

## Appendix A – System Validation Plots and Data

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Test Result for UIM Dielectric Parameter

Thu 04/Aug/2022

Freq Frequency(GHz)

FCC\_eH Limits for Head Epsilon

FCC\_sH Limits for Head Sigma

Test\_e Epsilon of UIM

Test\_s Sigma of UIM

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Freq	FCC_eH	FCC_sH	Test_e	Test_s
0.5800	42.82	0.88	41.46	0.88
0.5900	42.77	0.88	41.40	0.88
0.6000	42.72	0.88	41.35	0.88
0.6100	42.67	0.88	41.30	0.89
0.6200	42.62	0.88	41.25	0.89
0.6300	42.56	0.88	41.18	0.89
0.6400	42.51	0.88	41.12	0.89
0.6500	42.46	0.88	41.06	0.89
0.6600	42.41	0.88	41.00	0.90
0.6700	42.36	0.89	40.94	0.90
0.6730	42.345	0.89	40.922	0.90*
0.6800	42.31	0.89	40.88	0.90
0.6805	42.307	0.89	40.877	0.901*
0.6880	42.262	0.89	40.832	0.908*
0.6900	42.25	0.89	40.82	0.91
0.7000	42.20	0.89	40.76	0.91
0.7000	42.20	0.89	40.66	0.91
0.7100	42.15	0.89	40.59	0.91
0.7200	42.10	0.89	40.54	0.91
0.7300	42.05	0.89	40.47	0.92
0.7400	41.99	0.89	40.41	0.92
0.7500	41.94	0.89	40.36	0.92
0.7600	41.89	0.89	40.30	0.93

\* value intepolated

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Test Result for UIM Dielectric Parameter  
Fri 05/Aug/2022  
Freq Frequency(GHz)  
eH Limits for Head Epsilon  
sH Limits for Head Sigma  
Test\_e Epsilon of UIM  
Test\_s Sigma of UIM  
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Freq	eH	sH	Test_e	Test_s
0.8000	41.68	0.90	40.79	0.91
0.8100	41.63	0.90	40.74	0.92
0.8200	41.58	0.90	40.68	0.93
0.8240	41.56	0.90	40.70	0.93*
0.8300	41.53	0.90	40.73	0.93
0.8315	41.526	0.902	40.726	0.932*
0.8390	41.503	0.909	40.703	0.939*
0.8400	41.50	0.91	40.70	0.94
0.8500	41.50	0.92	40.68	0.95
0.8600	41.50	0.93	40.66	0.96
0.8700	41.50	0.94	40.64	0.97
0.8800	41.50	0.95	40.63	0.98
0.8900	41.50	0.96	40.62	0.99
0.9000	41.50	0.97	40.61	1.00
0.9100	41.50	0.98	40.60	1.01
0.9200	41.49	0.98	40.59	1.01

\* value interpolated

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Test Result for UIM Dielectric Parameter  
Thu 11/Aug/2022  
Freq Frequency(GHz)  
eH Limits for Head Epsilon  
sH Limits for Head Sigma  
Test\_e Epsilon of UIM  
Test\_s Sigma of UIM  
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Freq	eH	sH	Test_e	Test_s
1.7000	40.16	1.34	39.54	1.37
1.7100	40.14	1.35	39.52	1.38
1.7200	40.13	1.35	39.50	1.39
1.7300	40.11	1.36	39.48	1.39
1.7400	40.09	1.37	39.46	1.40
1.7450	40.085	1.37	39.45	1.405*
1.7500	40.08	1.37	39.44	1.41
1.7600	40.06	1.38	39.42	1.42
1.7700	40.05	1.38	39.40	1.43
1.7800	40.03	1.39	39.38	1.43
1.7900	40.02	1.39	39.36	1.44

\* value interpolated

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Test Result for UIM Dielectric Parameter  
Fri 12/Aug/2022  
Freq Frequency(GHz)  
eH Limits for Head Epsilon  
sH Limits for Head Sigma  
Test\_e Epsilon of UIM  
Test\_s Sigma of UIM  
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Freq	eH	sH	Test_e	Test_s
1.8500	40.00	1.40	39.19	1.44
1.8600	40.00	1.40	39.17	1.45
1.8700	40.00	1.40	39.15	1.45
1.8800	40.00	1.40	39.13	1.46
1.8825	40.00	1.40	39.125	1.46*
1.8900	40.00	1.40	39.11	1.46
1.9000	40.00	1.40	39.09	1.46
1.9050	40.00	1.40	39.08	1.465*
1.9100	40.00	1.40	39.07	1.47
1.9200	40.00	1.40	39.06	1.48

\* value interpolated

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Test Result for UIM Dielectric Parameter  
Mon 15/Aug/2022  
Freq Frequency(GHz)  
FCC\_eH Limits for Head Epsilon  
FCC\_sH Limits for Head Sigma  
Test\_e Epsilon of UIM  
Test\_s Sigma of UIM  
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Freq	FCC_eH	FCC_sH	Test_e	Test_s
2.4900	39.15	1.84	38.50	1.86
2.5000	39.14	1.85	38.48	1.87
2.5060	39.128	1.862	38.462	1.876*
2.5100	39.12	1.87	38.45	1.88
2.5200	39.11	1.88	38.43	1.90
2.5300	39.10	1.89	38.41	1.91
2.5350	39.095	1.895	38.395	1.915*
2.5400	39.09	1.90	38.38	1.92
2.5495	39.071	1.91	38.361	1.939*
2.5500	39.07	1.91	38.36	1.94
2.5600	39.06	1.92	38.34	1.95
2.5700	39.05	1.93	38.31	1.96
2.5800	39.03	1.94	38.29	1.98
2.5900	39.02	1.95	38.26	1.99
2.5930	39.017	1.953	38.263	1.99*
2.6000	39.01	1.96	38.27	1.99
2.6100	39.00	1.97	38.25	2.00
2.6200	38.98	1.99	38.24	2.01
2.6300	38.97	2.00	38.22	2.02
2.6365	38.964	2.007	38.207	2.027*
2.6400	38.96	2.01	38.20	2.03
2.6500	38.95	2.02	38.18	2.04
2.6600	38.93	2.03	38.17	2.05
2.6700	38.92	2.04	38.15	2.06
2.6800	38.91	2.05	38.13	2.07
2.6900	38.89	2.06	38.11	2.08
2.7000	38.88	2.07	38.10	2.09

\* value interpolated

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 Test Result for UIM Dielectric Parameter  
 Mon 08/Aug/2022  
 Freq Frequency(GHz)  
 FCC\_eH Limits for Head Epsilon  
 FCC\_sH Limits for Head Sigma  
 Test\_e Epsilon of UIM  
 Test\_s Sigma of UIM  
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Freq	FCC_eH	FCC_sH	Test_e	Test_s
3.3000	38.16	2.70	37.48	2.71
3.3100	38.15	2.71	37.47	2.72*
3.3200	38.14	2.72	37.46	2.73
3.3400	38.12	2.74	37.44	2.75
3.3600	38.09	2.76	37.41	2.77
3.3800	38.07	2.78	37.39	2.79
3.4000	38.05	2.80	37.37	2.81
3.4077	38.038	2.808	37.358	2.818*
3.4200	38.02	2.82	37.34	2.83
3.4400	38.00	2.85	37.32	2.86
3.4600	37.98	2.87	37.30	2.88
3.4800	37.95	2.89	37.27	2.90
3.5000	37.93	2.91	37.25	2.92
3.5054	37.925	2.915	37.245	2.925*
3.5200	37.91	2.93	37.23	2.94
3.5400	37.88	2.95	37.20	2.96
3.5600	37.86	2.97	37.18	2.98
3.5800	37.84	2.99	37.16	3.00
3.6000	37.81	3.02	37.13	3.03
3.6031	37.807	3.023	37.127	3.033*
3.6033	37.807	3.023	37.127	3.033*
3.6200	37.79	3.04	37.11	3.05
3.6400	37.77	3.06	37.09	3.07
3.6467	37.763	3.067	37.083	3.077*
3.6600	37.75	3.08	37.07	3.09
3.6800	37.72	3.10	37.04	3.11
3.6900	37.71	3.11	37.03	3.12*
3.7000	37.70	3.12	37.02	3.13
3.7008	37.699	3.121	37.019	3.131*
3.7200	37.68	3.14	37.00	3.15
3.7400	37.65	3.17	36.97	3.18
3.7600	37.63	3.19	36.95	3.20
3.7800	37.61	3.21	36.93	3.22
3.7985	37.582	3.229	36.902	3.239*
3.8000	37.58	3.23	36.90	3.24
3.8200	37.56	3.25	36.88	3.26
3.8400	37.54	3.27	36.86	3.28
3.8600	37.51	3.29	36.83	3.30
3.8800	37.49	3.31	36.81	3.32
3.8962	37.474	3.334	36.794	3.344*
3.9000	37.47	3.34	36.79	3.35
3.9200	37.44	3.36	36.76	3.37
3.9400	37.42	3.38	36.74	3.39
3.9600	37.40	3.40	36.72	3.41
3.9800	37.37	3.42	36.69	3.43
3.9939	37.356	3.434	36.676	3.444*
4.0000	37.35	3.44	36.67	3.45
4.0200	37.33	3.46	36.65	3.47
4.0400	37.30	3.48	36.62	3.49
4.0600	37.28	3.51	36.60	3.52
4.0800	37.26	3.53	36.58	3.54
4.0916	37.243	3.542	36.563	3.552*
4.1000	37.23	3.55	36.55	3.56
4.1200	37.21	3.57	36.53	3.58
4.1400	37.19	3.59	36.51	3.60
4.1600	37.16	3.61	36.48	3.62
4.1800	37.14	3.63	36.46	3.64
4.1900	37.13	3.64	36.45	3.65
4.2000	37.12	3.65	36.44	3.66
4.2200	37.09	3.68	36.52	3.71
4.2400	37.07	3.70	36.50	3.73

\* value interpolated

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Test Result for UIM Dielectric Parameter

Mon 19/Sep/2022

Freq Frequency(GHz)

FCC\_eH Limits for Head Epsilon

FCC\_sH Limits for Head Sigma

Test\_e Epsilon of UIM

Test\_s Sigma of UIM

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Freq	FCC_eH	FCC_sH	Test_e	Test_s
2.4900	39.15	1.84	38.89	1.89
2.5000	39.14	1.85	38.87	1.90
2.5060	39.128	1.862	38.852	1.906*
2.5100	39.12	1.87	38.84	1.91
2.5200	39.11	1.88	38.82	1.93
2.5300	39.10	1.89	38.80	1.94
2.5400	39.09	1.90	38.77	1.95
2.5495	39.071	1.91	38.751	1.969*
2.5500	39.07	1.91	38.75	1.97
2.5600	39.06	1.92	38.73	1.98
2.5700	39.05	1.93	38.70	1.99
2.5800	39.03	1.94	38.68	2.01
2.5900	39.02	1.95	38.65	2.02
2.5930	39.017	1.953	38.653	2.02*
2.6000	39.01	1.96	38.66	2.02
2.6100	39.00	1.97	38.64	2.03
2.6200	38.98	1.99	38.63	2.04
2.6300	38.97	2.00	38.61	2.05
2.6365	38.964	2.007	38.597	2.057*
2.6400	38.96	2.01	38.59	2.06
2.6500	38.95	2.02	38.57	2.07
2.6600	38.93	2.03	38.56	2.08
2.6700	38.92	2.04	38.54	2.09
2.6800	38.91	2.05	38.52	2.10
2.6900	38.89	2.06	38.50	2.11
2.7000	38.88	2.07	38.49	2.12

\* value interpolated

# RF Exposure Lab

## Plot 1

**DUT: Dipole 750 MHz D750V3; Type: D750V3; Serial: D750V3 - SN 1053**

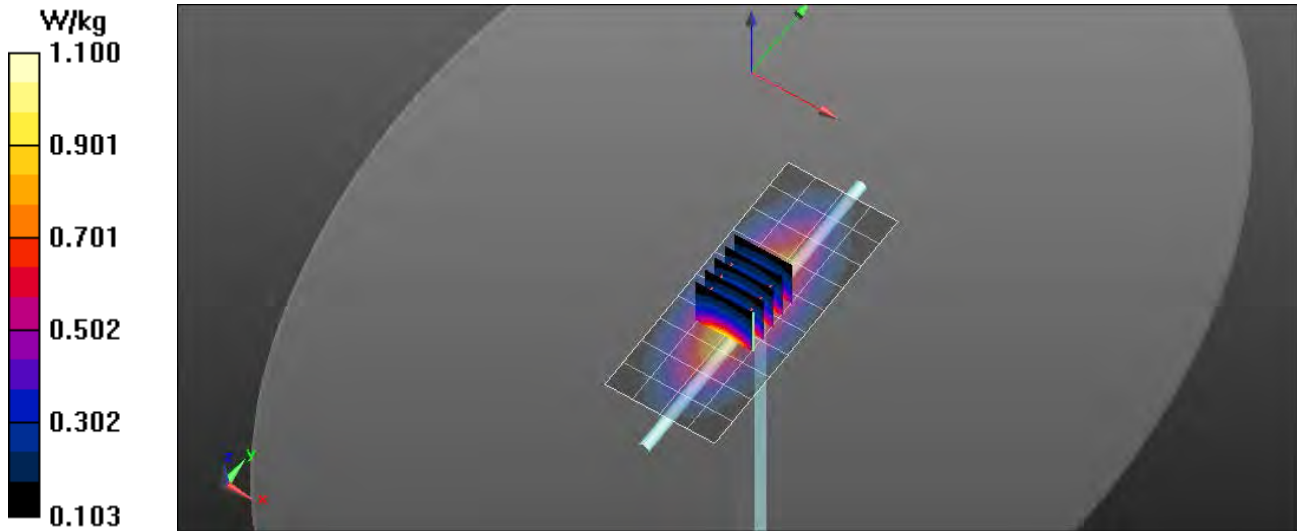
Communication System: CW; Frequency: 750 MHz; Duty Cycle: 1:1  
 Medium: HSL600; Medium parameters used (interpolated):  $f = 750 \text{ MHz}$ ;  $\sigma = 0.92 \text{ S/m}$ ;  $\epsilon_r = 40.36$ ;  $\rho = 1000 \text{ kg/m}^3$   
 Phantom section: Flat Section

Test Date: Date: 8/4/2022; Ambient Temp: 23 °C; Tissue Temp: 21 °C  
 Probe: EX3DV4 – SN7530; ConvF(10.44, 10.44, 10.44); Calibrated: 1/14/2022;  
 Sensor-Surface: 2mm (Mechanical Surface Detection)  
 Electronics: DAE4 Sn1217; Calibrated: 3/24/2022  
 Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1251  
 Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

### Procedure Notes:

**750 MHz Head/Verification/Area Scan (41x121x1):** Interpolated grid:  $dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$   
 Maximum value of SAR (measured) = 1.08 W/kg

**750 MHz Head/Verification /Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$   
 Reference Value = 31.227 V/m; Power Drift = 0.02 dB  
 Peak SAR (extrapolated) = 1.30 W/kg  
 $P_{in} = 100 \text{ mW}$   
**SAR(1 g) = 0.865 W/kg; SAR(10 g) = 0.549 W/kg**  
 Maximum value of SAR (measured) = 1.10 W/kg



# RF Exposure Lab

## Plot 2

**DUT: Dipole 900 MHz D900V2; Type: D900V2; Serial: D900V2 - SN:1d128**

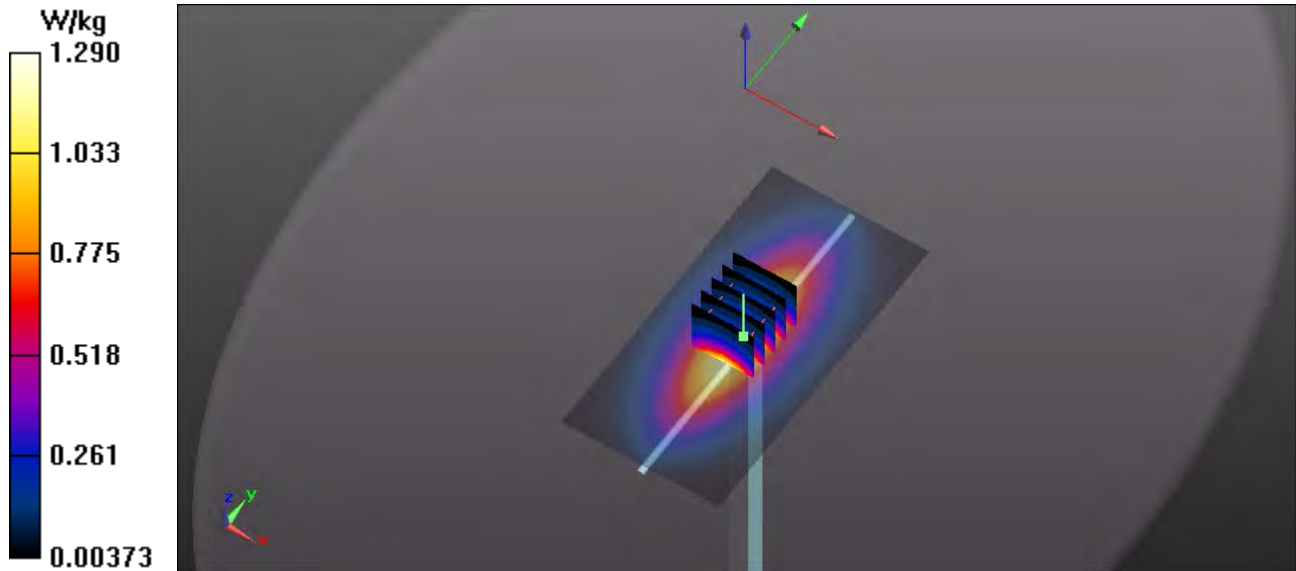
Communication System: CW; Frequency: 900 MHz; Duty Cycle: 1:1  
 Medium: HSL900; Medium parameters used:  $f = 900 \text{ MHz}$ ;  $\sigma = 1 \text{ S/m}$ ;  $\epsilon_r = 40.61$ ;  $\rho = 1000 \text{ kg/m}^3$   
 Phantom section: Flat Section

Test Date: Date: 8/5/2022; Ambient Temp: 23 °C; Tissue Temp: 21 °C  
 Probe: EX3DV4 - SN7530; ConvF(9.98, 9.98, 9.98); Calibrated: 1/14/2022;  
 Sensor-Surface: 2mm (Mechanical Surface Detection)  
 Electronics: DAE4 Sn1217; Calibrated: 3/24/2022  
 Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1251  
 Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

### Procedure Notes:

**900 MHz Head/Verification/Area Scan (41x101x1):** Interpolated grid:  $dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$   
 Maximum value of SAR (interpolated) = 1.29 W/kg

**900 MHz Head/Verification/Zoom Scan (5x5x8)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$   
 Reference Value = 52.612 V/m; Power Drift = -0.02 dB  
 Peak SAR (extrapolated) = 1.47 W/kg  
 $P_{in} = 100 \text{ mW}$   
**SAR(1 g) = 1.15 W/kg; SAR(10 g) = 0.722 W/kg**  
 Maximum value of SAR (measured) = 1.29 W/kg



# RF Exposure Lab

## Plot 3

**DUT: Dipole 1750 MHz D1750V2; Type: D1750V2; Serial: D1750V2 - SN:1061**

Communication System: CW; Frequency: 1750 MHz; Duty Cycle: 1:1  
 Medium: HSL1750; Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.41$  S/m;  $\epsilon_r = 39.44$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

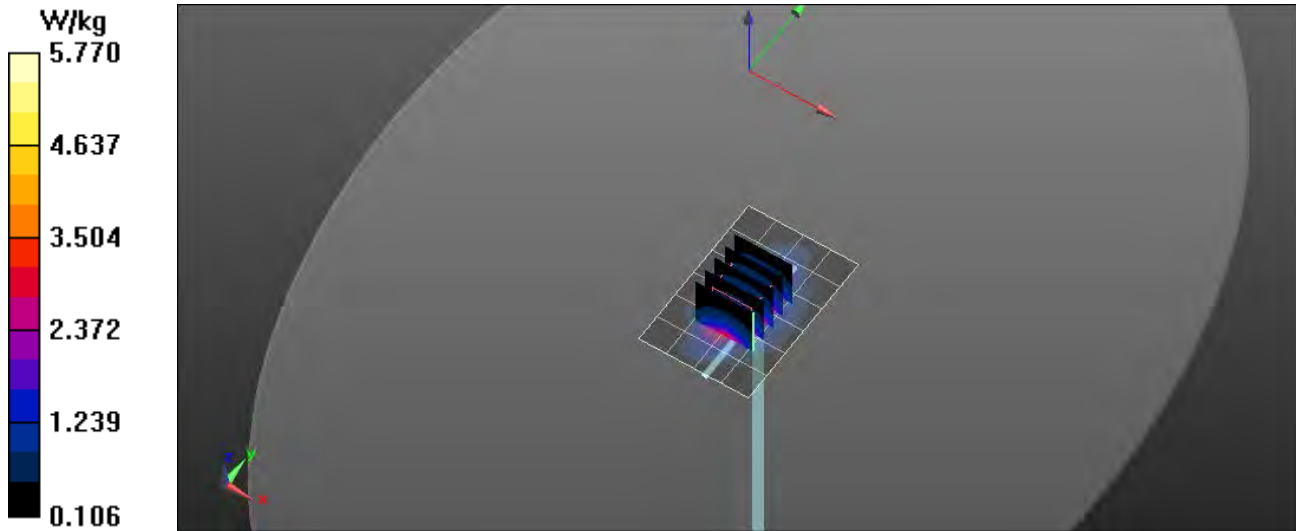
Test Date: Date: 8/11/2022; Ambient Temp: 23 °C; Tissue Temp: 21 °C  
 Probe: EX3DV4 - SN7530; ConvF(8.42, 8.42, 8.42); Calibrated: 1/14/2022;  
 Sensor-Surface: 2mm (Mechanical Surface Detection)  
 Electronics: DAE4 Sn1217; Calibrated: 3/24/2022  
 Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1251  
 Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

### Procedure Notes:

**1750 MHz/Verification/Area Scan (5x7x1):** Measurement grid: dx=15mm, dy=15mm  
 Maximum value of SAR (measured) = 5.46 W/kg

**1750 MHz/Verification/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
 Reference Value = 32.568 V/m; Power Drift = -0.03 dB  
 Peak SAR (extrapolated) = 6.92 W/kg  
 $P_{in} = 100$  mW

**SAR(1 g) = 3.79 W/kg; SAR(10 g) = 1.96 W/kg**  
 Maximum value of SAR (measured) = 5.47 W/kg





# RF Exposure Lab

## Plot 4

**DUT: Dipole 1900 MHz D1900V2; Type: D1900V2; Serial: D1900V2 - SN: 5d147**

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1  
Medium: HSL1900; Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.46$  S/m;  $\epsilon_r = 39.09$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

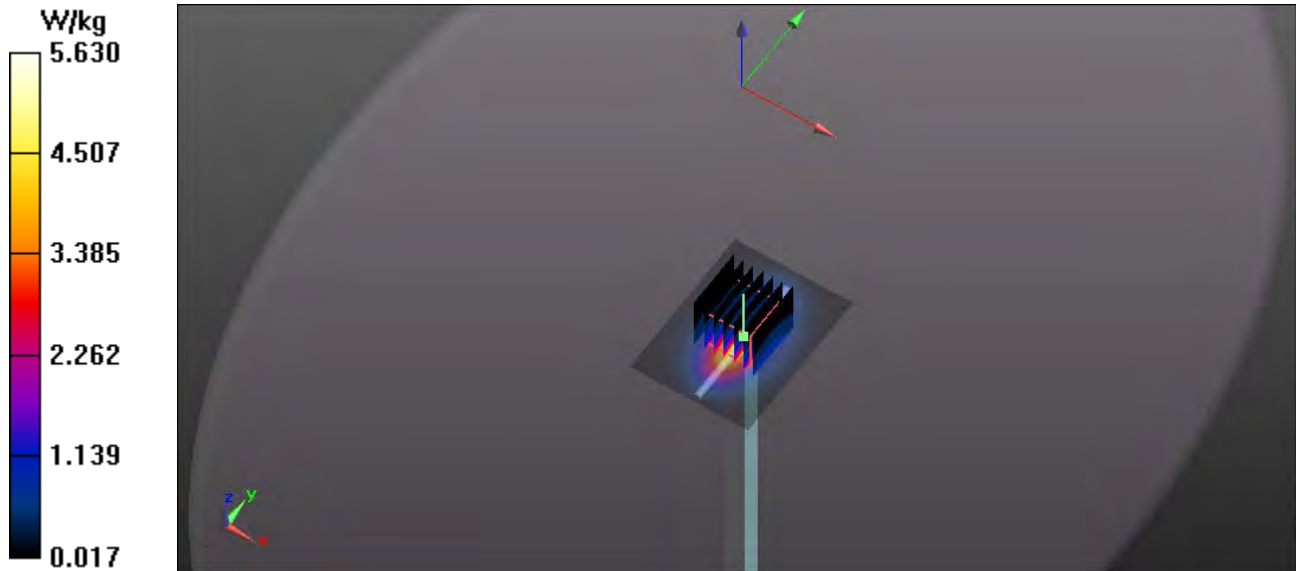
Test Date: Date: 8/12/2022; Ambient Temp: 23 °C; Tissue Temp: 21 °C  
Probe: EX3DV4 - SN7530; ConvF(8.06, 8.06, 8.06); Calibrated: 1/14/2022;  
Sensor-Surface: 2mm (Mechanical Surface Detection)  
Electronics: DAE4 Sn1217; Calibrated: 3/24/2022  
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1251  
Measurement SW: DASYS2, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

### Procedure Notes:

**1900 MHz/Verification/Area Scan (5x7x1):** Measurement grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 5.63 W/kg

**1900 MHz/Verification/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 52.612 V/m; Power Drift = -0.02 dB  
Peak SAR (extrapolated) = 6.68 W/kg  
 $P_{in} = 100$  mW

**SAR(1 g) = 4.11 W/kg; SAR(10 g) = 2.12 W/kg**  
Maximum value of SAR (measured) = 5.63 W/kg



# RF Exposure Lab

## Plot 5

**DUT: Dipole 2550 MHz D2550V2; Type: D2550V2; Serial: D2550V2 - SN:1003**

Communication System: CW; Frequency: 2550 MHz; Duty Cycle: 1:1  
 Medium: HSL2550; Medium parameters used:  $f = 2550$  MHz;  $\sigma = 1.94$  S/m;  $\epsilon_r = 38.36$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

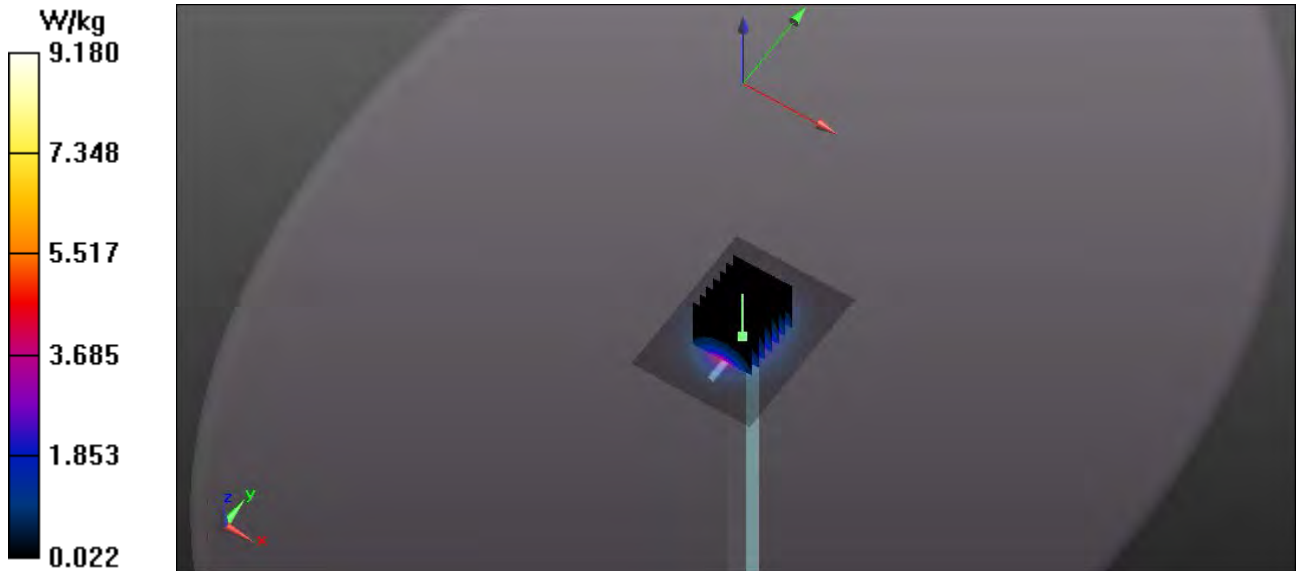
Test Date: Date: 8/15/2022; Ambient Temp: 23 °C; Tissue Temp: 21 °C  
 Probe: EX3DV4 - SN7530; ConvF(7.42, 7.42, 7.42); Calibrated: 1/14/2022;  
 Sensor-Surface: 2mm (Mechanical Surface Detection)  
 Electronics: DAE4 Sn1217; Calibrated: 3/24/2022  
 Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1251  
 Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

### Procedure Notes:

**2550 MHz/Verification/Area Scan (61x81x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm  
 Maximum value of SAR (interpolated) = 8.95 W/kg

**2550 MHz/Verification/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
 Reference Value = 53.249 V/m; Power Drift = -0.02 dB  
 Peak SAR (extrapolated) = 11.43 W/kg  
 Pin=100 mW

**SAR(1 g) = 5.67 W/kg; SAR(10 g) = 2.51 W/kg**  
 Maximum value of SAR (measured) = 9.17 W/kg



# RF Exposure Lab

## Plot 6

**DUT: Dipole D3300V2; Type: D3300V2; Serial: D3300V2 - SN: 1032**

Communication System: CW; Frequency: 3300 MHz; Duty Cycle: 1:1  
Medium: HSL 3-6 GHz; Medium parameters used:  $f = 3300$  MHz;  $\sigma = 2.71$  S/m;  $\epsilon_r = 37.48$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

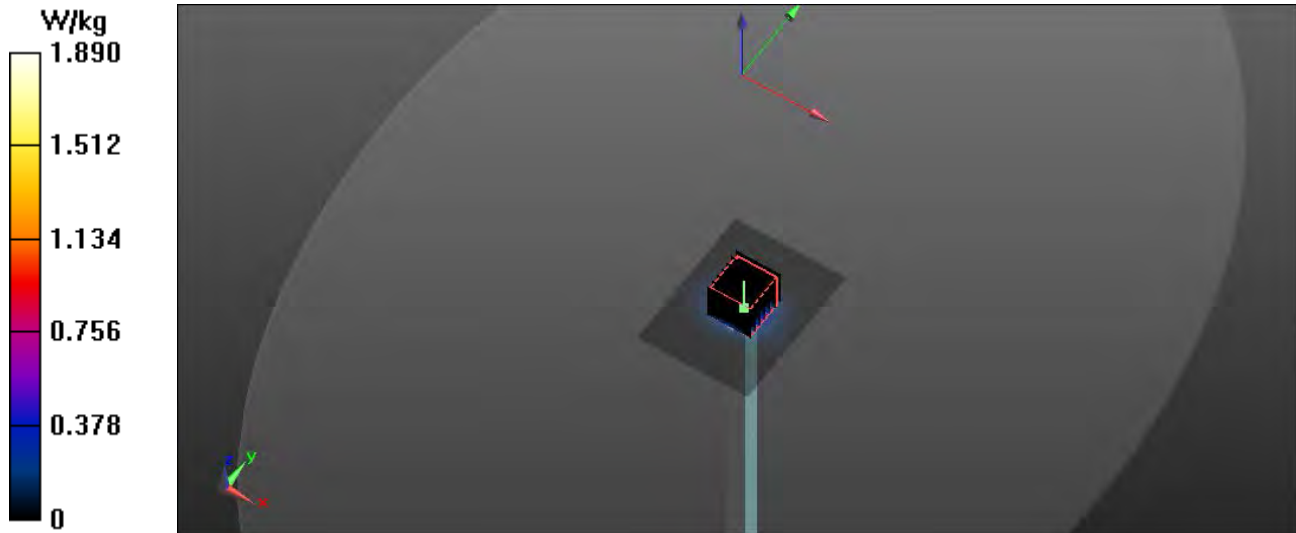
Test Date: Date: 8/8/2022; Ambient Temp: 23 °C; Tissue Temp: 21 °C  
Probe: EX3DV4 – SN7530; ConvF(7.12, 7.12, 7.12); Calibrated: 1/14/2022;  
Sensor-Surface: 2mm (Mechanical Surface Detection)  
Electronics: DAE4 Sn1217; Calibrated: 3/24/2022  
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1251  
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

### Procedure Notes:

**3300 MHz Head/Verification/Area Scan (61x81x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm  
Maximum value of SAR (interpolated) = 1.9 W/kg

**3300 MHz Head/Verification/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm  
Reference Value = 12.722 V/m; Power Drift = -0.01 dB  
Peak SAR (extrapolated) = 3.22 W/kg  
Pin=10 mW

**SAR(1 g) = 0.662 W/kg; SAR(10 g) = 0.255 W/kg**  
Maximum value of SAR (measured) = 1.89 W/kg



# RF Exposure Lab

## Plot 7

**DUT: Dipole D3500V2; Type: D3500V2; Serial: D3500V2 - SN: 1061**

Communication System: CW; Frequency: 3500 MHz; Duty Cycle: 1:1  
 Medium: HSL 3-6 GHz; Medium parameters used:  $f = 3500$  MHz;  $\sigma = 2.92$  S/m;  $\epsilon_r = 37.25$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

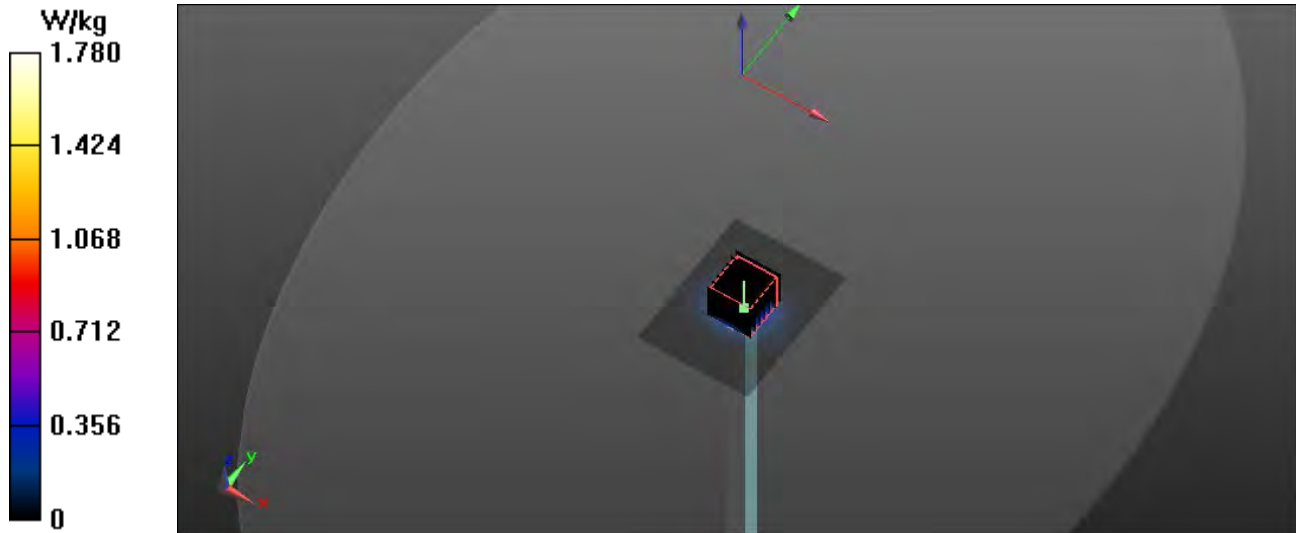
Test Date: Date: 8/8/2022; Ambient Temp: 23 °C; Tissue Temp: 21 °C  
 Probe: EX3DV4 - SN7530; ConvF(7.1, 7.1, 7.1); Calibrated: 4/12/2022;  
 Sensor-Surface: 2mm (Mechanical Surface Detection)  
 Electronics: DAE4 Sn1217; Calibrated: 3/24/2022  
 Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1251  
 Measurement SW: DASYS2, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

### Procedure Notes:

**3500 MHz Head/Verification/Area Scan (7x9x1):** Measurement grid: dx=10mm, dy=10mm  
 Maximum value of SAR (measured) = 1.76 W/kg

**3500 MHz Head/Verification/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=4mm  
 Reference Value = 12.321 V/m; Power Drift = -0.02 dB  
 Peak SAR (extrapolated) = 2.78 W/kg  
 $P_{in} = 10$  mW

**SAR(1 g) = 0.688 W/kg; SAR(10 g) = 0.252 W/kg**  
 Maximum value of SAR (measured) = 1.75 W/kg



# RF Exposure Lab

## Plot 8

**DUT: Dipole D3700V2; Type: D3700V2; Serial: D3700V2 - SN:1024**

Communication System: CW; Frequency: 3700 MHz; Duty Cycle: 1:1  
 Medium: HSL 3-6 GHz; Medium parameters used:  $f = 3700$  MHz;  $\sigma = 3.13$  S/m;  $\epsilon_r = 37.02$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

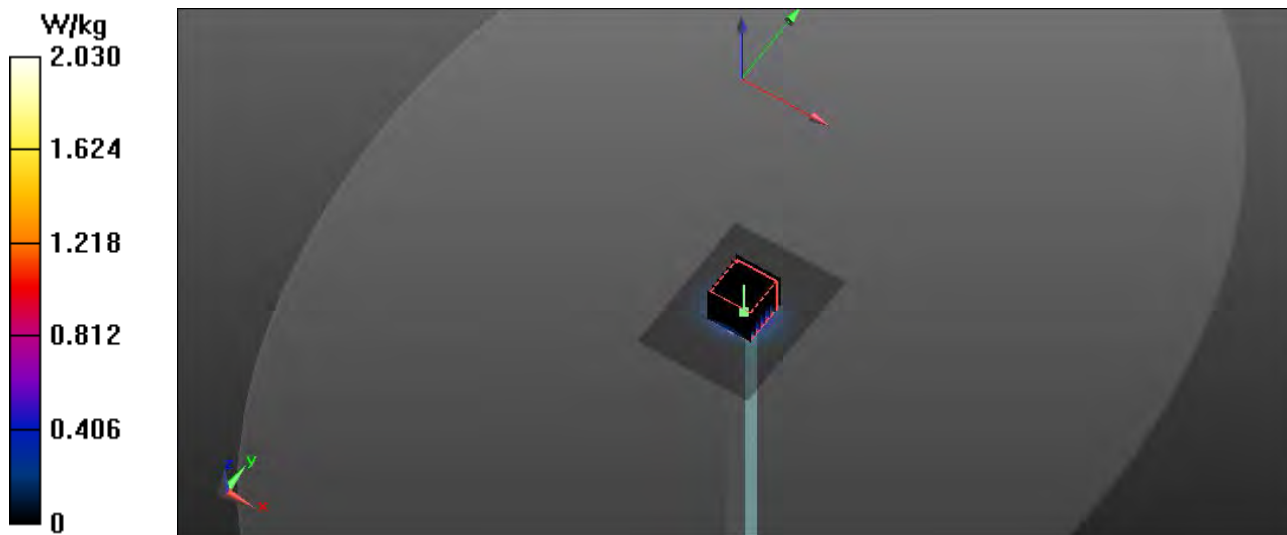
Test Date: Date: 8/8/2022; Ambient Temp: 23 °C; Tissue Temp: 21 °C  
 Probe: EX3DV4 – SN7530; ConvF(6.9, 6.9, 6.9); Calibrated: 1/14/2022;  
 Sensor-Surface: 2mm (Mechanical Surface Detection)  
 Electronics: DAE4 Sn1217; Calibrated: 3/24/2022  
 Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1251  
 Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

### Procedure Notes:

**3700 MHz Head/Verification/Area Scan (61x81x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm  
 Maximum value of SAR (interpolated) = 2.01 W/kg

**3700 MHz Head/Verification/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm  
 Reference Value = 13.367 V/m; Power Drift = -0.01 dB  
 Peak SAR (extrapolated) = 3.35 W/kg  
 $P_{in} = 10$  mW

**SAR(1 g) = 0.695 W/kg; SAR(10 g) = 0.249 W/kg**  
 Maximum value of SAR (measured) = 2.02 W/kg



# RF Exposure Lab

## Plot 9

**DUT: Dipole D3900V2; Type: D3900V2; Serial: D3900V2 - SN:1082**

Communication System: CW; Frequency: 3900 MHz; Duty Cycle: 1:1  
Medium: HSL 3-6 GHz; Medium parameters used:  $f = 3900$  MHz;  $\sigma = 3.35$  S/m;  $\epsilon_r = 36.79$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

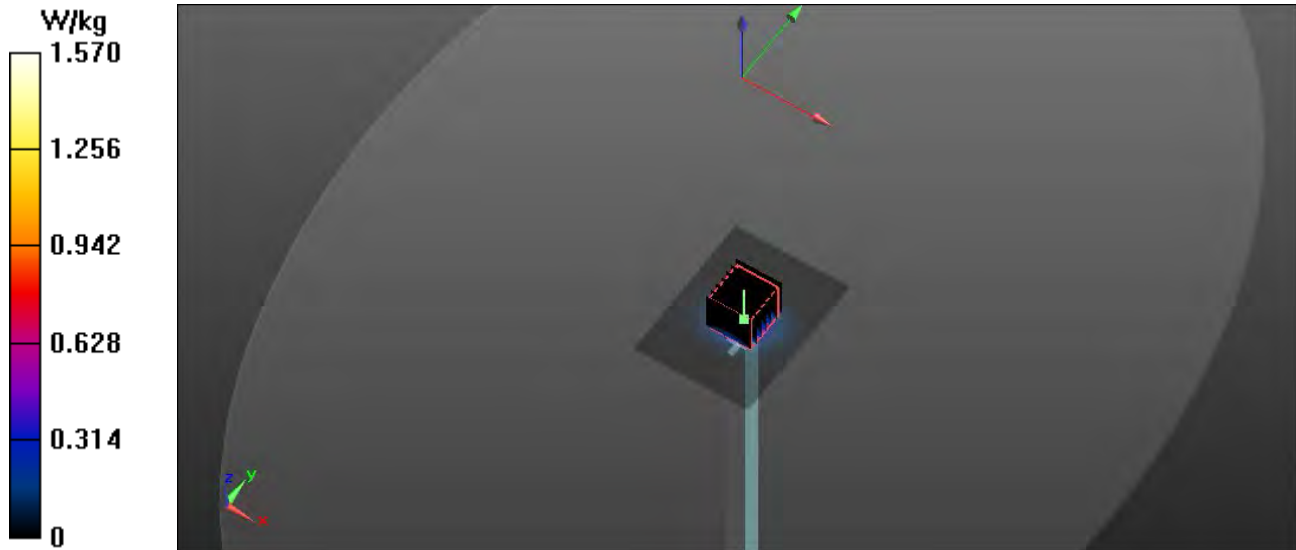
Test Date: Date: 8/8/2022; Ambient Temp: 23 °C; Tissue Temp: 21 °C  
Probe: EX3DV4 – SN7530; ConvF(4.9, 4.9, 4.9); Calibrated: 1/14/2022;  
Sensor-Surface: 2mm (Mechanical Surface Detection)  
Electronics: DAE4 Sn1217; Calibrated: 3/24/2022  
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1251  
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

### Procedure Notes:

**3900 MHz Head/Verification/Area Scan (61x81x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm  
Maximum value of SAR (interpolated) = 1.55 W/kg

**3900 MHz Head/Verification/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm  
Reference Value = 12.568 V/m; Power Drift = -0.03 dB  
Peak SAR (extrapolated) = 3.09 W/kg  
Pin=10 mW

**SAR(1 g) = 0.712 W/kg; SAR(10 g) = 0.251 W/kg**  
Maximum value of SAR (measured) = 1.57 W/kg



# RF Exposure Lab

## Plot 10

**DUT: Dipole D4200V2; Type: D4200V2; Serial: D4200V2 - SN:1025**

Communication System: CW; Frequency: 4200 MHz; Duty Cycle: 1:1  
 Medium: HSL 3-6 GHz; Medium parameters used:  $f = 4200$  MHz;  $\sigma = 3.66$  S/m;  $\epsilon_r = 36.44$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

Test Date: Date: 8/8/2022; Ambient Temp: 23 °C; Tissue Temp: 21 °C  
 Probe: EX3DV4 – SN7530; ConvF(6.38, 6.38, 6.38); Calibrated: 1/14/2022;  
 Sensor-Surface: 2mm (Mechanical Surface Detection)  
 Electronics: DAE4 Sn1217; Calibrated: 3/24/2022  
 Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1251  
 Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

### Procedure Notes:

**4200 MHz Head/Verification/Area Scan (61x81x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 1.68 W/kg

**4200 MHz Head/Verification/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 12.964 V/m; Power Drift = -0.02 dB

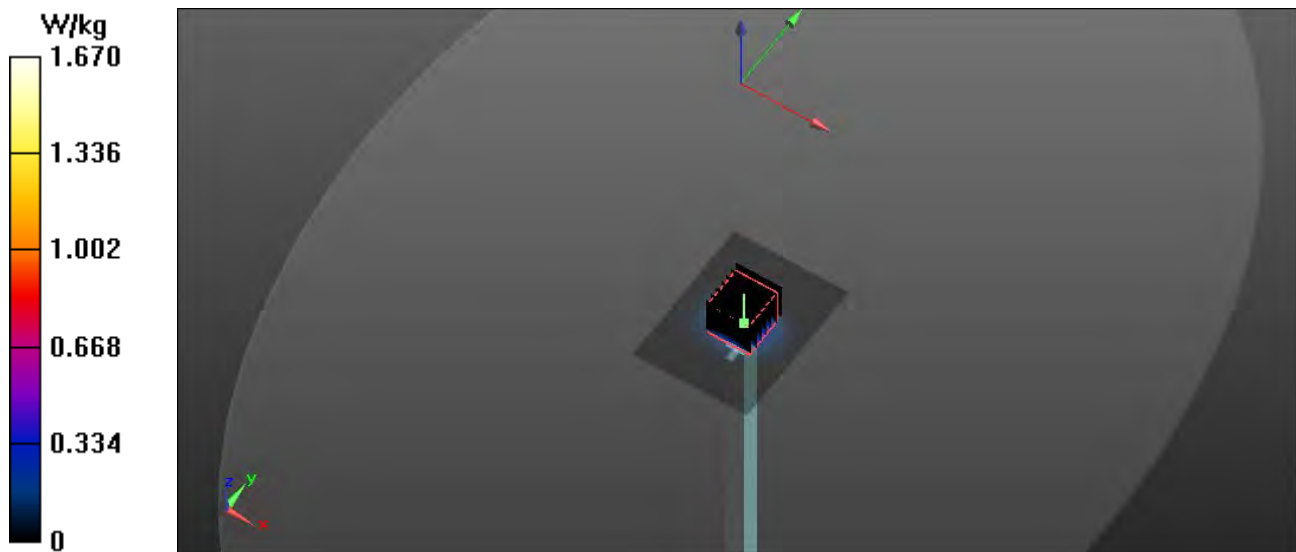
Peak SAR (extrapolated) = 3.37 W/kg

Pin=10 mW

**SAR(1 g) = 0.672 W/kg; SAR(10 g) = 0.225 W/kg**

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 1.67 W/kg



# RF Exposure Lab

## Plot 11

**DUT: Dipole 2550 MHz D2550V2; Type: D2550V2; Serial: D2550V2 - SN:1003**

Communication System: CW; Frequency: 2550 MHz; Duty Cycle: 1:1  
 Medium: HSL2550; Medium parameters used:  $f = 2550$  MHz;  $\sigma = 1.97$  S/m;  $\epsilon_r = 38.75$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

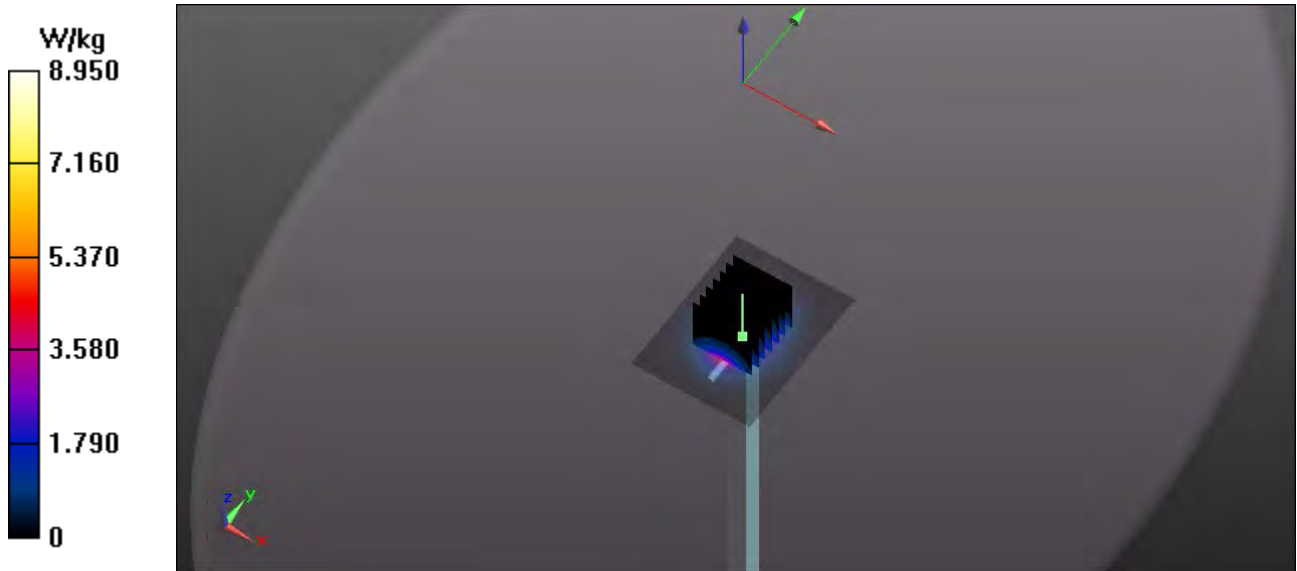
Test Date: Date: 9/19/2022; Ambient Temp: 23 °C; Tissue Temp: 21 °C  
 Probe: EX3DV4 - SN7530; ConvF(7.42, 7.42, 7.42); Calibrated: 1/14/2022;  
 Sensor-Surface: 2mm (Mechanical Surface Detection)  
 Electronics: DAE4 Sn1217; Calibrated: 3/24/2022  
 Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1251  
 Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

### Procedure Notes:

**2550 MHz/Verification/Area Scan (61x81x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm  
 Maximum value of SAR (interpolated) = 8.85 W/kg

**2550 MHz/Verification/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
 Reference Value = 51.895 V/m; Power Drift = -0.01 dB  
 Peak SAR (extrapolated) = 10.87 W/kg  
 Pin=100 mW

**SAR(1 g) = 5.62 W/kg; SAR(10 g) = 2.49 W/kg**  
 Maximum value of SAR (measured) = 8.98 W/kg





## Appendix B – SAR Test Data Plots

# RF Exposure Lab

## Plot 1

**DUT: M3000B; Type: Hotspot; FID: BI160522F00489**

Communication System: LTE (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 2535 MHz; Duty Cycle: 1:1  
Medium: HSL2550; Medium parameters used (interpolated):  $f = 2535$  MHz;  $\sigma = 1.915$  S/m;  $\epsilon_r = 38.395$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

Test Date: Date: 8/15/2022; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN7530; ConvF(7.42, 7.42, 7.42); Calibrated: 1/14/2022  
Sensor-Surface: 2mm (Mechanical Surface Detection)  
Electronics: DAE4 Sn1217; Calibrated: 3/24/2022  
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1251  
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

### Procedure Notes:

**Band n7 LTE/Side F 1 RB 49 Offset Ant 0 Mid/Area Scan (7x13x1):** Measurement grid: dx=10mm, dy=10mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 1.60 W/kg

**Band n7 LTE/Side F 1 RB 49 Offset Ant 0 Mid/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

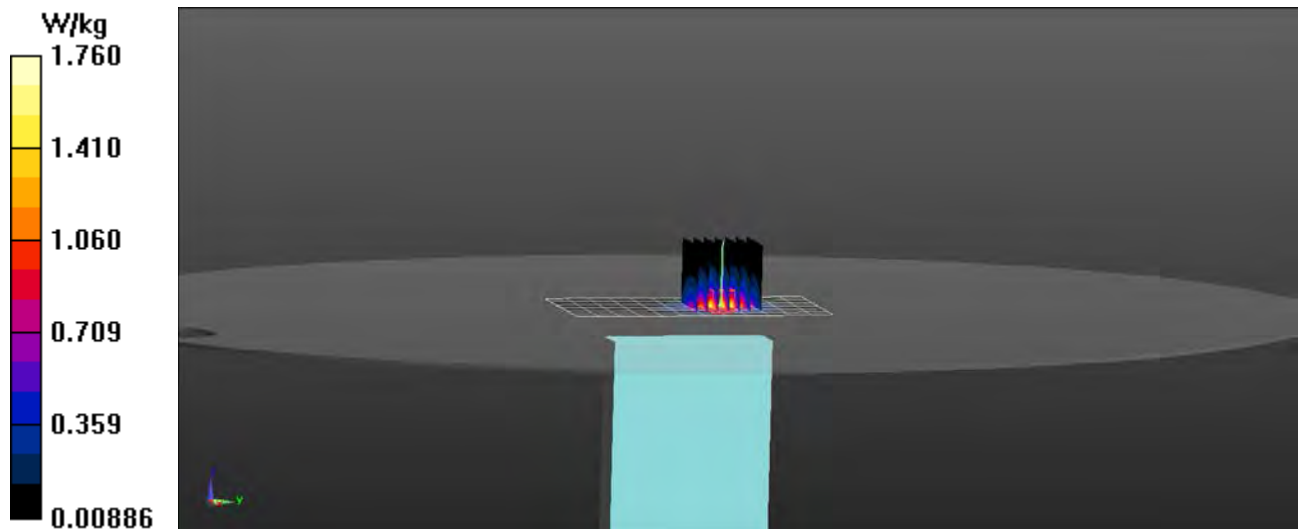
Reference Value = 17.14 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 2.32 W/kg

**SAR(1 g) = 1.17 W/kg**

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 1.76 W/kg



# RF Exposure Lab

## Plot 2

**DUT: M3000B; Type: Hotspot; FID: BI160522F00489**

Communication System: LTE (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 1860 MHz; Duty Cycle: 1:1  
Medium: HSL1900; Medium parameters used:  $f = 1860$  MHz;  $\sigma = 1.45$  S/m;  $\epsilon_r = 39.17$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

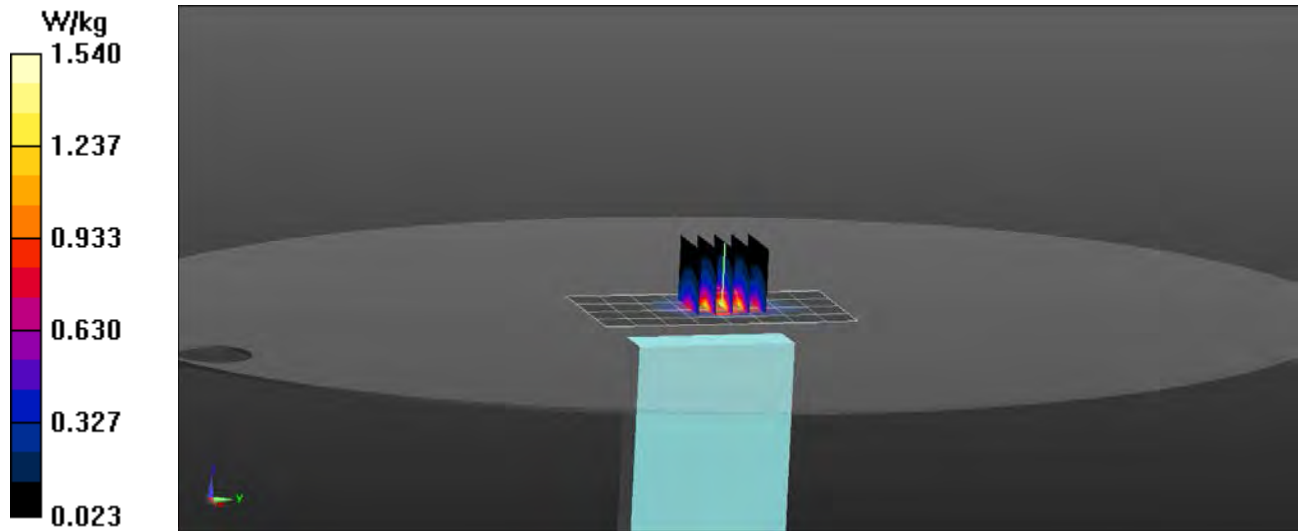
Test Date: Date: 8/12/2022; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN7530; ConvF(8.06, 8.06, 8.06); Calibrated: 1/14/2022  
Sensor-Surface: 2mm (Mechanical Surface Detection)  
Electronics: DAE4 Sn1217; Calibrated: 3/24/2022  
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1251  
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

### Procedure Notes:

**Band n25 LTE/Side F 1 RB 49 Offset Ant 0 Low/Area Scan (5x9x1):** Measurement grid: dx=15mm, dy=15mm  
Maximum value of SAR (measured) = 1.30 W/kg

**Band n25 LTE/Side F 1 RB 49 Offset Ant 0 Low/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 27.31 V/m; Power Drift = 0.03 dB  
Peak SAR (extrapolated) = 1.93 W/kg  
**SAR(1 g) = 1.1 W/kg**  
Maximum value of SAR (measured) = 1.54 W/kg



# RF Exposure Lab

## Plot 3

**DUT: M3000B; Type: Hotspot; FID: BI160522F00489**

Communication System: LTE (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 839 MHz; Duty Cycle: 1:1  
 Medium: HSL835; Medium parameters used (interpolated):  $f = 839$  MHz;  $\sigma = 0.939$  S/m;  $\epsilon_r = 40.703$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

Test Date: Date: 8/5/2022; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN7530; ConvF(9.98, 9.98, 9.98); Calibrated: 1/14/2022  
 Sensor-Surface: 2mm (Mechanical Surface Detection)  
 Electronics: DAE4 Sn1217; Calibrated: 3/24/2022  
 Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1251  
 Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

### Procedure Notes:

**Band n26 LTE/Side A 1 RB 49 Offset Ant 0 High/Area Scan (7x15x1):** Measurement grid: dx=15mm, dy=15mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 1.05 W/kg

**Band n26 LTE/Side A 1 RB 49 Offset Ant 0 High/Zoom Scan (5x6x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

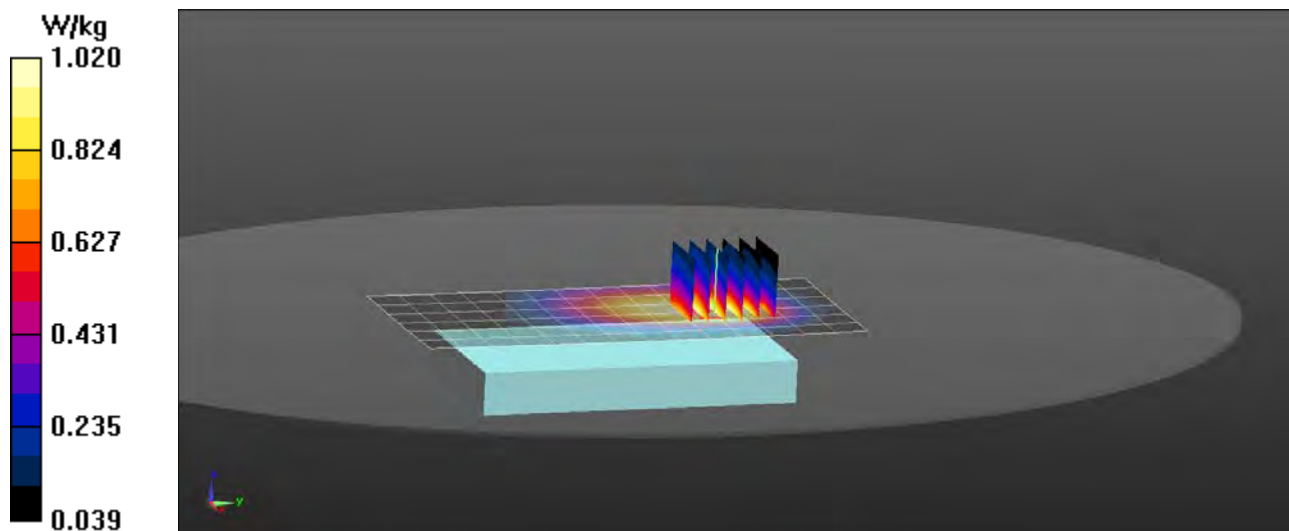
Reference Value = 22.24 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 1.21 W/kg

**SAR(1 g) = 0.853 W/kg**

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 1.02 W/kg



# RF Exposure Lab

## Plot 4

**DUT: M3000B; Type: Hotspot; FID: BI160522F00489**

Communication System: LTE (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 2593 MHz; Duty Cycle: 1:1  
Medium: HSL2550; Medium parameters used (interpolated):  $f = 2593$  MHz;  $\sigma = 1.99$  S/m;  $\epsilon_r = 38.263$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

Test Date: Date: 8/15/2022; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN7530; ConvF(7.42, 7.42, 7.42); Calibrated: 1/14/2022  
Sensor-Surface: 2mm (Mechanical Surface Detection)  
Electronics: DAE4 Sn1217; Calibrated: 3/24/2022  
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1251  
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

### Procedure Notes:

**Band n41 LTE/Side A 1 RB 49 Offset Ant 0 Mid/Area Scan (7x13x1):** Measurement grid: dx=10mm, dy=10mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 1.39 W/kg

**Band n41 LTE/Side A 1 RB 49 Offset Ant 0 Mid/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

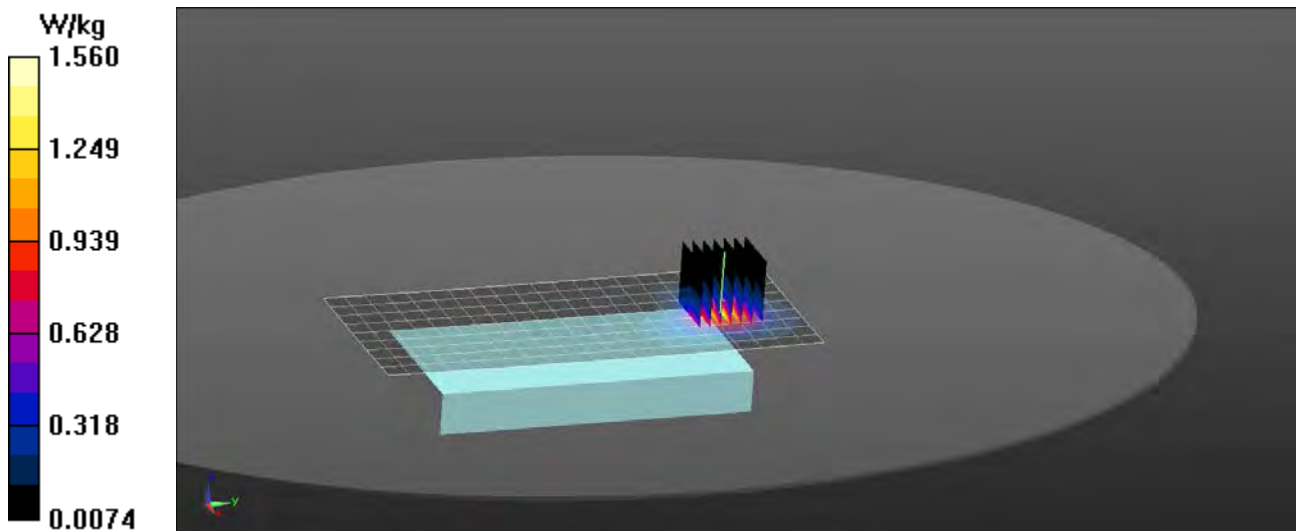
Reference Value = 16.95 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 2.07 W/kg

**SAR(1 g) = 0.752 W/kg**

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 1.56 W/kg



# RF Exposure Lab

## Plot 5

**DUT: M3000B; Type: Hotspot; FID: BI160522F00489**

Communication System: LTE (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 3603.3 MHz; Duty Cycle: 1:1  
Medium: HSL3-6GHz; Medium parameters used (interpolated):  $f = 3603.3$  MHz;  $\sigma = 3.033$  S/m;  $\epsilon_r = 37.127$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

Test Date: Date: 8/8/2022; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN7530; ConvF(6.9, 6.9, 6.9); Calibrated: 1/14/2022  
Sensor-Surface: 2mm (Mechanical Surface Detection)  
Electronics: DAE4 Sn1217; Calibrated: 3/24/2022  
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1251  
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

### Procedure Notes:

**Band n48 LTE/Side F 1 RB 49 Offset Ant 4 Mid1/Area Scan (7x13x1):** Measurement grid: dx=10mm, dy=10mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 1.80 W/kg

**Band n48 LTE/Side F 1 RB 49 Offset Ant 4 Mid1/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=4mm

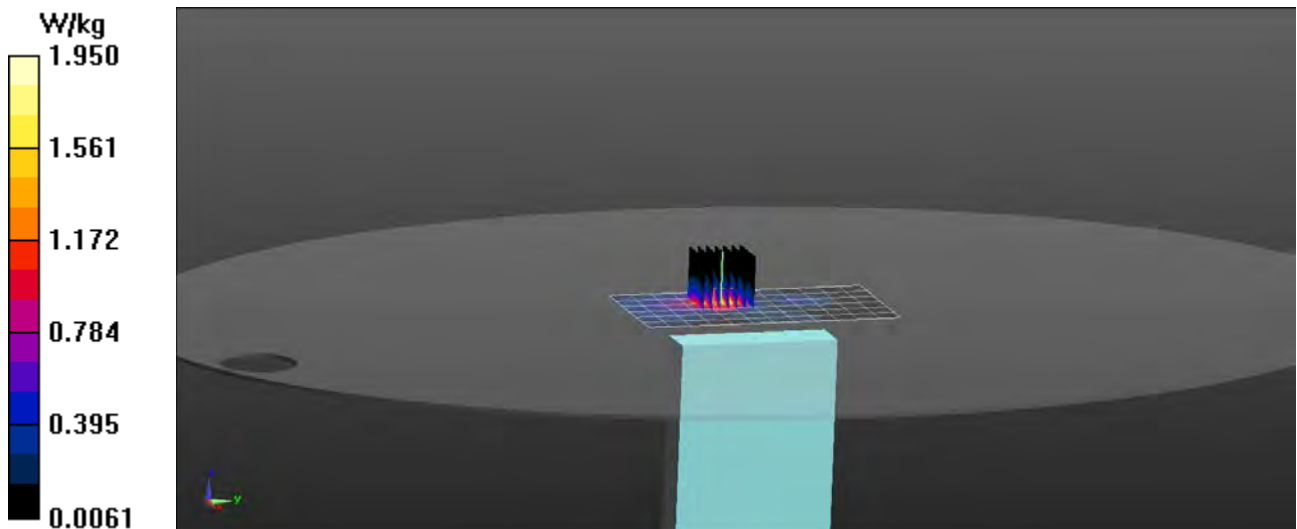
Reference Value = 9.832 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 2.75 W/kg

**SAR(1 g) = 1.17 W/kg**

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 1.95 W/kg



# RF Exposure Lab

## Plot 6

**DUT: M3000B; Type: Hotspot; FID: BI160522F00489**

Communication System: LTE (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 1745 MHz; Duty Cycle: 1:1  
 Medium: HSL1750; Medium parameters used (interpolated):  $f = 1745$  MHz;  $\sigma = 1.405$  S/m;  $\epsilon_r = 39.45$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

Test Date: Date: 8/11/2022; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN7530; ConvF(8.42, 8.42, 8.42); Calibrated: 1/14/2022  
 Sensor-Surface: 2mm (Mechanical Surface Detection)  
 Electronics: DAE4 Sn1217; Calibrated: 3/24/2022  
 Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1251  
 Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

### Procedure Notes:

**Band n66 LTE/Side F 1 RB 49 Offset Ant 0 Mid/Area Scan (5x9x1):** Measurement grid: dx=15mm, dy=15mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 1.13 W/kg

**Band n66 LTE/Side F 1 RB 49 Offset Ant 0 Mid/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

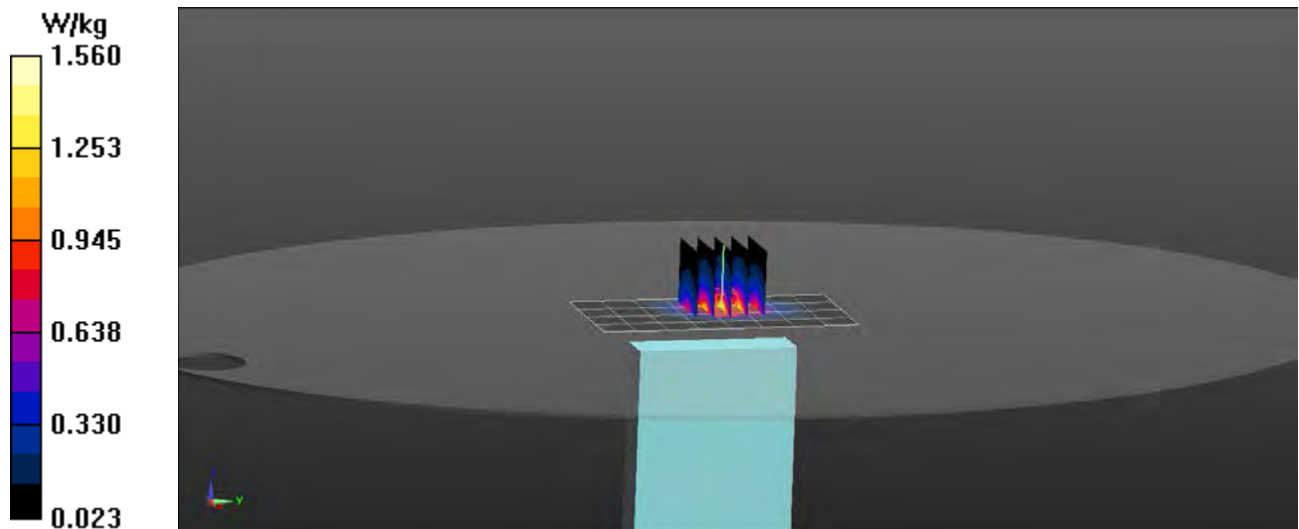
Reference Value = 22.62 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 1.97 W/kg

**SAR(1 g) = 1.12 W/kg**

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 1.56 W/kg



# RF Exposure Lab

## Plot 7

**DUT: M3000B; Type: Hotspot; FID: BI160522F00489**

Communication System: LTE (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 680.5 MHz; Duty Cycle: 1:1  
Medium: HSL600; Medium parameters used (interpolated):  $f = 680.5$  MHz;  $\sigma = 0.901$  S/m;  $\epsilon_r = 40.877$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

Test Date: Date: 8/4/2022; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN7530; ConvF(10.44, 10.44, 10.44); Calibrated: 1/14/2022  
Sensor-Surface: 2mm (Mechanical Surface Detection)  
Electronics: DAE4 Sn1217; Calibrated: 3/24/2022  
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1251  
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

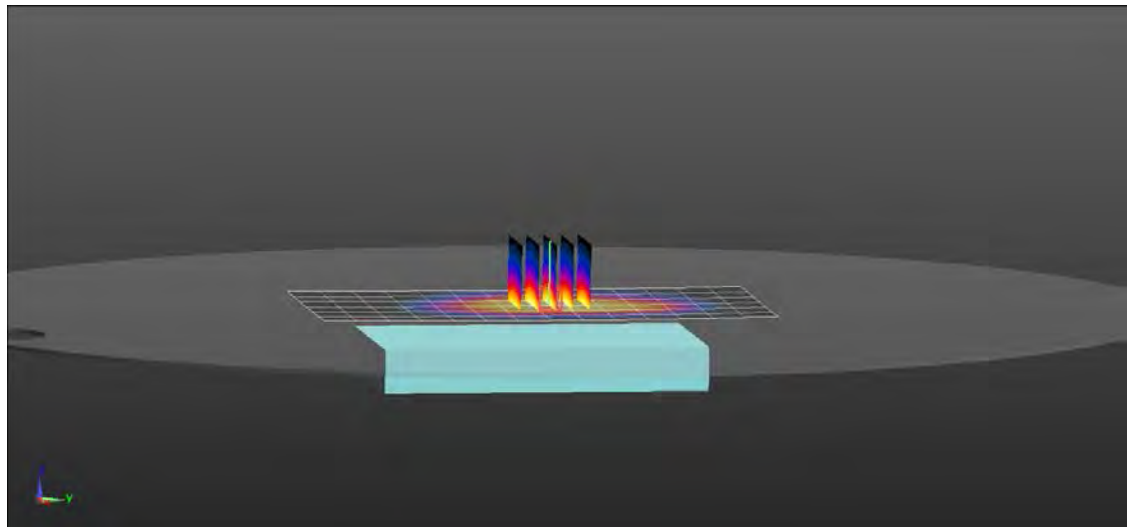
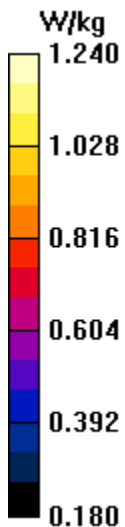
### Procedure Notes:

**Band n71 LTE/Side A 1 RB 49 Offset Ant 0 Mid/Area Scan (7x15x1):** Measurement grid: dx=15mm, dy=15mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)  
Maximum value of SAR (measured) = 1.22 W/kg

**Band n71 LTE/Side A 1 RB 49 Offset Ant 0 Mid/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 31.83 V/m; Power Drift = 0.03 dB  
Peak SAR (extrapolated) = 1.38 W/kg  
**SAR(1 g) = 1.06 W/kg**

[Info: Interpolated medium parameters used for SAR evaluation.](#)  
Maximum value of SAR (measured) = 1.24 W/kg





# RF Exposure Lab

## Plot 8

**DUT: M3000B; Type: Hotspot; FID: B1160522F00489**

Communication System: LTE (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 3700.8 MHz; Duty Cycle: 1:1  
 Medium: HSL3-6GHz; Medium parameters used (interpolated):  $f = 3700.8$  MHz;  $\sigma = 3.131$  S/m;  $\epsilon_r = 37.019$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

Test Date: Date: 8/9/2022; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN7530; ConvF(7.1, 7.1, 7.1); Calibrated: 1/14/2022  
 Sensor-Surface: 2mm (Mechanical Surface Detection)  
 Electronics: DAE4 Sn1217; Calibrated: 3/24/2022  
 Phantom: ELI v5.0; Type: QDOVA002AA; Serial: 1251  
 Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

### Procedure Notes:

**Band n77 LTE/Side A 1 RB 49 Offset Ant 4 Mid/Area Scan (10x22x1):** Measurement grid: dx=10mm, dy=10mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 1.81 W/kg

**Band n77 LTE/Side A 1 RB 49 Offset Ant 4 Mid/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=4mm

Reference Value = 8.061 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 2.51 W/kg

**SAR(1 g) = 0.745 W/kg**

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 1.73 W/kg

**Band n77 LTE/Side A 1 RB 49 Offset Ant 4 Mid/Zoom Scan (7x7x7)/Cube 1:** Measurement grid: dx=4mm, dy=4mm, dz=4mm

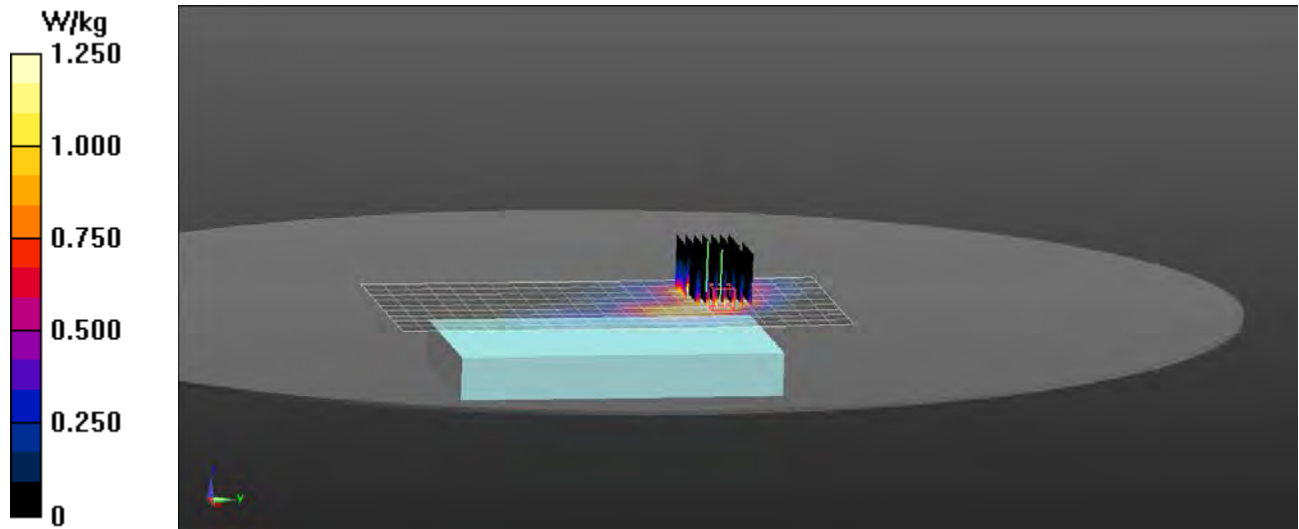
Reference Value = 8.061 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 5.30 W/kg

**SAR(1 g) = 0.574 W/kg**

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 1.25 W/kg



## Appendix C – SAR Test Setup Photos



**Test Position Side A 10 mm Gap**



**Test Position Side A 20 mm Gap**



**Test Position Side B 10 mm Gap**



**Test Position Side C 10 mm Gap**



**Test Position Side C 20 mm Gap**



**Test Position Side D 10 mm Gap**



**Test Position Side D 20 mm Gap**





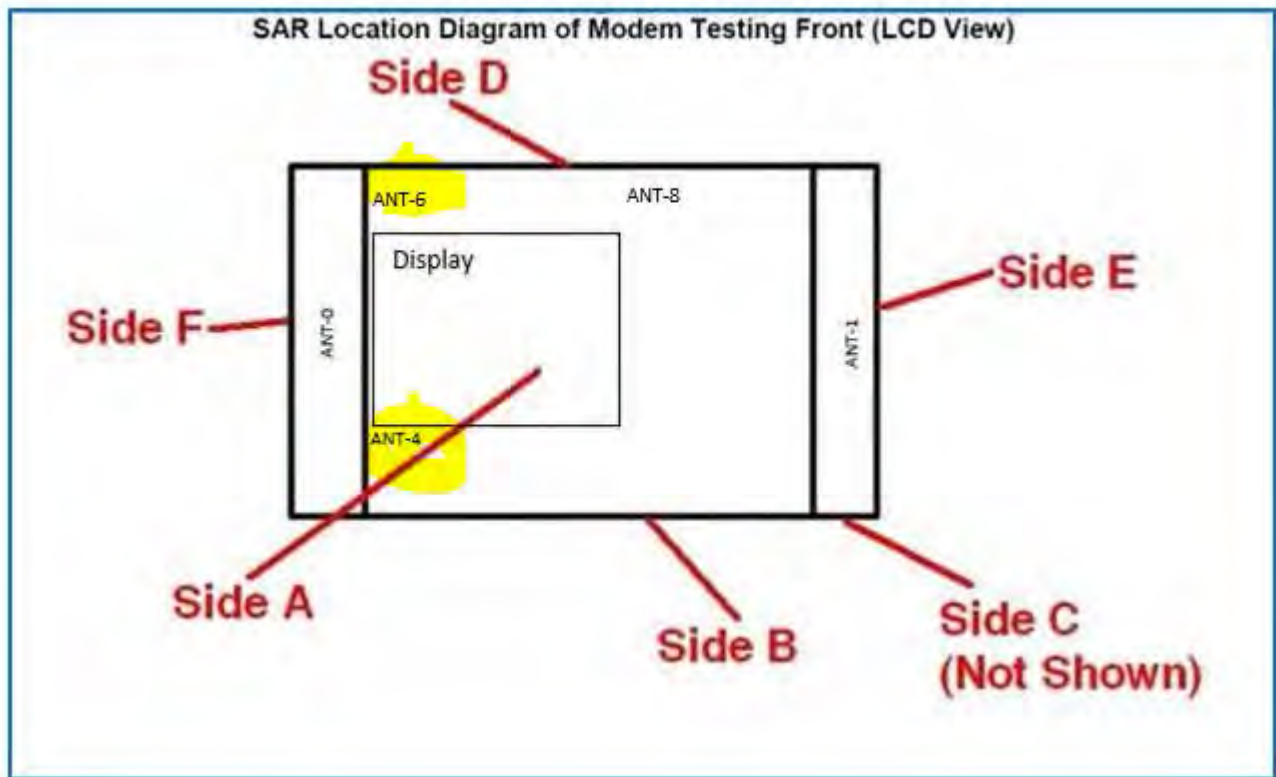
**Test Position Side E 10 mm Gap**



**Test Position Side F 10 mm Gap**



**Test Position Side F 20 mm Gap**



**Test Positions**





**Front of Device**



**Back of Device**

## Appendix D – Probe Calibration Data Sheets



**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

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **RF Exposure Lab**

Certificate No: **EX3-7530\_Jan22**

**CALIBRATION CERTIFICATE**

Object **EX3DV4 - SN:7530**

Calibration procedure(s) **QA CAL-01 v9, QA CAL-12 v9, QA CAL-14 v6, QA CAL-23 v5,  
QA CAL-25 v7  
Calibration procedure for dosimetric E-field probes**

Calibration date: **January 14, 2022**

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	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
Power sensor NRP-Z91	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22
Reference 20 dB Attenuator	SN: CC2552 (20x)	09-Apr-21 (No. 217-03343)	Apr-22
DAE4	SN: 660	13-Oct-21 (No. DAE4-660_Oct21)	Oct-22
Reference Probe ES3DV2	SN: 3013	27-Dec-21 (No. ES3-3013_Dec21)	Dec-22
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-20)	In house check: Jun-22
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-22

Calibrated by:	Name <b>Leif Klyssner</b>	Function <b>Laboratory Technician</b>	Signature 
Approved by:	Name <b>Sven Kühn</b>	Deputy Manager	

Issued: January 19, 2022

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Accreditation No.: **SCS 0108**

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### Glossary:

TSL	tissue simulating liquid
NORM <sub>x,y,z</sub>	sensitivity in free space
ConvF	sensitivity in TSL / NORM <sub>x,y,z</sub>
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization $\varphi$	$\varphi$ rotation around probe axis
Polarization $\vartheta$	$\vartheta$ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

### Calibration is Performed According to the Following Standards:

- IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

### Methods Applied and Interpretation of Parameters:

- NORM<sub>x,y,z</sub>**: Assessed for E-field polarization  $\vartheta = 0$  ( $f \leq 900$  MHz in TEM-cell;  $f > 1800$  MHz: R22 waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not affect the E<sup>2</sup>-field uncertainty inside TSL (see below *ConvF*).
- NORM(f)<sub>x,y,z</sub>** = NORM<sub>x,y,z</sub> \* *frequency\_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- DCP<sub>x,y,z</sub>**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A<sub>x,y,z</sub>; B<sub>x,y,z</sub>; C<sub>x,y,z</sub>; D<sub>x,y,z</sub>; VR<sub>x,y,z</sub>**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for  $f \leq 800$  MHz) and inside waveguide using analytical field distributions based on power measurements for  $f > 800$  MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM<sub>x,y,z</sub> \* *ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from  $\pm 50$  MHz to  $\pm 100$  MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM<sub>x</sub> (no uncertainty required).

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:7530

### Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ( $\mu\text{V}/(\text{V}/\text{m})^2$ ) <sup>A</sup>	0.42	0.48	0.43	$\pm 10.1 \%$
DCP (mV) <sup>B</sup>	99.3	99.7	98.7	

### Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Max dev.	Unc <sup>E</sup> (k=2)
0	CW	X	0.0	0.0	1.0	0.00	159.3	$\pm 2.2 \%$	$\pm 4.7 \%$
		Y	0.0	0.0	1.0		142.4		
		Z	0.0	0.0	1.0		141.6		

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%.

<sup>A</sup> The uncertainties of Norm X,Y,Z do not affect the  $E^2$ -field uncertainty inside TSL (see Pages 5 and 6).

<sup>B</sup> Numerical linearization parameter: uncertainty not required.

<sup>E</sup> Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:7530

### Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-141.7
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

**Note:** Measurement distance from surface can be increased to 3-4 mm for an *Area Scan* job.

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:7530

### Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) <sup>C</sup>	Relative Permittivity <sup>F</sup>	Conductivity (S/m) <sup>F</sup>	ConvF X	ConvF Y	ConvF Z	Alpha <sup>G</sup>	Depth <sup>G</sup> (mm)	Unc (k=2)
13	55.0	0.75	19.61	19.61	19.61	0.00	1.00	± 13.3 %
30	55.0	0.75	17.99	17.99	17.99	0.00	1.00	± 13.3 %
750	41.9	0.89	10.44	10.44	10.44	0.56	0.80	± 12.0 %
900	41.5	0.97	9.98	9.98	9.98	0.48	0.80	± 12.0 %
1300	40.8	1.14	9.27	9.27	9.27	0.40	0.95	± 12.0 %
1750	40.1	1.37	8.42	8.42	8.42	0.30	0.86	± 12.0 %
1900	40.0	1.40	8.06	8.06	8.06	0.30	0.86	± 12.0 %
2300	39.5	1.67	7.85	7.85	7.85	0.34	0.90	± 12.0 %
2450	39.2	1.80	7.65	7.65	7.65	0.33	0.90	± 12.0 %
2600	39.0	1.96	7.42	7.42	7.42	0.35	0.90	± 12.0 %
3300	38.2	2.71	7.12	7.12	7.12	0.35	1.30	± 13.1 %
3500	37.9	2.91	7.10	7.10	7.10	0.35	1.30	± 13.1 %
3700	37.7	3.12	6.90	6.90	6.90	0.35	1.30	± 13.1 %
3900	37.5	3.32	6.83	6.83	6.83	0.40	1.60	± 13.1 %
4200	37.1	3.63	6.38	6.38	6.38	0.40	1.70	± 13.1 %
5250	35.9	4.71	5.45	5.45	5.45	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.80	4.80	4.80	0.40	1.80	± 13.1 %
5750	35.4	5.22	4.98	4.98	4.98	0.40	1.80	± 13.1 %

<sup>C</sup> Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.

<sup>F</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

<sup>G</sup> Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:7530

### Calibration Parameter Determined in Head Tissue Simulating Media

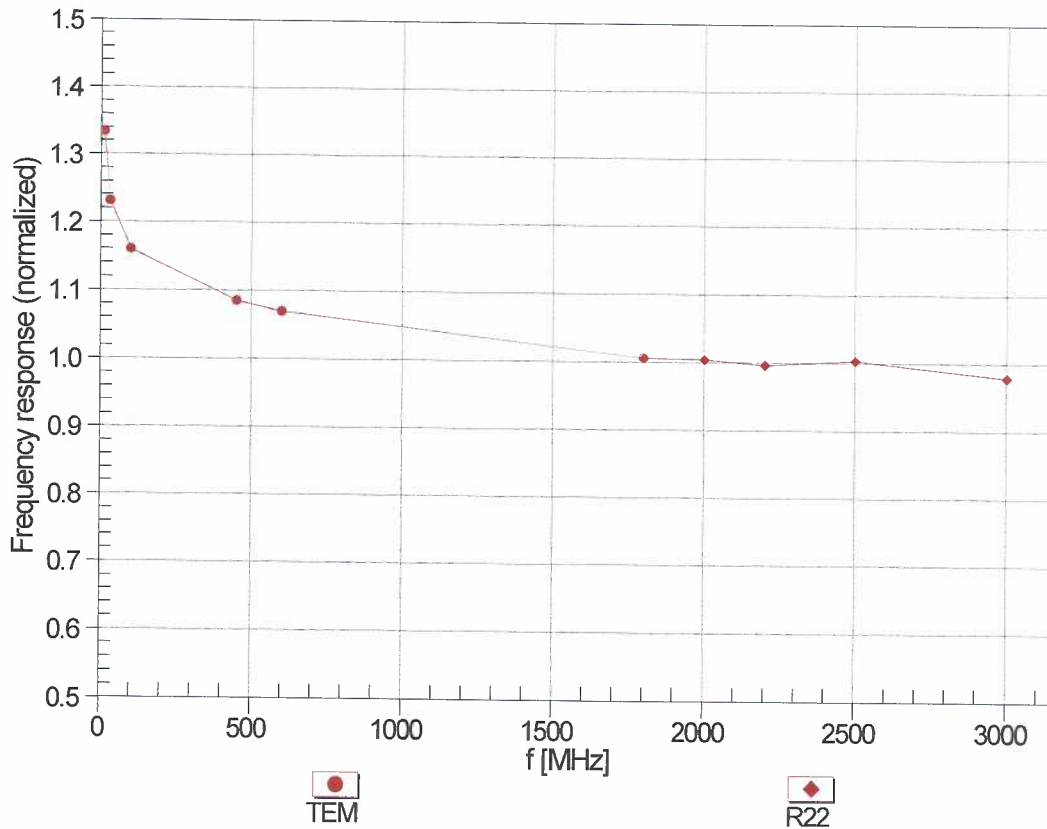
f (MHz) <sup>c</sup>	Relative Permittivity <sup>F</sup>	Conductivity (S/m) <sup>F</sup>	ConvF X	ConvF Y	ConvF Z	Alpha <sup>G</sup>	Depth <sup>G</sup> (mm)	Unc (k=2)
6500	34.5	6.07	5.60	5.60	5.60	0.20	2.50	± 18.6 %

<sup>c</sup> Frequency validity above 6GHz is ± 700 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

<sup>F</sup> At frequencies 6-10 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

<sup>G</sup> Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz; below ± 2% for frequencies between 3-6 GHz; and below ± 4% for frequencies between 6-10 GHz at any distance larger than half the probe tip diameter from the boundary.

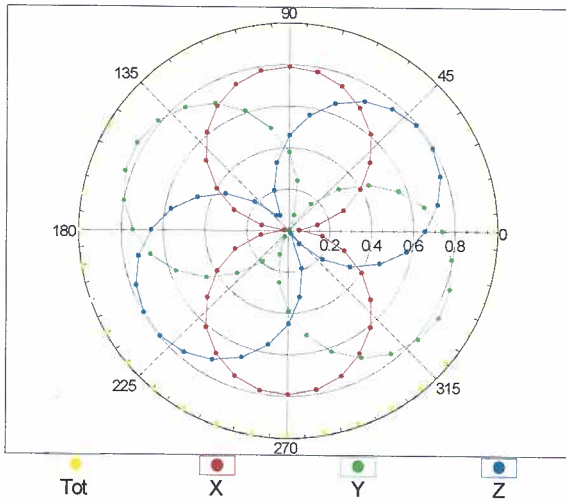
### Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)



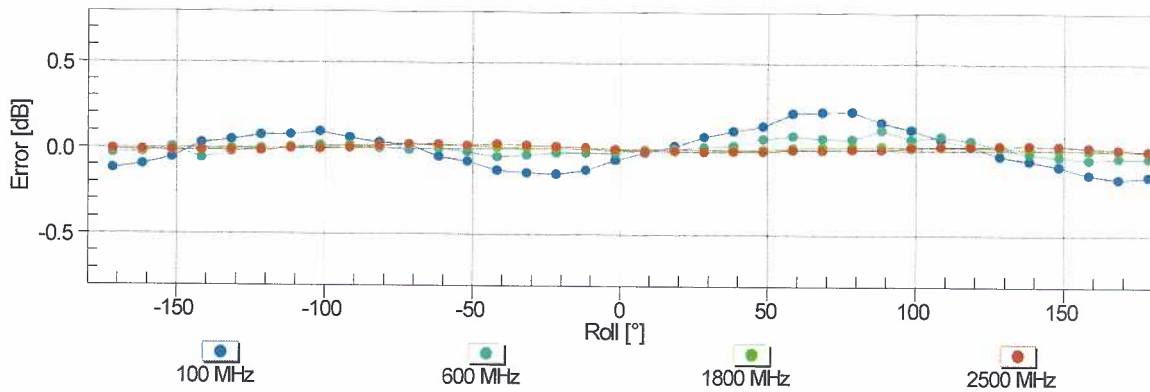
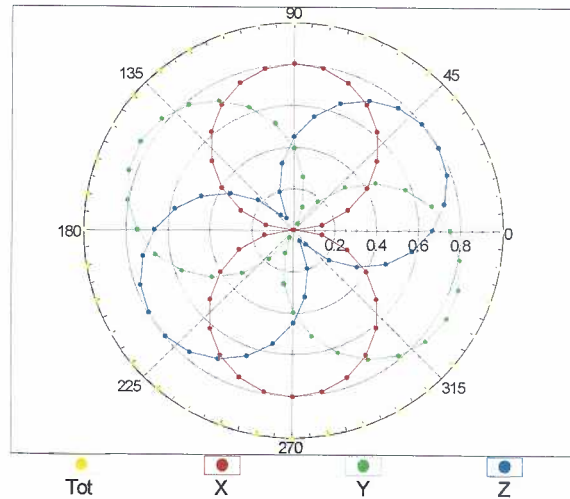
Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  (k=2)

# Receiving Pattern ( $\phi$ ), $\theta = 0^\circ$

f=600 MHz,TEM



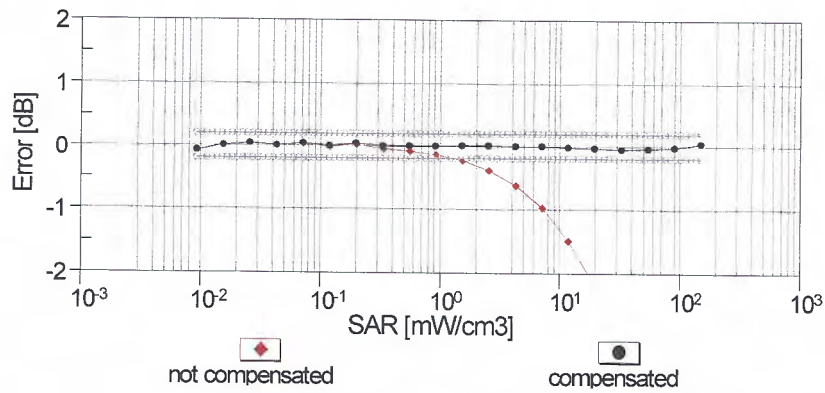
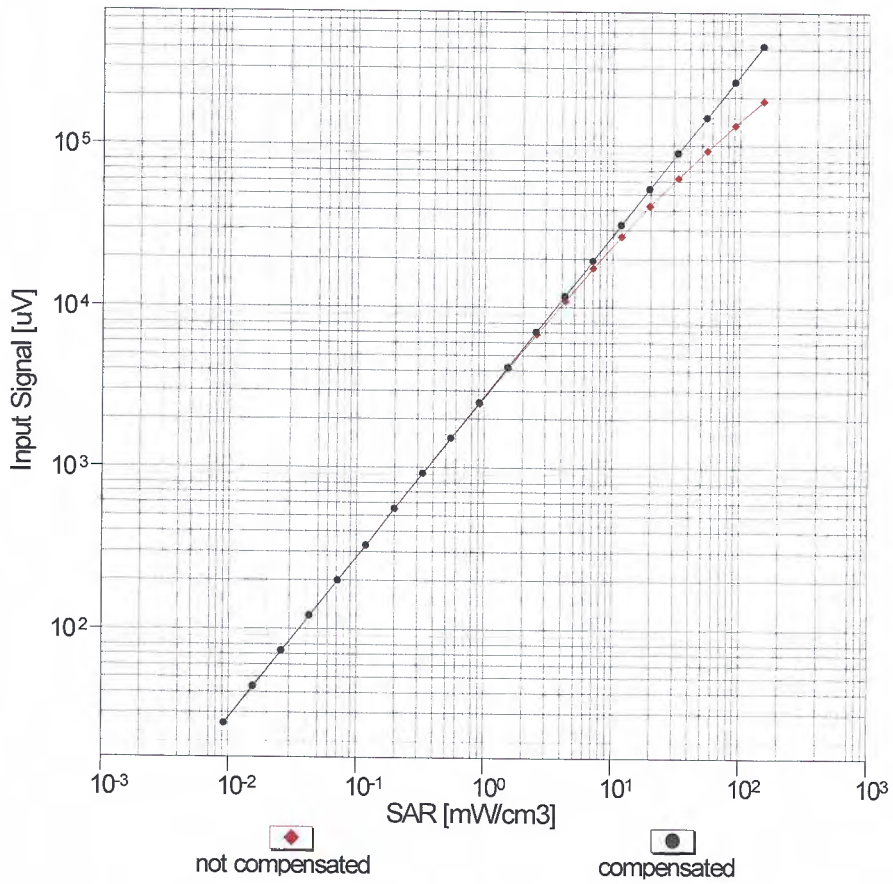
f=1800 MHz,R22



Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  ( $k=2$ )

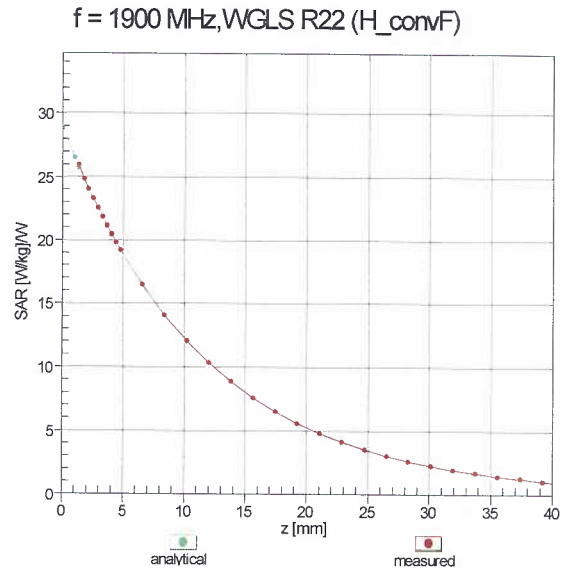
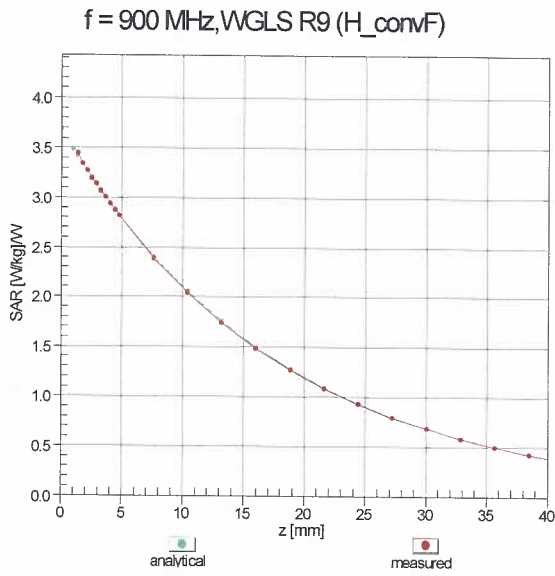


### Dynamic Range f(SAR<sub>head</sub>) (TEM cell , f<sub>eval</sub>= 1900 MHz)

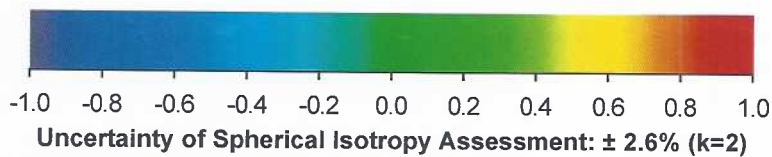
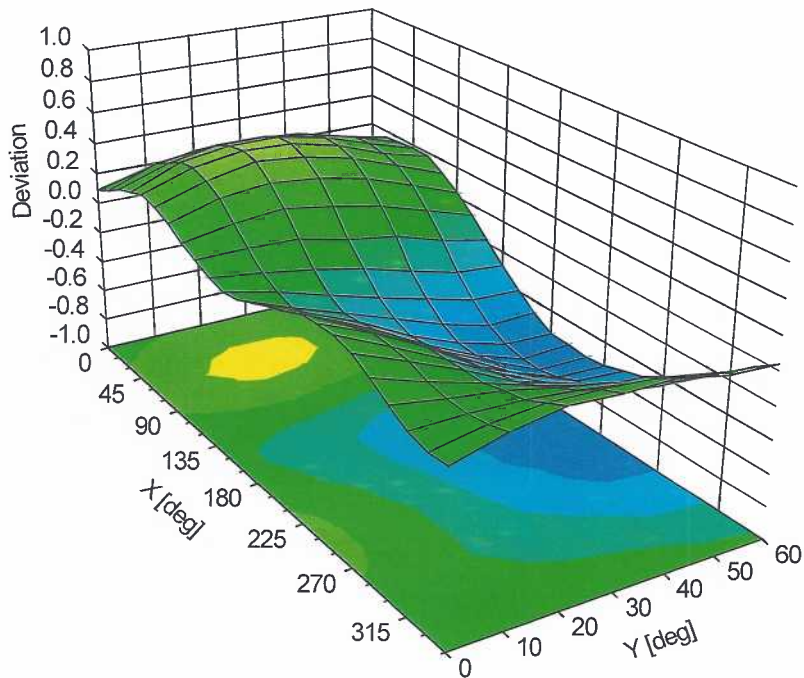


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

### Conversion Factor Assessment



### Deviation from Isotropy in Liquid Error ( $\phi, \theta$ ), f = 900 MHz



## Appendix E – Dipole Calibration Data Sheets

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



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **RF Exposure Lab**

Certificate No: **D750V3-1053\_Jun21**

## CALIBRATION CERTIFICATE

Object **D750V3 - SN:1053**

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

Calibration date: **June 04, 2021**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
Power sensor NRP-Z91	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22
Reference 20 dB Attenuator	SN: BH9394 (20k)	09-Apr-21 (No. 217-03343)	Apr-22
Type-N mismatch combination	SN: 310982 / 06327	09-Apr-21 (No. 217-03344)	Apr-22
Reference Probe EX3DV4	SN: 7349	28-Dec-20 (No. EX3-7349_Dec20)	Dec-21
DAE4	SN: 601	02-Nov-20 (No. DAE4-601_Nov20)	Nov-21
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-20)	In house check: Oct-22
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-21

Calibrated by: **Michael Weber**      Name: **Michael Weber**      Function: **Laboratory Technician**

Signature:

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

Signature:

Issued: June 8, 2021

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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:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

### Additional Documentation:

- DASY4/5 System Handbook

### Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

<b>DASY Version</b>	DASY5	V52.10.4
<b>Extrapolation</b>	Advanced Extrapolation	
<b>Phantom</b>	Modular Flat Phantom	
<b>Distance Dipole Center - TSL</b>	15 mm	with Spacer
<b>Zoom Scan Resolution</b>	dx, dy, dz = 5 mm	
<b>Frequency</b>	750 MHz $\pm$ 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	<b>Temperature</b>	<b>Permittivity</b>	<b>Conductivity</b>
<b>Nominal Head TSL parameters</b>	22.0 °C	41.9	0.89 mho/m
<b>Measured Head TSL parameters</b>	(22.0 $\pm$ 0.2) °C	42.7 $\pm$ 6 %	0.91 mho/m $\pm$ 6 %
<b>Head TSL temperature change during test</b>	< 0.5 °C	----	----

## SAR result with Head TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	250 mW input power	2.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>8.57 W/kg <math>\pm</math> 17.0 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	condition	
SAR measured	250 mW input power	1.41 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>5.58 W/kg <math>\pm</math> 16.5 % (k=2)</b>

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

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	56.5 $\Omega$ + 0.1 j $\Omega$
Return Loss	- 24.3 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.035 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
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#### Extended Calibration

Usage of SAR dipoles calibrated less than 3 years ago but more than 1 year ago were confirmed in maintaining return loss (<-20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in KDB Publication 865664 D01 v01r04.

D750V3 SN: 1053 - Head						
Date of Measurement	Return Loss (dB)	$\Delta\%$	Impedance Real ( $\Omega$ )	$\Delta\Omega$	Impedance Imaginary (j $\Omega$ )	$\Delta\Omega$
6/4/2021	-24.3		56.5		0.1	
6/4/2022	-26.2	7.8	57.9	1.4	0.3	0.2

## DASY5 Validation Report for Head TSL

Date: 04.06.2021

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1053**

Communication System: UID 0 - CW; Frequency: 750 MHz

Medium parameters used:  $f = 750$  MHz;  $\sigma = 0.91$  S/m;  $\epsilon_r = 42.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.11, 10.11, 10.11) @ 750 MHz; Calibrated: 28.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- 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 = 59.74 V/m; Power Drift = 0.01 dB

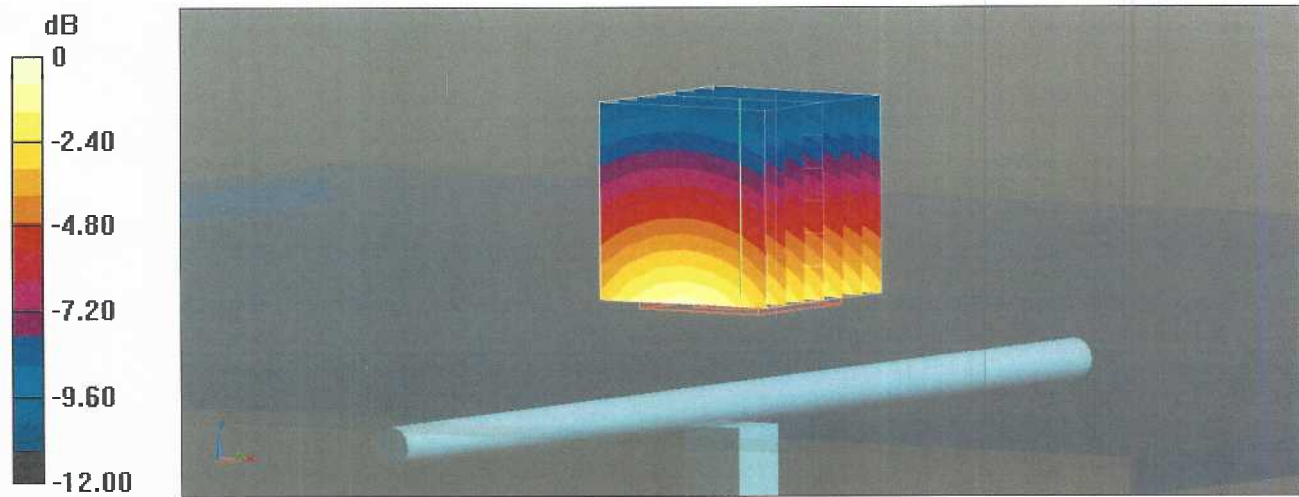
Peak SAR (extrapolated) = 3.30 W/kg

**SAR(1 g) = 2.17 W/kg; SAR(10 g) = 1.41 W/kg**

Smallest distance from peaks to all points 3 dB below: Larger than measurement grid (> 30mm)

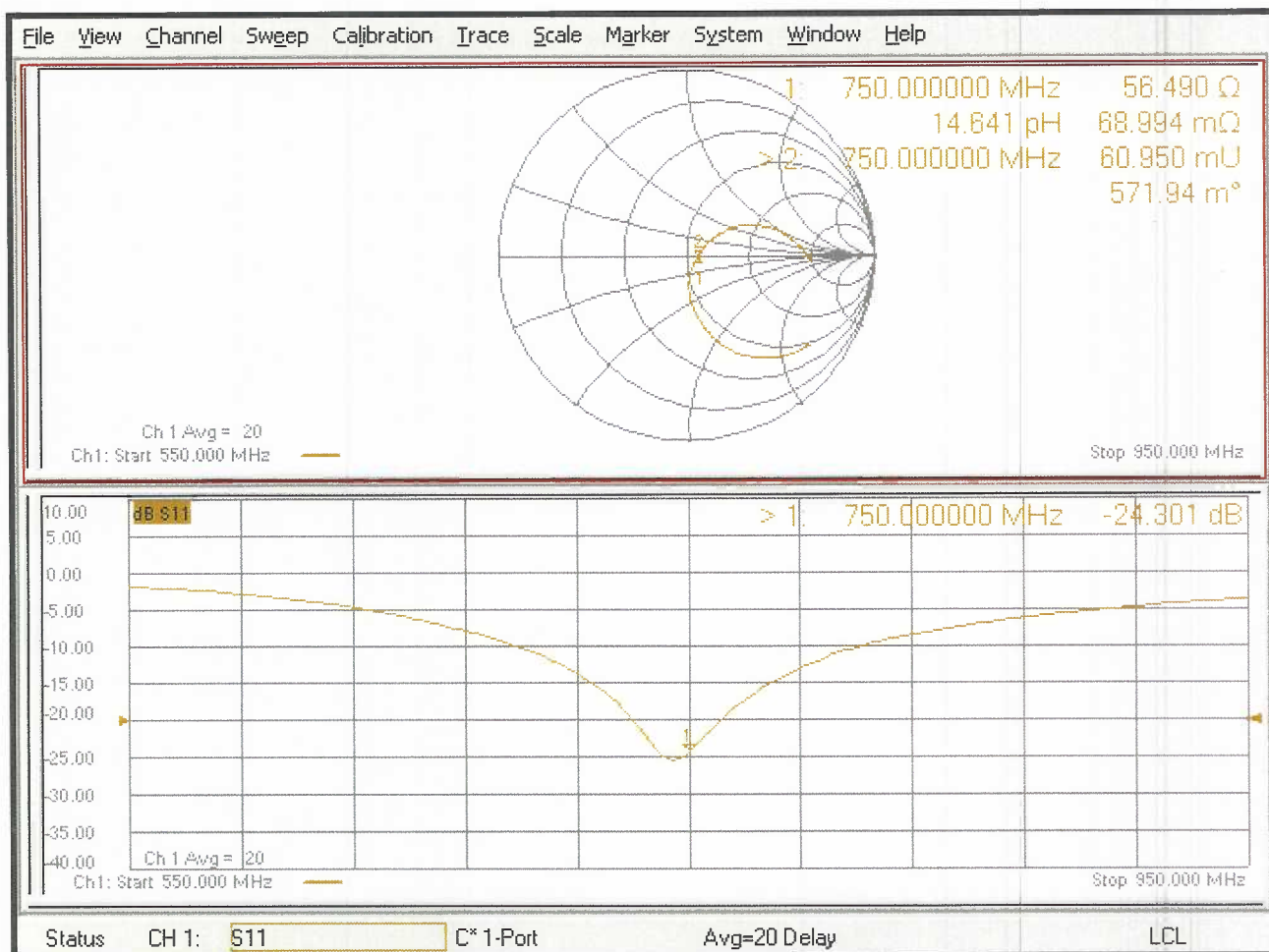
Ratio of SAR at M2 to SAR at M1 = 65.5%

Maximum value of SAR (measured) = 2.93 W/kg





# Impedance Measurement Plot for Head TSL



*Jm*

**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

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **RF Exposure Lab**

Certificate No: **D900V2-1d128\_Jun21**

## CALIBRATION CERTIFICATE

Object **D900V2 - SN:1d128**

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

Calibration date: **June 04, 2021**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
Power sensor NRP-Z91	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22
Reference 20 dB Attenuator	SN: BH9394 (20k)	09-Apr-21 (No. 217-03343)	Apr-22
Type-N mismatch combination	SN: 310982 / 06327	09-Apr-21 (No. 217-03344)	Apr-22
Reference Probe EX3DV4	SN: 7349	28-Dec-20 (No. EX3-7349_Dec20)	Dec-21
DAE4	SN: 601	02-Nov-20 (No. DAE4-601_Nov20)	Nov-21
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-20)	In house check: Oct-22
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-21

Calibrated by: **Michael Weber**      Name: **Michael Weber**      Function: **Laboratory Technician**

Signature: *M. Weber*

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

Signature: *Katja Pokovic*

Issued: June 8, 2021

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



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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:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

### Additional Documentation:

- DASY4/5 System Handbook

### Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

<b>DASY Version</b>	DASY5	V52.10.4
<b>Extrapolation</b>	Advanced Extrapolation	
<b>Phantom</b>	Modular Flat Phantom	
<b>Distance Dipole Center - TSL</b>	15 mm	with Spacer
<b>Zoom Scan Resolution</b>	dx, dy, dz = 5 mm	
<b>Frequency</b>	900 MHz $\pm$ 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	41.5	0.97 mho/m
<b>Measured Head TSL parameters</b>	(22.0 $\pm$ 0.2) °C	42.3 $\pm$ 6 %	0.96 mho/m $\pm$ 6 %
<b>Head TSL temperature change during test</b>	< 0.5 °C	----	----

## SAR result with Head TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	250 mW input power	2.76 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>11.2 W/kg <math>\pm</math> 17.0 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	condition	
SAR measured	250 mW input power	1.77 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>7.14 W/kg <math>\pm</math> 16.5 % (k=2)</b>

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

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.0 $\Omega$ - 0.6 j $\Omega$
Return Loss	- 38.5 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.412 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
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#### Extended Calibration

Usage of SAR dipoles calibrated less than 3 years ago but more than 1 year ago were confirmed in maintaining return loss (<-20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in KDB Publication 865664 D01 v01r04.

D900V2 SN: 1d128 - Head						
Date of Measurement	Return Loss (dB)	$\Delta\%$	Impedance Real ( $\Omega$ )	$\Delta\Omega$	Impedance Imaginary (j $\Omega$ )	$\Delta\Omega$
6/4/2021	-38.5		51.0		-0.6	
6/4/2022	-37.2	-3.4	52.3	1.3	-0.8	-0.2

# DASY5 Validation Report for Head TSL

Date: 04.06.2021

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN:1d128**

Communication System: UID 0 - CW; Frequency: 900 MHz

Medium parameters used:  $f = 900 \text{ MHz}$ ;  $\sigma = 0.96 \text{ S/m}$ ;  $\epsilon_r = 42.3$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(9.62, 9.62, 9.62) @ 900 MHz; Calibrated: 28.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- 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:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 65.79 V/m; Power Drift = 0.03 dB

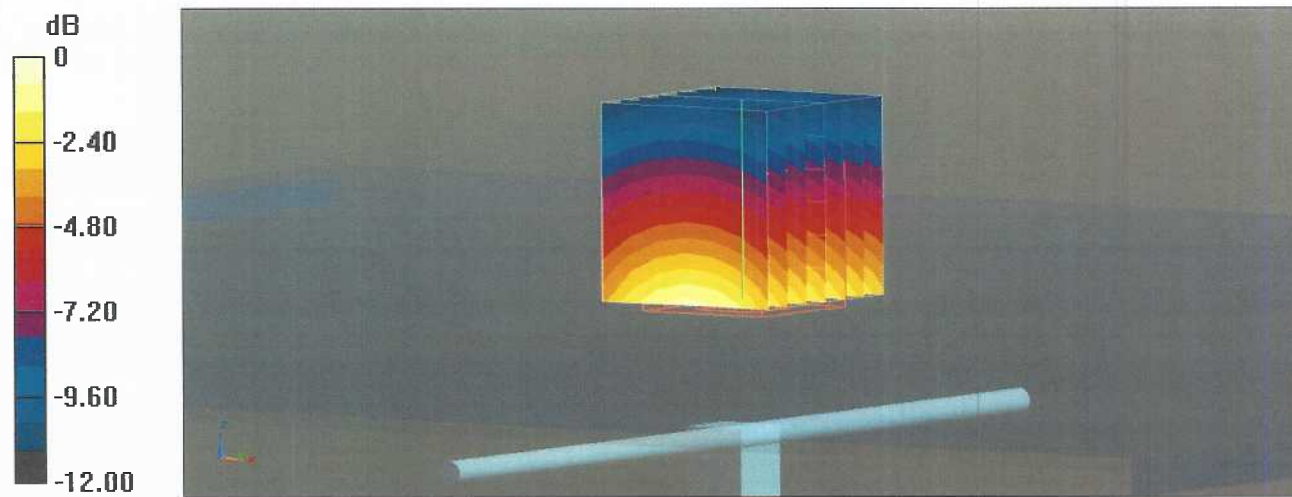
Peak SAR (extrapolated) = 4.23 W/kg

**SAR(1 g) = 2.76 W/kg; SAR(10 g) = 1.77 W/kg**

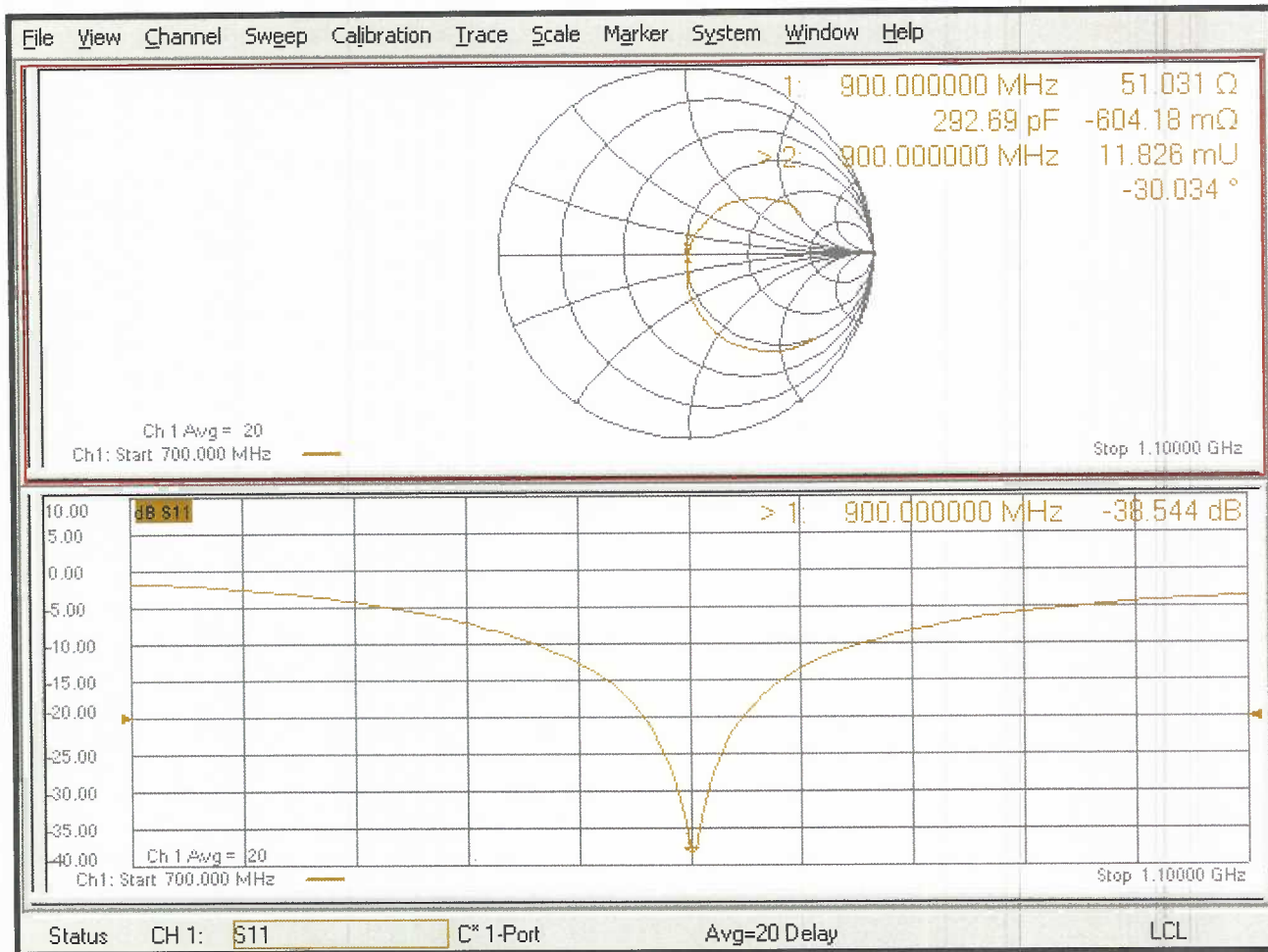
Smallest distance from peaks to all points 3 dB below = 16 mm

Ratio of SAR at M2 to SAR at M1 = 65%

Maximum value of SAR (measured) = 3.74 W/kg



# Impedance Measurement Plot for Head TSL



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Calibration Laboratory of  
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Engineering AG  
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C Service suisse d'étalonnage  
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client RF Exposure Lab

Certificate No: D1750V2-1061\_Jun21

### CALIBRATION CERTIFICATE

Object D1750V2 - SN:1061

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

Calibration date: June 03, 2021

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
Power sensor NRP-Z91	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22
Reference 20 dB Attenuator	SN: BH9394 (20k)	09-Apr-21 (No. 217-03343)	Apr-22
Type-N mismatch combination	SN: 310982 / 06327	09-Apr-21 (No. 217-03344)	Apr-22
Reference Probe EX3DV4	SN: 7349	28-Dec-20 (No. EX3-7349_Dec20)	Dec-21
DAE4	SN: 601	02-Nov-20 (No. DAE4-601_Nov20)	Nov-21

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

Calibrated by:	Name Jeffrey Katzman	Function Laboratory Technician	Signature 
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Approved by:	Name Katja Pokovic	Function Technical Manager	Signature 
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Issued: June 8, 2021

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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:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

### Additional Documentation:

- DASY4/5 System Handbook

### Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

<b>DASY Version</b>	DASY5	V52.10.4
<b>Extrapolation</b>	Advanced Extrapolation	
<b>Phantom</b>	Modular Flat Phantom	
<b>Distance Dipole Center - TSL</b>	10 mm	with Spacer
<b>Zoom Scan Resolution</b>	dx, dy, dz = 5 mm	
<b>Frequency</b>	1750 MHz ± 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	40.1	1.37 mho/m
<b>Measured Head TSL parameters</b>	(22.0 ± 0.2) °C	40.7 ± 6 %	1.37 mho/m ± 6 %
<b>Head TSL temperature change during test</b>	< 0.5 °C	----	----

## SAR result with Head TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	250 mW input power	9.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>37.7 W/kg ± 17.0 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	condition	
SAR measured	250 mW input power	4.93 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>19.8 W/kg ± 16.5 % (k=2)</b>

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

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.4 $\Omega$ + 0.0 j $\Omega$
Return Loss	- 44.5 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.221 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
-----------------	-------

#### Extended Calibration

Usage of SAR dipoles calibrated less than 3 years ago but more than 1 year ago were confirmed in maintaining return loss (<-20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in KDB Publication 865664 D01 v01r04.

D1750V2 SN: 1061 - Head						
Date of Measurement	Return Loss (dB)	$\Delta\%$	Impedance Real ( $\Omega$ )	$\Delta\Omega$	Impedance Imaginary (j $\Omega$ )	$\Delta\Omega$
6/3/2021	-44.5		49.4		0.0	
6/4/2022	-42.3	-4.9	47.9	-1.5	-0.2	-0.2

# DASY5 Validation Report for Head TSL

Date: 03.06.2021

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1061**

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.37$  S/m;  $\epsilon_r = 40.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.67, 8.67, 8.67) @ 1750 MHz; Calibrated: 28.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

## Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 107.4 V/m; Power Drift = 0.08 dB

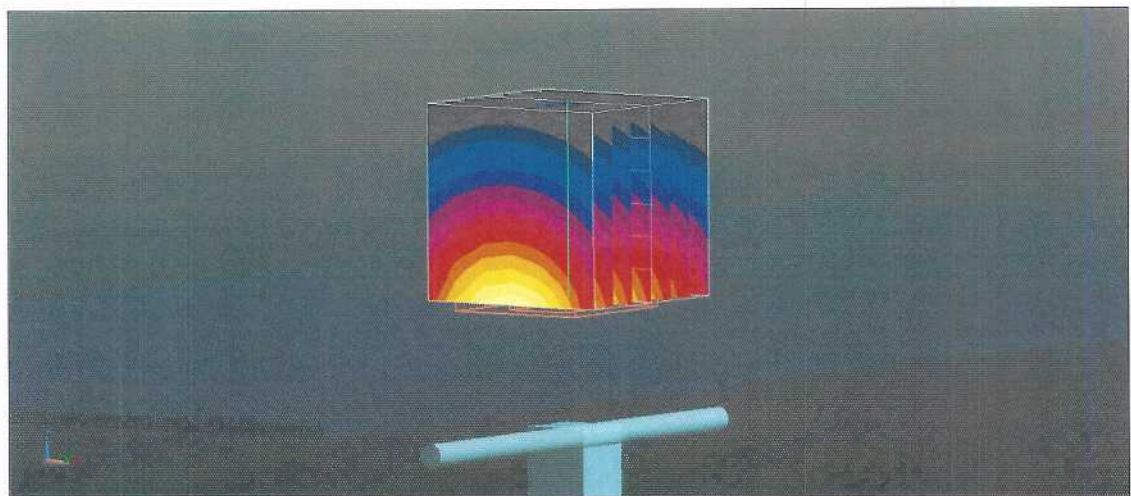
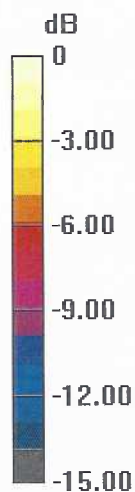
Peak SAR (extrapolated) = 17.5 W/kg

**SAR(1 g) = 9.38 W/kg; SAR(10 g) = 4.93 W/kg**

Smallest distance from peaks to all points 3 dB below = 9.1 mm

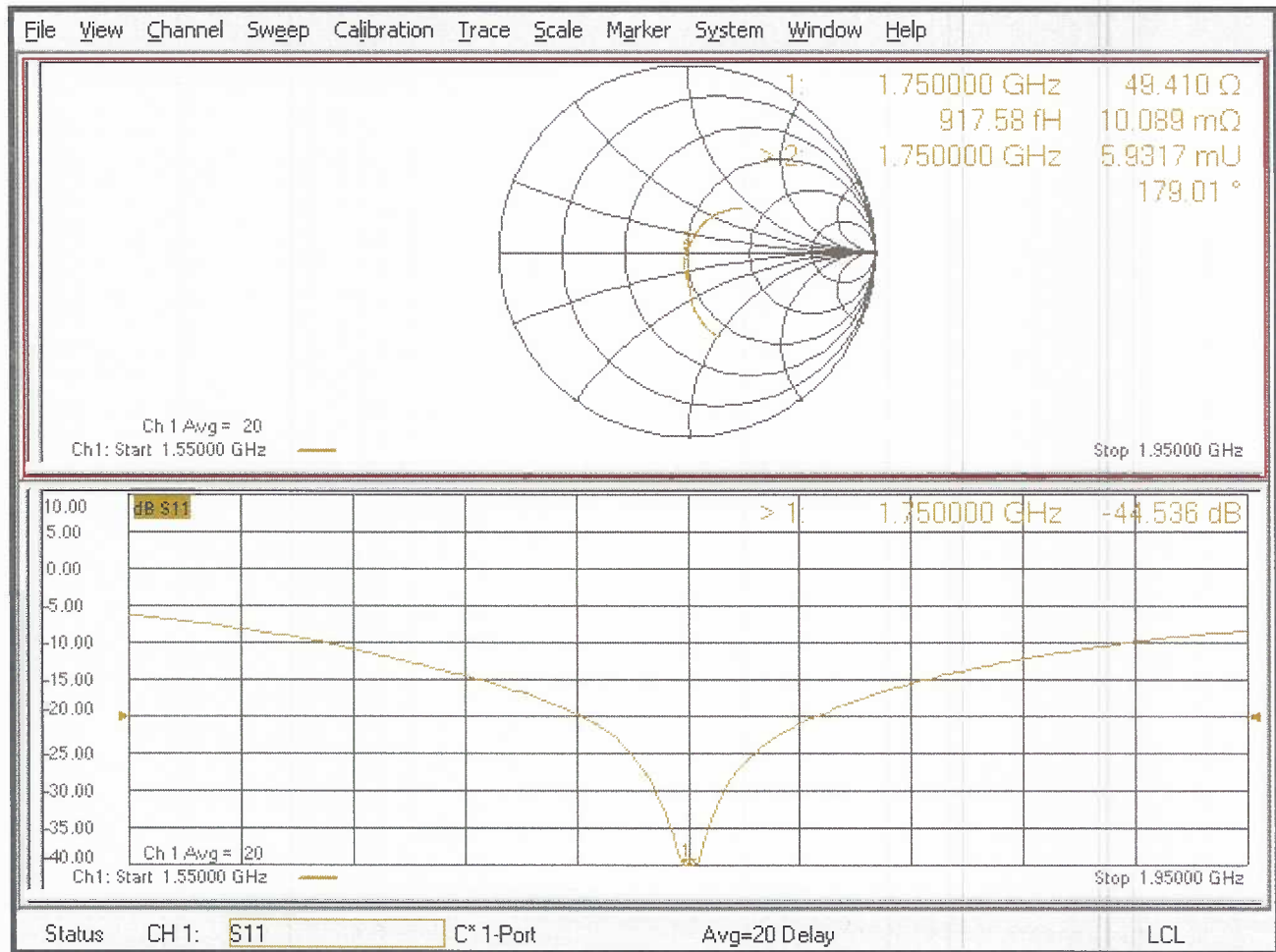
Ratio of SAR at M2 to SAR at M1 = 54%

Maximum value of SAR (measured) = 14.6 W/kg



0 dB = 14.6 W/kg = 11.64 dBW/kg

# Impedance Measurement Plot for Head TSL



Jon

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



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**C** Service suisse d'étalonnage  
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**S** Swiss Calibration Service

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **RF Exposure Lab**

Certificate No: **D1900V2-5d147\_Jun21**

## CALIBRATION CERTIFICATE

Object **D1900V2 - SN:5d147**

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

Calibration date: **June 04, 2021**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
Power sensor NRP-Z91	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22
Reference 20 dB Attenuator	SN: BH9394 (20k)	09-Apr-21 (No. 217-03343)	Apr-22
Type-N mismatch combination	SN: 310982 / 06327	09-Apr-21 (No. 217-03344)	Apr-22
Reference Probe EX3DV4	SN: 7349	28-Dec-20 (No. EX3-7349_Dec20)	Dec-21
DAE4	SN: 601	02-Nov-20 (No. DAE4-601_Nov20)	Nov-21
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-20)	In house check: Oct-22
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-21

Calibrated by: **Michael Weber** Laboratory Technician

Signature

Approved by: **Katja Pokovic** Technical Manager

Issued: June 8, 2021

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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.

<b>DASY Version</b>	DASY5	V52.10.4
<b>Extrapolation</b>	Advanced Extrapolation	
<b>Phantom</b>	Modular Flat Phantom	
<b>Distance Dipole Center - TSL</b>	10 mm	with Spacer
<b>Zoom Scan Resolution</b>	dx, dy, dz = 5 mm	
<b>Frequency</b>	1900 MHz $\pm$ 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	<b>Temperature</b>	<b>Permittivity</b>	<b>Conductivity</b>
<b>Nominal Head TSL parameters</b>	22.0 °C	40.0	1.40 mho/m
<b>Measured Head TSL parameters</b>	(22.0 $\pm$ 0.2) °C	40.9 $\pm$ 6 %	1.41 mho/m $\pm$ 6 %
<b>Head TSL temperature change during test</b>	< 0.5 °C	----	----

## SAR result with Head TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	250 mW input power	10.1 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>40.4 W/kg <math>\pm</math> 17.0 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	condition	
SAR measured	250 mW input power	5.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>21.1 W/kg <math>\pm</math> 16.5 % (k=2)</b>



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

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.3 $\Omega$ + 5.4 j $\Omega$
Return Loss	- 24.2 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.192 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
-----------------	-------

#### Extended Calibration

Usage of SAR dipoles calibrated less than 3 years ago but more than 1 year ago were confirmed in maintaining return loss (<-20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in KDB Publication 865664 D01 v01r04.

D1900V2 SN: 5d147 - Head						
Date of Measurement	Return Loss (dB)	$\Delta\%$	Impedance Real ( $\Omega$ )	$\Delta\Omega$	Impedance Imaginary (j $\Omega$ )	$\Delta\Omega$
6/4/2021	-24.2		53.3		5.4	
6/4/2022	-25.6	5.8	52.6	-0.7	5.7	0.3

## DASY5 Validation Report for Head TSL

Date: 04.06.2021

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d147**

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.41$  S/m;  $\epsilon_r = 40.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.43, 8.43, 8.43) @ 1900 MHz; Calibrated: 28.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

### Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 110.2 V/m; Power Drift = 0.04 dB

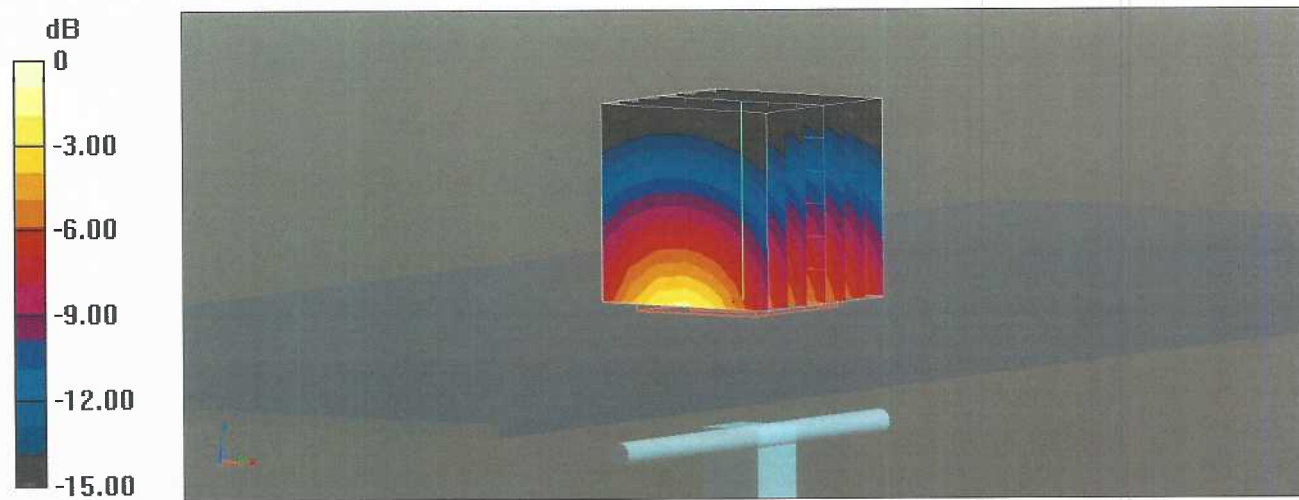
Peak SAR (extrapolated) = 18.7 W/kg

**SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.28 W/kg**

Smallest distance from peaks to all points 3 dB below = 10 mm

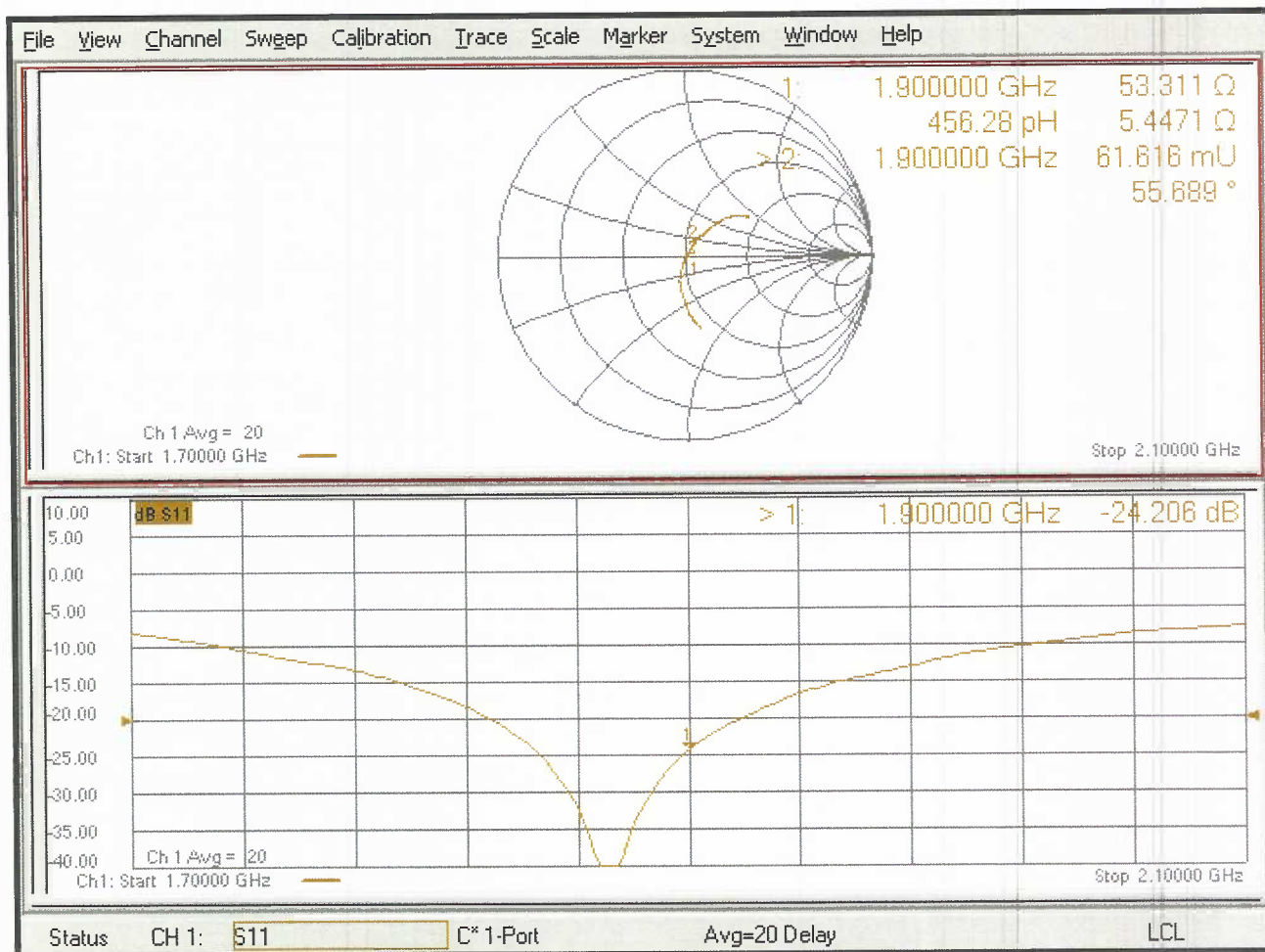
Ratio of SAR at M2 to SAR at M1 = 54.6%

Maximum value of SAR (measured) = 15.6 W/kg



0 dB = 15.6 W/kg = 11.93 dBW/kg

# Impedance Measurement Plot for Head TSL



*Jm*

**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 **RF Exposure Lab**

Certificate No: **D2300V2-1060\_Jun21**

## CALIBRATION CERTIFICATE

Object **D2300V2 - SN:1060**

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

Calibration date: **June 03, 2021**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
Power sensor NRP-Z91	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22
Reference 20 dB Attenuator	SN: BH9394 (20k)	09-Apr-21 (No. 217-03343)	Apr-22
Type-N mismatch combination	SN: 310982 / 06327	09-Apr-21 (No. 217-03344)	Apr-22
Reference Probe EX3DV4	SN: 7349	28-Dec-20 (No. EX3-7349_Dec20)	Dec-21
DAE4	SN: 601	02-Nov-20 (No. DAE4-601_Nov20)	Nov-21

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

	Name	Function	Signature
Calibrated by:	<b>Jeffrey Katzman</b>	<b>Laboratory Technician</b>	<i>J. Katzman</i>

	Name	Function	Signature
Approved by:	<b>Katja Pokovic</b>	<b>Technical Manager</b>	<i>K. Pokovic</i>

Issued: June 8, 2021

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



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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:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

### Additional Documentation:

- DASY4/5 System Handbook

### Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

<b>DASY Version</b>	DASY5	V52.10.4
<b>Extrapolation</b>	Advanced Extrapolation	
<b>Phantom</b>	Modular Flat Phantom	
<b>Distance Dipole Center - TSL</b>	10 mm	with Spacer
<b>Zoom Scan Resolution</b>	dx, dy, dz = 5 mm	
<b>Frequency</b>	2300 MHz ± 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	39.5	1.67 mho/m
<b>Measured Head TSL parameters</b>	(22.0 ± 0.2) °C	38.2 ± 6 %	1.70 mho/m ± 6 %
<b>Head TSL temperature change during test</b>	< 0.5 °C	----	----

## SAR result with Head TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	250 mW input power	12.6 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>49.6 W/kg ± 17.0 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	condition	
SAR measured	250 mW input power	6.00 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>23.8 W/kg ± 16.5 % (k=2)</b>

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

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.9 $\Omega$ - 4.6 j $\Omega$
Return Loss	- 26.3 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.171 ns
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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
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#### Extended Calibration

Usage of SAR dipoles calibrated less than 3 years ago but more than 1 year ago were confirmed in maintaining return loss (<-20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in KDB Publication 865664 D01 v01r04.

D2300V2 SN: 1060 - Head						
Date of Measurement	Return Loss (dB)	$\Delta\%$	Impedance ( $\Omega$ )	$\Delta\Omega$	Impedance Imaginary (j $\Omega$ )	$\Delta\Omega$
6/3/2021	-26.3		48.9		-4.6	
6/4/2022	-25.6	-2.7	47.3	-1.6	-4.4	0.2

# DASY5 Validation Report for Head TSL

Date: 03.06.2021

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN:1060**

Communication System: UID 0 - CW; Frequency: 2300 MHz

Medium parameters used:  $f = 2300$  MHz;  $\sigma = 1.7$  S/m;  $\epsilon_r = 38.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.98, 7.98, 7.98) @ 2300 MHz; Calibrated: 28.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

## Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 117.4 V/m; Power Drift = 0.00 dB

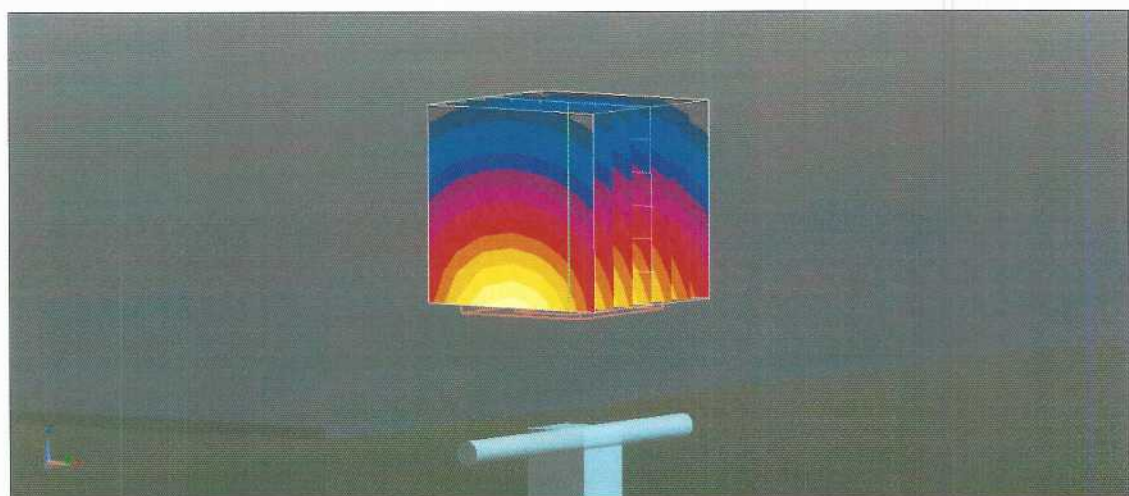
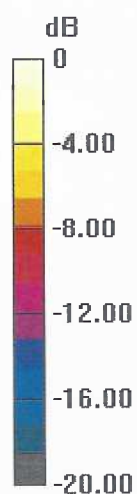
Peak SAR (extrapolated) = 23.2 W/kg

**SAR(1 g) = 12.6 W/kg; SAR(10 g) = 6 W/kg**

Smallest distance from peaks to all points 3 dB below = 9 mm

Ratio of SAR at M2 to SAR at M1 = 54.1%

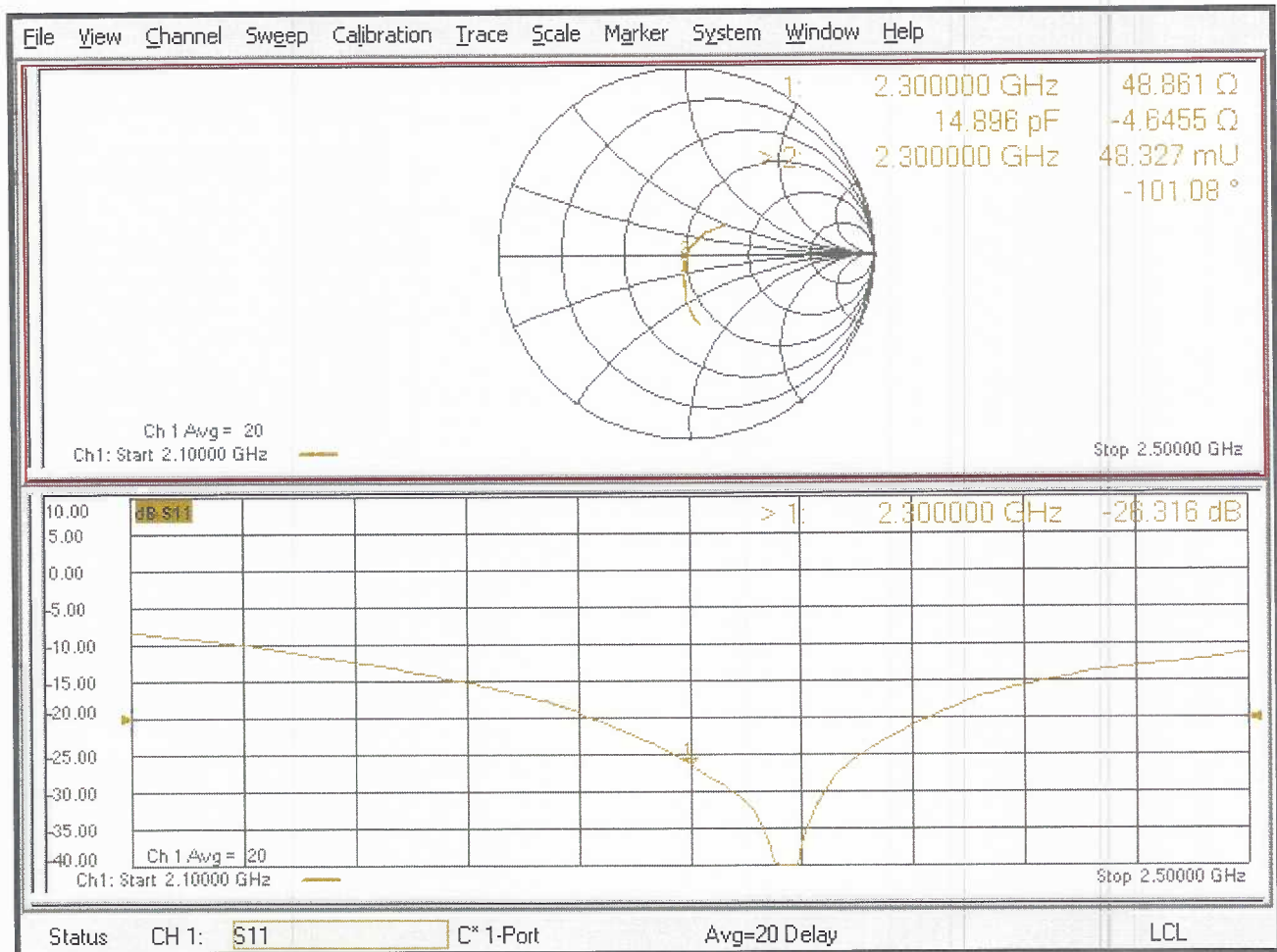
Maximum value of SAR (measured) = 19.8 W/kg



0 dB = 19.8 W/kg = 12.97 dBW/kg



# Impedance Measurement Plot for Head TSL



**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

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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 **RF Exposure Lab**

Certificate No: **D2550V2-1003\_Jun21**

## CALIBRATION CERTIFICATE

Object **D2550V2 - SN:1003**

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

Calibration date: **June 03, 2021**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
Power sensor NRP-Z91	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22
Reference 20 dB Attenuator	SN: BH9394 (20k)	09-Apr-21 (No. 217-03343)	Apr-22
Type-N mismatch combination	SN: 310982 / 06327	09-Apr-21 (No. 217-03344)	Apr-22
Reference Probe EX3DV4	SN: 7349	28-Dec-20 (No. EX3-7349_Dec20)	Dec-21
DAE4	SN: 601	02-Nov-20 (No. DAE4-601_Nov20)	Nov-21

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

	Name	Function	Signature
Calibrated by:	Jeffrey Katzman	Laboratory Technician	

	Name	Function	Signature
Approved by:	Katja Pokovic	Technical Manager	

Issued: June 8, 2021

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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:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

### Additional Documentation:

- DASY4/5 System Handbook

### Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

<b>DASY Version</b>	DASY5	V52.10.4
<b>Extrapolation</b>	Advanced Extrapolation	
<b>Phantom</b>	Modular Flat Phantom	
<b>Distance Dipole Center - TSL</b>	10 mm	with Spacer
<b>Zoom Scan Resolution</b>	dx, dy, dz = 5 mm	
<b>Frequency</b>	2550 MHz ± 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	39.1	1.91 mho/m
<b>Measured Head TSL parameters</b>	(22.0 ± 0.2) °C	37.3 ± 6 %	1.98 mho/m ± 6 %
<b>Head TSL temperature change during test</b>	< 0.5 °C	---	---

## SAR result with Head TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	250 mW input power	14.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>55.3 W/kg ± 17.0 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	condition	
SAR measured	250 mW input power	6.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>24.7 W/kg ± 16.5 % (k=2)</b>

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

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.4 $\Omega$ - 3.5 j $\Omega$
Return Loss	- 29.0 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.156 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
-----------------	-------

#### Extended Calibration

Usage of SAR dipoles calibrated less than 3 years ago but more than 1 year ago were confirmed in maintaining return loss (<-20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in KDB Publication 865664 D01 v01r04.

D2550V2 SN: 1003 - Head						
Date of Measurement	Return Loss (dB)	$\Delta\%$	Impedance ( $\Omega$ )	$\Delta\Omega$	Impedance Imaginary (j $\Omega$ )	$\Delta\Omega$
6/3/2021	-29.0		49.4		-3.5	
6/4/2022	-28.6	-1.4	48.5	-0.9	-3.8	-0.3

## DASY5 Validation Report for Head TSL

Date: 03.06.2021

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2550 MHz; Type: D2550V2; Serial: D2550V2 - SN:1003**

Communication System: UID 0 - CW; Frequency: 2550 MHz

Medium parameters used:  $f = 2550$  MHz;  $\sigma = 1.98$  S/m;  $\epsilon_r = 37.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.85, 7.85, 7.85) @ 2550 MHz; Calibrated: 28.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

### **Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:**

Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 117.6 V/m; Power Drift = 0.07 dB

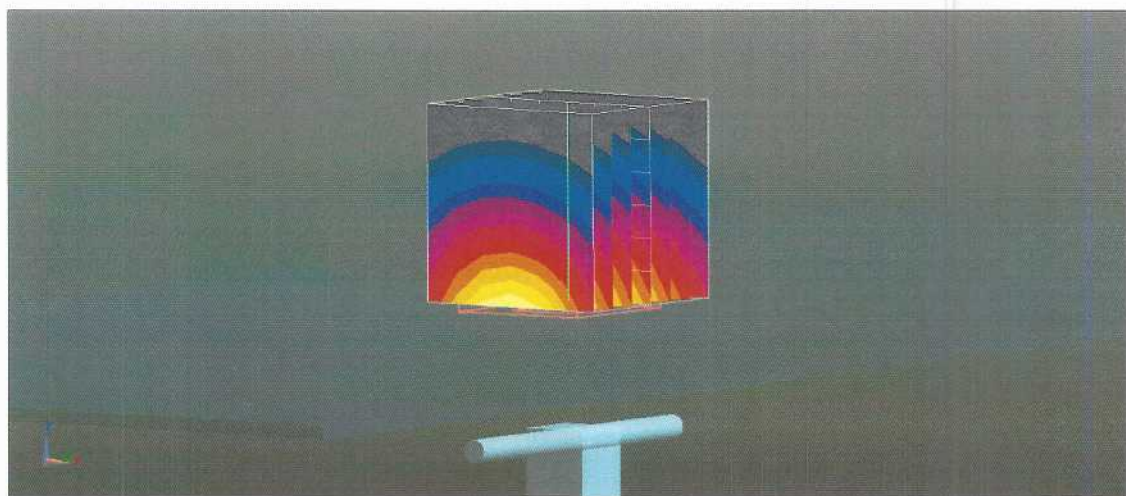
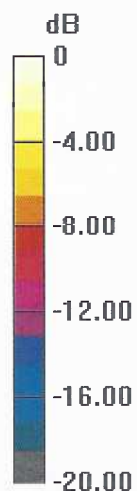
Peak SAR (extrapolated) = 29.9 W/kg

**SAR(1 g) = 14.2 W/kg; SAR(10 g) = 6.28 W/kg**

Smallest distance from peaks to all points 3 dB below = 8.5 mm

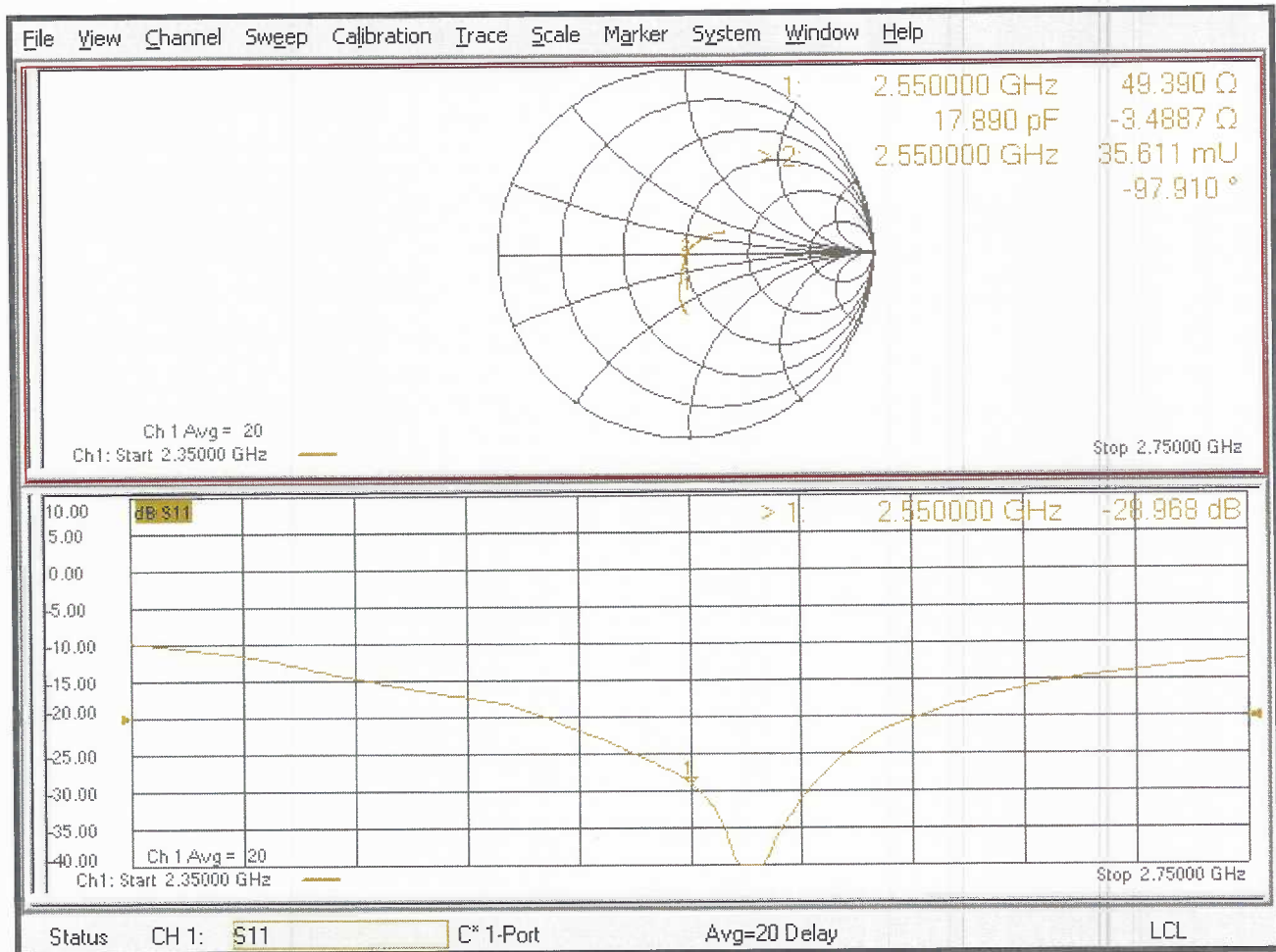
Ratio of SAR at M2 to SAR at M1 = 47.1%

Maximum value of SAR (measured) = 24.3 W/kg



0 dB = 24.3 W/kg = 13.86 dBW/kg

# Impedance Measurement Plot for Head TSL





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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **RF Exposure Lab**

Certificate No: **D3300V2-1032\_Jan22**

## CALIBRATION CERTIFICATE

Object **D3300V2 - SN:1032**

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

Calibration date: **January 17, 2022**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
Power sensor NRP-Z91	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22
Reference 20 dB Attenuator	SN: BH9394 (20k)	09-Apr-21 (No. 217-03343)	Apr-22
Type-N mismatch combination	SN: 310982 / 06327	09-Apr-21 (No. 217-03344)	Apr-22
Reference Probe EX3DV4	SN: 3503	31-Dec-21 (No. EX3-3503_Dec21)	Dec-22
DAE4	SN: 601	01-Nov-21 (No. DAE4-601_Nov21)	Nov-22
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-20)	In house check: Oct-22
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-22

Calibrated by:	Name <b>Michael Weber</b>	Function <b>Laboratory Technician</b>	Signature 
Approved by:	Name <b>Sven Kühn</b>	Function <b>Deputy Manager</b>	Signature 

Issued: January 19, 2022

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Accreditation No.: **SCS 0108**

### Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

### Calibration is Performed According to the Following Standards:

- a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

### Additional Documentation:

- c) DASY System Handbook

### Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

<b>DASY Version</b>	DASY52	V52.10.4
<b>Extrapolation</b>	Advanced Extrapolation	
<b>Phantom</b>	Modular Flat Phantom	
<b>Distance Dipole Center - TSL</b>	10 mm	with Spacer
<b>Zoom Scan Resolution</b>	dx, dy = 4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
<b>Frequency</b>	3300 MHz $\pm$ 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	<b>Temperature</b>	<b>Permittivity</b>	<b>Conductivity</b>
<b>Nominal Head TSL parameters</b>	22.0 °C	38.2	2.71 mho/m
<b>Measured Head TSL parameters</b>	(22.0 $\pm$ 0.2) °C	37.5 $\pm$ 6 %	2.78 mho/m $\pm$ 6 %
<b>Head TSL temperature change during test</b>	< 0.5 °C	----	----

## SAR result with Head TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	100 mW input power	6.56 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>64.9 W/kg <math>\pm</math> 19.9 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	condition	
SAR measured	100 mW input power	2.51 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>25.0 W/kg <math>\pm</math> 19.5 % (k=2)</b>

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

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	$50.4 \Omega + 2.9 j\Omega$
Return Loss	- 30.7 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.119 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
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## DASY5 Validation Report for Head TSL

Date: 17.01.2022

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 3300 MHz; Type: D3300V2; Serial: D3300V2 - SN:1032**

Communication System: UID 0 - CW; Frequency: 3300 MHz

Medium parameters used:  $f = 3300$  MHz;  $\sigma = 2.78$  S/m;  $\epsilon_r = 37.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(7.97, 7.97, 7.97) @ 3300 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 01.11.2021
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

**Dipole Calibration for Head Tissue/Pin=100 mW, d=10mm, f=3300MHz/Zoom Scan, dist=1.4mm (8x8x8)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 70.53 V/m; Power Drift = 0.03 dB

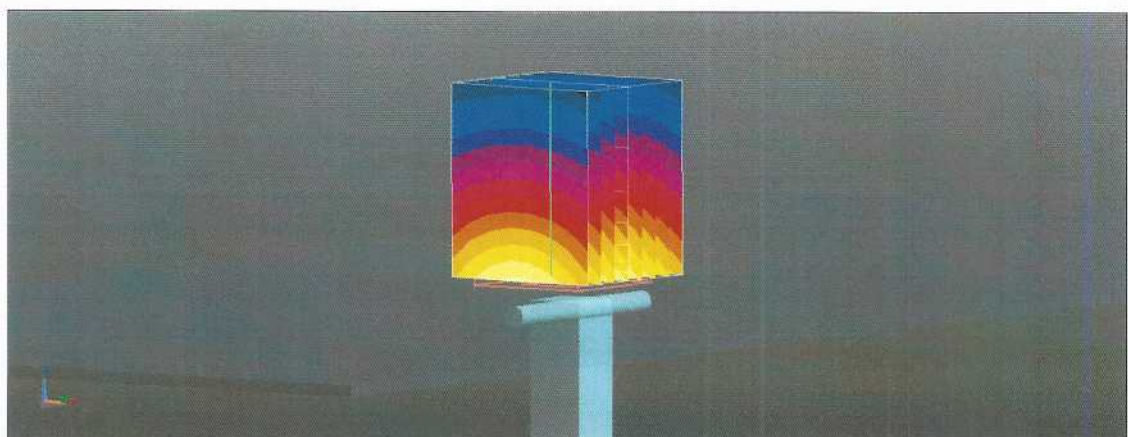
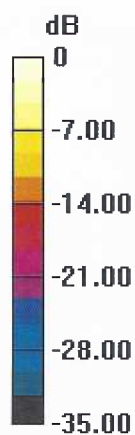
Peak SAR (extrapolated) = 17.1 W/kg

**SAR(1 g) = 6.56 W/kg; SAR(10 g) = 2.51 W/kg**

Smallest distance from peaks to all points 3 dB below = 8.2 mm

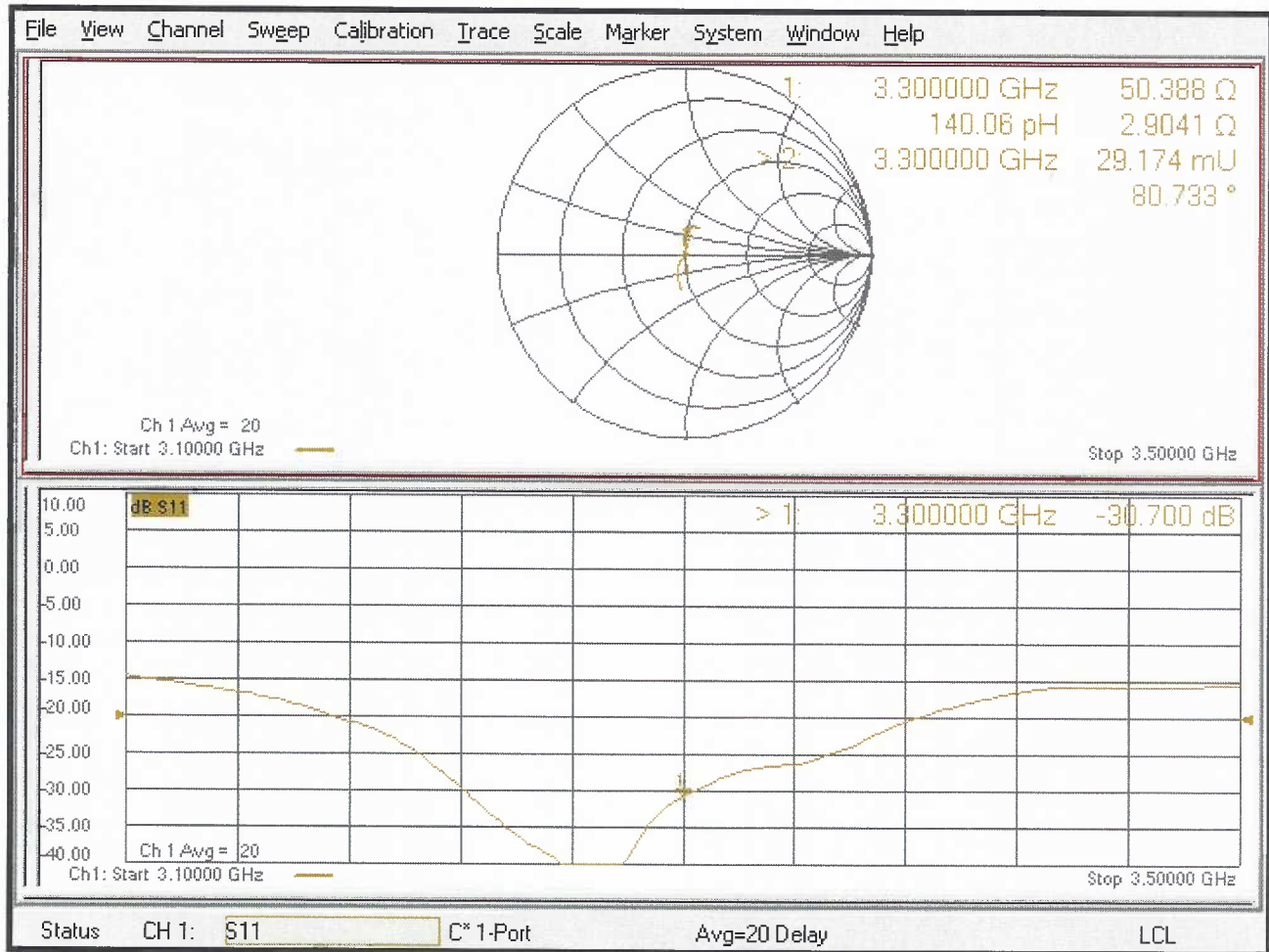
Ratio of SAR at M2 to SAR at M1 = 75.7%

Maximum value of SAR (measured) = 12.4 W/kg



0 dB = 12.4 W/kg = 10.92 dBW/kg

# Impedance Measurement Plot for Head TSL



*gm*

**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

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **RF Exposure Lab**

Certificate No: **D3500V2-1061\_Apr21**

## CALIBRATION CERTIFICATE

Object **D3500V2 - SN:1061**

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

Calibration date: **April 13, 2021**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
Power sensor NRP-Z91	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22
Reference 20 dB Attenuator	SN: BH9394 (20k)	09-Apr-21 (No. 217-03343)	Apr-22
Type-N mismatch combination	SN: 310982 / 06327	09-Apr-21 (No. 217-03344)	Apr-22
Reference Probe EX3DV4	SN: 3503	30-Dec-20 (No. EX3-3503_Dec20)	Dec-21
DAE4	SN: 601	02-Nov-20 (No. DAE4-601_Nov20)	Nov-21
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-20)	In house check: Oct-22
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-21

Calibrated by: **Michael Weber**      Name: **Michael Weber**      Function: **Laboratory Technician**

Signature  
*M. Weber*

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

Signature  
*K. Pokovic*

Issued: April 15, 2021

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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:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

### Additional Documentation:

- DASY4/5 System Handbook

### Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	3500 MHz ± 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	37.9	2.91 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.3 ± 6 %	2.93 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

## SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.73 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>67.0 W/kg ± 19.9 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.52 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>25.1 W/kg ± 19.5 % (k=2)</b>



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

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.5 $\Omega$ - 5.3 j $\Omega$
Return Loss	- 24.2 dB

### General Antenna Parameters and Design

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

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

Manufactured by	SPEAG
-----------------	-------

#### Extended Calibration

Usage of SAR dipoles calibrated less than 3 years ago but more than 1 year ago were confirmed in maintaining return loss (<-20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in KDB Publication 865664 D01 v01r04.

D3500V2 SN: 1061 - Head						
Date of Measurement	Return Loss (dB)	$\Delta\%$	Impedance Real ( $\Omega$ )	$\Delta\Omega$	Impedance Imaginary (j $\Omega$ )	$\Delta\Omega$
4/13/2018	-24.2		53.5		-5.3	
4/22/2019	-23.9	-1.2	51.9	-1.6	-4.8	0.5

## DASY5 Validation Report for Head TSL

Date: 13.04.2021

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 3500 MHz; Type: D3500V2; Serial: D3500V2 - SN: 1061**

Communication System: UID 0 - CW; Frequency: 3500 MHz

Medium parameters used:  $f = 3500$  MHz;  $\sigma = 2.93$  S/m;  $\epsilon_r = 37.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(7.91, 7.91, 7.91) @ 3500 MHz; Calibrated: 30.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

### Dipole Calibration for Head Tissue/Pin=100 mW, d=10mm 3500/Zoom Scan, dist=1.4mm

(8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 72.28 V/m; Power Drift = 0.02 dB

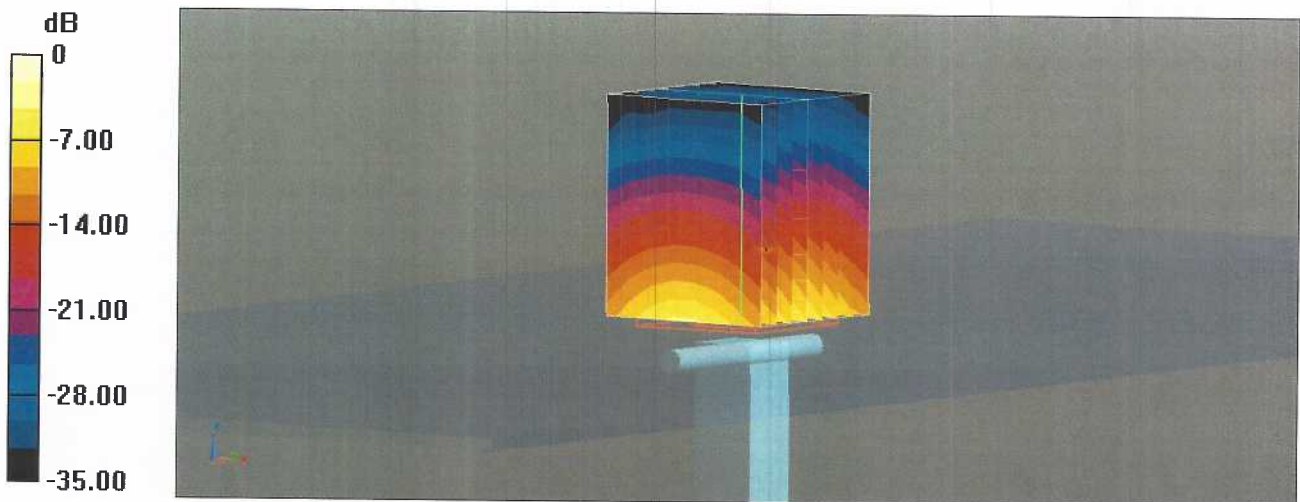
Peak SAR (extrapolated) = 18.2 W/kg

**SAR(1 g) = 6.73 W/kg; SAR(10 g) = 2.52 W/kg**

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

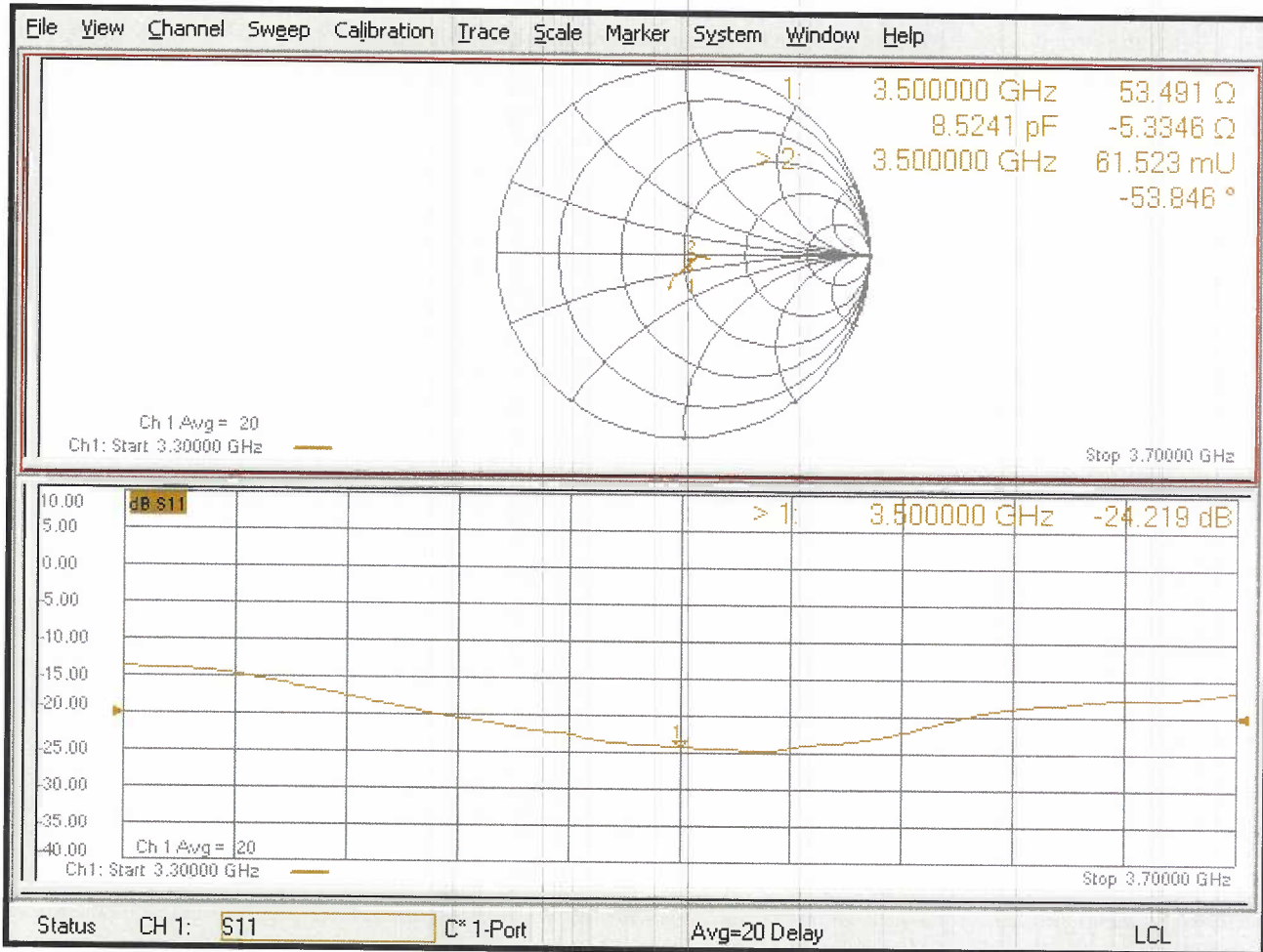
Ratio of SAR at M2 to SAR at M1 = 74.3%

Maximum value of SAR (measured) = 12.7 W/kg



0 dB = 12.7 W/kg = 11.05 dBW/kg

# Impedance Measurement Plot for Head TSL



*gm*

**Calibration Laboratory of  
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Zeughausstrasse 43, 8004 Zurich, Switzerland



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Accreditation No.: **SCS 0108**

Client **RF Exposure Lab**

Certificate No: **D3700V2-1024\_Apr21**

## CALIBRATION CERTIFICATE

Object **D3700V2 - SN:1024**

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

Calibration date: **April 13, 2021**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
Power sensor NRP-Z91	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22
Reference 20 dB Attenuator	SN: BH9394 (20k)	09-Apr-21 (No. 217-03343)	Apr-22
Type-N mismatch combination	SN: 310982 / 06327	09-Apr-21 (No. 217-03344)	Apr-22
Reference Probe EX3DV4	SN: 3503	30-Dec-20 (No. EX3-3503_Dec20)	Dec-21
DAE4	SN: 601	02-Nov-20 (No. DAE4-601_Nov20)	Nov-21
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-20)	In house check: Oct-22
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-21

Calibrated by:	Name <b>Michael Weber</b>	Function <b>Laboratory Technician</b>	Signature <i>M. Weber</i>
Approved by:	<b>Katja Pokovic</b>	<b>Technical Manager</b>	<i>[Signature]</i>

Issued: April 15, 2021

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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:**

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

- DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

- Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:* SAR measured at the stated antenna input power.
- SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

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

## Head TSL parameters

The following parameters and calculations were applied.

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

## SAR result with Head TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	100 mW input power	6.85 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>68.3 W/kg <math>\pm</math> 19.9 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	condition	
SAR measured	100 mW input power	2.47 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>24.6 W/kg <math>\pm</math> 19.5 % (k=2)</b>

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

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	46.1 $\Omega$ + 2.2 j $\Omega$
Return Loss	- 26.7 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.127 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
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#### Extended Calibration

Usage of SAR dipoles calibrated less than 3 years ago but more than 1 year ago were confirmed in maintaining return loss (<-20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in KDB Publication 865664 D01 v01r04.

D3700V2 SN: 1024 - Head						
Date of Measurement	Return Loss (dB)	$\Delta\%$	Impedance ( $\Omega$ )	$\Delta\Omega$	Impedance Imaginary (j $\Omega$ )	$\Delta\Omega$
4/13/2021	-26.7		46.1		2.2	
4/13/2022	-25.3	-5.2	44.5	-1.6	1.8	-0.4

# DASY5 Validation Report for Head TSL

Date: 13.04.2021

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 3700 MHz; Type: D3700V2; Serial: D3700V2 - SN: 1024**

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

Medium parameters used:  $f = 3700$  MHz;  $\sigma = 3.09$  S/m;  $\epsilon_r = 37$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

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

## Dipole Calibration for Head Tissue/Pin=100 mW, d=10mm 3700/Zoom Scan, dist=1.4mm

**(8x8x8)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 71.95 V/m; Power Drift = 0.04 dB

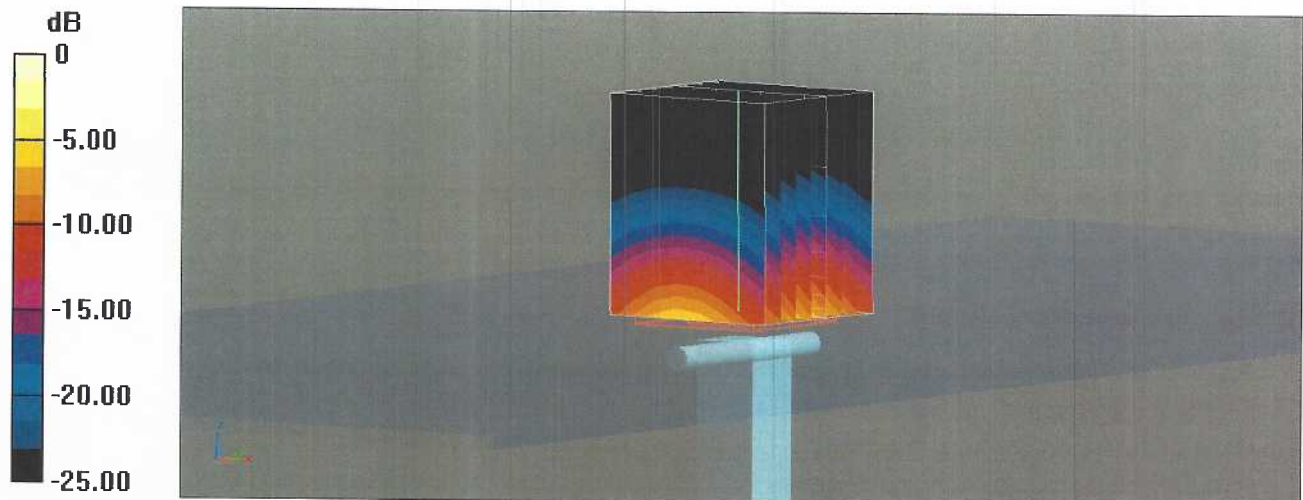
Peak SAR (extrapolated) = 19.6 W/kg

**SAR(1 g) = 6.85 W/kg; SAR(10 g) = 2.47 W/kg**

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

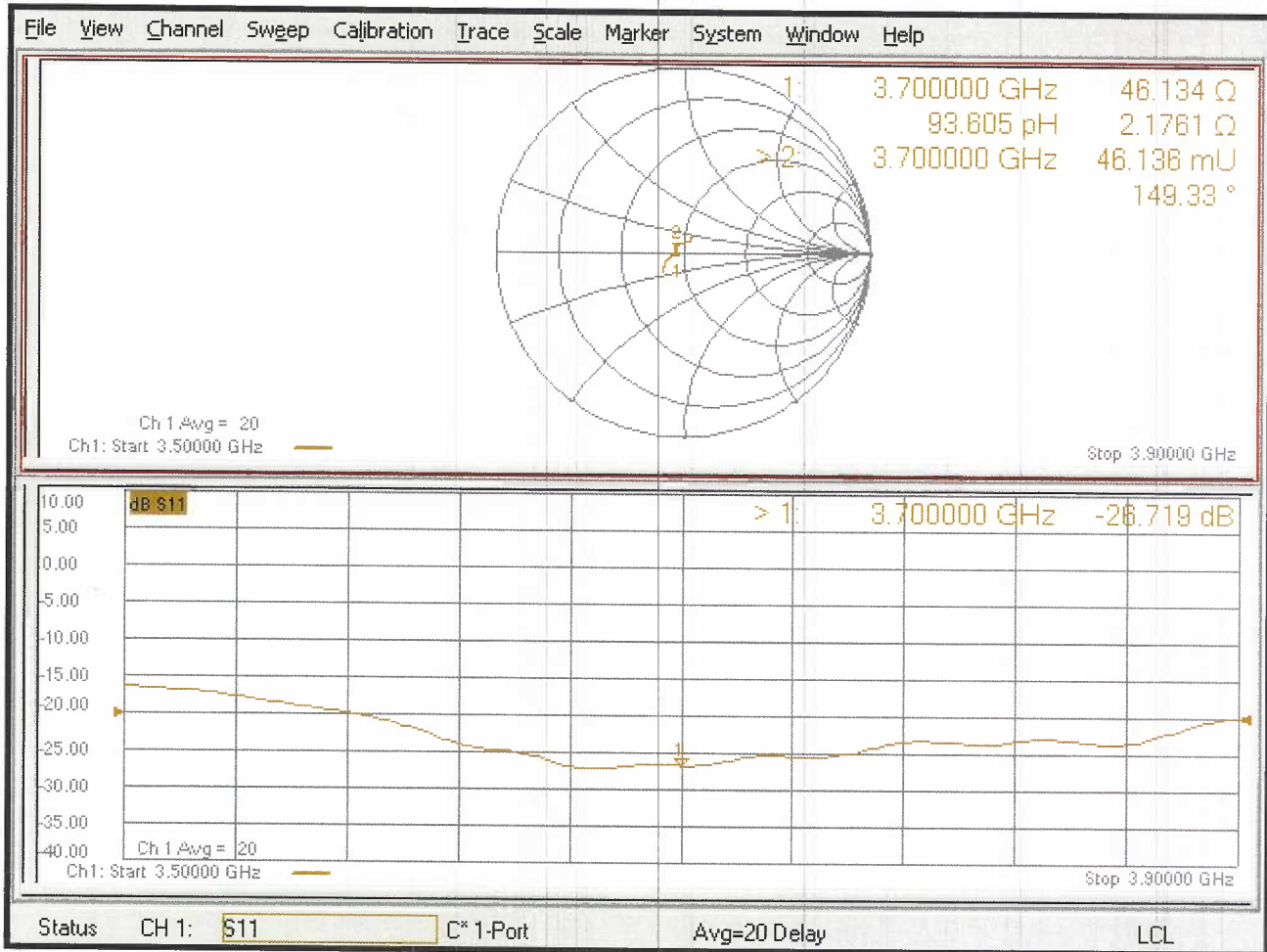
Ratio of SAR at M2 to SAR at M1 = 73.2%

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





# Impedance Measurement Plot for Head TSL





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 **RF Exposure Lab**

Certificate No: **D3900V2-1082\_Jan22**

## CALIBRATION CERTIFICATE

Object **D3900V2 - SN:1082**

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

Calibration date: **January 13, 2022**

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	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
Power sensor NRP-Z91	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22
Reference 20 dB Attenuator	SN: BH9394 (20k)	09-Apr-21 (No. 217-03343)	Apr-22
Type-N mismatch combination	SN: 310982 / 06327	09-Apr-21 (No. 217-03344)	Apr-22
Reference Probe EX3DV4	SN: 3503	31-Dec-21 (No. EX3-3503_Dec21)	Dec-22
DAE4	SN: 601	01-Nov-21 (No. DAE4-601_Nov21)	Nov-22
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-20)	In house check: Oct-22
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-22

Calibrated by: **Jeffrey Katzman**      Name: Jeffrey Katzman      Function: Laboratory Technician      Signature:

Approved by: **Sven Kühn**      Name: Sven Kühn      Function: Deputy Manager      Signature:

Issued: January 19, 2022

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



Accredited by the Swiss Accreditation Service (SAS)

The Swiss Accreditation Service is one of the signatories to the EA  
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

**Glossary:**

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

**Calibration is Performed According to the Following Standards:**

- a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

- c) DASY System Handbook

**Methods Applied and Interpretation of Parameters:**

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

<b>DASY Version</b>	DASY52	V52.10.4
<b>Extrapolation</b>	Advanced Extrapolation	
<b>Phantom</b>	Modular Flat Phantom V5.0	
<b>Distance Dipole Center - TSL</b>	10 mm	with Spacer
<b>Zoom Scan Resolution</b>	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
<b>Frequency</b>	3900 MHz ± 1 MHz	

## Head TSL parameters at 3900 MHz

The following parameters and calculations were applied.

	<b>Temperature</b>	<b>Permittivity</b>	<b>Conductivity</b>
<b>Nominal Head TSL parameters</b>	22.0 °C	37.5	3.32 mho/m
<b>Measured Head TSL parameters</b>	(22.0 ± 0.2) °C	36.8 ± 6 %	3.26 mho/m ± 6 %
<b>Head TSL temperature change during test</b>	< 0.5 °C	----	----

## SAR result with Head TSL at 3900 MHz

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	100 mW input power	7.00 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>69.9 W/kg ± 19.9 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	condition	
SAR measured	100 mW input power	2.43 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>24.2 W/kg ± 19.5 % (k=2)</b>

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

### Antenna Parameters with Head TSL at 3900 MHz

Impedance, transformed to feed point	47.0 $\Omega$ - 5.2 j $\Omega$
Return Loss	- 24.2 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.108 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

Manufactured by	SPEAG
-----------------	-------

## DASY5 Validation Report for Head TSL

Date: 13.01.2022

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 3900 MHz; Type: D3900V2; Serial: D3900V2 - SN:1082**

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

Medium parameters used:  $f = 3900$  MHz;  $\sigma = 3.26$  S/m;  $\epsilon_r = 36.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(7.39, 7.39, 7.39) @ 3900 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 01.11.2021
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

### **Dipole Calibration for Head Tissue/Pin=100 mW, d=10mm 3900/Zoom Scan, dist=1.4mm**

**(8x8x8)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 73.71 V/m; Power Drift = 0.00 dB

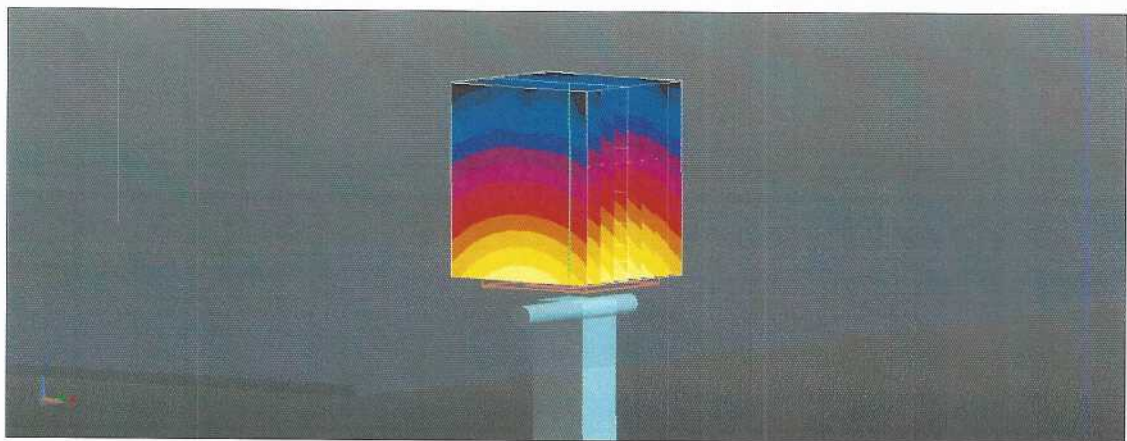
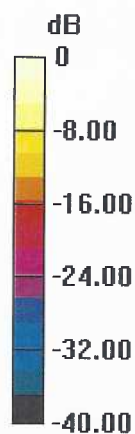
Peak SAR (extrapolated) = 19.6 W/kg

**SAR(1 g) = 7.00 W/kg; SAR(10 g) = 2.43 W/kg**

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

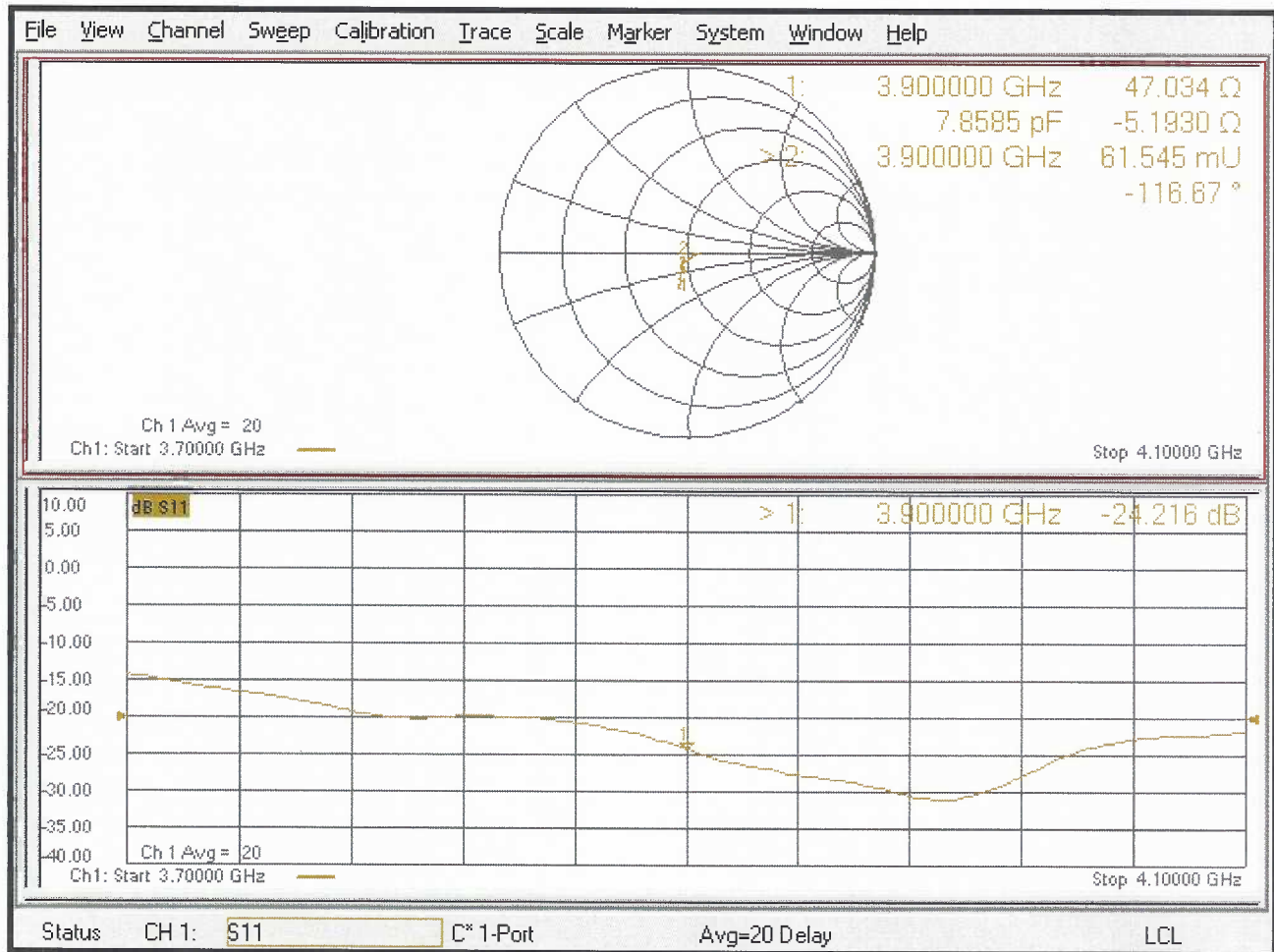
Ratio of SAR at M2 to SAR at M1 = 74.8%

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



0 dB = 13.7 W/kg = 11.38 dBW/kg

# Impedance Measurement Plot for Head TSL





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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **RF Exposure Lab**

Certificate No: **D4200V2-1025\_Jan22**

## CALIBRATION CERTIFICATE

Object **D4200V2 - SN:1025**

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

Calibration date: **January 13, 2022**

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	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
Power sensor NRP-Z91	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22
Reference 20 dB Attenuator	SN: BH9394 (20k)	09-Apr-21 (No. 217-03343)	Apr-22
Type-N mismatch combination	SN: 310982 / 06327	09-Apr-21 (No. 217-03344)	Apr-22
Reference Probe EX3DV4	SN: 3503	31-Dec-21 (No. EX3-3503_Dec21)	Dec-22
DAE4	SN: 601	01-Nov-21 (No. DAE4-601_Nov21)	Nov-22

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-20)	In house check: Oct-22
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-22

	Name	Function	Signature
Calibrated by:	<b>Jeffrey Katzman</b>	<b>Laboratory Technician</b>	

	Name	Function	Signature
Approved by:	<b>Sven Kühn</b>	<b>Deputy Manager</b>	

Issued: January 19, 2022

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Accreditation No.: **SCS 0108**

**Glossary:**

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

**Calibration is Performed According to the Following Standards:**

- a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

- c) DASY System Handbook

**Methods Applied and Interpretation of Parameters:**

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

<b>DASY Version</b>	DASY52	V52.10.4
<b>Extrapolation</b>	Advanced Extrapolation	
<b>Phantom</b>	Modular Flat Phantom	
<b>Distance Dipole Center - TSL</b>	10 mm	with Spacer
<b>Zoom Scan Resolution</b>	dx, dy = 4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
<b>Frequency</b>	4200 MHz $\pm$ 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	<b>Temperature</b>	<b>Permittivity</b>	<b>Conductivity</b>
<b>Nominal Head TSL parameters</b>	22.0 °C	37.1	3.63 mho/m
<b>Measured Head TSL parameters</b>	(22.0 $\pm$ 0.2) °C	36.4 $\pm$ 6 %	3.53 mho/m $\pm$ 6 %
<b>Head TSL temperature change during test</b>	< 0.5 °C	----	----

## SAR result with Head TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	100 mW input power	6.63 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>66.3 W/kg <math>\pm</math> 19.9 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	condition	
SAR measured	100 mW input power	2.24 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>22.3 W/kg <math>\pm</math> 19.5 % (k=2)</b>

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

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	46.5 $\Omega$ - 4.7 j $\Omega$
Return Loss	- 24.3 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.119 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
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# DASY5 Validation Report for Head TSL

Date: 13.01.2022

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 4200 MHz; Type: D4200V2; Serial: D4200V2 - SN:1025**

Communication System: UID 0 - CW; Frequency: 4200 MHz

Medium parameters used:  $f = 4200$  MHz;  $\sigma = 3.53$  S/m;  $\epsilon_r = 36.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(7.02, 7.02, 7.02) @ 4200 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 01.11.2021
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

**Dipole Calibration for Head Tissue/Pin=100 mW, d=10mm, f=4200MHz/Zoom Scan,**

**dist=1.4mm (8x8x8)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 71.28 V/m; Power Drift = -0.02 dB

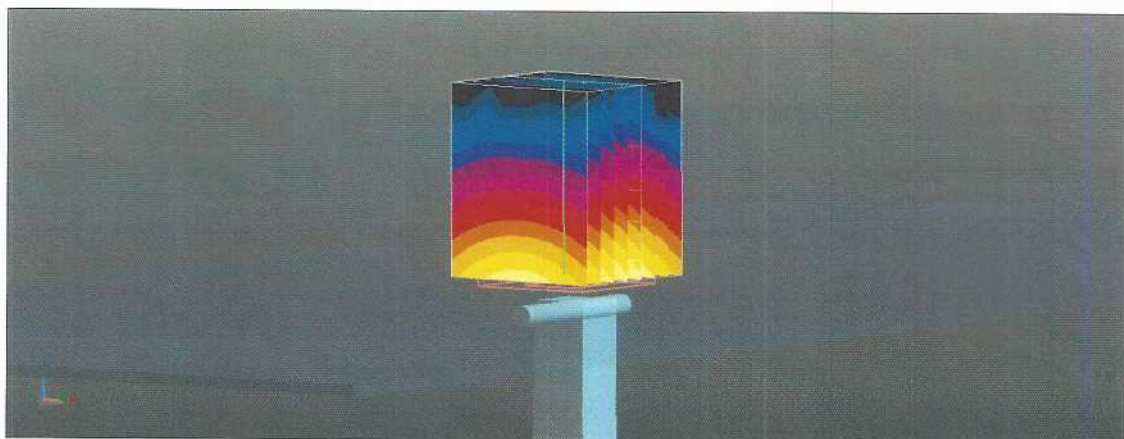
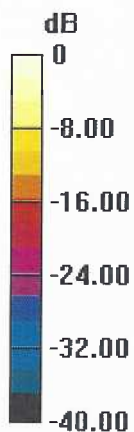
Peak SAR (extrapolated) = 17.9 W/kg

**SAR(1 g) = 6.63 W/kg; SAR(10 g) = 2.24 W/kg**

Smallest distance from peaks to all points 3 dB below = 7.6 mm

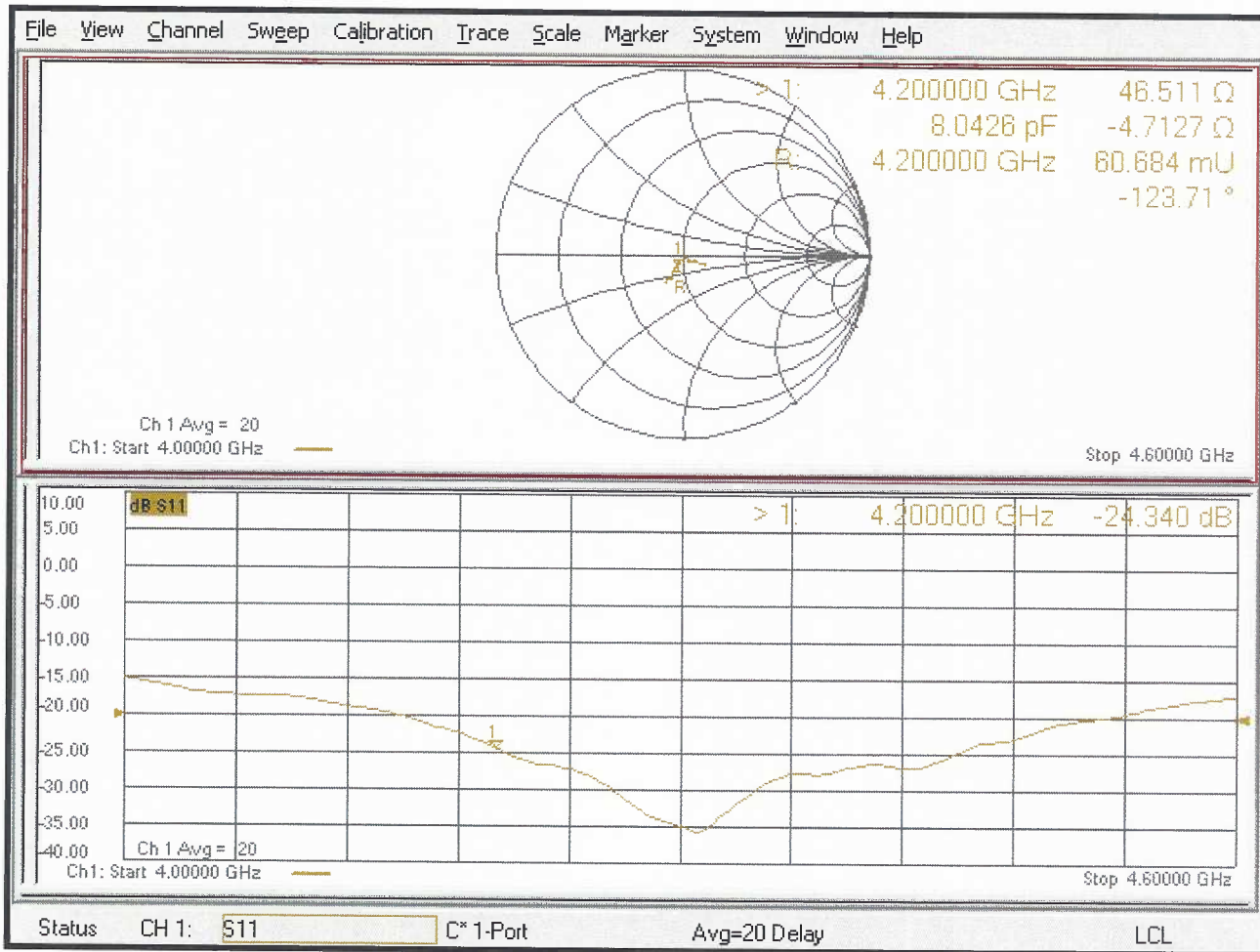
Ratio of SAR at M2 to SAR at M1 = 76.5%

Maximum value of SAR (measured) = 12.9 W/kg



0 dB = 12.9 W/kg = 11.12 dBW/kg

# Impedance Measurement Plot for Head TSL



## Appendix F – DAE Calibration Data Sheets

**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 **RF Exposure Lab**

Certificate No: **DAE4-1217\_Mar22**

## CALIBRATION CERTIFICATE

Object **DAE4 - SD 000 D04 BJ - SN: 1217**

Calibration procedure(s) **QA CAL-06.v30**  
**Calibration procedure for the data acquisition electronics (DAE)**

Calibration date: **March 24, 2022**

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
Keithley Multimeter Type 2001	SN: 0810278	31-Aug-21 (No:31368)	Aug-22
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Auto DAE Calibration Unit	SE UWS 053 AA 1001	24-Jan-22 (in house check)	In house check: Jan-23
Calibrator Box V2.1	SE UMS 006 AA 1002	24-Jan-22 (in house check)	In house check: Jan-23

Calibrated by: **Adrian Gehring**      Name: **Adrian Gehring**      Function: **Laboratory Technician**

Approved by: **Sven Kühn**      Name: **Sven Kühn**      Function: **Deputy Manager**

Signature  
*Adrian Gehring*  
*Sven Kühn*

Issued: March 24, 2022

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

## Glossary

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

## Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle:* The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
  - *Input Offset Measurement:* Output voltage and statistical results over a large number of zero voltage measurements.
  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
  - *Power consumption:* Typical value for information. Supply currents in various operating modes.



## DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1 $\mu$ V, full range = -100...+300 mV

Low Range: 1LSB = 61nV, full range = -1.....+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	403.715 $\pm$ 0.02% (k=2)	404.147 $\pm$ 0.02% (k=2)	403.540 $\pm$ 0.02% (k=2)
Low Range	3.95971 $\pm$ 1.50% (k=2)	3.99918 $\pm$ 1.50% (k=2)	3.95126 $\pm$ 1.50% (k=2)

## Connector Angle

Connector Angle to be used in DASY system	282.0 $^{\circ}$ $\pm$ 1 $^{\circ}$
---	-------------------------------------

## Appendix (Additional assessments outside the scope of SCS0108)

### 1. DC Voltage Linearity

High Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	199995.89	2.64	0.00
Channel X + Input	20002.93	0.70	0.00
Channel X - Input	-19999.20	2.01	-0.01
Channel Y + Input	199992.86	-0.37	-0.00
Channel Y + Input	20002.35	0.24	0.00
Channel Y - Input	-20002.11	-0.78	0.00
Channel Z + Input	199994.55	0.92	0.00
Channel Z + Input	20000.85	-1.14	-0.01
Channel Z - Input	-20004.38	-2.92	0.01

Low Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	2002.28	0.47	0.02
Channel X + Input	202.27	-0.42	-0.21
Channel X - Input	-198.23	-0.87	0.44
Channel Y + Input	2002.01	0.83	0.04
Channel Y + Input	201.05	-0.65	-0.32
Channel Y - Input	-198.60	-0.16	0.08
Channel Z + Input	2002.00	0.99	0.05
Channel Z + Input	200.64	-2.29	-1.13
Channel Z - Input	-200.51	-2.25	1.13

### 2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading ( $\mu\text{V}$ )	Low Range Average Reading ( $\mu\text{V}$ )
Channel X	200	-0.61	-3.06
	- 200	4.39	2.41
Channel Y	200	17.98	18.25
	- 200	-19.35	-19.67
Channel Z	200	-12.05	-11.93
	- 200	9.89	9.82

### 3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X ( $\mu\text{V}$ )	Channel Y ( $\mu\text{V}$ )	Channel Z ( $\mu\text{V}$ )
Channel X	200	-	0.45	-4.46
Channel Y	200	7.42	-	0.92
Channel Z	200	10.44	5.48	-

#### 4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	16292	14866
Channel Y	15799	14940
Channel Z	16823	16397

#### 5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Input 10M $\Omega$

	Average ( $\mu$ V)	min. Offset ( $\mu$ V)	max. Offset ( $\mu$ V)	Std. Deviation ( $\mu$ V)
Channel X	0.50	-0.43	1.46	0.37
Channel Y	-0.31	-1.57	0.59	0.40
Channel Z	-0.61	-1.63	0.73	0.46

#### 6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

#### 7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

#### 8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

#### 9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	-0.01	-8	-9

## Appendix G – Phantom Calibration Data Sheets

**Certificate of Conformity / First Article Inspection**

Item	Oval Flat Phantom ELI 4.0
Type No	QD OVA 001 B
Series No	1003 and higher
Manufacturer	Untersee Composites Knebelstrasse 8 CH-8268 Mannenbach, Switzerland

**Tests**

Complete tests were made on the prototype units QD OVA 001 AA 1001, QD OVA 001 AB 1002, pre-series units QD OVA 001 BA 1003-1005 as well as on the series units QD OVA 001 BB, 1006 ff.

Test	Requirement	Details	Units tested
Material thickness	Compliant with the standard requirements	Bottom plate: 2.0mm +/- 0.2mm	all
Material parameters	Dielectric parameters for required frequencies	< 6 GHz: Rel. permittivity = 4 +/-1, Loss tangent ≤ 0.05	Material sample
Material resistivity	The material has been tested to be compatible with the liquids defined in the standards if handled and cleaned according to the instructions.	DGBE based simulating liquids. Observe Technical Note for material compatibility.	Equivalent phantoms, Material sample
Shape	Thickness of bottom material, Internal dimensions, Sagging compatible with standards from minimum frequency	Bottom elliptical 600 x 400 mm Depth 190 mm, Shape is within tolerance for filling height up to 155 mm, Eventual sagging is reduced or eliminated by support via DUT	Prototypes, Sample testing

**Standards**

- [1] CENELEC EN 50361-2001, « Basic standard for the measurement of the Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz – 3 GHz) », July 2001
- [2] IEEE 1528-2003, "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques, December 2003
- [3] IEC 62209 – 1, "Specific Absorption Rate (SAR) in the frequency range of 300 MHz to 3 GHz – Measurement Procedure, Part 1: Hand-held mobile wireless communication devices", February 2005
- [4] IEC 62209 – 2, Draft, "Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices – Human models, Instrumentation and Procedures – Part 2: Procedure to determine the Specific Absorption Rate (SAR) in the head and body for 30 MHz to 6 GHz Handheld and Body-Mounted Devices used in close proximity to the Body.", February 2005
- [5] OET Bulletin 65, Supplement C, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", Edition January 2001

Based on the tests above, we certify that this item is in compliance with the standards [1] to [5] if operated according to the specific requirements and considering the thickness. The dimensions are fully compliant with [4] from 30 MHz to 6 GHz. For the other standards, the minimum lower frequency limit is limited due to the dimensional requirements ([1]: 450 MHz, [2]: 300 MHz, [3]: 800 MHz, [5]: 375 MHz) and possibly further by the dimensions of the DUT.

Date 28.4.2008 Signature / Stamp

**s p e a g**  
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