



Part 0: Power Density Characterization Report  
Rev 1.1

for

MODEL NO. 1997

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## I. Introduction

Model 1997 uses a 5G modem, transceivers, and two mmWave modules which together enable transmission in the 5G NR mmWave bands (FR2). It also utilizes Qualcomm’s Smart Transmit algorithms, using Gen1 features of that technology, which ensures the time-averaged power for all WWAN radios (2G/3G/4G/5G) remains below compliant levels for RF exposure. This technology requires characterizing the compliant time-averaged power levels for both SAR (for WWAN frequencies under 6 GHz) and Power Density (for 5G FR2 mmWave.)

Each mmWave module employs beamforming technology to steer the transmit beams in desired directions. There are 4 patch antenna elements in each module; the input signals to each element are controlled in phase and amplitude to create the beams. The list of all possible beams the device can use is called the codebook and is defined in the next section.

This report, in conjunction with the Power Density Simulation Report, details the process of characterizing the compliant average input power levels for the mmWave modules operating in the 5G FR2 mmWave bands, for all beams in the device’s codebook. All steps of the PD Characterization process shown below are covered.

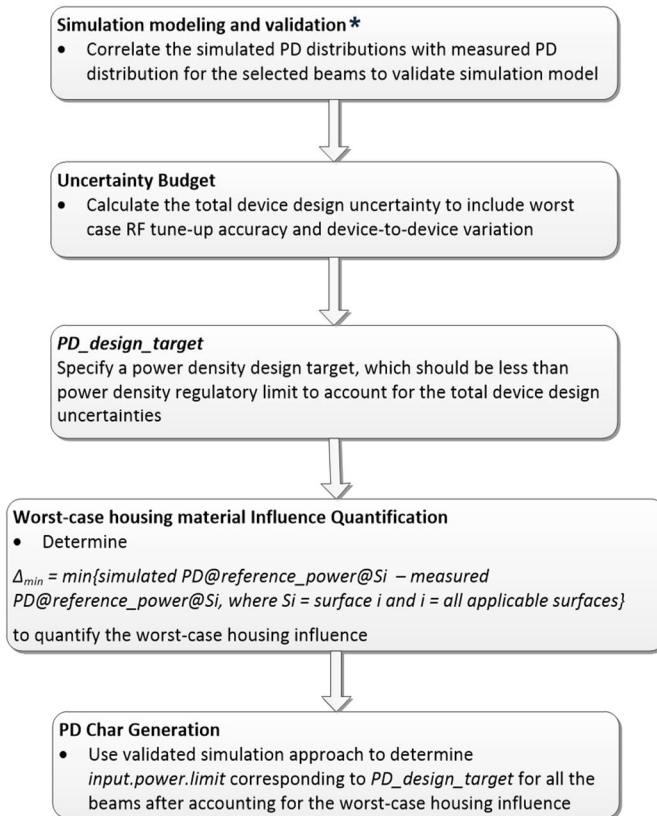
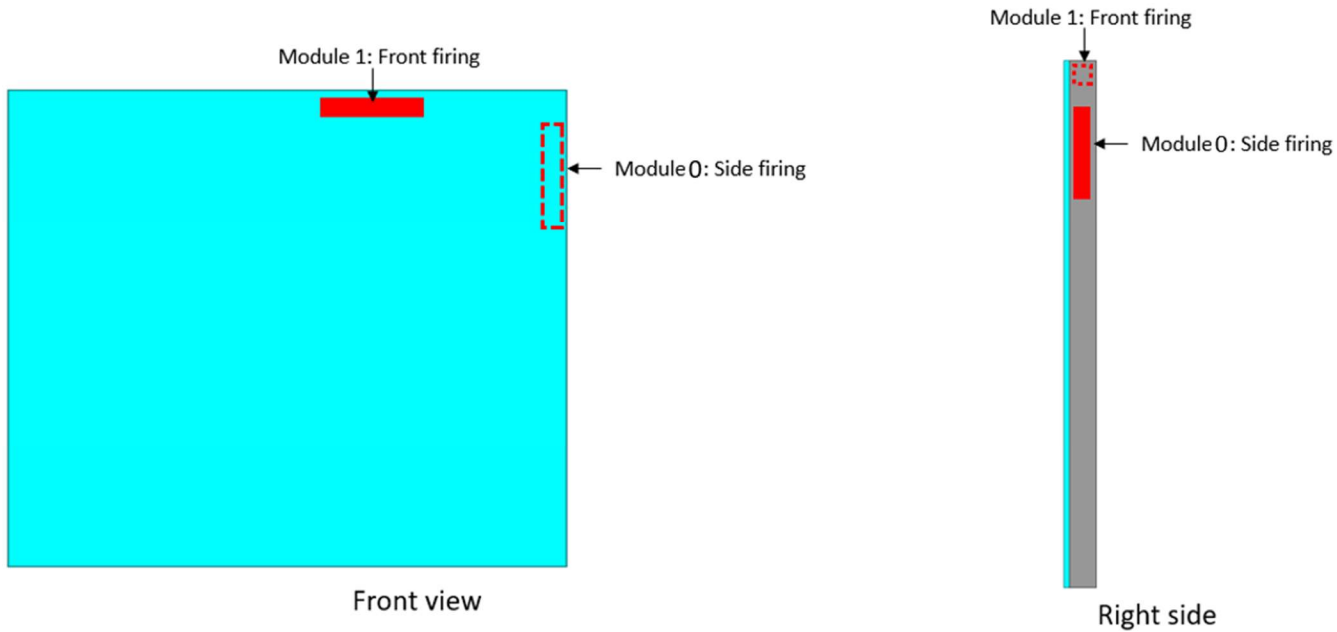


Figure 1. PD Characterization Process

## II. Device

### A. mmWave Antenna Module Locations

Model 1997 has two mmWave antenna modules. Module 0 faces out of the right edge, while module 1 faces out of the front (display) side. The locations of the antennas are shown in Figure 2 below. The surfaces which were chosen for evaluation, as explained in the simulation report, are again summarized in Tables 1.



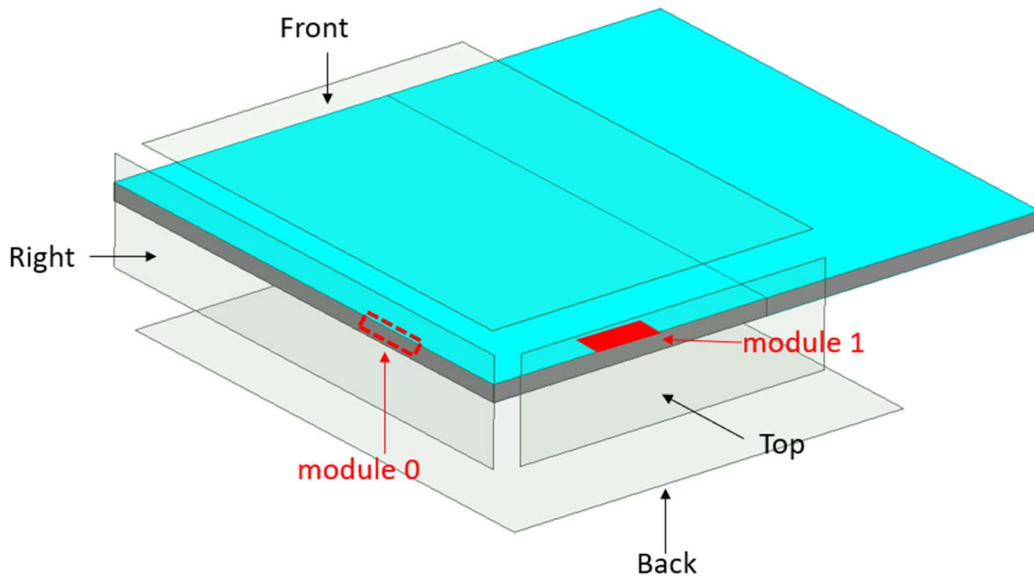


Figure 2. mmWave Antenna Module Locations and simulation surfaces

| 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 Evaluation

## B. Device Codebook

The codebook for the device defines the list of vertically and horizontally polarized beams which the device is capable of emitting. All beams shown have been evaluated for compliance.

| n261 Codebook           |        |                   |             |
|-------------------------|--------|-------------------|-------------|
| Module 0 = Side-Facing  |        |                   |             |
| Module 1 = Front-Facing |        |                   |             |
| Beam ID                 | Module | # of Active Feeds | Paired With |
| 0                       | 0      | 1                 | 128         |
| 1                       | 1      | 1                 | 129         |
| 2                       | 0      | 1                 | 130         |
| 3                       | 1      | 1                 | 131         |
| 4                       | 0      | 1                 | 132         |
| 5                       | 1      | 1                 | 133         |
| 6                       | 0      | 1                 | 134         |
| 7                       | 1      | 1                 | 135         |
| 8                       | 0      | 2                 | 136         |
| 9                       | 0      | 2                 | 137         |
| 10                      | 0      | 2                 | 138         |
| 11                      | 0      | 2                 | 139         |
| 12                      | 1      | 2                 | 140         |
| 13                      | 1      | 2                 | 141         |
| 14                      | 1      | 2                 | 142         |
| 15                      | 1      | 2                 | 143         |
| 16                      | 0      | 2                 | 144         |
| 17                      | 0      | 2                 | 145         |
| 18                      | 0      | 2                 | 146         |
| 19                      | 1      | 2                 | 147         |
| 20                      | 1      | 2                 | 148         |
| 21                      | 1      | 2                 | 149         |
| 22                      | 0      | 4                 | 150         |
| 23                      | 0      | 4                 | 151         |
| 24                      | 0      | 4                 | 152         |
| 25                      | 0      | 4                 | 153         |
| 26                      | 0      | 4                 | 154         |
| 27                      | 1      | 4                 | 155         |
| 28                      | 1      | 4                 | 156         |
| 29                      | 1      | 4                 | 157         |
| 30                      | 1      | 4                 | 158         |
| 31                      | 1      | 4                 | 159         |
| 32                      | 0      | 4                 | 160         |
| 33                      | 0      | 4                 | 161         |
| 34                      | 0      | 4                 | 162         |
| 35                      | 0      | 4                 | 163         |
| 36                      | 1      | 4                 | 164         |
| 37                      | 1      | 4                 | 165         |
| 38                      | 1      | 4                 | 166         |
| 39                      | 1      | 4                 | 167         |
| 128                     | 0      | 1                 | 0           |
| 129                     | 1      | 1                 | 1           |
| 130                     | 0      | 1                 | 2           |
| 131                     | 1      | 1                 | 3           |
| 132                     | 0      | 1                 | 4           |
| 133                     | 1      | 1                 | 5           |
| 134                     | 0      | 1                 | 6           |
| 135                     | 1      | 1                 | 7           |
| 136                     | 0      | 2                 | 8           |
| 137                     | 0      | 2                 | 9           |
| 138                     | 0      | 2                 | 10          |
| 139                     | 0      | 2                 | 11          |
| 140                     | 1      | 2                 | 12          |
| 141                     | 1      | 2                 | 13          |

| n261 Codebook<br>Module 0 = Side-Facing<br>Module 1 = Front-Facing |        |                   |             |
|--|--------|-------------------|-------------|
| Beam ID  | Module | # of Active Feeds | Paired With |
| 142  | 1      | 2                 | 14          |
| 143  | 1      | 2                 | 15          |
| 144  | 0      | 2                 | 16          |
| 145  | 0      | 2                 | 17          |
| 146  | 0      | 2                 | 18          |
| 147  | 1      | 2                 | 19          |
| 148  | 1      | 2                 | 20          |
| 149  | 1      | 2                 | 21          |
| 150  | 0      | 4                 | 22          |
| 151  | 0      | 4                 | 23          |
| 152  | 0      | 4                 | 24          |
| 153  | 0      | 4                 | 25          |
| 154  | 0      | 4                 | 26          |
| 155  | 1      | 4                 | 27          |
| 156  | 1      | 4                 | 28          |
| 157  | 1      | 4                 | 29          |
| 158  | 1      | 4                 | 30          |
| 159  | 1      | 4                 | 31          |
| 160  | 0      | 4                 | 32          |
| 161  | 0      | 4                 | 33          |
| 162  | 0      | 4                 | 34          |
| 163  | 0      | 4                 | 35          |
| 164  | 1      | 4                 | 36          |
| 165  | 1      | 4                 | 37          |
| 166  | 1      | 4                 | 38          |
| 167  | 1      | 4                 | 39          |

Table 2. Codebook for Band n261

| n260 Codebook           |        |                   |             |
|-------------------------|--------|-------------------|-------------|
| Module 0 = Side-Facing  |        |                   |             |
| Module 1 = Front-Facing |        |                   |             |
| Beam ID                 | Module | # of Active Feeds | Paired With |
| 0                       | 0      | 1                 | 128         |
| 1                       | 1      | 1                 | 129         |
| 2                       | 0      | 1                 | 130         |
| 3                       | 1      | 1                 | 131         |
| 4                       | 0      | 1                 | 132         |
| 5                       | 1      | 1                 | 133         |
| 6                       | 0      | 1                 | 134         |
| 7                       | 1      | 1                 | 135         |
| 8                       | 0      | 2                 | 136         |
| 9                       | 0      | 2                 | 137         |
| 10                      | 0      | 2                 | 138         |
| 11                      | 0      | 2                 | 139         |
| 12                      | 1      | 2                 | 140         |
| 13                      | 1      | 2                 | 141         |
| 14                      | 1      | 2                 | 142         |
| 15                      | 1      | 2                 | 143         |
| 16                      | 0      | 2                 | 144         |
| 17                      | 0      | 2                 | 145         |
| 18                      | 0      | 2                 | 146         |
| 19                      | 1      | 2                 | 147         |
| 20                      | 1      | 2                 | 148         |
| 21                      | 1      | 2                 | 149         |
| 22                      | 0      | 4                 | 150         |
| 23                      | 0      | 4                 | 151         |
| 24                      | 0      | 4                 | 152         |
| 25                      | 0      | 4                 | 153         |
| 26                      | 0      | 4                 | 154         |
| 27                      | 1      | 4                 | 155         |
| 28                      | 1      | 4                 | 156         |
| 29                      | 1      | 4                 | 157         |
| 30                      | 1      | 4                 | 158         |
| 31                      | 1      | 4                 | 159         |
| 32                      | 0      | 4                 | 160         |
| 33                      | 0      | 4                 | 161         |
| 34                      | 0      | 4                 | 162         |
| 35                      | 0      | 4                 | 163         |
| 36                      | 1      | 4                 | 164         |
| 37                      | 1      | 4                 | 165         |
| 38                      | 1      | 4                 | 166         |
| 39                      | 1      | 4                 | 167         |
| 128                     | 0      | 1                 | 0           |
| 129                     | 1      | 1                 | 1           |
| 130                     | 0      | 1                 | 2           |
| 131                     | 1      | 1                 | 3           |
| 132                     | 0      | 1                 | 4           |
| 133                     | 1      | 1                 | 5           |
| 134                     | 0      | 1                 | 6           |
| 135                     | 1      | 1                 | 7           |
| 136                     | 0      | 2                 | 8           |
| 137                     | 0      | 2                 | 9           |
| 138                     | 0      | 2                 | 10          |
| 139                     | 0      | 2                 | 11          |
| 140                     | 1      | 2                 | 12          |
| 141                     | 1      | 2                 | 13          |
| 142                     | 1      | 2                 | 14          |
| 143                     | 1      | 2                 | 15          |
| 144                     | 0      | 2                 | 16          |
| 145                     | 0      | 2                 | 17          |
| 146                     | 0      | 2                 | 18          |
| 147                     | 1      | 2                 | 19          |
| 148                     | 1      | 2                 | 20          |
| 149                     | 1      | 2                 | 21          |
| 150                     | 0      | 4                 | 22          |



| n260 Codebook<br>Module 0 = Side-Facing<br>Module 1 = Front-Facing |        |                   |             |
|--|--------|-------------------|-------------|
| Beam ID  | Module | # of Active Feeds | Paired With |
| 151  | 0      | 4                 | 23          |
| 152  | 0      | 4                 | 24          |
| 153  | 0      | 4                 | 25          |
| 154  | 0      | 4                 | 26          |
| 155  | 1      | 4                 | 27          |
| 156  | 1      | 4                 | 28          |
| 157  | 1      | 4                 | 29          |
| 158  | 1      | 4                 | 30          |
| 159  | 1      | 4                 | 31          |
| 160  | 0      | 4                 | 32          |
| 161  | 0      | 4                 | 33          |
| 162  | 0      | 4                 | 34          |
| 163  | 0      | 4                 | 35          |
| 164  | 1      | 4                 | 36          |
| 165  | 1      | 4                 | 37          |
| 166  | 1      | 4                 | 38          |
| 167  | 1      | 4                 | 39          |

*Table 3. Codebook for Band n260*

### III. Simulation Validation Results

The PD simulation results were validated through measurements as explained in the Power Density Simulation Report. The summary of these measurement results is again shown here since the difference between the simulation and measurement results is used as part of the PD characterization process. There is expected to be a difference between the simulation and measurement PD magnitudes due to unknown device housing material properties at mmWave frequencies.

All simulations and measurements were performed with 6 dBm reference input power to the antenna feeds. Simulations were performed at the low, mid, and high channels for each band. Correlation measurements in the lab using the DASY6/8 system were only performed on the worst device surfaces for each module / band combination. All simulations and physical measurements were done using CW signals.

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

| Band | Module | Surface | Beam ID | Measured PD (mW/cm <sup>2</sup> ) | Simulated PD (mW/cm <sup>2</sup> ) |
|------|--------|---------|---------|-----------------------------------|------------------------------------|
| n261 | 0      | Front   | 33      | 0.414                             | 0.52                               |
| n261 | 0      | Front   | 152     | 0.228                             | 0.28                               |
| n261 | 0      | Back    | 33      | 0.477                             | 0.95                               |
| n261 | 0      | Back    | 152     | 0.426                             | 0.53                               |
| n261 | 0      | Right   | 33      | 1.11                              | 1.93                               |
| n261 | 0      | Right   | 152     | 0.715                             | 1.09                               |
| n261 | 1      | Front   | 29      | 0.9                               | 1.42                               |
| n261 | 1      | Front   | 166     | 1.07                              | 1.16                               |
| n261 | 1      | Top     | 29      | 0.348                             | 0.84                               |
| n261 | 1      | Top     | 166     | 0.168                             | 1.09                               |

Table 4. 4 cm<sup>2</sup> Average Power Density Results for Measurements vs. Simulations, Band 261

| Band | Module | Surface | Beam ID | Measured PD<br>(mW/cm <sup>2</sup> ) | Simulated PD<br>(mW/cm <sup>2</sup> ) |
|------|--------|---------|---------|--------------------------------------|---------------------------------------|
| n260 | 0      | Front   | 34      | 0.28                                 | 0.32                                  |
| n260 | 0      | Front   | 152     | 0.298                                | 0.37                                  |
| n260 | 0      | Back    | 34      | 0.409                                | 0.49                                  |
| n260 | 0      | Back    | 152     | 0.844                                | 0.65                                  |
| n260 | 0      | Right   | 34      | 0.871                                | 0.96                                  |
| n260 | 0      | Right   | 152     | 1.17                                 | 1.45                                  |
| n260 | 1      | Front   | 27      | 0.736                                | 0.88                                  |
| n260 | 1      | Front   | 157     | 0.78                                 | 0.85                                  |
| n260 | 1      | Top     | 27      | 0.122                                | 0.46                                  |
| n260 | 1      | Top     | 157     | 0.231                                | 0.43                                  |

*Table 5. 4 cm<sup>2</sup> Average Power Density Results for Measurements vs. Simulations, Band 260*

## IV. PD Design Target

The PD design target is the target PD level that assures compliance after mmWave module power total uncertainty is taken into account. The  $PD_{design\_target}$  is defined as:

$$PD_{design\_target} < PD_{regulatory\_limit} \times 10^{\frac{-to\ uncertainty}{10}}$$

The total uncertainty budget declared by the module manufacturer for the mmWave module used in this device is 2.1 dB. The regulatory limit for 4 cm<sup>2</sup>-averaged PD is 1.0 mW/cm<sup>2</sup>. The PD design target is then calculated to be:

$$PD_{design\_target} = 0.617\ mW/cm^2$$

## V. $\Delta_{min}$ Determination – Housing Influence Characterization

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<sup>2</sup>-averaged PD, were used to determine the worst-case housing influence.  $\Delta_{min}$  represents the most conservative case where RF exposure is underestimated the most, or overestimated the least, by simulations. In most cases here the simulation values exceed the measured values, and in those cases  $\Delta_{min}$  represents the situation where RF exposure is being overestimated the least by the simulations.

Since the mmWave modules are placed in different locations, each may experience different housing material impacts due to their differing environments. So, 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 (H and V), for any surface which might contain the highest PD for a given module. The lowest  $\Delta_{min}$  determined for a given module + band combination was later used in the PD characterization process for that combination.

In the tables below, the lowest  $\Delta_{min}$  is highlighted for each module + band combination. This is the value which will be used in the PD char calculations for that module + band as lower values are more conservative.

| $\Delta_{\min}$ – Band n261 |        |         |         |                                      |                                       |                         |
|-----------------------------|--------|---------|---------|--------------------------------------|---------------------------------------|-------------------------|
| Band                        | Module | Surface | Beam ID | Measured PD<br>(mW/cm <sup>2</sup> ) | Simulated PD<br>(mW/cm <sup>2</sup> ) | $\Delta_{\min}$<br>(dB) |
| n261                        | 0      | Front   | 33      | 0.414                                | 0.52                                  | 0.99                    |
| n261                        | 0      | Front   | 152     | 0.228                                | 0.28                                  | <b>0.89</b>             |
| 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                                  | <b>0.35</b>             |
| n261                        | 1      | Top     | 29      | 0.348                                | 0.84                                  | 3.83                    |
| n261                        | 1      | Top     | 166     | 0.168                                | 1.09                                  | 8.12                    |

Table 6.  $\Delta_{\min}$  Calculated Values for n261 from 6 dBm Reference Power Simulations and Measurements

| Band | Module | Surface | Beam ID | Measured PD<br>(mW/cm <sup>2</sup> ) | Simulated PD<br>(mW/cm <sup>2</sup> ) | $\Delta_{\min}$<br>(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                                  | <b>-1.13</b>            |
| 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                                  | <b>0.37</b>             |
| n260 | 1      | Top     | 27      | 0.122                                | 0.46                                  | 5.76                    |
| n260 | 1      | Top     | 157     | 0.231                                | 0.43                                  | 2.70                    |

Table 7.  $\Delta_{\min}$  Calculated Values for n260 from 6 dBm Reference Power Simulations and Measurements

## VI. PD Characterization Calculations and Results

### A. Scaling Factor

The worst-case scaling factors for each module + band + channel + beam were shown in the PD simulation report. Those values are used here in conjunction with  $\Delta_{\min}$  to adjust the 6 dBm reference power level to the compliant levels and thus determine the compliant *input.power.limits*. The scaling factor for a given beam  $i$  of  $M$  possible beams is calculated as:

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

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, and thus for the *sim.PDsurface* in the equation above.

### B. Input Power Limit Calculations from $s(i)$ and $\Delta_{\min}$

In general, the input power limits are based on equation (1) below.

$$input.power.limit(i) = P_{ref} + 10 * \log(s(i)) + \Delta_{min}, i \in \text{all beams} \quad (1)$$

If simulation overestimates the housing influence, then  $\Delta_{\min}$  (=minimum {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 loss, then  $\Delta_{\min}$  is positive (measured PD would be lower than the simulated value.) Input power to antenna elements determined via simulation can be increased some with PD compliance still being maintained.

However, when measurements are made at the 6 dBm reference power to determine  $\Delta_{\min}$ , there is a **0.5 dB TxAGC uncertainty**. Since the TxAGC uncertainty at reference power level is embedded in the process of  $\Delta_{\min}$  determination, that uncertainty should be removed to avoid double counting the uncertainty.

The following logic is used in accordance with the mmWave module manufacturer's design guidelines to determine the input power limits while accounting for the TxAGC uncertainty at 6 dBm:

If  $(-\text{TxAGC uncertainty at reference power level}) < \Delta_{\min} < (\text{TxAGC uncertainty at reference power level})$ , then

$$\text{input.power.limit}(i) = P_{ref} + 10 * \log(s(i)), i \in \text{all beams} \quad (2)$$

Else If  $\Delta_{\min} < (-\text{TxAGC uncertainty at reference power level})$ , then

$$\text{input.power.limit}(i) = P_{ref} + 10 * \log(s(i)) + (\Delta_{\min} + \text{TxAGC uncertainty}), i \in \text{all beams} \quad (3)$$

Else If  $\Delta_{\min} > (\text{TxAGC uncertainty at reference power level})$ , then

$$\text{input.power.limit}(i) = P_{ref} + 10 * \log(s(i)) + (\Delta_{\min} - \text{TxAGC uncertainty}), i \in \text{all beams} \quad (4)$$

Table 8 below summarizes which equations are used for each band and module combination based on the value of  $\Delta_{\min}$ .

| Band | Module | $\Delta_{\min}$<br>(dB) | Equation used for <i>input.power.limit</i> calculation |
|------|--------|-------------------------|--|
| n261 | 0      | <b>0.89</b>             | Equation (4) ( $\Delta_{\min} > 0.5$ dB)               |
| n261 | 1      | <b>0.35</b>             | Equation (2) ( $-0.5$ dB $< \Delta_{\min} < 0.5$ dB)   |
| n260 | 0      | <b>-1.13</b>            | Equation (3) ( $\Delta_{\min} < -0.5$ dB)              |
| n260 | 1      | <b>0.37</b>             | Equation (2) ( $-0.5$ dB $< \Delta_{\min} < 0.5$ dB)   |

Table 8. Equation used to determine *input.power.limit* for each module+band combo, based on  $\Delta_{\min}$  value.

Tables 9-12 contain the worst-case  $s(i)$  values from the simulation report. The lowest  $s(i)$  value amongst the 3 channels is used to calculate the *input.power.limit* for that beam.

| <b>Module 0 – n261 – <i>input.power.limit</i> Determination</b> |                |                           |                 |                  |                                |
|---|----------------|---------------------------|-----------------|------------------|--------------------------------|
| Beam ID   | Paired Beam ID | $\Delta_{\min} = 0.89$ dB |                 |                  | <i>input.power.limit</i> (dBm) |
|   |                | <i>s(i)</i> Low           | <i>s(i)</i> Mid | <i>s(i)</i> High |                                |
| 0   |                | 1.340                     | 1.312           | 1.468            | 7.5                            |
| 2   |                | 1.285                     | 1.142           | 1.209            | 6.9                            |
| 4   |                | 1.285                     | 1.142           | 1.233            | 6.9                            |
| 6   |                | 1.233                     | 1.082           | 1.142            | 6.7                            |
| 8   |                | 0.629                     | 0.582           | 0.610            | 4.0                            |
| 9   |                | 0.629                     | 0.551           | 0.587            | 3.8                            |
| 10  |                | 0.678                     | 0.623           | 0.709            | 4.3                            |
| 11  |                | 0.629                     | 0.587           | 0.636            | 4.0                            |
| 16  |                | 0.629                     | 0.551           | 0.599            | 3.8                            |
| 17  |                | 0.629                     | 0.571           | 0.617            | 3.9                            |
| 18  |                | 0.610                     | 0.566           | 0.617            | 3.9                            |
| 22  |                | 0.457                     | 0.417           | 0.417            | 2.5                            |
| 23  |                | 0.398                     | 0.346           | 0.367            | 1.7                            |
| 24  |                | 0.408                     | 0.408           | 0.453            | 2.5                            |
| 25  |                | 0.478                     | 0.422           | 0.406            | 2.4                            |
| 26  |                | 0.478                     | 0.434           | 0.414            | 2.5                            |
| 32  |                | 0.450                     | 0.388           | 0.419            | 2.2                            |
| 33  |                | 0.344                     | 0.319           | 0.348            | 1.4                            |
| 34  |                | 0.378                     | 0.376           | 0.431            | 2.1                            |
| 35  |                | 0.474                     | 0.422           | 0.406            | 2.4                            |
| 128   |                | 1.340                     | 1.468           | 1.868            | 7.6                            |
| 130   |                | 1.370                     | 1.541           | 1.868            | 7.7                            |
| 132   |                | 1.434                     | 1.666           | 2.055            | 7.9                            |
| 134   |                | 1.762                     | 2.055           | 2.569            | 8.8                            |
| 136   |                | 0.845                     | 0.949           | 1.142            | 5.6                            |
| 137   |                | 0.894                     | 1.028           | 1.312            | 5.9                            |
| 138   |                | 0.752                     | 0.868           | 1.028            | 5.1                            |
| 139   |                | 0.822                     | 0.868           | 1.011            | 5.5                            |
| 144   |                | 0.709                     | 0.791           | 0.995            | 4.9                            |
| 145   |                | 1.063                     | 1.209           | 1.434            | 6.6                            |
| 146   |                | 0.781                     | 0.907           | 1.142            | 5.3                            |
| 150   |                | 0.385                     | 0.417           | 0.505            | 2.2                            |
| 151   |                | 0.422                     | 0.486           | 0.636            | 2.6                            |
| 152   |                | 0.486                     | 0.566           | 0.701            | 3.2                            |
| 153   |                | 0.510                     | 0.541           | 0.693            | 3.4                            |
| 154   |                | 0.474                     | 0.546           | 0.636            | 3.1                            |
| 160   |                | 0.417                     | 0.467           | 0.571            | 2.5                            |
| 161   |                | 0.464                     | 0.546           | 0.670            | 3.0                            |
| 162   |                | 0.457                     | 0.541           | 0.701            | 2.9                            |
| 163   |                | 0.649                     | 0.663           | 0.822            | 4.5                            |
| 0   | 128            | 0.685                     | 0.656           | 0.717            | 4.5                            |
| 2   | 130            | 0.636                     | 0.582           | 0.663            | 4.0                            |
| 4   | 132            | 0.656                     | 0.610           | 0.845            | 4.2                            |
| 6   | 134            | 0.587                     | 0.541           | 0.587            | 3.7                            |
| 8   | 136            | 0.346                     | 0.369           | 0.388            | 1.7                            |
| 9   | 137            | 0.381                     | 0.354           | 0.398            | 1.8                            |
| 10  | 138            | 0.325                     | 0.330           | 0.361            | 1.5                            |
| 11  | 139            | 0.352                     | 0.348           | 0.417            | 1.8                            |
| 16  | 144            | 0.313                     | 0.299           | 0.346            | 1.1                            |
| 17  | 145            | 0.371                     | 0.376           | 0.414            | 2.0                            |
| 18  | 146            | 0.514                     | 0.464           | 0.497            | 3.0                            |
| 22  | 150            | 0.187                     | 0.193           | 0.214            | -0.9                           |
| 23  | 151            | 0.193                     | 0.207           | 0.228            | -0.8                           |
| 24  | 152            | 0.236                     | 0.253           | 0.299            | 0.1                            |
| 25  | 153            | 0.260                     | 0.247           | 0.266            | 0.3                            |
| 26  | 154            | 0.228                     | 0.231           | 0.242            | -0.1                           |
| 32  | 160            | 0.202                     | 0.198           | 0.208            | -0.7                           |
| 33  | 161            | 0.197                     | 0.191           | 0.240            | -0.8                           |
| 34  | 162            | 0.253                     | 0.227           | 0.279            | -0.1                           |
| 35  | 163            | 0.291                     | 0.245           | 0.274            | 0.2                            |

Table 9. n261 Module 0  $\Delta_{\min}$  and worst-case *s(i)* values for all channels needed for *input.power.limit* calculations



| <b>Module 1 – n261 – <i>input.power.limit</i> Determination</b> |                |                           |                 |                  |                                |
|---|----------------|---------------------------|-----------------|------------------|--------------------------------|
| Beam ID   | Paired Beam ID | $\Delta_{\min} = 0.35$ dB |                 |                  | <i>input.power.limit</i> (dBm) |
|   |                | <i>s(i)</i> Low           | <i>s(i)</i> Mid | <i>s(i)</i> High |                                |
| 1   |                | 1.927                     | 2.055           | 2.055            | 8.8                            |
| 3   |                | 1.370                     | 1.468           | 1.666            | 7.3                            |
| 5   |                | 1.312                     | 1.312           | 1.434            | 7.1                            |
| 7   |                | 1.401                     | 1.401           | 1.434            | 7.4                            |
| 12  |                | 0.743                     | 0.761           | 0.833            | 4.7                            |
| 13  |                | 0.623                     | 0.629           | 0.678            | 3.9                            |
| 14  |                | 0.670                     | 0.693           | 0.781            | 4.2                            |
| 15  |                | 0.791                     | 0.868           | 0.920            | 4.9                            |
| 19  |                | 0.801                     | 0.781           | 0.801            | 4.9                            |
| 20  |                | 0.642                     | 0.636           | 0.693            | 4.0                            |
| 21  |                | 0.649                     | 0.670           | 0.734            | 4.1                            |
| 27  |                | 0.636                     | 0.623           | 0.693            | 3.9                            |
| 28  |                | 0.437                     | 0.440           | 0.489            | 2.4                            |
| 29  |                | 0.431                     | 0.434           | 0.460            | 2.3                            |
| 30  |                | 0.471                     | 0.474           | 0.536            | 2.7                            |
| 31  |                | 0.523                     | 0.561           | 0.636            | 3.1                            |
| 36  |                | 0.518                     | 0.536           | 0.561            | 3.1                            |
| 37  |                | 0.417                     | 0.417           | 0.444            | 2.2                            |
| 38  |                | 0.467                     | 0.471           | 0.514            | 2.6                            |
| 39  |                | 0.497                     | 0.523           | 0.587            | 2.9                            |
| 129   |                | 1.340                     | 1.504           | 1.762            | 7.2                            |
| 131   |                | 1.504                     | 1.468           | 1.504            | 7.6                            |
| 133   |                | 1.468                     | 1.468           | 1.504            | 7.6                            |
| 135   |                | 1.401                     | 1.401           | 1.504            | 7.4                            |
| 140   |                | 0.791                     | 0.791           | 0.833            | 4.9                            |
| 141   |                | 0.811                     | 0.801           | 0.822            | 5.0                            |
| 142   |                | 0.761                     | 0.752           | 0.771            | 4.7                            |
| 143   |                | 0.822                     | 0.822           | 0.833            | 5.1                            |
| 147   |                | 0.801                     | 0.801           | 0.833            | 5.0                            |
| 148   |                | 0.791                     | 0.771           | 0.791            | 4.8                            |
| 149   |                | 0.801                     | 0.791           | 0.761            | 4.8                            |
| 155   |                | 0.447                     | 0.478           | 0.541            | 2.5                            |
| 156   |                | 0.450                     | 0.450           | 0.471            | 2.5                            |
| 157   |                | 0.482                     | 0.486           | 0.510            | 2.8                            |
| 158   |                | 0.489                     | 0.501           | 0.514            | 2.9                            |
| 159   |                | 0.467                     | 0.471           | 0.505            | 2.6                            |
| 164   |                | 0.422                     | 0.440           | 0.478            | 2.2                            |
| 165   |                | 0.457                     | 0.453           | 0.474            | 2.5                            |
| 166   |                | 0.478                     | 0.532           | 0.514            | 2.7                            |
| 167   |                | 0.464                     | 0.471           | 0.482            | 2.6                            |
| 1   | 129            | 0.663                     | 0.701           | 0.734            | 4.2                            |
| 3   | 131            | 0.701                     | 0.725           | 0.791            | 4.4                            |
| 5   | 133            | 0.663                     | 0.685           | 0.693            | 4.2                            |
| 7   | 135            | 0.678                     | 0.685           | 0.685            | 4.3                            |
| 12  | 140            | 0.350                     | 0.350           | 0.371            | 1.4                            |
| 13  | 141            | 0.337                     | 0.361           | 0.403            | 1.2                            |
| 14  | 142            | 0.332                     | 0.346           | 0.388            | 1.2                            |
| 15  | 143            | 0.358                     | 0.374           | 0.403            | 1.5                            |
| 19  | 147            | 0.450                     | 0.428           | 0.422            | 2.2                            |
| 20  | 148            | 0.358                     | 0.361           | 0.385            | 1.5                            |
| 21  | 149            | 0.365                     | 0.369           | 0.385            | 1.6                            |
| 27  | 155            | 0.230                     | 0.228           | 0.239            | -0.5                           |
| 28  | 156            | 0.203                     | 0.209           | 0.228            | -1.0                           |
| 29  | 157            | 0.218                     | 0.224           | 0.244            | -0.7                           |
| 30  | 158            | 0.219                     | 0.230           | 0.256            | -0.6                           |
| 31  | 159            | 0.231                     | 0.235           | 0.302            | -0.4                           |
| 36  | 164            | 0.220                     | 0.225           | 0.243            | -0.6                           |
| 37  | 165            | 0.208                     | 0.212           | 0.230            | -0.9                           |
| 38  | 166            | 0.223                     | 0.231           | 0.254            | -0.6                           |
| 39  | 167            | 0.224                     | 0.240           | 0.269            | -0.5                           |

Table 10. n261 Module 1  $\Delta_{\min}$  and worst-case *s(i)* values for all channels needed for *input.power.limit* calculations

| <b>Module 0 – n260 – input.power.limit Determination</b> |                |                            |          |           |                         |
|--|----------------|----------------------------|----------|-----------|-------------------------|
| Beam ID  | Paired Beam ID | $\Delta_{\min} = -1.13$ dB |          |           | input.power.limit (dBm) |
|  |                | s(i) Low                   | s(i) Mid | s(i) High |                         |
| 0  |                | 1.028                      | 1.082    | 1.186     | 5.4                     |
| 2  |                | 1.011                      | 1.312    | 1.233     | 5.4                     |
| 4  |                | 1.045                      | 1.121    | 1.312     | 5.5                     |
| 6  |                | 1.163                      | 1.541    | 1.082     | 5.7                     |
| 8  |                | 0.561                      | 0.685    | 0.629     | 2.8                     |
| 9  |                | 0.571                      | 0.678    | 0.617     | 2.9                     |
| 10   |                | 0.593                      | 0.734    | 0.649     | 3.1                     |
| 11   |                | 0.576                      | 0.629    | 0.752     | 2.9                     |
| 16   |                | 0.486                      | 0.536    | 0.551     | 2.2                     |
| 17   |                | 0.510                      | 0.518    | 0.551     | 2.4                     |
| 18   |                | 0.605                      | 0.811    | 0.822     | 3.1                     |
| 22   |                | 0.390                      | 0.629    | 0.398     | 1.2                     |
| 23   |                | 0.305                      | 0.315    | 0.422     | 0.2                     |
| 24   |                | 0.339                      | 0.523    | 0.566     | 0.6                     |
| 25   |                | 0.301                      | 0.371    | 0.356     | 0.1                     |
| 26   |                | 0.385                      | 0.561    | 0.709     | 1.2                     |
| 32   |                | 0.298                      | 0.348    | 0.376     | 0.1                     |
| 33   |                | 0.328                      | 0.385    | 0.555     | 0.5                     |
| 34   |                | 0.434                      | 0.642    | 0.440     | 1.7                     |
| 35   |                | 0.301                      | 0.325    | 0.422     | 0.1                     |
| 128  |                | 1.163                      | 1.028    | 1.163     | 5.4                     |
| 130  |                | 1.028                      | 1.082    | 1.063     | 5.4                     |
| 132  |                | 0.995                      | 0.963    | 0.963     | 5.2                     |
| 134  |                | 1.186                      | 1.163    | 1.101     | 5.7                     |
| 136  |                | 0.605                      | 0.536    | 0.532     | 2.6                     |
| 137  |                | 0.587                      | 0.555    | 0.532     | 2.6                     |
| 138  |                | 0.642                      | 0.551    | 0.582     | 2.7                     |
| 139  |                | 0.623                      | 0.566    | 0.571     | 2.8                     |
| 144  |                | 0.561                      | 0.532    | 0.623     | 2.6                     |
| 145  |                | 0.629                      | 0.593    | 0.617     | 3.1                     |
| 146  |                | 0.582                      | 0.536    | 0.536     | 2.6                     |
| 150  |                | 0.289                      | 0.411    | 0.417     | -0.1                    |
| 151  |                | 0.302                      | 0.305    | 0.344     | 0.1                     |
| 152  |                | 0.390                      | 0.425    | 0.313     | 0.3                     |
| 153  |                | 0.291                      | 0.289    | 0.408     | -0.1                    |
| 154  |                | 0.348                      | 0.305    | 0.346     | 0.2                     |
| 160  |                | 0.367                      | 0.308    | 0.417     | 0.2                     |
| 161  |                | 0.434                      | 0.341    | 0.337     | 0.6                     |
| 162  |                | 0.428                      | 0.385    | 0.437     | 1.2                     |
| 163  |                | 0.325                      | 0.332    | 0.346     | 0.4                     |
| 0  | 128            | 0.447                      | 0.482    | 0.536     | 1.8                     |
| 2  | 130            | 0.505                      | 0.546    | 0.571     | 2.4                     |
| 4  | 132            | 0.450                      | 0.474    | 0.527     | 1.9                     |
| 6  | 134            | 0.474                      | 0.593    | 0.536     | 2.1                     |
| 8  | 136            | 0.259                      | 0.261    | 0.316     | -0.5                    |
| 9  | 137            | 0.234                      | 0.254    | 0.289     | -1.0                    |
| 10   | 138            | 0.482                      | 0.417    | 0.319     | 0.4                     |
| 11   | 139            | 0.274                      | 0.299    | 0.346     | -0.3                    |
| 16   | 144            | 0.252                      | 0.280    | 0.292     | -0.7                    |
| 17   | 145            | 0.328                      | 0.354    | 0.348     | 0.5                     |
| 18   | 146            | 0.354                      | 0.388    | 0.489     | 0.8                     |
| 22   | 150            | 0.171                      | 0.199    | 0.171     | -2.4                    |
| 23   | 151            | 0.138                      | 0.134    | 0.166     | -3.4                    |
| 24   | 152            | 0.175                      | 0.254    | 0.173     | -2.3                    |
| 25   | 153            | 0.193                      | 0.151    | 0.151     | -2.9                    |
| 26   | 154            | 0.190                      | 0.195    | 0.206     | -1.9                    |
| 32   | 160            | 0.139                      | 0.150    | 0.161     | -3.2                    |
| 33   | 161            | 0.161                      | 0.164    | 0.200     | -2.6                    |
| 34   | 162            | 0.195                      | 0.217    | 0.217     | -1.8                    |
| 35   | 163            | 0.143                      | 0.139    | 0.196     | -3.3                    |

Table 11. n260 Module 0  $\Delta_{\min}$  and worst-case s(i) values for all channels needed for input.power.limit calculation

| <b>Module 1 – n260 – <i>input.power.limit</i> Determination</b> |                |                           |                 |                  |                                |
|---|----------------|---------------------------|-----------------|------------------|--------------------------------|
| Beam ID   | Paired Beam ID | $\Delta_{\min} = 0.37$ dB |                 |                  | <i>input.power.limit</i> (dBm) |
|   |                | <i>s(i)</i> Low           | <i>s(i)</i> Mid | <i>s(i)</i> High |                                |
| 1   |                | 1.666                     | 1.666           | 1.713            | 8.2                            |
| 3   |                | 1.762                     | 1.623           | 1.623            | 8.1                            |
| 5   |                | 1.666                     | 1.623           | 1.581            | 7.9                            |
| 7   |                | 1.666                     | 1.581           | 1.504            | 7.7                            |
| 12  |                | 0.920                     | 0.979           | 0.868            | 5.3                            |
| 13  |                | 0.920                     | 0.995           | 0.963            | 5.6                            |
| 14  |                | 0.934                     | 0.979           | 0.868            | 5.3                            |
| 15  |                | 0.833                     | 0.781           | 0.781            | 4.9                            |
| 19  |                | 0.920                     | 0.963           | 0.894            | 5.5                            |
| 20  |                | 0.963                     | 0.934           | 0.979            | 5.7                            |
| 21  |                | 0.934                     | 0.934           | 0.822            | 5.1                            |
| 27  |                | 0.629                     | 0.701           | 0.518            | 3.1                            |
| 28  |                | 0.663                     | 0.593           | 0.678            | 3.7                            |
| 29  |                | 0.536                     | 0.599           | 0.678            | 3.2                            |
| 30  |                | 0.605                     | 0.551           | 0.566            | 3.4                            |
| 31  |                | 0.717                     | 0.636           | 0.649            | 4.0                            |
| 36  |                | 0.822                     | 0.617           | 0.464            | 2.6                            |
| 37  |                | 0.555                     | 0.663           | 0.636            | 3.4                            |
| 38  |                | 0.532                     | 0.571           | 0.566            | 3.2                            |
| 39  |                | 0.629                     | 0.587           | 0.709            | 3.6                            |
| 129   |                | 1.713                     | 1.623           | 2.569            | 8.1                            |
| 131   |                | 1.927                     | 2.055           | 2.936            | 8.8                            |
| 133   |                | 1.868                     | 1.814           | 3.083            | 8.5                            |
| 135   |                | 1.927                     | 2.803           | 2.284            | 8.8                            |
| 140   |                | 1.233                     | 1.045           | 1.814            | 6.1                            |
| 141   |                | 0.881                     | 0.949           | 1.340            | 5.4                            |
| 142   |                | 0.811                     | 0.845           | 1.401            | 5.0                            |
| 143   |                | 0.894                     | 1.028           | 1.581            | 5.5                            |
| 147   |                | 1.312                     | 1.258           | 1.814            | 7.0                            |
| 148   |                | 1.082                     | 1.063           | 1.581            | 6.2                            |
| 149   |                | 0.801                     | 0.894           | 1.434            | 5.0                            |
| 155   |                | 0.725                     | 0.663           | 1.028            | 4.2                            |
| 156   |                | 0.546                     | 0.605           | 1.121            | 3.3                            |
| 157   |                | 0.701                     | 0.725           | 1.101            | 4.4                            |
| 158   |                | 0.599                     | 0.617           | 0.979            | 3.7                            |
| 159   |                | 0.636                     | 0.629           | 1.028            | 3.9                            |
| 164   |                | 0.510                     | 0.693           | 1.045            | 3.0                            |
| 165   |                | 0.599                     | 0.761           | 1.028            | 3.7                            |
| 166   |                | 0.629                     | 0.610           | 1.258            | 3.8                            |
| 167   |                | 0.725                     | 0.629           | 0.979            | 3.9                            |
| 1   | 129            | 0.881                     | 0.811           | 0.995            | 5.0                            |
| 3   | 131            | 0.920                     | 0.868           | 0.995            | 5.3                            |
| 5   | 133            | 0.833                     | 0.822           | 0.934            | 5.1                            |
| 7   | 135            | 0.881                     | 0.822           | 0.791            | 4.9                            |
| 12  | 140            | 0.501                     | 0.467           | 0.623            | 2.6                            |
| 13  | 141            | 0.444                     | 0.447           | 0.501            | 2.4                            |
| 14  | 142            | 0.514                     | 0.419           | 0.478            | 2.2                            |
| 15  | 143            | 0.457                     | 0.428           | 0.478            | 2.3                            |
| 19  | 147            | 0.571                     | 0.555           | 0.593            | 3.4                            |
| 20  | 148            | 0.471                     | 0.493           | 0.610            | 2.7                            |
| 21  | 149            | 0.510                     | 0.425           | 0.486            | 2.2                            |
| 27  | 155            | 0.411                     | 0.406           | 0.390            | 1.9                            |
| 28  | 156            | 0.403                     | 0.330           | 0.388            | 1.1                            |
| 29  | 157            | 0.283                     | 0.361           | 0.388            | 0.5                            |
| 30  | 158            | 0.330                     | 0.282           | 0.369            | 0.5                            |
| 31  | 159            | 0.318                     | 0.275           | 0.425            | 0.4                            |
| 36  | 164            | 0.350                     | 0.295           | 0.428            | 0.7                            |
| 37  | 165            | 0.318                     | 0.330           | 0.395            | 1.0                            |
| 38  | 166            | 0.304                     | 0.294           | 0.341            | 0.6                            |
| 39  | 167            | 0.323                     | 0.367           | 0.388            | 1.0                            |

Table 12. n260 Module 1  $\Delta_{\min}$  and worst-case *s(i)* values for all channels needed for *input.power.limit* calculations

### C. PD Characterization Tables

These PD Characterization tables summarize the final input power limits for each module and band.

| <b>PD Char – Module 0 – n261</b> |       |                         |
|----------------------------------|-------|-------------------------|
| Beam1                            | Beam2 | input.Power.limit (dBm) |
| 0                                |       | 7.5                     |
| 2                                |       | 6.9                     |
| 4                                |       | 6.9                     |
| 6                                |       | 6.7                     |
| 8                                |       | 4.0                     |
| 9                                |       | 3.8                     |
| 10                               |       | 4.3                     |
| 11                               |       | 4.0                     |
| 16                               |       | 3.8                     |
| 17                               |       | 3.9                     |
| 18                               |       | 3.9                     |
| 22                               |       | 2.5                     |
| 23                               |       | 1.7                     |
| 24                               |       | 2.5                     |
| 25                               |       | 2.4                     |
| 26                               |       | 2.5                     |
| 32                               |       | 2.2                     |
| 33                               |       | 1.4                     |
| 34                               |       | 2.1                     |
| 35                               |       | 2.4                     |
| 128                              |       | 7.6                     |
| 130                              |       | 7.7                     |
| 132                              |       | 7.9                     |
| 134                              |       | 8.8                     |
| 136                              |       | 5.6                     |
| 137                              |       | 5.9                     |
| 138                              |       | 5.1                     |
| 139                              |       | 5.5                     |
| 144                              |       | 4.9                     |
| 145                              |       | 6.6                     |
| 146                              |       | 5.3                     |
| 150                              |       | 2.2                     |
| 151                              |       | 2.6                     |
| 152                              |       | 3.2                     |
| 153                              |       | 3.4                     |
| 154                              |       | 3.1                     |
| 160                              |       | 2.5                     |
| 161                              |       | 3.0                     |
| 162                              |       | 2.9                     |
| 163                              |       | 4.5                     |
| 0                                | 128   | 4.5                     |
| 2                                | 130   | 4.0                     |
| 4                                | 132   | 4.2                     |
| 6                                | 134   | 3.7                     |
| 8                                | 136   | 1.7                     |
| 9                                | 137   | 1.8                     |
| 10                               | 138   | 1.5                     |
| 11                               | 139   | 1.8                     |
| 16                               | 144   | 1.1                     |
| 17                               | 145   | 2.0                     |
| 18                               | 146   | 3.0                     |
| 22                               | 150   | -0.9                    |
| 23                               | 151   | -0.8                    |
| 24                               | 152   | 0.1                     |
| 25                               | 153   | 0.3                     |
| 26                               | 154   | -0.1                    |
| 32                               | 160   | -0.7                    |
| 33                               | 161   | -0.8                    |
| 34                               | 162   | -0.1                    |
| 35                               | 163   | 0.2                     |

Table 13. Module 0 – n261 PD Char Table

| <b>PD Char – Module 1 – n261</b> |       |                         |
|----------------------------------|-------|-------------------------|
| Beam1                            | Beam2 | input.Power.limit (dBm) |
| 1                                |       | 8.8                     |
| 3                                |       | 7.3                     |
| 5                                |       | 7.1                     |
| 7                                |       | 7.4                     |
| 12                               |       | 4.7                     |
| 13                               |       | 3.9                     |
| 14                               |       | 4.2                     |
| 15                               |       | 4.9                     |
| 19                               |       | 4.9                     |
| 20                               |       | 4.0                     |
| 21                               |       | 4.1                     |
| 27                               |       | 3.9                     |
| 28                               |       | 2.4                     |
| 29                               |       | 2.3                     |
| 30                               |       | 2.7                     |
| 31                               |       | 3.1                     |
| 36                               |       | 3.1                     |
| 37                               |       | 2.2                     |
| 38                               |       | 2.6                     |
| 39                               |       | 2.9                     |
| 129                              |       | 7.2                     |
| 131                              |       | 7.6                     |
| 133                              |       | 7.6                     |
| 135                              |       | 7.4                     |
| 140                              |       | 4.9                     |
| 141                              |       | 5.0                     |
| 142                              |       | 4.7                     |
| 143                              |       | 5.1                     |
| 147                              |       | 5.0                     |
| 148                              |       | 4.8                     |
| 149                              |       | 4.8                     |
| 155                              |       | 2.5                     |
| 156                              |       | 2.5                     |
| 157                              |       | 2.8                     |
| 158                              |       | 2.9                     |
| 159                              |       | 2.6                     |
| 164                              |       | 2.2                     |
| 165                              |       | 2.5                     |
| 166                              |       | 2.7                     |
| 167                              |       | 2.6                     |
| 1                                | 129   | 4.2                     |
| 3                                | 131   | 4.4                     |
| 5                                | 133   | 4.2                     |
| 7                                | 135   | 4.3                     |
| 12                               | 140   | 1.4                     |
| 13                               | 141   | 1.2                     |
| 14                               | 142   | 1.2                     |
| 15                               | 143   | 1.5                     |
| 19                               | 147   | 2.2                     |
| 20                               | 148   | 1.5                     |
| 21                               | 149   | 1.6                     |
| 27                               | 155   | -0.5                    |
| 28                               | 156   | -1.0                    |
| 29                               | 157   | -0.7                    |
| 30                               | 158   | -0.6                    |
| 31                               | 159   | -0.4                    |
| 36                               | 164   | -0.6                    |
| 37                               | 165   | -0.9                    |
| 38                               | 166   | -0.6                    |
| 39                               | 167   | -0.5                    |

Table 14. Module 1 – n261 PD Char Table

| <b>PD Char – Module 0 – n260</b> |              |                                |
|----------------------------------|--------------|--------------------------------|
| <b>Beam1</b>                     | <b>Beam2</b> | <b>input.Power.limit (dBm)</b> |
| 0                                |              | 5.4                            |
| 2                                |              | 5.4                            |
| 4                                |              | 5.5                            |
| 6                                |              | 5.7                            |
| 8                                |              | 2.8                            |
| 9                                |              | 2.9                            |
| 10                               |              | 3.1                            |
| 11                               |              | 2.9                            |
| 16                               |              | 2.2                            |
| 17                               |              | 2.4                            |
| 18                               |              | 3.1                            |
| 22                               |              | 1.2                            |
| 23                               |              | 0.2                            |
| 24                               |              | 0.6                            |
| 25                               |              | 0.1                            |
| 26                               |              | 1.2                            |
| 32                               |              | 0.1                            |
| 33                               |              | 0.5                            |
| 34                               |              | 1.7                            |
| 35                               |              | 0.1                            |
| 128                              |              | 5.4                            |
| 130                              |              | 5.4                            |
| 132                              |              | 5.2                            |
| 134                              |              | 5.7                            |
| 136                              |              | 2.6                            |
| 137                              |              | 2.6                            |
| 138                              |              | 2.7                            |
| 139                              |              | 2.8                            |
| 144                              |              | 2.6                            |
| 145                              |              | 3.1                            |
| 146                              |              | 2.6                            |
| 150                              |              | -0.1                           |
| 151                              |              | 0.1                            |
| 152                              |              | 0.3                            |
| 153                              |              | -0.1                           |
| 154                              |              | 0.2                            |
| 160                              |              | 0.2                            |
| 161                              |              | 0.6                            |
| 162                              |              | 1.2                            |
| 163                              |              | 0.4                            |
| 0                                | 128          | 1.8                            |
| 2                                | 130          | 2.4                            |
| 4                                | 132          | 1.9                            |
| 6                                | 134          | 2.1                            |
| 8                                | 136          | -0.5                           |
| 9                                | 137          | -1.0                           |
| 10                               | 138          | 0.4                            |
| 11                               | 139          | -0.3                           |
| 16                               | 144          | -0.7                           |
| 17                               | 145          | 0.5                            |
| 18                               | 146          | 0.8                            |
| 22                               | 150          | -2.4                           |
| 23                               | 151          | -3.4                           |
| 24                               | 152          | -2.3                           |
| 25                               | 153          | -2.9                           |
| 26                               | 154          | -1.9                           |
| 32                               | 160          | -3.2                           |
| 33                               | 161          | -2.6                           |
| 34                               | 162          | -1.8                           |
| 35                               | 163          | -3.3                           |

Table 15. Module 0 – n260 PD Char Table

| <b>PD Char – Module 1 – n260</b> |              |                                |
|----------------------------------|--------------|--------------------------------|
| <b>Beam1</b>                     | <b>Beam2</b> | <b>input.Power.limit (dBm)</b> |
| 1                                |              | 8.2                            |
| 3                                |              | 8.1                            |
| 5                                |              | 7.9                            |
| 7                                |              | 7.7                            |
| 12                               |              | 5.3                            |
| 13                               |              | 5.6                            |
| 14                               |              | 5.3                            |
| 15                               |              | 4.9                            |
| 19                               |              | 5.5                            |
| 20                               |              | 5.7                            |
| 21                               |              | 5.1                            |
| 27                               |              | 3.1                            |
| 28                               |              | 3.7                            |
| 29                               |              | 3.2                            |
| 30                               |              | 3.4                            |
| 31                               |              | 4.0                            |
| 36                               |              | 2.6                            |
| 37                               |              | 3.4                            |
| 38                               |              | 3.2                            |
| 39                               |              | 3.6                            |
| 129                              |              | 8.1                            |
| 131                              |              | 8.8                            |
| 133                              |              | 8.5                            |
| 135                              |              | 8.8                            |
| 140                              |              | 6.1                            |
| 141                              |              | 5.4                            |
| 142                              |              | 5.0                            |
| 143                              |              | 5.5                            |
| 147                              |              | 7.0                            |
| 148                              |              | 6.2                            |
| 149                              |              | 5.0                            |
| 155                              |              | 4.2                            |
| 156                              |              | 3.3                            |
| 157                              |              | 4.4                            |
| 158                              |              | 3.7                            |
| 159                              |              | 3.9                            |
| 164                              |              | 3.0                            |
| 165                              |              | 3.7                            |
| 166                              |              | 3.8                            |
| 167                              |              | 3.9                            |
| 1                                | 129          | 5.0                            |
| 3                                | 131          | 5.3                            |
| 5                                | 133          | 5.1                            |
| 7                                | 135          | 4.9                            |
| 12                               | 140          | 2.6                            |
| 13                               | 141          | 2.4                            |
| 14                               | 142          | 2.2                            |
| 15                               | 143          | 2.3                            |
| 19                               | 147          | 3.4                            |
| 20                               | 148          | 2.7                            |
| 21                               | 149          | 2.2                            |
| 27                               | 155          | 1.9                            |
| 28                               | 156          | 1.1                            |
| 29                               | 157          | 0.5                            |
| 30                               | 158          | 0.5                            |
| 31                               | 159          | 0.4                            |
| 36                               | 164          | 0.7                            |
| 37                               | 165          | 1.0                            |
| 38                               | 166          | 0.6                            |
| 39                               | 167          | 1.0                            |

Table 16. Module 1 – n260 PD Char Table

## Appendix A: $\Delta_{\min}$ Validation

To validate that all relevant surfaces were considered in the determination of the  $\Delta_{\min}$  values used for housing material loss quantification, the following procedure was followed:

1. Scale the simulated 4cm<sup>2</sup>-averaged PD values for all single beams to correspond to their *sim.power<sub>limit</sub>*, and identify the worst-PD beam per each non-selected surface.
2. Measure 4cm<sup>2</sup>-averaged PD at *input.power.limit* for the identified worst-PD beam at each non-selected surface.
3. Demonstrate all measured 4cm<sup>2</sup>-averaged PD values are below *PD\_design\_target*

*sim.power<sub>limit</sub>* is calculated as:

$$simpower_{limit}(i)dBm = 10 * \log(s(i)) + 6 dBm$$

Tables 17-20 show the simulated PD scaled to the *simpower<sub>limit</sub>* for the middle channel for all single beams. The highlighted values show the worst-case beam for a given surface for which PD has been measured here using the *input.power.limit* value for that beam. These are surfaces which were not selected for  $\Delta_{\min}$  determination. Measuring the worst simulated beam for these surfaces at the *input.power.limit* and showing that the result is below the PD design target validates that those surfaces were not included in  $\Delta_{\min}$  determination. All results in Tables 21 and 22 are well below the PD design target of 0.617 mW/cm<sup>2</sup>.



| Module 0 – n261 – Mid Channel<br>Simulated PD Scaled to $simpower_{limit}$ |                |                    |  |      |       |      |
|--|----------------|--------------------|--|------|-------|------|
| Beam ID  | Paired Beam ID | # o f Active Feeds | 4cm <sup>2</sup> PD (mW/cm <sup>2</sup> ) at 2mm |      |       |      |
|  |                |                    | Front  | Back | Right | Top  |
| 0  |                | 1                  | 0.22   | 0.16 | 0.617 | 0.03 |
| 2  |                | 1                  | 0.15   | 0.27 | 0.617 | 0.01 |
| 4  |                | 1                  | 0.16   | 0.24 | 0.617 | 0.02 |
| 6  |                | 1                  | 0.17   | 0.18 | 0.617 | 0.03 |
| 8  |                | 2                  | 0.21   | 0.24 | 0.617 | 0.01 |
| 9  |                | 2                  | 0.18   | 0.28 | 0.617 | 0.01 |
| 10   |                | 2                  | 0.15   | 0.25 | 0.617 | 0.02 |
| 11   |                | 2                  | 0.21   | 0.25 | 0.616 | 0.01 |
| 16   |                | 2                  | 0.15   | 0.27 | 0.617 | 0.03 |
| 17   |                | 2                  | 0.18   | 0.27 | 0.617 | 0.01 |
| 18   |                | 2                  | 0.20   | 0.25 | 0.617 | 0.01 |
| 22   |                | 4                  | 0.20   | 0.22 | 0.617 | 0.01 |
| 23   |                | 4                  | 0.17   | 0.26 | 0.616 | 0.04 |
| 24   |                | 4                  | 0.16   | 0.24 | 0.616 | 0.05 |
| 25   |                | 4                  | 0.19   | 0.28 | 0.616 | 0.04 |
| 26   |                | 4                  | 0.20   | 0.27 | 0.616 | 0.02 |
| 32   |                | 4                  | 0.16   | 0.17 | 0.617 | 0.05 |
| 33   |                | 4                  | 0.17   | 0.30 | 0.616 | 0.03 |
| 34   |                | 4                  | 0.18   | 0.19 | 0.617 | 0.04 |
| 35   |                | 4                  | 0.19   | 0.31 | 0.616 | 0.03 |
| 128  |                | 1                  | 0.10   | 0.21 | 0.617 | 0.01 |
| 130  |                | 1                  | 0.12   | 0.23 | 0.616 | 0.02 |
| 132  |                | 1                  | 0.12   | 0.25 | 0.616 | 0.02 |
| 134  |                | 1                  | 0.12   | 0.27 | 0.617 | 0.04 |
| 136  |                | 2                  | 0.16   | 0.31 | 0.617 | 0.03 |
| 137  |                | 2                  | 0.09   | 0.26 | 0.617 | 0.03 |
| 138  |                | 2                  | 0.10   | 0.21 | 0.616 | 0.03 |
| 139  |                | 2                  | 0.12   | 0.20 | 0.616 | 0.03 |
| 144  |                | 2                  | 0.14   | 0.30 | 0.617 | 0.02 |
| 145  |                | 2                  | 0.10   | 0.22 | 0.617 | 0.08 |
| 146  |                | 2                  | 0.13   | 0.26 | 0.617 | 0.05 |
| 150  |                | 4                  | 0.18   | 0.33 | 0.617 | 0.05 |
| 151  |                | 4                  | 0.16   | 0.32 | 0.617 | 0.02 |
| 152  |                | 4                  | 0.16   | 0.30 | 0.617 | 0.04 |
| 153  |                | 4                  | 0.15   | 0.22 | 0.617 | 0.06 |
| 154  |                | 4                  | 0.16   | 0.27 | 0.617 | 0.05 |
| 160  |                | 4                  | 0.17   | 0.32 | 0.616 | 0.03 |
| 161  |                | 4                  | 0.16   | 0.33 | 0.617 | 0.02 |
| 162  |                | 4                  | 0.14   | 0.25 | 0.617 | 0.03 |
| 163  |                | 4                  | 0.13   | 0.23 | 0.617 | 0.07 |

Table 17. Module 0 – n261 Simulated PD Scaled to  $simpower_{limit}$

| Module 1 – n261 – Mid Channel<br>Simulated PD Scaled to $simpower_{limit}$ |                |                    |  |      |       |      |
|--|----------------|--------------------|--|------|-------|------|
| Beam ID  | Paired Beam ID | # o f Active Feeds | 4cm <sup>2</sup> PD (mW/cm <sup>2</sup> ) at 2mm |      |       |      |
|  |                |                    | Front  | Back | Right | Top  |
| 1  |                | 1                  | 0.617  | 0.02 | N/A   | 0.27 |
| 3  |                | 1                  | 0.617  | 0.01 | N/A   | 0.40 |
| 5  |                | 1                  | 0.617  | 0.01 | N/A   | 0.42 |
| 7  |                | 1                  | 0.616  | 0.01 | N/A   | 0.31 |
| 12   |                | 2                  | 0.616  | 0.02 | N/A   | 0.44 |
| 13   |                | 2                  | 0.616  | 0.02 | N/A   | 0.44 |
| 14   |                | 2                  | 0.617  | 0.02 | N/A   | 0.38 |
| 15   |                | 2                  | 0.616  | 0.01 | N/A   | 0.42 |
| 19   |                | 2                  | 0.617  | 0.02 | N/A   | 0.28 |
| 20   |                | 2                  | 0.617  | 0.03 | N/A   | 0.39 |
| 21   |                | 2                  | 0.616  | 0.02 | N/A   | 0.43 |
| 27   |                | 4                  | 0.617  | 0.02 | N/A   | 0.36 |
| 28   |                | 4                  | 0.616  | 0.02 | N/A   | 0.39 |
| 29   |                | 4                  | 0.616  | 0.03 | N/A   | 0.36 |
| 30   |                | 4                  | 0.616  | 0.01 | N/A   | 0.36 |
| 31   |                | 4                  | 0.617  | 0.02 | N/A   | 0.40 |
| 36   |                | 4                  | 0.616  | 0.01 | N/A   | 0.37 |
| 37   |                | 4                  | 0.617  | 0.03 | N/A   | 0.39 |
| 38   |                | 4                  | 0.617  | 0.03 | N/A   | 0.33 |
| 39   |                | 4                  | 0.617  | 0.01 | N/A   | 0.41 |
| 129  |                | 1                  | 0.617  | 0.00 | N/A   | 0.32 |
| 131  |                | 1                  | 0.617  | 0.00 | N/A   | 0.37 |
| 133  |                | 1                  | 0.617  | 0.00 | N/A   | 0.38 |
| 135  |                | 1                  | 0.616  | 0.00 | N/A   | 0.35 |
| 140  |                | 2                  | 0.617  | 0.01 | N/A   | 0.44 |
| 141  |                | 2                  | 0.617  | 0.00 | N/A   | 0.50 |
| 142  |                | 2                  | 0.617  | 0.01 | N/A   | 0.38 |
| 143  |                | 2                  | 0.617  | 0.01 | N/A   | 0.25 |
| 147  |                | 2                  | 0.617  | 0.00 | N/A   | 0.48 |
| 148  |                | 2                  | 0.617  | 0.00 | N/A   | 0.46 |
| 149  |                | 2                  | 0.617  | 0.01 | N/A   | 0.32 |
| 155  |                | 4                  | 0.617  | 0.01 | N/A   | 0.46 |
| 156  |                | 4                  | 0.617  | 0.00 | N/A   | 0.53 |
| 157  |                | 4                  | 0.617  | 0.00 | N/A   | 0.59 |
| 158  |                | 4                  | 0.616  | 0.01 | N/A   | 0.51 |
| 159  |                | 4                  | 0.617  | 0.01 | N/A   | 0.35 |
| 164  |                | 4                  | 0.616  | 0.00 | N/A   | 0.49 |
| 165  |                | 4                  | 0.616  | 0.00 | N/A   | 0.53 |
| 166  |                | 4                  | 0.617  | 0.01 | N/A   | 0.58 |
| 167  |                | 4                  | 0.617  | 0.00 | N/A   | 0.45 |

Table 18. Module 1 – n261 Simulated PD Scaled to  $simpower_{limit}$

| Module 0 – n260 – Mid Channel<br>Simulated PD Scaled to $simpower_{limit}$ |                |                    |  |      |       |      |
|--|----------------|--------------------|--|------|-------|------|
| Beam ID  | Paired Beam ID | # o f Active Feeds | 4cm <sup>2</sup> PD (mW/cm <sup>2</sup> ) at 2mm |      |       |      |
|  |                |                    | Front  | Back | Right | Top  |
| 0  |                | 1                  | 0.12   | 0.23 | 0.617 | 0.01 |
| 2  |                | 1                  | 0.18   | 0.21 | 0.617 | 0.03 |
| 4  |                | 1                  | 0.11   | 0.19 | 0.617 | 0.02 |
| 6  |                | 1                  | 0.14   | 0.22 | 0.616 | 0.05 |
| 8  |                | 2                  | 0.16   | 0.23 | 0.617 | 0.03 |
| 9  |                | 2                  | 0.13   | 0.25 | 0.617 | 0.05 |
| 10   |                | 2                  | 0.15   | 0.34 | 0.617 | 0.03 |
| 11   |                | 2                  | 0.16   | 0.25 | 0.616 | 0.03 |
| 16   |                | 2                  | 0.17   | 0.17 | 0.616 | 0.03 |
| 17   |                | 2                  | 0.16   | 0.17 | 0.616 | 0.02 |
| 18   |                | 2                  | 0.13   | 0.34 | 0.616 | 0.02 |
| 22   |                | 4                  | 0.23   | 0.34 | 0.616 | 0.05 |
| 23   |                | 4                  | 0.14   | 0.26 | 0.617 | 0.02 |
| 24   |                | 4                  | 0.22   | 0.29 | 0.617 | 0.04 |
| 25   |                | 4                  | 0.15   | 0.22 | 0.616 | 0.05 |
| 26   |                | 4                  | 0.15   | 0.33 | 0.617 | 0.02 |
| 32   |                | 4                  | 0.12   | 0.19 | 0.616 | 0.03 |
| 33   |                | 4                  | 0.15   | 0.29 | 0.616 | 0.06 |
| 34   |                | 4                  | 0.21   | 0.31 | 0.616 | 0.03 |
| 35   |                | 4                  | 0.14   | 0.21 | 0.617 | 0.03 |
| 128  |                | 1                  | 0.13   | 0.26 | 0.617 | 0.01 |
| 130  |                | 1                  | 0.14   | 0.22 | 0.617 | 0.02 |
| 132  |                | 1                  | 0.13   | 0.26 | 0.616 | 0.01 |
| 134  |                | 1                  | 0.20   | 0.20 | 0.616 | 0.03 |
| 136  |                | 2                  | 0.17   | 0.23 | 0.616 | 0.03 |
| 137  |                | 2                  | 0.19   | 0.21 | 0.616 | 0.03 |
| 138  |                | 2                  | 0.14   | 0.27 | 0.617 | 0.02 |
| 139  |                | 2                  | 0.16   | 0.27 | 0.617 | 0.01 |
| 144  |                | 2                  | 0.17   | 0.29 | 0.617 | 0.01 |
| 145  |                | 2                  | 0.18   | 0.25 | 0.617 | 0.03 |
| 146  |                | 2                  | 0.17   | 0.20 | 0.616 | 0.03 |
| 150  |                | 4                  | 0.23   | 0.28 | 0.617 | 0.03 |
| 151  |                | 4                  | 0.17   | 0.30 | 0.616 | 0.02 |
| 152  |                | 4                  | 0.16   | 0.28 | 0.616 | 0.04 |
| 153  |                | 4                  | 0.16   | 0.24 | 0.616 | 0.02 |
| 154  |                | 4                  | 0.16   | 0.25 | 0.616 | 0.02 |
| 160  |                | 4                  | 0.18   | 0.27 | 0.616 | 0.02 |
| 161  |                | 4                  | 0.19   | 0.28 | 0.617 | 0.02 |
| 162  |                | 4                  | 0.17   | 0.25 | 0.616 | 0.03 |
| 163  |                | 4                  | 0.17   | 0.27 | 0.617 | 0.01 |

Table 19. Module 0 – n260 Simulated PD Scaled to  $simpower_{limit}$

| Module 1 – n260 – Mid Channel<br>Simulated PD Scaled to $simpower_{limit}$ |                |                    |  |      |       |      |
|--|----------------|--------------------|--|------|-------|------|
| Beam ID  | Paired Beam ID | # o f Active Feeds | 4cm <sup>2</sup> PD (mW/cm <sup>2</sup> ) at 2mm |      |       |      |
|  |                |                    | Front  | Back | Right | Top  |
| 1  |                | 1                  | 0.616  | 0.02 | N/A   | 0.25 |
| 3  |                | 1                  | 0.617  | 0.03 | N/A   | 0.26 |
| 5  |                | 1                  | 0.617  | 0.03 | N/A   | 0.28 |
| 7  |                | 1                  | 0.617  | 0.02 | N/A   | 0.28 |
| 12   |                | 2                  | 0.617  | 0.05 | N/A   | 0.34 |
| 13   |                | 2                  | 0.617  | 0.05 | N/A   | 0.28 |
| 14   |                | 2                  | 0.617  | 0.05 | N/A   | 0.29 |
| 15   |                | 2                  | 0.617  | 0.02 | N/A   | 0.23 |
| 19   |                | 2                  | 0.616  | 0.05 | N/A   | 0.32 |
| 20   |                | 2                  | 0.616  | 0.05 | N/A   | 0.29 |
| 21   |                | 2                  | 0.616  | 0.05 | N/A   | 0.31 |
| 27   |                | 4                  | 0.617  | 0.05 | N/A   | 0.32 |
| 28   |                | 4                  | 0.617  | 0.03 | N/A   | 0.34 |
| 29   |                | 4                  | 0.617  | 0.04 | N/A   | 0.31 |
| 30   |                | 4                  | 0.617  | 0.04 | N/A   | 0.33 |
| 31   |                | 4                  | 0.617  | 0.04 | N/A   | 0.31 |
| 36   |                | 4                  | 0.617  | 0.04 | N/A   | 0.35 |
| 37   |                | 4                  | 0.617  | 0.04 | N/A   | 0.32 |
| 38   |                | 4                  | 0.617  | 0.05 | N/A   | 0.34 |
| 39   |                | 4                  | 0.616  | 0.05 | N/A   | 0.31 |
| 129  |                | 1                  | 0.617  | 0.02 | N/A   | 0.24 |
| 131  |                | 1                  | 0.617  | 0.04 | N/A   | 0.29 |
| 133  |                | 1                  | 0.617  | 0.02 | N/A   | 0.29 |
| 135  |                | 1                  | 0.617  | 0.03 | N/A   | 0.22 |
| 140  |                | 2                  | 0.617  | 0.04 | N/A   | 0.31 |
| 141  |                | 2                  | 0.617  | 0.03 | N/A   | 0.27 |
| 142  |                | 2                  | 0.617  | 0.02 | N/A   | 0.21 |
| 143  |                | 2                  | 0.617  | 0.02 | N/A   | 0.25 |
| 147  |                | 2                  | 0.616  | 0.03 | N/A   | 0.29 |
| 148  |                | 2                  | 0.617  | 0.03 | N/A   | 0.30 |
| 149  |                | 2                  | 0.617  | 0.02 | N/A   | 0.23 |
| 155  |                | 4                  | 0.617  | 0.03 | N/A   | 0.25 |
| 156  |                | 4                  | 0.617  | 0.02 | N/A   | 0.29 |
| 157  |                | 4                  | 0.616  | 0.03 | N/A   | 0.31 |
| 158  |                | 4                  | 0.617  | 0.04 | N/A   | 0.30 |
| 159  |                | 4                  | 0.616  | 0.03 | N/A   | 0.26 |
| 164  |                | 4                  | 0.617  | 0.03 | N/A   | 0.30 |
| 165  |                | 4                  | 0.616  | 0.03 | N/A   | 0.35 |
| 166  |                | 4                  | 0.616  | 0.03 | N/A   | 0.31 |
| 167  |                | 4                  | 0.616  | 0.02 | N/A   | 0.28 |

Table 20. Module 1 – n260 Simulated PD Scaled to  $simpower_{limit}$

## $\Delta_{\min}$ Validation Measurement Results

| Band | Module | Surface | Beam | Test Power (dBm) | Input.power.limit | Measured PD (mW/cm <sup>2</sup> ) |
|------|--------|---------|------|------------------|-------------------|-----------------------------------|
| n261 | 0      | Top     | 145  | 6.8              | 6.8               | 0.03                              |
| n261 | 1      | Back    | 37   | 2.2              | 2.2               | 0.09                              |

Table 21. Band n261 Measured PD for Select Surfaces at input.power.limit

| Band | Module | Surface | Beam | Test Power (dBm) | Input.power.limit | Measured PD (mW/cm <sup>2</sup> ) |
|------|--------|---------|------|------------------|-------------------|-----------------------------------|
| n260 | 0      | Top     | 33   | 1.8              | 1.8               | 0.04                              |
| n260 | 1      | Back    | 39   | 3.7              | 3.7               | 0.19                              |

Table 22. Band n260 Measured PD for Select Surfaces at input.power.limit