



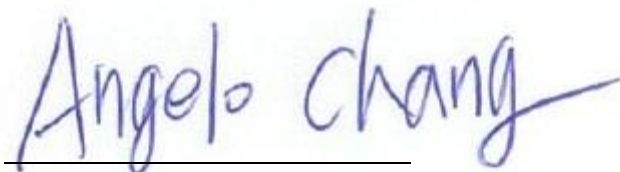
SAR TEST REPORT

Applicant : GN Audio USA Inc.
Address : 900 Chelmsford Street, Tower II, 8th Floor,
Lowell, MA 01851, USA
Manufacturer : GN Hearing A/S
Address : Lautrupbjerg 7, 2750 Ballerup, Denmark
Equipment : Wireless Headset
Model No. : HS39
Trade Name : 
FCC ID. : ZHK-HS39

I HEREBY CERTIFY THAT:

The sample was received on Jul. 02, 2025 and the testing was completed on Aug. 27, 2025 at CerpPASS Technology Corp. The test result refers exclusively to the test presented test model / sample. Without written approval of CerpPASS Technology Corp., the test report shall not be reproduced except in full.

Approved by:



Angelo Chang / Supervisor

Laboratory Accreditation:

CerpPASS Technology Corporation Test Laboratory





Contents

1. Summary of Maximum SAR Value.....	4
2. Test Configuration of Equipment under Test.....	5
3. General Information of Test	6
4. Remarks and comments	7
5. Basic restrictions and Standards.....	8
5.1 Test Standards	8
5.2 Reference Standards	8
5.3 Environment Condition	9
5.4 RF Exposure Limits	9
6. Test & System Description.....	10
6.1 SAR Definition	10
6.2 SAR Measurement System	11
6.3 Probes	12
6.4 Data Acquisition Electronics (DAE)	12
6.5 Robot.....	13
6.6 SAM Phantom	14
6.7 Device Holder.....	15
6.8 Test Equipment and Ancillaries Used for Tests	16
7. The SAR Measurement Procedure	18
7.1 System Performance Check	18
8. SAR Measurement Procedure	22
8.1 Test Procedures	22
8.2 EUT Testing Position	24
8.3 Measurement Evaluation	25
9. Wi-Fi SAR Exclusion and Results	27
9.1 Measured Conducted Average Power	27
9.2 Antenna Location	28
9.3 SAR Test Results Summary	29
9.4 SAR Measurement Variability	30
10. Simultaneous Transmission Analysis	31
10.1 Co-location	31
10.2 SPLSR Evaluation.....	31
11. Measurement Uncertainty	32
Appendix A. DASY Calibration Certificate	
Appendix B. System Performance Check	
Appendix C. Measured Conducted Power	
Appendix D. SAR Measurement Data	
Appendix E. Photographs of EUT Set up	



History of this test report

Attachment No.	Issued Date	Description
25030439-TRFCC04	Oct. 15, 2025	Original



1. Summary of Maximum SAR Value

Results for highest reported SAR values for each frequency band and mode are as below:

Equipment Class	Band	Maximum Report SAR (W/kg)
DSS/DTS	Bluetooth	0.65
Limit (W/kg)		1.6

Note :

1.Considering the results of the performed test according to FCC 47CFR Part 2.1093 and ISSED RSS 102, Issue 6 the item under test is IN COMPLIANCE with the requested specifications specified in Section1. Standards, reference documents and applicable test methods

2.The lab has reduced the uncertainty risk factor from test equipment, environment and staff technicians which according to the standard on contract. Therefore, the test result will only be determined by standard requirement.



2. Test Configuration of Equipment under Test

Operation Frequency Range	2400MHz-2483.5MHz
Center Frequency Range	BT: 2402MHz-2480MHz BLE GFSK 1Mbps: 2402MHz-2480MHz BLE GFSK 2Mbps: 2404MHz-2478MHz SRD GFSK 1Mbps: 2402MHz-2480MHz SRD GFSK 2Mbps: 2404MHz-2478MHz
Modulation Type	BT: GFSK, $\pi/4$ -DQPSK, 8DPSK BLE: GFSK SRD: GFSK
Modulation Technology	FHSS, DTS
Data Rate	BT: GFSK: 1Mbps, $\pi/4$ -DQPSK: 2Mbps, 8DPSK: 3Mbps BLE: GFSK: 1Mbps GFSK: 2Mbps SRD: GFSK: 1Mbps GFSK: 2Mbps
Antenna Type	BT: PIFA Antenna BLE: PIFA Antenna SRD: Dipole Antenna
Antenna Gain	BT: 1.6 dBi BLE: 1.6 dBi SRD: 2.7 dBi
Battery	Huizhou Fuji Energy Techonology Co., Ltd. \ NP-45A
USB Cable	steelseries \ 110430004107

Note: For more details, please refer to the User's manual of the EUT.



3. General Information of Test

Test Site	Cerpass Technology Corporation Test Laboratory Address: No.10, Ln. 2, Lianfu St., Luzhu Dist., Taoyuan City 33848, Taiwan (R.O.C.) Tel:+886-3-3226-888 Fax:+886-3-3226-881
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Test Item	Test Site	Tested By	Ambient Temperature	Ambient Relative Humidity	Test Period
SAR	RFSAR01-NK	Roy	18°C ~ 25°C	30% ~ 70%	2025/8/27



4. Remarks and comments

1. Variability and simultaneous transmission results shown in this report are based on the highest SAR value obtained among all antenna manufacturers.
2. Only the plots for the test positions with the highest measured SAR per band/mode are included in Annex C as required per FCC OET KDB 865664 D02, paragraph 2.3.8.



5. Basic restrictions and Standards

5.1 Test Standards

FCC	FCC 47 CFR Part 2 (2.1093)
	IEEE C95.1
ISED	RSS-102 Issue6

5.2 Reference Standards

FCC KDB Publication 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
FCC KDB Publication 447498 D01 General RF Exposure Guidance v06
FCC KDB Publication 447498 D04 Interim General RF Exposure Guidance v01
FCC KDB Publication 447498 D02: SAR procedure for USB dongle transmitter v02r01
FCC KDB Publication 616217 D04 SAR for laptop and tablets v01r02
FCC KDB Publication 248227 D01 802.11 Wi-Fi SAR v02r02
FCC KDB Publication 941225D06 Hot Spot SAR v02r01
FCC KDB Publication 41225 D07 UMPC Mini Tablet v01r02
IEEE 62209-1528 : 2020



5.3 Environment Condition

Item	Target
Ambient Temperature(°C)	18~25
Temperature of Simulant(°C)	20~22
Relative Humidity(%RH)	30~70

5.4 RF Exposure Limits

SAR assessments have been made in line with the requirements of FCC 47CFR Part 2.1093 and ISSED RSS 102 issue 5 on the limitation of exposure of the general population / uncontrolled exposure for portable devices.

Exposure Type	General Population / Uncontrolled Environment
Peak spatial-average SAR (averaged over any 1 gram of tissue)	1.6 W/kg
Whole body average SAR	0.08 W/kg
Peak spatial-average SAR (extremities) (averaged over any 10 grams of tissue)	4.0 W/kg

for above 6GHz

Exposure Type	Power density (S)
Limits for Occupational/Controlled Exposure. 1.5GHz – 100GHz	50.0 W/m²
Limits for General Population/ Uncontrolled Exposure. 1.5GHz – 100GHz	10.0 W/m²

According to ANSI/IEEE C95.1-1992, the criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in §1.1310. Peak Spatially Averaged Power Density was evaluated over a circular area of 4cm² per interim FCC Guidance for near-field power density evaluations per October 2018 TCB Workshop notes



6. Test & System Description

6.1 SAR Definition

Specific Absorption rate is defined as the time derivative of the incremental energy (dW) absorbed by (dissipated in) and incremental mass (dm) contained in a volume element (dV) of a given density (ρ).

$$SAR = \frac{d}{dt} \cdot \left(\frac{dW}{dm} \right) = \frac{d}{dt} \cdot \left(\frac{dW}{\rho \cdot dV} \right)$$

SAR is expressed in units of watts per kilogram (W/kg). SAR can be related to the electric field at a point by

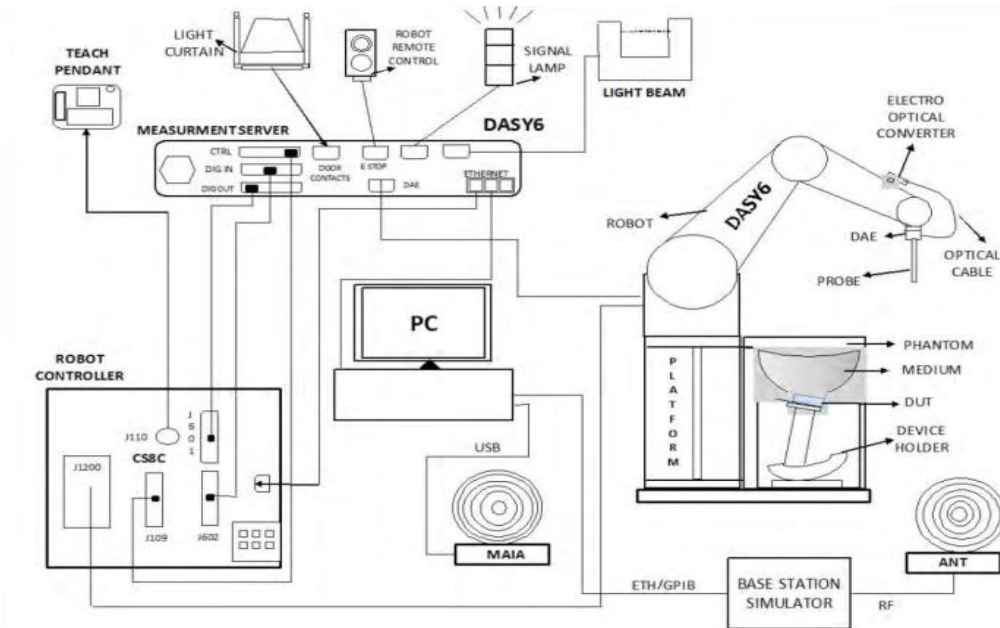
Where:

σ = Conductivity of the tissue (S/m)

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

E = RMS electric field strength (V/m)

6.2 SAR Measurement System



- ✓ A standard high precision 6-axis robot with controller, teach pendant and software. It includes an arm extension for accommodating the data acquisition electronics (DAE)
- ✓ An isotropic field probe optimized and calibrated for the targeted measurements.
- ✓ 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.
- ✓ The Electro-optical Converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. The EOC signal is transmitted to the measurement server.
- ✓ The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movements interrupts.
- ✓ The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- ✓ A computer running Win10 professional operating system and the cDASY6 and DASY5 V5.2 software.
- ✓ Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- ✓ The phantom, the device holder and other accessories according to the targeted measurement.

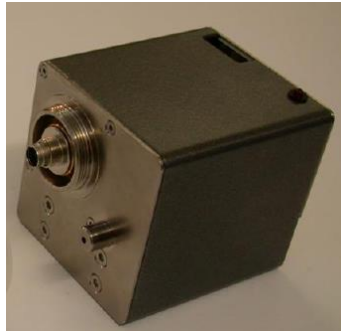


6.3 Probes

The SAR measurement is conducted with the dosimetric probe manufactured by SPEAG. The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency. SPEAG conducts the probe calibration in compliance with international and national standards (e.g. IEEE 1528, EN 62209-1, IEC 62209, etc.) under ISO 17025. The calibration data are in Appendix A.

Model	EX3DV4	
Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Frequency	4 MHz to 10 GHz Linearity: ± 0.2 dB (30 MHz to 10 GHz)	
Directivity	± 0.1 dB in TSL (rotation around probe axis) ± 0.3 dB in TSL (rotation normal to probe axis)	
Dynamic Range	10 μ W/g to 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 μ W/g)	
Dimensions	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	

6.4 Data Acquisition Electronics (DAE)

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



6.5 Robot

The DASY5 system uses the high precision robots TX60 L type out of the newer series from Stäubli SA (France). For the 6-axis controller DASY6 system, the CS8C robot controller version from Stäubli is used.

The XL robot series have many features that are important for our application:

- High precision (repeatability 0.02 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)
- 6-axis controller





6.6 SAM Phantom

The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region where shell thickness increases to 6mm). It has three measurement areas: ■ Left head ■ Right head ■ Flat phantom	 A photograph of the SAM twin phantom setup. It consists of a white fiberglass shell phantom mounted on a wooden frame. A black robotic arm is positioned above the phantom, and a black base is visible on the floor.
The ELI4 Phantom also is a fiberglass shell phantom with 2mm shell thickness. It has 30 liters filling volume, and with a dimension of 600mm for major ellipse axis, 400mm for minor axis. It is intended for compliance testing of handheld and body-mounted wireless devices in frequency range of 30 MHz to 6GHz. ELI4 is fully compatible with standard and all known tissue simulating liquids.	 A photograph of the ELI4 Phantom setup. It is a white fiberglass shell phantom mounted on a wooden frame. A red circular opening is visible on the top surface of the phantom.
The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.	



6.7 Device Holder

The DASY5 device holder is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation center for both scales is the ear reference point (EPR). Thus the device needs no repositioning when changing the angles. The DASY5 device holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity $\epsilon_r = 3$ and loss tangent $\delta = 0.02$. 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.



The laptop extension is lightweight and made of POM, acrylic glass and foam. It fits easily on upper part of the mounting device in place of the phone positioned. The extension is fully compatible with the SAM Twin and ELI phantoms.





6.8 Test Equipment and Ancillaries Used for Tests

Test Item	SAR					
Test Site	RFSAR01-NK					
Name of Equipment	Manufacturer	Type/Model	Serial No	Calibration Cycle(year)	Calibration Date	Valid Date
Robot	Staubli	TX60L Lspeag	F13/5P6VA1/A/01	/	NA	NA
DASY Test Software	Staubli	cDASY6 V16.0.2.136	/	/	NA	NA
DASY Test Software	Staubli	DASY5.2	14.6.14.7483	/	NA	NA
Signal Generator	KEYSIGHT	N5183A	MY50142931	1	2025/02/08	2026/02/07
S-Parameter Network Analyzer	Anritsu	MS46122B	2147302	1	2025/08/18	2026/08/17
Dielectric parameter probes	SPEAG	DAKS-3.5	1121	1	NA	NA
Power Meter	Anritsu	ML2495A	1224005	1	2025/02/12	2026/02/11
Power Sensor	Anritsu	MA2411B	1207295	1	2025/02/12	2026/02/11
Data Acquisition Electronics	SPEAG	DAE4	910	1	2025/07/14	2026/07/13
Dosimetric E-Field Probe	SPEAG	EX3DV4	3826	1	2025/07/03	2026/07/02
2450MHz System Validation Dipole	SPEAG	D2450V2	914	3	2024/07/10	2027/07/09
Amplifier	Mini-Circuits	ZVE-3W-183+	N636102230	/	NA	NA
Thermometer	Hi Sun	TH05A	11442	1	2025/07/18	2026/07/17

*Please Refer to the Appendix A. DASY Calibration Certificate.

Note:

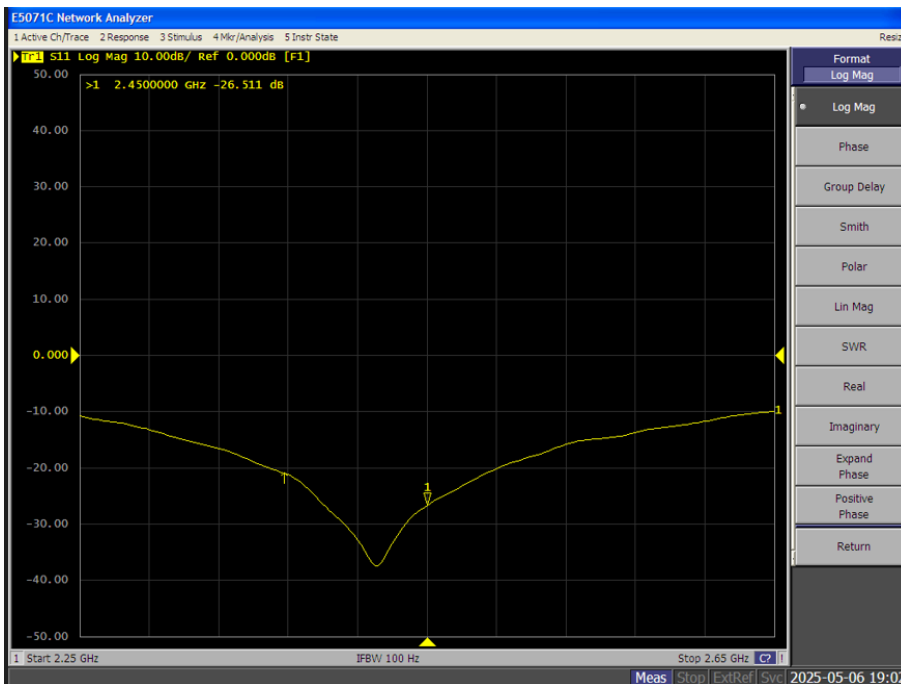
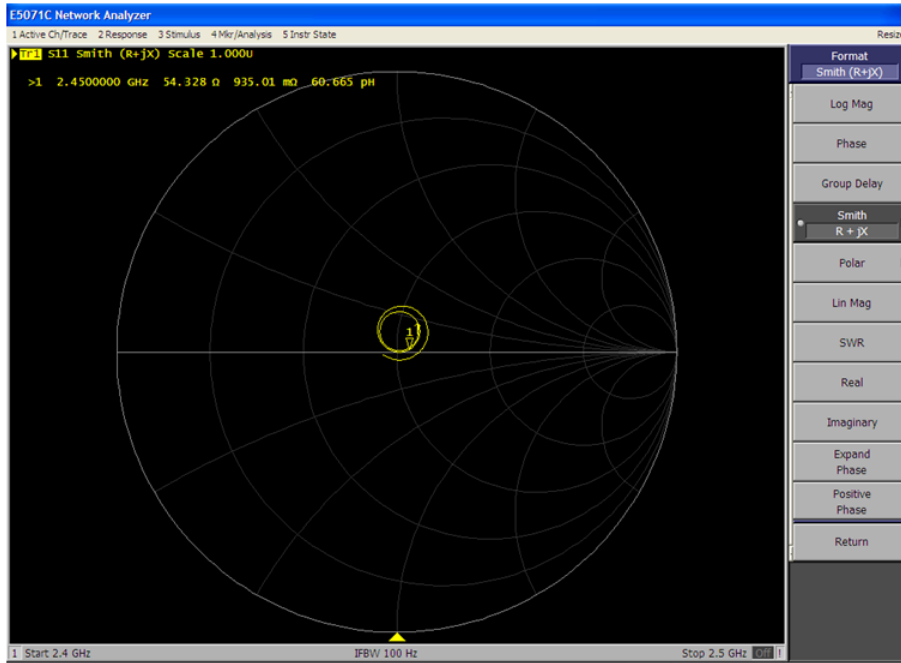
1. Prior to system verification and validation, the path loss from the signal generator to the system check source and the power meter, which includes the amplifier, cable, attenuator and directional coupler, was measured by the network analyzer. The reading of the power meter was offset by the path loss difference between the path to the power meter and the path to the system check source to monitor the actual power level fed to the system check source.
2. Referring to KDB 865664 D01v01r04, the dipole calibration interval can be extended to 3 years with justification. The dipoles are also not physically damaged, or repaired during the interval.
3. The justification data of dipole can be found in Appendix B. The return loss is < -20dB, within 20% of prior calibration, the impedance is within 5 ohm of prior calibration



2025:

2450MHz Head calibrated impedance: 52.592 Ω ; Measured impedance: **54.328 Ω** (within 5 Ω)

2450MHz Head calibrated return loss: -28.528 dB; Measured return loss: **-26.511 dB** (within 20%)





7. The SAR Measurement Procedure

7.1 System Performance Check

7.1.1 Purpose

1. To verify the simulating liquids are valid for testing.
2. To verify the performance of testing system is valid for testing.

7.1.2 Tissue Dielectric Parameters for Head Phantoms

For SAR measurement of the field distribution inside the phantom, the phantom must be filled with homogeneous tissue simulating liquid to a depth of at least 15 cm. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm. The nominal dielectric values of the tissue simulating liquids in the phantom and the tolerance of 10 % are listed in Table.

<Tissue Dielectric Parameters in IEEE 1528-2013 and IEC/IEEE 62209-1528>

Frequency (MHz)	Target Permittivity	Range of $\pm 10\%$	Target Conductivity	Range of $\pm 10\%$
450	43.5	39.2 ~ 47.9	0.87	0.78 ~ 0.96
750	41.9	37.7 ~ 46.1	0.89	0.80 ~ 0.98
835	41.5	37.4 ~ 45.7	0.90	0.81 ~ 0.99
900	41.5	37.4 ~ 45.7	0.97	0.87 ~ 1.07
1450	40.5	36.5 ~ 44.6	1.20	1.08 ~ 1.32
1500	40.4	36.4 ~ 44.4	1.23	1.11 ~ 1.35
1640	40.2	36.2 ~ 44.2	1.31	1.18 ~ 1.44
1750	40.1	36.1 ~ 44.1	1.37	1.23 ~ 1.51
1800	40.0	36.0 ~ 44.0	1.40	1.26 ~ 1.54
1900	40.0	36.0 ~ 44.0	1.40	1.26 ~ 1.54
2000	40.0	36.0 ~ 44.0	1.40	1.26 ~ 1.54
2100	39.8	35.8 ~ 43.8	1.49	1.34 ~ 1.64
2300	39.5	35.6 ~ 43.5	1.67	1.50 ~ 1.84
2450	39.2	35.3 ~ 43.1	1.80	1.62 ~ 1.98
2600	39.0	35.1 ~ 42.9	1.96	1.76 ~ 2.16
3000	38.5	34.7 ~ 42.4	2.40	2.16 ~ 2.64
3500	37.9	34.1 ~ 41.7	2.91	2.62 ~ 3.20
4000	37.4	33.7 ~ 41.1	3.43	3.09 ~ 3.77
4500	36.8	33.1 ~ 40.5	3.94	3.55 ~ 4.33
5000	36.2	32.6 ~ 39.8	4.45	4.01 ~ 4.90
5200	36.0	32.4 ~ 39.6	4.66	4.19 ~ 5.13
5400	35.8	32.2 ~ 39.4	4.86	4.37 ~ 5.35
5600	35.5	32.0 ~ 39.1	5.07	4.56 ~ 5.58
5800	35.3	31.8 ~ 38.8	5.27	4.74 ~ 5.80
6000	35.1	31.6 ~ 38.6	5.48	4.93 ~ 6.03
6500	34.5	31.1 ~ 38.0	6.07	5.46 ~ 6.68
7000	33.9	30.5 ~ 37.3	6.65	5.99 ~ 7.32

Note:

1. According to April 2019 TCB workshop, Effective February 19, 2019, FCC has permitted the use of single head-tissue simulating liquid specified in IEC 62209-1 for all SAR tests.



7.1.3 Tissue Calibration Result

The dielectric parameters of the liquids were verified prior to the SAR evaluation using DASY5 Dielectric Assessment Kit and Agilent Vector Network Analyzer E5071C.

Please Refer to the Appendix B System Performance Check.

Note:

1. The Delta Permittivity% and Delta Conductivity% should be both within $\pm 5\%$ limit of target values.
2. Refer to KDB 865664 D01 v01r04, The depth of body tissue-equivalent liquid in a phantom must be ≥ 15.0 cm with $\leq \pm 0.5$ cm variation for SAR measurements ≤ 3 GHz and ≥ 10.0 cm with $\leq \pm 0.5$ cm variation for measurements > 3 GHz.



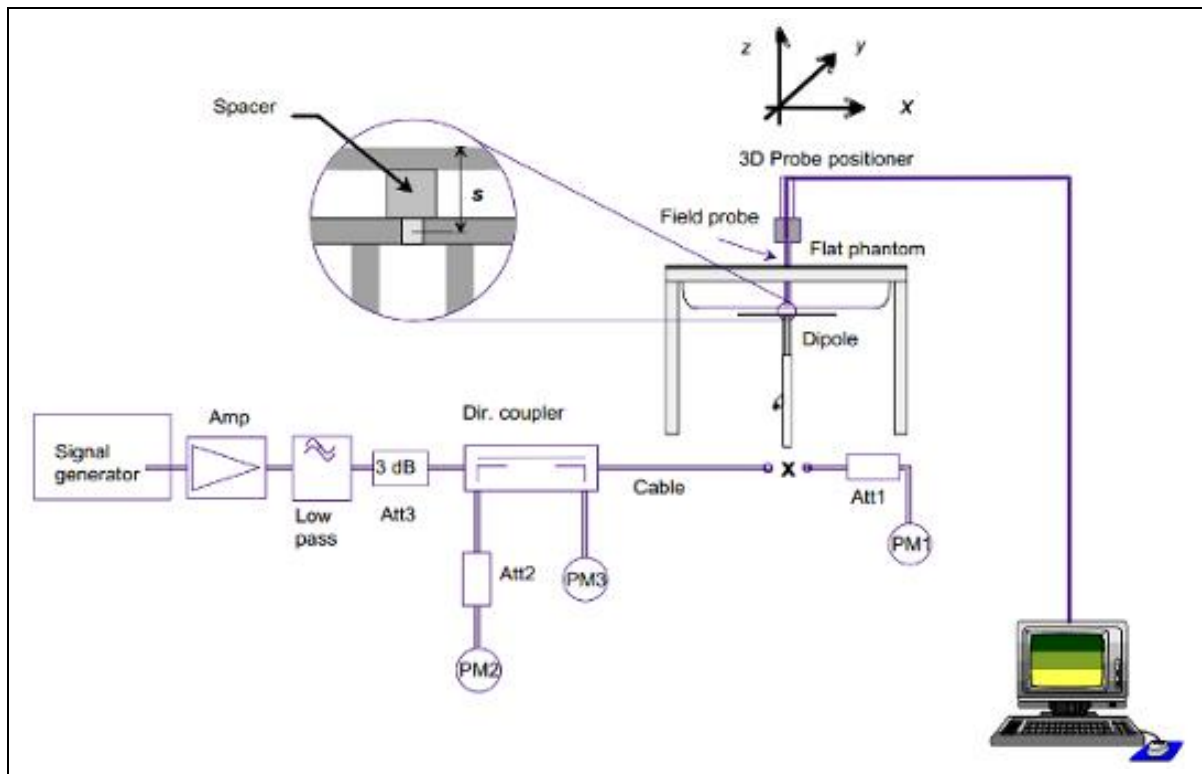
7.1.4 System Performance Check Procedure

The DASY5 installation includes predefined files with recommended procedures for measurements and the system performance check. They are read-only document files and destined as fully defined but unmeasured masks, so the finished system performance check must be saved under a different name. The system performance check document requires the SAM Twin Phantom or ELI4 Phantom, so the phantom must be properly installed in your system. (User defined measurement procedures can be created by opening a new document or editing an existing document file). Before you start the system performance check, you need only to tell the system with which components (probe, medium, and device) you are performing the system performance check; the system will take care of all parameters.

- **The Power Reference Measurement and Power Drift Measurement** jobs are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure. The indicated drift is mainly the variation of the Dipole output power. If it is too high (above ± 0.2 dB), the system performance check should be repeated;
- **The Surface Check** job tests the optical surface detection system of the DASY5 system by repeatedly detecting the surface with the optical and mechanical surface detector and comparing the results. The output gives the detecting heights of both systems, the difference between the two systems and the standard deviation of the detection repeatability. Air bubbles or refraction in the liquid due to separation of the sugar-water mixture gives poor repeatability (above ± 0.1 mm). In that case it is better to abort the system performance check and stir the liquid;
- **The Area Scan** job measures the SAR above the dipole on a plane parallel to the surface. It is used to locate the approximate location of the peak SAR. The proposed scan uses large grid spacing for faster measurement; due to the symmetric field, the peak detection is reliable;
- **The Zoom Scan** job measures the field in a volume around the peak SAR value assessed in the previous Area Scan job (for more information see the application note on SAR evaluation). If the system performance check gives reasonable results. The dipole input power (forward power) was 250mW, 1 g and 10 g spatial average SAR values normalized to 1W dipole input power give reference data for comparisons and it's equal to 10x(dipole forward power). The next sections analyze the expected uncertainties of these values, as well as additional checks for further information or troubleshooting.

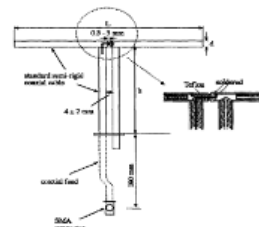


7.1.5 System Performance Check Setup



7.1.6 Validation Dipoles

The dipoles use is based on the IEEE Std.1528-2013 and FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04 standard, and is complied with mechanical and electrical specifications in line with the requirements of both EN62209-1 and EN62209-2. The table below provides details for the mechanical and electrical specifications for the dipoles.



7.1.7 Result of System Performance Check: Valid Result

Please Refer to the Appendix B System Performance Check.



8. SAR Measurement Procedure

8.1 Test Procedures

Step 1 Setup a Connection

First, engineer should record the conducted power before the test. Then establish a call in handset at the maximum power level with a base station simulator via air interface, or make the EUT estimate by itself in testing band. Place the EUT to the specific test location. After the testing, must export SAR test data by SEMCAD. Then writing down the conducted power of the EUT into the report, also the SAR values tested.

Step 2 Power Reference Measurements

To measure the local E-field value at a fixed location which value will be taken as a reference value for calculating a possible power drift.

Step 3 Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE Standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan). If only one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of Zoom Scans has to be increased accordingly.

Area Scan Parameters extracted from KDB 865664 D01v01r04

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

**Step 4 Zoom Scan**

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The Zoom Scan measures points (refer to table below) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1 g and 10 g and displays these values next to the job's label.

Zoom Scan Parameters extracted from KDB 865664 D01 v01r04

			≤ 3 GHz	> 3 GHz
Maximum zoom scan spatial resolution: Δx_{Zoom} , Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{\text{Zoom}}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{\text{Zoom}}(1)$: between 1 st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{\text{Zoom}}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{\text{Zoom}}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm
Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.				
* When zoom scan is required and the <i>reported</i> SAR from the <i>area scan based 1-g SAR estimation</i> procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.				

Step 5 Power Drift Measurements

Repetition of the E-field measurement at the fixed location mentioned in Step 1 to make sure the two results differ by less than ± 0.2 dB.



8.2 EUT Testing Position

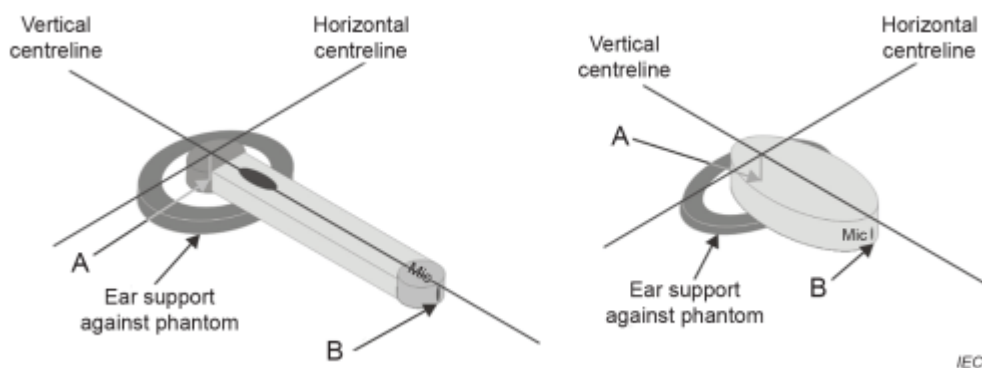
8.2.1 DUTs with alternative form factor

The basic principles identified and specified in 7.2.4 may be applied to devices with similar form factors. Wireless headsets (e.g. connected by Bluetooth) are examples of head-mounted devices that may be evaluated by applying these principles.

The geometry and coordinate mapping system shown in Figure 18 is applicable. Point A, being the acoustic output, is located at the mid-point of the width, and point B, being the primary microphone, is located at the bottom of the device (the end closest to the mouth). Note that for the purpose of applying the positioning procedures, the DUT is considered to be a conventional bar type (rectangular, cuboid) form factor.

Prior to using 7.2.7, consideration shall be made of the available operating modes and the maximum operating power levels, because some devices might not require testing.

All details relating to alternative form factor DUTs shall be fully documented in the measurement report, including diagrams or photographs. Sound engineering practice shall be applied to implement the mapping of an alternate form factor device.



An alternative form factor DUT with reference points and reference lines



8.3 Measurement Evaluation

<WLAN >

Initial Test Configuration

An initial test configuration is determined for OFDM transmission modes in 2.4 GHz and 5 GHz bands according to the channel bandwidth, modulation and data rate combination(s) with the highest maximum output power specified for production units in each standalone and aggregated frequency band. When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, for each frequency band.

Subsequent Test Configuration

SAR measurement requirements for the remaining 802.11 transmission mode configurations that have not been tested in the initial test configuration are determined separately for each standalone and aggregated frequency band, in each exposure condition, according to the maximum output power specified for production units. Additional power measurements may be required to determine if SAR measurements are required for subsequent highest output power channels in a subsequent test configuration. When the highest reported SAR for the initial test configuration according to the initial test position or fixed exposure position requirements, is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for that subsequent test configuration.

SAR Test Configuration and Channel Selection

When multiple channel bandwidth configurations in a frequency band have the same specified maximum output power, the initial test configuration is using largest channel bandwidth, lowest order modulation, lowest data rate, and lowest order 802.11 mode (i.e., 802.11a is chosen over 802.11n then 802.11ac or 802.11g is chosen over 802.11n). After an initial test configuration is determined, if multiple test channels have the same measured maximum output power, the channel chosen for SAR measurement is determined according to the following.

- 1) The channel closest to mid-band frequency is selected for SAR measurement.
- 2) For channels with equal separation from mid-band frequency; for example, high and low channels or two mid-band channels, the higher frequency (number) channel is selected for SAR measurement.

**Test Reduction for U-NII-1 (5.2 GHz) and U-NII-2A (5.3 GHz) Bands**

For devices that operate in both U-NII bands using the same transmitter and antenna(s), SAR test reduction is determined according to the following.

- 1) 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).
- 2) When different maximum output power is specified for the bands, 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.

A Wi-Fi device must be configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools for SAR measurement. The test frequencies established using test mode must correspond to the actual channel frequencies. When 802.11 frame gaps are accounted for in the transmission,

a maximum transmission duty factor of 92 - 96% is typically achievable in most test mode configurations. A minimum transmission duty factor of 85% is required to avoid certain hardware and device implementation issues related to wide range SAR scaling.

In addition, a periodic transmission duty factor is required for current generation SAR systems to measure SAR correctly. The reported SAR must be scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit.



9. Wi-Fi SAR Exclusion and Results

9.1 Measured Conducted Average Power

Please Refer to the Appendix C Measured Conducted Power.



9.2 Antenna Location



Antenna	Wireless Interface
AntB	SRD
AntA	BT/BLE



9.3 SAR Test Results Summary

Please Refer to the Appendix D SAR measurement data.

General Note:

1. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
 - a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
 - b. For SAR testing of WLAN signal with non-100% duty cycle, the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)"
 - c. For WWAN: Reported SAR(W/kg)= Measured SAR(W/kg)*Tune-up Scaling Factor
 - d. For WLAN/Bluetooth: Reported SAR(W/kg)= Measured SAR(W/kg)* Duty Cycle scaling factor * Tune-up scaling factor
2. Per KDB 447498 D01v06, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:
 - ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz.
 - ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
 - ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz
3. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥ 0.8 W/kg.

WLAN Note:

1. Per KDB248227 D01 v02r02 section 5.2.1 2), when the reported SAR is > 0.8 W/kg, SAR is required for that exposure configuration using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing.
2. 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, 802.11g/n OFDM SAR is not required, per KDB248227 D01 v02r01 section 5.2.2 2).



9.4 SAR Measurement Variability

According to KDB 865664 D01v01r04, SAR measurement variability must be assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media are required for SAR measurements in a frequency band, the variability measurement procedures should be applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. The following procedures are applied to determine if repeated measurements are required:

1. The original highest measured Reported SAR 1-g is ≥ 0.80 W/kg, repeated that measurement once.
2. Perform a second repeated measurement the ratio of the largest to the smallest SAR for the original and first repeated measurements is <1.2 W/kg, or when the original or repeated measurement is ≥ 1.45 W/kg (~10% from the 1-g SAR limit).



10. Simultaneous Transmission Analysis

1. The reported SAR summation is calculated based on the same configuration and test position.
 8. Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
 - i) Scalar SAR summation $< 1.6\text{W/kg}$.
 - ii) $\text{SPLSR} = (\text{SAR1} + \text{SAR2})^{1.5} / (\text{min. separation distance, mm})$, and the peak separation distance is determined from the square root of $[(x1-x2)^2 + (y1-y2)^2 + (z1-z2)^2]$, where $(x1, y1, z1)$ and $(x2, y2, z2)$ are the coordinates of the extrapolated peak SAR locations in the zoom scan.
 - iii) If $\text{SPLSR} \leq 0.04$, simultaneously transmission SAR measurement is not necessary.
 - iv) Simultaneously transmission SAR measurement, and the reported multi-band SAR $< 1.6\text{W/kg}$.
- The SPLSR calculated results please refer to section 8.2.

10.1 Co-location

N/A

10.2 SPLSR Evaluation

N/A



11. Measurement Uncertainty

DASY5 Uncertainty Budget According to IEEE 1528-2013 and IEC 62209-1/201x (0.3 - 3 GHz range)								
Error Description	Uncertainty Value (±%)	Probability	Divisor	(Ci) 1g	(Ci) 10g	Standard Uncertainty (1g) (±%)	Standard Uncertainty (10g) (±%)	(Vi) Veff
Measurement System								
Probe Calibration	6.00	N	1	1	1	6.0	6.0	∞
Axial Isotropy	4.70	R	1.732	0.7	0.7	1.9	1.9	∞
Hemispherical Isotropy	9.60	R	1.732	0.7	0.7	3.9	3.9	∞
Boundary Effects	1.00	R	1.732	1	1	0.6	0.6	∞
Linearity	4.70	R	1.732	1	1	2.7	2.7	∞
System Detection Limits	0.25	R	1.732	1	1	0.1	0.1	∞
Modulation Response	2.40	R	1.732	1	1	1.4	1.4	∞
Readout Electronics	0.30	N	1	1	1	0.3	0.3	∞
Response Time	0.00	R	1.732	1	1	0.0	0.0	∞
Integration Time	2.60	R	1.732	1	1	1.5	1.5	∞
RF Ambient Noise	3.00	R	1.732	1	1	1.7	1.7	∞
RF Ambient Reflections	3.00	R	1.732	1	1	1.7	1.7	∞
Probe Positioner	0.40	R	1.732	1	1	0.2	0.2	∞
Probe Positioning	2.90	R	1.732	1	1	1.7	1.7	∞
Max. SAR Eval.	2.00	R	1.732	1	1	1.2	1.2	∞
Test Sample Related								
Device Positioning	2.90	N	1	1	1	2.9	2.9	145
Device Holder	3.60	N	1	1	1	3.6	3.6	5
Power Drift	5.00	R	1.732	1	1	2.9	2.9	∞
Power Scaling	0.00	R	1.732	1	1	0.0	0.0	∞
Phantom and Setup								
Phantom Uncertainty	6.10	R	1.732	1	1	3.5	3.5	∞
SAR correction	1.90	R	1.732	1	0.84	1.1	0.9	∞
Liquid Conductivity (mea.)	2.50	R	1.732	0.78	0.71	1.1	1.0	∞
Temp. unc. - Conductivity	3.38	R	1.732	0.78	0.71	1.5	1.4	∞
Liquid Permittivity (mea.)	2.50	R	1.732	0.23	0.26	0.3	0.4	∞
Temp. unc. - Permittivity	0.40	R	1.732	0.23	0.26	0.1	0.1	∞
Combined Std. Uncertainty						11.1%	11.1%	441
Coverage Factor for 95 %						K=2	K=2	
Expanded STD Uncertainty						22.3%	22.2%	



DASY5 Uncertainty Budget According to IEEE 1528-2013 and IEC 62209-1/201x (3 - 6 GHz range)								
Error Description	Uncertainty Value (±%)	Probability	Divisor	(Ci) 1g	(Ci) 10g	Standard Uncertainty (1g) (±%)	Standard Uncertainty (10g) (±%)	(Vi) Veff
Measurement System								
Probe Calibration	6.55	N	1	1	1	6.6	6.6	∞
Axial Isotropy	4.70	R	1.732	0.7	0.7	1.9	1.9	∞
Hemispherical Isotropy	9.60	R	1.732	0.7	0.7	3.9	3.9	∞
Boundary Effects	2.00	R	1.732	1	1	1.2	1.2	∞
Linearity	4.70	R	1.732	1	1	2.7	2.7	∞
System Detection Limits	0.25	R	1.732	1	1	0.1	0.1	∞
Modulation Response	2.40	R	1.732	1	1	1.4	1.4	∞
Readout Electronics	0.30	N	1	1	1	0.3	0.3	∞
Response Time	0.00	R	1.732	1	1	0.0	0.0	∞
Integration Time	2.60	R	1.732	1	1	1.5	1.5	∞
RF Ambient Noise	3.00	R	1.732	1	1	1.7	1.7	∞
RF Ambient Reflections	3.00	R	1.732	1	1	1.7	1.7	∞
Probe Positioner	0.80	R	1.732	1	1	0.5	0.5	∞
Probe Positioning	6.70	R	1.732	1	1	3.9	3.9	∞
Max. SAR Eval.	2.00	R	1.732	1	1	1.2	1.2	∞
Test Sample Related								
Device Positioning	2.90	N	1	1	1	2.9	2.9	145
Device Holder	3.60	N	1	1	1	3.6	3.6	5
Power Drift	5.00	R	1.732	1	1	2.9	2.9	∞
Power Scaling	0.00	R	1.732	1	1	0.0	0.0	∞
Phantom and Setup								
Phantom Uncertainty	6.60	R	1.732	1	1	3.8	3.8	∞
SAR correction	1.90	R	1.732	1	0.84	1.1	0.9	∞
Liquid Conductivity (mea.)	2.50	R	1.732	0.78	0.71	1.1	1.0	∞
Temp. unc. - Conductivity	3.36	R	1.732	0.78	0.71	1.5	1.4	∞
Liquid Permittivity (mea.)	2.50	R	1.732	0.23	0.26	0.3	0.4	∞
Temp. unc. - Permittivity	0.40	R	1.732	0.23	0.26	0.1	0.1	∞
Combined Std. Uncertainty						12.1%	12.1%	614
Coverage Factor for 95 %						K=2	K=2	
Expanded STD Uncertainty						24.2%	24.1%	

-----THE END OF REPORT-----



Appendix A. DASY Calibration Certificate



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

Cerpass
Taoyuan

Certificate No.

D2450V2-914_Jul24

CALIBRATION CERTIFICATE

Object D2450V2 - SN: 914

Calibration procedure(s) QA CAL-05.v12
Calibration Procedure for SAR Validation Sources between 0.7 - 3 GHz

Calibration date July 10, 2024

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 $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Cal
Power Sensor R&S NRP-33T	SN: 100967	28-Mar-24 (No. 217-04038)	Mar-25
Power Sensor R&S NRP18A	SN: 101859	21-Mar-24 (No. 4030A315007801)	Mar-25
Spectrum Analyzer R&S FSV40	SN: 101832	25-Jan-24 (No. 4030-315007551)	Jan-25
Mismatch; Short [S4188] Attenuator [S4423]	SN: 1152	28-Mar-24 (No. 217-04050)	Mar-25
OCP DAK-12	SN: 1016	05-Oct-23 (No. OCP-DAK12-1016_Oct23)	Oct-24
OCP DAK-3.5	SN: 1249	05-Oct-23 (No. OCP-DAK3.5-1249_Oct23)	Oct-24
Reference Probe EX3DV4	SN: 7349	03-Jun-24 (No. EX3-7349_Jun24)	Jun-25
DAE4ip	SN: 1836	10-Jan-24 (No. DAE4ip-1836_Jan24)	Jan-25

Secondary Standards	ID	Check Date (in house)	Scheduled Check
ACAD Source Box	SN: 1000	28-May-24 (No. 675-ACAD_Source_Box-240528)	May-25
Signal Generator R&S SMB100A	SN: 182081	28-May-24 (No. 0001-300719404)	May-25
Mismatch; SMA	SN: 1102	22-May-24 (No. 675-Mismatch_SMA-240522)	May-25

	Name	Function	Signature
Calibrated by	Paulo Pina	Laboratory Technician	
Approved by	Sven Kühn	Technical Manager	

Issued: July 10, 2024

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



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

Accreditation No.: SCS 0108

Glossary

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

Calibration is Performed According to the Following Standards

- IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation

- DASY 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%.

Measurement Conditions

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

DASY Version	DASY8 Module SAR	16.4.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with spacer
Zoom Scan Resolution	dx, dy = 5mm, dz = 1.5mm	Graded Ratio = 1.5 mm (Z direction)
Frequency	2450MHz $\pm$ 1MHz	

Head TSL parameters at 2450 MHz

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 $\pm$ 0.2)°C	38.0 $\pm$ 6%	1.83 mho/m $\pm$ 6%
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL at 2450 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	24 dBm input power	13.0 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	51.8 W/kg $\pm$ 17.0% ($k = 2$)

SAR averaged over 10 cm³ (10 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	24 dBm input power	6.10 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.3 W/kg $\pm$ 16.5% ($k = 2$)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 2450 MHz

Impedance	52.6 Ω + 2.8 j Ω
Return Loss	-28.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.155 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured. The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard. No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
-----------------	-------

System Performance Check Report

Summary

Dipole	Frequency [MHz]	TSL	Power [dBm]
D2450V2 - SN914	2450	HSL	24

Exposure Conditions

Phantom Section, TSL	Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor	TSL Conductivity [S/m]	TSL Permittivity
Flat	10		CW, 0---	2450, 0	7.24	1.83	38.0

Hardware Setup

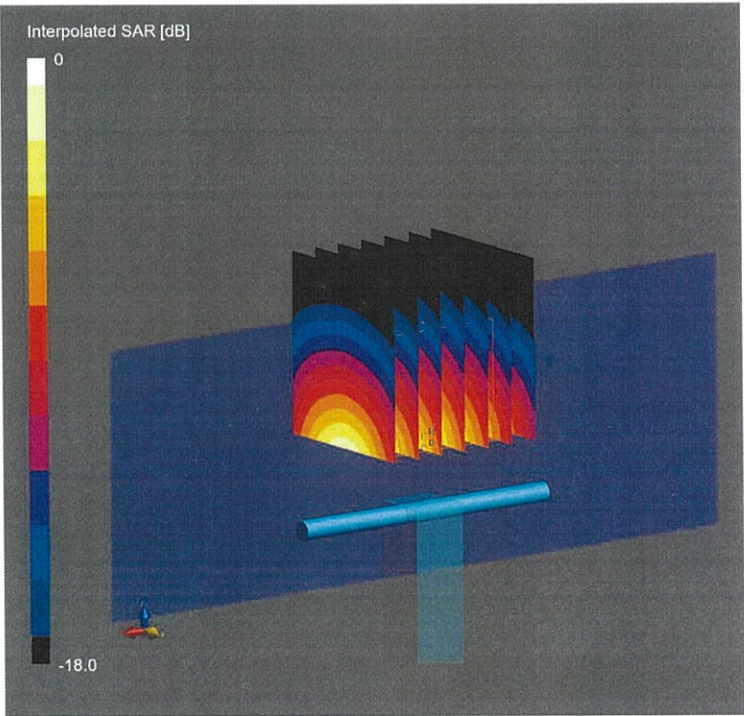
Phantom	TSL, Measured Date	Probe, Calibration Date	DAE, Calibration Date
MFP V8.0 Center	HSL, 2024-07-10	EX3DV4 - SN7349, 2024-06-03	DAE4ip Sn1836, 2024-01-10

Scans Setup

	Zoom Scan
Grid Extents [mm]	30 x 30 x 30
Grid Steps [mm]	5.0 x 5.0 x 1.5
Sensor Surface [mm]	1.4
Graded Grid	Yes
Grading Ratio	1.5
MAIA	N/A
Surface Detection	VMS + 6p
Scan Method	Measured

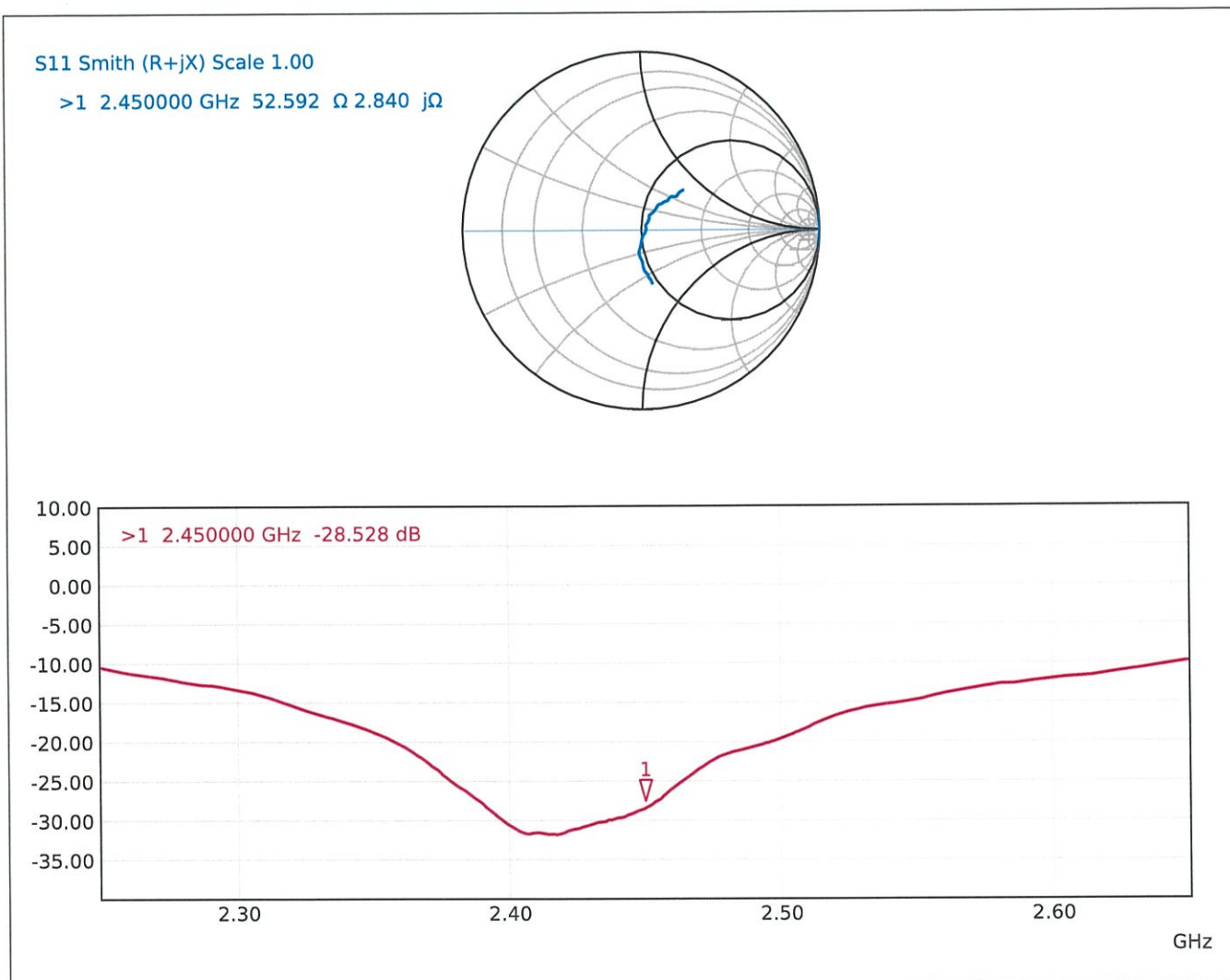
Measurement Results

	Zoom Scan
Date	2024-07-10
psSAR1g [W/Kg]	13.0
psSAR10g [W/Kg]	6.10
Power Drift [dB]	0.01
Power Scaling	Disabled
Scaling Factor [dB]	
TSL Correction	Positive / Negative



0 dB = 26.4 W/Kg

Impedance Measurement Plot for Head TSL





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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client

Auden
Taoyuan City

Certificate No.

EX-3826_Jul25

CALIBRATION CERTIFICATE

Object EX3DV4 - SN:3826

Calibration procedure(s) QA CAL-01.v10, QA CAL-12.v10, QA CAL-14.v7, QA CAL-23.v6,
QA CAL-25.v8
Calibration procedure for dosimetric E-field probes

Calibration date July 03, 2025

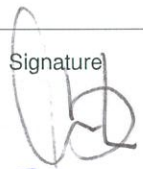
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Calibration Date (Certificate No.)	Sched. Cal.
Power Sensor R&S NRP-33T	SN: 100967	26-Mar-25 (No. 217-04290)	Mar-26
N-type mismatch combination	SN: L1119	26-Mar-25 (No. 217-04292)	Mar-26
OCP DAK-12	SN: 1016	24-Sept-24 (No. OCP-DAK12-1016_Sep24)	Sep-25
OCP DAK-3.5	SN: 1249	23-Sept-24 (No. OCP-DAK3.5-1249_Sep24)	Sep-25
Reference Probe EX3DV4	SN: 7349	10-Jan-25 (No. EX3-7349_Jan25)	Jan-26
DAE4	SN: 1301	07-Nov-24 (No. DAE4-1301_Nov24)	Nov-25

Secondary Standards	ID	Check Date (in house)	Sched. Check
ACAP 2020 Setup 1	SN: L1404	30-Sept-24 (No. Report_ACAP2020E-Cave_20240930s)	Sep-25
OCP DAK-12	SN: 1029	27-Feb-25 (No. OCP-DAK12-1029_Feb25)	Feb-26
OCP DAK-3.5	SN: 1336	09-Dec-24 (No. OCP-DAK3.5-1336_Dec24)	Dec-25

	Name	Function	Signature
Calibrated by	Claudio Leubler	Laboratory Technician	
Approved by	Sven Kühn	Technical Manager	
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

Issued: July 03, 2025

Calibration Laboratory of

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland



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

Accredited by the Swiss Accreditation Service (SAS)

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

Accreditation No.: **SCS 0108**

Glossary

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ 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:

- IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices – Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z} = NORM_{x,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.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal. 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
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}; A, B, C, D** are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

Parameters of Probe: EX3DV4 - SN:3826

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc ($k = 2$)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.48	0.41	0.35	$\pm 10.1\%$
DCP (mV) ^B	100.2	100.3	103.1	$\pm 4.7\%$

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B $\text{dB}\sqrt{\mu\text{V}}$	C	D dB	VR mV	Max dev.	Max Unc ^E $k = 2$
0	CW	X	0.00	0.00	1.00	0.00	147.5	$\pm 1.9\%$	$\pm 4.7\%$
		Y	0.00	0.00	1.00		137.2		
		Z	0.00	0.00	1.00		120.2		
10352	Pulse Waveform (200Hz, 10%)	X	20.00	91.14	20.82	10.00	60.0	$\pm 2.9\%$	$\pm 9.6\%$
		Y	20.00	90.69	20.46		60.0		
		Z	20.00	88.52	18.85		60.0		
10353	Pulse Waveform (200Hz, 20%)	X	20.00	93.42	21.03	6.99	80.0	$\pm 1.8\%$	$\pm 9.6\%$
		Y	20.00	93.47	20.49		80.0		
		Z	20.00	92.06	19.44		80.0		
10354	Pulse Waveform (200Hz, 40%)	X	20.00	100.37	23.20	3.98	95.0	$\pm 1.3\%$	$\pm 9.6\%$
		Y	20.00	100.02	22.09		95.0		
		Z	20.00	99.20	21.57		95.0		
10355	Pulse Waveform (200Hz, 60%)	X	20.00	111.34	27.05	2.22	120.0	$\pm 1.3\%$	$\pm 9.6\%$
		Y	20.00	109.56	25.11		120.0		
		Z	20.00	119.98	29.89		120.0		
10387	QPSK Waveform, 1 MHz	X	1.89	67.60	16.10	1.00	150.0	$\pm 2.0\%$	$\pm 9.6\%$
		Y	1.60	65.69	14.71		150.0		
		Z	2.02	70.98	17.51		150.0		
10388	QPSK Waveform, 10 MHz	X	2.55	70.02	16.85	0.00	150.0	$\pm 1.1\%$	$\pm 9.6\%$
		Y	2.09	67.01	15.35		150.0		
		Z	2.57	71.32	17.73		150.0		
10396	64-QAM Waveform, 100 kHz	X	3.26	72.33	19.76	3.01	150.0	$\pm 0.9\%$	$\pm 9.6\%$
		Y	2.37	66.88	17.22		150.0		
		Z	2.73	71.22	19.55		150.0		
10399	64-QAM Waveform, 40 MHz	X	3.61	67.55	16.12	0.00	150.0	$\pm 0.8\%$	$\pm 9.6\%$
		Y	3.44	66.70	15.60		150.0		
		Z	3.59	68.06	16.48		150.0		
10414	WLAN CCDF, 64-QAM, 40 MHz	X	4.95	65.79	15.69	0.00	150.0	$\pm 1.9\%$	$\pm 9.6\%$
		Y	4.78	65.43	15.43		150.0		
		Z	4.80	66.07	15.88		150.0		

Note: For details on UID parameters see Appendix

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

^A The uncertainties of Norm X,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 5 and 6).

^B Linearization parameter uncertainty for maximum specified field strength.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

Parameters of Probe: EX3DV4 - SN:3826

Sensor Model Parameters

	C1 fF	C2 fF	α V ⁻¹	T1 msV ⁻²	T2 msV ⁻¹	T3 ms	T4 V ⁻²	T5 V ⁻¹	T6
x	50.1	371.90	35.24	18.84	0.00	5.08	1.60	0.22	1.01
y	40.9	303.88	35.31	7.45	0.30	5.03	0.26	0.31	1.01
z	36.7	266.17	34.02	9.10	0.00	5.03	1.06	0.10	1.00

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle	49.5°
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

Note: Measurement distance from surface can be increased to 3–4 mm for an *Area Scan* job.

Parameters of Probe: EX3DV4 - SN:3826

Calibration Parameter Determined in HSL

f (MHz) ^C	Relative Permittivity ^F	Conductivity ^F (S/m)	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc ^H (k = 2)
750	41.9	0.89	9.01	8.86	9.15	0.30	1.27	±11.0%
835	41.5	0.90	8.81	8.65	8.94	0.30	1.27	±11.0%
900	41.5	0.97	8.69	8.54	8.83	0.30	1.27	±11.0%
1450	40.5	1.20	8.06	7.92	8.18	0.31	1.27	±11.0%
1750	40.1	1.37	7.69	7.55	7.81	0.31	1.27	±11.0%
1900	40.0	1.40	7.46	7.33	7.58	0.31	1.27	±11.0%
2000	40.0	1.40	7.32	7.19	7.43	0.31	1.27	±11.0%
2300	39.5	1.67	7.03	6.91	7.14	0.31	1.27	±11.0%
2450	39.2	1.80	6.85	6.73	6.96	0.31	1.27	±11.0%
2600	39.0	1.96	6.68	6.56	6.78	0.31	1.27	±11.0%
3300	38.2	2.71	6.55	6.43	6.65	0.32	1.27	±13.1%
3500	37.9	2.91	6.52	6.41	6.62	0.32	1.27	±13.1%
3700	37.7	3.12	6.48	6.37	6.58	0.32	1.27	±13.1%
3900	37.5	3.32	6.35	6.24	6.45	0.32	1.27	±13.1%
4100	37.2	3.53	6.30	6.19	6.40	0.33	1.27	±13.1%
4200	37.1	3.63	6.27	6.16	6.36	0.33	1.27	±13.1%
4400	36.9	3.84	6.22	6.11	6.31	0.33	1.27	±13.1%
4600	36.7	4.04	6.15	6.04	6.24	0.33	1.27	±13.1%
4800	36.4	4.25	6.10	5.99	6.19	0.33	1.27	±13.1%
4950	36.3	4.40	6.00	5.90	6.09	0.32	1.27	±13.1%
5250	35.9	4.71	5.29	5.20	5.38	0.30	1.27	±13.1%
5600	35.5	5.07	4.80	4.72	4.87	0.27	1.27	±13.1%
5750	35.4	5.22	4.90	4.82	4.98	0.26	1.27	±13.1%

^C Frequency validity above 300 MHz of ±100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ±50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ±10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4–9 MHz, and ConvF assessed at 13 MHz is 9–19 MHz. Above 5 GHz frequency validity can be extended to ±110 MHz.

^F The probes are calibrated using tissue simulating liquids (TSL) that deviate for ϵ and σ by less than ±5% from the target values (typically better than ±3%) and are valid for TSL with deviations of up to ±10% if SAR correction is applied.

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

^H The stated uncertainty is the total calibration uncertainty (k = 2) of Norm-ConvF. This is equivalent to the uncertainty component with the symbol CF in Table 9 of IEC/IEEE 62209-1528:2020.

Parameters of Probe: EX3DV4 - SN:3826

Calibration Parameter Determined in HSL

f (MHz) ^C	Relative Permittivity ^F	Conductivity ^F (S/m)	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc ^H (k = 2)
6500	34.5	6.07	5.15	5.07	5.24	0.20	1.27	±18.6%

^C Frequency validity is -600/+700 MHz at 6.5 GHz, ±700 MHz at or above 7 GHz, and ±150 MHz at 9.85 GHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F The probes are calibrated using tissue simulating liquids (TSL) that deviate for ϵ and σ by less than ±10% from the target values (typically better than ±6%) and are valid for TSL with deviations of up to ±10%.

^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; below ±2% for frequencies between 3–6 GHz; and below ±4% for frequencies between 6–10 GHz at any distance larger than half the probe tip diameter from the boundary.

^H The stated uncertainty is the total calibration uncertainty (k = 2) of Norm-ConvF. This is equivalent to the uncertainty component with the symbol CF in Table 9 of IEC/IEEE 62209-1528:2020.