SAR& Power Density TEST REPORT

Applicant	:	Hypertechnologie Ciara Inc.
Address	:	9300 Trans-Canada Hwy Saint-Laurent QC H4S 1K5 Canada
Manufacturer	:	Hypertechnologie Ciara Inc.
Address	:	9300 Trans-Canada Hwy Saint-Laurent QC H4S 1K5 Canada
Equipment	:	Notebook
Model No.	:	CRIUS CO310-G1, CRIUS CO310-G1-BL, CRIUS N320-G1, CRIUS N320-G1-BL, CRIUS N310-G1, CRIUS N310-G1-BL
Trade Name	:	CIARA
FCC ID.	:	2BDS2-CRIUS

I HEREBY CERTIFY THAT:

The sample was received on Nov. 15, 2023 and the testing was completed on Dec. 05, 2023 at Cerpass Technology Corp. The test result refers exclusively to the test presented test model / sample. Without written approval of Cerpass Technology Corp., the test report shall not be reproduced except in full.

Approved by:

Angelo Chang / Supervisor

Laboratory Accreditation:

Cerpass Technology Corporation Test Laboratory

Testing Laboratory
1439

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History of this test report

Attachment No.	Issued Date	Description
23110047-TRFCC01	Jan. 05, 2024	Original

1. Summary of Maximum SAR Value

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

<CRIUS CO310-G1>

Highest SAR (1 g Value)

Equipment Class	Band	Antenna	Maximum Scaled SAR (W/kg)	Maximum Report SAR (W/kg)
U-NII-5/6/7/8	6G WLAN	SISO-Main	0.06	0.06
U-NII-5/6/7/8	6G WLAN	SISO-Aux	0.03	
Limit (W/kg)		1.6		

Highest Simultaneous Transmission SAR Values (1 g Value)

Equipment Class	Maximum Report SAR (W/kg)	SPLSR
U-NII-5/6/7/8	0.09	/
Limit (W/kg)	1.6	/

Highest Power Density Result

Equipment Class	Band	Antenna	Maximum Scaled PD (W/m^2)	Maximu Report PD (W/m^2)
U-NII-5/6/7/8	6G WLAN	SISO-Main	0.75	0.75
Limit (W/m^2)		10		

Maximum Absorbed Power Density Result

Equipment Class	Band	Antenna	Maximum Scaled PD (W/m^2)	Maximu Report PD (W/m^2)
U-NII-5/6/7/8	6G WLAN	SISO-Main	0.36	0.36
U-NII-5/6/7/8	6G WLAN	SISO-Aux	0.22	
Limit (W/m^2)		20		

Highest Total Exposure Ratio

Total Exposure Ratio
0.62

<CRIUS N310-G1>

Highest SAR (1 g Value)

Equipment Class	Band	Antenna	Maximum Scaled SAR (W/kg)	Maximum Report SAR (W/kg)
U-NII-5/6/7/8	6G WLAN	SISO-Main	0.77	0.77
U-NII-5/6/7/8	6G WLAN	SISO-Aux	0.73	
Limit (W/kg)			1.6	

Highest Simultaneous Transmission SAR Values (1 g Value)

Equipment Class	Maximum Report SAR (W/kg)	SPLSR
U-NII-5/6/7/8	1.50	/
Limit (W/kg)	1.6	/

Highest Power Density Result

Equipment Class	Band	Antenna	Maximum Scaled PD (W/m^2)	Maximu Report PD (W/m^2)
U-NII-5/6/7/8	6G WLAN	SISO-Main	1.82	1.82
Limit (W/m^2)			10	

Maximum Absorbed Power Density Result

Equipment Class	Band	Antenna	Maximum Scaled PD (W/m^2)	Maximu Report PD (W/m^2)
U-NII-5/6/7/8	6G WLAN	SISO-Main	4.20	4.20
U-NII-5/6/7/8	6G WLAN	SISO-Aux	3.73	
Limit (W/m^2)			20	

Highest Total Exposure Ratio

Total Exposure Ratio
0.37

<CRIUS N320-G1>

Highest SAR (1 g Value)

Equipment Class	Band	Antenna	Maximum Scaled SAR (W/kg)	Maximum Report SAR (W/kg)
U-NII-5/6/7/8	6G WLAN	SISO-Main	0.78	0.79
U-NII-5/6/7/8	6G WLAN	SISO-Aux	0.79	
Limit (W/kg)			1.6	

Highest Simultaneous Transmission SAR Values (1 g Value)

Equipment Class	Maximum Report SAR (W/kg)	SPLSR
U-NII-5/6/7/8	1.57	/
Limit (W/kg)	1.6	/

Highest Power Density Result

Equipment Class	Band	Antenna	Maximum Scaled PD (W/m^2)	Maximu Report PD (W/m^2)
U-NII-5/6/7/8	6G WLAN	SISO-Aux	3.56	3.56
Limit (W/m^2)			10	

Maximum Absorbed Power Density Result

Equipment Class	Band	Antenna	Maximum Scaled PD (W/m^2)	Maximu Report PD (W/m^2)
U-NII-5/6/7/8	6G WLAN	SISO-Main	3.72	4.46
U-NII-5/6/7/8	6G WLAN	SISO-Aux	4.46	
Limit (W/m^2)			20	

Highest Total Exposure Ratio

Total Exposure Ratio
0.57

Note:

1. The SAR criteria (Head & Body: SAR-1g1.6 W/kg, and Extremity: SAR-10g 4.0 W/kg) for general population/uncontrolled exposure is specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992 and ISEDRSS 102, Issue 5.
2. According to 47 CFR part 2.1093, the MPE limits specified in part 1.1310 apply to portable devices that transmit at frequencies above 6 GHz. The localized power density limit for general population exposure is 1.0 mW/cm (equal to 10 W/m) for frequency up to 100 GHz.
3. Per FCC guidance in Oct 2018 TCBC workshop, the total exposure ratio calculated by taking ratio of maximum reported SAR divided by SAR limit and adding it to maximum measured power density divided by power density limit. Numerical sum of the ratios should be less than 1.
4. Per FCC interim guidance for near-field power density measurement, the power density was spatially averaged over a circular area of 4 cm^2

5. 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	6GHz: 802.11ax: 5925MHz~6425MHz, 6425MHz~6525MHz 6525MHz~6875MHz, 6875MHz~7125MHz
Center Frequency Range	6GHz: 802.11ax: 5955MHz~6415MHz, 6435MHz~6515MHz 6535MHz~6855MHz, 6875MHz~7115MHz
Modulation Type	6GHz: 802.11ax: BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM
Modulation Technology	OFDMA
Data Rate	802.11ax: MCS0 – MCS11, HE20/40/80/160
Antenna Type	FPCB Antenna
Antenna Gain (For CRIUS CO310-G1 ,CRIUS CO310-G1-BL)	5955~6415MHz:ANT A: 3.90dBi, ANT B: 5.10dBi 6435~6515MHz:ANT A: 2.41dBi, ANT B: 3.36dBi 6535~6855MHz:ANT A: 2.67dBi, ANT B: 4.99dBi 6875~7115MHz:ANT A: 2.15dBi, ANT B: 4.21dBi
Antenna Gain (For CRIUS N310-G1, CRIUS N310-G1-BL)	5955~6415MHz:ANT A: 4.99dBi, ANT B: 3.43dBi 6435~6515MHz:ANT A: 4.75dBi, ANT B: 3.50dBi 6535~6855MHz:ANT A: 5.68dBi, ANT B: 4.04dBi 6875~7115MHz:ANT A: 3.60dBi, ANT B: 3.45dBi
Antenna Gain (For CRIUS N320-G1, CRIUS N320-G1-BL)	5955~6415MHz:ANT A: 3.80dBi, ANT B: 2.31dBi 6435~6515MHz:ANT A: 3.77dBi, ANT B: 1.98dBi 6535~6855MHz:ANT A: 4.00dBi, ANT B: 2.58dBi 6875~7115MHz:ANT A: 4.23dBi, ANT B: 2.19dBi
Adapter	Brand: Shenzhen Aoda Power Technology Co Ltd Model: AB869-200325C-US1
Type C Cable	Brand: Hong Zhan Xin Electronics Co.,Ltd. Model: E.B.A.0000352

Note:
1. EUT support Indoor Client.
2. Main: ANT A , Aux: ANT B , Mimo:ANT A& ANT B
3. For more details, please refer to the User's manual of the EUT.
4.The EUT Only Support Full RU.

Difference description:

Model No.	Remark
CRIUS CO310-G1	Market segmentation.
CRIUS CO310-G1-BL	
CRIUS N310-G1	Market segmentation.
CRIUS N310-G1-BL	
CRIUS N320-G1	Market segmentation.
CRIUS N320-G1-BL	

Note 1: The Motherboard and Circuit principle are identical except different antenna gain,antenna location HVIN, appearance, keyboard, Interface Board, battery. More details please refer to Product Similarity Declaration.

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
CAB ID	TW1439

Test Item	Test Site	Tested By
SAR	RFSAR01-NK	Roy

Test Site	Test Period	Temp.	Humi.
RFSAR01-NK	2023/11/28~2023/12/5	22.5~23.5	45~53

Note:

The above equipment has been tested and found compliance with the requirement of the relative standards by CERPASS Inc. The test data, data evaluation, and equipment configuration contained in our test report were obtained utilizing the test procedures, test instruments, test sites that has been accredited by the Authority of TAF according to the ISO/IEC 17025 quality assessment standard and technical standard(s).

4. Basic restrictions and Standards

4.1 Test Standards

FCC	FCC 47 CFR Part 2 (2.1093) IEEE C95.1
ISED	RSS-102 Issue5

4.2 Reference Standards

FCC KDB Publication 447498 D04 Interim General RF Exposure Guidance v01
FCC KDB Publication 248227 D01 802.11 Wi-Fi SAR v02r02
FCC KDB Publication 941225D06 Hot Spot SAR v02r01
FCC KDB Publication 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
FCC KDB Publication 616217 D04 SAR for laptop and Tablets v01r02
IEEE 62209-1528 : 2020
TCBC WORKSHOP-2021,04& 2022.10 RF Exposure polices & peocedures.

4.3 Environment Condition

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

4.4 RF Exposure Limits

SAR assessments have been made in line with the requirements of FCC 47CFR Part 2.1093 and ISED 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/m^2**
Limits for General Population/ Uncontrolled Exposure. 1.5GHz – 100GHz	**10.0 W/m^2**

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 $4cm^2$ per interim FCC Guidance for near-field power density evaluations per October 2018 TCB Workshop notes

5. Test & System Description

5.1 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

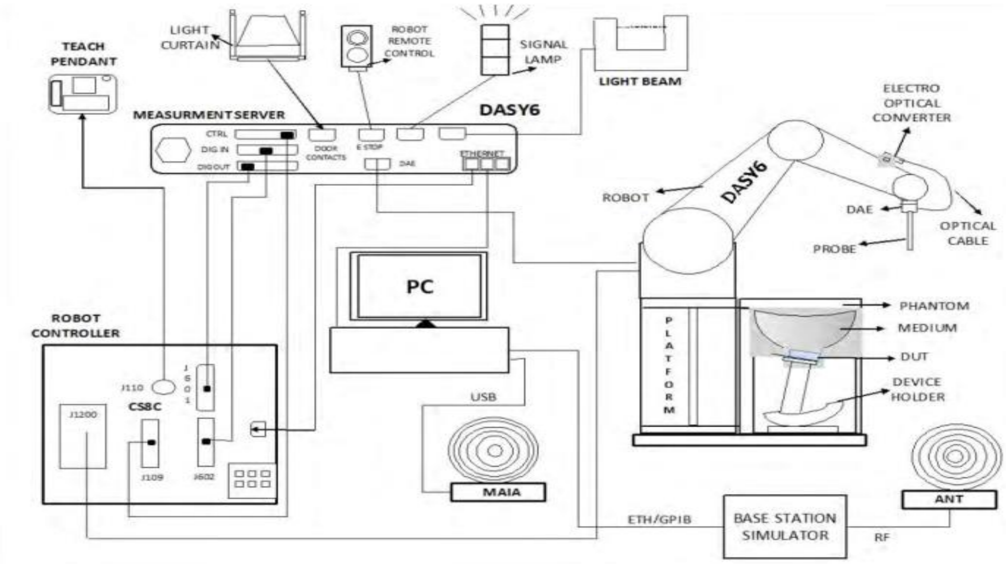
Where:

σ = Conductivity of the tissue (S/m)

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

E = RMS electric field strength (V/m)

5.2 SAR Measurement System



- ✓ A standard high precision 6-axis robot (Staübli TX/RX family) with controller, teach pendant and software. It includes an arm extension for accommodating the data acquisitionelectronics (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.

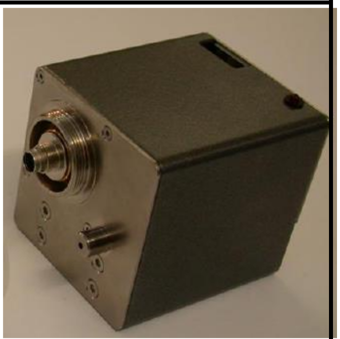
- ✓ The phantom, the device holder and other accessories according to the targeted measurement.

5.3 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 µW/g to 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 µW/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	

5.4 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 µV (with auto zero)	
Input Bias Current	Input Bias Current	
Dimensions	60 x 60 x 68 mm	

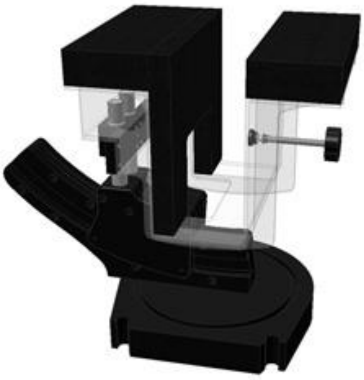
5.5 Robot

The DASY6 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	

5.6 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	
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.	
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.	

5.7 Device Holder

The DASY6 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 εr =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.	
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.	

5.8 Test Equipment and Ancillaries Used for Tests

Name of Equipment	Manufacturer	Type/Model	Serial Number	Calibration Cycle(year)	Calibration Period
Robot	Staubli	TX60L Lspeag	F13/5P6VA1/A/01	/	NCR
DASY Test Software	Staubli	cDASY6 V16.0.2.136	/	/	NCR
Signal Grenerator	KEYSIGHT	N5183A	MY50142931	1	2024/3/2
S-Parameter Network Analyzer	Agilent	E5071C	70045-459-220-350	1	2024/8/14
Dielectric parameter probes	SPEAG	DAKS-3.5	1121	1	NCR
Power Meter	Anritsu	ML2495A	1224005	1	2024/4/28
Power Sensor	Anritsu	MA2411B	1207295	1	2024/4/28
Data Acquisition Electronics	SPEAG	DAE4	1379	1	2024/6/16
Dosimetric E-Field Probe	SPEAG	EX3DV4	3927	1	2024/6/26
Dosimetric E-Field Probe	SPEAG	EUmmWV3	9403	1	2023/12/7
2450MHz System Validation Dipole	SPEAG	D2450V2	914	3	2024/8/26
5GHz System Validation Dipole	SPEAG	D5GHzV2	1156	3	2024/8/11
6.5GHz System Validation Dipole	SPEAG	D6.5GHzV2	1078	3	2025/6/15
10G Verification Source	SPEAG	10GHz	2003	1	2024/2/15
Amplifier	Mini-Circuits	ZVE-8G+	70501814	/	NCR
Amplifier	Mini-Circuits	ZVE-3W-183+	N636102230	/	NCR
Thermometer	Hi Sun	TH05A	11442	1	2024/7/27

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

Note: For dipole antennas, BALUN has adopted 3 years as calibration intervals, and on annual basis, every measurement dipole has been evaluated and is in compliance with the following criteria:

1. There is no physical damage on the dipole;
2. System validation with specific dipole is within 10% of calibrated value;
3. Return-loss in within 20% of calibrated measurement.
4. Impedance (real or imaginary parts) in within 5 Ohms of calibrated measurement.

6. The SAR Measurement Procedure

6.1 System Performance Check

6.1.1 Purpose

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

6.1.2 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 ±10 %	Target Conductivity	Range of ±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.

6.1.3 Tissue Calibration Result

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

Please Refer to the Appendix B System Performance Check.

Note:

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 %

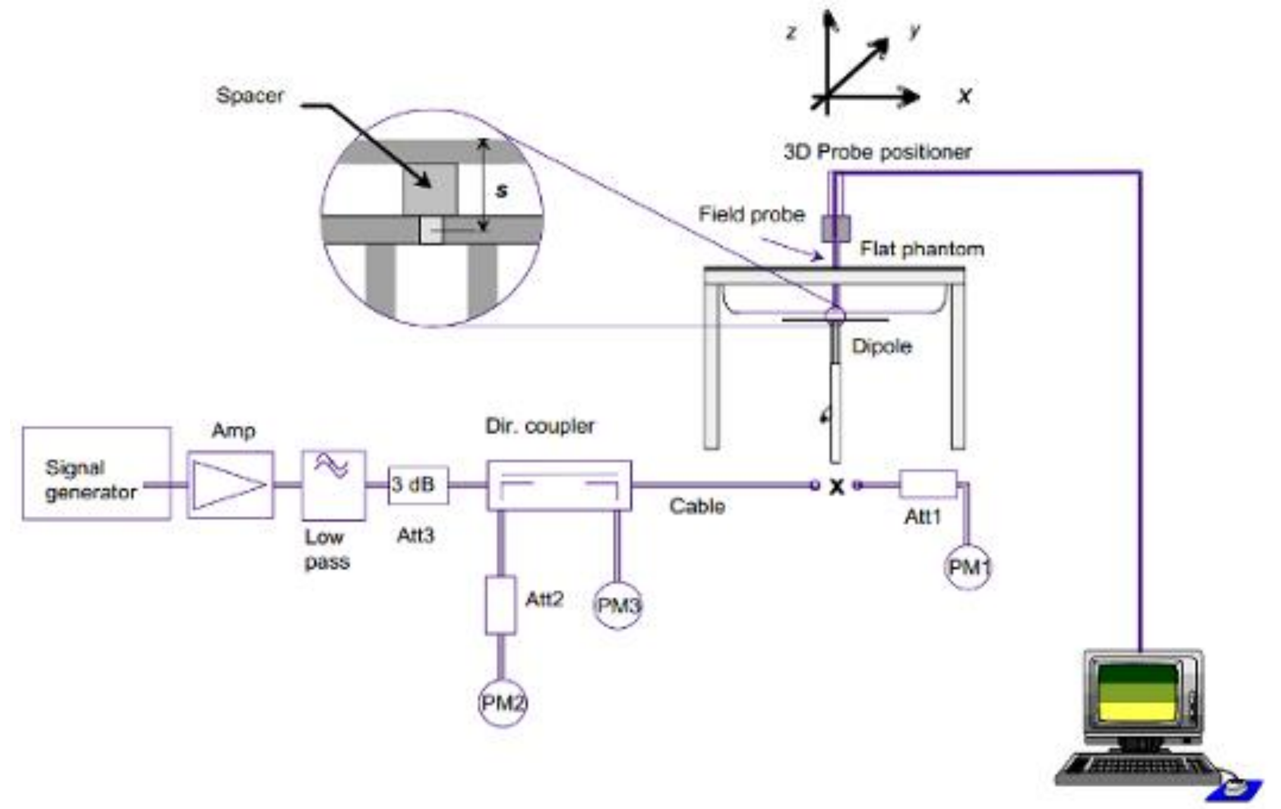
6.1.4 System Performance Check Procedure

The system performance check verifies that the system operates within its specifications.System and operator errors can be detected and corrected. It is recommended that the system performance check be performed prior to any usage of the system in order to guarantee reproducible results. The system performance check uses normal SAR measurements in a simplified setup with a well characterized source. This setup was selected to give a high sensitivity to all parameters that might fail or vary over time. The system check does not intend to replace the calibration of the components, but indicates situations where the system uncertainty is exceeded due to drift or failure. In the simplified setup for system check, the EUT is replaced by a calibrated dipole and the power source is replaced by a controlled continuous wave generated by a signal generator. The calibrated dipole must be placed beneath the flat phantom section of the phantom at the correct distance

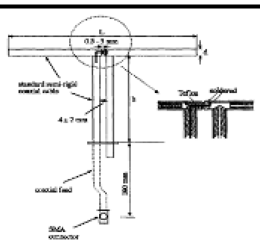
First, the power meter PM1 (including attenuator Att1) is connected to the cable to measure the forward power at the location of the connector (x) to the system check source. The signal generator is adjusted for the desired forward power at the connector as read by power meter PM1 after attenuation Att1 and also as coupled through Att2 to PM2. After connecting the cable to the source, the signal generator is readjusted for the same reading at power meter PM2. SAR results are normalized to a forward power of 1W to compare the values with the calibration reports results as described at IEC/IEEE 62209-1528:2020 standard.

6.1.5 System Performance Check Setup

The system check verifies that the system operates within its specifications. It is performed daily or before every SAR measurement.The system check uses normal SAR measurements in the flat section of the phantom with a matched dipole at a specified distance. The system verification setup is shown as below.



6.1.6 Validation Dipoles



6.1.7 Result of System Performance Check: Valid Result

Please Refer to the Appendix B System Performance Check.

7. Power Density Measurement System

7.1 Definition of Power Density

The power density for an electromagnetic field represents the rate of energy transfer per unit area. The local power density (i.e. Poynting vector) at a given spatial point is deduced from electromagnetic fields by the following formula:

$$S = \frac{1}{2}\mathrm{Re}\{E \times H^{*}\} \cdot \vec{n}$$

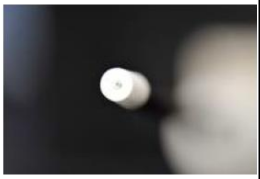
Where: E is the complex electric field peak phasor and H is the complex conjugate magnetic field peak phasor.

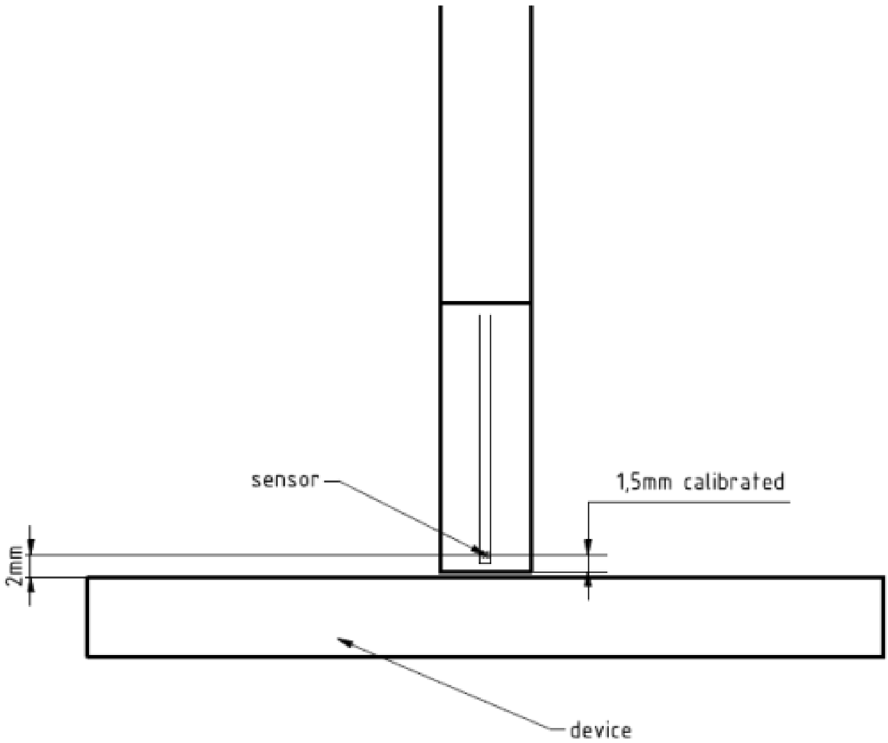
The spatial-average power density distribution on the evaluation surface is determined per the IEC TR 63170. The spatial area, A is specified by the applicable exposure limit or regulatory requirements. The circular shape was used.

$$S_{av} = \frac{1}{2A}\Re\left(\int E \times H^{*} \cdot \hat{n} dA\right)$$

7.2 EUmmWV2 mm-Wave Probe

The EUmmWV2 probe is an electric (E) universal (U) field probe with two dipole sensors for field measurements at frequencies up to 110 GHz and as close as 2 mm from any field source or transmitter. The sensors consist of two diode-loaded small dipoles that provide the rectified voltage from the coupled E-field. From the voltages at three different orientations in the field at known angles, both the magnitude of the field component and the field polarization can be calculated. Due to the small size of the sensors, the probe can be used for measurements over an extremely wide frequency range from <1 GHz to 110 GHz. The probe sensors are protected by non-removable 8 mm high-density foam.

Model	EUmmWV2	
Frequency	750 MHz to 110 GHz	
Dynamic Range	< 20 V/m - 10000 V/m with PRE-10 < 50 V/m - 3000 V/m minimum	
Linearity	< ±0.2 dB	
Hemispherical Isotropy	< 0.5 dB	
Position Precision	< 0.2 mm	
Dimensions	Overall length: 337 mm (tip: 20 mm) Tip diameter: encapsulation 8 mm (internal sensor < 1mm) Distance from probe tip to dipole centers: < 2 mm Sensor displacement to probe's calibration point: < 0.3 mm	



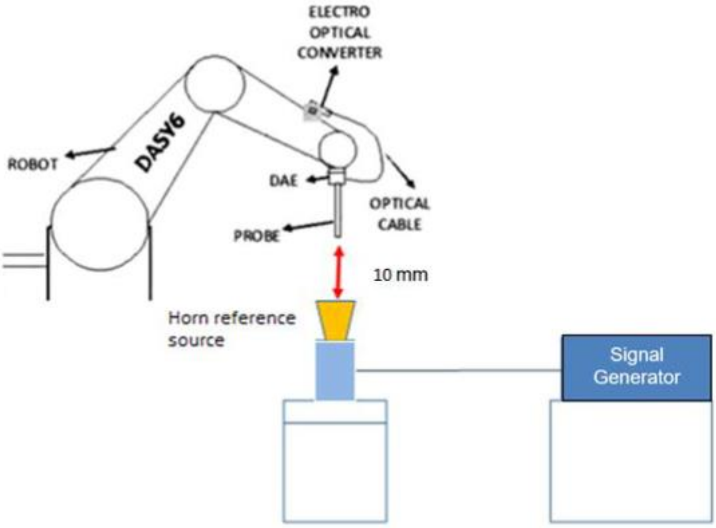
7.3 Power Density System Verification

The system performance check verifies that the system operates within its specifications. It is recommended that the system performance check be performed prior to any usage of the system in order to guarantee reproducible results.

The system performance check uses normal E-field measurements in a simplified setup with a well characterized source. This setup was selected to give a high sensitivity to all parameters that might fail or vary over time. The system check does not intend to replace the calibration of the components, but indicates situations where the system uncertainty is exceeded due to drift or failure.

In the simplified setup for system check, the EUT is replaced by a calibrated source and the power source is replaced by a controlled continuous wave generated by a signal generator. The calibrated source must be placed at the correct distance from the E-field probe according to the calibration certificate.

System check using 10 GHz source to support 6-7GHz incident-PD results done with EUmmWV probe, the test procedure was following by the SPEAG AppNote Procedures for Device Operating at 6 – 10GHz.



The system check is a complete measurement using simple well-defined reference sources. According to the DASY6 specification in the user's manual and SPEAG's recommendation, the deviation threshold of ±0.66 dB represents the expanded standard uncertainty for system performance check. The system check is successful if the measured results are within ±0.66 dB tolerances to the target value shown in the calibration certificate of the verification source.

7.3.1 Power Density Verification Summary

The system was verified to be within ±0.66 dB of the power density targets on the calibration certificate according to the test system specification in the user's manual and calibration facility recommendation. The 0.66 dB deviation threshold represents the expanded uncertainty for system performance checks using SPEAG's mmWave verification sources.
The same spatial resolution and measurement region used in the source calibration was applied during the system check. The measured power density distribution of verification source was also confirmed through visual inspection to have no noticeable differences, both spatially (shape) and numerically (level) from the distribution provided by the manufacturer, per November 2017 TCBC Workshop Notes.

Please Refer to the Appendix B System Performance Check.

Note:
The measured total PD was the average of psPDn+, psPDtot+ and psPDmod+, which refers to the demonstration from calibration certificate.

7.3.2 Interim Procedures for WLAN 6E

Interim procedures for FCC radio frequency (RF) exposure evaluations of U-NII 6-7 GHz band portable devices have been made available during the TCB workshop in April 2021. The procedure is summarized below:
a. Evaluate SAR / APD with DASY6 Module SAR V16.0 or higher. The configurations to be tested are defined in the relevant Knowledge Database (KDB).
The ps SAR and absorbed ps PD are reported.
b. 2. For the configuration with the highest SAR, evaluate the incident power density with DASY6 Module mmWave V2.4.2 or higher. The incident psPD must be adjusted per amount that the measurement uncertainty exceeds 30% before it is included in the test report.

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

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 is performed around the highest E-field value to determine the averaged SAR-distribution.

Measure the local SAR at a test point at 1.4 mm of the inner surface of the phantom recommended by SEPAG.The area scan (two-dimensional SAR distribution) is performed cover at least an area larger than the projection of the EUT or antenna. The measurement resolution and spatial resolution for interpolation shall be chosen to allow identification of the local peak locations to within one-half of the linear dimension of the corresponding side of the zoom scan volume. Following table provides the measurement parameters required for the area scan.

Parameter	$f \leq$ 3 GHz	3 GHz < $f \leq$ 10 GHz
Maximum distance from closest measurement point to phantom surface	5 ± 1	δ ln(2)/2 ±0.5
Maximum probe angle from probe axis to phantom surface normal at the measurement location	5° for flat phantom 30° for other phantom	5° for flat phantom 20° for other phantom
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 6 – 7 GHz: ≦7.5 mm

From the scanned SAR distribution, identify the position of the maximum SAR value, in addition identify the positions of any local maxima with SAR values within 2 dB of the maximum value that will not be within the zoom scan of other peaks. Additional peaks shall be measured only when the primary peak is within 2 dB of the SAR compliance limit

(e.g. 1 W/kg for 1.6 W/kg, 1 g limit; or 1.26 W/kg for 2 W/kg, 10 g limit).

Step 4 Zoom Scan

The zoom scan (three-dimensional SAR distribution) is performed at the local maxima locations identified in previous area scan procedure. The zoom scan volume must be larger than the required minimum dimensions. When graded grids are used, which only applies in the direction normal to the phantom surface, the initial grid separation closest to the phantom surface and subsequent graded grid increment ratios must satisfy the required protocols. The 1-g SAR averaging volume must be fully contained within the zoom scan measurement volume boundaries; otherwise, the measurement must be repeated by shifting or expanding the zoom scan volume. The similar requirements also apply to 10-g SAR measurements. Following table provides the measurement parameters required for the zoom scan.

Parameter		$f \leq$ 3 GHz	3 GHz < $f \leq$ 10 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 6 – 7 GHz: ≤3.4 mm
Maximum zoom scan spatial resolution, normal to phantom surface	*uniform grid:* $\Delta z_{Zoom}(n)$	≤5 mm	3 – 4 GHz: ≤4 mm 4 – 5 GHz: ≤3 mm 5 – 6 GHz: ≤2 mm 6 – 7 GHz: ≤2 mm
	graded grids: $\Delta z_{Zoom}(1)$	≤4 mm	3 – 4 GHz: ≤3.0 mm 4 – 5 GHz: ≤2.5 mm 5 – 6 GHz: ≤2.0 mm 6 – 7 GHz: ≤1.7 mm
	$\Delta z_{Zoom}(n>1)$	≤1.5·$\Delta z_{Zoom}(n-1)$ mm	
Minimum zoom scan volume (x, y, z)		≥30 mm	3 – 4 GHz: ≥28 mm 4 – 5 GHz: ≥25 mm 5 – 6 GHz: ≥22 mm 6 – 7 GHz: ≥22 mm

Per IEC 62209-1528:2020, the successively higher resolution zoom scan is required if the zoom scan measured as defined above complies with both of the following criteria, or if the peak spatial-average SAR is below 0.1 W/kg, no additional measurements are needed:

(1) The smallest horizontal distance from the local SAR peaks to all points 3 dB below the SAR peak shall be larger than the horizontal grid steps in both x and y directions (Δx, Δy). This shall be checked for the measured zoom scan plane conformal to the phantom at the distance zM1.

(2) The ratio of the SAR at the second measured point (M2) to the SAR at the closest measured point (M1) at the x-y location of the measured maximum SAR value shall be at least 30 %.

If one or both of the above criteria are not met, the zoom scan measurement shall be repeated using a finer resolution.

New horizontal and vertical grid steps shall be determined from the measured SAR distribution so that the above criteria are met. Compliance with the above two criteria shall be demonstrated for the new measured zoom scan.

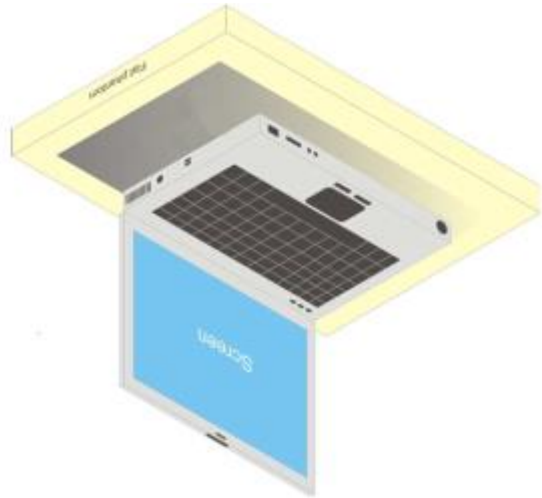
Step 5 Power Drift Measurements

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 RF Exposure Positions

8.2.1 Laptop Exposure Condition

For laptop PC, according to KDB 616217 D04, SAR evaluation is required for the bottom surface of the keyboard. This EUT was tested in the base of EUT directly against the flat phantom. The required minimum test separation distance for incorporating transmitters and antennas into laptop computer display is determined with the display screen opened at an angle of 90° to the keyboard compartment.



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.

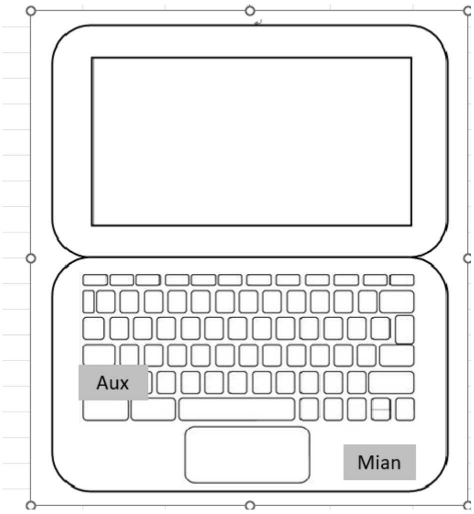
9. Wi-Fi SAR Exclusion and Results

9.1 Measured Conducted Average Power

Please Refer to the Appendix C Measured Conducted Power.

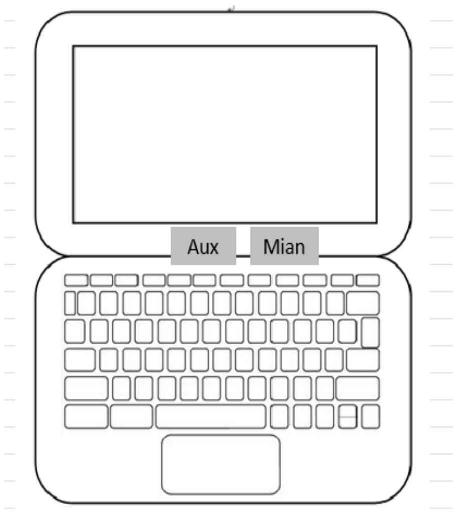
9.2 Test position Antenna Location

<CRIUS CO310-G1>



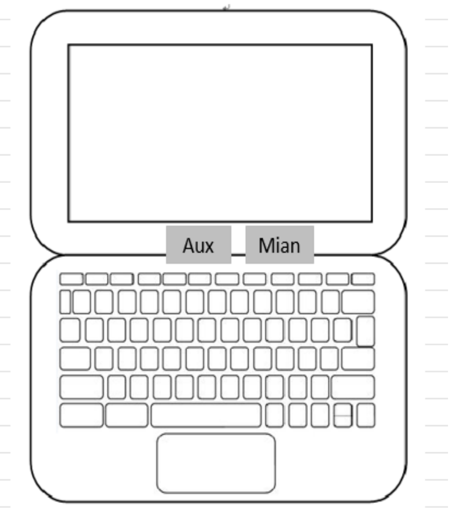
Antennas	Wireless Interface
Ant 0(Main)	WLAN 6GHz
Ant 1(Aux)	WLAN 6GHz

<CRIUS N310-G1>



Antennas	Wireless Interface
Ant A(Main)	WLAN 6GHz
Ant B(Aux)	WLAN 6GHz

<CRIUS N320-G1>



Antennas	Wireless Interface
Ant A(Main)	WLAN 6GHz
Ant M(Aux)	WLAN 6GHz

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 ≥0.8W/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).

N/A

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 < 1.6W/kg.

ii)SPLSR = (SAR1 + SAR2)^1.5 / (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 SPLSR ≤ 0.04, simultaneously transmission SAR measurement is not necessary.

iv)Simultaneously transmission SAR measurement, and the reported multi-band SAR < 1.6W/kg.

v) The SPLSR calculated results please refer to section 8.2.

10.1 Co-location

<CRIUS CO310-G1>

State	Position	Stand alone SAR	
		5.Wi-Fi 6 GHz Ant 0	6.Wi-Fi 6 GHz Ant 1
Body	Bottom of Laptop	0.06	0.03
Sum SAR			
Sum SAR(5+6)			
0.09			

<CRIUS N310-G1>

State	Position	Stand alone SAR	
		5.Wi-Fi 6 GHz Ant 0	6.Wi-Fi 6 GHz Ant 1
Body	Bottom of Laptop	0.77	0.73
Sum SAR			
Sum SAR(5+6)			
1.50			

<CRIUS N320-G1>

State	Position	Stand alone SAR	
		5.Wi-Fi 6 GHz Ant 0	6.Wi-Fi 6 GHz Ant 1
Body	Bottom of Laptop	0.78	0.79
Sum SAR			
Sum SAR(5+6)			
1.57			

Note: The highest Summed 1g SAR is 0.915W/Kg < 1.6 W/kg, so Simultaneous Transmission SAR test is not required.

10.2 SPLSR Evaluation

N/A

10.3 Total Exposure Ratio Analysis

The fields generated by the antennas can be correlated or uncorrelated. At different frequencies, fields are always uncorrelated, and the aggregate power density contributions can be summed according to spatially averaged values of corresponding sources at any point in space, r, to determine the total exposure ratio (TER). Assuming I sources, the TER at each point in space is equal to

$$TER^{uncorr}(r) = \sum_{i=1}^{I} ER_i = \sum_{i=1}^{I} \frac{S_{av,i}(r, f_i)}{S_{lim}(f_i)}$$

where Sav,i is the power density for the source i operating at a frequency fi, and Slim is the power density limit as specified by the relevant standard.

Exposure from transmitters operating above and below 6 GHz, where 6 GHz denotes the transition frequency where the basic restrictions change from being defined in terms of SAR to being defined in terms of power density, are therefore uncorrelated and the TER is determined as

$$TER^{uncorr}(r) = TER(r)_{f \le 6GHz} + TER(r)_{f > 6GHz}$$

According to the RSS 102 SPR-APD, the total exposure ratio calculated by taking ratio of maximum reported SAR divided by its limit and adding it to maximum measured absorbed power density divided by its limit. Numerical sum of the ratios should be less than 1.

<CRIUS CO310-G1>

Test Mode	Position	Mode	Power Density		1g SAR		Total Exposure Ratio
			(W/m2)	Limit	(W/kg)	Limit	
Body (Separation 0 mm)							
Laptop	Bottom Side	Max 6G WLAN	0.75	10	/	/	0.62
		Max 2.4G WLAN	/	/	0.879	1.6	
Note: The simultaneous transmission detail please refer to section 10							

<CRIUS N310-G1>

Test Mode	Position	Mode	Power Density		1g SAR		Total Exposure Ratio
			(W/m2)	Limit	(W/kg)	Limit	
Body (Separation 0 mm)							
Laptop	Bottom Side	Max 6G WLAN	1.82	10	/	/	0.37
		Max 2.4G WLAN	/	/	0.295	1.6	
Note: The simultaneous transmission detail please refer to section 10							

<CRIUS N320-G1>

Test Mode	Position	Mode	Power Density (W/m2)	Power Density Limit	1g SAR (W/kg)	1g SAR Limit	Total Exposure Ratio
Body (Separation 0 mm)							
Laptop	Bottom Side	Max 6G WLAN	3.56	10	/	/	0.57
		Max 2.4G WLAN	/	/	0.336	1.6	
Note: The simultaneous transmission detail please refer to section 10							

11. Measurement Uncertainty

Body SAR Uncertainty Budget for Frequency Range (2 GHz- 6 GHz range)								
Source Uncertainty	Uncertainty Value (±%)	Probability	Divisor	(Ci) 1g	(Ci) 10g	Standard Uncertainty (±%)	Standard Uncertainty (10g) (±%)	(Vi) Veff
Measurement System errors								
Probe Calibration	13.10	N	2	1	1	6.6	6.6	∞
Probe Calibration Drift	1.70	N	1.732	1	1	1.0	1.0	∞
Probe Linearity	4.70	R	1.732	1	1	2.7	2.7	∞
Broadband Signal	2.80	N	1.732	1	1	1.6	1.6	∞
Probe Isotropy	7.60	R	1.732	1	1	4.4	4.4	∞
DAE	0.30	N	1	1	1	0.3	0.3	∞
RF Ambient	1.80	N	1	1	1	1.8	1.8	∞
Probe Positioning	0.36	N	1	0.67	0.67	0.2	0.2	∞
Data Processing	2.30	N	1	1	1	2.3	2.3	∞
phantom and device errors								
Conductivity (meas.) DAK	2.50	N	1	0.78	0.71	2.0	1.8	∞
Conductivity (temp.) BB	2.40	R	1.732	0.78	0.71	1.1	1.0	∞
Phantom Permittivity	7.60	R	1.732	0.5	0.5	2.2	2.2	∞
Distance DUT–TSL	2.00	N	1	2	2	4.0	4.0	∞
Device Positioning	0.02	N	1	1	1	0.0	0.0	∞
Device Holder	3.60	N	1	1	1	3.6	3.6	∞
DUT Modulation	2.40	R	1.732	1	1	1.4	1.4	∞
DUT drift	2.50	N	1	1	1	2.5	2.5	∞
Correction to the SAR results								
Deviation to Target	0.06	N	1	1	0.84	0.1	0.1	∞
Combined Std. Uncertainty						11.3%	11.3%	
Coverage Factor for 95 %						K=2	K=2	
Expanded STD Uncertainty						22.7%	22.6%	

Uncertainty Budget for 6 - 10 GHz SAR and Absorbed Power Density Assessment (6 GHz- 10 GHz range)						
Source Uncertainty	**Uncertainty Value (±%)**	**Probability**	**Divisor**	**(Ci)**	**Standard Uncertainty (±%)**	**(Vi) Veff**
Measurement System errors						
Probe Calibration	18.60	N	2	1	9.3	∞
Probe Calibration Drift	1.70	N	1.732	1	1.0	∞
Probe Linearity	4.70	R	1.732	1	2.7	∞
Broadband Signal	2.60	N	1.732	1	1.5	∞
Probe Isotropy	7.60	R	1.732	1	4.4	∞
DAE	0.30	N	1	1	0.3	∞
RF Ambient	1.80	N	1	1	1.8	∞
Probe Positioning	0.20	N	1	0.67	0.1	∞
Data Processing	3.50	N	1	1	3.5	∞
phantom and device errors						
Conductivity (meas.) DAK	2.50	N	1	0.78	2.0	∞
Conductivity (temp.) BB	2.40	R	1.732	0.78	1.1	∞
Phantom Permittivity	14.00	R	1.732	0.5	4.0	∞
Distance DUT–TSL	2.00	N	1	2	4.0	∞
Device Positioning	3.60	N	1	1	3.6	∞
Device Holder	3.60	N	1	1	3.6	∞
DUT Modulation	2.40	R	1.732	1	1.4	∞
DUT drift	2.50	N	1	1	2.5	∞
Correction to the SAR results						
Deviation to Target	1.90	N	1	1	1.9	∞
Power Density Conversion						
Power Density Conversion	13.50	N	1.732	1	7.8	∞
Combined Std. Uncertainty					14.4%	
Coverage Factor for 95 %					K=2	
Expanded STD Uncertainty					28.8%	

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

Appendix A. DASY Calibration Certificate

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
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

Client **Cerpass**
Taoyuan

Certificate No. **EX-3927_Jun23**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3927
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	June 26, 2023

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP2	SN: 104778	30-Mar-23 (No. 217-03804/03805)	Mar-24
Power sensor NRP-Z91	SN: 103244	30-Mar-23 (No. 217-03804)	Mar-24
OCP DAK-3.5 (weighted)	SN: 1249	20-Oct-22 (OCP-DAK3.5-1249_Oct22)	Oct-23
OCP DAK-12	SN: 1016	20-Oct-22 (OCP-DAK12-1016_Oct22)	Oct-23
Reference 20 dB Attenuator	SN: CC2552 (20x)	30-Mar-23 (No. 217-03809)	Mar-24
DAE4	SN: 660	16-Mar-23 (No. DAE4-660_Mar23)	Mar-24
Reference Probe ES3DV2	SN: 3013	06-Jan-23 (No. ES3-3013_Jan23)	Jan-24

Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-22)	In house check: Jun-24
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-22)	In house check: Jun-24
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-22)	In house check: Jun-24
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-22)	In house check: Jun-24
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24

	Name	Function	Signature
Calibrated by	Jeton Kastrati	Laboratory Technician	
Approved by	Sven Kühn	Technical Manager	

Issued: June 27, 2023

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S **Schweizerischer Kalibrierdienst**
C **Service suisse d'étalonnage**
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
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ 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:

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

Parameters of Probe: EX3DV4 - SN:3927

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc ($k = 2$)
Norm ($\mu V/(V/m)^2$) [A]	0.59	0.68	0.61	±10.1%
DCP (mV) [B]	103.5	99.2	102.5	±4.7%

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB$\sqrt{\mu V}$	C	D dB	VR mV	Max dev.	Max Unc[E] $k = 2$
0	CW	X	0.00	0.00	1.00	0.00	125.3	±1.2%	±4.7%
		Y	0.00	0.00	1.00		126.2		
		Z	0.00	0.00	1.00		127.2		
10352	Pulse Waveform (200Hz, 10%)	X	2.07	63.44	8.39	10.00	60.0	±4.0%	±9.6%
		Y	20.00	90.22	20.30		60.0		
		Z	2.51	64.96	9.75		60.0		
10353	Pulse Waveform (200Hz, 20%)	X	1.23	61.71	6.74	6.99	80.0	±2.9%	±9.6%
		Y	20.00	90.51	19.42		80.0		
		Z	2.19	65.62	9.20		80.0		
10354	Pulse Waveform (200Hz, 40%)	X	0.61	60.15	5.20	3.98	95.0	±1.6%	±9.6%
		Y	20.00	91.35	18.52		95.0		
		Z	1.32	64.45	7.92		95.0		
10355	Pulse Waveform (200Hz, 60%)	X	0.36	60.00	4.52	2.22	120.0	±1.1%	±9.6%
		Y	20.00	90.62	16.93		120.0		
		Z	0.62	62.22	6.29		120.0		
10387	QPSK Waveform, 1 MHz	X	1.49	65.70	14.05	1.00	150.0	±2.9%	±9.6%
		Y	1.47	63.32	13.12		150.0		
		Z	1.48	65.42	13.87		150.0		
10388	QPSK Waveform, 10 MHz	X	2.01	66.99	14.97	0.00	150.0	±1.2%	±9.6%
		Y	1.92	65.10	13.82		150.0		
		Z	2.01	66.80	14.82		150.0		
10396	64-QAM Waveform, 100 kHz	X	2.62	69.49	18.26	3.01	150.0	±0.8%	±9.6%
		Y	2.91	69.18	18.00		150.0		
		Z	2.57	68.78	17.94		150.0		
10399	64-QAM Waveform, 40 MHz	X	3.38	66.80	15.43	0.00	150.0	±2.3%	±9.6%
		Y	3.29	65.68	14.78		150.0		
		Z	3.39	66.74	15.39		150.0		
10414	WLAN CCDF, 64-QAM, 40 MHz	X	4.71	65.64	15.40	0.00	150.0	±4.6%	±9.6%
		Y	4.74	64.86	14.97		150.0		
		Z	4.75	65.66	15.41		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:3927

Sensor Model Parameters

	C1 fF	C2 fF	α V^{-1}	T1 $ms V^{-2}$	T2 $ms V^{-1}$	T3 ms	T4 V^{-2}	T5 V^{-1}	T6
x	36.5	269.45	34.72	11.62	0.00	4.98	0.98	0.19	1.01
y	49.8	377.96	36.30	19.21	0.10	5.10	0.89	0.40	1.01
z	37.3	278.29	35.23	16.15	0.00	5.01	0.61	0.27	1.01

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle	21.0°
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:3927

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz)[C]	Relative Permittivity[F]	Conductivity[F] (S/m)	ConvF X	ConvF Y	ConvF Z	Alpha[G]	Depth[G] (mm)	Unc (k = 2)
2450	39.2	1.80	7.97	7.62	7.84	0.33	1.27	±12.0%
5250	35.9	4.71	5.63	5.39	5.61	0.33	1.72	±14.0%
5600	35.5	5.07	4.92	4.71	4.89	0.37	1.75	±14.0%
5750	35.4	5.22	5.05	4.84	5.06	0.36	1.84	±14.0%

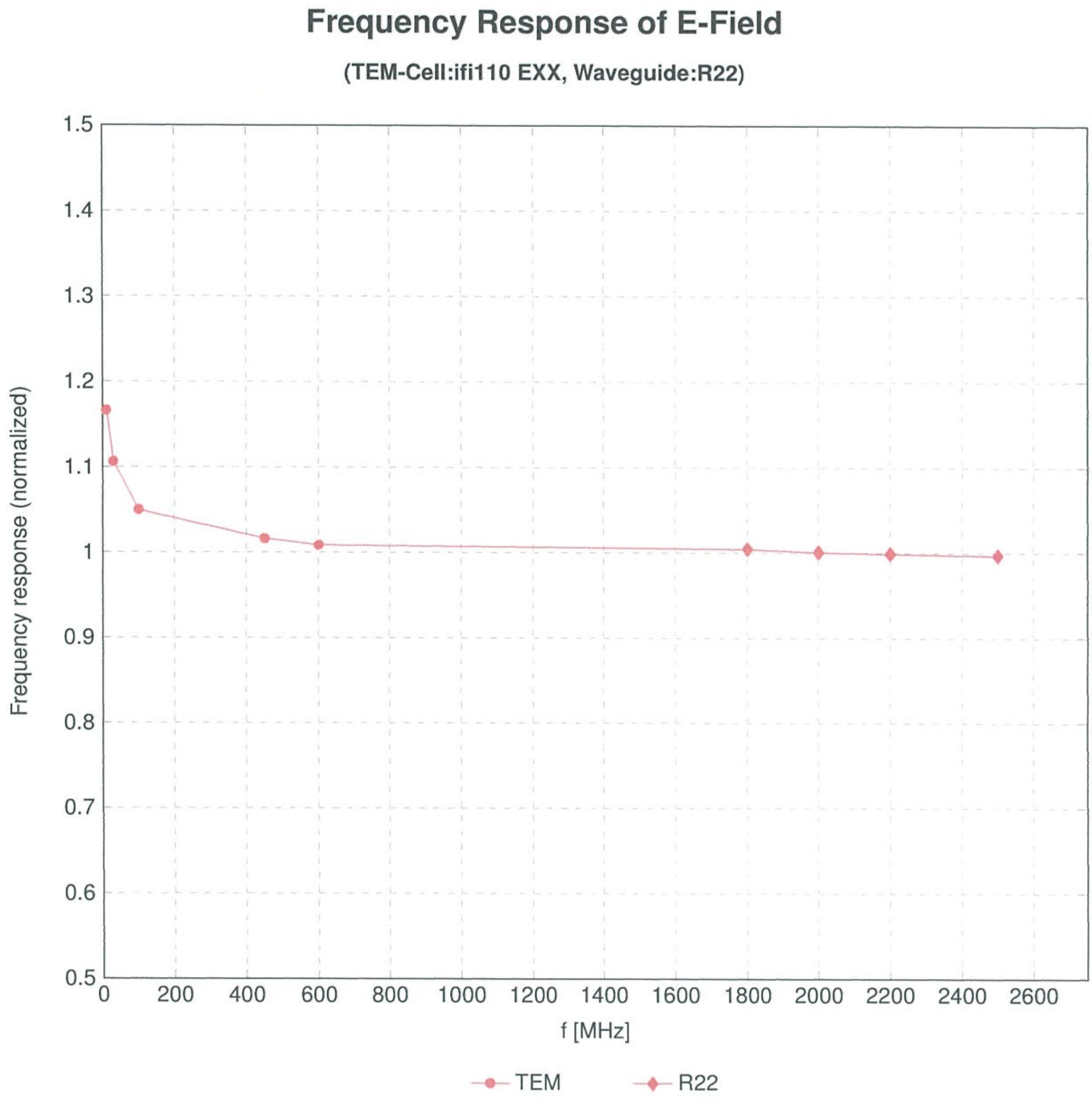
[C] Frequency validity above 300 MHz of ±100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ±50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ±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 TSL with deviations from the target of less than ±5% are used, the calibration uncertainties are 11.1% for 0.7 - 3 GHz and 13.1% for 3 - 6 GHz.
[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.

Parameters of Probe: EX3DV4 - SN:3927

Calibration Parameter Determined in Head Tissue Simulating Media

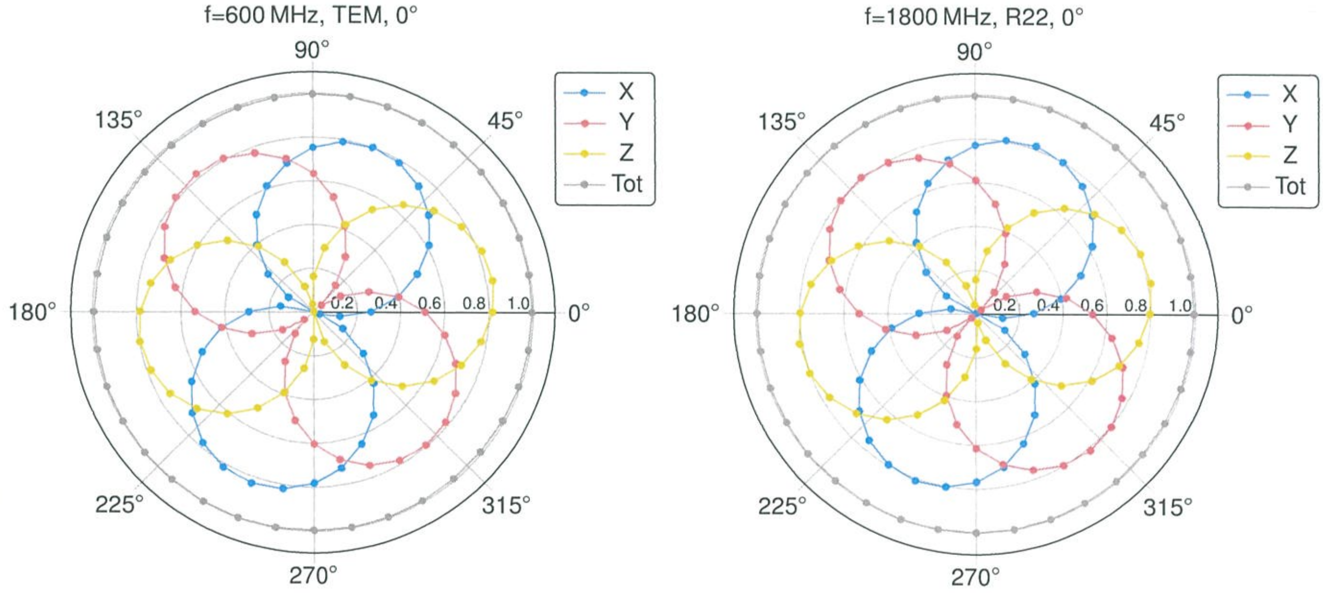
f (MHz)[C]	Relative Permittivity[F]	Conductivity[F] (S/m)	ConvF X	ConvF Y	ConvF Z	Alpha[G]	Depth[G] (mm)	Unc ($k = 2$)
6500	34.5	6.07	5.51	5.31	5.32	0.20	2.50	±18.6%

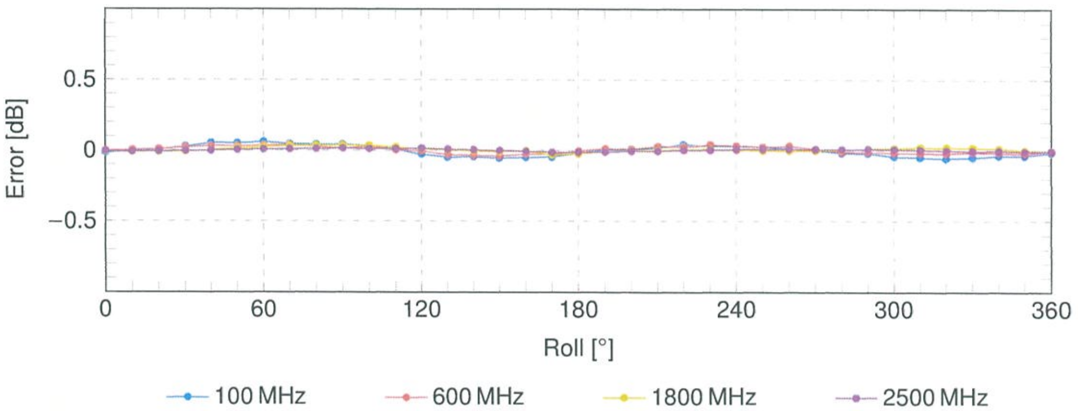
[C] Frequency validity at 6.5 GHz is −600/+700 MHz, and ±700 MHz at or above 7 GHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] The probes are calibrated using tissue simulating liquids (TSL) that deviate for ε 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.



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

Receiving Pattern (ϕ), $\vartheta = 0°$

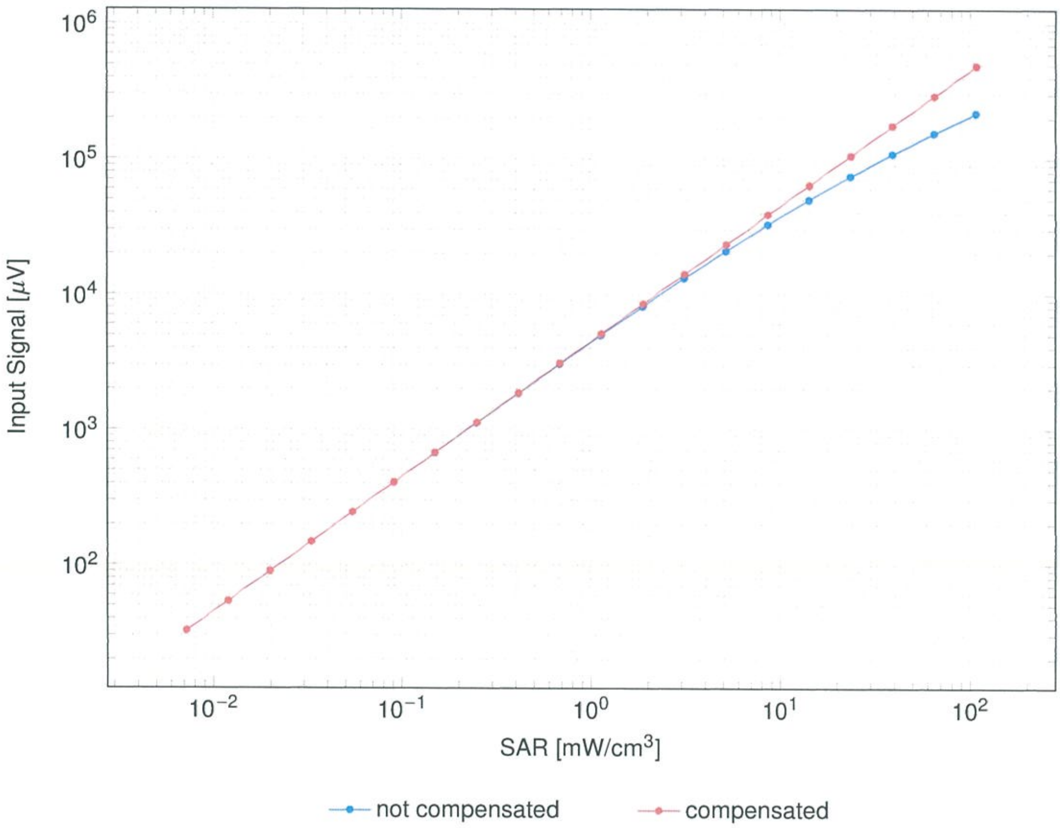


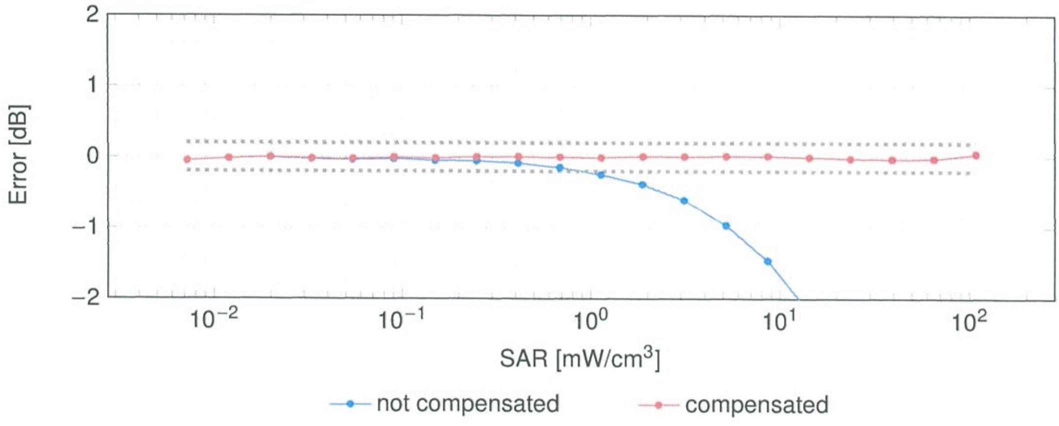


Uncertainty of Axial Isotropy Assessment: ±0.5% (k=2)

Dynamic Range f(SAR_{head})

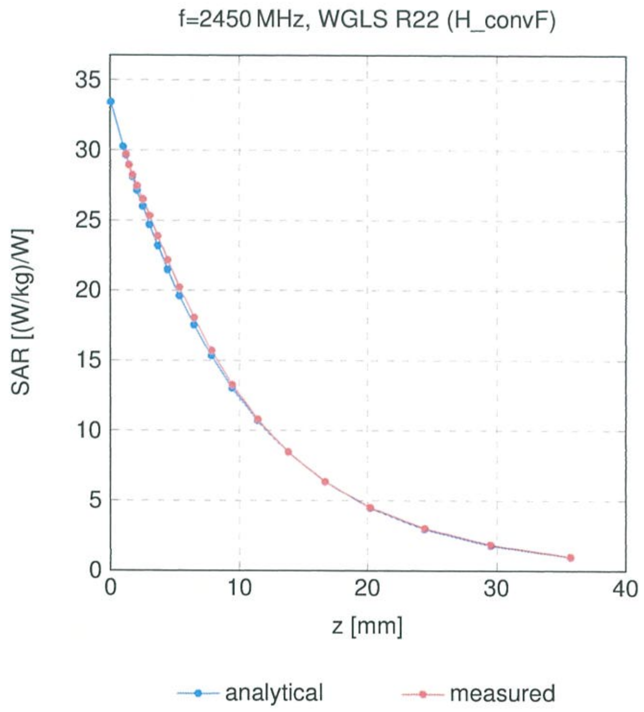
(TEM cell, f_{eval} = 1900 MHz)



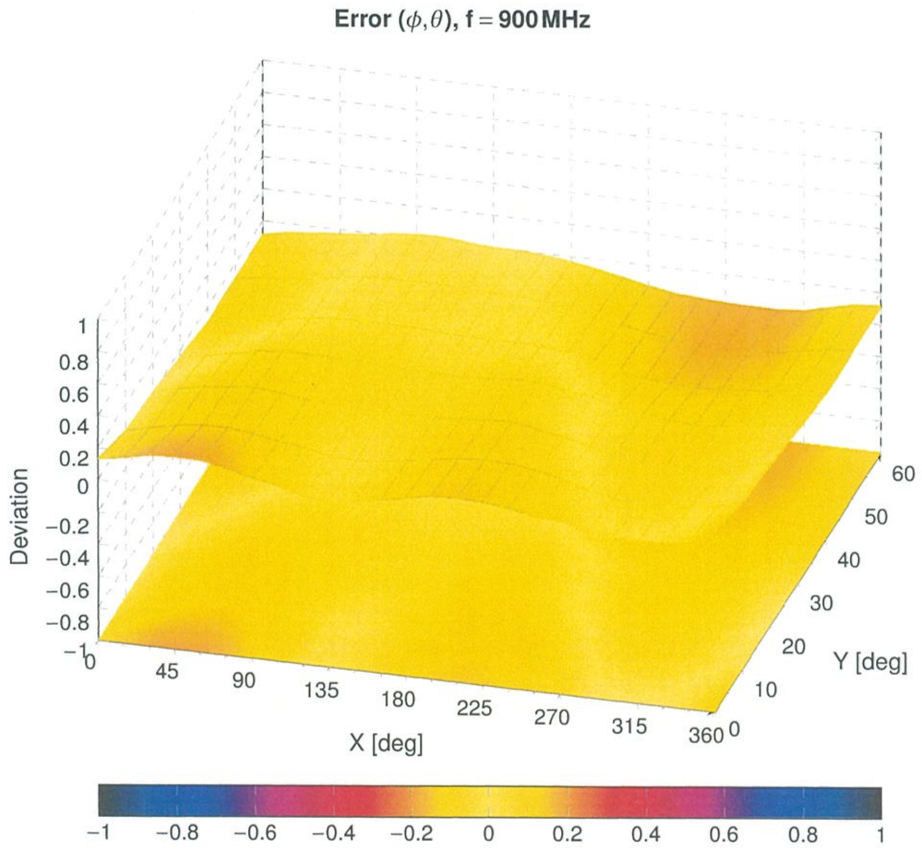


Uncertainty of Linearity Assessment: ±0.6% (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid



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