Bundesnetzagentur

BNetzA-CAB-02/21-102

TEST REPORT

Test Report No.: 1-4085/22-01-03-A

Testing Laboratory

CTC advanced GmbH
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Accredited Test Laboratory:
The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2018-03) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate starting with the registration number: D-PL-12076-01.

Applicant

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Test Standards

IEC/IEEE 62209-1528-2020	Measurement procedure for the assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Part 1528: Human models, instrumentation, and procedures (Frequency range of 4 MHz to 10 GHz)
RSS-102 Issue 5	Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

For further applied test standards please refer to section 3 of this test report.

Test Item

Kind of test item:	Payment terminal
Device type:	portable device
Model name:	**Move/5000 CL/4G/WiFi**
S/N serial number:	182787303201096503249553
FCC-ID:	XKB-M5000CL4GWI
ISED Number:	2586D-M5000CL4GWI
Product Marketing Name (PMN):	Move/5000 and Move/3500
Hardware Version Identification No. (HVIN):	Move/5000 CL/4G/WI and Move/3500 CL/4G/WI
IMEI-Number:	353086090013840
Hardware status:	01
Software status:	HTB009400
Firmware status:	ELS81-US
Module information:	Gemalto ELS81-US
Frequency:	see technical details
Antenna:	integrated antenna
Battery option:	Rechargeable Li-ion battery 3.6V/3180mAh
Test sample status:	identical prototype
Exposure category:	general population / uncontrolled environment

This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

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1 Table of contents

2 General information

2.1 Notes and disclaimer

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2.2 Application details

Date of receipt of order:	2022-03-30
Date of receipt of test item:	2022-06-27
Start of test:	2022-07-12
End of test:	2022-11-08

2.3 Statement of compliance

The SAR values found for the Move/5000 CL/4G/WiFi Payment terminal are below the maximum recommended levels of 4 W/Kg as averaged over any 10 g tissue according to the FCC rule §2.1093, the ANSI/IEEE C 95.1:1992, the NCRP Report Number 86 for uncontrolled environment, according to the Health Canada's Safety Code 6 and the Industry Canada Radio Standards Specification RSS-102 for General Population/Uncontrolled exposure.

Accreditation	Description	
D-PL-12076-01-01	SAR / EMF – EN and FCC https://www.dakks.de/files/data/as/pdf/D-PL-12076-01-01.pdf	ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-12076-01-01
D-PL-12076-01-04	Telecommunication and EMC Canada https://www.dakks.de/files/data/as/pdf/D-PL-12076-01-04e.pdfhttps://www.dakks.de/as/ast/d/D-PL-12076-01-04e.pdf	ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-12076-01-04

2.4 Technical details

Band tested for this test report	Technology	Lowest transmit frequency/MHz	Highest transmit frequency/MHz	Lowest receive Frequency/MHz	Highest receive Frequency/MHz	Kind of modulation	Power Class	Tested power control level	Test channel low	Test channel middle	Test channel high	Maximum output power/dBm
☒	UMTS FDD II	1852.4	1907.6	1932.4	1987.6	QPSK	3	max	9262	9400	9538	23.0
☒	UMTS FDD IV	1712.4	1752.6	2112.4	2152.6	QPSK	3	max	1312	1412	1513	22.8
☒	UMTS FDD V	826.4	846.6	871.4	891.6	QPSK	3	max	4132	4182	4233	23.4
☒	LTE FDD 2	1850	1910	1930	1990	QPSK	3	max	18700	18900	19100	22.3
☒	LTE FDD 4	1710	1755	2110	2155	QPSK	3	max	20050	20175	20300	22.9
☒	LTE FDD 5	824	849	869	894	QPSK	3	max	20450	20525	20600	23.3
☒	LTE FDD 12	704	711	734	741	QPSK	3	max	23060	23095	23130	23.5
☒	WLAN	2412	2462	2412	2462	CCK OFDM	--	max	1	6	11	10.2
☒	WLAN	5180	5240	5180	5240	OFDM	--	max	--	--	48	10.1
☒	WLAN	5260	5320	5260	5320	OFDM	--	max	52	--	--	9.4
☐	WLAN	5500	5700	5500	5700	OFDM	--	max	--	--	--	--
☒	WLAN	5745	5825	5745	5825	OFDM	--	max	149	--	--	3.1

LTE: Cat 4 / max. Data Rate DL / UL: 150 / 50 Mbps

2.5 Transmitter and Antenna Operating Configurations

Simultaneous transmission conditions		
UMTS / HSPA	+	WLAN 2.4GHz
UMTS / HSPA	+	WLAN 5GHz
LTE	+	WLAN 2.4GHz
LTE	+	WLAN 5GHz

Table 1: Simultaneous transmission conditions

3 Test standards/ procedures references

Test Standard	Version	Test Standard Description
RSS-102 Issue 5	2015-03	Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
RSS-102 Supplementary Procedures SPR-001	2011-01	SAR testing requirements with regard to bystanders for Lap Top Type Computers with antennas built-in on display screen (Laptop Mode / Tablet Mode)
RSS-102 Supplementary Procedures SPR-002	2022-10	SPR-002 — Supplementary Procedure for Assessing Compliance of Equipment Operating from 3 kHz to 10 MHz with RSS-102
Canada's Safety Code No. 6	2015-06	Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz
IEEE Std. C95-3	2002	IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave
IEEE Std. C95-1	2005	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.
IEC 62209-2	2010	Human exposure to radio frequency fields from hand-held and body mounted wireless communication devices. Human models, instrumentation, and procedures. 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)
IEC 62209-2: 2010/ AMD1:2019	2019	Amendment 1 - Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices Human models, instrumentation, and procedures - Part 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)
IEC/IEEE 62209-1528-2020	2020-10-19	Measurement procedure for the assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Part 1528: Human models, instrumentation, and procedures (Frequency range of 4 MHz to 10 GHz)
IEC 62209-2:2010/AMD1:2019	2019-05-17	Amendment 1 - Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 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)

FCC KDBs:

KDB 865664D01v01	August 7, 2015	FCC OET SAR measurement requirements 100 MHz to 6 GHz
KDB 865664D02v01	October 23, 2015	RF Exposure Compliance Reporting and Documentation Considerations
KDB 447498D01v06	October 23, 2015	Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies
KDB 648474D04v01	October 23, 2015	SAR Evaluation Considerations for Wireless Handsets
KDB 941225D01v03	October 23, 2015	SAR Measurements Procedures for 3G Devices
KDB 941225D05v02	October 23, 2015	SAR for LTE Devices
KDB 941225D05Av01	October 23, 2015	LTE Rel. 10 KDB Inquiry Sheet
KDB 248227D01v02	October 23, 2015	SAR Measurement Procedures for 802.11 a/b/g Transmitters

3.1 RF exposure limits

Human Exposure	Uncontrolled Environment General Population	Controlled Environment Occupational
Spatial Peak SAR* (Brain and Trunk)	1.60 mW/g	8.00 mW/g
Spatial Average SAR** (Whole Body)	0.08 mW/g	0.40 mW/g
Spatial Peak SAR*** (Hands/Feet/Ankle/Wrist)	**4.00 mW/g**	20.00 mW/g

Table 2: RF exposure limits

The limit applied in this test report is shown in bold letters

Notes:

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

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

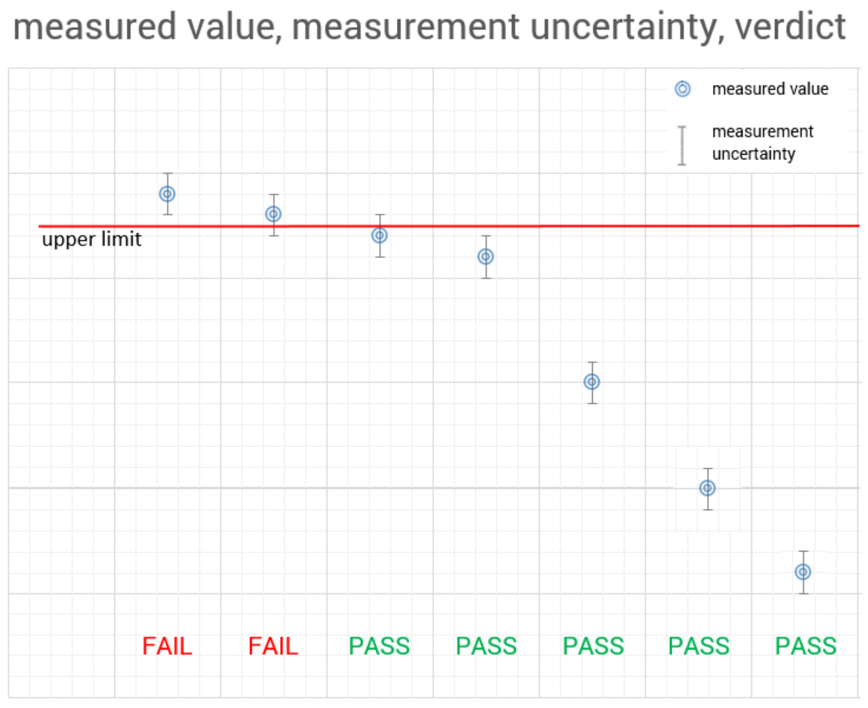
*** The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

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).

4 Reporting statements of conformity – decision rule

Only the measured values related to their corresponding limits will be used to decide whether the equipment under test meets the requirements of the test standards listed in chapter 3.
The measurement uncertainty is mentioned in this test report, see chapter 9, but is not taken into account - neither to the limits nor to the measurement results. Measurement results with a smaller margin to the corresponding limits than the measurement uncertainty have a potential risk of more than 20% that the decision might be wrong."



5 Summary of Measurement Results

☒	**No deviations from the technical specifications ascertained**		
☐	Deviations from the technical specifications ascertained		
Maximum SAR value (W/kg)			
		reported	**limit**
extremity 0 mm distance for 10g		**0.853**	**4.0**
collocated situations ΣSAR_{10g} evaluation		**0.900**	**4.0**

6 Test Environment

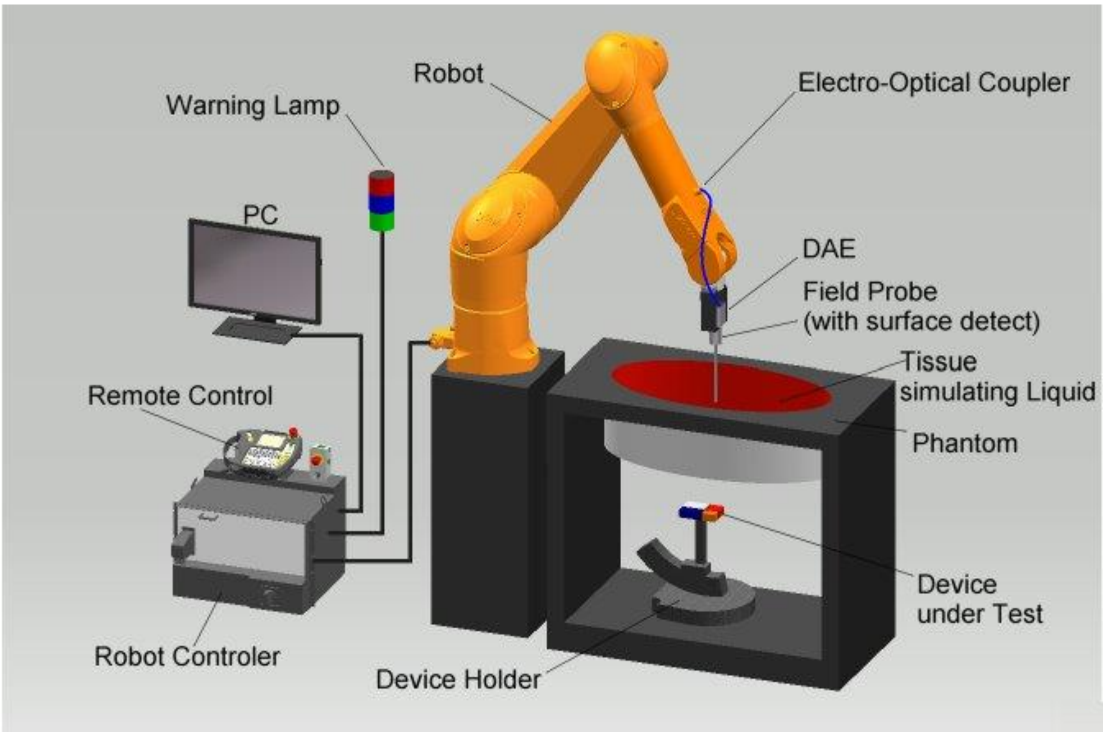
Ambient temperature:	20 – 24 °C
Tissue Simulating liquid:	20 – 24 °C
Relative humidity content:	40 – 50 %
Air pressure:	not relevant for this kind of testing
Power supply:	230 V / 50 Hz

NOTE: For the SAR measurements the exact temperature values for each test are shown in the SAR result tables and are also at the bottom of each measurement plot.

7 Test Set-up

7.1 Measurement system

7.1.1 System Description



- The DASY system for performing compliance tests consists of the following items:
- A standard high precision 6-axis robot (Stäubli RX/TX family) with controller and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e. an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid.
- A data acquisition electronic (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-Optical Coupler (EOC) performs the conversion from the optical into a digital electric signal of the DAE. The EOC is connected to the DASY measurement server.
- The DASY measurement server, which performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation. A computer operating Windows.
- DASY software and SEMCAD data evaluation software.
- Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.
- The generic twin phantom enabling the testing of left-hand and right-hand usage.
- The triple flat and eli phantom for the testing of handheld and body-mounted wireless devices.
- The device holder for handheld mobile phones and mounting device adaptor for laptops
- Tissue simulating liquid mixed according to the given recipes.
- System check dipoles allowing to validate the proper functioning of the system.

7.1.2 Test environment

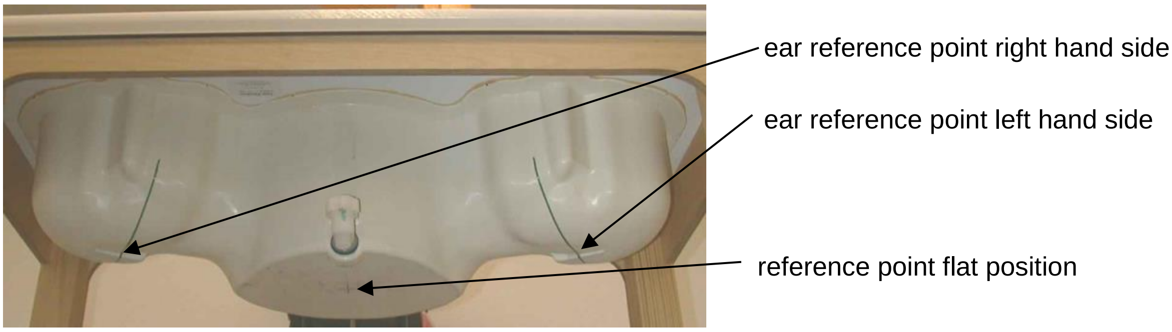
The DASY measurement system is placed in a laboratory room within an environment which avoids influence on SAR measurements by ambient electromagnetic fields and any reflection from the environment. The pictures at the beginning of the photo documentation show a complete view of the test environment. The system allows the measurement of SAR values larger than 0.005 mW/g.

7.1.3 Probe description

Isotropic E-Field Probe EX3DV4 for Dosimetric Measurements	
Technical data according to manufacturer information	
Construction	Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	ISO/IEC 17025 calibration service available.
Frequency	10 MHz to >6 GHz (dosimetry); Linearity: ± 0.2 dB (30 MHz to 6 GHz)
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)
Dynamic range	10 µW/g to > 100 mW/g; Linearity: ± 0.2 dB (noise: typically<1 µW/g)
Dimensions	Overall length: 337 mm (Tip: 20mm) Tip length: 2.5 mm (Body: 12mm) Typical distance from probe tip to dipole centers: 1mm
Application	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.

7.1.4 Phantom description

The used SAM Phantom meets the requirements specified in FCC KDB865664 D01 for Specific Absorption Rate (SAR) measurements.
The phantom consists of a fibreglass shell integrated in a wooden table. It allows left-hand and right-hand head as well as body-worn measurements with a maximum liquid depth of 18 cm in head position and 22 cm in planar position (body measurements). The thickness of the Phantom shell is 2 mm +/- 0.1 mm.



Triple Modular Phantom consists of three identical modules which can be installed and removed separately without emptying the liquid. It includes three reference points for phantom installation. Covers prevent evaporation of the liquid. Phantom material is resistant to DGBE based tissue simulating liquids.

7.1.5 Device holder description

The DASY device holder has two scales for device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear openings). The plane between the ear openings and the mouth tip has a rotation angle of 65°. The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. This device holder is used for standard mobile phones or PDA's only. If necessary an additional support of polystyrene material is used.

Larger DUT's (e.g. notebooks) cannot be tested using this device holder. Instead a support of bigger polystyrene cubes and thin polystyrene plates is used to position the DUT in all relevant positions to find and measure spots with maximum SAR values.
Therefore those devices are normally only tested at the flat part of the SAM.

7.1.6 Scanning procedure

- The DASY installation includes predefined files with recommended procedures for measurements and system check. They are read-only document files and destined as fully defined but unmeasured masks. All test positions (head or body-worn) are tested with the same configuration of test steps differing only in the grid definition for the different test positions.
- The „reference“ and „drift“ measurements are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure. The indicated drift is mainly the variation of the DUT’s output power and should vary max. +/- 5 %.
- The highest integrated SAR value is the main concern in compliance test applications. These values can mostly be found at the inner surface of the phantom and cannot be measured directly due to the sensor offset in the probe. To extrapolate the surface values, the measurement distances to the surface must be known accurately. A distance error of 0.5mm could produce SAR errors of 6% at 1800 MHz. Measurements can be performed in a fixed plane or by following an arbitrary surface.
- For an automatic and accurate detection of the phantom surface, the DASY system uses Mechanical Surface Detection:

  Mechanical Surface Detection
  Mechanical surface detection uses the probe collision detector built into the DAE. It is extremely accurate if the probe is normal to the surface (0.05 mm). For angled probes, the distance increases, because the detection is at the edge of the probe tip. It can be used in any liquid with any kind of probe. If the surface is strongly angled with respect to the probe, the probe slides along the surface and is defected sideways. The second switch system in the DAE will detect this situation and the probe will move backward until the touch condition is cleared. However, there will be some remaining uncertainty in the final probe position. In the job description, the desired distance from the probe sensors to the phantom surface can be entered. The detection is always at touch, but the probe will move backward from the surface the indicated distance before starting the measurement.

  Mother Scan in cDASY6/DASY8 Module SAR
  While the DASY5 V5.2 SAR system uses the mechanical surface detection at each point of the Area Scan / Zoom Scan, the cDASY6/DASY8 Module SAR provides the possibility to do a Mother Scan in which a high resolution Area Scan is done in the phantom filled with liquid to a fixed level using a special teaching probe. This mother scan data is used to recreate the phantom inner surface in software, and all future area and/or zoom scans, and a surface detection check is no longer required.

- The „area scan“ measures the SAR above the DUT or verification dipole on a parallel plane to the surface. It is used to locate the approximate location of the peak SAR with 2D spline interpolation. The robot performs a stepped movement along one grid axis while the local electrical field strength is measured by the probe. The probe is touching the surface of the SAM during acquisition of measurement values. The scan uses different grid spacings for different frequency measurements. Standard grid spacing for head measurements in frequency ranges ≤ 2GHz is 15 mm in x- and y- dimension. For higher frequencies a finer resolution is needed, thus for the grid spacing is reduced according the following table:

Area scan grid spacing for different frequency ranges	
Frequency range	Grid spacing
≤ 2 GHz	≤ 15 mm
2 – 4 GHz	≤ 12 mm
4 – 6 GHz	≤ 10 mm

  Grid spacing and orientation have no influence on the SAR result. For special applications where the standard scan method does not find the peak SAR within the grid, e.g. mobile phones with flip cover, the grid can be adapted in orientation. Results of this coarse scan are shown in annex B.

- A „zoom scan" measures the field in a volume around the 2D peak SAR value acquired in the previous „coarse" scan. It uses a fine meshed grid where the robot moves the probe in steps along all the 3 axis (x, y and z-axis) starting at the bottom of the Phantom. The grid spacing for the cube measurement is varied according to the measured frequency range, the dimensions are given in the following table:

Zoom scan grid spacing and volume for different frequency ranges			
Frequency range	Grid spacing for x, y axis	Grid spacing for z axis	Minimum zoom scan volume
≤ 2 GHz	≤ 8 mm	≤ 5 mm	≥ 30 mm
2 – 3 GHz	≤ 5 mm*	≤ 5 mm	≥ 28 mm
3 – 4 GHz	≤ 5 mm*	≤ 4 mm	≥ 28 mm
4 – 5 GHz	≤ 4 mm*	≤ 3 mm	≥ 25 mm
5 – 6 GHz	≤ 4 mm*	≤ 2 mm	≥ 22 mm

* When zoom scan is required and the reported 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.

- DASY provides an auto-extending feature to expand the size of the measurement area of the zoom scan as long as the maximum is found too close to the edge of the measured range, which eliminates the need to re-measure cubes whose maximum is found on the boundary of the defined measurement cube.

- To meet the requirements of **IEC / IEEE 62209-1528** it is necessary to perform graded grid measurements to avoid measurement mistakes. (First defined in IEC 62209-2 AMD1 from 2019)

  Below 3 GHz it defines:
  Horizontal grid step ≤ 8mm
  Vertical grid step ≤ 5mm for uniform spacing

  For variable spacing in vertical direction the maximum distance between the two closest measured points to the phantom shell (M1 and M2) shall be ≤ 4 mm and the spacing between farther points shall increase by a factor ≤ 1.5. Zoom Scan size ≤ 30 mm by 30 mm by 30 mm.

  Above 3 GHz it defines:
  Horizontal grid step ≤ (24/*f* [GHz]) mm
  Vertical grid step ≤ (10/(*f* [GHz] − 1)) mm for uniform spacing

  For variable spacing in vertical direction the maximum distance between the two closest measured points to the phantom shell (M1 and M2) shall be ≤ (12/*f* [GHz]) mm and the spacing between farther points shall increase by a factor ≤ 1.5. Zoom Scan size ≤ 22 mm by 22 mm by 22 mm.

  <u>If the zoom scan measured as defined above complies with both of the following criteria, or if the peak spatial-average SAR is below 0.1 W/kg, no additional measurements are needed:</u>

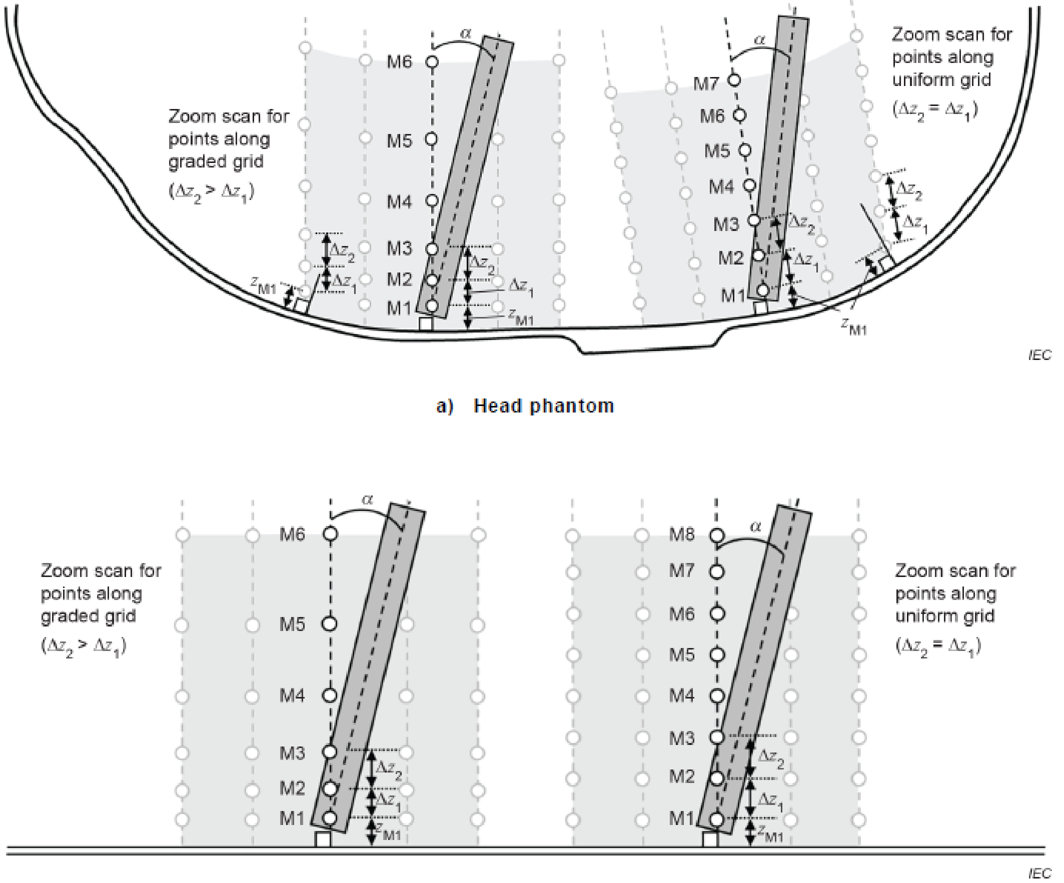
  1) the smallest horizontal distance from the local SAR peaks to all points 3 dB below the SAR peak shall be larger than the horizontal grid steps in both *x* and y directions (Δx, Δy). This shall be checked for the measured zoom scan plane conformal to the phantom at the distance z_{M1}. The minimum distance shall be recorded in the SAR test report;
  2) the ratio of the SAR at the second measured point (M2) to the SAR at the closest measured point (M1) at the *x*-*y* location of the measured maximum SAR value shall be at least 30 %. This ratio (in %) shall be recorded in the SAR test report.

If one or both of the above criteria are not met, the zoom scan measurement shall be repeated using a finer resolution while keeping the other zoom scan parameters compatible with the basic requirements for zoom scans.

New horizontal and vertical grid steps shall be determined from the measured SAR distribution so that the above criteria are met. Compliance with the above two criteria shall be demonstrated for the new measured zoom scan. The size of the higher resolution zoom scan and all other parameters shall apply. The closest point to the phantom shell shall be 2 mm or less for graded grids and the grading factor shall be 1.5 or less. Uncertainties due to field distortion between the media boundary and the dielectric enclosure of the probe should also be minimized, which is achieved if the distance between the phantom surface and physical tip of the probe is larger than the probe tip diameter. Other methods may utilize correction procedures to compensate for boundary effects that enable high precision measurements closer than half the probe tip diameter. For all measurement points, the angle of the probe normal to the flat phantom surface shall be less than 5°. If this cannot be achieved, an additional uncertainty evaluation is required.

Orientation of the probe with respect to the line normal to the phantom surface, shown at two different locations:

– 64 – IEC/IEEE 62209-1528:2020
© IEC/IEEE 2020



a) Head phantom

b) Flat phantom

NOTE M1 to M8 are example measurement points used for extrapolation to the surface. The maximum of the angle α between the evaluation axis and the surface normal line is given in Table 3 and Table 4. The distance z_{M1} is from the phantom shell to the first measurement point M1, and its maximum value is given in Table 3 and Table 4. The distances Δz_i (i = 1, 2, 3, ...) are the distances from measurement points M_i to M_{i+1}. For uniform grids, all Δz_i are equal. For graded grids, $\Delta z_{i+1} > \Delta z_i$. The term $R_z = \Delta z_{i+1}/\Delta z_i$ is a ratio with a maximum value given in Table 4. The z-direction corresponds to the vertical direction, the x-direction is horizontal and the y-direction is horizontal into the page.

Figure 20 – Orientation of the probe with respect to the line normal to the phantom surface, for head and flat phantoms, shown at two different locations

NOTE 1: The evaluation of the zoom scan is typically done by the post-processor by interpolation and extrapolation and without reconstruction of the field. More focused induced SAR distributions (e.g., for more localized sources such as capacitively coupled sources) require a more dense grid such that the same integration and extrapolation algorithms can be used for the same assessment uncertainty.

NOTE 2: The minimum ratio of 30 % is derived from the plane wave penetration depth at 6 GHz.

Detailed parameters can be seen in the following table:

Table 8 – Zoom scan parameters

Parameter	DUT transmit frequency being tested	
	$f \leq 3$ GHz	3 GHz < $f \leq 6$ GHz
Maximum distance between the closest measured points and the phantom surface (z_{M1} in Figure 14 and Table 2, in mm)	5	δ ln(2)/2 [a]
Maximum angle between the probe axis and the flat phantom surface normal (α in Figure 14)	5°	5°
Maximum spacing between measured points in the x- and y-directions (Δx and Δy, in mm)	8	$24/f$ [b,c]
For uniform grids: Maximum spacing between measured points in the direction normal to the phantom shell (Δz_1 in Figure 14, in mm)	5	$10/(f - 1)$
For graded grids: Maximum spacing between the two closest measured points in the direction normal to the phantom shell (Δz_1 in Figure 14, in mm)	4	$12/f$
For graded grids: Maximum incremental increase in the spacing between measured points in the direction normal to the phantom shell ($R_z = \Delta z_2/\Delta z_1$ in Figure 14)	1,5	1,5
Minimum edge length of the zoom scan volume in the x- and y-directions (L_z in 7.2.5.3, in mm)	30	22
Minimum edge length of the zoom scan volume in the direction normal to the phantom shell (L_h in 7.2.5.3, in mm)	30	22
Tolerance in the probe angle	1°	1°

[a] δ is the penetration depth for a plane-wave incident normally on a planar half-space.

[b] This is the maximum spacing allowed, which may not work for all circumstances.

[c] f is the frequency in GHz.

7.1.7 Comparison of DASY 52 NEO and cDASY6/DASY8

CTC advanced actually uses both systems side by side and the main differences of the DASY52 NEO and cDASY6/DASY8 system are system operation, reporting tools and measurement speed. DASY 52 still uses the DASY measurement software which has further in-depth options to adapt measurements to sophisticated test setups. For the reporting of the measurement results the companion software SEMCAD X is used. cDASY6/DASY8 is a different measurement system that is especially aimed to speed up standardized compliant measurements with high repeatability and less freedom of usability. It makes it possible to handle and rate compliance tests for a standardized product like a mobile phone in one place and it provides its own backend for reporting. The higher measurement speed is bought for the cost of less flexibility in the measurement setup and adding further sophisticated maintenance as it is necessary to perform regular mother scans.

Feature comparison:		
	DASY 52 (NEO)	cDASY6/DASY8
Warning feature for Zoom Scan according IEC 62209-2 AMD1 (graded Grid conditions)*	yes**	yes
Graded Grids for Area and Zoom Scan supported	yes**	yes
Measurement software	DASY 52 NEO	cDASY6/DASY8
Reporting tool	SEMCAD X post processor	cDASY6/DASY8 integrated post processor
Collusion detection to set probe to surface distance	yes	yes
Mother scans	no	yes

*) A warning appears if the stricter zoom scan criteria as defined in IEC 62209-2 AMD1 are violated using the actual zoom scan settings. In these cases a re-measurement with graded grid is performed and the result plot is updated with the information about the graded grid. This approach guarantees that the difference between the positions with maximum SAR to any adjacent point both horizontally and vertically is below the defined thresholds and that the SAR evaluation is correct.
(respecting both the 3 dB and the 30% criteria from section 7.4.2 d) 4) i),ii) of IEC / IEEE 62209-1528.)

**) features were added with version: DASY52 - 52.10.2(1504) to satisfy IEC / IEEE 62209-1528.

7.1.8 Spatial Peak SAR Evaluation

Both DASY5 V5.2 and cDASY6/DASY8 Module SAR software include all numerical procedures necessary to evaluate the spatial peak SAR values. Based on the IEEE 1528 standard, a new algorithm has been implemented. The spatial-peak SAR can be computed over any required mass.
The base for the evaluation is a "cube" measurement in a volume of $30mm^3$ below 3GHz or $22mm^3$ above 3GHz. The measured volume must include the 1 g and 10 g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan. If the 10g cube or both cubes are not entirely inside the measured volumes, the system issues a warning regarding the evaluated spatial peak values within the post-processing engine. This means that if the measured volume is shifted, higher values might be possible. To get the correct values a finer measurement grid for the area scan is used. In complicated field distributions, a large grid spacing for the area scan might miss some details and give an incorrectly interpolated peak location. Both DASY5 V5.2 and cDASY6/DASY8 Module SAR allow to automatically extend the grid to make sure that both cubes are inside the measured volume.

The entire evaluation of the spatial peak values is performed within the application in case of cDASY6/DASY8 Module SAR software or within Post-processing engine (SEMCAD X) for DASY5 V5.2. The system always gives the maximum values for the 1 g and 10 g cubes. The cDASY6/DASY8 software allow to automatically extend the grid to make sure that both cubes are inside the measured volume. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

1. extraction of the measured data (grid and values) from the Zoom Scan
2. calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
3. generation of a high-resolution mesh within the measured volume
4. interpolation of all measured values from the measurement grid to the high-resolution grid
5. extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
6. calculation of the averaged SAR within masses of 1 g and 10 g The significant parts are outlined in more detail within the following sections.

Interpolation, Extrapolation and Detection of Maxima

The probe is calibrated at the center of the dipole sensors which is located 1 to 2.7mm away from the probe tip. During measurements, the probe stops shortly above the phantom surface, depending on the probe and the surface detecting system. Both distances are included as parameters in the probe configuration file. The software always knows exactly how far away the measured point is from the surface. As the probe cannot directly measure at the surface, the values between the deepest measured point and the surface must be extrapolated.

The choice of the coordinate system defining the location of the measurement points has no influence on the uncertainty of the interpolation, Maxima Search and extrapolation routines. The interpolation, extrapolation and maximum search routines are all based on the modified Quadratic Shepard's method [Robert J. Renka, "Multivariate Interpolation Of Large Sets Of Scattered Data", University of North Texas ACM Transactions on Mathematical Software, vol. 14, no. 2, June 1988, pp. 139-148.].

Thereby, the interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation. The cDASY6/DASY8 routines construct a once-continuously differentiable function that interpolates the measurement values as follows:

- For each measurement point a trivariate (3-D) / bivariate (2-D) quadratic is computed. It interpolates the measurement values at the data point and forms a least-square fit to neighbouring measurement values.
- the spatial location of the quadratic with respect to the measurement values is attenuated by an inverse distance weighting. This is performed since the calculated quadratic will fit measurement values at nearby points more accurate than at points located further away.
- After the quadratics are calculated at all measurement points, the interpolating function is calculated as a weighted average of the quadratics.

There are two control parameters that govern the behavior of the interpolation method.

One specifies the number of measurement points to be used in computing the least-square fits for the local quadratics. These measurement points are the ones nearest the input point for which the quadratic is being computed.

The second parameter specifies the number of measurement points that will be used in calculating the weights for the quadratics to produce the final function. The input data points used there are the ones nearest the point at which the interpolation is desired. Appropriate defaults are chosen for each of the control parameters.

The trivariate quadratics that have been previously computed for the 3-D interpolation and whose input data are at the closest distance from the phantom surface, are used in order to extrapolate the fields to the surface of the phantom.

In order to determine all the field maxima in 2-D (Area Scan) and 3-D (Zoom Scan), the measurement grid is refined by a default factor of 10 (area) and 5 (zoom), respectively, and the interpolation function is used to evaluate all field values between corresponding measurement points. Subsequently, a linear search is applied to find all the candidate maxima. In a last step, non physical maxima are removed and only those maxima which are within 2 dB of the global maximum value are retained.

Important: To be processable by the interpolation/extrapolation scheme, the Area Scan requires at least6 measurement points. The Zoom Scan requires at least 10 measurement points to allow the application of these algorithms.

In the Area Scan, the gradient of the interpolation function is evaluated to find all the extrema of the SAR distribution. The uncertainty on the locations of the extrema is less than 1/20 of the grid size. Only local maxima within 2 dB of the global maximum are searched and passed for the Zoom Scan measurement.

In the Zoom Scan, the interpolation function is used to extrapolate the Peak SAR from the lowest measurement points to the inner phantom surface (the extrapolation distance). The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5 mm.

Averaging and Determination of spatial Peak SAR

Within DASY5 V5.2 software, the interpolated data is used to average the SAR over the 1g and 10g cubes by spatially discretizing the entire measured volume. The resolution of this spatial grid is around 1mm and chosen such that the cube side length is a multiple of the resolution. The resulting volumes are defined as cubical volumes containing the appropriate tissue parameters that are centered at the location. The location is defined as the center of the incremental volume.

The spatial-peak SAR must be evaluated in cubical volumes containing a mass that is within 5% of the required mass. The cubical volume centered at each location, as defined above, should be expanded in all directions until the desired value for the mass is reached, with no surface boundaries of the averaging volume extending beyond the outermost surface of the considered region. In addition, the cubical volume should not consist of more than 10% of non-liquid volume. If these conditions are not satisfied, then the center of the averaging volume is moved to the next location.

Reference is kept of all locations used and those not used for averaging the SAR. All average SAR values are finally assigned to the centered location in each valid averaging volume. All locations included in an averaging volume are marked as used to indicate that they have been used at least once. If a location has been marked as used, but has never been the center of a cube, the highest averaged SAR value of all other cubical volumes which have used this location for averaging is assigned to this location. For the case of an unused location, a new averaging volume must be constructed which will have the unused location centered at one surface of the cube. The remaining five surfaces are expanded evenly in all directions until the required mass is enclosed, regardless of the amount of included air. Of the six possible cubes with one surface centered on the unused location, the smallest cube is used, which still contains the required mass.

If the final cube containing the highest averaged SAR touches the surface of the measured volume, an appropriate warning is issued within the Post-processing engine.

Within cDASY6/DASY8 Module SAR software, the measured grid is interpolated to a high resolution grid, where the resolution is around 1mm and chosen such that the cube volume is a multiple of the resolution. Points which are outside of the measured grid are masked out and set to zero. Then, the antiderivative of the interpolated grid is computed by using a Gaussian quadrature consecutively for all spatial dimensions.

The antiderivative is used to compute all cube averages of the volume with the same resolution as the interpolated grid. The maximum of these SAR averages is reported. If the cube containing the maximum averaged SAR touches the surface of the measured volume, an appropriate warning is issued within the Post-processing engine.

7.1.9 Data Storage and Evaluation

Data Storage

The DASY software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension ".DA4", ".DA5x". The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type ([V/m], [A/m], [°C], [mW/g], [mW/cm²], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

Data Evaluation by SEMCAD

The SEMCAD software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe parameters:	- Sensitivity	$Norm_i$, a_{i0}, a_{i1}, a_{i2}
	- Conversion factor	$ConvF_i$
	- Diode compression point	Dcpi
Device parameters:	- Frequency	f
	- Crest factor	cf
Media parameters:	- Conductivity	σ
	- Density	ρ

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

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 as:

$$V_i = U_i + U_i^2 \cdot cf/dcp_i$$

with			
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: $$E_i = (V_i / Norm_i \cdot ConvF)^{1/2}$$

H-field probes: $$H_i = (V_i)^{1/2} \cdot (a_{i0} + a_{i1}f + a_{i2}f^2)/f$$

with	V_i	= compensated signal of channel i	(i = x, y, z)
	$Norm_i$	= sensor sensitivity of channel i [mV/(V/m)^2] for E-field Probes	(i = x, y, z)
	ConvF	= sensitivity enhancement in solution	
	a_{ij}	= sensor sensitivity factors for H-field probes	
	f	= carrier frequency [GHz]	
	E_i	= electric field strength of channel i in V/m	
	H_i	= magnetic field strength of channel i in A/m	

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

$$E_{tot} = (E_x^2 + E_Y^2 + E_z^2)^{1/2}$$

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

$$SAR = (E_{tot}^2 \cdot \sigma) / (\rho \cdot 1000)$$

with	SAR	= local specific absorption rate in mW/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

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid. The power flow density is calculated assuming the excitation field to be a free space field.

$$P_{pwe} = E_{tot}^2 / 3770 \quad \text{or} \quad P_{pwe} = H_{tot}^2 \cdot 37.7$$

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

Data Evaluation in cDASY6/DASY8

cDASY6/DASY8 features basic evaluation capabilities comparable to the above described SEMCAD evaluation. The main difference is that cDASY6/DASY8 is a stand-alone all-in-one solution whilst SEMCAD is only used to add these features to the DASY5.2 (NEO) platform. The final results are fully comparable no matter if they were generated by DASY5.2(NEO) + SEMCAD or in cDASY6/DASY8 directly.

7.1.10 Tissue simulating liquids: dielectric properties

The following materials are used for producing the tissue-equivalent materials.

HBBL600-10000MHz Simulating Head Liquid, Manufactured by SPEAG:

Ingredients	(% by weight)
Water	50-65%
Mineral oil	10-30%
Emulsifiers	8-25%
Sodium salt	0-1.5%

Table 3: Head tissue dielectric properties

7.1.11 Tissue simulating liquids: parameters

Liquid HSL	Freq. (MHz)	Target head tissue		Measurement **head** tissue					Measurement date
		Permittivity	Conductivity [S/m]	Permittivity	Dev. %	Conductivity ε"	Conductivity [S/m]	Dev. %	
750	704	42.15	0.89	41.6	-1.2	22.86	0.90	0.9	2022-07-15
	707	42.13	0.89	41.6	-1.2	22.79	0.90	1.0	
	711	42.11	0.89	41.6	-1.2	22.70	0.90	1.2	
	750	41.90	0.89	41.5	-0.9	21.83	0.91	2.4	
835	825	41.55	0.90	41.6	0.1	20.28	0.93	3.6	2022-07-13
	829	41.53	0.90	41.6	0.1	20.22	0.93	3.7	
	835	41.50	0.90	41.6	0.2	20.11	0.93	3.8	
	837	41.50	0.90	41.6	0.2	20.08	0.93	3.6	
	840	41.50	0.91	41.6	0.1	20.03	0.94	3.4	
	844	41.50	0.91	41.5	0.1	19.96	0.94	3.0	
	847	41.50	0.91	41.5	0.1	19.91	0.94	2.8	
1750	1712	40.13	1.35	39.9	-0.6	13.76	1.31	-2.9	2022-07-13
	1720	40.11	1.35	39.9	-0.6	13.74	1.31	-2.9	
	1732	40.10	1.36	39.8	-0.6	13.72	1.32	-2.9	
	1745	40.08	1.37	39.8	-0.6	13.69	1.33	-2.9	
	1747	40.08	1.37	39.8	-0.6	13.68	1.33	-2.9	
	1750	40.07	1.37	39.8	-0.6	13.68	1.33	-2.9	
1900	1852	40.00	1.40	39.7	-0.8	13.48	1.39	-0.8	2022-07-12
	1860	40.00	1.40	39.7	-0.9	13.47	1.39	-0.4	
	1880	40.00	1.40	39.6	-0.9	13.44	1.41	0.4	
	1900	40.00	1.40	39.6	-1.0	13.41	1.42	1.2	
	1905	40.00	1.40	39.6	-1.0	13.40	1.42	1.5	
	1908	40.00	1.40	39.6	-1.0	13.40	1.42	1.6	

Table 4: Parameter of the head tissue simulating liquid

Liquid **HSL**	Freq. (MHz)	Target head tissue		Measurement **head** tissue					Measurement date
		Permittivity	Conductivity [S/m]	Permittivity	Dev. %	Conductivity ε"	[S/m]	Dev. %	
2450	2412	39.27	1.77	39.4	0.3	13.14	1.76	-0.2	2022-11-07
	2437	39.22	1.79	39.3	0.3	13.16	1.78	-0.2	
	2442	39.21	1.79	39.3	0.3	13.16	1.79	-0.3	
	2450	39.20	1.80	39.3	0.3	13.17	1.80	-0.3	
	2462	39.20	1.81	39.3	0.2	13.18	1.81	-0.4	
5GHz	5180	36.02	4.64	35.8	-0.7	15.07	4.34	-6.4	2022-11-08
	5200	36.00	4.66	35.7	-0.7	15.08	4.36	-6.4	
	5220	35.98	4.68	35.7	-0.8	15.09	4.38	-6.4	
	5240	35.96	4.70	35.7	-0.8	15.10	4.40	-6.4	
	5260	35.94	4.72	35.6	-0.8	15.11	4.42	-6.3	
	5280	35.92	4.74	35.6	-0.9	15.13	4.44	-6.2	
	5300	35.90	4.76	35.6	-0.9	15.15	4.47	-6.2	
	5320	35.88	4.78	35.6	-0.9	15.17	4.49	-6.1	
	5500	35.65	4.96	35.4	-0.8	15.41	4.71	-5.0	
	5520	35.62	4.99	35.3	-0.8	15.44	4.74	-4.9	
	5540	35.60	5.01	35.3	-0.8	15.48	4.77	-4.7	
	5560	35.57	5.03	35.3	-0.8	15.52	4.80	-4.6	
	5580	35.55	5.05	35.3	-0.8	15.55	4.83	-4.4	
	5600	35.50	5.07	35.2	-0.8	15.58	4.85	-4.3	
	5620	35.48	5.09	35.2	-0.8	15.62	4.88	-4.1	
	5640	35.46	5.11	35.2	-0.9	15.66	4.91	-3.9	
	5660	35.44	5.13	35.1	-0.9	15.69	4.94	-3.7	
	5680	35.42	5.15	35.1	-0.9	15.72	4.97	-3.6	
	5700	35.40	5.17	35.1	-1.0	15.75	4.99	-3.4	
	5745	35.36	5.22	35.0	-1.1	15.81	5.05	-3.1	
	5765	35.34	5.24	34.9	-1.1	15.83	5.08	-3.0	
	5785	35.32	5.26	34.9	-1.2	15.86	5.10	-2.9	
	5800	35.30	5.27	34.9	-1.2	15.87	5.12	-2.8	
	5805	35.30	5.28	34.9	-1.3	15.88	5.13	-2.8	
	5825	35.28	5.30	34.8	-1.3	15.89	5.15	-2.8	

Table 5: Parameter of the head tissue simulating liquid (continued)

Note: The dielectric properties have been measured using the contact probe method at 22°C.

7.1.12 Measurement uncertainty evaluation for SAR test

Relative DASY6 Uncertainty Budget								
According to IEC62209-2 (Body-Worn: 30 MHz - 6 GHz range)								
Error Description	Uncertainty Value	Probability Distribution	Divisor	c_i (1g)	c_i (10g)	Standard Uncertainty ± %, (1g)	Standard Uncertainty ± %, (10g)	v_i^2 or v_{eff}
Measurement System								
Probe calibration	± 6.55 %	Normal	1	1	1	± 6.6 %	± 6.6 %	∞
Axial isotropy	± 4.7 %	Rectangular	√3	0.7	0.7	± 1.9 %	± 1.9 %	∞
Hemispherical isotropy	± 9.6 %	Rectangular	√3	0.7	0.7	± 3.9 %	± 3.9 %	∞
Boundary effects	± 2.0 %	Rectangular	√3	1	1	± 1.2 %	± 1.2 %	∞
Probe linearity	± 4.7 %	Rectangular	√3	1	1	± 2.7 %	± 2.7 %	∞
System detection limits	± 1.0 %	Rectangular	√3	1	1	± 0.6 %	± 0.6 %	∞
Modulation Response[m]	± 2.4 %	Rectangular	√3	1	1	± 1.4 %	± 1.4 %	∞
Readout electronics	± 0.3 %	Normal	1	1	1	± 0.3 %	± 0.3 %	∞
Response time	± 0.8 %	Rectangular	√3	1	1	± 0.5 %	± 0.5 %	∞
Integration time	± 2.6 %	Rectangular	√3	1	1	± 1.5 %	± 1.5 %	∞
RF ambient noise	± 3.0 %	Rectangular	√3	1	1	± 1.7 %	± 1.7 %	∞
RF ambient reflections	± 3.0 %	Rectangular	√3	1	1	± 1.7 %	± 1.7 %	∞
Probe positioner	± 0.04 %	Rectangular	√3	1	1	± 0.0 %	± 0.0 %	∞
Probe positioning	± 0.8 %	Rectangular	√3	1	1	± 0.5 %	± 0.5 %	∞
Max. SAR evaluation	± 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 uncertainty	± 3.6 %	Normal	1	1	1	± 3.6 %	± 3.6 %	5
Power drift	± 5.0 %	Rectangular	√3	1	1	± 2.9 %	± 2.9 %	∞
Power Scaling[p]	± 0.0 %	Rectangular	√3	1	1	± 0.0 %	± 0.0 %	∞
Phantom and Set-up								
Phantom uncertainty	± 7.6 %	Rectangular	√3	1	1	± 4.4 %	± 4.4 %	∞
SAR correction	± 1.9 %	Normal	1	1	0.84	± 1.9 %	± 1.6 %	∞
Liquid conductivity (mea.)[DAK]	± 5.0 %	Normal	1	0.78	0.71	± 3.9 %	± 3.6 %	∞
Liquid permittivity (mea.)[DAK]	± 5.0 %	Normal	1	0.23	0.26	± 1.2 %	± 1.3 %	∞
Temp. Unc. - conductivity [BB]	± 3.4 %	Rectangular	√3	0.78	0.71	± 1.5 %	± 1.4 %	∞
Temp. Unc. - permittivity [BB]	± 0.4 %	Rectangular	√3	0.23	0.26	± 0.1 %	± 0.1 %	∞
Combined Uncertainty						± 12.6 %	± 12.4 %	330
Expanded Std. Uncertainty						± **25.1** %	± **24.8** %	

Table 6: Measurement uncertainties

Worst-Case uncertainty budget for DASY6 assessed according to IEC 62209-2 standard. The budget is valid for the frequency range 30 MHz - 6 GHz and represents a worst-case analysis. For specific tests and configurations, the uncertainty could be considerable smaller.

Footnote details:

[m] SMC calibration is a new method for determining the total deviation from linearity.
For psSAR of approximately 10 W/kg the uncertainty is 9.6%. For psSAR of less than 2 W/kg the uncertainty is less than 2.4% (see modulation calibration parameter uncertainty in the probe calibration certificate);
[BB] if SPEAG's broad-band liquids (BBL) are used that have low temperature coefficients;
[DAK] if SPEAG's high precision dielectric probe kit (DAK) is applied;
[p] if power scaling is used, error item "Power Scaling" must be adjusted accordingly

DASY8 Uncertainty Budget According to IEC/IEEE 62209-1528 (Frequency band: 300 MHz - 3 GHz range)								
Symbol	Error Description	Uncertainty Value	Probability Distribution	Divisor	c_i (1g)	c_i (10g)	Standard Uncertainty ± %, (1g)	Standard Uncertainty ± %, (10g)
Measurement System Errors								
CF	Probe Calibration Repeat.	± 12.0 %	Normal	2	1	1	± 6.0 %	± 6.0 %
CFdrift	Probe Calibration Drift	± 1.7 %	Rectangular	√3	1	1	± 1.0 %	± 1.0 %
LIN	Probe linearity	± 4.7 %	Rectangular	√3	1	1	± 2.7 %	± 2.7 %
BBS	Broadband Signal	± 3.0 %	Rectangular	√3	1	1	± 1.7 %	± 1.7 %
ISO	Probe Isotropy (axial)	± 7.6 %	Rectangular	√3	1	1	± 4.4 %	± 4.4 %
DAE	Data Acquisition	± 0.3 %	Normal	1	1	1	± 0.3 %	± 0.3 %
AMB	RF Ambient	± 1.8 %	Normal	1	1	1	± 1.8 %	± 1.8 %
Δ_{sys}	Probe Positioning	± 0.006 mm	Normal	1	0.14	0.14	± 0.1 %	± 0.1 %
DAT	Data Processing	± 1.2 %	Normal	1	1	1	± 1.2 %	± 1.2 %
Phantom and Device Errors								
LIQ(σ)	Conductivity (meas.)[DAK]	± 2.5 %	Normal	1	0.78	0.71	± 2.0 %	± 1.8 %
LIQ(Tσ)	Conductivity (temp.)[BB]	± 3.3 %	Rectangular	√3	0.78	0.71	± 1.5 %	± 1.4 %
EPS	Phantom Permittivity	± 14.0 %	Rectangular	√3	0	0	± 0.0 %	± 0.0 %
DIS	Distance DUT - TSL	± 2.0 %	Normal	1	2	2	± 4.0 %	± 4.0 %
D_{xyz}	Device Positioning	± 1.0 %	Normal	1	1	1	± 1.0 %	± 1.0 %
H	Device Holder	± 3.6 %	Normal	1	1	1	± 3.6 %	± 3.6 %
MOD	DUT Modulation[m]	± 2.4 %	Rectangular	√3	1	1	± 1.4 %	± 1.4 %
TAS	Time-average SAR	± 1.7 %	Rectangular	√3	1	1	± 1.0 %	± 1.0 %
RF_{drift}	DUT drift	± 2.5 %	Normal	1	1	1	± 2.5 %	± 2.5 %
VAL	Val Antenna Unc.[val]	± 0.0 %	Normal	1	1	1	± 0.0 %	± 0.0 %
RF_{in}	Unc. Input Power[val]	± 0.0 %	Normal	1	1	1	± 0.0 %	± 0.0 %
Correction to the SAR results								
C(ε, σ)	Deviation to Target	± 1.9 %	Normal	1	1	0.84	± 1.9 %	± 1.6 %
C(R)	SAR scaling[p]	± 0.0 %	Rectangular	√3	1	1	± 0.0 %	± 0.0 %
u(ΔSAR)	**Combined Uncertainty**						± 11.0 %	± 10.9 %
U	**Expanded Uncertainty**						**± 21.9 %**	**± 21.7 %**

Table 7: Measurement uncertainties

Worst-Case uncertainty budget for DASY8 assessed according to IEC/IEEE 62209-1528 [4]. The budget is valid for the frequency range 300MHz - 3 GHz and represents a worst-case analysis. For specific tests and configurations, the uncertainty could be considerable smaller. All listed error components have υ_{eff} equal to ∞.

Footnote details:

[m] SMC calibration is a new method for determining the total deviation from linearity. The uncertainty is ≤ 2.4% for psSAR ≤ 2 W/kg, ≤ 4.8% for psSAR1g/10g ≤ 4 W/kg and ≤ 9.6% for psSAR1g/10g ≤ 10 W/kg (see modulation calibration parameter uncertainty in the probe calibration certificate);

[BB] if SPEAG's broad-band liquids (BBL) are used that have low temperature coefficients;

[DAK] if SPEAG's high precision dielectric probe kit (DAK) is applied;

[p] if power scaling is used, error item "SAR Scaling" must be adjusted accordingly;

[val] only applies in case of validation measurements.

7.1.13 Measurement uncertainty evaluation for System Check

Uncertainty of a System Performance Check with DASY6 System for the 0.3 - 3 GHz range								
Source of uncertainty	Uncertainty Value	Probability Distribution	Divisor	c_i (1g)	c_i (10g)	Standard Uncertainty ± %, (1g)	Standard Uncertainty ± %, (10g)	v_i^2 or v_{eff}
Measurement System								
Probe calibration	± 1.8 %	Normal	1	1	1	± 1.8 %	± 1.8 %	∞
Axial isotropy	± 0.0 %	Rectangular	√3	1	1	± 0.0 %	± 0.0 %	∞
Hemispherical isotropy	± 0.0 %	Rectangular	√3	1	1	± 0.0 %	± 0.0 %	∞
Boundary effects	± 0.0 %	Rectangular	√3	1	1	± 0.0 %	± 0.0 %	∞
Probe linearity	± 0.0 %	Rectangular	√3	1	1	± 0.0 %	± 0.0 %	∞
System detection limits	± 0.0 %	Rectangular	√3	1	1	± 0.0 %	± 0.0 %	∞
Modulation response	± 0.0 %	Rectangular	√3	1	1	± 0.0 %	± 0.0 %	∞
Readout electronics	± 0.0 %	Normal	1	1	1	± 0.0 %	± 0.0 %	∞
Response time	± 0.0 %	Rectangular	√3	1	1	± 0.0 %	± 0.0 %	∞
Integration time	± 0.0 %	Rectangular	√3	1	1	± 0.0 %	± 0.0 %	∞
RF ambient conditions	± 0.0 %	Rectangular	√3	1	1	± 0.0 %	± 0.0 %	∞
Probe positioner	± 0.02 %	Rectangular	√3	1	1	± 0.0 %	± 0.0 %	∞
Probe positioning	± 0.4 %	Rectangular	√3	1	1	± 0.2 %	± 0.2 %	∞
Max. SAR evaluation	± 0.0 %	Rectangular	√3	1	1	± 0.0 %	± 0.0 %	∞
Dipole Related								
Dev. of experimental dipole	± 0.0 %	Rectangular	√3	1	1	± 0.0 %	± 0.0 %	∞
Source to liquid distance	± 2.0 %	Rectangular	√3	1	1	± 1.2 %	± 1.2 %	∞
Power drift	± 3.4 %	Rectangular	√3	1	1	± 2.0 %	± 2.0 %	∞
Phantom and Set-up								
Phantom uncertainty	± 4.0 %	Rectangular	√3	1	1	± 2.3 %	± 2.3 %	∞
SAR correction	± 1.9 %	Rectangular	√3	1	0.84	± 1.1 %	± 0.9 %	∞
Liquid conductivity (meas.)	± 5.0 %	Normal	1	0.78	0.71	± 3.9 %	± 3.6 %	∞
Liquid permittivity (meas.)	± 5.0 %	Normal	1	0.26	0.26	± 1.3 %	± 1.3 %	∞
Temp. unc. - Conductivity	± 3.4 %	Rectangular	√3	0.78	0.71	± 1.5 %	± 1.4 %	∞
Temp. unc. - Permittivity	± 0.4 %	Rectangular	√3	0.23	0.26	± 0.1 %	± 0.1 %	∞
Combined Uncertainty						± 5.9 %	± 5.6 %	330
Expanded Std. Uncertainty						**± 11.7 %**	**± 11.1 %**	

Table 8: Measurement uncertainties of the System Check with DASY6 (0.3-3GHz)

Uncertainty of a System Performance Check with DASY6 System for the 3 - 6 GHz range								
Source of uncertainty	Uncertainty Value	Probability Distribution	Divisor	c_i (1g)	c_i (10g)	Standard Uncertainty ± %, (1g)	Standard Uncertainty ± %, (10g)	v_i^2 or v_{eff}
Measurement System								
Probe calibration	± 1.8 %	Normal	1	1	1	± 1.8 %	± 1.8 %	∞
Axial isotropy	± 0.0 %	Rectangular	√ 3	1	1	± 0.0 %	± 0.0 %	∞
Hemispherical isotropy	± 0.0 %	Rectangular	√ 3	1	1	± 0.0 %	± 0.0 %	∞
Boundary effects	± 0.0 %	Rectangular	√ 3	1	1	± 0.0 %	± 0.0 %	∞
Probe linearity	± 0.0 %	Rectangular	√ 3	1	1	± 0.0 %	± 0.0 %	∞
System detection limits	± 0.0 %	Rectangular	√ 3	1	1	± 0.0 %	± 0.0 %	∞
Readout electronics	± 0.0 %	Normal	1	1	1	± 0.0 %	± 0.0 %	∞
Response time	± 0.0 %	Rectangular	√ 3	1	1	± 0.0 %	± 0.0 %	∞
Integration time	± 0.0 %	Rectangular	√ 3	1	1	± 0.0 %	± 0.0 %	∞
RF ambient conditions	± 0.0 %	Rectangular	√ 3	1	1	± 0.0 %	± 0.0 %	∞
Probe positioner	± 0.04 %	Rectangular	√ 3	1	1	± 0.0 %	± 0.0 %	∞
Probe positioning	± 0.8 %	Rectangular	√ 3	1	1	± 0.5 %	± 0.5 %	∞
Max. SAR evaluation	± 0.0 %	Rectangular	√ 3	1	1	± 0.0 %	± 0.0 %	∞
Dipole Related								
Dev. of experimental dipole	± 0.0 %	Rectangular	√ 3	1	1	± 0.0 %	± 0.0 %	∞
Source to liquid distance	± 2.0 %	Rectangular	√ 3	1	1	± 1.2 %	± 1.2 %	∞
Power drift	± 3.4 %	Rectangular	√ 3	1	1	± 2.0 %	± 2.0 %	∞
Phantom and Set-up								
Phantom uncertainty	± 4.0 %	Rectangular	√ 3	1	1	± 2.3 %	± 2.3 %	∞
SAR correction	± 1.9 %	Rectangular	√ 3	1	0.84	± 1.1 %	± 0.9 %	∞
Liquid conductivity (meas.)	± 5.0 %	Normal	1	0.78	0.71	± 3.9 %	± 3.6 %	∞
Liquid permittivity (meas.)	± 5.0 %	Normal	1	0.26	0.26	± 1.3 %	± 1.3 %	∞
Temp. unc. - Conductivity	± 3.4 %	Rectangular	√ 3	0.78	0.71	± 1.5 %	± 1.4 %	∞
Temp. unc. - Permittivity	± 0.4 %	Rectangular	√ 3	0.23	0.26	± 0.1 %	± 0.1 %	∞
Combined Uncertainty						± 5.9 %	± 5.6 %	330
Expanded Std. Uncertainty						± **11.7** %	± **11.1** %	

Table 9: Measurement uncertainties of the System Check with DASY6 (3-6GHz)

Repeatability Budget for System Check (Frequency band: 300MHz - 6GHz range) with DASY8 System								
Symbol	Error Description	Uncertainty Value	Probability Distribution	Divisor	c_i (1g)	c_i (10g)	Standard Uncertainty ± %, (1g)	Standard Uncertainty ± %, (10g)
Measurement System Errors								
CF	Probe Calibration Repeat.	± 3.6 %	Normal	2	2	1	± 5.1 %	± 2.5 %
CFdrift	Probe Calibration Drift	± 1.7 %	Rectangular	√3	1	1	± 1.0 %	± 1.0 %
LIN	Probe linearity	± 4.7 %	Rectangular	√3	0	0	± 0.0 %	± 0.0 %
BBS	Broadband Signal	± 0.0 %	Rectangular	√3	0	0	± 0.0 %	± 0.0 %
ISO	Probe Isotropy (axial)	± 4.7 %	Rectangular	√3	0	0	± 0.0 %	± 0.0 %
DAE	Data Acquisition	± 0.3 %	Normal	1	0	0	± 0.0 %	± 0.0 %
AMB	RF Ambient	± 0.6 %	Normal	1	0	0	± 0.0 %	± 0.0 %
Δ_{sys}	Probe Positioning	± 0.2 %	Normal	1	0.33	0.33	± 0.1 %	± 0.1 %
DAT	Data Processing	± 0.0 %	Normal	1	1	1	± 0.0 %	± 0.0 %
Phantom and Device Errors								
LIQ(σ)	Conductivity (meas.)[DAK]	± 2.5 %	Normal	1	0.78	0.71	± 2.0 %	± 1.8 %
LIQ(Tσ)	Conductivity (temp.)[BB]	± 3.4 %	Rectangular	√3	0.78	0.71	± 1.5 %	± 1.4 %
EPS	Phantom Permittivity	± 14.0 %	Rectangular	√3	0	0	± 0.0 %	± 0.0 %
DIS	Distance Phantom - DUT	± 1.0 %	Normal	1	2	2	± 2.0 %	± 2.0 %
MOD	DUT Modulation[m]	± 0.0 %	Rectangular	√3	1	1	± 0.0 %	± 0.0 %
TAS	Time-average SAR	± 0.0 %	Rectangular	√3	1	1	± 0.0 %	± 0.0 %
VAL	Validation antenna	± 0.0 %	Normal	1	1	1	± 0.0 %	± 0.0 %
P_{in}	Accepted power	± 1.2 %	Normal	1	1	1	± 1.2 %	± 1.2 %
Correction to the SAR results								
C(ε, σ)	Deviation to Target	± 1.9 %	Normal	1	1	0.84	± 1.9 %	± 1.6 %
u(ΔSAR)	**Combined Uncertainty**						± 6.5 %	± 4.5 %
U	**Expanded Uncertainty**						± **13.0** %	± **9.1** %

Table 10: Repeatability of the system check (300MHz - 6 GHz).

All listed error components have v_{eff} equal to ∞.

Footnote details:
[BB] if SPEAG's broad-band liquids (BBL) are used that have low temperature coefficients;
[DAK] if SPEAG's high precision dielectric probe kit (DAK) is applied.

Note: Worst case probe calibration uncertainty has been applied for all probes used during the measurements.

7.1.14 System check

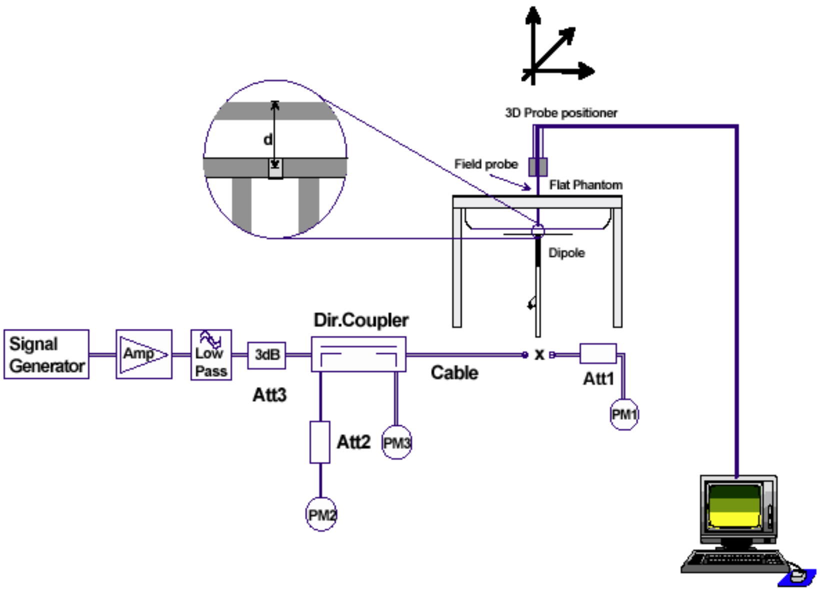
The system check is performed for verifying the accuracy of the complete measurement system and performance of the software. The system check is performed with tissue equivalent material according to IEEE 1528. The following table shows system check results for all frequency bands and tissue liquids used during the tests (plot(s) see annex A).

System performence check (1000 mW)									
System validation Kit	Probe	Frequency	Target SAR_{1g} /mW/g (+/-10%)	Target SAR_{10g} /mW/g (+/- 10%)	Measured SAR_{1g} / mW/g	SAR_{1g} dev.	Measured SAR_{10g} / mW/g	SAR_{10g} dev.	Measured date
D750V3 S/N: 1041	EX3DV4 S/N: 7566	750 MHz HSL	8.43	5.53	8.90	5.6%	5.79	4.7%	2022-07-15
D835V2 S/N: 4d153	EX3DV4 S/N: 3944	835 MHz HSL	9.43	6.17	9.58	1.6%	6.28	1.8%	2022-07-13
D1750V2 S/N: 1093	EX3DV4 S/N: 7566	1750 MHz HSL	37.20	19.50	38.60	3.8%	20.40	4.6%	2022-07-13
D1900V2 S/N: 5d009	EX3DV4 S/N: 7566	1900 MHz HSL	38.90	20.30	40.20	3.3%	20.70	2.0%	2022-07-12
D2450V2 S/N: 710	EX3DV4 S/N: 3944	2450 MHz HSL	51.80	24.10	48.40	-6.6%	22.60	-6.2%	2022-11-07
D5GHzV2 S/N: 1055	EX3DV4 S/N: 3944	5200 MHz HSL	80.30	22.80	79.60	-0.9%	23.00	0.9%	2022-11-08
D5GHzV2 S/N: 1055	EX3DV4 S/N: 3944	5800 MHz HSL	82.40	23.10	82.40	0.0%	23.30	0.9%	2022-11-08

Table 11: Results system check

7.1.15 System check procedure

The system check is performed by using a validation dipole which is positioned parallel to the planar part of the SAM phantom at the reference point. The distance of the dipole to the SAM phantom is determined by a plexiglass spacer. The dipole is connected to the signal source consisting of signal generator and amplifier via a directional coupler, N-connector cable and adaption to SMA. It is fed with a power of 1000 mW for frequencies below 2 GHz or 100 mW for frequencies above 2 GHz. To adjust this power a power meter is used. The power sensor is connected to the cable before the system check to measure the power at this point and do adjustments at the signal generator. At the outputs of the directional coupler both return loss as well as forward power are controlled during the validation to make sure that emitted power at the dipole is kept constant. This can also be checked by the power drift measurement after the test (result on plot).
System check results have to be equal or near the values determined during dipole calibration (target SAR in table above) with the relevant liquids and test system.



7.1.16 System validation

The system validation is performed in a similar way as a system check. It needs to be performed once a SAR measurement system has been established and allows an evaluation of the system accuracy with all components used together with the specified system. It has to be repeated at least once a year or when new system components are used (DAE, probe, phantom, dipole, liquid type).
In addition to the procedure used during system check a system validation also includes checks of probe isotropy, probe modulation factor and RF signal.

8 Detailed Test Results

8.1 Conducted power measurements

For the measurements the Rohde & Schwarz Radio Communication Tester CMU 200 and CMW500 were used. The output power was measured using an integrated RF connector and attached RF cable.
The conducted output power was also checked before and after each SAR measurement. The resulting power values were within a 0.2 dB tolerance of the values shown below.

8.1.1 Conducted power measurements WCDMA FDD V (850 MHz)

Max. RMS output power 850 MHz (FDD V) / dBm			
mode	CH 4132 / 826.4 MHz	CH 4182 / 836.6 MHz	CH 4233 / 846.6 MHz
RMC 12.2 kbit/s	**23.3**	**23.4**	**23.4**
RMC 64 kbit/s	23.2	23.3	23.4
RMC 144 kbit/s	23.1	23.3	23.3
RMC 384 kbit/s	23.2	23.2	23.3
AMR 4.75 kbit/s	23.2	23.3	23.3
AMR 5.15 kbit/s	23.1	23.2	23.2
AMR 5.9 kbit/s	23.2	23.4	23.3
AMR 6.7 kbit/s	23.2	23.3	23.3
AMR 7.4 kbit/s	23.1	23.4	23.2
AMR 7.95 kbit/s	23.2	23.4	23.2
AMR 10.2 kbit/s	23.2	23.3	23.3
AMR 12.2 kbit/s	23.2	23.2	23.4
HSDPA Sub test 1	**23.2**	**23.2**	**23.2**
HSDPA Sub test 2	22.0	22.1	22.2
HSDPA Sub test 3	21.5	21.6	21.8
HSDPA Sub test 4	21.6	21.8	21.6
HSUPA Sub test 1	23.3	23.2	23.3
HSUPA Sub test 2	21.1	21.1	21.2
HSUPA Sub test 3	22.2	22.2	22.3
HSUPA Sub test 4	21.2	21.1	21.1
HSUPA Sub test 5	**23.1**	**23.3**	**23.2**

Table 12: Test results conducted power measurement UMTS FDD V 850MHz

8.1.2 Conducted power measurements WCDMA FDD IV (1700 MHz)

Max. RMS output power FDD IV (1700MHz) / dBm			
mode	CH 1312 / 1712.4 MHz	CH 1412 / 1732.4 MHz	CH 1513 / 1752.6 MHz
RMC 12.2 kbit/s	**22.8**	**22.8**	**22.7**
RMC 64 kbit/s	22.6	22.7	22.7
RMC 144 kbit/s	22.7	22.6	22.6
RMC 384 kbit/s	22.6	22.6	22.6
AMR 4.75 kbit/s	22.6	22.8	22.6
AMR 5.15 kbit/s	22.7	22.6	22.6
AMR 5.9 kbit/s	22.6	22.7	22.6
AMR 6.7 kbit/s	22.6	22.7	22.5
AMR 7.4 kbit/s	22.7	22.7	22.6
AMR 7.95 kbit/s	22.6	22.7	22.6
AMR 10.2 kbit/s	22.6	22.7	22.6
AMR 12.2 kbit/s	22.7	22.7	22.5
HSDPA Sub test 1	**22.7**	**22.6**	**22.5**
HSDPA Sub test 2	21.5	21.6	21.5
HSDPA Sub test 3	21.1	21.0	21.0
HSDPA Sub test 4	21.1	21.2	20.9
HSUPA Sub test 1	22.6	22.6	22.5
HSUPA Sub test 2	20.6	20.7	20.5
HSUPA Sub test 3	21.7	21.7	21.6
HSUPA Sub test 4	20.6	20.6	20.5
HSUPA Sub test 5	**22.8**	**22.8**	**22.6**

Table 13: Test results conducted power measurement UMTS FDD IV 1700MHz

8.1.3 Conducted power measurements WCDMA FDD II (1900 MHz)

Max. RMS output power 1900 MHz (FDD II) / dBm			
	Channel / frequency		
mode	9262 / 1852.4 MHz	9400 / 1880.0 MHz	9538 / 1907.6 MHz
RMC 12.2 kbit/s	**22.7**	**22.7**	**23.0**
RMC 64 kbit/s	22.5	22.6	22.8
RMC 144 kbit/s	22.6	22.5	22.9
RMC 384 kbit/s	22.5	22.6	22.9
AMR 4.75 kbit/s	22.6	22.6	22.8
AMR 5.15 kbit/s	22.6	22.5	22.8
AMR 5.9 kbit/s	22.6	22.5	22.9
AMR 6.7 kbit/s	22.5	22.5	22.9
AMR 7.4 kbit/s	22.6	22.5	22.9
AMR 7.95 kbit/s	22.6	22.5	22.9
AMR 10.2 kbit/s	22.6	22.6	22.8
AMR 12.2 kbit/s	22.6	22.6	22.9
HSDPA Sub test 1	**22.6**	**22.5**	**23.0**
HSDPA Sub test 2	21.4	21.6	21.7
HSDPA Sub test 3	21.0	21.0	21.4
HSDPA Sub test 4	21.0	21.0	21.2
HSUPA Sub test 1	22.6	22.5	22.9
HSUPA Sub test 2	20.5	20.5	20.9
HSUPA Sub test 3	21.4	21.6	21.9
HSUPA Sub test 4	20.4	20.5	20.8
HSUPA Sub test 5	**22.6**	**22.5**	**22.8**

Table 14: Test results conducted power measurement UMTS FDD II 1900MHz

Remark: None of the HSDPA/HSUPA settings leads to conducted power values exceeding the conducted power in RMC mode by more than 0.25 dB.
Therefore no additional SAR measurements were performed in HSDPA/HSUPA mode.

8.1.4 Test-set-up information for WCDMA / HSPDA / HSUPA

a) WCDMA RMC

In RMC (reference measurement channel) mode the conducted power at 4 different bit rates was measured. They correspond with the used spreading factors as follows:

Bit rate	***12.2 kbit/s***	***64 kbit/s***	***144 kbit/s***	***384 kbit/s***
Spreading factor (SF)	64	16	8	4

In RMC mode only DPCCH and DPDCH are active. As bit rate changes do not influence the relative power of any code channel the measured RMS output power remains on the same level which is set to maximum by TPC (Transmit power control) pattern type 'All 1'.

b) HSDPA

HSDPA adds the HS-DPCCH in uplink as a control channel for high speed data transfer in downlink.
In HSDPA mode 4 sub-tests are defined by 3GPP 34.121 according to the following table:

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}, Δ_{CQI} = 8 $\Longleftrightarrow$ $A_{hs} = \beta_{hs}/\beta_c = 30/15$ $\Longleftrightarrow$ $\beta_{hs} = 30/15 * \beta_c$
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 signalled gain factors for the reference TFC (TF1,TF1) to $\beta_c = 11/15$ and $\beta_d = 15/15$

Table 15: Sub-tests for UMTS Release 5 HSDPA

The β_c and β_d gain factors for DPCCH and DPDCH were set according to the values in the above table, β_{hs} for HS-DPCCH is set automatically to the correct value when Δ_{ACK}, Δ_{NACK}, Δ_{CQI} = 8. The variation of the β_c/β_d ratio causes a power reduction at sub-tests 2 - 4.
The measurements were performed with a Fixed Reference Channel (FRC) and H-Set 1 QPSK.

Parameter	***Value***
Nominal average inf. bit rate	534 kbit/s
Inter-TTI Distance	3 TTI's
Number of HARQ Processes	2 Processes
Information Bit Payload	3202 Bits
MAC-d PDU size	336 Bits
Number Code Blocks	1 Block
Binary Channel Bits Per TTI	4800 Bits
Total Available SMLs in UE	19200 SMLs
Number of SMLs per HARQ Process	9600 SMLs
Coding Rate	0.67
Number of Physical Channel Codes	5

Table 16: settings of required H-Set 1 QPSK acc. to 3GPP 34.121

c) HSUPA

In HSUPA mode additional code channels (E-DPCCH, E-DPDCHn) are added for data transfer in uplink at higher bit rates.

5 sub-tests are defined by 3GPP 34.121 according to the following table:

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{hs}[1]	β_{ec}	β_{ed}	β_{ec} (SF)	β_{ed} (code)	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}, Δ_{CQI} = 8 ⟸⟹ $A_{hs} = \beta_{hs}/\beta_c$ = 30/15 ⟸⟹ β_{hs} = 30/15 * β_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 signalled 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 signalled 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} can not be set directly; it is set by Absolute Grant Value

Table 17: Subtests for UMTS Release 6 HSUPA

To achieve the settings above some additional procedures were defined by 3GPP 34.121. Those have been included in an application note for the CMU200 and were exactly followed:

- Test mode connection (BS signal tab):
RMC 12.2 kbit/s + HSPA 34.108 with loop mode 1
- HS-DSCH settings (BS signal tab):
- FRC with H-set 1 QPSK
- ACK-NACK repetition factor = 3
- CQI feedback cycle = 4ms
- CQI repetition factor = 2
- HSUPA-specific signalling settings (UE signal tab):
- E-TFCI table index = 0
- E-DCH minimum set E-TFCI = 9
- Puncturing limit non-max = 0.84
- max. number of channelisation codes = 2x SF4
- Initial Serving Grant Value = Off
- HSDPA and HSUPA Gain factors (UE signal tab)

Sub-test	β_c	β_d	Δ_{ACK}, Δ_{NACK}, Δ_{CQI}	ΔE–DPCCH)*
1	10	15	8	6
2	6	15	8	8
3	15	9	8	8
4	2	15	8	5
5	14	15	8	7

)* : β_{ec} and β_{ed} ratios (relative to β_c and β_d) are set by ΔE–DPCCH

- HSUPA Reference E-TFCIs (UE signal tab > HSUPA gain factors):

Sub-test	**1, 2, 4, 5**				
Number of E-TFCIs	5				
Reference E-TFCI	11	67	71	75	81
Reference E-TFCI power offset	4	18	23	26	27

Sub-test	**3**	
Number of E-TFCIs	2	
Reference E-TFCI	11	92
Reference E-TFCI power offset	4	18

- HSUPA-specific generator parameters (BS Signal tab > HSUPA > E-AGCH > AG Pattern)

Sub-test	***Absolute Grant Value (AG Index)***
1	20
2	12
3	15
4	17
5	21

- Power Level settings (BS Signal tab > Node B-settings):
- Level reference: Output Channel Power (Ior)
- Output Channel Power (Ior): -86 dBm

- Downlink Physical Channel Settings (BS signal tab)
- P-CPICH: -10 dB
- S-CPICH: Off
- P-SCH: -15 dB
- S-SCH : -15 dB
- P-CCPCH: -12 dB
- S-CCPCH: -12 dB
- PICH : -15 dB
- AICH : -12 dB
- DPDCH : -10 dB
- HS-SCCH : -8 dB
- HS-PDSCH : -3 dB
- E-AGCH : -20 dB
- E-RGCH/E-HICH - 20 dB
- E-RGCH Active: Off

The settings above were stored once for each sub-test and recalled before the measurement.

HSUPA test procedure:

To reach maximum output power in HSUPA mode the following procedures were followed:

3 different TPC patterns were defined:
Set 1 : Closed loop with target power 10 dBm
Set 2 : Single Pattern+Alternating with binary pattern '11111' for 1 dB steps 'up'
Set 3 : Single Pattern+Alternating with binary pattern '00000' for 1 dB steps 'down'

After recalling a certain HSUPA sub-test the HSUPA E-AGCH graph with E-TFCI event counter is displayed. After starting with the closed loop command the power is increased in 1 dB steps by activating pattern set 2 until the UE decreases the transmitted E-TFCI.
At this point set 3 is activated once to reduce the output power to the value at which the original E-TFCI, which is required for the sub-test, appears again.

For conducted power measurements the same steps are repeated in the power menu to read out the corresponding maximum RMS output power with the target E-TFCI.
For SAR measurements it is useful to switch to Code Domain Power vs. Time display.
Here the CMU200 shows relative power values (max. and min.) of each code channel which should roughly correspond to the numerators of the gain factors e.g.:

Sub-test	β_c	β_d	β_{hs}	β_{ec}	β_{ed}
5	15	15	30	24	134

By this way a surveillance of signalling conditions is possible to make sure that HSUPA code channels are active during the complete SAR measurement.

8.1.5 Conducted power measurements LTE FDD 2 1900 MHz

Bandwidth (MHz)	Channel / Frequency (MHz)	Resource block allocation	P_{avg} (dBm)	
			QPSK	16-QAM
1.4	18607 / 1850.7	1 RB low	22.2	21.2
		1 RB mid	22.1	21.2
		1 RB high	22.1	21.2
		50% RB low	22.1	21.1
		50% RB mid	22.1	21.1
		50% RB high	22.0	21.1
		100% RB	21.0	20.3
	18900 / 1880.0	1 RB low	22.1	21.5
		1 RB mid	22.1	21.5
		1 RB high	22.0	21.5
		50% RB low	22.1	21.2
		50% RB mid	22.1	21.1
		50% RB high	22.1	21.1
		100% RB	20.9	20.0
	19193 / 1909.3	1 RB low	22.0	20.9
		1 RB mid	21.9	20.8
		1 RB high	22.0	20.9
		50% RB low	22.0	21.1
		50% RB mid	21.9	21.1
		50% RB high	21.9	21.0
		100% RB	20.8	20.2
3.0	18615 / 1851.5	1 RB low	22.0	21.5
		1 RB mid	21.9	21.4
		1 RB high	21.8	21.3
		50% RB low	21.0	20.0
		50% RB mid	20.9	19.9
		50% RB high	20.9	19.9
		100% RB	20.9	20.1
	18900 / 1880.0	1 RB low	22.1	21.1
		1 RB mid	22.0	20.9
		1 RB high	22.0	21.0
		50% RB low	21.0	20.4
		50% RB mid	21.0	20.3
		50% RB high	21.0	20.3
		100% RB	20.9	20.0
	19185 / 1908.5	1 RB low	21.9	20.8
		1 RB mid	21.7	20.8
		1 RB high	21.8	20.7
		50% RB low	21.0	20.1
		50% RB mid	20.9	20.0
		50% RB high	20.9	20.0
		100% RB	20.9	20.0

Bandwidth (MHz)	Channel / Frequency (MHz)	Resource block allocation	P_{avg} (dBm)	
			QPSK	16-QAM
5.0	18625 / 1852.5	1 RB low	22.0	21.5
		1 RB mid	22.0	21.3
		1 RB high	21.8	21.3
		50% RB low	21.0	20.3
		50% RB mid	21.0	20.2
		50% RB high	20.9	20.1
		100% RB	21.0	20.1
	18900 / 1880.0	1 RB low	22.1	21.2
		1 RB mid	22.1	21.1
		1 RB high	22.0	21.1
		50% RB low	21.0	20.3
		50% RB mid	21.0	20.2
		50% RB high	21.0	20.2
		100% RB	21.0	20.1
	19175 / 1907.5	1 RB low	22.0	21.1
		1 RB mid	21.9	21.0
		1 RB high	21.8	20.9
		50% RB low	21.1	20.1
		50% RB mid	21.0	20.1
		50% RB high	20.8	20.0
		100% RB	21.0	20.0
10.0	18650 / 1855	1 RB low	22.2	21.6
		1 RB mid	21.8	21.4
		1 RB high	21.8	21.3
		50% RB low	21.1	20.2
		50% RB mid	20.9	20.0
		50% RB high	20.9	20.0
		100% RB	21.0	20.0
	18900 / 1880	1 RB low	22.2	21.4
		1 RB mid	21.9	21.0
		1 RB high	21.9	21.0
		50% RB low	21.1	20.3
		50% RB mid	21.1	20.2
		50% RB high	21.0	20.1
		100% RB	21.1	20.1
	19150 / 1905	1 RB low	22.1	21.2
		1 RB mid	21.8	20.9
		1 RB high	21.7	20.8
		50% RB low	21.1	20.1
		50% RB mid	20.9	20.0
		50% RB high	20.9	19.9
		100% RB	20.9	20.0

Bandwidth (MHz)	Channel / Frequency (MHz)	Resource block allocation	P_{avg} (dBm)	
			QPSK	16-QAM
15.0	18675 / 1857.5	1 RB low	22.3	21.8
		1 RB mid	21.8	21.2
		1 RB high	21.8	21.2
		50% RB low	21.2	20.3
		50% RB mid	21.0	20.1
		50% RB high	21.0	20.0
		100% RB	21.0	20.1
	18900 / 1880.0	1 RB low	22.5	21.9
		1 RB mid	21.9	21.3
		1 RB high	22.0	21.6
		50% RB low	21.2	20.3
		50% RB mid	21.0	20.1
		50% RB high	21.0	20.1
		100% RB	21.1	20.1
	19125 / 1902.5	1 RB low	22.3	21.5
		1 RB mid	21.9	21.0
		1 RB high	21.7	20.8
		50% RB low	21.2	20.2
		50% RB mid	21.0	20.0
		50% RB high	20.8	19.9
		100% RB	21.0	20.0
20.0	18700 / 1860	1 RB low	**22.3**	21.9
		1 RB mid	21.6	21.2
		1 RB high	21.6	21.1
		50% RB low	21.1	20.3
		50% RB mid	20.8	19.9
		50% RB high	20.8	19.9
		100% RB	21.0	20.0
	18900 / 1880	1 RB low	**22.2**	21.8
		1 RB mid	21.7	21.3
		1 RB high	21.5	21.1
		50% RB low	21.1	20.2
		50% RB mid	20.9	20.0
		50% RB high	20.8	19.9
		100% RB	21.0	20.1
	19100 / 1900	1 RB low	**22.2**	21.8
		1 RB mid	21.7	21.2
		1 RB high	21.4	21.0
		50% RB low	21.2	20.3
		50% RB mid	20.9	20.0
		50% RB high	20.8	19.9
		100% RB	21.0	20.1

Table 18: Test results conducted power measurement LTE FDD 2 1900MHz.

8.1.6 Conducted power measurements LTE FDD 4 1700 MHz

Bandwidth (MHz)	Channel / Frequency (MHz)	Resource block allocation	P_{avg} (dBm)	
			QPSK	16-QAM
1.4	19957 / 1710.7	1 RB low	22.6	21.9
		1 RB mid	22.5	21.9
		1 RB high	22.5	22.0
		50% RB low	22.5	21.6
		50% RB mid	22.6	21.6
		50% RB high	22.5	21.6
		100% RB	21.5	20.5
	20175 / 1732.5	1 RB low	22.4	21.4
		1 RB mid	22.3	21.3
		1 RB high	22.4	21.4
		50% RB low	22.4	21.5
		50% RB mid	22.3	21.5
		50% RB high	22.3	21.5
		100% RB	21.3	20.6
	20393 / 1754.3	1 RB low	22.3	21.3
		1 RB mid	22.2	21.3
		1 RB high	22.2	21.3
		50% RB low	22.2	21.3
		50% RB mid	22.2	21.3
		50% RB high	22.2	21.3
		100% RB	21.2	20.5
3	19965 / 1711.5	1 RB low	22.5	22.0
		1 RB mid	22.5	21.9
		1 RB high	22.4	21.9
		50% RB low	21.6	20.6
		50% RB mid	21.5	20.5
		50% RB high	21.5	20.5
		100% RB	21.5	20.6
	20175 / 1732.5	1 RB low	22.4	21.4
		1 RB mid	22.3	21.3
		1 RB high	22.3	21.2
		50% RB low	21.4	20.7
		50% RB mid	21.3	20.7
		50% RB high	21.3	20.6
		100% RB	21.3	20.4
	20385 / 1753.5	1 RB low	22.2	21.2
		1 RB mid	22.2	21.2
		1 RB high	22.1	21.1
		50% RB low	21.3	20.4
		50% RB mid	21.2	20.3
		50% RB high	21.2	20.4
		100% RB	21.2	20.4

Bandwidth (MHz)	Channel / Frequency (MHz)	Resource block allocation	P_{avg} (dBm)	
			QPSK	16-QAM
5	19975 / 1712.5	1 RB low	22.6	22.0
		1 RB mid	22.6	21.9
		1 RB high	22.4	21.8
		50% RB low	21.5	20.8
		50% RB mid	21.5	20.7
		50% RB high	21.4	20.7
		100% RB	21.5	20.6
	20175 / 1732.5	1 RB low	22.4	21.5
		1 RB mid	22.3	21.4
		1 RB high	22.3	21.3
		50% RB low	21.4	20.6
		50% RB mid	21.3	20.5
		50% RB high	21.3	20.4
		100% RB	21.3	20.4
	20375 / 1752.5	1 RB low	22.3	21.4
		1 RB mid	22.3	21.3
		1 RB high	22.1	21.2
		50% RB low	21.2	20.3
		50% RB mid	21.2	20.4
		50% RB high	21.1	20.4
		100% RB	21.2	20.3
10	20000 / 1715.0	1 RB low	22.7	22.1
		1 RB mid	22.4	21.9
		1 RB high	22.3	21.8
		50% RB low	21.5	20.7
		50% RB mid	21.4	20.5
		50% RB high	21.4	20.5
		100% RB	21.4	20.6
	20175 / 1732.5	1 RB low	22.5	21.4
		1 RB mid	22.2	21.2
		1 RB high	22.1	21.2
		50% RB low	21.4	20.6
		50% RB mid	21.3	20.5
		50% RB high	21.2	20.4
		100% RB	21.3	20.5
	20350 / 1750.0	1 RB low	22.3	21.4
		1 RB mid	22.1	21.1
		1 RB high	22.0	21.1
		50% RB low	21.3	20.4
		50% RB mid	21.1	20.2
		50% RB high	21.1	20.2
		100% RB	21.2	20.3

Bandwidth (MHz)	Channel / Frequency (MHz)	Resource block allocation	P_{avg} (dBm)	
			QPSK	16-QAM
15	20025 / 1717.5	1 RB low	22.9	22.3
		1 RB mid	22.4	21.9
		1 RB high	22.4	21.7
		50% RB low	21.7	20.8
		50% RB mid	21.5	20.7
		50% RB high	21.4	20.6
		100% RB	21.5	20.7
	20175 / 1732.5	1 RB low	22.8	22.3
		1 RB mid	22.3	21.8
		1 RB high	22.2	21.7
		50% RB low	21.5	20.6
		50% RB mid	21.3	20.5
		50% RB high	21.2	20.3
		100% RB	21.3	20.4
	20325 / 1747.5	1 RB low	22.6	21.6
		1 RB mid	22.1	21.2
		1 RB high	22.1	21.1
		50% RB low	21.4	20.5
		50% RB mid	21.2	20.3
		50% RB high	21.2	20.2
		100% RB	21.3	20.4
20	20050 / 1720.0	1 RB low	**22.9**	22.5
		1 RB mid	22.2	21.9
		1 RB high	22.0	21.7
		50% RB low	**21.7**	20.8
		50% RB mid	21.4	20.4
		50% RB high	21.3	20.4
		100% RB	**21.4**	20.5
	20175 / 1732.5	1 RB low	**22.6**	22.3
		1 RB mid	22.0	21.7
		1 RB high	21.8	21.4
		50% RB low	21.5	20.6
		50% RB mid	21.2	20.3
		50% RB high	21.1	20.2
		100% RB	21.4	20.4
	20300 / 1745.0	1 RB low	**22.6**	22.1
		1 RB mid	22.0	21.5
		1 RB high	21.9	21.4
		50% RB low	21.4	20.5
		50% RB mid	21.1	20.2
		50% RB high	21.1	20.2
		100% RB	21.2	20.4

Table 19: Test results conducted power measurement LTE FDD 4 1700 MHz.

8.1.7 Conducted power measurements LTE FDD 5 850 MHz

Bandwidth (MHz)	Channel / Frequency (MHz)	Resource block allocation	P_{avg} (dBm)	
			QPSK	16-QAM
1.4	20407 / 824.7	1 RB low	23.3	22.8
		1 RB mid	23.2	22.7
		1 RB high	23.3	22.8
		50% RB low	23.3	22.4
		50% RB mid	23.2	22.3
		50% RB high	23.2	22.3
		100% RB	22.0	21.1
	20525 / 836.5	1 RB low	23.0	22.2
		1 RB mid	23.1	22.0
		1 RB high	23.1	21.9
		50% RB low	23.0	22.3
		50% RB mid	23.0	22.3
		50% RB high	23.0	22.2
		100% RB	22.0	21.3
	20643 / 848.3	1 RB low	23.0	22.1
		1 RB mid	22.9	22.0
		1 RB high	22.9	22.0
		50% RB low	22.9	22.0
		50% RB mid	22.9	22.0
		50% RB high	22.9	22.0
		100% RB	21.9	21.1
3.0	20415 / 825.5	1 RB low	23.2	22.7
		1 RB mid	23.2	22.7
		1 RB high	23.1	22.6
		50% RB low	22.1	21.2
		50% RB mid	22.2	21.0
		50% RB high	22.2	21.1
		100% RB	22.2	21.3
	20525 / 836.5	1 RB low	22.9	22.1
		1 RB mid	22.9	22.1
		1 RB high	22.9	22.0
		50% RB low	21.9	21.3
		50% RB mid	21.9	21.2
		50% RB high	21.9	21.2
		100% RB	21.9	21.0
	20635 / 847.5	1 RB low	22.8	21.8
		1 RB mid	22.8	21.8
		1 RB high	22.8	21.7
		50% RB low	21.9	21.0
		50% RB mid	21.8	20.9
		50% RB high	21.9	21.0
		100% RB	21.9	21.0

Bandwidth (MHz)	Channel / Frequency (MHz)	Resource block allocation	P_{avg} (dBm)	
			QPSK	16-QAM
5.0	20425 / 826.5	1 RB low	23.2	22.6
		1 RB mid	23.2	22.6
		1 RB high	23.1	22.5
		50% RB low	22.2	21.4
		50% RB mid	22.2	21.4
		50% RB high	22.2	21.3
		100% RB	22.2	21.2
	20525 / 836.5	1 RB low	23.0	22.0
		1 RB mid	23.0	22.1
		1 RB high	22.9	22.0
		50% RB low	22.0	21.1
		50% RB mid	22.0	21.1
		50% RB high	21.9	21.0
		100% RB	22.0	21.1
	20625 / 846.5	1 RB low	22.9	21.9
		1 RB mid	23.0	22.0
		1 RB high	22.9	21.9
		50% RB low	22.0	21.0
		50% RB mid	21.9	21.1
		50% RB high	21.7	21.0
		100% RB	21.9	20.9
10.0	20450 / 829	1 RB low	**23.1**	22.7
		1 RB mid	23.0	22.6
		1 RB high	22.8	22.3
		50% RB low	**22.1**	21.2
		50% RB mid	22.1	21.1
		50% RB high	22.0	21.0
		100% RB	22.1	21.1
	20525 / 836.5	1 RB low	**23.0**	22.2
		1 RB mid	23.0	22.1
		1 RB high	22.7	21.8
		50% RB low	22.0	21.1
		50% RB mid	21.9	21.1
		50% RB high	21.9	21.1
		100% RB	21.9	20.9
	20600 / 844	1 RB low	**22.8**	21.8
		1 RB mid	22.8	21.8
		1 RB high	22.6	21.6
		50% RB low	21.8	20.9
		50% RB mid	21.8	20.8
		50% RB high	21.9	20.8
		100% RB	21.9	20.9

Table 20: Test results conducted power measurement LTE FDD 5 850 MHz.

8.1.8 Conducted power measurements LTE FDD 12 700 MHz

Bandwidth (MHz)	Channel / Frequency (MHz)	Resource block allocation	P_{avg} (dBm)	
			QPSK	16-QAM
1.4	23017 / 699.7	1 RB low	23.3	23.0
		1 RB mid	23.3	22.9
		1 RB high	23.4	22.9
		50% RB low	23.3	22.5
		50% RB mid	23.4	22.5
		50% RB high	23.4	22.5
		100% RB	22.3	21.3
	23095 / 707.5	1 RB low	23.3	22.3
		1 RB mid	23.4	22.1
		1 RB high	23.4	22.3
		50% RB low	23.3	22.5
		50% RB mid	23.3	22.5
		50% RB high	23.2	22.4
		100% RB	22.2	21.4
	23173 / 715.3	1 RB low	23.2	22.3
		1 RB mid	23.2	22.3
		1 RB high	23.2	22.4
		50% RB low	23.1	22.3
		50% RB mid	23.2	22.3
		50% RB high	23.2	22.3
		100% RB	22.1	21.3
3	23025 / 700.5	1 RB low	23.4	22.9
		1 RB mid	23.3	22.9
		1 RB high	23.3	22.9
		50% RB low	22.4	21.3
		50% RB mid	22.4	21.2
		50% RB high	22.3	21.2
		100% RB	22.3	21.3
	23095 / 707.5	1 RB low	23.3	22.5
		1 RB mid	23.3	22.3
		1 RB high	23.2	22.3
		50% RB low	22.2	21.5
		50% RB mid	22.2	21.5
		50% RB high	22.2	21.4
		100% RB	22.2	21.1
	23165 / 714.5	1 RB low	23.0	22.1
		1 RB mid	23.1	22.1
		1 RB high	23.1	22.0
		50% RB low	22.1	21.0
		50% RB mid	22.1	21.1
		50% RB high	22.1	21.1
		100% RB	22.1	21.1

Bandwidth (MHz)	Channel / Frequency (MHz)	Resource block allocation	P_{avg} (dBm)	
			QPSK	16-QAM
5	21475 / 882.5	1 RB low	23.3	22.8
		1 RB mid	23.5	22.7
		1 RB high	23.3	22.6
		50% RB low	22.3	21.5
		50% RB mid	22.3	21.5
		50% RB high	22.2	21.4
		100% RB	22.3	21.2
	23095 / 707.5	1 RB low	23.2	22.3
		1 RB mid	23.2	22.4
		1 RB high	23.1	22.2
		50% RB low	22.2	21.3
		50% RB mid	22.2	21.2
		50% RB high	22.1	21.2
		100% RB	22.2	21.1
	23155 / 713.5	1 RB low	23.1	22.3
		1 RB mid	23.2	22.3
		1 RB high	23.1	22.1
		50% RB low	22.1	21.1
		50% RB mid	22.1	21.1
		50% RB high	22.0	21.1
		100% RB	22.1	21.1
10	23060 / 704	1 RB low	23.3	22.8
		1 RB mid	**23.3**	22.8
		1 RB high	23.0	22.6
		50% RB low	22.2	21.2
		50% RB mid	**22.2**	21.2
		50% RB high	22.2	21.1
		100% RB	22.2	21.1
	23095 / 707.5	1 RB low	23.2	22.3
		1 RB mid	**23.2**	22.2
		1 RB high	22.9	22.1
		50% RB low	22.2	21.2
		50% RB mid	22.1	21.2
		50% RB high	22.1	21.1
		100% RB	22.1	21.1
	23130 / 711	1 RB low	23.1	22.1
		1 RB mid	**23.1**	22.1
		1 RB high	23.0	22.0
		50% RB low	22.2	21.1
		50% RB mid	22.1	21.1
		50% RB high	22.0	21.0
		100% RB	22.1	21.0

Table 21: Test results conducted power measurement LTE FDD12 700 MHz.

8.1.9 Justification of SAR measurements in LTE mode

According to Chapter 5 'SAR test procedures for LTE devices of FCC KDB Publication 941225 D05 the following test configurations for standalone measurements of the largest channel bandwidth (chapter 5.2) had to be taken into consideration:

5.2.1. QPSK with 1 RB allocation
Start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and *required test channel* combination with the highest maximum output power for RB offsets at the upper edge, middle and lower edge of each *required test channel*. When the *reported* SAR is ≤ 0.8 W/kg, testing of the remaining RB offset configurations and *required test channels* is not required for 1 RB allocation; otherwise, SAR is required for the remaining *required test channels* and only for the RB offset configuration with the highest output power for that channel.6 When the *reported* SAR of a *required test channel* is > 1.45 W/kg, SAR is required for all three RB offset configurations for that *required test channel*.

5.2.2. QPSK with 50% RB allocation
The procedures required for 1 RB allocation in 5.2.1 are applied to measure the SAR for QPSK with 50% RB allocation.

5.2.3. QPSK with 100% RB allocation
For QPSK with 100% RB allocation, SAR is not required when the highest maximum output power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest *reported* SAR for 1 RB and 50% RB allocation in 5.2.1 and 5.2.2 are ≤ 0.8 W/kg. Otherwise, SAR is measured for the highest output power channel and if the *reported* SAR is > 1.45 W/kg, the remaining *required test channels* must also be tested.

5.2.4. Higher order modulations
For each modulation besides QPSK; e.g., 16-QAM, 64-QAM, apply the QPSK procedures in sections 5.2.1, 5.2.2 and 5.2.3 to determine the QAM configurations that may need SAR measurement. For each configuration identified as required for testing, SAR is required only when the highest maximum output power for the configuration in the higher order modulation is > ½ dB higher than the same configuration in QPSK or when the *reported* SAR for the QPSK configuration is > 1.45 W/kg.

Testing of other channel bandwidths was not necessary because the output power of equivalent channel configurations was less than ½ dB larger compared to the largest channel bandwidth and reported SAR was < 1.45 W/kg.

Conducted and radiated measurements were performed with the maximum number of bundled TTIs supported by the DUT (see section 2.4 for details).

8.1.10 MPR information in LTE mode

There is a permanently applied MPR implemented by the manufacturer.
MPR is enabled for this device according to 3GPP TS36.101.

Modulation	Channel bandwidth / resource block configuration						Target MPR	3 GPP MPR
	1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz		
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	1	≤ 1
16QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	1	≤ 1
16QAM	> 5	> 4	> 8	> 12	> 16	> 18	2	≤ 2

Therefore there is no power reduction at 1.4 MHz bandwidth with 50% RB allocation (3 RBs).

Additional differences in conducted power are not caused by implemented MPR but depend on measurement uncertainty and allowable tolerances per 3GPP or tune-up.
A-MPR was disabled for all SAR tests.

8.1.11 Conducted power measurements WLAN 2450 MHz

802.11b		maximum average conducted output power [dBm]			
Band	**Ch**	**1Mbps**	**2Mbps**	**5.5Mbps**	**11Mbps**
2450MHz	1	8.8	8.7	8.6	8.6
	6	8.1	8.0	7.9	7.9
	11	8.4	8.3	8.2	8.2

Table 17: Test results conducted power measurement 802.11b

802.11g		maximum average conducted output power [dBm]							
Band	**Ch**	**6Mbps**	**9Mbps**	**12Mbps**	**18Mbps**	**24Mbps**	**36Mbps**	**48Mbps**	**54Mbps**
2450MHz	1	9.0	8.9	8.9	8.9	8.8	8.7	8.8	8.7
	2	9.6	9.5	9.5	9.4	9.4	9.3	9.4	9.3
	6	**10.2**	10.1	10.1	10.1	10.0	9.9	10.0	10.0
	10	8.9	8.8	8.8	8.8	8.7	8.6	8.7	8.7
	11	6.7	6.6	6.5	6.5	6.5	6.6	6.5	6.5

Table 18: Test results conducted power measurement 802.11g

802.11n HT-20		maximum average conducted output power [dBm]							
Band	**Ch**	**MCS-0 6.5Mbps**	**MCS-1 13Mbps**	**MCS-2 19.5Mbps**	**MCS-3 26Mbps**	**MCS-4 39Mbps**	**MCS-5 52Mbps**	**MCS-6 58.5Mbps**	**MCS-7 65Mbps**
2450MHz	1	8.0	7.9	7.8	7.8	7.8	7.9	7.9	7.8
	2	9.7	9.6	9.5	9.5	9.5	9.6	9.6	9.5
	6	8.3	8.2	8.1	8.1	8.1	8.2	8.2	8.1
	10	8.8	8.8	8.8	8.8	8.7	8.6	8.7	8.7
	11	6.7	6.6	6.5	6.5	6.5	6.6	6.6	6.5

Table 19: Test results conducted power measurement 802.11n HT-20

802.11n HT-40		maximum average conducted output power [dBm]							
Band	**Ch**	**MCS-0 13.5Mbps**	**MCS-1 27Mbps**	**MCS-2 40.5Mbps**	**MCS-3 54Mbps**	**MCS-4 81Mbps**	**MCS-5 108Mbps**	**MCS-6 121.5Mbps**	**MCS-7 135Mbps**
2450MHz	3	4.4	4.3	4.3	4.3	4.3	4.2	4.3	4.2
	6	7.4	7.3	7.3	7.3	7.3	7.2	7.3	7.2
	9	3.5	3.4	3.4	3.4	3.4	3.3	3.4	3.2

Table 20: Test results conducted power measurement 802.11n HT-40

8.1.12 Conducted power measurements WLAN 5 GHz

802.11a		maximum average conducted output power [dBm]							
Band [MHz]	Ch	6Mbps	9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps
5200	36	8.6	8.5	8.6	8.5	8.7	8.7	8.6	8.5
	40	9.5	9.3	9.4	9.3	9.5	9.5	9.4	9.3
	44	9.9	9.7	9.8	9.7	9.9	9.9	9.6	9.7
	48	**10.1**	10.3	10.2	10.3	10.1	10.1	10.4	**10.5**
5300	52	**9.4**	9.2	9.3	9.2	9.3	9.3	9.0	8.9
	56	9.1	9.0	9.1	9.0	9.1	9.1	9.0	8.9
	60	8.7	8.6	8.7	8.6	8.7	8.7	8.6	8.5
	64	8.4	8.2	8.3	8.2	8.4	8.4	8.1	8.0
5800	149	**3.1**	2.9	3.0	2.9	3.1	3.1	2.8	2.9
	153	2.9	2.7	2.8	2.7	2.9	2.9	2.6	2.5
	157	2.6	2.5	2.6	2.5	2.7	2.7	2.6	2.7
	161	2.4	2.3	2.4	2.3	2.5	2.5	2.4	2.3
	165	2.2	2.0	2.1	2.0	2.2	2.2	1.9	1.8

Table 21: Test results conducted power measurement 802.11a

802.11n HT-20 / 802.11ac VHT-20 maximum average conducted output power [dBm]									
Band [MHz]	Ch	MCS-0 6.5Mbps	MCS-1 13Mbps	MCS-2 19.5Mbps	MCS-3 26Mbps	MCS-4 39Mbps	MCS-5 52Mbps	MCS-6 58.5Mbps	MCS-7 65Mbps
5200	36	7.0	6.9	7.0	6.9	7.1	7.1	7.0	6.9
	40	7.7	7.5	7.6	7.5	7.7	7.7	7.6	7.5
	44	8.1	7.9	8.0	7.9	8.1	8.1	7.8	7.9
	48	8.5	8.4	8.4	8.4	8.3	8.6	8.6	8.5
5300	52	7.9	7.7	7.8	7.7	7.8	7.8	7.5	7.4
	56	7.8	7.7	7.8	7.7	7.8	7.8	7.7	7.6
	60	7.3	7.2	7.3	7.2	7.3	7.3	7.2	7.1
	64	6.7	6.5	6.6	6.5	6.7	6.7	6.4	6.3
5800	149	2.3	2.1	2.2	2.1	2.3	2.3	2.0	2.1
	153	2.2	2.0	2.1	2.0	2.2	2.2	1.9	1.8
	157	1.5	1.4	1.5	1.4	1.6	1.6	1.5	1.6
	161	1.3	1.2	1.3	1.2	1.4	1.4	1.3	1.2
	165	1.1	0.9	1.0	0.9	1.1	1.1	0.8	0.7

Table 22: Test results conducted power measurement 802.11n HT-20 / 802.11ac VHT-20

802.11n HT-40 / 802.11ac VHT-40 maximum average conducted output power [dBm]									
Band [MHz]	Ch	MCS-0 13.5Mbps	MCS-1 27Mbps	MCS-2 40.5Mbps	MCS-3 54Mbps	MCS-4 81Mbps	MCS-5 108Mbps	MCS-6 121.5Mbps	MCS-7 135Mbps
5200	38	3.0	2.9	3.0	2.9	3.1	3.1	3.0	2.9
	46	4.0	4.0	4.0	3.9	4.0	4.0	4.1	4.0
5300	54	3.9	3.7	3.8	3.7	3.9	3.9	3.6	3.7
	62	3.2	3.0	3.1	3.0	3.2	3.2	2.9	2.8
5800	151	-1.8	-2.0	-1.9	-2.0	-1.9	-1.9	-2.2	-2.3
	159	-2.6	-2.7	-2.6	-2.7	-2.6	-2.6	-2.7	-2.8

Table 23: Test results conducted power measurement 802.11n HT-40 / 802.11ac VHT-40

8.1.13 Standalone SAR Test Exclusion according to FCC KDB 447498 D01

Standalone SAR test exclusion considerations							
Communication system	freq. (MHz)	distance (mm)	P_{avg}* (dBm)	P_{avg}* (mW)	**threshold$_{1g}$ comparison value**	**SAR$_{1g}$ test exclusion thresholds**	SAR$_{1g}$ test exclusion
WLAN 5.2 GHz	5200	5	10.1	10.2	4.7	7.5	yes
WLAN 5.3 GHz	5300	5	9.4	8.7	4.0	7.5	yes
WLAN 5.8 GHz	5800	5	3.1	2.0	1.0	7.5	yes

Table 22: Standalone SAR test exclusion considerations

P_{avg}* - maximum possible output power declared by manufacturer

The **10-g SAR test exclusion thresholds** for 100 MHz to 6 GHz at *test separation distances* ≤ 50 mm are determined by:
[(*max. power of channel, including tune-up tolerance, mW*)/(*min. test separation distance, mm*)]×[√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ **7.5** for 10-g extremity SAR, where:

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

When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion

8.1.14 Standalone SAR Test Exclusion according to RSS-102 Issue 5

Standalone SAR test exclusion considerations						
Communication system	freq. (MHz)	distance (mm)	P_{avg}* (dBm)	P_{avg}* (mW)	**Exemption Limits$_{1g}$ (mW)**	SAR test exclusion
WLAN 5.2 GHz	5200	5	10.1	10.2	2.5	no
WLAN 5.3 GHz	5300	5	9.4	8.7	2.5	no
WLAN 5.8 GHz	5800	5	3.1	2.0	2.5	yes

Table 23: Standalone SAR test exclusion considerations

P_{avg}* - maximum possible output power declared by manufacturer. Output power level shall be the higher of the maximum conducted or equivalent isotropically radiated power (e.i.r.p.) source-based, time-averaged output power.
For limb-worn devices where the **10g** value applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of **2.5**. If the operating frequency of the device is between two frequencies located in Table, linear interpolation shall be applied for the applicable separation distance. For test separation distance less than 5 mm, the exemption limits for a separation distance of 5 mm can be applied to determine if a routine evaluation is required.

8.2 SAR test results

8.2.1 General description of test procedures

- The DUT is tested using CMU 200 and CMW 500 communications testers as controller unit to set test channels and maximum output power to the DUT, as well as for measuring the conducted peak power.
- Test positions as described in the tables above are in accordance with the specified test standard.
- UMTS was tested in RMC mode with 12.2 kbit/s and TPC bits set to 'all 1'.
- WLAN was tested in 802.11a/g mode with 6 MBit/s.
- Required WLAN test channels were selected according to KDB 248227
- According to IEEE 1528 the SAR test shall be performed at middle channel. Testing of top and bottom channel is optional.
- According to KDB 447498 D01 testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:
  - ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
  - ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
  - ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz
- According to IEC/IEEE 62209-1528 the SAR test shall be performed at the channel producing the highest rated output power.
  - When the width of the transmit frequency band ($\Delta f = f_{high} - f_{low}$) exceeds 1 % of its centre frequency fc, the channels at the lowest and highest frequencies of the transmit band shall also be tested.
  - When the width of the transmit frequency band exceeds 10 % of its centre frequency. The following formula shall be used to determine the number of channels, N_c, to be tested:

$$\mathrm{Nc} = 2 \times roundup\ [\frac{(fhigh - flow)}{fc}] + 1$$

where
f_c is the centre frequency channel of the transmission band in Hz;
f_{high} is the highest frequency channel of the transmission band in Hz;
f_{low} is the lowest frequency channel of the transmission band in Hz;
N_c is the number of channels

8.2.2 Results overview

measured / extrapolated SAR numbers - Extremities - UMTS FDD II 1900 MHz - Limit for 10g: 4W/Kg												
Ch.	Freq. (MHz)	test cond.	Position	cond. P_{max} (dBm)		SAR_{1g} (W/kg)		SAR_{10g} (W/kg)		power drift (dB)	liquid (°C)	dist. (mm)
				declared*	meas.	meas.	extrap.	meas.	extrap.			
9538	1907.6	RMC	front	23.5	23.0	0.101	0.113	0.056	0.063	0.01	21.3	0
9262	1852.4	RMC	back	23.5	23.0	1.910	2.143	**0.760**	**0.853**	-0.02	21.3	0
9400	1880.0	RMC	back	23.5	22.7	1.300	1.563	0.601	0.723	-0.02	21.3	0
9538	1907.6	RMC	back	23.5	22.7	0.961	1.155	0.501	0.602	0.00	21.3	0
9538	1907.6	RMC	left	23.5	23.0	0.567	0.636	0.323	0.362	-0.05	21.3	0
9538	1907.6	RMC	right	23.5	23.0	0.185	0.208	0.104	0.117	0.02	21.3	0
9538	1907.6	RMC	top	23.5	23.0	0.029	0.033	0.018	0.020	-0.04	21.3	0
9538	1907.6	RMC	bottom	23.5	23.0	0.047	0.053	0.027	0.030	-0.07	21.3	0

Table 24: Test results SAR UMTS FDD II 1880 MHz (see max. SAR plot Annex B:DASY measurement results on page 70)

measured / extrapolated SAR numbers - Extremities - UMTS FDD IV 1700 MHz - Limit for 10g: 4W/Kg												
Ch.	Freq. (MHz)	test cond.	Position	cond. P_{max} (dBm)		SAR_{1g} (W/kg)		SAR_{10g} (W/kg)		power drift (dB)	liquid (°C)	dist. (mm)
				declared*	meas.	meas.	extrap.	meas.	extrap.			
1412	1732.4	RMC	front	23.0	22.8	0.348	0.364	0.213	0.223	-0.08	21.6	0
1312	1712.4	RMC	back	23.0	22.8	1.320	1.382	0.701	0.734	-0.01	21.6	0
1412	1732.4	RMC	back	23.0	22.8	1.420	1.487	0.735	0.770	-0.09	21.6	0
1513	1752.6	RMC	back	23.0	22.8	1.840	1.927	**0.757**	**0.793**	-0.09	21.6	0
1412	1732.4	RMC	left	23.0	22.7	0.949	1.017	0.586	0.628	0.04	21.6	0
1412	1732.4	RMC	right	23.0	22.8	0.164	0.172	0.101	0.106	0.01	21.6	0
1412	1732.4	RMC	top	23.0	22.8	0.102	0.107	0.061	0.064	-0.12	21.6	0
1412	1732.4	RMC	bottom	23.0	22.8	0.255	0.267	0.155	0.162	-0.07	21.6	0

Table 25: Test results SAR UMTS FDD IV 1700 MHz MHz (see max. SAR plot Annex B:DASY measurement results on page 71)

measured / extrapolated SAR numbers - Extremities - UMTS FDD V 850 MHz - Limit for 10g: 4W/Kg												
Ch.	Freq. (MHz)	test cond.	Position	cond. P_{max} (dBm)		SAR_{1g} (W/kg)		SAR_{10g} (W/kg)		power drift (dB)	liquid (°C)	dist. (mm)
				declared*	meas.	meas.	extrap.	meas.	extrap.			
4182	836.4	RMC	front	24.0	23.4	0.133	0.153	0.078	0.090	0.06	21.2	0
4182	836.4	RMC	back	24.0	23.4	0.268	0.308	0.166	0.191	0.01	21.2	0
4132	826.4	RMC	left	24.0	23.3	1.100	1.292	**0.502**	**0.590**	0.05	21.2	0
4182	836.4	RMC	left	24.0	23.4	0.814	0.935	0.465	0.534	-0.03	21.2	0
4233	846.6	RMC	left	24.0	23.4	0.684	0.785	0.439	0.504	0.00	21.2	0
4182	836.4	RMC	right	24.0	23.4	0.131	0.150	0.085	0.098	0.05	21.2	0
4182	836.4	RMC	top	24.0	23.4	0.025	0.029	0.017	0.020	-0.03	21.2	0
4182	836.4	RMC	bottom	24.0	23.4	0.009	0.010	0.006	0.007	0.00	21.2	0

Table 26: Test results SAR UMTS FDD V 850 MHz (see max. SAR plot Annex B:DASY measurement results on page 72)

* - maximum possible output power declared by manufacturer

measured / extrapolated SAR numbers - Extremities - LTE FDD 2 1900 MHz - Limit for 10g: 4W/Kg												
Ch.	Freq. (MHz)	RB offset	Position	cond. P_{max} (dBm)		SAR_{1g} (W/kg)		SAR_{10g} (W/kg)		power drift (dB)	liquid (°C)	dist. (mm)
				declared*	meas.	meas.	extrap.	meas.	extrap.			
20MHz BW/1RB/QPSK												
18700	1860	0	front	22.5	22.3	0.085	0.089	0.049	0.051	-0.07	21.3	0
18700	1860	0	back	22.5	22.3	1.340	1.403	**0.545**	**0.571**	-0.04	21.3	0
18700	1880	0	back	22.5	22.2	1.120	1.200	0.524	0.561	0.00	21.3	0
18900	1900	0	back	22.5	22.2	1.030	1.104	0.513	0.550	-0.01	21.3	0
19100	1860	0	left	22.5	22.3	0.461	0.483	0.260	0.272	0.02	21.3	0
18700	1860	0	right	22.5	22.3	0.138	0.145	0.075	0.079	0.05	21.3	0
18700	1860	0	top	22.5	22.3	0.075	0.079	0.040	0.042	-0.03	21.3	0
18700	1860	0	bottom	22.5	22.3	0.155	0.162	0.082	0.086	0.02	21.3	0
20MHz BW/50RB/QPSK												
19100	1900	0	front	21.5	21.2	0.036	0.039	0.020	0.021	-0.12	21.3	0
19100	1900	0	back	21.5	21.2	0.723	0.775	0.383	0.410	0.03	21.3	0
19100	1900	0	left	21.5	21.2	0.276	0.296	0.145	0.155	-0.08	21.3	0
19100	1900	0	right	21.5	21.2	0.063	0.068	0.034	0.036	-0.02	21.3	0
19100	1900	0	top	21.5	21.2	0.037	0.040	0.019	0.020	-0.17	21.3	0
19100	1900	0	bottom	21.5	21.2	0.044	0.047	0.023	0.025	0.12	21.3	0

Table 27: Test results SAR LTE FDD 2 1900 MHz (see max. SAR plot Annex B:DASY measurement results on page 73)

measured / extrapolated SAR numbers - Extremities - LTE FDD 4 1750 MHz - Limit for 10g: 4W/Kg												
Ch.	Freq. (MHz)	RB offset	Position	cond. P_{max} (dBm)		SAR_{1g} (W/kg)		SAR_{10g} (W/kg)		power drift (dB)	liquid (°C)	dist. (mm)
				declared*	meas.	meas.	extrap.	meas.	extrap.			
20MHz BW/1RB/QPSK												
20050	1720.0	0	front	23.0	22.9	0.241	0.247	0.152	0.156	-0.07	21.6	0
20050	1720.0	0	back	23.0	22.9	1.090	1.115	0.597	0.611	-0.04	21.6	0
20175	1732.5	0	back	23.0	22.6	0.970	1.064	0.549	0.602	-0.02	21.6	0
20300	1745.0	0	back	23.0	22.6	1.620	1.776	**0.628**	**0.689**	-0.02	21.6	0
20050	1720.0	0	left	23.0	22.9	0.906	0.927	0.555	0.568	-0.08	21.6	0
20050	1720.0	0	right	23.0	22.9	0.160	0.164	0.097	0.099	0.00	21.6	0
20050	1720.0	0	top	23.0	22.9	0.099	0.101	0.060	0.061	0.02	21.6	0
20050	1720.0	0	bottom	23.0	22.9	0.354	0.362	0.214	0.219	-0.01	21.6	0
20MHz BW/50RB/QPSK												
20050	1720.0	0	front	22.0	21.7	0.225	0.241	0.138	0.148	0.05	21.6	0
20050	1720.0	0	back	22.0	21.7	0.793	0.850	0.446	0.478	-0.06	21.6	0
20050	1720.0	0	left	22.0	21.7	0.722	0.774	0.436	0.467	0.17	21.6	0
20050	1720.0	0	right	22.0	21.7	0.120	0.129	0.072	0.077	0.11	21.6	0
20050	1720.0	0	top	22.0	21.7	0.072	0.077	0.045	0.048	-0.08	21.6	0
20050	1720.0	0	bottom	22.0	21.7	0.252	0.270	0.153	0.164	-0.02	21.6	0

Table 28: Test results SAR LTE FDD 4 1750 MHz see max. SAR plot Annex B:DASY measurement results on page 74)

* - maximum possible output power declared by manufacturer

measured / extrapolated SAR numbers - Extremities - LTE FDD 5 850 MHz - Limit for 10g: 4W/Kg												
Ch.	Freq. (MHz)	RB offset	Position	cond. P_{max} (dBm)		SAR_{1g} (W/kg)		SAR_{10g} (W/kg)		power drift (dB)	liquid (°C)	dist. (mm)
				declared*	meas.	meas.	extrap.	meas.	extrap.			
10MHz BW/1RB/QPSK												
20450	829.0	0	front	24.0	23.1	0.176	0.217	0.107	0.132	0.02	21.2	0
20450	829.0	0	back	24.0	23.1	0.255	0.314	0.161	0.198	-0.06	21.2	0
20450	829.0	0	left	24.0	23.1	0.997	1.227	**0.454**	**0.559**	0.02	21.2	0
20525	836.5	0	left	24.0	23.0	0.910	1.146	0.414	0.521	-0.02	21.2	0
20600	844.0	0	left	24.0	22.8	0.675	0.890	0.401	0.529	0.03	21.2	0
20450	829.0	0	right	24.0	23.1	0.142	0.175	0.095	0.117	0.04	21.2	0
20450	829.0	0	top	24.0	23.1	0.031	0.038	0.021	0.026	0.03	21.2	0
20450	829.0	0	bottom	24.0	23.1	0.011	0.014	0.008	0.010	0.06	21.2	0
10MHz BW/25RB/QPSK												
20450	829.0	0	front	23.0	22.1	0.137	0.169	0.083	0.102	-0.04	21.2	0
20450	829.0	0	back	23.0	22.1	0.206	0.253	0.129	0.159	0.01	21.2	0
20450	829.0	0	left	23.0	22.1	0.647	0.796	0.380	0.468	0.06	21.2	0
20450	829.0	0	right	23.0	22.1	0.109	0.134	0.073	0.090	0.03	21.2	0
20450	829.0	0	top	23.0	22.1	0.024	0.030	0.016	0.020	0.07	21.2	0
20450	829.0	0	bottom	23.0	22.1	0.008	0.010	0.006	0.007	-0.01	21.2	0

Table 29: Test results SAR LTE FDD 5 850 MHz (see max. SAR plot Annex B:DASY measurement results on page 75)

measured / extrapolated SAR numbers - Extremities - LTE FDD 12 700 MHz - Limit for 10g: 4W/Kg												
Ch.	Freq. (MHz)	RB offset	Position	cond. P_{max} (dBm)		SAR_{1g} (W/kg)		SAR_{10g} (W/kg)		power drift (dB)	liquid (°C)	dist. (mm)
				declared*	meas.	meas.	extrap.	meas.	extrap.			
10MHz BW/1RB/QPSK												
23060	704.0	25	front	24.0	23.3	0.233	0.274	0.160	0.188	0.04	21.9	0
23060	704.0	25	back	24.0	23.3	0.451	0.530	0.295	0.347	0.03	21.9	0
23060	704.0	25	left	24.0	23.3	0.929	1.091	0.471	0.553	-0.03	21.9	0
23095	707.5	25	left	24.0	23.2	0.969	1.165	0.494	0.594	-0.01	21.9	0
23130	711.0	25	left	24.0	23.1	0.990	1.218	**0.502**	**0.618**	-0.01	21.9	0
23060	704.0	25	right	24.0	23.3	0.354	0.416	0.243	0.286	-0.04	21.9	0
23060	704.0	25	top	24.0	23.3	0.038	0.045	0.027	0.032	-0.02	21.9	0
23060	704.0	25	bottom	24.0	23.3	0.072	0.085	0.048	0.056	-0.02	21.9	0
10MHz BW/25RB/QPSK												
23060	704.0	12	front	23.0	22.2	0.182	0.219	0.126	0.151	0.05	21.9	0
23060	704.0	12	back	23.0	22.2	0.351	0.422	0.234	0.281	-0.01	21.9	0
23060	704.0	12	left	23.0	22.2	0.674	0.810	0.448	0.539	0.07	21.9	0
23060	704.0	12	right	23.0	22.2	0.272	0.327	0.188	0.226	0.06	21.9	0
23060	704.0	12	top	23.0	22.2	0.030	0.036	0.021	0.025	-0.04	21.9	0
23060	704.0	12	bottom	23.0	22.2	0.057	0.069	0.038	0.046	0.07	21.9	0

Table 30: Test results SAR LTE FDD 12 700 MHz (see max. SAR plot Annex B:DASY measurement results on page 76)

* - maximum possible output power declared by manufacturer

measured / extrapolated SAR numbers - Extremities - WLAN 2450 MHz - Limit for 10g: 4W/Kg 0 mm distance													
Ch.	Freq. (MHz)	test cond.	Position	cond. P_{max} (dBm)		SAR_{1g} (W/kg)			SAR_{10g} (W/kg)			power drift (dB)	liquid (°C)
				decl.*	meas.	meas.	extrap.	100% DF	meas.	extrap.	100% DF		
6	2437	6Mbit/s	front	10.5	10.2	0.054	0.058	0.059	0.026	0.028	0.028	0.01	20.4
6	2437	6Mbit/s	back	10.5	10.2	0.005	0.005	0.005	0.002	0.002	0.002	0.04	20.4
2	2417	6Mbit/s	left	10.5	9.6	0.085	0.105	0.107	0.033	0.041	0.041	0.10	20.4
6	2437	6Mbit/s	left	10.5	10.2	0.128	0.137	0.140	**0.049**	**0.053**	**0.054**	0.00	20.4
10	2457	6Mbit/s	left	10.5	8.9	0.058	0.084	0.086	0.022	0.032	0.032	0.02	20.4
6	2437	6Mbit/s	right	10.5	10.2	0.000	0.000	0.000	0.000	0.000	0.000	-0.01	20.4
6	2437	6Mbit/s	top	10.5	10.2	0.000	0.000	0.000	0.000	0.000	0.000	0.06	20.4
6	2437	6Mbit/s	bottom	10.5	10.2	0.002	0.002	0.002	0.002	0.002	0.002	-0.07	20.4

Table 31: Test results body worn SAR WLAN 2.45 GHz (see max. SAR plot Annex B:DASY measurement results on page 77)

* - maximum possible output power declared by manufacturer

measured / extrapolated SAR numbers - Extremities – WLAN 5 GHz - Limit for 10g: 4W/Kg 0 mm distance													
Ch.	Freq. (MHz)	test cond.	Position	cond. P_{max} (dBm)		SAR_{1g} (W/kg)			SAR_{10g} (W/kg)			power drift (dB)	liquid (°C)
				decl. *	meas.	meas.	extrap.	100% DF	meas.	extrap.	100% DF		
48	5240	6Mbit/s	front	10.5	10.1	0.124	0.136	0.139	0.042	0.046	0.047	-0.04	21.2
48	5240	6Mbit/s	back	10.5	10.1	0.095	0.104	0.106	0.042	0.046	0.047	0.01	21.2
48	5240	6Mbit/s	left	10.5	10.1	0.339	0.372	0.379	0.109	0.120	0.122	0.14	21.2
52	5260	6Mbit/s	left	10.5	9.4	0.450	0.580	0.592	**0.138**	**0.178**	**0.181**	0.01	21.2
149	5745	6Mbit/s	left	5.0	3.1	0.154	0.239	0.243	0.047	0.073	0.074	-0.02	21.2
48	5240	6Mbit/s	right	10.5	10.1	0.007	0.008	0.008	0.001	0.001	0.001	0.02	21.2
48	5240	6Mbit/s	top	10.5	10.1	0.000	0.000	0.000	0.000	0.000	0.000	-0.10	21.2
48	5240	6Mbit/s	bottom	10.5	10.1	0.020	0.022	0.022	0.008	0.009	0.009	0.03	21.2

Table 32: Test results body worn SAR WLAN 5 GHz (see max. SAR plot Annex B:DASY measurement results on page 77)

* - maximum possible output power declared by manufacturer

8.2.3 Multiple Transmitter Information

The following tables list information which is relevant for the decision if a simultaneous transmit evaluation is necessary according to FCC KDB 447498D01 General RF Exposure Guidance v05.

reported SAR WWAN and WLAN2.45GHz, ΣSAR evaluation				
Frequency band	Position	SAR_{max} /W/kg		ΣSAR
		WWAN	WLAN	<4W/kg
UMTS FDD II	front	0.063	0.028	0.091
	back	0.853	0.002	**0.855**
	left	0.362	0.054	0.416
	right	0.117	0.000	0.117
	top	0.020	0.000	0.020
	bottom	0.030	0.002	0.032
UMTS FDD IV	front	0.223	0.028	0.251
	back	0.793	0.002	0.795
	left	0.628	0.054	0.682
	right	0.106	0.000	0.106
	top	0.064	0.000	0.064
	bottom	0.162	0.002	0.164
WCDMA FDD V	front	0.090	0.028	0.118
	back	0.191	0.002	0.193
	left	0.590	0.054	0.644
	right	0.098	0.000	0.098
	top	0.020	0.000	0.020
	bottom	0.007	0.002	0.009
LTE FDD 2	front	0.051	0.028	0.079
	back	0.571	0.002	0.573
	left	0.272	0.054	0.326
	right	0.079	0.000	0.079
	top	0.042	0.000	0.042
	bottom	0.086	0.002	0.088
LTE FDD 4	front	0.156	0.028	0.184
	back	0.689	0.002	0.691
	left	0.568	0.054	0.622
	right	0.099	0.000	0.099
	top	0.061	0.000	0.061
	bottom	0.219	0.002	0.221
LTE FDD 5	front	0.132	0.028	0.160
	back	0.198	0.002	0.200
	left	0.559	0.054	0.613
	right	0.117	0.000	0.117
	top	0.026	0.000	0.026
	bottom	0.010	0.002	0.012
LTE FDD 12	front	0.188	0.028	0.216
	back	0.347	0.002	0.349
	left	0.618	0.054	0.672
	right	0.286	0.000	0.286
	top	0.032	0.000	0.032
	bottom	0.056	0.002	0.058

Table 33: SAR_{max} WWAN and **WLAN 2.4GHz**, $ΣSAR_{10g}$ evaluation

reported SAR WWAN and WLAN5GHz, ΣSAR evaluation				
Frequency band	Position	SAR_{max} /W/kg		ΣSAR
		WWAN	WLAN	<4W/kg
UMTS FDD II	front	0.063	0.047	0.110
	back	0.853	0.047	**0.900**
	left	0.362	0.181	0.543
	right	0.117	0.001	0.118
	top	0.020	0.000	0.020
	bottom	0.030	0.009	0.039
UMTS FDD IV	front	0.223	0.047	0.270
	back	0.793	0.047	0.840
	left	0.628	0.181	0.809
	right	0.106	0.001	0.107
	top	0.064	0.000	0.064
	bottom	0.162	0.009	0.171
WCDMA FDD V	front	0.090	0.047	0.137
	back	0.191	0.047	0.238
	left	0.590	0.181	0.771
	right	0.098	0.001	0.099
	top	0.020	0.000	0.020
	bottom	0.007	0.009	0.016
LTE FDD 2	front	0.051	0.047	0.098
	back	0.571	0.047	0.618
	left	0.272	0.181	0.453
	right	0.079	0.001	0.080
	top	0.042	0.000	0.042
	bottom	0.086	0.009	0.095
LTE FDD 4	front	0.156	0.047	0.203
	back	0.689	0.047	0.736
	left	0.568	0.181	0.749
	right	0.099	0.001	0.100
	top	0.061	0.000	0.061
	bottom	0.219	0.009	0.228
LTE FDD 5	front	0.132	0.047	0.179
	back	0.198	0.047	0.245
	left	0.559	0.181	0.740
	right	0.117	0.001	0.118
	top	0.026	0.000	0.026
	bottom	0.010	0.009	0.019
LTE FDD 12	front	0.188	0.047	0.235
	back	0.347	0.047	0.394
	left	0.618	0.181	0.799
	right	0.286	0.001	0.287
	top	0.032	0.000	0.032
	bottom	0.056	0.009	0.065

Table 34: SAR_{max} WWAN and **WLAN 5GHz**, $ΣSAR_{10g}$ evaluation

Conclusion:

ΣSAR < 4 W/kg therefore simultaneous transmissions SAR measurement with the enlarged zoom scan measurement and volume scan post-processing procedures is **not** required.

9 Test equipment and ancillaries used for tests

To simplify the identification of the test equipment and/or ancillaries which were used, the reporting of the relevant test cases only refer to the test item number as specified in the table below.

Equipment	Type	Manufacturer	Serial No.	Last Calibration	Frequency (months)
Dosimetric E-Field Probe	EX3DV4	Schmid & Partner Engineering AG	3944	May 17, 2022	12
Dosimetric E-Field Probe	EX3DV4	Schmid & Partner Engineering AG	7566	August 16, 2021	12
750 MHz System Validation Dipole	D750V3	Schmid & Partner Engineering AG	1041	May 7, 2020	36
835 MHz System Validation Dipole	D835V2	Schmid & Partner Engineering AG	4d153	May 7, 2020	36
1750 MHz System Validation Dipole	D1750V2	Schmid & Partner Engineering AG	1093	May 14, 2021	36
1900 MHz System Validation Dipole	D1900V2	Schmid & Partner Engineering AG	5d009	May 8, 2020	36
2450 MHz System Validation Dipole	D2450V2	Schmid & Partner Engineering AG	710	May 11, 2022	36
Data acquisition electronics	DAE3V1	Schmid & Partner Engineering AG	477	May 16, 2022	12
Data acquisition electronics	DAE4	Schmid & Partner Engineering AG	1387	August 06, 2021	12
Software	cDASY6 V16.0.0.116	Schmid & Partner Engineering AG	---	N/A	--
Software	DASY8 V16.0.0.65	Schmid & Partner Engineering AG	---	N/A	--
SAM Twin Phantom V5.0	QD 000 P40 C	Schmid & Partner Engineering AG	1977 2061	N/A	--
Universal Radio Communication Tester	CMU 200	Rohde & Schwarz	106240	December 09, 2020	24
Universal Radio Communication Tester	CMW500	Rohde & Schwarz	102375	December 12, 2019	24
Network Analyser 300 kHz to 6 GHz	8753ES	Agilent Technologies)*	US39174 436	December 14, 2021	24
Dielectric Assessment Kit (DAK)	DAK 200MHz – 20GHz Package	Schmid & Partner Engineering AG	1127	N/A	--
Signal Generator	SML03	Rohde & Schwarz	102519	December 06, 2021	12
RF Power Amplifier	BLMA 0760-6 (6 Watt)	BONN Elektronik	1510273	N/A	--
Power Meter	NRP	Rohde & Schwarz	101367	December 07, 2021	12
Power Meter Sensor	NRP Z22	Rohde & Schwarz	100227	December 06, 2021	12
Power Meter Sensor	NRP Z22	Rohde & Schwarz	100234	December 06, 2021	12
Directional Coupler	778D	Hewlett Packard	19171	December 06, 2021	12

)* : Network analyzer probe calibration against air, distilled water and a shorting block performed before measuring liquid parameters.

10 Observations

No observations exceeding those reported with the single test cases have been made.

Annex A: System performance check

Date/Time: 2022-07-15, 12:42 2022-07-15, 12:47

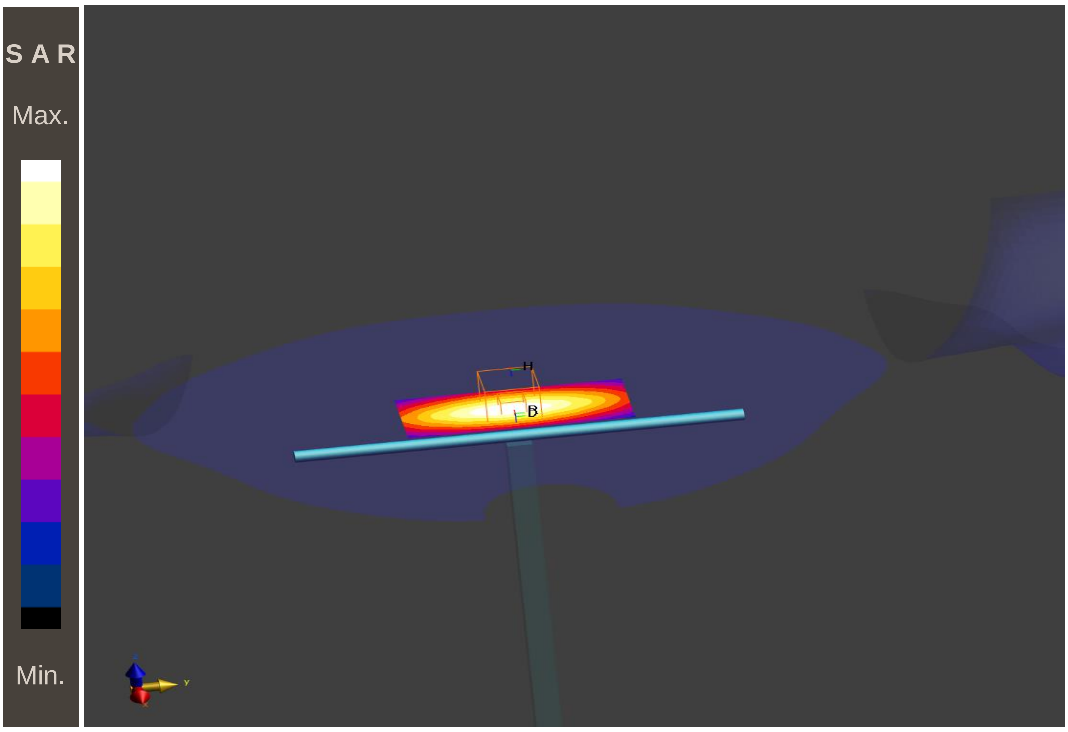
SystemPerformanceCheck-D750 HSL 2022-07-15

DUT: Dipole; Type: D750V3; Serial: SN1041

Communication System: CW; Communication System Frequency: 750.0 MHz
Medium parameters used: f = 750.0 MHz, σ = 0.911 S/m; ε_r=41.5; ρ= 1000 kg/m3
Phantom Section: Flat
Measurement Standard: DASY 8
DASY Configuration:
- Probe: EX3DV4 - SN7566; ConvF(10.23, 10.23, 10.23); Calibrated: 2021-08-16
- Sensor-Surface: 1.4 mm
- DAE: DAE4 Sn1387; Calibrated: 2021-08-06
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 1977;
- Software: DASY8 Module SAR V16.0.0.65

HBBL-600-10000/750.0MHz/Area Scan (10.0 x 15.0 x 1.0) :
Grid Extents [mm]: 40.0 x 90.0
Maximum value of SAR (interpolated) - SAR(1 g) = 0.916 W/kg; SAR(10 g) = 0.609 W/kg

HBBL-600-10000/750.0MHz/Zoom Scan (6.0 x 6.0 x 1.5) :
Grid Extents [mm]: 30.0 x 30.0 x 30.0
Power Drift = -0.03 dB
SAR(1 g) = 0.890 W/kg; SAR(10 g) = 0.579 W/kg



Additional information:
ambient temperature: 22.3°C; liquid temperature: 21.9°C;

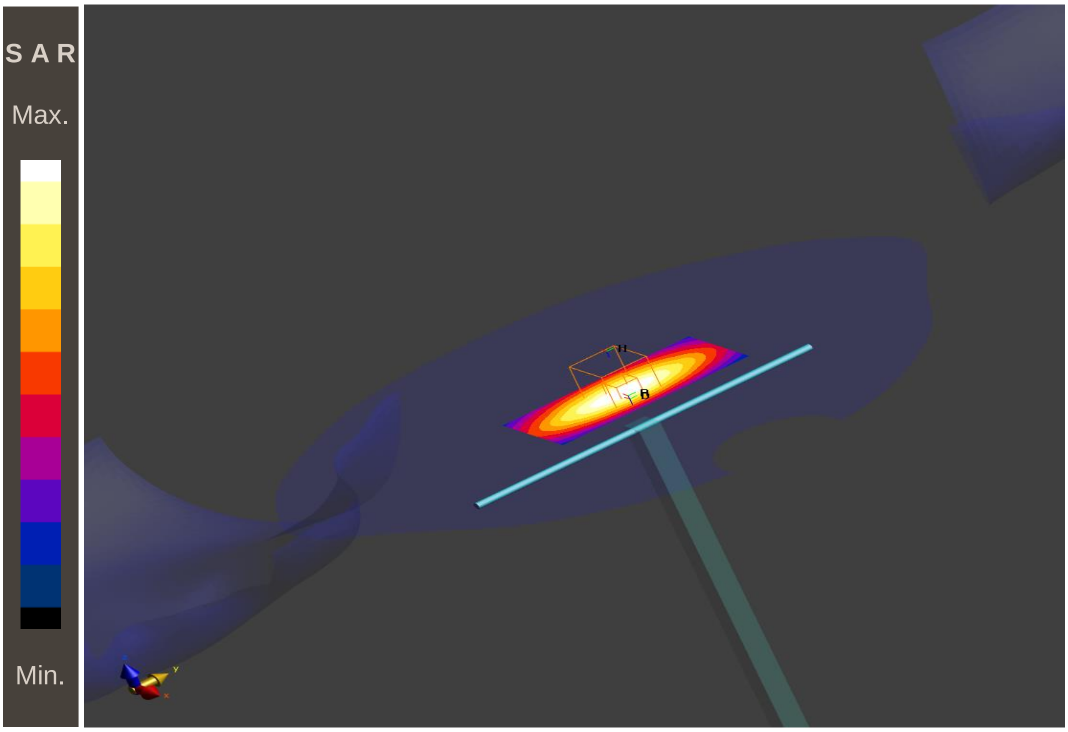
Date/Time: 2022-07-13, 07:43 2022-07-13, 07:49

SystemPerformanceCheck-D835 HSL 2022-07-13

DUT: Dipole; Type: D835V2; Serial: SN4d153
Communication System: CW; Communication System Frequency: 835.0 MHz
Medium parameters used: f = 835.0 MHz, σ = 0.934 S/m; ε_r=41.6; ρ= 1000 kg/m3
Phantom Section: Flat
Measurement Standard: DASY 6
DASY Configuration:
- Probe: EX3DV4 - SN3944; ConvF(10.17, 10.17, 10.17); Calibrated: 2022-05-17
- Sensor-Surface: 1.4 mm
- DAE: DAE3 Sn477; Calibrated: 2022-05-16
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 2061;
- Software: cDASY6 (16.0.0.116)

HBBL-600-10000/835.0MHz/Area Scan (10.0 x 15.0 x 1.0) :
Grid Extents [mm]: 40.0 x 90.0
Maximum value of SAR (interpolated) - SAR(1 g) = 0.961 W/kg; SAR(10 g) = 0.633 W/kg

HBBL-600-10000/835.0MHz/Zoom Scan (6.0 x 6.0 x 1.5) :
Grid Extents [mm]: 30.0 x 30.0 x 30.0
Power Drift = -0.02 dB
SAR(1 g) = 0.958 W/kg; SAR(10 g) = 0.628 W/kg



Additional information:
ambient temperature: 21.3°C; liquid temperature: 21.2°C;

Date/Time: 2022-07-13, 08:12 2022-07-13, 08:17

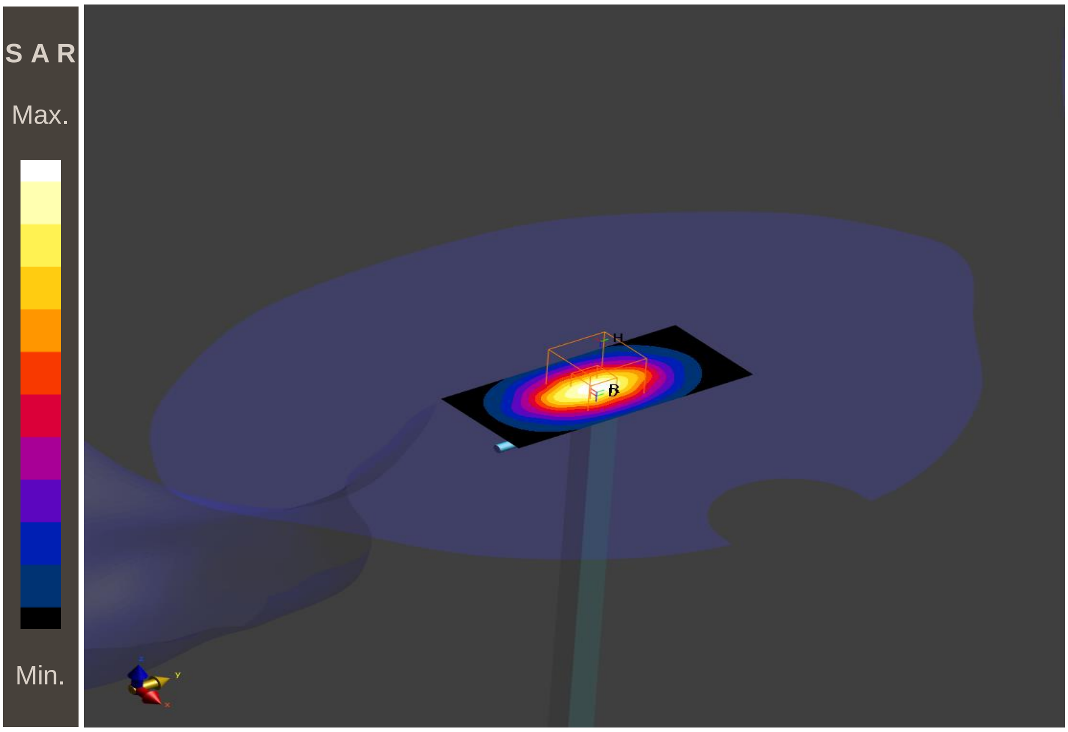
SystemPerformanceCheck-D1750 HSL 2022-07-13

DUT: Dipole; Type: D1750V2; Serial: SN1093

Communication System: CW; Communication System Frequency: 1750.0 MHz
Medium parameters used: f = 1750.0 MHz, σ = 1.33 S/m; ε_r=39.8; ρ= 1000 kg/m3
Phantom Section: Flat
Measurement Standard: DASY 8
DASY Configuration:
- Probe: EX3DV4 - SN7566; ConvF(8.58, 8.58, 8.58); Calibrated: 2021-08-16
- Sensor-Surface: 1.4 mm
- DAE: DAE4 Sn1387; Calibrated: 2021-08-06
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 1977;
- Software: DASY8 Module SAR V16.0.0.65

HBBL-600-10000/1750.0MHz/Area Scan (10.0 x 15.0 x 1.0) :
Grid Extents [mm]: 40.0 x 90.0
Maximum value of SAR (interpolated) - SAR(1 g) = 3.95 W/kg; SAR(10 g) = 2.09 W/kg

HBBL-600-10000/1750.0MHz/Zoom Scan (6.0 x 6.0 x 1.5) :
Grid Extents [mm]: 30.0 x 30.0 x 30.0
Power Drift = -0.09 dB
SAR(1 g) = 3.86 W/kg; SAR(10 g) = 2.04 W/kg



Additional information:
ambient temperature: 21.8°C; liquid temperature: 21.6°C;

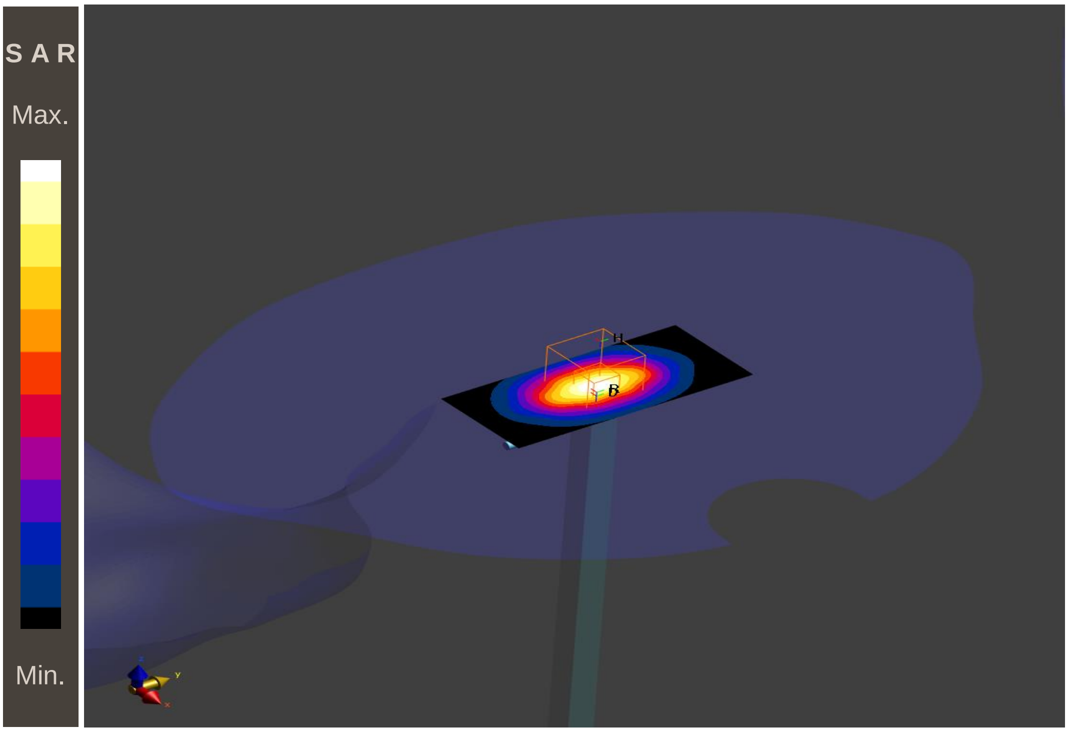
Date/Time: 2022-07-12, 10:48 2022-07-12, 10:53

SystemPerformanceCheck-D1900 HSL 2022-07-12

DUT: Dipole; Type: D1900V2; Serial: SN5d009
Communication System: CW; Communication System Frequency: 1900.0 MHz
Medium parameters used: f = 1900.0 MHz, σ = 1.42 S/m; ε_r=39.6; ρ= 1000 kg/m3
Phantom Section: Flat
Measurement Standard: DASY 8
DASY Configuration:
- Probe: EX3DV4 - SN7566; ConvF(8.2, 8.2, 8.2); Calibrated: 2021-08-16
- Sensor-Surface: 1.4 mm
- DAE: DAE4 Sn1387; Calibrated: 2021-08-06
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 1977;
- Software: DASY8 Module SAR V16.0.0.65

HBBL-600-10000/1900.0MHz/Area Scan (10.0 x 15.0 x 1.0) :
Grid Extents [mm]: 40.0 x 90.0
Maximum value of SAR (interpolated) - SAR(1 g) = 4.04 W/kg; SAR(10 g) = 2.09 W/kg

HBBL-600-10000/1900.0MHz/Zoom Scan (6.0 x 6.0 x 1.5) :
Grid Extents [mm]: 30.0 x 30.0 x 30.0
Power Drift = -0.02 dB
SAR(1 g) = 4.02 W/kg; SAR(10 g) = 2.07 W/kg



Additional information:
ambient temperature: 22.3°C; liquid temperature: 21.3°C;

Date/Time: 2022-11-07, 13:09 2022-11-07, 13:16

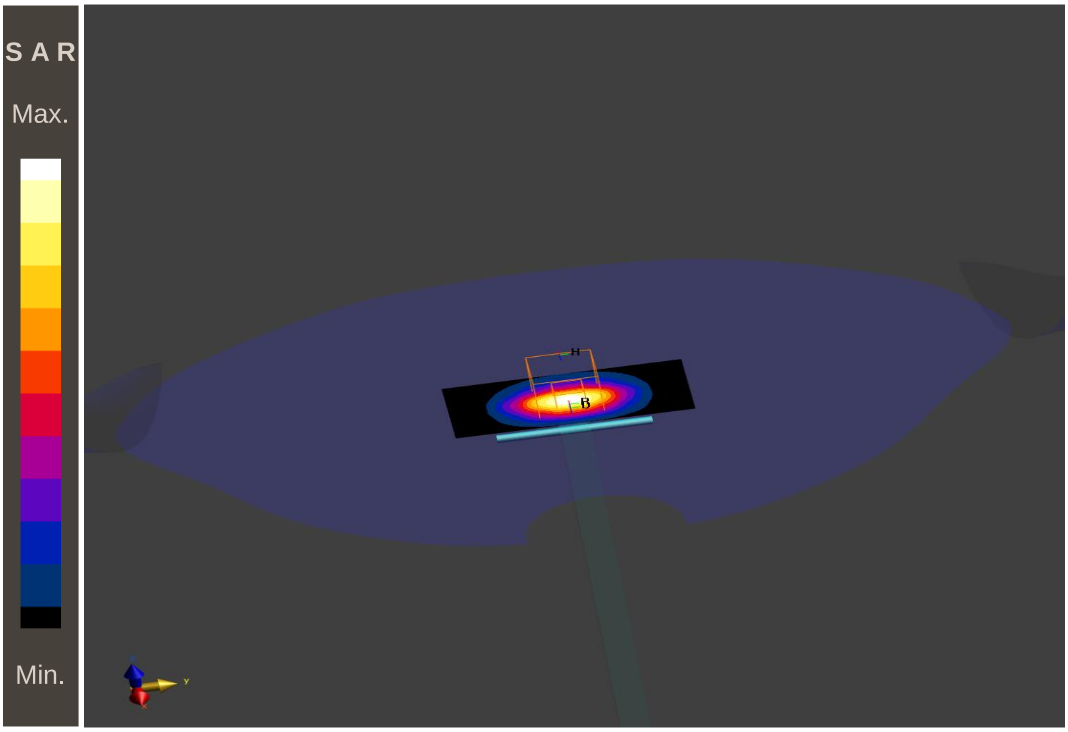
SystemPerformanceCheck-D2450 HSL 2022-11-07

DUT: Dipole; Type: D2600V2; Serial: SN1040

Communication System: CW; Communication System Frequency: 2450.0 MHz
Medium parameters used: f = 2450.0 MHz, σ = 1.80 S/m; ε_r=39.3; ρ= 1000 kg/m3
Phantom Section: Flat
Measurement Standard: DASY 6
DASY Configuration:
- Probe: EX3DV4 - SN3944; ConvF(7.97, 7.97, 7.97); Calibrated: 2022-05-17
- Sensor-Surface: 1.4 mm
- DAE: DAE3 Sn477; Calibrated: 2022-05-16
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 2061;
- Software: cDASY6 (16.0.0.116)

HBBL-600-10000/2450.0MHz/Area Scan (10.0 x 10.0 x 1.0) :
Grid Extents [mm]: 40.0 x 80.0
Maximum value of SAR (interpolated) - SAR(1 g) = 4.93 W/kg; SAR(10 g) = 2.27 W/kg

HBBL-600-10000/2450.0MHz/Zoom Scan (5.0 x 5.0 x 1.5) :
Grid Extents [mm]: 30.0 x 30.0 x 30.0
Power Drift = -0.01 dB
SAR(1 g) = 4.84 W/kg; SAR(10 g) = 2.26 W/kg



Additional information:
ambient temperature: 23.0°C; liquid temperature: 20.4°C;

Date/Time: 2022-11-08, 18:14 2022-11-08, 18:21

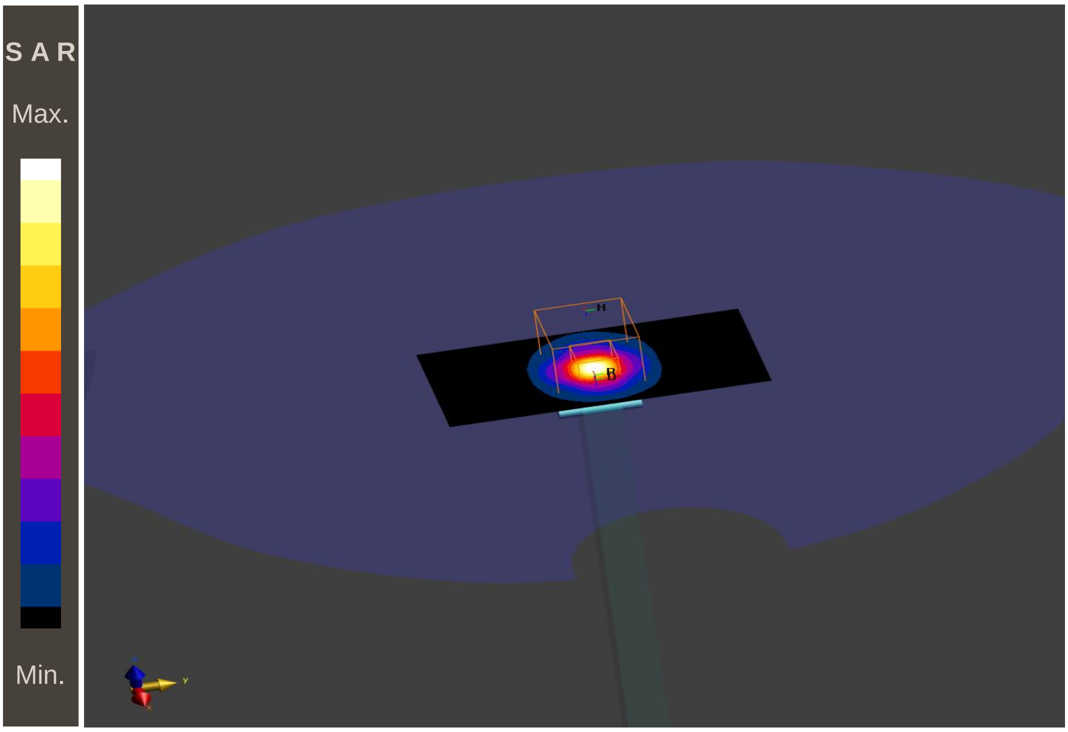
SystemPerformanceCheck-D5200 HSL 2022-11-08

DUT: Dipole; Type: D5GHzV2; Serial: SN1055

Communication System: CW; Communication System Frequency: 5200.0 MHz
Medium parameters used: f = 5200.0 MHz, σ = 4.36 S/m; ε_r=35.7; ρ= 1000 kg/m3
Phantom Section: Flat
Measurement Standard: DASY 6
DASY Configuration:
- Probe: EX3DV4 - SN3944; ConvF(5.22, 5.22, 5.22); Calibrated: 2022-05-17
- Sensor-Surface: 1.4 mm
- DAE: DAE3 Sn477; Calibrated: 2022-05-16
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 2061;
- Software: cDASY6 (16.0.0.116)

HBBL-600-10000/5200.0MHz/Area Scan (10.0 x 10.0 x 1.0) :
Grid Extents [mm]: 40.0 x 80.0
Maximum value of SAR (interpolated) - SAR(1 g) = 7.53 W/kg; SAR(10 g) = 2.14 W/kg

HBBL-600-10000/5200.0MHz/Zoom Scan (4.0 x 4.0 x 1.4) :
Grid Extents [mm]: 22.0 x 22.0 x 22.0
Power Drift = -0.03 dB
SAR(1 g) = 7.96 W/kg; SAR(10 g) = 2.30 W/kg



Additional information:
ambient temperature: 22.9°C; liquid temperature: 21.2°C;

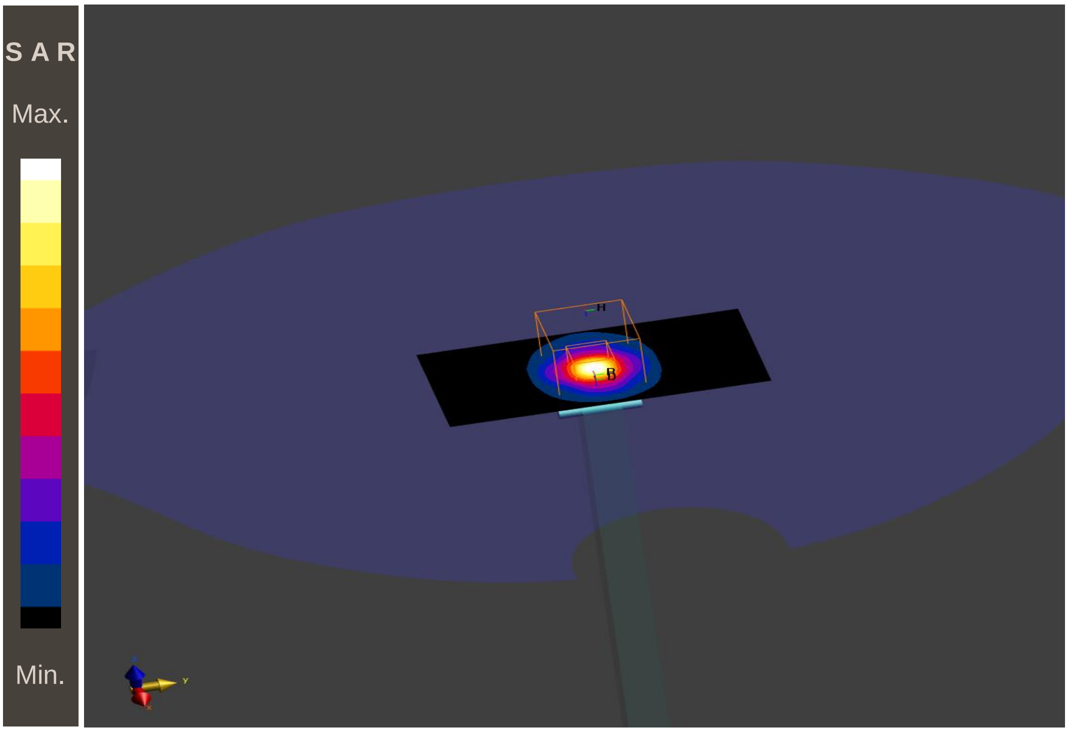
Date/Time: 2022-11-08, 18:52 2022-11-08, 18:59

SystemPerformanceCheck-D5800 HSL 2022-11-08

DUT: Dipole; Type: D5GHzV2; Serial: SN1055
Communication System: CW; Communication System Frequency: 5800.0 MHz
Medium parameters used: f = 5800.0 MHz, σ = 5.12 S/m; ε_r=34.9; ρ= 1000 kg/m3
Phantom Section: Flat
Measurement Standard: DASY 6
DASY Configuration:
- Probe: EX3DV4 - SN3944; ConvF(4.81, 4.81, 4.81); Calibrated: 2022-05-17
- Sensor-Surface: 1.4 mm
- DAE: DAE3 Sn477; Calibrated: 2022-05-16
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 2061;
- Software: cDASY6 (16.0.0.116)

HBBL-600-10000/5800.0MHz/Area Scan (10.0 x 10.0 x 1.0) :
Grid Extents [mm]: 40.0 x 80.0
Maximum value of SAR (interpolated) - SAR(1 g) = 7.72 W/kg; SAR(10 g) = 2.15 W/kg

HBBL-600-10000/5800.0MHz/Zoom Scan (4.0 x 4.0 x 1.4) :
Grid Extents [mm]: 22.0 x 22.0 x 22.0
Power Drift = -0.00 dB
SAR(1 g) = 8.24 W/kg; SAR(10 g) = 2.33 W/kg



Additional information:
ambient temperature: 22.9°C; liquid temperature: 21.2°C;

Annex B: DASY measurement results

SAR plots for **the highest measured SAR** in each exposure configuration, wireless mode and frequency band combination according to FCC KDB 865664 D02

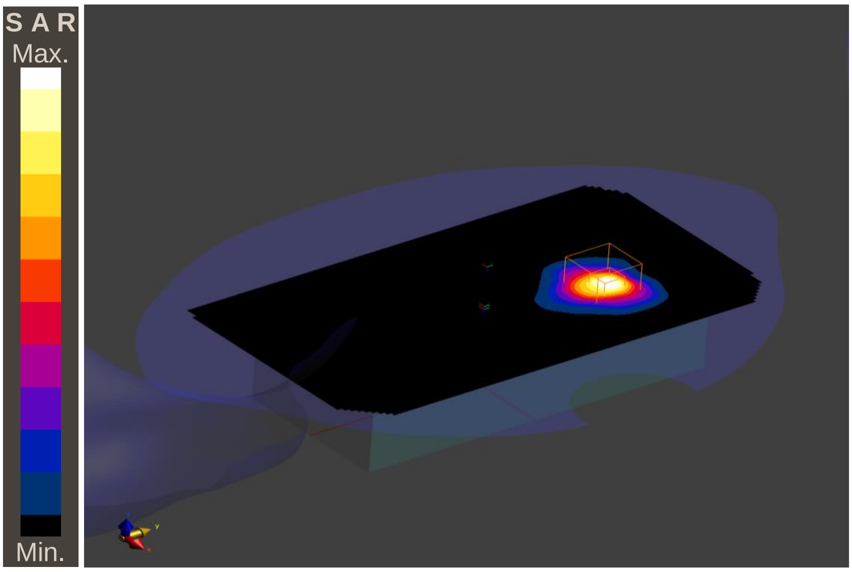
Date/Time: 2022-07-12, 17:53 2022-07-12, 18:03

IEC/IEEE 62209-1528 UMTS FDD II limb

DUT: Payment terminal; Type: Move/5000 CL/4G/WiFi; Serial: 182787303201096503249553
Communication System: UMTS-FDD (WCDMA); Communication System Band: Band 2, UTRA/FDD;
Communication System Frequency: 1852.4 MHz
Medium parameters used: f = 1852.4 MHz, σ = 1.39 S/m; ε_r=39.7; ρ= 1000 kg/m3
Phantom Section: Flat
Measurement Standard: DASY 8
DASY Configuration:
- Probe: EX3DV4 - SN7566; ConvF(8.2, 8.2, 8.2); Calibrated: 2021-08-16
- Sensor-Surface: 1.4mm
- DAE: DAE4 Sn1387; Calibrated: 2021-08-06
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 1977;
- Software: DASY8 Module SAR V16.0.0.65

HBBL-600-10000/BACK, 0 mm - Channel 9262/Area Scan (15.0 x 15.0 x 1.0) :
Grid Extents [mm]: 60.0 x 60.0
Maximum value of SAR (interpolated) - SAR(1 g) = 1.90 W/kg; SAR(10 g) = 0.844 W/kg

HBBL-600-10000/BACK, 0 mm - Channel 9262/Zoom Scan (3.75 x 3.75 x 1.5) :
Grid Extents [mm]: 30.0 x 30.0 x 30.0
Graded Grid: Ratio 1.5 - Distance Sensor to Surface 1.4 mm
Power Drift = -0.02 dB
SAR(1 g) = 1.91 W/kg; SAR(10 g) = 0.760 W/kg
Additional Info for IEC 62209-2 AMD1:
TDist 3dB Peak [mm]: 5.7
M1/M2%: 73.8



Additional information:
position or distance of DUT to SAM: 0 mm
ambient temperature: 22.3°C; liquid temperature: 21.3°C;

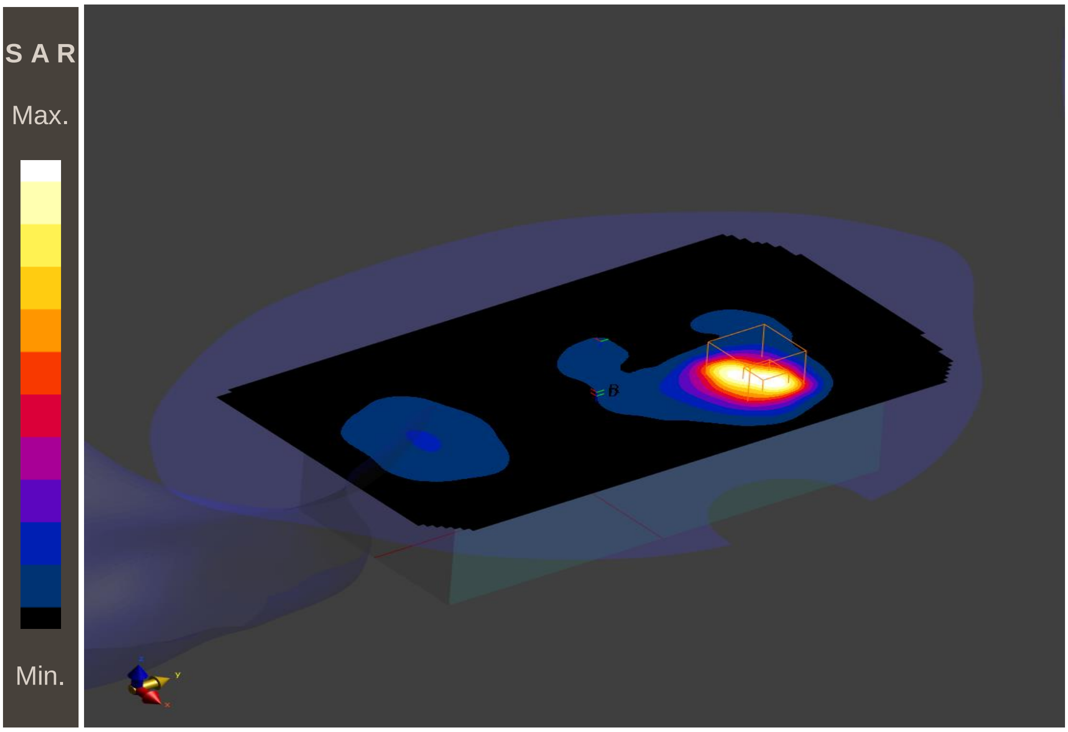
Date/Time: 2022-07-13, 09:22 2022-07-13, 09:34

IEC/IEEE 62209-1528 UMTS FDD IV limb

DUT: Payment terminal; Type: Move/5000 CL/4G/WiFi; Serial: 182787303201096503249553
Communication System: UMTS-FDD (WCDMA); Communication System Band: Band 4, UTRA/FDD;
Communication System Frequency: 1752.6 MHz
Medium parameters used: f = 1752.6 MHz, σ = 1.33 S/m; ε_r=39.8; ρ= 1000 kg/m3
Phantom Section: Flat
Measurement Standard: DASY 8
DASY Configuration:
- Probe: EX3DV4 - SN7566; ConvF(8.58, 8.58, 8.58); Calibrated: 2021-08-16
- Sensor-Surface: 1.4mm
- DAE: DAE4 Sn1387; Calibrated: 2021-08-06
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 1977;
- Software: DASY8 Module SAR V16.0.0.65

HBBL-600-10000/BACK, 0 mm - Channel 1513/Area Scan (15.0 x 15.0 x 1.0) :
Grid Extents [mm]: 60.0 x 60.0
Maximum value of SAR (interpolated) - SAR(1 g) = 1.65 W/kg; SAR(10 g) = 0.823 W/kg

HBBL-600-10000/BACK, 0 mm - Channel 1513/Zoom Scan (3.75 x 3.75 x 1.5) :
Grid Extents [mm]: 30.0 x 30.0 x 30.0
Graded Grid: Ratio 1.5 - Distance Sensor to Surface 1.4 mm
Power Drift = -0.09 dB
SAR(1 g) = 1.84 W/kg; SAR(10 g) = 0.757 W/kg
Additional Info for IEC 62209-2 AMD1:
TDist 3dB Peak [mm]: 6.7
M1/M2%: 73.2



Additional information:
position or distance of DUT to SAM: 0 mm
ambient temperature: 22.1°C; liquid temperature: 21.6°C;

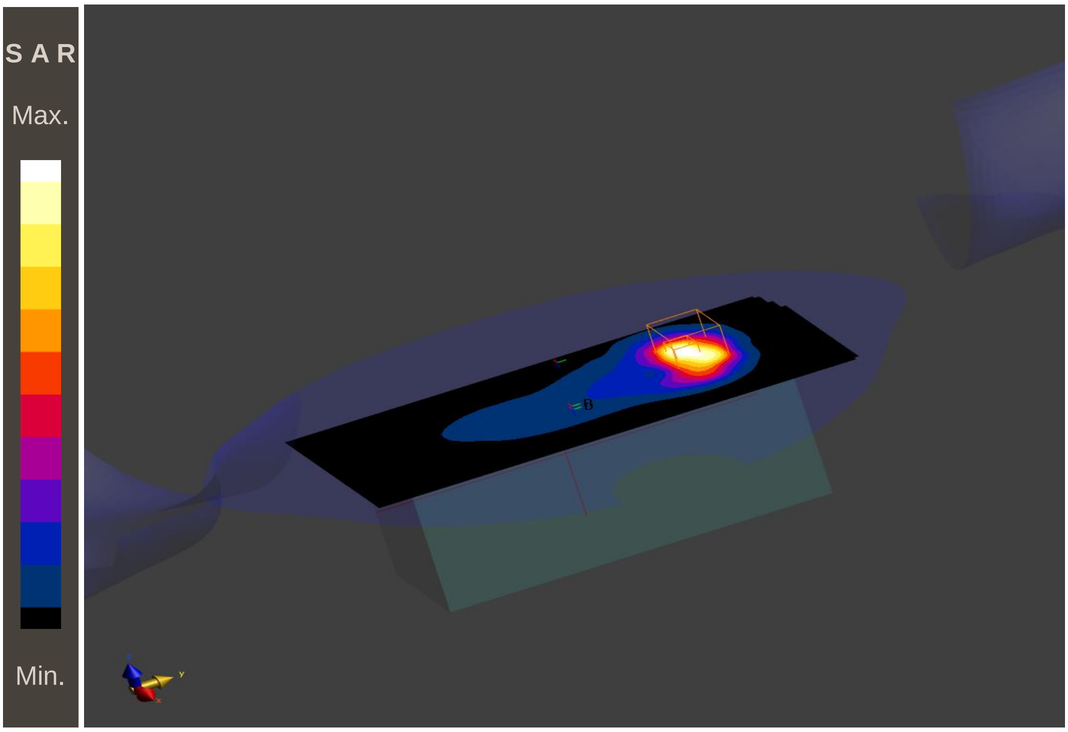
Date/Time: 2022-07-13, 13:11 2022-07-13, 13:24

IEC/IEEE 62209-1528 UMTS FDD V limb

DUT: Payment terminal; Type: Move/5000 CL/4G/WiFi; Serial: 182787303201096503249553
Communication System: UMTS-FDD (WCDMA); Communication System Band: Band 5, UTRA/FDD;
Communication System Frequency: 826.4 MHz
Medium parameters used: f = 826.4 MHz, σ = 0.931 S/m; ε_r=41.6; ρ= 1000 kg/m3
Phantom Section: Flat
Measurement Standard: DASY 6
DASY Configuration:
- Probe: EX3DV4 - SN3944; ConvF(10.17, 10.17, 10.17); Calibrated: 2022-05-17
- Sensor-Surface: 1.4mm
- DAE: DAE3 Sn477; Calibrated: 2022-05-16
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 2061;
- Software: cDASY6 (16.0.0.116)

HBBL-600-10000/EDGE LEFT, 0 mm - Channel 4132/Area Scan (15.0 x 15.0 x 1.0) :
Grid Extents [mm]: 60.0 x 60.0
Maximum value of SAR (interpolated) - SAR(1 g) = 1.06 W/kg; SAR(10 g) = 0.578 W/kg

HBBL-600-10000/EDGE LEFT, 0 mm - Channel 4132/Zoom Scan (3.75 x 3.75 x 1.5) :
Grid Extents [mm]: 30.0 x 30.0 x 30.0
Graded Grid: Ratio 1.5 - Distance Sensor to Surface 1.4 mm
Power Drift = 0.05 dB
SAR(1 g) = 1.10 W/kg; SAR(10 g) = 0.502 W/kg
Additional Info for IEC 62209-2 AMD1:
TDist 3dB Peak [mm]: 6.7
M1/M2%: 74.4



Additional information:
position or distance of DUT to SAM: 0 mm
ambient temperature: 22.2°C; liquid temperature: 21.2°C;

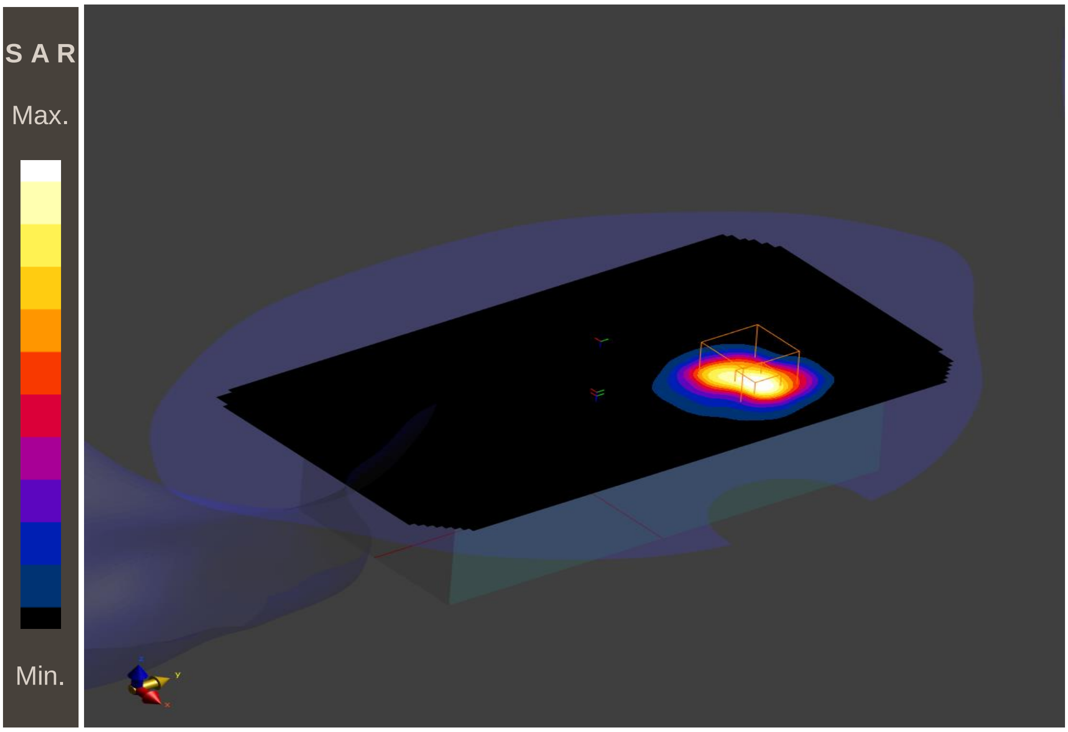
Date/Time: 2022-07-12, 16:36 2022-07-12, 16:48

IEC/IEEE 62209-1528 LTE FDD 2 limb

DUT: Payment terminal; Type: Move/5000 CL/4G/WiFi; Serial: 182787303201096503249553
Communication System: LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK) RBPosition:Low AntennaCfg:SISO;
Communication System Band: Band 2, E-UTRA/FDD; Communication System Frequency: 1860.0 MHz
Medium parameters used: f = 1860.0 MHz, σ = 1.39 S/m; ε_r=39.7; ρ= 1000 kg/m3
Phantom Section: Flat
Measurement Standard: DASY 8
DASY Configuration:
- Probe: EX3DV4 - SN7566; ConvF(8.2, 8.2, 8.2); Calibrated: 2021-08-16
- Sensor-Surface: 1.4mm
- DAE: DAE4 Sn1387; Calibrated: 2021-08-06
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 1977;
- Software: DASY8 Module SAR V16.0.0.65

HBBL-600-10000/BACK, 0 mm - Channel 18700/Area Scan (15.0 x 15.0 x 1.0) :
Grid Extents [mm]: 120.0 x 210.0
Maximum value of SAR (interpolated) - SAR(1 g) = 1.18 W/kg; SAR(10 g) = 0.574 W/kg

HBBL-600-10000/BACK, 0 mm - Channel 18700/Zoom Scan (3.75 x 3.75 x 1.5) :
Grid Extents [mm]: 30.0 x 30.0 x 30.0
Graded Grid: Ratio 1.5 - Distance Sensor to Surface 1.4 mm
Power Drift = -0.04 dB
SAR(1 g) = 1.34 W/kg; SAR(10 g) = 0.545 W/kg
Additional Info for IEC 62209-2 AMD1:
TDist 3dB Peak [mm]: 6.0
M1/M2%: 73.8



Additional information:
position or distance of DUT to SAM: 0 mm
ambient temperature: 22.3°C; liquid temperature: 21.3°C;

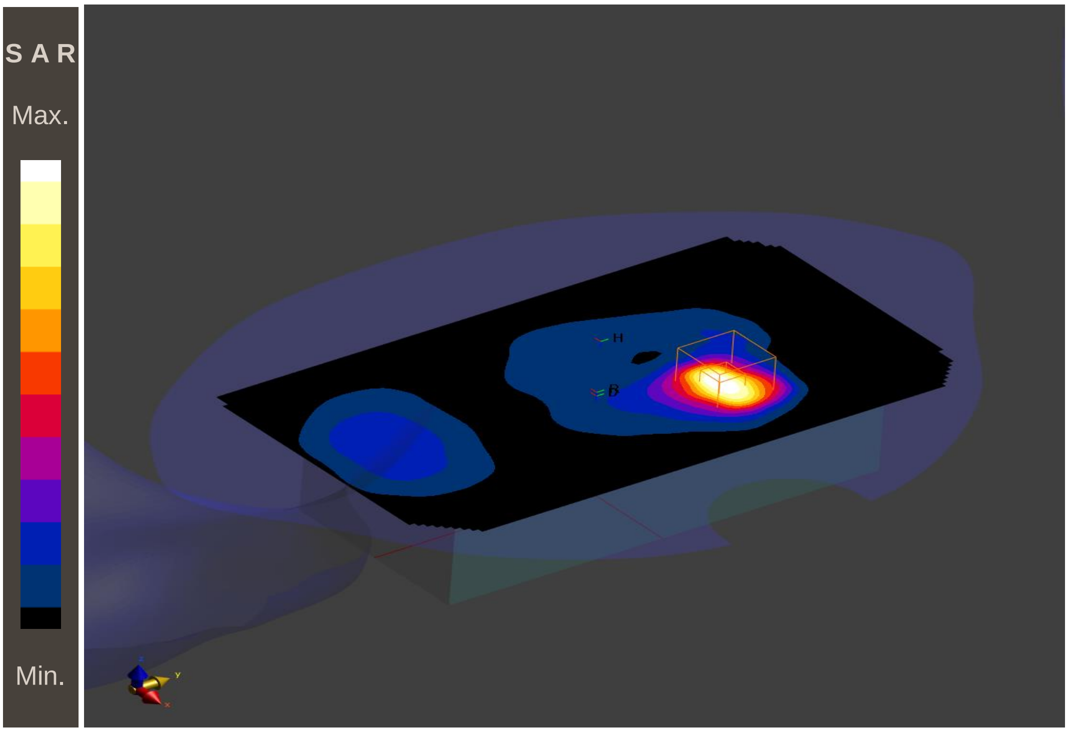
Date/Time: 2022-07-13, 12:18 2022-07-13, 12:28

IEC/IEEE 62209-1528 LTE FDD 4 limb

DUT: Payment terminal; Type: Move/5000 CL/4G/WiFi; Serial: 182787303201096503249553
Communication System: LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK) RBPosition:Low AntennaCfg:SISO;
Communication System Band: Band 4, E-UTRA/FDD; Communication System Frequency: 1745.0 MHz
Medium parameters used: f = 1745.0 MHz, σ = 1.33 S/m; ε_r=39.8; ρ= 1000 kg/m3
Phantom Section: Flat
Measurement Standard: DASY 8
DASY Configuration:
- Probe: EX3DV4 - SN7566; ConvF(8.58, 8.58, 8.58); Calibrated: 2021-08-16
- Sensor-Surface: 1.4mm
- DAE: DAE4 Sn1387; Calibrated: 2021-08-06
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 1977;
- Software: DASY8 Module SAR V16.0.0.65

HBBL-600-10000/BACK, 0 mm - Channel 20300/Area Scan (15.0 x 15.0 x 1.0) :
Grid Extents [mm]: 60.0 x 60.0
Maximum value of SAR (interpolated) - SAR(1 g) = 1.42 W/kg; SAR(10 g) = 0.719 W/kg

HBBL-600-10000/BACK, 0 mm - Channel 20300/Zoom Scan (3.75 x 3.75 x 1.5) :
Grid Extents [mm]: 30.0 x 30.0 x 30.0
Graded Grid: Ratio 1.5 - Distance Sensor to Surface 1.4 mm
Power Drift = -0.02 dB
SAR(1 g) = 1.62 W/kg; SAR(10 g) = 0.628 W/kg
Additional Info for IEC 62209-2 AMD1:
TDist 3dB Peak [mm]: 4.8
M1/M2%: 73.6



Additional information:
position or distance of DUT to SAM: 0 mm
ambient temperature: 22.1°C; liquid temperature: 21.6°C;

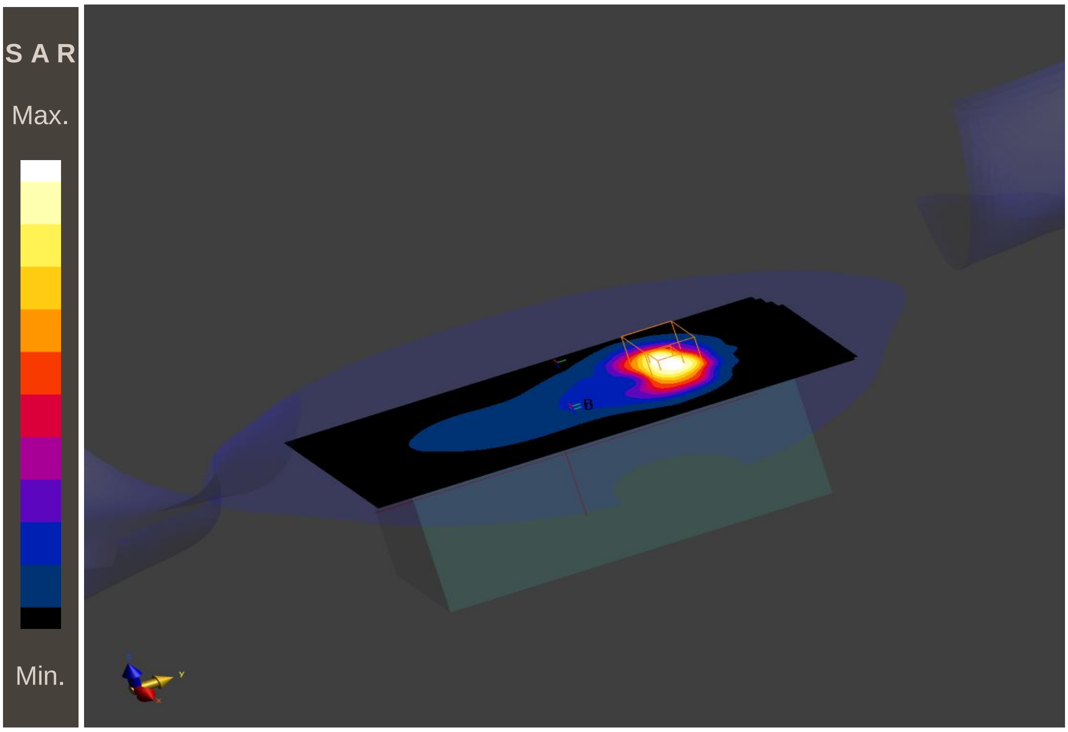
Date/Time: 2022-07-13, 14:26 2022-07-13, 14:40

IEC/IEEE 62209-1528 LTE FDD 5 limb

DUT: Payment terminal; Type: Move/5000 CL/4G/WiFi; Serial: 182787303201096503249553
Communication System: LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK) RBPosition:Mid AntennaCfg:SISO;
Communication System Band: Band 5, E-UTRA/FDD; Communication System Frequency: 829.0 MHz
Medium parameters used: f = 829.0 MHz, σ = 0.932 S/m; ε_r=41.6; ρ= 1000 kg/m3
Phantom Section: Flat
Measurement Standard: DASY 6
DASY Configuration:
- Probe: EX3DV4 - SN3944; ConvF(10.17, 10.17, 10.17); Calibrated: 2022-05-17
- Sensor-Surface: 1.4mm
- DAE: DAE3 Sn477; Calibrated: 2022-05-16
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 2061;
- Software: cDASY6 (16.0.0.116)

HBBL-600-10000/EDGE LEFT, 0 mm - Channel 20450/Area Scan (15.0 x 15.0 x 1.0) :
Grid Extents [mm]: 60.0 x 60.0
Maximum value of SAR (interpolated) - SAR(1 g) = 1.01 W/kg; SAR(10 g) = 0.546 W/kg

HBBL-600-10000/EDGE LEFT, 0 mm - Channel 20450/Zoom Scan (3.75 x 3.75 x 1.5) :
Grid Extents [mm]: 30.0 x 30.0 x 30.0
Graded Grid: Ratio 1.5 - Distance Sensor to Surface 1.4 mm
Power Drift = 0.02 dB
SAR(1 g) = 0.997 W/kg; SAR(10 g) = 0.454 W/kg
Additional Info for IEC 62209-2 AMD1:
TDist 3dB Peak [mm]: 6.7
M1/M2%: 72.8



Additional information:
position or distance of DUT to SAM: 0 mm
ambient temperature: 22.3°C; liquid temperature: 21.2°C;

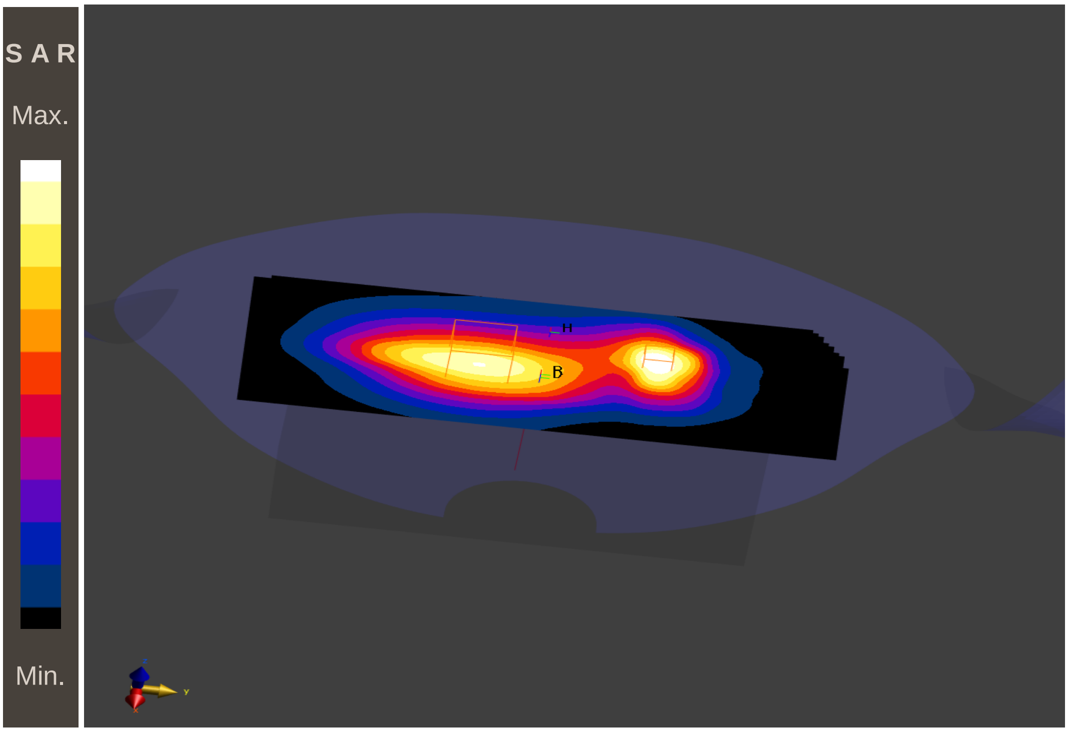
Date/Time: 2022-07-15, 14:04 2022-07-15, 14:09

IEC/IEEE 62209-1528 LTE FDD 12 limb

DUT: Payment terminal; Type: Move/5000 CL/4G/WiFi; Serial: 182787303201096503249553
Communication System: LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK) RBPosition:Low AntennaCfg:SISO;
Communication System Band: Band 12, E-UTRA/FDD; Communication System Frequency: 711.0 MHz
Medium parameters used: f = 711.0 MHz, σ = 0.897 S/m; ε_r=41.6; ρ= 1000 kg/m3
Phantom Section: Flat
Measurement Standard: DASY 8
DASY Configuration:
- Probe: EX3DV4 - SN7566; ConvF(10.23, 10.23, 10.23); Calibrated: 2021-08-16
- Sensor-Surface: 1.4mm
- DAE: DAE4 Sn1387; Calibrated: 2021-08-06
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 1977;
- Software: DASY8 Module SAR V16.0.0.65

HBBL-600-10000/EDGE LEFT, 5 mm - Channel 23130/Area Scan (15.0 x 15.0 x 1.0) :
Grid Extents [mm]: 60.0 x 60.0
Maximum value of SAR (interpolated) - SAR(1 g) = 1.04 W/kg; SAR(10 g) = 0.612 W/kg

HBBL-600-10000/EDGE LEFT, 5 mm - Channel 23130/Zoom Scan (6.0 x 6.0 x 1.5) :
Grid Extents [mm]: 30.0 x 30.0 x 30.0
Graded Grid: Ratio 1.5 - Distance Sensor to Surface 1.4 mm
Power Drift = -0.01 dB
SAR(1 g) = 0.990 W/kg; SAR(10 g) = 0.502 W/kg
Additional Info for IEC 62209-2 AMD1:
TDist 3dB Peak [mm]: 7.3
M1/M2%: 73.8



Additional information:
position or distance of DUT to SAM: 5 mm
ambient temperature: 22.3°C; liquid temperature: 21.9°C;

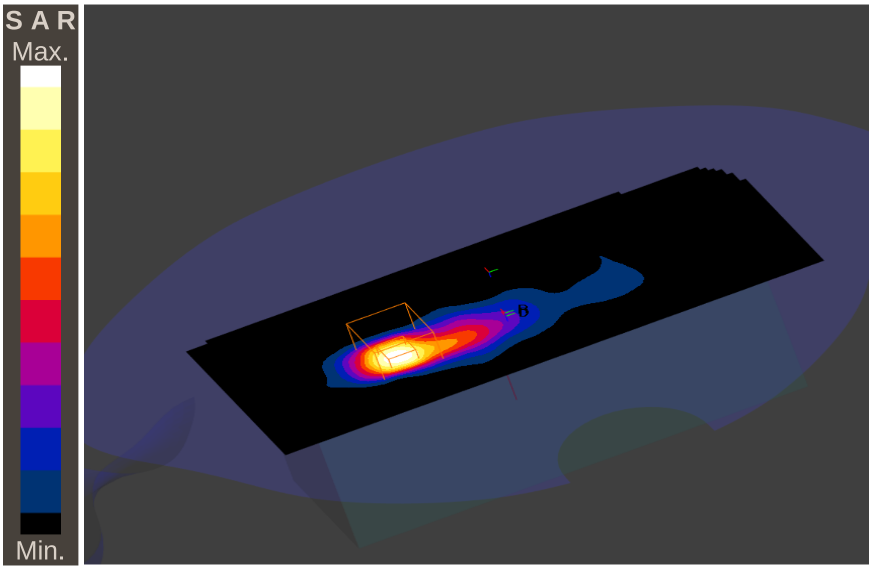
Date/Time: 2022-11-07, 15:02 2022-11-07, 15:14

IEC/IEEE 62209-1528 WLAN2450MHz limb

DUT: Payment terminal; Type: Move/5000 CL/4G/WiFi; Serial: 182787303201096503249553
Communication System: IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle);
Communication System Band: WLAN 2.4GHz; Communication System Frequency: 2437.0 MHz
Medium parameters used: f = 2437.0 MHz, σ = 1.78 S/m; εr=39.3; ρ= 1000 kg/m3
Phantom Section: Flat
Measurement Standard: DASY 6
DASY Configuration:
- Probe: EX3DV4 - SN3944; ConvF(7.97, 7.97, 7.97); Calibrated: 2022-05-17
- Sensor-Surface: 1.4mm
- DAE: DAE3 Sn477; Calibrated: 2022-05-16
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 2061;
- Software: cDASY6 (16.0.0.116)

HBBL-600-10000/EDGE LEFT, 0 mm - Channel 6/Area Scan (10.0 x 10.0 x 1.0) :
Grid Extents [mm]: 80.0 x 200.0
Maximum value of SAR (interpolated) - SAR(1 g) = 0.125 W/kg; SAR(10 g) = 0.052 W/kg

HBBL-600-10000/EDGE LEFT, 0 mm - Channel 6/Zoom Scan (3.75 x 3.75 x 1.5) :
Grid Extents [mm]: 30.0 x 30.0 x 30.0
Graded Grid: Ratio 1.5 - Distance Sensor to Surface 1.4 mm
Power Drift = 0.00 dB
SAR(1 g) = 0.128 W/kg; SAR(10 g) = 0.049 W/kg
Additional Info for IEC 62209-2 AMD1:
TDist 3dB Peak [mm]: 6.4
M1/M2%: 75.5



Additional information:
position or distance of DUT to SAM: 0 mm
ambient temperature: 22.3°C; liquid temperature: 20.4°C;

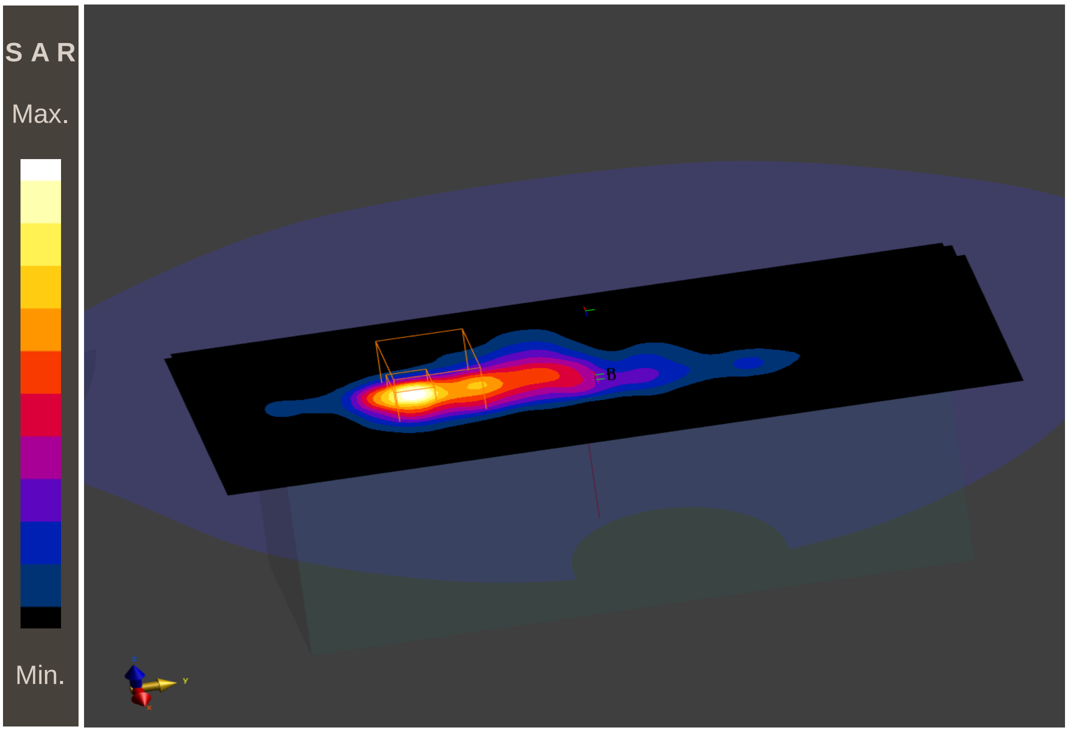
Date/Time: 2022-11-08, 15:01 2022-11-08, 15:16

IEC/IEEE 62209-1528 WLAN 5 GHz limb

DUT: Payment terminal; Type: Move/5000 CL/4G/WiFi; Serial: 182787303201096503249553
Communication System: IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 99pc duty cycle);
Communication System Band: WLAN 5GHz; Communication System Frequency: 5240.0 MHz
Medium parameters used: f = 5240.0 MHz, σ = 4.40 S/m; ε_r=35.7; ρ= 1000 kg/m3
Phantom Section: Flat
Measurement Standard: DASY 6
DASY Configuration:
- Probe: EX3DV4 - SN3944; ConvF(5.22, 5.22, 5.22); Calibrated: 2022-05-17
- Sensor-Surface: 1.4mm
- DAE: DAE3 Sn477; Calibrated: 2022-05-16
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 2061;
- Software: cDASY6 (16.0.0.116)

HBBL-600-10000/EDGE LEFT, 0 mm - Channel 48/Area Scan (10.0 x 10.0 x 1.0) :
Grid Extents [mm]: 80.0 x 200.0
Maximum value of SAR (interpolated) - SAR(1 g) = 0.405 W/kg; SAR(10 g) = 0.135 W/kg

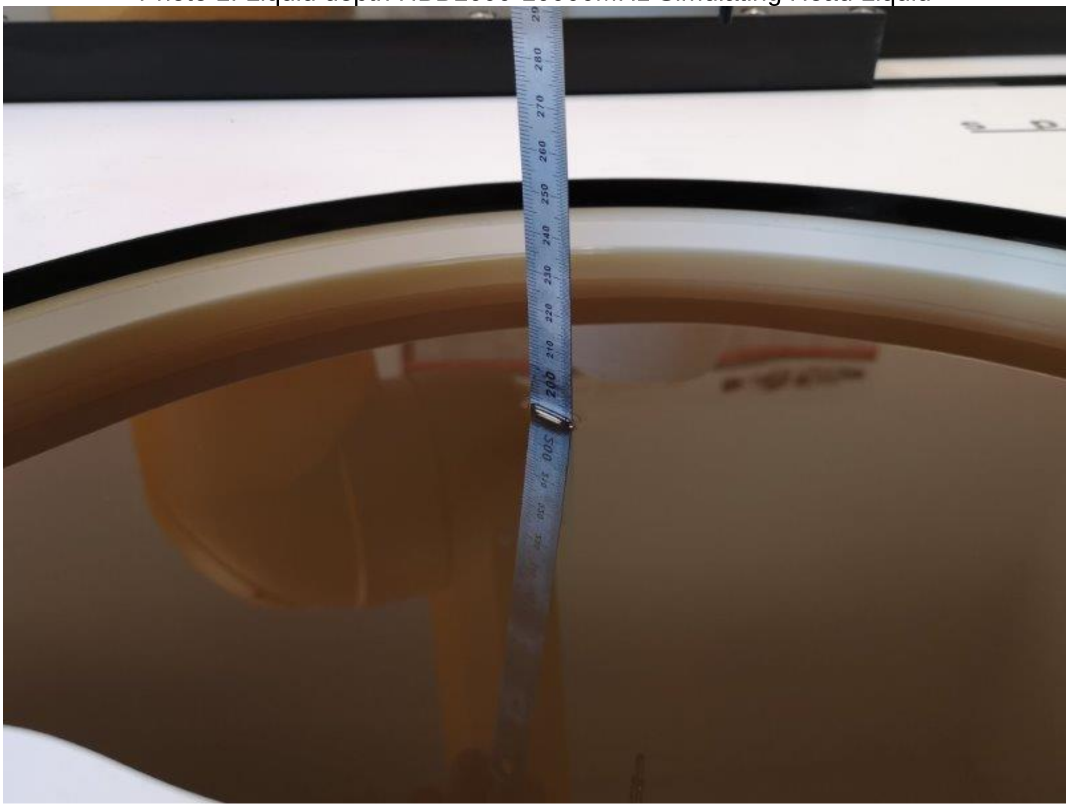
HBBL-600-10000/EDGE LEFT, 0 mm - Channel 48/Zoom Scan (3.75 x 3.75 x 1.4) :
Grid Extents [mm]: 22.0 x 22.0 x 22.0
Graded Grid: Ratio 1.4 - Distance Sensor to Surface 1.4 mm
Power Drift = 0.01 dB
SAR(1 g) = 0.450 W/kg; SAR(10 g) = 0.138 W/kg
Additional Info for IEC 62209-2 AMD1:
TDist 3dB Peak [mm]: 6.2
M1/M2%: 67.6



Additional information:
position or distance of DUT to SAM: 0 mm
ambient temperature: 22.6°C; liquid temperature: 21.2°C;

Annex B.1: Liquid depth

Photo 1: Liquid depth HBBL600-10000MHz Simulating Head Liquid



Annex C: Photo documentation

Photo documentation is described in the additional document:

Appendix to test report no. 1-4085/22-01-03-A Photo documentation

Annex D: Calibration parameters

Calibration parameters are described in the additional document:

Appendix to test report no. 1-4085/22-01-03-A
Calibration data, Phantom certificate
and detail information of the DASY System

Annex E: RSS-102 Annex A1

ISEDRF documents are described in the additional document:

Appendix to test report no. 1-4085/22-01-03-A_ISEDRF
RF Technical Brief Cover Sheet acc. To RSS-102 Annex A1.

Annex F: Document History

Version	Applied Changes	Date of Release
	Initial Release	2022-07-20
-A	WLAN 2450 MHz re-measured and WLAN 5 GHz measurements added.	2022-11-30

Annex G: Further Information

Glossary

BW	-	Bandwidth
DTS	-	Distributed Transmission System
DUT	-	Device under Test
EUT	-	Equipment under Test
FCC	-	Federal Communication Commission
FCC ID	-	Company Identifier at FCC
HW	-	Hardware
Inv. No.	-	Inventory number
ISED	-	Innovation, Science and Economic Development Canada
LTE	-	Long Term Evolution
N/A	-	not applicable
OET	-	Office of Engineering and Technology
RB	-	resource block(s)
SAR	-	Specific Absorption Rate
S/N	-	Serial Number
SW	-	Software
UNII	-	Unlicensed National Information Infrastructure