

# CERTIFICATE OF CALIBRATION

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

DATE OF ISSUE: 17/May/2021      CERTIFICATE NUMBER : 13685220JD01A



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**APPROVED SIGNATORY**

A handwritten signature in black ink, appearing to read 'M. Nasir'.

## Customer :

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

## Equipment Details:

Description:	Dipole Validation Kit	Date of Receipt:	10/May/2021
Manufacturer:	Speag		
Type/Model Number:	D750V3		
Serial Number:	1024		
Calibration Date:	11/May/2021		
Calibrated By:	Masood Khan Test Engineer		

Signature:

A handwritten signature in black ink, appearing to read 'Masood Khan'.

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

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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)
PRE0131609	Data Acquisition Electronics	SPEAG	DAE4	450	07 Oct 2020	12
PRE0134817	Probe	SPEAG	ES3DV3	3335	14 Jan 2021	12
PRE0135601	Dipole Antenna	SPEAG	D750V2	1147	06 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	22 Mar 2021	12
PRE0151154	Vector Network Analyser	Rohde & Schwarz	ZND	100151	23 Mar 2021	12
PRE0158684	Calibration Kit	Rhode & Schwarz	ZV-Z135	102144	27 May 2020	12
PRE0178154	Signal Generator	Rohde & Schwarz	SMB 100A	175325	25 Mar 2021	12

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## SAR System Specification

<b>Robot System Positioner:</b>	Stäubli Unimation Corp. Robot Model: TX60L
<b>Robot Serial Number:</b>	F17/5ENYG1/A/01
<b>DASY Version:</b>	cDASY6.14.0.959
<b>Phantom:</b>	Flat section of SAM Twin Phantom
<b>Distance Dipole Centre:</b>	15 mm (with spacer)
<b>Frequency:</b>	750 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	750	19.2 °C	19.6 °C	20.6 °C	20.7 °C	$\epsilon_r$	41.96	42.59	± 5%
						$\sigma$	0.89	0.89	± 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	2.15 W/Kg	<b>8.60 W/Kg</b>	+16.80% / -16.43%
	SAR averaged over 10g	1.43 W/Kg	<b>5.69 W/Kg</b>	+16.72% / -16.42%

## Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	45.13 $\Omega$ -0.50 $j\Omega$	± 0.28 $\Omega$ ± 0.044 $j\Omega$
	Return Loss	25.77	± 2.97 dB

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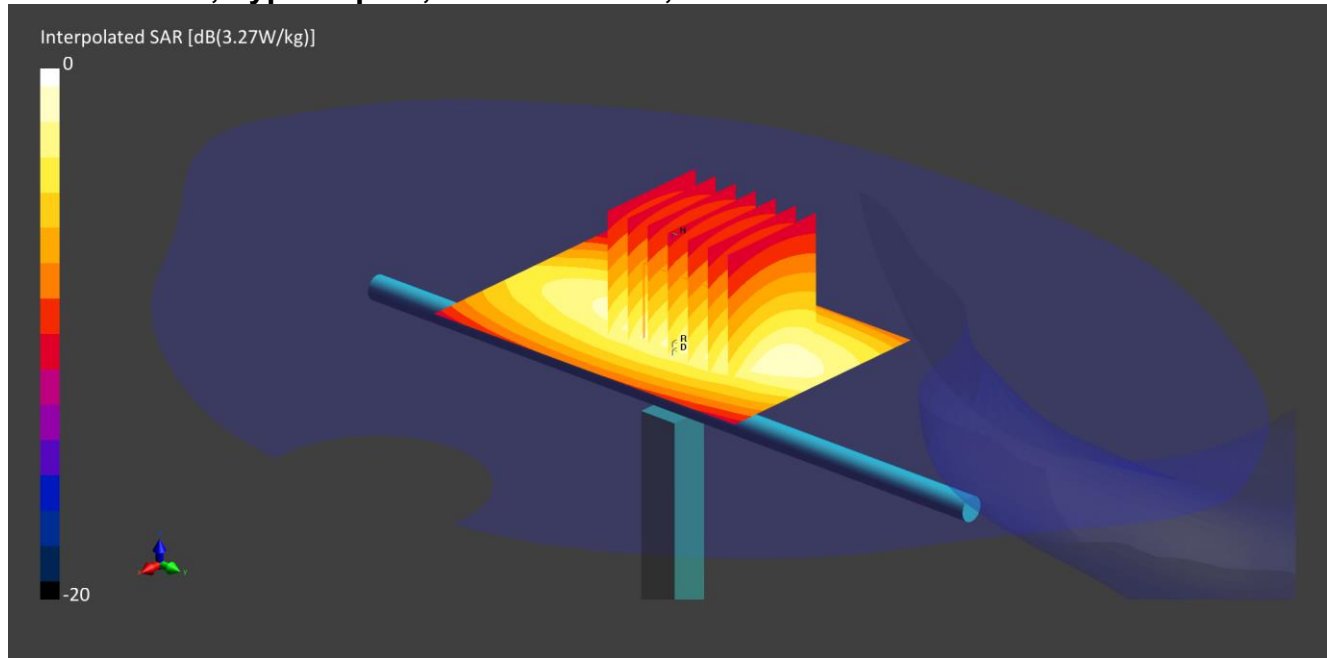
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### DASY Validation Scan for Head Stimulating Liquid (HSL)

**DUT: D750V3; Type: Dipole; Serial: SN1024;**



Communication System: CW UID: 0; Frequency: 750.0 MHz; Duty Cycle: 1;  
Medium: HSL; Site65\_10May2021\_154932\_Head - 750 900 5%; Medium parameters used:  $f = 750.0$  MHz;  $\sigma = 0.89$  S/m;  $\epsilon_r = 42.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>;  $\Delta\epsilon_r = 1.56$  %;  $\Delta\sigma = 0.06$  %; No correction

Phantom section: Flat;

DASY 6 Configuration:

- Probe: ES3DV3 - SN3335; ConvF(6.44, 6.44, 6.44); Calibrated: 14 Jan 2021
- Sensor-Surface: 3 mm; VMS + 6p
- Electronics: DAE4 - SN450; Calibrated: 07 Oct 2020
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 1945
- Measurement SW: cDASY6.14.0.959

**Area Scan (60x90):** Interpolated grid: dx=15 mm, dy=15 mm

**Zoom Scan1(30x30x30):** Measurement grid: dx=5 mm, dy=5 mm, dz=1.5 mm; Grading Ratio: 1.5; Reference Value = 2.520 V/m;  
Power Drift = 0.00 dB

Minimum horizontal 3dB distance: 26.0 mm;

Vertical M2/M1 Ratio: 88.4 %;

**SAR(1 g) = 2.150 W/kg; SAR(10 g) = 1.430 W/kg**

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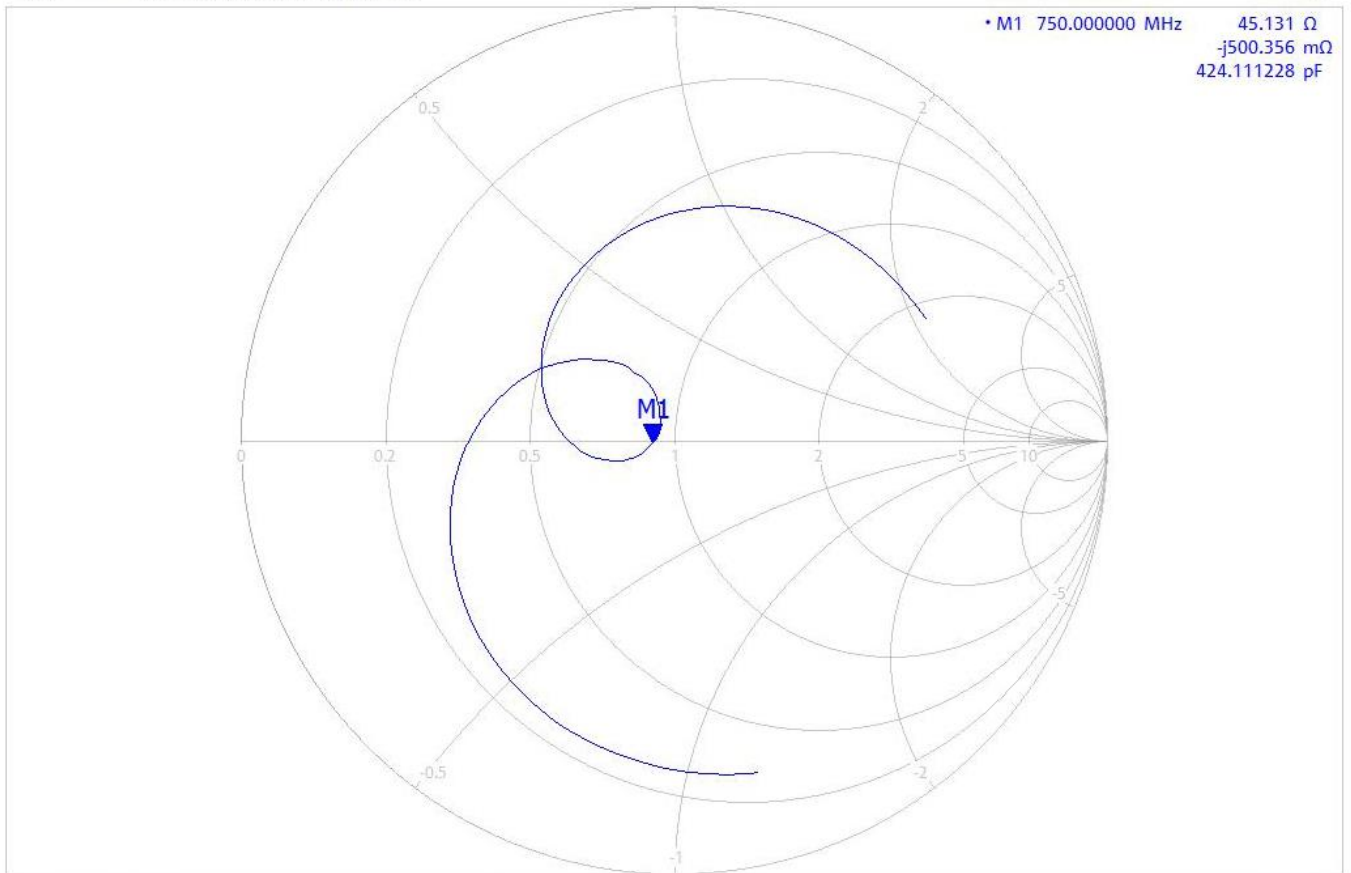
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## Impedance Measurement Plot for Head Stimulating Liquid (HSL)

5/11/2021 2:30:51 PM  
1328.5170K92-100151-MV

Trc1 — S11 Smith 200 mU/ Ref 1 U Cal

1



Ch1 Center 750 MHz

Pwr -10 dBm Bw 10 kHz

Span 400 MHz

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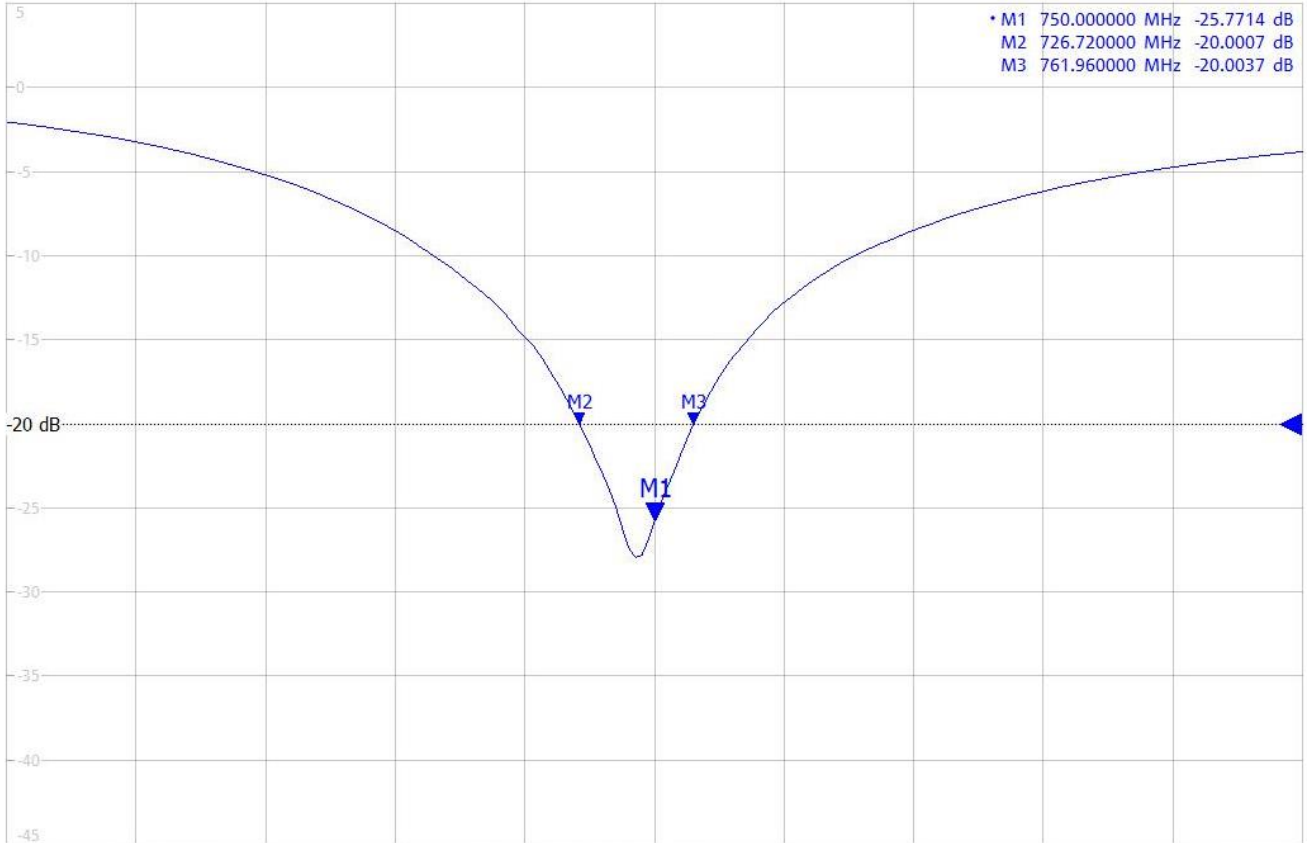
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### Return Loss Measurement Plot for Head Stimulating Liquid (HSL)

5/11/2021 2:29:56 PM  
1328.5170K92-100151-MV

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

1

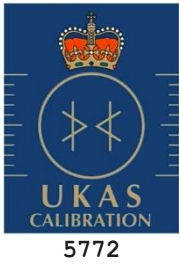



Ch1 Center 750 MHz


Pwr -10 dBm Bw 10 kHz

Span 400 MHz

**Calibration Certificate Label:**

 <p>UKAS CALIBRATION 5772</p>	<p><b>UL INTERNATIONAL (UK) LTD</b> <b>Tel: +44 (0) 1256312000</b></p> <p>Certificate Number: 13685220JD01A</p> <p>Instrument ID: 1024</p> <p>Calibration Date: 11/May/2021</p> <p>Calibration Due Date:</p>
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# CERTIFICATE OF CALIBRATION

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DATE OF ISSUE: 13/April/2021      CERTIFICATE NUMBER : 13697411JD01C



UL INTERNATIONAL (UK) LTD  
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Email: LST.UK.Calibration@ul.com



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**APPROVED SIGNATORY**

.....  
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:	D1900V2		
Serial Number:	5d140		
Calibration Date:	13/April/2021		
Calibrated By:	Ravish Foolchund Laboratory Technician		

Signature:

.....  
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.

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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
PRE0134198	Dipole Antenna	SPEAG	D1900V2	537	16 Feb 2021	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

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## 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:	1900 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	1900	20.0 °C	19.8 °C	19.8°C	19.8°C	$\epsilon_r$	40.00	39.53	± 5%
						$\sigma$	1.40	1.44	± 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	10.40 W/Kg	41.40 W/Kg	+16.80% / -16.43%
	SAR averaged over 10g	5.40 W/Kg	21.50 W/Kg	+16.72% / -16.42%

## Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	49.47 $\Omega$ - 4.77 j $\Omega$	± 0.28 $\Omega$ ± 0.044 j $\Omega$
	Return Loss	-26.34 dB	± 2.97 dB

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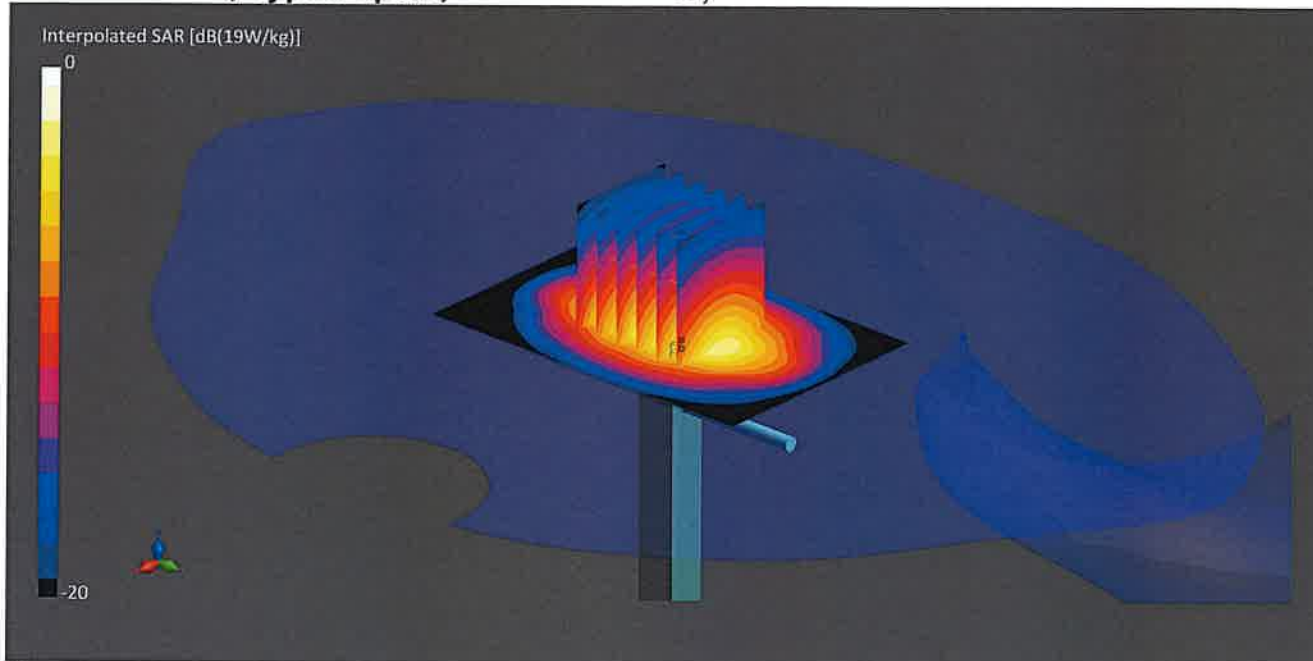
CERTIFICATE  
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### DASY Validation Scan for Head Stimulating Liquid (HSL)

DUT: D1900V2; Type: Dipole; Serial: SN5d140;



Communication System: CW UID: 0; Frequency: 1900.0 MHz; Duty Cycle: 1;  
Medium: HSL; Site65\_12Apr2021\_115940\_Head - 1750 1800 1900 2300 2450 2600 5%;  
Medium parameters used:  $f = 1900.0$  MHz;  $\sigma = 1.44$  S/m;  $\epsilon_r = 39.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>;  $\Delta\epsilon_r = -1.17$  %;  $\Delta\sigma = 2.77$  %; No correction

Phantom section: Flat;

DASY 6 Configuration:

- Laboratory Name: Site65;
- Probe: ES3DV3 - SN3335; ConvF(5.13, 5.13, 5.13); 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 (60x90):** Interpolated grid:  $dx=15$  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 = 13.240 V/m; Power Drift = 0.01 dB

Minimum horizontal 3dB distance: 10.8 mm;

Vertical M2/M1 Ratio: 84.2 %;

**SAR(1 g) = 10.400 W/kg; SAR(10 g) = 5.400 W/kg**

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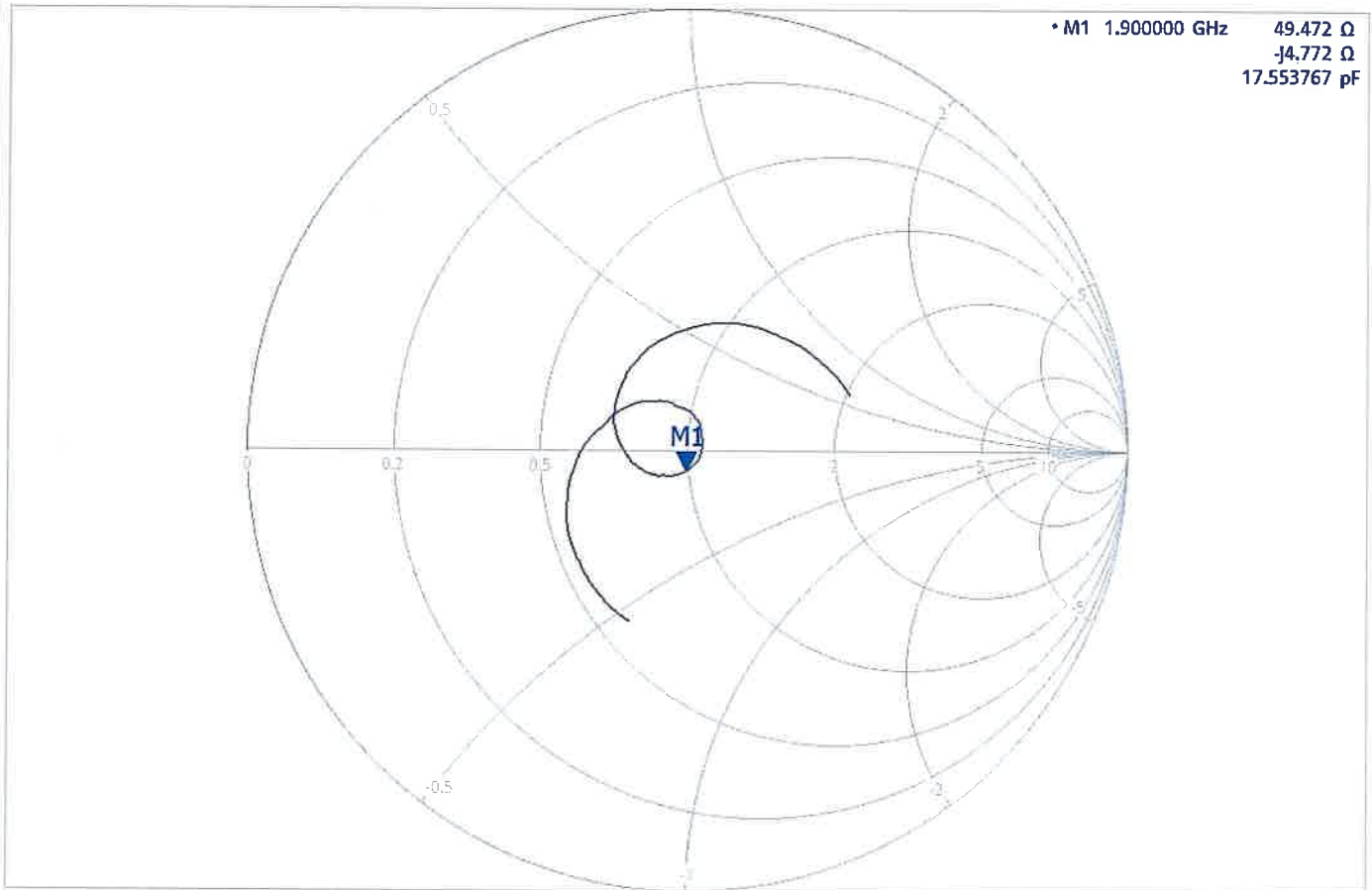
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### Impedance Measurement Plot for Head Stimulating Liquid (HSL)

4/12/2021 3:35:08 PM  
1328.5170K92-100151-MV

Trc1 — S11 Smith 200 mU/ Ref 1 U Cal

1



Ch1 Center 1.9 GHz

Pwr -10 dBm Bw 10 kHz

Span 400 MHz

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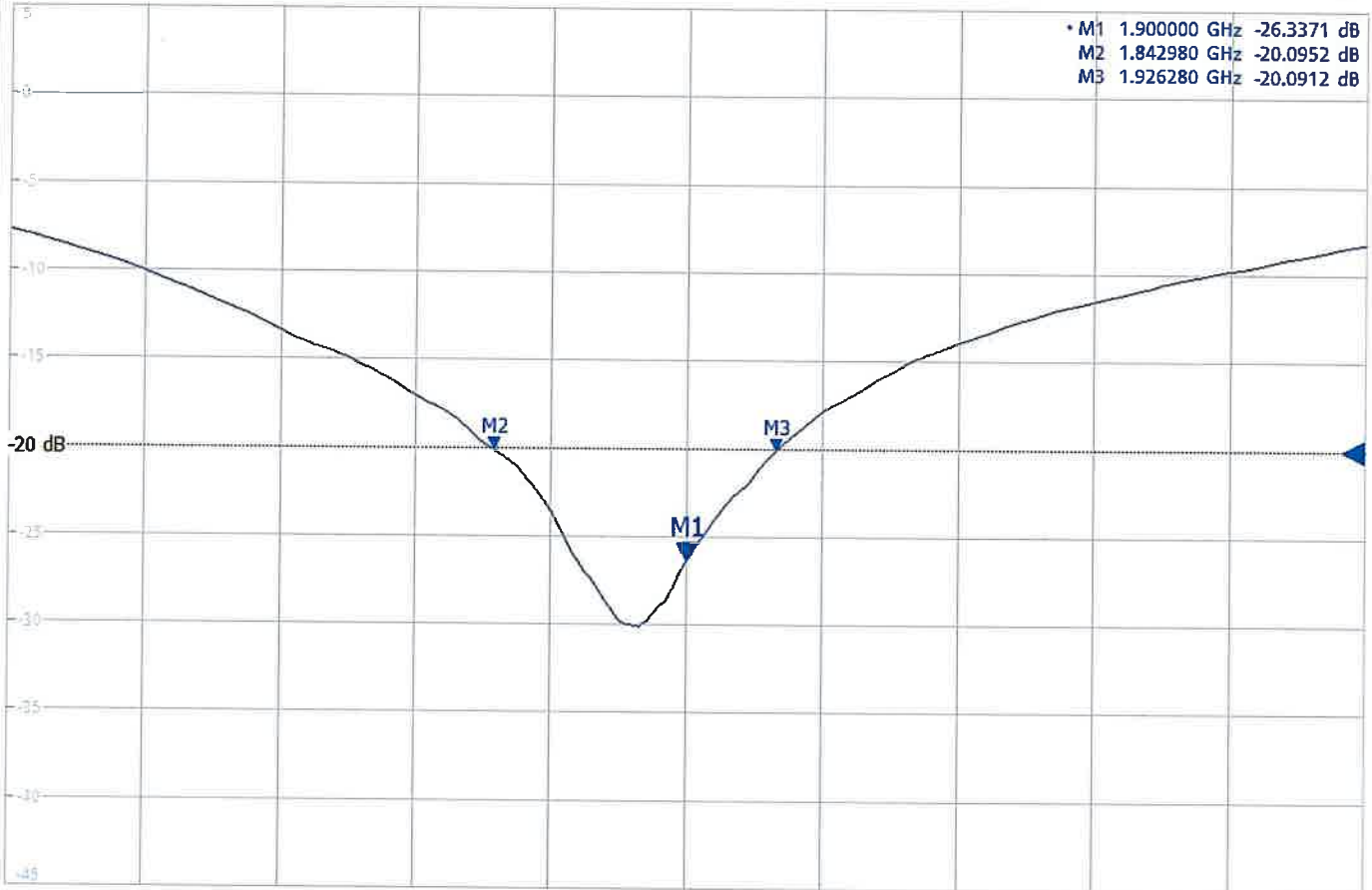
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### Return Loss Measurement Plot for Head Stimulating Liquid (HSL)

4/12/2021 3:33:00 PM  
1328.5170K92-100151-MV

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

1





Ch1 Center 1.9 GHz


Pwr -10 dBm Bw 10 kHz

Span 400 MHz

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