- **Case 16 in table 7-1: 2G GSM 1900 result for test sequence 2**

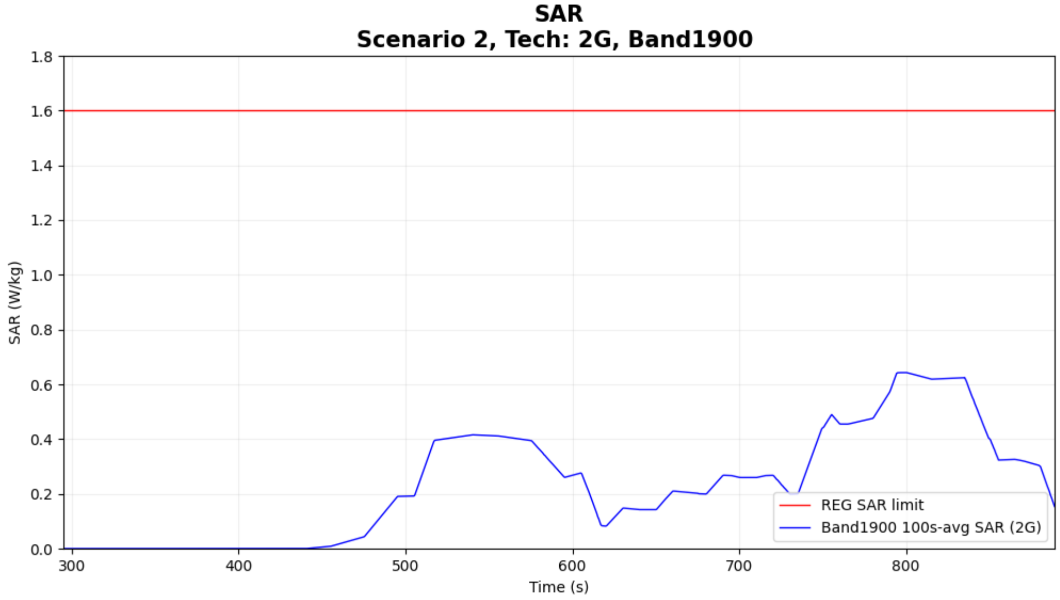


Figure 7-17 Time-averaged SAR for case 16 in table 7-1 (2G GSM 1900)

FCC 1gSAR limit	1.6 W/kg
Max 100s-time averaged 1gSAR	0.402 W/kg
Validation result: Pass	

8 Conclusions

This document proposes TA-SAR test scenarios and procedures, and further proves Mediatek's TA-SAR algorithms can meet the FCC SAR regulations with the proposed test scenarios and procedures. As shown in Chapters 6, Mediatek's TA-SAR algorithms are able to maintain SAR over time below the FCC regulatory limits (based on the agreed TX-power-to-SAR translation). Furthermore, the near-field measurements are also done in an FCC certified lab to further validate the proposed test methodologies, and the results shown in Chapters 7 demonstrate that Mediatek's TA-SAR algorithms really can maintain SAR over time below the FCC regulatory limits under the proposed test procedures. Based on the provided measurement evidences, it is concluded that Mediatek's TA-SAR algorithms can be tested by using the proposed test methodology for FCC compliance.

Appendix A   Pictures of TA-SAR Measurement Bench

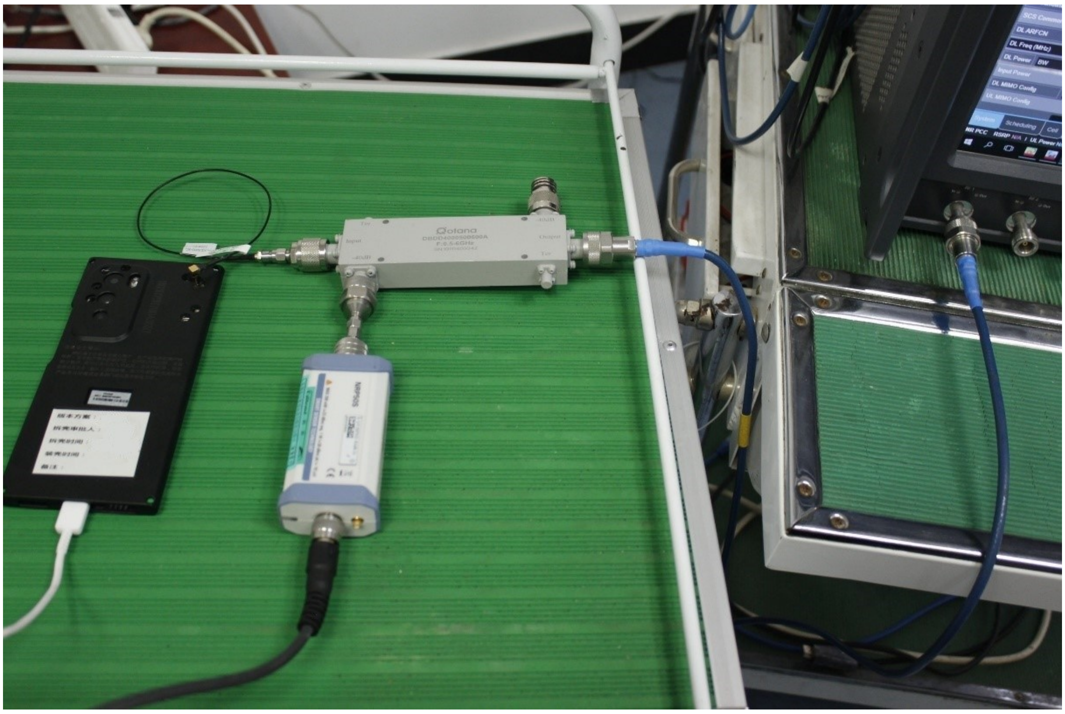


Figure A-1 Picture of the block diagram shown in Figure 6-2 (sub6 NR and LTE)

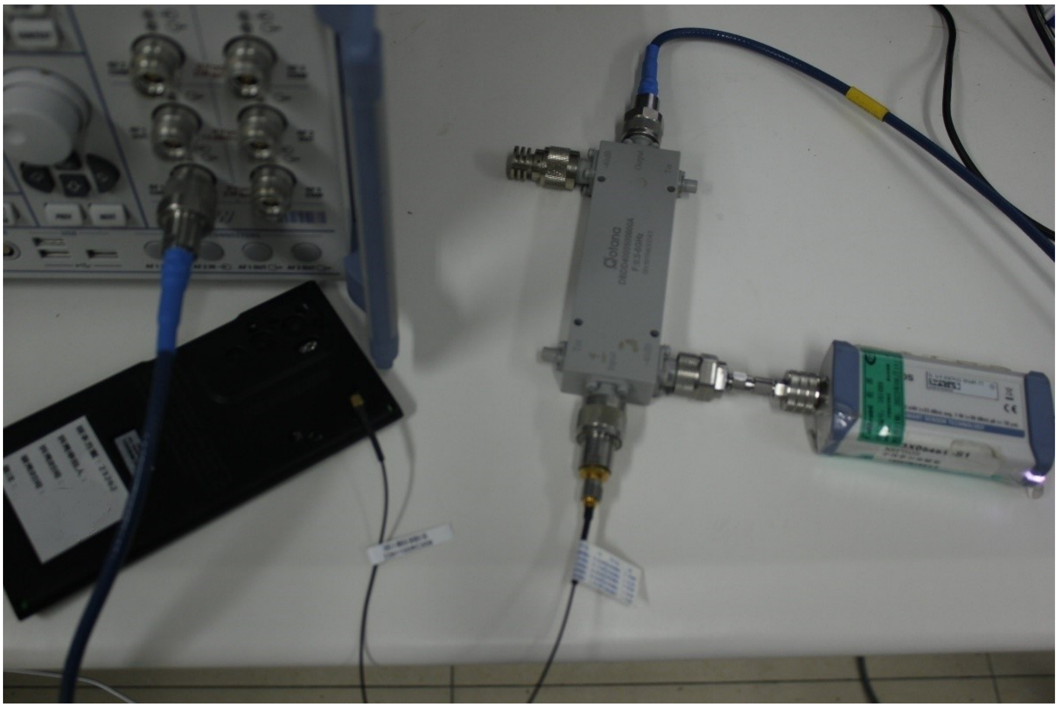


Figure A-2 Picture of the block diagram shown in Figure 6-2 (LTE/WCDMA/2G)

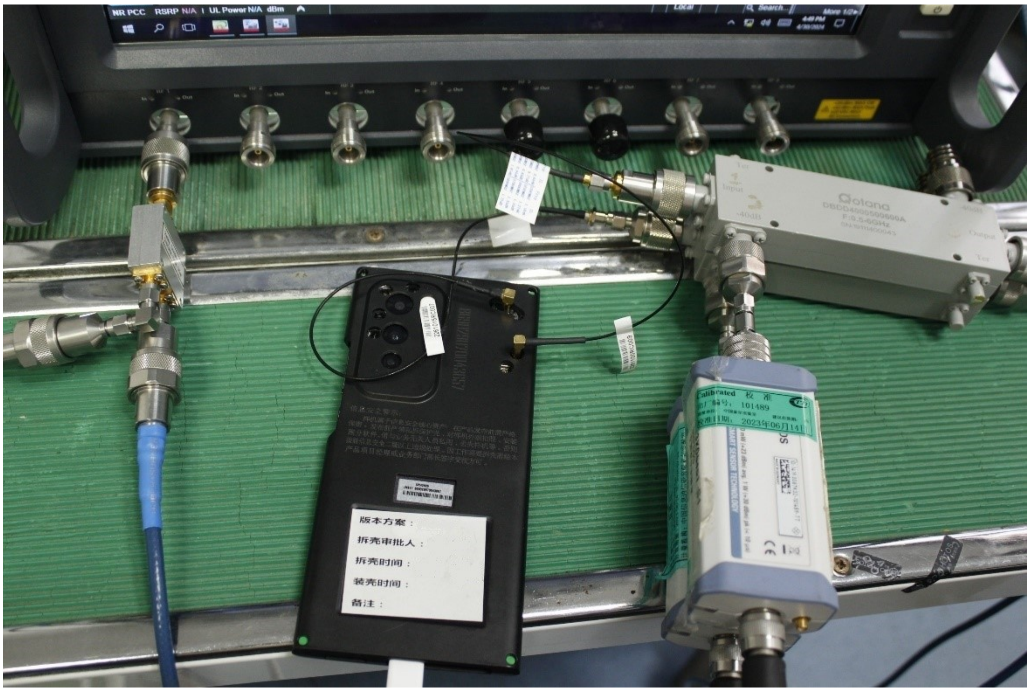


Figure A-3 Picture of the block diagram shown in Figure 6-3 (sub6 NR and LTE)

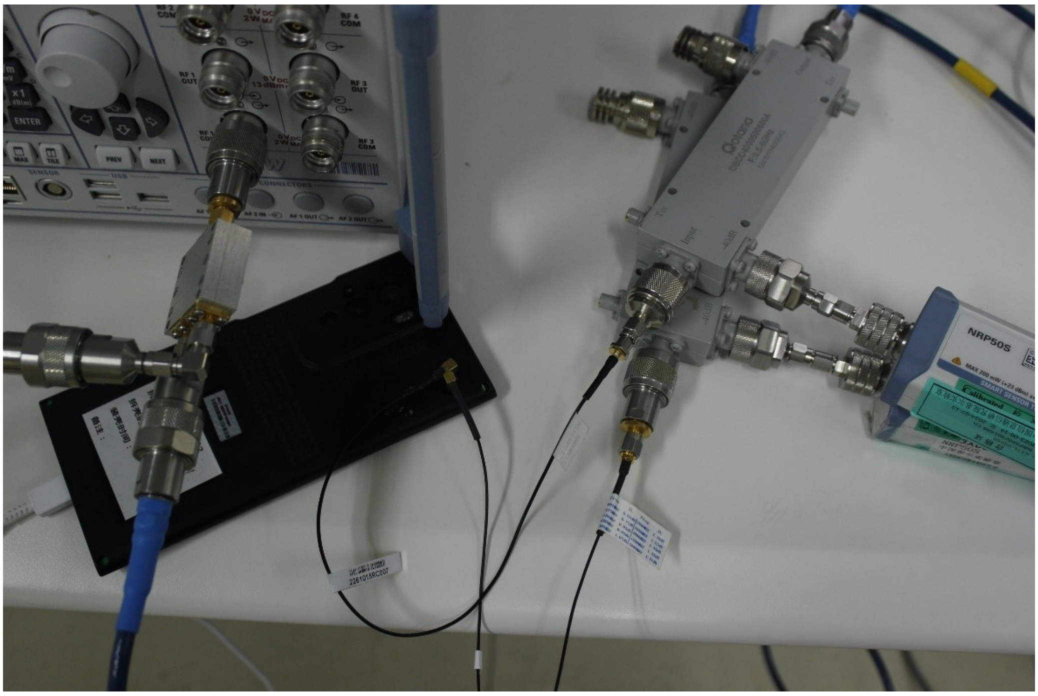


Figure A-4 Picture of the block diagram shown in Figure 6-3 (LTE/WCDMA/2G)

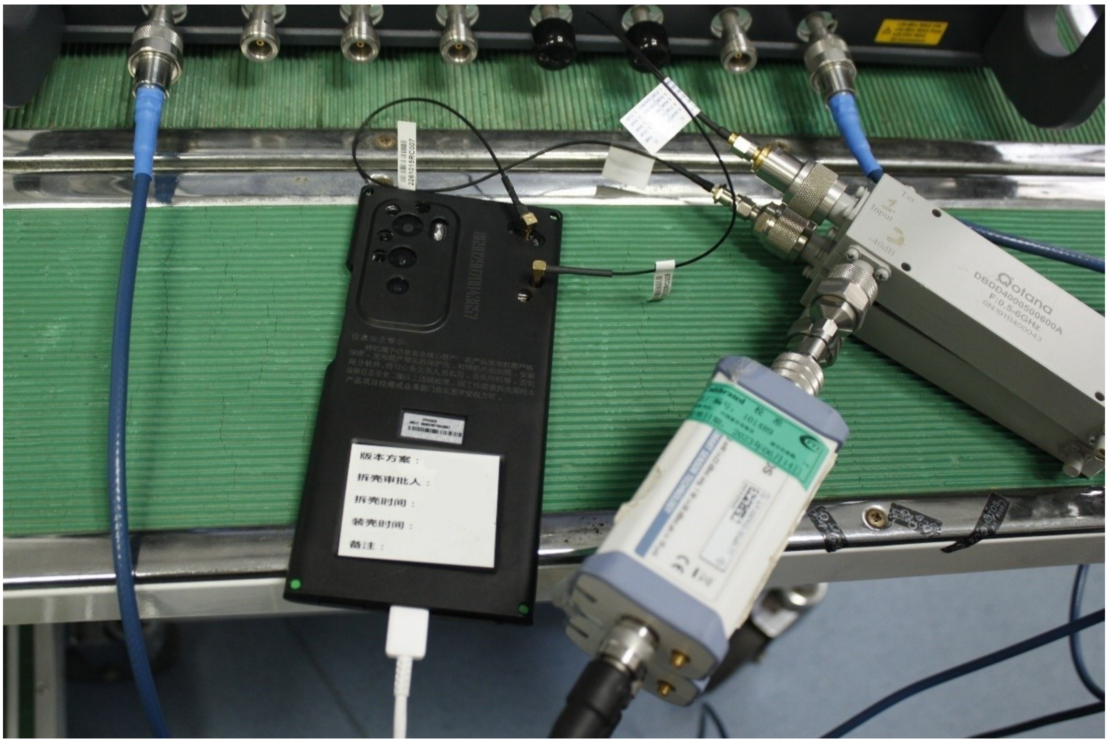


Figure A-5 Picture of the block diagram shown in Figure 6-5 (sub6 NR and LTE)

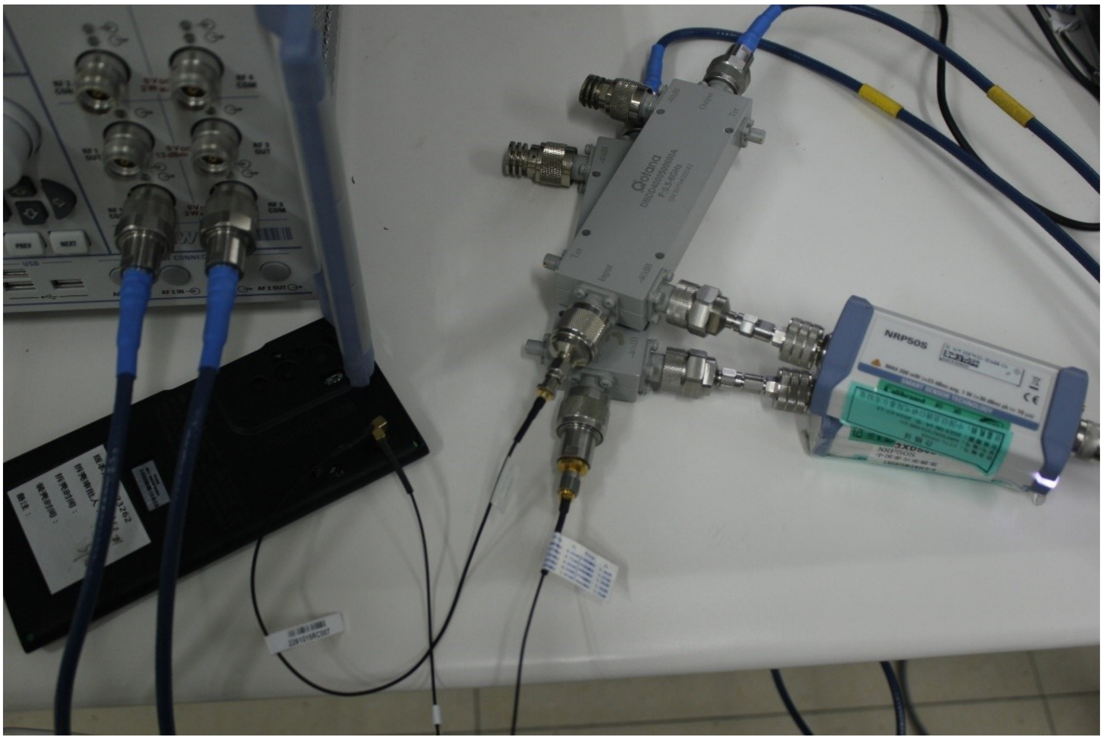


Figure A-6 Picture of the block diagram shown in Figure 6-5 (LTE/WCDMA/2G)

Appendix B Main Test Instruments

Table B-1 List of Main Instruments

	Name	Type	Serial Number	Calibration Date	Valid Period
01	Network analyzer	N5239A	MY55491241	June 5, 2023	One year
02	Power sensor	NRP50S	101488	June 14, 2023	One year
03	Power sensor	NRP50S	101489		
04	Signal Generator	MG3700A	6201052605	June 12 2023	One Year
05	Amplifier	60S1G4	0331848	No Calibration Requested	
06	Dual directional coupler	778D	MY48220216	No Calibration Requested	
07	Dual directional coupler	772D	MY46151265	No Calibration Requested	
08	BTS	CMW500	149646	November 21, 2023	One year
09	5G Wireless Test Platform	E7515B	MY60192696	July 21,2023	One year
10	DAE	SPEAG DAE4	1525	September 14,2023	One year
11	E-field Probe	SPEAG EX3DV4	7600	December 19，2023	One year
12	Dipole Validation Kit	SPEAG D1750V2	1003	July 12,2023	One year
13	Dipole Validation Kit	SPEAG D1900V2	5d101	July 17,2023	One year
14	Dipole Validation Kit	SPEAG D2600V2	1012	July 11,2023	One year

Appendix C Tissue Simulating Liquids

Table C-1 List of Main Instruments

Measurement Date (yyyy-mm-dd)	Type	Frequency	Permittivity ε	Drift (%)	Conductivity σ (S/m)	Drift (%)
2024/5/14	Head	1750 MHz	40.02	-0.15	1.348	-1.61
2024/5/14	Head	1900 MHz	38.99	-2.53	1.42	1.43
2024/5/15	Head	2600 MHz	38.52	-1.26	1.985	1.28

Appendix D System Validation

Measurement Date (yyyy-mm-dd)	Frequency	Target value (W/kg)		Measured value(W/kg)		Deviation	
		10 g Average	1 g Average	10 g Average	1 g Average	10 g Average	1 g Average
2024/5/14	1750 MHz	18.9	35.8	19.6	36.7	3.70%	2.46%
2024/5/14	1900 MHz	20.7	39.8	21.1	40.4	2.03%	1.51%
2024/5/15	2600 MHz	25.1	55.2	25.2	56.0	0.56%	1.45%

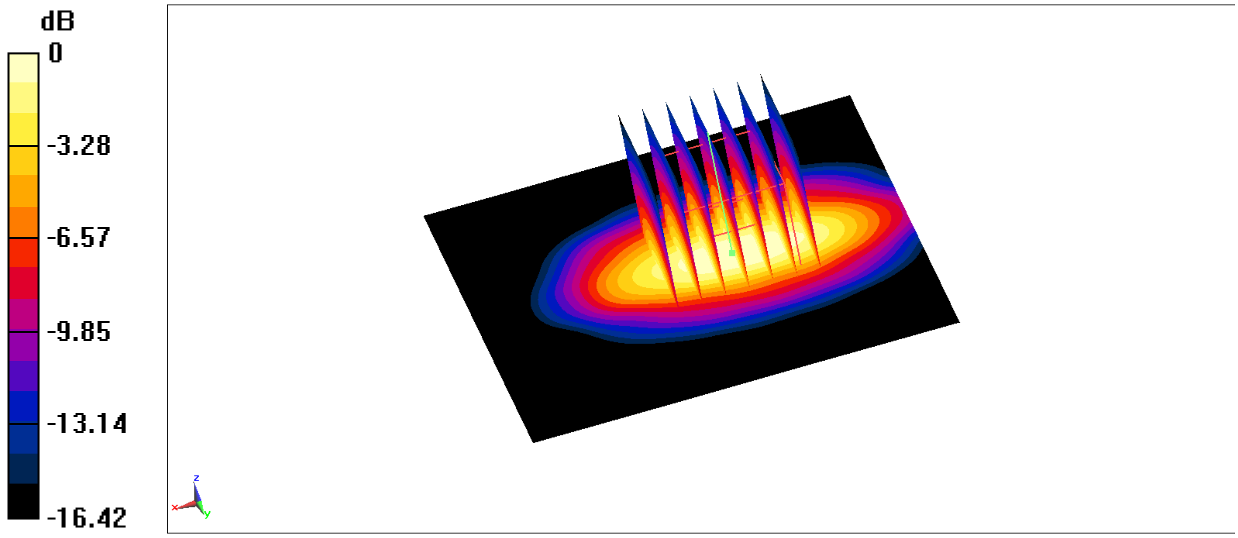
Appendix E System Validation Results

1750MHz

Date: 5/14/2024
Electronics: DAE4 Sn1525
Medium: H700-6000M
Medium parameters used: f = 1750 MHz; σ = 1.348 S/m; εr = 40.02; ρ = 1000 kg/m3
Ambient Temperature:23.3°C Liquid Temperature: 22.5°C
Communication System: UID 0, CW (0) Frequency: 1750 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN7600 ConvF(8.98, 8.98, 8.98)

Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 14.1 W/kg

Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.51 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 16.3 W/kg
SAR(1 g) = 9.17 W/kg; SAR(10 g) = 4.9 W/kg
Maximum value of SAR (measured) = 13.9 W/kg



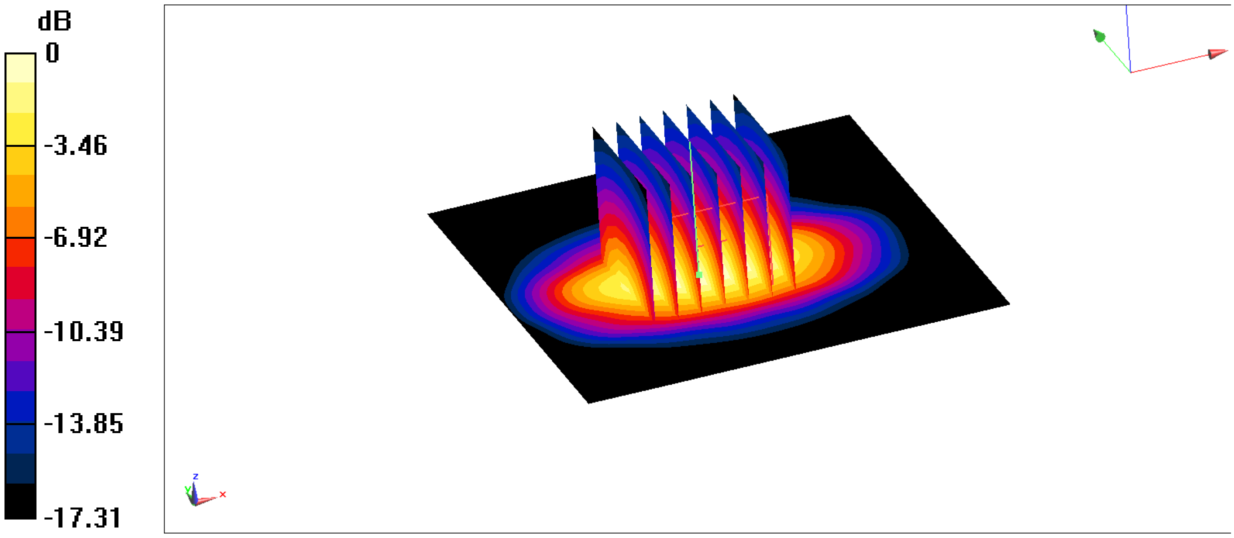
0 dB = 13.9 W/kg = 11.43 dBW/kg

1900MHz

Date: 5/14/2024
Electronics: DAE4 Sn1525
Medium: H700-6000M
Medium parameters used: f = 1900 MHz; σ = 1.42 S/m; εr = 38.99; ρ = 1000 kg/m3
Ambient Temperature:23.3°C Liquid Temperature: 22.5°C
Communication System: UID 0, CW (0) Frequency: 1900 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN7600 ConvF(8.63, 8.63, 8.63)

Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 15.4 W/kg

Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.84 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 18.2 W/kg
SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.28 W/kg
Maximum value of SAR (measured) = 15.5 W/kg



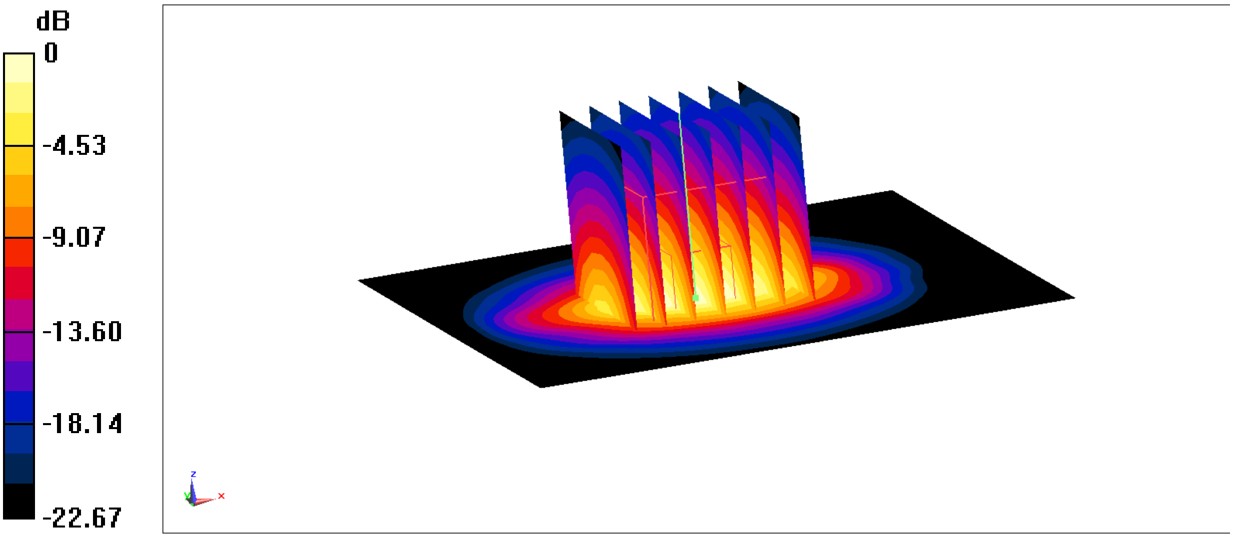
0 dB = 15.5 W/kg = 11.90 dBW/kg

26000MHz

Date: 5/15/2024
Electronics: DAE4 Sn1525
Medium: H700-6000M
Medium parameters used: f = 2600 MHz; σ = 1.985 S/m; εr = 38.52; ρ = 1000 kg/m3
Ambient Temperature:23.3°C   Liquid Temperature: 22.5°C
Communication System: UID 0, CW (0) Frequency: 2600 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN7600 ConvF(7.89, 7.89, 7.89)

Area Scan (61x61x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 22.5 W/kg

Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 102.9 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 28.9 W/kg
SAR(1 g) = 14 W/kg; SAR(10 g) = 6.31 W/kg
Maximum value of SAR (measured) = 23.6 W/kg



0 dB = 23.6 W/kg = 13.73 dBW/kg

ANNEX F Probe Calibration Certificate

Probe 7600 Calibration Certificate

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中国认可 国际互认 校准 CALIBRATION CNAS L0570

Client CTTL Certificate No: 23J02Z80177

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN : 7600

Calibration Procedure(s): FF-Z11-004-02
Calibration Procedures for Dosimetric E-field Probes

Calibration date: December 19, 2023

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)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	12-Jun-23(CTTL, No.J23X05435)	Jun-24
Power sensor NRP-Z91	101547	12-Jun-23(CTTL, No.J23X05435)	Jun-24
Power sensor NRP-Z91	101548	12-Jun-23(CTTL, No.J23X05435)	Jun-24
Reference 10dBAttenuator	18N50W-10dB	19-Jan-23(CTTL, No.J23X00212)	Jan-25
Reference 20dBAttenuator	18N50W-20dB	19-Jan-23(CTTL, No.J23X00211)	Jan-25
Reference Probe EX3DV4	SN 3846	31-May-23(SPEAG, No.EX-3846_May23)	May-24
DAE4	SN 1555	24-Aug-23(SPEAG, No.DAE4-1555_Aug23)	Aug-24
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
SignalGenerator MG3700A	6201052605	12-Jun-23(CTTL, No.J23X05434)	Jun-24
Network Analyzer E5071C	MY46110673	10-Jan-23(CTTL, No.J23X00104)	Jan-24
Reference 10dBAttenuator	BT0520	11-May-23(CTTL, No.J23X04061)	May-25
Reference 20dBAttenuator	BT0267	11-May-23(CTTL, No.J23X04062)	May-25
OCP DAK-3.5	SN 1040	18-Jan-23(SPEAG, No.OCP-DAK3.5-1040_Jan23)	Jan-24

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: December 21, 2023

Certificate No: 23J02Z80177 Page 1 of 9

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Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A,B,C,D	modulation dependent linearization parameters
Polarization Φ	Φ rotation around probe axis
Polarization θ	θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i θ=0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization θ=0 (f≤900MHz in TEM-cell; f>1800MHz: waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect the E^2-field uncertainty inside TSL (see below ConvF).
- *NORM(f)x,y,z = NORMx,y,z* frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- *Ax,y,z; Bx,y,z; Cx,y,z;VRx,y,z:*A,B,C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f≤800MHz) and inside waveguide using analytical field distributions based on power measurements for f >800MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty valued are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMx,y,z* ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from±50MHz to±100MHz.
- *Spherical isotropy (3D deviation from isotropy):* in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset:* The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle:* The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

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DASY/EASY – Parameters of Probe: EX3DV4 – SN:7600

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (*k*=2)
Norm(μV/(V/m)^2)[A]	0.67	0.65	0.67	±10.0%
DCP(mV)[B]	111.0	110.7	109.8	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (*k*=2)
0	CW	X	0.0	0.0	1.0	0.00	210.1	±2.1%
		Y	0.0	0.0	1.0		204.2	
		Z	0.0	0.0	1.0		209.2	

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%.

[A] The uncertainties of Norm X, Y, Z do not affect the E^2-field uncertainty inside TSL (see Page 4).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainly is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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DASY/EASY – Parameters of Probe: EX3DV4 – SN:7600

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)	Unct. (k=2)
750	41.9	0.89	10.95	10.95	10.95	0.13	1.42	±12.7%
900	41.5	0.97	10.47	10.47	10.47	0.14	1.45	±12.7%
1450	40.5	1.20	9.28	9.28	9.28	0.19	1.05	±12.7%
1750	40.1	1.37	8.98	8.98	8.98	0.24	1.05	±12.7%
1900	40.0	1.40	8.63	8.63	8.63	0.27	1.00	±12.7%
2000	40.0	1.40	8.55	8.55	8.55	0.24	1.08	±12.7%
2300	39.5	1.67	8.34	8.34	8.34	0.55	0.75	±12.7%
2450	39.2	1.80	8.08	8.08	8.08	0.55	0.76	±12.7%
2600	39.0	1.96	7.89	7.89	7.89	0.62	0.69	±12.7%
3300	38.2	2.71	7.45	7.45	7.45	0.40	0.98	±13.9%
3500	37.9	2.91	7.29	7.29	7.29	0.40	1.03	±13.9%
3700	37.7	3.12	7.12	7.12	7.12	0.40	1.06	±13.9%
3900	37.5	3.32	6.94	6.94	6.94	0.35	1.35	±13.9%
4100	37.2	3.53	6.85	6.85	6.85	0.35	1.28	±13.9%
4200	37.1	3.63	6.75	6.75	6.75	0.35	1.35	±13.9%
4400	36.9	3.84	6.64	6.64	6.64	0.35	1.35	±13.9%
4600	36.7	4.04	6.54	6.54	6.54	0.35	1.40	±13.9%
4800	36.4	4.25	6.49	6.49	6.49	0.35	1.48	±13.9%
4950	36.3	4.40	6.22	6.22	6.22	0.35	1.50	±13.9%
5250	35.9	4.71	5.65	5.65	5.65	0.40	1.52	±13.9%
5600	35.5	5.07	5.00	5.00	5.00	0.45	1.48	±13.9%
5750	35.4	5.22	5.11	5.11	5.11	0.40	1.58	±13.9%

[C] Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of 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. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[F] At frequency up to 6 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. 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 the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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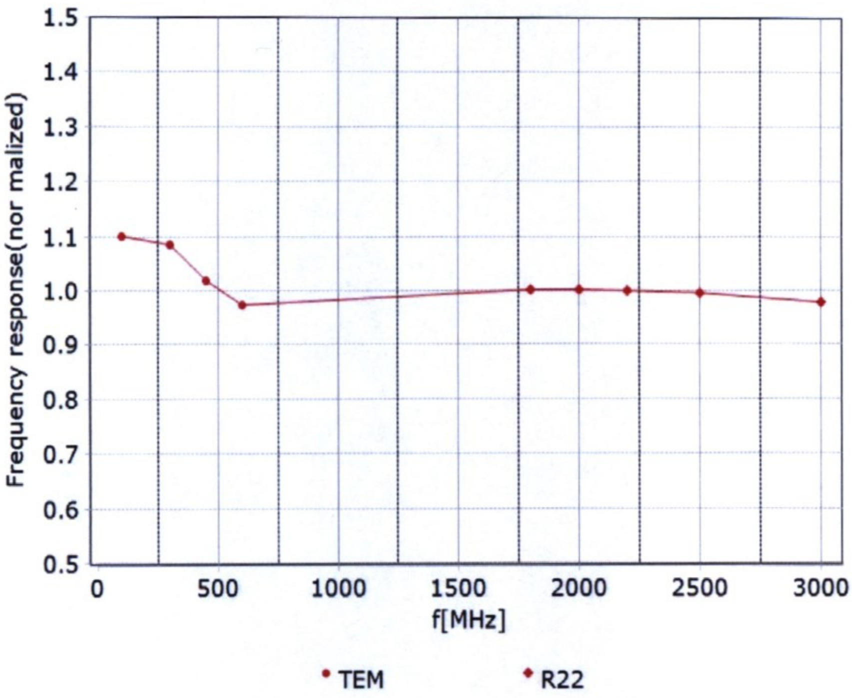
Frequency Response of E-Field
(TEM-Cell: ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ±7.4% (*k*=2)

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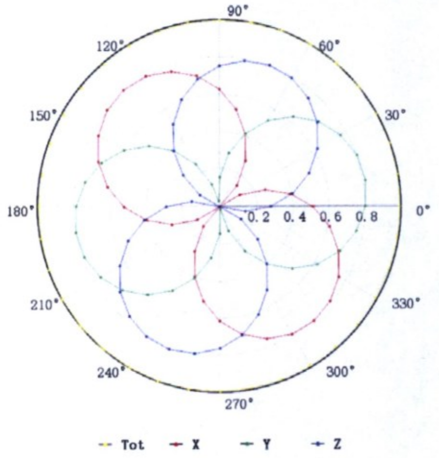
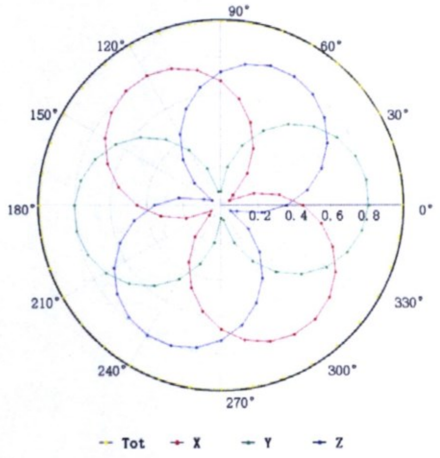
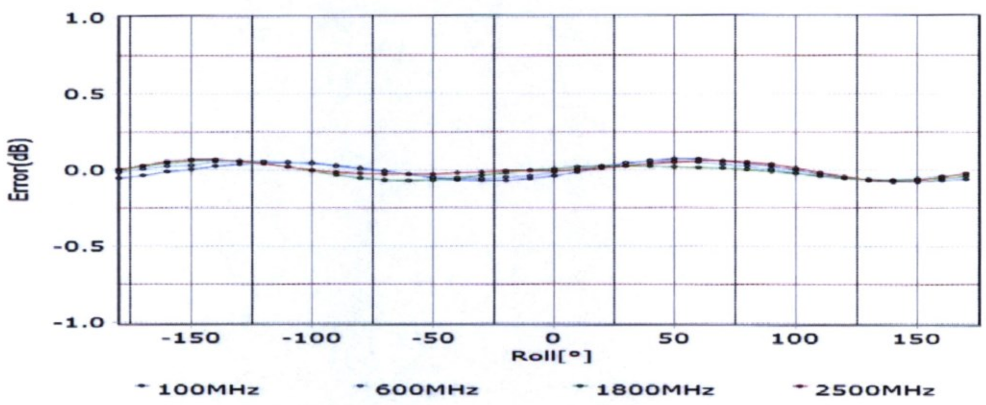
Receiving Pattern (Φ), θ=0°

f=600 MHz, TEM



f=1800 MHz, R22





Uncertainty of Axial Isotropy Assessment: ±1.2% (*k*=2)

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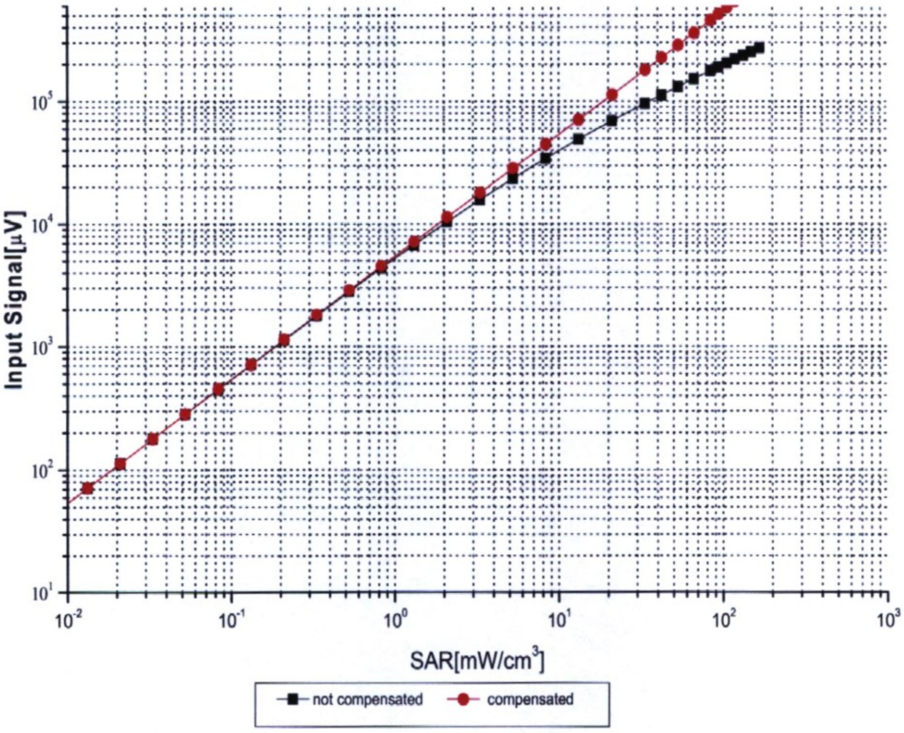
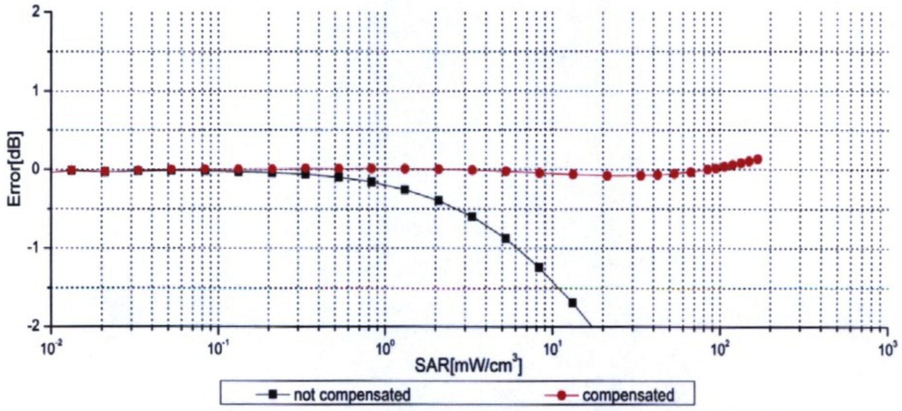
Dynamic Range f(SAR$_{head}$)
(TEM cell, f = 900 MHz)





Uncertainty of Linearity Assessment: ±0.9% (*k*=2)

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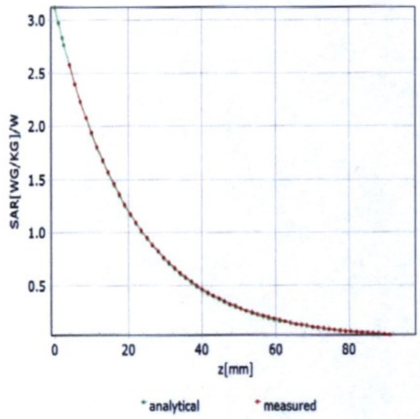
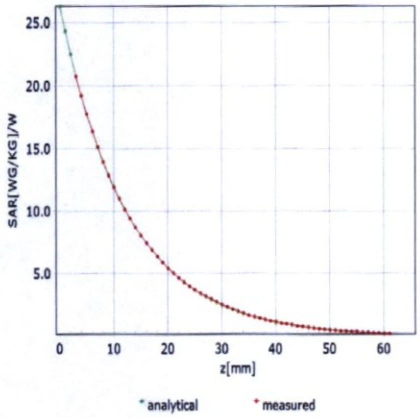
Conversion Factor Assessment

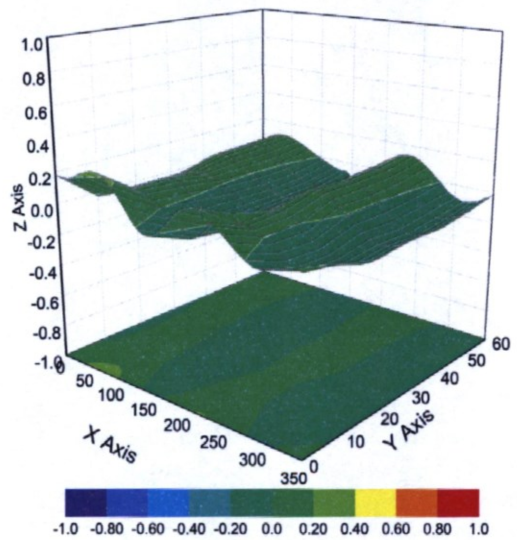
f=750 MHz,WGLS R9(H_convF)



f=1750 MHz,WGLS R22(H_convF)



Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: ±3.2% (*k*=2)

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2117
E-mail: emf@caict.ac.cn http://www.caict.ac.cn

DASY/EASY – Parameters of Probe: EX3DV4 – SN:7600

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	42.1
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	9mm
Tip Diameter	2.5mm
Probe Tip to Sensor X Calibration Point	1mm
Probe Tip to Sensor Y Calibration Point	1mm
Probe Tip to Sensor Z Calibration Point	1mm
Recommended Measurement Distance from Surface	1.4mm

ANNEX G Dipole Calibration Certificate

1750 MHz Dipole Calibration Certificate

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

S **Schweizerischer Kalibrierdienst**
C **Service suisse d'étalonnage**
S **Servizio svizzero di taratura**
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 0108

Client **CTTL**
Beijing

Certificate No. **D1750V2-1003_Jul23**

CALIBRATION CERTIFICATE

Object	D1750V2 - SN:1003
Calibration procedure(s)	QA CAL-05.v12 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz
Calibration date:	July 12, 2023

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 NRP2	SN: 104778	30-Mar-23 (No. 217-03804/03805)	Mar-24
Power sensor NRP-Z91	SN: 103244	30-Mar-23 (No. 217-03804)	Mar-24
Power sensor NRP-Z91	SN: 103245	30-Mar-23 (No. 217-03805)	Mar-24
Reference 20 dB Attenuator	SN: BH9394 (20k)	30-Mar-23 (No. 217-03809)	Mar-24
Type-N mismatch combination	SN: 310982 / 06327	30-Mar-23 (No. 217-03810)	Mar-24
Reference Probe EX3DV4	SN: 7349	10-Jan-23 (No. EX3-7349_Jan23)	Jan-24
DAE4	SN: 601	19-Dec-22 (No. DAE4-601_Dec22)	Dec-23

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-22)	In house check: Oct-24
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24

	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	M.Weber
Approved by:	Sven Kühn	Technical Manager	S. Kühn

Issued: July 18, 2023

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

Certificate No: D1750V2-1003_Jul23 Page 1 of 6

