

Appendix E - Calibration Certificate for Dipole



Accredited by the Swiss Accreditation Service (SAS)
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client

Eurofins E&E Wireless
New Taipei City

Certificate No.

D750V3-1222_Jun25

CALIBRATION CERTIFICATE

Object **D750V3 - SN: 1222**

Calibration procedure(s) **QA CAL-05.v12**
Calibration Procedure for SAR Validation Sources between 0.7 - 3 GHz

Calibration date **June 3, 2025**

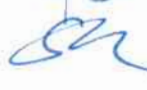
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Cal
Power Sensor R&S NRP-33T	SN: 100967	26-Mar-25 (No. 217-04290)	Mar-26
Power Sensor R&S NRP18A	SN: 101859	06-Feb-25 (No. 4030A315009541)	Feb-26
Spectrum Analyzer R&S FSV40	SN: 101832	29-Jan-25 (No. 4030A315009658)	Jan-26
3.5mm mismatch combination	SN: 1152	24-Mar-25 (No. 217-04293)	Mar-26
OCP DAK-12	SN: 1016	24-Sept-24 (No. OCP-DAK12-1016_Sep24)	Sep-25
OCP DAK-3.5	SN: 1249	23-Sept-24 (No. OCP-DAK3.5-1249_Sep24)	Sep-25
Reference Probe EX3DV4	SN: 7349	10-Jan-25 (No. EX3-7349_Jan25)	Jan-26
DAE4ip	SN: 1836	17-Apr-25 (No. DAE4ip-1836_Apr25)	Apr-26

Secondary Standards	ID	Check Date (in house)	Scheduled Check
ACAD Setup 1	SN: 1000	27-May-25 (No. 675-ACAD_Source_Box-250527)	May-26
Signal Generator R&S SMB100A	SN: 182081	27-May-25 (No. 675-CAL16-S4588-250527)	May-26
Mismatch; SMA	SN: 1102	24-Apr-25 (No. 675-Mismatch_SMA-250424)	Apr-26

	Name	Function	Signature
Calibrated by	Claudio Leubler	Laboratory Technician	
Approved by	Sven Kühn	Technical Manager	
Issued: June 3, 2025			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



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Multilateral Agreement for the recognition of calibration certificates**

Accreditation No.: SCS 0108

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

- 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.
- 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.
- *Electrical Delay*: One-way delay between the SMA connector and the antenna feed point. 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%.

Measurement Conditions

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

DASY Version	DASY8 Module SAR	16.4.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with spacer
Zoom Scan Resolution	dx, dy = 6mm, dz = 1.5mm	Graded Ratio = 1.5 mm (Z direction)
Frequency	750MHz $\pm$ 1MHz	

HSL parameters at 750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal HSL parameters	22.0 °C	41.9	0.890 mho/m
Measured HSL parameters	(22.0 $\pm$ 0.2)°C	43.2 $\pm$ 6%	0.900 mho/m $\pm$ 6%
HSL temperature change during test	< 0.5 °C		

SAR result with HSL at 750 MHz

SAR averaged over 1 cm³ (1 g) of HSL	Condition	
SAR for nominal HSL parameters	24 dBm input power	2.20 W/kg
SAR for nominal HSL parameters	normalized to 1W	8.76 W/kg $\pm$ 17.0% (k = 2)

SAR averaged over 10 cm³ (10 g) of HSL	Condition	
SAR for nominal HSL parameters	24 dBm input power	1.43 W/kg
SAR for nominal HSL parameters	normalized to 1W	5.69 W/kg $\pm$ 16.5% (k = 2)

Appendix (Additional assessments outside the scope of SCS 0108)**Antenna Parameters with HSL at 750 MHz**

Impedance	52.2 Ω – 3.5 j Ω
Return Loss	-27.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.036 ns
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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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System Performance Check Report

Summary

Dipole	Frequency [MHz]	TSL	Power [dBm]
D750V3 - SN1222	750	HSL	24

Exposure Conditions

Phantom Section, TSL	Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor	TSL Conductivity [S/m]	TSL Permittivity
Flat	15		CW, 0--	750, 0	9.55	0.90	43.2

Hardware Setup

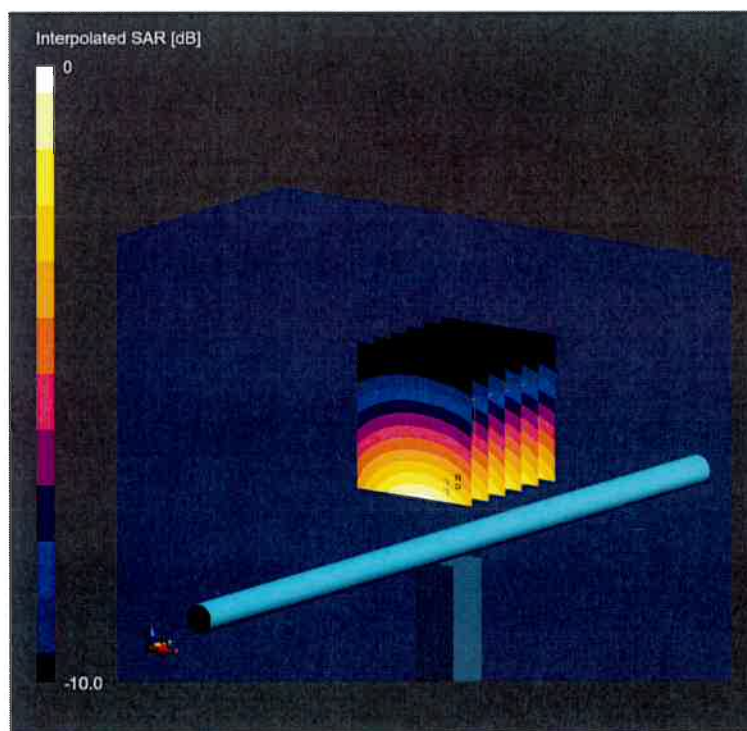
Phantom	TSL, Measured Date	Probe, Calibration Date	DAE, Calibration Date
Flat V4.9 mod	HSL, 2025-06-03	EX3DV4 - SN7349, 2025-01-10	DAE4ip Sn1836, 2025-04-17

Scans Setup

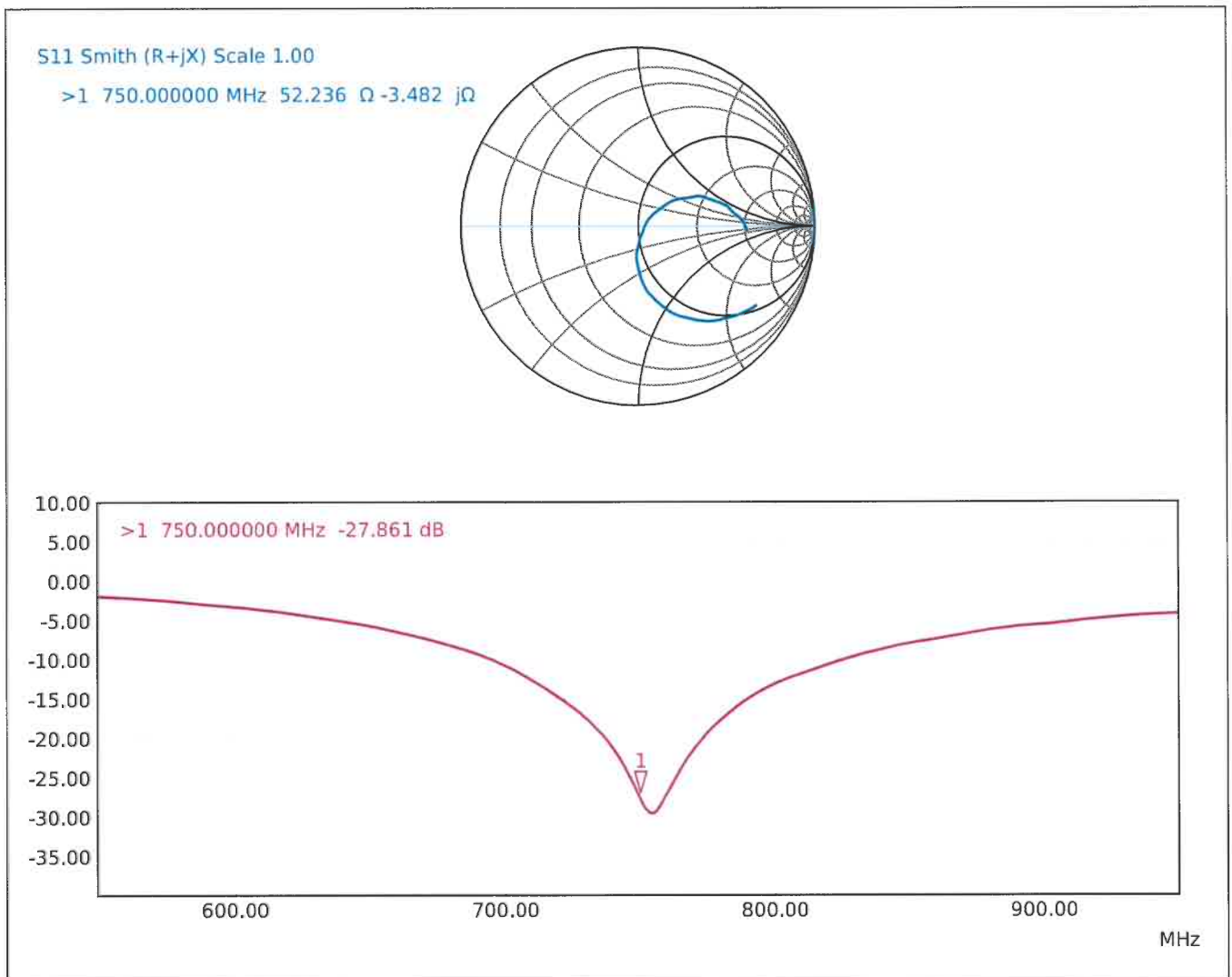
	Zoom Scan
Grid Extents [mm]	30 x 30 x 30
Grid Steps [mm]	6.0 x 6.0 x 1.5
Sensor Surface [mm]	1.4
Graded Grid	Yes
Grading Ratio	1.5
MAIA	N/A
Surface Detection	VMS + 6p
Scan Method	Measured

Measurement Results

	Zoom Scan
Date	2025-06-03
psSAR1g [W/Kg]	2.20
psSAR10g [W/Kg]	1.43
Power Drift [dB]	-0.01
Power Scaling	Disabled
Scaling Factor [dB]	
TSL Correction	Positive / Negative



Impedance Measurement Plot for HSL



ANNUAL DIPOLE VERIFICATION REPORT

Conforming to FCC KDB 865664 D01 v01r04 Section 3.2.2 & EN IEC/IEEE 62209-1528 & IEC/IEEE 62209-1528.

1. General Information

Device Under Test (DUT) Identification		Measurement Environment & Conditions	
Dipole Manufacturer :	SPEAG	Test Date :	Jun. 01, 2026
Dipole Model :	D750V3	Ambient Temperature :	22.5 °C
Serial Number (S/N) :	1222	Liquid Temperature :	21.1 °C
Original Cal. Date :	Jun. 03, 2025 (SPEAG)	VNA Model :	Keysight E5080B
Test Frequency (MHz) :	750	VNA Cal. Due Date :	Feb. 08, 2027

2. Visual Inspection Checklist

Prior to electrical measurements, a strict visual inspection must be conducted to ensure no physical deviations affect the dipole's antenna characteristics.

Check	Inspection Item	Description / Verification Details	Status
Good	Dipole Element Integrity	Visually check the dipole arms and center feed. No mechanical bending, structural deformation, or asymmetric misalignment.	Valid
Good	RF Connector Physical Status	Inspect the SMA/RF connector threads, inner pin, and outer shield. No stripped threads, metal burrs, corrosion, or inner pin displacement.	Valid
Good	Spacer & Mechanical Mount	Ensure the plastic spacer/clip and support distance holder are rigid, crack-free, and securely attached.	Valid

3. Electrical Verification Data & Comparison Results

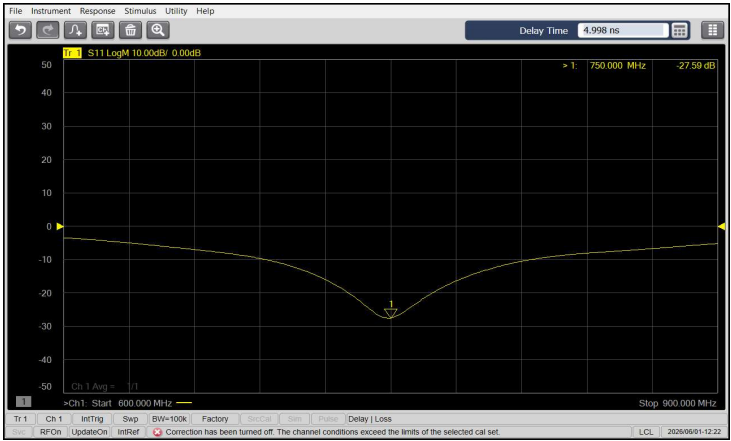
According to **FCC KDB 865664 D01 v01r04 Section 3.2.2** and accepted international practices for **CE (EN IEC/IEEE 62209-1528)** and **IEC/IEEE 62209-1528**, an annual dipole evaluation may be extended up to 3 years if the baseline parameters are verified annually against the following criteria:

- **Return Loss (S11):** Deviation must be **< 20 %** from the original calibration (i.e. **value in dB x 0.2**), AND the return loss must remain **< -20 dB**.
- **Impedance (Real & Imaginary parts):** Deviation must be **< 5 Ω** from the original calibration.
- **System Check (Optional / Supporting):** Normalized SAR output must remain within **± 10 %** of the calibrated target.

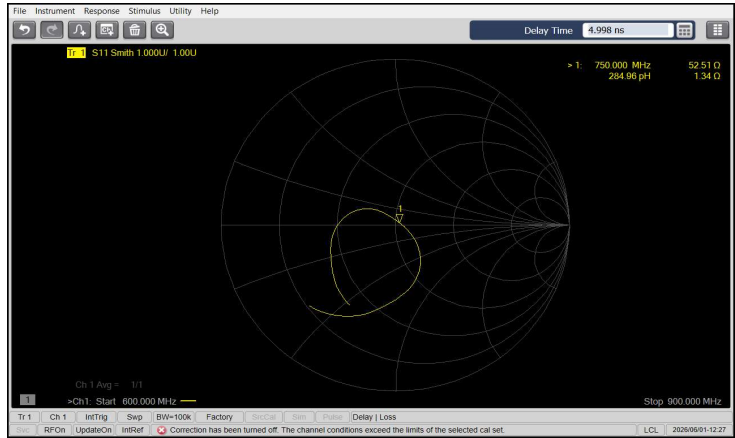
3.1 S11 Return Loss & Impedance Comparison

Frequency (MHz)	Parameter	Original Cal. Data (by SPEAG)	Annual Verified Data (by SAR Lab)	Absolute Difference	Criteria	Verdict
750	Return Loss (S11)	-27.861 dB	-27.59 dB	0.3 dB	< 5.57 dB	Pass
	Impedance, Real Part	52.236 Ω	52.51 Ω	0.27 Ω	< 5 Ω	Pass
	Impedance, Imaginary Part	-3.482 Ω	1.34 Ω	4.82 Ω	< 5 Ω	Pass

Return Loss:



Smith Chart:



3.2 System Performance Check (Supporting Validation)

Frequency (MHz)	Parameter	Target Value (1W) (SPEAG Cal. Report)	Measured Value (by SAR Lab)	Normalized to 1W (by SAR Lab)	Absolute Difference	Criteria	Verdict
750	Normalized SAR 1g	8.8 W/kg	0.41 W/kg	8.22 W/kg	6.16 %	< 10 %	Pass
	Normalized SAR 10g	5.7 W/kg	0.27 W/kg	5.40 W/kg	5.10 %	< 10 %	Pass

4. Conclusion & Status Verification

Final Justification Verdict : **COMPLIANT (Extension Justified)**

Based on the annual visual inspection and verification measurements performed by engineer, the System Validation Dipole satisfies all physical check parameters, electrical deviation criteria (Return Loss < 20 %, Impedance < 5 Ω delta, and System Check < ± 10 % deviation) and system check requirements specified under FCC KDB 865664 D01 v01r04, EN IEC/IEEE 62209-1528, and IEC/IEEE 62209-1528. No mechanical damage or structural deviations were observed.

Therefore, the validity of the original SPEAG calibration certificate is successfully extended for another 12-month period until the next annual review (not exceeding 3 years from the original calibration date).

Prepared By :

Mars Chang
SAR Test Supervisor
Date: 2026/6/1

Approved By :

Raymond Wu
Laboratory Assistant Manager
Date: 2026/6/1



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **Eurofins E&E Wireless**
New Taipei City

Certificate No. **D1800V2-2d167_Jun25**

CALIBRATION CERTIFICATE

Object **D1800V2 - SN: 2d167**

Calibration procedure(s) **QA CAL-05.v12**
Calibration Procedure for SAR Validation Sources between 0.7 - 3 GHz

Calibration date **June 4, 2025**

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 $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Cal
Power Sensor R&S NRP-33T	SN: 100967	26-Mar-25 (No. 217-04290)	Mar-26
Power Sensor R&S NRP18A	SN: 101859	06-Feb-25 (No. 4030A315009541)	Feb-26
Spectrum Analyzer R&S FSV40	SN: 101832	29-Jan-25 (No. 4030A315009658)	Jan-26
3.5mm mismatch combination	SN: 1152	24-Mar-25 (No. 217-04293)	Mar-26
OCP DAK-12	SN: 1016	24-Sept-24 (No. OCP-DAK12-1016_Sep24)	Sep-25
OCP DAK-3.5	SN: 1249	23-Sept-24 (No. OCP-DAK3.5-1249_Sep24)	Sep-25
Reference Probe EX3DV4	SN: 7349	10-Jan-25 (No. EX3-7349_Jan25)	Jan-26
DAE4ip	SN: 1836	17-Apr-25 (No. DAE4ip-1836_Apr25)	Apr-26

Secondary Standards	ID	Check Date (in house)	Scheduled Check
ACAD Setup 1	SN: 1000	27-May-25 (No. 675-ACAD_Source_Box-250527)	May-26
Signal Generator R&S SMB100A	SN: 182081	27-May-25 (No. 675-CAL16-S4588-250527)	May-26
Mismatch; SMA	SN: 1102	24-Apr-25 (No. 675-Mismatch_SMA-250424)	Apr-26

	Name	Function	Signature
Calibrated by	Leif Klysner	Laboratory Technician	
Approved by	Sven Kühn	Technical Manager	
Issued: June 4, 2025			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



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Accreditation No.: SCS 0108

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Calibration is Performed According to the Following Standards

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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.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. 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%.

Measurement Conditions

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

DASY Version	DASY8 Module SAR	16.4.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with spacer
Zoom Scan Resolution	dx, dy = 6mm, dz = 1.5mm	Graded Ratio = 1.5 mm (Z direction)
Frequency	1800MHz $\pm$ 1MHz	

HSL parameters at 1800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal HSL parameters	22.0 °C	40.0	1.40 mho/m
Measured HSL parameters	(22.0 $\pm$ 0.2)°C	41.2 $\pm$ 6%	1.39 mho/m $\pm$ 6%
HSL temperature change during test	< 0.5 °C		

SAR result with HSL at 1800 MHz

SAR averaged over 1 cm³ (1 g) of HSL	Condition	
SAR for nominal HSL parameters	24 dBm input power	9.63 W/kg
SAR for nominal HSL parameters	normalized to 1W	38.3 W/kg $\pm$ 17.0% (k = 2)

SAR averaged over 10 cm³ (10 g) of HSL	Condition	
SAR for nominal HSL parameters	24 dBm input power	5.08 W/kg
SAR for nominal HSL parameters	normalized to 1W	20.2 W/kg $\pm$ 16.5% (k = 2)

Appendix (Additional assessments outside the scope of SCS 0108)**Antenna Parameters with HSL at 1800 MHz**

Impedance	47.2 Ω – 2.6 j Ω
Return Loss	-28.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.215 ns
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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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System Performance Check Report

Summary

Dipole	Frequency [MHz]	TSL	Power [dBm]
D1800V2 - SN2d167	1800	HSL	24

Exposure Conditions

Phantom Section, TSL	Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor	TSL Conductivity [S/m]	TSL Permittivity
Flat	10		CW, 0--	1800, 0	7.94	1.39	41.2

Hardware Setup

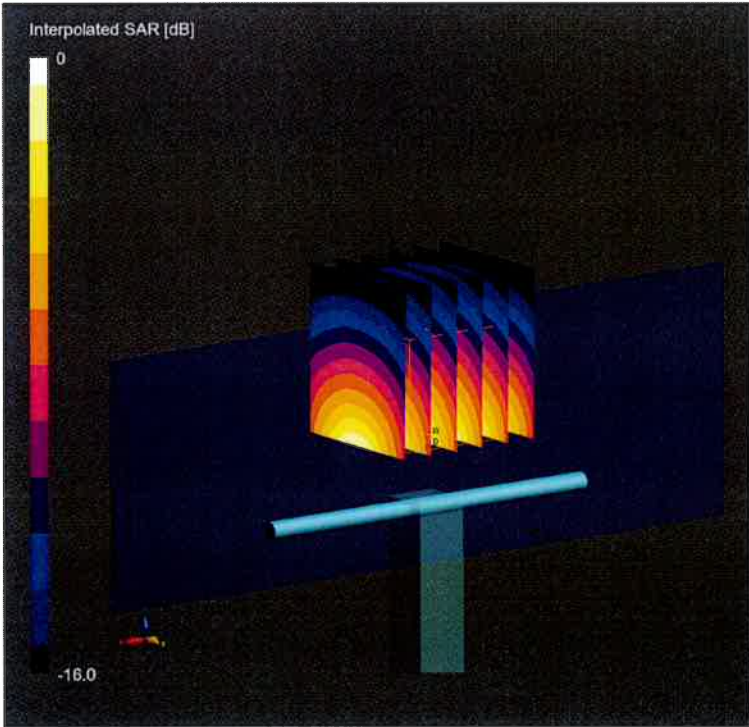
Phantom	TSL, Measured Date	Probe, Calibration Date	DAE, Calibration Date
MFP V8.0 Center	HSL, 2025-06-04	EX3DV4 - SN7349, 2025-01-10	DAE4ip Sn1836, 2025-04-17

Scans Setup

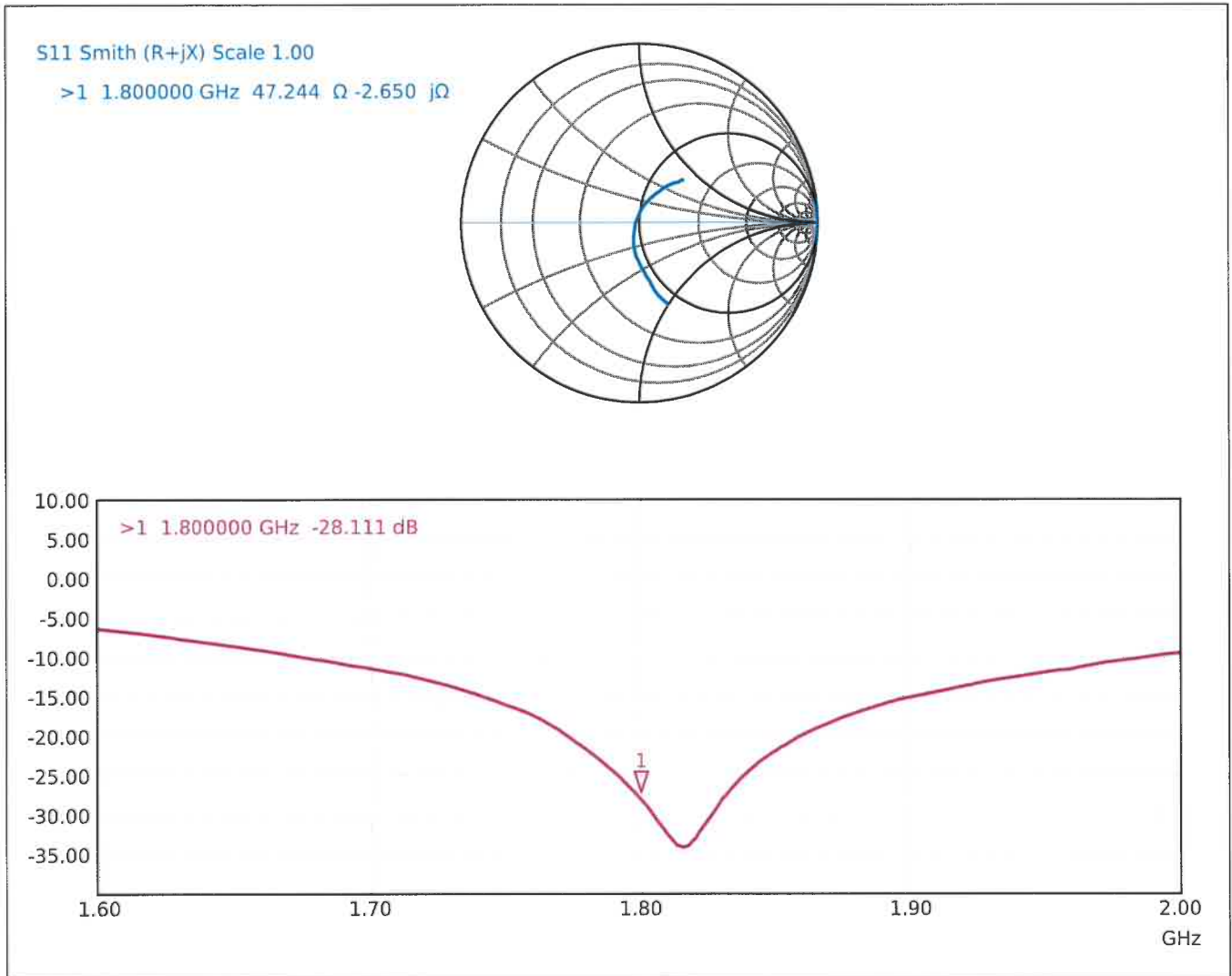
	Zoom Scan
Grid Extents [mm]	30 x 30 x 30
Grid Steps [mm]	6.0 x 6.0 x 1.5
Sensor Surface [mm]	1.4
Graded Grid	Yes
Grading Ratio	1.5
MAIA	N/A
Surface Detection	VMS + 6p
Scan Method	Measured

Measurement Results

	Zoom Scan
Date	2025-06-04
psSAR1g [W/Kg]	9.63
psSAR10g [W/Kg]	5.08
Power Drift [dB]	0.01
Power Scaling	Disabled
Scaling Factor [dB]	
TSL Correction	Positive / Negative



0 dB = 16.9 W/Kg

Impedance Measurement Plot for HSL

ANNUAL DIPOLE VERIFICATION REPORT

Conforming to FCC KDB 865664 D01 v01r04 Section 3.2.2 & EN IEC/IEEE 62209-1528 & IEC/IEEE 62209-1528.

1. General Information

Device Under Test (DUT) Identification		Measurement Environment & Conditions	
Dipole Manufacturer :	SPEAG	Test Date :	Jun. 01, 2026
Dipole Model :	D1800V2	Ambient Temperature :	22.5 °C
Serial Number (S/N) :	2d167	Liquid Temperature :	21.1 °C
Original Cal. Date :	Jun. 04, 2025 (SPEAG)	VNA Model :	Keysight E5080B
Test Frequency (MHz) :	1800	VNA Cal. Due Date :	Feb. 08, 2027

2. Visual Inspection Checklist

Prior to electrical measurements, a strict visual inspection must be conducted to ensure no physical deviations affect the dipole's antenna characteristics.

Check	Inspection Item	Description / Verification Details	Status
Good	Dipole Element Integrity	Visually check the dipole arms and center feed. No mechanical bending, structural deformation, or asymmetric misalignment.	Valid
Good	RF Connector Physical Status	Inspect the SMA/RF connector threads, inner pin, and outer shield. No stripped threads, metal burrs, corrosion, or inner pin displacement.	Valid
Good	Spacer & Mechanical Mount	Ensure the plastic spacer/clip and support distance holder are rigid, crack-free, and securely attached.	Valid

3. Electrical Verification Data & Comparison Results

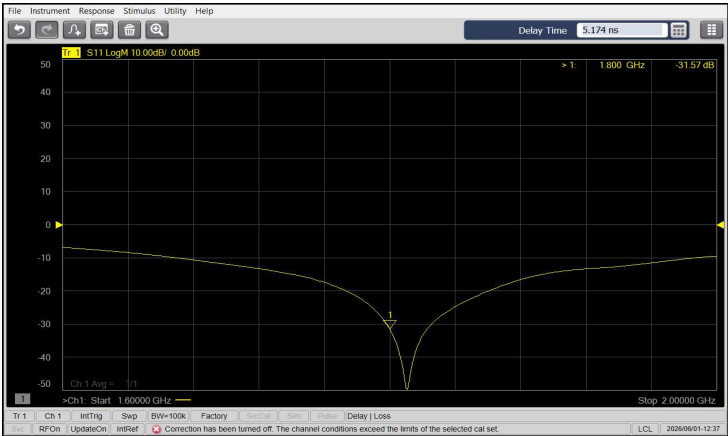
According to **FCC KDB 865664 D01 v01r04 Section 3.2.2** and accepted international practices for **CE (EN IEC/IEEE 62209-1528)** and **IEC/IEEE 62209-1528**, an annual dipole evaluation may be extended up to 3 years if the baseline parameters are verified annually against the following criteria:

- **Return Loss (S11):** Deviation must be **< 20 %** from the original calibration (i.e. **value in dB x 0.2**), AND the return loss must remain **< -20 dB**.
- **Impedance (Real & Imaginary parts):** Deviation must be **< 5 Ω** from the original calibration.
- **System Check (Optional / Supporting):** Normalized SAR output must remain within **$\pm 10 %$** of the calibrated target.

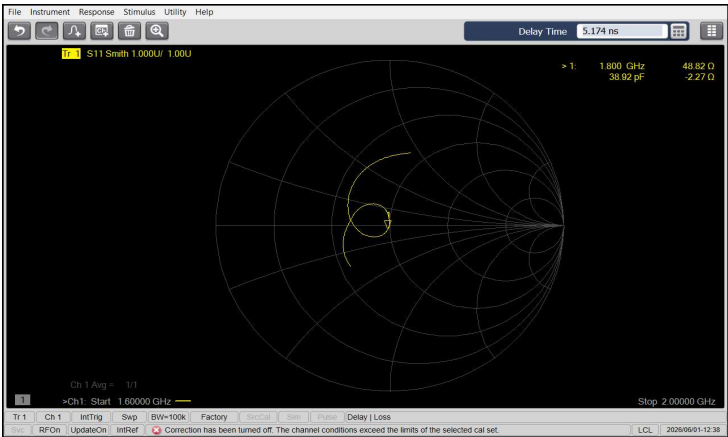
3.1 S11 Return Loss & Impedance Comparison

Frequency (MHz)	Parameter	Original Cal. Data (by SPEAG)	Annual Verified Data (by SAR Lab)	Absolute Difference	Criteria	Verdict
1800	Return Loss (S11)	-28.111 dB	-31.57 dB	3.5 dB	< 5.62 dB	Pass
	Impedance, Real Part	47.244 Ω	48.82 Ω	1.58 Ω	< 5 Ω	Pass
	Impedance, Imaginary Part	-2.650 Ω	-2.27 Ω	0.38 Ω	< 5 Ω	Pass

Return Loss:



Smith Chart:



3.2 System Performance Check (Supporting Validation)

Frequency (MHz)	Parameter	Target Value (1W) (SPEAG Cal. Report)	Measured Value (by SAR Lab)	Normalized to 1W (by SAR Lab)	Absolute Difference	Criteria	Verdict
1800	Normalized SAR 1g	38.3 W/kg	1.99 W/kg	39.80 W/kg	3.92 %	< 10 %	Pass
	Normalized SAR 10g	20.2 W/kg	1.06 W/kg	21.20 W/kg	4.95 %	< 10 %	Pass

4. Conclusion & Status Verification

Final Justification Verdict : **COMPLIANT (Extension Justified)**

Based on the annual visual inspection and verification measurements performed by engineer, the System Validation Dipole satisfies all physical check parameters, electrical deviation criteria (Return Loss < 20 %, Impedance < 5 Ω delta, and System Check < ± 10 % deviation) and system check requirements specified under FCC KDB 865664 D01 v01r04, EN IEC/IEEE 62209-1528, and IEC/IEEE 62209-1528. No mechanical damage or structural deviations were observed.

Therefore, the validity of the original SPEAG calibration certificate is successfully extended for another 12-month period until the next annual review (not exceeding 3 years from the original calibration date).

Prepared By :

Mars Chang
SAR Test Supervisor
Date: 2026/6/1

Approved By :

Raymond Wu
Laboratory Assistant Manager
Date: 2026/6/1



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Accreditation No.: SCS 0108

Client

Eurofins E&E Wireless
New Taipei City

Certificate No.

D1900V2-5d111_Jun25

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d111**

Calibration procedure(s) **QA CAL-05.v12**
Calibration Procedure for SAR Validation Sources between 0.7 - 3 GHz

Calibration date **June 3, 2025**

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 $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

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Power Sensor R&S NRP18A	SN: 101859	06-Feb-25 (No. 4030A315009541)	Feb-26
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OCP DAK-12	SN: 1016	24-Sept-24 (No. OCP-DAK12-1016_Sep24)	Sep-25
OCP DAK-3.5	SN: 1249	23-Sept-24 (No. OCP-DAK3.5-1249_Sep24)	Sep-25
Reference Probe EX3DV4	SN: 7349	10-Jan-25 (No. EX3-7349_Jan25)	Jan-26
DAE4ip	SN: 1836	17-Apr-25 (No. DAE4ip-1836_Apr25)	Apr-26

Secondary Standards	ID	Check Date (in house)	Scheduled Check
ACAD Setup 1	SN: 1000	27-May-25 (No. 675-ACAD_Source_Box-250527)	May-26
Signal Generator R&S SMB100A	SN: 182081	27-May-25 (No. 675-CAL16-S4588-250527)	May-26
Mismatch; SMA	SN: 1102	24-Apr-25 (No. 675-Mismatch_SMA-250424)	Apr-26

	Name	Function	Signature
Calibrated by	Claudio Leubler	Laboratory Technician	
Approved by	Sven Kühn	Technical Manager	

Issued: June 3, 2025

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



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

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

- 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.
- 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.
- *Electrical Delay*: One-way delay between the SMA connector and the antenna feed point. 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%.

Measurement Conditions

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

DASY Version	DASY8 Module SAR	16.4.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with spacer
Zoom Scan Resolution	dx, dy = 6mm, dz = 1.5mm	Graded Ratio = 1.5 mm (Z direction)
Frequency	1900MHz $\pm$ 1MHz	

HSL parameters at 1900 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal HSL parameters	22.0 °C	40.0	1.40 mho/m
Measured HSL parameters	(22.0 $\pm$ 0.2)°C	40.4 $\pm$ 6%	1.40 mho/m $\pm$ 6%
HSL temperature change during test	< 0.5 °C		

SAR result with HSL at 1900 MHz

SAR averaged over 1 cm³ (1 g) of HSL	Condition	
SAR for nominal HSL parameters	24 dBm input power	9.95 W/kg
SAR for nominal HSL parameters	normalized to 1W	39.6 W/kg $\pm$ 17.0% (k = 2)

SAR averaged over 10 cm³ (10 g) of HSL	Condition	
SAR for nominal HSL parameters	24 dBm input power	5.27 W/kg
SAR for nominal HSL parameters	normalized to 1W	21.0 W/kg $\pm$ 16.5% (k = 2)

Appendix (Additional assessments outside the scope of SCS 0108)**Antenna Parameters with HSL at 1900 MHz**

Impedance	50.0 Ω + 5.8 j Ω
Return Loss	-24.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.201 ns
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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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System Performance Check Report

Summary

Dipole	Frequency [MHz]	TSL	Power [dBm]
D1900V2 - SN5d111	1900	HSL	24

Exposure Conditions

Phantom Section, TSL	Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor	TSL Conductivity [S/m]	TSL Permittivity
Flat	10	CW, 0---	1900, 0		7.68	1.40	40.4

Hardware Setup

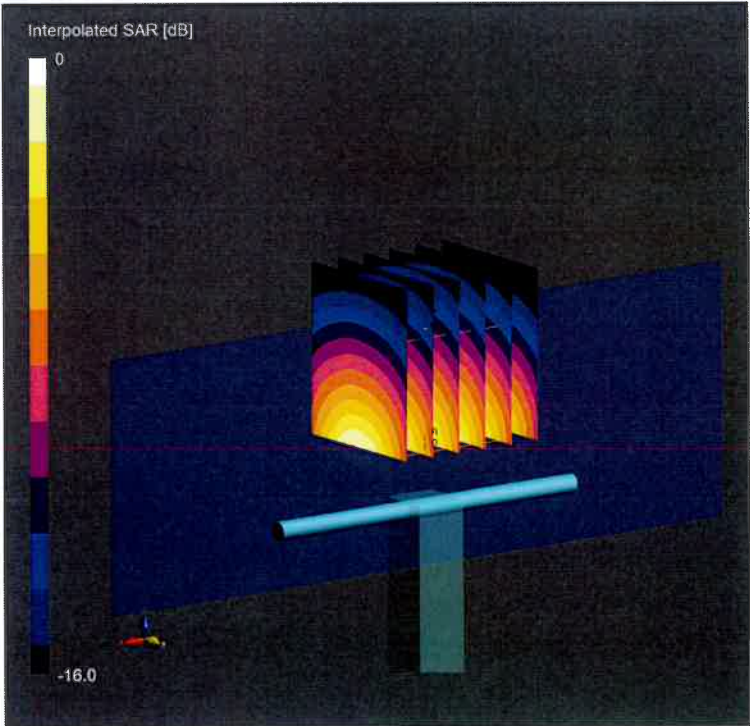
Phantom	TSL, Measured Date	Probe, Calibration Date	DAE, Calibration Date
MFP V8.0 Center	HSL, 2025-06-03	EX3DV4 - SN7349, 2025-01-10	DAE4ip Sn1836, 2025-04-17

Scans Setup

	Zoom Scan
Grid Extents [mm]	30 x 30 x 30
Grid Steps [mm]	6.0 x 6.0 x 1.5
Sensor Surface [mm]	1.4
Graded Grid	Yes
Grading Ratio	1.5
MAIA	N/A
Surface Detection	VMS + 6p
Scan Method	Measured

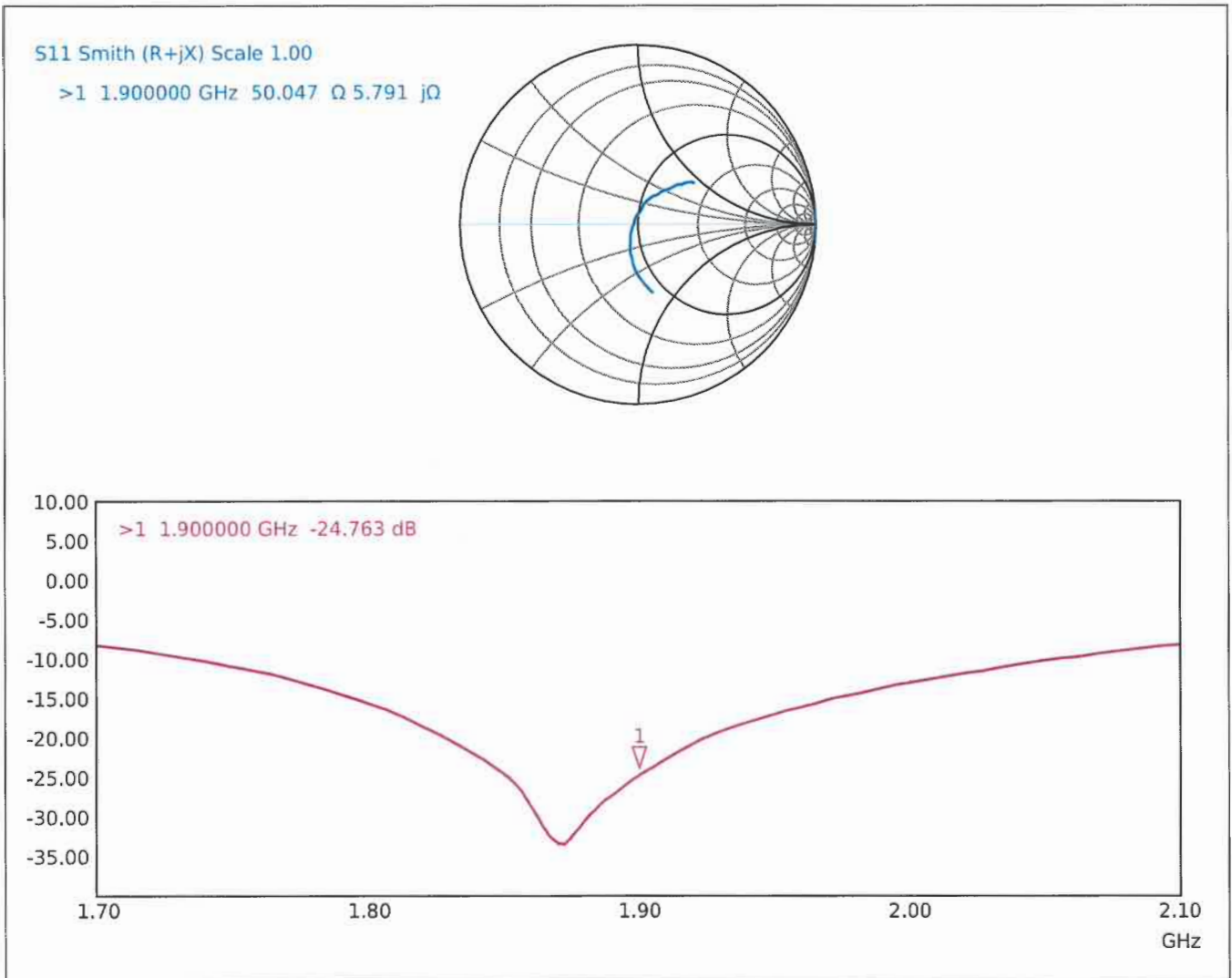
Measurement Results

	Zoom Scan
Date	2025-06-03
psSAR1g [W/Kg]	9.95
psSAR10g [W/Kg]	5.27
Power Drift [dB]	0.01
Power Scaling	Disabled
Scaling Factor [dB]	
TSL Correction	Positive / Negative



0 dB = 17.6 W/Kg

Impedance Measurement Plot for HSL



ANNUAL DIPOLE VERIFICATION REPORT

Conforming to FCC KDB 865664 D01 v01r04 Section 3.2.2 & EN IEC/IEEE 62209-1528 & IEC/IEEE 62209-1528.

1. General Information

Device Under Test (DUT) Identification		Measurement Environment & Conditions	
Dipole Manufacturer :	SPEAG	Test Date :	Jun. 01, 2026
Dipole Model :	D1900V2	Ambient Temperature :	22.5 °C
Serial Number (S/N) :	5d111	Liquid Temperature :	21.1 °C
Original Cal. Date :	Jun. 03, 2025 (SPEAG)	VNA Model :	Keysight E5080B
Test Frequency (MHz) :	1900	VNA Cal. Due Date :	Feb. 08, 2027

2. Visual Inspection Checklist

Prior to electrical measurements, a strict visual inspection must be conducted to ensure no physical deviations affect the dipole's antenna characteristics.

Check	Inspection Item	Description / Verification Details	Status
Good	Dipole Element Integrity	Visually check the dipole arms and center feed. No mechanical bending, structural deformation, or asymmetric misalignment.	Valid
Good	RF Connector Physical Status	Inspect the SMA/RF connector threads, inner pin, and outer shield. No stripped threads, metal burrs, corrosion, or inner pin displacement.	Valid
Good	Spacer & Mechanical Mount	Ensure the plastic spacer/clip and support distance holder are rigid, crack-free, and securely attached.	Valid

3. Electrical Verification Data & Comparison Results

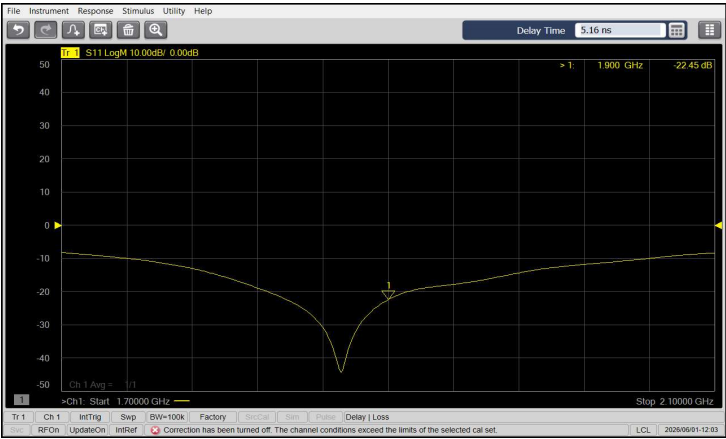
According to **FCC KDB 865664 D01 v01r04 Section 3.2.2** and accepted international practices for **CE (EN IEC/IEEE 62209-1528)** and **IEC/IEEE 62209-1528**, an annual dipole evaluation may be extended up to 3 years if the baseline parameters are verified annually against the following criteria:

- **Return Loss (S11):** Deviation must be **< 20 %** from the original calibration (i.e. **value in dB x 0.2**), AND the return loss must remain **< -20 dB**.
- **Impedance (Real & Imaginary parts):** Deviation must be **< 5 Ω** from the original calibration.
- **System Check (Optional / Supporting):** Normalized SAR output must remain within **± 10 %** of the calibrated target.

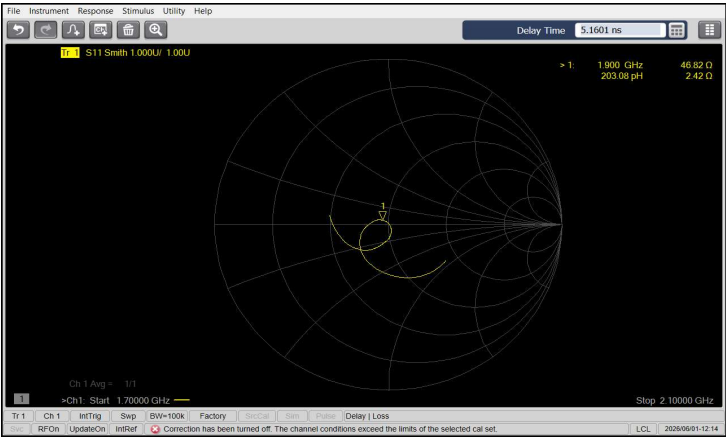
3.1 S11 Return Loss & Impedance Comparison

Frequency (MHz)	Parameter	Original Cal. Data (by SPEAG)	Annual Verified Data (by SAR Lab)	Absolute Difference	Criteria	Verdict
1900	Return Loss (S11)	-24.763 dB	-22.45 dB	2.3 dB	< 4.95 dB	Pass
	Impedance, Real Part	50.047 Ω	46.82 Ω	3.23 Ω	< 5 Ω	Pass
	Impedance, Imaginary Part	5.791 Ω	2.42 Ω	3.37 Ω	< 5 Ω	Pass

Return Loss:



Smith Chart:



3.2 System Performance Check (Supporting Validation)

Frequency (MHz)	Parameter	Target Value (1W) (SPEAG Cal. Report)	Measured Value (by SAR Lab)	Normalized to 1W (by SAR Lab)	Absolute Difference	Criteria	Verdict
1900	Normalized SAR 1g	39.6 W/kg	2.09 W/kg	41.80 W/kg	5.56 %	< 10 %	Pass
	Normalized SAR 10g	21.0 W/kg	1.11 W/kg	22.20 W/kg	5.71 %	< 10 %	Pass

4. Conclusion & Status Verification

Final Justification Verdict : **COMPLIANT (Extension Justified)**

Based on the annual visual inspection and verification measurements performed by engineer, the System Validation Dipole satisfies all physical check parameters, electrical deviation criteria (Return Loss < 20 %, Impedance < 5 Ω delta, and System Check < ± 10 % deviation) and system check requirements specified under FCC KDB 865664 D01 v01r04, EN IEC/IEEE 62209-1528, and IEC/IEEE 62209-1528. No mechanical damage or structural deviations were observed.

Therefore, the validity of the original SPEAG calibration certificate is successfully extended for another 12-month period until the next annual review (not exceeding 3 years from the original calibration date).

Prepared By :

Mars Chang
SAR Test Supervisor
Date: 2026/6/1

Approved By :

Raymond Wu
Laboratory Assistant Manager
Date: 2026/6/1