

CERTIFICATE OF CALIBRATION

ISSUED BY **UL VS LTD**

DATE OF ISSUE: 26/Mar/2018

CERTIFICATE NUMBER : 12134276JD01C



5248

UL VS LTD
PAVILION A
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Page 1 of 10

APPROVED SIGNATORY

A handwritten signature in blue ink, appearing to read 'N. Mirza'.

.....
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:	D2450V2		
Serial Number:	899		
Calibration Date:	16/Mar/2018		
Calibrated By:	Masood Khan Laboratory Engineer		

Signature:

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

.....

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

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CERTIFICATE OF CALIBRATION

ISSUED BY UL VS LTD

UKAS Accredited Calibration Laboratory No. 5248

CERTIFICATE
NUMBER :
12134276JD01C

Page 2 of 10

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
A2022	Dipole	SPEAG	D2440V2	701	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

CERTIFICATE OF CALIBRATION

ISSUED BY UL VS LTD

UKAS Accredited Calibration Laboratory No. 5248

CERTIFICATE
NUMBER :
12134276JD01C

Page 3 of 10

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:	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	23.5 °C	23.5 °C	22.5°C	22.5°C	ϵ_r	39.20	39.42	± 5%
						σ	1.80	1.83	± 5%

SAR Results – Head Simulating Liquid (HSL)

Simulant Liquid	SAR Measured	250 mW input Power	Normalised to 1.00 W	Uncertainty (%)
Head	SAR averaged over 1g	13.00 W/Kg	51.75 W/Kg	± 17.57%
	SAR averaged over 10g	6.08 W/Kg	24.20 W/Kg	± 17.32%

Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	46.548 Ω 1.86 j Ω	± 0.28 Ω ± 0.044 j Ω
	Return Loss	-27.26	± 2.03 dB

CERTIFICATE OF CALIBRATION

ISSUED BY UL VS LTD

UKAS Accredited Calibration Laboratory No. 5248

CERTIFICATE
NUMBER :
12134276JD01C

Page 4 of 10

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	2450	22.0 °C	22.0 °C	23.0°C	23.0°C	ϵ_r	52.70	51.71	± 5%
						σ	1.95	2.00	± 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	12.70 W/Kg	50.55 W/Kg	± 18.06%
	SAR averaged over 10g	5.83 W/Kg	23.20 W/Kg	± 17.44%

Antenna Parameters – Body Simulating Liquid (MSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Body	Impedance	44.85 Ω -2.77 j Ω	± 0.28 Ω ± 0.044 j Ω
	Return Loss	-25.93	± 2.03 dB

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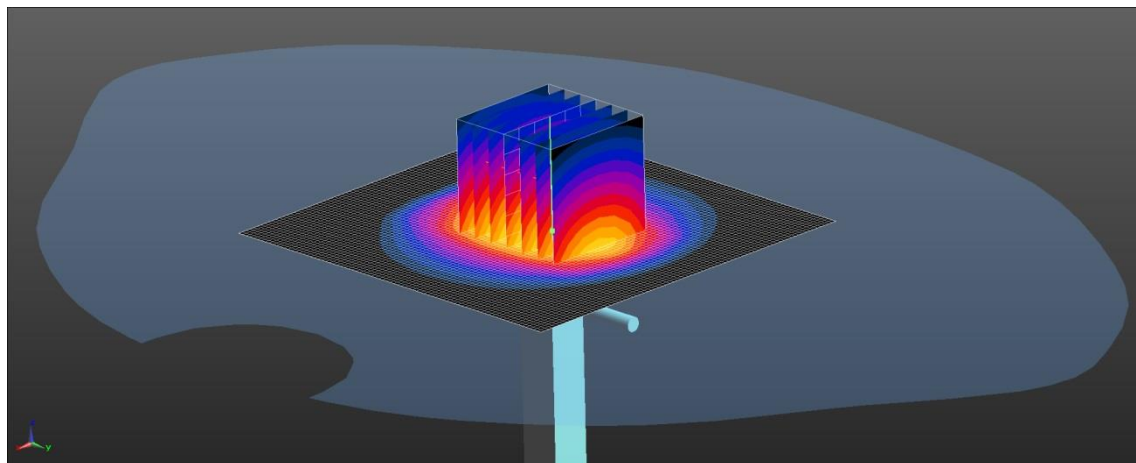
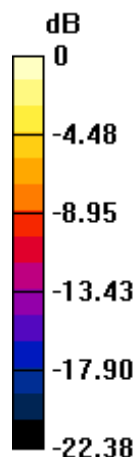
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CERTIFICATE
NUMBER :
12134276JD01C

Page 5 of 10

DASY Validation Scan for Head Stimulating Liquid (HSL)

DUT: D2450V2 - SN899; Type: D2450V2; Serial: SN899



0 dB = 19.6 W/kg = 12.92 dBW/kg

Communication System: UID 0, CW (0); Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: 2300 2450 2600 MHz HSL Medium parameters used: $f = 2450$ MHz; $\sigma = 1.831$ S/m; $\epsilon_r = 39.418$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3814; ConvF(7.04, 7.04, 7.04); 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) = 15.4 W/kg

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

Reference Value = 89.36 V/m; Power Drift = -0.12 dB

Peak SAR (extrapolated) = 26.7 W/kg

SAR(1 g) = 13 W/kg; SAR(10 g) = 6.08 W/kg

Maximum value of SAR (measured) = 19.6 W/kg

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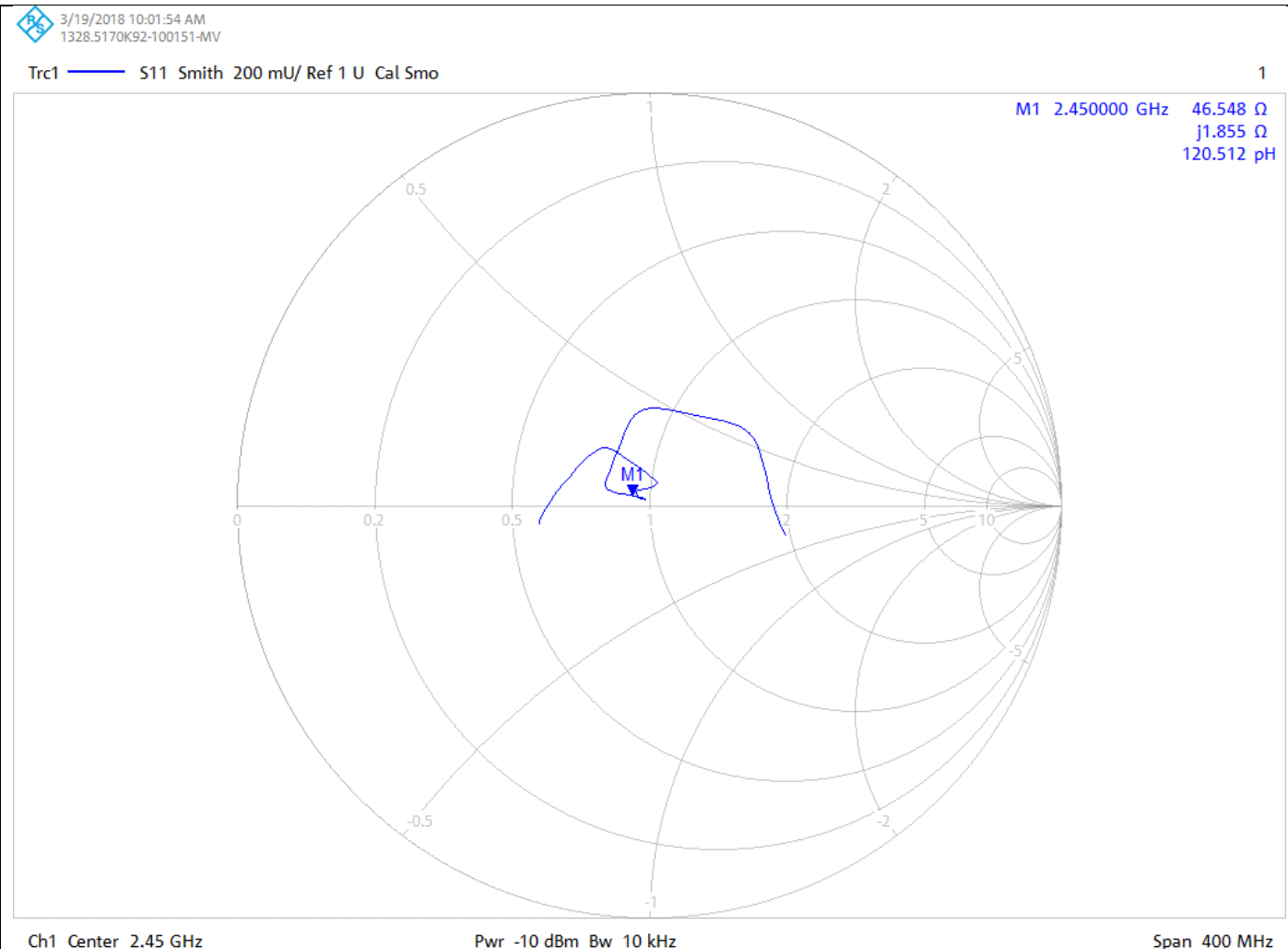
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UKAS Accredited Calibration Laboratory No. 5248

CERTIFICATE
NUMBER :
12134276JD01C

Page 6 of 10

Impedance Measurement Plot for Head Stimulating Liquid (HSL)



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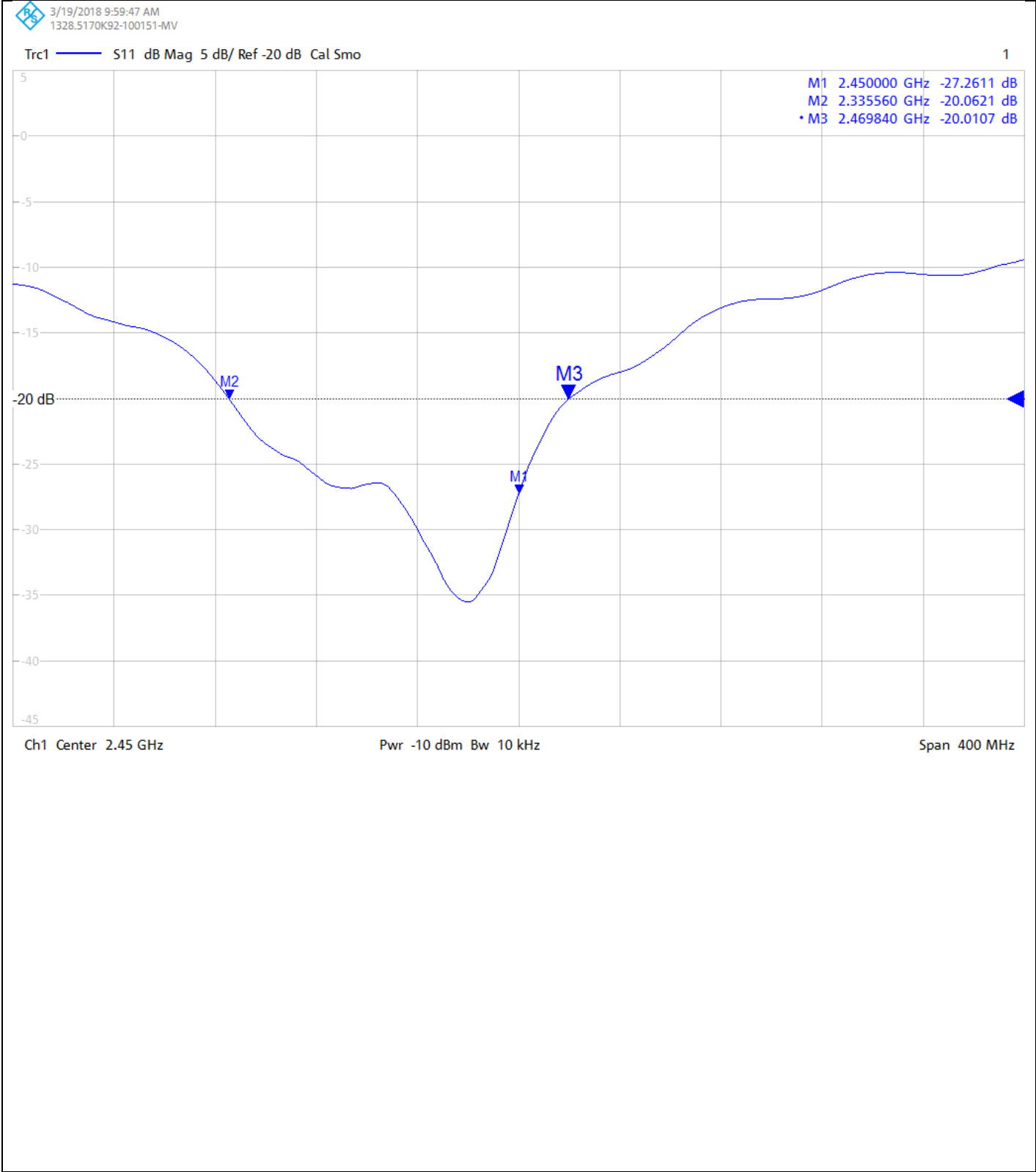
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UKAS Accredited Calibration Laboratory No. 5248

CERTIFICATE
NUMBER :
12134276JD01C

Page 7 of 10

Return Loss Measurement Plot for Head Stimulating Liquid (HSL)



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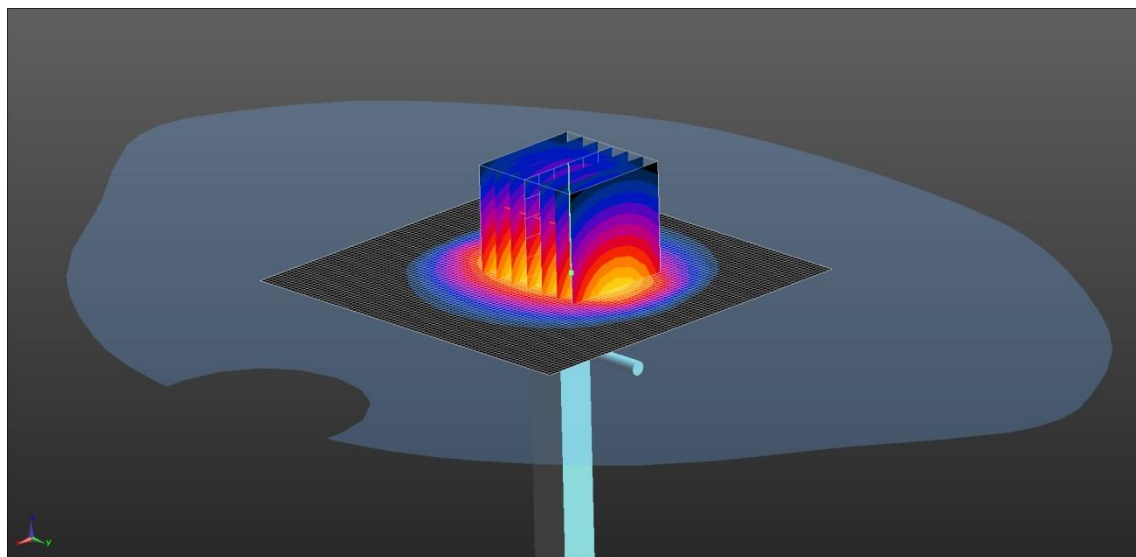
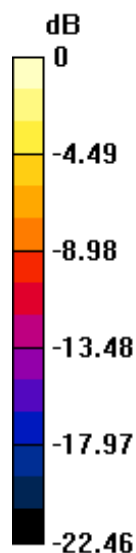
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CERTIFICATE
NUMBER :
12134276JD01C

Page 8 of 10

DASY Validation Scan for Body Stimulating Liquid (MSL)

DUT: D2450V2 - SN899; Type: D2450V2; Serial: SN899



0 dB = 19.2 W/kg = 12.83 dBW/kg

Communication System: UID 0, CW (0); Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: 2450 MHz HSL Medium parameters used: $f = 2450$ MHz; $\sigma = 2.003$ S/m; $\epsilon_r = 51.711$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3814; ConvF(7.2, 7.2, 7.2); 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) = 15.1 W/kg

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

Reference Value = 84.15 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 25.9 W/kg

SAR(1 g) = 12.7 W/kg; SAR(10 g) = 5.83 W/kg

Maximum value of SAR (measured) = 19.2 W/kg

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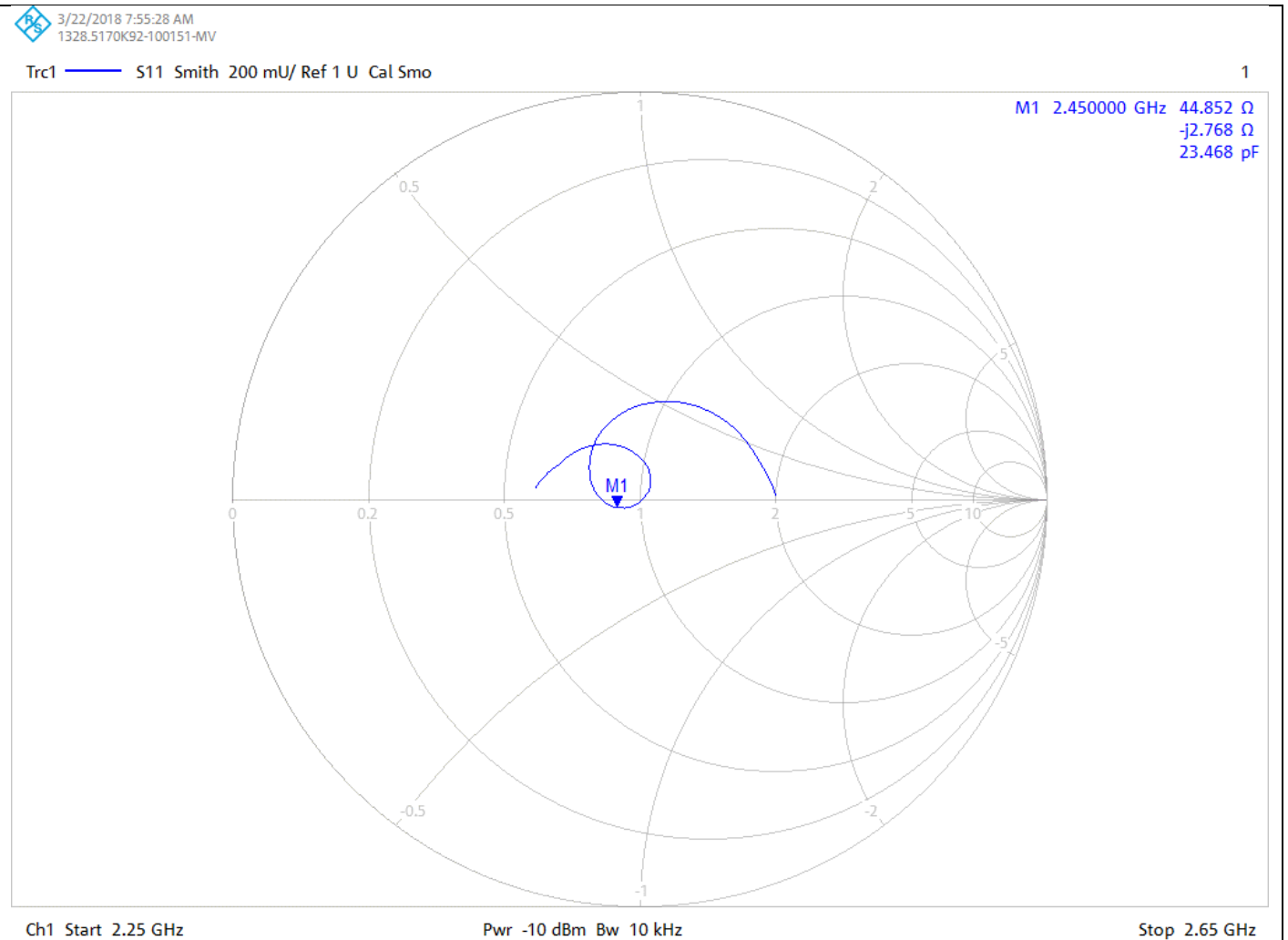
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UKAS Accredited Calibration Laboratory No. 5248

CERTIFICATE
NUMBER :
12134276JD01C

Page 9 of 10

Impedance Measurement Plot for Body Stimulating Liquid (MSL)



CERTIFICATE OF CALIBRATION

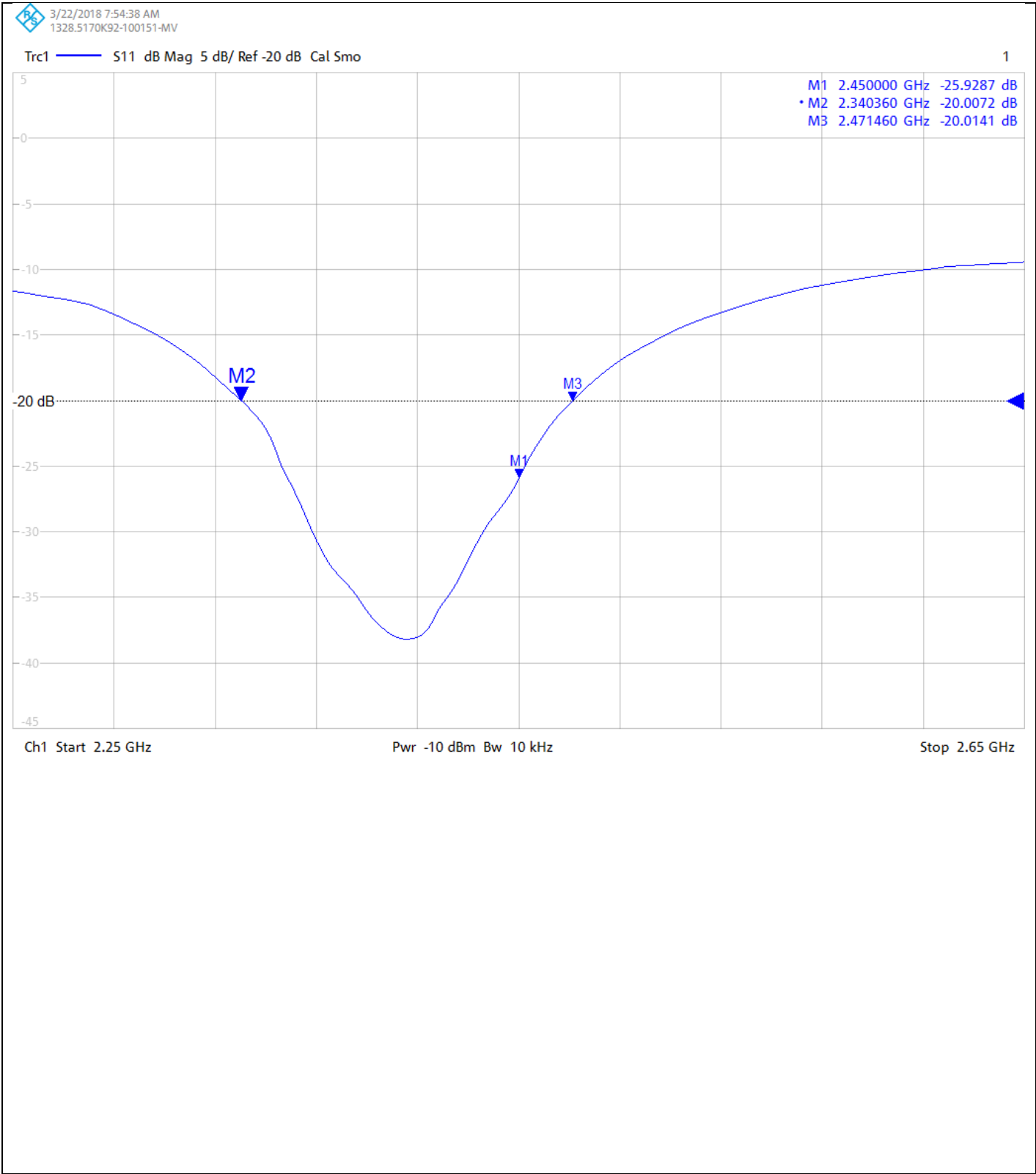
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UKAS Accredited Calibration Laboratory No. 5248


CERTIFICATE
NUMBER :
12134276JD01C


Page 10 of 10


Return Loss Measurement Plot for Body Stimulating Liquid (MSL)



Calibration Certificate Label:

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