

# CERTIFICATE OF CALIBRATION

ISSUED BY **UL VS LTD**

DATE OF ISSUE: 28/Mar/2018      CERTIFICATE NUMBER : 12134276JD01D



5248

UL VS LTD  
PAVILION A  
ASHWOOD PARK, ASHWOOD WAY  
BASINGSTOKE, HAMPSHIRE  
RG23 8BG, UK  
TEL: +44 (0) 1256 312000  
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/Mar/2018
Manufacturer:	Speag		
Type/Model Number:	D2600V2		
Serial Number:	1036		
Calibration Date:	16/Mar/2018		
Calibrated By:	Masood Khan Laboratory 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 62209-1:2005**: 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. **SPEAG DASY4/ DASY5 System Handbook**

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)
A2110	Data Acquisition Electronics	SPEAG	DAE4	431	08 Nov 2017	12
A2077	Probe	SPEAG	EX3DV4	3814	28 Sep 2017	12
A2767	Dipole	SPEAG	D2600V2	1109	05 Feb 2018	12
PRE0151451	Power Monitoring Kit	Art-Fi	ART 100850-01	0001	Cal as part of System	12
PRE0151441	Power Sensor	Rhode & Schwarz	NRP8S	102481	05 Feb 2018	12
M1015	Network Analyser	Agilent Technologies	8753ES	US39172406	10 Oct 2017	12
PRE0151154	Network Analyser	Rhode & Schwarz	ZND8	100151	14 Dec 2017	24
PRE0151877	Calibration Kit	Rhode & Schwarz	Z135	102947	09 May 2017	12
M1838	Signal Generator	Rhode & Schwarz	SME06	831377/005	30 Mar 2017	12

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### SAR System Specification

Robot System Positioner:	Stäubli Unimation Corp. Robot Model: TX60L
Robot Serial Number:	F14/5T5ZA1/A/01
DASY Version:	DASY 52 (v52.8.8.1258)
Phantom:	Flat section of SAM Twin Phantom
Distance Dipole Centre:	10 mm (with spacer)
Frequency:	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	23.5 °C	23.5 °C	22.5°C	22.5°C	$\epsilon_r$	39.00	39.14	± 5%
						$\sigma$	1.96	1.95	± 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	13.70 W/Kg	<b>54.54 W/Kg</b>	± 17.57%
	SAR averaged over 10g	6.17 W/Kg	<b>24.56 W/Kg</b>	± 17.32%

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

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	52.04 $\Omega$ -6.56 j $\Omega$	± 0.28 $\Omega$ ± 0.044 j $\Omega$
	Return Loss	-23.74	± 2.03 dB

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### Dielectric Property Measurements – Body Simulating Liquid (MSL)

Simulant Liquid	Frequency (MHz)	Room Temp		Liquid Temp		Parameters	Target Value	Measured Value	Uncertainty (%)
		Start	End	Start	End				
Body	2600	18.1 °C	18.1 °C	19.0°C	19.0°C	$\epsilon_r$	52.50	53.41	± 5%
						$\sigma$	2.16	2.24	± 5%

### SAR Results – Body Simulating Liquid (MSL)

Simulant Liquid	SAR Measured	250 mW input Power	Normalised to 1.00 W	Uncertainty (%)
Body	SAR averaged over 1g	14.10 W/Kg	<b>56.13 W/Kg</b>	± 18.06%
	SAR averaged over 10g	6.29 W/Kg	<b>25.04 W/Kg</b>	± 17.44%

### Antenna Parameters – Body Simulating Liquid (MSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Body	Impedance	48.29 $\Omega$ -6.55 j $\Omega$	± 0.28 $\Omega$ ± 0.044 j $\Omega$
	Return Loss	-25.48	± 2.03 dB

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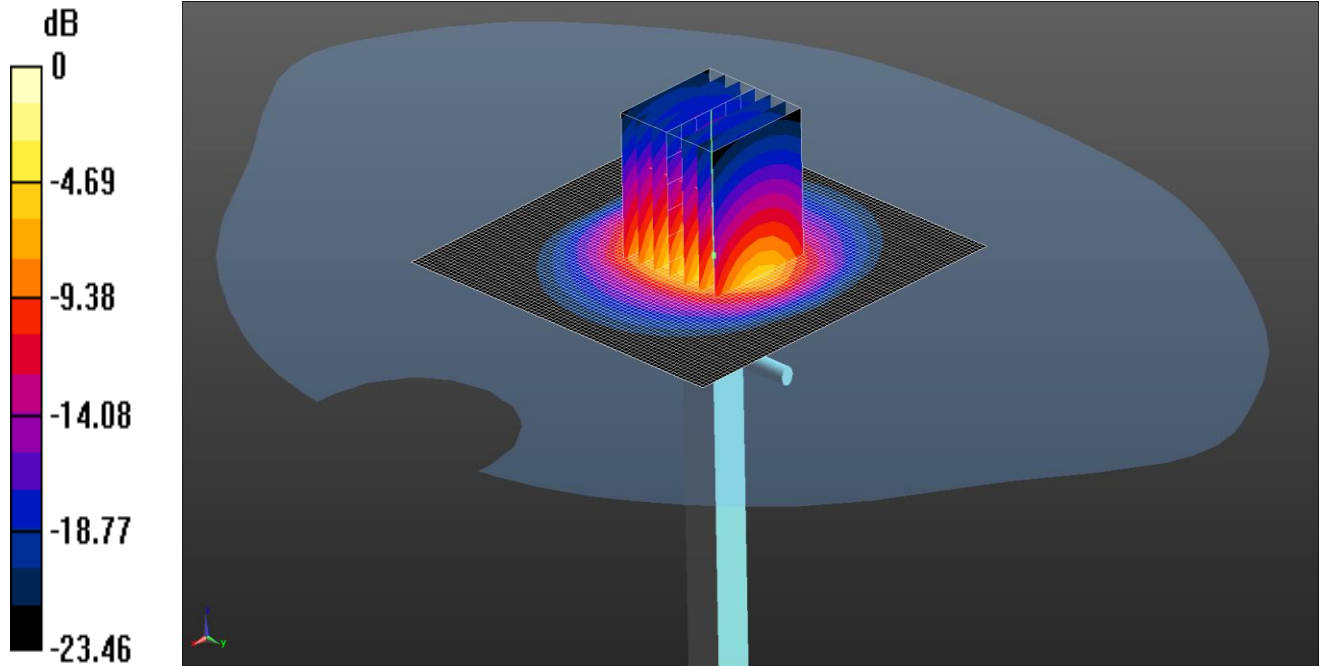
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### DASY Validation Scan for Head Stimulating Liquid (HSL)

DUT: D2600V2 - SN1036; Type: D2600V2; Serial: SN1036



0 dB = 21.3 W/kg = 13.28 dBW/kg

Communication System: UID 0, CW (0); Frequency: 2600 MHz; Duty Cycle: 1:1  
Medium: 2300 2450 2600 MHz HSL Medium parameters used:  $f = 2600$  MHz;  $\sigma = 1.956$  S/m;  $\epsilon_r = 39.142$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3814; ConvF(6.91, 6.91, 6.91); Calibrated: 28/09/2017;
- Sensor-Surface: 4mm (Mechanical Surface Detection), Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn431; Calibrated: 08/11/2017
- Phantom: SAM (20deg probe tilt) with CRP v4.0; Type: QD000P40CC; Serial: 1817
- ; SEMCAD X Version 14.6.10 (7372)

**Configuration/d=10mm, Pin=250mW/Area Scan (81x81x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm

Maximum value of SAR (interpolated) = 16.1 W/kg

**Configuration/d=10mm, Pin=250mW/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 91.37 V/m; Power Drift = -0.16 dB

Peak SAR (extrapolated) = 29.3 W/kg

**SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.17 W/kg**

Maximum value of SAR (measured) = 21.3 W/kg

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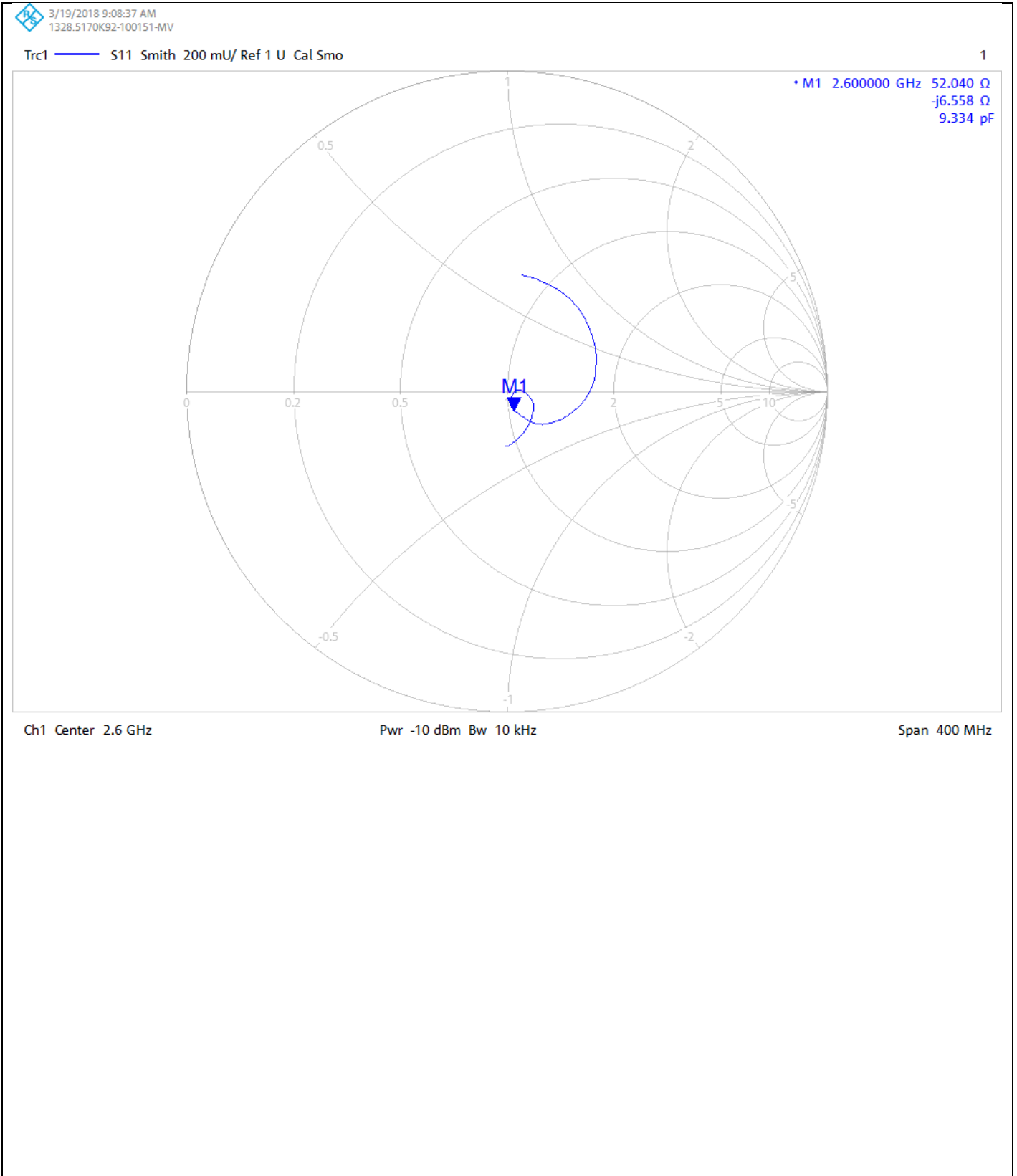
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### Impedance Measurement Plot for Head Stimulating Liquid (HSL)



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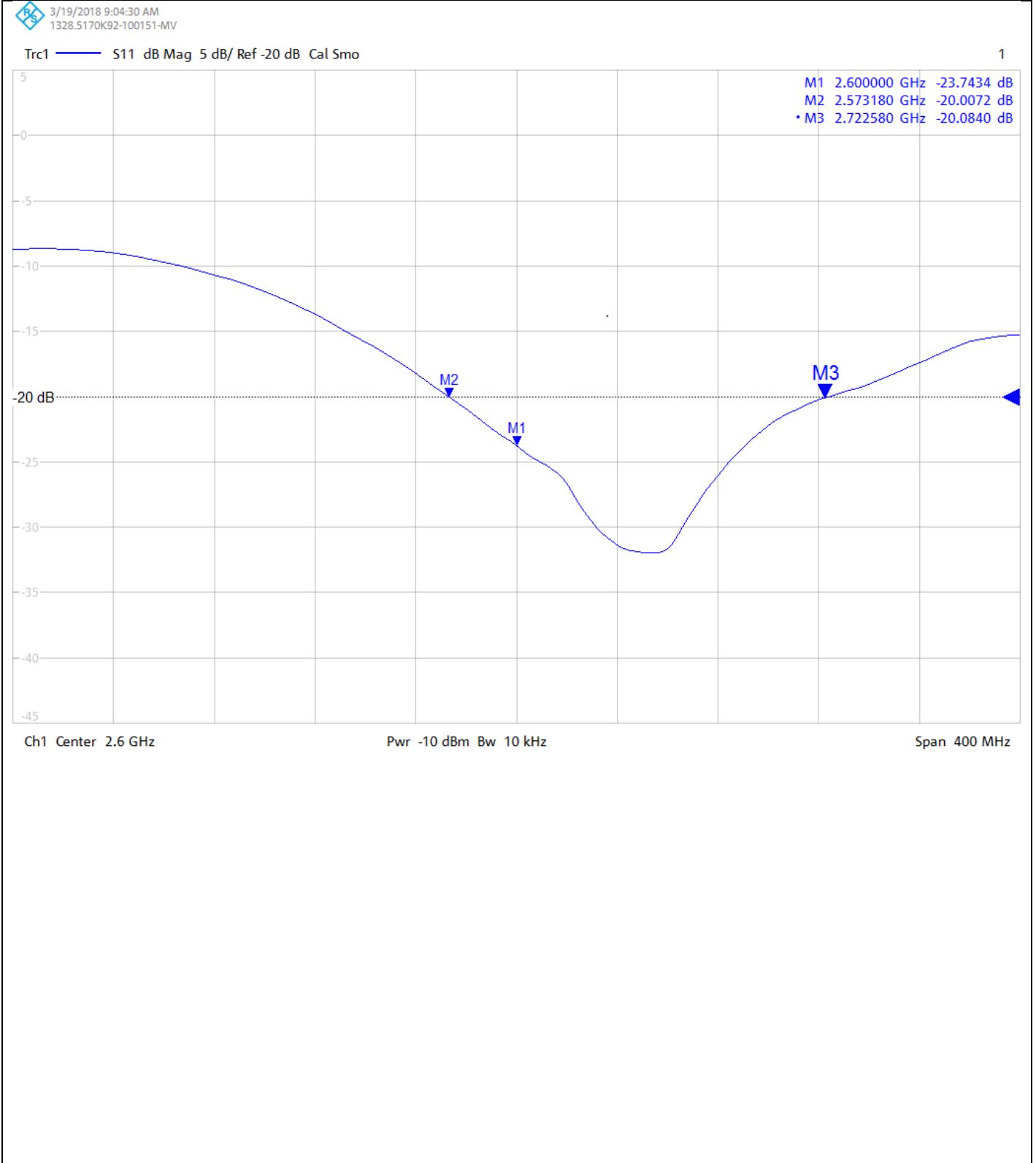
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### Return Loss Measurement Plot for Head Stimulating Liquid (HSL)



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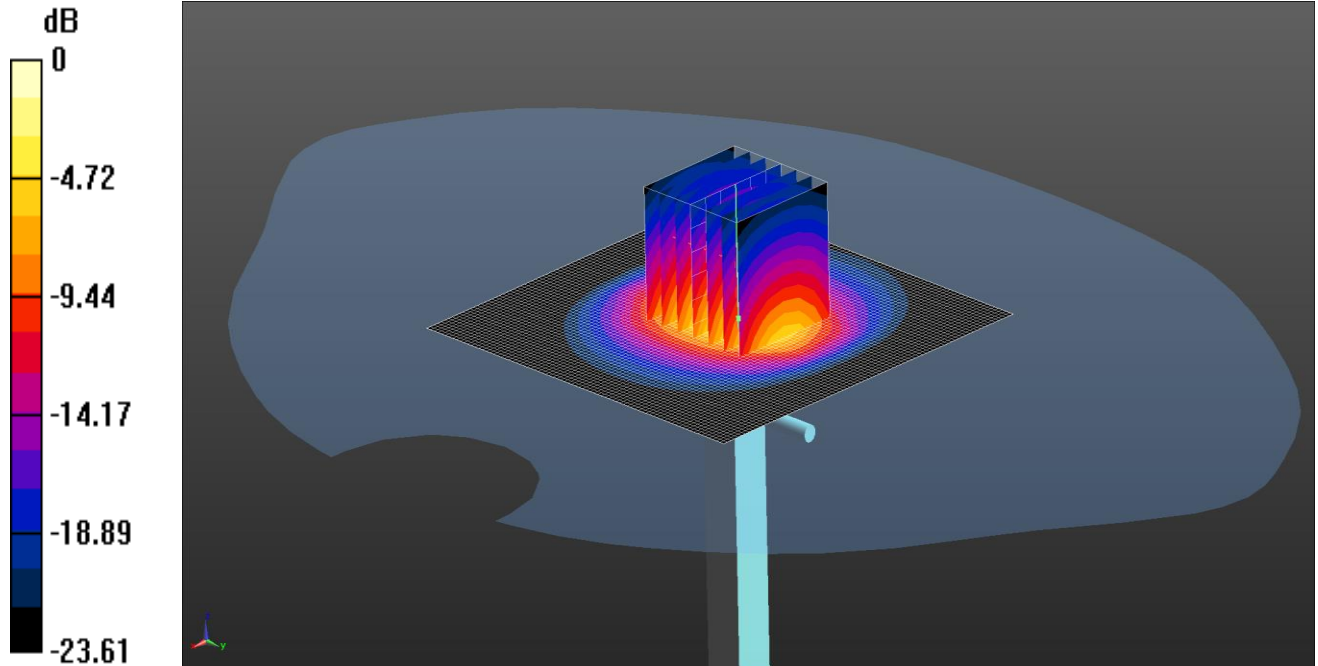
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### DASY Validation Scan for Body Stimulating Liquid (MSL)

Date: 20/03/2018

DUT: D2600V2 - SN1036; Type: D2600V2; Serial: SN1036



0 dB = 22.1 W/kg = 13.44 dBW/kg

Communication System: UID 0, CW (0); Frequency: 2600 MHz; Duty Cycle: 1:1  
Medium: 2600 MHz HSL Medium parameters used:  $f = 2600$  MHz;  $\sigma = 2.243$  S/m;  $\epsilon_r = 53.413$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3814; ConvF(7.03, 7.03, 7.03); Calibrated: 28/09/2017;
- Sensor-Surface: 4mm (Mechanical Surface Detection), Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn431; Calibrated: 08/11/2017
- Phantom: SAM (20deg probe tilt) with CRP v4.0; Type: QD000P40CC; Serial: 1817
- ; SEMCAD X Version 14.6.10 (7372)

**Configuration/d=10mm, Pin=250mW/Area Scan (81x81x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm

Maximum value of SAR (interpolated) = 16.2 W/kg

**Configuration/d=10mm, Pin=250mW/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 84.64 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 30.2 W/kg

**SAR(1 g) = 14.1 W/kg; SAR(10 g) = 6.29 W/kg**

Maximum value of SAR (measured) = 22.1 W/kg



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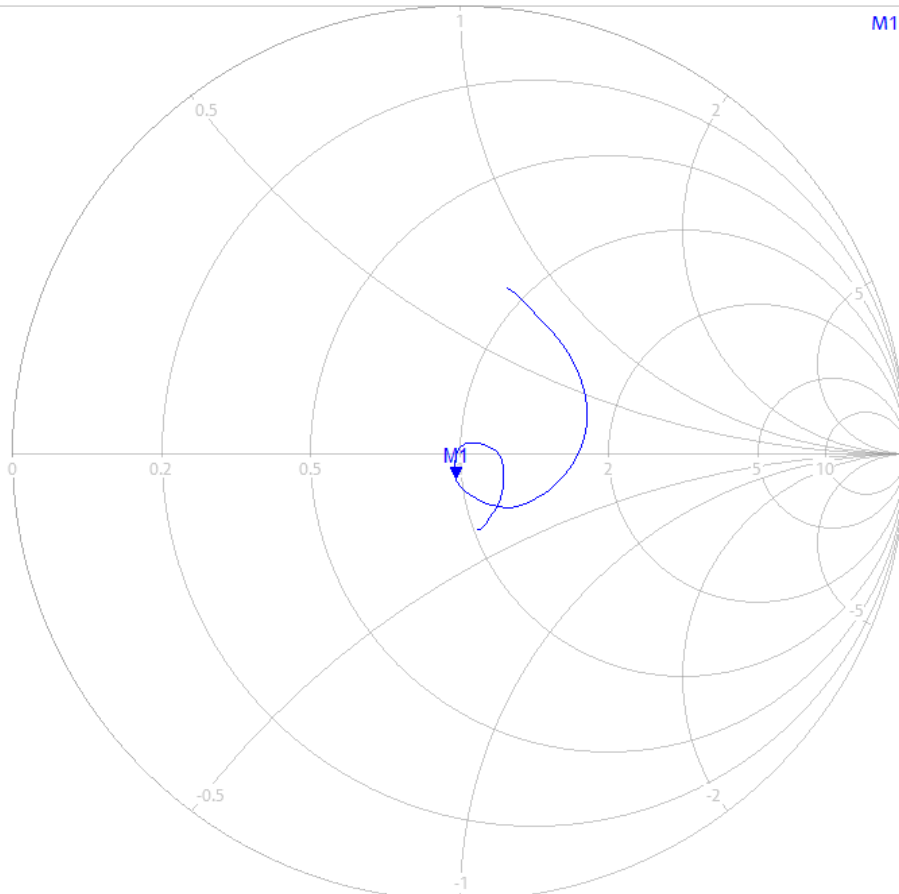
### Impedance Measurement Plot for Body Stimulating Liquid (MSL)

3/22/2018 7:41:40 AM  
1328.5170K92-100151-MV

Trc1 — S11 Smith 200 mU/ Ref 1 U Cal Smo

1

M1 2.60000 GHz 48.291  $\Omega$   
-j6.549  $\Omega$   
9.347 pF



Ch1 Start 2.4 GHz

Pwr -10 dBm Bw 10 kHz

Stop 2.8 GHz

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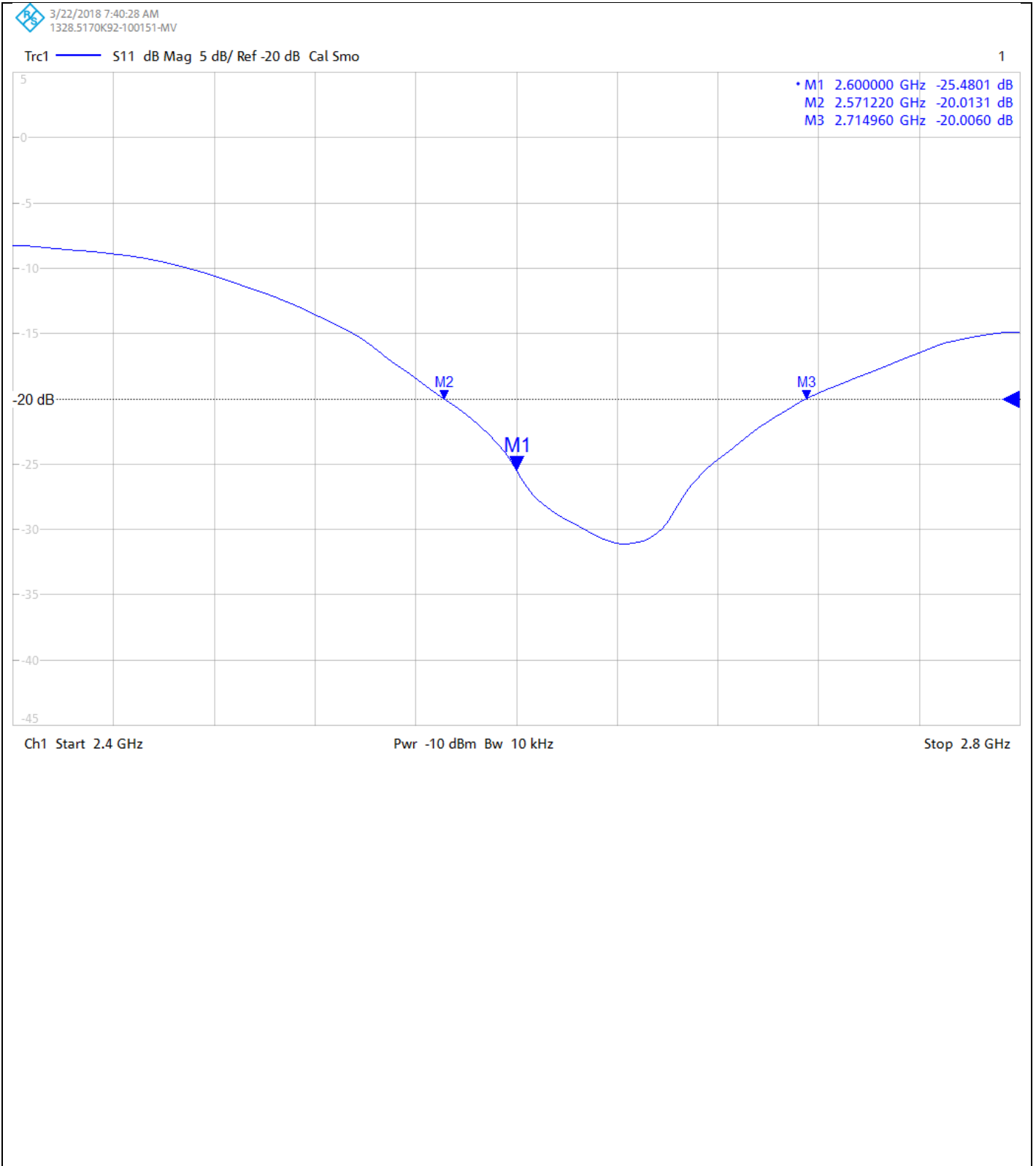
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### Return Loss Measurement Plot for Body Stimulating Liquid (MSL)



**Calibration Certificate Label:**

 <p>UKAS CALIBRATION 5248</p>	<p><b>UL VS LTD - Tel: +44 (0) 1256312000</b></p> <p>Certificate Number: 12134276JD01D</p> <p>Instrument ID: 1036</p> <p>Calibration Date: 16/Mar/2018</p> <p>Calibration Due Date:</p>
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