A Test Lab Techno Corp.

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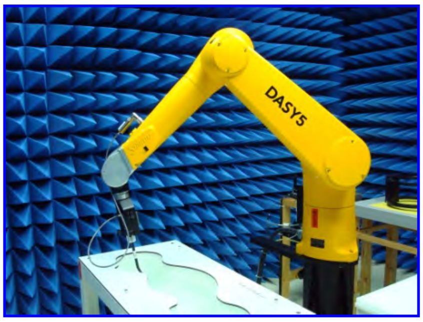
SAR EVALUATION REPORT

Applicant	:	MobileHelp, LLC
Product Type	:	LTE Module
Trade Name	:	Quectel
Model Number	:	SC20-A
Received Date	:	Apr. 09, 2019
Test Period	:	May 07 ~ May 09, 2019
Issue Date	:	Jun. 26, 2019
Test Environment	:	Ambient Temperature： 22 ±2 ° C Relative Humidity：40 - 70 %
Standard	:	ANSI/IEEE C95.1-1992 / IEEE Std. 1528-2013 47 CFR Part §2.1093 KDB 865664 D01 v01r04 / KDB 865664 D02 v01r02 KDB 447498 D01 v06 / KDB 941225 D01 v03r01 KDB 941225 D05 v02r05 / KDB 616217 D04 v01r01 KDB 248227 D01 v02r02
Test Firm MRA designation number	:	TW0010



1. A Test Lab Techno Corp. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by A Test Lab Techno Corp. based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.
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Approved By : Edison Hu (Edison Hu)

Tested By : Kris Pan (Kris Pan)

Revision History

Rev.	Issue Date	Revisions	Revised By
00	Jun. 14, 2019	Initial Issue	Shelly Chen
01	Jun. 26, 2019	Page 50 Revised Standalone SAR Test Exclusion Calculation. Page 52 Revised Tune-up Power.	Shelly Chen

Contents

1. Summary of Maximum Reported SAR Value

Equipment Class	Mode	Highest Reported Body standalone $SAR_{1\,g}$ (W/kg)
Licensed	WCDMA Band II	0.91
	WCDMA Band V	0.56
	LTE Band 2 (QPSK)	1.06
	LTE Band 4 (QPSK)	0.94
	LTE Band 5 (QPSK)	0.59
	LTE Band 12 (QPSK)	0.54
DTS	WLAN 2.4 GHz	0.14
U-NII	WLAN 5 GHz	0.21
DSS	Bluetooth	0.06
Highest Simultaneous Transmission SAR		Highest Simultaneous Transmission 1 g SAR (W/kg)
At test position side 4		1.31

NOTE: The SAR limit (Head & Body: SAR1 g 1.6 W/kg) for general population / uncontrolled exposure is specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992.

2. Description of Equipment under Test (EUT)

<table>
<tr><td>Applicant</td><td colspan="2">MobileHelp, LLC
5050 Conference Way N, Suite 125, Boca Raton, Florida 33431, United States</td></tr>
<tr><td>Manufacture</td><td colspan="2">Quectel Wireless Solutions Co., Ltd.
7th Floor, Hongye Building, No.1801 Hongmei Road, Xuhui District, Shanghai 200233, China</td></tr>
<tr><td>Product Type</td><td colspan="2">LTE Module</td></tr>
<tr><td>Trade Name</td><td colspan="2">Quectel</td></tr>
<tr><td>Model Number</td><td colspan="2">SC20-A</td></tr>
<tr><td>IMEI No.</td><td colspan="2">015559000091890</td></tr>
<tr><td>FCC ID</td><td colspan="2">PXT-201706SC20A</td></tr>
<tr><td>Class II permissive change</td><td colspan="2">This is to request a Class II permissive change for FCC ID: PXT-201706SC20A, originally granted on 6/13/2019.
The major change filed under this application is:
Change #1: Host added, MobileHelp, model number: DC-TBS2-01.
#2: Disable GSM, WCDMA B4 and LTE bands B7,B13,B25,B26 by firmware.
#3: Reduce the Output Power through firmware, and SAR measurement were evaluated.
(Only reduce WCDMA band 2/LTE band 2/Wi-Fi 2.4 GHz/Bluetooth output Power, other undescribed parts haven't changes).
#4: Addition antennas, the WWAN WCDMA/LTE band 2 antenna gain higher then original grant, WLAN/Bluetooth antenna type different from original grant. The radiated emission has verified and compliance with FCC regulations. Other undescribed parts antenna gain lower then original grant.</td></tr>
<tr><td>Host Information</td><td colspan="2">Product Type: Tablet Base Station
Trade Name: MobileHelp
Model Name: DC-TBS2-01</td></tr>
<tr><td rowspan="14">RF Function</td><td>Operate Bands</td><td>Operate Frequency (MHz)</td></tr>
<tr><td>WCDMA(RMC 12.2K) / HSDPA / HSUPA Band II</td><td>1852.4 - 1907.6</td></tr>
<tr><td>WCDMA (RMC 12.2K) / HSDPA / HSUPA Band V</td><td>826.4 - 846.6</td></tr>
<tr><td>LTE Band 2 (BW 1.4, 3, 5, 10, 15, 20 MHz)</td><td>1850 - 1910</td></tr>
<tr><td>LTE Band 4 (BW 1.4, 3, 5, 10, 15, 20 MHz)</td><td>1710 - 1755</td></tr>
<tr><td>LTE Band 5 (BW 1.4, 3, 5, 10 MHz)</td><td>824 - 849</td></tr>
<tr><td>LTE Band 12 (BW 1.4, 3, 5, 10 MHz)</td><td>699 - 716</td></tr>
<tr><td>IEEE 802.11b / 802.11g / 802.11n 2.4 GHz 20 MHz</td><td>2412 - 2462</td></tr>
<tr><td>IEEE 802.11n 2.4 GHz 40 MHz</td><td>2422 - 2452</td></tr>
<tr><td>IEEE 802.11a</td><td>5180 - 5825</td></tr>
<tr><td>IEEE 802.11n 5 GHz 20 MHz</td><td>5180 - 5825</td></tr>
<tr><td>IEEE 802.11n 5 GHz 40 MHz</td><td>5190 - 5795</td></tr>
<tr><td>Bluetooth BR/EDR</td><td>2402 - 2480</td></tr>
<tr><td>Bluetooth LE</td><td>2402 - 2480</td></tr>
</table>

Antenna Type	SMT PCB Antenna	
Battery Option	Standard	
	(1) Manufacturer: Fly Power Industries Limited Model: FLP-9373129 Spec: DC 3.7 V / 10000 mAh (2) Manufacturer: Mica Power Co. Ltd Model: MLP9073102 Spec: DC 3.7 V / 10000 mAh	
Device Category	Portable Device	
Application Type	Certification	

Note:The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

3. *Introduction*

The A Test Lab Techno Corp. has performed measurements of the maximum potential exposure to the user of **MobileHelp, LLC Trade Name：Quectel Model(s)：SC20-A**. The test procedures, as described in American National Standards, Institute C95.1-1999〔1〕were employed and they specify the maximum exposure limit of 1.6 mW/g as averaged over any 1 gram of tissue for portable devices being used within 20 cm between user and EUT in the uncontrolled environment. A description of the product and operating configuration, detailed summary of the test results, methodology and procedures used in the equipment used are included within this test report.

3.1 SAR Definition

Specific Absorption Rate (SAR) is defined as 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 (ρ). The equation description is as below :

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

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

SAR measurement can be related to the electrical field in the tissue by

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

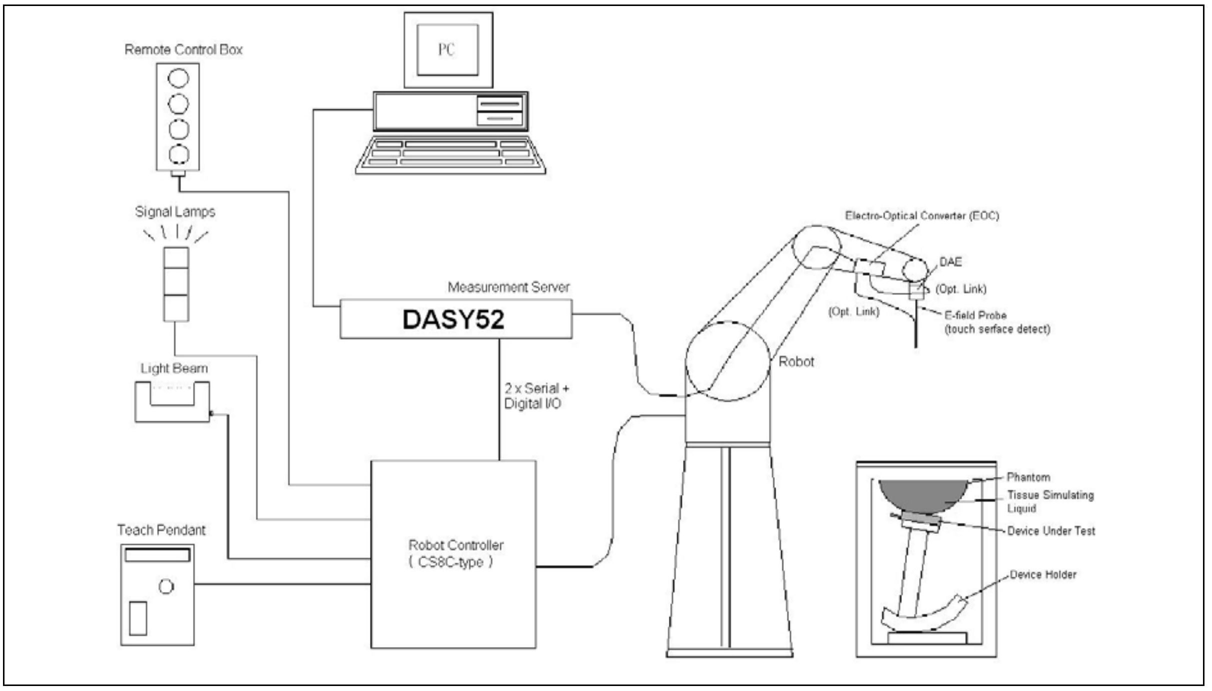
Where：

σ = conductivity of the tissue (S/m)

ρ = mass density of the tissue (kg/m3)

E = RMS electric field strength (V/m)

4. SAR Measurement Setup



The DASY52 system for performing compliance tests consists of the following items:

1. A standard high precision 6-axis robot (Stäubli TX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
2. A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
3. 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.
4. 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.
5. A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
6. A computer operating Windows 2000 or Windows XP.
7. DASY52 software.
8. Remote controls with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
9. The SAM twin phantom enabling testing left-hand and right-hand usage.
10. The device holder for handheld mobile phones.
11. Tissue simulating liquid mixed according to the given recipes.
12. Validation dipole kits allowing validating the proper functioning of the system.

4.1 DASY E-Field Probe System

The SAR measurements were conducted with the dosimetric probe (manufactured by SPEAG), designed in the classical triangular configuration〔3〕and optimized for dosimetric evaluation. The probes is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multi-fiber 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 DASY software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting. The approach is stopped when reaching the maximum.

4.1.1 E-Field Probe Specification

Construction	Symmetrical design with triangular core
	Built-in shielding against static charges
	PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	ISO/IEC 17025 calibration service available
Frequency	10 MHz to > 6 GHz
	Linearity: ± 0.2 dB (30 MHz to 6 GHz)
Directivity	±0.3 dB in brain tissue (rotation around probe axis)
	±0.5 dB in brain tissue (rotation normal probe axis)
Dimensions	Overall length: 337 mm (Tip: 20 mm)
	Tip diameter: 2.5 mm (Body: 12 mm)
	Typical distance from probe tip to dipole centers: 1 mm

Figure 1. E-field Probe

Figure 2. Probe setup on robot

4.2 Data Acquisition Electronic (DAE) System

Model：	DAE3, DAE4
Construction：	Signal amplifier, multiplexer, A/D converter and control logic. Serial optical link for communication with DASY4/5 embedded system (fully remote controlled). Two step probe touch detector for mechanical surface detection and emergency robot stop.
Measurement Range：	-100 to +300 mV (16 bit resolution and two range settings: 4 mV, 400 mV)
Input Offset Voltage：	< 5 μV (with auto zero)
Input Bias Current：	< 50 fA
Dimensions：	60 x 60 x 68 mm

4.3 Robot

Positioner：	Stäubli Unimation Corp. Robot Model: TX90XL
Repeatability：	±0.02 mm
No. of Axis：	6

4.4 Measurement Server

Processor：	PC/104 with a 400MHz intel ULV Celeron
I/O-board：	Link to DAE4 (or DAE3) 16-bit A/D converter for surface detection system Digital I/O interface Serial link to robot Direct emergency stop output for robot

4.5 Device Holder

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

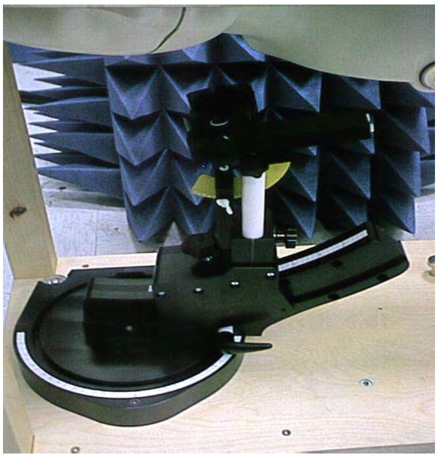


Figure 3. Device Holder

Figure 4. Device Holder for Laptops

4.6 Oval Flat Phantom - ELI 4.0

The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (Oval Flat) phantom defined in IEEE 1528-2013, CENELEC 50361 and IEC 62209. It enables the dosimetric evaluation of wireless portable device usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points with the robot.

Shell Thickness	2 ±0.2 mm
Filling Volume	Approx. 30 liters
Dimensions	190×600×400 mm (H×L×W)

Table 1. Specification of ELI 4.0

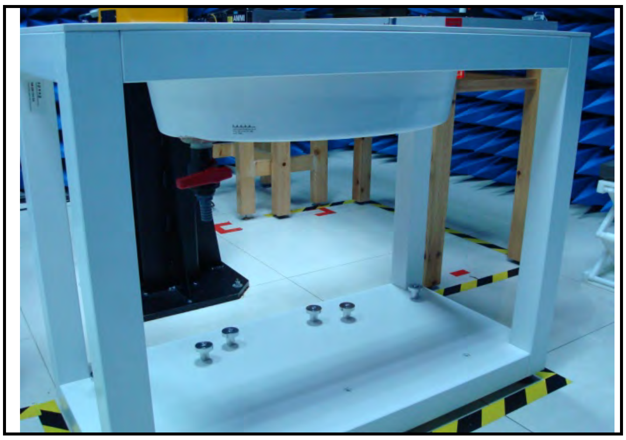


Figure 5. Oval Flat Phantom

5. Tissue Simulating Liquids

IEEE SCC-34/SC-2 in 1528 recommended Tissue Dielectric Parameters

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in 1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in human head. Other head and body tissue parameters that have not been specified in 1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equation and extrapolated according to the head parameter specified in 1528.

Target Frequency	Head		Body	
(MHz)	εr	σ (S/m)	εr	σ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 - 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00
(εr = relative permittivity, σ = conductivity and ρ = 1000 kg/m3)				

Table 2. Tissue dielectric parameters for head and body phantoms

5.1 The composition of the tissue simulating liquid

Ingredients (% by weight)	Frequency (MHz)												Frequency (GHz)	
	750		835		1750		1900		2450		2600		5 GHz	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	39.28	51.30	41.45	52.40	54.50	40.20	54.90	40.40	62.70	73.20	60.30	71.40	65.5	78.6
Salt (NaCl)	1.47	1.42	1.45	1.50	0.17	0.49	0.18	0.50	0.50	0.10	0.60	0.20	0.00	0.00
Sugar	58.15	46.18	56.00	45.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HEC	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bactericide	0.10	0.10	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Triton X-100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.2	10.7
DGBE	0.00	0.00	0.00	0.00	45.33	59.31	44.92	59.10	36.80	26.70	39.10	28.40	0.00	0.00
Dielectric Constant	41.88	54.60	42.54	56.10	40.10	53.60	39.90	54.00	39.80	52.50	39.80	52.50	35.1~ 36.2	47.9~ 49.3
Conductivity (S/m)	0.90	0.97	0.91	0.95	1.39	1.49	1.42	1.45	1.88	1.78	1.88	1.78	4.45~ 5.48	5.07~ 6.23
Diethylene Glycol Mono-hexlether	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.3	10.7

5.2 Liquid Parameters

The dielectric parameters of the liquids were verified prior to the SAR evaluation using an 85070C Dielectric Probe Kit and an E5071B Network Analyzer.

Tissue Temp (°C)	Head / Body	Frequency (MHz)	Cond.	Perm.	target Cond.	target Perm.	σ (Delta) (%)	εr (Delta) (%)	Limit (%)	Date
			σ	εr	σ	εr				
22.3	Body	1852.4	1.53	52.759	1.52	53.30	0.45	-1.02	±5	May. 07, 2019
22.3	Body	1880.0	1.56	52.727	1.52	53.30	2.62	-1.08	±5	May. 07, 2019
22.3	Body	1907.6	1.59	52.661	1.52	53.30	4.34	-1.20	±5	May. 07, 2019
22.3	Body	1860.0	1.54	52.746	1.52	53.30	1.16	-1.04	±5	May. 07, 2019
22.3	Body	1880.0	1.56	52.727	1.52	53.30	2.62	-1.08	±5	May. 07, 2019
22.3	Body	1900.0	1.58	52.694	1.52	53.30	3.89	-1.14	±5	May. 07, 2019
22.4	Body	826.4	0.99	56.991	0.97	55.23	2.23	3.19	±5	May. 08, 2019
22.4	Body	846.6	1.01	56.810	0.98	55.16	2.64	2.99	±5	May. 08, 2019
22.4	Body	836.6	1.00	56.894	0.97	55.200	2.98	3.07	±5	May. 08, 2019
22.4	Body	836.5	1.00	56.899	0.97	55.20	2.91	3.08	±5	May. 08, 2019
22.4	Body	1732.5	1.44	53.232	1.48	53.48	-2.51	-0.46	±5	May. 08, 2019
22.1	Body	707.5	0.93	57.160	0.96	55.67	-2.90	2.68	±5	May. 08, 2019
22.2	Body	2412.0	1.93	52.035	1.91	52.75	0.71	-1.35	±5	May. 09, 2019
22.2	Body	2437.0	1.96	51.979	1.94	52.72	0.91	-1.41	±5	May. 09, 2019
22.2	Body	2462.0	1.99	51.924	1.97	52.68	0.92	-1.44	±5	May. 09, 2019
22.2	Body	2402.0	1.92	52.058	1.90	52.76	0.65	-1.33	±5	May. 09, 2019
22.2	Body	2441.0	1.96	51.971	1.94	52.71	0.99	-1.40	±5	May. 09, 2019
22.2	Body	2480.0	2.01	51.877	1.99	52.66	0.69	-1.49	±5	May. 09, 2019
22.4	Body	5260.0	5.21	48.710	5.37	48.93	-2.96	-0.45	±5	May. 09, 2019
22.4	Body	5280.0	5.24	48.670	5.39	48.91	-2.84	-0.49	±5	May. 09, 2019
22.4	Body	5320.0	5.28	48.590	5.44	48.85	-2.87	-0.53	±5	May. 09, 2019
22.4	Body	5500.0	5.53	48.220	5.65	48.61	-2.09	-0.80	±5	May. 09, 2019
22.4	Body	5580.0	5.64	48.020	5.74	48.50	-1.83	-0.99	±5	May. 09, 2019
22.4	Body	5660.0	5.73	47.870	5.84	48.39	-1.78	-1.07	±5	May. 09, 2019
22.4	Body	5700.0	5.80	47.780	5.88	48.34	-1.38	-1.16	±5	May. 09, 2019
22.4	Body	5745.0	5.85	47.760	5.94	48.27	-1.47	-1.06	±5	May. 09, 2019
22.4	Body	5785.0	5.90	47.590	5.98	48.22	-1.30	-1.31	±5	May. 09, 2019
22.4	Body	5825.0	5.96	47.560	6.00	48.20	-0.65	-1.33	±5	May. 09, 2019

5.3 Liquid Depth

According to KDB865664 ,the depth of tissue-equivalent liquid in a phantom must be ≥ 15.0 cm with ≤ ± 0.5 cm variation for SAR measurements ≤ 3 GHz and ≥ 10.0 cm with ≤ ± 0.5 cm variation for measurements > 3 GHz.

Figure 6. Liquid Height for Body SAR

6. *SAR Testing with RF Transmitters*

6.1 SAR Testing with WCDMA Transmitters

The following tests were completed according to the test requirements outlined in section 5.2 of the 3GPP TS34.121-1 specification. The DUT supports power Class 3, which has a nominal maximum output power of 24 dBm (+1.7/-3.7).

- Step 1: set a Test Mode 1 loop back with a 12.2 kbps Reference Measurement Channel (RMC).
- Step 2: set and send continuously up power control commands to the device.
- Step 3: measure the power at the device antenna connector using the power meter with average detector and test SAR

6.2 SAR Testing with HSDPA Transmitters

HSDPA Date Devices setup for SAR Measurement

HSDPA should be configured according to the UE category of a test device. The number of HS-DSCH/HS-PDSCHs, HARQ processes, minimum inter-TTI interval, transport block sizes and RV coding sequence are defined by the H-set. To maintain a consistent test configuration and stable transmission conditions, QPSK is used in the H-set for SAR testing. HS-DPCCH should be configured with a CQI feedback cycle of 4 ms with a CQI repetition factor of 2 to maintain a constant rate of active CQI slots. DPCCH and DPDCH gain factors(βc, βd), and HS-DPCCH power offset parameters (ΔACK, ΔNACK, ΔCQI) should be set according to values indicated in the Table below. The CQI value is determined by the UE category, transport block size, number of HS-PDSCHs and modulation used in the H-set.

Setup for Release 5 HSDPA							
Sub-test	βc	βd	βd (SF)	βc/βd	βhs[(1,2)]	CM[(3)] (dB)	MRP[(3)] (dB)
1	2/15	15/15	64	2/15	4/15	0.0	0.0
2	12/15(4)	15/15(4)	64	12/15(4)	24/15	1.0	0.0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5

Note

1. Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 8 ⇔ Ahs = βhs/βc = 30/15 ⇔ βhs= 30/15 *βc
2. For theHS-DPCCH power mask requirement test in clause 5.2C, 5.7A, and the Error Vector Magnitude(EVM) with HS-DPCCH test in clause 5.13.1A and HSDPA EVM with phase discontinuity in clause 5.13.1AA, Δ_{ACK} and Δ_{NACK} = 30/15 with βhs = 30/15 *βc and Δ_{CQI} = 24/15 with βhs = 24/15*βc
3. CM = 1 for βc/βd =12/15, βhs/βc=24/15. For all other combinations of DPDCH, DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.
4. For subtest 2 the βc/βd ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to βc = 11/15 and βd = 15/15.

HSPA Date Devices setup for SAR Measurement.

The following procedures are applicable to HSPA (HSUPA/HSDPA) data devices operating under 3GPP Release 6. Body exposure conditions generally apply to these devices, including handsets and data modems operating in various electronic devices. HSUPA operates in conjunction with WCDMA and HSDPA. SAR is initially measured in WCDMA test configurations without HSPA. The default test configuration is to establish a radio link between the DUT and a communication test set to configure a 12.2 kbps RMC (reference measurement channel) in Test Loop Mode 1. SAR for HSPA is selectively measured with HS-DPCCH, EDPCCH and E-DPDCH, all enabled, along with a 12.2 kbps RMC using the highest SAR configuration in WCDMA with 12.2 kbps RMC only. An FRC is configured according to HSDPCCH Sub-test 1 using H-set 1 and QPSK. HSPA is configured according to E-DCH Subtest 5 requirements. SAR for other HSPA sub-test configurations is also confirmed selectively according to output power, exposure conditions and E-DCH UE Category. Maximum output power is verified according to procedures in applicable versions of 3GPP TS 34.121 and SAR must be measured according to these maximum output conditions. The UE Categories for HSDPCCH and HSPA should be clearly identified in the SAR report. The following procedures are applicable only if Maximum Power Reduction (MPR) is implemented according to Cubic Metric (CM) requirements.

When voice transmission and head exposure conditions are applicable to a WCDMA/HSPA data device, head exposure is measured according to the 'Head SAR Measurements' procedures in the 'WCDMA Handsets' section of this document. SAR for body exposure configurations are measured according to the 'Body SAR Measurements' procedures in the 'WCDMA Handsets' section of this document. In addition, body SAR is also measured for HSPA when the maximum average output of each RF channel with HSPA active is at least ¼ dB higher than that measured without HSPA using 12.2 kbps RMC or the maximum SAR for 12.2 kbps RMC is above 75% of the SAR limit. Body SAR for HSPA is measured with E-DCH Sub-test 5, using H-Set 1 and QPSK for FRC and a 12.2 kbps RMC configured in Test Loop Mode 1 with power control algorithm 2, according to the highest body SAR configuration in 12.2 kbps RMC without HSPA. When VOIP is applicable for head exposure, SAR is not required when the maximum output of each RF channel with HSPA is less than ¼ dB higher than that measured using 12.2 kbps RMC; otherwise, the same HSPA configuration used for body measurements should be used to test for head exposure.

Due to inner loop power control requirements in HSPA, a commercial communication test set should be used for the output power and SAR tests. The 12.2 kbps RMC, FRC H-set 1 and E-DCH configurations for HSPA should be configured according to the β values indicated below as well as other applicable procedures described in the 'WCDMA Handset' and 'Release 5 HSDPA Data Devices' sections of this document.

The highest body SAR measured in Antenna Extended & Retracted configurations on a channel in 12.2 kbps RMC. The possible channels are the High, Middle & Low channel. Contact the FCC Laboratory for test and approval requirements if the maximum output power measured in E-DCH Sub-test 2 - 4 is higher than Sub-test 5.

Setup for Release 6 HSPA / Release 7 HSPA+													
Sub-test	βc	βd	βd (SF)	βc/βd	βhs(1)	βec	βed	Bed (SF)	Bed (codes)	CM(2) (dB)	MPR (dB)	AG(4) Index	E-TFCI
1	11/15(3)	15/15(3)	64	11/15(3)	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	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	βed1: 47/15 βed2: 47/15	4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15(4)	15/15(4)	64	15/15(4)	30/15	24/15	134/15	4	1	1.0	0.0	21	81

Note

1. Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 8 ⇔ Ahs = βhs/βc = 30/15 ⇔ βhs= 30/15 *βc.
2. CM = 1 for βc/βd =12/15, βhs/βc=24/15. For all other combinations of DPDCH, DPCCH, HS-DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.
3. For subtest 1 the βc/βd ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to βc = 10/15 and βd = 15/15.
4. For subtest 5 the βc/βd ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to βc = 14/15 and βd = 15/15.
5. Testing UE using E-DPDCH Physical Layer category 1 Sub-test 3 is not required according to TS 25.306 Table 5.1g.
6. βed can not be set directly; it is set by Absolute Grant Value.

6.3 SAR Testing with LTE-FDD Transmitters

All SAR measurements for LTE were performed using the Anritsu MT8820C. A closed loop power control setting allowed the UE to transmit at the maximum output power during the SAR measurements.Configure the basestation to support LTE tests in respect to the 3GPP 36.521-1,and set ch , RB allocation number ,RB allocation offset , and send continuously Up power control commands to the device.
MPR was enabled for this device. A-MPR was disabled for all SAR test measurements.

6.4 SAR Testing with LTE-TDD Transmitters

All SAR measurements for LTE were performed using the Anritsu MT8820C. A closed loop power control setting allowed the UE to transmit at the maximum output power during the SAR measurements.Configure the basestation to support LTE tests in respect to the 3GPP 36.521-1,and set ch , TDD mode , RB allocation number ,RB allocation offset , and send continuously Up power control commands to the device.
MPR was enabled for this device. A-MPR was disabled for all SAR test measurements.
For 3GPP table 4.2.1 as below, support configurations and worst-case UpPTS information into the table.

3GPP Table 4.2-1: Configuration of special subframe (lengths of DwPTS/GP/UpPTS).

Special subframe configuration	Normal cyclic prefix in downlink			Extended cyclic prefix in downlink			EUT Support Special subframe	Worst case UpPTS
	DwPTS	UpPTS		DwPTS	UpPTS			
		Normal cyclic prefix in uplink	Extended cyclic prefix in uplink		Normal cyclic prefix in uplink	Extended cyclic prefix in uplink		
0	6592×Ts	2192×Ts	2560×Ts	7680×Ts	2192×Ts	2560×Ts	☐	☐
1	19760×Ts			20480×Ts			☐	☐
2	21952×Ts			23040×Ts			☐	☐
3	24144×Ts			25600×Ts			■	☐
4	26336×Ts			7680×Ts	4384×Ts	5120×Ts	■	☐
5	6592×Ts	4384×Ts	5120×Ts	20480×Ts			☐	☐
6	19760×Ts			23040×Ts			☐	☐
7	21952×Ts			12800×Ts			■	■
8	24144×Ts			-	-	-	☐	☐
9	13168×Ts			-	-	-	☐	☐
							Duty cycle$_{(maximum)}$	43.33 %

The EUT only supports the 40 % case, which is Table 4.2.2, configuration #1 below.

Uplink-downlink configuration	Downlink-to-Uplink Switch-point periodicity	Subframe number										Type of EUT
		0	1	2	3	4	5	6	7	8	9	
0	5ms	D	S	U	U	U	D	S	U	U	U	☐
1	5ms	D	S	U	U	D	D	S	U	U	D	■
2	5ms	D	S	U	D	D	D	S	U	D	D	☐
3	10ms	D	S	U	U	U	D	D	D	D	D	☐
4	10ms	D	S	U	U	D	D	D	D	D	D	☐
5	10ms	D	S	U	D	D	D	D	D	D	D	☐
6	5ms	D	S	U	U	U	D	S	U	U	D	☐

6.5 LTE Frequency range and channel bandwidth

Channel bandwidth support:

Band	BW (MHz)					
	1.4	3	5	10	15	20
LTE Band 2	V	V	V	V	V	V
LTE Band 4	V	V	V	V	V	V
LTE Band 5	V	V	V	V	---	---
LTE Band 12	V	V	V	V	---	---

LTE Band	Bandwidth (MHz)	Test requency ID	N_{UL}	Frequency of Uplink (MHz)
LTE Band 2	1.4	Low Range	18607	1850.7
		Mid Range	18900	1880.0
		High Range	19193	1909.3
	3	Low Range	18615	1851.5
		Mid Range	18900	1880.0
		High Range	19185	1908.5
	5	Low Range	18625	1852.5
		Mid Range	18900	1880.0
		High Range	19175	1907.5
	10	Low Range	18650	1855.0
		Mid Range	18900	1880.0
		High Range	19150	1905.0
	15	Low Range	18675	1857.5
		Mid Range	18900	1880.0
		High Range	19125	1902.5
	20	Low Range	18700	1860.0
		Mid Range	18900	1880.0
		High Range	19100	1900.0

LTE Band	Bandwidth (MHz)	Test requency ID	N_{UL}	Frequency of Uplink (MHz)
LTE Band 4	1.4	Low Range	19957	1710.7
		Mid Range	20175	1732.5
		High Range	20393	1754.3
	3	Low Range	19965	1711.5
		Mid Range	20175	1732.5
		High Range	20385	1753.5
	5	Low Range	19975	1712.5
		Mid Range	20175	1732.5
		High Range	20375	1752.5
	10	Low Range	20000	1715.0
		Mid Range	20175	1732.5
		High Range	20350	1750.0
	15	Low Range	20025	1717.5
		Mid Range	20175	1732.5
		High Range	20325	1747.5
	20	Low Range	20050	1720.0
		Mid Range	20175	1732.5
		High Range	20300	1745.0
LTE Band 5	1.4	Low Range	20407	824.7
		Mid Range	20525	836.5
		High Range	20643	848.3
	3	Low Range	20415	825.5
		Mid Range	20525	836.5
		High Range	20635	847.5
	5	Low Range	20425	826.5
		Mid Range	20525	836.5
		High Range	20625	846.5
	10	Low Range	20450	829.0
		Mid Range	20525	836.5
		High Range	20600	844.0

LTE Band	Bandwidth (MHz)	Test requency ID	N_{UL}	Frequency of Uplink (MHz)
LTE Band 12	1.4	Low Range	23017	699.7
		Mid Range	23095	707.5
		High Range	23173	715.3
	3	Low Range	23025	700.5
		Mid Range	23095	707.5
		High Range	23165	714.5
	5	Low Range	23035	701.5
		Mid Range	23095	707.5
		High Range	23155	713.5
	10	Low Range	23060	704.0
		Mid Range	23095	707.5
		High Range	23130	711.0

6.5.1 Maximum power reduction (MPR)

Identify the LTE voice/data requirements in each operating mode and exposure condition with respect to head and body test configurations, antenna locations, handset flip-cover or slide positions, antenna diversity conditions etc.

The voice and data transmission:

- Data only device.

Identify if Maximum Power Reduction (MPR) is optional or mandatory, i.e. built-in by design:

- Maximum Power Reduction (MPR) is mandatory, i.e. built-in by design.
- A-MPR (additional MPR) must be disabled
- A-MPR was disabled during testing.

Maximum Power Reduction (MPR) for Power Class 3							
Channel bandwidth / Transmission bandwidth configuration (RB)							
Modulation	1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20MHz	MPR (dB)
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

6.6 Power reduction

No power reduction issue.

6.7 SAR Testing with 802.11 Transmitters

SAR test reduction for 802.11 Wi-Fi transmission mode configurations are considered separately for DSSS and OFDM. An initial test position is determined to reduce the number of tests required for certain exposure configurations with multiple test positions. An initial test configuration is determined for each frequency band and aggregated band according to maximum output power, channel bandwidth, wireless mode configurations and other operating parameters to streamline the measurement requirements. For 2.4 GHz DSSS, either the initial test position or DSSS procedure is applied to reduce the number of SAR tests; these are mutually exclusive. For OFDM, an initial test position is only applicable to next to the ear, UMPC mini-tablet and hotspot mode configurations, which is tested using the initial test configuration to facilitate test reduction. For other exposure conditions with a fixed test position, SAR test reduction is determined using only the initial test configuration.

The multiple test positions require SAR measurements in head, hotspot mode or UMPC mini-tablet configurations may be reduced according to the highest reported SAR determined using the initial test position(s) by applying the DSSS or OFDM SAR measurement procedures in the required wireless mode test configuration(s). The initial test position(s) is measured using the highest measured maximum output power channel in the required wireless mode test configuration(s). When the reported SAR for the initial test position is:

- ≤ 0.4 W/kg, further SAR measurement is not required for the other test positions in that exposure configuration and wireless mode combination within the frequency band or aggregated band. DSSS and OFDM configurations are considered separately according to the required SAR procedures.
- > 0.4 W/kg, SAR is repeated using the same wireless mode test configuration tested in the initial test position to measure the subsequent next closet/smallest test separation distance and maximum coupling test position, on the highest maximum output power channel, until the reported SAR is ≤ 0.8 W/kg or all required test positions are tested.
  - For subsequent test positions with equivalent test separation distance or when exposure is dominated by coupling conditions, the position for maximum coupling condition should be tested.
  - When it is unclear, all equivalent conditions must be tested.

- For all positions/configurations tested using the initial test position and subsequent test positions, when the reported SAR is > 0.8 W/kg, measure the SAR for these positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required test channels are considered.
  - The additional power measurements required for this step should be limited to those necessary for identifying subsequent highest output power channels to apply the test reduction.

- When the specified maximum output power is the same for both UNII 1 and UNII 2A, begin SAR measurements in UNII 2A with the channel with the highest measured output power. If the reported SAR for UNII 2A is ≤ 1.2 W/kg, SAR is not required for UNII 1; otherwise treat the remaining bands separately and test them independently for SAR.
- When the specified maximum output power is different between UNII 1 and UNII 2A, begin SAR with the band that has the higher specified maximum output. If the highest reported SAR for the band with the highest specified power is ≤ 1.2 W/kg, testing for the band with the lower specified output power is not required; otherwise test the remaining bands independently for SAR.

To determine the initial test position, Area Scans were performed to determine the position with the Maximum Value of SAR (measured). The position that produced the highest Maximum Value of SAR is considered the worst case position; thus used as the initial test position.

6.8 Conducted Power

Band	Modulation	Sub-test	CH	Frequency (MHz)	Burst Average Power (dBm)
WCDMA Band II	RMC12.2K	---	Lowest	1852.4	20.37
			Middle	1880.0	20.49
			Highest	1907.6	20.46
HSDPA Band II	QPSK	1	Lowest	1852.4	20.38
			Middle	1880.0	20.41
			Highest	1907.6	20.44
		2	Lowest	1852.4	20.33
			Middle	1880.0	20.34
			Highest	1907.6	20.37
		3	Lowest	1852.4	19.91
			Middle	1880.0	19.97
			Highest	1907.6	20.03
		4	Lowest	1852.4	19.86
			Middle	1880.0	19.89
			Highest	1907.6	19.94
HSUPA Band II	QPSK	1	Lowest	1852.4	19.71
			Middle	1880.0	19.80
			Highest	1907.6	19.87
		2	Lowest	1852.4	17.70
			Middle	1880.0	17.79
			Highest	1907.6	17.86
		3	Lowest	1852.4	18.69
			Middle	1880.0	18.78
			Highest	1907.6	18.85
		4	Lowest	1852.4	17.68
			Middle	1880.0	17.77
			Highest	1907.6	17.84
		5	Lowest	1852.4	20.31
			Middle	1880.0	20.32
			Highest	1907.6	20.34

Band	Modulation	Sub-test	CH	Frequency (MHz)	Burst Average Power (dBm)
WCDMA Band V	RMC12.2K	---	Lowest	826.4	23.32
			Middle	836.6	23.44
			Highest	846.6	23.48
HSDPA Band V	QPSK	1	Lowest	826.4	22.46
			Middle	836.6	22.56
			Highest	846.6	22.61
		2	Lowest	826.4	22.24
			Middle	836.6	22.39
			Highest	846.6	22.52
		3	Lowest	826.4	21.85
			Middle	836.6	21.96
			Highest	846.6	22.16
		4	Lowest	826.4	21.91
			Middle	836.6	22.05
			Highest	846.6	22.10
HSUPA Band V	QPSK	1	Lowest	826.4	21.87
			Middle	836.6	22.01
			Highest	846.6	22.06
		2	Lowest	826.4	19.82
			Middle	836.6	20.03
			Highest	846.6	20.01
		3	Lowest	826.4	20.81
			Middle	836.6	20.92
			Highest	846.6	21.04
		4	Lowest	826.4	19.75
			Middle	836.6	19.96
			Highest	846.6	19.93
		5	Lowest	826.4	21.79
			Middle	836.6	21.82
			Highest	846.6	21.92

Band	Channel Bandwidth	Modulation	Channel	Frequency (MHz)	RB Configuration		Average Power	
					Size	Offset	(dBm)	(W)
LTE Band2	1.4 MHz	QPSK	18607	1850.7	1	0	20.63	0.116
					1	2	20.79	0.120
					1	5	20.65	0.116
					3	0	20.58	0.114
					3	1	20.52	0.113
					3	3	20.61	0.115
					6	0	20.00	0.100
			18900	1880.0	1	0	20.78	0.120
					1	2	21.09	0.129
					1	5	20.86	0.122
					3	0	21.01	0.126
					3	1	21.05	0.127
					3	3	21.14	0.130
					6	0	20.01	0.100
			19193	1909.3	1	0	20.88	0.122
					1	2	**21.29**	**0.135**
					1	5	21.23	0.133
					3	0	21.11	0.129
					3	1	21.11	0.129
					3	3	21.18	0.131
					6	0	20.13	0.103
		16QAM	18607	1850.7	1	0	19.97	0.099
					1	2	20.08	0.102
					1	5	19.87	0.097
					3	0	20.23	0.105
					3	1	20.17	0.104
					3	3	20.16	0.104
					6	0	18.93	0.078
			18900	1880.0	1	0	20.35	0.108
					1	2	**20.56**	**0.114**
					1	5	20.07	0.102
					3	0	20.42	0.110
					3	1	20.46	0.111
					3	3	20.52	0.113
					6	0	19.08	0.081
			19193	1909.3	1	0	20.29	0.107
					1	2	20.42	0.110
					1	5	20.08	0.102
					3	0	20.31	0.107
					3	1	20.40	0.110
					3	3	20.39	0.109
					6	0	19.14	0.082

Band	Channel Bandwidth	Modulation	Channel	Frequency (MHz)	RB Configuration		Average Power	
					Size	Offset	(dBm)	(W)
LTE Band2	3 MHz	QPSK	18615	1851.5	1	0	20.75	0.119
					1	7	20.87	0.122
					1	14	20.94	0.124
					8	0	19.90	0.098
					8	3	19.95	0.099
					8	7	19.91	0.098
					15	0	19.86	0.097
			18900	1880.0	1	0	20.87	0.122
					1	7	21.01	0.126
					1	14	21.03	0.127
					8	0	19.98	0.100
					8	3	19.88	0.097
					8	7	19.96	0.099
					15	0	19.88	0.097
			19185	1908.5	1	0	20.89	0.123
					1	7	21.06	0.128
					1	14	**21.08**	**0.128**
					8	0	20.00	0.100
					8	3	20.05	0.101
					8	7	20.03	0.101
					15	0	20.02	0.100
		16QAM	18615	1851.5	1	0	19.95	0.099
					1	7	19.77	0.095
					1	14	19.92	0.098
					8	0	18.82	0.076
					8	3	18.86	0.077
					8	7	18.81	0.076
					15	0	18.88	0.077
			18900	1880.0	1	0	20.13	0.103
					1	7	20.31	0.107
					1	14	20.19	0.104
					8	0	18.87	0.077
					8	3	18.81	0.076
					8	7	18.86	0.077
					15	0	18.89	0.077
			19185	1908.5	1	0	**20.46**	**0.111**
					1	7	19.99	0.100
					1	14	20.06	0.101
					8	0	18.99	0.079
					8	3	19.02	0.080
					8	7	19.03	0.080
					15	0	18.95	0.079

Band	Channel Bandwidth	Modulation	Channel	Frequency (MHz)	RB Configuration		Average Power	
					Size	Offset	(dBm)	(W)
LTE Band2	5 MHz	QPSK	18625	1852.5	1	0	20.46	0.111
					1	12	20.57	0.114
					1	24	20.75	0.119
					12	0	19.76	0.095
					12	6	19.73	0.094
					12	13	19.76	0.095
					25	0	19.76	0.095
			18900	1880.0	1	0	20.83	0.121
					1	12	20.82	0.121
					1	24	20.89	0.123
					12	0	19.85	0.097
					12	6	19.86	0.097
					12	13	19.83	0.096
					25	0	19.77	0.095
			19175	1907.5	1	0	20.83	0.121
					1	12	20.96	0.125
					1	24	**21.01**	**0.126**
					12	0	19.98	0.100
					12	6	19.89	0.097
					12	13	19.95	0.099
					25	0	19.99	0.100
		16QAM	18625	1852.5	1	0	19.91	0.098
					1	12	19.69	0.093
					1	24	19.88	0.097
					12	0	18.83	0.076
					12	6	18.81	0.076
					12	13	18.87	0.077
					25	0	18.89	0.077
			18900	1880.0	1	0	20.02	0.100
					1	12	19.72	0.094
					1	24	19.89	0.097
					12	0	18.84	0.077
					12	6	18.86	0.077
					12	13	18.83	0.076
					25	0	18.82	0.076
			19175	1907.5	1	0	**20.02**	**0.100**
					1	12	19.81	0.096
					1	24	20.01	0.100
					12	0	18.86	0.077
					12	6	18.95	0.079
					12	11	18.89	0.077
					25	0	19.04	0.080

Band	Channel Bandwidth	Modulation	Channel	Frequency (MHz)	RB Configuration		Average Power	
					Size	Offset	(dBm)	(W)
LTE Band2	10 MHz	QPSK	18650	1855.0	1	0	20.78	0.120
					1	24	20.79	0.120
					1	49	20.64	0.116
					25	0	19.74	0.094
					25	12	19.64	0.092
					25	25	19.71	0.094
					50	0	19.66	0.092
			18900	1880.0	1	0	20.88	0.122
					1	24	20.86	0.122
					1	49	20.84	0.121
					25	0	19.84	0.096
					25	12	19.75	0.094
					25	25	19.77	0.095
					50	0	19.81	0.096
			19150	1905.0	1	0	20.81	0.121
					1	24	**20.97**	**0.125**
					1	49	20.89	0.123
					25	0	19.87	0.097
					25	12	19.84	0.096
					25	25	19.94	0.099
					50	0	19.83	0.096
		16QAM	18650	1855.0	1	0	19.94	0.099
					1	24	19.93	0.098
					1	49	19.73	0.094
					25	0	18.88	0.077
					25	12	18.88	0.077
					25	25	18.85	0.077
					50	0	18.89	0.077
			18900	1880.0	1	0	20.10	0.102
					1	24	19.93	0.098
					1	49	20.09	0.102
					25	0	18.86	0.077
					25	12	18.83	0.076
					25	25	18.88	0.077
					50	0	18.81	0.076
			19150	1905.0	1	0	20.09	0.102
					1	24	**20.12**	**0.103**
					1	49	20.06	0.101
					25	0	18.82	0.076
					25	12	18.88	0.077
					25	25	18.99	0.079
					50	0	18.83	0.076

Band	Channel Bandwidth	Modulation	Channel	Frequency (MHz)	RB Configuration		Average Power	
					Size	Offset	(dBm)	(W)
LTE Band2	15 MHz	QPSK	18675	1857.5	1	0	20.49	0.112
					1	37	20.50	0.112
					1	74	20.70	0.117
					36	0	19.65	0.092
					36	19	19.53	0.090
					36	39	19.64	0.092
					75	0	19.61	0.091
			18900	1880.0	1	0	20.69	0.117
					1	37	20.65	0.116
					1	74	**20.88**	**0.122**
					36	0	19.76	0.095
					36	19	19.70	0.093
					36	39	19.66	0.092
					75	0	19.67	0.093
			19125	1902.5	1	0	20.80	0.120
					1	37	20.65	0.116
					1	74	20.83	0.121
					36	0	19.75	0.094
					36	19	19.71	0.094
					36	39	19.89	0.097
					75	0	19.75	0.094
		16QAM	18675	1857.5	1	0	19.94	0.099
					1	37	19.83	0.096
					1	74	19.83	0.096
					36	0	18.86	0.077
					36	19	18.83	0.076
					36	39	18.85	0.077
					75	0	18.82	0.076
			18900	1880.0	1	0	**20.15**	**0.104**
					1	37	19.59	0.091
					1	74	19.94	0.099
					36	0	18.82	0.076
					36	19	18.83	0.076
					36	39	18.89	0.077
					75	0	18.81	0.076
			19125	1902.5	1	0	19.98	0.100
					1	37	19.75	0.094
					1	74	20.12	0.103
					36	0	18.83	0.076
					36	19	18.85	0.077
					36	39	18.94	0.078
					75	0	18.82	0.076

Band	Channel Bandwidth	Modulation	Channel	Frequency (MHz)	RB Configuration		Average Power	
					Size	Offset	(dBm)	(W)
LTE Band2	20 MHz	QPSK	18700	1860.0	1	0	20.83	0.121
					1	49	20.65	0.116
					1	99	20.82	0.121
					50	0	19.71	0.094
					50	25	19.65	0.092
					50	50	19.66	0.092
					100	0	19.70	0.093
			18900	1880.0	1	0	20.81	0.121
					1	49	20.69	0.117
					1	99	20.63	0.116
					50	0	19.75	0.094
					50	25	19.75	0.094
					50	50	19.76	0.095
					100	0	19.80	0.095
			19100	1900.0	1	0	**20.85**	**0.122**
					1	49	20.79	0.120
					1	99	20.71	0.118
					50	0	19.83	0.096
					50	25	19.62	0.092
					50	50	19.75	0.094
					100	0	19.78	0.095
		16QAM	18700	1860.0	1	0	20.10	0.102
					1	49	19.88	0.097
					1	99	19.83	0.096
					50	0	19.86	0.097
					50	25	19.66	0.092
					50	50	19.69	0.093
					100	0	19.58	0.091
			18900	1880.0	1	0	20.11	0.103
					1	49	20.02	0.100
					1	99	19.93	0.098
					50	0	19.47	0.089
					50	25	19.53	0.090
					50	50	19.59	0.091
					100	0	19.29	0.085
			19100	1900.0	1	0	20.14	0.103
					1	49	20.11	0.103
					1	99	**20.29**	**0.107**
					50	0	19.88	0.097
					50	25	19.85	0.097
					50	50	19.86	0.097
					100	0	19.83	0.096

Band	Channel Bandwidth	Modulation	Channel	Frequency (MHz)	RB Configuration		Average Power	
					Size	Offset	(dBm)	(W)
LTE Band4	1.4 MHz	QPSK	19957	1710.7	1	0	23.20	0.209
					1	2	23.18	0.208
					1	5	23.13	0.206
					3	0	22.99	0.199
					3	1	23.02	0.200
					3	3	23.19	0.208
					6	0	22.11	0.163
			20175	1732.5	1	0	23.05	0.202
					1	2	**23.21**	**0.209**
					1	5	23.08	0.203
					3	0	23.13	0.206
					3	1	23.16	0.207
					3	3	23.10	0.204
					6	0	22.12	0.163
			20393	1754.3	1	0	22.85	0.193
					1	2	22.96	0.198
					1	5	22.82	0.191
					3	0	22.84	0.192
					3	1	22.87	0.194
					3	3	22.80	0.191
					6	0	21.93	0.156
		16QAM	19957	1710.7	1	0	22.08	0.161
					1	2	22.04	0.160
					1	5	22.34	0.171
					3	0	21.56	0.143
					3	1	21.38	0.137
					3	3	21.30	0.135
					6	0	20.57	0.114
			20175	1732.5	1	0	22.12	0.163
					1	2	22.25	0.168
					1	5	**22.37**	**0.173**
					3	0	21.73	0.149
					3	1	21.70	0.148
					3	3	21.60	0.145
					6	0	20.58	0.114
			20393	1754.3	1	0	22.07	0.161
					1	2	22.32	0.171
					1	5	22.18	0.165
					3	0	22.04	0.160
					3	1	22.19	0.166
					3	3	22.16	0.164
					6	0	21.24	0.133

Band	Channel Bandwidth	Modulation	Channel	Frequency (MHz)	RB Configuration		Average Power	
					Size	Offset	(dBm)	(W)
LTE Band4	3 MHz	QPSK	19965	1711.5	1	0	**23.22**	**0.210**
					1	7	23.07	0.203
					1	14	23.09	0.204
					8	0	22.13	0.163
					8	3	22.12	0.163
					8	7	21.99	0.158
					15	0	22.13	0.163
			20175	1732.5	1	0	23.13	0.206
					1	7	23.00	0.200
					1	14	23.03	0.201
					8	0	22.18	0.165
					8	3	22.18	0.165
					8	7	22.04	0.160
					15	0	22.12	0.163
			20385	1753.5	1	0	22.95	0.197
					1	7	22.79	0.190
					1	14	22.90	0.195
					8	0	21.97	0.157
					8	3	21.99	0.158
					8	7	21.89	0.155
					15	0	21.88	0.154
		16QAM	19965	1711.5	1	0	**22.27**	**0.169**
					1	7	22.15	0.164
					1	14	22.22	0.167
					8	0	21.24	0.133
					8	3	21.20	0.132
					8	7	21.10	0.129
					15	0	21.07	0.128
			20175	1732.5	1	0	22.17	0.165
					1	7	22.19	0.166
					1	14	22.22	0.167
					8	0	20.98	0.125
					8	3	20.89	0.123
					8	7	20.70	0.117
					15	0	21.14	0.130
			20385	1753.5	1	0	22.21	0.166
					1	7	22.17	0.165
					1	14	22.14	0.164
					8	0	20.90	0.123
					8	3	20.83	0.121
					8	7	20.84	0.121
					15	0	20.84	0.121

Band	Channel Bandwidth	Modulation	Channel	Frequency (MHz)	RB Configuration		Average Power	
					Size	Offset	(dBm)	(W)
LTE Band4	5 MHz	QPSK	19975	1712.5	1	0	23.06	0.202
					1	12	22.80	0.191
					1	24	22.99	0.199
					12	0	22.12	0.163
					12	6	21.98	0.158
					12	13	22.07	0.161
					25	0	22.07	0.161
			20175	1732.5	1	0	**23.26**	**0.212**
					1	12	22.87	0.194
					1	24	23.00	0.200
					12	0	22.05	0.160
					12	6	22.03	0.160
					12	13	22.09	0.162
					25	0	22.11	0.163
			20375	1752.5	1	0	22.85	0.193
					1	12	22.72	0.187
					1	24	22.87	0.194
					12	0	21.81	0.152
					12	6	21.85	0.153
					12	13	21.98	0.158
					25	0	21.84	0.153
		16QAM	19975	1712.5	1	0	22.00	0.158
					1	12	21.74	0.149
					1	24	22.10	0.162
					12	0	20.93	0.124
					12	6	20.81	0.121
					12	13	21.03	0.127
					25	0	21.12	0.129
			20175	1732.5	1	0	**22.32**	**0.171**
					1	12	21.89	0.155
					1	24	22.18	0.165
					12	0	21.24	0.133
					12	6	21.15	0.130
					12	13	21.20	0.132
					25	0	21.24	0.133
			20375	1752.5	1	0	22.08	0.161
					1	12	21.86	0.153
					1	24	22.13	0.163
					12	0	20.86	0.122
					12	6	20.80	0.120
					12	11	20.82	0.121
					25	0	20.89	0.123

Band	Channel Bandwidth	Modulation	Channel	Frequency (MHz)	RB Configuration		Average Power	
					Size	Offset	(dBm)	(W)
LTE Band4	10 MHz	QPSK	20000	1715.0	1	0	**23.34**	**0.216**
					1	24	23.29	0.213
					1	49	23.20	0.209
					25	0	22.18	0.165
					25	12	22.09	0.162
					25	25	22.13	0.163
					50	0	22.15	0.164
			20175	1732.5	1	0	23.31	0.214
					1	24	23.26	0.212
					1	49	23.09	0.204
					25	0	22.26	0.168
					25	12	22.07	0.161
					25	25	22.05	0.160
					50	0	22.11	0.163
			20350	1750.0	1	0	23.00	0.200
					1	24	22.93	0.196
					1	49	22.82	0.191
					25	0	22.02	0.159
					25	12	21.89	0.155
					25	25	21.95	0.157
					50	0	21.84	0.153
		16QAM	20000	1715.0	1	0	22.13	0.163
					1	24	22.39	0.173
					1	49	**22.45**	**0.176**
					25	0	20.67	0.117
					25	12	20.55	0.114
					25	25	20.56	0.114
					50	0	20.66	0.116
			20175	1732.5	1	0	22.27	0.169
					1	24	22.39	0.173
					1	49	22.17	0.165
					25	0	20.74	0.119
					25	12	20.56	0.114
					25	25	20.54	0.113
					50	0	20.65	0.116
			20350	1750.0	1	0	21.79	0.151
					1	24	22.16	0.164
					1	49	22.05	0.160
					25	0	20.61	0.115
					25	12	20.50	0.112
					25	25	20.55	0.114
					50	0	20.45	0.111

Band	Channel Bandwidth	Modulation	Channel	Frequency (MHz)	RB Configuration		Average Power	
					Size	Offset	(dBm)	(W)
LTE Band4	15 MHz	QPSK	20025	1717.5	1	0	23.44	0.221
					1	37	23.00	0.200
					1	74	23.33	0.215
					36	0	22.18	0.165
					36	19	22.09	0.162
					36	39	22.16	0.164
					75	0	22.08	0.161
			20175	1732.5	1	0	**23.48**	**0.223**
					1	37	23.00	0.200
					1	74	23.03	0.201
					36	0	22.25	0.168
					36	19	22.07	0.161
					36	39	22.09	0.162
					75	0	22.13	0.163
			20325	1747.5	1	0	23.14	0.206
					1	37	22.73	0.187
					1	74	23.05	0.202
					36	0	22.08	0.161
					36	19	21.96	0.157
					36	39	21.93	0.156
					75	0	21.98	0.158
		16QAM	20025	1717.5	1	0	22.61	0.182
					1	37	22.46	0.176
					1	74	22.35	0.172
					36	0	20.98	0.125
					36	19	20.86	0.122
					36	39	20.91	0.123
					75	0	21.14	0.130
			20175	1732.5	1	0	22.47	0.177
					1	37	22.50	0.178
					1	74	22.45	0.176
					36	0	21.29	0.135
					36	19	20.96	0.125
					36	39	21.01	0.126
					75	0	21.11	0.129
			20325	1747.5	1	0	22.46	0.176
					1	37	22.51	0.178
					1	74	**22.68**	**0.185**
					36	0	20.96	0.125
					36	19	20.84	0.121
					36	39	21.07	0.128
					75	0	21.04	0.127

Band	Channel Bandwidth	Modulation	Channel	Frequency (MHz)	RB Configuration		Average Power	
					Size	Offset	(dBm)	(W)
LTE Band4	20 MHz	QPSK	20050	1720.0	1	0	23.47	0.222
					1	49	23.55	0.226
					1	99	23.33	0.215
					50	0	22.28	0.169
					50	25	22.15	0.164
					50	50	22.14	0.164
					100	0	22.19	0.166
			20175	1732.5	1	0	**23.56**	**0.227**
					1	49	23.20	0.209
					1	99	22.99	0.199
					50	0	22.37	0.173
					50	25	22.16	0.164
					50	50	22.00	0.158
					100	0	22.16	0.164
			20300	1745.0	1	0	23.18	0.208
					1	49	22.81	0.191
					1	99	23.02	0.200
					50	0	22.10	0.162
					50	25	22.01	0.159
					50	50	22.05	0.160
					100	0	22.06	0.161
		16QAM	20050	1720.0	1	0	22.40	0.174
					1	49	22.26	0.168
					1	99	22.49	0.177
					50	0	21.43	0.139
					50	25	21.31	0.135
					50	50	21.33	0.136
					100	0	21.47	0.140
			20175	1732.5	1	0	22.54	0.179
					1	49	22.32	0.171
					1	99	21.91	0.155
					50	0	21.61	0.145
					50	25	21.38	0.137
					50	50	21.34	0.136
					100	0	21.37	0.137
			20300	1745.0	1	0	**22.67**	**0.185**
					1	49	22.44	0.175
					1	99	22.61	0.182
					50	0	21.41	0.138
					50	25	21.22	0.132
					50	50	21.24	0.133
					100	0	21.28	0.134

Band	Channel Bandwidth	Modulation	Channel	Frequency (MHz)	RB Configuration		Average Power	
					Size	Offset	(dBm)	(W)
LTE Band5	1.4 MHz	QPSK	20407	824.7	1	0	22.97	0.198
					1	2	23.11	0.205
					1	5	22.89	0.195
					3	0	23.08	0.203
					3	1	23.09	0.204
					3	3	22.96	0.198
					6	0	22.11	0.163
			20525	836.5	1	0	23.10	0.204
					1	2	**23.15**	**0.207**
					1	5	23.04	0.201
					3	0	23.02	0.200
					3	1	22.93	0.196
					3	3	22.87	0.194
					6	0	22.13	0.163
			20643	848.3	1	0	23.00	0.200
					1	2	22.99	0.199
					1	5	22.84	0.192
					3	0	23.10	0.204
					3	1	22.98	0.199
					3	3	22.90	0.195
					6	0	22.16	0.164
		16QAM	20407	824.7	1	0	22.17	0.165
					1	2	22.14	0.164
					1	5	22.28	0.169
					3	0	21.97	0.157
					3	1	21.98	0.158
					3	3	21.95	0.157
					6	0	20.61	0.115
			20525	836.5	1	0	22.20	0.166
					1	2	**22.31**	**0.170**
					1	5	22.20	0.166
					3	0	21.55	0.143
					3	1	21.63	0.146
					3	3	21.52	0.142
					6	0	20.52	0.113
			20643	848.3	1	0	22.05	0.160
					1	2	22.10	0.162
					1	5	21.85	0.153
					3	0	22.05	0.160
					3	1	22.05	0.160
					3	3	21.92	0.156
					6	0	21.18	0.131

Band	Channel Bandwidth	Modulation	Channel	Frequency (MHz)	RB Configuration		Average Power	
					Size	Offset	(dBm)	(W)
LTE Band5	3 MHz	QPSK	20415	825.5	1	0	23.08	0.203
					1	7	22.96	0.198
					1	14	23.09	0.204
					8	0	22.06	0.161
					8	3	22.07	0.161
					8	7	22.15	0.164
					15	0	21.99	0.158
			20525	836.5	1	0	23.10	0.204
					1	7	22.71	0.187
					1	14	22.97	0.198
					8	0	22.04	0.160
					8	3	22.02	0.159
					8	7	22.01	0.159
					15	0	21.93	0.156
			20635	847.5	1	0	**23.17**	**0.207**
					1	7	22.88	0.194
					1	14	22.94	0.197
					8	0	21.92	0.156
					8	3	21.95	0.157
					8	7	21.98	0.158
					15	0	22.03	0.160
		16QAM	20415	825.5	1	0	22.09	0.162
					1	7	22.16	0.164
					1	14	22.29	0.169
					8	0	20.64	0.116
					8	3	20.47	0.111
					8	7	20.43	0.110
					15	0	20.56	0.114
			20525	836.5	1	0	22.27	0.169
					1	7	22.13	0.163
					1	14	**22.34**	**0.171**
					8	0	20.73	0.118
					8	3	20.69	0.117
					8	7	20.80	0.120
					15	0	20.62	0.115
			20635	847.5	1	0	22.03	0.160
					1	7	21.66	0.147
					1	14	21.81	0.152
					8	0	20.76	0.119
					8	3	20.67	0.117
					8	7	20.56	0.114
					15	0	20.64	0.116

Band	Channel Bandwidth	Modulation	Channel	Frequency (MHz)	RB Configuration		Average Power	
					Size	Offset	(dBm)	(W)
LTE Band5	5 MHz	QPSK	20425	826.5	1	0	22.97	0.198
					1	12	22.75	0.188
					1	24	22.99	0.199
					12	0	22.07	0.161
					12	6	21.92	0.156
					12	13	22.11	0.163
					25	0	22.14	0.164
			20525	836.5	1	0	23.04	0.201
					1	12	22.71	0.187
					1	24	**23.20**	**0.209**
					12	0	21.95	0.157
					12	6	21.95	0.157
					12	13	21.98	0.158
					25	0	22.04	0.160
			20625	846.5	1	0	23.06	0.202
					1	12	22.84	0.192
					1	24	23.18	0.208
					12	0	22.15	0.164
					12	6	22.02	0.159
					12	13	22.13	0.163
					25	0	22.10	0.162
		16QAM	20425	826.5	1	0	22.14	0.164
					1	12	21.78	0.151
					1	24	22.11	0.163
					12	0	21.19	0.132
					12	6	21.02	0.126
					12	13	21.15	0.130
					25	0	21.20	0.132
			20525	836.5	1	0	**22.40**	**0.174**
					1	12	21.96	0.157
					1	24	22.16	0.164
					12	0	21.21	0.132
					12	6	21.17	0.131
					12	13	21.24	0.133
					25	0	21.18	0.131
			20625	846.5	1	0	22.38	0.173
					1	12	21.84	0.153
					1	24	22.13	0.163
					12	0	21.13	0.130
					12	6	21.00	0.126
					12	11	21.12	0.129
					25	0	21.19	0.132

Band	Channel Bandwidth	Modulation	Channel	Frequency (MHz)	RB Configuration		Average Power	
					Size	Offset	(dBm)	(W)
LTE Band5	10 MHz	QPSK	20450	829.0	1	0	23.19	0.208
					1	24	22.92	0.196
					1	49	22.97	0.198
					25	0	22.13	0.163
					25	12	21.98	0.158
					25	25	21.98	0.158
					50	0	22.12	0.163
			20525	836.5	1	0	**23.24**	**0.211**
					1	24	22.87	0.194
					1	49	22.86	0.193
					25	0	22.13	0.163
					25	12	22.05	0.160
					25	25	22.01	0.159
					50	0	22.09	0.162
			20600	844.0	1	0	23.10	0.204
					1	24	22.90	0.195
					1	49	22.85	0.193
					25	0	22.05	0.160
					25	12	22.02	0.159
					25	25	22.00	0.158
					50	0	22.06	0.161
		16QAM	20450	829.0	1	0	22.24	0.167
					1	24	22.06	0.161
					1	49	21.92	0.156
					25	0	20.81	0.121
					25	12	20.60	0.115
					25	25	20.60	0.115
					50	0	20.81	0.121
			20525	836.5	1	0	22.22	0.167
					1	24	22.21	0.166
					1	49	22.27	0.169
					25	0	21.00	0.126
					25	12	20.82	0.121
					25	25	20.76	0.119
					50	0	20.74	0.119
			20600	844.0	1	0	**22.44**	**0.175**
					1	24	22.32	0.171
					1	49	22.44	0.175
					25	0	20.87	0.122
					25	12	20.71	0.118
					25	25	20.70	0.117
					50	0	20.86	0.122

Band	Channel Bandwidth	Modulation	Channel	Frequency (MHz)	RB Configuration		Average Power	
					Size	Offset	(dBm)	(W)
LTE Band12	1.4 MHz	QPSK	23017	699.7	1	0	22.88	0.194
					1	2	23.09	0.204
					1	5	23.14	0.206
					3	0	23.02	0.200
					3	1	22.97	0.198
					3	3	23.04	0.201
					6	0	22.17	0.165
			23095	707.5	1	0	**23.20**	**0.209**
					1	2	23.13	0.206
					1	5	23.10	0.204
					3	0	23.10	0.204
					3	1	23.15	0.207
					3	3	23.12	0.205
					6	0	22.19	0.166
			23173	715.3	1	0	23.08	0.203
					1	2	23.00	0.200
					1	5	23.08	0.203
					3	0	23.04	0.201
					3	1	23.03	0.201
					3	3	23.05	0.202
					6	0	22.23	0.167
		16QAM	23017	699.7	1	0	22.03	0.160
					1	2	22.24	0.167
					1	5	**22.37**	**0.173**
					3	0	21.63	0.146
					3	1	21.60	0.145
					3	3	21.61	0.145
					6	0	20.96	0.125
			23095	707.5	1	0	22.04	0.160
					1	2	22.06	0.161
					1	5	22.03	0.160
					3	0	21.60	0.145
					3	1	21.82	0.152
					3	3	21.84	0.153
					6	0	20.84	0.121
			23173	715.3	1	0	21.90	0.155
					1	2	22.01	0.159
					1	5	22.32	0.171
					3	0	21.91	0.155
					3	1	22.23	0.167
					3	3	22.09	0.162
					6	0	20.98	0.125

Band	Channel Bandwidth	Modulation	Channel	Frequency (MHz)	RB Configuration		Average Power	
					Size	Offset	(dBm)	(W)
LTE Band12	3 MHz	QPSK	23025	700.5	1	0	23.01	0.200
					1	7	22.88	0.194
					1	14	22.90	0.195
					8	0	22.05	0.160
					8	3	22.02	0.159
					8	7	21.96	0.157
					15	0	22.01	0.159
			23095	707.5	1	0	23.07	0.203
					1	7	22.85	0.193
					1	14	23.02	0.200
					8	0	22.09	0.162
					8	3	22.04	0.160
					8	7	21.97	0.157
					15	0	22.01	0.159
			23165	714.5	1	0	23.20	0.209
					1	7	23.22	0.210
					1	14	**23.24**	**0.211**
					8	0	22.09	0.162
					8	3	22.07	0.161
					8	7	22.01	0.159
					15	0	22.07	0.161
		16QAM	23025	700.5	1	0	22.32	0.171
					1	7	22.28	0.169
					1	14	**22.35**	**0.172**
					8	0	20.84	0.121
					8	3	20.68	0.117
					8	7	20.58	0.114
					15	0	20.67	0.117
			23095	707.5	1	0	22.24	0.167
					1	7	22.23	0.167
					1	14	22.13	0.163
					8	0	20.86	0.122
					8	3	20.66	0.116
					8	7	20.64	0.116
					15	0	20.77	0.119
			23165	714.5	1	0	22.19	0.166
					1	7	22.07	0.161
					1	14	22.04	0.160
					8	0	20.82	0.121
					8	3	20.74	0.119
					8	7	20.79	0.120
					15	0	20.77	0.119

Band	Channel Bandwidth	Modulation	Channel	Frequency (MHz)	RB Configuration		Average Power	
					Size	Offset	(dBm)	(W)
LTE Band12	5 MHz	QPSK	23035	701.5	1	0	22.76	0.189
					1	12	22.76	0.189
					1	24	22.92	0.196
					12	0	21.95	0.157
					12	6	21.94	0.156
					12	13	22.02	0.159
					25	0	21.89	0.155
			23095	707.5	1	0	22.96	0.198
					1	12	23.05	0.202
					1	24	22.97	0.198
					12	0	21.89	0.155
					12	6	21.89	0.155
					12	13	22.02	0.159
					25	0	21.99	0.158
			23155	713.5	1	0	22.93	0.196
					1	12	22.86	0.193
					1	24	**23.23**	**0.210**
					12	0	22.08	0.161
					12	6	22.11	0.163
					12	13	22.10	0.162
					25	0	22.01	0.159
		16QAM	23035	701.5	1	0	21.87	0.154
					1	12	21.70	0.148
					1	24	21.91	0.155
					12	0	21.02	0.126
					12	6	20.75	0.119
					12	13	20.80	0.120
					25	0	20.91	0.123
			23095	707.5	1	0	21.96	0.157
					1	12	22.31	0.170
					1	24	**22.33**	**0.171**
					12	0	20.94	0.124
					12	6	20.80	0.120
					12	13	20.84	0.121
					25	0	21.01	0.126
			23155	713.5	1	0	21.96	0.157
					1	12	21.89	0.155
					1	24	22.18	0.165
					12	0	20.97	0.125
					12	6	21.05	0.127
					12	11	21.06	0.128
					25	0	21.06	0.128

Band	Channel Bandwidth	Modulation	Channel	Frequency (MHz)	RB Configuration		Average Power	
					Size	Offset	(dBm)	(W)
LTE Band12	10 MHz	QPSK	23060	704.0	1	0	23.13	0.206
					1	24	23.11	0.205
					1	49	22.63	0.183
					25	0	21.81	0.152
					25	12	22.05	0.160
					25	25	21.99	0.158
					50	0	21.89	0.155
			23095	707.5	1	0	22.86	0.193
					1	24	**23.25**	**0.211**
					1	49	22.60	0.182
					25	0	22.00	0.158
					25	12	21.90	0.155
					25	25	21.79	0.151
					50	0	21.88	0.154
			23130	711.0	1	0	23.24	0.211
					1	24	23.10	0.204
					1	49	22.88	0.194
					25	0	22.08	0.161
					25	12	21.94	0.156
					25	25	21.97	0.157
					50	0	22.10	0.162
		16QAM	23060	704.0	1	0	22.08	0.161
					1	24	22.15	0.164
					1	49	22.22	0.167
					25	0	20.38	0.109
					25	12	20.63	0.116
					25	25	20.58	0.114
					50	0	20.61	0.115
			23095	707.5	1	0	22.21	0.166
					1	24	22.22	0.167
					1	49	22.13	0.163
					25	0	20.72	0.118
					25	12	20.75	0.119
					25	25	20.75	0.119
					50	0	20.63	0.116
			23130	711.0	1	0	22.22	0.167
					1	24	**22.27**	**0.169**
					1	49	21.93	0.156
					25	0	20.75	0.119
					25	12	20.70	0.117
					25	25	20.63	0.116
					50	0	20.79	0.120

Band	Data Rate	CH	Frequency (MHz)	Average Power (dBm)
IEEE 802.11b	1 M	1	2412.0	12.10
		6	2437.0	12.50
		11	2462.0	**13.03**
IEEE 802.11g	6 M	1	2412.0	10.37
		6	2437.0	**12.49**
		11	2462.0	11.76
IEEE 802.11n 2.4 GHz 20 MHz	6.5 M	1	2412.0	9.39
		6	2437.0	**12.22**
		11	2462.0	10.59
IEEE 802.11n 2.4 GHz 40 MHz	13.5 M	3	2422.0	7.14
		6	2437.0	**12.15**
		9	2452.0	7.98
IEEE 802.11a	6 M	36	5180.0	12.23
		40	5200.0	12.08
		44	5220.0	12.51
		48	5240.0	**12.66**
		52	5260.0	**12.83**
		56	5280.0	12.42
		60	5300.0	12.56
		64	5320.0	12.53
		100	5500.0	12.23
		104	5520.0	12.31
		108	5540.0	12.28
		112	5560.0	12.18
		116	5580.0	12.87
		132	5660.0	12.58
		136	5680.0	12.60
		140	5700.0	**12.90**
		149	5745.0	**11.77**
		153	5765.0	11.36
		157	5785.0	11.39
		161	5805.0	10.99
		165	5825.0	11.42

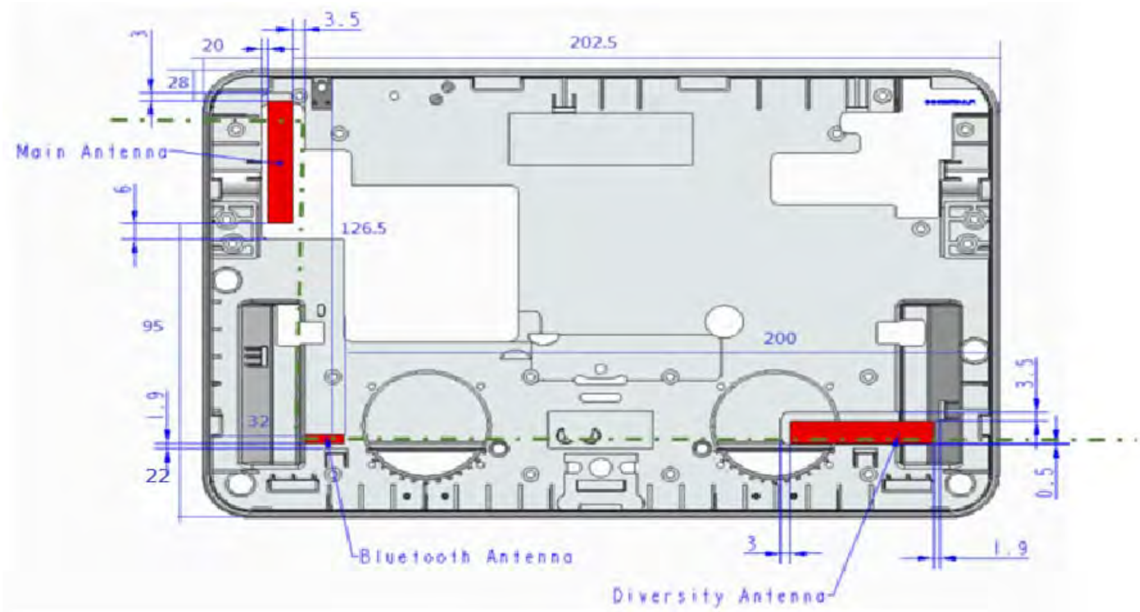
Band	Data Rate	CH	Frequency (MHz)	Average Power (dBm)
IEEE 802.11n 5 GHz 20 MHz	6.5 M	36	5180.0	12.82
		40	5200.0	13.32
		44	5220.0	13.66
		48	5240.0	**13.68**
		52	5260.0	**13.74**
		56	5280.0	13.35
		60	5300.0	13.51
		64	5320.0	13.26
		100	5500.0	12.26
		104	5520.0	12.32
		108	5540.0	12.29
		112	5560.0	12.23
		116	5580.0	12.47
		132	5660.0	12.50
		136	5680.0	12.65
		140	5700.0	**13.06**
		149	5745.0	11.41
		153	5765.0	**11.42**
		157	5785.0	11.33
		161	5805.0	11.05
		165	5825.0	10.41
IEEE 802.11n 5 GHz 40 MHz	13.5 M	38	5190.0	12.38
		46	5230.0	**12.81**
		54	5270.0	**12.83**
		62	5310.0	12.76
		102	5510.0	10.20
		110	5550.0	10.19
		134	5670.0	**11.99**
		151	5755.0	10.22
		159	5795.0	**10.38**

Band	CH	Frequency (MHz)	Packet Type	Average Power (dBm)
Bluetooth BR GFSK	0	2402.0	DH1	5.09
			DH3	5.10
			DH5	5.14
	39	2441.0	DH1	5.05
			DH3	5.06
			DH5	5.08
	78	2480.0	DH1	5.52
			DH3	5.53
			DH5	**5.55**
Bluetooth EDR π/4-DQPSK	0	2402.0	2DH1	3.23
			2DH3	3.24
			2DH5	3.28
	39	2441.0	2DH1	3.20
			2DH3	3.20
			2DH5	3.23
	78	2480.0	2DH1	3.65
			2DH3	3.65
			2DH5	**3.67**
Bluetooth EDR 8DPSK	0	2402.0	3DH1	3.23
			3DH3	3.25
			3DH5	3.28
	39	2441.0	3DH1	3.20
			3DH3	3.20
			3DH5	3.23
	78	2480.0	3DH1	3.65
			3DH3	3.66
			3DH5	**3.68**
Bluetooth LE	0	2402.0	---	0.84
	19	2440.0		0.86
	39	2480.0		**0.97**

6.9 Antenna location

Ant	Antenna to user distance (mm)				
	Back	Side 1	Side 2	Side 3	Side 4
WWAN ANT	5	28	202.5	95	20
WLAN ANT	5	126.5	200	22	32
Bluetooth ANT	5	126.5	200	22	32

Note：We use a minimum distance of 5 mm for back side.

Antenna location



6.10 Standalone SAR Test Exclusion Calculation

Ant. Used	Band	Frequency	Tune-Power		Distance of Ant. To User (mm)				
		(GHz)	(dBm)	(mW)	Back	Side 1	Side 2	Side 3	Side 4
WWAN Antenna	WCDMA Band II	1.907	20.5	112	5	28	202.5	95	20
	WCDMA Band V	0.846	24.0	251	5	28	202.5	95	20
	LTE Band 2	1.909	21.4	138	5	28	202.5	95	20
	LTE Band 4	1.754	24.5	282	5	28	202.5	95	20
	LTE Band 5	0.848	24.5	282	5	28	202.5	95	20
	LTE Band 12	0.715	24.0	251	5	28	202.5	95	20
Bluetooth Antenna	BT	2.480	7.0	5	5	126.5	200	22	32
WLAN Antenna	WLAN 2.4 GHz	2.462	13.5	22	5	126.5	200	22	32
	WLAN 5 GHz	5.825	14.0	25	5	126.5	200	22	32

Ant. Used	Band	Frequency	Tune-Power		Calculated value and evaluated result					
		(GHz)	(dBm)	(mW)	Back	Side1	Side2	Side3	Side4	exclusion threshold
WWAN Antenna	WCDMA Band II	1.907	20.5	112	30.9	5.5	1634.0	559.0	7.7	3
					MEASURE	MEASURE	EXEMPT	EXEMPT	MEASURE	
	WCDMA Band V	0.846	24.0	251	46.2	8.3	1023.2mW	416.9mW	11.5	3
					MEASURE	MEASURE	EXEMPT	EXEMPT	MEASURE	
	LTE Band 2	1.909	21.4	138	38.1	6.8	1634.0	559.0	9.5	3
					MEASURE	MEASURE	EXEMPT	EXEMPT	MEASURE	
	LTE Band 4	1.754	24.5	282	74.7	13.3	1638.0	563.0	18.7	3
					MEASURE	MEASURE	EXEMPT	EXEMPT	MEASURE	
	LTE Band 5	0.848	24.5	282	51.9	9.3	1025mW	417.3mW	13.0	3
					MEASURE	MEASURE	EXEMPT	EXEMPT	MEASURE	
	LTE Band 12	0.715	24.0	251	42.5	7.6	904.3mW	391.9mW	10.6	3
					MEASURE	MEASURE	EXEMPT	EXEMPT	MEASURE	
Bluetooth Antenna	BT	2.480	7.0	5	1.6	860.0	1595.0	0.4	0.3	3
					EXEMPT	EXEMPT	EXEMPT	EXEMPT	EXEMPT	
WLAN Antenna	WLAN 2.4 GHz	2.462	13.5	22	6.9	861.0	1596.0	1.6	1.1	3
					MEASURE	EXEMPT	EXEMPT	EXEMPT	EXEMPT	
	WLAN 5 GHz	5.825	14.0	25	12.1	827.0	1562.0	2.7	1.9	3
					MEASURE	EXEMPT	EXEMPT	EXEMPT	EXEMPT	

Note:

1. The test reduction for distance less than 50 mm and more than 50 mm. Use the max power to make sure minimum distance by evaluated for SAR testing.
2. For 100 MHz to 6 GHz and test separation distances > 50 mm, According to KDB 447498, if the calculated Power threshold is less than the output power then SAR testing is required. Calculated Value include string "mW",that is meam through compare output power with threshold, if the output power more than threshold value the SAR test should be perform. Otherwise, the SAR test could be exempt. (> 50mm).
3. For 100 MHz to 6 GHz and test separation distances ≤ 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following:
   According to KDB 447498, if the calculated threshold value are >3 then Body SAR and >7.5 then Limbs SAR testing are required. Calculated Value only inculde number format, that is mean through compare output power with threshold, if the Calculated value more than 3, the SAR test should be perform. Otherwise, the SAR test could be exempt. (<50 mm).
4. When an antenna qualifies for the standalone SAR test exclusion of KDB 447498 section 4.3.1 and also transmits simultaneously with other antennas, the standalone SAR value must be estimated according to KDB 447498 section "4.3.2. Simultaneous transmission SAR test exclusion considerations b)".
5. We used highest frequency and power, that result should be evaluated the worst case.
6. Power and distance are rounded to the nearest mW and mm before calculation.
7. The result is rounded to one decimal place for comparison.

6.11 Simultaneous Transmitting Evaluate

Simultaneous transmission configurations as below:

Condition	Frequency Band			
	WWAN ANT	WLAN 2.4 GHz ANT	WLAN 5 GHz ANT	Bluetooth ANT
1	V	V	V	V

Estimated SAR

Ant. Used	Band	Frequency	Tune-Power		Estimated SAR 1-g (W/kg)				
		(GHz)	(dBm)	(mW)	Back	Side1	Side2	Side3	Side4
WWAN Antenna	WCDMA Band II	1.907	20.5	112	---	---	0.4	0.4	---
	WCDMA Band V	0.846	24.0	251	---	---	0.4	0.4	---
	LTE Band 2	1.909	21.4	138	---	---	0.4	0.4	---
	LTE Band 4	1.754	24.5	282	---	---	0.4	0.4	---
	LTE Band 5	0.848	24.5	282	---	---	0.4	0.4	---
	LTE Band 12	0.715	24.0	251	---	---	0.4	0.4	---
Bluetooth Antenna	BT	2.480	7.0	5	0.21	0.4	0.4	0.05	0.03
WLAN Antenna	WLAN 2.4 GHz	2.462	13.5	22	---	0.4	0.4	0.21	0.14
	WLAN 5 GHz	5.825	14.0	25	---	0.4	0.4	0.37	0.25

6.11.1 Sum of 1-g SAR of all simultaneously transmitting

When the sum of 1-g SAR of all simultaneously transmitting antennas in and operating mode and exposure condition combination is within the SAR limit, SAR test exclusion applies to that simultaneous transmission configuration.

Sum of 1-g SAR of summary as below:

Phantom Position		Spacing (mm)	ASSY	WWAN ANT (1)		WLAN 2.4 GHz ANT (2)		(1)+(2) ∑ SAR_{1g} (W/Kg)	Event
				Band	SAR_{1g} (W/Kg)	Band	SAR_{1g} (W/Kg)		
Flat	Back	0	N/A	LTE Band	0.94	IEEE 802.11	0.14	1.08	<1.6
	Side 1	0	N/A	LTE Band	0.29	IEEE 802.11	0.4	0.69	<1.6
	Side 2	0	N/A	LTE Band	0.08	IEEE 802.11	0.4	0.48	<1.6
	Side 3	0	N/A	LTE Band	0.07	IEEE 802.11	0.21	0.28	<1.6
	Side 4	0	N/A	LTE Band	1.06	IEEE 802.11	0.14	1.20	<1.6

Phantom Position		Spacing (mm)	ASSY	WWAN ANT (1)		WLAN 5 GHz ANT (3)		(1)+(3) ∑ SAR_{1g} (W/Kg)	Event
				Band	SAR_{1g} (W/Kg)	Band	SAR_{1g} (W/Kg)		
Flat	Back	0	N/A	LTE Band	0.94	IEEE 802.11	0.21	1.15	<1.6
	Side 1	0	N/A	LTE Band	0.29	IEEE 802.11	**0.4	0.69	<1.6
	Side 2	0	N/A	LTE Band	0.08	IEEE 802.11	**0.4	0.48	<1.6
	Side 3	0	N/A	LTE Band	0.07	IEEE 802.11	*0.37	0.44	<1.6
	Side 4	0	N/A	LTE Band	1.06	IEEE 802.11	*0.25	1.31	<1.6

Phantom Position		Spacing (mm)	ASSY	WWAN ANT (1)		Bluetooth ANT (4)		(1)+(4) ∑ SAR_{1g} (W/Kg)	Event
				Band	SAR_{1g} (W/Kg)	Band	SAR_{1g} (W/Kg)		
Flat	Back	0	N/A	LTE Band	0.94	Bluetooth	0.06	1.00	<1.6
	Side 1	0	N/A	LTE Band	0.29	Bluetooth	**0.4	0.69	<1.6
	Side 2	0	N/A	LTE Band	0.08	Bluetooth	**0.4	0.48	<1.6
	Side 3	0	N/A	LTE Band	0.07	Bluetooth	*0.05	0.12	<1.6
	Side 4	0	N/A	LTE Band	1.06	Bluetooth	*0.03	1.09	<1.6

Phantom Position		Spacing (mm)	ASSY	WLAN 2.4 GHz ANT (2)		WLAN 5 GHz ANT (3)		(2)+(3) ∑ SAR_{1g} (W/Kg)	Event
				Band	SAR_{1g} (W/Kg)	Band	SAR_{1g} (W/Kg)		
Flat	Back	0	N/A	IEEE 802.11	0.14	IEEE 802.11	0.21	0.35	<1.6
	Side 1	0	N/A	IEEE 802.11	**0.4	IEEE 802.11	**0.4	0.80	<1.6
	Side 2	0	N/A	IEEE 802.11	**0.4	IEEE 802.11	**0.4	0.80	<1.6
	Side 3	0	N/A	IEEE 802.11	*0.21	IEEE 802.11	*0.37	0.58	<1.6
	Side 4	0	N/A	IEEE 802.11	*0.14	IEEE 802.11	*0.25	0.39	<1.6

Phantom Position		Spacing (mm)	ASSY	WLAN 2.4 GHz ANT (2)		Bluetooth ANT (4)		(2)+(4) ∑ SAR_{1g} (W/Kg)	Event
				Band	SAR_{1g} (W/Kg)	Band	SAR_{1g} (W/Kg)		
Flat	Back	0	N/A	IEEE 802.11	0.14	Bluetooth	0.06	0.20	<1.6
	Side 1	0	N/A	IEEE 802.11	**0.4	Bluetooth	**0.4	0.80	<1.6
	Side 2	0	N/A	IEEE 802.11	**0.4	Bluetooth	**0.4	0.80	<1.6
	Side 3	0	N/A	IEEE 802.11	*0.21	Bluetooth	*0.05	0.26	<1.6
	Side 4	0	N/A	IEEE 802.11	*0.14	Bluetooth	*0.03	0.17	<1.6

Phantom Position		Spacing (mm)	ASSY	WLAN 5 GHz ANT (3)		Bluetooth ANT (4)		(3)+(4) ∑ SAR_{1g} (W/Kg)	Event
				Band	SAR_{1g} (W/Kg)	Band	SAR_{1g} (W/Kg)		
Flat	Back	0	N/A	IEEE 802.11	0.21	Bluetooth	0.06	0.27	<1.6
	Side 1	0	N/A	IEEE 802.11	**0.4	Bluetooth	**0.4	0.80	<1.6
	Side 2	0	N/A	IEEE 802.11	**0.4	Bluetooth	**0.4	0.80	<1.6
	Side 3	0	N/A	IEEE 802.11	*0.37	Bluetooth	*0.05	0.42	<1.6
	Side 4	0	N/A	IEEE 802.11	*0.25	Bluetooth	*0.03	0.28	<1.6

Note:
1. *=Estimated SAR.
2. **The Estimated SAR 0.4 W/Kg, test separation distances is > 50 mm.
3. When the sum of 1-g SAR of all simultaneously transmitting antennas in and operating mode and exposure condition combination is within the SAR limit, SAR test exclusion applies to that simultaneous transmission configuration.

6.11.2 SAR to peak location separation ratio (SPLSR)

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.

All of sum of SAR < 1.6 W/kg, therefore SPLSR is not required.

6.12 SAR test reduction according to KDB

General:

- The test data reported are the worst-case SAR value with the position set in a typical configuration. Test procedures used were according to FCC, Supplement C [June 2001], IEEE1528-2013.
- All modes of operation were investigated, and worst-case results are reported.
- Tissue parameters and temperatures are listed on the SAR plots.
- Batteries are fully charged for all readings.
- When the Channel's SAR 1 g of maximum conducted power is > 0.8 mW/g, low, middle and high channel are supposed to be tested.

KDB 447498:

- The test data reported are the worst-case SAR value with the position set in a typical configuration. Test procedures used were according to IEEE1528-2013.

KDB 865664:

- Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg.
- When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.
- 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.
- 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.

KDB 941225:

- When HSDPA & (HSUPA / HSPA+ uplink with QPSK) power are not more than WCDMA 12.2K RMC 0.25 dB and the SAR value of WCDMA BII/BV<1.2 W/kg ,therefore HSDPA & HSUPA / HSPA+ Stand-alone SAR is not required.
- SAR for EVDO Rev. A is not required when the maximum average output of each RF channels is less than that measured in Subtype 0/1 Physical layer configurations.
- For 1xRTT SAR is not required when the maximum average output of each channel is less than 1/4 dB higher than that measured in EVDO Rev.0.
- 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.
- 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 5.2.1 and 5.2.2 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.
- SAR is required only when the highest maximum output power for the configuration in the higher order modulation is > ½ dB higher than the same configuration in QPSK or when the reported SAR for the QPSK configuration is > 1.45 W/kg.
- For smaller channel bandwidth SAR when the highest maximum output power of a configuration requiring testing in the smaller channel bandwidth is > ½ dB higher than the equivalent channel configurations in the largest channel bandwidth configuration or the reported SAR of a configuration for the largest channel bandwidth is > 1.45 W/kg.

KDB 248227:

- Refer 6.7 SAR Testing with 802.11 Transmitters.

7. *System Verification and Validation*

7.1 Symmetric Dipoles for System Verification

Construction	Symmetrical dipole with l/4 balun enables measurement of feed point impedance with NWA matched for use near flat phantoms filled with head simulating solutions Includes distance holder and tripod adaptor Calibration Calibrated SAR value for specified position and input power at the flat phantom in head simulating solutions.
Return Loss	> 20 dB at specified verification position
Options	Dipoles for other frequencies or solutions and other calibration conditions are available upon request

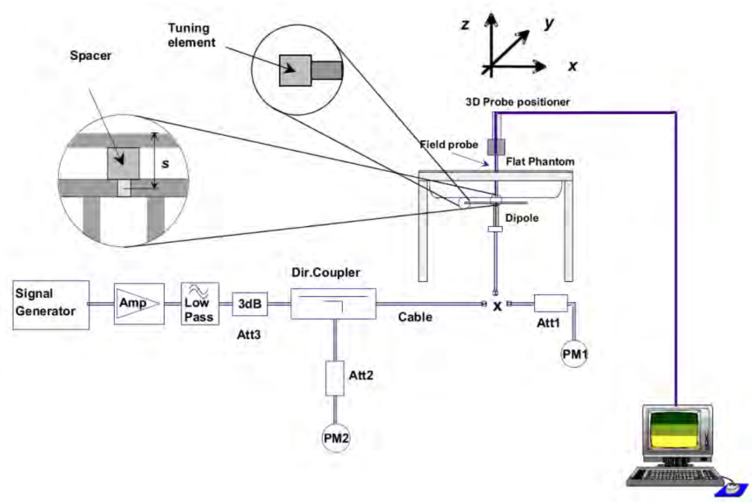


Figure 7. System Verification Setup Diagram

Figure 8. Validation Kit

7.2 Verification Summary

Prior to the assessment, the system validation kit was used to test whether the system was operating within its specifications of ± 10 %. The measured SAR will be normalized to 1 W input power. The verification was performed at 750, 835, 1750, 1900, 2450, 5200, 5500 and 5800 MHz.

Mixture Type	Frequency (MHz)	Power	Probe Model / Serial No.	Dipole Model / Serial No.	$SAR_{1\,g}$ (W/Kg)	$SAR_{10\,g}$ (W/Kg)	1 W Target $SAR_{1\,g}$ [W/kg]	1 W Target $SAR_{10\,g}$ [W/kg]	Difference percentage 1 g	Difference percentage 10 g	Date
Body	750	250 mW	EX3DV4-SN3578	D750V3-SN1004	2.38	1.61	8.80	5.97	7.6 %	7.3 %	May 08, 2019
		Normalize to 1 Watt			9.52	6.44					
Body	835	250 mW	EX3DV4-SN3578	D835V2-SN4d082	2.42	1.59	9.66	6.50	0.2 %	-2.2 %	May 08, 2019
		Normalize to 1 Watt			9.68	6.36					
Body	1750	250 mW	EX3DV4-SN3578	D1750V2-SN1023	9.39	4.85	36.80	19.70	2.0 %	-1.5 %	May 07, 2019
		Normalize to 1 Watt			37.56	19.40					
Body	1900	250 mW	EX3DV4-SN3578	D1900V2-SN5d111	10.5	5.42	40.40	21.80	3.8 %	-0.6 %	May 07, 2019
		Normalize to 1 Watt			42.00	21.68					
Body	2450	250 mW	EX3DV4-SN3578	D2450V2-SN735	13.2	5.8	50.20	23.70	4.9 %	-2.2 %	May 09, 2019
		Normalize to 1 Watt			52.80	23.20					
Body	5200	100 mW	EX3DV4-SN3578	D5200V2-SN1021	7.71	2.08	74.80	20.90	3.0 %	-0.5 %	May 09, 2019
		Normalize to 1 Watt			77.10	20.80					
Body	5500	100 mW	EX3DV4-SN3578	D5500V2-SN1021	8.49	2.3	81.50	22.60	4.0 %	1.7 %	May 09, 2019
		Normalize to 1 Watt			84.90	23.00					
Body	5800	100 mW	EX3DV4-SN3578	D5800V2-SN1021	8.46	2.26	77.70	21.60	8.2 %	4.4 %	May 09, 2019
		Normalize to 1 Watt			84.60	22.60					

8. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Cal. Date	Cal.Period
SPEAG	750 MHz System Validation Kit	D750V3	1004	09/05/2018	1 year
SPEAG	835 MHz System Validation Kit	D835V2	4d082	09/06/2018	1 year
SPEAG	1800 MHz System Validation Kit	D1750V2	1023	06/11/2018	1 year
SPEAG	1900 MHz System Validation Kit	D1900V2	5d111	09/11/2018	1 year
SPEAG	2450 MHz System Validation Kit	D2450V2	735	12/11/2018	1 year
SPEAG	5 GHz System Validation Kit	D5GHzV2	1021	04/19/2019	1 year
SPEAG	Dosimetric E-Field Probe	EX3DV4	3578	05/29/2018	1 year
SPEAG	Data Acquisition Electronics	DAE4	541	03/19/2019	1 year
SPEAG	Measurement Server	SE UMS 011 AA	1025	NCR	
SPEAG	Device Holder	N/A	N/A	NCR	
SPEAG	Phantom	ELI V4.0	1036	NCR	
SPEAG	Robot	Staubli TX90XL	F16/54FTA1/A/01	NCR	
SPEAG	Software	DASY52 V52.10 (2)	N/A	NCR	
SPEAG	Software	SEMCAD X V14.6.12 (7450)	N/A	NCR	
R&S	Wireless Communication Test Set	CMU200	112387	12/03/2018	1 year
Anritsu	Radio Communication Analyzer	MT8820C	6201342039	12/13/2018	1 year
Agilent	ENA Series Network Analyzer	E5071B	MY42404655	04/17/2019	1 year
Agilent	Dielectric Probe Kit	85070C	US99360094	NCR	
HILA	Digital Thermometer	TM-906	GF-006	05/22/2018	1 year
Agilent	Power Sensor	8481H	3318A20779	06/12/2018	1 year
Agilent	Power Meter	EDM Series E4418B	GB40206143	06/12/2018	1 year
Agilent	Signal Generator	E8257D	MY44320425	03/05/2019	1 year
Agilent	Dual Directional Coupler	778D	50334	NCR	
Woken	Dual Directional Coupler	0100AZ20200801O	11012409517	NCR	
Mini-Circuits	Power Amplifier	EMC014225P	980292	NCR	
Mini-Circuits	Power Amplifier	EMC2830P	980293	NCR	
Aisi	Attenuator	IEAT 3dB	N/A	NCR	

Table 3. Test Equipment List

9. Measurement Uncertainty

Item	Uncertainty Component	Uncertainty Value	Prob. Dist	Div.	c_i (1 g)	c_i (10 g)	Std. Unc. (1-g)	Std. Unc. (10-g)	v_i or V_{eff}
Measurement System									
u1	Probe Calibration (*k*=1)	±6.0 %	Normal	1	1	1	±6.0 %	±6.0 %	∞
u2	Axial Isotropy	±4.7 %	Rectangular	$\sqrt{3}$	0.7	0.7	±1.9 %	±1.9 %	∞
u3	Hemispherical Isotropy	±9.6 %	Rectangular	$\sqrt{3}$	0.7	0.7	±3.9 %	±3.9 %	
u4	Boundary Effect	±1.0 %	Rectangular	$\sqrt{3}$	1	1	±0.6 %	±0.6 %	∞
u5	Linearity	±4.7 %	Rectangular	$\sqrt{3}$	1	1	±2.7 %	±2.7 %	∞
u6	System Detection Limit	±1.0 %	Rectangular	$\sqrt{3}$	1	1	±0.6 %	±0.6 %	∞
u7	Readout Electronics	±0.3 %	Normal	1	1	1	±0.3 %	±0.3 %	∞
u8	Response Time	±0.8 %	Rectangular	$\sqrt{3}$	1	1	±0.5 %	±0.5 %	∞
u9	Integration Time	±1.9 %	Rectangular	$\sqrt{3}$	1	1	±1.1 %	±1.1 %	∞
u10	RF Ambient Conditions	±3.0 %	Rectangular	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
u11	RF Ambient Reflections	±3.0 %	Rectangular	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
u12	Probe Positioner Mechanical Tolerance	±0.4 %	Rectangular	$\sqrt{3}$	1	1	±0.2 %	±0.2 %	∞
u13	Probe Positioning with respect to Phantom Shell	±2.9 %	Rectangular	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
u14	Extrapolation, interpolation and integration Algorithms for Max. SAR Evaluation	±1.0 %	Rectangular	$\sqrt{3}$	1	1	±0.6 %	±0.6 %	∞
Test sample Related									
u15	Test sample Positioning	±2.9 %	Normal	1	1	1	±2.9 %	±2.9 %	89
u16	Device Holder Uncertainty	±3.6 %	Normal	1	1	1	±3.6 %	±3.6 %	5
u17	Output Power Variation - SAR drift measurement	±5.0 %	Rectangular	$\sqrt{3}$	1	1	±2.9 %	±2.9 %	∞
Phantom and Tissue Parameters									
u18	Phantom Uncertainty (shape and thickness tolerances)	±4.0 %	Rectangular	$\sqrt{3}$	1	1	±2.3 %	±2.3 %	∞
u19	Liquid Conductivity - deviation from target values	±5.0 %	Rectangular	$\sqrt{3}$	0.64	0.43	±1.8 %	±1.2 %	∞
u20	Liquid Conductivity - measurement uncertainty	±2.5 %	Normal	1	0.64	0.43	±1.6 %	±1.08 %	69
u21	Liquid Permittivity - deviation from target values	±5.0 %	Rectangular	$\sqrt{3}$	0.6	0.49	±1.7 %	±1.4 %	∞
u22	Liquid Permittivity - measurement uncertainty	±2.5 %	Normal	1	0.6	0.49	±1.5 %	±1.23 %	69
Combined standard uncertainty			RSS				±10.94 %	±10.71 %	380
Expanded uncertainty (95 % CONFIDENCE LEVEL)			*k*=2				±21.88 %	±21.41 %	

Table 4. Uncertainty Budget for frequency range 300 MHz to 3 GHz

Item	Uncertainty Component	Uncertainty Value	Prob. Dist	Div.	c_i (1 g)	c_i (10 g)	Std. Unc. (1-g)	Std. Unc. (10-g)	v_i or V_{eff}
Measurement System									
u1	Probe Calibration (k=1)	±6.5 %	Normal	1	1	1	±6.5 %	±6.5 %	∞
u2	Axial Isotropy	±4.7 %	Rectangular	$\sqrt{3}$	0.7	0.7	±1.9 %	±1.9 %	∞
u3	Hemispherical Isotropy	±9.6 %	Rectangular	$\sqrt{3}$	0.7	0.7	±3.9 %	±3.9 %	
u4	Boundary Effect	±2.0 %	Rectangular	$\sqrt{3}$	1	1	±1.2 %	±1.2 %	∞
u5	Linearity	±4.7 %	Rectangular	$\sqrt{3}$	1	1	±2.7 %	±2.7 %	∞
u6	System Detection Limit	±1.0 %	Rectangular	$\sqrt{3}$	1	1	±0.6 %	±0.6 %	∞
u7	Readout Electronics	±0.0 %	Normal	1	1	1	±0.0 %	±0.0 %	∞
u8	Response Time	±0.8 %	Rectangular	$\sqrt{3}$	1	1	±0.5 %	±0.5 %	∞
u9	Integration Time	±2.8 %	Rectangular	$\sqrt{3}$	1	1	±2.8 %	±2.8 %	∞
u10	RF Ambient Conditions	±3.0 %	Rectangular	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
u11	RF Ambient Reflections	±3.0 %	Rectangular	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
u12	Probe Positioner Mechanical Tolerance	±0.7 %	Rectangular	$\sqrt{3}$	1	1	±0.7 %	±0.7 %	∞
u13	Probe Positioning with respect to Phantom Shell	±9.9 %	Rectangular	$\sqrt{3}$	1	1	±5.7 %	±5.7 %	∞
u14	Extrapolation, interpolation and integration Algorithms for Max. SAR Evaluation	±3.0 %	Rectangular	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
Test sample Related									
u15	Test sample Positioning	±2.9 %	Normal	1	1	1	±2.9 %	±2.9 %	89
u16	Device Holder Uncertainty	±3.6 %	Normal	1	1	1	±3.6 %	±3.6 %	5
u17	Output Power Variation - SAR drift measurement	±5.0 %	Rectangular	$\sqrt{3}$	1	1	±2.9 %	±2.9 %	∞
Phantom and Tissue Parameters									
u18	Phantom Uncertainty (shape and thickness tolerances)	±4.0 %	Rectangular	$\sqrt{3}$	1	1	±2.3 %	±2.3 %	∞
u19	Liquid Conductivity - deviation from target values	±5.0 %	Rectangular	$\sqrt{3}$	0.64	0.43	±1.8 %	±1.2 %	∞
u20	Liquid Conductivity - measurement uncertainty	±2.5 %	Normal	1	0.64	0.43	±1.6 %	±1.08 %	69
u21	Liquid Permittivity - deviation from target values	±5.0 %	Rectangular	$\sqrt{3}$	0.6	0.49	±1.7 %	±1.4 %	∞
u22	Liquid Permittivity - measurement uncertainty	±2.5 %	Normal	1	0.6	0.49	±1.5 %	±1.23 %	69
Combined standard uncertainty			RSS				±12.68 %	±12.48 %	700
Expanded uncertainty (95 % CONFIDENCE LEVEL)			k=2				±25.37 %	±24.97 %	

Table 5. Uncertainty Budget for frequency range 3 GHz to 6 GHz

10. Measurement Procedure

The measurement procedures are as follows:

1. For WLAN function, engineering testing software installed on DUTs can provide continuous transmitting signal.
2. Measure output power through RF cable and power meter
3. Set scan area, grid size and other setting on the DASY software
4. Find out the largest SAR result on these testing positions of each band
5. Measure SAR results for other channels in worst SAR testing position if the SAR of highest power channel is larger than 0.8 W/kg

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

1. Power reference measurement
2. Area scan
3. Zoom scan
4. Power drift measurement

10.1 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1 g and 10 g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1 g and 10 g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1 g and 10 g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages

1. Extraction of the measured data (grid and values) from the Zoom Scan
2. Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
3. Generation of a high-resolution mesh within the measured volume
4. Interpolation of all measured values form the measurement grid to the high-resolution grid
5. Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
6. Calculation of the averaged SAR within masses of 1 g and 10 g

10.2 Area & Zoom Scan Procedures

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan measures points and step size follow as below. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g.

Grid Type	Frequency		Step size (mm)			X*Y*Z (Point)	Cube size			Step size		
			X	Y	Z		X	Y	Z	X	Y	Z
uniform grid	≦ 3 GHz	≦2 GHz	≤ 8	≤ 8	≤ 5	5*5*7	32	32	30	8	8	5
		2 G - 3 G	≤ 5	≤ 5	≤ 5	7*7*7	30	30	30	5	5	5
	3 - 6 GHz	3 - 4 GHz	≤ 5	≤ 5	≤ 4	7*7*8	30	30	28	5	5	4
		4 - 5 GHz	≤ 4	≤ 4	≤ 3	8*8*10	28	28	27	4	4	3
		5 - 6 GHz	≤ 4	≤ 4	≤ 2	8*8*12	28	28	22	4	4	2

(Our measure settings are refer KDB Publication 865664 D01v01r04)

10.3 Volume Scan Procedures

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1 g aggregate SAR, the DUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

10.4 SAR Averaged Methods

In DASY, the interpolation and extrapolation are both based on the modified Quadratic Shepard's method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation. Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5 mm.

10.5 Power Drift Monitoring

All SAR testing is under the DUT install full charged battery and transmit maximum output power. In DASY measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of DUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drift more than 5 %, the SAR will be retested.

11. SAR Test Results Summary

1. Based on the IEEE1528 and IEC 62209 requirements, the low, mid and high frequency channels for the configuration with the highest SAR value must be tested regardless of the SAR value measured.
2. 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 for RB offsets at the upper edge, middle and lower edge of each required test channel.
3. When the highest reported SAR for 1 RB and 50 % RB allocation are > 0.8 W/kg, SAR is measured for the highest output power channel in 100 % RB.
4. The procedures required for 1 RB allocation are applied to measure the SAR for QPSK with 50 % RB allocation.
5. When a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing; therefore, the requirement for H, M, and L channels may not fully apply.
6. When the maximum output power and tune-up tolerance specified for production units in a secondary mode is ≤ ¼ dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for the secondary mode.
7. The 3G SAR test reduction procedure is applied to HSPA (HSUPA/HSDPA with RMC) configurations with 12.2 kbps RMC as the primary mode.
8. When the reported SAR of the highest measured maximum output power channel is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS.
9. The initial test configuration for OFDM transmission modes is determined by the 802.11 configuration with the highest maximum output power specified for production units, including tune-up tolerance, in each standalone and aggregated frequency band.
10. SAR for the initial test configuration is measured using the highest maximum output power channel.
11. When different maximum output power is specified for the band1&band2A, begin SAR measurement in the band with higher specified maximum output power.The highest reported SAR for the tested configuration is adjusted by the ratio of lower to higher specified maximum output power for the two bands.When the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for the band with lower maximum output power in that test configuration; otherwise, each band is tested independently for SAR.
12. When the highest reported SAR for the initial test configuration, according to the initial test position or fixed exposure position requirements, is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for that subsequent test configuration.
13. Model MLP9073102 is the battery 2 which using in test mode.

11.1 Body SAR Measurement

Index.	Band	Frequency		Modulation or Sub-Test	Test Position	Spacing (mm)	EUT & Accessory	SAR_{1g} (W/kg)	Burst Avg Power	Max tune-up	Duty Cycle (%)	Reported SAR_{1g} (W/kg)
		Ch.	MHz									
#1	WCDMA Band II	9400	1880.0	RMC12.2K	Back	0	---	0.707	20.49	20.5	100	0.71
#2	WCDMA Band II	9400	1880.0	RMC12.2K	Side 1	0	---	0.210	20.49	20.5	100	0.21
#3	WCDMA Band II	9400	1880.0	RMC12.2K	Side 4	0	---	0.906	20.49	20.5	100	0.91
#6	WCDMA Band II	9400	1880.0	RMC12.2K	Side 4	0	Battery 2	0.879	20.49	20.5	100	0.88
#4	WCDMA Band II	9262	1852.4	RMC12.2K	Side 4	0	---	0.830	20.37	20.5	100	0.86
#5	WCDMA Band II	9538	1907.6	RMC12.2K	Side 4	0	---	0.814	20.46	20.5	100	0.82
#33	WCDMA Band V	4233	846.6	RMC12.2K	Back	0	---	0.489	23.48	24.0	100	0.55
#34	WCDMA Band V	4132	826.4	RMC12.2K	Back	0	---	0.477	23.32	24.0	100	0.56
#40	WCDMA Band V	4132	826.4	RMC12.2K	Back	0	Battery 2	0.463	23.32	24.0	100	0.54
#35	WCDMA Band V	4183	836.6	RMC12.2K	Back	0	---	0.480	23.44	24.0	100	0.55
#36	WCDMA Band V	4233	846.6	RMC12.2K	Side 1	0	---	0.244	23.48	24.0	100	0.28
#37	WCDMA Band V	4233	846.6	RMC12.2K	Side 2	0	---	0.053	23.48	24.0	100	0.06
#38	WCDMA Band V	4233	846.6	RMC12.2K	Side 3	0	---	0.036	23.48	24.0	100	0.04
#39	WCDMA Band V	4233	846.6	RMC12.2K	Side 4	0	---	0.297	23.48	24.0	100	0.34

Index.	Band	Frequency		Bandwidth	RB Size	RB Offset	Test Position	Spacing (mm)	EUT & Accessory	SAR_{1g} (W/kg)	Burst Avg Power	Max tune-up	Duty Cycle (%)	Reported SAR_{1g} (W/kg)
		Ch.	MHz											
#7	LTE Band 2 (QPSK)	19100	1900.0	20 MHz	1	0	Back	0	---	0.748	20.85	21.0	100	0.77
#13	LTE Band 2 (QPSK)	18700	1860.0	20 MHz	1	0	Back	0	---	0.807	20.83	21.0	100	0.84
#14	LTE Band 2 (QPSK)	18900	1880.0	20 MHz	1	0	Back	0	---	0.832	20.81	21.0	100	0.87
#8	LTE Band 2 (QPSK)	19100	1900.0	20 MHz	50	0	Back	0	---	0.616	19.83	20.0	100	0.64
#15	LTE Band 2 (QPSK)	18900	1880.0	20 MHz	100	0	Back	0	---	0.582	19.80	20.0	100	0.61
#9	LTE Band 2 (QPSK)	19100	1900.0	20 MHz	1	0	Side 1	0	---	0.239	20.85	21.0	100	0.25
#10	LTE Band 2 (QPSK)	19100	1900.0	20 MHz	50	0	Side 1	0	---	0.193	19.83	20.0	100	0.20
#11	LTE Band 2 (QPSK)	19100	1900.0	20 MHz	1	0	Side 4	0	---	1.000	20.85	21.0	100	1.04
#16	LTE Band 2 (QPSK)	18700	1860.0	20 MHz	1	0	Side 4	0	---	0.914	20.83	21.0	100	0.95
#17	LTE Band 2 (QPSK)	18900	1880.0	20 MHz	1	0	Side 4	0	---	1.010	20.81	21.0	100	1.06
#21	LTE Band 2 (QPSK)	18900	1880.0	20 MHz	1	0	Side 4	0	Battery 2	0.985	20.81	21.0	100	1.03
#12	LTE Band 2 (QPSK)	19100	1900.0	20 MHz	50	0	Side 4	0	---	0.776	19.83	20.0	100	0.81
#18	LTE Band 2 (QPSK)	18700	1860.0	20 MHz	50	0	Side 4	0	---	0.729	19.71	20.0	100	0.78
#19	LTE Band 2 (QPSK)	18900	1880.0	20 MHz	50	50	Side 4	0	---	0.769	19.76	20.0	100	0.81
#20	LTE Band 2 (QPSK)	18900	1880.0	20 MHz	100	0	Side 4	0	---	0.784	19.80	20.0	100	0.82
#23	LTE Band 4 (QPSK)	20175	1732.5	20 MHz	1	0	Back	0	---	0.754	23.56	24.5	100	0.94
#24	LTE Band 4 (QPSK)	20175	1732.5	20 MHz	50	0	Back	0	---	0.629	22.37	23.5	100	0.82
#25	LTE Band 4 (QPSK)	20175	1732.5	20 MHz	100	0	Back	0	---	0.631	22.16	23.5	100	0.86
#26	LTE Band 4 (QPSK)	20175	1732.5	20 MHz	1	0	Side 1	0	---	0.235	23.56	24.5	100	0.29
#27	LTE Band 4 (QPSK)	20175	1732.5	20 MHz	50	0	Side 1	0	---	0.180	22.37	23.5	100	0.23
#28	LTE Band 4 (QPSK)	20175	1732.5	20 MHz	1	0	Side 4	0	---	0.755	23.56	24.5	100	0.94
#31	LTE Band 4 (QPSK)	20175	1732.5	20 MHz	1	0	Side 4	0	Battery 2	0.734	23.56	24.5	100	0.91
#29	LTE Band 4 (QPSK)	20175	1732.5	20 MHz	50	0	Side 4	0	---	0.615	22.37	23.5	100	0.80
#30	LTE Band 4 (QPSK)	20175	1732.5	20 MHz	100	0	Side 4	0	---	0.624	22.16	23.5	100	0.85

Index.	Band	Frequency		Bandwidth	RB Size	RB Offset	Test Position	Spacing (mm)	EUT & Accessory	SAR_{1g} (W/kg)	Burst Avg Power	Max tune-up	Duty Cycle (%)	Reported SAR_{1g} (W/kg)
		Ch.	MHz											
#42	LTE Band 5 (QPSK)	20525	836.5	10 MHz	1	0	Back	0	---	0.440	23.24	24.5	100	0.59
#52	LTE Band 5 (QPSK)	20525	836.5	10 MHz	1	0	Back	0	Battery 2	0.428	23.24	24.5	100	0.57
#43	LTE Band 5 (QPSK)	20525	836.5	10 MHz	25	0	Back	0	---	0.360	22.13	23.5	100	0.49
#44	LTE Band 5 (QPSK)	20525	836.5	10 MHz	1	0	Side 1	0	---	0.200	23.24	24.5	100	0.27
#45	LTE Band 5 (QPSK)	20525	836.5	10 MHz	25	0	Side 1	0	---	0.161	22.13	23.5	100	0.22
#46	LTE Band 5 (QPSK)	20525	836.5	10 MHz	1	0	Side 2	0	---	0.060	23.24	24.5	100	0.08
#47	LTE Band 5 (QPSK)	20525	836.5	10 MHz	25	0	Side 2	0	---	0.048	22.13	23.5	100	0.07
#48	LTE Band 5 (QPSK)	20525	836.5	10 MHz	1	0	Side 3	0	---	0.031	23.24	24.5	100	0.04
#49	LTE Band 5 (QPSK)	20525	836.5	10 MHz	25	0	Side 3	0	---	0.026	22.13	23.5	100	0.04
#50	LTE Band 5 (QPSK)	20525	836.5	10 MHz	1	0	Side 4	0	---	0.237	23.24	24.5	100	0.32
#51	LTE Band 5 (QPSK)	20525	836.5	10 MHz	25	0	Side 4	0	---	0.189	22.13	23.5	100	0.26
#54	LTE Band 12 (QPSK)	23095	707.5	10 MHz	1	24	Back	0	---	0.458	23.25	24.0	100	0.54
#64	LTE Band 12 (QPSK)	23095	707.5	10 MHz	1	24	Back	0	Battery 2	0.441	23.25	24.0	100	0.52
#55	LTE Band 12 (QPSK)	23095	707.5	10 MHz	25	0	Back	0	---	0.362	22.00	23.0	100	0.46
#56	LTE Band 12 (QPSK)	23095	707.5	10 MHz	1	24	Side 1	0	---	0.126	23.25	24.0	100	0.15
#57	LTE Band 12 (QPSK)	23095	707.5	10 MHz	25	0	Side 1	0	---	0.102	22.00	23.0	100	0.13
#58	LTE Band 12 (QPSK)	23095	707.5	10 MHz	1	24	Side 2	0	---	0.047	23.25	24.0	100	0.06
#59	LTE Band 12 (QPSK)	23095	707.5	10 MHz	25	0	Side 2	0	---	0.034	22.00	23.0	100	0.04
#60	LTE Band 12 (QPSK)	23095	707.5	10 MHz	1	24	Side 3	0	---	0.060	23.25	24.0	100	0.07
#61	LTE Band 12 (QPSK)	23095	707.5	10 MHz	25	0	Side 3	0	---	0.047	22.00	23.0	100	0.06
#62	LTE Band 12 (QPSK)	23095	707.5	10 MHz	1	24	Side 4	0	---	0.295	23.25	24.0	100	0.35
#63	LTE Band 12 (QPSK)	23095	707.5	10 MHz	25	0	Side 4	0	---	0.251	22.00	23.0	100	0.32

Index.	Band	Mode	Frequency		Data Rate	Test Position	Spacing (mm)	EUT & Accessory	SAR_{1g} (W/kg)	Burst Avg Power	Max tune-up	Duty Cycle %	Reported SAR_{1g} (W/kg)
			Ch.	MHz									
#66	WLAN 2.4 GHz	802.11b	6	2437.0	1 Mbps	Back	0	---	0.105	12.50	13.5	97.6	0.14
#67	WLAN 2.4 GHz	802.11b	1	2412.0	1 Mbps	Back	0	---	0.084	12.10	13.5	97.6	0.12
#69	WLAN 2.4 GHz	802.11b	1	2412.0	1 Mbps	Back	0	Battery 2	0.081	12.10	13.5	97.6	0.12
#68	WLAN 2.4 GHz	802.11b	11	2462.0	1 Mbps	Back	0	---	0.074	13.03	13.5	97.6	0.09
#72	Bluetooth	---	0	2402.0	1 Mbps	Back	0	---	0.031	5.14	7.0	76.5	0.05
#73	Bluetooth	---	39	2441.0	1 Mbps	Back	0	---	0.033	5.08	7.0	76.5	0.06
#74	Bluetooth	---	78	2480.0	1 Mbps	Back	0	---	0.034	5.55	7.0	76.5	0.05
#75	Bluetooth	---	78	2480.0	1 Mbps	Back	0	Battery 2	0.033	5.55	7.0	76.5	0.05
#77	WLAN 5 GHz	802.11n 20 MHz	60	5300.0	6.5 Mbps	Back	0	---	0.106	13.51	14.0	84.3	0.14
#78	WLAN 5 GHz	802.11n 20 MHz	52	5260.0	6.5 Mbps	Back	0	---	0.083	13.74	14.0	84.3	0.11
#79	WLAN 5 GHz	802.11n 20 MHz	56	5280.0	6.5 Mbps	Back	0	---	0.090	13.35	14.0	84.3	0.12
#80	WLAN 5 GHz	802.11n 20 MHz	64	5320.0	6.5 Mbps	Back	0	---	0.104	13.26	14.0	84.3	0.15
#81	WLAN 5 GHz	802.11n 20 MHz	64	5320.0	6.5 Mbps	Back	0	Battery 2	0.100	13.26	14.0	84.3	0.14
#83	WLAN 5 GHz	802.11n 20 MHz	116	5580.0	6.5 Mbps	Back	0	---	0.120	12.47	13.5	84.3	0.18
#84	WLAN 5 GHz	802.11n 20 MHz	100	5500.0	6.5 Mbps	Back	0	---	0.109	12.26	13.5	84.3	0.17
#86	WLAN 5 GHz	802.11n 20 MHz	132	5660.0	6.5 Mbps	Back	0	---	0.135	12.50	13.5	84.3	0.20
#88	WLAN 5 GHz	802.11n 20 MHz	132	5660.0	6.5 Mbps	Back	0	Battery 2	0.130	12.50	13.5	84.3	0.19
#87	WLAN 5 GHz	802.11n 20 MHz	140	5700.0	6.5 Mbps	Back	0	---	0.129	13.06	13.5	84.3	0.17
#90	WLAN 5 GHz	802.11a	165	5825.0	6 Mbps	Back	0	---	0.145	11.42	12.5	89.8	0.21
#93	WLAN 5 GHz	802.11a	165	5825.0	6 Mbps	Back	0	Battery 2	0.144	11.42	12.5	89.8	0.21
#91	WLAN 5 GHz	802.11a	149	5745.0	6 Mbps	Back	0	---	0.119	11.77	12.5	89.8	0.16
#92	WLAN 5 GHz	802.11a	157	5785.0	6 Mbps	Back	0	---	0.128	11.39	12.5	89.8	0.18

11.2 SAR Variability Measurement

Detailed evaluations please refer KDB 865664 on "SAR test reduction according to KDB" section.

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.The original highest measured Reported SAR 1g is ≥ 0.80 W/kg, repeat that measurement once.

2.Perform a second repeated measurement the ratio of largest to smallest SAR for the original and first repeated measurements is < 1.2,the original or repeated measurement is ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).

3.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.

Index.	Band	Frequency		Bandwidth	RB Size	RB Offset	Test Position	Spacing (mm)	EUT & Accessory	Note	Original SAR_{1g} (W/Kg)	First SAR_{1g} (W/Kg)	Ratio
		Ch.	MHz										
#22	LTE Band 2 (QPSK)	18900	1880.0	20 MHz	1	0	Side 4	0	---	original #17	1.010	1.000	1.01

11.3 Std. C95.1-1992 RF Exposure Limit

Human Exposure	Population Uncontrolled Exposure (W/kg) or (mW/g)	Occupational Controlled Exposure (W/kg) or (mW/g)
Spatial Peak SAR* (head)	1.60	8.00
Spatial Peak SAR** (Whole Body)	0.08	0.40
Spatial Peak SAR*** (Partial-Body)	1.60	8.00
Spatial Peak SAR**** (Hands / Feet / Ankle / Wrist)	4.00	20.00

Table 6. Safety Limits for Partial Body Exposure

Notes：

***** The Spatial Peak value of the SAR averaged over any 1 gram of tissue.
(defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

****** The Spatial Average value of the SAR averaged over the whole – body.

******* The Spatial Average value of the SAR averaged over the partial – body.

******** The Spatial Peak value of the SAR averaged over any 10 grams of tissue.
(defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

Population / Uncontrolled Environments **:** are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

Occupational / Controlled Environments **:** are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation).

12. References

[1] Std. C95.1-1999, "*American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 300KHz to 100GHz",* New York.

[2] NCRP, National Council on Radiation Protection and Measurements, "Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields", NCRP report NO. 86, 1986.

[3] T. Schmid, O. Egger, and N. Kuster, "Automatic E-field scanning system for dosimetric assessments", IEEE Transactions on Microwave Theory and Techniques, vol. 44, pp, 105-113, Jan. 1996.

[4] K. Pokovic, T. Schmid, and N. Kuster, "Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequency", in ICECOM'97, Dubrovnik, October 15-17, 1997, pp.120-124.

[5] K. Pokovic, T. Schmid, and N. Kuster, "E-field probe with improved isotropy in brain simulating liquids", in Proceedings of the ELMAR, Zadar, Croatia, 23-25 June, 1996, pp.172-175.

[6] N. Kuster, and Q. Balzano, "Energy absorption mechanism by biological bodies in the near field of dipole antennas above 300MHz", IEEE Transaction on Vehicular Technology, vol. 41, no. 1, Feb. 1992, pp. 17-23.

[7] Robert J. Renka, "Multivariate Interpolation Of Large Sets Of Scattered Data", University of North Texas ACM Transactions on Mathematical Software, vol. 14, no. 2, June 1988 , pp. 139-148.

[8] N. Kuster, R. Kastle, T. Schmid, Dosimetric evaluation of mobile communications equipment with known precision, IEEE Transaction on Communications, vol. E80-B, no. 5, May 1997, pp. 645-652.

[9] Std. C95.3-1991, "IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave, New York: IEEE, Aug. 1992.

[10] CENELEC CLC/SC111B, European Prestandard (prENV 50166-2), Human Exposure to Electromagnetic Fields High-frequency: 10KHz-300GHz, Jan. 1995.

[11] IEEE Std 1528™-2013 - IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head From Wireless Communications Devices: Measurement Techniques

Appendix A - System Performance Check

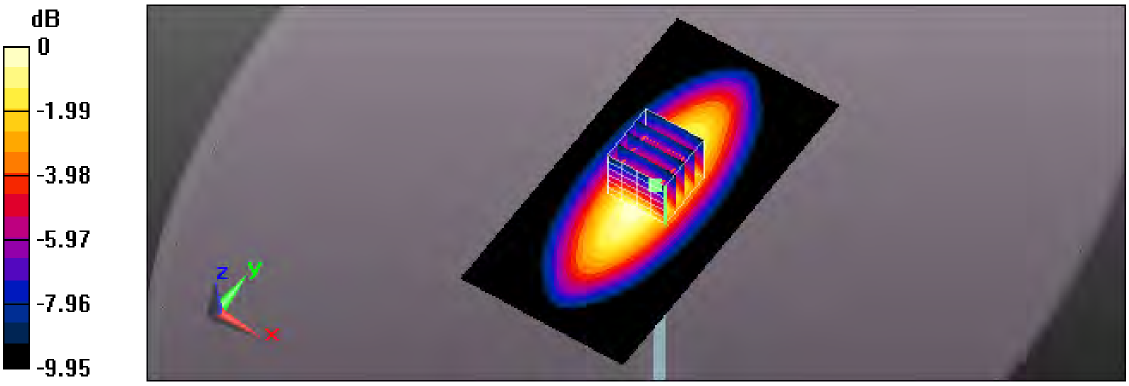
Test Laboratory: A Test Lab Techno Corp.
Date/Time: 2019/5/8
System Performance Check at 750MHz_20190508_Body
DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1004

Communication System: UID 0, CW (0); Frequency: 750 MHz;Duty Cycle: 1:1
Medium parameters used: f = 750 MHz; σ = 0.969 S/m; ε_r = 56.569; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5.2 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV4 - SN3578; ConvF(9.89, 9.89, 9.89); Calibrated: 2018/5/29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2019/3/19
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1036
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

System Performance Check at 750MHz/Area Scan (61x121x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 3.18 W/kg

System Performance Check at 750MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 59.16 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 3.60 W/kg
SAR(1 g) = 2.38 W/kg; SAR(10 g) = 1.61 W/kg
Maximum value of SAR (measured) = 3.16 W/kg



0 dB = 3.16 W/kg = 5.00 dBW/kg

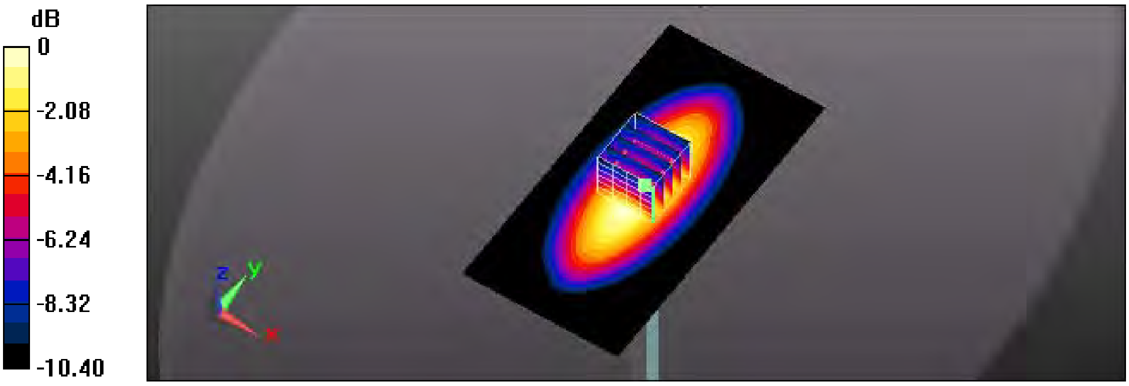
Test Laboratory: A Test Lab Techno Corp.
Date/Time: 2019/5/8
System Performance Check at 835MHz_20190508_Body
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d082

Communication System: UID 0, CW (0); Frequency: 835 MHz;Duty Cycle: 1:1
Medium parameters used: f = 835 MHz; σ = 0.999 S/m; ε_r = 56.912; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5.2 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV4 - SN3578; ConvF(9.49, 9.49, 9.49); Calibrated: 2018/5/29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2019/3/19
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1036
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

System Performance Check at 835MHz/Area Scan (61x121x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 3.27 W/kg

System Performance Check at 835MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 59.13 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 3.72 W/kg
SAR(1 g) = 2.42 W/kg; SAR(10 g) = 1.59 W/kg
Maximum value of SAR (measured) = 3.27 W/kg



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

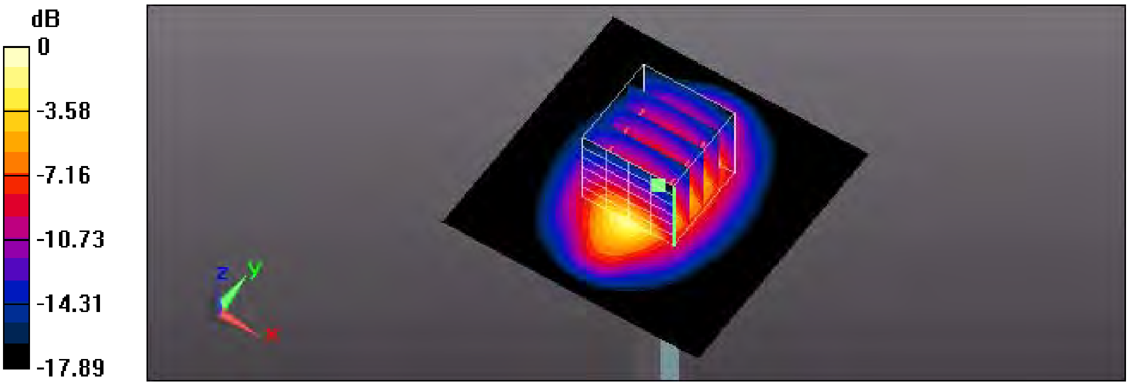
Test Laboratory: A Test Lab Techno Corp.
Date/Time: 2019/5/7
System Performance Check at 1750MHz_20190507_Body
DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1023

Communication System: UID 0, CW (0); Frequency: 1750 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1750 MHz; σ = 1.457 S/m; ε_r = 53.164; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5.2 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV4 - SN3578; ConvF(7.92, 7.92, 7.92); Calibrated: 2018/5/29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2019/3/19
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1036
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

System Performance Check at 1750MHz/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 14.9 W/kg

System Performance Check at 1750MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 103.8 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 17.8 W/kg
SAR(1 g) = 9.39 W/kg; SAR(10 g) = 4.85 W/kg
Maximum value of SAR (measured) = 14.8 W/kg



0 dB = 14.8 W/kg = 11.70 dBW/kg

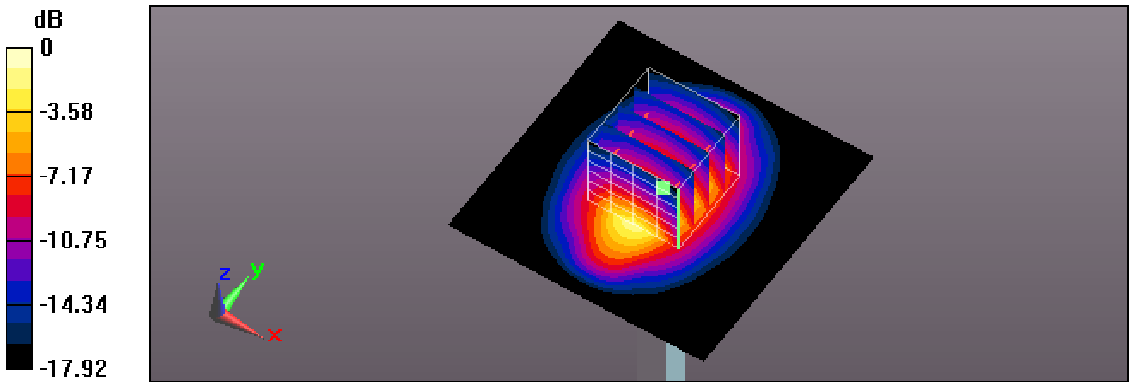
Test Laboratory: A Test Lab Techno Corp.
Date/Time: 2019/5/7
System Performance Check at 1900MHz_20190507_Body
DUT: Dipole 1900MHz; Type: D1900V2; Serial: D1900V2 - SN:5d111

Communication System: UID 0, CW (0); Frequency: 1900 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1900 MHz; σ = 1.579 S/m; ε_r = 52.694; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5.2 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV4 - SN3578; ConvF(7.68, 7.68, 7.68); Calibrated: 2018/5/29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2019/3/19
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1036
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

System Performance Check at 1900MHz/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 16.7 W/kg

System Performance Check at 1900MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 105.7 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 20.0 W/kg
SAR(1 g) = 10.5 W/kg; SAR(10 g) = 5.42 W/kg
Maximum value of SAR (measured) = 16.6 W/kg



0 dB = 16.6 W/kg = 12.20 dBW/kg

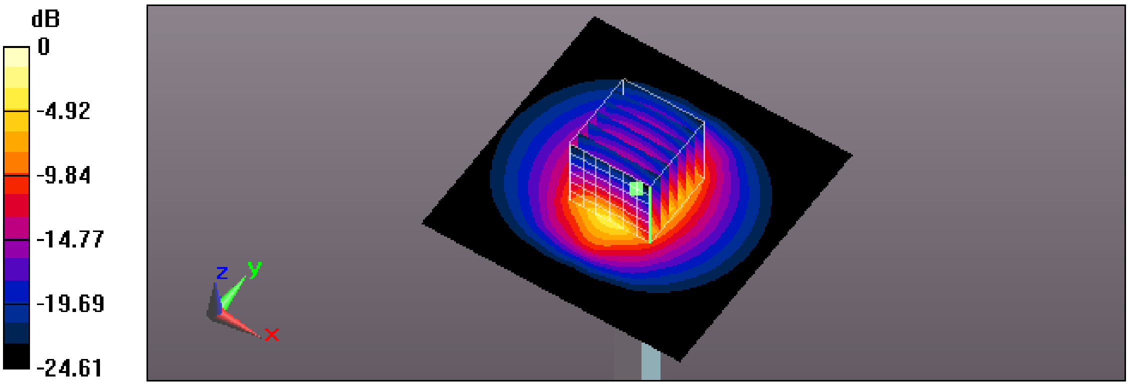
Test Laboratory: A Test Lab Techno Corp.
Date/Time: 2019/5/9
System Performance Check at 2450MHz_20190509_Body
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:735

Communication System: UID 0, CW (0); Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.971 S/m; ε_r = 51.951; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5.2 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV4 - SN3578; ConvF(7.44, 7.44, 7.44); Calibrated: 2018/5/29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2019/3/19
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1036
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

System Performance Check at 2450MHz/Area Scan (81x81x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 22.6 W/kg

System Performance Check at 2450MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 112.6 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 28.6 W/kg
SAR(1 g) = 13.2 W/kg; SAR(10 g) = 5.8 W/kg
Maximum value of SAR (measured) = 23.0 W/kg



0 dB = 23.0 W/kg = 13.62 dBW/kg

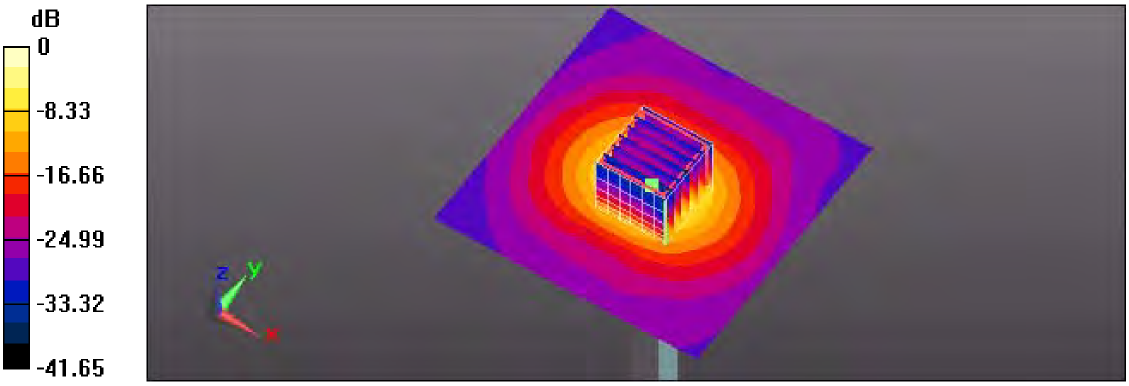
Test Laboratory: A Test Lab Techno Corp.
Date/Time: 2019/5/9
System Performance Check at 5200MHz_20190509_Body
DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1021

Communication System: UID 0, CW (0); Frequency: 5200 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5200 MHz; σ = 5.136 S/m; ε_r = 48.83; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5.2 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV4 - SN3578; ConvF(4.96, 4.96, 4.96); Calibrated: 2018/5/29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2019/3/19
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1036
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

System Performance Check at 5200MHz/Area Scan (91x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 18.3 W/kg

System Performance Check at 5200MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 69.50 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 32.7 W/kg
SAR(1 g) = 7.71 W/kg; SAR(10 g) = 2.08 W/kg
Maximum value of SAR (measured) = 19.7 W/kg



0 dB = 19.7 W/kg = 12.94 dBW/kg

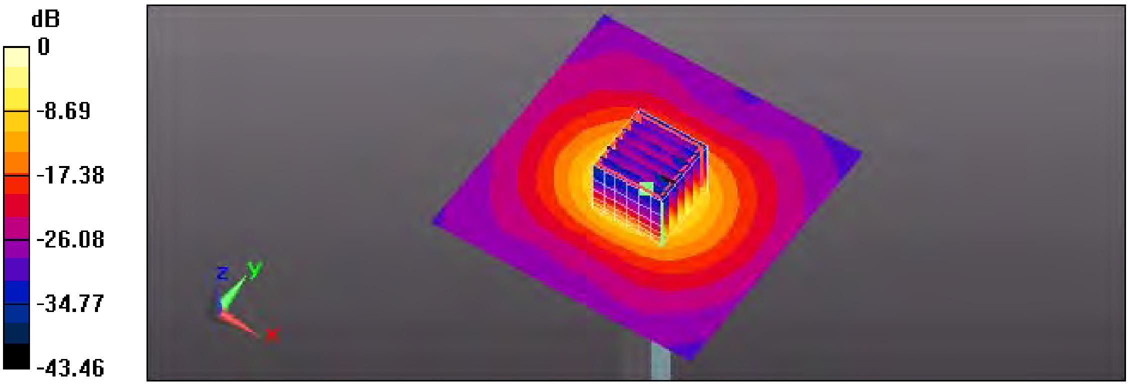
Test Laboratory: A Test Lab Techno Corp.
Date/Time: 2019/5/9
System Performance Check at 5500MHz_20190509_Body
DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1021

Communication System: UID 0, CW (0); Frequency: 5500 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5500 MHz; σ = 5.532 S/m; ε_r = 48.225; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5.2 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV4 - SN3578; ConvF(4.22, 4.22, 4.22); Calibrated: 2018/5/29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2019/3/19
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1036
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

System Performance Check at 5500MHz/Area Scan (91x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 20.8 W/kg

System Performance Check at 5500MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 71.27 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 39.8 W/kg
SAR(1 g) = 8.49 W/kg; SAR(10 g) = 2.3 W/kg
Maximum value of SAR (measured) = 22.0 W/kg



0 dB = 22.0 W/kg = 13.42 dBW/kg

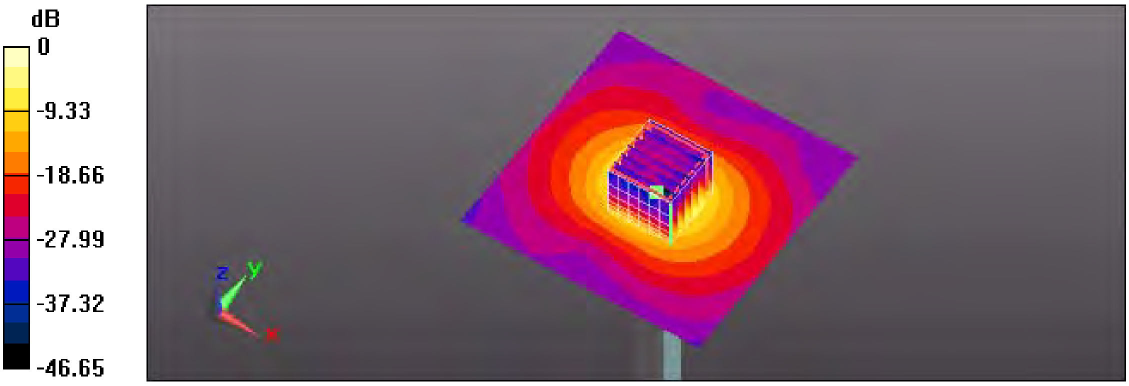
Test Laboratory: A Test Lab Techno Corp.
Date/Time: 2019/5/9
System Performance Check at 5800MHz_20190509_Body
DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1021

Communication System: UID 0, CW (0); Frequency: 5800 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5800 MHz; σ = 5.93 S/m; ε_r = 47.571; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5.2 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV4 - SN3578; ConvF(4.34, 4.34, 4.34); Calibrated: 2018/5/29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2019/3/19
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1036
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

System Performance Check at 5800MHz/Area Scan (91x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 20.7 W/kg

System Performance Check at 5800MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 68.72 V/m; Power Drift = -0.12 dB
Peak SAR (extrapolated) = 42.4 W/kg
SAR(1 g) = 8.46 W/kg; SAR(10 g) = 2.26 W/kg
Maximum value of SAR (measured) = 22.5 W/kg



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

Appendix B - SAR Measurement Data

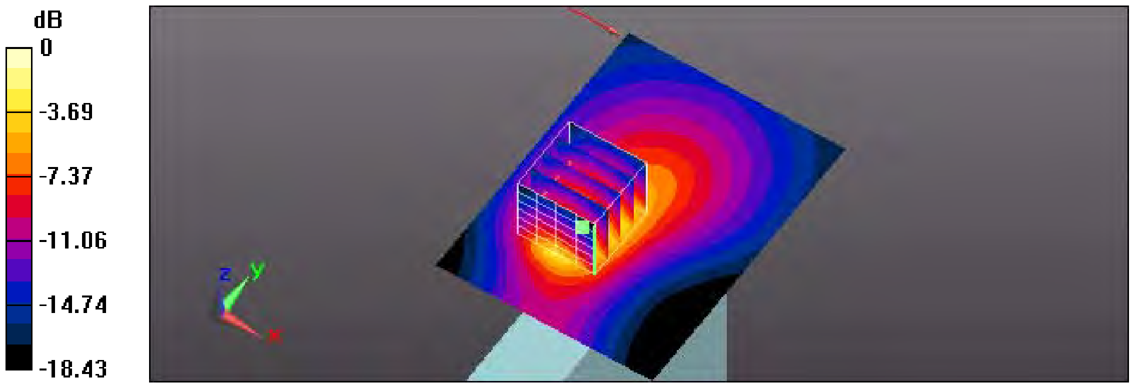
Test Laboratory: A Test Lab Techno Corp.
Date/Time: 2019/5/7
03_WCDMA Band II CH 9400_Side 4_0mm
DUT: SC20-A; Type: LTE Module

Communication System: UID 0, WCDMA Band II (0); Frequency: 1880 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1880 MHz; σ = 1.56 S/m; ε_r = 52.727; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5.2 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV4 - SN3578; ConvF(7.68, 7.68, 7.68); Calibrated: 2018/5/29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2019/3/19
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1036
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

Area Scan (61x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 1.37 W/kg

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 27.33 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 1.67 W/kg
SAR(1 g) = 0.906 W/kg; SAR(10 g) = 0.460 W/kg
Maximum value of SAR (measured) = 1.39 W/kg



0 dB = 1.39 W/kg = 1.43 dBW/kg

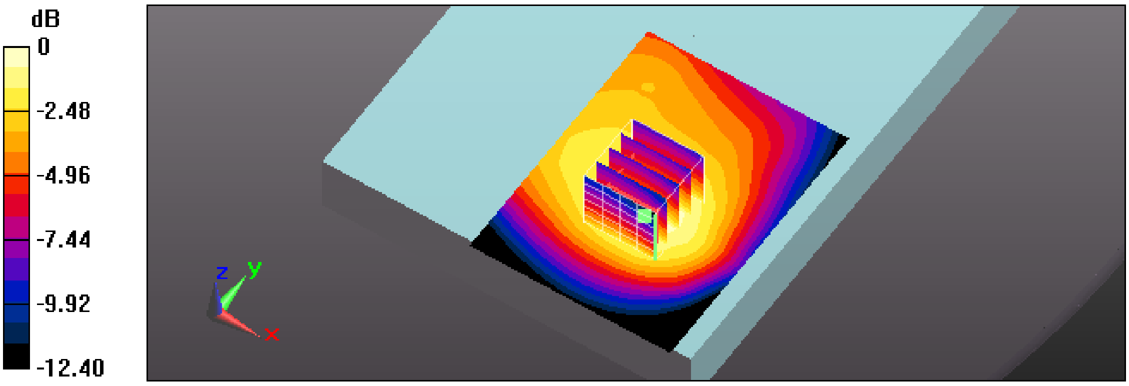
Test Laboratory: A Test Lab Techno Corp.
Date/Time: 2019/5/8
34_WCDMA Band V CH 4132_Back_0mm
DUT: SC20-A; Type: LTE Module

Communication System: UID 0, WCDMA Band V (0); Frequency: 826.4 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 826.4 MHz; σ = 0.991 S/m; ε_r = 56.991; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5.2 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV4 - SN3578; ConvF(9.49, 9.49, 9.49); Calibrated: 2018/5/29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2019/3/19
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1036
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

Area Scan (61x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.643 W/kg

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 24.92 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 0.735 W/kg
SAR(1 g) = 0.477 W/kg; SAR(10 g) = 0.321 W/kg
Maximum value of SAR (measured) = 0.633 W/kg



0 dB = 0.633 W/kg = -1.99 dBW/kg

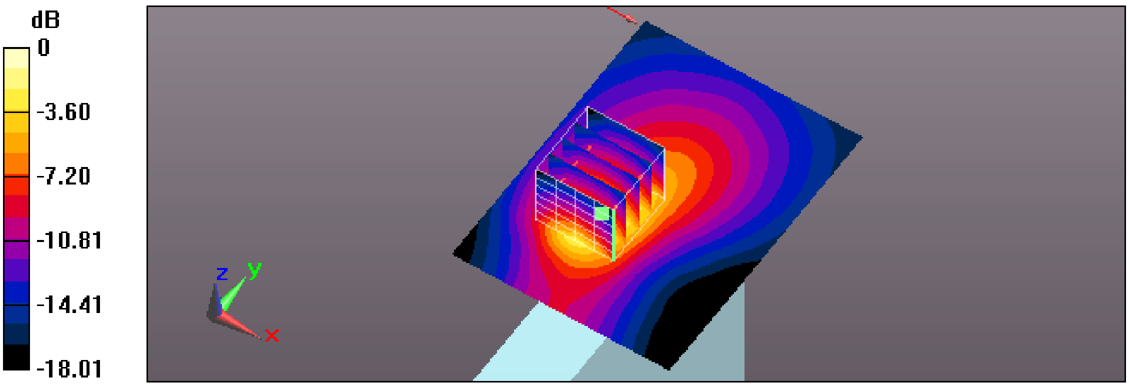
Test Laboratory: A Test Lab Techno Corp.
Date/Time: 2019/5/7
17_LTE Band 2 CH 18900_QPSK_BW 20M_1RB Size 0RB Offset_Side 4_0mm
DUT: SC20-A; Type: LTE Module

Communication System: UID 0, Generic LTE (0); Frequency: 1880 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1880 MHz; σ = 1.56 S/m; ϵ_r = 52.727; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5.2 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV4 - SN3578; ConvF(7.68, 7.68, 7.68); Calibrated: 2018/5/29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2019/3/19
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1036
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

Area Scan (61x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 1.53 W/kg

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 28.93 V/m; Power Drift = -0.10 dB
Peak SAR (extrapolated) = 1.86 W/kg
SAR(1 g) = 1.01 W/kg; SAR(10 g) = 0.525 W/kg
Maximum value of SAR (measured) = 1.52 W/kg



0 dB = 1.52 W/kg = 1.82 dBW/kg

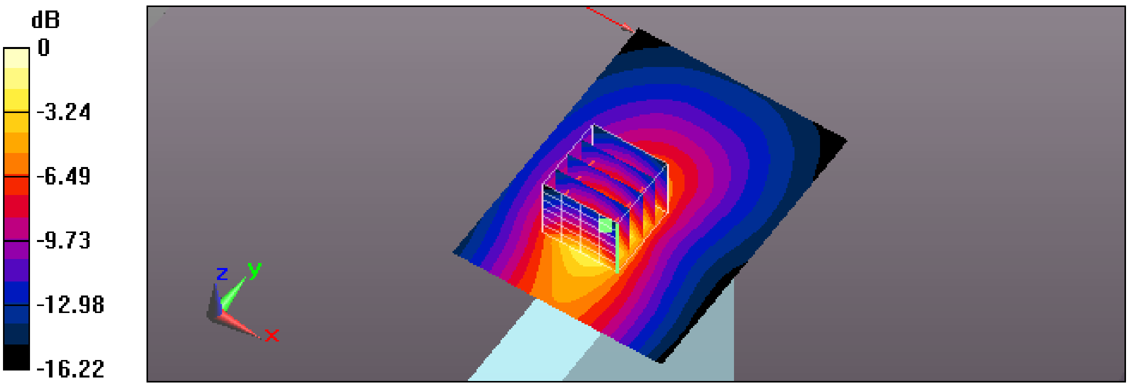
Test Laboratory: A Test Lab Techno Corp.
Date/Time: 2019/5/8
28_LTE Band 4 CH 20175_QPSK_BW 20M_1RB Size 0RB Offset_Side 4_0mm
DUT: SC20-A; Type: LTE Module

Communication System: UID 0, Generic LTE (0); Frequency: 1732.5 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 1732.5 MHz; σ = 1.44 S/m; ε_r = 53.232; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5.2 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV4 - SN3578; ConvF(7.92, 7.92, 7.92); Calibrated: 2018/5/29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2019/3/19
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1036
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

Area Scan (61x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 1.13 W/kg

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 24.35 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 1.27 W/kg
SAR(1 g) = 0.755 W/kg; SAR(10 g) = 0.418 W/kg
Maximum value of SAR (measured) = 1.09 W/kg



0 dB = 1.09 W/kg = 0.37 dBW/kg

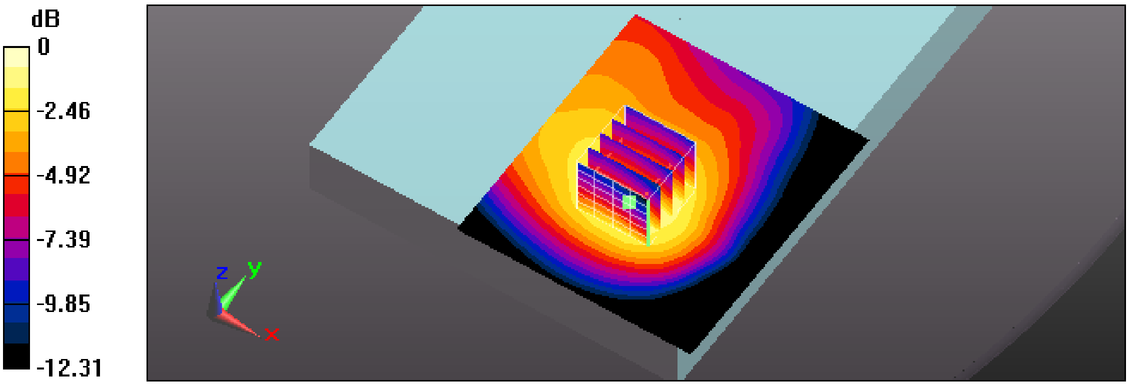
Test Laboratory: A Test Lab Techno Corp.
Date/Time: 2019/5/8
42_LTE Band 5 CH 20525_QPSK_BW 10M_1RB Size 0RB Offset_Back_0mm
DUT: SC20-A; Type: LTE Module

Communication System: UID 0, Generic LTE (0); Frequency: 836.5 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 836.5 MHz; σ = 1 S/m; ε_r = 56.899; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5.2 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV4 - SN3578; ConvF(9.49, 9.49, 9.49); Calibrated: 2018/5/29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2019/3/19
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1036
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

Area Scan (71x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.572 W/kg

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 25.18 V/m; Power Drift = -0.10 dB
Peak SAR (extrapolated) = 0.668 W/kg
SAR(1 g) = 0.440 W/kg; SAR(10 g) = 0.296 W/kg
Maximum value of SAR (measured) = 0.587 W/kg



0 dB = 0.587 W/kg = -2.31 dBW/kg

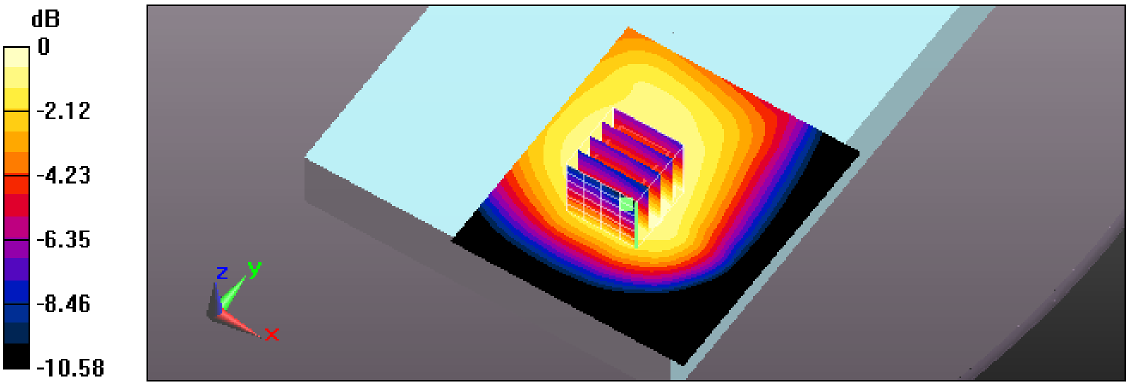
Test Laboratory: A Test Lab Techno Corp.
Date/Time: 2019/5/8
54_LTE Band 12 CH 23095_QPSK_BW 10M_1RB Size 24RB Offset_Back_0mm
DUT: SC20-A; Type: LTE Module

Communication System: UID 0, Generic LTE (0); Frequency: 707.5 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 707.5 MHz; σ = 0.929 S/m; ε_r = 57.16; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5.2 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV4 - SN3578; ConvF(9.89, 9.89, 9.89); Calibrated: 2018/5/29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2019/3/19
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1036
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

Area Scan (71x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.556 W/kg

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 25.68 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 0.661 W/kg
SAR(1 g) = 0.458 W/kg; SAR(10 g) = 0.338 W/kg
Maximum value of SAR (measured) = 0.575 W/kg



0 dB = 0.575 W/kg = -2.40 dBW/kg

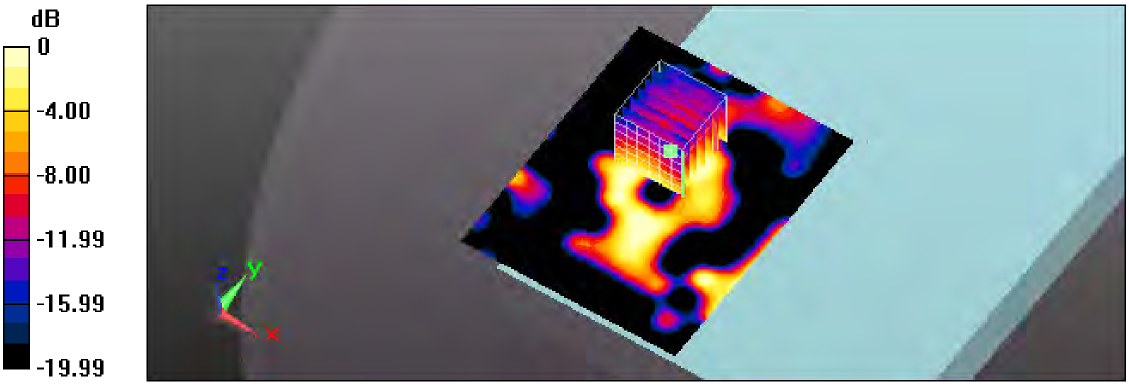
Test Laboratory: A Test Lab Techno Corp.
Date/Time: 2019/5/9
66_IEEE 802.11b CH6_1M_Back_0mm
DUT: SC20-A; Type: LTE Module

Communication System: UID 0, IEEE 802.11b (0); Frequency: 2437 MHz;Duty Cycle: 1:1.025
Medium parameters used: f = 2437 MHz; σ = 1.956 S/m; ε_r = 51.979; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5.2 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV4 - SN3578; ConvF(7.44, 7.44, 7.44); Calibrated: 2018/5/29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2019/3/19
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1036
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

Area Scan (81x101x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.402 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 8.957 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 0.178 W/kg
SAR(1 g) = 0.105 W/kg; SAR(10 g) = 0.059 W/kg
Maximum value of SAR (measured) = 0.151 W/kg



0 dB = 0.151 W/kg = -8.21 dBW/kg

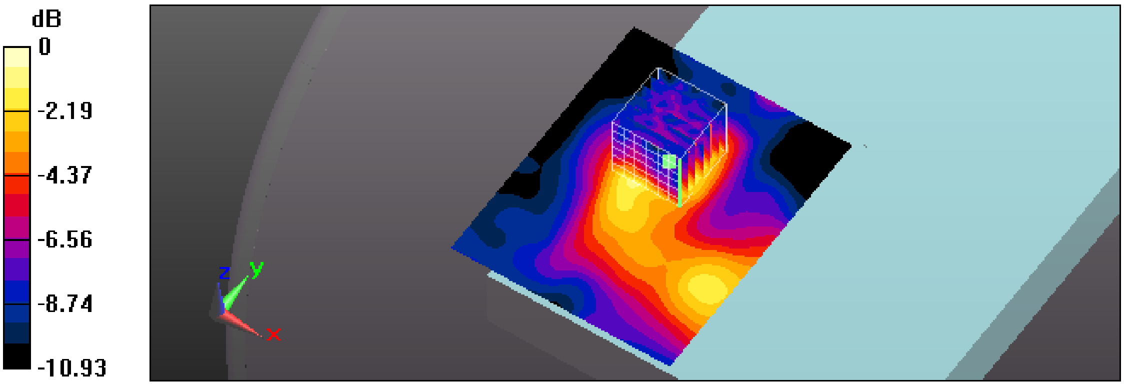
Test Laboratory: A Test Lab Techno Corp.
Date/Time: 2019/5/9 PM 02:34:44
73_Bluetooth CH39_1M_Back_0mm
DUT: SC20-A; Type: LTE Module

Communication System: UID 0, Bluetooth 3.0 (0); Frequency: 2441 MHz;Duty Cycle: 1:1.089
Medium parameters used: f = 2441 MHz; σ = 1.96 S/m; εr = 51.971; ρ = 1000 kg/m3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5.2 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV4 - SN3578; ConvF(7.44, 7.44, 7.44) @ 2441 MHz; Calibrated: 2018/5/29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2019/3/19
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1036
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

Area Scan (81x101x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.0469 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.745 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.0510 W/kg
SAR(1 g) = 0.033 W/kg; SAR(10 g) = 0.020 W/kg
Maximum value of SAR (measured) = 0.0445 W/kg



0 dB = 0.0445 W/kg = -13.52 dBW/kg

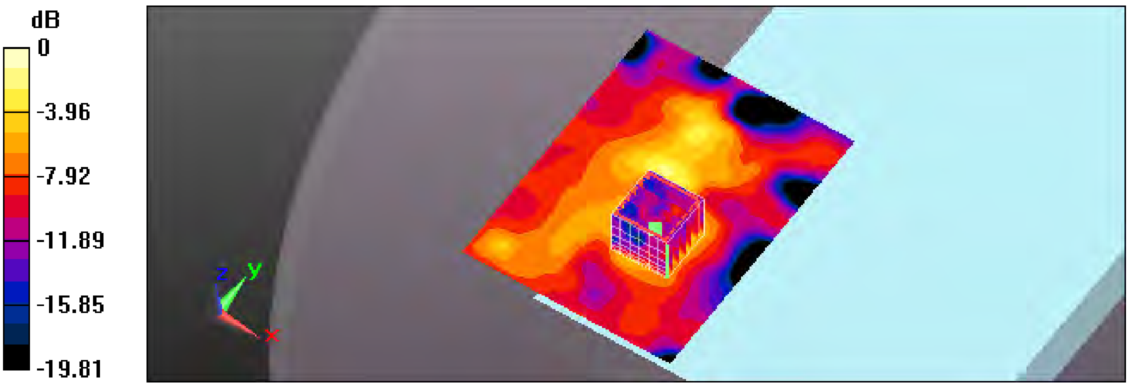
Test Laboratory: A Test Lab Techno Corp.
Date/Time: 2019/5/9
80_IEEE 802.11n20 CH64_HT0_Back_0mm
DUT: SC20-A; Type: LTE Module

Communication System: UID 0, IEEE 802.11n(5GHz)HT20 (0); Frequency: 5320 MHz;Duty Cycle: 1:1.186
Medium parameters used: f = 5320 MHz; σ = 5.283 S/m; ε_r = 48.586; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5.2 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV4 - SN3578; ConvF(4.96, 4.96, 4.96); Calibrated: 2018/5/29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2019/3/19
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1036
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

Area Scan (91x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.247 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 6.535 V/m; Power Drift = 0.15 dB
Peak SAR (extrapolated) = 0.403 W/kg
SAR(1 g) = 0.104 W/kg; SAR(10 g) = 0.038 W/kg
Maximum value of SAR (measured) = 0.226 W/kg



0 dB = 0.226 W/kg = -6.46 dBW/kg

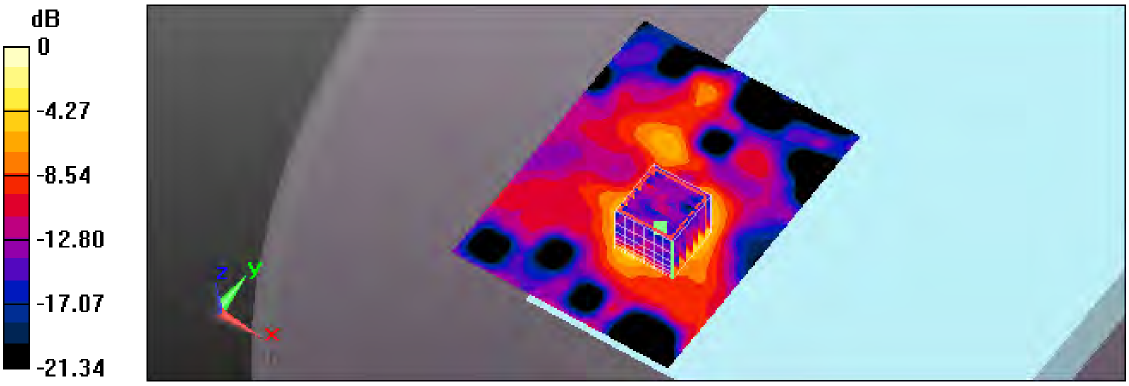
Test Laboratory: A Test Lab Techno Corp.
Date/Time: 2019/5/9
86_IEEE 802.11n20 CH132_HT0_Back_0mm
DUT: SC20-A; Type: LTE Module

Communication System: UID 0, IEEE 802.11n(5GHz)HT20 (0); Frequency: 5660 MHz;Duty Cycle: 1:1.186
Medium parameters used: f = 5660 MHz; σ = 5.732 S/m; ε_r = 47.867; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5.2 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV4 - SN3578; ConvF(4.22, 4.22, 4.22); Calibrated: 2018/5/29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2019/3/19
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1036
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

Area Scan (91x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.313 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 7.107 V/m; Power Drift = 0.15 dB
Peak SAR (extrapolated) = 0.611 W/kg
SAR(1 g) = 0.135 W/kg; SAR(10 g) = 0.050 W/kg
Maximum value of SAR (measured) = 0.313 W/kg



0 dB = 0.313 W/kg = -5.04 dBW/kg

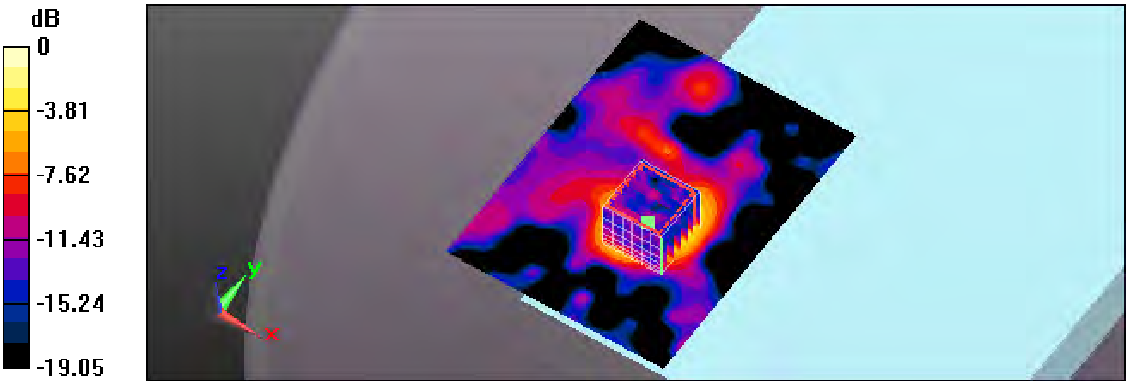
Test Laboratory: A Test Lab Techno Corp.
Date/Time: 2019/5/9
90_IEEE 802.11a CH165_6M_Back_0mm
DUT: SC20-A; Type: LTE Module

Communication System: UID 0, IEEE 802.11a (0); Frequency: 5825 MHz;Duty Cycle: 1:1.114
Medium parameters used: f = 5825 MHz; σ = 5.961 S/m; ε_r = 47.563; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5.2 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV4 - SN3578; ConvF(4.34, 4.34, 4.34); Calibrated: 2018/5/29
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2019/3/19
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1036
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

Area Scan (91x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.348 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 6.934 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 0.629 W/kg
SAR(1 g) = 0.145 W/kg; SAR(10 g) = 0.053 W/kg
Maximum value of SAR (measured) = 0.327 W/kg



0 dB = 0.327 W/kg = -4.85 dBW/kg

Appendix C - Calibration

All of the instruments Calibration information are listed below.

- Dipole _ D750V3 SN:1004
- Dipole _ D835V2 SN:4d082
- Dipole _ D1750V2 SN:1023
- Dipole _ D1900V2 SN:5d111
- Dipole _ D2450V2 SN:735
- Dipole _ D5GHzV2 SN:1021
- Probe _ EX3DV4 SN:3578
- DAE _ DAE4 SN:541

ST-044_18-245

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Client ATL Certificate No: Z18-60307

CALIBRATION CERTIFICATE

Object	D750V3 - SN: 1004
Calibration Procedure(s)	FF-Z11-003-01 Calibration Procedures for dipole validation kits
Calibration date:	September 5, 2018

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRVD	102083	01-Nov-17 (CTTL, No.J17X08756)	Oct-18
Power sensor NRV-Z5	100542	01-Nov-17 (CTTL, No.J17X08756)	Oct-18
Reference Probe EX3DV4	SN 7464	12-Sep-17(SPEAG,No.EX3-7464_Sep17)	Sep-18
DAE4	SN 1524	13-Sep-17(SPEAG,No.DAE4-1524_Sep17)	Sep-18
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
Signal Generator E4438C	MY49071430	23-Jan-18 (CTTL, No.J18X00560)	Jan-19
NetworkAnalyzer E5071C	MY46110673	24-Jan-18 (CTTL, No.J18X00561)	Jan-19

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	[signature]
Reviewed by:	Lin Hao	SAR Test Engineer	[signature]
Approved by:	Qi Dianyuan	SAR Project Leader	[signature]

Issued: September 8, 2018

Certificate No: Z18-60307 Page 1 of 8

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Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

b) IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016

c) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010

d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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Measurement Conditions

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

DASY Version	DASY52	52.10.1.1476
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	43.1 ± 6 %	0.87 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.06 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**8.47 mW /g ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.39 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**5.68 mW /g ± 18.7 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	56.8 ± 6 %	0.93 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.14 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**8.80 mW /g ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.46 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**5.97 mW /g ±18.7 % (k=2)**

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.4Ω+ 0.96jΩ
Return Loss	- 27.3dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.2Ω- 1.43jΩ
Return Loss	- 32.5dB

General Antenna Parameters and Design

Electrical Delay (one direction)	0.906 ns

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

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

Additional EUT Data

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DASY5 Validation Report for Head TSL Date: 09.05.2018

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1004

Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium parameters used: f = 750 MHz; σ = 0.866 S/m; ε_r = 43.13; ρ = 1000 kg/m3

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(10.57, 10.57, 10.57) @ 750 MHz; Calibrated: 9/12/2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1524; Calibrated: 9/13/2017
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

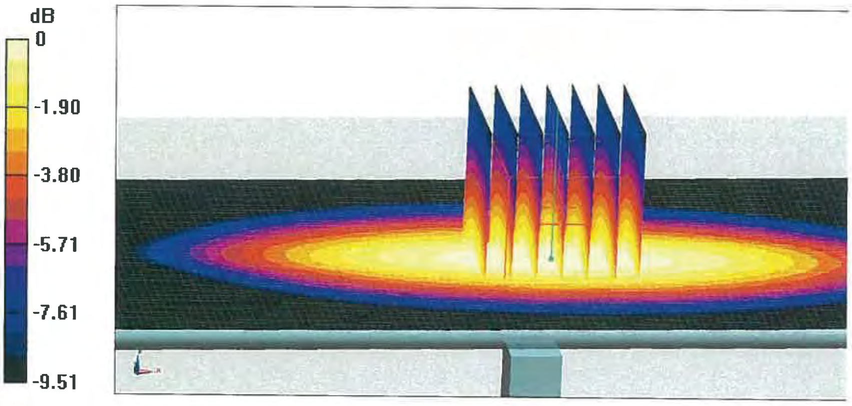
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.10 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 3.01 W/kg

SAR(1 g) = 2.06 W/kg; SAR(10 g) = 1.39 W/kg

Maximum value of SAR (measured) = 2.69 W/kg



0 dB = 2.69 W/kg = 4.30 dBW/kg

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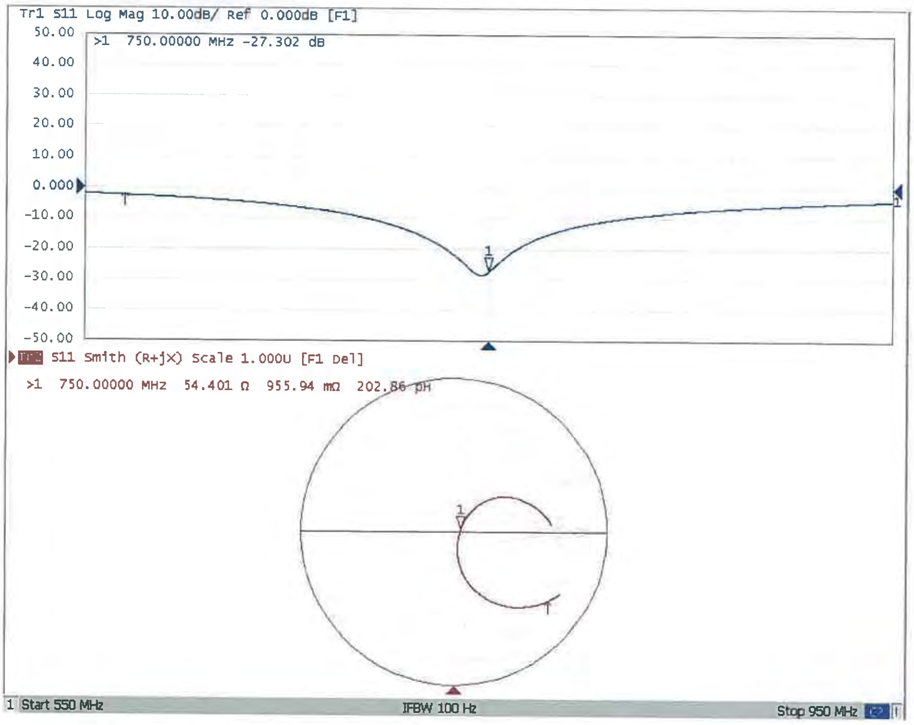
Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 09.05.2018

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1004

Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium parameters used: f = 750 MHz; σ = 0.932 S/m; ε_r = 56.82; ρ = 1000 kg/m3

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(10.63, 10.63, 10.63) @ 750 MHz; Calibrated: 9/12/2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1524; Calibrated: 9/13/2017
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

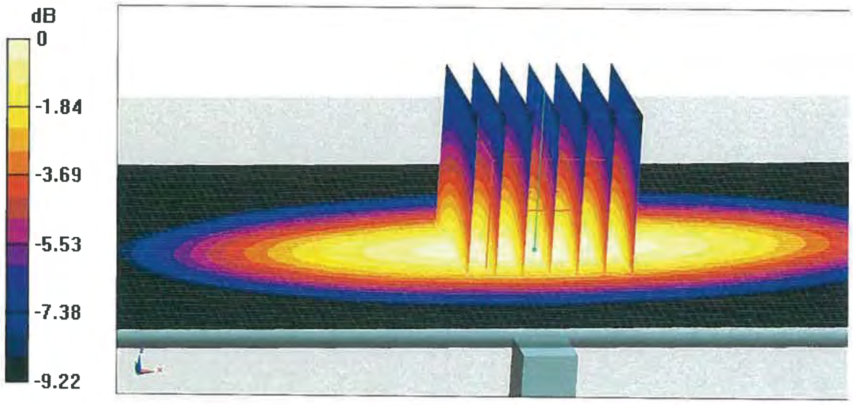
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 54.38 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 3.08 W/kg

SAR(1 g) = 2.14 W/kg; SAR(10 g) = 1.46 W/kg

Maximum value of SAR (measured) = 2.77 W/kg



0 dB = 2.77 W/kg = 4.42 dBW/kg

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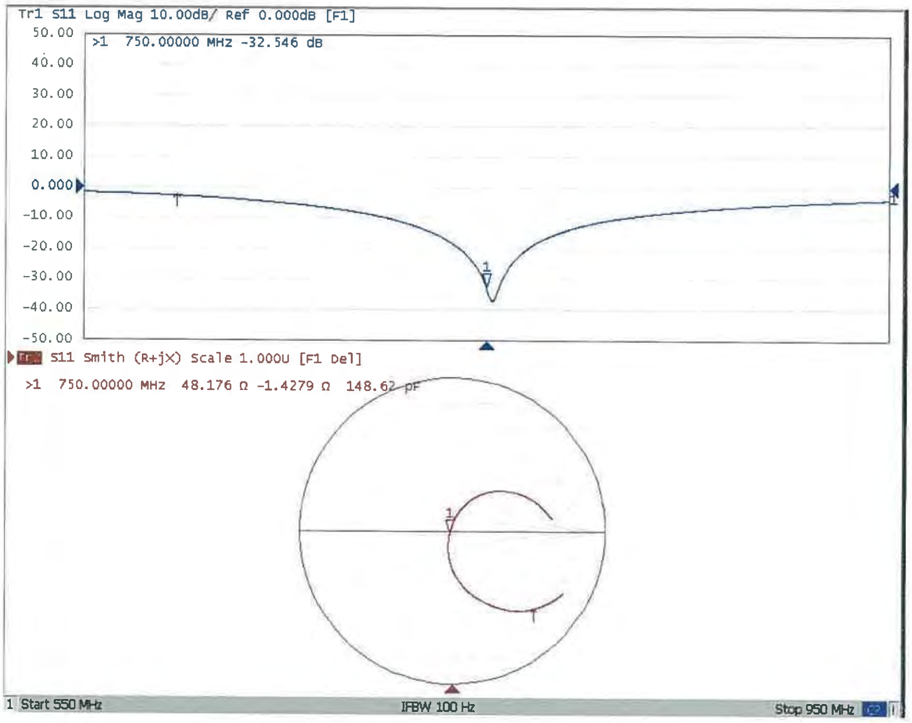
Impedance Measurement Plot for Body TSL



Certificate No: Z18-60307 Page 8 of 8

ST-037_18-246

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Client ATL Certificate No: Z18-60308

CALIBRATION CERTIFICATE

Object: D835V2 - SN: 4d082

Calibration Procedure(s): FF-Z11-003-01
Calibration Procedures for dipole validation kits

Calibration date: September 6, 2018

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRVD	102083	01-Nov-17 (CTTL, No.J17X08756)	Oct-18
Power sensor NRV-Z5	100542	01-Nov-17 (CTTL, No.J17X08756)	Oct-18
Reference Probe EX3DV4	SN 7464	12-Sep-17(SPEAG,No.EX3-7464_Sep17)	Sep-18
DAE4	SN 1524	13-Sep-17(SPEAG,No.DAE4-1524_Sep17)	Sep-18
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
Signal Generator E4438C	MY49071430	23-Jan-18 (CTTL, No.J18X00560)	Jan-19
NetworkAnalyzer E5071C	MY46110673	24-Jan-18 (CTTL, No.J18X00561)	Jan-19

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: September 9, 2018

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Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
c) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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Measurement Conditions

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

DASY Version	DASY52	52.10.1.1476
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.7 ± 6 %	0.90 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.32 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**9.31 mW /g ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.52 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**6.09 mW /g ± 18.7 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	56.0 ± 6 %	1.00 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.46 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**9.66 mW /g ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.65 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**6.50 mW /g ± 18.7 % (k=2)**

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.7Ω- 4.27jΩ
Return Loss	- 27.4dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.5Ω- 6.62jΩ
Return Loss	- 22.8dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.252 ns

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

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

Additional EUT Data

Manufactured by	SPEAG

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DASY5 Validation Report for Head TSL Date: 09.04.2018

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d082

Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium parameters used: f = 835 MHz; σ = 0.904 S/m; ε_r = 42.71; ρ = 1000 kg/m3

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(10.28, 10.28, 10.28) @ 835 MHz; Calibrated: 9/12/2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1524; Calibrated: 9/13/2017
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

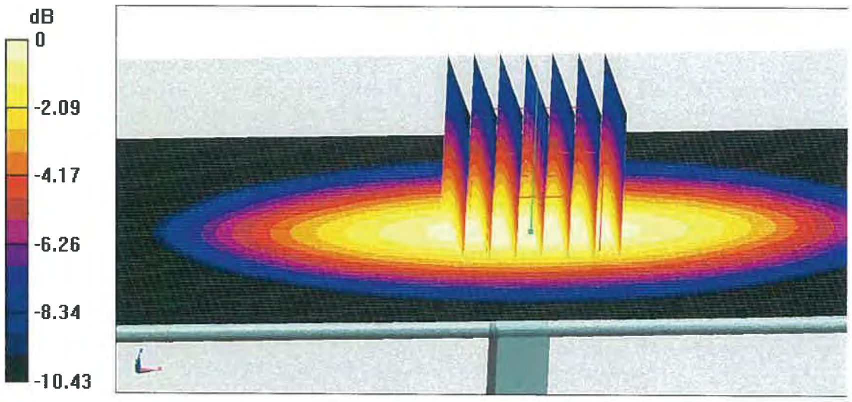
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.68 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 3.52 W/kg

SAR(1 g) = 2.32 W/kg; SAR(10 g) = 1.52 W/kg

Maximum value of SAR (measured) = 3.11 W/kg



0 dB = 3.11 W/kg = 4.93 dBW/kg

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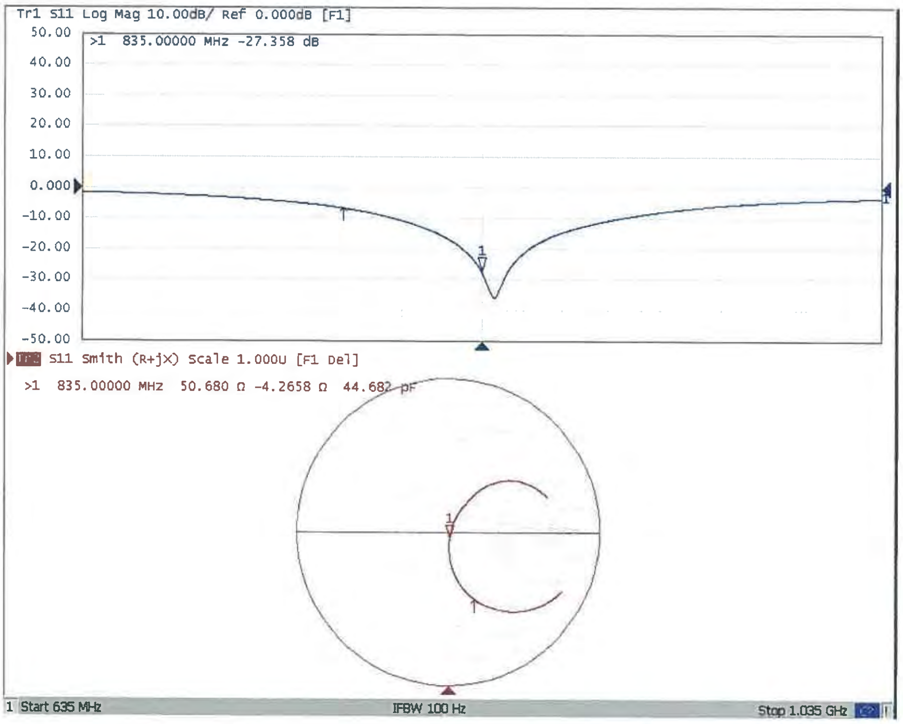
Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL Date: 09.06.2018

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d082

Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium parameters used: f = 835 MHz; σ = 0.998 S/m; ε_r = 56.04; ρ = 1000 kg/m3

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(10.21, 10.21, 10.21) @ 835 MHz; Calibrated: 9/12/2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1524; Calibrated: 9/13/2017
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

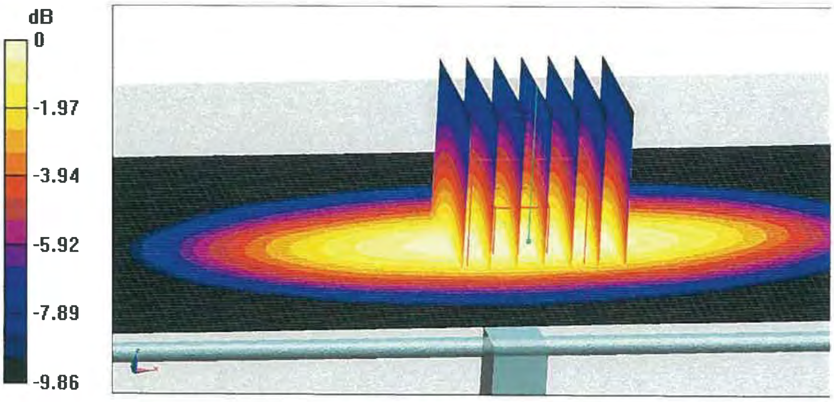
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.02 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 3.69 W/kg

SAR(1 g) = 2.46 W/kg; SAR(10 g) = 1.65 W/kg

Maximum value of SAR (measured) = 3.26 W/kg



0 dB = 3.26 W/kg = 5.13 dBW/kg

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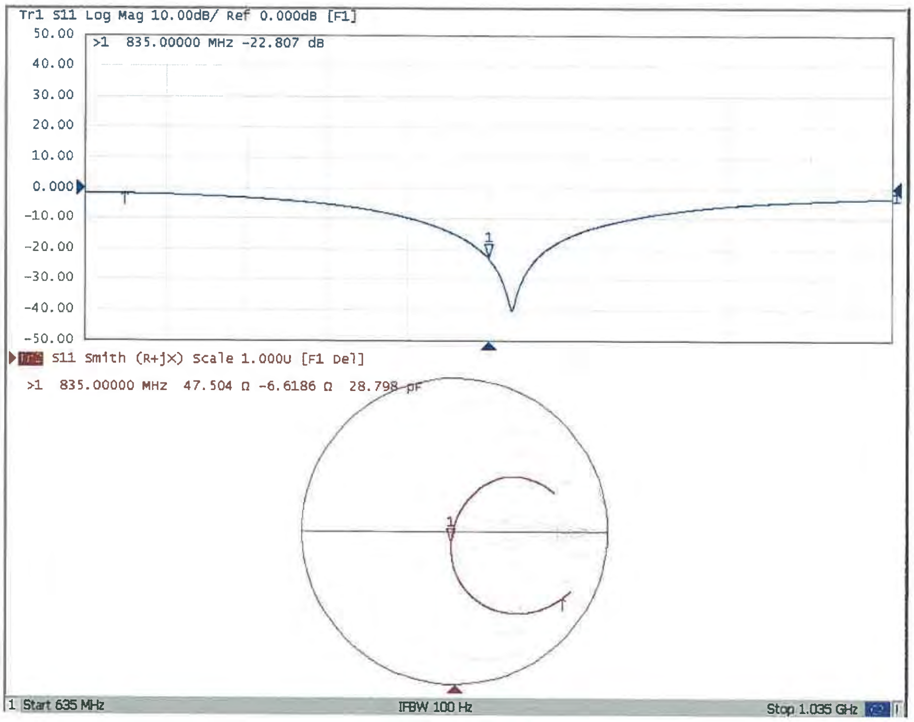
Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 0108

Client **Auden**

Certificate No: D1750V2-1023_Jun18

CALIBRATION CERTIFICATE

Object	D1750V2 - SN:1023
Calibration procedure(s)	QA CAL-05.v10 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	June 11, 2018

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19
Reference Probe EX3DV4	SN: 7349	30-Dec-17 (No. EX3-7349_Dec17)	Dec-18
DAE4	SN: 601	26-Oct-17 (No. DAE4-601_Oct17)	Oct-18

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-17)	In house check: Oct-18

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

Issued: June 11, 2018

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

Certificate No: D1750V2-1023_Jun18 Page 1 of 8

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.0 ± 6 %	1.36 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.10 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**36.3 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.82 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**19.3 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.6 ± 6 %	1.47 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.12 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**36.8 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	4.90 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**19.7 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.0 Ω - 0.5 jΩ
Return Loss	- 39.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.0 Ω + 0.3 jΩ
Return Loss	- 27.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.217 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	August 20, 2009

DASY5 Validation Report for Head TSL

Date: 11.06.2018

Test Laboratory: SPEAG, Zurich, Switzerland

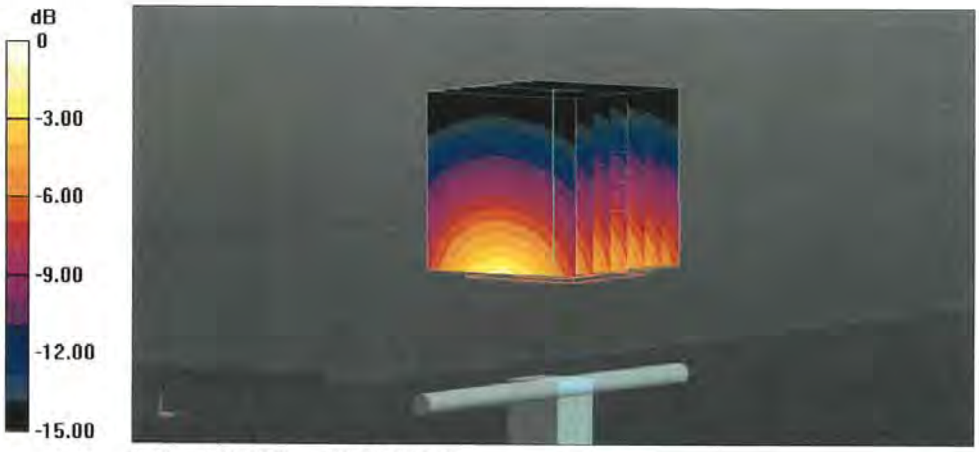
DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1023

Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; σ = 1.36 S/m; ε_r = 39; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

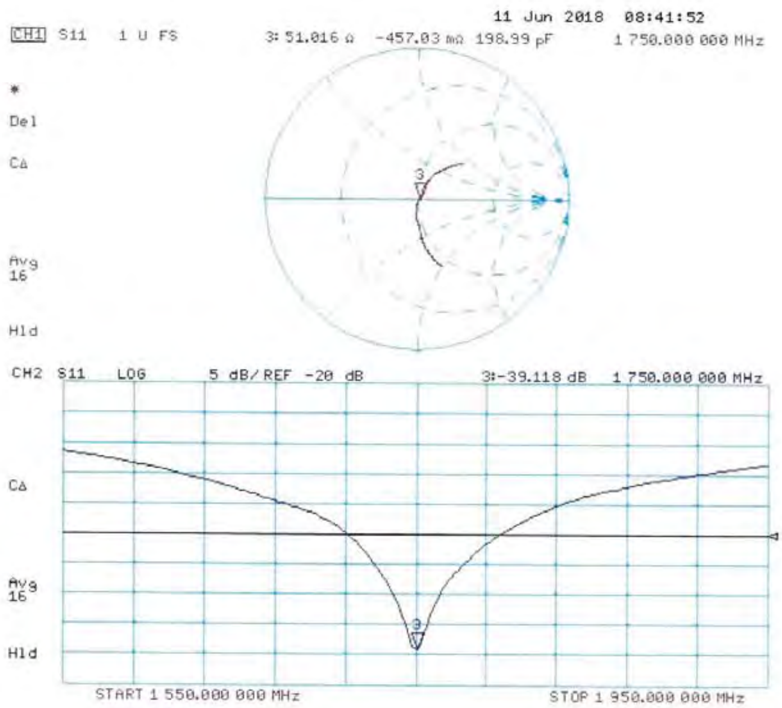
- Probe: EX3DV4 - SN7349; ConvF(8.5, 8.5, 8.5) @ 1750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 106.5 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 16.5 W/kg
SAR(1 g) = 9.1 W/kg; SAR(10 g) = 4.82 W/kg
Maximum value of SAR (measured) = 14.0 W/kg



0 dB = 14.0 W/kg = 11.46 dBW/kg

Impedance Measurement Plot for Head TSL



Certificate No: D1750V2-1023_Jun18 Page 6 of 8

DASY5 Validation Report for Body TSL

Date: 11.06.2018

Test Laboratory: SPEAG, Zurich, Switzerland

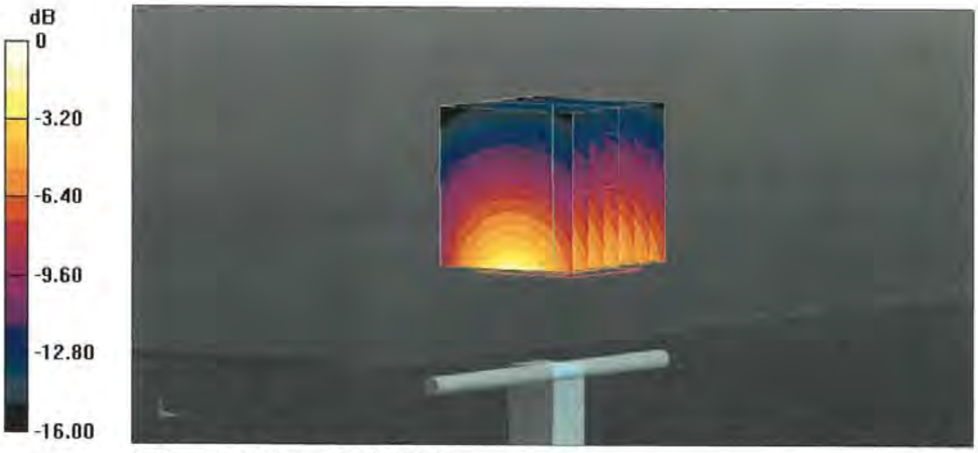
DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1023

Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; σ = 1.47 S/m; ε_r = 53.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

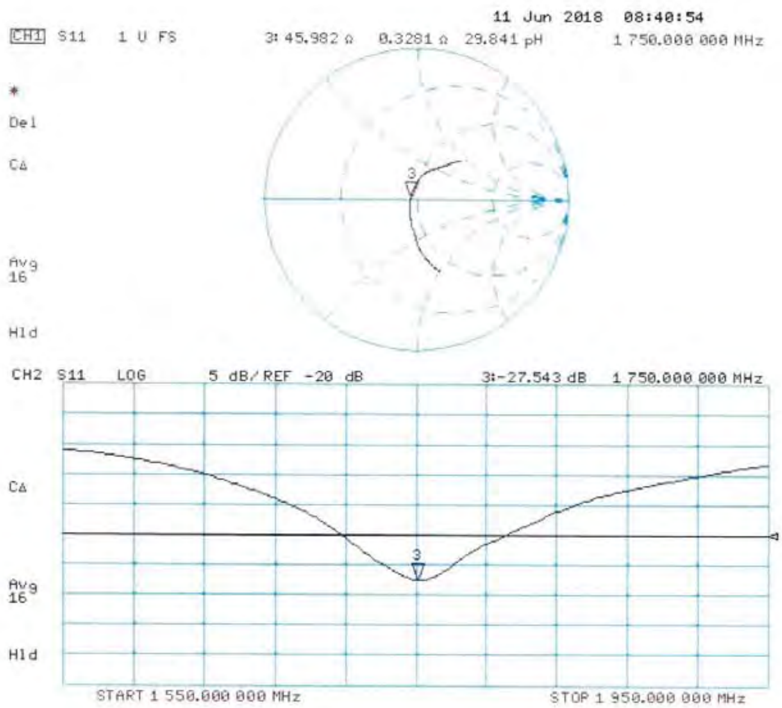
- Probe: EX3DV4 - SN7349; ConvF(8.35, 8.35, 8.35) @ 1750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 102.3 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 15.8 W/kg
SAR(1 g) = 9.12 W/kg; SAR(10 g) = 4.9 W/kg
Maximum value of SAR (measured) = 13.5 W/kg



0 dB = 13.5 W/kg = 11.30 dBW/kg

Impedance Measurement Plot for Body TSL



Certificate No: D1750V2-1023_Jun18 Page 8 of 8

ST-038_18-247

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Client **ATL** **Certificate No: Z18-60309**

CALIBRATION CERTIFICATE

Object	D1900V2 - SN: 5d111
Calibration Procedure(s)	FF-Z11-003-01 Calibration Procedures for dipole validation kits
Calibration date:	September 11, 2018

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRVD	102083	01-Nov-17 (CTTL, No.J17X08756)	Oct-18
Power sensor NRV-Z5	100542	01-Nov-17 (CTTL, No.J17X08756)	Oct-18
Reference Probe EX3DV4	SN 7464	12-Sep-17(SPEAG,No.EX3-7464_Sep17)	Sep-18
DAE4	SN 1524	13-Sep-17(SPEAG,No.DAE4-1524_Sep17)	Sep-18
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	23-Jan-18 (CTTL, No.J18X00560)	Jan-19
NetworkAnalyzer E5071C	MY46110673	24-Jan-18 (CTTL, No.J18X00561)	Jan-19

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Lin Jun	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: September 15, 2018

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lossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

b) IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016

c) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010

d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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Measurement Conditions

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

DASY Version	DASY52	52.10.1.1476
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.4 ± 6 %	1.44 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.1 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**39.8 mW /g ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.33 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**21.1 mW /g ± 18.7 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.3 ± 6 %	1.49 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.99 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**40.4 mW /g ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.41 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**21.8 mW /g ± 18.7 % (k=2)**

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.6Ω+ 6.78jΩ
Return Loss	- 23.3dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.3Ω+ 6.22jΩ
Return Loss	- 22.5dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.066 ns

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

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

Additional EUT Data

Manufactured by	SPEAG

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DASY5 Validation Report for Head TSL Date: 09.10.2018

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d111

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium parameters used: f = 1900 MHz; σ = 1.438 S/m; ε_r = 40.37; ρ = 1000 kg/m3

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(8.39, 8.39, 8.39) @ 1900 MHz; Calibrated: 9/12/2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1524; Calibrated: 9/13/2017
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

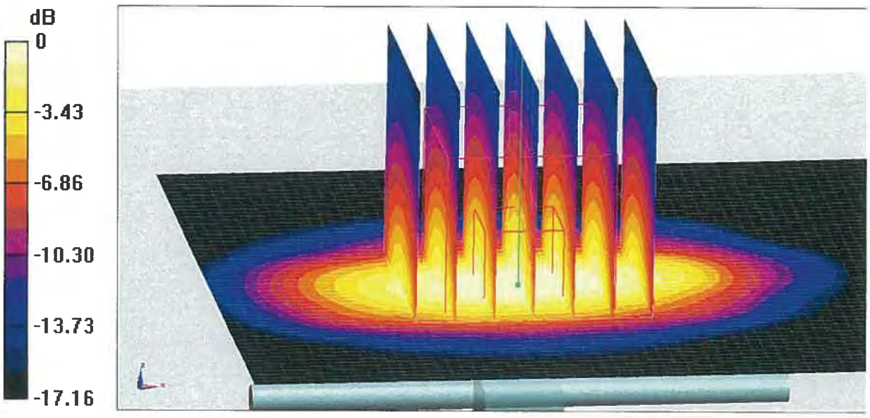
System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.90 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 19.0 W/kg

SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.33 W/kg

Maximum value of SAR (measured) = 15.8 W/kg



0 dB = 15.8 W/kg = 11.99 dBW/kg

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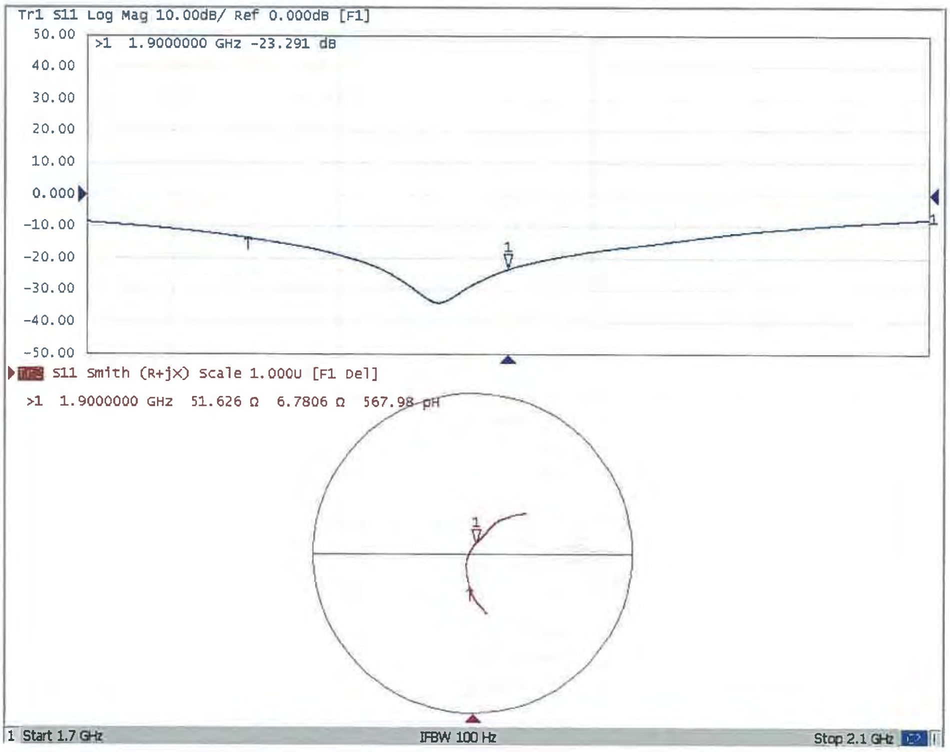
Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL Date: 09.10.2018

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d111

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium parameters used: f = 1900 MHz; σ = 1.493 S/m; ε_r = 53.34; ρ = 1000 kg/m3

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(8.32, 8.32, 8.32) @ 1900 MHz; Calibrated: 9/12/2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1524; Calibrated: 9/13/2017
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439))

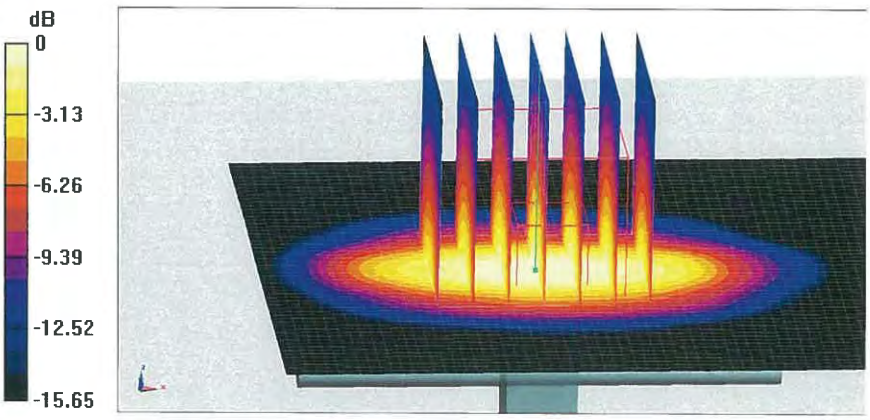
System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.64 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 17.6 W/kg

SAR(1 g) = 9.99 W/kg; SAR(10 g) = 5.41 W/kg

Maximum value of SAR (measured) = 15.0 W/kg



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

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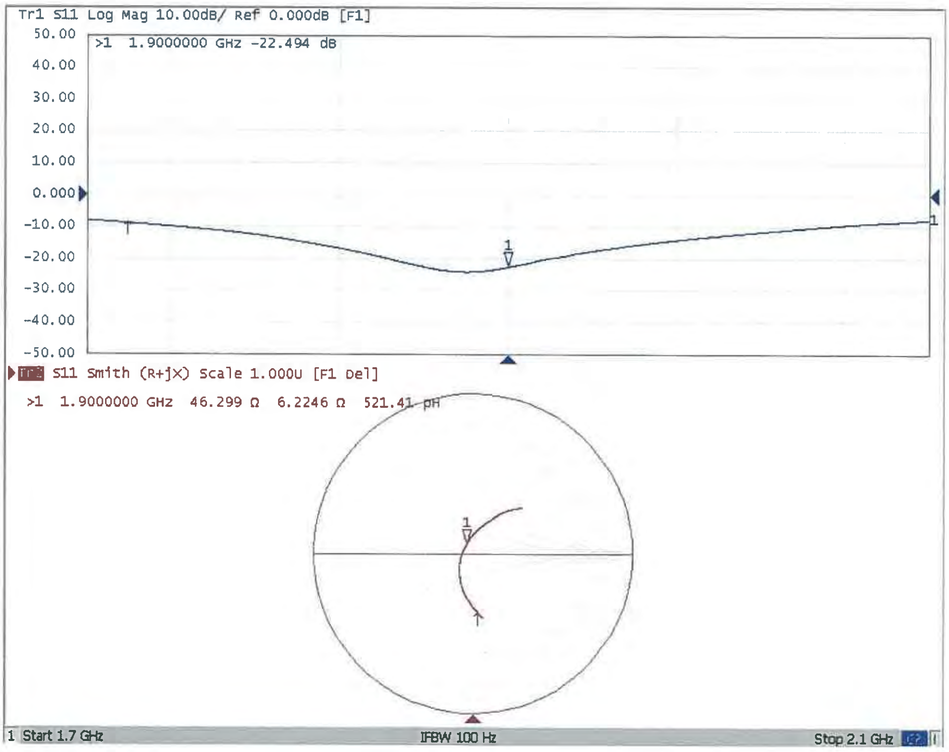
Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 0108

Client **Auden**

Certificate No: D2450V2-735_Dec18

CALIBRATION CERTIFICATE

Object	D2450V2 - SN:735
Calibration procedure(s)	QA CAL-05.v10 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	December 11, 2018

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19
Reference Probe EX3DV4	SN: 7349	30-Dec-17 (No. EX3-7349_Dec17)	Dec-18
DAE4	SN: 601	04-Oct-18 (No. DAE4-601_Oct18)	Oct-19

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

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

Issued: December 13, 2018

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

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

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.8 ± 6 %	1.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.4 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**52.3 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.19 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.4 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.0 ± 6 %	2.03 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.9 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**50.2 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.01 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.7 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	55.3 Ω + 5.7 jΩ
Return Loss	- 22.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.5 Ω + 6.5 jΩ
Return Loss	- 23.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.154 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	May 07, 2003

DASY5 Validation Report for Head TSL

Date: 11.12.2018

Test Laboratory: SPEAG, Zurich, Switzerland

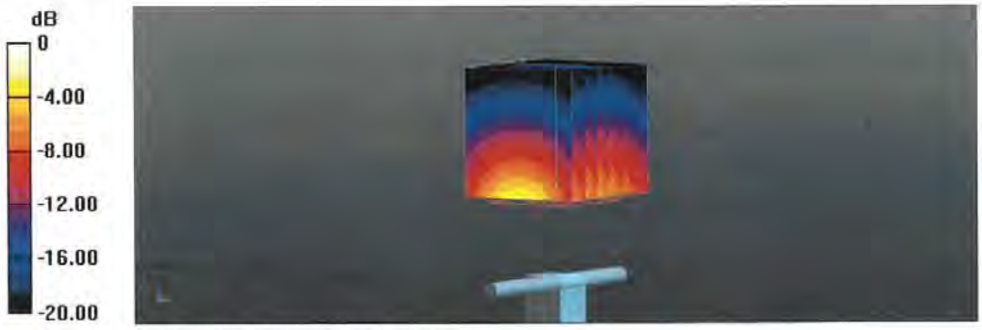
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:735

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.86 S/m; ε_r = 37.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

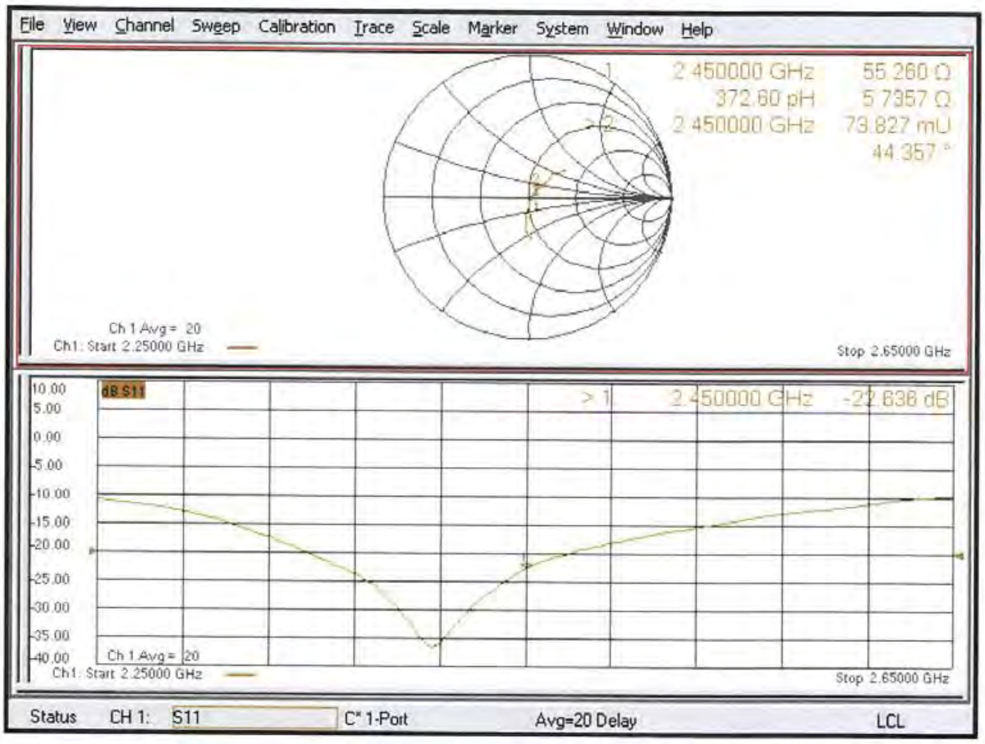
- Probe: EX3DV4 - SN7349; ConvF(7.88, 7.88, 7.88) @ 2450 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 117.4 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 27.2 W/kg
SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.19 W/kg
Maximum value of SAR (measured) = 22.4 W/kg



0 dB = 22.4 W/kg = 13.50 dBW/kg

Impedance Measurement Plot for Head TSL



Certificate No: D2450V2-735_Dec18 Page 6 of 8

DASY5 Validation Report for Body TSL

Date: 11.12.2018

Test Laboratory: SPEAG, Zurich, Switzerland

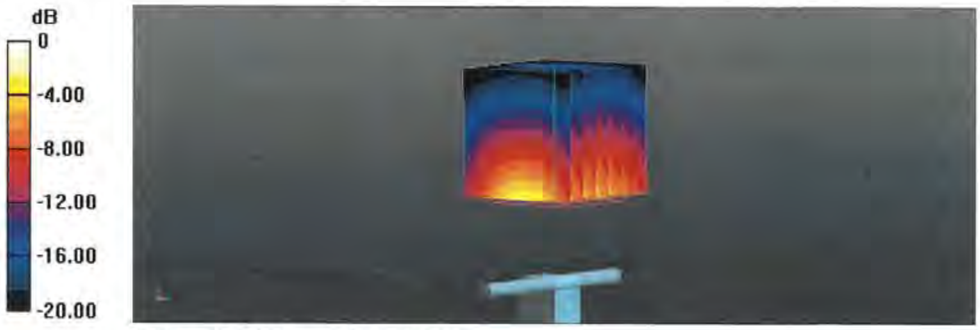
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:735

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.03 S/m; ε_r = 51; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

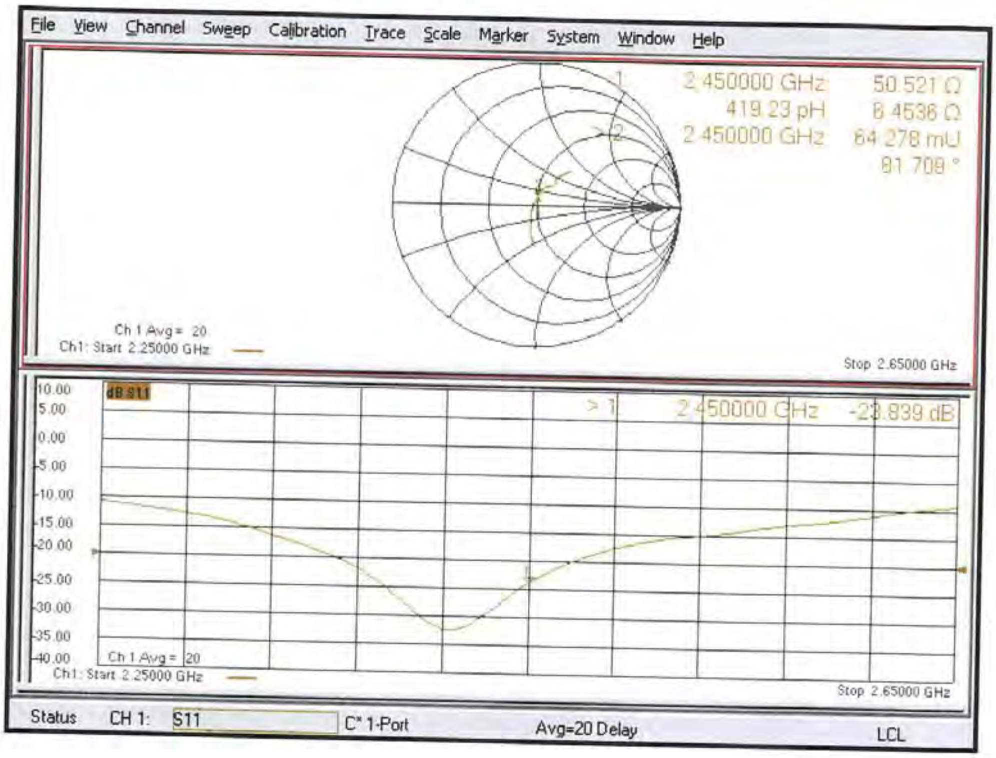
- Probe: EX3DV4 - SN7349; ConvF(8.01, 8.01, 8.01) @ 2450 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 107.2 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 25.8 W/kg
SAR(1 g) = 12.9 W/kg; SAR(10 g) = 6.01 W/kg
Maximum value of SAR (measured) = 21.0 W/kg



0 dB = 21.0 W/kg = 13.22 dBW/kg

Impedance Measurement Plot for Body TSL



Certificate No: D2450V2-735_Dec18 Page 8 of 8

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Client ATL Certificate No: Z19-60131

CALIBRATION CERTIFICATE

Object	D5GHzV2 - SN: 1021
Calibration Procedure(s)	FF-Z11-003-01 Calibration Procedures for dipole validation kits
Calibration date:	April 19, 2019

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Power sensor NRP8S	104291	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
ReferenceProbe EX3DV4	SN 7514	27-Aug-18(SPEAG,No.EX3-7514_Aug18/2)	Aug-19
DAE4	SN 1331	06-Feb-19(SPEAG,No.DAE4-1331_Feb19)	Feb-20
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
Signal Generator E4438C	MY49071430	23-Jan-19 (CTTL, No.J19X00336)	Jan-20
NetworkAnalyzerE5071C	MY46110673	24-Jan-19 (CTTL, No.J19X00547)	Jan-20

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: April 25, 2019

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

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Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

b) IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016

c) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010

d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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Measurement Conditions

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

DASY Version	DASY52	52.10.2.1495
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz	

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.9 ± 6 %	4.58 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.66 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**76.1 W/kg ± 24.4 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.18 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.6 W/kg ± 24.2 % (k=2)**

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Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.5 ± 6 %	4.92 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.16 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**81.0 W/kg ± 24.4 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.29 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.7 W/kg ± 24.2 % (k=2)**

Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.4 ± 6 %	5.07 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.66 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**76.1 W/kg ± 24.4 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.15 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.3 W/kg ± 24.2 % (k=2)**

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Body TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.36 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	50.3 ± 6 %	5.49 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL at 5250 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.39 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**74.4 W/kg ± 24.4 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.09 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.1 W/kg ± 24.2 % (k=2)**

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	49.9 ± 6 %	5.94 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.65 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**77.0 W/kg ± 24.4 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.16 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.8 W/kg ± 24.2 % (k=2)**

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Body TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.3	5.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	49.7 ± 6 %	6.11 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.41 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**74.6 W/kg ± 24.4 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.08 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.0 W/kg ± 24.2 % (k=2)**

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	51.9Ω - 4.22jΩ
Return Loss	- 26.9dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	58.4Ω - 0.27jΩ
Return Loss	- 22.2dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	56.7Ω + 1.19jΩ
Return Loss	- 23.9dB

Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	52.3Ω - 2.82jΩ
Return Loss	- 28.9dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	58.7Ω + 1.14jΩ
Return Loss	- 21.8dB

Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	57.5Ω + 1.49jΩ
Return Loss	- 23.0dB

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General Antenna Parameters and Design

Electrical Delay (one direction)	1.064 ns

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

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

Additional EUT Data

Manufactured by	SPEAG

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DASY5 Validation Report for Head TSL Date: 04.17.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1021

Communication System: CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz,
Medium parameters used: f = 5250 MHz; σ = 4.576 S/m; εr = 34.9; ρ = 1000 kg/m3, Medium parameters used: f = 5600 MHz; σ = 4.923 S/m; εr = 34.46; ρ = 1000 kg/m3, Medium parameters used: f = 5750 MHz; σ = 5.066 S/m; εr = 34.4; ρ = 1000 kg/m3,
Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7514; ConvF(5.02, 5.02, 5.02) @ 5250 MHz; Calibrated: 8/27/2018, ConvF(4.41, 4.41, 4.41) @ 5600 MHz; Calibrated: 8/27/2018, ConvF(4.47, 4.47, 4.47) @ 5750 MHz; Calibrated: 8/27/2018,
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 2/6/2019
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

Dipole Calibration /Pin=100mW, d=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 70.41 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 33.3 W/kg
SAR(1 g) = 7.66 W/kg; SAR(10 g) = 2.18 W/kg
Maximum value of SAR (measured) = 18.1 W/kg

Dipole Calibration /Pin=100mW, d=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 61.17 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 38.8 W/kg
SAR(1 g) = 8.16 W/kg; SAR(10 g) = 2.29 W/kg
Maximum value of SAR (measured) = 21.0 W/kg

Dipole Calibration /Pin=100mW, d=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.86 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 38.0 W/kg
SAR(1 g) = 7.66 W/kg; SAR(10 g) = 2.15 W/kg
Maximum value of SAR (measured) = 19.2 W/kg

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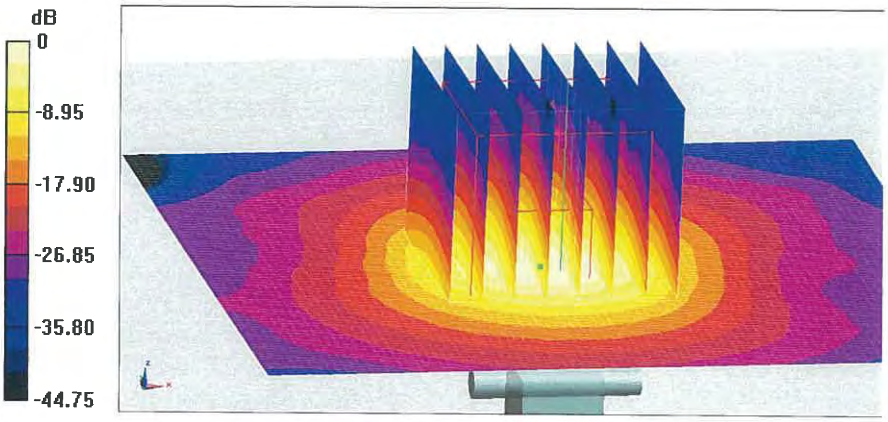

0 dB = 19.2 W/kg = 12.83 dBW/kg

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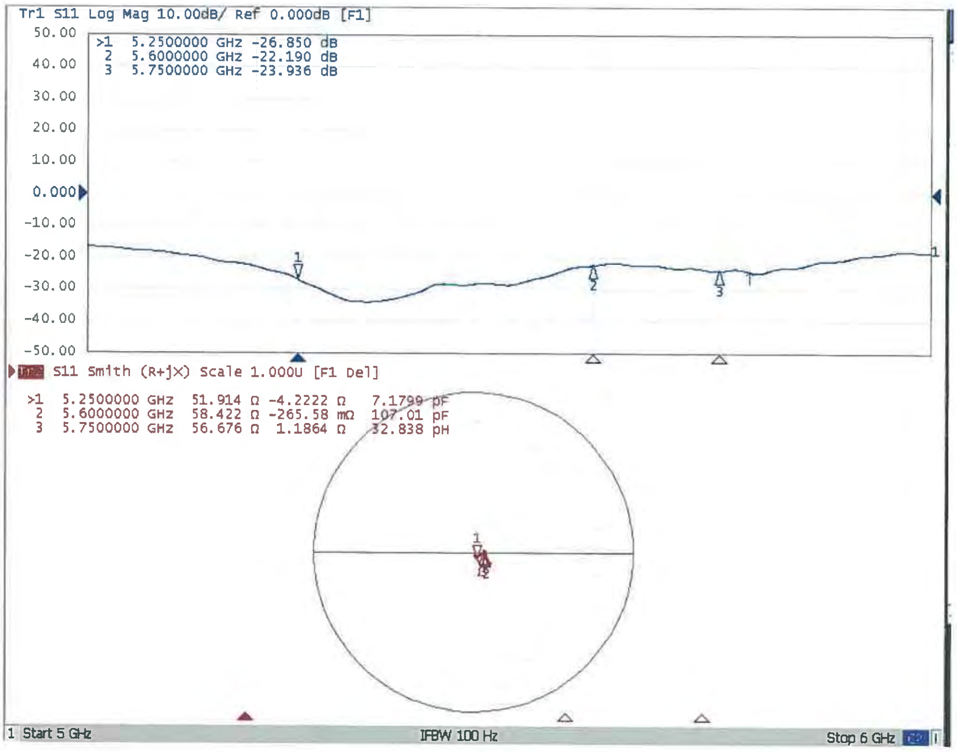
Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL Date: 04.19.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1021

Communication System: CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz,

Medium parameters used: f = 5250 MHz; σ = 5.492 S/m; ε_r = 50.32; ρ = 1000 kg/m3, Medium parameters used: f = 5600 MHz; σ = 5.937 S/m; ε_r = 49.85; ρ = 1000 kg/m3, Medium parameters used: f = 5750 MHz; σ = 6.109 S/m; ε_r = 49.74; ρ = 1000 kg/m3,

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7514; ConvF(4.54, 4.54, 4.54) @ 5250 MHz; Calibrated: 8/27/2018, ConvF(4, 4, 4) @ 5600 MHz; Calibrated: 8/27/2018, ConvF(3.98, 3.98, 3.98) @ 5750 MHz; Calibrated: 8/27/2018,
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 2/6/2019
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

Dipole Calibration /Pin=100mW, d=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 58.99 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 29.9 W/kg
SAR(1 g) = 7.39 W/kg; SAR(10 g) = 2.09 W/kg
Maximum value of SAR (measured) = 17.3 W/kg

Dipole Calibration /Pin=100mW, d=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 54.86 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 35.6 W/kg
SAR(1 g) = 7.65 W/kg; SAR(10 g) = 2.16 W/kg
Maximum value of SAR (measured) = 19.2 W/kg

Dipole Calibration /Pin=100mW, d=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 55.96 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 35.0 W/kg
SAR(1 g) = 7.41 W/kg; SAR(10 g) = 2.08 W/kg
Maximum value of SAR (measured) = 18.5 W/kg

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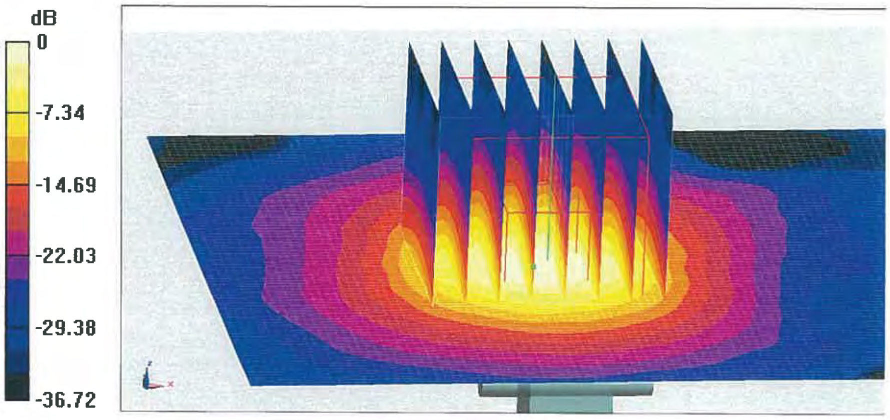

0 dB = 18.5 W/kg = 12.67 dBW/kg

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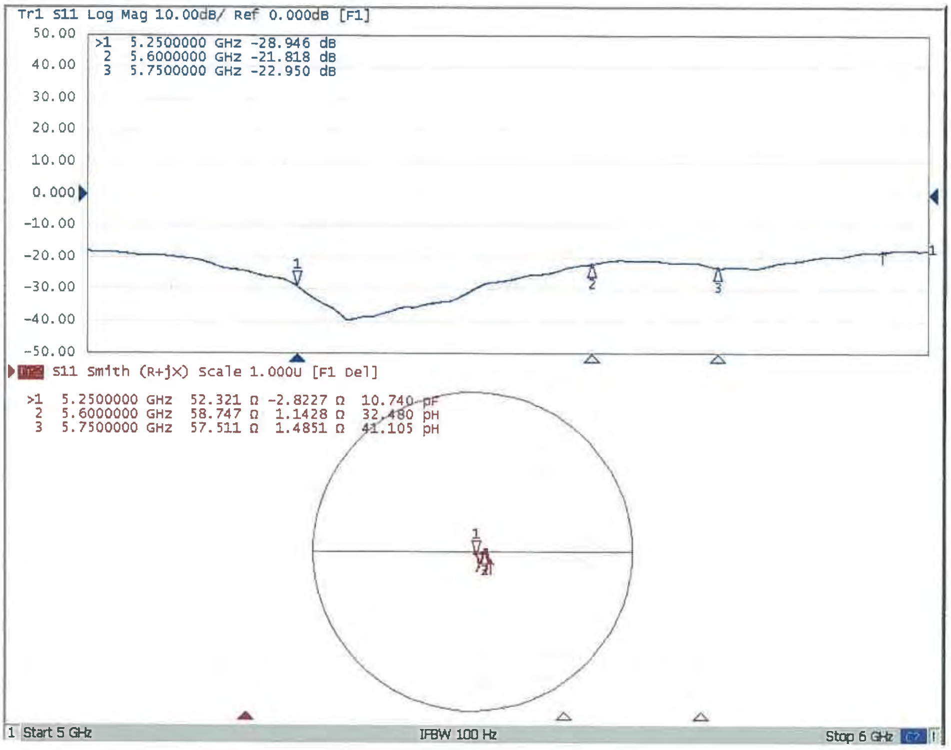
Impedance Measurement Plot for Body TSL



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Client **Auden** **Certificate No: Z18-60104**

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3578

Calibration Procedure(s): FF-Z11-004-01
Calibration Procedures for Dosimetric E-field Probes

Calibration date: May 29, 2018

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	27-Jun-17 (CTTL, No.J17X05857)	Jun-18
Power sensor NRP-Z91	101547	27-Jun-17 (CTTL, No.J17X05857)	Jun-18
Power sensor NRP-Z91	101548	27-Jun-17 (CTTL, No.J17X05857)	Jun-18
Reference10dBAttenuator	18N50W-10dB	09-Feb-18(CTTL, No.J18X01133)	Feb-20
Reference20dBAttenuator	18N50W-20dB	09-Feb-18(CTTL, No.J18X01132)	Feb-20
Reference Probe EX3DV4	SN 3846	25-Jan-18(SPEAG,No.EX3-3846_Jan18)	Jan-19
DAE4	SN 777	15-Dec-17(SPEAG, No.DAE4-777_Dec17)	Dec -18
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
SignalGeneratorMG3700A	6201052605	27-Jun-17 (CTTL, No.J17X05858)	Jun-18
Network Analyzer E5071C	MY46110673	14-Jan-18 (CTTL, No.J18X00561)	Jan -19

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: May 31, 2018

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

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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 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≤900MHz in TEM-cell; f>1800MHz: waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect 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 (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;VRx,y,z:*A,B,C 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≤800MHz) and inside waveguide using analytical field distributions based on power measurements for f >800MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty valued 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±50MHz to±100MHz.
- *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).

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Probe EX3DV4

SN: 3578

Calibrated: May 29, 2018

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3578

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm(μV/(V/m)^2)[A]	0.42	0.38	0.45	±10.0%
DCP(mV)[B]	104.5	108.3	108.1	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	151.8	±2.2%
		Y	0.0	0.0	1.0		142.8	
		Z	0.0	0.0	1.0		161.3	

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 Page 5 and Page 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainly is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3578

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)	Unct. (k=2)
750	41.9	0.89	9.69	9.69	9.69	0.40	0.80	±12.1%
835	41.5	0.90	9.36	9.36	9.36	0.12	1.69	±12.1%
900	41.5	0.97	9.49	9.49	9.49	0.15	1.40	±12.1%
1750	40.1	1.37	8.20	8.20	8.20	0.18	1.16	±12.1%
1900	40.0	1.40	7.93	7.93	7.93	0.20	1.09	±12.1%
2000	40.0	1.40	8.10	8.10	8.10	0.22	1.05	±12.1%
2300	39.5	1.67	7.96	7.96	7.96	0.40	0.75	±12.1%
2450	39.2	1.80	7.51	7.51	7.51	0.40	0.90	±12.1%
2600	39.0	1.96	7.30	7.30	7.30	0.51	0.76	±12.1%
3500	37.9	2.91	6.93	6.93	6.93	0.57	0.95	±13.3%
5250	35.9	4.71	5.44	5.44	5.44	0.40	1.45	±13.3%
5600	35.5	5.07	4.75	4.75	4.75	0.45	1.15	±13.3%
5750	35.4	5.22	4.78	4.78	4.78	0.45	1.55	±13.3%

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

[F] At frequency 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 the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3578

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)	Unct. (k=2)
750	55.5	0.96	9.89	9.89	9.89	0.40	0.80	±12.1%
835	55.2	0.97	9.49	9.49	9.49	0.18	1.39	±12.1%
900	55.0	1.05	9.45	9.45	9.45	0.22	1.19	±12.1%
1750	53.4	1.49	7.92	7.92	7.92	0.18	1.18	±12.1%
1900	53.3	1.52	7.68	7.68	7.68	0.17	1.28	±12.1%
2000	53.3	1.52	7.88	7.88	7.88	0.20	1.18	±12.1%
2300	52.9	1.81	7.65	7.65	7.65	0.50	0.83	±12.1%
2450	52.7	1.95	7.44	7.44	7.44	0.35	1.14	±12.1%
2600	52.5	2.16	7.12	7.12	7.12	0.52	0.81	±12.1%
3500	51.3	3.31	6.57	6.57	6.57	0.64	0.91	±13.3%
5250	48.9	5.36	4.96	4.96	4.96	0.55	1.25	±13.3%
5600	48.5	5.77	4.22	4.22	4.22	0.48	1.40	±13.3%
5750	48.3	5.94	4.34	4.34	4.34	0.49	1.45	±13.3%

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

[F] At frequency 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 the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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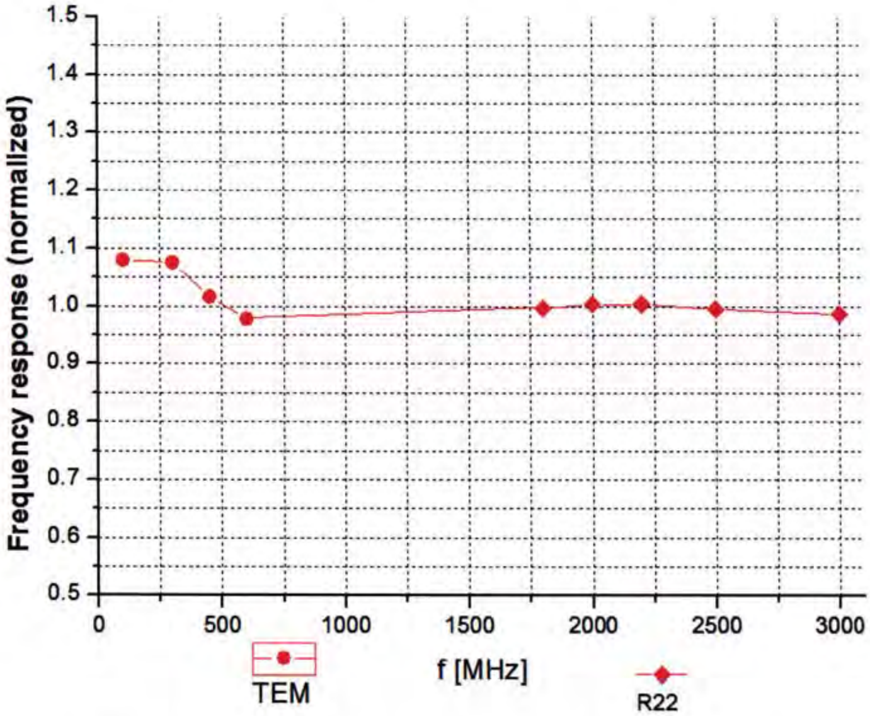
Frequency Response of E-Field
(TEM-Cell: ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ±7.4% (k=2)

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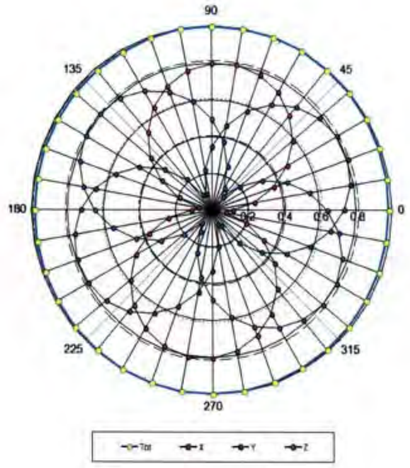
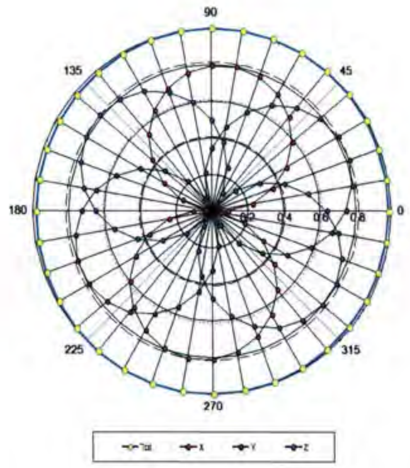
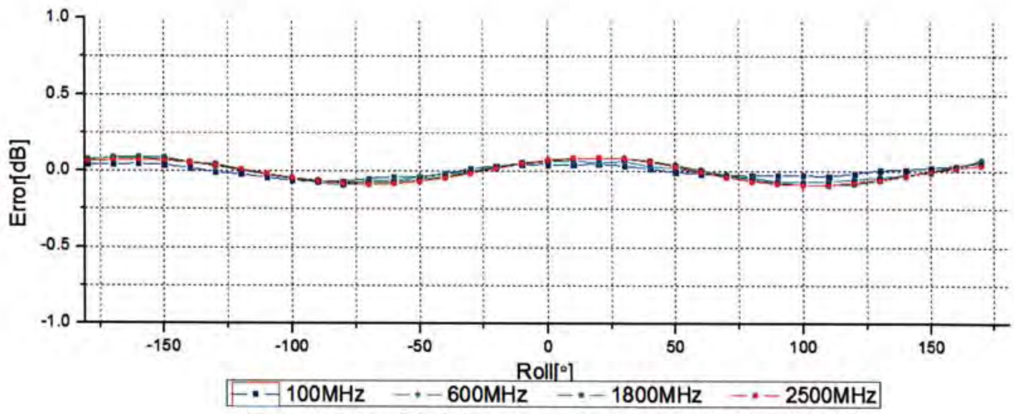
Receiving Pattern (Φ), θ=0°

f=600 MHz, TEM



f=1800 MHz, R22





Uncertainty of Axial Isotropy Assessment: ±1.2% (k=2)

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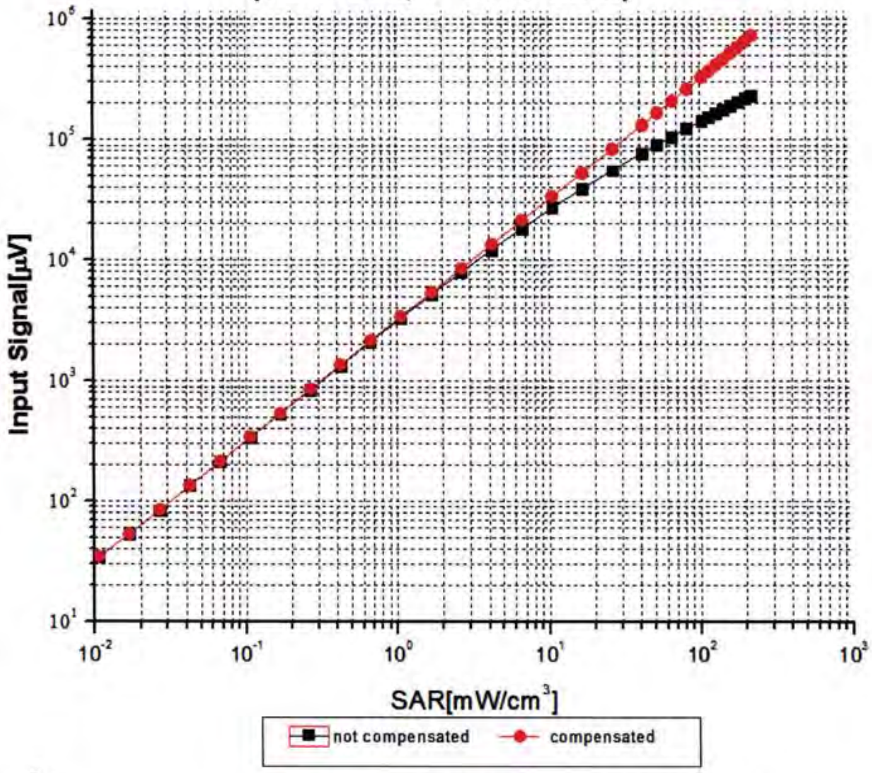
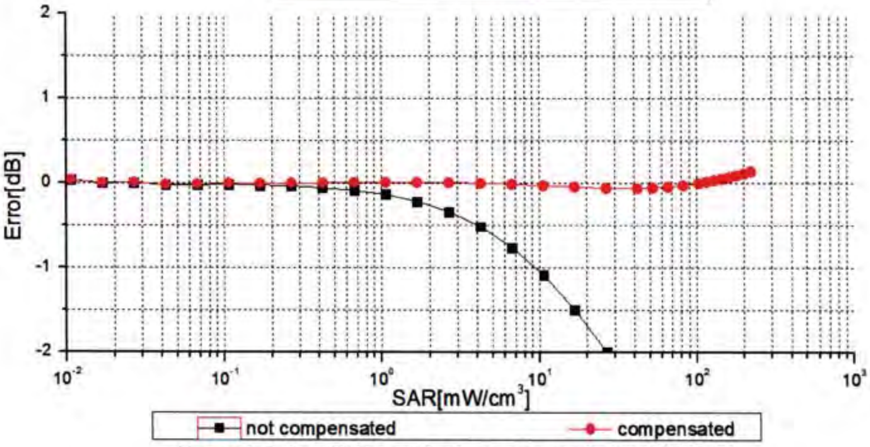
Dynamic Range f(SAR$_{head}$)
(TEM cell, f = 900 MHz)





Uncertainty of Linearity Assessment: ±0.9% (k=2)

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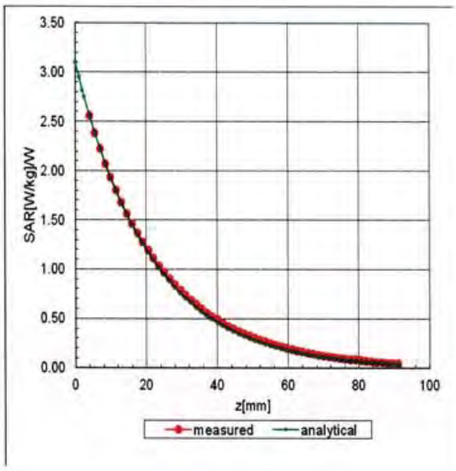
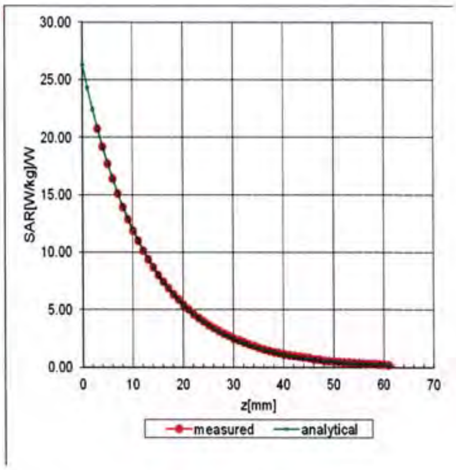
Conversion Factor Assessment

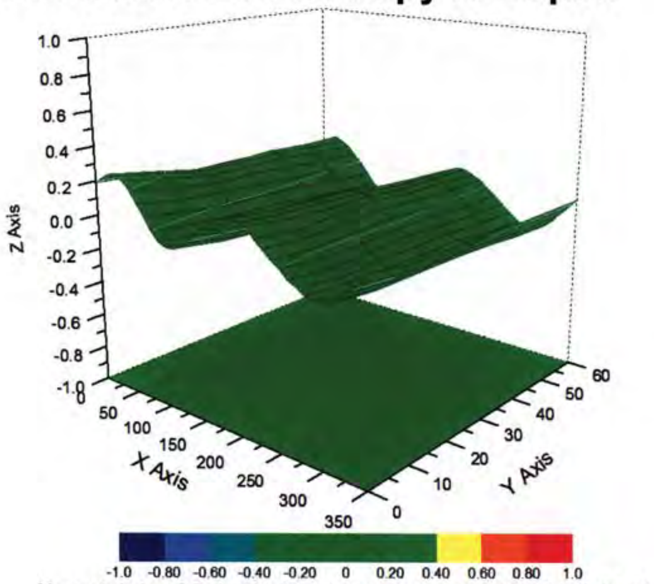
f=750 MHz, WGLS R9(H_convF)



f=1750 MHz, WGLS R22(H_convF)



Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: ±3.2% (K=2)

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3578

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	169.7
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	9mm
Tip Diameter	2.5mm
Probe Tip to Sensor X Calibration Point	1mm
Probe Tip to Sensor Y Calibration Point	1mm
Probe Tip to Sensor Z Calibration Point	1mm
Recommended Measurement Distance from Surface	1.4mm

MR-008_19-056

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Client : ATL

Certificate No: Z19-60080

CALIBRATION CERTIFICATE

Object	DAE4 - SN: 541
Calibration Procedure(s)	FF-Z11-002-01 Calibration Procedure for the Data Acquisition Electronics (DAEx)
Calibration date:	March 19, 2019

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Process Calibrator 753	1971018	20-Jun-18 (CTTL, No.J18X05034)	June-19

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: March 20, 2019

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Glossary:

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters:

- *DC Voltage Measurement*: Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The report provide only calibration results for DAE, it does not contain other performance test results.

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DC Voltage Measurement

A/D - Converter Resolution nominal
High Range: 1LSB = 6.1μV , full range = -100…+300 mV
Low Range: 1LSB = 61nV , full range = -1…….+3mV
DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	404.544 ± 0.15% (k=2)	404.406 ± 0.15% (k=2)	404.170 ± 0.15% (k=2)
Low Range	3.96863 ± 0.7% (k=2)	3.93444 ± 0.7% (k=2)	3.97515 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	288.5° ± 1 °