Registration
No.788871

TEST REPORT
FOR SAR TESTING

Report No.: SRTC2018-9004(F)-18111202(H)

Product Name: Mobile Phone

Product Model: KS605

Applicant: Hisense International Co., Ltd.

Manufacturer: Hisense Communications Co., Ltd.

Specification: Part 2.1093

IEEE Std 1528

KDB Procedures

FCC ID: 2ADOBKS605

The State Radio_monitoring_center Testing Center (SRTC)

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Contents

1. GENERAL INFORMATION

1.1 Notes of the test report

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The test results relate only to individual items of the samples which have been tested.

1.2 Information about the testing laboratory

Company:	The State Radio_monitoring_center Testing Center (SRTC)
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1.3 Applicant's details

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1.4 Manufacturer's details

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1.5 Test Environment

Date of Receipt of test sample at SRTC:	2018.11.12
Testing Start Date:	2018.11.14
Testing End Date:	2018.11.28

Environmental Data:	Temperature (°C)	Humidity (%)
Ambient	21-23	40-45

Normal Supply Voltage (V d.c.):	3.8

2. DESCRIPTION OF THE DEVICE UNDER TEST

2.1 Final Equipment Build Status

Wireless Technology and Frequency Bands	☒GSM Band: GSM850/PCS1900 ☒WCDMA Band: FDD2/5 ☐LTE Band ☒Bluetooth Band: 2.4GHz ☒Wi-Fi Band: 2.4GHz
Mode	GSM ☒Voice (GMSK) ☒GPRS (GMSK) ☒EGPRS (GMSK) WCDMA ☒UMTS Rel. 99 (Voice & Data) ☒HSDPA (Rel. 5) ☒HSUPA (Rel. 6) ☐HSPA+ (Rel.) ☐DC-HSDPA (Rel.) Wi-Fi (802.11a/b/g/n) ☐802.11a ☒802.11b ☒802.11g ☒802.11n (20MHz) ☐802.11n (40MHz) ☐802.11ac (20MHz) ☐802.11ac (40MHz) ☐802.11ac (80MHz) Bluetooth ☒BR(GFSK) ☒EDR (π/4 DQPSK, 8-DPSK) ☒BLE(GFSK) LTE ☐QPSK ☐16QAM ☐64QAM
Duty Cycle	GSM Voice: 12.5%; GPRS: 12.5% (1 Slot), 25% (2 Slots), 37.5% (3 Slots), 50% (4 Slots) WCDMA: 100% Wi-Fi 802.11b/g/n: 100% Bluetooth: 32.25% (DH1), 66.68% (DH3), 77.52% (DH5)
GPRS/EGPRS Multi-Slot Class	☐Class 8 - One Up ☐Class 10 - Two Up ☒Class 12 - Four Up
Mobile Phone Capability	☐Class A - Mobile phones can be connected to both GPRS and GSM services simultaneously. ☒Class B - Mobile phones can be attached to both GPRS and GSM services, using one service at a time. ☐Class C - Mobile phones are attached to either GPRS or GSM voice service. You need to switch manually between services
DTM (Dual Transfer Mode)	Not Supported

2.2 Support Equipment

The following support equipment was used to exercise the DUT during testing:

State of sample	Normal
Headset	B1G513A07
Batteries	LIW38150A/Li-Lon
H/W Version S/W Version	V1.00 Hisense_U605_01_S02_20181102
IMEI	866747040002577
Notes	As the information described above, we use test sample offered by the customer. The relevant tests have been performed in order to verify in which combination case the EUT would have the worst features.

3. REFERENCE SPECIFICATION

Specification	Version	Title
Part 2.1093	2018	Radiofrequency radiation exposure evaluation: portable devices.
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
IEEE Std 1528a	2005	IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques Amendment 1: CAD File for Human Head Model (SAM Phantom)
KDB 447498 D01	v06	General RF Exposure Guidance
KDB 648474 D04	v01r03	Handset SAR
KDB 941225 D01	v03r01	3G SAR Procedures
KDB 941225 D06	v02r01	Hotspot Mode
KDB 248227 D01	v02r02	SAR GUIDANCE FOR IEEE 802.11 (Wi-Fi) TRANSMITTERS
KDB 865664 D01	v01r04	SAR Measurement from 100 MHz to 6 GHz
KDB 865664 D02	v01r02	RF Exposure Reporting
KDB 941225 D05	v02r05	SAR for LTE Devices

4. TEST CONDITIONS

4.1 Picture to demonstrate the required liquid depth

The liquid depth in the used SAM phantoms

Liquid depth for SAR Measurement

4.2 Test Signal, Frequencies and Output Power

The device was put into operation by using a call tester. Communication between the device and the call tester was established by air link.
The device output power was set to maximum power level for all tests; a fully charged battery was used for every test sequence.
In all operating bands the measurements were performed on middle channel, and few of them were also performed on lowest and highest channels.

4.3 SAR Measurement Set-up

The system is based on a high precision robot (working range greater than 0.9m), which positions the probes with a positional repeatability of better than ± 0.02mm. Special E-field probes have been developed for measurements close to material discontinuity, the sensors of which are directly loaded with a Schottky diode and connected via highly resistive lines (length =300mm) to the data acquisition unit. A cell controller system contains the power supply, robot controller, teaches pendant (Joystick), and remote control, is used to drive the robot motors.

The PC consists of the Micron Pentium IV computer with Win7 system and SAR Measurement Software DASY5 Professional, A/D interface card, monitor, mouse, and keyboard. The Stäubli Robot is connected to the cell controller to allow software manipulation of the robot.
A data acquisition electronic (DAE) circuit performs the signal amplification; signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card. The DAE consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines.
The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection
The robot uses its own controller with a built in VME-bus computer.

4.4 Phantoms

The phantom used for all tests i.e. for both system checks and device testing, was the twin headed "SAM Phantom", manufactured by SPEAG. The phantom conforms to the requirements of IEEE 1528 - 2013.
System checking was performed using the flat section, whilst Head SAR tests used the left and right head profile sections. Body SAR testing also used the flat section between the head profiles.
The SPEAG device holder (see Section 5.1) was used to position the device in all tests whilst a tripod was used to position the validation dipoles against the flat section of phantom.

4.5 Tissue Simulants

Recommended values for the dielectric parameters of the tissue simulants are given in IEEE 1528 - 2013 and FCC Supplement C to OET Bulletin 65. All tests were carried out using simulants whose dielectric parameters were within ± 5% of the recommended values. All tests were carried out within 24 hours of measuring the dielectric parameters.
The depth of the tissue simulant was 15.0 ± 0.5 cm measured from the ear reference point during system checking and device measurements.

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4.5.1 Tissue Stimulant Recipes

The following tissue stimulants were used for Head and Body test:

Name	Broadband tissue-equivalent liquid
Type for Head	HBBL600-6000V6 Head Simulating Liquid
Type for Body	MBBL600-6000V6 Body Simulating Liquid

4.6 DESCRIPTION OF THE TEST PROCEDURE

4.6.1 Device Holder

The device was placed in the device holder (illustrated below) that is supplied by SPEAG as an integral part of the Dasy5 system.

Device holder supplied by SPEAG

4.6.2 Test positions

4.6.2.1 Against Phantom Head

Measurements were made in “cheek” and “tilt” positions on both the left hand and right-hand sides of the phantom.
The positions used in the measurements were according to IEEE 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".

4.6.2.2 Body Worn Configuration

The device was placed in the SPEAG holder below the flat section of the phantom. The distance between the device and the phantom was kept at the separation distance using a separate flat spacer that was removed before the start of the measurements. And the distance is 10mm.The device was oriented with its antenna facing the phantom since this orientation gives higher results.

4.6.3 Scan Procedure

First, area scans were used for determination of the field distribution and the approximate location of the local peak SAR values. The SAR distribution is scanned along the inside surface, at least for an area larger than the projection of the handset and antenna. The angle between the probe axis and the surface normal line is recommended but not required to be less than 30°. The SAR distribution is first measured on a 2-D coarse grid. The scan region should cover all areas that are exposed and encompassed by the projection of the handset. There are 15 mm × 15 mm (equal or less than 2GHz), 12 mm × 12 mm (from 2GHz~3GHz) and 10mm x 10mm (above 5GHz) measurement grid used when two staggered one-dimensional cubic splines are used to estimate the maximum SAR location. Next, a zoom scan, a minimum of 7 x 7x7 points covering a volume of at least 30x30x30mm, was performed around the highest E-field value to determine the averaged SAR value. Drift was determined by measuring the same point at the start of the area scan and again at the end of the zoom scan.

4.6.4 SAR Averaging Methods

The maximum SAR value was averaged over a cube of tissue using interpolation and extrapolation.
The interpolation, extrapolation and maximum search routines within DASY5 are all based on the modified Quadratic Shepard’s method (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).
The interpolation scheme combines a least-square fitted function method with a weighted average method. A triradiate 3-D / bivariate 2-D quadratic function is computed for each measurement point and fitted to neighboring points by a least-square method. For the zoom scan, inverse distance weighting is incorporated to fit distant points more accurately. The interpolating function is finally calculated as a weighted average of the quadratics.
In the zoom scan, the interpolation function is used to extrapolate the Peak SAR from the deepest measurement points to the inner surface of the phantom.

5 RESULT SUMMAR

The maximum reported SAR values for Head configuration and Body Worn configuration are given as follows. The device conforms to the requirements of the standard(s) when the maximum reported SAR value is less than or equal to the limit.

Exposure Position	Frequency Band	1g-SAR Reported Result (W/kg)	Highest 1g-SAR Reported Result (W/kg)		Limit (W/kg)/1g	Result
Head	GSM 850	0.55	0.84	1.27	1.6	pass
	GSM 1900	0.39				
	WCDMA Band 2	0.63				
	WCDMA Band 5	0.44				
	WLAN 2.4GHz Band	0.84				
Body Worn (10mm Gap)	GSM 850	1.27	1.27			
	GSM 1900	0.69				
	WCDMA Band 2	0.95				
	WCDMA Band 5	1.10				
	WLAN 2.4GHz Band	0.13				
Hotspot (10mm Gap)	GSM 850	1.27	1.27			
	GSM 1900	1.01				
	WCDMA Band 2	1.06				
	WCDMA Band 5	1.10				
	WLAN 2.4GHz Band	0.16				

Simultaneous Transmission Summary

Exposure Position	Frequency Band	1g-SAR Result(W/kg)	Highest 1g-SAR Result(W/kg)		Limit (W/kg) /1g	Result
Head	GSM & Wi-Fi	1.23	1.47	1.47	1.6	pass
	WCDMA & Wi-Fi	1.47				
	GSM & Bluetooth	0.64				
	WCDMA & Bluetooth	0.72				
Body Worn (10mm Gap)	GSM & Wi-Fi	1.39	1.39			
	WCDMA & Wi-Fi	1.22				
	GSM & Bluetooth	1.31				
	WCDMA & Bluetooth	1.14				
Hotspot (10mm Gap)	GSM & Wi-Fi	1.39	1.39			
	WCDMA & Wi-Fi	1.22				

This Test Report Is Issued by: Mr. Peng Zhen	Checked by: Mr. Li Bin
Tested by: Mr. Chang Tianyu	Issued date: 20181203

6 TEST RESULT

6.1 Manufacturing Tolerance

GSM

GSM 850			
Channel	Channel 128	Channel 189	Channel 251
Tolerance (dBm)	30.0~34.0	30.0~34.0	30.0~34.0
GSM 1900			
Channel	Channel 512	Channel 661	Channel 810
Tolerance (dBm)	26.5~30.5	26.5~30.5	26.5~30.5

GSM 850 GPRS				
Channel		128	189	251
1 Txslot	Tolerance (dBm)	30.0~34.0	30.0~34.0	30.0~34.0
2 Txslot	Tolerance (dBm)	28.0~32.0	28.0~32.0	28.0~32.0
3 Txslot	Tolerance (dBm)	26.5~30.5	26.5~30.5	26.5~30.5
4 Txslot	Tolerance (dBm)	24.5~28.5	24.5~28.5	24.5~28.5

GSM 850 EGPRS(GMSK)				
Channel		128	189	251
1 Txslot	Tolerance (dBm)	30.0~34.0	30.0~34.0	30.0~34.0
2 Txslot	Tolerance (dBm)	28.0~32.0	28.0~32.0	28.0~32.0
3 Txslot	Tolerance (dBm)	26.5~30.5	26.5~30.5	26.5~30.5
4 Txslot	Tolerance (dBm)	24.5~28.5	24.5~28.5	24.5~28.5

GSM 1900 GPRS				
Channel		512	661	810
1 Txslot	Tolerance (dBm)	26.5~30.5	26.5~30.5	26.5~30.5
2 Txslot	Tolerance (dBm)	24.5~28.5	24.5~28.5	24.5~28.5
3 Txslot	Tolerance (dBm)	23.0~27.0	23.0~27.0	23.0~27.0
4 Txslot	Tolerance (dBm)	21.5~25.5	21.5~25.5	21.5~25.5

GSM 1900 EGPRS (GMSK)				
Channel		512	661	810
1 Txslot	Tolerance (dBm)	26.5~30.5	26.5~30.5	26.5~30.5
2 Txslot	Tolerance (dBm)	24.5~28.5	24.5~28.5	24.5~28.5
3 Txslot	Tolerance (dBm)	23.0~27.0	23.0~27.0	23.0~27.0
4 Txslot	Tolerance (dBm)	21.5~25.5	21.5~25.5	21.5~25.5

WCDMA

WCDMA Band2			
Channel	9262	9400	9538
Tolerance (dBm)	18.50~22.50	18.50~22.50	18.50~22.50
WCDMA Band5			
Channel	4132	4183	4233
Tolerance (dBm)	19.50~23.50	19.50~23.50	19.50~23.50

HSDPA Band2				
Channel		9262	9400	9538
Sub test 1	Tolerance (dBm)	17.0~21.0	17.0~21.0	17.0~21.0
Sub test 2	Tolerance (dBm)	17.0~21.0	17.0~21.0	17.0~21.0
Sub test 3	Tolerance (dBm)	17.0~21.0	17.0~21.0	17.0~21.0
Sub test 4	Tolerance (dBm)	17.0~21.0	17.0~21.0	17.0~21.0
HSDPA Band5				
Channel		4132	4183	4233
Sub test 1	Tolerance (dBm)	18.0~22.0	18.0~22.0	18.0~22.0
Sub test 2	Tolerance (dBm)	18.0~22.0	18.0~22.0	18.0~22.0
Sub test 3	Tolerance (dBm)	18.0~22.0	18.0~22.0	18.0~22.0
Sub test 4	Tolerance (dBm)	18.0~22.0	18.0~22.0	18.0~22.0

HSUPA Band2				
Channel		9262	9400	9538
Sub test 1	Tolerance (dBm)	16.5~20.5	16.5~20.5	16.5~20.5
Sub test 2	Tolerance (dBm)	16.5~20.5	16.5~20.5	16.5~20.5
Sub test 3	Tolerance (dBm)	16.5~20.5	16.5~20.5	16.5~20.5
Sub test 4	Tolerance (dBm)	16.5~20.5	16.5~20.5	16.5~20.5
Sub test 5	Tolerance (dBm)	16.5~20.5	16.5~20.5	16.5~20.5

HSUPA Band5				
Channel		4132	4183	4233
Sub test 1	Tolerance (dBm)	17.5~21.5	17.5~21.5	17.5~21.5
Sub test 2	Tolerance (dBm)	17.5~21.5	17.5~21.5	17.5~21.5
Sub test 3	Tolerance (dBm)	17.5~21.5	17.5~21.5	17.5~21.5
Sub test 4	Tolerance (dBm)	17.5~21.5	17.5~21.5	17.5~21.5
Sub test 5	Tolerance (dBm)	17.5~21.5	17.5~21.5	17.5~21.5

Bluetooth

GFSK			
Channel	0	39	78
Tolerance (dBm)	-0.5~3.5	-0.5~3.5	-0.5~3.5
π/4DQPSK			
Channel	0	39	78
Tolerance (dBm)	-3.0~1.0	-3.0~1.0	-3.0~1.0
8DPSK			
Channel	0	39	78
Tolerance (dBm)	-3.0~1.0	-3.0~1.0	-3.0~1.0

Bluetooth (BLE)

GFSK			
Channel	0	19	39
Tolerance (dBm)	-14.0~-10.0	-14.0~-10.0	-14.0~-10.0

Wi-Fi (2.4GHz)

802.11b			
Channel	1	6	11
Tolerance (dBm)	9.5~13.5	10.5~14.5	11.0~15.0
802.11g			
Channel	1	6	11
Tolerance (dBm)	7.5~11.5	11.0~14.0	11.0~14.0
802.11n HT20			
Channel	1	6	11
Tolerance (dBm)	7.5~11.5	8.5~12.5	8.5~12.5

6.2 GSM Measurement result

GSM Measured Power

Mode	GSM850			GSM1900		
Channel	128	189	251	512	661	810
Frequency (MHz)	824.2	836.4	848.8	1850.2	1880.0	1909.8
Measured Power(dBm)	33.46	33.50	33.31	30.21	30.22	30.19

GSM Frame Average Power

Mode	GSM850			GSM1900		
Channel	128	189	251	512	661	810
Frequency (MHz)	824.2	836.4	848.8	1850.2	1880.0	1909.8
Frame Average Power (dBm)	24.43	24.47	24.28	21.18	21.19	21.16

GPRS Measured Power

Mode	GPRS850			GPRS1900		
Channel	128	189	251	512	661	810
Frequency (MHz)	824.2	836.4	848.8	1850.2	1880.0	1909.8
4Downlink1uplinkPower(dBm)	33.45	33.50	33.31	30.42	30.24	30.18
3Downlink2uplinkPower(dBm)	31.59	31.58	31.42	27.93	28.08	28.27
2Downlink3uplinkPower(dBm)	**30.10**	**30.02**	**29.89**	**26.64**	**26.80**	**27.00**
1Downlink4uplinkPower(dBm)	28.44	28.36	28.20	24.86	25.02	25.26

GPRS Frame Average Power

Mode	GPRS850			GPRS1900		
Channel	128	189	251	512	661	810
Frequency (MHz)	824.2	836.4	848.8	1850.2	1880.0	1909.8
4Downlink1uplinkPower(dBm)	24.42	24.47	24.28	21.39	21.21	21.15
3Downlink2uplinkPower(dBm)	25.57	25.56	25.40	21.91	22.06	22.25
2Downlink3uplinkPower(dBm)	**25.84**	**25.76**	**25.63**	**22.38**	**22.54**	**22.74**
1Downlink4uplinkPower(dBm)	25.43	25.35	25.19	21.85	22.01	22.25

Division Factors (for Measured Power and Frame Average Power):
To average the power, the division factor is as follows:
1TX-slot (4Downlink1uplink) = 1 transmit time slot out of 8 time slots=> conducted power divided by (8/1) => -9.03dB
2TX-slots(3Downlink2uplink) = 2 transmit time slots out of 8 time slots=> conducted power divided by (8/2) => -6.02dB
3TX-slots (2Downlink3uplink) = 3 transmit time slots out of 8 time slots=> conducted power divided by (8/3) => -4.26dB
4TX-slots (1Downlink4uplink) = 4 transmit time slots out of 8 time slots=> conducted power divided by (8/4) => -3.01dB
According to the conducted power as above, the body measurements are performed with **3Txslots** (2Downlink3uplink) for GPRS.

EGPRS Measured Power

Mode	EGPRS850(GMSK)			EGPRS1900(GMSK)		
Channel	128	189	251	512	661	810
Frequency (MHz)	824.2	836.4	848.8	1850.2	1880.0	1909.8
4Downlink1uplinkPower(dBm)	33.45	33.50	33.31	30.42	30.24	30.18
3Downlink2uplinkPower(dBm)	31.59	31.58	31.42	27.93	28.08	28.27
2Downlink3uplinkPower(dBm)	30.10	30.02	29.89	26.64	26.80	27.00
1Downlink4uplinkPower(dBm)	28.44	28.36	28.20	24.86	25.02	25.26

EGPRS Frame Average Power

Mode	EGPRS850(GMSK)			EGPRS1900(GMSK)		
Channel	128	189	251	512	661	810
Frequency (MHz)	824.2	836.4	848.8	1850.2	1880.0	1909.8
4Downlink1uplinkPower(dBm)	24.42	24.47	24.28	21.39	21.21	21.15
3Downlink2uplinkPower(dBm)	25.57	25.56	25.40	21.91	22.06	22.25
2Downlink3uplinkPower(dBm)	25.84	25.76	25.63	22.38	22.54	22.74
1Downlink4uplinkPower(dBm)	25.43	25.35	25.19	21.85	22.01	22.25

Division Factors (for Measured Power and Frame Average Power):

To average the power, the division factor is as follows:

1TX-slot (4Downlink1uplink) = 1 transmit time slot out of 8 time slots=> conducted power divided by (8/1) => -9.03dB

2TX-slots(3Downlink2uplink) = 2 transmit time slots out of 8 time slots=> conducted power divided by (8/2) => -6.02dB

3TX-slots (2Downlink3uplink) = 3 transmit time slots out of 8 time slots=> conducted power divided by (8/3) => -4.26dB

4TX-slots (1Downlink4uplink) = 4 transmit time slots out of 8 time slots=> conducted power divided by (8/4) => -3.01dB

According to the conducted power as above, the body measurements are performed with **3Txslots** (2Downlink3uplink) for EGPRS (GMSK).

Note: EGPRS do not support 8PSK modulation type.

6.3 WCDMA Measurement result

The following procedures are according to FCC KDB Publication 941225 D01.
Release 99
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).

Mode	Subtest	Rel99
WCDMA General Settings	Loopback Mode	Test Mode 1
	Rel99 RMC	12.2kbps RMC
	Power Control Algorithm	Algorithm2
	βc/βd	8/15

Measured Results

Mode	Band2			Band5		
Channel	9262	9400	9538	4132	4183	4233
Frequency (MHz)	1852.4	1880	1907.6	826.4	836.4	846.6
RB test mode1+64kRMC(dBm)	21.84	22.12	22.00	22.77	22.58	23.06
RB test mode1+12.2kRMC(dBm)	**21.86**	**22.18**	**22.02**	**22.79**	**22.62**	**23.10**
RB test mode1+144kRMC(dBm)	21.85	22.09	21.99	22.82	22.61	23.08
RB test mode1+384kRMC(dBm)	21.84	22.08	21.98	22.83	22.61	23.09

HSDPA
The following 4 Sub-tests were completed according to Release 5 procedures in section 5.2 of 3GPP TS34.121.

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{hs} (1)	CM(dB) (2)
1	2/15	15/15	64	2/15	4/15	0.0
2	12/15(3)	15/15(3)	64	12/15(3)	24/15	1.0
3	15/15	8/15	64	15/18	30/15	1.5
4	15/15	4/15	64	15/4	30/15	1.5

Note1: $\triangle_{ACK}$, $\triangle_{NACK}$ and $\triangle_{CQI}$ =8⇔ $A_{hs}=\beta_{hs}/\beta_c=30/15$⇔$\beta_{hs}=30/15*\beta_c$.
Note2:CM=1 for $\beta_c/\beta_d=12/15$, $\beta_{hs}/\beta_c=24/15$.
Note3: For subtest 2 the β_c/β_d 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 $\beta_c=11/15$ and $\beta_d=15/15$.

Measured Results

Mode	HSDPA Band 2			HSDPA Band 5		
Channel	9262	9400	9538	4132	4183	4233
Frequency (MHz)	1852.4	1880	1907.6	826.4	836.4	846.6
sub-test1(dBm)	20.33	20.61	20.52	21.26	21.56	21.06
sub-test2(dBm)	20.34	20.67	20.51	21.25	21.60	21.13
sub-test3(dBm)	20.36	20.56	20.45	21.34	21.59	21.14
sub-test4(dBm)	20.35	20.57	20.46	21.32	21.57	21.10

HSUPA

The following 5 Sub-tests were completed according to Release 6 procedures in section 5.2 of 3GPP TS34.121.

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{hs} (1)	β_{ec}	β_{ed}	β_{ed} (SF)	β_{ed} (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	2.0	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	β_{ed1}:47/15 β_{ed2}:47/15	4	2	2.0	2.0	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	2.0	21	81

Note1: Δ_{ACK}, Δ_{NACK} and Δ_{CQI} =8⇔$A_{hs}=\beta_{hs}/\beta_c$=30/15⇔$\beta_{hs}$=30/15*$\beta_c$.

Note2: CM=1 for β_c/β_d =12/15, β_{hs}/β_c=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.

Note3: For subtest 1 the β_c/β_d 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 β_c=10/15 and β_d=15/15.

Note4: For subtest 5 the β_c/β_d 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 β_c=14/15 and β_d=15/15.

NOTE5: Testing UE using E-DPDCH Physical layer category 1 Sub-test 3 is not required according to TS 25.306 Table 5.1g.

NOTE6: β_{ed} can not be set directly; it is set by Absolute Grant Value.

Measured Results

Mode	HSUPA Band 2			HSUPA Band 5		
Channel	9262	9400	9538	4132	4183	4233
Frequency (MHz)	1852.4	1880	1907.6	826.4	836.4	846.6
sub-test1(dBm)	20.23	20.50	20.42	21.17	20.98	21.26
sub-test2(dBm)	20.14	20.47	20.31	21.29	21.22	21.49
sub-test3(dBm)	20.16	20.36	20.25	21.32	20.91	21.28
sub-test4(dBm)	20.15	20.27	20.16	21.03	20.90	21.49
sub-test5(dBm)	20.18	20.25	20.14	21.16	20.95	21.50

Note: UMTS SAR was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01.HSPA SAR was not required since the average output power of the HSPA subtests was not more than 0.25 dB higher than the RMC level and SAR was less than 1.2 W/kg.

6.4 Bluetooth Measurement result

Modulation type	Test Result (dBm)		
	2402MHz (Ch0)	2441MHz (Ch39)	2480MHz (Ch78)
GFSK	3.27	3.31	3.44
π/4DQPSK	0.63	0.08	0.45
8DPSK	0.68	0.19	0.08
GFSK(BLE)	2402MHz (Ch0)	2440MHz (Ch19)	2480MHz (Ch39)
	-12.34	-11.94	-10.92

6.5 Wi-Fi Measurement result

WIFI 2.4GHz

Modulation type	Average power output (dBm)		
	2412MHz	2437MHz	2462MHz
11b	13.33	14.16	14.59
11g	11.02	13.69	13.98
11n HT20	11.03	12.07	12.28

6.6 Standalone SAR Test Exclusion Considerations

Standalone 1-g head or body SAR evaluation by measurement or numerical simulation is not required when the corresponding SAR Exclusion Threshold condition, listed below, is satisfied.

SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and ≤ 50 mm

According to the KDB447498 4.3.1 (1)

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:

[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] · [√f (GHz)] ≤ 3.0 for 1-g SAR, where

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

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm, and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

This is equivalent to [(max. power of channel, including tune-up tolerance, mW)/(60/√f(GHz) mW)] ·[20 mm/(min.test separation distance, mm)] ≤ 1.0 for 1-g SAR; also see Appendix A for approximate exclusion threshold values at selected frequencies and distances.
According to the KDB447498 appendix A

Approximate SAR Test Exclusion Power Thresholds at Selected Frequencies and Test Separation Distances are illustrated in the following Table.

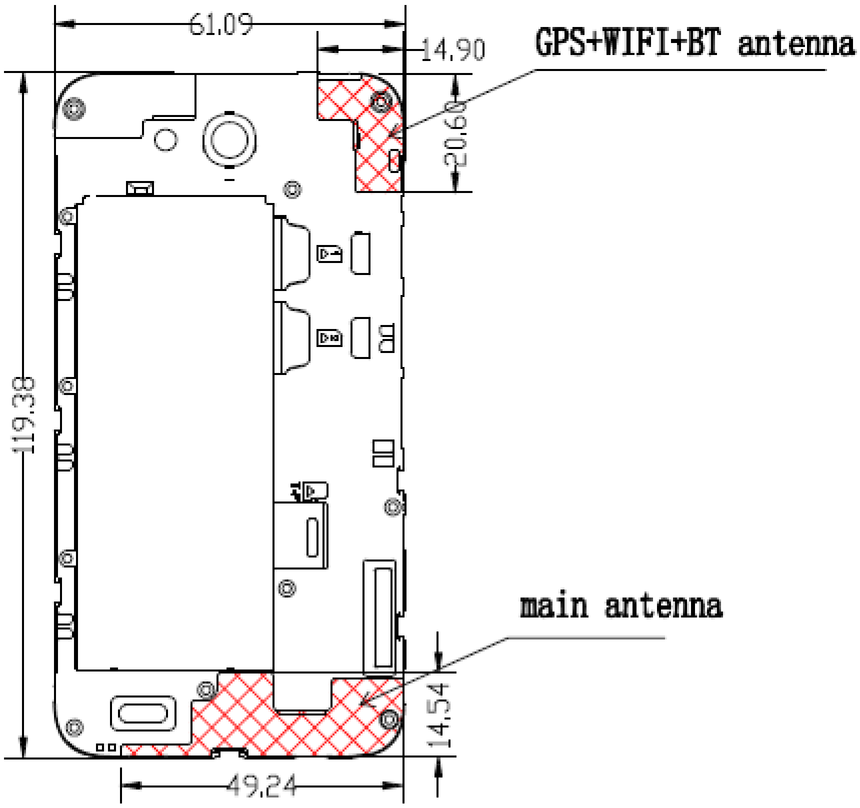
MHz	5	10	15	20	25	mm
150	39	77	116	155	194	*SAR Test Exclusion Threshold* (mW)
300	27	55	82	110	137	
450	22	45	67	89	112	
835	16	33	49	66	82	
900	16	32	47	63	79	
1500	12	24	37	49	61	
1900	11	22	33	44	54	
2450	10	19	29	38	48	
3600	8	16	24	32	40	
5200	7	13	20	26	33	
5400	6	13	19	26	32	
5800	6	12	19	25	31	

Summary of Transmitters

Band/Mode	Position	Max. RF output power (mW)	SAR test exclusion Threshold (mW)	SAR Required
(2.4~2.4835) GHz Bluetooth	Head	2.21	10	No
	Body	2.21	19	No
(2.4~2.4835) GHz Wi-Fi	Head	28.77	10	Yes
	Body	28.77	19	Yes

6.7 RF exposure conditions

Refer to the follow picture “Antenna Locations & Separation Distances” for the specific details of the antenna-to-antenna and antenna-to-edge(s) distances.



6.7.1 Head Exposure Conditions

For WWAN

Test Configurations	SAR Required	Note
Left Touch	yes	/
Left Tilt (15°)	yes	/
Right Touch	yes	/
Right Tilt (15°)	yes	/

For WLAN

Test Configurations	SAR Required	Note
Left Touch	yes	/
Left Tilt (15°)	yes	/
Right Touch	yes	/
Right Tilt (15°)	yes	/

6.7.2 Body Exposure conditions

For WWAN

Test Configurations	SAR Required	Note
Back	yes	/
Front	yes	/

For WLAN

Test Configurations	SAR Required	Note
Back	yes	/
Front	yes	/

6.7.3 Hotspot Exposure Conditions

For WWAN

Test Configurations	Antenna-to-edge/surface	SAR Required
Back	<25 mm	Yes
Front	<25 mm	Yes
Top	>25 mm	No
Bottom	<25 mm	Yes
Right	<25 mm	Yes
Left	<25 mm	Yes

For WLAN

Test Configurations	Antenna-to-edge/surface	SAR Required
Back	<25 mm	Yes
Front	<25 mm	Yes
Top	<25 mm	Yes
Bottom	>25 mm	No
Right	>25 mm	No
Left	<25 mm	Yes

Note: For hotspot mode, it's not necessary test Rear and Front position cause we already test the these position without hotspot mode in Body Exposure conditions, Normally if the hotspot mode opened, the technology "power reduction" used for mobile, so we consider the worst condition, and remain the data of body worn as hotspots mode.

6.8 System Checking

The manufacturer calibrates the probes annually. Dielectric parameters of the tissue simulants were measured every day using the dielectric probe kit and the network analyser. A system check measurement was made following the determination of the dielectric parameters of the simulant, using the dipole validation kit. A power level of 250 mW was supplied to the dipole antenna, which was placed under the flat section of the twin SAM phantom. The system checking results (dielectric parameters and SAR values) are given in the table below.

Date Tested	System dipole	T.S. Liquid	SAR measured (normalized to 1W)		Target (Ref.Value)	Delta (%)	Tolerance (%)
2018/11/15	D835V2	Head	1g	9.16	9.37	-2.2	±10
2018/11/18	D1800V2	Head	1g	37.84	38.90	-2.7	±10
2018/11/20	D2450V2	Head	1g	51.20	52.40	-2.3	±10

Date Tested	System dipole	T.S. Liquid	SAR measured (normalized to 1W)		Target (Ref.Value)	Delta (%)	Tolerance (%)
2018/11/14	D835V2	Body	1g	9.12	9.47	-3.7	±10
2018/11/15	D1800V2	Body	1g	38.68	39.00	-0.8	±10
2018/11/21	D2450V2	Body	1g	53.20	52.30	1.7	±10

Plots of the system checking scans are given in Appendix A.
Tissue Simulants used in the Measurements
For the measurement of the following parameters the SPEAG DAKS-3.5 dielectric parameter probe is used, representing the open-ended coaxial probe measurement procedure.

Date Tested	Freq.(MHz)	Liquid parameters	measured	Target	Delta(%)	Tolerance(%)
2018/11/15	Head 835	εr	41.11	41.50	-0.9	±5
		σ[S/m]	0.92	0.90	2.2	±5
2018/11/18	Head 1800	εr	40.61	40.00	1.5	±5
		σ[S/m]	1.41	1.40	0.7	±5
2018/11/20	Head 2450	εr	39.58	39.20	1.0	±5
		σ[S/m]	1.83	1.80	1.7	±5

Date Tested	Freq.(MHz)	Liquid parameters	measured	Target	Delta(%)	Tolerance(%)
2018/11/14	Body 835	εr	56.20	55.20	1.8	±5
		σ[S/m]	0.97	0.97	0.0	±5
2018/11/15	Body 1800	εr	51.72	53.30	-3.0	±5
		σ[S/m]	1.54	1.52	1.3	±5
2018/11/21	Body 2450	εr	51.05	52.70	-3.1	±5
		σ[S/m]	2.03	1.95	4.1	±5

6.9 SAR TEST RESULT

In order to determine the largest value of the peak spatial-average SAR of a handset, all device positions, configurations, and operational modes should be tested for each frequency band according to Steps 1 to 3 below.

Step 1: The tests should be performed at the channel that is closest to the center of the transmit frequency band.
a) All device positions (cheek and tilt, for both left and right sides of the SAM phantom),
b) All configurations for each device position in a), e.g., antenna extended and retracted, and
c) All operational modes for each device position in item a) and configuration in item b) in each frequency band, e.g., analog and digital, If more than three frequencies need to be tested (i.e., Nc > 3), then all frequencies, configurations and modes shall be tested for all of the above test conditions.
Step 2: For the condition providing the highest peak spatial-average SAR determined in Step 1 for each frequency, perform all tests at all other test frequency channels, e.g., lowest and highest frequencies. In addition, for all other conditions (device position, configuration, and operational mode) where the peak spatial-average SAR value determined in Step 1 is within 3 dB of the applicable SAR limit, it is recommended that all other test frequencies should be tested as well.
Step 3: Examine all data to determine the largest value of the peak.
Note:
1. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
Scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
Reported SAR (W/kg) = Measured SAR (W/kg) * Scaling Factor
2. Per KDB 447498 D01v06, for each exposure position, if the highest output channel reported SAR ≤0.8W/kg, other channels SAR testing are not necessary.
3. The distance between the EUT and the phantom bottom is 10mm.

The measured and reported Head/body SAR values for the test device are tabulated below:

Mode: GSM 850(GPRS)
fL(MHz)=824.2MHz fM(MHz)=836.5MHz fH(MHz)= 848.8MHz
SAR Values (850MHz Band)
Limit of SAR (W/kg): <1.6W/kg (1g Average)

Test Case		Ch	Measure Conducted Power (dBm)	Tune-up limit (dBm)	Scaling Factor	Measure Results (W/kg)	Reported Results (W/kg)
position	mode					1g Average	1g Average
Left cheek	GPRS 3TX (head)	L	30.10	30.50	1.10	---	---
		M	30.20	30.50	1.07	0.514	0.550
		H	29.89	30.50	1.15	---	---
Left Tilted		L	30.10	30.50	1.10	---	---
		M	30.20	30.50	1.07	0.312	0.334
		H	29.89	30.50	1.15	---	---
Right cheek		L	30.10	30.50	1.10	---	---
		M	30.20	30.50	1.07	0.297	0.318
		H	29.89	30.50	1.15	---	---
Right Tilted		L	30.10	30.50	1.10	---	---
		M	30.20	30.50	1.07	0.267	0.286
		H	29.89	30.50	1.15	---	---
Back	GPRS 3TX (body-worn& hotspot)	L1	30.10	30.50	1.10	0.961	1.057
		M1	30.20	30.50	1.07	1.100	1.177
		H1	29.89	30.50	1.15	1.100	1.265
		L2	30.10	30.50	1.10	0.941	1.032
		M2	30.20	30.50	1.07	1.080	1.157
		H2	29.89	30.50	1.15	1.100	1.265
Front		L	30.10	30.50	1.10	---	---
		M	30.20	30.50	1.07	0.519	0.555
		H	29.89	30.50	1.15	---	---
Bottom	GPRS 3TX (hotspot)	L	30.10	30.50	1.10	---	---
		M	30.20	30.50	1.07	0.135	0.144
		H	29.89	30.50	1.15	---	---
Right		L	30.10	30.50	1.10	---	---
		M	30.20	30.50	1.07	0.345	0.369
		H	29.89	30.50	1.15	---	---
Left		L	30.10	30.50	1.10	---	---
		M	30.20	30.50	1.07	0.748	0.800
		H	29.89	30.50	1.15	---	---

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Mode: GSM1900(GPRS)
fL (MHz)=1850.2MHz fM (MHz)=1880.0MHz fH (MHz)=1909.8MHz
SAR Values (1900MHz Band)
Limit of SAR (W/kg): <1.6W/kg (1g Average)

Test Case		Ch	Measure Conducted Power (dBm)	Tune-up limit (dBm)	Scaling Factor	Measure Results (W/kg)	Reported Results (W/kg)
position	mode					1g Average	1g Average
Left cheek	GPRS 3TX (head)	L	26.64	27.00	1.09	---	---
		M	26.80	27.00	1.05	0.368	0.386
		H	27.00	27.00	1.00	---	---
Left Tilted		L	26.64	27.00	1.09	---	---
		M	26.80	27.00	1.05	0.161	0.169
		H	27.00	27.00	1.00	---	---
Right cheek		L	26.64	27.00	1.09	---	---
		M	26.80	27.00	1.05	0.366	0.384
		H	27.00	27.00	1.00	---	---
Right Tilted		L	26.64	27.00	1.09	---	---
		M	26.80	27.00	1.05	0.179	0.188
		H	27.00	27.00	1.00	---	---
Back	GPRS 3TX (body-worn& hotspot)	L	26.64	27.00	1.09	---	---
		M	26.80	27.00	1.05	0.658	0.691
		H	27.00	27.00	1.00	---	---
Front		L	26.64	27.00	1.09	---	---
		M	26.80	27.00	1.05	0.530	0.557
		H	27.00	27.00	1.00	---	---
Bottom	GPRS 3TX (hotspot)	L1	26.64	27.00	1.09	0.875	0.954
		M1	26.80	27.00	1.05	0.959	1.007
		H1	27.00	27.00	1.00	0.857	0.857
		L2	26.64	27.00	1.09	0.875	0.954
		M2	26.80	27.00	1.05	0.902	0.945
		H2	27.00	27.00	1.00	0.852	0.852
Right		L	26.64	27.00	1.09	---	---
		M	26.80	27.00	1.05	0.119	0.125
		H	27.00	27.00	1.00	---	---
Left		L	26.64	27.00	1.09	---	---
		M	26.80	27.00	1.05	0.111	0.117
		H	27.00	27.00	1.00	---	---

Mode: WCDMA BAND2

fL (MHz)=1852.4MHz fM (MHz)=1880MHz fH (MHz)= 1907.6MHz
SAR Values (WCDMA BAND2)
Limit of SAR (W/kg) :< 1.6W/kg (1g Average)

Test Case		Ch	Measure Conducted Power (dBm)	Tune-up limit (dBm)	Scaling Factor	Measure Results (W/kg)	Reported Results (W/kg)
position	mode					1g Average	1g Average
Left cheek	12.2KRMC (head)	L	21.86	22.50	1.16	---	---
		M	22.18	22.50	1.08	0.269	0.291
		H	22.02	22.50	1.12	---	---
Left Tilted		L	21.86	22.50	1.16	---	---
		M	22.18	22.50	1.08	0.143	0.154
		H	22.02	22.50	1.12	---	---
Right cheek		L	21.86	22.50	1.16	---	---
		M	22.18	22.50	1.08	0.583	0.630
		H	22.02	22.50	1.12	---	---
Right Tilted		L	21.86	22.50	1.16	---	---
		M	22.18	22.50	1.08	0.147	0.159
		H	22.02	22.50	1.12	---	---
Back	12.2KRMC (body-worn& hotspot)	L1	21.86	22.50	1.16	0.672	0.780
		M1	22.18	22.50	1.08	0.833	0.900
		H1	22.02	22.50	1.12	0.844	0.945
		M2	22.18	22.50	1.08	0.829	0.892
		H2	22.02	22.50	1.12	0.840	0.938
Front		L	21.86	22.50	1.16	---	---
		M	22.18	22.50	1.08	0.563	0.608
		H	22.02	22.50	1.12	---	---
Bottom1	12.2KRMC (hotspot)	L1	21.86	22.50	1.16	0.813	0.943
		M1	22.18	22.50	1.08	0.983	1.062
		H1	22.02	22.50	1.12	0.903	1.011
Bottom2		L2	21.86	22.50	1.16	0.812	0.941
		M2	22.18	22.50	1.08	0.979	1.054
		H2	22.02	22.50	1.12	0.901	1.006
Right		L	21.86	22.50	1.16	---	---
		M	22.18	22.50	1.08	0.159	0.172
		H	22.02	22.50	1.12	---	---
Left		L	21.86	22.50	1.16	---	---
		M	22.18	22.50	1.08	0.106	0.114
		H	22.02	22.50	1.12	---	---

Mode: WCDMA BAND5
fL (MHz)=826.4MHz fM (MHz)=836.4MHz fH (MHz)= 846.6MHz
SAR Values (WCDMA BAND5)
Limit of SAR (W/kg): <1.6W/kg (1g Average)

Test Case		Ch	Measure Conducted Power (dBm)	Tune-up limit (dBm)	Scaling Factor	Measure Results (W/kg)	Reported Results (W/kg)
position	mode					1g Average	1g Average
Left cheek	12.2KRMC (head)	L	22.79	23.50	1.18	---	---
		M	22.62	23.50	1.22	0.358	0.437
		H	23.10	23.50	1.10	---	---
Left Tilted		L	22.79	23.50	1.18	---	---
		M	22.62	23.50	1.22	0.203	0.248
		H	23.10	23.50	1.10	---	---
Right cheek		L	22.79	23.50	1.18	---	---
		M	22.62	23.50	1.22	0.306	0.373
		H	23.10	23.50	1.10	---	---
Right Tilted		L	22.79	23.50	1.18	---	---
		M	22.62	23.50	1.22	0.200	0.244
		H	23.10	23.50	1.10	---	---
Back	12.2KRMC (body-worn& hotspot)	L1	22.79	23.50	1.18	0.929	1.096
		M1	22.62	23.50	1.22	0.831	1.014
		H1	23.10	23.50	1.10	0.906	0.997
		L2	22.79	23.50	1.18	0.925	1.089
		M2	22.62	23.50	1.22	0.829	1.015
		H2	23.10	23.50	1.10	0.901	0.988
Front		L	22.79	23.50	1.18	---	---
		M	22.62	23.50	1.22	0.689	0.841
		H	23.10	23.50	1.10	---	---
Bottom	12.2KRMC (hotspot)	L	22.79	23.50	1.18	---	---
		M	22.62	23.50	1.22	0.112	0.137
		H	23.10	23.50	1.10	---	---
Right		L	22.79	23.50	1.18	---	---
		M	22.62	23.50	1.22	0.291	0.355
		H	23.10	23.50	1.10	---	---
Left		L	22.79	23.50	1.18	---	---
		M	22.62	23.50	1.22	0.448	0.547
		H	23.10	23.50	1.10	---	---

Mode: Wi-Fi 2.4GHz
fL (MHz)=2412MHz fM (MHz)=2437MHz fH (MHz)= 2462MHz
SAR Values (Wi-Fi 802.11b)
Limit of SAR (W/kg): <1.6W/kg (1g Average)

Test Case		Ch	Measure Conducted Power (dBm)	Tune-up limit (dBm)	Scaling Factor	Measure Results (W/kg)	Reported Results (W/kg)
position	mode					1g Average	1g Average
Left cheek	802.11b (head)	L	13.33	13.50	1.04	---	---
		M	14.16	14.50	1.08	0.341	0.440
		H	14.59	15.00	1.10	---	---
Left Tilted		L	13.33	13.50	1.04	---	---
		M	14.16	14.50	1.08	0.286	0.369
		H	14.59	15.00	1.10	---	---
Right cheek		L	13.33	13.50	1.04	0.758	0.788
		M	14.16	14.50	1.08	0.779	0.841
		H	14.59	15.00	1.10	0.695	0.765
Right Tilted		L	13.33	13.50	1.04	---	---
		M	14.16	14.50	1.08	0.490	0.529
		H	14.59	15.00	1.10	---	---
Back	802.11b (body-worn& hotspot)	L	13.33	13.50	1.04	---	---
		M	14.16	14.50	1.08	0.119	0.129
		H	14.59	15.00	1.10	---	---
Front		L	13.33	13.50	1.04	---	---
		M	14.16	14.50	1.08	0.091	0.098
		H	14.59	15.00	1.10	---	---
Top	802.11b (hotspot)	L	13.33	13.50	1.04	---	---
		M	14.16	14.50	1.08	0.150	0.162
		H	14.59	15.00	1.10	---	---
Left		L	13.33	13.50	1.04	---	---
		M	14.16	14.50	1.08	0.137	0.148
		H	14.59	15.00	1.10	---	---

6.10 SAR Measurement Variability

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

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

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

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

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

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

The Highest Reported SAR configuration in Each Frequency Band

Frequency band	Air interface	Head(w/kg)	Body(w/kg)
850 MHz	GSM850 WCDMA BAND5	<0.8	>0.8
1800/1900 MHz	GSM1900 WCDMA BAND2	<0.8	>0.8
2.4 GHz	WIFI	>0.8	<0.8

6.11 Simultaneous Transmission SAR Analysis

The sum of SAR values for GSM & Wi-Fi

	MAXIMUM SAR VALUE FOR HEAD	MAXIMUM SAR VALUE FOR BODY WORN	MAXIMUM SAR VALUE FOR HOTSPOT
GSM	0.384	1.265	1.265
Wi-Fi	0.841	0.129	0.129
Sum	1.225	1.394	1.394
Note	Right cheek: GSM1900+wifi2.4G	Back: GSM850+wifi2.4G	Back: GSM850+wifi2.4G

According to the above tables, the sum of SAR values for GSM and Wi-Fi ＜1.6W/kg. So simultaneous transmission SAR are not required for Wi-Fi transmitter.

The sum of SAR values for WCDMA & Wi-Fi

	MAXIMUM SAR VALUE FOR HEAD	MAXIMUM SAR VALUE FOR BODY	MAXIMUM SAR VALUE FOR HOTSPOT
WCDMA	0.630	1.096	1.096
Wi-Fi	0.841	0.129	0.129
Sum	1.471	1.225	1.225
Note	Right cheek: WCDMA2 +WIFI 2.4G	Back: WCDMA5+ WIFI 2.4G	Back: WCDMA5+ WIFI 2.4G

According to the above tables, the sum of SAR values for WCDMA and Wi-Fi ＜1.6W/kg. So simultaneous transmission SAR are not required for Wi-Fi transmitter.

According to the formula (KDB447498 4.3.2) the Bluetooth SAR as follow:
[(max. power of channel, including tune-up tolerance, mw)/ (min. test separation distance, mm)]
[√f(GHz)/x] W/kg for test separation distances≤50mm.
Head:
min. test separation distance = 5mm
Body:
min. test separation distance = 10mm
Where x=7.5 for 1-g SAR, and x=18.75 for 10-g SAR.

Estimated SAR Bluetooth

Mode	Position	F(GHz)	Distance(mm)	Estimated
Bluetooth	Head	2.402	5	0.094
	Body	2.402	10	0.047

The sum of SAR values for GSM & Bluetooth

	MAXIMUM SAR VALUE FOR HEAD	MAXIMUM SAR VALUE FOR BODY WORN
GSM	0.550	1.266
Bluetooth	0.094	0.047
Sum	0.644	1.313
Note	Left cheek: GSM850+BT	Back: GSM850+BT

According to the above tables, the sum of SAR values for GSM and Bluetooth <1.6W/kg. So simultaneous transmission SAR are not required for Bluetooth transmitter.

The sum of SAR values for WCDMA & Bluetooth

	MAXIMUM SAR VALUE FOR HEAD	MAXIMUM SAR VALUE FOR BODY WORN
WCDMA	0.630	1.096
Bluetooth	0.094	0.047
Sum	0.724	1.143
Note	Right cheek: WCDMA2+BT	Back: WCDMA5+BT

According to the above tables, the sum of SAR values for WCDMA and Bluetooth <1.6W/kg. So simultaneous transmission SAR are not required for Bluetooth transmitter.

7 MEASUREMENT UNCERTAINTY

(0.3 - 3 GHz range)

Error Description	Uncert. value	Prob. Dist.	Div.	(c_i) 1g	(c_i) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) v_{eff}
Measurement System								
Probe Calibration	±6.0 %	N	1	1	1	±6.0 %	±6.0 %	∞
Axial Isotropy	±4.7 %	R	$\sqrt{3}$	0.7	0.7	±1.9 %	±1.9 %	∞
Hemispherical Isotropy	±9.6 %	R	$\sqrt{3}$	0.7	0.7	±3.9 %	±3.9 %	∞
Boundary Effects	±1.0 %	R	$\sqrt{3}$	1	1	±0.6 %	±0.6 %	∞
Linearity	±4.7 %	R	$\sqrt{3}$	1	1	±2.7 %	±2.7 %	∞
System Detection Limits	±1.0 %	R	$\sqrt{3}$	1	1	±0.6 %	±0.6 %	∞
Modulation Response^m	±2.4 %	R	$\sqrt{3}$	1	1	±1.4 %	±1.4 %	∞
Readout Electronics	±0.3 %	N	1	1	1	±0.3 %	±0.3 %	∞
Response Time	±0.8 %	R	$\sqrt{3}$	1	1	±0.5 %	±0.5 %	∞
Integration Time	±2.6 %	R	$\sqrt{3}$	1	1	±1.5 %	±1.5 %	∞
RF Ambient Noise	±3.0 %	R	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
RF Ambient Reflections	±3.0 %	R	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
Probe Positioner	±0.4 %	R	$\sqrt{3}$	1	1	±0.2 %	±0.2 %	∞
Probe Positioning	±2.9 %	R	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
Max. SAR Eval.	±2.0 %	R	$\sqrt{3}$	1	1	±1.2 %	±1.2 %	∞
Test Sample Related								
Device Positioning	±2.9 %	N	1	1	1	±2.9 %	±2.9 %	145
Device Holder	±3.6 %	N	1	1	1	±3.6 %	±3.6 %	5
Power Drift	±5.0 %	R	$\sqrt{3}$	1	1	±2.9 %	±2.9 %	∞
Power Scaling^p	±0 %	R	$\sqrt{3}$	1	1	±0.0 %	±0.0 %	∞
Phantom and Setup								
Phantom Uncertainty	±6.1 %	R	$\sqrt{3}$	1	1	±3.5 %	±3.5 %	∞
SAR correction	±1.9 %	R	$\sqrt{3}$	1	0.84	±1.1 %	±0.9 %	∞
Liquid Conductivity (mea.)^{DAK}	±2.5 %	R	$\sqrt{3}$	0.78	0.71	±1.1 %	±1.0 %	∞
Liquid Permittivity (mea.)^{DAK}	±2.5 %	R	$\sqrt{3}$	0.26	0.26	±0.3 %	±0.4 %	∞
Temp. unc. - Conductivity^{BB}	±3.4 %	R	$\sqrt{3}$	0.78	0.71	±1.5 %	±1.4 %	∞
Temp. unc. - Permittivity^{BB}	±0.4 %	R	$\sqrt{3}$	0.23	0.26	±0.1 %	±0.1 %	∞
Combined Std. Uncertainty						±11.2 %	±11.1 %	361
Expanded STD Uncertainty						**±22.3 %**	**±22.2 %**	

(3 - 6 GHz range)								
Error Description	Uncert. value	Prob. Dist.	Div.	(c_i) 1g	(c_i) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) v_{eff}
Measurement System								
Probe Calibration	±6.55 %	N	1	1	1	±6.55 %	±6.55 %	∞
Axial Isotropy	±4.7 %	R	$\sqrt{3}$	0.7	0.7	±1.9 %	±1.9 %	∞
Hemispherical Isotropy	±9.6 %	R	$\sqrt{3}$	0.7	0.7	±3.9 %	±3.9 %	∞
Boundary Effects	±2.0 %	R	$\sqrt{3}$	1	1	±1.2 %	±1.2 %	∞
Linearity	±4.7 %	R	$\sqrt{3}$	1	1	±2.7 %	±2.7 %	∞
System Detection Limits	±1.0 %	R	$\sqrt{3}$	1	1	±0.6 %	±0.6 %	∞
Modulation Response^m	±2.4 %	R	$\sqrt{3}$	1	1	±1.4 %	±1.4 %	∞
Readout Electronics	±0.3 %	N	1	1	1	±0.3 %	±0.3 %	∞
Response Time	±0.8 %	R	$\sqrt{3}$	1	1	±0.5 %	±0.5 %	∞
Integration Time	±2.6 %	R	$\sqrt{3}$	1	1	±1.5 %	±1.5 %	∞
RF Ambient Noise	±3.0 %	R	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
RF Ambient Reflections	±3.0 %	R	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
Probe Positioner	±0.8 %	R	$\sqrt{3}$	1	1	±0.5 %	±0.5 %	∞
Probe Positioning	±6.7 %	R	$\sqrt{3}$	1	1	±3.9 %	±3.9 %	∞
Max. SAR Eval.	±4.0 %	R	$\sqrt{3}$	1	1	±2.3 %	±2.3 %	∞
Test Sample Related								
Device Positioning	±2.9 %	N	1	1	1	±2.9 %	±2.9 %	145
Device Holder	±3.6 %	N	1	1	1	±3.6 %	±3.6 %	5
Power Drift	±5.0 %	R	$\sqrt{3}$	1	1	±2.9 %	±2.9 %	∞
Power Scaling^p	±0 %	R	$\sqrt{3}$	1	1	±0.0 %	±0.0 %	∞
Phantom and Setup								
Phantom Uncertainty	±6.6 %	R	$\sqrt{3}$	1	1	±3.8 %	±3.8 %	∞
SAR correction	±1.9 %	R	$\sqrt{3}$	1	0.84	±1.1 %	±0.9 %	∞
Liquid Conductivity (mea.)^{DAK}	±2.5 %	R	$\sqrt{3}$	0.78	0.71	±1.1 %	±1.0 %	∞
Liquid Permittivity (mea.) ^{DAK}	±2.5 %	R	$\sqrt{3}$	0.26	0.26	±0.3 %	±0.4 %	∞
Temp. unc. - Conductivity ^{BB}	±3.4 %	R	$\sqrt{3}$	0.78	0.71	±1.5 %	±1.4 %	∞
Temp. unc. - Permittivity ^{BB}	±0.4 %	R	$\sqrt{3}$	0.23	0.26	±0.1 %	±0.1 %	∞
Combined Std. Uncertainty						±12.3 %	±12.2 %	748
Expanded STD Uncertainty						**±24.6 %**	**±24.5 %**	

8 TEST EQUIPMENTS

The measurements were performed using an automated near-field scanning system, DASY5, manufactured by Schmid & Partner Engineering AG (SPEAG) in Switzerland. The SAR extrapolation algorithm used in all measurements was the ‘advanced extrapolation’ algorithm.

The following table lists calibration dates of SPEAG components:

Test Equipment	Model	Serial Number	Calibration date	Calibration Due data
DAE	DAE4	546	2018.10.15	2019.10.14
Dosimetric E-field Probe	ES3DV3	3127	2018.11.02	2019.11.01
Dipole Validation Kit	D835V2	4d023	2017.09.13	2020.09.12
Dipole Validation Kit	D1800V2	2d084	2017.09.15	2020.09.14
Dipole Validation Kit	D2450V2	738	2017.09.18	2020.09.17

According to KDB 865664 D01 section 3.2.2, instead of the typical annual calibration recommended by measurement standards, longer calibration intervals of up to three years may be considered when it is demonstrated that the **SAR target**, **impedance** and **return loss** of a dipole have remain stable according to the following requirements.

1) The test laboratory must ensure that the required supporting information and documentation are included in the SAR report to qualify for the three-year extended calibration interval; otherwise, the IEEE Std 1528-2013 recommended annual calibration applies.
2) Immediate re-calibration is required for the following conditions.
a) After a dipole is damaged and properly repaired to meet required specifications.
b) When the measured SAR deviates from the calibrated SAR value by more than 10% due to changes in physical, mechanical, electrical or other relevant dipole conditions; i.e., the error is not introduced by incorrect measurement procedures or other issues relating to the SAR measurement system.
c) When the most recent return-loss result, measured at least annually, deviates by more than 20% from the previous measurement (i.e. value in dB×0.2) or not meeting the required 20 dB minimum return-loss requirement.
d) When the most recent measurement of the real or imaginary parts of the impedance, measured at least annually, deviates by more than 5 Ω from the previous measurement.

Dipole 835

SAR target

Refers to system check, measured SAR (1g and 10g) deviates from the Target SAR value of calibration report within 10%.

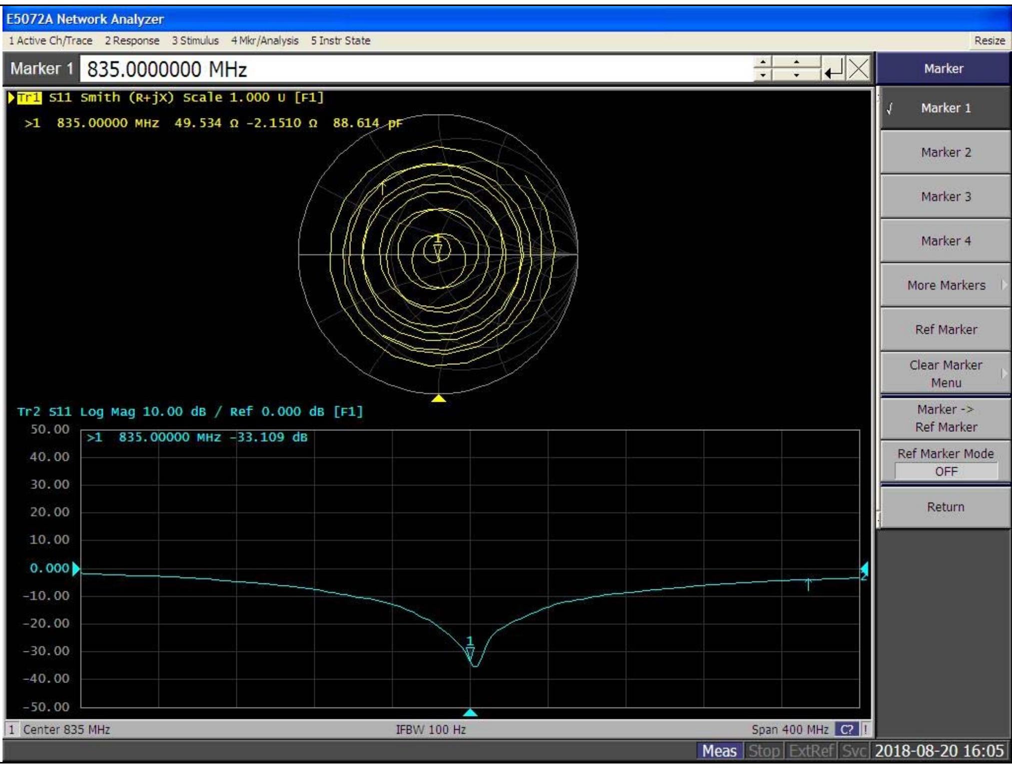
Impedance and Return loss measured by Network analyzer

The most recent measurement of the real or imaginary parts of the impedance (measured on 2018.8.20), deviates within 5 Ω from the previous measurement. (Data from the last calibration report)

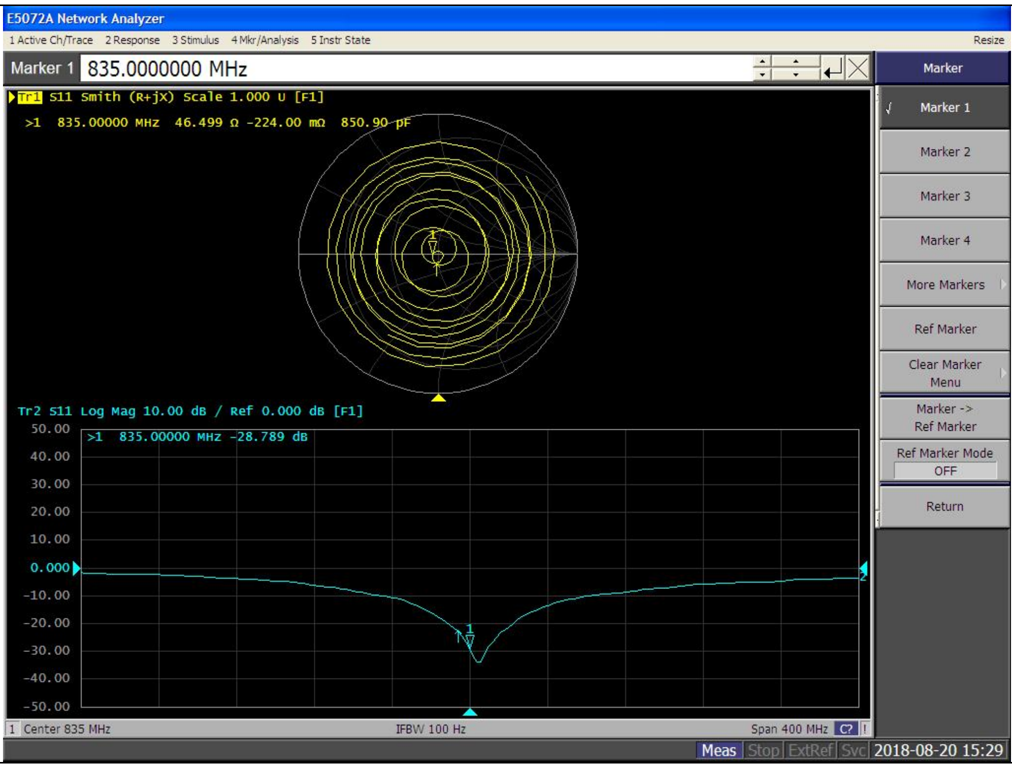
The most recent return-loss result (measured on 2018.8.20) deviates within 20% from the previous measurement. (Data from the last calibration report)

Head TSL Parameters			
Parameters	Target (Ref. Value)	Measured data	deviation
Impedance	51.0Ω-2.79jΩ	49.5Ω-2.15jΩ	<5Ω
Return loss	-30.7 db	-33.1 db	<20%

Body TSL Parameters			
Parameters	Target (Ref. Value)	Measured data	deviation
Impedance	46.6Ω-3.61jΩ	49.5Ω-0.22jΩ	<5Ω
Return loss	-25.8db	-28.8db	<20%



Head TSL Parameters



Body TSL Parameters

Dipole1800

SAR target

Refers to system check, measured SAR (1g and 10g) deviates from the Target SAR value of calibration report within 10%.

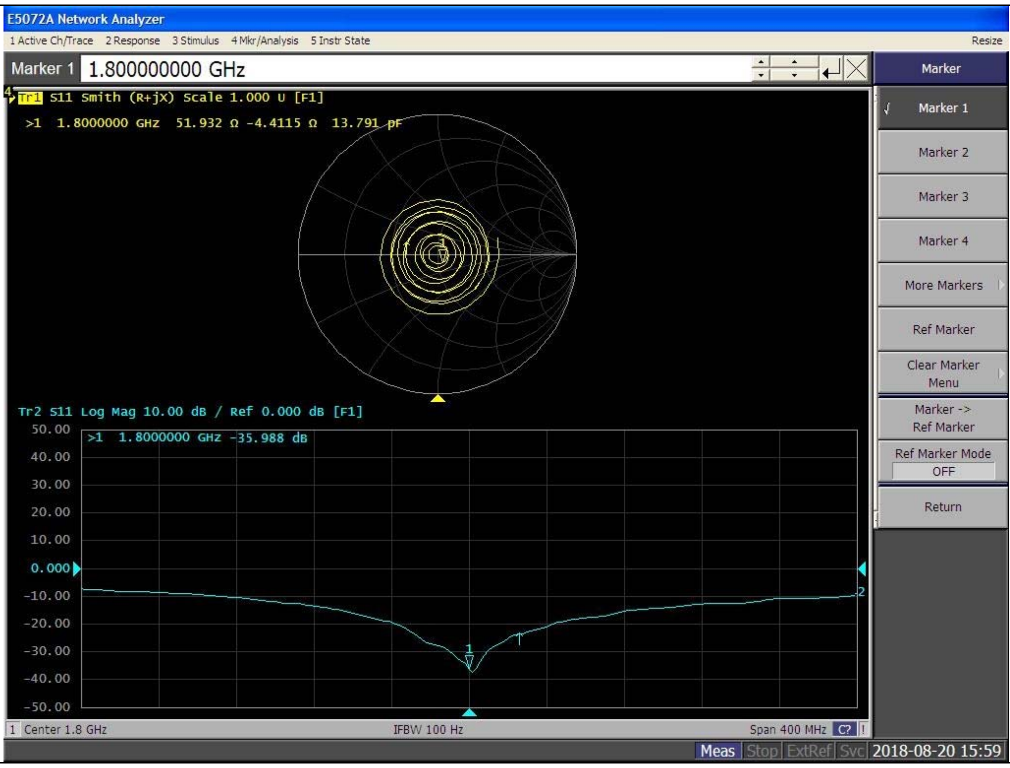
Impedance and Return loss measured by Network analyzer

The most recent measurement of the real or imaginary parts of the impedance (measured on 2018.8.20), deviates within 5 Ω from the previous measurement. (Data from the last calibration report)

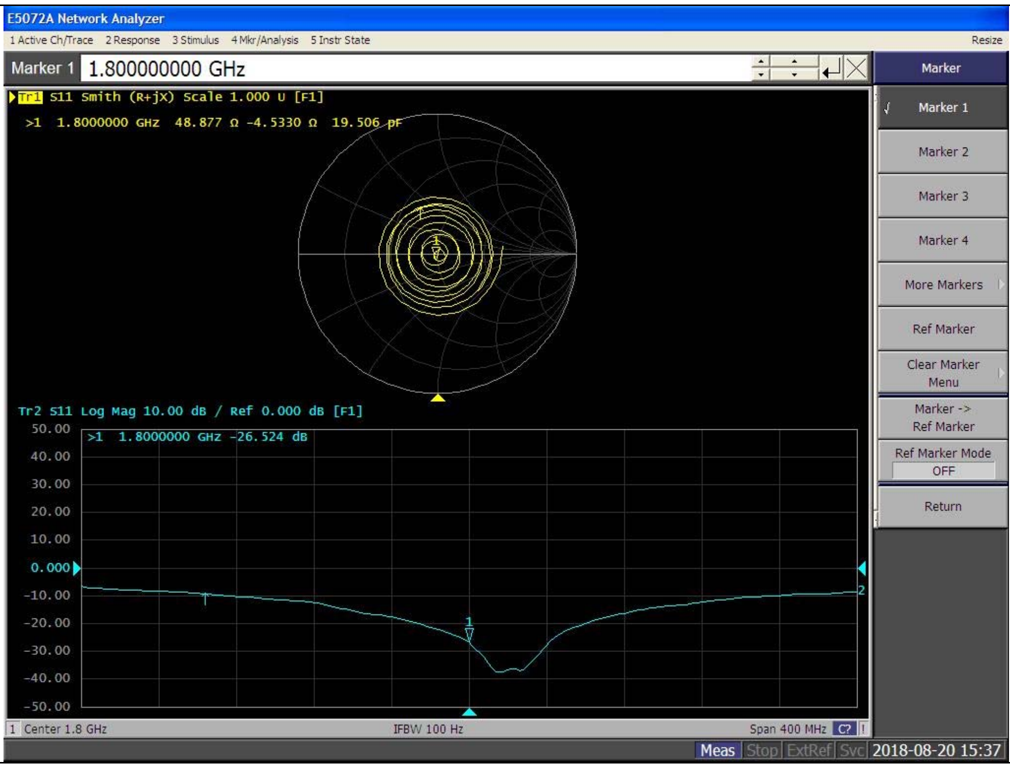
The most recent return-loss result (measured on 2018.8.20) deviates within 20% from the previous measurement. (Data from the last calibration report)

Head TSL Parameters			
Parameters	Target (Ref. Value)	Measured data	deviation
Impedance	49.3Ω-1.55jΩ	51.9Ω-4.41jΩ	<5Ω
Return loss	-35.4 db	-36.0db	<20%

Body TSL Parameters			
Parameters	Target (Ref. Value)	Measured data	deviation
Impedance	46.0Ω-1.32jΩ	48.9Ω-4.53jΩ	<5Ω
Return loss	-27.1db	-26.5db	<20%



Head TSL Parameters



Body TSL Parameters

Dipole2450

SAR target

Refers to system check, measured SAR (1g and 10g) deviates from the Target SAR value of calibration report within 10%.

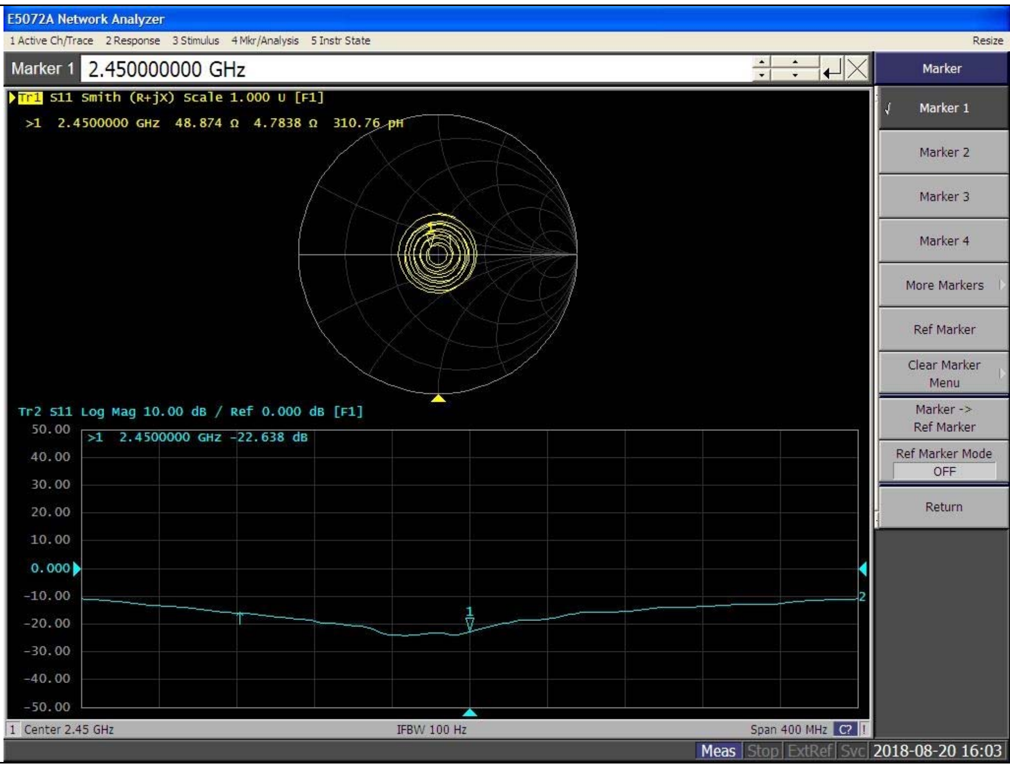
Impedance and Return loss measured by Network analyzer

The most recent measurement of the real or imaginary parts of the impedance (measured on 2018.8.20), deviates within 5 Ω from the previous measurement. (Data from the last calibration report)

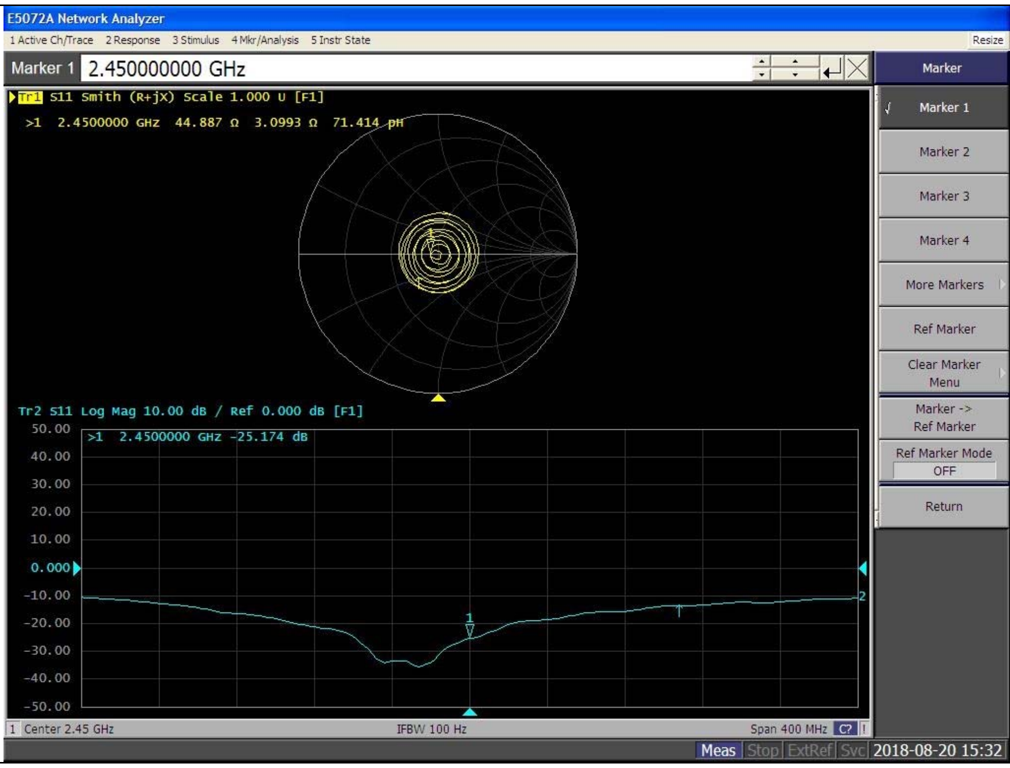
The most recent return-loss result (measured on 2018.8.20) deviates within 20% from the previous measurement. (Data from the last calibration report)

Head TSL Parameters			
Parameters	Target (Ref. Value)	Measured data	deviation
Impedance	51.3Ω+5.92jΩ	48.9Ω+4.78jΩ	<5Ω
Return loss	-24.5 db	-22.6db	<20%

Body TSL Parameters			
Parameters	Target (Ref. Value)	Measured data	deviation
Impedance	47.6Ω+6.39jΩ	44.9Ω+3.10jΩ	<5Ω
Return loss	-23.1db	-25.2db	<20%



Head TSL Parameters



Body TSL Parameters

Additional test equipment used in testing:

Test Equipment	Model	Serial Number	Calibration date	Calibration Due data
Signal Generator	E4428C	MY45280865	2018.08.20	2019.08.19
Signal Generator	SML 03	103514	2018.08.20	2019.08.19
Power meter	E4417A	MY45101182	2018.08.20	2019.08.19
Power Sensor	E4412A	MY41502214	2018.08.20	2019.08.19
Power Sensor	E4412A	MY41502130	2018.08.20	2019.08.19
Power meter	E4417A	MY45101004	2018.08.20	2019.08.19
Power Sensor	E9300B	MY41496001	2018.08.20	2019.08.19
Power Sensor	E9300B	MY41496003	2018.08.20	2019.08.19
Communication Tester	8960	MY48367401	2018.08.20	2019.08.19
Vector Network Analyzer	VNA R140	0011213	2018.10.17	2019.10.16
Dielectric Parameter Probe	DAKS-3.5	1042	2018.10.17	2019.10.16
Network Analyzer	E5072A	MY51100334	2018.03.01	2019.02.28

Detailed information of Isotropic E-field Probe Type ES3DV3

Construction	Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	Calibration certificate in Appendix C
Frequency	10 MHz to 4 GHz; Linearity: ± 0.2 dB (30 MHz to 4 GHz)
Optical Surface Detection	± 0.2 mm repeatability in air and clear liquids over diffuse reflecting surfaces
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.0 mm
Dynamic Range	5 μW/g to > 100 W/kg; Linearity: ± 0.2 dB
Application	General dosimetry up to 4 GHz Dosimetry in strong gradient fields Compliance tests of mobile phones

Detailed information of Isotropic E-field Probe Type EX3DV4

Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	Calibration certificate in Appendix C
Frequency	10 MHz to > 6 GHz Linearity: ± 0.2 dB (30 MHz to 6 GHz)
Optical Surface Detection	± 0.3 mm repeatability in air and clear liquids over diffuse reflecting surfaces
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
Dynamic Range	10 μW/g to > 100 W/kg Linearity: ± 0.2 dB (noise: typically < 1 μW/g)
Application	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields); the only probe that enables compliance testing for frequencies up to 6 GHz with precision of better 30%.

ANNEX A – TEST PLOTS

Please refer to the attachment.

ANNEX B – RELEVANT PAGES FROM CALIBRATION REPORTS

Please refer to the attachment.

ANNEX A – TEST PLOTS

Head liquid

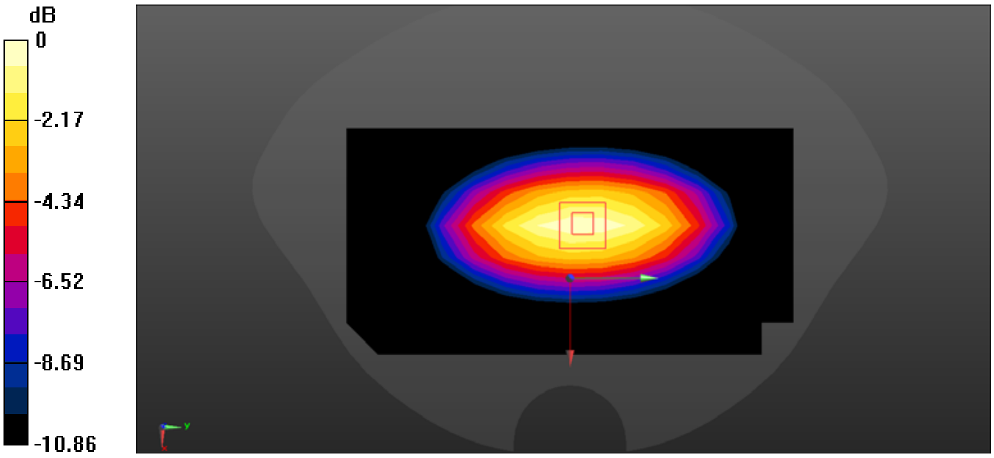
System check	835MHz

Communication System: UID 0, CW (0); Frequency: 835 MHz
Medium parameters used (interpolated): f = 835 MHz; σ = 0.915 S/m; ε_r = 41.114; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: ES3DV3 - SN3127; ConvF(6.18, 6.18, 6.18); Calibrated: 2018/11/2;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn546; Calibrated: 2018/10/15
- Phantom: 1660; Type: QD 000 P40 CD; Serial: xxxx
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

  Configuration 835/835/Area Scan (8x15x1): Measurement grid: dx=15mm, dy=15mm
  Maximum value of SAR (measured) = 2.87 W/kg
  Configuration 835/835/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
  Reference Value = 52.13 V/m; Power Drift = 0.02 dB
  Peak SAR (extrapolated) = 3.66 W/kg
  SAR(1 g) = 2.29 W/kg; SAR(10 g) = 1.55 W/kg
  Maximum value of SAR (measured) = 2.67 W/kg



0 dB = 2.67 W/kg = 4.27 dBW/kg

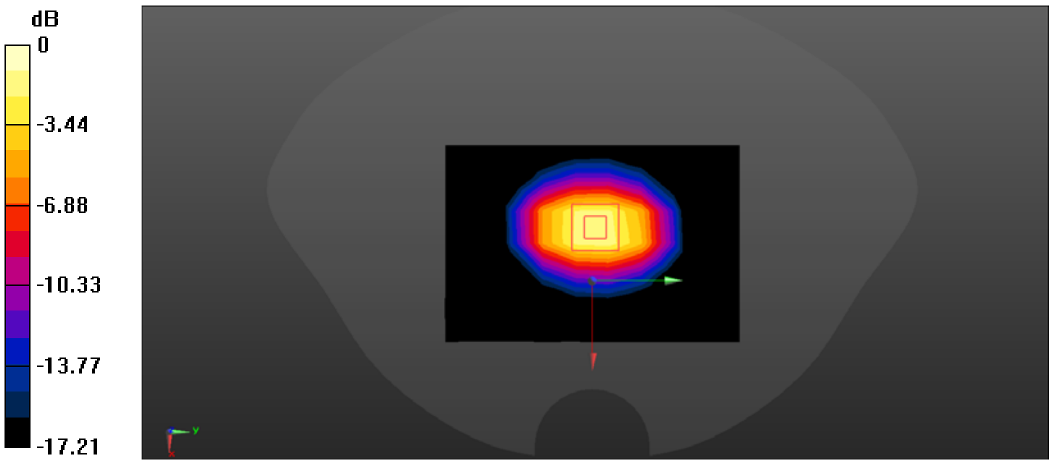
System check	1800MHz

Communication System: UID 0, CW (0); Frequency: 1800 MHz
Medium parameters used: f = 1800 MHz; σ = 1.411 S/m; ε_r = 40.607; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: ES3DV3 - SN3127; ConvF(5.07, 5.07, 5.07); Calibrated: 2018/11/2;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn546; Calibrated: 2018/10/15
- Phantom: 1659; Type: QD 000 P40 CD; Serial: xxxx
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

Configuration 1800/1800/Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 8.31 W/kg
Configuration 1800/1800/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 76.60 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 17.5 W/kg
SAR(1 g) = 9.46 W/kg; SAR(10 g) = 4.96 W/kg
Maximum value of SAR (measured) = 12.1 W/kg



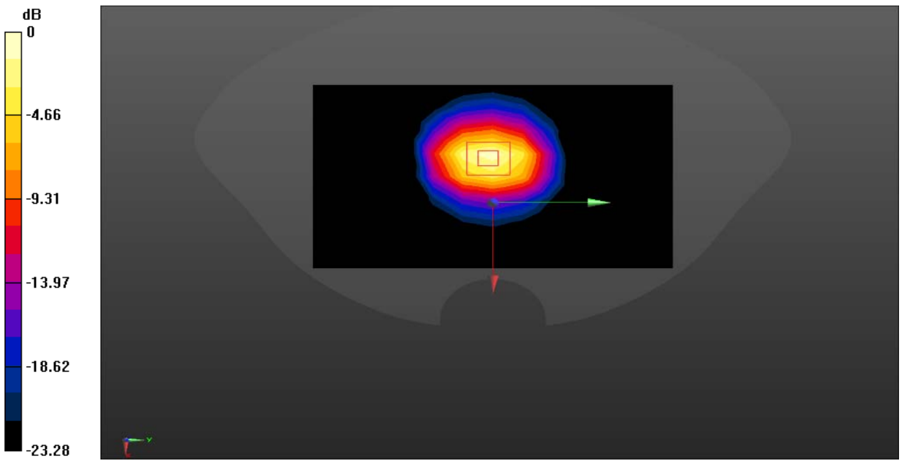
0 dB = 12.1 W/kg = 10.83 dBW/kg

System check	2450MHz

Communication System: UID 0, CW (0); Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.833 S/m; ε_r = 39.583; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: ES3DV3 - SN3127; ConvF(4.66, 4.66, 4.66); Calibrated: 2018/11/2;
- Sensor-Surface: 3mm (Mechanical Surface Detection), z = -3.0, 32.0
- Electronics: DAE4 Sn546; Calibrated: 2018/10/15
- Phantom: 1660; Type: QD 000 P40 CD; Serial: xxxx
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)**System Performance Check at Frequencies 2450MHz Head/d=10mm, Pin=250 mW, dist=4.0mm (EX-Probe)/Area Scan (9x13x1):** Measurement grid: dx=12mm, dy=12mm
  Maximum value of SAR (measured) = 21.87 W/kg
  System Performance Check at Frequencies 2450MHz Head/d=10mm, Pin=250 mW, dist=4.0mm (EX-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
  Reference Value = 98.95 V/m; Power Drift = 0.14 dB
  Peak SAR (extrapolated) = 27.9 W/kg
  SAR(1 g) = 12.8 W/kg; SAR(10 g) = 5.96 W/kg
  Maximum value of SAR (measured) = 12.56 W/kg



0 dB = 12.56 W/kg = 10.99 dBW/kg

Body liquid

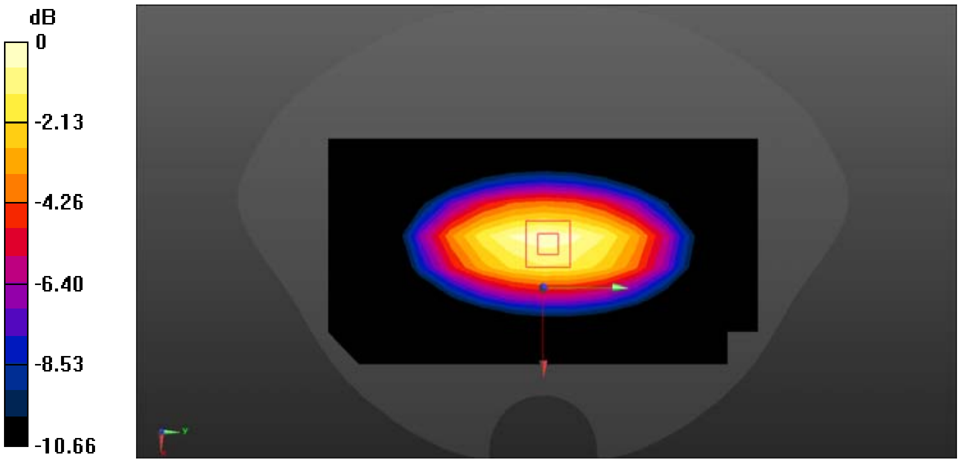
System check	835MHz

Communication System: UID 0, CW (0); Frequency: 835 MHz
Medium parameters used (interpolated): f = 835 MHz; σ = 0.966 S/m; ε_r = 56.196; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: ES3DV3 - SN3127; ConvF(6.13, 6.13, 6.13); Calibrated: 2018/11/2;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn546; Calibrated: 2018/10/15
- Phantom: 1659; Type: QD 000 P40 CD; Serial: xxxx
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

Configuration 835/835/Area Scan (8x15x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 2.57 W/kg
Configuration 835/835/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 51.34 V/m; Power Drift = 0.12 dB
Peak SAR (extrapolated) = 3.26 W/kg
SAR(1 g) = 2.28 W/kg; SAR(10 g) = 1.49 W/kg
Maximum value of SAR (measured) = 2.58 W/kg



0 dB = 2.58 W/kg = 4.11 dBW/kg

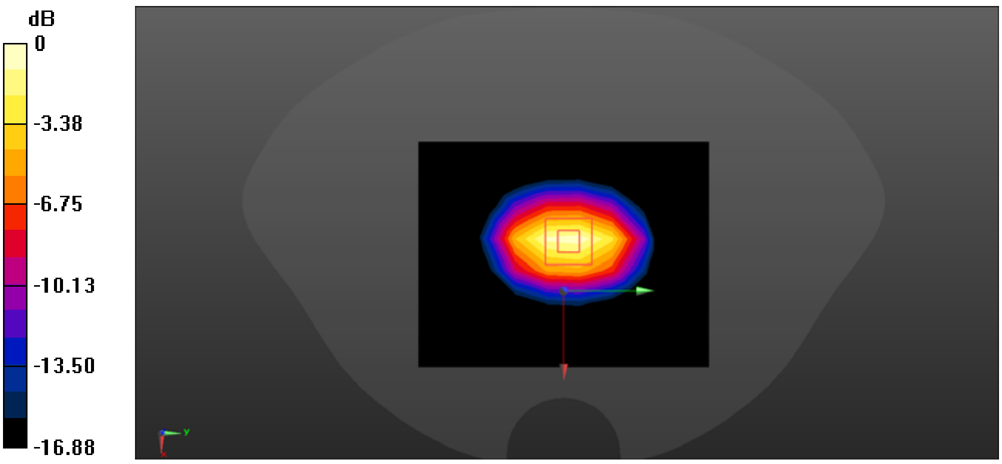
System check	1800MHz

Communication System: UID 0, CW (0); Frequency: 1800 MHz
Medium parameters used: f = 1800 MHz; σ = 1.542 S/m; ε_r = 51.717; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: ES3DV3 - SN3127; ConvF(4.76, 4.76, 4.76); Calibrated: 2018/11/2;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn546; Calibrated: 2018/10/15
- Phantom: 1659; Type: QD 000 P40 CD; Serial: xxxx

- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)
  Configuration 1800/1800/Area Scan (8x10x1): Measurement grid: dx=15mm, dy=15mm
  Maximum value of SAR (measured) = 11.5 W/kg
  Configuration 1800/1800/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
  Reference Value = 80.17 V/m; Power Drift = 0.15 dB
  Peak SAR (extrapolated) = 17.8 W/kg
  SAR(1 g) = 9.67 W/kg; SAR(10 g) = 5.03 W/kg
  Maximum value of SAR (measured) = 12.4 W/kg



0 dB = 12.4 W/kg = 10.93 dBW/kg

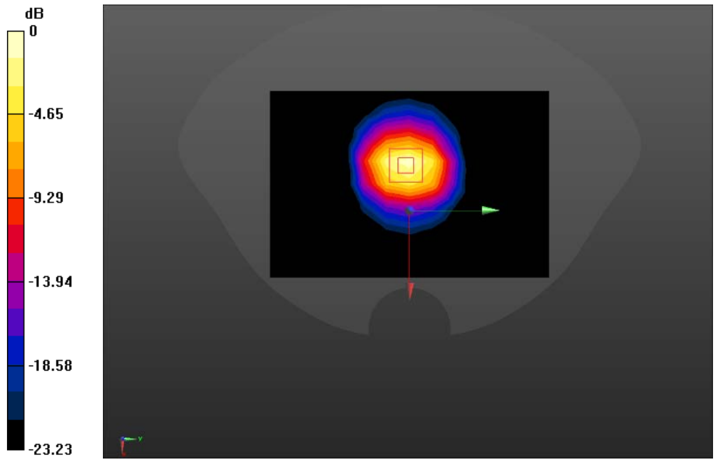
System check	2450MHz

Communication System: UID 0, CW (0); Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz;
Medium parameters used: f = 2450 MHz; σ = 2.027 S/m; ε_r = 51.046; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: ES3DV3 - SN3127; ConvF(4.31, 4.31, 4.31); Calibrated: 2018/11/2;
- Sensor-Surface: 3mm (Mechanical Surface Detection), z = -3.0, 32.0
- Electronics: DAE4 Sn546; Calibrated: 2018/10/15
- Phantom: 1659; Type: QD 000 P40 CD; Serial: xxxx
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

System Performance Check at Frequencies 2450MHz Head/d=10mm, Pin=250 mW, dist=4.0mm (EX-Probe)/Area Scan (9x13x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 13.4 W/kg
System Performance Check at Frequencies 2450MHz Head/d=10mm, Pin=250 mW, dist=4.0mm (EX-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 62.29 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 29.3 W/kg
SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.13 W/kg
Maximum value of SAR (measured) = 18.9 W/kg



0 dB = 18.9 W/kg = 12.76 dBW/kg

GSM (850MHz/Head)

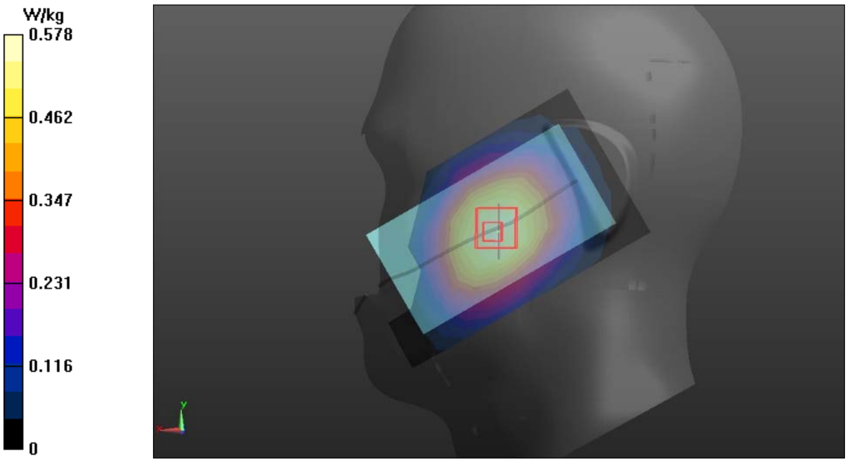
Left Side	Cheek

Communication System: UID 0, Generic GSM (0); Frequency: 836.6 MHz
Medium parameters used (interpolated): f = 836.6 MHz; σ = 0.905 S/m; ε_r = 41.528; ρ = 1000 kg/m^3
Phantom section: Left Section

DASY Configuration:

- Probe: ES3DV3 - SN3127; ConvF(6.18, 6.18, 6.18); Calibrated: 2018/11/2;
- Sensor-Surface: 3mm (Mechanical Surface Detection), z = -3.0, 32.0
- Electronics: DAE4 Sn546; Calibrated: 2018/10/15
- Phantom: 1660; Type: QD 000 P40 CD; Serial: xxxx
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

  GSM850 left/GSM850 left 0 3/Area Scan (7x11x1): Measurement grid: dx=15mm, dy=15mm
  Maximum value of SAR (measured) = 0.578 W/kg
  GSM850 left/GSM850 left 0 3/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
  Reference Value = 13.17 V/m; Power Drift = -0.04 dB
  Peak SAR (extrapolated) = 0.688 W/kg
  SAR(1 g) = 0.514 W/kg; SAR(10 g) = 0.372 W/kg
  Maximum value of SAR (measured) = 0.574 W/kg



GSM (850MHz with GPRS/Flat)

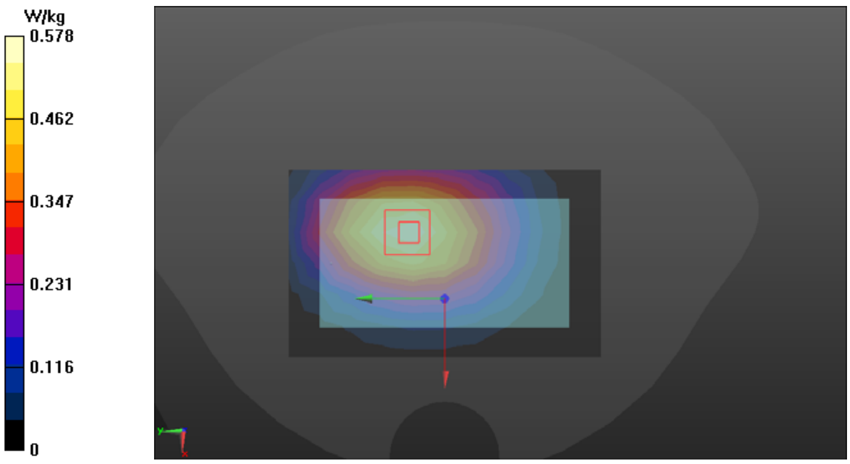
Body worn&Hotspot	**Back**

Communication System: UID 0, Generic GSM (0); Frequency: 836.6 MHz
Medium parameters used (interpolated): f = 836.6 MHz; σ = 0.976 S/m; ε_r = 55.195; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: ES3DV3 - SN3127; ConvF(6.13, 6.13, 6.13); Calibrated: 2018/11/2;
- Sensor-Surface: 3mm (Mechanical Surface Detection), z = -3.0, 32.0
- Electronics: DAE4 Sn546; Calibrated: 2018/10/15
- Phantom: 1659; Type: QD 000 P40 CD; Serial: xxxx
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

GSM flat/GSM850 Back/Area Scan (7x11x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 1.27 W/kg
GSM flat/GSM850 Back/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 32.88 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 1.58 W/kg
SAR(1 g) = 1.1 W/kg; SAR(10 g) = 0.766 W/kg
Maximum value of SAR (measured) = 1.25 W/kg



GSM (1900MHz/Head)

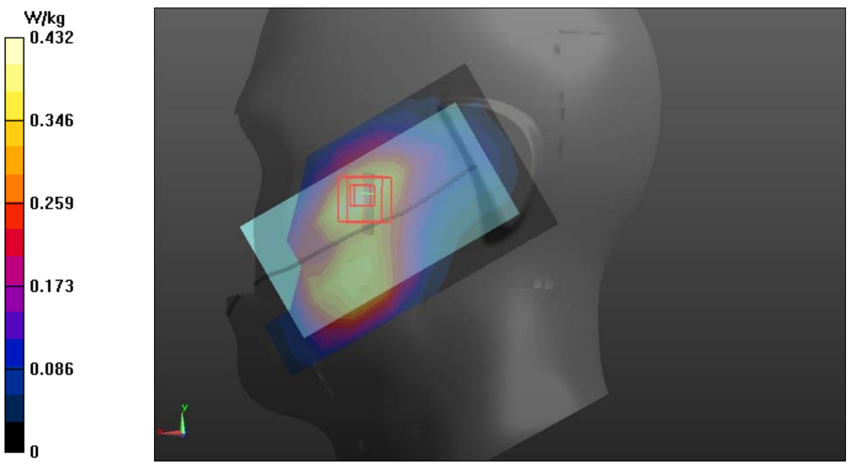
Left Side	Cheek

Communication System: UID 0, Generic GSM (0); Frequency: 1880 MHz
Medium parameters used (interpolated): f = 1880 MHz; σ = 1.4 S/m; ε_r = 40; ρ = 1000 kg/m^3
Phantom section: Left Section

DASY Configuration:

- Probe: ES3DV3 - SN3127; ConvF(5.07, 5.07, 5.07); Calibrated: 2018/11/2;
- Sensor-Surface: 3mm (Mechanical Surface Detection), z = -3.0, 32.0
- Electronics: DAE4 Sn546; Calibrated: 2018/10/15
- Phantom: 1660; Type: QD 000 P40 CD; Serial: xxxx
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

GSM1900 left/180925 GSM1900 left 0/Area Scan (7x11x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.432 W/kg
GSM1900 left/180925 GSM1900 left 0/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 9.168 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 0.583 W/kg
SAR(1 g) = 0.368 W/kg; SAR(10 g) = 0.229 W/kg
Maximum value of SAR (measured) = 0.439 W/kg



GSM (1900MHz with GPRS/Flat)

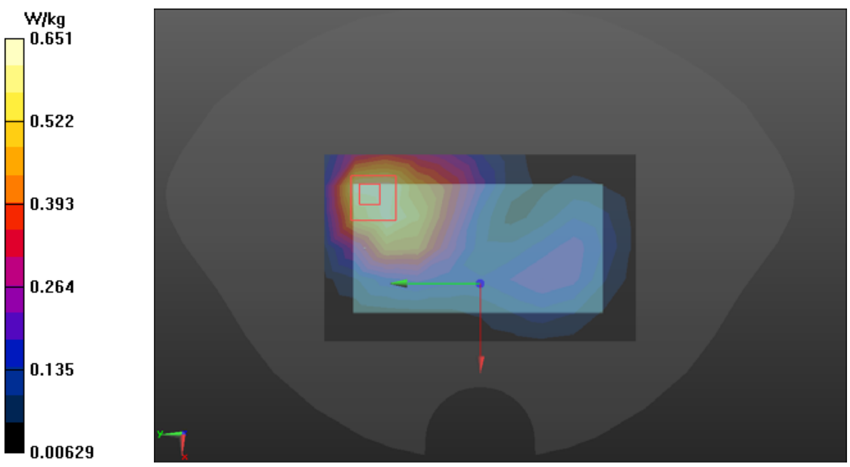
Body worn	Back

Communication System: UID 0, Generic GSM (0); Frequency: 1880 MHz
Medium parameters used (interpolated): f = 1880 MHz; σ = 1.526 S/m; ε_r = 53.291; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5

DASY Configuration:

- Probe: ES3DV3 - SN3127; ConvF(4.76, 4.76, 4.76); Calibrated: 2018/11/2;
- Sensor-Surface: 3mm (Mechanical Surface Detection), z = -3.0, 32.0
- Electronics: DAE4 Sn546; Calibrated: 2018/10/15
- Phantom: 1659; Type: QD 000 P40 CD; Serial: xxxx
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

GSM1900 flat/180925 GSM1900 TG/Area Scan (7x11x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.651 W/kg
GSM1900 flat/180925 GSM1900 TG/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 8.925 V/m; Power Drift = -0.17 dB
Peak SAR (extrapolated) = 1.17 W/kg
SAR(1 g) = 0.658 W/kg; SAR(10 g) = 0.365 W/kg
Maximum value of SAR (measured) = 0.814 W/kg



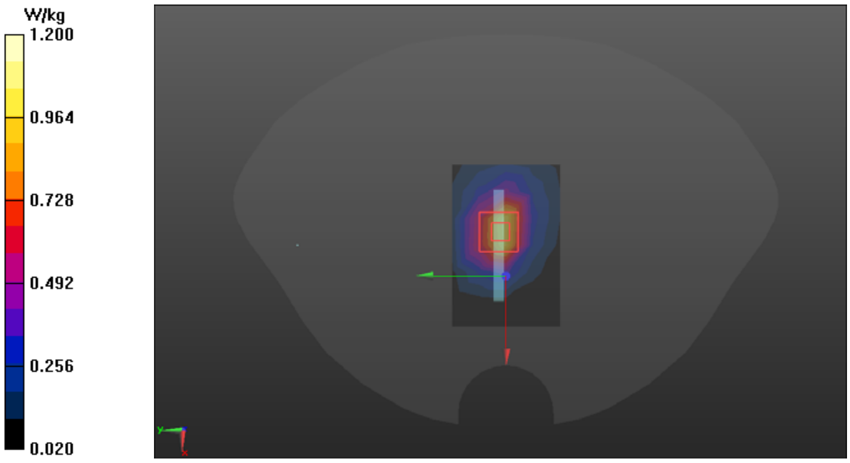
Hotspot	Bottom

Communication System: UID 0, Generic GSM (0); Frequency: 1880 MHz
Medium parameters used (interpolated): f = 1880 MHz; σ = 1.526 S/m; ε_r = 53.291; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5

DASY Configuration:

- Probe: ES3DV3 - SN3127; ConvF(4.76, 4.76, 4.76); Calibrated: 2018/11/2;
- Sensor-Surface: 3mm (Mechanical Surface Detection), z = -3.0, 32.0
- Electronics: DAE4 Sn546; Calibrated: 2018/10/15
- Phantom: 1659; Type: QD 000 P40 CD; Serial: xxxx
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

GSM1900 hotspot/GSM1900 hotspot bottom 3/Area Scan (7x5x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 1.04 W/kg
GSM1900 hotspot/GSM1900 hotspot bottom 3/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 26.18 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 1.69 W/kg
SAR(1 g) = 0.959 W/kg; SAR(10 g) = 0.501 W/kg
Maximum value of SAR (measured) = 1.20 W/kg



WCDMA Band 2

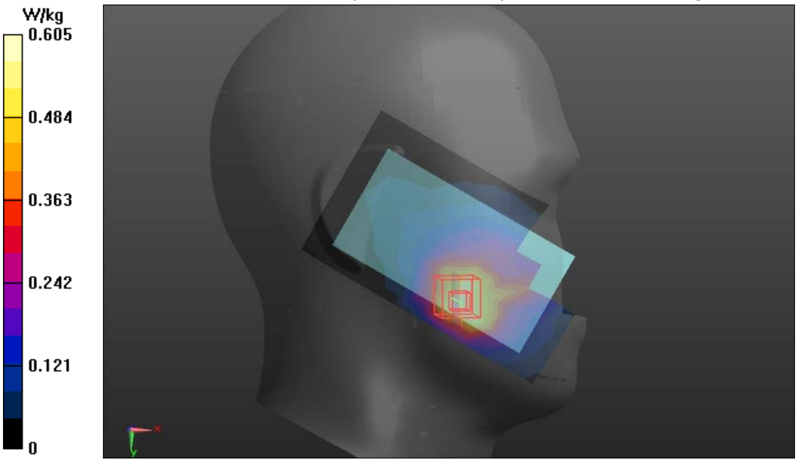
Right Side	Cheek

Communication System: UID 0, Generic GSM (0); Frequency: 1880 MHz
Medium parameters used (interpolated): f = 1880 MHz; σ = 1.4 S/m; ε_r = 40; ρ = 1000 kg/m^3
Phantom section: Left Section

DASY Configuration:

- Probe: ES3DV3 - SN3127; ConvF(5.07, 5.07, 5.07); Calibrated: 2018/11/2;
- Sensor-Surface: 3mm (Mechanical Surface Detection), z = -3.0, 32.0
- Electronics: DAE4 Sn546; Calibrated: 2018/10/15
- Phantom: 1660; Type: QD 000 P40 CD; Serial: xxxx
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

FDD2 right/right 0/Area Scan (7x11x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.605 W/kg
FDD2 right/right 0/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 6.173 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 0.911 W/kg
SAR(1 g) = 0.583 W/kg; SAR(10 g) = 0.345 W/kg
Maximum value of SAR (measured) = 0.693 W/kg



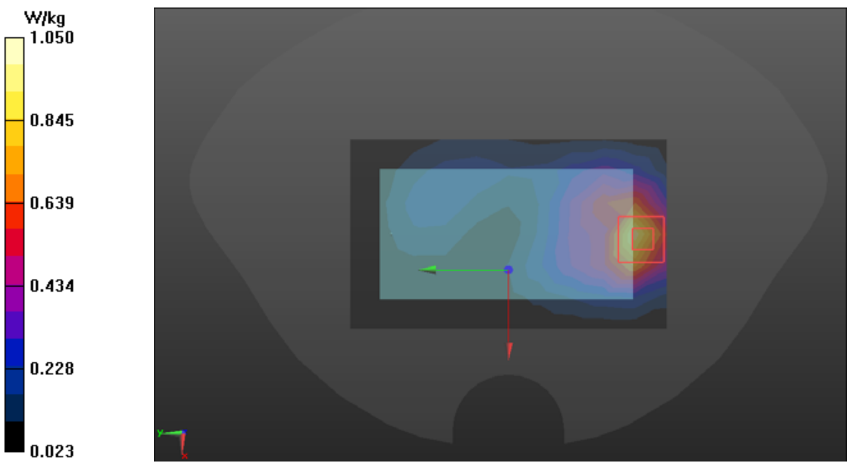
Body worn	Back

Communication System: UID 0, WCDMA BAND2 (0); Frequency: 1907.6 MHz
Medium parameters used (interpolated): f = 1907.6 MHz; σ = 1.52 S/m; ε_r = 53.304; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5

DASY Configuration:

- Probe: ES3DV3 - SN3127; ConvF(4.76, 4.76, 4.76); Calibrated: 2018/11/2;
- Sensor-Surface: 3mm (Mechanical Surface Detection), z = -3.0, 32.0
- Electronics: DAE4 Sn546; Calibrated: 2018/10/15
- Phantom: 1659; Type: QD 000 P40 CD; Serial: xxxx
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

FDD2 flat/Back High 2/Area Scan (7x11x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.965 W/kg
FDD2 flat/Back High 2/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 5.885 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 1.48 W/kg
SAR(1 g) = 0.844 W/kg; SAR(10 g) = 0.454 W/kg
Maximum value of SAR (measured) = 1.05 W/kg



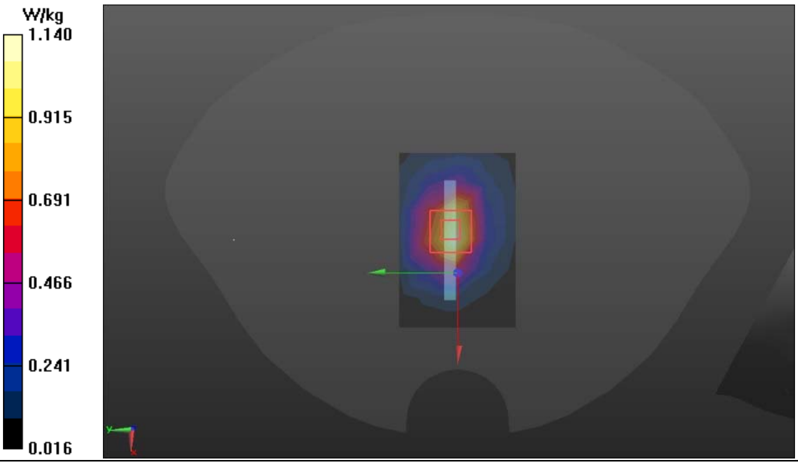
Hotspot	Bottom

Communication System: UID 0, Generic GSM (0); Frequency: 1880 MHz
Medium parameters used (interpolated): f = 1880 MHz; σ = 1.526 S/m; ε_r = 53.291; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: ES3DV3 - SN3127; ConvF(4.76, 4.76, 4.76); Calibrated: 2018/11/2;
- Sensor-Surface: 3mm (Mechanical Surface Detection), z = -3.0, 32.0
- Electronics: DAE4 Sn546; Calibrated: 2018/10/15
- Phantom: 1659; Type: QD 000 P40 CD; Serial: xxxx
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

hotspot/bottom/Area Scan (7x5x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 1.14 W/kg
hotspot/bottom/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 28.62 V/m; Power Drift = -0.37 dB
Peak SAR (extrapolated) = 1.70 W/kg
SAR(1 g) = 0.983 W/kg; SAR(10 g) = 0.524 W/kg
Maximum value of SAR (measured) = 1.21 W/kg



WCDMA Band 5

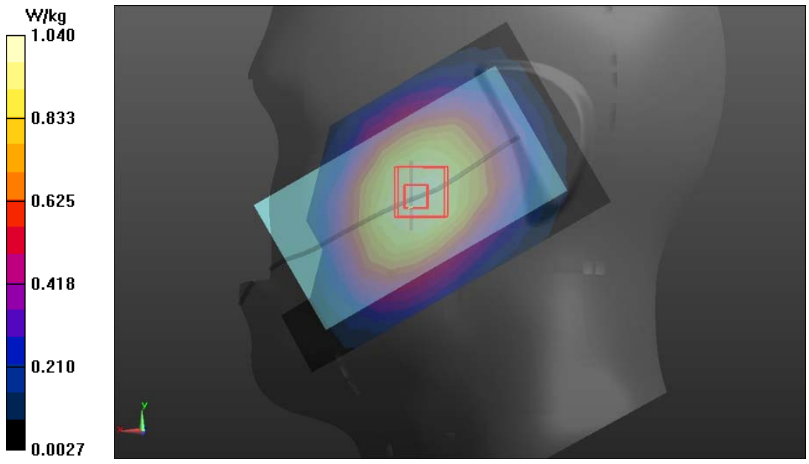
Left Side	Cheek

Communication System: UID 0, WCDMA BAND 5 (0); Frequency: 836.6 MHz
Medium parameters used (interpolated): f = 836.6 MHz; σ = 0.905 S/m; ε_r = 41.528; ρ = 1000 kg/m^3
Phantom section: Left Section

DASY Configuration:

- Probe: ES3DV3 - SN3127; ConvF(6.18, 6.18, 6.18); Calibrated: 2018/11/2;
- Sensor-Surface: 3mm (Mechanical Surface Detection), z = -3.0, 32.0
- Electronics: DAE4 Sn546; Calibrated: 2018/10/15
- Phantom: 1660; Type: QD 000 P40 CD; Serial: xxxx
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

FDD5 left/left 0 2/Area Scan (7x11x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.395 W/kg
FDD5 left/left 0 2/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 12.63 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 0.468 W/kg
SAR(1 g) = 0.358 W/kg; SAR(10 g) = 0.263 W/kg



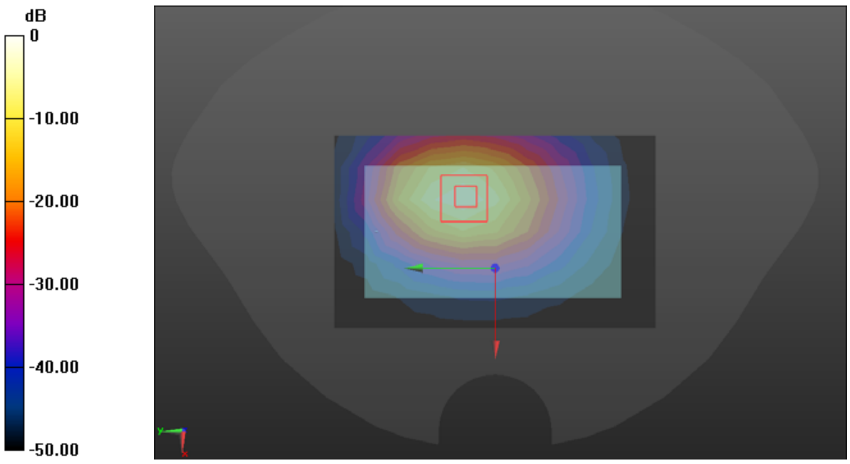
Body worn&Hotspot	Back

Communication System: UID 0, WCDMA BAND 5 (0); Frequency: 826.4 MHz
Medium parameters used (interpolated): f = 826.4 MHz; σ = 0.973 S/m; ε_r = 55.23; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: ES3DV3 - SN3127; ConvF(6.13, 6.13, 6.13); Calibrated: 2018/11/2;
- Sensor-Surface: 3mm (Mechanical Surface Detection), z = -3.0, 32.0
- Electronics: DAE4 Sn546; Calibrated: 2018/10/15
- Phantom: 1659; Type: QD 000 P40 CD; Serial: xxxx
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)

FDD5 flat/Back Low/Area Scan (7x11x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 1.04 W/kg
FDD5 flat/Back Low/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 29.26 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 1.25 W/kg
SAR(1 g) = 0.929 W/kg; SAR(10 g) = 0.664 W/kg



0 dB = 0.395 W/kg = -4.03 dBW/kg

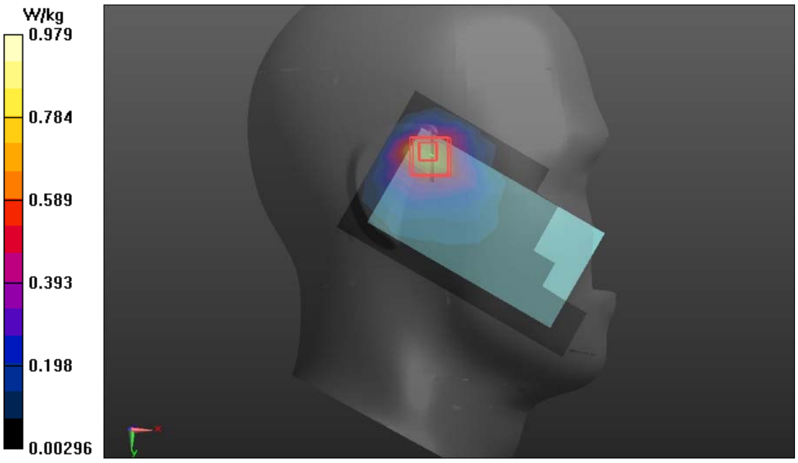
WLAN 2.4GHz

Right Side	Cheek

Communication System: UID 0, WIFI 2.4GHz (0); Frequency: 2437 MHz
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.788 S/m; ε_r = 39.219; ρ = 1000 kg/m^3
Phantom section: Right Section
Measurement Standard: DASY5

DASY Configuration:

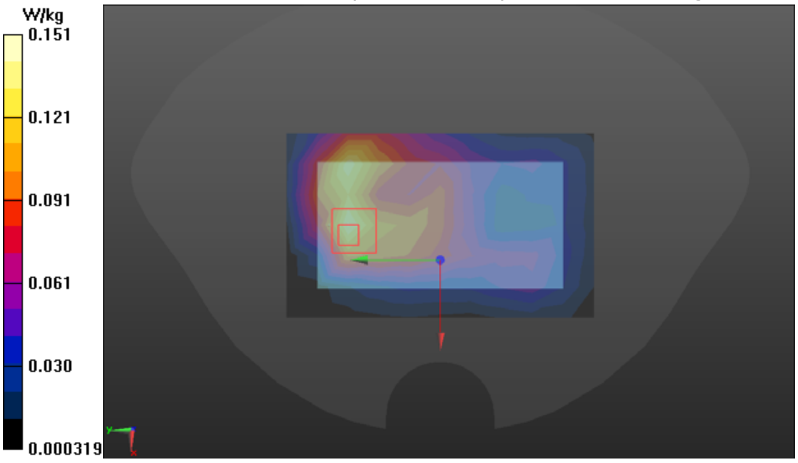
- Probe: ES3DV3 - SN3127; ConvF(4.66, 4.66, 4.66); Calibrated: 2018/11/2;
- Sensor-Surface: 3mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 3mm (Mechanical Surface Detection), z = -3.0, 32.0
- Electronics: DAE4 Sn546; Calibrated: 2018/10/15
- Phantom: 1660; Type: QD 000 P40 CD; Serial: xxxx
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)
- **2.4G right/2.4G right 0 2/Area Scan (7x11x1):** Measurement grid: dx=15mm, dy=15mm
  Maximum value of SAR (measured) = 0.807 W/kg
  2.4G right/2.4G right 0 2/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
  Reference Value = 15.32 V/m; Power Drift = 0.06 dB
  Peak SAR (extrapolated) = 1.72 W/kg
  SAR(1 g) = 0.779W/kg;SAR(10 g) = 0.377 W/kg
  Maximum value of SAR (measured) = 0.979 W/kg



Body worn	Back

Communication System: UID 0, WIFI 2.4GHz (0); Frequency: 2437 MHz
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.933 S/m; ε_r = 52.717; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5

DASY Configuration:

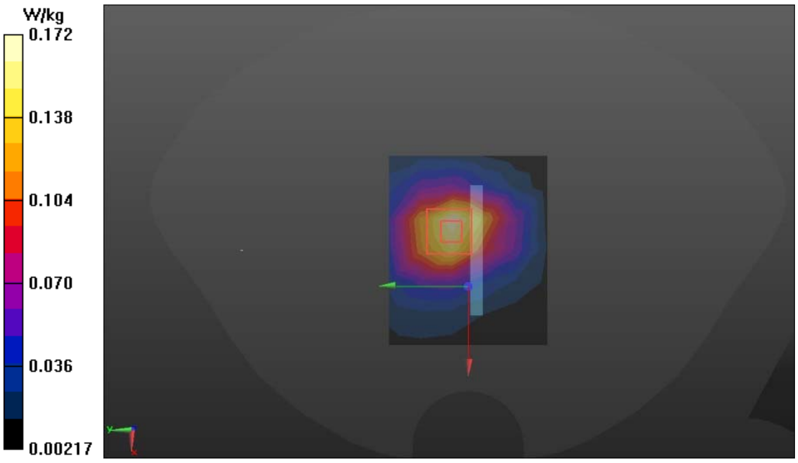
- Probe: ES3DV3 - SN3127; ConvF(4.31, 4.31, 4.31); Calibrated: 2018/11/2;
- Sensor-Surface: 3mm (Mechanical Surface Detection), z = -3.0, 32.0
- Electronics: DAE4 Sn546; Calibrated: 2018/10/15
- Phantom: 1659; Type: QD 000 P40 CD; Serial: xxxx
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)
  2.4G flat/2.4G Back/Area Scan (7x11x1): Measurement grid: dx=15mm, dy=15mm
  Maximum value of SAR (measured) = 0.144 W/kg
  2.4G flat/2.4G Back/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
  Reference Value = 6.923 V/m; Power Drift = 0.02 dB
  Peak SAR (extrapolated) = 0.257 W/kg
  SAR(1 g) = 0.119 W/kg; SAR(10 g) = 0.060 W/kg
  Maximum value of SAR (measured) = 0.151 W/kg
- 

Hotspot	Top

Communication System: UID 0, WIFI 2.4GHz (0); Frequency: 2437 MHz
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.933 S/m; ε_r = 52.717; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5

DASY Configuration:

- Probe: ES3DV3 - SN3127; ConvF(4.31, 4.31, 4.31); Calibrated: 2018/11/2;
- Sensor-Surface: 3mm (Mechanical Surface Detection), z = -3.0, 32.0
- Electronics: DAE4 Sn546; Calibrated: 2018/10/15
- Phantom: 1659; Type: QD 000 P40 CD; Serial: xxxx
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)
- **2.4G hotspot/2.4G hotspot Front/Area Scan (7x6x1):** Measurement grid: dx=15mm, dy=15mm
  Maximum value of SAR (measured) = 0.172 W/kg
  2.4G hotspot/2.4G hotspot Front/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
  Reference Value = 8.290 V/m; Power Drift = -0.12 dB
  Peak SAR (extrapolated) = 0.271 W/kg
  SAR(1 g) = 0.150 W/kg; SAR(10 g) = 0.080 W/kg
  Maximum value of SAR (measured) = 0.186 W/kg



ANNEX B – RELEVANT PAGES FROM CALIBRATION REPORTS

DAE4 Sn:546

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CNAS 中国认可 国际互认 校准 CALIBRATION CNAS L0570

Client : SRTC Certificate No: Z18-60400

CALIBRATION CERTIFICATE

Object	DAE4 - SN: 546
Calibration Procedure(s)	FF-Z11-002-01 Calibration Procedure for the Data Acquisition Electronics (DAEx)
Calibration date:	October 15, 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
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: October 17, 2018

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Certificate No: Z18-60400 Page 1 of 3

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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.

Certificate No: Z18-60400 Page 2 of 3

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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	405.306 ± 0.15% (k=2)	404.059 ± 0.15% (k=2)	404.180 ± 0.15% (k=2)
Low Range	3.98893 ± 0.7% (k=2)	3.95876 ± 0.7% (k=2)	3.98021 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	238° ± 1 °

Certificate No: Z18-60400 Page 3 of 3

ES3DV3 Sn:3127

CTTL In Collaboration with speag CALIBRATION LABORATORY
CNAS CALIBRATION CNAS L0570
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Client SRTC Certificate No: Z18-60398

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3127
Calibration Procedure(s)	FF-Z11-004-01 Calibration Procedures for Dosimetric E-field Probes
Calibration date:	November 02, 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	20-Jun-18 (CTTL, No.J18X05032)	Jun-19
Power sensor NRP-Z91	101547	20-Jun-18 (CTTL, No.J18X05032)	Jun-19
Power sensor NRP-Z91	101548	20-Jun-18 (CTTL, No.J18X05032)	Jun-19
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	21-Jun-18 (CTTL, No.J18X05033)	Jun-19
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: November 04, 2018

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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).

Certificate No: Z18-60398 Page 2 of 11

Probe ES3DV3

SN: 3127

Calibrated: November 02, 2018

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

Certificate No: Z18-60398 Page 3 of 11

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DASY/EASY – Parameters of Probe: ES3DV3 - SN: 3127

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm($\mu V/(V/m)^2$)[A]	1.27	1.26	1.21	±10.0%
DCP(mV)[B]	103.3	104.4	105.0	

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	285.6	±2.2%
		Y	0.0	0.0	1.0		287.9	
		Z	0.0	0.0	1.0		282.9	

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: ES3DV3 - SN: 3127

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	6.34	6.34	6.34	0.40	1.35	±12.1%
835	41.5	0.90	6.18	6.18	6.18	0.35	1.58	±12.1%
1810	40.0	1.40	5.07	5.07	5.07	0.66	1.24	±12.1%
2000	40.0	1.40	4.96	4.96	4.96	0.70	1.20	±12.1%
2300	39.5	1.67	4.79	4.79	4.79	0.90	1.08	±12.1%
2450	39.2	1.80	4.66	4.66	4.66	0.90	1.08	±12.1%
2600	39.0	1.96	4.40	4.40	4.40	0.80	1.21	±12.1%

[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: ES3DV3 - SN: 3127

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	6.33	6.33	6.33	0.40	1.40	±12.1%
835	55.2	0.97	6.13	6.13	6.13	0.37	1.62	±12.1%
1810	53.3	1.52	4.76	4.76	4.76	0.65	1.27	±12.1%
2000	53.3	1.52	4.80	4.80	4.80	0.67	1.27	±12.1%
2300	52.9	1.81	4.46	4.46	4.46	0.90	1.15	±12.1%
2450	52.7	1.95	4.31	4.31	4.31	0.78	1.28	±12.1%
2600	52.5	2.16	4.14	4.14	4.14	0.90	1.10	±12.1%

[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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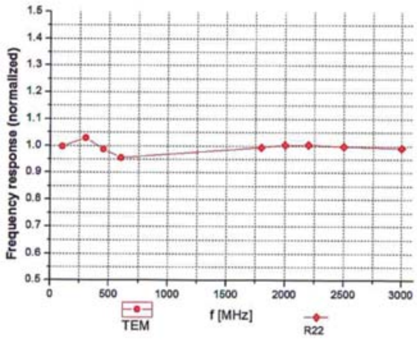
Frequency Response of E-Field

(TEM-Cell: ifi110 EXX, Waveguide: R22)



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

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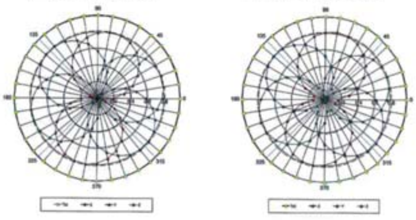
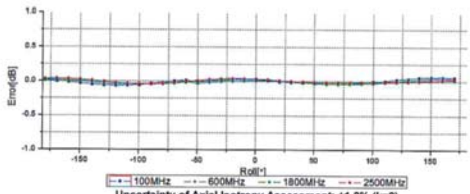
Receiving Pattern (Φ), θ=0°

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





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

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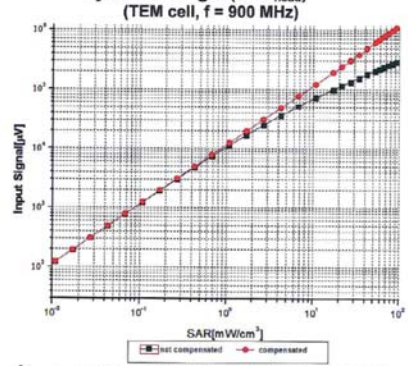
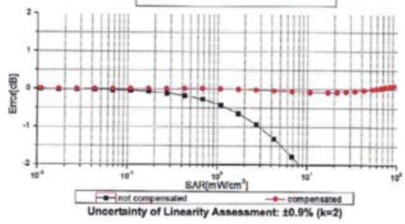
Dynamic Range f(SAR$_{head}$)
(TEM cell, f = 900 MHz)





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

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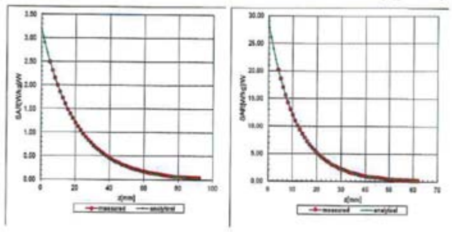
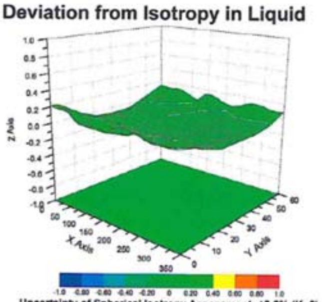
Conversion Factor Assessment

f=750 MHz, WGLS R9(H_convF) f=1810 MHz, WGLS R22(H_convF)



Deviation from Isotropy in Liquid



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

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Appendix: Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB√μV	C	VR mV	Unc[E] (k=2)
0	CW	0.00	X	0.0	0.0	1.0	282.3	±2.5%
			Y	0.0	0.0	1.0	280.9	
			Z	0.0	0.0	1.0	275.1	
10012	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	1.87	X	2.77	68.02	18.46	143.0	±1.8%
			Y	2.75	68.05	18.52	145.0	
			Z	2.71	67.79	18.25	142.3	
10100	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	5.67	X	6.13	66.4	18.97	141.9	±1.9%
			Y	6.15	66.49	19.06	144.2	
			Z	6.09	66.32	18.90	140.9	
10108	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	5.80	X	6.09	66.24	19.07	139.5	±1.9%
			Y	6.10	66.33	19.15	141.5	
			Z	6.05	66.19	19.05	138.0	
10154	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	5.75	X	5.81	65.85	18.93	136.1	±1.9%
			Y	5.82	65.92	19.01	137.8	
			Z	5.79	65.89	18.97	134.7	
10169	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	5.73	X	4.84	65.92	19.20	130.8	±1.9%
			Y	4.82	65.98	19.27	131.3	
			Z	4.80	66.00	19.29	129.1	
10175	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	5.72	X	4.88	66.14	19.40	131.6	±1.9%
			Y	4.83	66.08	19.33	130.9	
			Z	4.79	66.02	19.29	129.3	
10297	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	5.81	X	6.19	66.61	19.42	141.9	±1.9%
			Y	6.13	66.43	19.26	140.7	
			Z	6.14	66.52	19.33	139.6	

D835V2 Sn:4d023

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Client SRTC Certificate No: Z17-97135

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 4d023
Calibration Procedure(s)	FF-Z11-003-01 Calibration Procedures for dipole validation kits
Calibration date:	September 13, 2017

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	102196	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Power sensor NRV-Z5	100596	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Reference Probe EX3DV4	SN 7433	26-Sep-16(SPEAG,No.EX3-7433_Sep16)	Sep-17
DAE4	SN 1331	19-Jan-17(CTTL-SPEAG,No.Z17-97015)	Jan-18
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
Signal Generator E4438C	MY49071430	13-Jan-17 (CTTL, No.J17X00286)	Jan-18
Network Analyzer E5071C	MY46110673	13-Jan-17 (CTTL, No.J17X00285)	Jan-18

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

Issued: September 16, 2017

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

Certificate No: Z17-97135 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	52.10.0.1446
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	41.3 ± 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	2.35 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**9.37 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	**6.06 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	55.7 ± 6 %	0.96 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	2.34 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**9.47 mW /g ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.53 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**6.17 mW /g ± 18.7 % (k=2)**

Certificate No: Z17-97135 Page 3 of 8

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.0Ω- 2.79jΩ
Return Loss	- 30.7dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.6Ω- 3.61jΩ
Return Loss	- 25.8dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.495 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

Certificate No: Z17-97135 Page 4 of 8

D835V2 Sn:4d023

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DASY5 Validation Report for Head TSL Date: 09.13.2017

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d023

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

Medium parameters used: f = 835 MHz; σ = 0.903 S/m; ε_r = 41.34; ρ = 1000 kg/m^3

Phantom section: Left Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(9.82, 9.82, 9.82); Calibrated: 9/26/2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 1/19/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

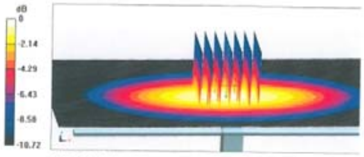
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.28V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 3.66 W/kg

SAR(1 g) = 2.35 W/kg; SAR(10 g) = 1.52 W/kg

Maximum value of SAR (measured) = 3.21 W/kg



0 dB = 3.21 W/kg = 5.07 dBW/kg

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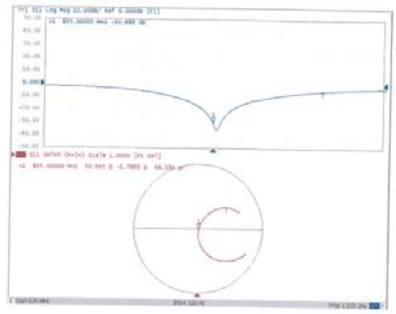
Impedance Measurement Plot for Head TSL



Certificate No: Z17-97135 Page 6 of 8

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DASY5 Validation Report for Body TSL Date: 09.13.2017

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d023

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

Medium parameters used: f = 835 MHz; σ = 0.958 S/m; ε_r = 55.68; ρ = 1000 kg/m^3

Phantom section: Center Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(9.5,9.5, 9.5); Calibrated: 9/26/2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 1/19/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

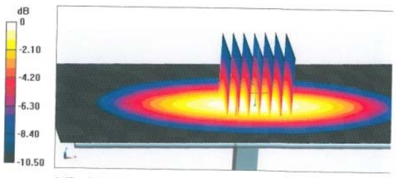
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.17 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 3.57 W/kg

SAR(1 g) = 2.34 W/kg; SAR(10 g) = 1.53 W/kg

Maximum value of SAR (measured) = 3.15 W/kg



0 dB = 3.15 W/kg = 4.98 dBW/kg

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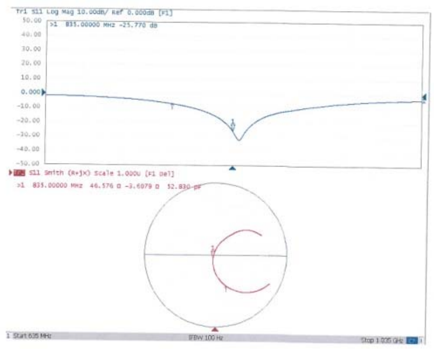
Impedance Measurement Plot for Body TSL



Certificate No: Z17-97135 Page 8 of 8

D1800V2 Sn:2d084

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Client SRTC Certificate No: Z17-97138

CALIBRATION CERTIFICATE

Object: D1800V2 - SN: 2d084

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

Calibration date: September 15, 2017

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	102196	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Power sensor NRP-Z91	100596	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Reference Probe EX3DV4	SN 7433	26-Sep-16(SPEAG,No.EX3-7433_Sep16)	Sep-17
DAE4	SN 1331	19-Jan-17(CTTL-SPEAG,No.Z17-97015)	Jan-18
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
Signal Generator E4438C	MY49071430	13-Jan-17 (CTTL, No.J17X00286)	Jan-18
Network Analyzer E5071C	MY46110673	13-Jan-17 (CTTL, No.J17X00285)	Jan-18

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

Issued: September 18, 2017

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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, "Procedure to measure the Specific Absorption Rate (SAR) For hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3GHz)", February 2005
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	52.10.0.1446
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	1800 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 %	1.42 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	9.79 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**38.9 mW /g ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.12 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**20.4 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	53.8 ± 6 %	1.50 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	9.84 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**39.7 mW /g ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.18 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**20.8 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	49.3Ω- 1.55jΩ
Return Loss	- 35.4dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.0Ω- 1.32jΩ
Return Loss	- 27.1dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.316 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

D1800V2 Sn:2d084

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DASY5 Validation Report for Head TSL Date: 09.15.2017

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN: 2d084

Communication System: UID 0, CW; Frequency: 1800 MHz; Duty Cycle: 1:1

Medium parameters used: f = 1800 MHz; σ = 1.423 S/m; εr = 40.37; ρ = 1000 kg/m3

Phantom section: Left Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(7.97, 7.97, 7.97); Calibrated: 9/26/2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 1/19/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

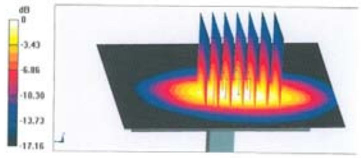
System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.90 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 18.7 W/kg

SAR(1 g) = 9.79 W/kg; SAR(10 g) = 5.12 W/kg

Maximum value of SAR (measured) = 15.5 W/kg



0 dB = 15.5 W/kg = 11.90 dBW/kg

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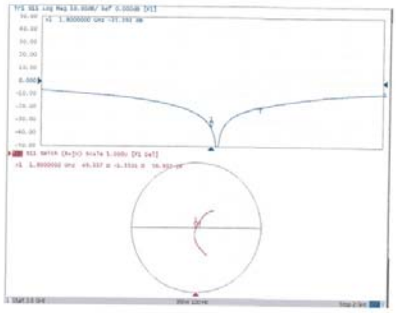
Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL Date: 09.14.2017

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN: 2d084

Communication System: UID 0, CW; Frequency: 1800 MHz; Duty Cycle: 1:1

Medium parameters used: f = 1800 MHz; σ = 1.503 S/m; ε_r = 53.79; ρ = 1000 kg/m^3

Phantom section: Center Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(7.75, 7.75, 7.75); Calibrated: 9/26/2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 1/19/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7413)

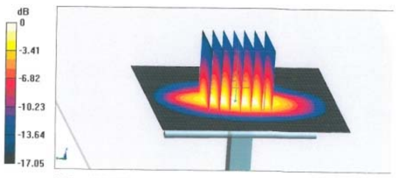
System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 97.57 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 18.0 W/kg

SAR(1 g) = 9.84 W/kg; SAR(10 g) = 5.18 W/kg

Maximum value of SAR (measured) = 15.2 W/kg



0 dB = 15.2 W/kg = 11.82 dBW/kg

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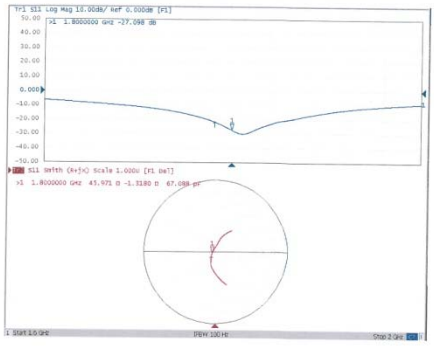
Impedance Measurement Plot for Body TSL



D2450V2 Sn:738

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Client SRTC Certificate No: Z17-97140

CALIBRATION CERTIFICATE

Object: D2450V2 - SN: 738

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

Calibration date: September 18, 2017

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	102196	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Power sensor NRV-Z5	100596	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Reference Probe EX3DV4	SN 7433	26-Sep-16(SPEAG,No.EX3-7433_Sep16)	Sep-17
DAE4	SN 1331	19-Jan-17(CTTL-SPEAG,No.Z17-97015)	Jan-18

Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	13-Jan-17 (CTTL, No.J17X00286)	Jan-18
Network Analyzer E5071C	MY46110673	13-Jan-17 (CTTL, No.J17X00285)	Jan-18

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

Issued: September 21, 2017

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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	52.10.0.1446
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	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.7 ± 6 %	1.79 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	13.1 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**52.4 mW /g ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.10 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**24.4 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	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.5 ± 6 %	1.98 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	13.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**52.3 mW /g ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	6.10 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**24.3 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	51.3Ω+ 5.92jΩ
Return Loss	- 24.5dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.6Ω+ 6.39jΩ
Return Loss	- 23.1dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.268 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

D2450V2 Sn:738

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DASY5 Validation Report for Head TSL Date: 09.18.2017

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 738

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used: f = 2450 MHz; σ = 1.788 S/m; εr = 38.67; ρ = 1000 kg/m3

Phantom section: Left Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(7.45, 7.45, 7.45); Calibrated: 9/26/2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 1/19/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

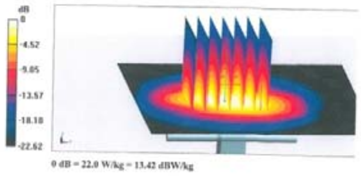
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 102.1 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 27.8 W/kg

SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.1 W/kg

Maximum value of SAR (measured) = 22.0 W/kg



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

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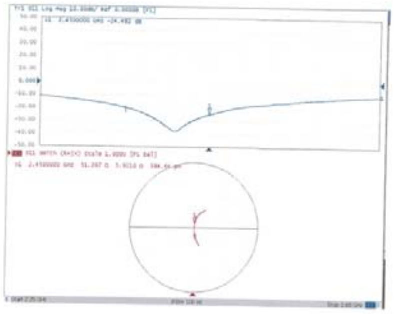
Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL Date: 09.18.2017

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 738

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used: f = 2450 MHz; σ = 1.983 S/m; ε_r = 52.51; ρ = 1000 kg/m^3

Phantom section: Center Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(7.46, 7.46, 7.46); Calibrated: 9/26/2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 1/19/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

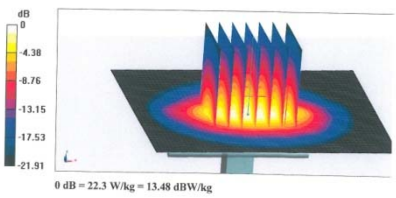
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.41 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 27.8 W/kg

SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.1 W/kg

Maximum value of SAR (measured) = 22.3 W/kg



0 dB = 22.3 W/kg = 13.48 dBW/kg

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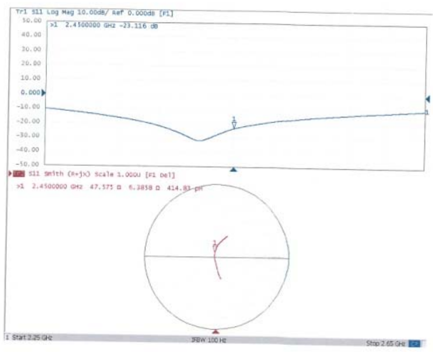
Impedance Measurement Plot for Body TSL



--End of the test report--