WiFi 802.11b Left Cheek Middle

Date/Time: 2017/2/7
Electronics: DAE4 Sn1244
Medium: Head 2450MHz
Medium parameters used: f = 2437 MHz; σ = 1.827 S/m; ε_r = 39.463; ρ = 1000 kg/m^3
Ambient Temperature:22 ℃   Liquid Temperature:22 ℃
Communication System: Wifi 2450 2450MHz;   Frequency: 2437 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN3754ConvF(7.26, 7.26, 7.26); Calibrated: 1/13/2017
WiFi 802.11b Left Cheek Middle/Area Scan (131x81x1):
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR   (Measurement) = 0.517 W/kg
WiFi 802.11b Left Cheek Middle/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 5.360 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 0.878 W/kg
SAR(1 g) = 0.306 W/kg; SAR(10 g) = 0.123 W/kg
Maximum value of SAR   (measured) = 0.363 W/kg

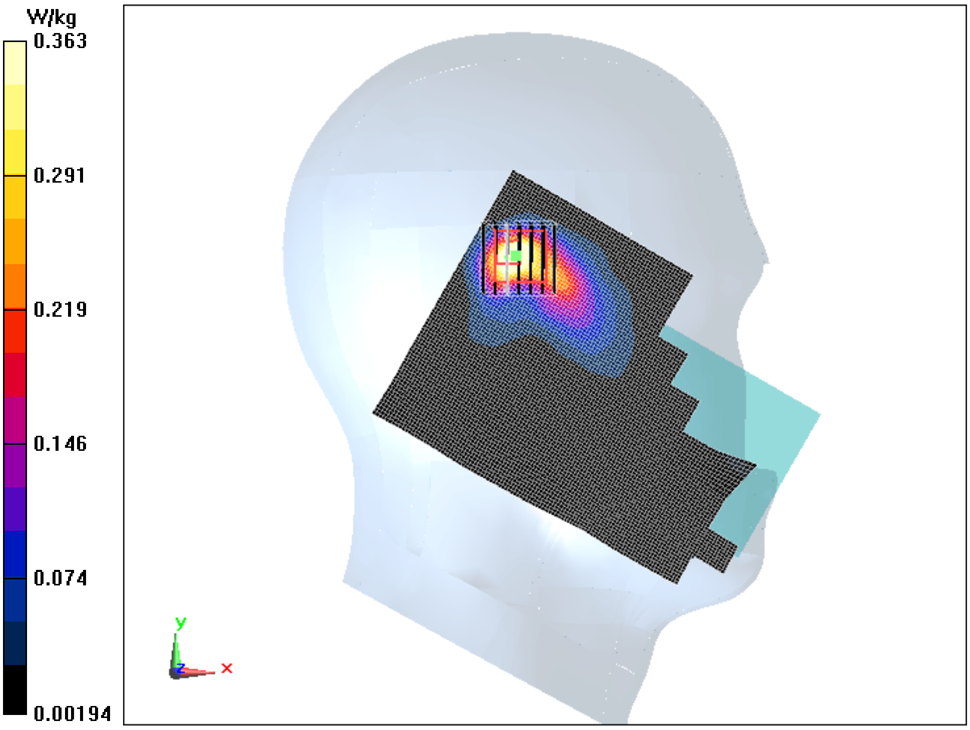


Fig.5 WiFi 802.11b Left Cheek Middle

WiFi 802.11b Left Cheek Middle

Date/Time: 2017/2/7
Electronics: DAE4 Sn1244
Medium: Head 2450MHz
Medium parameters used: f = 2437 MHz; σ = 1.827 S/m; ε_r = 39.463; ρ = 1000 kg/m^3
Ambient Temperature:22 ℃ Liquid Temperature:22 ℃
Communication System: Wifi 2450 2450MHz; Frequency: 2437 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN3754ConvF(7.26, 7.26, 7.26); Calibrated: 1/13/2017
WiFi 802.11b Left Cheek Middle/Area Scan (121x71x1):
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 0.0338 W/kg
WiFi 802.11b Left Cheek Middle/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.810 V/m; Power Drift = -0.15 dB
Peak SAR (extrapolated) = 0.106 W/kg
SAR(1 g) = 0.022 W/kg; SAR(10 g) = 0.0066 W/kg
Maximum of SAR (measured) = 0.0248 W/kg

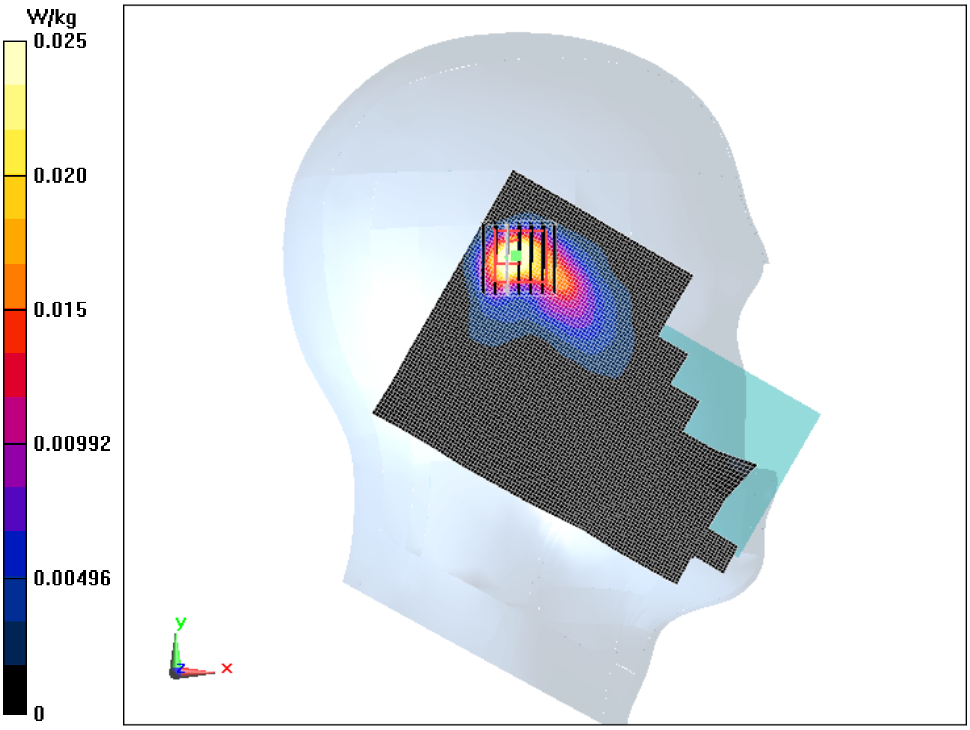


Fig.6 WiFi 802.11b Left Cheek Middle

GPRS 850MHz 2TS Ground Mode High

Date/Time: 2017/1/14
Electronics: DAE3 Sn360
Medium: Body 850MHz
Medium parameters used: f = 849 MHz; σ = 1.012 S/m; ε_r = 56.205; ρ = 1000 kg/m^3
Ambient Temperature:22 ℃ Liquid Temperature:22 ℃
Communication System: GSM 850MHz GPRS 2TS (0); Frequency: 848.8 MHz; Duty Cycle: 1:4
Probe: EX3DV4 - SN7375ConvF(9.94, 9.94, 9.94); Calibrated: 12/8/2016
GPRS 850MHz 2TS Ground Mode High/Area Scan (71x111x1):
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 0.693 W/kg
GPRS 850MHz 2TS Ground Mode High/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 24.87 V/m; Power Drift = 0.15 dB
Peak SAR (extrapolated) = 0.856 W/kg
SAR(1 g) = 0.680 W/kg; SAR(10 g) = 0.516 W/kg
Maximum value of SAR (measured) = 0.711 W/kg

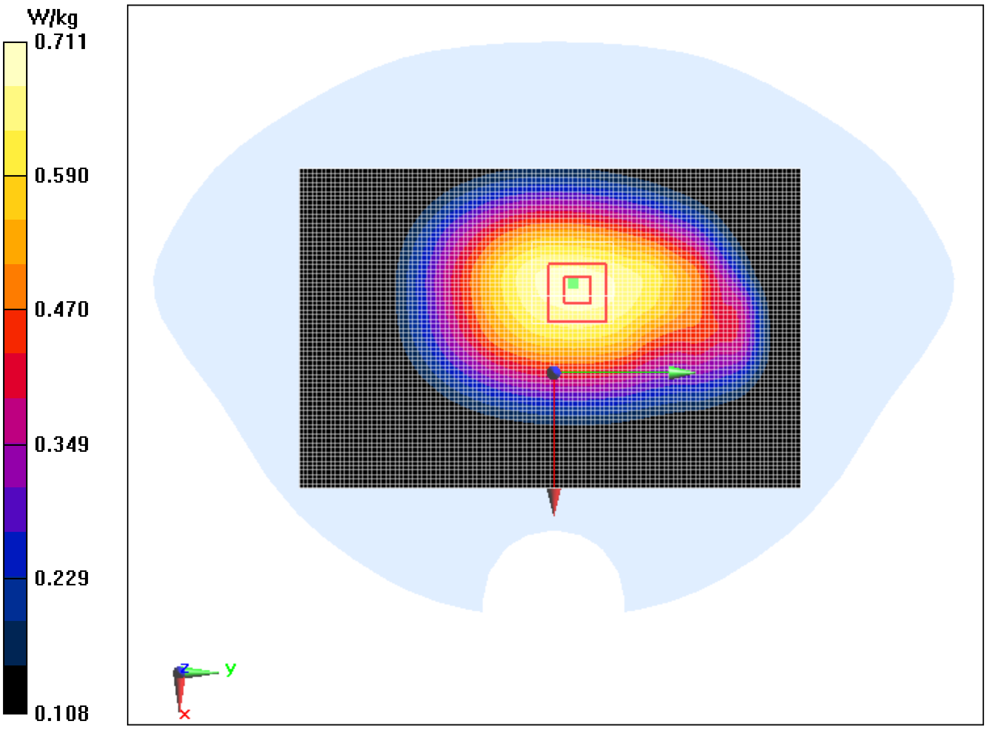


Fig.7 GPRS 850MHz 2TS Ground Mode High

GPRS 850MHz 2TS Ground Mode High

Date/Time: 2017/1/14
Electronics: DAE4 Sn1244
Medium: Body 850MHz
Medium parameters used: f = 849 MHz; σ = 1.012 S/m; ε_r = 56.205; ρ = 1000 kg/m^3
Ambient Temperature:22 ℃ Liquid Temperature:22 ℃
Communication System: GSM 850MHz GPRS 2TS (0); Frequency: 848.8 MHz; Duty Cycle: 1:4
Probe: EX3DV4 - SN3754ConvF(9.66, 9.66, 9.66); Calibrated: 1/13/2017

GPRS 850MHz 2TS Ground Mode High/Area Scan (71x111x1):
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 0.560 W/kg

GPRS 850MHz 2TS Ground Mode High/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 22.32 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 0.921 W/kg
SAR(1 g) = 0.486 W/kg; SAR(10 g) = 0.269 W/kg
Maximum value of SAR (measured) = 0.546 W/kg

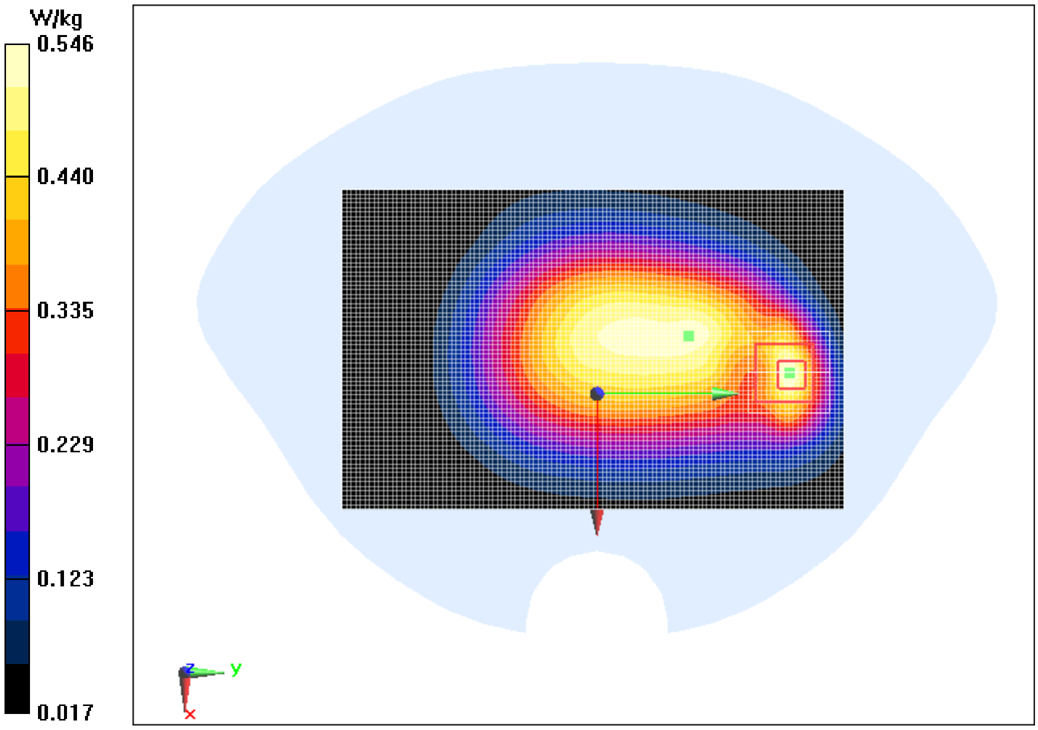


Fig.8 GPRS 850MHz 2TS Ground Mode High

GPRS 1900MHz 3TS Bottom Mode High

Date/Time: 2017/1/15
Electronics: DAE3 Sn360
Medium: Body 1900MHz
Medium parameters used: f = 1910 MHz; σ = 1.564 S/m; ε_r = 53.487; ρ = 1000 kg/m^3
Ambient Temperature:22 ℃ Liquid Temperature:22 ℃
Communication System: GSM 1900MHz GPRS 3TS (0); Frequency: 1909.8 MHz; Duty Cycle: 1:2.77
Probe: EX3DV4 - SN7375ConvF(7.62, 7.62, 7.62); Calibrated: 12/8/2016
GPRS 1900MHz 3TS Bottom Mode High/Area Scan (41x81x1):
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 0.852 W/kg
GPRS 1900MHz 3TS Bottom Mode High/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 21.16 V/m; Power Drift = -0.13 dB
Peak SAR (extrapolated) = 1.28 W/kg
SAR(1 g) = 0.753 W/kg; SAR(10 g) = 0.416 W/kg
Maximum value of SAR (measured) = 0.822 W/kg

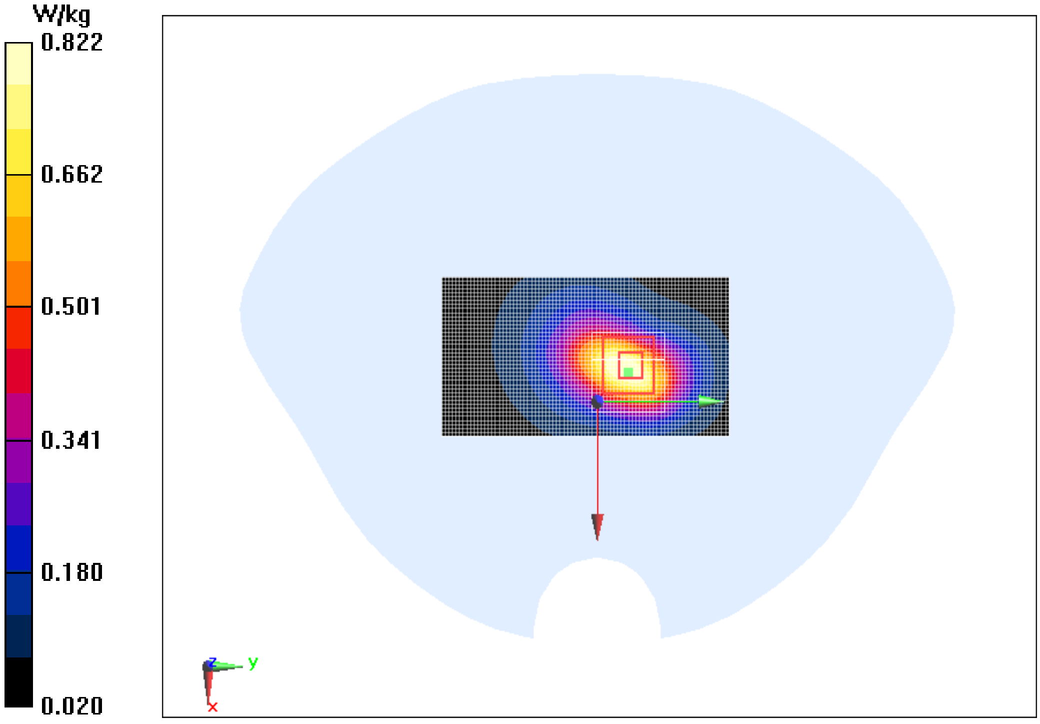


Fig.9 GPRS 1900MHz 3TS Bottom Mode High

GPRS 1900MHz 3TS Bottom Mode High

Date/Time: 2017/1/15
Electronics: DAE3 Sn360
Medium: Body 1900MHz
Medium parameters used: f = 1910 MHz; σ = 1.564 S/m; ε_r = 53.487; ρ = 1000 kg/m^3
Ambient Temperature:22 ℃ Liquid Temperature:22 ℃
Communication System: GSM 1900MHz GPRS 3TS (0); Frequency: 1909.8 MHz; Duty Cycle: 1:2.77
Probe: EX3DV4 - SN7375ConvF(7.62, 7.62, 7.62); Calibrated: 12/8/2016
GPRS 1900MHz 3TS Bottom Mode High/Area Scan (41x81x1):
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 0.771 W/kg
GPRS 1900MHz 3TS Bottom Mode High/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 12.71 V/m; Power Drift = 0.18 dB
Peak SAR (extrapolated) = 1.16 W/kg
SAR(1 g) = 0.684 W/kg; SAR(10 g) = 0.374 W/kg
Maximum value of SAR (measured) = 0.771 W/kg

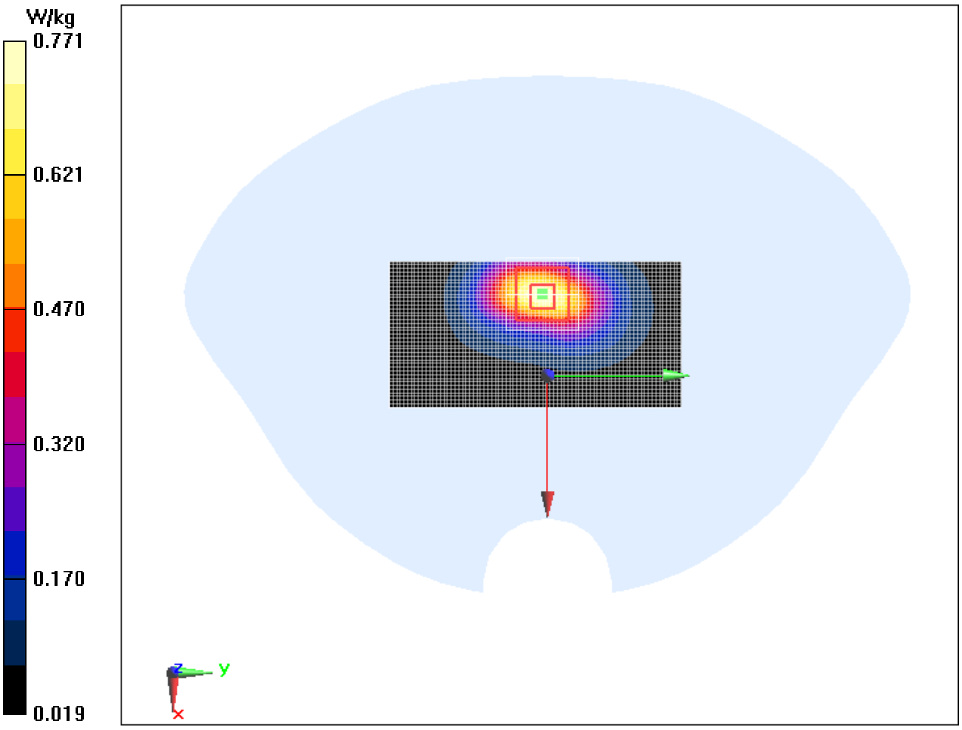


Fig.10 GPRS 1900MHz 3TS Bottom Mode High

WCDMA Band 2 Ground Mode High

Date/Time: 2017/2/15
Electronics: DAE3 Sn360
Medium: Body 1900MHz
Medium parameters used: f = 1908 MHz; σ = 1.562 S/m; ε_r = 53.499; ρ = 1000 kg/m^3
Ambient Temperature:22 ℃ Liquid Temperature:22 ℃
Communication System: WCDMA Professional Band Ⅱ; Frequency: 1907.6 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN3754ConvF(7.6, 7.6, 7.6); Calibrated: 1/13/2017
WCDMA Band 2 Ground Mode High/Area Scan (71x111x1):
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 0.763 W/kg
WCDMA Band 2 Ground Mode High/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 6.877 V/m; Power Drift = 0.20 dB
Peak SAR (extrapolated) = 1.31 W/kg
SAR(1 g) = 0.727 W/kg; SAR(10 g) = 0.384 W/kg
Maximum value of SAR (measured) = 0.803 W/kg

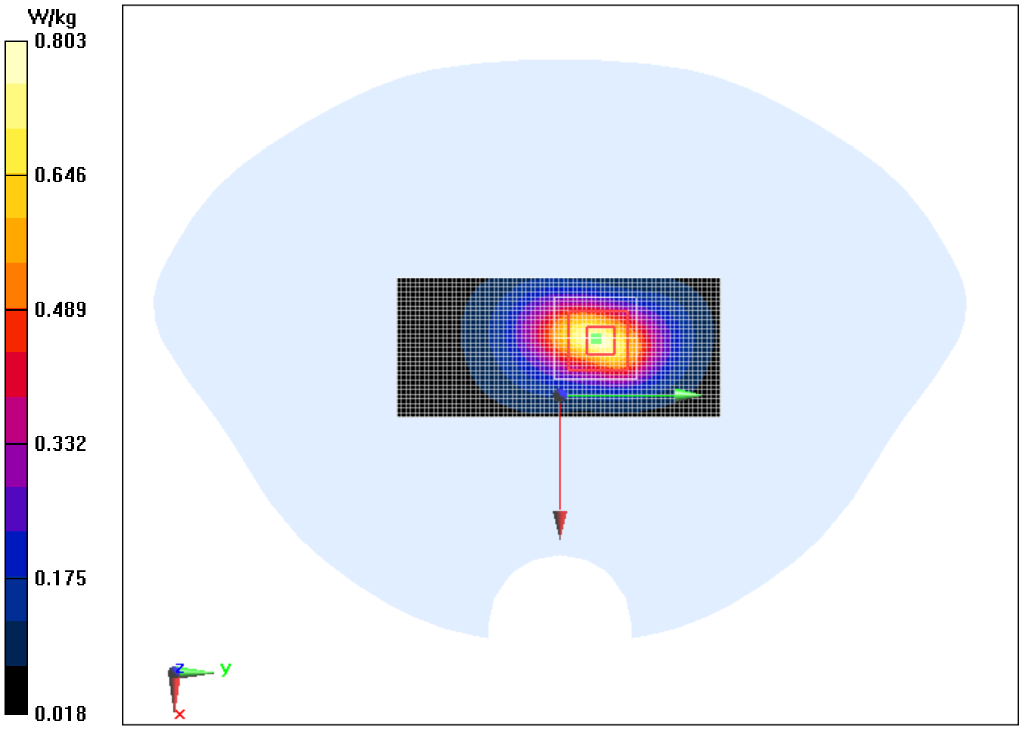


Fig.11 WCDMA Band 2 Ground Mode High

WCDMA Band 2 Bottom Mode High

Date/Time: 2017/1/15
Electronics: DAE3 Sn360
Medium: Body 1900MHz
Medium parameters used: f = 1908 MHz; σ = 1.562 S/m; ε_r = 53.499; ρ = 1000 kg/m^3
Ambient Temperature:22 ℃ Liquid Temperature:22 ℃
Communication System: WCDMA Professional Band Ⅱ; Frequency: 1907.6 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN7375ConvF(7.62, 7.62, 7.62); Calibrated: 12/8/2016
WCDMA Band 2 Bottom Mode High/Area Scan (31x71x1):
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 0.769 W/kg
WCDMA Band 2 Bottom Mode High/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 18.74 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 1.27 W/kg
SAR(1 g) = 0.698 W/kg; SAR(10 g) = 0.362 W/kg
Maximum value of SAR (measured) = 0.787 W/kg

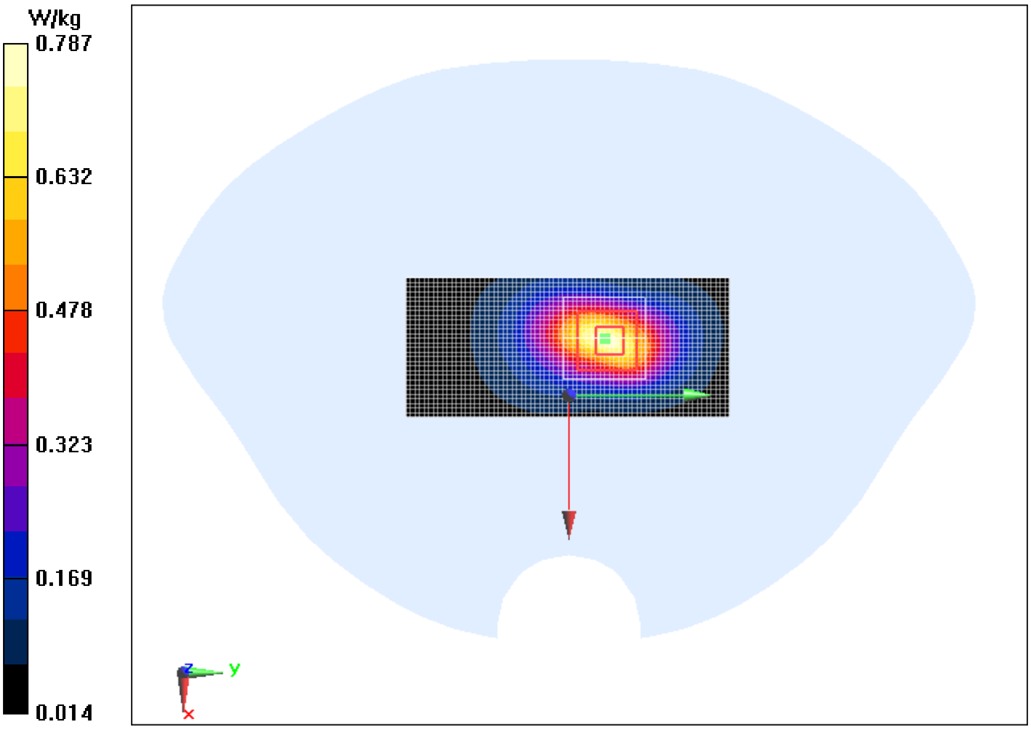


Fig.12 WCDMA Band 2 Bottom Mode High

WCDMA Band5 Ground Mode High

Date/Time: 2017/2/14
Electronics: DAE3 Sn360
Medium: Body 850MHz
Medium parameters used: f = 847 MHz; σ = 1.009 S/m; ε_r = 56.214; ρ = 1000 kg/m^3
Ambient Temperature:22 ℃ Liquid Temperature:22 ℃
Communication System: WCDMA Professional Band Ⅴ; Frequency: 846.6 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN7375ConvF(9.94, 9.94, 9.94); Calibrated: 12/8/2016
WCDMA Band5 Ground Mode High/Area Scan (71x121x1):
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 0.578 W/kg
WCDMA Band5 Ground Mode High/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 21.48 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 0.668 W/kg
SAR(1 g) = 0.528 W/kg; SAR(10 g) = 0.400 W/kg
Maximum value of SAR (measured) = 0.555 W/kg

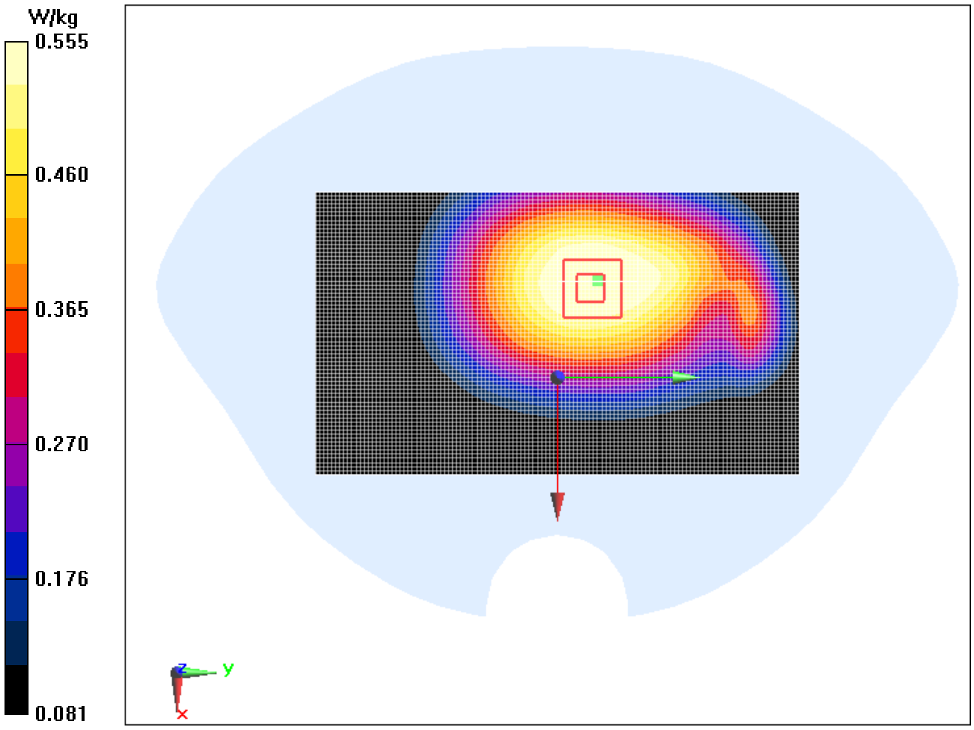


Fig.13 WCDMA Band5 Ground Mode High

WCDMA Band5 Ground Mode High

Date/Time: 2017/1/14
Electronics: DAE3 Sn360
Medium: Body 850MHz
Medium parameters used: f = 847 MHz; σ = 1.009 S/m; ε_r = 56.214; ρ = 1000 kg/m^3
Ambient Temperature:22 ℃ Liquid Temperature:22 ℃
Communication System: WCDMA Professional Band Ⅴ; Frequency: 846.6 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN7375ConvF(9.94, 9.94, 9.94); Calibrated: 12/8/2016
WCDMA Band5 Ground Mode High/Area Scan (71x121x1):
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 0.437 W/kg
WCDMA Band5 Ground Mode High/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 20.44 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 0.530 W/kg
SAR(1 g) = 0.418 W/kg; SAR(10 g) = 0.316 W/kg
Maximum of SAR (measured) = 0.438 W/kg

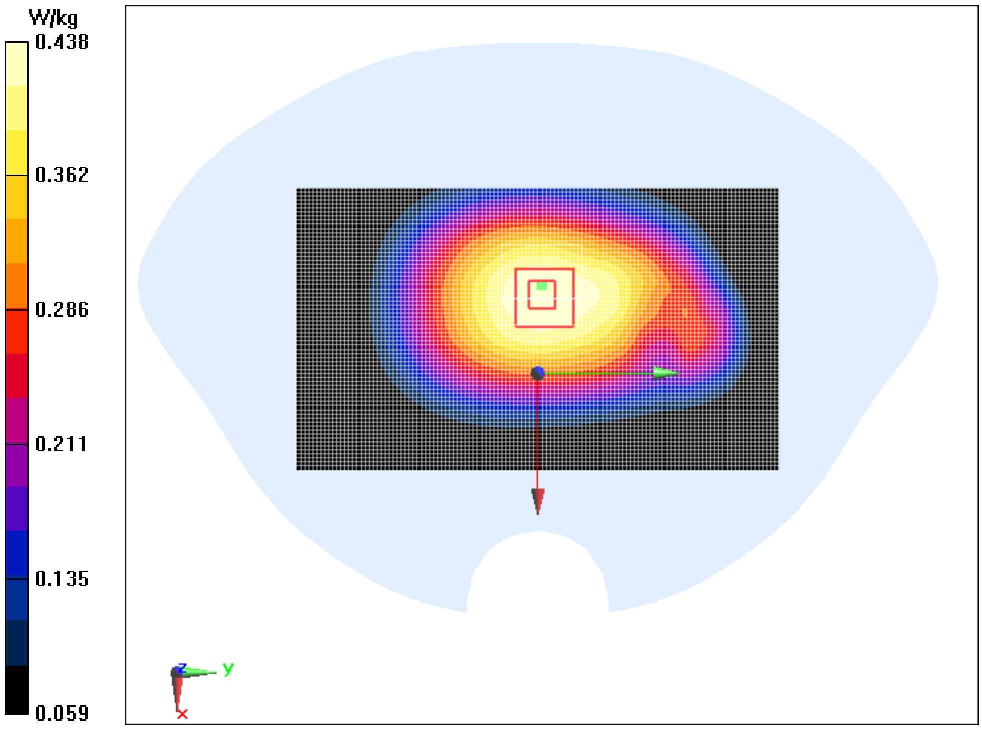


Fig.14 WCDMA Band5 Ground Mode High

WiFi 802.11b Phantom Mode Middle

Date/Time: 2017/2/7
Electronics: DAE4 Sn1244
Medium: Body 2450MHz
Medium parameters used: f = 2437 MHz; σ = 1.892 S/m; ε_r = 53.646; ρ = 1000 kg/m^3
Ambient Temperature:22 ℃ Liquid Temperature:22 ℃
Communication System: Wifi 2450 2450MHz; Frequency: 2437 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN3754ConvF(7.22, 7.22, 7.22); Calibrated: 1/13/2017
WiFi 802.11b Phantom Mode Middle/Area Scan (71x111x1):
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 0.0580 W/kg
WiFi 802.11b Phantom Mode Middle/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.465 V/m; Power Drift = -0.13 dB
Peak SAR (extrapolated) = 0.0730 W/kg
SAR(1 g) = 0.030 W/kg; SAR(10 g) = 0.015 W/kg
Maximum of SAR (measured) = 0.0344 W/kg

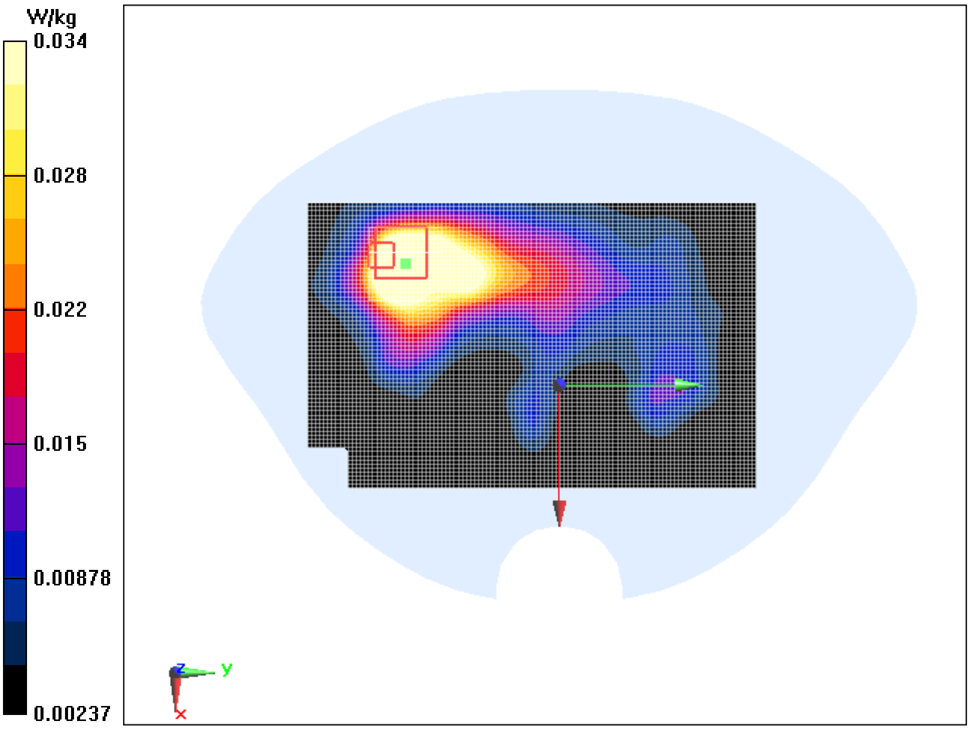


Fig.15 WiFi 802.11b Phantom Mode Middle

ANNEX B. SYSTEM VALIDATION RESULTS

835 MHz

Date/Time: 2017/1/14

Electronics: DAE3 Sn360

Medium: Head 835MHz

Medium parameters used: f = 835 MHz; σ = 0.898 S/m; ε_r = 41.512; ρ = 1000 kg/m^3

Ambient Temperature:22.5 ℃ Liquid Temperature:22.5 ℃

Communication System: CW 835MHz; Frequency: 835 MHz; Duty Cycle: 1:1

Probe: EX3DV4 - SN7375ConvF(9.73, 9.73, 9.73);

System Validation /Area Scan (60x120x1):

Measurement grid: dx=10 mm, dy=10 mm

Maximum value of SAR (Measurement) = 2.81 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0:

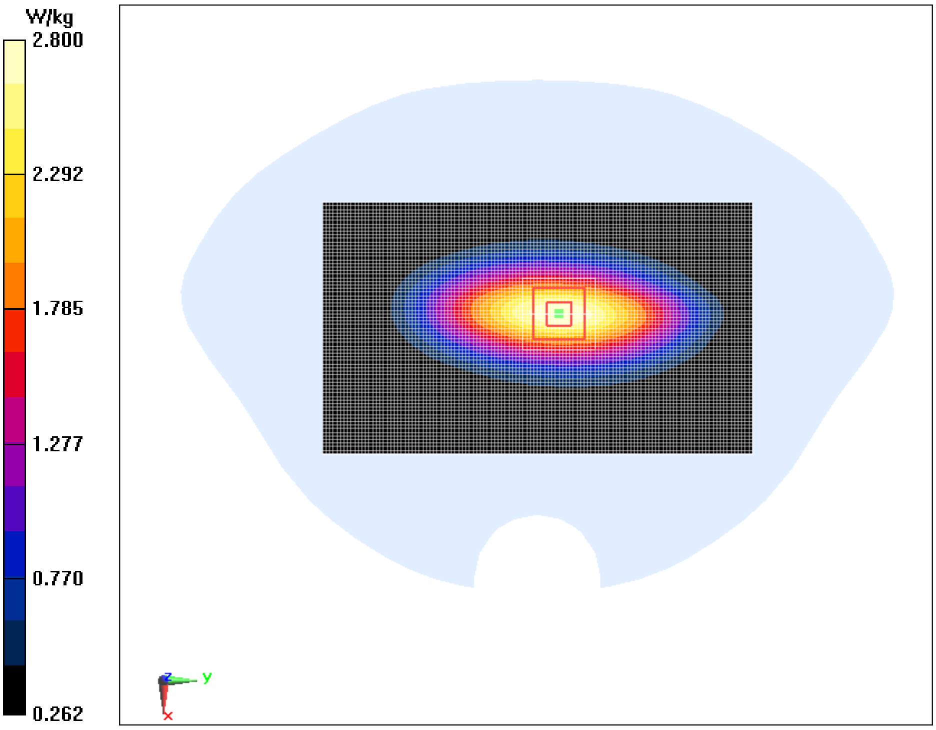
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 50.89 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 3.16 W/kg

SAR(1 g) = 2.30W/kg; SAR(10 g) = 1.50 W/kg

Maximum value of SAR (measured) = 2.80 W/kg



1900MHz

Date/Time: 2017/1/15

Electronics: DAE3 Sn360

Medium: Head 1900MHz

Medium parameters used: f = 1900 MHz; σ = 1.386 S/m; ε_r = 39.631; ρ = 1000 kg/m^3

Ambient Temperature:22.5 ℃ Liquid Temperature:22.5 ℃

Communication System: CW 1900MHz; Frequency: 1900 MHz; Duty Cycle: 1:1

Probe: EX3DV4 - SN7375ConvF (7.92, 7.92, 7.92);

System check Validation /Area Scan (60x60x1):

Measurement grid: dx=10 mm, dy=10 mm

Maximum value of SAR (Measurement) = 15.4 W/kg

System check Validation /Zoom Scan (7x7x7) /Cube 0:

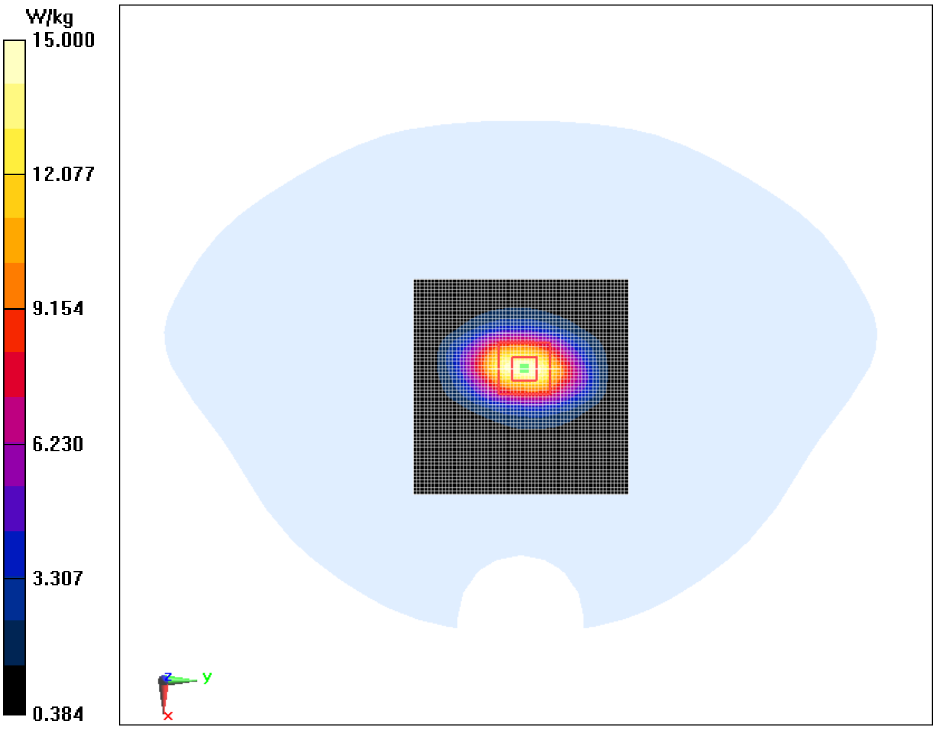
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 105.1 V/m; Power Drift = 0.12 dB

Peak SAR (extrapolated) = 19.3 W/kg

SAR(1 g) = 9.89 W/kg; SAR(10 g) = 5.14 W/kg

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



2450MHz

Date/Time: 2017/2/7

Electronics: DAE4 Sn1244

Medium: Head 2450MHz

Medium parameters used: f = 2450 MHz; σ = 1.812 S/m; ε_r = 39.113; ρ = 1000 kg/m^3

Ambient Temperature:22.5 ℃ Liquid Temperature:22.5 ℃

Communication System: CW 2450MHz; Frequency: 2450 MHz; Duty Cycle: 1:1

Probe: EX3DV4 - SN3754ConvF(7.26, 7.26, 7.26);

System Validation /Area Scan (40x80x1):

Measurement grid: dx=10 mm, dy=10 mm

Maximum value of SAR (Measurement) = 21.2 W/kg

System Validation/Zoom Scan (7x7x7) /Cube 0:

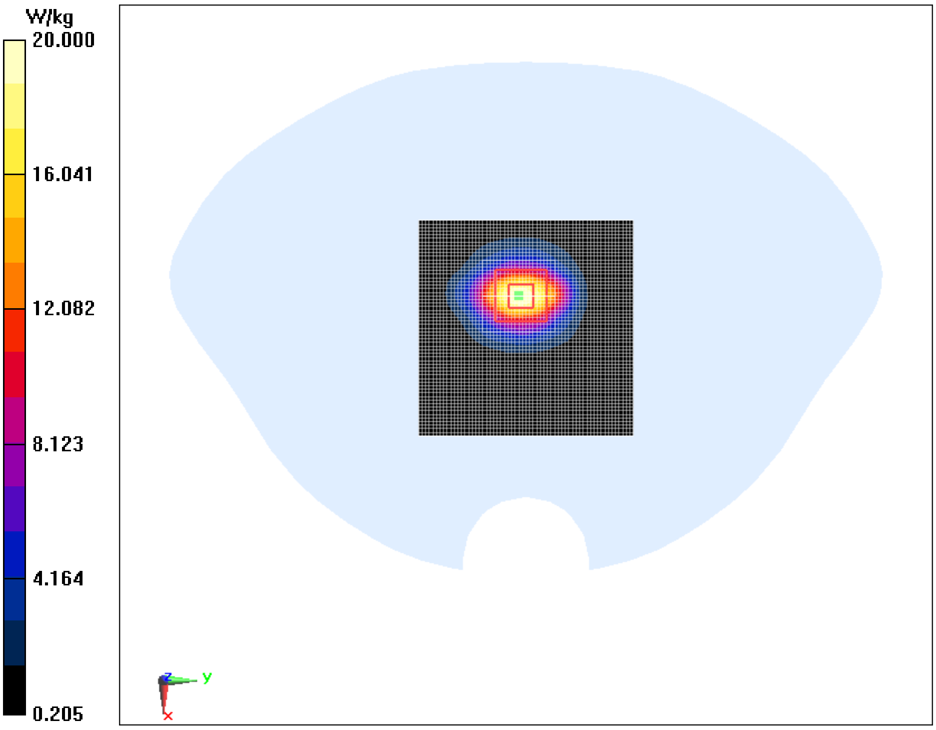
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 101.3 V/m; Power Drift = -0.11 dB

Peak SAR (extrapolated) = 26.6 W/kg

SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.13 W/kg

Maximum value of SAR (measured) = 20.0 W/kg



835 MHz Body

Date/Time: 2017/1/14

Electronics: DAE3 Sn360

Medium: Body 835MHz

Medium parameters used: f = 835 MHz; σ = 1.002 S/m; ε_r = 56.158; ρ = 1000 kg/m^3

Ambient Temperature:22.5 ℃ Liquid Temperature:22.5 ℃

Communication System: CW 850MHz; Frequency: 835 MHz; Duty Cycle: 1:1

Probe: EX3DV4 - SN7375ConvF (9.94, 9.94, 9.94);

System Validation/Area Scan (60x120x1):

Measurement grid: dx=10 mm, dy=10 mm

Maximum value of SAR (Measurement) = 2.79 W/kg

System Validation/Zoom Scan(7x7x7)/Cube 0:

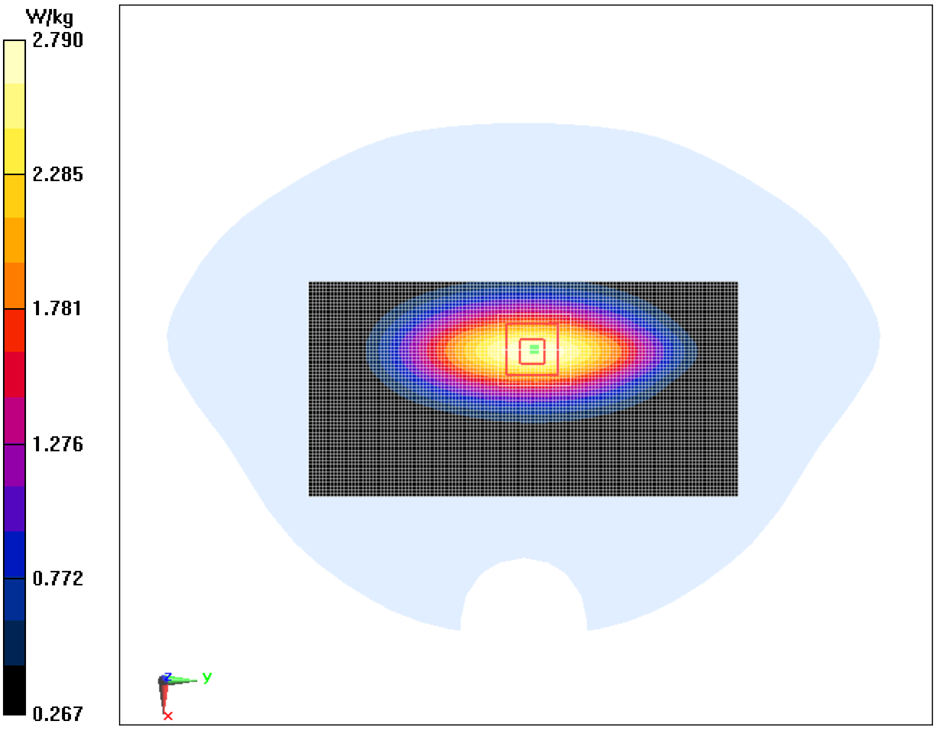
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.31 V/m; Power Drift = 0.14 dB

Peak SAR (extrapolated) = 3.55 W/kg

SAR(1 g) = 2.36 W/kg; SAR(10 g) = 1.54 W/kg

Maximum value of SAR (measured) = 2.79 W/kg



1900MHz Body

Date/Time: 2017/1/15

Electronics: DAE3 Sn360

Medium: Body 1900MHz

Medium parameters used: f = 1900 MHz; σ = 1.526 S/m; ε_r = 53.234; ρ = 1000 kg/m^3

Ambient Temperature:22.5 ℃ Liquid Temperature:22.5 ℃

Communication System: CW 1900MHz; Frequency: 1900 MHz; Duty Cycle: 1:1

Probe: EX3DV4 - SN7375ConvF (7.62, 7.62, 7.62);

System Validation/Area Scan (60x90x1):

Measurement grid: dx=10 mm, dy=10 mm

Maximum value of SAR (Measurement) = 13.8 W/kg

System Validation/Zoom Scan(7x7x7)/Cube 0:

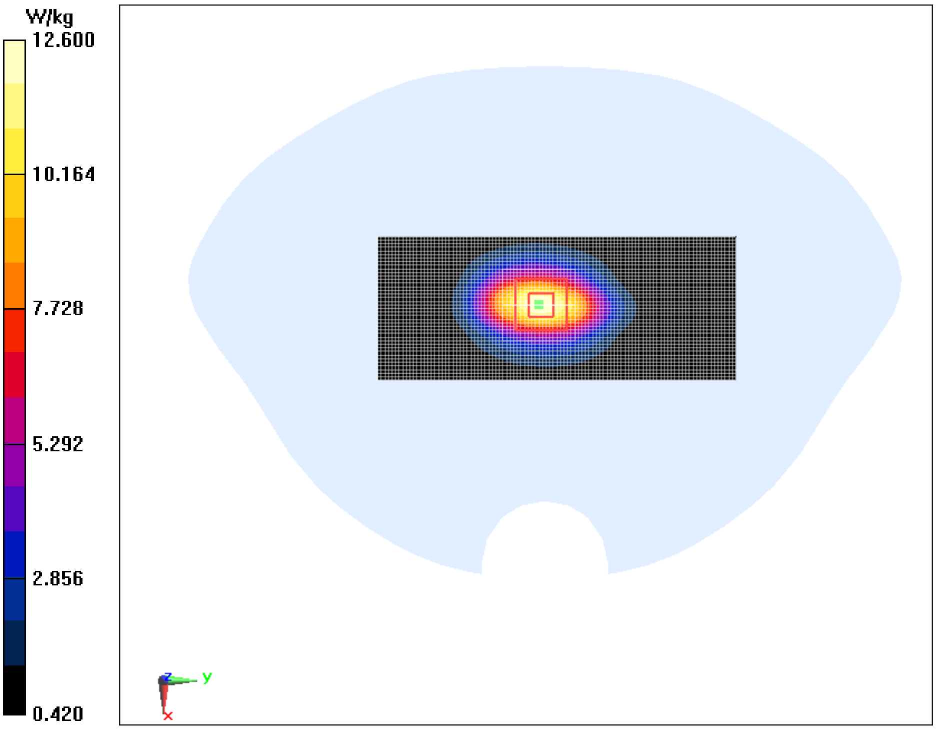
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 88.21 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 18.8 W/kg

SAR(1 g) = 9.89 W/kg; SAR(10 g) = 5.14 W/kg

Maximum value of SAR (measured) = 12.6 W/kg



2450MHz Body

Date/Time: 2017/2/7

Electronics: DAE4 Sn1244

Medium: Body 2450 MHz

Medium parameters used: f = 2450 MHz; σ = 1.921 S/m; εr = 53.936; ρ = 1000 kg/m3

Ambien Temperature:22.5° C Liquid Temperature:22.5° C

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Probe: EX3DV4 - SN3754ConvF(7.22, 7.22, 7.22);

System Validation/ Area Scan (100x100x1):

Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 22.76 W/kg

System Validation/Zoom Scan (7x7x7)/Cube 0:

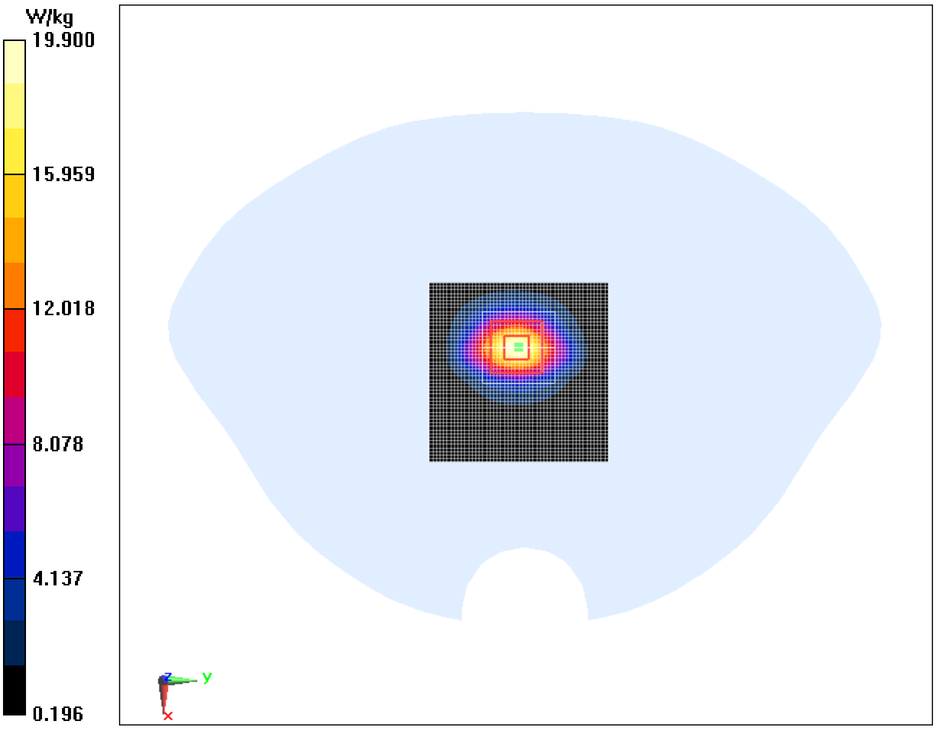
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 104.3 V/m; Power Drift = 0.15 dB

Peak SAR (extrapolated) = 28.18 W/kg

SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.11 W/kg

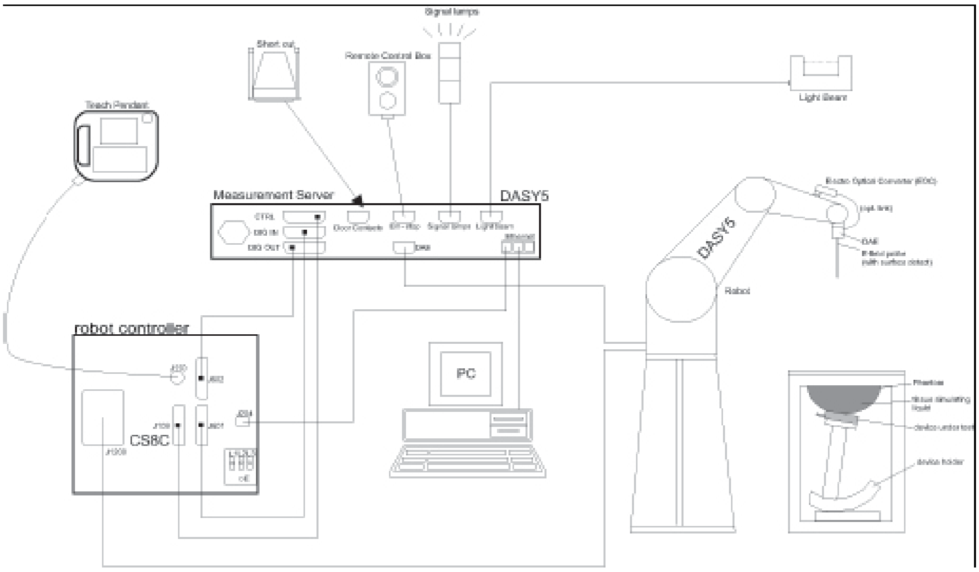
Maximum value of SAR (measured) = 19.9 W/kg



ANNEX C. SAR Measurement Setup

C.1. Measurement Set-up

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



Picture C.1 SAR Lab Test Measurement Set-up

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

- warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

C.2. DASY5 E-field Probe System

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

Picture C.2 Near-field Probe

Probe Specifications:

Model: ES3DV3, EX3DV4

Frequency

Range: 700MHz — 2.6GHz(ES3DV3)

Calibration: In head and body simulating tissue at

Frequencies from 835 up to 2450MHz

Linearity:

± 0.2 dB(700MHz — 2.0GHz) for ES3DV3

Dynamic Range: 10 mW/kg — 100W/kg

Probe Length: 330 mm

Probe Tip

Length: 20 mm

Body Diameter: 12 mm

Tip Diameter: 2.5 mm (3.9 mm for ES3DV3)

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

Application:SAR Dosimetry Testing

Compliance tests of mobile phones

Dosimetry in strong gradient fields

Picture C.3 E-field Probe

C.3. E-field Probe Calibration

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

The free space E-field from amplified probe outputs is determined in a test chamber. This calibration can be performed in a TEM cell if the frequency is below 1 GHz and inn a waveguide or other methodologies above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is then rotated 360 degrees until the three channels show the maximum reading. The power density readings equates to 1 mW/ cm^2.

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The E-field in the medium correlates with the temperature rise in the dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

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

Where:

Δt = Exposure time (30 seconds),

C = Heat capacity of tissue (brain or muscle),

ΔT = Temperature increase due to RF exposure.

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

Where:

σ = Simulated tissue conductivity,

ρ = Tissue density (kg/m^3).

C.4. Other Test Equipment

C.4.1. Data Acquisition Electronics(DAE)

The data acquisition electronics consist of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder with a control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information, as well as an optical uplink for commands and the clock.

The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection.

The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

PictureC.4: DAE

C.4.2. Robot

The SPEAG DASY system uses the high precision robots (DASY5: RX90L) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version from Stäubli is used. The Stäubli robot series have many features that are important for our application:

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

Picture C.5 DASY 5

C.4.3. Measurement Server

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

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

Picture C.6 Server for DASY 5

C.4.4. Device Holder for Phantom

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

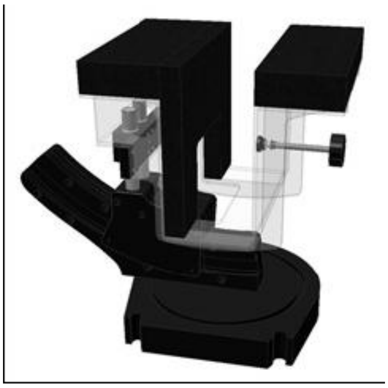
The DASY device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference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

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

<Laptop Extension Kit>

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

Picture C.7: Device Holder



Picture C.8: Laptop Extension Kit

C.4.5. Phantom

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

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

Shell Thickness: 2 ± 0. 2 mm

Filling Volume: Approx. 25 liters

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

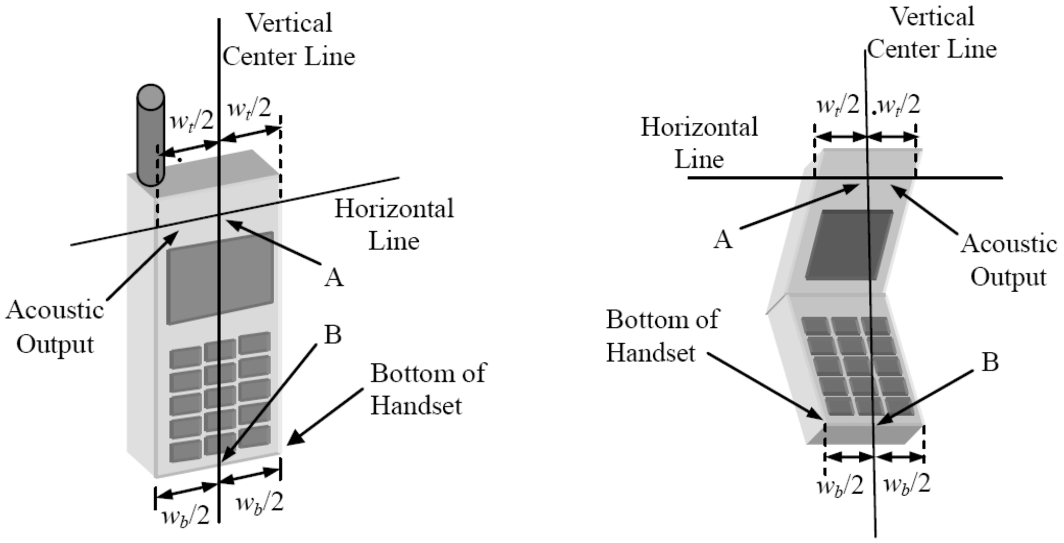
Available: Special

Picture C.9: SAM Twin Phantom

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

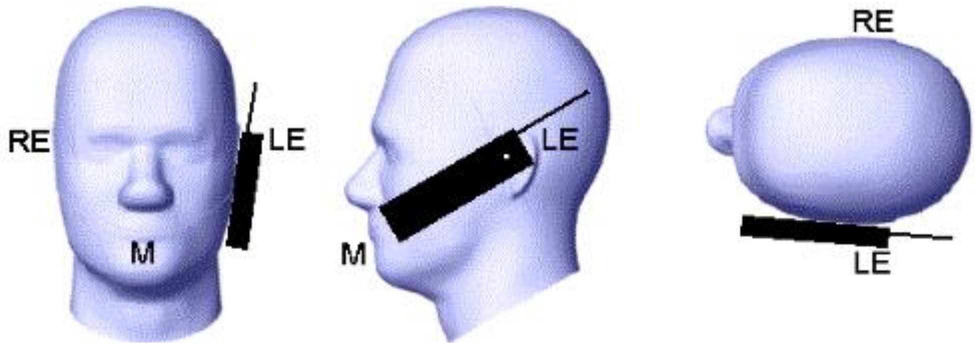
D.1. General considerations

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

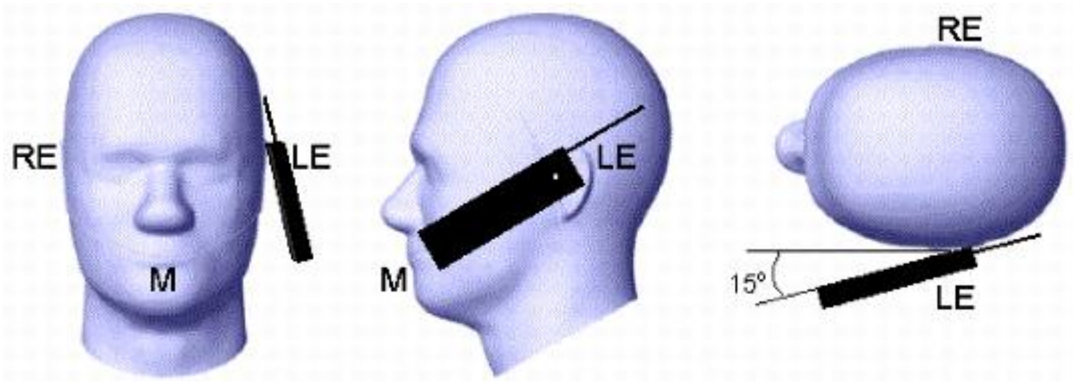


w_t	Width of the handset at the level of the acoustic
w_b	Width of the bottom of the handset
A	Midpoint of the width w_t of the handset at the level of the acoustic output
B	Midpoint of the width w_b of the bottom of the handset

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



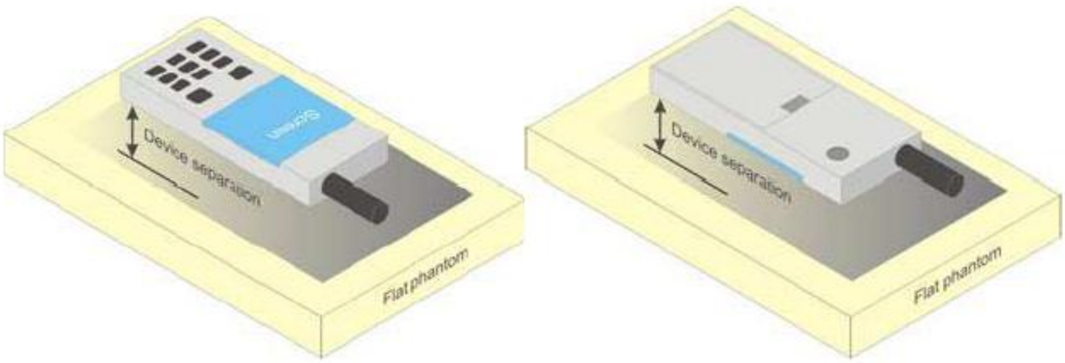
Picture D.2 Cheek position of the wireless device on the left side of SAM



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

D.2. Body-worn device

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

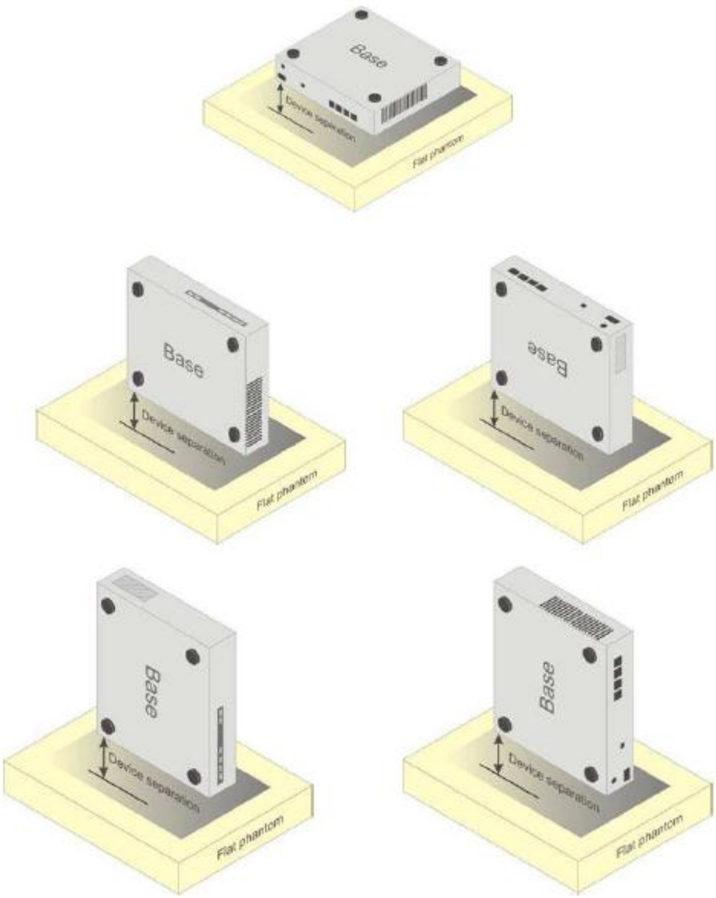


Picture D.4Test positions for body-worn devices

D.3. Desktop device

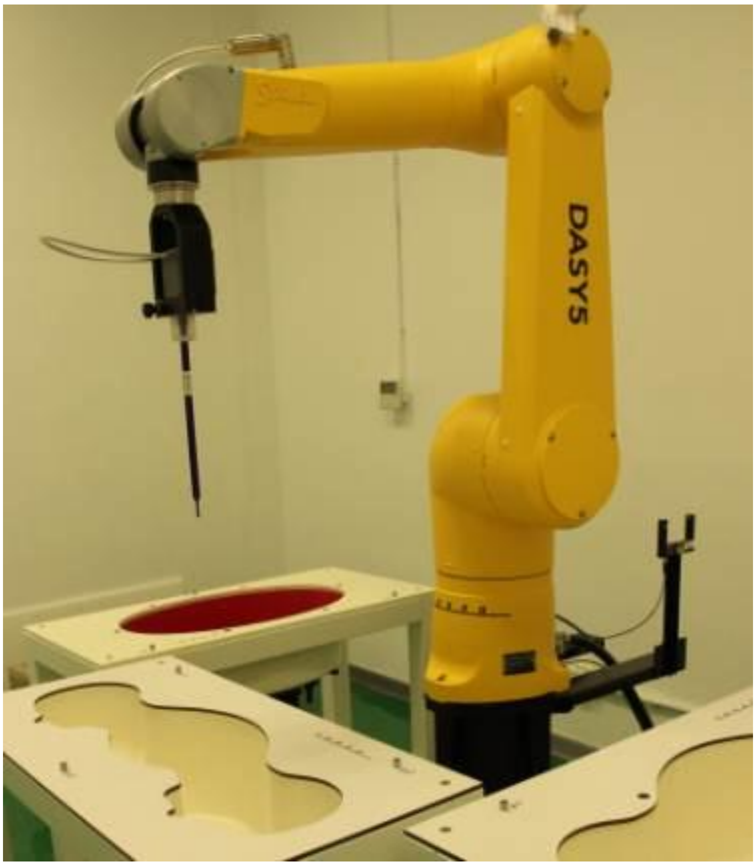
A typical example of a desktop device is a wireless enabled desktop computer placed on a table or desk when used.

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



Picture D.5 Test positions for desktop devices

D.4. DUT Setup Photos



Picture D.6 DSY5 system Set-up

Note:

The photos of test sample and test positions show in additional document.

ANNEX E. Equivalent Media Recipes

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

Table E.1: Composition of the Tissue Equivalent Matter

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

ANNEX F. System Validation

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

Table F.1: System Validation Part 1

System No.	Probe SN.	Liquid name	Validation date	Frequency point	**Permittivity ε**	**Conductivity σ (S/m)**
1	7375	Head 835MHz	Jan 14, 2017	835MHz	41.51	0.898
2	7375	Head 1900MHz	Jan 15, 2017	1900MHz	39.63	1.386
3	3754	Head 2450MHz	Feb 7, 2017	2450MHz	39.11	1.812
4	7375	Body 835MHz	Jan 14, 2017	835MHz	56.16	1.002
5	7375	Body 1900MHz	Jan 15, 2017	1900MHz	53.23	1.526
6	3754	Body 2450MHz	Feb 7, 2017	2450MHz	53.94	1.921

Table F.2: System Validation Part 2

CW Validation	Sensitivity	PASS	PASS
	Probe linearity	PASS	PASS
	Probe Isotropy	PASS	PASS
Mod Validation	MOD.type	GMSK	GMSK
	MOD.type	OFDM	OFDM
	Duty factor	PASS	PASS
	PAR	PASS	PASS

ANNEX G. Probe and DAE Calibration Certificate

TTL In Collaboration with speag CALIBRATION LABORATORY
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E-mail: cttl@chinattl.com Http://www.chinattl.cn

ilac-MRA CNAS 中国认可 国际互认 校准 CALIBRATION CNAS L0570

Client : **Auden** **Certificate No: Z16-97204**

CALIBRATION CERTIFICATE

Object	DAE3 - SN: 360
Calibration Procedure(s)	FD-Z11-002-01 Calibration Procedure for the Data Acquisition Electronics (DAEx)
Calibration date:	November 08, 2016

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

All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)℃ 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	27-June-16 (CTTL, No:J16X04778)	June-17

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Lu Bingsong	Deputy Director of the laboratory	

Issued: November 09, 2016

Certificate No: Z16-97204 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.

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E-mail: cttl@chinattl.com Http://www.chinattl.cn

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV

Low Range: 1LSB = 61nV , full range = -1.......+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	404.141 ± 0.15% (k=2)	404.039 ± 0.15% (k=2)	404.054 ± 0.15% (k=2)
Low Range	3.93503 ± 0.7% (k=2)	3.93694 ± 0.7% (k=2)	3.97213 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	37.5° ± 1 °

Schmid & Partner Engineering AG

s p e a g

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Phone +41 44 245 9700, Fax +41 44 245 9779
info@speag.com, http://www.speag.com

1244

IMPORTANT NOTICE

USAGE OF THE DAE 4

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

Battery Exchange: The battery cover of the DAE4 unit is closed using a screw, over tightening the screw may cause the threads inside the DAE to wear out.

Shipping of the DAE: Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an antistatic bag. This antistatic bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

E-Stop Failures: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

Repair: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

DASY Configuration Files: Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.

Important Note:
Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.

Important Note:
Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.

Important Note:
To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.

Schmid & Partner Engineering

TN_BR040315AD DAE4.doc 11.12.2009

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

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

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

Accreditation No.: **SCS 0108**

Client: TMC - SH (Auden)
Certificate No: DAE4-1244_Dec16

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BM - SN: 1244
Calibration procedure(s)	QA CAL-06.v29 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	December 12, 2016

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	09-Sep-16 (No:19065)	Sep-17
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	05-Jan-16 (in house check)	In house check: Jan-17
Calibrator Box V2.1	SE UMS 006 AA 1002	05-Jan-16 (in house check)	In house check: Jan-17

	Name	Function	Signature
Calibrated by:	Dominique Steffen	Technician	
Approved by:	Fin Bomholt	Deputy Technical Manager	i.V.

Issued: December 13, 2016

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

Certificate No: DAE4-1244_Dec16 Page 1 of 5

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Accreditation No.: **SCS 0108**

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 following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
    - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
    - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
    - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
    - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
    - *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
    - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
    - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
    - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
    - *Power consumption:* Typical value for information. Supply currents in various operating modes.

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	403.872 ± 0.02% (k=2)	403.613 ± 0.02% (k=2)	404.527 ± 0.02% (k=2)
Low Range	3.95409 ± 1.50% (k=2)	3.97148 ± 1.50% (k=2)	3.98215 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	22.0 ° ± 1 °

Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	199995.09	-0.83	-0.00
Channel X	+ Input	20004.47	2.58	0.01
Channel X	- Input	-19997.82	2.60	-0.01
Channel Y	+ Input	199993.65	-2.29	-0.00
Channel Y	+ Input	20001.27	-0.51	-0.00
Channel Y	- Input	-19997.58	2.97	-0.01
Channel Z	+ Input	199992.15	-3.40	-0.00
Channel Z	+ Input	19999.95	-1.78	-0.01
Channel Z	- Input	-20002.51	-1.92	0.01

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2002.00	0.39	0.02
Channel X	+ Input	202.04	0.13	0.07
Channel X	- Input	-197.82	0.13	-0.06
Channel Y	+ Input	2000.90	-0.59	-0.03
Channel Y	+ Input	202.65	0.73	0.36
Channel Y	- Input	-197.74	0.13	-0.06
Channel Z	+ Input	2001.79	0.42	0.02
Channel Z	+ Input	200.75	-1.05	-0.52
Channel Z	- Input	-199.15	-1.06	0.53

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	-3.59	-5.16
	- 200	6.94	5.14
Channel Y	200	-3.41	-3.57
	- 200	2.60	2.96
Channel Z	200	-8.21	-8.18
	- 200	5.71	5.56

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	1.06	-4.10
Channel Y	200	7.19	-	1.88
Channel Z	200	9.77	4.29	-

4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	16885	16322
Channel Y	16457	16417
Channel Z	15874	17196

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	-0.50	-1.93	1.16	0.62
Channel Y	0.32	-1.78	2.06	0.72
Channel Z	-2.19	-4.30	-0.47	0.66

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	−0.01	-8	-9

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中国认可 国际互认 校准 CALIBRATION CNAS L0570

Client **Auden** **Certificate No: Z16-97206**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:7375
Calibration Procedure(s)	FD-Z11-004-01 Calibration Procedures for Dosimetric E-field Probes
Calibration date:	December 08, 2016

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Power sensor NRP-Z91	101547	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Power sensor NRP-Z91	101548	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Reference10dBAttenuator	18N50W-10dB	13-Mar-16(CTTL,No.J16X01547)	Mar-18
Reference20dBAttenuator	18N50W-20dB	13-Mar-16(CTTL, No.J16X01548)	Mar-18
Reference Probe EX3DV4	SN 7307	19-Feb-16(SPEAG,No.EX3-7307_Feb16)	Feb-17
DAE4	SN 1331	21-Jan-16(SPEAG, No.DAE4-1331_Jan16)	Jan -17
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
SignalGeneratorMG3700A	6201052605	27-Jun-16 (CTTL, No.J16X04776)	Jun-17
Network Analyzer E5071C	MY46110673	26-Jan-16 (CTTL, No.J16X00894)	Jan -17

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Lu Bingsong	Deputy Director of the laboratory	

Issued: December 09, 2016

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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, "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 determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010

d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

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

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Probe EX3DV4

SN: 7375

Calibrated: December 08, 2016

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 7375

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm(μV/(V/m)^2)[A]	0.52	0.42	0.46	±10.8%
DCP(mV)[B]	99.7	98.3	100.7	

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	195.6	±2.4%
		Y	0.0	0.0	1.0		177.1	
		Z	0.0	0.0	1.0		187.8	

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

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

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 7375

Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz][C]	Relative Permittivity[F]	Conductivity (S/m)[F]	ConvF X	ConvF Y	ConvF Z	Alpha[G]	Depth[G] (mm)	Unct. (k=2)
750	41.9	0.89	9.90	9.90	9.90	0.40	0.75	±12%
835	41.5	0.90	9.73	9.73	9.73	0.15	1.41	±12%
900	41.5	0.97	9.78	9.78	9.78	0.15	1.43	±12%
1750	40.1	1.37	8.31	8.31	8.31	0.30	0.95	±12%
1900	40.0	1.40	7.92	7.92	7.92	0.25	1.04	±12%
2000	40.0	1.40	7.99	7.99	7.99	0.26	1.04	±12%
2100	39.8	1.49	8.30	8.30	8.30	0.32	0.92	±12%
2300	39.5	1.67	7.57	7.57	7.57	0.32	1.02	±12%
2450	39.2	1.80	7.27	7.27	7.27	0.38	1.01	±12%
2600	39.0	1.96	7.25	7.25	7.25	0.49	0.81	±12%
3500	37.9	2.91	7.01	7.01	7.01	0.38	1.22	±13%
5200	36.0	4.66	5.58	5.58	5.58	0.36	1.55	±13%
5300	35.9	4.76	5.31	5.31	5.31	0.36	1.55	±13%
5500	35.6	4.96	5.09	5.09	5.09	0.36	1.55	±13%
5600	35.5	5.07	4.79	4.79	4.79	0.36	1.68	±13%
5800	35.3	5.27	4.78	4.78	4.78	0.40	1.65	±13%

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

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

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

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 7375

Calibration Parameter Determined in Body Tissue Simulating Media

f [MHz][C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha[G]	Depth[G] (mm)	Unct. (k=2)
750	55.5	0.96	9.94	9.94	9.94	0.30	0.85	±12%
835	55.2	0.97	9.94	9.94	9.94	0.15	1.50	±12%
900	55.0	1.05	9.89	9.89	9.89	0.21	1.22	±12%
1750	53.4	1.49	8.22	8.22	8.22	0.23	1.12	±12%
1900	53.3	1.52	7.62	7.62	7.62	0.19	1.24	±12%
2000	53.3	1.52	7.90	7.90	7.90	0.16	1.62	±12%
2100	53.2	1.62	8.17	8.17	8.17	0.17	1.75	±12%
2300	52.9	1.81	7.43	7.43	7.43	0.45	0.95	±12%
2450	52.7	1.95	7.33	7.33	7.33	0.33	1.22	±12%
2600	52.5	2.16	7.16	7.16	7.16	0.48	0.92	±12%
3500	51.3	3.31	6.52	6.52	6.52	0.44	1.33	±13%
5200	49.0	5.30	4.82	4.82	4.82	0.45	1.50	±13%
5300	48.9	5.42	4.57	4.57	4.57	0.45	1.50	±13%
5500	48.6	5.65	4.20	4.20	4.20	0.48	1.60	±13%
5600	48.5	5.77	3.99	3.99	3.99	0.50	1.65	±13%
5800	48.2	6.00	4.08	4.08	4.08	0.55	1.95	±13%

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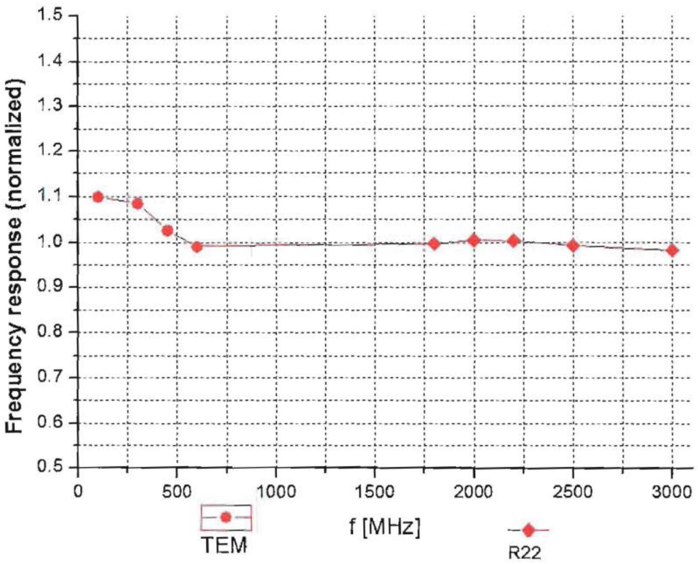
Frequency Response of E-Field
(TEM-Cell: ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ±7.5% (k=2)

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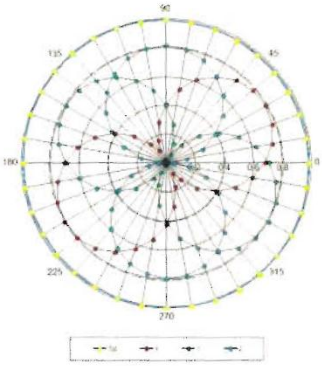
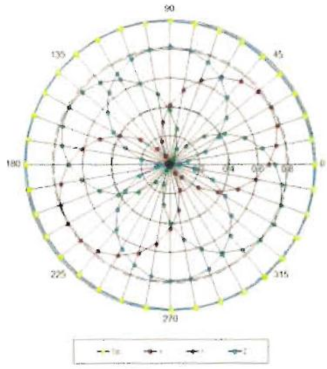
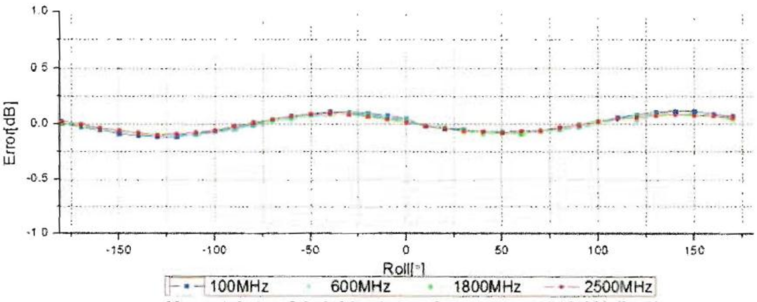
Receiving Pattern (Φ), θ=0°

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







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

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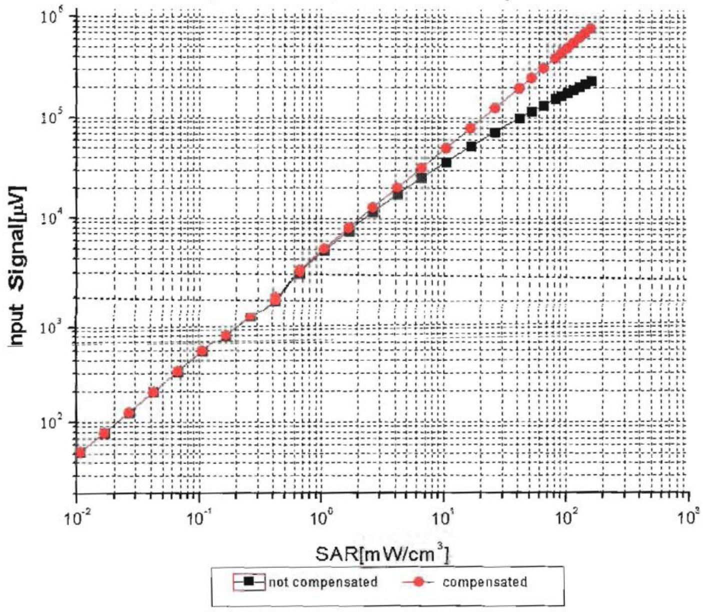
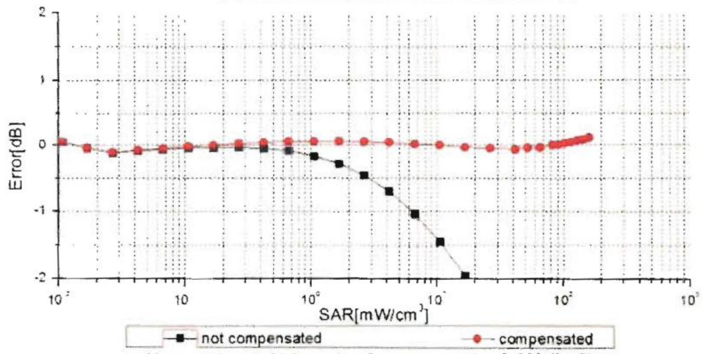
Dynamic Range f(SAR_{head})
(TEM cell, f = 900 MHz)





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

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