

Appendix D:

Dipole Calibration Parameters



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

Client

Kyocera USA

CALIBRATION	CERTIFICA	TE			
Object(s)	D835V2 - SN	454			
Calibration procedure(s)	QA CAL-05 v2 Calibration pr	2 ocedure for dipole validation kits			
Calibration date:	April 20, 2004				
Condition of the calibrated item	In Tolerance (according to the specific calibration document)				
This calibration statement docum international standard.	ents traceability of M&TE	used in the calibration procedures and conformity of the	ne procedures with the ISO/IEC 170		
All calibrations have been conduc	ted in the closed laborator	ry facility: environment temperature 22 +/- 2 degrees C	elsius and humidity < 75%.		
Calibration Equipment used (M&	TE critical for calibration)				
Model Type	ID#	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration		
Power meter EPM E442	GB37480704	6-Nov-03 (METAS, No. 252-0254)	Nov-04		
Power sensor HP 8481A	US37292783	6-Nov-03 (METAS, No. 252-0254)	Nov-04		
Power sensor HP 8481A	MY41092317	18-Oct-02 (Agilent, No. 20021018)	Oct-04		
RF generator R&S SML-03	100698	27-Mar-2002 (R&S, No. 20-92389)	In house check: Mar-05		
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Nov-03)	In house check: Oct 05		
	Name	Function	Signature		
Calibrated by:	Name Judith Mueller	Function Technician	Signature		
Calibrated by: Approved by:	CONTRACTOR AND ADDRESS OF THE PROPERTY OF THE PARTY OF TH	POWN KESSER ENGINEERING SECTIONS AND SECTION OF THE PROPERTY O	Signature Splittelled John's Market		
	Judith Mueller	Technician	Signature John Strict School Strict Sch		
Approved by:	Judith Mueller Katja Pokovic ed as an intermediate solu	Technician (Laboratory Director ution until the accreditation process (based on ISO/IEC	Date issued: April 21, 2004		
Approved by: This calibration certificate is issue	Judith Mueller Katja Pokovic ed as an intermediate solu	Technician (Laboratory Director ution until the accreditation process (based on ISO/IEC	Date issued: April 21, 2004		

880-KP0301061-A

Page 1 (1)



Schmid & Partner Engineering AG

s p e a g

Zeughausstrasse 43, 8004 Zurich, Switzerland Phone +41 1 245 9700, Fax +41 1 245 9779 info@speag.com, http://www.speag.com

DASY

Dipole Validation Kit

Type: D835V2

Serial: 454

Manufactured: January 31, 2002 Calibrated: April 20, 2004





1. Measurement Conditions

The measurements were performed in the flat section of the SAM twin phantom filled with **head** simulating solution of the following electrical parameters at 835 MHz:

Relative Dielectricity 42.8 \pm 5% Conductivity 0.94 mho/m \pm 5%

The DASY4 System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 6.3 at 835 MHz) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 15mm from dipole center to the solution surface. The included distance spacer was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 15mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.

The dipole input power (forward power) was 250 mW \pm 3 %. The results are normalized to 1W input power.

2. SAR Measurement with DASY4 System

Standard SAR-measurements were performed according to the measurement conditions described in section 1. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the <u>advanced extrapolation</u> are:

averaged over 1 cm³ (1 g) of tissue: $10.2 \text{ mW/g} \pm 16.8 \% \text{ (k=2)}^{1}$

averaged over 10 cm³ (10 g) of tissue: **6.64 mW/g** \pm 16.2 % (k=2)¹

_

¹ validation uncertainty





Dipole Impedance and Return Loss

The impedance was measured at the SMA-connector with a network analyzer and numerically transformed to the dipole feedpoint. The transformation parameters from the SMA-connector to the dipole feedpoint are:

Electrical delay: 1.378 ns

(one direction) Transmission factor: 0.988 (voltage transmission, one direction)

The dipole was positioned at the flat phantom sections according to section 1 and the distance holder was in place during impedance measurements.

Feedpoint impedance at 835 MHz: $Re{Z} = 50.9 \Omega$

Im $\{Z\} = -2.2 \Omega$

Return Loss at 835 MHz -32.3 dB

Measurement Conditions

The measurements were performed in the flat section of the SAM twin phantom filled with body simulating solution of the following electrical parameters at 835 MHz:

Relative Dielectricity ±5% 55.5 0.99 mho/m $\pm 5\%$ Conductivity

The DASY4 System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 6.13 at 835 MHz) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 15mm from dipole center to the solution surface. The included distance spacer was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 15mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.

The dipole input power (forward power) was 250 mW ± 3 %. The results are normalized to 1W input power.



SAR Measurement with DASY4 System

Standard SAR-measurements were performed according to the measurement conditions described in section 4. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the <u>advanced extrapolation</u> are:

averaged over 1 cm3 (1 g) of tissue:

10.1 mW/g \pm 16.8 % (k=2)²

averaged over 10 cm3 (10 g) of tissue:

6.64 mW/g \pm 16.2 % (k=2)²

6. Dipole Impedance and Return Loss

The dipole was positioned at the flat phantom sections according to section 4 and the distance holder was in place during impedance measurements.

Feedpoint impedance at 835 MHz:

 $Re{Z} = 47.2 \Omega$

Im $\{Z\} = -1.1 \Omega$

Return Loss at 835 MHz

-29.6 dB

7. Handling

Do not apply excessive force to the dipole arms, because they might bend. Bending of the dipole arms stresses the soldered connections near the feedpoint leading to a damage of the dipole.

8. Design

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.

9. Power Test

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

Dipole Calibration Parameters

² validation uncertainty



Date/Time: 04/20/04 12:55:03

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN454

Communication System: CW-835; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: HSL 835 MHz;

Medium parameters used: f = 835 MHz; $\sigma = 0.94$ mho/m; $\varepsilon_r = 42.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 SN1507; ConvF(6.3, 6.3, 6.3); Calibrated: 1/23/2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn411; Calibrated: 11/6/2003
- Phantom: SAM with CRP TP1006; Type: SAM 4.0; Serial: TP:1006;
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Pin = 250 mW; d = 15 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm Reference Value = 55.5 V/m; Power Drift = -0.0 dB

Maximum value of SAR (interpolated) = 2.75 mW/g

Pin = 250 mW; d = 15 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm,

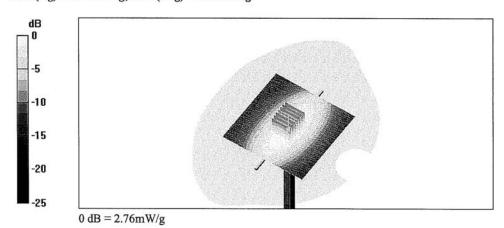
dy=5mm, dz=5mm

Reference Value = 55.5 V/m; Power Drift = -0.0 dB

Maximum value of SAR (measured) = 2.76 mW/g

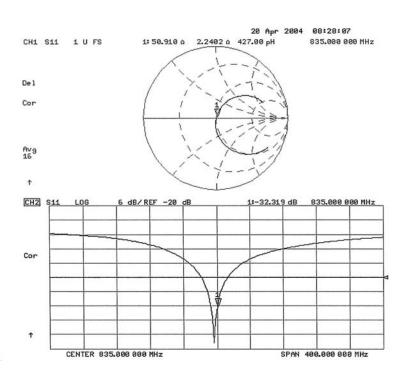
Peak SAR (extrapolated) = 3.88 W/kg

SAR(1 g) = 2.56 mW/g; SAR(10 g) = 1.66 mW/g



HEACH







Date/Time: 04/16/04 13:28:44

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN454

Communication System: CW-835; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: Muscle 835 MHz;

Medium parameters used: f = 835 MHz; σ = 0.99 mho/m; ϵ_r = 55; ρ = 1000 kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 SN1507; ConvF(6.13, 6.13, 6.13); Calibrated: 1/23/2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn411; Calibrated: 11/6/2003
- Phantom: SAM with CRP TP1006; Type: SAM 4.0; Serial: TP:1006;
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Pin = 250 mW; d = 15 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm Reference Value = 54.2 V/m; Power Drift = 0.004 dB Maximum value of SAR (interpolated) = 2.74 mW/g

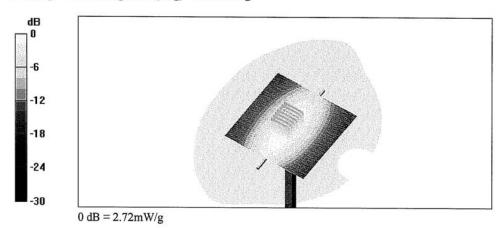
Pin = 250 mW; d = 15 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 54.2 V/m; Power Drift = 0.004 dB

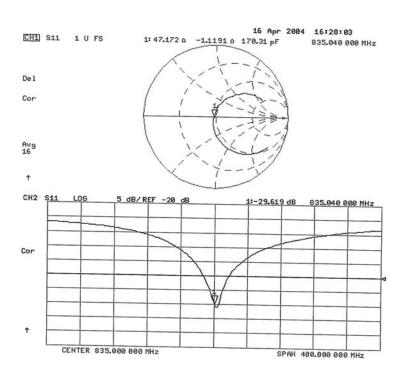
Maximum value of SAR (measured) = 2.72 mW/g

Peak SAR (extrapolated) = 3.69 W/kg

SAR(1 g) = 2.52 mW/g; SAR(10 g) = 1.66 mW/g











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

Client

Kyocera USA

CALIBRATION	CERTIFICA	TE	
MALE STATE STATE OF STATE OF STATE OF STATE STAT	TO COMPANY THE PROPERTY OF THE PARTY OF THE		
Object(s)	D1900V2 - SI	N:5d003	
Calibration procedure(s)	QA CAL-05.v. Calibration pr	2 ocedure for dipole validation kits	
Calibration date:	April 15, 2004	•	
Condition of the calibrated item	In Tolerance	(according to the specific calibratio	n document)
international standard.		used in the calibration procedures and conformity of the	
All calibrations have been conduc	ted in the closed laborato	ry facility: environment temperature 22 +/- 2 degrees C	celsius and humidity < 75%.
Calibration Equipment used (M&T	E critical for calibration)		
Model Type	ID#	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM E442	GB37480704	6-Nov-03 (METAS, No. 252-0254)	Nov-04
Power sensor HP 8481A	US37292783	6-Nov-03 (METAS, No. 252-0254)	Nov-04
Power sensor HP 8481A	MY41092317	18-Oct-02 (Agilent, No. 20021018)	Oct-04
RF generator R&S SML-03	100698	27-Mar-2002 (R&S, No. 20-92389)	In house check: Mar-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Nov-03)	In house check: Oct 05
	Name	Function	Signature
Calibrated by:	Judith Mueller	Technician	Mouther
Approved by:	Katja Pokovic	Laboratory Director	Mon's Wety-
			Date issued: April 20, 2004
This calibration certificate is issue Calibration Laboratory of Schmid		ution until the accreditation process (based on ISO/IEC G is completed.	C 17025 International Standard) for





Schmid & Partner Engineering AG

speaq

Zeughausstrasse 43, 8004 Zurich, Switzerland Phone +41 1 245 9700, Fax +41 1 245 9779 info@speag.com, http://www.speag.com

DASY

Dipole Validation Kit

Type: D1900V2

Serial: 5d003

Manufactured: February 14, 2002 Calibrated: April 15, 2004





Measurement Conditions

The measurements were performed in the flat section of the SAM twin phantom filled with head simulating liquid of the following electrical parameters at 1900 MHz:

40.1 ±5% Relative Dielectricity 1.45 mho/m ± 5% Conductivity

The DASY4 System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 4.96 at 1900 MHz) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from dipole center to the solution surface. The included distance spacer was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 15mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.

The dipole input power (forward power) was $250 \text{mW} \pm 3 \text{ }\%$. The results are normalized to 1 W input power.

SAR Measurement with DASY4 System

Standard SAR-measurements were performed according to the measurement conditions described in section 1. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the advanced extrapolation are:

averaged over 1 cm³ (1 g) of tissue: 39.3 mW/g \pm 16.8 % (k=2)¹ averaged over 10 cm3 (10 g) of tissue: **20.6** mW/g \pm 16.2 % (k=2)¹

¹ validation uncertainty





3. Dipole Impedance and Return Loss

The impedance was measured at the SMA-connector with a network analyzer and numerically transformed to the dipole feedpoint. The transformation parameters from the SMA-connector to the dipole feedpoint are:

Electrical delay: 1.188

1.188 ns (one direction)

Transmission factor: 0.973

(voltage transmission, one direction)

The dipole was positioned at the flat phantom sections according to section 1 and the distance spacer was in place during impedance measurements.

Feedpoint impedance at 1900 MHz:

 $Re{Z} = 50.2 \Omega$

Im $\{Z\} = 1.1 \Omega$

Return Loss at 1900 MHz

-39.3 dB

4. Measurement Conditions

The measurements were performed in the flat section of the SAM twin phantom filled with **body simulating tissue** of the following electrical parameters at 1900 MHz:

Relative Dielectricity

2.2 ± 5%

Conductivity

1.58 mho/m $\pm 5\%$

The DASY4 System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 4.57 at 1900 MHz) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from dipole center to the solution surface. The included distance spacer was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 15mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.

The dipole input power (forward power) was $250 \text{mW} \pm 3$ %. The results are normalized to 1W input power.





SAR Measurement with DASY4 System

Standard SAR-measurements were performed according to the measurement conditions described in section 4. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the <u>advanced extrapolation</u> are:

averaged over 1 cm³ (1 g) of tissue: $41.6 \text{ mW/g} \pm 16.8 \% \text{ (k=2)}^2$

averaged over 10 cm³ (10 g) of tissue: 21.9 mW/g \pm 16.2 % (k=2)²

6. Dipole Impedance and Return Loss

The dipole was positioned at the flat phantom sections according to section 4 and the distance spacer was in place during impedance measurements.

Feedpoint impedance at 1900 MHz: $Re\{Z\} = 46.9 \Omega$

Im $\{Z\} = 1.4 \Omega$

Return Loss at 1900 MHz -28.9 dB

7. Handling

Do not apply excessive force to the dipole arms, because they might bend. Bending of the dipole arms stresses the soldered connections near the feedpoint leading to a damage of the dipole.

8. Design

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.

Small end caps have been added to the dipole arms in order to improve matching when loaded according to the position as explained in Section 1. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

9. Power Test

After long term use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

Dipole Calibration Parameters

² validation uncertainty





Date/Time: 04/15/04 15:14:36

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN5d003

Communication System: CW-1900; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: HSL 1900 MHz;

Medium parameters used: f = 1900 MHz; $\sigma = 1.45$ mho/m; $\varepsilon_r = 40.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 SN1507; ConvF(4.96, 4.96, 4.96); Calibrated: 1/23/2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn411; Calibrated: 11/6/2003
- Phantom: SAM with CRP TP1006; Type: SAM 4.0; Serial: TP:1006;
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Pin = 250 mW; d = 10 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm Reference Value = 91.1 V/m; Power Drift = -0.002 dB Maximum value of SAR (interpolated) = 11.4 mW/g

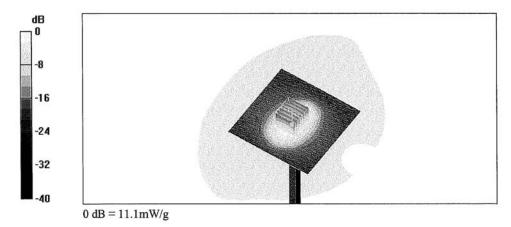
Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 91.1 V/m; Power Drift = -0.002 dB

Maximum value of SAR (measured) = 11.1 mW/g

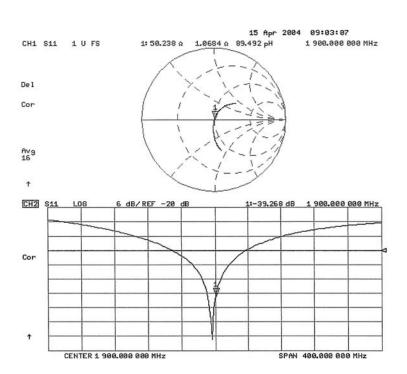
Peak SAR (extrapolated) = 17.4 W/kg

SAR(1 g) = 9.83 mW/g; SAR(10 g) = 5.16 mW/g



Head









Date/Time: 04/14/04 12:04:25

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN5d003

Communication System: CW-1900; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: Muscle 1900 MHz;

Medium parameters used: f = 1900 MHz; $\sigma = 1.58 \text{ mho/m}$; $\varepsilon_r = 52.2$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 SN1507; ConvF(4.57, 4.57, 4.57); Calibrated: 1/23/2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn411; Calibrated: 11/6/2003
- Phantom: SAM with CRP TP1006; Type: SAM 4.0; Serial: TP:1006;
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

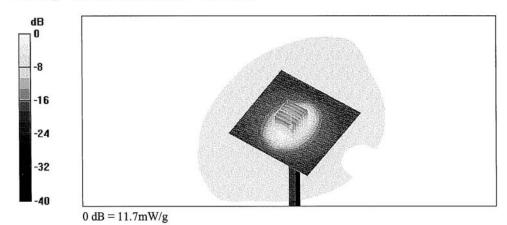
Pin = 250 mW; d = 10 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm Reference Value = 89.5 V/m; Power Drift = 0.0 dB Maximum value of SAR (interpolated) = 12 mW/g

Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 89.5 V/m; Power Drift = 0.0 dB Maximum value of SAR (measured) = 11.7 mW/g

Peak SAR (extrapolated) = 18.5 W/kg

SAR(1 g) = 10.4 mW/g; SAR(10 g) = 5.47 mW/g



Body



