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Shenzhen Branch

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TEST REPORT

Application No.:	SZEM1802001299CR
Applicant:	Hytera Communications Corporation Limited Baolong Branch
Address of Applicant:	Plant No.3, Hytera Hi-Tech Park, Baolong Industrial Area, Longgang District, Shenzhen, People's Republic of China
Manufacturer:	Hytera Communications Corporation Limited Baolong Branch
Address of Manufacturer:	Plant No.3, Hytera Hi-Tech Park, Baolong Industrial Area, Longgang District, Shenzhen, People's Republic of China
Factory:	Hytera Communications Corporation Limited Baolong Branch
Address of Factory:	Plant No.3, Hytera Hi-Tech Park, Baolong Industrial Area, Longgang District, Shenzhen, People's Republic of China
Equipment Under Test (EUT):	
EUT Name:	Multi-mode Radio
Model No.:	PDC760 V1B1
Trade mark:	Hytera
FCC ID:	YAMPDC760V1B1
Standard(s) :	FCC 47 CFR Part 2 (2.1093) IEEE 1528-2013 KDB 865664 KDB 447498 KDB 643646
Date of Receipt:	2018-02-11
Date of Test:	2018-03-01 to 2018-03-16
Date of Issue:	2018-04-25
Test Result:	**Pass***

* In the configuration tested, the EUT complied with the standards specified above.

Keny Xu
EMC Laboratory Manager

The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.
If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or testing done by SGS International Electrical Approvals in connection with, distribution or use of the product described in this report must be approved by SGS International Electrical Approvals in writing.

Revision Record				
Version	***Chapter***	***Date***	***Modifier***	***Remark***
01		*2018-04-25*		*Original*

Authorized for issue by:				
		Edison Li		
		Edison Li /Project Engineer		
		Eric Fu		
		Eric Fu /Reviewer		

Contents

1. TEST STANDARDS

The tests were performed according to following standards:

FCC 47 Part 2.1093 Radiofrequency Radiation Exposure Evaluation:Portable Devices

IEEE Std C95.1, 1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 KHz to 300 GHz.

IEEE Std 1528™-2013: IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.

KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04: SAR Measurement Requirements for 100 MHz to 6 GHz

KDB 865664 D02 RF Exposure Reporting v01r02: RF Exposure Compliance Reporting and Documentation Considerations

KDB 447498 D01 General RF Exposure Guidance v06: Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies

KDB :643646 D01 SAR Test for PTT Radios v01r03l: SAR Test Reduction considerations for occupational PTT radios

2. SUMMARY

2.1. Product Description

Product Name:	Multi-mode Radio
Brand name:	Hytera
Model Name.:	PDC760 V1B1
Series Model:	N/A
FCC ID:	YAMPDC760V1B1
DTM Description:	N/A
Device Category:	Production unit
Exposure Category:	GENERAL POPULATION/UNCONTROLLED EXPOSURE
Frequency Range:	136 MHz~174 MHz
Test Frequncy:	136.05 MHz (Low), 155.05 MHz(Middle), 173.95 MHz(High)
Modulation Technique:	FM(Analog), 4FSK(Digital)
Channel Separation:	12.5KHz & 25KHz for FM; 12.5KHz for 4FSK
Operating Mode:	Maximum continuous output
Conducted RF Power:	36.7dBm(Maximum)
Power Source:	DC 7.6V, 2900mAh Li-ion battery which charged by MCU Charger MCU Charger Model: CH20L08 Input: DC 12V, 2000mA Output: DC12V, 2000mA AC Adapter Model: HKA02412020-XG Input: AC 100-240V, 50/60Hz, 0.8A Output: DC 12V, 2A
Test Voltage:	7.6V DC Li-ion battery
Normal Operation:	Face Up and Body-worn

2.2. Summary SAR Results

The maximum results of Specific Absorption Rate (SAR) found during testing for PDC760 V1B1 are as follows (with expanded uncertainty 20.4%)

Table 1:Max. SAR Measured(1g)

FCC					
Mode	**Channel Separation**	**Frequency (MHz)**	**Position**	**Maximum Report SAR_{1g} Results (W/Kg)**	
				100% duty cycle	**50% duty cycle**
Digital/4FSK	12.5KHz	173.05	Face-held	0.11	**0.06**
Digital/4FSK	12.5KHz	155.05	Body-Worn	0.34	**0.17**
Limit Value			8 W/Kg		
Test Verdict			Pass		

Note: This device is in compliance with Specific Absorption Rate (SAR) for Occupational /uncontrolled exposure limits specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013.

2.3. Equipment under Test

Power supply system utilised

Power supply voltage	:	○	110V / 60 Hz	○	115V / 60Hz
		●	7.6 V DC	○	24 V DC
		○	Other (specified in blank below)		

2.4. EUT operation mode

The spatial peak SAR values were assessed for Hytera systems. Battery and accessories shell be specified by the manufacturer. The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power output.

2.5. EUT configuration

The following peripheral devices and interface cables were connected during the measurement:

Accessory name	Internal Identification	Model	Description	Remark
Antenna	A1	N/A	External Antenna	performed
Battery	B1	N/A	Intrinsically Safe Li-ion Battery	performed

AE ID: is used to identify the test sample in the lab internally.

3. TEST LOCATION

Company:	SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch
Address:	No. 1 Workshop, M-10, Middle section, Science & Technology Park, Shenzhen, Guangdong, China
Post code:	518057
Telephone:	+86 (0) 755 2601 2053
Fax:	+86 (0) 755 2671 0594
E-mail:	ee.shenzhen@sgs.com

4. TEST ENVIRONMENT

4.1. Address of the test laboratory

The testing and technology center for industrial products.

No.149, 7th Industry Road, Shekou, Nanshan District, Shenzhen, Guangdong, China

4.2. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	20-24 ° C
Humidity:	40-65 %
Atmospheric pressure:	950-1050mbar

4.3. SAR Limits

FCC Limit (1g Tissue)

Exposure Limits	**SAR (W/kg)**	
	(General Population / Uncontrolled Exposure Environment)	(Occupational / Controlled Exposure Environment)
Spatial Average (averaged over the whole body)	0.08	0.4
Spatial Peak (averaged over any 1 g of tissue)	**1.60**	**8.0**
Spatial Peak (hands/wrists/feet/ankles averaged over 10 g)	4.0	20.0

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

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

4.4. Equipments Used during the Test

Test Equipment	Manufacturer	Type/Model	Serial Number	Calibration	
				Last Calibration	Calibration Interval
Data Acquisition Electronics DAEx	SPEAG	DAE 4	910	2017/07/13	1
E-field Probe	SPEAG	ES3DV3	3292	2018/01/25	1
System Validation Dipole CLA150	SPEAG	CLA150	4019	2016/02/11	3
Network analyzer	Agilent	N9923A	JD463	2017/09/05	1
Dielectric Probe Kit	Agilent	DAK-3.5	1038	2016/08/25	3
Power meter	Agilent	N1914A	MY52090010	2017/03/20	1
Power sensor	Agilent	E9304A	MY52140008	2017/03/20	1
Signal generator	RS	SMB100A	175248	2017/09/02	1
Amplifier	Mini-Circuits	ZHL-42W	QA1202003	2017/11/27	1

5. SAR Measurements System configuration

5.1. SAR Measurement Set-up

The DASY5 system for performing compliance tests consists of the following items:

A standard high precision 6-axis robot (Stäubli RX 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. The probe is equipped with an optical surface detector system.

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.

A unit to operate the optical surface detector which is connected 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 DASY5 measurement server.

The DASY5 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 2003.

DASY5 software and SEMCAD data evaluation software.

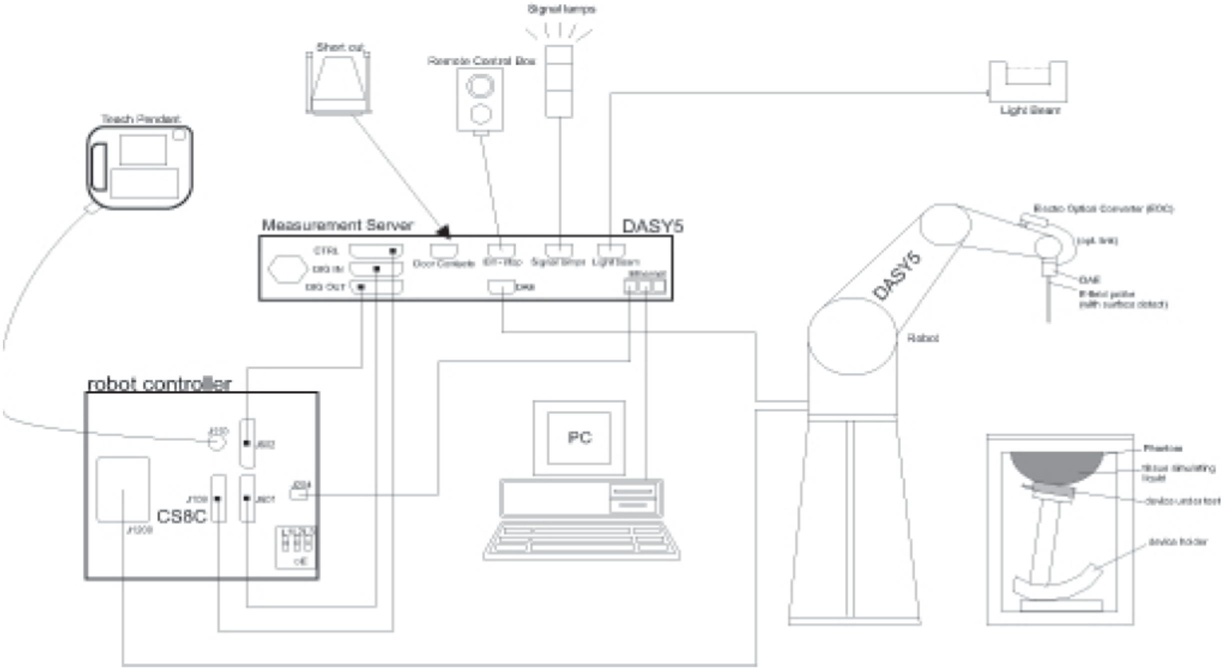
Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.

The generic twin phantom enabling the testing of left-hand and right-hand usage.

The device holder for handheld Mobile Phones.

Tissue simulating liquid mixed according to the given recipes.

System validation dipoles allowing to validate the proper functioning of the system.


Signal lamps
Short cut
Remote Control Box
Teach Pendant
Light Beam
Measurement Server
DASY5
robot controller
CS8C
PC
DASY5
Robot

5.2. DASY5 E-field Probe System

The SAR measurements were conducted with the dosimetric probe EX3DV4 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation.

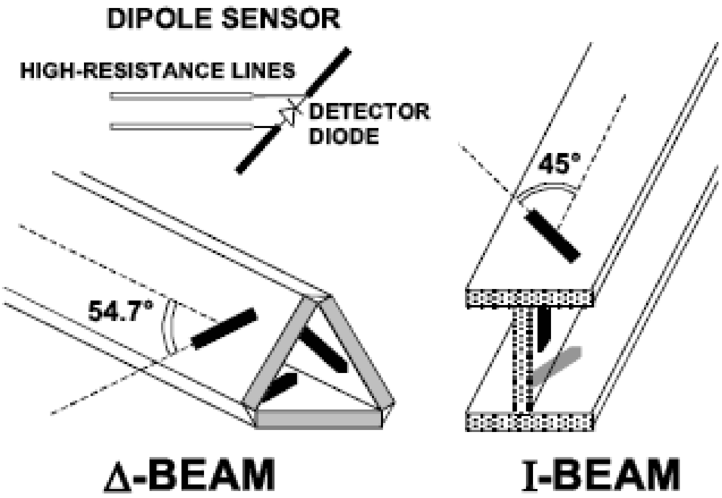
Probe Specification

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 4 GHz; Linearity: ± 0.2 dB (30 MHz to 4 GHz)
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.3 dB in tissue material (rotation normal to probe axis)
Dynamic Range	5 µW/g to > 100 mW/g; Linearity: ± 0.2 dB
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.0 mm
Application	General dosimetry up to 4 GHz Dosimetry in strong gradient fields Compliance tests of Mobile Phones
Compatibility	DASY3, DASY4, DASY52 SAR and higher, EASY4/MRI

Isotropic E-Field Probe

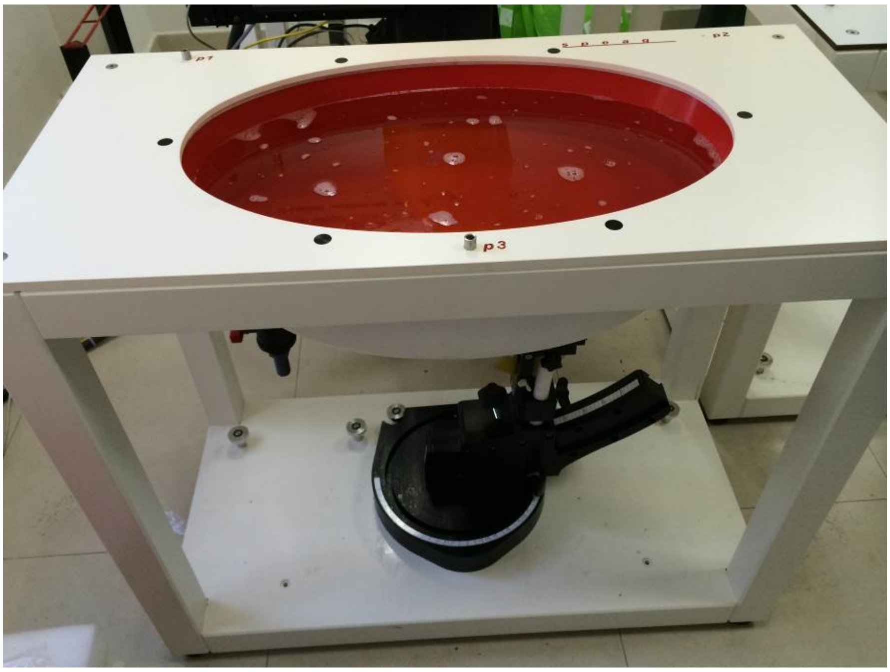
The isotropic E-Field probe has been fully calibrated and assessed for isotropicity, and boundary effect within a controlled environment. Depending on the frequency for which the probe is calibrated the method utilized for calibration will change.

The E-Field probe utilizes a triangular sensor arrangement as detailed in the diagram below:



5.3. Phantoms

Phantom for compliance testing of handheld andbody-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI isfully compatible with the IEC 62209-2 standard and all known tissuesimulating liquids. ELI has been optimized regarding its performance and can beintegrated into our standard phantom tables. A cover prevents evaporation ofthe liquid. Reference markings on the phantom allow installation of thecomplete setup, including all predefined phantom positions and measurementgrids, by teaching three points. The phantom is compatible with all SPEAGdosimetric probes and dipoles.

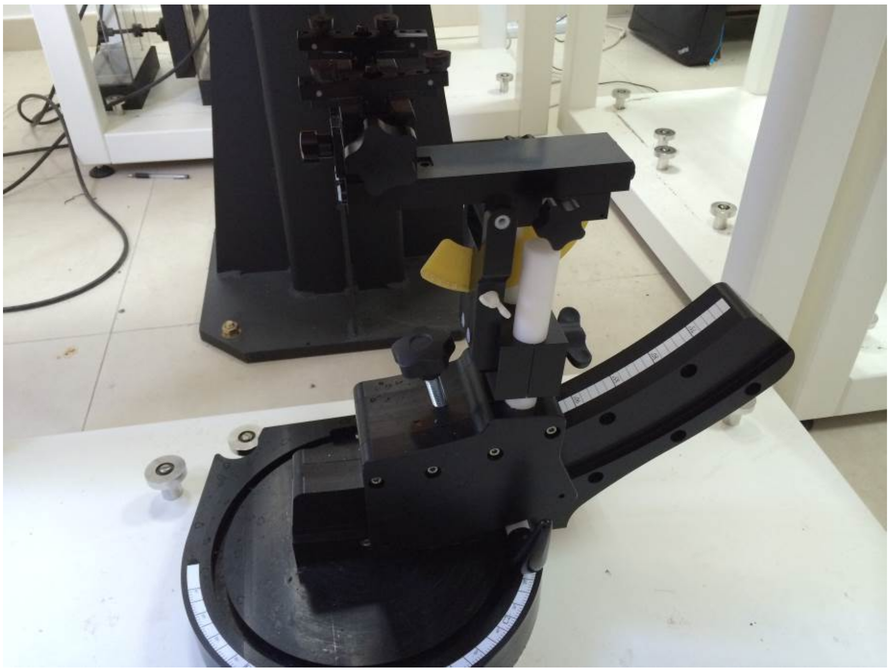


ELI Phantom

5.4. Device Holder

The device was placed in the device holder (illustrated below) that is supplied by SPEAG as an integral part of the DASY system.

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



Device holder supplied by SPEAG

5.5. Scanning Procedure

The DASY5 installation includes predefined files with recommended procedures for measurements and validation. 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 “surface check” measurement tests the optical surface detection system of the DASY5 system by repeatedly detecting the surface with the optical and mechanical surface detector and comparing the results. The output gives the detecting heights of both systems, the difference between the two systems and the standard deviation of the detection repeatability. Air bubbles or refraction in the liquid due to separation of the sugar-water mixture gives poor repeatability (above ± 0.1mm). To prevent wrong results tests are only executed when the liquid is free of air bubbles. The difference between the optical surface detection and the actual surface depends on the probe and is specified with each probe (It does not depend on the surface reflectivity or the probe angle to the surface within ± 30°.)

Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values before running a detailed measurement around the hot spot.Before starting the area scan a grid spacing of 15 mm x 15 mm is set. During the scan the distance of the probe to the phantom remains unchanged. After finishing area scan, the field maxima within a range of 2 dB will be ascertained.

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 mm ± 1 mm	½·δ·ln(2) mm ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

Zoom Scan

Zoom Scans are used to estimate the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default Zoom Scan is done by 7x7x7 points within a cube whose base is centered around the maxima found in the preceding area scan.

Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	≤ 1.5·$\Delta z_{Zoom}(n-1)$ mm	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm
Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 for details. * When zoom scan is required and the <u>*reported*</u> SAR from the *area scan based 1-g SAR estimation* procedures of KDB Publication 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.				

Spatial Peak Detection

The procedure for spatial peak SAR evaluation has been implemented and can determine values of massesof 1g and 10g, as well as for user-specific masses.The DASY5 system allows evaluations that combine measured data and robot positions, such as: • maximum search • extrapolation • boundary correction • peak search for averaged SAR During a maximum search, global and local maxima searches are automatically performed in 2-D after each Area Scan measurement with at least 6 measurement points. It is based on the evaluation of the local SAR gradient calculated by the Quadratic Shepard's method. The algorithm will find the global maximum and all local maxima within -2 dB of the global maxima for all SAR distributions.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. Several measurements at different distances are necessary for the extrapolation. Extrapolation routines require at least 10 measurement points in 3-D space. They are used in the Zoom Scan to obtain SAR values between the lowest measurement points and the inner phantom surface. The routine uses the modified Quadratic Shepard's method for extrapolation. For a grid using 7x7x7 measurement points with 5mm resolution amounting to 343 measurement points, the uncertainty of the extrapolation routines is less than 1% for 1g and 10g cubes.

A Z-axis scan measures the total SAR value at the x-and y-position of the maximum SAR value found during the cube 7x7x7 scan. The probe is moved away in z-direction from the bottom of the SAM phantom in 5mm steps.

5.6. Data Storage and Evaluation

Data Storage

The DASY5 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". 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

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 DASY5 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:

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

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:

$$\mathrm{E-fieldprobes:} \qquad E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

$$\mathrm{H-fieldprobes:} \qquad H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1} f + a_{i2} f^2}{f}$$

With Vi = compensated signal of channel i (i = x, y, z)
Normi = sensor sensitivity of channel i (i = x, y, z)
[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):

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

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

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1'000}$$

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/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.

5.7. SAR Measurement System

The SAR measurement system being used is the DASY5 system, the system is controlled remotely from a PC, which contains the software to control the robot and data acquisition equipment. The software also displays the data obtained from test scans.

In operation, the system first does an area (2D) scan at a fixed depth within the liquid from the inside wall of the phantom. When the maximum SAR point has been found, the system will then carry out a 3D scan centred at that point to determine volume averaged SAR level.

5.7.1 Tissue Dielectric Parameters for Head and Body Phantoms

The liquid is consisted of water,salt,Glycol,Sugar,Preventol and Cellulose.The liquid has previously been proven to be suited for worst-case.It's satisfying the latest tissue dielectric parameters requirements proposed by the IEC62209-1.

The composition of the tissue simulating liquid

Target Frequency	Head		Body	
(MHz)	ε_r	σ(S/m)	ε_r	σ(S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800-2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00

(ε_r = relative permittivity, σ = conductivity and ρ = 1000 kg/m^3)

Targets for tissue simulating liquid

Frequency (MHz)	**Liquid Type**	**Liquid Type (σ)**	**± 5% Range**	**Permittivity (ε)**	**± 5% Range**
300	Head	0.87	0.83～0.91	45.30	40.04～47.57
350	Head	0.87	0.83～0.91	44.70	42.47～46.93
450	Head	0.87	0.83～0.91	43.50	41.33～45.68
835	Head	0.90	0.86～0.95	41.50	39.43～43.58
900	Head	0.97	0.92～1.02	41.50	39.43～43.58
1450	Head	1.20	1.14～1.26	40.50	38.48～42.53
1800	Head	1.40	1.33～1.47	40.00	38.00～42.00
1900	Head	1.40	1.33～1.47	40.00	38.00～42.00
1950	Head	1.40	1.33～1.47	40.00	38.00～42.00
2000	Head	1.40	1.33～1.47	40.00	38.00～42.00
2450	Head	1.80	1.71～1.89	39.20	37.24～41.16
3000	Head	2.40	2.28～2.52	38.50	36.58～40.43
300	Body	0.87	0.83～0.91	45.30	40.04～47.57
450	Body	0.87	0.83～0.91	43.50	41.33～45.68
835	Body	0.90	0.86～0.95	41.50	39.43～43.58
900	Body	0.97	0.92～1.02	41.50	39.43～43.58

1450	Body	1.20	1.14～1.26	40.50	38.48～42.53
1800	Body	1.40	1.33～1.47	40.00	38.00～42.00
1900	Body	1.40	1.33～1.47	40.00	38.00～42.00
1950	Body	1.40	1.33～1.47	40.00	38.00～42.00
2000	Body	1.40	1.33～1.47	40.00	38.00～42.00
2100	Body	1.49	1.42～1.56	39.80	37.81～41.79
2450	Body	1.80	1.71～1.89	39.20	37.24～41.16
2600	Body	1.96	1.86～2.06	39.00	37.05～40.95
3000	Body	2.40	2.28～2.52	38.50	36.58～40.43
3500	Body	2.91	2.77～3.06	37.90	36.01～39.80
4000	Body	3.43	3.26～3.61	37.40	35.53～39.27
4500	Body	3.94	3.74～4.14	36.80	34.96～38.64
5000	Body	4.45	4.23～4.67	36.20	34.39～38.01
5200	Body	4.66	4.23～4.89	36.00	34.20～37.80
5400	Body	4.86	4.62～5.10	35.80	34.01～37.59
5600	Body	5.07	4.82～5.32	35.50	33.73～37.28
5800	Body	5.27	5.01～5.53	35.30	33.54～37.07
6000	Body	5.48	5.21～5.75	35.10	33.35～36.86

5.8. Tissue equivalent liquid properties

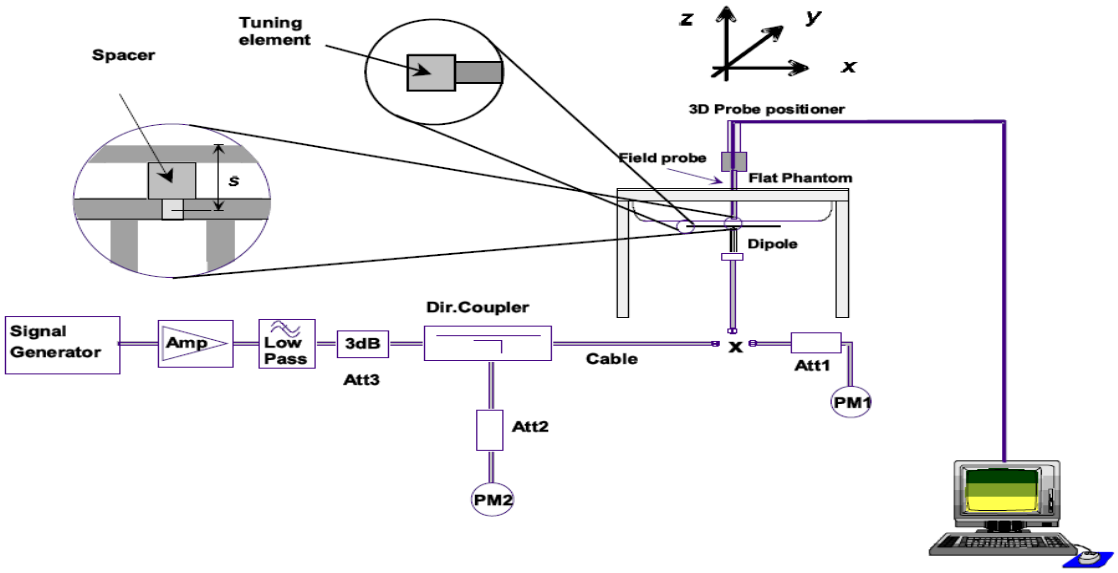
Tissue Type	Measured Frequency (MHz)	Target Tissue		Measured Tissue				Liquid Temp.	Test Data
		ε_r	σ	ε_r	Dev. %	σ	Dev. %		
150H	150	52.30	0.76	52.43	0.2	0.79	3.9	22.2 degree	2018-03-27
150B	150	61.9	0.80	63.4	2.4	0.81	1.3	22.2 degree	2018-03-27

5.9. System Check

The purpose of the system check is to verify that the system operates within its specifications at the device test frequency. The system check is simple check of repeatability to make sure that the system works correctly at the time of the compliance test;

System check results have to be equal or near the values determined during dipole calibration with the relevant liquids and test system (±10 %).

System check is performed regularly on all frequency bands where tests are performed with the DASY5 system.



The output power on dipole port must be calibrated to 21 dBm (250mW) before dipole is connected.

Justification for Extended SAR Dipole Calibrations

Referring to KDB 865664D01V01r03, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended. While calibration intervals not exceed 3 years.

System Check in Head Tissue Simulating Liquid

Freq	Test Date	Dielectric Parameters		Temp	250mW Measured		1W Normalized		1W Target		Limit (±10% Deviation)	
		ε_r	σ(s/m)		SAR_{1g}	SAR_{10g}	SAR_{1g}	SAR_{10g}	SAR_{1g}	SAR_{10g}	SAR_{1g}	SAR_{10g}
150MHz	2018/03/27	52.43	0.79	22.2	0.939	0.616	3.756	2.464	3.79	2.52	-0.90 %	-2.22%
150MHz	2018/03/27	63.4	0.81	22.2	0.940	0.621	3.760	2.484	3.89	2.59	-3.34%	-4.09%

Note:

1. The graph results see system check.
2. Target Values used derive from the calibration certificate

5.10. Measurement Procedures

The procedure for assessing the average SAR value consists of the following steps:

➢ Power Reference Measurement

The Power Reference Measurement and Power Drift Measurement jobs are useful jobs for monitoring the power drift of the device under test in the batch process. Both jobs measure the field at a specified reference position, at a selectable distance from the phantom surface. The reference position can be either the selected section's grid reference point or a user point in this section. The reference job projects the selected point onto the phantom surface, orients the probe perpendicularly to the surface, and approaches the surface using the selected detection method.

➢ Area Scan

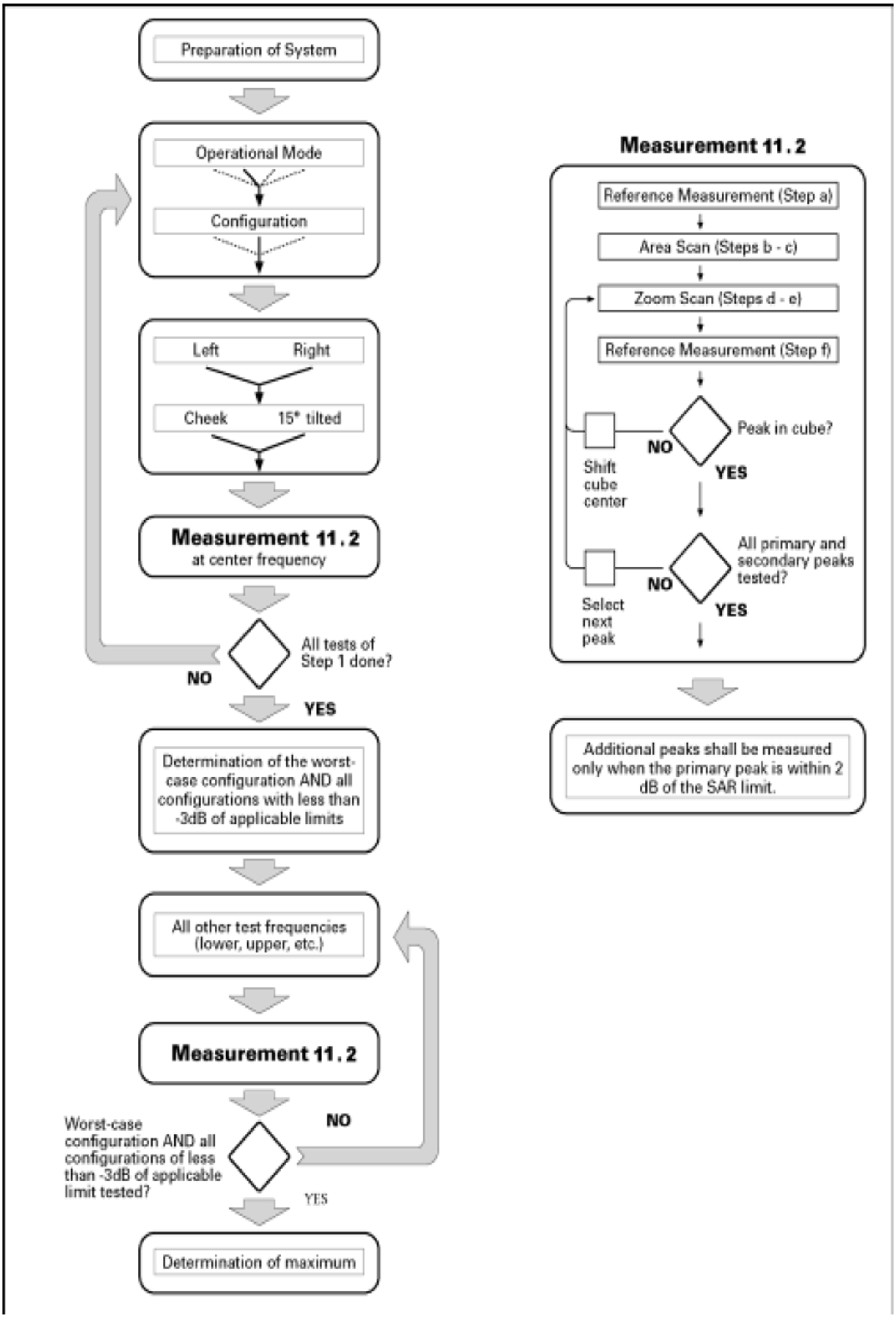
The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a finer measurement around the hot spot. The sophisticated interpolation routines implemented in DASY4 software can find the maximum locations even in relatively coarse grids. The scanning area is defined by an editable grid. This grid is anchored at the grid reference point of the selected section in the phantom. When the Area Scan's property sheet is brought-up, grid settings can be edited by a user.

➢ Zoom Scan

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default Zoom Scan measures 7 x 7 x 7 points (5mmE545mmE545mm) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure.

➢ Power Drift Measurement

The Power Drift Measurement job measures the field at the same location as the most recent power reference measurement job within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement.



Picture 11 Block diagram of the tests to be performed

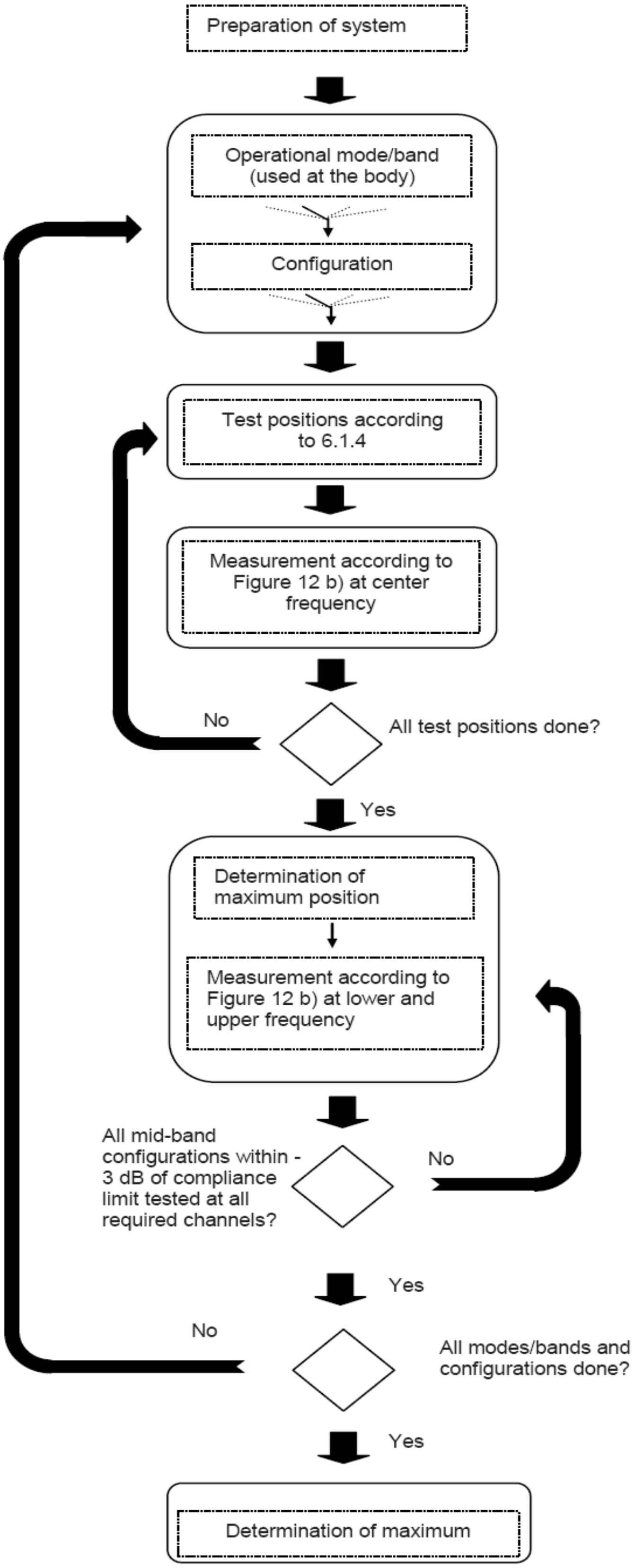


Figure 12a – Tests to be performed

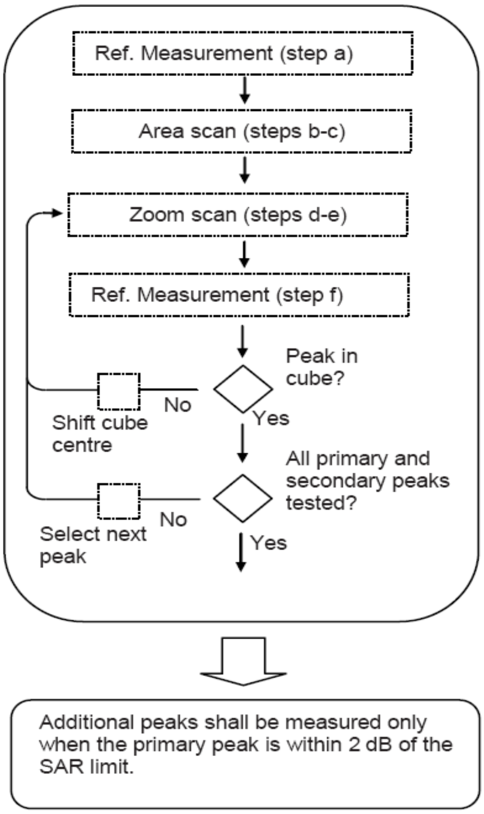


Figure 12b – General procedure

Picture 12 Block diagram of the tests to be performed

Measurement procedure

The following procedure shall be performed for each of the test conditions (see Picture 11) described in 11.1:

a) Measure the local SAR at a test point within 8 mm or less in the normal direction from the inner surface of the phantom.
b) Measure the two-dimensional SAR distribution within the phantom (area scan procedure). The boundary of the measurement area shall not be closer than 20 mm from the phantom side walls. The distance between the measurement points should enable the detection of the location of local maximum with an accuracy of better than half the linear dimension of the tissue cube after interpolation. A maximum grip spacing of 20 mm for frequencies below 3 GHz and (60/f [GHz]) mm for frequencies of 3GHz and greater is recommended. The maximum distance between the geometrical centre of the probe detectors and the inner surface of the phantom shall be 5 mm for frequencies below 3 GHz andδln(2)/2 mm for frequencies of 3 GHz and greater, whereδis the plane wave skin depth and In(x) is the natural logarithm. The maximum variation of the sensor-phantom surface shall be ±1 mm for frequencies below 3 GHz and ±0.5 mm for frequencies of 3 GHz and greater. At all measurement points the angle of the probe with respect to the line normal to the surface should be less than 5°. If this cannot be achieved for a measurement distance to the phantom inner surface shorter than the probe diameter, additional measurement distance to the phantom inner surface shorter than the probe diameter, additional
c) From the scanned SAR distribution, identify the position of the maximum SAR value, in addition identify the positions of any local maxima with SAR values within 2 dB of the maximum value that are not within the zoom-scan volume; additional peaks shall be measured only when the primary peak is within 2 dB of the SAR limit. This is consistent with the 2 dB threshold already stated;
d) Measure the three-dimensional SAR distribution at the local maxima locations identified in step
e) The horizontal grid step shall be (24 / f[GHz]) mm or less but not more than 8 mm. The minimum zoom size of 30 mm by 30 mm and 30 mm for frequencies below 3 GHz. For higher frequencies, the minimum zoom size of 22 mm by 22 mm and 22 mm. The grip step in the vertical direction shall be (8-f[GHz]) mm or less but not more than 5 mm, if uniform spacing is used. If variable spacing is used in the vertical direction, the maximum spacing between the two closest measured points to the phantom shell shall be (12 / f[GHz]) mm or less but not more than 4 mm, and the spacing between father points shall increase by an incremental factor not exceeding 1.5. When variable spacing is used, extrapolation routines shall be tested with the same spacing as used in measurements. The maximum distance between the geometrical centre of the probe detectors and the inner surface of the phantom shall be 5 mm for frequencies below 3 GHz and δln(2)/2 mm for frequencies of 3 GHz and greater, where δis the plane wave skin depth and In(x) is the natural logarithm. Separate grids shall be centered on each of the local SAR maxima found in step c). Uncertainties due to field distortion between the media boundary and the dielectric enclosure of the probe should also be minimized, which is achieved is the distance between the phantom surface and physical tip of the probe is larger than probe tip diameter. Other methods may utilize correction procedures for these boundary effects that enable high precision measurements closer than half the probe diameter. For all measurement points, the angle of the probe with respect to the flat phantom surface shall be less than 5. If this cannot be achieved an additional uncertainty evaluation is needed.
f) Use post processing(e.g. interpolation and extrapolation) procedures to determine the local SAR values at the spatial resolution needed for mass averaging.

Measurement procedure

The following procedure shall be performed for each of the test conditions (see Picture 11) described in 11.1:

g) Measure the local SAR at a test point within 8 mm or less in the normal direction from the inner surface of the phantom.
h) Measure the two-dimensional SAR distribution within the phantom (area scan procedure). The boundary of the measurement area shall not be closer than 20 mm from the phantom side walls. The distance between the measurement points should enable the detection of the location of local maximum with an accuracy of better than half the linear dimension of the tissue cube after interpolation. A maximum grip spacing of 20 mm for frequencies below 3 GHz and (60/f [GHz]) mm for frequencies of 3GHz and greater is recommended. The maximum distance between the geometrical centre of the probe detectors and the inner surface of the phantom shall be 5 mm for frequencies below 3 GHz andδln(2)/2 mm for frequencies of 3 GHz and greater, whereδis the plane wave skin depth and In(x) is the natural logarithm. The

maximum variation of the sensor-phantom surface shall be ±1 mm for frequencies below 3 GHz and ±0.5 mm for frequencies of 3 GHz and greater. At all measurement points the angle of the probe with respect to the line normal to the surface should be less than 5°. If this cannot be achieved for a measurement distance to the phantom inner surface shorter than the probe diameter, additional measurement distance to the phantom inner surface shorter than the probe diameter, additional

i) From the scanned SAR distribution, identify the position of the maximum SAR value, in addition identify the positions of any local maxima with SAR values within 2 dB of the maximum value that are not within the zoom-scan volume; additional peaks shall be measured only when the primary peak is within 2 dB of the SAR limit. This is consistent with the 2 dB threshold already stated;
j) Measure the three-dimensional SAR distribution at the local maxima locations identified in step
k) The horizontal grid step shall be (24 / f[GHz]) mm or less but not more than 8 mm. The minimum zoom size of 30 mm by 30 mm and 30 mm for frequencies below 3 GHz. For higher frequencies, the minimum zoom size of 22 mm by 22 mm and 22 mm. The grip step in the vertical direction shall be (8-f[GHz]) mm or less but not more than 5 mm, if uniform spacing is used. If variable spacing is used in the vertical direction, the maximum spacing between the two closest measured points to the phantom shell shall be (12 / f[GHz]) mm or less but not more than 4 mm, and the spacing between father points shall increase by an incremental factor not exceeding 1.5. When variable spacing is used, extrapolation routines shall be tested with the same spacing as used in measurements. The maximum distance between the geometrical centre of the probe detectors and the inner surface of the phantom shall be 5 mm for frequencies below 3 GHz and δIn(2)/2 mm for frequencies of 3 GHz and greater, where δis the plane wave skin depth and In(x) is the natural logarithm. Separate grids shall be centered on each of the local SAR maxima found in step c). Uncertainties due to field distortion between the media boundary and the dielectric enclosure of the probe should also be minimized, which is achieved is the distance between the phantom surface and physical tip of the probe is larger than probe tip diameter. Other methods may utilize correction procedures for these boundary effects that enable high precision measurements closer than half the probe diameter. For all measurement points, the angle of the probe with respect to the flat phantom surface shall be less than 5. If this cannot be achieved an additional uncertainty evaluation is needed.
l) Use post processing(e.g. interpolation and extrapolation) procedures to determine the local SAR values at the spatial resolution needed for mass averaging.

5.11. Operational Conditions during Test

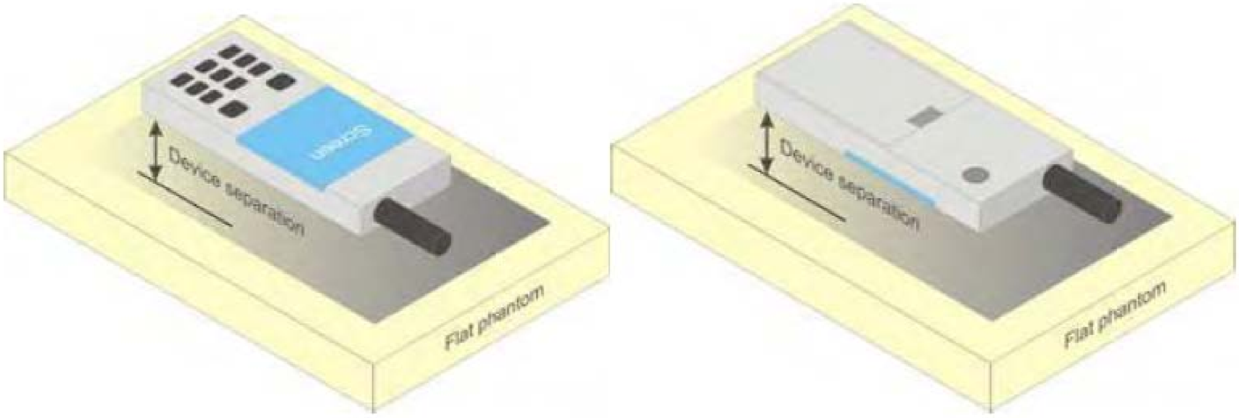
5.11.1. General Description of Test Procedures

The sample can work at continuous transmit by specific test software provided by manufacturer.

5.11.2. Test Positions

5.12.2.1 Face-Held Configuration

Face-held Configuration- per EN62209-2: “If the user instructions provided by the manufacturer specify an intended use with an appropriate accessory at a certain separation distance to the body, the device shall be positioned as intended at the distance to the outer surface of the phantom that corresponds to the specified distance (Figure 5). When evaluating device SAR without a specific carry accessory, the separation distance shall not exceed 25 mm”



5.12.2.2 Body-worn Configuration

Body-worn measurements-per EN62209-2: The surface of the device pointing towards the flat phantom should be parallel to the surface of the phantom. However, all devices do not have a flat surface. Therefore the details of the device position, e.g. the definition of the distance and the physical relationship between the device and the phantom (see 6.1.4.1), shall be documented in the measurement report according to the manufacturer instructions

5.12. Power Drift

To control the output power stability during the SAR test, DASY5 system calculates the power drift by measuring the E-field at the same location at the beginning and at the end of the measurement for each test position. These drift values can be found in Table 14.1 to Table 14.11 labeled as: (Power Drift [dB]). This ensures that the power drift during one measurement is within 5%.

6. TEST CONDITIONS AND RESULTS

6.1. Conducted Power Results

Modulation Type	Channel Separation	Test Channel	Test Frequency (MHz)	Rated High power level		Tune Up
				dBm	Wattes	
Analog/FM	25 KHz	Low	136.05	36.6	4.57	37
		Middle	155.05	36.5	4.47	37
		High	173.95	36.5	4.47	37
Analog/FM	12.5 KHz	Low	136.05	36.6	4.57	37
		Middle	155.05	36.2	4.17	37
		High	173.95	36.4	4.37	37
Digital/4FSK	12.5 KHz	Low	136.05	**36.7**	4.68	37
		Middle	155.05	36.5	4.47	37
		High	173.95	36.5	4.47	37

6.2. SAR Measurement Results

Test Frequency		Conducted Power (dBm)	Tune Up Power	Test Configuration	Measurement SAR_{1-g} (W/Kg)		Power drift	SAR_{1g} limit (W/kg)	Ref. Plot
Channel	MHz				100% Duty Cycle	50% Duty Cycle			
The EUT display towards phantom for 12.5 KHz (Digital, face held) for Rated High power level									
Low	136.05	36.7	37	Face Held	0.020	0.010	-0.08	8	
Middle	155.05	36.5	37	Face Held	0.064	0.032	0.02	8	
High	173.95	36.5	37	Face Held	**0.108**	**0.054**	0.03	8	#1
The EUT display towards ground with A1, B1 and C1(Digital,Body-Worn) for 12.5 KHz for Rated High power level									
Low	136.05	36.7	37	Body Worn	0.086	0.043	-0.09	8	
Middle	155.05	36.5	37	Body Worn	**0.333**	**0.166**	0.06	8	#2
High	173.95	36.5	37	Body Worn	0.125	0.063	0.08	8	
The EUT display towards ground with A1, B1 and C1(Digital, Body-Worn) for 12.5 KHz for Rated High power level with belt clip									
Middle	155.05	36.5	37	Body Worn	**0.330**	**0.151**	0.06	8	

Test position	Test mode	Test Ch./Freq.	Duty Cycle	SAR (W/kg) 1-g	Power Drift (dB)	Conducted Power (dBm)	Tune up Limit (dBm)	Scaled factor	Scaled SAR (W/kg)	Liquid Temp	SAR limit (W/kg)
Face Held Test data											
Low	PTT	136.05	100%	0.020	-0.08	36.7	37	1.072	0.020	22.2	8
Middle	PTT	155.05	100%	0.064	0.02	36.5	37	1.122	0.065	22.2	8
High	PTT	173.95	100%	0.108	0.03	36.5	37	1.122	0.109	22.2	8
Low	PTT	136.05	50%	0.010	-0.08	36.7	37	1.072	0.010	22.2	8
Middle	PTT	155.05	50%	0.032	0.02	36.5	37	1.122	0.032	22.2	8
High	PTT	173.95	50%	0.054	0.03	36.5	37	1.122	0.055	22.2	8
Body-Worn Test data											
Low	PTT	136.05	100%	0.086	-0.09	36.7	37	1.072	0.087	22.2	8
Middle	PTT	155.05	100%	0.333	0.06	36.5	37	1.122	0.338	22.2	8
High	PTT	173.95	100%	0.125	0.08	36.5	37	1.122	0.127	22.2	8
Low	PTT	136.05	50%	0.043	-0.09	36.7	37	1.072	0.043	22.2	8
Middle	PTT	155.05	50%	0.166	0.06	36.5	37	1.122	0.168	22.2	8
High	PTT	173.95	50%	0.063	0.08	36.5	37	1.122	0.064	22.2	8
Body-Worn with belt clip Test data											
Middle	PTT	155.05	100%	0.330	0.06	36.5	37	1.122	0.335	22.2	8
Middle	PTT	155.05	50%	0.151	0.06	36.5	37	1.122	0.153	22.2	8

6.3. Simultaneous TX SAR Considerations

5.3.1 Introduction

Simultaneous multi-band transmission means that the device can transmit multiple transmission modes at the same time. The time-averaged output power of a secondary transmitter may be much lower than that of the primary transmitter. In some cases, the secondary transmitter can be excluded from SAR testing when used alone. However, when the primary and secondary transmitters are used together, the SAR limit may still be exceeded. A means of determining the threshold power for the secondary transmitter that allows it to be excluded from SAR testing is needed.

For the DUT, the sample with only one antenna, cannot transmit signal simultaneously. Not need to condsider simultaneous transmitter.

6.4. Measurement Uncertainty (300-3GHz)

No.	Error Description	Type	Uncertainty Value	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	Degree of freedom
According to IEEE 1528:2013										
Measurement System										
1	Probe calibration	B	5.50%	N	1	1	1	5.50%	5.50 %	∞
2	Axial isotropy	B	4.70%	R	$\sqrt{3}$	0.7	0.7	1.90%	1.90 %	∞
3	Hemispherical isotropy	B	9.60%	R	$\sqrt{3}$	0.7	0.7	3.90%	3.90 %	∞
4	Boundary Effects	B	1.00%	R	$\sqrt{3}$	1	1	0.60%	0.60 %	∞
5	Probe Linearity	B	4.70%	R	$\sqrt{3}$	1	1	2.70%	2.70 %	∞
6	Detection limit	B	1.00%	R	$\sqrt{3}$	1	1	0.60%	0.60 %	∞
7	RF ambient conditions-noise	B	0.00%	R	$\sqrt{3}$	1	1	0.00%	0.00 %	∞
8	RF ambient conditions-reflection	B	0.00%	R	$\sqrt{3}$	1	1	0.00%	0.00 %	∞
9	Response time	B	0.80%	R	$\sqrt{3}$	1	1	0.50%	0.50 %	∞
10	Integration time	B	5.00%	R	$\sqrt{3}$	1	1	2.90%	2.90 %	∞
11	RF ambient	B	3.00%	R	$\sqrt{3}$	1	1	1.70%	1.70 %	∞
12	Probe positioned mech. restrictions	B	0.40%	R	$\sqrt{3}$	1	1	0.20%	0.20 %	∞
13	Probe positioning with respect to phantom shell	B	2.90%	R	$\sqrt{3}$	1	1	1.70%	1.70 %	∞
14	Max.SAR evalation	B	3.90%	R	$\sqrt{3}$	1	1	2.30%	2.30 %	∞
Test Sample Related										
15	Test sample	A	1.86%	N	1	1	1	1.86%	1.86	∞

	positioning								%	
16	Device holder uncertainty	A	1.70%	N	1	1	1	1.70%	1.70 %	∞
17	Drift of output power	B	5.00%	R	$\sqrt{3}$	1	1	2.90%	2.90 %	∞
Phantom and Set-up										
18	Phantom uncertainty	B	4.00%	R	$\sqrt{3}$	1	1	2.30%	2.30 %	∞
19	Liquid conductivity (target)	B	5.00%	R	$\sqrt{3}$	0.6 4	0.43	1.80%	1.20 %	∞
20	Liquid conductivity (meas.)	A	0.50%	N	1	0.6 4	0.43	0.32%	0.26 %	∞
21	Liquid permittivity (target)	B	5.00%	R	$\sqrt{3}$	0.6 4	0.43	1.80%	1.20 %	∞
22	Liquid cpermittivity (meas.)	A	0.16%	N	1	0.6 4	0.43	0.10%	0.07 %	∞
Combined standard uncertainty	$u_c = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$		/	/	/	/	/	10.20 %	10.0 0%	∞
Expanded uncertainty (confidence interval of 95 %)	$u_e = 2u_c$		/	R	K= 2	/	/	20.40 %	20.0 0%	∞

Uncertainty of a System Performance Check with DASY5 System										
No.	Error Description	Type	Uncertainty Value	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	Degree of freedom
Measurement System										
1	Probe calibration	B	6.00%	N	1	1	1	6.00 %	6.00 %	∞
2	Axial isotropy	B	4.70%	R	$\sqrt{3}$	0.7	0.7	1.90 %	1.90 %	∞
3	Hemispherical isotropy	B	0.00%	R	$\sqrt{3}$	0.7	0.7	0.00 %	0.00 %	∞
4	Boundary Effects	B	1.00%	R	$\sqrt{3}$	1	1	0.60 %	0.60 %	∞
5	Probe Linearity	B	4.70%	R	$\sqrt{3}$	1	1	2.70 %	2.70 %	∞
6	Detection limit	B	1.00%	R	$\sqrt{3}$	1	1	0.60 %	0.60 %	∞

7	RF ambient conditions-noise	B	0.00%	R	$\sqrt{3}$	1	1	0.00 %	0.00 %	∞
8	RF ambient conditions-reflection	B	0.00%	R	$\sqrt{3}$	1	1	0.00 %	0.00 %	∞
9	Response time	B	0.80%	R	$\sqrt{3}$	1	1	0.50 %	0.50 %	∞
10	Integration time	B	5.00%	R	$\sqrt{3}$	1	1	2.90 %	2.90 %	∞
11	RF Ambient	B	3.00%	R	$\sqrt{3}$	1	1	1.70 %	1.70 %	∞
12	Probe positioned mech. restrictions	B	0.80%	R	$\sqrt{3}$	1	1	0.50 %	0.50 %	∞
13	Probe positioning with respect to phantom shell	B	6.70%	R	$\sqrt{3}$	1	1	3.90 %	3.90 %	∞
14	Max.SAR Evalation	B	3.90%	R	$\sqrt{3}$	1	1	2.30 %	2.30 %	∞
15	Modulation Response	B	2.40%	R	$\sqrt{3}$	1	1	1.40 %	1.40 %	∞
Test Sample Related										
16	Test sample positioning	A	0.00%	N	1	1	1	0.00 %	0.00 %	∞
17	Device holder uncertainty	A	2.00%	N	1	1	1	2.00 %	2.00 %	∞
18	Drift of output power	B	3.40%	R	$\sqrt{3}$	1	1	2.00 %	2.00 %	∞
Phantom and Set-up										
19	Phantom uncertainty	B	4.00%	R	$\sqrt{3}$	1	1	2.30 %	2.30 %	∞
20	SAR correction	B	1.90%	R	$\sqrt{3}$	1	0.84	1.11 %	0.90 %	∞
21	Liquid conductivity (meas.)	A	0.50%	N	1	0.64	0.43	0.32 %	0.26 %	∞
22	Liquid cpermittivity (meas.)	A	0.16%	N	1	0.64	0.43	0.10 %	0.07 %	∞
23	Temp.Unc.-Conductivity	B	1.70%	R	$\sqrt{3}$	0.78	0.71	0.80 %	0.80 %	∞

24	Temp.Unc.-Permittivity	B	0.40%	R	$\sqrt{3}$	0.23	0.26	0.10 %	0.10 %	∞
Combined standard uncertainty	$u_c = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$		/	/	/	/	/	12.90%	12.70%	∞
Expanded uncertainty (confidence interval of 95 %)	$u_e = 2u_c$		/	R	K=2	/	/	18.80%	18.40%	∞

6.5. System Check Results

System Performance Check at 150 MHz Head

DUT: CLA-150; Type: Loop, 150MHz; Serial: 4019

Communication System: CW; Frequency: 150 MHz; Duty Cycle: 1:1
Medium parameters used: f = 150 MHz; σ = 0.79 mho/m; ε_r = 52.43; ρ = 1000 kg/m^3
Phantom section: Flat Section

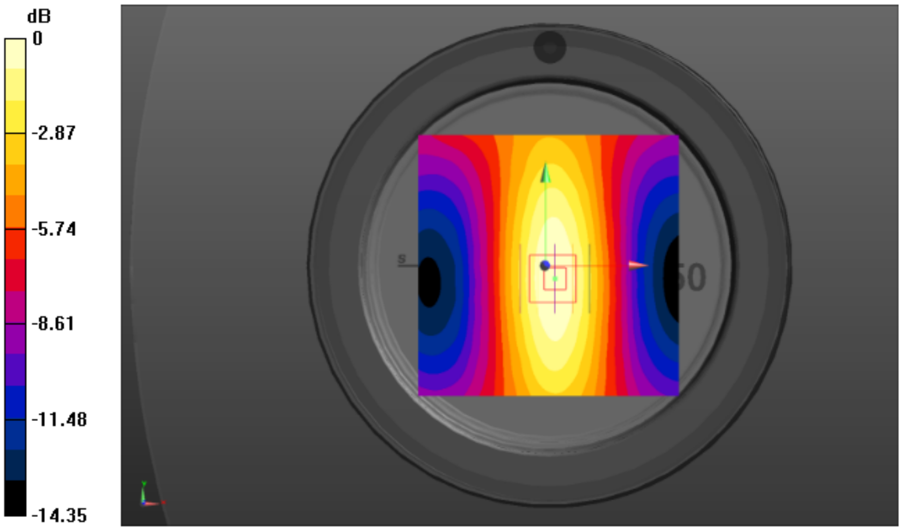
DASY5 Configuration:

- Probe: ES3DV3 - SN3292; ConvF(7.85, 7.85, 7.85); Calibrated: 2018/1/25;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 2017/7/13
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1151
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

Area Scan (81x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 1.05 W/kg

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 36.570 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 1.525 mW/g

SAR(1 g) = 0.939 W/kg; SAR(10 g) = 0.616 W/kg
Maximum value of SAR (measured) = 1.03 W/kg



0 dB = 1.05 W/kg = 0.42 dB W/kg

System Performance Check at 150 MHz Body

DUT: CLA-150; Type: Loop, 150MHz; Serial: 4019

Communication System: CW; Frequency: 150 MHz;Duty Cycle: 1:1

Medium parameters used: f = 150 MHz; σ = 0.815 mho/m; εr = 63.406; ρ = 1000 kg/m3
Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 - SN3292; ConvF(7.59, 7.59, 7.59); Calibrated: 2018/1/25;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn910; Calibrated: 2017/7/13

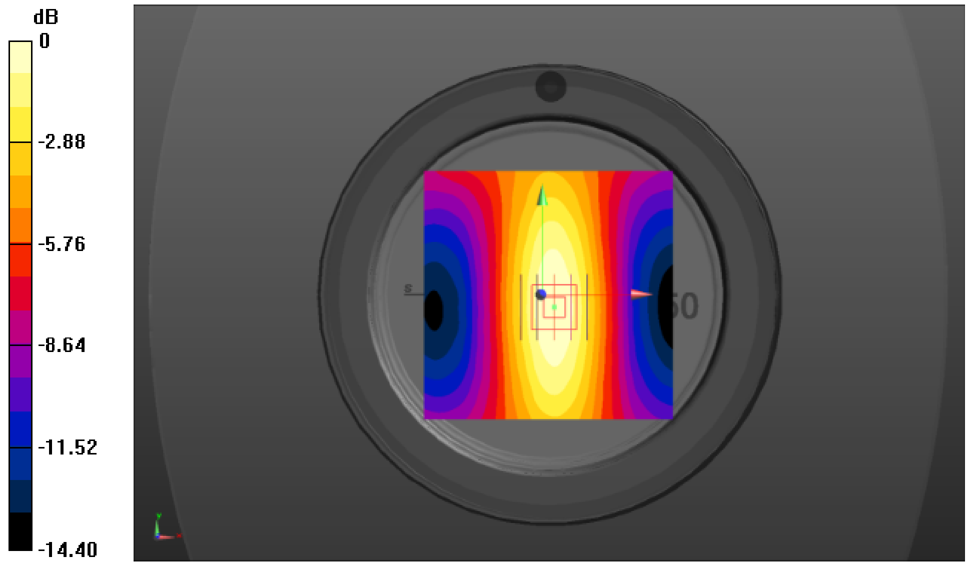
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1151

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

Area Scan (81x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 1.06 W/kg

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 35.666 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 1.555 mW/g

SAR(1 g) = 0.940 W/kg; SAR(10 g) = 0.621 W/kg
Maximum value of SAR (measured) = 1.05 W/kg



0 dB = 1.06 W/kg = 0.51 dB W/kg

6.6. SAR Test Graph Results

Face Held for Data Modulation at 12.5KHz Channel Separation, Front towards Phantom 173.95MHz
The distance was 25mm

Communication System: Multi-mode Radio; Frequency: 173.95 MHz;Duty Cycle:1:1

Medium parameters used (interpolated): f = 173.95 MHz; σ = 0.79 mho/m; εr = 52.43; ρ = 1000 kg/m3

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 - SN3292; ConvF(7.85, 7.85, 7.85); Calibrated: 2018/1/25;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn910; Calibrated: 2017/7/13

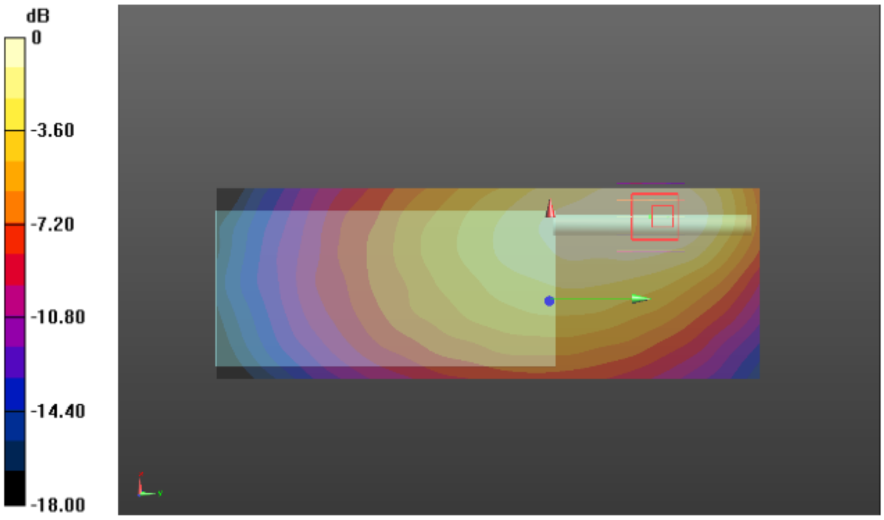
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1151

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

Front to face/Area Scan (61x171x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.110 W/kg

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 8.542 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.176 mW/g

SAR(1 g) = 0.108 W/kg; SAR(10 g) = 0.074 W/kg
Maximum value of SAR (measured) = 0.114 W/kg



0 dB = 0.110 W/kg = -19.17 dB W/kg

Date/Time: 03/28/2018

Plot 1: Face held for Digital Modulation at 12.5KHz Channel Separation Front towards Phantom 173.95MHz

Body- Worn Data Modulation at 12.5KHz Channel Separation, Front towards Ground 155.05 MHz
The distance was 0mm

Communication System: Multi-mode Radio; Frequency: 155.05 MHz;Duty Cycle:1:1

Medium parameters used (interpolated): f = 155.05 MHz; σ = 0.815 mho/m; εr = 63.406;; ρ = 1000 kg/m3

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 - SN3292; ConvF(7.85, 7.85, 7.85); Calibrated: 2018/1/25;

Sensor-Surface: 4mm (Mechanical Surface Detection)

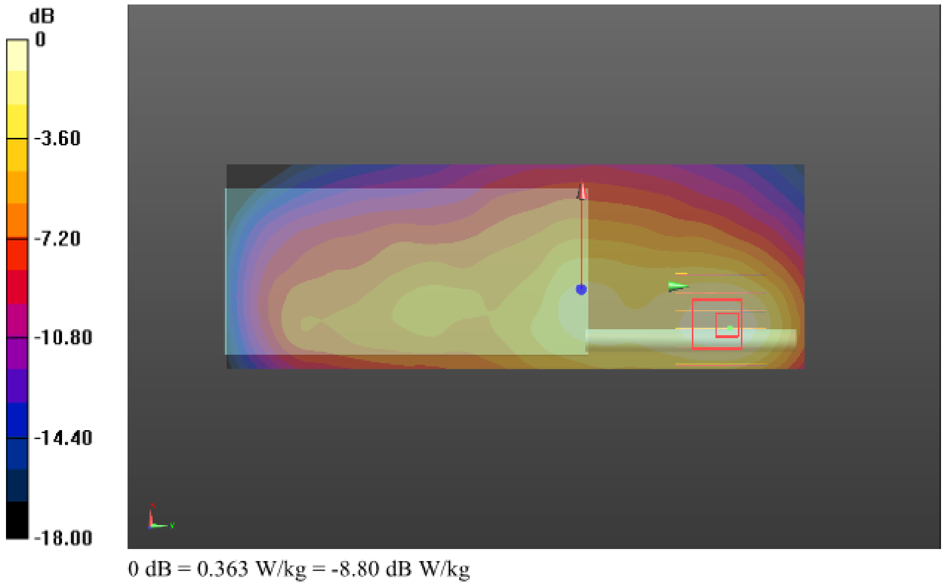
Electronics: DAE4 Sn910; Calibrated: 2017/7/13

Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1151

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

Front to face/Area Scan (61x171x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.363 W/kg

Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15.343 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 0.645 mW/g
SAR(1 g) = 0.333 W/kg; SAR(10 g) = 0.205 W/kg
Maximum value of SAR (measured) = 0.358 W/kg



Plot 2: Body-worn for Digital Modulation at 12.5KHz Channel Separation;Front towards Ground 155.05MHz

7. Calibration Certificate

7.1. Probe Calibration Ceriticate

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

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **CIQ-SZ (Auden)**

Certificate No: **ES3-3292_Jan18**

CALIBRATION CERTIFICATE

Object: ES3DV3 - SN:3292

Calibration procedure(s): QA CAL-01.v9, QA CAL-12.v9, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

Calibration date: January 25, 2018

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02525)	Apr-18
Reference 20 dB Attenuator	SN: S5277 (20x)	07-Apr-17 (No. 217-02528)	Apr-18
Reference Probe ES3DV2	SN: 3013	30-Dec-17 (No. ES3-3013_Dec17)	Dec-18
DAE4	SN: 660	21-Dec-17 (No. DAE4-660_Dec17)	Dec-18
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-16)	In house check: Jun-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-17)	In house check: Oct-18

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: January 25, 2018

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

Certificate No: ES3-3292_Jan18 Page 1 of 11

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe ES3DV3

SN:3292

Manufactured: July 6, 2010
Calibrated: January 25, 2018

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3292

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.95	0.96	0.93	± 10.1 %
DCP (mV)[B]	104.2	107.6	112.3	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB$\sqrt{\mu V}$	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	191.5	±3.3 %
		Y	0.0	0.0	1.0		187.6	
		Z	0.0	0.0	1.0		190.2	

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

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3292

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
150	52.3	0.76	7.85	7.85	7.85	0.04	1.20	± 13.3 %
450	43.5	0.87	7.12	7.12	7.12	0.18	1.20	± 13.3 %

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

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

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

ES3DV3– SN:3292 January 25, 2018

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3292

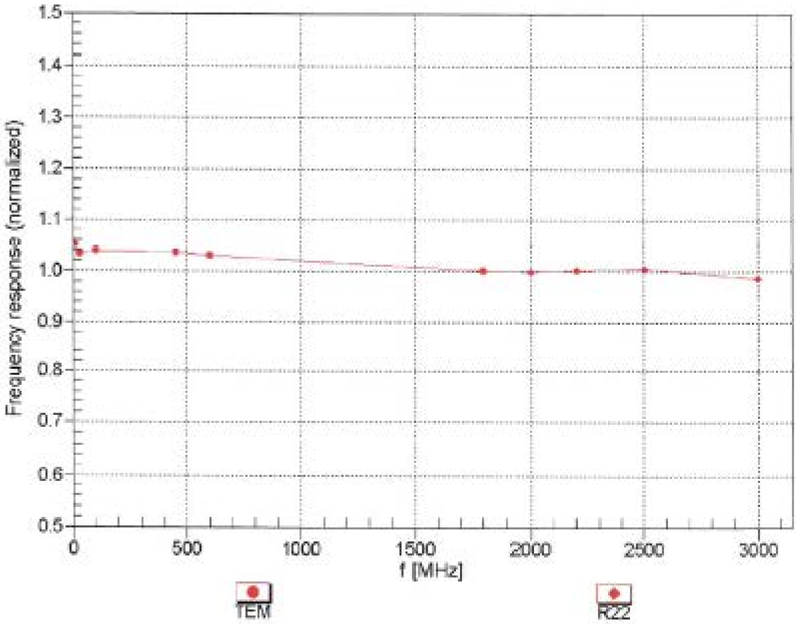
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
150	61.9	0.80	7.59	7.59	7.59	0.04	1.20	± 13.3 %
450	56.7	0.94	7.28	7.28	7.28	0.12	1.20	± 13.3 %

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

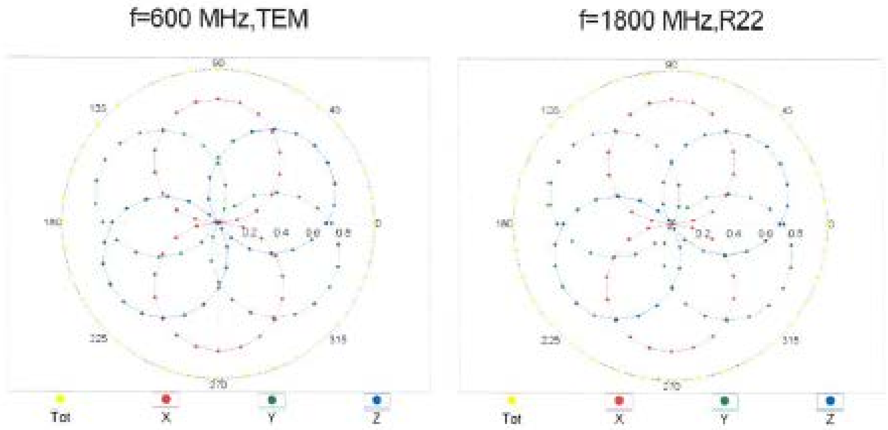
Frequency Response of E-Field

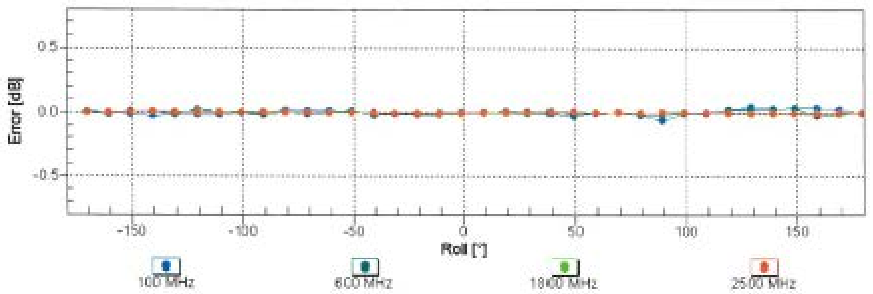
(TEM-Cell:ifi110 EXX, Waveguide: R22)



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

Receiving Pattern (ϕ), ϑ = 0°



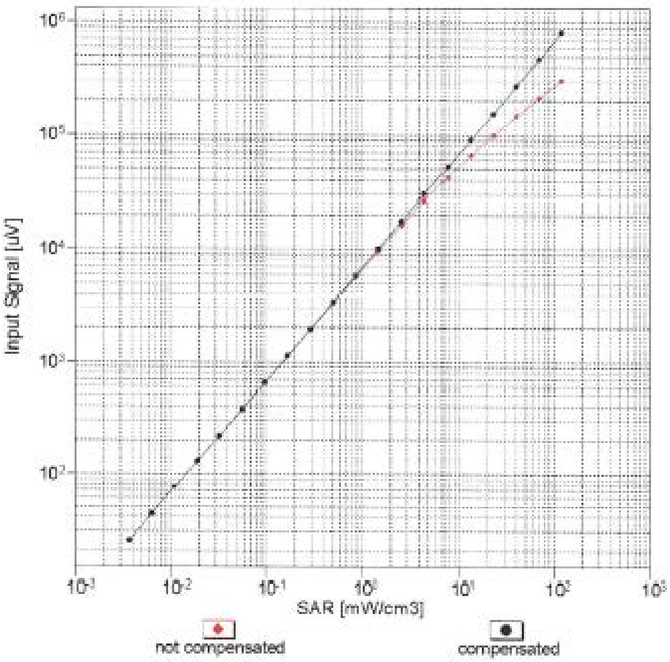


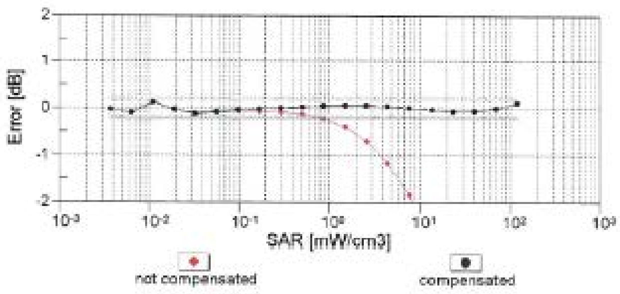
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

ES3DV3– SN:3292 January 25, 2018

Dynamic Range f(SAR_{head})

(TEM cell , f_{eval}= 1900 MHz)





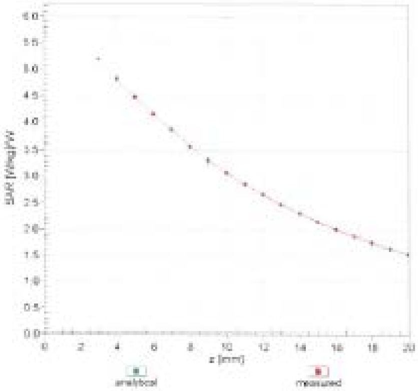
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Certificate No: ES3-3292_Jan18 Page 9 of 11

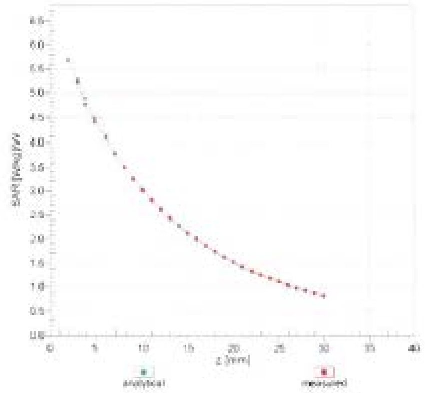
ES3DV3– SN:3292 January 25, 2018

Conversion Factor Assessment

f = 450 MHz,WGLS Flat Phantom 4.4

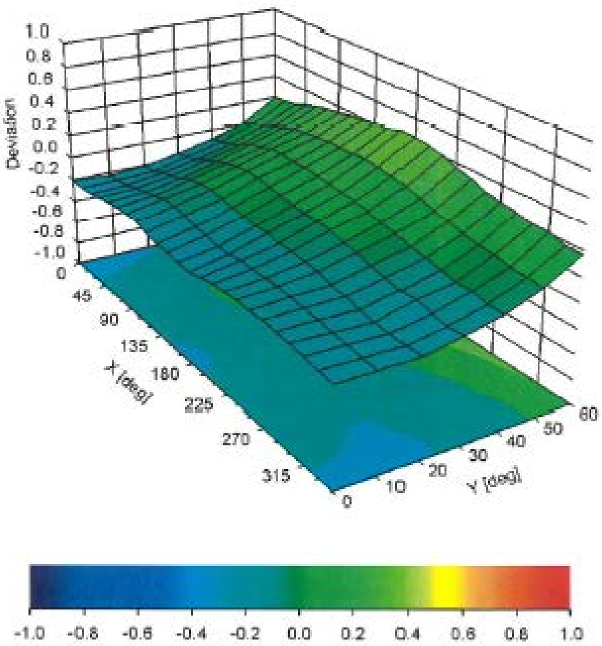


f = 450 MHz,WGLS Flat Phantom 4.4



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3292

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	39.1
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

7.2. D450V3 Dipole Calibration Certificate

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

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client CIQ (Auden)

Certificate No: CLA150-4019_Feb16

CALIBRATION CERTIFICATE

Object: CLA150 - SN: 4019

Calibration procedure(s): QA CAL-15.v8
Calibration procedure for system validation sources below 700 MHz

Calibration date: February 11, 2016

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	01-Apr-15 (No. 217-02128)	Mar-16
Power sensor E4412A	MY41498087	01-Apr-15 (No. 217-02128)	Mar-16
Reference 3 dB Attenuator	SN: S5054 (3c)	01-Apr-15 (No. 217-02129)	Mar-16
Reference 20 dB Attenuator	SN: S5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe EX3DV4	SN: 3877	31-Dec-15 (No. EX3-3877_Dec15)	Dec-16
DAE4	SN: 654	08-Jul-15 (No. DAE4-654_Jul15)	Jul-16

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	04-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: February 15, 2016

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Certificate No: CLA150-4019_Feb16 Page 1 of 8

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	ELI4 Flat Phantom	Shell thickness: 2 ± 0.2 mm
EUT Positioning	Touch Position	
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	150 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	52.3	0.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	50.4 ± 6 %	0.78 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	1 W input power	3.90 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**3.79 W/kg ± 18.4 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	1 W input power	2.59 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**2.52 W/kg ± 18.0 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	61.9	0.80 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	60.4 ± 6 %	0.84 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	1 W input power	4.06 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**3.89 W/kg ± 18.4 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	1 W input power	2.70 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**2.59 W/kg ± 18.0 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	47.4 Ω - 5.3 jΩ
Return Loss	- 24.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.9 Ω - 8.0 jΩ
Return Loss	- 22.0 dB

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	November 25, 2015

DASY5 Validation Report for Head TSL

Date: 11.02.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: CLA150; Type: CLA150; Serial: CLA150 - SN: 4019

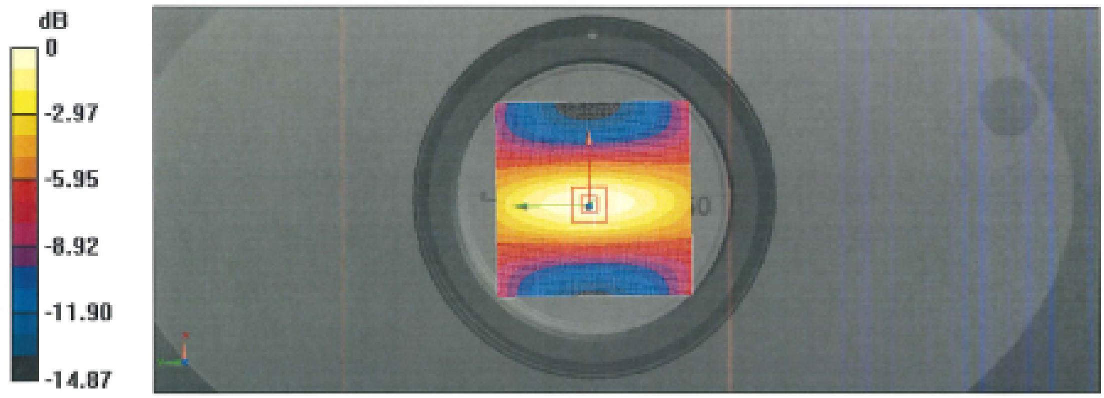
Communication System: UID 0 - CW; Frequency: 150 MHz
Medium parameters used: f = 150 MHz; $\sigma = 0.78$ S/m; $\varepsilon_r = 50.4$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3877; ConvF(12.02, 12.02, 12.02); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 08.07.2015
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

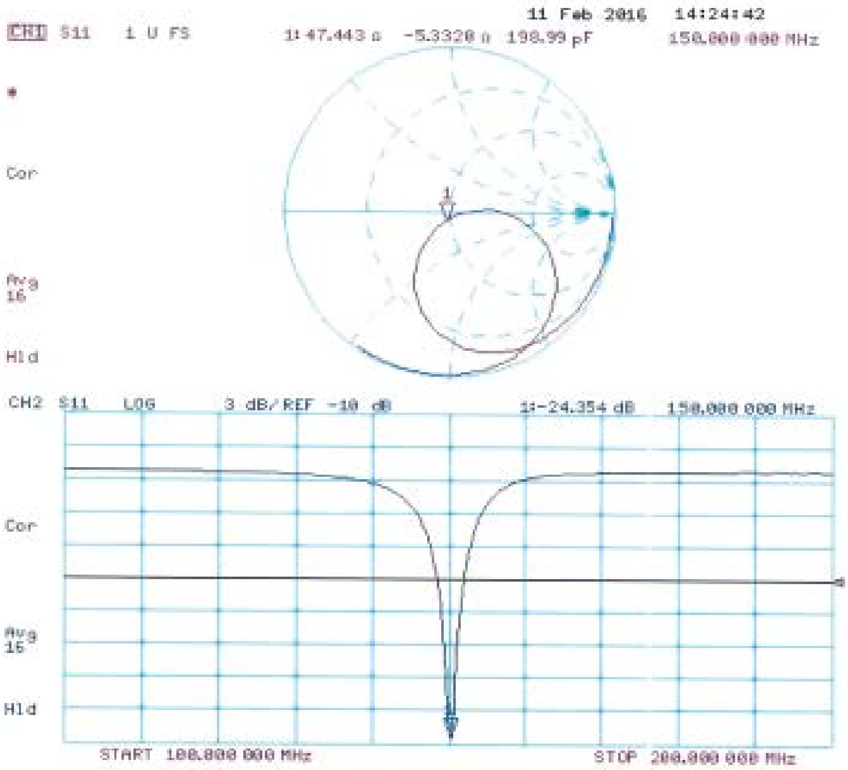
CLA Calibration for HSL-LF Tissue/CLA150, touch configuration, Pin=1W/Area Scan (81x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 5.13 W/kg

CLA Calibration for HSL-LF Tissue/CLA150, touch configuration, Pin=1W/Zoom Scan, dist=1.4mm (8x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 83.28 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 7.21 W/kg
SAR(1 g) = 3.9 W/kg; SAR(10 g) = 2.59 W/kg
Maximum value of SAR (measured) = 5.45 W/kg



0 dB = 5.46 W/kg = 7.37 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 11.02.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: CLA150; Type: CLA150; Serial: CLA150 - SN: 4019

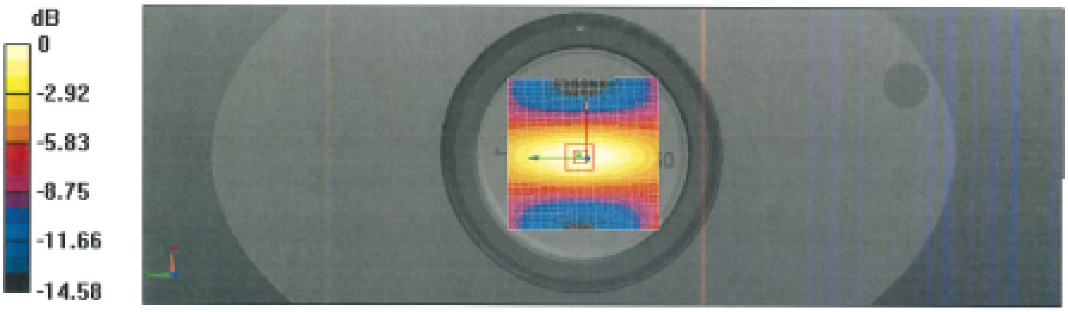
Communication System: UID 0 - CW; Frequency: 150 MHz
Medium parameters used: f = 150 MHz; σ = 0.84 S/m; ε_r = 60.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3877; ConvF(11.44, 11.44, 11.44); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 08.07.2015
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

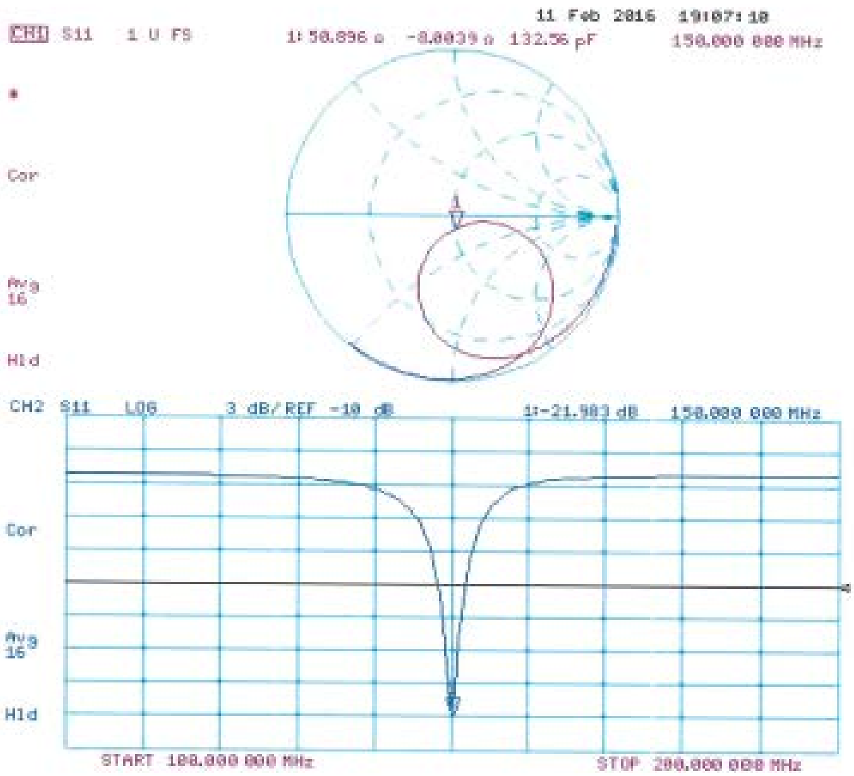
CLA Calibration for MSL-LF Tissue/CLA150, touch configuration, Pin=1W/Area Scan (81x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 5.71 W/kg

CLA Calibration for MSL-LF Tissue/CLA150, touch configuration, Pin=1W/Zoom Scan, dist=1.4mm (8x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 82.17 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 7.49 W/kg
SAR(1 g) = 4.06 W/kg; SAR(10 g) = 2.7 W/kg
Maximum value of SAR (measured) = 5.65 W/kg



0 dB = 5.71 W/kg = 7.57 dBW/kg

Impedance Measurement Plot for Body TSL



7.3. DAE4 Calibration Certificate

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

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

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

Accreditation No.: **SCS 0108**

Client **Auden**

Certificate No: **DAE4-910_Jul17**

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BK - SN: 910
Calibration procedure(s)	QA CAL-06.v29 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	July 13, 2017

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	09-Sep-16 (No:19065)	Sep-17
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	05-Jan-17 (in house check)	In house check: Jan-18
Calibrator Box V2.1	SE UMS 006 AA 1002	05-Jan-17 (in house check)	In house check: Jan-18

	Name	Function	Signature
Calibrated by:	Dominique Steffen	Laboratory Technician	
Approved by:	Sven Kühn	Deputy Manager	i.V.

Issued: July 13, 2017

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

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

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

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

Accreditation No.: **SCS 0108**

Glossary

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
  - *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range:	1LSB =	6.1μV ,	full range =	-100…+300 mV
Low Range:	1LSB =	61nV ,	full range =	-1…….+3mV

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

Calibration Factors	X	Y	Z
High Range	403.334 ± 0.02% (k=2)	402.753 ± 0.02% (k=2)	403.237 ± 0.02% (k=2)
Low Range	3.98292 ± 1.50% (k=2)	3.94291 ± 1.50% (k=2)	3.95052 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	314.5 ° ± 1 °

Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	200041.03	2.05	0.00
Channel X	+ Input	20007.58	1.82	0.01
Channel X	- Input	-20002.98	2.20	-0.01
Channel Y	+ Input	200040.02	1.21	0.00
Channel Y	+ Input	20005.15	-0.63	-0.00
Channel Y	- Input	-20006.28	-1.10	0.01
Channel Z	+ Input	200037.04	-2.06	-0.00
Channel Z	+ Input	20005.67	0.05	0.00
Channel Z	- Input	-20003.93	1.44	-0.01

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2001.98	0.38	0.02
Channel X	+ Input	201.29	-0.33	-0.16
Channel X	- Input	-199.23	-0.91	0.46
Channel Y	+ Input	2002.19	0.63	0.03
Channel Y	+ Input	200.31	-1.21	-0.60
Channel Y	- Input	-199.63	-1.19	0.60
Channel Z	+ Input	2001.61	0.17	0.01
Channel Z	+ Input	200.09	-1.31	-0.65
Channel Z	- Input	-201.44	-2.88	1.45

2. Common mode sensitivity

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

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	-12.83	-14.46
	- 200	16.33	14.63
Channel Y	200	6.01	5.68
	- 200	-6.91	-7.34
Channel Z	200	-12.16	-12.11
	- 200	9.79	9.86

3. Channel separation

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

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	4.30	-3.56
Channel Y	200	9.53	-	4.89
Channel Z	200	10.35	8.14	-

4. AD-Converter Values with inputs shorted

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

	High Range (LSB)	Low Range (LSB)
Channel X	16196	16895
Channel Y	15382	16517
Channel Z	16727	17469

5. Input Offset Measurement

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

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	0.83	-0.49	2.69	0.64
Channel Y	0.36	-0.92	1.37	0.54
Channel Z	-1.12	-2.44	0.17	0.55

6. Input Offset Current

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

7. Input Resistance (Typical values for information)

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

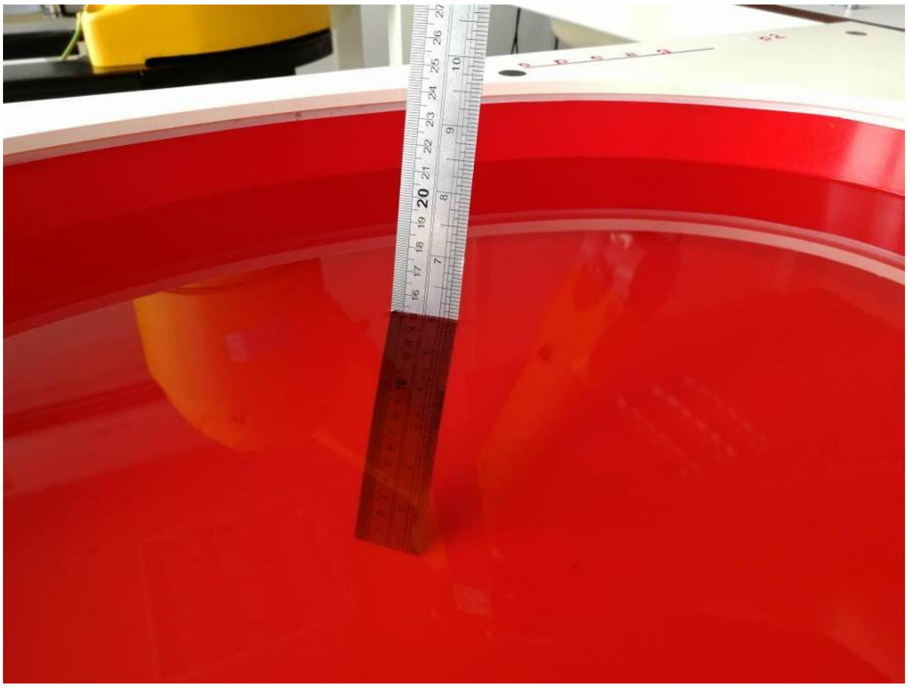
8. Low Battery Alarm Voltage (Typical values for information)

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

9. Power Consumption (Typical values for information)

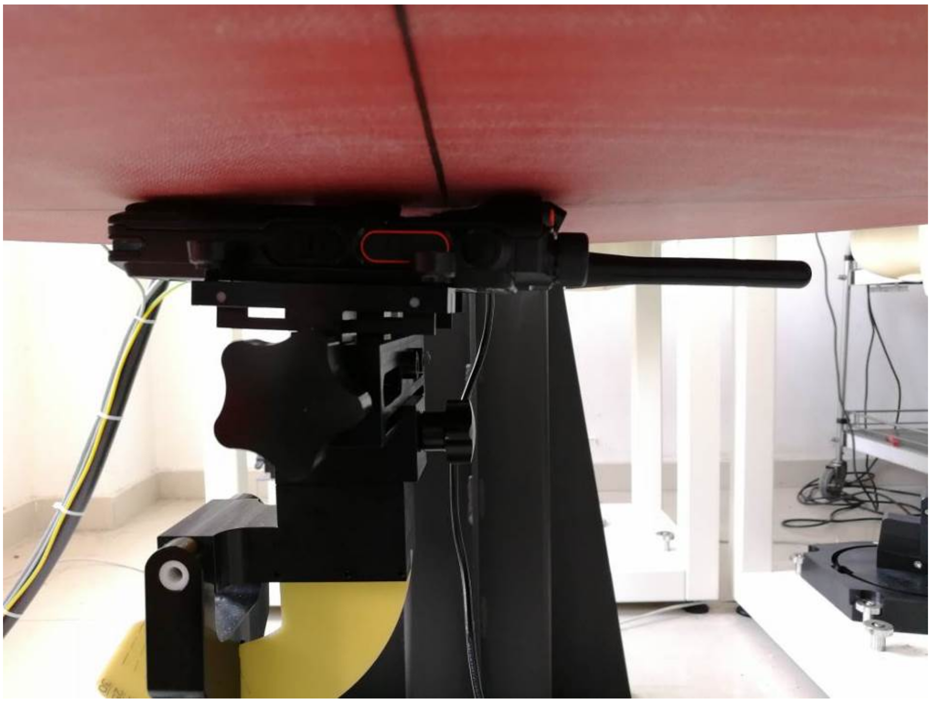
Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	–0.01	-8	-9

8. Test Setup Photos



Photograph of the depth in the Head Phantom (150MHz)

Face-held, the front of the EUT towards phantom (The distance was 25mm)



Body-worn, the front of the EUT towards ground
(The distance was 0mm)

Body-worn, the front of the EUT towards ground with Belt Clip
(The distance was 0mm)

Photo of Sample

.....................End of Report.........................