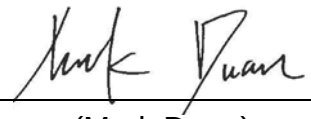
SAR Report

Applicant	:	Edimax Technology Co., Ltd.
Product Type	:	11ac Wireless Dual-Band Selectable USB Adapter
Trade Name	:	EDIMAX
Model Number	:	EW-7822UNC, EW-7822ULC
Test Specification	:	IEEE Std 1528-2013
		IEC 62209-2 / IEC 62479
		AS/NZS 2772.1
		AS/NZS 2772.2
Received Date	:	Jun. 29, 2020
Test Period	:	Aug. 01, 2019 ~ Jul. 13, 2020
Issue Date	:	Jul. 20, 2020

Issue by

Approved By : 

(Mark Duan)

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Taiwan Accreditation Foundation accreditation number: 1330

Note:

1.The test results are valid only for samples provided by customers and under the test conditions described in this report.
2.This report shall not be reproduced except in full, without the written approval of A Test Lab Technology Corporation.
3.The relevant information is provided by customers in this test report. According to the correctness, appropriateness or completeness of the information provided by the customer, if there is any doubt or error in the information which affects the validity of the test results, the laboratory does not take the responsibility.

Revision History

Rev.	Issue Date	Revisions	Revised By
00	Jul. 20, 2020	Initial Issue	Nicole Chu

Contents

1. General Information 4
1.1 Reference Testing Standards 4
1.2 Test Site Environment 4
2. Summary of Maximum SAR Value 5
3. Description of Equipment under Test (EUT) 6
4. Introduction 7
5. SAR Definition 7
6. SAR Measurement Setup 8
7. Test Equipment List 9
8. Tissue Simulating Liquids 10
8.1 Liquid Parameters 11
8.2 Liquid Depth 11
9. Measurement Process 12
9.1 Device and Test Conditions 12
9.2 Conducted Power 13
9.3 Validation Summary 14
9.4 Dosimetric Assessment Setup 15
9.5 Spatial Peak SAR Evaluation 16
10. Measurement Uncertainty 16
11. SAR Test Results Summary 19
11.1 Body SAR 19
11.2 European Council Recommendation 1999 519 EC 21
12. Conclusion 22
13. References 22
Appendix A - System Performance Check 23
Appendix B - SAR Measurement Data 26
Appendix C - Calibration 31

1. General Information

1.1 Reference Testing Standards

Standard	Description	Version
IEEE 1528	IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head From Wireless Communications Devices: Measurement Techniques.	2013
AS/NZS 2772.1	Radio frequency fields Part 1: Maximum exposure levels—3 kHz to 300 GHz	1998+A1:1999
AS/NZS 2772.2	Radio frequency fields Part 2: Principles and methods of measurement and computation—3 kHz to 300 GHz	2016+A1:2018
IEC 62209-2	Human exposure to radio frequency fields from hand-held and bodymounted wireless communication devices-Human models, instrumentation, and procedures; part2: Procedure to determine the specific absorption rate (SAR) for Wireless communication devices used in close proximity to the human body (30 MHz to 6GHz)	2010+AMD1: 2019
IEC 62479	Assessment of the compliance of low power electronic and electrical equipment with the basic restrictions related to human exposure to electromagnetic fields (10 MHz to 300 GHz)	2010

1.2 Test Site Environment

Items	Required (IEEE 1528-2013)	Actual
Temperature (°C)	18-25	23

2. Summary of Maximum SAR Value

Equipment Class	Mode	Highest Reported 10g SAR (W/kg)
		Body standalone SAR $_{10g}$ (W/Kg)
DTS	WLAN 2.4GHz Ant-A	0.345
U-NII	WLAN 5GHz Ant-A	0.414
	WLAN 5GHz Ant-B	0.432
Highest Simultaneous Transmission SAR		Body standalone SAR $_{10g}$ (W/Kg)
At test position Horizontal-Down		0.846

Note: The $SAR_{10\,g}$ limit(2.0 W/kg) for general population/uncontrolled exposure is specified in Council Recommendation 1999/519/EC..

3. Description of Equipment under Test (EUT)

Applicant	Edimax Technology Co., Ltd. No.278, Xinhu 1st Rd., Neihu Dist., Taipei City, Taiwan	
Manufacturer	Edimax Technology Co., Ltd. No.278, Xinhu 1st Rd., Neihu Dist., Taipei City, Taiwan	
Product Type	11ac Wireless Dual-Band Selectable USB Adapter	
Trade Name	EDIMAX	
Model Number	EW-7822UNC, EW-7822ULC	
Models Different Description	These model numbers differ from each other in selling region.	
RF Function	Operate Bands	Operate Frequency (MHz)
	IEEE 802.11b / 802.11g / 802.11n 2.4 GHz 20 MHz	2412 - 2472
	IEEE 802.11n 2.4 GHz 40 MHz	2422 - 2462
	IEEE 802.11a	5180 - 5240
		5745 - 5825
	IEEE 802.11n 5 GHz / 802.11ac 20 MHz	5180 - 5240
		5745 - 5825
	IEEE 802.11n 5 GHz / 802.11ac 40 MHz	5190 - 5230
		5755 - 5795
	IEEE 802.11ac 80 MHz	5210
		5775
Antenna Type	Monopole	
Device Category	Portable	
RF Exposure Environment	General Population / Uncontrolled	
Application Type	Certification	

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) limits specified in European Council Recommendation 1999 519 EC and had been tested in accordance with the measurement procedures specified in EN 62209-2.

4. Introduction

The A Test Lab Techno Corp. has performed measurements of the maximum potential exposure to the user. The test procedures, as described in European Council Recommendation 1999 519 EC were employed and they specify the maximum exposure limit of 2.0 W/kg as averaged over any 10 gram of tissue. A description of the product and operating configuration, detailed summary of the test results, methodology and procedures used in the equipment are included within this test report.

5. SAR Definition

Specific Absorption Rate (SAR) is defined as the time derivative (rate) of the incremental energy (dw) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below :

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

SAR is expressed in units of watts per kilogram (W/kg)

SAR measurement can be related to the electrical field in the tissue by

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

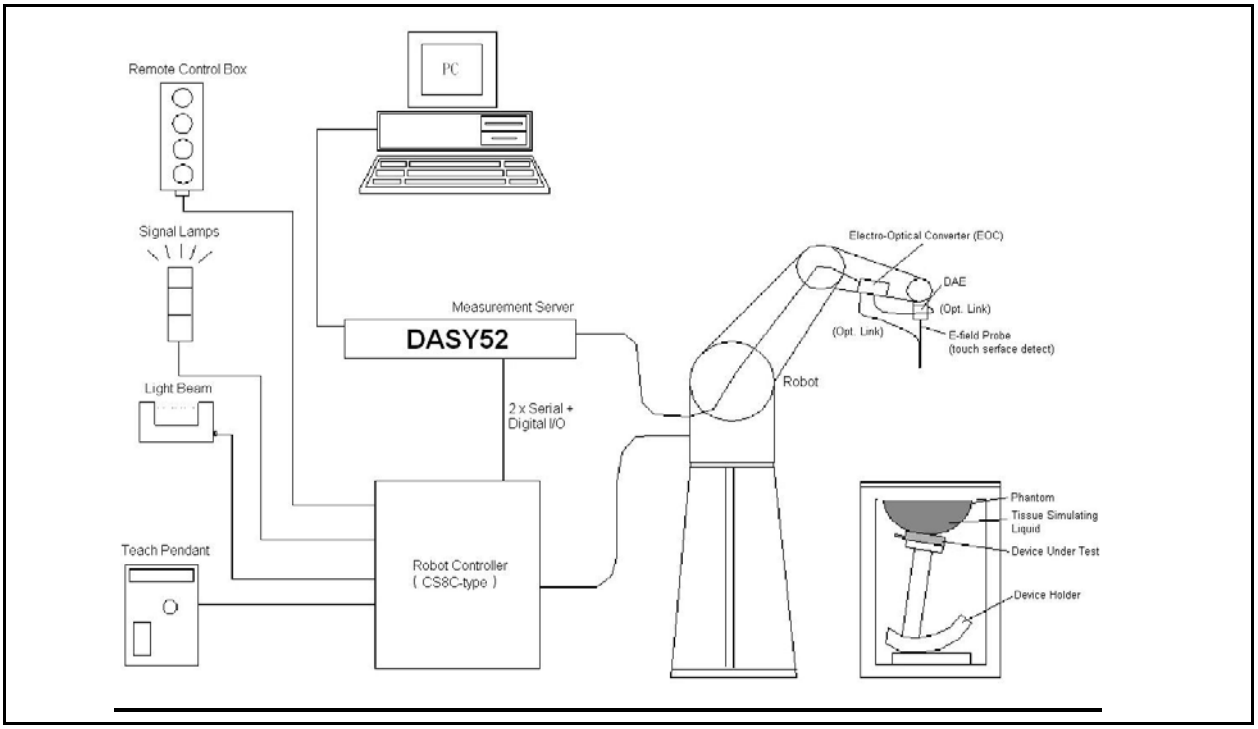
Where：

σ= conductivity of body tissue in S/m

ρ= density of body tissue in kg/m^3

Ei= RMS value of the electric field strength in the tissue in V/m

6. SAR Measurement Setup



The DASY52 system for performing compliance tests consists of the following items:

1. A standard high precision 6-axis robot (Stäubli TX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
2. 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.
3. A data acquisition electronics (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.
4. The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
5. A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
6. A computer operating Windows 2000 or Windows XP.
7. DASY52 software.
8. Remote controls with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
9. The SAM twin phantom enabling testing left-hand and right-hand usage.
10. The device holder for handheld mobile phones.
11. Tissue simulating liquid mixed according to the given recipes.
12. Validation dipole kits allowing validating the proper functioning of the system.

7. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Cal. Date	Cal.Period
SPEAG	2450MHz System Validation Kit	D2450V2	712	2019/04/15	1 year
SPEAG	5GHz System Validation Kit	D5GHzV2	1021	2019/04/19	1 year
SPEAG	5GHz System Validation Kit	D5GHzV2	1021	2020/04/23	1 year
SPEAG	Dosimetric E-Field Probe	EX3DV4	3847	2019/05/16	1 year
SPEAG	Data Acquisition Electronics	EX3DV4	7346	2020/05/20	1 year
SPEAG	Dosimetric E-Field Probe	DAE4	541	2019/03/19	1 year
SPEAG	Data Acquisition Electronics	DAE4	913	2020/05/06	1 year
SPEAG	Measurement Server	SE UMS 011 AA	1025	NCR	
SPEAG	Device Holder	N/A	N/A	NCR	
SPEAG	Phantom	ELI V4.0	1036	NCR	
SPEAG	Robot	Staubli TX90XL	F07/564ZA1/A/01	NCR	
SPEAG	Software	DASY52	N/A	NCR	
		V52.10 (2)			
SPEAG	Software	SEMCAD X	N/A	NCR	
		V14.6.12(7450)			
SPEAG	Network Analyzer	DAKS_VNA R140	0010318	2019/05/03	1 year
SPEAG	Dielectric Probe Kit	DAKS-3.5	1101	2019/05/02	1 year
SPEAG	Network Analyzer	DAKS_VNA R140	0010318	2020/05/26	1 year
SPEAG	Dielectric Probe Kit	DAKS-3.5	1101	2020/05/26	1 year
HILA	Digital Thermometer	TM-906A	1500033	2018/10/30	1 year
HILA	Digital Thermometer	TM-906A	1500033	2019/10/28	1 year
Agilent	Power Sensor	8481H	3318A20779	2019/06/11	1 year
Agilent	Power Meter	EDM Series E4418B	GB40206143	2019/06/11	1 year
Agilent	Power Sensor	8481H	3318A20779	2020/06/09	1 year
Agilent	Power Meter	EDM Series E4418B	GB40206143	2020/06/09	1 year
Agilent	Signal Generator	E8257D	MY44320425	2019/03/05	1 year
Agilent	Signal Generator	E8257D	MY44320425	2020/03/04	1 year
Agilent	Dual Directional Coupler	778D	50334	NCR	
Woken	Dual Directional Coupler	0100AZ20200801O	11012409517	NCR	
Mini-Circuits	Power Amplifier	EMC014225P	980292	NCR	
Mini-Circuits	Power Amplifier	EMC2830P	980293	NCR	
Aisi	Attenuator	IEAT 3dB	N/A	NCR	

Note: N.C.R. = No Calibration Request.

Table 1. Test Equipment List

8. Tissue Simulating Liquids

The dielectric properties of the tissue simulating liquids are defined in IEC 62209-1 and IEC 62209-2.

Frequency (MHz)	Real part of the complex relative permittivity, ε 'r	Conductivity, σ
30	55.0	0.75
150	52.3	0.76
300	45.3	0.87
450	43.5	0.87
750	41.9	0.89
835	41.5	0.90
900	41.5	0.97
1450	40.5	1.20
1800	40.0	1.40
1900	40.0	1.40
1950	40.0	1.40
2000	40.0	1.40
2100	39.8	1.49
2450	39.2	1.80
2600	39.0	1.98
3000	38.5	2.40
3500	37.9	2.91
4000	37.4	3.43
4500	36.8	3.94
5000	36.2	4.45
5200	36.0	4.66
5400	35.8	4.86
5600	35.5	5.07
5800	35.3	5.27
6000	35.1	5.48

Table 2. Dielectric properties of the tissue – equivalent liquid material

8.1 Liquid Parameters

The dielectric parameters of the liquids were verified prior to the SAR evaluation using an 85070C Dielectric Probe Kit and an E5071B Network Analyzer.

Tissue Temp (°C)	Head / Body	Frequency (MHz)	Cond.	Perm.	target Cond.	target Perm.	σ (Delta) (%)	εr (Delta) (%)	Limit (%)	Date
			σ	εr	σ	εr				
22.4	Head	2308 Mhz	1.60	39.838	1.67	39.44	-4.38	1.01	±5	Aug. 01, 2019
22.4	Head	2390 Mhz	1.69	39.532	1.75	39.30	-3.54	0.59	±5	Aug. 01, 2019
22.4	Head	2472 Mhz	1.76	39.191	1.82	39.17	-3.28	0.05	±5	Aug. 01, 2019
22.3	Head	5180 Mhz	4.56	37.181	4.64	36.02	-1.75	3.22	±5	Aug. 02, 2019
22.3	Head	5500 Mhz	4.92	36.597	4.97	35.65	-0.99	2.66	±5	Aug. 02, 2019
22.3	Head	5825 Mhz	5.26	35.766	5.30	35.28	-0.67	1.38	±5	Aug. 02, 2019
22.1	Head	5750 Mhz	5.28	35.947	5.22	35.35	1.05	1.69	±5	Jul. 13, 2020
22.1	Head	5755 Mhz	5.31	35.813	5.23	35.35	1.63	1.31	±5	Jul. 13, 2020
22.1	Head	5795 Mhz	5.25	35.767	5.27	35.31	-0.34	1.29	±5	Jul. 13, 2020

8.2 Liquid Depth

The liquid level was during measurement 15 cm ±0.5 cm.

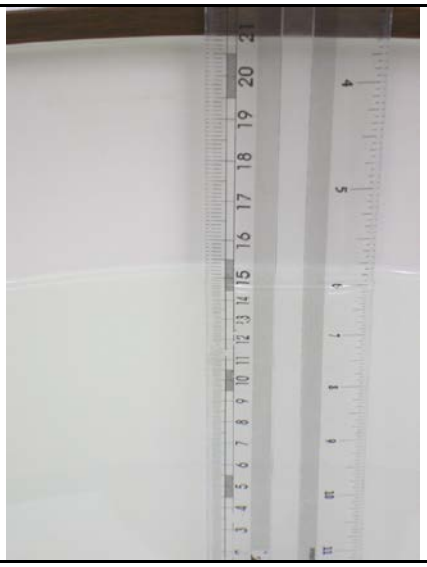


Figure 2. Liquid Height for Body SAR

9. Measurement Process

9.1 Device and Test Conditions

The Test Device was provided by **EDIMAX TECHNOLOGY CO., LTD.** for this evaluation. The device was put in operation using the R&S CMU200 wireless Communication Test Set. The antenna(s), battery and accessories shall be those specified by the manufacturer. The battery shall be fully charged before each measurement and there shall be no external connections.

The output power and frequency (channel) shall be controlled using an internal test program or by the use of appropriate test equipment (base station simulator). The mobile phone shall be set to transmit at its highest output peak power level allowed by the base station emulator. The antenna shall be placed at least 50 cm from the device. The signal emitted by the emulator at antenna feed point shall be lower than the output level of the phone by at least 30 dB.

All SAR measurements for LTE were performed using the Anritsu MT8820C. A closed loop power control setting allowed the UE to transmit at the maximum output power during the SAR measurements. Configure the base station to support LTE tests, and set channel, RB allocation number, RB allocation offset, and send continuously up power control commands to the device. MPR was enabled for this device. A-MPR was disabled for all SAR test measurements.

9.2 Conducted Power

< 2.4 GHz WLAN >

Band	Date Rate or Sub-test	CH	Frequency (MHz)	Average Conducted power		Average Tune-up power	
				Ant-A	Ant-B	Ant-A	Ant-B
IEEE 802.11b	1M	1	2412.0	16.41	---	17.00	---
		7	2442.0	16.69	---	17.00	---
		13	2472.0	16.70	---	17.00	---
IEEE 802.11g	6M	1	2412.0	16.33	---	17.00	---
		7	2442.0	16.81	---	17.00	---
		13	2472.0	16.60	---	17.00	---
IEEE 802.11n 2.4 GHz 20 MHz	6.5M	1	2412.0	13.90	13.23	14.50	14.00
		7	2442.0	14.48	13.64	14.50	14.00
		13	2472.0	14.32	13.55	14.50	14.00
IEEE 802.11n 2.4 GHz 40 MHz	13.5M	3	2422.0	14.51	13.84	15.00	14.00
		7	2442.0	13.86	13.28	15.00	14.00
		11	2462.0	13.85	13.23	15.00	14.00

< 5 GHz WLAN >

Band	Date Rate or Sub-test	CH	Frequency (MHz)	Average Conducted power		Average Tune-up power	
				Ant-A	Ant-B	Ant-A	Ant-B
802.11a	6M	36	5180.0	13.56	---	14.00	---
		40	5200.0	13.17	---	14.00	---
		48	5240.0	13.11	---	14.00	---
		149	5745.0	13.67	---	14.50	---
		157	5785.0	14.21	---	14.50	---
		165	5825.0	14.27	---	14.50	---
IEEE 802.11ac 20 MHz	6.5M	36	5180.0	16.08	13.35	16.50	13.50
		40	5200.0	15.68	13.12	16.50	13.50
		48	5240.0	15.67	13.40	16.50	13.50
		149	5745.0	14.24	13.55	14.50	14.00
		157	5785.0	14.12	13.87	14.50	14.00
		165	5825.0	14.03	13.74	14.50	14.00
IEEE 802.11ac 40 MHz	13.5M	38	5190.0	15.06	13.20	15.50	13.50
		46	5230.0	14.47	12.93	15.50	13.50
		151	5755.0	14.23	14.33	14.50	14.50
		159	5795.0	14.34	14.22	14.50	14.50
802.11ac_5G_VHT80	29.3M	42	5210.0	14.23	11.78	14.50	12.00
		155	5775.0	12.68	13.33	13.00	13.50

9.3 Validation Summary

Prior to the assessment, the system validation kit was used to test whether the system was operating within its specifications of ± 10 %. The measured SAR will be normalized to 1 W input power.

Mixture Type	Frequency (MHz)	Power	Probe	Dipole	$SAR_{1\,g}$ (W/Kg)	$SAR_{10\,g}$ (W/Kg)	1 W Target		Difference percentage		Date
			Model / Serial No.	Model / Serial No.			$SAR_{1\,g}$ [W/kg]	$SAR_{10\,g}$ [W/kg]	1 g	10 g	
Head	2450.0	250 mW	EX3DV4-SN3847	D2450V2 – SN712	13	6.1	52.10	24.00	-0.2%	1.6%	Aug. 01, 2019
		Normalize to 1 Watt			52.00	24.40					
Head	5250.0	100 mW	EX3DV4-SN3847	D5250V2 – SN1021	8.18	2.29	76.10	21.60	7.0%	5.7%	Aug. 02, 2019
		Normalize to 1 Watt			81.80	22.90					
Head	5750.0	100 mW	EX3DV4-SN7346	D5750V2 – SN1021	8.12	2.25	76.00	21.30	6.4%	5.3%	Jul. 13, 2020
		Normalize to 1 Watt			81.20	22.50					

9.4 Dosimetric Assessment Setup

The evaluation was performed with the following procedures：

Surface Check： A surface checks job gathers data used with optical surface detection. It determines the distance from the phantom surface where the reflection from the optical detector has its peak. Any following measurement jobs using optical surface detection will then rely on this value. The surface check performs its search a specified number of times, so that the repeatability can be verified. The probe tip distance is 1.3 mm to phantom inner surface during scans.

Reference： The reference job measures the field at a specified reference position, at 2 mm from the selected section's grid reference point.

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 can find the maximum locations even in relatively coarse grids. When an area scan has measured all reachable points, it computes the field maxima found in the scanned area, within a range of the global maximum. Any following zoom scan within the same procedure will then perform fine scans around these maxima. The area covered the entire dimension of the EUT and the horizontal grid spacing was 15 mm × 15 mm.

Zoom Scan： Zoom scans are used to assess the highest averaged SAR for cubic averaging volumes with 1 g and 10 g of simulated tissue. The zoom scan measures 7 x 7 x 7 points in a 30 x 30 x 30 mm cube whose base faces are centered around the maxima returned from a preceding area scan within the same procedure.

Drift： The drift job measures the field at the same location as the most recent reference job within the same procedure, with the same settings. The drift measurement gives the field difference in dB from the last reference measurement. Several drift measurements are possible for each reference measurement. This allows monitoring of the power drift of the device in the batch process. If the value changed by more than 5 %, the evaluation was repeated.

9.5 Spatial Peak SAR Evaluation

The DASY52 software includes all numerical procedures necessary to evaluate the spatial peak SAR values. Based on the Draft: SCC-34, SC-2, WG-2 - Computational Dosimetry, IEEE P1529/D0.0 (Draft Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) Associated with the Use of Wireless Handsets - Computational Techniques), a new algorithm has been implemented. The spatial-peak SAR can be computed over any required mass.

The base for the evaluation is a ”cube” measurement in a volume of (30x30x30)mm (7x7x7 points). The measured volume must include the 1 g and 10 g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan. If the 10 g cube or both cubes are not entirely inside the measured volumes, the system issues a warning regarding the evaluated spatial peak values within the Post processing engine (SEMCAD). This means that if the measured volume is shifted, higher values might be possible. To get the correct values you can use a finer measurement grid for the area scan. In complicated field distributions, a large grid spacing for the area scan might miss some details and give an incorrectly interpolated peak location.

The entire evaluation of the spatial peak values is performed within the Post processing engine (SEMCAD). The system always gives the maximum values for the 1 g and 10 g cubes. The algorithm to find the cube with highest averaged SAR is divided into three stages:

Interpolation and Extrapolation

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

In DASY52, the choice of the coordinate system defining the location of the measurement points has no influence on the uncertainty of the interpolation, Maxima Search and SAR extrapolation routines. The interpolation, Maxima Search and extrapolation routines are all based on the modified Quadratic Shepard’s method [7]

10. Measurement Uncertainty

Desicision Rule

■Uncertainty is not included.

□Uncertainty is included.

IEC 62209-2 Measurement uncertainty evaluation template for handset SAR test (300 MHz~3 GHz)								
Uncertainty component	**Tol.**	**Prob. Dist.**	**Div.**	**C_i - 1g**	**C_i - 10g**	**u_i - 1g (± %)**	**u_i - 10g (± %)**	**v_i**
Measurement system								
Probe calibration	6.1	N	1	1	1	6.1	6.1	∞
Axial isotropy	4.7	R	1.732	0.7	0.7	1.9	1.9	∞
Hemispherical isotropy	9.6	R	1.732	0.7	0.7	3.9	3.9	∞
Boundary effect	1.0	R	1.732	1	1	0.6	0.6	∞
Linearity	4.7	R	1.732	1	1	2.7	2.7	∞
System detection limits	0.25	R	1.732	1	1	0.1	0.1	∞
Readout electronics	0.3	N	1	1	1	0.3	0.3	∞
Response time	0.0	R	1.732	1	1	0.0	0.0	∞
Integration time	2.6	R	1.732	1	1	1.5	1.5	∞
RF Ambient Noise	3.0	R	1.732	1	1	1.7	1.7	∞
RF Ambient Reflections	3.0	R	1.732	1	1	1.7	1.7	∞
Probe Positioner	0.02	R	1.732	1	1	0.01	0.01	∞
Probe Positioning	0.4	R	1.732	1	1	0.2	0.2	∞
Max. SAR evaluation	2.0	R	1.732	1	1	1.2	1.2	∞
Test sample related								
Test sample positioning	2.9	N	1	1	1	2.9	2.9	145
Device holder uncertainty	3.6	N	1	1	1	3.6	3.6	7
SAR drift measurement	5.0	R	1.732	1	1	2.9	2.9	∞
Phantom and tissue parameters								
Phantom shell uncertainty	7.2	R	1.732	1	1	4.2	4.2	∞
Liquid Conductivity (target)	5.0	R	1.732	0.78	0.71	2.3	2.0	∞
Liquid Conductivity (measurement)	4.8	R	1.732	0.78	0.71	2.2	2.0	∞
Liquid Permittivity (target)	5.0	R	1.732	0.23	0.26	0.7	0.8	∞
Liquid Permittivity (measurement)	4.8	R	1.732	0.23	0.26	0.6	0.7	∞
Combined standard uncertainty								
-	-	RSS	-	-	-	11.4	11.4	693
Expanded uncertainty (95% confidence interval)								
-	-	k =2	-	-	-	22.9	22.7	-

IEC 62209-2 Measurement uncertainty evaluation template for handset SAR test (3 GHz~6 GHz)								
Uncertainty component	**Tol.**	**Prob. Dist.**	**Div.**	**C_i - 1g**	**C_i - 10g**	**u_i - 1g (± %)**	**u_i - 10g (± %)**	**v_i**
Measurement system								
Probe calibration	6.1	N	1	1	1	6.1	6.1	∞
Axial isotropy	4.7	R	1.732	0.7	0.7	1.9	1.9	∞
Hemispherical isotropy	9.6	R	1.732	0.7	0.7	3.9	3.9	∞
Boundary effect	1.0	R	1.732	1	1	0.6	0.6	∞
Linearity	4.7	R	1.732	1	1	2.7	2.7	∞
System detection limits	0.25	R	1.732	1	1	0.1	0.1	∞
Readout electronics	0.3	N	1	1	1	0.3	0.3	∞
Response time	0.0	R	1.732	1	1	0.0	0.0	∞
Integration time	2.6	R	1.732	1	1	1.5	1.5	∞
RF Ambient Noise	3.0	R	1.732	1	1	1.7	1.7	∞
RF Ambient Reflections	3.0	R	1.732	1	1	1.7	1.7	∞
Probe Positioner	0.02	R	1.732	1	1	0.01	0.01	∞
Probe Positioning	0.4	R	1.732	1	1	0.2	0.2	∞
Max. SAR evaluation	2.0	R	1.732	1	1	1.2	1.2	∞
Test sample related								
Test sample positioning	2.9	N	1	1	1	2.9	2.9	145
Device holder uncertainty	3.6	N	1	1	1	3.6	3.6	7
SAR drift measurement	5.0	R	1.732	1	1	2.9	2.9	∞
Phantom and tissue parameters								
Phantom shell uncertainty	7.6	R	1.732	1	1	4.4	4.4	∞
Liquid Conductivity (target)	5.0	R	1.732	0.78	0.71	2.3	2.0	∞
Liquid Conductivity (measurement)	4.8	R	1.732	0.78	0.71	2.2	2.0	∞
Liquid Permittivity (target)	5.0	R	1.732	0.23	0.26	0.7	0.8	∞
Liquid Permittivity (measurement)	4.8	R	1.732	0.23	0.26	0.6	0.7	∞
Combined standard uncertainty								
-	-	RSS	-	-	-	12.1	12.0	859
Expanded uncertainty (95% confidence interval)								
-	-	k =2	-	-	-	24.1	24.0	-

11. SAR Test Results Summary

1.This device is designed to Wi-Fi 2.4GHz and 5GHz can not be transmitted simultaneously, combine SAR is not required.

11.1 Body SAR

Measurement Results													
Index.	Band	Mode	Frequency (MHz)		Data Rate (Mbps)	Test Position	Spacing (mm)	$SAR_{10\,g}$ [W/Kg]	Avg Power	Max tune-up	Duty Cycle (%)	Reported $SAR_{10\,g}$ (W/kg)	Note
			Ch.	MHz									
	WLAN 2.4 GHz	802.11g	7	2442.0	6 Mbps	Horizontal-UP	5	0.189	16.81	17.0	99.86	0.198	Ant A
	WLAN 2.4 GHz	802.11g	7	2442.0	6 Mbps	Horizontal-Down	5	0.233	16.81	17.0	99.86	0.244	Ant A
	WLAN 2.4 GHz	802.11g	1	2412.0	6 Mbps	Horizontal-Down	5	0.249	16.33	17.0	99.86	0.291	Ant A
#7	WLAN 2.4 GHz	802.11g	13	2472.0	6 Mbps	Horizontal-Down	5	0.314	16.60	17.0	99.86	0.345	Ant A
	WLAN 2.4 GHz	802.11g	7	2442.0	6 Mbps	Vertical-Front	5	0.115	16.81	17.0	99.86	0.120	Ant A
	WLAN 2.4 GHz	802.11g	7	2442.0	6 Mbps	Vertical-Back	5	0.185	16.81	17.0	99.86	0.193	Ant A
	WLAN 2.4 GHz	802.11g	7	2442.0	6 Mbps	Tip	5	0.128	16.81	17.0	99.86	0.134	Ant A
	WLAN 5 GHz	802.11ac 20 MHz	36	5180.0	13 Mbps	Horizontal-UP	5	0.224	16.08	16.5	96.81	0.255	Ant A
#14	WLAN 5 GHz	802.11ac 20 MHz	36	5180.0	13 Mbps	Horizontal-Down	5	0.364	16.08	16.5	96.81	0.414	Ant A
	WLAN 5 GHz	802.11ac 20 MHz	36	5180.0	13 Mbps	Vertical-Front	5	0.079	16.08	16.5	96.81	0.090	Ant A
	WLAN 5 GHz	802.11ac 20 MHz	36	5180.0	13 Mbps	Vertical-Back	5	0.067	16.08	16.5	96.81	0.076	Ant A
	WLAN 5 GHz	802.11ac 20 MHz	36	5180.0	13 Mbps	Tip	5	0.091	16.08	16.5	96.81	0.104	Ant A
#39	WLAN 5GHz	802.11ac 40 MHz	159	5795.0	27 Mbps	Horizontal-UP	5	0.164	14.34	14.50	96.81	0.176	Ant A
	WLAN 5GHz	802.11ac 40 MHz	151	5755.0	27 Mbps	Horizontal-UP	5	0.084	14.23	14.50	96.81	0.093	Ant A
	WLAN 5GHz	802.11ac 40 MHz	159	5795.0	27 Mbps	Horizontal-Down	5	0.122	14.34	14.50	96.81	0.131	Ant A
	WLAN 5GHz	802.11ac 40 MHz	159	5795.0	27 Mbps	Vertical-Front	5	0.080	14.34	14.50	96.81	0.086	Ant A
	WLAN 5GHz	802.11ac 40 MHz	159	5795.0	27 Mbps	Vertical-Back	5	0.069	14.34	14.50	96.81	0.074	Ant A
	WLAN 5GHz	802.11ac 40 MHz	159	5795.0	27 Mbps	Tip	5	0.095	14.34	14.50	96.81	0.102	Ant A
Safety Limit / Spatial Peak European Council Recommendation 1999 519 EC							Muscle 2.0 W/kg Averaged over 10 gram						

Measurement Results													
Index.	Band	Mode	Frequency (MHz)		Data Rate (Mbps)	Test Position	Spacing (mm)	$SAR_{10\,g}$ [W/Kg]	Avg Power	Max tune-up	Duty Cycle (%)	Reported $SAR_{10\,g\backslash}$ (W/kg)	Note
			Ch.	MHz									
	WLAN 5 GHz	802.11ac 20 MHz	36	5180.0	13 Mbps	Horizontal-UP	5	0.161	13.35	13.5	96.60	0.172	Ant B
#20	WLAN 5 GHz	802.11ac 20 MHz	36	5180.0	13 Mbps	Horizontal-Down	5	0.403	13.35	13.5	96.60	0.432	Ant B
	WLAN 5 GHz	802.11ac 20 MHz	40	5200.0	13 Mbps	Horizontal-Down	5	0.280	13.12	13.5	96.60	0.316	Ant B
	WLAN 5 GHz	802.11ac 20 MHz	48	5240.0	13 Mbps	Horizontal-Down	5	0.234	13.40	13.5	96.60	0.248	Ant B
	WLAN 5 GHz	802.11ac 20 MHz	36	5180.0	13 Mbps	Vertical-Front	5	0.105	13.35	13.5	96.60	0.112	Ant B
	WLAN 5 GHz	802.11ac 20 MHz	36	5180.0	13 Mbps	Vertical-Back	5	0.212	13.35	13.5	96.60	0.227	Ant B
	WLAN 5 GHz	802.11ac 20 MHz	36	5180.0	13 Mbps	Tip	5	0.230	13.35	13.5	96.60	0.246	Ant B
	WLAN 5GHz	802.11ac 40 MHz	151	5755.0	27 Mbps	Horizontal-UP	5	0.125	14.33	14.50	96.60	0.135	Ant B
	WLAN 5GHz	802.11ac 40 MHz	151	5755.0	27 Mbps	Horizontal-Down	5	0.231	14.33	14.50	96.60	0.249	Ant B
#50	WLAN 5GHz	802.11ac 40 MHz	159	5795.0	27 Mbps	Horizontal-Down	5	0.352	14.22	14.50	96.60	0.389	Ant B
	WLAN 5GHz	802.11ac 40 MHz	151	5755.0	27 Mbps	Vertical-Front	5	0.059	14.33	14.50	96.60	0.064	Ant B
	WLAN 5GHz	802.11ac 40 MHz	151	5755.0	27 Mbps	Vertical-Back	5	0.178	14.33	14.50	96.60	0.192	Ant B
	WLAN 5GHz	802.11ac 40 MHz	151	5755.0	27 Mbps	Tip	5	0.144	14.33	14.50	96.60	0.155	Ant B
Safety Limit / Spatial Peak European Council Recommendation 1999 519 EC							Muscle 2.0 W/kg Averaged over 10 gram						

11.2 European Council Recommendation 1999 519 EC

Depending on frequency, the following physical quantities (dosimetric / exposimetric quantities) are used to specify the basic restrictions on electromagnetic fields：

- between 0 and 1 Hz basic restrictions are provided for magnetic flux density for static magnetic fields (0 Hz) and current density for time-varying fields up to 1 Hz, in order to prevent effects on the cardiovascular and central nervous system,
- between 1Hz and 10 MHz basic restrictions are provided for current density to prevent effects on nervous system functions,
- between 100 kHz and 10 GHz basic restrictions on SAR are provided to prevent whole-body heat stress and excessive localized heating of tissues. In the range 100 kHz to 10 MHz, restrictions on both current density and SAR are provided,
- between 10 GHz and 300 GHz basic restrictions on power density are provided to prevent heating in tissue at or near the body surface.

Frequency range	Magnetic flux density (mT)	Current density (mA/m^2) (rms)	Whole body average SAR (W/kg)	Localised SAR (head and trunk) (W/kg)	Localised SAR (limbs) (W/kg)	Power density, S (W/m^2)
0 Hz	40	—	—	—	—	—
>0-1 Hz	—	8	—	—	—	—
1-4 Hz	—	8/f	—	—	—	—
4-1 000 Hz	—	2	—	—	—	—
1 000 Hz-100 kHz	—	f/500	—	—	—	—
100 kHz-10 MHz	—	f/500	0,08	2	4	—
10 MHz-10 GHz	—	—	0,08	2	4	—
10-300 GHz	—	—	—	—	—	10

Table 3. Reference levels for electric, magnetic and electromagnetic fields (0Hz to 300GHz, unperturbed RMS values)

12. Conclusion

The SAR test values found for the portable mobile phone is below the maximum recommended level of 2.0 W/kg (mW/g).

13. References

Radio frequency Electromagnetic Fields", NCRP report NO. 86, 1986.

[2] T. Schmid, O. Egger, and N. Kuster, "*Automatic E-field scanning system for dosimetric assessments*", IEEE Transactions on Microwave Theory and Techniques, vol. 44, pp, 105-113, Jan. 1996.

[3] K. Pokovi ć, T. Schmid, and N. Kuster, "*Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequency*", in ICECOM'97, Dubrovnik, October 15-17, 1997, pp.120-124.

[4] K. Pokovi ć, T. Schmid, and N. Kuster, "E-field probe with improved isotropy in brain simulating liquids", in Proceedings of the ELMAR, Zadar, Croatia, 23-25 June, 1996, pp.172-175.

[5] N. Kuster, and Q. Balzano, "Energy absorption mechanism by biological bodies in the near field of dipole antennas above 300MHz", IEEE Transaction on Vehicular Technology, vol. 41, no. 1, Feb. 1992, pp. 17-23.

[6] V. Hombach, K. Meier, M. Burkhardt, E. K ü hn, N. Kuster, "The Dependence of EM Energy Absorption upon Human Head Modeling at 900MHz", IEEE Transaction on Microwave Theory and Techniques, vol. 44, no. 10, Oct. 1996, pp. 1865-1873.

[7 V. Hombach, K. Meier, R. K ä stle, R. Tay, N. Kuster, "The Dependence of EM Energy Absorption upon Human Head Modeling at 1800MHz", IEEE Transaction on Microwave Theory and Techniques, Oct. 1997, in press.

[8] N. Kuster, R. Kastle, T. Schmid, Dosimetric evaluation of mobile communications equipment with known precision, IEEE Transaction on Communications, vol. E80-B, no. 5, May 1997, pp. 645-652.

[9] CENELEC CLC/SC111B, European Prestandard (prENV 50166-2), Human Exposure to Electromagnetic Fields High-frequency: 10KHz-300GHz, Jan. 1995.

Appendix A - System Performance Check

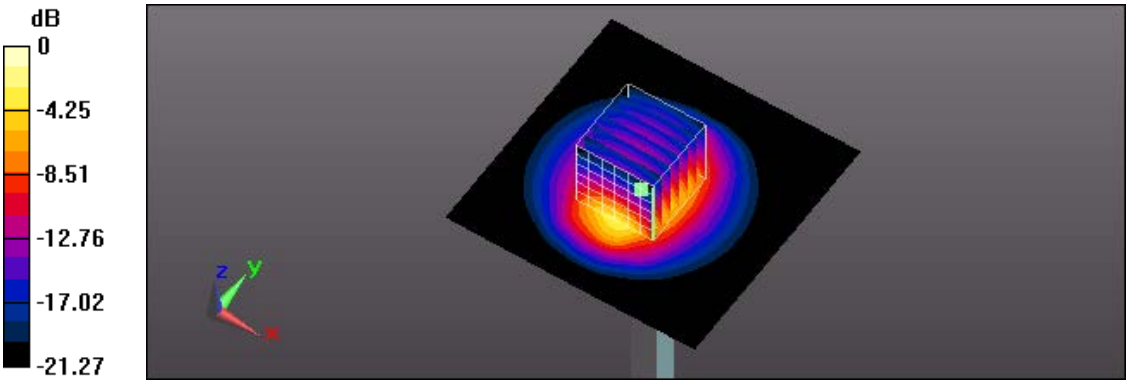
Test Laboratory: A Test Lab Techno Corp.
Date: 2019/8/1
System Performance Check at 2450MHz_20190801_Head
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:712

Communication System: UID 0, CW (0); Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.736 S/m; ε_r = 39.281; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5.2 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV4 - SN3847; ConvF(7.14, 7.14, 7.14); Calibrated: 2019/5/16
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2019/3/19
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1036
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

Area Scan (81x81x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 21.6 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 111.8 V/m; Power Drift = 0.16 dB
Peak SAR (extrapolated) = 26.1 W/kg
SAR(1 g) = 13 W/kg; SAR(10 g) = 6.1 W/kg
Maximum value of SAR (measured) = 21.4 W/kg



0 dB = 21.4 W/kg = 13.30 dBW/kg

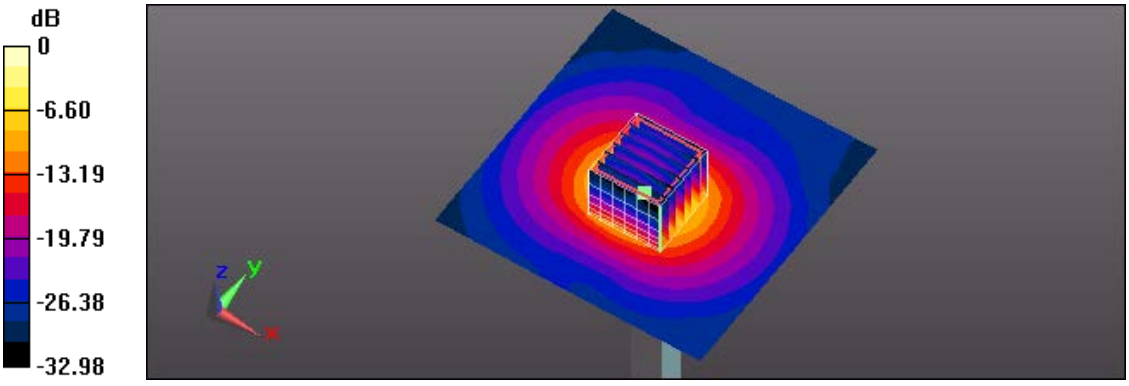
Test Laboratory: A Test Lab Techno Corp.
Date: 2019/8/2
System Performance Check at 5250MHz_20190802_Head
DUT: Dipole 5GHzV2; Type: D5GHz; Serial: 1021

Communication System: UID 0, CW (0); Frequency: 5250 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5250 MHz; σ = 4.64 S/m; ε_r = 37.043; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5.2 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV4 - SN3847; ConvF(5.22, 5.22, 5.22); Calibrated: 2019/5/16
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2019/3/19
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1036
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

Area Scan (91x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 18.6 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.46 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 31.1 W/kg
SAR(1 g) = 8.18 W/kg; SAR(10 g) = 2.29 W/kg
Maximum value of SAR (measured) = 19.8 W/kg



0 dB = 19.8 W/kg = 12.97 dBW/kg

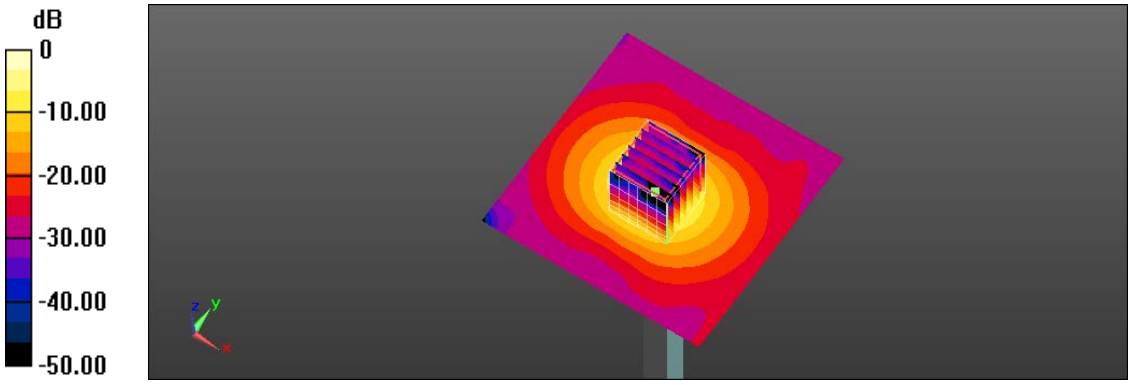
Test Laboratory: A Test Lab Techno Corp.
Date: 2020/7/13
System Performance Check at 5750MHz_20200713_Head
DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1021

Communication System: UID 0, CW (0); Frequency: 5750 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5750 MHz; σ = 5.275 S/m; ε_r = 35.947; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5.2 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV4 - SN7346; ConvF(4.84, 4.84, 4.84); Calibrated: 2020/5/20
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn913; Calibrated: 2020/5/6
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1036
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

Area Scan (91x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 20.5 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.80 V/m; Power Drift = 0.17 dB
Peak SAR (extrapolated) = 34.4 W/kg
SAR(1 g) = 8.12 W/kg; SAR(10 g) = 2.25 W/kg
Smallest distance from peaks to all points 3 dB below = 7.4 mm
Ratio of SAR at M2 to SAR at M1 = 63.4%
Maximum value of SAR (measured) = 20.2 W/kg



0 dB = 20.2 W/kg = 13.05 dBW/kg

Appendix B - SAR Measurement Data

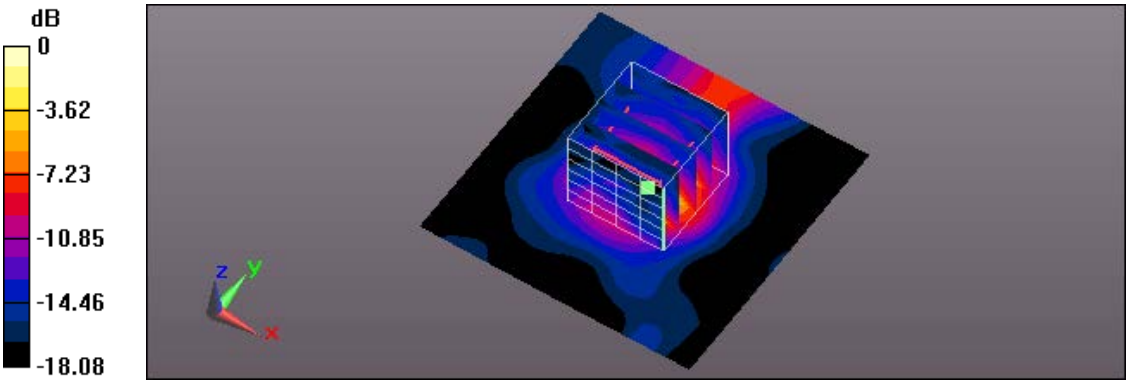
Test Laboratory: A Test Lab Techno Corp.
Date: 2019/8/1
7_IEEE 802.11g CH13_6M_Horizontal-Down_5mm_Ant A
DUT: EW-7822UNC ; Type: 11ac Wireless Dual-Band Selectable USB Adapter

Communication System: UID 0, IEEE 802.11g (0); Frequency: 2472 MHz;Duty Cycle: 1:1.001
Medium parameters used: f = 2472 MHz; σ = 1.763 S/m; ε_r = 39.191; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5.2 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV4 - SN3847; ConvF(7.14, 7.14, 7.14); Calibrated: 2019/5/16
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2019/3/19
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1036
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 1.36 W/kg

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 14.67 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 1.70 W/kg
SAR(1 g) = 0.741 W/kg; SAR(10 g) = 0.314 W/kg
Maximum value of SAR (measured) = 1.28 W/kg



0 dB = 1.28 W/kg = 1.07 dBW/kg

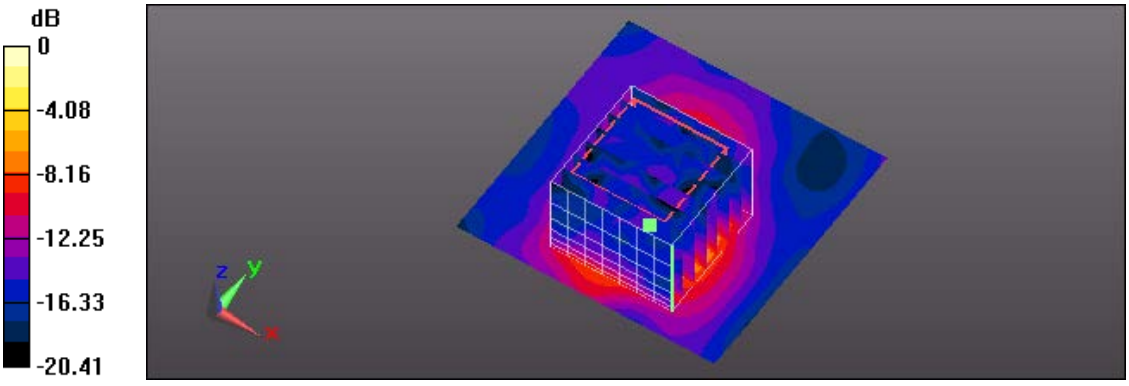
Test Laboratory: A Test Lab Techno Corp.
Date: 2019/8/2
14_IEEE 802.11ac_CH36_VHT20_Horizontal-Down_5mm_Ant A
DUT: EW-7822UNC ; Type: 11ac Wireless Dual-Band Selectable USB Adapter

Communication System: UID 0, IEEE 802.11ac(5GHz)VHT20 (0); Frequency: 5180 MHz;Duty Cycle: 1:1.033
Medium parameters used: f = 5180 MHz; σ = 4.556 S/m; ε_r = 37.196; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5.2 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV4 - SN3847; ConvF(5.22, 5.22, 5.22); Calibrated: 2019/5/16
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2019/3/19
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1036
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

Area Scan (61x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 2.55 W/kg

Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 19.92 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 3.94 W/kg
SAR(1 g) = 1.1 W/kg; SAR(10 g) = 0.364 W/kg
Maximum value of SAR (measured) = 2.57 W/kg



0 dB = 2.57 W/kg = 4.10 dBW/kg

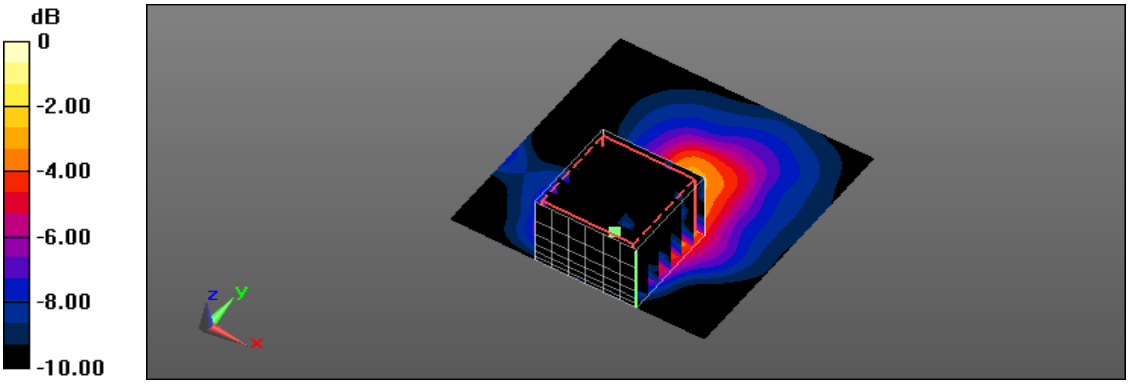
Test Laboratory: A Test Lab Techno Corp.
Date: 2020/7/13
39_IEEE 802.11ac_CH159_VHT40_Horizontal-Up_5mm_Ant A
DUT: EW-7822UNC ; Type: 11ac Wireless Dual-Band Selectable USB Adapter

Communication System: UID 0, IEEE 802.11ac(5GHz)HT40 (0); Frequency: 5795 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5795 MHz; σ = 5.247 S/m; ε_r = 35.767; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5.2 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV4 - SN7346; ConvF(4.84, 4.84, 4.84) @ 5795 MHz; Calibrated: 2020/5/20
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn913; Calibrated: 2020/5/6
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1036
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

Area Scan (61x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.841 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 11.25 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 1.57 W/kg
SAR(1 g) = 0.399 W/kg; SAR(10 g) = 0.164 W/kg
Smallest distance from peaks to all points 3 dB below = 7.2 mm
Ratio of SAR at M2 to SAR at M1 = 64.3%
Maximum value of SAR (measured) = 0.900 W/kg



0 dB = 0.900 W/kg = -0.46 dBW/kg

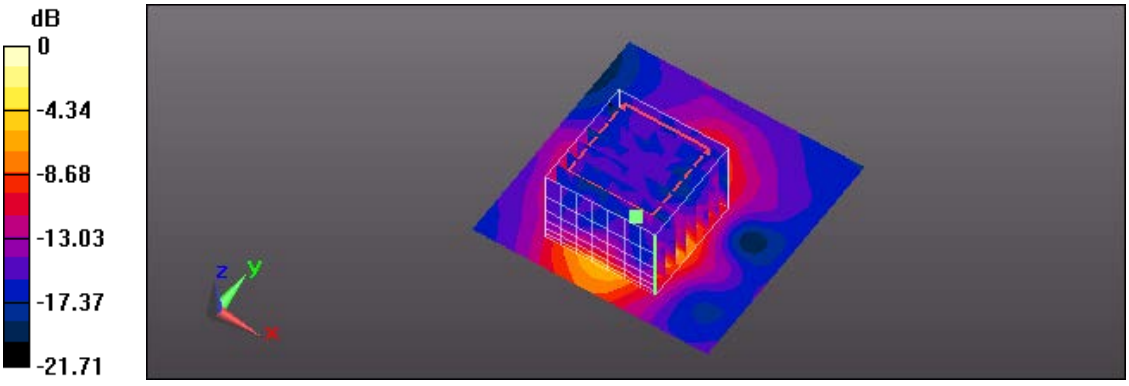
Test Laboratory: A Test Lab Techno Corp.
Date: 2019/8/2
20_IEEE 802.11ac_CH36_VHT20_Horizontal-Down_5mm_Ant B
DUT: EW-7822UNC ; Type: 11ac Wireless Dual-Band Selectable USB Adapter

Communication System: UID 0, IEEE 802.11ac(5GHz)VHT20 (0); Frequency: 5180 MHz;Duty Cycle: 1:1.035
Medium parameters used: f = 5180 MHz; σ = 4.556 S/m; ε_r = 37.196; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5.2 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV4 - SN3847; ConvF(5.22, 5.22, 5.22); Calibrated: 2019/5/16
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2019/3/19
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1036
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

Area Scan (61x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 2.86 W/kg

Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 25.17 V/m; Power Drift = -0.19 dB
Peak SAR (extrapolated) = 4.21 W/kg
SAR(1 g) = 1.18 W/kg; SAR(10 g) = 0.403 W/kg
Maximum value of SAR (measured) = 2.61 W/kg



0 dB = 2.61 W/kg = 4.17 dBW/kg

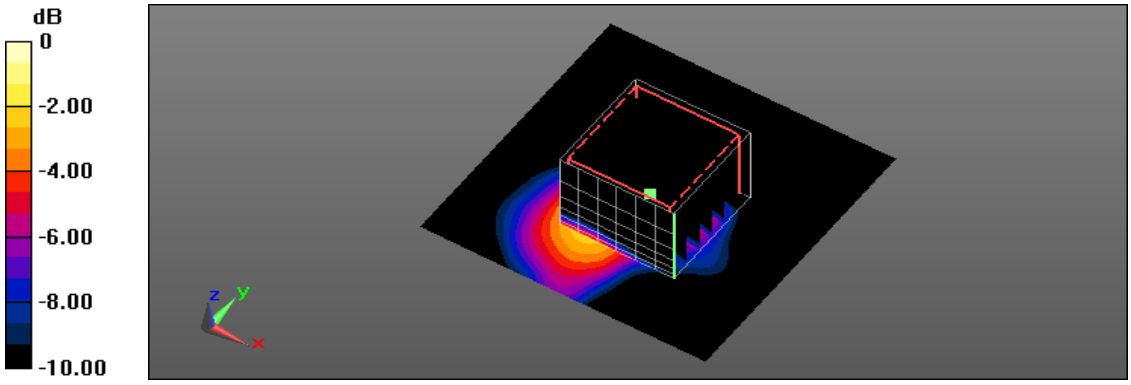
Test Laboratory: A Test Lab Techno Corp.
Date: 2020/7/13
50_IEEE 802.11ac_CH159_VHT40_Horizontal-Down_5mm_Ant B
DUT: EW-7822UNC ; Type: 11ac Wireless Dual-Band Selectable USB Adapter

Communication System: UID 0, IEEE 802.11ac(5GHz)HT40 (0); Frequency: 5795 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5795 MHz; σ = 5.247 S/m; ε_r = 35.767; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5.2 Configuration:

- Area Scan setting - Find Secondary Maximum Within:2.0dB and with a peak SAR value greater than 0.5 W/Kg
- Probe: EX3DV4 - SN7346; ConvF(4.84, 4.84, 4.84) @ 5795 MHz; Calibrated: 2020/5/20
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn913; Calibrated: 2020/5/6
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1036
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

Area Scan (61x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 2.74 W/kg

Zoom Scan (7x7x7)/Cube: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 25.36 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 4.45 W/kg
SAR(1 g) = 1 W/kg; SAR(10 g) = 0.352 W/kg
Smallest distance from peaks to all points 3 dB below = 6.9 mm
Ratio of SAR at M2 to SAR at M1 = 61.7%
Maximum value of SAR (measured) = 2.47 W/kg



0 dB = 2.47 W/kg = 3.93 dBW/kg

Appendix C - Calibration

All of the instruments Calibration information are listed below.

- Dipole _ D2450V2 SN:712
- Dipole _ D5GHzV2 SN:1021
- Probe _ EX3DV4 SN:7346
- Probe _ EX3DV4 SN:3847
- DAE _ DAE4 SN:541
- DAE _ DAE4 SN:913

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Client **ATL** **Certificate No: Z19-60129**

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 712
Calibration Procedure(s)	FF-Z11-003-01 Calibration Procedures for dipole validation kits
Calibration date:	April 15, 2019

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Power sensor NRP8S	104291	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Reference Probe EX3DV4	SN 3617	31-Jan-19(SPEAG,No.EX3-3617_Jan19)	Jan-20
DAE4	SN 1331	06-Feb-19(SPEAG,No.DAE4-1331_Feb19)	Feb-20
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
Signal Generator E4438C	MY49071430	23-Jan-19 (CTTL, No.J19X00336)	Jan-20
NetworkAnalyzer E5071C	MY46110673	24-Jan-19 (CTTL, No.J19X00547)	Jan-20

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: April 20, 2019

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Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
c) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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Measurement Conditions

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

DASY Version	DASY52	52.10.2.1495
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.4 ± 6 %	1.85 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.1 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**52.1 W/kg ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.02 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.0 W/kg ± 18.7 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.3 ± 6 %	2.01 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.7 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**50.5 W/kg ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.88 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.5 W/kg ± 18.7 % (k=2)**

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.4Ω+ 3.38 jΩ
Return Loss	- 27.9dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.9Ω+ 5.55 jΩ
Return Loss	- 24.4dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.022 ns

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

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

Additional EUT Data

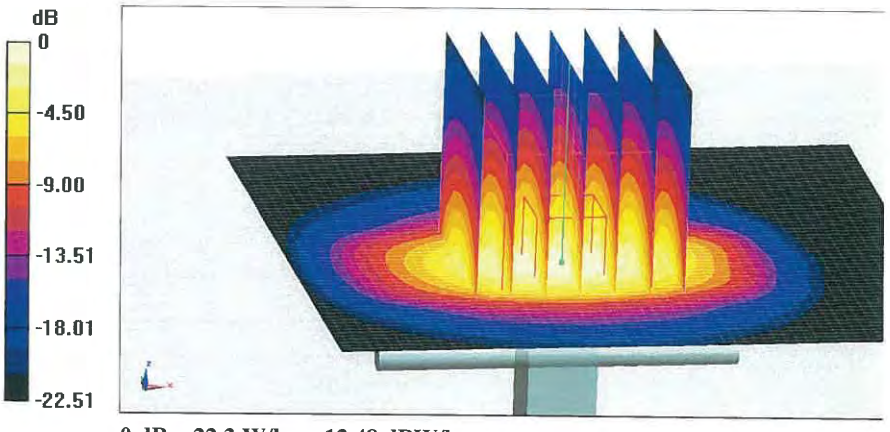
Manufactured by	SPEAG

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DASY5 Validation Report for Head TSL Date: 04.15.2019
Test Laboratory: CTTL, Beijing, China
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 712
Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.85 S/m; ε_r = 40.35; ρ = 1000 kg/m3
Phantom section: Right Section
DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(7.62, 7.62, 7.62) @ 2450 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 2/6/2019
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

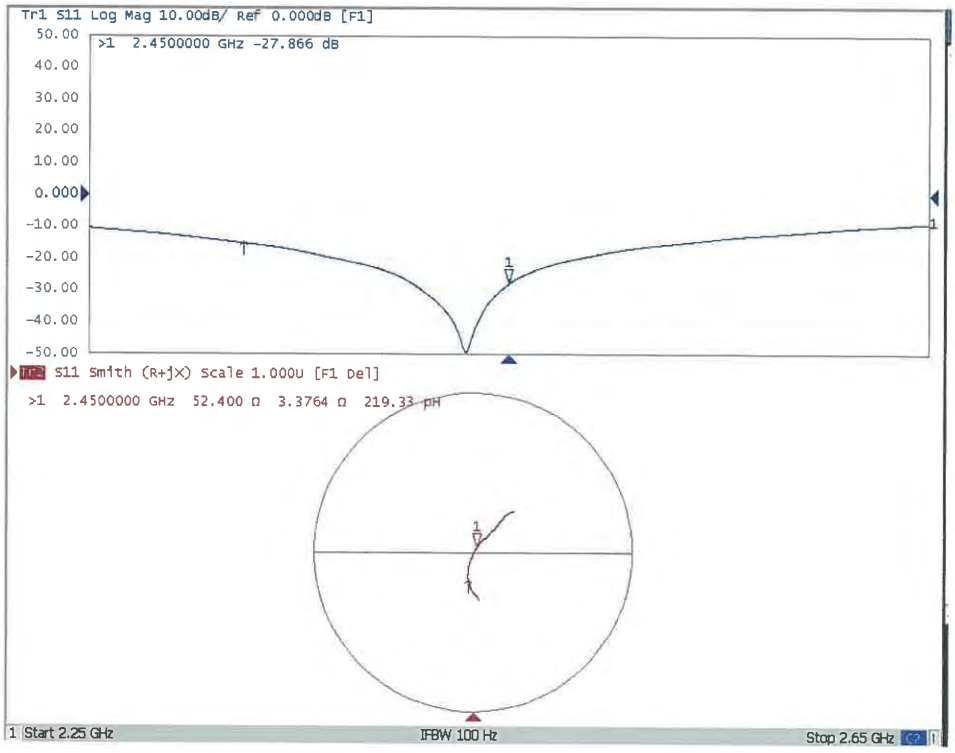
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 87.05 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 28.1 W/kg
SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.02 W/kg
Maximum value of SAR (measured) = 22.3 W/kg



0 dB = 22.3 W/kg = 13.48 dBW/kg

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Impedance Measurement Plot for Head TSL

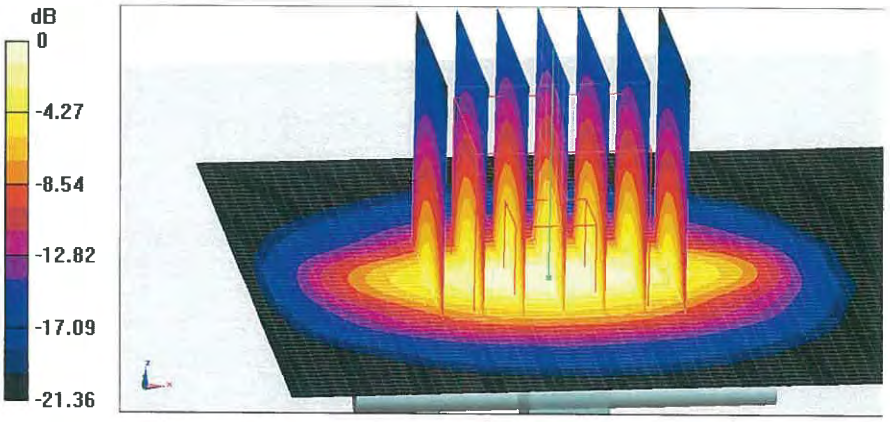


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DASY5 Validation Report for Body TSL Date: 04.15.2019
Test Laboratory: CTTL, Beijing, China
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 712
Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 2.005 S/m; ε_r = 54.25; ρ = 1000 kg/m3
Phantom section: Center Section
DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(7.79, 7.79, 7.79) @ 2450 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 2/6/2019
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

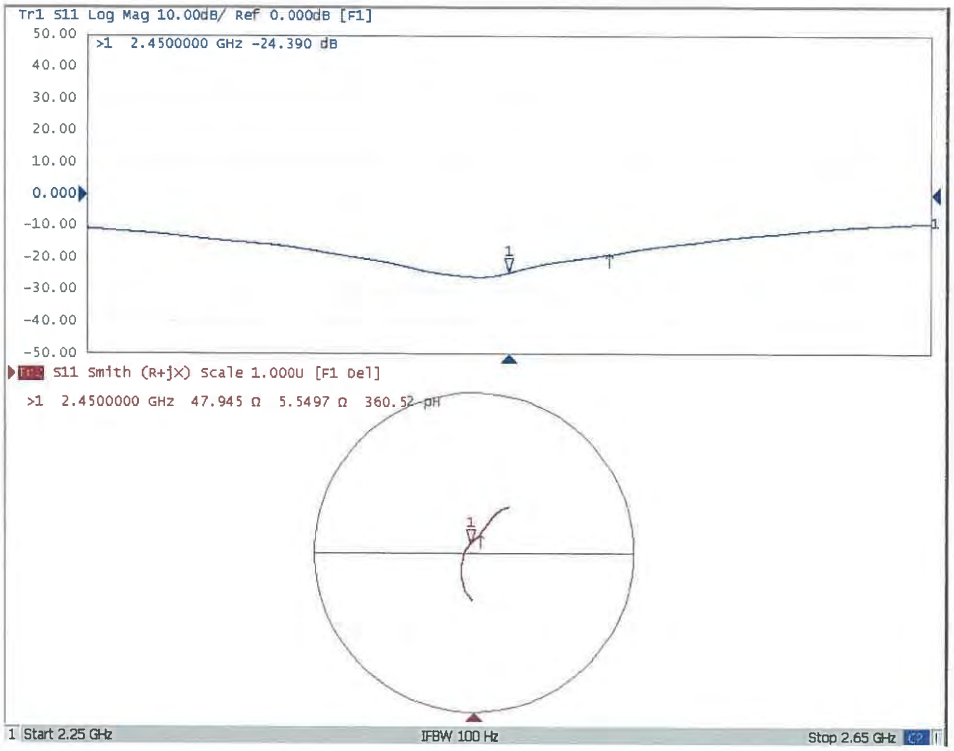
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 94.06 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 26.5 W/kg
SAR(1 g) = 12.7 W/kg; SAR(10 g) = 5.88 W/kg
Maximum value of SAR (measured) = 21.1 W/kg



0 dB = 21.1 W/kg = 13.24 dBW/kg

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Impedance Measurement Plot for Body TSL



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Client ATL Certificate No: Z19-60131

CALIBRATION CERTIFICATE

Object D5GHzV2 - SN: 1021

Calibration Procedure(s) FF-Z11-003-01
Calibration Procedures for dipole validation kits

Calibration date: April 19, 2019

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Power sensor NRP8S	104291	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
ReferenceProbe EX3DV4	SN 7514	27-Aug-18(SPEAG,No.EX3-7514_Aug18/2)	Aug-19
DAE4	SN 1331	06-Feb-19(SPEAG,No.DAE4-1331_Feb19)	Feb-20
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
Signal Generator E4438C	MY49071430	23-Jan-19 (CTTL, No.J19X00336)	Jan-20
NetworkAnalyzerE5071C	MY46110673	24-Jan-19 (CTTL, No.J19X00547)	Jan-20

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: April 25, 2019

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Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
c) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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Measurement Conditions

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

DASY Version	DASY52	52.10.2.1495
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz	

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.9 ± 6 %	4.58 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.66 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**76.1 W/kg ± 24.4 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.18 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.6 W/kg ± 24.2 % (k=2)**

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Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.5 ± 6 %	4.92 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.16 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**81.0 W/kg ± 24.4 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.29 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.7 W/kg ± 24.2 % (k=2)**

Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.4 ± 6 %	5.07 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.66 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**76.1 W/kg ± 24.4 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.15 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.3 W/kg ± 24.2 % (k=2)**

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Body TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.36 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	50.3 ± 6 %	5.49 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL at 5250 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.39 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**74.4 W/kg ± 24.4 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.09 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.1 W/kg ± 24.2 % (k=2)**

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	49.9 ± 6 %	5.94 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.65 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**77.0 W/kg ± 24.4 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.16 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.8 W/kg ± 24.2 % (k=2)**

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Body TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.3	5.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	49.7 ± 6 %	6.11 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.41 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**74.6 W/kg ± 24.4 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.08 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.0 W/kg ± 24.2 % (k=2)**

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	51.9Ω - 4.22jΩ
Return Loss	- 26.9dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	58.4Ω - 0.27jΩ
Return Loss	- 22.2dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	56.7Ω + 1.19jΩ
Return Loss	- 23.9dB

Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	52.3Ω - 2.82jΩ
Return Loss	- 28.9dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	58.7Ω + 1.14jΩ
Return Loss	- 21.8dB

Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	57.5Ω + 1.49jΩ
Return Loss	- 23.0dB

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General Antenna Parameters and Design

Electrical Delay (one direction)	1.064 ns

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

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

Additional EUT Data

Manufactured by	SPEAG

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DASY5 Validation Report for Head TSL Date: 04.17.2019
Test Laboratory: CTTL, Beijing, China
DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1021

Communication System: CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz,
Medium parameters used: f = 5250 MHz; σ = 4.576 S/m; εr = 34.9; ρ = 1000 kg/m3, Medium parameters used: f = 5600 MHz; σ = 4.923 S/m; εr = 34.46; ρ = 1000 kg/m3, Medium parameters used: f = 5750 MHz; σ = 5.066 S/m; εr = 34.4; ρ = 1000 kg/m3,
Phantom section: Center Section

DASY5 Configuration:

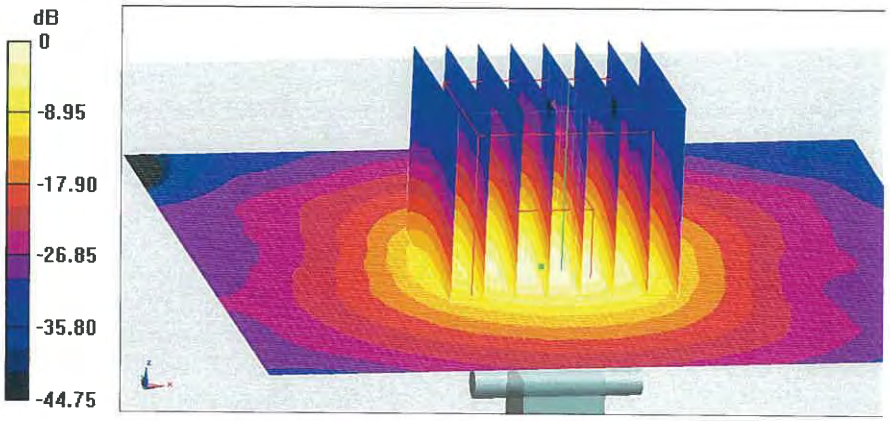
- Probe: EX3DV4 - SN7514; ConvF(5.02, 5.02, 5.02) @ 5250 MHz; Calibrated: 8/27/2018, ConvF(4.41, 4.41, 4.41) @ 5600 MHz; Calibrated: 8/27/2018, ConvF(4.47, 4.47, 4.47) @ 5750 MHz; Calibrated: 8/27/2018,
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 2/6/2019
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

Dipole Calibration /Pin=100mW, d=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 70.41 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 33.3 W/kg
SAR(1 g) = 7.66 W/kg; SAR(10 g) = 2.18 W/kg
Maximum value of SAR (measured) = 18.1 W/kg

Dipole Calibration /Pin=100mW, d=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 61.17 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 38.8 W/kg
SAR(1 g) = 8.16 W/kg; SAR(10 g) = 2.29 W/kg
Maximum value of SAR (measured) = 21.0 W/kg

Dipole Calibration /Pin=100mW, d=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.86 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 38.0 W/kg
SAR(1 g) = 7.66 W/kg; SAR(10 g) = 2.15 W/kg
Maximum value of SAR (measured) = 19.2 W/kg

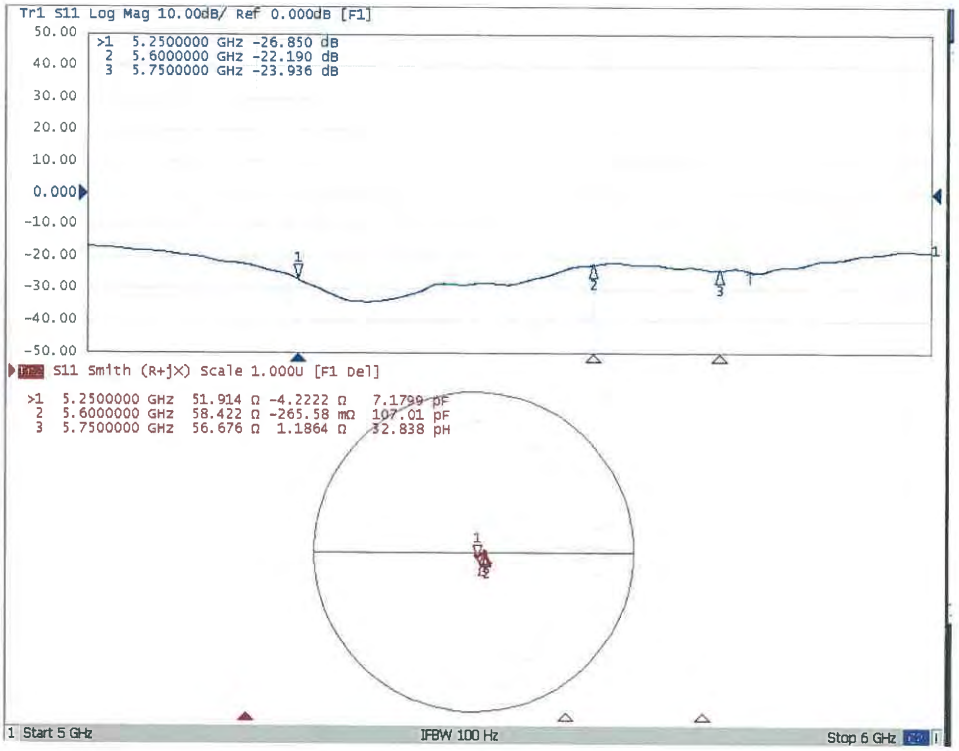
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0 dB = 19.2 W/kg = 12.83 dBW/kg

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Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL Date: 04.19.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1021

Communication System: CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz,

Medium parameters used: f = 5250 MHz; σ = 5.492 S/m; ε_r = 50.32; ρ = 1000 kg/m3, Medium parameters used: f = 5600 MHz; σ = 5.937 S/m; ε_r = 49.85; ρ = 1000 kg/m3, Medium parameters used: f = 5750 MHz; σ = 6.109 S/m; ε_r = 49.74; ρ = 1000 kg/m3,

Phantom section: Right Section

DASY5 Configuration:

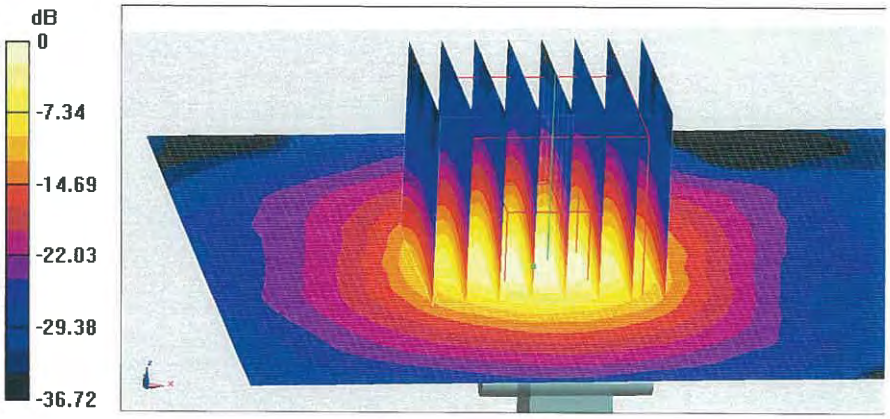
- Probe: EX3DV4 - SN7514; ConvF(4.54, 4.54, 4.54) @ 5250 MHz; Calibrated: 8/27/2018, ConvF(4, 4, 4) @ 5600 MHz; Calibrated: 8/27/2018, ConvF(3.98, 3.98, 3.98) @ 5750 MHz; Calibrated: 8/27/2018,
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 2/6/2019
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

Dipole Calibration /Pin=100mW, d=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 58.99 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 29.9 W/kg
SAR(1 g) = 7.39 W/kg; SAR(10 g) = 2.09 W/kg
Maximum value of SAR (measured) = 17.3 W/kg

Dipole Calibration /Pin=100mW, d=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 54.86 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 35.6 W/kg
SAR(1 g) = 7.65 W/kg; SAR(10 g) = 2.16 W/kg
Maximum value of SAR (measured) = 19.2 W/kg

Dipole Calibration /Pin=100mW, d=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 55.96 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 35.0 W/kg
SAR(1 g) = 7.41 W/kg; SAR(10 g) = 2.08 W/kg
Maximum value of SAR (measured) = 18.5 W/kg

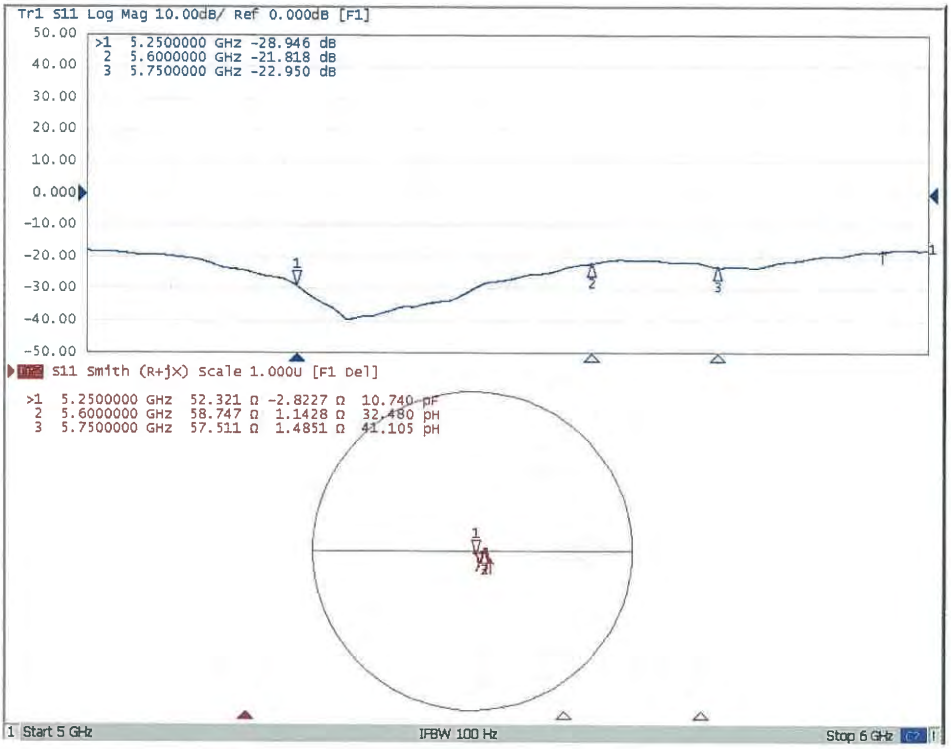
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0 dB = 18.5 W/kg = 12.67 dBW/kg

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Impedance Measurement Plot for Body TSL



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CALIBRATION
CNAS L0570

ST-007_Z0-071

Client ATL Certificate No: Z20-60164

CALIBRATION CERTIFICATE

Object D5GHzV2 - SN: 1021

Calibration Procedure(s) FF-Z11-003-01
Calibration Procedures for dipole validation kits

Calibration date: April 23, 2020

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)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	04-Sep-19 (CTTL, No.J19X07825)	Sep-20
Power sensor NRP8S	104291	04-Sep-19 (CTTL, No.J19X07825)	Sep-20
ReferenceProbe EX3DV4	SN 7307	24-May-19(SPEAG,No.EX3-7307_May19)	May-20
DAE4	SN 1555	22-Aug-19(CTTL-SPEAG,No.Z19-60295)	Aug-20
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
Signal Generator E4438C	MY49071430	25-Feb-20 (CTTL, No.J20X00516)	Feb-21
NetworkAnalyzerE5071C	MY46110673	10-Feb-20 (CTTL, No.J20X00515)	Feb-21

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: April 30, 2020

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

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Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
c) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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Measurement Conditions

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

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz	

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.9 ± 6 %	4.67 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.55 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**75.5 W/kg ± 24.4 % (*k*=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.14 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.4 W/kg ± 24.2 % (*k*=2)**

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Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.3 ± 6 %	5.05 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.97 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**79.6 W/kg ± 24.4 % (*k*=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.24 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.4 W/kg ± 24.2 % (*k*=2)**

Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.1 ± 6 %	5.21 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.62 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**76.0 W/kg ± 24.4 % (*k*=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.14 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.3 W/kg ± 24.2 % (*k*=2)**

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	52.9Ω - 3.93jΩ
Return Loss	- 26.5dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	56.8Ω + 0.21jΩ
Return Loss	- 23.9dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	55.6Ω + 2.86jΩ
Return Loss	- 24.5dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.067 ns

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

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

Additional EUT Data

Manufactured by	SPEAG

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DASY5 Validation Report for Head TSL Date: 04.23.2020

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1021

Communication System: CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz,

Medium parameters used: f = 5250 MHz; σ = 4.671 S/m; ε_r = 35.88; ρ = 1000 kg/m^3, Medium parameters used: f = 5600 MHz; σ = 5.048 S/m; ε_r = 35.28; ρ = 1000 kg/m^3, Medium parameters used: f = 5750 MHz; σ = 5.211 S/m; ε_r = 35.06; ρ = 1000 kg/m^3,

Phantom section: Center Section

DASY5 Configuration:

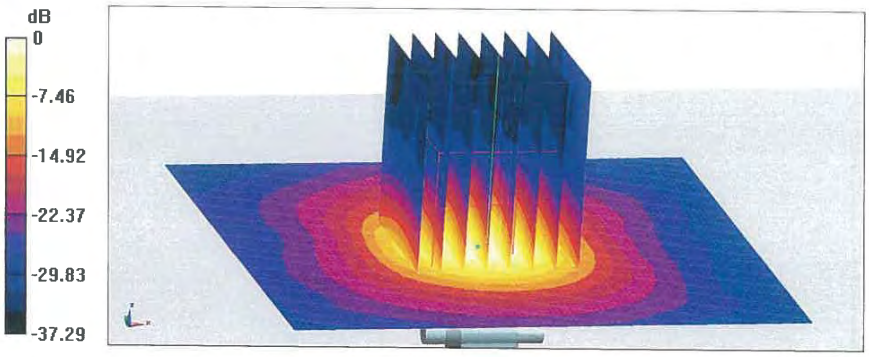
- Probe: EX3DV4 - SN7307; ConvF(5.61, 5.61, 5.61) @ 5250 MHz; ConvF(5.12, 5.12, 5.12) @ 5600 MHz; ConvF(5.15, 5.15, 5.15) @ 5750 MHz; Calibrated: 2019-05-24
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 2019-08-22
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Dipole Calibration /Pin=100mW, d=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 70.74 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 32.5 W/kg
SAR(1 g) = 7.55 W/kg; SAR(10 g) = 2.14 W/kg
Smallest distance from peaks to all points 3 dB below = 7.4 mm
Ratio of SAR at M2 to SAR at M1 = 63.5%
Maximum value of SAR (measured) = 18.6 W/kg

Dipole Calibration /Pin=100mW, d=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 70.28 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 37.3 W/kg
SAR(1 g) = 7.97 W/kg; SAR(10 g) = 2.24 W/kg
Smallest distance from peaks to all points 3 dB below = 7.4 mm
Ratio of SAR at M2 to SAR at M1 = 60.6%
Maximum value of SAR (measured) = 20.2 W/kg

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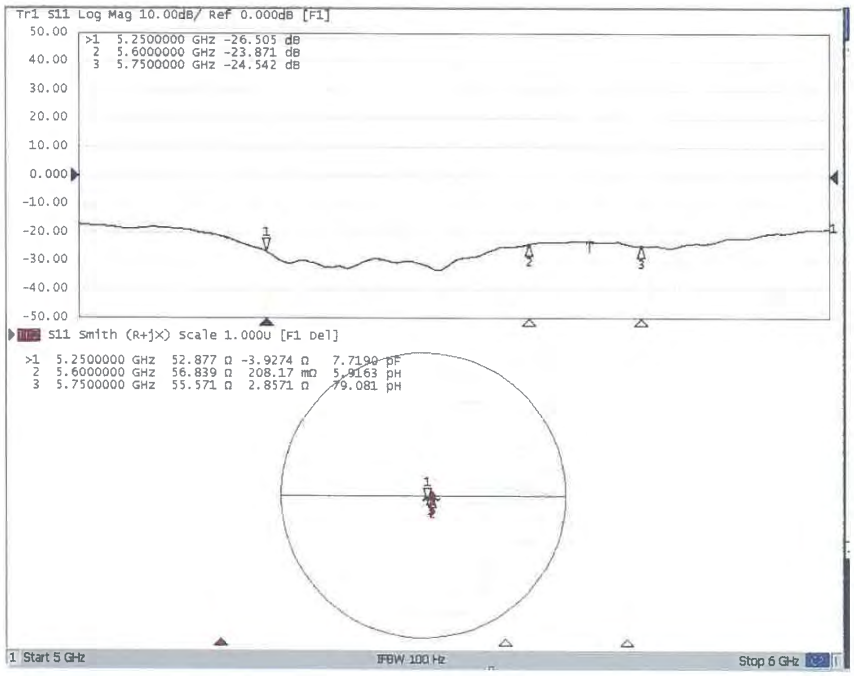
Dipole Calibration /Pin=100mW, d=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 68.29 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 36.8 W/kg
SAR(1 g) = 7.62 W/kg; SAR(10 g) = 2.14 W/kg
Smallest distance from peaks to all points 3 dB below = 7.4 mm
Ratio of SAR at M2 to SAR at M1 = 59.5%
Maximum value of SAR (measured) = 19.2 W/kg



0 dB = 19.2 W/kg = 12.83 dBW/kg

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Impedance Measurement Plot for Head TSL



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CNAS L0570

Client **Auden** **Certificate No: Z20-60167**

CALIBRATION CERTIFICAT

Object	EX3DV4 - SN : 7346
Calibration Procedure(s)	FF-Z11-004-01 Calibration Procedures for Dosimetric E-field Probes
Calibration date:	May 20, 2020

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)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	18-Jun-19(CTTL, No.J19X05125)	Jun-20
Power sensor NRP-Z91	101547	18-Jun-19(CTTL, No.J19X05125)	Jun-20
Power sensor NRP-Z91	101548	18-Jun-19(CTTL, No.J19X05125)	Jun-20
Reference 10dBAttenuator	18N50W-10dB	10-Feb-20(CTTL, No.J20X00525)	Feb-22
Reference 20dBAttenuator	18N50W-20dB	10-Feb-20(CTTL, No.J20X00526)	Feb-22
Reference Probe EX3DV4	SN 3617	30-Jan-20(SPEAG, No.EX3-3617_Jan20/2)	Jan-21
DAE4	SN 1556	4-Feb-20(SPEAG, No.DAE4-1556_Feb20)	Feb-21

Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
SignalGenerator MG3700A	6201052605	18-Jun-19(CTTL, No.J19X05127)	Jun-20
Network Analyzer E5071C	MY46110673	10-Feb-20(CTTL, No.J20X00515)	Feb-21

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: May 22, 2020

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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 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≤900MHz in TEM-cell; f>1800MHz: waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect 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 (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;VRx,y,z*:A,B,C 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≤800MHz) and inside waveguide using analytical field distributions based on power measurements for f >800MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty valued 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±50MHz to±100MHz.
- *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).

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DASY/EASY – Parameters of Probe: EX3DV4 – SN:7346

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (*k*=2)
Norm(μV/(V/m)²)[A]	0.43	0.50	0.50	±10.0%
DCP(mV)[B]	101.4	106.5	105.2	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (*k*=2)
0	CW	X	0.0	0.0	1.0	0.00	167.8	±3.1%
		Y	0.0	0.0	1.0		186.1	
		Z	0.0	0.0	1.0		190.4	

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 E²-field uncertainty inside TSL (see Page 4).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainly is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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DASY/EASY – Parameters of Probe: EX3DV4 – SN:7346

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)	Unct. (*k*=2)
750	41.9	0.89	10.29	10.29	10.29	0.40	0.75	±12.1%
835	41.5	0.90	9.91	9.91	9.91	0.15	1.35	±12.1%
900	41.5	0.97	9.90	9.90	9.90	0.17	1.27	±12.1%
1450	40.5	1.20	8.86	8.86	8.86	0.13	1.38	±12.1%
1750	40.1	1.37	8.52	8.52	8.52	0.60	0.69	±12.1%
1900	40.0	1.40	8.08	8.08	8.08	0.27	1.00	±12.1%
2000	40.0	1.40	8.20	8.20	8.20	0.25	1.06	±12.1%
2300	39.5	1.67	7.87	7.87	7.87	0.60	0.68	±12.1%
2450	39.2	1.80	7.66	7.66	7.66	0.56	0.73	±12.1%
2600	39.0	1.96	7.40	7.40	7.40	0.46	0.82	±12.1%
3300	38.2	2.71	7.09	7.09	7.09	0.46	0.92	±13.3%
3500	37.9	2.91	7.02	7.02	7.02	0.45	0.92	±13.3%
3700	37.7	3.12	6.79	6.79	6.79	0.45	0.98	±13.3%
3900	37.5	3.32	6.70	6.70	6.70	0.40	1.15	±13.3%
4100	37.2	3.53	6.67	6.67	6.67	0.40	1.20	±13.3%
4200	37.1	3.63	6.57	6.57	6.57	0.40	1.15	±13.3%
4400	36.9	3.84	6.40	6.40	6.40	0.40	1.20	±13.3%
4600	36.7	4.04	6.35	6.35	6.35	0.45	1.12	±13.3%
4800	36.4	4.25	6.29	6.29	6.29	0.45	1.25	±13.3%
4950	36.3	4.40	6.14	6.14	6.14	0.50	1.17	±13.3%
5250	35.9	4.71	5.38	5.38	5.38	0.45	1.30	±13.3%
5600	35.5	5.07	4.79	4.79	4.79	0.55	1.32	±13.3%
5750	35.4	5.22	4.84	4.84	4.84	0.50	1.47	±13.3%

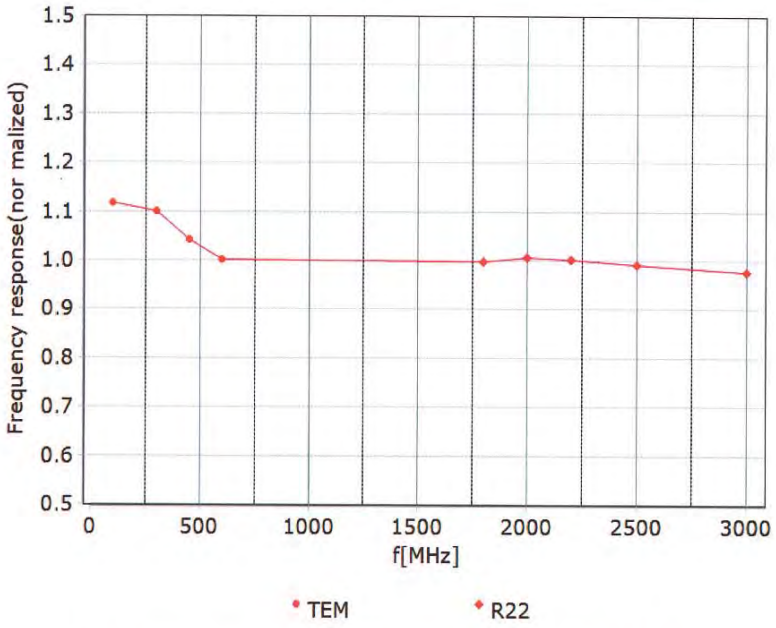
[C] Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 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 frequency 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 the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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

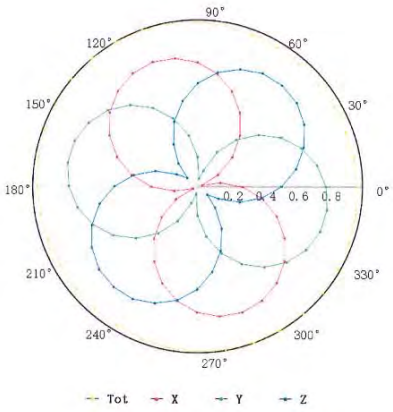


Uncertainty of Frequency Response of E-field: ±7.4% (*k*=2)

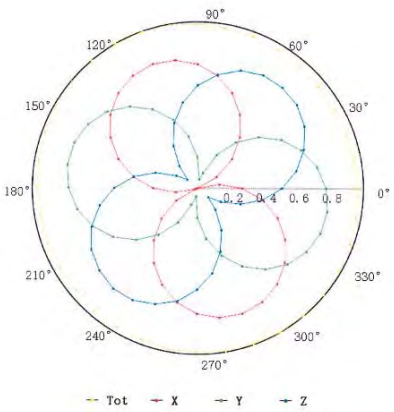
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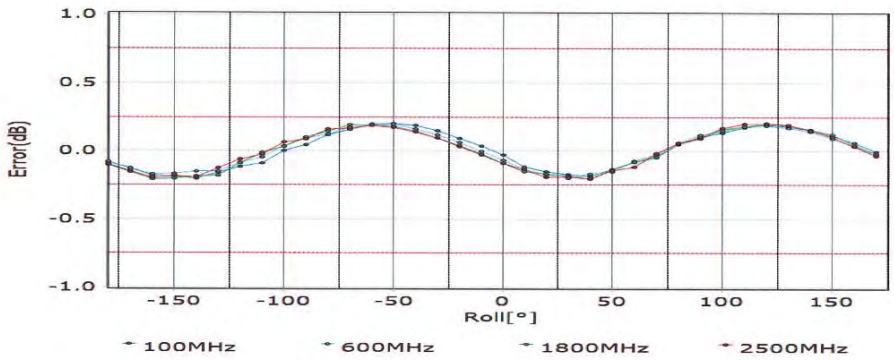
Receiving Pattern (Φ), θ=0°

f=600 MHz, TEM



f=1800 MHz, R22

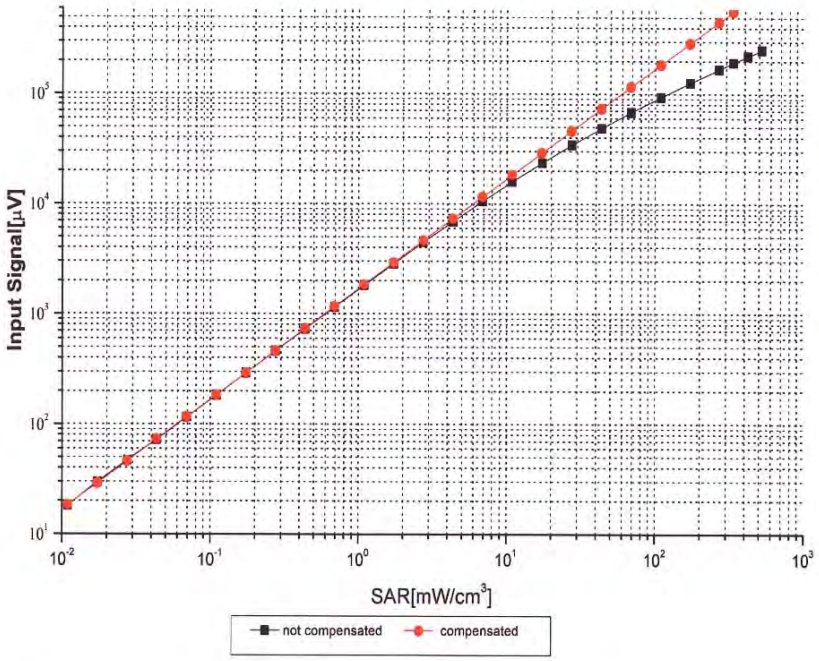


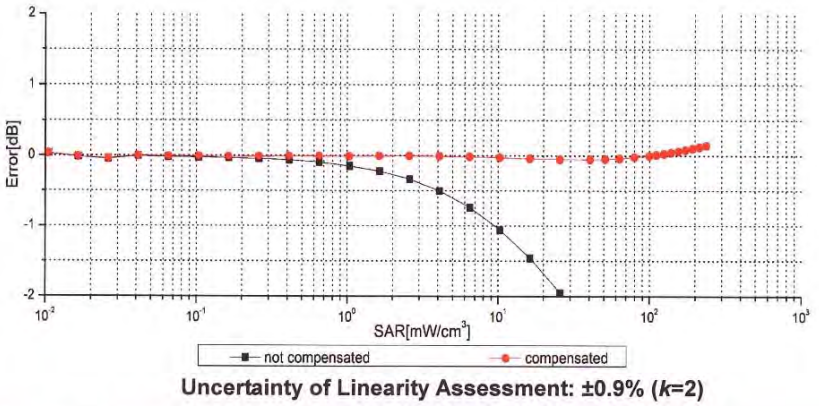


Uncertainty of Axial Isotropy Assessment: ±1.2% (*k*=2)

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Dynamic Range f(SAR$_{head}$)
(TEM cell, f = 900 MHz)



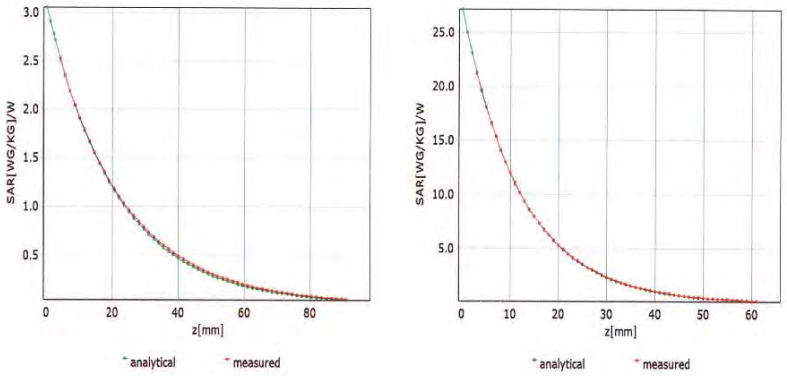


Uncertainty of Linearity Assessment: ±0.9% (*k*=2)

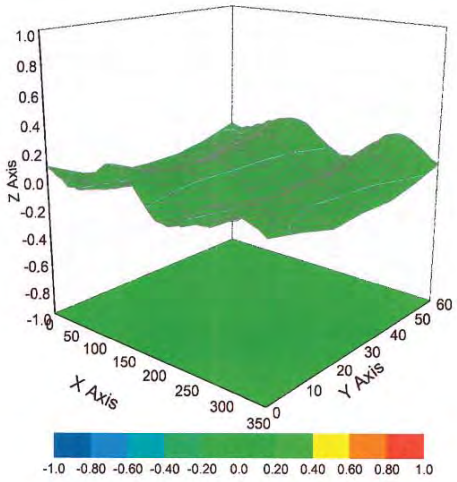
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Conversion Factor Assessment

f=750 MHz,WGLS R9(H_convF) **f=1750 MHz,WGLS R22(H_convF)**



Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: ±3.2% (*k*=2)

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DASY/EASY – Parameters of Probe: EX3DV4 – SN:7346

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	91.1
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	10mm
Tip Diameter	2.5mm
Probe Tip to Sensor X Calibration Point	1mm
Probe Tip to Sensor Y Calibration Point	1mm
Probe Tip to Sensor Z Calibration Point	1mm
Recommended Measurement Distance from Surface	1.4mm

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Client ATL Certificate No: Z19-60136

CALIBRATION CERTIFICATE

Object EX-042_19-119 EX3DV4 - SN:3847

Calibration Procedure(s) FF-Z11-004-01
Calibration Procedures for Dosimetric E-field Probes

Calibration date: May 16, 2019

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

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Power sensor NRP-Z91	101548	20-Jun-18 (CTTL, No.J18X05032)	Jun-19
Reference10dBAttenuator	18N50W-10dB	09-Feb-18(CTTL, No.J18X01133)	Feb-20
Reference20dBAttenuator	18N50W-20dB	09-Feb-18(CTTL, No.J18X01132)	Feb-20
Reference Probe EX3DV4	SN 7514	27-Aug-18(SPEAG,No.EX3-7514_Aug18/2)	Aug-19
DAE4	SN 1555	20-Aug-18(SPEAG, No.DAE4-1555_Aug18)	Aug -19
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
SignalGeneratorMG3700A	6201052605	21-Jun-18 (CTTL, No.J18X05033)	Jun-19
Network Analyzer E5071C	MY46110673	24-Jan-19 (CTTL, No.J19X00547)	Jan -20

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: May 18, 2019

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Glossary:

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- *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.
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- *Ax,y,z; Bx,y,z; Cx,y,z; VRx,y,z:* A,B,C 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≤800MHz) and inside waveguide using analytical field distributions based on power measurements for f >800MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty valued 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±50MHz to±100MHz.
- *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).

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Probe EX3DV4

SN: 3847

Calibrated: May 16, 2019

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3847

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm(μV/(V/m)^2)^A	0.55	0.50	0.44	±10.0%
DCP(mV)^B	98.3	99.1	102.0	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	176.8	±2.2%
		Y	0.0	0.0	1.0		168.2	
		Z	0.0	0.0	1.0		156.2	

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 Page 5 and Page 6).
^{B} Numerical linearization parameter: uncertainty not required.
^{E} Uncertainly is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3847

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)	Unct. (k=2)
750	41.9	0.89	9.67	9.67	9.67	0.17	1.19	±12.1%
835	41.5	0.90	9.35	9.35	9.35	0.16	1.18	±12.1%
900	41.5	0.97	9.29	9.29	9.29	0.17	1.17	±12.1%
1750	40.1	1.37	8.15	8.15	8.15	0.26	1.02	±12.1%
1900	40.0	1.40	7.72	7.72	7.72	0.29	0.93	±12.1%
2000	40.0	1.40	7.93	7.93	7.93	0.24	1.18	±12.1%
2300	39.5	1.67	7.52	7.52	7.52	0.59	0.72	±12.1%
2450	39.2	1.80	7.14	7.14	7.14	0.61	0.72	±12.1%
2600	39.0	1.96	7.11	7.11	7.11	0.69	0.69	±12.1%
3500	37.9	2.91	6.61	6.61	6.61	0.60	1.05	±13.3%
3700	37.7	3.12	6.51	6.51	6.51	0.60	0.90	±13.3%
5250	35.9	4.71	5.22	5.22	5.22	0.50	1.30	±13.3%
5600	35.5	5.07	4.68	4.68	4.68	0.55	1.22	±13.3%
5750	35.4	5.22	4.66	4.66	4.66	0.55	1.25	±13.3%

[C] Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of 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 frequency 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 the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3847

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)	Unct. (k=2)
750	55.5	0.96	9.58	9.58	9.58	0.40	0.80	±12.1%
835	55.2	0.97	9.33	9.33	9.33	0.17	1.42	±12.1%
900	55.0	1.05	9.30	9.30	9.30	0.26	1.16	±12.1%
1750	53.4	1.49	7.84	7.84	7.84	0.23	1.13	±12.1%
1900	53.3	1.52	7.61	7.61	7.61	0.23	1.12	±12.1%
2000	53.3	1.52	7.56	7.56	7.56	0.24	1.17	±12.1%
2300	52.9	1.81	7.41	7.41	7.41	0.58	0.80	±12.1%
2450	52.7	1.95	7.37	7.37	7.37	0.68	0.72	±12.1%
2600	52.5	2.16	7.20	7.20	7.20	0.68	0.70	±12.1%
3500	51.3	3.31	6.47	6.47	6.47	0.55	1.03	±13.3%
3700	51.0	3.55	6.35	6.35	6.35	0.55	0.98	±13.3%
5250	48.9	5.36	4.80	4.80	4.80	0.50	1.46	±13.3%
5600	48.5	5.77	4.11	4.11	4.11	0.55	1.60	±13.3%
5750	48.3	5.94	4.15	4.15	4.15	0.55	1.45	±13.3%

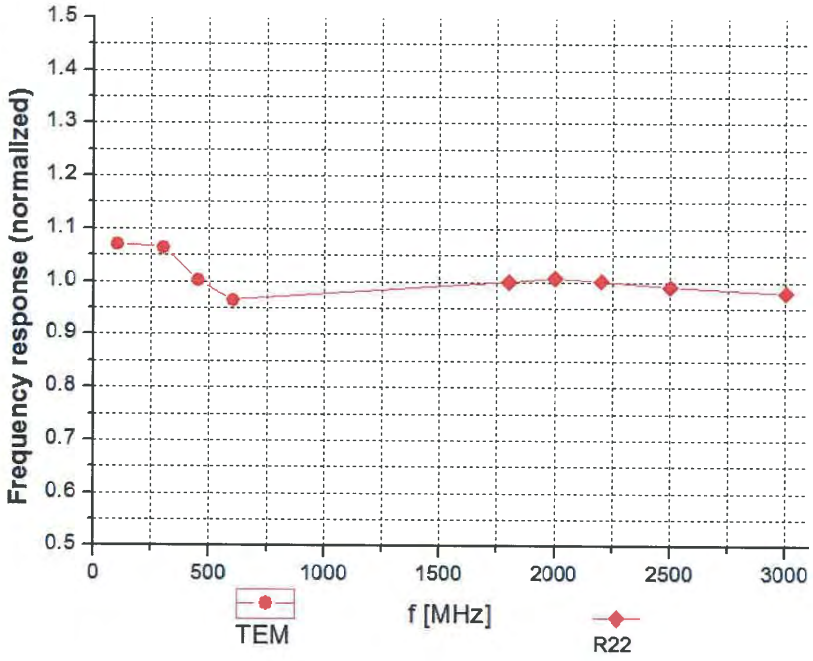
[C] Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 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 frequency 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 the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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

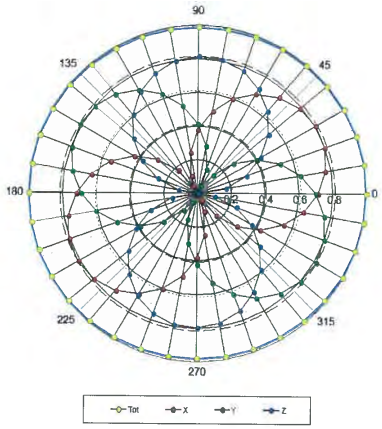


Uncertainty of Frequency Response of E-field: ±7.4% (k=2)

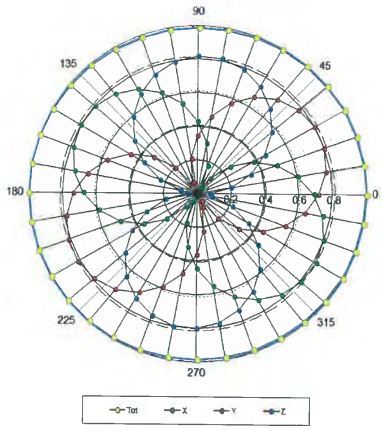
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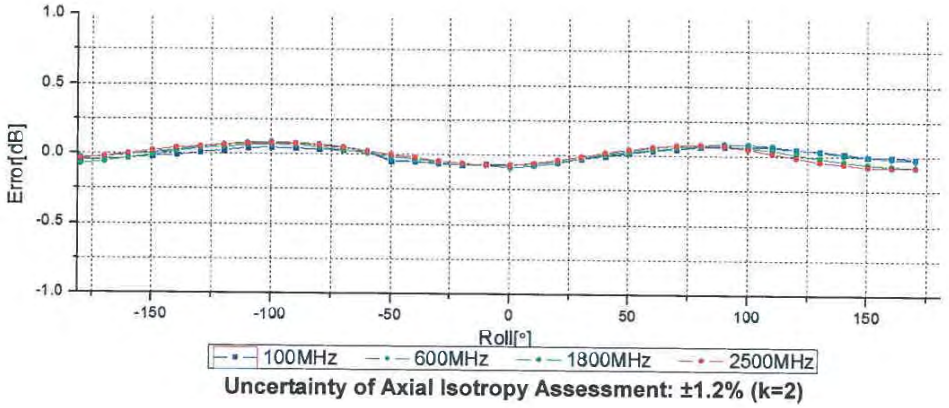
Receiving Pattern (Φ), θ=0°

f=600 MHz, TEM



f=1800 MHz, R22

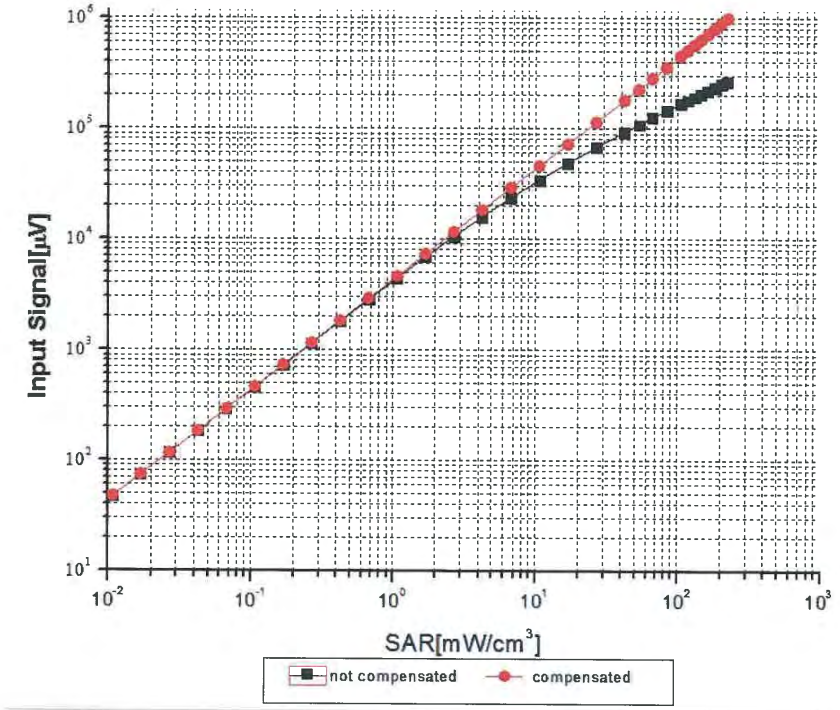


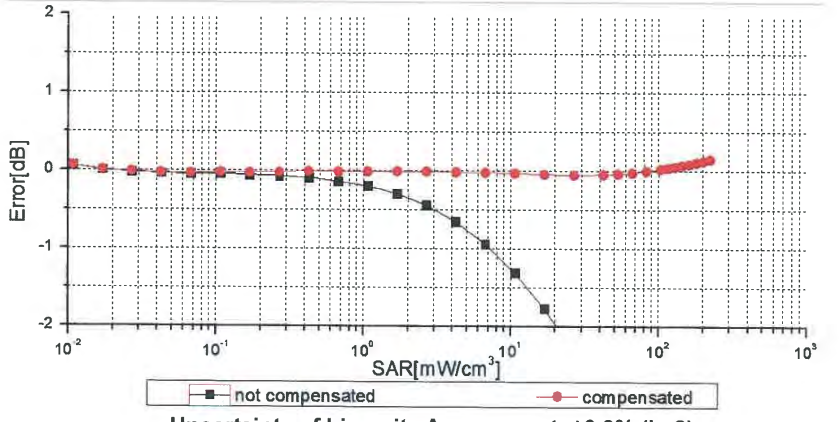


Uncertainty of Axial Isotropy Assessment: ±1.2% (k=2)

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Dynamic Range f(SAR_{head})
(TEM cell, f = 900 MHz)



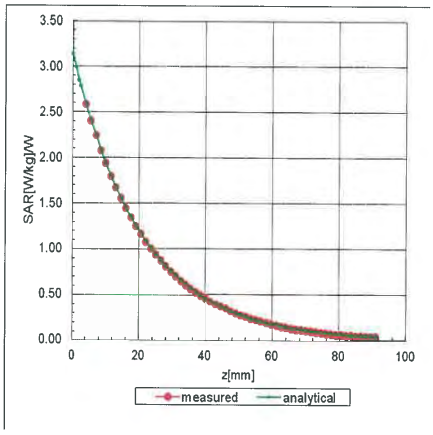


Uncertainty of Linearity Assessment: ±0.9% (k=2)

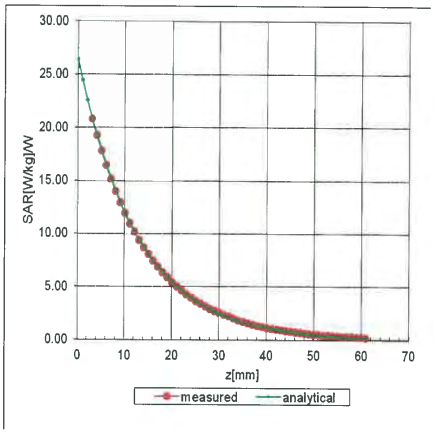
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Conversion Factor Assessment

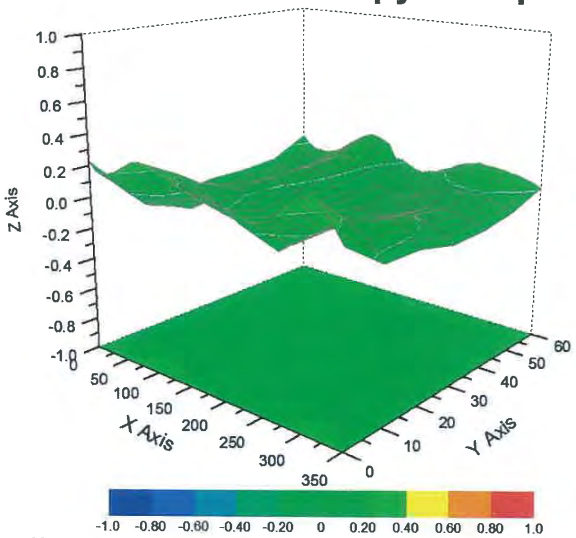
f=750 MHz, WGLS R9(H_convF)



f=1750 MHz, WGLS R22(H_convF)



Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: ±3.2% (K=2)

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3847

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	101.2
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	9mm
Tip Diameter	2.5mm
Probe Tip to Sensor X Calibration Point	1mm
Probe Tip to Sensor Y Calibration Point	1mm
Probe Tip to Sensor Z Calibration Point	1mm
Recommended Measurement Distance from Surface	1.4mm

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Client : ATL Certificate No: Z19-60080

CALIBRATION CERTIFICATE

Object	DAE4 - SN: 541
Calibration Procedure(s)	FF-Z11-002-01 Calibration Procedure for the Data Acquisition Electronics (DAEx)
Calibration date:	March 19, 2019

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Process Calibrator 753	1971018	20-Jun-18 (CTTL, No.J18X05034)	June-19

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: March 20, 2019

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

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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 report provide only calibration results for DAE, it does not contain other performance test results.

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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	404.544 ± 0.15% (k=2)	404.406 ± 0.15% (k=2)	404.170 ± 0.15% (k=2)
Low Range	3.96863 ± 0.7% (k=2)	3.93444 ± 0.7% (k=2)	3.97515 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	288.5° ± 1 °

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校准
CALIBRATION
CNAS L0570

Client : **Auden** **Certificate No: Z20-60151**

CALIBRATION CERTIFICATE

Object	DAE4 - SN: 913
Calibration Procedure(s)	FF-Z11-002-01 Calibration Procedure for the Data Acquisition Electronics (DAEx)
Calibration date:	May 06, 2020

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)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Process Calibrator 753	1971018	24-Jun-19 (CTTL, No.J19X05126)	Jun-20

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: May 08, 2020

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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 report provide only calibration results for DAE, it does not contain other performance test results.

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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	404.004 ± 0.15% (k=2)	404.403 ± 0.15% (k=2)	404.962 ± 0.15% (k=2)
Low Range	3.98604 ± 0.7% (k=2)	3.99421 ± 0.7% (k=2)	4.01919 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	184° ± 1 °

---- END ----