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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **UL CCS USA**

Certificate No: **EX3-7501_May19**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:7501**

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

Calibration date: **May 21, 2019**

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	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
Power sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-19 (No. 217-02894)	Apr-20
DAE4	SN: 660	19-Dec-18 (No. DAE4-660_Dec18)	Dec-19
Reference Probe ES3DV2	SN: 3013	31-Dec-18 (No. ES3-3013_Dec18)	Dec-19
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-18)	In house check: Jun-20
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

Calibrated by:	Name Jeton Kastrati	Function Laboratory Technician	Signature
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature
			Issued: May 21, 2019
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7501

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
750	41.9	0.89	10.83	10.83	10.83	0.51	0.81	± 12.0 %
900	41.5	0.97	10.18	10.18	10.18	0.39	0.97	± 12.0 %
1750	40.1	1.37	9.11	9.11	9.11	0.40	0.80	± 12.0 %
1900	40.0	1.40	8.72	8.72	8.72	0.37	0.84	± 12.0 %
2300	39.5	1.67	8.38	8.38	8.38	0.36	0.85	± 12.0 %
2450	39.2	1.80	7.98	7.98	7.98	0.35	0.85	± 12.0 %
2600	39.0	1.96	7.81	7.81	7.81	0.29	0.98	± 12.0 %
5250	35.9	4.71	5.60	5.60	5.60	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.97	4.97	4.97	0.40	1.80	± 13.1 %
5750	35.4	5.22	5.16	5.16	5.16	0.40	1.80	± 13.1 %

^C 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.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) 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 (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^G 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:7501

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
750	55.5	0.96	10.88	10.88	10.88	0.41	0.80	± 12.0 %
900	55.0	1.05	10.28	10.28	10.28	0.50	0.82	± 12.0 %
1750	53.4	1.49	8.80	8.80	8.80	0.35	0.85	± 12.0 %
1900	53.3	1.52	8.44	8.44	8.44	0.38	0.87	± 12.0 %
2300	52.9	1.81	8.26	8.26	8.26	0.35	0.80	± 12.0 %
2450	52.7	1.95	8.03	8.03	8.03	0.37	0.88	± 12.0 %
2600	52.5	2.16	7.91	7.91	7.91	0.29	0.98	± 12.0 %
5250	48.9	5.36	5.00	5.00	5.00	0.50	1.90	± 13.1 %
5600	48.5	5.77	4.36	4.36	4.36	0.50	1.90	± 13.1 %
5750	48.3	5.94	4.60	4.60	4.60	0.50	1.90	± 13.1 %

^C 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.

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^G 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.



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **UL CCS USA**

Certificate No: **EX3-7498_Apr19**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:7498**

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

Calibration date: **April 18, 2019**

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	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
Power sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-19 (No. 217-02894)	Apr-20
DAE4	SN: 660	19-Dec-18 (No. DAE4-660_Dec18)	Dec-19
Reference Probe ES3DV2	SN: 3013	31-Dec-18 (No. ES3-3013_Dec18)	Dec-19
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-18)	In house check: Jun-20
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

Calibrated by:	Name Claudio Leubler	Function Laboratory Technician	Signature
Approved by:	Name Katja Pokovic	Function Technical Manager	

Issued: April 19, 2019

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7498

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
750	41.9	0.89	10.42	10.42	10.42	0.38	0.85	± 12.0 %
900	41.5	0.97	9.89	9.89	9.89	0.43	0.85	± 12.0 %
1750	40.1	1.37	8.76	8.76	8.76	0.33	0.84	± 12.0 %
1900	40.0	1.40	8.48	8.48	8.48	0.26	0.85	± 12.0 %
2300	39.5	1.67	8.13	8.13	8.13	0.32	0.85	± 12.0 %
2450	39.2	1.80	7.84	7.84	7.84	0.33	0.90	± 12.0 %
2600	39.0	1.96	7.58	7.58	7.58	0.37	0.85	± 12.0 %
5250	35.9	4.71	5.40	5.40	5.40	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.67	4.67	4.67	0.40	1.80	± 13.1 %
5750	35.4	5.22	5.01	5.01	5.01	0.40	1.80	± 13.1 %

^C 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.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) 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 (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^G 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:7498

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
750	55.5	0.96	10.33	10.33	10.33	0.50	0.80	± 12.0 %
900	55.0	1.05	9.94	9.94	9.94	0.47	0.80	± 12.0 %
1750	53.4	1.49	8.50	8.50	8.50	0.36	0.80	± 12.0 %
1900	53.3	1.52	8.24	8.24	8.24	0.39	0.80	± 12.0 %
2300	52.9	1.81	8.02	8.02	8.02	0.35	0.85	± 12.0 %
2450	52.7	1.95	7.85	7.85	7.85	0.34	0.88	± 12.0 %
2600	52.5	2.16	7.60	7.60	7.60	0.32	0.93	± 12.0 %
5250	48.9	5.36	4.85	4.85	4.85	0.50	1.90	± 13.1 %
5600	48.5	5.77	4.19	4.19	4.19	0.50	1.90	± 13.1 %
5750	48.3	5.94	4.41	4.41	4.41	0.50	1.90	± 13.1 %

^C 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.

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^G 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.



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **UL CCS USA**

Certificate No: **EX3-3990_Aug19**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3990**

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

Calibration date: **August 28, 2019**

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	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
Power sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-19 (No. 217-02894)	Apr-20
DAE4	SN: 660	19-Dec-18 (No. DAE4-660_Dec18)	Dec-19
Reference Probe ES3DV2	SN: 3013	31-Dec-18 (No. ES3-3013_Dec18)	Dec-19
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-18)	In house check: Jun-20
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: August 31, 2019

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3990

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
450	43.5	0.87	11.35	11.35	11.35	0.13	1.20	± 13.3 %
750	41.9	0.89	10.33	10.33	10.33	0.53	0.84	± 12.0 %
900	41.5	0.97	9.67	9.67	9.67	0.48	0.86	± 12.0 %
1450	40.5	1.20	9.02	9.02	9.02	0.35	0.80	± 12.0 %
1640	40.2	1.31	8.81	8.81	8.81	0.34	0.85	± 12.0 %
1750	40.1	1.37	8.72	8.72	8.72	0.34	0.85	± 12.0 %
1900	40.0	1.40	8.33	8.33	8.33	0.33	0.85	± 12.0 %
2300	39.5	1.67	7.97	7.97	7.97	0.34	0.88	± 12.0 %
2450	39.2	1.80	7.63	7.63	7.63	0.33	0.95	± 12.0 %
2600	39.0	1.96	7.59	7.59	7.59	0.37	0.95	± 12.0 %
3500	37.9	2.91	7.13	7.13	7.13	0.30	1.25	± 13.1 %
3700	37.7	3.12	6.97	6.97	6.97	0.30	1.25	± 13.1 %
4950	36.3	4.40	5.82	5.82	5.82	0.40	1.80	± 13.1 %
5250	35.9	4.71	5.51	5.51	5.51	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.90	4.90	4.90	0.40	1.80	± 13.1 %
5750	35.4	5.22	5.08	5.08	5.08	0.40	1.80	± 13.1 %

^C 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.

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^G 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:3990

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
450	56.7	0.94	11.40	11.40	11.40	0.08	1.20	± 13.3 %
750	55.5	0.96	10.26	10.26	10.26	0.44	0.84	± 12.0 %
900	55.0	1.05	9.93	9.93	9.93	0.45	0.82	± 12.0 %
1450	54.0	1.30	8.81	8.81	8.81	0.28	0.80	± 12.0 %
1640	53.7	1.42	8.66	8.66	8.66	0.35	0.85	± 12.0 %
1750	53.4	1.49	8.49	8.49	8.49	0.39	0.85	± 12.0 %
1900	53.3	1.52	8.17	8.17	8.17	0.29	0.98	± 12.0 %
2300	52.9	1.81	7.88	7.88	7.88	0.38	0.88	± 12.0 %
2450	52.7	1.95	7.73	7.73	7.73	0.33	0.95	± 12.0 %
2600	52.5	2.16	7.54	7.54	7.54	0.19	1.10	± 12.0 %
3500	51.3	3.31	6.76	6.76	6.76	0.40	1.40	± 13.1 %
3700	51.0	3.55	6.46	6.46	6.46	0.40	1.40	± 13.1 %
4950	49.4	5.01	5.40	5.40	5.40	0.50	1.80	± 13.1 %
5250	48.9	5.36	4.99	4.99	4.99	0.50	1.80	± 13.1 %
5600	48.5	5.77	4.39	4.39	4.39	0.50	1.80	± 13.1 %
5750	48.3	5.94	4.55	4.55	4.55	0.50	1.80	± 13.1 %

^C 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.

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