

# CERTIFICATE OF CALIBRATION

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

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



UL INTERNATIONAL (UK) LTD  
UNIT 1-3 HORIZON  
KINGSLAND PARK, WADE ROAD  
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**APPROVED SIGNATORY**

**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:

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

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# CERTIFICATE OF CALIBRATION

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UKAS Accredited Calibration Laboratory No. 5772

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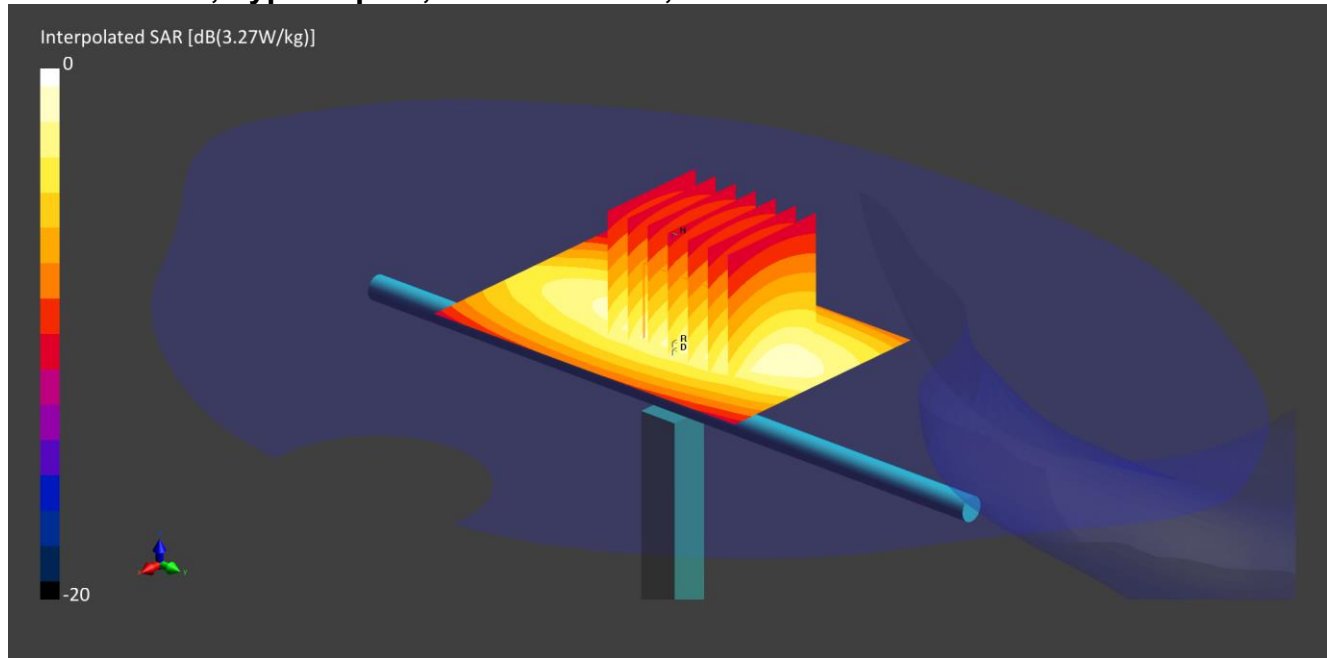
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### DASY Validation Scan for Head Stimulating Liquid (HSL)

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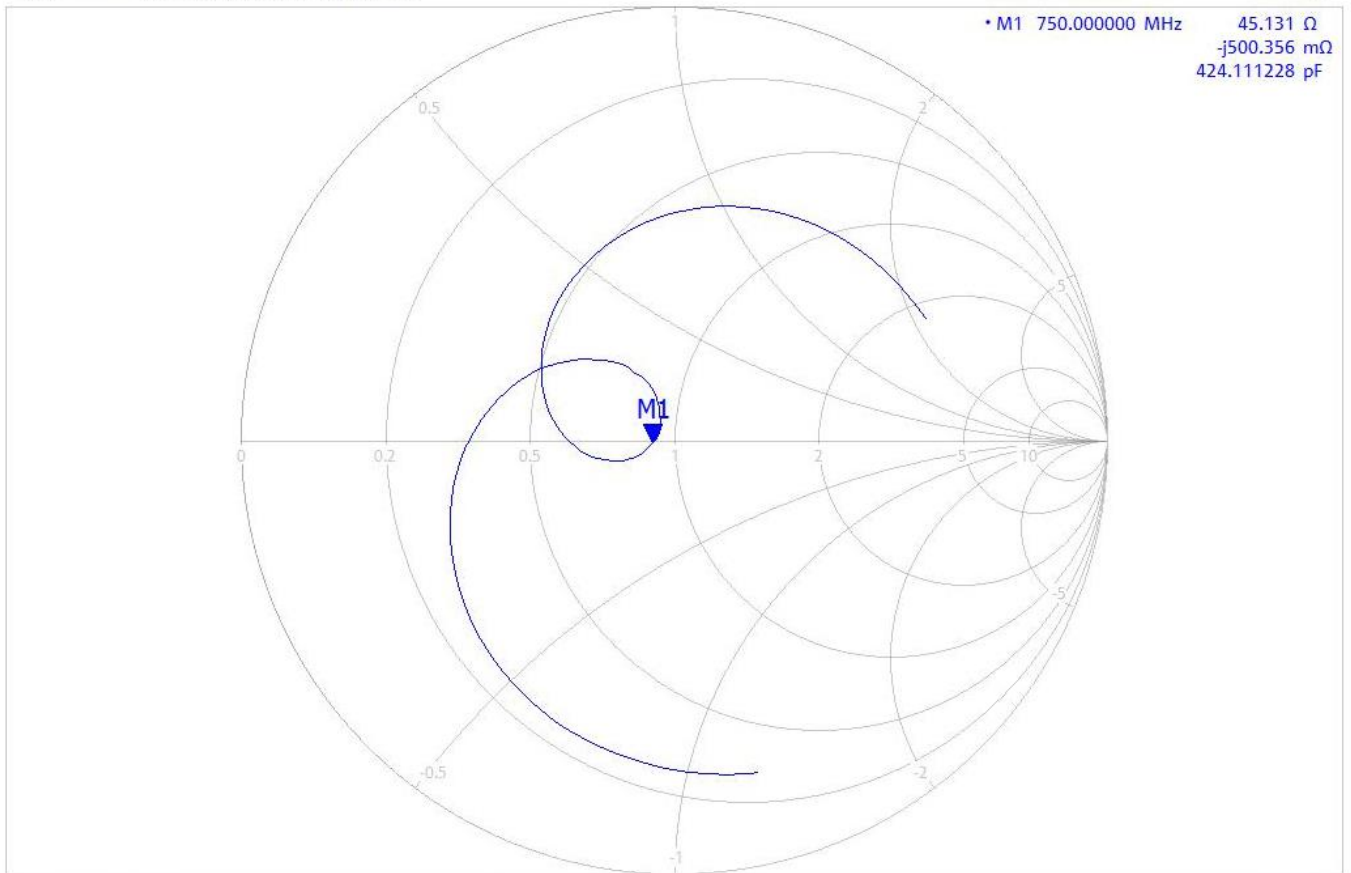
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## Impedance Measurement Plot for Head Stimulating Liquid (HSL)

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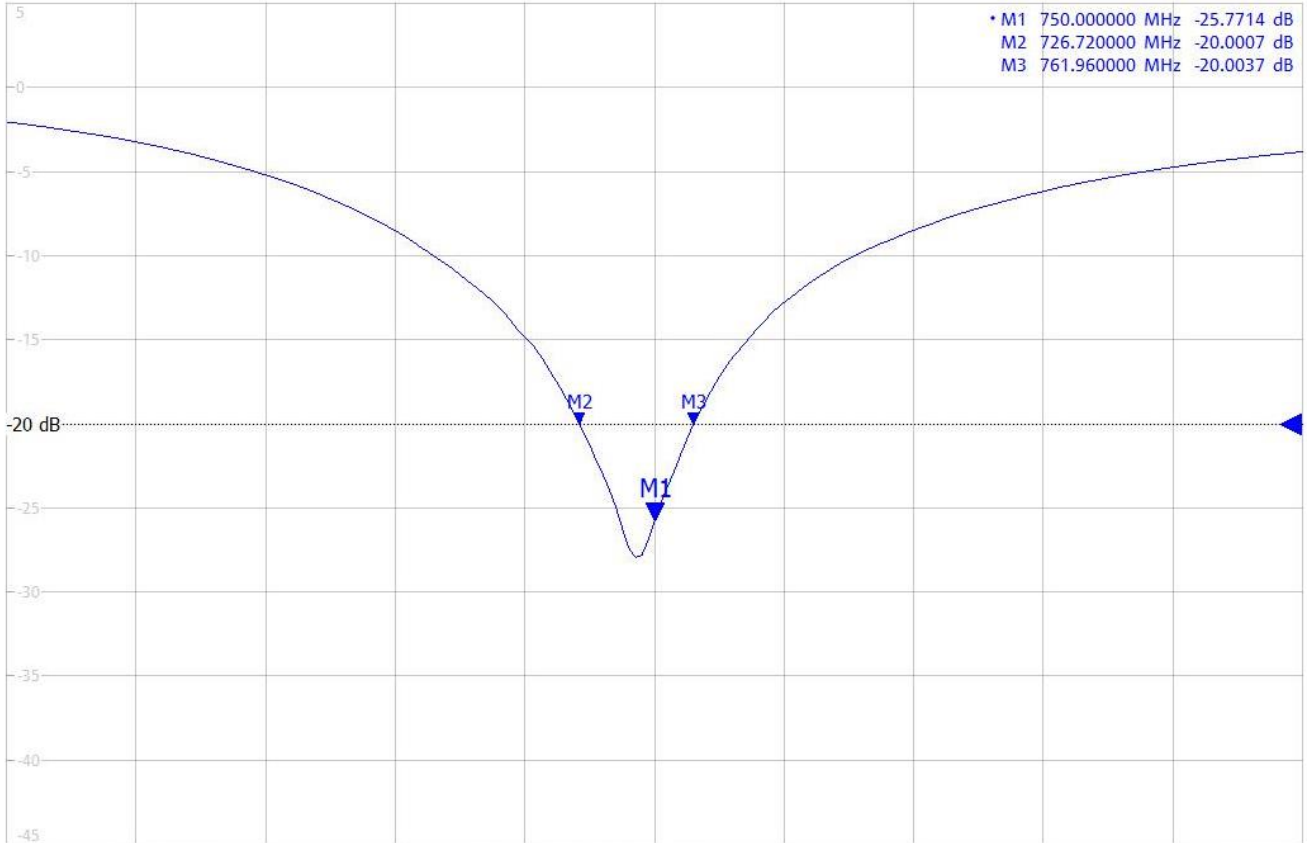
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### Return Loss Measurement Plot for Head Stimulating Liquid (HSL)

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

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

1

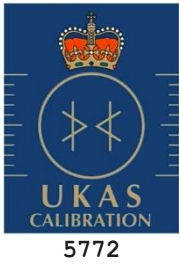



Ch1 Center 750 MHz


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

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

DATE OF ISSUE: 06/Oct/2021

CERTIFICATE NUMBER : 13697410JD01A



5772

UL INTERNATIONAL (UK) LTD  
UNIT 1-3 HORIZON  
KINGSLAND PARK, WADE ROAD  
BASINGSTOKE, HAMPSHIRE  
RG24 8AH, UK  
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Email: LST.UK.Calibration@ul.com



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**APPROVED SIGNATORY**

.....  
Naseer Mirza

## Customer :

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

## Equipment Details:

Description:	Dipole Validation Kit	Date of Receipt:	24/Sep/2021
Manufacturer:	Speag		
Type/Model Number:	D900V2		
Serial Number:	1d143		
Calibration Date:	29/Sep/2021		
Calibrated By:	Masood Khan Test Engineer		

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)
PRE0135115	Data Acquisition Electronics	SPEAG	DAE4	1438	12 Apr 2021	12
PRE0134817	Probe	SPEAG	ES3DV3	3335	14 Jan 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

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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>	cDASY16.0.0.116
<b>Phantom:</b>	Flat section of SAM Twin Phantom
<b>Distance Dipole Centre:</b>	15 mm (with spacer)
<b>Frequency:</b>	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 °C	20.9 °C	20.8 °C	20.6 °C	$\epsilon_r$	41.50	42.05	± 5%
						$\sigma$	0.97	0.95	± 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	2.69 W/Kg	<b>10.71 W/Kg</b>	+16.80 / -16.43%
	SAR averaged over 10g	1.75 W/Kg	<b>6.97 W/Kg</b>	+16.72 / -16.42%

### Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	48.64 - 0.027j $\Omega$	± 3.01
	Return Loss	36.76	± 3.34

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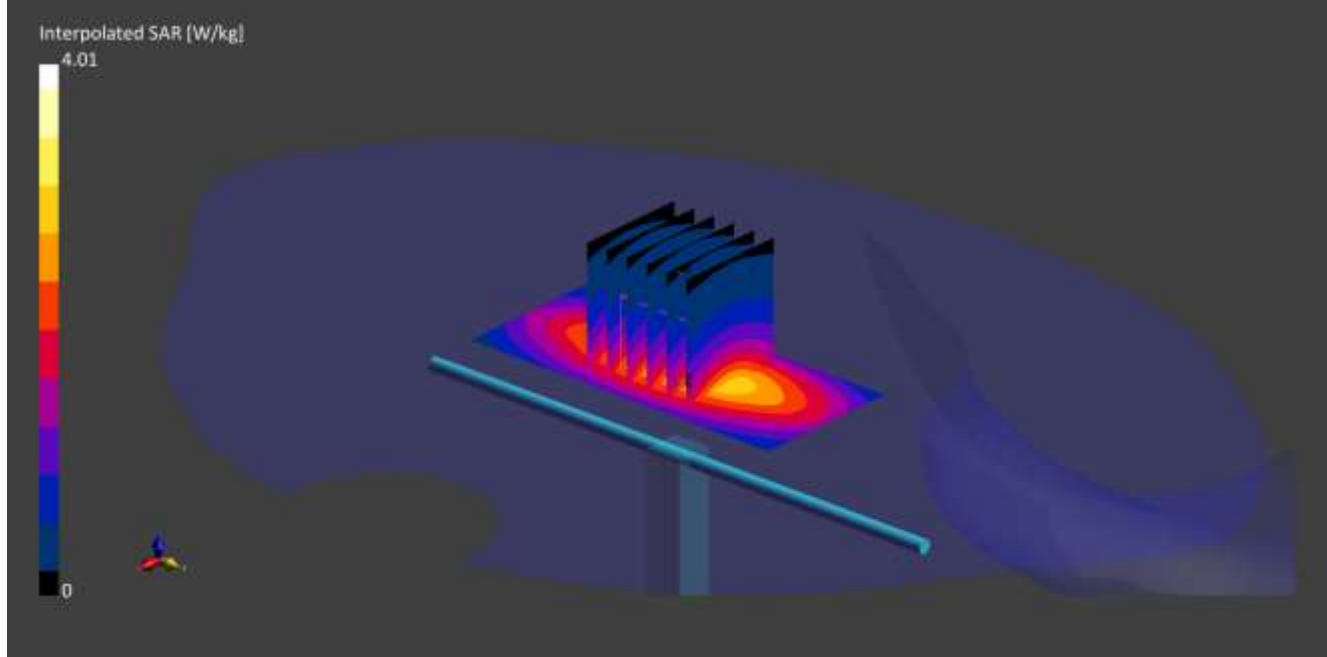
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### DASY Validation Scan for Head Stimulating Liquid (HSL)

DUT: D900V2; Type: Dipole; Serial: SN1d143;



Communication System: CW UID: 0; Frequency: 900.0 MHz; Duty Cycle: 1;  
Medium: HSL; Site65\_28Sep2021\_082639\_Head - 900 1800 1900 2300 2600 5%; Medium  
parameters used:  $f = 900.0$  MHz;  $\sigma = 0.946$  S/m;  $\epsilon_r = 42.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>;  $\Delta\epsilon_r = 1.33$  %;  $\Delta\sigma =$   
-2.48 %; No correction

Phantom section: Flat;

DASY 6 Configuration:

- Laboratory Name: Site65;
- Probe: ES3DV3 - SN3335; ConvF(6.18, 6.18, 6.18); Calibrated: 14 Jan 2021
- Sensor-Surface: 3 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 = 3.130 V/m; Power Drift = 0.00 dB

Minimum horizontal 3dB distance: 22.1 mm;

Vertical M2/M1 Ratio: 88.9 %;

**SAR(1 g) = 2.690 W/kg; SAR(10 g) = 1.750 W/kg**

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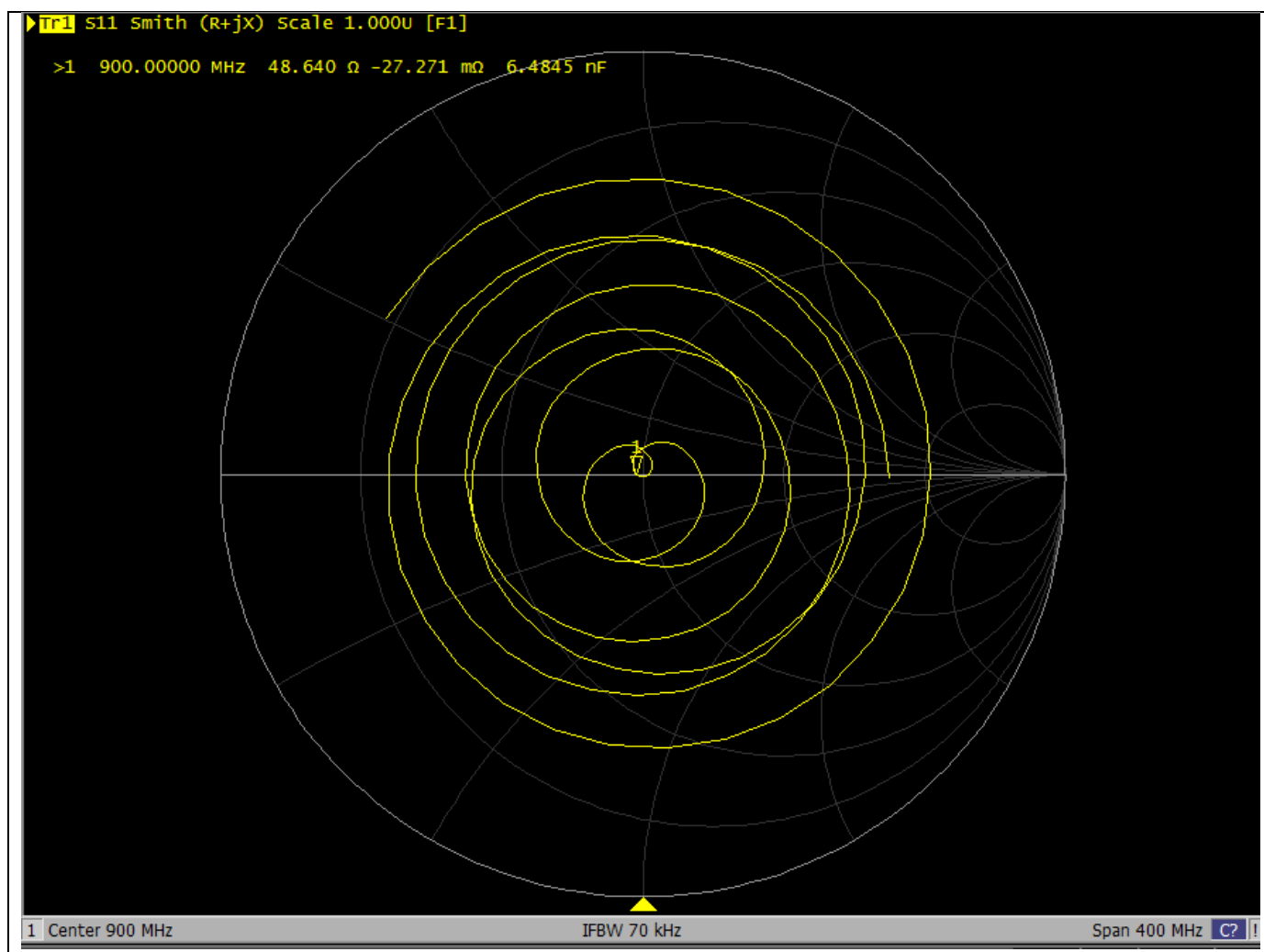
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### Impedance Measurement Plot for Head Stimulating Liquid (HSL)



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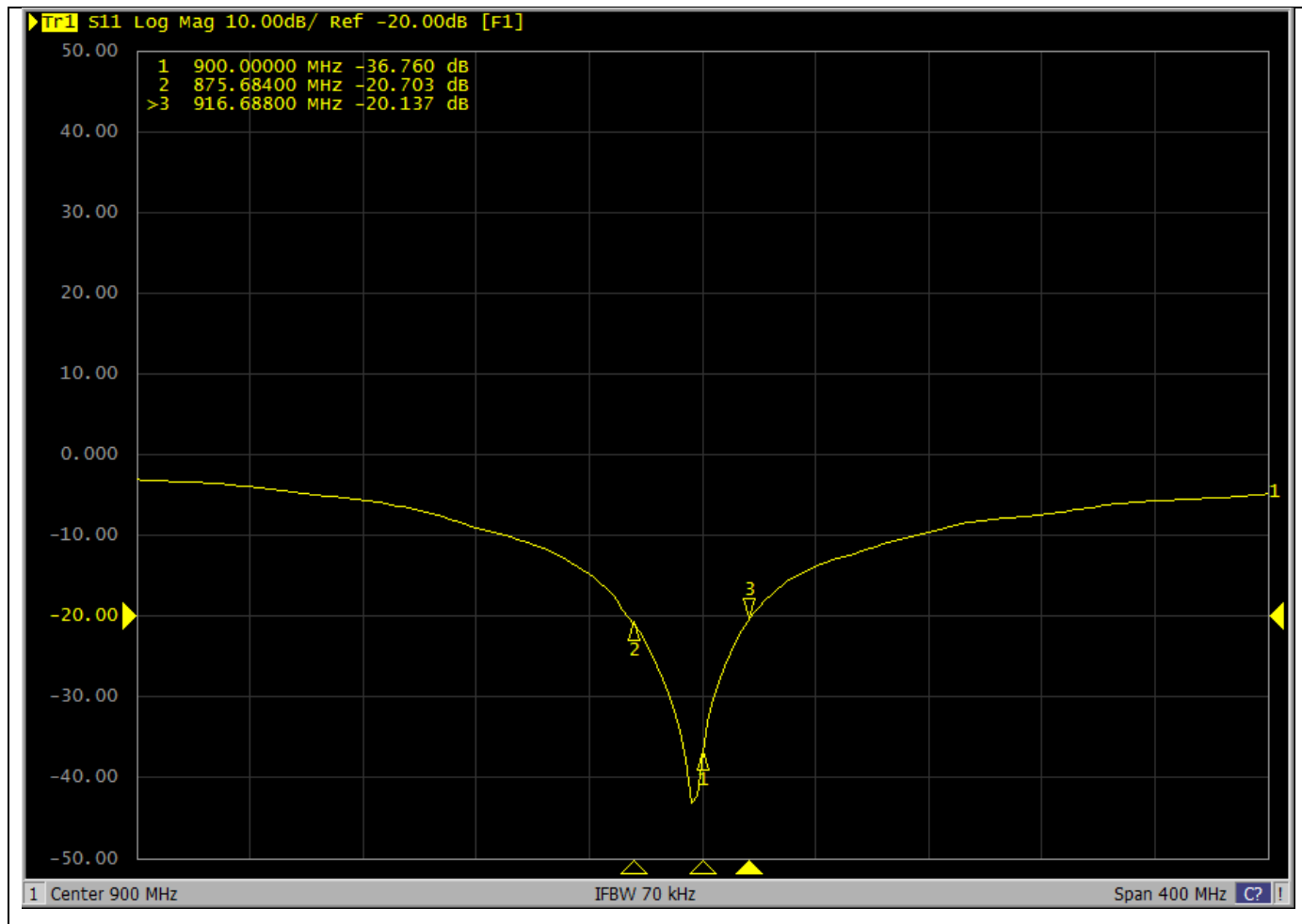
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### Return Loss Measurement Plot for Head Stimulating Liquid (HSL)



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	<p><b>UL INTERNATIONAL (UK) LTD</b> <b>Tel: +44 (0) 1256312000</b></p> <p>Certificate Number: 13697410JD01A</p> <p>Instrument ID: 1d143</p> <p>Calibration Date: 29/Sep/2021</p> <p>Calibration Due Date:</p>
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	<p><b>UL INTERNATIONAL (UK) LTD</b> <b>Tel: +44 (0) 1256312000</b></p> <p>Certificate Number: 13697410JD01A</p> <p>Instrument ID: 1d143</p> <p>Calibration Date: 29/Sep/2021</p> <p>Calibration Due Date:</p>
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# CERTIFICATE OF CALIBRATION

ISSUED BY UL INTERNATIONAL (UK) LTD

DATE OF ISSUE: 13/April/2021      CERTIFICATE NUMBER : 13697411JD01A



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



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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:	D1750V2		
Serial Number:	1050		
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%

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The calibration methods and procedures used were as detailed in:

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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
PRE0131610	Dipole Antenna	SPEAG	D1800V2	2d009	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:	1750 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	1750	20.0 °C	19.8 °C	19.8°C	19.8°C	$\epsilon_r$	40.08	39.83	± 5%
						$\sigma$	1.37	1.35	± 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	9.31 W/Kg	37.06 W/Kg	+16.80% / -16.43%
	SAR averaged over 10g	4.99 W/Kg	19.87 W/Kg	+16.72% / -16.42%

## Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	50.19 $\Omega$ - 0.067 j $\Omega$	± 0.28 $\Omega$ ± 0.044 j $\Omega$
	Return Loss	-54.08 dB	± 3.34 dB

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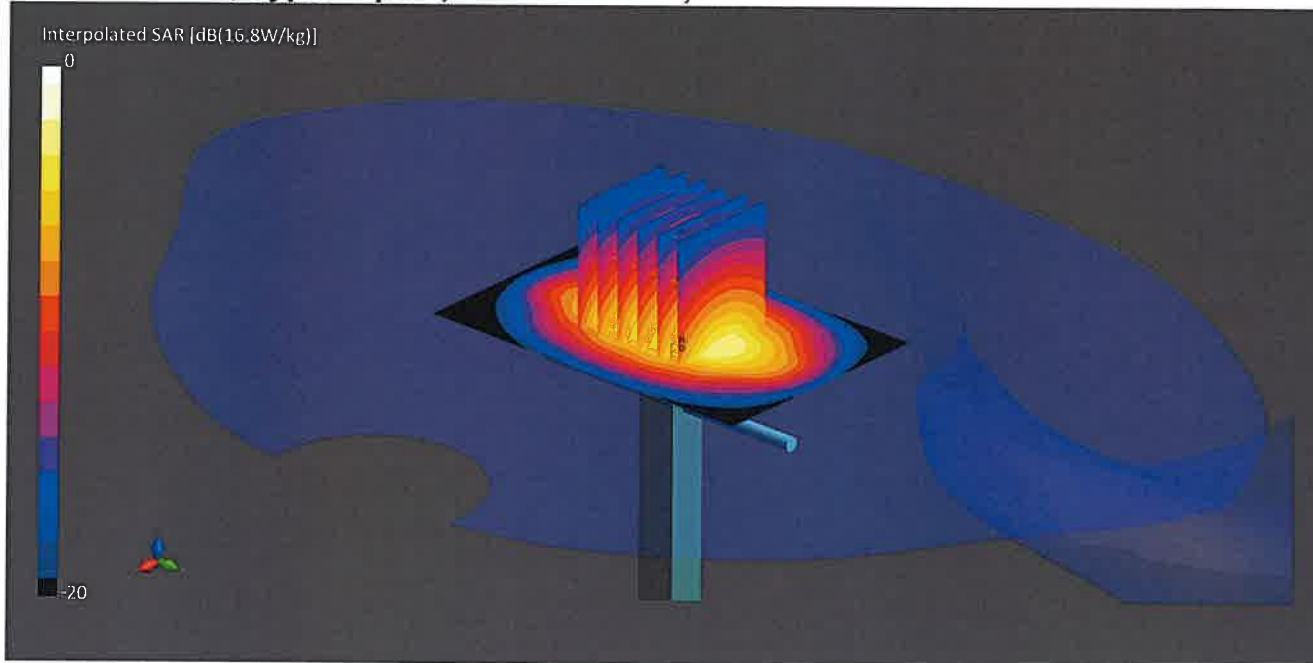
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### DASY Validation Scan for Head Stimulating Liquid (HSL)

DUT: D1750V2; Type: Dipole; Serial: SN1050;



Communication System: CW UID: 0; Frequency: 1750.0 MHz; Duty Cycle: 1;  
Medium: HSL; Site65\_12Apr2021\_115940\_Head - 1750 1800 1900 2300 2450 2600 5%;  
Medium parameters used:  $f = 1750.0$  MHz;  $\sigma = 1.35$  S/m;  $\epsilon_r = 39.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>;  $\Delta\epsilon_r = -0.62$  %;  $\Delta\sigma = -1.80$  %; No correction

Phantom section: Flat;

DASY 6 Configuration:

- Laboratory Name: Site65;
- Probe: ES3DV3 - SN3335; ConvF(5.25, 5.25, 5.25); 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 = 11.810 V/m; Power Drift = 0.00 dB

Minimum horizontal 3dB distance: 10.8 mm;

Vertical M2/M1 Ratio: 84.6 %;

**SAR(1 g) = 9.310 W/kg; SAR(10 g) = 4.990 W/kg**

# CERTIFICATE OF CALIBRATION

## ISSUED BY UL INTERNATIONAL (UK) LTD

CERTIFICATE  
NUMBER :  
13697411JD01A

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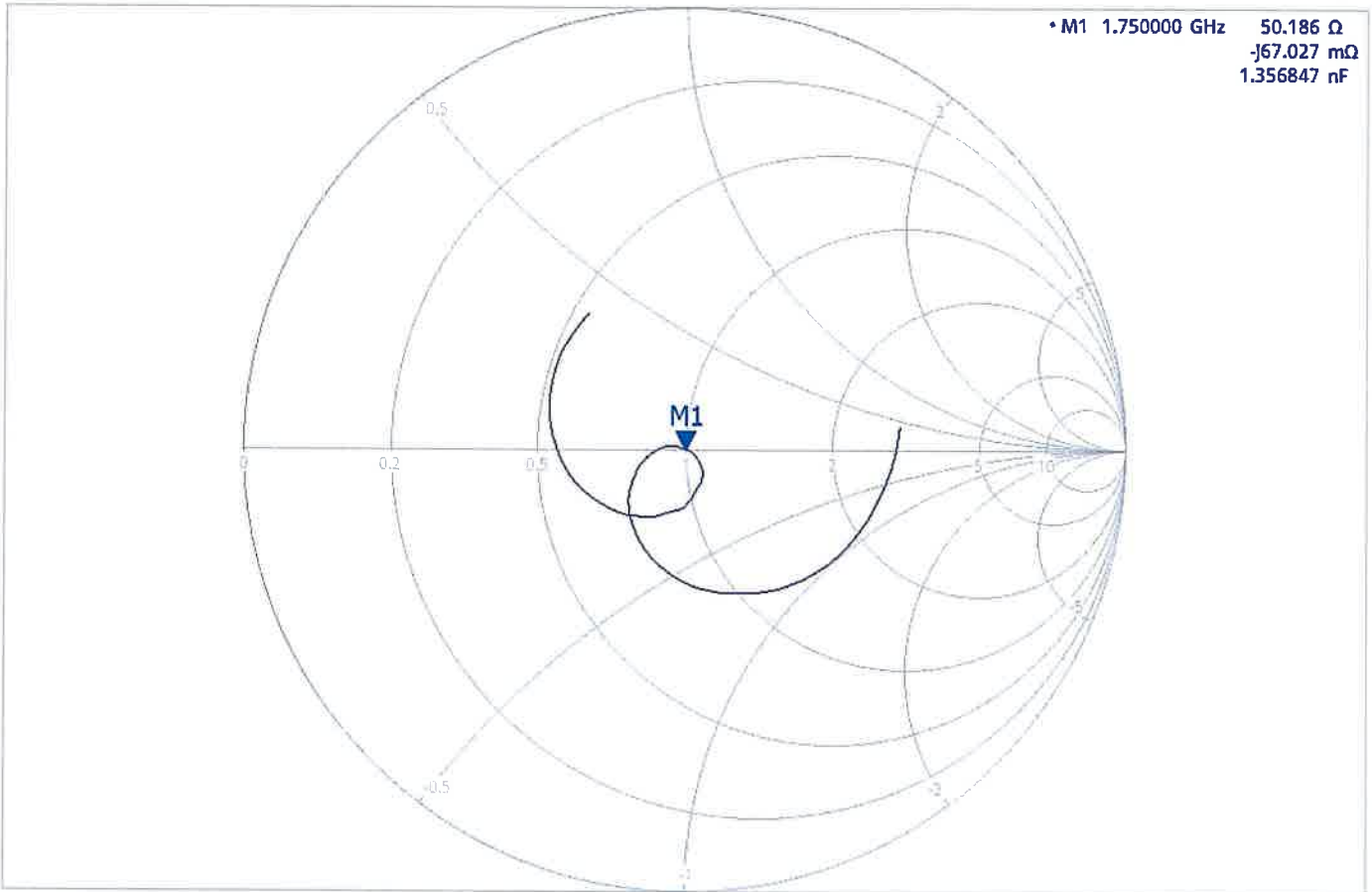
Page 5 of 6

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

4/13/2021 9:12:49 AM  
1328.5170K92-100151-MV

Trc1 — S11 Smith 200 mU/ Ref 1 U Cal

1



Ch1 Center 1.75 GHz

Pwr -10 dBm Bw 10 kHz

Span 400 MHz

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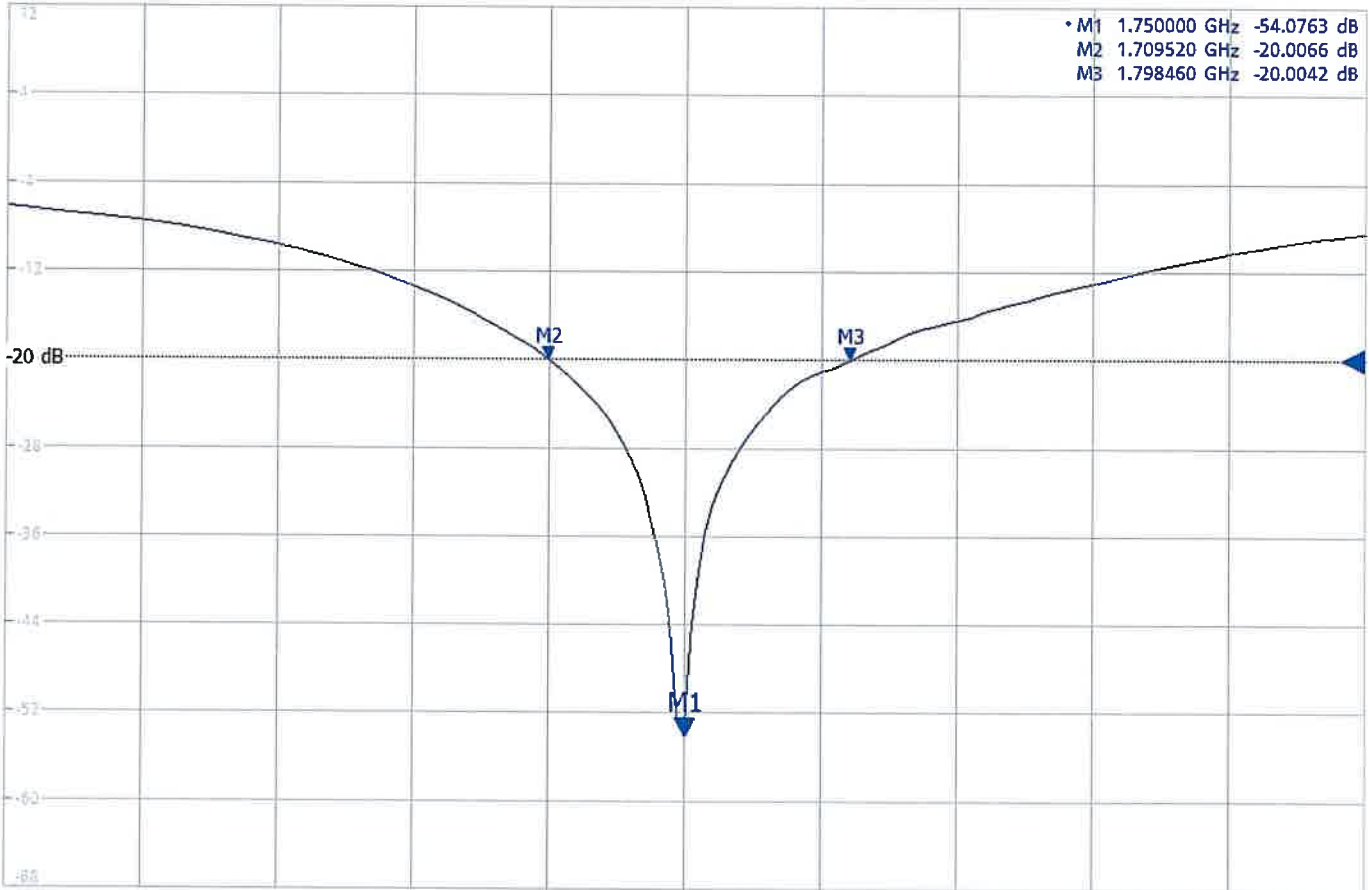
Page 6 of 6

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

4/13/2021 9:05:46 AM  
1328.5170K92-100151-MV

Trc1 — S11 dB Mag 8 dB/Ref -20 dB Cal

1





Ch1 Center 1.75 GHz


Pwr -10 dBm Bw 10 kHz

Span 400 MHz

**Calibration Certificate Label:**

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BASINGSTOKE, HAMPSHIRE  
RG24 8AH, UK  
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FAX: +44 (0) 1256 312001  
Email: LST.UK.Calibration@ul.com



Page 1 of 10

**APPROVED SIGNATORY**

.....  
Naseer Mirza

**Customer :**

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

**Equipment Details:**

Description:	Dipole Validation Kit	Date of Receipt:	24/Sep/2021
Manufacturer:	Speag		
Type/Model Number:	D1750V2		
Serial Number:	1053		
Calibration Date:	29/Sep/2021		
Calibrated By:	Masood Khan Test Engineer		

Signature:

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)
PRE0135115	Data Acquisition Electronics	SPEAG	DAE4	1438	12 Apr 2021	12
PRE0134817	Probe	SPEAG	ES3DV3	3335	14 Jan 2021	12
PRE0131610	Dipole	SPEAG	D1800V2	SN2d009	16 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
M1647	Signal Generator	HP	8648C	3537A01598	03 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>	cDASY16.0.0.116
<b>Phantom:</b>	Flat section of SAM Twin Phantom
<b>Distance Dipole Centre:</b>	10 mm (with spacer)
<b>Frequency:</b>	1750 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	1750	21.1 °C	20.6 °C	20.8 °C	20.4 °C	$\epsilon_r$	40.08	40.44	± 5%
						$\sigma$	1.37	1.35	± 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	9.25 W/Kg	<b>36.82 W/Kg</b>	+16.80 / -16.43%
	SAR averaged over 10g	4.94 W/Kg	<b>19.67 W/Kg</b>	+16.72 / -16.42%

### Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	50.66 - 1.73j $\Omega$	± 3.01
	Return Loss	34.74	± 3.34



# CERTIFICATE OF CALIBRATION

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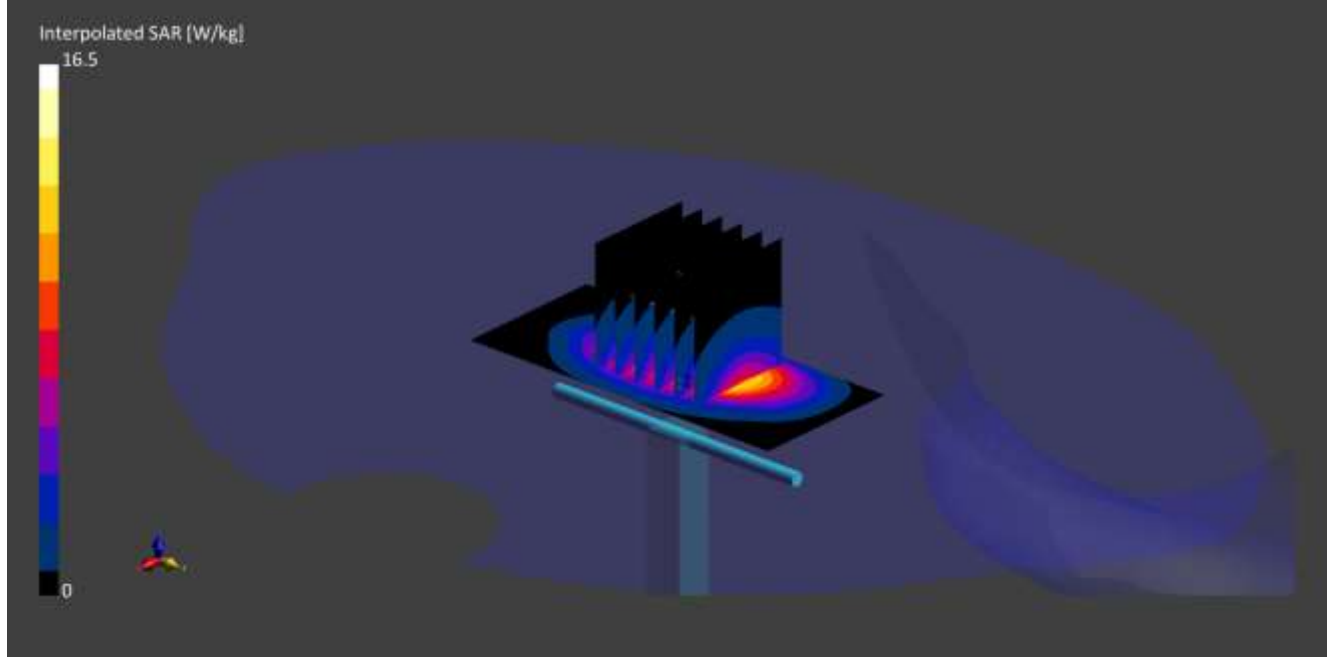
UKAS Accredited Calibration Laboratory No. 5772

CERTIFICATE  
NUMBER :  
13697410JD01B

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

DUT: D1750V2; Type: Dipole; Serial: SN1053;



Communication System: CW UID: 0; Frequency: 1750.0 MHz; Duty Cycle: 1;  
Medium: HSL; Site65\_28Sep2021\_082639\_Head - 900 1800 1900 2300 2600 5%; Medium  
parameters used:  $f = 1750.0$  MHz;  $\sigma = 1.35$  S/m;  $\epsilon_r = 40.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>;  $\Delta\epsilon_r = 0.91$  %;  $\Delta\sigma = -1.51$  %; No correction

Phantom section: Flat;

DASY 6 Configuration:

- Laboratory Name: Site65;
- Probe: ES3DV3 - SN3335; ConvF(5.25, 5.25, 5.25); Calibrated: 14 Jan 2021
- Sensor-Surface: 3 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 = 11.670 V/m; Power Drift = 0.00 dB

Minimum horizontal 3dB distance: 9.9 mm;

Vertical M2/M1 Ratio: 84.4 %;

**SAR(1 g) = 9.250 W/kg; SAR(10 g) = 4.940 W/kg**

# CERTIFICATE OF CALIBRATION

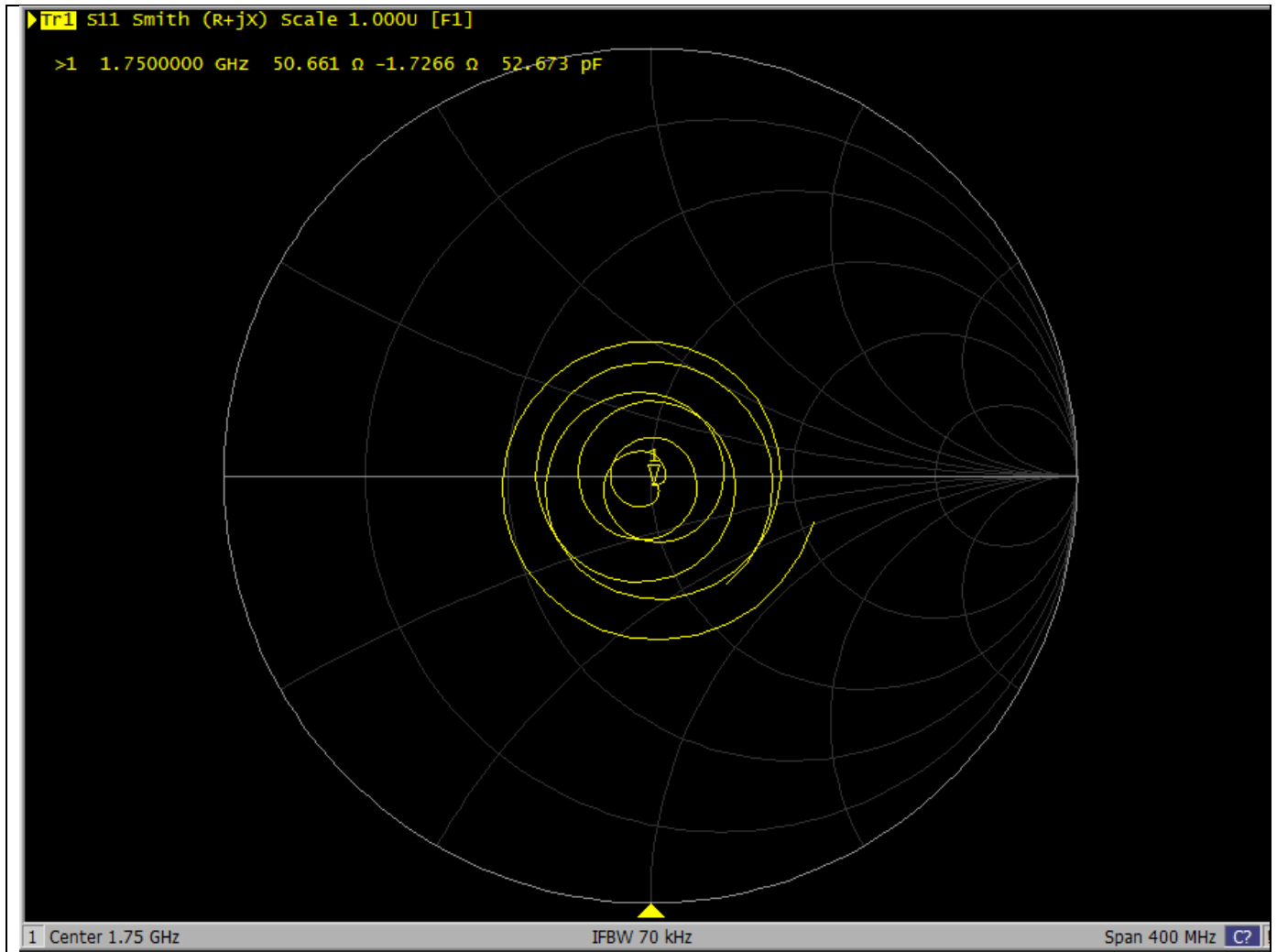
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### Impedance Measurement Plot for Head Stimulating Liquid (HSL)



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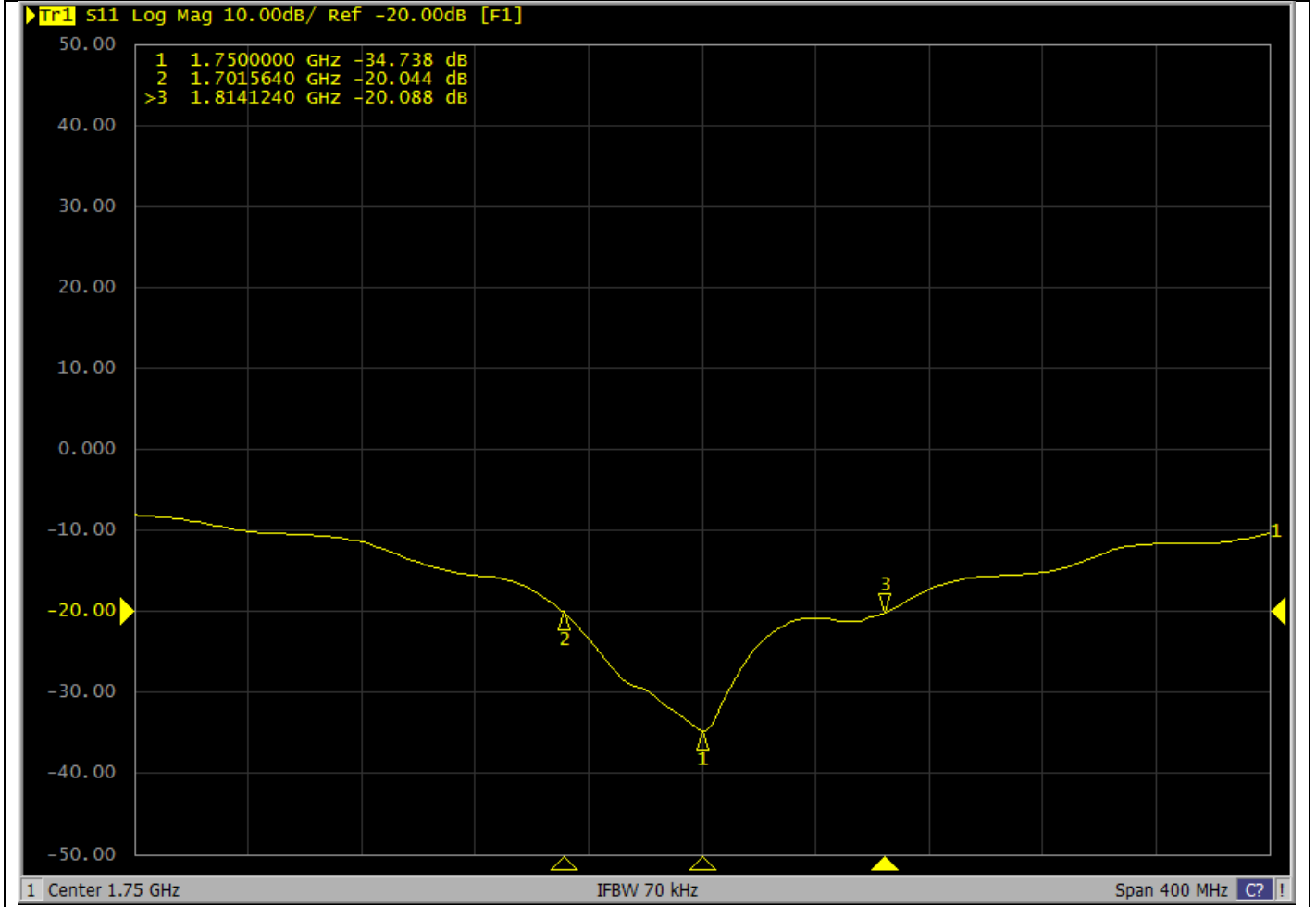
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### Return Loss Measurement Plot for Head Stimulating Liquid (HSL)



**Calibration Certificate Label:**

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	<p><b>UL INTERNATIONAL (UK) LTD</b> <b>Tel: +44 (0) 1256312000</b></p> <p>Certificate Number: 13697410JD01B</p> <p>Instrument ID: 1053</p> <p>Calibration Date: 29/Sep/2021</p> <p>Calibration Due Date:</p>
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	<p><b>UL INTERNATIONAL (UK) LTD</b> <b>Tel: +44 (0) 1256312000</b></p> <p>Certificate Number: 13697410JD01B</p> <p>Instrument ID: 1053</p> <p>Calibration Date: 29/Sep/2021</p> <p>Calibration Due Date:</p>
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FAX: +44 (0) 1256 312001  
Email: LST.UK.Calibration@ul.com



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**APPROVED SIGNATORY**

.....  
Naseer Mirza

## Customer :

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

## Equipment Details:

Description:	Dipole Validation Kit	Date of Receipt:	24/Sep/2021
Manufacturer:	Speag		
Type/Model Number:	D1900V2		
Serial Number:	5d163		
Calibration Date:	29/Sep/2021		
Calibrated By:	Masood Khan Test Engineer		

Signature:

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)
PRE0135115	Data Acquisition Electronics	SPEAG	DAE4	1438	12 Apr 2021	12
PRE0134817	Probe	SPEAG	ES3DV3	3335	14 Jan 2021	12
PRE0134198	Dipole	SPEAG	D19000V2	SN537	16 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
M1647	Signal Generator	HP	8648C	3537A01598	03 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>	cDASY16.0.0.116
<b>Phantom:</b>	Flat section of SAM Twin Phantom
<b>Distance Dipole Centre:</b>	10 mm (with spacer)
<b>Frequency:</b>	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	21.2 °C	20.6 °C	20.8 °C	20.5 °C	$\epsilon_r$	40.00	40.26	± 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	10.20 W/Kg	<b>40.61 W/Kg</b>	+16.80 / -16.43%
	SAR averaged over 10g	5.28 W/Kg	<b>21.02 W/Kg</b>	+16.72 / -16.42%

### Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	51.95 - 4.40j $\Omega$	± 3.01
	Return Loss	26.51	± 2.97

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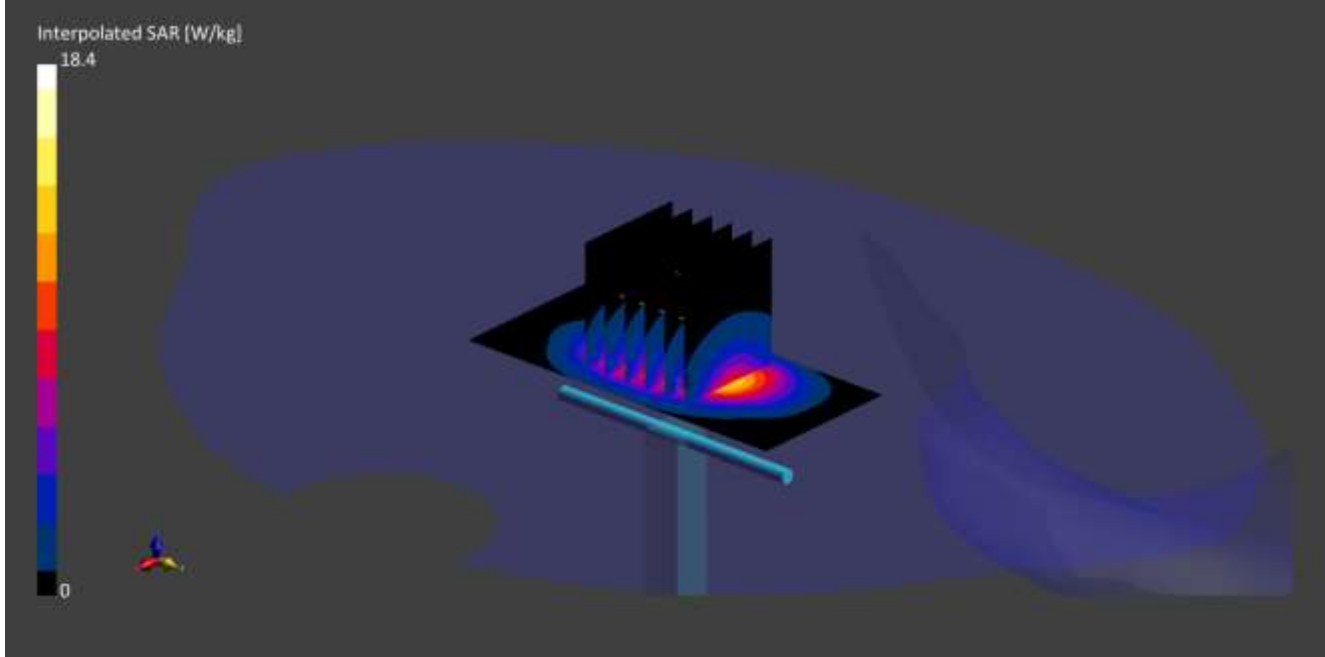
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### DASY Validation Scan for Head Stimulating Liquid (HSL)

DUT: D1900V2; Type: Dipole; Serial: SN5d163;



Communication System: CW UID: 0; Frequency: 1900.0 MHz; Duty Cycle: 1;  
Medium: HSL; Site65\_28Sep2021\_082639\_Head - 900 1800 1900 2300 2600 5%; Medium  
parameters used:  $f = 1900.0$  MHz;  $\sigma = 1.44$  S/m;  $\epsilon_r = 40.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>;  $\Delta\epsilon_r = 0.66$  %;  $\Delta\sigma = 2.96$  %; 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 - 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 = 12.810 V/m; Power Drift = 0.02 dB

Minimum horizontal 3dB distance: 10.7 mm;

Vertical M2/M1 Ratio: 83.9 %;

**SAR(1 g) = 10.200 W/kg; SAR(10 g) = 5.280 W/kg**



# CERTIFICATE OF CALIBRATION

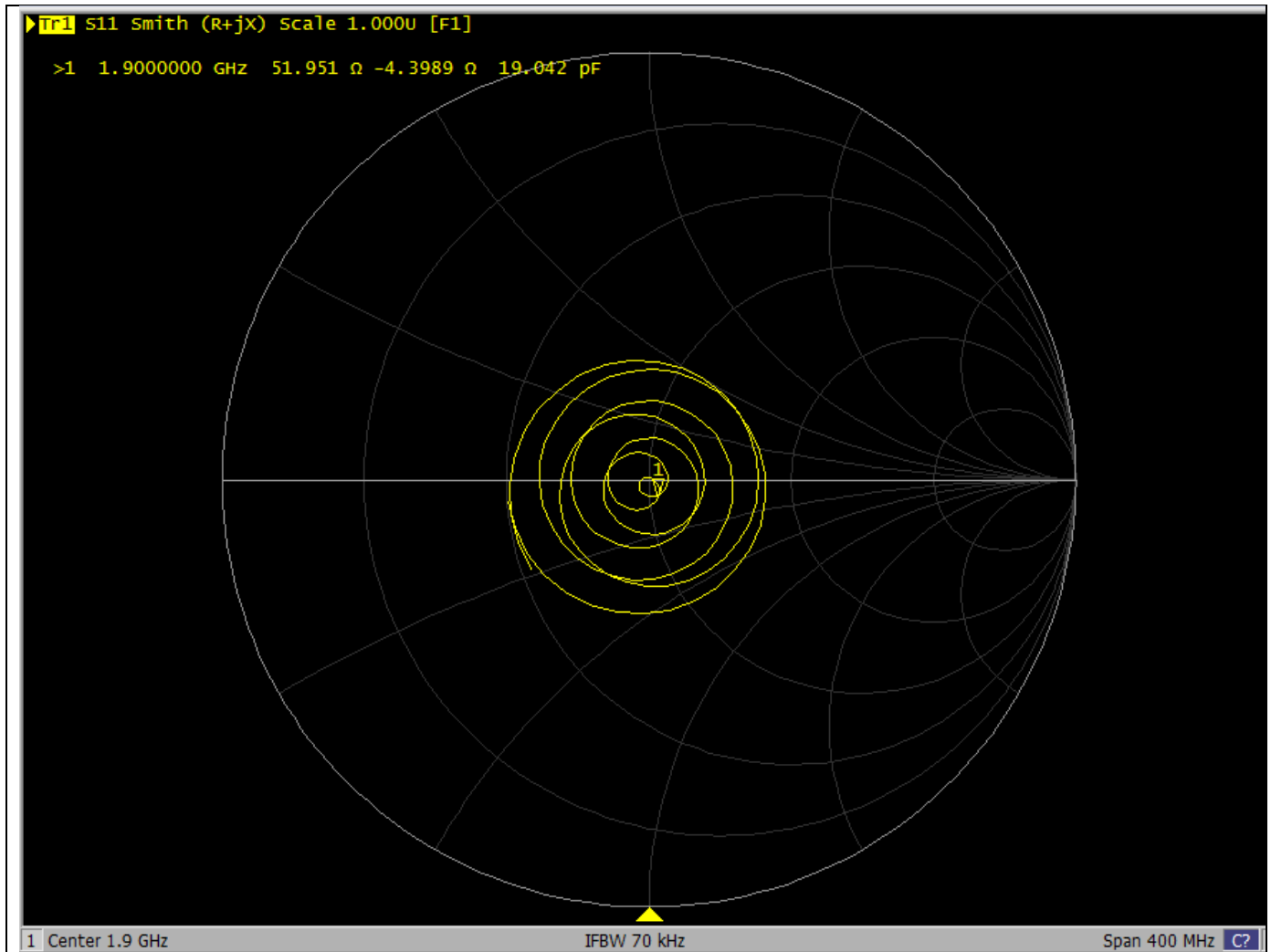
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### Impedance Measurement Plot for Head Stimulating Liquid (HSL)



# CERTIFICATE OF CALIBRATION

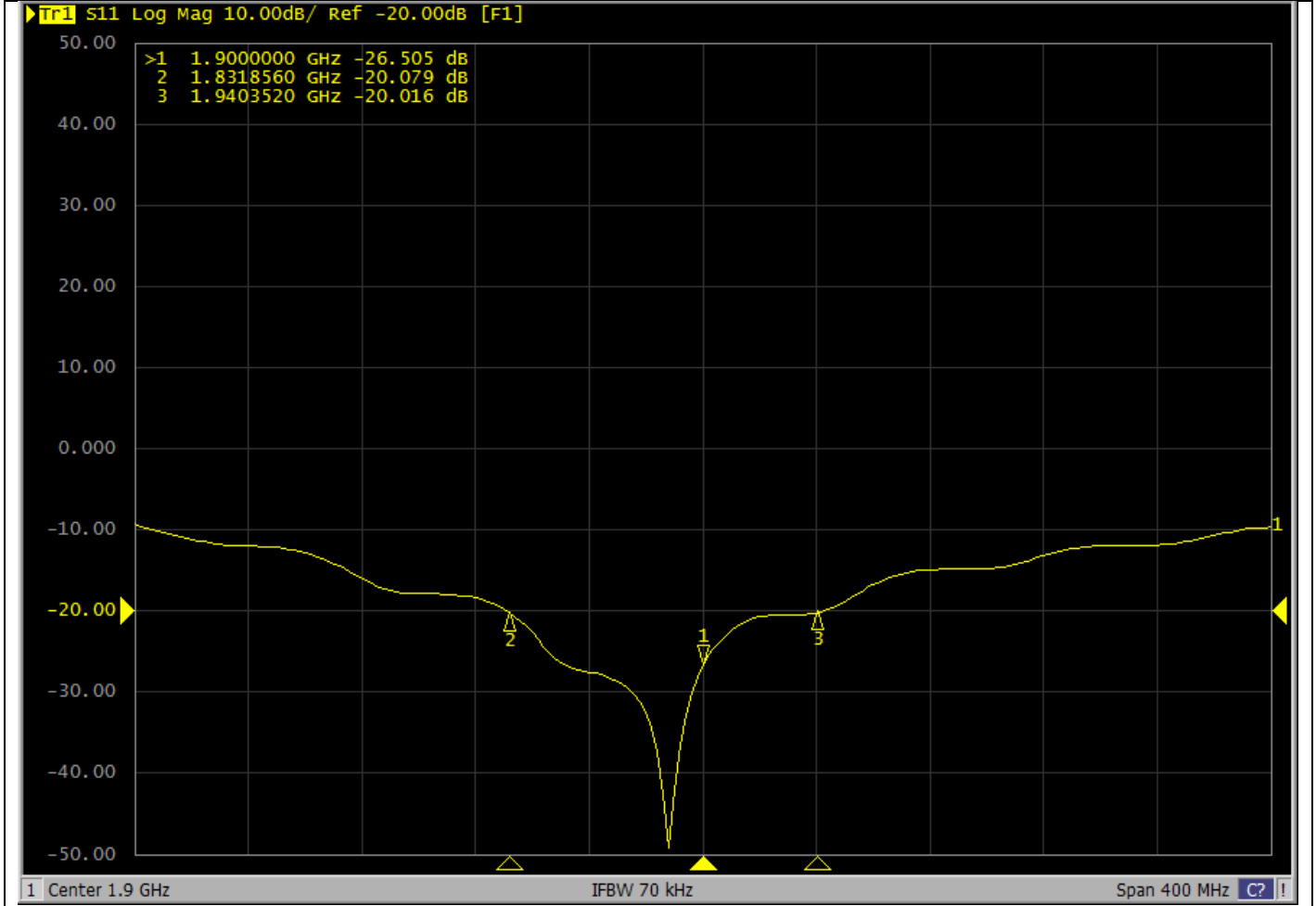
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### Return Loss Measurement Plot for Head Stimulating Liquid (HSL)



**Calibration Certificate Label:**

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--	---

 <p>UKAS CALIBRATION 5772</p>	<p><b>UL INTERNATIONAL (UK) LTD</b> <b>Tel: +44 (0) 1256312000</b></p> <p>Certificate Number: 13697410JD01E</p> <p>Instrument ID: 5d163</p> <p>Calibration Date: 29/Sep/2021</p> <p>Calibration Due Date:</p>
--	---

 <p>UKAS CALIBRATION 5772</p>	<p><b>UL INTERNATIONAL (UK) LTD</b> <b>Tel: +44 (0) 1256312000</b></p> <p>Certificate Number: 13697410JD01E</p> <p>Instrument ID: 5d163</p> <p>Calibration Date: 29/Sep/2021</p> <p>Calibration Due Date:</p>
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FAX: +44 (0) 1256 312001  
Email: LST.UK.Calibration@ul.com



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**APPROVED SIGNATORY**

.....  
Naseer Mirza

**Customer :**

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

**Equipment Details:**

Description:	Dipole Validation Kit	Date of Receipt:	24/Sep/2021
Manufacturer:	Speag		
Type/Model Number:	D2300V2		
Serial Number:	1058		
Calibration Date:	29/Sep/2021		
Calibrated By:	Masood Khan Test Engineer		

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)
PRE0135115	Data Acquisition Electronics	SPEAG	DAE4	1438	12 Apr 2021	12
PRE0134817	Probe	SPEAG	ES3DV3	3335	14 Jan 2021	12
PRE0134944	Dipole	SPEAG	D2300V2	SN1036	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
M1647	Signal Generator	HP	8648C	3537A01598	03 Mar 2021	12

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CERTIFICATE  
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Page 3 of 10

### 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>	cDASY16.0.0.116
<b>Phantom:</b>	Flat section of SAM Twin Phantom
<b>Distance Dipole Centre:</b>	10 mm (with spacer)
<b>Frequency:</b>	2300 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	2300	21.3 °C	20.5 °C	20.8 °C	20.5 °C	$\epsilon_r$	39.47	39.61	± 5%
						$\sigma$	1.67	1.71	± 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	12.70 W/Kg	<b>50.56 W/Kg</b>	+16.80 / -16.43%
	SAR averaged over 10g	6.16 W/Kg	<b>24.52 W/Kg</b>	+16.72 / -16.42%

### Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	50.03 - 1.77j $\Omega$	± 3.01
	Return Loss	34.91	± 3.34

# CERTIFICATE OF CALIBRATION

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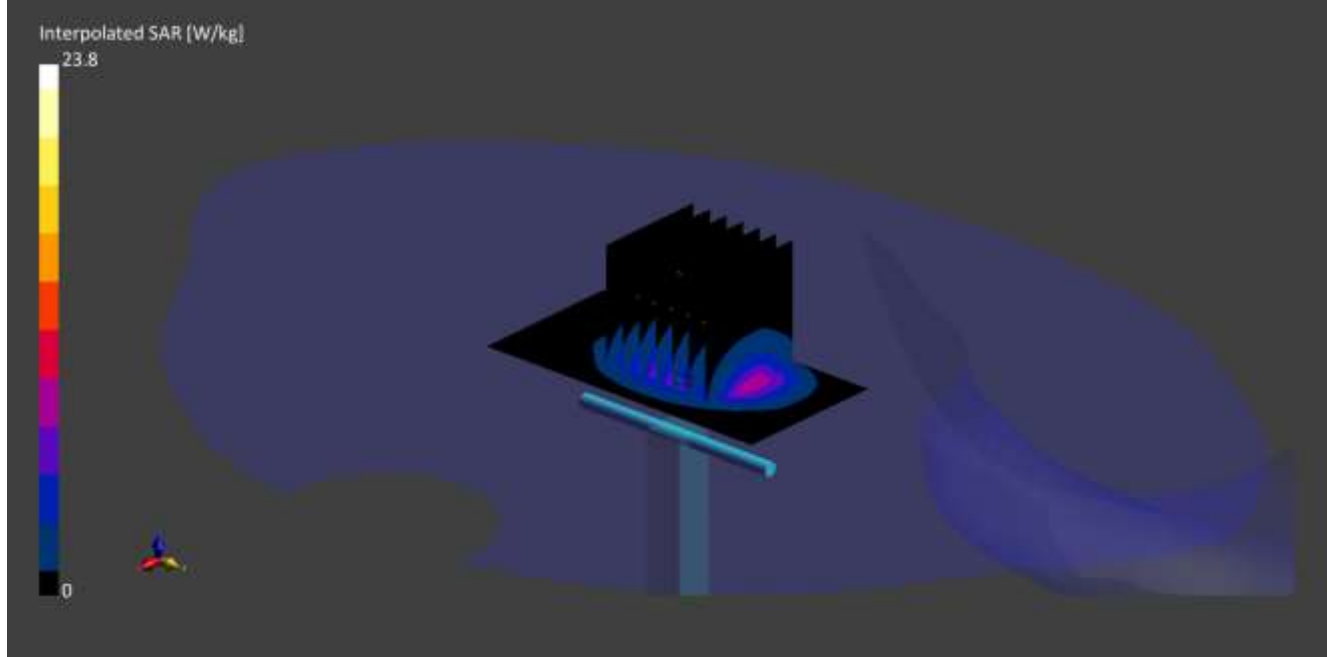
UKAS Accredited Calibration Laboratory No. 5772

CERTIFICATE  
NUMBER :  
13697410JD01G

Page 5 of 10

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

**DUT: D2300V2; Type: Dipole; Serial: SN1058;**



Communication System: CW UID: 0; Frequency: 2300.0 MHz; Duty Cycle: 1;  
Medium: HSL; Site65\_28Sep2021\_082639\_Head - 900 1800 1900 2300 2600 5%; Medium  
parameters used:  $f = 2300.0$  MHz;  $\sigma = 1.71$  S/m;  $\epsilon_r = 39.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>;  $\Delta\epsilon_r = 0.38$  %;  $\Delta\sigma = 2.71$  %; No correction

Phantom section: Flat;

DASY 6 Configuration:

- Laboratory Name: Site65;
- Probe: ES3DV3 - SN3335; ConvF(4.76, 4.76, 4.76); Calibrated: 14 Jan 2021
- Sensor-Surface: 3 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 (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 = 16.420 V/m; Power Drift = 0.01 dB

Minimum horizontal 3dB distance: 10.0 mm;

Vertical M2/M1 Ratio: 82.6 %;

**SAR(1 g) = 12.700 W/kg; SAR(10 g) = 6.160 W/kg**

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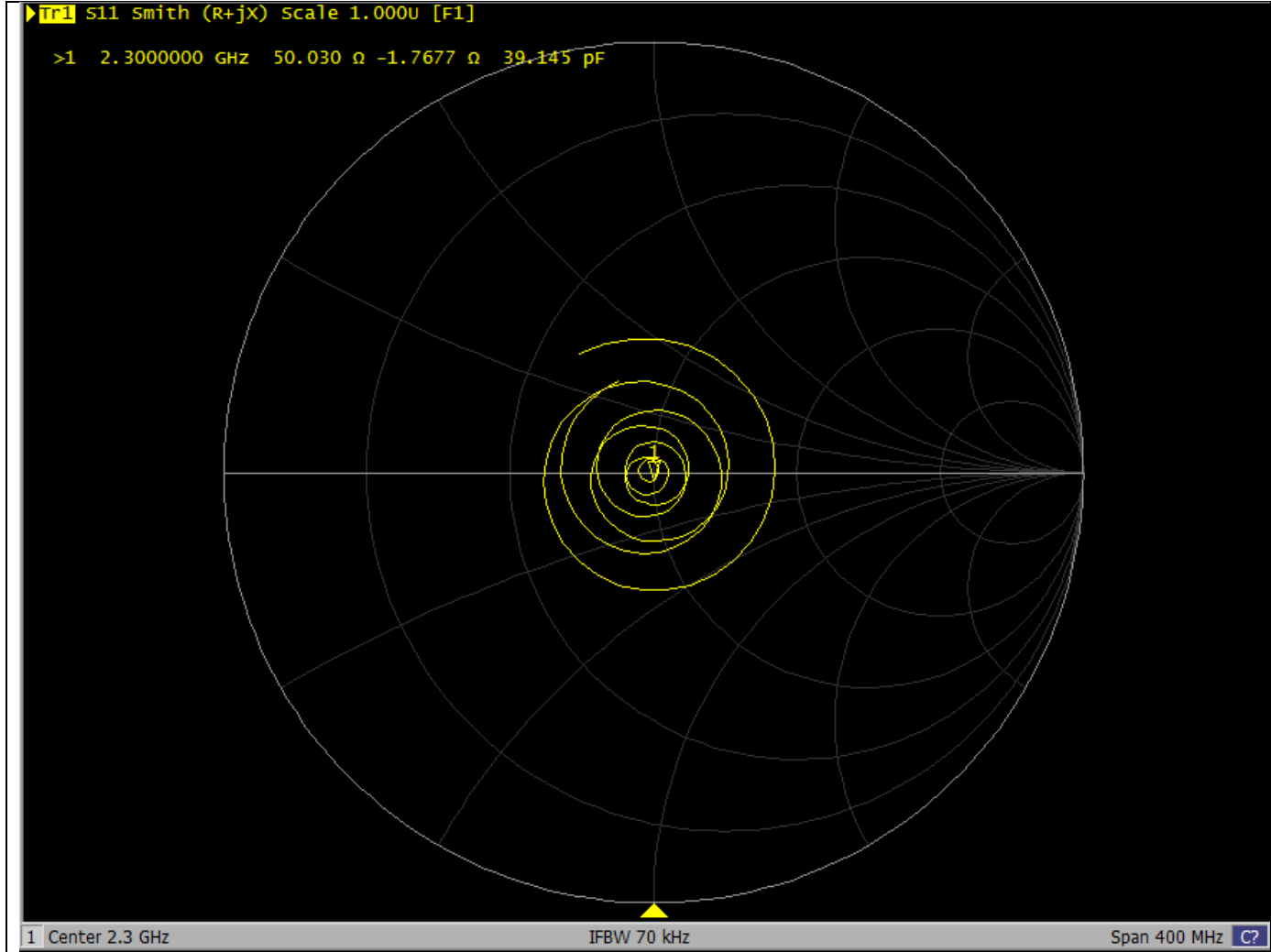
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### Impedance Measurement Plot for Head Stimulating Liquid (HSL)





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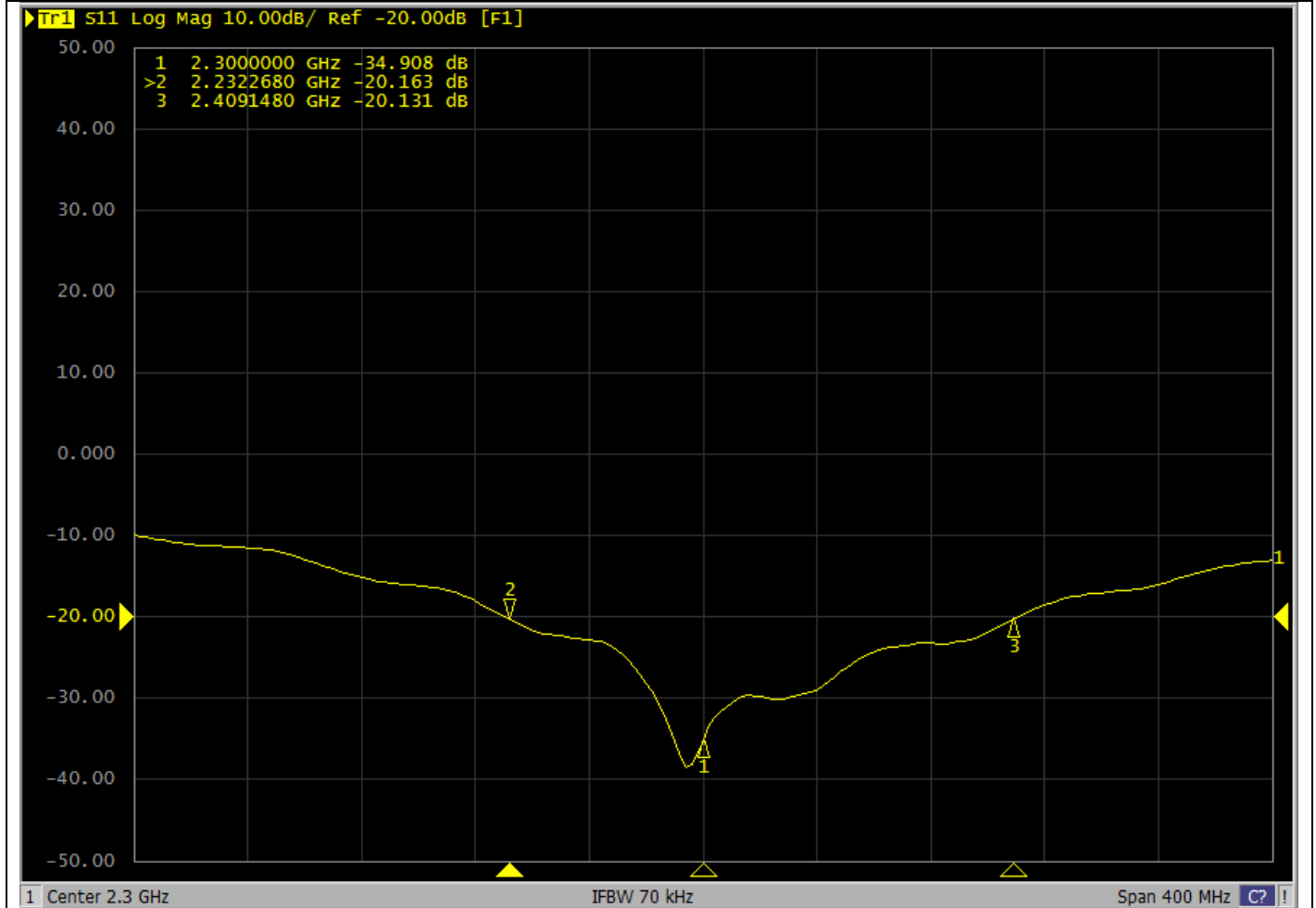
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### Return Loss Measurement Plot for Head Stimulating Liquid (HSL)



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DATE OF ISSUE: 26/Feb/2021      CERTIFICATE NUMBER : 13685197JD01A



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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 'M. Naseer', is written over a horizontal dotted line.

Naseer Mirza

## Customer :

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

## Equipment Details:

Description:	Dipole Validation Kit	Date of Receipt:	15/Feb/2021
Manufacturer:	Speag		
Type/Model Number:	D2450V2		
Serial Number:	748		
Calibration Date:	19/Feb/2021		
Calibrated By:	Masood Khan Test Engineer		
Signature:	A handwritten signature in black ink, appearing to read 'Masood Khan', is written over a horizontal dotted line.		

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)
PRE0178317	Data Acquisition Electronics	SPEAG	DAE4	1542	17 Mar 2020	12
PRE0178313	Probe	SPEAG	EX3DV4	7497	24 Mar 2020	12
A1322	Dipole	SPEAG	D2450V2	725	08 Oct 2020	12
PRE0151451	Power Monitoring Kit	Art-Fi	ART 100850-01	0001	Cal as part of System	-
PRE0151441	Power Sensor	Rhode & Schwarz	NRP8S	102481	27 Mar 2020	12
PRE0151154	Vector Network Analyser	Rhode & Schwarz	ZND	100151	15 Jun 2020	12
PRE0158684	Calibration Kit	Rhode & Schwarz	ZV-Z135	102144	27 May 2020	12
PRE0178154	Signal Generator	Rhode & Schwarz	SMB100A	175325	10 Jun 2020	12

# CERTIFICATE OF CALIBRATION

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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:	ELI 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	20.6 °C	20.4 °C	20.6°C	20.6°C	$\epsilon_r$	39.2	39.60	± 5%
						$\sigma$	1.80	1.80	± 5%

### SAR Results – Head Simulating Liquid (HSL)

Simulant Liquid	SAR Measured	200 mW input Power	Normalised to 1.00 W	Uncertainty (%)
Head	SAR averaged over 1g	13.10 W/Kg	<b>52.15 W/Kg</b>	+ 16.80% / - 16.43%
	SAR averaged over 10g	6.15 W/Kg	<b>24.48 W/Kg</b>	+ 16.72% / - 16.42%

### Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	47.403 $\Omega$ +2.719 j $\Omega$	± 0.28 $\Omega$ ± 0.044 j $\Omega$
	Return Loss	28.27	± 2.03 dB

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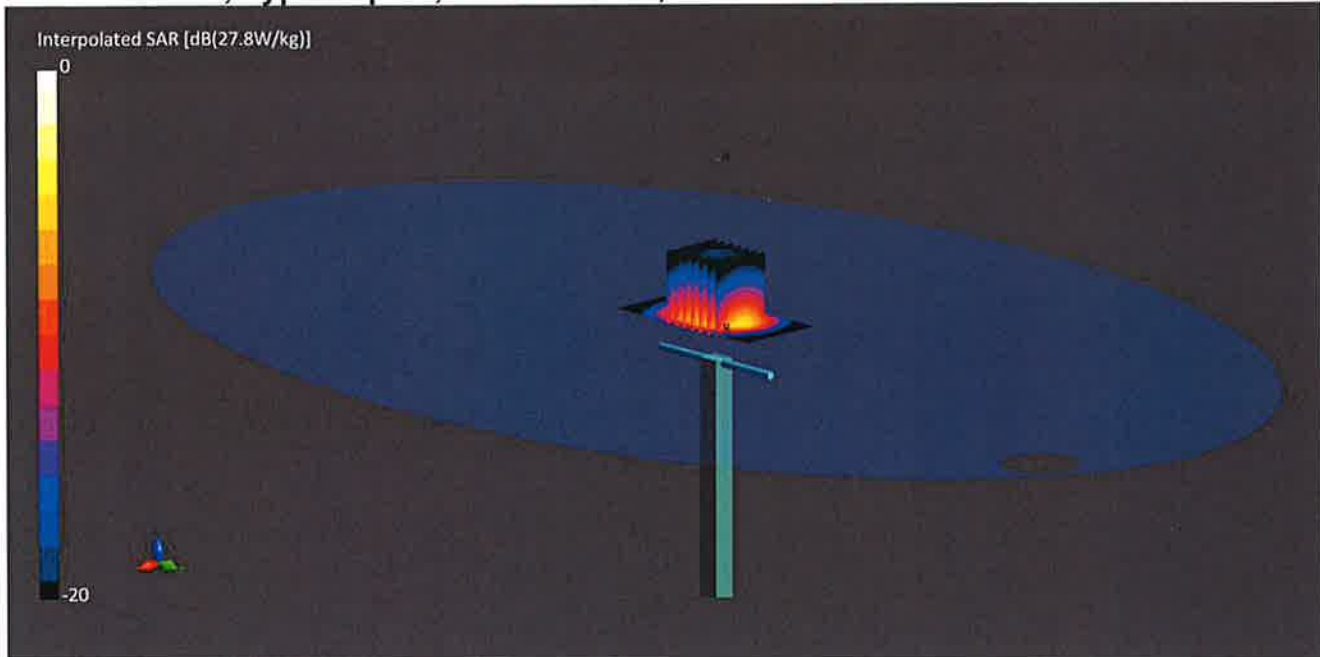
CERTIFICATE  
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### DASY Validation Scan for Head Stimulating Liquid (HSL)

DUT: D2450V2; Type: Dipole; Serial: SN748;



Communication System: CW UID: 0; Frequency: 2450.0 MHz; Duty Cycle: 1;  
Medium: HSL; Site59\_19Feb2021\_104323\_Head - 2450 5%; Medium parameters used:  $f = 2450.0$  MHz;  $\sigma = 1.8$  S/m;  $\epsilon_r = 39.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>;  $\Delta\epsilon_r = 0.92$  %;  $\Delta\sigma = 0.26$  %; No correction  
Phantom section: Flat;  
DASY 6 Configuration:

- Laboratory Name: Site59;
- Probe: EX3DV4 - SN7497; ConvF(7.62, 7.62, 7.62); Calibrated: 24 Mar 2020
- Sensor-Surface: 1.4 mm; All points
- Electronics: DAE4 - SN1542; Calibrated: 17 Mar 2020
- Phantom: ELI V8.0 (20deg probe tilt); Serial: 2100
- 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 = 9.560 V/m; Power Drift = 0.00 dB

Minimum horizontal 3dB distance: 9.5 mm;

Vertical M2/M1 Ratio: 78.6 %;

**SAR(1 g) = 13.100 W/kg; SAR(10 g) = 6.150 W/kg**

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

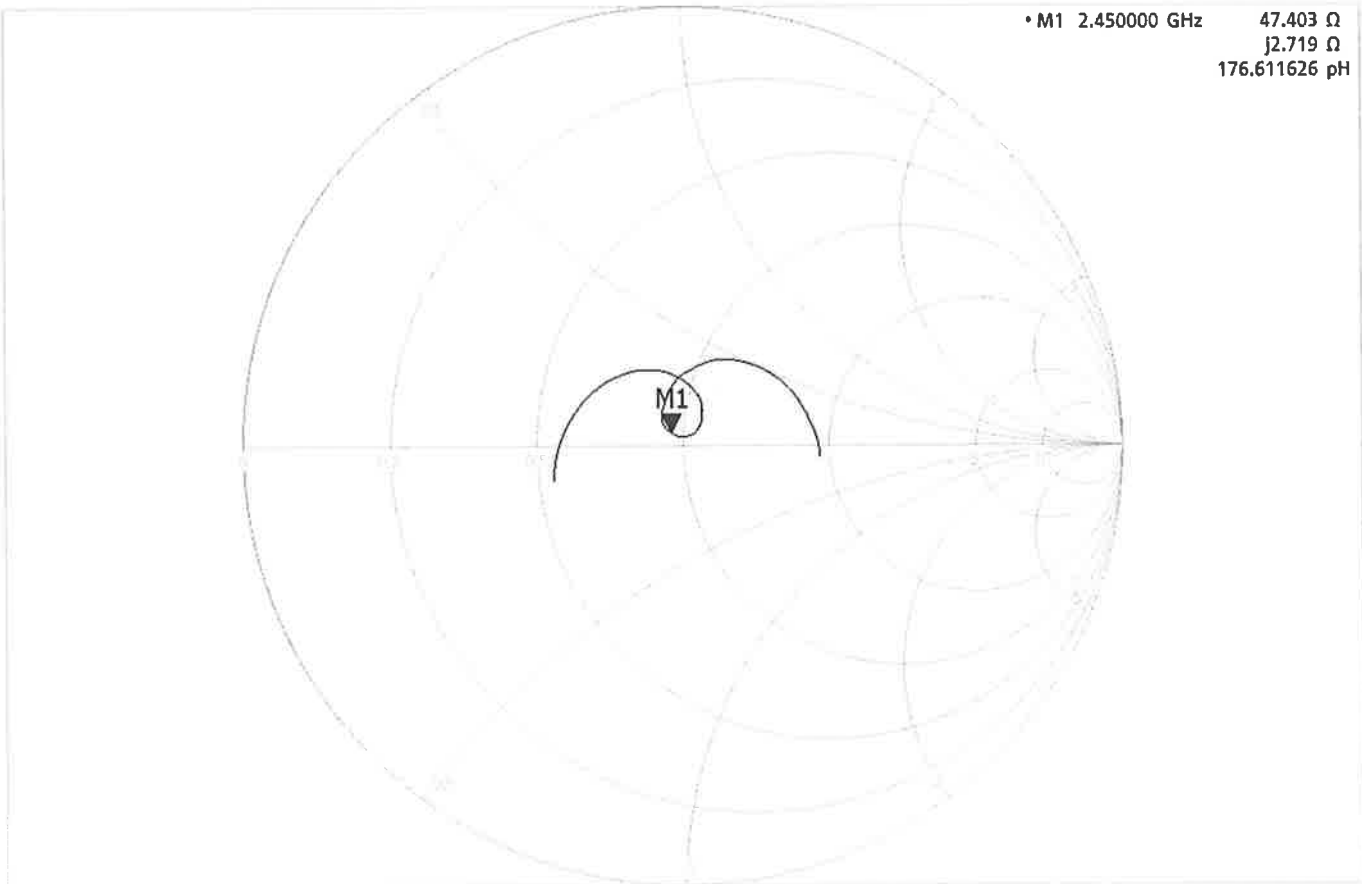


2/19/2021 3:17:56 PM  
1328.5170K92-100151-MV

Trc1 — 511 Smith 200 mU/ Ref 1 U Cal

1

• M1 2.450000 GHz 47.403 Ω  
j2.719 Ω  
176.611626 pH



Ch1 Center 2.45 GHz

Pwr -10 dBm Bw 10 kHz

Span 400 MHz

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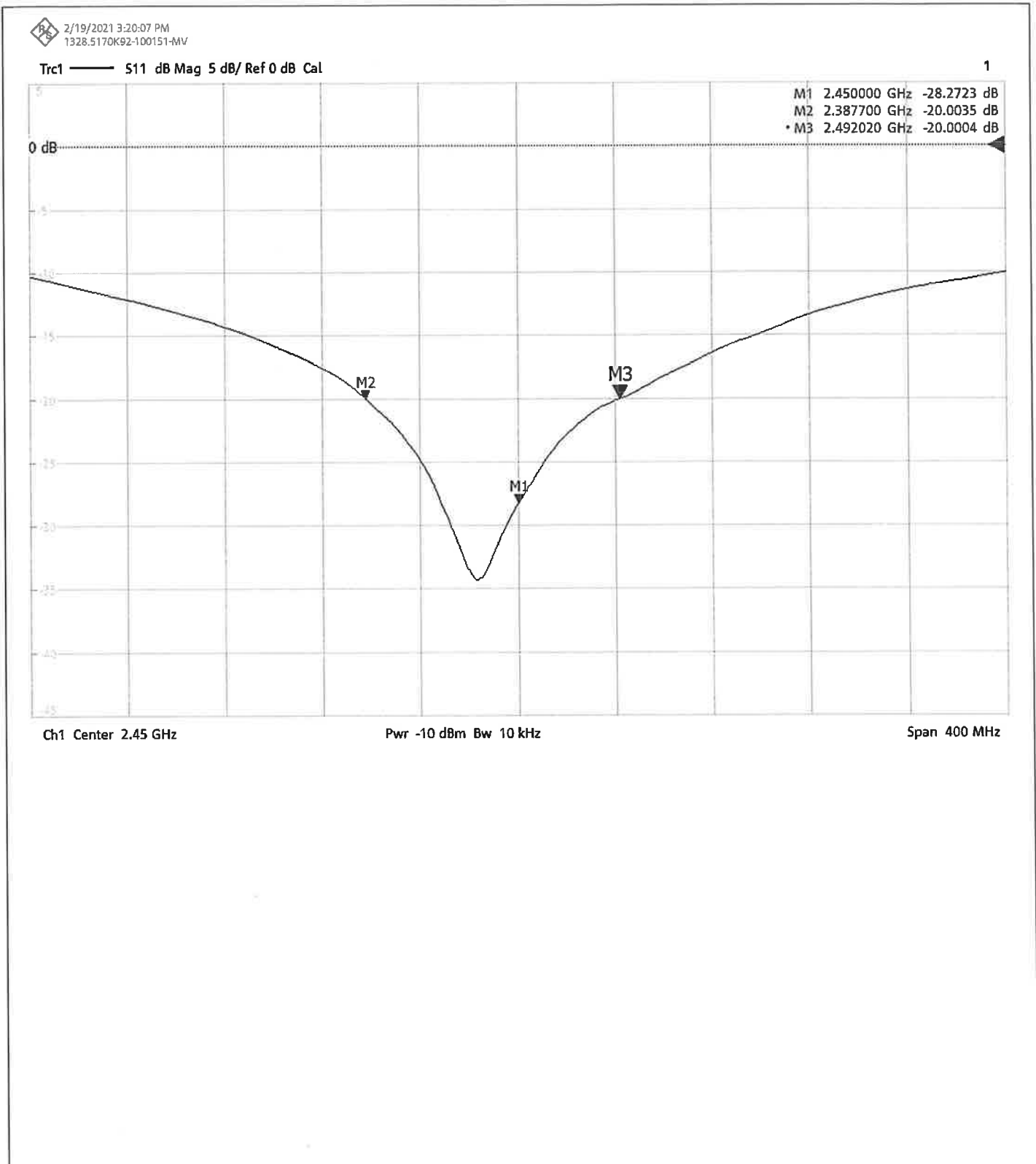
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### Return Loss Measurement Plot for Head Stimulating Liquid (HSL)






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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:	D2600V2		
Serial Number:	1036		
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%

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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
PRE0134263	Dipole Antenna	SPEAG	D2600V2	1046	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

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## SAR System Specification

<b>Robot System Positioner:</b>	Stäubli Unimation Corp. Robot Model: TX60L
<b>Robot Serial Number:</b>	F13/5SC6F1/A/01
<b>DASY Version:</b>	cDASY6.14.0.959
<b>Phantom:</b>	Flat section of SAM Twin Phantom
<b>Distance Dipole Centre:</b>	10mm (with spacer)
<b>Frequency:</b>	2600 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	2600	20.0 °C	19.8 °C	19.8°C	19.8°C	$\epsilon_r$	39.00	38.48	± 5%
						$\sigma$	1.96	1.94	± 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	13.90 W/Kg	<b>55.34 W/Kg</b>	+16.80% / -16.43%
	SAR averaged over 10g	6.26 W/Kg	<b>24.92 W/Kg</b>	+16.72% / -16.42%

## Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	52.11 $\Omega$ - 4.70 j $\Omega$	± 0.28 $\Omega$ ± 0.044 j $\Omega$
	Return Loss	-25.95 dB	± 2.97 dB

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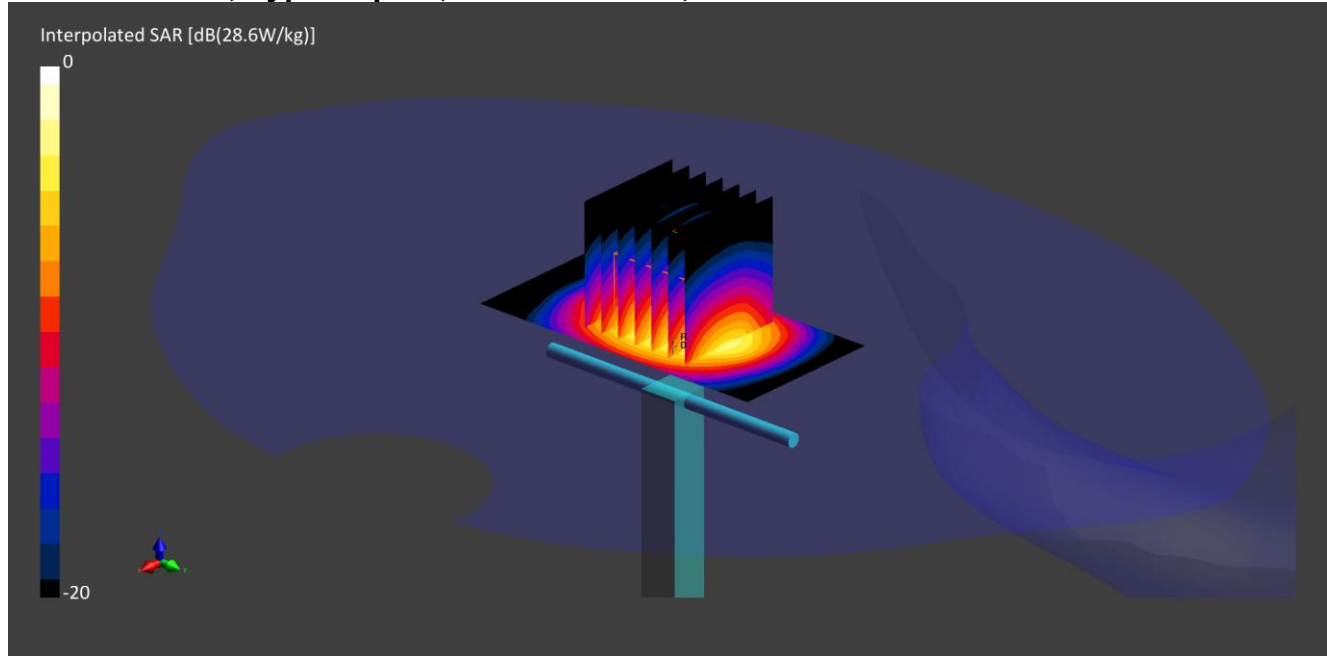
UKAS Accredited Calibration Laboratory No. 5772

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NUMBER :  
13697411JD01F

Page 4 of 6

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

**DUT: D2600V2; Type: Dipole; Serial: SN1036;**



Communication System: CW UID: 0; Frequency: 2600.0 MHz; Duty Cycle: 1;  
Medium: HSL; Site65\_12Apr2021\_115940\_Head - 1750 1800 1900 2300 2450 2600 5%;  
Medium parameters used:  $f = 2600.0$  MHz;  $\sigma = 1.94$  S/m;  $\epsilon_r = 38.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>;  $\Delta\epsilon_r = -1.35$  %;  $\Delta\sigma = -0.97$  %; No correction

Phantom section: Flat;

DASY 6 Configuration:

- Laboratory Name: Site65;
- Probe: ES3DV3 - SN3335; ConvF(4.44, 4.44, 4.44); 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 = 18.890 V/m; Power Drift = -0.01 dB

Minimum horizontal 3dB distance: 9.0 mm;

Vertical M2/M1 Ratio: 80.7 %;

**SAR(1 g) = 13.900 W/kg; SAR(10 g) = 6.260 W/kg**

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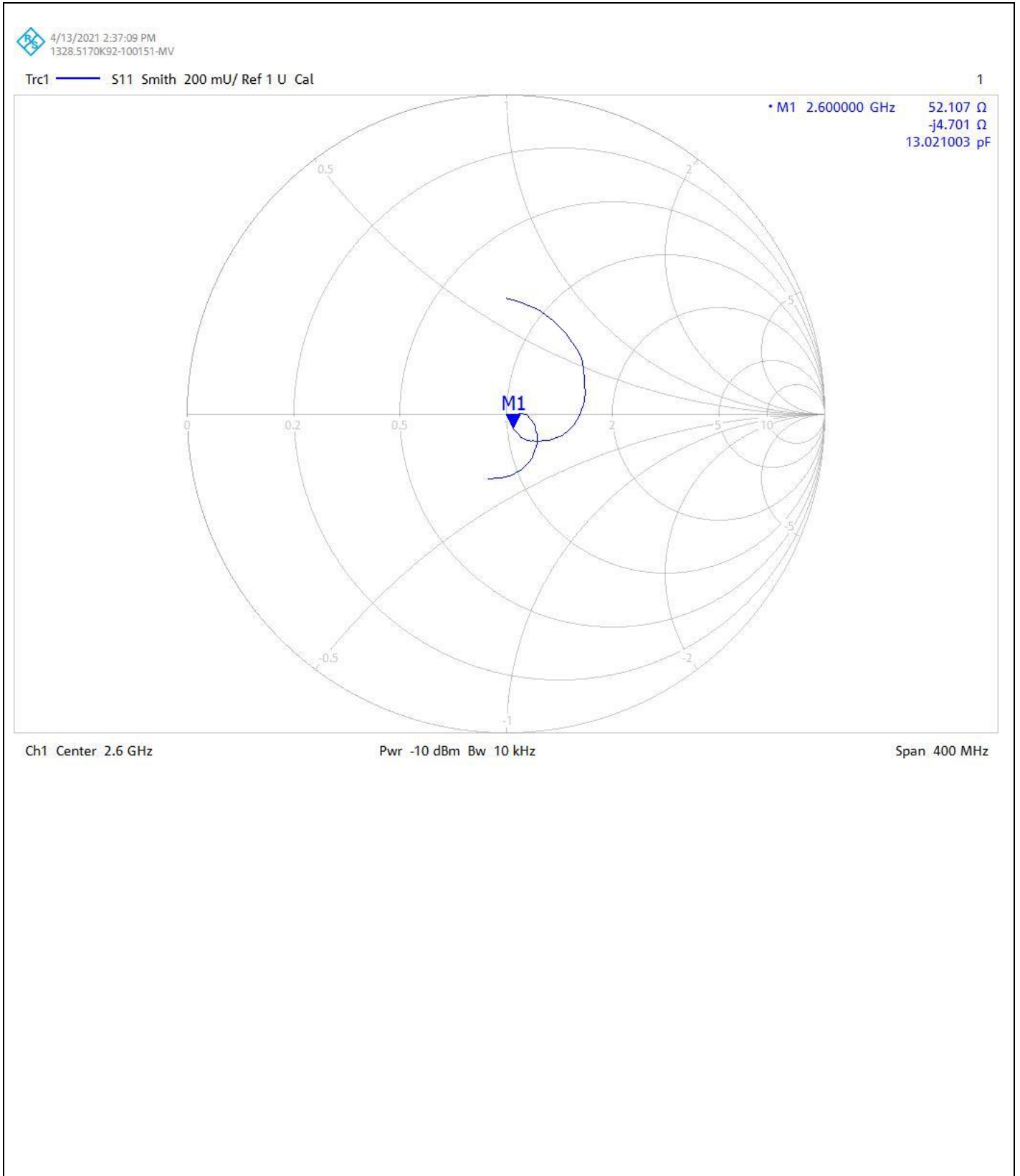
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### Impedance Measurement Plot for Head Stimulating Liquid (HSL)



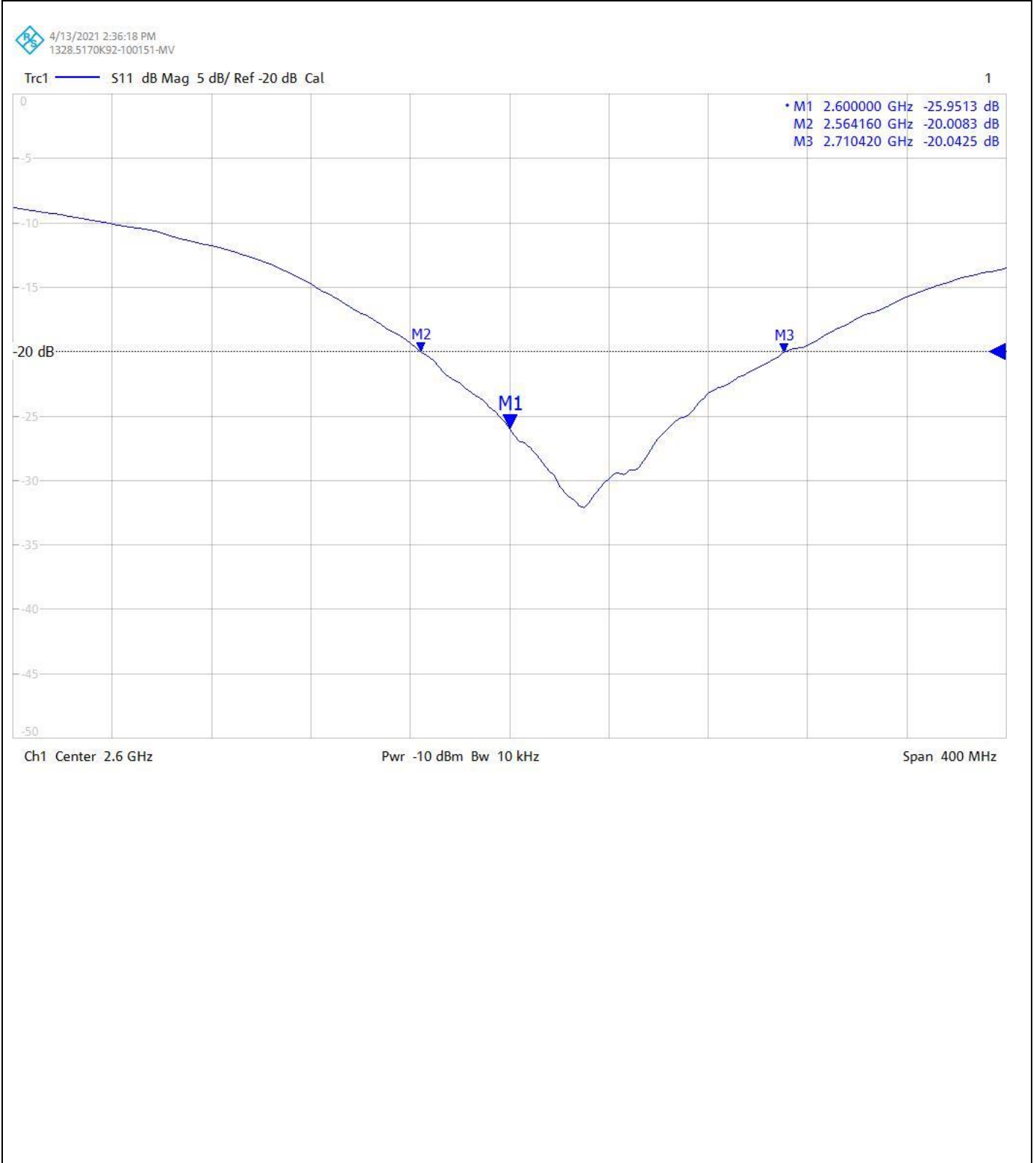
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## Return Loss Measurement Plot for Head Stimulating Liquid (HSL)



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# CERTIFICATE OF CALIBRATION

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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', is written over a horizontal line.

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:	D3500V2		
Serial Number:	1011		
Calibration Date:	15/April/2021		
Calibrated By:	Ravish Foolchund Laboratory Technician		

Signature:

A handwritten signature in black ink, appearing to read 'Ravish Foolchund', is written over a horizontal line.

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)
PRE0134060	Data Acquisition Electronics	SPEAG	DAE4	432	09 Oct 2020	12
PRE0134817	Probe	SPEAG	ES3DV3	3335	14 Jan 2021	12
PRE0135600	Dipole Antenna	SPEAG	D3500V2	1044	11 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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NUMBER :  
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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:	3500 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	3500	20.0 °C	20.2 °C	22.0°C	22°C	$\epsilon_r$	37.93	37.27	± 5%
						$\sigma$	2.91	2.97	± 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	15.80 W/Kg	<b>62.90 W/Kg</b>	+16.77% / -16.70%
	SAR averaged over 10g	5.88 W/Kg	<b>23.41 W/Kg</b>	±16.70%

## Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	55.51 $\Omega$ - 1.96 j $\Omega$	± 0.28 $\Omega$ ± 0.044 j $\Omega$
	Return Loss	-25.12 dB	± 2.97 dB

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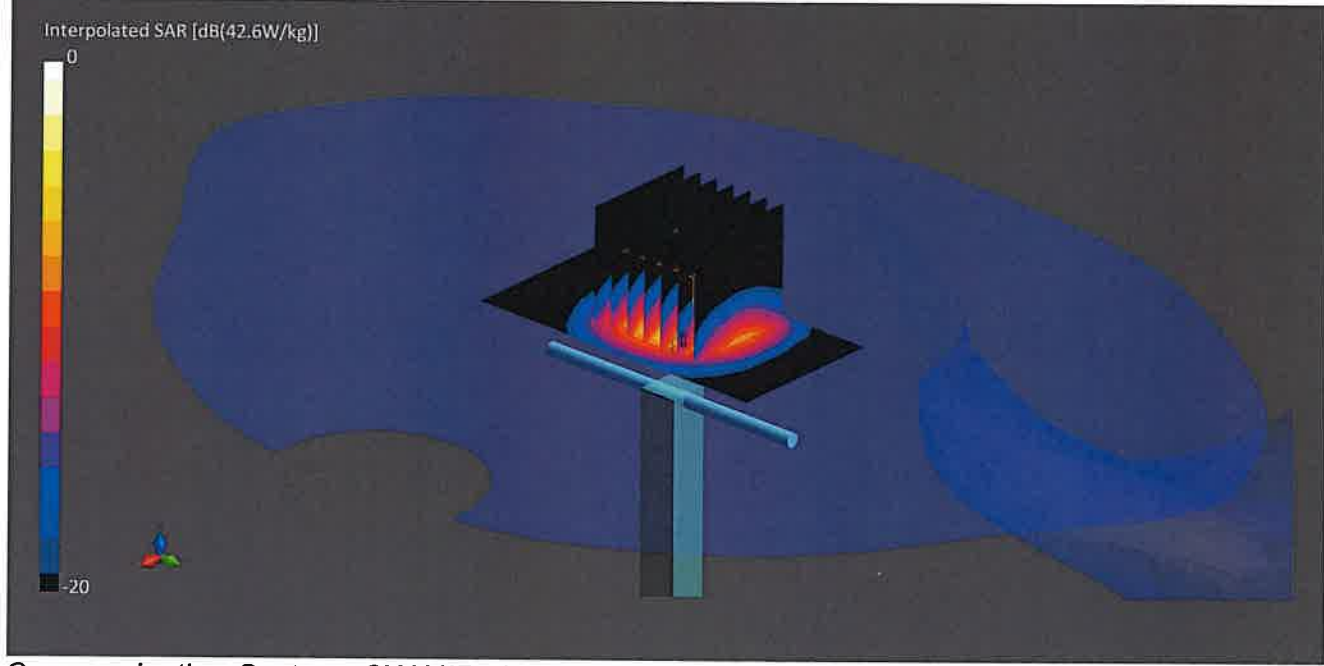
CERTIFICATE  
NUMBER :  
13697411JD01G

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

DUT: D3500V2; Type: Dipole; Serial: SN1011;



Communication System: CW UID: 0; Frequency: 3500.0 MHz; Duty Cycle: 1;  
Medium: HSL; Site65\_14Apr2021\_183123\_Head - 3500 5%; Medium parameters used:  $f = 3500.0$  MHz;  $\sigma = 2.97$  S/m;  $\epsilon_r = 37.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>;  $\Delta\epsilon_r = -1.72$  %;  $\Delta\sigma = 2.03$  %; No correction  
Phantom section: Flat;

DASY 6 Configuration:

- Laboratory Name: Site65;
- Probe: ES3DV3 - SN3335; ConvF(4.09, 4.09, 4.09); Calibrated: 14 Jan 2021
- Sensor-Surface: 3 mm; VMS + 6p
- Electronics: DAE4 - SN432; Calibrated: 09 Oct 2020
- Phantom: Twin-SAM V5.0 (30deg probe tilt); Serial: 1818
- Measurement SW: cDASY6.14.0.959

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

**Zoom Scan1(28x28x28):** Measurement grid: dx=5 mm, dy=5 mm, dz=1.4 mm; Grading Ratio: 1.5; Reference Value = 23.010 V/m; Power Drift = 0.01 dB

Minimum horizontal 3dB distance: 8.9 mm;

Vertical M2/M1 Ratio: 73.9 %;

**SAR(1 g) = 15.800 W/kg; SAR(10 g) = 5.880 W/kg**

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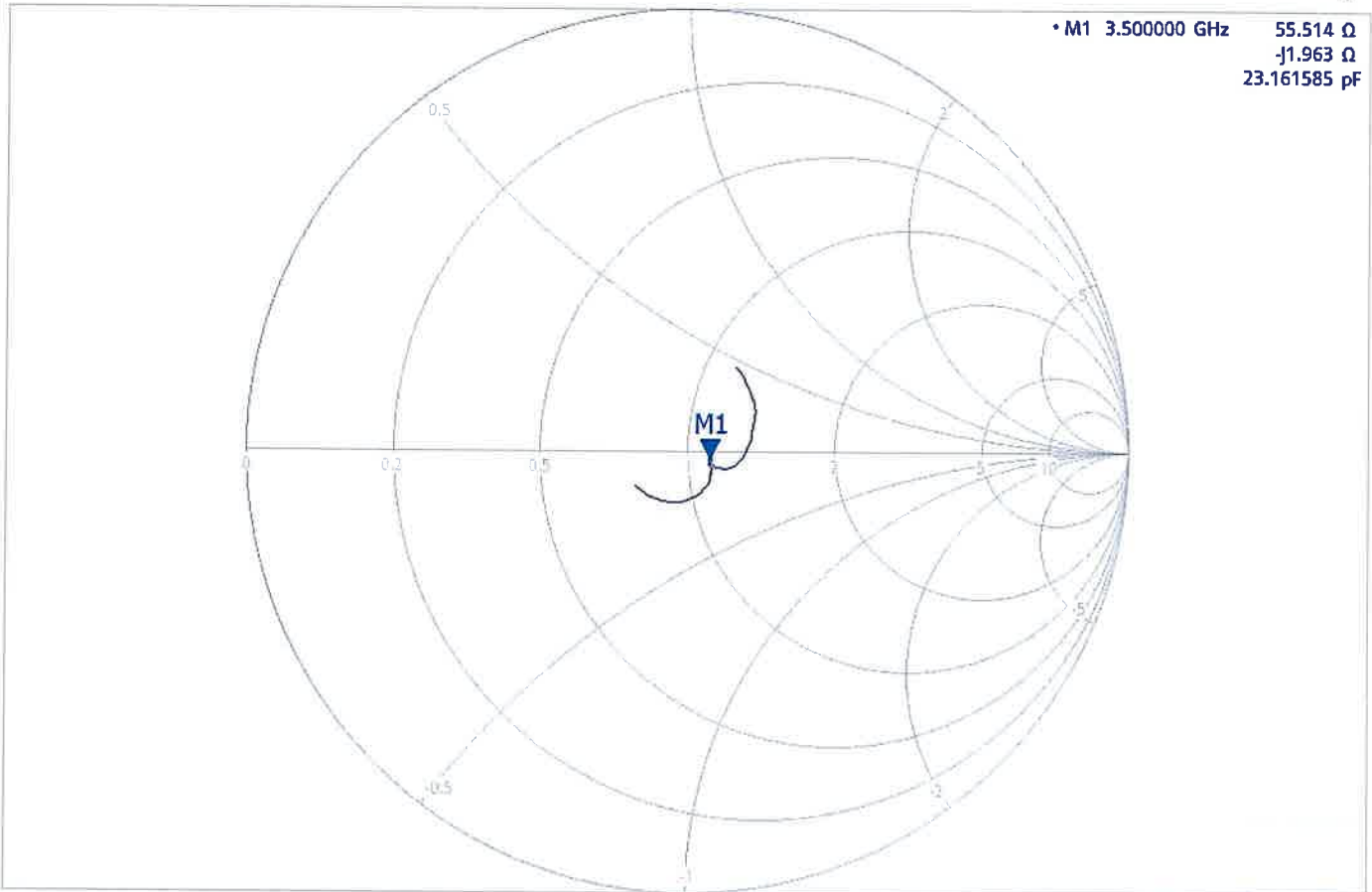
Page 5 of 6

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

4/15/2021 9:59:14 AM  
1328.5170K92-100151-MV

Trc1 — S11 Smith 200 mU/ Ref 1 U Cal

1



Ch1 Center 3.5 GHz

Pwr -10 dBm Bw 10 kHz

Span 400 MHz

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CERTIFICATE  
NUMBER :  
13697411JD01G

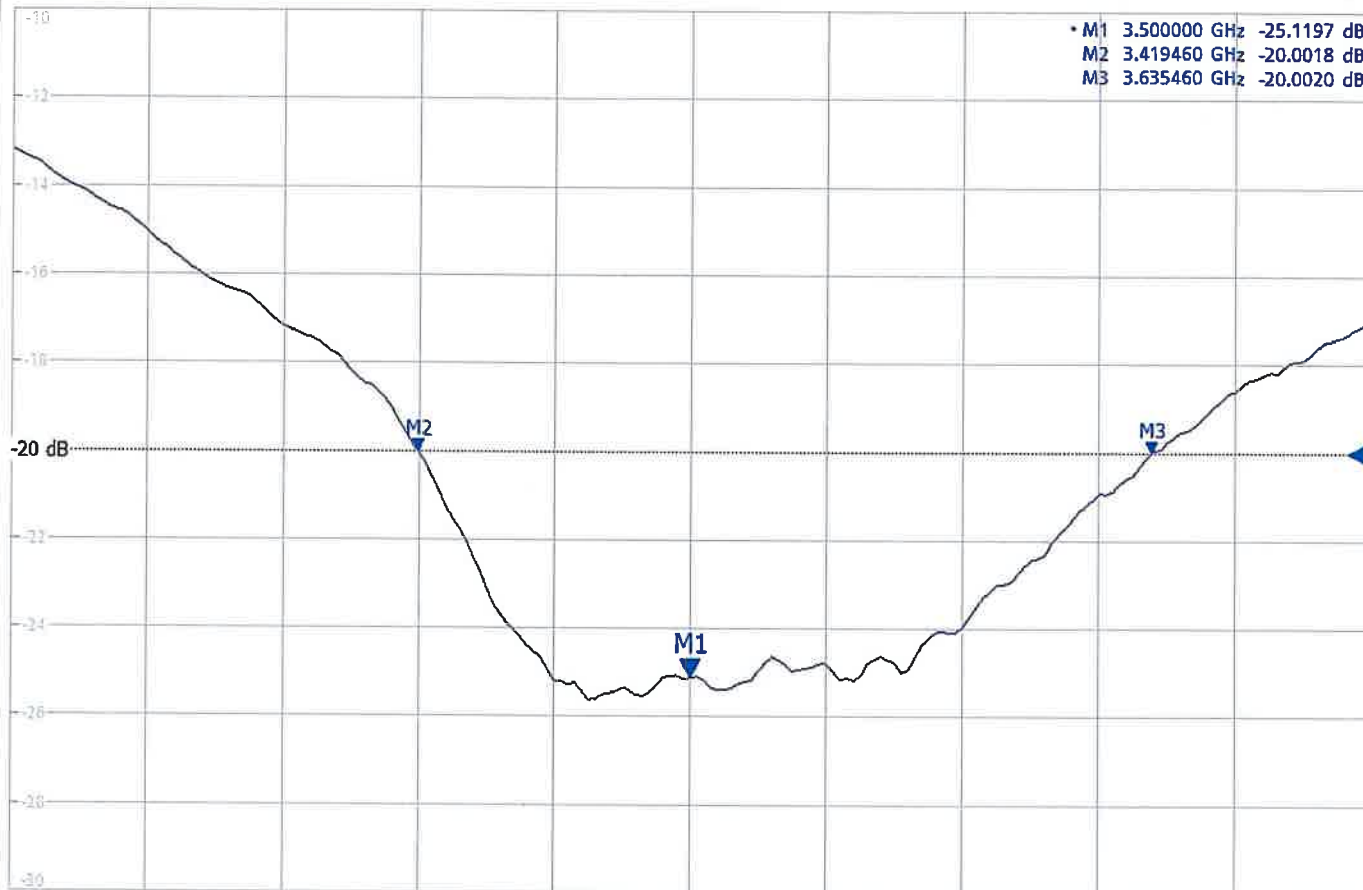
Page 6 of 6

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

4/15/2021 9:56:53 AM  
1328.5170K92-100151-MV

Trc1 — S11 dB Mag 2 dB/ Ref -20 dB Cal

1





Ch1 Center 3.5 GHz


Pwr -10 dBm Bw 10 kHz

Span 400 MHz

**Calibration Certificate Label:**

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# CERTIFICATE OF CALIBRATION

ISSUED BY UL INTERNATIONAL (UK) LTD

DATE OF ISSUE: 26/Feb/2021      CERTIFICATE NUMBER : 13685197JD01B



UL INTERNATIONAL (UK) LTD  
UNIT 1-3 HORIZON  
KINGSLAND PARK, WADE ROAD  
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RG24 8AH, UK  
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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 'M. Naseer', is written over a horizontal line.

Naseer Mirza

## Customer :

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

## Equipment Details:

Description:	Dipole Validation Kit	Date of Receipt:	15/Feb/2021
Manufacturer:	Speag		
Type/Model Number:	D3500V2		
Serial Number:	1060		
Calibration Date:	25/Feb/2021		
Calibrated By:	Masood Khan Test Engineer		
Signature:	A handwritten signature in black ink, appearing to read 'Masood Khan', is written over a horizontal line.		

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)
PRE0178317	Data Acquisition Electronics	SPEAG	DAE4	1542	17 Mar 2020	12
PRE0178313	Probe	SPEAG	EX3DV4	7497	24 Mar 2020	12
PRE0135600	Dipole	SPEAG	D3500V2	1044	11 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	27 Mar 2020	12
PRE0151154	Vector Network Analyser	Rhode & Schwarz	ZND	100151	15 Jun 2020	12
PRE0158684	Calibration Kit	Rhode & Schwarz	ZV-Z135	102144	27 May 2020	12
PRE0178154	Signal Generator	Rhode & Schwarz	SMB100A	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:	3500 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	3500	20.0 °C	19.8 °C	20.4°C	20.2°C	$\epsilon_r$	37.93	39.38	± 10%
						$\sigma$	2.91	2.79	± 10%

### SAR Results – Head Simulating Liquid (HSL)

Simulant Liquid	SAR Measured	200 mW input Power	Normalised to 1.00 W	Uncertainty (%)
Head	SAR averaged over 1g	15.60 W/Kg	<b>62.10W/Kg</b>	+16.77% / -16.70%
	SAR averaged over 10g	5.91 W/Kg	<b>23.53 W/Kg</b>	± 16.70%

### Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	53.917 $\Omega$ -4.632 j $\Omega$	± 0.28 $\Omega$ ± 0.044 j $\Omega$
	Return Loss	24.68	± 2.03 dB

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

DUT: D3500V2; Type: Dipole; Serial: SN1060;



Communication System: CW UID: 0; Frequency: 3500.0 MHz; Duty Cycle: 1;  
Medium: HSL; Site59\_25Feb2021\_111544\_Head - 3500 5%; Medium parameters used:  $f = 3500.0$  MHz;  $\sigma = 2.79$  S/m;  $\epsilon_r = 39.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>;  $\Delta\epsilon_r = 3.82$  %;  $\Delta\sigma = -4.19$  %; No correction  
Phantom section: Flat;

DASY 6 Configuration:

- Laboratory Name: Site59;
- Probe: EX3DV4 - SN7497; ConvF(7.17, 7.17, 7.17); Calibrated: 24 Mar 2020
- Sensor-Surface: 1.4 mm; VMS + 6p
- Electronics: DAE4 - SN1542; Calibrated: 17 Mar 2020
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 1927
- Measurement SW: cDASY6.14.0.959

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

**Zoom Scan1(28x28x28):** Measurement grid: dx=5 mm, dy=5 mm, dz=1.4 mm; Grading Ratio: 1.5; Reference Value = 21.350 V/m; Power Drift = -0.01 dB

Minimum horizontal 3dB distance: 8.0 mm;

Vertical M2/M1 Ratio: 74.4 %;

**SAR(1 g) = 15.600 W/kg; SAR(10 g) = 5.910 W/kg**

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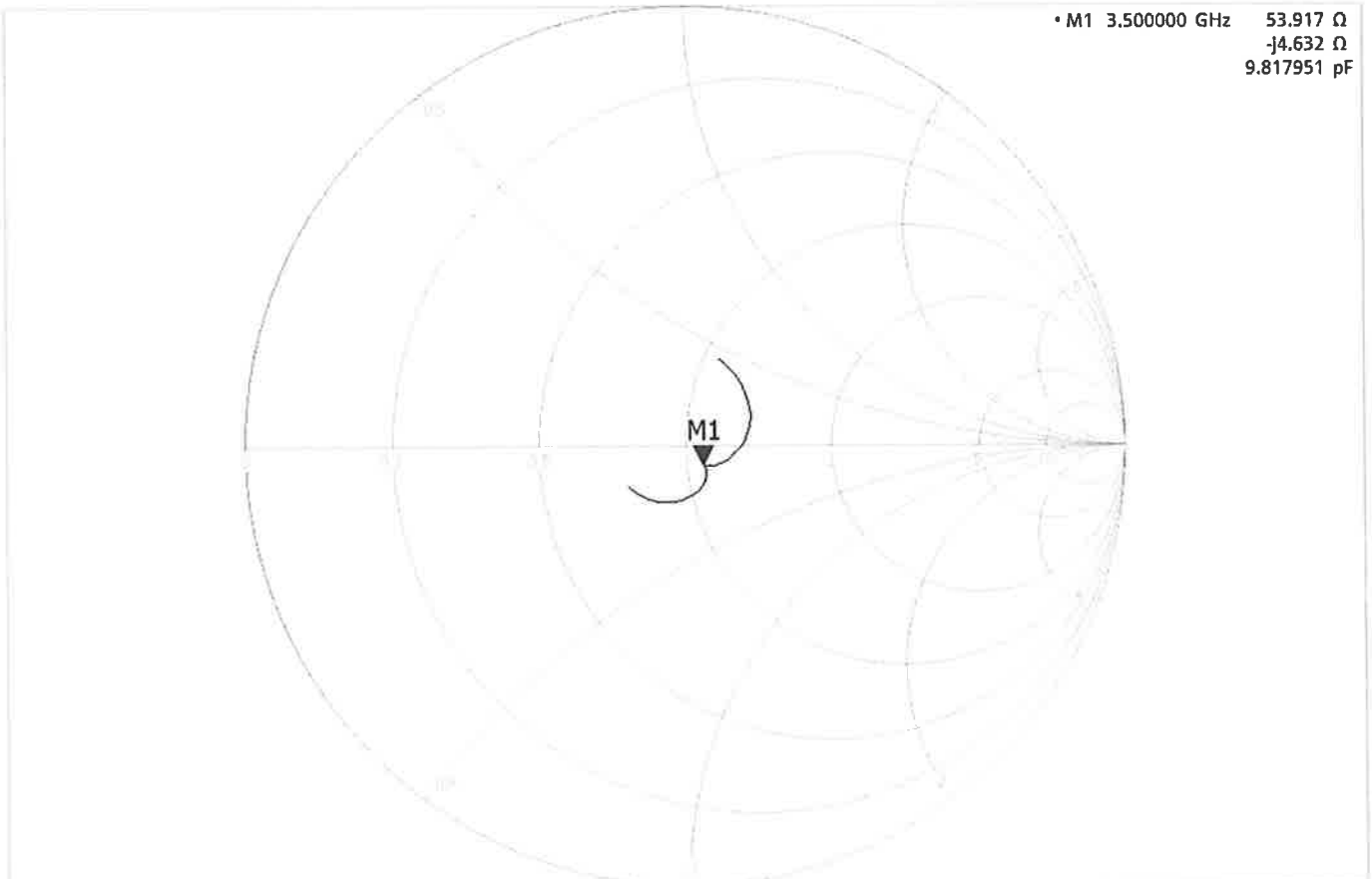
### Impedance Measurement Plot for Head Stimulating Liquid (HSL)

2/25/2021 3:35:28 PM  
1328.5170K92-100151-MV

Trc1 — S11 Smith 200 mU/ Ref 1 U Cal

1

• M1 3.500000 GHz 53.917  $\Omega$   
-j4.632  $\Omega$   
9.817951 pF



Ch1 Center 3.5 GHz

Pwr -10 dBm Bw 10 kHz

Span 400 MHz

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NUMBER :  
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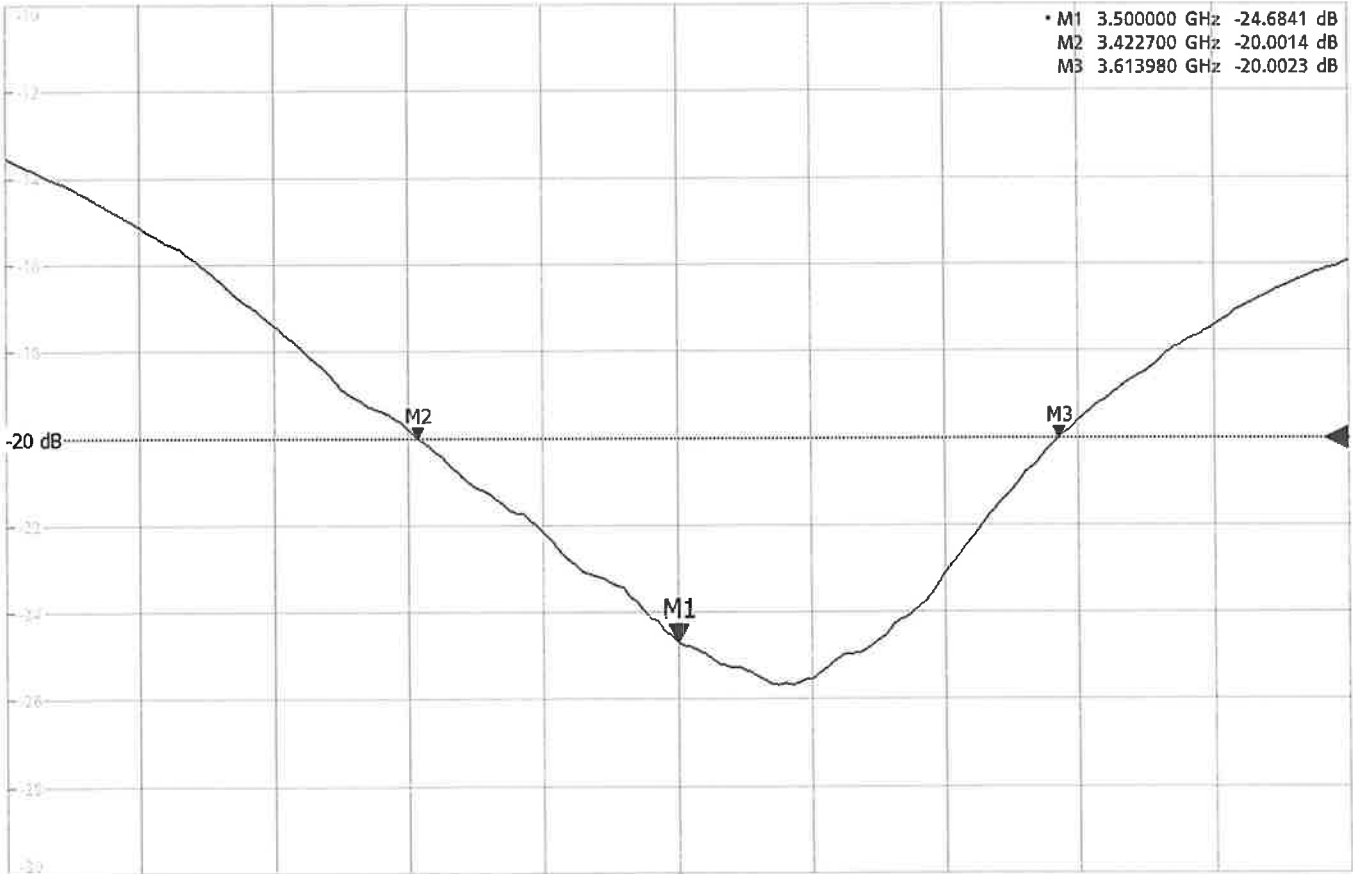
Page 6 of 6

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

2/25/2021 3:34:02 PM  
1328.5170K92-100151-MV

Trc1 — S11 dB Mag 2 dB/ Ref -20 dB Cal

1





Ch1 Center 3.5 GHz


Pwr -10 dBm Bw 10 kHz

Span 400 MHz

**Calibration Certificate Label:**

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Accreditation No.: **SCS 0108**

Accredited by the Swiss Accreditation Service (SAS)  
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Multilateral Agreement for the recognition of calibration certificates

Client **UL USA**

Certificate No: **D3700V2-1039\_Apr21**

## CALIBRATION CERTIFICATE

Object **D3700V2 - SN:1039**

Calibration procedure(s) **QA CAL-22.v6  
Calibration Procedure for SAR Validation Sources between 3-10 GHz**

Calibration date: **April 16, 2021**

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 ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
Power sensor NRP-Z91	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22
Reference 20 dB Attenuator	SN: BH9394 (20k)	09-Apr-21 (No. 217-03343)	Apr-22
Type-N mismatch combination	SN: 310982 / 06327	09-Apr-21 (No. 217-03344)	Apr-22
Reference Probe EX3DV4	SN: 3503	30-Dec-20 (No. EX3-3503_Dec20)	Dec-21
DAE4	SN: 601	02-Nov-20 (No. DAE4-601_Nov20)	Nov-21

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-20)	In house check: Oct-22
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-21

Calibrated by: **Jeffrey Katzman**      **Jeffrey Katzman**      **Laboratory Technician**

Approved by: **Katja Pokovic**      **Katja Pokovic**      **Technical Manager**

Issued: April 16, 2021

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



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### 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:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "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)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

### Additional Documentation:

- DASY4/5 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.

<b>DASY Version</b>	DASY5	V52.10.4
<b>Extrapolation</b>	Advanced Extrapolation	
<b>Phantom</b>	Modular Flat Phantom	
<b>Distance Dipole Center - TSL</b>	10 mm	with Spacer
<b>Zoom Scan Resolution</b>	dx, dy = 4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
<b>Frequency</b>	3700 MHz $\pm$ 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	37.7	3.12 mho/m
<b>Measured Head TSL parameters</b>	(22.0 $\pm$ 0.2) °C	37.0 $\pm$ 6 %	3.09 mho/m $\pm$ 6 %
<b>Head TSL temperature change during test</b>	< 0.5 °C	----	----

## SAR result with Head TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	100 mW input power	6.65 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>66.4 W/kg <math>\pm</math> 19.9 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	condition	
SAR measured	100 mW input power	2.41 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>24.0 W/kg <math>\pm</math> 19.5 % (k=2)</b>

## Appendix (Additional assessments outside the scope of SCS 0108)

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	45.9 $\Omega$ - 1.6 j $\Omega$
Return Loss	- 26.7 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.134 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
-----------------	-------

# DASY5 Validation Report for Head TSL

Date: 16.04.2021

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 3700 MHz; Type: D3700V2; Serial: D3700V2 - SN:1039**

Communication System: UID 0 - CW; Frequency: 3700 MHz

Medium parameters used:  $f = 3700$  MHz;  $\sigma = 3.09$  S/m;  $\epsilon_r = 37.0$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(7.73, 7.73, 7.73) @ 3700 MHz; Calibrated: 30.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

**Dipole Calibration for Head Tissue/Pin=100 mW, d=10mm, f=3700MHz/Zoom Scan, dist=1.4mm (8x8x8)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 71.87 V/m; Power Drift = -0.04 dB

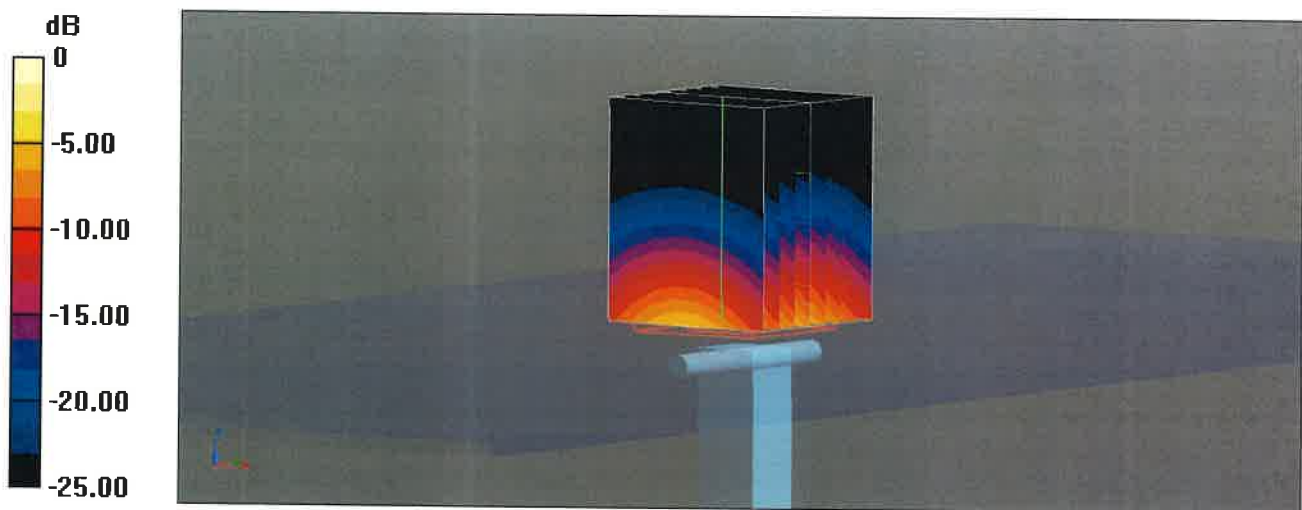
Peak SAR (extrapolated) = 18.9 W/kg

**SAR(1 g) = 6.65 W/kg; SAR(10 g) = 2.41 W/kg**

Smallest distance from peaks to all points 3 dB below = 8.4 mm

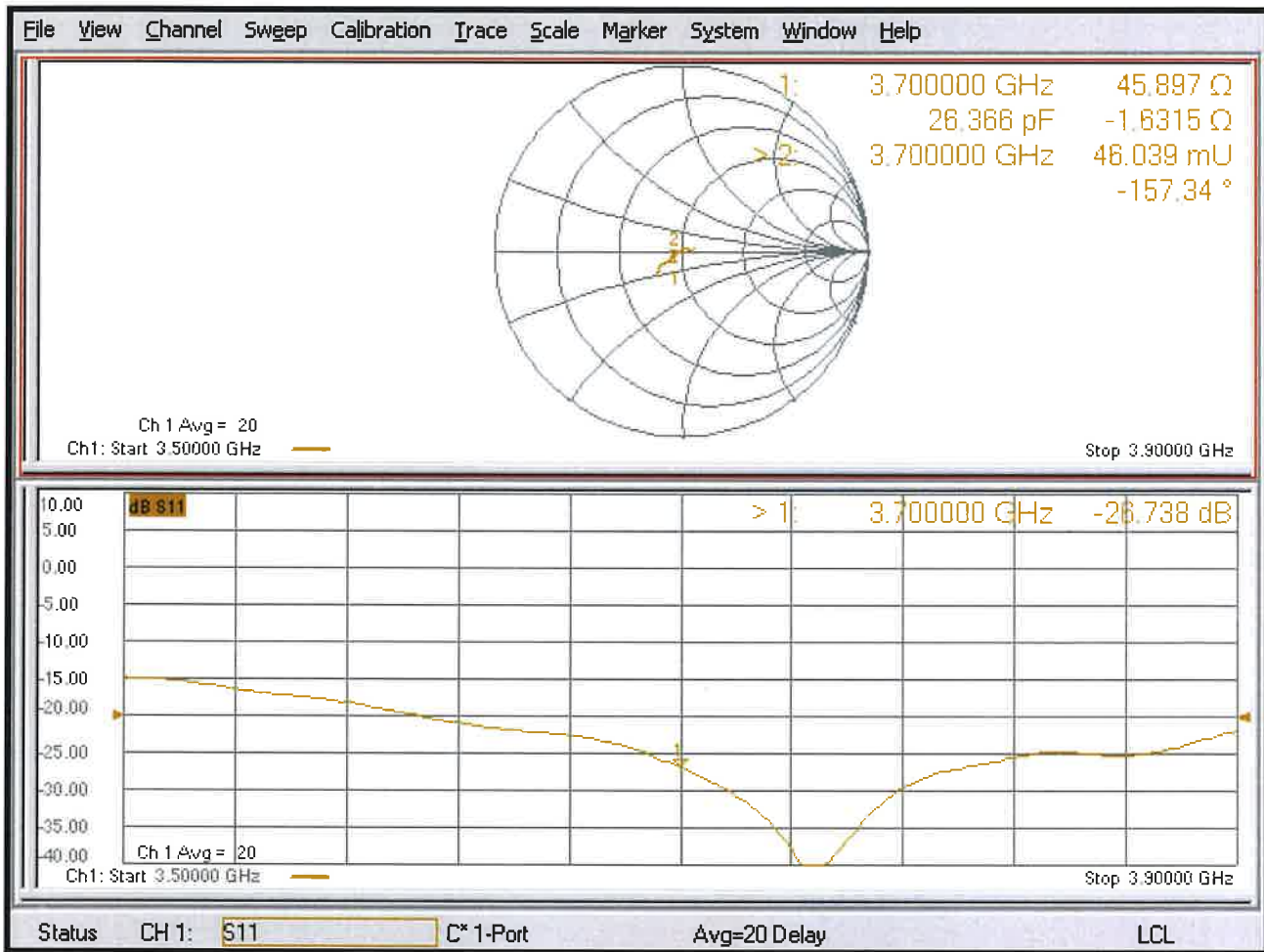
Ratio of SAR at M2 to SAR at M1 = 73.5%

Maximum value of SAR (measured) = 13.2 W/kg



0 dB = 13.2 W/kg = 11.19 dBW/kg

# Impedance Measurement Plot for Head TSL





Accreditation No.: **SCS 0108**

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Client **UL USA**

Certificate No: **D3900V2-1052\_Sep21**

## CALIBRATION CERTIFICATE

Object **D3900V2 - SN:1052**

Calibration procedure(s) **QA CAL-22.v6  
Calibration Procedure for SAR Validation Sources between 3-10 GHz**

Calibration date: **September 16, 2021**

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 ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
Power sensor NRP-Z91	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22
Reference 20 dB Attenuator	SN: BH9394 (20k)	09-Apr-21 (No. 217-03343)	Apr-22
Type-N mismatch combination	SN: 310982 / 06327	09-Apr-21 (No. 217-03344)	Apr-22
Reference Probe EX3DV4	SN: 3503	30-Dec-20 (No. EX3-3503_Dec20)	Dec-21
DAE4	SN: 601	02-Nov-20 (No. DAE4-601_Nov20)	Nov-21

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-20)	In house check: Oct-22
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-21

Calibrated by: **Leif Klysner** Laboratory Technician 

Approved by: **Katja Pokovic** Technical Manager 

Issued: September 21, 2021

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:**

- 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"

**Additional Documentation:**

- c) 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 source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. 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.

<b>DASY Version</b>	DASY52	V52.10.4
<b>Extrapolation</b>	Advanced Extrapolation	
<b>Phantom</b>	Modular Flat Phantom	
<b>Distance Dipole Center - TSL</b>	10 mm	with Spacer
<b>Zoom Scan Resolution</b>	dx, dy = 4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
<b>Frequency</b>	3900 MHz $\pm$ 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	<b>Temperature</b>	<b>Permittivity</b>	<b>Conductivity</b>
<b>Nominal Head TSL parameters</b>	22.0 °C	37.5	3.32 mho/m
<b>Measured Head TSL parameters</b>	(22.0 $\pm$ 0.2) °C	36.5 $\pm$ 6 %	3.25 mho/m $\pm$ 6 %
<b>Head TSL temperature change during test</b>	< 0.5 °C	----	----

## SAR result with Head TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	<b>Condition</b>	
SAR measured	100 mW input power	7.02 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>70.1 W/kg <math>\pm</math> 19.9 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	<b>condition</b>	
SAR measured	100 mW input power	2.44 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>24.3 W/kg <math>\pm</math> 19.5 % (k=2)</b>

## Appendix (Additional assessments outside the scope of SCS 0108)

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.6 $\Omega$ - 4.2 j $\Omega$
Return Loss	- 27.0 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.105 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
-----------------	-------



# DASY5 Validation Report for Head TSL

Date: 16.09.2021

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 3900 MHz; Type: D3900V2; Serial: D3900V2 - SN:1052**

Communication System: UID 0 - CW; Frequency: 3900 MHz

Medium parameters used:  $f = 3900$  MHz;  $\sigma = 3.25$  S/m;  $\epsilon_r = 36.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(7.39, 7.39, 7.39) @ 3900 MHz; Calibrated: 30.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

**Dipole Calibration for Head Tissue/Pin=100 mW, d=10mm, f=3900MHz/Zoom Scan, dist=1.4mm (8x8x8)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 73.79 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 19.5 W/kg

**SAR(1 g) = 7.02 W/kg; SAR(10 g) = 2.44 W/kg**

Smallest distance from peaks to all points 3 dB below = 8 mm

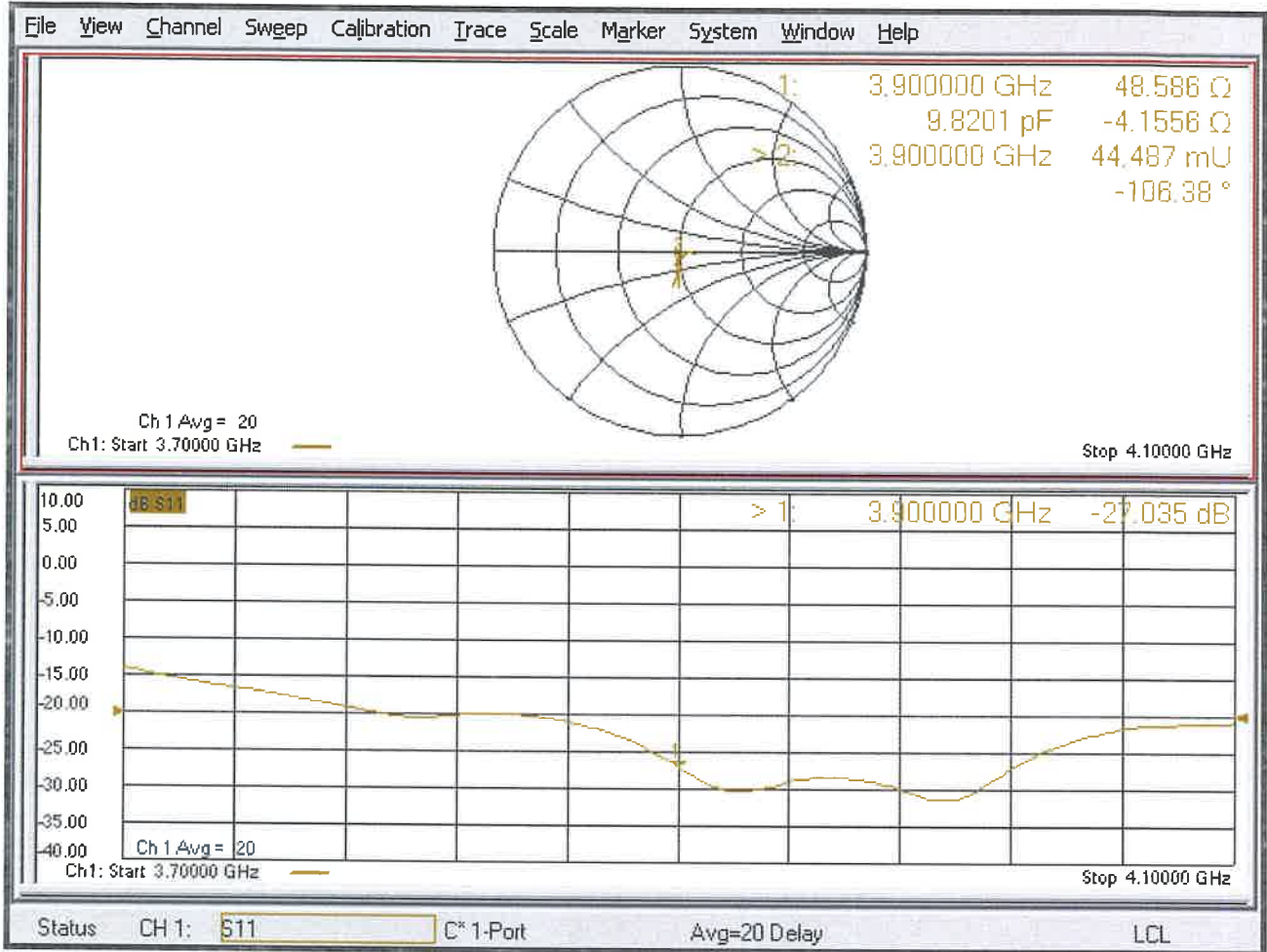
Ratio of SAR at M2 to SAR at M1 = 74.5%

Maximum value of SAR (measured) = 13.7 W/kg



0 dB = 13.7 W/kg = 11.36 dBW/kg

# Impedance Measurement Plot for Head TSL



# CERTIFICATE OF CALIBRATION

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DATE OF ISSUE: 04/May/2021      CERTIFICATE NUMBER : 13685197JD01C



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



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**APPROVED SIGNATORY**

.....  
Naseer Mirza

## Customer :

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

## Equipment Details:

Description:	Dipole Validation Kit	Date of Receipt:	15/Feb/2021
Manufacturer:	Speag		
Type/Model Number:	D5GHzV2		
Serial Number:	1003		
Calibration Date:	17/Feb/2021		
Calibrated By:	Masood Khan Test Engineer		
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.

Use of the UKAS mark demonstrates that compliance with the requirements of BS/EN/ISO/IEC 17025:2017 has been independently assessed.

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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)
PRE0178316	Data Acquisition Electronics	SPEAG	DAE4	1541	17 Mar 2020	12
PRE0178266	Probe	SPEAG	EX3DV4	7495	24 Mar 2020	12
PRE0178323	Dipole	SPEAG	D5GHzV2	1274	13 Mar 2020	12
PRE0151451	Power Monitoring Kit	Art-Fi	ART 100850-01	0001	Cal as part of System	-
PRE0151441	Power Sensor	Rhode & Schwarz	NRP8S	102481	27 Mar 2020	12
PRE0151154	Vector Network Analyser	Rhode & Schwarz	ZND	100151	15 Jun 2020	12
PRE0158684	Calibration Kit	Rhode & Schwarz	ZV-Z135	102144	27 May 2020	12
PRE0178154	Signal Generator	Rhode & Schwarz	SMB100A	175325	10 Jun 2020	12

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### SAR System Specification

Robot System Positioner:	Stäubli Unimation Corp. Robot Model: TX60L
Robot Serial Number:	F17/5ENYG1/A/01
DASY Version:	cDASY6.14.0.959
Phantom:	Flat section of SAM Twin Phantom
Distance Dipole Centre:	10mm (with spacer)
Frequency:	5GHz

**Frequency :5250 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	5250	20.0 °C	19.8 °C	20.4°C	20.4°C	$\epsilon_r$	35.93	36.39	± 5%
						$\sigma$	4.71	4.78	± 5%

### SAR Results – Head Simulating Liquid (HSL)

Simulant Liquid	SAR Measured	100 mW input Power	Normalised to 1.00 W	Uncertainty (%)
Head	SAR averaged over 1g	7.71 W/Kg	<b>77.1 W/Kg</b>	+16.77% / -16.70%
	SAR averaged over 10g	2.22 W/Kg	<b>22.2 W/Kg</b>	± 16.70%

### Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	58.749 $\Omega$ +3.909 j $\Omega$	± 0.28 $\Omega$ ± 0.044 j $\Omega$
	Return Loss	21.10	± 2.03 dB

**Frequency :5600 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	5600	20.0 °C	19.8 °C	20.4°C	20.4°C	$\epsilon_r$	35.53	35.71	± 5%
						$\sigma$	5.10	5.20	± 5%

### SAR Results – Head Simulating Liquid (HSL)

Simulant Liquid	SAR Measured	100 mW input Power	Normalised to 1.00 W	Uncertainty (%)
Head	SAR averaged over 1g	8.47 W/Kg	<b>84.7 W/Kg</b>	+16.77% / -16.70%
	SAR averaged over 10g	2.42 W/Kg	<b>24.2 W/Kg</b>	± 16.70%

### Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	46.857 $\Omega$ +1.626 j $\Omega$	± 0.28 $\Omega$ ± 0.044 j $\Omega$
	Return Loss	28.75	± 2.03 dB

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**Frequency :5750 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	5750	20.0 °C	19.8 °C	20.4°C	20.4°C	$\epsilon_r$	35.36	35.42	± 5%
						$\sigma$	5.22	5.38	± 5%

## SAR Results – Head Simulating Liquid (HSL)

Simulant Liquid	SAR Measured	100 mW input Power	Normalised to 1.00 W	Uncertainty (%)
Head	SAR averaged over 1g	7.57 W/Kg	<b>75.7 W/Kg</b>	+16.77% / -16.70%
	SAR averaged over 10g	2.18 W/Kg	<b>21.8 W/Kg</b>	± 16.70%

## Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	59.697 $\Omega$ + 0.126 j $\Omega$	± 0.28 $\Omega$ ± 0.044 j $\Omega$
	Return Loss	21.07	± 2.03 dB

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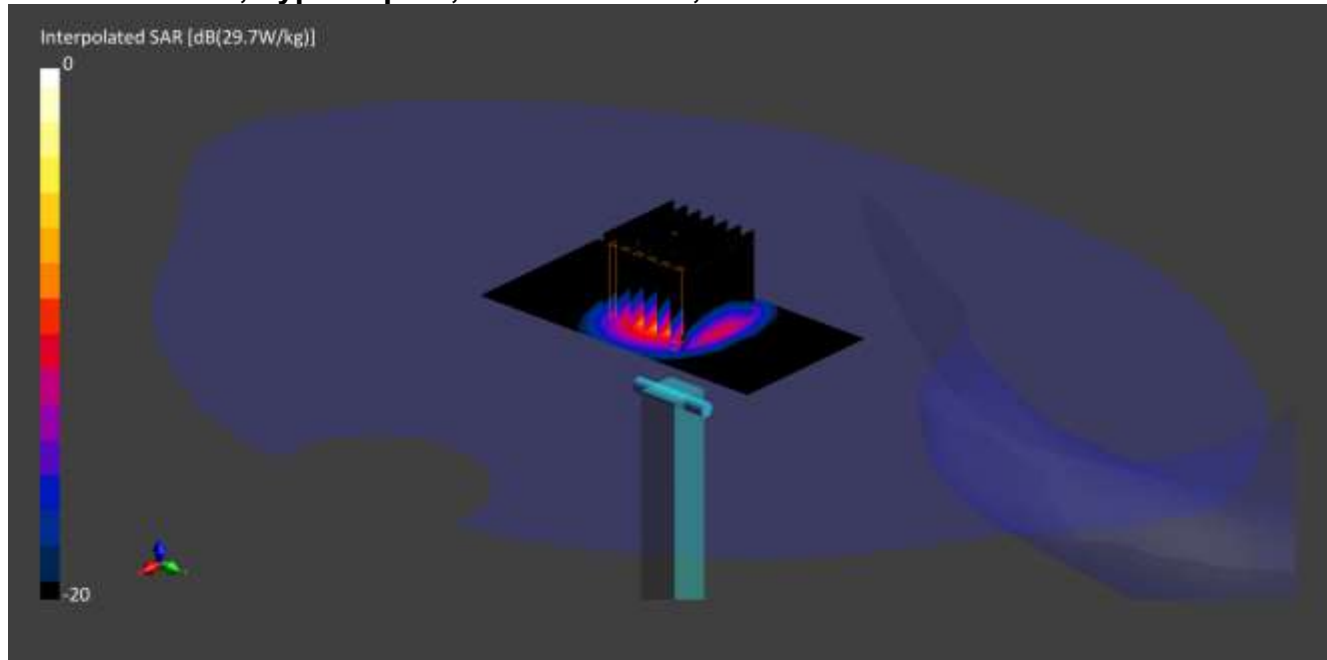
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### DASY Validation Scan for Head Stimulating Liquid (HSL)

DUT: D5GHzV2; Type: Dipole; Serial: SN1003;



Communication System: CW UID: 0; Frequency: 5250.0 MHz; Duty Cycle: 1;  
Medium: HSL; Site65\_17Feb2021\_110903\_Head - 3500 5250 5600 5750 5%; Medium  
parameters used:  $f = 5250.0$  MHz;  $\sigma = 4.78$  S/m;  $\epsilon_r = 36.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>;  $\Delta\epsilon_r = 1.27$  %;  $\Delta\sigma = 1.65$  %; No correction

Phantom section: Flat;

DASY 6 Configuration:

- Laboratory Name: Site65;
- Probe: EX3DV4 - SN7495; ConvF(5.17, 5.17, 5.17); Calibrated: 24 Mar 2020
- Sensor-Surface: 1.4 mm; VMS + 6p
- Electronics: DAE4 - SN1541; Calibrated: 17 Mar 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(22x22x22):** Measurement grid: dx=4 mm, dy=4 mm, dz=1.4 mm; Grading Ratio: 1.4; Reference Value = 10.780 V/m; Power Drift = 0.00 dB

Minimum horizontal 3dB distance: 7.2 mm;

Vertical M2/M1 Ratio: 64.8 %;

**SAR(1 g) = 7.710 W/kg; SAR(10 g) = 2.220 W/kg**

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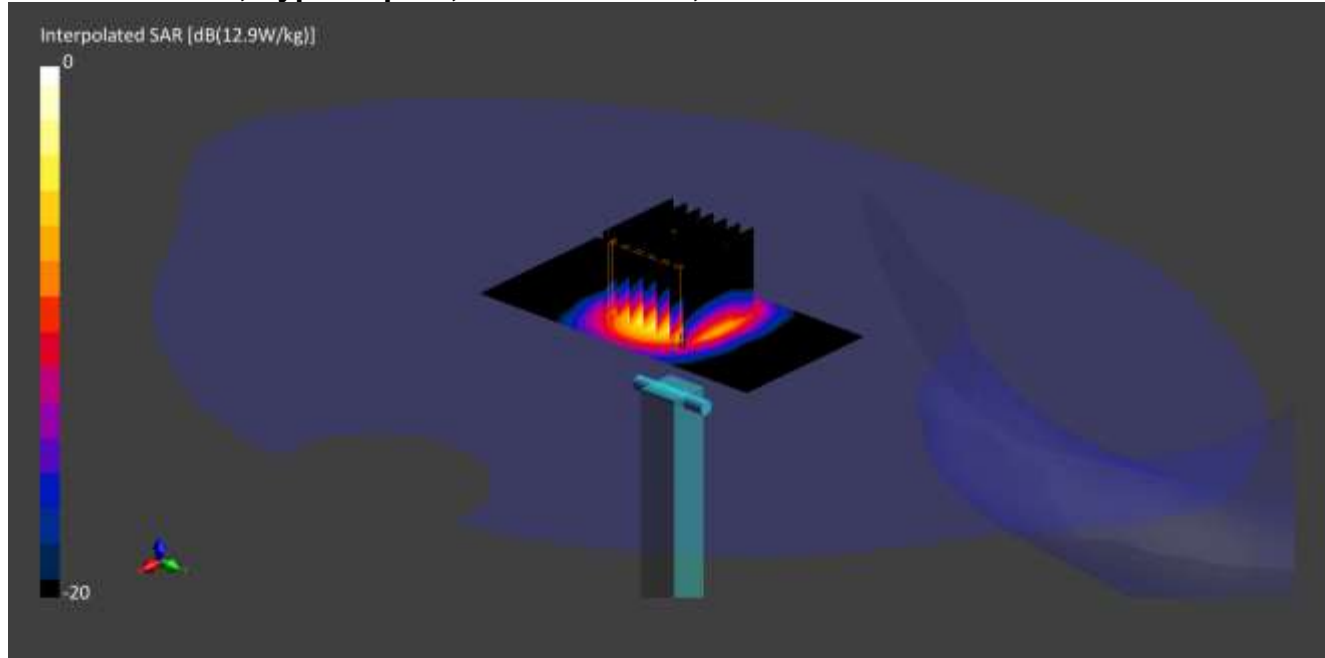
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### DASY Validation Scan for Head Stimulating Liquid (HSL)

DUT: D5GHzV2; Type: Dipole; Serial: SN1003;



Communication System: CW UID: 0; Frequency: 5600.0 MHz; Duty Cycle: 1;  
Medium: HSL; Site65\_17Feb2021\_110903\_Head - 3500 5250 5600 5750 5%; Medium  
parameters used:  $f = 5600.0$  MHz;  $\sigma = 5.2$  S/m;  $\epsilon_r = 35.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>;  $\Delta\epsilon_r = 0.50$  %;  $\Delta\sigma = 2.66$  %; No correction

Phantom section: Flat;

DASY 6 Configuration:

- Laboratory Name: Site65;
- Probe: EX3DV4 - SN7495; ConvF(4.66, 4.66, 4.66); Calibrated: 24 Mar 2020
- Sensor-Surface: 1.4 mm; VMS + 6p
- Electronics: DAE4 - SN1541; Calibrated: 17 Mar 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(22x22x22):** Measurement grid: dx=4 mm, dy=4 mm, dz=1.4 mm; Grading Ratio:  
1.4; Reference Value = 12.690 V/m; Power Drift = 0.00 dB

Minimum horizontal 3dB distance: 7.2 mm;

Vertical M2/M1 Ratio: 61.8 %;

**SAR(1 g) = 8.470 W/kg; SAR(10 g) = 2.420 W/kg**



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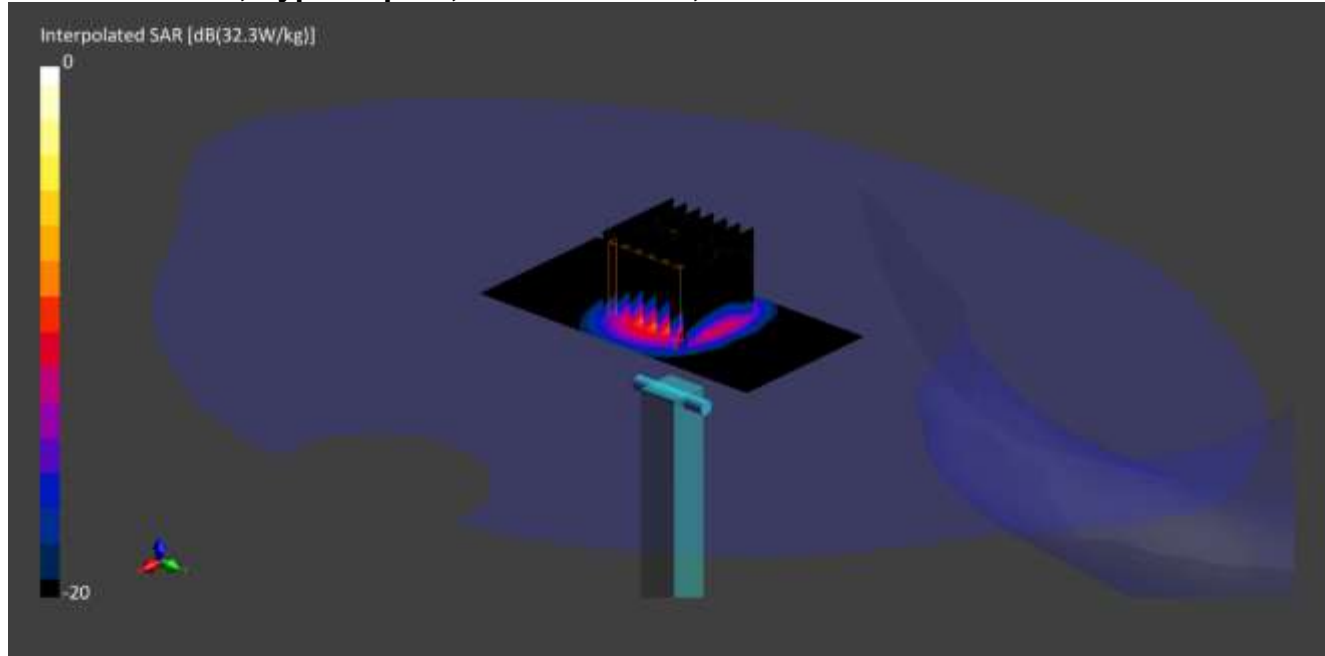
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### DASY Validation Scan for Head Stimulating Liquid (HSL)

DUT: D5GHzV2; Type: Dipole; Serial: SN1003;



Communication System: CW UID: 0; Frequency: 5750.0 MHz; Duty Cycle: 1;  
Medium: HSL; Site65\_17Feb2021\_110903\_Head - 3500 5250 5600 5750 5%; Medium  
parameters used:  $f = 5750.0$  MHz;  $\sigma = 5.38$  S/m;  $\epsilon_r = 35.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>;  $\Delta\epsilon_r = 0.17$  %;  $\Delta\sigma = 3.17$  %; No correction

Phantom section: Flat;

DASY 6 Configuration:

- Laboratory Name: Site65;
- Probe: EX3DV4 - SN7495; ConvF(4.89, 4.89, 4.89); Calibrated: 24 Mar 2020
- Sensor-Surface: 1.4 mm; VMS + 6p
- Electronics: DAE4 - SN1541; Calibrated: 17 Mar 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(22x22x22):** Measurement grid:  $dx=4$  mm,  $dy=4$  mm,  $dz=1.4$  mm; Grading Ratio: 1.4; Reference Value = 11.320 V/m; Power Drift = 0.00 dB

Minimum horizontal 3dB distance: 7.5 mm;

Vertical M2/M1 Ratio: 60.3 %;

**SAR(1 g) = 7.570 W/kg; SAR(10 g) = 2.180 W/kg**

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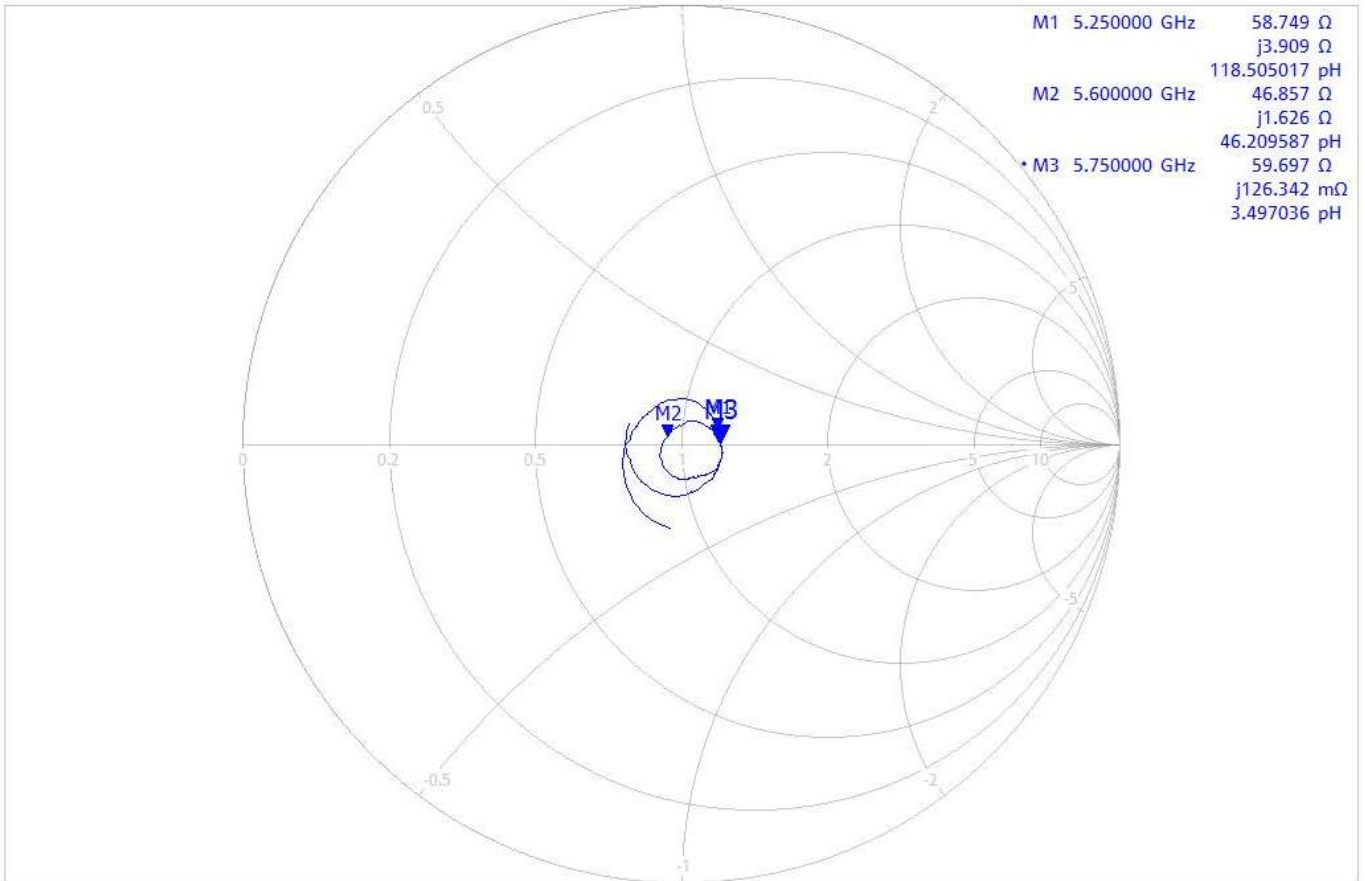
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### Impedance Measurement Plot for Head Stimulating Liquid (HSL)

2/18/2021 2:18:03 PM  
1328.5170K92-100151-MV

Trc1 — S11 Smith 200 mU/ Ref 1 U Cal

1



Ch1 Center 5.5 GHz

Pwr -10 dBm Bw 10 kHz

Span 1 GHz

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

2/18/2021 2:25:45 PM  
1328.5170K92-100151-MV

Trc1 — S11 dB Mag 5 dB/ Ref 0 dB Cal

1

M1 5.250000 GHz -21.1048 dB  
M2 5.600000 GHz -28.7474 dB  
M3 5.750000 GHz -21.0700 dB





Ch1 Center 5.5 GHz


Pwr -10 dBm Bw 10 kHz

Span 1 GHz

**Calibration Certificate Label:**

 <p>5772</p>	<p><b>UL INTERNATIONAL (UK) LTD</b> <b>Tel: +44 (0) 1256312000</b></p> <p>Certificate Number: 13685197JD01C</p> <p>Instrument ID: 1003</p> <p>Calibration Date: 17/Feb/2021</p> <p>Calibration Due Date:</p>
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 <p>5772</p>	<p><b>UL INTERNATIONAL (UK) LTD</b> <b>Tel: +44 (0) 1256312000</b></p> <p>Certificate Number: 13685197JD01C</p> <p>Instrument ID: 1003</p> <p>Calibration Date: 17/Feb/2021</p> <p>Calibration Due Date:</p>
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