TEST REPORT

EUT Description	**Wireless Module installed in 2 in 1 PC/Tablet**
Brand Name	**Intel® Model 18265 inside Dell Model T02J**
Model Name	**18265NGW**
FCC/IC ID	**FCC ID: PD918265NG/IC ID: 1000M-18265NG**
Date of Test Start/End	**2017-07-12 / 2017-07-13**
Features	**WiGig + 802.11 a/b/g/n/ac Wireless LAN + BDR/EDR 2.1 + BLE 4.2** (see section 5)

Applicant	**Intel Mobile Communications**
Address	**100 Center Point Circle, Suite 200 / Columbia, SC 29210 / United States**
Contact Person	**Steven Hackett**
Telephone/Fax/ Email	**steven.c.hackett@intel.com**

Reference Standards	**FCC 47 CFR Part §2.1093** **FCC 47 CFR Part §15.255(f)** (see section 1)
RF Exposure Environment	**Portable devices - General population/uncontrolled exposure**
Min. test separation distance	**2 mm (from probe sensor to evaluation plane)**

Test Report identification	**170420-01.TR01**
Revision Control	**Rev. 01** **This test report revision replaces any previous test report revision** (see section 8)

The test results relate only to the samples tested.
The test report shall not be reproduced in full, without written approval of the laboratory.

Reviewed by

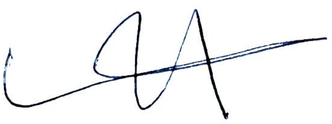

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Table of Contents

1. Standards, reference documents and applicable test methods

1. FCC 47 CFR Part §2.1093 – Radiofrequency radiation exposure evaluation: portable devices.
2. FCC 47 CFR Part 15 – Subpart C – §15.255 Operation within the band 57-64 GHz.
3. SPEAG Application Note – 5G Compliance Testing with DASY6 (5GModule V1.0Beta)

2. General conditions, competences and guarantees

- ✓ Intel Mobile Communications France SAS Wireless RF Lab (Intel WRF Lab) is a testing laboratory competent to perform this testing.
- ✓ Intel WRF Lab only provides testing services and is committed to providing reliable, unbiased test results and interpretations.
- ✓ Intel WRF Lab is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.
- ✓ Intel WRF Lab has developed calibration and proficiency programs for its measurement equipment to ensure correlated and reliable results to its customers.
- ✓ This report is only referred to the item that has undergone the test.
- ✓ This report does not imply an approval of the product by the Certification Bodies or competent Authorities.

3. Environmental Conditions

- ✓ At the site where the measurements were performed the following limits were not exceeded during the tests:

Temperature	24ºC ± 1ºC
Humidity	55% ± 10%

4. Test samples

Sample	Control #	Description	Model	Serial #	Date of receipt	Note
#01	170420-01.S01	Tablet PC (with embedded radio module model 18265NGW sn: 3413E8344160)	T02J	4358756100004	2017-03-31	NA
	170420-01.S01	AC Adapter	LA45NM150	CN-0HDCY5-72438-69G-0AB6-A01	2017-03-31	NA

5. EUT Features

Brand Name	Intel® Model 18265 inside Dell Model T02J
Model Name	18265NGW
FCC/IC ID	FCC ID: PD918265NG/IC ID: 1000M-18265NG
Software Version	1.9.0-04603
Prototype / Production	Production
Host Identification	T02J series
Exposure Conditions	Localized free space power density
Supported Radios	WiGig: 60GHz (57.24 – 63.72 GHz) 802.11b/g/n: 2.4GHz (2400.0 – 2483.5 MHz) 802.11a/n/ac: 5.2GHz (5150.0 – 5250.0 MHz) 5.3GHz (5250.0 – 5350.0 MHz) 5.6GHz (5470.0 – 5725.0 MHz) 5.8GHz (5725.0 – 5825.0 MHz) Bluetooth: 2.4GHz (2400.0 – 2483.5 MHz)
Antenna Information	RFEM3 (10101RRFW)

Note: RF exposure compliance for 802.11 and Bluetooth capabilities are not addressed in this document neither the associated documents mentioned in section 7. The compliance for 82.11 and Bluetooth technologies is addressed in report number “SAR 20170207” dated Feb 8-11, 2017 with FCC ID number PD918265NGU.

6. Remarks and comments

1. Per the location of the active antenna array (a.k.a. RFEM3) in the Dell model T02J platform, the distance between the antenna arrays to the body of an end user, at the closest contact point, will be in the near-field.
2. In order to prove that during typical use the energy goes in most cases away from the human body, several tests of beamforming behavior were performed under different use case conditions. The results are presented in the associated document [2].
3. These tests are supported by a determination of the near-field power average density performed using an EM simulation supported by a near-field measurement. An EM simulation that includes the RFEM3 transmitter model embedded inside the Dell model T02J is used to determine the worst case configuration and the correspondent near-field power density. This worst case power density which is a conservative case considering that the energy is always oriented toward the human body is also supported by a near-field measurement. The simulation method is described in associated document [2]. The simulation results and the near-field measurement results are described in Annex D.
4. The worst-case power density found in simulation is supported by performing the E-field measurement in the near-field using SPEAG system. The measurement system and test results are presented in this report.

7. Associated Documents

[1] Dell T02J –Theory of Operation Report Revision 1.1.
[2] Dell T02J – RF Exposure Power Density Evaluation and Test Report Revision 1.1.

8. Document Revision History

Revision #	Date	Modified by	Revision Details
Rev. 00	2017-07-20	K. Rida I. Kharrat	First Issue
Rev. 01	2017-08-20	K. Rida A. Dhouibi	Revision 0.1 according to FCC questions

Annex A. Test & System Description

A.1 Power Density Definition

The power density for an electromagnetic field represents the rate of energy transfer per unit area.
The local power density (i.e. Poynting vector) at a given spatial point is deduced from electromagnetic fields by the following formula:

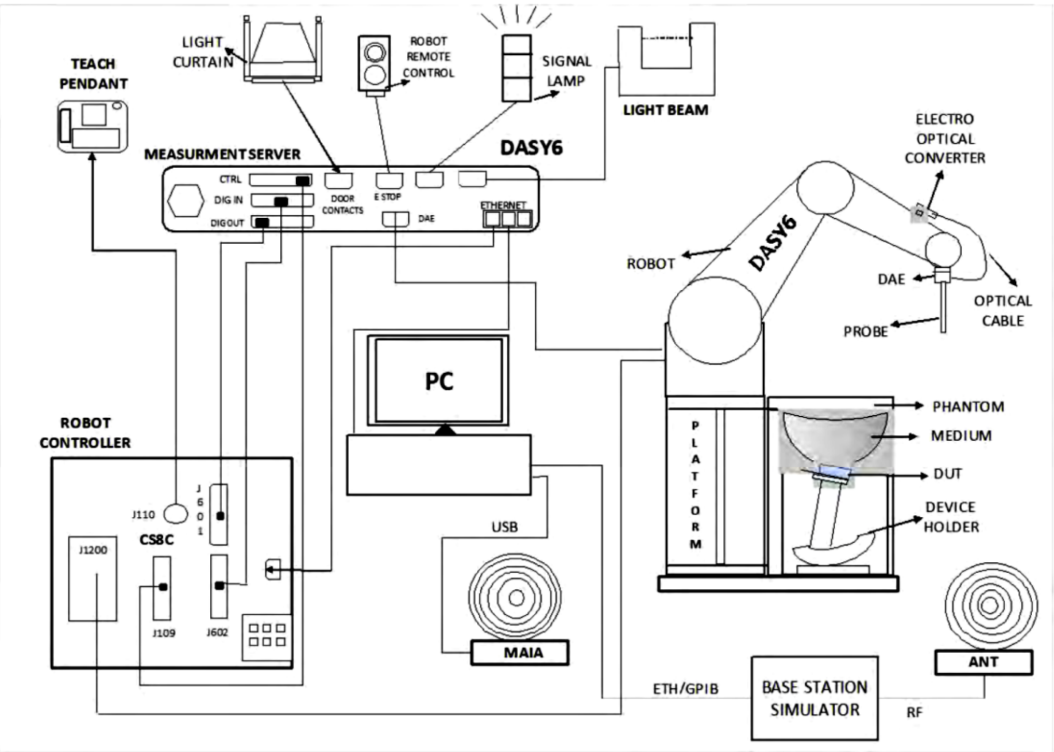
$$\overrightarrow{P_{local}} = \frac{1}{2}\text{Re}\left(\vec{E} \times \vec{H}^{*}\right)$$

Where $\vec{E}$ is the complex electric field peak phasor and $\vec{H}^{*}$ is the complex conjugate magnetic field peak phasor.
This power density is also called “single-point” or “spot power density”.
Considering that the FCC’s Maximum Permissible Exposure (MPE) limit is applicable on the average power density inside $1cm^2$ area, the single point power densities in the evaluation plane should be averaged inside the $1cm^2$ area.

A.2 SPEAG free space Measurement System

A.2.1 Measurement Setup

The DASY6 system for performing compliance tests consists of the following items:



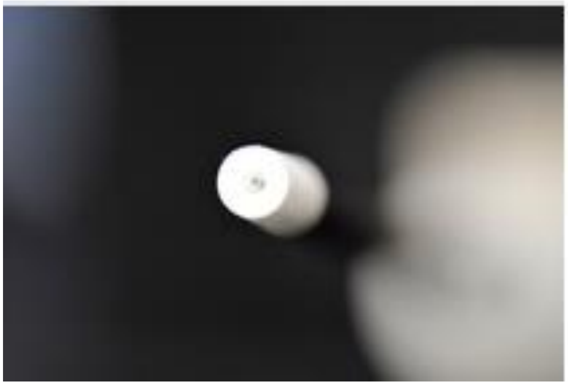
- ✓ A standard high precision 6-axis robot (Staübli TX/RX family) with controller, teach pendant and software. It includes an arm extension for accommodating the data acquisition electronics (DAE)
- ✓ An isotropic field probe optimized and calibrated for the targeted measurements.
- ✓ A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- ✓ The Electro-optical Converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. The EOC signal is transmitted to the measurement server.
- ✓ The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movements interrupts.
- ✓ The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- ✓ A computer running Win7 professional operating system and the cDASY6 software.
- ✓ Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.

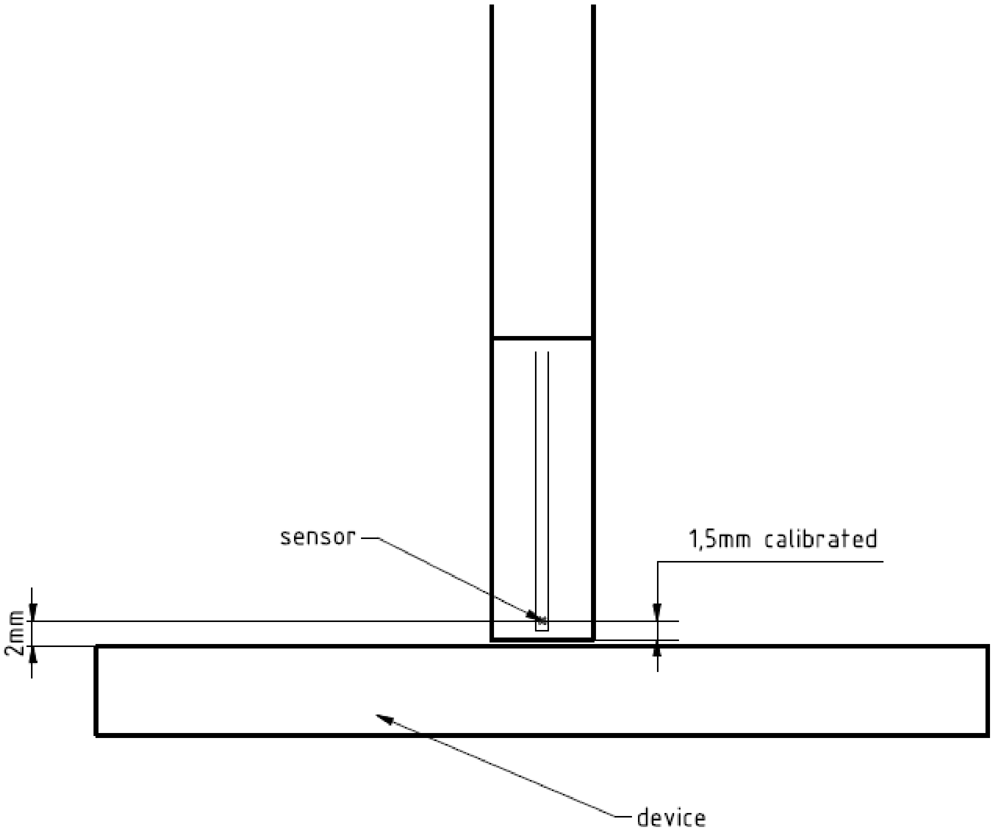
A.2.2 E-Field Measurement Probe

The probe consist of two dipoles (0.8 mm length) optimally arranged with different angles (γ_1 and γ_2) to obtain pseudo-vector information, printed on glass substrate protected by high density foam that allows low perturbation of the measured field.
Three or more measurements are taken for different probe rotational angles, deriving the amplitude and polarization information.

The probe's characteristics are:

Frequency Range	750 MHz – 110 GHz[1]
Length	320 mm
Probe tip external diameter	8 mm
Probe's two dipoles length	0.9mm – Diode loaded
Probe's substrate	Quartz 0.9 x 20 x 0.18mm (εr=3.8)
Distance between diode sensors and probe's tip	1.5 mm
Axial Isotropy	±0.6 dB
Maximum operating E-field	3000 V/m
Lower E-field detection threshold	5 V/m @ 60 GHz
Minimum Mechanical separation between probe tip and a Surface	0.5mm
Calibration reference point	Diode Sensor





[1] *The probe calibration range is 750 MHz – 90 GHz*

A.2.3 Worst Case Linearization Error

For continuously transmitting signals (100% duty cycle), the worst case linearization error is given by the difference between non linearized voltage and linearized voltage using CW parameters. The error is increasing with the voltage levels. In our particular case, the measured voltages averaged over the signal period are below 1mV. We use 1mV in the below calculation to have the worst case condition. The signal PAR (Peak to Average Ratio) is 6dB and the diode compression point 100mV.

The maximum voltage through the diode is given by:

$$\mathrm{vpeak} = \mathrm{vmeas\ avg} \times \mathrm{PARlinear}$$
$$vpeak = 1 * 4 = 4\ mV$$

The linearized voltage using CW parameter is given by:

$$vlin\ peak = vpeak + \frac{v_{peak}^2}{diode\ compression\ point}$$
$$vlin\ peak = 4 + \frac{4^2}{100} = 4.16\ mV$$

The worst case linearization error is:

$$lin\ error = \frac{vlin\ peak}{v\ peak} = \frac{4.16}{4} = 1.04 => 4\%$$

A.2.4 Data Evaluation

A.2.4.1 Scan

The scan involves the measurement of two planes with three different probe rotations. The grid steps are optimized by the software based on the test frequency. The location of the lowest measurement plane is defined by the distance of first measurement layer from device under test (DUT) entered by the user. The DUT location settings can be used to offset the center of the grid.

A.2.4.2 Total Field and Power Flux Density Reconstruction

Computation of the power density in general requires knowledge of the electric (E-) and magnetic (H-) field amplitudes and phases in the plane of incidence. Reconstruction of these quantities from pseudo-vector E-field measurements is feasible, as they are constrained by Maxwell's equations.
The reconstruction algorithm developed by the system manufacturer, together with the ability of the probe to measure extremely close to the source without perturbing the field, permits reconstruction of the E- and H-fields, as well as of the power density, on measurement planes located as near as 0.5mm away in the frequency band of 60 GHz.

The average of the reconstructed power density is evaluated over a circular area in each measurement plane. The area of the circle is defined by the user; the default is 1 cm^2.

A.3 System Check

The system performance check verifies that the system operates within its specifications. System and operator errors can be detected and corrected. It is recommended that the system performance check be performed prior to any usage of the system in order to guarantee reproducible results.
The system performance check uses normal E-field measurements in a simplified setup with a well characterized source. This setup was selected to give a high sensitivity to all parameters that might fail or vary over time. The system check does not intend to replace the calibration of the components, but indicates situations where the system uncertainty is exceeded due to drift or failure.
In the simplified setup for system check, the EUT is replaced by a calibrated source and the power source is replaced by a controlled continuous wave generated by a signal generator. The calibrated source must be placed at the correct distance from the E-field probe according to the calibration certificate.

First, the power meter is connected to the output of the signal generator to measure the forward power at the location of the connector to the system check source. The signal generator is adjusted for the desired forward power to match the system check
source calibration setup at the connector as read by power meter. Then the power meter is replaced by the system check source.

The output power on the reference source is set to 5 dBm (3.16 mW) and E-field results are normalized to a forward power of 10mW to compare the values with the calibration report.

A.4 Test Equipment List

A.4.1 System #2

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
0599	Measurement SW	cDASY6 5G module	v1.0.0.11898	SPEAG	NA	NA
0459	Light Beam Unit	LB5 / 80	-	Di-soric	NA	NA
0451	6-axis Robot	TX60 L	F12/5MZ3A1/A/01	STAÜBLI	NA	NA
0233	Robot Controller	CS8C	F12/5MZ3A1/C/01	STAÜBLI	NA	NA
0453	Measurement Server	DASY5 P/N: SE UMS 011 EA	1444	SPEAG	NA	NA
0456	Electro-Optical Converter	EOC60	1076	SPEAG	NA	NA
0575	E-field mm-Wave Probe	EUmmWV2	9354	SPEAG	2017-02-23	2018-02-23
0242	Data Acquisition Electronics	DAE4	1429	SPEAG	2017-02-07	2018-02-07

A.4.2 Shared Equipment

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
0398	Temperature & Humidity Logger	TR-72NW-H + HHA-3151	Logger: 62180216 Sensor: 0202622A	TandD	2016-02-01	2018-02-01
0427	Frequency Multiplier, 50GHz-75GHz	SMZ75	101257	R&S	N/A	N/A
0309	Signal Generator	SMB100A	178217	R&S	2017-03-10	2019-03-10
0012	Power Meter	NRP2	101567	R&S	N/A	N/A
0014	Power Sensor	NRP-Z57	101280	R&S	2017-04-25	2019-04-25
0590	Horn reference source	PE9881-24	201715	Pasternack	2017-05-08	2019-05-08

A.5 Measurement Uncertainty Evaluation

The system uncertainty evaluation is shown in the below table:

Uncertainty Budget						
Error Description	Uncertainty Value (±dB)	Probability Distribution	Div.	(c_i)	Std. Unc. (±dB)	(v_i) v_{eff}
Measurement System						
Probe Calibration	0.43	N	1	1	0.43	∞
Hemispherical Isotropy	0.60	R	√3	1	0.35	∞
Linearity	0.20	R	√3	1	0.12	∞
System Detection Limits	0.04	R	√3	1	0.02	∞
Modulation Response*	0.17	R	√3	1	0.10	∞
Readout Electronics	0.01	N	1	1	0.01	∞
Response Time	0.03	R	√3	1	0.02	∞
Integration Time	0.11	R	√3	1	0.06	∞
RF Ambient Noise	0.04	R	√3	1	0.02	∞
RF Ambient Reflections	0.21	R	√3	1	0.12	∞
Probe Positioner	0.04	R	√3	1	0.02	∞
Probe Positioning	0.11	R	√3	1	0.06	∞
S_{avg} Reconstruction	0.61	R	√3	1	0.35	∞
Test Sample Related						
Power Drift	0.57	R	√3	1	0.33	∞
Power Scaling	0.00	R	√3	1	0.00	∞
Combined Std. Uncertainty					0.77	∞
Expanded Std. Uncertainty					**1.54**	

* The modulation response contribution in A.5 is calculated according to 4% linearization error of A.2.3 by :

Uncertainty Modulation Response (dB)= 10log(1+0.04)= 0.17

Annex B. Test Results

B.1 Test Conditions

B.1.1 Test signal, Output power and Test Frequencies

The device under test was an Intel 18265NGW WiGig module (FCC ID: PD918265NG), including an active antenna array, embedded inside the Dell model T02J.
The device was put into operation by using an Intel Proprietary software (DRTU version 1.9.0-04603).

B.1.2 Measurement configuration

The measurements were performed at several distances from the evaluation plane (see Annex E) using the 4 worst cases power density configurations (see table below) found in the simulation among the 6 worst cases corresponding to three subsets (2 worst cases per subset). The simulation method is described in associated document [2]. The simulation results are presented in Annex D.

	Plane position	MCS index[3] @ Duty Cycle	Subset	Channel	Worst-case	Measurement Distances [mm]	Scan Plane size [cm^2]
Case 1#	Back plane	MCS 1 @ 100%	1	1	1	2, 5	4.23x4.23
Case 2#	Back plane	MCS 1 @ 100%	1	1	2	2, 5	4.23x4.23
Case 3#	Back plane	MCS 1 @ 100%	3	1	1	2, 5	4.23x4.23
Case 4#	Back plane	MCS 1 @ 100%	3	1	2	2, 5	4.23x4.23

B.2 System Check Measurements

Frequency	Target E-field [2] (V/m)	Measured E-field [2] (V/m)	Deviation (%)	Date
60 GHz	90.3	92.1	2.0	2017-07-12

The fields presented in the System Check Measurements table are RMS values normalized to 10 mW input power. Indeed, as indicated in the calibration certificate of the reference horn antenna (see Annex F), the maximum measured E-field value at 10 mm from the sensor is 67.91 V/m with 7.53 dBm (5.66 mW) source power. This is equivalent to 90.3 V/m target E-field value showed in the table above normalized to 10 dBm (10 mW) source power.
The system check measurement is performed at 5 dBm (3.16 mW) source power. The maximum measured E-field value is 51.8 V/m (see plot 9 in Annex C). This is equivalent to 92.1 V/m measured E-field value showed in the table above normalized to 10 dBm source power.

[2] *Normalized to 10mW*
[3] *MCS1 Modulation and coding scheme uses π/2-BPSK modulation*

B.3 Test Results

Test case	Distance (mm)	Max E-Field [V/m]	Max H-Field [A/m]	Max localized PD [mW/cm^2]	Spatially Averaged PD [mW/cm^2]	Plot #
Case 1#	2	131.203	0.348	1.856	**0.445**	**1**
	5	92.877	0.362	1.388	0.353	**2**
Case 2#	2	120.954	0.315	1.884	0.417	**3**
	5	113.322	0.342	1.444	0.386	**4**
Case 3#	2	136.279	0.280	1.904	0.379	**5**
	5	87.247	0.242	0.836	0.231	**6**
Case 4#	2	102.463	0.265	0.871	0.198	**7**
	5	76.436	0.182	0.682	0.166	**8**

All fields' strength showed in the table are peak values.
The measured PAPR level of the modulation used in the tests is 5 dB.

The measurement distance correspond to the distance from the probe sensor and evaluation plane boundary. The figure in section A.2.2 illustrates the measurement distance of 2 mm.

Annex C. Test System Plots

1. Case # 1 - 2 mm distance from Evaluation plane

DUT: Sample 170420-01.S01; Type: RFEM-3; Serial: 4358756100004

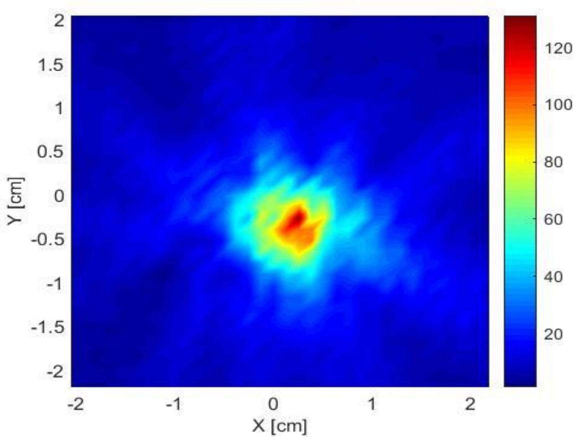
Communication System: UID 0, Wi-Gig (0); Communication System Band: 60 GHz; Frequency: 58320 MHz;
Communication System PAR: 0 dB
Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 0 kg/m^3
Phantom section: Table Section
Measurement Standard: DASY6 (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

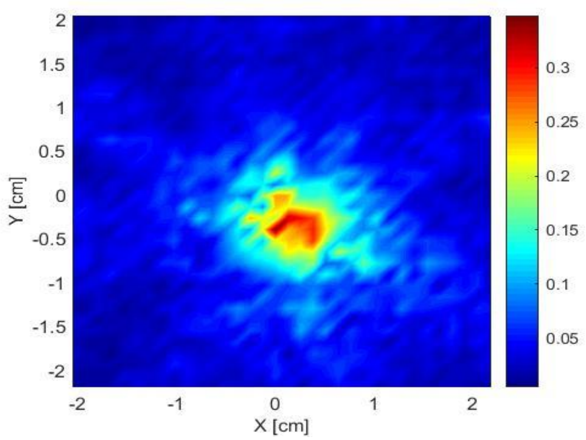
- Probe: EUmmW - SN9354; ConvF(1, 1, 1); Calibrated: 2017-02-23;
  - Modulation Compensation:
- Sensor-Surface: 0 mm (Fix Surface), z = 2 mm
- Electronics: DAE4 Sn1496; Calibrated: 2016-12-06
- Phantom: Cover; Type: SPEAG Phantom Cover;
- cDASY6 5G Module V1.0.0.11898;

Channel 1-Distance-2mm/Measure Sample 170420-01.S01 (42.3x42.3):
Resolution = 1.29 mm

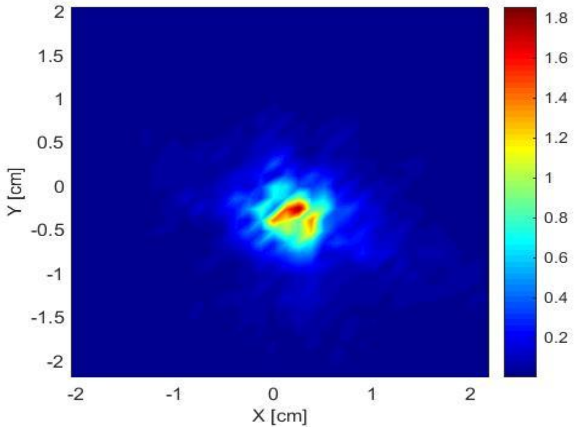
Measured E-field
Maximum value = 131.203 V/m - Peak



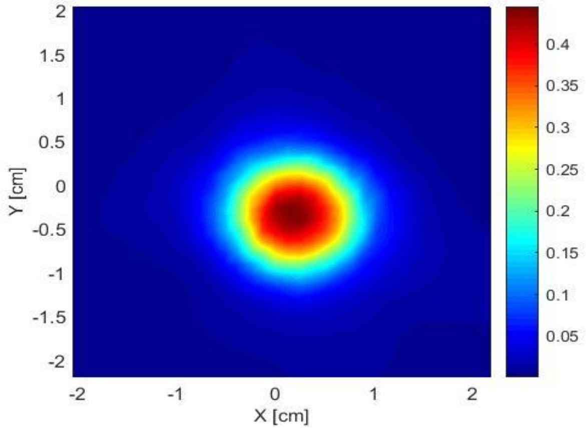
Reconstructed H-field (from Measured E-field)
Maximum value = 0.348 A/m - Peak



Reconstructed localized free space power density
Maximum value = 1.856 mW/cm^2



Reconstructed Spatially Averaged power density
Maximum value = 0.445 mW/cm^2



2. Case # 1 - 5 mm distance from Evaluation plane

DUT: Sample 170420-01.S01; Type: RFEM-3; Serial: 4358756100004

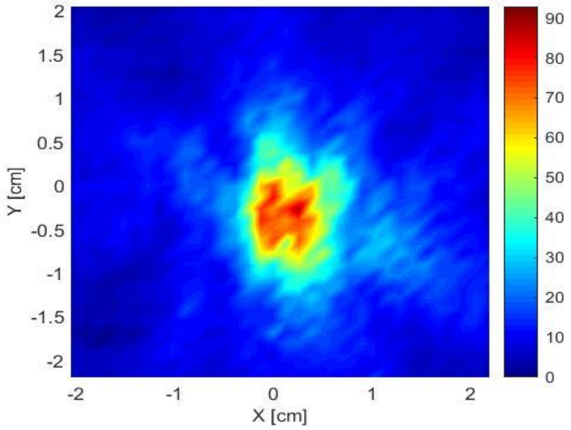
Communication System: UID 0, Wi-Gig (0); Communication System Band: 60 GHz; Frequency: 58320 MHz;
Communication System PAR: 0 dB
Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 0 kg/m[3]
Phantom section: Table Section
Measurement Standard: DASY6 (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

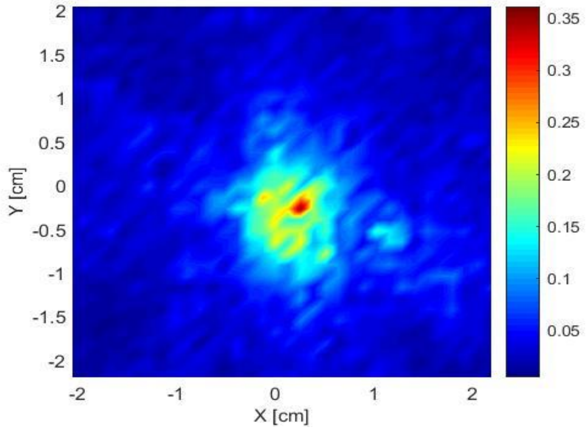
- Probe: EUmmW - SN9354; ConvF(1, 1, 1); Calibrated: 2017-02-23;
    - Modulation Compensation:
- Sensor-Surface: 0mm (Fix Surface), z = 5 mm
- Electronics: DAE4 Sn1496; Calibrated: 2016-12-06
- Phantom: Cover; Type: SPEAG Phantom Cover;
- cDASY6 5G Module V1.0.0.11898;

Channel 1-Distance-5mm/Measure Sample 170420-01.S01 (42.3x42.3):
Resolution = 1.29 mm

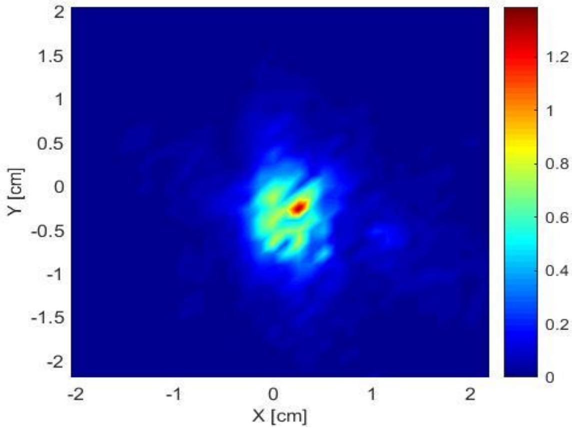
Measured E-field
Maximum value = 92.877 V/m - Peak



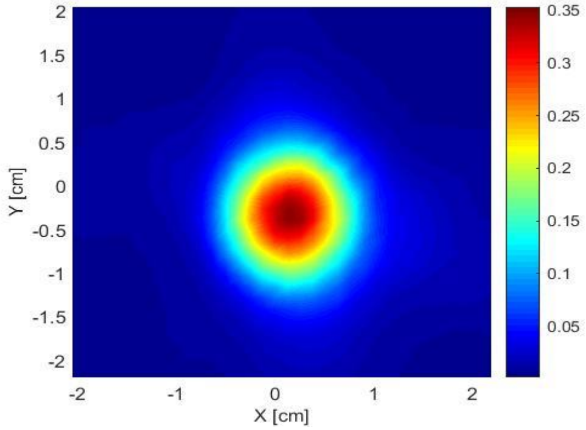
Reconstructed H-field (from Measured E-field)
Maximum value = 0.362 A/m - Peak



Reconstructed localized free space power density
Maximum value = 1.388 mW/cm²



Reconstructed Spatially Averaged power density
Maximum value = 0.353 mW/cm²



3. Case # 2 - 2 mm distance from Evaluation plane

DUT: Sample 170420-01.S01; Type: RFEM-3; Serial: 4358756100004

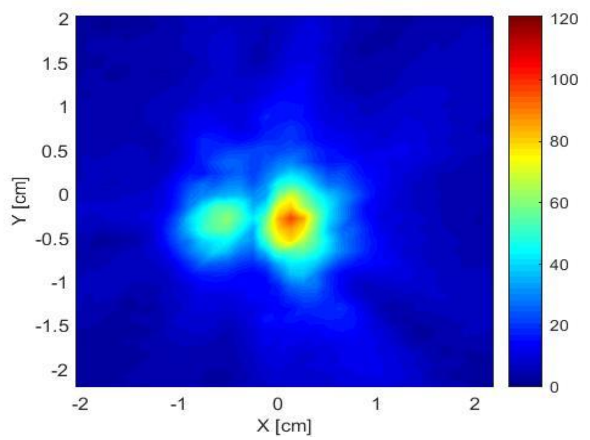
Communication System: UID 0, Wi-Gig (0); Communication System Band: 60 GHz; Frequency: 58320 MHz;
Communication System PAR: 0 dB
Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Phantom section: Table Section
Measurement Standard: DASY6 (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

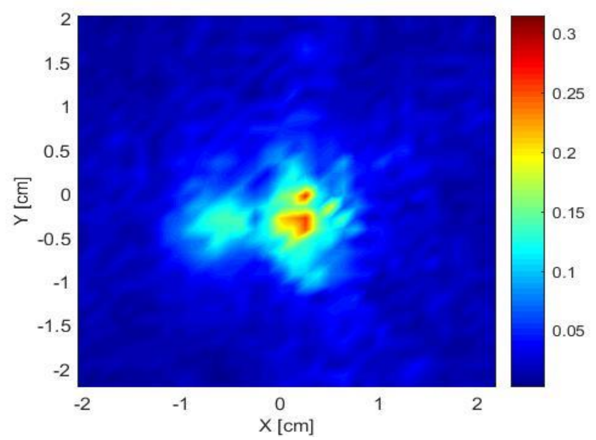
- Probe: EUmmW - SN9354; ConvF(1, 1, 1); Calibrated: 2017-02-23;
    - Modulation Compensation:
- Sensor-Surface: 0 mm (Fix Surface), z = 2 mm
- Electronics: DAE4 Sn1496; Calibrated: 2016-12-06
- Phantom: Cover; Type: SPEAG Phantom Cover;
- cDASY6 5G Module V1.0.0.11898;

Channel 1-Distance-2mm/Measure Sample 170420-01.S01 (42.3x42.3):
Resolution = 1.29 mm

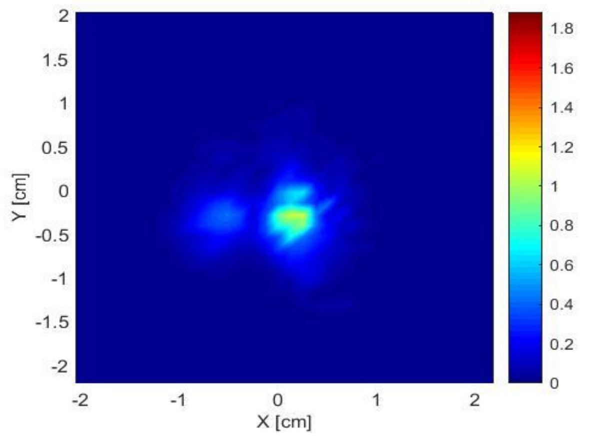
Measured E-field
Maximum value = 120.954 V/m - Peak



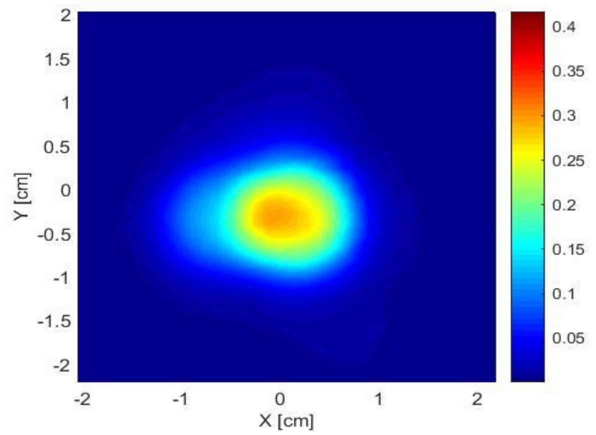
Reconstructed H-field (from Measured E-field)
Maximum value = 0.315 A/m - Peak



Reconstructed localized free space power density
Maximum value = 1.884 mW/cm^2



Reconstructed Spatially Averaged power density
Maximum value = 0.417 mW/cm^2



4. Case # 2 - 5 mm distance from Evaluation plane

DUT: Sample 170420-01.S01; Type: RFEM-3; Serial: 4358756100004

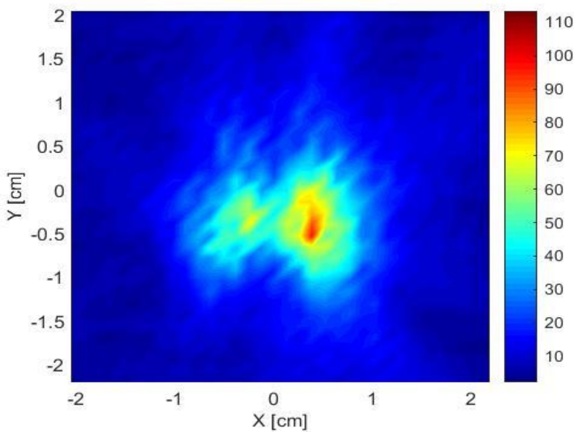
Communication System: UID 0, Wi-Gig (0); Communication System Band: 60 GHz; Frequency: 58320 MHz;
Communication System PAR: 0 dB
Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Phantom section: Table Section
Measurement Standard: DASY6 (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

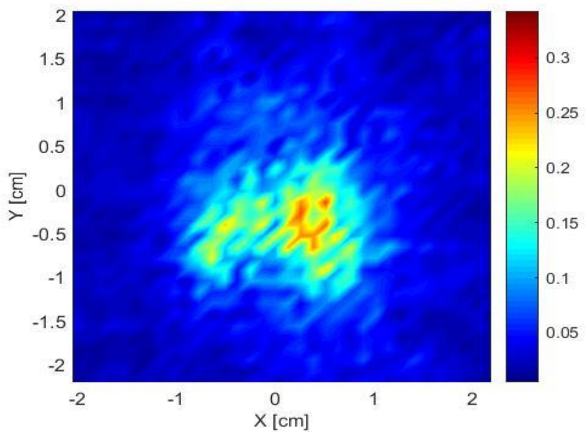
- Probe: EUmmW - SN9354; ConvF(1, 1, 1); Calibrated: 2017-02-23;
  - Modulation Compensation:
- Sensor-Surface: 0mm (Fix Surface), z = 5 mm
- Electronics: DAE4 Sn1496; Calibrated: 2016-12-06
- Phantom: Cover; Type: SPEAG Phantom Cover;
- cDASY6 5G Module V1.0.0.11898;

Channel 1-Distance-5mm/Measure Sample 170420-01.S01 (42.3x42.3):
Resolution = 1.29 mm

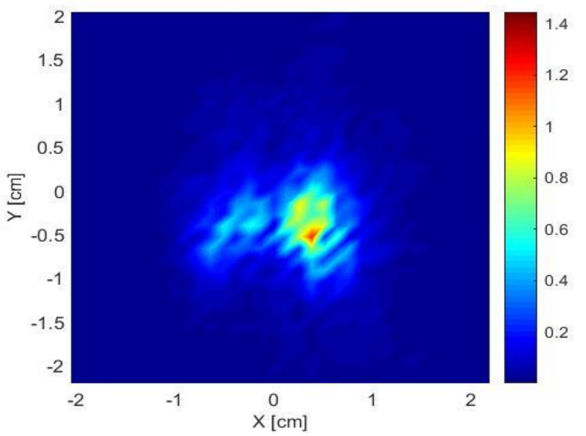
Measured E-field
Maximum value = 113.322 V/m - Peak



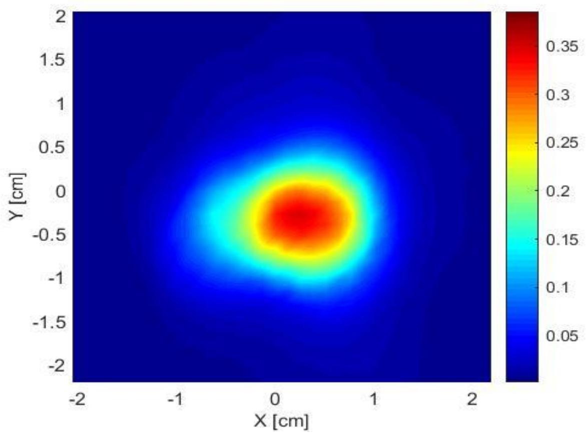
Reconstructed H-field (from Measured E-field)
Maximum value = 0.342 A/m - Peak



Reconstructed localized free space power density
Maximum value = 1.444 mW/cm^2



Reconstructed Spatially Averaged power density
Maximum value = 0.386 mW/cm^2



5. Case # 3 - 2 mm distance from Evaluation plane

DUT: Sample 170420-01.S01; Type: RFEM-3; Serial: 4358756100004

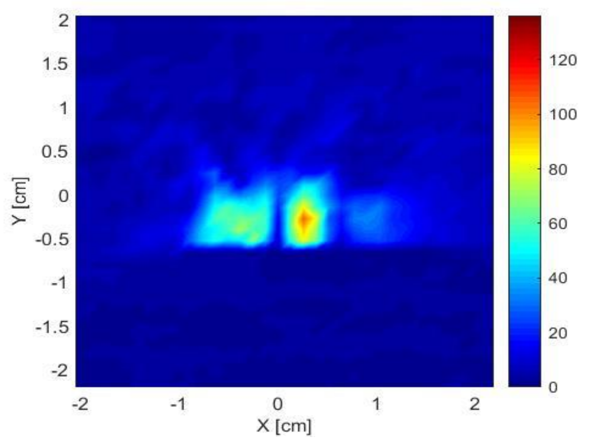
Communication System: UID 0, Wi-Gig (0); Communication System Band: 60 GHz; Frequency: 58320 MHz;
Communication System PAR: 0 dB
Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 0 kg/m^3
Phantom section: Table Section
Measurement Standard: DASY6 (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

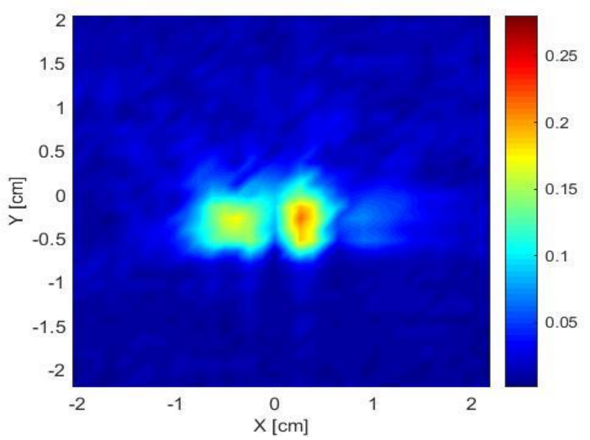
- Probe: EUmmW - SN9354; ConvF(1, 1, 1); Calibrated: 2017-02-23;
    - Modulation Compensation:
- Sensor-Surface: 0 mm (Fix Surface), z = 2 mm
- Electronics: DAE4 Sn1496; Calibrated: 2016-12-06
- Phantom: Cover; Type: SPEAG Phantom Cover;
- cDASY6 5G Module V1.0.0.11898;

Channel 1-Distance-2mm/Measure Sample 170420-01.S01 (42.3x42.3):
Resolution = 1.29 mm

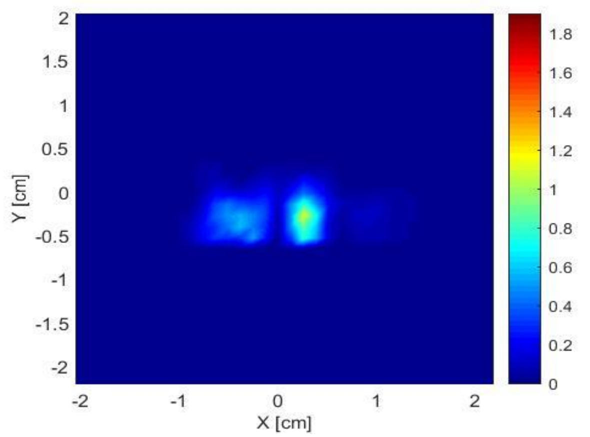
Measured E-field
Maximum value = 136.279 V/m - Peak



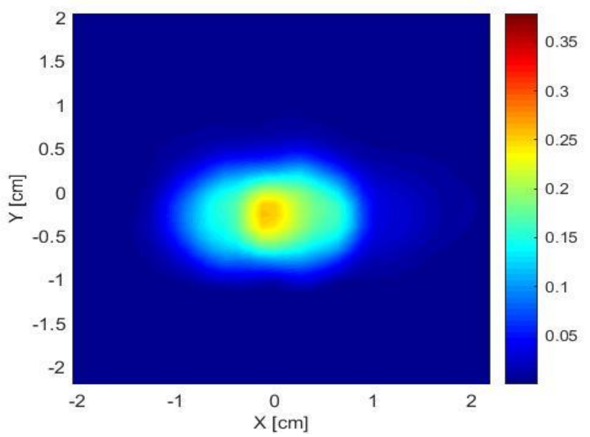
Reconstructed H-field (from Measured E-field)
Maximum value = 0.280 A/m - Peak



Reconstructed localized free space power density
Maximum value = 1.904 mW/cm^2



Reconstructed Spatially Averaged power density
Maximum value = 0.379 mW/cm^2



6. Case # 3 - 5 mm distance from Evaluation plane

DUT: Sample 170420-01.S01; Type: RFEM-3; Serial: 4358756100004

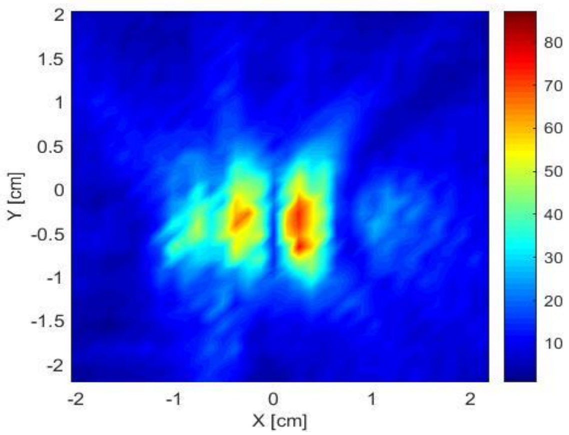
Communication System: UID 0, Wi-Gig (0); Communication System Band: 60 GHz; Frequency: 58320 MHz; Communication System PAR: 0 dB
Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 0 kg/m^3
Phantom section: Table Section
Measurement Standard: DASY6 (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

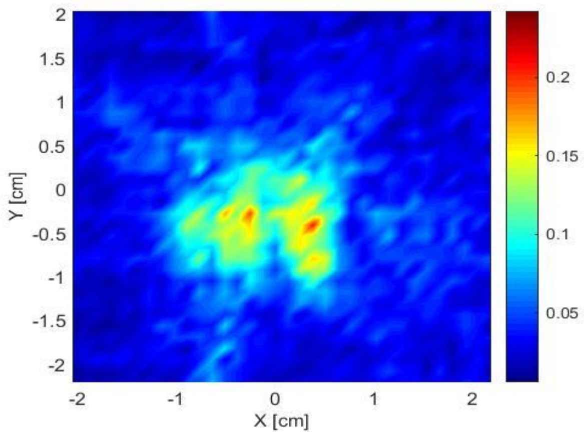
- Probe: EUmmW - SN9354; ConvF(1, 1, 1); Calibrated: 2017-02-23;
  - Modulation Compensation:
- Sensor-Surface: 0mm (Fix Surface), z = 5 mm
- Electronics: DAE4 Sn1496; Calibrated: 2016-12-06
- Phantom: Cover; Type: SPEAG Phantom Cover;
- cDASY6 5G Module V1.0.0.11898;

Channel 1-Distance-5mm/Measure Sample 170420-01.S01 (42.3x42.3):
Resolution = 1.29 mm

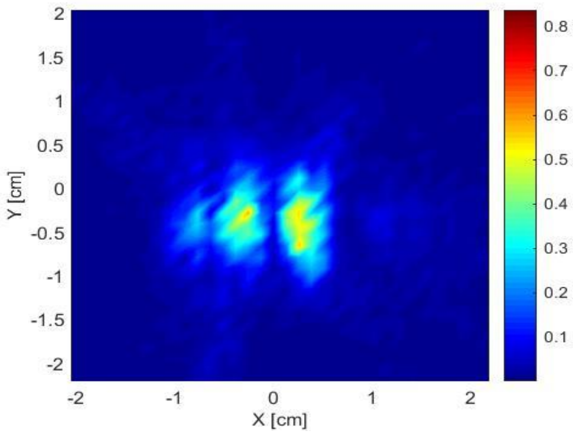
Measured E-field
Maximum value = 87.247 V/m - Peak



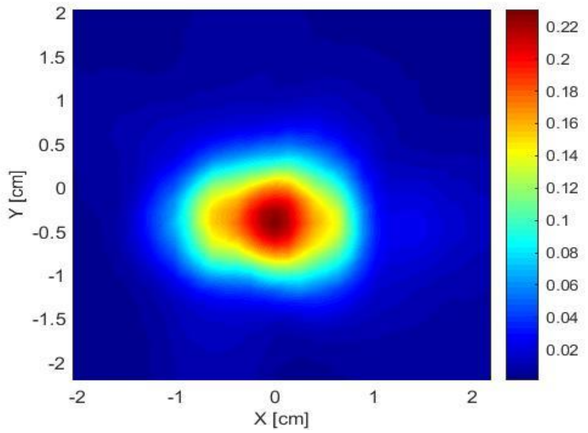
Reconstructed H-field (from Measured E-field)
Maximum value = 0.242 A/m - Peak



Reconstructed localized free space power density
Maximum value = 0.836 mW/cm^2



Reconstructed Spatially Averaged power density
Maximum value = 0.231 mW/cm^2



7. Case # 4 - 2 mm distance from Evaluation plane

DUT: Sample 170420-01.S01; Type: RFEM-3; Serial: 4358756100004

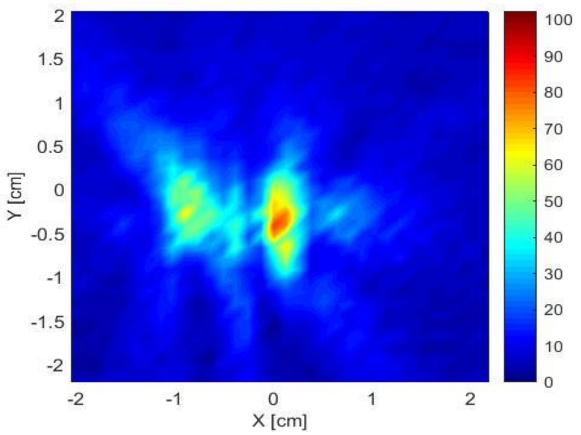
Communication System: UID 0, Wi-Gig (0); Communication System Band: 60 GHz; Frequency: 58320 MHz;
Communication System PAR: 0 dB
Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 0 kg/m^3
Phantom section: Table Section
Measurement Standard: DASY6 (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

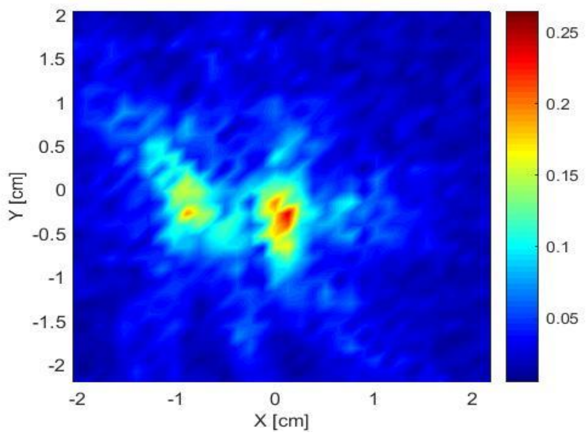
- Probe: EUmmW - SN9354; ConvF(1, 1, 1); Calibrated: 2017-02-23;
    - Modulation Compensation:
- Sensor-Surface: 0 mm (Fix Surface), z = 2 mm
- Electronics: DAE4 Sn1496; Calibrated: 2016-12-06
- Phantom: Cover; Type: SPEAG Phantom Cover;
- cDASY6 5G Module V1.0.0.11898;

Channel 1-Distance-2mm/Measure Sample 170420-01.S01 (42.3x42.3):
Resolution = 1.29 mm

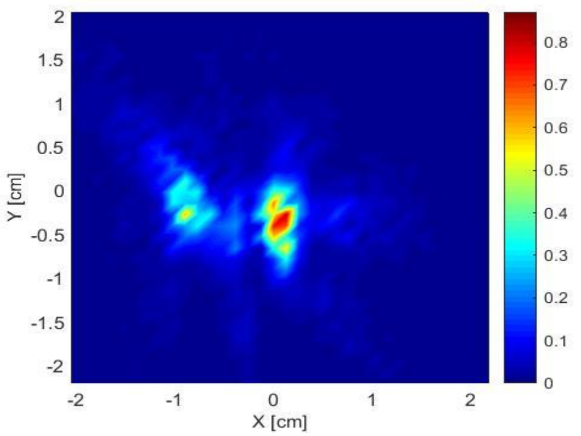
Measured E-field
Maximum value = 102.463 V/m - Peak



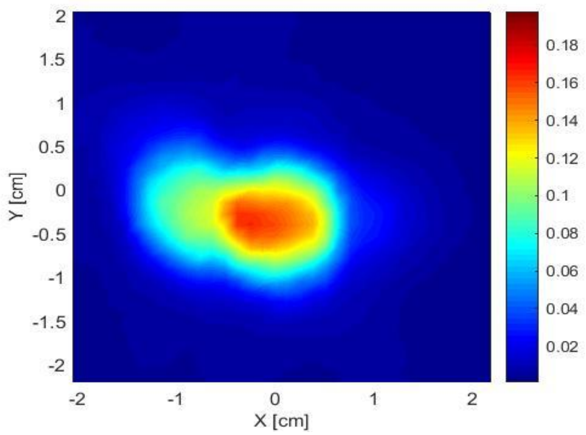
Reconstructed H-field (from Measured E-field)
Maximum value = 0.265 A/m - Peak



Reconstructed localized free space power density
Maximum value = 0.871 mW/cm^2



Reconstructed Spatially Averaged power density
Maximum value = 0.198 mW/cm^2



8. Case # 4 - 5 mm distance from Evaluation plane

DUT: Sample 170420-01.S01; Type: RFEM-3; Serial: 4358756100004

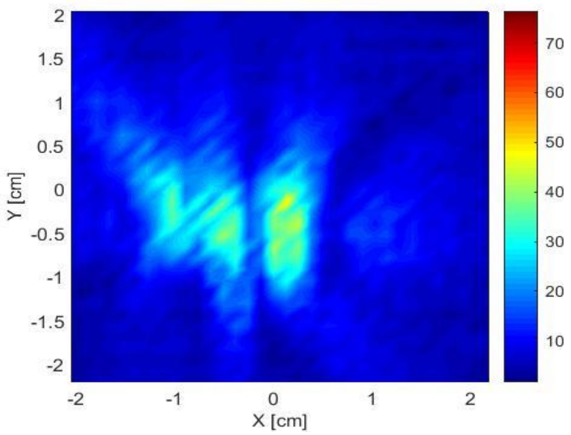
Communication System: UID 0, Wi-Gig (0); Communication System Band: 60 GHz; Frequency: 58320 MHz;
Communication System PAR: 0 dB
Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 0 kg/m³
Phantom section: Table Section
Measurement Standard: DASY6 (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

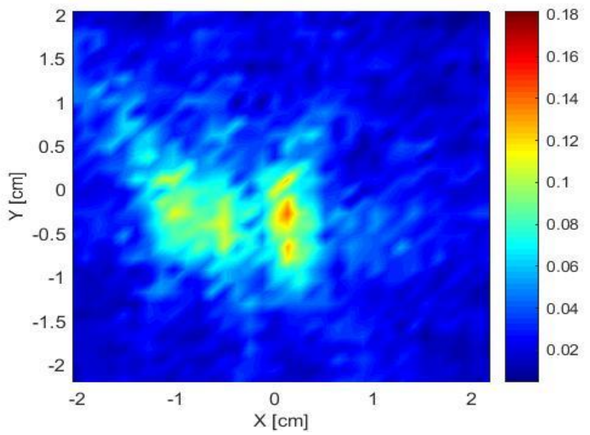
- Probe: EUmmW - SN9354; ConvF(1, 1, 1); Calibrated: 2017-02-23;
  - Modulation Compensation:
- Sensor-Surface: 0mm (Fix Surface), z = 5 mm
- Electronics: DAE4 Sn1496; Calibrated: 2016-12-06
- Phantom: Cover; Type: SPEAG Phantom Cover;
- cDASY6 5G Module V1.0.0.11898;

Channel 1-Distance-5mm/Measure Sample 170420-01.S01 (42.3x42.3):
Resolution = 1.29 mm

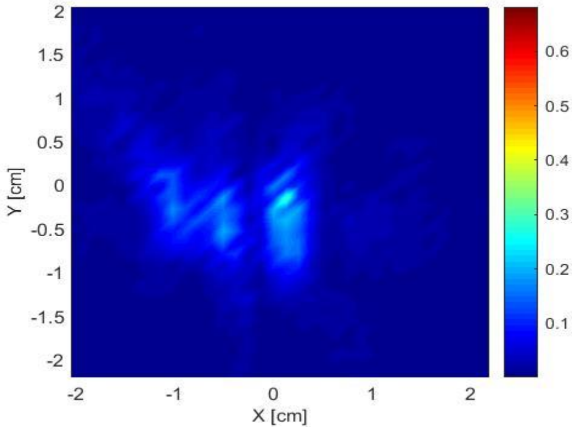
Measured E-field
Maximum value = 76.436 V/m - Peak



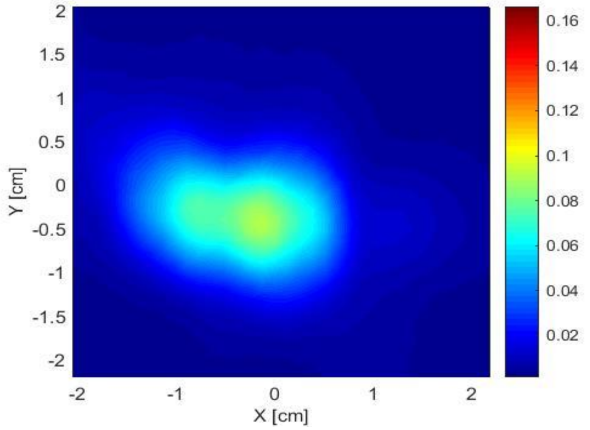
Reconstructed H-field (from Measured E-field)
Maximum value = 0.182 A/m - Peak



Reconstructed localized free space power density
Maximum value = 0.682 mW/cm²



Reconstructed Spatially Averaged power density
Maximum value = 0.166 mW/cm²



9. System Check 60 GHz

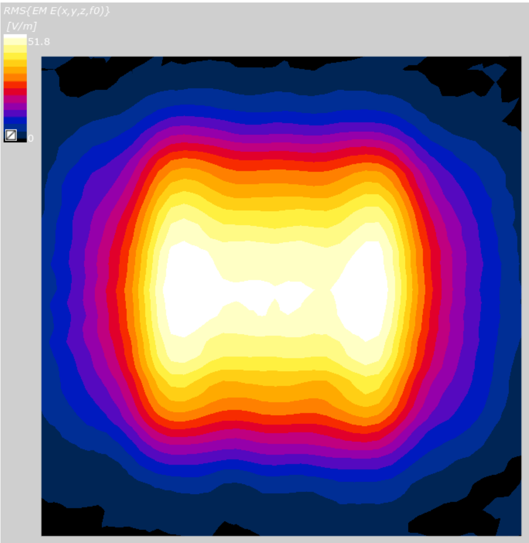
DUT: Horn reference source; Type: PE9881-24; Serial: 201715

Communication System: UID 0, Wi-Gig (0); Communication System Band: 60 GHz; Frequency: 60000 MHz;
Communication System PAR: 0 dB
Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Phantom section: Table Section
Measurement Standard: DASY6 (IEEE/IEC/ANSI C63.19-2011)

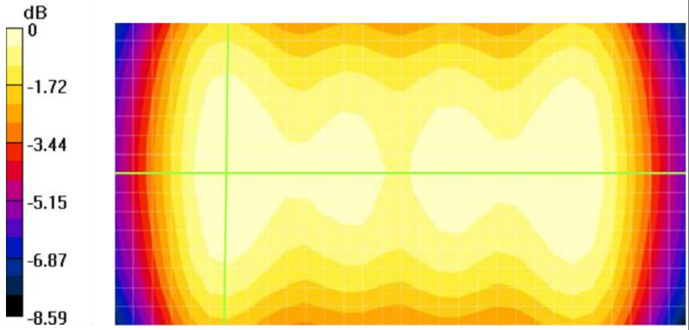
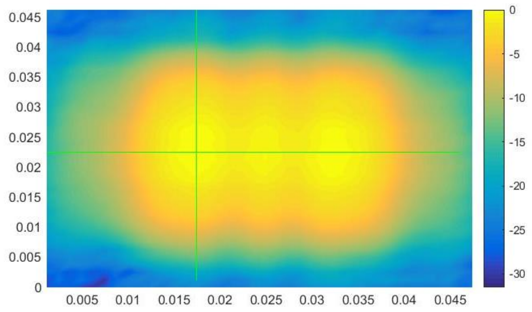
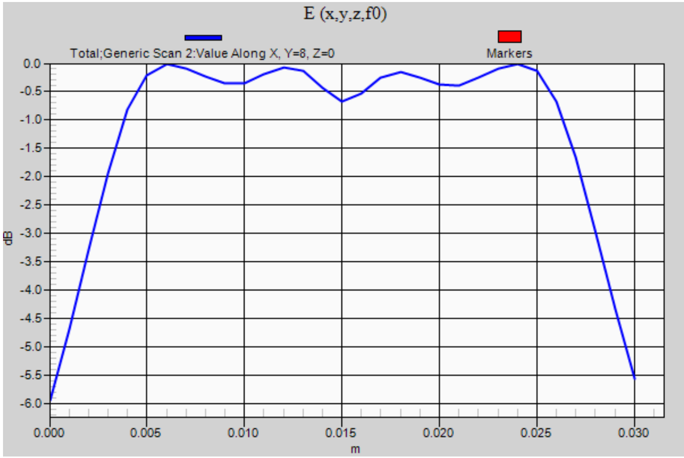
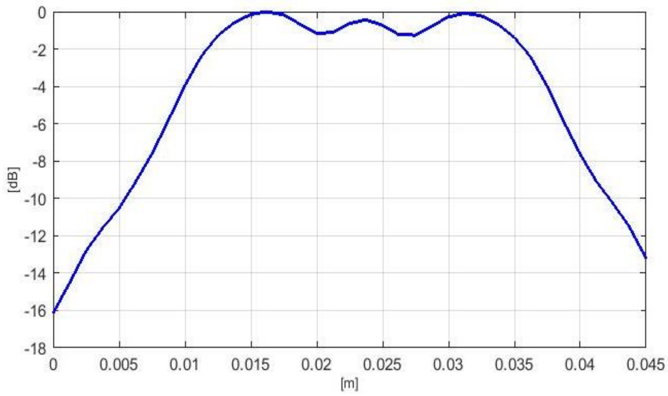
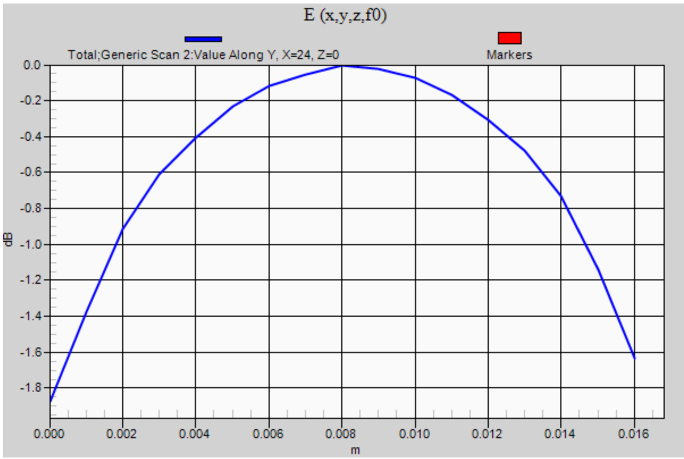
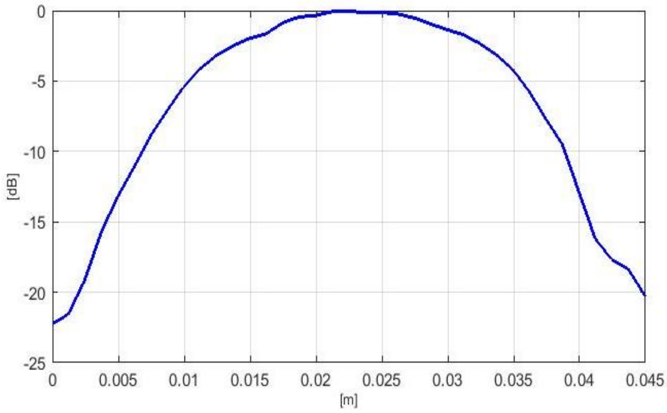
DASY Configuration:

- Probe: EUmmW - SN9354 ; ConvF(1, 1, 1); Calibrated: 2017-02-23;
  - Modulation Compensation:
- Sensor-Surface: 0mm (Fix Surface), z = 10 mm
- Electronics: DAE4 Sn1496; Calibrated: 2016-12-06
- Phantom: Cover; Type: SPEAG Phantom Cover;
- cDASY6 5G Module V1.0.0.11898;

Distance-10mm/Measure Horn reference source (46.2x46.2):
Resolution = 1.3 mm
Maximum value measured: 51.8 V/m (RMS) for 5 dBm input power.



The plots below show the comparison between the calibration certificate and the system check results in terms of normalized E-field distribution and the 1D variation along the two axis of the maximum.

Calibration Certificate - scan area: 30 mm x 16 mm - Resolution: 1 mm	**System Check** - scan area:46.2 mm x 46.2 mm - Resolution: 1.3 mm
	
	
Field variation through the maximum along the E-field polarization	
	
Field variation through the maximum along the H-field polarization	

Annex D. Informative Test Results vs. Simulation Results

The tables below summarizes the simulation results at 0, 2 and 5 mm and the measurement results at 2 and 5 mm.

Case #1: Simulation Vs. test results

	Measurement Distance (mm)	Simulated	Measured	Max. Deviation (dB)
E-field (V/m)	0 mm	176.836	-	-
	2 mm	116.795	131.203	1.010
	5 mm	85.640	92.877	0.705
H-field (A/m)	0 mm	0.544	-	-
	2 mm	0.313	0.348	0.934
	5 mm	0.267	0.362	2.651
Single-point PD (mW/cm^2)	0 mm	3.987	-	-
	2 mm	1.946	1.856	0.204
	5 mm	1.038	1.388	1.262
Average PD (mW/cm^2)	0 mm	0.842	-	-
	2 mm	0.593	0.445	1.247
	5 mm	0.435	0.353	0.908

Case #2: Simulation Vs. test results

	Measurement Distance (mm)	Simulated	Measured	Max. Deviation (dB)
E-field (V/m)	0 mm	169.537	-	-
	2 mm	123.700	120.954	0.195
	5 mm	95.050	113.322	1.527
H-field (A/m)	0 mm	0.501	-	-
	2 mm	0.331	0.315	0.411
	5 mm	0.274	0.342	1.931
Single-point PD (mW/cm^2)	0 mm	3.643	-	-
	2 mm	2.108	1.884	0.488
	5 mm	1.391	1.444	0.162
Average PD (mW/cm^2)	0 mm	0.840	-	-
	2 mm	0.562	0.417	1.296
	5 mm	0.392	0.386	0.072

Case #3: Simulation Vs. test results

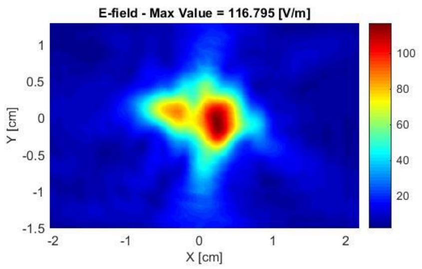
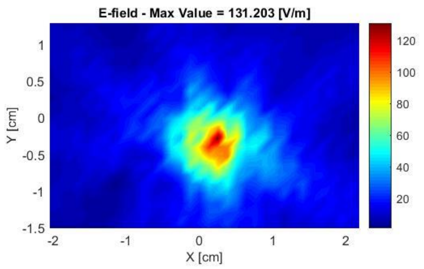
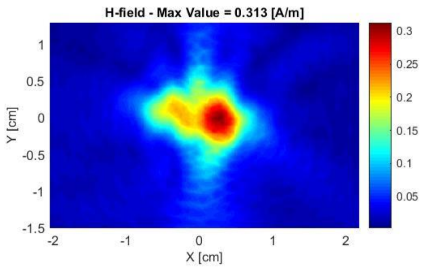
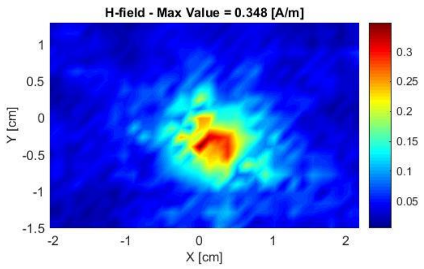
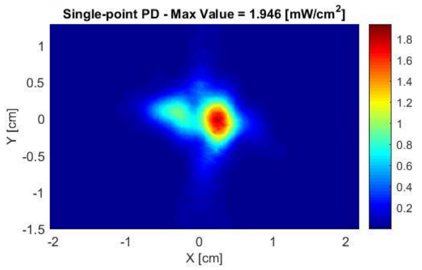
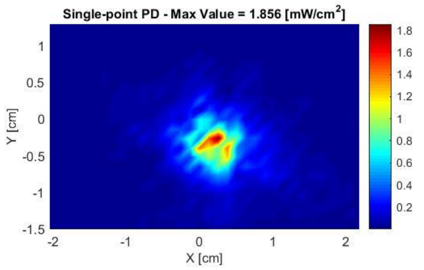
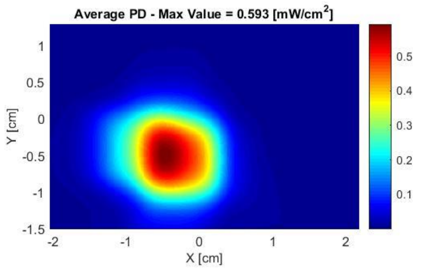
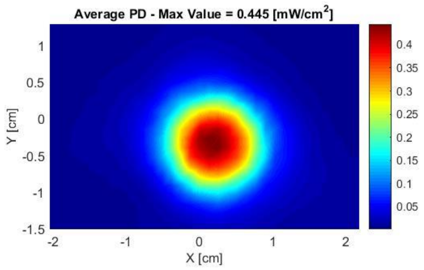
	Measurement Distance (mm)	Simulated	Measured	Max. Deviation (dB)
E-field (V/m)	0 mm	150.848	-	-
	2 mm	97.048	136.279	2.949
	5 mm	78.574	87.247	0.909
H-field (A/m)	0 mm	0.439	-	-
	2 mm	0.271	0.280	0.308
	5 mm	0.186	0.242	2.323
Single-point PD (mW/cm^2)	0 mm	2.805	-	-
	2 mm	1.259	1.904	1.794
	5 mm	0.848	0.836	0.060
Average PD (mW/cm^2)	0 mm	0.612	-	-
	2 mm	0.457	0.379	0.812
	5 mm	0.349	0.231	1.796

Case #4: Simulation Vs. test results

	Measurement Distance (mm)	Simulated	Measured	Max. Deviation (dB)
E-field (V/m)	0 mm	136.541	-	-
	2 mm	100.302	102.463	0.185
	5 mm	73.658	76.436	0.322
H-field (A/m)	0 mm	0.366	-	-
	2 mm	0.241	0.265	0.814
	5 mm	0.194	0.182	0.585
Single-point PD (mW/cm^2)	0 mm	2.164	-	-
	2 mm	1.158	0.871	1.233
	5 mm	0.780	0.682	0.584
Average PD (mW/cm^2)	0 mm	0.591	-	-
	2 mm	0.392	0.198	2.970
	5 mm	0.299	0.166	2.548

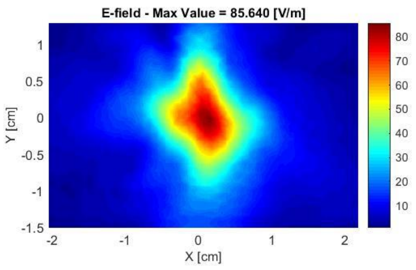
All fields in simulation and measurement are peak values.

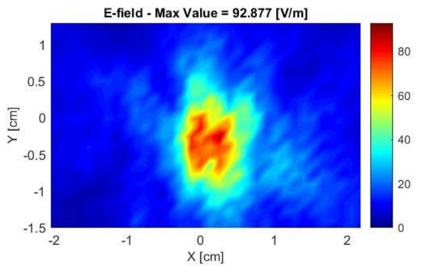
Simulation is using square averaging and measurement is using circular averaging.

Case #1 - DISTANCE = 2 mm	
Simulated	**Measured**
	
E-field (V/m) @ 2 mm – Deviation of Max Value: 1.010 dB	
	
H-field (V/m) @ 2 mm – Deviation of Max Value: 0.934 dB	
	
Localized free space PD (mW/cm2) @ 2 mm – Deviation of Max Value: 0.204 dB	
	
Spatially Averaged PD (mW/cm2) @ 2 mm – Deviation of Max Value: 1.247 dB	

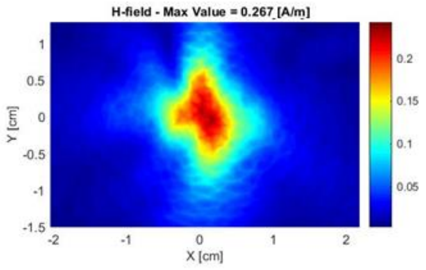
Case #1 - DISTANCE = 5 mm

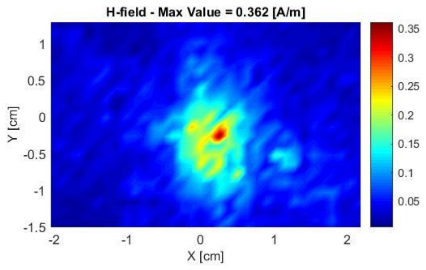
Simulated | **Measured**



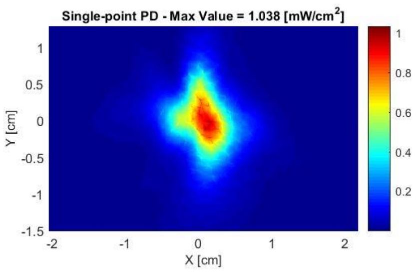


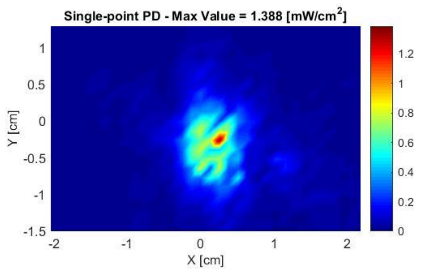
E-field (V/m) @ 5 mm – Deviation of Max Value: 0.705 dB



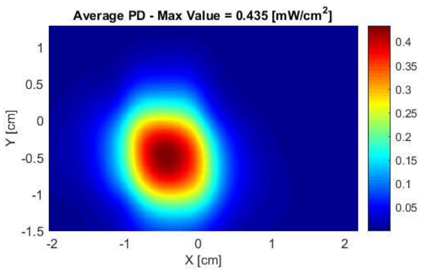


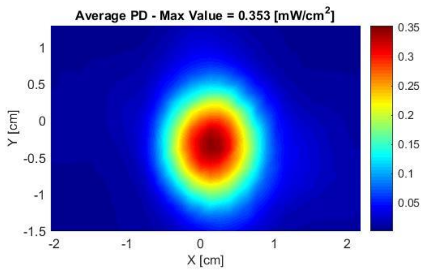
H-field (V/m) @ 5 mm – Deviation of Max Value: 2.651 dB



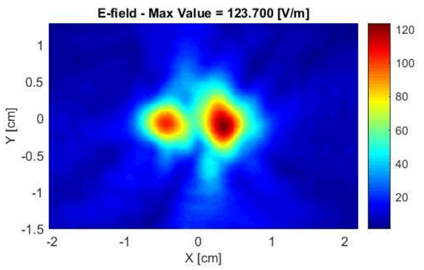
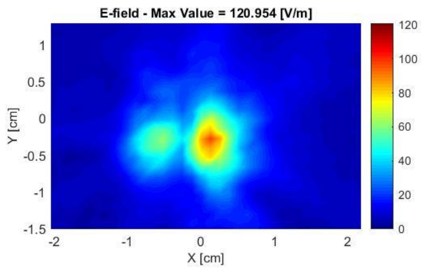
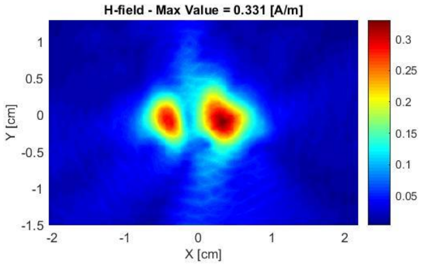
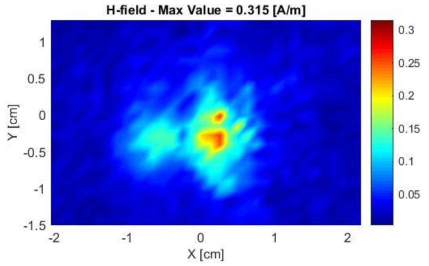
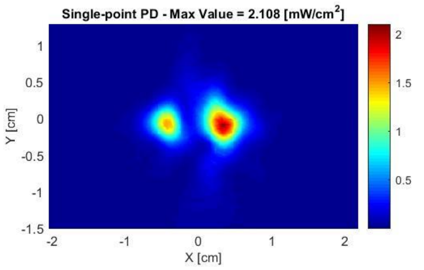
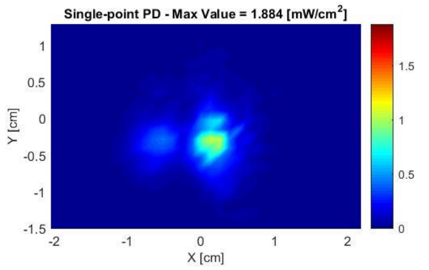


Localized free space PD (mW/cm2) @ 5 mm – Deviation of Max Value: 1.262 dB





Spatially Averaged PD (mW/cm2) @ 5 mm – Deviation of Max Value: 0.908 dB

<table>
<tr><th colspan="2">Case #2 - DISTANCE = 2 mm</th></tr>
<tr><th>Simulated</th><th>Measured</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td colspan="2">E-field (V/m) @ 2 mm – Deviation of Max Value: 0.195 dB</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td colspan="2">H-field (V/m) @ 2 mm – Deviation of Max Value: 0.411 dB</td></tr>
<tr><td>
</td><td>
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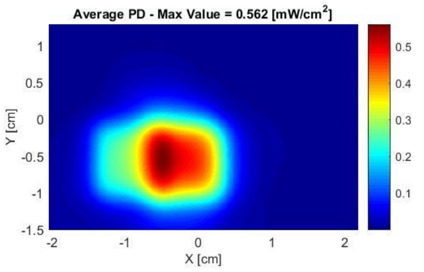
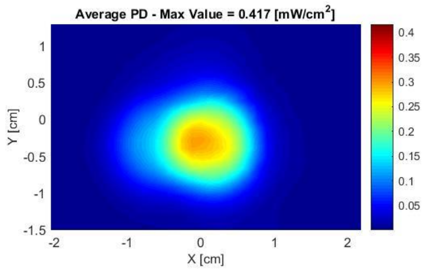
<tr><td colspan="2">Localized free space PD (mW/cm2) @ 2 mm – Deviation of Max Value: 0.488 dB</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td colspan="2">Spatially Averaged PD (mW/cm2) @ 2 mm – Deviation of Max Value: 1.296 dB</td></tr>
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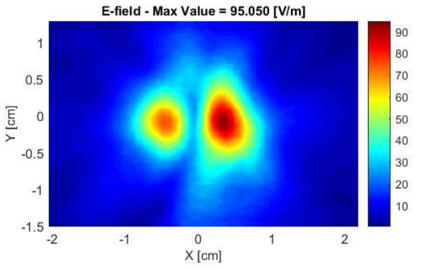
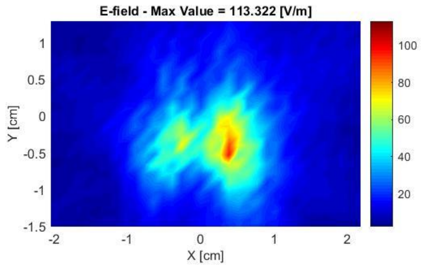
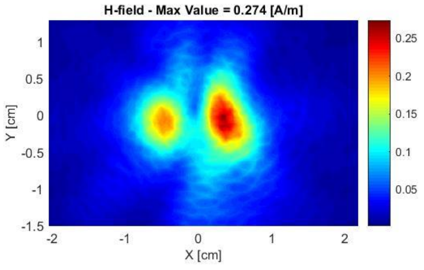
Case #2 - DISTANCE = 5 mm

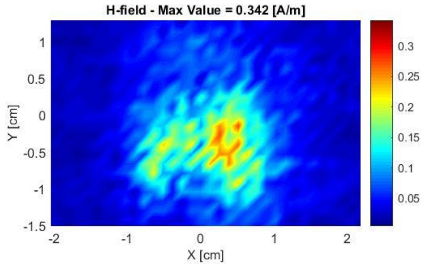
Simulated | **Measured**



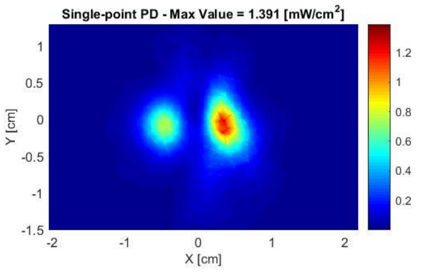


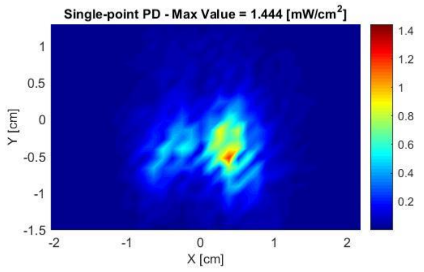
E-field (V/m) @ 5 mm – Deviation of Max Value: 1.527 dB



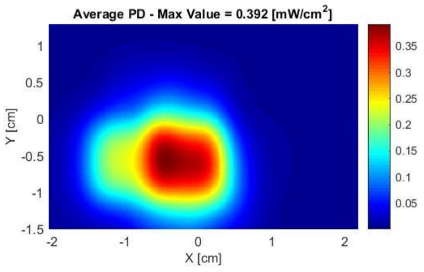


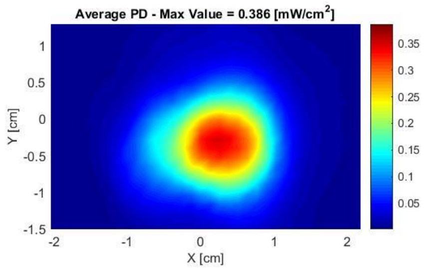
H-field (V/m) @ 5 mm – Deviation of Max Value: 1.931 dB



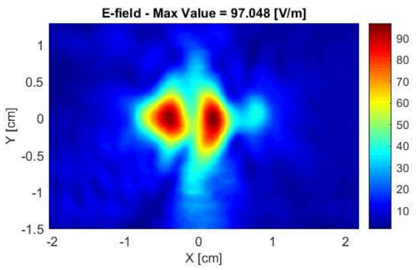
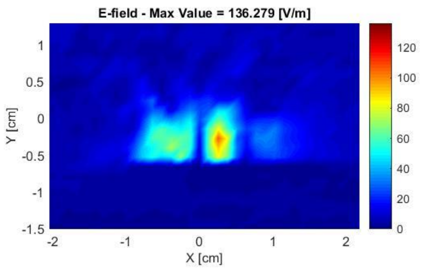
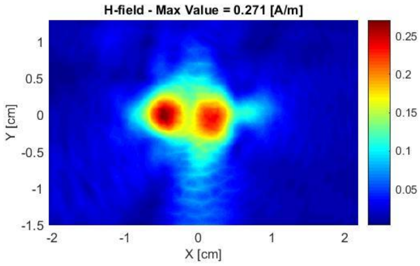
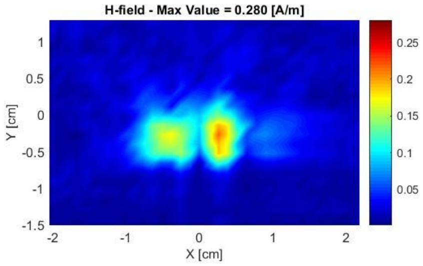
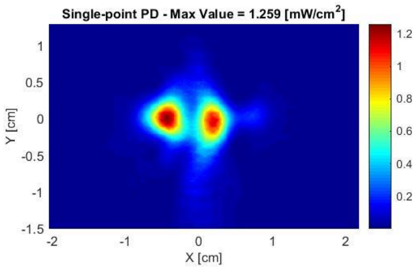
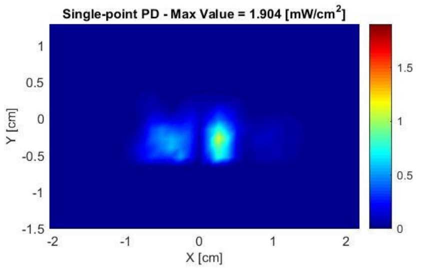
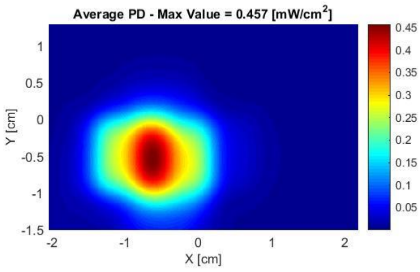
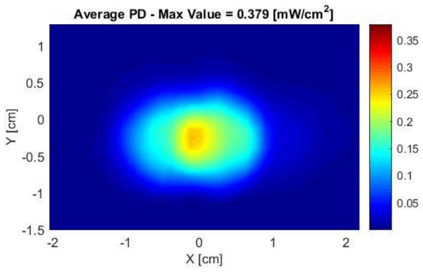


Localized free space PD (mW/cm2) @ 5 mm – Deviation of Max Value: 0.162 dB

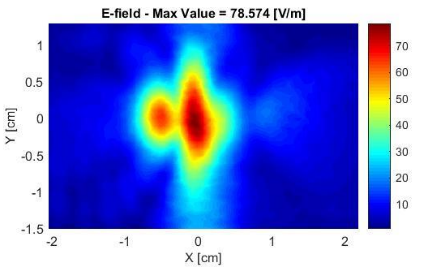
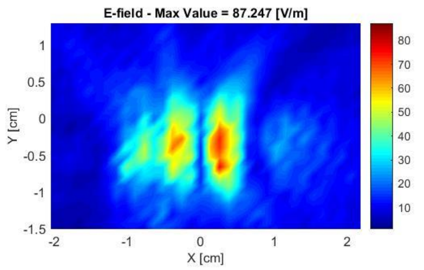




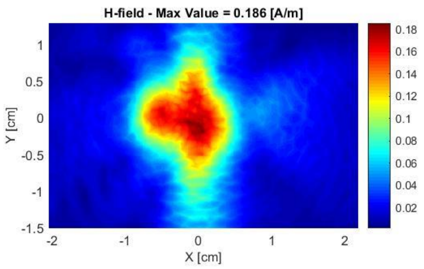
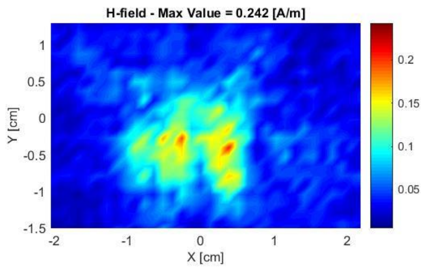
Spatially Averaged PD (mW/cm2) @ 5 mm – Deviation of Max Value: 0.072 dB

Case #3 - DISTANCE = 2 mm	
Simulated	**Measured**
	
E-field (V/m) @ 2 mm – Deviation of Max Value: 2.949 dB	
	
H-field (V/m) @ 2 mm – Deviation of Max Value: 0.308 dB	
	
Localized free space PD (mW/cm2) @ 2 mm – Deviation of Max Value: 1.794 dB	
	
Spatially Averaged PD (mW/cm2) @ 2 mm – Deviation of Max Value: 0.812 dB	

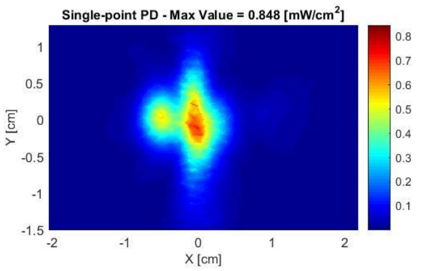
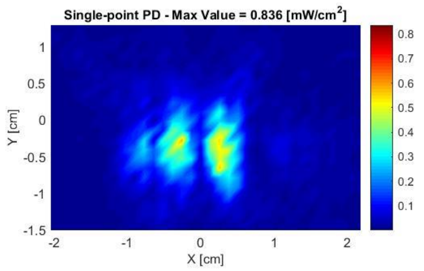
Case #3 - DISTANCE = 5 mm

Simulated	Measured
	

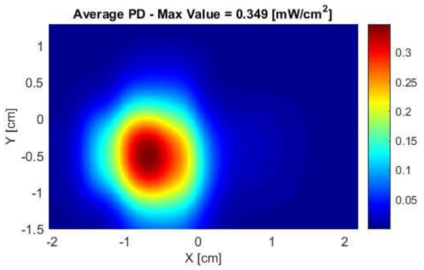
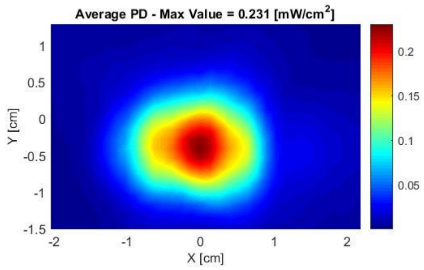
E-field (V/m) @ 5 mm – Deviation of Max Value: 0.909 dB

Simulated	Measured
	

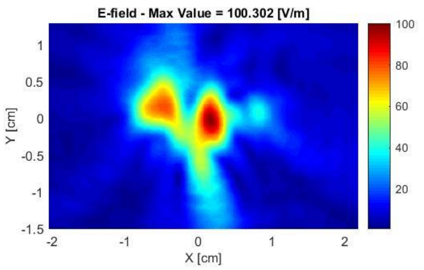
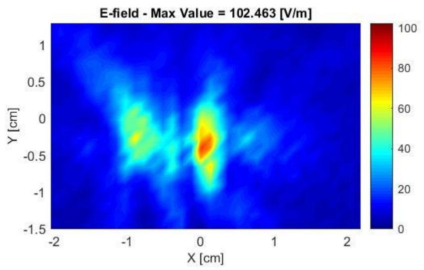
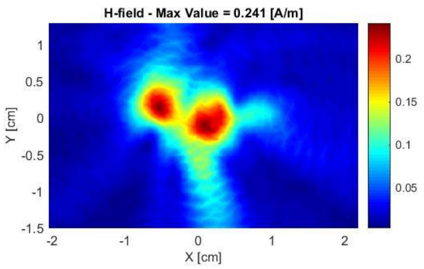
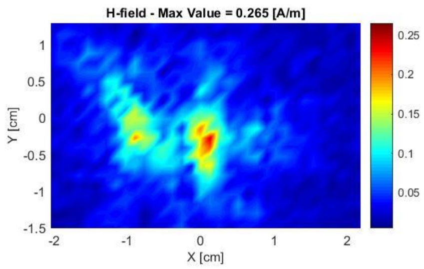
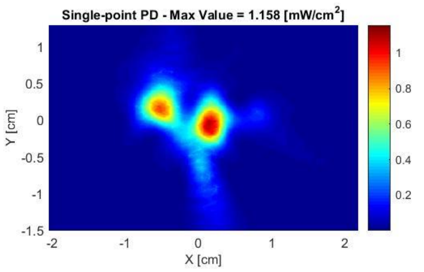
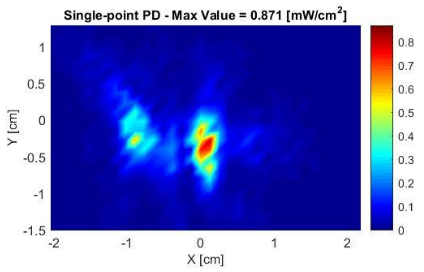
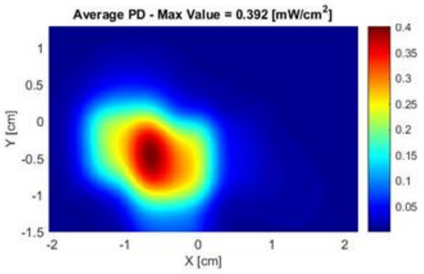
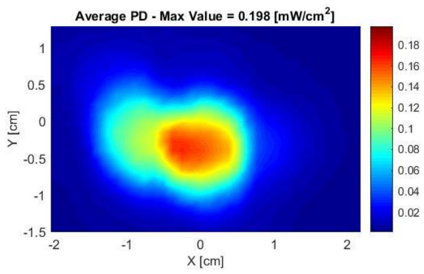
H-field (V/m) @ 5 mm – Deviation of Max Value: 2.323 dB

Simulated	Measured
	

Localized free space PD (mW/cm2) @ 5 mm – Deviation of Max Value: 0.060 dB

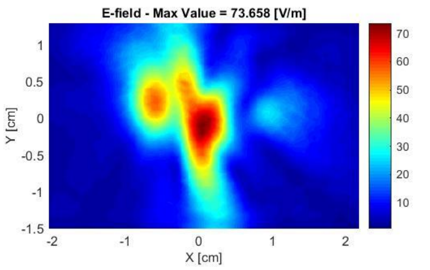
Simulated	Measured
	

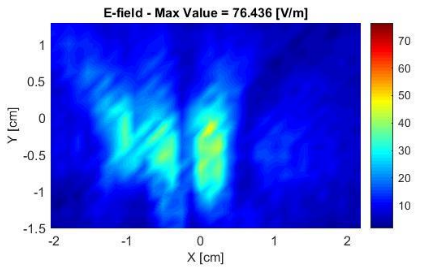
Spatially Averaged PD (mW/cm2) @ 5 mm – Deviation of Max Value: 1.796 dB

Case #4 - DISTANCE = 2 mm	
Simulated	**Measured**
	
E-field (V/m) @ 2 mm – Deviation of Max Value: 0.185 dB	
	
H-field (V/m) @ 2 mm – Deviation of Max Value: 0.814 dB	
	
Localized free space PD (mW/cm2) @ 2 mm – Deviation of Max Value: 1.233 dB	
	
Spatially Averaged PD (mW/cm2) @ 2 mm – Deviation of Max Value: 2.970 dB	

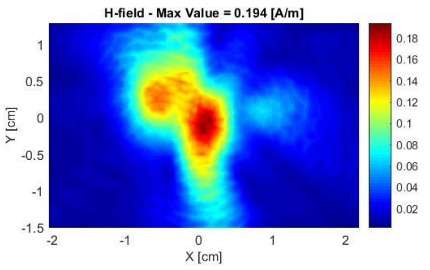
Case #4 - DISTANCE = 5 mm

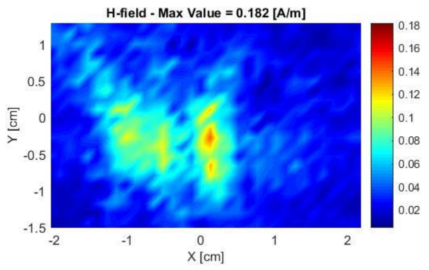
Simulated | **Measured**



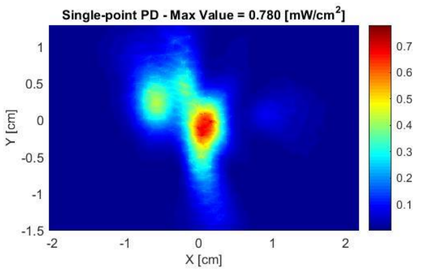


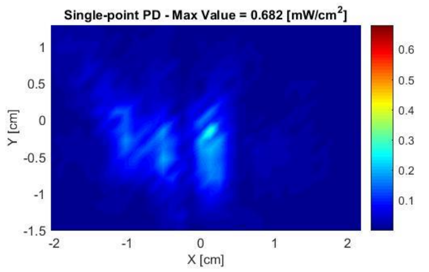
E-field (V/m) @ 5 mm – Deviation of Max Value: 0.322 dB



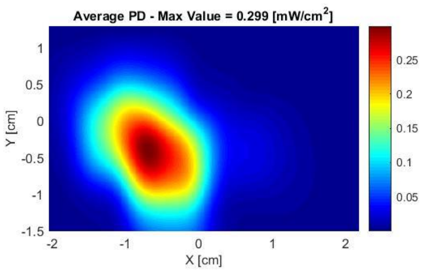


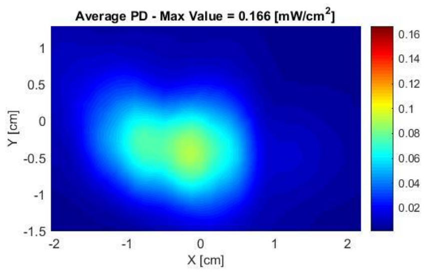
H-field (V/m) @ 5 mm – Deviation of Max Value: 0.585 dB





Localized free space PD (mW/cm2) @ 5 mm – Deviation of Max Value: 0.584 dB





Spatially Averaged PD (mW/cm2) @ 5 mm – Deviation of Max Value: 2.548 dB

Annex E. Photographs

E.1 Test Setup

Evaluation plane Position

Measurement Setup


E.2 Test Sample

Sample #01

Tablet Mode Front

Tablet Mode Back


Annex F. Calibration Certificates

ID	Device	Type/Model	Serial Number	Manufacturer
0575	E-field mm-Wave Probe	EUmmWV2	9354	SPEAG
0590	Horn reference source	PE9881-24	201715	Pasternack

Calibration certificates are in attachment