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





S Schweizerischer Kalibrierdienst
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S Servizio svizzero di taratura
Swiss Calibration Service

Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)

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Glossary

CW

Continuous wave

#### Calibration is Performed According to the Following Standards

- Internal procedure QA CAL-45-5Gsources
- IEC TR 63170 ED1, "Measurement procedure for the evaluation of power density related to human exposure to radio frequency fields from wireless communication devices operating between 6 GHz and 100 GHz", January 2018

#### 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 farfield 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 (1cm² and 4cm²) 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/m²) averaged over the surface area of 1 cm² and 4cm² 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	cDASY6 Module mmWave	V2.4
Phantom	5G Phantom	
Distance Horn Aperture - plane	10 mm	
XY Scan Resolution	dx, dy = 7.5 mm	
Number of measured planes	2 (10mm, 10mm + \lambda/4)	
Frequency	10 GHz ± 10 MHz	

# Calibration Parameters, 10 GHz

Circular Averaging

Distance Horn Aperture to Measured Plane	Prad¹ (mW)	Max E-field (V/m)	Uncertainty (k = 2)	Avg Power Density Avg (psPDn+, psPDtot+, psPDmod+) (W/m²)		Uncertainty (k = 2)
				1 cm <sup>2</sup>	4 cm <sup>2</sup>	
10 mm	86.1	147	1.27 dB	55.1	51.3	1.28 dB

**Square Averaging** 

Distance Horn Aperture to Measured Plane	Prad <sup>r</sup> (mW)	Max E-field (V/m)	Uncertainty (k = 2)	Avg Power Density Avg (psPDn+, psPDtot+, psPDmod+) (W/m²)		Uncertainty (k = 2)
				1 cm <sup>2</sup>	4 cm <sup>2</sup>	
10 mm	86.1	147	1.27 dB	55.1	51.2	1.28 dB

Certificate No: 5G-Veri10-1022\_Mar22

Assessed ohmic and mismatch loss plus numerical offset: 0.55 dB

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

### **Device under Test Properties**

Name, Manufacturer	Dimensions [mm	1]	IMEI	DUT Type	
5G Verification Source	10 GHz 100.0 x 100.0 x 1	172.0	SN: 1022	-	
<b>Exposure Conditio</b>	ns				
Phantom Section	Position, Test Distance [mm]	Band	Group,	Frequency [MHz], Channel Number	Conversion Factor
5G -	10.0 mm	Validation band	CW	10000.0,	1.0

10000

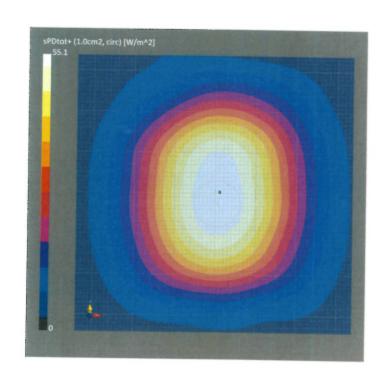
0.02

#### Hardware Setup

Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave Phantom - 1002	Air	EUmmWV3 - SN9374_F1-55GHz, 2021-12-21	DAE4ip Sn1602, 2021-06-25

#### Scan Setup

	5G Scan		5G Scan
Grid Extents [mm]	120.0 x 120.0	Date	2022-03-01, 08:39
Grid Steps [lambda]	0.25 x 0.25	Avg. Area [cm <sup>2</sup> ]	
Sensor Surface [mm]	10.0	psPDn+ [W/m²]	1.00
MAIA	MAIA not used	psPDtot+ [W/m²]	54.9
	······································	psPDmod+ [W/m²]	55.1
			55.3
		E <sub>max</sub> [V/m]	147
		Power Drift [dB]	0.02



### 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 172.0 SN: 1022

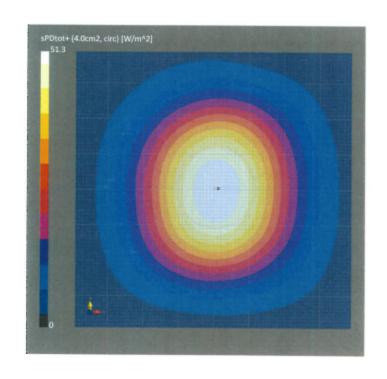
Phantom Section	Position, Test Distance [mm]	Band	Group,	Frequency [MHz], Channel Number	Conversion Factor
5G -	10.0 mm	Validation band	CW	10000.0, 10000	1.0

#### **Hardware Setup**

Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave Phantom - 1002	Air	EUmmWV3 - SN9374_F1-55GHz, 2021-12-21	DAE4ip Sn1602, 2021-06-25

#### Scan Setup

	5G Scan		5G Scan
Grid Extents [mm]	120.0 x 120.0	Date	2022-03-01, 08:39
Grid Steps [lambda]	0.25 x 0.25	Avg. Area [cm <sup>2</sup> ]	4.00
Sensor Surface [mm]	10.0	psPDn+ [W/m <sup>2</sup> ]	51.1
MAIA	MAIA not used	psPDtot+ [W/m²]	51.3
		psPDmod+ [W/m <sup>2</sup> ]	51.5
		E <sub>max</sub> [V/m]	147
		Power Drift [dB]	0.02



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

#### **Device under Test Properties**

Name, Manufacturer DUT Type Dimensions [mm] IMEI 5G Verification Source 10 GHz 100.0 x 100.0 x 172.0 SN: 1022

#### 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,	1.0

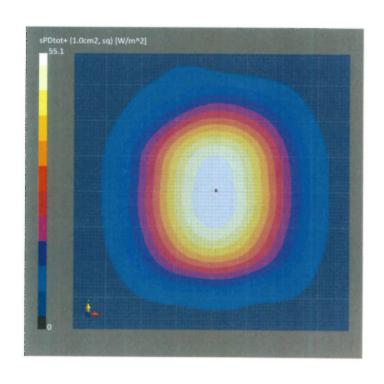
#### **Hardware Setup**

Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave Phantom - 1002	Air	EUmmWV3 - SN9374_F1-55GHz, 2021-12-21	DAE4ip Sn1602, 2021-06-25

#### Scan Setup

	5G Scan		5G Scan
Grid Extents [mm]	120.0 x 120.0	Date	2022-03-01, 08:39
Grid Steps [lambda]	0.25 x 0.25	Avg. Area [cm <sup>2</sup> ]	1.00
Sensor Surface [mm]	10.0	psPDn+ [W/m <sup>2</sup> ]	54.9
MAIA	MAIA not used	psPDtot+ [W/m <sup>2</sup> ]	55.1
		psPDmod+ [W/m²]	55.3
		E <sub>max</sub> [V/m]	147
		Power Drift [dB]	0.02

**Measurement Results** 



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

### **Device under Test Properties**

Name, Manufacturer Dimensions [mm] DUT Type IMEI 5G Verification Source 10 GHz 100.0 x 100.0 x 172.0 SN: 1022

#### 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,	1.0	

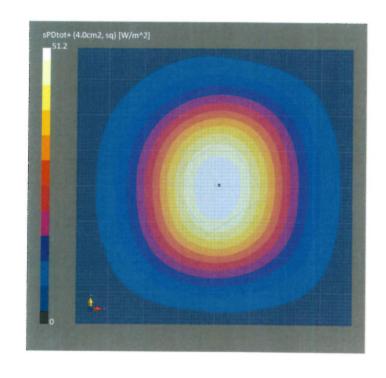
Hardware Setup			
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave Phantom - 1002	Air	EUmmWV3 - SN9374_F1-55GHz, 2021-12-21	DAE4ip Sn1602, 2021-06-25

#### Scan Setup

	5G Scan		5G Scan
Grid Extents [mm]	120.0 x 120.0	Date	2022-03-01, 08:39
Grid Steps [lambda]	0.25 x 0.25	Avg. Area [cm <sup>2</sup> ]	4.00
Sensor Surface [mm]	10.0	psPDn+ [W/m <sup>2</sup> ]	51.0
MAIA	MAIA not used	psPDtot+ [W/m <sup>2</sup> ]	51.2
		psPDmod+ [W/m²]	51.4
		E <sub>max</sub> [V/m]	147
		Power Drift [dB]	0.02

**Measurement Results** 

0.02



# Appendix: Source Evaluation for Relative System Check

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

Item	ID#	Cal Date (Certificate No.)
Probe EUmmWV4	SN: 9536	February 28, 2022

#### **Measurement Conditions**

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

DASY Version	cDASY6 Module mmWave	V2.4
Phantom	5G Phantom	
Distance Horn Aperture - plane	10 mm	
XY Scan Resolution	dx, dy = 7.5 mm	
Number of measured planes	2 (10mm, 10mm + λ/4)	
Frequency	10 GHz ± 10 MHz	

## Calibration Parameters, 10 GHz

### Circular Averaging

Distance Horn Aperture to Measured Plane	Prad <sup>e</sup> (mW)	Max E-field (V/m)	Uncertainty (k = 2)	Avg (psPDn+, psl	er Density Polot+, psPomod+) /m²)	Uncertainty (k = 2)
				1 cm <sup>2</sup>	4 cm <sup>2</sup>	
10 mm	86.1	152	1.27 dB	59.6	54.8	1.28 dB

### **Square Averaging**

Distance Horn Aperture to Measured Plane	Prad <sup>e</sup> (mW)	Max E-field (V/m)	Uncertainty (k = 2)	Avg (psPDn+, psl	er Density Potot+, psPomod+) /m²)	Uncertainty (k = 2)
				1 cm <sup>2</sup>	4 cm <sup>2</sup>	
10 mm	86.1	152	1.27 dB	59.7	54.6	1.28 dB

Certificate No: 5G-Veri10-1022\_Mar22

 $<sup>^{\</sup>rm 2}$  Assessed ohmic and mismatch loss: 0.55 dB

# 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 172.0	SN: 1022	

#### **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 - SN9536_F1-55GHz, 2022-02-28	DAE4 Sn1215, 2021-06-25

**Measurement Results** 

Power Drift [dB]

**5G Scan** 2022-03-01, 10:06

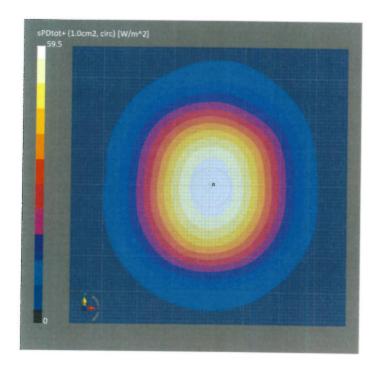
1.00 59.4 59.5 59.8

152

0.04

#### Scan Setup

	5G Scan		
Grid Extents [mm]	120.0 x 120.0	Date	
Grid Steps [lambda]	0.25 x 0.25	Avg. Area [cm²]	
Sensor Surface [mm]	10.0	psPDn+ [W/m²]	
MAIA	MAIA not used	psPDtot+ [W/m²]	
		psPDmod+ [W/m²]	
		E <sub>max</sub> [V/m]	



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

#### **Device under Test Properties**

Name, ManufacturerDimensions [mm]IMEIDUT Type5G Verification Source 10 GHz100.0 x 100.0 x 172.0SN: 1022

#### **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

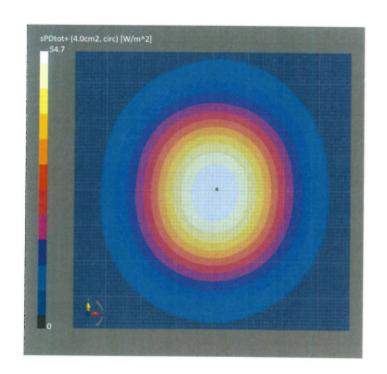
#### **Hardware Setup**

PhantomMediumProbe, Calibration DateDAE, Calibration DatemmWave Phantom - 1002AirEUmmWV4 - SN9536\_F1-55GHz,<br/>2022-02-28DAE4 Sn1215,<br/>2021-06-25

#### Scan Setup

	5G Scan	
Grid Extents [mm]	120.0 x 120.0	Dat
Grid Steps [lambda]	0.25 x 0.25	Avg
Sensor Surface [mm]	10.0	psP
MAIA	MAIA not used	psP

	5G Scan
Date	2022-03-01, 10:06
Avg. Area [cm²]	4.00
psPDn+ [W/m²]	54.6
psPDtot+ [W/m²]	54.7
psPDmod+ [W/m²]	55.0
E <sub>max</sub> [V/m]	152
Power Drift [dB]	0.04



#### 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 172.0
 SN: 1022

#### **Exposure Conditions**

Phantom Section Position, Test Distance [mm] Frequency [MHz], Channel Number

5G - 10.0 mm Validation band CW 10000.0, 10000

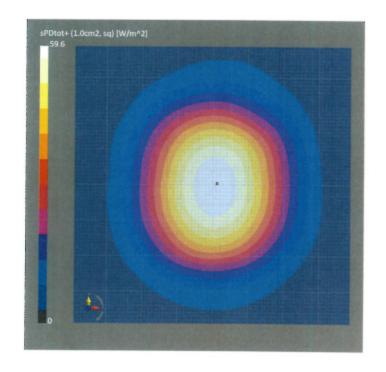
#### **Hardware Setup**

PhantomMediumProbe, Calibration DateDAE, Calibration DatemmWave Phantom - 1002AirEUmmWV4 - SN9536\_F1-55GHz,<br/>2022-02-28DAE4 Sn1215,<br/>2021-06-25

#### Scan Setup

	ou otan		
Grid Extents [mm]	120.0 x 120.0	Date	
Grid Steps [lambda]	0.25 x 0.25	Avg. Area [cm <sup>2</sup> ]	
Sensor Surface [mm]	10.0	psPDn+ [W/m <sup>2</sup> ]	
MAIA	MAIA not used	psPDtot+ [W/m <sup>2</sup> ]	
		psPDmod+ [W/m <sup>2</sup> ]	

	5G Scan
Date	2022-03-01, 10:06
Avg. Area [cm²]	1.00
psPDn+ [W/m <sup>2</sup> ]	59.5
psPDtot+ [W/m²]	59.6
psPDmod+ [W/m <sup>2</sup> ]	59.9
E <sub>max</sub> [V/m]	152
Power Drift [dB]	0.04



### 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 172 0	SN: 1022	_

#### **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,	1.0

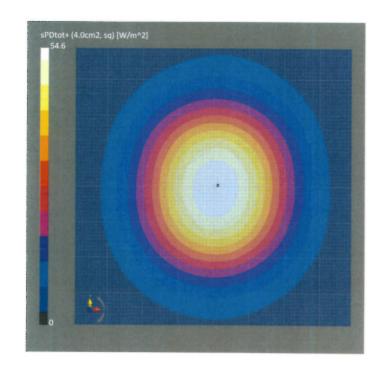
#### **Hardware Setup**

Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave Phantom - 1002	Air	EUmmWV4 - SN9536_F1-55GHz, 2022-02-28	DAE4 Sn1215, 2021-06-25

#### Scan Setup

5G Scan
120.0 x 120.0
0.25 x 0.25
10.0
MAIA not used

	5G Scan
Date	2022-03-01, 10:06
Avg. Area [cm²]	4.00
psPDn+ [W/m <sup>2</sup> ]	54.4
psPDtot+ [W/m <sup>2</sup> ]	54.6
psPDmod+ [W/m <sup>2</sup> ]	54.9
E <sub>max</sub> [V/m]	152
Power Drift [dB]	0.04



## Appendix: Source Evaluation for Relative System Check

#### **Measurement Equipment**

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

Item	ID#	Cal Date (Certificate No.)	
Probe EUmmWV4	SN: 9559	February 28, 2022	

#### **Measurement Conditions**

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

DASY Version	cDASY6 Module mmWave	V2.4
Phantom	5G Phantom	
Distance Horn Aperture - plane	10 mm	
XY Scan Resolution	dx, dy = 7.5 mm	
Number of measured planes	2 (10mm, 10mm + λ/4)	
Frequency	10 GHz ± 10 MHz	

### Calibration Parameters, 10 GHz

### Circular Averaging

Distance Horn Aperture to Measured Plane	Prad³ (mW)	Max E-field (V/m)	Uncertainty (k = 2)	Avg Power Density Avg (psPDn+, psPDtot+, psPDmod+) (W/m²)		Uncertainty (k = 2)
				1 cm <sup>2</sup>	4 cm <sup>2</sup>	
10 mm	86.1	155	1.27 dB	61.6	55.7	1.28 dB

### **Square Averaging**

Distance Horn Aperture to Measured Plane	Prad² (mW)	Max E-field (V/m)	Uncertainty (k = 2)	Avg Power Density Avg (psPDn+, psPDtot+, psPDmod+) (W/m²)		Uncertainty (k = 2)
				1 cm <sup>2</sup>	4 cm <sup>2</sup>	
10 mm	86.1	155	1.27 dB	61.7	55.7	1.28 dB

Certificate No: 5G-Veri10-1022\_Mar22

 $<sup>^3</sup>$  Assessed ohmic and mismatch loss: 0.55  $\ensuremath{\mathrm{dB}}$ 

# 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 172.0	SN: 1022	

#### **Exposure Conditions**

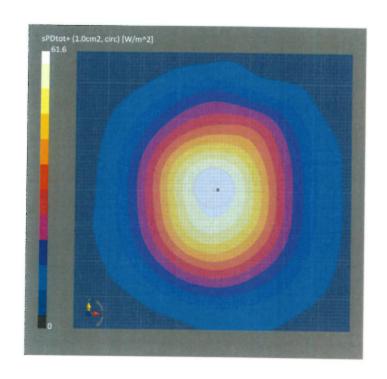
Phantom Section	Position, Test Distance [mm]	Band	Group,	Frequency [MHz], Channel Number	Conversion Factor
5G -	10.0 mm	Validation band	CW	10000.0, 10000	1.0

#### Hardware Setup

Phantom mmWave Phantom - 1002	Medium	Probe, Calibration Date	DAE, Calibration Date
minwave i nantom - 1002	Air	EUmmWV4 - SN9559_F1-55GHz, 2022-02-28	DAE4 Sn1215, 2021-06-25

#### Scan Setup

	5G Scan		5G Scan
Grid Extents [mm] Grid Steps [lambda] Sensor Surface [mm] MAIA	120.0 x 120.0 0.25 x 0.25 10.0 MAIA not used	Date Avg. Area [cm²] psPDn+ [W/m²] psPDtot+ [W/m²] psPDmod+ [W/m²] E <sub>max</sub> [V/m] Power Drift [dB]	2022-03-01, 10:51 1.00 61.2 61.6 61.9 155



# 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 172.0	SN: 1022	- DOT Type

#### **Exposure Conditions**

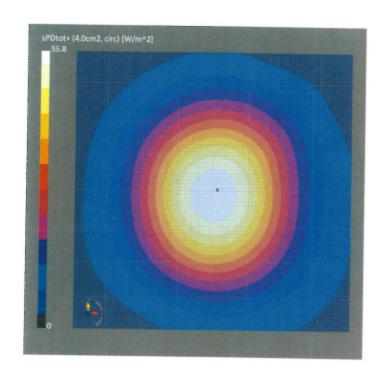
Phantom Section	Position, Test Distance [mm]	Band	Group,	Frequency [MHz], Channel Number	Conversion Factor
5G -	10.0 mm	Validation band	CW	10000.0, 10000	1.0

#### **Hardware Setup**

Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave Phantom - 1002	Air	EUmmWV4 - SN9559_F1-55GHz, 2022-02-28	DAE4 Sn1215, 2021-06-25

#### Scan Setup

	5G Scan		5G Scan
Grid Extents [mm]	120.0 x 120.0	Date	2022-03-01, 10:51
Grid Steps [lambda]	0.25 x 0.25	Avg. Area [cm²]	4.00
Sensor Surface [mm] MAIA	10.0	psPDn+ [W/m²]	55.2
············	MAIA not used	psPDtot+ [W/m²]	55.8
		psPDmod+ [W/m²]	56.1
•		E <sub>max</sub> [V/m]	155
		Power Drift [dB]	0.03



## 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 172.0	SN: 1022	-

#### **Exposure Conditions**

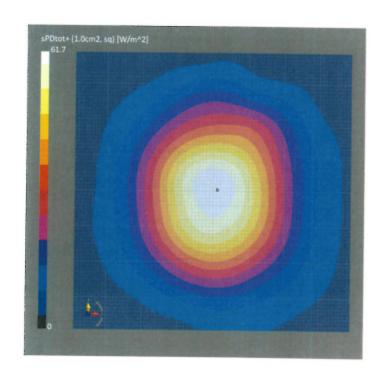
Phantom Section	Position, Test Distance [mm]	Band	Group,	Frequency [MHz], Channel Number	Conversion Factor
5G -	10.0 mm	Validation band	CW	10000.0, 10000	1.0

#### **Hardware Setup**

Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave Phantom - 1002	Air	EUmmWV4 - SN9559_F1-55GHz, 2022-02-28	DAE4 Sn1215, 2021-06-25

#### Scan Setup

	5G Scan		5G Scan
Grid Extents [mm]	120.0 x 120.0	Date	2022-03-01, 10:51
Grid Steps [lambda]	0.25 x 0.25	Avg. Area [cm²]	1.00
Sensor Surface [mm] MAIA	10.0 MAIA not used	psPDn+ [W/m²] psPDtot+ [W/m²] psPDmod+ [W/m²] E <sub>max</sub> [V/m]	61.3
			61.7
			62.0
			155
		Power Drift [dB]	0.03



# 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 172.0	SN: 1022		

#### **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 - SN9559_F1-55GHz, 2022-02-28	DAE4 Sn1215, 2021-06-25

#### Scan Setup

	5G Scan		5G Scan
Grid Extents [mm]	120.0 x 120.0	Date	2022-03-01, 10:51
Grid Steps [lambda]	0.25 x 0.25	Avg. Area [cm <sup>2</sup> ]	4.00
Sensor Surface [mm]	10.0	psPDn+ [W/m <sup>2</sup> ]	55.2
MAIA	MAIA not used	psPDtot+ [W/m²]	55.8
		psPDmod+ [W/m²]	56.0
		E <sub>max</sub> [V/m]	155
		Power Drift [dB]	0.03

**Measurement Results** 

0.03

