Microsoft

Power Density Simulation Report

for

MODEL NO. 1997

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I. Introduction

Model 1997 uses a 5G modem, transceivers, and two mmWave modules which together enable the device to transmit in the 5G NR mmWave bands (FR2.)

Each mmWave module employs beamforming technology to steer the transmit beams in desired directions. There are four patch antenna elements in each module; the relative phase and amplitudes of the signals delivered to each antenna element are controlled to create the beams. The list of all possible beams the device can use is called the codebook, which is determined through a beam characterization process prior to power density evaluations. Since RF exposure must be evaluated for all of the many possible beams on each of the device's applicable surfaces, power density simulations are used here to support the RF exposure evaluation process.

This report summarizes the power density simulations and correlation measurements performed to support RF Exposure compliance evaluation for the 5G mmWave antenna modules in Model 1997 using the device's codebook. The report has three main sections:

- Simulation Methodology
- Simulation Validation through Measurements
- Simulation Results

A. Power Density

Power density is the amount of power propagating in a given area. The units of power density are typically given in either W/m^2 or mW/cm^2. The FCC limit for power density with respect to RF exposure is 1.0 mW/cm^2. For localized exposure the power density is averaged over a $4cm^2$ area before comparison to the limit.

Physically, power density can be described as the cross product of the E (electric) and H (magnetic) field vectors at a given location, also known as the Poynting Vector. To find the average power density over a $4cm^2$ area then, the integral of that cross product over that area and then divided by the area can be used. The goal of all simulations and measurements detailed in this report is to determine this $4cm^2$-average power density for all possible beams of the device, in all possible transmit modes, on any surface which might pose the highest potential power density exposure from the device.

$$\mathrm{PD}_{av} = \frac{1}{A}\int_A \langle \vec{\mathrm{S}} \rangle \cdot ds = \frac{1}{2A_{av}}\iint_{A_{av}} \|Re\{ExH^*\}\| \, dA$$

II. Simulation Methodology

A. Simulation Modeling and Surface Selection

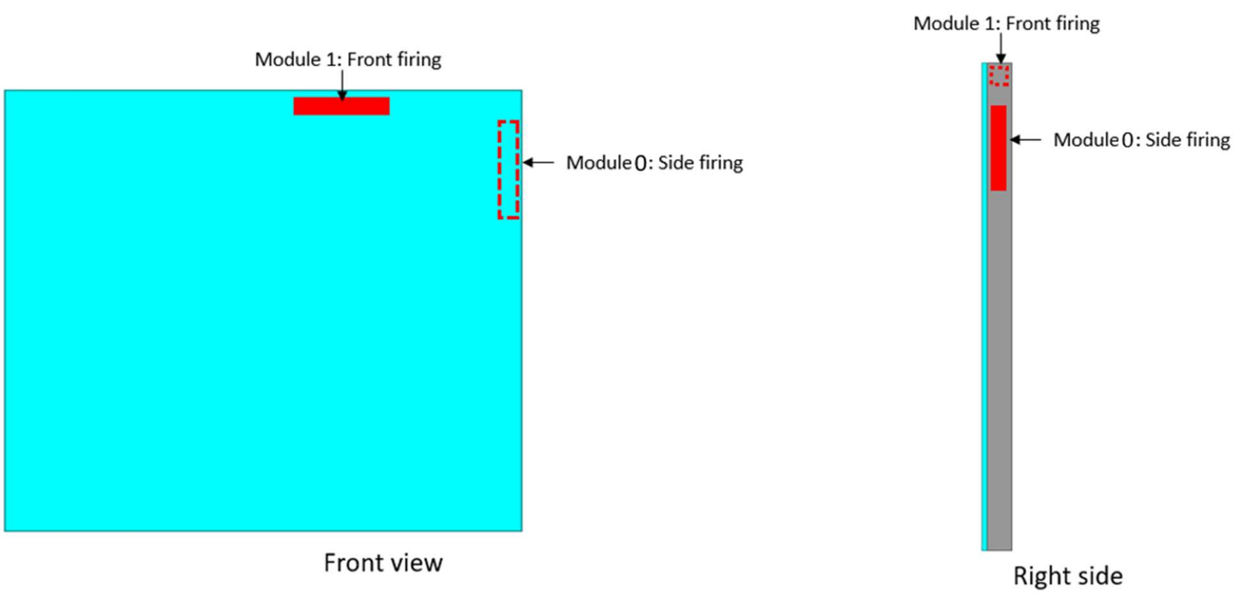
The simulation approach to perform PD assessment requires accurate modeling for the mmW antenna modules as well as the device itself. The device contains two mmW antenna modules. Each module contains four patch antenna elements which support dual polarization (horizontal and vertical). The encrypted Ansys model of mmW module for simulations was provided by the module manufacturer.

The device level simulation model for PD assessment was modeled according to best engineering practices. For PD simulations all the important details of the device such as housing, mmW antenna modules, all sub6 antennas, PCB, mmW flex, battery, shields were included within at least two wavelengths around each mmW antenna module.

Figures 1 shows the device along with the simulation planes as they are defined. All PD evaluation simulation planes are 2mm from the applicable device surfaces.

All six surfaces of the device were examined, but not all were chosen for power density simulations. Some surfaces were excluded due to their distance from the mmWave modules. For example, for Module 1, the PD evaluation was performed only for front, back, and top planes as the PD values on other planes such as the right plane are much lower due to the large separation distance to the other planes. Similarly, for Module 0, the PD evaluation was conducted on the front, back, right, and top planes only. All PD reports were generated at low, mid, and high channels for all bands.

Table 1 shows which surfaces were chosen for power density simulations.



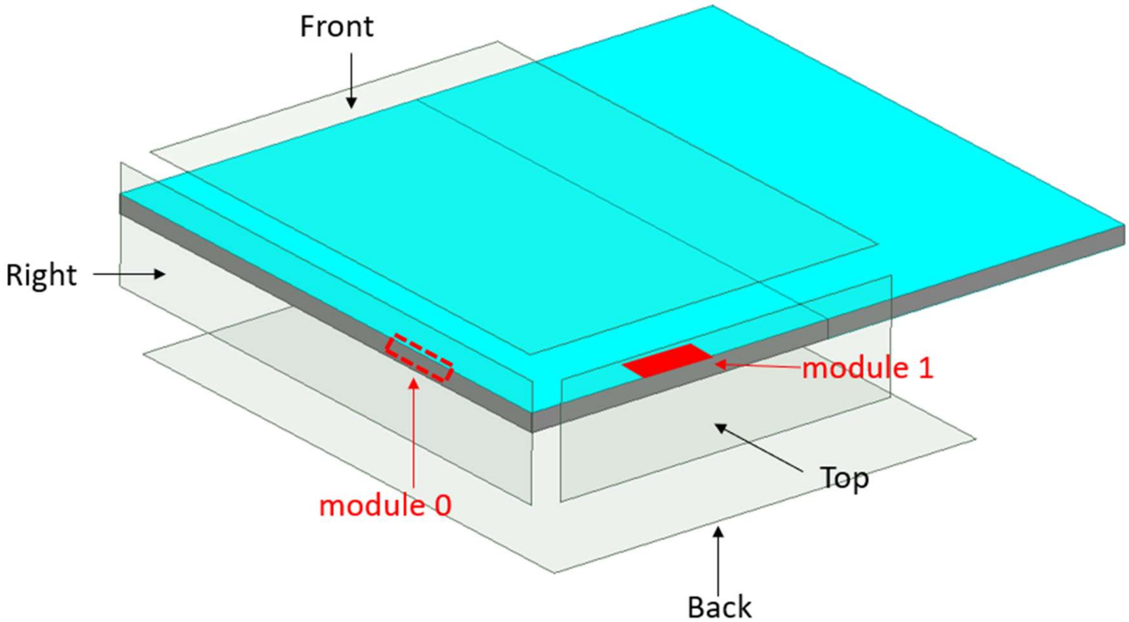


Figure 1. mmWave Antenna Module Locations and Simulation Evaluation Planes

Module	Front	Back	Left	Right	Top	Bottom
0	Yes	Yes	No	Yes	Yes	No
1	Yes	Yes	No	No	Yes	No

Table 1. Surfaces Selected for PD Simulation

B. Simulation Setup

ANSYS Electromagnetics suite version v21.2 (HFSS) was used to estimate power density. This tool is based on Finite Element Method (FEM), which operates in the frequency domain. 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 were selected as adaptive options in the simulation setup.

The system (ANSYS Electromagnetics suite v21.2) computes the error, and the iterative process (solve – error analysis – adaptive mesh refinement) repeats until the convergence criteria Max. Delta S reaches to the value equal or less than the specified value assigned in simulation setup. The Max. Delta (Mag S) is the maximum difference of S-Matrix magnitudes between two consecutive passes. For PD calculations Max. Delta S was taken as 0.02. In ANSYS Electromagnetics suite v21.2, as long as convergence is reached, the converged results are accurate. Fig. 2 is an example of adaptive mesh of the device (side view).

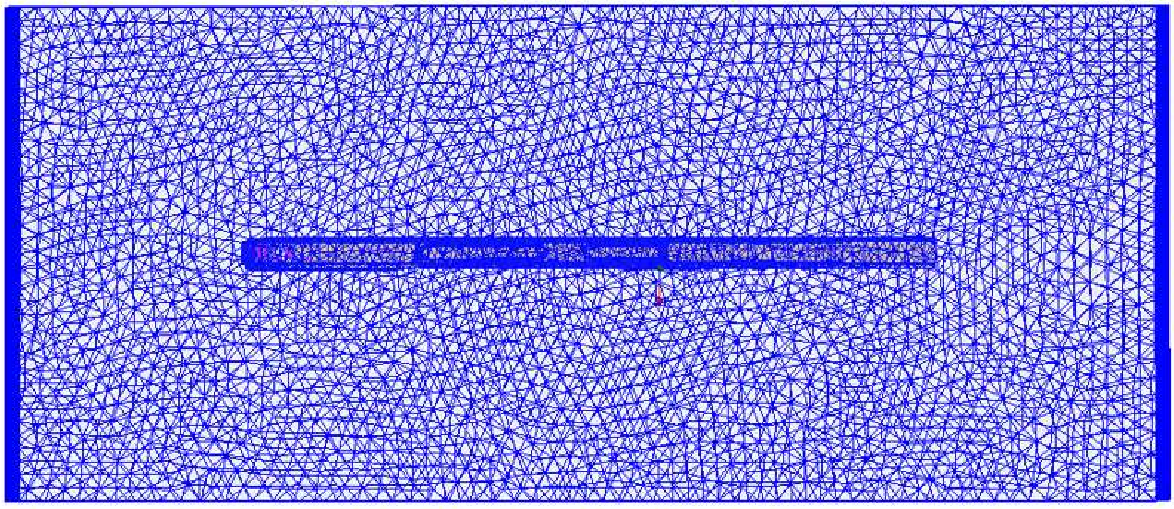


Figure 2. Example of adaptive mesh (side view)

To simulate antennas, HFSS requires a radiation boundary that approximates free space. In this report, all simulations are done with a perfectly matched layer boundary condition (PML) due to its low dependence on field incident angle and distance from the source. The PML boundary is more suitable for antenna array simulation compared to the ABC radiation boundary that is commonly used.

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. There is a minimum three wavelength spacing between the surface of the device and the radiation boundary in all main beam directions in this RF exposure report. An example of the radiation boundary used in this report can be found in Figure 3.

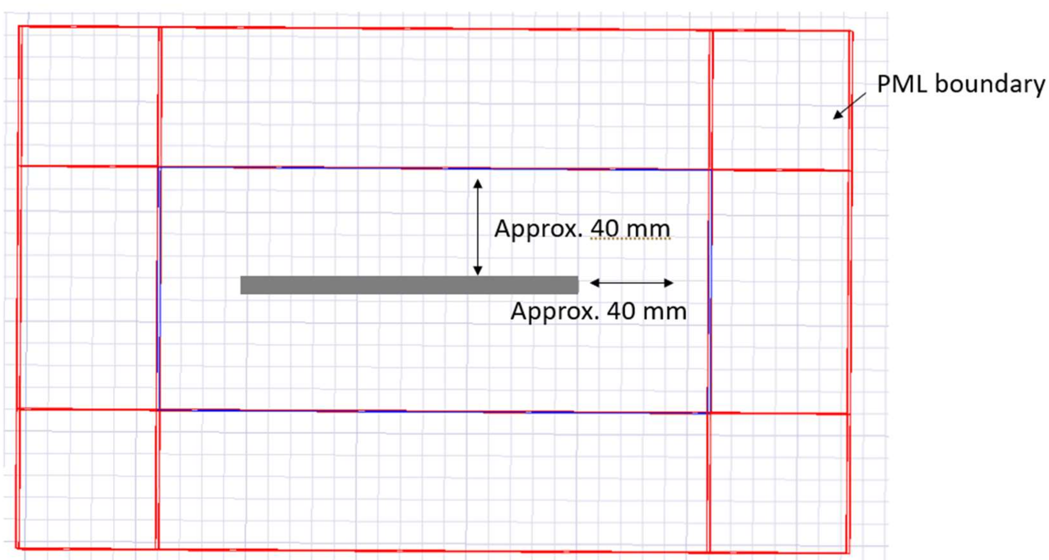


Figure 3. Radiation Boundary Setup

III. Simulation Validation through Measurements

A. Measurement System

The simulations were validated by power density measurements made with SPEAG's DASY measurement system with EUmmWVx probe extension. This system uses a pseudo-vector probe which measures E-Field. The robotic system positions the measurement probe so that sensors in the probe tip measure in a plane 2mm from the surface of the device, and then in a second plane further away. Together the E-Field measurements from these two planes are used to reconstruct both the E- and H-fields, as well as to determine the power density. The 4 cm^2-average power density can thus be determined through measurements in the same planes which were previously simulated 2mm from the device.

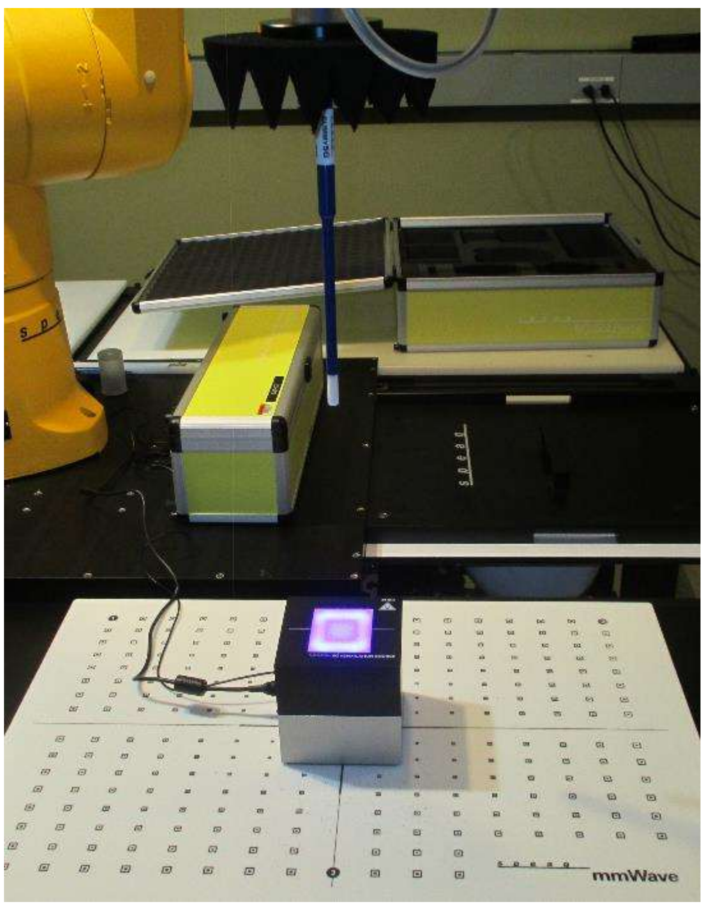


Figure 4. DASY mmWave Measurement Setup

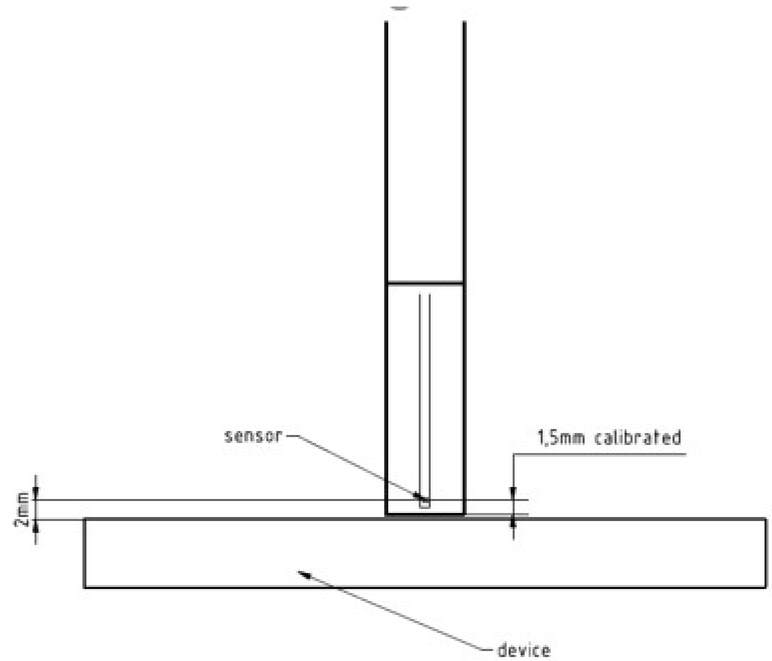


Figure 5. Illustration of 2mm Measurement Distance between mmWave Probe Sensor Elements and Device Surface

B. Simulation Validation

The following process was used to correlate the Power Density simulations.

1. For each band, one single beam in each polarization (horizontal and vertical) was selected for each antenna. Each beam should employ a higher number of active antenna elements.
2. For each of these beams, measurements on select key surfaces near the antenna module were performed to correlate with the simulations for the same surfaces. All measurements were made with the device transmitting at the mid channel of the given band using CW signals.
3. A reference power level of 6 dBm was used since that is the transmit power level defined by the module manufacturer to have a 0.5 dB uncertainty when transmitting CW signals.
4. The PD distributions between the measurements and simulations were compared for similarities to show correlation, see Appendix A for plots. There are expected differences in the magnitudes of the simulations and measurements. The discrepancy can be due to several reasons such as housing material properties used in simulations and field dispersion effect of probe during measurements.

C. Δ_{min} Determination – Worst-case Housing Influence

The difference in magnitude between the simulated and measured PD is used to determine the worst-case housing influence since non-metal material properties can't be accurately characterized at mmWave frequencies. Only surfaces which might impact the PD char, the worst-case surfaces with the highest $4cm^2$-averaged PD, were used to determine the worst-case housing influence. Δ_{min} represents the worst case where RF exposure is underestimated the most by simulations.

Since the mmWave modules are placed in different locations, each may experience different housing material impacts due to their differing environments. The worst-case housing influence is determined per antenna module, per band. Measurements and simulations were performed at the 6 dBm reference power, at the middle channel of each band, for each polarization, for any surface which might contain the highest PD for a given module. To be conservative, the lowest Δ_{min} determined for a given module + band combination was later used in the PD characterization process for that combination.

Simulations and measurements were performed 2mm from the applicable device surfaces.

Δ_{min} – Band n261

Band	Module	Surface	Beam ID	Measured PD (mW/cm^2)	Simulated PD (mW/cm^2)	Δ_{min} (dB)
n261	0	Front	33	0.414	0.52	0.99
n261	0	Front	152	0.228	0.28	**0.89**
n261	0	Back	33	0.477	0.95	2.99
n261	0	Back	152	0.426	0.53	0.95
n261	0	Right	33	1.11	1.93	2.40
n261	0	Right	152	0.715	1.09	1.83
n261	1	Front	29	0.9	1.42	1.98
n261	1	Front	166	1.07	1.16	**0.35**
n261	1	Top	29	0.348	0.84	3.83
n261	1	Top	166	0.168	1.09	8.12

Table 2. Δ_{min} Calculated Values for n261 from 6 dBm Reference Power Simulations and Measurements

Δ_{min} – Band n260

Band	Module	Surface	Beam ID	Measured PD (mW/cm^2)	Simulated PD (mW/cm^2)	Δ_{min} (dB)
n260	0	Front	34	0.28	0.32	0.58
n260	0	Front	152	0.298	0.37	0.94
n260	0	Back	34	0.409	0.49	0.78
n260	0	Back	152	0.844	0.65	**-1.13**
n260	0	Right	34	0.871	0.96	0.42
n260	0	Right	152	1.17	1.45	0.93
n260	1	Front	27	0.736	0.88	0.78
n260	1	Front	157	0.78	0.85	**0.37**
n260	1	Top	27	0.122	0.46	5.76
n260	1	Top	157	0.231	0.43	2.70

Table 3. Δ_{min} Calculated Values for n260 from 6 dBm Reference Power Simulations and Measurements

IV. Simulation Results

All simulated PD values shown in the tables below are for the planes 2mm from the given surface of the device. These are the worst-case surfaces for the given module which are near that module, and thus might contain the highest PD values needed for PD characterization later.

The worst-case overall scaling factor per module + band + beam are also included here which will later be used to determine the compliant *input.power.limits.* The scaling factor is used to adjust the 6 dBm reference power level to the compliant levels during PD characterization. Lower scaling factors are more conservative; the scaling factor was calculated for each surface and the lowest from all surfaces was taken for each beam. The scaling factor for a given beam *i* of M possible beams is calculated as:

$$s(i) = \frac{PD\ design\ target}{sim.PDsurface}, i = 1, 2, \dots M$$

Note that for beam pairs, the relative phase between beam pairs is not controlled by the mmWave module. So any relative phase between beam pairs is possible and the worst-case relative phase must be accounted for in the simulations. The relative phase between beam pairs is swept from 0 to 360 degrees in 5 degree increments to find the relative phase resulting in the highest PD. This worst-case phase was used to determine all beam pair PD values in the tables below, and thus for the *sim.PDsurface* in the equation above.

All simulated PD results shown on the following pages are for the plane 2mm from the given surface of the device. Some edges not included in the simulation report were confirmed to have much lower PD than the reported edges for those band + antenna combinations.

Band n261 – Simulated PD

Module 0 – n261 – Low Channel							
Beam ID	Paired Beam ID	# of Active Feeds	4cm² PD (mW/cm²) at 2mm				s(i) – Scaling Factor
			Front	Back	Right	Top	
0		1	0.16	0.12	0.46	0.01	1.340
2		1	0.13	0.26	0.48	0.01	1.285
4		1	0.13	0.24	0.48	0.02	1.285
6		1	0.16	0.18	0.50	0.02	1.233
8		2	0.35	0.48	0.98	0.01	0.629
9		2	0.31	0.56	0.98	0.02	0.629
10		2	0.25	0.45	0.91	0.04	0.678
11		2	0.34	0.45	0.98	0.01	0.629
16		2	0.26	0.53	0.98	0.05	0.629
17		2	0.31	0.53	0.98	0.01	0.629
18		2	0.34	0.46	1.01	0.02	0.610
22		4	0.42	0.56	1.35	0.01	0.457
23		4	0.43	0.82	1.55	0.12	0.398
24		4	0.43	0.66	1.51	0.10	0.408
25		4	0.47	0.79	1.29	0.10	0.478
26		4	0.41	0.69	1.29	0.04	0.478
32		4	0.36	0.48	1.37	0.09	0.450
33		4	0.48	1.00	1.79	0.10	0.344
34		4	0.52	0.54	1.63	0.12	0.378
35		4	0.39	0.82	1.30	0.08	0.474
128		1	0.08	0.16	0.46	0.01	1.340
130		1	0.10	0.18	0.45	0.01	1.370
132		1	0.08	0.18	0.43	0.02	1.434
134		1	0.08	0.15	0.35	0.03	1.762
136		2	0.18	0.38	0.73	0.03	0.845
137		2	0.16	0.31	0.69	0.03	0.894
138		2	0.11	0.29	0.82	0.05	0.752
139		2	0.18	0.30	0.75	0.07	0.822
144		2	0.23	0.44	0.87	0.04	0.709
145		2	0.13	0.21	0.58	0.09	1.063
146		2	0.20	0.35	0.79	0.07	0.781
150		4	0.48	0.88	1.60	0.12	0.385
151		4	0.39	0.78	1.46	0.05	0.422
152		4	0.32	0.69	1.27	0.09	0.486
153		4	0.29	0.47	1.21	0.15	0.510
154		4	0.38	0.58	1.30	0.13	0.474
160		4	0.44	0.81	1.48	0.07	0.417
161		4	0.37	0.74	1.33	0.02	0.464
162		4	0.33	0.64	1.35	0.08	0.457
163		4	0.27	0.40	0.95	0.17	0.649
0	128	2	0.28	0.32	0.90	0.04	0.685
2	130	2	0.28	0.59	0.97	0.03	0.636
4	132	2	0.30	0.55	0.94	0.04	0.656
6	134	2	0.25	0.41	1.05	0.09	0.587
8	136	4	0.56	0.99	1.78	0.05	0.346
9	137	4	0.56	1.05	1.62	0.04	0.381
10	138	4	0.47	0.94	1.90	0.12	0.325
11	139	4	0.53	0.80	1.75	0.07	0.352
16	144	4	0.75	1.33	1.97	0.11	0.313
17	145	4	0.52	0.92	1.66	0.13	0.371
18	146	4	0.43	0.59	1.20	0.11	0.514
22	150	8	1.00	1.63	3.29	0.19	0.187
23	151	8	1.00	1.90	3.19	0.22	0.193
24	152	8	0.68	1.38	2.61	0.34	0.236
25	153	8	0.84	1.11	2.37	0.20	0.260
26	154	8	0.83	1.42	2.70	0.21	0.228
32	160	8	0.91	1.47	3.05	0.23	0.202
33	161	8	0.83	1.79	3.13	0.16	0.197
34	162	8	0.84	1.12	2.44	0.24	0.253
35	163	8	0.79	1.32	2.12	0.24	0.291

Module 0 – n261 – Mid Channel							
Beam ID	Paired Beam ID	# of Active Feeds	$4cm^2$ PD (mW/cm^2) at 2mm				s(i) – Scaling Factor
			Front	Back	Right	Top	
0		1	0.17	0.12	0.47	0.02	1.312
2		1	0.13	0.24	0.54	0.01	1.142
4		1	0.14	0.21	0.54	0.02	1.142
6		1	0.16	0.17	0.57	0.03	1.082
8		2	0.36	0.42	1.06	0.02	0.582
9		2	0.32	0.50	1.12	0.02	0.551
10		2	0.24	0.40	0.99	0.04	0.623
11		2	0.35	0.42	1.05	0.01	0.587
16		2	0.27	0.49	1.12	0.05	0.551
17		2	0.32	0.47	1.08	0.01	0.571
18		2	0.35	0.44	1.09	0.01	0.566
22		4	0.48	0.52	1.48	0.03	0.417
23		4	0.49	0.75	1.78	0.11	0.346
24		4	0.39	0.58	1.51	0.13	0.408
25		4	0.45	0.67	1.46	0.09	0.422
26		4	0.46	0.63	1.42	0.04	0.434
32		4	0.40	0.43	1.59	0.13	0.388
33		4	0.52	0.95	1.93	0.09	0.319
34		4	0.48	0.51	1.64	0.10	0.376
35		4	0.44	0.73	1.46	0.06	0.422
128		1	0.07	0.14	0.42	0.01	1.468
130		1	0.08	0.15	0.40	0.01	1.541
132		1	0.07	0.15	0.37	0.01	1.666
134		1	0.06	0.13	0.30	0.02	2.055
136		2	0.17	0.33	0.65	0.03	0.949
137		2	0.09	0.25	0.60	0.03	1.028
138		2	0.11	0.24	0.71	0.04	0.868
139		2	0.14	0.23	0.71	0.04	0.868
144		2	0.18	0.38	0.78	0.03	0.791
145		2	0.08	0.18	0.51	0.07	1.209
146		2	0.14	0.29	0.68	0.06	0.907
150		4	0.42	0.79	1.48	0.12	0.417
151		4	0.32	0.66	1.27	0.04	0.486
152		4	0.28	0.53	1.09	0.07	0.566
153		4	0.27	0.41	1.14	0.11	0.541
154		4	0.30	0.50	1.13	0.10	0.546
160		4	0.37	0.69	1.32	0.06	0.467
161		4	0.29	0.61	1.13	0.03	0.546
162		4	0.26	0.47	1.14	0.06	0.541
163		4	0.19	0.34	0.93	0.11	0.663
0	128	2	0.27	0.29	0.94	0.04	0.656
2	130	2	0.27	0.53	1.06	0.03	0.582
4	132	2	0.29	0.50	1.01	0.04	0.610
6	134	2	0.23	0.38	1.14	0.09	0.541
8	136	4	0.60	0.89	1.67	0.05	0.369
9	137	4	0.54	0.92	1.74	0.04	0.354
10	138	4	0.41	0.84	1.87	0.10	0.330
11	139	4	0.54	0.78	1.77	0.05	0.348
16	144	4	0.69	1.22	2.06	0.11	0.299
17	145	4	0.49	0.83	1.64	0.11	0.376
18	146	4	0.43	0.55	1.33	0.08	0.464
22	150	8	1.01	1.54	3.19	0.21	0.193
23	151	8	0.97	1.74	2.98	0.18	0.207
24	152	8	0.64	1.16	2.44	0.35	0.253
25	153	8	0.75	0.95	2.50	0.17	0.247
26	154	8	0.86	1.40	2.67	0.17	0.231
32	160	8	0.94	1.26	3.12	0.26	0.198
33	161	8	0.76	1.67	3.23	0.14	0.191
34	162	8	0.75	1.06	2.72	0.17	0.227
35	163	8	0.71	1.27	2.52	0.20	0.245

Module 0 – n261 – High Channel							
Beam ID	Paired Beam ID	# of Active Feeds	$4cm^2$ PD (mW/cm^2) at 2mm				s(i) – Scaling Factor
			Front	Back	Right	Top	
0		1	0.14	0.10	0.42	0.01	1.468
2		1	0.13	0.21	0.51	0.01	1.209
4		1	0.15	0.18	0.50	0.02	1.233
6		1	0.15	0.16	0.54	0.03	1.142
8		2	0.33	0.37	1.01	0.02	0.610
9		2	0.33	0.45	1.05	0.02	0.587
10		2	0.23	0.35	0.87	0.04	0.709
11		2	0.32	0.38	0.97	0.01	0.636
16		2	0.28	0.44	1.03	0.04	0.599
17		2	0.30	0.41	1.00	0.01	0.617
18		2	0.32	0.41	1.00	0.02	0.617
22		4	0.44	0.49	1.48	0.03	0.417
23		4	0.50	0.68	1.68	0.08	0.367
24		4	0.36	0.47	1.36	0.12	0.453
25		4	0.44	0.61	1.52	0.08	0.406
26		4	0.40	0.62	1.49	0.04	0.414
32		4	0.34	0.40	1.47	0.13	0.419
33		4	0.52	0.80	1.77	0.08	0.348
34		4	0.45	0.48	1.43	0.08	0.431
35		4	0.39	0.70	1.52	0.07	0.406
128		1	0.05	0.12	0.33	0.01	1.868
130		1	0.07	0.12	0.33	0.01	1.868
132		1	0.05	0.12	0.30	0.01	2.055
134		1	0.05	0.10	0.24	0.02	2.569
136		2	0.11	0.28	0.54	0.02	1.142
137		2	0.10	0.18	0.47	0.02	1.312
138		2	0.10	0.19	0.60	0.02	1.028
139		2	0.12	0.20	0.61	0.03	1.011
144		2	0.15	0.30	0.62	0.03	0.995
145		2	0.06	0.13	0.43	0.05	1.434
146		2	0.10	0.24	0.54	0.04	1.142
150		4	0.33	0.58	1.22	0.12	0.505
151		4	0.26	0.52	0.97	0.03	0.636
152		4	0.22	0.42	0.88	0.06	0.701
153		4	0.22	0.32	0.89	0.08	0.693
154		4	0.22	0.47	0.97	0.07	0.636
160		4	0.29	0.56	1.08	0.05	0.571
161		4	0.21	0.47	0.92	0.03	0.670
162		4	0.21	0.37	0.88	0.03	0.701
163		4	0.18	0.32	0.75	0.08	0.822
0	128	2	0.24	0.26	0.86	0.03	0.717
2	130	2	0.28	0.45	0.93	0.02	0.663
4	132	2	0.29	0.41	0.73	0.04	0.845
6	134	2	0.21	0.35	1.05	0.08	0.587
8	136	4	0.56	0.77	1.59	0.05	0.388
9	137	4	0.53	0.76	1.55	0.03	0.398
10	138	4	0.46	0.73	1.71	0.08	0.361
11	139	4	0.50	0.68	1.48	0.04	0.417
16	144	4	0.68	1.00	1.78	0.08	0.346
17	145	4	0.45	0.66	1.49	0.09	0.414
18	146	4	0.40	0.48	1.24	0.07	0.497
22	150	8	0.95	1.29	2.88	0.20	0.214
23	151	8	0.92	1.40	2.70	0.17	0.228
24	152	8	0.56	0.99	2.06	0.30	0.299
25	153	8	0.66	0.81	2.32	0.13	0.266
26	154	8	0.80	1.19	2.55	0.13	0.242
32	160	8	0.89	1.07	2.97	0.24	0.208
33	161	8	0.78	1.32	2.57	0.14	0.240
34	162	8	0.60	0.95	2.21	0.16	0.279
35	163	8	0.71	1.11	2.25	0.16	0.274

Module 1 – n261 – Low Channel							
Beam ID	Paired Beam ID	# of Active Feeds	$4cm^2$ PD (mW/cm^2) at 2mm				s(i) – Scaling Factor
			Front	Back	Right	Top	
1		1	0.32	0.01	N/A	0.15	1.927
3		1	0.45	0.01	N/A	0.28	1.370
5		1	0.47	0.01	N/A	0.31	1.312
7		1	0.44	0.01	N/A	0.22	1.401
12		2	0.83	0.03	N/A	0.58	0.743
13		2	0.99	0.02	N/A	0.73	0.623
14		2	0.92	0.02	N/A	0.56	0.670
15		2	0.78	0.02	N/A	0.46	0.791
19		2	0.77	0.02	N/A	0.32	0.801
20		2	0.96	0.01	N/A	0.63	0.642
21		2	0.95	0.02	N/A	0.64	0.649
27		4	0.97	0.03	N/A	0.55	0.636
28		4	1.41	0.03	N/A	0.91	0.437
29		4	1.43	0.05	N/A	0.86	0.431
30		4	1.31	0.04	N/A	0.76	0.471
31		4	1.18	0.05	N/A	0.79	0.523
36		4	1.19	0.03	N/A	0.71	0.518
37		4	1.48	0.04	N/A	0.94	0.417
38		4	1.32	0.04	N/A	0.74	0.467
39		4	1.24	0.04	N/A	0.84	0.497
129		1	0.46	0.00	N/A	0.24	1.340
131		1	0.41	0.00	N/A	0.25	1.504
133		1	0.42	0.00	N/A	0.26	1.468
135		1	0.44	0.00	N/A	0.26	1.401
140		2	0.78	0.00	N/A	0.55	0.791
141		2	0.76	0.00	N/A	0.62	0.811
142		2	0.81	0.01	N/A	0.49	0.761
143		2	0.75	0.01	N/A	0.31	0.822
147		2	0.77	0.00	N/A	0.60	0.801
148		2	0.78	0.00	N/A	0.59	0.791
149		2	0.77	0.01	N/A	0.40	0.801
155		4	1.38	0.02	N/A	1.03	0.447
156		4	1.37	0.01	N/A	1.20	0.450
157		4	1.28	0.01	N/A	1.24	0.482
158		4	1.26	0.01	N/A	1.05	0.489
159		4	1.32	0.01	N/A	0.72	0.467
164		4	1.46	0.01	N/A	1.18	0.422
165		4	1.35	0.01	N/A	1.21	0.457
166		4	1.29	0.00	N/A	1.12	0.478
167		4	1.33	0.01	N/A	0.98	0.464
1	129	2	0.93	0.01	N/A	0.41	0.663
3	131	2	0.88	0.02	N/A	0.57	0.701
5	133	2	0.93	0.01	N/A	0.60	0.663
7	135	2	0.91	0.02	N/A	0.56	0.678
12	140	4	1.76	0.04	N/A	1.32	0.350
13	141	4	1.83	0.03	N/A	1.46	0.337
14	142	4	1.86	0.01	N/A	1.14	0.332
15	143	4	1.72	0.04	N/A	1.10	0.358
19	147	4	1.37	0.02	N/A	0.97	0.450
20	148	4	1.72	0.02	N/A	1.25	0.358
21	149	4	1.69	0.03	N/A	1.04	0.365
27	155	8	2.68	0.07	N/A	1.73	0.230
28	156	8	3.04	0.04	N/A	2.24	0.203
29	157	8	2.83	0.03	N/A	2.16	0.218
30	158	8	2.82	0.05	N/A	1.88	0.219
31	159	8	2.67	0.08	N/A	1.49	0.231
36	164	8	2.80	0.05	N/A	2.00	0.220
37	165	8	2.97	0.05	N/A	2.20	0.208
38	166	8	2.77	0.04	N/A	2.20	0.223
39	167	8	2.75	0.05	N/A	1.84	0.224

Module 1 – n261 – Mid Channel							
Beam ID	Paired Beam ID	# of Active Feeds	4cm[2] PD (mW/cm[2]) at 2mm				s(i) – Scaling Factor
			Front	Back	Right	Top	
1		1	0.30	0.01	N/A	0.13	2.055
3		1	0.42	0.01	N/A	0.27	1.468
5		1	0.47	0.01	N/A	0.32	1.312
7		1	0.44	0.01	N/A	0.22	1.401
12		2	0.81	0.02	N/A	0.58	0.761
13		2	0.98	0.03	N/A	0.70	0.629
14		2	0.89	0.03	N/A	0.55	0.693
15		2	0.71	0.01	N/A	0.48	0.868
19		2	0.79	0.02	N/A	0.36	0.781
20		2	0.97	0.04	N/A	0.61	0.636
21		2	0.92	0.03	N/A	0.64	0.670
27		4	0.99	0.03	N/A	0.58	0.623
28		4	1.40	0.05	N/A	0.89	0.440
29		4	1.42	0.06	N/A	0.84	0.434
30		4	1.30	0.03	N/A	0.76	0.474
31		4	1.10	0.03	N/A	0.72	0.561
36		4	1.15	0.02	N/A	0.69	0.536
37		4	1.48	0.06	N/A	0.93	0.417
38		4	1.31	0.06	N/A	0.71	0.471
39		4	1.18	0.02	N/A	0.78	0.523
129		1	0.41	0.00	N/A	0.21	1.504
131		1	0.42	0.00	N/A	0.25	1.468
133		1	0.42	0.00	N/A	0.26	1.468
135		1	0.44	0.00	N/A	0.25	1.401
140		2	0.78	0.01	N/A	0.55	0.791
141		2	0.77	0.00	N/A	0.63	0.801
142		2	0.82	0.01	N/A	0.50	0.752
143		2	0.75	0.01	N/A	0.30	0.822
147		2	0.77	0.00	N/A	0.60	0.801
148		2	0.80	0.00	N/A	0.60	0.771
149		2	0.78	0.01	N/A	0.40	0.791
155		4	1.29	0.02	N/A	0.97	0.478
156		4	1.37	0.01	N/A	1.17	0.450
157		4	1.27	0.01	N/A	1.21	0.486
158		4	1.23	0.01	N/A	1.01	0.501
159		4	1.31	0.02	N/A	0.74	0.471
164		4	1.40	0.01	N/A	1.12	0.440
165		4	1.36	0.01	N/A	1.18	0.453
166		4	1.16	0.01	N/A	1.09	0.532
167		4	1.31	0.01	N/A	0.95	0.471
1	129	2	0.88	0.01	N/A	0.41	0.701
3	131	2	0.85	0.01	N/A	0.56	0.725
5	133	2	0.90	0.02	N/A	0.58	0.685
7	135	2	0.90	0.02	N/A	0.57	0.685
12	140	4	1.76	0.02	N/A	1.32	0.350
13	141	4	1.71	0.06	N/A	1.44	0.361
14	142	4	1.78	0.05	N/A	1.12	0.346
15	143	4	1.65	0.03	N/A	1.08	0.374
19	147	4	1.44	0.03	N/A	0.95	0.428
20	148	4	1.71	0.05	N/A	1.17	0.361
21	149	4	1.67	0.03	N/A	1.07	0.369
27	155	8	2.71	0.07	N/A	1.74	0.228
28	156	8	2.95	0.08	N/A	2.16	0.209
29	157	8	2.75	0.04	N/A	2.13	0.224
30	158	8	2.68	0.04	N/A	1.87	0.230
31	159	8	2.62	0.06	N/A	1.57	0.235
36	164	8	2.74	0.06	N/A	1.96	0.225
37	165	8	2.91	0.08	N/A	2.16	0.212
38	166	8	2.67	0.05	N/A	2.03	0.231
39	167	8	2.57	0.04	N/A	1.80	0.240

Module 1 – n261 – High Channel							
Beam ID	Paired Beam ID	# of Active Feeds	4cm² PD (mW/cm²) at 2mm				s(i) – Scaling Factor
			Front	Back	Right	Top	
1		1	0.30	0.01	N/A	0.13	2.055
3		1	0.37	0.01	N/A	0.25	1.666
5		1	0.43	0.02	N/A	0.25	1.434
7		1	0.43	0.01	N/A	0.22	1.434
12		2	0.74	0.02	N/A	0.50	0.833
13		2	0.91	0.05	N/A	0.58	0.678
14		2	0.79	0.03	N/A	0.47	0.781
15		2	0.67	0.01	N/A	0.45	0.920
19		2	0.77	0.02	N/A	0.41	0.801
20		2	0.89	0.04	N/A	0.49	0.693
21		2	0.84	0.04	N/A	0.53	0.734
27		4	0.89	0.04	N/A	0.52	0.693
28		4	1.26	0.07	N/A	0.73	0.489
29		4	1.34	0.05	N/A	0.68	0.460
30		4	1.15	0.06	N/A	0.61	0.536
31		4	0.97	0.02	N/A	0.66	0.636
36		4	1.10	0.05	N/A	0.61	0.561
37		4	1.39	0.06	N/A	0.76	0.444
38		4	1.20	0.04	N/A	0.57	0.514
39		4	1.05	0.04	N/A	0.70	0.587
129		1	0.35	0.00	N/A	0.17	1.762
131		1	0.41	0.01	N/A	0.24	1.504
133		1	0.41	0.00	N/A	0.24	1.504
135		1	0.41	0.01	N/A	0.24	1.504
140		2	0.74	0.01	N/A	0.50	0.833
141		2	0.75	0.01	N/A	0.58	0.822
142		2	0.80	0.01	N/A	0.46	0.771
143		2	0.74	0.01	N/A	0.29	0.833
147		2	0.74	0.01	N/A	0.55	0.833
148		2	0.78	0.01	N/A	0.56	0.791
149		2	0.81	0.01	N/A	0.39	0.761
155		4	1.14	0.02	N/A	0.86	0.541
156		4	1.31	0.02	N/A	1.11	0.471
157		4	1.21	0.02	N/A	1.07	0.510
158		4	1.20	0.01	N/A	0.95	0.514
159		4	1.22	0.01	N/A	0.70	0.505
164		4	1.29	0.02	N/A	0.95	0.478
165		4	1.30	0.02	N/A	1.13	0.474
166		4	1.20	0.01	N/A	1.06	0.514
167		4	1.28	0.01	N/A	0.91	0.482
1	129	2	0.84	0.01	N/A	0.38	0.734
3	131	2	0.78	0.02	N/A	0.54	0.791
5	133	2	0.89	0.04	N/A	0.49	0.693
7	135	2	0.90	0.02	N/A	0.53	0.685
12	140	4	1.66	0.06	N/A	1.18	0.371
13	141	4	1.53	0.09	N/A	1.24	0.403
14	142	4	1.59	0.03	N/A	0.99	0.388
15	143	4	1.53	0.03	N/A	0.97	0.403
19	147	4	1.46	0.05	N/A	0.82	0.422
20	148	4	1.60	0.07	N/A	1.05	0.385
21	149	4	1.60	0.04	N/A	0.91	0.385
27	155	8	2.58	0.07	N/A	1.57	0.239
28	156	8	2.70	0.08	N/A	1.86	0.228
29	157	8	2.53	0.07	N/A	1.96	0.244
30	158	8	2.41	0.05	N/A	1.76	0.256
31	159	8	2.04	0.04	N/A	1.48	0.302
36	164	8	2.54	0.06	N/A	1.69	0.243
37	165	8	2.68	0.09	N/A	2.00	0.230
38	166	8	2.43	0.07	N/A	1.82	0.254
39	167	8	2.29	0.06	N/A	1.61	0.269

Band n260 – Simulated PD

Module 0 – n260 – Low Channel							
Beam ID	Paired Beam ID	# of Active Feeds	$4cm^2$ PD (mW/cm^2) at 2mm				s(i) – Scaling Factor
			Front	Back	Right	Top	
0		1	0.13	0.24	0.60	0.01	1.028
2		1	0.19	0.19	0.61	0.02	1.011
4		1	0.16	0.18	0.59	0.03	1.045
6		1	0.10	0.19	0.53	0.04	1.163
8		2	0.34	0.42	1.10	0.06	0.561
9		2	0.25	0.38	1.08	0.06	0.571
10		2	0.32	0.46	1.04	0.03	0.593
11		2	0.32	0.40	1.07	0.06	0.576
16		2	0.49	0.29	1.27	0.07	0.486
17		2	0.41	0.32	1.21	0.04	0.510
18		2	0.24	0.51	1.02	0.01	0.605
22		4	0.46	0.77	1.58	0.15	0.390
23		4	0.47	0.70	2.02	0.13	0.305
24		4	0.50	0.89	1.82	0.04	0.339
25		4	0.68	0.47	2.05	0.16	0.301
26		4	0.38	0.95	1.60	0.06	0.385
32		4	0.66	0.56	2.07	0.1	0.298
33		4	0.55	0.79	1.88	0.14	0.328
34		4	0.34	0.68	1.42	0.1	0.434
35		4	0.67	0.64	2.05	0.12	0.301
128		1	0.16	0.22	0.53	0.01	1.163
130		1	0.13	0.25	0.60	0.01	1.028
132		1	0.16	0.24	0.62	0.01	0.995
134		1	0.12	0.18	0.52	0.03	1.186
136		2	0.22	0.40	1.02	0.05	0.605
137		2	0.23	0.36	1.05	0.07	0.587
138		2	0.27	0.46	0.96	0.04	0.642
139		2	0.26	0.47	0.99	0.01	0.623
144		2	0.32	0.54	1.10	0	0.561
145		2	0.24	0.44	0.98	0.04	0.629
146		2	0.24	0.33	1.06	0.05	0.582
150		4	0.65	0.84	2.13	0.08	0.289
151		4	0.52	0.96	2.04	0.04	0.302
152		4	0.40	0.73	1.58	0.11	0.390
153		4	0.59	0.91	2.12	0.06	0.291
154		4	0.48	0.70	1.77	0.05	0.348
160		4	0.48	0.94	1.68	0.04	0.367
161		4	0.43	0.59	1.42	0.08	0.434
162		4	0.53	0.68	1.44	0.07	0.428
163		4	0.46	0.83	1.90	0.05	0.325
0	128	2	0.37	0.67	1.38	0.02	0.447
2	130	2	0.48	0.60	1.22	0.04	0.505
4	132	2	0.42	0.57	1.37	0.05	0.450
6	134	2	0.23	0.41	1.30	0.09	0.474
8	136	4	0.63	1.11	2.38	0.13	0.259
9	137	4	0.56	0.90	2.64	0.22	0.234
10	138	4	0.49	0.60	1.28	0.06	0.482
11	139	4	0.70	0.89	2.25	0.08	0.274
16	144	4	0.75	0.88	2.45	0.1	0.252
17	145	4	0.68	0.68	1.88	0.09	0.328
18	146	4	0.44	0.73	1.74	0.07	0.354
22	150	8	1.29	1.39	3.61	0.22	0.171
23	151	8	0.99	2.08	4.46	0.23	0.138
24	152	8	0.86	1.74	3.52	0.21	0.175
25	153	8	1.04	1.76	3.20	0.21	0.193
26	154	8	1.20	1.76	3.25	0.14	0.190
32	160	8	1.28	1.95	4.43	0.21	0.139
33	161	8	1.12	1.66	3.84	0.28	0.161
34	162	8	1.24	1.51	3.17	0.18	0.195
35	163	8	0.88	2.04	4.32	0.27	0.143

Module 0 – n260 – Mid Channel							
Beam ID	Paired Beam ID	# of Active Feeds	4cm² PD (mW/cm²) at 2mm				s(i) – Scaling Factor
			Front	Back	Right	Top	
0		1	0.11	0.21	0.57	0.01	1.082
2		1	0.14	0.16	0.47	0.02	1.312
4		1	0.10	0.17	0.55	0.02	1.121
6		1	0.09	0.14	0.40	0.03	1.541
8		2	0.23	0.33	0.90	0.04	0.685
9		2	0.19	0.37	0.91	0.07	0.678
10		2	0.20	0.47	0.84	0.04	0.734
11		2	0.26	0.40	0.98	0.05	0.629
16		2	0.31	0.32	1.15	0.05	0.536
17		2	0.31	0.33	1.19	0.04	0.518
18		2	0.16	0.42	0.76	0.03	0.811
22		4	0.36	0.54	0.98	0.08	0.629
23		4	0.45	0.83	1.96	0.07	0.315
24		4	0.42	0.55	1.18	0.08	0.523
25		4	0.40	0.58	1.66	0.14	0.371
26		4	0.27	0.58	1.10	0.04	0.561
32		4	0.34	0.56	1.77	0.08	0.348
33		4	0.39	0.75	1.60	0.15	0.385
34		4	0.32	0.49	0.96	0.05	0.642
35		4	0.43	0.65	1.90	0.08	0.325
128		1	0.13	0.25	0.60	0.01	1.028
130		1	0.13	0.20	0.57	0.02	1.082
132		1	0.14	0.27	0.64	0.01	0.963
134		1	0.17	0.17	0.53	0.03	1.163
136		2	0.31	0.42	1.15	0.05	0.536
137		2	0.34	0.38	1.11	0.06	0.555
138		2	0.25	0.49	1.12	0.04	0.551
139		2	0.28	0.48	1.09	0.01	0.566
144		2	0.32	0.54	1.16	0.01	0.532
145		2	0.31	0.43	1.04	0.05	0.593
146		2	0.31	0.38	1.15	0.05	0.536
150		4	0.57	0.69	1.50	0.07	0.411
151		4	0.56	0.97	2.02	0.06	0.305
152		4	0.37	0.65	1.45	0.10	0.425
153		4	0.55	0.83	2.13	0.06	0.289
154		4	0.51	0.83	2.02	0.05	0.305
160		4	0.58	0.89	2.00	0.05	0.308
161		4	0.56	0.81	1.81	0.06	0.341
162		4	0.43	0.64	1.60	0.07	0.385
163		4	0.51	0.80	1.86	0.03	0.332
0	128	2	0.24	0.59	1.28	0.03	0.482
2	130	2	0.37	0.52	1.13	0.04	0.546
4	132	2	0.28	0.63	1.30	0.04	0.474
6	134	2	0.42	0.44	1.04	0.08	0.593
8	136	4	0.53	1.16	2.36	0.11	0.261
9	137	4	0.84	0.95	2.43	0.13	0.254
10	138	4	0.40	0.68	1.48	0.08	0.417
11	139	4	0.54	0.86	2.06	0.07	0.299
16	144	4	0.62	0.98	2.20	0.06	0.280
17	145	4	0.57	0.66	1.74	0.10	0.354
18	146	4	0.38	0.69	1.59	0.06	0.388
22	150	8	0.99	1.32	3.10	0.15	0.199
23	151	8	1.40	1.97	4.60	0.16	0.134
24	152	8	0.76	1.17	2.43	0.19	0.254
25	153	8	0.98	1.31	4.07	0.17	0.151
26	154	8	0.70	1.89	3.17	0.15	0.195
32	160	8	1.10	1.50	4.12	0.15	0.150
33	161	8	1.28	1.82	3.77	0.21	0.164
34	162	8	0.65	1.46	2.84	0.24	0.217
35	163	8	0.79	1.89	4.45	0.13	0.139

Module 0 – n260 – High Channel							
Beam ID	Paired Beam ID	# of Active Feeds	$4cm^2$ PD (mW/cm^2) at 2mm				s(i) – Scaling Factor
			Front	Back	Right	Top	
0		1	0.10	0.14	0.52	0.02	1.186
2		1	0.08	0.09	0.50	0.01	1.233
4		1	0.10	0.12	0.47	0.02	1.312
6		1	0.12	0.13	0.57	0.04	1.082
8		2	0.18	0.21	0.98	0.04	0.629
9		2	0.19	0.26	1.00	0.11	0.617
10		2	0.23	0.20	0.95	0.06	0.649
11		2	0.22	0.19	0.82	0.07	0.752
16		2	0.19	0.27	1.12	0.06	0.551
17		2	0.23	0.34	1.12	0.05	0.551
18		2	0.18	0.13	0.75	0.02	0.822
22		4	0.49	0.38	1.55	0.06	0.398
23		4	0.39	0.45	1.46	0.15	0.422
24		4	0.37	0.31	1.09	0.09	0.566
25		4	0.37	0.52	1.73	0.15	0.356
26		4	0.24	0.29	0.87	0.06	0.709
32		4	0.41	0.43	1.64	0.11	0.376
33		4	0.36	0.41	1.11	0.11	0.555
34		4	0.46	0.41	1.40	0.08	0.440
35		4	0.41	0.50	1.46	0.20	0.422
128		1	0.14	0.18	0.53	0.01	1.163
130		1	0.11	0.24	0.58	0.02	1.063
132		1	0.13	0.28	0.64	0.02	0.963
134		1	0.11	0.21	0.56	0.03	1.101
136		2	0.24	0.49	1.16	0.06	0.532
137		2	0.27	0.39	1.16	0.06	0.532
138		2	0.27	0.50	1.06	0.02	0.582
139		2	0.33	0.45	1.08	0.01	0.571
144		2	0.31	0.44	0.99	0.01	0.623
145		2	0.21	0.48	1.00	0.04	0.617
146		2	0.20	0.45	1.15	0.08	0.536
150		4	0.30	0.58	1.48	0.14	0.417
151		4	0.52	0.74	1.79	0.08	0.344
152		4	0.32	0.79	1.97	0.09	0.313
153		4	0.40	0.72	1.51	0.07	0.408
154		4	0.47	0.76	1.78	0.08	0.346
160		4	0.57	0.83	1.48	0.05	0.417
161		4	0.51	0.81	1.83	0.06	0.337
162		4	0.30	0.66	1.41	0.06	0.437
163		4	0.49	0.68	1.78	0.07	0.346
0	128	2	0.24	0.38	1.15	0.03	0.536
2	130	2	0.32	0.38	1.08	0.03	0.571
4	132	2	0.32	0.47	1.17	0.05	0.527
6	134	2	0.36	0.41	1.15	0.08	0.536
8	136	4	0.40	0.96	1.95	0.15	0.316
9	137	4	0.75	0.86	2.13	0.25	0.289
10	138	4	0.40	0.71	1.93	0.09	0.319
11	139	4	0.62	0.67	1.78	0.08	0.346
16	144	4	0.47	0.84	2.11	0.07	0.292
17	145	4	0.46	0.69	1.77	0.11	0.348
18	146	4	0.42	0.69	1.26	0.15	0.489
22	150	8	0.80	1.22	3.60	0.29	0.171
23	151	8	1.19	1.04	3.72	0.30	0.166
24	152	8	0.89	1.14	3.56	0.21	0.173
25	153	8	0.75	1.37	4.08	0.25	0.151
26	154	8	0.99	1.55	2.99	0.15	0.206
32	160	8	0.88	1.25	3.82	0.24	0.161
33	161	8	1.02	1.30	3.08	0.20	0.200
34	162	8	0.95	1.71	2.84	0.15	0.217
35	163	8	1.06	1.00	3.14	0.36	0.196

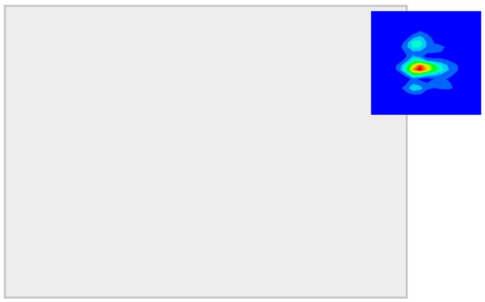
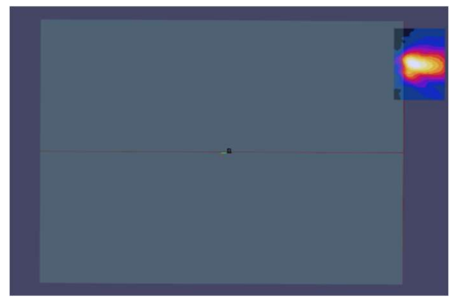
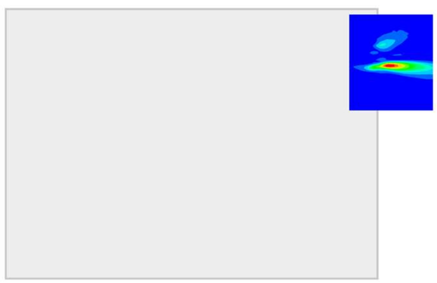
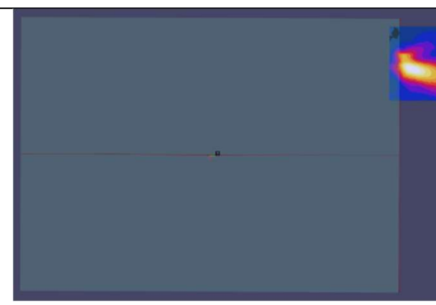
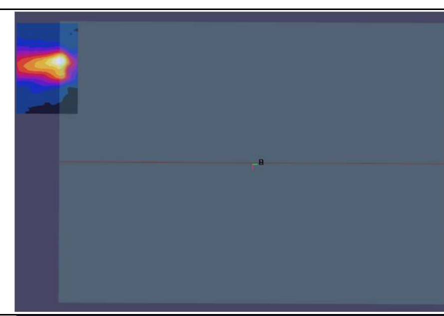
Module 1 – n260 – Low Channel							
Beam ID	Paired Beam ID	# of Active Feeds	$4cm^2$ PD (mW/cm^2) at 2mm				s(i) – Scaling Factor
			Front	Back	Right	Top	
1		1	0.37	0.01	N/A	0.11	1.666
3		1	0.35	0.02	N/A	0.20	1.762
5		1	0.37	0.03	N/A	0.21	1.666
7		1	0.37	0.01	N/A	0.16	1.666
12		2	0.67	0.05	N/A	0.39	0.920
13		2	0.67	0.05	N/A	0.38	0.920
14		2	0.66	0.05	N/A	0.37	0.934
15		2	0.74	0.03	N/A	0.28	0.833
19		2	0.67	0.05	N/A	0.39	0.920
20		2	0.64	0.05	N/A	0.36	0.963
21		2	0.66	0.04	N/A	0.36	0.934
27		4	0.98	0.08	N/A	0.48	0.629
28		4	0.93	0.08	N/A	0.47	0.663
29		4	1.15	0.09	N/A	0.64	0.536
30		4	1.02	0.07	N/A	0.59	0.605
31		4	0.86	0.07	N/A	0.44	0.717
36		4	0.75	0.06	N/A	0.47	0.822
37		4	1.11	0.08	N/A	0.56	0.555
38		4	1.16	0.09	N/A	0.68	0.532
39		4	0.98	0.06	N/A	0.56	0.629
129		1	0.36	0.01	N/A	0.17	1.713
131		1	0.32	0.01	N/A	0.16	1.927
133		1	0.33	0.01	N/A	0.18	1.868
135		1	0.32	0.01	N/A	0.12	1.927
140		2	0.50	0.02	N/A	0.30	1.233
141		2	0.70	0.02	N/A	0.34	0.881
142		2	0.76	0.01	N/A	0.31	0.811
143		2	0.69	0.01	N/A	0.34	0.894
147		2	0.47	0.03	N/A	0.26	1.312
148		2	0.57	0.02	N/A	0.27	1.082
149		2	0.77	0.01	N/A	0.34	0.801
155		4	0.85	0.03	N/A	0.48	0.725
156		4	1.13	0.03	N/A	0.45	0.546
157		4	0.88	0.02	N/A	0.52	0.701
158		4	1.03	0.03	N/A	0.62	0.599
159		4	0.97	0.04	N/A	0.52	0.636
164		4	1.21	0.04	N/A	0.40	0.510
165		4	1.03	0.03	N/A	0.54	0.599
166		4	0.98	0.03	N/A	0.55	0.629
167		4	0.85	0.04	N/A	0.58	0.725
1	129	2	0.70	0.02	N/A	0.33	0.881
3	131	2	0.67	0.04	N/A	0.40	0.920
5	133	2	0.74	0.04	N/A	0.51	0.833
7	135	2	0.70	0.03	N/A	0.35	0.881
12	140	4	1.23	0.09	N/A	0.77	0.501
13	141	4	1.39	0.08	N/A	0.63	0.444
14	142	4	1.20	0.08	N/A	0.67	0.514
15	143	4	1.35	0.06	N/A	0.65	0.457
19	147	4	1.08	0.11	N/A	0.62	0.571
20	148	4	1.31	0.07	N/A	0.82	0.471
21	149	4	1.21	0.08	N/A	0.79	0.510
27	155	8	1.50	0.12	N/A	1.29	0.411
28	156	8	1.53	0.14	N/A	0.93	0.403
29	157	8	2.18	0.15	N/A	1.15	0.283
30	158	8	1.87	0.10	N/A	1.15	0.330
31	159	8	1.94	0.16	N/A	1.02	0.318
36	164	8	1.76	0.13	N/A	1.07	0.350
37	165	8	1.94	0.12	N/A	1.17	0.318
38	166	8	2.03	0.14	N/A	1.19	0.304
39	167	8	1.91	0.14	N/A	1.26	0.323

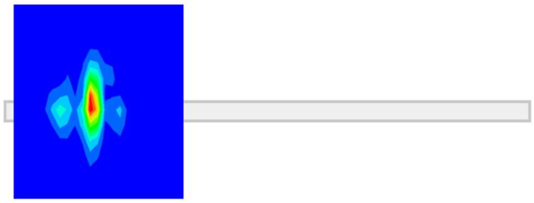
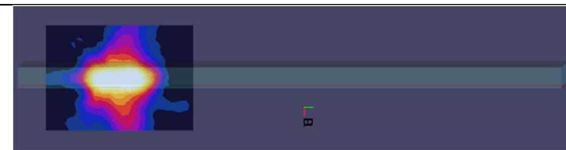
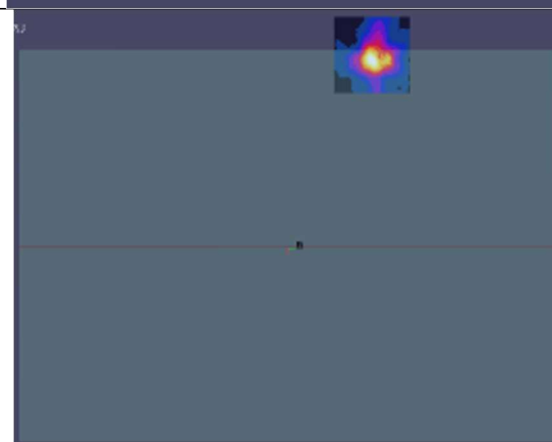
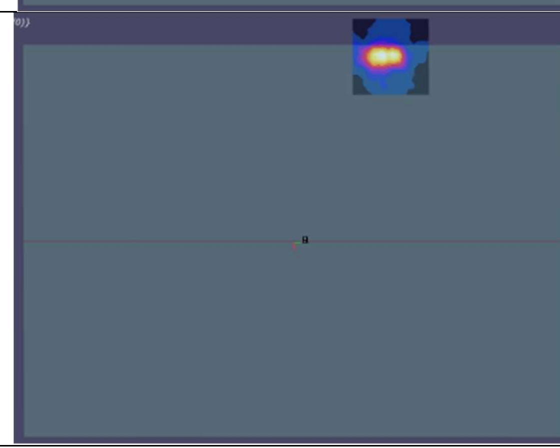
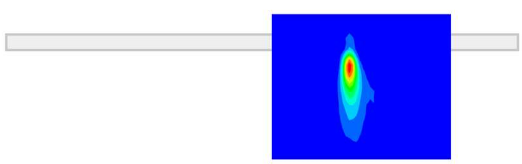
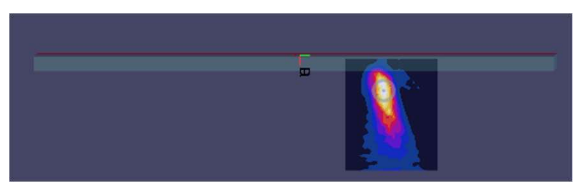
Module 1 – n260 – Mid Channel							
Beam ID	Paired Beam ID	# of Active Feeds	$4cm^2$ PD (mW/cm^2) at 2mm				s(i) – Scaling Factor
			Front	Back	Right	Top	
1		1	0.37	0.01	N/A	0.15	1.666
3		1	0.38	0.02	N/A	0.16	1.623
5		1	0.38	0.02	N/A	0.17	1.623
7		1	0.39	0.01	N/A	0.18	1.581
12		2	0.63	0.05	N/A	0.35	0.979
13		2	0.62	0.05	N/A	0.28	0.995
14		2	0.63	0.05	N/A	0.30	0.979
15		2	0.79	0.03	N/A	0.30	0.781
19		2	0.64	0.05	N/A	0.33	0.963
20		2	0.66	0.05	N/A	0.31	0.934
21		2	0.66	0.05	N/A	0.33	0.934
27		4	0.88	0.07	N/A	0.46	0.701
28		4	1.04	0.05	N/A	0.58	0.593
29		4	1.03	0.07	N/A	0.52	0.599
30		4	1.12	0.08	N/A	0.59	0.551
31		4	0.97	0.07	N/A	0.48	0.636
36		4	1.00	0.06	N/A	0.56	0.617
37		4	0.93	0.06	N/A	0.49	0.663
38		4	1.08	0.08	N/A	0.59	0.571
39		4	1.05	0.08	N/A	0.53	0.587
129		1	0.38	0.01	N/A	0.15	1.623
131		1	0.30	0.02	N/A	0.14	2.055
133		1	0.34	0.01	N/A	0.16	1.814
135		1	0.22	0.01	N/A	0.08	2.803
140		2	0.59	0.04	N/A	0.30	1.045
141		2	0.65	0.03	N/A	0.28	0.949
142		2	0.73	0.02	N/A	0.25	0.845
143		2	0.60	0.02	N/A	0.24	1.028
147		2	0.49	0.02	N/A	0.23	1.258
148		2	0.58	0.03	N/A	0.28	1.063
149		2	0.69	0.02	N/A	0.26	0.894
155		4	0.93	0.05	N/A	0.37	0.663
156		4	1.02	0.04	N/A	0.48	0.605
157		4	0.85	0.04	N/A	0.43	0.725
158		4	1.00	0.06	N/A	0.49	0.617
159		4	0.98	0.04	N/A	0.42	0.629
164		4	0.89	0.04	N/A	0.44	0.693
165		4	0.81	0.04	N/A	0.46	0.761
166		4	1.01	0.05	N/A	0.50	0.610
167		4	0.98	0.03	N/A	0.45	0.629
1	129	2	0.76	0.02	N/A	0.36	0.811
3	131	2	0.71	0.07	N/A	0.41	0.868
5	133	2	0.75	0.07	N/A	0.45	0.822
7	135	2	0.75	0.03	N/A	0.28	0.822
12	140	4	1.32	0.10	N/A	0.75	0.467
13	141	4	1.38	0.09	N/A	0.66	0.447
14	142	4	1.47	0.11	N/A	0.67	0.419
15	143	4	1.44	0.07	N/A	0.75	0.428
19	147	4	1.11	0.10	N/A	0.64	0.555
20	148	4	1.25	0.09	N/A	0.68	0.493
21	149	4	1.45	0.08	N/A	0.77	0.425
27	155	8	1.52	0.14	N/A	0.83	0.406
28	156	8	1.87	0.10	N/A	1.12	0.330
29	157	8	1.71	0.16	N/A	1.11	0.361
30	158	8	2.19	0.14	N/A	1.07	0.282
31	159	8	2.24	0.12	N/A	0.86	0.275
36	164	8	2.09	0.09	N/A	1.25	0.295
37	165	8	1.87	0.11	N/A	0.90	0.330
38	166	8	2.10	0.16	N/A	1.22	0.294
39	167	8	1.68	0.13	N/A	0.94	0.367

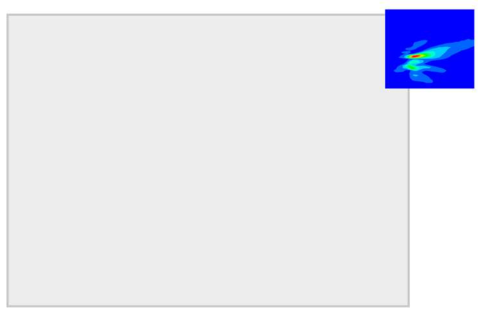
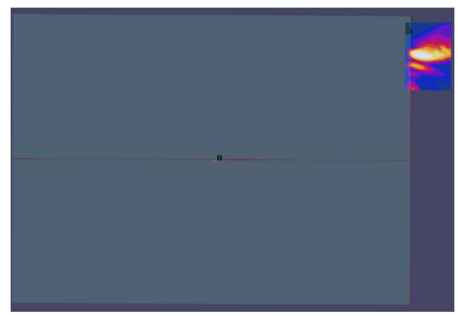
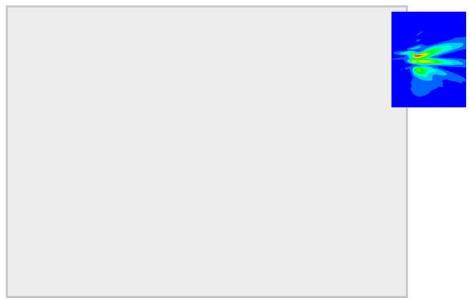
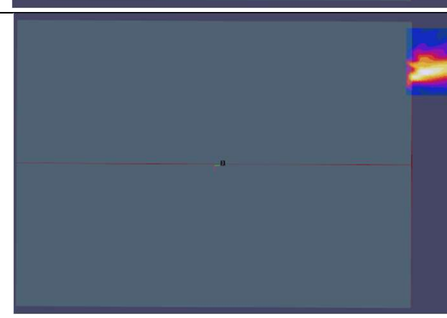
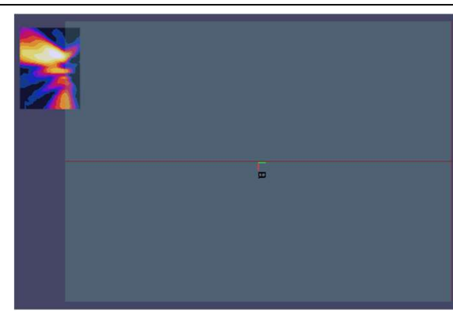
Module 1 – n260 – High Channel							
Beam ID	Paired Beam ID	# of Active Feeds	$4cm^2$ PD (mW/cm^2) at 2mm				s(i) – Scaling Factor
			Front	Back	Right	Top	
1		1	0.36	0.01	N/A	0.17	1.713
3		1	0.38	0.01	N/A	0.16	1.623
5		1	0.39	0.02	N/A	0.14	1.581
7		1	0.41	0.01	N/A	0.17	1.504
12		2	0.71	0.02	N/A	0.30	0.868
13		2	0.64	0.02	N/A	0.28	0.963
14		2	0.71	0.04	N/A	0.27	0.868
15		2	0.79	0.01	N/A	0.31	0.781
19		2	0.69	0.02	N/A	0.29	0.894
20		2	0.63	0.04	N/A	0.23	0.979
21		2	0.75	0.03	N/A	0.33	0.822
27		4	1.19	0.04	N/A	0.48	0.518
28		4	0.91	0.04	N/A	0.47	0.678
29		4	0.91	0.05	N/A	0.49	0.678
30		4	1.09	0.05	N/A	0.50	0.566
31		4	0.95	0.04	N/A	0.47	0.649
36		4	1.33	0.04	N/A	0.59	0.464
37		4	0.97	0.04	N/A	0.46	0.636
38		4	1.09	0.06	N/A	0.48	0.566
39		4	0.87	0.05	N/A	0.48	0.709
129		1	0.24	0.01	N/A	0.11	2.569
131		1	0.21	0.02	N/A	0.09	2.936
133		1	0.20	0.02	N/A	0.10	3.083
135		1	0.27	0.01	N/A	0.13	2.284
140		2	0.34	0.05	N/A	0.19	1.814
141		2	0.46	0.02	N/A	0.21	1.340
142		2	0.44	0.02	N/A	0.21	1.401
143		2	0.39	0.02	N/A	0.18	1.581
147		2	0.34	0.02	N/A	0.15	1.814
148		2	0.39	0.02	N/A	0.15	1.581
149		2	0.43	0.02	N/A	0.20	1.434
155		4	0.60	0.07	N/A	0.34	1.028
156		4	0.55	0.04	N/A	0.25	1.121
157		4	0.56	0.03	N/A	0.35	1.101
158		4	0.63	0.07	N/A	0.30	0.979
159		4	0.60	0.07	N/A	0.37	1.028
164		4	0.59	0.04	N/A	0.30	1.045
165		4	0.60	0.04	N/A	0.33	1.028
166		4	0.49	0.04	N/A	0.30	1.258
167		4	0.63	0.07	N/A	0.38	0.979
1	129	2	0.62	0.02	N/A	0.31	0.995
3	131	2	0.62	0.03	N/A	0.29	0.995
5	133	2	0.66	0.04	N/A	0.28	0.934
7	135	2	0.78	0.02	N/A	0.30	0.791
12	140	4	0.99	0.07	N/A	0.53	0.623
13	141	4	1.23	0.07	N/A	0.49	0.501
14	142	4	1.29	0.09	N/A	0.51	0.478
15	143	4	1.29	0.05	N/A	0.54	0.478
19	147	4	1.04	0.04	N/A	0.49	0.593
20	148	4	1.01	0.08	N/A	0.45	0.610
21	149	4	1.27	0.08	N/A	0.47	0.486
27	155	8	1.58	0.12	N/A	0.91	0.390
28	156	8	1.59	0.09	N/A	0.80	0.388
29	157	8	1.59	0.09	N/A	0.96	0.388
30	158	8	1.67	0.13	N/A	0.76	0.369
31	159	8	1.45	0.09	N/A	0.75	0.425
36	164	8	1.44	0.09	N/A	0.84	0.428
37	165	8	1.56	0.09	N/A	0.89	0.395
38	166	8	1.81	0.11	N/A	0.92	0.341
39	167	8	1.59	0.13	N/A	0.83	0.388

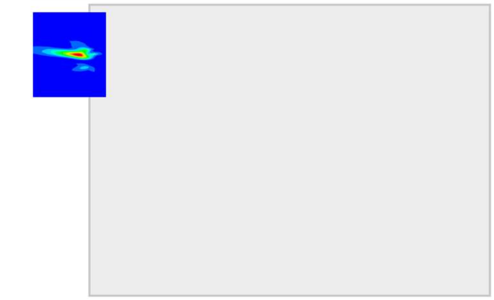
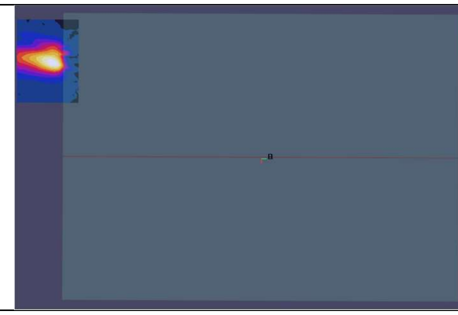
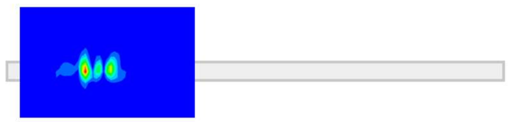
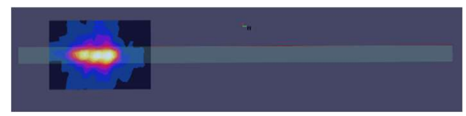
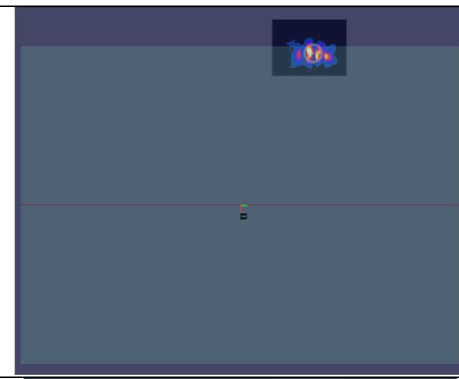
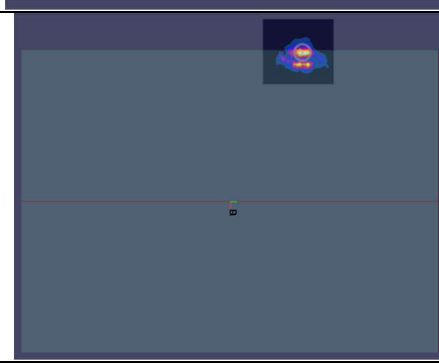
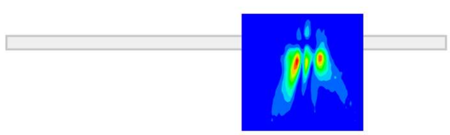
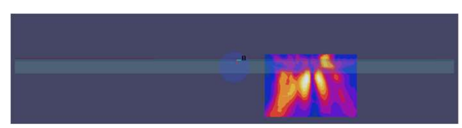
Appendix A: PD Simulation vs. Measurement Distributions for Worst-Case Surfaces

Simulation and Measurement PD Distribution Plots for Selected Beams and Surfaces

Band	Module	Surface	Beam ID	Simulated PD Distribution	Measured PD Distribution
261	0 Side Facing	Front	33		
261	0 Side Facing	Front	152		
261	0 Side Facing	Back	33		
261	0 Side Facing	Back	152		

261	0 Side Facing	Right	33		
261	0 Side Facing	Right	152		
261	1 Front Facing	Front	29		
261	1 Front Facing	Front	166		
261	1 Front Facing	Top	29		
261	1 Front Facing	Top	166		

Band	Module	Surface	Beam ID	Simulated PD Distribution	Measured PD Distribution
260	0 Side Facing	Front	34		
260	0 Side Facing	Front	152		
260	0 Side Facing	Back	34		

260	0 Side Facing	Back	152		
260	0 Side Facing	Right	34		
260	0 Side Facing	Right	152		
260	1 Front Facing	Front	27		
260	1 Front Facing	Front	157		
260	1 Front Facing	Top	27		
260	1 Front Facing	Top	157