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60 GHz RF Exposure Report

Applicant Name:

LG Electronics Inc.

222, LG-ro, Jinwi-myeon, Pyeongtaek, Gyeonggi-do, 451-713,
Korea

Date of Issue: Apr. 07, 2023

Test Report No.: HCT-SR-2304-FI002

Test Site: HCT CO., LTD.

FCC ID:

BEJLGSRFR1

ISED ID:

2703H-LGSRFR1

Equipment Type:

RF Module

Application Type

Certification

FCC Rule Part(s):

CFR §2.1093

ISED Rule Part(s):

RSS-102

Model Name:

LGSRFR1

Date of Test:

Feb. 27, 2023 ~ Mar. 13, 2023

Band	Tx. Frequency	Equipment Class	PD
			psPD
			(mW/cm ²)
60 GHz	57 GHz ~ 66 GHz	DXX	0.191

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Tested By

Da Sol, Lee

Test Engineer

SAR Team

Certification Division

Reviewed By

Yun Jeang, Heo

Technical Manager

SAR Team

Certification Division

This report only responds to the tested sample and may not be reproduced, except in full, without written approval of the HCT Co., Ltd.

REVISION HISTORY

The revision history for this test report is shown in table.

Revision No.	Date of Issue	Description
0	Apr. 07, 2023	Initial Release

This test results were applied only to the test methods required by the standard.

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1. Test Regulations

FCC/ISED RF Exposure evaluation of 60 GHz Band of this device were measured by referring to the interim procedures in TCB Workshop document of Apr. 27 2022, IEC/IEEE 62209-1528:2020 and also the App Note of SPEAG, the manufacturer of measuring equipment.

April 2016, May 2017, November 2017, October 2018, April 2019, November 2019, October 2020, April 2022 TCBC Workshop Notes.

SPEAG DASY6 System Handbook

IEEE 1528-2013

IEC TR 63170:2018

IEC 62479:2010

FCC KDB 865664 D02 v01r02

FCC KDB 447498 D01 v07

FCC KDB 865664 D01 v01r04

RSS-102

2. Test Location

2.1 Test Laboratory

Company Name	HCT Co., Ltd.
Address	74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383 KOREA
Telephone	031-645-6300
Fax.	031-645-6401

2.2 Test Facilities

Our laboratories are accredited and approved by the following approval agencies according to ISO/IEC 17025.

Korea	National Radio Research Agency (Designation No. KR0032)
	KOLAS (Testing No. KT197)

3. Information of the EUT

3.1 General Information of the EUT

Equipment Type	RF Module
FCC ID	BEJLGSRFR1
ISED ID	2703H-LGSRFR1
PMN	RF Module
HVIN	LGSRFR1
FVIN	W22_RF1.0
HMN	N/A
Model Name	LGSRFR1
Application Type	Certification
Applicant	LG Electronics Inc.

4. Device Under Test Description

4.1 DUT specification

Band & Mode	Tx Frequency
60 GHz	57 GHz – 66 GHz

4.2 Nominal and Maximum Output Power Specifications

4.2.1 Maximum 60 GHz WIFI output EIRP

Maximum Power

:Power to 60 GHz

Left module

Mode	Ant 0(Front) (dBm)	Ant 1(Bottom) (dBm)	Ant 2(Left) (dBm)
60GHZ	35	22	17

(Upper tolerance: target+2.0 dB)

Right module

Mode	Ant 0(Front) (dBm)	Ant 1(Bottom) (dBm)	Ant 2(Right) (dBm)
60GHZ	35	22	17

(Upper tolerance: target+2.0 dB)

4.3 DUT Antenna Locations

The dimensions and separation distances of this model are shown in the Technical Descriptions.

Mode	Device Configurations for Testing					
	Rear	Front	Left	Right	Top	Bottom
Display_Left	No	Yes	Yes	No	No	Yes
Display_Right	No	Yes	No	Yes	No	Yes

Particular EUT edges were not required to be evaluated for PD if the edges were the transmitting antenna according to antenna radiation pattern.

- Note: All test configurations are based on front view position.

4.4 Test Considerations

PD was performed using 60GHz mmWave Probe calibration factors. mmWave PD were followed for test positions, distances, and modes. The equipment class of this model is DXX of 60 GHz.

Per Oct. 2020 TCBC Workshop notes:

Portable devices transmitting at frequencies > 6 GHz, including 60 GHz band, are subject to MPE incident power density (PD, or IPD) limits.

MPE limit is 1 mW/cm²(10W/m²) plane-wave-equivalent PD, averaged over 4 cm², evaluation distance emulating normal use conditions

5. Limits

RF Exposure Limits for Frequencies Above 6 GHz

Per §1.1310 (d)(3), the MPE limits are applied for frequencies above 6 GHz. Power Density is expressed in units of mW/cm^2 or W/m^2 .

Peak Spatially Averaged Power Density was evaluated over a circular area of 4 cm^2 per interim FCC Guidance for near-field power density evaluations per October 2018 TCB Workshop notes.

HUMAN EXPOSURE	Limits For Occupational / Controlled Environments	Limits For General Population / Uncontrolled Environments
Frequency Range[MHz]	1,500 – 100,000	1,500 – 100,000
Power Density[mW/cm ²]	5.0	1.0
Average Time[Minutes]	6	30

NOTES: $1.0 \text{ mW}/\text{cm}^2$ is $10 \text{ W}/\text{m}^2$

6. RF EIRP

6.1 Maximum EIRP

Left Module

Frequency [MHz]	Channel	(60 GHz) RF EIRP [dBm]		
		Ant 0	Ant 1	Ant 2
59 400	9	35.41	22.50	15.55
61 560	10	34.16	22.46	17.01
63 720	11	34.10	21.45	16.73

Right Module

Frequency [MHz]	Channel	(60 GHz) RF EIRP [dBm]		
		Ant 0	Ant 1	Ant 2
59 400	9	35.13	19.46	17.66
61 560	10	33.86	19.52	17.16
63 720	11	33.82	21.47	17.46

Note:

For testing the WIGIG 60 GHz of this DUT, the selection of test channels was based on FCC guidance, with three channels selected across the entire WIGIG 60 GHz Bands.

- EIRP measurements were performed for the transmission mode configuration with the highest maximum EIRP specified for production units.
- For transmission modes with identical maximum specified output EIRP, channel bandwidth, modulation and data rates, power measurements were required for all identical configurations.

7. System Verification

7.1 Power Density Verification for 60GHz

Freq. [GHz]	Date	Probe SN	Dipole S/N	Normal psPD (W/m ² over 4 cm ²)		Deviation [dB]	Total psPD (W/m ² over 4 cm ²)		Deviation [dB]
				Measured	Target		Measured	Target	
60	02/27/2023	9486	1041	92.4	92.2	+ 0.01	93.3	93.2	+ 0.00
60	02/28/2023	9486	1041	84.0	92.2	- 0.40	85.3	93.2	- 0.38
60	03/02/2023	9486	1041	83.5	92.2	- 0.43	84.8	93.2	- 0.41
60	03/03/2023	9486	1041	84.1	92.2	- 0.40	84.8	93.2	- 0.41
60	03/06/2023	9486	1041	83.2	92.2	- 0.45	84.5	93.2	- 0.43
60	03/07/2023	9486	1041	82.9	92.2	- 0.46	84.3	93.2	- 0.44
60	03/08/2023	9486	1041	82.9	92.2	- 0.46	84.3	93.2	- 0.44
60	03/09/2023	9486	1041	83.5	92.2	- 0.43	84.2	93.2	- 0.44
60	03/10/2023	9486	1041	82.7	92.2	- 0.47	84.1	93.2	- 0.45
60	03/13/2023	9486	1041	89.7	92.2	- 0.12	90.7	93.2	- 0.12

7.4 System Verification Procedure

For Power Density Measurement

The system was verified to be within ± 0.66 dB of the power density targets on the calibration certificate according to the test system specification in the user's manual and calibration facility recommendation. The 0.66 dB deviation threshold represents the expanded uncertainty for system performance checks using SPEAG's mmWave verification sources. The same spatial resolution and measurement region used in the source calibration was applied during the system check.

The measured power density distribution of verification source was also confirmed through visual inspection to have no noticeable differences, both spatially(shape) and numerically (level) from the distribution provided by the manufacturer, per November 2017 TCBC Workshop Notes.

8. PD Test Data Summary

8.1 Power Density Results

60 GHz Power Density(Display)_Left																
Frequency		Mode	Ant No.	Band width (GHz)	Data Rate (Mbps)	Tune-Up Limit (dBm)	Meas. EIRP (dBm)	Power Drift (dB)	Peak No.	Distance (mm)	Test Position	Ant Config.	Grid Step (λ)	Normal psPD (mW/cm²)	Total psPD (mW/cm²)	Plot No.
MHz	Ch.															
59 400	9	60 GHz	0	4.32	MCS1	37.0	35.41	0.08	1	200	Front	SISO	0.25	0.180	0.180	1
61 560	10	60 GHz	0	4.32	MCS1	37.0	34.16	0.07	1	200	Front	SISO	0.25	0.163	0.163	-
63 720	11	60 GHz	0	4.32	MCS1	37.0	34.10	-0.04	1	200	Front	SISO	0.25	0.141	0.141	-
59 400	9	60 GHz	2	4.32	MCS1	19.0	15.55	-0.16	1	200	Left	SISO	0.25	0.0039	0.0041	-
61 560	10	60 GHz	2	4.32	MCS1	19.0	17.01	0.16	1	200	Left	SISO	0.25	0.0044	0.0045	2
63 720	11	60 GHz	2	4.32	MCS1	19.0	16.73	-0.12	1	200	Left	SISO	0.25	0.0041	0.0042	-
59 400	9	60 GHz	1	4.32	MCS1	24.0	22.50	0.15	1	200	Bottom	SISO	0.25	0.0354	0.0356	3
61 560	10	60 GHz	1	4.32	MCS1	24.0	22.46	-0.18	1	200	Bottom	SISO	0.25	0.0319	0.0320	-
63 720	11	60 GHz	1	4.32	MCS1	24.0	21.45	-0.16	1	200	Bottom	SISO	0.25	0.0264	0.0266	-
47 CFR §1.1310 – Safety Limit Spatial Average Uncontrolled Exposure/ General Population												Power Density 1 mW/cm² Averaged over 4 cm²				

60 GHz Power Density(Display)_Right																
Frequency		Mode	Ant No.	Band width (GHz)	Data Rate (Mbps)	Tune-Up Limit (dBm)	Meas. EIRP (dBm)	Power Drift (dB)	Peak No.	Distance (mm)	Test Position	Ant Config.	Grid Step (λ)	Normal psPD (mW/cm²)	Total psPD (mW/cm²)	Plot No.
MHz	Ch.															
59 400	9	60 GHz	0	4.32	MCS1	37.0	35.13	0.03	1	200	Front	SISO	0.25	0.191	0.191	4
61 560	10	60 GHz	0	4.32	MCS1	37.0	33.86	0.03	1	200	Front	SISO	0.25	0.174	0.174	-
63 720	11	60 GHz	0	4.32	MCS1	37.0	33.82	0.05	1	200	Front	SISO	0.25	0.160	0.160	-
59 400	9	60 GHz	2	4.32	MCS1	19.0	17.66	-0.18	1	200	Right	SISO	0.25	0.0043	0.0044	5
61 560	10	60 GHz	2	4.32	MCS1	19.0	17.16	0.12	1	200	Right	SISO	0.25	0.0029	0.0031	-
63 720	11	60 GHz	2	4.32	MCS1	19.0	17.46	-0.11	1	200	Right	SISO	0.25	0.0037	0.0038	-
59 400	9	60 GHz	1	4.32	MCS1	24.0	19.46	0.14	1	200	Bottom	SISO	0.25	0.0044	0.0047	-
61 560	10	60 GHz	1	4.32	MCS1	24.0	19.52	-0.18	1	200	Bottom	SISO	0.25	0.0075	0.0082	-
63 720	11	60 GHz	1	4.32	MCS1	24.0	21.47	0.18	1	200	Bottom	SISO	0.25	0.0084	0.0092	6
47 CFR §1.1310 – Safety Limit Spatial Average Uncontrolled Exposure/ General Population												Power Density 1 mW/cm² Averaged over 4 cm²				

8.2 Power Density General Notes

1. The manufacturer has confirmed that the device tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
2. Batteries are fully charged at the beginning of the measurements. The DUT was connected to a wall charger for some measurements due to the test duration. It was confirmed that the charger plugged into this DUT did not impact the near-field PD test results.
3. Power density was calculated by repeated E-field measurements on two measurement planes separated by $\lambda/4$.
4. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools.
5. Tested Power Density modulation is used from maximum EIRP modulation in RF Report.

9. Measurement Uncertainty

For Power Density Measurements:

Measurement Uncertainty for CDASY6 Power density module						
<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i> = <i>b x e / d</i>	<i>g</i>
Source of uncertainty	Uncertainty Value (± dB)	Probability distribution	Div.	<i>c</i>	Standard Uncertainty (± dB)	<i>v</i>
Probe calibration	0.49	N	1	1	0.49	∞
Probe correction	0.00	R	1.73	1	0.00	∞
Frequency Response(BW ≤ 1GHz)	0.20	R	1.73	1	0.12	∞
Sensor cross coupling	0.00	R	1.73	1	0.00	∞
Istropy	0.50	R	1.73	1	0.29	∞
Linearity	0.20	R	1.73	1	0.12	∞
Probe scattering	0.00	R	1.73	1	0.00	∞
Probe positioning offset	0.30	R	1.73	1	0.17	∞
Probe positioning Repeatability	0.04	R	1.73	1	0.02	∞
Probe spatial Resolution	0.00	R	1.73	1	0.00	∞
Field Impedence Dependence	0.00	R	1.73	1	0.00	∞
Sensor Mechanical Offset	0.00	R	1.73	1	0.00	∞
Amplitude and Phase drift	0.00	R	1.73	1	0.00	∞
Amplitude and Phase noise	0.04	R	1.73	1	0.02	∞
Measurement area truncation	0.00	R	1.73	1	0.00	∞
System Detection Limit	0.04	R	1.73	1	0.02	∞
Data acquisition	0.03	N	1	1	0.03	∞
Field Reconstruction	2.00	R	1.73	1	1.15	∞
Forward Transformation	0.00	R	1.73	1	0.00	∞
Power density Scailing	0.00	R	1.73	1	0.00	∞
Spatial Averaging	0.10	R	1.73	1	0.06	∞
System Detection Limit	0.04	R	1.73	1	0.02	∞
Test sample and Environmental Factors						
Probe coupling with DUT	0.00	R	1.73	1	0.00	∞
Modulation Response	0.40	R	1.73	1	0.23	∞
Integration time	0.00	R	1.73	1	0.00	∞
Response time	0.00	R	1.73	1	0.00	∞
Device holder influence	0.10	R	1.73	1	0.06	∞
DUT alignment	0.00	R	1.73	1	0.00	∞
RF Ambient Conditions	0.04	R	1.73	1	0.02	∞
RF ambient - reflections	0.04	R	1.73	1	0.02	∞
Immunity/Secondary Reception	0.00	R	1.73	1	0.00	∞
Power Drif of DUT	0.21	R	1.73	1	0.12	∞
Combined standard uncertainty (k = 1)		RSS			1.34	∞
Expanded uncertainty (95% confidence level)		<i>k</i> = 2			2.68	

10. PD Test Equipment

Manufacturer	Type / Model	S/N	Calib. Date	Calib.Interval	Calib.Due
HP	SAR System Control PC	-	N/A	N/A	N/A
Staubli	CS8Cspeag-TX90	F08/5AJ0A1/C/01	N/A	N/A	N/A
Staubli	TX90 XLspeag	F08/5AJ0A1/A/01	N/A	N/A	N/A
Staubli	Teach Pendant (Joystick)	020885	N/A	N/A	N/A
SPEAG	DAE4	868	09/21/2022	Annual	09/21/2023
SPEAG	E-Field Probe EUmWV3	9486	04/06/2022	Annual	04/06/2023
SPEAG	5G Verification source 60GHz	1041	11/15/2022	Annual	11/15/2023
TESTO	175-H1/Thermometer	40331949309	12/29/2022	Annual	12/29/2023

*The E-field probe was calibrated by SPEAG, by the waveguide technique procedure. Dipole Verification measurement is performed by HCT Lab. before each test. The brain/body simulating material is calibrated by HCT using the DAKS 3.5 to determine the conductivity and permittivity (dielectric constant) of the brain/body-equivalent material.

11. Conclusion

The PD measurement indicates that the EUT complies with the RF radiation exposure limits of the ANSI/ IEEE C95.1 - 2005.

These measurements were taken to simulate the RF effects exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The results and statements relate only to the item(s) tested.

Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.

12. References

- [1] Federal Communications Commission, ET Docket 93-62, Guidelines for Evaluating the Environmental Effects of Radio frequency Radiation, Aug. 1996.
- [2] ANSI/IEEE C95.1 - 2005 , American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 300 kHz to 300 GHz, New York: IEEE, Sept. 1992
- [3] ANSI/IEEE C 95.1 - 2005, American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 3 kHz to 300 GHz, New York: IEEE, 2006
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- [10] Q. Balzano, O. Garay, T. Manning Jr., Electromagnetic Energy Exposure of Simulated Users of Portable Cellular Telephones, IEEE Transactions on Vehicular Technology, vol. 44, no.3, Aug. 1995.
- [11] W. Gander, Computer mathematick, Birkhaeuser, Basel, 1992.
- [12] W.H. Press, S.A. Teukolsky, W.T. Vetterling, and B.P. Flannery, Numerical Recepies in C, The Art of Scientific Computing, Second edition, Cambridge University Press, 1992.
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- [15] Prof. Dr. Niels Kuster, ETH, EidgenØssischeTechnischeHoschschuleZØrich, Dosimetric Evaluation of the Cellular Phone.
- [16] Health Canada Safety Code 6 Limits of Human Exposure to Radio Frequency Electromagnetic Fields in the Frequency Rage from 3 kHz – 300 GHz, 2009
- [17] SAR Measurement Guidance for IEEE 802.11 transmitters, KDB 248227 D01v02r02

[18] SAR Evaluation of Handsets with Multiple Transmitters and Antennas KDB 648474 D03, D04.

[19] FCC General RF Exposure Guidance and SAR procedures for Dongles, KDB 447498 D01,D02.

Appendix A. – DUT Ant. Information & SETUP PHOTO

Please refer to test DUT Ant. Information & setup photo file no. as follows:

Report No.
HCT-SR-2304-FI002-P



Appendix B. – PD Test Plots

Test Laboratory: HCT CO., LTD
EUT Type: Module
Ambient Temperature: 20.7 °C
Test Date: 02/27/2023
Plot No.: 1

Measurement Report for Device, FRONT, Custom Band, CW, Channel 59400000 (59400.0 MHz)

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5G	FRONT, 200.00	Custom Band	CW, 0--	59400.0, 59400000	1.0

Hardware Setup

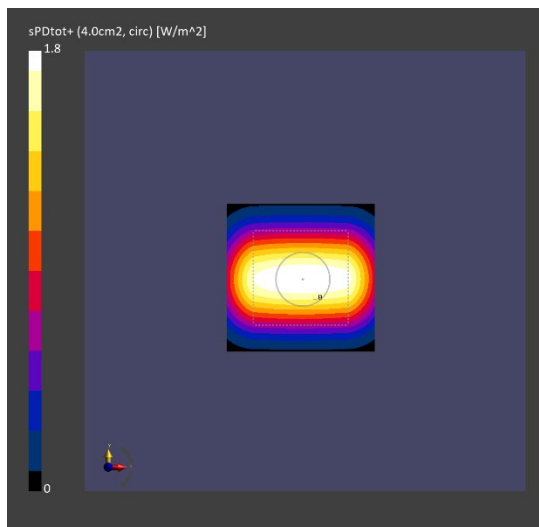
Phantom Medium Probe, Calibration Date DAE, Calibration Date
mmWave - xxxx Air - EUmmWV3 - SN9486_F55-110GHz, 2022-04-06 DAE4 Sn868, 2022-09-21

Scans Setup

Scan Type 5G Scan
Grid Extents [mm] 60.0 x 60.0
Grid Steps [lambda] 0.25 x 0.25
Sensor Surface [mm] 200.0

Measurement Results

Scan Type 5G Scan
Avg. Area [cm²] 4.00
psPDn+ [W/m²] 1.80
psPDtot+ [W/m²] 1.80
psPDmod+ [W/m²] 1.80
E_{max} [V/m] 27.5
Power Drift [dB] 0.08



Test Laboratory: HCT CO., LTD
EUT Type: Module
Ambient Temperature: 21.7 °C
Test Date: 03/03/2023
Plot No.: 2

Measurement Report for Device, EDGE LEFT, Custom Band, CW, Channel 61560000 (61560.0 MHz)

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5G	EDGE LEFT, 200.00	Custom Band	CW, 0--	61560.0, 61560000	1.0

Hardware Setup

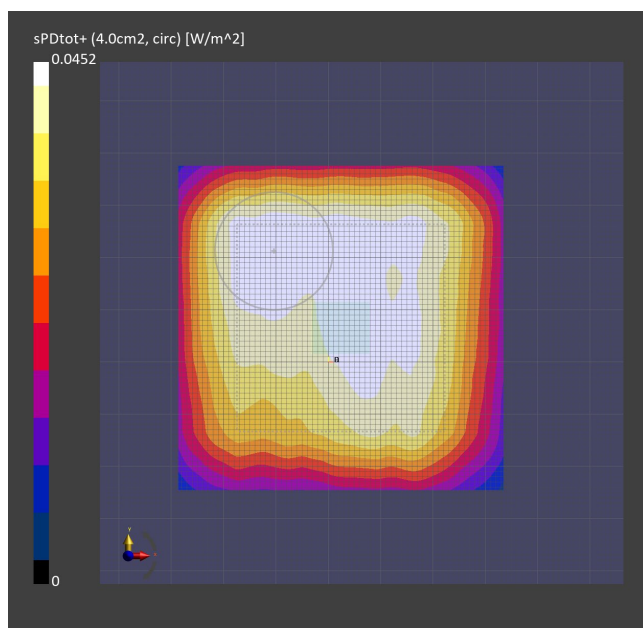
Phantom Medium Probe, Calibration Date DAE, Calibration Date
mmWave - xxxx Air - EUmmWV3 - SN9486_F55-110GHz, 2022-04-06 DAE4 Sn868, 2022-09-21

Scans Setup

Scan Type	5G Scan
Grid Extents [mm]	60.0 x 60.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	200.0

Measurement Results

Scan Type	5G Scan
Avg. Area [cm ²]	4.00
psPDn+ [W/m ²]	0.044
psPDtot+ [W/m ²]	0.045
psPDmod+ [W/m ²]	0.047
E _{max} [V/m]	5.68
Power Drift [dB]	0.16



Test Laboratory: HCT CO., LTD
EUT Type: Module
Ambient Temperature: 20.1 °C
Test Date: 02/28/2023
Plot No.: 3

Measurement Report for Device, Bottom, Custom Band, CW, Channel 59400000 (59400.0 MHz)

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5G	Bottom, 200.00	Custom Band	CW, 0--	59400.0, 59400000	1.0

Hardware Setup

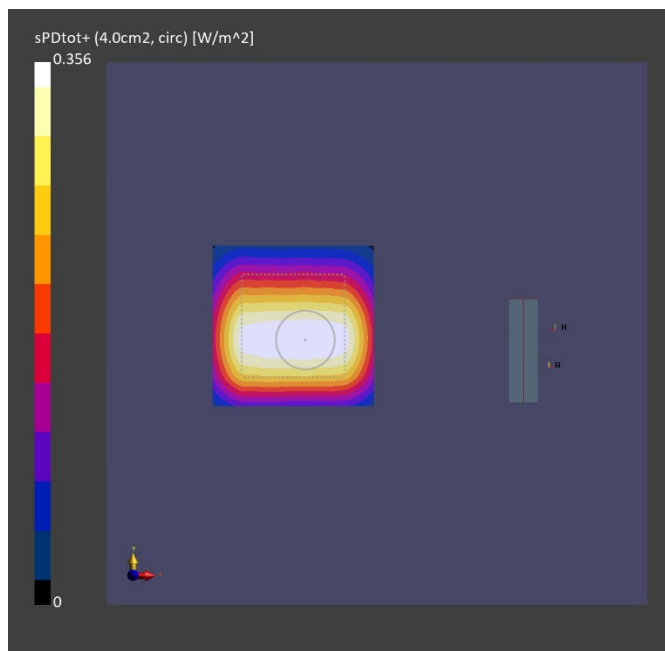
Phantom Medium Probe, Calibration Date DAE, Calibration Date
mmWave - xxxx Air - EUmmWV3 - SN9486_F55-110GHz, 2022-04-06 DAE4 Sn868, 2022-09-21

Scans Setup

Scan Type	5G Scan
Grid Extents [mm]	60.0 x 60.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	200.0

Measurement Results

Scan Type	5G Scan
Avg. Area [cm ²]	4.00
psPDn+ [W/m ²]	0.354
psPDtot+ [W/m ²]	0.356
psPDmod+ [W/m ²]	0.356
E _{max} [V/m]	12.4
Power Drift [dB]	0.15



Test Laboratory: HCT CO., LTD
EUT Type: Module
Ambient Temperature: 21.2 °C
Test Date: 03/07/2023
Plot No.: 4

Measurement Report for Device, FRONT, Custom Band, CW, Channel 59400000 (59400.0 MHz)

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5G	FRONT, 200.00	Custom Band	CW, 0--	59400.0, 59400000	1.0

Hardware Setup

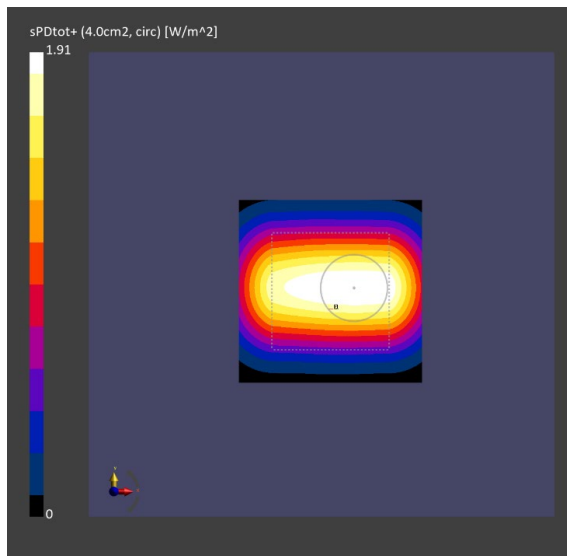
Phantom Medium Probe, Calibration Date DAE, Calibration Date
mmWave - xxxx Air - EUmmWV3 - SN9486_F55-110GHz, 2022-04-06 DAE4 Sn868, 2022-09-21

Scans Setup

Scan Type	5G Scan
Grid Extents [mm]	60.0 x 60.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	200.0

Measurement Results

Scan Type	5G Scan
Avg. Area [cm ²]	4.00
psPDn+ [W/m ²]	1.91
psPDtot+ [W/m ²]	1.91
psPDmod+ [W/m ²]	1.91
E _{max} [V/m]	28.4
Power Drift [dB]	0.03



Test Laboratory: HCT CO., LTD
EUT Type: Module
Ambient Temperature: 21.1 °C
Test Date: 03/10/2023
Plot No.: 5

Measurement Report for Device, EDGE RIGHT, Custom Band, CW, Channel 59400000 (59400.0 MHz)

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5G	EDGE RIGHT, 200.00	Custom Band	CW, 0--	59400.0, 59400000	1.0

Hardware Setup

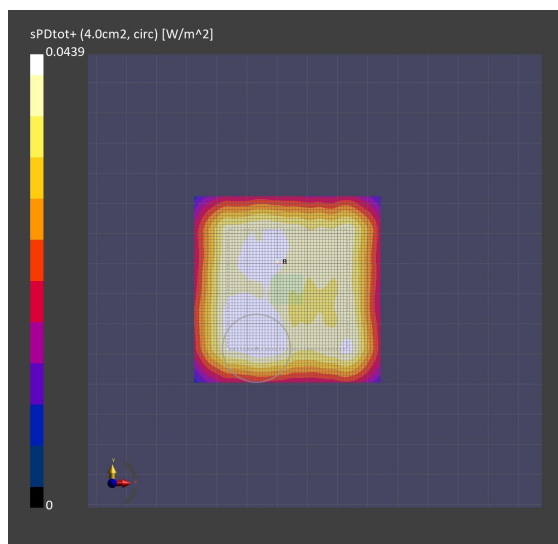
Phantom Medium Probe, Calibration Date DAE, Calibration Date
mmWave - xxxx Air - EUmmWV3 - SN9486_F55-110GHz, 2022-04-06 DAE4 Sn868, 2022-09-21

Scans Setup

Scan Type	5G Scan
Grid Extents [mm]	60.0 x 60.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	200.0

Measurement Results

Scan Type	5G Scan
Avg. Area [cm ²]	4.00
psPDn+ [W/m ²]	0.043
psPDtot+ [W/m ²]	0.044
psPDmod+ [W/m ²]	0.045
E _{max} [V/m]	5.70
Power Drift [dB]	-0.08



Test Laboratory: HCT CO., LTD
EUT Type: Module
Ambient Temperature: 20.8 °C
Test Date: 03/09/2023
Plot No.: 6

Measurement Report for Device, Bottom, Custom Band, CW, Channel 63720000 (63720.0 MHz)

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5G	Bottom, 200.00	Custom Band	CW, 0--	63720.0, 63720000	1.0

Hardware Setup

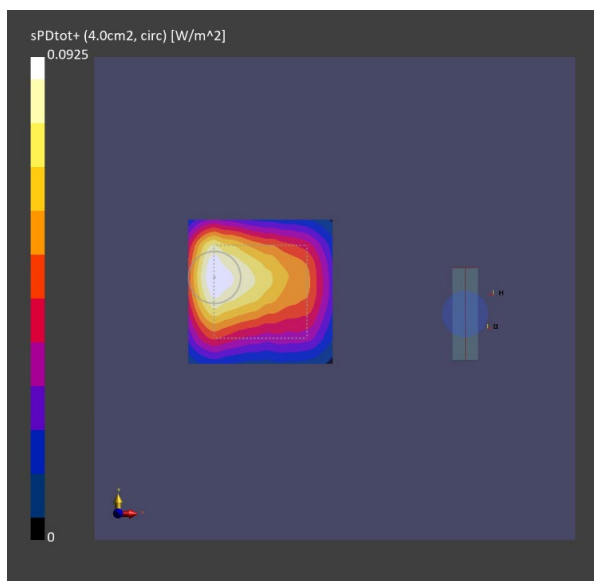
Phantom Medium Probe, Calibration Date DAE, Calibration Date
mmWave - xxxx Air - EUmmWV3 - SN9486_F55-110GHz, 2022-04-06 DAE4 Sn868, 2022-09-21

Scans Setup

Scan Type	5G Scan
Grid Extents [mm]	60.0 x 60.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	200.0

Measurement Results

Scan Type	5G Scan
Avg. Area [cm ²]	4.00
psPDn+ [W/m ²]	0.084
psPDtot+ [W/m ²]	0.092
psPDmod+ [W/m ²]	0.093
E _{max} [V/m]	7.30
Power Drift [dB]	0.18





Appendix C. – Dipole Verification Plots

■ Verification Data (60 000 MHz)

Test Laboratory: HCT CO., LTD
Ambient Temp: 20.7 °C
Test Date: 02/27/2023

Measurement Report for Device, FRONT, Custom Band, CW, Channel 60000000 (60000.0 MHz)

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5G	FRONT, 5.55	Custom Band	CW, 0--	60000.0, 60000000	1.0

Hardware Setup

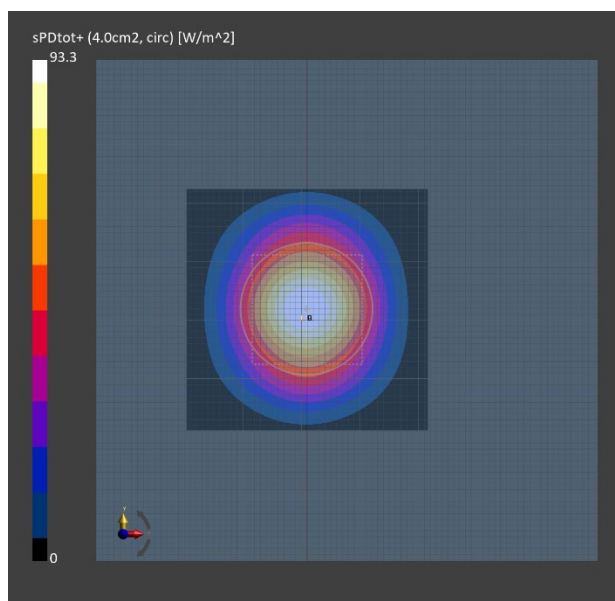
Phantom Medium Probe, Calibration Date DAE, Calibration Date
mmWave - xxxx Air - EUmmWV3 - SN9486_F55-110GHz, 2022-04-06 DAE4 Sn868, 2022-09-21

Scans Setup

Scan Type	5G Scan
Grid Extents [mm]	40.0 x 40.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	5.55

Measurement Results

Scan Type	5G Scan
Avg. Area [cm ²]	4.00
psPDn+ [W/m ²]	92.4
psPDtot+ [W/m ²]	93.3
psPDmod+ [W/m ²]	93.6
E _{max} [V/m]	267
Power Drift [dB]	-0.12



■ Verification Data (60 000 MHz)

Test Laboratory: HCT CO., LTD
Ambient Temp 20.1 °C
Test Date: 02/28/2023

Measurement Report for Device, FRONT, Custom Band, CW, Channel 60000000 (60000.0 MHz)

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5G	FRONT, 5.55	Custom Band	CW, 0--	60000.0, 60000000	1.0

Hardware Setup

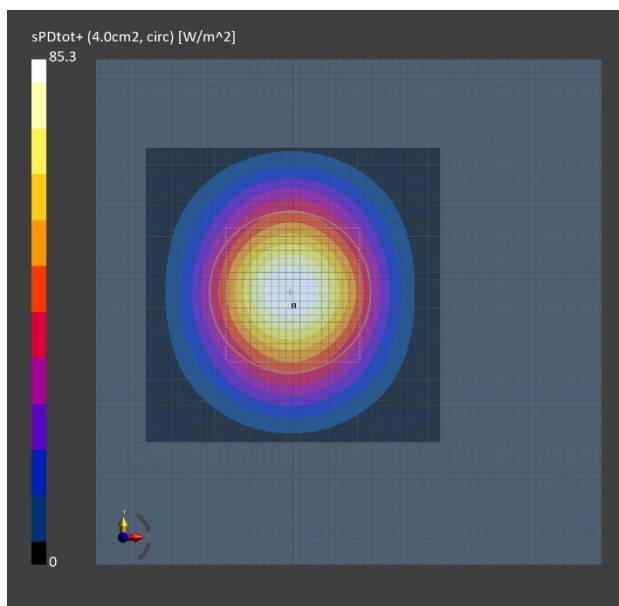
Phantom Medium Probe, Calibration Date DAE, Calibration Date
mmWave - xxxx Air - EUmmWV3 - SN9486_F55-110GHz, 2022-04-06 DAE4 Sn868, 2022-09-21

Scans Setup

Scan Type	5G Scan
Grid Extents [mm]	40.0 x 40.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	5.55

Measurement Results

Scan Type	5G Scan
Avg. Area [cm ²]	4.00
psPDn+ [W/m ²]	84.0
psPDtot+ [W/m ²]	85.3
psPDmod+ [W/m ²]	85.7
E _{max} [V/m]	247
Power Drift [dB]	-0.01



■ Verification Data (60 000 MHz)

Test Laboratory: HCT CO., LTD
Ambient Temp 20.6 °C
Test Date: 03/02/2023

Measurement Report for Device, FRONT, Custom Band, CW, Channel 60000000 (60000.0 MHz)

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5G	FRONT, 5.55	Custom Band	CW, 0--	60000.0, 60000000	1.0

Hardware Setup

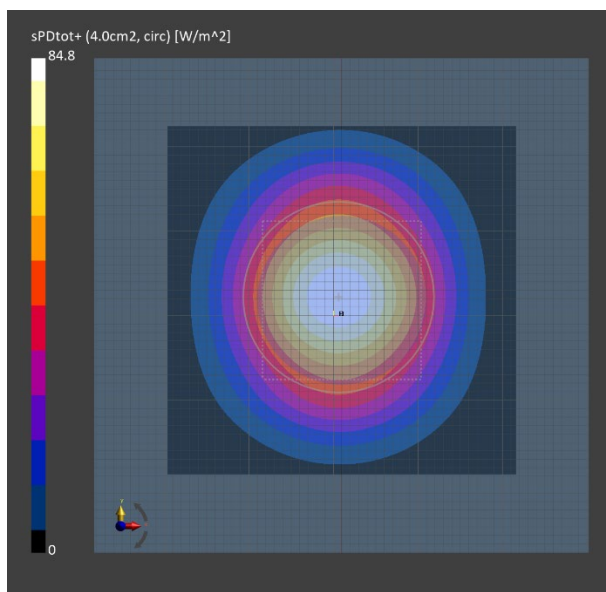
Phantom Medium Probe, Calibration Date DAE, Calibration Date
mmWave - xxxx Air - EUmmWV3 - SN9486_F55-110GHz, 2022-04-06 DAE4 Sn868, 2022-09-21

Scans Setup

Scan Type	5G Scan
Grid Extents [mm]	40.0 x 40.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	5.55

Measurement Results

Scan Type	5G Scan
Avg. Area [cm ²]	4.00
psPDn+ [W/m ²]	83.5
psPDtot+ [W/m ²]	84.8
psPDmod+ [W/m ²]	85.3
E _{max} [V/m]	248
Power Drift [dB]	0.01



■ Verification Data (60 000 MHz)

Test Laboratory: HCT CO., LTD
Ambient Temp 21.7 °C
Test Date: 03/03/2023

Measurement Report for Device, FRONT, Custom Band, CW, Channel 60000000 (60000.0 MHz)

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5G	FRONT, 5.55	Custom Band	CW, 0--	60000.0, 60000000	1.0

Hardware Setup

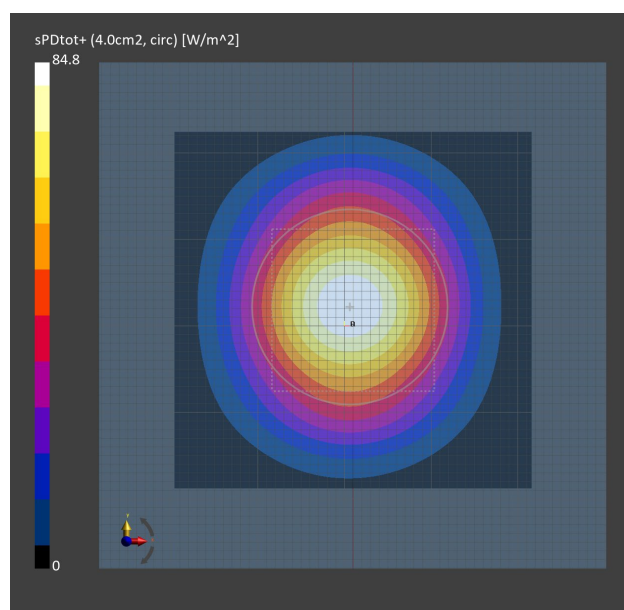
Phantom Medium Probe, Calibration Date DAE, Calibration Date
mmWave - xxxx Air - EUmmWV3 - SN9486_F55-110GHz, 2022-04-06 DAE4 Sn868, 2022-09-21

Scans Setup

Scan Type	5G Scan
Grid Extents [mm]	40.0 x 40.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	5.55

Measurement Results

Scan Type	5G Scan
Avg. Area [cm ²]	4.00
psPDn+ [W/m ²]	84.1
psPDtot+ [W/m ²]	84.8
psPDmod+ [W/m ²]	85.2
E _{max} [V/m]	247
Power Drift [dB]	-0.04



Verification Data (60 000 MHz)

Test Laboratory: HCT CO., LTD
Ambient Temp 21.5 °C
Test Date: 03/06/2023

Measurement Report for Device, FRONT, Custom Band, CW, Channel 60000000 (60000.0 MHz)

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5G	FRONT, 5.55	Custom Band	CW, 0--	60000.0, 60000000	1.0

Hardware Setup

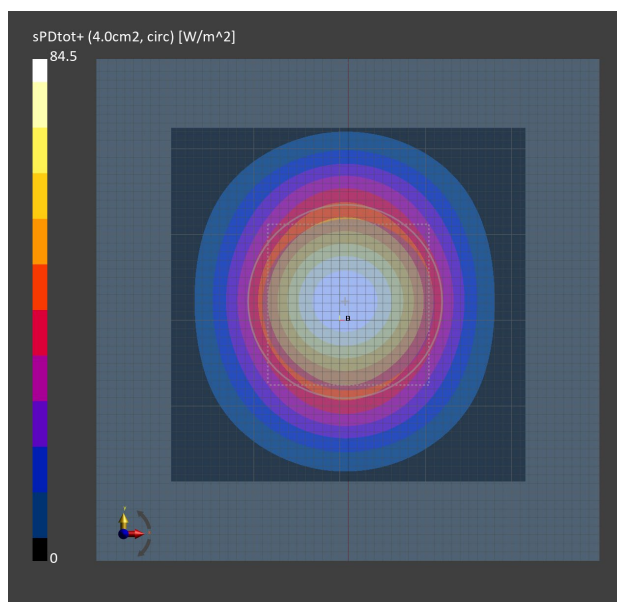
Phantom Medium Probe, Calibration Date DAE, Calibration Date
mmWave - xxxx Air - EUmmWV3 - SN9486_F55-110GHz, 2022-04-06 DAE4 Sn868, 2022-09-21

Scans Setup

Scan Type	5G Scan
Grid Extents [mm]	40.0 x 40.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	5.55

Measurement Results

Scan Type	5G Scan
Avg. Area [cm ²]	4.00
psPDn+ [W/m ²]	83.2
psPDtot+ [W/m ²]	84.5
psPDmod+ [W/m ²]	84.9
E _{max} [V/m]	248
Power Drift [dB]	-0.04



Verification Data (60 000 MHz)

Test Laboratory: HCT CO., LTD

Ambient Temp 21.2 °C
Test Date: 03/07/2023

Measurement Report for Device, FRONT, Custom Band, CW, Channel 60000000 (60000.0 MHz)

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5G	FRONT, 5.55	Custom Band	CW, 0--	60000.0, 60000000	1.0

Hardware Setup

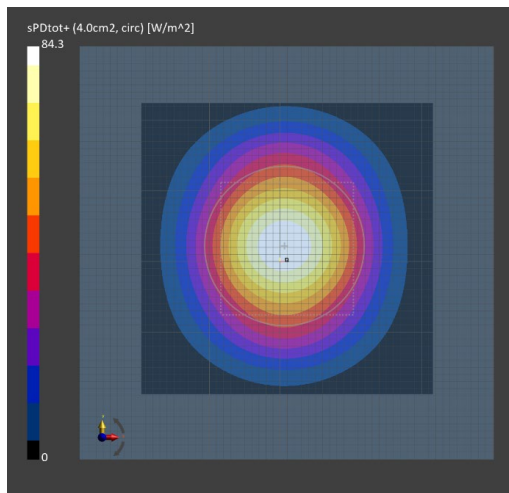
Phantom Medium Probe, Calibration Date DAE, Calibration Date
mmWave - xxxx Air - EUmmWV3 - SN9486_F55-110GHz, 2022-04-06 DAE4 Sn868, 2022-09-21

Scans Setup

Scan Type	5G Scan
Grid Extents [mm]	40.0 x 40.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	5.55

Measurement Results

Scan Type	5G Scan
Avg. Area [cm ²]	4.00
psPDn+ [W/m ²]	82.9
psPDtot+ [W/m ²]	84.3
psPDmod+ [W/m ²]	84.7
E _{max} [V/m]	247
Power Drift [dB]	-0.02



■ Verification Data (60 000 MHz)

Test Laboratory: HCT CO., LTD
Ambient Temp 21.1 °C
Test Date: 03/08/2023

Measurement Report for Device, FRONT, Custom Band, CW, Channel 60000000 (60000.0 MHz)

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5G	FRONT, 5.55	Custom Band	CW, 0--	60000.0, 60000000	1.0

Hardware Setup

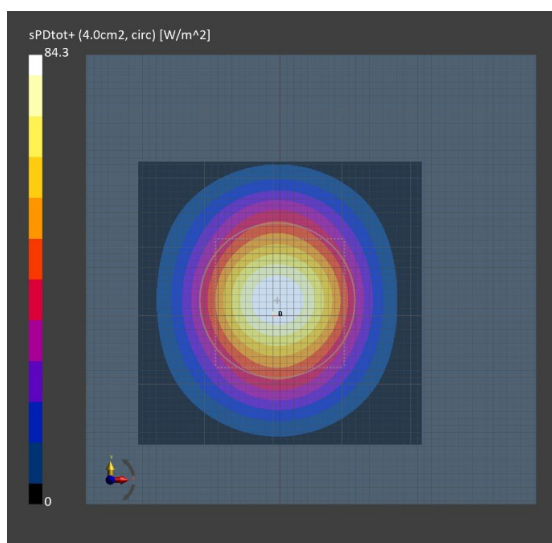
Phantom Medium Probe, Calibration Date DAE, Calibration Date
mmWave - xxxx Air - EUmmWV3 - SN9486_F55-110GHz, 2022-04-06 DAE4 Sn868, 2022-09-21

Scans Setup

Scan Type	5G Scan
Grid Extents [mm]	40.0 x 40.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	5.55

Measurement Results

Scan Type	5G Scan
Avg. Area [cm ²]	4.00
psPDn+ [W/m ²]	82.9
psPDtot+ [W/m ²]	84.3
psPDmod+ [W/m ²]	84.7
E _{max} [V/m]	247
Power Drift [dB]	-0.01



■ Verification Data (60 000 MHz)

Test Laboratory: HCT CO., LTD
Ambient Temp 20.8 °C
Test Date: 03/09/2023

Measurement Report for Device, FRONT, Custom Band, CW, Channel 60000000 (60000.0 MHz)

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5G	FRONT, 5.55	Custom Band	CW, 0--	60000.0, 60000000	1.0

Hardware Setup

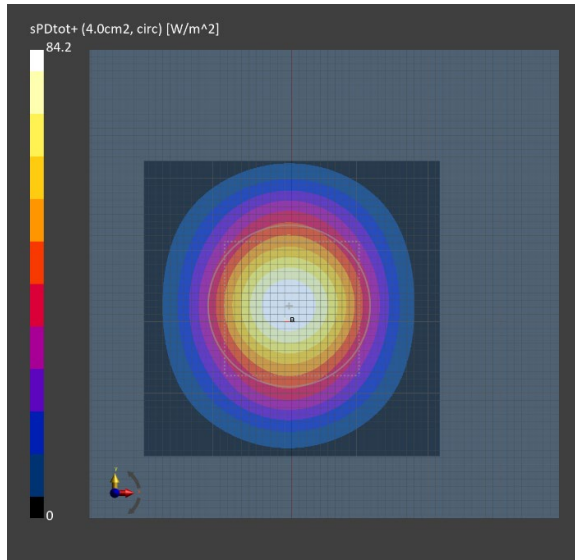
Phantom Medium Probe, Calibration Date DAE, Calibration Date
mmWave - xxxx Air - EUmmWV3 - SN9486_F55-110GHz, 2022-04-06 DAE4 Sn868, 2022-09-21

Scans Setup

Scan Type	5G Scan
Grid Extents [mm]	40.0 x 40.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	5.55

Measurement Results

Scan Type	5G Scan
Avg. Area [cm ²]	4.00
psPDn+ [W/m ²]	83.5
psPDtot+ [W/m ²]	84.2
psPDmod+ [W/m ²]	84.6
E _{max} [V/m]	247
Power Drift [dB]	0.03



■ Verification Data (60 000 MHz)

Test Laboratory: HCT CO., LTD
Ambient Temp 21.1 °C
Test Date: 03/10/2023

Measurement Report for Device, FRONT, Custom Band, CW, Channel 60000000 (60000.0 MHz)

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5G	FRONT, 5.55	Custom Band	CW, 0--	60000.0, 60000000	1.0

Hardware Setup

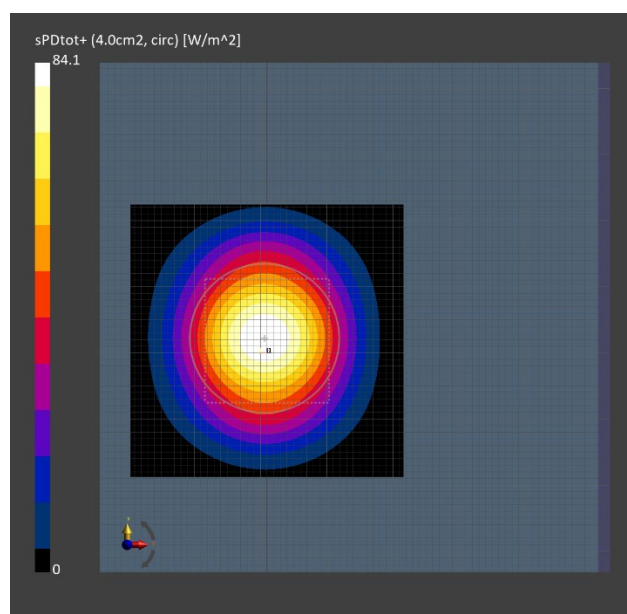
Phantom Medium Probe, Calibration Date DAE, Calibration Date
mmWave - xxxx Air - EUmmWV3 - SN9486_F55-110GHz, 2022-04-06 DAE4 Sn868, 2022-09-21

Scans Setup

Scan Type	5G Scan
Grid Extents [mm]	40.0 x 40.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	5.55

Measurement Results

Scan Type	5G Scan
Avg. Area [cm ²]	4.00
psPDn+ [W/m ²]	82.7
psPDtot+ [W/m ²]	84.1
psPDmod+ [W/m ²]	84.5
E _{max} [V/m]	247
Power Drift [dB]	0.00



■ Verification Data (60 000 MHz)

Test Laboratory: HCT CO., LTD
Ambient Temp 21.4 °C
Test Date: 03/13/2023

Measurement Report for Device, FRONT, Custom Band, CW, Channel 60000000 (60000.0 MHz)

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
5G	FRONT, 5.55	Custom Band	CW, 0--	60000.0, 60000000	1.0

Hardware Setup

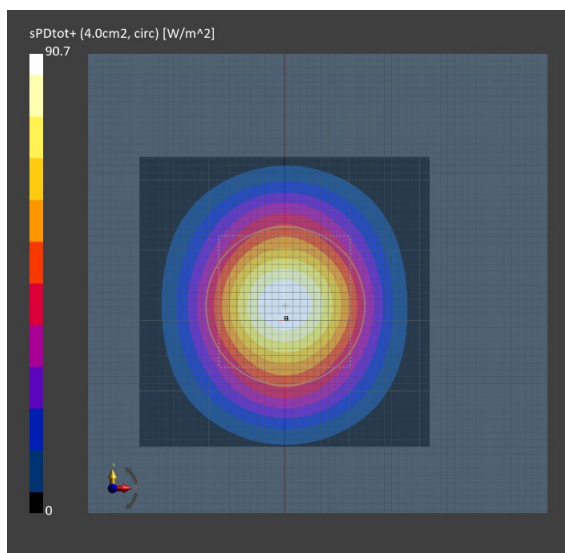
Phantom Medium Probe, Calibration Date DAE, Calibration Date
mmWave - xxxx Air - EUmmWV3 - SN9486_F55-110GHz, 2022-04-06 DAE4 Sn868, 2022-09-21

Scans Setup

Scan Type	5G Scan
Grid Extents [mm]	40.0 x 40.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	5.55

Measurement Results

Scan Type	5G Scan
Avg. Area [cm ²]	4.00
psPDn+ [W/m ²]	89.7
psPDtot+ [W/m ²]	90.7
psPDmod+ [W/m ²]	91.0
E _{max} [V/m]	258
Power Drift [dB]	-0.12





Appendix D. – Probe Calibration Data

Schmid & Partner Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 44 245 9700, Fax +41 44 245 9779
www.speag.swiss, info@speag.swiss

s p e a g

IMPORTANT NOTICE PLEASE READ BEFORE USING THE EQUIPMENT

Care and Handling of EUmmWVx Probe

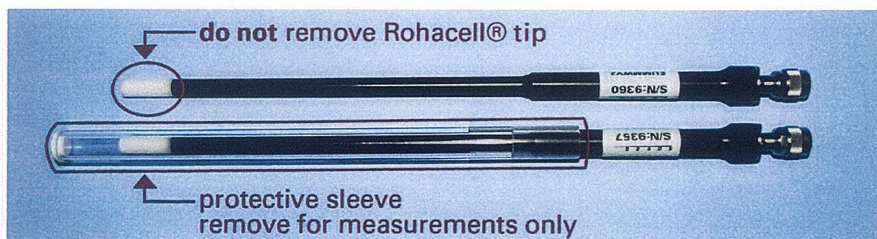
CAUTION!

The field sensors in the tip of the EUmmWVx probe are printed on very thin quartz glass in order to allow for outstanding performance with minimal scattering.

The glass tip is protected by the Rohacell® foam – **DO NOT REMOVE THE FOAM** as it is part of the probe design and removal will cause permanent probe damage!

Please note; despite the protective foam, the glass tip of the probe is **fragile and extremely sensitive to any mechanical stress**, so please **handle with care!** If the glass tip breaks, the probe is damaged beyond economical repair.

For storage, the probe is further protected with a transparent sleeve (see picture below); **the sleeve must be removed before connecting the probe to the DAE**; after using the probe, carefully remove from the DAE and re-attach the sleeve and store the probe in a safe place.



Note that probe usage is limited to free-space measurements; water, sugar-water solutions, nutrient solutions and glycol solutions will permanently damage the probe.

We at SPEAG do our best to increase the robustness of the probe as much as possible while allowing for maximum performance. For further questions and support, or to sign up to our probe care program, please contact us at: support@speag.swiss.

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
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **HCT (Dymstec)**

Certificate No: **EUmmWV3-9486_Apr22**

CALIBRATION CERTIFICATE

Object **EUmmWV3 - SN:9486**

Calibration procedure(s) **QA CAL-02.v9, QA CAL-25.v7, QA CAL-42.v2**
Calibration procedure for E-field probes optimized for close near field evaluations in air

Calibration date: **April 06, 2022**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power sensor NRP33T	SN: 100967	08-Apr-21 (No. 217-03293)	Apr-22
R&S FSV40 Spectrum Analyzer	SN: 101832	25-Jan-22 (No. 4030-315003399)	Jan-25
Reference Probe EUmmWV3	SN: 9374	21-Dec-21 (No. EUmmWv3-9374_Dec21)	Dec-22
DAE4	SN: 789	24-Dec-21 (No. DAE4-789_Dec21)	Dec-22
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-22

Calibrated by:	Name Leif Klysner	Function Laboratory Technician	Signature
Approved by:	Name Sven Kühn	Function Deputy Manager	Signature

Issued: April 8, 2022

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

Certificate No: EUmmWV3-9486_Apr22

Page 1 of 20

결	담당자	확인자
재	DL / 박성호 2022. 04. 15	DL / 박성호 2022. 04. 15

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



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Glossary:

$NORM_{x,y,z}$	sensitivity in free space
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.e., $\vartheta = 0$ is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system
Sensor Angles k	sensor deviation from the probe axis, used to calculate the field orientation and polarization is the wave propagation direction

Calibration is Performed According to the Following Standards:

- IEEE Std 1309-2005, "IEEE Standard for calibration of electromagnetic field sensors and probes, excluding antennas, from 9 kHz to 40 GHz", December 2005

Methods Applied and Interpretation of Parameters:

- $NORM_{x,y,z}$: Assessed for E-field polarization $\vartheta = 0$ for XY sensors and $\vartheta = 90$ for Z sensor ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). For frequencies > 6 GHz, the far field in front of waveguide horn antennas is measured for a set of frequencies in various waveguide bands up to 110 GHz.
- $DCP_{x,y,z}$: DCP is numerical linearization parameters assessed based on the data of power sweep with CW signal (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
- The frequency sensor model parameters are determined prior to calibration based on a frequency sweep (sensor model involving resistors R, R_p , inductance L and capacitors C, C_p).
- $A_{x,y,z}$; $B_{x,y,z}$; $C_{x,y,z}$; $D_{x,y,z}$; $VR_{x,y,z}$: A, B, C, D 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.
- Sensor Offset**: The sensor offset corresponds to the mechanical 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).
- Equivalent Sensor Angle**: The two probe sensors are mounted in the same plane at different angles. The angles are assessed using the information gained by determining the $NORM_x$ (no uncertainty required).
- Spherical isotropy (3D deviation from isotropy)**: in a locally homogeneous field realized using an open waveguide / horn setup.

EUmmWV3 - SN: 9486

April 06, 2022

DASY - Parameters of Probe: EUmmWV3 - SN:9486

Basic Calibration Parameters

	Sensor X	Sensor Y	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$)	0.02168	0.02409	$\pm 10.1\%$
DCP (mV) ^B	106.8	105.0	
Equivalent Sensor Angle	-59.7	34.5	

Calibration results for Frequency Response (750 MHz – 110 GHz)

Frequency GHz	Target E-Field V/m	Deviation Sensor X dB	Deviation Sensor Y dB	Unc (k=2) dB
0.75	77.2	-0.08	-0.14	± 0.43 dB
1.8	140.4	0.05	0.05	± 0.43 dB
2	133.0	0.03	0.06	± 0.43 dB
2.2	124.8	0.06	0.09	± 0.43 dB
2.5	123.0	-0.02	0.00	± 0.43 dB
3.5	256.2	0.13	0.08	± 0.43 dB
3.7	249.8	0.20	0.11	± 0.43 dB
6.6	41.8	0.44	0.52	± 0.98 dB
8	48.4	-0.14	-0.14	± 0.98 dB
10	54.4	-0.06	0.00	± 0.98 dB
15	71.5	0.72	-0.57	± 0.98 dB
18	85.3	-0.08	0.24	± 0.98 dB
26.6	96.9	-0.09	0.05	± 0.98 dB
30	92.6	0.01	0.05	± 0.98 dB
35	93.7	-0.03	-0.01	± 0.98 dB
40	91.5	-0.13	-0.30	± 0.98 dB
50	19.6	0.20	0.08	± 0.98 dB
55	22.4	-0.09	-0.01	± 0.98 dB
60	23.0	0.09	0.05	± 0.98 dB
65	27.4	-0.50	-0.25	± 0.98 dB
70	23.9	-0.32	-0.37	± 0.98 dB
75	20.0	-0.06	-0.06	± 0.98 dB
75	14.8	0.10	0.06	± 0.98 dB
80	22.5	0.00	0.23	± 0.98 dB
85	22.8	-0.02	-0.05	± 0.98 dB
90	23.8	0.07	0.10	± 0.98 dB
92	23.9	-0.08	-0.22	± 0.98 dB
95	20.5	-0.34	-0.35	± 0.98 dB
97	24.4	-0.06	-0.21	± 0.98 dB
100	22.6	-0.04	-0.11	± 0.98 dB
105	22.7	0.01	0.10	± 0.98 dB
110	19.7	0.17	0.28	± 0.98 dB

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%.

^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 - Parameters of Probe: EUmmWV3 - SN:9486

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB/μV	C	D dB	VR mV	Max dev.	Max Unc ^E (k=2)
0	CW	X	0.00	0.00	1.00	0.00	128.8	± 3.5 %	± 4.7 %
		Y	0.00	0.00	1.00		67.3		
10352-AAA	Pulse Waveform (200Hz, 10%)	X	1.73	60.00	13.72	10.00	6.0	± 1.6 %	± 9.6 %
		Y	2.05	60.00	14.55		6.0		
10353-AAA	Pulse Waveform (200Hz, 20%)	X	1.18	60.00	12.59	6.99	12.0	± 1.0 %	± 9.6 %
		Y	2.00	64.00	15.00		12.0		
10354-AAA	Pulse Waveform (200Hz, 40%)	X	0.70	60.00	11.32	3.98	23.0	± 1.5 %	± 9.6 %
		Y	0.81	60.00	12.55		23.0		
10355-AAA	Pulse Waveform (200Hz, 60%)	X	0.42	60.00	10.54	2.22	27.0	± 1.0 %	± 9.6 %
		Y	0.59	60.00	11.50		27.0		
10387-AAA	QPSK Waveform, 1 MHz	X	1.00	60.00	11.28	1.00	22.0	± 1.9 %	± 9.6 %
		Y	1.15	60.00	11.57		22.0		
10388-AAA	QPSK Waveform, 10 MHz	X	1.26	60.00	11.59	0.00	22.0	± 0.8 %	± 9.6 %
		Y	1.44	60.00	11.72		22.0		
10396-AAA	64-QAM Waveform, 100 kHz	X	1.87	60.00	13.51	3.01	17.0	± 0.7 %	± 9.6 %
		Y	2.07	60.00	13.71		17.0		
10399-AAA	64-QAM Waveform, 40 MHz	X	2.11	60.00	12.16	0.00	19.0	± 1.0 %	± 9.6 %
		Y	2.21	60.00	12.34		19.0		
10414-AAA	WLAN CCDF, 64-QAM, 40MHz	X	3.17	60.00	12.63	0.00	12.0	± 0.7 %	± 9.6 %
		Y	3.28	60.00	12.79		12.0		

Note: For details on all calibrated UID parameters see Appendix

Calibration Results for Linearity Response

Frequency GHz	Target E-Field V/m	Deviation Sensor X dB	Deviation Sensor Y dB	Unc (k=2) dB
0.9	50.0	0.03	0.08	± 0.2 dB
0.9	100.0	0.03	0.01	± 0.2 dB
0.9	500.0	0.05	0.00	± 0.2 dB
0.9	1000.0	0.06	0.00	± 0.2 dB
0.9	1500.0	0.04	-0.02	± 0.2 dB
0.9	2000.0	0.00	-0.04	± 0.2 dB

Sensor Frequency Model Parameters (750 MHz – 55 GHz)

	Sensor X	Sensor Y
R (Ω)	73.24	64.03
R _p (Ω)	96.20	102.84
L (nH)	0.10530	0.06850
C (pF)	0.2320	0.2654
C _p (pF)	0.0746	0.0839

Sensor Frequency Model Parameters (55 GHz – 110 GHz)

	Sensor X	Sensor Y
R (Ω)	32.46	26.67
R _p (Ω)	95.58	98.85
L (nH)	0.03112	0.01523
C (pF)	0.2173	1.2134
C _p (pF)	0.1420	0.2112

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DASY - Parameters of Probe: EUmmWV3 - SN:9486**Sensor Model Parameters**

	C1 fF	C2 fF	α V^{-1}	T1 $ms.V^{-2}$	T2 $ms.V^{-1}$	T3 ms	T4 V^{-2}	T5 V^{-1}	T6
X	33.1	241.43	33.89	0.92	3.07	5.00	0.00	0.92	1.01
Y	34.4	250.38	33.82	0.92	4.03	5.00	0.00	1.54	1.00

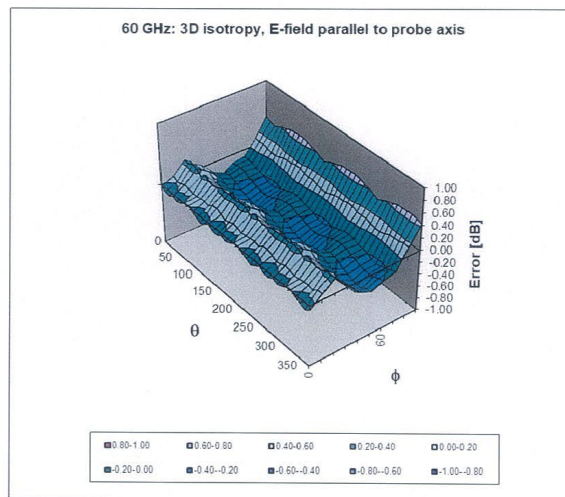
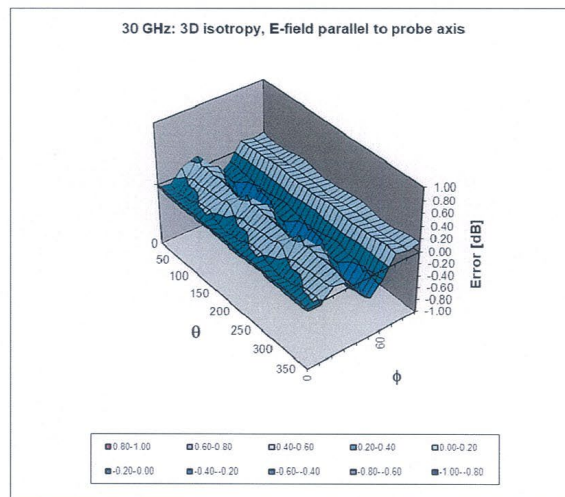
Other Probe Parameters

Sensor Arrangement	Rectangular
Connector Angle (°)	98.4
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	320 mm
Probe Body Diameter	8 mm
Tip Length	23 mm
Tip Diameter	8.0 mm
Probe Tip to Sensor X Calibration Point	1.5 mm
Probe Tip to Sensor Y Calibration Point	1.5 mm

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Deviation from Isotropy in Air f = 30, 60 GHz



Probe isotropy for E_{tot} : probe rotated $\phi = 0^\circ$ to 360° , tilted from field propagation direction $\vec{k}$
 Parallel to the field propagation ($\psi = 0^\circ - 90^\circ$) at 30 GHz: deviation within ± 0.36 dB
 Parallel to the field propagation ($\psi = 0^\circ - 90^\circ$) at 60 GHz: deviation within ± 0.41 dB