

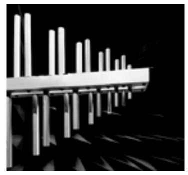
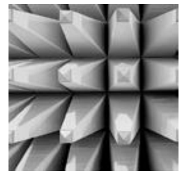

FCC SAR Test Report

Test report no.: 17-1-0172601T25a-C2

DAkkS
Deutsche Akkreditierungsstelle
D-PL-12047-01-01
D PL 12047 01 03
D-PL-12047-01-04

Testing Laboratory

CETECOM GmbH
Im Teelbruch 116
45219 Essen / Germany

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Accredited Test Laboratory:
The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 by the Deutsche Akkreditierungsstelle GmbH (DakkS)
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number: D-PL-12047-01-01

Applicant

Robert Bosch Tool Corporation

1800 W, Central Road
Mount Prospect
IL, 60056 USA
Contact: Mr. Gerard Pasciak

Manufacturer

Robert Bosch Power Tools GmbH

70538, Stuttgart
Germany
Contact: Mr. Thomas Moser

Test Standard/s

FCC 47CFR §2.1093: Radiofrequency radiation exposure evaluation: portable devices.
For further applied test standards please refer to the test standards/ procedures references of this test report.
RSS-102 Issue 5: Radio Frequency Exposure Compliance of Radio communication Apparatus (All Frequency Bands) Issue 5 of March 2015.
For further applied test standards please refer to section 3 of this report

Test Item

Kind of test item:	LTE USB Modem
Model name:	MI2C001-001-US
FCC ID:	TXTGSH27
ISED:	909H-GSH27
S/N serial number:	IMEI-No: 352753090048834
Hardware status:	MI2C001-001-US#200
Software status:	Doberman-intern-US-1.0.0
Frequency:	see technical details
Antenna:	integrated antenna
Battery option:	integrated battery
Device type:	portable device
Test sample status:	identical prototype
Exposure category:	general population / uncontrolled environment

Revision History

Version	Date	Comments	Revised By
V1	19/7/2018	Initial Issue	Marc Schäfers
C1	25/03/2019	Maximum SAR values added for LTE B02, B05 and B12, additional comments for testing added, test channel corrected	Ninovic Perez
C2	29/04/2019	Applicant changed	Yeliz Böyük

Table of Contents

1 Summary of Measurement Results

1.1 Test measurement overview

☒	**No deviations from the technical specifications ascertained**
☐	Deviations from the technical specifications ascertained

Maximum SAR value reported (W/kg)		
LTE Band	**Body**	**Limbs**
2	0.489	0.243
4	1.310	0.642
5	0.158	0.111
12	0.247	0.165

1.2 Attestation

I declare that all measurements were performed by me or under my supervision and that all measurements have been performed and are correct to my best knowledge and belief to Innovation, Science and Economic Development (ISED) Canada standards. All requirements as shown in chapter 3.1 are met in accordance with enumerated standards.

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

The current version of the Test Report CETECOM_TR17-1-0172601T25a-C2 replaces the Test Report CETECOM_ TR17-1-0172601T25-C1 dated 2019-03-25. The replaced test report is herewith invalid.

Dipl.-Ing. Niels Jeß
Responsible for test section

Marc Schäfers
Responsible for test report

2 General information

2.1 Test Lab information

The test facility is recognized, certified, or accredited by the following organizations:

1	**VCCI:** CETECOM GmbH has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-2666 C-2914, C2914, T-1967, and G-301 respectively.	Voluntary Controls for Electromagnetic Emissions Reg. No.: R-2666 C-2914, T-1967, G-301
2	**Wi-Fi:** CETECOM GmbH has been recognized as an accredited testing laboratory.	AUTHORIZED RF LABORATORY
3	**CTIA:** CETECOM GmbH has been recognized as an accredited testing laboratory. Lab Code: 20011130-00	Authorized™ Test Lab Lab Code: 20011130-00

2.2 Application details

Date of receipt of test item: 2018-4-09
Start of test: 2018-7-13
End of test: 2018-7-19
Date of report: 2019-4-29
Person(s) present during the test: Marc Schäfers

2.3 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.

Ambient temperature:	20 – 24 °C
Tissue Simulating liquid:	20 – 24 °C
Relative humidity content:	30 – 70 %
Air pressure:	not relevant for this kind of testing

Exact temperature values for each test are shown in the table(s) under 7.2 and/or on the measurement plots.

2.4 Notes and disclaimer

This test report is electronically signed and valid without handwriting signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory. The testing service provided by CETECOM GmbH has been rendered under the current "General Terms and Conditions for CETECOM GmbH". CETECOM GmbH will not be liable for any loss or damage resulting from false, inaccurate, inappropriate or incomplete product information provided by the customer. Under no circumstances does the CETECOM GmbH test report include any endorsement or warranty regarding the functionality, quality or performance of any other product or service provided. Under no circumstances does the CETECOM GmbH test report include or imply any product or service warranties from CETECOM GmbH, including, without limitation, any implied warranties of merchantability, fitness for purpose, or non-infringement, all of which are expressly disclaimed by CETECOM GmbH. All rights and remedies regarding vendor's products and services for which CETECOM GmbH has prepared this test report shall be provided by the party offering such products or services and not by CETECOM GmbH. In no case this test report can be considered as a Letter of Approval.

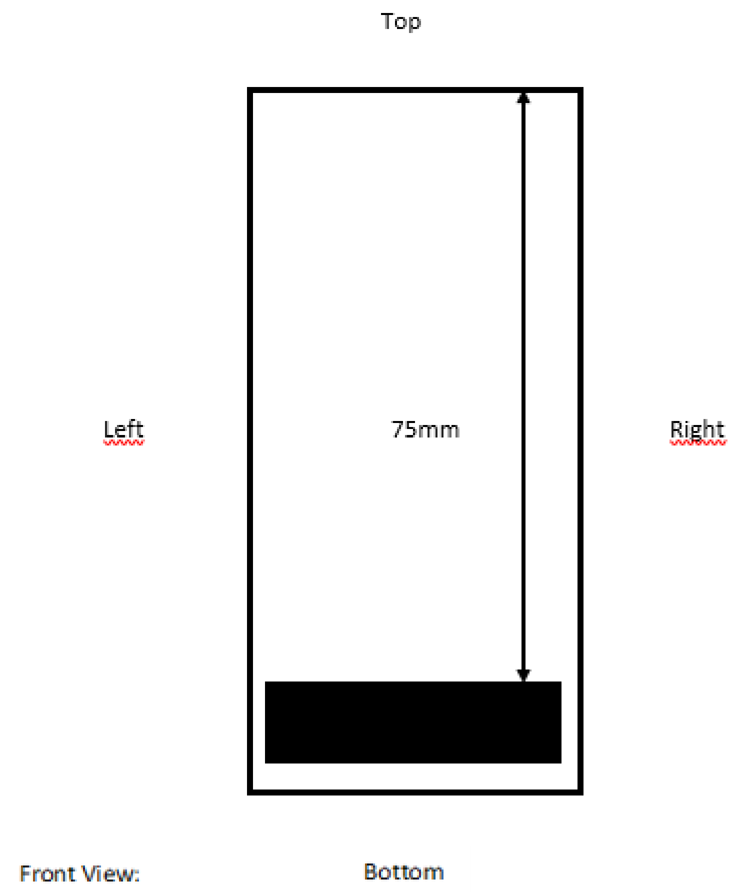
2.5 Statement of compliance

The SAR values found for the DUT are below the maximum recommended levels of 1.6 W/Kg as averaged over any 1 g tissue according to the FCC rule §2.1093, the ANSI/IEEE C 95.1:1992, the NCRP Report Number 86 for uncontrolled environment for General Population/Uncontrolled exposure.

2.6 DUT Technical details

Device Type :	portable device		
Exposure Category:	uncontrolled environment / general population		
Product Name:	LTE USB Modem		
Model No.(EUT):	**MI2C001-001-US**		
FCC ID:	TXTGSH27		
ISED:	909H-GSH27		
Product Phase:	identical prototype		
SN:	IMEI-No: 352753090048834		
Hardware Version:	MI2C001-001-US#200		
Software Version:	Doberman-intern-US-1.0.0		
Antenna Details :	Integrated antenna		
ANT1 Gain (Peak)	Band-12# 699-716MHz Band: (-2,22) dBi Band-5# 824-849MHz Band: (-2,22) dBi Band-4# 1710-1755MHz Band: 0.5 dBi Band-2# 1850-1909MHz Band: 0.5 dBi (According to Applicants Declaration)		
Device Operating Configurations :			
Modulation Mode:	QPSK, 16-QAM		
Frequency Bands:	Band	Tx (MHz)	Rx (MHz)
	LTE Band 2	1850 - 1910	1930-1990
	LTE Band 4	1710 – 1755	2110 - 2155
	LTE Band 5	824 - 849	869-894
	LTE Band 12	699 - 716	729 - 746
Battery Information:	Model: ABI-L18650-1S1P		
	Rated capacity :2500mAh		
	Battery Type :Rechargeable Li-ion Battery		
	Manufacturer: Alium Batteries		

2.6.1 DUT Antenna(s) Location



EUT Sides for SAR Testing(Main Antenna)						
Mode	Front	Back	Left	Right	Top	Bottom
LTE FDD	No	Yes	Yes	Yes	No	Yes

Table 1： EUT Sides for SAR Testing

Front and Top side was not tested because distance to antenna > 25mm.

3 Test standards/ procedures references

3.1 Test standards

Test Standard	Test Standard Description
FCC 47CFR §2.1093	Radiofrequency Radiation Exposure Evaluation: Portable Devices
IEEE Std C95.1 – 1991	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz – 300 GHz.
IEEE 1528-2013	Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
RSS-102	Radio Frequency Exposure Compliance of Radio communication Apparatus (All Frequency Bands) Issue 5 of March 2015
Canada's Safety Code 6	Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz (99-EHD-237)
IEC 62209-2	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)
KDB447498 D01 General RF Exposure Guidance v06	Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies
KDB447498 D03 Supplement C Cross-Reference v01	OET Bulletin 65, Supplement C Cross-Reference
KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04	SAR Measurement Requirements for 100 MHz to 6 GHz

3.2 RF exposure limits

Human Exposure	Uncontrolled Environment General Population	Controlled Environment Occupational
Spatial Peak SAR* (Brain*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

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 SAR measurement variability and uncertainty

4.1 SAR measurement variability

Per KDB865664 D01 SAR measurement 100 MHz to 6 GHz, SAR measurement variability must be assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. The additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

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

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

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

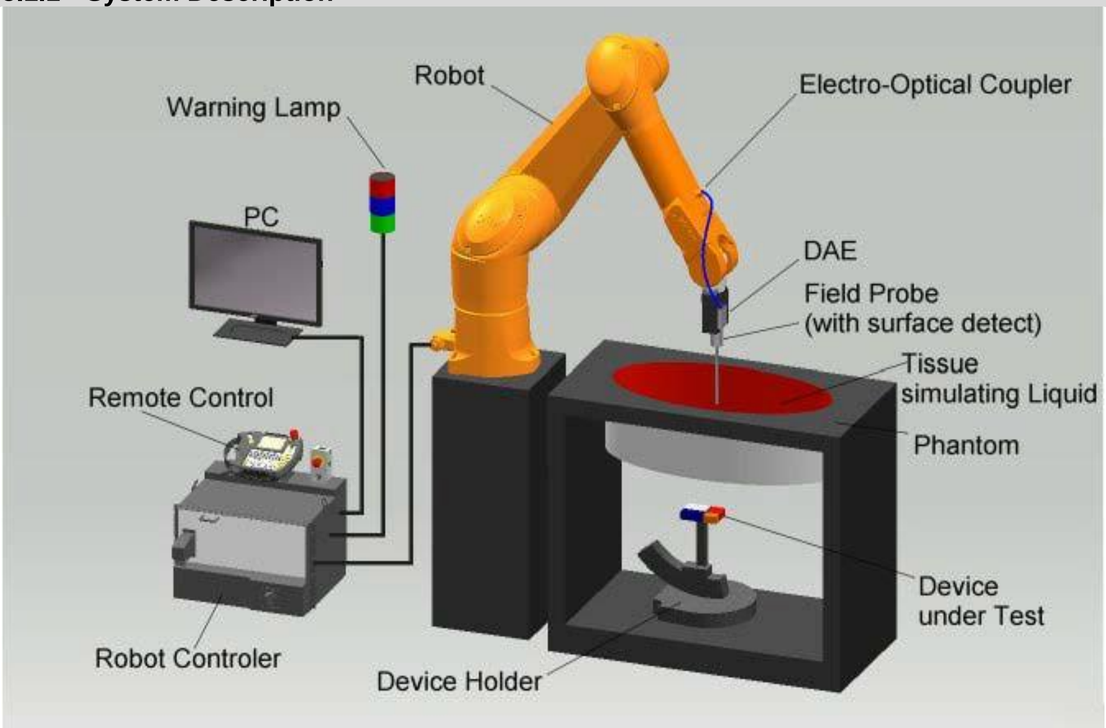
4) Perform a third repeated measurement only if the original, first or second repeated measurement is ⩾1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

The same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds.

4.2 SAR measurement uncertainty

Per KDB865664 D01 SAR Measurement 100 MHz to 6 GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg, the extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval. The equivalent ratio (1.5/1.6) is applied to extremity and occupational exposure conditions.

5 Test Set-up
5.1 Measurement system
5.1.1 System Description



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

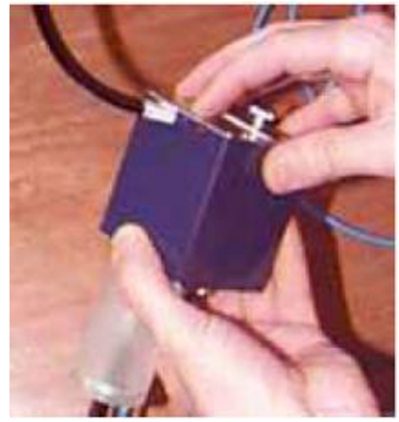
- A standard high precision 6-axis robot (Stäubli RX/TX family) with controller and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e. an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid.
- A data acquisition 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 7.
- 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.

5.1.2 Probe description

Isotropic E-Field Probe EX3DV4 for Dosimetric Measurements

	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	ISO/IEC 17025 calibration service available.
Frequency	10 MHz to > 6 GHz Linearity: ± 0.2 dB (30 MHz to 6 GHz)
Directivity	± 0.3 dB in TSL (rotation around probe axis) ± 0.5 dB in TSL (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: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm
Application	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields); the only probe that enables compliance testing for frequencies up to 6 GHz with precision of better 30%.
Compatibility	DASY3, DASY4, DASY52 SAR and higher, EASY4/MRI

5.1.3 Data Acquisition Electronics (DAE) description

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

5.1.4 Phantom description

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.

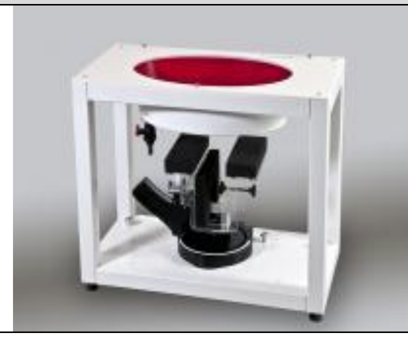
5.1.4.1 SAM Twin Phantom

Material	Vinylester, glass fiber reinforced (VE-GF)	
Liquid Compatibility	Compatible with all SPEAG tissue simulating liquids (incl. DGBE type)	
Shell Thickness	2 ± 0.2 mm (6 ± 0.2 mm at ear point)	
Dimensions (incl. Wooden Support)	Length: 1000 mm Width: 500 mm Height: adjustable feet	
Filling Volume	approx. 25 liters	
Wooden Support	SPEAG standard phantom table	

The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209-1. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot.

Twin SAM V5.0 has the same shell geometry and is manufactured from the same material as Twin SAM V4.0, but has reinforced top structure.

5.1.4.2 ELI Phantom

Material	Vinylester, glass fiber reinforced (VE-GF)	
Liquid Compatibility	Compatible with all SPEAG tissue simulating liquids (incl. DGBE type)	
Shell Thickness	2.0 ± 0.2 mm (bottom plate)	
Dimensions	Major axis: 600 mm Minor axis: 400 mm	
Filling Volume	approx. 30 liters	
Wooden Support	SPEAG standard phantom table	

Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG dosimetric probes and dipoles.
ELI V5.0 has the same shell geometry and is manufactured from the same material as ELI4, but has reinforced top structure.

5.1.5 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.

5.1.6 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. Using predefined locations for measurements is not accurate enough. Any shift of the phantom (e.g., slight deformations after filling it with liquid) would produce high uncertainties. For an automatic and accurate detection of the phantom surface, the DASY5 system uses the mechanical surface detection. The detection is always at touch, but the probe will move backward from the surface the indicated distance before starting the measurement.

- 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

DASY is also able to perform repeated zoom scans if more than 1 peak is found during area scan. In this document, the evaluated peak 1g and 10g averaged SAR values are shown in the 2D-graphics in annex

B. Test results relevant for the specified standard are shown in table form.

5.1.7 Spatial Peak SAR Evaluation

The spatial peak SAR - value for 1 and 10 g is evaluated after the Cube measurements have been done. The basis of the evaluation are the SAR values measured at the points of the fine cube grid consisting of all points in the three directions x, y and z. The algorithm that finds the maximal averaged volume is separated into three different stages.

- The data between the dipole center of the probe and the surface of the phantom are extrapolated. This data cannot be measured since the center of the dipole is 1 to 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is about 1 mm (see probe calibration sheet). The extrapolated data from a cube measurement can be visualized by selecting 'Graph Evaluated'.

- The maximum interpolated value is searched with a straight-forward algorithm. Around this maximum the SAR - values averaged over the spatial volumes (1g or 10 g) are computed using the 3d-spline interpolation algorithm. If the volume cannot be evaluated (i.e., if a part of the grid was cut off by the boundary of the measurement area) the evaluation will be started on the corners of the bottom plane of the cube.

- All neighbouring volumes are evaluated until no neighbouring volume with a higher average value is found.

Extrapolation

The extrapolation is based on a least square algorithm [W. Gander, Computermathematik, p.168-180]. Through the points in the first 3 cm along the z-axis, polynomials of order four are calculated. These polynomials are then used to evaluate the points between the surface and the probe tip. The points, calculated from the surface, have a distance of 1 mm from each other.

Interpolation

The interpolation of the points is done with a 3d-Spline. The 3d-Spline is composed of three one-dimensional splines with the "Not a knot"-condition [W. Gander, Computermathematik, p.141-150] (x, y and z -direction) [Numerical Recipes in C, Second Edition, p.123ff].

Volume Averaging

At First the size of the cube is calculated. Then the volume is integrated with the trapezoidal algorithm. 8000 points (20x20x20) are interpolated to calculate the average.

Advanced Extrapolation

DASY uses the advanced extrapolation option which is able to compensate boundary effects on E-field probes.

5.1.8 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	Normi, ai0, ai1, ai2
	- Conversion factor	ConvFi
	- 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:

Vi = Ui + U 2 •cf/dcpi

With Vi = compensated signal of channel i (i = x, y, z)
Ui = input signal of channel i (i = x, y, z)
cf= crest factor of exciting field (DASY parameter)
dcpi= diode compression point ((DASY parameter)

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

E-field probes: $Ei = (Vi / Normi \cdot ConvF)^{1/2}$
H-field probes: $Hi = (Vi)^{1/2} \cdot (a_{i0} + a_{i1}f + ai^2f^2)/f$

[mV/(V/m)2] for E-field Probes ConvF = sensitivity enhancement in solution
aij = sensor sensitivity factors for H-field probes
f = carrier frequency [GHz]
Ei = electric field strength of channel i in V/m
Hi = magnetic field strength of channel i in A/m

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

$Etot = (E^2 + E^2 + E^2)^{1/2}$

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
Etot = 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.

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

With P_{pwe} = equivalent power density of a plane wave in mW/cm2
E_{tot} = total electric field strength in V/m
H_{tot} = total magnetic field strength in A/m

5.2 Description of Test Position

5.2.1 EUT constructions

5.2.2 Body Exposure Condition

5.2.2.1 Body exposure conditions

The back surface and edges of the tablet should be tested for SAR compliance with the DUT touching the phantom. The SAR Exclusion Threshold in KDB 447498 D01 can be applied to determine SAR test exclusion for adjacent edge configurations. The closest distance from the antenna to an adjacent DUT edge is used to determine if SAR testing is required for the adjacent edges, with the adjacent edge positioned against the phantom and the edge containing the antenna positioned perpendicular to the phantom.

5.2.2.2 Extremity exposure conditions

Devices that are designed or intended for use on extremities or mainly operated in extremity only exposure conditions; i.e., hands, wrists, feet and ankles, may require extremity SAR evaluation. When the device also operates in close proximity to the user's body, SAR compliance for the body is also required. The 1-g body and 10-g extremity SAR Exclusion Thresholds found in KDB Publication 447498 D01 should be applied to determine SAR test requirements.

5.3 System Verification

5.3.1 Tissue simulating liquids: dielectric properties

(Liquids used for tests are marked with☒)

☐HSL600-6000MHz is composed of the following ingredients and provided by SPEAG： Water：50-65% Mineral oil：10-30% Emulsifiers：8-25% Sodium salt：0-1.5%
☒MSL600-6000MHz is composed of the following ingredients and provided by SPEAG： Water：64-78% Mineral oil：11-18% Emulsifiers：9-15% Sodium salt：2-3%

Table 3： Body tissue dielectric properties

5.3.2 Tissue simulating liquids: parameters

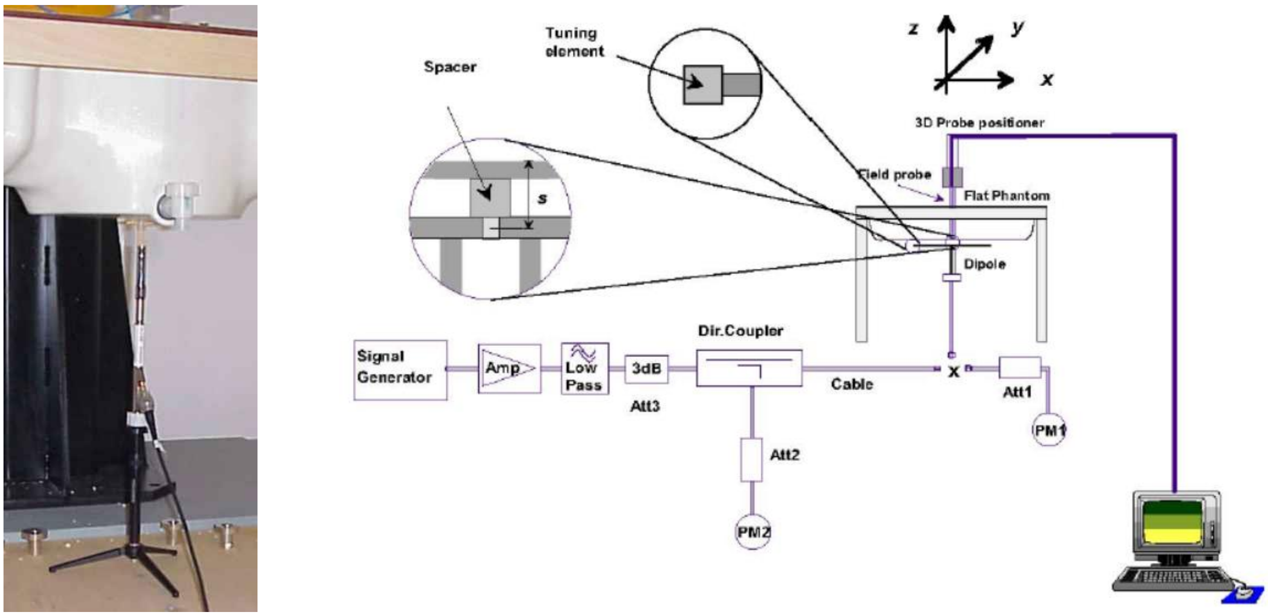
The dielectric properties for this Tissue Simulate Liquids were measured by using the DAK. The Conductivity (σ) and Permittivity (ρ) are listed in bellow Table .For the SAR measurement given in this report. The temperature variation of the Tissue Simulate Liquids was 22±2°C.

Tissue Type	Measured Frequency （MHz）	Target Tissue (±5%)		Measured Tissue		Liquid Temp. (℃)	Measured Date
		ε_r	σ(S/m)	ε_r	σ(S/m)		
600-6000 Body	750	55.50 (52.73~58.28)	0.96 (0.91~1.00)	55.56	0.97	22.8	17/7/2018
	900	55.3 (52.54~58.07)	0.98 (0,93~1,03)	54.64	1.02	22.2	17/7/2018
	1800	53.4 (50.73~56.07)	1.49 (1.42~1.56)	54.6	1.48	22.2	18/7/2018
	1900	53.3 (50.64~55.97)	1.52 (1.44~1.60)	54.15	1.55	22.2	18/7/2018

5.3.3 System check

5.3.3.1 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. 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.



F-1. the microwave circuit arrangement used for SAR system check

5.3.3.2 System check result(s)

Validation Kit		Measured SAR 250mW 1g (W/kg)	Measured SAR 250mW 10g (W/kg)	Measured SAR (normalized to 1w) 1g (W/kg)	Measured SAR ormalized to 1w) 10g (W/kg)	Target SAR (normalized to 1w) (±10%) 1-g(W/kg)	Target SAR (normalized to 1w) (±10%) 10-g(W/kg)	Liquid Temp. (℃)	Measured Date
D750V2	Body	1.96	1.28	7.84	5.12	8.49 (7.64~9.34)	5.64 (5.09~6.23)	22.8	19/7/2018
D900V2	Body	2.55	1.64	10.2	6.56	11.0 (9.9~12.1)	7.12 (5.81~7.11)	22.8	19/7/2018
D1800V2	Body	9.58	5.06	38.32	20.24	37.0 (33.3~40.7)	19.7 (17.73~21.67)	22.8	19/7/2018
D1900V2	Body	9.47	4.91	37.88	19.64	39.8 (35.82~43.78)	21.0 (18.9~23.1)	22.8	19/7/2018

Table 4： SAR System Check Result.
Note：Detailed System Check Results please see Annex A

5.3.4 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.

5.3.5 Justification for Extended SAR Dipole Calibrations

1) Referring to KDB865664 D01 requirements for dipole calibration, instead of the typical annual calibration recommended by measurement standards, longer calibration intervals of up to three years may be considered when it is demonstrated that the SAR target, impedance and return loss of a dipole have remain stable according to the following requirements. Each measured dipole is expected to evaluate with the following criteria at least on annual interval in Appendix C.
a) There is no physical damage on the dipole;
b) System check with specific dipole is within 10% of calibrated value;
c) Return-loss is within 10% of calibrated measurement;
d) Impedance is within 5Ω from the previous measurement.

2) DAK's probe calibration against air, distilled water and a shorting block performed before measuring liquid parameters.

6 Technology Test Configuration

6.1 Operation Configurations

6.2 LTE Test Configuration

LTE modes were tested according to FCC KDB 941225 D05 publication. Please see notes after the tabulated SAR data for required test configurations. Establishing connections with base station simulators ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. The R&S CMW500 was used for LTE output power measurements and SAR testing. Max power control was used so the UE transmits with maximum output power during SAR testing. SAR must be measured with the maximum TTI (transmit time interval) supported by the device in each LTE configuration.

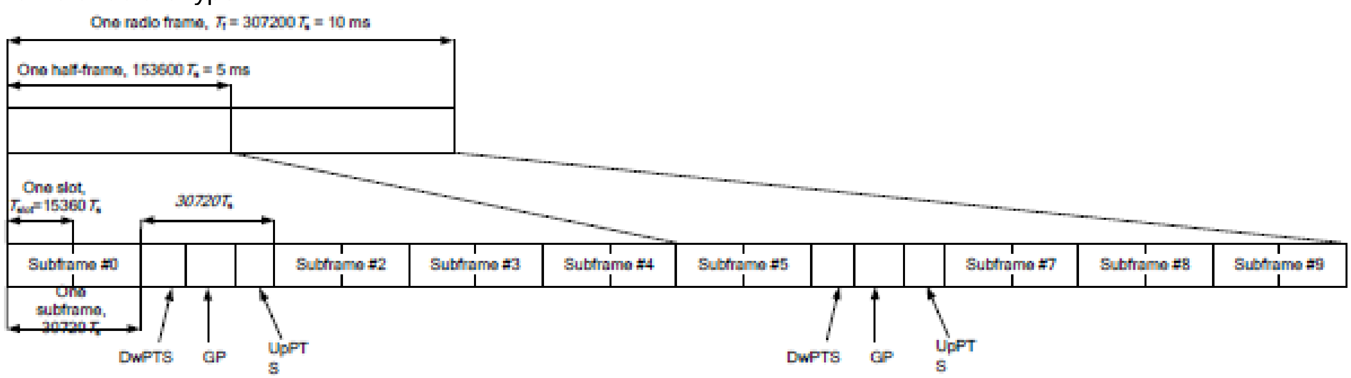
TDD LTE test consideration

For Time-Division Duplex (TDD) systems, SAR must be tested using a fixed periodic duty factor according to the highest transmission duty factor implemented for the device and supported by the defined 3GPP LTE TDD configurations.

SAR was tested with the highest transmission duty factor (63.33%) using Uplink-downlink configuration 0 and Special subframe configuration 7.

LTE TDD Band support 3GPP TS 36.211 section 4.2 for Type 2 Frame Structure and Table 4.2-2 for uplink-downlink configurations and Table 4.2-1 for Special subframe configurations.

Frame structure type 2:



Configuration of special subframe (lengths of DwPTS/GP/UpPTS).

Special subframe configuration	Normal cyclic prefix in downlink			Extended cyclic prefix in downlink		
	DwPTS	UpPTS		DwPTS	UpPTS	
		Normal cyclic prefix in uplink	Extended cyclic prefix in uplink		Normal cyclic prefix in uplink	Extended cyclic prefix in uplink
0	6592.Ts	2192.Ts	2560.Ts	7680.Ts	2192.Ts	2560.Ts
1	19760.Ts			20480.Ts		
2	21952.Ts			23040.Ts		
3	24144.Ts			25600.Ts		
4	26336.Ts			7680.Ts	4384.Ts	5120.Ts
5	6592.Ts	4384.Ts	5120.Ts	20480.Ts		
6	19760.Ts			23040.Ts		
7	21952.Ts			25600.Ts		
8	24144.Ts			-	-	-
9	13168.Ts			-	-	-

Uplink-downlink configurations.

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

Calculated Duty Cycle=[Extended cyclic prefix in uplink x (Ts) x # of S + # of U]/10ms

Uplink-Downlink Configuration	Downlink-to-Uplink Switch-point Periodicity	Subframe Number										Calculated Duty Cycle (%)
		0	1	2	3	4	5	6	7	8	9	
0	5 ms	D	S	U	U	U	D	S	U	U	U	63.33
1	5 ms	D	S	U	U	D	D	S	U	U	D	43.33
2	5 ms	D	S	U	D	D	D	S	U	D	D	23.33
3	10 ms	D	S	U	U	U	D	D	D	D	D	31.67
4	10 ms	D	S	U	U	D	D	D	D	D	D	21.67
5	10 ms	D	S	U	D	D	D	D	D	D	D	11.67
6	5 ms	D	S	U	U	U	D	S	U	U	D	53.33

A) Spectrum Plots for RB Configurations
A properly configured base station simulator was used for SAR tests and power measurements. Therefore, spectrum plots for RB configurations were not required to be included in this report.
B) MPR
MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.
C) A-MPR
A-MPR (Additional MPR) has been disabled for all SAR tests by setting NS=01 on the base station simulator.
D) Largest channel bandwidth standalone SAR test requirements
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. 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.

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

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 1) and 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.

4) Higher order modulations
For each modulation besides QPSK; e.g., 16-QAM, 64-QAM, apply the QPSK procedures in above sections 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.

E) Other channel bandwidth standalone SAR test requirements
For the other channel bandwidths used by the device in a frequency band, apply all the procedures required for the largest channel bandwidth in section A) to determine the channels and RB configurations that need SAR testing and only measure SAR when the highest maximum output power of a configuration requiring testing in the smaller channel bandwidth is > ½ dB higher than the equivalent channel configurations in the largest channel bandwidth configuration or the reported SAR of a configuration for the largest channel bandwidth is > 1.45 W/kg.

7 Detailed Test Results
7.1 Conducted power measurements
7.1.1 Conducted Power of LTE

LTE-Band 2			QPSK-Modulation	16-QAM-Modulation	Tune Up	SAR Test
channel bandwidth	ARFCN-Frequency [MHz]	Resource block allocation	RMS detektor [dBm]	RMS detektor [dBm]		
1.4 MHz	1850,7	1 RB low	22.98	23.18	25	No
		1 RB high	23	23.28	25	No
		50% RB mid	22.69	23.29	25	No
		100% RB	22.69	23.37	25	No
	1880	1 RB low	22.92	23.84	25	No
		1 RB high	22.97	23.8	25	No
		50% RB mid	22.84	23.43	25	No
		100% RB	22.78	23.33	25	No
	1909,3	1 RB low	24.77	23.31	25	No
		1 RB high	24.99	23.32	25	**Yes**
		50% RB mid	24.98	23.32	25	**Yes**
		100% RB	24.78	23.32	25	No

LTE-Band 4						
channel bandwidth	ARFCN-Frequency [MHz]	Resource block allocation	RMS detektor [dBm]	RMS detektor [dBm]	Tune Up	SAR Test
1.4 MHz	1710,7	1 RB low	23.81	23.74	25	No
		1 RB high	23.67	23.74	25	No
		50% RB mid	23.93	23.74	25	No
		100% RB	23.85	23.81	25	No
	1732,5	1 RB low	23.51	24.07	25	No
		1 RB high	23.58	24.01	25	**Yes**
		50% RB mid	23.51	23.55	25	**Yes**
		100% RB	23.44	23.46	25	No
	1754,3	1 RB low	23.54	23.66	25	No
		1 RB high	23.63	23.65	25	No
		50% RB mid	23.55	23.55	25	No
		100% RB	23.55	23.69	25	No

LTE-Band 5						
channel bandwidth	ARFCN-Frequency [MHz]	Resource block allocation	RMS detektor [dBm]	RMS detektor [dBm]	Tune Up	SAR Test
1.4 MHz	824.7	1 RB low	21.6	23.49	25	No
		1 RB high	23.41	23.48	25	No
		50% RB mid	23.37	23.29	25	No
		100% RB	23.42	23.41	25	No
	836.5	1 RB low	23.42	23.56	25	No
		1 RB high	23.42	23.56	25	**Yes**
		50% RB mid	23.42	23.54	25	**Yes**
		100% RB	23.45	23.8	25	No
	848.3	1 RB low	23.55	23.44	25	No
		1 RB high	23.54	23.57	25	No
		50% RB mid	23.55	23.58	25	No
		100% RB	23.56	23.72	25	No

LTE-Band 12						
channel bandwidth	ARFCN-Frequency [MHz]	Resource block allocation	RMS detektor [dBm]	RMS detektor [dBm]	Tune Up	SAR Test
1.4 MHz	699.7	1 RB low	23.83	24.22	25	No
		1 RB high	23.85	24.19	25	No
		50% RB mid	23.86	23.81	25	No
		100% RB	23.73	23.71	25	No
	707.5	1 RB low	24.17	23.76	25	**Yes**
		1 RB high	24.10	23.76	25	No
		50% RB mid	23.83	23.82	25	**Yes**
		100% RB	23.96	23.92	25	No
	715.3	1 RB low	23.73	23.73	25	No
		1 RB high	23.89	23.63	25	No
		50% RB mid	23.73	23.72	25	No
		100% RB	23.75	23.96	25	No

Note：Only 1.4MHz Bandwidth was measured due to LTE CAT-M1

7.2 SAR test results
7.2.1 Results overview of LTE

Test position	LTE Band	Test Ch./Freq.	SAR (W/kg) 1-g	Power drift (dB)	Conducted power (dBm)	Tune up Limit (dBm)	Scaled factor	Scaled SAR (W/kg)	Liquid Temp.
Main Antenna Body Test data 1RB (Separate 0mm)									
Back side	2	19193/1909,3	0.22	0.18	24.99	25	1.002	0.221	22.8
Left side	2	19193/1909,3	0.488	0.04	24.99	25	1.002	**0.489**	22.8
Right side	2	19193/1909,3	0.0783	0.18	24.99	25	1.002	0.078	22.8
Bottom side	2	19193/1909,3	0.31	0.08	24.99	25	1.002	0.311	22.8

Test position	LTE Band	Test Ch./Freq.	SAR (W/kg) 10-g	Power drift (dB)	Conducted power (dBm)	Tune up Limit (dBm)	Scaled factor	Scaled SAR (W/kg)	Liquid Temp.
Main Antenna Limbs Test data 1RB (Separate 0mm)									
Back side	2	19193/1909,3	0.13	0.18	24.99	25	1.002	0.131	22.8
Left side	2	19193/1909,3	0.242	0.04	24.99	25	1.002	**0.243**	22.8
Right side	2	19193/1909,3	0.036	0.18	24.99	25	1.002	0.036	22.8
Bottom side	2	19193/1909,3	0.151	0.08	24.99	25	1.002	0.152	22.8

Test position	LTE Band	Test Ch./Freq.	SAR (W/kg) 1-g	Power drift (dB)	Conducted power (dBm)	Tune up Limit (dBm)	Scaled factor	Scaled SAR (W/kg)	Liquid Temp.
Main Antenna Body Test data 50%RB (Separate 0mm)									
Back side	2	19193/1909,3	0.156	-0.10	24.98	25	1.005	0.157	22.8
Left side	2	19193/1909,3	0.263	-0.09	24.98	25	1.005	0.264	22.8
Right side	2	19193/1909,3	0.0615	0.13	24.98	25	1.005	0.062	22.8
Bottom side	2	19193/1909,3	0.239	-0.06	24.98	25	1.005	0.240	22.8

Test position	LTE Band	Test Ch./Freq.	SAR (W/kg) 10-g	Power drift (dB)	Conducted power (dBm)	Tune up Limit (dBm)	Scaled factor	Scaled SAR (W/kg)	Liquid Temp.
Main Antenna Limbs Test data 50%RB (Separate 0mm)									
Back side	2	19193/1909,3	0.092	-0.10	24.98	25	1.005	0,092	22.8
Left side	2	19193/1909,3	0.133	-0.09	24.98	25	1.005	0.134	22.8
Right side	2	19193/1909,3	0.029	0.13	24.98	25	1.005	0.029	22.8
Bottom side	2	19193/1909,3	0.121	-0.06	24.98	25	1.005	0.122	22.8

Test position	LTE Band	Test Ch./Freq.	SAR (W/kg) 1-g	Power drift (dB)	Conducted power (dBm)	Tune up Limit (dBm)	Scaled factor	Scaled SAR (W/kg)	Liquid Temp.
Main Antenna Body Test data 1RB (Separate 0mm)									
Back side	4	20175/1732,5	0.363	0.02	24.01	25	1.256	0.456	22.8
Left side	4	20175/1732,5	0.689	0.12	24.01	25	1.256	0.865	22.8
Left side	4	19957/1710,7	0.996	0.16	23.81	25	1.315	**1.310**	22.8
Left side	4	20393/1754,3	0.921	-0.14	23.63	25	1.371	1.263	22.8
Right side	4	20175/1732,5	0.107	0.15	24.01	25	1.256	0.134	22.8
Bottom side	4	20175/1732,5	0.280	0.02	24.01	25	1.256	0.352	22.8

Test position	LTE Band	Test Ch./Freq.	SAR (W/kg) 10-g	Power drift (dB)	Conducted power (dBm)	Tune up Limit (dBm)	Scaled factor	Scaled SAR (W/kg)	Liquid Temp.
Main Antenna Limbs Test data 1RB (Separate 0mm)									
Back side	4	20175/1732,5	0.208	0.02	24.01	25	1.256	0.261	22.8
Left side	4	20175/1732,5	0.342	0.12	24.01	25	1.256	0.430	22.8
Left side	4	19957/1710,7	0.488	0.16	23.81	25	1.315	**0.642**	22.8
Left side	4	20393/1754,3	0.462	-0.14	23.63	25	1.371	0.633	22.8
Right side	4	20175/1732,5	0.0567	0.15	24.01	25	1.256	0.071	22.8
Bottom side	4	20175/1732,5	0.143	0.02	24.01	25	1.256	0.180	22.8

Test position	LTE Band	Test Ch./Freq.	SAR (W/kg) 1-g	Power drift (dB)	Conducted power (dBm)	Tune up Limit (dBm)	Scaled factor	Scaled SAR (W/kg)	Liquid Temp.
Main Antenna Body Test data 50%RB (Separate 0mm)									
Back side	4	20175/1732,5	0.241	0.02	23.55	25	1.396	0.337	22.8
Left side	4	20175/1732,5	0.606	0.03	23.55	25	1.396	0.846	22.8
Left side	4	19957/1710,7	0.815	0.10	23.93	25	1.279	1.043	22.8
Left side	4	20393/1754,3	0.75	0.04	23.55	25	1.396	1.047	22.8
Right side	4	20175/1732,5	0.0839	0.20	23.55	25	1.396	0.117	22.8
Bottom side	4	20175/1732,5	0.214	0.05	23.55	25	1.396	0.299	22.8

Test position	LTE Band	Test Ch./Freq.	SAR (W/kg) 10-g	Power drift (dB)	Conducted power (dBm)	Tune up Limit (dBm)	Scaled factor	Scaled SAR (W/kg)	Liquid Temp.
Main Antenna Limbs Test data 50%RB (Separate 0mm)									
Back side	4	20175/1732,5	0.138	0.02	23.55	25	1.396	0.193	22.8
Left side	4	20175/1732,5	0.300	0.03	23.55	25	1.396	0.419	22.8
Left side	4	19957/1710,7	0.393	0.10	23.93	25	1.279	0.503	22.8
Left side	4	20393/1754,3	0.375	0.04	23.55	25	1.396	0.524	22.8
Right side	4	20175/1732,5	0.045	0.20	23.55	25	1.396	0.063	22.8
Bottom side	4	20175/1732,5	0.110	0.05	23.55	25	1.396	0.154	22.8

Test position	LTE Band	Test Ch./Freq.	SAR (W/kg) 1-g	Power drift (dB)	Conducted power (dBm)	Tune up Limit (dBm)	Scaled factor	Scaled SAR (W/kg)	Liquid Temp.
Main Antenna Body Test data 1RB (Separate 0mm)									
Back side	5	20525/836.5	0.1100	0.16	23.42	25	1.439	**0.158**	22.8
Left side	5	20525/836.5	0.0715	-0.05	23.42	25	1.439	0.103	22.8
Right side	5	20525/836.5	0.0667	0.18	23.42	25	1.439	0.096	22.8
Bottom side	5	20525/836.5	0.0508	0.01	23.42	25	1.439	0.073	22.8

Test position	LTE Band	Test Ch./Freq.	SAR (W/kg) 10-g	Power drift (dB)	Conducted power (dBm)	Tune up Limit (dBm)	Scaled factor	Scaled SAR (W/kg)	Liquid Temp.
Main Antenna Limbs Test data 1RB (Separate 0mm)									
Back side	5	20525/836.5	0.0774	0.16	23.42	25	1.439	**0.111**	22.8
Left side	5	20525/836.5	0.0411	-0.05	23.42	25	1.439	0.059	22.8
Right side	5	20525/836.5	0.0448	0.18	23.42	25	1.439	0.064	22.8
Bottom side	5	20525/836.5	0.0237	0.01	23.42	25	1.439	0.034	22.8

Test position	LTE Band	Test Ch./Freq.	SAR (W/kg) 1-g	Power drift (dB)	Conducted power (dBm)	Tune up Limit (dBm)	Scaled factor	Scaled SAR (W/kg)	Liquid Temp.
Main Antenna Body Test data 50%RB (Separate 0mm)									
Back side	5	20525/836.5	0.0951	0.05	23.42	25	1.439	0.137	22.8
Left side	5	20525/836.5	0.0608	0.13	23.42	25	1.439	0.087	22.8
Right side	5	20525/836.5	0.0552	0.15	23.42	25	1.439	0.079	22.8
Bottom side	5	20525/836.5	0.0418	0.19	23.42	25	1.439	0.060	22.8

Test position	LTE Band	Test Ch./Freq.	SAR (W/kg) 10-g	Power drift (dB)	Conducted power (dBm)	Tune up Limit (dBm)	Scaled factor	Scaled SAR (W/kg)	Liquid Temp.
Main Antenna Limbs Test data 50%RB (Separate 0mm)									
Back side	5	20525/836.5	0.0673	0.05	23.42	25	1.439	0.097	22.8
Left side	5	20525/836.5	0.0347	0.13	23.42	25	1.439	0.050	22.8
Right side	5	20525/836.5	0.0370	0.15	23.42	25	1.439	0.053	22.8
Bottom side	5	20525/836.5	0.0245	0.19	23.42	25	1.439	0.035	22.8

Test position	LTE Band	Test Ch./Freq.	SAR (W/kg) 1-g	Power drift (dB)	Conducted power (dBm)	Tune up Limit (dBm)	Scaled factor	Scaled SAR (W/kg)	Liquid Temp.
Main Antenna Body Test data 1RB (Separate 0mm)									
Back side	12	23095/707.5	0.192	0.04	24.17	25	1.211	0.232	22.8
Left side	12	23095/707.5	0.204	0.06	24.17	25	1.211	**0.247**	22.8
Right side	12	23095/707.5	0.149	0.13	24.17	25	1.211	0.180	22.8
Bottom side	12	23095/707.5	0.107	0.03	24.17	25	1.211	0.130	22.8

Test position	LTE Band	Test Ch./Freq.	SAR (W/kg) 10-g	Power drift (dB)	Conducted power (dBm)	Tune up Limit (dBm)	Scaled factor	Scaled SAR (W/kg)	Liquid Temp.
Main Antenna Limbs Test data 1RB (Separate 0mm)									
Back side	12	23095/707.5	0.136	0.04	24.17	25	1.211	**0.165**	22.8
Left side	12	23095/707.5	0.116	0.06	24.17	25	1.211	0.140	22.8
Right side	12	23095/707.5	0.0997	0.13	24.17	25	1.211	0.118	22.8
Bottom side	12	23095/707.5	0.0469	0.03	24.17	25	1.211	0.057	22.8

Test position	LTE Band	Test Ch./Freq.	SAR (W/kg) 1-g	Power drift (dB)	Conducted power (dBm)	Tune up Limit (dBm)	Scaled factor	Scaled SAR (W/kg)	Liquid Temp.
Main Antenna Body Test data 50%RB (Separate 0mm)									
Back side	12	23095/707.5	0.156	0.01	23.96	25	1.211	0.198	22.8
Left side	12	23095/707.5	0.161	0.04	23.96	25	1.211	0.205	22.8
Right side	12	23095/707.5	0.123	0.12	23.96	25	1.211	0.156	22.8
Bottom side	12	23095/707.5	0.0723	-0.09	23.96	25	1.211	0.092	22.8

Test position	LTE Band	Test Ch./Freq.	SAR (W/kg) 10-g	Power drift (dB)	Conducted power (dBm)	Tune up Limit (dBm)	Scaled factor	Scaled SAR (W/kg)	Liquid Temp.
Main Antenna Limbs Test data 50%RB (Separate 0mm)									
Back side	12	23095/707.5	0.109	0.01	23.96	25	1.211	0.132	22.8
Left side	12	23095/707.5	0.0918	0.04	23.96	25	1.211	0.111	22.8
Right side	12	23095/707.5	0.0819	0.12	23.96	25	1.211	0.099	22.8
Bottom side	12	23095/707.5	0.0415	-0.09	23.96	25	1.211	0.050	22.8

Note：Only 1.4MHz Bandwidth was measured due to LTE CAT-M1

Note 2:

1) The maximum Scaled SAR value is marked in bold. Graph results refer to Appendix B

2) Per FCC KDB Publication 447498 D01, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s).

7.2.2 Simultaneous Transmission SAR Analysis

When the sum of SAR is larger than the limit, SAR test exclusion is determined by the SAR to peak location separation ratio (SPLSR). The simultaneously transmitting antennas in each operating mode and exposure condition combination must be considered one pair at a time to determine the SAR to peak location separation ratio to qualify for test exclusion. The ratio is determined by $(SAR_1 + SAR_2)^{1.5}/Ri$, rounded to two decimal digits, and must be ≤ 0.04 for all antenna pairs in the configuration to qualify for 1-g SAR test exclusion. When 10-g SAR applies, the ratio must be ≤ 0.10. SAR_1 and SAR_2 are the highest *reported* or estimated SAR values for each antenna in the pair, and R_i is the separation distance in mm between the peak SAR locations for the antenna pair. The antennas in all antenna pairs that do not qualify for simultaneous transmission SAR test exclusion must be tested for SAR compliance, according to the enlarged zoom scan and volume scan post-processing procedures in KDB Publication 865664 D01.

7.2.2.1 Simultaneous Transmission condition

No simultaneous transmission.

8 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	ES3DV3	Schmid & Partner Engineering AG	3340	2018.2.14	12
750 MHz System Validation Dipole	D750V3	Schmid & Partner Engineering AG	1171	2017.3.22*2)	36
900 MHz System Validation Dipole	D900V2	Schmid & Partner Engineering AG	099	2016.5.11*2)	36
1800 MHz System Validation Dipole	D1800V2	Schmid & Partner Engineering AG	287	2018.1.09	36
1900 MHz System Validation Dipole	D1900V2	Schmid & Partner Engineering AG	531	2016.5.12*2)	36
Data acquisition electronics	DAE4	Schmid & Partner Engineering AG	1233	2017.2.16*2)	12
Software	DASY52 52.8.8	Schmid & Partner Engineering AG	---	N/A	--
Flat Phantom	QD OVA 002 Ax	Schmid & Partner Engineering AG	1125	N/A	--
SAM Twin Phantom V5.0	QD 000 P40 CD	Schmid & Partner Engineering AG	1639	N/A	--
Vector Reflectometer	DAKS_VNA R40	Schmid & Partner Engineering AG	0150616	2017.4.25	12
Dielectric Probe Kit	DAKS-3.5	Schmid & Partner Engineering AG	1081	2017.4.25	12
Signal Generator	SMR 20	Rohde & Schwarz	832033/011	2017.5.18	12
Amplifier	TLV204400 61-2	Telemeter Electronic	14061801A	N/A	--
Power Meter	NRVD	Rohde & Schwarz	101700	2018.5.16	12
Power Meter Sensor	NRV-Z4	Rohde & Schwarz	100399	2018.5.14	12
Power Meter Sensor	NRV-Z5	Rohde & Schwarz	8435323	2017.5.15	24
Directional Coupler	1851	KRYTAR	109891	N/A	--

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

*2) Please refer to Annex C for additional declarations to extend calibration.

9 Observations

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

10 Calibration parameters

Please see Annex C

11 Photo documentation

Please see Annex D

Annex A: System performance check

Annex B: DASY5 measurement results

Annex C: Calibration parameters

Annex D: Photo documentation

Glossary

DTS	-	Distributed Transmission System
DUT	-	Device under Test
EUT	-	Equipment under Test
FCC	-	Federal Communication Commission
FCC ID	-	Company Identifier at FCC
HW	-	Hardware
IC	-	Industry Canada
Inv. No.	-	Inventory number
N/A	-	not applicable
SAR	-	Specific Absorption Rate
S/N	-	Serial Number
SW	-	Software
UNII	-	Unlicensed National Information Infrastructure

End of the report