CERTIFICATE OF CALIBRATION

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

DATE OF ISSUE: 29/Oct/2020 CERTIFICATE NUMBER : 13252590JD01A

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APPROVED SIGNATORY

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Harmohan Sahota

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

Equipment Details:

Description:	Dipole Validation Kit	Date of Receipt:	15/Oct/2020
Manufacturer:	Speag		
Type/Model Number:	D900V2		
Serial Number:	1d143		
Calibration Date:	21/Oct/2020		
Calibrated By:	Kaan Corbacioglu Laboratory Technician		
Signature:			

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All Calibration have been conducted in the closed laboratory facility: Lab Temperature (22±3) ^{0}C and humidity < 70%

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. **DASY5/6 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	14 Apr 2020	12
PRE0178314	Probe	SPEAG	EX3DV4	7496	24 Mar 2020	12
PRE0134199	Dipole	SPEAG	D900V2	035	11 Feb 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	ZNB 8	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

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:	15 mm (with spacer)
Frequency:	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	20.1 ℃	20.4 ℃	20.0 ℃	20.1 ℃	**εr**	41.50	41.72	± 5%
						σ	0.97	0.93	± 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	2.66 W/Kg	**10.59 W/Kg**	± 17.57%
	SAR averaged over 10g	1.74 W/Kg	**6.93 W/Kg**	± 17.32%

Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	50.05 Ω - 0.19j Ω	± 0.28 Ω ± 0.044 jΩ
	Return Loss	53.99	± 2.03 dB

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	900	19.4 ℃	19.5 ℃	19.9 ℃	20.1 ℃	**εr**	55.00	55.49	± 5%
						σ	1.05	1.00	± 5%

SAR Results – Body Simulating Liquid (MSL)

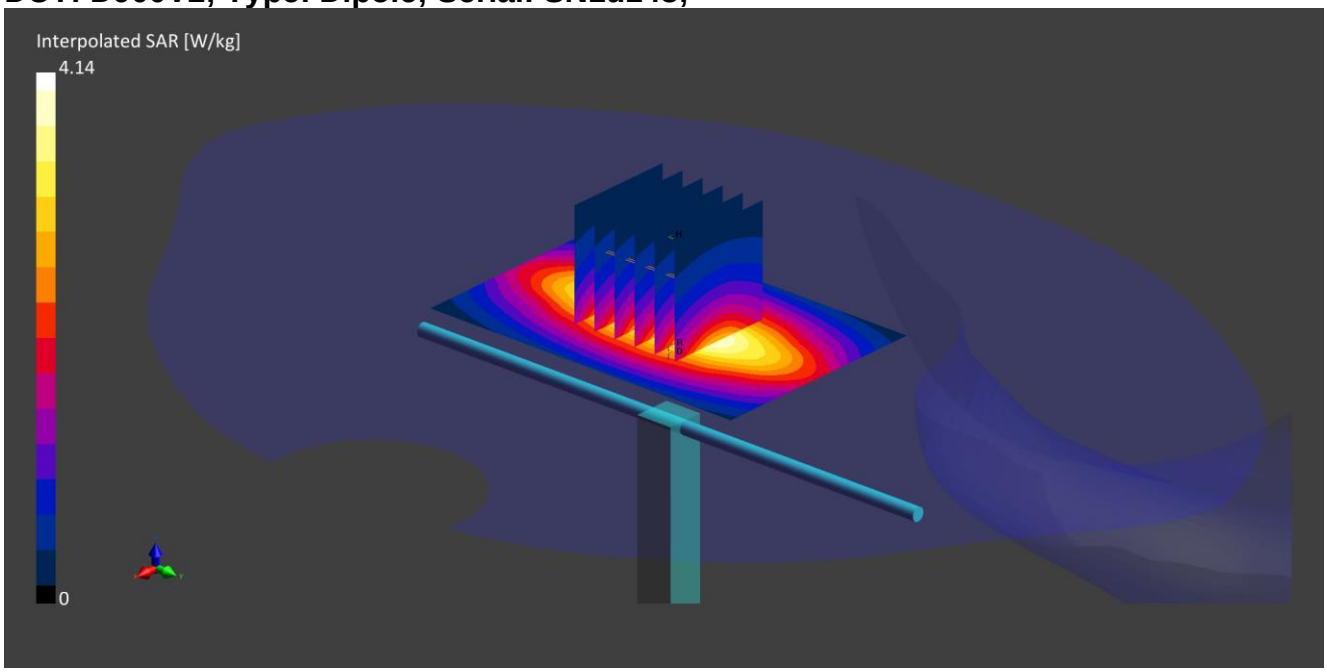
Simulant Liquid	**SAR Measured**	250 mW input Power	Normalised to 1.00 W	Uncertainty (%)
Body	SAR averaged over 1g	2.68 W/Kg	**10.67 W/Kg**	± 18.06%
	SAR averaged over 10g	1.77 W/Kg	**7.05 W/Kg**	± 17.44%

Antenna Parameters – Body Simulating Liquid (MSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Body	Impedance	55.14 Ω + 1.57j Ω	± 0.28 Ω ± 0.044 jΩ
	Return Loss	25.83	± 2.03 dB

DASY Validation Scan for Head Stimulating Liquid (HSL)

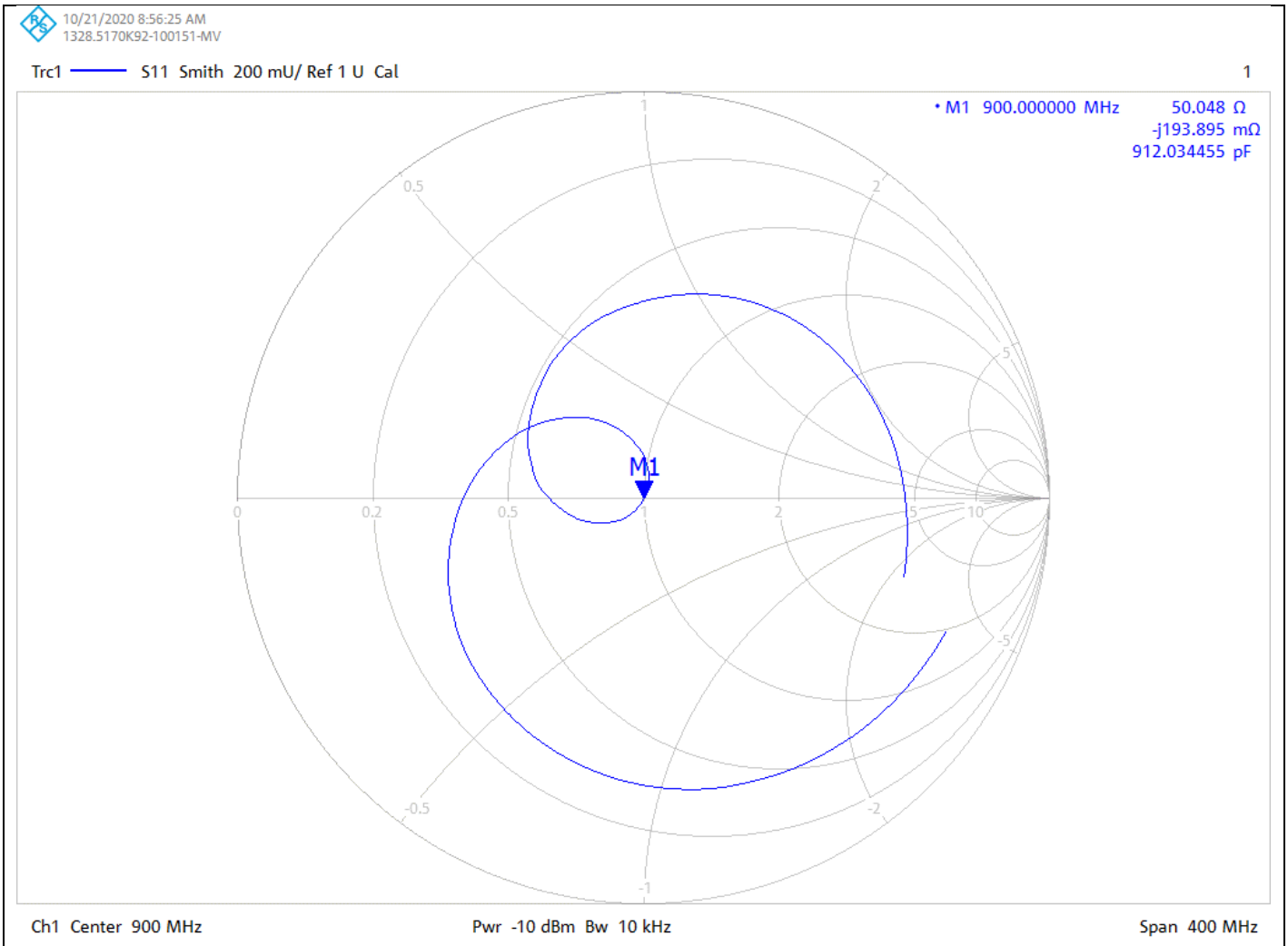
DUT: D900V2; Type: Dipole; Serial: SN1d143;



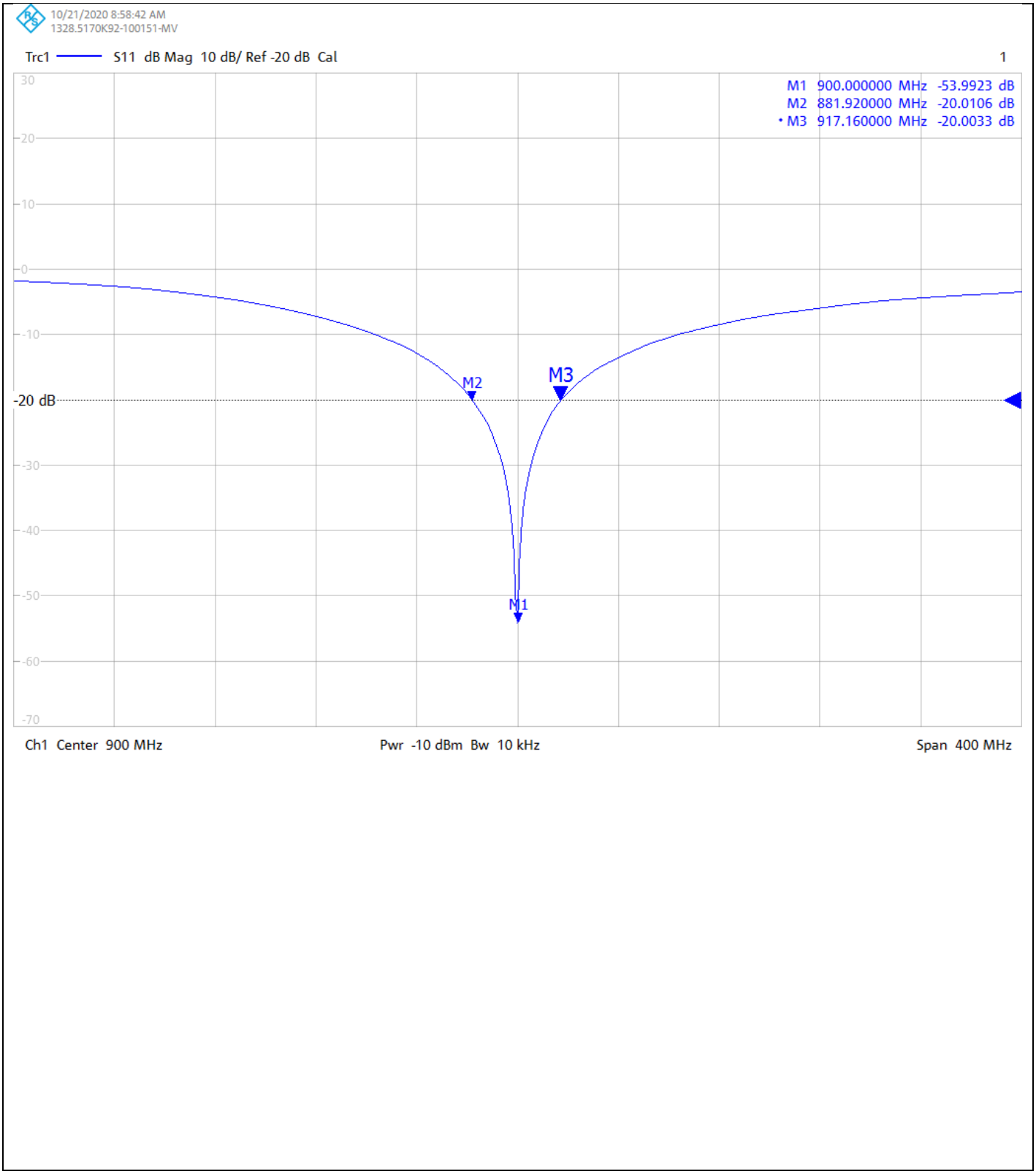
Communication System: CW UID: 0; Frequency: 900.0 MHz; Duty Cycle: 1;
Medium: HSL; Site65_21Oct2020_085903_Head - 900 2300 5%; Medium parameters used: f = 900.0 MHz; σ = 0.93 S/m; ε_r = 41.7; ρ = 1000 kg/m3; $\Delta\varepsilon_r$ = 0.53 %; $\Delta\sigma$ = -3.71 %; No correction
Phantom section: Flat;
DASY 6 Configuration:
- Laboratory Name: Site65;
- Probe: EX3DV4 - SN7496; ConvF(9.65, 9.65, 9.65); Calibrated: 24 Mar 2020
- Sensor-Surface: 1.4 mm; VMS + 6p
- Electronics: DAE4 - SN1438; Calibrated: 14 Apr 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 = 3.090 V/m; Power Drift = 0.00 dB
Minimum horizontal 3dB distance: 16.1 mm;
Vertical M2/M1 Ratio: 87.1 %;
SAR(1 g) = 2.660 W/kg; SAR(10 g) = 1.740 W/kg

Impedance Measurement Plot for Head Stimulating Liquid (HSL)

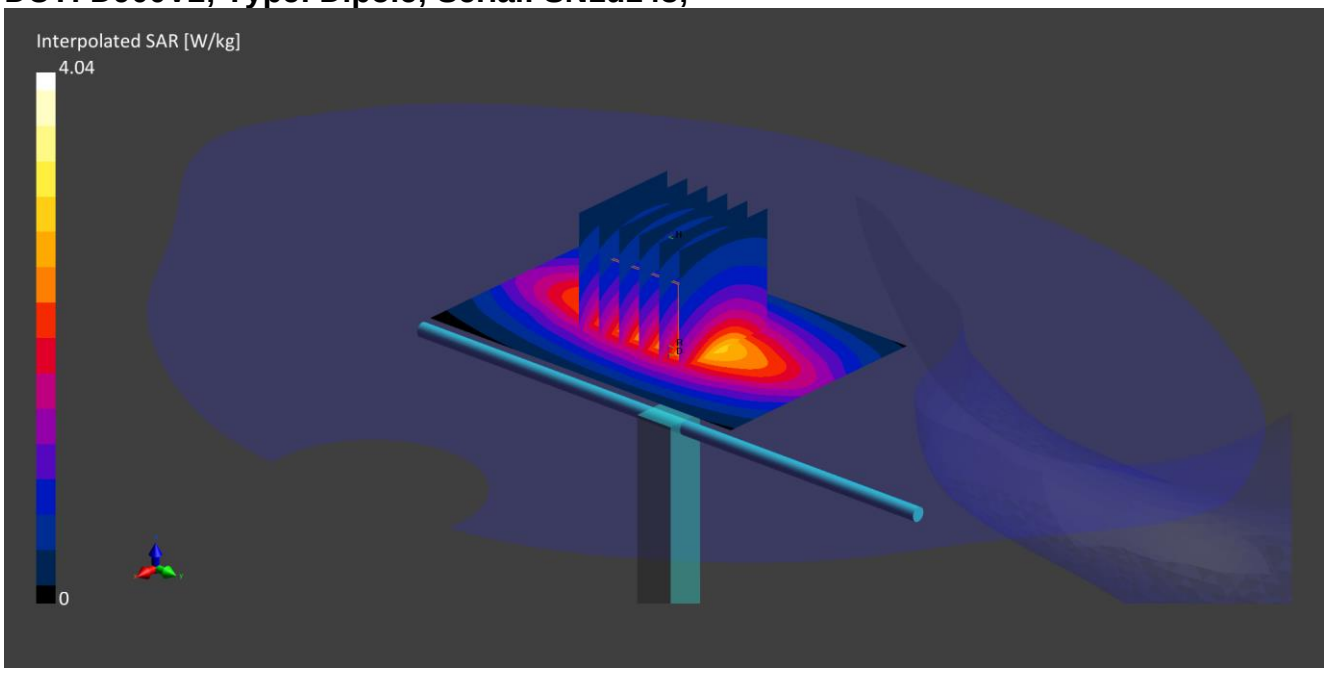


Return Loss Measurement Plot for Head Stimulating Liquid (HSL)



DASY Validation Scan for Body Stimulating Liquid (MSL)

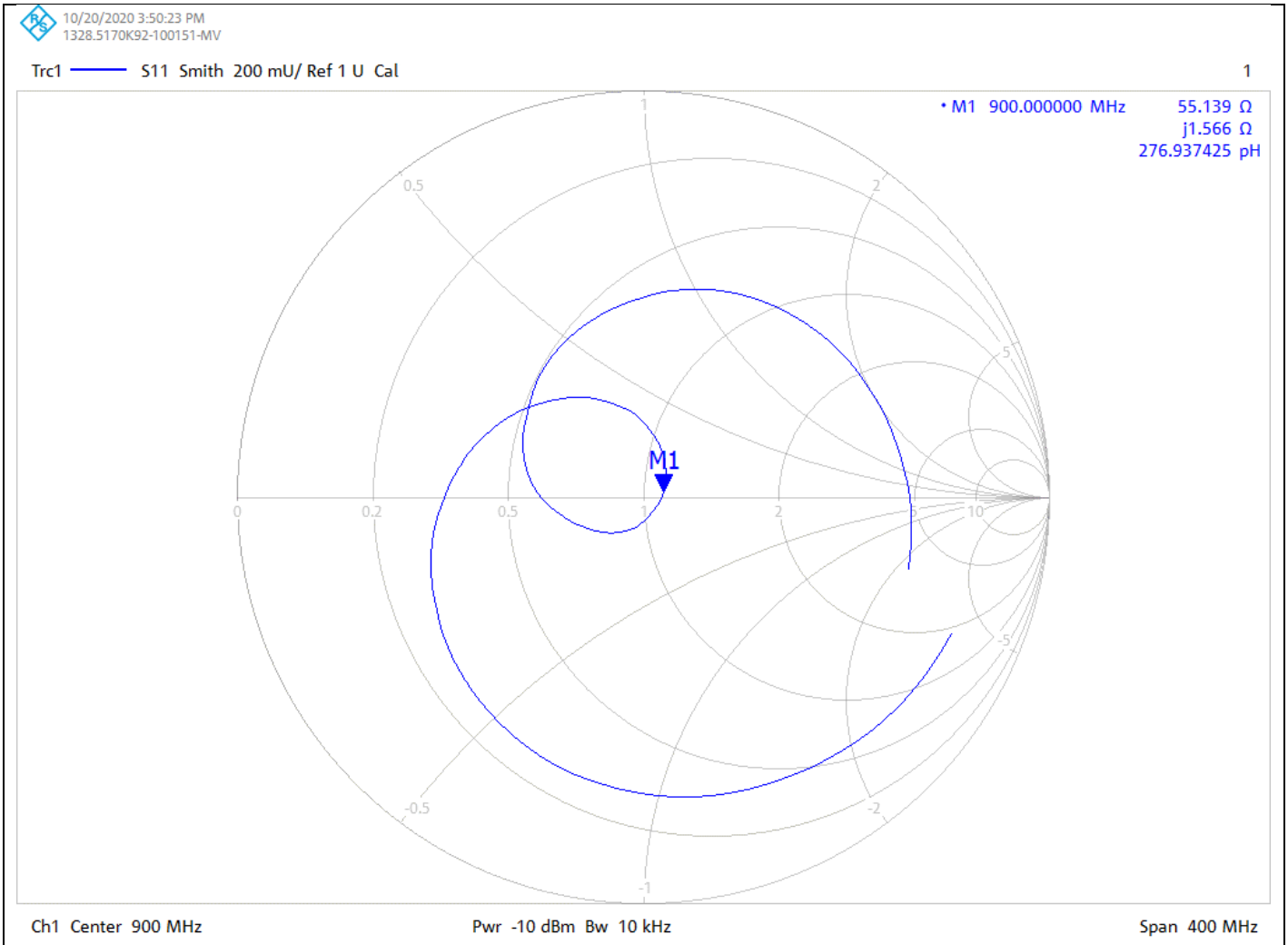
DUT: D900V2; Type: Dipole; Serial: SN1d143;



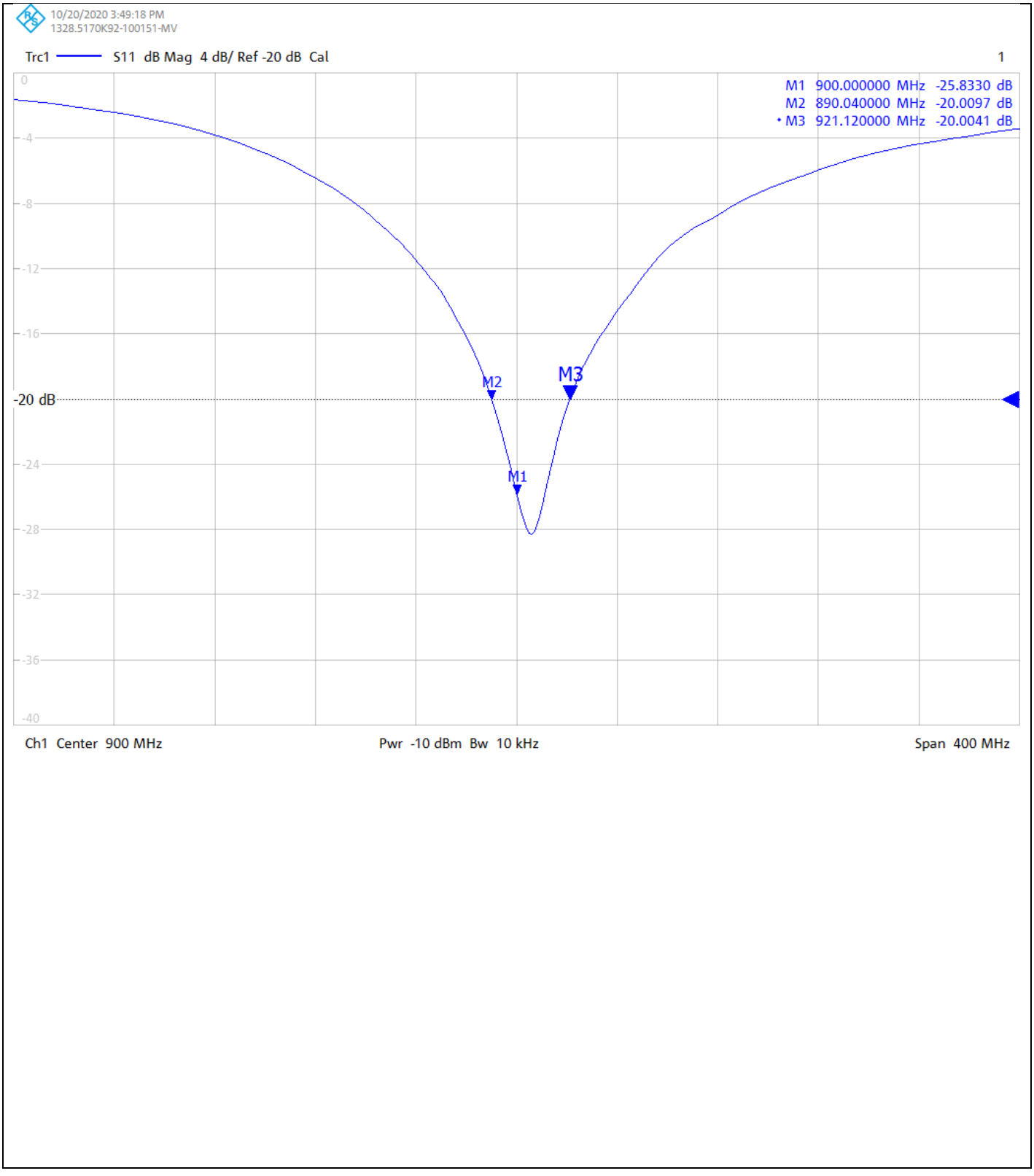
Communication System: CW UID: 0; Frequency: 900.0 MHz; Duty Cycle: 1;
Medium: MSL; Site65_19Oct2020_142913_Body - 900 5%; Medium parameters used: f = 900.0 MHz; σ = 1 S/m; ε_r = 55.5; ρ = 1000 kg/m3; $\Delta\varepsilon_r$ = 0.88 %; $\Delta\sigma$ = -4.49 %; No correction
Phantom section: Flat;
DASY 6 Configuration:
- Laboratory Name: Site65;
- Probe: EX3DV4 - SN7496; ConvF(9.7, 9.7, 9.7); Calibrated: 24 Mar 2020
- Sensor-Surface: 1.4 mm; VMS + 6p
- Electronics: DAE4 - SN1438; Calibrated: 14 Apr 2020
- Phantom: Twin-SAM V5.0 (30deg probe tilt); Serial: 1818
- 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 = 3.070 V/m; Power Drift = 0.01 dB
Minimum horizontal 3dB distance: 15.6 mm;
Vertical M2/M1 Ratio: 87.5 %;
SAR(1 g) = 2.680 W/kg; SAR(10 g) = 1.770 W/kg

Impedance Measurement Plot for Body Stimulating Liquid (MSL)



Return Loss Measurement Plot for Body Stimulating Liquid (MSL)



Calibration Certificate Label:

UL INTERNATIONAL (UK) LTD
Tel: +44 (0) 1256312000

Certificate Number: 13252590JD01A

Instrument ID: 1d143

Calibration Date: 21/Oct/2020

Calibration Due Date:

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