



Appendix C

Calibration certificate

1. Dipole
D2450V2-SN 808
D5GHzV2-SN 1046
2. DAE
DAE3-SN 373
3. Probe
EX3DV4-SN 3805



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CALIBRATION
CNAS L0570

CAICT

Client **SHENZHEN LCS** Certificate No: **26J02Z000503**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 808**

Calibration Procedure(s) **FF-Z11-0003-02**
Calibration Procedures for dipole validation kits

Calibration date: **August 19, 2026**

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 (Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106276	04-Aug-25 (CTTL, No. 26J02X006385)	Aug-27
Power sensor NRP18A	102171	04-Aug-25 (CTTL, No. 26J02X006385)	Aug-27
Reference Probe EX3DV4	SN 7600	19-Jan-26(CTTL-SPEAG, No. 26J02Z000008)	Jan-27
DAE4	SN 1588	29-Aug-25(CTTL-SPEAG, No. 25J02Z000631)	Aug-26

Secondary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
SignalGeneratorSMA200A	107732	01-Dec-25 (CTTL, No. 25J02X102467)	Nov-26
NetworkAnalyzer E5071C	MY46110673	26-Nov-25 (CTTL, No. 25J02X102468)	Nov-26
OCP DAKS-3.5	0015	20-Oct-25(SPEAG, No. OCP-DAKS-0015_Oct25)	Oct-26

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Lin Jun	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: August 21, 2026

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Glossary:

TSL	tissue simulating liquid
HSL	head simulating liquid
MSL	muscle 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:

- 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-mounted Wireless Communication Devices- Part 1528: Human Models, Instrumentation and Procedures (Frequency range of 4 MHz to 10 GHz)", October 2020
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- 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 dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. 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%.

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Measurement Conditions

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

DASY Version	DASY6	V18.0.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Frequency	2450 MHz $\pm$ 1 MHz	

HSL parameters at 2450 MHz

The following parameters and calculations were applied.

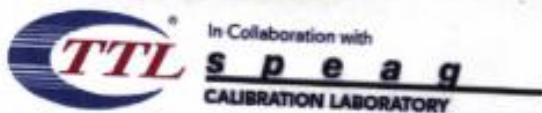
	Temperature	Permittivity	Conductivity
Nominal HSL parameters	22.0 °C	39.2	1.80 mho/m
Measured HSL parameters	(22.0 $\pm$ 0.2) °C	39.0 $\pm$ 6 %	1.81 mho/m $\pm$ 6 %
HSL temperature change during test	<1.0 °C	—	—

SAR result with HSL at 2450 MHz

SAR averaged over 1 cm ³ (1 g) of HSL	Condition	
SAR for nominal HSL parameters	24 dBm input power	13.2 W/kg
SAR for nominal HSL parameters	normalized to 1W	52.8 W/kg $\pm$ 20 % (k=2)
SAR averaged over 10 cm ³ (10 g) of HSL	Condition	
SAR for nominal HSL parameters	24 dBm input power	6.25 W/kg
SAR for nominal HSL parameters	normalized to 1W	25.0 W/kg $\pm$ 20 % (k=2)

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with HSL at 2450 MHz

Impedance, transformed to feed point	52.6Q+ 4.71jQ
Return Loss	- 25.6dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.062 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point 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 feed-point may be damaged.

Additional EUT Data

Manufactured by	SPEAG
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DASY6 Validation Report for HSL
Test Laboratory: CTTL, Beijing, China

Date: 2026-08-19

Summary

Dipole	Frequency [MHz]	TSL	Power [dBm]
D2450V2 - SN 858	2450	Head	24

Exposure Conditions

Phantom	Position, Test	Band Group	Frequency	Conversion	TSL Cond.	TSL
Section, TSL	Distance [mm]	UID	[MHz]	Factor	[S/m]	Permittivity
Flat	10	CW,	2450	8.05	1.81	39.0

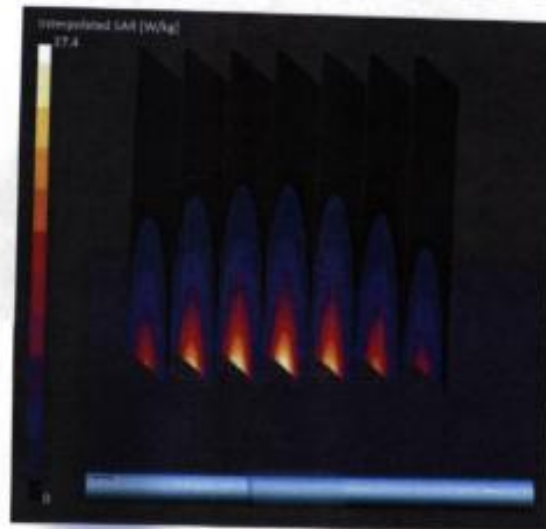
Hardware Setup

Phantom	TSL	Probe, Calibration Date	DAE, Calibration Date
MFP V8.0 Right	2450 Head	EX3DV4 - SN7600, 2026-01-19	DAE4 Sn1588, 2025-08-29

Scan Setup

Measurement Results

Zoom Scan		Zoom Scan
Grid Extents [mm]	30.0×30.0×30.0	psSAR1g [W/kg]
Grid Steps [mm]	5.0×5.0×1.5	psSAR10g [W/kg]
Sensor Surface [mm]	1.4	Power Drift [dB]
Graded Grid	Yes	Power Scaling
Grading Ratio	1.5	Scaling Factor [dB]
MAIA	N/A	TSL Correction
Surface Detection	VMS + 6p	Positive / Negative
Scan Method	Measured	M2/M1 [%]
		Dist 3dB Peak [mm]



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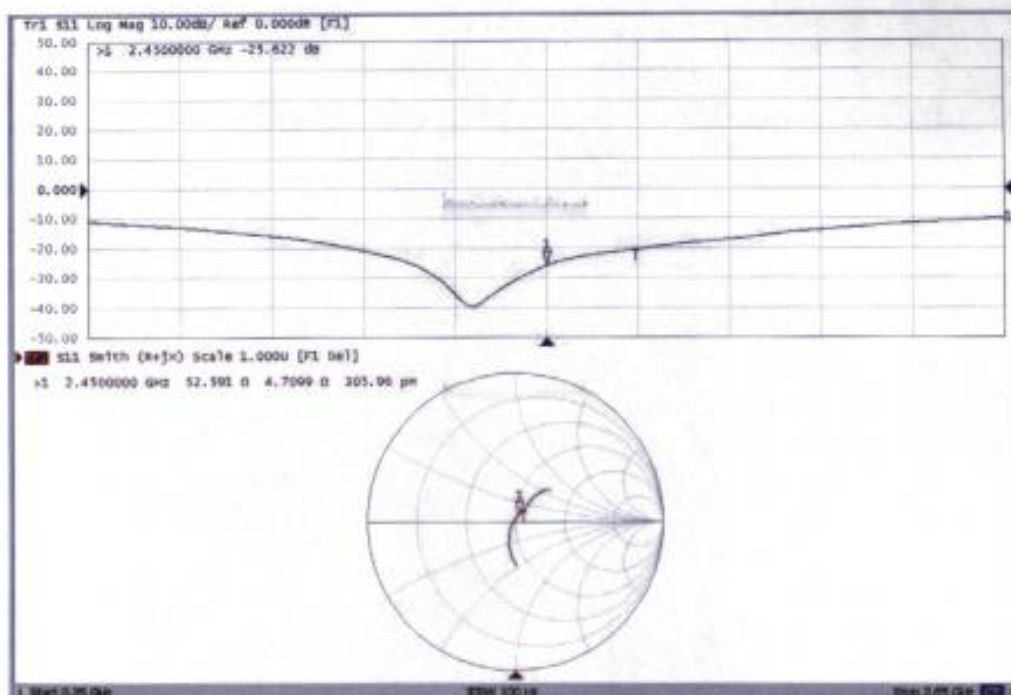


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Impedance Measurement Plot for HSL



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CNAS L0570

Client **SHENZHEN LCS**Certificate No: **26J02Z000504****CALIBRATION CERTIFICATE**Object **D5GHzV2 - SN: 1046**Calibration Procedure(s) **FF-Z11-0003-02
Calibration Procedures for dipole validation kits**Calibration date: **August 18, 2026**

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 (Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106276	04-Aug-25 (CTTL, No. 26J02X006385)	Aug-27
Power sensor NRP18A	102171	04-Aug-25 (CTTL, No. 26J02X006385)	Aug-27
Reference Probe EX3DV4	SN 7600	19-Jan-26(CTTL-SPEAG, No. 26J02Z000008)	Jan-27
DAE4	SN 1588	29-Aug-25(CTTL-SPEAG, No. 25J02Z000631)	Aug-26
Secondary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
SignalGeneratorSMA200A	107732	01-Dec-25 (CTTL, No. 25J02X102467)	Nov-26
NetworkAnalyzer E5071C	MY46110673	26-Nov-25 (CTTL, No. 25J02X102468)	Nov-26
OCP DAKS-3.5	0015	20-Oct-25(SPEAG, No. OCP-DAKS-0015_Oct25)	Oct-26

	Name	Function
Calibrated by:	Zhao Jing	SAR Test Engineer
Reviewed by:	Lin Jun	SAR Test Engineer
Approved by:	Qi Dianyuan	SAR Project Leader

Signature

Issued: August 21, 2026

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Glossary:

TSL	tissue simulating liquid
HSL	head simulating liquid
MSL	muscle 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:

- 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-mounted Wireless Communication Devices- Part 1528: Human Models, Instrumentation and Procedures (Frequency range of 4 MHz to 10 GHz)", October 2020
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- 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 dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. 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%.



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Measurement Conditions

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

DASY Version	DASY6	V18.0.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Frequency	5250 MHz $\pm$ 1 MHz 5600 MHz $\pm$ 1 MHz 5750 MHz $\pm$ 1 MHz	

HSL parameters at 5250MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal HSL parameters	22.0 °C	35.9	4.71 mho/m
Measured HSL parameters	(22.0 $\pm$ 0.2) °C	35.4 $\pm$ 6 %	4.72 mho/m $\pm$ 6 %
HSL temperature change during test	<1.0 °C	—	—

SAR result with HSL at 5250MHz

SAR averaged over 1 cm^3 (1 g) of HSL	Condition	
SAR for nominal HSL parameters	20 dBm input power	7.78 W/kg
SAR for nominal HSL parameters	normalized to 1W	77.8 W/kg $\pm$ 24 % ($k=2$)
SAR averaged over 10 cm^3 (10 g) of HSL	Condition	
SAR for nominal HSL parameters	20 dBm input power	2.22 W/kg
SAR for nominal HSL parameters	normalized to 1W	22.2 W/kg $\pm$ 24 % ($k=2$)

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HSL parameters at 5600MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal HSL parameters	22.0 °C	35.5	5.07 mho/m
Measured HSL parameters	(22.0 ± 0.2) °C	34.8 ± 6 %	5.10 mho/m ± 6 %
HSL temperature change during test	<1.0 °C	---	---

SAR result with HSL at 5600MHz

SAR averaged over 1 cm ³ (1 g) of HSL	Condition	
SAR for nominal HSL parameters	20 dBm input power	8.16 W/kg
SAR for nominal HSL parameters	normalized to 1W	81.6 W/kg ± 24 % (k=2)
SAR averaged over 10 cm ³ (10 g) of HSL	Condition	
SAR for nominal HSL parameters	20 dBm input power	2.33 W/kg
SAR for nominal HSL parameters	normalized to 1W	23.3 W/kg ± 24 % (k=2)

HSL parameters at 5750MHz

The following parameters and calculations were applied.

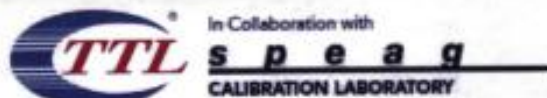
	Temperature	Permittivity	Conductivity
Nominal HSL parameters	22.0 °C	35.4	5.22 mho/m
Measured HSL parameters	(22.0 ± 0.2) °C	34.7 ± 6 %	5.27 mho/m ± 6 %
HSL temperature change during test	<1.0 °C	---	---

SAR result with HSL at 5750MHz

SAR averaged over 1 cm ³ (1 g) of HSL	Condition	
SAR for nominal HSL parameters	20 dBm input power	7.70 W/kg
SAR for nominal HSL parameters	normalized to 1W	77.0 W/kg ± 24 % (k=2)
SAR averaged over 10 cm ³ (10 g) of HSL	Condition	
SAR for nominal HSL parameters	20 dBm input power	2.17 W/kg
SAR for nominal HSL parameters	normalized to 1W	21.7 W/kg ± 24 % (k=2)

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with HSL at 5250MHz

Impedance, transformed to feed point	50.7Ω- 2.42jΩ
Return Loss	- 32.1dB

Antenna Parameters with HSL at 5600MHz

Impedance, transformed to feed point	55.9Ω- 0.38jΩ
Return Loss	- 25.1dB

Antenna Parameters with HSL at 5750MHz

Impedance, transformed to feed point	55.1Ω+ 0.72jΩ
Return Loss	- 26.2dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.105 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point 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 feed-point may be damaged.

Additional EUT Data

Manufactured by	SPEAG
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DASY6 Validation Report for HSL
Test Laboratory: CTTL, Beijing, China

Date: 2026-08-18

Summary

Dipole	Frequency [MHz]	TSL	Power [dBm]
D5GHzV2 – SN 1046	5250	Head	20

Exposure Conditions

Phantom	Position, Test	Band Group,	Frequency	Conversion	TSL Cond.	TSL
Section, TSL	Distance [mm]	UID	[MHz]	Factor	[S/m]	Permittivity
Flat	10	CW,	5250	5.67	4.72	35.4

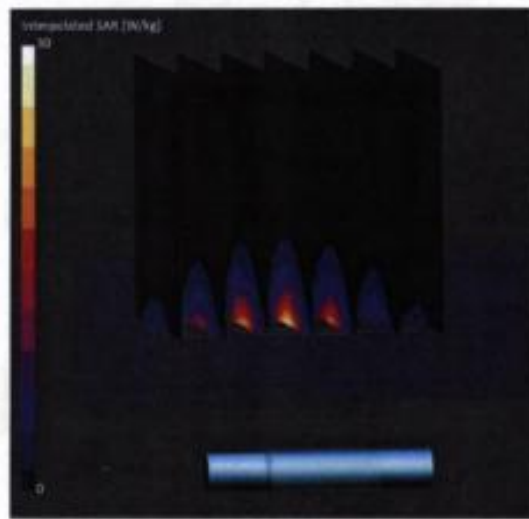
Hardware Setup

Phantom	TSL	Probe, Calibration Date	DAE, Calibration Date
MFP V8.0 Right	HSL5G	EX3DV4 - SN7600, 2026-01-19	DAE4 Sn1588, 2025-08-29

Scan Setup

Measurement Results

	Zoom Scan	Zoom Scan
Grid Extents [mm]	22.0×22.0×22.0	psSAR1g [W/kg]
Grid Steps [mm]	4.0×4.0×1.4	psSAR10g [W/kg]
Sensor Surface [mm]	1.4	Power Drift [dB]
Graded Grid	Yes	Power Scaling
Grading Ratio	1.4	Scaling Factor [dB]
MAIA	N/A	TSL Correction
Surface Detection	VMS + 6p	M2/M1 [%]
Scan Method	Measured	Dist 3dB Peak [mm]



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DASY6 Validation Report for HSL
Test Laboratory: CTTL, Beijing, China

Date: 2026-08-18

Summary

Dipole	Frequency [MHz]	TSL	Power [dBm]
D5GHzV2 – SN 1046	5600	Head	20

Exposure Conditions

Phantom	Position, Test	Band Group,	Frequency	Conversion	TSL Cond.	TSL
Section, TSL	Distance [mm]	UID	[MHz]	Factor	[S/m]	Permittivity
Flat	10	CW,	5600	5.07	5.10	34.8

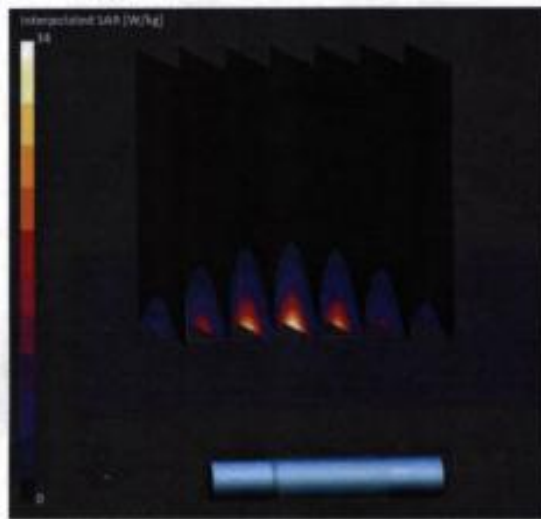
Hardware Setup

Phantom	TSL	Probe, Calibration Date	DAE, Calibration Date
MFP V8.0 Right	HSL5G	EX3DV4 - SN7600, 2026-01-19	DAE4 Sn1588, 2025-08-29

Scan Setup

Measurement Results

	Zoom Scan		Zoom Scan
Grid Extents [mm]	22.0×22.0×22.0	psSAR1g [W/kg]	8.16
Grid Steps [mm]	4.0×4.0×1.4	psSAR10g [W/kg]	2.33
Sensor Surface [mm]	1.4	Power Drift [dB]	0.00
Graded Grid	Yes	Power Scaling	Disabled
Grading Ratio	1.4	Scaling Factor [dB]	
MAIA	N/A	TSL Correction	Positive / Negative
Surface Detection	VMS + 6p	M2/M1 [%]	62.1
Scan Method	Measured	Dist 3dB Peak [mm]	6.8



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DASY6 Validation Report for HSL
Test Laboratory: CTTL, Beijing, China

Date: 2026-08-18

Summary

Dipole	Frequency [MHz]	TSL	Power [dBm]
D5GHzV2 - SN 1046	5750	Head	20

Exposure Conditions

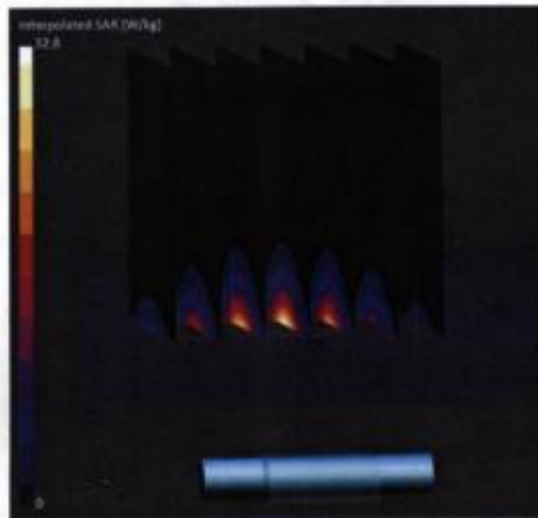
Phantom	Position, Test	Band Group, UID	Frequency [MHz]	Conversion Factor	TSL Cond. [S/m]	TSL Permittivity
Flat	10	CW,	5750	5.15	5.27	34.7

Hardware Setup

Phantom	TSL	Probe, Calibration Date	DAE, Calibration Date
MFP V8.0 Right	HSL5G	EX3DV4 - SN7600, 2026-01-19	DAE4 Sn1588, 2025-08-29

Scan Setup**Measurement Results**

	Zoom Scan		Zoom Scan
Grid Extents [mm]	22.0×22.0×22.0	psSAR1g [W/kg]	7.70
Grid Steps [mm]	4.0×4.0×1.4	psSAR10g [W/kg]	2.17
Sensor Surface [mm]	1.4	Power Drift [dB]	0.01
Graded Grid	Yes	Power Scaling	Disabled
Grading Ratio	1.4	Scaling Factor [dB]	
MAIA	N/A	TSL Correction	Positive / Negative
Surface Detection	VMS + 6p	M2/M1 [%]	61.4
Scan Method	Measured	Dist 3dB Peak [mm]	6.8



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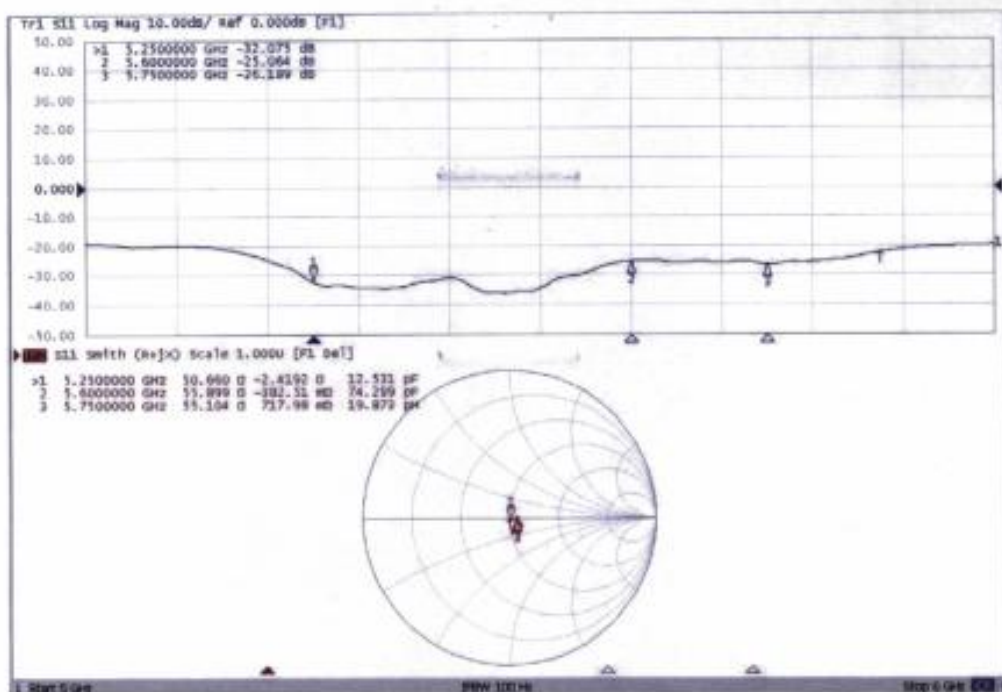


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Testing Lab

Impedance Measurement Plot for HSL



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立讯测试股份
Testing Lab

Client:

SHENZHEN LCS

Certificate No: 26J02Z000108

CALIBRATION CERTIFICATE

Object DAE3 - SN: 373

Calibration Procedure(s) FF-Z11-002-01
Calibration Procedure for the Data Acquisition Electronics
(DAEx)

Calibration date: March 02, 2026

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
Process Calibrator 753	1971018	11-Jun-25 (CTTL, No.25J02X004977)	Jun-26

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

Issued: March 05, 2026

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Glossary:

DAE data acquisition electronics
Connector angle information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters:

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle:* The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The report provide only calibration results for DAE, it does not contain other performance test results.

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DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1 μ V, full range = -100...+300 mV

Low Range: 1LSB = 61nV, full range = -1.....+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	402.672 $\pm$ 0.15% (k=2)	403.248 $\pm$ 0.15% (k=2)	402.707 $\pm$ 0.15% (k=2)
Low Range	3.92029 $\pm$ 0.7% (k=2)	3.97624 $\pm$ 0.7% (k=2)	3.93424 $\pm$ 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	293.5° $\pm$ 1°
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CALIBRATION CERTIFICATE

Object EX3DV4 - SN : 3805

Calibration Procedure(s) FF-Z11-0004-03
Calibration Procedures for Dosimetric E-field Probes

Calibration date: March 02, 2026

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(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	20-Oct-25(CTTL, No.25J02X100272)	Oct-26
Power sensor NRP8S	104291	20-Oct-25(CTTL, No.25J02X100272)	Oct-26
Power sensor NRP8S	104292	20-Oct-25(CTTL, No.25J02X100272)	Oct-26
Reference 10dBAttenuator	18N50W-10dB	22-Jan-25(CTTL, No.25J02X000465)	Jan-27
Reference 20dBAttenuator	18N50W-20dB	22-Jan-25(CTTL, No.25J02X000466)	Jan-27
Reference Probe EX3DV4	SN 7307	27-May-25(SPEAG, No.EX-7307_May25)	May-26
DAE4	SN 1525	12-Sep-25(SPEAG, No.DAE4-1525_Sep25)	Sep-26
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
SignalGenerator MG3700A	6201052605	10-Jun-25(CTTL, No.25J02X004975)	Jun-26
SignalGenerator APSIN26G	181-33A6D0700-1959	27-Mar-25(CTTL, No.25J02X001962)	Mar-26
Network Analyzer E5071C	MY46110673	26-Nov-25(CTTL, No.25J02X102468)	Nov-26
Reference 10dBAttenuator	BT0520	15-May-25(CTTL, No.25J02X003069)	May-27
Reference 20dBAttenuator	BT0267	15-May-25(CTTL, No. 25J02X003070)	May-27
OCP DAKS-3.5	SN 0015	20-Oct-25(SPEAG, No. OCP-DAKS-0015_Oct25)	Oct-26

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

Issued: March 05, 2026

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

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Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,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 $\theta=0$ 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:

- IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency 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.
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\theta=0$ ($f \leq 900\text{MHz}$ in TEM-cell; $f > 1800\text{MHz}$: waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not effect the E^2 -field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z} = NORM_{x,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.
- DCP_{x,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.
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; VR_{x,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 $f \leq 800\text{MHz}$) and inside waveguide using analytical field distributions based on power measurements for $f > 800\text{MHz}$. 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 NORM_{x,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 $\pm 50\text{MHz}$ to $\pm 100\text{MHz}$.
- 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 NORM_x (no uncertainty required).



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DASY/EASY – Parameters of Probe: EX3DV4 – SN:3805

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm($\mu V/(V/m)^2$) ^A	0.49	0.63	0.45	±10.0%
DCP(mV) ^B	102.2	98.1	102.0	

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	169.2	±2.2%
		Y	0.0	0.0	1.0		190.5	
		Z	0.0	0.0	1.0		156.5	

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 E²-field uncertainty inside TSL (see Page 4).

^B Numerical linearization parameter; uncertainty not required.

^E Uncertainty 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:3805

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	9.51	9.51	9.51	0.10	1.57	±13%
835	41.5	0.90	9.11	9.11	9.11	0.15	1.27	±13%
1750	40.1	1.37	8.05	8.05	8.05	0.18	1.20	±13%
1900	40.0	1.40	7.75	7.75	7.75	0.20	1.19	±13%
2000	40.0	1.40	7.73	7.73	7.73	0.19	1.13	±13%
2300	39.5	1.67	7.64	7.64	7.64	0.59	0.68	±13%
2450	39.2	1.80	7.38	7.38	7.38	0.58	0.69	±13%
2600	39.0	1.96	7.20	7.20	7.20	0.63	0.67	±13%
3300	38.2	2.71	6.80	6.80	6.80	0.43	0.94	±14%
3500	37.9	2.91	6.66	6.66	6.66	0.39	1.09	±14%
3700	37.7	3.12	6.50	6.50	6.50	0.47	1.00	±14%
3900	37.5	3.32	6.43	6.43	6.43	0.30	1.52	±14%
4100	37.2	3.53	6.37	6.37	6.37	0.40	1.15	±14%
4200	37.1	3.63	6.26	6.26	6.26	0.35	1.35	±14%
4800	36.4	4.25	6.06	6.06	6.06	0.40	1.40	±14%
5250	35.9	4.71	5.35	5.35	5.35	0.45	1.40	±14%
5600	35.5	5.07	4.75	4.75	4.75	0.55	1.20	±14%
5750	35.4	5.22	4.87	4.87	4.87	0.50	1.30	±14%

^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.

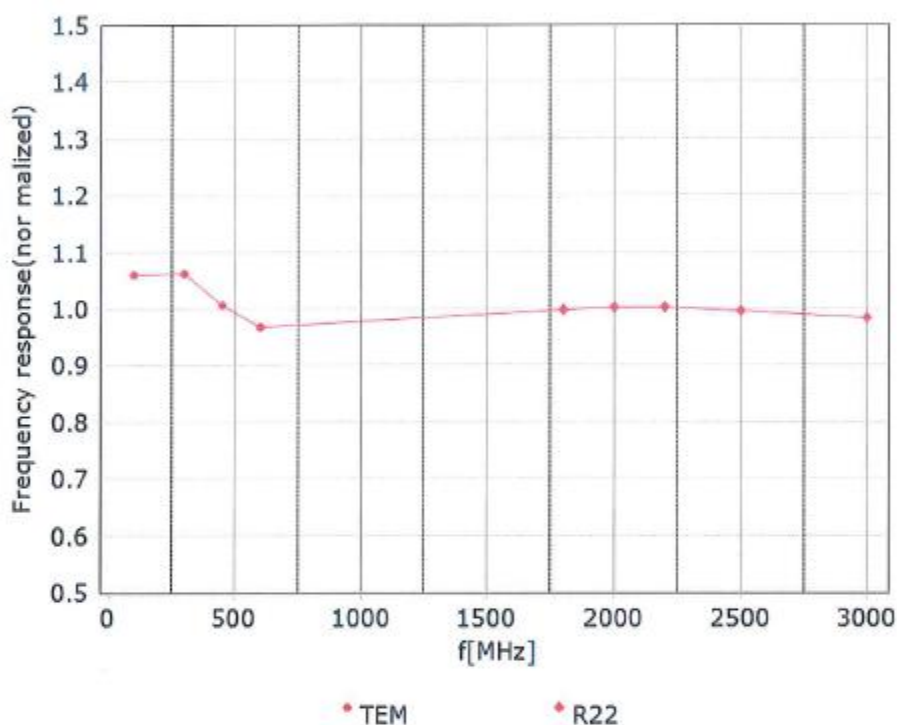


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Frequency Response of E-Field (TEM-Cell: ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: $\pm 7.4\%$ ($k=2$)

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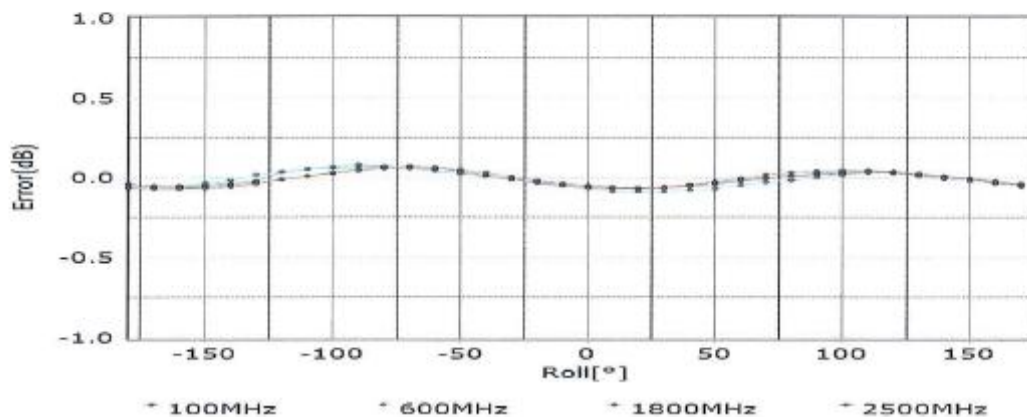
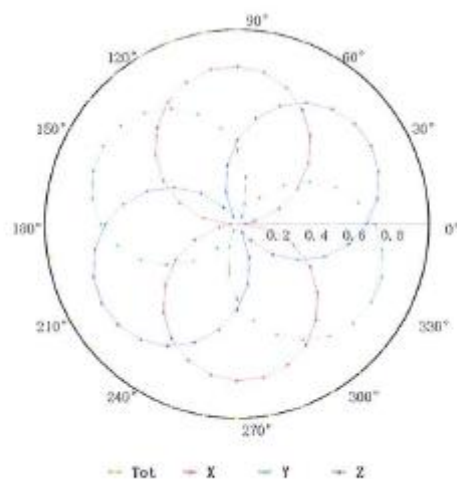
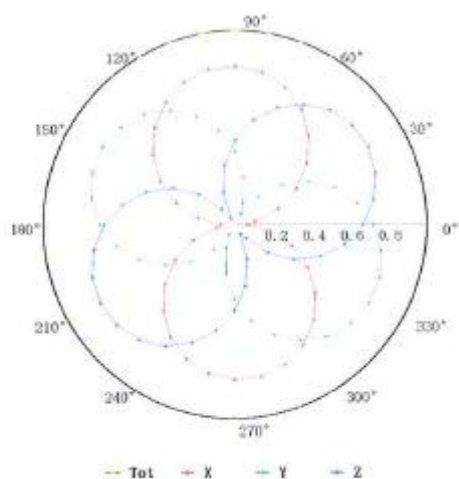
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Receiving Pattern (Φ), $\theta=0^\circ$

f=600 MHz, TEM

f=1800 MHz, R22



Uncertainty of Axial Isotropy Assessment: $\pm 1.2\%$ ($k=2$)

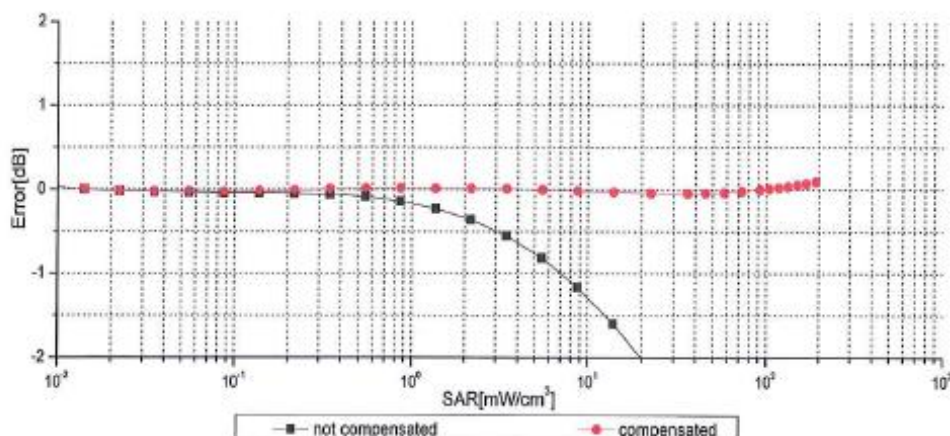
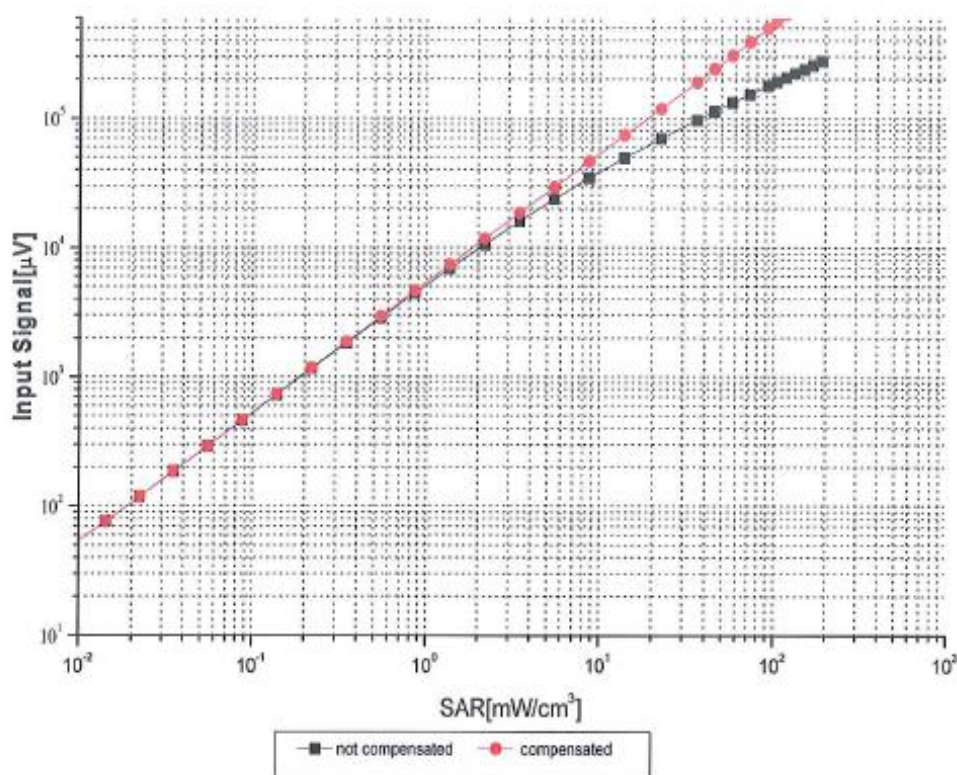
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Dynamic Range f(SAR_{head}) (TEM cell, f = 900 MHz)



Uncertainty of Linearity Assessment: $\pm 0.9\%$ ($k=2$)

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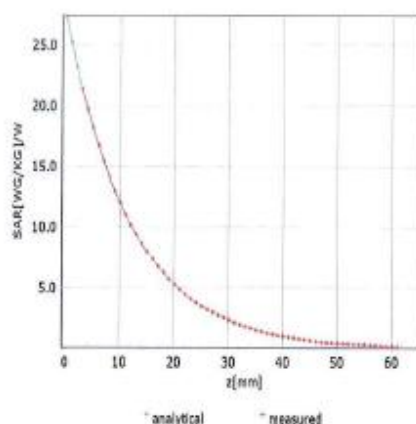
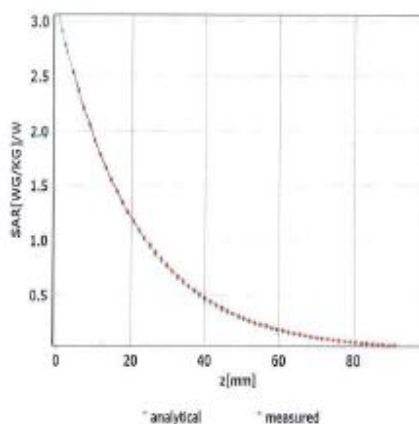


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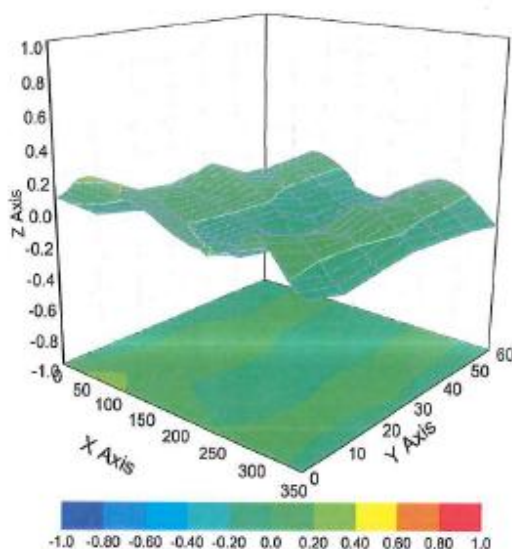
Conversion Factor Assessment

$f=750\text{ MHz, WGLS R9(H_convF)}$

$f=1750\text{ MHz, WGLS R22(H_convF)}$



Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: $\pm 3.2\%$ ($k=2$)

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DASY/EASY – Parameters of Probe: EX3DV4 – SN:3805

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	124.7
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