

F.3 5G Verification Source 10GHz

**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

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **Balun**  
Shenzhen

Certificate No. **5G-Veri10-2010\_Jun23**

**CALIBRATION CERTIFICATE**

Object	5G Verification Source 10 GHz - SN: 2010		
Calibration procedure(s)	QA CAL-45.v4 Calibration procedure for sources in air above 6 GHz		
Calibration date:	June 19, 2023		
<p>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.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity &lt; 70%.</p>			
Calibration Equipment used (M&TE critical for calibration)			
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Reference Probe EUMmWV3	SN: 9374	22-May-23 (No. EUMm-9374_May23)	May-24
DAE4ip	SN: 1602	27-Jun-22 (No. DAE4ip-1602_Jun22)	Jun-23
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMF100A	SN: 100184	19-May-22 (in house check Nov-22)	In house check: Nov-23
Power sensor R&S NRP18S-10	SN: 101258	31-May-22 (in house check Nov-22)	In house check: Nov-23
Network Analyzer Keysight E5063A	SN: MY54504221	31-Oct-19 (in house check Oct-22)	In house check: Oct-25
Calibrated by:	Name Jeton Kastrati	Function Laboratory Technician	Signature 
Approved by:	Sven Kühn	Technical Manager	
			Issued: July 11, 2023
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

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## Glossary

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**CW** Continuous wave

## Calibration is Performed According to the Following Standards

- Internal procedure QA CAL-45, Calibration procedure for sources in air above 6 GHz.
- IEC/IEEE 63195-1, "Assessment of power density of human exposure to radio frequency fields from wireless devices in close proximity to the head and body (frequency range of 6 GHz to 300 GHz)", May 2022

## Methods Applied and Interpretation of Parameters

- *Coordinate System:* z-axis in the waveguide horn boresight, x-axis is in the direction of the E-field, y-axis normal to the others in the field scanning plane parallel to the horn flare and horn flange.
- *Measurement Conditions:* (1) 10 GHz: The radiated power is the forward power to the horn antenna minus ohmic and mismatch loss. The forward power is measured prior and after the measurement with a power sensor. During the measurements, the horn is directly connected to the cable and the antenna ohmic and mismatch losses are determined by far-field measurements. (2) 30, 45, 60 and 90 GHz: The verification sources are switched on for at least 30 minutes. Absorbers are used around the probe cub and at the ceiling to minimize reflections.
- *Horn Positioning:* The waveguide horn is mounted vertically on the flange of the waveguide source to allow vertical positioning of the EUmmW probe during the scan. The plane is parallel to the phantom surface. Probe distance is verified using mechanical gauges positioned on the flare of the horn.
- *E- field distribution:* E field is measured in two x-y-plane (10mm, 10mm +  $\lambda/4$ ) with a vectorial E-field probe. The E-field value stated as calibration value represents the E-field-maxima and the averaged (1cm<sup>2</sup> and 4cm<sup>2</sup>) power density values at 10mm in front of the horn.
- *Field polarization:* Above the open horn, linear polarization of the field is expected. This is verified graphically in the field representation.

## Calibrated Quantity

- Local peak E-field (V/m) and average of peak spatial components of the poynting vector (W/m<sup>2</sup>) averaged over the surface area of 1 cm<sup>2</sup> and 4cm<sup>2</sup> at the nominal operational frequency of the verification source. Both square and circular averaging results are listed.

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 mmWave	V3.2
Phantom	5G Phantom	
Distance Horn Aperture - plane	10 mm	
Number of measured planes	2 (10mm, 10mm + $\lambda/4$ )	
Frequency	10 GHz $\pm$ 10 MHz	

**Calibration Parameters, 10 GHz**

**Circular Averaging**

Distance Horn Aperture to Measured Plane	<i>Prad</i> <sup>1</sup> (mW)	Max E-field (V/m)	Uncertainty (k = 2)	Avg Power Density Avg (psPDn+, psPDtot+, psPDmod+) (W/m <sup>2</sup> )		Uncertainty (k = 2)
				1 cm <sup>2</sup>	4 cm <sup>2</sup>	
10 mm	138	296	1.27 dB	228	177	1.28 dB

Distance Horn Aperture to Measured Plane	<i>Prad</i> <sup>1</sup> (mW)	Max E-field (V/m)	Uncertainty (k = 2)	Power Density psPDn+, psPDtot+, psPDmod+ (W/m <sup>2</sup> )		Uncertainty (k = 2)
				1 cm <sup>2</sup>	4 cm <sup>2</sup>	
10 mm	138	296	1.27 dB	227, 228, 230	176, 177, 177	1.28 dB

**Square Averaging**

Distance Horn Aperture to Measured Plane	<i>Prad</i> <sup>1</sup> (mW)	Max E-field (V/m)	Uncertainty (k = 2)	Avg Power Density Avg (psPDn+, psPDtot+, psPDmod+) (W/m <sup>2</sup> )		Uncertainty (k = 2)
				1 cm <sup>2</sup>	4 cm <sup>2</sup>	
10 mm	138	296	1.27 dB	228	178	1.28 dB

Distance Horn Aperture to Measured Plane	<i>Prad</i> <sup>1</sup> (mW)	Max E-field (V/m)	Uncertainty (k = 2)	Power Density psPDn+, psPDtot+, psPDmod+ (W/m <sup>2</sup> )		Uncertainty (k = 2)
				1 cm <sup>2</sup>	4 cm <sup>2</sup>	
10 mm	138	296	1.27 dB	227, 228, 230	175, 177, 182	1.28 dB

**Max Power Density**

Distance Horn Aperture to Measured Plane	<i>Prad</i> <sup>1</sup> (mW)	Max E-field (V/m)	Uncertainty (k = 2)	Max Power Density Sn, Stot,  Stot  (W/m <sup>2</sup> )	Uncertainty (k = 2)
10 mm	138	296	1.27 dB	249, 250, 250	1.28 dB

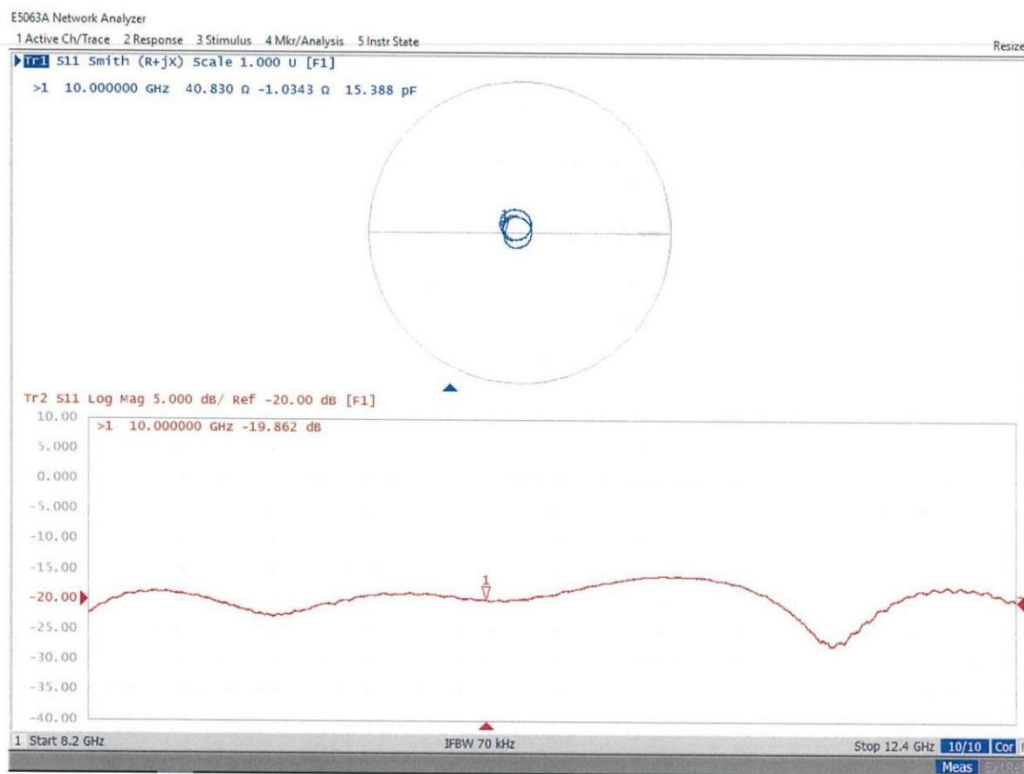
<sup>1</sup> Assessed ohmic and mismatch loss plus numerical offset: 0.60 dB

**Appendix (Additional assessments outside the scope of SCS 0108)**

**Antenna Parameters**

Impedance, transformed to feed point	40.8 $\Omega$ - 1.0 $j\Omega$
Return Loss	- 19.9 dB

**Impedance Measurement Plot**



### DASY Report

#### Measurement Report for 5G Verification Source 10 GHz, UID 0 -, Channel 10000 (10000.0MHz)

##### Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
5G Verification Source 10 GHz	100.0 x 100.0 x 100.0	SN: 2010	-

##### Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group,	Frequency [MHz], Channel Number	Conversion Factor
5G -	10.0 mm	Validation band	CW	10000.0, 10000	1.0

##### Hardware Setup

Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave Phantom - 1002	Air	EUmWV4 - SN9374_F1-55GHz, 2023-05-22	DAE4ip Sn1602, 2022-06-27

##### Scan Setup

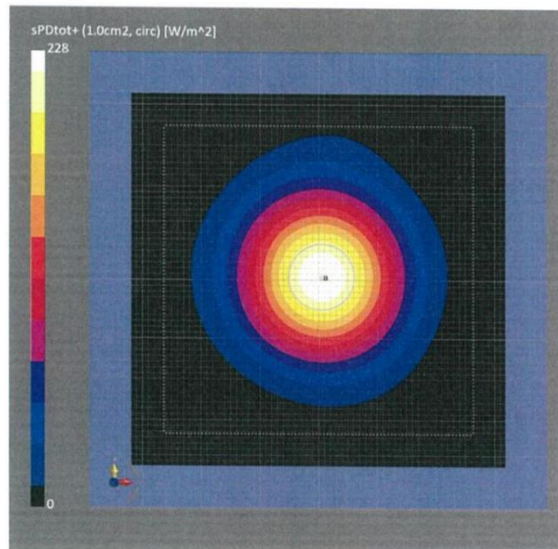
Sensor Surface [mm]  
MAIA

5G Scan  
10.0  
MAIA not used

##### Measurement Results

Date  
Avg. Area [cm<sup>2</sup>]  
Avg. Type  
psPDn+ [W/m<sup>2</sup>]  
psPDtot+ [W/m<sup>2</sup>]  
psPDmod+ [W/m<sup>2</sup>]  
Max(Sn) [W/m<sup>2</sup>]  
Max(Stot) [W/m<sup>2</sup>]  
Max(|Stot|) [W/m<sup>2</sup>]  
E<sub>max</sub> [V/m]  
Power Drift [dB]

5G Scan  
2023-06-19, 17:21  
1.00  
Circular Averaging  
227  
228  
230  
249  
250  
250  
296  
-0.01



### DASY Report

#### Measurement Report for 5G Verification Source 10 GHz, UID 0 -, Channel 10000 (10000.0MHz)

##### Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
5G Verification Source 10 GHz	100.0 x 100.0 x 100.0	SN: 2010	-

##### Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group,	Frequency [MHz], Channel Number	Conversion Factor
5G -	10.0 mm	Validation band	CW	10000.0, 10000	1.0

##### Hardware Setup

Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave Phantom - 1002	Air	EUmWV4 - SN9374_F1-55GHz, 2023-05-22	DAE4ip Sn1602, 2022-06-27

##### Scan Setup

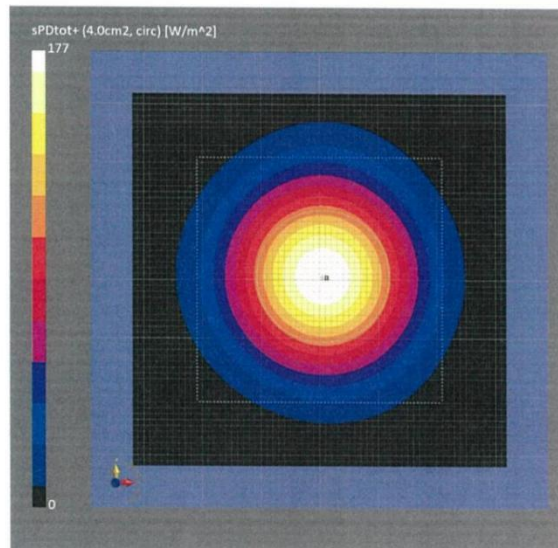
Sensor Surface [mm]  
MAIA

5G Scan  
10.0  
MAIA not used

##### Measurement Results

Date  
Avg. Area [cm<sup>2</sup>]  
Avg. Type  
psPDn+ [W/m<sup>2</sup>]  
psPDtot+ [W/m<sup>2</sup>]  
psPDmod+ [W/m<sup>2</sup>]  
Max(Sn) [W/m<sup>2</sup>]  
Max(Stot) [W/m<sup>2</sup>]  
Max(|Stot|) [W/m<sup>2</sup>]  
E<sub>max</sub> [V/m]  
Power Drift [dB]

5G Scan  
2023-06-19, 17:21  
4.00  
Circular Averaging  
176  
177  
177  
249  
250  
250  
296  
-0.01



## DASY Report

### Measurement Report for 5G Verification Source 10 GHz, UID 0 -, Channel 10000 (10000.0MHz)

#### Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
5G Verification Source 10 GHz	100.0 x 100.0 x 100.0	SN: 2010	-

#### Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group,	Frequency [MHz], Channel Number	Conversion Factor
5G -	10.0 mm	Validation band	CW	10000.0, 10000	1.0

#### Hardware Setup

Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave Phantom - 1002	Air	EUmmWV4 - SN9374_F1-55GHz, 2023-05-22	DAE4ip Sn1602, 2022-06-27

#### Scan Setup

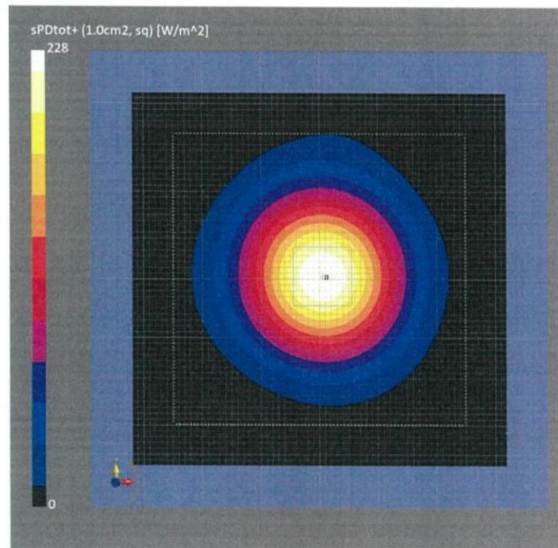
Sensor Surface [mm]  
MAIA

5G Scan  
10.0  
MAIA not used

#### Measurement Results

Date  
Avg. Area [cm<sup>2</sup>]  
Avg. Type  
psPDn+ [W/m<sup>2</sup>]  
psPDtot+ [W/m<sup>2</sup>]  
psPDmod+ [W/m<sup>2</sup>]  
Max(Sn) [W/m<sup>2</sup>]  
Max(Stot) [W/m<sup>2</sup>]  
Max(|Stot|) [W/m<sup>2</sup>]  
E<sub>max</sub> [V/m]  
Power Drift [dB]

5G Scan  
2023-06-19, 17:21  
1.00  
Square Averaging  
227  
228  
230  
249  
250  
250  
296  
-0.01



### DASY Report

Measurement Report for 5G Verification Source 10 GHz, UID 0 -, Channel 10000 (10000.0MHz)

#### Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
5G Verification Source 10 GHz	100.0 x 100.0 x 100.0	SN: 2010	-

#### Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group,	Frequency [MHz], Channel Number	Conversion Factor
5G -	10.0 mm	Validation band	CW	10000.0, 10000	1.0

#### Hardware Setup

Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave Phantom - 1002	Air	EUmmWV4 - SN9374_F1-55GHz, 2023-05-22	DAE4ip Sn1602, 2022-06-27

#### Scan Setup

Sensor Surface [mm]  
MAIA

5G Scan  
10.0  
MAIA not used

#### Measurement Results

Date  
Avg. Area [cm<sup>2</sup>]  
Avg. Type  
psPDn+ [W/m<sup>2</sup>]  
psPDtot+ [W/m<sup>2</sup>]  
psPDmod+ [W/m<sup>2</sup>]  
Max(Sn) [W/m<sup>2</sup>]  
Max(Stot) [W/m<sup>2</sup>]  
Max(|Stot|) [W/m<sup>2</sup>]  
E<sub>max</sub> [V/m]  
Power Drift [dB]

5G Scan  
2023-06-19, 17:21  
4.00  
Square Averaging  
175  
177  
182  
249  
250  
250  
296  
-0.01

