SAR Report

Applicant	:	Edimax Technology Co., Ltd.
Applicant Address	:	No.278, Xinhu 1st Rd., Neihu Dist., Taipei City, Taiwan
Product Type	:	11ac 2T2R Wireless Dual-Band USB Adapter
Trade Name	:	EDIMAX
Model Number	:	EW-7822UAC V2.0A, EW-7822UAD
Applicable Standard	:	IEEE Std. 1528-2013
		ANSI/IEEE C95.1
		47 CFR Part §2.1093
Received Date	:	Aug. 06, 2020
Test Period	:	Sep. 29 ~ Oct. 04, 2020
Issued Date	:	Nov. 02, 2020

Issued by

Approved By : Kris Pan

(Kris Pan)

A Test Lab Techno Corp.
No. 140-1, Changan Street, Bade District,
Taoyuan City 33465, Taiwan (R.O.C.)
Tel：+886-3-2710188 / Fax：+886-3-2710190

Taiwan Accreditation Foundation accreditation number: 1330
Test Firm MRA designation number: TW0010

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.	Issued Date	Revisions	Revised By
00	Nov. 02, 2020	Initial Issue	Nicole Chu

Contents

1. General Information

1.1 Reference Applicable Standard

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
ANSI/IEEE C95.1	American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 300 KHz to 100 GHz, New York.	1992
47 CFR Part §2.1093	Radiofrequency radiation exposure evaluation: portable devices.	-
KDB 248227 D01	SAR guidance for IEEE 802.11 (Wi-Fi) transmitters	v02r02
KDB 447498 D01	RF exposure procedures and equipment authorization policies for mobile and portable devices	v06
KDB 447498 D02	SAR measurement procedures for usb dongle transmitters	v02r01
KDB 865664 D01	SAR measurement requirement for 100 MHz to 6 GHz.	v01r04
KDB 865664 D02	RF exposure compliance reporting and documentation considerations.	v01r02

1.2 Test Site Environment

Items	Required (IEEE 1528-2013)	Actual
Temperature (°C)	18-25	21-23

2. *Summary of Maximum Reported SAR Value*

Equipment Class	Mode	Highest Reported 1g SAR (W/kg)
		Body standalone SAR $_{1\,g}$(W/kg)
DTS	WLAN2.4GHz Ant A	0.81
	WLAN2.4GHz Ant B	0.74
U-NII	WLAN5GHz Ant A	0.71
	WLAN5GHz Ant B	0.77
Highest Simultaneous Transmission SAR		Highest Simultaneous Transmission 1g SAR (W/kg)
Bottom of laptop at 0mm		**1.58**

Note:
The SAR limit (Head & Body: SAR1g 1.6 W/kg) for general population / uncontrolled exposure is specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992.

3. Description of Equipment under Test (EUT)

<table>
<tr><td>Applicant</td><td colspan="2">Edimax Technology Co., Ltd.
No.278, Xinhu 1st Rd., Neihu Dist., Taipei City, Taiwan</td></tr>
<tr><td>Manufacturer</td><td colspan="2">Edimax Technology Co., Ltd.
No.278, Xinhu 1st Rd., Neihu Dist., Taipei City, Taiwan</td></tr>
<tr><td>Product Type</td><td colspan="2">11ac 2T2R Wireless Dual-Band USB Adapter</td></tr>
<tr><td>Trade Name</td><td colspan="2">EDIMAX</td></tr>
<tr><td>Model Number</td><td colspan="2">EW-7822UAC V2.0A, EW-7822UAD</td></tr>
<tr><td>FCC ID</td><td colspan="2">NDD9578222003</td></tr>
<tr><td rowspan="12">RF Function</td><td>Operate Bands</td><td>Operate Frequency (MHz)</td></tr>
<tr><td>IEEE 802.11b / 802.11g / 802.11n 2.4 GHz 20 MHz</td><td>2412 - 2462</td></tr>
<tr><td>IEEE 802.11n 2.4 GHz 40 MHz</td><td>2422 - 2452</td></tr>
<tr><td rowspan="2">IEEE 802.11a</td><td>5180 - 5240</td></tr>
<tr><td>5745 - 5825</td></tr>
<tr><td rowspan="2">IEEE 802.11n 5 GHz / 802.11ac 20 MHz</td><td>5180 - 5240</td></tr>
<tr><td>5745 - 5825</td></tr>
<tr><td rowspan="2">IEEE 802.11n 5 GHz / 802.11ac 40 MHz</td><td>5190 - 5230</td></tr>
<tr><td>5755 - 5795</td></tr>
<tr><td rowspan="2">IEEE 802.11ac 80 MHz</td><td>5210</td></tr>
<tr><td>5775</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td>Device Category</td><td colspan="2">Portable Device</td></tr>
<tr><td>Application Type</td><td colspan="2">Certification</td></tr>
</table>

Note:

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. When the antenna is built-in within the housing of a dongle, a swivel or rotating connector may allow the antenna to assume different positions.We evaluated the worst condition and obtained FCC approval and guidance testing.

Antenna list：

<table>
<tr><td colspan="2">Antenna Source</td><td>Model Name</td><td>Type</td><td>Frequency</td><td>Max. Gain (dBi)</td></tr>
<tr><td rowspan="6">1</td><td rowspan="3">ANT-1</td><td rowspan="3">GY121HT632-003</td><td rowspan="3">Dipole antenna</td><td>2402 - 2480</td><td>1.32</td></tr>
<tr><td>5150 - 5250</td><td>2.80</td></tr>
<tr><td>5725 - 5850</td><td>2.54</td></tr>
<tr><td rowspan="3">ANT-2</td><td rowspan="3">GY121HT632-003</td><td rowspan="3">Dipole antenna</td><td>2402 - 2480</td><td>2.09</td></tr>
<tr><td>5150 - 5250</td><td>2.26</td></tr>
<tr><td>5725 - 5850</td><td>4.37</td></tr>
</table>

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 American National Standards, Institute C95.1-1999〔1〕were employed and they specify the maximum exposure limit of 1.6 W/kg as averaged over any 1 gram of tissue for portable devices being used within 20 cm between user and EUT in the uncontrolled environment. A description of the product and operating configuration, detailed summary of the test results, methodology and procedures used in the equipment used are included within this test report.

4.1 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 :

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

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

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

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

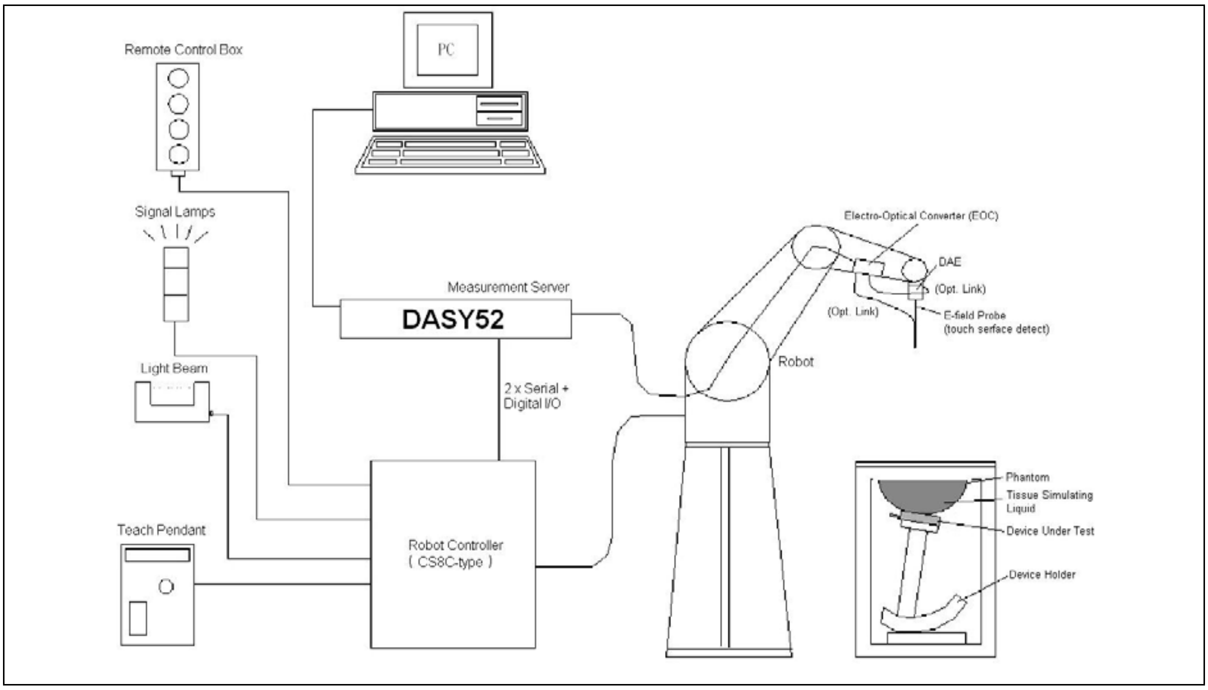
Where：

σ = conductivity of the tissue (S/m)

ρ = mass density of the tissue (kg/m3)

E = RMS electric field strength (V/m)

5. 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. An isotropic field probe optimized and calibrated for the targeted measurements.
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 Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
5. 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.
6. The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
7. A computer running Win7/Win8 professional operating system and the cDASY6 and DASY5 V5.2 software.
8. Remote controls with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
9. The phantom, the device holder and other accessories according to the targeted measurement.
10. Tissue simulating liquid mixed according to the given recipes.
11. The validation dipole has been calibrated within and the system performance check has been successful.

5.1 DASY E-Field Probe System

The SAR measurements were conducted with the dosimetric probe (manufactured by SPEAG), designed in the classical triangular configuration〔3〕and optimized for dosimetric evaluation. The probes is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multi-fiber line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting. The approach is stopped when reaching the maximum.

5.1.1 E-Field Probe Specification

Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Frequency	10 MHz to > 6 GHz Linearity: ± 0.2 dB (30 MHz to 6 GHz)
Directivity	±0.3 dB in brain tissue (rotation around probe axis) ±0.5 dB in brain tissue (rotation normal probe axis)
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm
Calibration	ISO/IEC 17025 calibration service available

	
EX3DV4 E-Field Probe	**Probe setup on robot**

5.2 Data Acquisition Electronic (DAE) System

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

5.3 Robot

Positioner	Stäubli Unimation Corp.
Robot Model	TX90XL
Number of Axes	6
Norminal Load	5 kg
Reach	1450 mm
Repeatability	$\pm$ 0.035 mm

5.4 Device Holder

The DASY device holder is constructed of low-loss POM material having the following dielectric parameters: relative permittivity ε=3 and loss tangent δ=0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

	
Device Holder 1	Device Holder 2

5.5 Oval Flat Phantom - ELI

The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (Oval Flat) phantom defined in IEEE 1528-2013, CENELEC 50361 and IEC 62209-2. It enables the dosimetric evaluation of wireless portable device usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points with the robot.

Shell Thickness	2 ±0.2 mm
Filling Volume	Approx. 30 liters
Dimensions	190×600×400 mm (H×L×W)

Table 1. Specification of ELI

6. *Tissue Simulating Liquids*

IEEE SCC-34/SC-2 in 1528 recommended Tissue Dielectric Parameters

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in 1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in human head. Other head and body tissue parameters that have not been specified in 1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equation and extrapolated according to the head parameter specified in 1528.

Target Frequency	Head		Body	
(MHz)	εr	σ (S/m)	εr	σ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 - 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00
(εr = relative permittivity, σ = conductivity and ρ = 1000 kg/m^3)				

Table 2. Tissue dielectric parameters for head and body phantoms

6.1 The composition of the tissue simulating liquid

Ingredients (% by weight)	Frequency (MHz)												Frequency (GHz)	
	750		835		1750		1900		2450		2600		5 GHz	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	39.28	51.30	41.45	52.40	54.50	40.20	54.90	40.40	62.70	73.20	60.30	71.40	65.5	78.6
Salt (NaCl)	1.47	1.42	1.45	1.50	0.17	0.49	0.18	0.50	0.50	0.10	0.60	0.20	0.00	0.00
Sugar	58.15	46.18	56.00	45.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HEC	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bactericide	0.10	0.10	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Triton X-100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.2	10.7
DGBE	0.00	0.00	0.00	0.00	45.33	59.31	44.92	59.10	36.80	26.70	39.10	28.40	0.00	0.00
Diethylene Glycol Mono-hexlether	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.3	10.7
Dielectric Constant	41.88	54.60	42.54	56.10	40.10	53.60	39.90	54.00	39.80	52.50	39.80	52.50	35.1~ 36.2	47.9~ 49.3
Conductivity (S/m)	0.90	0.97	0.91	0.95	1.39	1.49	1.42	1.45	1.88	1.78	1.88	1.78	4.45~ 5.48	5.07~ 6.23

6.2 Liquid Parameters

1. The dielectric parameters of the liquids were verified prior to the SAR evaluation using an DAKS 3.5 Probe Kit.
2. The SAR testing with IEC tissue parameters as an alternative option to Head and body parameters. We used head TSL for body SAR tests. There are some limitations though:

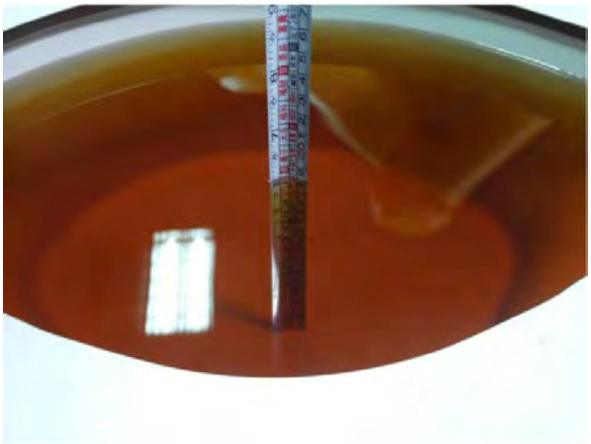
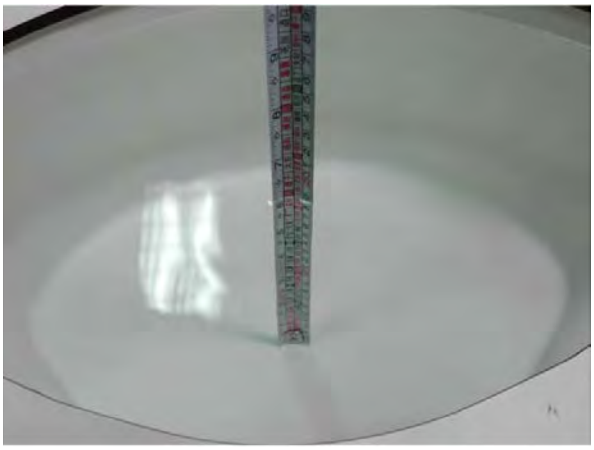
(a) The mixing and matching of head TSL and body TSL for body SAR testing in a single application are not permitted. For example, we cannot start testing body SAR with head TSL and then switch to testing Body SAR with Body TSL.

(b) The TSL used for body SAR testing can be changed via a Permissive Change. However, if the body SAR increases and the original Body SAR was > 1.2 W/kg, additional SAR measurements may be required.

Tissue Temp (°C)	Liquid Type	Frequency (MHz)	Cond.	Perm.	target Cond.	target Perm.	σ (Delta) (%)	εr (Delta) (%)	Limit (%)	Date
			σ	εr	σ	εr				
22.1	Head	5180 MHz	4.56	37.229	4.64	36.02	-1.63	3.36	±5	Sep. 29, 2020
22.1	Head	5190 MHz	4.58	37.195	4.65	36.01	-1.60	3.29	±5	Sep. 29, 2020
22.1	Head	5200 MHz	4.59	37.142	4.66	36.00	-1.49	3.17	±5	Sep. 29, 2020
22.1	Head	5220 MHz	4.62	37.083	4.68	35.98	-1.20	3.06	±5	Sep. 29, 2020
22.1	Head	5230 MHz	4.64	37.059	4.69	35.97	-1.04	3.03	±5	Sep. 29, 2020
22.1	Head	5240 MHz	4.65	37.031	4.70	35.96	-1.09	2.98	±5	Sep. 29, 2020
22.1	Head	5250 MHz	4.66	37.026	4.71	35.95	-1.10	2.99	±5	Sep. 29, 2020
22.1	Head	5745 MHz	5.29	35.984	5.22	35.36	1.35	1.76	±5	Sep. 29, 2020
22.1	Head	5755 MHz	5.27	36.028	5.23	35.35	0.91	1.92	±5	Sep. 29, 2020
22.1	Head	5775 MHz	5.24	36.070	5.25	35.33	-0.06	2.09	±5	Sep. 29, 2020
22.1	Head	5785 MHz	5.23	36.061	5.26	35.32	-0.40	2.10	±5	Sep. 29, 2020
22.1	Head	5795 MHz	5.23	36.063	5.27	35.31	-0.61	2.13	±5	Sep. 29, 2020
22.1	Head	5825 MHz	5.24	35.939	5.30	35.28	-1.04	1.87	±5	Sep. 29, 2020
22.6	Head	2412 MHz	1.81	39.617	1.77	39.27	2.47	0.88	±5	Oct. 04, 2020
22.6	Head	2422 MHz	1.82	39.577	1.78	39.25	2.57	0.83	±5	Oct. 04, 2020
22.6	Head	2437 MHz	1.84	39.529	1.79	39.22	2.74	0.79	±5	Oct. 04, 2020
22.6	Head	2452 MHz	1.85	39.484	1.80	39.20	2.79	0.72	±5	Oct. 04, 2020
22.6	Head	2462 MHz	1.86	39.444	1.81	39.18	2.73	0.67	±5	Oct. 04, 2020
22.6	Head	2467 MHz	1.87	39.425	1.82	39.18	2.75	0.63	±5	Oct. 04, 2020
22.6	Head	2472 MHz	1.87	39.409	1.82	39.17	2.76	0.61	±5	Oct. 04, 2020

6.3 Liquid Depth

According to KDB865664, the depth of tissue-equivalent liquid in a phantom must be ≥ 15.0 cm. Which is shown in Figure 7 & 8.

	
Liquid Height for Body SAR (Low Freq.)	Liquid Height for Body SAR (High Freq.)

7. SAR Testing with RF Transmitters

7.1 SAR Testing with WLAN

SAR test reduction for 802.11 Wi-Fi transmission mode configurations are considered separately for DSSS and OFDM. An initial test position is determined to reduce the number of tests required for certain exposure configurations with multiple test positions. An initial test configuration is determined for each frequency band and aggregated band according to maximum output power, channel bandwidth, wireless mode configurations and other operating parameters to streamline the measurement requirements. For 2.4 GHz DSSS, either the initial test position or DSSS procedure is applied to reduce the number of SAR tests; these are mutually exclusive. For OFDM, an initial test position is only applicable to next to the ear, UMPC mini-tablet and hotspot mode configurations, which is tested using the initial test configuration to facilitate test reduction. For other exposure conditions with a fixed test position, SAR test reduction is determined using only the initial test configuration.

The multiple test positions require SAR measurements in head, hotspot mode or UMPC mini-tablet configurations may be reduced according to the highest reported SAR determined using the initial test position(s) by applying the DSSS or OFDM SAR measurement procedures in the required wireless mode test configuration(s). The initial test position(s) is measured using the highest measured maximum output power channel in the required wireless mode test configuration(s). When the reported SAR for the initial test position is:

- ≤ 0.4 W/kg, further SAR measurement is not required for the other test positions in that exposure configuration and wireless mode combination within the frequency band or aggregated band. DSSS and OFDM configurations are considered separately according to the required SAR procedures.
- > 0.4 W/kg, SAR is repeated using the same wireless mode test configuration tested in the initial test position to measure the subsequent next closet/smallest test separation distance and maximum coupling test position, on the highest maximum output power channel, until the reported SAR is ≤ 0.8 W/kg or all required test positions are tested.
  - For subsequent test positions with equivalent test separation distance or when exposure is dominated by coupling conditions, the position for maximum coupling condition should be tested.
  - When it is unclear, all equivalent conditions must be tested.

- For all positions/configurations tested using the initial test position and subsequent test positions, when the reported SAR is > 0.8 W/kg, measure the SAR for these positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required test channels are considered.
  - The additional power measurements required for this step should be limited to those necessary for identifying subsequent highest output power channels to apply the test reduction.

- When the specified maximum output power is the same for both UNII 1 and UNII 2A, begin SAR measurements in UNII 2A with the channel with the highest measured output power. If the reported SAR for UNII 2A is ≤ 1.2 W/kg, SAR is not required for UNII 1; otherwise treat the remaining bands separately and test them independently for SAR.
- When the specified maximum output power is different between UNII 1 and UNII 2A, begin SAR with the band that has the higher specified maximum output. If the highest reported SAR for the band with the highest specified power is ≤ 1.2 W/kg, testing for the band with the lower specified output power is not required; otherwise test the remaining bands independently for SAR.

To determine the initial test position, Area Scans were performed to determine the position with the Maximum Value of SAR (measured). The position that produced the highest Maximum Value of SAR is considered the worst case position; thus used as the initial test position.

7.2 Conducted Power Measurements

§15.247 (2.4 GHz)						
Mode	Channel	Frequency (MHz)	MAIN		AUX	
			Average power (dBm)	Tune-Up Limit	Average power (dBm)	Tune-Up Limit
802.11b 1Mbps	1	2412	17.02	18.00	---	---
	6	2437	17.21	18.00	---	---
	11	2462	16.80	18.00	---	---
802.11g 6Mbps	1	2412	16.72	17.00	---	---
	6	2437	18.94	19.00	---	---
	11	2462	16.51	17.00	---	---
802.11n-HT20 MCS0	1	2412	13.04	14.00	14.44	15.00
	6	2437	16.72	17.00	18.54	19.00
	11	2462	12.72	13.00	14.32	15.00
802.11n-HT40 MCS0	1	2412	12.75	13.00	14.14	15.00
	6	2437	13.22	14.00	14.64	15.00
	11	2462	12.04	13.00	13.62	14.00

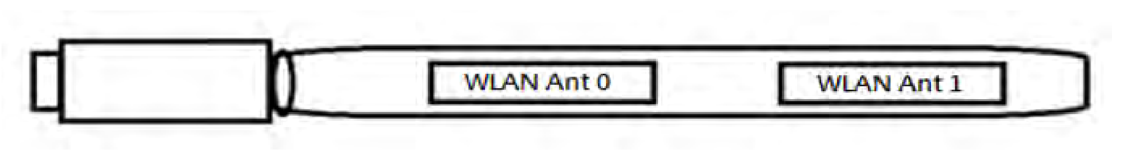
1. As per FCC OET KDB 248227 D01, conducted output power and SAR testing are not required for 802.11g/n20/n40/ax channels when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2W/kg.
2. When the reported SAR of the initial test configuration is > 0.8 W/kg, SAR measurement is required for subsequent next highest measured output power channel(s) in the initial test configuration until reported SAR is ≤ 1.2 W/kg or all required channels are tested.

U-NII-1						
Mode	Channel	Frequency (MHz)	MAIN		AUX	
			Average power (dBm)	Tune-Up Limit	Average power (dBm)	Tune-Up Limit
802.11a 6Mbps	36	5180	10.18	10.50	---	---
	40	5200	10.07	10.50	---	---
	44	5220	10.02	10.50	---	---
	48	5240	10.12	10.50	---	---
802.11n-HT20 MCS0	36	5180	10.02	10.50	14.45	15.00
	40	5200	10.15	10.50	14.32	15.00
	44	5220	9.93	10.50	14.17	15.00
	48	5240	9.86	10.50	14.13	15.00
802.11n-HT40 MCS0	38	5190	10.20	10.50	14.26	15.00
	46	5230	9.98	10.50	14.49	15.00
802.11ac-VHT20 MCS0	36	5180	10.04	10.50	14.54	15.00
	40	5200	10.17	10.50	14.34	15.00
	44	5220	10.05	10.50	14.28	15.00
	48	5240	9.92	10.50	14.23	15.00
802.11ac-VHT40 MCS0	38	5190	10.27	10.50	14.31	15.00
	46	5230	10.09	10.50	14.62	15.00
802.11ac-VHT80 MCS0	42	5210	10.31	10.50	13.91	14.50

U-NII-3/§15.247 (5.8 GHz)						
Mode	Channel	Frequency (MHz)	MAIN		AUX	
			Average power (dBm)	Tune-Up Limit	Average power (dBm)	Tune-Up Limit
802.11a MCS0	149	5745	10.08	11.00	---	---
	157	5785	10.06	11.00	---	---
	165	5825	10.03	11.00	---	---
802.11n-HT20 MCS0	149	5745	10.03	11.00	9.38	10.50
	157	5785	9.82	11.00	9.29	10.50
	165	5825	10.16	11.00	9.22	10.50
802.11n-HT40 MCS0	151	5755	10.03	11.00	9.42	10.50
	159	5795	9.93	11.00	9.26	10.50
802.11ac-VHT20 MCS0	149	5745	10.13	11.00	9.47	10.50
	157	5785	9.86	11.00	9.34	10.50
	165	5825	10.26	11.00	9.28	10.50
802.11ac-VHT40 MCS0	151	5755	10.07	11.00	9.48	10.50
	159	5795	10.01	11.00	9.37	10.50
802.11ac-VHT80 MCS0	155	5775	10.47	11.00	9.88	10.50

1. Additional conducted power measurement is required when reported SAR is > 1.2W/kg. In case the subsequent test configuration and the channel bandwidth is smaller than the initial test configuration, all channels that overlap with the larger channel bandwidth in the initial configuration should be tested.
2. The initial test configuration for 2.4 GHz and 5 GHz OFDM transmission modes is determined by the 802.11 configuration with the highest maximum output power specified for production units, including tune-up tolerance, in each standalone and aggregated frequency band. SAR for the initial test configuration is measured using the highest maximum output power channel determined by the default power measurement procedures. When multiple transmission modes (802.11a/g/n/ac/ax) have the same specified maximum output power, largest channel bandwidth, lowest order modulation and lowest data rate, lowest order 802.11 mode is selected (i.e. a, g, n, ac then ax)
3. When the highest reported SAR for the initial test configuration (when applicable, include subsequent highest output channels), according to the initial test position or fixed exposure requirements, is adjusted by the ratio of the subsequent test configuration to the initial test configuration specified maximum output power and the adjusted SAR is ≤1.2 W/Kg, SAR is not required for that subsequent test configuration.

7.3 Antenna location



7.4 Simultaneous Transmitting Evaluate

Simultaneous transmission configurations as below:

Condition	Band			
	2.4 GHz WLAN Ant Main	2.4 GHz WLAN Ant Aux	5 GHz WLAN Ant Main	5 GHz WLAN Ant Aux
1	V	V	---	---
2	V	---	---	V
3	---	V	V	---
4	---	---	V	V

7.4.1 Sum of 1-g SAR of all simultaneously transmitting

1. When the sum of 1-g SAR of all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit, SAR test exclusion applies to that simultaneous transmission configuration.
2. Sum of 1-g SAR of simultaneously transmitting portable device exposure condition combination is within the SAR limit of 1.6W/kg.

8. *System Verification and Validation*

8.1 Symmetric Dipoles for System Verification

Construction	Symmetrical dipole with l/4 balun enables measurement of feed point impedance with NWA matched for use near flat phantoms filled with head simulating solutions Includes distance holder and tripod adaptor Calibration Calibrated SAR value for specified position and input power at the flat phantom in head simulating solutions.
Return Loss	> 20 dB at specified verification position
Options	Dipoles for other frequencies or solutions and other calibration conditions are available upon request

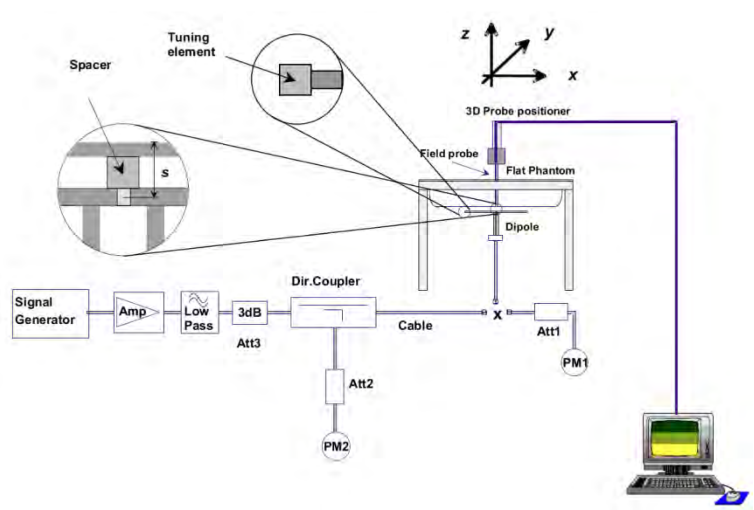


Figure 1. System Verification Setup Diagram

Figure 2. Validation Kit

8.2 Verification 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. The verification was performed at 2450, 5250, 5600 and 5750 MHz.

Mixture Type	Frequency (MHz)	Power	Probe Model / Serial No.	Dipole Model / Serial No.	$SAR_{1\,g}$ (W/Kg)	Normalize to 1 Watt 1 g (W/Kg)	1 W Target $SAR_{1\,g}$ (W/Kg)	$SAR_{10\,g}$ (W/Kg)	Normalize to 1 Watt 10 g (W/Kg)	1 W Target $SAR_{10\,g}$ (W/Kg)	Difference percentage 1 g	Difference percentage 10 g	Date
Head	2450	250 mW	EX3DV4-SN3847	D2450V2 – SN712	13.4	53.6	51.20	6.36	25.44	23.60	4.5%	7.2%	Oct. 04, 2020
Head	5250	100 mW	EX3DV4-SN3847	D5250V2 – SN1021	7.7	77	75.50	2.16	21.6	21.40	1.9%	0.9%	Sep. 29, 2020
Head	5750	100 mW	EX3DV4-SN3847	D5750V2 – SN1021	8	80	76.00	2.19	21.9	21.30	5.0%	2.7%	Sep. 29, 2020

9. Test Equipment List

Testing Engineer: Jason Tsao

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Cal. Date	Cal.Period
SPEAG	2450MHz System Validation Kit	D2450V2	712	2020/04/26	1 year
SPEAG	5GHz System Validation Kit	D5GHzV2	1021	2020/04/23	1 year
SPEAG	Dosimetric E-Field Probe	EX3DV4	3847	2020/05/20	1 year
SPEAG	Data Acquisition Electronics	DAE4	541	2020/03/18	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	F16/54FTA1/A/01	NCR	
SPEAG	Software	DASY52 V52.10 (3)	N/A	NCR	
SPEAG	Software	SEMCAD X V14.6.10(7331)	N/A	NCR	
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	2019/10/28	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	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	

Table 1. Test Equipment List

10. Measurement Uncertainty

Decision 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	-

Uncertainty Budget for frequency range 300 MHz to 3 GHz

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	-

Uncertainty Budget for frequency range 3 GHz to 6 GHz

11. Measurement Procedure

The measurement procedures are as follows:

1. For WLAN function, engineering testing software installed on DUTs can provide continuous transmitting signal.
2. Measure output power through RF cable and power meter
3. Set scan area, grid size and other setting on the DASY software
4. Find out the largest SAR result on these testing positions of each band
5. Measure SAR results for other channels in worst SAR testing position if the SAR of highest power channel is larger than 0.8 W/kg

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

1. Power reference measurement
2. Area scan
3. Zoom scan
4. Power drift measurement

11.1 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1 g and 10 g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.
The base for the evaluation is a "cube" measurement. 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.
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 the following stages

1. Extraction of the measured data (grid and values) from the Zoom Scan
2. Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
3. Generation of a high-resolution mesh within the measured volume
4. Interpolation of all measured values form the measurement grid to the high-resolution grid
5. Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
6. Calculation of the averaged SAR within masses of 1 g and 10 g

11.2 Area & Zoom Scan Procedures

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan measures points and step size follow as below. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g.

<table>
<tr><th colspan="3"></th><th>≤ 3 GHz</th><th>> 3 GHz</th></tr>
<tr><td colspan="3">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 mm ± 1 mm</td><td>$\frac{1}{2} \cdot \delta \cdot \ln(2)$ mm ± 0.5 mm</td></tr>
<tr><td colspan="3">Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td colspan="3" rowspan="2">Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}</td><td>≤ 2 GHz: ≤ 15 mm
2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm
4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>≤ 2 GHz: ≤ 8 mm
2 – 3 GHz: ≤ 5 mm*</td><td>3 – 4 GHz: ≤ 5 mm*
4 – 6 GHz: ≤ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm
4 – 5 GHz: ≤ 3 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>≤ 4 mm</td><td>3 – 4 GHz: ≤ 3 mm
4 – 5 GHz: ≤ 2.5 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">≤ $1.5 \cdot \Delta z_{Zoom}(n-1)$ mm</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>≥ 30 mm</td><td>3 – 4 GHz: ≥ 28 mm
4 – 5 GHz: ≥ 25 mm
5 – 6 GHz: ≥ 22 mm</td></tr>
<tr><td colspan="5">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 for details.
* When zoom scan is required and the reported SAR from the area scan based 1-g SAR estimation procedures of KDB Publication 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

(Our measure settings are refer KDB Publication 865664 D01v01r04)

11.3 Volume Scan Procedures

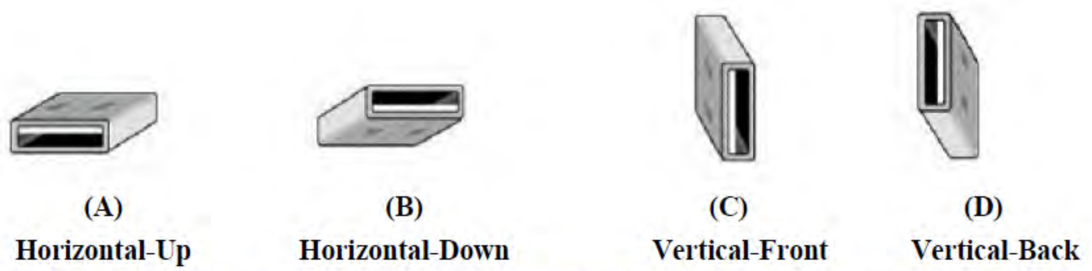
The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1 g aggregate SAR, the DUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

11.4 Power Drift Monitoring

All SAR testing is under the DUT install full charged battery and transmit maximum output power. In DASY measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of DUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drifts more than 5 %, the SAR will be retested.

11.5 Simple Dongle Procedures

Test all USB orientations [see figure below: (A) Horizontal-Up, (B) Horizontal-Down, (C) Vertical-Front, and (D) Vertical-Back] with a device-to-phantom separation distance of 5 mm.



Note: These are USB connector orientations on laptop computers; USB dongles have the reverse configuration for plugging into the corresponding laptop computers.

Figure 1 – USB Connector Orientations Implemented on Laptop Computers

12. SAR Test Results Summary

Note:

1. According to KDB 248227 D01 Section 5.2.1, SAR is measured for 2.4 GHz 802.11b DSSS using either a fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following:
   a. When the reported SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.
   b. When the reported SAR is > 0.8 W/kg, SAR is required for that exposure configuration using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing.
2. According to KDB 248227 D01 Section 5.2.2, when SAR measurement is required for 2.4 GHz 802.11g/n OFDM configurations, the measurement and test reduction procedures for OFDM are applied. SAR is not required for the following 2.4 GHz OFDM conditions.
   a. When KDB Publication 447498 D01 SAR test exclusion applies to the OFDM configuration.
   b. When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.
3. According to KDB 248227 D01 Section 5.3.2, the initial test configuration for 2.4 GHz and 5 GHz OFDM transmission modes is determined by the 802.11 configuration with the highest maximum output power specified for production units, including tune-up tolerance, in each standalone and aggregated frequency band. SAR for the initial test configuration is measured using the highest maximum output power channel determined by the default power measurement procedures.
   a. When multiple channel bandwidth configurations in a frequency band have the same specified maximum output power, the initial test configuration is determined by applying the following steps sequentially.
      1) The largest channel bandwidth configuration is selected among the multiple configurations in a frequency band with the same specified maximum output power.
      2) If multiple configurations have the same specified maximum output power and largest channel bandwidth, the lowest order modulation among the largest channel bandwidth configurations is selected.
      3) If multiple configurations have the same specified maximum output power, largest channel bandwidth and lowest order modulation, the lowest data rate configuration among these configurations is selected.
      4) When multiple transmission modes (802.11a/g/n/ac /ax) have the same specified maximum output power, largest channel bandwidth, lowest order modulation and lowest data rate,lowest order 802.11 mode is selected; (i.e. a/g/n/ac/ax).
   b. After an initial test configuration is determined, if multiple test channels have the same measured maximum output power, the channel chosen for SAR measurement is determined according to the following. These channel selection procedures apply to both the initial test configuration and subsequent test configuration(s) selection.
      1) The channel closest to mid-band frequency is selected for SAR measurement.
      2) For channels with equal separation from mid-band frequency; for example, high and low channels or two mid-band channels, the higher frequency (number) channel is selected for SAR measurement.

12.1 Body SAR Measurement

Measurement Results													
Index	Band	Mode	Frequency		Data Rate	Test Position	Spacing (mm)	$SAR_{1\,g}$ (W/Kg)	Burst Avg Power	Max tune-up	Duty Cycle %	Reported $SAR_{1\,g}$	Note
			Ch.	MHz									
#200	WLAN 2.4GHz	802.11b	6	2437	1 Mbps	Horizontal-UP	5	0.603	17.21	18	99.80	0.73	Ant 0
#203	WLAN 2.4GHz	802.11b	6	2437	1 Mbps	Horizontal-Down	5	0.554	17.21	18	99.80	0.67	Ant 0
#204	WLAN 2.4GHz	802.11b	6	2437	1 Mbps	Vertical-Front	5	0.217	17.21	18	99.80	0.26	Ant 0
#207	WLAN 2.4GHz	802.11b	6	2437	1 Mbps	Vertical-Back	5	0.162	17.21	18	99.80	0.20	Ant 0
#208	WLAN 2.4GHz	802.11b	6	2437	1 Mbps	Tip	5	0.039	17.21	18	99.80	0.05	Ant 0
#211	WLAN 2.4GHz	802.11b	6	2437	1 Mbps	Bottom	5	0.028	17.21	18	99.80	0.03	Ant 0
#301	WLAN 2.4GHz	802.11g	6	2437	6 Mbps	Horizontal-UP	5	0.799	18.94	19	99.90	0.81	Ant 0
#302	WLAN 2.4GHz	802.11g	6	2437	6 Mbps	Horizontal-Down	5	0.754	18.94	19	99.90	0.77	Ant 0
#303	WLAN 2.4GHz	802.11g	6	2437	6 Mbps	Vertical-Front	5	0.289	18.94	19	99.90	0.29	Ant 0
#304	WLAN 2.4GHz	802.11g	6	2437	6 Mbps	Vertical-Back	5	0.216	18.94	19	99.90	0.22	Ant 0
#305	WLAN 2.4GHz	802.11g	6	2437	6 Mbps	Tip	5	0.052	18.94	19	99.90	0.05	Ant 0
#306	WLAN 2.4GHz	802.11g	6	2437	6 Mbps	Bottom	5	0.037	18.94	19	99.90	0.04	Ant 0
#201	WLAN 2.4GHz	802.11n 20 MHz	6	2437	HT0	Horizontal-UP	5	0.621	18.54	19	93.69	0.74	Ant 1
#202	WLAN 2.4GHz	802.11n 20 MHz	6	2437	HT0	Horizontal-Down	5	0.587	18.54	19	93.69	0.70	Ant 1
#205	WLAN 2.4GHz	802.11n 20 MHz	6	2437	HT0	Vertical-Front	5	0.155	18.54	19	93.69	0.18	Ant 1
#206	WLAN 2.4GHz	802.11n 20 MHz	6	2437	HT0	Vertical-Back	5	0.117	18.54	19	93.69	0.14	Ant 1
#209	WLAN 2.4GHz	802.11n 20 MHz	6	2437	HT0	Tip	5	0.013	18.54	19	93.69	0.02	Ant 1
#210	WLAN 2.4GHz	802.11n 20 MHz	6	2437	HT0	Bottom	5	0.023	18.54	19	93.69	0.03	Ant 1

Measurement Results														
Index	Band	Mode	Frequency		Data Rate	Test Position	Spacing (mm)	$SAR_{1\,g}$ (W/Kg)	Burst Avg Power	Max tune-up	Duty Cycle %	Reported $SAR_{1\,g}$	Note
			Ch.	MHz									
#02	WLAN 5GHz	802.11ac 80 MHz	42	5210	VHT0	Horizontal-UP	5	0.588	10.31	10.5	87.07	0.71	Ant 0
#11	WLAN 5GHz	802.11ac 80 MHz	42	5210	VHT0	Horizontal-Down	5	0.562	10.31	10.5	87.07	0.68	Ant 0
#14	WLAN 5GHz	802.11ac 80 MHz	42	5210	VHT0	Vertical-Front	5	0.226	10.31	10.5	87.07	0.27	Ant 0
#25	WLAN 5GHz	802.11ac 80 MHz	42	5210	VHT0	Vertical-Back	5	0.372	10.31	10.5	87.07	0.45	Ant 0
#26	WLAN 5GHz	802.11ac 80 MHz	42	5210	VHT0	Tip	5	0.04	10.31	10.5	87.07	0.05	Ant 0
#32	WLAN 5GHz	802.11ac 80 MHz	42	5210	VHT0	Bottom	5	0.02	10.31	10.5	87.07	0.02	Ant 0
#03	WLAN 5GHz	802.11ac 80 MHz	155	5775	VHT0	Horizontal-UP	5	0.54	10.47	11	87.03	0.70	Ant 0
#12	WLAN 5GHz	802.11ac 80 MHz	155	5775	VHT0	Horizontal-Down	5	0.528	10.47	11	87.03	0.69	Ant 0
#15	WLAN 5GHz	802.11ac 80 MHz	155	5775	VHT0	Vertical-Front	5	0.346	10.47	11	87.03	0.45	Ant 0
#24	WLAN 5GHz	802.11ac 80 MHz	155	5775	VHT0	Vertical-Back	5	0.328	10.47	11	87.03	0.43	Ant 0
#27	WLAN 5GHz	802.11ac 80 MHz	155	5775	VHT0	Tip	5	0.051	10.47	11	87.03	0.07	Ant 0
#35	WLAN 5GHz	802.11ac 80 MHz	155	5775	VHT0	Bottom	5	0.025	10.47	11	87.03	0.03	Ant 0
#04	WLAN 5GHz	802.11n 40 MHz	46	5230	HT0	Horizontal-UP	5	0.596	14.49	15	93.48	0.72	Ant 1
#13	WLAN 5GHz	802.11n 40 MHz	46	5230	HT0	Horizontal-Down	5	0.471	14.49	15	93.48	0.57	Ant 1
#16	WLAN 5GHz	802.11n 40 MHz	46	5230	HT0	Vertical-Front	5	0.238	14.49	15	93.48	0.29	Ant 1
#23	WLAN 5GHz	802.11n 40 MHz	46	5230	HT0	Vertical-Back	5	0.265	14.49	15	93.48	0.32	Ant 1
#28	WLAN 5GHz	802.11n 40 MHz	46	5230	HT0	Tip	5	0.019	14.49	15	93.48	0.02	Ant 1
#36	WLAN 5GHz	802.11n 40 MHz	46	5230	HT0	Bottom	5	0.04	14.49	15	93.48	0.05	Ant 1
#05	WLAN 5GHz	802.11ac 80 MHz	155	5775	VHT0	Horizontal-UP	5	0.583	9.88	10.5	87.03	0.77	Ant 1
#10	WLAN 5GHz	802.11ac 80 MHz	155	5775	VHT0	Horizontal-Down	5	0.55	9.88	10.5	87.03	0.73	Ant 1
#17	WLAN 5GHz	802.11ac 80 MHz	155	5775	VHT0	Vertical-Front	5	0.221	9.88	10.5	87.03	0.29	Ant 1
#22	WLAN 5GHz	802.11ac 80 MHz	155	5775	VHT0	Vertical-Back	5	0.286	9.88	10.5	87.03	0.38	Ant 1
#29	WLAN 5GHz	802.11ac 80 MHz	155	5775	VHT0	Tip	5	0.024	9.88	10.5	87.03	0.03	Ant 1

12.2 SAR Exposure Limit

Human Exposure	Population Uncontrolled Exposure (W/kg)	Occupational Controlled Exposure (W/kg)
Spatial Peak SAR* (head or Body)	1.60	8.00
Spatial Peak SAR** (Whole Body)	0.08	0.40
Spatial Peak SAR*** (Hands / Feet / Ankle / Wrist)	4.00	20.00

Table 2. Safety Limits for Controlled / Uncontrolled Environment Exposure

Notes：

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

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

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

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

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

13. References

[1] Std. C95.1-1999, "*American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 300KHz to 100GHz",* New York.

[2] NCRP, National Council on Radiation Protection and Measurements, "Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields", NCRP report NO. 86, 1986.

[3] 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.

[4] K. Pokovic, 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.

[5] K. Pokovic, 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.

[6] 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.

[7] Robert J. Renka, "Multivariate Interpolation Of Large Sets Of Scattered Data", University of North Texas ACM Transactions on Mathematical Software, vol. 14, no. 2, June 1988 , pp. 139-148.

[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] Std. C95.3-1991, "IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave, New York: IEEE, Aug. 1992.

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

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

Appendix A - System Performance Check

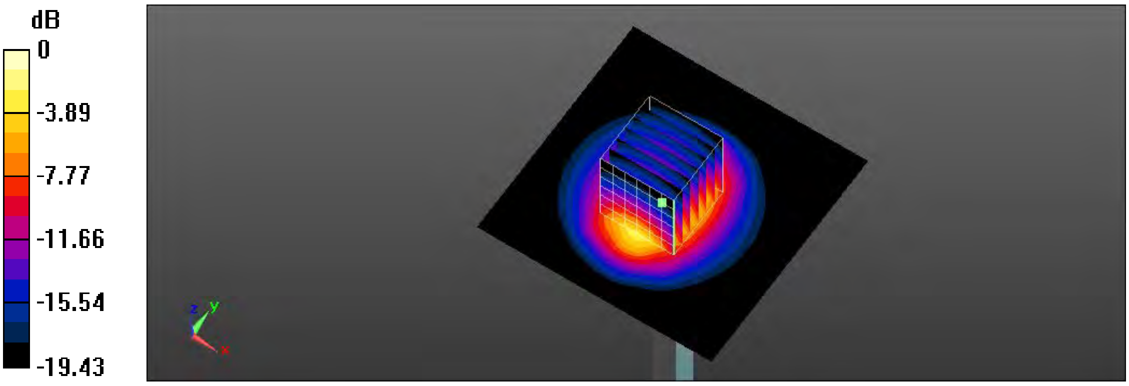
Test Laboratory: A Test Lab Techno Corp.
Date: 2020/10/4
System Performance Check at 2450MHz_Head
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:712

Communication System: UID 0, CW (0); Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.85 S/m; ε_r = 39.491; 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(7.38, 7.38, 7.38) @ 2450 MHz; Calibrated: 2020/5/20
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2020/3/18
- Phantom: ELI V4.0 (20deg probe tilt); Type: QD OVA 001 BB; Serial: 1036
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.10 (7331)

System Performance Check at 2450MHz/Area Scan (81x81x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 22.6 W/kg

System Performance Check at 2450MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 111.5 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 27.5 W/kg
SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.36 W/kg
Smallest distance from peaks to all points 3 dB below = 9 mm
Ratio of SAR at M2 to SAR at M1 = 49.1%
Maximum value of SAR (measured) = 22.4 W/kg



0 dB = 22.4 W/kg = 13.50 dBW/kg

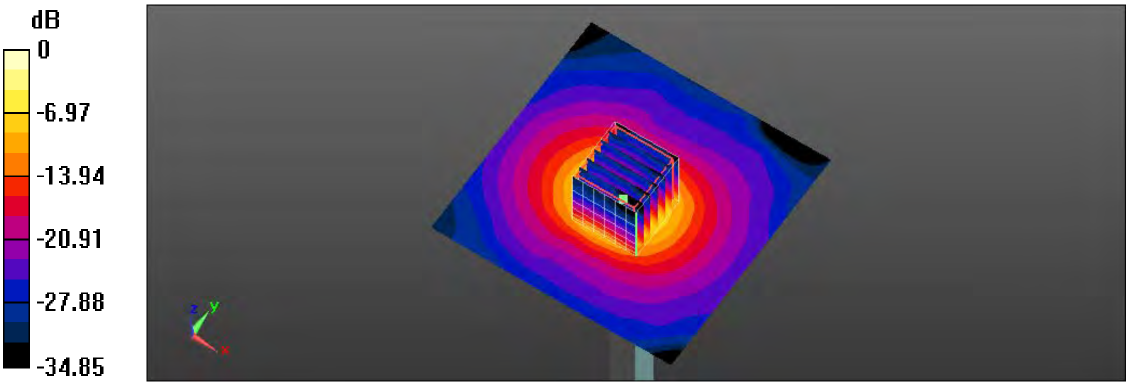
Test Laboratory: A Test Lab Techno Corp.
Date: 2020/9/29
System Performance Check at 5250MHz_Head
DUT: Dipole 5GHzV2; Type: D5GHz; Serial: 1021

Communication System: UID 0, CW (0); Frequency: 5250 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5250 MHz; σ = 4.658 S/m; ε_r = 37.026; 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(5.19, 5.19, 5.19) @ 5250 MHz; Calibrated: 2020/5/20
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2020/3/18
- Phantom: ELI V4.0 (20deg probe tilt); Type: QD OVA 001 BB; Serial: 1036
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.10 (7331)

System Performance Check at 5250MHz/Area Scan (91x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 17.9 W/kg

System Performance Check at 5250MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 66.18 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 31.0 W/kg
SAR(1 g) = 7.7 W/kg; SAR(10 g) = 2.16 W/kg
Smallest distance from peaks to all points 3 dB below = 7.2 mm
Ratio of SAR at M2 to SAR at M1 = 65.2%
Maximum value of SAR (measured) = 18.9 W/kg



0 dB = 18.9 W/kg = 12.76 dBW/kg

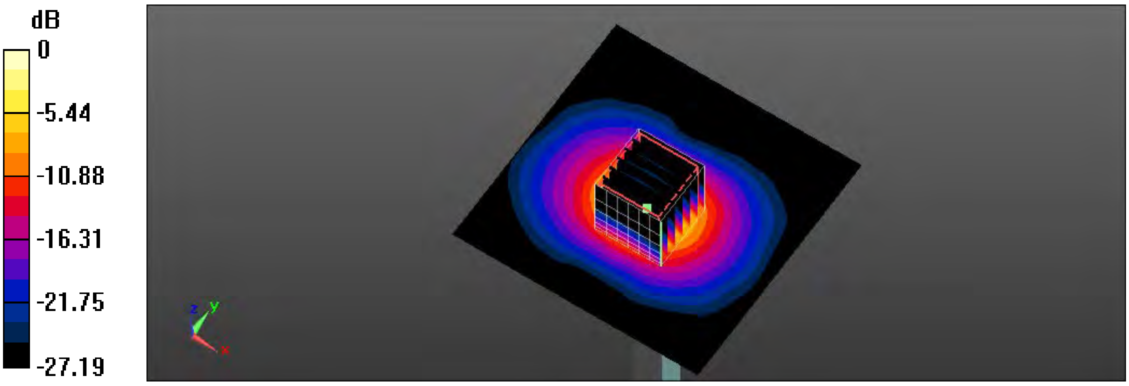
Test Laboratory: A Test Lab Techno Corp.
Date: 2020/9/29
System Performance Check at 5750MHz_Head
DUT: Dipole 5GHzV2; Type: D5GHz; Serial: 1021

Communication System: UID 0, CW (0); Frequency: 5750 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5750 MHz; σ = 5.279 S/m; ε_r = 36.01; 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(4.65, 4.65, 4.65) @ 5750 MHz; Calibrated: 2020/5/20
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2020/3/18
- Phantom: ELI V4.0 (20deg probe tilt); Type: QD OVA 001 BB; Serial: 1036
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.10 (7331)

System Performance Check at 5750MHz/Area Scan (91x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 19.2 W/kg

System Performance Check at 5750MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 65.00 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 34.8 W/kg
SAR(1 g) = 8 W/kg; SAR(10 g) = 2.19 W/kg
Smallest distance from peaks to all points 3 dB below = 7.2 mm
Ratio of SAR at M2 to SAR at M1 = 62.9%
Maximum value of SAR (measured) = 20.9 W/kg



0 dB = 20.9 W/kg = 13.20 dBW/kg

Appendix B - SAR Measurement Data

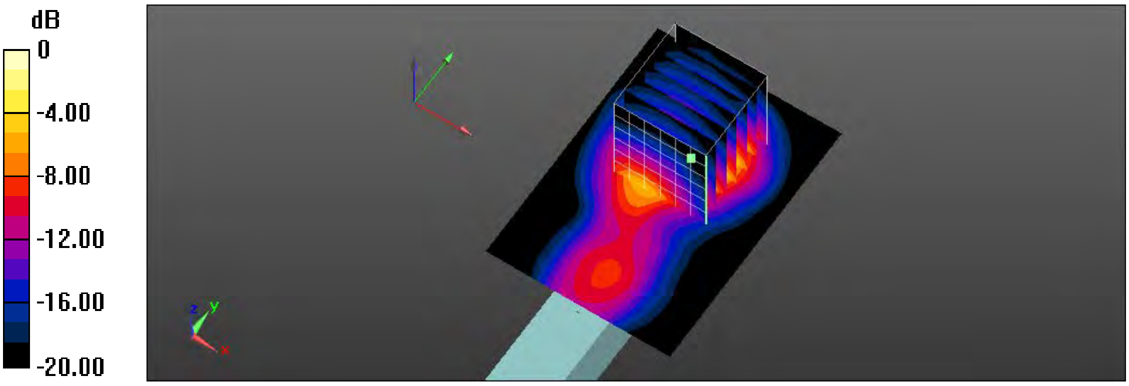
Test Laboratory: A Test Lab Techno Corp.
Date: 2020/10/4
301_IEEE 802.11g CH 6_6M_Horizontal-UP_5mm_Ant 0
DUT: EW-7822UAC V2.0A, EW-7822UAD; Type: 11ac 2T2R Wireless Dual-Band USB Adapter

Communication System: UID 0, IEEE 802.11b (0); Frequency: 2437 MHz;Duty Cycle: 1:1.001
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.837 S/m; ε_r = 39.529; 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(7.38, 7.38, 7.38) @ 2437 MHz; Calibrated: 2020/5/20
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2020/3/18
- Phantom: ELI V4.0 (20deg probe tilt); Type: QD OVA 001 BB; Serial: 1036
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.10 (7331)

Area Scan (51x71x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 1.01 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 27.54 V/m; Power Drift = -0.10 dB
Peak SAR (extrapolated) = 1.49 W/kg
SAR(1 g) = 0.799 W/kg; SAR(10 g) = 0.331 W/kg
Smallest distance from peaks to all points 3 dB below = 7.2 mm
Ratio of SAR at M2 to SAR at M1 = 41.7%
Maximum value of SAR (measured) = 1.12 W/kg



0 dB = 1.12 W/kg = 0.49 dBW/kg

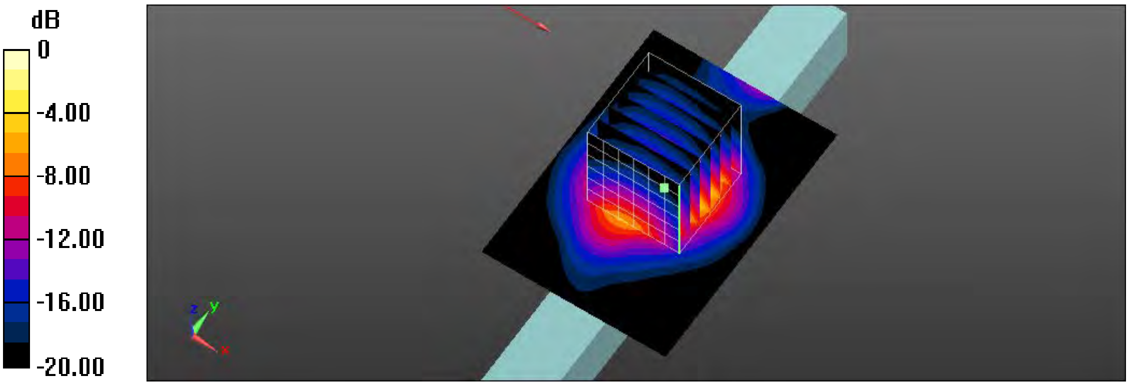
Test Laboratory: A Test Lab Techno Corp.
Date: 2020/10/4
201_IEEE 802.11n 20 CH 6_HT0_Horizontal-UP_5mm_Ant 1
DUT: EW-7822UAC V2.0A, EW-7822UAD; Type: 11ac 2T2R Wireless Dual-Band USB Adapter

Communication System: UID 0, IEEE 802.11n(2.4GHz) (0); Frequency: 2437 MHz;Duty Cycle: 1:1.067
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.837 S/m; ε_r = 39.529; 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(7.38, 7.38, 7.38) @ 2437 MHz; Calibrated: 2020/5/20
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2020/3/18
- Phantom: ELI V4.0 (20deg probe tilt); Type: QD OVA 001 BB; Serial: 1036
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.10 (7331)

Area Scan (51x71x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 1.29 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 21.64 V/m; Power Drift = -0.10 dB
Peak SAR (extrapolated) = 1.53 W/kg
SAR(1 g) = 0.621 W/kg; SAR(10 g) = 0.250 W/kg
Smallest distance from peaks to all points 3 dB below = 7.8 mm
Ratio of SAR at M2 to SAR at M1 = 42.7%
Maximum value of SAR (measured) = 1.16 W/kg



0 dB = 1.16 W/kg = 0.64 dBW/kg

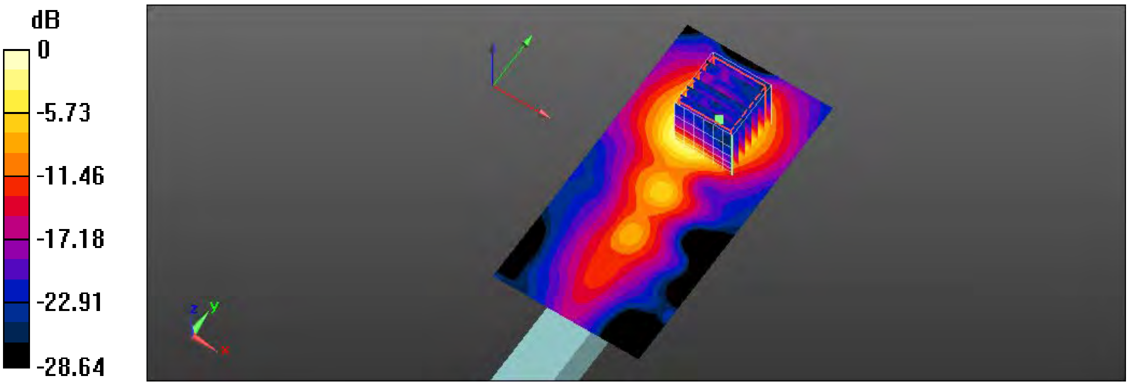
Test Laboratory: A Test Lab Techno Corp.
Date: 2020/9/29
02_IEEE 802.11ac 80 CH 42_VHT0_Horizontal-UP_5mm_Ant 0
DUT: EW-7822UAC V2.0A, EW-7822UAD; Type: 11ac 2T2R Wireless Dual-Band USB Adapter

Communication System: UID 0, IEEE 802.11ac(5GHz)VHT80 (0); Frequency: 5210 MHz;Duty Cycle: 1:1.149
Medium parameters used: f = 5210 MHz; σ = 4.608 S/m; ε_r = 37.105; 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(5.19, 5.19, 5.19) @ 5210 MHz; Calibrated: 2020/5/20
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2020/3/18
- Phantom: ELI V4.0 (20deg probe tilt); Type: QD OVA 001 BB; Serial: 1036
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.10 (7331)

Area Scan (61x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.40 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 16.91 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 2.27 W/kg
SAR(1 g) = 0.588 W/kg; SAR(10 g) = 0.200 W/kg
Smallest distance from peaks to all points 3 dB below = 8.8 mm
Ratio of SAR at M2 to SAR at M1 = 63.5%
Maximum value of SAR (measured) = 1.35 W/kg



0 dB = 1.35 W/kg = 1.30 dBW/kg

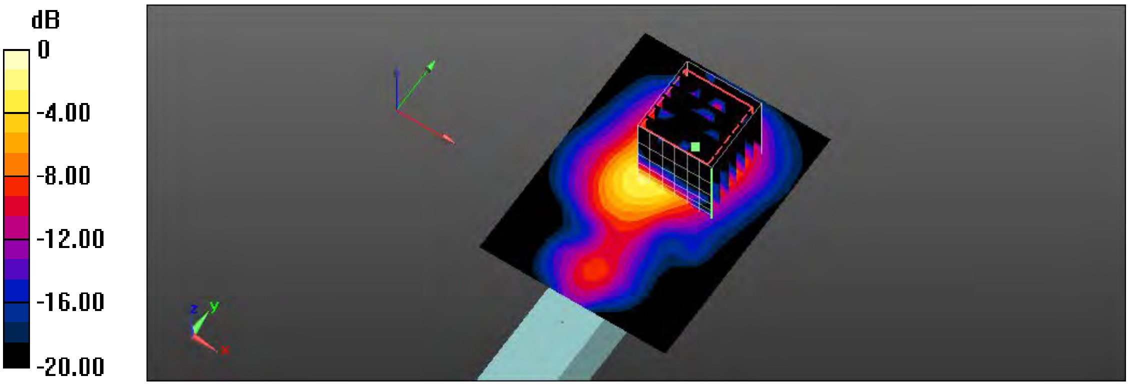
Test Laboratory: A Test Lab Techno Corp.
Date: 2020/9/29
03_IEEE 802.11ac 80 CH 155_VHT0_Horizontal-UP_5mm_Ant 0
DUT: EW-7822UAC V2.0A, EW-7822UAD; Type: 11ac 2T2R Wireless Dual-Band USB Adapter

Communication System: UID 0, IEEE 802.11ac(5GHz)VHT80 (0); Frequency: 5775 MHz;Duty Cycle: 1:1.149
Medium parameters used: f = 5775 MHz; σ = 5.242 S/m; ε_r = 36.07; 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(4.65, 4.65, 4.65) @ 5775 MHz; Calibrated: 2020/5/20
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2020/3/18
- Phantom: ELI V4.0 (20deg probe tilt); Type: QD OVA 001 BB; Serial: 1036
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.10 (7331)

Area Scan (61x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.40 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 13.81 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 2.39 W/kg
SAR(1 g) = 0.540 W/kg; SAR(10 g) = 0.151 W/kg
Smallest distance from peaks to all points 3 dB below = 8.5 mm
Ratio of SAR at M2 to SAR at M1 = 63.4%
Maximum value of SAR (measured) = 1.62 W/kg



0 dB = 1.62 W/kg = 2.10 dBW/kg

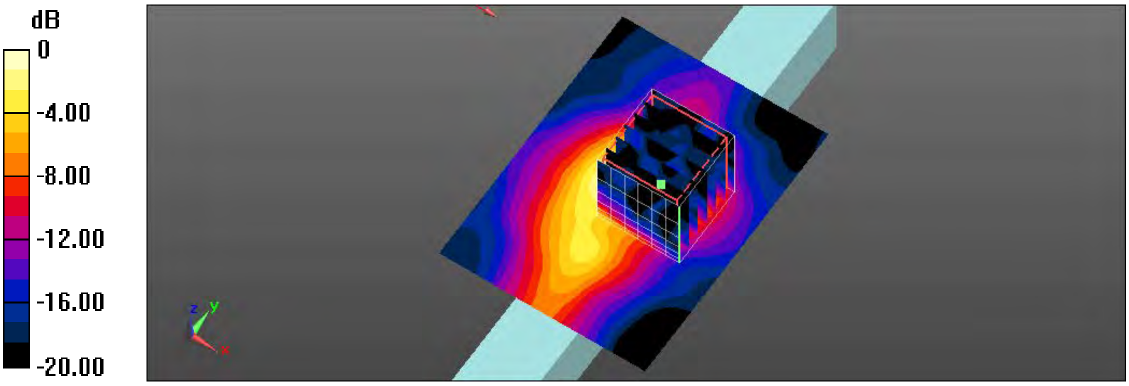
Test Laboratory: A Test Lab Techno Corp.
Date: 2020/9/29
04_IEEE 802.11n 40 CH 46_HT0_Horizontal-UP_5mm_Ant 1
DUT: EW-7822UAC V2.0A, EW-7822UAD; Type: 11ac 2T2R Wireless Dual-Band USB Adapter

Communication System: UID 0, IEEE 802.11n(5GHz)HT40 (0); Frequency: 5230 MHz;Duty Cycle: 1:1.070
Medium parameters used: f = 5230 MHz; σ = 4.641 S/m; ε_r = 37.059; 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(5.19, 5.19, 5.19) @ 5230 MHz; Calibrated: 2020/5/20
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2020/3/18
- Phantom: ELI V4.0 (20deg probe tilt); Type: QD OVA 001 BB; Serial: 1036
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.10 (7331)

Area Scan (61x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.30 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 12.14 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 2.46 W/kg
SAR(1 g) = 0.596 W/kg; SAR(10 g) = 0.184 W/kg
Smallest distance from peaks to all points 3 dB below = 7.5 mm
Ratio of SAR at M2 to SAR at M1 = 63%
Maximum value of SAR (measured) = 1.40 W/kg



0 dB = 1.40 W/kg = 1.46 dBW/kg

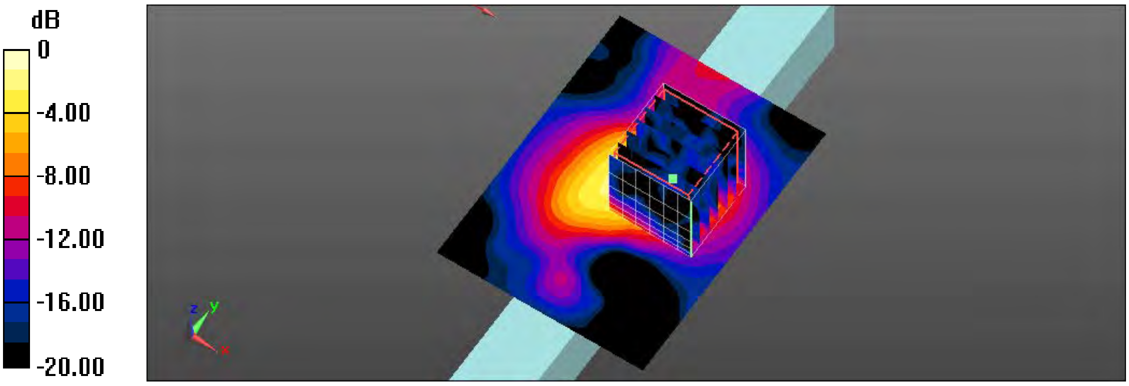
Test Laboratory: A Test Lab Techno Corp.
Date: 2020/9/29
05_IEEE 802.11ac 80 CH 155_VHT0_Horizontal-UP_5mm_Ant 1
DUT: EW-7822UAC V2.0A, EW-7822UAD; Type: 11ac 2T2R Wireless Dual-Band USB Adapter

Communication System: UID 0, IEEE 802.11ac(5GHz)VHT80 (0); Frequency: 5775 MHz;Duty Cycle: 1:1.149
Medium parameters used: f = 5775 MHz; σ = 5.242 S/m; ε_r = 36.07; 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(4.65, 4.65, 4.65) @ 5775 MHz; Calibrated: 2020/5/20
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2020/3/18
- Phantom: ELI V4.0 (20deg probe tilt); Type: QD OVA 001 BB; Serial: 1036
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.10 (7331)

Area Scan (61x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.79 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 12.80 V/m; Power Drift = -0.17 dB
Peak SAR (extrapolated) = 2.80 W/kg
SAR(1 g) = 0.583 W/kg; SAR(10 g) = 0.163 W/kg
Smallest distance from peaks to all points 3 dB below = 7.2 mm
Ratio of SAR at M2 to SAR at M1 = 60.1%
Maximum value of SAR (measured) = 1.56 W/kg



0 dB = 1.56 W/kg = 1.93 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: 3847
- DAE _ DAE4 SN: 541

ST-002_20-072

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

中国认可
国际互认
校准
CALIBRATION
CNAS L0570

Client ATL Certificate No: Z20-60163

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 712
Calibration Procedure(s)	FF-Z11-003-01 Calibration Procedures for dipole validation kits
Calibration date:	April 26, 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
NetworkAnalyzer E5071C	MY46110673	10-Feb-20 (CTTL, No.J20X00515)	Feb-21

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	赵静
Reviewed by:	Lin Hao	SAR Test Engineer	林浩
Approved by:	Qi Dianyuan	SAR Project Leader	[signature]

Issued: April 30, 2020

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

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%.

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

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, 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	39.1 ± 6 %	1.80 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	12.8 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**51.2 W/kg ± 18.8 % (*k*=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.89 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.6 W/kg ± 18.7 % (*k*=2)**

In Collaboration with
speag
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.4Ω+ 3.22 jΩ
Return Loss	- 28.1dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.024 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

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

DASY5 Validation Report for Head TSL Date: 04.26.2020

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

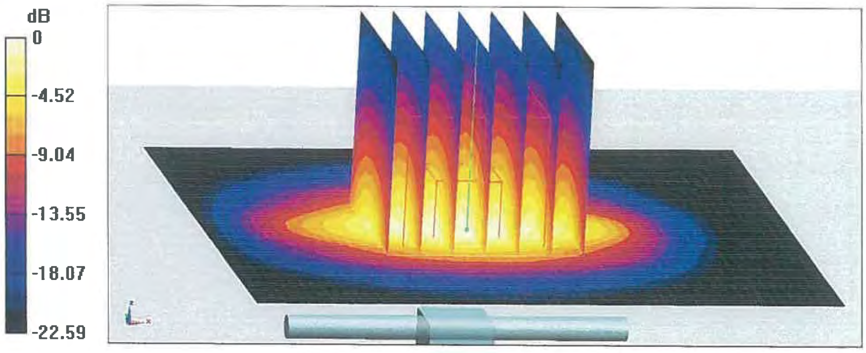
Medium parameters used: f = 2450 MHz; σ = 1.796 S/m; ε_r = 39.05; ρ = 1000 kg/m3

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7307; ConvF(7.83, 7.83, 7.83) @ 2450 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/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 106.6 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 27.2 W/kg
SAR(1 g) = 12.8 W/kg; SAR(10 g) = 5.89 W/kg
Smallest distance from peaks to all points 3 dB below = 9 mm
Ratio of SAR at M2 to SAR at M1 = 47.1%
Maximum value of SAR (measured) = 21.8 W/kg



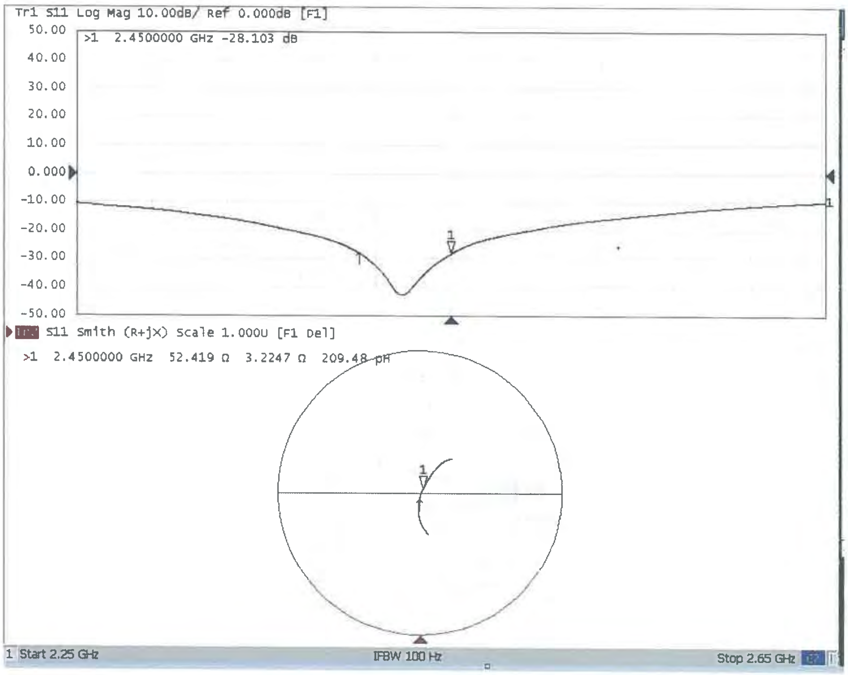
0 dB = 21.8 W/kg = 13.38 dBW/kg

Certificate No: Z20-60163 Page 5 of 6

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Impedance Measurement Plot for Head TSL



In Collaboration with
speag
CALIBRATION LABORATORY

中国认可
国际互认
校准
CALIBRATION
CNAS L0570

ST-007_20-071

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

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

In Collaboration with
speag
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

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%.

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

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)**

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

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)**

In Collaboration with
speag
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

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

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

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)

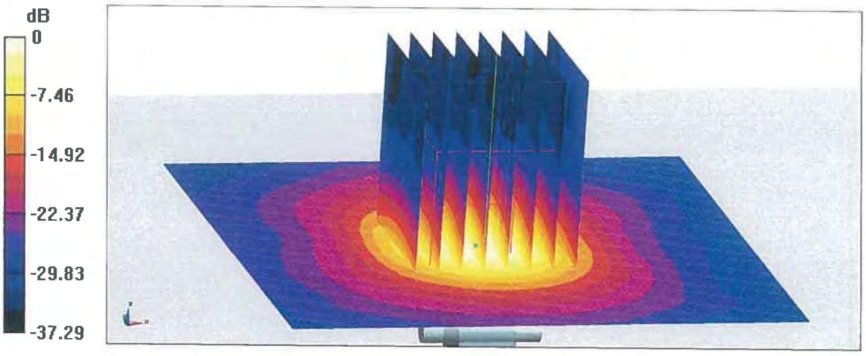
Dipole Calibration /Pin=100mW, d=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 70.74 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 32.5 W/kg
SAR(1 g) = 7.55 W/kg; SAR(10 g) = 2.14 W/kg
Smallest distance from peaks to all points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

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

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

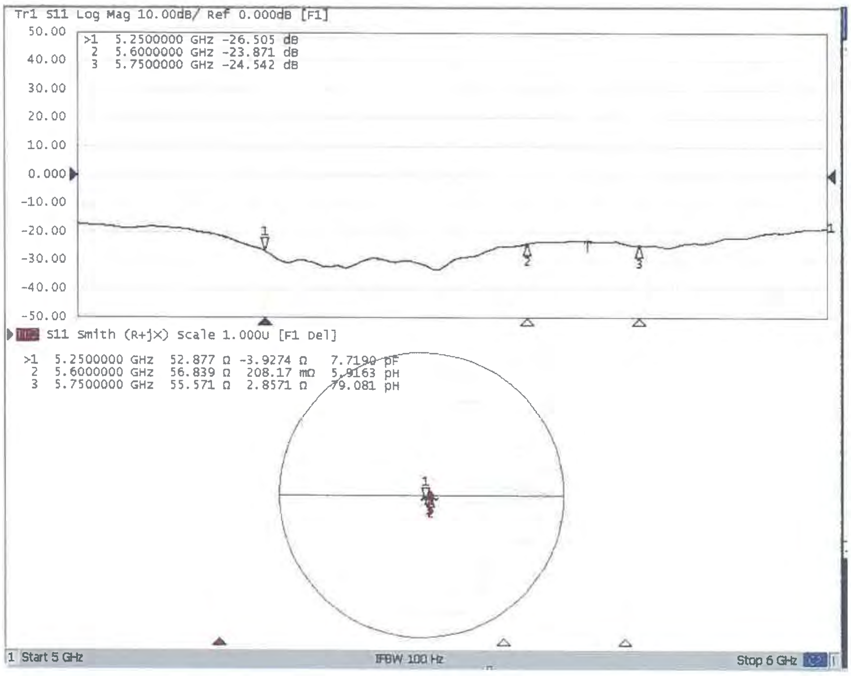


0 dB = 19.2 W/kg = 12.83 dBW/kg

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Impedance Measurement Plot for Head TSL



Certificate No: Z20-60164 Page 8 of 8

In Collaboration with s p e a g CALIBRATION LABORATORY
中国认可 国际互认 校准 CALIBRATION CNAS L0570

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

EX-042_20-107

Client ATL Certificate No: Z20-60165

CALIBRATION CERTIFICAT

Object	EX3DV4 - SN : 3847
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

In Collaboration with
s p e a g
CALIBRATION LABORATORY
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

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).

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

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]	0.56	0.50	0.44	±10.0%
DCP(mV)[B]	98.7	99.2	102.8	

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	172.6	±2.1%
		Y	0.0	0.0	1.0		166.4	
		Z	0.0	0.0	1.0		151.0	

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 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.

In Collaboration with
s p e a g
CALIBRATION LABORATORY
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

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	9.54	9.54	9.54	0.40	0.80	±12.1%
835	41.5	0.90	9.26	9.26	9.26	0.13	1.41	±12.1%
900	41.5	0.97	9.30	9.30	9.30	0.27	0.94	±12.1%
1450	40.5	1.20	8.35	8.35	8.35	0.30	0.83	±12.1%
1750	40.1	1.37	8.14	8.14	8.14	0.22	1.11	±12.1%
1810	40.0	1.40	7.96	7.96	7.96	0.22	1.07	±12.1%
1900	40.0	1.40	7.78	7.78	7.78	0.22	1.17	±12.1%
2000	40.0	1.40	7.86	7.86	7.86	0.19	1.23	±12.1%
2300	39.5	1.67	7.57	7.57	7.57	0.51	0.71	±12.1%
2450	39.2	1.80	7.38	7.38	7.38	0.55	0.72	±12.1%
2600	39.0	1.96	7.20	7.20	7.20	0.63	0.69	±12.1%
3300	38.2	2.71	6.79	6.79	6.79	0.43	0.96	±13.3%
3500	37.9	2.91	6.74	6.74	6.74	0.48	0.90	±13.3%
3700	37.7	3.12	6.52	6.52	6.52	0.46	0.93	±13.3%
3900	37.5	3.32	6.43	6.43	6.43	0.40	1.15	±13.3%
4100	37.2	3.53	6.29	6.29	6.29	0.40	1.20	±13.3%
4200	37.1	3.63	6.20	6.20	6.20	0.40	1.20	±13.3%
4400	36.9	3.84	6.06	6.06	6.06	0.40	1.20	±13.3%
4600	36.7	4.04	6.00	6.00	6.00	0.55	1.01	±13.3%
4800	36.4	4.25	5.95	5.95	5.95	0.55	1.11	±13.3%
4950	36.3	4.40	5.80	5.80	5.80	0.55	1.11	±13.3%
5250	35.9	4.71	5.19	5.19	5.19	0.50	1.20	±13.3%
5600	35.5	5.07	4.71	4.71	4.71	0.55	1.23	±13.3%
5750	35.4	5.22	4.65	4.65	4.65	0.60	1.20	±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.

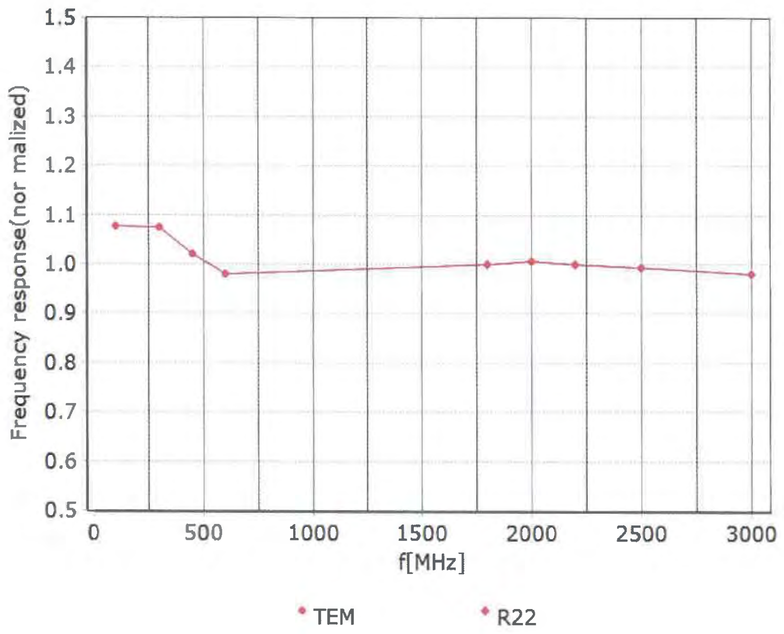
[F] At frequency below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty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

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

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



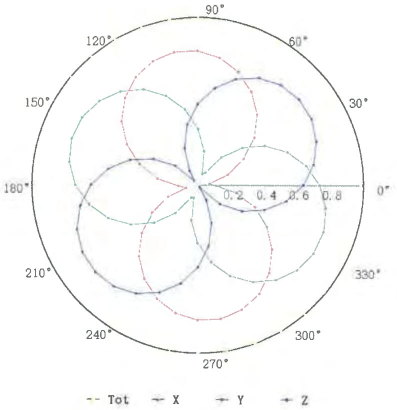
Uncertainty of Frequency Response of E-field: ±7.4% (*k*=2)

In Collaboration with
speag
CALIBRATION LABORATORY

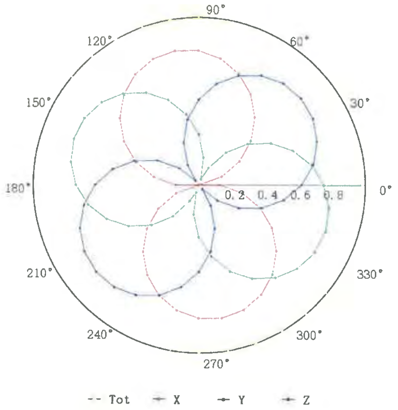
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

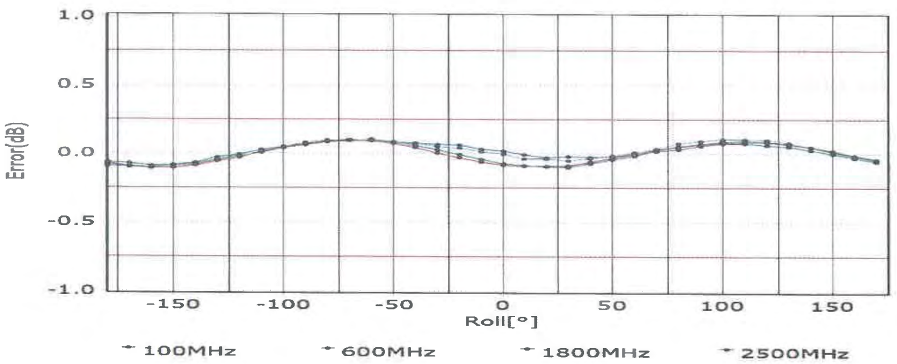
Receiving Pattern (Φ), θ=0°

f=600 MHz, TEM



f=1800 MHz, R22



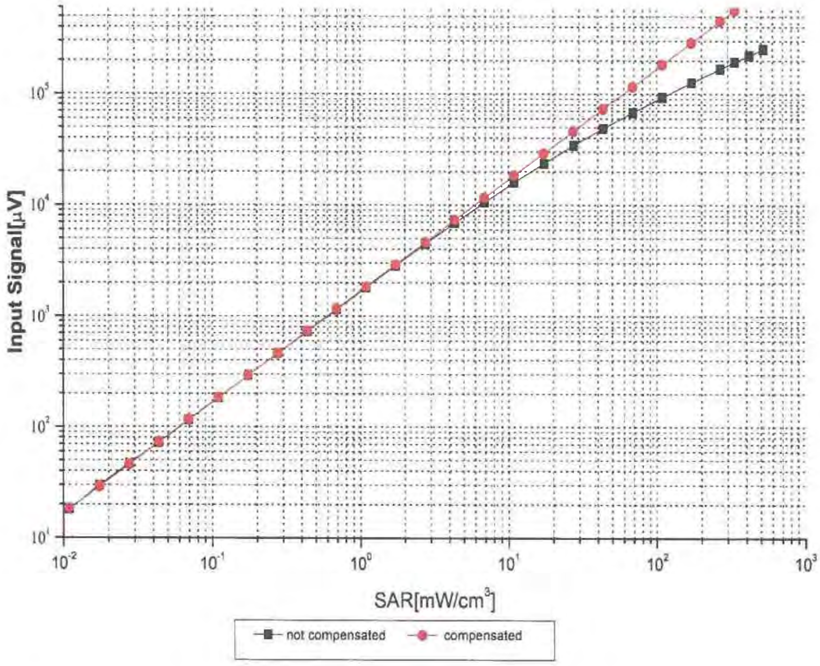


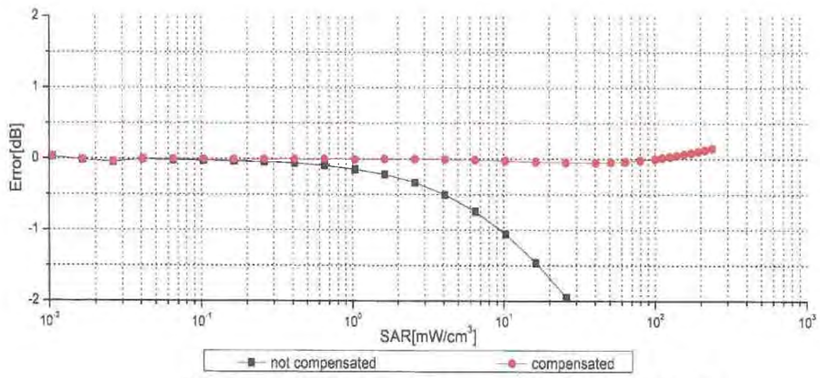
Uncertainty of Axial Isotropy Assessment: ±1.2% (k=2)

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

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



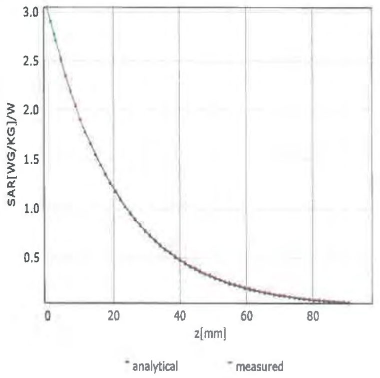


Uncertainty of Linearity Assessment: ±0.9% (*k*=2)

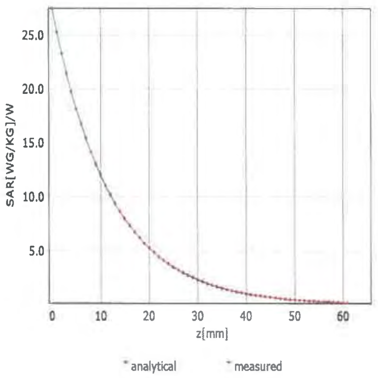
In Collaboration with
s p e a g
CALIBRATION LABORATORY
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

Conversion Factor Assessment

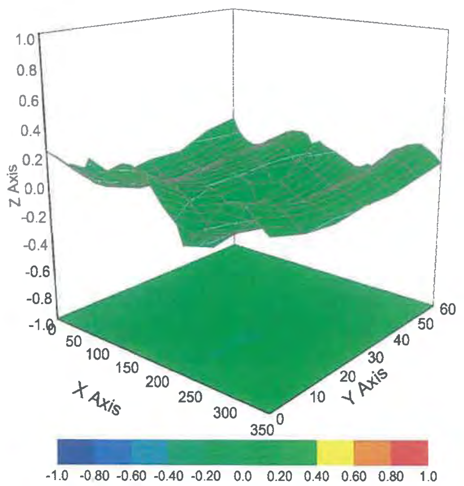
f=750 MHz,WGLS R9(H_convF)



f=1750 MHz,WGLS R22(H_convF)



Deviation from Isotropy in Liquid



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

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	100.7
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

MR-008_20-041

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

中国认可
国际互认
校准
CALIBRATION
CNAS L0570

Client : ATL

Certificate No: Z20-60115

CALIBRATION CERTIFICATE

Object	DAE4 - SN: 541
Calibration Procedure(s)	FF-Z11-002-01 Calibration Procedure for the Data Acquisition Electronics (DAEx)
Calibration date:	March 18, 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: March 20, 2020

In Collaboration with
speag
CALIBRATION LABORATORY
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

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.

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

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	404.553 ± 0.15% (k=2)	404.412 ± 0.15% (k=2)	404.179 ± 0.15% (k=2)
Low Range	3.96888 ± 0.7% (k=2)	3.93481 ± 0.7% (k=2)	3.97551 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	288° ± 1 °

---- END ----