Netgear 5G MHS Travel Router (FCC ID: PY319100441) RF Exposure Compliance Test Report

Part 0: SAR and Power Density Characterization

(PD Simulation & Comparison with Measurement)

Rev. C

June 5, 2019

Revision history

Revision	Date	Description
A	May 2019	Initial release
B	May 2019	Minor update to Table 3.1
C	June 2019	Minor update to Section 3.5

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Tables

1 Introduction

The equipment under test (EUT) is Netgear 5G MHS Travel Router (FCC ID: PY319100441). It contains the Qualcomm SDM8150 modem supporting 4G WWAN technologies and SDX50 modem supporting mmW 5G NR bands. Both modems are enabled with Qualcomm Smart Transmit feature to control and manage transmitting power in real time and to ensure at all times the time-averaged RF exposure is compliant to the FCC requirement.

For WWAN technology, this EUT supports LTE radio and 5G mmW NR. In Part 0 report, the EUT SAR and power density (PD) are characterized for WWAN radios (4G and 5G mmW NR) to determine the power limit that corresponds to the exposure design target after accounting for all device design related uncertainties, i.e., *SAR_design_target* (< FCC SAR limit) for sub-6 radio and *PD_design_target* (< FCC PD limit) for mmW radio. The SAR characterization and PD characterization are denoted as SAR Char and PD Char in this report.

SAR Char and PD Char will be used as input for Qualcomm Smart Transmit to operate. Both SAR Char and PD Char will be loaded and stored in the EUT via the Embedded File System (EFS), and cannot be accessed by end users.

The EUT supports WLAN radio as well but WLAN modem is not enabled with time-averaging algorithm. Refer to Part 1 report for WLAN SAR test report and for simultaneous transmission analysis.

2 SAR Characterization

SAR Char is generated to cover all LTE bands and exposure scenarios that EUT supports.

2.1 Worst-case SAR determination

This EUT is a travel router. The body exposure condition is tested according to the hotspot SAR procedures specified in KDB 941225 D06. A test separation distance of 10 mm is used between the SAM flat phantom and all surfaces with a transmitting antenna within 25 mm from that surface. See Bureau Veritas Report No. SA181015C09: *FCC SAR Test Report* for details.

The worst-case SAR for each band is determined by taking the maximum SAR value among all applicable surfaces tested. Fig.3-1 shows LTE antennas 2 and 3 as part of the SAR measurement.

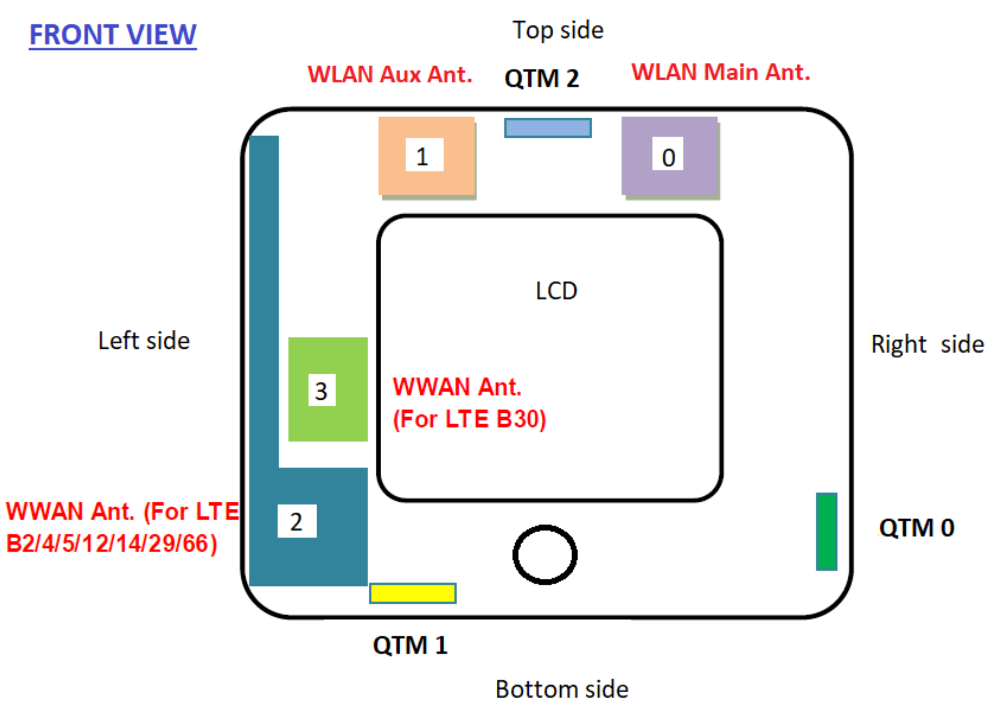


Figure 2-1: Netgear 5G MHS Travel Router (FCC ID: PY319100441) Antenna Block Diagram

2.2 SAR design target

The total device design related uncertainties of Netgear 5G MHS Travel Router (FCC ID: PY319100441) is 1dB (k=2), which includes TxAGC and device to device variation.

To account for the total uncertainty, *SAR_design_target* needs to be:

$$SAR\_design\_target < SAR_{regulatory\_limit} \times 10^{\frac{-total\ uncertainty}{10}}$$

For FCC SAR requirement of 1.6 W/kg for 1gSAR, the *SAR_design_target* for Netgear 5G MHS Travel Router (FCC ID: PY319100441) is determined as

$$SAR\_design\_target \ = 1.20\ W/kg\ for\ 1gSAR$$

2.3 SAR Char of Netgear 5G MHS Travel Router (FCC ID: PY319100441)

Referring to Bureau Veritas Report No. SA181015C09: *FCC SAR Test Report*, the worst-case *reported* SAR for each LTE band supported is summarized in Table 2-1:

Table 2-1: Worst-case *reported* SAR (extracted from Bureau Veritas Report No. SA181015C09: *FCC SAR Test Report*)

Band	Max tune up power P_{max} (dBm)	Reported SAR 1g (W/kg)
LTE 2	24	1.16
LTE 5	24	0.56
LTE 12	24	0.59
LTE 14	24	0.79
LTE 30	23.5	1.09
LTE 4/66	24	1

With 1.2 W/kg of SAR_design_target, the SAR Char for this EUT is determined and listed in Table 2-2.

Table 2-2: SAR Char of Netgear 5G MHS Travel Router (FCC ID: PY319100441)

Regulatory requirement	FCC
Reserve_power_margin	3dB
DSI	15
Tech/Band, Antenna	P_{limit} (dBm)
LTE 2	24.1
LTE 5	27.3
LTE 12	27.1
LTE 14	25.8
LTE 30	23.9
LTE 4/66	24.8

Comparing maximum tune-up power, P_{max} in Table 2-1 to P_{limit} in Table 2-2 it can be seen that $P_{limit} > P_{max}$ for all the LTE bands. Therefore, for this EUT, Smart Transmit shall monitor Tx transmission but will not perform power enforcement when only LTE radio is active.

3 Power Density Characterization

Netgear 5G MHS Travel Router (FCC ID: PY319100441) 5G mmW NR contains three Qualcomm QTM052 mmW antenna modules, denoted as QTM 0, 1 & 2 which are installed at three different locations as shown in Fig.3-1. These are referred to as "Module" or "Phasor" interchangeably throughout this report. Total 189 beams or antenna array configurations are supported. In this chapter, a hybrid approach using electromagnetic (EM) simulation in combination with measurement is taken to efficiently and conservatively characterize power density profile for Netgear 5G MHS Travel Router (FCC ID: PY319100441).

Figure 3-1: Netgear 5G MHS Travel Router (FCC ID: PY319100441) with three QTM052 mmW antenna modules

3.1 Exposure scenarios in PD evaluation

In general, for a device operating at frequencies > 6 GHz, the PD is required to be assessed for all antenna configurations (beams) from all mmW antenna modules that are installed inside the device. Furthermore, this PD evaluation should be performed at low, mid, and high channels for each supported mmW band.

For this EUT, the 4cm^2 spatially-averaged PD is evaluated along the surfaces (*S1, S2, S3, S4, S5, S6* as shown in Fig.3-2) of the EUT, and the worst-case PD is determined by taking the maximum PD among all PDs at the evaluated surfaces for each beam/band.

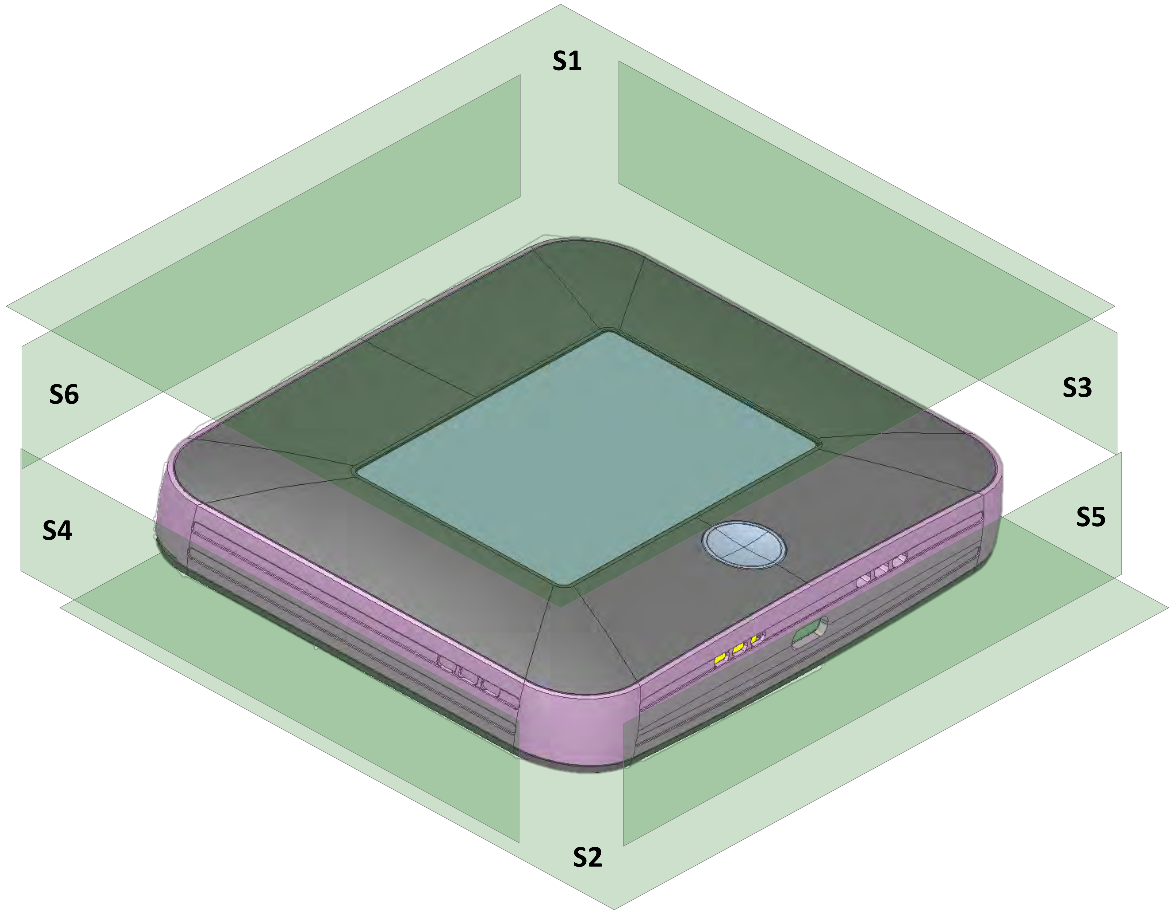


Figure 3-2: EUT surface definition: S1=front, S2=back, S3=right, S4=left, S5=bottom, S6=top

3.2 PD characterization overview

Parameters used in PD characterization:

- The EUT supports total 189 beams in n260 band, where 126 beams are single beams (SISO) and 63 are beam pairs (MIMO) where two single beams are excited at the same time.
- ***PD_design_target***: The design target for PD compliance as defined in the 80-W5567-3 Rev. A: *Compliance Summary Report*. It should be less than FCC PD limit to account for all device design related uncertainties.
- ***input.power.limit***: For a PD characterized wireless device, the input power level at antenna port(s) for each beam corresponding to *PD_design_target*.
- **PD Char**: the table that contains *input.power.limit* fed to antenna port(s) for all supported beams.

Figure 3-3 in the next page outlines the PD Char process.

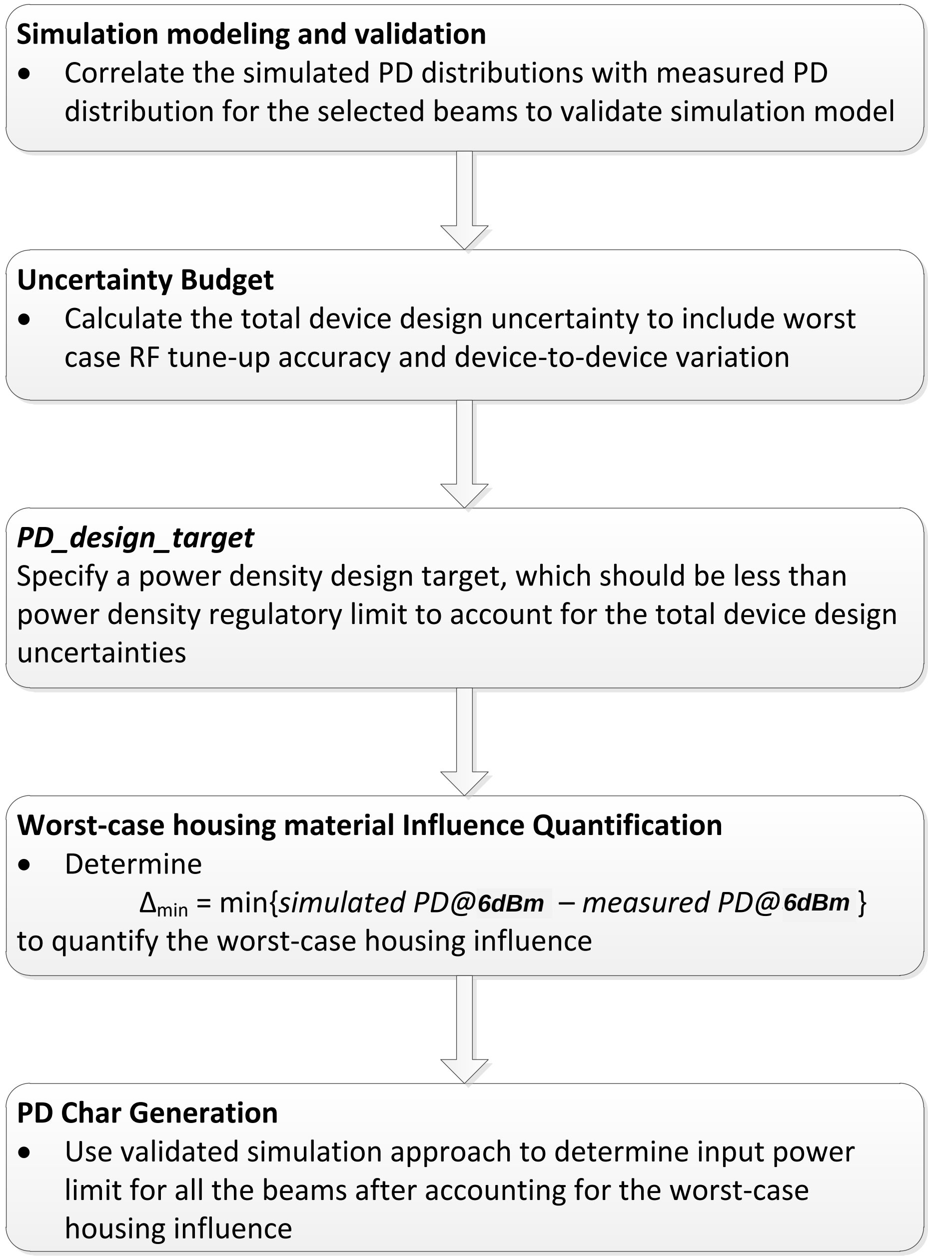


Figure 3-3 High level flow chart for power density characterization

3.3 Codebook for Netgear 5G MHS Travel Router (FCC ID: PY319100441)

In general, all the beams that the device supports are specified in the pre-defined codebook. The codebook contains a codeword for each beam in a defined set of beam pairs, which is a list of magnitude and phase weights applied to each active antenna element group's feeds to cause the desired beam to be formed. The codebook is device design specific and generated after evaluating radiation coverage from this specific device.

Table 3-1 shows all the beams and their relevant information in the codebook of Netgear 5G MHS Travel Router (FCC ID: PY319100441). There are three QTM mmW modules with module ID = 0, 1 and 2, respectively, as shown in Fig.3-1 & 3-2. The PD evaluation needs to be performed for all the beams listed in Table 3-1.

Table 3-1: Codebook of Netgear 5G MHS Travel Router (FCC ID: PY319100441)

(The single beams selected for modeling validation are highlighted in yellow)

Beam_ID	Module_ID	Ant_Type	No_active_elements	Paired_With
0	1	DIPOLE	1	128
1	1	PATCH	1	129
2	0	DIPOLE	1	130
3	0	PATCH	1	131
4	2	PATCH	1	132
5	2	DIPOLE	1	133
6	1	DIPOLE	2	135
7	1	DIPOLE	2	134
8	1	DIPOLE	2	136
9	1	PATCH	2	138
10	1	PATCH	2	137
11	1	PATCH	2	139
12	0	DIPOLE	2	140
13	0	DIPOLE	2	142
14	0	DIPOLE	2	141
15	0	PATCH	2	143
16	0	PATCH	2	144
17	0	PATCH	2	145
18	2	PATCH	2	146
19	2	PATCH	2	147
20	2	PATCH	2	148
21	2	DIPOLE	2	149
22	2	DIPOLE	2	150
23	2	DIPOLE	2	151
24	1	DIPOLE	2	152
25	1	DIPOLE	2	153
26	1	PATCH	2	155

Beam_ID	Module_ID	Ant_Type	No_active_elements	Paired_With
27	1	PATCH	2	154
28	0	DIPOLE	2	156
29	0	DIPOLE	2	157
30	0	PATCH	2	158
31	0	PATCH	2	159
32	2	PATCH	2	161
33	2	PATCH	2	160
34	2	DIPOLE	2	162
35	2	DIPOLE	2	163
36	1	PATCH	4	167
37	1	PATCH	4	166
38	1	PATCH	4	165
39	1	PATCH	4	164
40	1	PATCH	4	168
41	0	PATCH	4	172
42	0	PATCH	4	170
43	0	PATCH	4	169
44	0	PATCH	4	173
45	0	PATCH	4	171
46	2	PATCH	4	178
47	2	PATCH	4	176
48	2	PATCH	4	175
49	2	PATCH	4	174
50	2	PATCH	4	177
51	1	PATCH	4	181
52	1	PATCH	4	180
53	1	PATCH	4	182
54	1	PATCH	4	179
55	0	PATCH	4	183
56	0	PATCH	4	185
57	0	PATCH	4	186
58	0	PATCH	4	184
59	2	PATCH	4	189
60	2	PATCH	4	190
61	2	PATCH	4	187
62	2	PATCH	4	188
128	1	DIPOLE	1	0
129	1	PATCH	1	1
130	0	DIPOLE	1	2
131	0	PATCH	1	3
132	2	PATCH	1	4
133	2	DIPOLE	1	5

Beam_ID	Module_ID	Ant_Type	No_active_elements	Paired_With
134	1	DIPOLE	2	7
135	1	DIPOLE	2	6
136	1	DIPOLE	2	8
137	1	PATCH	2	10
138	1	PATCH	2	9
139	1	PATCH	2	11
140	0	DIPOLE	2	12
141	0	DIPOLE	2	14
142	0	DIPOLE	2	13
143	0	PATCH	2	15
144	0	PATCH	2	16
145	0	PATCH	2	17
146	2	PATCH	2	18
147	2	PATCH	2	19
148	2	PATCH	2	20
149	2	DIPOLE	2	21
150	2	DIPOLE	2	22
151	2	DIPOLE	2	23
152	1	DIPOLE	2	24
153	1	DIPOLE	2	25
154	1	PATCH	2	27
155	1	PATCH	2	26
156	0	DIPOLE	2	28
157	0	DIPOLE	2	29
158	0	PATCH	2	30
159	0	PATCH	2	31
160	2	PATCH	2	33
161	2	PATCH	2	32
162	2	DIPOLE	2	34
163	2	DIPOLE	2	35
164	1	PATCH	4	39
165	1	PATCH	4	38
166	1	PATCH	4	37
167	1	PATCH	4	36
168	1	PATCH	4	40
169	0	PATCH	4	43
170	0	PATCH	4	42
171	0	PATCH	4	45
172	0	PATCH	4	41
173	0	PATCH	4	44
174	2	PATCH	4	49
175	2	PATCH	4	48

Beam_ID	Module_ID	Ant_Type	No_active_elements	Paired_With
176	2	PATCH	4	47
177	2	PATCH	4	50
178	2	PATCH	4	46
179	1	PATCH	4	54
180	1	PATCH	4	52
181	1	PATCH	4	51
182	1	PATCH	4	53
183	0	PATCH	4	55
184	0	PATCH	4	58
185	0	PATCH	4	56
186	0	PATCH	4	57
187	2	PATCH	4	61
188	2	PATCH	4	62
189	2	PATCH	4	59
190	2	PATCH	4	60

3.4 PD Simulation and Comparison with Measurement

3.4.1 Simulation Model

The EUT has three QTM052-8L mmW modules highlighted in (Fig.3-4), which contains both dipole and patch antenna arrays. The QTM052_8L is designed by Qualcomm, who have provided the encrypted simulation model of this module for EM simulation. The entire Netgear MHS is first modeled along with housing, mmW modules, all LTE antennas, PCB, shields, LCD, flex cables, and battery etc. as shown below.

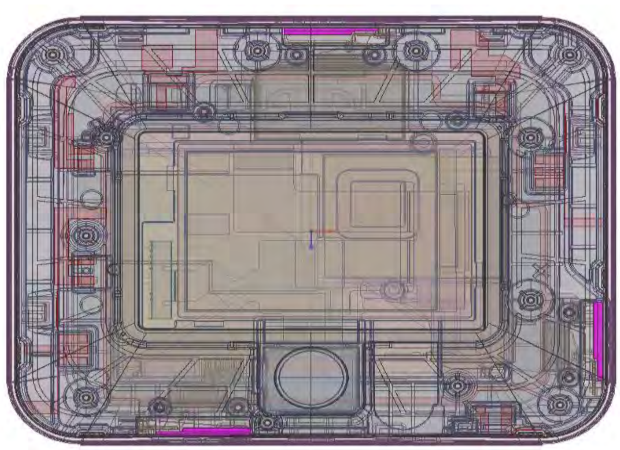


Figure 3-4: Netgear 5G travel router simulation model

To be practical, as shown in Fig.3-5, the EM simulation is conducted for Module 0, 1 and 2 separately with truncated sections of the device and the relevant PD evaluation planes S1, S2, S3, S5 & S6 at d=10mm where the PD is dominant. More details on surface selection are in Sec. 3.4.4.

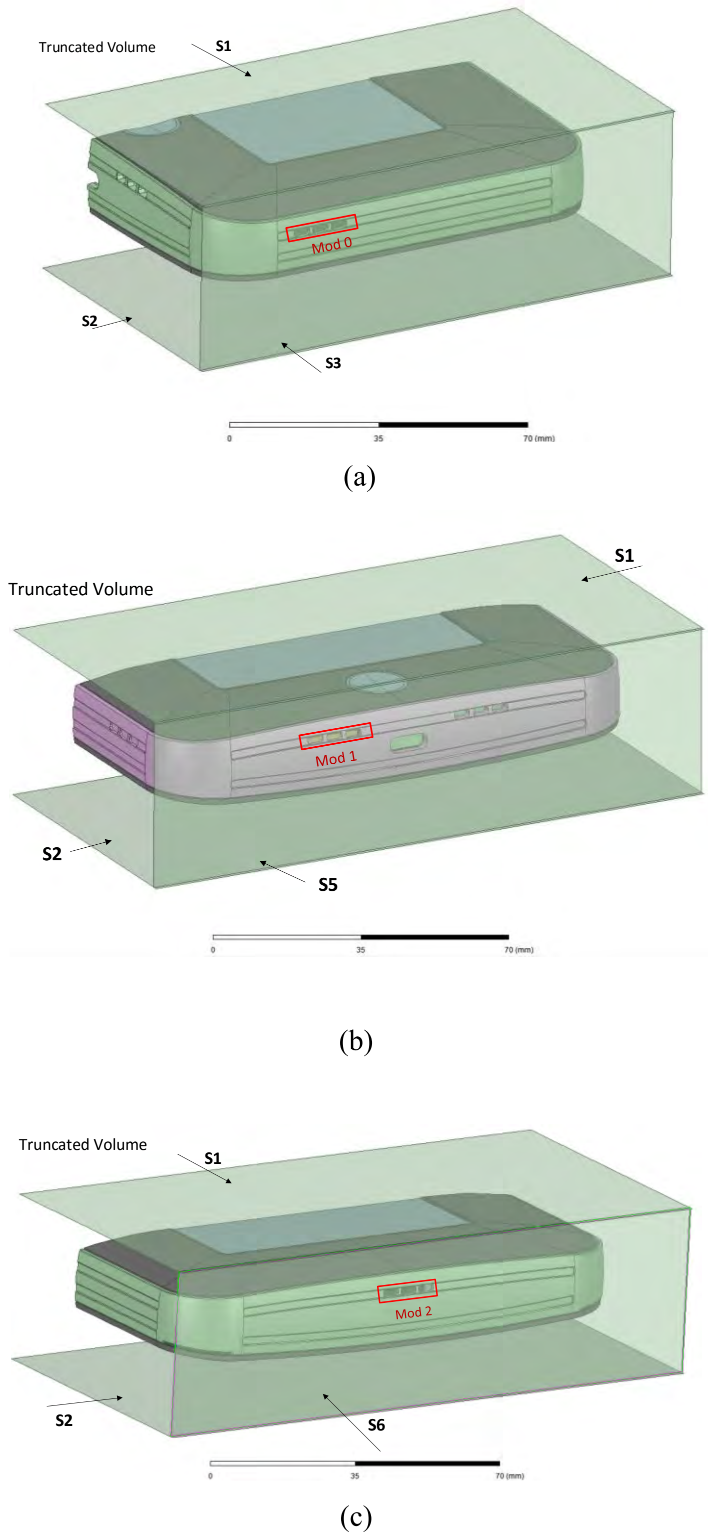


Figure 3-5: Simplified simulation model: (a) Module 0, (b) Module 1, (c) Module 2

These device level simulation models for PD assessment are constructed according to best engineering practices. However, to characterize the mm-wave PD behavior accurately all the important details within at least two wavelengths around each QTM module should be considered and the whole device need not be simulated which can be computationally very memory intensive.

3.4.2 Simulation Setup

FEM simulations were performed to assess the power density of the EUT with QTM052-8L modules using ANSYS Electromagnetics Suite 2019.R2. The auto initial mesh defined “lambda refinement” (i.e., ANSYS refines the initial mesh based on the material-dependent wavelength) and 30% maximum refinement per pass are selected as adaptive options in the simulation setup.

The system (ANSYS Electromagnetics suite 2019R2) computes the error, and the iterative process (solve –> error analysis –> adaptive refinement) repeats until the convergence criteria is met with maximum magnitude of delta S less than 2% which is defined by the user. As long as convergence is reached, the converged results are accurate. Fig.3-6 shows the adaptive mesh setup over a cross section.

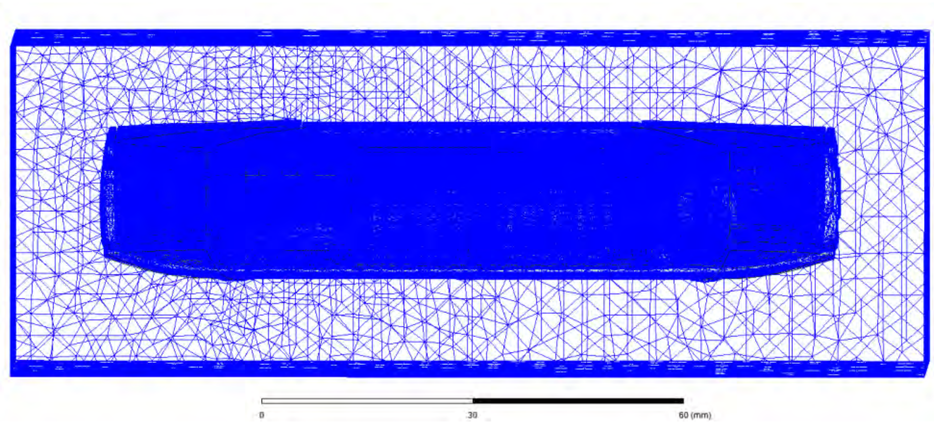
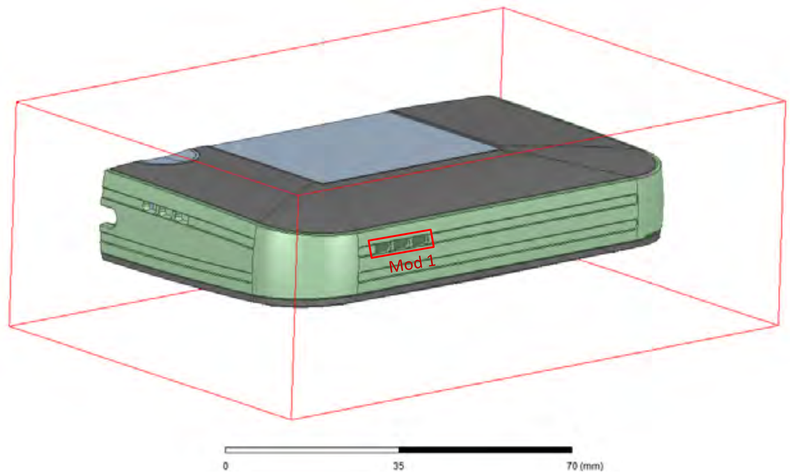


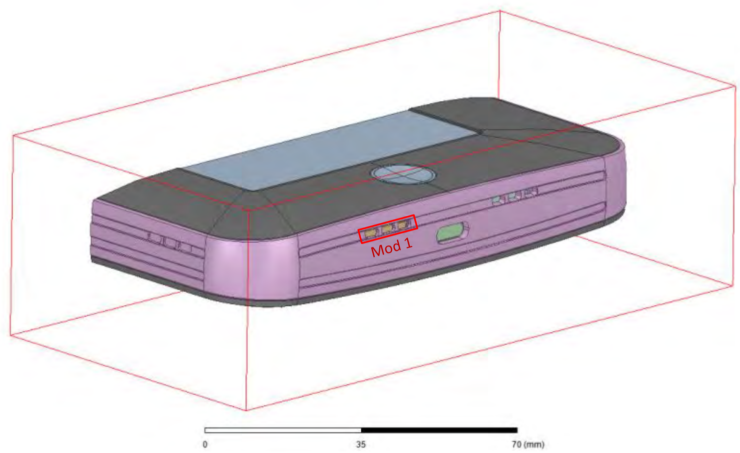
Figure 3-6 Simulation mesh setup

For radiation boundary, the 2nd order absorbing boundary condition (ABC) is used for all simulations in this report. This radiation boundary simulates an electrically open surface that allows waves to radiate infinitely far into space. The system absorbs the wave via the 2nd order radiation boundary condition, essentially ballooning the boundary infinitely far away from the structure and into space. The radiation boundaries may also be placed relatively close to a structure and can be of arbitrary shape.

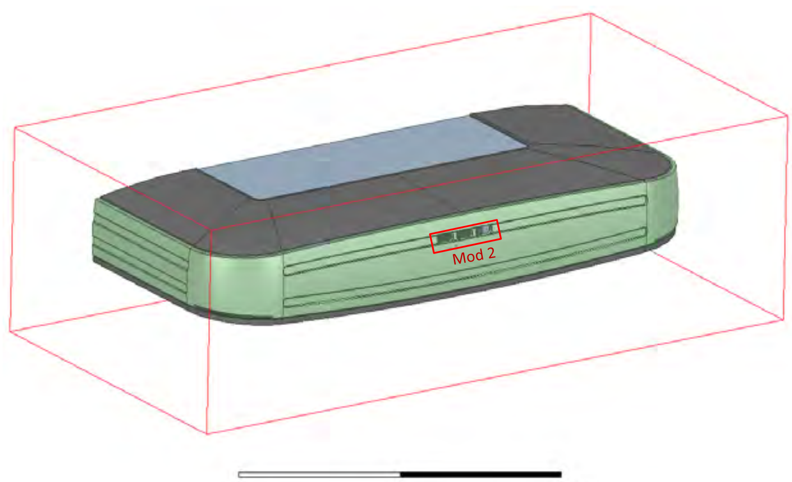
Per ANSYS recommendations for their simulation tool, the radiation boundary plane must be located at least a quarter wavelength from strongly radiating structure, or at least a tenth of a wavelength from a weakly radiating structure. In this report, about two wavelengths spacing (15mm) from the truncated EUT in all directions are applied to ensure convergence (see Fig.3-7). This is enough to capture the PD hotspots at d=10mm which fall well within the simulation domain and have been verified later in Table 3-3.



(a)



(b)



(c)

Figure 3-7 Radiation boundary for: (a) Module 0, (b) Module 1, (c) Module 2

Each antenna module 0, 1 & 2 are identical and has 16 ports. Out of these, 8 ports are for 1x4 patch array antennas and 8 ports are for 1x4 dipole array antennas respectively. Out of 8 ports of the patch array, 4 are for vertical polarization feeding and 4 are for horizontal polarization feeding. Whereas, for the dipole, each element in the 1x4 array has 2 differentially fed ports. With the encrypted QTM simulation model, the magnitude and phase information can be loaded for each port by using "Edit Sources" in ANSYS Electromagnetics suite 2019R2. Fig.3-8 shows the antenna port excitations.

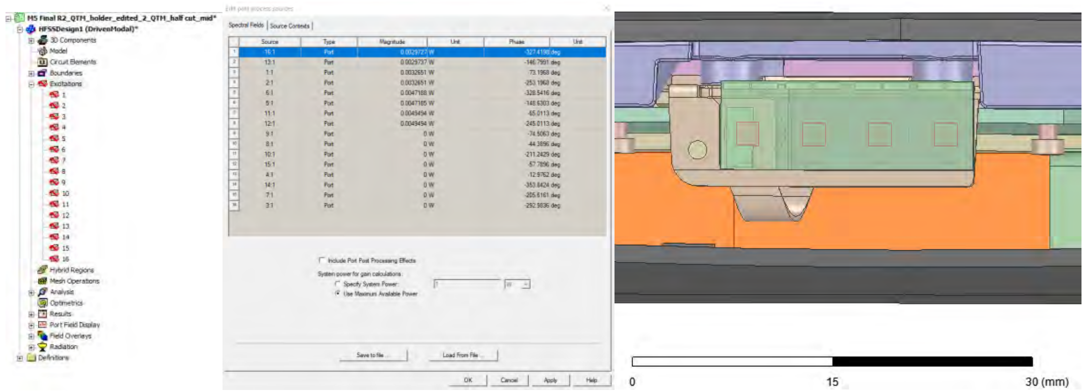


Figure 3-8 Antenna port excitations in ANSYS EM Suite 2019R2

After simulating the electric and magnetic (E & H) fields for a single beam formed by an array, the Poynting vector is calculated based on "peak" (i.e. non-RMS) field values in a grid with 0.95 mm step size, on the appropriate evaluation planes defined in Table 3-2. The Poynting vector at each spatial point is readily available in ANSYS Electromagnetics Suite 2019.R2 through the "Field Calculator" navigation option. The magnitude of the real part of the Poynting vector (all X, Y, Z components) at each spatial point i.e. the point power density is exported to do the averaging. The spatially averaged power density at each point on a given surface is then calculated by taking the average of the point power density over a 4 square cm area. Thus, the total power density (all X, Y, Z components) through any given surface is used to calculate the averaged power density

$$P_{avg} = \frac{1}{2A}\int_A \left|Re(\vec{E}\times\vec{H}^*)\right|.\,dS$$

The PD calculation from the simulated E & H fields for a dual or beam pair is given in Appendix A.

3.4.3 Modeling validation with PD measurements

To validate modeling and simulation the process below is followed:

1. Select at-least one beam (i.e., antenna array configuration) per antenna type (dipole and/or patch) and per antenna module.

   This EUT contains three QTM052-8L mmW antenna modules (Mod 0, Mod 1 and Mod 2). Each module has both dipole and patch antenna arrays. Therefore, the beam selection criteria for each mmW antenna are:

   a) three beams (one dipole beam and two patch beams) from Module 0
   b) three beams (one dipole beam and two patch beams) from Module 1
   c) three beams (one dipole beam and two patch beams) from Module 2

Note: Since the relative phase between two single beams in a beam pair is uncontrolled and could vary from run to run, for the validation purpose, the selection is limited to the single beam antenna array configuration. Additionally, single beam containing a higher number of active antenna elements is selected. For example, a single beam with four active patches should be selected over beam with a single active patch antenna beam.

The single beams for modeling validation are already highlighted in yellow in Table 3-1.

2. For a given input power, perform both PD simulation and PD measurement to obtain the simulated PD distributions and measured PD distributions on the surface in front of the antenna array as well as the surfaces that are adjacent to the antenna array as they could potentially have strong radiating energy when considering the orientation of antenna array and type of antenna array (i.e., patch array or dipole array).

3. Validate modeling and simulation by correlating the simulated PD distribution and measured PD distribution for all antenna array configurations selected in Step 1 and for all surfaces selected in Step 2.

   The modeling validation is performed through correlating the simulated point PD distribution to measured point PD distribution.

   The difference in $4cm^2$-avg PD is not used for the purpose of validity of the modeling because the housing material property (for non-metal material) used in the simulation is an approximation (note that accurate material properties are not available at mmW frequencies). This discrepancy in PD magnitude will be used to determine the worst-case housing influence (due to non-metal material property uncertainty) later in Section 3.6. The worst-case housing influence will be accounted for in PD Char generation for conservative RF exposure assessment, see Section 3.7 for details.

Based on the selection criteria described in Step 1 and Step 2, the beams and surfaces selected for modeling validation of the EUT are listed in Table 3-2.

Table 3-2: Beams and surfaces selection for PD correlation

Band	**mmW Antenna**	**Beam ID**	**Surface** (see Fig.3-3)
n260	0	56	S1,S2,S3
		185	S1,S2,S3
		13	S1,S2,S3
	1	37	S1,S2,S5
		180	S1,S2,S5
		24	S1,S2,S5
	2	48	S1,S2,S6
		175	S1,S2,S6
		22	S1,S2,S6

With an input power of 6 dBm for n260 band, PD measurement and PD simulation are conducted for all beams and surfaces listed in Table 3-2:

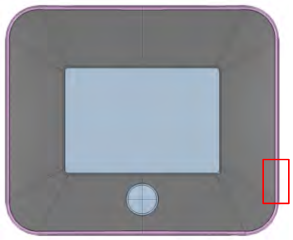
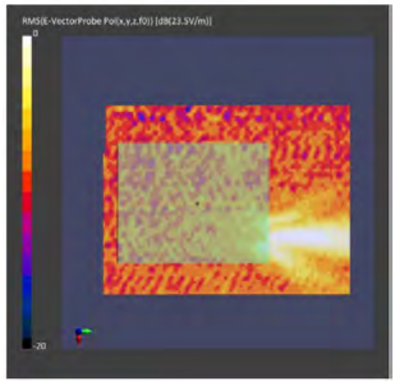
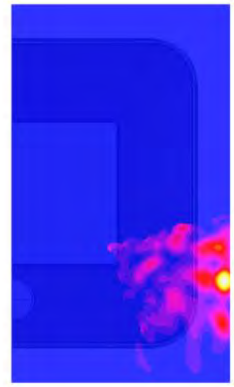
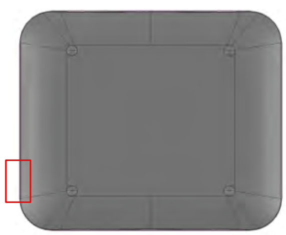
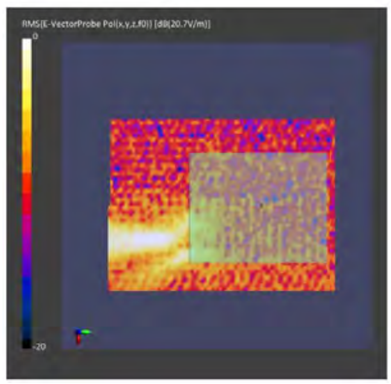
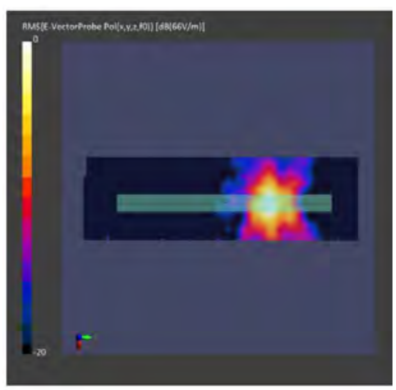
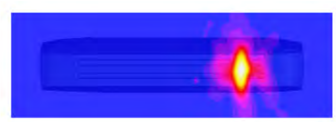
- PD distribution

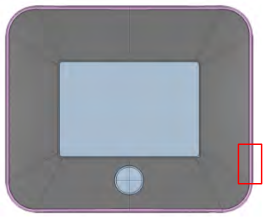
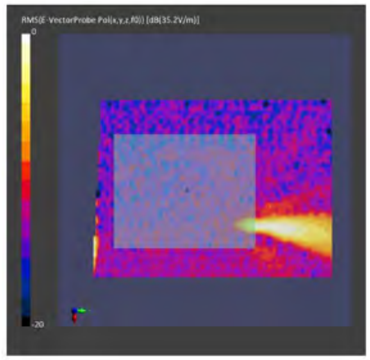
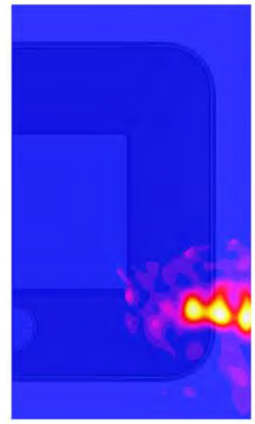
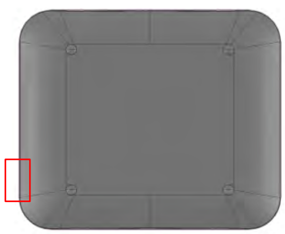
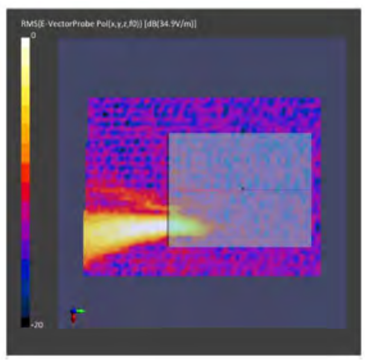
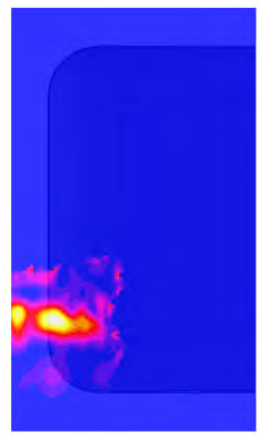
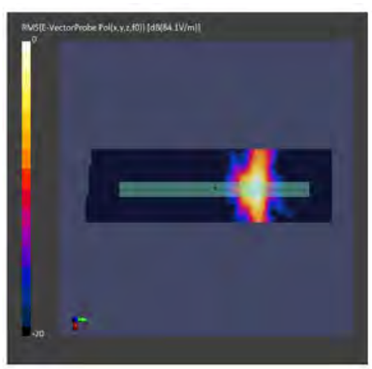
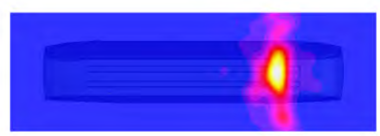
  Table 3-3 shows the measured and simulated point PD distributions for all selected beams and surfaces for n260 band. The "View" column depicts the orientation of the device and the antenna module location is outlined in red. As can be seen, the simulated PD distributions in the truncated domains correlate well with the measured PD distributions for all selected beams on all identified surfaces of the EUT. This confirms that the modeling is a good representation of the actual mmW QTM modules installed in the EUT. The location of the peak PD hotspots on various planes in Bureau Veritas Report No. SP181015C09B: *Power Density Measurement Report* also match well with simulation. Therefore, the simulation model to be used for performing mmW NR RF exposure assessment is valid for this EUT.

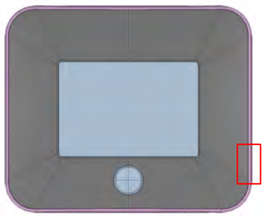
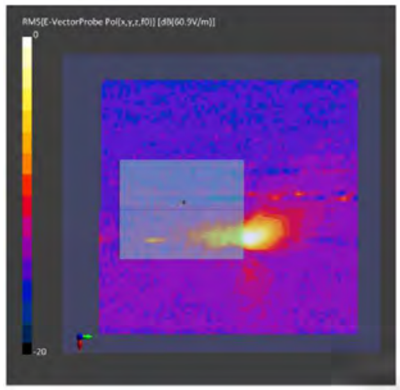
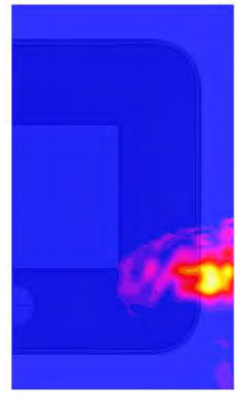
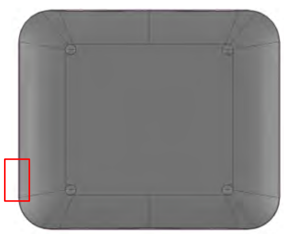
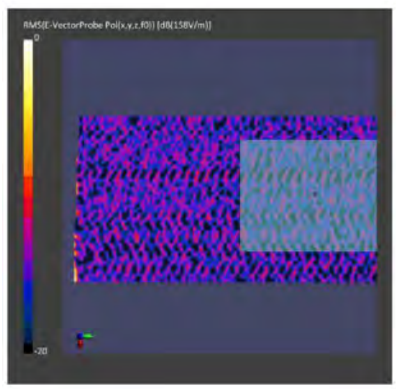
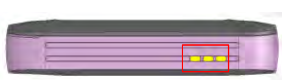
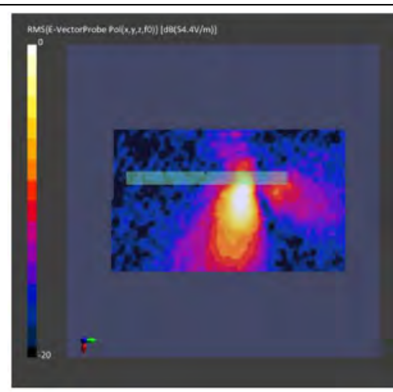
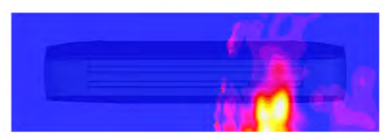
- $4cm^2$-averaged PD value

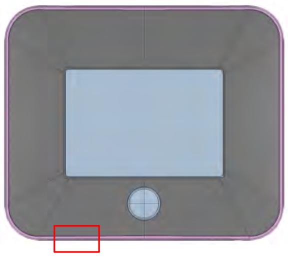
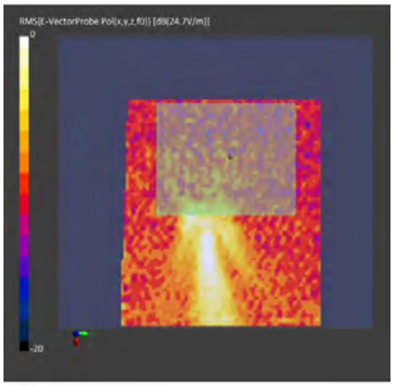
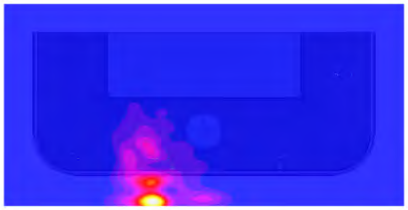
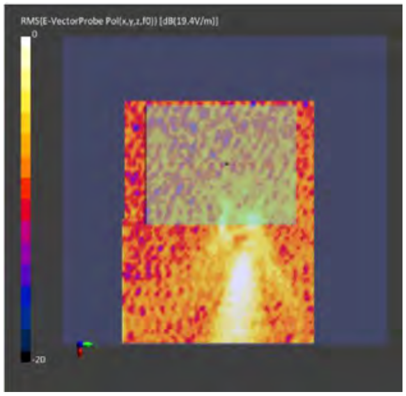
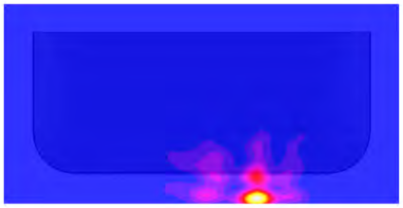
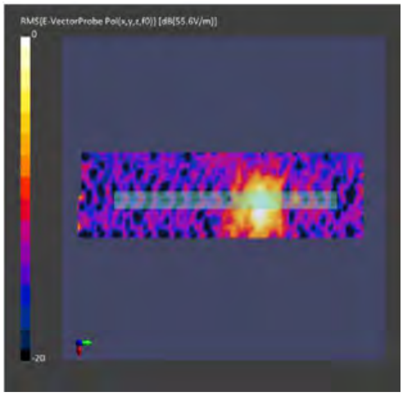
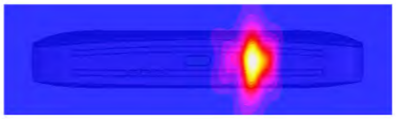
  Table 3-4 lists the measured $4cm^2$-averaged PD and simulated $4cm^2$-averaged PD for all selected beams and surfaces for n260 band. Refer to Bureau Veritas Report No. SP181015C09B: *Power Density Measurement Report* for measurement details. The discrepancy between simulated and measured PD value will be used to determine worst-case housing influence for conservative assessment (see Section 3.6).

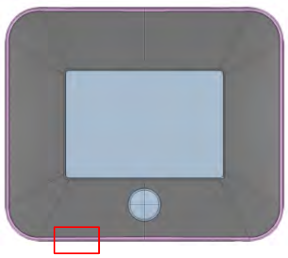
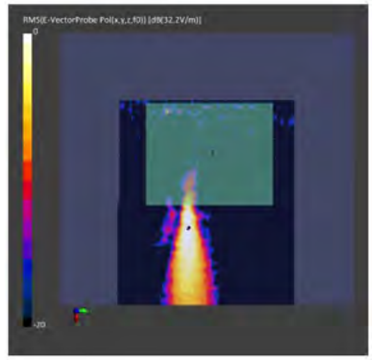
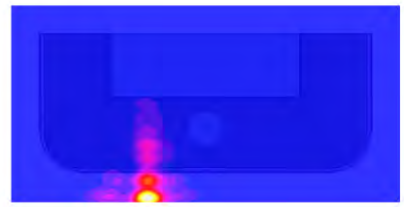
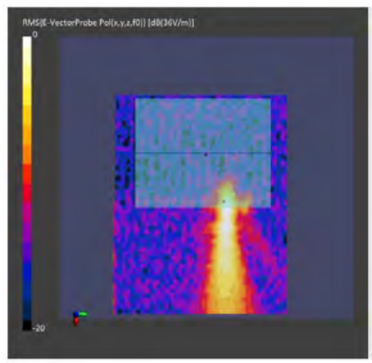
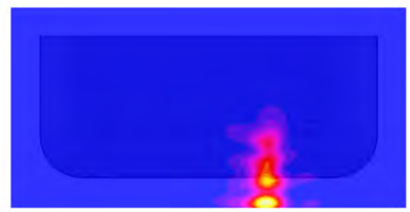
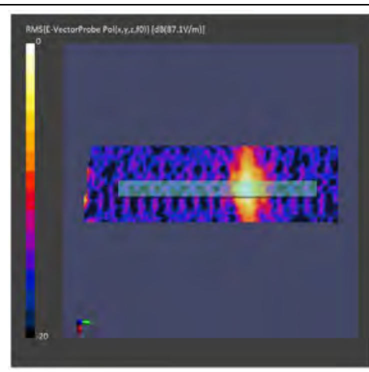
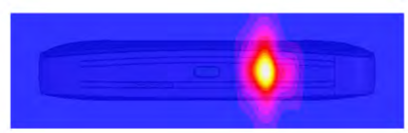
Table 3-3 Measured and simulated PD distributions for selected beams in n260 band

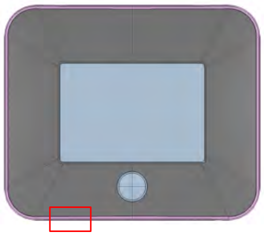
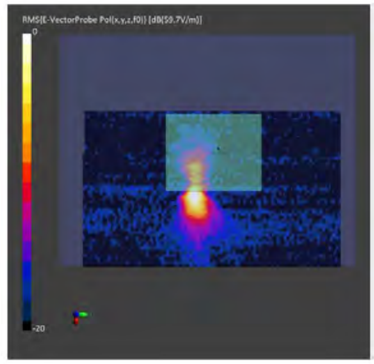
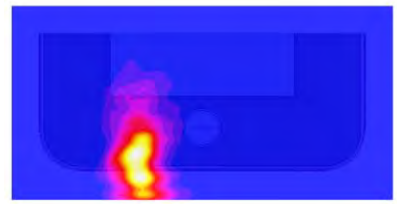
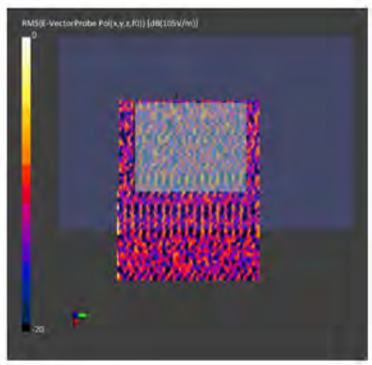
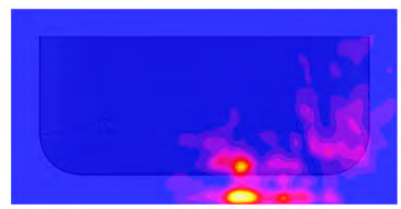
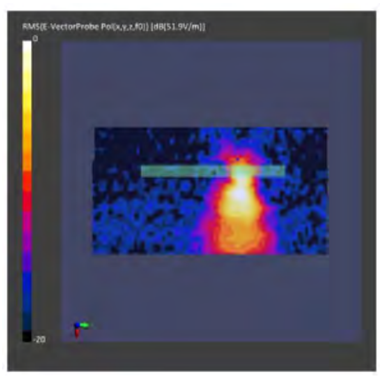
n260				
Beam ID	**Surface**	**View**	**Measured PD**	**Simulated PD**
56	S1			
	S2			
	S3			

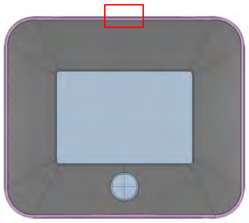
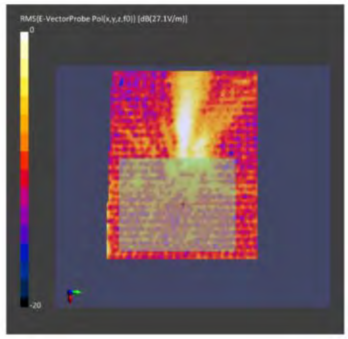
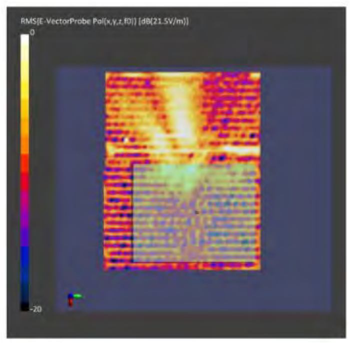
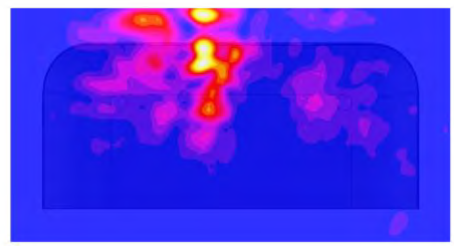
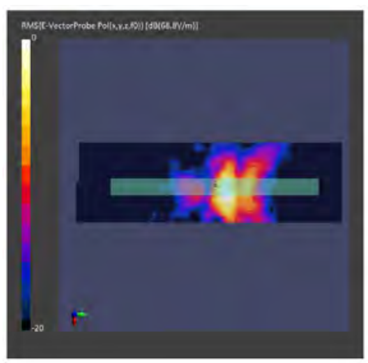
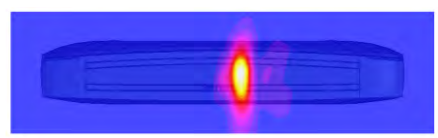
n260				
Beam ID	**Surface**	**View**	**Measured PD**	**Simulated PD**
185	S1			
	S2			
	S3			

n260				
Beam ID	**Surface**	**View**	**Measured PD**	**Simulated PD**
	S1			
13	S2			
	S3			

n260				
Beam ID	**Surface**	**View**	**Measured PD**	**Simulated PD**
37	S1			
	S2			
	S5			

n260				
Beam ID	**Surface**	**View**	**Measured PD**	**Simulated PD**
180	S1			
	S2			
	S5			

n260				
Beam ID	**Surface**	**View**	**Measured PD**	**Simulated PD**
	S1			
24	S2			
	S5			

n260				
Beam ID	**Surface**	**View**	**Measured PD**	**Simulated PD**
48	S1			
	S2			
	S6			

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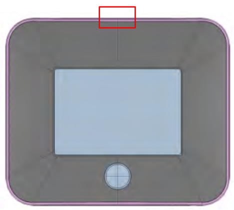
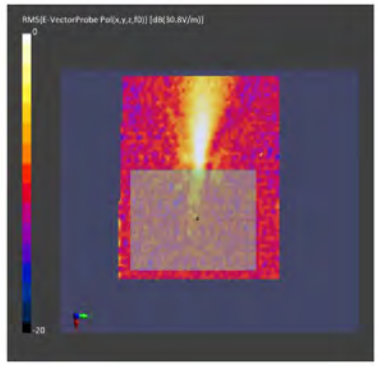
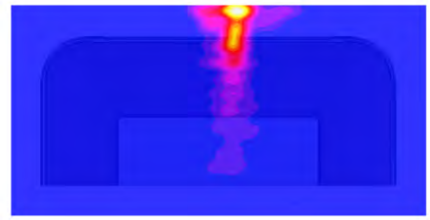
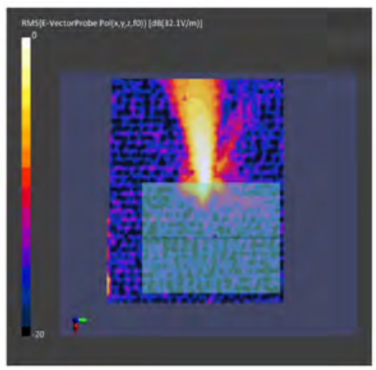
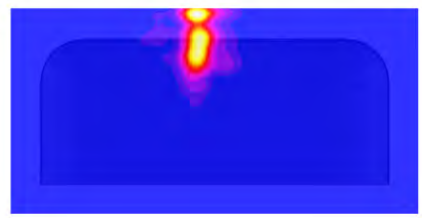
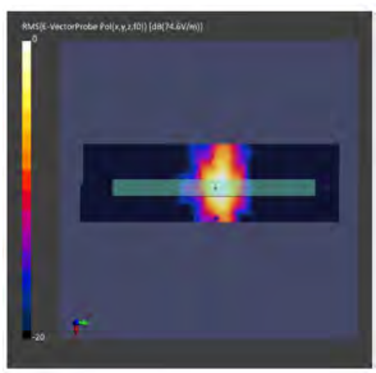
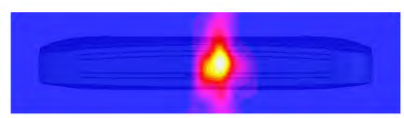
n260				
Beam ID	**Surface**	**View**	**Measured PD**	**Simulated PD**
175	S1			
	S2			
	S6			

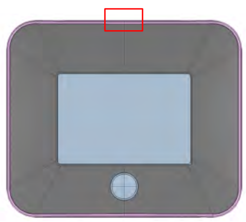
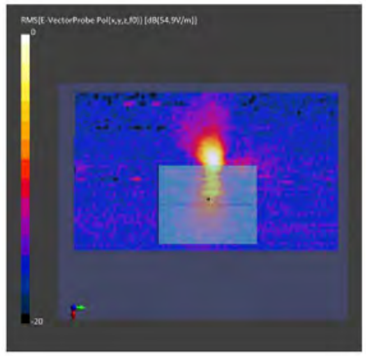
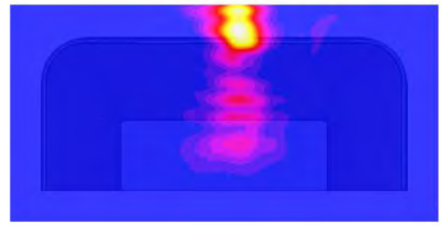
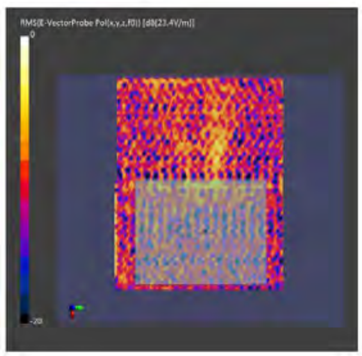
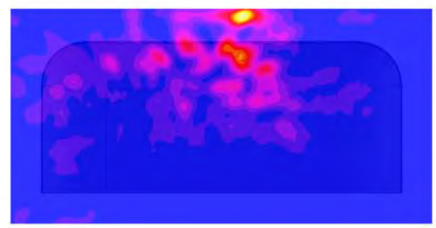
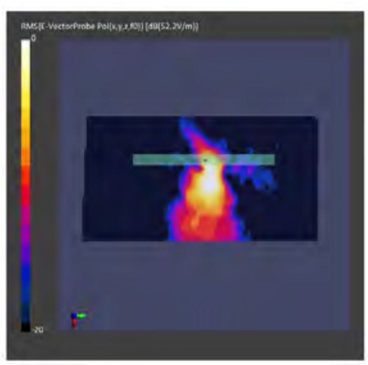
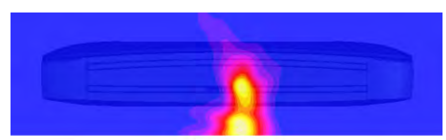
n260				
Beam ID	**Surface**	**View**	**Measured PD**	**Simulated PD**
22	S1			
	S2			
	S6			

Table 3-4 Measured and simulated 4cm^2 averaged PD for selected beams with 6 dBm input power

Band	Beam ID	Surface	4cm2 avg. PD (W/m2) Meas.	Sim	Delta = Sim. - Meas. (dB)
n260	56	S1	0.95	2.03	3.30
		S2	0.826	1.25	1.80
		S3	4.84	10.38	3.31
	185	S1	1.2	2.69	3.51
		S2	1.4	3.16	3.54
		S3	7.64	11.16	1.65
	13	S1	5.97	10.32	2.38
		S2	0.581	1.34	3.63
		S3	5.33	9.05	2.30
	37	S1	1.1	1.88	2.33
		S2	0.699	1.14	2.12
		S5	4.09	15.24	5.71
	180	S1	1.25	1.68	1.28
		S2	1.08	2.25	3.19
		S5	8.07	17.15	3.27
	24	S1	5.67	7.12	0.99
		S2	0.489	0.53	0.35
		S5	4.66	8.32	2.52
	48	S1	1.35	1.71	1.03
		S2	0.429	0.84	2.92
		S6	5.02	8.36	2.22
	175	S1	1.22	2.95	3.83
		S2	1.1	2.85	4.13
		S6	7.42	10.77	1.62
	22	S1	5.25	8.05	1.86
		S2	0.304	0.41	1.30
		S6	4.95	6.9	1.44

3.4.4 Simulation of PD with validated model

The model is validated in Section 3.4.3 and the PD exposure of EUT can be reliably assessed using the validated simulation approach.

In general, all six surfaces of wireless device as shown in Fig. 3-2 should be assessed for RF exposure from mmW radio, and the worst-case PD should be determined by

$$\boldsymbol{PD_{worst\text{-}case}} = \max\{PD_{s1}, PD_{s2}, PD_{s3}, PD_{s4}, PD_{s5}, PD_{s6}\} \qquad (1)$$

where $PD_{s1}, PD_{s2}, PD_{s3}, PD_{s4}, PD_{s5}, PD_{s6}$ are the highest 4cm^2-averaged PD on surface S1, S2, S3, S4, S5 and S6 of the device. respectively.

However, depending on the location of the mmW module and the antenna array orientation relative to the surface of the device, one or more surface(s) can be excluded for PD calculation as the PD value(s) on the excluded surface(s) will be undoubtedly lower when comparing to other surfaces, thus, the exclusion will have no impact for the worst-case PD determined using Equation 1.

For this EUT, based on the location of Mod 0, Mod 1 and Mod 2 shown in Figure 3-1, and type of antenna array (containing in each mmW Ant), the surface planes identified for PD evaluation to determine the worst-case PD are selected and listed in Table 3-5.

Table 3-5: PD evaluation plane

	FRONT	BACK	RIGHT	LEFT	BOTTOM	TOP
	S1	S2	S3	S4	S5	S6
MOD 0	yes	yes	yes	no	no	no
MOD 1	yes	yes	no	no	yes	no
MOD 2	yes	yes	no	no	no	yes

The EM simulation is performed to characterize PD at low, mid, and high channels for each supported band. The simulation setup (mesh, convergence criteria and radiation boundary settings) as described in Section 3.4.2, ensures the accurate and reliable result for PD simulation on the planes identified. Both point PD and 4cm^2-averaged PD distributions on all the surfaces relevant for each module are plotted for all 189 beams (single & pair) and provided in Appendix C to show that that all PD hotspots at d=10mm are captured in this analysis.

3.5 *PD_design_target*

The 2.8 dB of total uncertainty (k=2) provided by Qualcomm (please refer to document *80-W5669-4: 5G MHS Travel Router (FCC ID: PY319100441) SDX50/QTM052 Uncertainty Budget* for details) includes TxAGC (RF calibration) and IC/element level part to part variation.

To account for the total design related uncertainty, *PD_design_target* need to be:

$$PD\_design\_target < PD_{regulatory\_limit} \times 10^{\frac{-total\ uncertainty}{10}}$$

For FCC 4cm^2-averaged PD requirement of 10 W/m^2, the *PD_design_target* for Netgear 5G MHS Travel Router (FCC ID: PY319100441) is determined as

$$PD_{design_{target}} = 5.2W/\text{m}^2$$

3.6 Worst-case housing influence determination

For non-metal material, the material property cannot be accurately characterized at mmW frequencies to date. The estimated material property for the device housing used in the simulation model could influence the accuracy in simulation for PD amplitude quantification. Since the housing influence on PD could vary from surface to surface where the EM field propagates through, the most underestimated surface is used to quantify the worst-case housing influence for conservative assessment.

For this EUT, when comparing a simulated 4cm^2-averaged PD and measured 4 cm^2-averaged PD in Table 3-4, the worst error introduced when using the estimated material property in the simulation is 1.65dB for Mod 0, 0.35dB for Mod 1 & 1.03dB for Mod 2. This worst-case housing influence, denoted as $\Delta_{min} = \text{Sim. PD} - \text{Meas. PD}$, represents the worst case where RF exposure is underestimated the most in simulation for each module when using the estimated material property for glass/plastics of the housing in the vicinity of the relevant module. For conservative assessment, Δ_{min} is used as the worst-case factor and applied to all the beams of a given QTM module to determine input power limits in PD char for compliance (see Section 3.7.3 for details).

3.7 PD Char of Netgear 5G MHS Travel Router (FCC ID: PY319100441)

This section describes the PD Char generation that complies with the *PD_design_target* determined in Section 3.5 and is compliant to the regulatory power density limit.

3.7.1 Scaling factor for single beams

To determine the input power limit at each antenna port, perform simulation at low, mid and high channel for each mmW band supported, with a given input power per active port (i.e., 6 dBm):

1. Obtain $PD_{surface}$ value (the worst PD among all identified surfaces of the EUT) at all three channels for all single beams specified in the codebook of Table 3-1.
2. Derive a scaling factor at low, mid and high channel, $s(i)_{low\_or\_mid\_or\_high}$, by using:

$$s(i)_{low\_or\_mid\_or\_high} = \frac{PD\ design\ target}{sim.PD_{surface}(i)},\ i \in single\ beams \qquad (2)$$

3. Determine the worst-case scaling factor, $\boldsymbol{s(i)}$, among low, mid and high channels:

$$\boldsymbol{s(i)} = min\{s_{low}(i), s_{mid}(i), s_{high}(i)\},\ i \in single\ beams \qquad (3)$$

and apply this scaling factor to the input power at each antenna port.

3.7.2 Scaling factor for beam pairs

The relative phase between beam pair is not controlled in QTM052 design and could vary from run to run. Therefore, for beam pair, based on the simulation results, the worst-case scaling factor needs to be determined mathematically to ensure the compliance.

For a beam pair, extract the E-fields and H-fields from the corresponding single beams at low, mid and high channel for each supported band and for all identified surfaces of the EUT.

For a given beam pair containing *beam_a* and *beam_b*, and for a given channel, let

relative phase between *beam_a* and *beam_b* = ∅,

the total PD of the beam pair can be expressed as

$$total\ PD\ (\emptyset) = \frac{1}{2}\sqrt{Re\{PD_x(\emptyset)\}^2 + Re\{PD_y(\emptyset)\}^2 + Re\{PD_z(\emptyset)\}^2}$$

$$= \frac{1}{2} Re\left\{\left(\overrightarrow{E_a} + \overrightarrow{E_b e^{J\omega\emptyset}}\right) \times \left(\overrightarrow{H_a} + \overrightarrow{H_b e^{J\omega\emptyset}}\right)^*\right\} \quad (4)$$

where, $PD_x(\emptyset)$, $PD_y(\emptyset)$ and $PD_z(\emptyset)$ are the three components of the $total\ PD\ (\emptyset)$; E_a and H_a are the extracted E-fields and H-fields of *beam_a*, while E_b and H_b are the extracted E-fields and H-fields of *beam_b*.

Sweep $\emptyset$ with a 5° step from 0° to 360° to determine the worst-case $\emptyset_{worstcase}$ which results in the highest $total\ PD\ (\emptyset)$ among all identified surfaces for this beam pair at this channel. For details on worst case $total\ PD\ (\emptyset)$ derivation, see Appendix A.

Follow the above procedure to determine $\emptyset_{worstcase}$ for all three channels, and obtain the scaling factor given by the below equation for low, mid and high channels:

$$s(i)_{low\_or\_mid\_or\_high} = \frac{PD\ design\ target}{total\ PD\ (\emptyset(i)_{worstcase})}, i \in beam\ pairs \quad (5)$$

The $\emptyset_{worstcase}$ varies with channel and beam pair, the lowest scaling factor among all three channels, $s(i)$, is determined for the beam pair *i*:

$$\boldsymbol{s(i)} = min\{s_{low}(i), s_{mid}(i), s_{high}(i)\},\ i \in beam\ pairs \quad (6)$$

All the scaling factors for single and pair beams are given in Table B-1 in Appendix B. Also, the simulated 4cm^2 averaged PD values on all relevant surfaces for these beams are grouped per module and shown in Table B-2 in Appendix B for low, mid & high channels.

3.7.3 Input power limit

The PD Char specifies the limit of input power at any given antenna port that corresponds to *PD_design_target* for all the beams.

Ideally, if there is no uncertainty associated with hardware design, the input power limit, denoted as $input.power.limit(i)$, for beam *i* can be obtained after accounting for the housing influence (Δ_{min}) determined in Section 3.6, given by:

$$input.power.limit(i) = 6\ dBm + 10 * \log(s(i)) + \Delta_{min},\ i \in all\ beams \quad (7)$$

where 6 dBm is the input power used in simulation; $s(i)$ is the scaling factor obtained from Eq. (3) or Eq. (6) for beam *i*; Δ_{min} is the worst-case housing influence factor (determined in Sec.3.6) for beam *i* for a module.

If simulation overestimates the housing influence, then Δ_{min} = (simulated PD – measured PD) is negative, which means that the measured PD would be higher than the simulated PD. The input power to antenna elements determined via simulation must be decreased for compliance.

Similarly, if simulation underestimates the loss, then Δ_{min} is positive (measured PD would be lower than the simulated value). Input power to antenna elements determined via simulation can be increased and still be PD compliant.

In reality, the hardware design has uncertainty which must be properly considered. In Section 3.6, the TxAGC uncertainty is embedded in the process of Δ_{min} determination. Since TxAGC uncertainty is already accounted for in *PD_design_target* (see Section 3.5), it needs to be removed to avoid double counting this uncertainty.

Thus, Equation 7 is modified to:

If -TxAGC uncertainty < Δ_{min} < TxAGC uncertainty,

$$input.power.limit(i) = 6\ dBm + 10 * \log(s(i)),\ i \in all\ beams \qquad (8)$$

else if Δ_{min} < -TxAGC uncertainty,

$$input.power.limit(i) = 6\ dBm + 10 * \log(s(i)) + (\Delta_{min} + \text{TxAGC uncertainty}),\ i \in all\ beams \qquad (9)$$

else if Δ_{min} > TxAGC uncertainty,

$$input.power.limit(i) = 6\ dBm + 10 * \log(s(i)) + (\Delta_{min} - \text{TxAGC uncertainty}),\ i \in all\ beams \qquad (10)$$

Following above logic, the *input.power.limit* for this EUT can be calculated using Equations (8), (9) and (10), i.e.,

Table 3-6: *input.power.limit* calculation

Band	Module	Δ_{min} (dB)	*Input.power.limit* (dBm) =	Notes
n260	0	1.65	$6\ dBm + 10 * \log(s(i))$	Using Eg. 8
	1	0.35	$6\ dBm + 10 * \log(s(i))$	Using Eg. 8
	2	1.03	$6\ dBm + 10 * \log(s(i))$	Using Eg. 8

Thus, the EUT PD Char for n260 is shown in Table 3-7.

Table 3-7: PD Char of Netgear 5G MHS Travel Router (FCC ID: PY319100441)

	n260 mmW NR		
Pair with Beam_ID	Beam_ID	module#	*Input.power.limit* (dBm)
	0	1	8.6
	1	1	8.0
	2	0	7.5
	3	0	9.2
	4	2	11.1
	5	2	8.0
	6	1	4.0
	7	1	3.8
	8	1	6.4
	9	1	6.2
	10	1	4.6
	11	1	6.5
	12	0	3.8
	13	0	2.9
	14	0	4.3
	15	0	6.8
	16	0	6.6
	17	0	7.1
	18	2	7.8
	19	2	6.9
	20	2	8.1
	21	2	4.4
	22	2	3.2
	23	2	5.7
	24	1	3.7
	25	1	4.7
	26	1	4.6
	27	1	6.0
	28	0	3.1
	29	0	4.0
	30	0	6.8
	31	0	7.4
	32	2	7.0
	33	2	7.8
	34	2	3.5
	35	2	3.6
	36	1	3.7
	37	1	1.3
	38	1	1.8
	39	1	3.6
	40	1	3.8
	41	0	3.9
	42	0	4.0
	43	0	4.1
	44	0	4.2
	45	0	4.2
	46	2	4.0
	47	2	4.6

	n260 mmW NR		
Pair with Beam_ID	Beam_ID	module#	*Input.power.limit* (dBm)
	48	2	3.9
	49	2	4.1
	50	2	4.0
	51	1	1.8
	52	1	1.3
	53	1	3.2
	54	1	4.0
	55	0	4.0
	56	0	3.0
	57	0	4.2
	58	0	4.2
	59	2	4.1
	60	2	3.3
	61	2	4.6
	62	2	4.0
	128	1	10.3
	129	1	8.2
	130	0	8.4
	131	0	10.3
	132	2	9.7
	133	2	10.0
	134	1	6.3
	135	1	5.7
	136	1	7.5
	137	1	4.8
	138	1	3.7
	139	1	4.6
	140	0	4.5
	141	0	4.5
	142	0	5.4
	143	0	6.4
	144	0	5.3
	145	0	7.4
	146	2	6.9
	147	2	5.8
	148	2	8.3
	149	2	6.1
	150	2	4.5
	151	2	6.7
	152	1	5.7
	153	1	6.6
	154	1	3.7
	155	1	3.9
	156	0	4.2
	157	0	5.0
	158	0	5.7
	159	0	5.6
	160	2	5.6
	161	2	6.6

	n260 mmW NR		
Pair with Beam_ID	Beam_ID	module#	*Input.power.limit* (dBm)
	162	2	4.5
	163	2	5.9
	164	1	1.4
	165	1	1.0
	166	1	0.8
	167	1	1.0
	168	1	2.1
	169	0	3.2
	170	0	3.0
	171	0	2.3
	172	0	3.4
	173	0	4.2
	174	2	4.1
	175	2	2.8
	176	2	3.3
	177	2	4.7
	178	2	4.3
	179	1	1.0
	180	1	0.8
	181	1	3.2
	182	1	1.3
	183	0	3.1
	184	0	2.6
	185	0	2.7
	186	0	3.9
	187	2	3.3
	188	2	2.8
	189	2	4.0
	190	2	4.7
0	128		6.0
1	129		4.8
2	130		4.7
3	131		7.4
4	132		7.0
5	133		5.9
6	135		2.2
7	134		1.7
8	136		3.3
9	138		1.6
10	137		1.6
11	139		1.6
12	140		0.6
13	142		0.6
14	141		1.7
15	143		3.7
16	144		3.4
17	145		4.1
18	147		3.3
19	146		3.1

	n260 mmW NR		
Pair with Beam_ID	Beam_ID	module#	*Input.power.limit* (dBm)
20	148		4.9
21	150		2.3
22	149		0.9
23	151		2.1
24	152		1.7
25	153		2.2
26	155		1.4
27	154		2.2
28	156		0.5
29	157		0.8
30	158		3.1
31	159		3.3
32	161		3.9
33	160		3.1
34	162		1.5
35	163		1.3
36	167		-1.3
37	166		-2.2
38	165		-1.6
39	164		-1.2
40	168		-1.2
41	172		0.6
42	170		-0.2
43	169		1.0
44	173		1.5
45	171		0.0
46	177		0.2
47	178		2.2
48	174		0.4
49	175		1.0
50	176		0.6
51	181		-0.7
52	180		-2.1
53	182		0.0
54	179		-1.0
55	183		0.0
56	185		-0.4
57	186		0.5
58	184		0.2
59	189		0.2
60	190		1.3
61	187		0.6
62	188		0.9

A Worst Phase Derivation for Beam Pair

For beam pairs, beam ID M+1 ~ N – since the relative phase between two beams is unknown – finding the worst-case PD by sweeping the relative phase for all possible angles is required for conservative assessment.

Assuming E-field and H-field of *beam_a* are $\{Ex_{\_a}, Ey_{\_a}, Ez_{\_a}\}$ and $\{Hx_{\_a}, Hy_{\_a}, Hz_{\_a}\}$, respectively; E-field and H-field of *beam_b* are $\{Ex_{\_b}, Ey_{\_b}, Ez_{\_b}\}$ and $\{Hx_{\_b}, Hy_{\_b}, Hz_{\_b}\}$, respectively; and the relative phase is $\emptyset$, for beam pair consisting of *beam_a* and *beam_b*, the combined E and H, $\{Ex_{\_pair\_i}, Ey_{\_pair\_i}, Ez_{\_pair\_i}\}$ and $\{Hx_{\_pair\_i}, Hy_{\_pair\_i}, Hz_{\_pair\_i}\}$, can be expressed as:

$$Ex(\emptyset)_{\_pair\_i} = E_{x\_a} + E_{x\_b} \times e^{-j\omega\emptyset}$$

$$Ey(\emptyset)_{\_pair\_i} = E_{y\_a} + E_{y\_b} \times e^{-j\omega\emptyset}$$

$$Ez(\emptyset)_{\_pair\_i} = E_{z\_a} + E_{z\_b} \times e^{-j\omega\emptyset}$$

$$Hx(\emptyset)_{\_pair\_i} = H_{x\_a} + H_{x\_b} \times e^{-j\omega\emptyset}$$

$$Hy(\emptyset)_{\_pair\_i} = H_{y\_a} + H_{y\_b} \times e^{-j\omega\emptyset}$$

$$Hz(\emptyset)_{\_pair\_i} = H_{z\_a} + H_{z\_b} \times e^{-j\omega\emptyset}$$

The combined PD can then be calculated:

$$PDx(\emptyset)_{pair\_i} = Ey(\emptyset)_{\_pair\_i} \times Hz(\emptyset)^{*}_{pair\_i} - Ez(\emptyset)_{\_pair\_i} \times Hy(\emptyset)^{*}_{\_pair\_i}$$

$$PDy(\emptyset)_{\_pair\_i} = Ez(\emptyset)_{\_pair\_i} \times Hx(\emptyset)^{*}_{\_pair\_i} - Ex(\emptyset)_{\_pair\_i} \times Hz(\emptyset)^{*}_{\_pair\_i}$$

$$PDz(\emptyset)_{\_pair\_i} = Ex(\emptyset)_{\_pair\_i} \times Hy(\emptyset)^{*}_{\_pair\_i} - Ey(\emptyset)_{\_pair\_i} \times Hx(\emptyset)^{*}_{\_pair\_i}$$

$$PD(\emptyset) = \frac{1}{2}\sqrt{Re\{PDx(\emptyset)\}^{2}_{\_pair\_i} + Re\{PDy(\emptyset)\}^{2}_{\_pair\_i} + Re\{PDz(\emptyset)\}^{2}_{\_pair\_i}}$$

Sweep $\emptyset$ from 0 degree to 360 degree to find the highest PD (out of low, mid and high channel) and its corresponding $\emptyset$, $\emptyset_{worstcase}$, for all the beam pairs specified in the *codebook_sim*. The worst-case scaling factor *s(i)* for beam pair will be determined with $\emptyset(i)_{worstcase}$.

B Scaling Factor & Simulated 4cm^2 avg. PD

Table B-1 lists scaling factor S for all the beams that Netgear 5G MHS Travel Router (FCC ID: PY319100441) supports.

NOTE: *S* = min {*S_low, S_mid, S_high*}, where *S_low, S_mid, S_high* are the scaling factors for low, mid, and high channels, respectively.

Table B-1 Scaling factors

Pair with Beam_ID	Beam_ID	S_low	S_mid	S_high	S
	0	1.894511	1.822598	1.870311	1.822598
	1	1.640721	1.592728	1.750037	1.592728
	2	1.416639	1.453013	1.644395	1.416639
	3	3.284968	2.112418	2.873009	2.112418
	4	3.773369	3.215794	3.315777	3.215794
	5	1.595568	1.804067	1.656144	1.595568
	6	0.684817	0.661019	0.63568	0.63568
	7	0.599691	0.645578	0.62495	0.599691
	8	1.105143	1.128124	1.139341	1.105143
	9	1.090862	1.054742	1.13494	1.054742
	10	0.733241	0.731239	0.79809	0.731239
	11	1.178298	1.131803	1.211332	1.131803
	12	0.608741	0.610208	0.624972	0.608741
	13	0.486896	0.504006	0.530008	0.486896
	14	0.855451	0.670308	0.871337	0.670308
	15	1.910737	1.195424	1.450173	1.195424
	16	1.345133	1.139161	1.181868	1.139161
	17	1.338542	1.320958	1.293994	1.293994
	18	1.727509	1.539791	1.5208	1.5208
	19	1.312162	1.22253	1.247408	1.22253
	20	2.041065	1.711556	1.619155	1.619155
	21	0.695343	0.780394	0.803968	0.695343
	22	0.528916	0.646113	0.597523	0.528916
	23	0.926562	0.961994	0.948539	0.926562
	24	0.619362	0.624976	0.590332	0.590332
	25	0.742608	0.842642	0.894332	0.742608
	26	0.724201	0.721871	0.792185	0.721871
	27	1.017894	0.997561	1.035393	0.997561

Pair with Beam_ID	Beam_ID	S_low	S_mid	S_high	S
	28	0.513541	0.535109	0.54184	0.513541
	29	0.649214	0.658204	0.631442	0.631442
	30	1.313951	1.210868	1.219612	1.210868
	31	1.423092	1.439539	1.372798	1.372798
	32	1.436167	1.259252	1.263988	1.259252
	33	1.900019	1.627902	1.504911	1.504911
	34	0.565339	0.723613	0.697906	0.565339
	35	0.579956	0.643589	0.640741	0.579956
	36	0.584955	0.600534	0.620657	0.584955
	37	0.354264	0.341298	0.388711	0.341298
	38	0.383325	0.408141	0.461649	0.383325
	39	0.593539	0.578638	0.580396	0.578638
	40	0.596107	0.610785	0.627395	0.596107
	41	0.838097	0.643953	0.612279	0.612279
	42	0.701807	0.63563	0.704208	0.63563
	43	0.74478	0.651115	0.72452	0.651115
	44	0.690524	0.658476	0.683403	0.658476
	45	0.697708	0.666254	0.69467	0.666254
	46	0.779261	0.680202	0.633961	0.633961
	47	0.764693	0.732956	0.787336	0.732956
	48	0.683049	0.622314	0.660005	0.622314
	49	0.790778	0.67727	0.647238	0.647238
	50	0.810589	0.673462	0.63097	0.63097
	51	0.379276	0.415529	0.48494	0.379276
	52	0.34885	0.336652	0.374514	0.336652
	53	0.523863	0.553797	0.570808	0.523863
	54	0.628293	0.643811	0.634486	0.628293
	55	0.697371	0.656638	0.62419	0.62419
	56	0.626346	0.500845	0.577488	0.500845
	57	0.812305	0.683114	0.664384	0.664384
	58	0.71279	0.664953	0.7237	0.664953
	59	0.803622	0.678045	0.642406	0.642406
	60	0.651925	0.538844	0.591278	0.538844
	61	0.797373	0.760124	0.726704	0.726704
	62	0.774026	0.683861	0.62859	0.62859
	128	2.736861	2.885068	2.686437	2.686437
	129	1.698598	1.679451	1.80546	1.679451
	130	2.14656	1.738178	1.99222	1.738178
	131	3.321934	2.718757	2.708398	2.708398
	132	2.693717	2.323272	2.379033	2.323272
	133	2.504248	3.007206	2.759503	2.504248
	134	1.078409	1.150513	1.150531	1.078409

Pair with Beam_ID	Beam_ID	S_low	S_mid	S_high	S
	135	0.925483	0.986478	0.964464	0.925483
	136	1.406462	1.505572	1.534919	1.406462
	137	0.796274	0.756789	0.815663	0.756789
	138	0.595703	0.584718	0.651333	0.584718
	139	0.731611	0.719708	0.759701	0.719708
	140	0.752696	0.711269	0.788606	0.711269
	141	0.805389	0.712952	0.742361	0.712952
	142	0.904909	0.861593	0.903159	0.861593
	143	1.369405	1.097171	1.124166	1.097171
	144	1.027141	0.867594	0.86136	0.86136
	145	1.774461	1.38366	1.373313	1.373313
	146	1.593481	1.301362	1.241975	1.241975
	147	1.102548	0.960958	0.964743	0.960958
	148	2.137858	1.781586	1.6851	1.6851
	149	1.017078	1.12478	1.054696	1.017078
	150	0.713139	0.91566	0.930404	0.713139
	151	1.329955	1.358205	1.177966	1.177966
	152	0.938074	1.000947	0.980882	0.938074
	153	1.137856	1.211995	1.224145	1.137856
	154	0.615413	0.592076	0.637769	0.592076
	155	0.619228	0.61829	0.706628	0.61829
	156	0.744198	0.65508	0.712302	0.65508
	157	0.834715	0.791704	0.828539	0.791704
	158	1.07525	0.932786	0.94264	0.932786
	159	1.148981	0.927391	0.91279	0.91279
	160	1.117215	0.955622	0.922318	0.922318
	161	1.399716	1.191156	1.151944	1.151944
	162	0.713781	0.925625	0.931156	0.713781
	163	1.034308	1.118235	0.984997	0.984997
	164	0.344439	0.375107	0.418985	0.344439
	165	0.335132	0.316563	0.337223	0.316563
	166	0.317205	0.299355	0.332572	0.299355
	167	0.317764	0.322742	0.378984	0.317764
	168	0.403991	0.411129	0.459096	0.403991
	169	0.645968	0.526714	0.543528	0.526714
	170	0.549226	0.502862	0.520034	0.502862
	171	0.528303	0.443366	0.430134	0.430134
	172	0.619584	0.552198	0.579553	0.552198
	173	0.912221	0.689063	0.655669	0.655669
	174	0.751321	0.658908	0.646215	0.646215
	175	0.55754	0.482617	0.49397	0.482617
	176	0.597444	0.540843	0.565067	0.540843

Pair with Beam_ID	Beam_ID	S_low	S_mid	S_high	S
	177	0.97726	0.787972	0.738794	0.738794
	178	0.853945	0.738508	0.678026	0.678026
	179	0.319817	0.336917	0.39955	0.319817
	180	0.326983	0.303276	0.324768	0.303276
	181	0.543028	0.525813	0.56675	0.525813
	182	0.336318	0.347211	0.410254	0.336318
	183	0.579488	0.513302	0.544739	0.513302
	184	0.539948	0.464425	0.461595	0.461595
	185	0.535608	0.465942	0.466089	0.465942
	186	0.813175	0.649954	0.621378	0.621378
	187	0.600862	0.542526	0.568188	0.542526
	188	0.562037	0.483509	0.498099	0.483509
	189	0.737877	0.636755	0.638236	0.636755
	190	1.001351	0.818816	0.735922	0.735922
0	128	1.061897	1.077693	0.996782	0.996782
1	129	0.819201	0.759725	0.768151	0.759725
2	130	0.74267	0.766321	0.844714	0.74267
3	131	1.924897	1.385748	1.641728	1.385748
4	132	1.544315	1.251483	1.246497	1.246497
5	133	0.988332	1.025884	1.021737	0.988332
6	135	0.427034	0.418302	0.412982	0.412982
7	134	0.370262	0.405042	0.418009	0.370262
8	136	0.533758	0.543469	0.552473	0.533758
9	138	0.379705	0.364514	0.388854	0.364514
10	137	0.381159	0.366963	0.402973	0.366963
11	139	0.406305	0.366657	0.37208	0.366657
12	140	0.28961	0.333407	0.333569	0.28961
13	142	0.291596	0.295248	0.331541	0.291596
14	141	0.424538	0.373457	0.397186	0.373457
15	143	0.803031	0.587515	0.656154	0.587515
16	144	0.694852	0.582275	0.555633	0.555633
17	145	0.746312	0.673522	0.650357	0.650357
18	147	0.701557	0.582352	0.541592	0.541592
19	146	0.682273	0.538449	0.511741	0.511741
20	148	1.000122	0.824577	0.771682	0.771682
21	150	0.430501	0.549761	0.523354	0.430501
22	149	0.310799	0.376263	0.351998	0.310799
23	151	0.442292	0.452219	0.407742	0.407742
24	152	0.372889	0.375158	0.373894	0.372889
25	153	0.417586	0.463967	0.506573	0.417586
26	155	0.364605	0.345681	0.365077	0.345681
27	154	0.427457	0.413698	0.436421	0.413698

Pair with Beam_ID	Beam_ID	S_low	S_mid	S_high	S
28	156	0.309144	0.284184	0.305682	0.284184
29	157	0.302086	0.322519	0.302188	0.302086
30	158	0.601094	0.508459	0.507402	0.507402
31	159	0.665457	0.573081	0.540297	0.540297
32	161	0.767953	0.652117	0.621821	0.621821
33	160	0.714186	0.556051	0.509159	0.509159
34	162	0.356714	0.458394	0.43598	0.356714
35	163	0.335348	0.369316	0.362838	0.335348
36	167	0.190159	0.184591	0.196147	0.184591
37	166	0.163447	0.149945	0.160977	0.149945
38	165	0.174494	0.174278	0.180887	0.174278
39	164	0.19708	0.189618	0.195239	0.189618
40	168	0.197488	0.188665	0.191769	0.188665
41	172	0.346214	0.287287	0.293307	0.287287
42	170	0.283963	0.238822	0.240415	0.238822
43	169	0.397858	0.319529	0.330884	0.319529
44	173	0.407037	0.366403	0.356944	0.356944
45	171	0.304139	0.269339	0.25176	0.25176
46	177	0.368636	0.29528	0.260291	0.260291
47	178	0.506689	0.435307	0.414733	0.414733
48	174	0.34483	0.285102	0.276596	0.276596
49	175	0.384013	0.334186	0.313734	0.313734
50	176	0.342058	0.290502	0.286138	0.286138
51	181	0.217884	0.211937	0.225071	0.211937
52	180	0.165717	0.155863	0.171489	0.155863
53	182	0.252395	0.252933	0.27613	0.252395
54	179	0.218895	0.200994	0.215761	0.200994
55	183	0.301734	0.2522	0.253272	0.2522
56	185	0.282927	0.237751	0.230645	0.230645
57	186	0.364146	0.309033	0.284474	0.284474
58	184	0.299661	0.263422	0.264554	0.263422
59	189	0.345152	0.284653	0.264939	0.264939
60	190	0.43787	0.342634	0.34135	0.34135
61	187	0.322064	0.287719	0.290641	0.287719
62	188	0.39583	0.334807	0.306045	0.306045

Table B-2 lists the simulated averaged 4cm^2 PD with 6dBm input power for all the beams that Netgear 5G MHS Travel Router (FCC ID: PY319100441) supports.

Table B-2 Simulated 4cm^2 Avg PD in W/m^2 on surfaces S1, S2, S3, S5 & S6

MODULE 0 (Low Freq.)				
Pair with Beam_ID	Beam_ID	S1	S2	S3
	2	3.602215	0.537756	3.67066
	3	0.484719	0.318074	1.582968
	12	8.542226	0.756238	8.519487
	13	10.67991	1.014123	10.1226
	14	5.684658	1.349715	6.078666
	15	1.017216	0.945898	2.721463
	16	0.86432	0.699388	3.865789
	17	0.727164	0.75306	3.884823
	28	10.12578	0.913887	9.572961
	29	7.940401	1.524276	8.009688
	30	0.691376	0.496709	3.957529
	31	0.75925	0.920888	3.654016
	41	3.08983	3.039235	6.204536
	42	2.01274	1.342689	7.409443
	43	2.659985	1.510962	6.98193
	44	2.173091	2.150327	7.530512
	45	1.914757	1.786554	7.45297
	55	2.595488	2.55171	7.456574
	56	1.359136	0.81151	8.302122
	57	3.334964	3.147311	6.401538
	58	2.06405	1.632656	7.295273
	130	2.422481	0.300104	2.113221
	131	0.347497	0.511425	1.565353
	140	6.908502	0.645825	5.421148
	141	6.456504	0.57672	5.3526
	142	5.746433	0.647403	3.901728
	143	0.883349	1.731444	3.797271
	144	1.120999	1.582426	5.062596
	145	0.752917	1.410944	2.930468
	156	6.987384	0.569528	5.625222
	157	6.229671	0.587581	4.374719
	158	1.119103	1.665023	4.836086
	159	0.815317	1.457423	4.52575
	169	1.714565	3.8288	8.049935
	170	2.300839	2.956485	9.467864

Pair with Beam_ID	Beam_ID	S1	S2	S3
	171	2.321955	2.61537	9.84284
	172	1.515781	2.674513	8.392728
	173	1.521688	2.783393	5.700374
	183	1.802587	3.38212	8.973446
	184	2.070247	2.741937	9.630551
	185	2.383022	2.416916	9.708592
	186	1.155117	2.962416	6.394691
2	130	7.001763	0.929734	6.755671
3	131	0.981587	0.976698	2.701444
12	140	17.95521	2.022793	15.25222
13	142	17.8329	2.067996	15.95672
14	141	12.24861	2.2417	11.74253
15	143	2.215722	3.47807	6.475463
16	144	2.379112	2.41101	7.483613
17	145	1.636515	1.862504	6.967598
28	156	16.82067	1.731671	15.3203
29	157	17.21365	2.888656	15.55644
30	158	2.171741	2.677114	8.650892
31	159	1.689191	2.24315	7.814176
41	172	4.908215	5.070437	15.01963
42	170	5.552261	6.2708	18.31226
43	169	3.958649	5.63515	13.06998
44	173	4.796994	6.152931	12.77526
45	171	4.557439	5.635989	17.09747
55	183	4.751991	8.47135	17.23374
56	185	3.929939	3.5113	18.37928
57	186	5.968455	7.585958	14.27998
58	184	5.393021	6.612602	17.35296
MODULE 1 (Low Freq.)				
		S1	**S2**	**S5**
	0	2.740463	0.28953	2.744771
	1	0.40547	0.242999	3.169339
	6	7.593273	0.463329	7.441487
	7	8.671126	0.734676	7.888146
	8	4.705275	0.919983	4.037455
	9	0.628377	0.436272	4.766873
	10	0.930203	0.730958	7.091804
	11	0.636951	0.464939	4.413146
	24	8.39574	0.472903	8.078951
	25	7.002351	1.037803	5.546838
	26	0.908737	0.590009	7.180323
	27	0.749488	0.669139	5.108585

Pair with Beam_ID	Beam_ID	S1	S2	S5
	36	1.864092	1.465257	8.889574
	37	1.845004	1.154719	14.67833
	38	1.929428	1.162533	13.5655
	39	2.067107	1.821751	8.761008
	40	1.891178	1.426145	8.72326
	51	1.783814	1.480327	13.71034
	52	1.922695	1.097735	14.90613
	53	1.54047	1.682072	9.926253
	54	1.978197	1.585056	8.276394
	128	1.899987	0.120375	1.728668
	129	0.285128	0.280321	3.061348
	134	4.821919	0.2862	4.285447
	135	5.61869	0.185717	5.048256
	136	3.69722	0.490182	2.56828
	137	0.682543	0.891879	6.530412
	138	0.96735	1.26533	8.729185
	139	0.830541	0.894033	7.107601
	152	5.543274	0.186328	4.975556
	153	4.57	0.491593	3.569094
	154	0.895211	1.185293	8.449608
	155	0.993234	1.254626	8.397558
	164	2.190735	2.024553	15.09701
	165	1.654265	2.265049	15.51628
	166	1.79696	2.458663	16.3932
	167	2.255758	2.64675	16.36432
	168	2.353399	1.902182	12.87159
	179	2.177775	2.327889	16.25929
	180	1.575628	2.209968	15.90296
	181	1.265032	1.660682	9.575939
	182	2.37966	2.466825	15.46157
0	128	4.896898	0.546753	4.60423
1	129	0.96342	0.63625	6.347646
6	135	12.177	0.821621	11.40864
7	134	14.0441	1.542131	13.03637
8	136	9.742245	1.730382	8.179139
9	138	1.873656	2.162283	13.69485
10	137	1.833947	2.121254	13.6426
11	139	1.676447	1.81748	12.79826
24	152	13.94516	0.857004	13.28263
25	153	12.45254	1.67892	9.991438
26	155	2.187869	2.081551	14.26201
27	154	1.54845	1.837624	12.16495

Pair with Beam_ID	Beam_ID	S1	S2	S5
36	167	5.516602	5.654124	27.34551
37	166	3.958474	4.305869	31.81465
38	165	4.809401	4.331541	29.80048
39	164	6.341236	5.940871	26.38524
40	168	6.961962	5.063899	26.33068
51	181	4.127363	4.572214	23.86587
52	180	4.195087	3.771785	31.37888
53	182	3.579135	3.593441	20.6026
54	179	4.474097	4.315427	23.75566
MODULE 2 (Low Freq.)				
		S1	**S2**	**S6**
	4	0.244733	0.153466	1.378079
	5	3.259027	0.23767	2.417212
	18	0.743716	0.433507	3.010115
	19	0.784801	0.476894	3.962926
	20	0.814355	0.522208	2.54769
	21	7.478325	0.480744	5.977223
	22	9.831438	0.450348	7.80372
	23	5.612143	0.809003	4.237217
	32	0.723626	0.498793	3.620749
	33	0.717273	0.515176	2.736815
	34	9.198026	0.410622	6.718163
	35	8.966204	0.81752	7.236444
	46	2.080159	1.476408	6.672985
	47	1.51801	0.921865	6.800116
	48	1.6342	0.721105	7.612919
	49	2.050215	1.502165	6.575799
	50	1.702312	1.104535	6.415089
	59	1.802011	1.256477	6.470707
	60	1.53609	0.726264	7.976377
	61	1.594459	1.467568	6.521415
	62	2.0688	1.5608	6.718118
	132	0.376715	0.413105	1.930418
	133	2.076472	0.12174	1.285062
	146	0.684165	0.978667	3.263295
	147	1.00592	1.350173	4.716348
	148	0.452935	0.723952	2.432341
	149	5.112684	0.486092	3.811004
	150	7.291708	0.198182	4.279756
	151	3.909908	0.380392	2.587221
	160	0.9975	1.278568	4.654431
	161	0.794493	1.027763	3.71504

Pair with Beam_ID	Beam_ID	S1	S2	S6
	162	7.285144	0.263783	4.624944
	163	5.027518	0.245425	3.171239
	174	1.548359	2.351571	6.921141
	175	2.121449	2.33611	9.326688
	176	1.827201	2.675465	8.703751
	177	1.3258	1.977439	5.321
	178	1.100511	2.16791	6.089383
	187	1.880776	2.450413	8.654233
	188	1.981032	2.523834	9.252067
	189	1.532756	2.461015	7.047243
	190	0.767546	1.823105	5.192984
4	132	0.835404	0.739522	3.367188
5	133	5.261389	0.440494	3.770221
18	147	1.628231	2.378175	7.412086
19	146	1.93126	2.364865	7.62158
20	148	1.39331	1.467854	5.199366
21	150	12.07896	0.698066	8.079758
22	149	16.73106	0.938381	12.1495
23	151	11.75694	1.35907	8.550974
32	161	1.650259	1.981749	6.771248
33	160	1.34508	1.862619	7.281015
34	162	14.5775	0.916765	10.19967
35	163	15.50626	1.368646	11.64834
46	177	5.138647	5.108941	14.10607
47	178	2.40559	2.498234	10.2627
48	174	3.690835	3.550811	15.0799
49	175	3.250643	2.696145	13.54119
50	176	3.596543	5.985835	15.2021
59	189	4.190914	5.984985	15.06582
60	190	2.649614	3.041129	11.87568
61	187	4.56149	5.670926	16.14586
62	188	2.95923	3.728218	13.13695
MODULE 0 (Mid Freq.)				
		S1	**S2**	**S3**
	2	3.222844	0.531592	3.57877
	3	0.599093	0.405577	2.461634
	12	8.144011	1.149935	8.521683
	13	10.31734	1.34304	9.048869
	14	6.332947	1.120421	7.757633
	15	1.519959	1.275584	4.349921
	16	1.375067	0.761516	4.564764
	17	1.386768	0.9568	3.936536

Pair with Beam_ID	Beam_ID	S1	S2	S3
	28	9.717642	1.16936	8.691084
	29	7.900286	1.339439	7.429511
	30	0.828554	0.619491	4.294441
	31	1.713291	1.140625	3.612268
	41	3.440978	2.541323	8.075128
	42	1.51677	1.196616	8.180862
	43	3.355016	2.345233	7.9863
	44	2.141405	3.630924	7.897026
	45	1.553529	1.705282	7.804827
	55	2.532918	3.571202	7.919127
	56	2.034493	1.250013	10.38246
	57	3.143881	3.050128	7.612202
	58	1.453057	1.267788	7.820099
	130	2.991639	0.370666	2.499208
	131	0.531848	0.514976	1.912639
	140	7.310881	0.740589	5.175854
	141	7.293616	0.613424	6.172123
	142	6.03533	0.667851	5.393116
	143	1.017177	1.47279	4.73946
	144	1.186315	1.886818	5.993586
	145	0.980819	1.902643	3.75815
	156	7.937962	0.719904	6.229094
	157	6.56811	0.585712	5.733557
	158	1.265891	1.701583	5.574697
	159	1.124922	1.768266	5.607128
	169	1.601177	3.310017	9.872531
	170	2.753162	3.642605	10.34082
	171	2.695381	3.19298	11.72847
	172	2.706164	3.074419	9.416907
	173	2.086453	3.384642	7.546484
	183	2.111384	3.511284	10.13048
	184	2.801433	3.441982	11.19664
	185	2.69348	3.1611	11.16019
	186	2.596663	3.431475	8.000562
2	130	6.785668	0.905584	5.900709
3	131	1.262879	0.961282	3.752485
12	140	15.59653	2.278414	13.84808
13	142	17.6123	2.068907	14.69773
14	141	13.92396	2.15559	12.20804
15	143	2.486196	3.228193	8.850838
16	144	2.462805	3.145442	8.93049
17	145	2.368298	2.633685	7.72061

Pair with Beam_ID	Beam_ID	S1	S2	S3
28	156	18.298	2.193249	14.31888
29	157	16.12307	2.31633	13.67015
30	158	2.247494	2.582821	10.22699
31	159	2.903353	2.772327	9.073769
41	172	6.349435	6.109826	18.10037
42	170	4.97392	6.82849	21.77358
43	169	5.144175	6.269091	16.27397
44	173	4.077924	7.241687	14.19203
45	171	5.116314	6.618606	19.30649
55	183	5.603386	8.765403	20.61852
56	185	5.711423	4.883204	21.87165
57	186	6.173934	7.676675	16.8267
58	184	5.199584	7.544655	19.74015
MODULE 1 (Mid Freq.)				
		S1	**S2**	**S5**
	0	2.561592	0.277067	2.85307
	1	0.408808	0.255672	3.264838
	6	6.910895	0.640574	7.866647
	7	7.366366	0.664954	8.054797
	8	4.555262	0.610061	4.609423
	9	0.650306	0.475142	4.930116
	10	0.947132	0.671102	7.111218
	11	0.72219	0.536713	4.59444
	24	7.12127	0.527988	8.320326
	25	6.171064	0.724798	5.861457
	26	0.8846	0.553598	7.203505
	27	1.006909	0.784859	5.212716
	36	1.875017	1.756291	8.658957
	37	1.884553	1.137141	15.23595
	38	1.778657	0.946908	12.74071
	39	2.375863	1.784637	8.986617
	40	1.93418	1.674127	8.513628
	51	1.607009	1.100843	12.51416
	52	1.957747	0.979813	15.44621
	53	2.05288	1.396762	9.389729
	54	2.137992	1.811626	8.076907
	128	1.640987	0.13706	1.802384
	129	0.338443	0.307289	3.096249
	134	4.157561	0.365933	4.519723
	135	4.726966	0.247634	5.271277
	136	3.453836	0.389751	3.050326
	137	0.912856	0.845446	6.871135

Pair with Beam_ID	Beam_ID	S1	S2	S5
	138	1.151612	1.293042	8.893171
	139	0.918869	0.875996	7.22515
	152	4.632773	0.248857	5.19508
	153	4.290447	0.426352	3.933512
	154	1.02079	1.181368	8.782655
	155	1.215826	1.214566	8.410293
	164	2.570876	1.664034	13.86271
	165	1.941996	2.383319	16.42641
	166	2.040838	2.392796	17.37071
	167	2.681313	2.365281	16.11196
	168	2.449087	1.456714	12.64811
	179	2.912567	1.928762	15.43407
	180	1.67962	2.248862	17.14608
	181	1.616775	1.668945	9.889456
	182	2.729206	1.941384	14.97649
0	128	4.576295	0.581708	4.825121
1	129	1.162235	0.687416	6.844586
6	135	10.40716	1.084459	12.43121
7	134	12.09106	1.599742	12.83817
8	136	9.345324	1.442696	9.568157
9	138	1.98323	2.150952	14.26559
10	137	2.28514	1.933392	14.17035
11	139	1.646587	1.921111	14.18219
24	152	12.09664	1.121464	13.86083
25	153	11.20769	1.176699	10.60629
26	155	2.346548	1.993939	15.04279
27	154	2.17733	1.821388	12.56955
36	167	5.999828	4.993546	28.1704
37	166	4.256088	3.985204	34.67938
38	165	5.010231	4.692483	29.83734
39	164	7.601187	5.367757	27.4235
40	168	7.158485	4.886005	27.56204
51	181	4.258029	3.740218	24.53563
52	180	4.661304	3.942414	33.36272
53	182	4.83548	3.526936	20.55881
54	179	6.186903	4.101437	25.87136
MODULE 2 (Mid Freq.)				
		S1	**S2**	**S6**
	4	0.279891	0.194668	1.617019
	5	2.882376	0.234948	2.284666
	18	0.985202	0.531227	3.377082
	19	0.879005	0.641863	4.253474

Pair with Beam_ID	Beam_ID	S1	S2	S6
	20	0.923614	0.714316	3.038172
	21	6.663297	0.416415	5.993066
	22	8.048127	0.405221	6.898925
	23	5.405437	0.632036	4.704482
	32	1.0344	0.530542	4.129435
	33	0.842407	0.564134	3.194295
	34	7.186163	0.423553	6.06618
	35	8.079696	0.665151	6.676906
	46	2.547021	1.690844	7.644783
	47	1.265315	1.024831	7.094555
	48	1.711103	0.841706	8.35591
	49	2.36741	1.666237	7.677884
	50	2.118547	1.568956	7.721298
	59	2.230839	1.700283	7.669102
	60	1.720346	0.92491	9.650289
	61	1.454601	1.237677	6.840991
	62	2.493077	1.880084	7.603882
	132	0.488116	0.471716	2.238223
	133	1.72918	0.103186	1.175231
	146	0.751291	1.123739	3.995814
	147	1.555151	1.364315	5.411268
	148	0.584011	0.870813	2.918747
	149	4.623128	0.47576	3.530507
	150	5.678964	0.162628	3.834572
	151	3.828582	0.332796	2.776787
	160	1.275348	1.410426	5.441483
	161	0.886954	1.417101	4.365507
	162	5.617825	0.229485	4.125283
	163	4.650187	0.206726	3.150051
	174	1.889646	2.234966	7.891846
	175	2.94675	2.848424	10.7746
	176	2.374496	2.821513	9.614624
	177	1.759035	2.487847	6.599221
	178	1.703714	2.39352	7.041227
	187	2.43919	2.628103	9.584793
	188	2.798832	2.789846	10.75472
	189	1.688509	2.636123	8.166409
	190	1.26065	1.94158	6.350633
4	132	0.926172	0.896716	4.15507
5	133	5.068797	0.412712	3.745564
18	147	2.777968	2.393773	8.929311
19	146	2.336262	3.122013	9.657362

Pair with Beam_ID	Beam_ID	S1	S2	S6
20	148	1.720751	2.055972	6.306266
21	150	9.458662	0.801734	7.54301
22	149	13.82013	0.997486	10.58849
23	151	11.49886	1.065249	9.445334
32	161	2.106278	2.213171	7.974034
33	160	1.723679	2.020287	9.35166
34	162	11.34396	1.046947	9.053314
35	163	14.08009	1.104839	10.91068
46	177	7.096555	6.933862	17.61042
47	178	2.532415	3.298163	11.94558
48	174	4.688827	4.059192	18.23909
49	175	4.112032	3.677007	15.56018
50	176	5.070241	6.589921	17.90006
59	189	5.833946	6.756124	18.26786
60	190	3.363562	3.813595	15.17657
61	187	5.086918	6.061079	18.07317
62	188	4.314964	4.49715	15.53133
MODULE 0 (High Freq.)				
		S1	**S2**	**S3**
	2	3.162258	0.296422	3.027352
	3	0.225431	0.208435	1.809949
	12	8.320372	0.829247	7.545071
	13	9.81118	0.714869	8.6042
	14	5.967841	0.597677	5.779316
	15	1.059033	0.515051	3.585779
	16	1.223125	0.835502	4.399813
	17	0.887253	0.791029	4.018567
	28	9.596928	0.745363	8.365466
	29	8.235114	0.693436	7.334581
	30	0.591854	0.582088	4.263651
	31	1.036737	0.956256	3.787883
	41	2.671357	1.781114	8.492854
	42	0.983809	1.213629	7.384187
	43	0.995787	1.135372	7.177163
	44	2.042825	2.260262	7.608977
	45	1.297895	1.553337	7.485566
	55	2.065466	2.040254	8.330792
	56	2.009037	0.817181	9.004517
	57	2.21923	2.07527	7.826802
	58	1.063293	1.150083	7.185294
	130	2.610153	0.19096	2.1063
	131	0.487629	0.447117	1.919954

Pair with Beam_ID	Beam_ID	S1	S2	S3
	140	6.593911	0.470527	5.385972
	141	7.004679	0.466544	5.288941
	142	5.757569	0.308215	4.591544
	143	0.908144	1.406757	4.625651
	144	1.11611	1.249636	6.036965
	145	0.645294	1.268864	3.786465
	156	7.300279	0.487478	5.807813
	157	6.276104	0.306232	4.811396
	158	1.193461	1.000227	5.516424
	159	0.858707	1.50057	5.696818
	169	2.199047	2.562611	9.567116
	170	2.013683	2.788956	9.99935
	171	2.732494	2.841207	12.08924
	172	2.032174	2.846554	8.972432
	173	1.797303	2.701982	7.930825
	183	1.938671	2.565621	9.54586
	184	2.452841	2.829283	11.2653
	185	2.524299	2.928057	11.15666
	186	2.00224	2.729026	8.3685
2	130	6.155926	0.520548	5.847416
3	131	0.790608	0.736557	3.167394
12	140	15.58898	1.729741	14.18119
13	142	15.68434	1.249518	13.14902
14	141	13.0921	1.0816	10.39847
15	143	2.219765	2.306027	7.92497
16	144	1.743499	1.86732	9.358693
17	145	1.561021	2.720217	7.995608
28	156	17.01115	1.341336	13.89175
29	157	17.20784	1.267112	14.57136
30	158	2.198336	2.125252	10.24829
31	159	1.50245	2.176205	9.624336
41	172	5.061907	5.823042	17.72887
42	170	3.95116	6.041679	21.62923
43	169	2.965546	4.103935	15.71548
44	173	5.33283	7.077836	14.5681
45	171	4.827195	6.36547	20.65456
55	183	6.557474	6.944013	20.53128
56	185	5.093039	4.479933	22.54546
57	186	6.880832	8.047499	18.27932
58	184	4.799285	6.961211	19.65572

MODULE 1 (High Freq.)				
Pair with Beam_ID	Beam_ID	S1	S2	S5
	0	2.162941	0.260071	2.780286
	1	0.447133	0.22189	2.971365
	6	6.148381	0.941624	8.180222
	7	6.266262	0.597682	8.320671
	8	4.338602	0.68085	4.564041
	9	0.663729	0.522046	4.581741
	10	1.087745	0.623256	6.515556
	11	0.678792	0.58864	4.292795
	24	6.065461	0.586386	8.808606
	25	5.689595	0.522696	5.814396
	26	0.858439	0.466066	6.564121
	27	1.081823	0.822735	5.022249
	36	1.671324	1.568318	8.378219
	37	1.809465	0.735694	13.37753
	38	1.506684	1.021411	11.26398
	39	2.325195	1.545632	8.959404
	40	1.722789	1.457293	8.288234
	51	1.380478	0.726367	10.72298
	52	1.914176	0.897547	13.88468
	53	2.066684	1.305171	9.109886
	54	1.927484	1.52549	8.195609
	128	1.407942	0.183691	1.935649
	129	0.307167	0.293283	2.880153
	134	3.879261	0.376967	4.519654
	135	3.908579	0.369557	5.391597
	136	3.3878	0.285148	3.367352
	137	0.772447	0.834244	6.375185
	138	1.112498	1.057605	7.983626
	139	0.754764	0.787214	6.844799
	152	3.875486	0.375456	5.301351
	153	3.947971	0.327788	4.247863
	154	0.843265	1.048616	8.153428
	155	1.172476	0.946985	7.358889
	164	1.631499	1.536615	12.41094
	165	2.100403	2.110878	15.42005
	166	2.062203	2.121304	15.63572
	167	2.251972	1.505683	13.72089
	168	1.702923	1.437782	11.3266
	179	2.167926	1.543085	13.01463
	180	1.77175	2.146603	16.01145
	181	1.683528	1.271769	9.175124

Pair with Beam_ID	Beam_ID	S1	S2	S5
	182	1.9921	1.362909	12.67507
0	128	4.011142	0.623571	5.216787
1	129	1.096094	0.702356	6.769501
6	135	9.086285	1.597881	12.59136
7	134	9.779266	1.532619	12.43991
8	136	9.412228	1.36734	9.384222
9	138	2.053473	1.724095	13.37264
10	137	2.192464	1.923292	12.90408
11	139	1.611084	1.836838	13.97548
24	152	10.00701	1.387603	13.90769
25	153	10.10668	1.007161	10.26506
26	155	2.192577	1.6318	14.24358
27	154	2.119953	1.579757	11.9151
36	167	5.463475	3.479456	26.51072
37	166	4.552715	3.048797	32.30283
38	165	4.469948	4.483839	28.7472
39	164	5.64933	5.035491	26.63403
40	168	5.466151	4.593258	27.11598
51	181	4.480101	2.51162	23.1038
52	180	4.613425	4.132023	30.32269
53	182	4.016181	3.125349	18.83173
54	179	4.548972	3.666925	24.10076
MODULE 2 (High Freq)				
		S1	**S2**	**S6**
	4	0.254456	0.189871	1.56826
	5	3.139823	0.230782	2.125857
	18	1.091872	0.562649	3.419252
	19	0.822385	0.806205	4.168645
	20	1.038865	0.763257	3.211551
	21	6.467919	0.488623	5.267406
	22	8.702588	0.398637	6.787061
	23	5.482118	0.494138	4.340599
	32	1.146989	0.573301	4.113963
	33	0.939382	0.541855	3.455353
	34	7.450862	0.516473	6.183754
	35	8.115603	0.550357	6.347632
	46	2.603587	1.671715	8.202395
	47	1.155895	1.045324	6.604552
	48	1.825927	0.91731	7.878725
	49	2.473693	1.612368	8.034143
	50	2.220166	1.659711	8.241281
	59	2.268075	1.796267	8.094566

Pair with Beam_ID	Beam_ID	S1	S2	S6
	60	2.231095	0.90858	8.794505
	61	1.458737	1.146216	7.155594
	62	2.50104	1.884061	8.272485
	132	0.574959	0.52041	2.185762
	133	1.884397	0.138852	1.263706
	146	0.79431	1.175607	4.18688
	147	1.606851	1.221641	5.390034
	148	0.752806	0.987673	3.08587
	149	4.930329	0.374706	3.517025
	150	5.588971	0.292346	3.848569
	151	4.414387	0.223957	2.74116
	160	1.315298	1.348906	5.637966
	161	0.987017	1.553076	4.514109
	162	5.584458	0.29474	4.085863
	163	5.279205	0.217053	3.269838
	174	2.113397	2.0743	8.046862
	175	3.046384	2.974814	10.52695
	176	2.468564	2.71367	9.202447
	177	2.191505	2.03887	7.038499
	178	2.153026	2.164725	7.669323
	187	2.449114	2.606497	9.151895
	188	3.197355	2.978299	10.43969
	189	1.924916	2.477803	8.147462
	190	1.721259	2.002552	7.065969
4	132	1.077023	1.075979	4.171691
5	133	5.089373	0.430628	3.822418
18	147	3.337615	2.094367	9.601327
19	146	2.386063	3.580548	10.1614
20	148	2.239277	2.427613	6.738529
21	150	9.935917	0.966852	7.162574
22	149	14.77281	0.870652	10.58726
23	151	12.75316	0.876339	9.183321
32	161	2.256744	2.382978	8.362539
33	160	1.915862	2.262208	10.21292
34	162	11.92716	1.127469	9.309505
35	163	14.33146	0.917767	10.92709
46	177	8.319878	6.379804	19.97764
47	178	3.405702	3.356553	12.53819
48	174	5.658437	4.332919	18.79997
49	175	4.684131	4.137537	16.57456
50	176	6.626856	6.486769	18.17305
59	189	7.028011	6.164646	19.62715

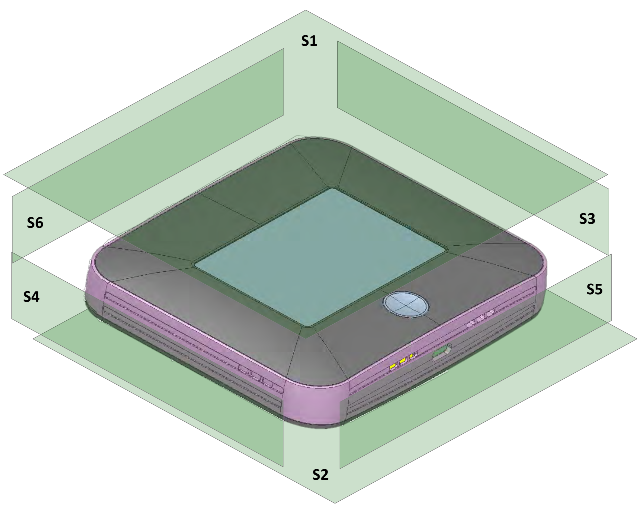
Pair with Beam_ID	Beam_ID	S1	S2	S6
60	190	4.56431	4.271222	15.23365
61	187	5.508792	6.298144	17.8915
62	188	5.30665	4.671001	16.99096

C Simulated PD Distribution Plots

The PD distributions for all 189 beams on all the three surfaces are provided in this Appendix:

- For Module 0, PD is displayed on S1(front), S2 (back) & S3 (right)
- For Module 1, PD is displayed on S1(front), S2 (back) and S5 (bottom)
- For Module 2, PD is displayed on S1(front), S2 (back) and S6 (top)

As shown in Fig.C-1, the PD simulations in this Appendix for the front side (S1) & back side (S2) should be both viewed from the front of the device and looking through the device (i.e., along negative z direction). The PD distributions for the right (S3) side should be viewed from the right side of the device and looking through the device (i.e., along positive x direction). The PD distributions for the bottom (S5) side should be viewed from the bottom side of the device and looking through the device (i.e., along negative y direction). Similarly, the PD distributions for the top (S6) side should be viewed from the top side of the device and looking through the device (i.e., along positive y direction). The views with device outlines (white) are shown in more detail in Fig. C-2, Fig C-3 & C-4 for different antenna modules or phasors.



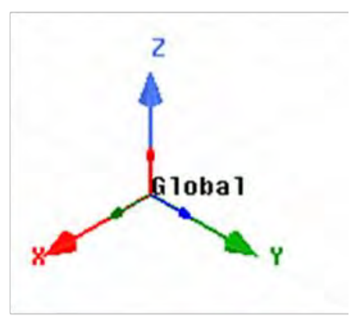


Figure C-1: EUT surface definition

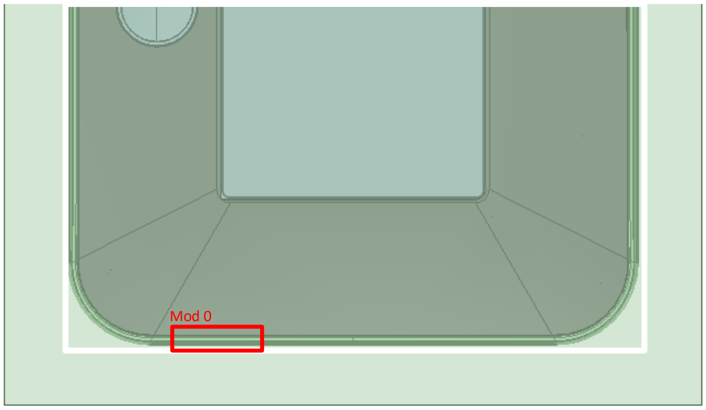
All PD distribution plots (Pages 65-631) are normalized to their own maximum value and plotted for only mid channel as the PD distribution for low, mid and high channels are similar.

The plots are arranged as:

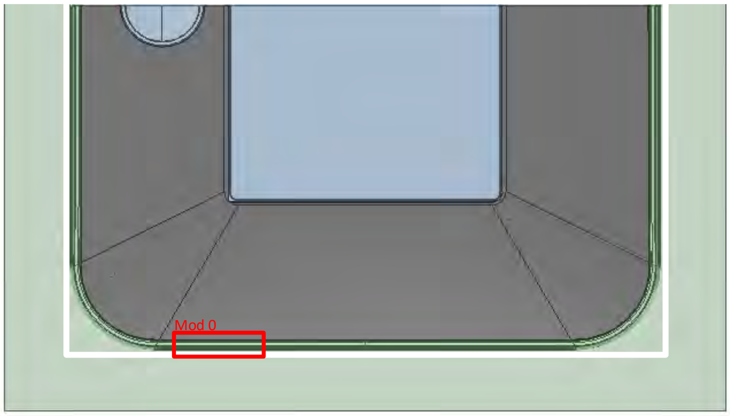
Mod 0 (Phasor 0): Point & 4cm^2 Avg. PD (Single Beam) → *Point & 4cm^2 Avg. PD (Dual Beam)*

Mod 1 (Phasor 1): Point & 4cm^2 Avg. PD (Single Beam) → *Point & 4cm^2 Avg. PD (Dual Beam)*

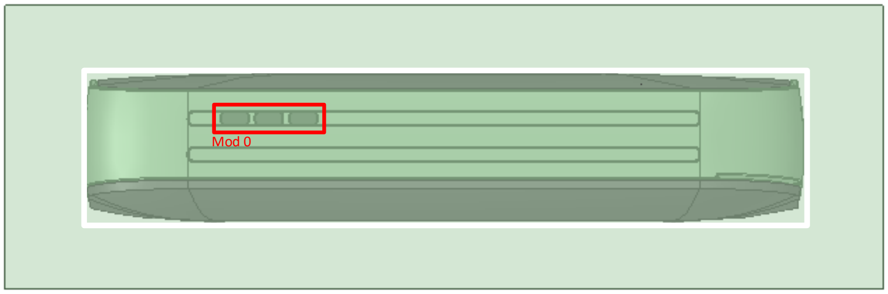
Mod 2 (Phasor 2): Point & 4cm^{2}Avg. PD (Single Beam) → *Point & 4cm^2 Avg. PD (Dual Beam)*



S1

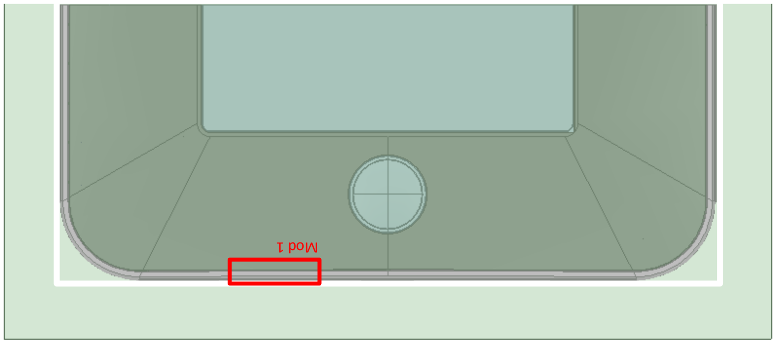


S2

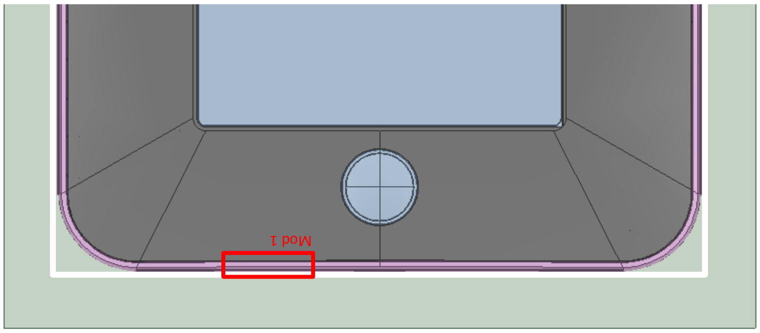


S3

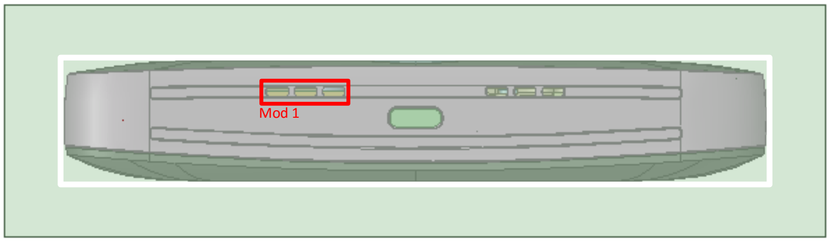
Figure C-2: Phasor 0 views for S1 (Front), S2 (Back) & S3 (Right)



S1

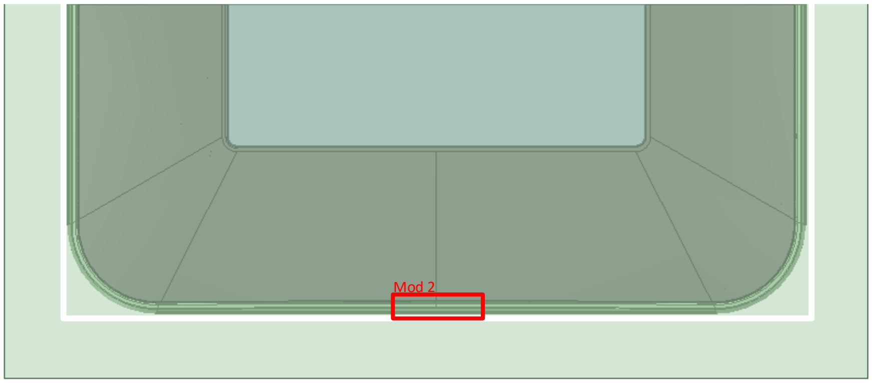


S2

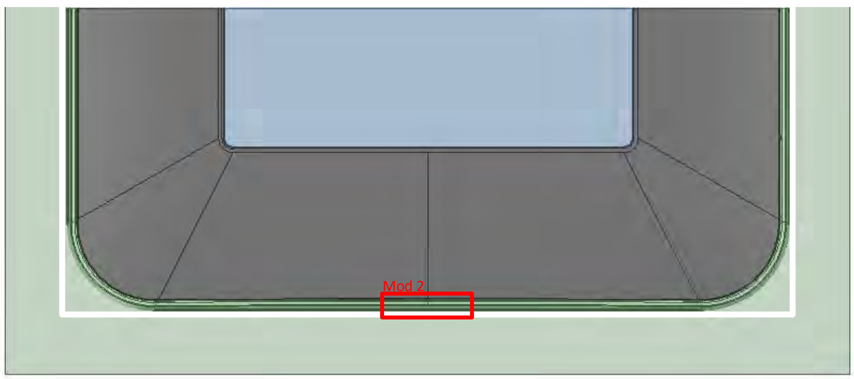


S5

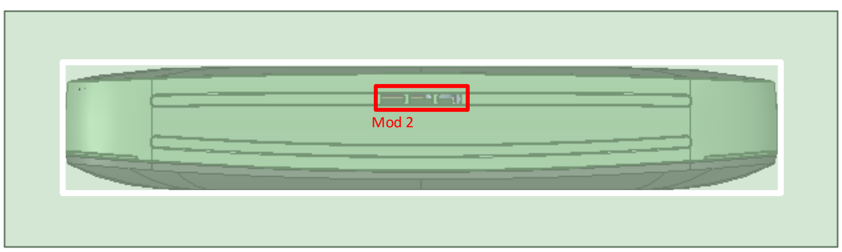
Figure C-3: Phasor 1 views for S1 (Front), S2 (Back) & S5 (Bottom)



S1



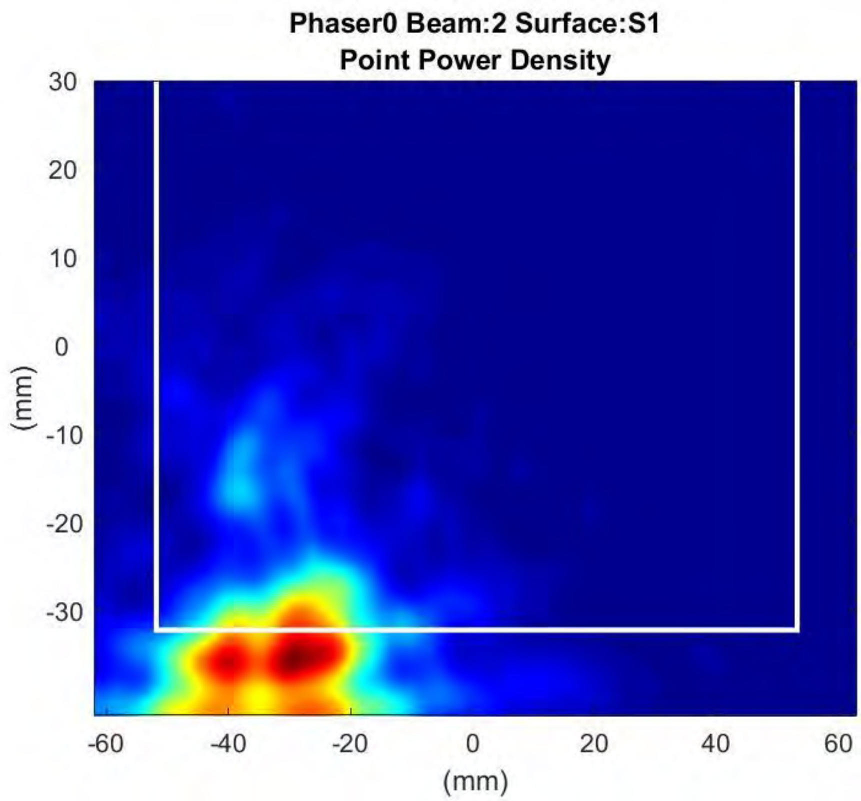
S2

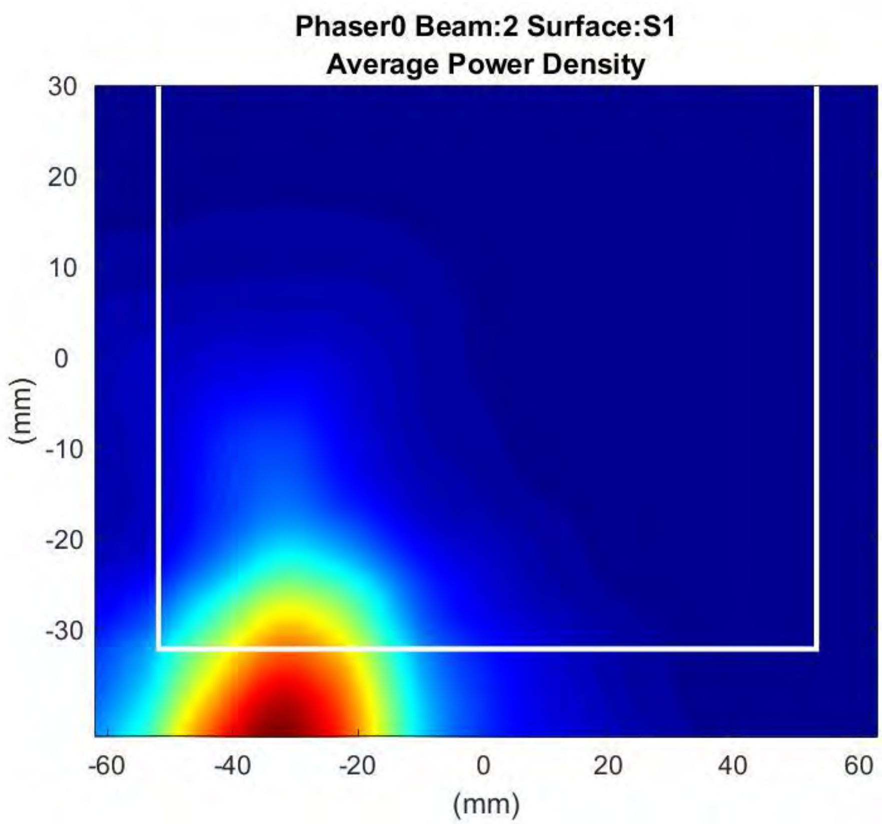


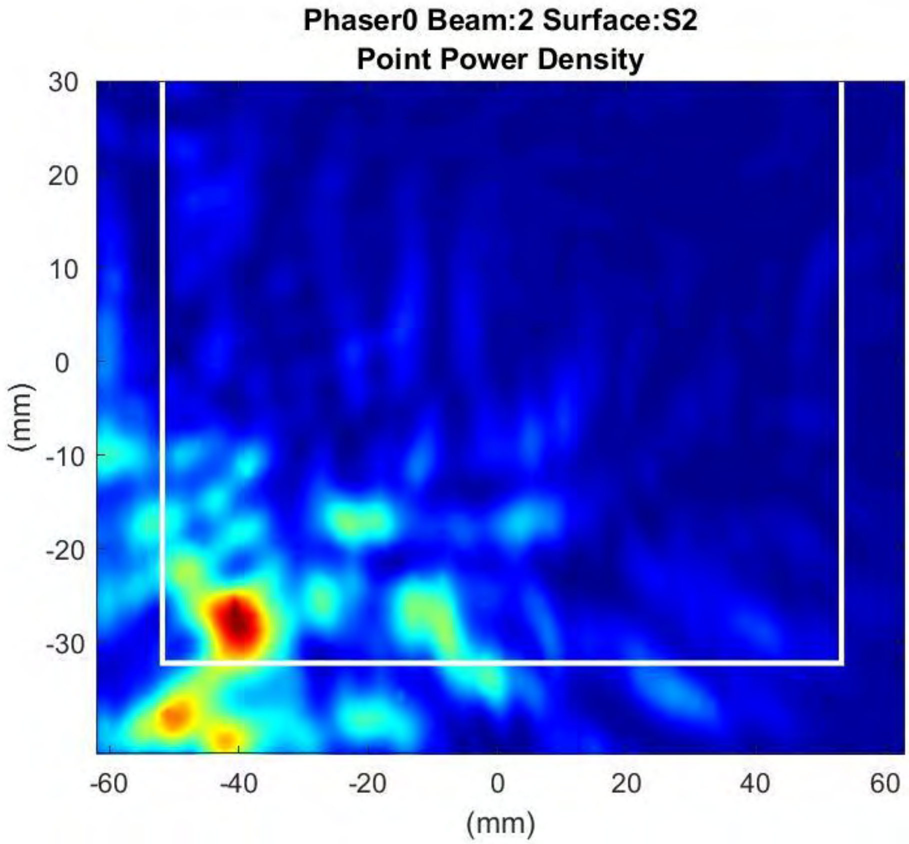
S6

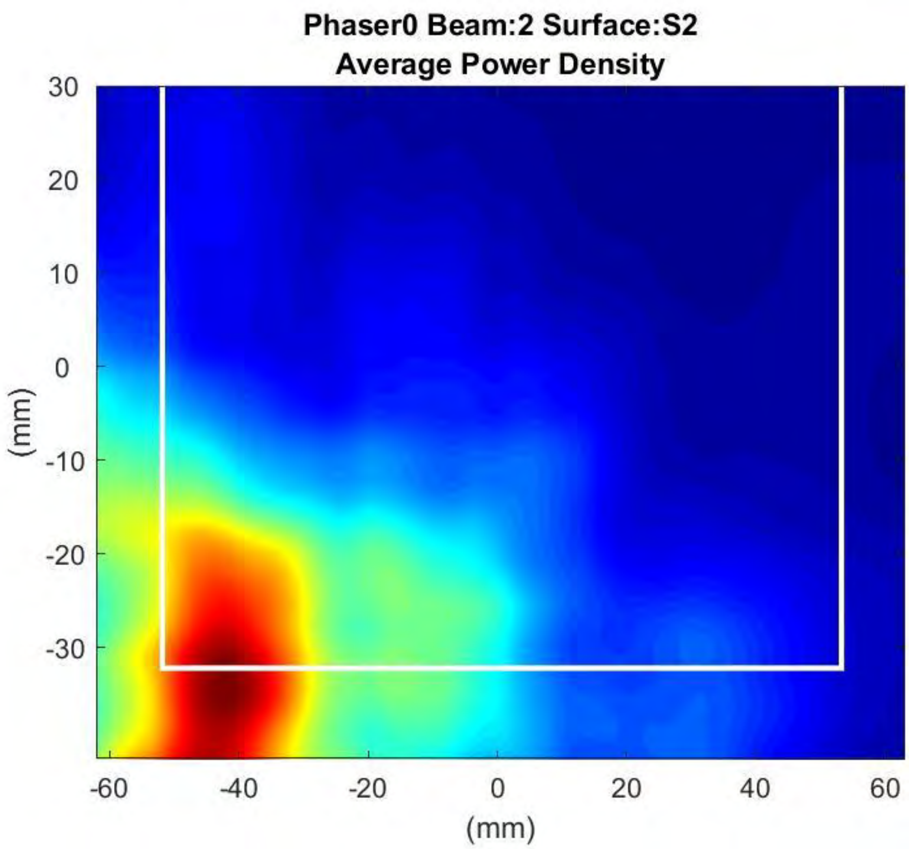
Figure C-4: Phasor 1 views for S1 (Front), S2 (Back) & S6 (Top)

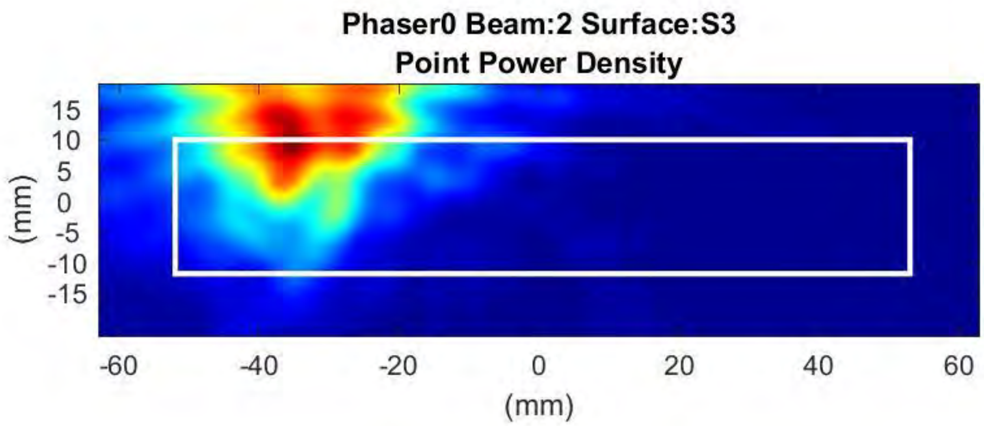
Plots of Point PD & Avg. PD for all Beams






Phaser0 Beam:2 Surface:S2
Point Power Density
30
20
10
0
-10
-20
-30
(mm)
-60
-40
-20
0
20
40
60
(mm)


Phaser0 Beam:2 Surface:S2
Average Power Density
30
20
10
0
-10
-20
-30
(mm)
-60
-40
-20
0
20
40
60
(mm)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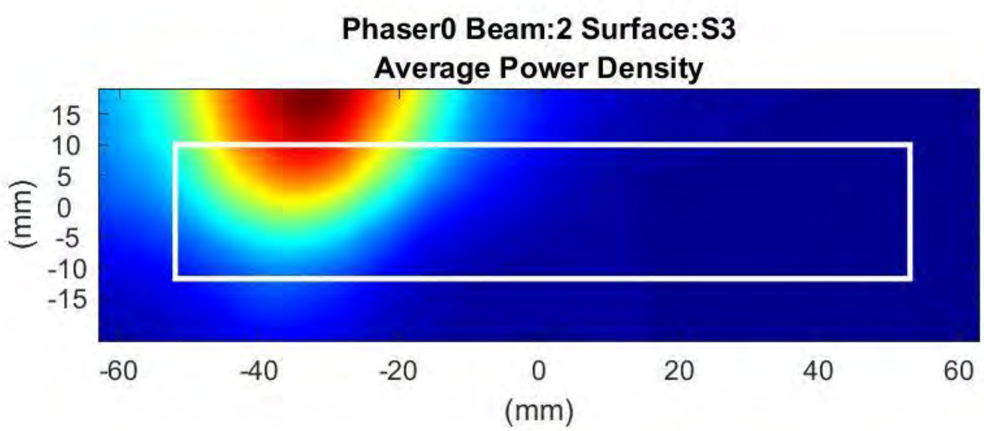
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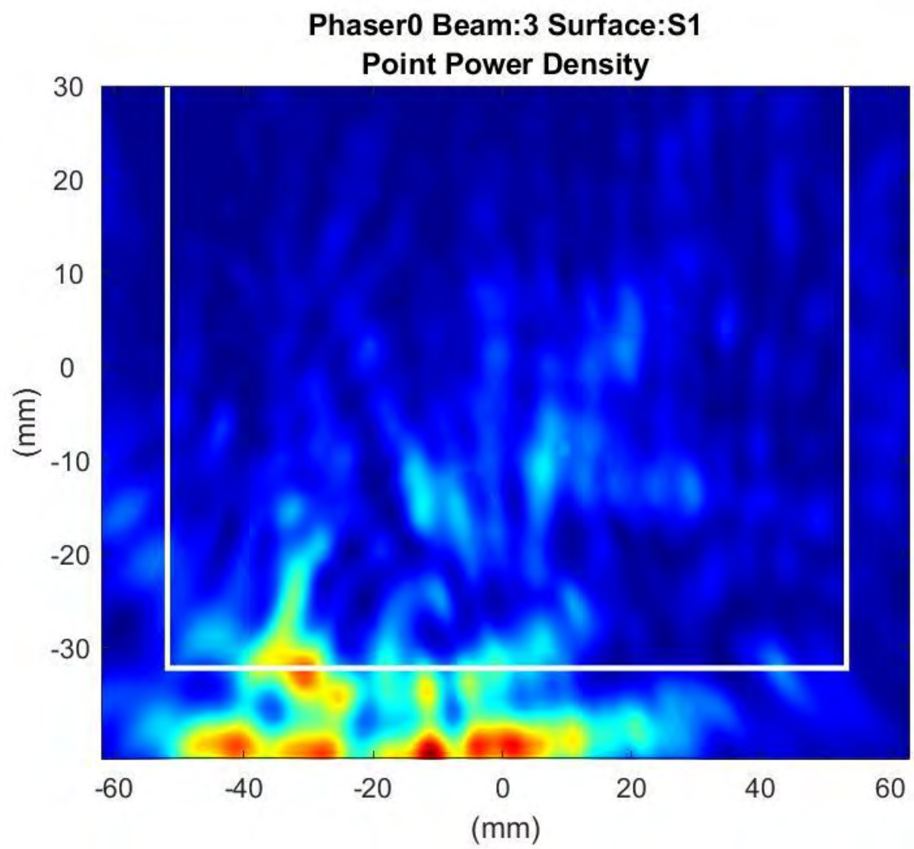
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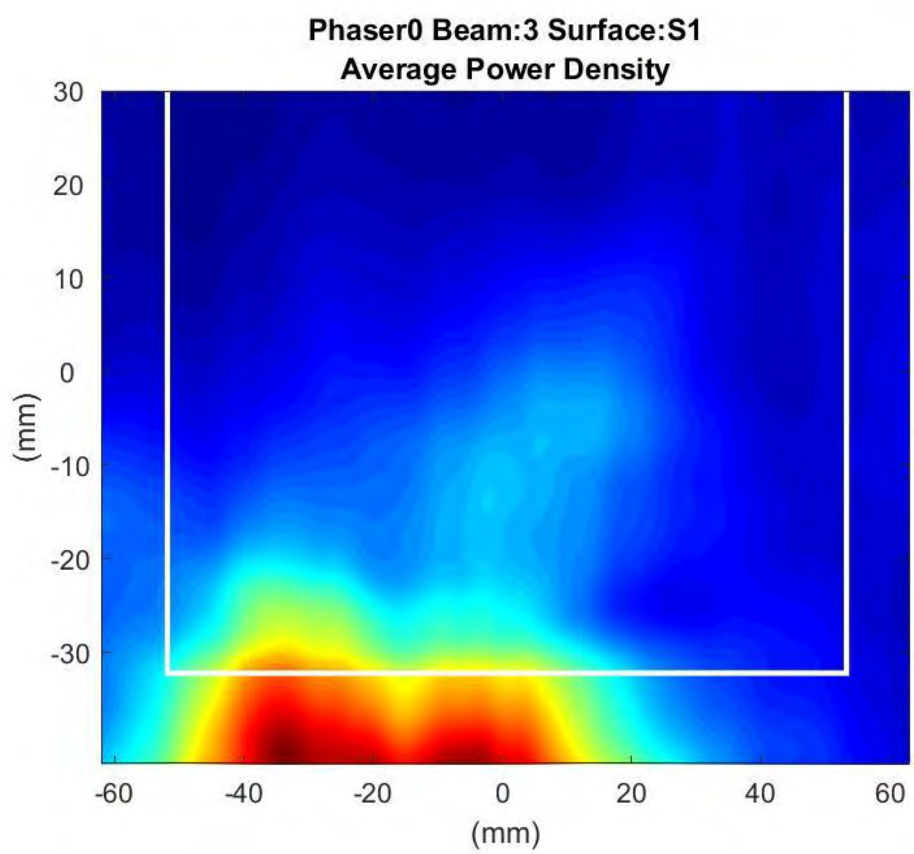
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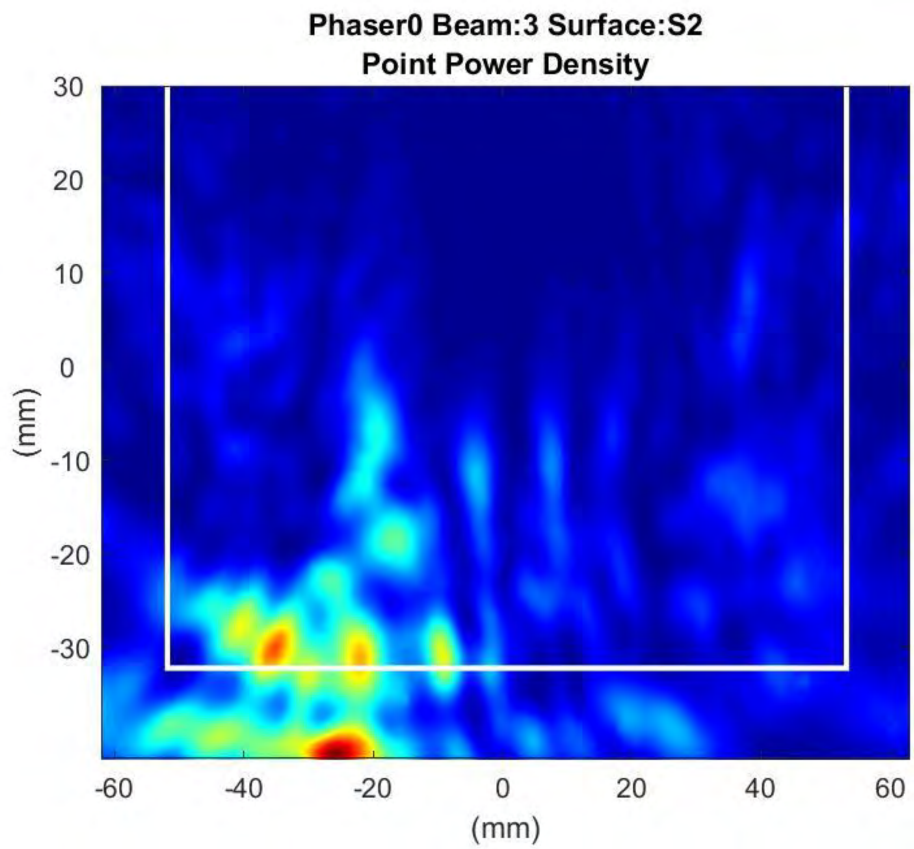
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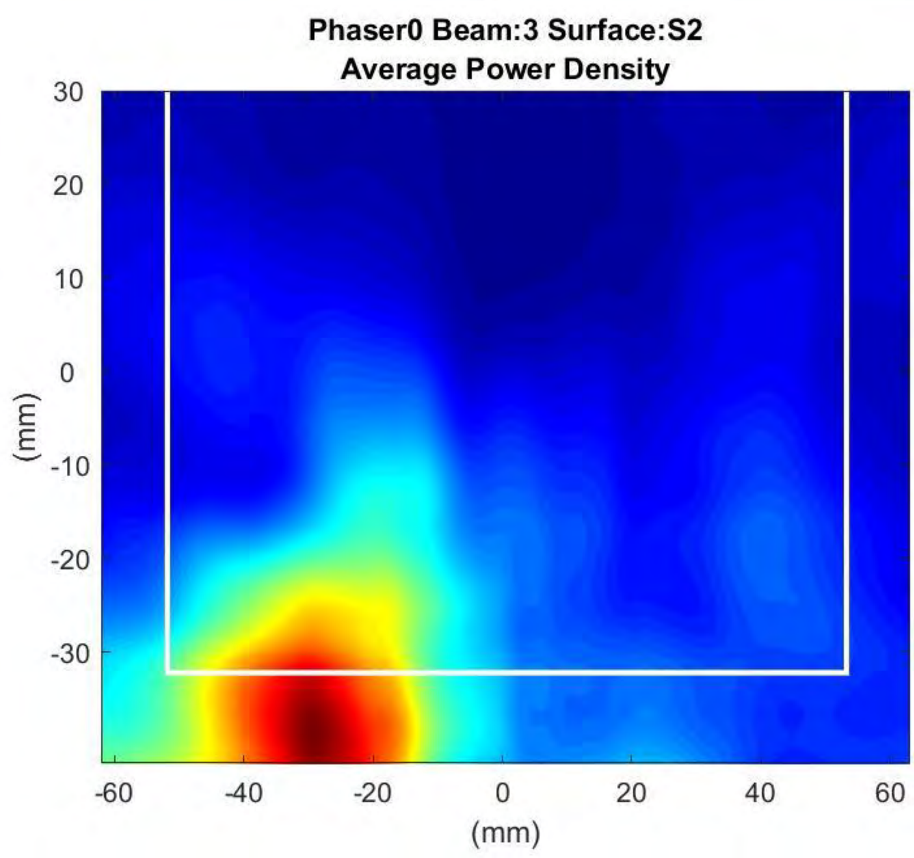
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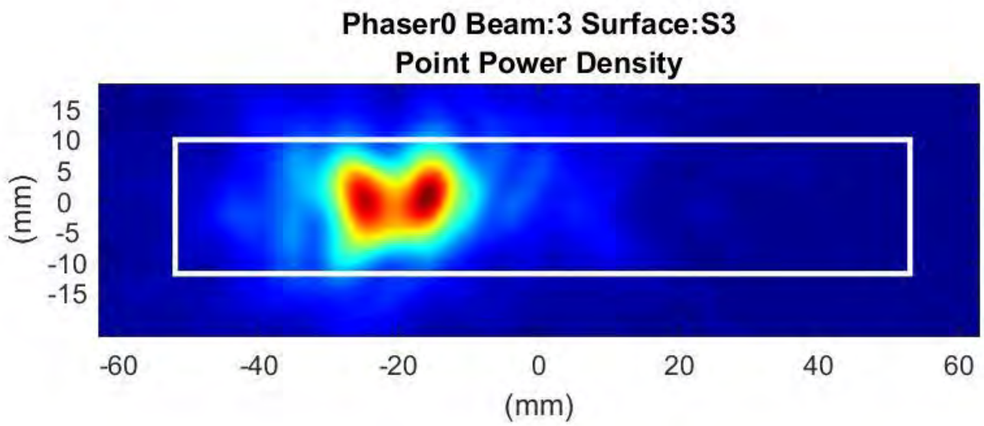
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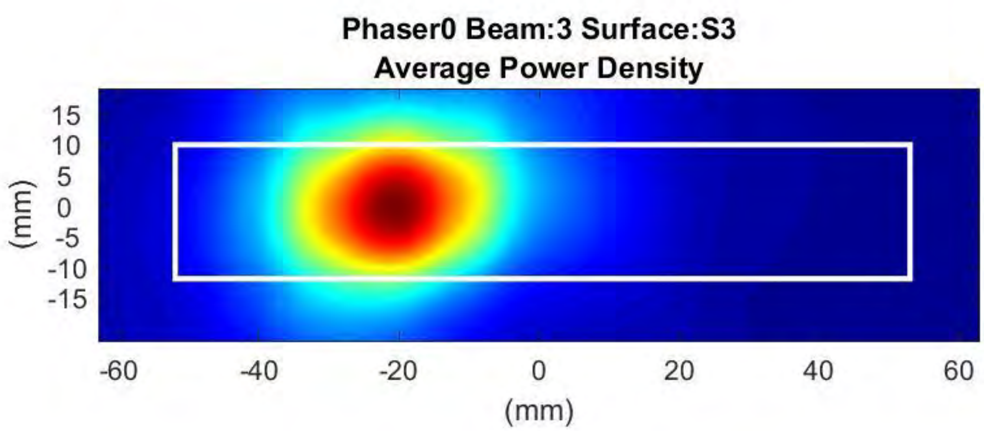
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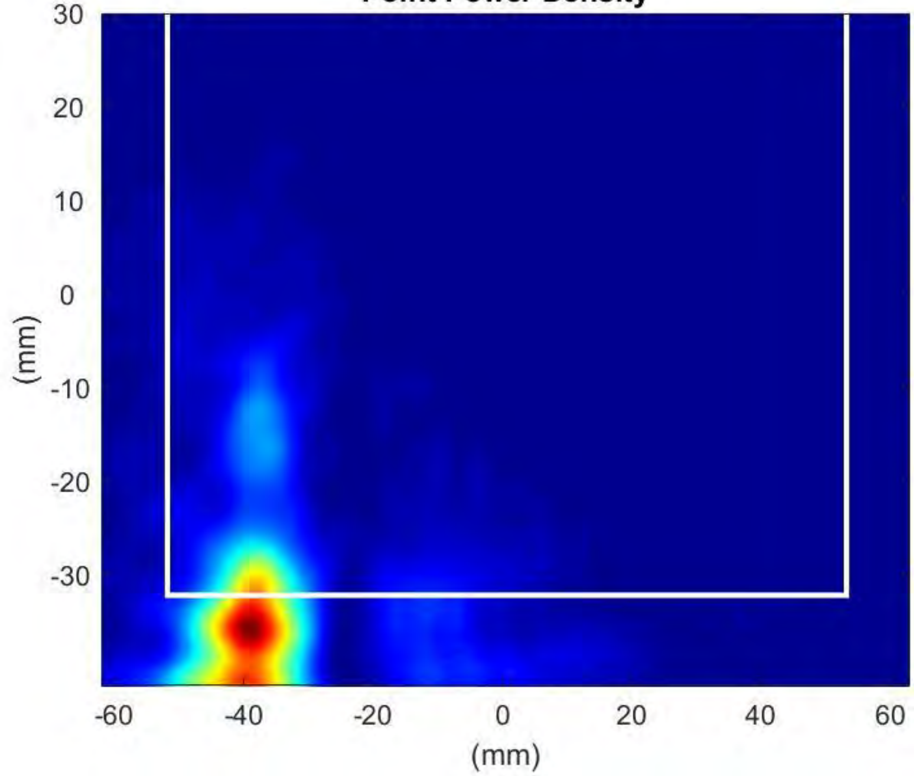

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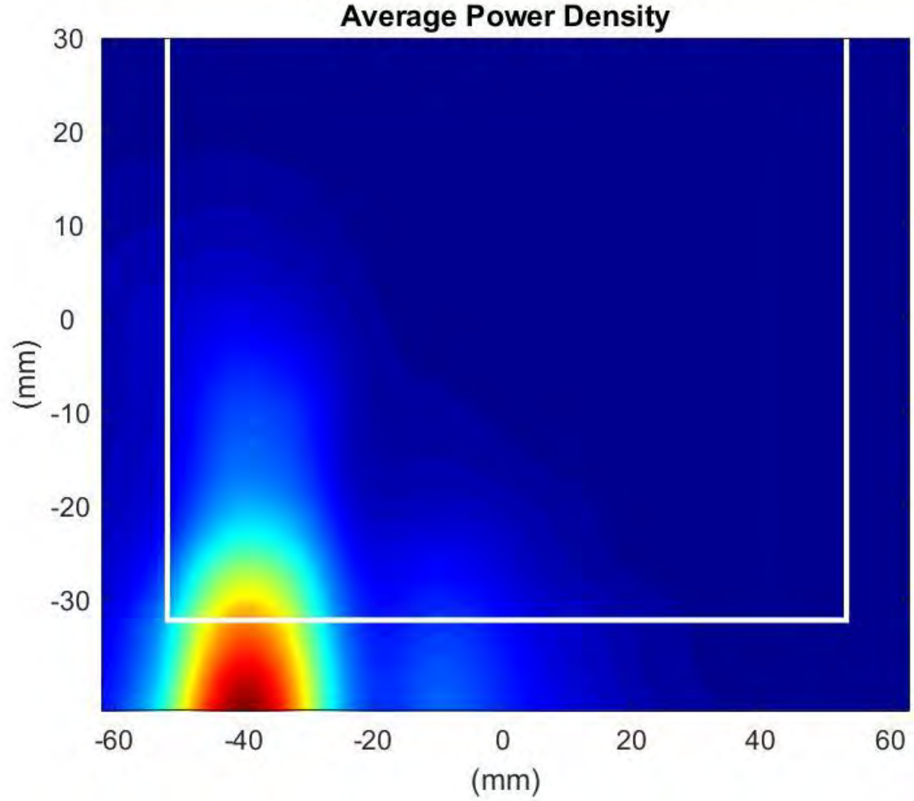

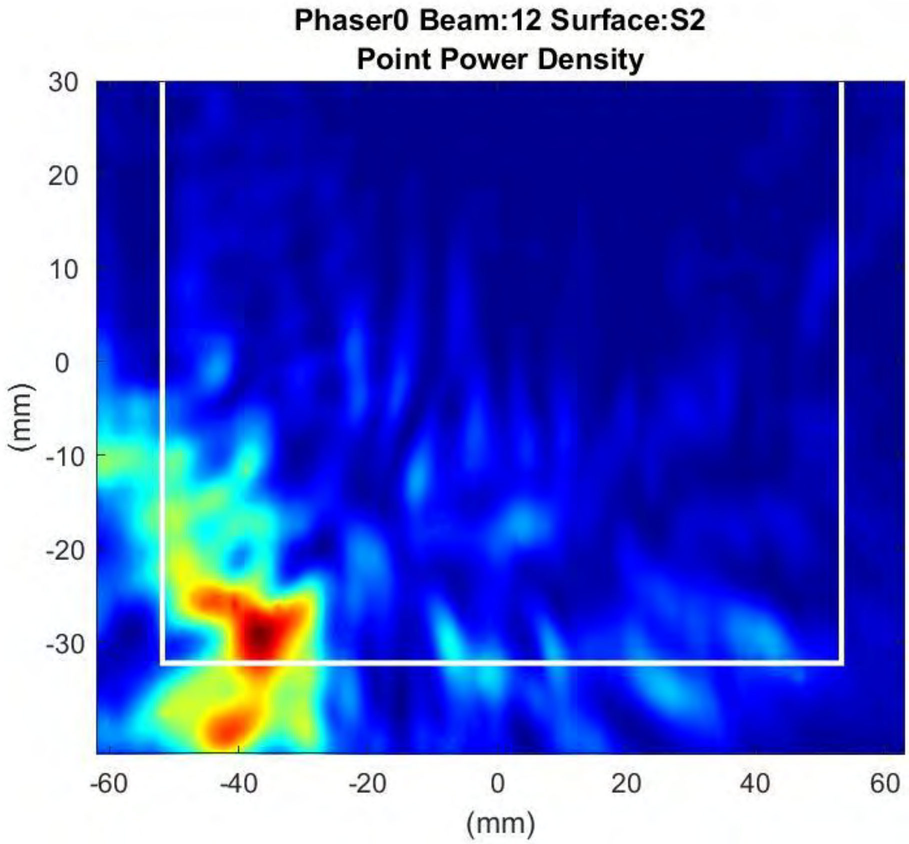
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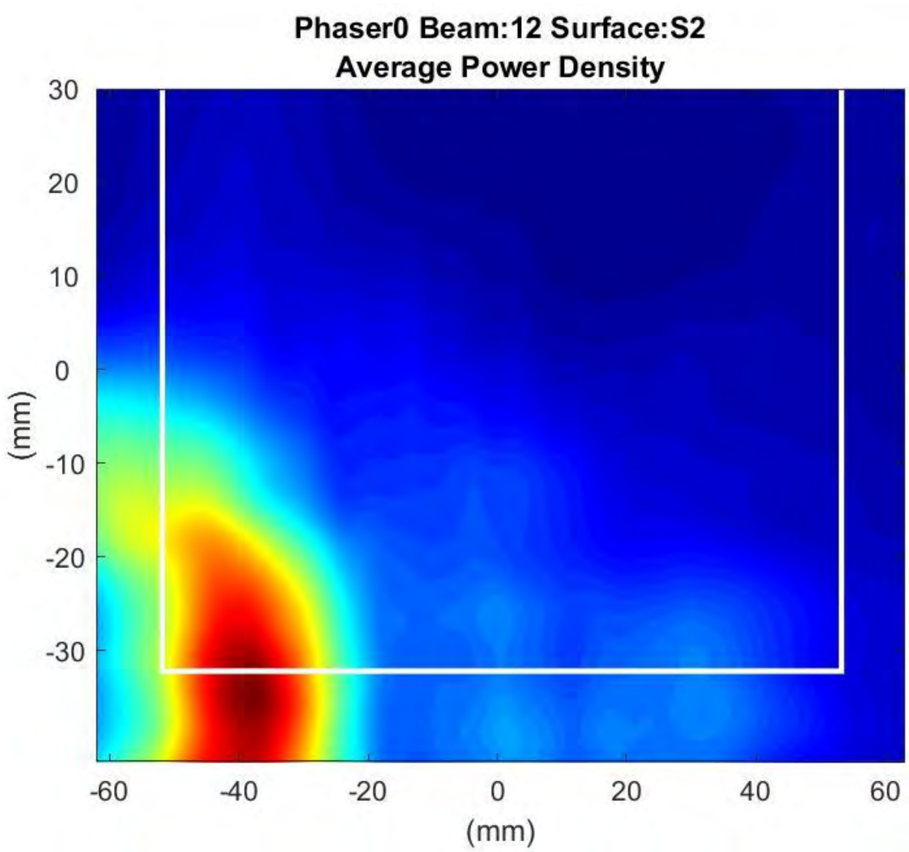
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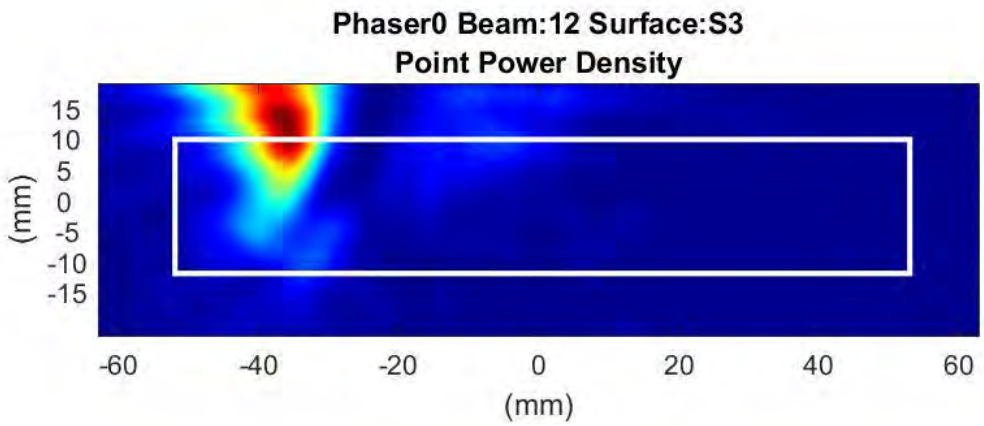
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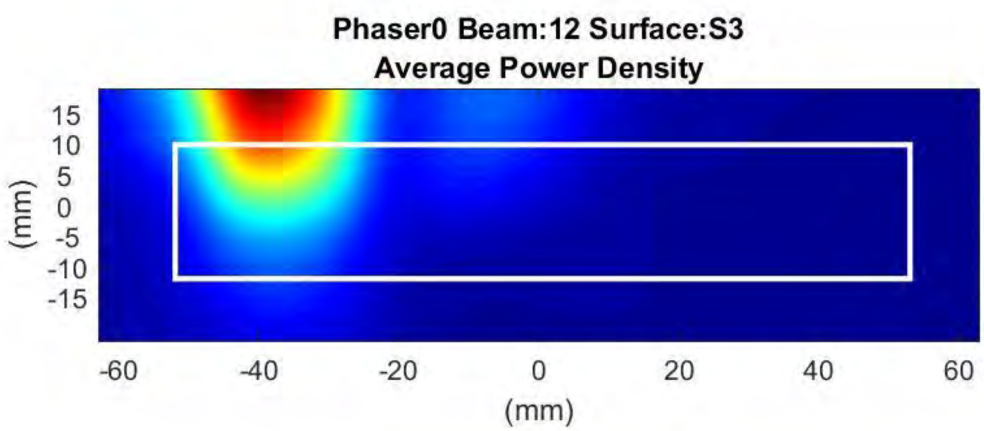
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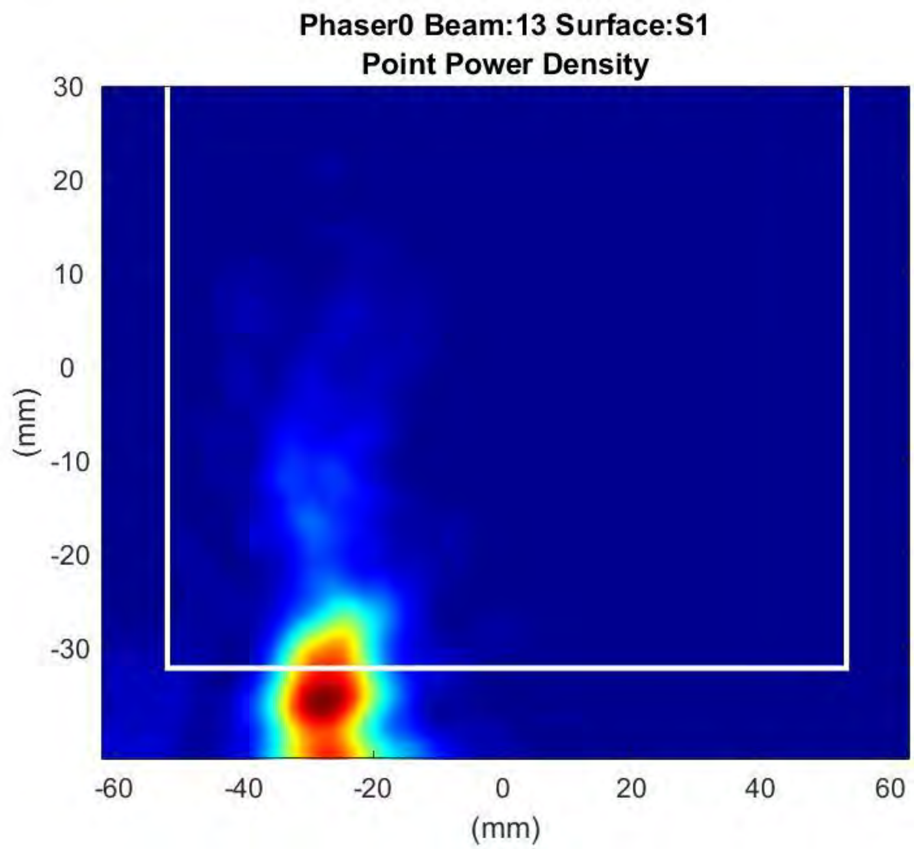
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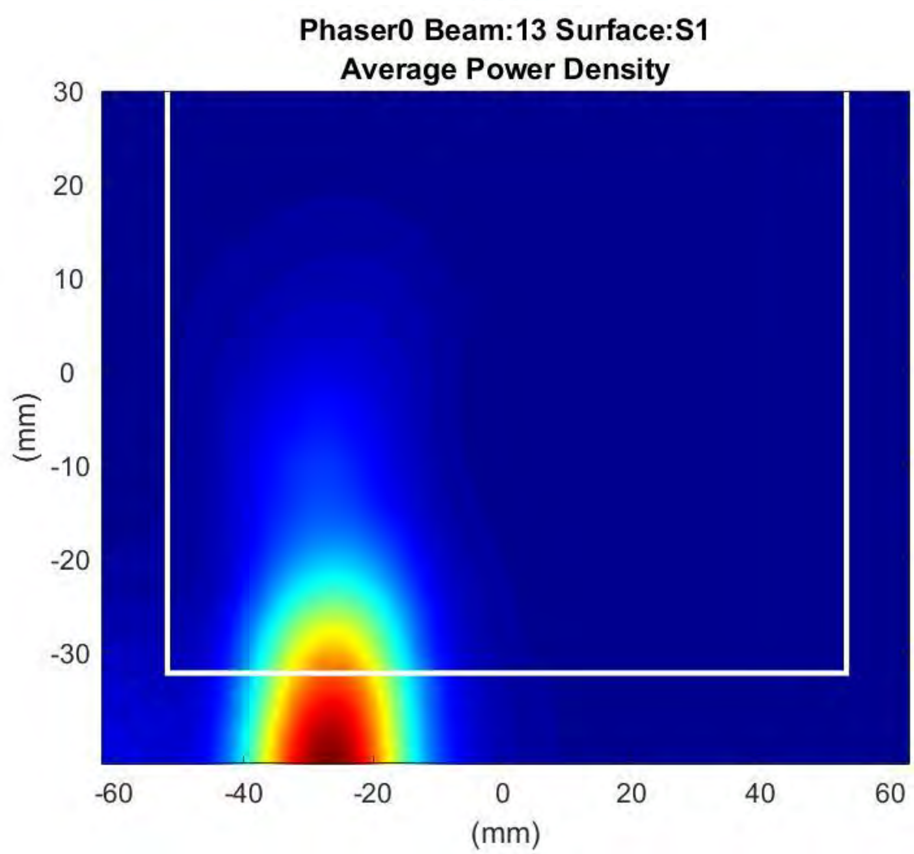
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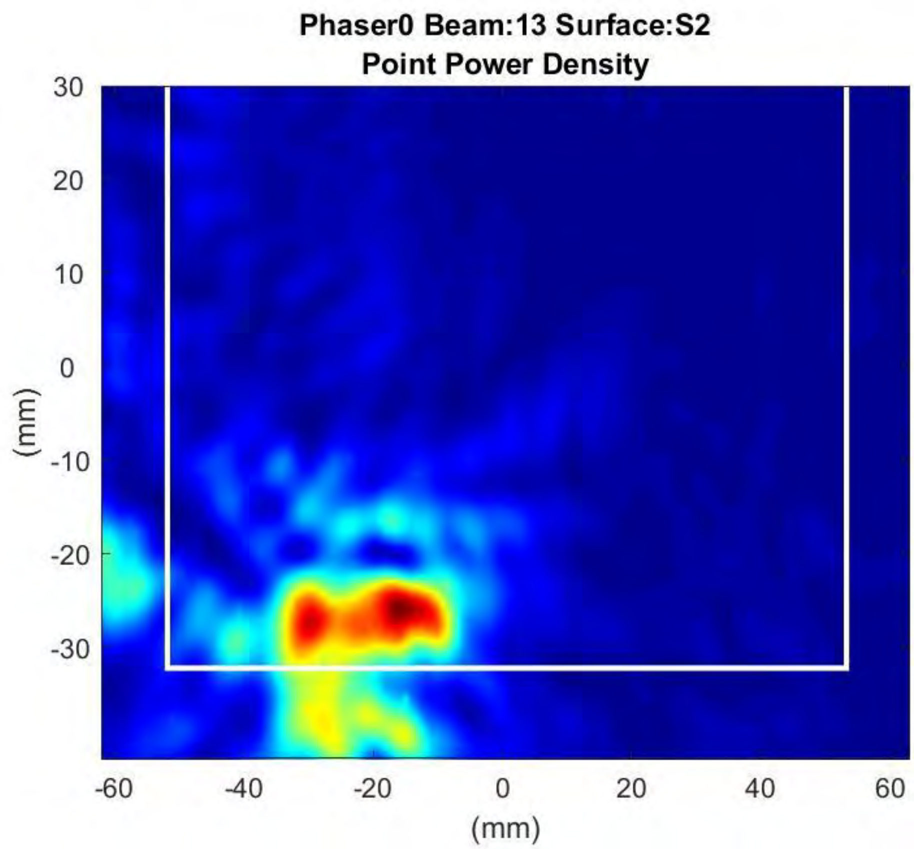
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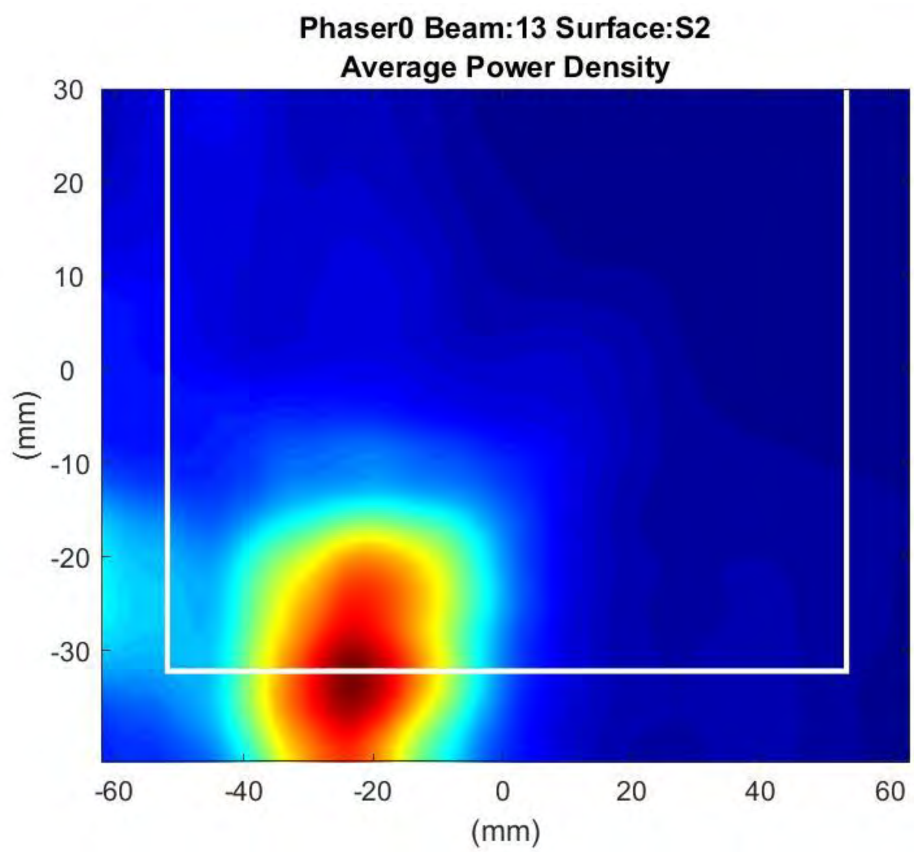
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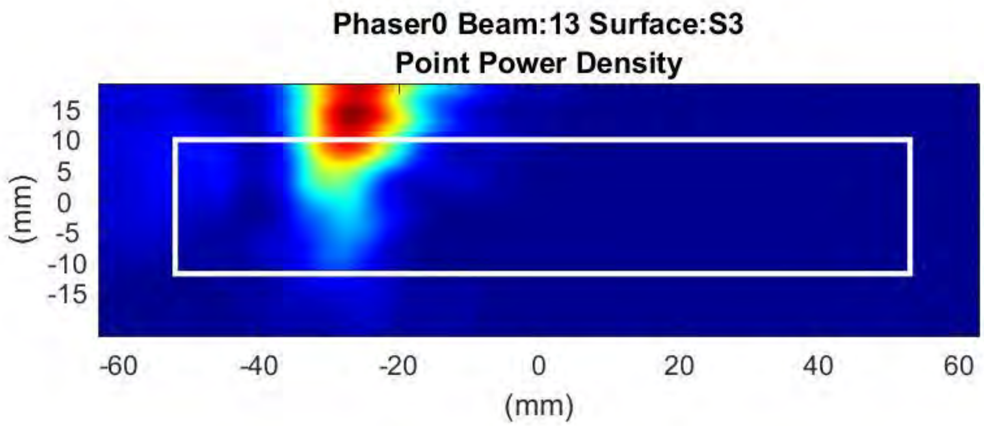
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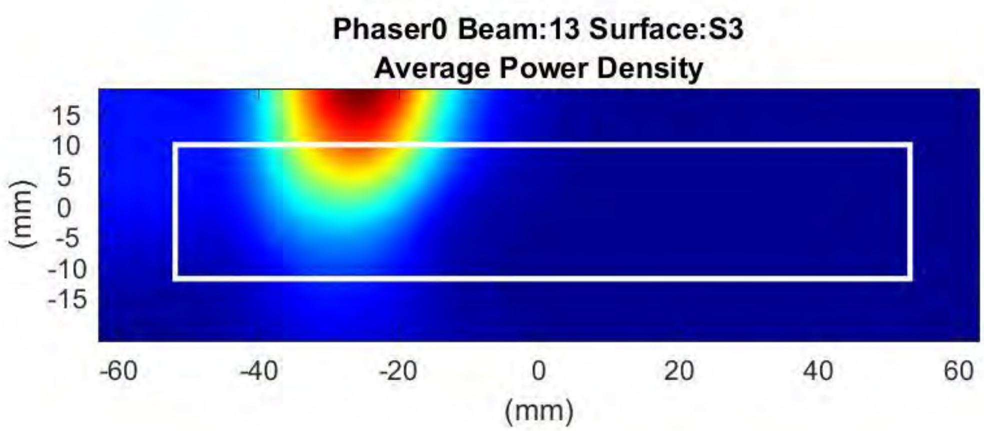
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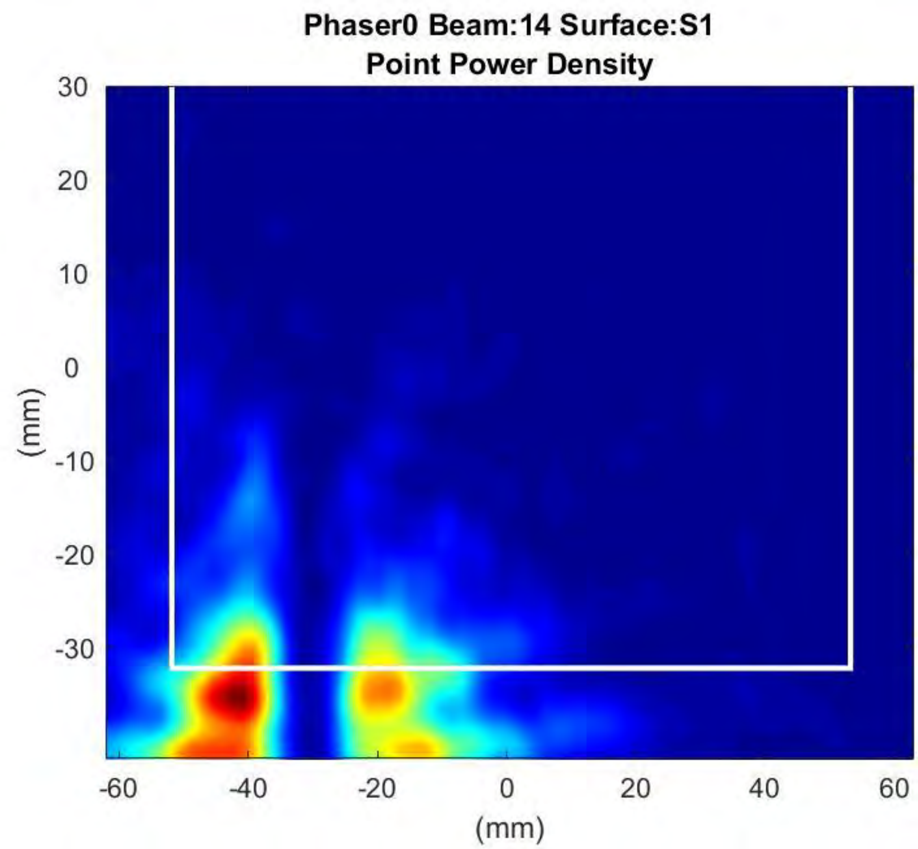
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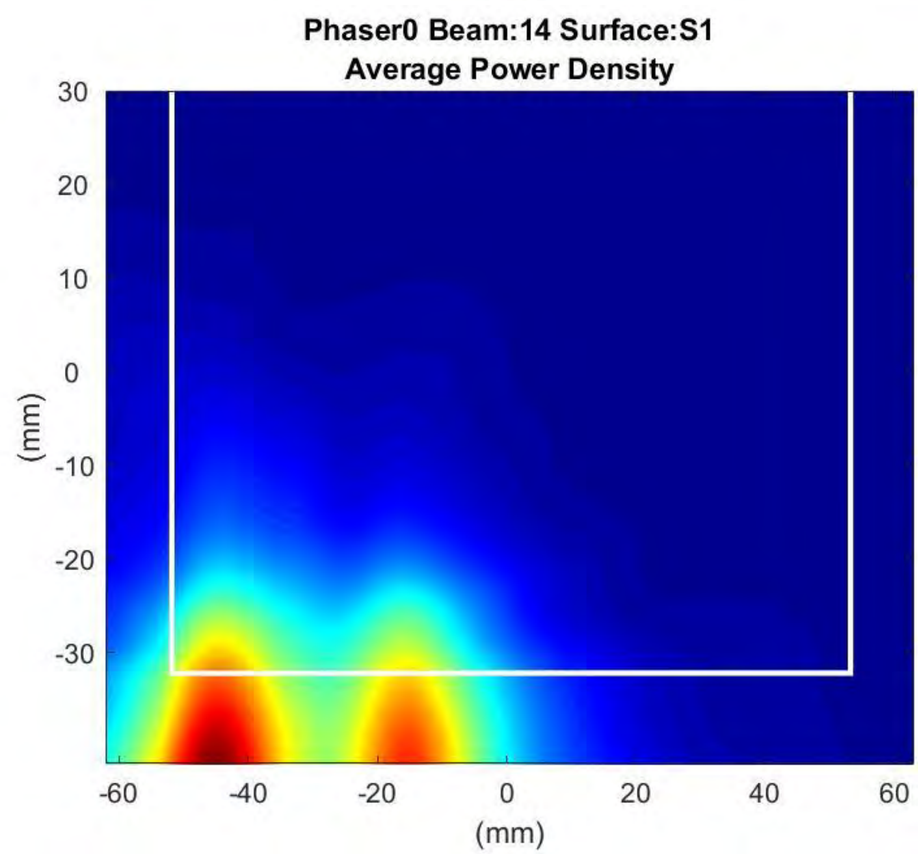
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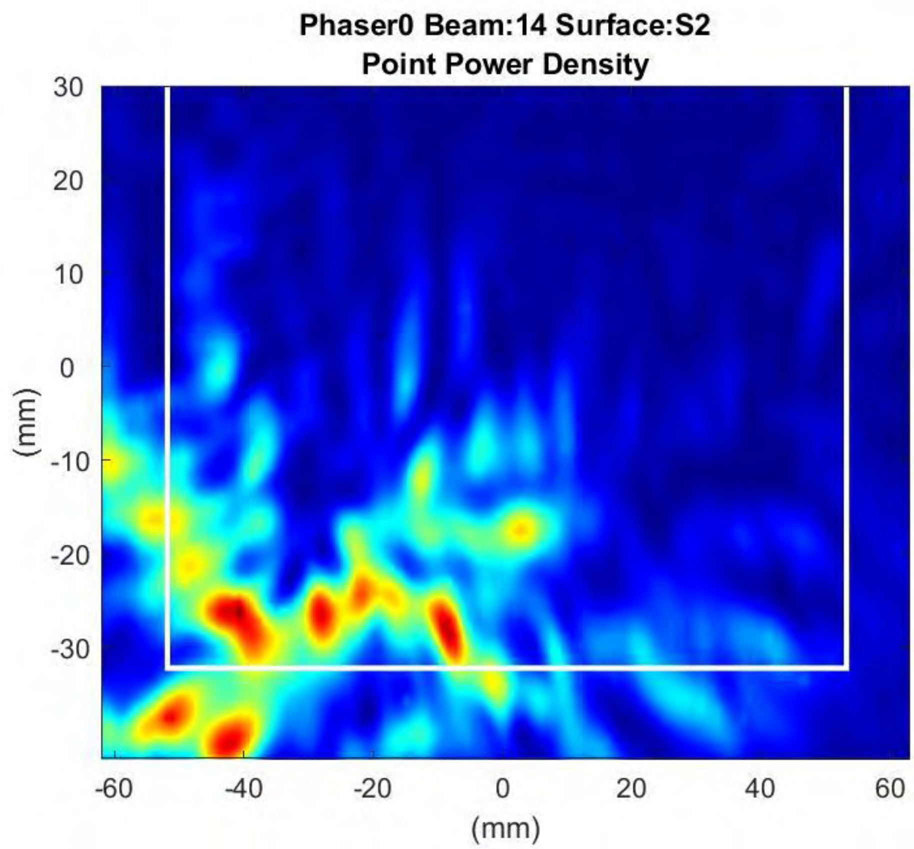
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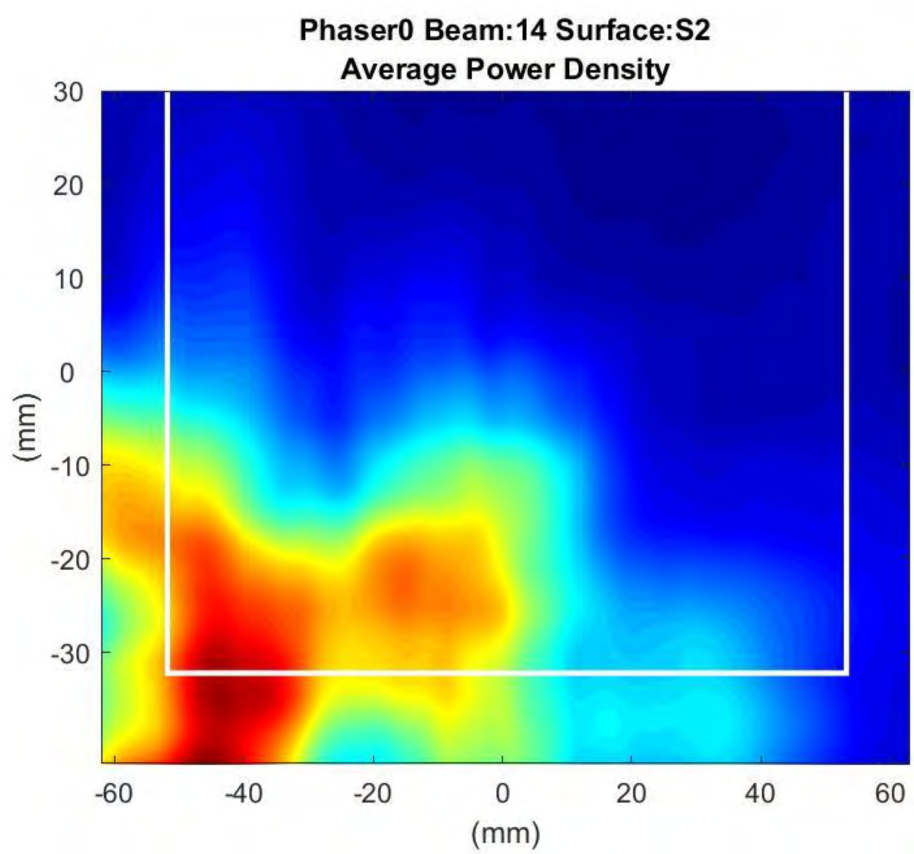
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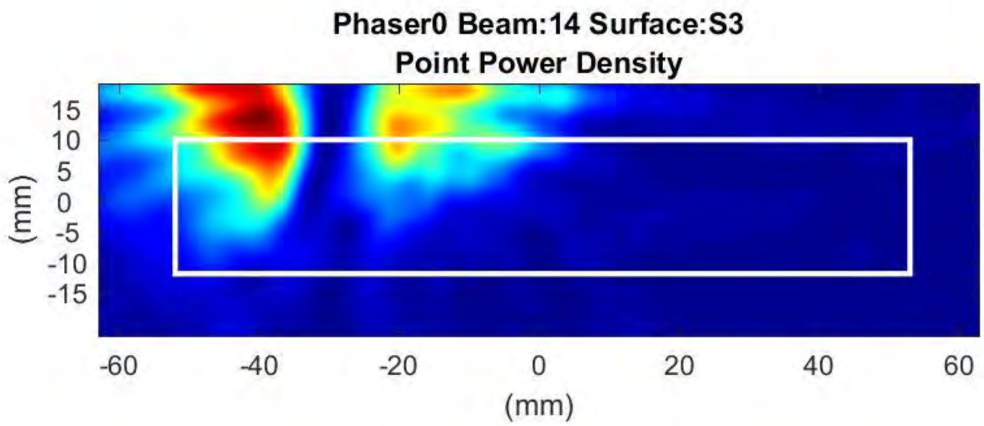
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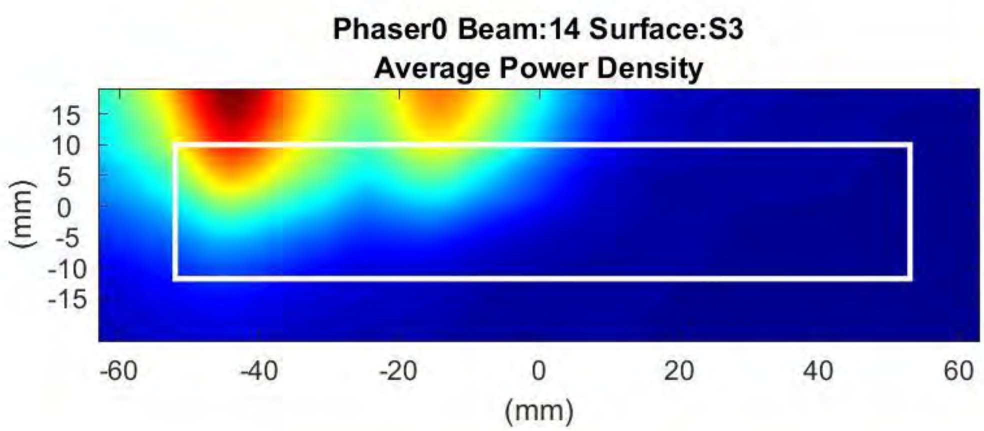
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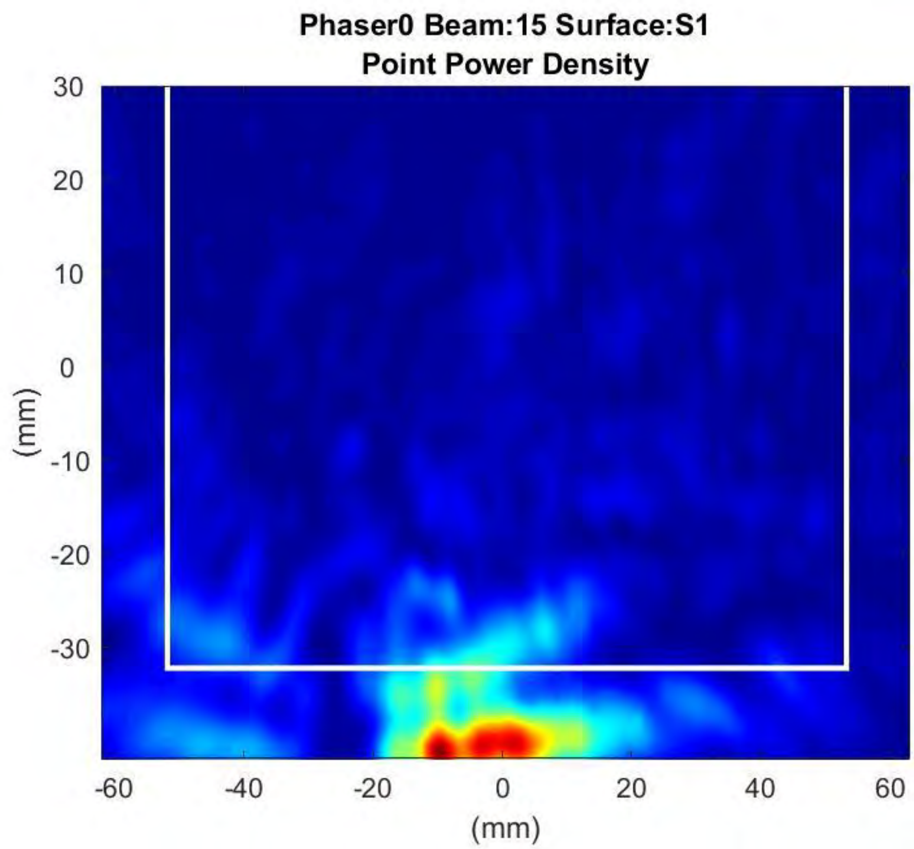
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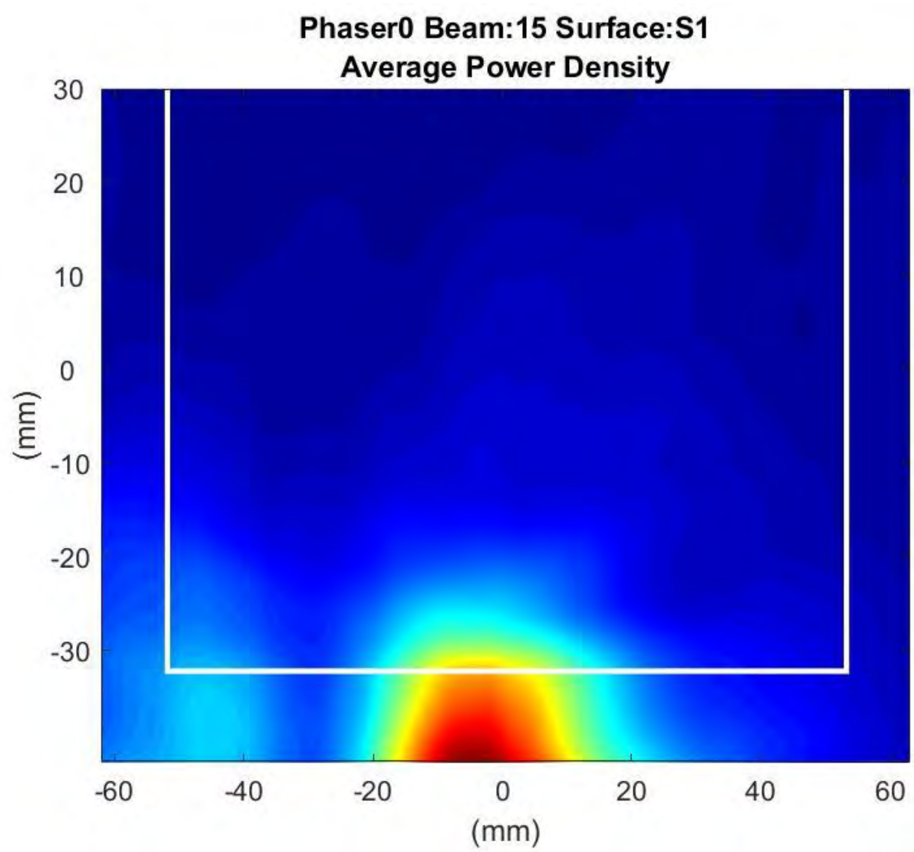
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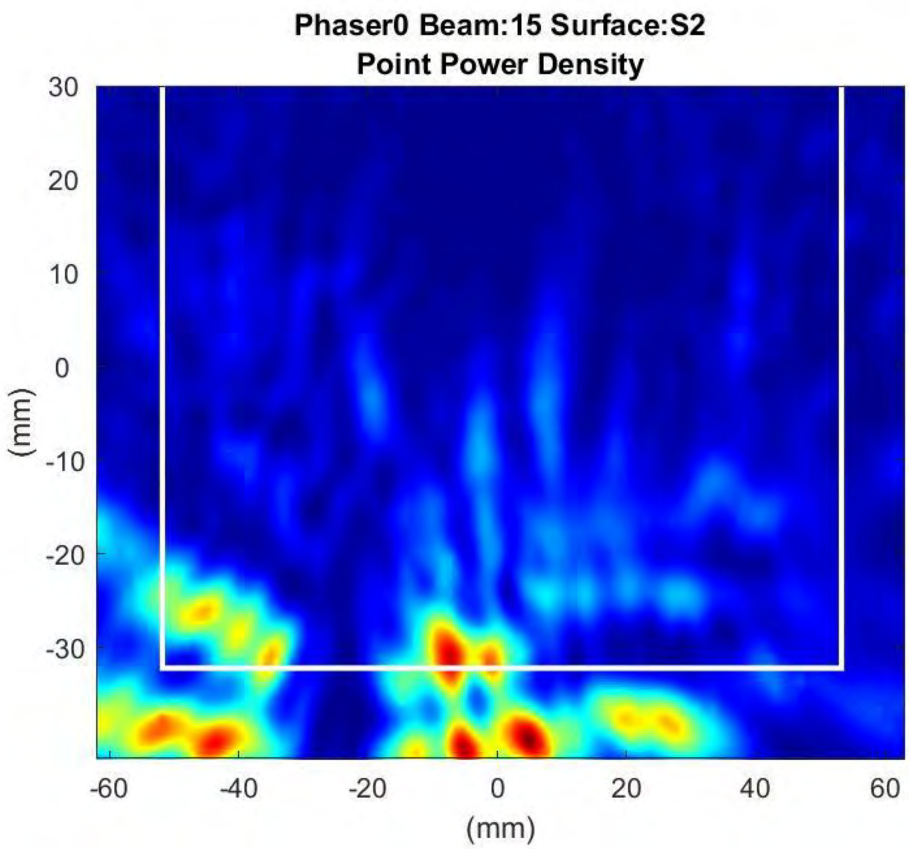
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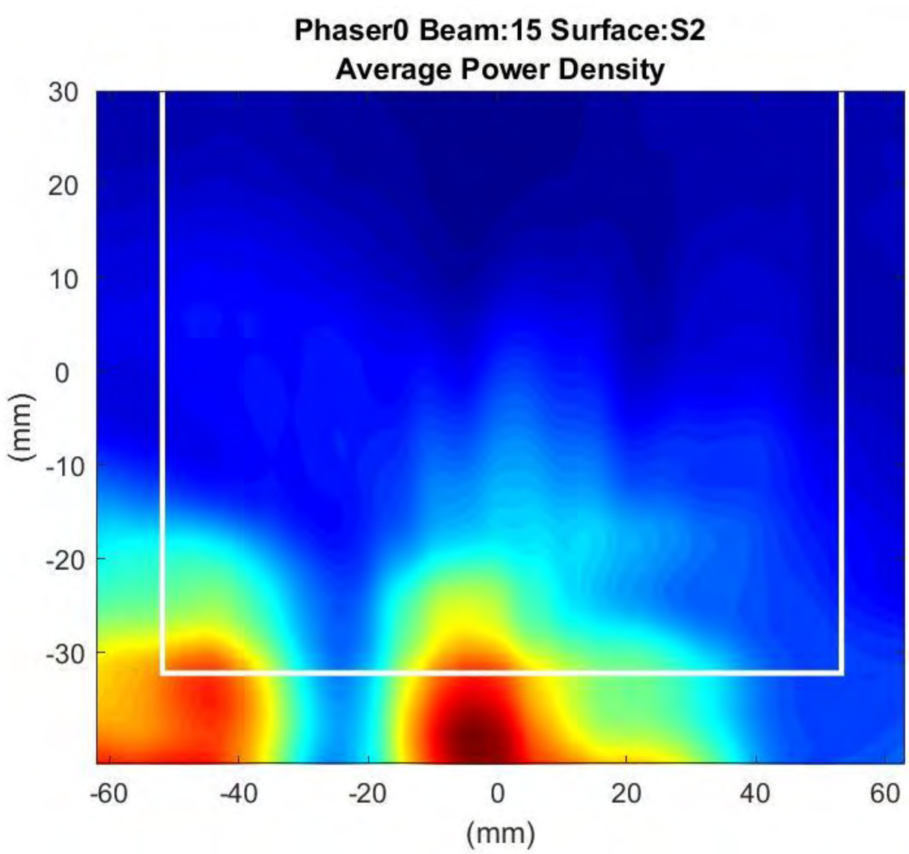
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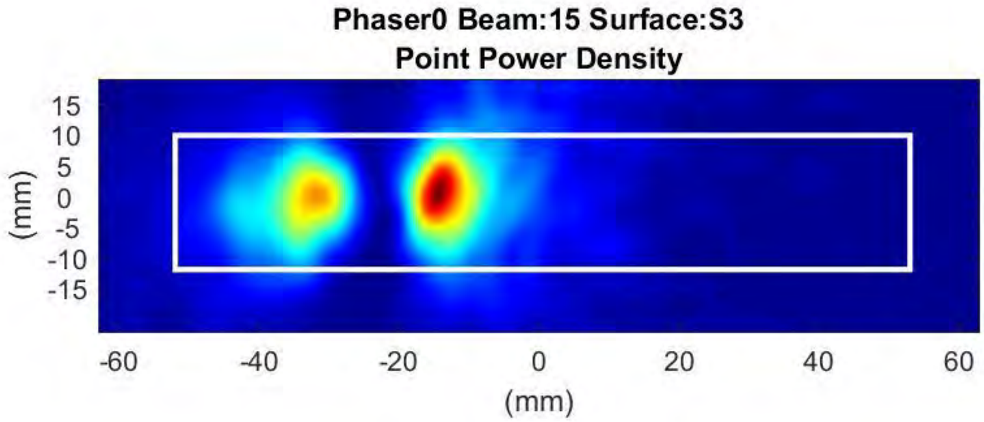
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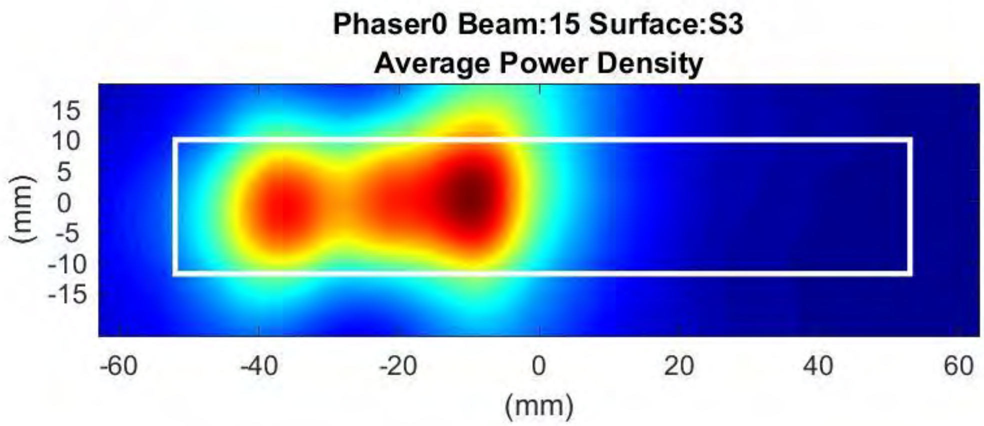
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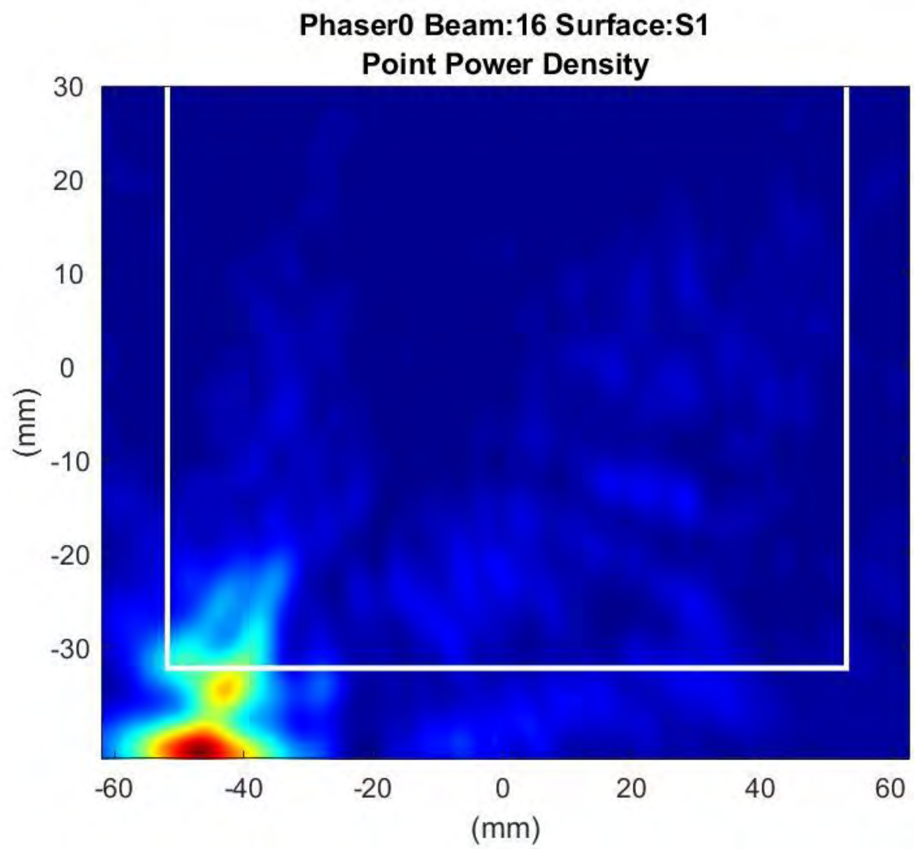
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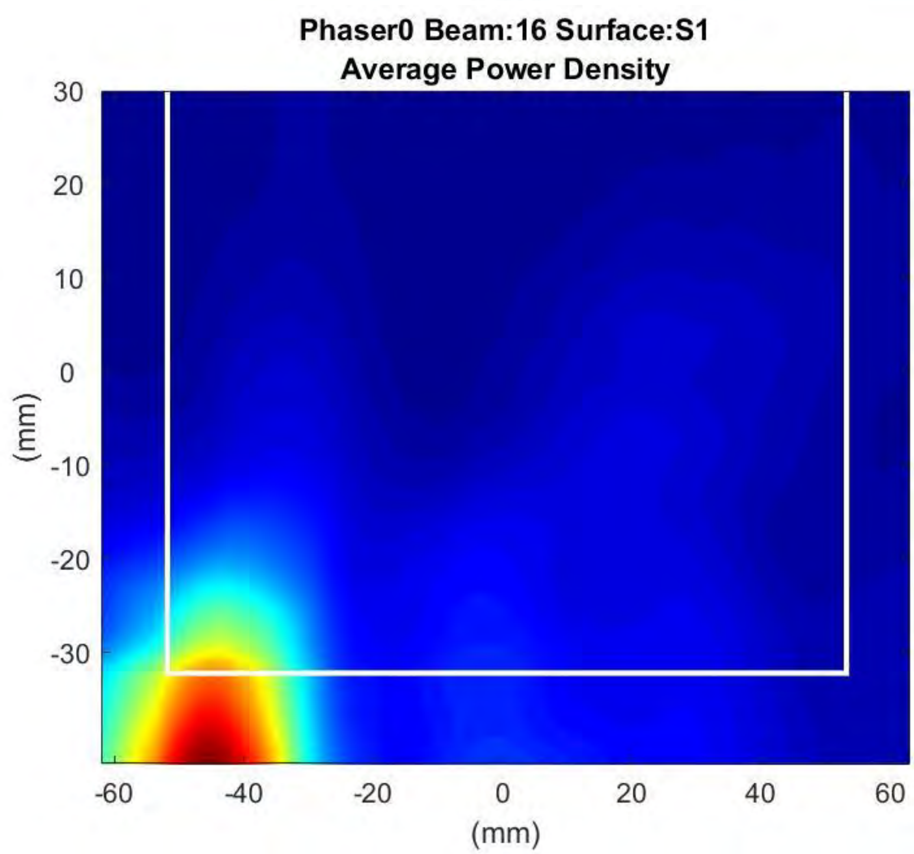
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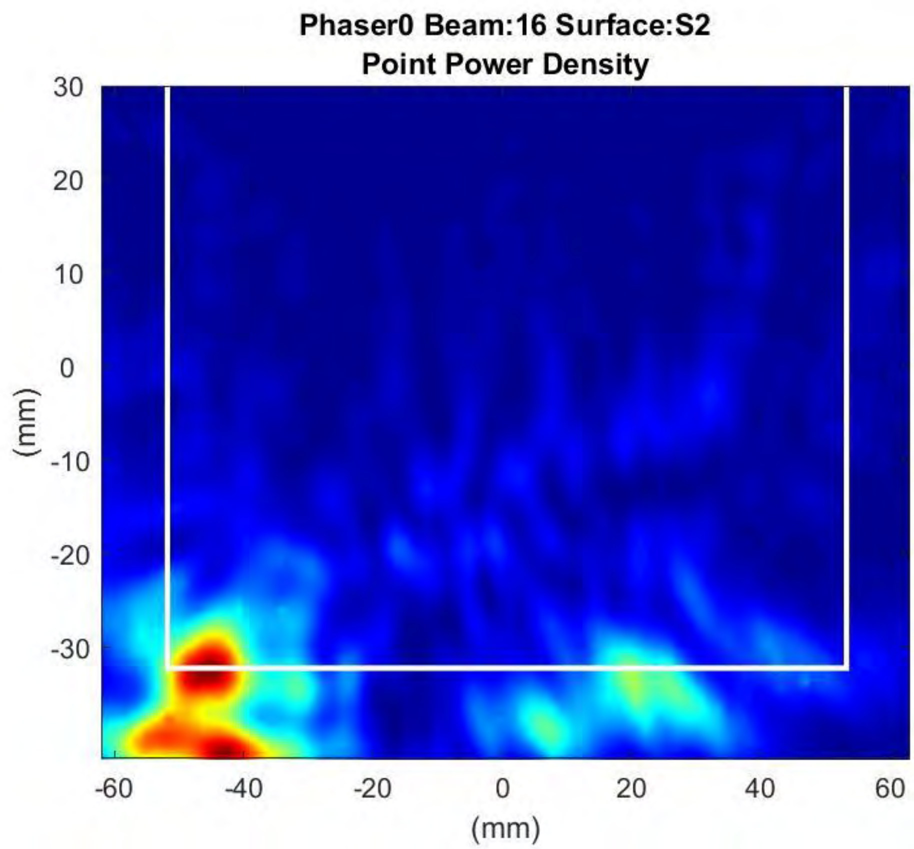
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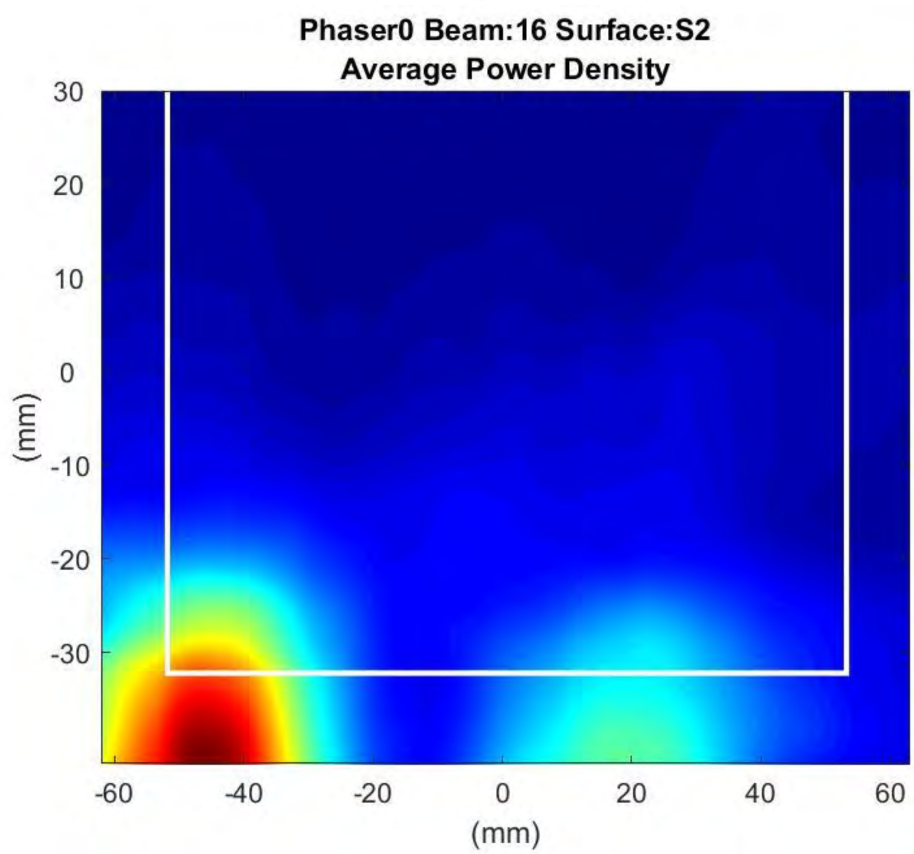
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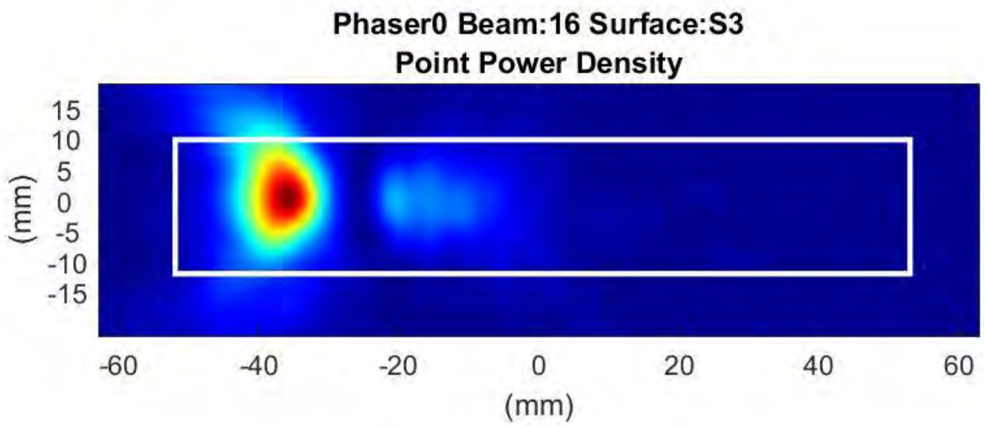
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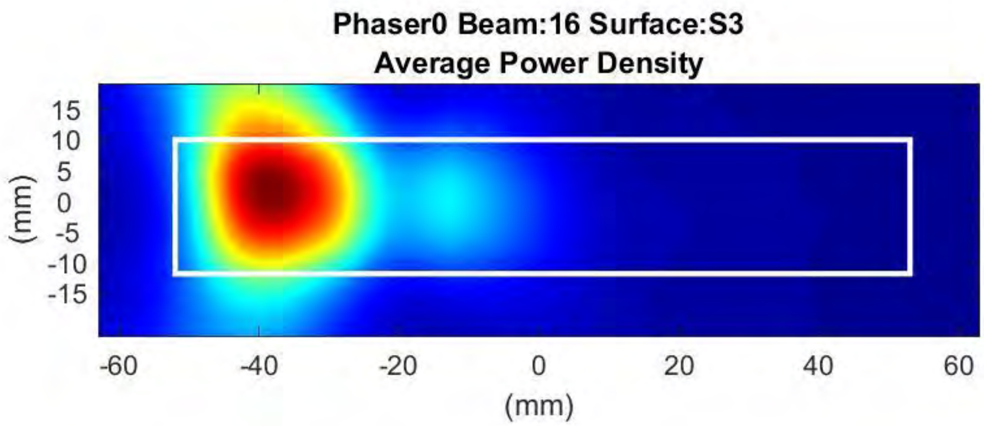
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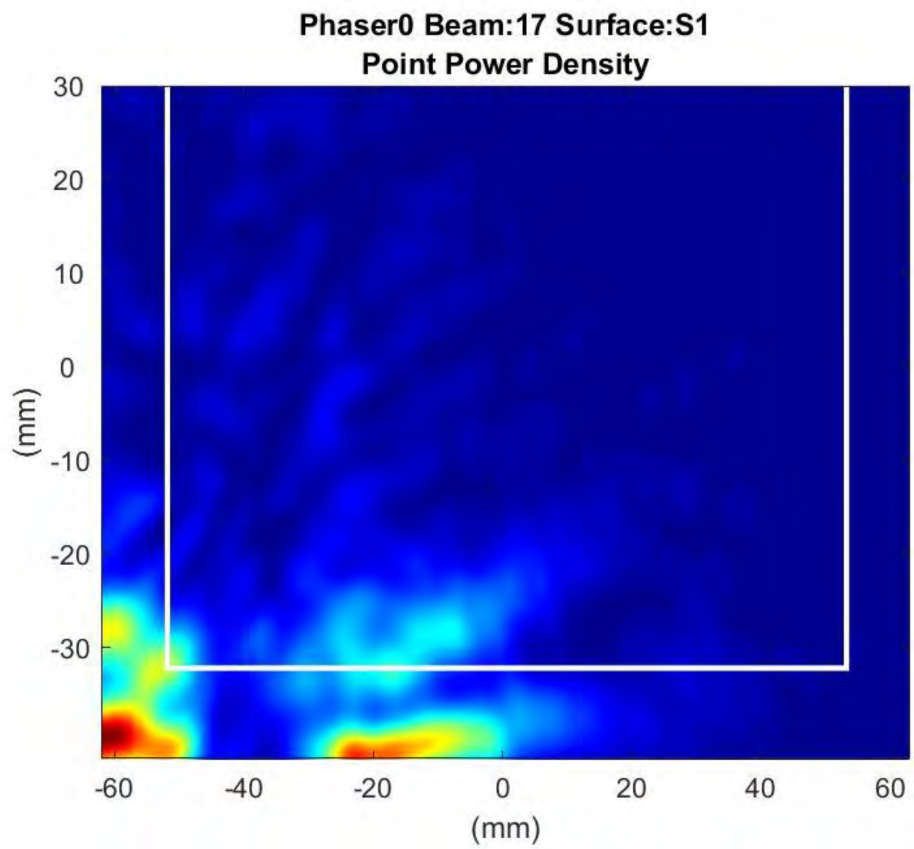
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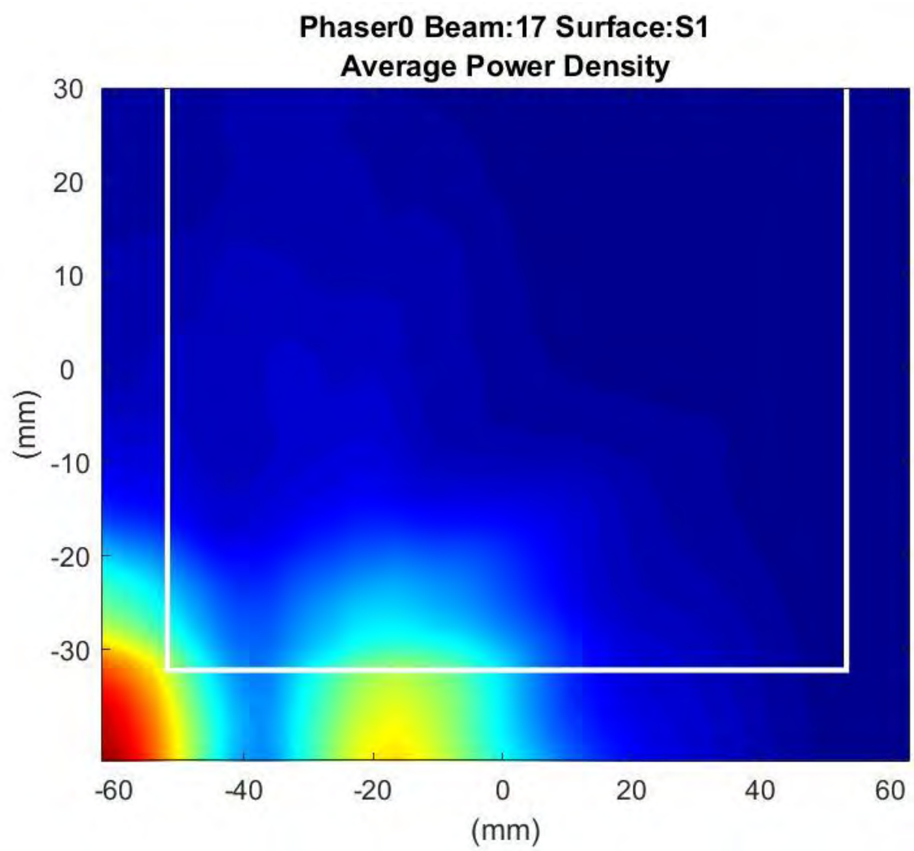
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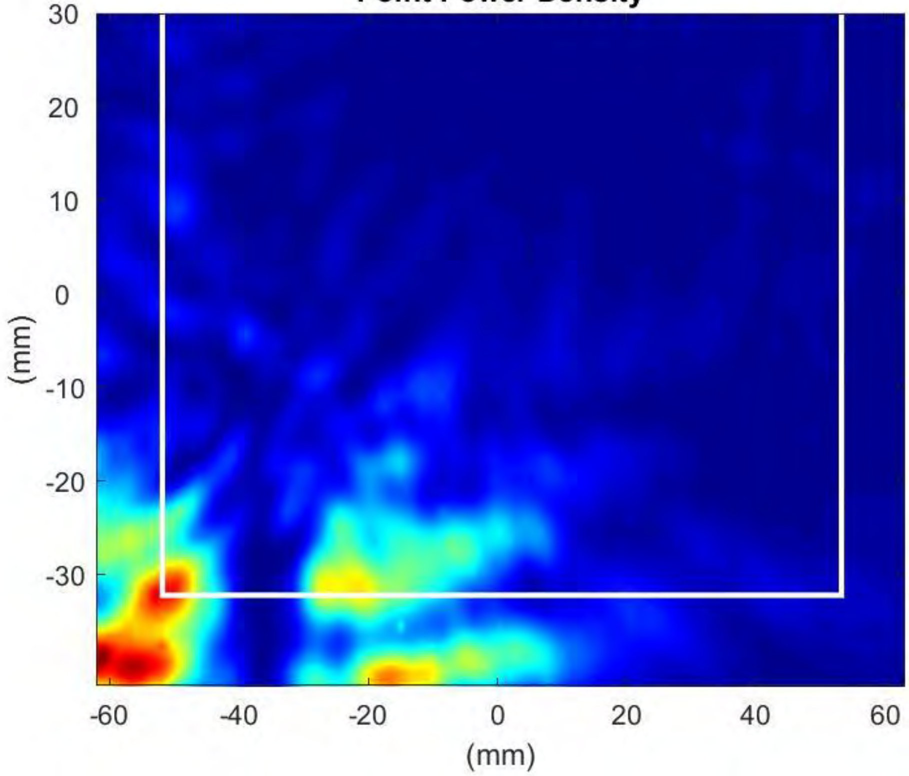

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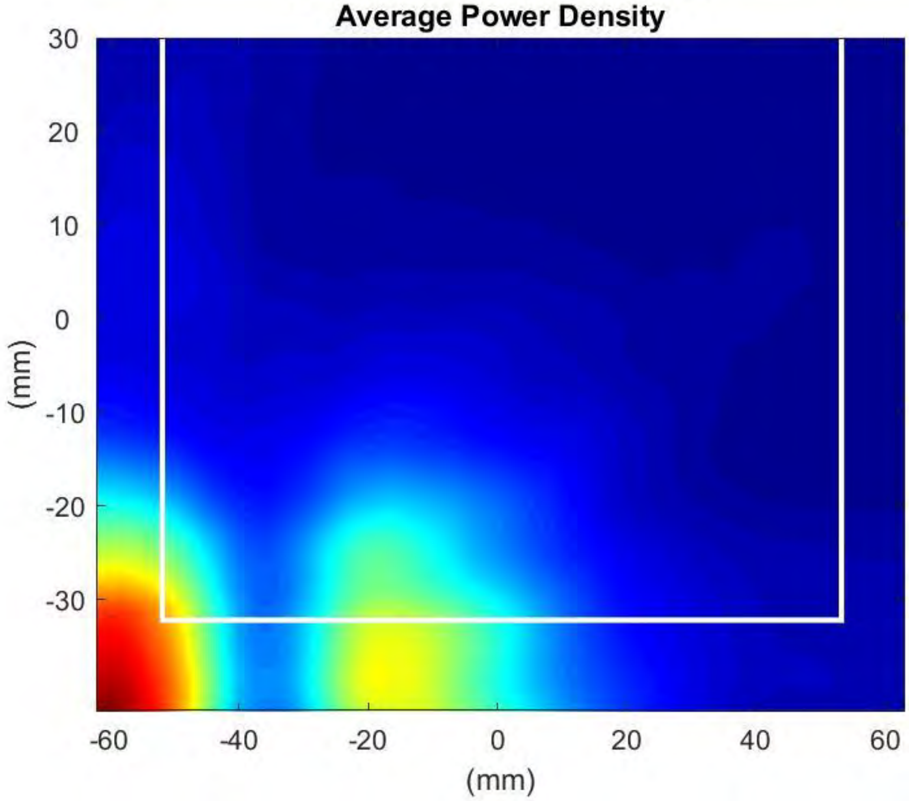

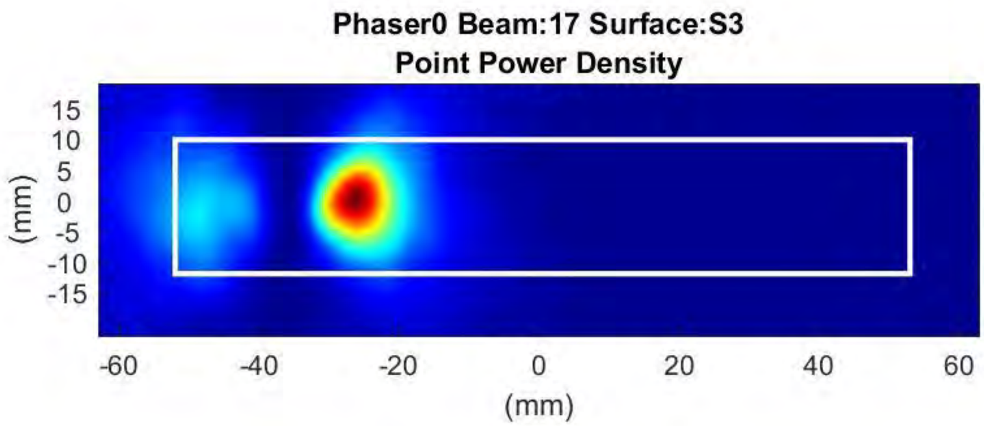
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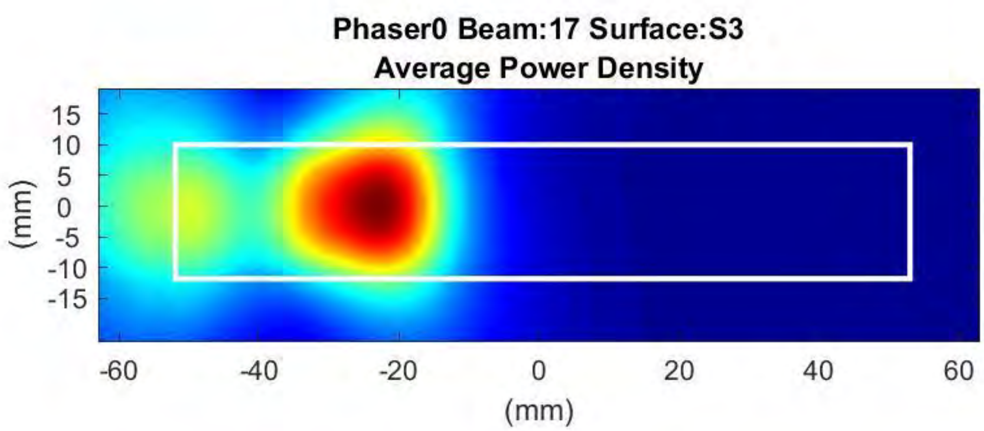
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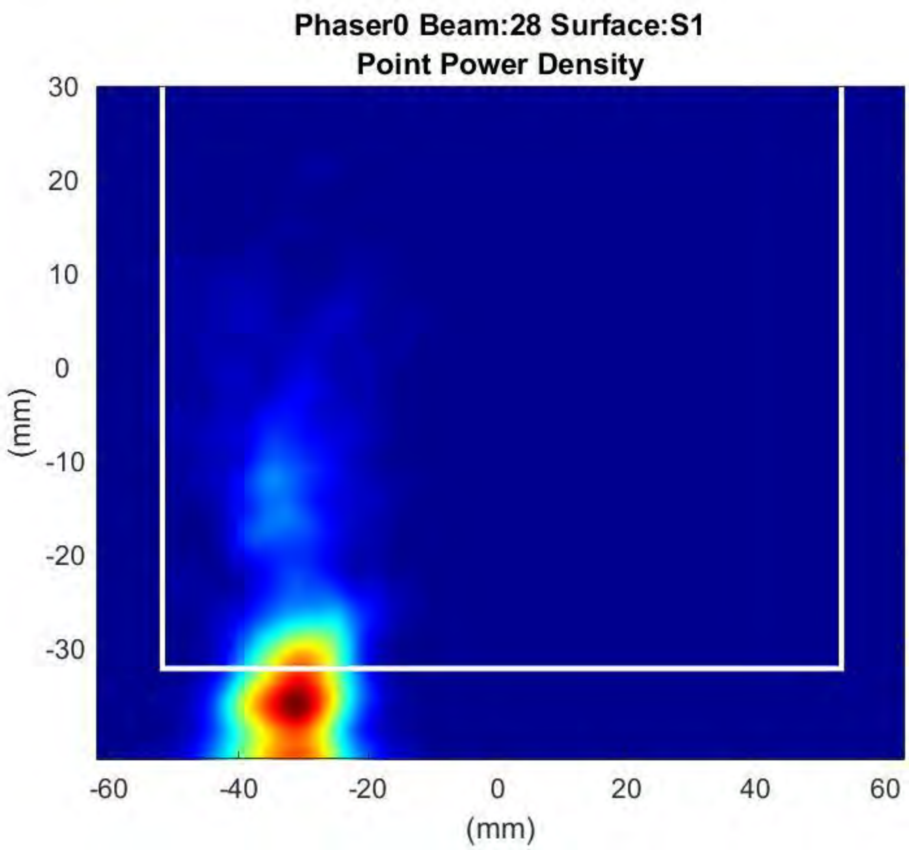

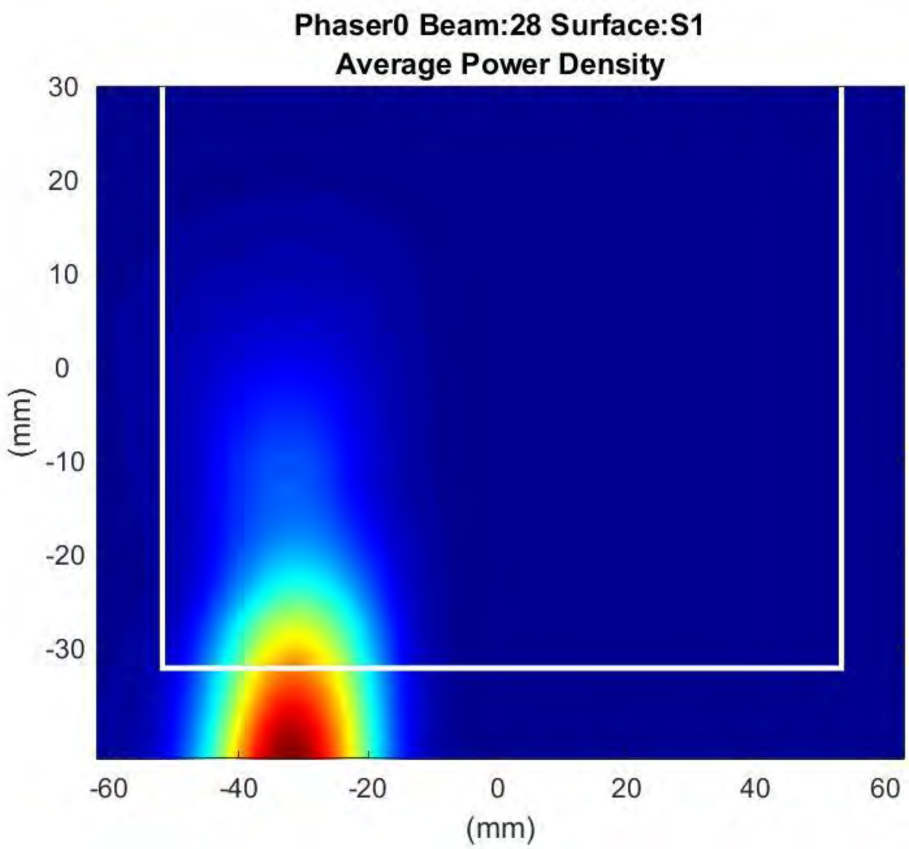

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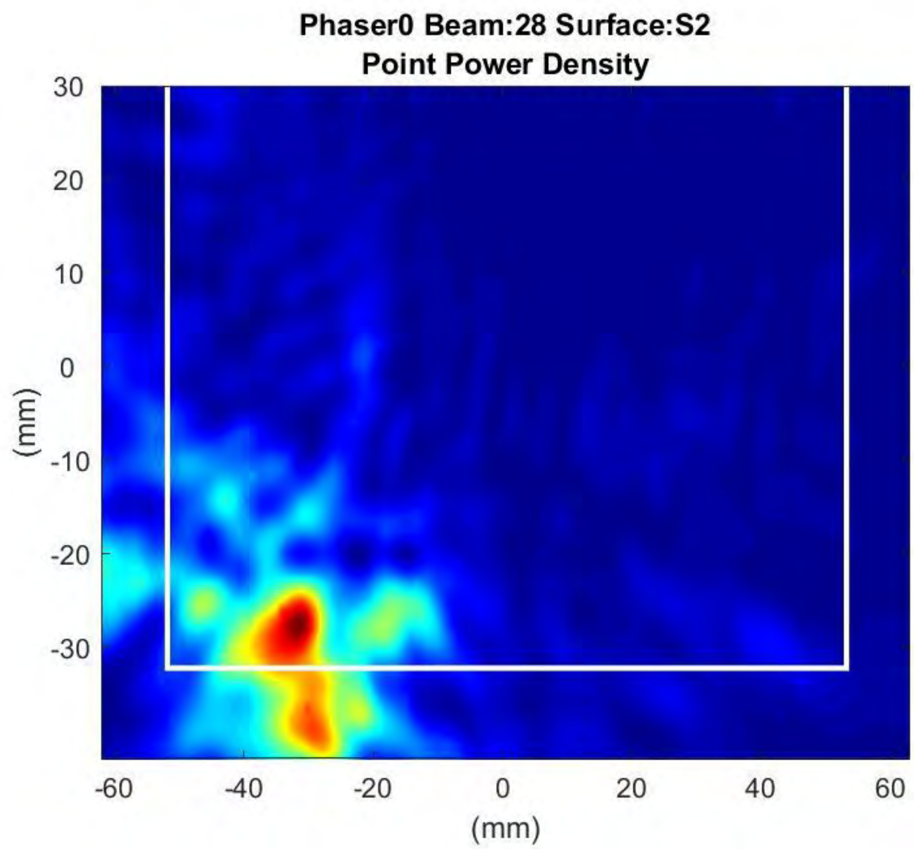
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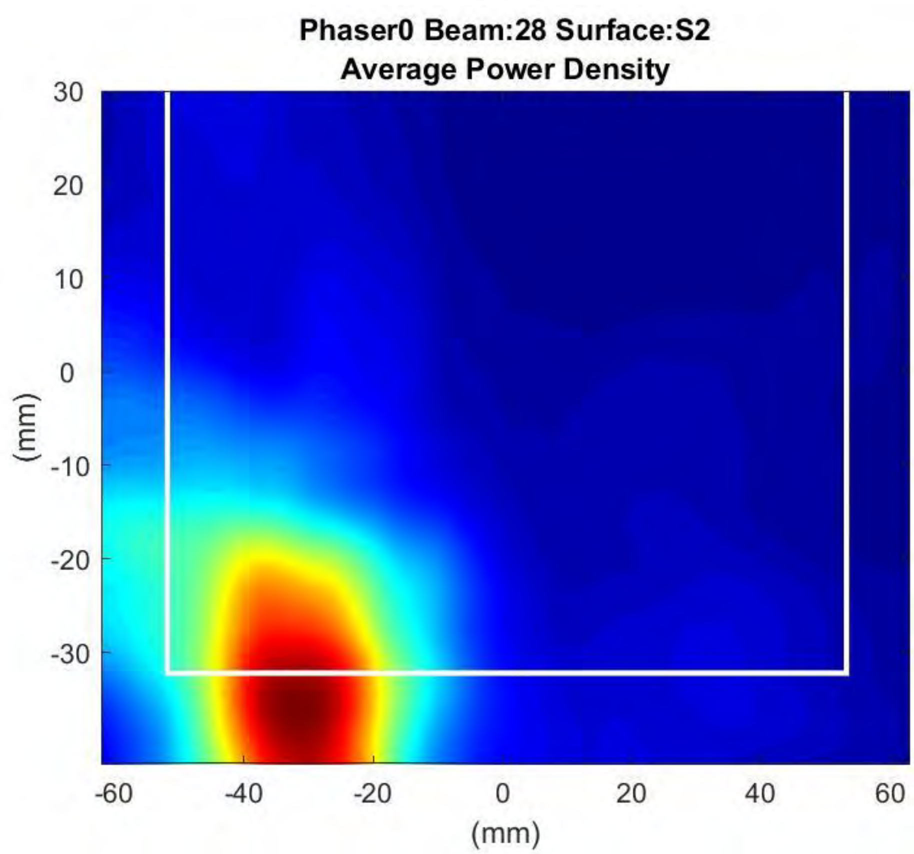
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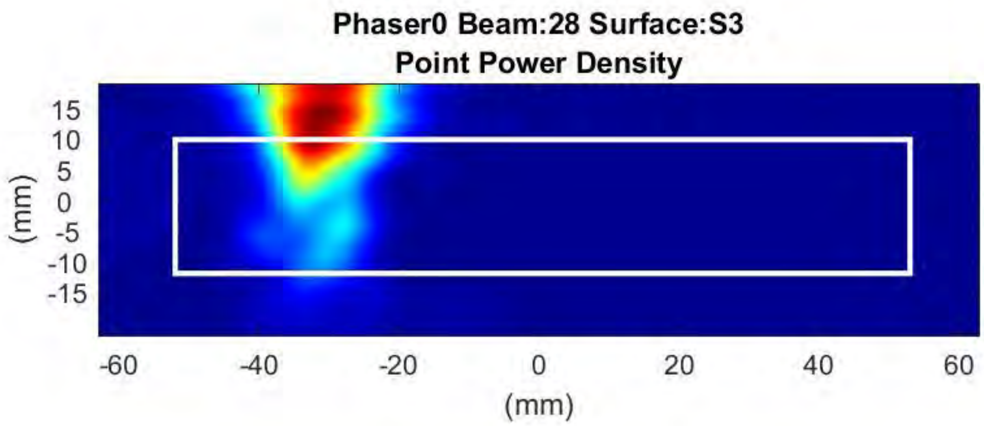
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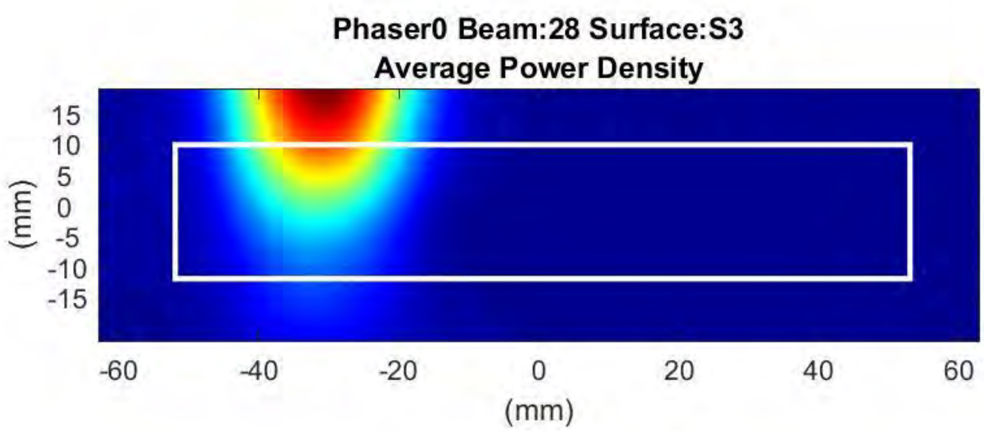
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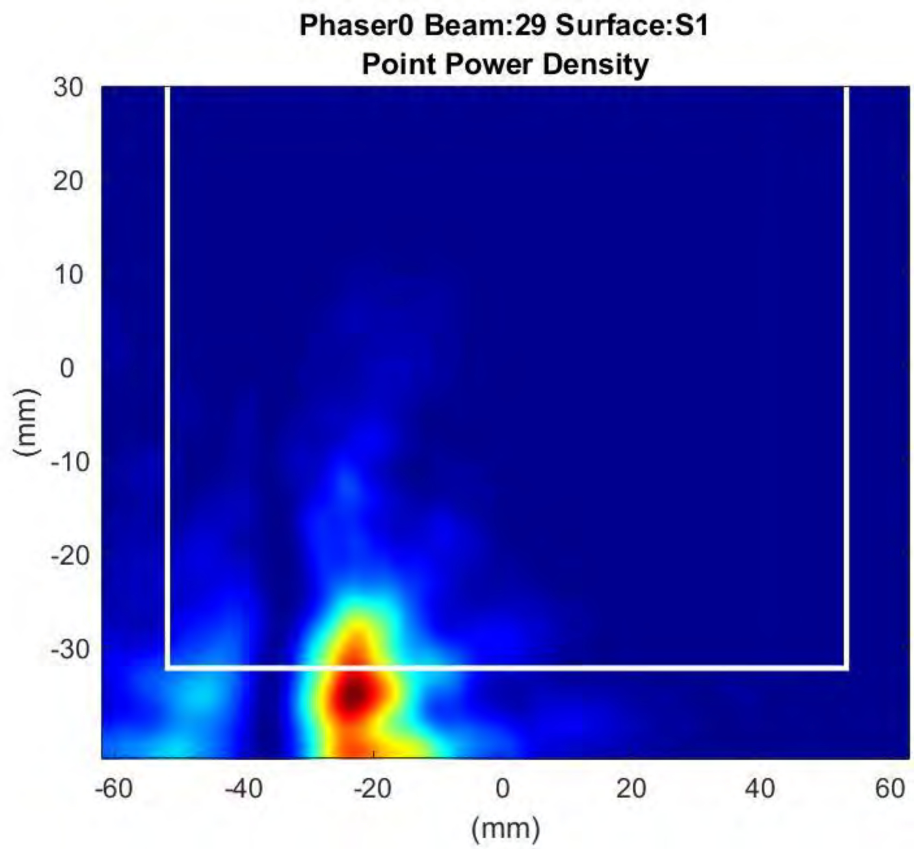
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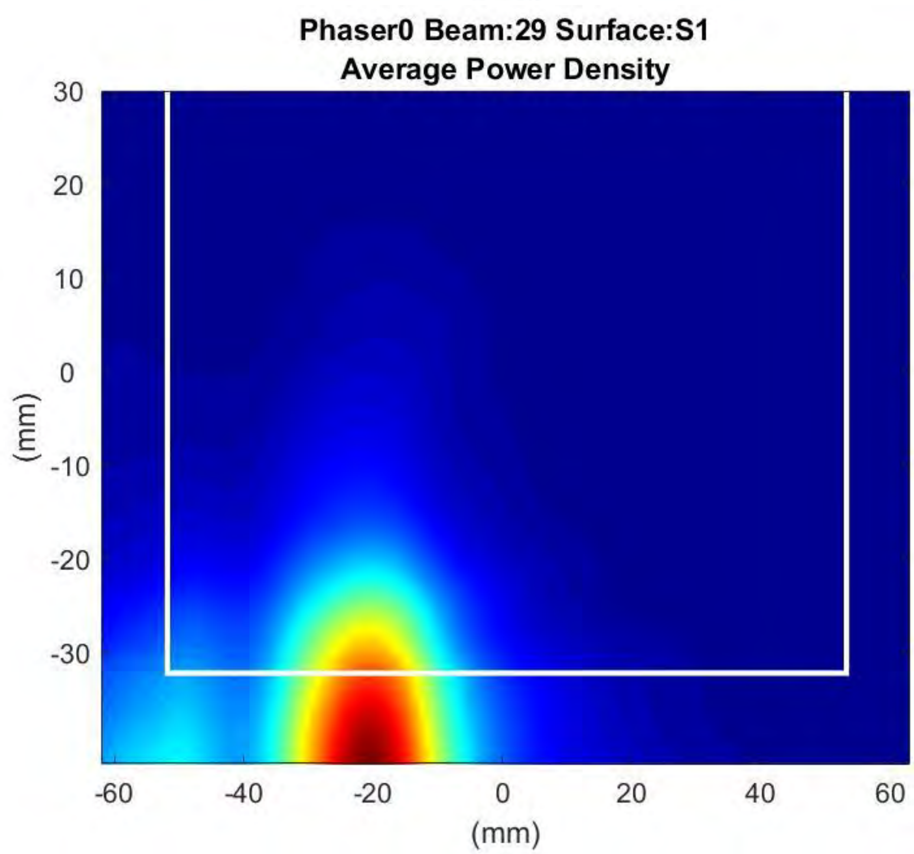
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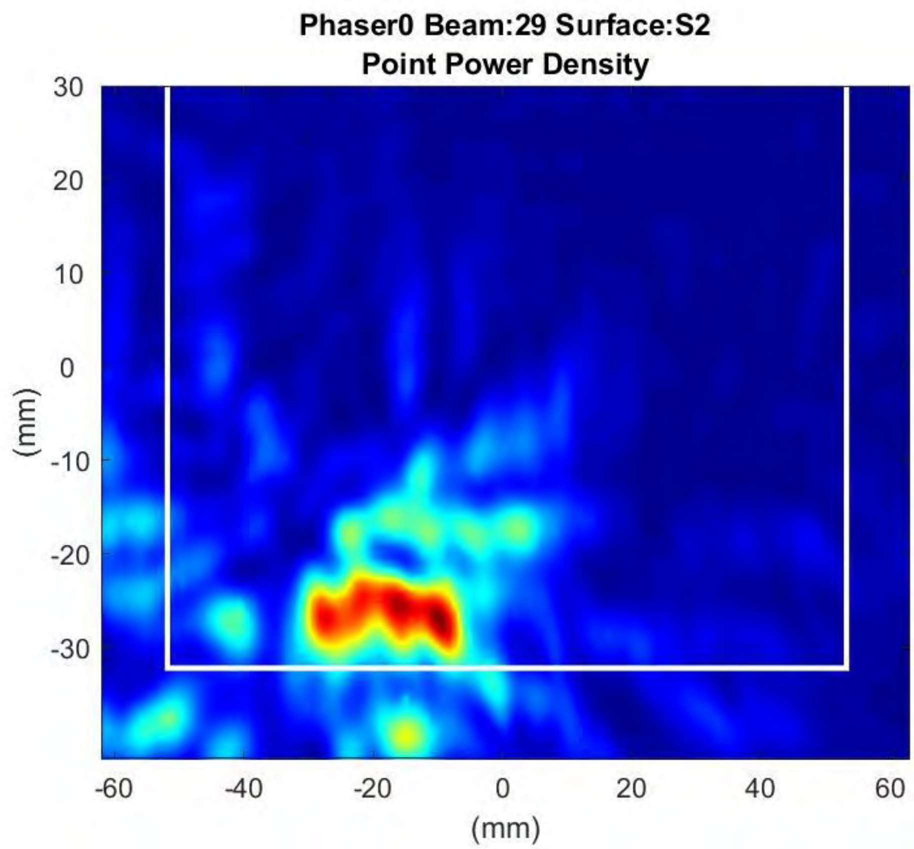
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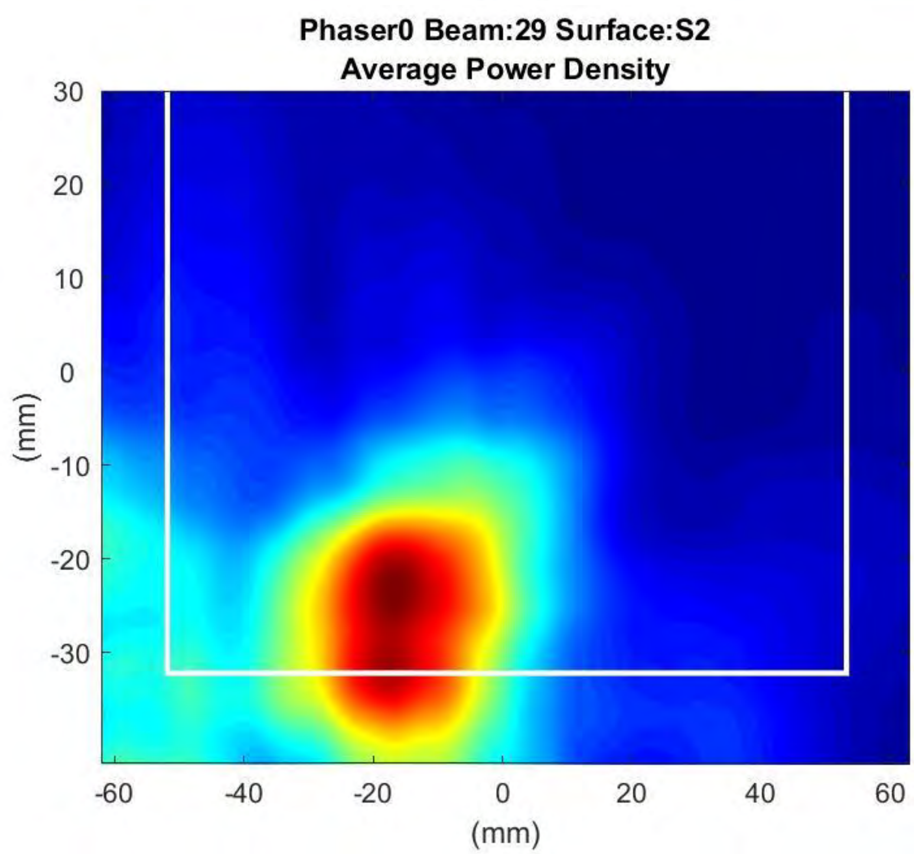
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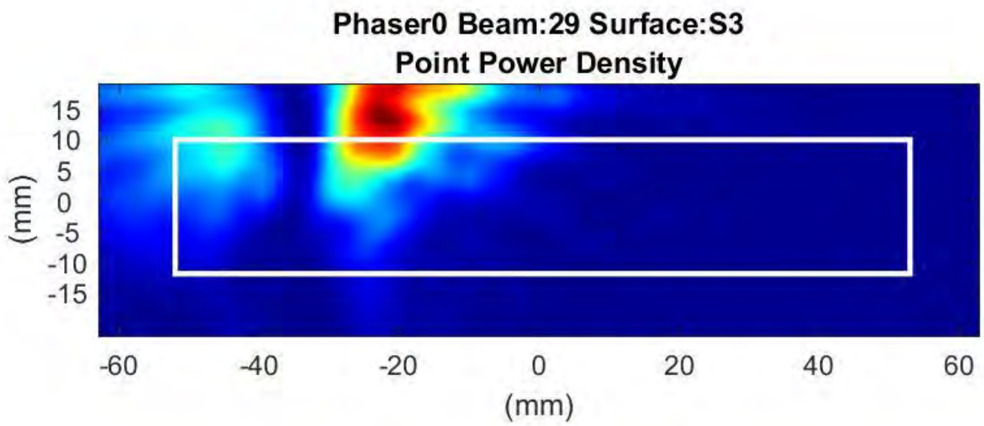
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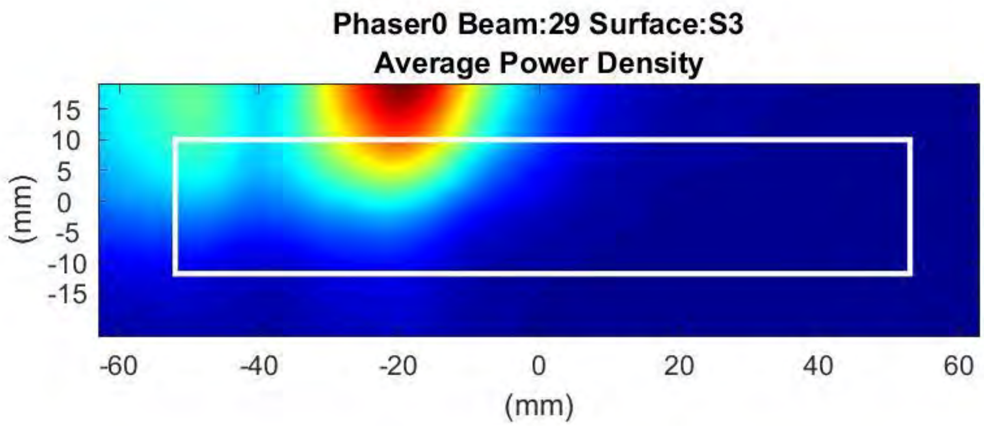
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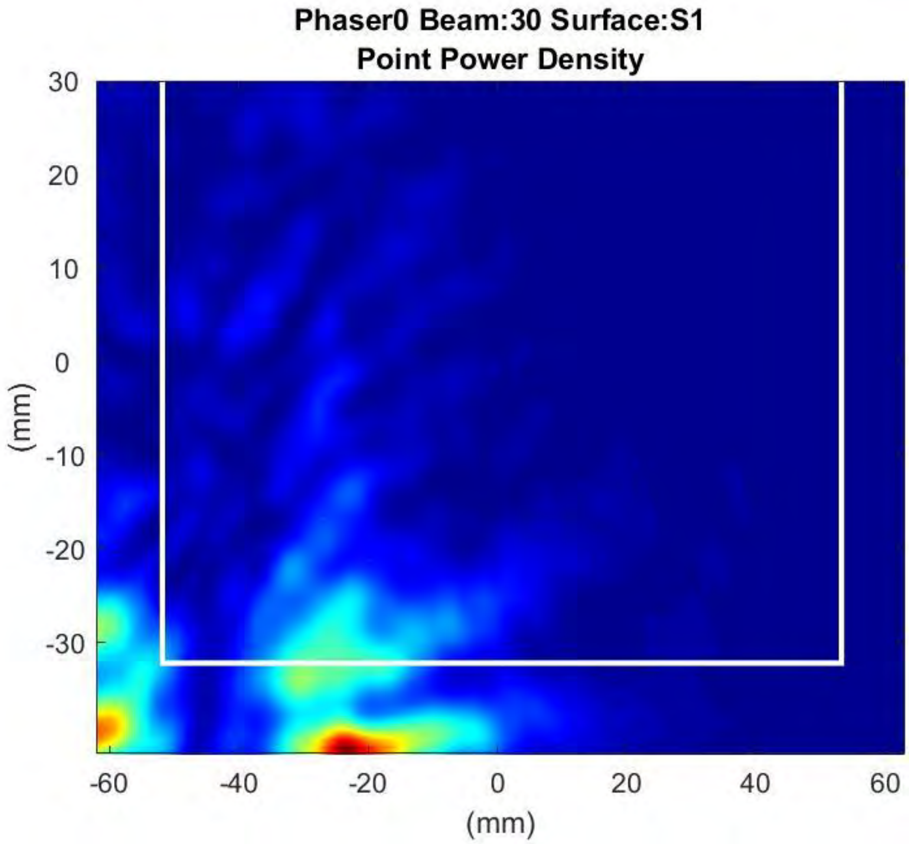
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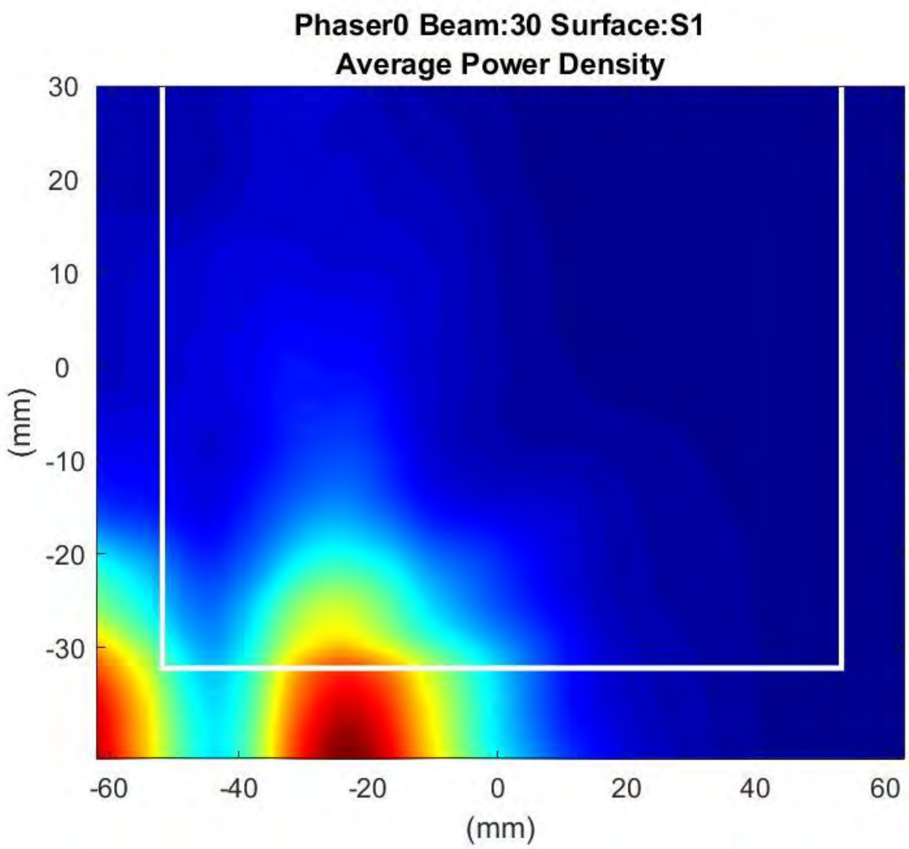
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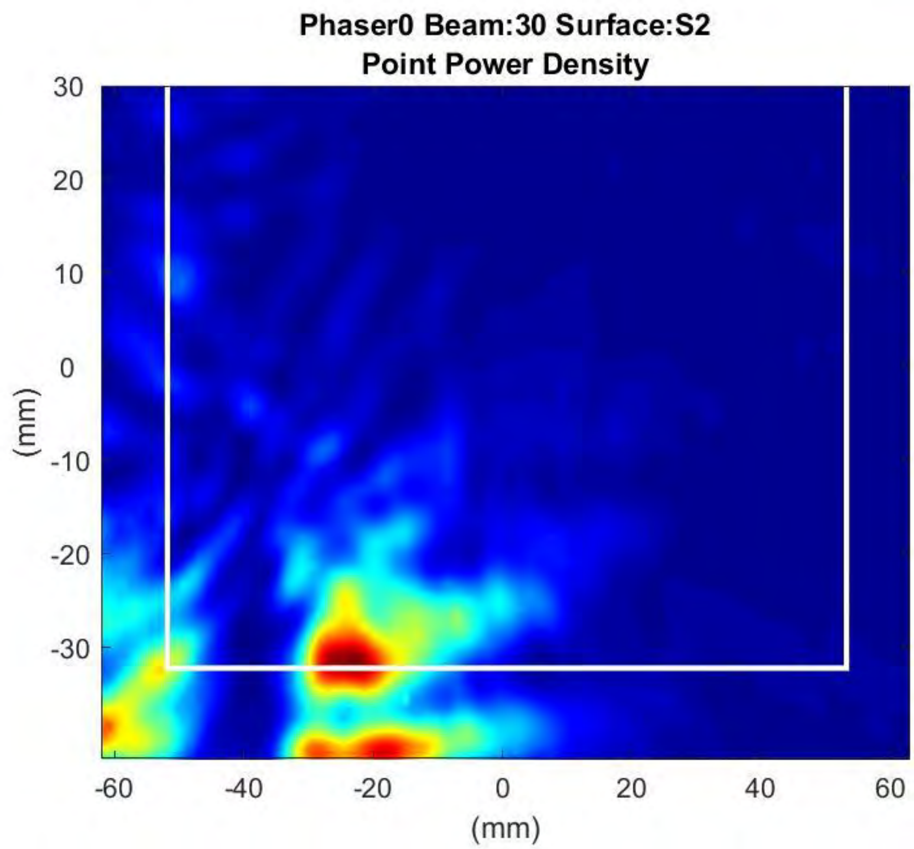
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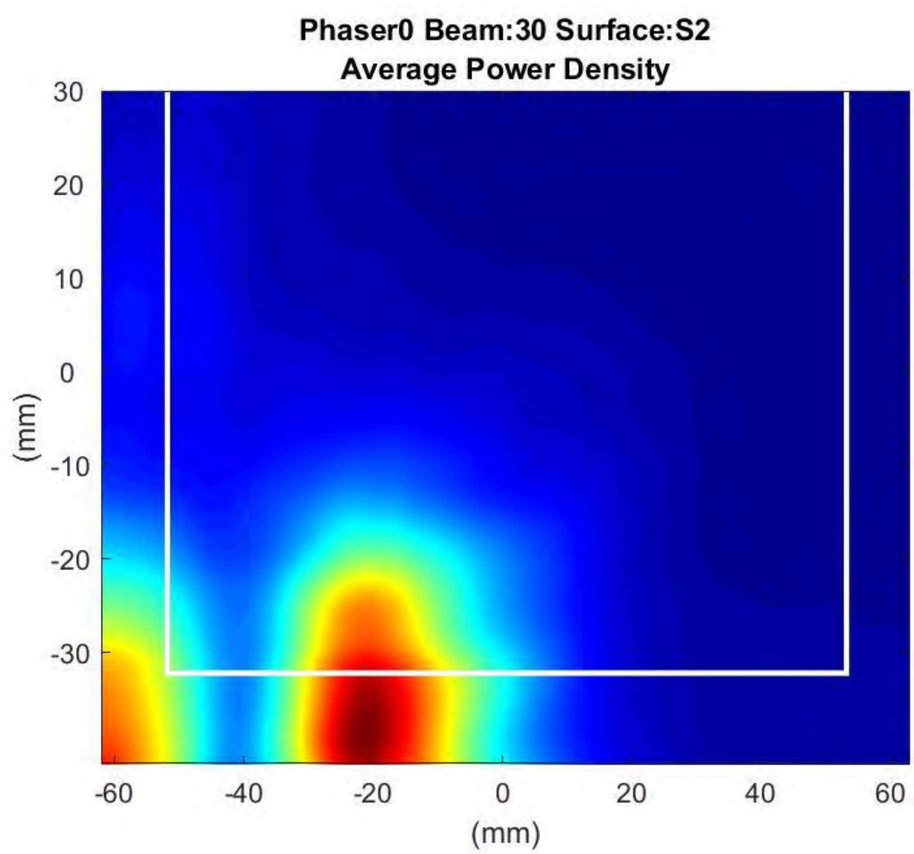
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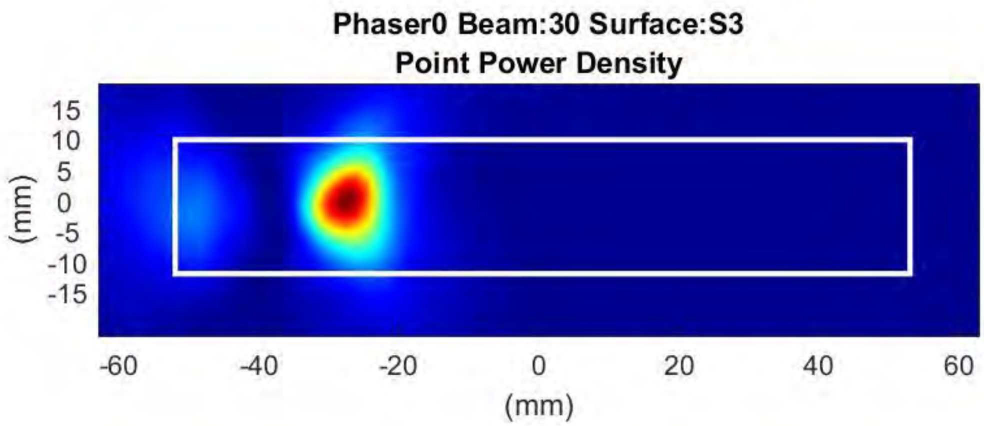
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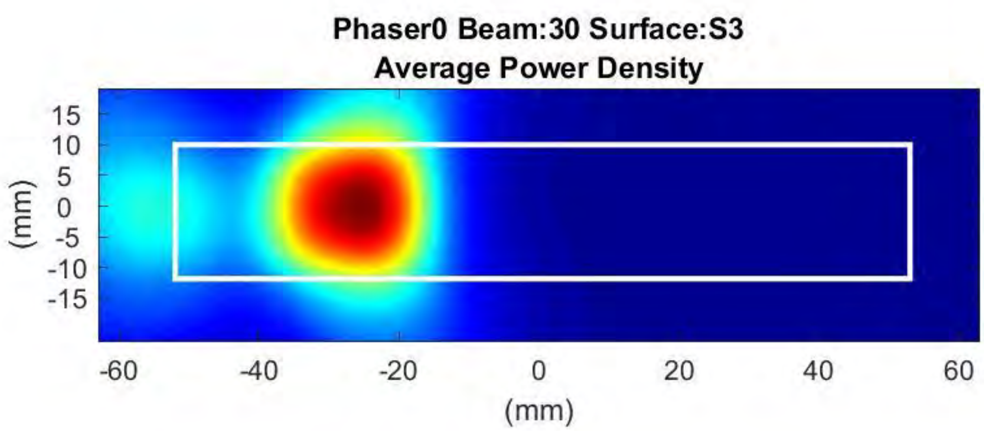
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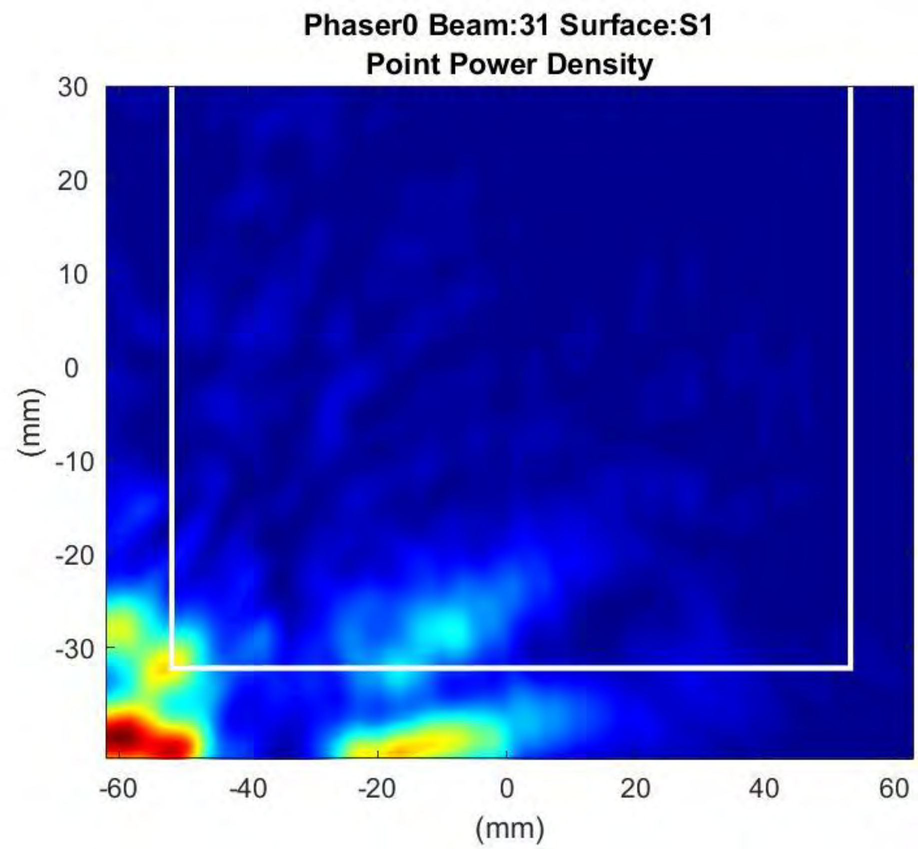
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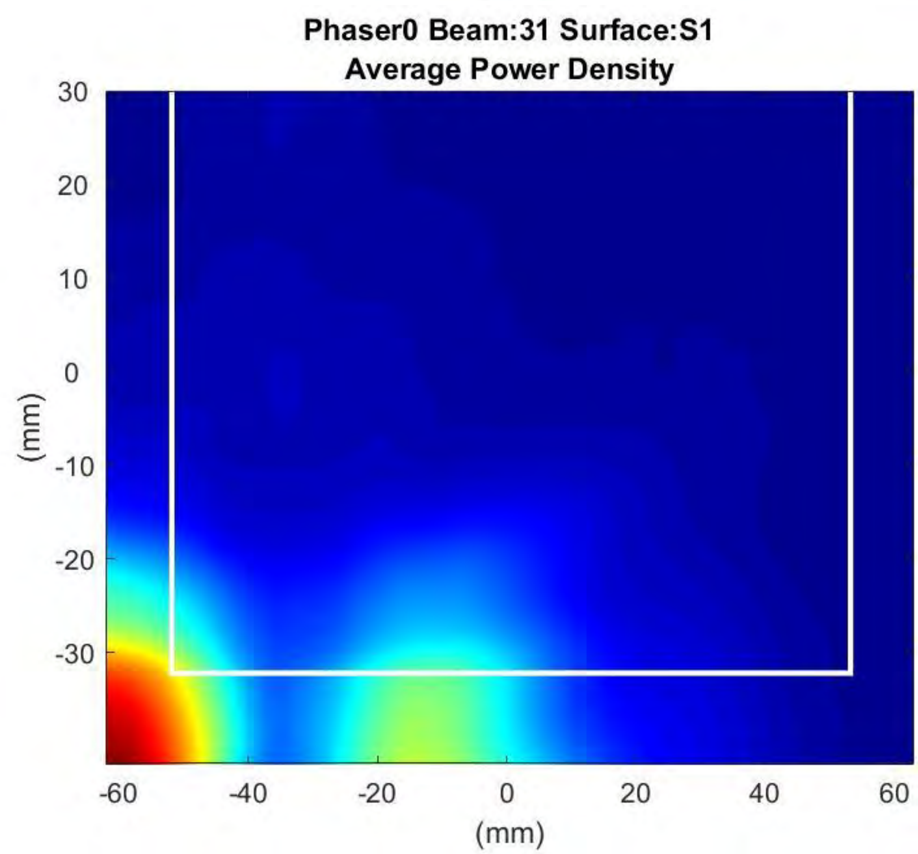
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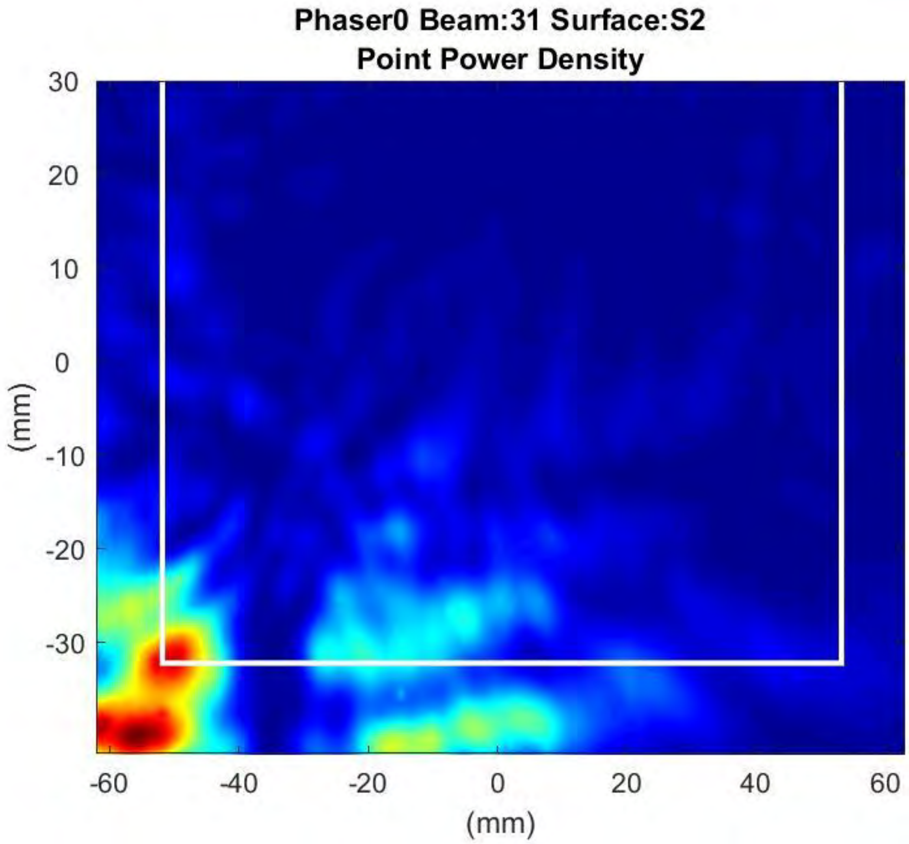
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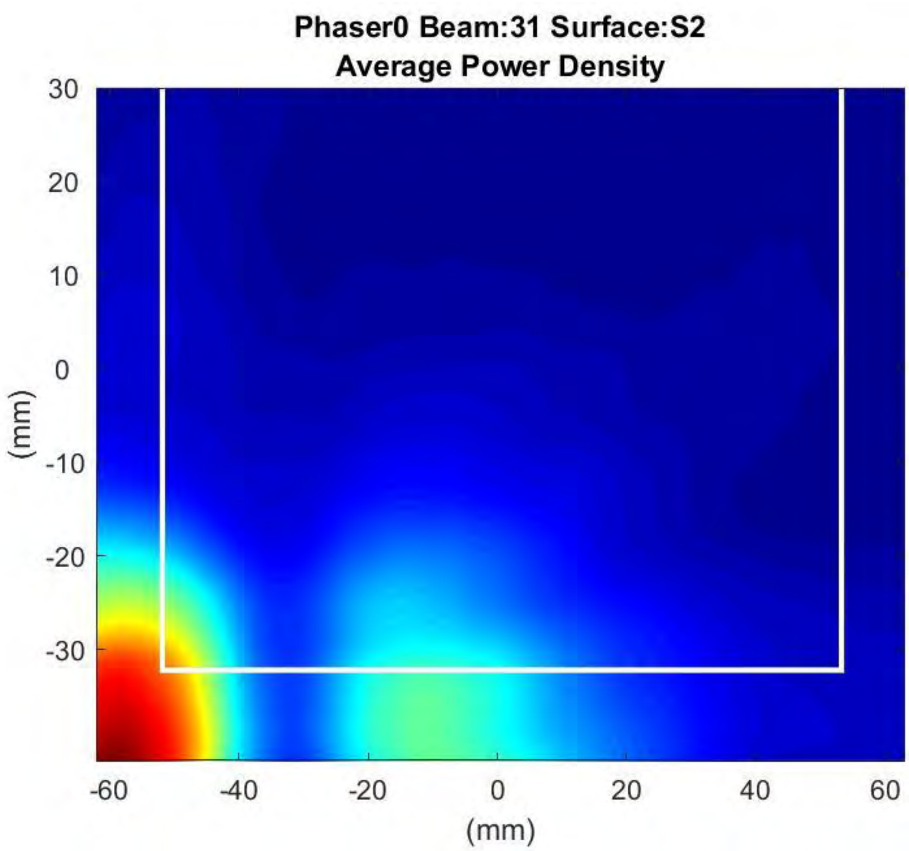
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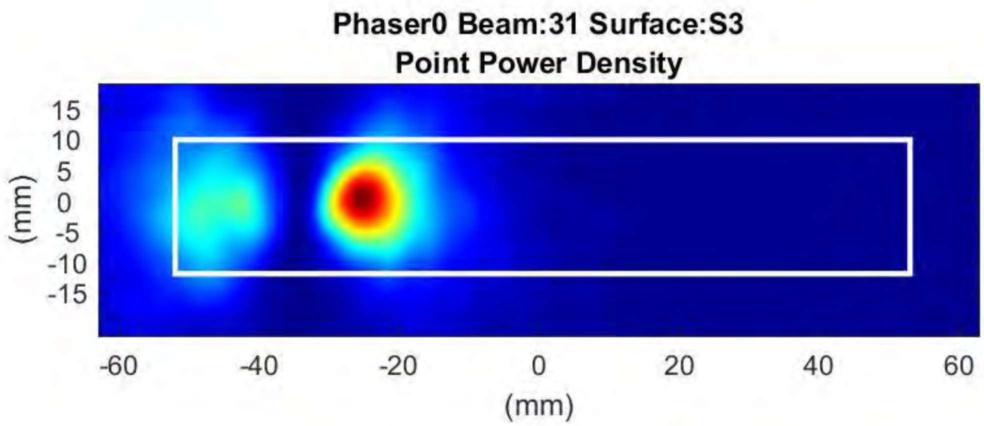
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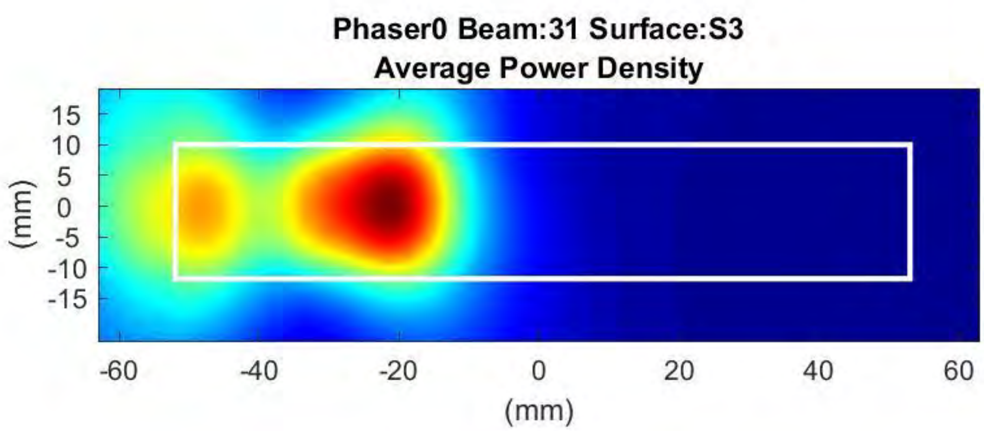
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