# SAR TEST REPORT

## No. I15Z42203-SEM01

**For**

**TCL Communication Ltd.**

**GSM Quad-band / UMTS Tri-band / LTE Quad-band mobile phone**

**Model name: A621BL**

**With**

**Hardware Version: 06**

**Software Version: SVN01**

**FCC ID: 2ACCJA009**

**Issued Date: 2015-09-29**

TESTING
CNAS L0570

**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.

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## REPORT HISTORY

| Report Number | Revision | Issue Date | Description |
|---|---|---|---|
| I15Z42203-SEM01 | Rev.0 | 2015-09-29 | Initial creation of test report |

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# 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 |

## 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 |

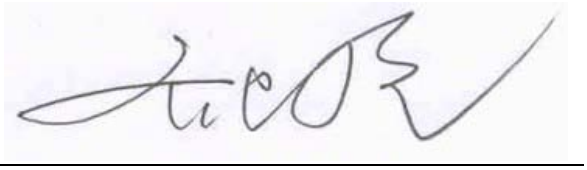
## 1.3 Project Data

| | |
|---|---|
| Project Leader: | Qi Dianyuan |
| Test Engineer: | Lin Xiaojun |
| Testing Start Date: | September 14, 2015 |
| Testing End Date: | September 17, 2015 |

## 1.4 Signature

**Lin Xiaojun**

**(Prepared this test report)**



**Qi Dianyuan**

**(Reviewed this test report)**

**Xiao Li**

**Deputy Director of the laboratory**

**(Approved this test report)**

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## 2 Statement of Compliance

The maximum results of SAR found during testing for TCL Communication Ltd. GSM Quad-band / UMTS Tri-band / LTE Quad-band mobile phone A621BL are as follows:

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

| Exposure Configuration | Technology Band | Highest Reported SAR 1g (W/Kg) | Equipment Class |
|---|---|---|---|
| Head (Separation Distance 0mm) | GSM 850 | 0.30 | PCE |
| | PCS 1900 | 0.13 | |
| | UMTS FDD 5 | 0.27 | |
| | UMTS FDD 4 | 0.47 | |
| | UMTS FDD 2 | 0.30 | |
| | LTE Band 2 | 0.16 | |
| | LTE Band 4 | 0.35 | |
| | LTE Band 5 | 0.25 | |
| | LTE Band 17 | 0.20 | |
| | WLAN 2.4 GHz | 1.46 | DTS |
| Hotspot (Separation Distance 10mm) | GSM 850 | 0.53 | PCE |
| | PCS 1900 | 0.52 | |
| | UMTS FDD 5 | 0.46 | |
| | UMTS FDD 4 | 0.94 | |
| | UMTS FDD 2 | 1.01 | |
| | LTE Band 2 | 0.95 | |
| | LTE Band 4 | 0.75 | |
| | LTE Band 5 | 0.34 | |
| | LTE Band 17 | 0.40 | |
| | WLAN 2.4 GHz | 0.46 | DTS |
| Body-worn (Data) (Separation Distance 15mm) | PCS 1900 | 0.74 | PCE |
| | UMTS FDD 4 | 1.18 | |
| | UMTS FDD 2 | 1.36 | |
| | LTE Band 2 | 0.87 | |
| | LTE Band 4 | 0.84 | |

The SAR values found for the Mobile Phone 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 of 10 mm for hotspot on and 15mm for hotspot off and speech 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.

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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**: 1.46 W/kg (1g).**

**Table 2.2: The sum of reported SAR values for main antenna and WLAN**

| | Band | Position | Main antenna | WLAN | Sum | Distance (mm) | Ratio |
|---|---|---|---|---|---|---|---|
| **Maximum reported SAR value for Head** | WCDMA 1700 | Left hand, Touch cheek | 0.47 | 0.61 | **1.08** | **/** | **/** |
| | GSM 850 | Right hand, Touch cheek | 0.27 | 1.46 | **1.73** | 79.5 | **0.03** |
| | WCDMA 850 | | 0.25 | | **1.71** | 77.3 | **0.03** |
| | WCDMA 1700 | | 0.23 | | **1.69** | 96.9 | **0.02** |
| | LTE Band 4 | | 0.18 | | **1.64** | 98.8 | **0.02** |
| | LTE Band 5_1RB | | 0.23 | | **1.69** | 74.7 | **0.03** |
| | LTE Band 5_25RB | | 0.17 | | **1.63** | 79.5 | **0.03** |
| | LTE Band 17 | | 0.16 | | **1.62** | 79.9 | **0.03** |
| **Maximum reported SAR value for Body** | LTE Band 2 | Rear 10mm | 0.77 | 0.46 | **1.23** | / | **/** |
| | WCDMA 1900 | Bottom 10mm | 1.01 | / | **1.01** | / | **/** |
| | WCDMA 1900 | Bottom 15mm | 1.36 | / | **1.36** | / | **/** |

According to the KDB 447498 D01, when the sum of SAR is larger than the limit, SAR test exclusion is determined by the SAR to peak location separation ratio. The ratio is determined by $(SAR1 + SAR2)^{1.5}/Ri$, rounded to two decimal digits, and must be ≤ 0.04 for all antenna pairs in the configuration to qualify for 1-g SAR test exclusion.

**Table 2.3: The sum of reported SAR values for main antenna and Bluetooth**

| | Position | Main antenna | BT* | Sum |
|---|---|---|---|---|
| **Highest reported SAR value for Head** | Left hand, Touch cheek | 0.47 | 0.33 | **0.80** |
| **Highest reported SAR value for Body** | Rear 10mm | 0.77 | 0.17 | **0.94** |
| | Bottom 10mm | 1.01 | / | **1.01** |
| | Bottom 15mm | 1.36 | / | **1.36** |

BT* - Estimated SAR for Bluetooth (see the table 13.3)

According to the above tables, the highest sum of reported SAR values is **1.73 W/kg (1g)**. The detail for simultaneous transmission consideration is described in chapter 13.

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# 3 Client Information

## 3.1 Applicant Information

| | |
|---|---|
| Company Name: | TCL Communication Ltd. |
| Address /Post: | 5F, C building, No. 232, Liang Jing Road ZhangJiang High-Tech Park, Pudong Area Shanghai, P.R. China. 201203 |
| City: | Shanghai |
| Postal Code: | 201203 |
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| Telephone: | 0086-21-51798260 |
| Fax: | 0086-21-61460602 |

## 3.2 Manufacturer Information

| | |
|---|---|
| Company Name: | TCL Communication Ltd. |
| Address /Post: | 5F, C building, No. 232, Liang Jing Road ZhangJiang High-Tech Park, Pudong Area Shanghai, P.R. China. 201203 |
| City: | Shanghai |
| Postal Code: | 201203 |
| Country: | China |
| Contact Person: | Gong Zhizhou |
| Email: | zhizhou.gong@tcl.com |
| Telephone: | 0086-21-51798260 |
| Fax: | 0086-21-61460602 |

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

## 4.1 About EUT

| | |
|---|---|
| Description: | GSM Quad-band / UMTS Tri-band / LTE Quad-band mobile phone |
| Model name: | A621BL |
| Operating mode(s): | GSM 850/900/1800/1900, WCDMA 850/1700/1900<br>BT, Wi-Fi, LTE Band 2/4/5/17 |
| Tested Tx Frequency: | 825 – 848.8 MHz (GSM 850) |
| | 1850.2 – 1910 MHz (GSM 1900) |
| | 826.4–846.6 MHz (WCDMA850 Band V) |
| | 1712.4 – 1752.6 MHz (WCDMA 1700 Band IV) |
| | 1852.4–1907.6 MHz (WCDMA1900 Band II) |
| | 1860 – 1900 MHz (LTE Band 2) |
| | 1720 – 1745 MHz (LTE Band 4) |
| | 824.7 – 848.3 MHz (LTE Band 5) |
| | 709 – 711 MHz (LTE Band 17) |
| | 2412 – 2462 MHz (Wi-Fi 2.4G) |
| GPRS/EGPRS Multislot Class: | 33 |
| GPRS capability Class: | B |
| Test device Production information: | Production unit |
| Device type: | Portable device |
| Antenna type: | Integrated antenna |
| Accessories/Body-worn configurations: | Headset |
| Hotspot mode: | Support simultaneous transmission of hotspot and voice(or data) |

## 4.2 Internal Identification of EUT used during the test

| EUT ID* | IMEI | HW | SW Version |
|---|---|---|---|
| EUT1 | 014470000051903 | 06 | SVN01 |
| EUT2 | 014470000050368 | 06 | SVN01 |
| EUT3 | 014470000051952 | 06 | SVN01 |
| EUT4 | 014470000050723 | 06 | SVN01 |
| EUT5 | 014470000050970 | 06 | SVN01 |

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

**Note:** It is performed to test SAR with the EUT1&2&3 and conducted power with the EUT4&5.

## 4.3 Internal Identification of AE used during the test

| AE ID* | Description | Model | SN | Manufacturer |
|---|---|---|---|---|
| AE1 | Battery | CAC2500028C2 | / | SCUD (LG) |
| AE2 | Headset | CCB3160A11C1 | / | Juwei |
| AE3 | Headset | CCB3160A11C6 | / | Shenhua |

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

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# 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 v05r02:** Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

**KDB648474 D04 Handset SAR v01r02:** SAR Evaluation Considerations for Wireless Handsets.

**KDB941225 D01 SAR test for 3G devices v03:** SAR Measurement Procedures for 3G Devices

**KDB941225 D05 SAR for LTE Devices v02r03:** SAR Evaluation Considerations for LTE Devices

**KDB941225 D06 Hotspot Mode SAR v02:** SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities

**KDB248227 D01 802.11 Wi-Fi SAR v02:** SAR GUIDANCE FOR IEEE 802.11 (Wi-Fi) TRANSMITTERS

**KDB865664 D01SAR measurement 100 MHz to 6 GHz v01r03:** SAR Measurement Requirements for 100 MHz to 6 GHz.

**KDB865664 D02 RF Exposure Reporting v01r01:** RF Exposure Compliance Reporting and Documentation Considerations

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# 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:

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

SAR is expressed in units of Watts per kilogram (W/kg)
SAR measurement can be either related to the temperature elevation in tissue by

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

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.

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# 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 |
|---|---|---|---|---|---|
| 750 | Head | 0.89 | 0.85～0.93 | 41.94 | 39.8～44.0 |
| 750 | Body | 0.96 | 0.91～1.01 | 55.5 | 52.7～58.3 |
| 835 | Head | 0.90 | 0.86～0.95 | 41.5 | 39.4～43.6 |
| 835 | Body | 0.97 | 0.92～1.02 | 55.2 | 52.4～58.0 |
| 1750 | Head | 1.37 | 1.30～1.44 | 40.08 | 38.1～42.1 |
| 1750 | Body | 1.49 | 1.42～1.56 | 53.4 | 50.7～56.1 |
| 1900 | Head | 1.40 | 1.33～1.47 | 40.0 | 38.0～42.0 |
| 1900 | Body | 1.52 | 1.44～1.60 | 53.3 | 50.6～56.0 |
| 2450 | Head | 1.80 | 1.71～1.89 | 39.2 | 37.2～41.2 |
| 2450 | Body | 1.95 | 1.85～2.05 | 52.7 | 50.1～55.3 |

## 7.2 Dielectric Performance

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

| Measurement Date (yyyy-mm-dd) | Type | Frequency | Permittivity ε | Drift (%) | Conductivity σ (S/m) | Drift (%) |
|---|---|---|---|---|---|---|
| 2015-09-17 | Head | 750 MHz | 41.01 | -2.22 | 0.923 | 3.71 |
| | Body | 750 MHz | 56.37 | 1.57 | 0.968 | 0.83 |
| 2015-09-14 | Head | 835 MHz | 41.64 | 0.34 | 0.929 | 3.22 |
| | Body | 835 MHz | 54.64 | -1.01 | 0.99 | 2.06 |
| 2015-09-16 | Head | 1750 MHz | 41.31 | 3.07 | 1.321 | -3.58 |
| | Body | 1750 MHz | 54.04 | 1.20 | 1.549 | 3.96 |
| 2015-09-15 | Head | 1900 MHz | 41.45 | 3.63 | 1.375 | -1.79 |
| | Body | 1900 MHz | 54.49 | 2.23 | 1.496 | -1.58 |
| 2015-09-17 | Head | 2450 MHz | 39.55 | 0.89 | 1.807 | 0.39 |
| | Body | 2450 MHz | 54.38 | 3.19 | 2.006 | 2.87 |

Note: The liquid temperature is 22.0 ℃

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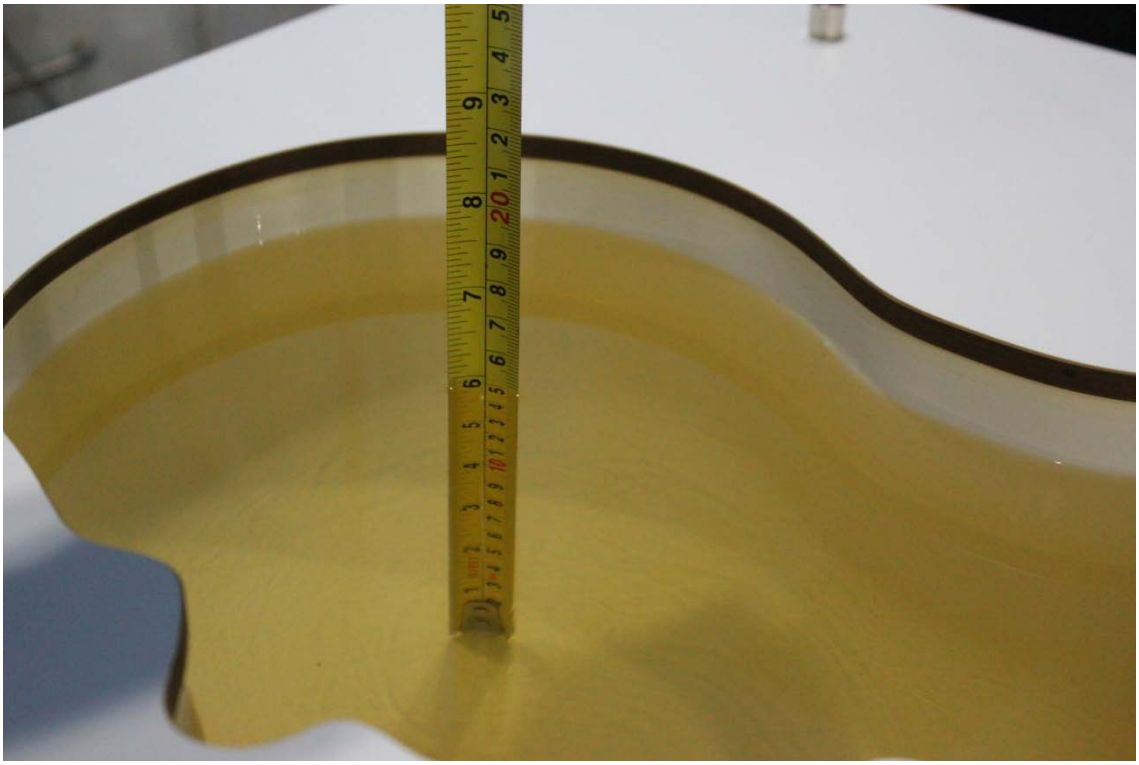

**Picture 7-1: Liquid depth in the Head Phantom (750 MHz)**

**Picture 7-2: Liquid depth in the Flat Phantom (750 MHz)**

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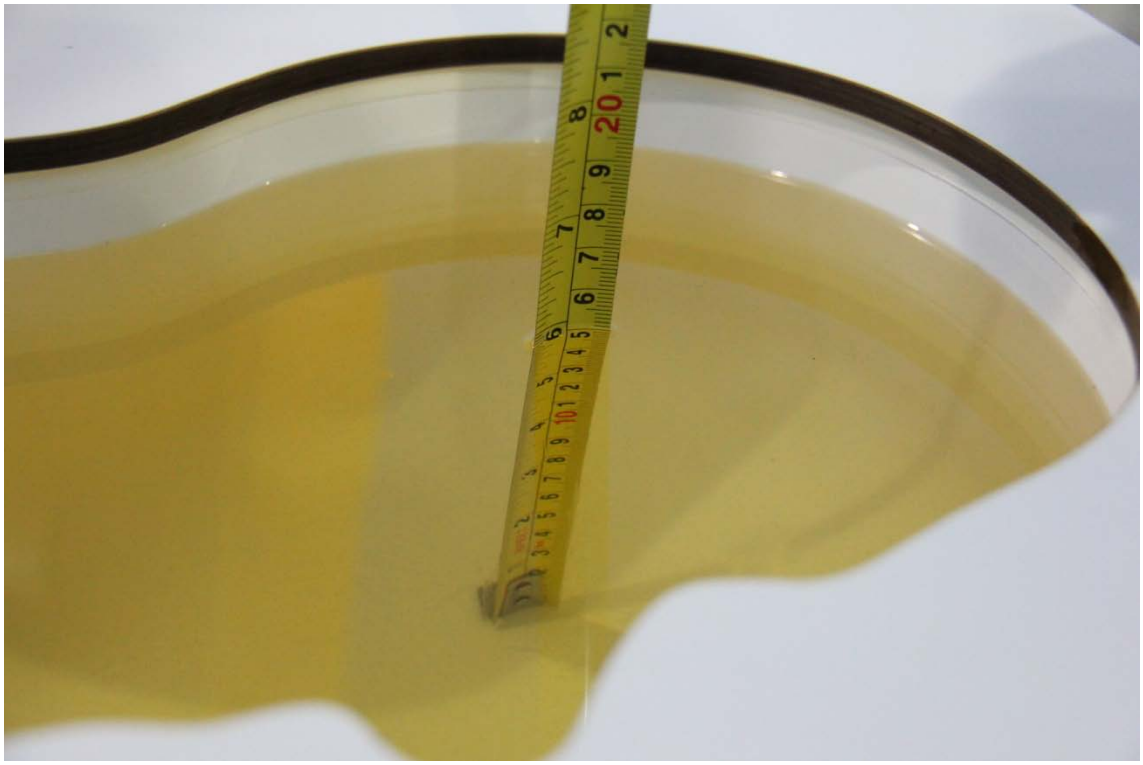
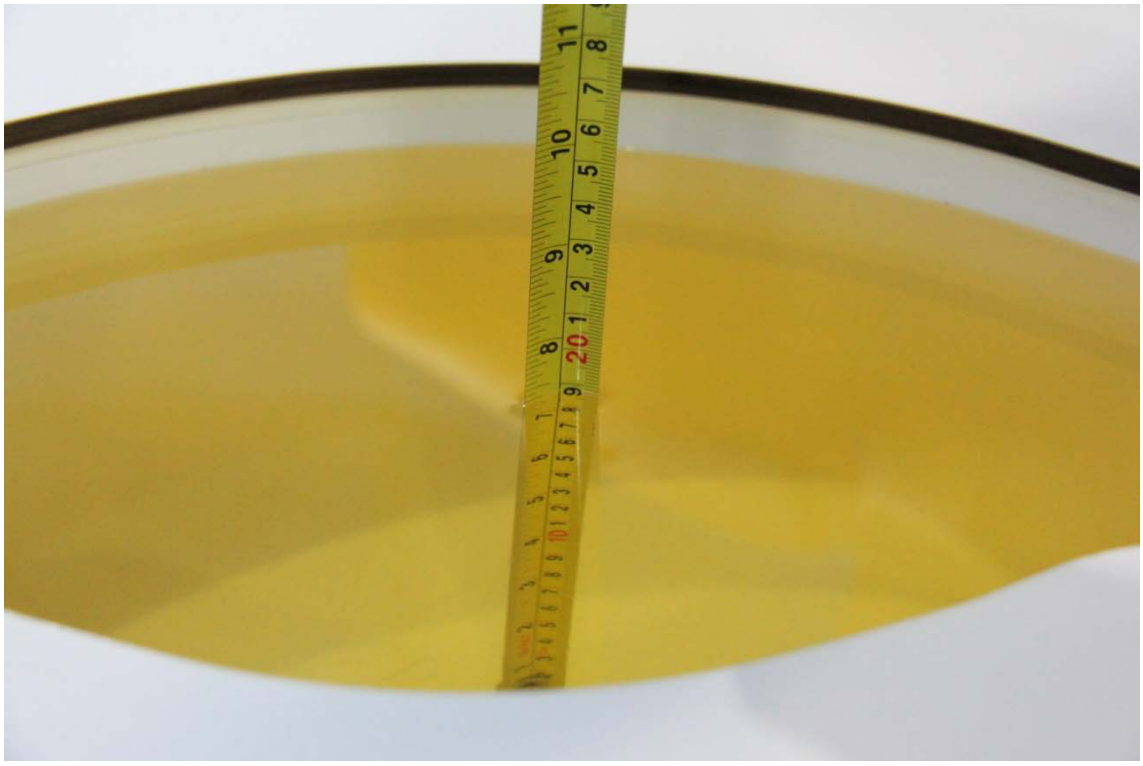


**Picture 7-3: Liquid depth in the Head Phantom (835 MHz)**



**Picture 7-4: Liquid depth in the Flat Phantom (835 MHz)**

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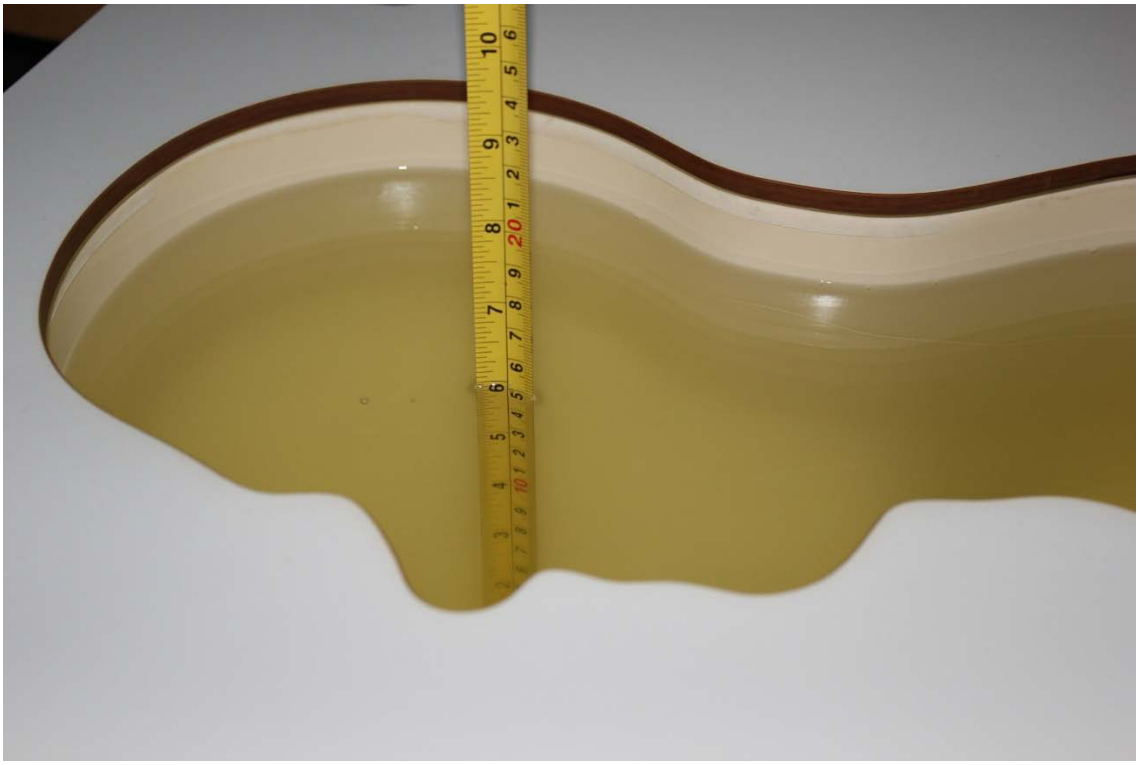
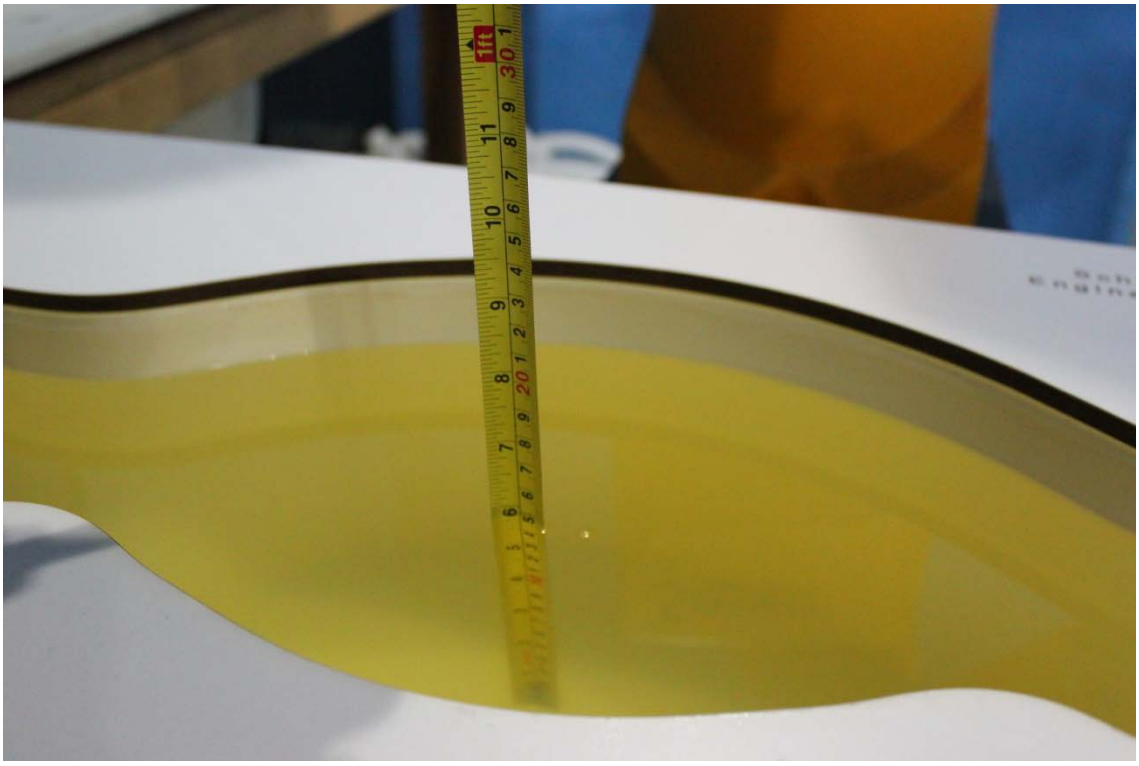


**Picture 7-5: Liquid depth in the Head Phantom (1750 MHz)**



**Picture 7-6 Liquid depth in the Flat Phantom (1750MHz)**

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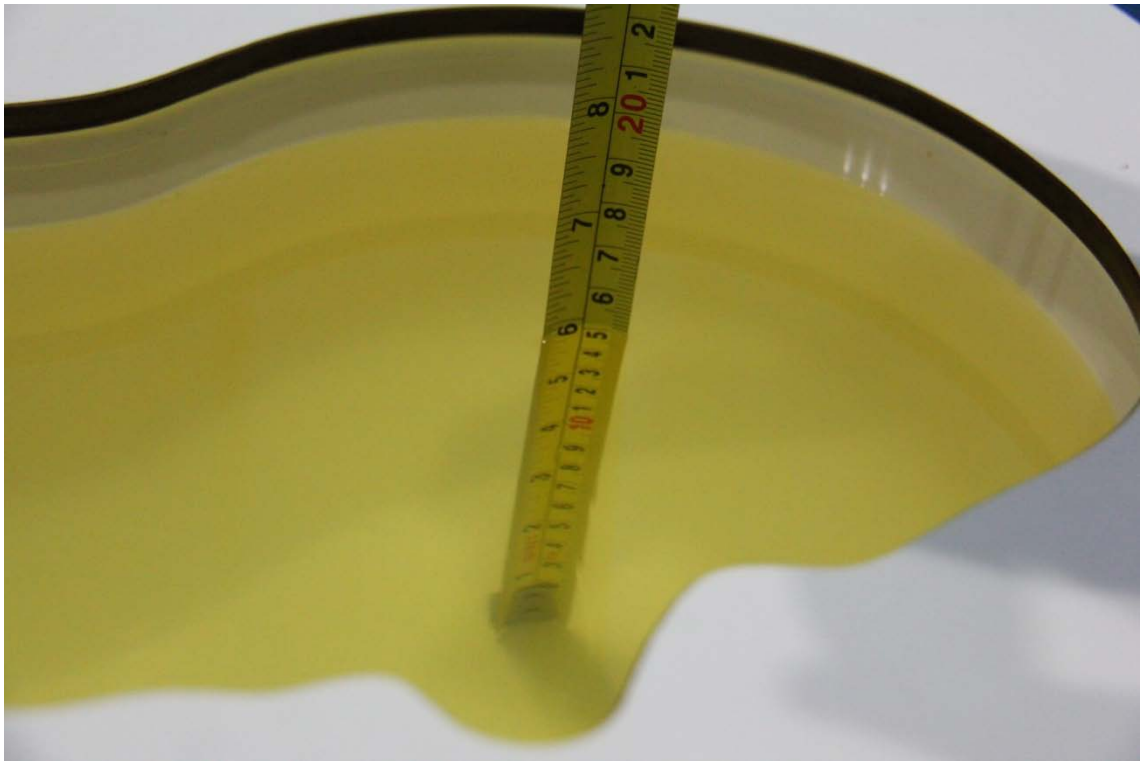
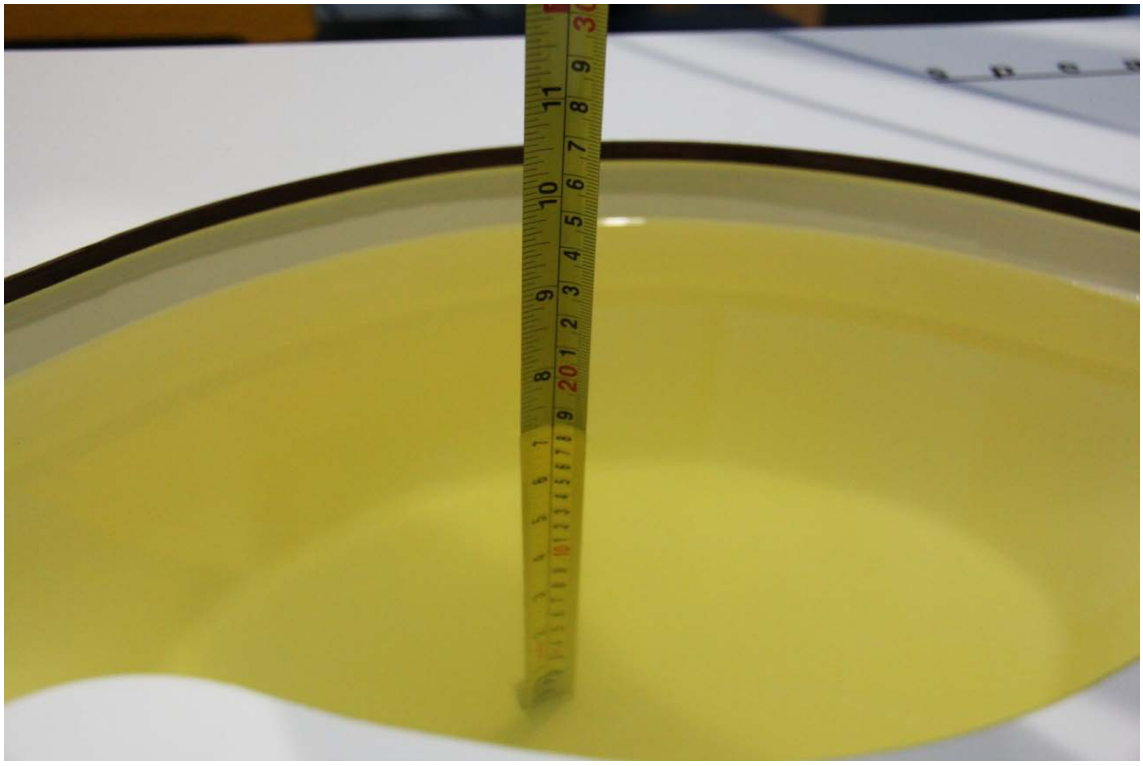


**Picture 7-7: Liquid depth in the Head Phantom (1900 MHz)**



**Picture 7-8 Liquid depth in the Flat Phantom (1900MHz)**

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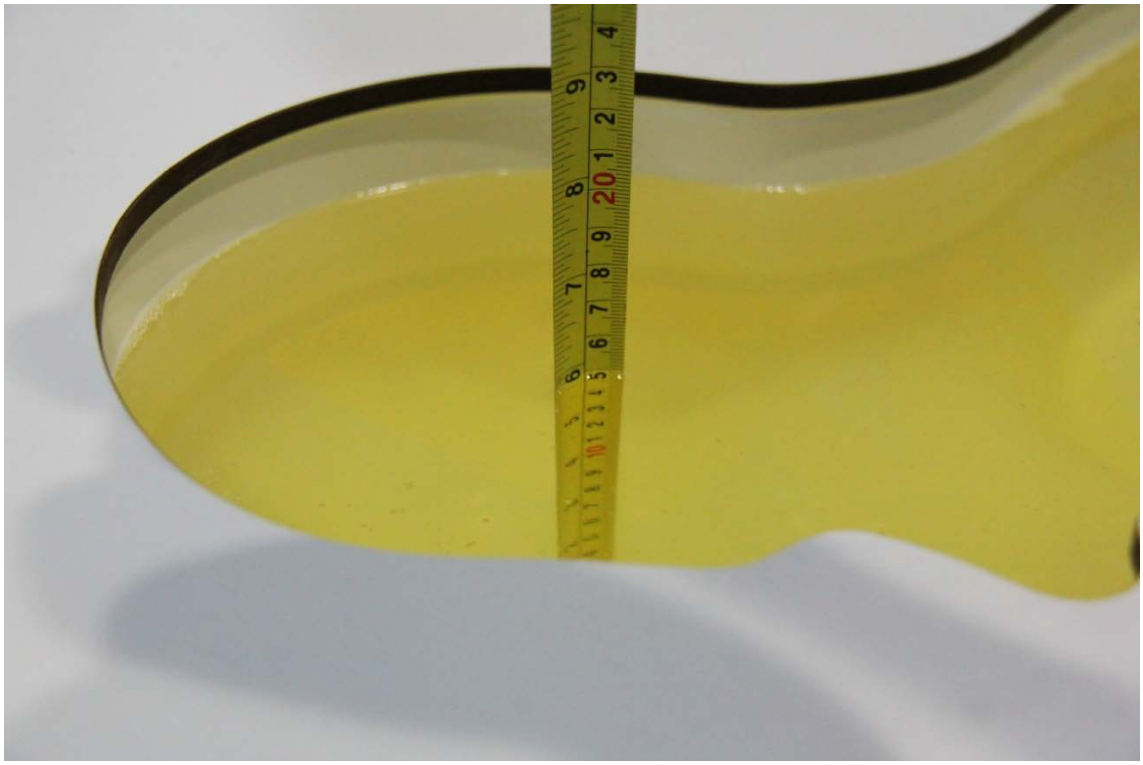
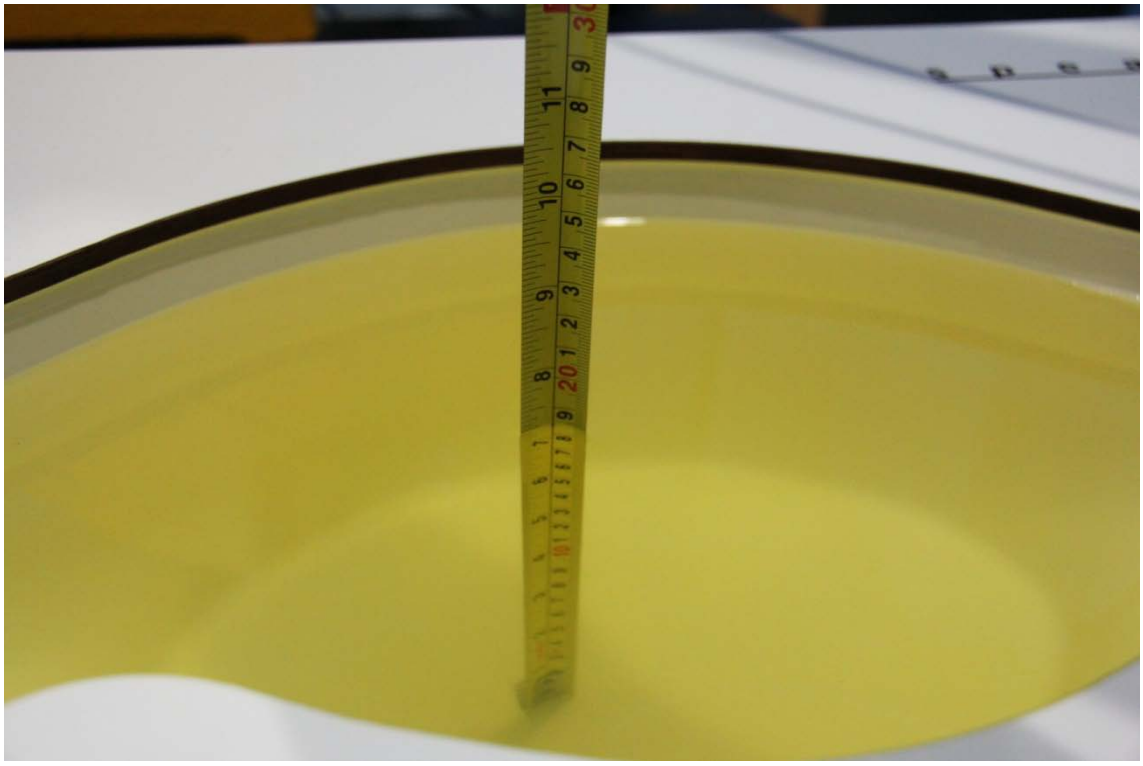


**Picture 7-9 Liquid depth in the Head Phantom (2450MHz)**



**Picture 7-10 Liquid depth in the Flat Phantom (2450MHz)**

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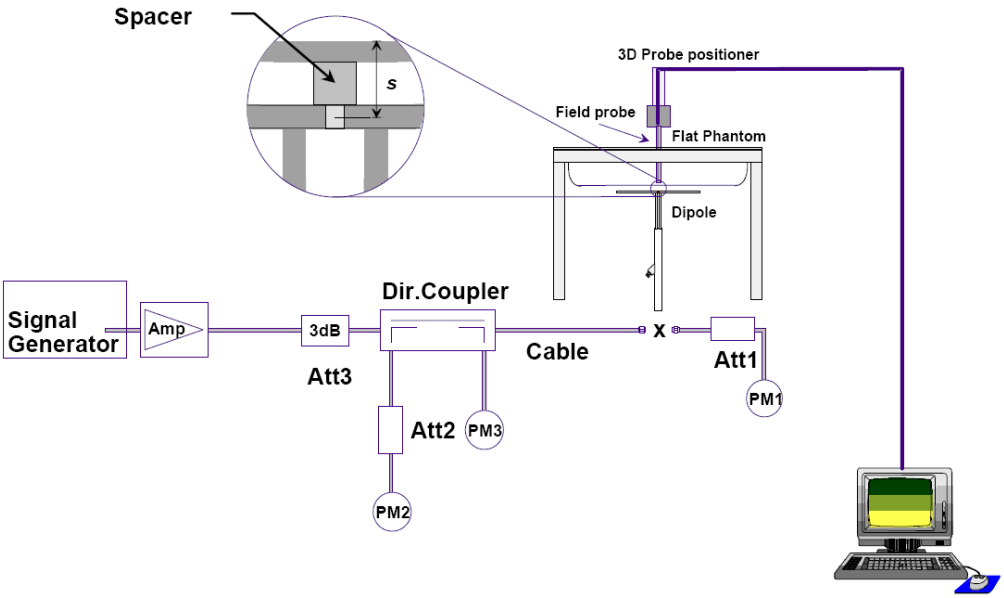
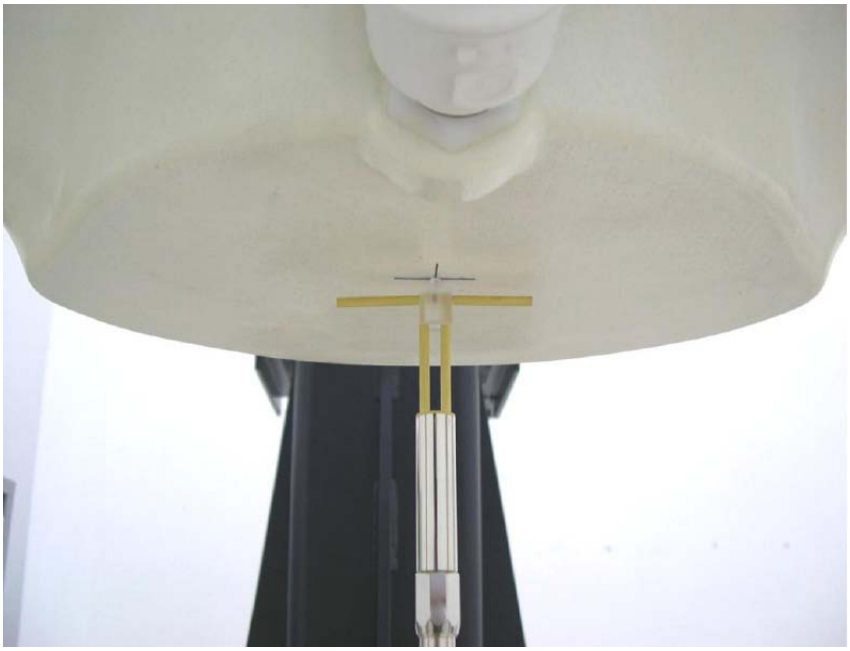
# 8 System verification

## 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**

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## 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 Head**

| 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 |
| 2015-09-17 | 750 MHz | 5.33 | 8.15 | 5.20 | 8.04 | -2.44% | -1.35% |
| 2015-09-14 | 835 MHz | 5.86 | 9.01 | 6.04 | 9.32 | 3.07% | 3.44% |
| 2015-09-16 | 1750 MHz | 19.9 | 36.9 | 19.36 | 36.24 | -2.71% | -1.79% |
| 2015-09-15 | 1900 MHz | 21.5 | 40.7 | 21.92 | 41.60 | 1.95% | 2.21% |
| 2015-09-17 | 2450 MHz | 24.5 | 52.5 | 24.44 | 52.40 | -0.24% | -0.19% |

**Table 8.2: 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 |
| 2015-09-17 | 750 MHz | 5.60 | 8.49 | 5.72 | 8.68 | 2.14% | 2.24% |
| 2015-09-14 | 835 MHz | 6.12 | 9.29 | 6.20 | 9.40 | 1.31% | 1.18% |
| 2015-09-16 | 1750 MHz | 20.3 | 37.4 | 19.92 | 37.20 | -1.87% | -0.53% |
| 2015-09-15 | 1900 MHz | 21.7 | 40.4 | 21.80 | 41.20 | 0.46% | 1.98% |
| 2015-09-17 | 2450 MHz | 24.4 | 52.1 | 23.96 | 50.80 | -1.80% | -2.50% |

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# 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 centre 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.

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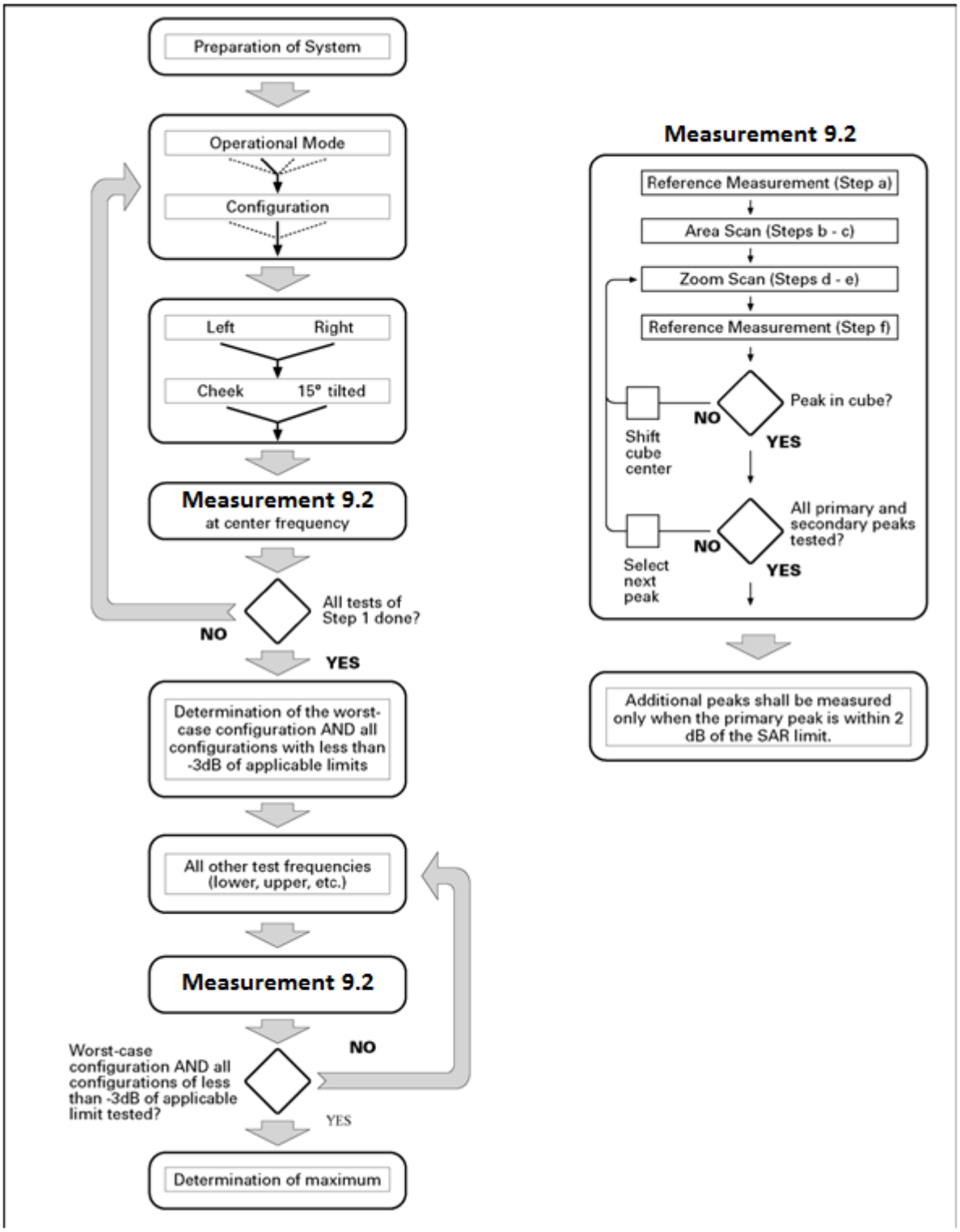


**Picture 9.1 Block diagram of the tests to be performed**

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## 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 1528-2003. 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.

| | | | ≤ 3 GHz | > 3 GHz |
|---|---|---|---|---|
| Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface | | | 5 ± 1 mm | ½·δ·ln(2) ± 0.5 mm |
| Maximum probe angle from probe axis to phantom surface normal at the measurement location | | | 30° ± 1° | 20° ± 1° |
| Maximum area scan spatial resolution: $\Delta x_{Area}$, $\Delta y_{Area}$ | | | ≤ 2 GHz: ≤ 15 mm<br>2 – 3 GHz: ≤ 12 mm | 3 – 4 GHz: ≤ 12 mm<br>4 – 6 GHz: ≤ 10 mm |
| | | | When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device. | |
| Maximum zoom scan spatial resolution: $\Delta x_{Zoom}$, $\Delta y_{Zoom}$ | | | ≤ 2 GHz: ≤ 8 mm<br>2 – 3 GHz: ≤ 5 mm* | 3 – 4 GHz: ≤ 5 mm*<br>4 – 6 GHz: ≤ 4 mm* |
| Maximum zoom scan spatial resolution, normal to phantom surface | uniform grid: $\Delta z_{Zoom}(n)$ | | ≤ 5 mm | 3 – 4 GHz: ≤ 4 mm<br>4 – 5 GHz: ≤ 3 mm<br>5 – 6 GHz: ≤ 2 mm |
| | graded grid | $\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface | ≤ 4 mm | 3 – 4 GHz: ≤ 3 mm<br>4 – 5 GHz: ≤ 2.5 mm<br>5 – 6 GHz: ≤ 2 mm |
| | | $\Delta z_{Zoom}(n>1)$: between subsequent points | $\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$ | |
| Minimum zoom scan volume | x, y, z | | ≥ 30 mm | 3 – 4 GHz: ≥ 28 mm<br>4 – 5 GHz: ≥ 25 mm<br>5 – 6 GHz: ≥ 22 mm |

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.

* When zoom scan is required and the *reported* SAR from the area scan based *1-g SAR estimation* procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.

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## 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 | 1.0 | 0.0 | 20 | 75 |
| 2 | 6/15 | 15/15 | 64 | 6/15 | 12/15 | 12/15 | 12/15 | 4 | 1 | 3.0 | 2.0 | 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 | 2.0 | 1.0 | 15 | 92 |
| 4 | 2/15 | 15/15 | 64 | 2/15 | 4/15 | 4/15 | 56/75 | 4 | 1 | 3.0 | 2.0 | 17 | 71 |
| 5 | 15/15 | 15/15 | 64 | 15/15 | 24/15 | 30/15 | 134/15 | 4 | 1 | 1.0 | 0.0 | 21 | 81 |

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## 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.

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### 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.

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# 11 Conducted Output Power

When WLAN Hotspot mode is activated (AP ON), the conducted output power will be reduced for PCS1900, WCDMA1700, WCDMA1900, LTE band 2 and LTE band 4. When WLAN Hotspot mode is deactivated (AP OFF), the RF output power level return to their normal RF power level.

## 11.1 Manufacturing tolerance

**When the hotspot mode is ON:**

**Table 11.1: GSM Speech**

| GSM 1900 | | | |
|---|---|---|---|
| Channel | Channel 810 | Channel 661 | Channel 512 |
| Target (dBm) | 25.5 | 25.5 | 25.5 |
| Tune-up (dBm) | 26.5 | 26.5 | 26.5 |

**Table 11.2: GPRS and EGPRS**

| GSM 1900 GPRS (GMSK) | | | | |
|---|---|---|---|---|
| Channel | | **810** | **661** | **512** |
| 1 Txslot | Target (dBm) | 25.5 | 25.5 | 25.5 |
| | Tune-up (dBm) | 26.5 | 26.5 | 26.5 |
| 2 Txslots | Target (dBm) | 23.5 | 23.5 | 23.5 |
| | Tune-up (dBm) | 24.5 | 24.5 | 24.5 |
| 3 Txslots | Target (dBm) | 21.5 | 21.5 | 21.5 |
| | Tune-up (dBm) | 22.5 | 22.5 | 22.5 |
| 4 Txslots | Target (dBm) | 20.5 | 20.5 | 20.5 |
| | Tune-up (dBm) | 21.5 | 21.5 | 21.5 |
| GSM 1900 EGPRS (GMSK) | | | | |
| Channel | | **810** | **661** | **512** |
| 1 Txslot | Target (dBm) | 25.5 | 25.5 | 25.5 |
| | Tune-up (dBm) | 26.5 | 26.5 | 26.5 |
| 2 Txslots | Target (dBm) | 23.5 | 23.5 | 23.5 |
| | Tune-up (dBm) | 24.5 | 24.5 | 24.5 |
| 3 Txslots | Target (dBm) | 21.5 | 21.5 | 21.5 |
| | Tune-up (dBm) | 22.5 | 22.5 | 22.5 |
| 4 Txslots | Target (dBm) | 20.5 | 20.5 | 20.5 |
| | Tune-up (dBm) | 21.5 | 21.5 | 21.5 |

**Table 11.3: WCDMA**

| WCDMA 1700 CS | | | |
|---|---|---|---|
| Channel | Channel 1513 | Channel 1412 | Channel 1312 |
| Target (dBm) | 20 | 20 | 20 |
| Tune-up (dBm) | 21 | 21 | 21 |
| WCDMA 1900 CS | | | |
| Channel | Channel 9538 | Channel 9400 | Channel 9262 |
| Target (dBm) | 20 | 20 | 20 |
| Tune-up (dBm) | 21 | 21 | 21 |

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**Table 11.4: LTE**

| Mode | Target (dBm) | Tune-up (dBm) |
|---|---|---|
| LTE Band 2 | 20 | 21 |
| LTE Band 4 | 20 | 21 |

**Note: When the hotspot mode is ON, MPR settings doesn't work.**

**When the hotspot mode is OFF:**

**Table 11.5: GSM Speech**

| GSM 850 | | | |
|---|---|---|---|
| Channel | Channel 251 | Channel 190 | Channel 128 |
| Target (dBm) | 32.5 | 32.5 | 32.5 |
| Tune-up (dBm) | 33.5 | 33.5 | 33.5 |
| GSM 1900 | | | |
| Channel | Channel 810 | Channel 661 | Channel 512 |
| Target (dBm) | 30 | 30 | 30 |
| Tune-up (dBm) | 31 | 31 | 31 |

**Table 11.6: GPRS and EGPRS**

| GSM 850 GPRS (GMSK) | | | | |
|---|---|---|---|---|
| Channel | | **251** | **190** | **128** |
| 1 Txslot | Target (dBm) | 32.5 | 32.5 | 32.5 |
| | Tune-up (dBm) | 33.5 | 33.5 | 33.5 |
| 2 Txslots | Target (dBm) | 31 | 31 | 31 |
| | Tune-up (dBm) | 32 | 32 | 32 |
| 3 Txslots | Target (dBm) | 29.3 | 29.3 | 29.3 |
| | Tune-up (dBm) | 30.3 | 30.3 | 30.3 |
| 4 Txslots | Target (dBm) | 28 | 28 | 28 |
| | Tune-up (dBm) | 29 | 29 | 29 |
| GSM 850 EGPRS (GMSK) | | | | |
| Channel | | **251** | **190** | **128** |
| 1 Txslot | Target (dBm) | 32.5 | 32.5 | 32.5 |
| | Tune-up (dBm) | 33.5 | 33.5 | 33.5 |
| 2 Txslots | Target (dBm) | 31 | 31 | 31 |
| | Tune-up (dBm) | 32 | 32 | 32 |
| 3 Txslots | Target (dBm) | 29.3 | 29.3 | 29.3 |
| | Tune-up (dBm) | 30.3 | 30.3 | 30.3 |
| 4 Txslots | Target (dBm) | 28 | 28 | 28 |
| | Tune-up (dBm) | 29 | 29 | 29 |
| GSM 1900 GPRS (GMSK) | | | | |
| Channel | | **810** | **661** | **512** |
| 1 Txslot | Target (dBm) | 30 | 30 | 30 |
| | Tune-up (dBm) | 31 | 31 | 31 |
| 2 Txslots | Target (dBm) | 28 | 28 | 28 |
| | Tune-up (dBm) | 29 | 29 | 29 |

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| | | | | |
|---|---|---|---|---|
| 3 Txslots | Target (dBm) | 26.5 | 26.5 | 26.5 |
| | Tune-up (dBm) | 27.5 | 27.5 | 27.5 |
| 4 Txslots | Target (dBm) | 25.5 | 25.5 | 25.5 |
| | Tune-up (dBm) | 26.5 | 26.5 | 26.5 |
| GSM 1900 EGPRS (GMSK) | | | | |
| Channel | | **810** | **661** | **512** |
| 1 Txslot | Target (dBm) | 30 | 30 | 30 |
| | Tune-up (dBm) | 31 | 31 | 31 |
| 2 Txslots | Target (dBm) | 28 | 28 | 28 |
| | Tune-up (dBm) | 29 | 29 | 29 |
| 3 Txslots | Target (dBm) | 26.5 | 26.5 | 26.5 |
| | Tune-up (dBm) | 27.5 | 27.5 | 27.5 |
| 4 Txslots | Target (dBm) | 25.5 | 25.5 | 25.5 |
| | Tune-up (dBm) | 26.5 | 26.5 | 26.5 |

**Table 11.7: WCDMA**

| WCDMA 850 CS | | | |
|---|---|---|---|
| Channel | Channel 4233 | Channel 4182 | Channel 4132 |
| Target (dBm) | 24 | 24 | 24 |
| Tune-up (dBm) | 25 | 25 | 25 |
| HSUPA (sub-test 1/5) | | | |
| Channel | Channel 4233 | Channel 4182 | Channel 4132 |
| Target (dBm) | 22.5 | 22.5 | 22.5 |
| Tune-up (dBm) | 23.5 | 23.5 | 23.5 |
| HSUPA (sub-test 2) | | | |
| Channel | Channel 4233 | Channel 4182 | Channel 4132 |
| Target (dBm) | 21.5 | 21.5 | 21.5 |
| Tune-up (dBm) | 22.5 | 22.5 | 22.5 |
| HSUPA (sub-test 3) | | | |
| Channel | Channel 4233 | Channel 4182 | Channel 4132 |
| Target (dBm) | 21 | 21 | 21 |
| Tune-up (dBm) | 22 | 22 | 22 |
| HSUPA (sub-test 4) | | | |
| Channel | Channel 4233 | Channel 4182 | Channel 4132 |
| Target (dBm) | 22 | 22 | 22 |
| Tune-up (dBm) | 23 | 23 | 23 |
| DC-HSDPA (sub-test 1~4) | | | |
| Channel | Channel 4233 | Channel 4182 | Channel 4132 |
| Target (dBm) | 22.5 | 22.5 | 22.5 |
| Tune-up (dBm) | 23.5 | 23.5 | 23.5 |
| WCDMA 1700 CS | | | |
| Channel | Channel 1513 | Channel 1412 | Channel 1312 |
| Target (dBm) | 24 | 24 | 24 |
| Tune-up (dBm) | 25 | 25 | 25 |

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| HSUPA (sub-test 1/5) | | | |
|---|---|---|---|
| Channel | Channel 1513 | Channel 1412 | Channel 1312 |
| Target (dBm) | 22 | 22 | 22 |
| Tune-up (dBm) | 23 | 23 | 23 |
| HSUPA (sub-test 2/3) | | | |
| Channel | Channel 1513 | Channel 1412 | Channel 1312 |
| Target (dBm) | 21 | 21 | 21 |
| Tune-up (dBm) | 22 | 22 | 22 |
| HSUPA (sub-test 4) | | | |
| Channel | Channel 1513 | Channel 1412 | Channel 1312 |
| Target (dBm) | 21.5 | 21.5 | 21.5 |
| Tune-up (dBm) | 22.5 | 22.5 | 22.5 |
| DC-HSDPA (sub-test 1~4) | | | |
| Channel | Channel 1513 | Channel 1412 | Channel 1312 |
| Target (dBm) | 22.5 | 22.5 | 22.5 |
| Tune-up (dBm) | 23.5 | 23.5 | 23.5 |
| WCDMA 1900 CS | | | |
| Channel | Channel 9538 | Channel 9400 | Channel 9262 |
| Target (dBm) | 24 | 24 | 24 |
| Tune-up (dBm) | 25 | 25 | 25 |
| HSUPA (sub-test 1/4) | | | |
| Channel | Channel 9538 | Channel 9400 | Channel 9262 |
| Target (dBm) | 21.5 | 21.5 | 21.5 |
| Tune-up (dBm) | 22.5 | 22.5 | 22.5 |
| HSUPA (sub-test 2) | | | |
| Channel | Channel 9538 | Channel 9400 | Channel 9262 |
| Target (dBm) | 21 | 21 | 21 |
| Tune-up (dBm) | 22 | 22 | 22 |
| HSUPA (sub-test 3) | | | |
| Channel | Channel 9538 | Channel 9400 | Channel 9262 |
| Target (dBm) | 20.5 | 20.5 | 20.5 |
| Tune-up (dBm) | 21.5 | 21.5 | 21.5 |
| HSUPA (sub-test 4) | | | |
| Channel | Channel 9538 | Channel 9400 | Channel 9262 |
| Target (dBm) | 21.5 | 21.5 | 21.5 |
| Tune-up (dBm) | 22.5 | 22.5 | 22.5 |
| DC-HSDPA (sub-test 1~4) | | | |
| Channel | Channel 9538 | Channel 9400 | Channel 9262 |
| Target (dBm) | 22.5 | 22.5 | 22.5 |
| Tune-up (dBm) | 23.5 | 23.5 | 23.5 |

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**Table 11.8: LTE**

| Mode | Target (dBm) | Tune-up (dBm) |
|---|---|---|
| LTE Band 2 | 23 | 24 |
| LTE Band 4 | 23 | 24 |
| LTE Band 5 | 23 | 24 |
| LTE Band 17 | 23 | 24 |

**LTE MPR will follow up 3GPP setting as below:**

| Modulation | Channel bandwidth / Transmission bandwidth (NRB) | | | | | | MPR (dB) |
|---|---|---|---|---|---|---|---|
| | 1.4MHz | 3.0MHz | 5MHz | 10MHz | 15MHz | 20MHz | |
| QPSK | ≤ 5 | ≤ 4 | ≤ 8 | ≤ 12 | ≤ 16 | ≤ 18 | 0 |
| QPSK | > 5 | > 4 | > 8 | > 12 | > 16 | > 18 | 1 |
| 16 QAM | ≤ 5 | ≤ 4 | ≤ 8 | ≤ 12 | ≤ 16 | ≤ 18 | 1 |
| 16 QAM | > 5 | > 4 | > 8 | > 12 | > 16 | > 18 | 2 |

**Table 11.9: Bluetooth**

| GFSK | | | |
|---|---|---|---|
| Channel | Channel 0 | Channel 39 | Channel 78 |
| Target (dBm) | 7 | 8 | 6 |
| Tune-up (dBm) | 8 | 9 | 7 |

**Table 11.10: WiFi**

802.11b

| Channel\ rate | 1Mbps | | 2Mbps | | 5.5Mbps | | 11Mbps | |
|---|---|---|---|---|---|---|---|---|
| | dBm | ± | dBm | ± | dBm | ± | dBm | ± |
| 1 | 17.5 | 1 | 17.5 | 1 | 17.5 | 1 | 17.5 | 1 |
| 6 | 17.2 | 1 | 17.2 | 1 | 17.2 | 1 | 17.2 | 1 |
| 11 | 17.5 | 1 | 17.5 | 1 | 17.5 | 1 | 17.5 | 1 |

802.11g

| Channel\ rate | 6Mbps | | 9Mbps | | 12Mbps | | 18Mbps | | 24Mbps | | 36Mbps | | 48Mbps | | 54Mbps | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | dBm | ± | dBm | ± | dBm | ± | dBm | ± | dBm | ± | dBm | ± | dBm | ± | dBm | ± |
| 1 | 15.2 | 1 | 14.9 | 1 | 14.7 | 1 | 14.4 | 1 | 14.0 | 1 | 12.5 | 1 | 12.0 | 1 | 10.8 | 1 |
| 6 | 14.6 | 1 | 14.9 | 1 | 14.7 | 1 | 14.4 | 1 | 14.0 | 1 | 12.5 | 1 | 12.0 | 1 | 10.8 | 1 |
| 11 | 14.9 | 1 | 14.9 | 1 | 14.7 | 1 | 14.4 | 1 | 14.0 | 1 | 12.5 | 1 | 12.0 | 1 | 10.8 | 1 |

802.11n-20M

| Channel\ rate | MCS0 | | MCS1 | | MCS2 | | MCS3 | | MCS4 | | MCS5 | | MCS6 | | MCS7 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | dBm | ± | dBm | ± | dBm | ± | dBm | ± | dBm | ± | dBm | ± | dBm | ± | dBm | ± |
| 1 | 13.1 | 1 | 12.7 | 1 | 12.3 | 1 | 12.0 | 1 | 11.5 | 1 | 10.0 | 1 | 8.8 | 1 | 8.6 | 1 |
| 6 | 12.6 | 1 | 12.7 | 1 | 12.3 | 1 | 12.0 | 1 | 11.5 | 1 | 10.0 | 1 | 8.8 | 1 | 8.6 | 1 |
| 11 | 12.9 | 1 | 12.7 | 1 | 12.3 | 1 | 12.0 | 1 | 11.5 | 1 | 10.0 | 1 | 8.8 | 1 | 8.6 | 1 |

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