CORNERSTONE

Quick reference design guidelines for the fourth fabrication call – September 2017

Mask submission deadline – Friday 1st December 2017

File format = *.gdsII*.

Manufacturing grid size = 1 nm.

Design area = **11.47 x 4.9 mm²**, with 0.5 mm bleed regions on the east and west facets if desired.

1. Design rules summary

A summary of the design rules and GDS layer numbers can be found in Table 1 below.

Table 1 – Design rules summary.

Layer description	GDS number	Field	Max. pattern density	Min. feature size	Max. feature width
Silicon Etch 1 (70 nm ± 15 nm)	6	Dark	N/a	250 nm	N/a
Silicon Etch 2 (120 nm ± 15 nm)	3	Light	N/a	250 nm	N/a
	4	Dark	0.5%		
Silicon Etch 3 (100 nm to BOX)	5	Light	N/a	250 nm	N/a
Low Dose *p*-type Implant	7	Dark	N/a	250 nm	40 µm
Low Dose *n*-type Implant*	8	Dark	N/a	250 nm	10 µm
High Dose *p*-type Implant	9	Dark	N/a	250 nm	10 µm
High Dose *n*-type Implant	11	Dark	N/a	250 nm	10 µm
Vias (rounded feature corners)	12	Dark	N/a	3 µm	10 µm
Electrodes**	13	Light	25%	6 µm	N/a
Heater Filaments	39	Light	N/a	900 nm	1.4 µm
Heater Contact Pads	41	Light	10%	2 µm	N/a
Cell Outline	99	N/a	N/a	N/a	N/a
Bleed Area	98	N/a	N/a	N/a	N/a

* 45° angled implant from the south direction.
**Minimum gap between features in electrode layer = 2 µm.

2. Minimum feature sizes, tolerances and other design rules

- Minimum feature sizes, maximum feature widths (where applicable), and maximum pattern densities (where applicable) for each GDS layer are detailed in Table 1.
- A minimum spacing between waveguides of at least 5 µm is recommended to avoid power coupling.
- An overlap of at least 200 nm between GDS layers is essential to account for the alignment tolerance between layers.
- All structures drawn in GDS layer 6 (Grating couplers) must overlap by at least 200 nm with GDS layer 3 (Waveguides).
- All structures drawn in GDS layer 5 (Rib protect) should extend 10 µm beyond the edge of GDS layer 3 (Waveguides), with the exception of rib-to-strip transitions.
- All structures drawn in GDS layer 12 (Vias) must have the corners rounded with a minimum bend radius of 1 µm (recommended bend radius = 2.5 µm).

- All structures drawn in GDS layer 12 (Vias) must be inclusive of either GDS layer 9 (High Dose *p*-type Implant) or GDS layer 11 (High Dose *n*-type Implant) by at least 500 nm (i.e. the high dose implant layer must extend in all directions at least 500 nm beyond the vias layer).
- All structures drawn in GDS layer 12 (Vias) must be inclusive of the metal contacts drawn in GDS layer 13 (Electrodes) by at least 500 nm (i.e. the electrode layer must extend in all directions at least 500 nm beyond the vias layer).
- An overlap of at least 10 µm between GDS layer 39 (Heater Filaments) and GDS layer 41 (Heater Contact Pads) is recommended for optimal heater performance.
- Ensure all structures drawn in GDS layer 6 (Grating couplers) do not overlap with either GDS layer 12 (Vias) or any of the metal/heater layers.

3. Process parameters overview

A cross-section of a carrier depletion modulator structure is shown in Figure 1, along with the important device parameters, including doping concentrations, listed in Table 2.

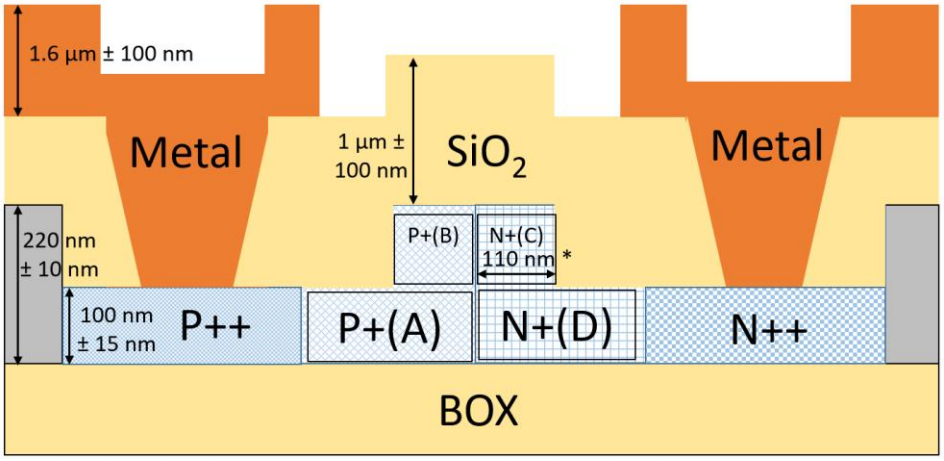

*Figure 1 – Process parameters overview. *The N+ implant is performed at 45°, so the implanted region is fixed at 110 nm from waveguide edge (controlled by the angled implant energy).*

Table 2 – Important device parameters.

Property	Specification
Si overlayer thickness	220 nm ± 10 nm
Grating etch depth	70 nm ± 15 nm
Rib w/g etch depth	120 nm ± 15 nm
P+ region (A)	~3.8E17 cm^{-3}
P+ region (B)	~1.5E17 cm^{-3}
N+ region (C)*	~7.5E17 cm^{-3}
N+ region (D)*	~1.1E18 cm^{-3}
P++	~1E20 cm^{-3}
N++	~1E20 cm^{-3}
Top cladding SiO_2 thickness	1 µm ± 100 nm
Metal thickness	1.6 µm ± 100 nm

**Note:* The low dose *n*-type implant concentrations are compensated by the background low dose *p*-type implant (i.e. the low dose *n*-type region must fully overlap with the low dose *p*-type region; otherwise, the actual *n*-type concentrations will be higher than specified).

4. Technical support

For all queries, email cornerstone@soton.ac.uk.