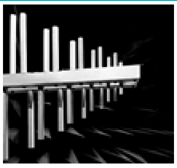

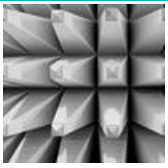

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TEST REPORT

Test Report No.: 1-2536/16-02-02

DAkkS Deutsche Akkreditierungsstelle D-PL-12076-01-01

Testing Laboratory

CTC advanced GmbH
Untertürkheimer Straße 6 – 10
66117 Saarbrücken/Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
Internet: http://www.ctcadvanced.com
e-mail: mail@ctcadvanced.com

Accredited Test Laboratory:
The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2005) 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-12076-01-01

Applicant

Intel Corporation
2200 Mission College Boulevard
Santa Clara, CA 95054, USA

Phone: +1 408 765 8080

Manufacturer

Intel Deutschland GmbH
Konrad-Zuse-Bogen 4,
82152 Krailling, GERMANY

Test Standard/s

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 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:	Professional Drone Remote Control
Device type:	portable device
Model name:	**INTEL COCKPIT GROUND CONTROL STATION V0.96**
S/N serial number:	600
FCC-ID / IC:	COCKPIT will be certified as host device containing FCC IDs & ICs. See chapter 2.4 EUT description details.
Hardware status:	0.95
Software status:	0.793
Frequency:	2.45 and 5 GHz proprietary control signal
Battery option:	Fully Charged Internal Power Packs (INTEL POWERPACK PP4000|14.8 V DC-4000mAh-59.2Wh)
Test sample status:	identical prototype
Exposure category:	general population / uncontrolled environment

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.

Test Report authorised:

p.o. Thomas Vogler
DN: cn=Thomas Vogler, o=CTC advanced GmbH, ou=VOG-161125, email=thomas.vogler@ctcadvanced.com, c=DE
Datum: 2017.04.27 14:56:38 +02'00'

Alexander Hnatovskiy
Lab Manager
Radio Communications & EMC

Test performed:

Marco Scigliano
cn=Marco Scigliano, o=CTC advanced GmbH, ou=SCI-161125, email=marco.scigliano@ctcadvanced.com, c=DE
2017.04.27 14:53:32 +02'00'

Marco Scigliano
Testing Manager
Radio Communications & EMC

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:	2017-03-15
Date of receipt of test item:	2017-03-16
Start of test:	2017-03-16
End of test:	2017-03-16
Person(s) present during the test:	

2.3 Statement of compliance

The SAR values found for the INTEL COCKPIT GROUND CONTROL STATION V0.96 Professional Drone Remote Control 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, according to the Health Canada's Safety Code 6 and the Industry Canada Radio Standards Specification RSS-102 for General Population/Uncontrolled exposure.

2.4 EUT description details I

EUT Information : COCKPIT	
Manufacturer:	Intel
Model:	INTEL COCKPIT GROUND CONTROL STATION
EUT Type:	Professional Drone Remote Control
Model:	INTEL COCKPIT GROUND CONTROL V0.96
HW version:	0.95
SW version:	0.793
Serial number:	600
Test Mode Settings:	EMC0.3 Software
Power Supply: **Battery Option:**	Fully Charged Internal Power Packs (INTEL POWERPACK PP4000|14.8 V DC-4000mAh-59.2Wh)
Comment:	Power Packs changed at regular time intervals (every 60 Min)
Integrated Antenna Details	
Antenna Location:	Integrated
Antenna Name:	Intel FA5 Antenna
Antenna Hardware Version:	Antenna-002
Antenna Details (For 5 GHz)	Intel FA5 Antenna ports 2 | 3| 4 connected to VLMRX58G Modules RX | TX | RX connector respectively
Antenna Type (For 5 GHz):	Circularly Polarized Patch Antenna
Antenna Gain (For 5 GHz): (Port 3 TX Port)	8.02 dBi
Antenna Details (For 2.4 GHz)	Intel FA5 Antenna's Port 1(Lower 2.4 GHz Port)
Antenna Gain (For 2.4 GHz): (Port 1 Lower 2.4 GHz Port)	3.19 dBi
Antenna Gain (For 2.4 GHz): (Port 5 Upper 2.4 GHz Port)	4.49 dBi

Above mentioned EUT: COCKPIT will be certified as host device containing following FCC IDs & IC.

Parameter	2.4 GHz Modular Certification	5 GHz Modular Certification
Module Type:	RCM24G(Radio Control Module 2.4GHz)	VLMRX58G (Video Link Module Rx5.8GHz)
FCC ID	2AJ2A-RCM24G	2AJ2A-VLMRX58G
IC	1000B-RCM24G	1000B-VLMRX58G
ISED	1000B	1000B
PMN	RCM24G	VLMRX58G
UPN	RCM24G	VMRX58G
HVIN	D	AMN-PCB_183 REV 2.0
FVIN	RCM24G_12017USCN	4.2.2

HOST CERTIFICATION	
HMN (For Host device)	Intel Cockpit Ground Control Station
Applicant Details	
Applicant Name: Intel Corporation **Address: 2200 Mission College Boulevard** **Santa Clara, CA 95054, USA** **Contact : +1 408-765-8080**	
Manufacturer Details	
Manufacturer : Intel Deutschland GmbH **Address: Konrad-Zuse-Bogen 4,** **82152 Krailling, GERMANY**	
Canada Representative Details	
HMN (For Host device)	**Intel Cockpit Ground Control Station**
Applicant	**Intel Canada Ltd.** **ISED Company Number: 1000T** **200 Ronson Drive, Ste 401, Toronto,** **Ontario, Canada, M9W 5Z9**
Contact Name: **Email:** **Telephone No:** **FAX:**	**Elaine Mah** **Elaine.mah@intel.com** **647-259-0114** **647-259-0195**

2.5 EUT description details II (Area specific)

5 GHz Technical data of main EUT as declared by applicant (USA only)

Model	**INTEL COCKPIT GROUND CONTROL STATION**				
Model Type	**INTEL COCKPIT GROUND CONTROL STATION V0.96**				
FCC Filing Type:	**Host Approval**				
FCC ID	**Contains 5 GHz Transmitter Module FCC-ID: 2AJ2A-VLMRX58G**				
Main Function	Professional Drone Wireless Remote Control				
Hardware Version	0.95				
Software Version	0.793				
Frequency Band | **Channels** (USA bands only)	U-NII 1: (5150-5250MHz) | **5190 MHz & 5230 MHz**				
	U-NII2A: (5250-5350MHz) | **5270 MHz & 5310 MHz**				
	U-NII 2C (5470-5725MHz) | **5510 MHz, 5550 MHz, 5590 MHz, 5670 MHz**				
	U-NII-3 (5725 -5850 MHz) | **5755 MHz & 5795 MHz**				
Nominal Channel Bandwidth	40MHz				
Type of Modulations	BPSK, OFDM				
Antenna Connections	Integrated				
Antenna Details	**Intel FA5 Antenna**				
Antenna Type	Monopole Antenna (2.4 GHz)		Circularly Polarized Patch Antenna(5GHz)		
Antenna Ports Number |Type	5	Port 1 & Port 5: 2.4 GHz	Port 2 | Port 3| Port 4: 5 GHz		
5 GHz Antenna Ports Antenna Gain (Peak)	According to Applicant's declaration				
	Frequency Band		Port 2 : RX	**Port 3 : TX**	Port 4 : RX
	U-NII 1: (5150-5250MHz)		7.98 dBi	**6.15 dBi**	9.37 dBi
	U-NII2A: (5250-5350MHz)		7.98 dBi	**6.15 dBi**	9.37 dBi
	U-NII 2C (5470-5725MHz)		11.08 dBi	**8.02 dBi**	11.18 dBi
	U-NII-3 (5725 -5850 MHz)		11.08 dBi	**8.02 dBi**	11.18 dBi
Total Number of Antennas	**1 (Intel FA5 Antenna)**				
Total Number of Modules	**1 (5 GHz Transmitter Module FCC-ID: 2AJ2A-VLMRX58G)**				
Max. Power Settings	**+11 dBm** (Using 11 dBm Power Scripts + EMC0.3 Software)				
Power Supply	DC power only: **Total: 1 INTEL POWERPACK** INTEL POWERPACK | Type PP4000|Ratings: 14.8 V DC-4000mAh-59.2Wh				
Special EMI Components	--				
EUT Sample Type	Production	Pre-Production	Engineering		
Firmware	for normal use	Special version for test execution : EMC0.3 Software			
FCC label attached	Yes	No			

5 GHz Technical data of main EUT as declared by applicant (CANADA only)

Model	**INTEL COCKPIT GROUND CONTROL STATION**			
Model Type	**INTEL COCKPIT GROUND CONTROL STATION V0.96**			
ISED Filing Type:	**Host Approval**			
IC	**Contains 5 GHz Transmitter Module IC: 1000B-VLMRX58G**			
Main Function	Professional Drone Wireless Remote Control			
Hardware Version	0.95			
Software Version	0.793			
Frequency Band | **Channels** (Canada bands only)	U-NII 1: 5150-5250 MHz	| **Frequency Band Software Disabled***		
	U-NII2A: 5250-5350 MHz	| **5310 MHz** ***		
	U-NII 2C: 5470-5600 MHz	| **5510 MHz & 5550 MHz****		
	U-NII 2C: 5650-5725 MHz	| **5670 MHz****		
	U-NII 3: 5725 -5850 MHz	| **5755 MHz & 5795 MHz**		
Nominal Channel Bandwidth	40MHz			
Type of Modulations	BPSK, OFDM			
Antenna Connections	Integrated			
Antenna Details	**Intel FA5 Antenna**			
Antenna Type	Monopole Antenna (2.4 GHz)	Circularly Polarized Patch Antenna(5GHz)		
Antenna Ports Number |Type	5 | Port 1 & Port 5: 2.4 GHz	Port 2 | Port 3| Port 4: 5 GHz		
5 GHz Antenna Ports Antenna Gain (Peak)	According to Applicant's declaration			
	Frequency Band	Port 2 : RX	**Port 3 : TX**	Port 4 : RX
	U-NII 1: (5150-5250MHz)	7.98 dBi	**6.15 dBi**	9.37 dBi
	U-NII2A: (5250-5350MHz)	7.98 dBi	**6.15 dBi**	9.37 dBi
	U-NII 2C (5470-5725MHz)	11.08 dBi	**8.02 dBi**	11.18 dBi
	U-NII-3 (5725 -5850 MHz)	11.08 dBi	**8.02 dBi**	11.18 dBi
Total Number of Antennas	**1 (Intel FA5 Antenna)**			
Total Number of Modules	**1 (5 GHz Transmitter Module IC: 1000B-VLMRX58G)**			
Max. Power Settings	**+11 dBm** (Using 11 dBm Power Scripts + EMC0.3 Software)			
Power Supply	DC power only: **Total: 1 INTEL POWERPACK** INTEL POWERPACK | Type PP4000|Ratings: 14.8 V DC-4000mAh-59.2Wh			
EUT Sample Type	Production	Pre-Production	Engineering	
Firmware	for normal use	Special version for test execution : EMC0.3 Software		
ISED label attached	Yes	No		
*For further details refer Applicants declaration & Product user manual.				
** Until further notice, devices subject to RSS-247, Issue 2,February 2017 section 6.2.3 **Operating in Frequency bands 5470-5600 MHz and 5650-5725 MHz shall not transmit in the band 5600-5650 MHz.** This restriction is for the protection of Environment Canada's weather radars operating in this band.				
*** **U-NII2A: Channel 5270 MHz Software Disabled** refer Applicants declaration & Product user manual.				

2.4 GHz Technical data of main EUT as declared by applicant (USA & CANADA)

Model	**INTEL COCKPIT GROUND CONTROL STATION**			
Model Type	**INTEL COCKPIT GROUND CONTROL STATION V0.96**			
FCC Filing Type:	**Host Approval**			
FCC ID	**Contains 2.4 GHz Transmitter Module FCC-ID: 2AJ2A-RCM24G / IC: 1000B-RCM24G**			
Main Function	Professional Drone Wireless Remote Control			
Hardware Version	0.95			
Software Version	0.793			
Frequency Band	2.4 GHz ISM Band (2400-2483.5 MHz)			
Frequency Channels (Range)	**Channel 0: 2402.5 MHz to Channel 69: 2471.5 MHz**			
Number of Channels	**70 Frequency Hopping Channels**			
Nominal Channel Bandwidth	1 MHz			
Channels Power Settings	According to Applicant's declaration (Max. Typical Power Values)			
	Channel Range	**Channel Power**	**Channel Range**	**Channel Power**
	Channel 0-3	**12 dBm**	**Channel 40-43**	**20 dBm**
	Channel 4-7	**13 dBm**	**Channel 44-48**	**19 dBm**
	Channel 8-10	**14 dBm**	**Channel 49-52**	**18 dBm**
	Channel 11-14	**16 dBm**	**Channel 53-57**	**16 dBm**
	Channel 15-17	**18 dBm**	**Channel 58-61**	**14 dBm**
	Channel 18-21	**19 dBm**	**Channel 62-66**	**13 dBm**
	Channel 22-24	**20 dBm**	**Channel 67-69**	**12 dBm**
	Channel 25-39	**21 dBm**	**--**	**--**

Type of Modulations	MSK (Minimum Shift Keying)		
Supported Data Rates	50 Kbps | 100 Kbps | 250 Kbps | 500 Kbps		
Antenna Connections	Integrated		
Antenna Details	**Intel FA5 Antenna**		
Antenna Type	Monopole Antenna (2.4 GHz)		Circularly Polarized Patch Antenna(5GHz)
Antenna Ports Number |Type	5	Port 1 & Port 5: 2.4 GHz	Port 2 | Port 3| Port 4: 5 GHz
2.4 GHz Antenna Ports Antenna Gain (Peak)	**Port 1: 3.19 dBi | Port 5: 4.86 dBi** (According to Applicant's declaration)		
Total Number of Antennas	**1 (Intel FA5 Antenna)**		
Total Number of Modules	**2** (**2.4 GHz Transmitter Module FCC-ID: 2AJ2A-RCM24G / IC: 1000B-RCM24G**)		
Test Mode. Settings	EMC0.3 Software		
Power Supply	DC power only: **Total: 1 INTEL POWERPACK** INTEL POWERPACK | Type PP4000|Ratings: 14.8 V DC-4000mAh-59.2Wh		
Special EMI Components	--		
EUT Sample Type	Production	Pre-Production	Engineering
Firmware	for normal use	Special version for test execution : EMC0.3 Software	
FCC /IC label attached	Yes	No	

3 Test standards/ procedures references

Test Standard	Version	Test Standard Description
IEEE 1528-2013	2013-06	Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
RSS-102 Issue 5	2015-03	Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
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 bodymounted 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)

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

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 1: 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 Summary of Measurement Results

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

Maximum SAR value reported for 1g (W/kg)			
		DTS	**UNII**
body worn 0 mm distance		**0.082**	**0.036**
collocated situations	**ΣSAR evaluation**	**0.183**	

5 Test Environment

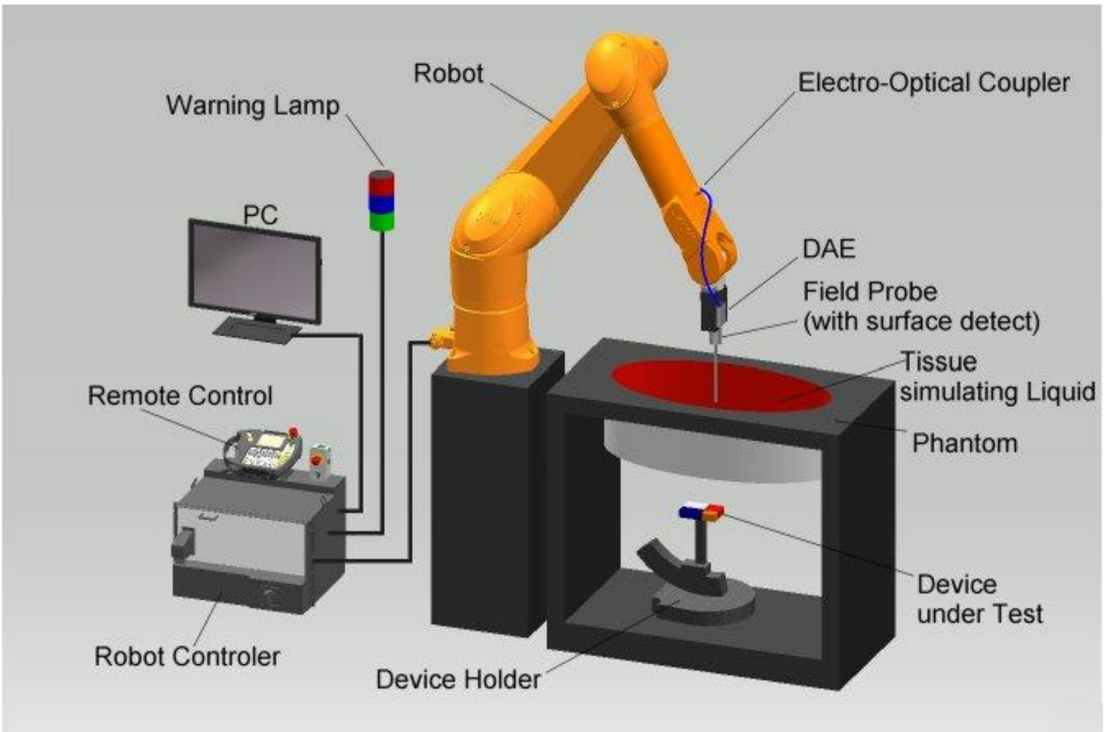
Ambient temperature:	20 – 24 °C
Tissue Simulating liquid:	20 – 24 °C
Relative humidity content:	40 – 50 %
Air pressure:	not relevant for this kind of testing
Power supply:	230 V / 50 Hz

Exact temperature values for each test are shown in the table(s) under 7.1 and/or on the measurement plots.

6 Test Set-up

6.1 Measurement system

6.1.1 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.

6.1.2 Test environment

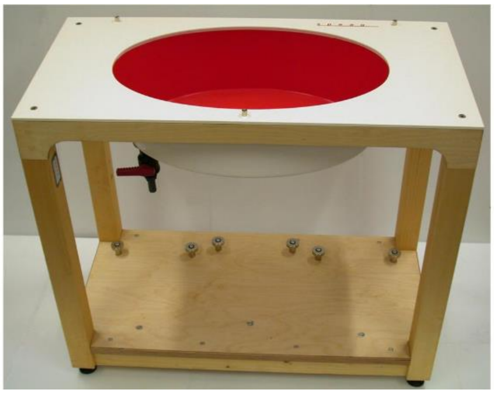
The DASY measurement system is placed in a laboratory room within an environment which avoids influence on SAR measurements by ambient electromagnetic fields and any reflection from the environment. The pictures at the beginning of the photo documentation show a complete view of the test environment.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

6.1.3 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%.

6.1.1 Phantom description

The used ELI4 Phantom meets the requirements specified in KDB865664 D01 for Specific Absorption Rate (SAR) measurements. The phantom consists of a fibreglass shell integrated in a wooden table.



The ELI4 phantom is intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30MHz to 6 GHz. ELI4 is fully compatible with the standard IEC 62209-2 and all known tissue simulating liquids.

6.1.2 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.

6.1.3 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

  * 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 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 (see section 3) are shown in table form in section 7.

6.1.4 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.

6.1.5 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	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/cm³

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/cm²
	E_{tot}	= total electric field strength in V/m
	H_{tot}	= total magnetic field strength in A/m

6.1.6 Tissue simulating liquids: dielectric properties

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

(Liquids used for tests described in section 7. are marked with ☒):

Ingredients (% of weight)	Frequency (MHz)								
frequency band	☐ 450	☐ 750	☐ 835	☐ 900	☐ 1450	☐ 1750	☐ 1900	☒ 2450	☒ 5000
Water	51.16	51.7	52.4	56.0	71.40	71.45	71.56	71.65	64 - 78
Salt (NaCl)	1.49	0.9	1.40	0.76	0.55	0.5	0.39	0.3	2 - 3
Sugar	46.78	47.2	45.0	41.76	0.0	0.0	0.0	0.0	0.0
HEC	0.52	0.0	1.0	1.21	0.0	0.0	0.0	0.0	0.0
Bactericide	0.05	0.1	0.1	0.27	0.1	0.1	0.1	0.1	0.0
Tween 20	0.0	0.0	0.0	0.0	27.95	27.95	27.95	27.95	0.0
Emulsifiers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9 - 15
Mineral Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11 - 18

Table 2: Body tissue dielectric properties

Salt: 99+% Pure Sodium Chloride
Sugar: 98+% Pure Sucrose
Water: De-ionized, 16MΩ+ resistivity
HEC: Hydroxyethyl Cellulose
Tween 20: Polyoxyethylene (20) sorbitan monolaurate

6.1.7 Tissue simulating liquids: parameters

Liquid MSL	Freq. (MHz)	Target body tissue		Measurement **body** tissue					Measurement date
		Permittivity	Conductivity (S/m)	Permittivity	Dev.	Conductivity		Dev.	
						ε"	(S/m)		
2450	2402	52.76	1.90	51.8	-1.8%	14.51	1.94	1.8%	2017-03-16
	2437	52.72	1.94	51.6	-2.0%	14.62	1.98	2.3%	
	2450	52.70	1.95	51.7	-2.0%	14.68	2.00	2.6%	
	2472	52.67	1.98	51.6	-2.1%	14.74	2.03	2.3%	
5GHz	5200	49.01	5.30	48.0	-2.0%	18.71	5.41	2.1%	2017-03-16
	5230	48.97	5.33	47.8	-2.4%	18.65	5.43	1.7%	
	5310	48.87	5.43	47.8	-2.2%	18.90	5.58	2.8%	
	5500	48.61	5.65	47.2	-2.9%	18.98	5.81	2.8%	
	5670	48.38	5.85	47.1	-2.6%	19.13	6.03	3.2%	
	5795	48.21	5.99	46.9	-2.8%	19.01	6.13	2.2%	
	5800	48.20	6.00	46.9	-2.8%	18.93	6.11	1.8%	

Table 3: Parameter of the body tissue simulating liquid
Note: The dielectric properties have been measured using the contact probe method at 22°C.

6.1.8 Measurement uncertainty evaluation for SAR test

DASY5 Uncertainty Budget According to IEEE 1528/2003 and IEC 62209-1 for the 300 MHz - 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	± 6.0 %	Normal	1	1	1	± 6.0 %	± 6.0 %	∞
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	± 1.0 %	Rectangular	√3	1	1	± 0.6 %	± 0.6 %	∞
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 %	∞
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	± 0.4 %	Rectangular	√3	1	1	± 0.2 %	± 0.2 %	∞
Probe positioning	± 2.9 %	Rectangular	√3	1	1	± 1.7 %	± 1.7 %	∞
Max.SAR evaluation	± 1.0 %	Rectangular	√3	1	1	± 0.6 %	± 0.6 %	∞
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 %	∞
Phantom and Set-up								
Phantom uncertainty	± 4.0 %	Rectangular	√3	1	1	± 2.3 %	± 2.3 %	∞
Liquid conductivity (target)	± 5.0 %	Rectangular	√3	0.64	0.43	± 1.8 %	± 1.2 %	∞
Liquid conductivity (meas.)	± 5.0 %	Rectangular	√3	0.64	0.43	± 1.8 %	± 1.2 %	∞
Liquid permittivity (target)	± 5.0 %	Rectangular	√3	0.6	0.49	± 1.7 %	± 1.4 %	∞
Liquid permittivity (meas.)	± 5.0 %	Rectangular	√3	0.6	0.49	± 1.7 %	± 1.4 %	∞
Combined Std.						± 11.1 %	± 10.8 %	387
Expanded Std.						**± 22.1 %**	**± 21.6 %**	

Table 4: Measurement uncertainties

Worst-Case uncertainty budget for DASY5 assessed according to IEEE 1528/2003.
The budget is valid for 2G and 3G communication signals and frequency range 300MHz - 3 GHz.
For these conditions it represents a worst-case analysis. For specifc tests and configurations, the uncertainty could be considerable smaller.

Relative DASY5 Uncertainty Budget for SAR Tests According to IEEE 1528/2013 and IEC62209/2011 for the 0.3 - 3GHz range								
Error Description	ncertainty Valu ± %	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	± 6.0 %	Normal	1	1	1	± 6.0 %	± 6.0 %	∞
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	± 1.0 %	Rectangular	√3	1	1	± 0.6 %	± 0.6 %	∞
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	± 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	± 0.4 %	Rectangular	√3	1	1	± 0.2 %	± 0.2 %	∞
Probe positioning	± 2.9 %	Rectangular	√3	1	1	± 1.7 %	± 1.7 %	∞
Max. SAR evaluation	± 2.0 %	Rectangular	√3	1	1	± 1.2 %	± 1.2 %	∞
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 %	∞
Phantom and Set-up								
Phantom uncertainty	± 6.1 %	Rectangular	√3	1	1	± 3.5 %	± 3.5 %	∞
SAR correction	± 1.9 %	Rectangular	√3	1	0.84	± 1.1 %	± 0.9 %	∞
Liquid conductivity (meas.)	± 5.0 %	Rectangular	√3	0.78	0.71	± 2.3 %	± 2.0 %	∞
Liquid permittivity (meas.)	± 5.0 %	Rectangular	√3	0.26	0.26	± 0.8 %	± 0.8 %	∞
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						± 11.3 %	± 11.3 %	330
Expanded Std. Uncertainty						± **22.7** %	± **22.5** %	

Table 5: Measurement uncertainties

Worst-Case uncertainty budget for DASY5 assessed according to IEEE 1528/2013 and IEC 62209-1/2011 standards. 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.

DASY5 Uncertainty Budget According to IEC 62209-2/2010 for the 300 MHz - 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	± 6.6 %	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	± 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	± 0.8 %	Rectangular	√ 3	1	1	± 0.5 %	± 0.5 %	∞
Probe positioning	± 6.7 %	Rectangular	√ 3	1	1	± 3.9 %	± 3.9 %	∞
Post-processing	± 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 %	∞
Phantom and Set-up								
Phantom uncertainty	± 7.9 %	Rectangular	√ 3	1	1	± 4.6 %	± 4.6 %	∞
SAR correction	± 1.9 %	Rectangular	√ 3	1	0.84	± 1.1 %	± 0.9 %	∞
Liquid conductivity (meas.)	± 5.0 %	Rectangular	√ 3	0.78	0.71	± 2.3 %	± 2.0 %	∞
Liquid permittivity (meas.)	± 5.0 %	Rectangular	√ 3	0.26	0.26	± 0.8 %	± 0.8 %	∞
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						± 12.7 %	± 12.6 %	330
Expanded Std. Uncertainty						± **25.4** %	± **25.3** %	

Table 6: Measurement uncertainties.

Worst-Case uncertainty budget for DASY5 assessed according to according to IEC 62209-2/2010 standard. The budget is valid for the frequency range 300MHz - 6 GHz and represents a worst-case analysis. For specific tests and configurations, the uncertainty could be considerable smaller.

Relative DASY5 Uncertainty Budget for SAR Tests								
According to IEEE 1528/2003 and IEC 62209-1 for the 3 - 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	± 6.6 %	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 %	∞
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	± 0.8 %	Rectangular	√3	1	1	± 0.5 %	± 0.5 %	∞
Probe positioning	± 6.7 %	Rectangular	√3	1	1	± 3.9 %	± 3.9 %	∞
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 %	∞
Phantom and Set-up								
Phantom uncertainty	± 4.0 %	Rectangular	√3	1	1	± 2.3 %	± 2.3 %	∞
Liquid conductivity (target)	± 5.0 %	Rectangular	√3	0.64	0.43	± 1.8 %	± 1.2 %	∞
Liquid conductivity (meas.)	± 5.0 %	Rectangular	√3	0.64	0.43	± 1.8 %	± 1.2 %	∞
Liquid permittivity (target)	± 5.0 %	Rectangular	√3	0.6	0.49	± 1.7 %	± 1.4 %	∞
Liquid permittivity (meas.)	± 5.0 %	Rectangular	√3	0.6	0.49	± 1.7 %	± 1.4 %	∞
Combined Uncertainty						± 12.1 %	± 11.9 %	330
Expanded Std. Uncertainty						± **24.3** %	± **23.8** %	

Table 7: Measurement uncertainties

Worst-Case uncertainty budget for DASY5 valid for 3G communication signals and frequency range 3 - 6 GHz. Probe calibration error reflects uncertainty of the EX3D probe. For specific tests and configurations, the uncertainty could be considerable smaller.

Relative DASY5 Uncertainty Budget for SAR Tests								
According to IEEE 1528/2013 and IEC62209-1/2011 (3-6GHz 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	± 6.6 %	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	± 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	± 0.8 %	Rectangular	√3	1	1	± 0.5 %	± 0.5 %	∞
Probe positioning	± 6.7 %	Rectangular	√3	1	1	± 3.9 %	± 3.9 %	∞
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 %	∞
Phantom and Set-up								
Phantom uncertainty	± 6.6 %	Rectangular	√3	1	1	± 3.8 %	± 3.8 %	∞
SAR correction	± 1.9 %	Rectangular	√3	1	0.84	± 1.1 %	± 0.9 %	∞
Liquid conductivity (meas.)	± 5.0 %	Rectangular	√3	0.78	0.71	± 2.3 %	± 2.0 %	∞
Liquid permittivity (meas.)	± 5.0 %	Rectangular	√3	0.26	0.26	± 0.8 %	± 0.8 %	∞
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						± 12.4 %	± 12.4 %	330
Expanded Std. Uncertainty						± **24.9** %	± **24.8** %	

Table 8: Measurement uncertainties

Worst-Case uncertainty budget for DASY5 assessed according to IEEE 1528/2013 and IEC 62209-1/2011 standards. The budget is valid for the frequency range 3GHz -6GHz and represents a worst-case analysis. For specific tests and configurations, the uncertainty could be considerable smaller.

6.1.9 Measurement uncertainty evaluation for System Check

Uncertainty of a System Performance Check with DASY5 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	± 6.0 %	Normal	1	1	1	± 6.0 %	± 6.0 %	∞
Axial isotropy	± 4.7 %	Rectangular	√ 3	0.7	0.7	± 1.9 %	± 1.9 %	∞
Hemispherical isotropy	± 0.0 %	Rectangular	√ 3	0.7	0.7	± 0.0 %	± 0.0 %	∞
Boundary effects	± 1.0 %	Rectangular	√ 3	1	1	± 0.6 %	± 0.6 %	∞
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 %	∞
Readout electronics	± 0.3 %	Normal	1	1	1	± 0.3 %	± 0.3 %	∞
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	± 3.0 %	Rectangular	√ 3	1	1	± 1.7 %	± 1.7 %	∞
Probe positioner	± 0.4 %	Rectangular	√ 3	1	1	± 0.2 %	± 0.2 %	∞
Probe positioning	± 2.9 %	Rectangular	√ 3	1	1	± 1.7 %	± 1.7 %	∞
Max. SAR evaluation	± 1.0 %	Rectangular	√ 3	1	1	± 0.6 %	± 0.6 %	∞
Test Sample 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	± 1.7 %	Rectangular	√ 3	0.78	0.71	± 0.8 %	± 0.7 %	∞
Temp. unc. - Permittivity	± 0.3 %	Rectangular	√ 3	0.23	0.26	± 0.0 %	± 0.0 %	∞
Combined Uncertainty						± 9.1 %	± 8.9 %	330
Expanded Std. Uncertainty						**± 18.2 %**	**± 17.9 %**	

Table 9: Measurement uncertainties of the System Check with DASY5 (0.3-3GHz)

Uncertainty of a System Performance Check with DASY5 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	± 6.6 %	Normal	1	1	1	± 6.6 %	± 6.6 %	∞
Axial isotropy	± 4.7 %	Rectangular	√ 3	0.7	0.7	± 1.9 %	± 1.9 %	∞
Hemispherical isotropy	± 0.0 %	Rectangular	√ 3	0.7	0.7	± 0.0 %	± 0.0 %	∞
Boundary effects	± 1.0 %	Rectangular	√ 3	1	1	± 0.6 %	± 0.6 %	∞
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 %	∞
Readout electronics	± 0.3 %	Normal	1	1	1	± 0.3 %	± 0.3 %	∞
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	± 3.0 %	Rectangular	√ 3	1	1	± 1.7 %	± 1.7 %	∞
Probe positioner	± 0.8 %	Rectangular	√ 3	1	1	± 0.5 %	± 0.5 %	∞
Probe positioning	± 6.7 %	Rectangular	√ 3	1	1	± 3.9 %	± 3.9 %	∞
Max. SAR evaluation	± 1.0 %	Rectangular	√ 3	1	1	± 0.6 %	± 0.6 %	∞
Test Sample 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	± 1.7 %	Rectangular	√ 3	0.78	0.71	± 0.8 %	± 0.7 %	∞
Temp. unc. - Permittivity	± 0.3 %	Rectangular	√ 3	0.23	0.26	± 0.0 %	± 0.0 %	∞
Combined Uncertainty						± 10.1 %	± 10.0 %	330
Expanded Std. Uncertainty						± **20.2** %	± **19.9** %	

Table 10: Measurement uncertainties of the System Check with DASY5 (3-6GHz)

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

6.1.10 System check

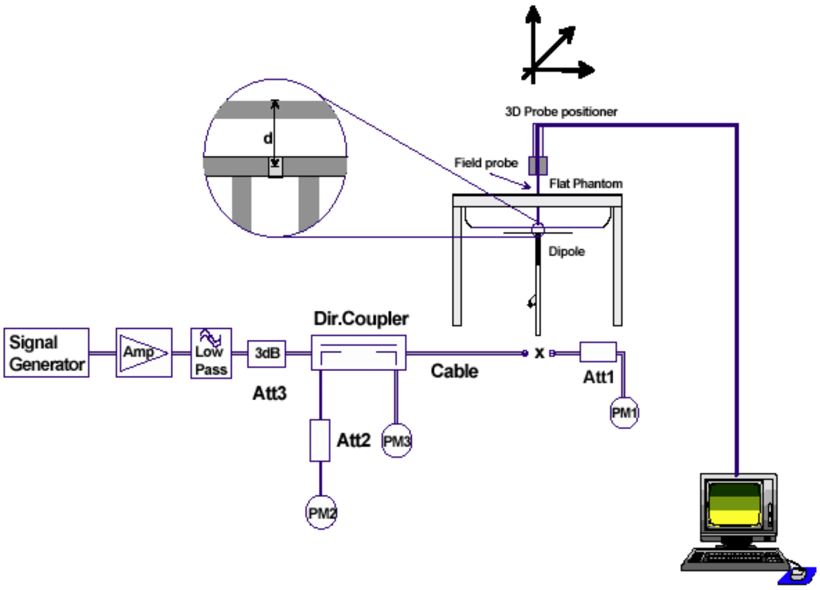
The system check is performed for verifying the accuracy of the complete measurement system and performance of the software. The system check is performed with tissue equivalent material according to IEEE 1528. The following table shows system check results for all frequency bands and tissue liquids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

System performence check (1000 mW)								
System validation Kit	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
D2450V2 S/N: 710	2450 MHz body	51.20	23.90	48.80	-4.5%	22.50	-7.0%	2017-03-16
D5GHzV2 S/N: 1055	5200 MHz body	74.20	20.80	72.70	-5.1%	20.50	-4.7%	2017-03-16
D5GHzV2 S/N: 1055	5500 MHz body	77.90	21.70	83.20	-0.7%	23.30	0.0%	2017-03-16
D5GHzV2 S/N: 1055	5800 MHz body	73.30	20.20	73.40	-8.6%	20.70	-6.8%	2017-03-16

Table 11: Results system check

6.1.11 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.



6.1.12 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.

The following table lists the system validations relevant for this test report:

Frequency (MHz)	DASY SW	Dipole Type /SN	Probe Type / SN	Calibrated signal type(s)	DAE unit Type / SN	body validation
2450	V52.8.7	D2450V2 / 710	EX3DV4 / 3944	CW	DAE3 / 413	2016-09-20
5200	V52.8.7	D5GHzV2 / 1055	EX3DV4 / 3944	CW	DAE3/ 477	2016-10-25
5500	V52.8.7	D5GHzV2 / 1055	EX3DV4 / 3944	CW	DAE3/ 477	2016-10-26
5800	V52.8.7	D5GHzV2 / 1055	EX3DV4 / 3944	CW	DAE3/ 477	2016-10-27

7 Detailed Test Results

7.1 Conducted power measurements

For the measurements the Rohde & Schwarz NRP Power Meter was used.

7.1.1 Conducted power measurements FHSS MSK 2450 MHz

FHSS MSK [MHz]	Data Rate (Kbps)	Channel no./ frequency [MHz]	Conducted avg. Power (dBm)	Conducted avg. Power (mW)
2402.5 -2471.5 (70 Channels)	50	0 / 2402.5	8.6	7.2
	50	34 / 2436.5	**17.8**	60.3
	50	69 / 2471.5	8.1	6.5
	100	0 / 2402.5	8.5	7.1
	100	34 / 2436.5	17.4	55.0
	100	69 / 2471.5	8.0	6.3
	250	0 / 2402.5	8.6	7.2
	250	34 / 2436.5	17.6	57.5
	250	69 / 2471.5	8.0	6.3
	500	0 / 2402.5	8.6	7.2
	500	34 / 2436.5	17.7	58.9
	500	69 / 2471.5	8.0	6.3

7.1.2 Conducted power measurements FHSS MSK 5 GHz

Frequency	TX Port 3	TX Port 3	Antenna Gain	EIRP
(MHz)	(dBm)	(mW)	(dBi)	(dBm)
5190	11.35	13.6458	11.18	22.53
5230	**12.04**	15.9956	11.18	23.22
(MHz)	(dBm)	(mW)	(dBi)	(dBm)
5270	12.14	16.3682	11.18	23.32
5310	**12.85**	19.2752	11.18	24.03
Frequency	TX Port 3	TX Port 3	Antenna Gain	EIRP
(MHz)	(dBm)	(mW)	(dBi)	(dBm)
5510	10.35	10.8393	11.18	21.53
5550	10.40	10.9648	11.18	21.58
5590	10.40	10.9648	11.18	21.58
5630	10.40	10.9648	11.18	21.58
5670	**10.70**	11.7490	11.18	21.88
Frequency	TX Port 3	TX Port 3	Antenna Gain	EIRP
(MHz)	(dBm)	(mW)	(dBi)	(dBm)
5755	10.66	11.6413	11.18	21.84
5795	**11.58**	14.3880	11.18	22.76

7.2 SAR test results

7.2.1 General description of test procedures

- Test positions as described in the tables above are in accordance with the specified test standard.
- Tests in body position were performed in that configuration, which generates the highest time based averaged output power (see conducted power results).
- 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
- IEEE 1528-2013 requires the middle channel to be tested first. This generally applies to wireless devices that are designed to operate in technologies with tight tolerances for maximum output power variations across channels in the band. When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel must be used.

7.2.2 Results overview

measured / extrapolated SAR numbers - Body worn - FSSH MSK 2450 MHz												
Freq. (MHz)	Position	cond. P_{max} (dBm)		SAR_{1g} (W/kg)		SAR_{10g} (W/kg)		power drift (dB)	liquid (°C)	Ant. Orientation	Ant.
		decl.**	meas.	meas.	extrap.	meas.	extrap.				
2436.5	bottom	19.8	17.8	0.021	0.034	0.012	0.018	0.09	23.2	28°	1
2436.5	bottom	19.8	17.8	**0.041**	**0.065**	**0.023**	**0.036**	-0.07	23.2	touch	1
2436.5	bottom	19.8	17.8	0.002	0.003	0.000	0.001	0.02	23.2	0°	1
2436.5	bottom	19.8	17.8	**0.052**	**0.082**	**0.030**	**0.048**	-0.05	23.2	touch	2
2402.5	bottom	10.6	8.6	0.000	0.000	0.000	0.000	N/A	23.2	touch	2
2471.5	bottom	10.1	8.1	0.000	0.000	0.000	0.000	N/A	23.2	touch	2

Table 12: Test results (see max. SAR plot on page 39/40 in Annex B - DAISY 5 measurement results.)

measured / extrapolated SAR numbers - Body worn - FSSH MSK 5 GHz										
Freq. (MHz)	Position	cond. P_{max} (dBm)		SAR_{1g} (W/kg)		SAR_{10g} (W/kg)		power drift (dB)	liquid (°C)	Ant. Orientation
		declared**	meas.	meas.	extrap.	meas.	extrap.			
5230.0	bottom	14.0	12.0	0.022	0.035	**0.008**	**0.013**	0.05	23.3	touch
5310.0	bottom	14.9	12.9	**0.023**	**0.036**	0.007	0.011	-0.19	23.3	touch
5670.0	bottom	14.0	12.0	0.000	0.000	0.000	0.000	N/A	23.3	touch
5795.0	bottom	14.9	12.9	0.000	0.000	0.000	0.000	N/A	23.3	touch

Table 13: Test results (see max. SAR plot on page 41 in Annex B - DAISY 5 measurement results.)

7.2.3 Multiple Transmitter Information

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

Conservative Addition of all worst cases for $SAR_{(1g)}$:
FSSH MSK (2450 ANT1 + 2450 ANT2 + 5000 ANT) = (0.065 + 0.082 + 0.036) W/kg = **0.183 W/kg**

Conclusion:
ΣSAR << 1.6 W/kg, no further investigation necessary

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	EX3DV4	Schmid & Partner Engineering AG	3944	August 23, 2016	12
2450 MHz System Validation Dipole	D2450V2	Schmid & Partner Engineering AG	710	August 15, 2016	24
5 GHz System Validation Dipole	D5GHzV 2	Schmid & Partner Engineering AG	1055	August 14, 2015	24
Data acquisition electronics	DAE3V1	Schmid & Partner Engineering AG	477	May 11, 2016	12
Software	DASY52 52.8.7	Schmid & Partner Engineering AG	---	N/A	--
Phantom ELI 4.0	QDOVA0 01BA	Schmid & Partner Engineering AG	1046	N/A	--
Network Analyser 300 kHz to 6 GHz	8753ES	Hewlett Packard)*	US39174436	January 28, 2016	24
Dielectric Probe Kit	85070C	Hewlett Packard	US99360146	N/A	12
Signal Generator	8671B	Hewlett Packard	2823A00656	January 31, 2017	24
Amplifier	25S1G4 (25 Watt)	Amplifier Reasearch	20452	N/A	--
Power Meter	NRP	Rohde & Schwarz	101367	January 31, 2017	24
Power Meter Sensor	NRP Z22	Rohde & Schwarz	100227	January 31, 2017	12
Power Meter Sensor	NRP Z22	Rohde & Schwarz	100234	January 31, 2017	12
Directional Coupler	778D	Hewlett Packard	19171	January 31, 2017	12

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

9 Observations

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

Annex A: System performance check

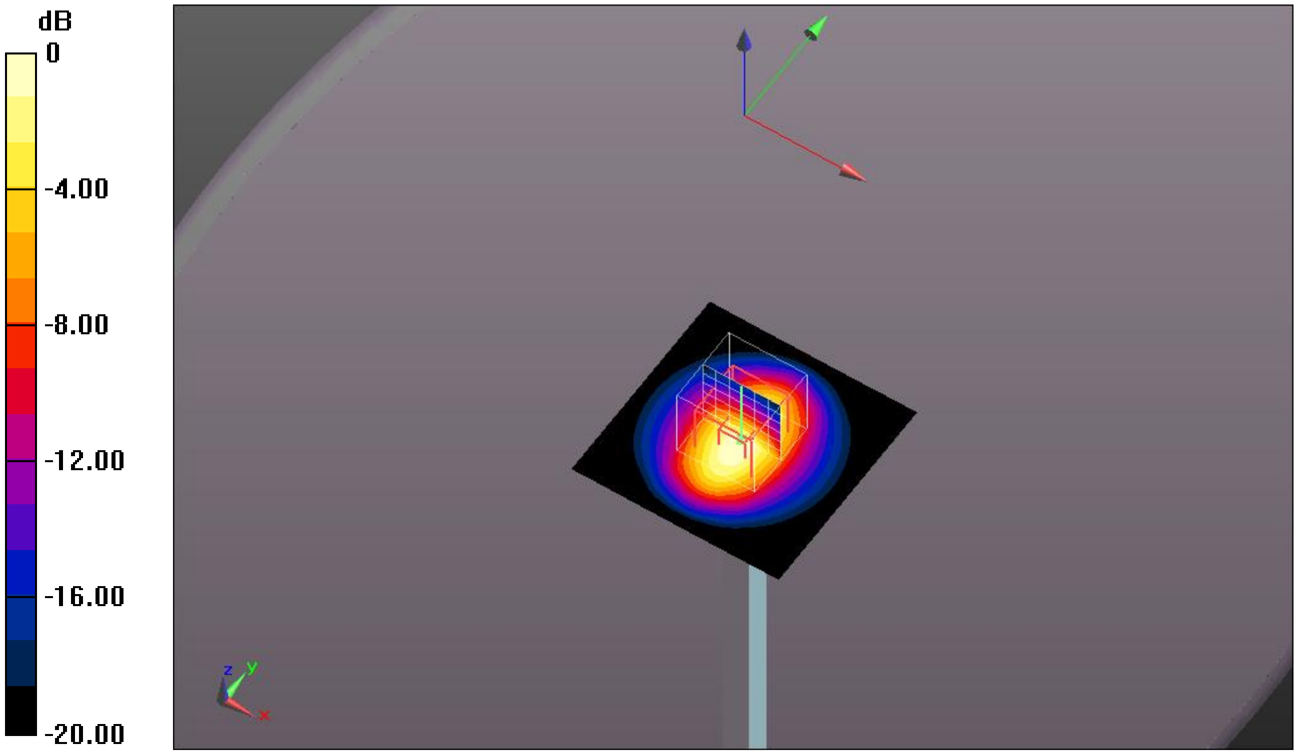
Date/Time: 16.03.2017 11:27:06

SystemPerformanceCheck-D2450 MSL 2017-03-16

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 710
Communication System: UID 0, CW (0); Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz; Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 2450 MHz; σ = 2.002 S/m; ε_r = 51.647; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5
DASY5 Configuration:
- Probe: EX3DV4 - SN3944; ConvF(7.8, 7.8, 7.8); Calibrated: 23.08.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE3 Sn477; Calibrated: 11.05.2016
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1046
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

MSL2450/d=10mm, Pin=100mW, dist=1.4mm/Area Scan (81x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 8.30 W/kg

MSL2450/d=10mm, Pin=100mW, dist=1.4mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 66.625 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 10.2 W/kg
SAR(1 g) = 4.88 W/kg; SAR(10 g) = 2.25 W/kg
Maximum value of SAR (measured) = 8.25 W/kg



0 dB = 8.25 W/kg = 9.16 dBW/kg

Additional information:
ambient temperature: 23.8°C; liquid temperature: 23.2°C

Date/Time: 16.03.2017 19:19:23

SystemPerformanceCheck-D5GHz MSL 2017-03-16

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: 1055

Communication System: UID 0, CW (0); Communication System Band: D5GHz (5000.0 - 6000.0 MHz); Frequency: 5200 MHz; Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 5200 MHz; $\sigma = 5.411$ S/m; $\varepsilon_r = 48.029$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5
DASY5 Configuration:

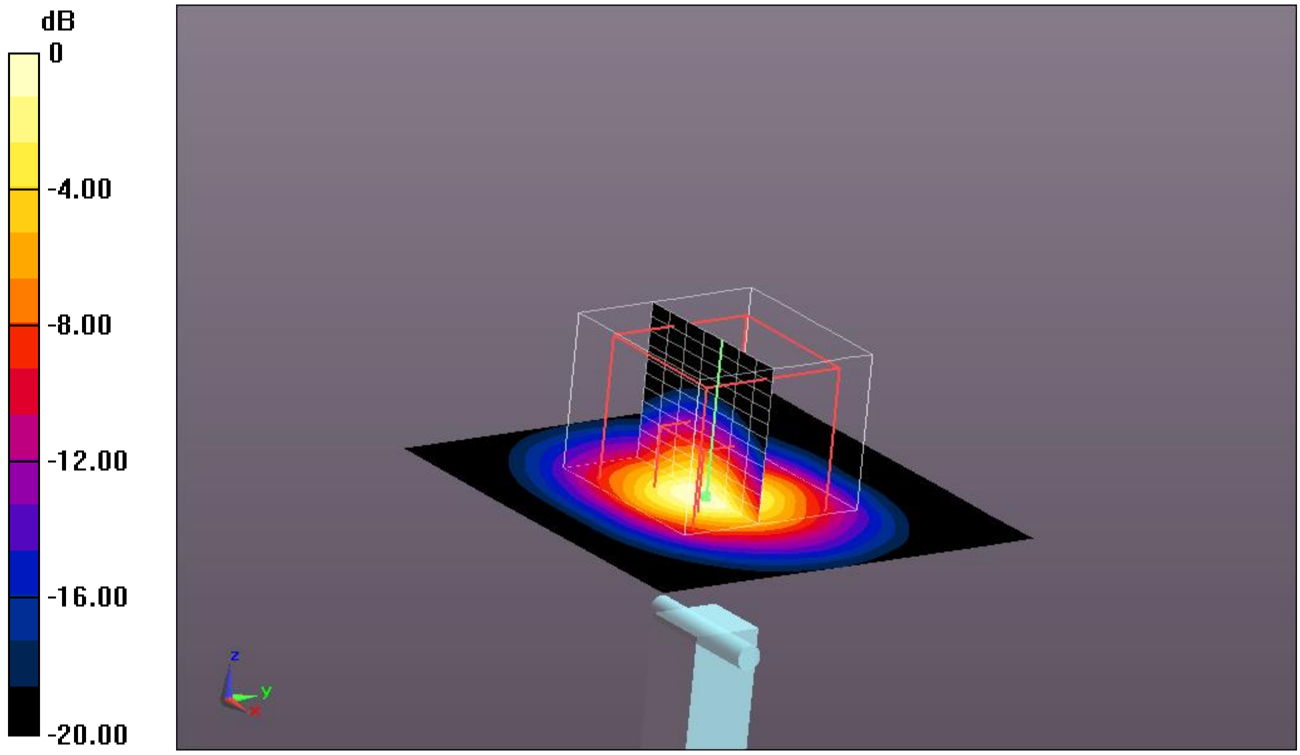
- Probe: EX3DV4 - SN3944; ConvF(4.85, 4.85, 4.85); Calibrated: 23.08.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 1.0, 23.0
- Electronics: DAE3 Sn477; Calibrated: 11.05.2016
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1046
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

MSL 5GHz/d=10mm, Pin=100mW 5.2GHz/Area Scan (61x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 18.8 W/kg

MSL 5GHz/d=10mm, Pin=100mW 5.2GHz/Zoom Scan (8x8x12)/Cube 0:

Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 65.420 V/m; Power Drift = -0.15 dB
Peak SAR (extrapolated) = 29.0 W/kg
SAR(1 g) = 7.27 W/kg; SAR(10 g) = 2.05 W/kg
Maximum value of SAR (measured) = 17.7 W/kg



0 dB = 17.7 W/kg = 12.48 dBW/kg

Additional information:
ambient temperature: 23.8°C; liquid temperature: 23.3°C

Date/Time: 16.03.2017 19:44:41

SystemPerformanceCheck-D5GHz MSL 2017-03-16

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: 1055

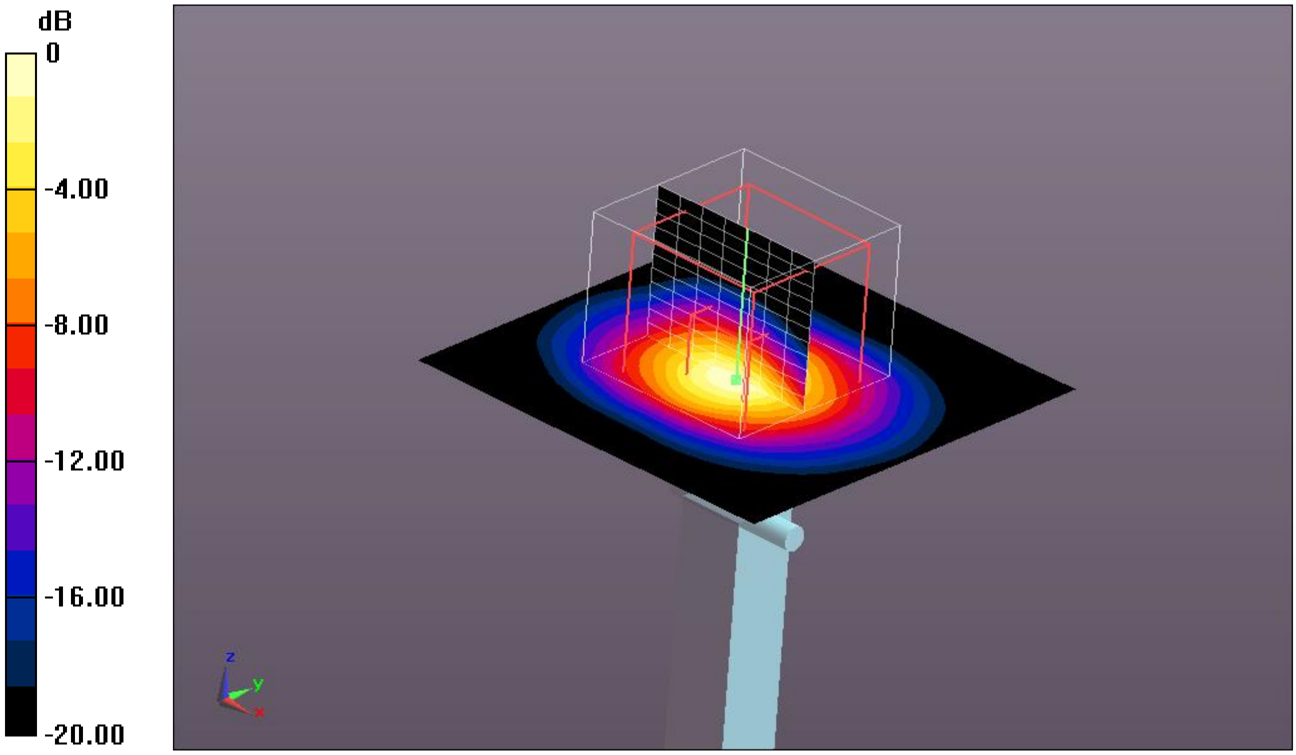
Communication System: UID 0, CW (0); Communication System Band: D5GHz (5000.0 - 6000.0 MHz);
Frequency: 5500 MHz; Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 5500 MHz; σ = 5.807 S/m; ε_r = 47.209; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5
DASY5 Configuration:
- Probe: EX3DV4 - SN3944; ConvF(4.26, 4.26, 4.26); Calibrated: 23.08.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 1.0, 23.0
- Electronics: DAE3 Sn477; Calibrated: 11.05.2016
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1046
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

MSL 5GHz/d=10mm, Pin=100mW 5.5GHz/Area Scan (61x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 19.5 W/kg

MSL 5GHz/d=10mm, Pin=100mW 5.5GHz/Zoom Scan (8x8x12)/Cube 0:

Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 65.247 V/m; Power Drift = 0.13 dB
Peak SAR (extrapolated) = 35.8 W/kg
SAR(1 g) = 8.32 W/kg; SAR(10 g) = 2.33 W/kg
Maximum value of SAR (measured) = 21.6 W/kg



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

Additional information:
ambient temperature: 23.8°C; liquid temperature: 23.3°C

Date/Time: 16.03.2017 20:28:50

SystemPerformanceCheck-D5GHz MSL 2017-03-16

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: 1055

Communication System: UID 0, CW (0); Communication System Band: D5GHz (5000.0 - 6000.0 MHz); Frequency: 5800 MHz; Communication System PAR: 0 dB; PMF: 1

Medium parameters used: f = 5800 MHz; σ = 6.119 S/m; ε_r = 46.863; ρ = 1000 kg/m^3

Phantom section: Flat Section

Measurement Standard: DASY5

DASY5 Configuration:

- Probe: EX3DV4 - SN3944; ConvF(4.13, 4.13, 4.13); Calibrated: 23.08.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 1.0, 23.0
- Electronics: DAE3 Sn477; Calibrated: 11.05.2016
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1046
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

MSL 5GHz/d=10mm, Pin=100mW 5.8GHz/Area Scan (61x61x1): Interpolated grid:

dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 18.9 W/kg

MSL 5GHz/d=10mm, Pin=100mW 5.8GHz/Zoom Scan (8x8x12)/Cube 0:

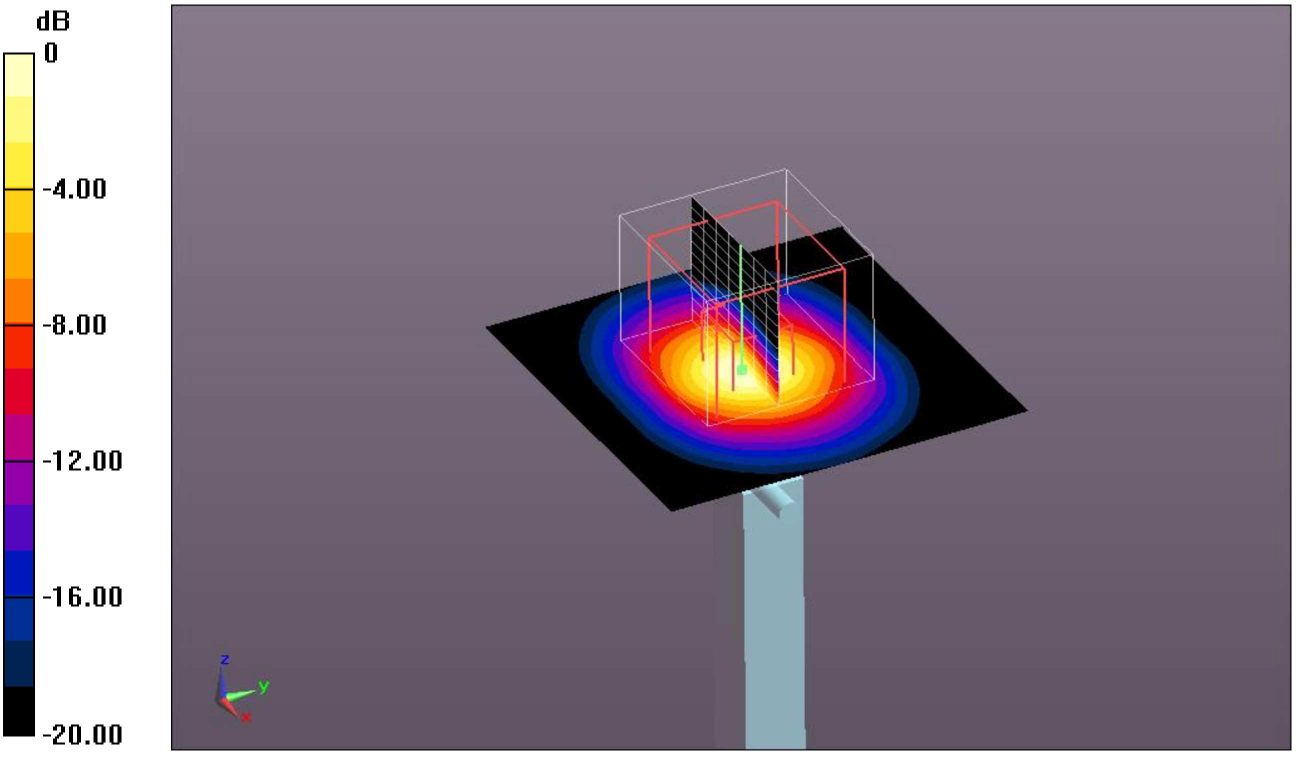
Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 63.518 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 32.2 W/kg

SAR(1 g) = 7.34 W/kg; SAR(10 g) = 2.07 W/kg

Maximum value of SAR (measured) = 19.1 W/kg



0 dB = 19.1 W/kg = 12.81 dBW/kg

Additional information:

ambient temperature: 23.8°C; liquid temperature: 23.3°C

Annex B: DASY5 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

Annex B.1: FSSH MSK 2450 MHz

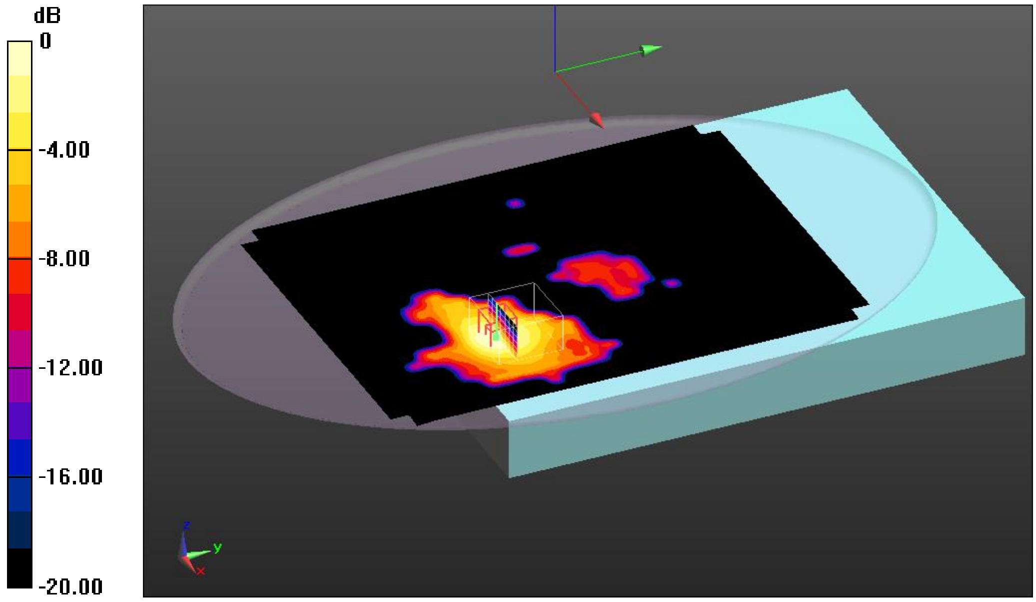
Date/Time: 16.03.2017 13:13:29

FCC_EN62209-2 2.4GHz

DUT: Intel; Type: Cockpit; Serial: 603
Communication System: UID 0, FHSS (MSK) 2.4(0); Communication System Band: 2.4 GHz; Frequency: 2436.5 MHz; Communication System PAR: 0 dB; PMF: 1
Medium parameters used (interpolated): f = 2436.5 MHz; σ = 1.981 S/m; ε_r = 51.632; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5
DASY5 Configuration:
- Probe: EX3DV4 - SN3944; ConvF(7.8, 7.8, 7.8); Calibrated: 23.08.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE3 Sn477; Calibrated: 11.05.2016
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1046
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

MSL2450/Bottom Middle Antenna 1 touch/Area Scan (201x261x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.0629 W/kg

MSL2450/Bottom Middle Antenna 1 touch/Zoom Scan (8x8x7)/Cube 0:
Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 5.789 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 0.0760 W/kg
SAR(1 g) = 0.041 W/kg; SAR(10 g) = 0.023 W/kg
Maximum value of SAR (measured) = 0.0622 W/kg



0 dB = 0.0622 W/kg = -12.06 dBW/kg

Additional information:
position or distance of DUT to SAM: 0 mm
ambient temperature: 23.8°C; liquid temperature: 23.2°C

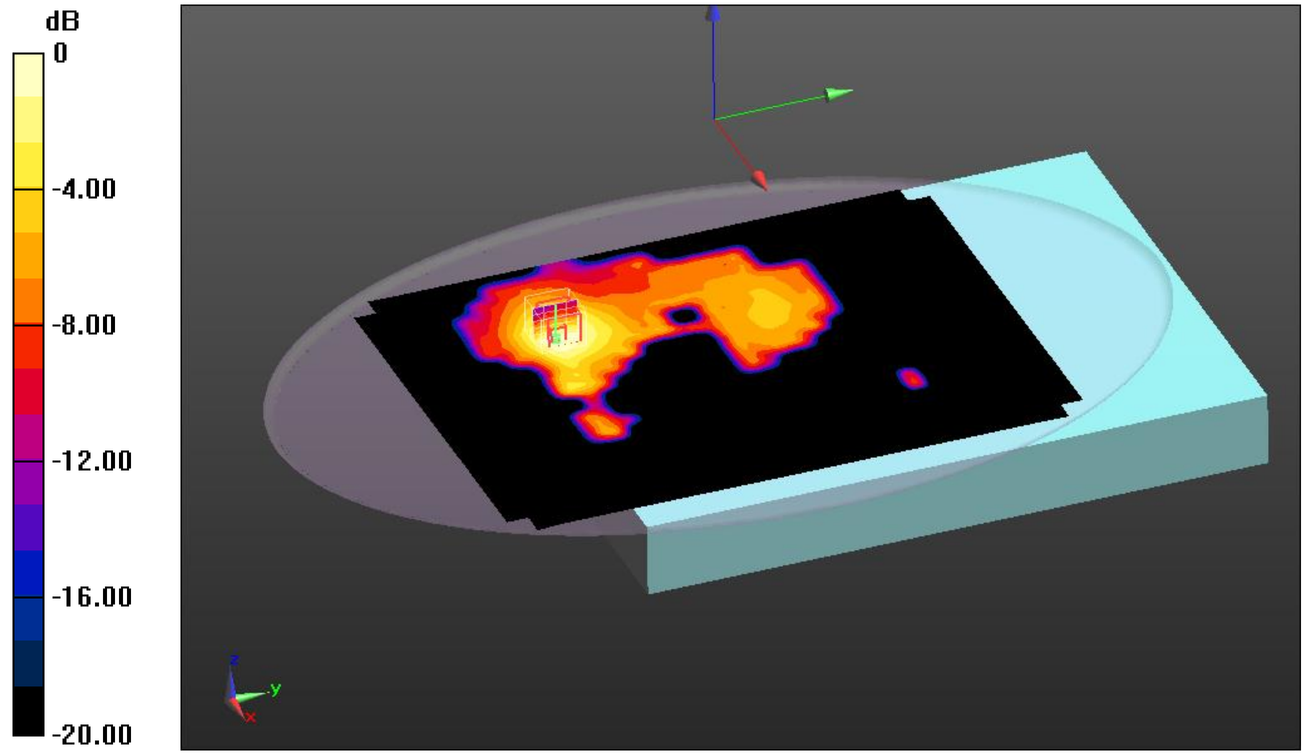
Date/Time: 16.03.2017 14:24:40

FCC_EN62209-2 2.4GHz

DUT: Intel; Type: Cockpit; Serial: 603
Communication System: UID 0, FHSS (MSK) 2.4(0); Communication System Band: 2.4 GHz; Frequency: 2436.5 MHz; Communication System PAR: 0 dB; PMF: 1
Medium parameters used (interpolated): f = 2436.5 MHz; σ = 1.981 S/m; ε_r = 51.632; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5
DASY5 Configuration:
- Probe: EX3DV4 - SN3944; ConvF(7.8, 7.8, 7.8); Calibrated: 23.08.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 1.0, 26.0
- Electronics: DAE3 Sn477; Calibrated: 11.05.2016
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1046
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

MSL2450/Bottom Middle Antenna 2 touch/Area Scan (201x261x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.0778 W/kg

MSL2450/Bottom Middle Antenna 2 touch/Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 6.150 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 0.0920 W/kg
SAR(1 g) = 0.052 W/kg; SAR(10 g) = 0.030 W/kg
Maximum value of SAR (measured) = 0.0768 W/kg



0 dB = 0.0768 W/kg = -11.15 dBW/kg

Additional information:
position or distance of DUT to SAM: 0 mm
ambient temperature: 23.8°C; liquid temperature: 23.2°C

Annex B.2: FSSH MSK 5 GHz

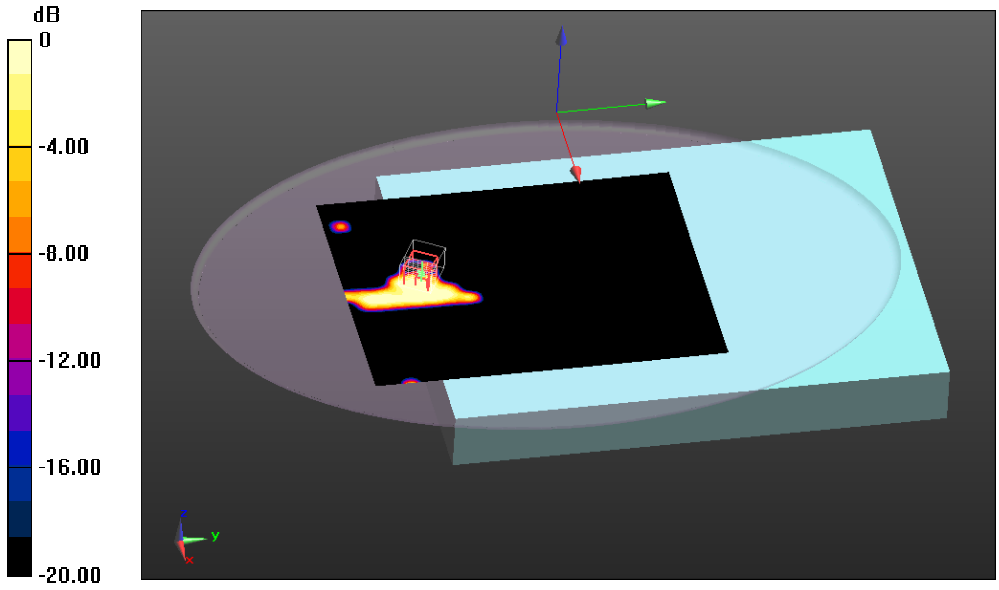
Date/Time: 16.03.2017 16:12:14

FCC_EN62209-2 5GHz

DUT: Intel; Type: Cockpit; Serial: 603
Communication System: UID 0, 5GHz (0); Communication System Band: 5 GHz Band; Frequency: 5230 MHz; Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 5230 MHz; σ = 5.426 S/m; ε_r = 47.821; ρ = 1000 kg/m³
Phantom section: Flat Section
Measurement Standard: DASY5
DASY5 Configuration:
- Probe: EX3DV4 - SN3944; ConvF(4.85, 4.85, 4.85); Calibrated: 23.08.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 23.0
- Electronics: DAE3 Sn477; Calibrated: 11.05.2016
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1046
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

MSL5000/Bottom Ch 5230 Antenna touch/Area Scan (161x201x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.0908 W/kg

MSL5000/Bottom Ch 5230 Antenna touch/Zoom Scan (8x10x12)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 2.631 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 0.198 W/kg
SAR(1 g) = 0.022 W/kg; SAR(10 g) = 0.0081 W/kg
Maximum value of SAR (measured) = 0.0405 W/kg



0 dB = 0.0405 W/kg = -13.93 dBW/kg

Additional information:
position or distance of DUT to SAM: 0 mm
ambient temperature: 23.9°C; liquid temperature: 23.3°C

Date/Time: 16.03.2017 17:12:19

FCC_EN62209-2 5GHz

DUT: Intel; Type: Cockpit; Serial: 603

Communication System: UID 0, 5GHz (0); Communication System Band: 5 GHz Band; Frequency: 5310 MHz; Communication System PAR: 0 dB; PMF: 1

Medium parameters used: f = 5310 MHz; σ = 5.583 S/m; ε_r = 47.769; ρ = 1000 kg/m^3

Phantom section: Flat Section

Measurement Standard: DASY5

DASY5 Configuration:

- Probe: EX3DV4 - SN3944; ConvF(4.48, 4.48, 4.48); Calibrated: 23.08.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 23.0
- Electronics: DAE3 Sn477; Calibrated: 11.05.2016
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1046
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

MSL5000/Bottom 5310 Antenna touch/Area Scan (161x201x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.0420 W/kg

MSL5000/Bottom 5310 Antenna touch/Zoom Scan (8x10x12)/Cube 0:

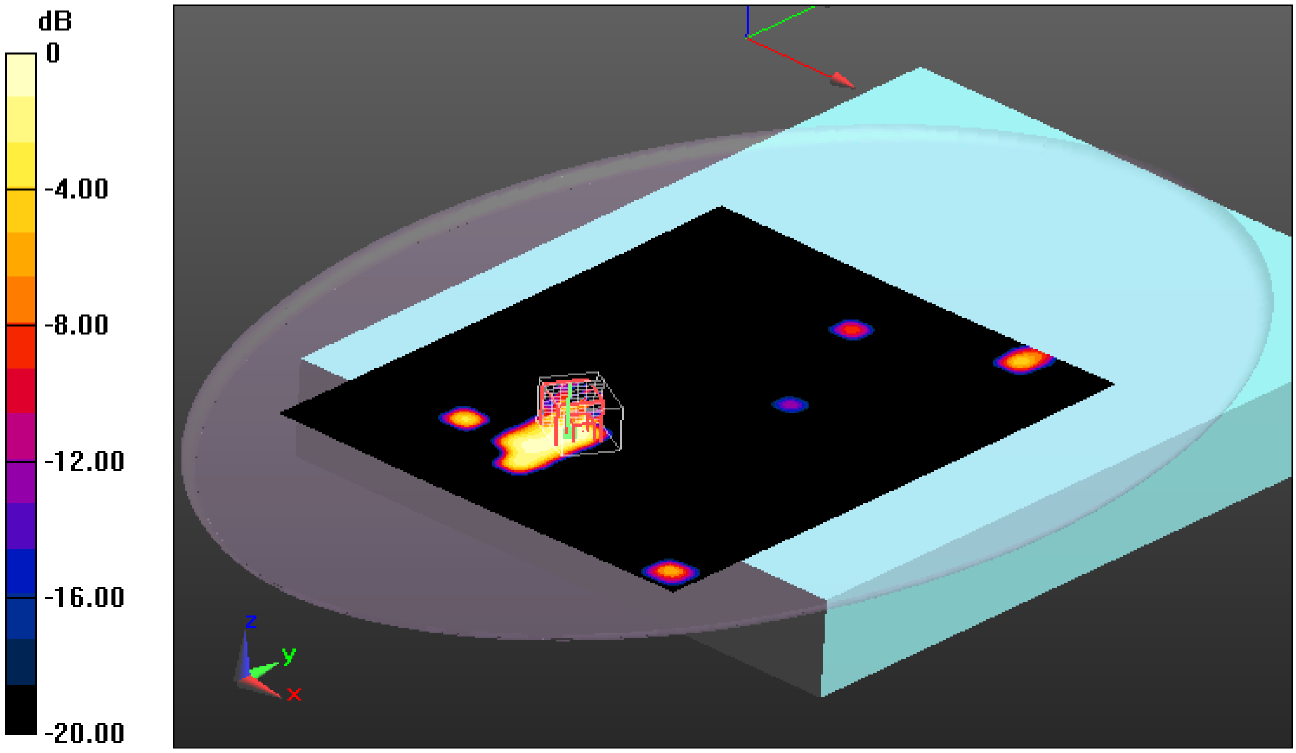
Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 2.760 V/m; Power Drift = -0.19 dB

Peak SAR (extrapolated) = 0.281 W/kg

SAR(1 g) = 0.023 W/kg; SAR(10 g) = 0.00677 W/kg

Maximum value of SAR (measured) = 0.0363 W/kg



0 dB = 0.0363 W/kg = -14.40 dBW/kg

Additional information:

position or distance of DUT to SAM: 0 mm

ambient temperature: 23.9°C; liquid temperature: 23.3°C

Annex B.3: Liquid depth

Photo 1: Liquid depth 2450 MHz body simulating liquid

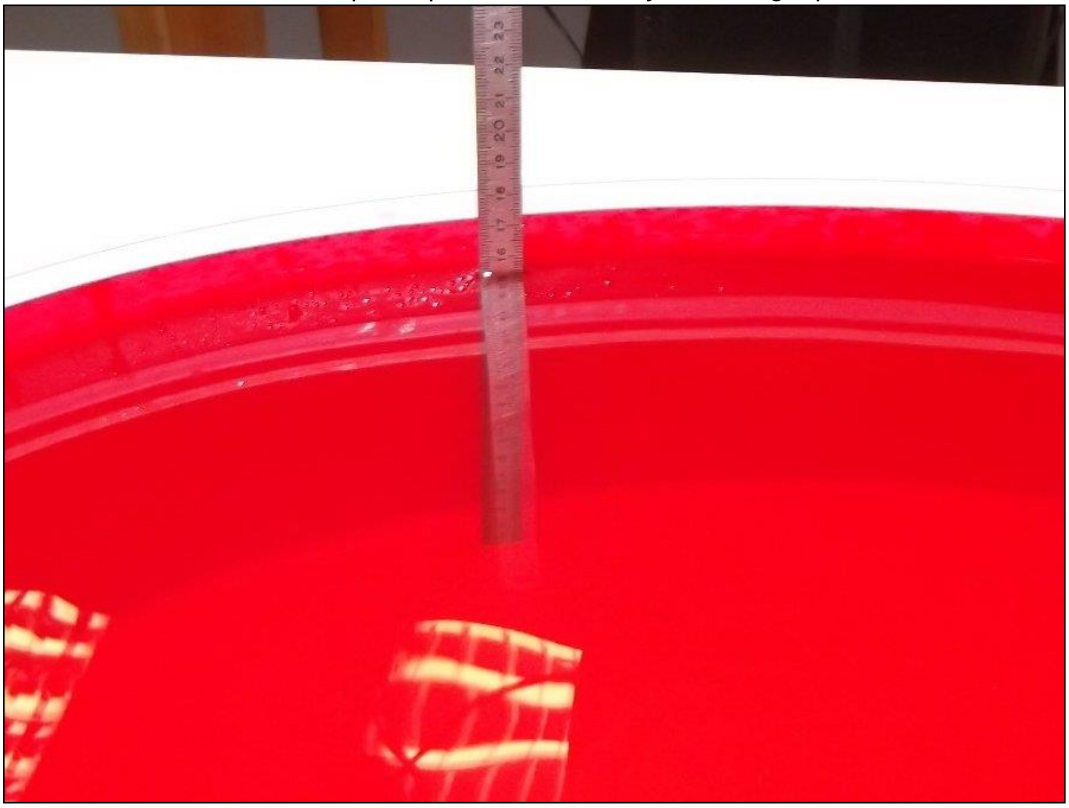
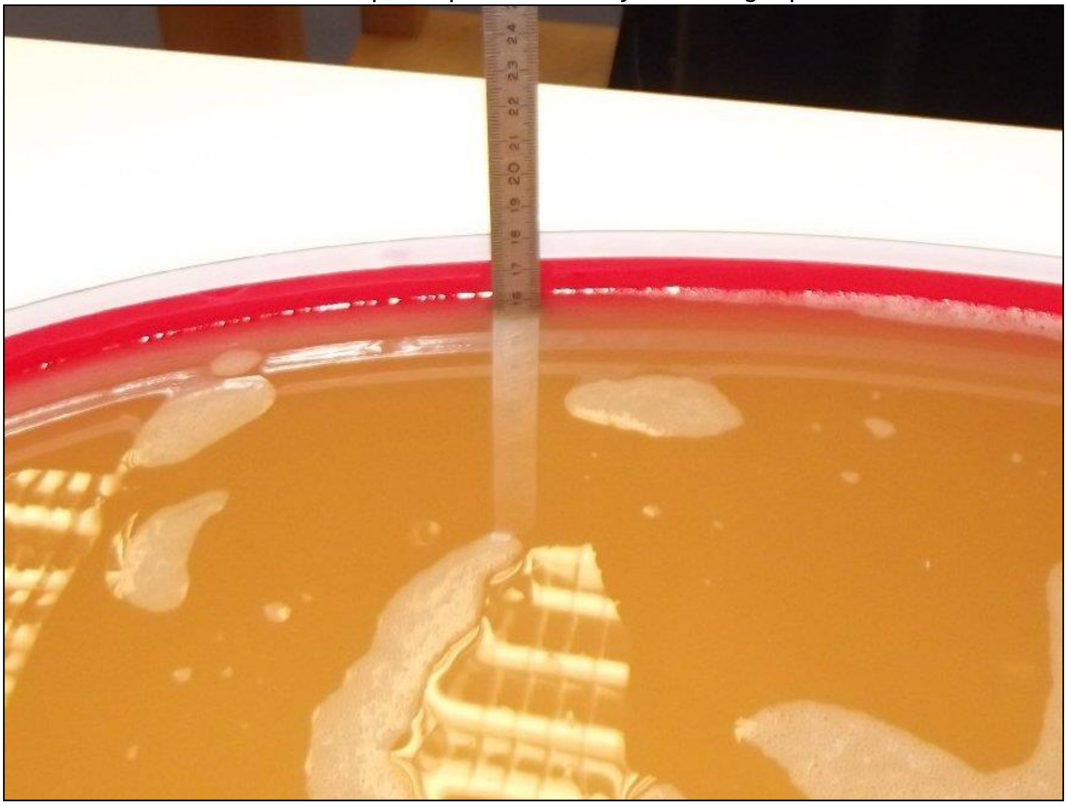


Photo 2: Liquid depth 5 GHz body simulating liquid



Annex C: Photo documentation

Photo documentation is described in the additional document:

Appendix to test report no. 1-2536/16-02-02 Photo documentation

Annex D: Calibration parameters

Calibration parameters are described in the additional document:

Appendix to test report no. 1-2536/16-02-02
Calibration data, Phantom certificate
and detail information of the DASY5 System

Annex E: RF Technical Brief Cover Sheet acc. to RSS-102 Annex A

1. COMPANY NUMBER: **1000B**

2. PRODUCT MARKETING NAME (PMN): RCM24G + VLMRX58G

3. HARDWARE VERSION IDENTIFICATION NO. (HVIN): D + AMN-PCB_183 REV 2.0

4. FIRMWARE VERSION IDENTIFICATION NO. (FVIN): RCM24G_12017USCN + 4.2.2

5. HOST MARKETING NAME (HMN): Intel Cockpit Ground Control Station

6. IC CERTIFICATION NUMBER: **1000B-RCM24G + 1000B-VLMRX58G**

7. APPLICANT: **Intel Canada Ltd.**

8. SAR/RF EXPOSURE TEST LABORATORY: **CTC advanced GmbH**

9. TYPE OF EVALUATION:

(a) SAR Evaluation: **Device not Used in the Vicinity of the Human Head.**

(b) SAR Evaluation: **Body-Worn Device**
- Multiple transmitters: Yes ☒ No ☐
- Evaluated against exposure limits: General Public Use ☒ Controlled Use ☐
- Duty cycle used in evaluation: 100 %
- Standard used for evaluation: listed in separate table below.
- SAR value: **0.082 W/kg**. Measured ☒ Computed ☐ Calculated ☐

(c) SAR Evaluation: **Limb-Worn Device**
- Multiple transmitters: Yes ☒ No ☐
- Evaluated against exposure limits: General Public Use ☒ Controlled Use ☐
- Duty cycle used in evaluation: 100 %
- Standard used for evaluation: listed in separate table below.
- SAR value: **0.048 W/kg**. Measured ☒ Computed ☐ Calculated ☐

Annex E.1: Declaration of RF Exposure Compliance Annex B

ATTESTATION: I attest that the information provided in Annex E: is correct; that a Technical Brief was prepared and the information it contains is correct; that the device evaluation was performed or supervised by me; that applicable measurement methods and evaluation methodologies have been followed and that the device meets the SAR and/or RF exposure limits of RSS-102.

Signature: p.o. Thomas Vogler

DN: cn=Thomas Vogler, o=CTC advanced GmbH, ou=VOG-161125, email=thomas.vogler@ctcadvanced.com, c=DE
Datum: 2017.04.27 14:55:35 +02'00'

NAME: **Alexander Hnatovskiy**

TITLE: Dipl.-Ing. (FH)

COMPANY: CTC advanced GmbH

PRODUCT MARKETING NAME (PMN): RCM24G + VLMRX58G

HARDWARE VERSION IDENTIFICATION NO. (HVIN): D + AMN-PCB_183 REV 2.0

FIRMWARE VERSION IDENTIFICATION NO. (FVIN): RCM24G_12017USCN + 4.2.2

HOST MARKETING NAME (HMN): Intel Cockpit Ground Control Station

IC CERTIFICATION NUMBER: **1000B-RCM24G + 1000B-VLMRX58G**

Test Standard	Version	Description
IEEE 1528-2013	2014-06	Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
RSS-102 Issue 5	2015-04	Radio Frequency Exposure Compliance of Radio communication Apparatus (All Frequency Bands)
Canada's Safety Code No. 6	2015-03	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)
FCC KDBs		
KDB 865664D01v01r03	2014-02-07	FCC OET SAR measurement requirements 100 MHz to 6 GHz
KDB 447498D01v05r02	2014-02-07	Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies
KDB 248227D01v02r01	2015-05-28	SAR Measurement Procedures for 802.11 a/b/g Transmitters

Annex F: Document History

Version	Applied Changes	Date of Release
	Initial Release	2017-03-17

Annex G: Further Information

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
PCE	-	Personal Consumption Expenditure
OET	-	Office of Engineering and Technology
SAR	-	Specific Absorption Rate
S/N	-	Serial Number
SW	-	Software
UNII	-	Unlicensed National Information Infrastructure