CERTIFICATE OF CALIBRATION

ISSUED BY **UL INTERNATIONAL (UK) LTD**

DATE OF ISSUE: 11/Oct/2021 CERTIFICATE NUMBER : 14030223JD01B

5772

UL INTERNATIONAL (UK) LTD
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APPROVED SIGNATORY

…………………………………
Naseer Mirza

Customer :
UL LLC
12 Laboratory Dr.
RTP, NC 27709 USA

Equipment Details:

Description:	Dipole Validation Kit	Date of Receipt:	04/Oct/2021
Manufacturer:	Speag		
Type/Model Number:	D900V2		
Serial Number:	1d180		
Calibration Date:	06/Oct/2021		
Calibrated By:	Masood Khan Test Engineer		
Signature:	…………………………………		

All Calibration have been conducted in the closed laboratory facility: Lab Temperature (22±3) ^{0}C and humidity < 70%

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.
Use of the UKAS mark demonstrates that compliance with the requirements of BS/EN/ISO/IEC 17025:2017 has been independently assessed.

The calibration methods and procedures used were as detailed in:

1. **IEC 62209-1:2016**: Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)
2. **IEC 62209-2:2010:** Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)
3. **IEEE 1528: 2013:** IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communication Devices: Measurement Techniques
4. FCC KDB Publication Number**: "KDB865664 D01 SAR Measurement 100 MHz to 6 GHz"**
5. **DASY 6 System Handbook**
6. **Dipole Calibration Procedure V1.2:** Calibration performed as per internal procedure

The measuring equipment used to perform the calibration, documented in this certificate has been calibrated in accordance with the manufacturers' recommendations, and is traceable to recognized national standards.

UL No.	Instrument	Manufacturer	Type No.	Serial No.	Date Last Calibrated	Cal. Interval (Months)
PRE0135115	Data Acquisition Electronics	SPEAG	DAE4	1438	12 Apr 2021	12
PRE0178314	Probe	SPEAG	EX3DV4	3995	16 Mar 2021	12
PRE0134199	Dipole	SPEAG	D900V2	SN035	15 Feb 2021	12
PRE0151451	Power Monitoring Kit	Art-Fi	ART 100850-01	0001	Cal as part of System	-
PRE0151441	Power Sensor	Rhode & Schwarz	NRP8S	102481	22 Mar 2021	12
M2028	Vector Network Analyser	Keysight Technologies	E5071C	MY46521873	20 Jul 2021	12
M2029	Calibration Kit	Keysight Technologies	N4691B	MY46181255	02 Aug 2021	12
PRE0134063	Signal Generator	HP	8648C	3537A01598	03 Mar 2021	12
PRE0135028	Signal Generator	R&S	SME 06	831377/005	29 Mar 2021	12

SAR System Specification

Robot System Positioner:	Stäubli Unimation Corp. Robot Model: TX60L
Robot Serial Number:	F17/5ENYG1/A/01
DASY Version:	cDASY16.0.0.116
Phantom:	Flat section of SAM Twin Phantom
Distance Dipole Centre:	15 mm (with spacer)
Frequency:	900 MHz

Dielectric Property Measurements – Head Simulating Liquid (HSL)

Simulant Liquid	Frequency (MHz)	Room Temp		Liquid Temp		Parameters	Target Value	Measured Value	Uncertainty (%)
		Start	End	Start	End				
Head	900	21.1 ℃	20.9 ℃	21.8 ℃	21.2 ℃	**εr**	41.50	42.32	± 5%
						σ	0.97	0.96	± 5%

SAR Results – Head Simulating Liquid (HSL)

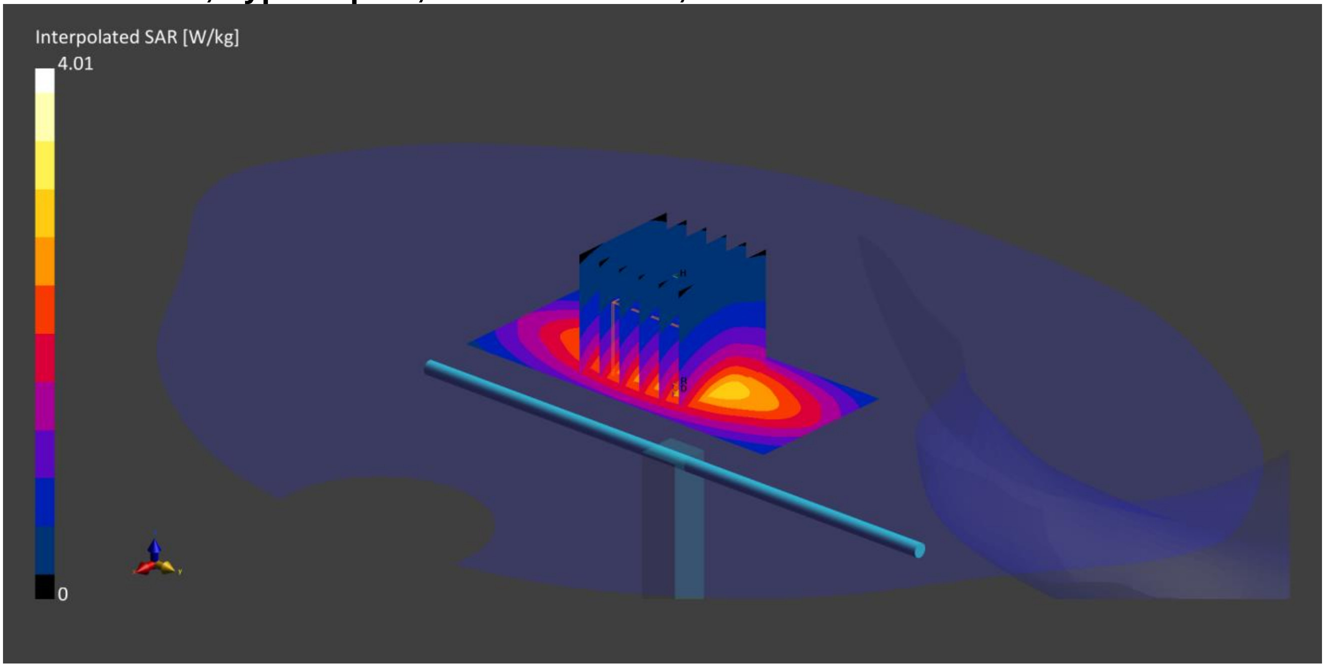
Simulant Liquid	SAR Measured	250 mW input Power	Normalised to 1.00 W	Uncertainty (%)
Head	SAR averaged over 1g	2.67 W/Kg	**10.63 W/Kg**	+16.80 / -16.43%
	SAR averaged over 10g	1.75 W/Kg	**6.97 W/Kg**	+16.72 / -16.42%

Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	47.97 -0.564j Ω	± 3.01
	Return Loss	33.79	± 3.34

DASY Validation Scan for Head Stimulating Liquid (HSL)

DUT: D900V2; Type: Dipole; Serial: SN1d180;

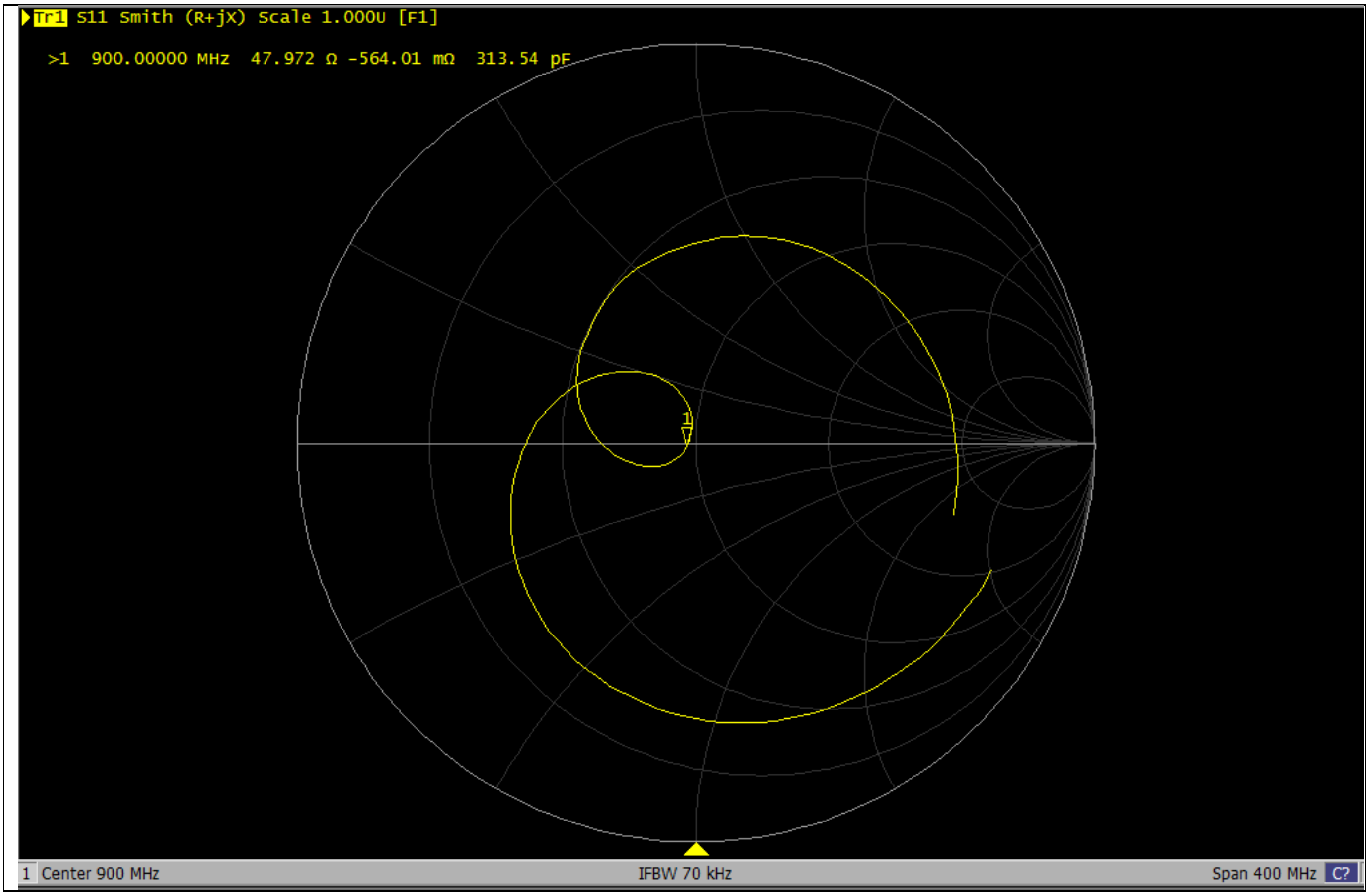


Communication System: CW UID: 0; Frequency: 900.0 MHz; Duty Cycle: 1;
Medium: HSL; Site65_04Oct2021_115853_Head - 750 900 1750 2450 5250 5600 5750 5%;
Medium parameters used: f = 900.0 MHz; σ = 0.96 S/m; ε_r = 42.3; ρ = 1000 kg/m3; $\Delta\varepsilon_r$ = 1.97 %; $\Delta\sigma$ = -1.06 %; No correction
Phantom section: Flat;
DASY 6 Configuration:

- Laboratory Name: Site65;
- Probe: EX3DV4 - SN7496; ConvF(9.7, 9.7, 9.7); Calibrated: 16 Mar 2021
- Sensor-Surface: 1.4 mm; VMS + 6p
- Electronics: DAE4 - SN1438; Calibrated: 12 Apr 2021
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 1945
- Measurement SW: cDASY16.0.0.116

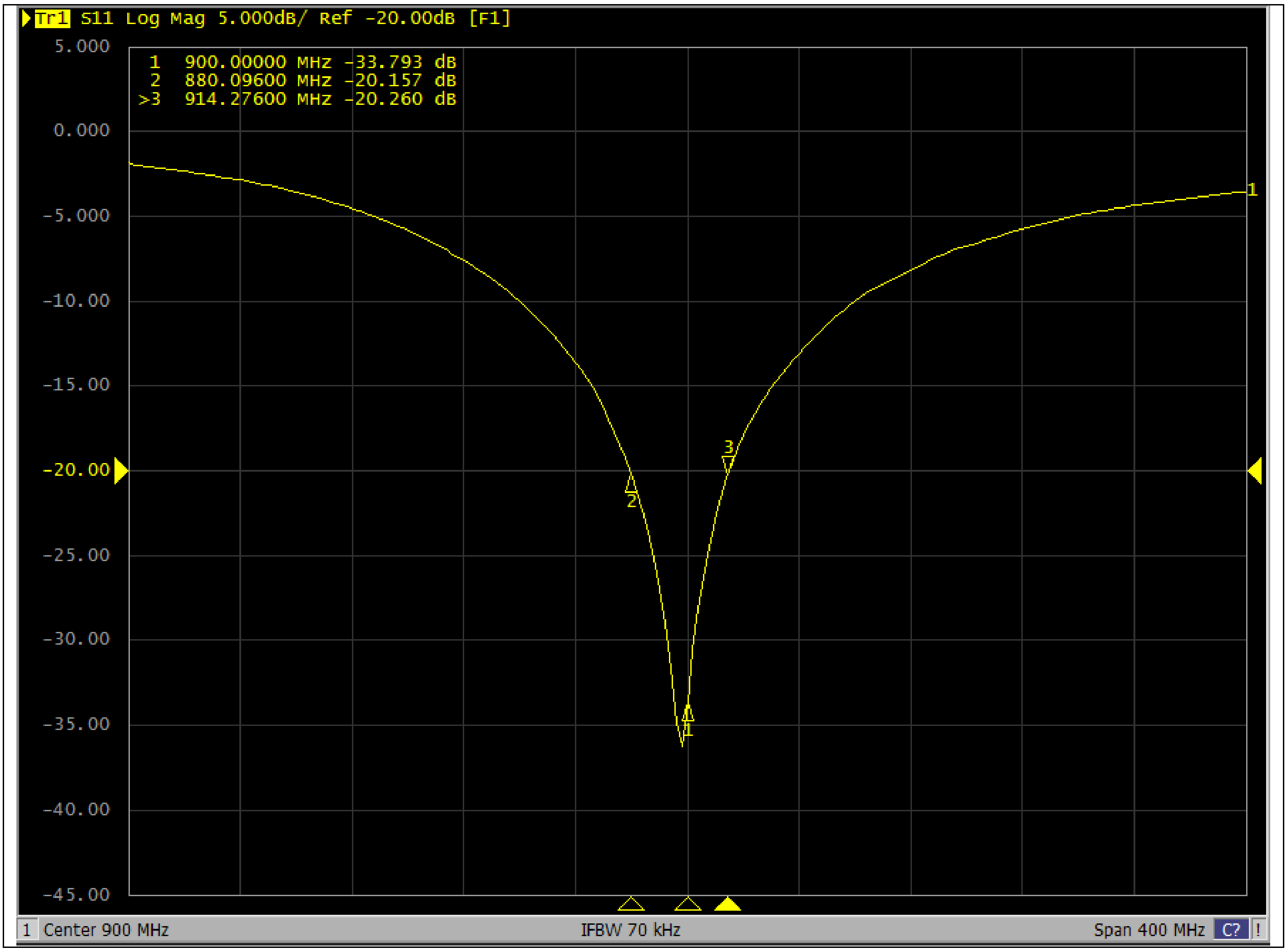
Area Scan (40x90): Interpolated grid: dx=10 mm, dy=15 mm
Zoom Scan1(30x30x30): Measurement grid: dx=6 mm, dy=6 mm, dz=1.5 mm; Grading Ratio: 1.5; Reference Value = 3.110 V/m; Power Drift = -0.02 dB
Minimum horizontal 3dB distance: 18.0 mm;
Vertical M2/M1 Ratio: 88.7 %;
SAR(1 g) = 2.670 W/kg; SAR(10 g) = 1.750 W/kg

Impedance Measurement Plot for Head Stimulating Liquid (HSL)



```
Tr1 S11 Smith (R+jX) Scale 1.000U [F1]
 >1  900.00000 MHz  47.972 Ω -564.01 mΩ  313.54 pF
```

Return Loss Measurement Plot for Head Stimulating Liquid (HSL)



```
Tr1 S11 Log Mag 5.000dB/ Ref -20.00dB [F1]
 1   900.00000 MHz -33.793 dB
 2   880.09600 MHz -20.157 dB
>3   914.27600 MHz -20.260 dB
```

Calibration Certificate Label:

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UL INTERNATIONAL (UK) LTD
Tel: +44 (0) 1256312100

Certificate Number: 14030223JD01B

Instrument ID: 1d180

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