

CERTIFICATE OF CALIBRATION

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

DATE OF ISSUE: 13/April/2021 CERTIFICATE NUMBER : 13697411JD01E



UL INTERNATIONAL (UK) LTD
UNIT 1-3 HORIZON
KINGSLAND PARK, WADE ROAD
BASINGSTOKE, HAMPSHIRE
RG24 8AH, UK
TEL: +44 (0) 1256 312100
FAX: +44 (0) 1256 312001
Email: LST.UK.Calibration@ul.com



Page 1 of 6

APPROVED SIGNATORY

A handwritten signature in black ink, appearing to read 'Harmohan Sahota'.

.....
Harmohan Sahota

Customer :

UL VS Inc
47173 Benicia Street
Fremont, CA 94538, USA

Equipment Details:

Description:	Dipole Validation Kit	Date of Receipt:	12/April/2021
Manufacturer:	Speag		
Type/Model Number:	D2450V2		
Serial Number:	899		
Calibration Date:	13/April/2021		
Calibrated By:	Ravish Foolchund Laboratory Technician		

Signature:

A handwritten signature in black ink, appearing to read 'Ravish Foolchund'.

.....
All Calibration have been conducted in the closed laboratory facility: Lab Temperature (22±3) °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.

CERTIFICATE OF CALIBRATION

ISSUED BY UL INTERNATIONAL (UK) LTD

UKAS Accredited Calibration Laboratory No. 5772

CERTIFICATE
NUMBER :
13697411JD01E

Page 2 of 6

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)
PRE0134060	Data Acquisition Electronics	SPEAG	DAE4	432	09 Oct 2020	12
PRE0134817	Probe	SPEAG	ES3DV3	3335	14 Jan 2021	12
PRE0131865	Dipole Antenna	SPEAG	D2450V2	725	07 Oct 2020	12
PRE0151451	Power Monitoring Kit	Art-Fi	ART 100850-01	0001	Cal as part of System	-
PRE0151441	Power Sensor	Rohde & Schwarz	NRP8S	102481	17 Apr 2020	12
PRE0151154	Vector Network Analyser	Rohde & Schwarz	ZND	100151	15 Jun 2020	12
PRE0158684	Calibration Kit	Rhode & Schwarz	ZV-Z135	102144	27 May 2020	12
PRE0178154	Signal Generator	Rohde & Schwarz	SMB 100A	175325	10 Jun 2020	12

CERTIFICATE OF CALIBRATION

ISSUED BY UL INTERNATIONAL (UK) LTD

CERTIFICATE
NUMBER :
13697411JD01E

UKAS Accredited Calibration Laboratory No. 5772

Page 3 of 6

SAR System Specification

Robot System Positioner:	Stäubli Unimation Corp. Robot Model: TX60L
Robot Serial Number:	F13/5SC6F1/A/01
DASY Version:	cDASY6.14.0.959
Phantom:	Flat section of SAM Twin Phantom
Distance Dipole Centre:	10mm (with spacer)
Frequency:	2450 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	2450	20.0 °C	19.8 °C	19.8°C	19.8°C	ϵ_r	39.20	38.75	± 5%
						σ	1.80	1.83	± 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	12.80 W/Kg	50.96 W/Kg	+16.80% / -16.43%
	SAR averaged over 10g	6.00 W/Kg	23.89 W/Kg	+16.72% / -16.42%

Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	44.55 Ω - 0.17 j Ω	± 0.28 Ω ± 0.044 j Ω
	Return Loss	-24.78 dB	± 2.93 dB

CERTIFICATE OF CALIBRATION

ISSUED BY UL INTERNATIONAL (UK) LTD

CERTIFICATE
NUMBER :
13697411JD01E

UKAS Accredited Calibration Laboratory No. 5772

Page 4 of 6

DASY Validation Scan for Head Stimulating Liquid (HSL)

DUT: D2450V2; Type: Dipole; Serial: SN899;



Communication System: CW UID: 0; Frequency: 2450.0 MHz; Duty Cycle: 1;
Medium: HSL; Site65_12Apr2021_115940_Head - 1750 1800 1900 2300 2450 2600 5%;
Medium parameters used: $f = 2450.0$ MHz; $\sigma = 1.82$ S/m; $\epsilon_r = 38.7$; $\rho = 1000$ kg/m³; $\Delta\epsilon_r = -1.16$ %; $\Delta\sigma = 1.39$ %; No correction

Phantom section: Flat;

DASY 6 Configuration:

- Laboratory Name: Site65;
- Probe: ES3DV3 - SN3335; ConvF(4.64, 4.64, 4.64); Calibrated: 14 Jan 2021
- Sensor-Surface: 3 mm; VMS + 6p
- Electronics: DAE4 - SN432; Calibrated: 09 Oct 2020
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 1945
- Measurement SW: cDASY6.14.0.959

Area Scan (40x80): Interpolated grid: $dx=10$ mm, $dy=10$ mm

Zoom Scan1(30x30x30): Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=1.5$ mm; Grading Ratio: 1.5; Reference Value = 17.230 V/m; Power Drift = -0.01 dB

Minimum horizontal 3dB distance: 9.0 mm;

Vertical M2/M1 Ratio: 82.1 %;

SAR(1 g) = 12.800 W/kg; SAR(10 g) = 6.000 W/kg

CERTIFICATE OF CALIBRATION

ISSUED BY UL INTERNATIONAL (UK) LTD

UKAS Accredited Calibration Laboratory No. 5772

CERTIFICATE
NUMBER :
13697411JD01E

Page 5 of 6

Impedance Measurement Plot for Head Stimulating Liquid (HSL)

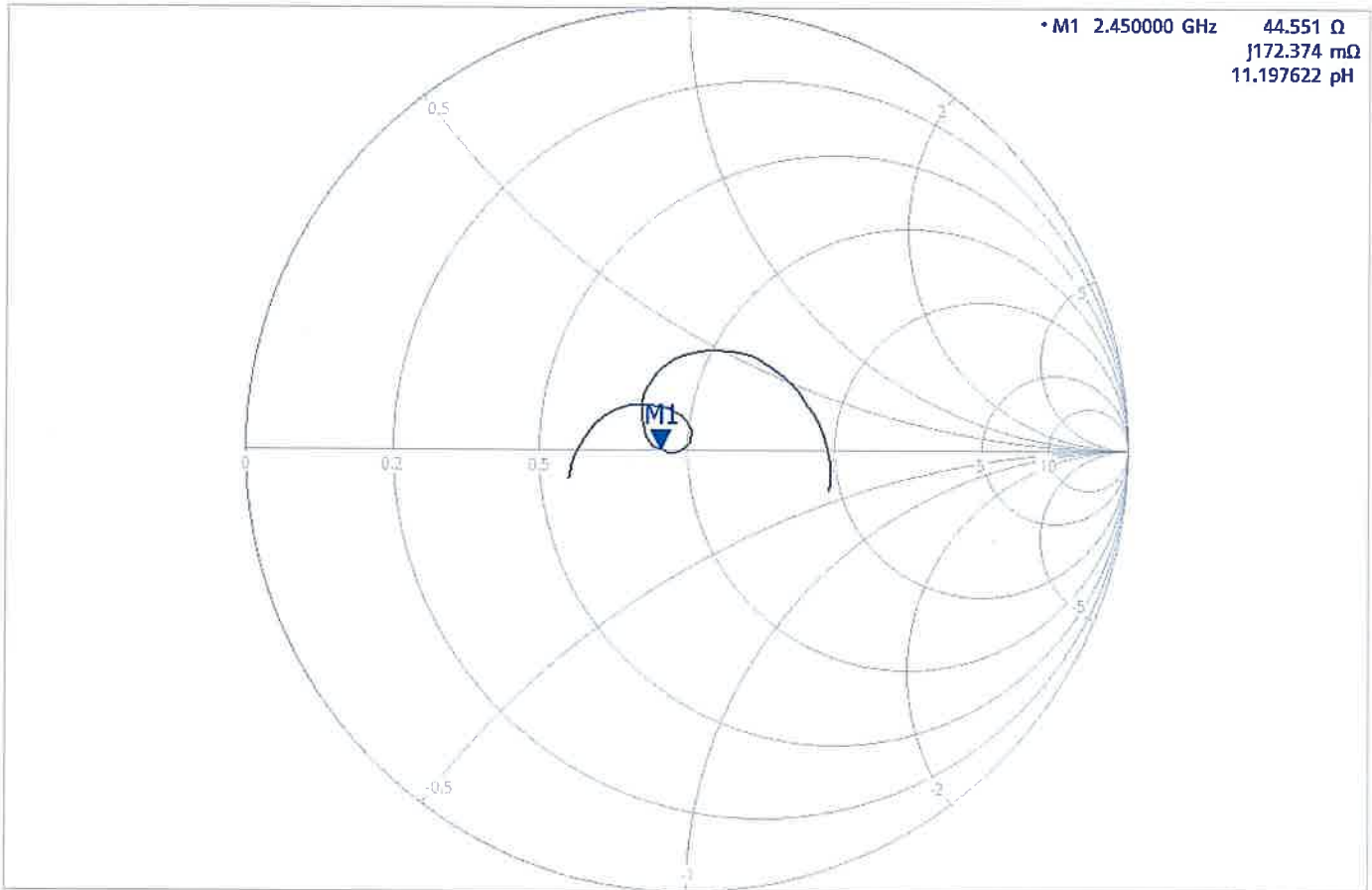


4/13/2021 2:23:33 PM
1328.5170K92-100151-MV

Trc1 — S11 Smth 200 mU/ Ref 1 U Cal

1

• M1 2.450000 GHz 44.551 Ω
j172.374 m Ω
11.197622 pH



Ch1 Center 2.45 GHz

Pwr -10 dBm Bw 10 kHz

Span 400 MHz

CERTIFICATE OF CALIBRATION

ISSUED BY UL INTERNATIONAL (UK) LTD

UKAS Accredited Calibration Laboratory No. 5772

CERTIFICATE
NUMBER :
13697411JD01E

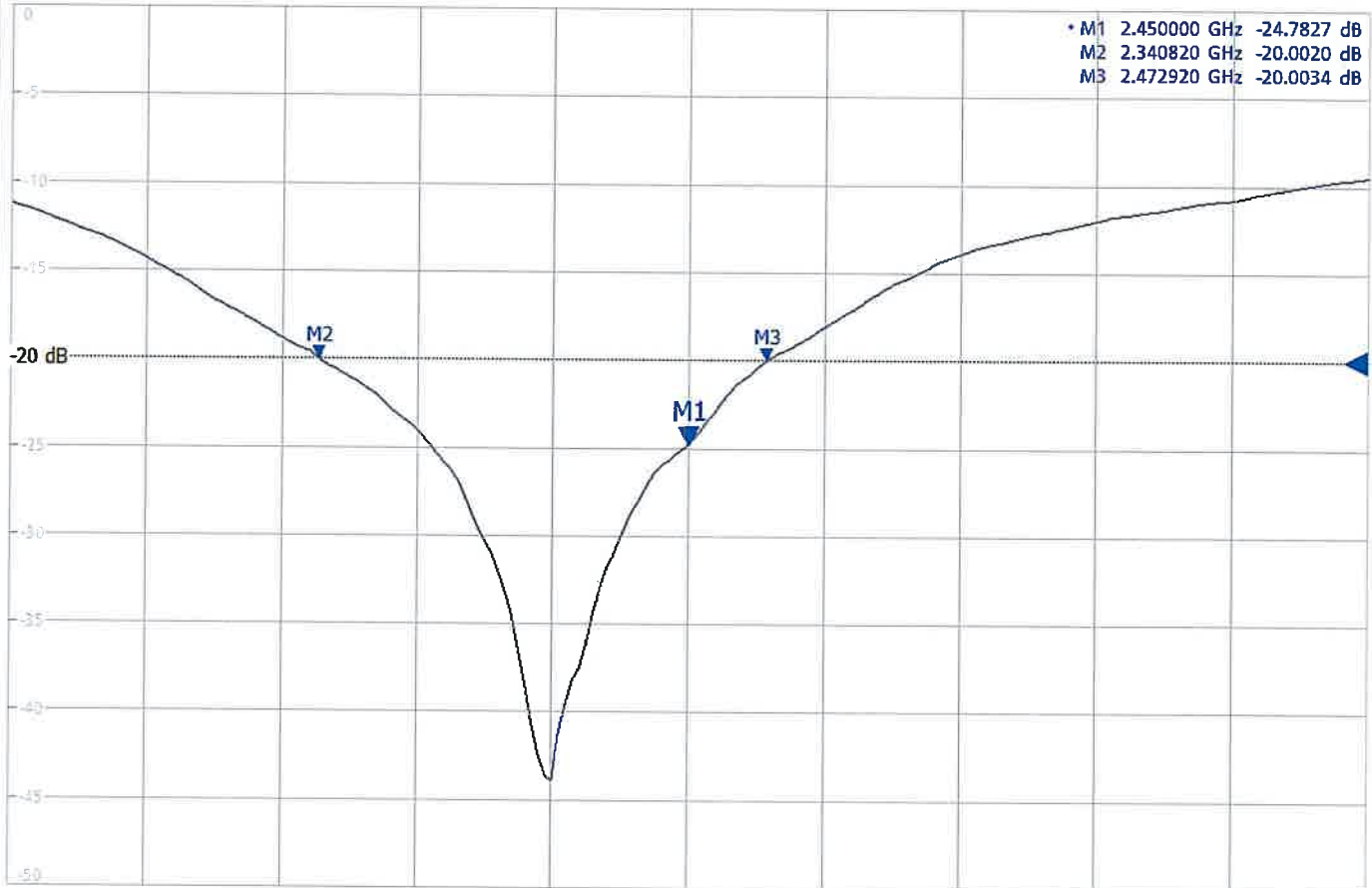
Page 6 of 6

Return Loss Measurement Plot for Head Stimulating Liquid (HSL)

4/13/2021 2:22:47 PM
1328.5170K92-100151-MV

Trc1 — S11 dB Mag 5 dB/ Ref -20 dB Cal

1





Ch1 Center 2.45 GHz


Pwr -10 dBm Bw 10 kHz

Span 400 MHz

Calibration Certificate Label:

 <p>5772</p>	<p>UL INTERNATIONAL (UK) LTD Tel: +44 (0) 1256312000</p> <p>Certificate Number: 13697411JD01E</p> <p>Instrument ID: 899</p> <p>Calibration Date: 13/April/2021</p> <p>Calibration Due Date:</p>
--	---

 <p>5772</p>	<p>UL INTERNATIONAL (UK) LTD Tel: +44 (0) 1256312000</p> <p>Certificate Number: 13697411JD01E</p> <p>Instrument ID: 899</p> <p>Calibration Date: 13/April/2021</p> <p>Calibration Due Date:</p>
--	---

 <p>5772</p>	<p>UL INTERNATIONAL (UK) LTD Tel: +44 (0) 1256312000</p> <p>Certificate Number: 13697411JD01E</p> <p>Instrument ID: 899</p> <p>Calibration Date: 13/April/2021</p> <p>Calibration Due Date:</p>
--	---