



DASY5 Validation Report for Head TSL

Date: 12.07.2021

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1017

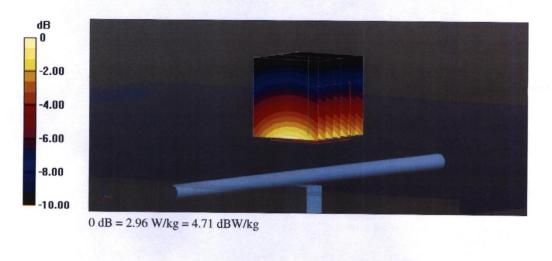
Communication System: UID 0 - CW; Frequency: 750 MHz Medium parameters used: f = 750 MHz; σ = 0.91 S/m; ϵ_r = 42.4; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

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(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 60.01 V/m; Power Drift = -0.01 dB Peak SAR (extrapolated) = 3.39 W/kg SAR(1 g) = 2.20 W/kg; SAR(10 g) = 1.43 W/kg Smallest distance from peaks to all points 3 dB below = 16 mm Ratio of SAR at M2 to SAR at M1 = 64.8% Maximum value of SAR (measured) = 2.96 W/kg



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File View Channel Sweep Calibration Irace Scale Marker System Window Help 750.000000 MHz 53.782 Ω 1.1666 nF -181.90 mΩ 50.000000 MHz 36.480 mU -2.6534 ° Ch 1 Avg = 20 Ch1: Start 550.000 MHz Stop 950.000 MHz 10.00 5.00 750.000000 MHz > 28.759 dB 0.00 -5.00 -10.00 -15.00 -20.00 25.00 30.00 35.00 40.00 Ch 1 Avg = 20 Ch1: Start 550.000 MHz Stop 950.000 MHz CH 1: 511 C* 1-Port Status Avg=20 Delay LCL

Impedance Measurement Plot for Head TSL

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835 MHz Dipole Calibration Certificate

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

Accredited by the Swiss Accreditation Service (SAS)



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Accreditation No.: SCS 0108

The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates Certificate No: D835V2-4d069_Jul21 CTTL (Auden) Client CALIBRATION CERTIFICATE D835V2 - SN:4d069 Object QA CAL-05.v11 Calibration procedure(s) Calibration Procedure for SAR Validation Sources between 0.7-3 GHz July 12, 2021 Calibration date: 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) ID # Cal Date (Certificate No.) Scheduled Calibration Primary Standards 09-Apr-21 (No. 217-03291/03292) Apr-22 SN: 104778 Power meter NRP Apr-22 09-Apr-21 (No. 217-03291) Power sensor NRP-Z91 SN: 103244 SN: 103245 09-Apr-21 (No. 217-03292) Apr-22 Power sensor NRP-Z91 Apr-22 SN: BH9394 (20k) 09-Apr-21 (No. 217-03343) Reference 20 dB Attenuator Apr-22 Type-N mismatch combination SN: 310982 / 06327 09-Apr-21 (No. 217-03344) 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 Check Date (in house) Scheduled Check Secondary Standards ID # SN: GB39512475 30-Oct-14 (in house check Oct-20) In house check: Oct-22 Power meter E4419B In house check: Oct-22 Power sensor HP 8481A SN: US37292783 07-Oct-15 (in house check Oct-20) SN: MY41092317 In house check: Oct-22 Power sensor HP 8481A 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) Network Analyzer Agilent E8358A SN: US41080477 31-Mar-14 (in house check Oct-20) In house check: Oct-21 Function Name Signature Jeffrey Katzman Laboratory Technician Calibrated by: Katja Pokovic **Technical Manager** Approved by: Issued: July 15, 2021 This calibration certificate shall not be reproduced except in full without written approval of the laboratory. Certificate No: D835V2-4d069_Jul21 Page 1 of 6





Calibration Laboratory of Schmid & Partner

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland



Schweizerischer Kalibrierdienst Service suisse d'étalonnage С Servizio svizzero di taratura S Swiss Calibration Service

Accreditation No.: SCS 0108

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

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%.

Certificate No: D835V2-4d069 Jul21

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Measurement Conditions

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

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.2 ± 6 %	0.94 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.48 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.63 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR averaged over 10 cm ³ (10 g) of Head TSL SAR measured	condition 250 mW input power	1.60 W/kg

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.7 Ω - 2.3 jΩ	
Return Loss	- 31.0 dB	

General Antenna Parameters and Design

Electrical Delay (one direction)	1.393 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

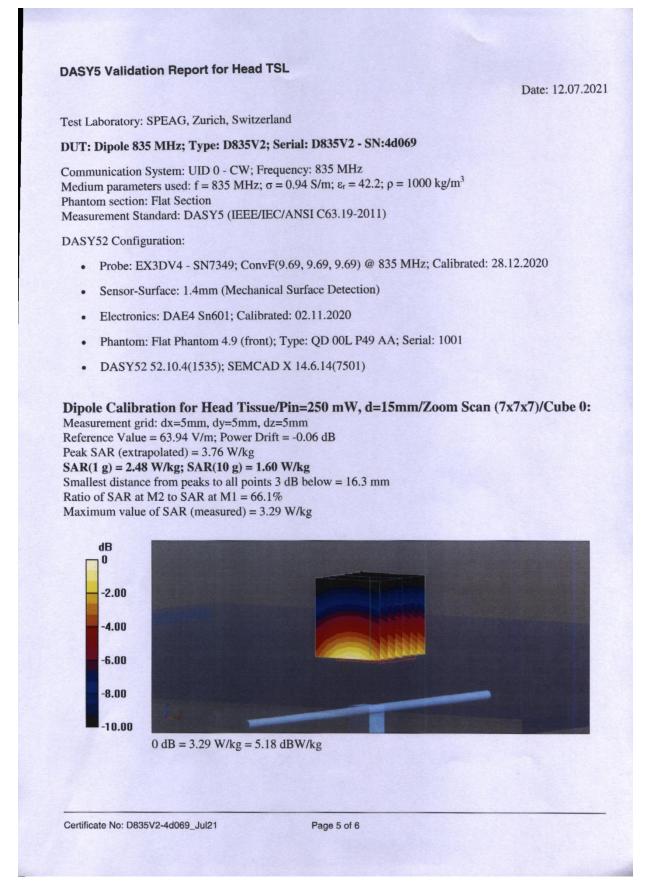
Manufactured by	SPEAG
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Certificate No: D835V2-4d069_Jul21

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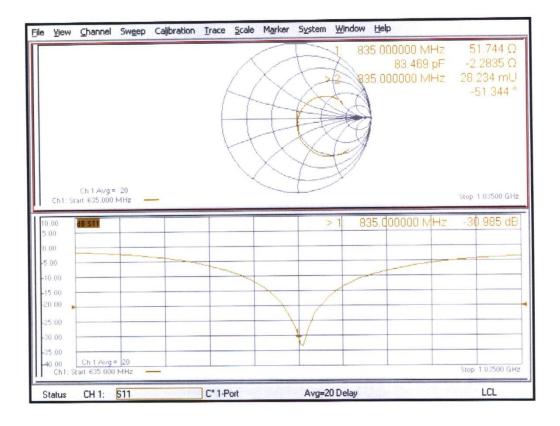








Impedance Measurement Plot for Head TSL



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1800 MHz Dipole Calibration Certificate

Engineering AG Ceughausstrasse 43, 8004 Zurich,	of Switzerland		Service suisse d'étalonnage
Accredited by the Swiss Accreditation	is one of the signatorie	s to the EA	Accreditation No.: SCS 0108
Iultilateral Agreement for the rec	cognition of calibration	certificates	
Client CTTL (Auden)		Certificate N	lo: D1800V2-2d145_Jul21
CALIBRATION C	ERTIFICATI	E	
Object	D1800V2 - SN:20	d145	
Calibration procedure(s)	QA CAL-05.v11		
		edure for SAR Validation Source	s between 0.7-3 GHz
Calibration date:	July 12, 2021		
		robability are given on the following pages a	
All calibrations have been conducte	ed in the closed laborator	robability are given on the following pages any facility: environment temperature (22 ± 3)°	
All calibrations have been conducte	ed in the closed laborator		
NI calibrations have been conducte Calibration Equipment used (M&TE Primary Standards Power meter NRP	ed in the closed laborator	y facility: environment temperature $(22 \pm 3)^\circ$	°C and humidity < 70%.
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All calibrations have been conducte Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Vower sensor NRP-Z91 Reference 20 dB Attenuator Vpe-N mismatch combination	ad in the closed laborator critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327	2 facility: environment temperature (22 ± 3)° Cal Date (Certificate No.) 09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344)	°C and humidity < 70%. Scheduled Calibration Apr-22 Apr-22 Apr-22
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All calibrations have been conducte Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A	ad in the closed laborator critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317	Cal Date (Certificate No.) 09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 28-Dec-20 (No. EX3-7349_Dec20) 02-Nov-20 (No. DAE4-601_Nov20) Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20)	C and humidity < 70%. Scheduled Calibration Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-21 Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22
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Certificate No: D1800V2-2d145_Jul21

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



Schweizerischer Kalibrierdienst Service suisse d'étalonnage Servizio svizzero di taratura

Swiss Calibration Service

Accreditation No.: SCS 0108

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

Glossary:

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- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

c) DASY System Handbook

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 of the certificate. All figures stated in the certificate are valid at the frequency indicated.
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- 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.

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Certificate No: D1800V2-2d145_Jul21

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Measurement Conditions

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

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1800 MHz ± 1 MHz	

Head TSL parameters The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.4 ± 6 %	1.39 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.51 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	38.3 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR averaged over 10 cm ³ (10 g) of Head TSL SAR measured	condition 250 mW input power	4.95 W/kg

Certificate No: D1800V2-2d145_Jul21

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	47.9 Ω - 2.8 jΩ	
Return Loss	- 28.8 dB	

General Antenna Parameters and Design

Electrical Delay (one direction)	1.214 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	ODEAC
manaradured by	SPEAG

Certificate No: D1800V2-2d145_Jul21

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DASY5 Validation Report for Head TSL

Date: 12.07.2021

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN:2d145

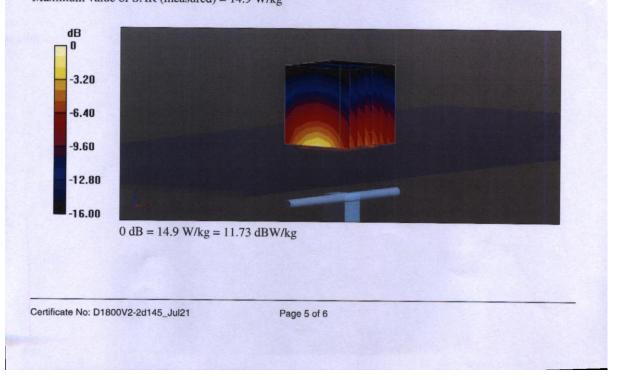
Communication System: UID 0 - CW; Frequency: 1800 MHz Medium parameters used: f = 1800 MHz; σ = 1.39 S/m; ε_r = 40.4; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.63, 8.63, 8.63) @ 1800 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(1535); SEMCAD X 14.6.14(7501)

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 = 107.9 V/m; Power Drift = 0.04 dB Peak SAR (extrapolated) = 17.7 W/kg SAR(1 g) = 9.51 W/kg; SAR(10 g) = 4.95 W/kg

Smallest distance from peaks to all points 3 dB below = 9.5 mmRatio of SAR at M2 to SAR at M1 = 54.3%Maximum value of SAR (measured) = 14.9 W/kg







Channel Sweep Calibration Irace Scale View File Marker System Window Help 1.800000 GHz 47.858 Ω 31.027 pF -2.8498 Ω 1.800000 GHz 36.418 mU -125.27 ° Ch 1 Awg = 20 Ch1: Start 1.60000 GHz Stop 2.00000 GHz 10.00 1.800000 GHz 774 dB 5.00 \$ 0.00 5.00 10.00 15.00 20.00 25.00 30.00 35.00 40.00 Ch 1 Avg = 20 Ch1: Start 1.60000 GHz Stop 2.00000 GHz Status CH 1: 511 C* 1-Port Avg=20 Delay LCL

Impedance Measurement Plot for Head TSL



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1900 MHz Dipole Calibration Certificate

Engineering AG eughausstrasse 43, 8004 Zurich,	Of Switzerland	S C MRA	Schweizerischer Kalibrierdiens Service suisse d'étalonnage Servizio svizzero di taratura Swiss Calibration Service
ccredited by the Swiss Accreditation he Swiss Accreditation Service is			ccreditation No.: SCS 0108
Iultilateral Agreement for the rec		Certificate No	»: D1900V2-5d101_Jul2
CALIBRATION CI	D1900V2 - SN:50		
Calibration procedure(s)	QA CAL-05.v11 Calibration Proce	dure for SAR Validation Sources	s between 0.7-3 GHz
Calibration date:	July 15, 2021		
All calibrations have been conducte	ainties with confidence p ad in the closed laborator	robability are given on the following pages and y facility: environment temperature $(22 \pm 3)^{\circ}$	nd are part of the certificate.
The measurements and the uncerta All calibrations have been conducte Calibration Equipment used (M&TE	ainties with confidence p ad in the closed laborator E critical for calibration)	robability are given on the following pages are y facility: environment temperature $(22 \pm 3)^{\circ}$	nd are part of the certificate. C and humidity < 70%.
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