TEST REPORT

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1. Report No : DRRFCC1909-0088
2. Customer
   - Name : Kyocera Corporation
   - Address : Yokohama Office 2-1-1 Kagahara, Tsuzuki-ku Yokohama-shi, Kanagawa, Japan
3. Use of Report : FCC Original Grant
4. Product Name / Model Name : Mobile Phone / DB62

   FCC ID : JOYDB62
5. Test Method Used : IEEE 1528-2013, FCC SAR KDB Publications (Details in test report)

   Test Specification : CFR §2.1093
6. Date of Test : 2019.08.21 ~ 2019.08.28
7. Testing Environment : Refer to appended test report.
8. Test Result : Refer to attached test report.

Affirmation	Tested by Name : ChangWon Lee (Signature)	Reviewed by Name : HakMin Kim (Signature)

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2019 . 09 . 30 .

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Test Report Version

Test Report No.	Date	Description
DRRFCC1909-0088	Sep. 30, 2019	Initial issue

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1. DESCRIPTION OF DEVICE

1.1 General Information

EUT type	Mobile Phone
FCC ID	JOYDB62
Equipment model name	DB62
Equipment add model name	N/A
Equipment serial no.	Identical prototype
Mode(s) of Operation	GSM 1900, WCDMA 1700, WCDMA1900, LTE Band 2, LTE Band 4, 2.4 G W-LAN (802.11b/g/n-HT20), Bluetooth

	Band	Mode	Operating Modes	Bandwidth	Frequency
TX Frequency Range	GSM 1900	GSM/GPRS	Voice/Data	-	1850.2 ~ 1909.8 MHz
	WCDMA 1700	WCDMA	Voice/Data	-	1712.4 ~ 1752.6 MHz
	WCDMA 1900	WCDMA	Voice/Data	-	1852.4 ~ 1907.6 MHz
	LTE Band 4	LTE	Voice/Data	1.4/3/5/10/15/20MHz	1710.7 ~ 1754.3 MHz
	LTE Band 2	LTE	Voice/Data	1.4/3/5/10/15/20MHz	1850.7 ~ 1909.3 MHz
	2.4 GHz W-LAN	802.11b/g/n	Voice/Data	HT20	2412 ~ 2472 MHz
	Bluetooth	-	Data	-	2402 ~ 2480 MHz
RX Frequency Range	GSM 1900	GSM/GPRS	Voice/Data	-	1930.2 ~ 1989.8 MHz
	WCDMA 1700	WCDMA	Voice/Data	-	2112.4 ~ 2152.6 MHz
	WCDMA 1900	WCDMA	Voice/Data	-	1932.4 ~ 1987.6 MHz
	LTE Band 4	LTE	Voice/Data	1.4/3/5/10/15/20MHz	2110.7 ~ 2154.3 MHz
	LTE Band 2	LTE	Voice/Data	1.4/3/5/10/15/20MHz	1930.7 ~ 1989.3 MHz
	2.4 GHz W-LAN	802.11b/g/n	Voice/Data	HT20	2412 ~ 2472 MHz
	Bluetooth	-	Data	-	2402 ~ 2480 MHz

Equipment Class	Band	Reported SAR		
		1g SAR (W/kg)		
		Head	Body-Worn	Hotspot
PCE	GSM 1900	0.40	0.45	-
PCE	GPRS 1900	0.57	0.83	0.83
PCE	WCDMA 1700	0.92	1.03	1.03
PCE	WCDMA 1900	0.95	1.11	1.11
PCE	LTE Band 4	0.96	1.24	1.24
PCE	LTE Band 2	1.14	1.35	1.35
DTS	2.4 GHz W-LAN	< 0.1	0.12	0.12
DSS	Bluetooth	< 0.1	< 0.1	< 0.1
Simultaneous SAR per KDB 690783 D01v01r03		1.16	1.47	1.47

FCC Equipment Class	Licensed Portable Transmitter Held to Ear (PCE) Part 15 Spread Spectrum Transmitter(DSS) Digital Transmission System(DTS)
Date(s) of Tests	2019.08.21 ~ 2019.08.28
Antenna Type	Internal Antenna
Note	Bluetooth SAR was estimated.
Functions	● GSM/GPRS (GPRS Class: 12) supported. * DTM not supported. ● No simultaneous transmission between BT & 2.4GHz WLAN ● Simultaneous transmission between [GSM, WCDMA voice & WLAN], [GPRS, WCDMA & WLAN], [LTE & WLAN]. ● VoIP is supported. ● W-LAN 2.4GHz is supported Hotspot.

1.2 Power Reduction for SAR

There is no power reduction used for any band/mode implemented in this device for SAR purposes.

1.3 Nominal and Maximum Output Power Specifications

The Nominal and Maximum Output Power Specifications are in section 9 of this test report.

1.4 DUT Antenna Locations

The overall dimensions of this device are > 9 x 5 cm. A diagram showing the location of the device of the device antenna can be found in JOYDB62_Antenna Location. Since the overall diagonal dimension of the device is ≤160 mm and the diagonal display is ≤150 mm. A diagram showing the location of the device of the device antenna can be found in Antenna_distance.pdf. It is not considered a "phablet".

Mode	Device Sides for SAR Testing					
	Top	Bottom	Front	Rear	Right	Left
GSM/GPRS 1900	O	X	O	O	O	O
WCDMA 1700	O	X	O	O	O	O
WCDMA 1900	O	X	O	O	O	O
LTE Band 4	O	X	O	O	O	O
LTE Band 2	O	X	O	O	O	O
2.4G W-LAN	X	O	O	O	X	O
Bluetooth	X	O	O	O	X	O

Note 1: Particular DUT edges were not required to be evaluated for Hotspot SAR or Phablet SAR if the edges were greater than 2.5 cm from the transmitting antenna according to FCC KDB Publication 648474 D04v01r03.The antenna document shows the distances between the transmit antennas and the edges of the device.

Note 2: O - Test / X - Not test.

1.5 Simultaneous Transmission Capabilities

The Simultaneous Transmission Capabilities are in section 12 of this test report.

1.6 Miscellaneous SAR Test Considerations

(A) Licensed Transmitter(s)

GSM/GPRS DTM is not supported for US bands. Therefore, the GSM Voice modes in this report do not transmit simultaneously with GPRS Data.

LTE SAR for the higher modulations and lower bandwidths were not tested since the maximum average output power of all required channels and configurations was not more than 0.5 dB higher than the highest bandwidth and the reported LTE SAR for the highest bandwidth was less than 1.45 W/kg for all configurations according to FCC KDB 941225 D05v02r04.

1.7 Guidance Applied

- IEEE 1528-2013
- FCC KDB Publication 941225 D01v03r01 (3G SAR Procedures)
- FCC KDB Publication 941225 D05v02r05 (SAR for LTE Devices)
- FCC KDB Publication 941225 D05Av01r02 (LTE Rel.10 KDB Inquiry Sheet)
- FCC KDB Publication 941225 D06v02r01(Hotspot Mode)
- FCC KDB Publication 248227 D01v02r02 (802.11 Wi-Fi SAR)
- FCC KDB Publication 447498 D01v06 (General RF Exposure Guidance)
- FCC KDB Publication 648474 D04v01r03 (Handset SAR)
- FCC KDB Publication 690783 D01v01r03 (SAR Listings on Grants)
- FCC KDB Publication 865664 D01v01r04 (SAR Measurement 100 MHz to 6 GHz)
- FCC KDB Publication 865664 D02v01r02 (RF Exposure Reporting)
- October 2013 TCB Workshop Notes (GPRS testing criteria)
- April 2015 TCB Workshop Notes (Simultaneous transmission summation clarified)
- October 2016 TCB Workshop Notes (Bluetooth Duty Factor)

1.8 Device Serial Numbers

Several samples with identical hardware were used to support SAR testing. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units. The serial numbers used for each test are indicated alongside the results in Section 11.

2. LTE INFORMATION

LTE Information					
FCC ID	**JOYDB62**				
Form Factor	Mobile Phone				
Frequency Range of each LTE transmission Band	LTE Band 4 (AWS) (1710.7 ~ 1754.3 MHz) LTE Band 2 (PCS) (1850.7 ~ 1909.3 MHz)				
Channel Bandwidths	LTE Band 4 : 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz LTE Band 2 : 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz				
Channel Number and Frequencies(MHz)	Low	Low-Mid	Mid	Mid-High	High
LTE Band 4 (AWS): 1.4 MHz	1710.7 (19957)	N/A	1732.5 (20175)	N/A	1754.3 (20393)
LTE Band 4 (AWS): 3 MHz	1711.5 (19965)	N/A	1732.5 (20175)	N/A	1753.5 (20385)
LTE Band 4 (AWS): 5 MHz	1712.5 (19975)	N/A	1732.5 (20175)	N/A	1752.5 (20375)
LTE Band 4 (AWS): 10 MHz	1715.0 (20000)	N/A	1732.5 (20175)	N/A	1750.0 (20350)
LTE Band 4 (AWS): 15 MHz	1717.5 (20025)	N/A	1732.5 (20175)	N/A	1747.5 (20325)
LTE Band 4 (AWS): 20 MHz	1720.0 (20050)	N/A	**1732.5 (20175)** Note1	N/A	1745.0 (20300)
LTE Band 2 (PCS): 1.4 MHz	1850.7 (18607)	N/A	1880.0 (18900)	N/A	1909.3 (19193)
LTE Band 2 (PCS): 3 MHz	1851.5 (18615)	N/A	1880.0 (18900)	N/A	1908.5 (19185)
LTE Band 2 (PCS): 5 MHz	1852.5 (18625)	N/A	1880.0 (18900)	N/A	1907.5 (19175)
LTE Band 2 (PCS): 10 MHz	1855.0 (18650)	N/A	1880.0 (18900)	N/A	1905.0 (19150)
LTE Band 2 (PCS): 15 MHz	1857.5 (18675)	N/A	1880.0 (18900)	N/A	1902.5 (19125)
LTE Band 2 (PCS): 20 MHz	**1860.0 (18700)**	N/A	**1880.0 (18900)**	N/A	**1900.0 (19100)**
UE Category	UE Cat 4				
Modulations Supported in UL	QPSK, 16QAM				
LTE MPR Permanently implemented per 3GPP TS 36.101 section 6.2.3~6.2.5? (manufacturer attestation to be provided)	Yes				
A-MPR (Additional MPR) disabled for SAR Testing?	Yes				
LTE Carrier Aggregation	This device does not support both UL and DL carrier aggregation.				

Note(s)
1. LTE B4 (AWS) can not contain three non-overlapping channels of 20 MHz bandwidth.
Per KDB 941225 D05v02r05, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

3. INTROCUCTION

The FCC and Industry Canada have adopted the guidelines for evaluating the environmental effects of radio frequency (RF) radiation in ET Docket 93-62 on Aug. 6, 1996 and Health Canada Safety Code 6 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices.

The FCC has adopted the guidelines for evaluating the environmental effects of radio frequency radiation in ET Docket 93-62 on Aug. 6, 1996 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices. The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz. The measurement procedure described in IEEE/ANSI C95.3-2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave is used for guidance in measuring SAR due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields," NCRP Report No. 86 NCRP, 1986, Bethesda, MD 20814. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

SAR Definition

Specific Absorption Rate (SAR) is defined as the time derivative (rate) of the incremental energy (dU) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (ρ) It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Fig. 3.1)

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

Fig. 3.1 SAR Mathematical Equation

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

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

where:

σ = conductivity of the tissue-simulating material (S/m)

ρ = mass density of the tissue-simulating material (kg/m^3)

E = Total RMS electric field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relations to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.

4. DOSIMETRIC ASSESSMENT

4.1 Measurement Procedure

The evaluation was performed using the following procedure compliant to FCC KDB Publication 865664 D01v01r04 and IEEE 1528-2013:

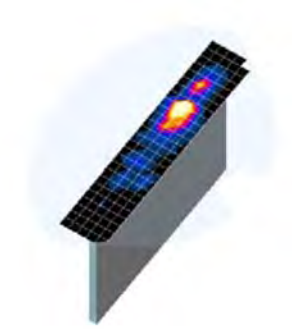

Figure 4.1
Sample SAR Area Scan

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01r04 (See Table 4.1) and IEEE1528-2013.

2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1g/10g cube evaluation. SAR at this fixed point was measured and used as a reference value.

3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01r04 (See Table 4.1) and IEEE 1528-2013. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online for more details):

   a. SAR values at the inner surface of the phantom are extrapolated from the measured values along the line away from the surface with spacing no greater than that in Table 4.1. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).

   b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the “Not a knot” condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.

   c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

<table>
<tr><td colspan="3"></td><td>≤ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td colspan="3">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 mm ± 1 mm</td><td>½·δ·ln(2) mm ± 0.5 mm</td></tr>
<tr><td colspan="3">Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td colspan="3" rowspan="2">Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}</td><td>≤ 2 GHz: ≤ 15 mm
2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm
4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>≤ 2 GHz: ≤ 8 mm
2 – 3 GHz: ≤ 5 mm*</td><td>3 – 4 GHz: ≤ 5 mm*
4 – 6 GHz: ≤ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm
4 – 5 GHz: ≤ 3 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>≤ 4 mm</td><td>3 – 4 GHz: ≤ 3 mm
4 – 5 GHz: ≤ 2.5 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">≤ 1.5·$\Delta z_{Zoom}(n-1)$ mm</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>≥ 30 mm</td><td>3 – 4 GHz: ≥ 28 mm
4 – 5 GHz: ≥ 25 mm
5 – 6 GHz: ≥ 22 mm</td></tr>
<tr><td colspan="5">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 for details.
* When zoom scan is required and the <u>reported</u> SAR from the area scan based 1-g SAR estimation procedures of KDB Publication 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

Table 4.1 Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01r04*

5. DEFINITION OF REFERENCE POINTS

5.1 Ear Reference Point

Figure 5.1 shows the front, back and side views of the SAM Twin Phantom. The point"M" is the reference point for the center of the mouth, "LE" is the left ear reference point(ERP), and "RE" is the right ERP. The ERPs are 15 mm posterior to the entrance to the Ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 5.1. The plane Passing, through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck- Front) is perpendicular to the reference plane and passing through the RE (or LE) is called the Reference Pivoting Line (see Figure 5.1). Line B-M is perpendicular to the N-F line. Both N-F and B-M lines are marked on the external phantom shell to facilitate handset positioning.

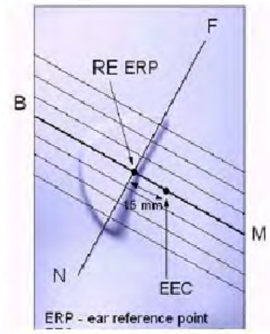

Figure 5.1 Close-up side view of ERP

5.2 Handset Reference Points

Two imaginary lines on the handset were established: the vertical centerline and the horizontal line. The test device was placed in a normal operating position with the "test device reference point" located along the "vertical centerline" on the front of the device aligned to the "ear reference point" (See Fig. 5.3). The "test device reference point" was than located at the same level as the center of the ear reference point. The test device was positioned so that the "vertical centerline" was bisecting the front surface of the handset at it's top and bottom edges, positioning the "ear reference point" on the outer surface of the both the left and right head phantoms on the ear reference point.

Figure 5.2 Front, back and side view SAM Twin Phantom

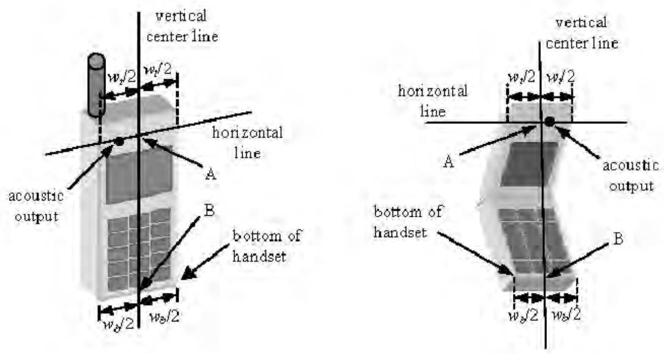

Figure 5.3 Handset Vertical Center & Horizontal Line Reference Points

6. TEST CONFIGURATION POSITIONS FOR HANDSETS

6.1 Device Holder

The device holder is made out of low-loss POM material having the following dielectric parameters: relative permittivity ε = 3 and loss tangent δ = 0.02.

6.2 Positioning for Cheek/Touch

1. The test device was positioned with the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 6.1), such that the plane defined by the vertical center line and the horizontal line of the phone is approximately parallel to the sagittal plane of the phantom.

Figure 6.1 Front, Side and Top View of Cheek/Touch Position

2. The handset was translated towards the phantom along the line passing through RE & LE until the handset touches the ear.
3. While maintaining the handset in this plane, the handset was rotated around the LE-RE line until the vertical centerline was in the plane normal to MB-NF including the line MB (reference plane).
4. The phone was hen rotated around the vertical centerline until the phone (horizontal line) was symmetrical was respect to the line NF.
5. While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the phone contact with the ear, the handset was rotated about the line NF until any point on the handset made contact with a phantom point below the ear (cheek). (See Figure 6.2)

6.3 Positioning for Ear / 15 ° Tilt

With the test device aligned in the "Cheek/Touch Position":

1. While maintaining the orientation of the phone, the phone was retracted parallel to the reference plane far enough to enable a rotation of the phone by 15 degree.
2. The phone was then rotated around the horizontal line by 15 degree.
3. While maintaining the orientation of the phone, the phone was moved parallel to the reference plane until any part of the phone touches the head. (In this position, point A was located on the line RE-LE). The tilted position is obtained when the contact is on the pinna. If the contact was at any location other than the pinna, the angle of the phone would then be reduced. The tilted position was obtained when any part of the phone was in contact of the ear as well as a second part of the phone was in contact with the head (see Figure 6.3).

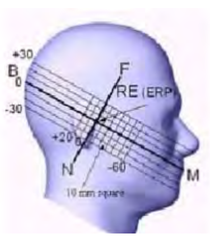

Figure 6.2 Side view w/relevant markings

Figure 6.3 Front, Side and Top View of Ear/15° Position

6.4 Body-Worn Accessory Configurations

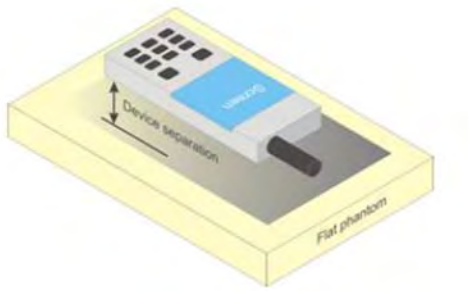

Figure 6.4 Sample Body-Worn Diagram

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 6.4). Per FCC KDB Publication 648474 D04v01r03, Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB Publication 447498 D01v06 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

Accessories for Body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that do contain metallic components. When multiple accessories that do not contain metallic components are supplied with the device, the device is tested with only the accessory that dictates the closest spacing to the body. Then multiple accessories that contain metallic components are tested with the device with each accessory. If multiple accessories share an identical metallic component (i.e. the same metallic belt-clip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

Body-worn accessories may not always be supplied or available as options for some devices intended to be authorized for body-worn use. In this case, a test configuration with a separation distance between the back of the device and the flat phantom is used. Test position spacing was documented.
Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance with the front of the device positioned to face the flat phantom in head fluid. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessories, including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration.

6.5 Extremity Exposure Configurations

Devices that are designed or intended for use on extremities or mainly operated in extremity only exposure conditions; i.e., hands, wrists, feet and ankles, may require extremity SAR evaluation. When the device also operates in close proximity to the user's body, SAR compliance for the body is also required. The 1-g body and 10-g extremity SAR Exclusion Thresholds found in KDB Publication 447498 D01v06 should be applied to determine SAR test requirements.

Per KDB Publication 447498 D01v06, Cell phones (handsets) are not normally designed to be used on extremities or operated in extremity only exposure conditions. The maximum output power levels of handsets generally do not require extremity SAR testing to show compliance. Therefore, extremity SAR was not evaluated for this device.

6.6 Wireless Router Configurations

Some battery-operated handsets have the capability to transmit and receive user data through simultaneous transmission of WIFI simultaneously with a separate licensed transmitter. The FCC has provided guidance in FCC KDB Publication 941225 D06v02r01 where SAR test considerations for handsets (L x W ≥ 9 cm x 5 cm) are based on a composite test separation distance of 10 mm from the front the front, rear and edges of the device containing transmitting antennas within 2.5 cm of their edges, determined from general mixed use conditions for this type of devices. When the same wireless transmission configuration is used for testing body-worn accessory and hotspot mode SAR, respectively, in voice and data mode, SAR results for the most conservative test separation distance configuration may be used to support both SAR conditions.

When the user enables the personal wireless router functions for the handset, actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitter often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions due to the limitations of the SAR assessment probes. Therefore, SAR must be evaluated for each KDB Publication 447498 D01v06 procedures. The “Portable Hotspot” feature on the handset was not activated during SAR assessment, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal at a time.

7. RF EXPOSURE LIMITS

Uncontrolled Environment:

UNCONTROLLED ENVIRONMENTS are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

Controlled Environment:

CONTROLLED ENVIRONMENTS are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Table 7.1.SAR Human Exposure Specified in ANSI/IEEE C95.1-1992

	HUMAN EXPOSURE LIMITS	
	General Public Exposure (W/kg) or (mW/g)	Occupational Exposure (W/kg) or (mW/g)
SPATIAL PEAK SAR * (Brain)	1.60	8.00
SPATIAL AVERAGE SAR ** (Whole Body)	0.08	0.40
SPATIAL PEAK SAR *** (Hands / Feet / Ankle / Wrist)	4.00	20.0

1. The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
2. The Spatial Average value of the SAR averaged over the whole body.
3. The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

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

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

8. FCC MEASUREMENT PROCEDURES

Power measurements were performed using a base station simulator under digital average power.

8.1 Measured and Reported SAR

Per FCC KDB Publication 447498 D01v06, When SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance. For simultaneous transmission, the measured aggregate SAR must be scaled according to the sum of the differences between the maximum tune-up tolerance and actual power used to test each transmitter. When SAR is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as reported SAR. The highest reported SAR results are identified on the grant of equipment authorization according to procedures in KDB 690783 D01v01r03.

8.2 Procedures Used to Establish RF Signal for SAR

The following procedures are according to FCC KDB Publication 941225 D01v03r01.

The device was placed into a simulated call using a base station simulator in a RF shielded chamber. Establishing connections in this manner ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. Devices under test were evaluated prior to testing, with a fully charged battery and were configured to operate at maximum output power. In order to verify that the device was tested throughout the SAR test at maximum output power, the SAR measurement system measures a “point SAR” at an arbitrary reference point at the start and end of the 1 gram SAR evaluation, to assess for any power drifts during the evaluation. If the power drift deviated by more than 5%, the SAR test and drift measurements were repeated.

8.3 SAR Measurement Conditions for WCDMA (UMTS)

8.3.1 Output Power Verification

Maximum output power is measured on the High, Middle and Low channels for each applicable transmission band according to the general descriptions in section 5.2 of 3GPP TS 34.121, using the appropriate RMC or AMR with TPC (transmit power control) set to all “1s”.

Maximum output power is verified on the High, Middle and Low channels according to the general, descriptions in section 5.2 of 3GPP TS 34.121 (release 5), using the appropriate RMC with TPC,(transmit power control) set to all “1s” or applying the required inner loop power control procedures to maintain maximum output power while HSUPA is active. Results for all applicable physical channel configurations (DPCCH, DPDCHn and spreading codes, HS-DPCCH etc) are tabulated in this test report. All configurations that are not supported by the DUT or cannot be measured due to technical or equipment limitations are identified.

8.3.2 Head SAR Measurements for Handsets

SAR for head exposure configurations is measured using the 12.2 kbps RMC with TPC bits configured to all “1s”. SAR in AMR configurations is not required when the maximum average output of each RF channel for 12.2 kbps AMR is less than 0.25 dB higher than that measured in12.2 kbps RMC. Otherwise, SAR is measured on the maximum output channel in 12.2 AMR with a 3.4 kbps SRB (signaling radio bearer) using the exposure configuration that resulted in the highest SAR for that RF channel in the 12.2 kbps RMC mode.

8.3.3 Body SAR Measurements

SAR for body exposure configurations is measured using the 12.2 kbps RMC with the TPC bits all"1s".

8.3.4 Release 5 HSDPA Data Devices

The following procedures are applicable to HSDPA data devices operating under 3GPP Release 5. SAR is required for devices in body-worn accessory and other body exposure conditions, including handsets and data modems operating in various electronic devices. HSDPA operates in conjunction with WCDMA and requires an active DPCCH. The default test configuration is to measure SAR in WCDMA with HSDPA remain inactive, to establish a radio link between the test device and a communication test set using a 12.2 kbps RMC configured in Test Loop Mode 1. SAR for HSDPA is selectively measured using the highest reported SAR configuration in WCDMA, with an FRC in H-set 1 and a 12.2 kbps RMC. SAR is selectively confirmed for other physical channel configurations (DPCCH & DPDCHn) according to exposure conditions, device operating capabilities and maximum output power specified for production units, including tune-up tolerance by applying the 3G SAR test reduction procedures. Maximum output power is verified according to the applicable versions of 3GPP TS 34.121. SAR must be measured based on these maximum output conditions and requirements in KDB Publication 447498, with respect to the UE Categories, and explained in the SAR report. When Maximum Power Reduction (MPR) applies, the implementations must be clearly identified in the SAR report to support test results according to Cubic Metric (CM) and, as appropriate, Enhanced MPR (E-MPR) requirements.

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	15/8	30/15	1.5
4	15/15	4/15	64	15/4	30/15	1.5

Note 1: Δ_{ACK}, Δ_{NACK} and $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$
Note 2: CM = 1 for $\beta_c/\beta_d = 12/15$, $\beta_{hs}/\beta_c = 24/15$.
Note 3: 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 $\beta_d = 15/15$.

Figure 8.1 Table 1

8.3.5 Release 6 HSUPA Data Devices

The following procedures are applicable to HSPA (HSUPA/HSDPA) data devices operating under 3GPP Release 6. SAR is required for devices in body-worn accessory and other body exposure conditions, including handsets and data modems operating in various electronic devices. HSUPA operates in conjunction with WCDMA and HSDPA. SAR is initially measured in WCDMA test configurations with HSPA remain inactive. The default test configuration is to establish a radio link between the test device and a communication test set to configure a 12.2 kbps RMC in Test Loop Mode 1. SAR for HSPA is selectively measured with HS-DPCCH, E-DPCCH and E-DPDCH, all enabled, along with a 12.2 kbps RMC using the highest reported SAR configuration in WCDMA with 12.2 kbps RMC only.
An FRC is configured according to HS-DPCCH Sub-test 1 using H-set 1 and QPSK. HSPA is configured according to E-DCH Sub-test 5 requirements. SAR for other HSPA sub-test configurations is confirmed selectively according to exposure conditions, E-DCH UE Category and maximum output power of production units, including tune-up tolerance by applying the 3G SAR test reduction procedure. Maximum output power is verified according to procedures in applicable versions of 3GPP TS 34.121. SAR must be measured based on these maximum output conditions and requirements in KDB Publication 447498, with respect to the UE Categories for HS-DPCCH and HSPA, and explained in the SAR report. When Maximum Power Reduction (MPR) applies, the implementations must be clearly identified in the SAR report to support test results according to Cubic Metric (CM) and, as appropriate, Enhanced MPR (E-MPR) requirements.

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	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	β_{ed1}: 47/15 β_{ed2}: 47/15	4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15 (4)	15/15 (4)	64	15/15 (4)	30/15	24/15	134/15	4	1	1.0	0.0	21	81

Note 1: Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 8 ⇔ $A_{hs} = \beta_{hs}/\beta_c = 30/15$ ⇔ $\beta_{hs} = 30/15 * \beta_c$.
Note 2: 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.
Note 3: 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.
Note 4: 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.
Note 5: Testing UE using E-DPDCH Physical Layer category 1 Sub-test 3 is not required according to TS 25.306 Table 5.1g.
Note 6: β_{ed} cannot be set directly; it is set by Absolute Grant Value.

Figure 8.2 Table 2

8.4 SAR Measurement Conditions for LTE

LTE modes were tested according to FCC KDB 941225 D05v02r05 publication. Please see notes after the tabulated SAR data for required test configurations. Establishing connections with base station simulators ensure a consistent means for testing SAR and are recommended for evaluating SAR. The call simulator was used for LTE output power measurement and SAR testing. Closed loop power control was used so the UE transmits with maximum output power during SAR testing. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

8.4.1 Spectrum Plots for RB Configurations

A properly configured base station simulator was used for SAR tests and power measurements. Therefore, spectrum plots for RB configurations were not required to be included in this report.

8.4.2 MPR

MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36. 101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.

8.4.3 A-MPR

A-MPR (Addition MPR) has been disable for all SAR tests by setting NS=01 on the base station simulator.

8.4.4 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 D05v02r05:

a. Per Section 5.2.1, SAR is required for QPSK 1 RB Allocation for the largest bandwidth
   i. The required channel and offset combination with the highest maximum output power is required for SAR.
   ii. When the reported SAR is ≤ 0.8 W/kg, testing of the remaining RB offset configurations and required test channel is not required. Otherwise, SAR is required for the remaining required test channels using the RB offset configuration with highest output power for that channel.
   iii. When the reported SAR for a required test channel is > 1.45 W/kg, SAR is required for all RB offset configurations for that channel.
b. Per Section 5.2.2, SAR is required for 50% RB allocation using the largest bandwidth following the same procedures outlined in Section 5.2.1.
c. Per Section 5.2.3, QPSK SAR is not required for the 100% allocation when the highest maximum output power for the 100% allocation is less than the highest maximum output power of the 1 RB and 50% RB allocations and the reported SAR for the 1 RB and 50% RB allocations is < 0.8 W/kg. Otherwise, SAR is measured for the highest output power channel; and if the reported SAR is > 1.45 W/kg, the remaining required test channels must also be tested.
d. Per Section 5.2.4 and 5.3, SAR tests for higher order modulations and lower bandwidths configurations are not required when the conducted power of the required test configurations determined by Sections 5.2.1 through 5.2.3 is less than or equal to 0.5 dB higher than the equivalent configuration using QPSK modulation and when the QPSK SAR for those configurations is < 1.45 W/kg.

8.5 SAR Testing with 802.11 Transmitters

The normal network operating configurations are not suitable for measuring the SAR of 802.11 b/g/n transmitters. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure the results are consistent and reliable. See KDB Publication 248227D01v02r02 for more details.

8.5.1 General Device Setup

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters. The test frequencies should correspond to actual channel frequencies defined for domestic use. SAR for devices with switched diversity should be measured with only one antenna transmitting at a time during each SAR measurement, according to a fixed modulation and data rate. The same data pattern should be used for all measurements.

A periodic duty factor is required for current generation SAR systems to measure SAR. When 802.11 frame gaps are accounted for in the in the transmission, a maximum transmission duty factor of 92-96% is typically achievable in most test mode configurations. A minimum transmission duty factor of 85% is required to avoid certain hardware and device implementation issues related to wide range SAR scaling. The reported SAR is scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit.

8.5.2 Initial Test Position Procedure

For exposure conditions with multiple test positions, such as handset operating next to the ear, devices with hotspot mode or UMPC mini-tablet, procedures for initial test position can be applied. Using the transmission mode determined by the DSSS procedure or initial test configuration, area scans are measured for all position in an exposure condition. The test position with the highest extrapolated (peak) SAR is used as the initial test position. When reported SAR for the initial test position is ≤ 0.4 W/kg, no additional testing for the remaining test positions is required. Otherwise, SAR is evaluated at the subsequent highest peak SAR position until the reported SAR result is ≤ 0.8 W/kg or all test position are measured.

8.5.3 2.4 GHz SAR Test Requirements

SAR is measured for 2.4 GHz 802.11b DSSS using either a fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following:

1) When the reported SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.
2) When the reported SAR is > 0.8 W/kg, SAR is required for that exposure configuration using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing.

2.4 GHz 802.11 g/n OFDM are additionally evaluated for SAR if the highest reported SAR for 802.11b, adjusted by the ratio of the OFDM to DSSS specified maximum output power is > 1.2 W/kg. When SAR is required for OFDM modes in 2.4 GHz band, the Initial Test Configuration Procedures should be followed.

8.5.4 OFDM Transmission Mode and SAR Test Channel Selection

For the 2.4 GHz bands, when the same maximum output power was specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration with the largest channel bandwidth, lowest order modulation and lowest data rate. When the maximum output power of a channel is the same for equivalent OFDM configurations; for example, 802.11g and 802.11n with the same channel bandwidth, modulation and data rate etc., the lower order 802.11 mode i.e., 802.11g then 802.11n is used for SAR measurement. When the maximum output power ware the same for multiple test channels, either according to the default or additional power measurement requirements, SAR is measured using the channel closest to the middle of the frequency band or aggregated band. When there are multiple channels with the same maximum output power, SAR is measured using the higher number channel.

8.5.5 Initial Test Configuration Procedure

For OFDM, in both 2.4 bands, an initial test configuration is determined for each frequency band and aggregated band, according to the transmission mode with the highest maximum output power specified for SAR measurements. When the same maximum output is specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration(s) with the largest channel bandwidth, lowest order modulation, and lowest data rate. The channel of the transmission mode with the highest average RF output conducted power will be the initial test configuration.

When the reported SAR is ≤ 0.8 W/kg, no additional measurements on other test channels are required.
Otherwise, SAR is evaluated using the subsequent highest average RF output channel until the reported SAR result is ≤ 1.2 W/kg or all channels are measured.

8.5.6 Subsequent Test Configuration Procedures

For OFDM configurations, in each frequency band and aggregated band, SAR is evaluated for initial test configuration using the fixed test position or the initial test position procedure, when applicable. When the highest reported SAR for the initial test configuration, adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power is ≤ 1.2 W/kg, no additional SAR testing for the subsequent test configurations is required.

9. RF CONDUCTED POWERS

This device operates using the following maximum and nominal output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB Publication 447498 D01v06

9.1 GSM Nominal and Maximum Output Power Spec and Conducted Powers

Band & Mode		Voice[dBm]	Burst Average GMSK [dBm]			
		1 TX Slot	1 TX Slot	2 TX Slot	3 TX Slot	4 TX Slot
GSM/GPRS 1900	Maximum	31.0	31.0	28.5	26.7	25.5
	Nominal	29.5	29.5	27.0	25.2	24.0

Table 9.1.1 GSM Nominal and Maximum Output Power Spec

Band	Channel	Maximum Burst-Averaged Output Power(dBm)				
		Voice	GPRS Data (GMSK)			
		GSM CS 1 Slot	GPRS 1 TX Slot	GPRS 2 TX Slot	GPRS 3 TX Slot	GPRS 4 TX Slot
PCS 1900	512	29.6	29.6	26.6	24.3	23.6
	661	29.5	29.5	26.5	24.3	23.7
	810	29.4	29.4	26.4	24.3	23.5
Band	**Channel**	**Calculated Maximum Frame-Averaged Output Power(dBm)**				
		Voice	**GPRS Data (GMSK)**			
		GSM CS 1 Slot	**GPRS 1 TX Slot**	**GPRS 2 TX Slot**	**GPRS 3 TX Slot**	**GPRS 4 TX Slot**
PCS 1900	512	20.57	20.57	20.59	20.04	20.59
	661	20.47	20.47	20.50	20.04	20.69
	810	20.37	20.37	20.37	20.04	20.49
PCS 1900	**Frame Avg. Targets:**	20.47	20.47	20.98	20.94	20.99

Table 9.1.2 GSM Conducted Power

Note:

1. Both burst-averaged and calculated frame-averaged powers are included. Frame-averaged power was calculated from the measured burst-averaged power by converting the slot powers into linear units and calculating the energy over 8 timeslots.
2. GPRS (GMSK) output powers were measured with coding scheme setting of 1 (CS1) on the base station simulator. CS1 was configured to measure GPRS output power measurements and SAR to ensure GMSK modulation in the signal. Our Investigation has shown that CS1 - CS4 settings do not have any impact on the output levels or modulation in the GPRS modes.

GPRS Multislot class: 12 (max 4 TX Uplink slots)
EDGE Multislot class: N/A
DTM Multislot Class: N/A

Figure 9.1 Power Measurement Setup

9.2 WCDMA Nominal and Maximum Output Power Spec and Conducted Powers

3GPP Release Version	Mode			AWS Band (dBm)	PCS Band (dBm)	3GPP MPR (dB)
99	WCDMA	Voice	Maximum	23.0	23.0	-
			Nominal	21.5	21.5	
5	HSDPA	Subtest 1	Maximum	23.0	23.0	0
			Nominal	21.5	21.5	
5		Subtest 2	Maximum	23.0	23.0	0
			Nominal	21.5	21.5	
5		Subtest 3	Maximum	23.0	23.0	0.5
			Nominal	21.5	21.5	
5		Subtest 4	Maximum	23.0	23.0	0.5
			Nominal	21.5	21.5	
6	HSUPA	Subtest 1	Maximum	23.0	23.0	0
			Nominal	21.5	21.5	
6		Subtest 2	Maximum	21.5	21.5	2
			Nominal	20.0	20.0	
6		Subtest 3	Maximum	22.5	22.5	1
			Nominal	21.0	21.0	
6		Subtest 4	Maximum	21.5	21.5	2
			Nominal	20.0	20.0	
6		Subtest 5	Maximum	23.0	23.0	0
			Nominal	21.5	21.5	

Table 9.2.1 WCDMA Nominal and Maximum Output Power Spec

3GPP Release Version	Mode	3GPP 34.121 Subtest	AWS Band (dBm)			PCS Band (dBm)			3GPP MPR (dB)
			1312	1412	1513	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	21.09	20.96	20.81	21.53	21.60	21.58	-
99		12.2 kbps AMR	21.08	20.95	20.77	21.42	21.59	21.49	-
5	HSDPA	Subtest 1	21.04	21.00	20.76	21.44	21.53	21.48	0
5		Subtest 2	21.06	20.99	20.78	21.46	21.51	21.54	0
5		Subtest 3	21.03	21.01	20.77	21.44	21.52	21.51	0.5
5		Subtest 4	21.01	21.00	20.74	21.49	21.49	21.55	0.5
6	HSUPA	Subtest 1	20.48	19.86	20.43	20.89	21.39	20.72	0
6		Subtest 2	19.64	19.42	19.20	20.01	19.94	19.94	2
6		Subtest 3	20.46	19.89	19.81	20.81	20.80	20.68	1
6		Subtest 4	19.95	19.71	19.55	20.32	20.50	20.49	2
6		Subtest 5	21.02	21.01	20.72	21.48	21.51	21.58	0

Table 9.2.2 WCDMA Conducted Power

WCDMA SAR was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01v03r01. 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.

The manufacturer declares that the HSDPA and HSUPA transmitter's power will not exceed the R99 maximum transmit power in devices based on Qualcomm's HSPA chipset solutions.

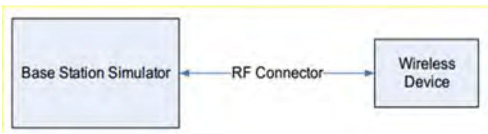

Figure 9.2 Power Measurement Setup

9.3 LTE Nominal and Maximum Output Power Spec and Conducted Powers

Band & Mode		Modulated Average[dBm]
LTE Band 4	Maximum	24.5
	Nominal	23.0

Table 9.3.1.1 Nominal and Maximum Output Power Spec

1) LTE Band 4

LTE Band 4 (AWS) Conducted Power– 20 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel 20175 (1732.5 MHz) Conducted Power (dBm)	MPR Allowed Per 3GPP(dB)	MPR (dB)
QPSK	**1**	**0**	**23.99**	≤ 1	0
	1	50	23.93		
	1	99	23.92		
	50	**0**	**23.00**		1
	50	25	22.98		
	50	50	22.99		
	100	**0**	**22.96**		1
16QAM	1	0	23.00	≤ 1	1
	1	50	23.01		
	1	99	22.97		
	50	0	22.01	≤ 2	2
	50	25	22.01		
	50	50	21.99		
	100	0	22.00		2

Table 9.3.1.2 LTE Conducted Power

Note: LTE B4 (AWS) can not contain three non-overlapping channels of 20 MHz bandwidth.
Per KDB 941225 D05v02r05, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

LTE Band 4 (AWS) Conducted Power– 15 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 20025 (1717.5 MHz)	Mid Channel 20175 (1732.5 MHz)	High Channel 20325 (1747.5 MHz)	MPR Allowed Per 3GPP(dB)	MPR (dB)
			Conducted Power (dBm)				
QPSK	1	0	23.95	23.98	23.96	≤ 1	0
	1	36	23.98	23.99	23.98		
	1	74	23.94	23.96	23.94		
	36	0	22.95	22.98	22.97		1
	36	18	22.98	22.99	22.99		
	36	37	22.95	22.95	22.93		
	75	0	22.95	22.97	22.95		1
16QAM	1	0	22.94	22.97	22.95	≤ 1	1
	1	36	23.00	23.00	22.98		
	1	74	22.96	22.96	22.96		
	36	0	21.96	22.01	21.98	≤ 2	2
	36	18	22.00	21.99	21.99		
	36	37	21.95	21.94	21.93		
	75	0	22.95	21.97	21.93		2

Table 9.3.1.3 LTE Conducted Power

LTE Band 4 (AWS) Conducted Power– 10 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed Per 3GPP(dB)	MPR (dB)
			20000 (1715.0 MHz)	20175 (1732.5 MHz)	20350 (1750.0 MHz)		
			Conducted Power (dBm)				
QPSK	1	0	23.94	23.95	23.98	≤ 1	0
	1	25	23.96	23.997	24.00		
	1	49	23.91	23.93	23.96		
	25	0	22.96	22.92	22.98		1
	25	12	22.96	22.96	22.99		
	25	25	22.90	22.94	22.96		
	50	0	22.90	22.95	22.96		1
16QAM	1	0	22.96	22.95	22.99	≤ 1	1
	1	25	22.94	22.98	23.00		
	1	49	22.92	22.93	22.94		
	25	0	21.97	21.95	22.01	≤ 2	2
	25	12	21.94	21.98	21.99		
	25	25	21.91	21.95	21.94		
	50	0	21.91	21.95	21.96		2

Table 9.3.1.4 LTE Conducted Power

LTE Band 4 (AWS) Conducted Power– 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed Per 3GPP(dB)	MPR (dB)
			19975 (1712.5 MHz)	20175 (1732.5 MHz)	20375 (1752.5 MHz)		
			Conducted Power (dBm)				
QPSK	1	0	23.88	23.89	23.90	≤ 1	0
	1	12	23.91	23.92	23.85		
	1	24	23.89	23.86	23.88		
	12	0	22.88	22.88	22.84		1
	12	6	22.87	22.92	22.83		
	12	13	22.89	22.85	22.88		
	25	0	22.88	22.86	22.89		1
16QAM	1	0	22.91	22.86	22.89	≤ 1	1
	1	12	22.88	22.93	22.85		
	1	24	22.89	22.89	22.89		
	12	0	21.87	21.89	21.86	≤ 2	2
	12	6	21.90	21.91	21.84		
	12	13	21.87	21.85	21.87		
	25	0	21.91	21.84	21.87		2

Table 9.3.1.5 LTE Conducted Power

LTE Band 4 (AWS) Conducted Power– 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed Per 3GPP(dB)	MPR (dB)
			19965 (1711.5 MHz)	20175 (1732.5 MHz)	20385 (1753.5 MHz)		
			Conducted Power (dBm)				
QPSK	1	0	23.85	23.87	23.91	≤ 1	0
	1	7	23.88	23.90	23.87		
	1	14	23.84	23.88	23.89		
	8	0	22.85	22.88	22.88		1
	8	4	22.89	22.90	22.87		
	8	7	22.83	22.88	22.91		
	15	0	22.84	22.88	22.90		1
16QAM	1	0	22.84	22.89	22.92	≤ 1	1
	1	7	22.89	22.90	22.88		
	1	14	22.88	22.90	22.89		
	8	0	21.87	21.88	21.89	≤ 2	2
	8	4	21.89	21.91	21.85		
	8	7	21.83	21.88	21.91		
	15	0	21.84	21.89	21.89		2

Table 9.3.1.6 LTE Conducted Power

TE Band 4 (AWS) Conducted Power– 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed Per 3GPP(dB)	MPR (dB)
			19957 (1710.7 MHz)	20175 (1732.5 MHz)	20393 (1754.3 MHz)		
			Conducted Power (dBm)				
QPSK	1	0	23.84	23.86	23.88	≤ 1	0
	1	2	23.87	23.90	23.94		
	1	5	23.88	23.92	23.96		
	3	0	23.90	23.91	23.91		0
	3	2	23.88	23.95	23.96		
	3	3	23.87	23.89	24.00		
	6	0	22.88	22.91	22.89		1
16QAM	1	0	22.83	22.84	22.88	≤ 1	1
	1	2	22.89	22.92	22.98		
	1	5	22.88	22.95	22.94		
	3	0	22.90	22.90	22.92		1
	3	2	22.85	22.94	22.98		
	3	3	22.89	22.89	22.99		
	6	0	21.88	21.93	21.91	≤ 2	2

Table 9.3.1.7 LTE Conducted Power

Band & Mode		Modulated Average[dBm]
LTE Band 2(PCS)	Maximum	24.5
	Nominal	23.0

Table 9.3.2.1 Nominal and Maximum Output Power Spec

2) LTE Band 2 (PCS)

LTE Band 2 (PCS) Conducted Power– 20 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18700 (1860.0 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19100 (1900.0 MHz)	MPR Allowed Per 3GPP(dB)	MPR (dB)
			Conducted Power (dBm)				
QPSK	**1**	**0**	**23.98**	**24.03**	**23.95**	≤ 1	0
	1	50	23.78	23.76	23.83		
	1	99	23.76	23.83	23.99		
	50	**0**	**22.51**	**22.99**	**22.81**		1
	50	25	22.76	22.80	22.74		
	50	50	22.75	22.81	22.79		
	100	**0**	**22.75**	**22.80**	**22.78**		1
16QAM	1	0	22.98	22.98	22.94	≤ 1	1
	1	50	22.76	22.79	22.74		
	1	99	22.76	22.74	22.87		
	50	0	21.52	21.78	21.76	≤ 2	2
	50	25	21.68	21.68	21.67		
	50	50	21.65	21.78	21.76		
	100	0	21.76	21.77	21.68		2

Table 9.3.2.2 LTE Conducted Power

LTE Band 2 (PCS) Conducted Power– 15 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18675 (1857.5 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19125 (1902.5 MHz)	MPR Allowed Per 3GPP(dB)	MPR (dB)
			Conducted Power (dBm)				
QPSK	1	0	23.86	23.87	23.91	≤ 1	0
	1	36	23.90	23.88	23.84		
	1	74	23.82	23.91	23.88		
	36	0	22.88	22.90	22.92		1
	36	18	22.96	22.88	22.86		
	36	37	22.86	22.92	22.86		
	75	0	22.85	22.91	22.86		1
16QAM	1	0	22.89	22.97	23.91	≤ 1	1
	1	36	22.92	22.86	23.84		
	1	74	22.86	22.91	23.88		
	36	0	21.88	21.93	22.92	≤ 2	2
	36	18	21.99	21.88	22.86		
	36	37	21.86	21.93	22.86		
	75	0	21.86	21.92	22.86		2

Table 9.3.2.3 LTE Conducted Power

LTE Band 2 (PCS) Conducted Power– 10 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18650 (1855.0 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19150 (1905.0 MHz)	MPR Allowed Per 3GPP(dB)	MPR (dB)
			Conducted Power (dBm)				
QPSK	1	0	23.86	23.90	23.93	≤ 1	0
	1	25	23.87	23.86	23.88		
	1	49	23.88	23.88	23.86		
	25	0	23.86	22.90	22.93		1
	25	12	22.87	22.87	22.87		
	25	25	22.88	22.90	22.86		
	50	0	22.87	22.89	22.86		1
16QAM	1	0	22.91	22.98	22.93	≤ 1	1
	1	25	22.95	22.87	22.90		
	1	49	22.93	22.88	22.88		
	25	0	21.88	21.94	21.94	≤ 2	2
	25	12	21.87	21.88	21.87		
	25	25	21.89	21.90	21.88		
	50	0	21.87	21.90	21.86		2

Table 9.3.2.4 LTE Conducted Power

LTE Band 2 (PCS) Conducted Power– 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18625 (1852.5 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19175 (1907.5 MHz)	MPR Allowed Per 3GPP(dB)	MPR (dB)
			Conducted Power (dBm)				
QPSK	1	0	23.80	23.86	23.84	≤ 1	0
	1	12	23.84	23.88	23.86		
	1	24	23.86	23.84	23.83		
	12	0	22.88	22.87	22.88		1
	12	6	22.97	22.88	22.86		
	12	13	22.88	22.85	22.84		
	25	0	22.88	22.85	22.83		1
16QAM	1	0	22.86	22.87	22.86	≤ 1	1
	1	12	22.98	22.88	22.85		
	1	24	22.89	22.84	22.86		
	12	0	21.87	21.90	21.88	≤ 2	2
	12	6	21.98	21.84	21.87		
	12	13	21.87	21.86	21.85		
	25	0	21.88	21.86	21.83		2

Table 9.3.2.5 LTE Conducted Power

LTE Band 2 (PCS) Conducted Power– 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18615 (1851.5 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19185 (1908.5 MHz)	MPR Allowed Per 3GPP(dB)	MPR (dB)
			Conducted Power (dBm)				
QPSK	1	0	23.81	23.84	23.82	≤ 1	0
	1	7	23.85	23.87	23.80		
	1	14	23.84	23.82	23.83		
	8	0	22.84	22.86	22.90		1
	8	4	22.88	22.87	22.84		
	8	7	22.83	22.81	22.83		
	15	0	22.82	22.82	22.83		1
16QAM	1	0	22.81	22.90	22.87	≤ 1	1
	1	7	22.86	22.89	22.80		
	1	14	22.89	22.85	22.87		
	8	0	21.87	21.88	21.89	≤ 2	2
	8	4	21.88	21.89	21.86		
	8	7	21.85	21.81	21.85		
	15	0	21.85	21.83	21.83		2

Table 9.3.2.6 LTE Conducted Power

LTE Band 2 (PCS) Conducted Power– 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18607 (1850.7 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19193 (1909.3 MHz)	MPR Allowed Per 3GPP(dB)	MPR (dB)
			Conducted Power (dBm)				
QPSK	1	0	23.80	23.82	23.83	≤ 1	0
	1	2	23.84	23.84	23.85		
	1	5	23.87	23.86	23.87		
	3	0	23.83	23.86	23.80		0
	3	2	23.80	23.90	23.84		
	3	3	23.84	23.86	23.89		
	6	0	22.87	22.87	22.88		1
16QAM	1	0	22.80	22.87	22.86	≤ 1	1
	1	2	22.87	22.90	22.93		
	1	5	22.89	22.88	22.84		
	3	0	22.84	22.83	22.83		1
	3	2	22.89	22.95	22.89		
	3	3	22.88	22.91	22.86		
	6	0	21.86	21.90	21.87	≤ 2	2

Table 9.3.2.7 LTE Conducted Power

9.4 WLAN Nominal and Maximum Output Power Spec and Conducted Powers

Band (GHz)	Mode	Ch	Modulated Average[dBm]	
			Maximum	Nominal
2.4	802.11b	1~11	14.0	12.0
	802.11g	1~11	10.0	8.0
	802.11n	1~11	10.0	8.0

Table 9.4.1 Nominal and Maximum Output Power Spec

Mode	Freq. (MHz)	Channel	IEEE 802.11 (2.4 GHz) Conducted Power [dBm]
802.11b	**2412**	**1**	12.90
	2437	6	12.43
	2462	11	12.82
802.11g	2412	1	8.86
	2437	6	8.61
	2462	11	8.75
802.11n (HT-20)	2412	1	8.29
	2437	6	7.93
	2462	11	8.73

Table 9.4.2 IEEE 802.11 Average RF Power

Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v02r02:

- Power measurements were performed for the transmission mode configuration with the highest maximum output power specified for production units.
- For transmission modes with the same maximum output power specification, powers were measured for the largest channel bandwidth, lowest order modulation and lowest data rate.
- For transmission modes with identical maximum specified output power, channel bandwidth, modulation and data rates, power measurements were required for all identical configurations.
- For each transmission mode configuration, powers were measured for the highest and lowest channels; and at the mid-band channel(s) when there were at least 3 channels supported. For configurations with multiple mid-band channels, duo to an even number of channels, both channels were measured.
- Output Power and SAR is not required for 802.11 g/n HT20/ac VHT20 channels when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjust SAR is ≤ 1.2 W/kg.
- The underlined data rate and channel above were tested for SAR.

The average output powers of this device were tested by below configuration.

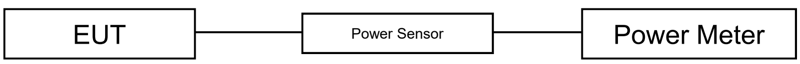

Figure 9.4 Power Measurement Setup

9.5 Bluetooth Conducted Powers

Frame Modulated Average[dBm]		
Bluetooth 1 Mbps	Maximum	11.4
	Nominal	7.7
Bluetooth 2 Mbps	Maximum	9.7
	Nominal	6.0
Bluetooth 3 Mbps	Maximum	9.7
	Nominal	6.0
Bluetooth (LE)	Maximum	6.1
	Nominal	2.4

Table 9.5.1 Nominal and Maximum Output Power Spec (Frame)

Channel	Frequency (MHz)	Frame AVG Output Power (1Mbps) (dBm)	Frame AVG Output Power (2Mbps) (dBm)	Frame AVG Output Power (3Mbps) (dBm)
Low	2402	7.90	4.56	4.61
Mid	2441	7.61	5.97	5.99
High	2480	7.07	5.58	5.59

Table 9.5.2 Bluetooth Burst and Frame Average RF Power

Channel	Frequency (MHz)	Frame AVG Output Power(LE) (dBm)
Low	2402	3.28
Mid	2440	3.16
High	2480	2.35

Table 9.5.3 Bluetooth LE Burst and Frame Average RF Power

- **Bluetooth Conducted Powers procedures**

1. Bluetooth (BDR, EDR)
   1) Enter DUT mode in EUT and operate it.
      When it operating, The EUT is transmitting at maximum power level and duty cycle fixed.
   2) Instruments and EUT were connected like Figure 9.5.1(A).
   3) The maximum output powers of BDR(1 Mbps), EDR(2, 3 Mbps) and each frequency were set by a Bluetooth Tester.
   4) Power levels were measured by a Power Meter.

2. Bluetooth (LE)
   1) Enter LE mode in EUT and operate it.
      When it operating, The EUT is transmitting at maximum power level and duty cycle fixed.
   2) Instruments and EUT were connected like Figure 9.5.1(B).
   3) The average conducted output powers of LE and each frequency can measurement according to setting program in EUT.
   4) Power levels were measured by a Power Meter.

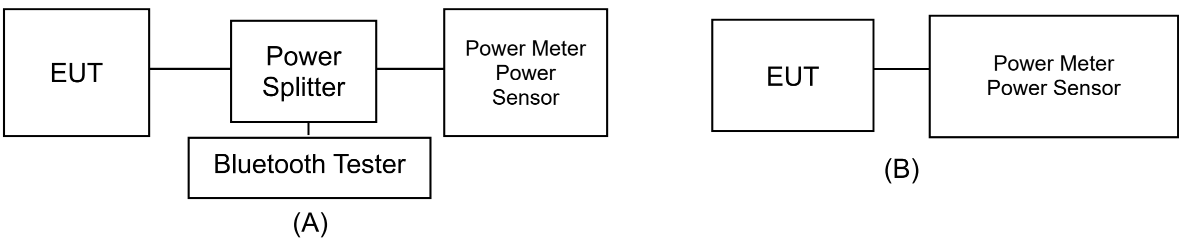

Figure 9.5.1 Average Power Measurement Setup

10. SYSTEM VERIFICATION

10.1 Tissue Verification

MEASURED TISSUE PARAMETERS

Date(s)	Tissue Type	Ambient Temp.[°C]	Liquid Temp.[°C]	Measured Frequency [MHz]	Target Dielectric Constant, εr	Target Conductivity, σ (S/m)	Measured Dielectric Constant, εr	Measured Conductivity, σ (S/m)	Er Deviation [%]	σ Deviation [%]
Aug. 28. 2019	1800 Head	20.8	21.4	1712.4	40.126	1.350	38.945	1.303	-2.94	-3.48
				1720.0	40.114	1.354	38.914	1.309	-2.99	-3.32
				1732.4	40.097	1.361	38.845	1.320	-3.12	-3.01
				1732.5	40.097	1.361	38.844	1.320	-3.12	-3.01
				1745.0	40.079	1.369	38.774	1.330	-3.26	-2.85
				1752.6	40.069	1.373	38.731	1.337	-3.34	-2.62
				1770.0	40.043	1.383	38.632	1.352	-3.52	-2.24
				1800.0	40.000	1.400	38.490	1.381	-3.78	-1.36
Aug. 26. 2019	1900 Head	21.1	21.0	1850.2	40.000	1.400	41.483	1.377	3.71	-1.64
				1852.4	40.000	1.400	41.481	1.379	3.70	-1.50
				1860.0	40.000	1.400	41.460	1.386	3.65	-1.00
				1880.0	40.000	1.400	41.389	1.405	3.47	0.36
				1900.0	40.000	1.400	41.314	1.427	3.29	1.93
				1907.6	40.000	1.400	41.282	1.435	3.20	2.50
				1909.8	40.000	1.400	41.276	1.438	3.19	2.71
Aug. 21. 2019	2450 Head	21.4	20.4	2402.0	39.282	1.757	40.665	1.763	3.52	0.34
				2412.0	39.265	1.766	40.638	1.773	3.50	0.40
				2437.0	39.222	1.788	40.561	1.801	3.41	0.73
				2441.0	39.215	1.792	40.547	1.805	3.40	0.73
				2450.0	39.200	1.800	40.516	1.816	3.36	0.89
				2462.0	39.184	1.813	40.485	1.829	3.32	0.88
				2467.0	39.177	1.818	40.472	1.835	3.31	0.94
				2472.0	39.171	1.823	40.455	1.840	3.28	0.93
				2480.0	39.160	1.832	40.428	1.849	3.24	0.93

The above measured tissue parameters were used in the DASY software. The DASY software was used to perform interpolation to determine the dielectric parameters at the SAR test device frequencies (per KDB 865664 and IEEE 1528-2013 6.6.1.2). The tissue parameters listed in the SAR test plots may slightly differ from the table above due to significant digit rounding in the software.

Measurement Procedure for Tissue verification:

1) The network analyzer and probe system was configured and calibrated.
2) The probe was immersed in the sample which was placed in a nonmetallic container. Trapped air bubbles beneath the flange were minimized by placing the probe at a slight angle.
3) The complex admittance with respect to the probe aperture was measured
4) The complex relative permittivity , for example from the below equation (Pournaropoulos and Misra):

$$Y = \frac{j2\omega\varepsilon_r\varepsilon_0}{[\ln(b/a)]^2}\int_a^b\int_a^b\int_0^\pi \cos\phi' \frac{\exp\left[-j\omega r(\mu_0\varepsilon_r'\varepsilon_0)^{1/2}\right]}{r}\, d\phi' d\rho' d\rho$$

where Y is the admittance of the probe in contact with the sample, the primed and unprimed coordinates refer to source and observation points, respectively, $r^2 = \rho^2 + \rho'^2 - 2\rho\rho'\cos\phi'$, ω is the angular frequency, and $j = \sqrt{-1}$.

10.2 Test System Verification

Prior to assessment, the system is verified to the ± 10 % of the specifications at using the SAR Dipole kit(s). (Graphic Plots Attached)

Table 10.2.1 System Verification Results (1g)

SYSTEM DIPOLE VERIFICATION TARGET & MEASURED												
SAR System #	Freq. [MHz]	SAR Dipole kits	Date(s)	Tissue Type	Ambient Temp. [°C]	Liquid Temp. [°C]	Probe S/N	Input Power (mW)	1 W Target SAR_{1g} (W/kg)	Measured SAR_{1g} (W/kg)	1 W Normalized SAR_{1g} (W/kg)	Deviation [%]
F	1800	D1900V2, SN:2d047	Aug. 28. 2019	Head	20.8	21.4	3328	100	38.1	3.90	39.00	2.36
F	1900	D1900V2, SN:5d029	Aug. 26. 2019	Head	21.1	21.0	3328	100	40.4	4.10	41.00	1.49
F	2450	D2450V2, SN: 920	Aug. 21. 2019	Head	21.4	20.4	3328	100	51.9	5.09	50.90	-1.93

Note1 : System Verification was measured with input 250 mW, 100 mW and normalized to 1W.
Note2 : Full system validation status and results can be found in Attachment 3.

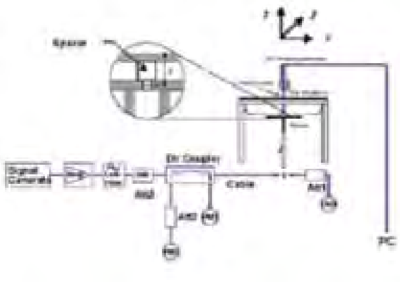

Figure 10.1 Dipole Verification Test Setup Diagram & Photo

11. SAR TEST RESULTS

11.1 Head SAR Results

Table 11.1.1 PCS/GPRS 1900 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/ Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	# of Time Slots	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch													
1880.0	661	PCS1900	PCS	31.00	29.50	0.030	Left Touch	FCC #1	1	1:8.3	0.242	1.413	0.342	
1880.0	661	PCS1900	PCS	31.00	29.50	0.060	Right Touch	FCC #1	1	1:8.3	0.283	1.413	**0.400**	A1
1880.0	661	PCS1900	PCS	31.00	29.50	0.020	Left Tilt	FCC #1	1	1:8.3	0.118	1.413	0.167	
1880.0	661	PCS1900	PCS	31.00	29.50	0.160	Right Tilt	FCC #1	1	1:8.3	0.100	1.413	0.141	
1880.0	661	PCS1900	GPRS	25.50	23.70	0.140	Left Touch	FCC #1	4	1:2.075	0.357	1.514	0.540	
1880.0	661	PCS1900	GPRS	25.50	23.70	-0.110	Right Touch	FCC #1	4	1:2.075	0.377	1.514	**0.571**	A2
1880.0	661	PCS1900	GPRS	25.50	23.70	0.110	Left Tilt	FCC #1	4	1:2.075	0.170	1.514	0.257	
1880.0	661	PCS1900	GPRS	25.50	23.70	-0.010	Right Tilt	FCC #1	4	1:2.075	0.131	1.514	0.198	
1880.0	661	PCS1900	GPRS	25.50	23.70	-0.100	Right Touch	FCC #1	4	1:2.075	0.362	1.514	0.548	
ANSI / IEEE C95.1-1992– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure								**Head 1.6 W/kg (mW/g)** averaged over 1 gram						

Note(s):
1. Blue entries represent Non-camera measurement on the worst case for camera measurement.

Table 11.1.2 WCDMA 1700 Head SAR

MEASUREMENT RESULTS													
FREQUENCY		Mode/ Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch												
1732.4	1412	WCDMA 1700	RMC	23.00	20.96	0.140	Left Touch	FCC #1	1:1	0.465	1.600	0.744	
1712.4	1312	WCDMA 1700	RMC	23.00	21.90	0.170	Right Touch	FCC #1	1:1	0.371	1.288	0.478	
1732.4	1412	WCDMA 1700	RMC	23.00	20.96	0.080	Right Touch	FCC #1	1:1	0.574	1.600	**0.918**	A3
1752.6	1513	WCDMA 1700	RMC	23.00	20.81	-0.030	Right Touch	FCC #1	1:1	0.387	1.656	0.641	
1732.4	1412	WCDMA 1700	RMC	23.00	20.96	-0.030	Left Tilt	FCC #1	1:1	0.270	1.600	0.432	
1732.4	1412	WCDMA 1700	RMC	23.00	20.96	-0.010	Right Tilt	FCC #1	1:1	0.234	1.600	0.374	
1732.4	1412	WCDMA 1700	RMC	23.00	20.96	-0.160	Right Touch	FCC #1	1:1	0.536	1.600	0.858	
ANSI / IEEE C95.1-1992– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure								**Head 1.6 W/kg (mW/g)** averaged over 1 gram					

Note(s):
1. Blue entries represent Non-camera measurement on the worst case for camera measurement.

Table 11.1.2 WCDMA 1900 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/ Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch												
1852.4	9262	WCDMA 1900	RMC	23.00	21.53	-0.030	Left Touch	FCC #1	1:1	0.449	1.403	0.630	
1880.0	9400	WCDMA 1900	RMC	23.00	21.60	-0.140	Left Touch	FCC #1	1:1	0.621	1.380	0.857	
1907.6	9538	WCDMA 1900	RMC	23.00	21.58	0.110	Left Touch	FCC #1	1:1	0.545	1.387	0.756	
1852.4	9262	WCDMA 1900	RMC	23.00	21.53	-0.090	Right Touch	FCC #1	1:1	0.440	1.403	0.617	
1880.0	9400	WCDMA 1900	RMC	23.00	21.60	-0.050	Right Touch	FCC #1	1:1	0.686	1.380	**0.947**	A4
1907.6	9538	WCDMA 1900	RMC	23.00	21.58	0.080	Right Touch	FCC #1	1:1	0.501	1.387	0.695	
1880.0	9400	WCDMA 1900	RMC	23.00	21.60	0.040	Left Tilt	FCC #1	1:1	0.307	1.380	0.424	
1880.0	9400	WCDMA 1900	RMC	23.00	21.60	0.000	Right Tilt	FCC #1	1:1	0.266	1.380	0.367	
1880.0	9400	WCDMA 1900	RMC	23.00	21.60	0.080	Right Touch	FCC #1	1:1	0.631	1.380	0.871	
ANSI / IEEE C95.1-1992– SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population Exposure**								**Head** **1.6 W/kg (mW/g)** averaged over 1 gram					

Note(s):
1. Blue entries represent Non-camera measurement on the worst case for camera measurement.

Table 11.1.6 LTE Band 4 (AWS) Head SAR

MEASUREMENT RESULTS																	
FREQUENCY		Mode/ Band	BW [MHz]	Max Allowed Power [dBm]	Cond. PWR [dBm]	Drift Power [dB]	MPR	Position	Device Serial Number	Mod.	RB Size	RB Offs.	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch																
1732.5	20175	LTE B4	20	24.50	23.99	-0.120	0	Left Touch	FCC #1	QPSK	1	0	1:1	0.661	1.125	0.744	
1732.5	20175	LTE B4	20	23.50	23.00	0.100	1	Left Touch	FCC #1	QPSK	50	0	1:1	0.530	1.122	0.595	
1732.5	20175	LTE B4	20	24.50	23.99	0.060	0	Right Touch	FCC #1	QPSK	1	0	1:1	0.854	1.125	**0.961**	A5
1732.5	20175	LTE B4	20	23.50	23.00	0.050	1	Right Touch	FCC #1	QPSK	50	0	1:1	0.627	1.122	0.703	
1732.5	20175	LTE B4	20	23.50	22.96	0.040	1	Right Touch	FCC #1	QPSK	100	0	1:1	0.626	1.132	0.709	
1732.5	20175	LTE B4	20	24.50	23.99	-0.010	0	Left Tilt	FCC #1	QPSK	1	0	1:1	0.404	1.125	0.455	
1732.5	20175	LTE B4	20	23.50	23.00	-0.130	1	Left Tilt	FCC #1	QPSK	50	0	1:1	0.347	1.122	0.389	
1732.5	20175	LTE B4	20	24.50	23.99	-0.020	0	Right Tilt	FCC #1	QPSK	1	0	1:1	0.548	1.125	0.617	
1732.5	20175	LTE B4	20	23.50	23.00	-0.120	1	Right Tilt	FCC #1	QPSK	50	0	1:1	0.405	1.122	0.454	
1732.5	20175	LTE B4	20	24.50	23.99	0.020	0	Right Touch	FCC #1	QPSK	1	0	1:1	0.793	1.125	0.892	
1732.5	20175	LTE B4	20	24.50	23.99	0.000	0	Right Touch	FCC #1	QPSK	1	0	1:1	0.793	1.125	0.892	
ANSI / IEEE C95.1-1992– SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population Exposure**									**Head** **1.6 W/kg (mW/g)** averaged over 1 gram								

Note(s):
1. Green entries represent variability measurements.
2. Blue entries represent Non-camera measurement on the worst case for camera measurement.

Table 11.1.6 LTE Band 2 (PCS) Head SAR

MEASUREMENT RESULTS																	
FREQUENCY		Mode/ Band	BW [MHz]	Max Allowed Power [dBm]	Cond. PWR [dBm]	Drift Power [dB]	MPR	Position	Device Serial Number	Mod.	RB Size	RB Offs.	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch																
1860.0	18700	LTE B2	20	24.50	23.98	-0.100	0	Left Touch	FCC #1	QPSK	1	0	1:1	0.851	1.127	0.959	
1880.0	18900	LTE B2	20	24.50	24.03	0.120	0	Left Touch	FCC #1	QPSK	1	0	1:1	0.805	1.114	0.897	
1900.0	19100	LTE B2	20	24.50	23.95	0.140	0	Left Touch	FCC #1	QPSK	1	0	1:1	0.928	1.135	1.053	
1880.0	18900	LTE B2	20	23.50	22.99	0.010	1	Left Touch	FCC #1	QPSK	50	0	1:1	0.708	1.125	0.797	
1880.0	18900	LTE B2	20	23.50	22.80	0.150	1	Left Touch	FCC #1	QPSK	100	0	1:1	0.581	1.175	0.683	
1860.0	18700	LTE B2	20	24.50	23.98	0.100	0	Right Touch	FCC #1	QPSK	1	0	1:1	0.827	1.127	0.932	
1880.0	18900	LTE B2	20	24.50	24.03	0.110	0	Right Touch	FCC #1	QPSK	1	0	1:1	0.829	1.114	0.924	
1900.0	19100	LTE B2	20	24.50	23.95	0.080	0	Right Touch	FCC #1	QPSK	1	0	1:1	1.000	1.135	**1.135**	A6
1880.0	18900	LTE B2	20	23.50	22.99	0.120	1	Right Touch	FCC #1	QPSK	50	0	1:1	0.684	1.125	0.770	
1880.0	18900	LTE B2	20	23.50	22.80	0.180	1	Right Touch	FCC #1	QPSK	100	0	1:1	0.712	1.175	0.837	
1880.0	18900	LTE B2	20	24.50	24.03	0.060	0	Left Tilt	FCC #1	QPSK	1	0	1:1	0.408	1.114	0.455	
1880.0	18900	LTE B2	20	23.50	22.99	0.100	1	Left Tilt	FCC #1	QPSK	50	0	1:1	0.328	1.125	0.369	
1880.0	18900	LTE B2	20	24.50	24.03	0.070	0	Right Tilt	FCC #1	QPSK	1	0	1:1	0.399	1.114	0.444	
1880.0	18900	LTE B2	20	23.50	22.99	-0.020	1	Right Tilt	FCC #1	QPSK	50	0	1:1	0.352	1.125	0.396	
1900.0	19100	LTE B2	20	24.50	24.03	0.010	0	Right Touch	FCC #1	QPSK	1	0	1:1	0.961	1.114	1.071	
1900.0	19100	LTE B2	20	24.50	24.03	0.130	0	Right Touch	FCC #1	QPSK	1	0	1:1	0.876	1.114	0.976	
ANSI / IEEE C95.1-1992– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure									**Head 1.6 W/kg (mW/g)** averaged over 1 gram								

Note(s):
1. Green entries represent variability measurements.
2. Blue entries represent Non-camera measurement on the worst case for camera measurement.

Table 11.1.11 DTS Head SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode (Antenna)	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Peak SAR of Area Scan	Data Rate [Mbps]	Duty Cycle	1g SAR (W/kg)	Scaling Factor	Scaling Factor (Duty Cycle)	1g Scaled SAR (W/kg)	Plots #
MHz	Ch														
2412.0	1	802.11b	14.00	12.90	0.000	Left Touch	FCC #2	0.015	1	98.8	0.013	1.288	1.012	0.017	
2412.0	1	802.11b	14.00	12.90	0.030	Right Touch	FCC #2	0.020	1	98.8	0.017	1.288	1.012	**0.022**	A7
2412.0	1	802.11b	14.00	12.90	-0.030	Left Tilt	FCC #2	0.012	1	98.8	0.011	1.288	1.012	0.014	
2412.0	1	802.11b	14.00	12.90	0.150	Right Tilt	FCC #2	0.016	1	98.8	0.016	1.288	1.012	0.021	
2412.0	1	802.11b	14.00	12.90	0.000	Right Touch	FCC #2	0.015	1	98.8	0.013	1.288	1.012	0.017	
ANSI / IEEE C95.1-1992– SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population Exposure**								**Head** **1.6 W/kg (mW/g)** averaged over 1 gram							

Note(s):
1. Blue entries represent Non-camera measurement on the worst case for camera measurement.

Adjusted SAR results for OFDM SAR												
FREQUENCY		Mode/ Antenna	Service	Maximum Allowed Power [dBm]	1g Scaled SAR (W/kg)	FREQUENCY [MHz]	Mode	Service	Maximum Allowed Power [dBm	Ratio of OFDM to DSSS	1g Adjusted SAR (W/kg)	Determine OFDM SAR
MHz	Ch											
2412.0	1	802.11b	DSSS	14.0	0.022	2437.0	802.11g	OFDM	10.0	0.398	**0.009**	X
2412.0	1	802.11b	DSSS	14.0	0.022	2437.0	802.11n	OFDM	10.0	0.398	**0.009**	X
ANSI / IEEE C95.1-1992– SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population Exposure**						**Head** **1.6 W/kg (mW/g)** averaged over 1 gram						

Note: SAR is not required for the following 2.4 GHz OFDM conditions. When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

Table 11.1.12 Bluetooth Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode (Antenna)	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Data Rate [Mbps]	Duty Cycle	1g SAR (W/kg)	Scaling Factor	Scaling Factor (Duty Cycle)	1g Scaled SAR (W/kg)	Plots #
MHz	Ch													
2441.0	39	Bluetooth	11.40	7.61	0.000	Left Touch	FCC #2	1	76.8	0.001	2.393	1.302	0.003	
2441.0	39	Bluetooth	11.40	7.61	0.000	Right Touch	FCC #2	1	76.8	0.008	2.393	1.302	**0.025**	A8
2441.0	39	Bluetooth	11.40	7.61	0.000	Left Tilt	FCC #2	1	76.8	0.001	2.393	1.302	0.003	
2441.0	39	Bluetooth	11.40	7.61	0.000	Right Tilt	FCC #2	1	76.8	0.002	2.393	1.302	0.006	
2441.0	39	Bluetooth	11.40	7.61	0.000	Right Touch	FCC #2	1	76.8	0.004	2.393	1.302	0.012	
ANSI / IEEE C95.1-1992– SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population Exposure**								**Head** **1.6 W/kg (mW/g)** averaged over 1 gram						

Note(s):
1. Blue entries represent Non-camera measurement on the worst case for camera measurement.

11.2 Standalone Body-Worn SAR Worn SAR Results

Table 11.2.1 GSM/PCS/GPRS/WCDMA Body-Worn SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/ Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Spacing [Side]	Device Serial Number	# of Time Slots	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch													
1880.0	661	PCS1900	PCS	31.00	29.50	-0.040	10 mm [Front]	FCC #1	1	1:8.3	0.220	1.413	0.311	
1880.0	661	PCS1900	PCS	31.00	29.50	0.100	10 mm [Rear]	FCC #1	1	1:8.3	0.320	1.413	**0.452**	A9
1880.0	661	PCS1900	GPRS	25.50	23.70	-0.010	10 mm [Front]	FCC #1	4	1:2.075	0.311	1.514	0.471	
1850.2	512	PCS1900	GPRS	25.50	23.60	0.010	10 mm [Rear]	FCC #1	4	1:2.075	0.404	1.549	0.626	
1880.0	661	PCS1900	GPRS	25.50	23.70	-0.020	10 mm [Rear]	FCC #1	4	1:2.075	0.551	1.514	**0.834**	A10
1909.8	810	PCS1900	GPRS	25.50	23.50	0.070	10 mm [Rear]	FCC #1	4	1:2.075	0.421	1.585	0.667	
1880.0	661	PCS1900	GPRS	25.50	23.70	-0.040	10 mm [Rear]	FCC #1	4	1:2.075	0.463	1.514	0.701	
1732.4	1412	WCDMA 1700	RMC	23.00	20.96	-0.000	10 mm [Front]	FCC #1	N/A	1:1	0.337	1.600	0.539	
1712.4	1312	WCDMA 1700	RMC	23.00	21.90	0.090	10 mm [Rear]	FCC #1	N/A	1:1	0.523	1.288	0.674	
1732.4	1412	WCDMA 1700	RMC	23.00	20.96	-0.000	10 mm [Rear]	FCC #1	N/A	1:1	0.642	1.600	**1.027**	A11
1752.6	1513	WCDMA 1700	RMC	23.00	20.81	0.070	10 mm [Rear]	FCC #1	N/A	1:1	0.584	1.656	0.967	
1732.4	1412	WCDMA 1700	RMC	23.00	20.96	-0.010	10 mm [Rear]	FCC #1	N/A	1:1	0.583	1.600	0.933	
1880.0	9400	WCDMA 1900	RMC	23.00	21.60	-0.060	10 mm [Front]	FCC #1	N/A	1:1	0.504	1.380	0.696	
1852.4	9262	WCDMA 1900	RMC	23.00	21.53	0.000	10 mm [Rear]	FCC #1	N/A	1:1	0.786	1.403	1.103	
1880.0	9400	WCDMA 1900	RMC	23.00	21.60	0.070	10 mm [Rear]	FCC #1	N/A	1:1	0.750	1.380	1.035	
1907.6	9538	WCDMA 1900	RMC	23.00	21.58	0.000	10 mm [Rear]	FCC #1	N/A	1:1	0.801	1.387	**1.111**	A12
1907.6	9538	WCDMA 1900	RMC	23.00	21.58	-0.060	10 mm [Rear]	FCC #1	N/A	1:1	0.795	1.387	1.103	
1907.6	9538	WCDMA 1900	RMC	23.00	21.58	0.000	10 mm [Rear]	FCC #1	N/A	1:1	0.772	1.387	1.071	
ANSI / IEEE C95.1-1992– SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population Exposure**								**Body** **1.6 W/kg (mW/g)** averaged over 1 gram						

Note(s):
1. Green entries represent variability measurements.
2. Blue entries represent Non-camera measurement on the worst case for camera measurement.

Table 11.2.2 LTE B4, B2 Body-Worn SAR

MEASUREMENT RESULTS																	
FREQUENCY		Mode/ Band	BW [MHz]	Max Allowed Power [dBm]	Cond. PWR [dBm]	Drift Power [dB]	MPR	Position	Device Serial Number	Mod.	RB Size	RB Offs.	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch																
1732.5	20175	LTE B4	20	24.50	23.99	-0.050	0	10 mm [Front]	FCC #1	QPSK	1	0	1:1	0.505	1.125	0.568	
1732.5	20175	LTE B4	20	23.50	23.00	-0.010	1	10 mm [Front]	FCC #1	QPSK	50	0	1:1	0.384	1.122	0.431	
1732.5	20175	LTE B4	20	24.50	23.99	-0.090	0	10 mm [Rear]	FCC #1	QPSK	1	0	1:1	1.100	1.125	**1.238**	A13
1732.5	20175	LTE B4	20	23.50	23.00	-0.030	1	10 mm [Rear]	FCC #1	QPSK	50	0	1:1	0.813	1.122	0.912	
1732.5	20175	LTE B4	20	23.50	22.96	-0.180	1	10 mm [Rear]	FCC #1	QPSK	100	0	1:1	0.781	1.132	0.884	
1732.5	20175	LTE B4	20	24.50	23.99	-0.130	0	10 mm [Rear]	FCC #1	QPSK	1	0	1:1	1.090	1.125	1.226	
1732.5	20175	LTE B4	20	24.50	23.99	-0.150	1	10 mm [Rear]	FCC #1	QPSK	1	0	1:1	1.090	1.125	1.226	
1732.5	20175	LTE B4	20	24.50	23.99	-.060	1	10 mm [Rear]	FCC #1	QPSK	1	0	1:1	1.040	1.125	1.170	
1880.0	18900	LTE B2	20	24.50	24.03	0.100	0	10 mm [Front]	FCC #1	QPSK	1	0	1:1	0.711	1.114	0.792	
1880.0	18900	LTE B2	20	23.50	22.99	0.010	1	10 mm [Front]	FCC #1	QPSK	50	0	1:1	0.697	1.125	0.784	
1860.0	18700	LTE B2	20	24.50	23.98	-0.050	0	10 mm [Rear]	FCC #1	QPSK	1	0	1:1	1.060	1.127	1.195	
1880.0	18900	LTE B2	20	24.50	24.03	-0.070	0	10 mm [Rear]	FCC #1	QPSK	1	0	1:1	1.060	1.114	1.181	
1900.0	19100	LTE B2	20	24.50	23.95	-0.120	0	10 mm [Rear]	FCC #1	QPSK	1	0	1:1	1.190	1.135	**1.351**	A14
1860.0	18700	LTE B2	20	23.50	22.51	-0.020	1	10 mm [Rear]	FCC #1	QPSK	50	0	1:1	0.825	1.256	1.036	
1880.0	18900	LTE B2	20	23.50	22.99	-0.100	1	10 mm [Rear]	FCC #1	QPSK	50	0	1:1	0.844	1.125	0.950	
1900.0	19100	LTE B2	20	23.50	22.81	0.000	1	10 mm [Rear]	FCC #1	QPSK	50	0	1:1	0.896	1.172	1.050	
1880.0	18900	LTE B2	20	23.50	22.80	0.120	1	10 mm [Rear]	FCC #1	QPSK	100	0	1:1	0.903	1.175	1.061	
1900.0	19100	LTE B2	20	24.50	24.03	-0.020	0	10 mm [Rear]	FCC #1	QPSK	1	0	1:1	1.090	1.114	1.214	
1900.0	19100	LTE B2	20	24.50	24.03	-0.030	0	10 mm [Rear]	FCC #1	QPSK	1	0	1:1	1.100	1.114	1.225	
1900.0	19100	LTE B2	20	24.50	24.03	0.030	0	10 mm [Rear]	FCC #1	QPSK	1	0	1:1	1.070	1.114	1.192	
ANSI / IEEE C95.1-1992– SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population Exposure**									**Body** **1.6 W/kg (mW/g)** averaged over 1 gram								

Note(s):
1. Green entries represent variability measurements.
2. Blue entries represent Non-camera measurement on the worst case for camera measurement.
3. Yellow entries represent Ear set measurement.

Table 11.2.4 DTS Body-Worn SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Peak SAR of Area Scan	Data Rate [Mbps]	Duty Cycle	1g SAR (W/kg)	Scaling Factor	Scaling Factor (Duty Cycle)	SAR (W/kg)	Plots #
MHz	Ch														
2412.0	1	802.11b	14.00	12.90	0.120	10 mm [Front]	FCC #2	0.052	1	98.8	0.050	1.288	1.012	0.065	
2412.0	1	802.11b	14.00	12.90	0.060	10 mm [Rear]	FCC #2	0.094	1	98.8	0.091	1.288	1.012	**0.119**	A15
2412.0	1	802.11b	14.00	12.90	-0.040	10 mm [Rear]	FCC #2	0.083	1	98.8	0.078	1.288	1.012	0.102	
ANSI / IEEE C95.1-1992– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure								**Body 1.6 W/kg (mW/g)** averaged over 1 gram							

Note(s):
1. Blue entries represent Non-camera measurement on the worst case for camera measurement.

Adjusted SAR results for OFDM SAR												
FREQUENCY		Mode/ Antenna	Service	Maximum Allowed Power [dBm]	1g Scaled SAR (W/kg)	FREQUENCY [MHz]	Mode	Service	Maximum Allowed Power [dBm	Ratio of OFDM to DSSS	1g Adjusted SAR (W/kg)	Determine OFDM SAR
MHz	Ch											
2412.0	1	802.11b	DSSS	14.0	0.119	2437.0	802.11g	OFDM	10.0	0.398	**0.047**	X
2412.0	1	802.11b	DSSS	14.0	0.119	2437.0	802.11n	OFDM	10.0	0.398	**0.047**	X
ANSI / IEEE C95.1-1992– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure						**Body 1.6 W/kg (mW/g)** averaged over 1 gram						

Note: SAR is not required for the following 2.4 GHz OFDM conditions. When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

Table 11.1.12 Bluetooth Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode (Antenna)	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Data Rate [Mbps]	Duty Cycle	1g SAR (W/kg)	Scaling Factor	Scaling Factor (Duty Cycle)	1g Scaled SAR (W/kg)	Plots #
MHz	Ch													
2441.0	39	Bluetooth	11.40	7.61	0.040	10 mm [Front]	FCC #2	1	76.8	0.005	2.393	1.302	0.016	
2441.0	39	Bluetooth	11.40	7.61	-0.110	10 mm [Rear]	FCC #2	1	76.8	0.015	2.393	1.302	**0.047**	A16
2441.0	39	Bluetooth	11.40	7.61	0.110	10 mm [Rear]	FCC #2	1	76.8	0.010	2.393	1.302	0.031	
ANSI / IEEE C95.1-1992– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure								**Body 1.6 W/kg (mW/g)** averaged over 1 gram						

Note(s):
1. Blue entries represent Non-camera measurement on the worst case for camera measurement.

11.3 Standalone Hotspot SAR Results

Table 11.3.1 GPRS/WCDMA Hotspot SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/ Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Spacing [Side]	Device Serial Number	# of Time Slots	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch													
1880.0	661	PCS1900	GPRS	25.50	23.70	-0.110	10 mm [Top]	FCC #1	4	1:2.075	0.299	1.514	0.453	
1880.0	661	PCS1900	GPRS	25.50	23.70	-0.010	10 mm [Front]	FCC #1	4	1:2.075	0.311	1.514	0.471	
1850.2	512	PCS1900	GPRS	25.50	23.60	0.010	10 mm [Rear]	FCC #1	4	1:2.075	0.404	1.549	0.626	
1880.0	661	PCS1900	GPRS	25.50	23.70	-0.020	10 mm [Rear]	FCC #1	4	1:2.075	0.551	1.514	**0.834**	A10
1909.8	810	PCS1900	GPRS	25.50	23.50	0.070	10 mm [Rear]	FCC #1	4	1:2.075	0.421	1.585	0.667	
1880.0	661	PCS1900	GPRS	25.50	23.70	0.050	10 mm [Right]	FCC #1	4	1:2.075	0.096	1.514	0.145	
1880.0	661	PCS1900	GPRS	25.50	23.70	-0.000	10 mm [Left]	FCC #1	4	1:2.075	0.174	1.514	0.263	
1880.0	661	PCS1900	GPRS	25.50	23.70	-0.040	10 mm [Rear]	FCC #1	4	1:2.075	0.463	1.514	0.701	
1732.4	1412	WCDMA 1700	RMC	23.00	20.96	0.040	10 mm [Top]	FCC #1	N/A	1:1	0.442	1.600	0.707	
1732.4	1412	WCDMA 1700	RMC	23.00	20.96	-0.000	10 mm [Front]	FCC #1	N/A	1:1	0.337	1.600	0.539	
1712.4	1312	WCDMA 1700	RMC	23.00	21.90	0.090	10 mm [Rear]	FCC #1	N/A	1:1	0.523	1.288	0.674	
1732.4	1412	WCDMA 1700	RMC	23.00	20.96	-0.000	10 mm [Rear]	FCC #1	N/A	1:1	0.642	1.600	**1.027**	A11
1752.6	1513	WCDMA 1700	RMC	23.00	20.81	0.070	10 mm [Rear]	FCC #1	N/A	1:1	0.584	1.656	0.967	
1732.4	1412	WCDMA 1700	RMC	23.00	20.96	0.030	10 mm [Right]	FCC #1	N/A	1:1	0.129	1.600	0.206	
1732.4	1412	WCDMA 850	RMC	23.00	20.96	0.110	10 mm [Left]	FCC #1	N/A	1:1	0.257	1.600	0.411	
1732.4	1412	WCDMA 1700	RMC	23.00	20.96	-0.010	10 mm [Rear]	FCC #1	N/A	1:1	0.583	1.600	0.933	
1880.0	9400	WCDMA 1900	RMC	23.00	21.60	0.140	10 mm [Bottom]	FCC #1	N/A	1:1	0.436	1.380	0.602	
1880.0	9400	WCDMA 1900	RMC	23.00	21.53	-0.060	10 mm [Front]	FCC #1	N/A	1:1	0.504	1.403	0.707	
1852.4	9262	WCDMA 1900	RMC	23.00	21.60	0.000	10 mm [Rear]	FCC #1	N/A	1:1	0.786	1.380	1.085	
1880.0	9400	WCDMA 1900	RMC	23.00	21.58	0.070	10 mm [Rear]	FCC #1	N/A	1:1	0.750	1.387	1.040	
1907.6	9538	WCDMA 1900	RMC	23.00	21.60	0.000	10 mm [Rear]	FCC #1	N/A	1:1	0.801	1.380	**1.105**	A12
1880.0	9400	WCDMA 1900	RMC	23.00	21.60	0.060	10 mm [Right]	FCC #1	N/A	1:1	0.268	1.380	0.370	
1880.0	9400	WCDMA 1900	RMC	23.00	21.60	0.060	10 mm [Left]	FCC #1	N/A	1:1	0.573	1.380	0.791	
1907.6	9538	WCDMA 1900	RMC	23.00	21.58	-0.060	10 mm [Rear]	FCC #1	N/A	1:1	0.795	1.387	1.103	
1907.6	9538	WCDMA 1900	RMC	23.00	21.58	0.000	10 mm [Rear]	FCC #1	N/A	1:1	0.772	1.387	1.071	
ANSI / IEEE C95.1-1992– SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population Exposure**								**Body** **1.6 W/kg (mW/g)** averaged over 1 gram						

Note(s):
1. Green entries represent variability measurements.
2. Blue entries represent Non-camera measurement on the worst case for camera measurement.

Table 11.3.2 LTE B4 Hotspot SAR

MEASUREMENT RESULTS																
FREQUENCY		Mode/ Band	BW [MHz]	Max Allowed Power [dBm]	Cond. PWR [dBm]	Drift Power [dB]	MPR	Position	Device Serial Number	Mod.	RB Size	RB Offs.	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch																
1732.5	20175	LTE B4	20	24.50	23.99	0.130	0	10 mm [Top]	FCC #1	QPSK	1	0	1:1	0.652	1.125	0.734	
1732.5	20175	LTE B4	20	23.50	23.00	0.140	1	10 mm [Top]	FCC #1	QPSK	50	0	1:1	0.481	1.122	0.540	
1732.5	20175	LTE B4	20	24.50	23.99	-0.050	0	10 mm [Front]	FCC #1	QPSK	1	0	1:1	0.505	1.125	0.568	
1732.5	20175	LTE B4	20	23.50	23.00	-0.010	1	10 mm [Front]	FCC #1	QPSK	50	0	1:1	0.384	1.122	0.431	
1732.5	20175	LTE B4	20	24.50	23.99	-0.090	0	10 mm [Rear]	FCC #1	QPSK	1	0	1:1	1.100	1.125	**1.238**	A13
1732.5	20175	LTE B4	20	23.50	23.00	-0.030	1	10 mm [Rear]	FCC #1	QPSK	50	0	1:1	0.813	1.122	0.912	
1732.5	20175	LTE B4	20	23.50	22.96	-0.180	1	10 mm [Rear]	FCC #1	QPSK	100	0	1:1	0.781	1.132	0.884	
1732.5	20175	LTE B4	20	24.50	23.99	0.150	0	10 mm [Right]	FCC #1	QPSK	1	0	1:1	0.194	1.125	0.218	
1732.5	20175	LTE B4	20	23.50	23.00	0.010	1	10 mm [Right]	FCC #1	QPSK	50	0	1:1	0.145	1.122	0.163	
1732.5	20175	LTE B4	20	24.50	23.99	-0.130	0	10 mm [Left]	FCC #1	QPSK	1	0	1:1	0.403	1.125	0.453	
1732.5	20175	LTE B4	20	23.50	23.00	0.050	1	10 mm [Left]	FCC #1	QPSK	50	0	1:1	0.305	1.122	0.342	
1732.5	20175	LTE B4	20	24.50	23.99	-0.130	0	10 mm [Rear]	FCC #1	QPSK	1	0	1:1	1.090	1.125	1.226	
1732.5	20175	LTE B4	20	24.50	23.99	-0.150	0	10 mm [Rear]	FCC #1	QPSK	1	0	1:1	1.090	1.125	1.226	
1732.5	20175	LTE B4	20	24.50	23.99	-.060	1	10 mm [Rear]	FCC #1	QPSK	1	0	1:1	1.040	1.125	1.170	
ANSI / IEEE C95.1-1992– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure									**Body 1.6 W/kg (mW/g)** averaged over 1 gram								

Note(s):
1. Green entries represent variability measurements.
2. Blue entries represent Non-camera measurement on the worst case for camera measurement.
3. Yellow entries represent headset measurement.

Table 11.3.2 LTE B2 Hotspot SAR

MEASUREMENT RESULTS																	
FREQUENCY		Mode/ Band	BW [MHz]	Max Allowed Power [dBm]	Cond. PWR [dBm]	Drift Power [dB]	MPR	Position	Device Serial Number	Mod.	RB Size	RB Offs.	Duty Cycle	1g SAR (W/kg)	Scaling Factor	1g Scaled SAR (W/kg)	Plots #
MHz	Ch																
1860.0	18700	LTE B2	20	24.50	23.98	-0.030	0	10 mm [Top]	FCC #1	QPSK	1	0	1:1	0.734	1.127	0.827	
1880.0	18900	LTE B2	20	24.50	24.03	0.140	0	10 mm [Top]	FCC #1	QPSK	1	0	1:1	0.780	1.114	0.869	
1900.0	19100	LTE B2	20	24.50	23.95	0.110	0	10 mm [Top]	FCC #1	QPSK	1	0	1:1	0.810	1.135	0.919	
1880.0	18900	LTE B2	20	23.50	22.99	0.130	1	10 mm [Top]	FCC #1	QPSK	50	0	1:1	0.614	1.125	0.691	
1880.0	18900	LTE B2	20	23.50	22.80	0.130	1	10 mm [Top]	FCC #1	QPSK	100	0	1:1	0.624	1.175	0.733	
1880.0	18900	LTE B2	20	24.50	24.03	0.100	0	10 mm [Front]	FCC #1	QPSK	1	0	1:1	0.711	1.122	0.798	
1880.0	18900	LTE B2	20	23.50	22.99	0.010	1	10 mm [Front]	FCC #1	QPSK	50	0	1:1	0.697	1.122	0.782	
1860.0	18700	LTE B2	20	24.50	23.98	-0.050	0	10 mm [Rear]	FCC #1	QPSK	1	0	1:1	1.060	1.127	1.195	
1880.0	18900	LTE B2	20	24.50	24.03	-0.070	0	10 mm [Rear]	FCC #1	QPSK	1	0	1:1	1.060	1.114	1.181	
1900.0	19100	LTE B2	20	24.50	23.95	-0.120	0	10 mm [Rear]	FCC #1	QPSK	1	0	1:1	1.190	1.135	**1.351**	A14
1860.0	18700	LTE B2	20	23.50	22.51	-0.020	1	10 mm [Rear]	FCC #1	QPSK	50	0	1:1	0.825	1.256	1.036	
1880.0	18900	LTE B2	20	23.50	22.99	-0.100	1	10 mm [Rear]	FCC #1	QPSK	50	0	1:1	0.844	1.125	0.950	
1900.0	19100	LTE B2	20	23.50	22.81	0.000	1	10 mm [Rear]	FCC #1	QPSK	50	0	1:1	0.896	1.172	1.050	
1880.0	18900	LTE B2	20	23.50	22.80	0.120	1	10 mm [Rear]	FCC #1	QPSK	100	0	1:1	0.903	1.175	1.061	
1880.0	18900	LTE B2	20	24.50	24.03	-0.180	0	10 mm [Right]	FCC #1	QPSK	1	0	1:1	0.211	1.114	0.235	
1880.0	18900	LTE B2	20	23.50	22.99	0.110	1	10 mm [Right]	FCC #1	QPSK	50	0	1:1	0.180	1.125	0.203	
1880.0	18900	LTE B2	20	24.50	24.03	-0.010	0	10 mm [Left]	FCC #1	QPSK	1	0	1:1	0.461	1.114	0.514	
1880.0	18900	LTE B2	20	23.50	22.99	-0.000	1	10 mm [Left]	FCC #1	QPSK	50	0	1:1	0.376	1.125	0.423	
1900.0	19100	LTE B2	20	24.50	24.03	-0.020	0	10 mm [Rear]	FCC #1	QPSK	1	0	1:1	1.090	1.114	1.214	
1900.0	19100	LTE B2	20	24.50	24.03	-0.030	0	10 mm [Rear]	FCC #1	QPSK	1	0	1:1	1.100	1.114	1.225	
1900.0	19100	LTE B2	20	24.50	24.03	0.030	0	10 mm [Rear]	FCC #1	QPSK	1	0	1:1	1.070	1.114	1.192	
ANSI / IEEE C95.1-1992– SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population Exposure**									**Body** **1.6 W/kg (mW/g)** averaged over 1 gram								

Note(s):
1. Green entries represent variability measurements.
2. Blue entries represent Non-camera measurement on the worst case for camera measurement.
3. Yellow entries represent headset measurement.

Table 11.3.6 DTS Hotspot SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Peak SAR of Area Scan	Data Rate [Mbps]	Duty Cycle	1g SAR (W/kg)	Scaling Factor	Scaling Factor (Duty Cycle)	SAR (W/kg)	Plots #
MHz	Ch														
2412.0	1	802.11b	14.00	12.90	-0.020	10 mm [Bottom]	FCC #2	0.018	1	98.8	0.017	1.288	1.012	0.022	
2412.0	1	802.11b	14.00	12.90	0.120	10 mm [Front]	FCC #2	0.052	1	98.8	0.050	1.288	1.012	0.065	
2412.0	1	802.11b	14.00	12.90	0.060	10 mm [Rear]	FCC #2	0.094	1	98.8	0.091	1.288	1.012	**0.119**	A15
2412.0	1	802.11b	14.00	12.90	-0.110	10 mm [Right]	FCC #2	0.022	1	98.8	0.017	1.288	1.012	0.022	
2412.0	1	802.11b	14.00	12.90	-0.040	10 mm [Rear]	FCC #2	0.083	1	98.8	0.078	1.288	1.012	0.102	
ANSI / IEEE C95.1-1992– SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population Exposure**								**Body** **1.6 W/kg (mW/g)** averaged over 1 gram							

Note(s):
1. Blue entries represent Non-camera measurement on the worst case for camera measurement.

Adjusted SAR results for OFDM SAR													
FREQUENCY		Mode/ Antenna	Service	Maximum Allowed Power [dBm]	1g Scaled SAR (W/kg)	FREQUENCY [MHz]	Mode	Service	Maximum Allowed Power [dBm	Ratio of OFDM to DSSS	1g Adjusted SAR (W/kg)	Determine OFDM SAR
MHz	Ch											
2412.0	1	802.11b	DSSS	14.0	0.119	2437.0	802.11g	OFDM	10.0	0.398	**0.047**	X
2412.0	1	802.11b	DSSS	14.0	0.119	2437.0	802.11n	OFDM	10.0	0.398	**0.047**	X
ANSI / IEEE C95.1-1992– SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population Exposure**						**Body** **1.6 W/kg (mW/g)** averaged over 1 gram						

Note: SAR is not required for the following 2.4 GHz OFDM conditions. When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

Table 11.1.12 Bluetooth Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode (Antenna)	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Data Rate [Mbps]	Duty Cycle	1g SAR (W/kg)	Scaling Factor	Scaling Factor (Duty Cycle)	1g Scaled SAR (W/kg)	Plots #
MHz	Ch													
2441.0	39	Bluetooth	11.40	7.61	0.150	10 mm [Bottom]	FCC #2	1	76.8	0.011	2.393	1.302	0.034	
2441.0	39	Bluetooth	11.40	7.61	0.040	10 mm [Front]	FCC #2	1	76.8	0.005	2.393	1.302	0.016	
2441.0	39	Bluetooth	11.40	7.61	-0.110	10 mm [Rear]	FCC #2	1	76.8	0.015	2.393	1.302	**0.047**	A16
2441.0	39	Bluetooth	11.40	7.61	-0.080	10 mm [Right]	FCC #2	1	76.8	0.006	2.393	1.302	0.019	
2441.0	39	Bluetooth	11.40	7.61	0.110	10 mm [Rear]	FCC #2	1	76.8	0.010	2.393	1.302	0.031	
ANSI / IEEE C95.1-1992– SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population Exposure**								**Body** **1.6 W/kg (mW/g)** averaged over 1 gram						

Note(s):
1. Blue entries represent Non-camera measurement on the worst case for camera measurement.

11.4 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2013, and FCC KDB Publication 447498 D01v06.
2. Batteries are fully charged at the beginning of the SAR measurements. A standard battery was used for all SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v06.
6. Device was tested using a fixed spacing for body-worn accessory testing. A separation distance of 10 mm was considered because the manufacturer has determined that there will be body-worn accessories available in the marketplace for users to support this separation distance.
7. Per FCC KDB Publication 648474 D04v01r03, body-worn SAR was evaluated with a headset connected to the device. Since the standalone reported boy-worn SAR was > 1.2 W/kg, additional body-worn SAR evaluations using a headset cable were performed.
8. During SAR Testing for the Wireless Router conditions per FCC KDB Publication 941225 D06v02r01, the actual Portable Hotspot operation (with actual simultaneous transmission of a transmitter with WIFI) was not activated.
9. SAR measurements were performed using the DASY5 automated system. The procedure for spatial peak SAR evaluation has been implemented according to the IEEE 1528 standard. During a maximum search, global and local maxima searches are automatically performed in 2-D after each area scan measurement. The algorithm will find the global maximum and all local maxima within 2 dB of the global maxima for all SAR distributions. All local maxima within 2 dB of the global maximum were searched and passed for the Zoom Scan measurement.

GSM Notes:

1. Body-Worn accessory testing is typically associated with voice operations. Therefore, GSM voice was evaluated for body-worn SAR.
2. This device supports GSM VOIP in the head and body-worn configurations; therefore GPRS was additionally evaluated for head and body-worn compliance.
3. Justification for reduced test configurations per KDB Publication 941225 D01v03r01 and October2013 TCB Workshop Notes: The source-based frame-averaged output power was evaluated for all GPRS/EDGE slot configurations. The configuration with the highest target frame averaged output power was evaluated for hotspot SAR.
4. Per FCC KDB Publication 447498 D01v06, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). Since the maximum output power variation across the required test channels is not > ½ dB, the middle channel was used for testing.

WCDMA (UMTS) Notes:

1. WCDMA (UMTS) mode in was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01v03r01. AMR and 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.
2. Per FCC KDB Publication 447498 D01v06, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel was used.

LTE Notes:

1. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Considerations for LTE Devices in FCC KDB Publication 941225 D05v02r05. The general test procedures used for testing can be found in Section 8.4.4.
2. According to FCC KDB 941225 D05v02r05, when the reported SAR is ≤ 0.8 W/kg, testing of the 100% RB allocation and required test channels is not required.
   Otherwise, SAR is required for the remaining required test channels using the 1 RB, 50% RB and 100% RB allocation with highest output power for that channel.
   Only one channel, and as reported SAR values for 1 RB allocation and 50% RB allocation were less than 1.45 W/kg only the highest power RB offset for each allocation was required.
3. MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36. 101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.
4. A-MPR was disabled for all SAR tests by setting NS=1 on the base station simulator. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).
5. SAR test reduction is applied using the following criteria:
   Start with the largest channel bandwidth and measure SAR for QPSK with 1 RB, and 50% RB allocation, using the RB offset and required test channel combination with the highest maximum output power among RB offsets at the upper edge, middle and lower edge of each required test channel. When the reported SAR is > 0.8 W/kg, testing for other channels is performed at the highest output power level for 1 RB, and 50% RB configuration for that channel. Testing for 100% RB configuration is performed at the highest output power level for 100% RB configuration across the Low, Mid and High channel when the highest reported SAR for 1 RB and 50% RB are > 0.8 W/kg, Testing for the remaining required channels is not needed because the reported SAR for 100% RB Allocation < 1.45 W/kg. Testing for 16QAM modulation is not required because the reported SAR for QPSK is < 1.45 W/kg and its output power is not more than 0.5 dB higher than that a QPSK. Testing for the other channel bandwidths is not required because the reported SAR for the highest channel bandwidth is < 1.45 W/kg and its output power is not more than 0.5 dB higher than that of the highest channel bandwidth.

WLAN Notes:

1. The initial test position procedures were applied. The test position with the highest extrapolated peak SAR will be used as the initial test position. When reported SAR for the initial test position is ≤ 0.4 W/kg, no additional testing for the remaining test positions was required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is ≤ 0.8 W/kg or all test positions are measured.
2. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 2.4 GHz WIFI single transmission chain operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4 GHz 802.11g/n) was not required duo to the maximum allowed powers and the highest reported DSSS SAR when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output and the adjust SAR is ≤ 1.2 W/kg.
3. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 5 GHz WIFI single transmission chain operations, the initial test configuration was selected according to the transmission mode with the highest maximum allowed powers. Other transmission modes were not investigated since the highest reported SAR for initial test configuration adjusted by the ratio of maximum output powers is less than 1.2 W/kg.
4. When the maximum reported 1g averaged SAR ≤ 0.8 W/kg, SAR testing on additional channels was not required. Otherwise, SAR for the next highest output power channel was required until the reported SAR result was ≤ 1.20 W/kg or all test channels were measured.
5. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor to determine compliance.

12. FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

12.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D01v06 are applicable to handsets with built-in unlicensed transmitters such as 802.11b/g/n and Bluetooth devices which may simultaneously transmit with the licensed transmitter.

12.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore simultaneous transmission analysis is required. Per FCC KDB 447498 D01v06 4.3.2 and IEEE 1528-2013 Section 6.3.4.1.2,simultaneous transmission SAR test exclusion may be applied when the sum of the sum 1-g SAR for all the simultaneous transmitting antennas in a specific a physical test configuration is ≤ 1.6 W/kg. The different test positon in an exposure condition may be considered collectively to determine SAR test exclusion according to the sum of 1-g or 10-g SAR.

12.3 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D01v06, transmitters are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds.

This device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneous transmission analysis according to FCC KDB Publication 447498 D01v06.

Table 12.3.1 Simultaneous Transmission Scenarios

No.	Capable TX Configuration	GSM1900(Voice)	GPRS1900(Data)	WCDMAB2/B4 (Voice/Data)	LTE B2/B4	WIFI 2.4GHz(802.11b/g/n)	Bluetooth
1	GSM1900(Voice)		No	No	No	Yes	Yes
2	GPRS1900(Data)	No		No	No	Yes	Yes
3	WCDMAB2/B4(Voice/Data)	No	No		No	Yes	Yes
4	LTE B2/B4	No	No	No		Yes	Yes
5	WIFI 2.4GHz(802.11b/g/n)	Yes	Yes	Yes	Yes		No
6	Bluetooth	Yes	Yes	Yes	Yes	No	

Table 12.3.2 Simultaneous SAR Cases

No.	Capable Transmit Configuration	Head SAR	Body-Worn SAR	Hotspot SAR	Note
1	GSM Voice + Wi-Fi 2.4 GHz	Yes	Yes	N/A	
2	GSM Voice + Bluetooth 2.4 GHz	Yes	Yes	N/A	
3	GPRS + Wi-Fi 2.4 GHz	Yes	Yes	Yes	
4	GPRS + Bluetooth 2.4 GHz	Yes	Yes	Yes	
5	WCDMA + Wi-Fi 2.4 GHz	Yes	Yes	Yes	
6	WCDMA + Bluetooth 2.4 GHz	Yes	Yes	Yes	
7	LTE + Wi-Fi 2.4 GHz	Yes	Yes	Yes	
8	LTE + Bluetooth 2.4 GHz	Yes	Yes	Yes	

Notes:

1. WiFi 2.4GHz is supported Hotspot.
2. LTE, WCDMA, GPRS is supported Hotspot.
3. VoIP is supported in LTE, WCDMA, GSM
4. Bluetooth and WiFi can not transmit simultaneously at 2.4G band.
5. GSM, WCDMA and LTE can not transmit simultaneously since they share the same chip.

12.4 Head SAR Simultaneous Transmission Analysis

Table 12.4.1 Simultaneous Transmission Scenario : 2G/3G/4G + 2.4 GHz W-LAN (Held to Ear)

Exposure Condition	Mode	Configuration	2G/3G/4G SAR (W/kg)	2.4G W-LAN SAR (W/kg)	ΣSAR (W/kg)
			1	2	1+2
Head SAR	GSM 1900	Left Touch	0.342	0.017	0.359
		Right Touch	0.400	0.022	0.422
		Left Tilt	0.167	0.014	0.181
		Right Tilt	0.141	0.021	0.162
	GPRS 1900	Left Touch	0.540	0.017	0.557
		Right Touch	0.571	0.022	0.593
		Left Tilt	0.257	0.014	0.271
		Right Tilt	0.198	0.021	0.219
	WCDMA 1700	Left Touch	0.744	0.017	0.761
		Right Touch	0.918	0.022	0.940
		Left Tilt	0.432	0.014	0.446
		Right Tilt	0.374	0.021	0.395
	WCDMA 1900	Left Touch	0.857	0.017	0.874
		Right Touch	0.947	0.022	0.969
		Left Tilt	0.424	0.014	0.438
		Right Tilt	0.367	0.021	0.388
	LTE Band 4	Left Touch	0.744	0.017	0.761
		Right Touch	0.961	0.022	0.983
		Left Tilt	0.455	0.014	0.469
		Right Tilt	0.617	0.021	0.638
	LTE Band 2	Left Touch	1.053	0.017	1.070
		Right Touch	1.135	0.022	**1.157**
		Left Tilt	0.455	0.014	0.469
		Right Tilt	0.444	0.021	0.465

Table 12.4.2 Simultaneous Transmission Scenario : 2G/3G/4G + Bluetooth (Held to Ear)

Exposure Condition	Mode	Configuration	2G/3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	ΣSAR (W/kg)
			1	2	1+2
Head SAR	GSM 1900	Left Touch	0.342	0.003	0.345
		Right Touch	0.400	0.025	0.425
		Left Tilt	0.167	0.003	0.170
		Right Tilt	0.141	0.006	0.147
	GPRS 1900	Left Touch	0.540	0.003	0.543
		Right Touch	0.571	0.025	0.596
		Left Tilt	0.257	0.003	0.260
		Right Tilt	0.198	0.006	0.204
	WCDMA 1700	Left Touch	0.744	0.003	0.747
		Right Touch	0.918	0.025	0.943
		Left Tilt	0.432	0.003	0.435
		Right Tilt	0.374	0.006	0.380
	WCDMA 1900	**Left Touch**	0.857	0.003	0.860
		Right Touch	0.947	0.025	0.972
		Left Tilt	0.424	0.003	0.427
		Right Tilt	0.367	0.006	0.373
	LTE Band 4	Left Touch	0.744	0.003	0.747
		Right Touch	0.961	0.025	0.986
		Left Tilt	0.455	0.003	0.458
		Right Tilt	0.617	0.006	0.623
	LTE Band 2	Left Touch	1.053	0.003	1.056
		Right Touch	**1.135**	**0.025**	**1.160**
		Left Tilt	0.455	0.003	0.458
		Right Tilt	0.444	0.006	0.450

12.5 Body-Worn Simultaneous Transmission Analysis

Table 12.5.1 Simultaneous Transmission Scenario : 2G/3G/4G + 2.4 GHz W-LAN (Body-Worn at 10 mm)

Exposure Condition	Mode	Configuration	2G/3G/4G SAR (W/kg)	2.4G W-LAN SAR (W/kg)	ΣSAR (W/kg)
			1	2	1+2
Body-Worn SAR	GSM 1900	Front	0.311	0.065	0.376
		Rear	0.452	0.119	0.571
	GPRS 1900	Front	0.471	0.065	0.536
		Rear	0.834	0.119	0.953
	WCDMA 1700	Front	0.539	0.065	0.604
		Rear	1.027	0.119	1.146
	WCDMA 1900	Front	0.696	0.065	0.761
		Rear	1.111	0.119	1.230
	LTE Band 4	Front	0.568	0.065	0.633
		Rear	1.238	0.119	1.357
	LTE Band 2	Front	0.792	0.065	0.857
		Rear	**1.351**	**0.119**	1.470

Table 12.5.2 Simultaneous Transmission Scenario : 2G/3G/4G + Bluetooth (Body-Worn at 10 mm)

Exposure Condition	Mode	Configuration	2G/3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	ΣSAR (W/kg)
			1	2	1+2
Body-Worn SAR	GSM 1900	Front	0.311	0.016	0.327
		Rear	0.452	0.047	0.499
	GPRS 1900	Front	0.471	0.016	0.487
		Rear	0.834	0.047	0.881
	WCDMA 1700	Front	0.539	0.016	0.555
		Rear	1.027	0.047	1.074
	WCDMA 1900	Front	0.696	0.016	0.712
		Rear	1.111	0.047	1.158
	LTE Band 4	Front	0.568	0.016	0.584
		Rear	1.238	0.047	1.285
	LTE Band 2	Front	0.792	0.016	0.808
		Rear	1.351	0.047	1.398

12.6 Hotspot SAR Simultaneous Transmission Analysis

Per FCC KDB Publication 941225 D06v02r01, the device edges with antennas more than 2.5 cm from edge are not required to be evaluated for SAR ("-").

Table 12.6.1 Simultaneous Transmission Scenario : 2G/3G/4G + 2.4 GHz W-LAN (Hotspot at 10 mm)

Exposure Condition	Mode	Configuration	2G/3G/4G SAR (W/kg)	2.4G W-LAN SAR (W/kg)	ΣSAR (W/kg)
			1	2	1+2
Hotspot SAR	GPRS 1900	Top	0.453		0.453
		Bottom	-	0.022	0.022
		Front	0.471	0.065	0.536
		Rear	0.834	0.119	0.953
		Right	0.145	0.022	0.167
		Left	0.263		0.263
	WCDMA 1700	Top	0.707		0.707
		Bottom	-	0.022	0.022
		Front	0.539	0.065	0.604
		Rear	1.027	0.119	1.146
		Right	0.206	0.022	0.228
		Left	0.411		0.411
	WCDMA 1900	Top	0.602		0.602
		Bottom	-	0.022	0.022
		Front	0.707	0.065	0.772
		Rear	1.105	0.119	1.224
		Right	0.370	0.022	0.392
		Left	0.791		0.791
	LTE Band 4	Top	0.734		0.734
		Bottom	-	0.022	0.022
		Front	0.568	0.065	0.633
		Rear	1.238	0.119	1.357
		Right	0.218	0.022	0.240
		Left	0.453		0.453
	LTE Band 2	Top	0.919		0.919
		Bottom	-	0.022	0.022
		Front	0.798	0.065	0.863
		Rear	**1.351**	**0.119**	**1.470**
		Right	0.235	0.022	0.257
		Left	0.514		0.514

Table 12.6.2 Simultaneous Transmission Scenario : 2G/3G/4G + Bluetooth (Hotspot at 10 mm)

Exposure Condition	Mode	Configuration	2G/3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	ΣSAR (W/kg)
			1	2	1+2
Hotspot SAR	GPRS 1900	Top	0.453	-	0.453
		Bottom	-	0.034	0.034
		Front	0.471	0.016	0.487
		Rear	0.834	0.047	0.881
		Right	0.145	0.019	0.164
		Left	0.263	-	0.263
	WCDMA 1700	Top	0.707	-	0.707
		Bottom	-	0.034	0.034
		Front	0.539	0.016	0.555
		Rear	1.027	0.047	1.074
		Right	0.206	0.019	0.225
		Left	0.411	-	0.411
	WCDMA 1900	Top	0.602	-	0.602
		Bottom	-	0.034	0.034
		Front	0.707	0.016	0.723
		Rear	1.105	0.047	1.152
		Right	0.370	0.019	0.389
		Left	0.791	-	0.791
	LTE Band 4	Top	0.734	-	0.734
		Bottom	-	0.034	0.034
		Front	0.568	0.016	0.584
		Rear	1.238	0.047	1.285
		Right	0.218	0.019	0.237
		Left	0.453	-	0.453
	LTE Band 2	Top	0.919	-	0.919
		Bottom	-	0.034	0.034
		Front	0.798	0.016	0.814
		Rear	1.351	0.047	**1.398**
		Right	0.235	0.019	0.254
		Left	0.514	-	0.514

12.7 Simultaneous Transmission Conclusion

The above numerical summed SAR results for all the worst-case simultaneous transmission conditions were below the SAR limit. Therefore, the above analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit and therefore no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D01v06 and IEEE 1528-2013 Section 6.3.4.1.2.

13. SAR MEASUREMENT VARIABILITY

13.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01r04, SAR measurement variability was assessed for each frequency band, which was determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media were required for SAR measurements in a frequency band, the variability measurement procedures were applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. These additional measurements were repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device was returned to ambient conditions (normal room temperature) with the battery fully charged before it was re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

SAR Measurement Variability was assessed using the following procedures for each frequency band:

1. When the original highest measured SAR is ≥ 0.80 W/kg, the measurement was repeated once.
2. A second repeated measurement was performed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).
3. A third repeated measurement was performed only if the original, first or second repeated measurement was ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.
4. Repeated measurements are not required when the original highest measured SAR is < 0.80 W/kg
5. The same procedures should be adapted for measurements according to extremity exposure limits by applying a factor of 2.5 for extremity exposure to the corresponding SAR thresholds.

Table 13.1 Head SAR Measurement Variability Results

Frequency		Mode	Service	# of Time Slots	Spacing [Side]	Measured SAR (1g)	1st Repeated SAR(1g)	Ratio	2nd Repeated SAR(1g)	Ratio	3rd Repeated SAR(1g)	Ratio
MHz	Ch.					(W/kg)	(W/kg)		(W/kg)		(W/kg)	
1732.5	20175	LTE B4	QPSK	-	Right Touch	0.854	0.793	1.08	-	-	-	-
1900.0	19100	LTE B2	QPSK	-	Right Touch	1.000	0.961	1.04	-	-	-	-
ANSI / IEEE C95.1-1992– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure							Head 1.6 W/kg (mW/g) averaged over 1 gram					

Table 13.2 Body SAR Measurement Variability Results

Frequency		Mode	Service	# of Time Slots	Spacing [Side]	Measured SAR (1g)	1st Repeated SAR(1g)	Ratio	2nd Repeated SAR(1g)	Ratio	3rd Repeated SAR(1g)	Ratio
MHz	Ch.					(W/kg)	(W/kg)		(W/kg)		(W/kg)	
1907.6	9538	WCDMA1900	RMC	-	10 mm [Rear]	0.801	0.795	1.01	-	-	-	-
1732.5	20175	LTE B4	QPSK	-	10 mm [Rear]	1.100	1.090	1.01	-	-	-	-
1900.0	19100	LTE B2	QPSK	-	10 mm [Rear]	1.190	1.090	1.09	-	-	-	-
ANSI / IEEE C95.1-1992– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure							Body 1.6 W/kg (mW/g) averaged over 1 gram					

13.2 Measurement Uncertainty

The measured SAR was < 1.5 W/kg for 1g and < 3.75 W/kg for 10g for all frequency bands. Therefore, per KDB Publication 865664 D01v01r04, the extended measurement uncertainty analysis per IEEE 1528-2013 was not required.

14. EQUIPMENT LIST

Table 14.1.1 Test Equipment Calibration

	Type	Manufacturer	Model	Cal.Date	Next.Cal.Date	S/N
☒	SEMITEC Engineering	SEMITEC	N/A	N/A	N/A	Shield Room
☒	Robot	SPEAG	TX60L	N/A	N/A	F14/5WV5D1/A/01
☒	Robot Controller	SPEAG	CS8C	N/A	N/A	F14/5VR2A1/C/01
☒	Joystick	SPEAG	N/A	N/A	N/A	D21142605A
☒	Intel Core i7-4770 3.40 GHz Windows 7 Professional	N/A	SuP-PC30	N/A	N/A	N/A
☒	Probe Alignment Unit LB	N/A	N/A	N/A	N/A	SE UKS 030 AA
☒	Device Holder	SPEAG	Holder	N/A	N/A	SD000H01KA
☒	Twin SAM Phantom	SPEAG	QD000P40CD	N/A	N/A	1837
☒	Data Acquisition Electronics	SPEAG	DAE4V1	2019-07-18	2020-07-18	1335
☒	Dosimetric E-Field Probe	SPEAG	ES3DV3	2019-03-28	2020-03-28	3328
☒	1800 MHz SAR Dipole	SPEAG	D1800V2	2019-04-24	2021-04-24	2d047
☒	1900 MHz SAR Dipole	SPEAG	D1900V2	2019-07-17	2021-07-17	5d029
☒	2450 MHz SAR Dipole	SPEAG	D2450V2	2018-08-24	2020-08-24	920
☒	Network Analyzer	Agilent	E5071C	2018-12-19	2019-12-19	MY46111534
☒	Signal Generator	Agilent	E4438C	2019-06-24	2020-06-24	US41461520
☒	High Power RF Amplifier	EMPOWER	BBS3Q8CCJ	2019-06-24	2020-06-24	1005
☒	Power Meter	HP	EPM-442A	2018-12-19	2019-12-19	GB37170267
☒	Power Meter	Anritsu	ML2495A	2019-08-02	2020-08-02	1435003
☒	Power Sensor	Anritsu	MA2490A	2019-08-02	2020-08-02	1409034
☒	Power Sensor	HP	8481A	2018-12-19	2019-12-19	3318A96566
☒	Power Sensor	HP	8481A	2018-12-19	2019-12-19	2702A65976
☒	Dual Directional Coupler	Agilent	778D-012	2018-12-19	2019-12-19	50228
☒	Directional Coupler	HP	772D	2019-06-24	2020-06-24	2889A01064
☒	Low Pass Filter 3.0 GHz	Micro LAB	LA-30N	2019-06-24	2020-06-24	N/A
☒	Attenuators (3 dB)	Agilent	8491B	2018-12-19	2019-12-19	MY39260700
☒	Attenuators (10 dB)	WEINSCHEL	23-10-34	2018-12-19	2019-12-19	BP4387
☒	Dielectric Probe kit	SPEAG	DAK-3.5	2019-07-23	2020-07-23	1046
☒	8960 Series 10 Wireless Comms. Test Set	Agilent	E5515C	2019-06-28	2020-06-28	GB41321164
☒	Wideband Radio Communication Tester	Rohde Schwarz	CMW500	2018-12-19	2019-12-19	101414
☒	Power Splitter	Anritsu	K241B	2018-12-18	2019-12-18	1301183
☒	Bluetooth Tester	TESCOM	TC-3000B	2018-12-18	2019-12-18	3000B770243

NOTE(S):
1. The E-field probe was calibrated by SPEAG, by temperature measurement procedure. Dipole Verification measurement is performed by DT&C before each test. The brain and muscle simulating material are calibrated by DT&C using the dielectric probe system and network analyzer to determine the conductivity and permittivity (dielectric constant) of the brain and muscle-equivalent material. Each equipment item was used solely within its respective calibration period.
2. CBT(Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. signal generator) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.

15. MEASUREMENT UNCERTAINTIES

1800 MHz

Error Description	Uncertainty value ±%	Probability Distribution	Divisor	(Ci) 1g	(Ci) 10g	Standard (1g)	Standard (10g)	vi 2 or Veff
Measurement System								
Probe calibration	± 6.0	Normal	1	1	1	± 6.0 %	± 6.0 %	∞
Isotropy	± 1.3	Normal	1	1	1	± 1.3 %	± 1.3 %	∞
Boundary Effects	± 2.0	Rectangular	√3	1	1	± 1.2 %	± 1.2 %	∞
Probe Linearity	± 0.3	Normal	1	1	1	± 0.3 %	± 0.3 %	∞
Probe modulation response	± 0.0	Rectangular	√3	1	1	± 0.0 %	± 0.0 %	∞
Detection limits	± 0.25	Rectangular	√3	1	1	± 0.14 %	± 0.14 %	∞
Readout Electronics	± 0.3	Normal	1	1	1	± 0.3 %	± 0.3 %	∞
Response time	± 0.8	Rectangular	√3	1	1	± 0.46 %	± 0.46 %	∞
Integration time	± 2.6	Rectangular	√3	1	1	± 1.5 %	± 1.5 %	∞
RF Ambient Conditions – Noise	± 3.0	Rectangular	√3	1	1	± 1.7 %	± 1.7 %	∞
RF Ambient Conditions – Reflections	± 3.0	Rectangular	√3	1	1	± 1.7 %	± 1.7 %	∞
Probe Positioner	± 0.8	Rectangular	√3	1	1	± 0.46 %	± 0.46 %	∞
Probe Positioning	± 6.7	Rectangular	√3	1	1	± 3.9 %	± 3.9 %	∞
Algorithms for Max. SAR Eval.	± 4.0	Rectangular	√3	1	1	± 2.3 %	± 2.3 %	∞
Test Sample Related								
Device Positioning	± 2.9	Normal	1	1	1	± 2.9 %	± 2.9 %	145
Device Holder	± 3.6	Normal	1	1	1	± 3.6 %	± 3.6 %	5
Power Drift	± 5.0	Rectangular	√3	1	1	± 2.9 %	± 2.9 %	∞
SAR Scaling	± 0.0	Rectangular	√3	1	1	± 0.0 %	± 0.0 %	∞
Physical Parameters								
Phantom Shell	± 7.6	Rectangular	√3	1	1	± 4.4 %	± 4.4 %	∞
SAR correction	± 0.0	Normal	1	1	0.84	± 0.0 %	± 0.0 %	∞
Liquid conductivity (Target)	± 5.0	Rectangular	√3	0.64	0.43	± 1.8 %	± 1.2 %	∞
Liquid conductivity (Meas.)	± 3.8	Normal	1	0.78	0.71	± 3.0 %	± 2.7 %	10
Liquid permittivity (Target)	± 5.0	Rectangular	√3	0.60	0.49	± 1.7 %	± 1.4 %	∞
Liquid permittivity (Meas.)	± 4.1	Normal	1	0.23	0.26	± 0.94 %	± 1.1 %	10
Temp. unc. - Conductivity	± 1.8	Rectangular	√3	0.78	0.71	± 0.81 %	± 0.74 %	∞
Temp. unc. - Permittivity	± 1.8	Rectangular	√3	0.23	0.26	± 0.24 %	± 0.27 %	∞
Combined Standard Uncertainty						**± 13 %**	**± 13 %**	330
Expanded Uncertainty (k=2)						**± 26 %**	**± 26 %**	

The above measurement uncertainties are according to IEEE Std 1528

1900 MHz

Error Description	Uncertainty value ±%	Probability Distribution	Divisor	(Ci) 1g	(Ci) 10g	Standard (1g)	Standard (10g)	vi 2 or Veff
Measurement System								
Probe calibration	± 6.0	Normal	1	1	1	± 6.0 %	± 6.0 %	∞
Isotropy	± 1.3	Normal	1	1	1	± 1.3 %	± 1.3 %	∞
Boundary Effects	± 2.0	Rectangular	√3	1	1	± 1.2 %	± 1.2 %	∞
Probe Linearity	± 0.3	Normal	1	1	1	± 0.3 %	± 0.3 %	∞
Probe modulation response	± 0.0	Rectangular	√3	1	1	± 0.0 %	± 0.0 %	∞
Detection limits	± 0.25	Rectangular	√3	1	1	± 0.14 %	± 0.14 %	∞
Readout Electronics	± 0.3	Normal	1	1	1	± 0.3 %	± 0.3 %	∞
Response time	± 0.8	Rectangular	√3	1	1	± 0.46 %	± 0.46 %	∞
Integration time	± 2.6	Rectangular	√3	1	1	± 1.5 %	± 1.5 %	∞
RF Ambient Conditions – Noise	± 3.0	Rectangular	√3	1	1	± 1.7 %	± 1.7 %	∞
RF Ambient Conditions – Reflections	± 3.0	Rectangular	√3	1	1	± 1.7 %	± 1.7 %	∞
Probe Positioner	± 0.8	Rectangular	√3	1	1	± 0.46 %	± 0.46 %	∞
Probe Positioning	± 6.7	Rectangular	√3	1	1	± 3.9 %	± 3.9 %	∞
Algorithms for Max. SAR Eval.	± 4.0	Rectangular	√3	1	1	± 2.3 %	± 2.3 %	∞
Test Sample Related								
Device Positioning	± 2.9	Normal	1	1	1	± 2.9 %	± 2.9 %	145
Device Holder	± 3.6	Normal	1	1	1	± 3.6 %	± 3.6 %	5
Power Drift	± 5.0	Rectangular	√3	1	1	± 2.9 %	± 2.9 %	∞
SAR Scaling	± 0.0	Rectangular	√3	1	1	± 0.0 %	± 0.0 %	∞
Physical Parameters								
Phantom Shell	± 7.6	Rectangular	√3	1	1	± 4.4 %	± 4.4 %	∞
SAR correction	± 0.0	Normal	1	1	0.84	± 0.0 %	± 0.0 %	∞
Liquid conductivity (Target)	± 5.0	Rectangular	√3	0.64	0.43	± 1.8 %	± 1.2 %	∞
Liquid conductivity (Meas.)	± 3.7	Normal	1	0.78	0.71	± 2.9 %	± 2.6 %	10
Liquid permittivity (Target)	± 5.0	Rectangular	√3	0.60	0.49	± 1.7 %	± 1.4 %	∞
Liquid permittivity (Meas.)	± 4.2	Normal	1	0.23	0.26	± 0.97 %	± 1.1 %	10
Temp. unc. - Conductivity	± 1.9	Rectangular	√3	0.78	0.71	± 0.86 %	± 0.78 %	∞
Temp. unc. - Permittivity	± 1.9	Rectangular	√3	0.23	0.26	± 0.25 %	± 0.29 %	∞
Combined Standard Uncertainty						**± 13 %**	**± 13 %**	330
Expanded Uncertainty (k=2)						**± 26 %**	**± 26 %**	

The above measurement uncertainties are according to IEEE Std 1528

2450 MHz

Error Description	Uncertainty value ±%	Probability Distribution	Divisor	(Ci) 1g	(Ci) 10g	Standard (1g)	Standard (10g)	vi 2 or Veff
Measurement System								
Probe calibration	± 6.0	Normal	1	1	1	± 6.0 %	± 6.0 %	∞
Isotropy	± 1.3	Normal	1	1	1	± 1.3 %	± 1.3 %	∞
Boundary Effects	± 2.0	Rectangular	√3	1	1	± 1.2 %	± 1.2 %	∞
Probe Linearity	± 0.3	Normal	1	1	1	± 0.3 %	± 0.3 %	∞
Probe modulation response	± 0.0	Rectangular	√3	1	1	± 0.0 %	± 0.0 %	∞
Detection limits	± 0.25	Rectangular	√3	1	1	± 0.14 %	± 0.14 %	∞
Readout Electronics	± 0.3	Normal	1	1	1	± 0.3 %	± 0.3 %	∞
Response time	± 0.8	Rectangular	√3	1	1	± 0.46 %	± 0.46 %	∞
Integration time	± 2.6	Rectangular	√3	1	1	± 1.5 %	± 1.5 %	∞
RF Ambient Conditions – Noise	± 3.0	Rectangular	√3	1	1	± 1.7 %	± 1.7 %	∞
RF Ambient Conditions – Reflections	± 3.0	Rectangular	√3	1	1	± 1.7 %	± 1.7 %	∞
Probe Positioner	± 0.8	Rectangular	√3	1	1	± 0.46 %	± 0.46 %	∞
Probe Positioning	± 6.7	Rectangular	√3	1	1	± 3.9 %	± 3.9 %	∞
Algorithms for Max. SAR Eval.	± 4.0	Rectangular	√3	1	1	± 2.3 %	± 2.3 %	∞
Test Sample Related								
Device Positioning	± 2.9	Normal	1	1	1	± 2.9 %	± 2.9 %	145
Device Holder	± 3.6	Normal	1	1	1	± 3.6 %	± 3.6 %	5
Power Drift	± 5.0	Rectangular	√3	1	1	± 2.9 %	± 2.9 %	∞
SAR Scaling	± 0.0	Rectangular	√3	1	1	± 0.0 %	± 0.0 %	∞
Physical Parameters								
Phantom Shell	± 7.6	Rectangular	√3	1	1	± 4.4 %	± 4.4 %	∞
SAR correction	± 0.0	Normal	1	1	0.84	± 0.0 %	± 0.0 %	∞
Liquid conductivity (Target)	± 5.0	Rectangular	√3	0.64	0.43	± 1.8 %	± 1.2 %	∞
Liquid conductivity (Meas.)	± 3.8	Normal	1	0.78	0.71	± 3.0 %	± 2.7 %	10
Liquid permittivity (Target)	± 5.0	Rectangular	√3	0.60	0.49	± 1.7 %	± 1.4 %	∞
Liquid permittivity (Meas.)	± 4.0	Normal	1	0.23	0.26	± 0.92 %	± 1.0 %	10
Temp. unc. - Conductivity	± 1.9	Rectangular	√3	0.78	0.71	± 0.86 %	± 0.78 %	∞
Temp. unc. - Permittivity	± 1.7	Rectangular	√3	0.23	0.26	± 0.23 %	± 0.26 %	∞
Combined Standard Uncertainty						**± 13 %**	**± 13 %**	330
Expanded Uncertainty (k=2)						**± 26 %**	**± 26 %**	

The above measurement uncertainties are according to IEEE Std 1528

16. CONCLUSION

Measurement Conclusion

The SAR measurement indicates that the EUT complies with the RF radiation exposure limits of the FCC. These measurements are taken to simulate the RF effects exposure under the worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The tested device complies with the requirements in respect to all parameters subject to the test. The test results and statements relate only to the item(s) tested.

Please note that the absorption and distribution of electromagnetic energy in the body are every complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role impossible biological effect are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease).

Because innumerable factors may interact to determine the specific biological outcome of an exposure to electromagnetic fields, any protection guide shall consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.

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APPENDIX A. – Probe Calibration Data

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

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

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

Accreditation No.: SCS 0108

Client **DT&C (Dymstec)**

Certificate No: ES3-3328_Mar19

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3328
Calibration procedure(s)	QA CAL-01.v9, QA CAL-12.v9, QA CAL-14.v5, QA CAL-23.v5, QA CAL-25.v7 Calibration procedure for dosimetric E-field probes
Calibration date:	March 28, 2019

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-18 (No. 217-02682)	Apr-19
DAE4	SN: 660	19-Dec-18 (No. DAE4-660_Dec18)	Dec-19
Reference Probe ES3DV2	SN: 3013	31-Dec-18 (No. ES3-3013_Dec18)	Dec-19
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-18)	In house check: Jun-20
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

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

Issued: March 28, 2019

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

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The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3328

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m)^2)[A]	1.03	1.05	1.08	± 10.1 %
DCP (mV)[B]	106.5	105.2	105.6	

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB√µV	C	D dB	VR mV	Max dev.	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	191.9	±3.5 %	± 4.7 %
		Y	0.0	0.0	1.0		191.3		
		Y	0.0	0.0	1.0		191.2		

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

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3328

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-22.1
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3328

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
750	41.9	0.89	6.53	6.53	6.53	0.34	1.73	± 12.0 %
835	41.5	0.90	6.26	6.26	6.26	0.62	1.27	± 12.0 %
900	41.5	0.97	6.16	6.16	6.16	0.43	1.56	± 12.0 %
1750	40.1	1.37	5.42	5.42	5.42	0.80	1.12	± 12.0 %
1900	40.0	1.40	5.10	5.10	5.10	0.67	1.28	± 12.0 %
2450	39.2	1.80	4.67	4.67	4.67	0.80	1.30	± 12.0 %
2600	39.0	1.96	4.46	4.46	4.46	0.75	1.35	± 12.0 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

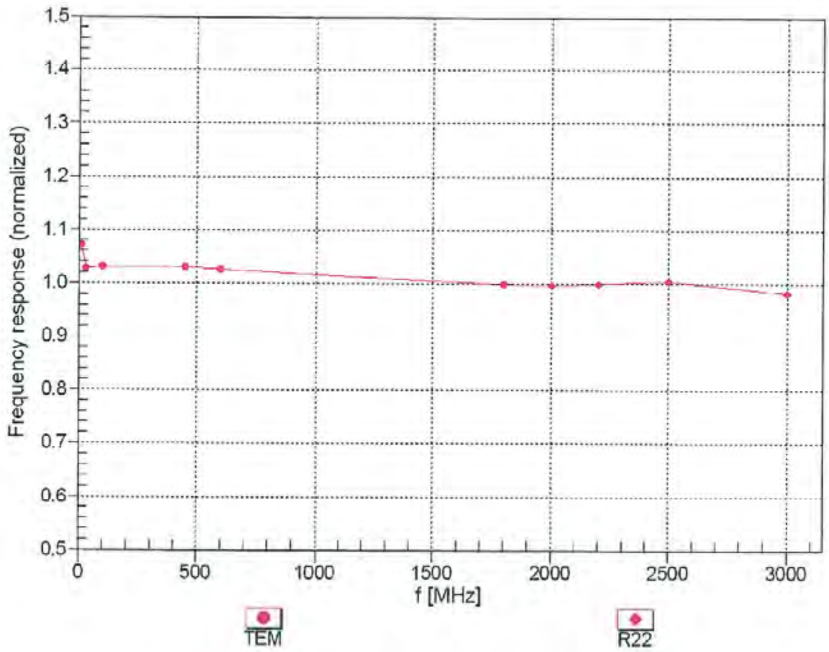
DASY/EASY - Parameters of Probe: ES3DV3 - SN:3328

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
750	55.5	0.96	6.26	6.26	6.26	0.56	1.33	± 12.0 %
835	55.2	0.97	6.14	6.14	6.14	0.80	1.17	± 12.0 %
900	55.0	1.05	6.26	6.26	6.26	0.54	1.43	± 12.0 %
1750	53.4	1.49	5.01	5.01	5.01	0.58	1.40	± 12.0 %
1900	53.3	1.52	4.81	4.81	4.81	0.61	1.44	± 12.0 %
2450	52.7	1.95	4.43	4.43	4.43	0.80	1.20	± 12.0 %
2600	52.5	2.16	4.26	4.26	4.26	0.80	1.20	± 12.0 %

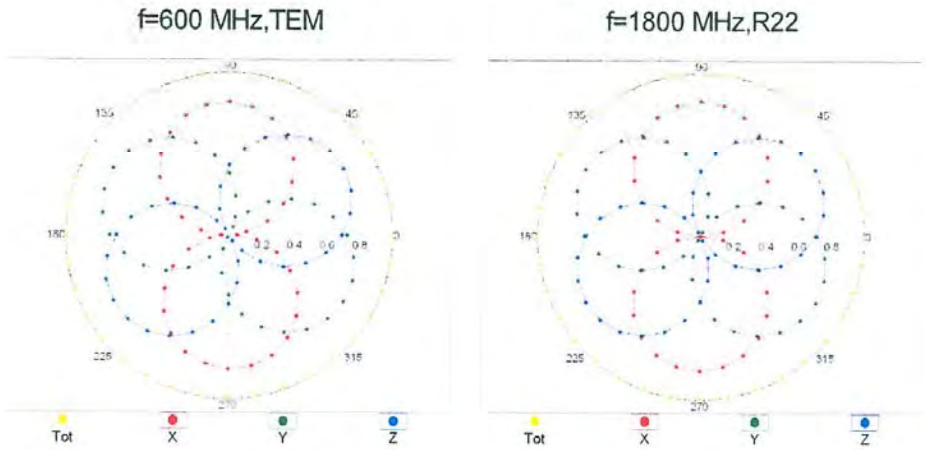
[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

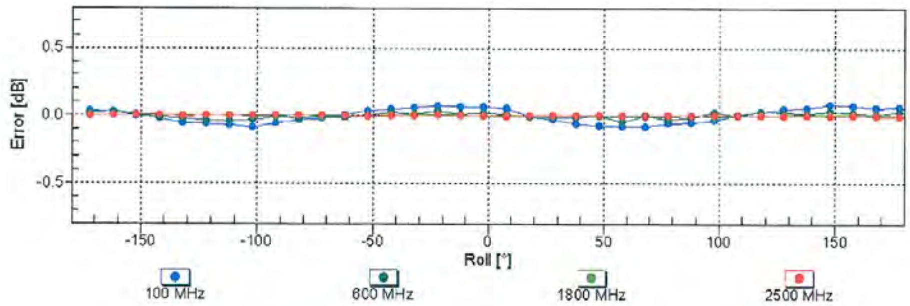
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



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

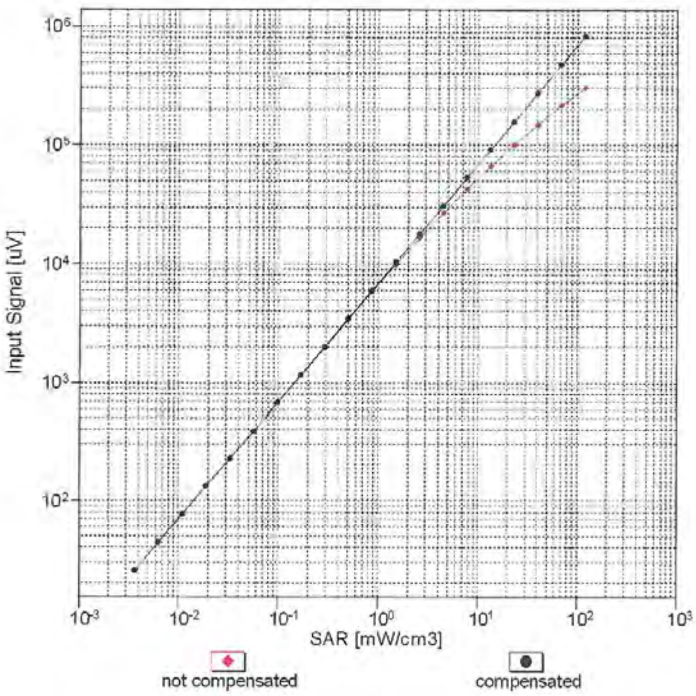
Receiving Pattern (ϕ), ϑ = 0°

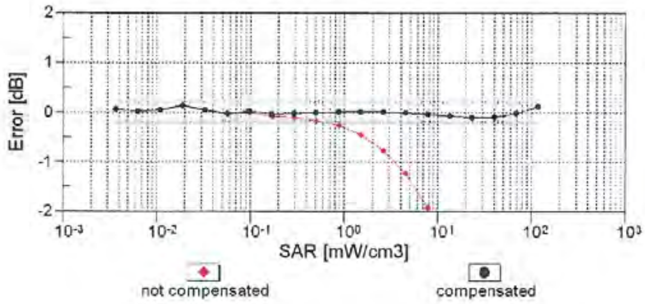




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})
(TEM cell , f_{eval}= 1900 MHz)

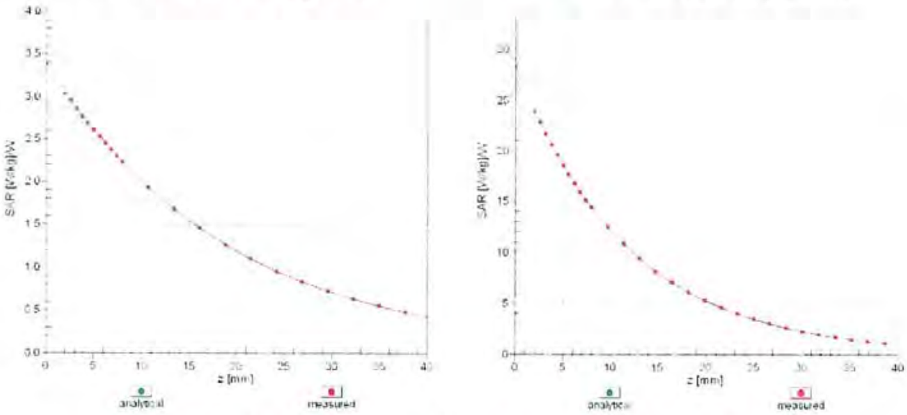




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

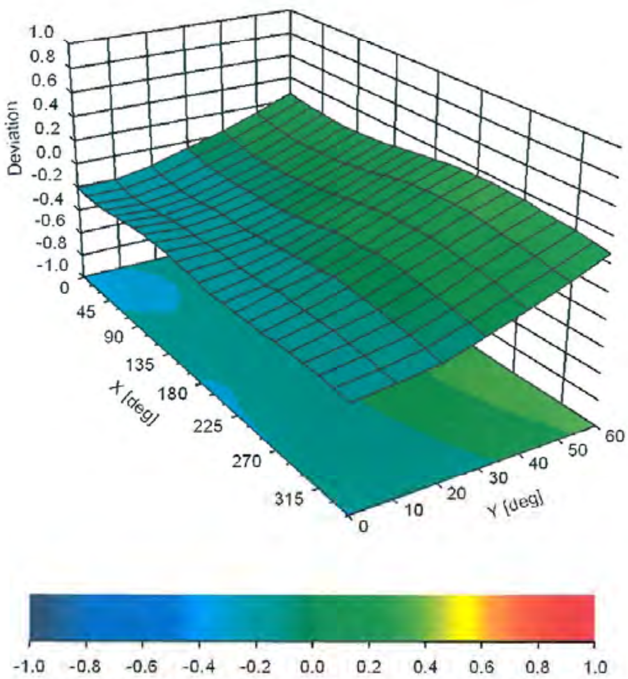
Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF) f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

APPENDIX B. – Dipole Calibration Data

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
Servizio svizzero di taratura
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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 **DT&C (Dymstec)**

Certificate No: **D1800V2-2d047_Apr19**

CALIBRATION CERTIFICATE

Object: D1800V2 - SN:2d047

Calibration procedure(s): QA CAL-05.v11
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz

Calibration date: April 24, 2019

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
Power sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-19 (No. 217-02894)	Apr-20
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-19 (No. 217-02895)	Apr-20
Reference Probe EX3DV4	SN: 7349	31-Dec-18 (No. EX3-7349_Dec18)	Dec-19
DAE4	SN: 601	04-Oct-18 (No. DAE4-601_Oct18)	Oct-19
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Power meter E4419B	SN: GB39512475	07-Oct-15 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: April 25, 2019

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Certificate No: D1800V2-2d047_Apr19 Page 1 of 8

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	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	40.0 ± 6 %	1.37 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**38.1 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.92 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**19.8 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.2 ± 6 %	1.51 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.51 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**38.0 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	4.99 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.0 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.1 Ω - 4.5 jΩ
Return Loss	- 26.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.7 Ω - 5.9 jΩ
Return Loss	- 22.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.213 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

DASY5 Validation Report for Head TSL

Date: 24.04.2019

Test Laboratory: SPEAG, Zurich, Switzerland

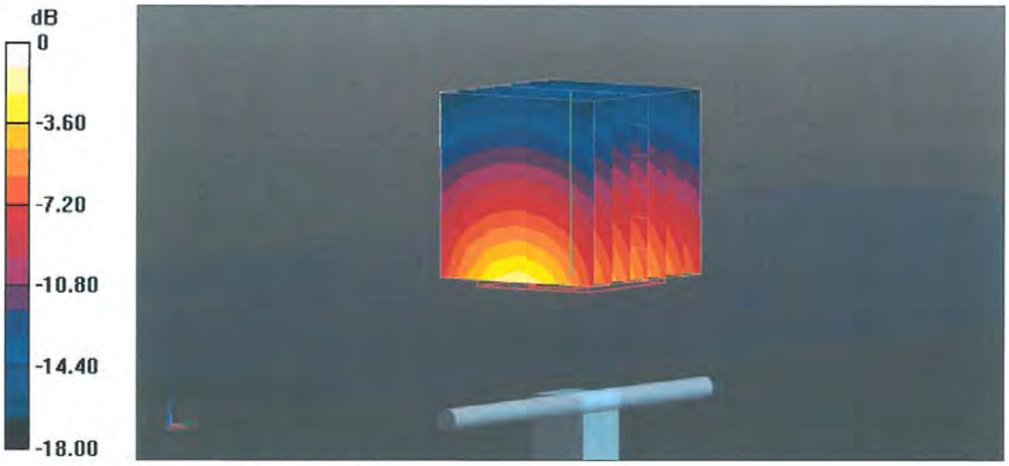
DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN:2d047

Communication System: UID 0 - CW; Frequency: 1800 MHz
Medium parameters used: f = 1800 MHz; σ = 1.37 S/m; ε_r = 40; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

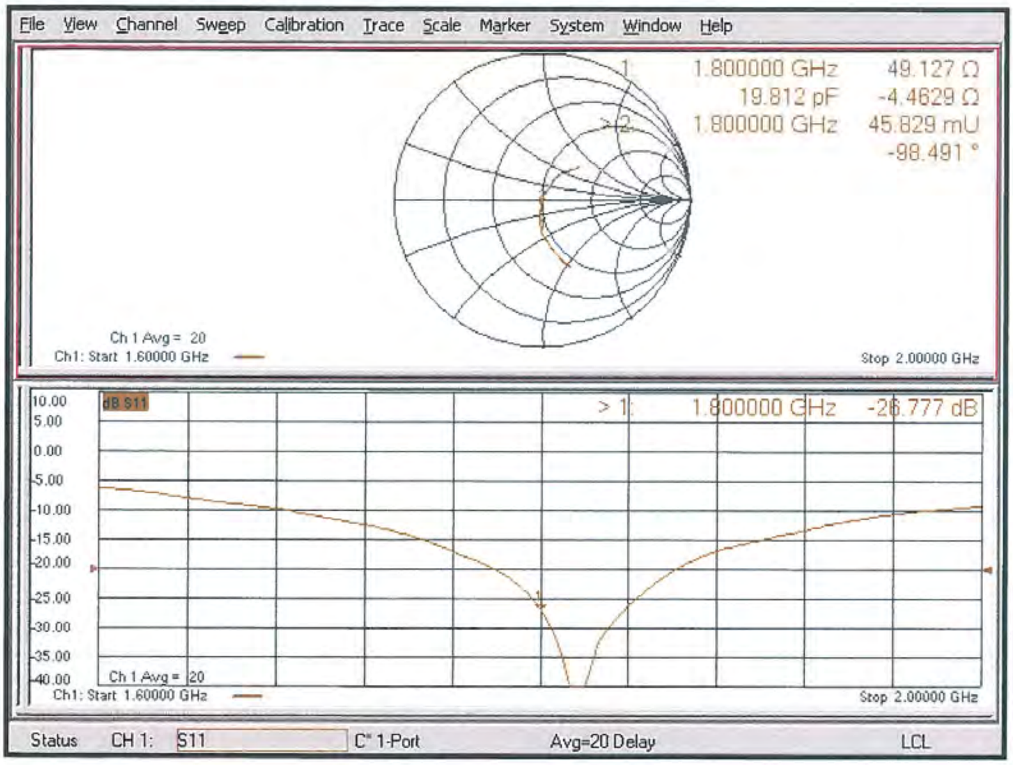
- Probe: EX3DV4 - SN7349; ConvF(8.42, 8.42, 8.42) @ 1800 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 109.1 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 16.8 W/kg
SAR(1 g) = 9.4 W/kg; SAR(10 g) = 4.92 W/kg
Maximum value of SAR (measured) = 14.4 W/kg



0 dB = 14.4 W/kg = 11.58 dBW/kg

Impedance Measurement Plot for Head TSL



Certificate No: D1800V2-2d047_Apr19 Page 6 of 8

DASY5 Validation Report for Body TSL

Date: 24.04.2019

Test Laboratory: SPEAG, Zurich, Switzerland

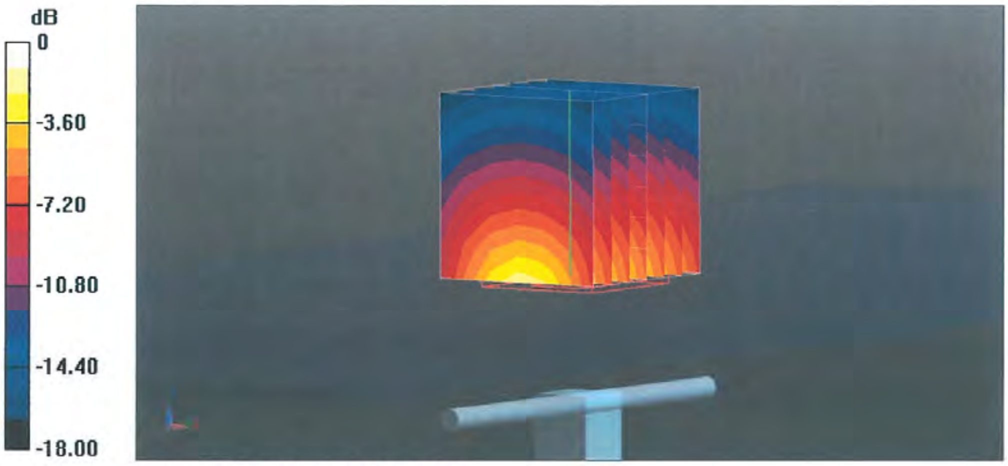
DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN:2d047

Communication System: UID 0 - CW; Frequency: 1800 MHz
Medium parameters used: f = 1800 MHz; σ = 1.51 S/m; ε_r = 52.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

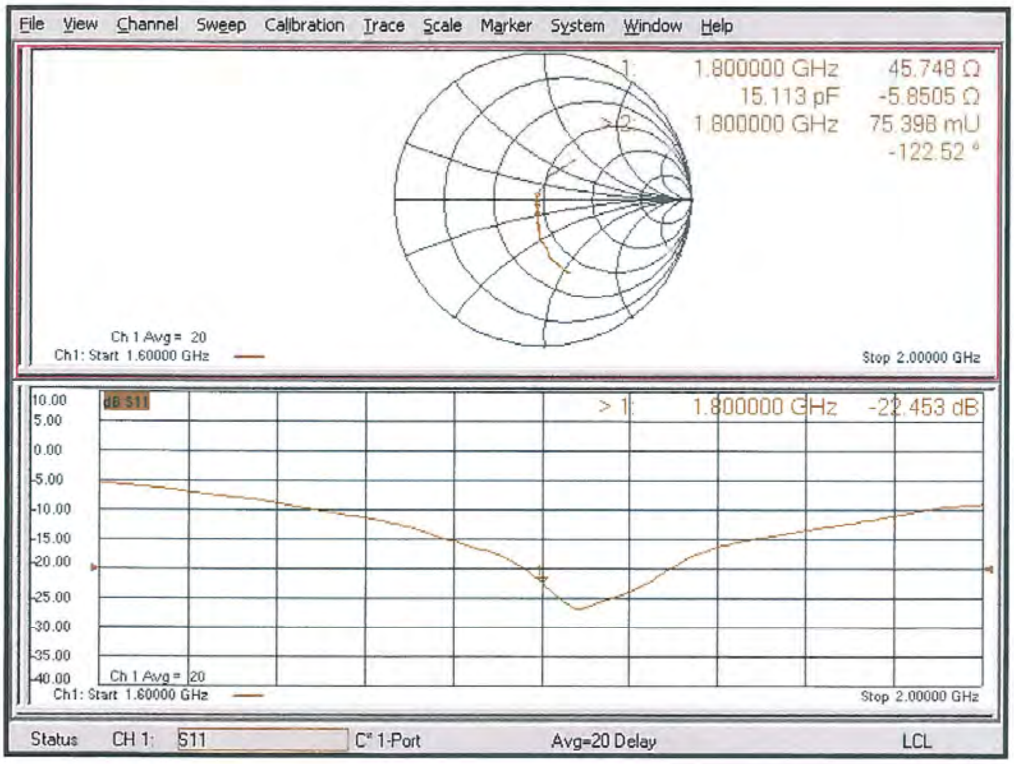
- Probe: EX3DV4 - SN7349; ConvF(8.33, 8.33, 8.33) @ 1800 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 104.9 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 16.6 W/kg
SAR(1 g) = 9.51 W/kg; SAR(10 g) = 4.99 W/kg
Maximum value of SAR (measured) = 14.3 W/kg



0 dB = 14.3 W/kg = 11.55 dBW/kg

Impedance Measurement Plot for Body TSL



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Accreditation No.: **SCS 0108**

Client **DT&C (Dymstec)**

Certificate No: **D1900V2-5d029_Jul19**

CALIBRATION CERTIFICATE

Object	D1900V2 - SN:5d029
Calibration procedure(s)	QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz
Calibration date:	July 17, 2019

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
Power sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-19 (No. 217-02894)	Apr-20
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-19 (No. 217-02895)	Apr-20
Reference Probe EX3DV4	SN: 7349	29-May-19 (No. EX3-7349_May19)	May-20
DAE4	SN: 601	30-Apr-19 (No. DAE4-601_Apr19)	Apr-20
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	M.Weber
Approved by:	Katja Pokovic	Technical Manager	

Issued: July 19, 2019

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.5 ± 6 %	1.37 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.88 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**40.4 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.21 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.1 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.1 ± 6 %	1.48 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.78 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**39.9 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.19 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.0 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.0 Ω + 3.4 jΩ
Return Loss	- 29.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.8 Ω + 4.9 jΩ
Return Loss	- 24.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.199 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

DASY5 Validation Report for Head TSL

Date: 17.07.2019

Test Laboratory: SPEAG, Zurich, Switzerland

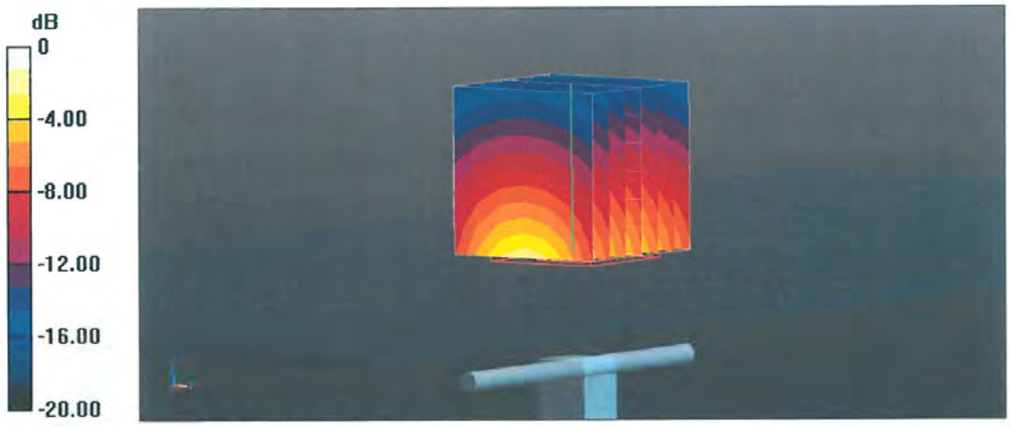
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d029

Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.37 S/m; ε_r = 41.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

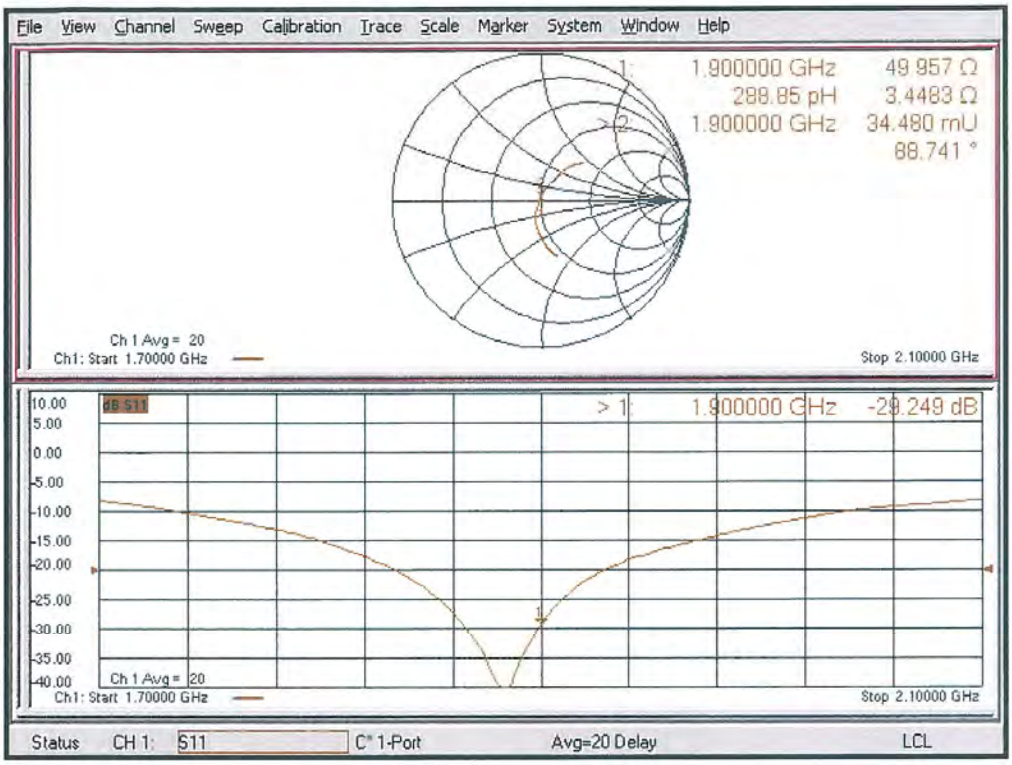
- Probe: EX3DV4 - SN7349; ConvF(8.44, 8.44, 8.44) @ 1900 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 109.6 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 18.1 W/kg
SAR(1 g) = 9.88 W/kg; SAR(10 g) = 5.21 W/kg
Maximum value of SAR (measured) = 15.3 W/kg



0 dB = 15.3 W/kg = 11.85 dBW/kg

Impedance Measurement Plot for Head TSL



Certificate No: D1900V2-5d029_Jul19 Page 6 of 8

DASY5 Validation Report for Body TSL

Date: 17.07.2019

Test Laboratory: SPEAG, Zurich, Switzerland

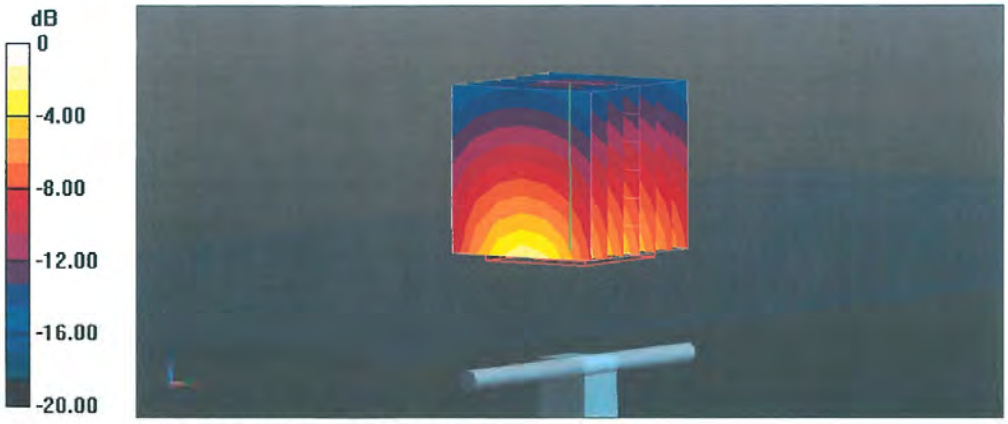
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d029

Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; $\sigma = 1.48$ S/m; $\varepsilon_r = 54.1$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.42, 8.42, 8.42) @ 1900 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

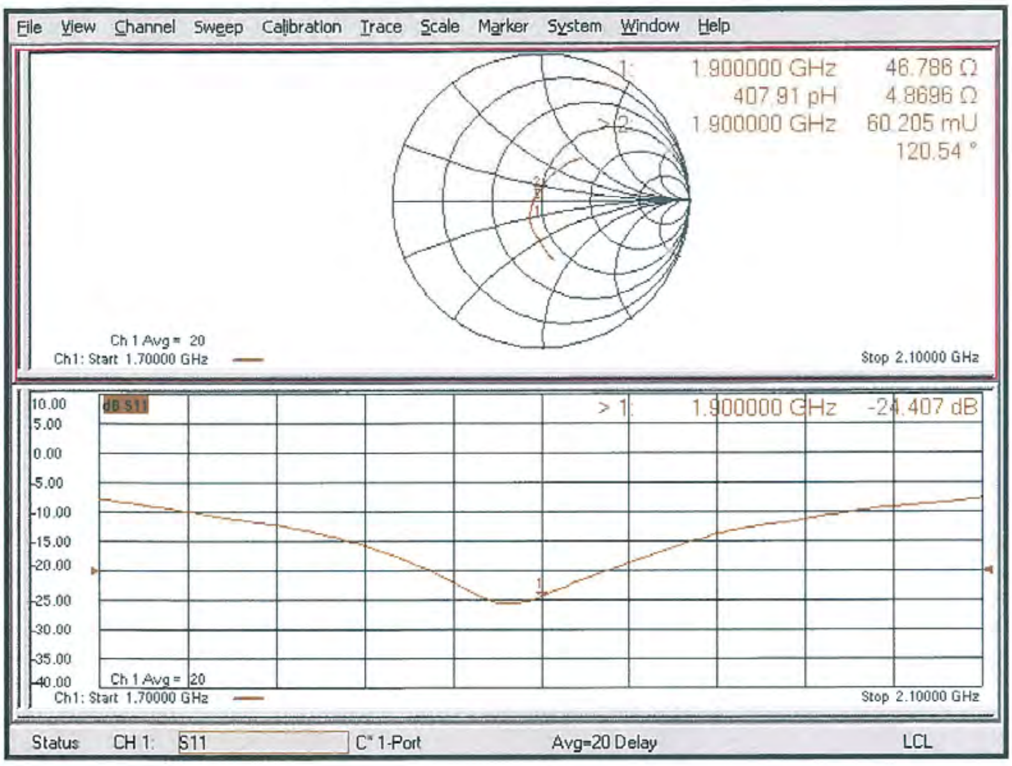
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 104.7 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 17.4 W/kg
SAR(1 g) = 9.78 W/kg; SAR(10 g) = 5.19 W/kg
Maximum value of SAR (measured) = 14.9 W/kg



0 dB = 14.9 W/kg = 11.73 dBW/kg

Certificate No: D1900V2-5d029_Jul19 Page 7 of 8

Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 0108

Client **DT&C (Dymstec)**

Certificate No: **D2450V2-920_Aug18**

CALIBRATION CERTIFICATE

Object	D2450V2 - SN:920
Calibration procedure(s)	QA CAL-05.v10 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	August 24, 2018

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

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

Calibration Equipment used (M&TE critical for calibration)

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

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-17)	In house check: Oct-18

	Name	Function	Signature
Calibrated by:	Manu Seitz	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: August 24, 2018

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.7 ± 6 %	1.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.3 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**51.9 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.18 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.4 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.8 ± 6 %	2.02 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.3 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**52.1 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.22 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**24.6 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	57.3 Ω + 1.9 jΩ
Return Loss	- 23.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	52.1 Ω + 6.2 jΩ
Return Loss	- 23.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.153 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	December 19, 2012

DASY5 Validation Report for Head TSL

Date: 23.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:920

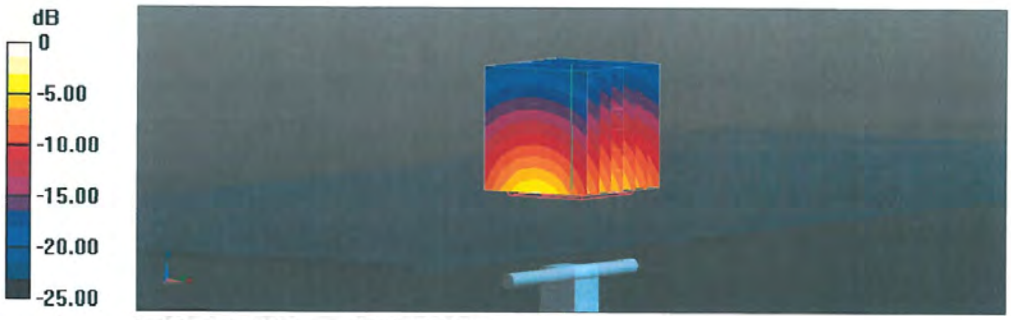
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.86 S/m; ε_r = 37.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.88, 7.88, 7.88) @ 2450 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

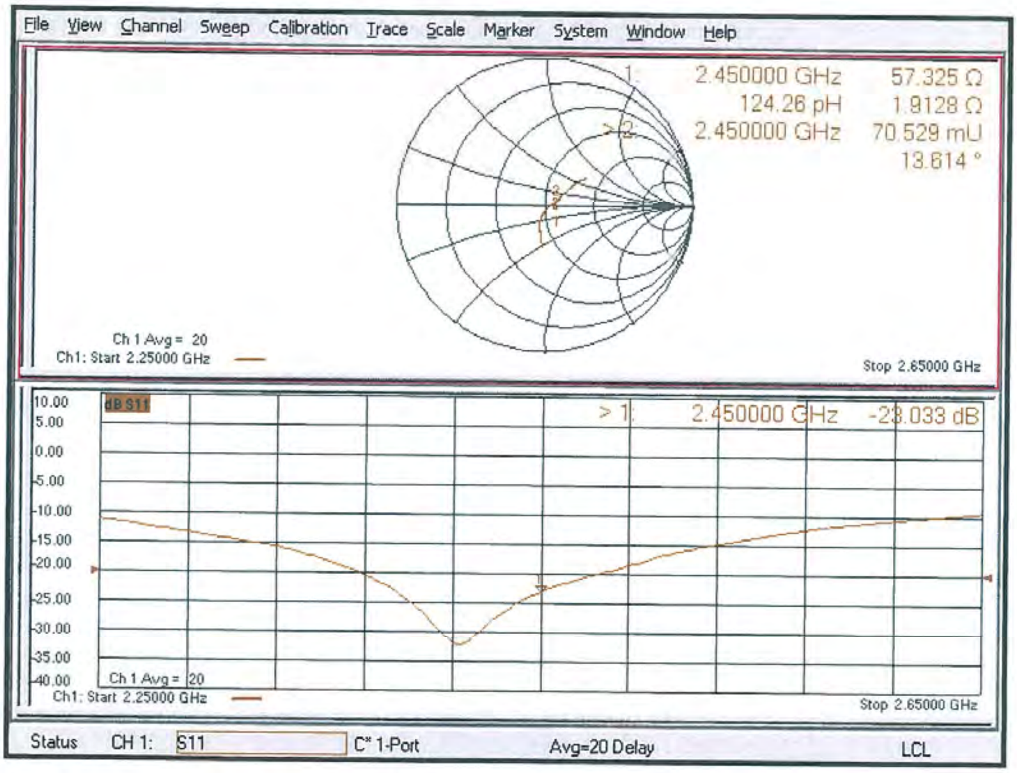
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 115.8 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 26.4 W/kg
SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.18 W/kg
Maximum value of SAR (measured) = 21.8 W/kg



0 dB = 21.8 W/kg = 13.38 dBW/kg

Impedance Measurement Plot for Head TSL



Certificate No: D2450V2-920_Aug18 Page 6 of 8

DASY5 Validation Report for Body TSL

Date: 24.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

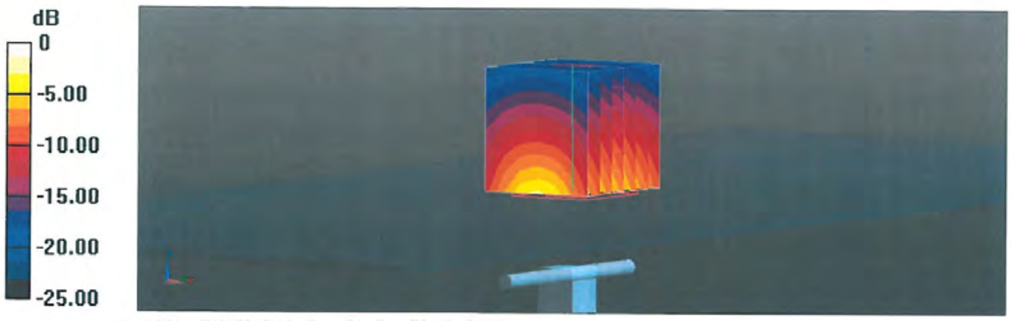
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:920

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.02 S/m; ε_r = 51.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

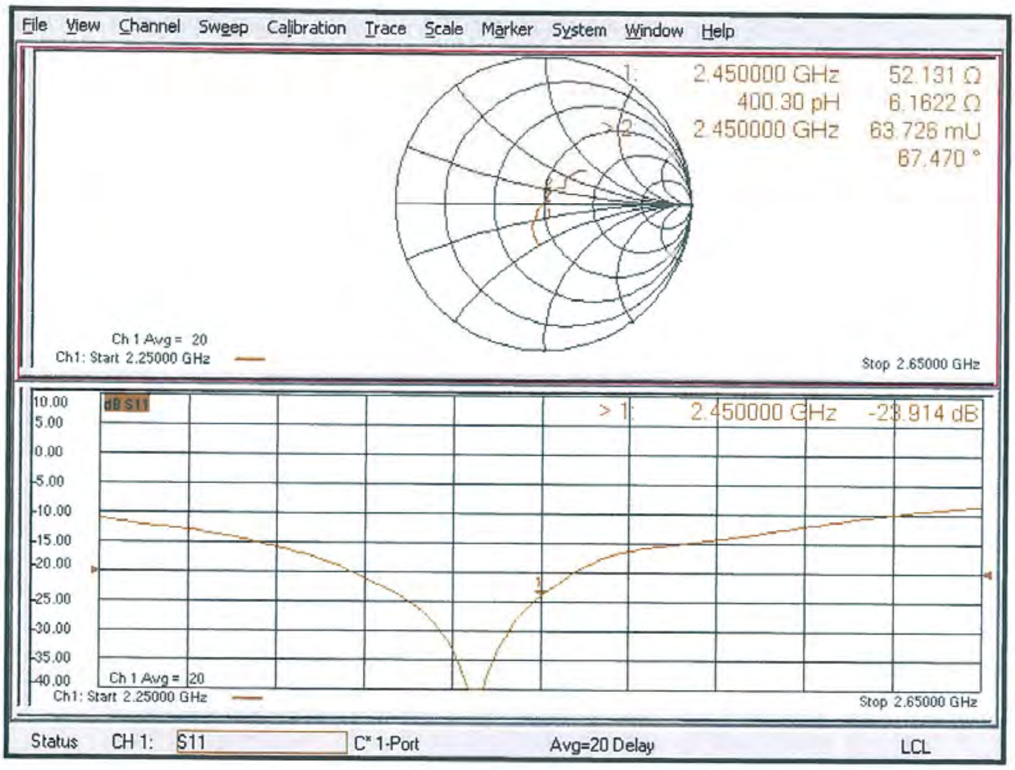
- Probe: EX3DV4 - SN7349; ConvF(8.01, 8.01, 8.01) @ 2450 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 109.0 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 26.2 W/kg
SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.22 W/kg
Maximum value of SAR (measured) = 21.6 W/kg



0 dB = 21.6 W/kg = 13.34 dBW/kg

Impedance Measurement Plot for Body TSL



APPENDIX C. – SAR Tissue Specifications

The brain and muscle mixtures consist of a viscous gel using hydrox-ethylcellulose (HEC) gelling agent and saline solution (see Table C.1). Preservation with a bactericide is added and visual inspection is made to make sure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. The mixture characterizations used for the brain and muscle tissue simulating liquids are according to the data by C. Gabriel and G. Harts grove.

Figure C.1 Simulated Tissue

Table C.1 Composition of the Tissue Equivalent Matter

Ingredients (% by weight)	Frequency (MHz)							
	835		1900		2450		5200 ~ 5800	
Tissue Type	**Head**	**Body**	**Head**	**Body**	**Head**	**Body**	**Head**	**Body**
Water	40.19	50.75	55.24	70.23	71.88	73.40	65.52	80.00
Salt (NaCl)	1.480	0.940	0.310	0.290	0.160	0.060	-	-
Sugar	57.90	48.21	-	-	-	-	-	-
HEC	0.250	-	-	-	-	-	-	-
Bactericide	0.180	0.100	-	-	-	-	-	-
Triton X-100	-	-	-	-	19.97	-	17.24	-
DGBE	-	-	44.45	29.48	7.990	26.54	-	-
Diethylene glycol hexyl ether	-	-	-	-	-	-	17.24	-
Polysorbate (Tween) 80	-	-	-	-	-	-		20.00
Target for Dielectric Constant	41.5	55.2	40.0	53.3	39.2	52.7	-	-
Target for Conductivity (S/m)	0.90	0.97	1.40	1.52	1.80	1.95	-	-

Salt:	99 % Pure Sodium Chloride	Sugar:	98 % Pure Sucrose
Water:	De-ionized, 16M resistivity	HEC:	Hydroxyethyl Cellulose
DGBE:	99 % Di(ethylene glycol) butyl ether,[2-(2-butoxyethoxy) ethanol]		
Triton X-100(ultra pure):	Polyethylene glycol mono[4-(1,1,3,3-tetramethylbutyl)phenyl] ether		

APPENDIX D. – SAR SYSTEM VALIDATION

SAR System Validation

Per FCC KDB 865664 D02v01r02, SAR system validation status should be documented to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the required tissue- equivalent media for system validation, according to the procedures outlined in FCC KDB 865664 D01v01r04 and IEEE 1528-2013.Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters has been included.

Table D.1 SAR System Validation Summary

SAR System	Freq. [MHz]	Date	Probe SN	Probe Type	Probe CAL. Point		PERM.	COND.	CW Validation			MOD. Validation		
							(εr)	(σ)	Sensi-tivity	Probe Linearity	Probe Isortopy	MOD. Type	Duty Factor	PAR
F	1800	2018.04.17	3328	ES3DV3	1800	Head	39.464	1.369	PASS	PASS	PASS	GMSK	PASS	N/A
F	1900	2018.04.18	3328	ES3DV3	1900	Head	39.428	1.414	PASS	PASS	PASS	GMSK	PASS	N/A
F	2450	2018.04.19	3328	ES3DV3	2450	Head	38.885	1.779	PASS	PASS	PASS	OFDM/TDD	PASS	PASS

NOTE: While the probes have been calibrated for both a CW and modulated signals, all measurements were performed using communication systems calibrated for CW signals only. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01v01r04 for scenarios when CW probe calibrations are used with other signal types. SAR systems were validated for modulated signals with a periodic duty cycle, such as GMSK, or with a high peak to average ratio (>5 dB), such as OFDM according to KDB 865664.

APPENDIX E. – Description of Test Equipment

E.1 SAR Measurement Setup

Measurements are performed using the DASY5 automated dosimetric assessment system. The DASY5 is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of high precision robotics system (Staubli), robot controller, desktop computer, near-field probe, probe alignment sensor, and the generic twin phantom containing the brain equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Fig. E.1.1).

A cell controller system contains the power supply, robot controller each pendant (Joystick), and a remote control used to drive the robot motors. The PC consists of the Intel Core i7-4770 3.40 GHz desktop computer with Windows 7 system and SAR Measurement Software DASY5,A/D interface card, monitor, mouse, and keyboard. The Staubli Robotis connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit that 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.

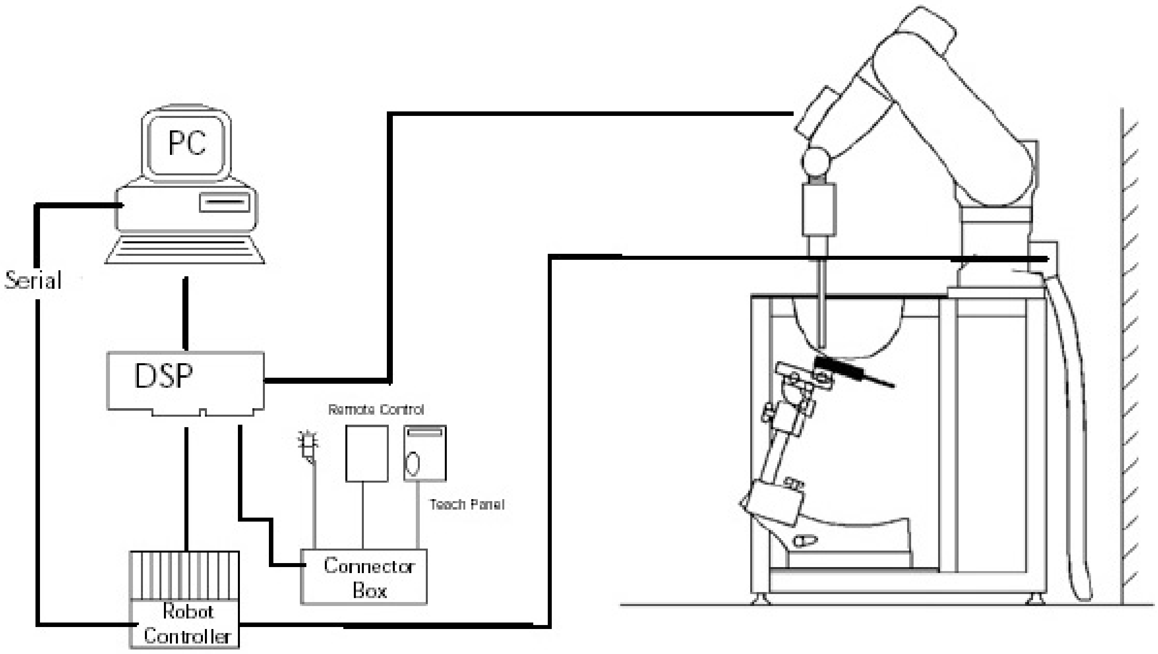


Figure E.1.1 SAR Measurement System Setup

The DAE4 consists 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 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. The system is described in detail.

E.2 Probe Specification

Calibration	In air from 10 MHz to 4 GHz In brain and muscle simulating tissue at Frequencies of 750 MHz, 835 MHz, 900 MHz, 1750 MHz, 1900 MHz, 2450 MHz, 2600 MHz	
Frequency	10 MHz to 4 GHz	
Linearity	± 0.2 dB(30 MHz to 4 GHz)	
Dynamic	10 μW/g to > 100 mW/g	
Range	Linearity :	±0.2dB
Dimensions	Overall length :	337 mm
Tip length	20 mm	
Body diameter	12 mm	
Tip diameter	3.9 mm	
Distance from probe tip to sensor center	2.0 mm/1.0 mm	
Application	SAR Dosimetry Testing Compliance tests of mobile phones	

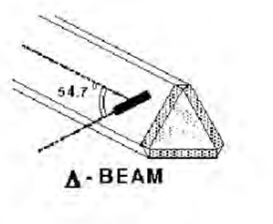


Figure E.2.1 Triangular Probe Configurations

Figure E.2.2 Probe Thick-Film Technique

DAE System

The SAR measurements were conducted with the dosimetric probe ES3DV3 designed in the classical triangular configuration(see E.2.1) 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 multitier 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 during a software approach and looks for the maximum using a 2nd order fitting. The approach is stopped at reaching the maximum.

E.3 E-Probe Calibration Process

Dosimetric Assessment Procedure

Each probe is calibrated according to a dosimetric assessment procedure with accuracy better than +/- 10%. The spherical isotropy was evaluated with the procedure and found to be better than +/-0.25dB. The sensitivity parameters (Norm X, Norm Y, Norm Z), the diode compression parameter (DCP) and the conversion factor (Conv F) of the probe is tested.

Free Space Assessment

The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies below 1 GHz, and in a waveguide above 1GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity at the proper orientation with the field. The probe is then rotated 360 degrees.

Temperature Assessment *

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

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

where:

Δt = exposure time (30 seconds),

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

ΔT = temperature increase due to RF exposure.

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

where:

σ = simulated tissue conductivity,

ρ = Tissue density (1.25 g/cm^3 for brain tissue)

SAR is proportional to ΔT / Δt , the initial rate of tissue heating, before thermal diffusion takes place. Now it's possible to quantify the electric field in the simulated tissue by equating the thermally derived SAR to the E- field;

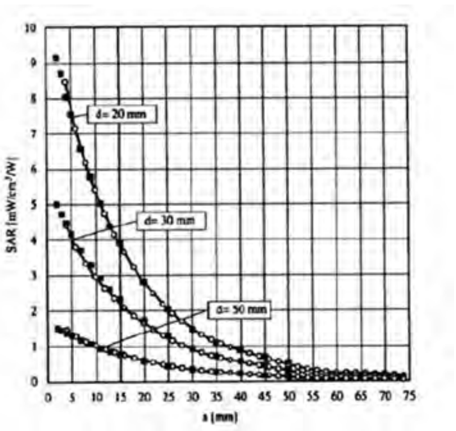


Figure E.3.1 E-Field and Temperature Measurements at 900MHz

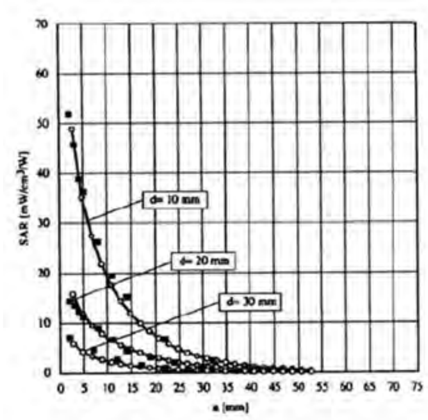


Figure E.3.2 E-Field and Temperature Measurements at 1800MHz

E.4 Data Extrapolation

The DASY5 software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given like below;

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

with V_i = compensated signal of channel i (i=x,y,z)
U_i = input signal of channel i (i=x,y,z)
cf = crest factor of exciting field (DASY parameter)
dcp_i = diode compression point (DASY parameter)

From the compensated input signals the primary field data for each channel can be evaluated:

E-field probes:

$$E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

with V_i = compensated signal of channel i (i = x,y,z)
$Norm_i$ = sensor sensitivity of channel i (i = x,y,z) $\mu V/(V/m)^2$ for E-field probes
ConvF = sensitivity of enhancement in solution
E_i = electric field strength of channel i in V/m

The RSS value of the field components gives the total field strength (Hermetian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

with SAR = local specific absorption rate in W/g
E_{tot} = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm^3

The power flow density is calculated assuming the excitation field to be a free space field.

$$P_{pwe} = \frac{E_{tot}^2}{3770}$$

with P_{pwe} = equivalent power density of a plane wave in W/cm^2
E_{tot} = total electric field strength in V/m

E.5 SAM Twin Phantom

The SAM Twin Phantom V5.0 is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid.

Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. (see Fig. E.5.1)

Figure E.5.1 SAM Twin Phantom

SAM Twin Phantom Specification:

Construction	The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209-1. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot. Twin SAM V5.0 has the same shell geometry and is manufactured from the same material as Twin SAM V4.0, but has reinforced top structure.
Shell Thickness	2 ± 0.2 mm
Filling Volume	Approx. 25 liters
Dimensions	Length: 1000 mm Width: 500 mm Height: adjustable feet

Specific Anthropomorphic Mannequin (SAM) Specifications:

The phantom for handset SAR assessment testing is a low-loss dielectric shell, with shape and dimensions derived from the anthropometric data of the 90th percentile adult male head dimensions as tabulated by the US Army. The SAM Twin Phantom shell is bisected along the mid-sagittal plane into right and left halves (see Fig. E.5.2). The perimeter sidewalls of each phantom halves are extended to allow filling with liquid to a depth that is sufficient to minimized reflections from the upper surface. The liquid depth is maintained at a minimum depth of 15cm to minimize reflections from the upper surface.

Figure E.5.2 Sam Twin Phantom shell

E.6 Device Holder for Transmitters

Figure E.6.1 Mounting Device

In combination with the Twin SAM Phantom V4.0/V4.0c, V5.0 or ELI4, the Mounting Device enables the rotation of the mounted transmitter device in spherical coordinates. Rotation point is the ear opening point. Transmitter devices can be easily and accurately positioned according to IEC, IEEE, FCC or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat).
Note: A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produce infinite number of configurations. To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.

E.7 Automated Test System Specifications

Positioner

Robot	Stäubli Unimation Corp. Robot Model: TX60L
Repeatability	0.02 mm
No. of axis	6

Data Acquisition Electronic (DAE) System

Cell Controller

Processor	Intel Core i7-4770
Clock Speed	3.40 GHz
Operating System	Windows 7 Professional
Data Card	DASY5 PC-Board

Data Converter

Features	Signal, multiplexer, A/D converter. & control logic
Software	DASY5
Connecting Lines	Optical downlink for data and status info Optical uplink for commands and clock

PC Interface Card

Function	24 bit (64 MHz) DSP for real time processing Link to DAE 4 16 bit A/D converter for surface detection system serial link to robot direct emergency stop output for robot

E-Field Probes

Model	ES3DV3 S/N: 3328
Construction	Triangular core fiber optic detection system
Frequency	10 MHz to 4 GHz
Linearity	± 0.2 dB (30 MHz to 4 GHz)

Phantom

Phantom	SAM Twin Phantom (V5.0)
Shell Material	Composite
Thickness	2.0 ± 0.2 mm

Figure E.7.1 DASY5 Test System