CERTIFICATE OF CALIBRATION

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

DATE OF ISSUE: 27/Nov/2020 CERTIFICATE NUMBER : 13252589JD01A

5772

UL INTERNATIONAL (UK) LTD
UNIT 1-3 HORIZON
KINGSLAND PARK, WADE ROAD
BASINGSTOKE, HAMPSHIRE
RG24 8AH, UK
TEL: +44 (0) 1256 312000
FAX: +44 (0) 1256 312001
Email: LST.UK.Calibration@ul.com

APPROVED SIGNATORY

.....

Naseer Mirza

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

Equipment Details:

Description:	Dipole Validation Kit	Date of Receipt:	26/Nov/2020
Manufacturer:	Speag		
Type/Model Number:	D750V3		
Serial Number:	1071		
Calibration Date:	26/Nov/2020		
Calibrated By:	Masood Khan Laboratory Engineer		
Signature:			

.....

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. **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	14 Apr 2020	12
PRE0178314	Probe	SPEAG	EX3DV4	7496	24 Mar 2020	12
PRE0133692	Dipole	SPEAG	D750V3	1011	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	HP	8648C	3537A01598	22 Jan 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:	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	20.9 ℃	20.5 ℃	20.5℃	20.1℃	**εr**	41.96	42.87	± 5%
						σ	0.89	0.87	± 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	2.12 W/Kg	**8.44 W/Kg**	± 17.57%
	SAR averaged over 10g	1.40 W/Kg	**5.57 W/Kg**	± 17.32%

Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	46.925 Ω + 1.53 jΩ	± 0.28 Ω ± 0.044 jΩ
	Return Loss	26.47	± 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	750	20.0 ℃	20.0 ℃	19.3℃	20.0℃	**εr**	55.53	55.82	± 5%
						σ	0.96	0.94	± 5%

SAR Results – Body Simulating Liquid (MSL)

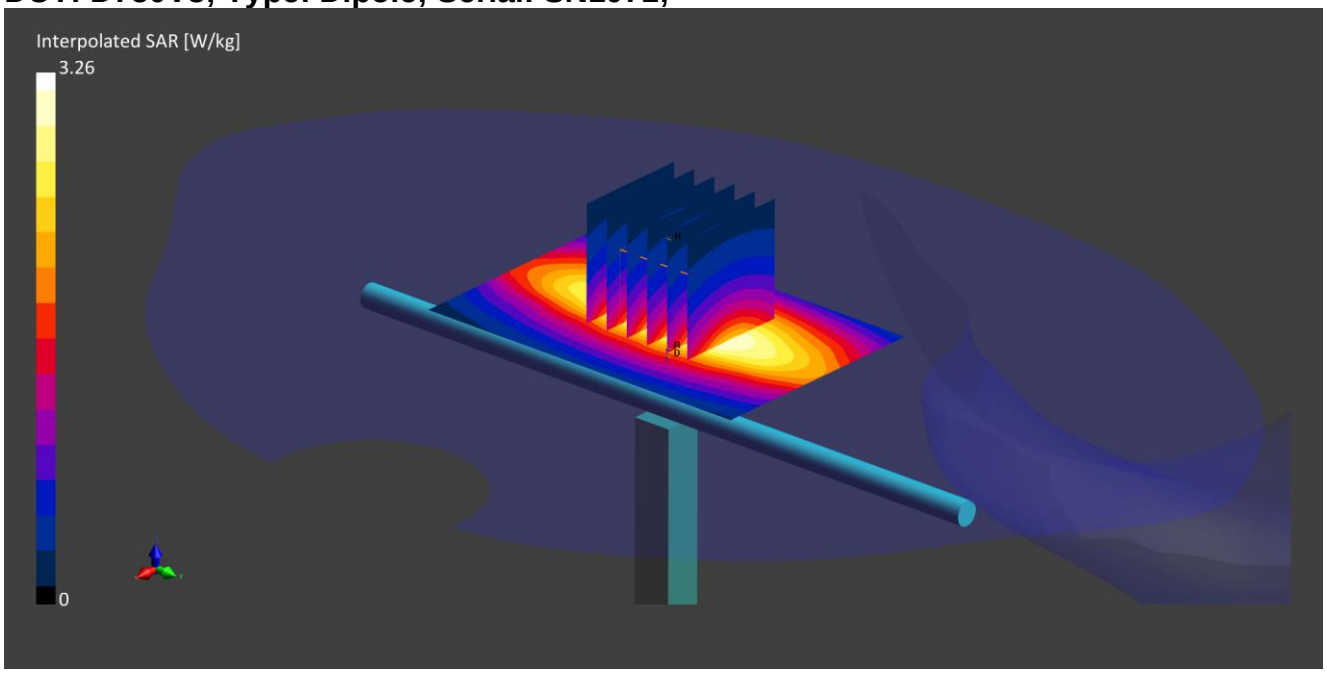
Simulant Liquid	**SAR Measured**	250 mW input Power	Normalised to 1.00 W	Uncertainty (%)
Body	SAR averaged over 1g	2.22 W/Kg	**8.88 W/Kg**	± 18.06%
	SAR averaged over 10g	1.48 W/Kg	**5.89 W/Kg**	± 17.44%

Antenna Parameters – Body Simulating Liquid (MSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Body	Impedance	51.96 Ω +2.82 jΩ	± 0.28 Ω ± 0.044 jΩ
	Return Loss	31.29	± 2.03 dB

DASY Validation Scan for Head Stimulating Liquid (HSL)

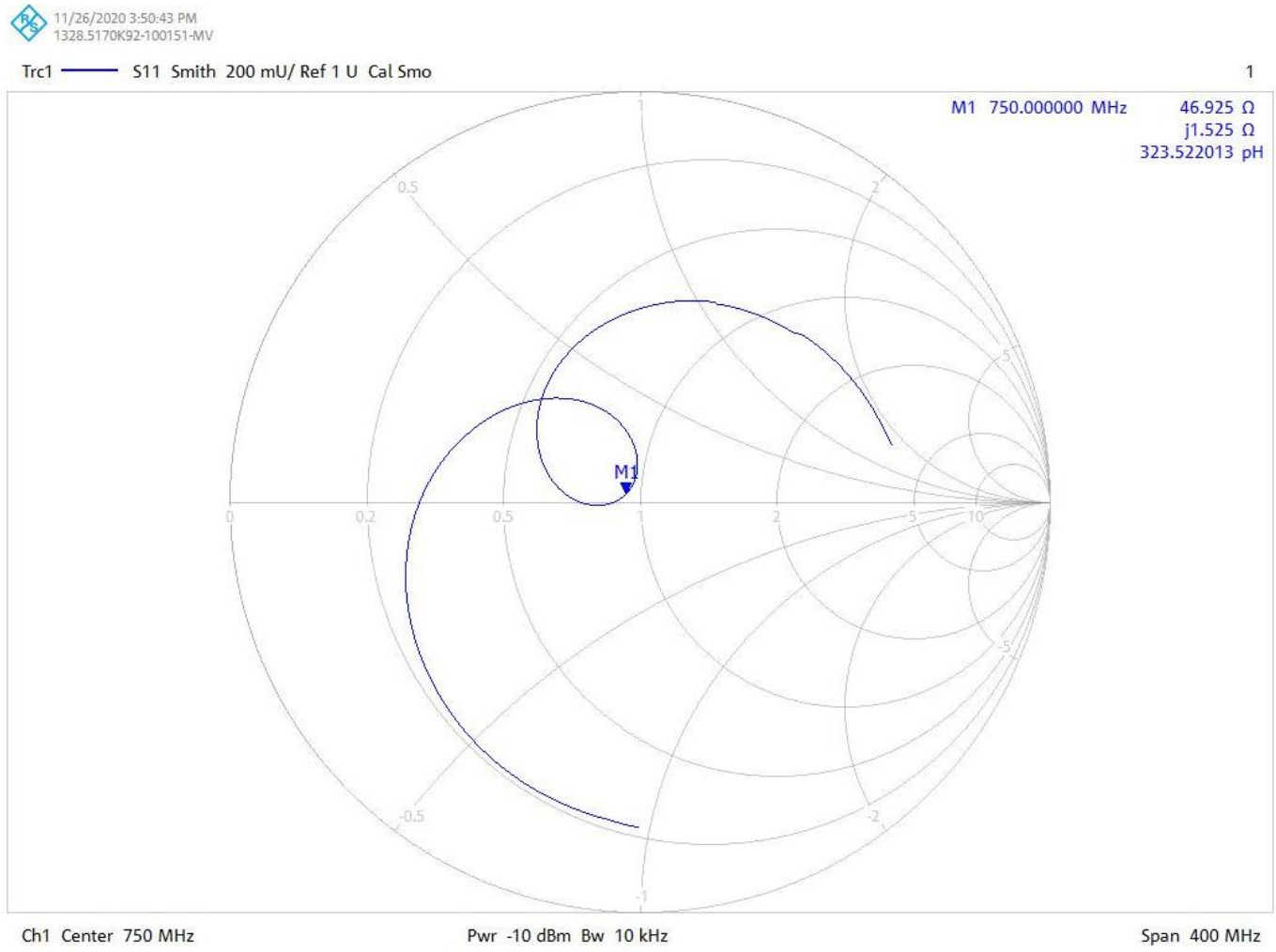
DUT: D750V3; Type: Dipole; Serial: SN1071;



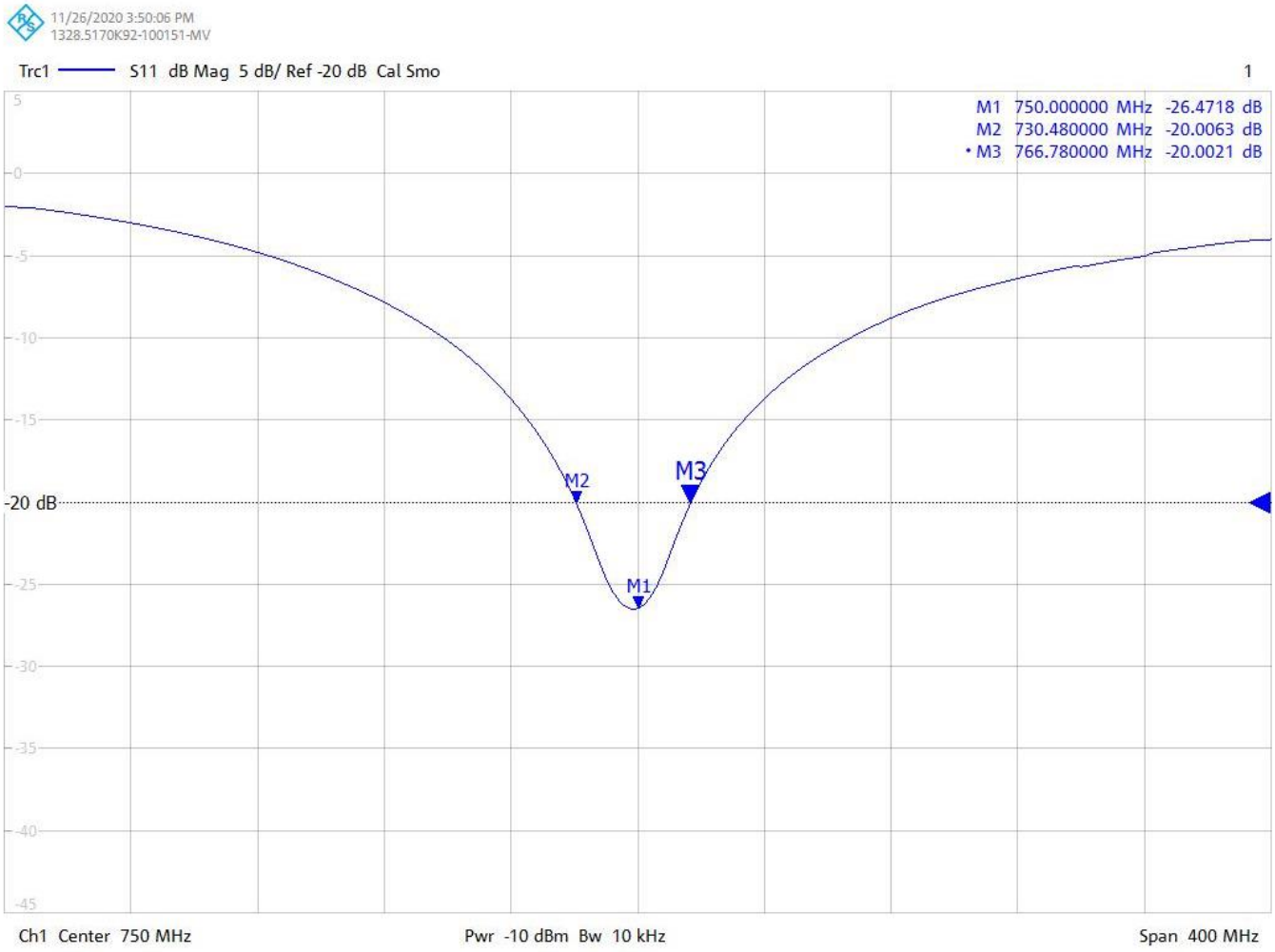
Communication System: CW UID: 0; Frequency: 750.0 MHz; Duty Cycle: 1;
Medium: HSL; Site65_26Nov2020_101608_Head - 750 900 1800 1900 5%; Medium parameters used: f = 750.0 MHz; σ = 0.87 S/m; ε_r= 42.9; ρ = 1000 kg/m3; $\Delta\varepsilon_r$= 2.21 %; $\Delta\sigma$ = -2.07 %; No correction
Phantom section: Flat;
DASY 6 Configuration:
- Probe: EX3DV4 - SN7496; ConvF(10.29, 10.29, 10.29); 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 = 2.450 V/m; Power Drift = 0.00 dB
Minimum horizontal 3dB distance: 22.9 mm;
Vertical M2/M1 Ratio: 87.3 %;
SAR(1 g) = 2.120 W/kg; SAR(10 g) = 1.400 W/kg

Impedance Measurement Plot for Head Stimulating Liquid (HSL)

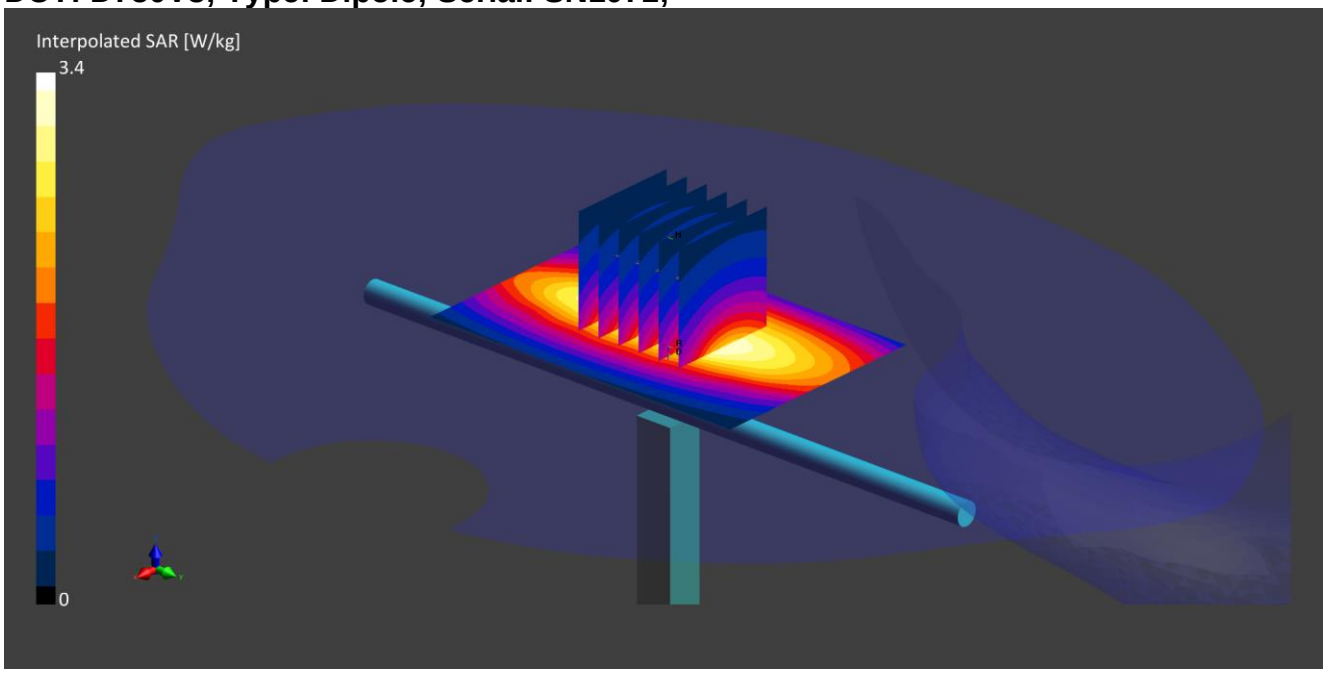


Return Loss Measurement Plot for Head Stimulating Liquid (HSL)



DASY Validation Scan for Body Stimulating Liquid (MSL)

DUT: D750V3; Type: Dipole; Serial: SN1071;

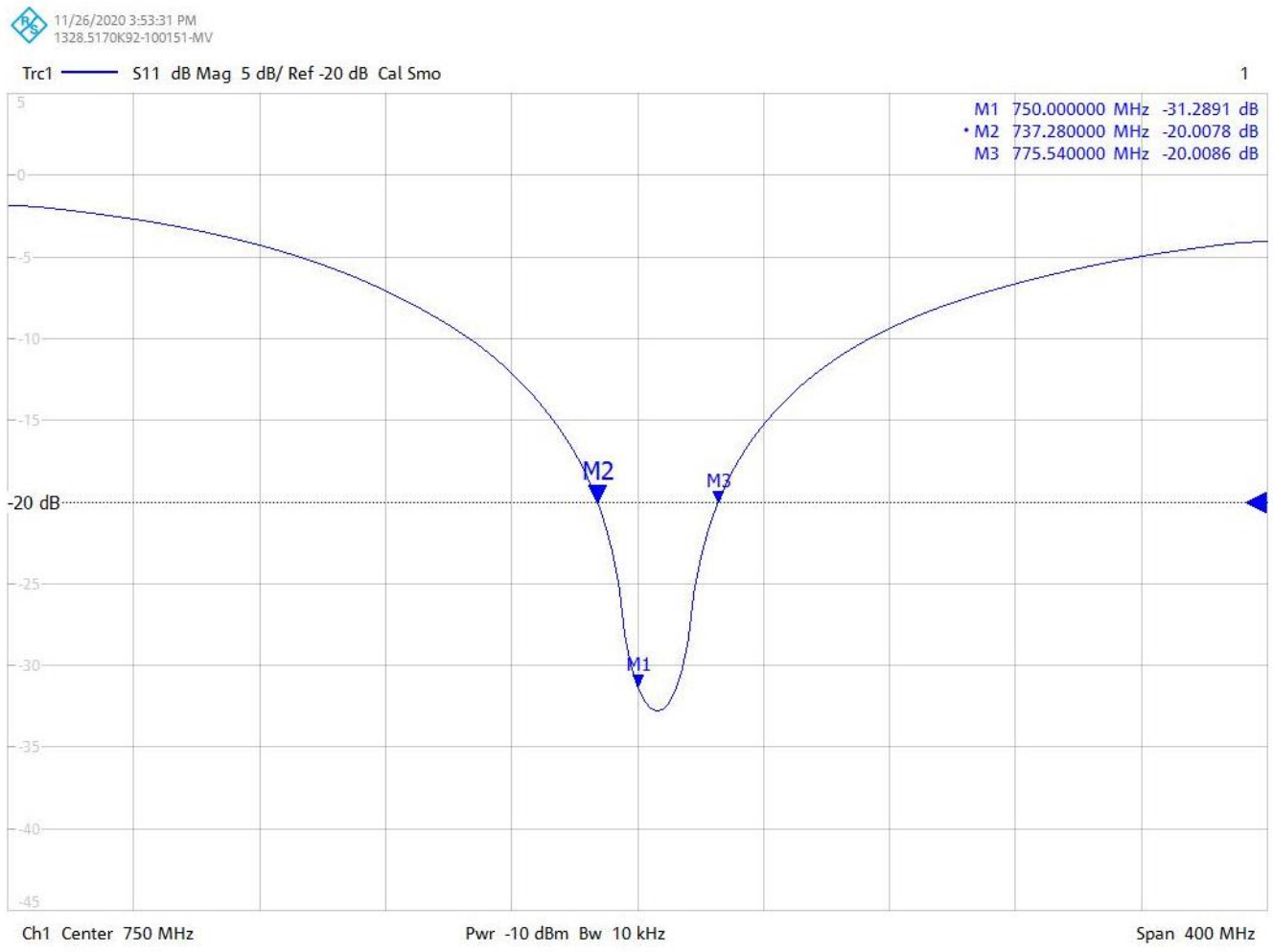


Communication System: CW UID: 0; Frequency: 750.0 MHz; Duty Cycle: 1;
Medium: MSL; Site65_26Nov2020_103812_Body - 750 900 1800 1900 5%; Medium parameters used: f = 750.0 MHz; σ = 0.94 S/m; ε_r= 55.8; ρ = 1000 kg/m3; $\Delta\varepsilon_r$= 0.51 %; $\Delta\sigma$ = -2.26 %; No correction
Phantom section: Flat;
DASY 6 Configuration:
- Probe: EX3DV4 - SN7496; ConvF(10.1, 10.1, 10.1); 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 = 2.570 V/m; Power Drift = 0.00 dB
Minimum horizontal 3dB distance: 16.0 mm;
Vertical M2/M1 Ratio: 87.3 %;
SAR(1 g) = 2.220 W/kg; SAR(10 g) = 1.480 W/kg

Impedance Measurement Plot for Body Stimulating Liquid (MSL)

Return Loss Measurement Plot for Body Stimulating Liquid (MSL)



Calibration Certificate Label:

UKAS CALIBRATION 5772	**UL INTERNATIONAL (UK) LTD** **Tel: +44 (0) 1256312000** Certificate Number: 13252589JD01A Instrument ID: 1071 Calibration Date: 26/Nov/2020 Calibration Due Date:

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CERTIFICATE OF CALIBRATION

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

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

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UL INTERNATIONAL (UK) LTD
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KINGSLAND PARK, WADE ROAD
BASINGSTOKE, HAMPSHIRE
RG24 8AH, UK
TEL: +44 (0) 1256 312000
FAX: +44 (0) 1256 312001
Email: LST.UK.Calibration@ul.com

APPROVED SIGNATORY

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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) ^{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. **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

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:	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 ℃	19.6 ℃	20.6 ℃	20.7 ℃	**εr**	41.96	42.59	± 5%
						σ	0.89	0.89	± 5%

SAR Results – Head Simulating Liquid (HSL)

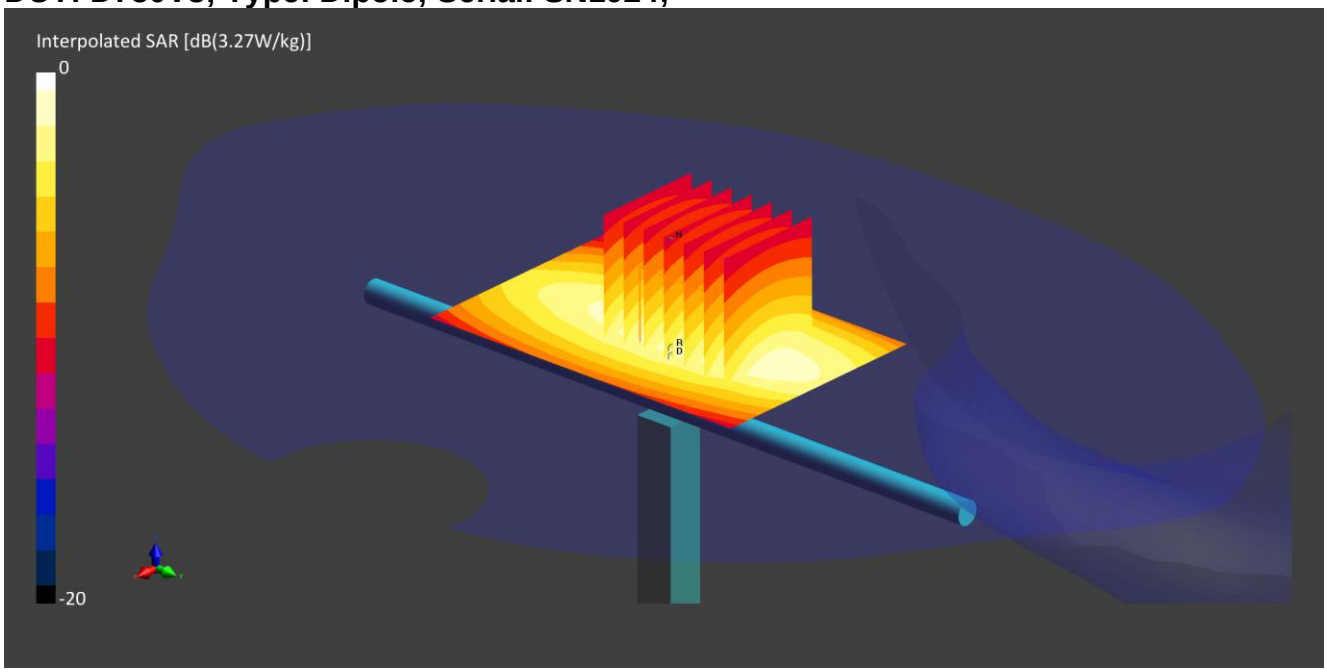
Simulant Liquid	SAR Measured	250 mW input Power	Normalised to 1.00 W	Uncertainty (%)
Head	SAR averaged over 1g	2.15 W/Kg	**8.60 W/Kg**	+16.80% / -16.43%
	SAR averaged over 10g	1.43 W/Kg	**5.69 W/Kg**	+16.72% / -16.42%

Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	45.13 Ω -0.50 jΩ	± 0.28 Ω ± 0.044 jΩ
	Return Loss	25.77	± 2.97 dB

DASY Validation Scan for Head Stimulating Liquid (HSL)

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

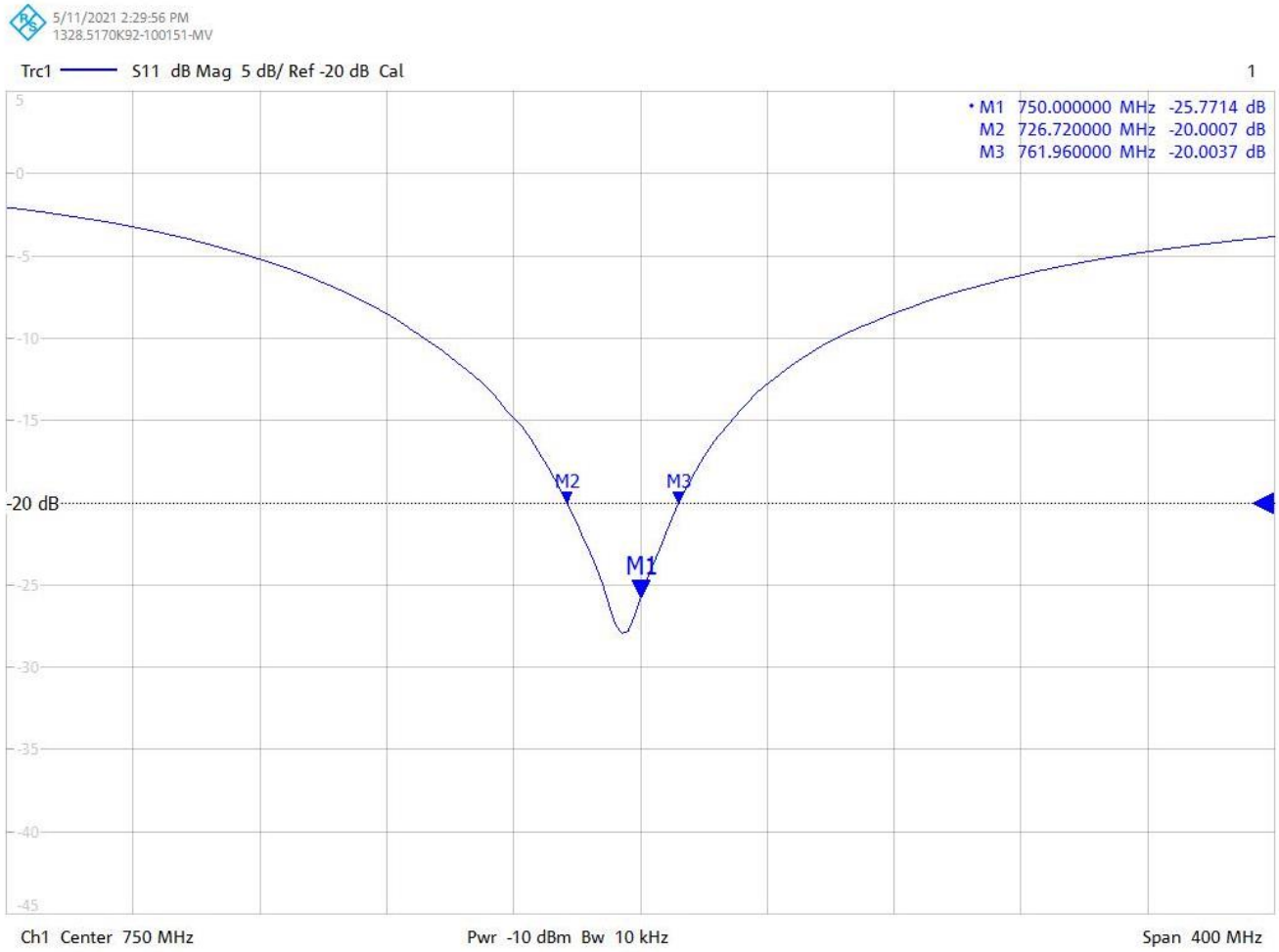


Communication System: CW UID: 0; Frequency: 750.0 MHz; Duty Cycle: 1;
Medium: HSL; Site65_10May2021_154932_Head - 750 900 5%; Medium parameters used: f = 750.0 MHz; σ = 0.89 S/m; ε_r= 42.6; ρ = 1000 kg/m3; $\Delta\varepsilon_r$= 1.56 %; $\Delta\sigma$ = 0.06 %; No correction
Phantom section: Flat;
DASY 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

Impedance Measurement Plot for Head Stimulating Liquid (HSL)

Return Loss Measurement Plot for Head Stimulating Liquid (HSL)



Calibration Certificate Label:

UKAS CALIBRATION 5772	**UL INTERNATIONAL (UK) LTD** **Tel: +44 (0) 1256312000** Certificate Number: 13685220JD01A Instrument ID: 1024 Calibration Date: 11/May/2021 Calibration Due Date:

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UKAS CALIBRATION 5772	**UL INTERNATIONAL (UK) LTD** **Tel: +44 (0) 1256312000** Certificate Number: 13685220JD01A Instrument ID: 1024 Calibration Date: 11/May/2021 Calibration Due Date:

CERTIFICATE OF CALIBRATION

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DATE OF ISSUE: 17/May/2021 CERTIFICATE NUMBER : 13685220JD01B

5772

UL INTERNATIONAL (UK) LTD
UNIT 1-3 HORIZON
KINGSLAND PARK, WADE ROAD
BASINGSTOKE, HAMPSHIRE
RG24 8AH, UK
TEL: +44 (0) 1256 312000
FAX: +44 (0) 1256 312001
Email: LST.UK.Calibration@ul.com

APPROVED SIGNATORY

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Naseer Mirza

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:	D835V2		
Serial Number:	4d117		
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) ^{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. **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
PRE0135218	Dipole	SPEAG	D900V2	1d168	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

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:	835 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	835	19.2 ℃	19.6 ℃	20.6℃	20.7℃	**εr**	41.50	42.36	± 5%
						σ	0.90	0.92	± 5%

SAR Results – Head Simulating Liquid (HSL)

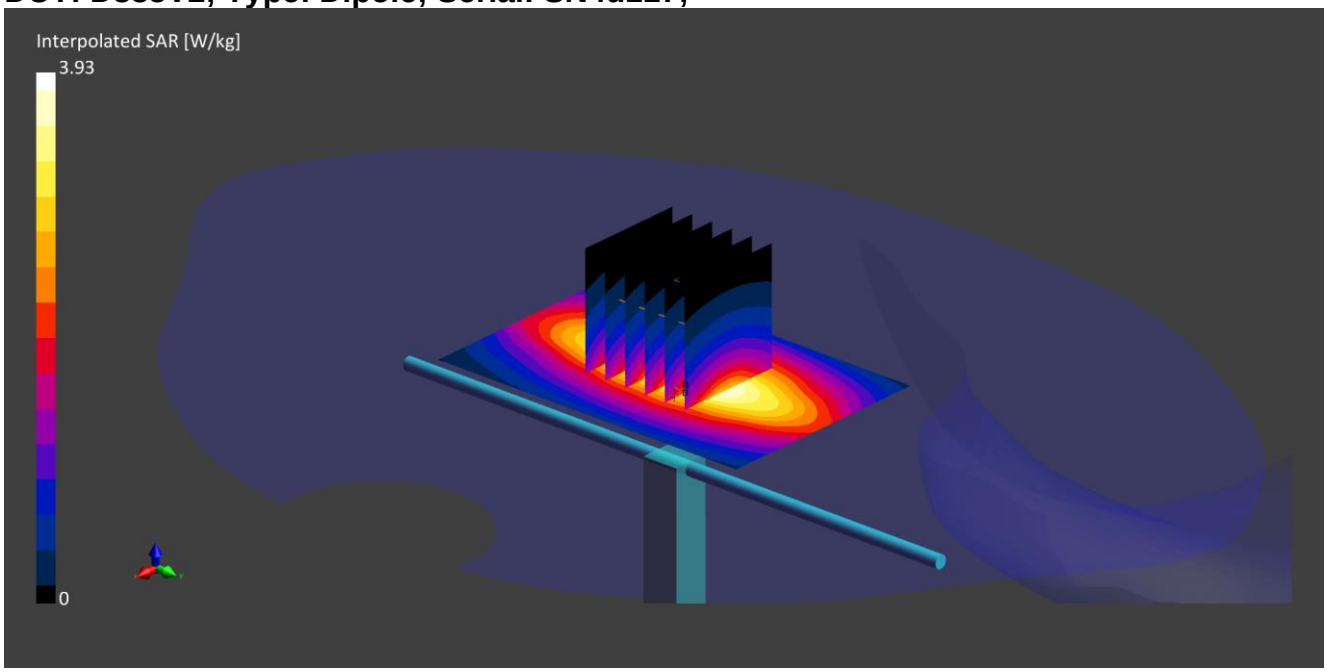
Simulant Liquid	SAR Measured	250 mW input Power	Normalised to 1.00 W	Uncertainty (%)
Head	SAR averaged over 1g	2.57 W/Kg	**10.23 W/Kg**	+16.80% / -16.43%
	SAR averaged over 10g	1.68 W/Kg	**6.69 W/Kg**	+16.72% / -16.42%

Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	46.460 Ω + 1.066 jΩ	± 0.28 Ω ± 0.044 jΩ
	Return Loss	28.33	± 2.97 dB

DASY Validation Scan for Head Stimulating Liquid (HSL)

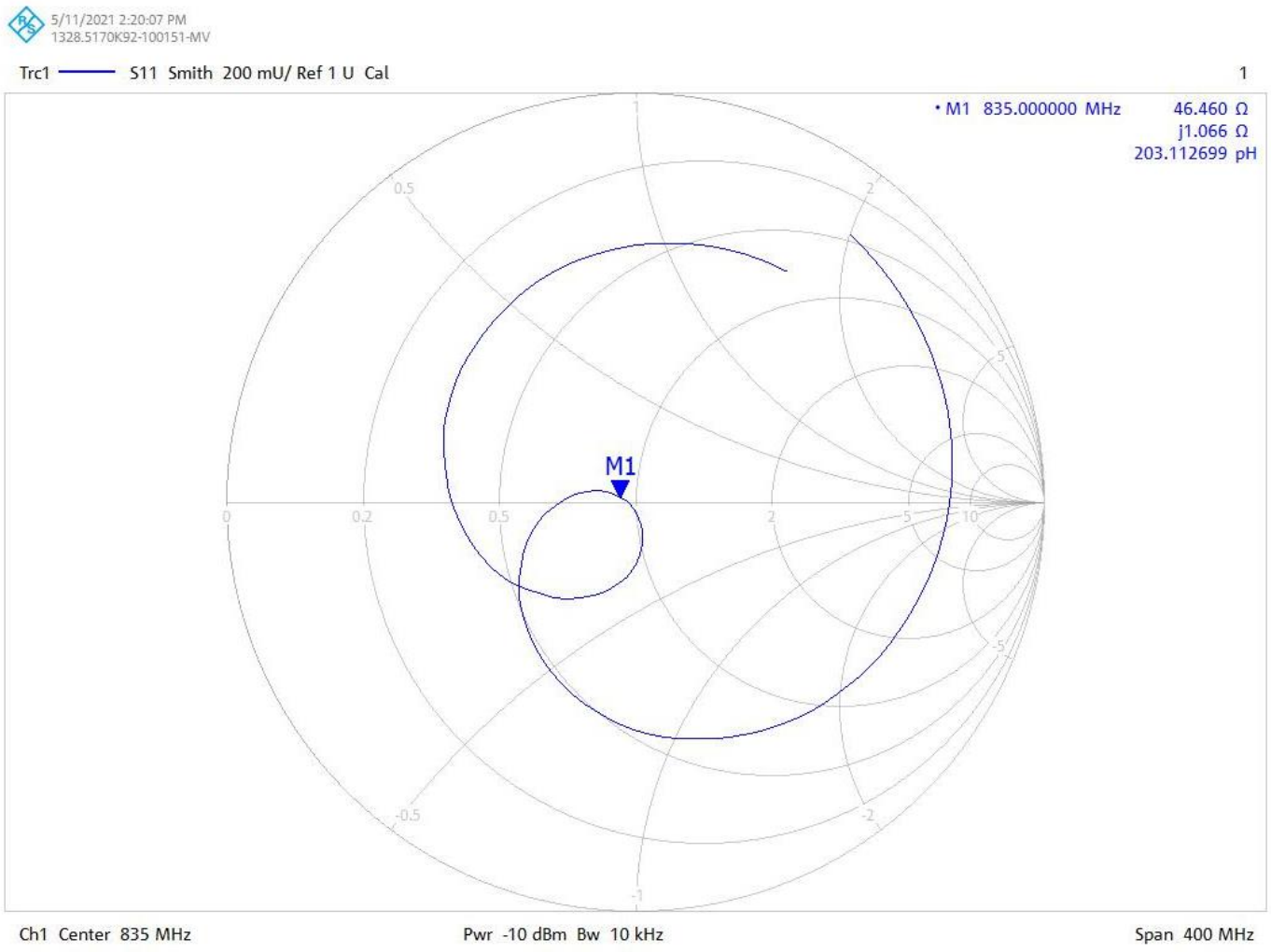
DUT: D835V2; Type: Dipole; Serial: SN4d117;



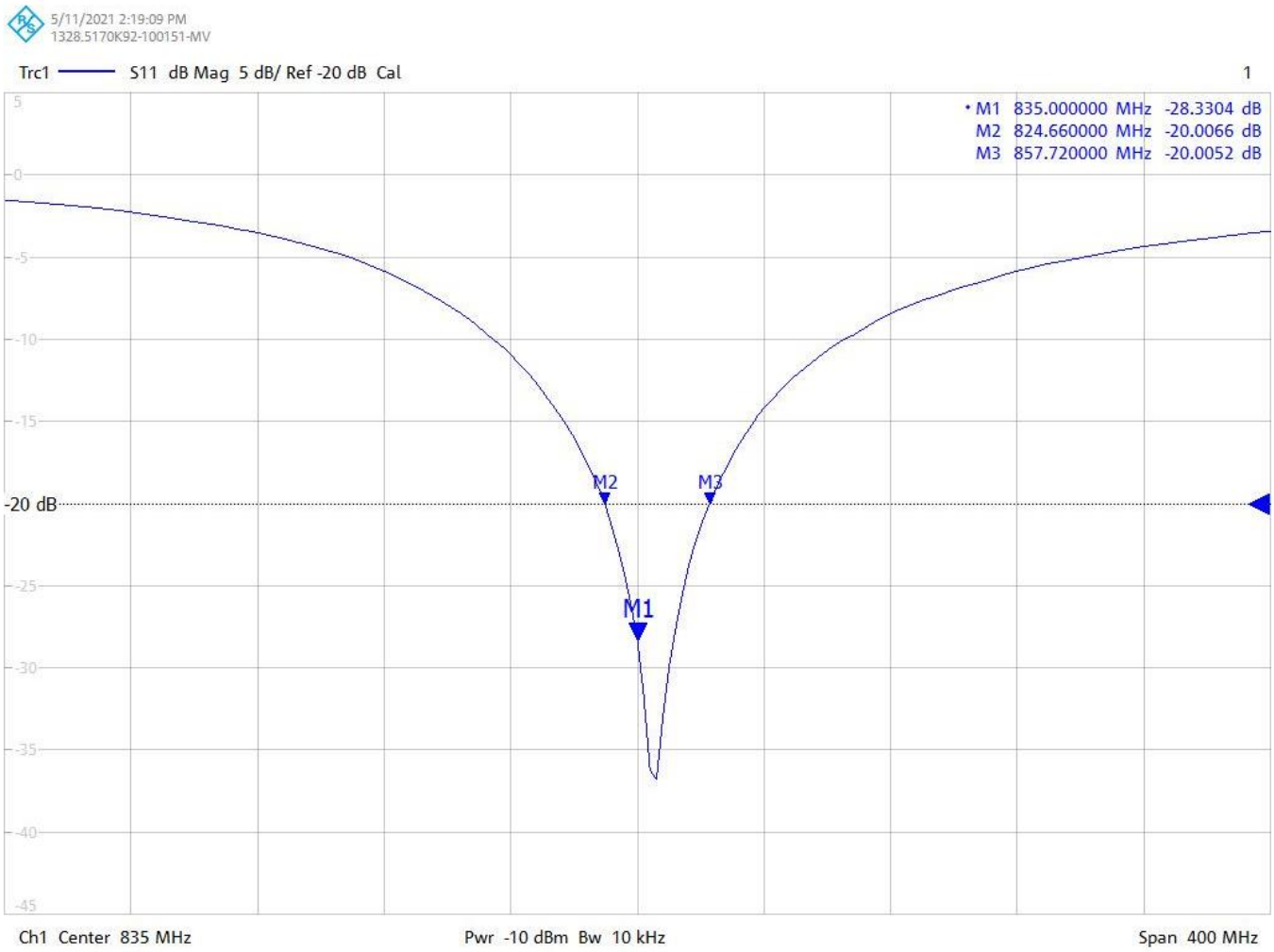
Communication System: CW UID: 0; Frequency: 835.0 MHz; Duty Cycle: 1;
Medium: HSL; Site65_10May2021_154932_Head - 750 900 5%; Medium parameters used: f = 835.0 MHz; σ = 0.92 S/m; ε_r = 42.4; ρ = 1000 kg/m3; $\Delta\varepsilon_r$ = 1.84 %; $\Delta\sigma$ = 1.50 %; No correction
Phantom section: Flat;
DASY 6 Configuration:
- Laboratory Name: Site65;
- Probe: ES3DV3 - SN3335; ConvF(6.31, 6.31, 6.31); 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=6 mm, dy=6 mm, dz=1.5 mm; Grading Ratio: 1.5; Reference Value = 3.090 V/m; Power Drift = -0.08 dB
Minimum horizontal 3dB distance: 21.2 mm;
Vertical M2/M1 Ratio: 88.4 %;
SAR(1 g) = 2.570 W/kg; SAR(10 g) = 1.680 W/kg

Impedance Measurement Plot for Head Stimulating Liquid (HSL)



Return Loss Measurement Plot for Head Stimulating Liquid (HSL)



Calibration Certificate Label:

UKAS CALIBRATION 5772	**UL INTERNATIONAL (UK) LTD** **Tel: +44 (0) 1256312000** Certificate Number: 13685220JD01B Instrument ID: 4d117 Calibration Date: 11/May/2021 Calibration Due Date:

UKAS CALIBRATION 5772	**UL INTERNATIONAL (UK) LTD** **Tel: +44 (0) 1256312000** Certificate Number: 13685220JD01B Instrument ID: 4d117 Calibration Date: 11/May/2021 Calibration Due Date:

UKAS CALIBRATION 5772	**UL INTERNATIONAL (UK) LTD** **Tel: +44 (0) 1256312000** Certificate Number: 13685220JD01B Instrument ID: 4d117 Calibration Date: 11/May/2021 Calibration Due Date:

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

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

Client **UL USA**

Certificate No: D835V2-4d142_Aug20

CALIBRATION CERTIFICATE

Object: D835V2 - SN:4d142

Calibration procedure(s): QA CAL-05.v11
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz

Calibration date: August 18, 2020

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 ± 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	01-Apr-20 (No. 217-03100/03101)	Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
Reference 20 dB Attenuator	SN: BH9394 (20k)	31-Mar-20 (No. 217-03106)	Apr-21
Type-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
Reference Probe EX3DV4	SN: 7349	29-Jun-20 (No. EX3-7349_Jun20)	Jun-21
DAE4	SN: 601	27-Dec-19 (No. DAE4-601_Dec19)	Dec-20

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-19)	In house check: Oct-20

	Name	Function	Signature
Calibrated by:	Jeffrey Katzman	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: August 18, 2020

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

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) 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
b) 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
c) 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
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) 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.

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.2 ± 6 %	0.93 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.39 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.36 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.55 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**6.09 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.0 Ω - 4.8 jΩ
Return Loss	- 26.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.391 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

Date: 18.08.2020

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d142

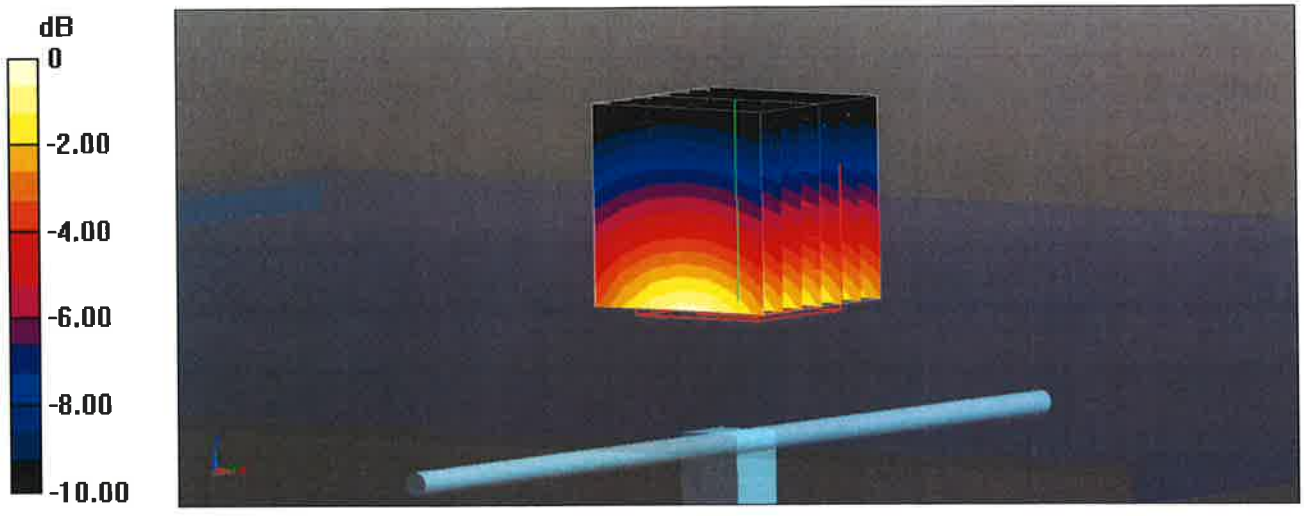
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.93 S/m; ε_r = 42.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(9.69, 9.69, 9.69) @ 835 MHz; Calibrated: 29.06.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.12.2019
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

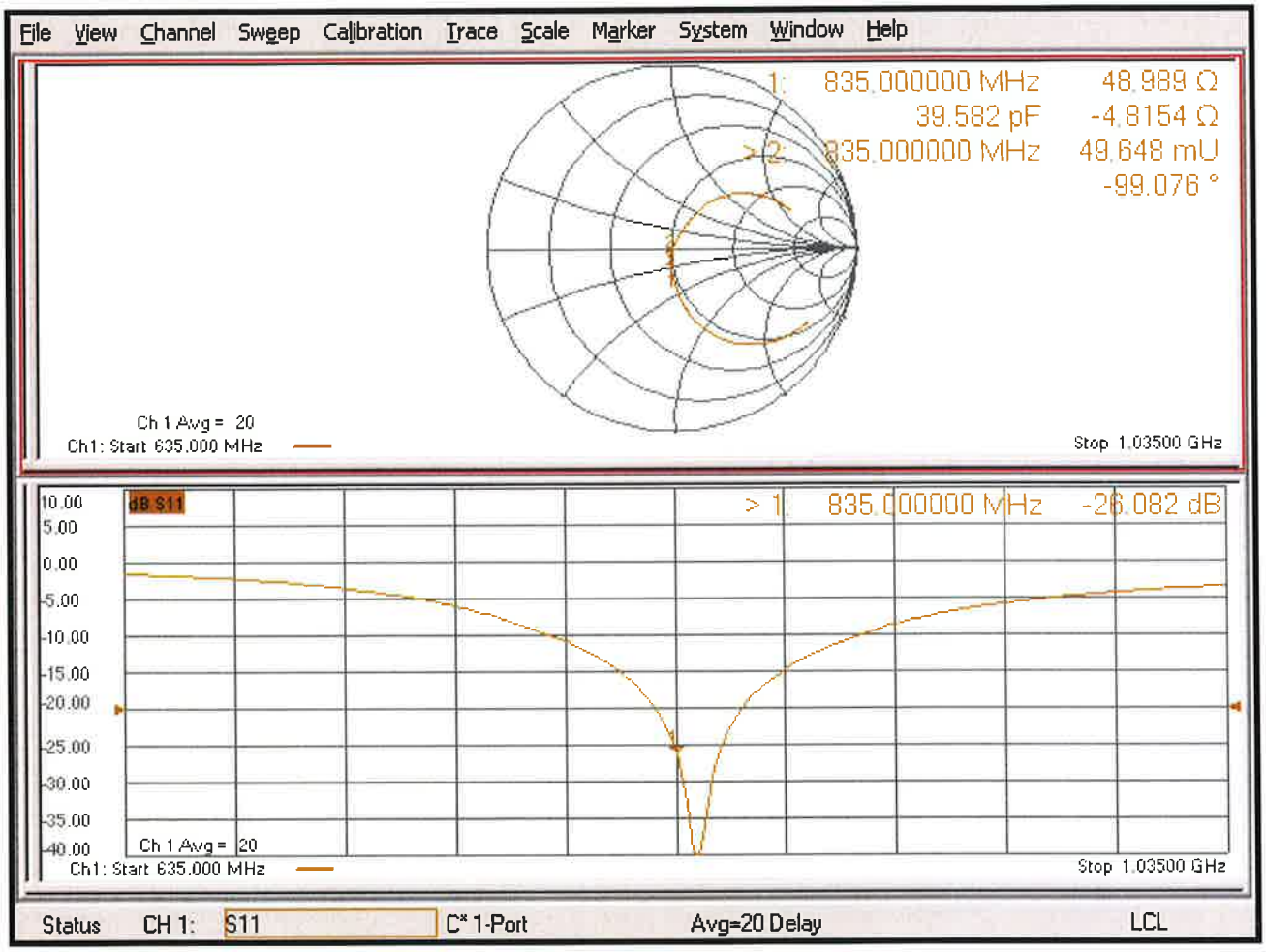
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 62.86 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 3.52 W/kg
SAR(1 g) = 2.39 W/kg; SAR(10 g) = 1.55 W/kg
Smallest distance from peaks to all points 3 dB below = 17 mm
Ratio of SAR at M2 to SAR at M1 = 67.6%
Maximum value of SAR (measured) = 3.14 W/kg



0 dB = 3.14 W/kg = 4.97 dBW/kg

Impedance Measurement Plot for Head TSL



CERTIFICATE OF CALIBRATION

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

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

5772

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

APPROVED SIGNATORY

.....

Harmohan Sahota

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

Equipment Details:

Description:	Dipole Validation Kit	Date of Receipt:	12/April/2021
Manufacturer:	Speag		
Type/Model Number:	D1750V2		
Serial Number:	1050		
Calibration Date:	13/April/2021		
Calibrated By:	Ravish Foolchund Laboratory Technician		
Signature:	.....		

All Calibration have been conducted in the closed laboratory facility: Lab Temperature (22±3) ^{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. **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

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 ℃	19.8 ℃	19.8℃	19.8℃	**εr**	40.08	39.83	± 5%
						σ	1.37	1.35	± 5%

SAR Results – Head Simulating Liquid (HSL)

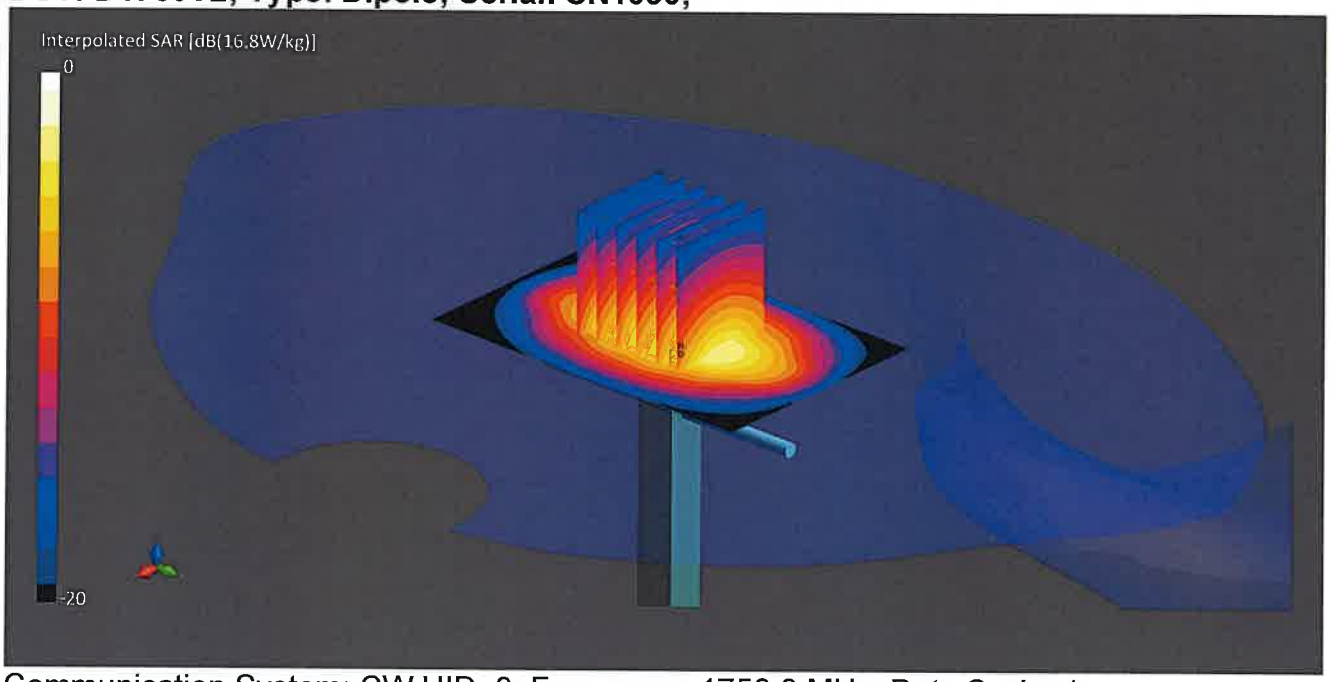
Simulant Liquid	SAR Measured	250 mW input Power	Normalised to 1.00 W	Uncertainty (%)
Head	SAR averaged over 1g	9.31 W/Kg	**37.06 W/Kg**	+16.80% / -16.43%
	SAR averaged over 10g	4.99 W/Kg	**19.87 W/Kg**	+16.72% / -16.42%

Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	50.19 Ω - 0.067 jΩ	± 0.28 Ω ± 0.044 jΩ
	Return Loss	-54.08 dB	± 3.34 dB

DASY Validation Scan for Head Stimulating Liquid (HSL)

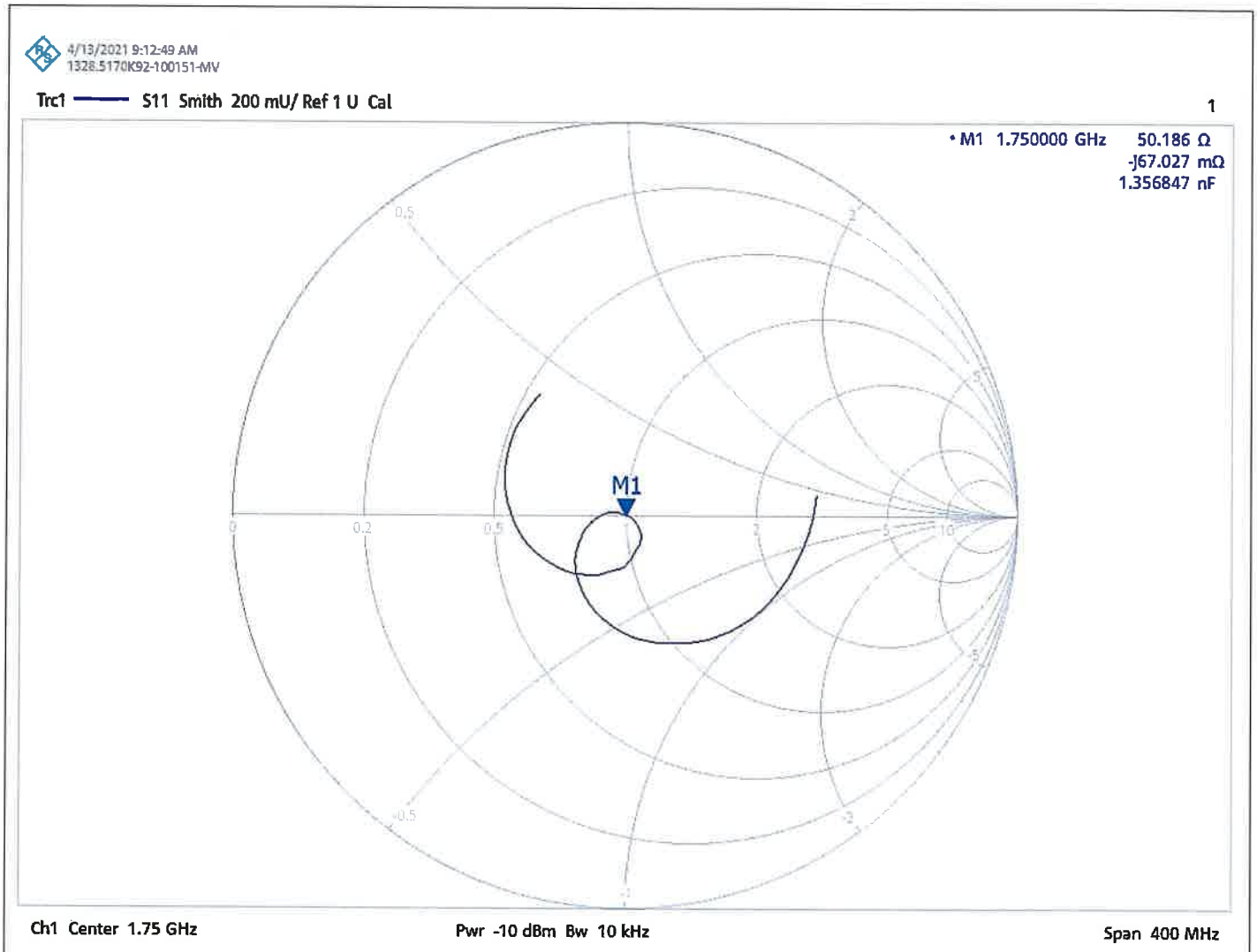
DUT: D1750V2; Type: Dipole; Serial: SN1050;



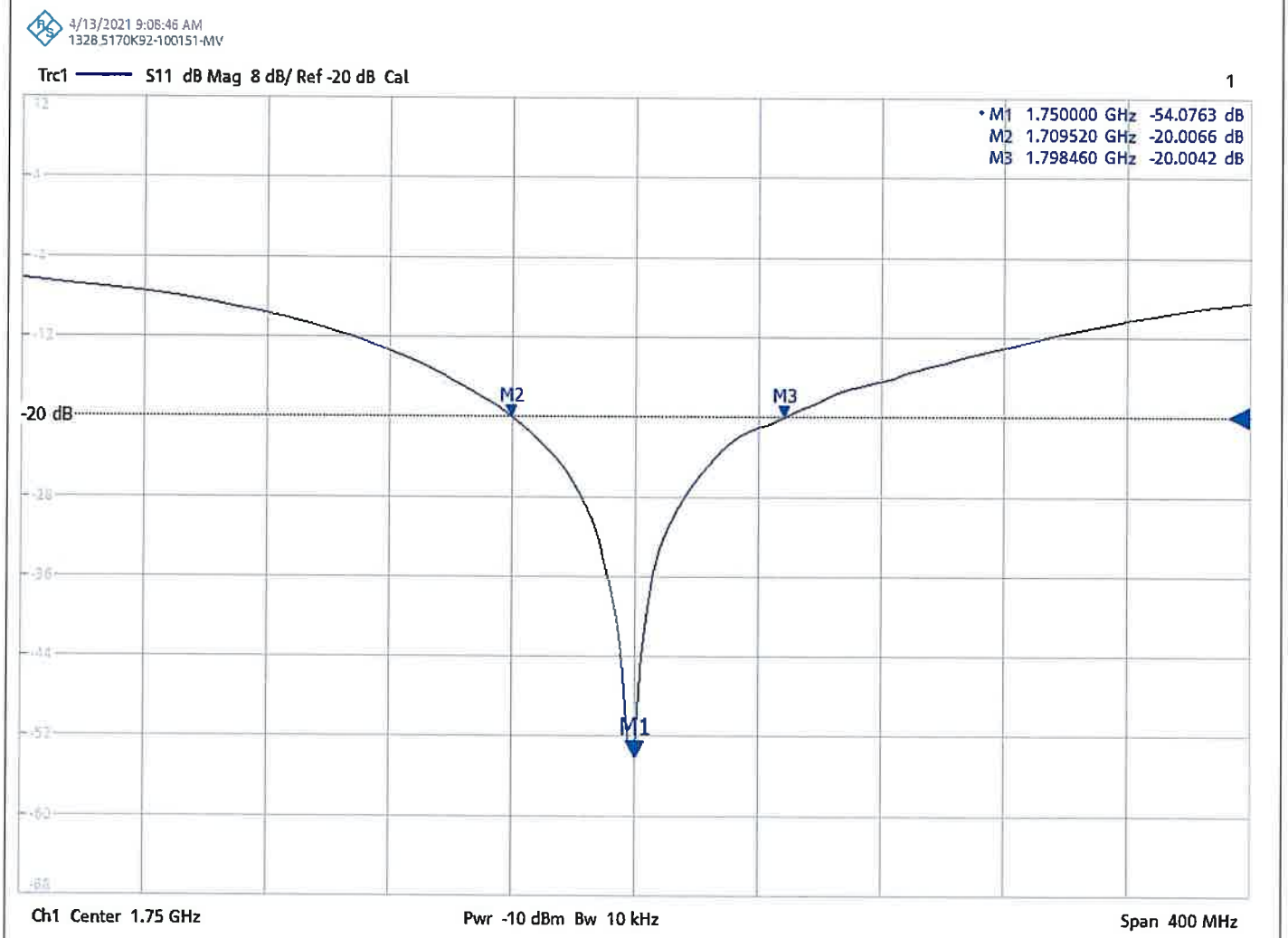
Communication System: CW UID: 0; Frequency: 1750.0 MHz; Duty Cycle: 1;
Medium: HSL; Site65_12Apr2021_115940_Head - 1750 1800 1900 2300 2450 2600 5%;
Medium parameters used: f = 1750.0 MHz; σ = 1.35 S/m; ε_r = 39.8; ρ = 1000 kg/m3; $\Delta\varepsilon_r$ = -0.62 %; $\Delta\sigma$ = -1.80 %; No correction
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

Impedance Measurement Plot for Head Stimulating Liquid (HSL)



Return Loss Measurement Plot for Head Stimulating Liquid (HSL)



Calibration Certificate Label:

UKAS CALIBRATION
5772

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

Certificate Number: 13697411JD01A

Instrument ID: 1050

Calibration Date: 13/April/2021

Calibration Due Date:

UKAS CALIBRATION
5772

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

Certificate Number: 13697411JD01A

Instrument ID: 1050

Calibration Date: 13/April/2021

Calibration Due Date:

UKAS CALIBRATION
5772

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

Certificate Number: 13697411JD01A

Instrument ID: 1050

Calibration Date: 13/April/2021

Calibration Due Date:

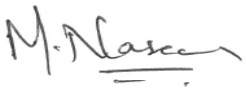
CERTIFICATE OF CALIBRATION

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

DATE OF ISSUE: 29/Oct/2020 CERTIFICATE NUMBER : 13252590JD01B

UL INTERNATIONAL (UK) LTD
UNIT 1-3 HORIZON
KINGSLAND PARK, WADE ROAD
BASINGSTOKE, HAMPSHIRE
RG24 8AH, UK
TEL: +44 (0) 1256 312000
FAX: +44 (0) 1256 312001
Email: LST.UK.Calibration@ul.com

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/Oct/2020
Manufacturer:	Speag		
Type/Model Number:	D1750V2		
Serial Number:	1077		
Calibration Date:	16/Oct/2020		
Calibrated By:	Harmohan Sahota Laboratory Engineer		
Signature:			

……

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
PRE0131610	Dipole	SPEAG	D1800V2	2d009	12 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:	10 mm (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	22.0 ℃	22.2 ℃	22.0℃	22.1℃	**εr**	40.08	40.06	± 5%
						σ	1.37	1.37	± 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	8.83 W/Kg	**35.15 W/Kg**	± 17.57%
	SAR averaged over 10g	4.70 W/Kg	**18.71 W/Kg**	± 17.32%

Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	48.85 Ω + 0.59 jΩ	± 0.28 Ω ± 0.044 jΩ
	Return Loss	37.68	± 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	1750	21.3 ℃	21.2℃	19.9℃	20.1℃	**εr**	53.43	54.47	± 5%
						σ	1.49	1.53	± 5%

SAR Results – Body Simulating Liquid (MSL)

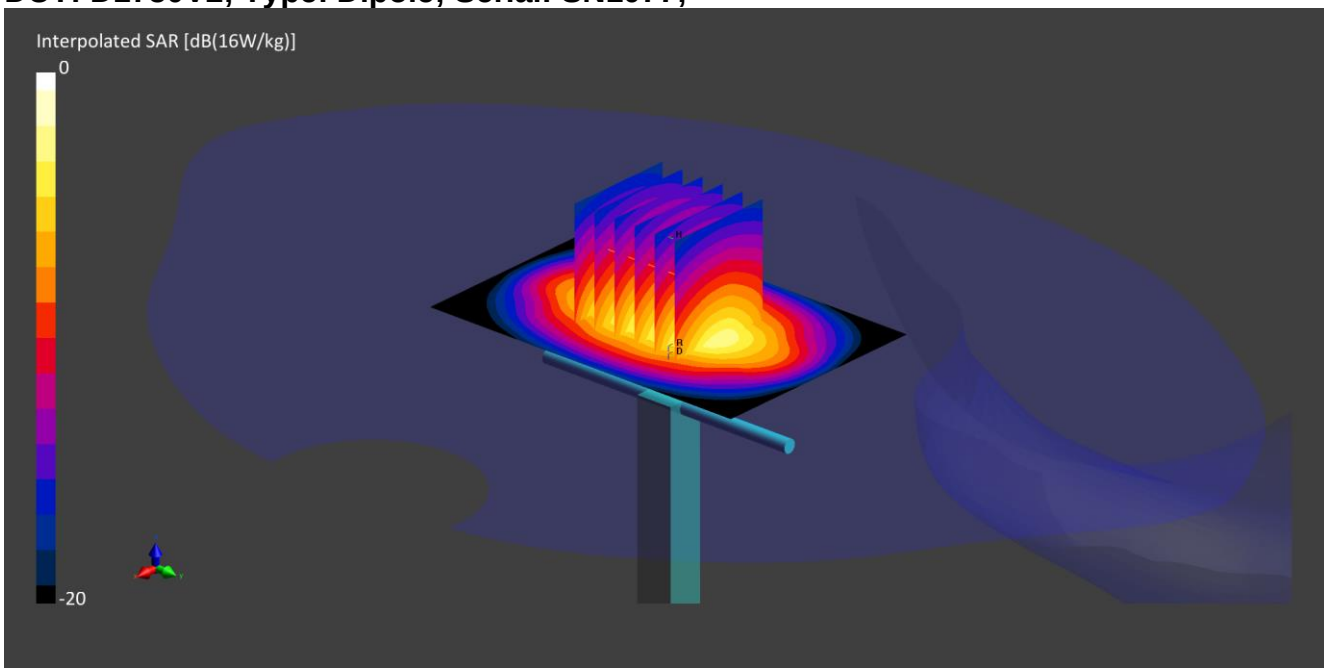
Simulant Liquid	**SAR Measured**	250 mW input Power	Normalised to 1.00 W	Uncertainty (%)
Body	SAR averaged over 1g	9.34 W/Kg	**37.18 W/Kg**	± 18.06%
	SAR averaged over 10g	5.02 W/Kg	**19.99 W/Kg**	± 17.44%

Antenna Parameters – Body Simulating Liquid (MSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Body	Impedance	49.30 Ω + 5.03 jΩ	± 0.28 Ω ± 0.044 jΩ
	Return Loss	25.84	± 2.03 dB

DASY Validation Scan for Head Stimulating Liquid (HSL)

DUT: D1750V2; Type: Dipole; Serial: SN1077;

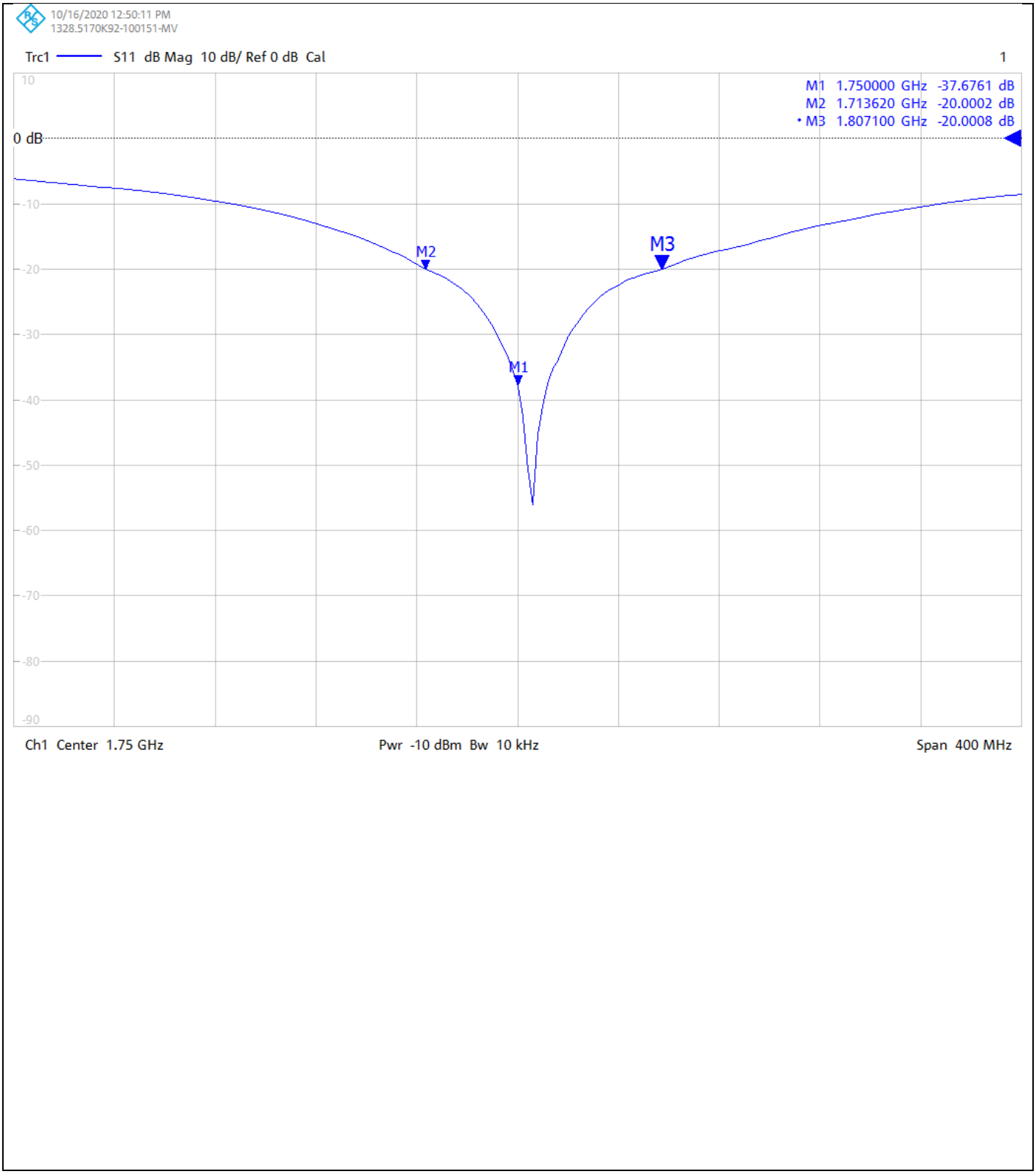


Communication System: CW UID: 0; Frequency: 1750.0 MHz; Duty Cycle: 1;
Medium: HSL; Site65_15Oct2020_093903_Head - 1750 1800 5%; Medium parameters used: f = 1750.0 MHz; σ = 1.37 S/m; ε_r = 40.1; ρ = 1000 kg/m3; $\Delta\varepsilon_r$ = -0.04 %; $\Delta\sigma$ = 0.16 %; No correction
Phantom section: Flat;
DASY 6 Configuration:
- Laboratory Name: Site65;
- Probe: EX3DV4 - SN7496; ConvF(8.79, 8.79, 8.79); 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 = 11.190 V/m; Power Drift = 0.00 dB
Minimum horizontal 3dB distance: 9.9 mm;
Vertical M2/M1 Ratio: 82.5 %;
SAR(1 g) = 8.830 W/kg; SAR(10 g) = 4.700 W/kg

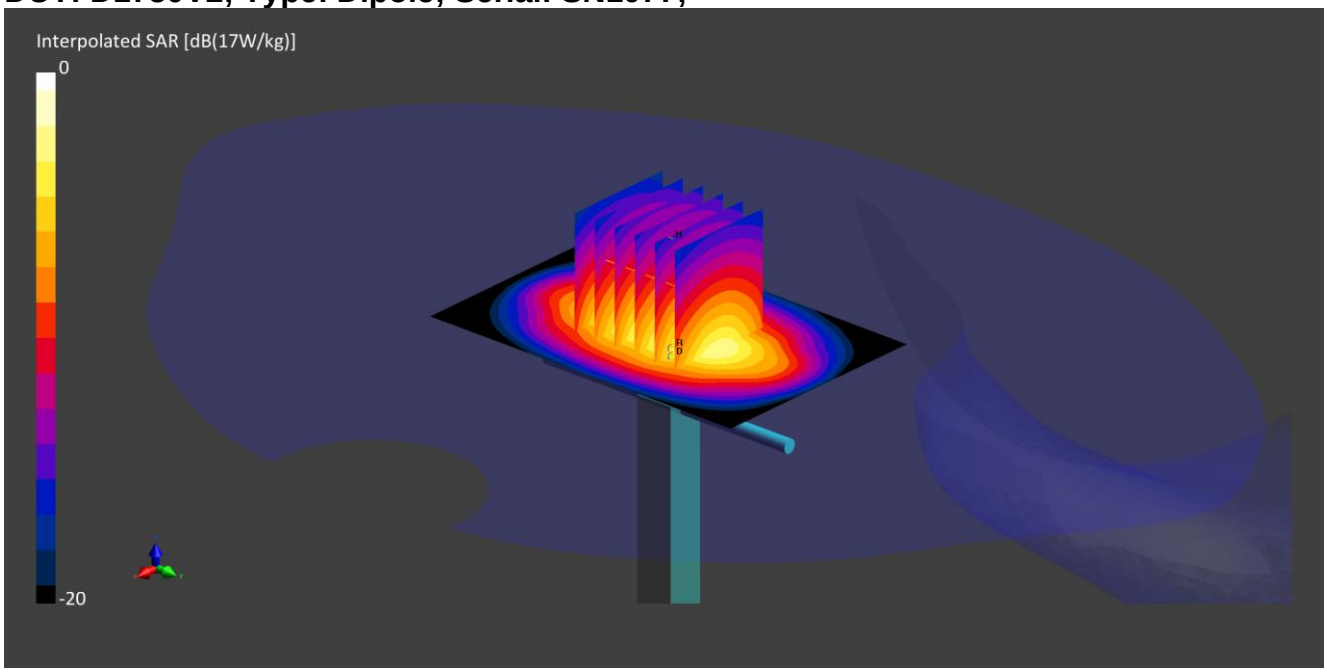
Impedance Measurement Plot for Head Stimulating Liquid (HSL)

Return Loss Measurement Plot for Head Stimulating Liquid (HSL)



DASY Validation Scan for Body Stimulating Liquid (MSL)

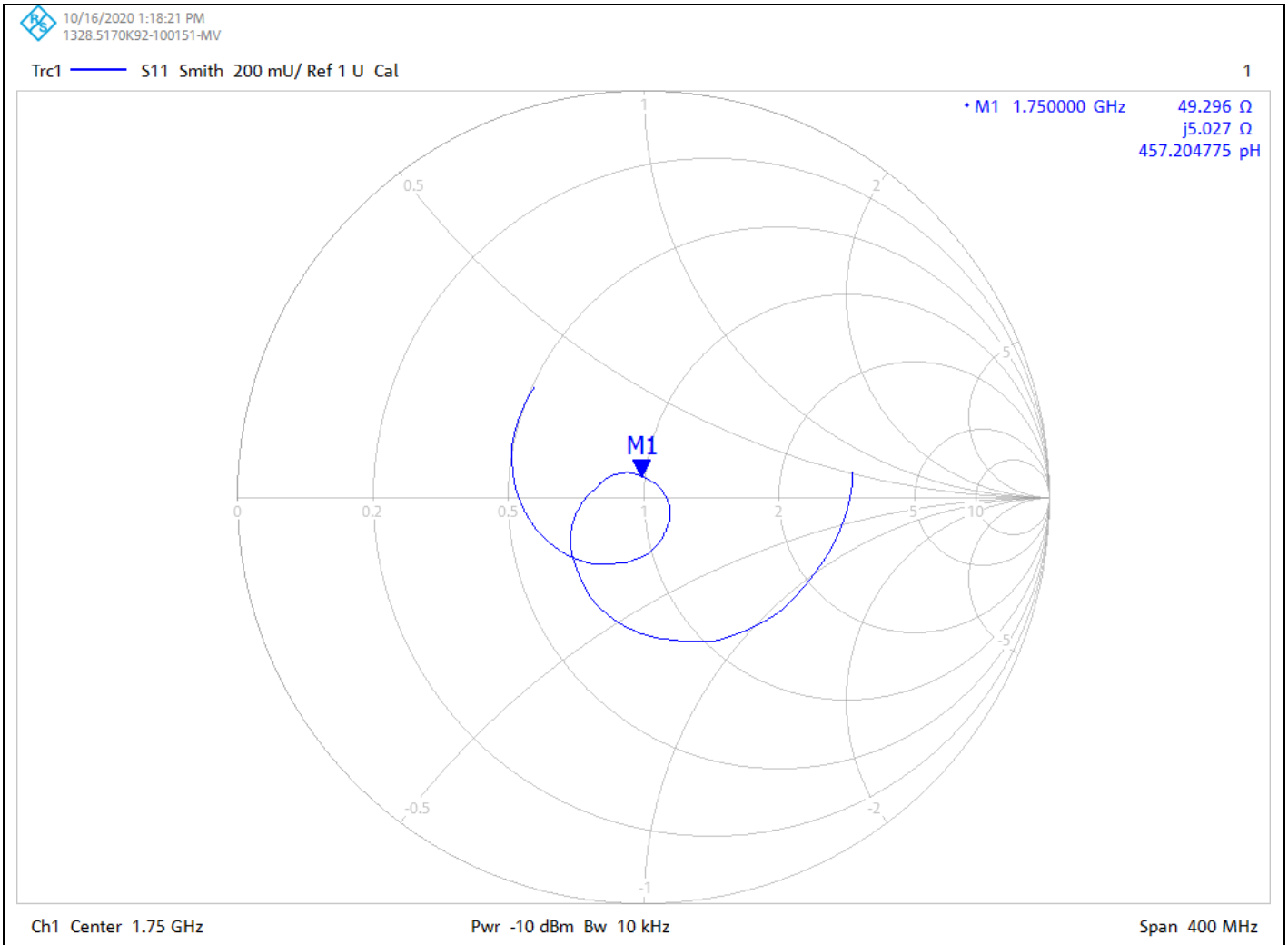
DUT: D1750V2; Type: Dipole; Serial: SN1077;



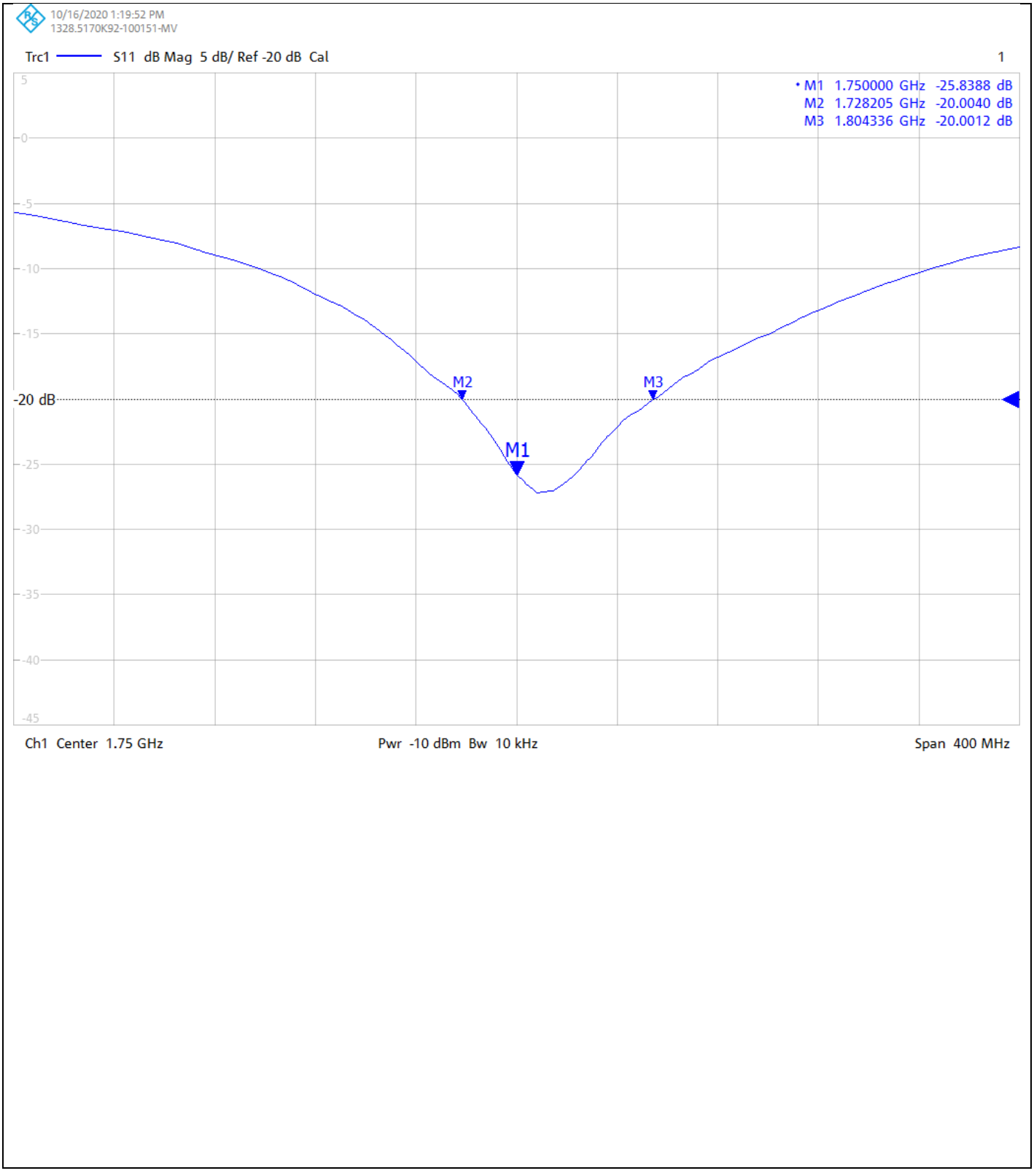
Communication System: CW UID: 0; Frequency: 1750.0 MHz; Duty Cycle: 1;
Medium: MSL; Site65_15Oct2020_125932_Body - 1800 5%; Medium parameters used: f = 1750.0 MHz; σ = 1.53 S/m; ε_r = 54.5; ρ = 1000 kg/m3; $\Delta\varepsilon_r$ = 1.95 %; $\Delta\sigma$ = 2.49 %; No correction
Phantom section: Flat;
DASY 6 Configuration:
- Laboratory Name: Site65;
- Probe: EX3DV4 - SN7496; ConvF(8.34, 8.34, 8.34); 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 = 11.740 V/m; Power Drift = 0.01 dB
Minimum horizontal 3dB distance: 9.7 mm;
Vertical M2/M1 Ratio: 82.9 %;
SAR(1 g) = 9.340 W/kg; SAR(10 g) = 5.020 W/kg

Impedance Measurement Plot for Body Stimulating Liquid (MSL)



Return Loss Measurement Plot for Body Stimulating Liquid (MSL)



Calibration Certificate Label:

UKAS TESTING 5772

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

Certificate Number: 13252590JD01B

Instrument ID: 1077

Calibration Date: 16/Oct/2020

Calibration Due Date:

UKAS TESTING 5772

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

Certificate Number: 13252590JD01B

Instrument ID: 1077

Calibration Date: 16/Oct/2020

Calibration Due Date:

UKAS TESTING 5772

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

Certificate Number: 13252590JD01B

Instrument ID: 1077

Calibration Date: 16/Oct/2020

Calibration Due Date:

CERTIFICATE OF CALIBRATION

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

DATE OF ISSUE: 27/Nov/2020 CERTIFICATE NUMBER : 13252589JD01E

5772

UL INTERNATIONAL (UK) LTD
UNIT 1-3 HORIZON
KINGSLAND PARK, WADE ROAD
BASINGSTOKE, HAMPSHIRE
RG24 8AH, UK
TEL: +44 (0) 1256 312000
FAX: +44 (0) 1256 312001
Email: LST.UK.Calibration@ul.com

APPROVED SIGNATORY

.....

Naseer Mirza

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

Equipment Details:

Description:	Dipole Validation Kit	Date of Receipt:	26/Nov/2020
Manufacturer:	Speag		
Type/Model Number:	D1900V2		
Serial Number:	5d043		
Calibration Date:	27/Nov/2020		
Calibrated By:	Masood Khan Test Engineer		
Signature:			

.....

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. **DASY6 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
PRE0134198	Dipole	SPEAG	D1900V2	537	12 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	HP	8648C	3537A01598	22 Jan 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:	10 mm (with spacer)
Frequency:	1900 MHz

Dielectric Property Measurements – Head Simulating Liquid (HSL)

Simulant Liquid	Frequency (MHz)	Room Temp		Liquid Temp		Parameters	Target Value	Measured Value	Uncertainty (%)
		Start	End	Start	End				
Head	1900	20.9 ℃	20.5 ℃	20.5℃	20.5℃	**εr**	40.00	40.70	± 5%
						σ	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	10.50 W/Kg	**41.80 W/Kg**	± 17.57%
	SAR averaged over 10g	5.41 W/Kg	**21.54 W/Kg**	± 17.32%

Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	50.883 Ω -3.91 jΩ	± 0.28 Ω ± 0.044 jΩ
	Return Loss	27.36	± 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	1900	20.5 ℃	20.9 ℃	20.1℃	20.5℃	**εr**	53.30	54.12	± 5%
						σ	1.52	1.54	± 5%

SAR Results – Body Simulating Liquid (MSL)

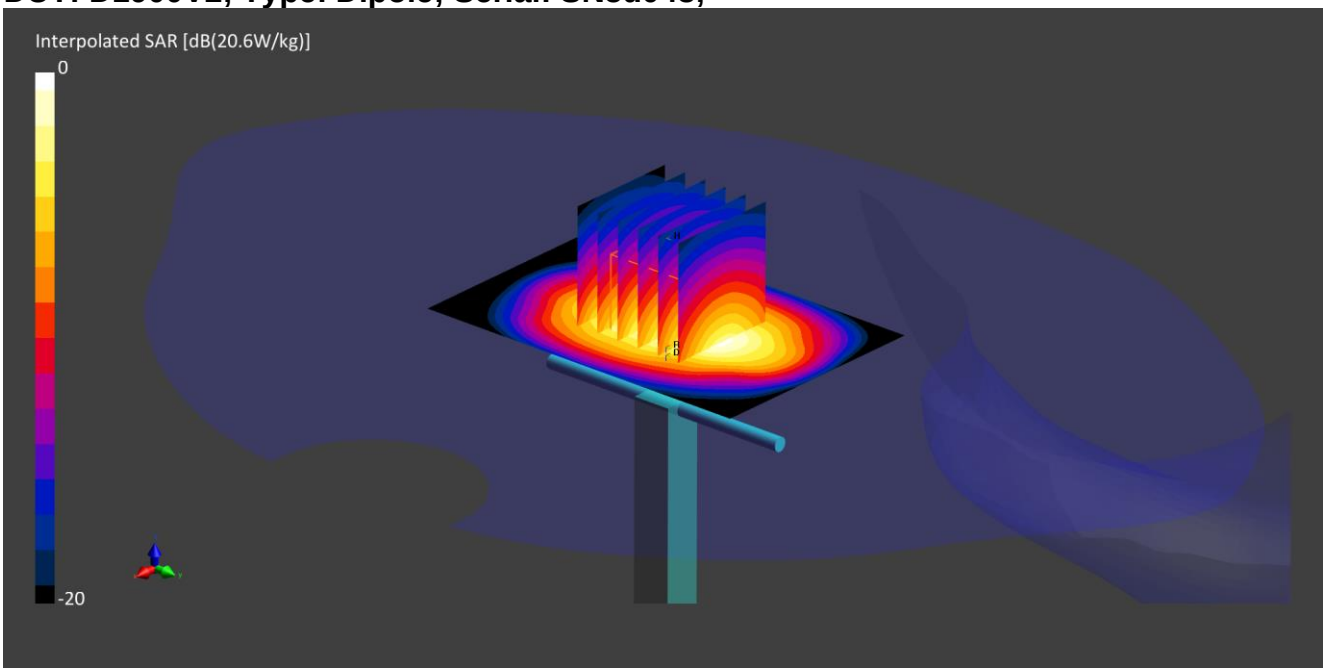
Simulant Liquid	**SAR Measured**	250 mW input Power	Normalised to 1.00 W	Uncertainty (%)
Body	SAR averaged over 1g	10.80 W/Kg	**43.00 W/Kg**	± 18.06%
	SAR averaged over 10g	5.65 W/Kg	**22.49 W/Kg**	± 17.44%

Antenna Parameters – Body Simulating Liquid (MSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Body	Impedance	54.54 Ω -5.95 jΩ	± 0.28 Ω ± 0.044 jΩ
	Return Loss	22.65	± 2.03 dB

DASY Validation Scan for Head Stimulating Liquid (HSL)

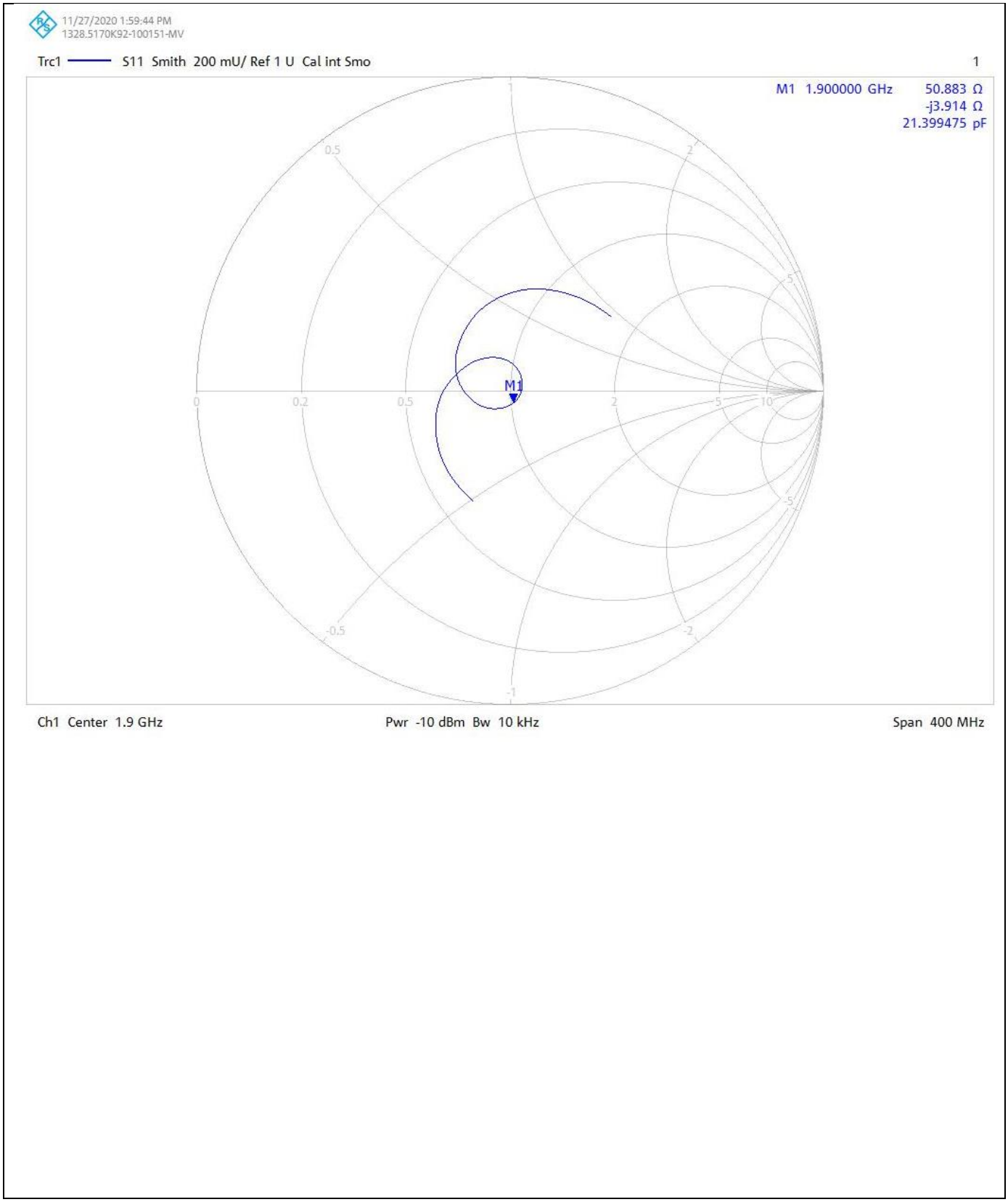
DUT: D1900V2; Type: Dipole; Serial: SN5d043;



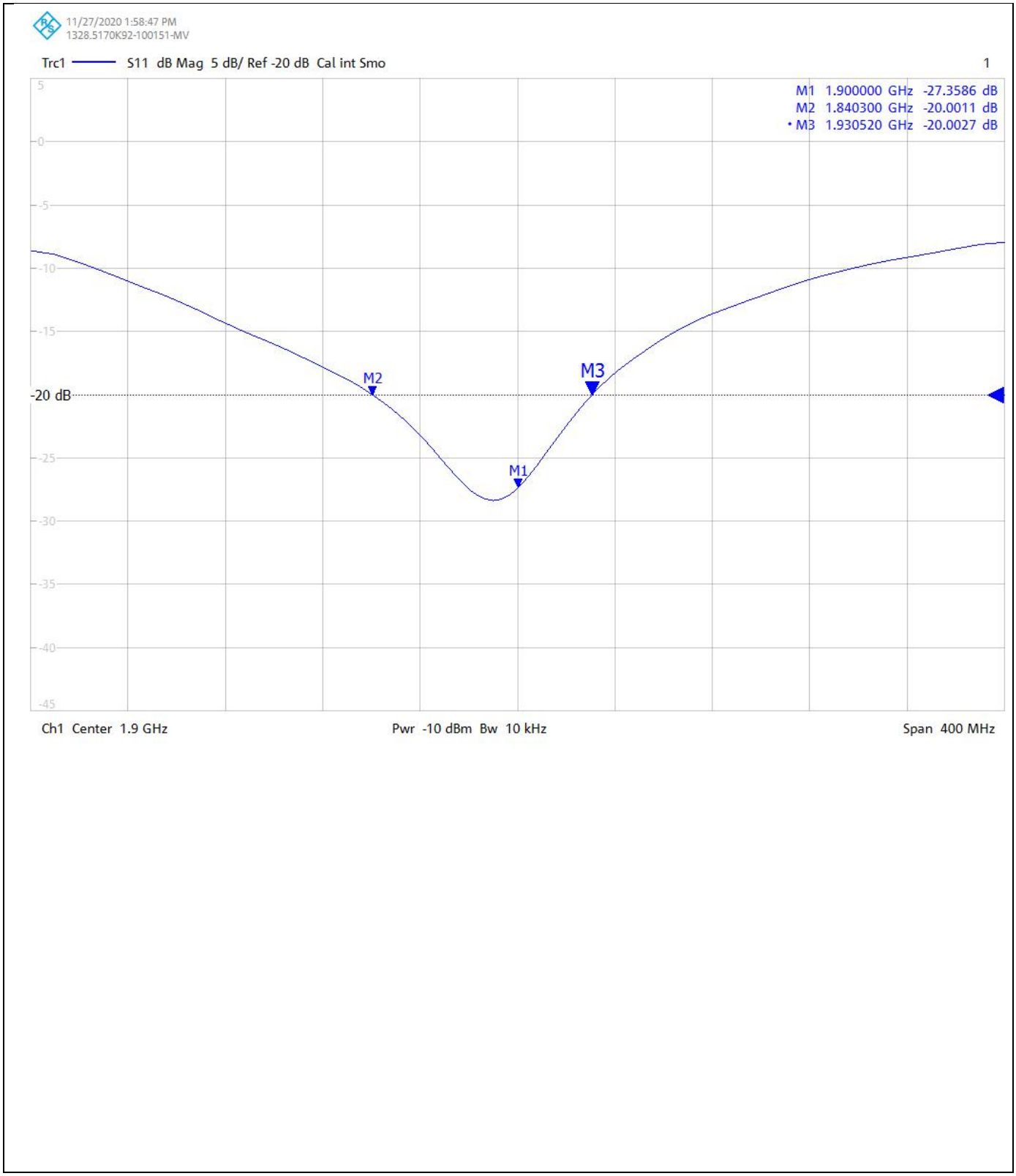
Communication System: CW UID: 0; Frequency: 1900.0 MHz; Duty Cycle: 1;
Medium: HSL; Site65_26Nov2020_101608_Head - 750 900 1800 1900 5%; Medium parameters used: f = 1900.0 MHz; σ = 1.44 S/m; ε_r= 40.7; ρ = 1000 kg/m3; $\Delta\varepsilon_r$= 1.74 %; $\Delta\sigma$ = 3.01 %; No correction
Phantom section: Flat;
DASY 6 Configuration:
- Probe: EX3DV4 - SN7496; ConvF(8.53, 8.53, 8.53); 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 = 13.100 V/m; Power Drift = 0.01 dB
Minimum horizontal 3dB distance: 9.6 mm;
Vertical M2/M1 Ratio: 80.7 %;
SAR(1 g) = 10.500 W/kg; SAR(10 g) = 5.410 W/kg

Impedance Measurement Plot for Head Stimulating Liquid (HSL)

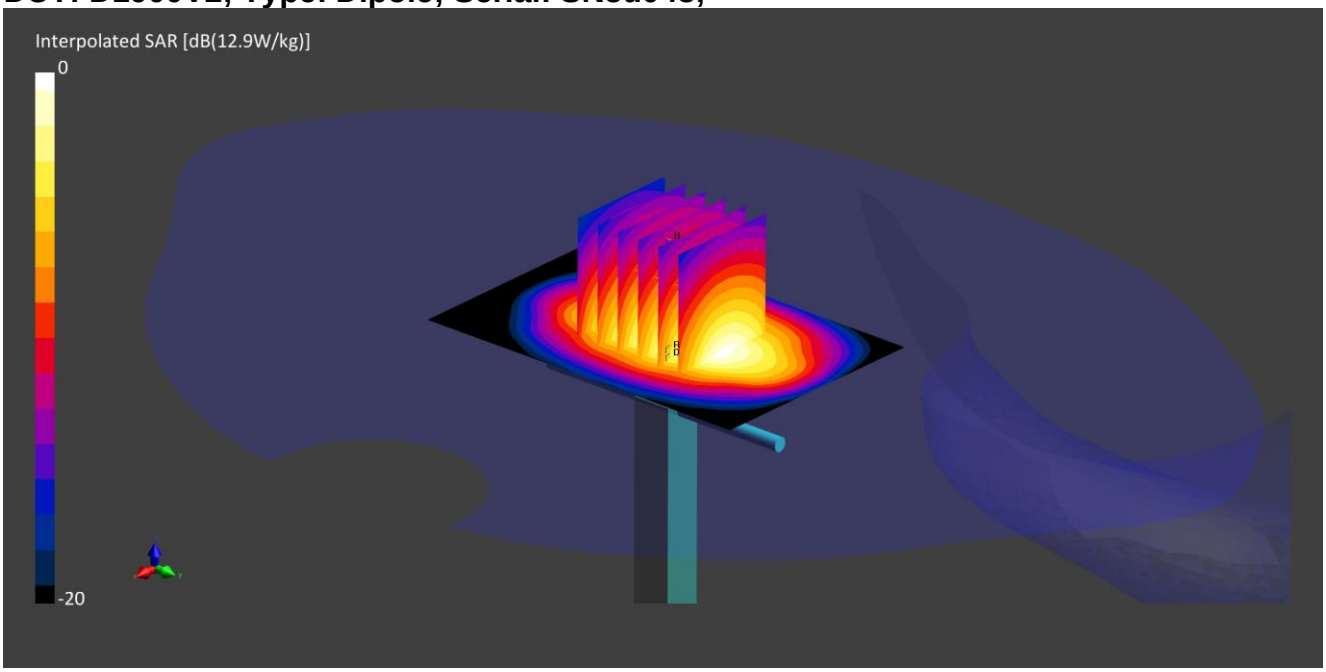


Return Loss Measurement Plot for Head Stimulating Liquid (HSL)



DASY Validation Scan for Body Stimulating Liquid (MSL)

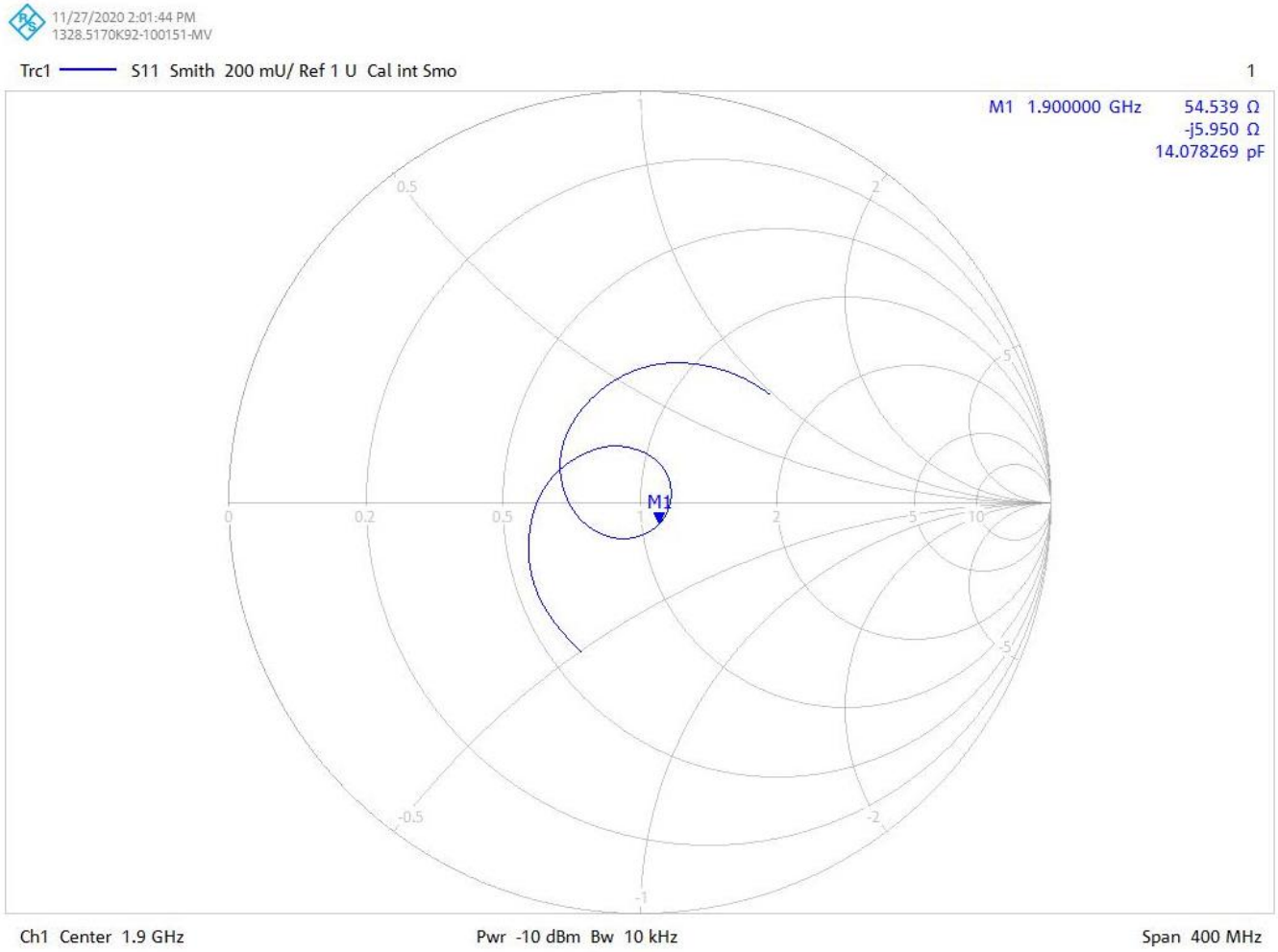
DUT: D1900V2; Type: Dipole; Serial: SN5d043;



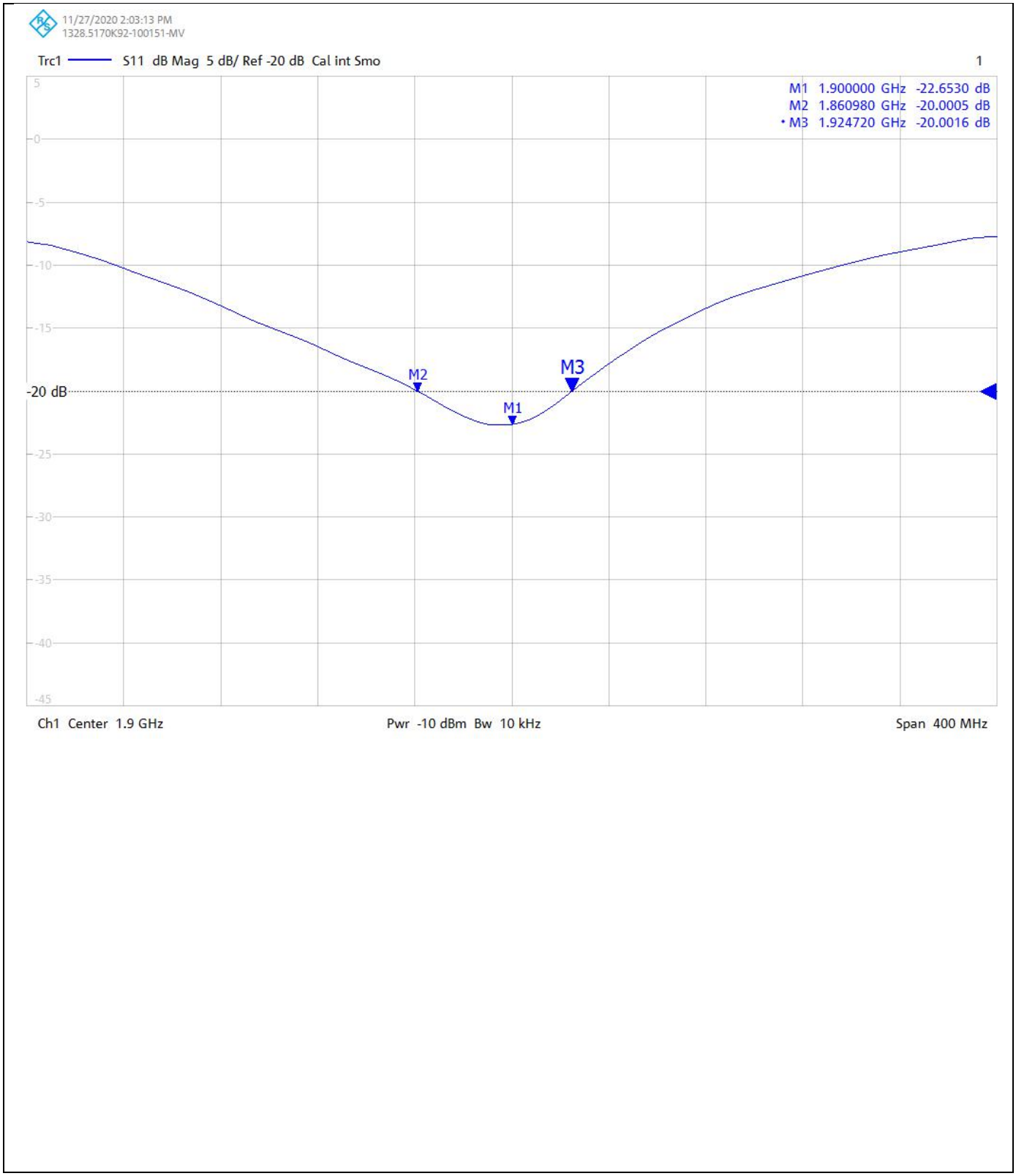
Communication System: CW UID: 0; Frequency: 1900.0 MHz; Duty Cycle: 1;
Medium: MSL; Site65_27Nov2020_090407_Body - 1900 5%; Medium parameters used: f = 1900.0 MHz; σ = 1.54 S/m; ε_r= 54.1; ρ = 1000 kg/m3; $\Delta\varepsilon_r$= 1.54 %; $\Delta\sigma$ = 1.41 %; No correction
Phantom section: Flat;
DASY 6 Configuration:
- Probe: EX3DV4 - SN7496; ConvF(8.03, 8.03, 8.03); 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 = 13.540 V/m; Power Drift = 0.02 dB
Minimum horizontal 3dB distance: 9.6 mm;
Vertical M2/M1 Ratio: 84.3 %;
SAR(1 g) = 10.800 W/kg; SAR(10 g) = 5.650 W/kg

Impedance Measurement Plot for Body Stimulating Liquid (MSL)



Return Loss Measurement Plot for Body Stimulating Liquid (MSL)



Calibration Certificate Label:

UKAS CALIBRATION 5772	**UL INTERNATIONAL (UK) LTD** **Tel: +44 (0) 1256312000** Certificate Number: 13252589JD01E Instrument ID: 5d043 Calibration Date: 27/Nov/2020 Calibration Due Date:

UKAS CALIBRATION 5772	**UL INTERNATIONAL (UK) LTD** **Tel: +44 (0) 1256312000** Certificate Number: 13252589JD01E Instrument ID: 5d043 Calibration Date: 27/Nov/2020 Calibration Due Date:

UKAS CALIBRATION 5772	**UL INTERNATIONAL (UK) LTD** **Tel: +44 (0) 1256312000** Certificate Number: 13252589JD01E Instrument ID: 5d043 Calibration Date: 27/Nov/2020 Calibration Due Date:

CERTIFICATE OF CALIBRATION

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

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

5772

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

APPROVED SIGNATORY

Harmohan Sahota

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

Equipment Details:

Description:	Dipole Validation Kit	Date of Receipt:	12/April/2021
Manufacturer:	Speag		
Type/Model Number:	D1900V2		
Serial Number:	5d140		
Calibration Date:	13/April/2021		
Calibrated By:	Ravish Foolchund Laboratory Technician		
Signature:			

All Calibration have been conducted in the closed laboratory facility: Lab Temperature (22±3) ^{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. **DASY 6 System Handbook**
6. **Dipole Calibration Procedure V1.2:** Calibration performed as per internal procedure

The measuring equipment used to perform the calibration, documented in this certificate has been calibrated in accordance with the manufacturers' recommendations, and is traceable to recognized national standards.

UL No.	Instrument	Manufacturer	Type No.	Serial No.	Date Last Calibrated	Cal. Interval (Months)
PRE0134060	Data Acquisition Electronics	SPEAG	DAE4	432	09 Oct 2020	12
PRE0134817	Probe	SPEAG	ES3DV3	3335	14 Jan 2021	12
PRE0134198	Dipole Antenna	SPEAG	D1900V2	537	16 Feb 2021	12
PRE0151451	Power Monitoring Kit	Art-Fi	ART 100850-01	0001	Cal as part of System	-
PRE0151441	Power Sensor	Rohde & Schwarz	NRP8S	102481	17 Apr 2020	12
PRE0151154	Vector Network Analyser	Rohde & Schwarz	ZND	100151	15 Jun 2020	12
PRE0158684	Calibration Kit	Rhode & Schwarz	ZV-Z135	102144	27 May 2020	12
PRE0178154	Signal Generator	Rohde & Schwarz	SMB 100A	175325	10 Jun 2020	12

SAR System Specification

Robot System Positioner:	Stäubli Unimation Corp. Robot Model: TX60L
Robot Serial Number:	F13/5SC6F1/A/01
DASY Version:	cDASY6.14.0.959
Phantom:	Flat section of SAM Twin Phantom
Distance Dipole Centre:	10mm (with spacer)
Frequency:	1900 MHz

Dielectric Property Measurements – Head Simulating Liquid (HSL)

Simulant Liquid	Frequency (MHz)	Room Temp		Liquid Temp		Parameters	Target Value	Measured Value	Uncertainty (%)
		Start	End	Start	End				
Head	1900	20.0 °C	19.8 °C	19.8°C	19.8°C	**εr**	40.00	39.53	± 5%
						σ	1.40	1.44	± 5%

SAR Results – Head Simulating Liquid (HSL)

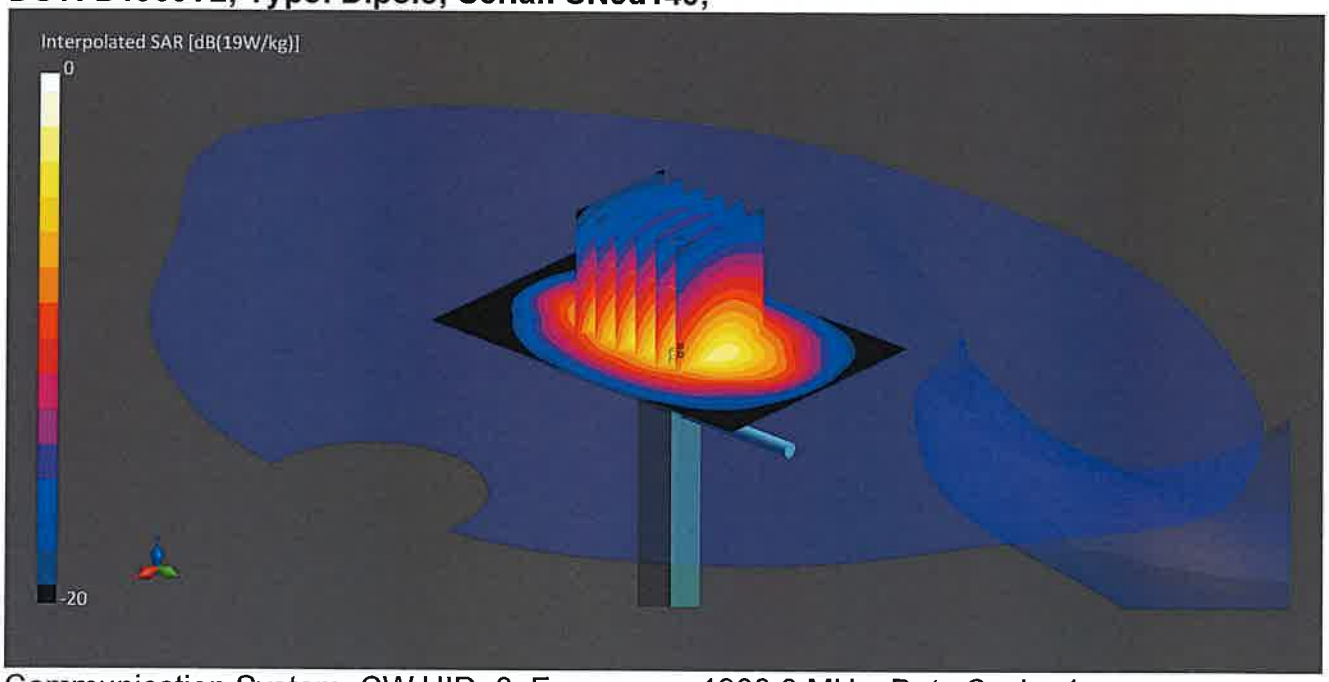
Simulant Liquid	SAR Measured	250 mW input Power	Normalised to 1.00 W	Uncertainty (%)
Head	SAR averaged over 1g	10.40 W/Kg	**41.40 W/Kg**	+16.80% / -16.43%
	SAR averaged over 10g	5.40 W/Kg	**21.50 W/Kg**	+16.72% / -16.42%

Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	49.47 Ω - 4.77 jΩ	± 0.28 Ω ± 0.044 jΩ
	Return Loss	-26.34 dB	± 2.97 dB

DASY Validation Scan for Head Stimulating Liquid (HSL)

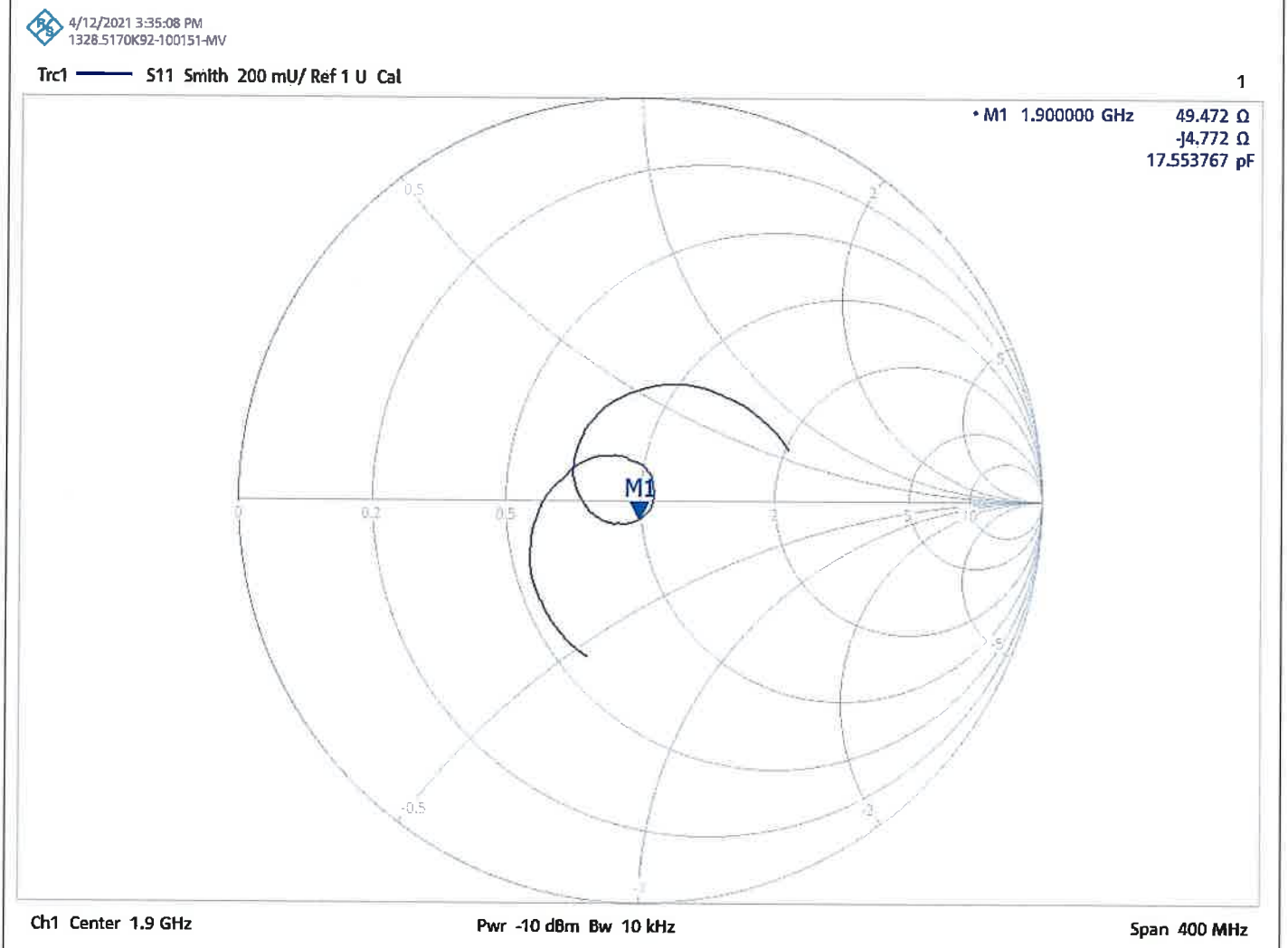
DUT: D1900V2; Type: Dipole; Serial: SN5d140;



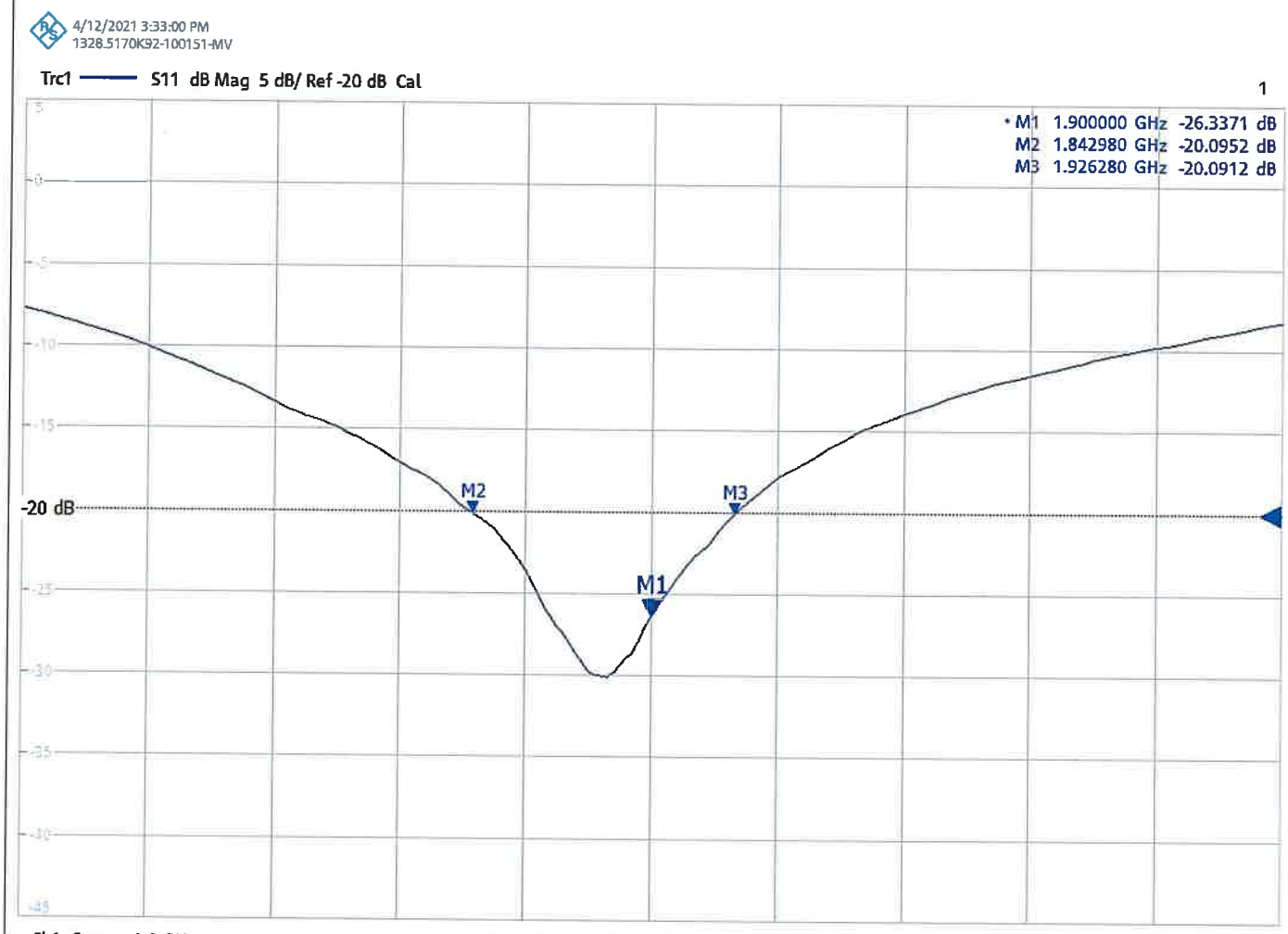
Communication System: CW UID: 0; Frequency: 1900.0 MHz; Duty Cycle: 1;
Medium: HSL; Site65_12Apr2021_115940_Head - 1750 1800 1900 2300 2450 2600 5%;
Medium parameters used: f = 1900.0 MHz; σ = 1.44 S/m; ε_r = 39.5; ρ = 1000 kg/m3; $\Delta\varepsilon_r$ = -1.17 %; $\Delta\sigma$ = 2.77 %; No correction
Phantom section: Flat;
DASY 6 Configuration:
- Laboratory Name: Site65;
- Probe: ES3DV3 - SN3335; ConvF(5.13, 5.13, 5.13); Calibrated: 14 Jan 2021
- Sensor-Surface: 3 mm; VMS + 6p
- Electronics: DAE4 - SN432; Calibrated: 09 Oct 2020
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 1945
- Measurement SW: cDASY6.14.0.959

Area Scan (60x90): Interpolated grid: dx=15 mm, dy=15 mm
Zoom Scan1(30x30x30): Measurement grid: dx=6 mm, dy=6 mm, dz=1.5 mm; Grading Ratio: 1.5; Reference Value = 13.240 V/m; Power Drift = 0.01 dB
Minimum horizontal 3dB distance: 10.8 mm;
Vertical M2/M1 Ratio: 84.2 %;
SAR(1 g) = 10.400 W/kg; SAR(10 g) = 5.400 W/kg

Impedance Measurement Plot for Head Stimulating Liquid (HSL)



Return Loss Measurement Plot for Head Stimulating Liquid (HSL)



Calibration Certificate Label:

UKAS CALIBRATION 5772	**UL INTERNATIONAL (UK) LTD** **Tel: +44 (0) 1256312000** Certificate Number: 13697411JD01C Instrument ID: 5d140 Calibration Date: 13/April/2021 Calibration Due Date:

UKAS CALIBRATION 5772	**UL INTERNATIONAL (UK) LTD** **Tel: +44 (0) 1256312000** Certificate Number: 13697411JD01C Instrument ID: 5d140 Calibration Date: 13/April/2021 Calibration Due Date:

UKAS CALIBRATION 5772	**UL INTERNATIONAL (UK) LTD** **Tel: +44 (0) 1256312000** Certificate Number: 13697411JD01C Instrument ID: 5d140 Calibration Date: 13/April/2021 Calibration Due Date:

CERTIFICATE OF CALIBRATION

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

DATE OF ISSUE: 29/Oct/2020 CERTIFICATE NUMBER : 13252590JD01D

UL INTERNATIONAL (UK) LTD
UNIT 1-3 HORIZON
KINGSLAND PARK, WADE ROAD
BASINGSTOKE, HAMPSHIRE
RG24 8AH, UK
TEL: +44 (0) 1256 312000
FAX: +44 (0) 1256 312001
Email: LST.UK.Calibration@ul.com

APPROVED SIGNATORY

.....

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:	D1900V2		
Serial Number:	5d163		
Calibration Date:	22/Oct/2020		
Calibrated By:	Kaan Corbacioglu Laboratory Technician		
Signature:			

.....

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
PRE0134198	Dipole	SPEAG	D1900V2	537	12 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:	10 mm (with spacer)
Frequency:	1900 MHz

Dielectric Property Measurements – Head Simulating Liquid (HSL)

Simulant Liquid	Frequency (MHz)	Room Temp		Liquid Temp		Parameters	Target Value	Measured Value	Uncertainty (%)
		Start	End	Start	End				
Head	1900	20.1 ℃	20.3 ℃	20.0 ℃	20.0 ℃	**εr**	40.00	39.61	± 5%
						σ	1.40	1.43	± 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	10.00 W/Kg	**39.81 W/Kg**	± 17.57%
	SAR averaged over 10g	5.20 W/Kg	**20.70 W/Kg**	± 17.32%

Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	49.832 Ω - 3.79j Ω	± 0.28 Ω ± 0.044 jΩ
	Return Loss	28.42	± 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	1900	20.1 ℃	20.3 ℃	20.1 ℃	20.2 ℃	**εr**	53.30	54.78	± 5%
						σ	1.52	1.59	± 5%

SAR Results – Body Simulating Liquid (MSL)

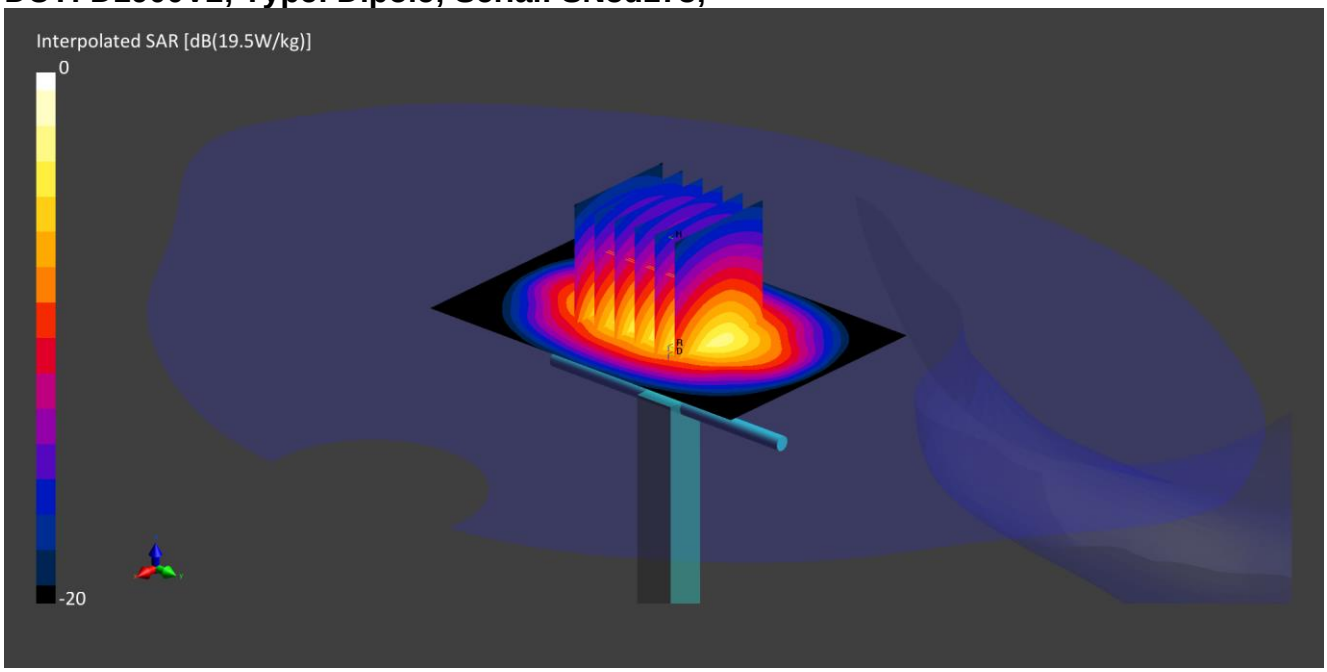
Simulant Liquid	**SAR Measured**	250 mW input Power	Normalised to 1.00 W	Uncertainty (%)
Body	SAR averaged over 1g	10.40 W/Kg	**41.40 W/Kg**	± 18.06%
	SAR averaged over 10g	5.48 W/Kg	**21.82 W/Kg**	± 17.44%

Antenna Parameters – Body Simulating Liquid (MSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Body	Impedance	53.77 Ω - 6.42j Ω	± 0.28 Ω ± 0.044 jΩ
	Return Loss	22.90	± 2.03 dB

DASY Validation Scan for Head Stimulating Liquid (HSL)

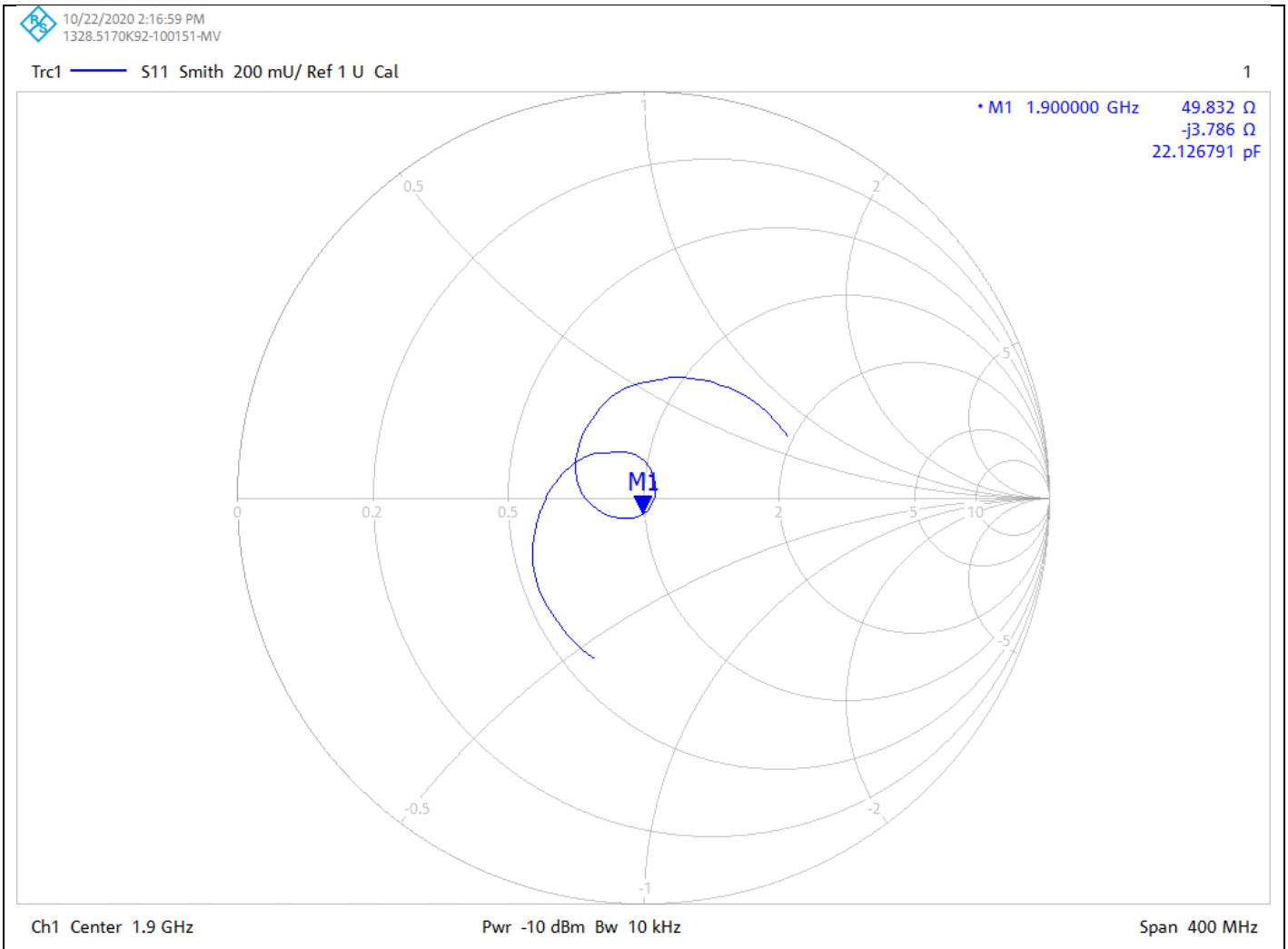
DUT: D1900V2; Type: Dipole; Serial: SN5d173;



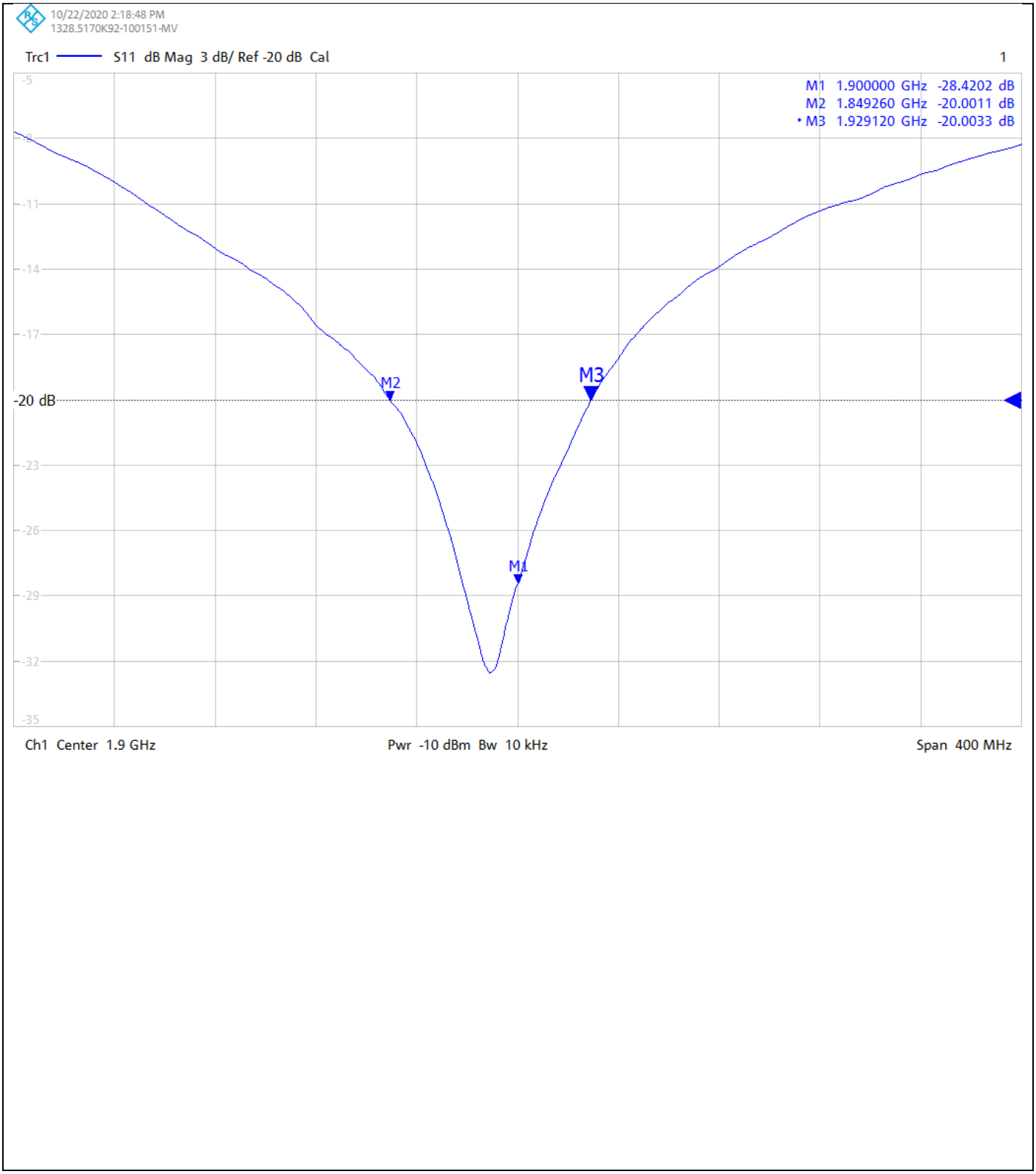
Communication System: CW UID: 0; Frequency: 1900.0 MHz; Duty Cycle: 1;
Medium: HSL; Site65_21Oct2020_085903_Head - 900 1900 2300 5%; Medium parameters used: f = 1900.0 MHz; σ = 1.43 S/m; ε_r = 39.6; ρ = 1000 kg/m3; $\Delta\varepsilon_r$ = -0.97 %; $\Delta\sigma$ = 2.14 %; No correction
Phantom section: Flat;
DASY 6 Configuration:
- Laboratory Name: Site65;
- Probe: EX3DV4 - SN7496; ConvF(8.53, 8.53, 8.53); 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 = 12.900 V/m; Power Drift = -0.09 dB
Minimum horizontal 3dB distance: 9.6 mm;
Vertical M2/M1 Ratio: 81.2 %;
SAR(1 g) = 10.000 W/kg; SAR(10 g) = 5.200 W/kg

Impedance Measurement Plot for Head Stimulating Liquid (HSL)

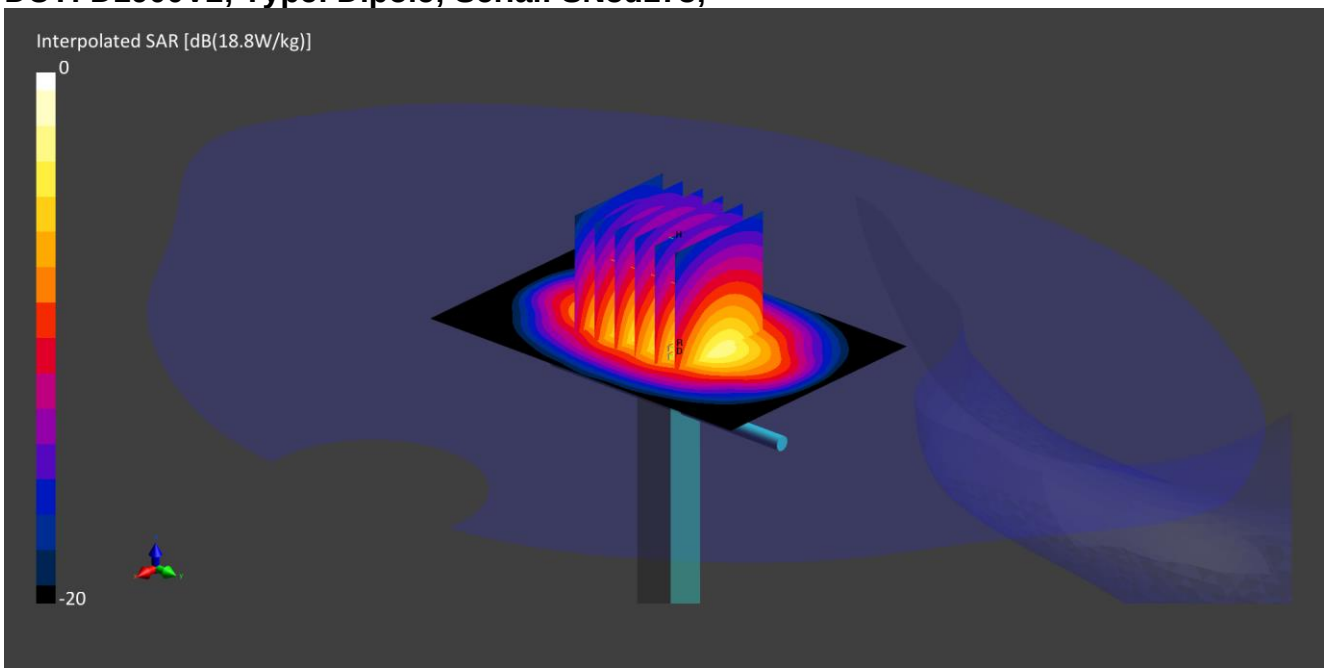


Return Loss Measurement Plot for Head Stimulating Liquid (HSL)



DASY Validation Scan for Body Stimulating Liquid (MSL)

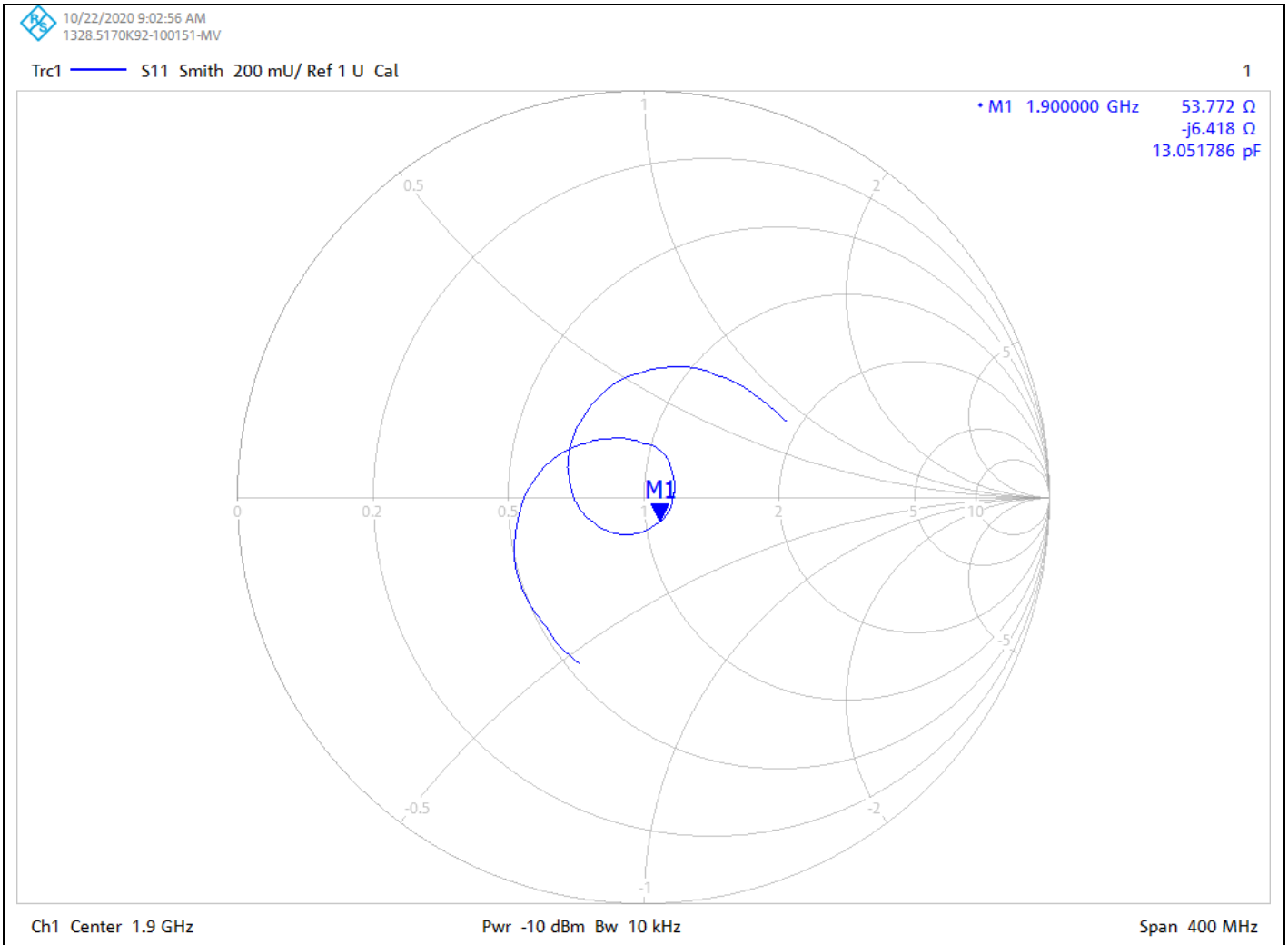
DUT: D1900V2; Type: Dipole; Serial: SN5d173;



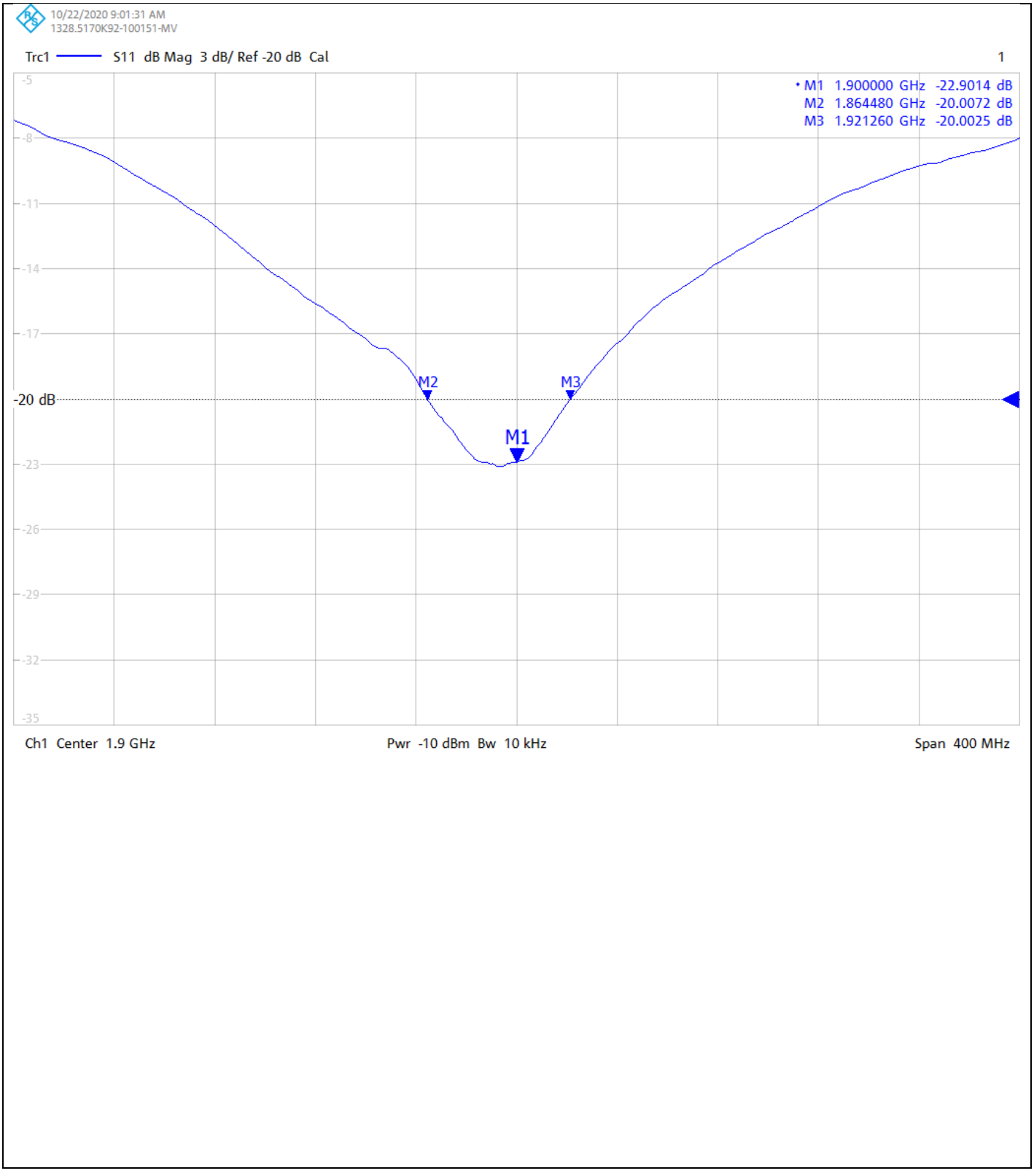
Communication System: CW UID: 0; Frequency: 1900.0 MHz; Duty Cycle: 1;
Medium: MSL; Site65_21Oct2020_162814_Body - 1900 5%; Medium parameters used: f = 1900.0 MHz; σ = 1.59 S/m; ε_r = 54.8; ρ = 1000 kg/m3; $\Delta\varepsilon_r$ = 2.77 %; $\Delta\sigma$ = 4.38 %; No correction
Phantom section: Flat;
DASY 6 Configuration:
- Laboratory Name: Site65;
- Probe: EX3DV4 - SN7496; ConvF(8.03, 8.03, 8.03); 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 = 13.030 V/m; Power Drift = 0.00 dB
Minimum horizontal 3dB distance: 9.6 mm;
Vertical M2/M1 Ratio: 84.7 %;
SAR(1 g) = 10.400 W/kg; SAR(10 g) = 5.480 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: 13252590JD01D

Instrument ID: 5d163

Calibration Date: 22/Oct/2020

Calibration Due Date:

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

Certificate Number: 13252590JD01D

Instrument ID: 5d163

Calibration Date: 22/Oct/2020

Calibration Due Date:

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

Certificate Number: 13252590JD01D

Instrument ID: 5d163

Calibration Date: 22/Oct/2020

Calibration Due Date:

CERTIFICATE OF CALIBRATION

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

DATE OF ISSUE: 13/April/2021 CERTIFICATE NUMBER : 13697411JD01D

5772

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

APPROVED SIGNATORY

Harmohan Sahota

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

Equipment Details:

Description:	Dipole Validation Kit	Date of Receipt:	12/April/2021
Manufacturer:	Speag		
Type/Model Number:	D2300V2		
Serial Number:	1002		
Calibration Date:	13/April/2021		
Calibrated By:	Ravish Foolchund Laboratory Technician		
Signature:			

All Calibration have been conducted in the closed laboratory facility: Lab Temperature (22±3) ^{o}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. **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
PRE0135602	Dipole Antenna	SPEAG	D2300V3	1057	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

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:	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	20.0 °C	19.8 °C	19.8°C	19.8°C	εr	39.47	39.00	± 5%
						σ	1.67	1.70	± 5%

SAR Results – Head Simulating Liquid (HSL)

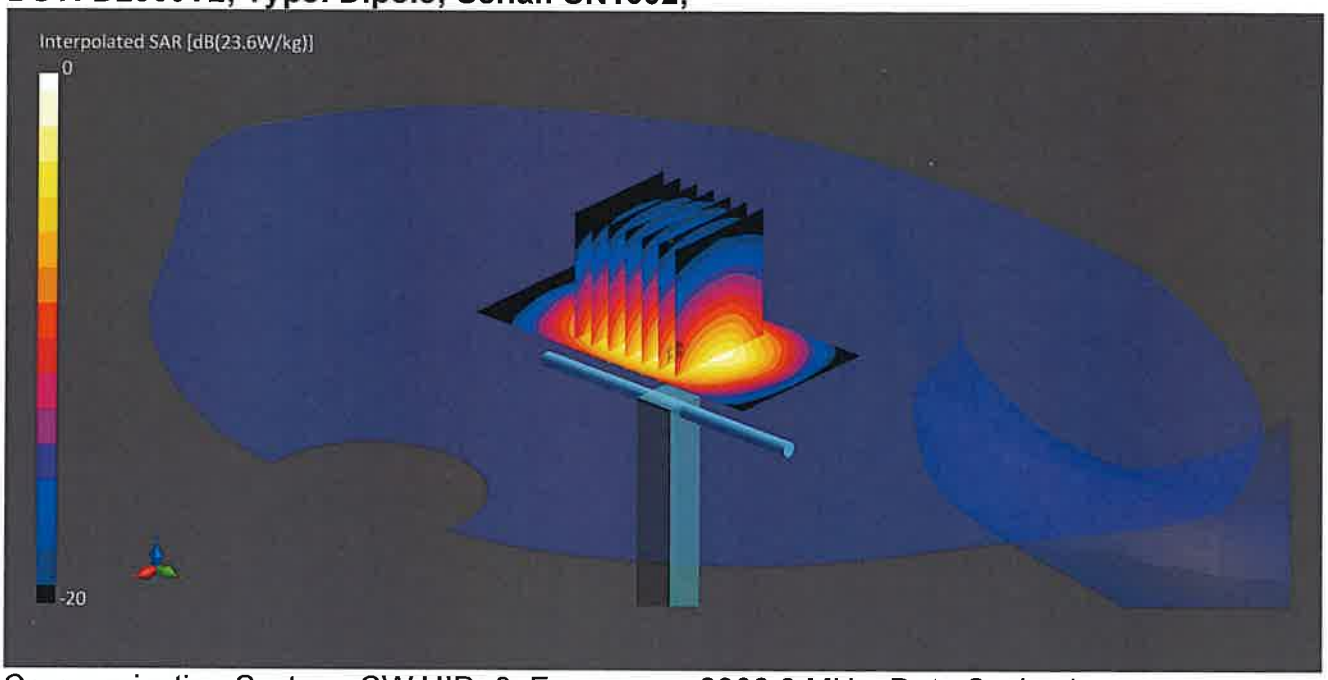
Simulant Liquid	SAR Measured	250 mW input Power	Normalised to 1.00 W	Uncertainty (%)
Head	SAR averaged over 1g	12.20 W/Kg	**48.57 W/Kg**	+16.80% / -16.43%
	SAR averaged over 10g	5.89 W/Kg	**23.45 W/Kg**	+16.72% / -16.42%

Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	50.73 Ω - 2.07 jΩ	± 0.28 Ω ± 0.044 jΩ
	Return Loss	-33.22 dB	± 3.34 dB

DASY Validation Scan for Head Stimulating Liquid (HSL)

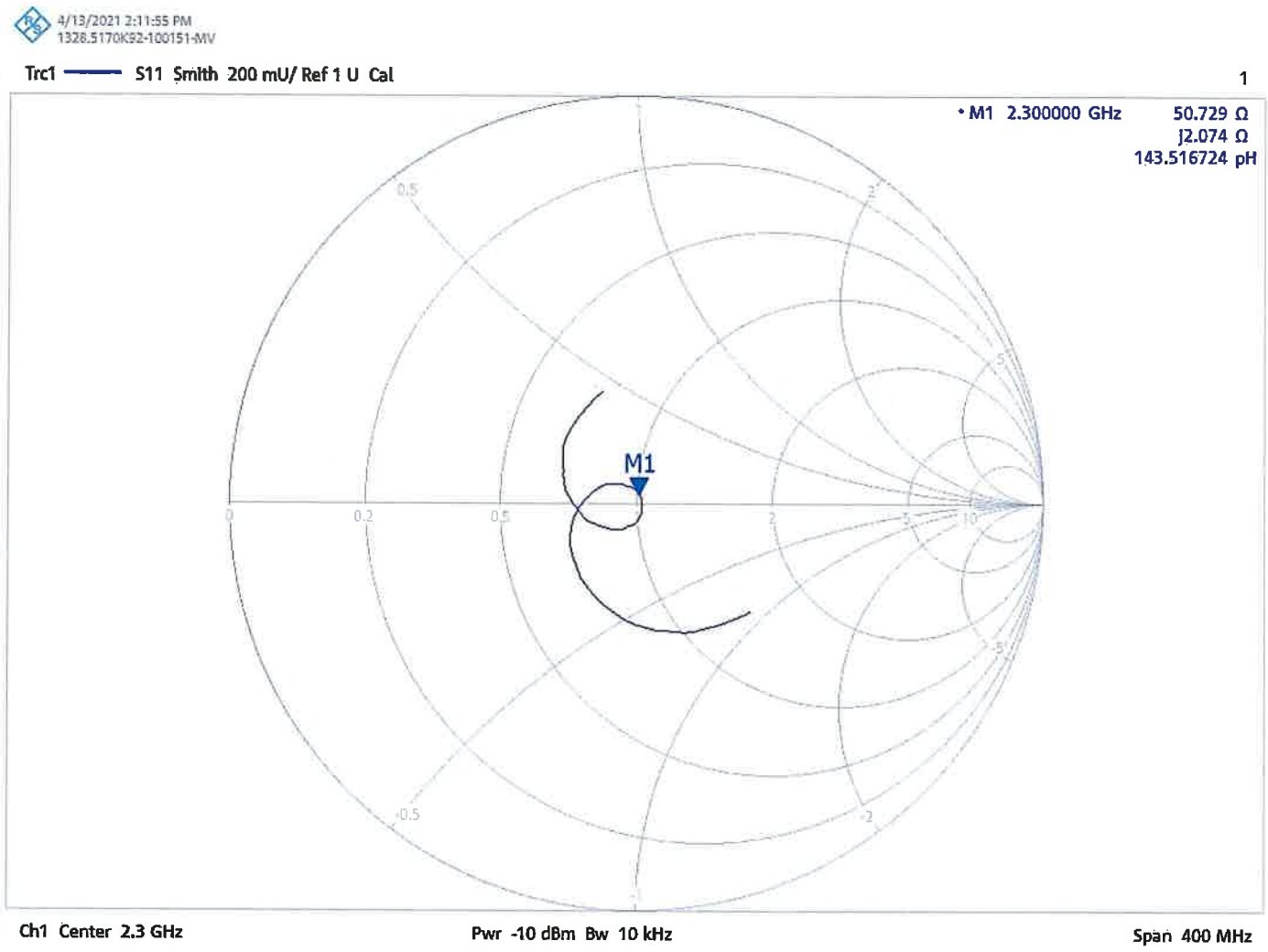
DUT: D2300V2; Type: Dipole; Serial: SN1002;



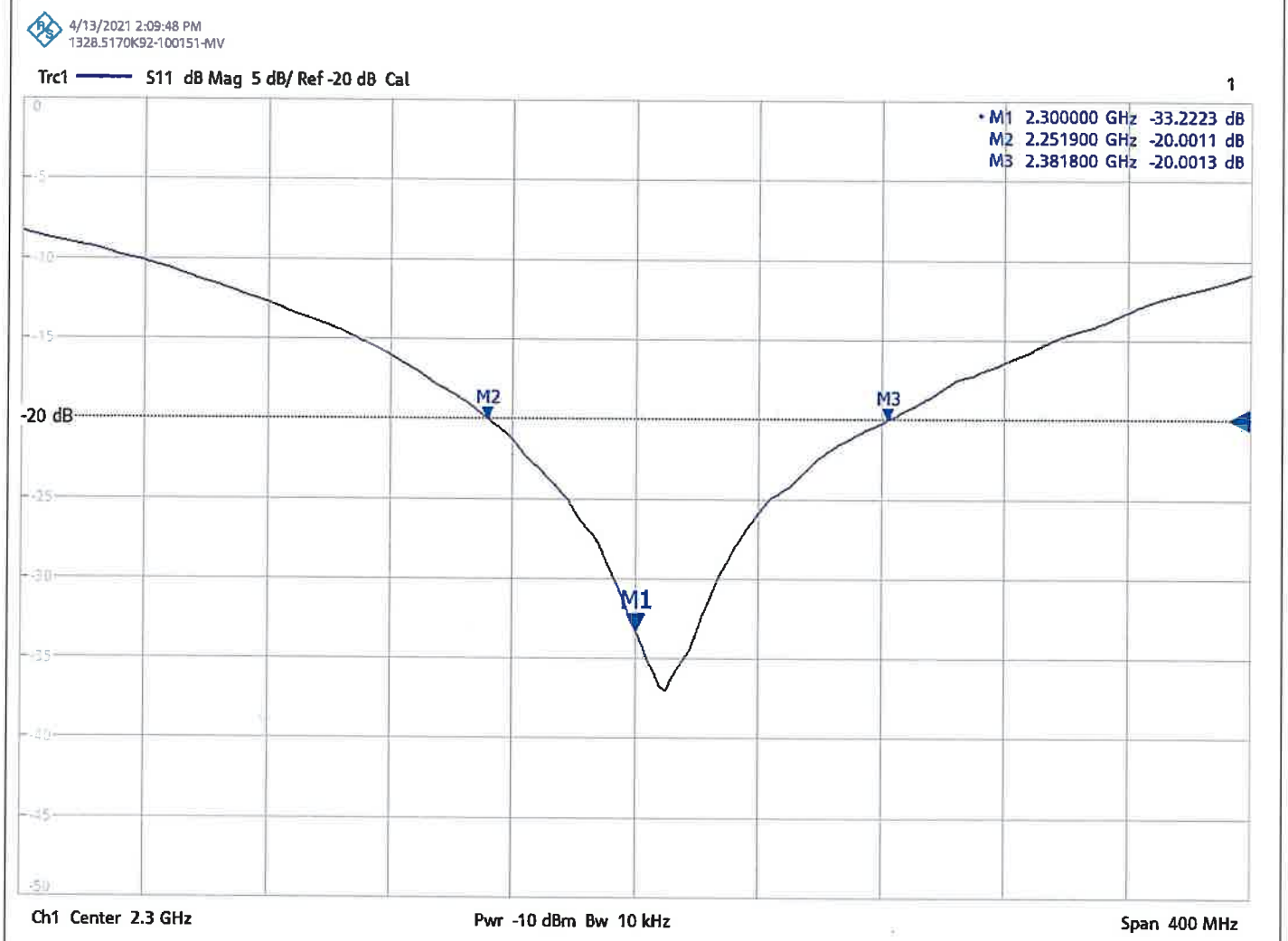
Communication System: CW UID: 0; Frequency: 2300.0 MHz; Duty Cycle: 1;
Medium: HSL; Site65_12Apr2021_115940_Head - 1750 1800 1900 2300 2450 2600 5%;
Medium parameters used: f = 2300.0 MHz; σ = 1.7 S/m; ε_r = 39; ρ = 1000 kg/m3; $\Delta\varepsilon_r$ = -1.19 %; $\Delta\sigma$ = 2.28 %; No correction
Phantom 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 - 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 = 15.750 V/m; Power Drift = 0.01 dB
Minimum horizontal 3dB distance: 9.1 mm;
Vertical M2/M1 Ratio: 82.6 %;
SAR(1 g) = 12.200 W/kg; SAR(10 g) = 5.890 W/kg

Impedance Measurement Plot for Head Stimulating Liquid (HSL)



Return Loss Measurement Plot for Head Stimulating Liquid (HSL)



Calibration Certificate Label:

5772

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

Certificate Number: 13697411JD01D

Instrument ID: 1002

Calibration Date: 13/April/2021

Calibration Due Date:

5772

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

Certificate Number: 13697411JD01D

Instrument ID: 1002

Calibration Date: 13/April/2021

Calibration Due Date:

5772

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

Certificate Number: 13697411JD01D

Instrument ID: 1002

Calibration Date: 13/April/2021

Calibration Due Date:

CERTIFICATE OF CALIBRATION

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

DATE OF ISSUE: 29/Oct/2020 CERTIFICATE NUMBER : 13252592JD01D

UL INTERNATIONAL (UK) LTD
UNIT 1-3 HORIZON
KINGSLAND PARK, WADE ROAD
BASINGSTOKE, HAMPSHIRE
RG24 8AH, UK
TEL: +44 (0) 1256 312000
FAX: +44 (0) 1256 312001
Email: LST.UK.Calibration@ul.com

APPROVED SIGNATORY

.....

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:	D2300V2		
Serial Number:	1058		
Calibration Date:	27/Oct/2020		
Calibrated By:	Ravish Foolchund Laboratory Technician		
Signature:			

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
PRE0134944	Dipole	SPEAG	D2300V2	1036	14 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:	10mm (with spacer)
Frequency:	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	20.1 ℃	20.6 ℃	20℃	20.9℃	**εr**	39.50	39.04	± 5%
						σ	1.67	1.69	± 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	11.80 W/Kg	**46.98 W/Kg**	± 17.57%
	SAR averaged over 10g	5.69 W/Kg	**22.65 W/Kg**	± 17.32%

Antenna Parameters – Head Simulating Liquid (HSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Head	Impedance	51.27 Ω + 3.05j Ω	± 0.28 Ω ± 0.044 jΩ
	Return Loss	29.73	± 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	2300	18.1℃	18.5℃	18.1℃	18.9℃	**εr**	52.90	53.23	± 5%
						σ	1.81	1.84	± 5%

SAR Results – Body Simulating Liquid (MSL)

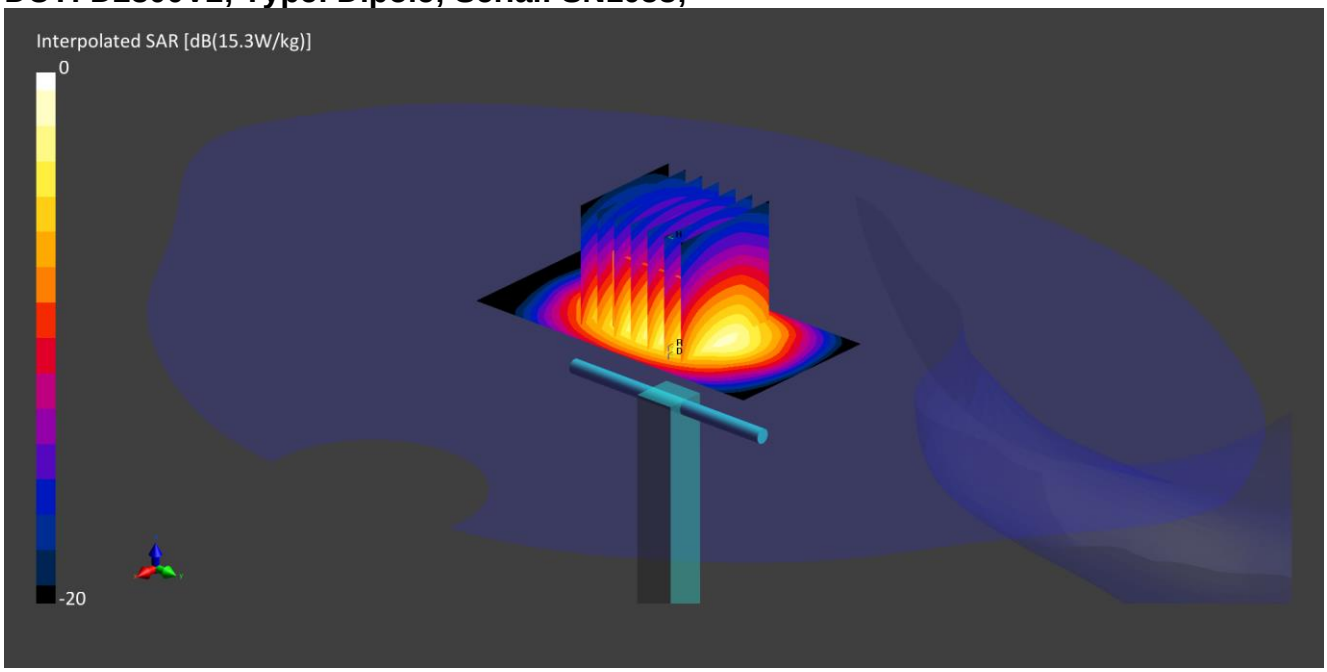
Simulant Liquid	**SAR Measured**	250 mW input Power	Normalised to 1.00 W	Uncertainty (%)
Body	SAR averaged over 1g	11.60 W/Kg	**46.18 W/Kg**	± 18.06%
	SAR averaged over 10g	5.56 W/Kg	**22.13 W/Kg**	± 17.44%

Antenna Parameters – Body Simulating Liquid (MSL)

Simulant Liquid	Parameter	Measured Level	Uncertainty (%)
Body	Impedance	54.92 Ω + 5.39j Ω	± 0.28 Ω ± 0.044 jΩ
	Return Loss	23.14	± 2.03 dB

DASY Validation Scan for Head Stimulating Liquid (HSL)

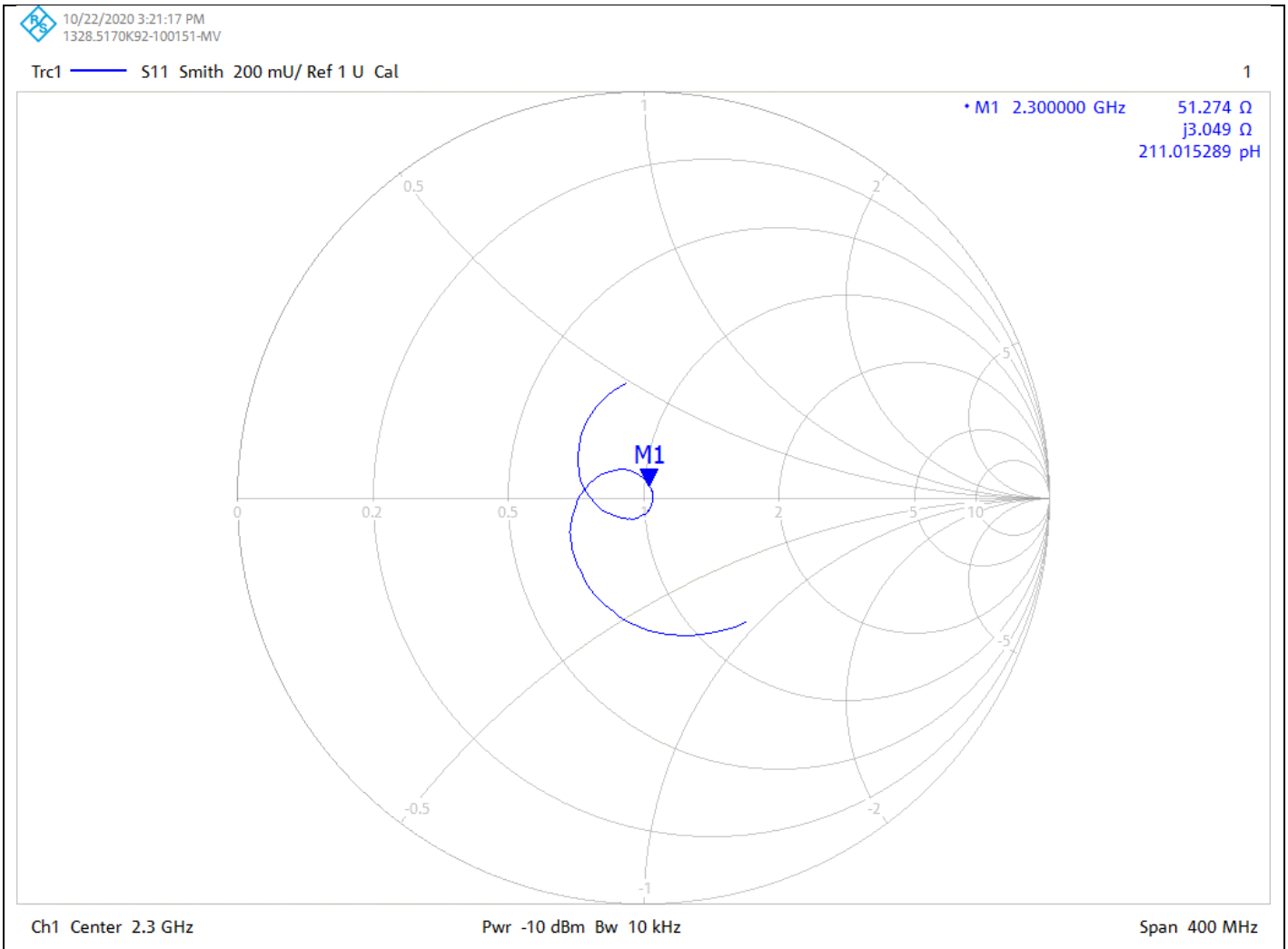
DUT: D2300V2; Type: Dipole; Serial: SN1058;



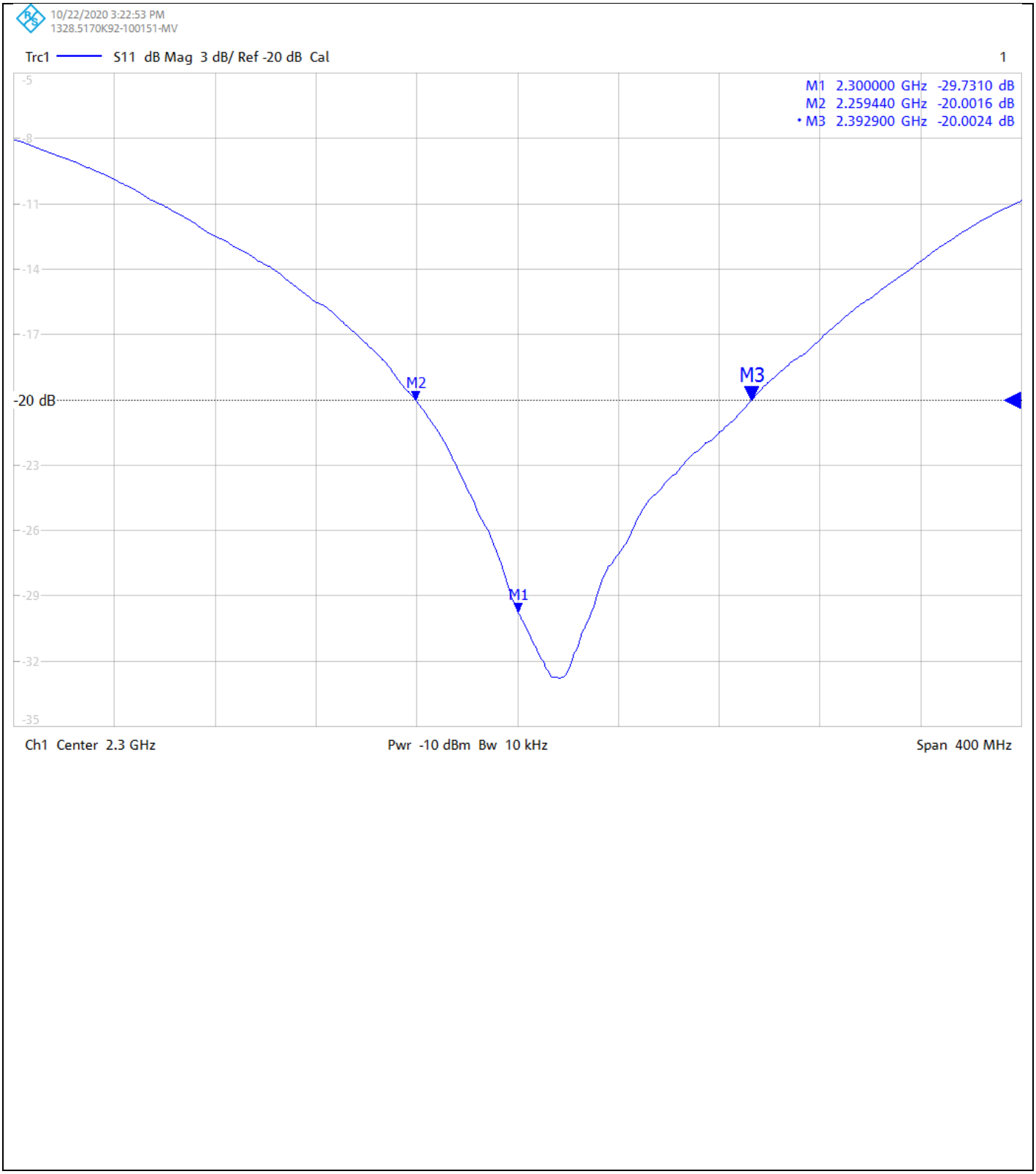
Communication System: CW UID: 0; Frequency: 2300.0 MHz; Duty Cycle: 1;
Medium: HSL; Site65_21Oct2020_085903_Head - 900 1900 2300 5%; Medium parameters used: f = 2300.0 MHz; σ = 1.69 S/m; ε_r = 39; ρ = 1000 kg/m3; $\Delta\varepsilon_r$ = -1.08 %; $\Delta\sigma$ = 1.46 %; No correction
Phantom section: Flat;
DASY 6 Configuration:
- Laboratory Name: Site65;
- Probe: EX3DV4 - SN7496; ConvF(8.19, 8.19, 8.19); 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 (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 = 15.420 V/m; Power Drift = -0.01 dB
Minimum horizontal 3dB distance: 9.0 mm;
Vertical M2/M1 Ratio: 81.6 %;
SAR(1 g) = 11.800 W/kg; SAR(10 g) = 5.690 W/kg

Impedance Measurement Plot for Head Stimulating Liquid (HSL)

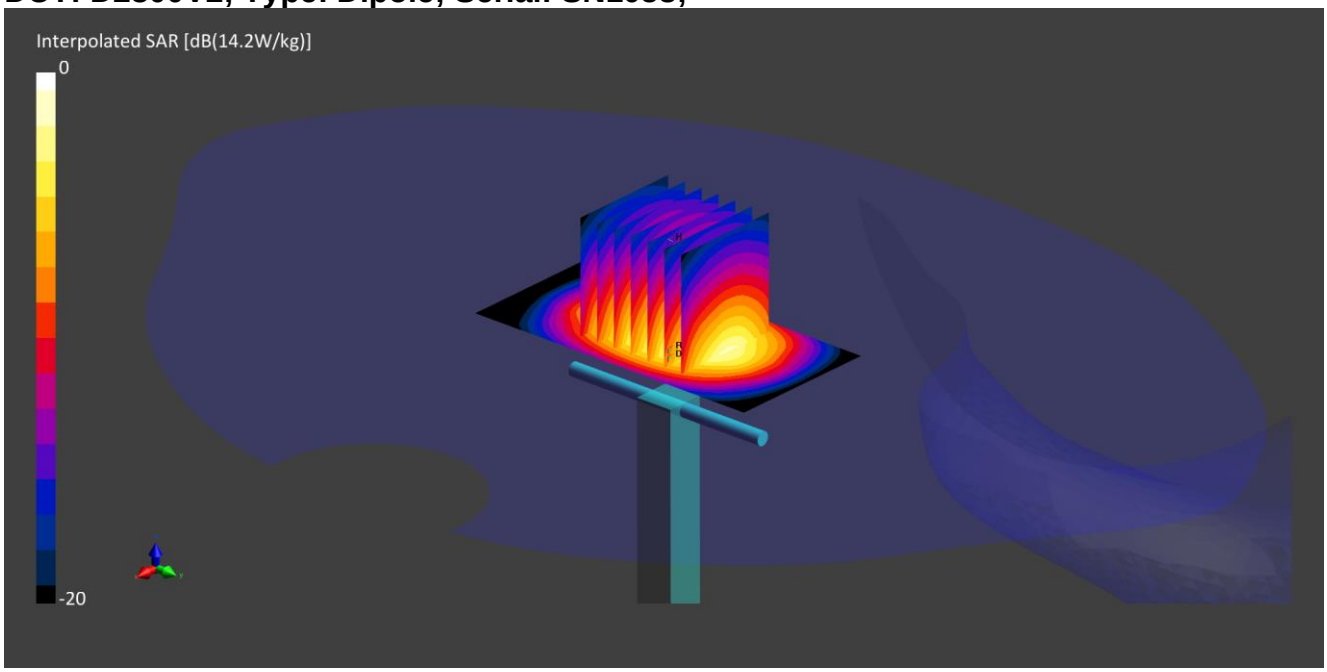


Return Loss Measurement Plot for Head Stimulating Liquid (HSL)



DASY Validation Scan for Body Stimulating Liquid (MSL)

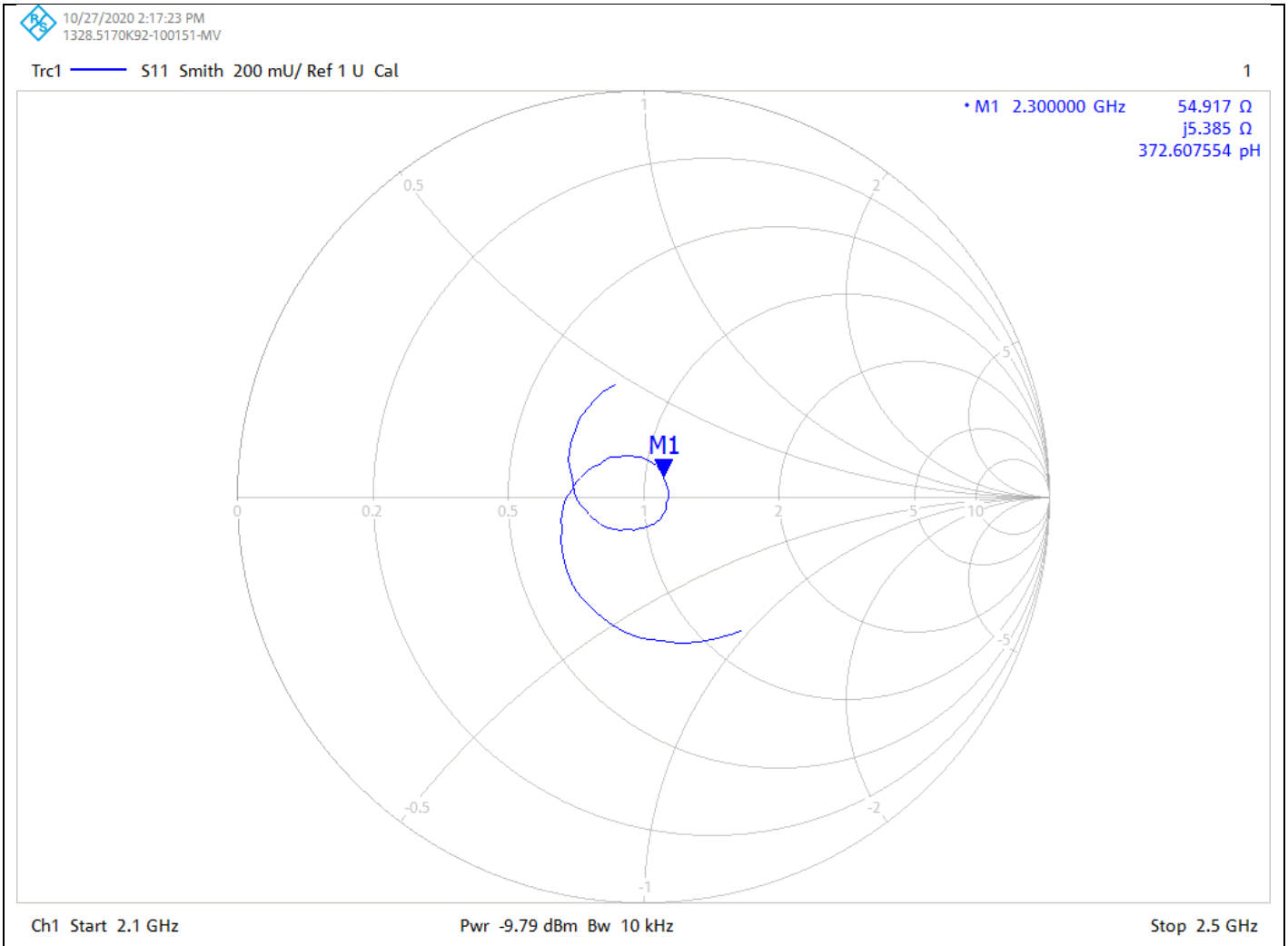
DUT: D2300V2; Type: Dipole; Serial: SN1058;



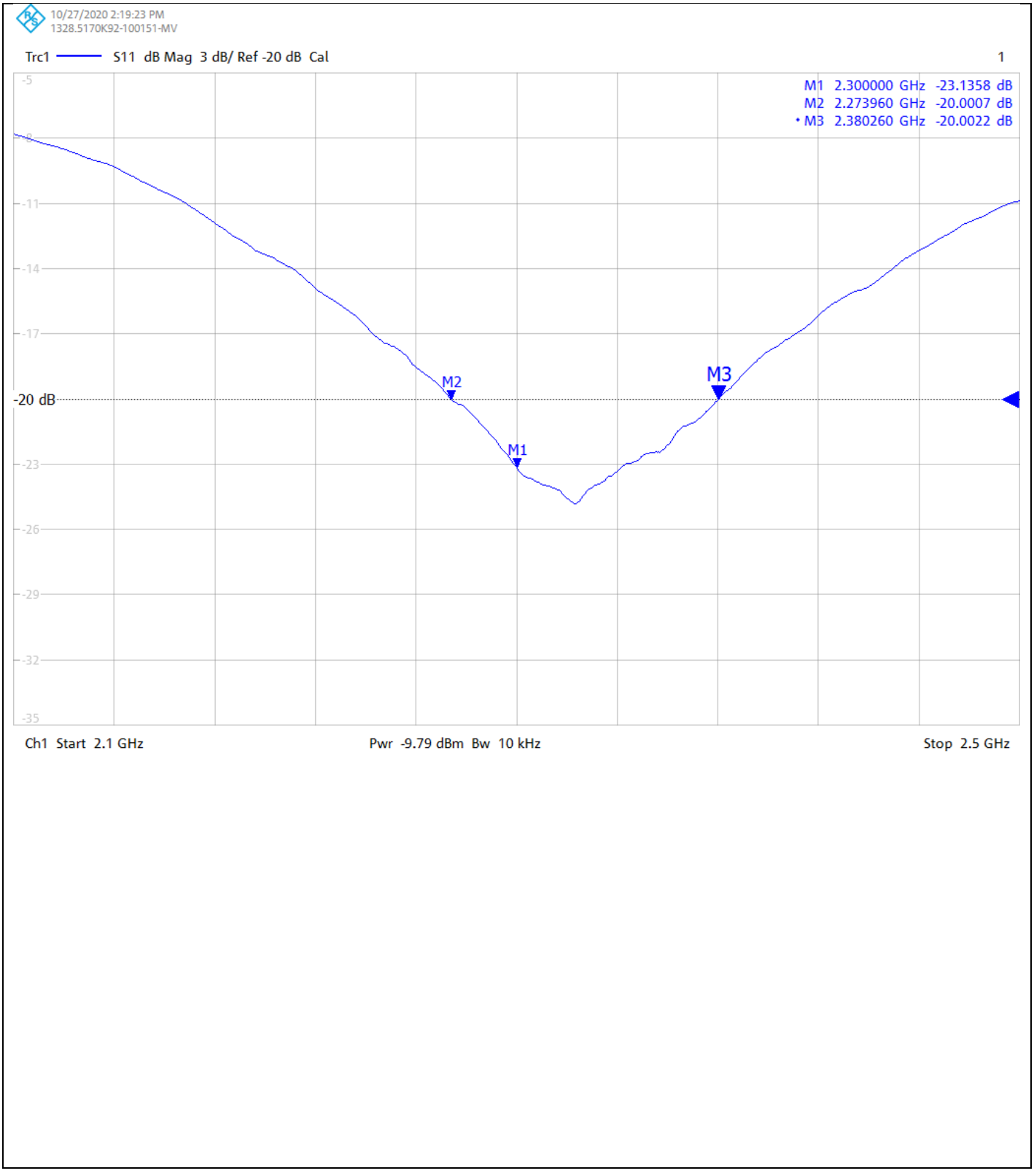
Communication System: CW UID: 0; Frequency: 2300.0 MHz; Duty Cycle: 1;
Medium: MSL; Site65_27Oct2020_112932_Body - 2000 2300 5%; Medium parameters used: f = 2300.0 MHz; σ = 1.84 S/m; ε_r = 53.2; ρ = 1000 kg/m3; $\Delta\varepsilon_r$ = 0.60 %; $\Delta\sigma$ = 2.07 %; No correction
Phantom section: Flat;
DASY 6 Configuration:
- Laboratory Name: Site65;
- Probe: EX3DV4 - SN7496; ConvF(7.96, 7.96, 7.96); 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 (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 = 15.070 V/m; Power Drift = 0.02 dB
Minimum horizontal 3dB distance: 8.9 mm;
Vertical M2/M1 Ratio: 81.1 %;
SAR(1 g) = 11.600 W/kg; SAR(10 g) = 5.560 W/kg

Impedance Measurement Plot for Body Stimulating Liquid (MSL)



Return Loss Measurement Plot for Body Stimulating Liquid (MSL)



Calibration Certificate Label:

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

Certificate Number: 13252592JD01D

Instrument ID: 1058

Calibration Date: 27/Oct/2020

Calibration Due Date:

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

Certificate Number: 13252592JD01D

Instrument ID: 1058

Calibration Date: 27/Oct/2020

Calibration Due Date:

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5772

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

Certificate Number: 13252592JD01D

Instrument ID: 1058

Calibration Date: 27/Oct/2020

Calibration Due Date: