

### Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.9 ± 6 %	4.84 mho/m ± 6 %
Head TSL temperature during test	(22.5 ± 0.2) °C	----	----

### SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	condition	
SAR measured	100 mW input power	8.79 mW / g
SAR normalized	normalized to 1W	87.9 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>88.0 mW / g ± 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	2.48 mW / g
SAR normalized	normalized to 1W	24.8 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>24.8 mW / g ± 19.5 % (k=2)</b>

### Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.4 ± 6 %	5.09 mho/m ± 6 %
Head TSL temperature during test	(22.5 ± 0.2) °C	----	----

### SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	condition	
SAR measured	100 mW input power	8.13 mW / g
SAR normalized	normalized to 1W	81.3 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>81.2 mW / g ± 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	2.30 mW / g
SAR normalized	normalized to 1W	23.0 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>23.0 mW / g ± 19.5 % (k=2)</b>

### Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	49.0 ± 6 %	5.47 mho/m ± 6 %
Body TSL temperature during test	(22.5 ± 0.2) °C	----	----

### SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	condition	
SAR measured	100 mW input power	7.57 mW / g
SAR normalized	normalized to 1W	7.57 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	<b>75.7 mW / g ± 19.9 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.11 mW / g
SAR normalized	normalized to 1W	21.1 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	<b>21.1 mW / g ± 19.5 % (k=2)</b>

### Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.3 ± 6 %	5.83 mho/m ± 6 %
Body TSL temperature during test	(22.5 ± 0.2) °C	----	----

### SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	condition	
SAR measured	100 mW input power	8.04 mW / g
SAR normalized	normalized to 1W	80.4 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	<b>80.3 mW / g ± 19.9 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.23 mW / g
SAR normalized	normalized to 1W	22.3 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	<b>22.3 mW / g ± 19.5 % (k=2)</b>

## Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.7 ± 6 %	6.18 mho/m ± 6 %
Body TSL temperature during test	(22.5 ± 0.2) °C	----	----

## SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	condition	
SAR measured	100 mW input power	6.93 mW / g
SAR normalized	normalized to 1W	69.3 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	<b>69.2 mW / g ± 19.9 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	100 mW input power	1.92 mW / g
SAR normalized	normalized to 1W	19.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	<b>19.2 mW / g ± 19.5 % (k=2)</b>

## Appendix

### Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	49.9 $\Omega$ - 7.6 j $\Omega$
Return Loss	-22.4 dB

### Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	52.5 $\Omega$ - 5.4 j $\Omega$
Return Loss	-24.8 dB

### Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	55.9 $\Omega$ - 1.7 j $\Omega$
Return Loss	-24.7 dB

### Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	51.0 $\Omega$ - 4.9 j $\Omega$
Return Loss	-26.1 dB

### Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	53.9 $\Omega$ - 3.4 j $\Omega$
Return Loss	-26.1 dB

### Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	56.9 $\Omega$ - 2.2 j $\Omega$
Return Loss	-23.4 dB

## General Antenna Parameters and Design

Electrical Delay (one direction)	1.211 ns
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After long term use with 40 W 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.

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
Manufactured on	December 30, 2005

## DASY5 Validation Report for Head TSL

Date/Time: 22.06.2010 12:12:25

Test Laboratory: SPEAG, Zurich, Switzerland

### DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN:1040

Communication System: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz; Duty Cycle: 1:1

Medium: HSL 5000

Medium parameters used:  $f = 5200$  MHz;  $\sigma = 4.56$  mho/m;  $\epsilon_r = 36.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used:  $f = 5500$  MHz;  $\sigma = 4.82$  mho/m;  $\epsilon_r = 35.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used:  $f = 5800$  MHz;  $\sigma = 5.07$  mho/m;  $\epsilon_r = 35.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

### DASY5 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.36, 5.36, 5.36), ConvF(4.85, 4.85, 4.85), ConvF(4.74, 4.74, 4.74); Calibrated: 05.03.2010
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY52, V52.2 Build 0, Version 52.2.0 (163)
- Postprocessing SW: SEMCAD X, V14.2 Build 2, Version 14.2.2 (1685)

### D5GHzV2 Dipole (Head)/d=10mm, Pin=100mW, f=5200 MHz/Zoom Scan (4x4x2.5mm), dist=2mm

(8x8x10)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm

Reference Value = 62.2 V/m; Power Drift = 0.079 dB

Peak SAR (extrapolated) = 31.1 W/kg

**SAR(1 g) = 8.23 mW/g; SAR(10 g) = 2.35 mW/g**

Maximum value of SAR (measured) = 16 mW/g

### D5GHzV2 Dipole (Head)/d=10mm, Pin=100mW, f=5500 MHz/Zoom Scan (4x4x2.5mm), dist=2mm

(8x8x10)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm

Reference Value = 62.7 V/m; Power Drift = 0.090 dB

Peak SAR (extrapolated) = 35.2 W/kg

**SAR(1 g) = 8.79 mW/g; SAR(10 g) = 2.48 mW/g**

Maximum value of SAR (measured) = 17.3 mW/g

### D5GHzV2 Dipole (Head)/d=10mm, Pin=100mW, f=5800 MHz/Zoom Scan (4x4x2.5mm), dist=2mm

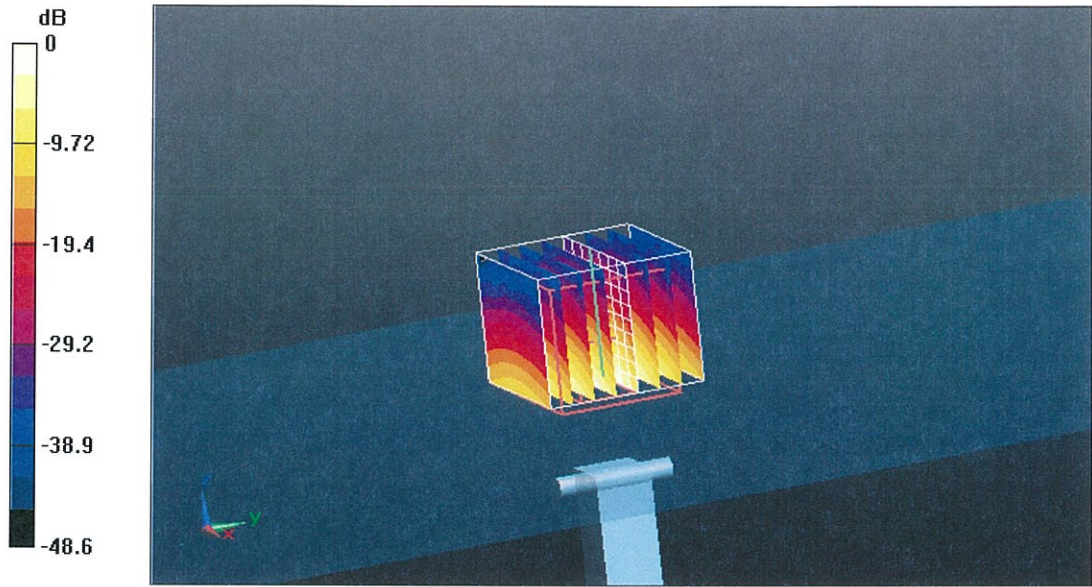
(8x8x10)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm

Reference Value = 59.6 V/m; Power Drift = 0.078 dB

Peak SAR (extrapolated) = 33.7 W/kg

**SAR(1 g) = 8.13 mW/g; SAR(10 g) = 2.3 mW/g**

Maximum value of SAR (measured) = 16.2 mW/g

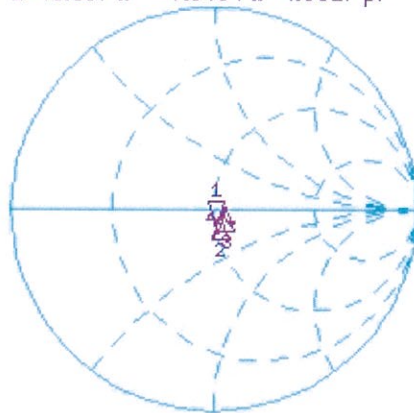


0 dB = 16.2mW/g

# Impedance Measurement Plot for Head TSL

22 Jun 2010 08:50:12  
 [CH1] S11 1 U FS 1: 49.887  $\Omega$  -7.6484  $\Omega$  4.0017 pF 5 200.000 000 MHz

\*  
 Del  
 Cor

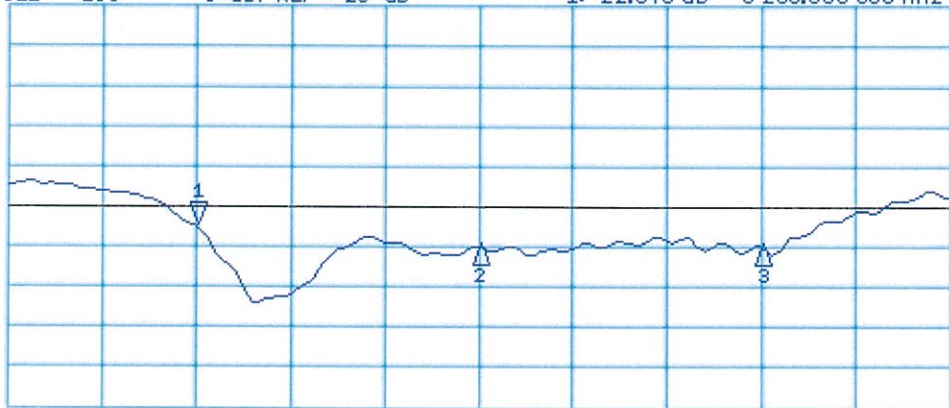


CH1 Markers  
 2: 52.457  $\Omega$   
 -5.3652  $\Omega$   
 5.50000 GHz  
 3: 55.855  $\Omega$   
 -1.6777  $\Omega$   
 5.80000 GHz

Avg  
 15  
 ↑

CH2 S11 LOG 5 dB/REF -20 dB 1:-22.345 dB 5 200.000 000 MHz

Cor



CH2 Markers  
 2:-24.804 dB  
 5.50000 GHz  
 3:-24.798 dB  
 5.80000 GHz

Avg  
 15  
 ↑

START 5 000.000 000 MHz

STOP 6 000.000 000 MHz



## DASY5 Validation Report for Body TSL

Date/Time: 23.06.2010 12:48:48

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN:1040**

Communication System: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz; Duty Cycle: 1:1

Medium: MSL 5000 MHz

Medium parameters used:  $f = 5200$  MHz;  $\sigma = 5.44$  mho/m;  $\epsilon_r = 49$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used:  $f = 5500$  MHz;  $\sigma = 5.8$  mho/m;  $\epsilon_r = 48.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used:  $f = 5800$  MHz;  $\sigma = 6.14$  mho/m;  $\epsilon_r = 47.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.88, 4.88, 4.88), ConvF(4.37, 4.37, 4.37), ConvF(4.57, 4.57, 4.57); Calibrated: 05.03.2010
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY52, V52.2 Build 0, Version 52.2.0 (163)
- Postprocessing SW: SEMCAD X, V14.2 Build 2, Version 14.2.2 (1685)

**D5GHzV2 Dipole (Body)/d=10mm, Pin=100mW, f=5200 MHz/Zoom Scan (4x4x2.5mm), dist=2mm**

**(8x8x10)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2.5mm

Reference Value = 58.4 V/m; Power Drift = -0.057 dB

Peak SAR (extrapolated) = 28.8 W/kg

**SAR(1 g) = 7.57 mW/g; SAR(10 g) = 2.11 mW/g**

Maximum value of SAR (measured) = 14.8 mW/g

**D5GHzV2 Dipole (Body)/d=10mm, Pin=100mW, f=5500 MHz/Zoom Scan (4x4x2.5mm), dist=2mm**

**(8x8x10)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2.5mm

Reference Value = 58.9 V/m; Power Drift = -0.052 dB

Peak SAR (extrapolated) = 32.5 W/kg

**SAR(1 g) = 8.04 mW/g; SAR(10 g) = 2.23 mW/g**

Maximum value of SAR (measured) = 15.9 mW/g

**D5GHzV2 Dipole (Body)/d=10mm, Pin=100mW, f=5800 MHz/Zoom Scan (4x4x2.5mm), dist=2mm**

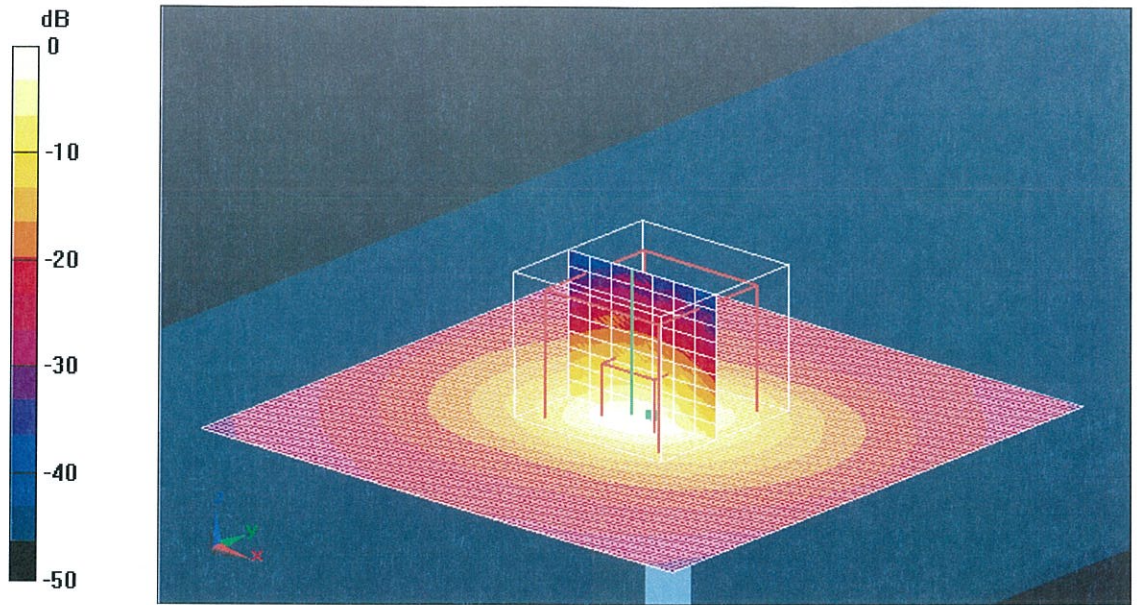
**(8x8x10)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2.5mm

Reference Value = 53.2 V/m; Power Drift = -0.037 dB

Peak SAR (extrapolated) = 29.8 W/kg

**SAR(1 g) = 6.93 mW/g; SAR(10 g) = 1.92 mW/g**

Maximum value of SAR (measured) = 14 mW/g

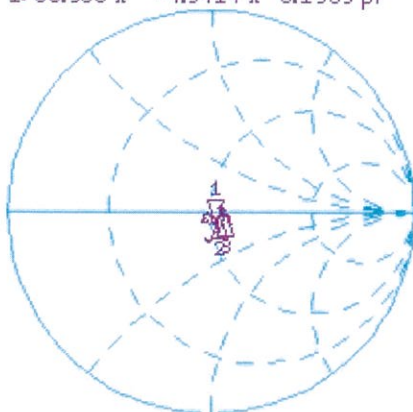


0 dB = 14mW/g

# Impedance Measurement Plot for Body TSL

23 Jun 2010 08:15:16  
 [CH1] S11 1 U FS 1: 50.953  $\Omega$  -4.9414  $\Omega$  6.1939 pF 5 200.000 000 MHz

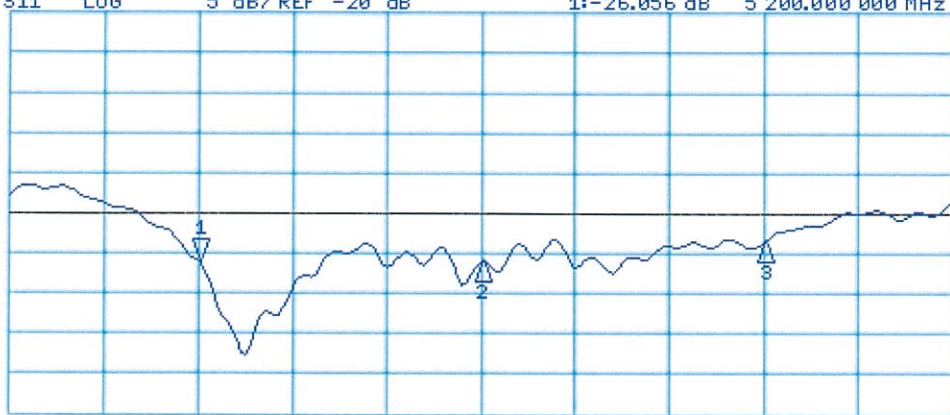
\*  
 Del  
 Cor  
 Avg  
 16  
 ↑



CH1 Markers  
 2: 53.875  $\Omega$   
 -3.4180  $\Omega$   
 5.50000 GHz  
 3: 56.852  $\Omega$   
 -2.2344  $\Omega$   
 5.80000 GHz

CH2 S11 LOG 5 dB/REF -20 dB 1: -26.056 dB 5 200.000 000 MHz

Cor  
 Avg  
 16  
 ↑



CH2 Markers  
 2: -26.053 dB  
 5.50000 GHz  
 3: -23.418 dB  
 5.80000 GHz

START 5 000.000 000 MHz

STOP 6 000.000 000 MHz



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



S Schweizerischer Kalibrierdienst, S 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 108

Client Sporton (Auden)

Certificate No: DAE4-778\_Oct10

CALIBRATION CERTIFICATE

Object: DAE4 - SD 000 D04 BJ - SN: 778
Calibration procedure(s): QA CAL-06.v22 Calibration procedure for the data acquisition electronics (DAE)
Calibration date: October 22, 2010

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)

Table with 4 columns: Standards, ID #, Date, and Check/Calibration status. Includes Primary Standards (Keithley Multimeter) and Secondary Standards (Calibrator Box).

Calibrated by: Eric Hainfeld, Technician
Approved by: Fin Bornholt, R&D Director

Issued: October 22, 2010

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