

EX3DV4 Sn:3708 (1/7)

Calibration Laboratory of Schmid & Partner Engineering AG Zwingenstrasse 63, 8954 Zurich, Switzerland			Schweizerischer Kalibrierdienst Service suisse de l'étalonnage Servizio svizzero di taratura Swiss Calibration Service
Accredited by the Swiss Accreditation Service (SAS) This Swiss Accreditation Service is one of the signatories to the EA Mutual Recognition Agreement for the recognition of calibration certificates			Accreditation No: SCS 0109
Client: BRTC (Auden)			Certificate No: E03-3708_Oct18

CALIBRATION CERTIFICATE																									
Object	EXIDV4 - SN-3708																								
Calibration procedure(s)	QA CAL-01.19, QA CAL-12.15, QA CAL-14.14, QA CAL-23.15, QA CAL-25.06 Calibration procedure for dosimetric E-field probes																								
Calibration date	October 22, 2018																								
This calibration certificate conforms to the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probabilities are given on the following pages and are part of the certificate.																									
All calibrations have been conducted in the stated laboratory facility, environment temperature (23 ± 0.5°C) and humidity = 70%.																									
Calibration Equipment used: M4810 (noted for calibration)																									
Primary Standards	<table border="0" style="width: 100%;"> <tr> <td style="width: 30%;">Power meter 100P</td> <td style="width: 30%;">SN: 104779</td> <td style="width: 30%;">Cal Date (Certificate No.)</td> <td style="width: 10%;">Scheduled Calibration</td> </tr> <tr> <td>Power meter 100P</td> <td>SN: 102244</td> <td>04-Apr-18 (No. 217-039755027)</td> <td>Apr-19</td> </tr> <tr> <td>Power meter 100P</td> <td>SN: 103345</td> <td>04-Apr-18 (No. 217-039755027)</td> <td>Apr-19</td> </tr> <tr> <td>Reference Plane 800070</td> <td>SN: 080717 (20H)</td> <td>20-Apr-18 (No. 217-039755027)</td> <td>Apr-19</td> </tr> <tr> <td>Reference Plane 800070</td> <td>SN: 26193</td> <td>30-Jun-18 (No. 217-039755027)</td> <td>Oct-18</td> </tr> <tr> <td>Cable</td> <td>SN: 686</td> <td>21-Oct-17 (No. 2042-00901_00017)</td> <td>Oct-18</td> </tr> </table>	Power meter 100P	SN: 104779	Cal Date (Certificate No.)	Scheduled Calibration	Power meter 100P	SN: 102244	04-Apr-18 (No. 217-039755027)	Apr-19	Power meter 100P	SN: 103345	04-Apr-18 (No. 217-039755027)	Apr-19	Reference Plane 800070	SN: 080717 (20H)	20-Apr-18 (No. 217-039755027)	Apr-19	Reference Plane 800070	SN: 26193	30-Jun-18 (No. 217-039755027)	Oct-18	Cable	SN: 686	21-Oct-17 (No. 2042-00901_00017)	Oct-18
Power meter 100P	SN: 104779	Cal Date (Certificate No.)	Scheduled Calibration																						
Power meter 100P	SN: 102244	04-Apr-18 (No. 217-039755027)	Apr-19																						
Power meter 100P	SN: 103345	04-Apr-18 (No. 217-039755027)	Apr-19																						
Reference Plane 800070	SN: 080717 (20H)	20-Apr-18 (No. 217-039755027)	Apr-19																						
Reference Plane 800070	SN: 26193	30-Jun-18 (No. 217-039755027)	Oct-18																						
Cable	SN: 686	21-Oct-17 (No. 2042-00901_00017)	Oct-18																						
Secondary Standards	<table border="0" style="width: 100%;"> <tr> <td style="width: 30%;">Power meter E2478</td> <td style="width: 30%;">SN: 0000020474</td> <td style="width: 30%;">Cal Date (on request)</td> <td style="width: 10%;">Scheduled Calibration</td> </tr> <tr> <td>Power meter 4441A</td> <td>SN: 1014100007</td> <td>08-Apr-18 (No. between 04838-Jun-18)</td> <td>Nov-18</td> </tr> <tr> <td>Power meter 4441A</td> <td>SN: 0001102109</td> <td>08-Apr-18 (No. between 04838-Jun-18)</td> <td>In house check Jun-20</td> </tr> <tr> <td>Power meter 4441A</td> <td>SN: 0001102109</td> <td>08-Apr-18 (No. between 04838-Jun-18)</td> <td>In house check Jun-20</td> </tr> <tr> <td>RF generator HP 8542C</td> <td>SN: 0000000007</td> <td>20-Mar-14 (No. between 04838-Jun-18)</td> <td>In house check Oct-18</td> </tr> <tr> <td>Network Analyzer HP 8592C</td> <td>SN: 0000000007</td> <td>20-Mar-14 (No. between 04838-Jun-18)</td> <td>In house check Oct-18</td> </tr> </table>	Power meter E2478	SN: 0000020474	Cal Date (on request)	Scheduled Calibration	Power meter 4441A	SN: 1014100007	08-Apr-18 (No. between 04838-Jun-18)	Nov-18	Power meter 4441A	SN: 0001102109	08-Apr-18 (No. between 04838-Jun-18)	In house check Jun-20	Power meter 4441A	SN: 0001102109	08-Apr-18 (No. between 04838-Jun-18)	In house check Jun-20	RF generator HP 8542C	SN: 0000000007	20-Mar-14 (No. between 04838-Jun-18)	In house check Oct-18	Network Analyzer HP 8592C	SN: 0000000007	20-Mar-14 (No. between 04838-Jun-18)	In house check Oct-18
Power meter E2478	SN: 0000020474	Cal Date (on request)	Scheduled Calibration																						
Power meter 4441A	SN: 1014100007	08-Apr-18 (No. between 04838-Jun-18)	Nov-18																						
Power meter 4441A	SN: 0001102109	08-Apr-18 (No. between 04838-Jun-18)	In house check Jun-20																						
Power meter 4441A	SN: 0001102109	08-Apr-18 (No. between 04838-Jun-18)	In house check Jun-20																						
RF generator HP 8542C	SN: 0000000007	20-Mar-14 (No. between 04838-Jun-18)	In house check Oct-18																						
Network Analyzer HP 8592C	SN: 0000000007	20-Mar-14 (No. between 04838-Jun-18)	In house check Oct-18																						
Calibrated by:	<table border="0" style="width: 100%;"> <tr> <td style="width: 40%;">Name</td> <td style="width: 40%;">Function</td> <td style="width: 20%;"></td> </tr> <tr> <td>Olavdo Lauber</td> <td>Laboratory Technician</td> <td style="text-align: center;">  </td> </tr> </table>	Name	Function		Olavdo Lauber	Laboratory Technician																			
Name	Function																								
Olavdo Lauber	Laboratory Technician																								
Approved by:	<table border="0" style="width: 100%;"> <tr> <td style="width: 40%;">Name</td> <td style="width: 40%;">Function</td> <td style="width: 20%;"></td> </tr> <tr> <td>Karin Pfister</td> <td>Technical Manager</td> <td style="text-align: center;">  </td> </tr> </table>	Name	Function		Karin Pfister	Technical Manager																			
Name	Function																								
Karin Pfister	Technical Manager																								
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.																									

Certificate No. E03-3708_Oct18

Page 1 of 20

Issued: October 23, 2018

[illegible]

EX3DV4 - SN:3708

October 22, 2018

Probe EX3DV4

SN:3708

Manufactured: July 21, 2009
Calibrated: October 22, 2018

Calibrated for DASY/EASY Systems
(Probe: non-compatible with DASY2 system)

Certificate No. EX3-2708_Oct18 Page 3 of 38

EX3DV4 - User's Guide

October 20, 2015

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3708

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm $\sqrt{V_{X0}^2 + V_{Y0}^2 + V_{Z0}^2}$	0.30	0.35	0.43	$\pm 10.1\%$
DCP $\mu V/V$	95.4	103.6	100.4	

Modulation Calibration Parameters

Communication System Name		A	B	C	D	V8	Unc ¹
UD		dB	dB	dB	dB	dB	(k=2)
1	UD1	5	0.2	0.0	1.0	0.00	$\pm 0.5\%$
2		7	0.0	0.0	1.0	1.00	
3		2	0.0	0.0	1.0	1.00	

Note: For details on UD parameters see Appendix.

Sensor Model Parameters

	C1	C2	a	T1	T2	T3	T4	T5	T6
	W	W	V ²	ms, V ²	ms, V ²	ms	V ²	V ²	V ²
X	33.84	270.1	40.07	9.393	1.302	0.322	0.000	0.742	1.008
Y	40.04	291.1	34.08	13.47	0.801	0.012	1.788	0.196	1.005
Z	36.84	262.2	36.87	11.65	0.630	0.201	0.000	0.909	1.004

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%.

¹ The uncertainty in Norm, A, B, C, D, does not affect the W^2 test uncertainty norm T6. See Page 9 and 10.

² Numerical Integration parameter: uncertainty not required.

³ Uncertainty is determined using the min. deviation from linear response applying rectangular distribution and is expressed by the square of the test value.

Copyright © 2015, Fluke Corporation

Page 4 of 18

EX3DV4 Sn:3708 (2/7)

EX3DV4 - SN:3708

October 22, 2019

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3708

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ¹	Relative Permittivity ²	Conductivity (S/m) ³	Coef. X	Coef. Y	Coef. Z	Alpha ⁴	Depth (mm)	Unc. (k=2)
420	52.5	0.37	9.79	9.79	9.79	0.16	1.20	± 13.0 %
750	41.9	0.80	9.50	9.50	9.59	0.54	0.80	± 12.0 %
920	41.5	0.90	9.15	9.15	9.16	0.51	0.77	± 12.0 %
1450	40.5	1.20	8.90	8.90	8.90	0.59	0.60	± 12.0 %
1750	40.1	1.37	8.70	8.70	8.70	0.59	0.54	± 12.0 %
1900	40.0	1.40	7.89	7.89	7.89	0.59	0.50	± 12.0 %
2200	40.0	1.45	7.55	7.55	7.56	0.54	0.40	± 12.0 %
2300	39.5	1.67	7.51	7.51	7.51	0.22	0.35	± 12.0 %
2400	39.2	1.80	7.13	7.13	7.13	0.59	0.30	± 12.0 %
2600	38.0	1.95	7.01	7.01	7.01	0.37	0.27	± 12.0 %
4000	34.0	4.48	6.48	6.48	6.40	1.80	0.10	± 13.1 %
5000	30.0	6.79	5.79	5.79	5.79	0.40	1.00	± 13.1 %
6000	26.0	8.97	4.84	4.84	4.84	0.40	1.80	± 13.1 %
8000	20.0	9.97	5.04	5.04	5.04	0.40	1.00	± 13.1 %

¹ Frequency validity above 300 MHz of a 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 10 MHz. The uncertainty is the 95% of the Coef. uncertainty of calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 30, 40, 50 and 70 MHz for Coef. assessments at 30, 60, 100, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 100 MHz.
² As frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be related to a 10% if input compensation formula is applied to measured S11 values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the 95% of the Coef. uncertainty for indicated target tissue parameters.
³ AlphaDepth are determined during calibration. SPFLAC warns 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.

Certificate No: EX3-3708_Out18

Page 3 of 39

EX3DV4 - SN:3708

October 22, 2019

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3708

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ¹	Relative Permittivity ²	Conductivity (S/m) ³	Coef. X	Coef. Y	Coef. Z	Alpha ⁴	Depth (mm)	Unc. (k=2)
420	52.7	0.34	10.30	10.30	10.30	0.08	1.20	± 13.0 %
750	45.9	0.98	9.51	9.51	9.51	0.50	0.80	± 12.0 %
920	45.5	0.97	9.33	9.33	9.33	0.47	0.74	± 12.0 %
1450	44.0	1.30	7.84	7.84	7.84	0.30	0.60	± 12.0 %
1750	43.4	1.49	7.69	7.69	7.69	0.37	0.50	± 12.0 %
1900	43.3	1.52	7.56	7.56	7.56	0.40	0.44	± 12.0 %
2200	43.0	1.52	7.53	7.53	7.53	0.41	0.34	± 12.0 %
2300	42.9	1.81	7.34	7.34	7.34	0.39	0.30	± 12.0 %
2400	42.7	1.95	7.10	7.10	7.10	0.39	0.24	± 12.0 %
2600	42.5	2.19	7.14	7.14	7.14	0.33	0.20	± 12.0 %
4000	34.0	4.48	4.83	4.83	4.83	0.60	1.80	± 13.1 %
5000	30.0	6.79	4.41	4.41	4.41	0.40	1.00	± 13.1 %
6000	26.0	8.97	5.04	5.04	5.04	0.50	1.80	± 13.1 %
8000	20.0	9.97	5.21	5.21	5.21	0.50	1.00	± 13.1 %

¹ Frequency validity above 300 MHz of a 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 10 MHz. The uncertainty is the 95% of the Coef. uncertainty of calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 30, 40, 50 and 70 MHz for Coef. assessments at 30, 60, 100, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 100 MHz.
² As frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be related to a 10% if input compensation formula is applied to measured S11 values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the 95% of the Coef. uncertainty for indicated target tissue parameters.
³ AlphaDepth are determined during calibration. SPFLAC warns 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.

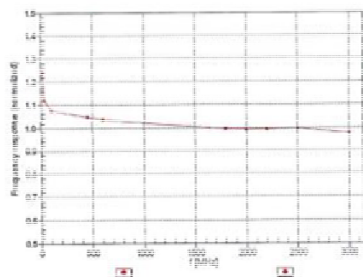
Certificate No: EX3-3708_Out18

Page 4 of 39

EX3DV4 - SN:3708

October 22, 2019

Frequency Response of E-Field (TEM-Cell:R110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-Field: ± 0.3% (k=2)

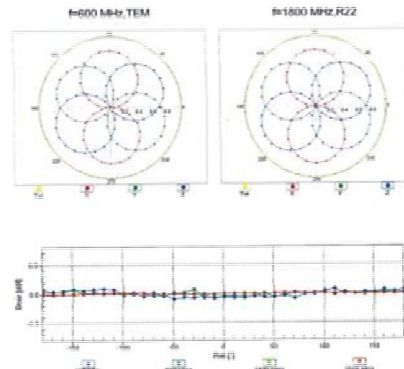
Certificate No: EX3-3708_Out18

Page 7 of 39

EX3DV4 - SN:3708

October 22, 2019

Receiving Pattern (ψ, θ = 0°)

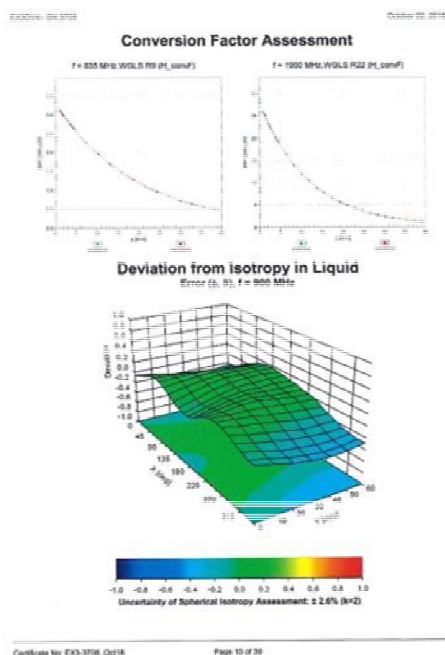
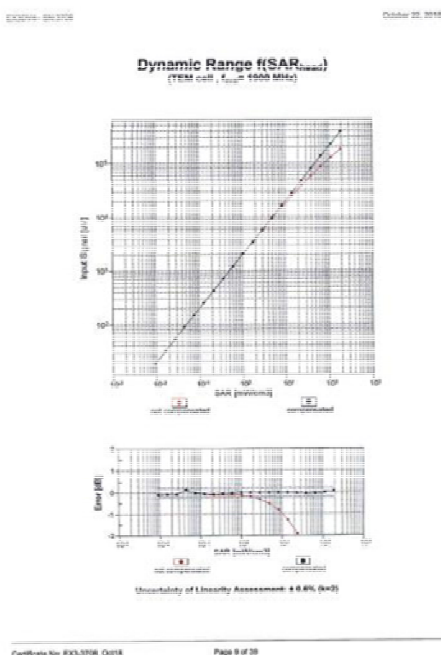


Uncertainty of Axial Isotropy Assessment: ± 0.3% (k=2)

Certificate No: EX3-3708_Out18

Page 8 of 39

EX3DV4 Sn:3708 (3/7)



EX3DV4 - SN:3708 October 22, 2019

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3708

Other Probe Parameters	
Probe Arrangement	Triangular
Unimodular Angle (°)	6.87
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Channel Length	207 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	4.4 mm

Certificate No: EX3-3708_Out18 Page 11 of 38