 | 4.96 | 5.14 | 5.14 | 5.14 | 0.40 | 1.80 | ± 13.1 % |
| 5600 | 35.5 | 5.07 | 4.99 | 4.99 | 4.99 | 0.40 | 1.80 | ± 13.1 % |
| 5750 | 35.4 | 5.22 | 5.10 | 5.10 | 5.10 | 0.40 | 1.80 | ± 13.1 % |
| 5800 | 35.3 | 5.27 | 5.00 | 5.00 | 5.00 | 0.40 | 1.80 | ± 13.1 % |

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.

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

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



# DASY/EASY - Parameters of Probe: EX3DV4 - SN:3617

## Calibration Parameter Determined in Body Tissue Simulating Media

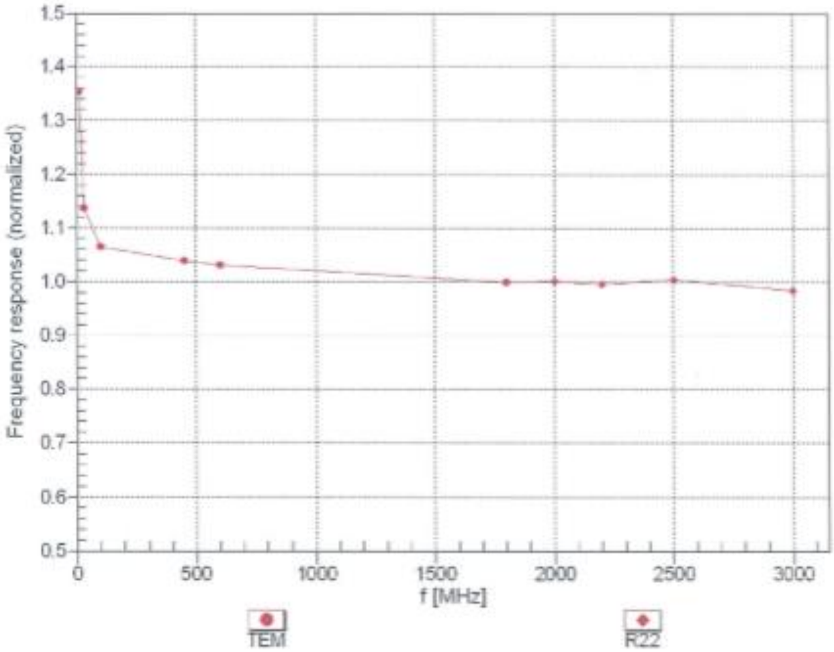
| f (MHz) [C] | Relative Permittivity [F] | Conductivity (S/m) [F] | ConvF X | ConvF Y | ConvF Z | Alpha [G] | Depth [G] (mm) | Unc (k=2) |
|---|---|---|---|---|---|---|---|---|
| 750 | 55.5 | 0.96 | 9.80 | 9.80 | 9.80 | 0.50 | 0.80 | ± 12.0 % |
| 835 | 55.2 | 0.97 | 9.53 | 9.53 | 9.53 | 0.43 | 0.80 | ± 12.0 % |
| 900 | 55.0 | 1.05 | 9.49 | 9.49 | 9.49 | 0.42 | 0.80 | ± 12.0 % |
| 1450 | 54.0 | 1.30 | 8.56 | 8.56 | 8.56 | 0.25 | 0.80 | ± 12.0 % |
| 1640 | 53.7 | 1.42 | 8.44 | 8.44 | 8.44 | 0.32 | 0.80 | ± 12.0 % |
| 1750 | 53.4 | 1.49 | 8.09 | 8.09 | 8.09 | 0.48 | 0.80 | ± 12.0 % |
| 1810 | 53.3 | 1.52 | 8.05 | 8.05 | 8.05 | 0.44 | 0.80 | ± 12.0 % |
| 1900 | 53.3 | 1.52 | 7.94 | 7.94 | 7.94 | 0.39 | 0.80 | ± 12.0 % |
| 2000 | 53.3 | 1.52 | 7.92 | 7.92 | 7.92 | 0.37 | 0.86 | ± 12.0 % |
| 2100 | 53.2 | 1.62 | 7.89 | 7.89 | 7.89 | 0.35 | 0.89 | ± 12.0 % |
| 2300 | 52.9 | 1.81 | 7.78 | 7.78 | 7.78 | 0.39 | 0.85 | ± 12.0 % |
| 2450 | 52.7 | 1.95 | 7.76 | 7.76 | 7.76 | 0.41 | 0.80 | ± 12.0 % |
| 2600 | 52.5 | 2.16 | 7.45 | 7.45 | 7.45 | 0.32 | 0.80 | ± 12.0 % |
| 3300 | 51.6 | 3.08 | 6.44 | 6.44 | 6.44 | 0.40 | 1.70 | ± 13.1 % |
| 3500 | 51.3 | 3.31 | 6.30 | 6.30 | 6.30 | 0.40 | 1.70 | ± 13.1 % |
| 3700 | 51.0 | 3.55 | 6.27 | 6.27 | 6.27 | 0.40 | 1.70 | ± 13.1 % |
| 3900 | 51.2 | 3.78 | 6.24 | 6.24 | 6.24 | 0.40 | 1.70 | ± 13.1 % |
| 4100 | 50.5 | 4.01 | 6.21 | 6.21 | 6.21 | 0.40 | 1.70 | ± 13.1 % |
| 4200 | 50.4 | 4.13 | 6.20 | 6.20 | 6.20 | 0.40 | 1.70 | ± 13.1 % |
| 4400 | 50.1 | 4.37 | 5.97 | 5.97 | 5.97 | 0.40 | 1.70 | ± 13.1 % |
| 4600 | 49.8 | 4.60 | 5.83 | 5.83 | 5.83 | 0.40 | 1.70 | ± 13.1 % |
| 4800 | 49.6 | 4.83 | 5.72 | 5.72 | 5.72 | 0.50 | 1.80 | ± 13.1 % |
| 4950 | 49.4 | 5.01 | 5.41 | 5.41 | 5.41 | 0.50 | 1.90 | ± 13.1 % |
| 5200 | 49.0 | 5.30 | 4.80 | 4.80 | 4.80 | 0.50 | 1.90 | ± 13.1 % |
| 5250 | 48.9 | 5.36 | 4.70 | 4.70 | 4.70 | 0.50 | 1.90 | ± 13.1 % |
| 5300 | 48.9 | 5.42 | 4.61 | 4.61 | 4.61 | 0.50 | 1.90 | ± 13.1 % |
| 5500 | 48.6 | 5.65 | 4.32 | 4.32 | 4.32 | 0.50 | 1.90 | ± 13.1 % |
| 5600 | 48.5 | 5.77 | 4.23 | 4.23 | 4.23 | 0.50 | 1.90 | ± 13.1 % |
| 5750 | 48.3 | 5.94 | 4.36 | 4.36 | 4.36 | 0.50 | 1.90 | ± 13.1 % |
| 5800 | 48.2 | 6.00 | 4.22 | 4.22 | 4.22 | 0.50 | 1.90 | ± 13.1 % |

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.

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

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

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



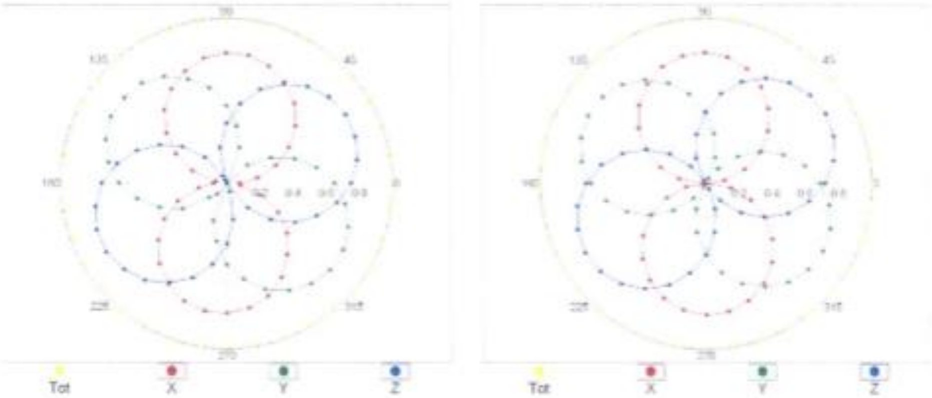

**Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)**

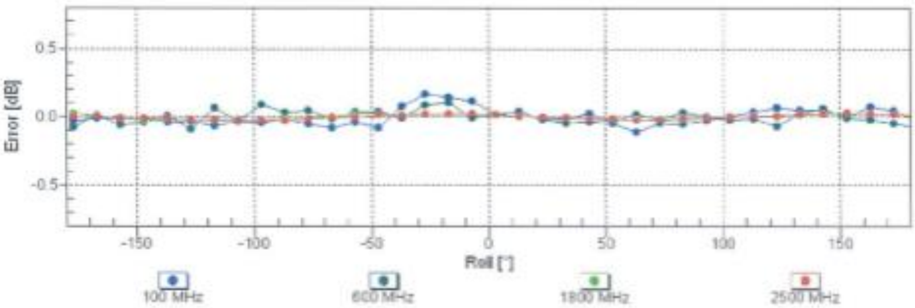


## Receiving Pattern (ϕ), $\vartheta = 0°$

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



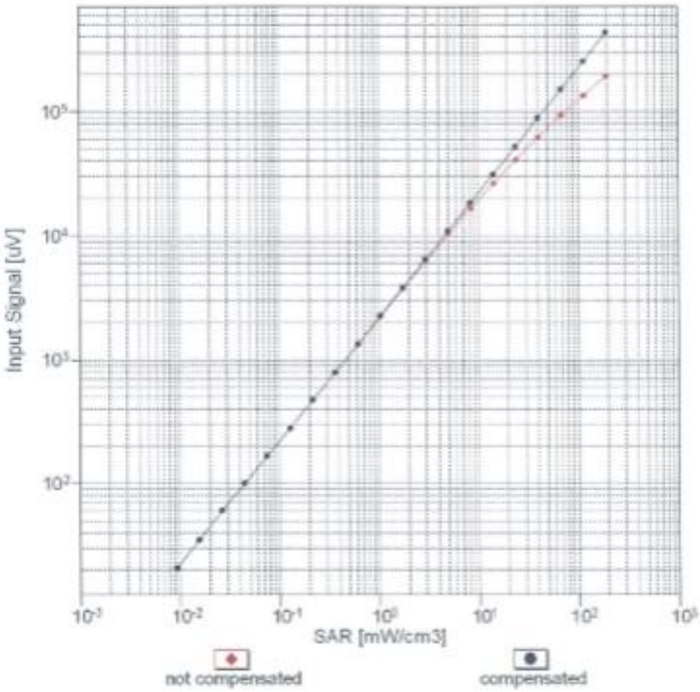

**Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)**

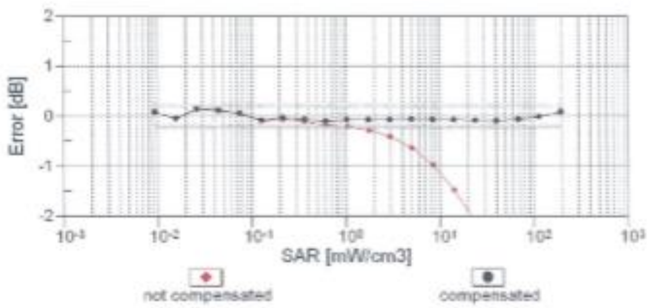


## Dynamic Range f(SAR$_{head}$)

**(TEM cell , f$_{eval}$= 1900 MHz)**



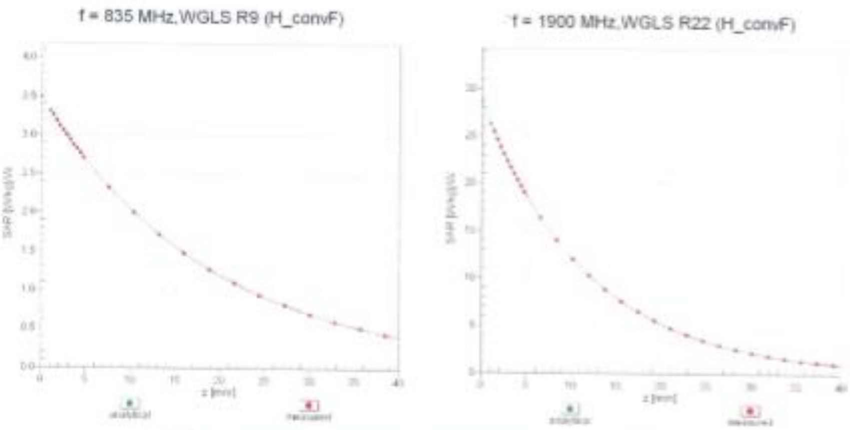




**Uncertainty of Linearity Assessment: ± 0.6% (k=2)**



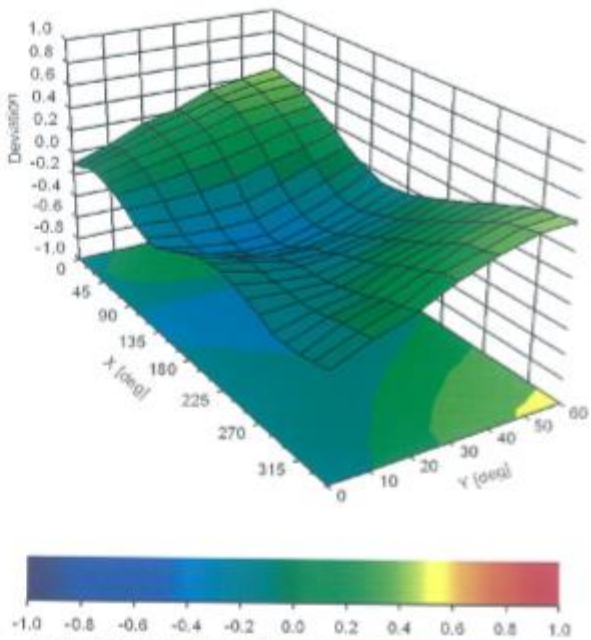
 

## Conversion Factor Assessment




## Deviation from Isotropy in Liquid

**Error (ϕ, ϑ), f = 900 MHz**




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



## Appendix: Modulation Calibration Parameters

| UID | Rev | Communication System Name | Group | PAR (dB) | Unc[E] (k=2) |
|---|---|---|---|---|---|
| 0 | | CW | CW | 0.00 | ± 4.7 % |
| 10010 | CAA | SAR Validation (Square, 100ms, 10ms) | Test | 10.00 | ± 9.6 % |
| 10011 | CAB | UMTS-FDD (WCDMA) | WCDMA | 2.91 | ± 9.6 % |
| 10012 | CAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps) | WLAN | 1.87 | ± 9.6 % |
| 10013 | CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps) | WLAN | 9.46 | ± 9.6 % |
| 10021 | DAC | GSM-FDD (TDMA, GMSK) | GSM | 9.39 | ± 9.6 % |
| 10023 | DAC | GPRS-FDD (TDMA, GMSK, TN 0) | GSM | 9.57 | ± 9.6 % |
| 10024 | DAC | GPRS-FDD (TDMA, GMSK, TN 0-1) | GSM | 6.56 | ± 9.6 % |
| 10025 | DAC | EDGE-FDD (TDMA, 8PSK, TN 0) | GSM | 12.62 | ± 9.6 % |
| 10026 | DAC | EDGE-FDD (TDMA, 8PSK, TN 0-1) | GSM | 9.55 | ± 9.6 % |
| 10027 | DAC | GPRS-FDD (TDMA, GMSK, TN 0-1-2) | GSM | 4.80 | ± 9.6 % |
| 10028 | DAC | GPRS-FDD (TDMA, GMSK, TN 0-1-2-3) | GSM | 3.55 | ± 9.6 % |
| 10029 | DAC | EDGE-FDD (TDMA, 8PSK, TN 0-1-2) | GSM | 7.78 | ± 9.6 % |
| 10030 | CAA | IEEE 802.15.1 Bluetooth (GFSK, DH1) | Bluetooth | 5.30 | ± 9.6 % |
| 10031 | CAA | IEEE 802.15.1 Bluetooth (GFSK, DH3) | Bluetooth | 1.87 | ± 9.6 % |
| 10032 | CAA | IEEE 802.15.1 Bluetooth (GFSK, DH5) | Bluetooth | 1.16 | ± 9.6 % |
| 10033 | CAA | IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH1) | Bluetooth | 7.74 | ± 9.6 % |
| 10034 | CAA | IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH3) | Bluetooth | 4.53 | ± 9.6 % |
| 10035 | CAA | IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH5) | Bluetooth | 3.83 | ± 9.6 % |
| 10036 | CAA | IEEE 802.15.1 Bluetooth (8-DPSK, DH1) | Bluetooth | 8.01 | ± 9.6 % |
| 10037 | CAA | IEEE 802.15.1 Bluetooth (8-DPSK, DH3) | Bluetooth | 4.77 | ± 9.6 % |
| 10038 | CAA | IEEE 802.15.1 Bluetooth (8-DPSK, DH5) | Bluetooth | 4.10 | ± 9.6 % |
| 10039 | CAB | CDMA2000 (1xRTT, RC1) | CDMA2000 | 4.57 | ± 9.6 % |
| 10042 | CAB | IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Halfrate) | AMPS | 7.78 | ± 9.6 % |
| 10044 | CAA | IS-91/EIA/TIA-553 FDD (FDMA, FM) | AMPS | 0.00 | ± 9.6 % |
| 10048 | CAA | DECT (TDD, TDMA/FDM, GFSK, Full Slot, 24) | DECT | 13.80 | ± 9.6 % |
| 10049 | CAA | DECT (TDD, TDMA/FDM, GFSK, Double Slot, 12) | DECT | 10.79 | ± 9.6 % |
| 10056 | CAA | UMTS-TDD (TD-SCDMA, 1.28 Mcps) | TD-SCDMA | 11.01 | ± 9.6 % |
| 10058 | DAC | EDGE-FDD (TDMA, 8PSK, TN 0-1-2-3) | GSM | 6.52 | ± 9.6 % |
| 10059 | CAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps) | WLAN | 2.12 | ± 9.6 % |
| 10060 | CAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps) | WLAN | 2.83 | ± 9.6 % |
| 10061 | CAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps) | WLAN | 3.60 | ± 9.6 % |
| 10062 | CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps) | WLAN | 8.68 | ± 9.6 % |
| 10063 | CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps) | WLAN | 8.63 | ± 9.6 % |
| 10064 | CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 12 Mbps) | WLAN | 9.09 | ± 9.6 % |
| 10065 | CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 18 Mbps) | WLAN | 9.00 | ± 9.6 % |
| 10066 | CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 24 Mbps) | WLAN | 9.38 | ± 9.6 % |
| 10067 | CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 36 Mbps) | WLAN | 10.12 | ± 9.6 % |
| 10068 | CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 48 Mbps) | WLAN | 10.24 | ± 9.6 % |
| 10069 | CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps) | WLAN | 10.56 | ± 9.6 % |
| 10071 | CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 9 Mbps) | WLAN | 9.83 | ± 9.6 % |
| 10072 | CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 12 Mbps) | WLAN | 9.62 | ± 9.6 % |
| 10073 | CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 18 Mbps) | WLAN | 9.94 | ± 9.6 % |
| 10074 | CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 24 Mbps) | WLAN | 10.30 | ± 9.6 % |
| 10075 | CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 36 Mbps) | WLAN | 10.77 | ± 9.6 % |
| 10076 | CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 48 Mbps) | WLAN | 10.94 | ± 9.6 % |
| 10077 | CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps) | WLAN | 11.00 | ± 9.6 % |
| 10081 | CAB | CDMA2000 (1xRTT, RC3) | CDMA2000 | 3.97 | ± 9.6 % |
| 10082 | CAB | IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Fullrate) | AMPS | 4.77 | ± 9.6 % |
| 10090 | DAC | GPRS-FDD (TDMA, GMSK, TN 0-4) | GSM | 6.56 | ± 9.6 % |
| 10097 | CAB | UMTS-FDD (HSDPA) | WCDMA | 3.98 | ± 9.6 % |
| 10098 | CAB | UMTS-FDD (HSUPA, Subtest 2) | WCDMA | 3.98 | ± 9.6 % |
| 10099 | DAC | EDGE-FDD (TDMA, 8PSK, TN 0-4) | GSM | 9.55 | ± 9.6 % |
| 10100 | CAE | LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK) | LTE-FDD | 5.67 | ± 9.6 % |
| 10101 | CAE | LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM) | LTE-FDD | 6.42 | ± 9.6 % |
| 10102 | CAE | LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) | LTE-FDD | 6.60 | ± 9.6 % |
| 10103 | CAG | LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK) | LTE-TDD | 9.29 | ± 9.6 % |
| 10104 | CAG | LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM) | LTE-TDD | 9.97 | ± 9.6 % |
| 10105 | CAG | LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) | LTE-TDD | 10.01 | ± 9.6 % |
| 10108 | CAG | LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK) | LTE-FDD | 5.80 | ± 9.6 % |



| | | | | | |
|---|---|---|---|---|---|
| 10109 | CAG | LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM) | LTE-FDD | 6.43 | ± 9.6 % |
| 10110 | CAG | LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK) | LTE-FDD | 5.75 | ± 9.6 % |
| 10111 | CAG | LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM) | LTE-FDD | 6.44 | ± 9.6 % |
| 10112 | CAG | LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM) | LTE-FDD | 6.59 | ± 9.6 % |
| 10113 | CAG | LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM) | LTE-FDD | 6.62 | ± 9.6 % |
| 10114 | CAC | IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK) | WLAN | 8.10 | ± 9.6 % |
| 10115 | CAC | IEEE 802.11n (HT Greenfield, 81 Mbps, 16-QAM) | WLAN | 8.46 | ± 9.6 % |
| 10116 | CAC | IEEE 802.11n (HT Greenfield, 135 Mbps, 64-QAM) | WLAN | 8.15 | ± 9.6 % |
| 10117 | CAC | IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK) | WLAN | 8.07 | ± 9.6 % |
| 10118 | CAC | IEEE 802.11n (HT Mixed, 81 Mbps, 16-QAM) | WLAN | 8.59 | ± 9.6 % |
| 10119 | CAC | IEEE 802.11n (HT Mixed, 135 Mbps, 64-QAM) | WLAN | 8.13 | ± 9.6 % |
| 10140 | CAE | LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM) | LTE-FDD | 6.49 | ± 9.6 % |
| 10141 | CAE | LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM) | LTE-FDD | 6.53 | ± 9.6 % |
| 10142 | CAE | LTE-FDD (SC-FDMA, 100% RB, 3 MHz, QPSK) | LTE-FDD | 5.73 | ± 9.6 % |
| 10143 | CAE | LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM) | LTE-FDD | 6.35 | ± 9.6 % |
| 10144 | CAE | LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 64-QAM) | LTE-FDD | 6.65 | ± 9.6 % |
| 10145 | CAF | LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK) | LTE-FDD | 5.76 | ± 9.6 % |
| 10146 | CAF | LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM) | LTE-FDD | 6.41 | ± 9.6 % |
| 10147 | CAF | LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 64-QAM) | LTE-FDD | 6.72 | ± 9.6 % |
| 10149 | CAE | LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM) | LTE-FDD | 6.42 | ± 9.6 % |
| 10150 | CAE | LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM) | LTE-FDD | 6.60 | ± 9.6 % |
| 10151 | CAG | LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK) | LTE-TDD | 9.28 | ± 9.6 % |
| 10152 | CAG | LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM) | LTE-TDD | 9.92 | ± 9.6 % |
| 10153 | CAG | LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM) | LTE-TDD | 10.05 | ± 9.6 % |
| 10154 | CAG | LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK) | LTE-FDD | 5.75 | ± 9.6 % |
| 10155 | CAG | LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM) | LTE-FDD | 6.43 | ± 9.6 % |
| 10156 | CAG | LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK) | LTE-FDD | 5.79 | ± 9.6 % |
| 10157 | CAG | LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM) | LTE-FDD | 6.49 | ± 9.6 % |
| 10158 | CAG | LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM) | LTE-FDD | 6.62 | ± 9.6 % |
| 10159 | CAG | LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM) | LTE-FDD | 6.56 | ± 9.6 % |
| 10160 | CAE | LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK) | LTE-FDD | 5.82 | ± 9.6 % |
| 10161 | CAE | LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM) | LTE-FDD | 6.43 | ± 9.6 % |
| 10162 | CAE | LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM) | LTE-FDD | 6.58 | ± 9.6 % |
| 10166 | CAF | LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK) | LTE-FDD | 5.46 | ± 9.6 % |
| 10167 | CAF | LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM) | LTE-FDD | 6.21 | ± 9.6 % |
| 10168 | CAF | LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 64-QAM) | LTE-FDD | 6.79 | ± 9.6 % |
| 10169 | CAE | LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK) | LTE-FDD | 5.73 | ± 9.6 % |
| 10170 | CAE | LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM) | LTE-FDD | 6.52 | ± 9.6 % |
| 10171 | AAE | LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM) | LTE-FDD | 6.49 | ± 9.6 % |
| 10172 | CAG | LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK) | LTE-TDD | 9.21 | ± 9.6 % |
| 10173 | CAG | LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM) | LTE-TDD | 9.48 | ± 9.6 % |
| 10174 | CAG | LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM) | LTE-TDD | 10.25 | ± 9.6 % |
| 10175 | CAG | LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK) | LTE-FDD | 5.72 | ± 9.6 % |
| 10176 | CAG | LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM) | LTE-FDD | 6.52 | ± 9.6 % |
| 10177 | CAI | LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK) | LTE-FDD | 5.73 | ± 9.6 % |
| 10178 | CAG | LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM) | LTE-FDD | 6.52 | ± 9.6 % |
| 10179 | CAG | LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM) | LTE-FDD | 6.50 | ± 9.6 % |
| 10180 | CAG | LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM) | LTE-FDD | 6.50 | ± 9.6 % |
| 10181 | CAE | LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK) | LTE-FDD | 5.72 | ± 9.6 % |
| 10182 | CAE | LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM) | LTE-FDD | 6.52 | ± 9.6 % |
| 10183 | AAD | LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM) | LTE-FDD | 6.50 | ± 9.6 % |
| 10184 | CAE | LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK) | LTE-FDD | 5.73 | ± 9.6 % |
| 10185 | CAE | LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM) | LTE-FDD | 6.51 | ± 9.6 % |
| 10186 | AAE | LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM) | LTE-FDD | 6.50 | ± 9.6 % |
| 10187 | CAF | LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK) | LTE-FDD | 5.73 | ± 9.6 % |
| 10188 | CAF | LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM) | LTE-FDD | 6.52 | ± 9.6 % |
| 10189 | AAF | LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM) | LTE-FDD | 6.50 | ± 9.6 % |
| 10193 | CAC | IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK) | WLAN | 8.09 | ± 9.6 % |
| 10194 | CAC | IEEE 802.11n (HT Greenfield, 39 Mbps, 16-QAM) | WLAN | 8.12 | ± 9.6 % |
| 10195 | CAC | IEEE 802.11n (HT Greenfield, 65 Mbps, 64-QAM) | WLAN | 8.21 | ± 9.6 % |
| 10196 | CAC | IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK) | WLAN | 8.10 | ± 9.6 % |
| 10197 | CAC | IEEE 802.11n (HT Mixed, 39 Mbps, 16-QAM) | WLAN | 8.13 | ± 9.6 % |
| 10198 | CAC | IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM) | WLAN | 8.27 | ± 9.6 % |
| 10219 | CAC | IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK) | WLAN | 8.03 | ± 9.6 % |



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| 10220 | CAC | IEEE 802.11n (HT Mixed, 43.3 Mbps, 16-QAM) | WLAN | 8.13 | ± 9.6 % |
| 10221 | CAC | IEEE 802.11n (HT Mixed, 72.2 Mbps, 64-QAM) | WLAN | 8.27 | ± 9.6 % |
| 10222 | CAC | IEEE 802.11n (HT Mixed, 15 Mbps, BPSK) | WLAN | 8.06 | ± 9.6 % |
| 10223 | CAC | IEEE 802.11n (HT Mixed, 90 Mbps, 16-QAM) | WLAN | 8.48 | ± 9.6 % |
| 10224 | CAC | IEEE 802.11n (HT Mixed, 150 Mbps, 64-QAM) | WLAN | 8.08 | ± 9.6 % |
| 10225 | CAB | UMTS-FDD (HSPA+) | WCDMA | 5.97 | ± 9.6 % |
| 10226 | CAB | LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM) | LTE-TDD | 9.49 | ± 9.6 % |
| 10227 | CAB | LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM) | LTE-TDD | 10.26 | ± 9.6 % |
| 10228 | CAB | LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK) | LTE-TDD | 9.22 | ± 9.6 % |
| 10229 | CAD | LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM) | LTE-TDD | 9.48 | ± 9.6 % |
| 10230 | CAD | LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM) | LTE-TDD | 10.25 | ± 9.6 % |
| 10231 | CAD | LTE-TDD (SC-FDMA, 1 RB, 3 MHz, QPSK) | LTE-TDD | 9.19 | ± 9.6 % |
| 10232 | CAG | LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM) | LTE-TDD | 9.48 | ± 9.6 % |
| 10233 | CAG | LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM) | LTE-TDD | 10.25 | ± 9.6 % |
| 10234 | CAG | LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK) | LTE-TDD | 9.21 | ± 9.6 % |
| 10235 | CAG | LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM) | LTE-TDD | 9.48 | ± 9.6 % |
| 10236 | CAG | LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM) | LTE-TDD | 10.25 | ± 9.6 % |
| 10237 | CAG | LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK) | LTE-TDD | 9.21 | ± 9.6 % |
| 10238 | CAF | LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM) | LTE-TDD | 9.48 | ± 9.6 % |
| 10239 | CAF | LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM) | LTE-TDD | 10.25 | ± 9.6 % |
| 10240 | CAF | LTE-TDD (SC-FDMA, 1 RB, 15 MHz, QPSK) | LTE-TDD | 9.21 | ± 9.6 % |
| 10241 | CAB | LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM) | LTE-TDD | 9.82 | ± 9.6 % |
| 10242 | CAB | LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 64-QAM) | LTE-TDD | 9.86 | ± 9.6 % |
| 10243 | CAB | LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK) | LTE-TDD | 9.46 | ± 9.6 % |
| 10244 | CAD | LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM) | LTE-TDD | 10.06 | ± 9.6 % |
| 10245 | CAD | LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 64-QAM) | LTE-TDD | 10.06 | ± 9.6 % |
| 10246 | CAD | LTE-TDD (SC-FDMA, 50% RB, 3 MHz, QPSK) | LTE-TDD | 9.30 | ± 9.6 % |
| 10247 | CAG | LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM) | LTE-TDD | 9.91 | ± 9.6 % |
| 10248 | CAG | LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM) | LTE-TDD | 10.09 | ± 9.6 % |
| 10249 | CAG | LTE-TDD (SC-FDMA, 50% RB, 5 MHz, QPSK) | LTE-TDD | 9.29 | ± 9.6 % |
| 10250 | CAG | LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM) | LTE-TDD | 9.81 | ± 9.6 % |
| 10251 | CAG | LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM) | LTE-TDD | 10.17 | ± 9.6 % |
| 10252 | CAG | LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK) | LTE-TDD | 9.24 | ± 9.6 % |
| 10253 | CAF | LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM) | LTE-TDD | 9.90 | ± 9.6 % |
| 10254 | CAF | LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM) | LTE-TDD | 10.14 | ± 9.6 % |
| 10255 | CAF | LTE-TDD (SC-FDMA, 50% RB, 15 MHz, QPSK) | LTE-TDD | 9.20 | ± 9.6 % |
| 10256 | CAB | LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM) | LTE-TDD | 9.96 | ± 9.6 % |
| 10257 | CAB | LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 64-QAM) | LTE-TDD | 10.08 | ± 9.6 % |
| 10258 | CAB | LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK) | LTE-TDD | 9.34 | ± 9.6 % |
| 10259 | CAD | LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM) | LTE-TDD | 9.98 | ± 9.6 % |
| 10260 | CAD | LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 64-QAM) | LTE-TDD | 9.97 | ± 9.6 % |
| 10261 | CAD | LTE-TDD (SC-FDMA, 100% RB, 3 MHz, QPSK) | LTE-TDD | 9.24 | ± 9.6 % |
| 10262 | CAG | LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM) | LTE-TDD | 9.83 | ± 9.6 % |
| 10263 | CAG | LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM) | LTE-TDD | 10.16 | ± 9.6 % |
| 10264 | CAG | LTE-TDD (SC-FDMA, 100% RB, 5 MHz, QPSK) | LTE-TDD | 9.23 | ± 9.6 % |
| 10265 | CAG | LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM) | LTE-TDD | 9.92 | ± 9.6 % |
| 10266 | CAG | LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM) | LTE-TDD | 10.07 | ± 9.6 % |
| 10267 | CAG | LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK) | LTE-TDD | 9.30 | ± 9.6 % |
| 10268 | CAF | LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM) | LTE-TDD | 10.06 | ± 9.6 % |
| 10269 | CAF | LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM) | LTE-TDD | 10.13 | ± 9.6 % |
| 10270 | CAF | LTE-TDD (SC-FDMA, 100% RB, 15 MHz, QPSK) | LTE-TDD | 9.58 | ± 9.6 % |
| 10274 | CAB | UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10) | WCDMA | 4.87 | ± 9.6 % |
| 10275 | CAB | UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4) | WCDMA | 3.96 | ± 9.6 % |
| 10277 | CAA | PHS (QPSK) | PHS | 11.81 | ± 9.6 % |
| 10278 | CAA | PHS (QPSK, BW 884MHz, Rolloff 0.5) | PHS | 11.81 | ± 9.6 % |
| 10279 | CAA | PHS (QPSK, BW 884MHz, Rolloff 0.38) | PHS | 12.18 | ± 9.6 % |
| 10290 | AAB | CDMA2000, RC1, SO55, Full Rate | CDMA2000 | 3.91 | ± 9.6 % |
| 10291 | AAB | CDMA2000, RC3, SO55, Full Rate | CDMA2000 | 3.46 | ± 9.6 % |
| 10292 | AAB | CDMA2000, RC3, SO32, Full Rate | CDMA2000 | 3.39 | ± 9.6 % |
| 10293 | AAB | CDMA2000, RC3, SO3, Full Rate | CDMA2000 | 3.50 | ± 9.6 % |
| 10295 | AAB | CDMA2000, RC1, SO3, 1/8th Rate 25 fr. | CDMA2000 | 12.49 | ± 9.6 % |
| 10297 | AAD | LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK) | LTE-FDD | 5.81 | ± 9.6 % |
| 10298 | AAD | LTE-FDD (SC-FDMA, 50% RB, 3 MHz, QPSK) | LTE-FDD | 5.72 | ± 9.6 % |
| 10299 | AAD | LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM) | LTE-FDD | 6.39 | ± 9.6 % |



 

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| 10300 | AAD | LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 64-QAM) | LTE-FDD | 6.60 | ± 9.6 % |
| 10301 | AAA | IEEE 802.16e WiMAX (29:18, 5ms, 10MHz, QPSK, PUSC) | WiMAX | 12.03 | ± 9.6 % |
| 10302 | AAA | IEEE 802.16e WiMAX (29:18, 5ms, 10MHz, QPSK, PUSC, 3 CTRL symbols) | WiMAX | 12.57 | ± 9.6 % |
| 10303 | AAA | IEEE 802.16e WiMAX (31:15, 5ms, 10MHz, 64QAM, PUSC) | WiMAX | 12.52 | ± 9.6 % |
| 10304 | AAA | IEEE 802.16e WiMAX (29:18, 5ms, 10MHz, 64QAM, PUSC) | WiMAX | 11.86 | ± 9.6 % |
| 10305 | AAA | IEEE 802.16e WiMAX (31:15, 10ms, 10MHz, 64QAM, PUSC, 15 symbols) | WiMAX | 15.24 | ± 9.6 % |
| 10306 | AAA | IEEE 802.16e WiMAX (29:18, 10ms, 10MHz, 64QAM, PUSC, 18 symbols) | WiMAX | 14.67 | ± 9.6 % |
| 10307 | AAA | IEEE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, PUSC, 18 symbols) | WiMAX | 14.49 | ± 9.6 % |
| 10308 | AAA | IEEE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, PUSC) | WiMAX | 14.46 | ± 9.6 % |
| 10309 | AAA | IEEE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, AMC 2x3, 18 symbols) | WiMAX | 14.58 | ± 9.6 % |
| 10310 | AAA | IEEE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 symbols) | WiMAX | 14.57 | ± 9.6 % |
| 10311 | AAD | LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK) | LTE-FDD | 6.06 | ± 9.6 % |
| 10313 | AAA | iDEN 1:3 | iDEN | 10.51 | ± 9.6 % |
| 10314 | AAA | iDEN 1:6 | iDEN | 13.48 | ± 9.6 % |
| 10315 | AAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle) | WLAN | 1.71 | ± 9.6 % |
| 10316 | AAB | IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle) | WLAN | 8.36 | ± 9.6 % |
| 10317 | AAC | IEEE 802.11a WiFi 5 GHz (OFDM, 6 Mbps, 96pc duty cycle) | WLAN | 8.36 | ± 9.6 % |
| 10352 | AAA | Pulse Waveform (200Hz, 10%) | Generic | 10.00 | ± 9.6 % |
| 10353 | AAA | Pulse Waveform (200Hz, 20%) | Generic | 6.99 | ± 9.6 % |
| 10354 | AAA | Pulse Waveform (200Hz, 40%) | Generic | 3.98 | ± 9.6 % |
| 10355 | AAA | Pulse Waveform (200Hz, 60%) | Generic | 2.22 | ± 9.6 % |
| 10356 | AAA | Pulse Waveform (200Hz, 80%) | Generic | 0.97 | ± 9.6 % |
| 10387 | AAA | QPSK Waveform, 1 MHz | Generic | 5.10 | ± 9.6 % |
| 10388 | AAA | QPSK Waveform, 10 MHz | Generic | 5.22 | ± 9.6 % |
| 10396 | AAA | 64-QAM Waveform, 100 kHz | Generic | 6.27 | ± 9.6 % |
| 10399 | AAA | 64-QAM Waveform, 40 MHz | Generic | 6.27 | ± 9.6 % |
| 10400 | AAD | IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle) | WLAN | 8.37 | ± 9.6 % |
| 10401 | AAD | IEEE 802.11ac WiFi (40MHz, 64-QAM, 99pc duty cycle) | WLAN | 8.60 | ± 9.6 % |
| 10402 | AAD | IEEE 802.11ac WiFi (80MHz, 64-QAM, 99pc duty cycle) | WLAN | 8.53 | ± 9.6 % |
| 10403 | AAB | CDMA2000 (1xEV-DO, Rev. 0) | CDMA2000 | 3.76 | ± 9.6 % |
| 10404 | AAB | CDMA2000 (1xEV-DO, Rev. A) | CDMA2000 | 3.77 | ± 9.6 % |
| 10406 | AAB | CDMA2000, RC3, SO32, SCH0, Full Rate | CDMA2000 | 5.22 | ± 9.6 % |
| 10410 | AAG | LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9, Subframe Conf=4) | LTE-TDD | 7.82 | ± 9.6 % |
| 10414 | AAA | WLAN CCDF, 64-QAM, 40MHz | Generic | 8.54 | ± 9.6 % |
| 10415 | AAA | IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle) | WLAN | 1.54 | ± 9.6 % |
| 10416 | AAA | IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle) | WLAN | 8.23 | ± 9.6 % |
| 10417 | AAB | IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 99pc duty cycle) | WLAN | 8.23 | ± 9.6 % |
| 10418 | AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Long preambule) | WLAN | 8.14 | ± 9.6 % |
| 10419 | AAA | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Short preambule) | WLAN | 8.19 | ± 9.6 % |
| 10422 | AAB | IEEE 802.11n (HT Greenfield, 7.2 Mbps, BPSK) | WLAN | 8.32 | ± 9.6 % |
| 10423 | AAB | IEEE 802.11n (HT Greenfield, 43.3 Mbps, 16-QAM) | WLAN | 8.47 | ± 9.6 % |
| 10424 | AAB | IEEE 802.11n (HT Greenfield, 72.2 Mbps, 64-QAM) | WLAN | 8.40 | ± 9.6 % |
| 10425 | AAB | IEEE 802.11n (HT Greenfield, 15 Mbps, BPSK) | WLAN | 8.41 | ± 9.6 % |
| 10426 | AAB | IEEE 802.11n (HT Greenfield, 90 Mbps, 16-QAM) | WLAN | 8.45 | ± 9.6 % |
| 10427 | AAB | IEEE 802.11n (HT Greenfield, 150 Mbps, 64-QAM) | WLAN | 8.41 | ± 9.6 % |
| 10430 | AAD | LTE-FDD (OFDMA, 5 MHz, E-TM 3.1) | LTE-FDD | 8.28 | ± 9.6 % |
| 10431 | AAD | LTE-FDD (OFDMA, 10 MHz, E-TM 3.1) | LTE-FDD | 8.38 | ± 9.6 % |
| 10432 | AAC | LTE-FDD (OFDMA, 15 MHz, E-TM 3.1) | LTE-FDD | 8.34 | ± 9.6 % |
| 10433 | AAC | LTE-FDD (OFDMA, 20 MHz, E-TM 3.1) | LTE-FDD | 8.34 | ± 9.6 % |
| 10434 | AAA | W-CDMA (BS Test Model 1, 64 DPCH) | WCDMA | 8.60 | ± 9.6 % |
| 10435 | AAF | LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 7.82 | ± 9.6 % |
| 10447 | AAD | LTE-FDD (OFDMA, 5 MHz, E-TM 3.1, Clipping 44%) | LTE-FDD | 7.56 | ± 9.6 % |
| 10448 | AAD | LTE-FDD (OFDMA, 10 MHz, E-TM 3.1, Clippin 44%) | LTE-FDD | 7.53 | ± 9.6 % |
| 10449 | AAC | LTE-FDD (OFDMA, 15 MHz, E-TM 3.1, Cliping 44%) | LTE-FDD | 7.51 | ± 9.6 % |
| 10450 | AAC | LTE-FDD (OFDMA, 20 MHz, E-TM 3.1, Clipping 44%) | LTE-FDD | 7.48 | ± 9.6 % |



 

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| 10451 | AAA | W-CDMA (BS Test Model 1, 64 DPCH, Clipping 44%) | WCDMA | 7.59 | ± 9.6 % |
| 10453 | AAD | Validation (Square, 10ms, 1ms) | Test | 10.00 | ± 9.6 % |
| 10456 | AAB | IEEE 802.11ac WiFi (160MHz, 64-QAM, 99pc duty cycle) | WLAN | 8.63 | ± 9.6 % |
| 10457 | AAA | UMTS-FDD (DC-HSDPA) | WCDMA | 6.62 | ± 9.6 % |
| 10458 | AAA | CDMA2000 (1xEV-DO, Rev. B, 2 carriers) | CDMA2000 | 6.55 | ± 9.6 % |
| 10459 | AAA | CDMA2000 (1xEV-DO, Rev. B, 3 carriers) | CDMA2000 | 8.25 | ± 9.6 % |
| 10460 | AAA | UMTS-FDD (WCDMA, AMR) | WCDMA | 2.39 | ± 9.6 % |
| 10461 | AAB | LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 7.82 | ± 9.6 % |
| 10462 | AAB | LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 8.30 | ± 9.6 % |
| 10463 | AAB | LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 8.56 | ± 9.6 % |
| 10464 | AAC | LTE-TDD (SC-FDMA, 1 RB, 3 MHz, QPSK, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 7.82 | ± 9.6 % |
| 10465 | AAC | LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 8.32 | ± 9.6 % |
| 10466 | AAC | LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 8.57 | ± 9.6 % |
| 10467 | AAF | LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 7.82 | ± 9.6 % |
| 10468 | AAF | LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 8.32 | ± 9.6 % |
| 10469 | AAF | LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 8.56 | ± 9.6 % |
| 10470 | AAF | LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 7.82 | ± 9.6 % |
| 10471 | AAF | LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 8.32 | ± 9.6 % |
| 10472 | AAF | LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 8.57 | ± 9.6 % |
| 10473 | AAE | LTE-TDD (SC-FDMA, 1 RB, 15 MHz, QPSK, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 7.82 | ± 9.6 % |
| 10474 | AAE | LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 8.32 | ± 9.6 % |
| 10475 | AAE | LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 8.57 | ± 9.6 % |
| 10477 | AAF | LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 8.32 | ± 9.6 % |
| 10478 | AAF | LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 8.57 | ± 9.6 % |
| 10479 | AAB | LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 7.74 | ± 9.6 % |
| 10480 | AAB | LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 8.18 | ± 9.6 % |
| 10481 | AAB | LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 8.45 | ± 9.6 % |
| 10482 | AAC | LTE-TDD (SC-FDMA, 50% RB, 3 MHz, QPSK, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 7.71 | ± 9.6 % |
| 10483 | AAC | LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 8.39 | ± 9.6 % |
| 10484 | AAC | LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 8.47 | ± 9.6 % |
| 10485 | AAF | LTE-TDD (SC-FDMA, 50% RB, 5 MHz, QPSK, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 7.59 | ± 9.6 % |
| 10486 | AAF | LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 8.38 | ± 9.6 % |
| 10487 | AAF | LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 8.60 | ± 9.6 % |
| 10488 | AAF | LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 7.70 | ± 9.6 % |
| 10489 | AAF | LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 8.31 | ± 9.6 % |
| 10490 | AAF | LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9) | LTE-TDD | 8.54 | ± 9.6 % |