SAR Report

Applicant	:	Getac Technology Corporation
Product Type	:	Wireless module
Trade Name	:	Getac
Model Number	:	AX200NGW
Applicable Standard	:	ANSI/IEEE C95.1-1992 / IEEE Std. 1528-2013 47 CFR Part §2.1093 KDB 865664 D01 / KDB 865664 D02 KDB 447498 D01 / KDB 248227 D01 KDB 616217 D04
Received Date	:	May 13, 2020
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Issued by

Approved By :

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Taiwan Accreditation Foundation accreditation number: 1330
Test Firm IC Registration number: 7381A

Note:
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Revision History

Rev.	Issued Date	Revisions	Revised By
00	May 22, 2020	Initial Issue	Nicole Chu
01	Jun. 23, 2020	P06 Revised Frequency range & C2PC explain P26 Revised item	Nicole Chu

Contents

1. General Information

1.1 Reference Applicable Standard

Standard	Description	Version
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
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
47 CFR Part §2.1093	Radiofrequency radiation exposure evaluation: portable devices.	-
KDB 865664 D01	SAR measurement requirement for 100 MHz to 6 GHz.	v01r04
KDB 865664 D02	RF exposure compliance reporting and documentation considerations.	v01r02
KDB 447498 D01	RF exposure procedures and equipment authorization policies for mobile and portable devices	v06
KDB 248227 D01	SAR guidance for IEEE 802.11 (Wi-Fi) transmitters	v02r02
KDB 616217 D04	SAR evaluation considerations for laptop, notebook and tablet computers.	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

System2 Full		
Equipment Class	Mode	Highest Reported 1_g SAR (W/kg)
		Body standalone SAR 1_g(W/kg)
Licensed	WCDMA Band II	0.95
	WCDMA Band IV	0.98
	WCDMA Band V	0.97
	LTE Band 4 (QPSK)	1.03
	LTE Band 7 (QPSK)	1.07
	LTE Band 12 (QPSK)	1.02
	LTE Band 13 (QPSK)	1.04
	LTE Band 25 (QPSK)	1.10
	LTE Band 26 (QPSK)	0.99
	LTE Band 41 (QPSK)	1.14
DTS	WLAN 2.4 GHz Ant Main	0.59
	WLAN 2.4 GHz Ant Aux	1.00
U-NII	WLAN 5 GHz Ant Main	0.83
	WLAN 5 GHz Ant Aux	1.01
DSS	Bluetooth Ant Aux	0.16
Highest Simultaneous Position		Highest Simultaneous Transmission 1_g SAR (W/kg)
Back		1.54

NOTE: 1. 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.
2. WWAN of the SAR value reference to the FCC ID QYLEM7455U of the report no. 1904RS12-03.
3. WLAN test data refer to the report number: 2002FS15 Rev.00.

3. Description of Equipment under Test (EUT)

Applicant	Getac Technology Corporation 5F.,Building A,No.209,Sec.1 Nangang.,Rd., Taipei City, 11568, Taiwan	
Manufacture	Intel Mobile Communications 100 Center Point Circle, Suite 200, Columbia, South Carolina 29210, USA	
Product Type	Wireless module	
Trade Name	Getac	
Model Number	AX200NGW	
FCC ID	QYLAX200NG	
Class II Permissive Change	(1) This is to request a Class II permissive change for FCC ID:QYLAX200NG , originally granted on 2020/3/18 Modification: The major change filed under this application is: Change #1: Additional the accessory is for finger print (Egistec / ETU-801)	
Host Information	Product Type: Tablet Trade Name: Getac Model Name: UX10	
RF Function	Operate Bands	Operate Frequency (MHz)
	IEEE 802.11b / 802.11g / 802.11n	2412 - 2472
	IEEE 802.11n 2.4 GHz 20 MHz IEEE 802.11ax 2.4 GHz 20 MHz	2412 - 2472
	IEEE 802.11n 2.4 GHz 40 MHz IEEE 802.11ax 2.4 GHz 40 MHz	2422 - 2462
	IEEE 802.11a	5180 - 5825
	IEEE 802.11n 5 GHz 20 MHz IEEE 802.11ax 20 MHz	5180 - 5825
	IEEE 802.11n 5 GHz 40 MHz IEEE 802.11ax 40 MHz	5190 - 5795
	IEEE 802.11ac 80 MHz IEEE 802.11ax 80 MHz	5210 - 5775
	IEEE 802.11ac 160 MHz IEEE 802.11ax 160 MHz	5250 - 5570
	Bluetooth BR/EDR	2402 - 2480
	Bluetooth LE	2402 - 2480
Antenna Type	PIFA Antenna	
Device Category	Portable Device	
Application Type	Certification	

Note:The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

Decision of Test Mode

Description	Remarks	SYSTEM 2 Full
Main Board	---	V
CPU	i7-10710U	V
Memory	16 GB	V
HDD	512 GB	V
LCM	Digitizer	V
Upside Option	SE4710	V
Large Battery (Optional)	10.8 VDC, 9240 mAh	V
Bridge Battery (Optional)	7.4 VDC, 2100 mAh	V
Fingerprint CrossMatch(1)	Right Expansion Bay	V
Finger print (2) (Egistec / ETU-801)(*)		V
MSR Reader		V
Module	Intel AX200NGW (WLAN/BT)	V
Module	Getac EM7455 (WWAN / GPS)	V
AC Adapter	INPUT: 100-240 VAC, 50-60 Hz, 1.5 A OUTPUT: 19 VDC, 3.42 A Non-Shielded,1.5 m, with one core	V
Power Cord	3 pin Non-Shielded,1.75 m	V
Digitizer Pen (Optional)	---	V

(*) Add a keypart

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 1.6mW/g as averaged over any 1 gram of tissue for portable devices being used within 20cm 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

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

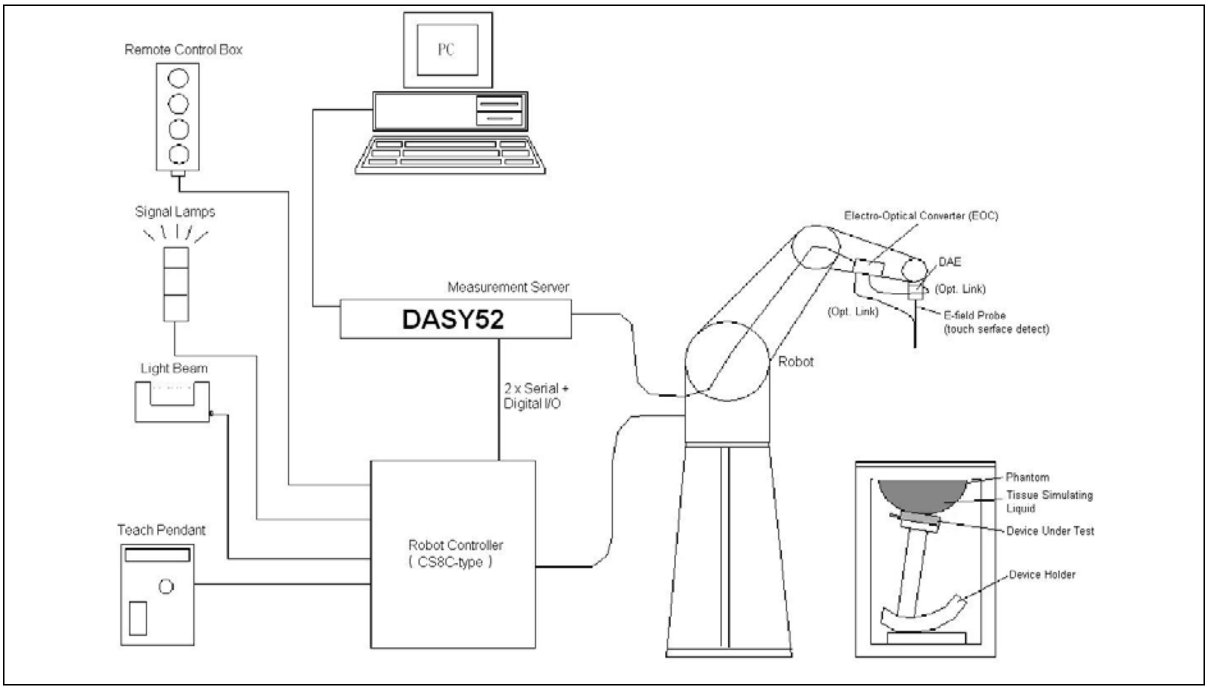
Where：

σ = conductivity of the tissue (S/m)

ρ = mass density of the tissue (kg/m^3)

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. A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
3. A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
4. The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
5. A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
6. A computer operating Windows 2000 or Windows XP.
7. DASY52 software.
8. Remote controls with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
9. The SAM twin phantom enabling testing left-hand and right-hand usage.
10. The device holder for handheld mobile phones.
11. Tissue simulating liquid mixed according to the given recipes.
12. Validation dipole kits allowing validating the proper functioning of the system.

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)
Calibration	ISO/IEC 17025 calibration service available
Frequency	10 MHz to > 6 GHz
	Linearity: ± 0.2 dB (30 MHz to 6 GHz)
Directivity	±0.3 dB in 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

Figure 1. E-field Probe

Figure 2. Probe setup on robot

5.2 Data Acquisition Electronic (DAE) System

Model：	DAE3, DAE4
Construction：	Signal amplifier, multiplexer, A/D converter and control logic. Serial optical link for communication with DASY4/5 embedded system (fully remote controlled). Two step probe touch detector for mechanical surface detection and emergency robot stop.
Measurement Range：	-100 to +300 mV (16 bit resolution and two range settings: 4mV, 400mV)
Input Offset Voltage：	< 5μV (with auto zero)
Input Bias Current：	< 50 fA
Dimensions：	60 x 60 x 68 mm

5.3 Robot

Positioner：	Stäubli Unimation Corp. Robot Model: TX90XL
Repeatability：	±0.02 mm
No. of Axis：	6

5.4 Measurement Server

Processor：	PC/104 with a 400MHz intel ULV Celeron
I/O-board：	Link to DAE4 (or DAE3)
	16-bit A/D converter for surface detection system
	Digital I/O interface
	Serial link to robot
	Direct emergency stop output for robot

5.5 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.

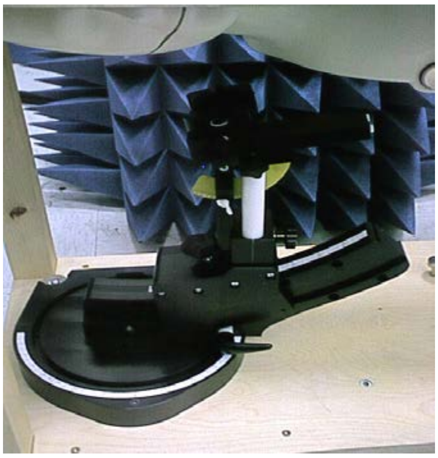


Figure 3. Device Holder

Figure 4. Device Holder for Laptops

5.6 Oval Flat Phantom - ELI 4.0

The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (Oval Flat) phantom defined in IEEE 1528-2013, CENELEC 50361 and IEC 62209. 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 4.0

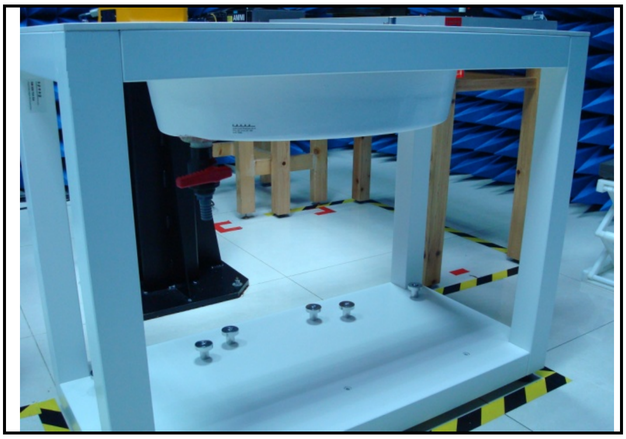


Figure 5. Oval Flat Phantom

5.7 Data Storage and Evaluation

5.7.1 Data Storage

The DASY software stores the assessed data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all the necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension DA4 or DA5. The post processing software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of erroneous parameter settings. For example, if a measurement has been performed with an incorrect crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be reevaluated.

5.7.2 Data Evaluation

The DASY post processing software (SEMCAD) automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software：

Probe parameters：	- Sensitivity	*Normi, ai0, ai1, ai2*
	- Conversion factor	*ConvFi*
	- Diode compression point	*dcpi*
Device parameters：	- Frequency	*f*
	- Crest factor	*cf*
Media parameters：	- Conductivity	*σ*
	- Density	*ρ*

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.
The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as：

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

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

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

E-field probes：

$$E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

H-field probes：

$$H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1} f + a_{i2} f^2}{f}$$

with *Vi* = compensated signal of channel i (i = x, y, z)

Normi= sensor sensitivity of channel i (i = x, y, z)

μV/(V/m)2 for E-field Probes

ConvF = sensitivity enhancement in solution

aij = sensor sensitivity factors for H-field probes

f = carrier frequency [GHz]

Ei = electric field strength of channel i in V/*m*

Hi = magnetic field strength of channel i in A/m

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

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

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

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

with *SAR* = local specific absorption rate in mW/g

Etot = total field strength in V/m

σ = conductivity in [mho/m] or [Siemens/m]

ρ = equivalent tissue density in g/cm3

＊Note：That the density is set to 1, to account for actual head tissue density rather than the density of the tissue simulating liquid.

The power flow density is calculated assuming the excitation field to be a free space field.

$$P_{pwe} = \frac{E_{tot}^2}{3770} \quad \textit{or} \quad P_{pwe} = \frac{H_{tot}^2}{37.7}$$

with *Ppwe* = equivalent power density of a plane wave in mW/cm2

Etot = total electric field strength in V/m

Htot = total magnetic field strength in A/m

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
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
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

6.2 Liquid Parameters

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

Tissue Temp (°C)	Head / Body	Frequency (MHz)	Cond.	Perm.	target Cond.	target Perm.	σ (Delta) (%)	εr (Delta) (%)	Limit (%)	Date
			σ	εr	σ	εr				
22.6	Head	2441 MHz	1.79	39.985	1.79	39.22	0.06	1.95	±5	May. 05, 2020
22.6	Head	2437 MHz	1.79	39.994	1.79	39.22	0.06	1.97	±5	May. 05, 2020
22.6	Head	2462 MHz	1.82	39.930	1.81	39.18	0.33	1.91	±5	May. 05, 2020
22.5	Head	5290 MHz	4.71	36.399	4.75	35.91	-0.95	1.36	±5	May. 07, 2020
22.5	Head	5690 MHz	5.25	35.556	5.16	35.41	1.78	0.41	±5	May. 07, 2020
22.5	Head	5775 MHz	5.28	35.586	5.25	35.33	0.63	0.72	±5	May. 07, 2020

6.3 Liquid Depth

According to KDB865664 ,the depth of tissue-equivalent liquid in a phantom must be ≥ 15.0 cm with ≤ ± 0.5 cm variation for SAR measurements ≤ 3 GHz and ≥ 10.0 cm with ≤ ± 0.5 cm variation for measurements > 3 GHz.

Figure 6. Liquid Height for Body SAR

7. SAR Testing with RF Transmitters

7.1 SAR Testing with 802.11 Transmitters

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

< 2.4 GHz WLAN >

According to KDB 248227 D01, 802.11a/g/n/ac/ax modes have the same specified maximum output power, largest channel bandwidth, lowest order modulation and lowest data rate, the lowest order 802.11 mode is selected; i.e., 802.11a is chosen over 802.11n then 802.11ac or 802.11g is chosen over 802.11n.

System2 Full							
Band	Data Rate	CH	Frequency (MHz)	Average			
				Conducted power		Tune-up power	
				Ant-Main	Ant-Aux	Ant-Main	Ant-Aux
IEEE 802.11b	1M	1	2412.0	19.38	18.33	20.00	18.50
		6	2437.0	19.81	18.38	20.00	18.50
		11	2462.0	18.92	18.35	20.00	18.50
IEEE 802.11g	6M	1	2412.0	16.87	16.91	17.00	17.00
		6	2437.0	19.71	18.08	20.00	18.50
		11	2462.0	14.82	14.72	15.00	15.00
IEEE 802.11n 2.4 GHz 20 MHz	6.5M	1	2412.0	16.81	16.91	17.00	17.00
		6	2437.0	19.69	18.07	20.00	18.50
		11	2462.0	16.77	16.77	17.00	17.00
IEEE 802.11n 2.4 GHz 40 MHz	13.5M	3	2422.0	16.11	16.43	16.50	16.50
		6	2437.0	16.71	16.81	17.00	17.00
		9	2452.0	15.31	15.14	15.50	15.50
IEEE 802.11ax 2.4 GHz 20 MHz	6.5M	1	2412.0	16.73	16.82	17.00	17.00
		6	2437.0	19.11	17.54	19.50	18.00
		11	2462.0	16.36	16.23	16.50	16.50
IEEE 802.11ax 2.4 GHz 40 MHz	13.5M	3	2422.0	16.71	16.76	17.00	17.00
		6	2437.0	16.17	16.37	16.50	16.50
		9	2452.0	14.83	14.61	15.00	15.00

< 5 GHz WLAN >

The initial test configuration for 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) 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).

System2 Full								
Band		Date Rate or Sub-test	CH	Frequency (MHz)	Average Conducted power		Average Tune-up power	
					Ant-Main	Ant-Aux	Ant-Main	Ant-Aux
802.11a	U-NII-1	6M	36	5180.0	11.27	17.41	11.50	17.50
			40	5200.0	11.30	17.44	11.50	17.50
			48	5240.0	11.37	17.39	11.50	17.50
	U-NII-2A		52	5260.0	11.26	17.38	11.50	17.50
			56	5280.0	11.43	17.42	11.50	17.50
			64	5320.0	11.32	17.36	11.50	17.50
	U-NII-2C		100	5500.0	12.84	17.36	13.00	17.50
			120	5600.0	12.93	17.36	13.00	17.50
			140	5700.0	12.78	17.40	13.00	17.50
	U-NII-3		149	5745.0	12.93	17.33	13.00	17.50
			157	5785.0	12.86	17.43	13.00	17.50
			165	5825.0	12.80	17.25	13.00	17.50
IEEE 802.11n 20 MHz	U-NII-1	6.5M	36	5180.0	11.43	17.27	11.50	17.50
			40	5200.0	11.29	17.36	11.50	17.50
			48	5240.0	11.36	17.24	11.50	17.50
	U-NII-2A		52	5260.0	11.47	17.34	11.50	17.50
			56	5280.0	11.43	17.40	11.50	17.50
			64	5320.0	11.40	17.18	11.50	17.50
	U-NII-2C		100	5500.0	12.91	17.39	13.00	17.50
			120	5600.0	12.94	17.41	13.00	17.50
			140	5700.0	12.98	17.45	13.00	17.50
	U-NII-3		149	5745.0	12.99	17.36	13.00	17.50
			157	5785.0	12.79	17.35	13.00	17.50
			165	5825.0	12.76	17.24	13.00	17.50
IEEE 802.11ax 20 MHz	U-NII-1	6.5M	36	5180.0	11.36	17.12	11.50	17.50
			40	5200.0	11.39	17.34	11.50	17.50
			48	5240.0	11.39	17.18	11.50	17.50
	U-NII-2A		52	5260.0	11.46	17.33	11.50	17.50
			56	5280.0	11.29	17.33	11.50	17.50
			64	5320.0	11.43	17.15	11.50	17.50
	U-NII-2C		100	5500.0	12.79	17.37	13.00	17.50
			120	5600.0	12.92	17.38	13.00	17.50
			140	5700.0	12.92	17.42	13.00	17.50
	U-NII-3		149	5745.0	12.92	17.29	13.00	17.50
			157	5785.0	12.96	17.32	13.00	17.50
			165	5825.0	12.76	17.20	13.00	17.50

< 5 GHz WLAN >

System2 Full								
Band		Date Rate or Sub-test	CH	Frequency (MHz)	Average Conducted power		Average Tune-up power	
					Ant-Main	Ant-Aux	Ant-Main	Ant-Aux
IEEE 802.11n 40 MHz	U-NII-1	13.5M	38	5190.0	11.42	17.38	11.50	17.50
			46	5230.0	11.23	17.03	11.50	17.50
	U-NII-2A		54	5270.0	11.44	17.46	11.50	17.50
			62	5310.0	11.41	17.22	11.50	17.50
	U-NII-2C		102	5510.0	12.81	17.11	13.00	17.50
			118	5590.0	12.92	17.29	13.00	17.50
			134	5670.0	12.84	17.34	13.00	17.50
	U-NII-3		151	5755.0	12.99	17.47	13.00	17.50
			159	5795.0	12.79	17.36	13.00	17.50
IEEE 802.11ax 40 MHz	U-NII-1	13.5M	38	5190.0	11.32	17.34	11.50	17.50
			46	5230.0	11.31	17.01	11.50	17.50
	U-NII-2A		54	5270.0	11.42	17.44	11.50	17.50
			62	5310.0	11.41	17.19	11.50	17.50
	U-NII-2C		102	5510.0	12.94	17.10	13.00	17.50
			118	5590.0	12.86	17.27	13.00	17.50
			134	5670.0	12.95	17.31	13.00	17.50
	U-NII-3		151	5755.0	12.86	17.45	13.00	17.50
			159	5795.0	12.93	17.32	13.00	17.50
IEEE 802.11ac 80 MHz	U-NII-1	29.3M	42	5210.0	11.27	17.11	11.50	17.50
	U-NII-2A		58	5290.0	11.48	17.23	11.50	17.50
	U-NII-2C		106	5530.0	12.98	17.26	13.00	17.50
			122	5610.0	12.93	17.16	13.00	17.50
			138	5690.0	12.91	17.28	13.00	17.50
	U-NII-3		155	5775.0	12.98	17.24	13.00	17.50
IEEE 802.11ax 80 MHz	U-NII-1	29.3M	42	5210.0	11.31	17.00	11.50	17.50
	U-NII-2A		58	5290.0	11.27	17.21	11.50	17.50
	U-NII-2C		106	5530.0	12.92	17.22	13.00	17.50
			122	5610.0	12.84	17.14	13.00	17.50
			138	5690.0	12.89	17.24	13.00	17.50
	U-NII-3		155	5775.0	12.84	17.23	13.00	17.50
IEEE 802.11ac 160 MHz	U-NII-1+2A	58.5M	50	5250.0	10.77	14.32	11.00	14.50
	U-NII-2C		114	5570.0	12.28	14.79	12.50	15.00
IEEE 802.11ax 160 MHz	U-NII-1+2A	58.5M	50	5250.0	10.76	14.65	11.00	15.00
	U-NII-2C		114	5570.0	12.29	14.63	12.50	15.00

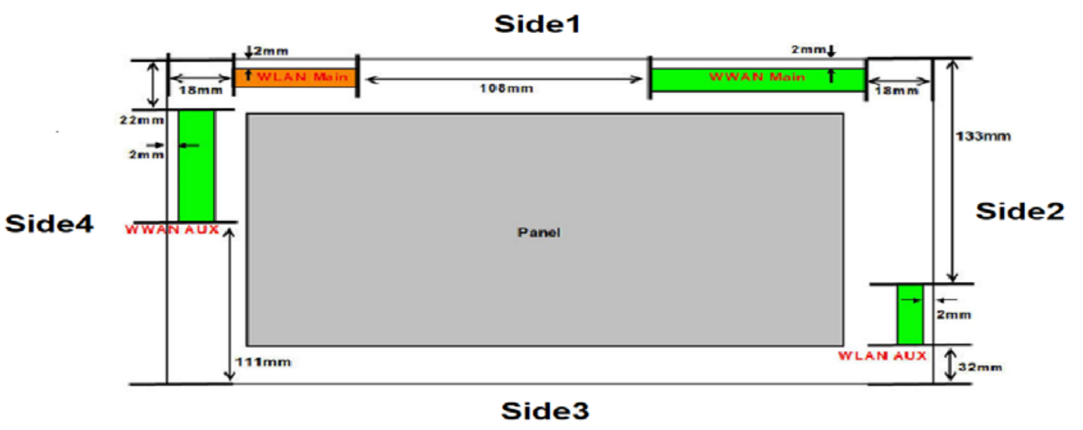
< Buletooth >

Band	CH	Frequency (MHz)	Packet Type	Average Power	Average Tune-up Power
				dBm	dBm
1Mbps (GFSK)	0	2402.0	DH1	8.75	9.50
			DH3	8.76	9.50
			DH5	8.77	9.50
	39	2441.0	DH1	8.93	9.50
			DH3	8.95	9.50
			DH5	8.96	9.50
	78	2480.0	DH1	9.30	9.50
			DH3	9.31	9.50
			DH5	**9.32**	9.50
2Mbps (π/4-DQPSK)	0	2402.0	DH1	5.57	6.00
			DH3	5.59	6.00
			DH5	5.60	6.00
	39	2441.0	DH1	5.50	6.00
			DH3	5.51	6.00
			DH5	5.52	6.00
	78	2480.0	DH1	6.11	6.50
			DH3	6.12	6.50
			DH5	6.14	6.50
3Mbps (8DPSK)	0	2402.0	DH1	5.58	6.00
			DH3	5.60	6.00
			DH5	5.62	6.00
	39	2441.0	DH1	5.52	6.00
			DH3	5.53	6.00
			DH5	5.55	6.00
	78	2480.0	DH1	6.13	6.50
			DH3	6.14	6.50
			DH5	6.16	6.50
Bluetooth LE 1M	0	2402.0	---	7.62	8.00
	19	2440.0		7.54	8.00
	39	2480.0		7.96	8.00
Bluetooth LE C2	0	2402.0	---	7.60	8.00
	19	2440.0		7.51	8.00
	39	2480.0		6.95	8.00
Bluetooth LE 2M	0	2402.0	---	7.63	8.00
	19	2440.0		7.54	8.00
	39	2480.0		7.95	8.00

7.3 Antenna location

Ant. Used	Antenna to user distance (mm)					
	Front	Back	Side 1	Side 2	Side 3	Side 4
WLAN Ant-Main	5	5	2	150	205	18
WLAN Ant-Aux / Bluetooth Ant	2	2	133	2	32	216

System2 Full



7.4 Standalone SAR Test Exclusion Calculation

Transmitter and antenna implementation as below:

Body SAR test reduction											
Ant. Used	Band	Frequency	Tune-Power		Distance of Ant. To User (mm)						
		(GHz)	(dBm)	(mW)	Front	Back	Side1	Side2	Side3	Side4	
Bluetooth Antenna	Bluetooth	2.480	9.5	9	5	5	133	5	32	216	
WLAN Antenna	2.4GHz WLAN Ant-Main	2.462	20.0	100	5	5	5	150	205	18	
	2.4GHz WLAN Ant-Aux	2.462	18.5	71	5	5	133	5	32	216	
	5GHz WLAN Ant-Main	5.825	13.0	20	5	5	5	150	205	18	
	5GHz WLAN Ant-Aux	5.825	17.5	56	5	5	133	5	32	216	

Body SAR test reduction									
Ant. Used	Band	Frequency	Tune-Power		Distance of Ant. To User (mm)				
		(GHz)	(dBm)	(mW)	Back	Side1	Side2	Side3	Side4
Bluetooth Antenna	Bluetooth	2.480	9.5	9	2.8	925.0	2.8	0.4	1755.0
					EXEMPT	EXEMPT	EXEMPT	EXEMPT	EXEMPT
WLAN Antenna	2.4GHz WLAN Ant-Main	2.462	20.0	100	31.4	31.4	1096.0	1646.0	8.7
					MEASURE	MEASURE	EXEMPT	EXEMPT	MEASURE
	2.4GHz WLAN Ant-Aux	2.462	18.5	71	22.3	926.0	22.3	3.5	1756.0
					MEASURE	EXEMPT	MEASURE	MEASURE	EXEMPT
	5GHz WLAN Ant-Main	5.825	13.0	20	9.7	9.7	1062.0	1612.0	2.7
					MEASURE	MEASURE	EXEMPT	EXEMPT	EXEMPT
	5GHz WLAN Ant-Aux	5.825	17.5	56	27.0	892.0	27.0	4.2	1722.0
					MEASURE	EXEMPT	MEASURE	MEASURE	EXEMPT

Test Note

1.The test reduction for distance less than 50mm and more than 50mm. Use the max power to make sure minimum distance by evaluated for SAR testing.

2.For 100 MHz to 6 GHz and test separation distances > 50 mm, According to KDB 447498, if the calculated Power threshold is less than the output power then SAR testing is required.

3.For 100 MHz to 6 GHz and test separation distances ≤ 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following:

According to KDB 447498, if the calculated threshold value are >3 then Body SAR and >7.5 then Limbs SAR Calculated Value only inculde number format, that is mean through compare output power with threshold, if the Calculated value more than 3, the SAR test should be perform. Otherwise, the SAR test could be exempt. (<50mm)

4.When an antenna qualifies for the standalone SAR test exclusion of KDB 447498 section 4.3.1 and also transmits simultaneously with other antennas, the standalone SAR value must be estimated according to KDB 447498 section "4.3.2. Simultaneous transmission

5.We used highest frequency and power,that result should be evaluated the worst case.

6.Power and distance are rounded to the nearest mW and mm before calculation.

7.The result is rounded to one decimal place for comparison.

7.5 Simultaneous Transmitting Evaluate

Simultaneous transmission configurations as below:

Condition(s)	Band					
	WWAN Ant	WLAN 2.4 GHz Ant-Main	WLAN 2.4 GHz Ant-Aux	WLAN 5 GHz Ant-Main	WLAN 5 GHz Ant-Aux	Bluetooth Ant
1	V	V	---	---	---	V
2	V	V	V	---	---	---
3	V	---	---	V	---	V
4	V	---	---	V	V	---
5	V	---	---	V	V	V

7.5.1 Estimated SAR

Body SAR test reduction											
Ant. Used	Band	Frequency	Tune-Power		Distance of Ant. To SAR (W/kg)						
		(GHz)	(dBm)	(mW)	Front	Back	Side1	Side2	Side3	Side4	
Bluetooth Antenna	Bluetooth	2.480	9.5	9	0.38	0.38	0.01	0.38	0.06	0.01	
WLAN Antenna	2.4GHz WLAN Ant-Main	2.462	20	100	---	---	---	0.14	0.1	---	
	2.4GHz WLAN Ant-Aux	2.462	18.5	71	---	---	0.11	---	---	0.07	
	5GHz WLAN Ant-Main	5.825	13	20	---	---	---	0.04	0.03	0.36	
	5GHz WLAN Ant-Aux	5.825	17.5	56	---	---	0.14	---	---	0.08	

7.5.2 Sum of 1-g SAR of all simultaneously transmitting

When the sum of 1-g SAR of all simultaneously transmitting antennas in and operating mode and exposure condition combination is within the SAR limit, SAR test exclusion applies to that simultaneous transmission configuration.

Sum of 1-g SAR of summary as below:

System2 Full									
Phantom Position		Spacing (mm)	ASSY	WWAN Ant (1) Band	WWAN Ant (1) SAR^{1g} (W/Kg)	5 GHz WLAN Ant Main (2) Band	5 GHz WLAN Ant Main (2) SAR^{1g} (W/Kg)	(1)+(2) Σ SAR^{1g} (W/Kg)	Event
Flat	Back	0	N/A	WWAN Band	1.10	IEEE 802.11	0.08	1.18	<1.6
	Side 1	0	N/A	WWAN Band	1.14	IEEE 802.11	0.83	1.97	>1.6
	Side 2	0	N/A	WWAN Band	0.11	IEEE 802.11	*0.04	0.15	<1.6
	Side 3	0	N/A	WWAN Band	0.04	IEEE 802.11	*0.03	0.07	<1.6
	Side 4	0	N/A	WWAN Band	0.17	IEEE 802.11	*0.36	0.53	<1.6
Phantom Position		Spacing (mm)	ASSY	WWAN Ant (1) Band	WWAN Ant (1) SAR^{1g} (W/Kg)	5 GHz WLAN Ant Aux (3) Band	5 GHz WLAN Ant Aux (3) SAR^{1g} (W/Kg)	(1)+(3) Σ SAR^{1g} (W/Kg)	Event
Flat	Back	0	N/A	WWAN Band	1.10	IEEE 802.11	0.44	1.54	<1.6
	Side 1	0	N/A	WWAN Band	1.14	IEEE 802.11	*0.14	1.28	<1.6
	Side 2	0	N/A	WWAN Band	0.11	IEEE 802.11	1.01	1.12	<1.6
	Side 3	0	N/A	WWAN Band	0.04	IEEE 802.11	0.31	0.35	<1.6
	Side 4	0	N/A	WWAN Band	0.17	IEEE 802.11	*0.08	0.25	<1.6
Phantom Position		Spacing (mm)	ASSY	WWAN Ant (1) Band	WWAN Ant (1) SAR^{1g} (W/Kg)	2.4 GHz WLAN Ant Main (4) Band	2.4 GHz WLAN Ant Main (4) SAR^{1g} (W/Kg)	(1)+(4) Σ SAR^{1g} (W/Kg)	Event
Flat	Back	0	N/A	WWAN Band	1.10	IEEE 802.11	0.17	1.27	<1.6
	Side 1	0	N/A	WWAN Band	1.14	IEEE 802.11	0.59	1.73	>1.6
	Side 2	0	N/A	WWAN Band	0.11	IEEE 802.11	*0.14	0.25	<1.6
	Side 3	0	N/A	WWAN Band	0.04	IEEE 802.11	*0.10	0.14	<1.6
	Side 4	0	N/A	WWAN Band	0.17	IEEE 802.11	0.05	0.22	<1.6
Phantom Position		Spacing (mm)	ASSY	WWAN Ant (1) Band	WWAN Ant (1) SAR^{1g} (W/Kg)	2.4 GHz WLAN Ant Aux (5) Band	2.4 GHz WLAN Ant Aux (5) SAR^{1g} (W/Kg)	(1)+(5) Σ SAR^{1g} (W/Kg)	Event
Flat	Back	0	N/A	WWAN Band	1.10	IEEE 802.11	0.26	1.36	<1.6
	Side 1	0	N/A	WWAN Band	1.14	IEEE 802.11	*0.11	1.25	<1.6
	Side 2	0	N/A	WWAN Band	0.11	IEEE 802.11	1.00	1.11	<1.6
	Side 3	0	N/A	WWAN Band	0.04	IEEE 802.11	0.28	0.32	<1.6
	Side 4	0	N/A	WWAN Band	0.17	IEEE 802.11	*0.07	0.24	<1.6
Phantom Position		Spacing (mm)	ASSY	WWAN Ant (1) Band	WWAN Ant (1) SAR^{1g} (W/Kg)	Bluetooth Ant Aux (6) Band	Bluetooth Ant Aux (6) SAR^{1g} (W/Kg)	(1)+(6) Σ SAR^{1g} (W/Kg)	Event
Flat	Back	0	N/A	WWAN Band	1.10	Bluetooth	0.04	1.14	<1.6
	Side 1	0	N/A	WWAN Band	1.14	Bluetooth	*0.01	1.15	<1.6
	Side 2	0	N/A	WWAN Band	0.11	Bluetooth	0.16	0.27	<1.6
	Side 3	0	N/A	WWAN Band	0.04	Bluetooth	*0.06	0.10	<1.6
	Side 4	0	N/A	WWAN Band	0.17	Bluetooth	*0.01	0.18	<1.6

System2 Full

Phantom Position		Spacing (mm)	ASSY	5 GHz WLAN Ant Main (2)		5 GHz WLAN Ant Aux (3)		(1)+(3) ∑ SAR^{1g} (W/Kg)	Event
				Band	SAR^{1g} (W/Kg)	Band	SAR^{1g} (W/Kg)		
Flat	Back	0	N/A	IEEE 802.11	0.08	IEEE 802.11	0.44	0.52	<1.6
	Side 1	0	N/A	IEEE 802.11	0.83	IEEE 802.11	*0.14	0.97	<1.6
	Side 2	0	N/A	IEEE 802.11	*0.04	IEEE 802.11	1.01	1.05	<1.6
	Side 3	0	N/A	IEEE 802.11	*0.03	IEEE 802.11	0.31	0.34	<1.6
	Side 4	0	N/A	IEEE 802.11	*0.36	IEEE 802.11	*0.08	0.44	<1.6

Phantom Position		Spacing (mm)	ASSY	5 GHz WLAN Ant Main (2)		Bluetooth Ant Aux (6)		(2)+(3) ∑ SAR^{1g} (W/Kg)	Event
				Band	SAR^{1g} (W/Kg)	Band	SAR^{1g} (W/Kg)		
Flat	Back	0	N/A	IEEE 802.11	0.08	Bluetooth	0.04	0.12	<1.6
	Side 1	0	N/A	IEEE 802.11	0.83	Bluetooth	*0.01	0.84	<1.6
	Side 2	0	N/A	IEEE 802.11	*0.04	Bluetooth	0.16	0.20	<1.6
	Side 3	0	N/A	IEEE 802.11	*0.03	Bluetooth	*0.06	0.09	<1.6
	Side 4	0	N/A	IEEE 802.11	*0.36	Bluetooth	*0.01	0.37	<1.6

Phantom Position		Spacing (mm)	ASSY	5 GHz WLAN Ant Aux (3)		Bluetooth Ant Aux (6)		(3)+(6) ∑ SAR^{1g} (W/Kg)	Event
				Band	SAR^{1g} (W/Kg)	Band	SAR^{1g} (W/Kg)		
Flat	Back	0	N/A	IEEE 802.11	0.44	Bluetooth	0.04	0.48	<1.6
	Side 1	0	N/A	IEEE 802.11	*0.14	Bluetooth	*0.01	0.15	<1.6
	Side 2	0	N/A	IEEE 802.11	1.01	Bluetooth	0.16	1.17	<1.6
	Side 3	0	N/A	IEEE 802.11	0.31	Bluetooth	*0.06	0.37	<1.6
	Side 4	0	N/A	IEEE 802.11	*0.08	Bluetooth	*0.01	0.09	<1.6

Phantom Position		Spacing (mm)	ASSY	2.4 GHz WLAN Ant Main (4)		2.4 GHz WLAN Ant Aux (5)		(4)+(5) ∑ SAR^{1g} (W/Kg)	Event
				Band	SAR^{1g} (W/Kg)	Band	SAR^{1g} (W/Kg)		
Flat	Back	0	N/A	IEEE 802.11	0.17	IEEE 802.11	0.26	0.43	<1.6
	Side 1	0	N/A	IEEE 802.11	0.59	IEEE 802.11	*0.11	0.70	<1.6
	Side 2	0	N/A	IEEE 802.11	*0.14	IEEE 802.11	1.00	1.14	<1.6
	Side 3	0	N/A	IEEE 802.11	*0.10	IEEE 802.11	0.28	0.38	<1.6
	Side 4	0	N/A	IEEE 802.11	0.05	IEEE 802.11	*0.07	0.12	<1.6

Phantom Position		Spacing (mm)	ASSY	2.4 GHz WLAN Ant Main (4)		Bluetooth Ant Aux (6)		(4)+(6) ∑ SAR^{1g} (W/Kg)	Event
				Band	SAR^{1g} (W/Kg)	Band	SAR^{1g} (W/Kg)		
Flat	Back	0	N/A	IEEE 802.11	0.17	Bluetooth	0.04	0.21	<1.6
	Side 1	0	N/A	IEEE 802.11	0.59	Bluetooth	*0.01	0.60	<1.6
	Side 2	0	N/A	IEEE 802.11	*0.14	Bluetooth	0.16	0.30	<1.6
	Side 3	0	N/A	IEEE 802.11	*0.10	Bluetooth	*0.06	0.16	<1.6
	Side 4	0	N/A	IEEE 802.11	0.05	Bluetooth	*0.01	0.06	<1.6

Note: *=Estimated SAR

7.5.3 SAR to peak location separation ratio (SPLSR)

When the sum of SAR is larger than the limit, SAR test exclusion is determined by the SAR to peak location separation ratio. The ratio is determined by (SAR1 + SAR2)^1.5/Ri, rounded to two decimal digits, and must be ≤ 0.04 for all antenna pairs in the configuration to qualify for 1-g SAR test exclusion.

WWAN +5 GHz Main

Antenna	Frequency (GHz)	Reported SAR1g (W/Kg)	Σ Reported SAR1g (W/Kg)	Antenna pair (mm)	Peak location separation ratio
WWAN Main	2.506	1.14	1.97	188.08	0.01
WLAN 5 GHz Main	5.290	0.83			

Maxima and position w.r.t. Grid Reference Point	associated 1g averages
Zoom Scan (C:\Users\dasy\Desktop\0401 SPLSR\79_LTE Band 41 CH 39750_QPSK_BW 20M_1RB Size 49RB O...	
Max. 1 at (-9.00, 86.20, 10.04) mm	1.14 W/kg (Power Scale Factor: 1.072)
Zoom Scan (C:\Users\dasy\Desktop\0401 SPLSR\801_IEEE 802.11ac80 CH58_VHT0_Side 1_0mm_ant B.da53:0...	
Max. 2 at (6.40, -101.00, 0.41) mm	0.83 W/kg (Power Scale Factor: 1.03113)
Distances and Separation Ratios	
Max. 1 - Max. 2	Distance [mm]: 188.08 / Separation ratio [W/kg/mm]: 0.01

WWAN + 2.4 GHz Main

Antenna	Frequency (GHz)	Reported SAR1g (W/Kg)	Σ Reported SAR1g (W/Kg)	Antenna pair (mm)	Peak location separation ratio
WWAN Main	2.506	1.14	1.73	191.2	0.01
WLAN 2.4 GHz Main	2.437	0.59	0.69		

Maxima and position w.r.t. Grid Reference Point	associated 1g averages
Zoom Scan (C:\Users\dasy\Desktop\0401 SPLSR\79_LTE Band 41 CH 39750_QPSK_BW 20M_1RB Size 49RB O...	
Max. 1 at (-9.00, 86.20, 10.04) mm	1.14 W/kg (Power Scale Factor: 1.072)
Zoom Scan (C:\Users\dasy\Desktop\0401 SPLSR\750_IEEE 802.11b CH6_1M_Side 1_0mm_ant B.da53:0/Flat)	
Max. 2 at (8.00, -104.00, 0.38) mm	0.59 W/kg (Power Scale Factor: 1.052315)
Distances and Separation Ratios	
Max. 1 - Max. 2	Distance [mm]: 191.20 / Separation ratio [W/kg/mm]: 0.01

7.6 SAR test reduction according to KDB

General:

- The test data reported are the worst-case SAR value with the position set in a typical configuration.
  Test procedures used were according to FCC, Supplement C [June 2001], IEEE1528-2013.
- All modes of operation were investigated, and worst-case results are reported.
- Tissue parameters and temperatures are listed on the SAR plots.
- Batteries are fully charged for all readings.
- When the Channel's SAR 1 g of maximum conducted power is > 0.8 mW/g, low, middle and high channel are supposed to be tested.

KDB 447498:

- The test data reported are the worst-case SAR value with the position set in a typical configuration.
  Test procedures used were according to IEEE1528-2013.

KDB 865664:

- Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg.
- When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.
- Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg.
- Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

KDB 248227:

- Refer 7.1 SAR Testing with 802.11 Transmitters.

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

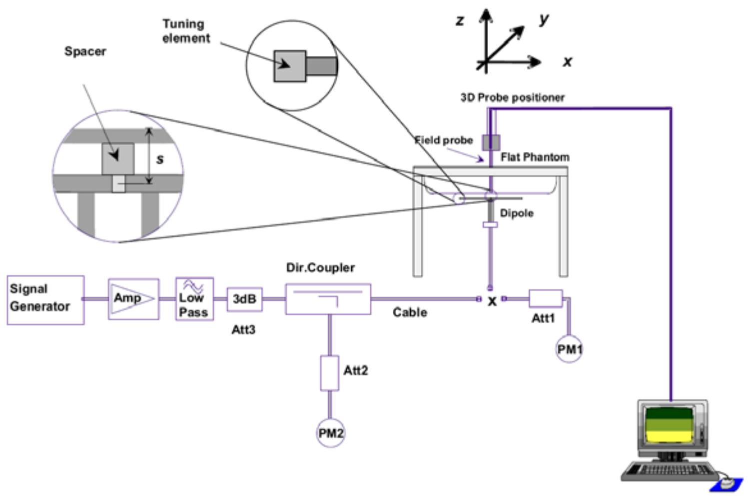


Figure 7. System Verification Setup Diagram

Figure 8. 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.

Mixture Type	Frequency (MHz)	Power	Probe	Dipole	SAR1 g (W/Kg)	Normalize to 1 Watt 1 g (W/Kg)	1 W T arget SAR1 g [W/kg]	SAR10 g (W/Kg)	Normalize to 1 Watt 10 g (W/Kg)	1 W Target SAR10 g [W/kg]	Difference percentage		Date
			Model / Serial No.	Model / Serial No.							1 g	10 g	
Head	2450	250 mW	EX3DV4-SN3977	D2450V2 – SN903	13.6	54.4	51.10	6.43	25.72	23.40	6.1%	9.0%	May. 05, 2020
Head	5250	100 mW	EX3DV4-SN3977	D5250V2 – SN1145	7.94	79.4	78.80	2.13	21.8	22.60	0.8%	-3.7%	May. 07, 2020
Head	5600	100 mW	EX3DV4-SN3977	D5600V2 – SN1145	8.63	86.3	81.00	2.37	23.7	23.20	6.1%	2.1%	May. 07, 2020
Head	5750	100 mW	EX3DV4-SN3977	D5750V2 – SN1145	8.13	81.3	78.80	2.26	22.6	22.40	3.1%	0.9%	May. 07, 2020

8.3 Test Equipment List

Testing Engineer: Kris Pan, Jason Tsao

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Cal. Date	Cal. Period
SPEAG	2450MHz System Validation Kit	D2450V2	903	2019/10/15	1 year
SPEAG	5GHz System Validation Kit	D5GHzV2	1145	2019/10/16	1 year
SPEAG	Dosimetric E-Field Probe	EX3DV4	3977	2019/08/30	1 year
SPEAG	Data Acquisition Electronics	DAE4	779	2019/11/29	1 year
SPEAG	Measurement Server	SE UMS 011 AA	1025	NCR	
SPEAG	Device Holder	N/A	N/A	NCR	
SPEAG	Phantom	ELI V4.0	1036	NCR	
SPEAG	Robot	Staubli TX90XL	F07/564ZA1/A/01	NCR	
SPEAG	Software	DASY52 V52.10 (3)	N/A	NCR	
SPEAG	Software	SEMCAD X V14.6.10 (7331)	N/A	NCR	
HILA	Digital Thermometer	TM-906A	1500033	2019/10/28	1 year
Agilent	Power Sensor	8481H	3318A20779	2019/06/11	1 year
Agilent	Power Meter	EDM Series E4418B	GB40206143	2019/06/11	1 year
Agilent	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 3. Test Equipment List

9. Measurement Uncertainty

Decision Rule

■Uncertainty is not included.

□Uncertainty is included.

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

IEC 62209-2 Measurement uncertainty evaluation template for 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	-

10. 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

10.1 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

10.2 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.

Grid Type	Frequency		Step size (mm)			X*Y*Z (Point)	Cube size			Step size		
			X	Y	Z		X	Y	Z	X	Y	Z
uniform grid	≦ 3 GHz	≦2 GHz	≤ 8	≤ 8	≤ 5	5*5*7	32	32	30	8	8	5
		2 G – 3 G	≤ 5	≤ 5	≤ 5	7*7*7	30	30	30	5	5	5
	3 – 6 GHz	3 – 4 GHz	≤ 5	≤ 5	≤ 4	7*7*8	30	30	28	5	5	4
		4 – 5 GHz	≤ 4	≤ 4	≤ 3	8*8*10	28	28	27	4	4	3
		5 – 6 GHz	≤ 4	≤ 4	≤ 2	8*8*12	28	28	22	4	4	2

(Our measure settings are refer KDB Publication 865664 D01v01r04)

10.3 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.

10.4 SAR Averaged Methods

In DASY, the interpolation and extrapolation are both based on the modified Quadratic Shepard's method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation. Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1 % for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5 mm.

10.5 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 drift more than 5 %, the SAR will be retested.

11. SAR Test Results Summary

1. When the reported SAR of the highest measured maximum output power channel is > 0.8 W/kg, SAR is required using the next highest measured output power channel for 802.11b DSSS.
2. 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, SAR is not required for 2.4G OFDM configuration.
3. The initial test configuration for 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.
4. SAR for the initial test configuration is measured using the highest maximum output power channel.
5. When the same maximum output power is specified for both bands, begin SAR measurement in U-NII-2A band by applying the OFDM SAR requirements. If the highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band for that configuration (802.11 mode and exposure condition); otherwise, each band is tested independently for SAR.
6. When different maximum output power is specified for the band1&band2A, begin SAR measurement in the band with higher specified maximum output power.The highest reported SAR for the tested configuration is adjusted by the ratio of lower to higher specified maximum output power for the two bands.When the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for the band with lower maximum output power in that test configuration; otherwise, each band is tested independently for SAR.
7. If Initial test configuration SAR for 5G OFDM band is > 0.8 W/kg, SAR is required for next highest output channel in initial test configuration. The next highest output channel SAR is ≤ 1.2 W/kg, SAR is not required for subsequent next highest output channel.
8. Bridge battery is the battery2 which using in test mode.

11.1 Body SAR Measurement

System2 Full														
Index.	Band	Mode	Frequency		Data Rate	Test Position	Spacing	EUT & Accessory	SAR 1 g	Burst Avg Powe (dBm)	Max tune-up (dBm)	Duty Cycle (%)	Reported SAR 1 g	Note
			Ch.	MHz			(mm)		(W/Kg)					
	WLAN 2.4 GHz	802.11b	6	2437.0	1 Mbps	Back	0	---	0.157	19.81	20.00	99.28	0.17	Ant Main
#750	WLAN 2.4 GHz	802.11b	6	2437.0	1 Mbps	Side 1	0	---	0.559	19.81	20.00	99.28	0.59	Ant Main
	WLAN 2.4 GHz	802.11b	6	2437.0	1 Mbps	Side 1	0	Battery 2	0.551	19.81	20.00	99.28	0.58	Ant Main
	WLAN 2.4 GHz	802.11b	6	2437.0	1 Mbps	Side 4	0	---	0.047	19.81	20.00	99.28	0.05	Ant Main
	WLAN 2.4 GHz	802.11b	6	2437.0	1 Mbps	Back	0	---	0.252	18.38	18.50	99.28	0.26	Ant Aux
	WLAN 2.4 GHz	802.11b	6	2437.0	1 Mbps	Side 2	0	---	0.928	18.38	18.50	99.28	0.96	Ant Aux
	WLAN 2.4 GHz	802.11b	1	2412.0	1 Mbps	Side 2	0	---	0.919	18.33	18.50	99.28	0.96	Ant Aux
#755	WLAN 2.4 GHz	802.11b	11	2462.0	1 Mbps	Side 2	0	---	0.961	18.35	18.50	99.28	1.00	Ant Aux
	WLAN 2.4 GHz	802.11b	11	2462.0	1 Mbps	Side 2	0	Repeat	0.958	18.35	18.50	99.28	1.00	Ant Aux
	WLAN 2.4 GHz	802.11b	11	2462.0	1 Mbps	Side 2	0	Battery 2	0.957	18.35	18.50	99.28	1.00	Ant Aux
	WLAN 2.4 GHz	802.11b	6	2437.0	1 Mbps	Side 3	0	---	0.271	18.38	18.50	99.28	0.28	Ant Aux
	Bluetooth	---	78	2480.0	1 Mbps	Back	0	---	0.029	9.32	9.50	79.63	0.04	Ant Aux
	Bluetooth	---	78	2480.0	1 Mbps	Side 2	0	---	0.102	9.32	9.50	79.63	0.13	Ant Aux
	Bluetooth	---	0	2402.0	1 Mbps	Side 2	0	---	0.078	8.77	9.50	79.63	0.12	Ant Aux
#761	Bluetooth	---	39	2441.0	1 Mbps	Side 2	0	---	0.109	8.96	9.50	79.63	0.16	Ant Aux
	Bluetooth	---	39	2441.0	1 Mbps	Side 2	0	Battery 2	0.108	8.96	9.50	79.63	0.15	Ant Aux
	WLAN 5 GHz	802.11ac 80 MHz	58	5290.0	VHT0	Back	0	---	0.036	11.48	11.50	97.50	0.04	Ant Main
#801	WLAN 5 GHz	802.11ac 80 MHz	58	5290.0	VHT0	Side 1	0	---	0.801	11.48	11.50	97.50	0.83	Ant Main
	WLAN 5 GHz	802.11ac 80 MHz	58	5290.0	VHT0	Side 1	0	Battery 2	0.788	11.48	11.50	97.50	0.81	Ant Main
	WLAN 5 GHz	802.11ac 80 MHz	58	5290.0	VHT0	Back	0	---	0.402	17.23	17.50	97.50	0.44	Ant Aux
#781	WLAN 5 GHz	802.11ac 80 MHz	58	5290.0	VHT0	Side 2	0	---	0.912	17.23	17.50	97.50	1.00	Ant Aux
	WLAN 5 GHz	802.11ac 80 MHz	58	5290.0	VHT0	Side 2	0	Battery 2	0.908	17.23	17.50	97.50	0.99	Ant Aux
	WLAN 5 GHz	802.11ac 80 MHz	58	5290.0	VHT0	Side 3	0	---	0.280	17.23	17.50	97.50	0.31	Ant Aux
	WLAN 5 GHz	802.11ac 80 MHz	106	5530.0	VHT0	Back	0	---	0.058	12.98	13.00	97.50	0.06	Ant Main
	WLAN 5 GHz	802.11ac 80 MHz	106	5530.0	VHT0	Side 1	0	---	0.778	12.98	13.00	97.50	0.80	Ant Main
	WLAN 5 GHz	802.11ac 80 MHz	122	5610.0	VHT0	Side 1	0	-	0.748	12.93	13.00	97.50	0.78	Ant Main
#802	WLAN 5 GHz	802.11ac 80 MHz	138	5690.0	VHT0	Side 1	0	---	0.780	12.91	13.00	97.50	0.82	Ant Main
	WLAN 5 GHz	802.11ac 80 MHz	138	5690.0	VHT0	Side 1	0	Battery 2	0.771	12.91	13.00	97.50	0.81	Ant Main
	WLAN 5 GHz	802.11ac 80 MHz	138	5690.0	VHT0	Back	0	---	0.262	17.28	17.50	97.50	0.28	Ant Aux

Index.	Band	Mode	Frequency		Data Rate	Test Position	Spacing	EUT & Accessory	SAR 1 g	Burst Avg Powe	Max tune-up	Duty Cycle	Reported SAR 1 g	Note
			Ch.	MHz			(mm)		(W/Kg)	(dBm)	(dBm)	(%)		
#788	WLAN 5 GHz	802.11ac 80 MHz	138	5690.0	VHT0	Side 2	0	---	0.939	17.28	17.50	97.50	1.01	Ant Aux
	WLAN 5 GHz	802.11ac 80 MHz	138	5690.0	VHT0	Side 2	0	Repeat	0.931	17.28	17.50	97.50	1.01	Ant Aux
	WLAN 5 GHz	802.11ac 80 MHz	138	5690.0	VHT0	Side 2	0	Battery 2	0.934	17.28	17.50	97.50	1.01	Ant Aux
	WLAN 5 GHz	802.11ac 80 MHz	106	5530.0	VHT0	Side 2	0	---	0.506	17.26	17.50	97.50	0.55	Ant Aux
	WLAN 5 GHz	802.11ac 80 MHz	122	5610.0	VHT0	Side 2	0	-	0.482	17.16	17.50	97.50	0.54	Ant Aux
	WLAN 5 GHz	802.11ac 80 MHz	138	5690.0	VHT0	Side 3	0	---	0.291	17.28	17.50	97.50	0.31	Ant Aux
	WLAN 5 GHz	802.11ac 80 MHz	155	5775.0	VHT0	Back	0	---	0.078	12.98	13.00	97.50	0.08	Ant Main
#803	WLAN 5 GHz	802.11ac 80 MHz	155	5775.0	VHT0	Side 1	0	---	0.781	12.98	13.00	97.50	0.81	Ant Main
	WLAN 5 GHz	802.11ac 80 MHz	155	5775.0	VHT0	Side 1	0	Battery 2	0.774	12.98	13.00	97.50	0.80	Ant Main
	WLAN 5 GHz	802.11ac 80 MHz	155	5775.0	VHT0	Back	0	---	0.185	17.24	17.50	97.50	0.20	Ant Aux
#796	WLAN 5 GHz	8802.11ac 80 MHz	155	5775.0	VHT0	Side 2	0	---	0.903	17.24	17.50	97.50	0.98	Ant Aux
	WLAN 5 GHz	802.11ac 80 MHz	155	5775.0	VHT0	Side 3	0	---	0.233	17.24	17.50	97.50	0.25	Ant Aux

11.2 Std. C95.1-1992 RF Exposure Limit

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

Table 4. Safety Limits for Partial Body 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 Average value of the SAR averaged over the partial – 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).

12. References

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[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.

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

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[12] IEC 62209-2:2010 - Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz).

Appendix A - System Performance Check

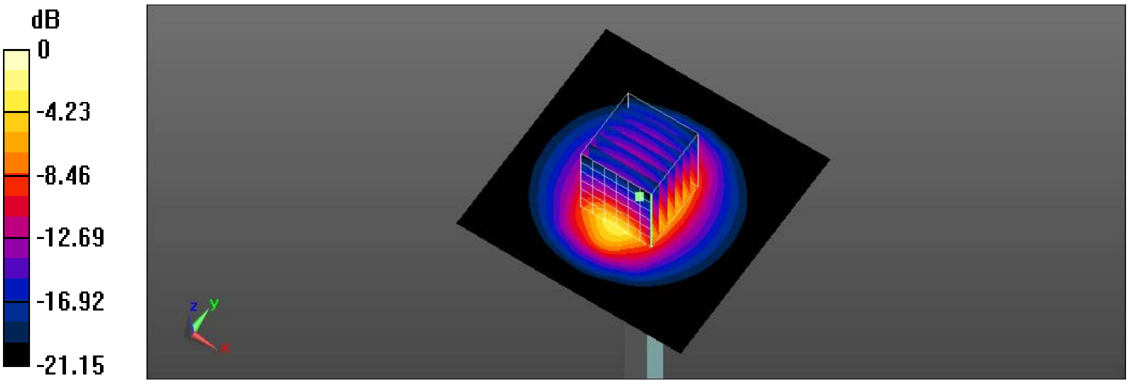
Test Laboratory: A Test Lab Techno Corp.
Date: 2020/5/5
System Performance Check at 2450MHz_20200505_Head
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:903

Communication System: UID 0, CW (0); Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.804 S/m; ε_r = 39.965; 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 - SN3977; ConvF(7.65, 7.65, 7.65) @ 2450 MHz; Calibrated: 2019/8/30
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 2019/11/29
- 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) = 22.4 W/kg

System Performance Check at 2450MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 115.8 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 27.0 W/kg
SAR(1 g) = 13.6 W/kg; SAR(10 g) = 6.43 W/kg
Smallest distance from peaks to all points 3 dB below = 9 mm
Ratio of SAR at M2 to SAR at M1 = 50.5%
Maximum value of SAR (measured) = 22.2 W/kg



0 dB = 22.2 W/kg = 13.47 dBW/kg

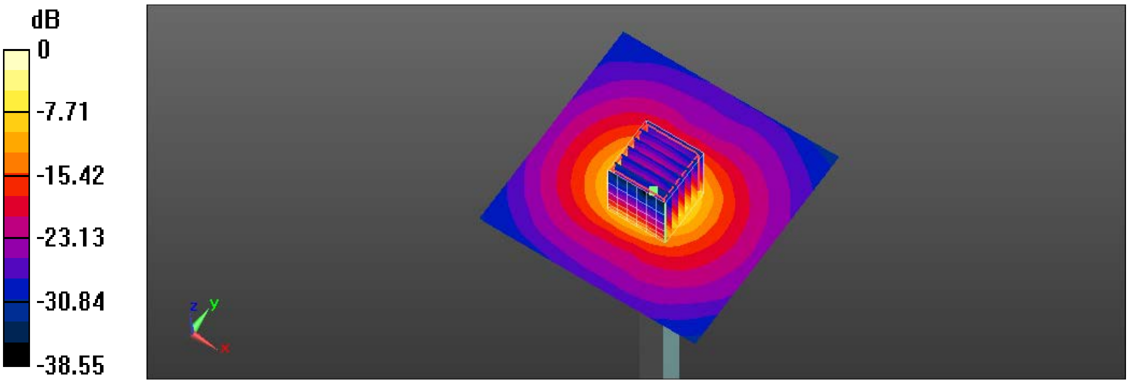
Test Laboratory: A Test Lab Techno Corp.
Date: 2020/5/7
System Performance Check at 5250MHz_20200507_Head
DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1145

Communication System: UID 0, CW (0); Frequency: 5250 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5250 MHz; σ = 4.666 S/m; ε_r = 36.492; 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 - SN3977; ConvF(5.57, 5.57, 5.57) @ 5250 MHz; Calibrated: 2019/8/30
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 2019/11/29
- 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) = 15.9 W/kg

System Performance Check at 5250MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 70.88 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 27.5 W/kg
SAR(1 g) = 7.94 W/kg; SAR(10 g) = 2.13 W/kg
Smallest distance from peaks to all points 3 dB below = 7.2 mm
Ratio of SAR at M2 to SAR at M1 = 65.1%
Maximum value of SAR (measured) = 16.8 W/kg



0 dB = 16.8 W/kg = 12.25 dBW/kg

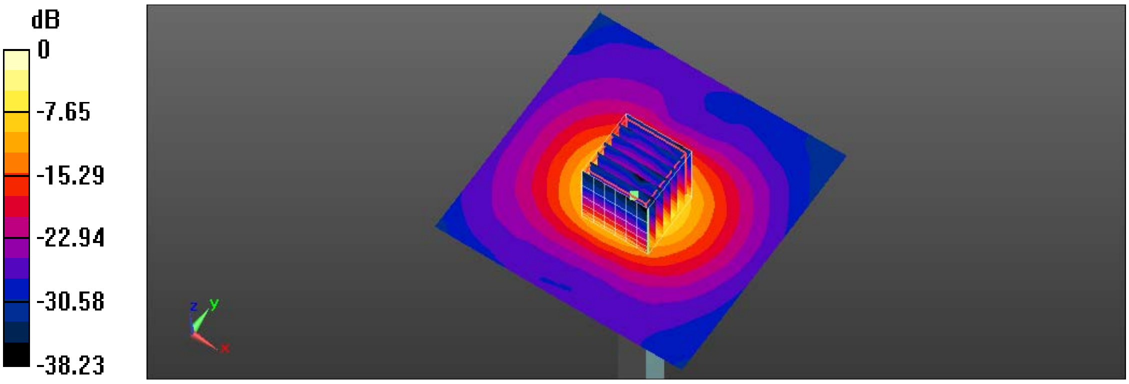
Test Laboratory: A Test Lab Techno Corp.
Date: 2020/5/7
System Performance Check at 5600MHz_20200507_Head
DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1145

Communication System: UID 0, CW (0); Frequency: 5600 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5600 MHz; σ = 5.036 S/m; ε_r = 35.875; 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 - SN3977; ConvF(4.81, 4.81, 4.81) @ 5600 MHz; Calibrated: 2019/8/30
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 2019/11/29
- 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 5600MHz/Area Scan (91x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 18.6 W/kg

System Performance Check at 5600MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.65 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 32.5 W/kg
SAR(1 g) = 8.63 W/kg; SAR(10 g) = 2.37 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%
Maximum value of SAR (measured) = 19.1 W/kg



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

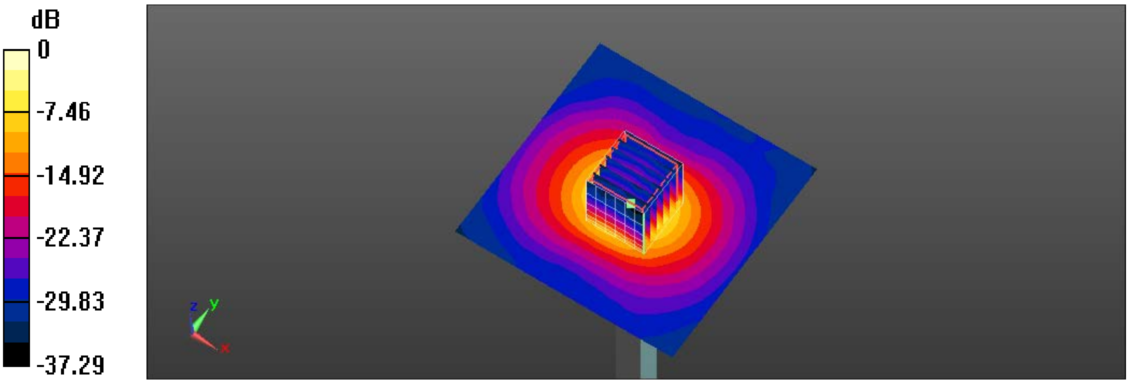
Test Laboratory: A Test Lab Techno Corp.
Date: 2020/5/7
System Performance Check at 5750MHz_20200507_Head
DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1145

Communication System: UID 0, CW (0); Frequency: 5750 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5750 MHz; σ = 5.305 S/m; ε_r = 35.552; 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 - SN3977; ConvF(5.06, 5.06, 5.06) @ 5750 MHz; Calibrated: 2019/8/30
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 2019/11/29
- 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) = 17.1 W/kg

System Performance Check at 5750MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.69 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 31.3 W/kg
SAR(1 g) = 8.13 W/kg; SAR(10 g) = 2.26 W/kg
Smallest distance from peaks to all points 3 dB below = 7.5 mm
Ratio of SAR at M2 to SAR at M1 = 61.3%
Maximum value of SAR (measured) = 17.4 W/kg



0 dB = 17.4 W/kg = 12.41 dBW/kg

Appendix B - SAR Measurement Data

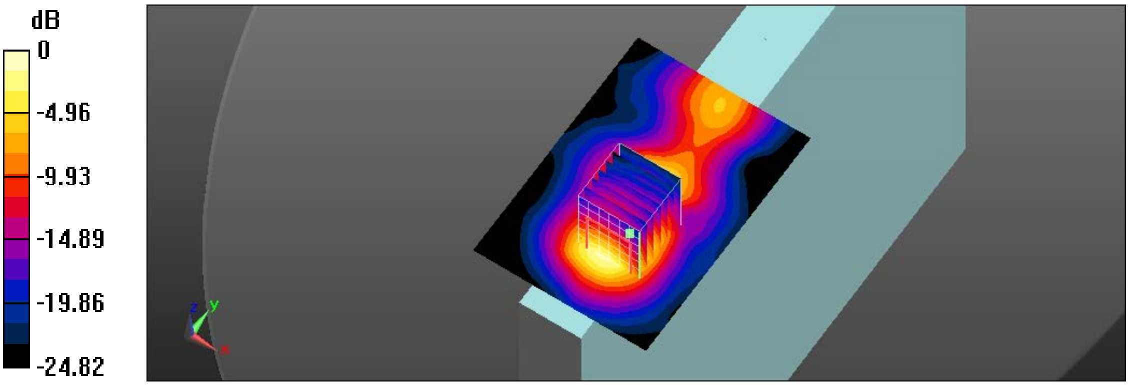
Test Laboratory: A Test Lab Techno Corp.
Date: 2020/5/5
750_IEEE 802.11b CH6_1M_Side 1_0mm_Ant-Main
DUT: AX200NGW ; Type: Wireless module

Communication System: UID 0, IEEE 802.11b (0); Frequency: 2437 MHz;Duty Cycle: 1:1.007
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.789 S/m; ε_r = 39.994; 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 - SN3977; ConvF(7.65, 7.65, 7.65) @ 2437 MHz; Calibrated: 2019/8/30
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 2019/11/29
- 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 (71x101x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 1.05 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 21.47 V/m; Power Drift = 0.16 dB
Peak SAR (extrapolated) = 1.41 W/kg
SAR(1 g) = 0.559 W/kg; SAR(10 g) = 0.256 W/kg
Smallest distance from peaks to all points 3 dB below = 5.1 mm
Ratio of SAR at M2 to SAR at M1 = 32.5%
Maximum value of SAR (measured) = 0.964 W/kg



0 dB = 0.964 W/kg = -0.16 dBW/kg

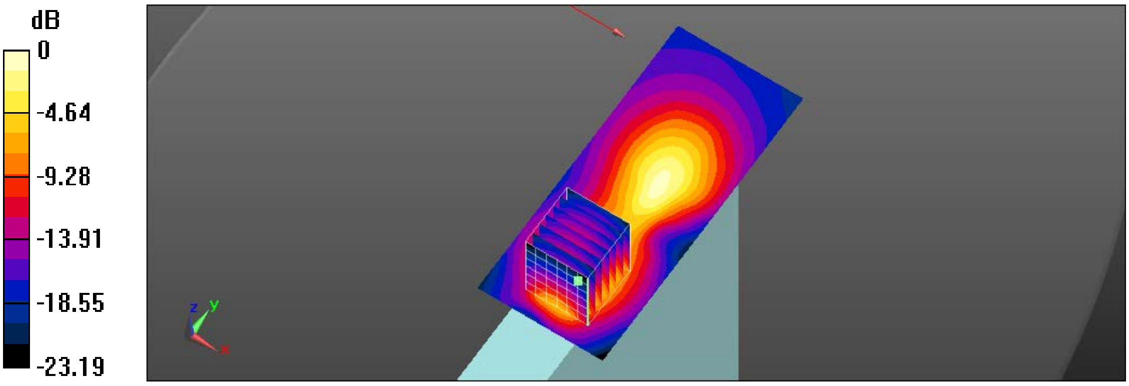
Test Laboratory: A Test Lab Techno Corp.
Date: 2020/5/5
755_IEEE 802.11b CH11_1M_Side 2_0mm_Ant-Aux
DUT: AX200NGW ; Type: Wireless module

Communication System: UID 0, IEEE 802.11b (0); Frequency: 2462 MHz;Duty Cycle: 1:1.007
Medium parameters used: f = 2462 MHz; σ = 1.819 S/m; ε_r = 39.93; 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 - SN3977; ConvF(7.65, 7.65, 7.65) @ 2462 MHz; Calibrated: 2019/8/30
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 2019/11/29
- 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 (51x121x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 1.70 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 29.42 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 2.00 W/kg
SAR(1 g) = 0.961 W/kg; SAR(10 g) = 0.432 W/kg
Smallest distance from peaks to all points 3 dB below = 8.5 mm
Ratio of SAR at M2 to SAR at M1 = 49.1%
Maximum value of SAR (measured) = 1.63 W/kg



0 dB = 1.63 W/kg = 2.12 dBW/kg

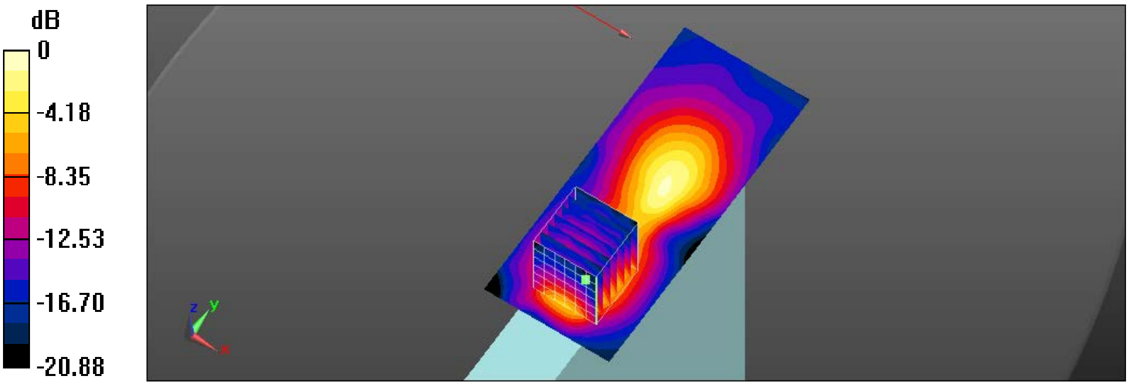
Test Laboratory: A Test Lab Techno Corp.
Date: 2020/5/5
761_Bluetooth CH39_1M_Side 2_0mm_Ant Aux
DUT: AX200NGW ; Type: Wireless module

Communication System: UID 0, Bluetooth (0); Frequency: 2441 MHz;Duty Cycle: 1:1.256
Medium parameters used (interpolated): f = 2441 MHz; σ = 1.793 S/m; ε_r = 39.985; 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 - SN3977; ConvF(7.65, 7.65, 7.65) @ 2441 MHz; Calibrated: 2019/8/30
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 2019/11/29
- 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 (51x121x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.182 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 9.924 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 0.226 W/kg
SAR(1 g) = 0.109 W/kg; SAR(10 g) = 0.050 W/kg
Smallest distance from peaks to all points 3 dB below = 8.9 mm
Ratio of SAR at M2 to SAR at M1 = 49.2%
Maximum value of SAR (measured) = 0.183 W/kg



0 dB = 0.183 W/kg = -7.38 dBW/kg

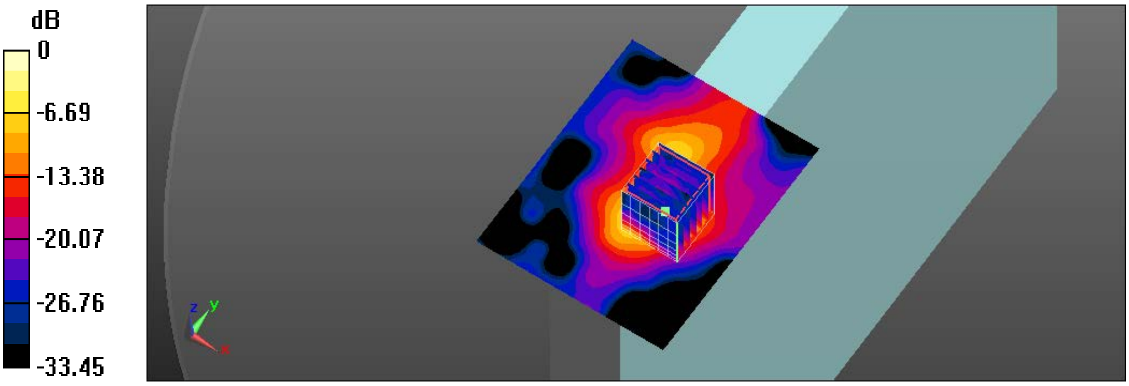
Test Laboratory: A Test Lab Techno Corp.
Date: 2020/5/7
801_IEEE 802.11ac80 CH58_VHT0_Side 1_0mm_Ant Main
DUT: AX200NGW ; Type: Wireless module

Communication System: UID 0, IEEE 802.11ac(5GHz)VHT80 (0); Frequency: 5290 MHz;Duty Cycle: 1:1.026
Medium parameters used: f = 5290 MHz; σ = 4.705 S/m; ε_r = 36.399; 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 - SN3977; ConvF(5.57, 5.57, 5.57) @ 5290 MHz; Calibrated: 2019/8/30
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 2019/11/29
- 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 (81x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.81 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 21.22 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 3.59 W/kg
SAR(1 g) = 0.801 W/kg; SAR(10 g) = 0.184 W/kg
Smallest distance from peaks to all points 3 dB below = 4.3 mm
Ratio of SAR at M2 to SAR at M1 = 66.5%
Maximum value of SAR (measured) = 2.17 W/kg



0 dB = 2.17 W/kg = 3.36 dBW/kg

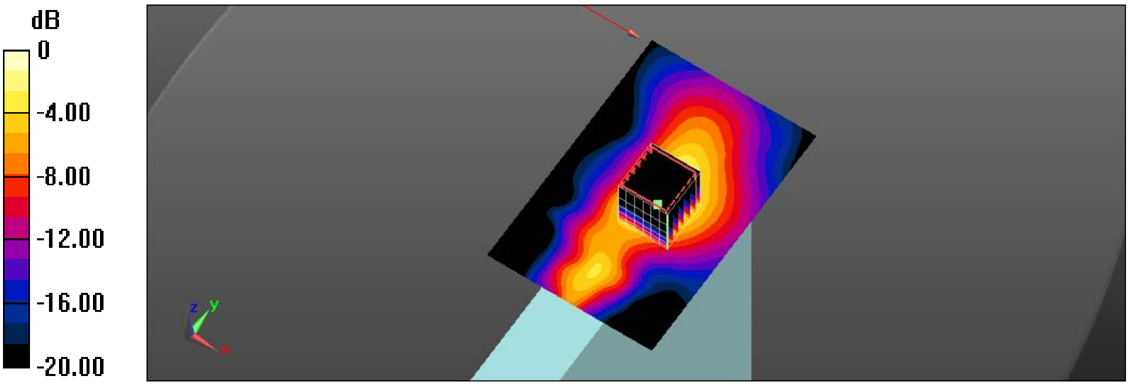
Test Laboratory: A Test Lab Techno Corp.
Date: 2020/5/7
781_IEEE 802.11ac80 CH58_VHT0_Side 2_0mm_Ant Aux
DUT: AX200NGW ; Type: Wireless module

Communication System: UID 0, IEEE 802.11ac(5GHz)VHT80 (0); Frequency: 5290 MHz;Duty Cycle: 1:1.026
Medium parameters used: f = 5290 MHz; σ = 4.705 S/m; ε_r = 36.399; 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 - SN3977; ConvF(5.57, 5.57, 5.57) @ 5290 MHz; Calibrated: 2019/8/30
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 2019/11/29
- 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 (81x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 2.05 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 16.20 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 3.56 W/kg
SAR(1 g) = 0.912 W/kg; SAR(10 g) = 0.309 W/kg
Smallest distance from peaks to all points 3 dB below = 7.4 mm
Ratio of SAR at M2 to SAR at M1 = 64%
Maximum value of SAR (measured) = 2.13 W/kg



0 dB = 2.13 W/kg = 3.28 dBW/kg

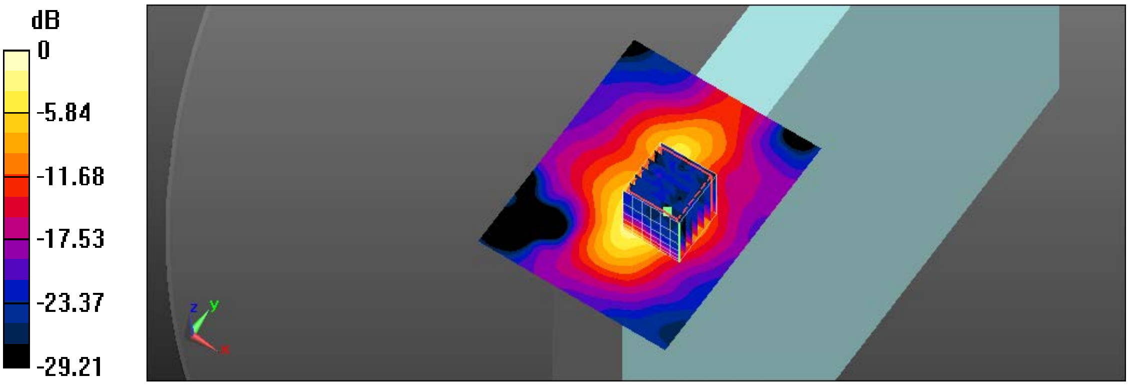
Test Laboratory: A Test Lab Techno Corp.
Date: 2020/5/7
802_IEEE 802.11ac80 CH138_VHT0_Side 1_0mm_Ant Main
DUT: AX200NGW ; Type: Wireless module

Communication System: UID 0, IEEE 802.11ac(5GHz)VHT80 (0); Frequency: 5690 MHz;Duty Cycle: 1:1.026
Medium parameters used: f = 5690 MHz; σ = 5.252 S/m; ε_r = 35.556; 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 - SN3977; ConvF(4.81, 4.81, 4.81) @ 5690 MHz; Calibrated: 2019/8/30
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 2019/11/29
- 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 (81x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 2.73 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 17.08 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 3.98 W/kg
SAR(1 g) = 0.780 W/kg; SAR(10 g) = 0.189 W/kg
Smallest distance from peaks to all points 3 dB below = 5.4 mm
Ratio of SAR at M2 to SAR at M1 = 62.1%
Maximum value of SAR (measured) = 2.21 W/kg



0 dB = 2.21 W/kg = 3.44 dBW/kg

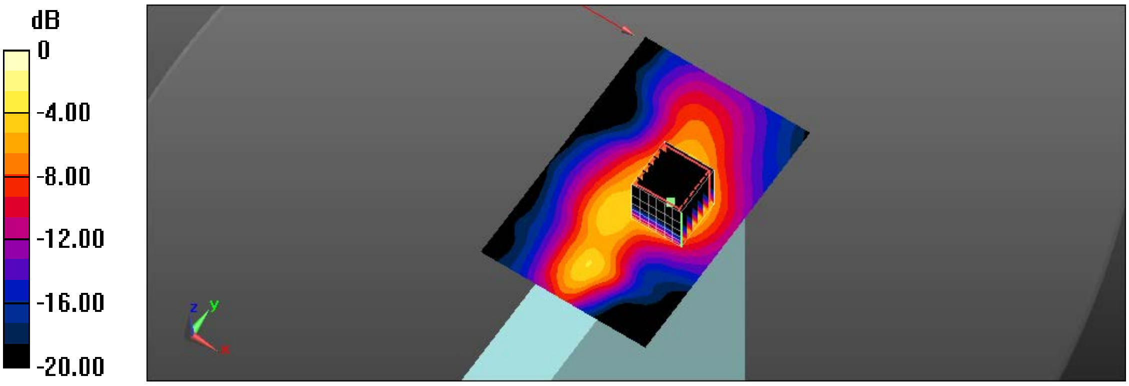
Test Laboratory: A Test Lab Techno Corp.
Date: 2020/5/7
788_IEEE 802.11ac80 CH138_VHT0_Side 2_0mm_Ant Aux
DUT: AX200NGW ; Type: Wireless module

Communication System: UID 0, IEEE 802.11ac(5GHz)VHT80 (0); Frequency: 5690 MHz;Duty Cycle: 1:1.026
Medium parameters used: f = 5690 MHz; σ = 5.252 S/m; ε_r = 35.556; 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 - SN3977; ConvF(4.81, 4.81, 4.81) @ 5690 MHz; Calibrated: 2019/8/30
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 2019/11/29
- 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 (81x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 2.37 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 19.68 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 4.22 W/kg
SAR(1 g) = 0.939 W/kg; SAR(10 g) = 0.295 W/kg
Smallest distance from peaks to all points 3 dB below = 6.6 mm
Ratio of SAR at M2 to SAR at M1 = 60.3%
Maximum value of SAR (measured) = 2.32 W/kg



0 dB = 2.32 W/kg = 3.65 dBW/kg

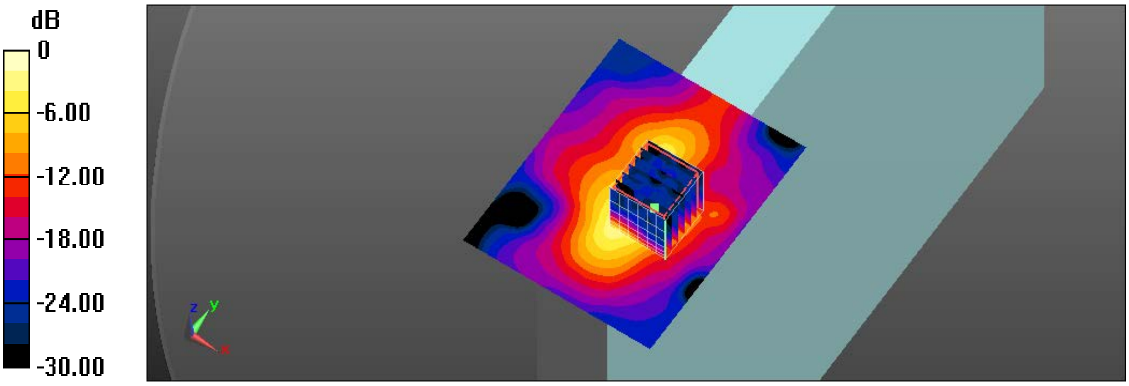
Test Laboratory: A Test Lab Techno Corp.
Date: 2020/5/7
803_IEEE 802.11ac80 CH155_VHT0_Side 1_0mm_Ant Main
DUT: AX200NGW ; Type: Wireless module

Communication System: UID 0, IEEE 802.11ac(5GHz)VHT80 (0); Frequency: 5775 MHz;Duty Cycle: 1:1.026
Medium parameters used: f = 5775 MHz; σ = 5.278 S/m; ε_r = 35.586; 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 - SN3977; ConvF(5.06, 5.06, 5.06) @ 5775 MHz; Calibrated: 2019/8/30
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 2019/11/29
- 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 (81x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 2.52 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 17.05 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 3.97 W/kg
SAR(1 g) = 0.781 W/kg; SAR(10 g) = 0.189 W/kg
Smallest distance from peaks to all points 3 dB below = 4.3 mm
Ratio of SAR at M2 to SAR at M1 = 62.7%
Maximum value of SAR (measured) = 2.22 W/kg



0 dB = 2.22 W/kg = 3.46 dBW/kg

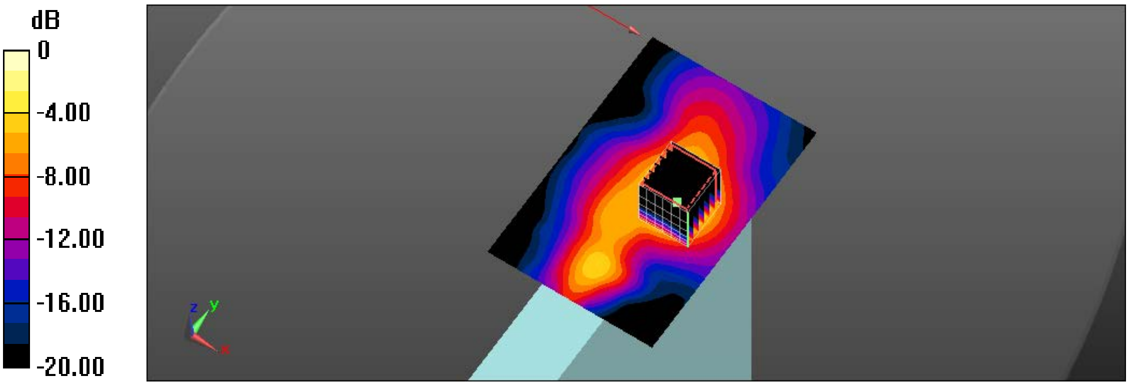
Test Laboratory: A Test Lab Techno Corp.
Date: 2020/5/7
796_IEEE 802.11ac80 CH155_VHT0_Side 2_0mm_Ant Aux
DUT: AX200NGW ; Type: Wireless module

Communication System: UID 0, IEEE 802.11ac(5GHz)VHT80 (0); Frequency: 5775 MHz;Duty Cycle: 1:1.026
Medium parameters used: f = 5775 MHz; σ = 5.278 S/m; ε_r = 35.586; 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 - SN3977; ConvF(5.06, 5.06, 5.06) @ 5775 MHz; Calibrated: 2019/8/30
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn779; Calibrated: 2019/11/29
- 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 (81x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 2.38 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 18.55 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 4.14 W/kg
SAR(1 g) = 0.903 W/kg; SAR(10 g) = 0.287 W/kg
Smallest distance from peaks to all points 3 dB below = 6.8 mm
Ratio of SAR at M2 to SAR at M1 = 58.7%
Maximum value of SAR (measured) = 2.24 W/kg



0 dB = 2.24 W/kg = 3.50 dBW/kg

Appendix C - Calibration

All of the instruments Calibration information are listed below.

- Dipole _ D2450V2 SN: 903
- Dipole _ D5GHzV2 SN: 1145
- Probe _ EX3DV4 SN: 3977
- DAE _ DAE4 SN: 779

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Client AUDEN Certificate No: Z19-60366

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 903
Calibration Procedure(s)	FF-Z11-003-01 Calibration Procedures for dipole validation kits
Calibration date:	October 15, 2019

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106276	11-Apr-19 (CTTL, No.J19X02605)	Apr-20
Power sensor NRP6A	101369	11-Apr-19 (CTTL, No.J19X02605)	Apr-20
Reference Probe EX3DV4	SN 3617	31-Jan-19(SPEAG,No.EX3-3617_Jan19)	Jan-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	23-Jan-19 (CTTL, No.J19X00336)	Jan-20
NetworkAnalyzer E5071C	MY46110673	24-Jan-19 (CTTL, No.J19X00547)	Jan-20

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

Issued: October 19, 2019

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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Measurement Conditions

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

DASY Version	DASY52	V52.10.2
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	39.8 ± 6 %	1.76 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	12.6 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**51.1 W/kg ± 18.8 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.80 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.4 W/kg ± 18.7 % (k=2)**

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	55.0Ω+ 2.78 jΩ
Return Loss	- 25.3dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.022 ns

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

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

Additional EUT Data

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DASY5 Validation Report for Head TSL Date: 10.15.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 903

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used: f = 2450 MHz; σ = 1.759 S/m; ε_r = 39.82; ρ = 1000 kg/m3

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(7.62, 7.62, 7.62) @ 2450 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/22/2019
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

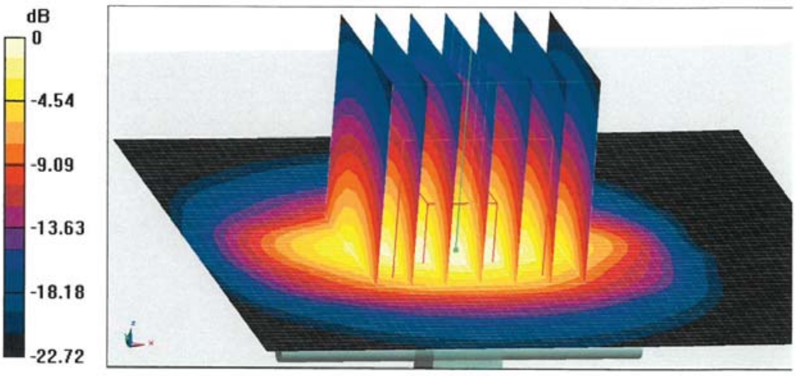
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 100.5 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 26.6 W/kg

SAR(1 g) = 12.6 W/kg; SAR(10 g) = 5.8 W/kg

Maximum value of SAR (measured) = 21.3 W/kg



0 dB = 21.3 W/kg = 13.28 dBW/kg

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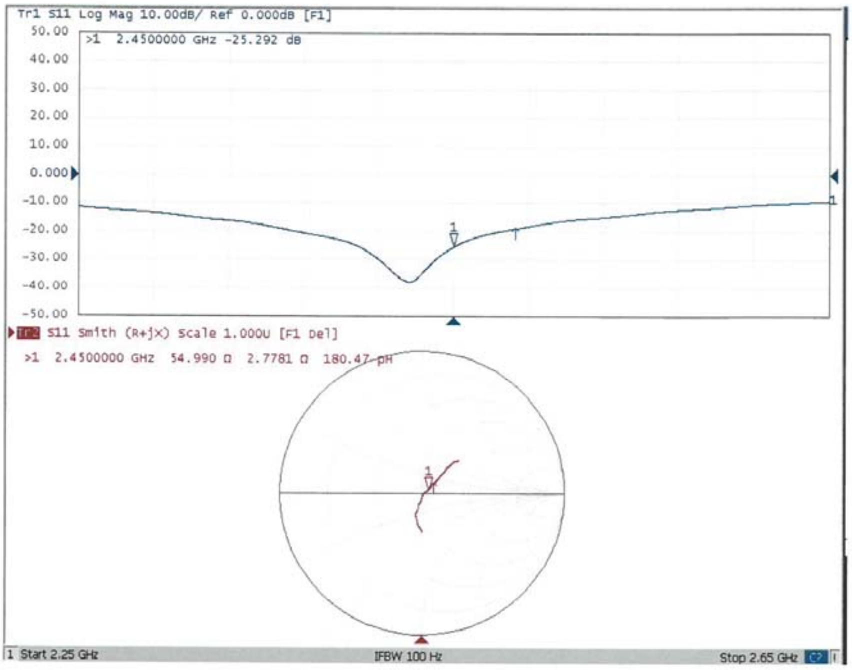
Impedance Measurement Plot for Head TSL



Certificate No: Z19-60366 Page 6 of 6

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Client AUDEN Certificate No: Z19-60367

CALIBRATION CERTIFICATE

Object	D5GHzV2 - SN: 1145
Calibration Procedure(s)	FF-Z11-003-01 Calibration Procedures for dipole validation kits
Calibration date:	October 16, 2019

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

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	106276	11-Apr-19 (CTTL, No.J19X02605)	Apr-20
Power sensor NRP6A	101369	11-Apr-19 (CTTL, No.J19X02605)	Apr-20
ReferenceProbe EX3DV4	SN 3617	31-Jan-19(SPEAG,No.EX3-3617_Jan19)	Jan-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	23-Jan-19 (CTTL, No.J19X00336)	Jan-20
NetworkAnalyzerE5071C	MY46110673	24-Jan-19 (CTTL, No.J19X00547)	Jan-20

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

Issued: October 20, 2019

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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Measurement Conditions

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

DASY Version	DASY52	V52.10.2
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	36.0 ± 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	7.88 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**78.8 W/kg ± 24.4 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.26 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.6 W/kg ± 24.2 % (k=2)**

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Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.2 ± 6 %	5.14 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.11 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**81.0 W/kg ± 24.4 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.32 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.2 W/kg ± 24.2 % (k=2)**

Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.9 ± 6 %	5.34 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	7.89 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**78.8 W/kg ± 24.4 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.25 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.4 W/kg ± 24.2 % (k=2)**

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	55.4Ω - 6.86jΩ
Return Loss	- 21.7dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	58.4Ω + 3.93jΩ
Return Loss	- 21.3dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	56.6Ω + 2.24jΩ
Return Loss	- 23.6dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.074 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

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DASY5 Validation Report for Head TSL Date: 10.16.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1145

Communication System: CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz,
Medium parameters used: f = 5250 MHz; σ = 4.673 S/m; ε_r = 35.99; ρ = 1000 kg/m^3,
Medium parameters used: f = 5600 MHz; σ = 5.14 S/m; ε_r = 35.23; ρ = 1000 kg/m^3,
Medium parameters used: f = 5750 MHz; σ = 5.336 S/m; ε_r = 34.91; ρ = 1000 kg/m^3,
Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(5.39, 5.39, 5.39) @ 5250 MHz; ConvF(5.06, 5.06, 5.06) @ 5600 MHz; ConvF(5.07, 5.07, 5.07) @ 5750 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/22/2019
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

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 = 69.63 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 32.6 W/kg
SAR(1 g) = 7.88 W/kg; SAR(10 g) = 2.26 W/kg
Maximum value of SAR (measured) = 18.9 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 = 68.18 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 36.7 W/kg
SAR(1 g) = 8.11 W/kg; SAR(10 g) = 2.32 W/kg
Maximum value of SAR (measured) = 19.8 W/kg

Dipole Calibration /Pin=100mW, d=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.28 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 37.1 W/kg
SAR(1 g) = 7.89 W/kg; SAR(10 g) = 2.25 W/kg
Maximum value of SAR (measured) = 20.2 W/kg

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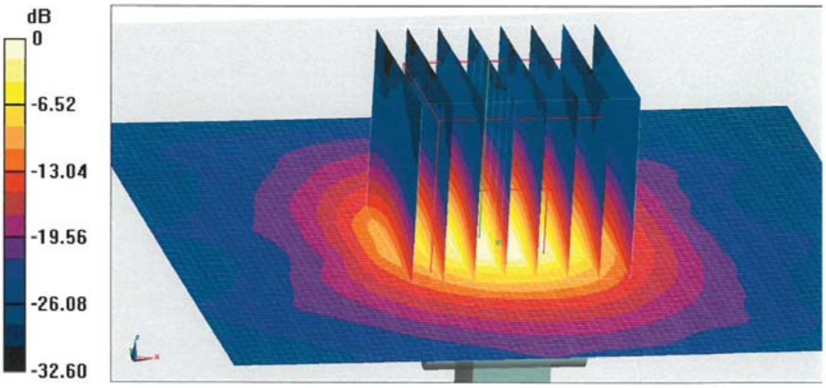

0 dB = 20.2 W/kg = 13.05 dBW/kg

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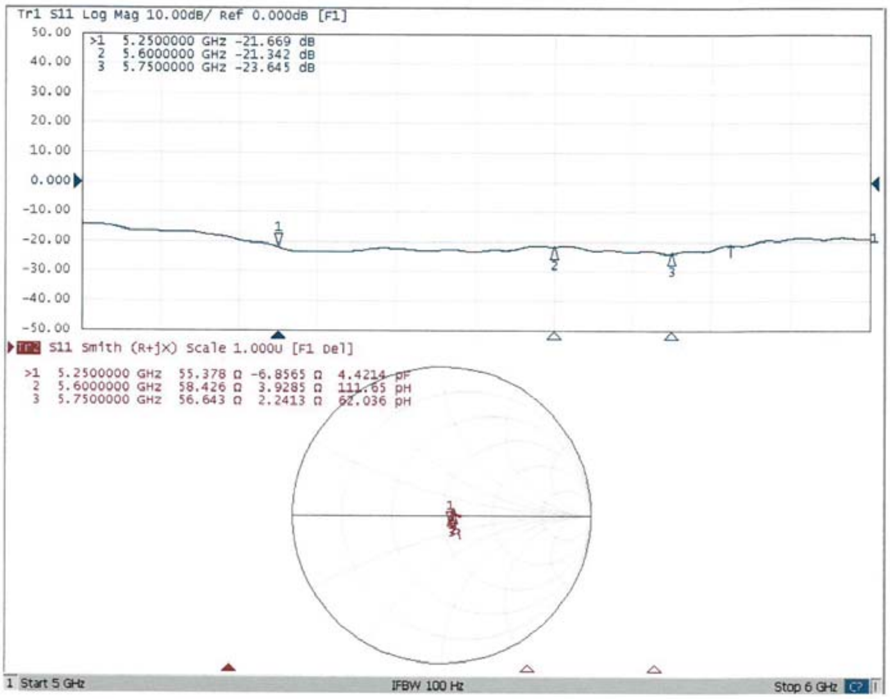
Impedance Measurement Plot for Head TSL



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EX-043_19-175

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Client ATL **Certificate No: Z19-60275**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3977
Calibration Procedure(s)	FF-Z11-004-01 Calibration Procedures for Dosimetric E-field Probes
Calibration date:	August 30, 2019

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	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
Reference10dBAttenuator	18N50W-10dB	09-Feb-18(CTTL, No.J18X01133)	Feb-20
Reference20dBAttenuator	18N50W-20dB	09-Feb-18(CTTL, No.J18X01132)	Feb-20
Reference Probe EX3DV4	SN 7307	24-May-19(SPEAG,No.EX3-7307_May19)	May-20
DAE4	SN 1331	06-Feb-19(SPEAG, No.DAE4-1331_Feb19)	Feb -20
DAE4	SN 917	07-Dec-18(SPEAG, No.DAE4-917_Dec18)	Dec -19
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
SignalGeneratorMG3700A	6201052605	18-Jun-19 (CTTL, No.J19X05127)	Jun-20
Network Analyzer E5071C	MY46110673	24-Jan-19 (CTTL, No.J19X00547)	Jan -20

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

Issued: August 31, 2019

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Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016

c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010

d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

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

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Probe EX3DV4

SN: 3977

Calibrated: August 30, 2019

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3977

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm(μV/(V/m)^2)[A]	0.53	0.58	0.51	±10.0%
DCP(mV)[B]	102.2	101.8	102.5	

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	182.0	±2.4%
		Y	0.0	0.0	1.0		194.2	
		Z	0.0	0.0	1.0		182.6	

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

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

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3977

Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz][C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha[G]	Depth[G] (mm)	Unct. (k=2)
750	41.9	0.89	10.19	10.19	10.19	0.40	0.80	±12.1%
835	41.5	0.90	9.79	9.79	9.79	0.16	1.32	±12.1%
900	41.5	0.97	9.74	9.74	9.74	0.18	1.33	±12.1%
1750	40.1	1.37	8.47	8.47	8.47	0.22	1.05	±12.1%
1900	40.0	1.40	8.24	8.24	8.24	0.25	1.04	±12.1%
2000	40.0	1.40	8.31	8.31	8.31	0.21	1.05	±12.1%
2450	39.2	1.80	7.65	7.65	7.65	0.62	0.70	±12.1%
2600	39.0	1.96	7.43	7.43	7.43	0.53	0.80	±12.1%
5250	35.9	4.71	5.57	5.57	5.57	0.50	1.15	±13.3%
5600	35.5	5.07	4.81	4.81	4.81	0.50	1.30	±13.3%
5750	35.4	5.22	5.06	5.06	5.06	0.50	1.30	±13.3%

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

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3977

Calibration Parameter Determined in Body Tissue Simulating Media

f [MHz][C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha[G]	Depth[G] (mm)	Unct. (k=2)
750	55.5	0.96	10.20	10.20	10.20	0.16	1.48	±12.1%
835	55.2	0.97	9.83	9.83	9.83	0.21	1.29	±12.1%
900	55.0	1.05	9.80	9.80	9.80	0.24	1.14	±12.1%
1750	53.4	1.49	8.18	8.18	8.18	0.21	1.10	±12.1%
1900	53.3	1.52	7.89	7.89	7.89	0.23	1.09	±12.1%
2000	53.3	1.52	7.91	7.91	7.91	0.20	1.18	±12.1%
2450	52.7	1.95	7.69	7.69	7.69	0.64	0.76	±12.1%
2600	52.5	2.16	7.34	7.34	7.34	0.54	0.83	±12.1%
5250	48.9	5.36	5.00	5.00	5.00	0.50	1.20	±13.3%
5600	48.5	5.77	4.38	4.38	4.38	0.50	1.30	±13.3%
5750	48.3	5.94	4.46	4.46	4.46	0.50	1.40	±13.3%

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

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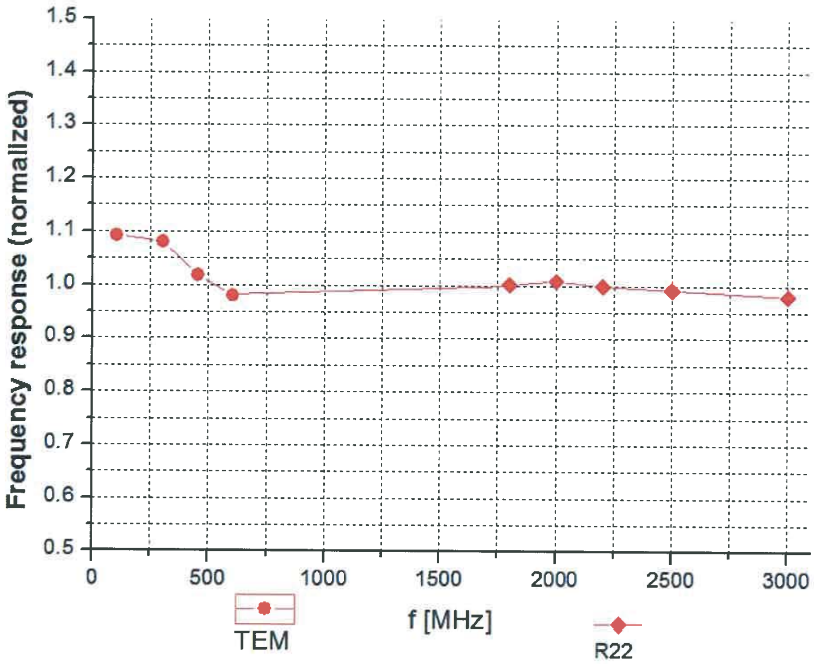
Frequency Response of E-Field
(TEM-Cell: ifi110 EXX, Waveguide: R22)



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

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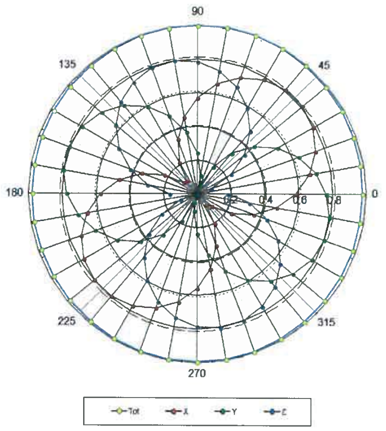
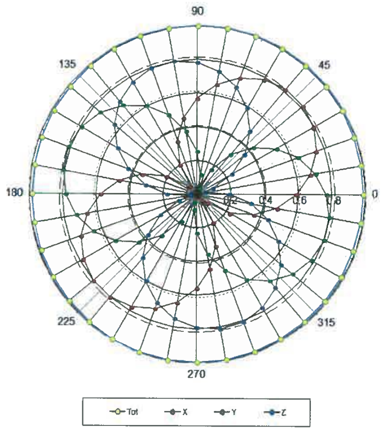
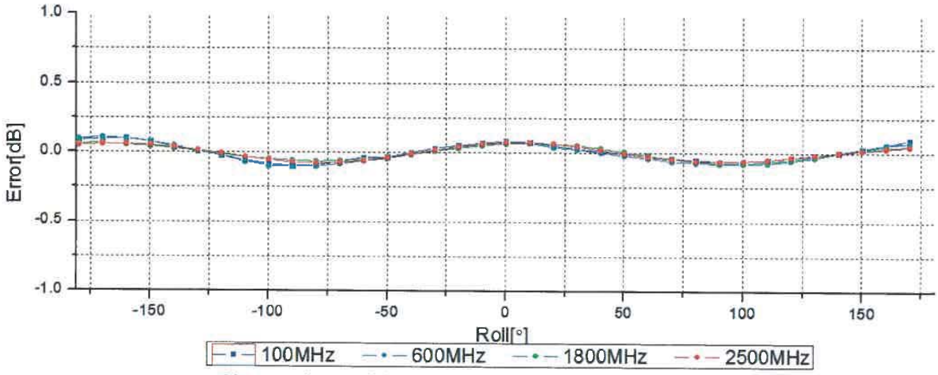
Receiving Pattern (Φ), θ=0°

f=600 MHz, TEM



f=1800 MHz, R22





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

Certificate No: Z19-60275 Page 8 of 11

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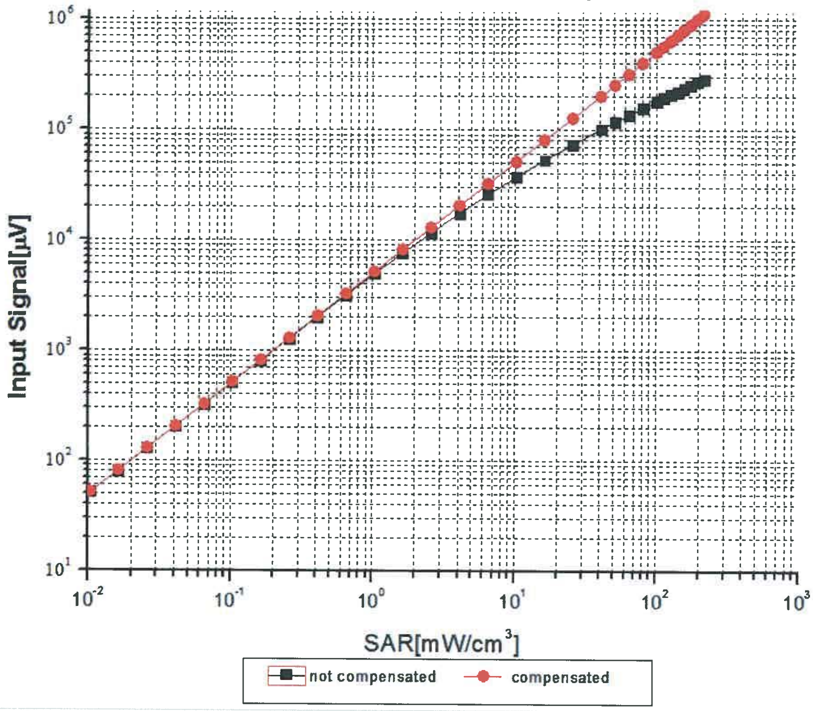
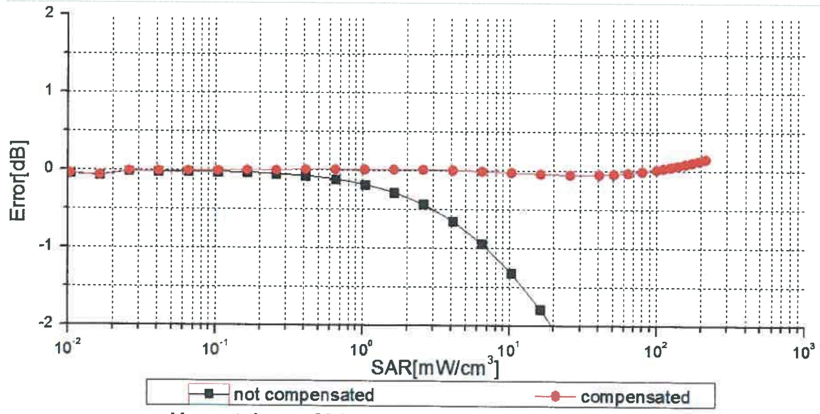
Dynamic Range f(SAR$_{head}$)
(TEM cell, f = 900 MHz)





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

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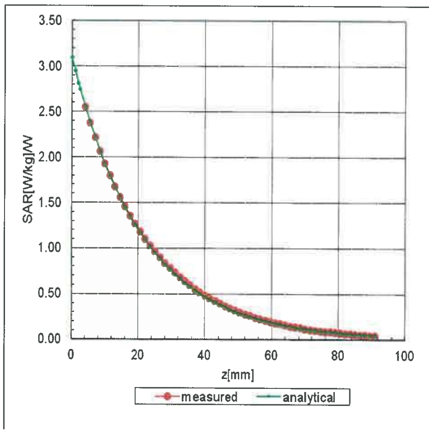
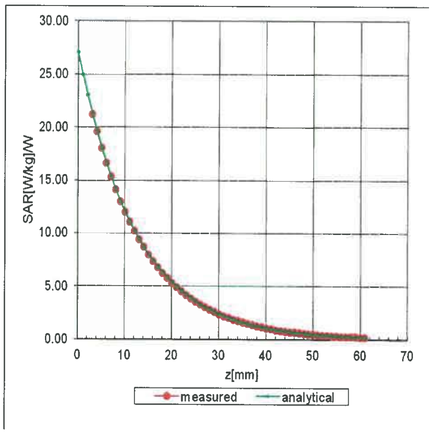
Conversion Factor Assessment

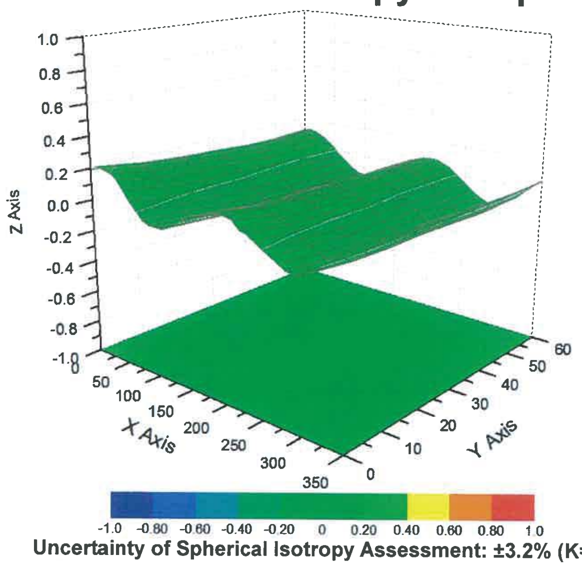
f=750 MHz, WGLS R9(H_convF)



f=1900 MHz, WGLS R22(H_convF)



Deviation from Isotropy in Liquid



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

Certificate No: Z19-60275 Page 10 of 11

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3977

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	27.3
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	9mm
Tip Diameter	2.5mm
Probe Tip to Sensor X Calibration Point	1mm
Probe Tip to Sensor Y Calibration Point	1mm
Probe Tip to Sensor Z Calibration Point	1mm
Recommended Measurement Distance from Surface	1.4mm

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

MR-041_19-226

S **Schweizerischer Kalibrierdienst**
C **Service suisse d'étalonnage**
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Swiss Calibration Service

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

Accreditation No.: SCS 0108

Client **ATL (Auden)**

Certificate No: DAE4-779_Nov19

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BM - SN: 779
Calibration procedure(s)	QA CAL-06.v29 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	November 29, 2019

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	03-Sep-19 (No:25949)	Sep-20
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	07-Jan-19 (in house check)	In house check: Jan-20
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-19 (in house check)	In house check: Jan-20

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

Issued: November 29, 2019

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

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

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The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Glossary

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

Methods Applied and Interpretation of Parameters

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

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1µV , full range = -100…+300 mV

Low Range: 1LSB = 61nV , full range = -1…….+3mV

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

Calibration Factors	X	Y	Z
High Range	404.527 ± 0.02% (k=2)	403.769 ± 0.02% (k=2)	403.988 ± 0.02% (k=2)
Low Range	3.97165 ± 1.50% (k=2)	3.98100 ± 1.50% (k=2)	3.99627 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	233.0 ° ± 1 °

Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	200036.99	0.85	0.00
Channel X	+ Input	20007.02	1.21	0.01
Channel X	- Input	-20003.80	2.20	-0.01
Channel Y	+ Input	200037.82	1.95	0.00
Channel Y	+ Input	20005.28	-0.38	-0.00
Channel Y	- Input	-20004.26	1.91	-0.01
Channel Z	+ Input	200035.48	-0.16	-0.00
Channel Z	+ Input	20006.67	1.09	0.01
Channel Z	- Input	-20004.22	2.00	-0.01

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2001.61	0.29	0.01
Channel X	+ Input	200.85	-0.40	-0.20
Channel X	- Input	-199.04	-0.38	0.19
Channel Y	+ Input	2002.24	1.07	0.05
Channel Y	+ Input	199.39	-1.64	-0.81
Channel Y	- Input	-199.36	-0.53	0.26
Channel Z	+ Input	2001.65	0.42	0.02
Channel Z	+ Input	200.80	-0.22	-0.11
Channel Z	- Input	-200.15	-1.34	0.67

2. Common mode sensitivity

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

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	-3.33	-5.00
	- 200	5.02	3.31
Channel Y	200	15.12	14.18
	- 200	-16.14	-16.91
Channel Z	200	3.47	3.28
	- 200	-5.28	-5.22

3. Channel separation

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

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	-1.38	-3.57
Channel Y	200	10.71	-	-0.67
Channel Z	200	7.53	8.36	-

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4. AD-Converter Values with inputs shorted

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

	High Range (LSB)	Low Range (LSB)
Channel X	15593	13061
Channel Y	15851	16662
Channel Z	16207	16263

5. Input Offset Measurement

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

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	-0.89	-2.31	0.36	0.54
Channel Y	-1.14	-3.53	0.14	0.65
Channel Z	-0.90	-2.16	0.62	0.47

6. Input Offset Current

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

7. Input Resistance (Typical values for information)

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

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

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

9. Power Consumption (Typical values for information)

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

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IMPORTANT NOTICE

USAGE OF THE DAE4

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

Battery Exchange: The battery cover of the DAE4 unit is fixed using a screw, over tightening the screw may cause the threads inside the DAE to wear out.

Shipping of the DAE: Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an antistatic bag. This antistatic bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

E-Stop Failures: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

Repair: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

DASY Configuration Files: Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.

Important Note:
Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.

Important Note:
Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.

Important Note:
To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.

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