Schematic/Pre Layout Simulation Review

ChipiChapa Team

ChipiChapa Overview

Team Members:

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4. Saputra Yudika Marpaung

Project Overview:

Extend OSU library with AOI211,AOI221, OAI211, and OAI221 standard cells.

Design Approach:

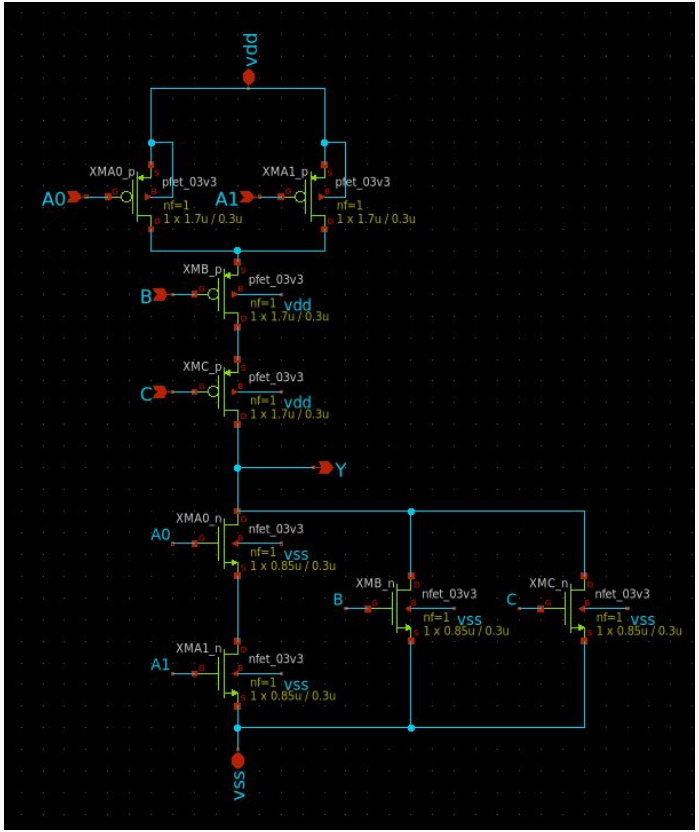
- **Goal of Design:** 4-input AOI211, OAI211 and 5-input AOI221, OAI221 all with drive strength x1 and use 9 track.
- **Transistor Sizing :** Followed OSU transistor sizing with NMOS width 0.85um and PMOS width 1.7um, all the transistor use L=0.3um.
- **Done**
  - Functional simulation and some timing measurement with ngspice.
- **Future Progress**
  - Delay and output transition time mesurement
  - Layout and LVS
  - Specificiation Target Adjustment

Schematic & Functional Simulation

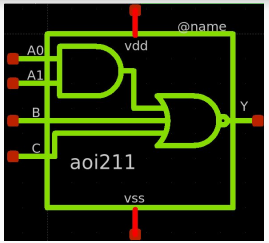
AOI211

NMOS Sizing: 0.85u/0.3u
PMOS Sizing: 1.7u/0.3u

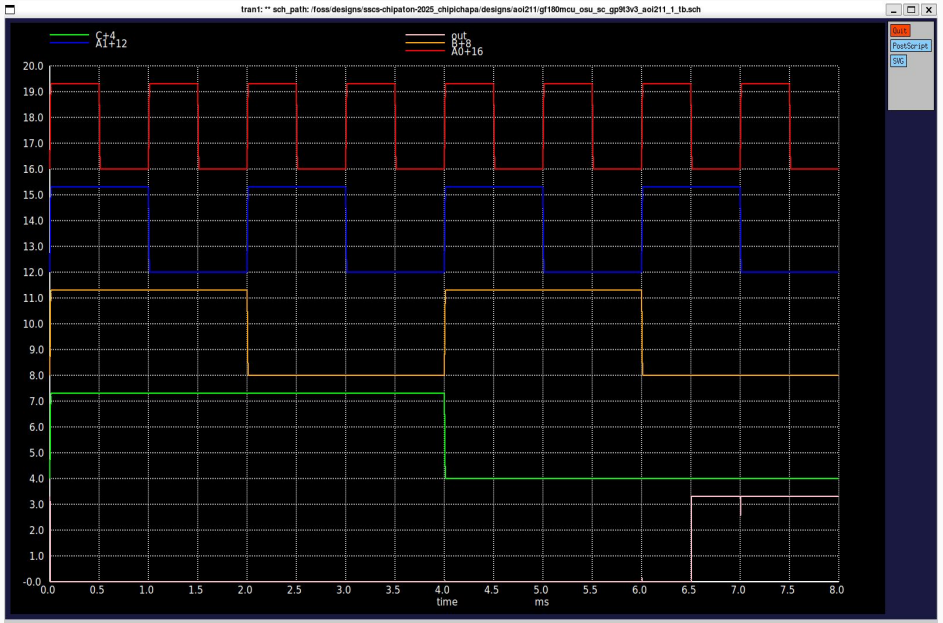
Schematic



Symbol



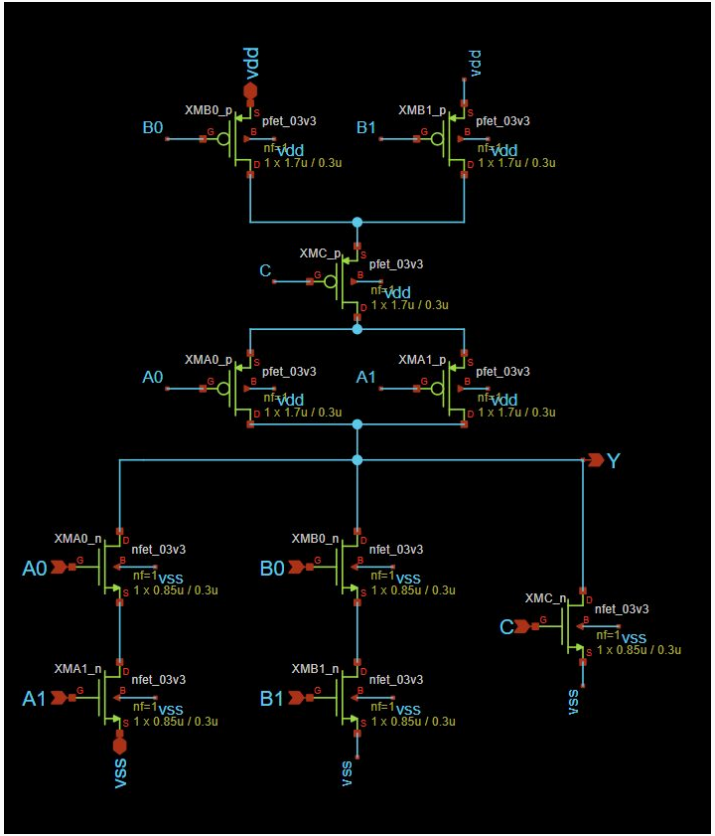
Functional Simulation



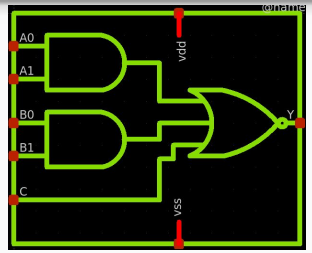
AOI221

NMOS Sizing: 0.85u/0.3u
PMOS Sizing: 1.7u/0.3u

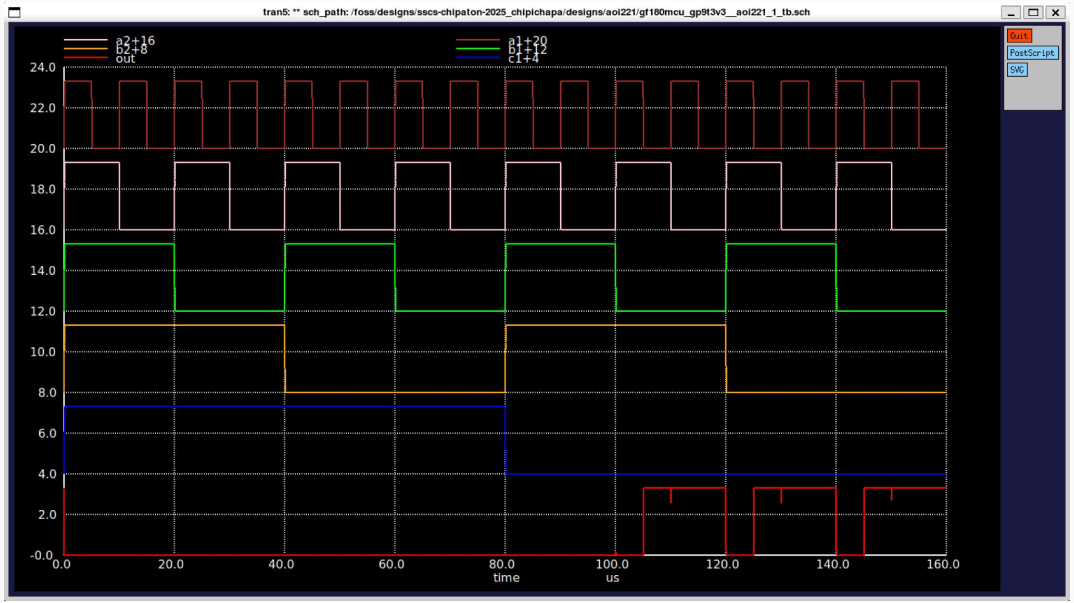
Schematic



Symbol



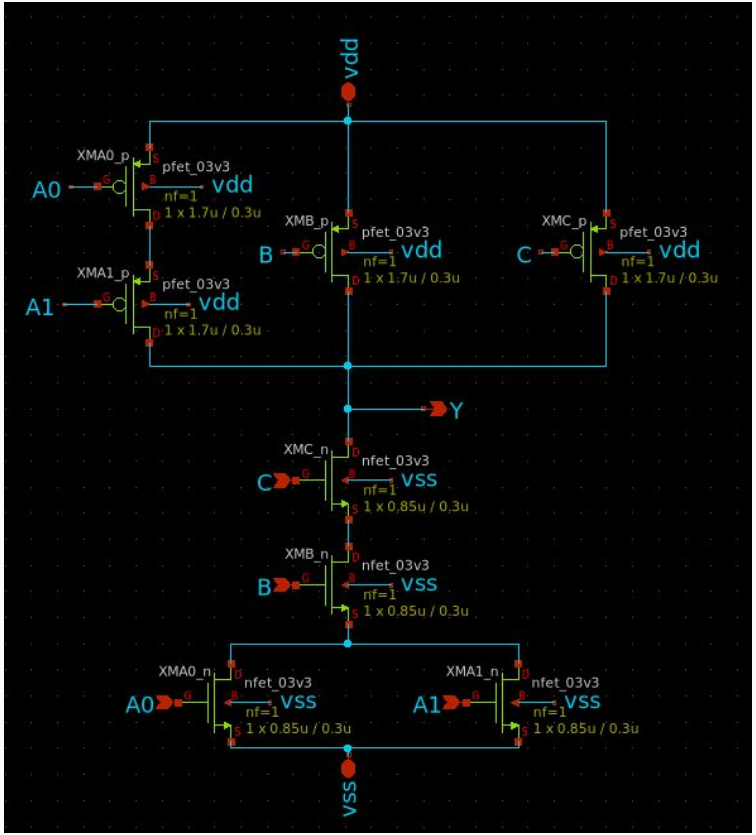
Functional Simulation



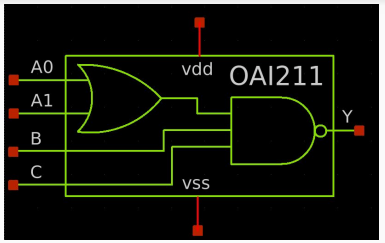
OAI211

NMOS Sizing: 0.85u/0.3u
PMOS Sizing: 1.7u/0.3u

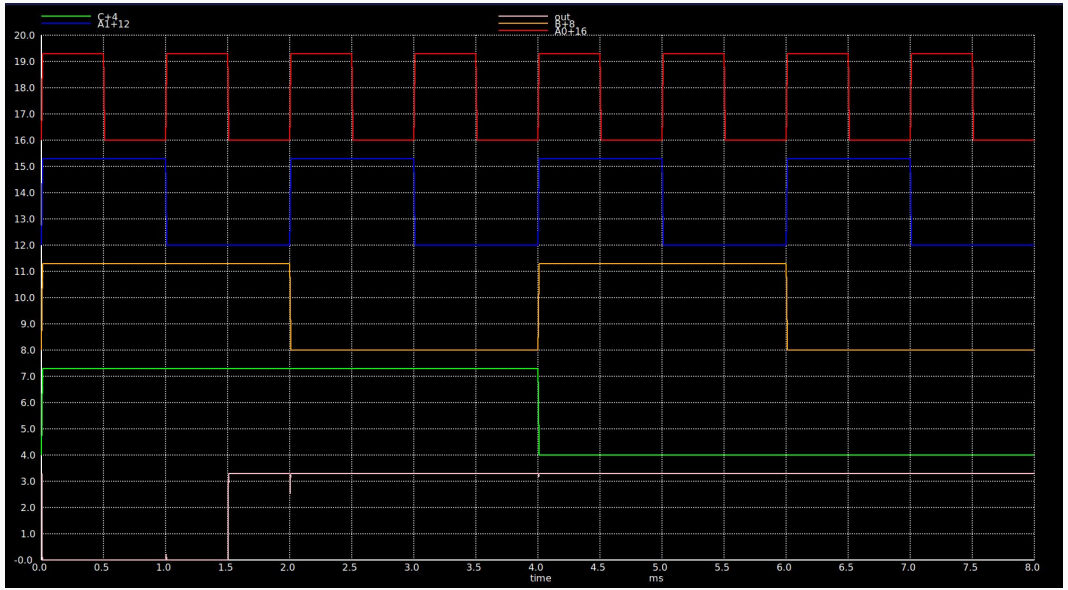
Schematic



Symbol



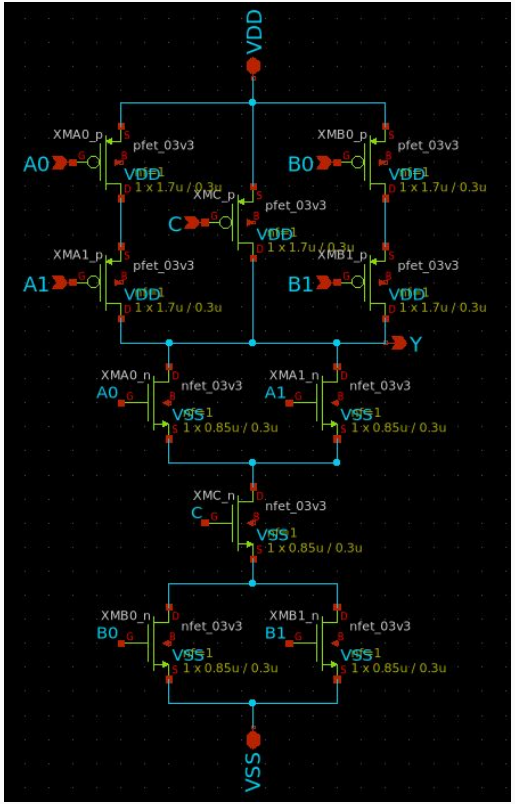
Functional Simulation



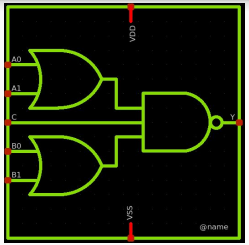
OAI221

NMOS Sizing: 0.85u/0.3u
PMOS Sizing: 1.7u/0.3u

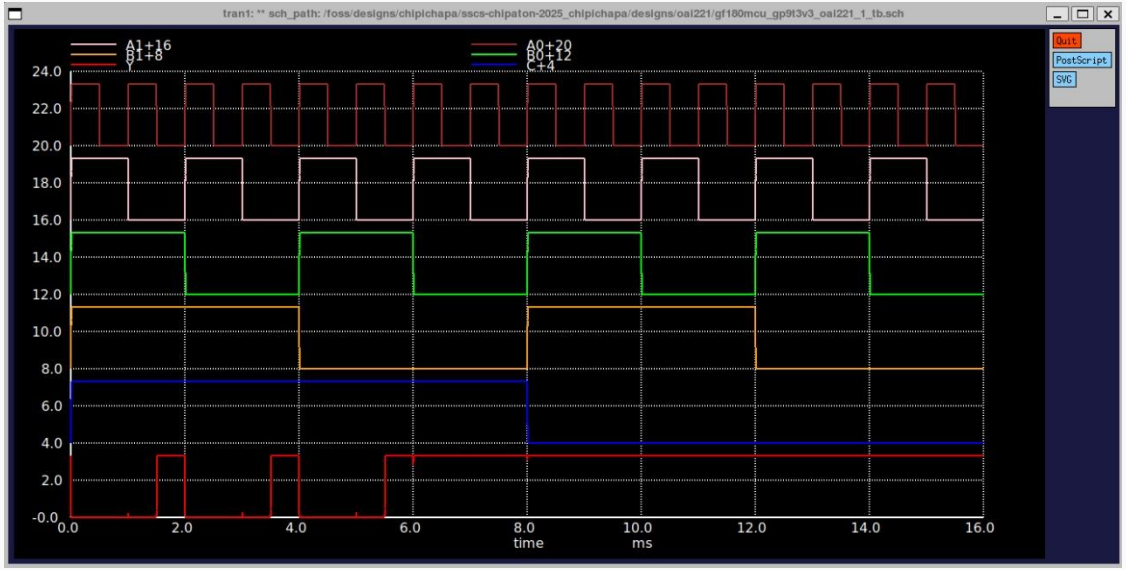
Schematic



Symbol



Functional Simulation



Timing Characterization

Slews and Load Variations

For AOI211 and AOI221 (followed OSU's liberty files slew rate and output load for AOI21)

Slews	0.0778447	0.205581	0.542922	1.43381	3.78657	10
Loads	0.00103698	0.00390104	0.0146754	0.0552075	0.207686	0.781296

For OAI211 and OAI221 (followed OSU's liberty files slew rate and output load for OAI21)

Slews	0.0778447	0.205581	0.542922	1.43381	3.78657	10
Loads	0.00103698	0.00389877	0.0146583	0.0551109	0.207201	0.779018

Note : Only values that correspond to min. slew time and min. output load are shown in this presentation.

AOI211

Timing Characteristic (Worst Case)

Input Pin	Output	Tin (ns)	Out Load (pf)	Delay (ns)	Tout (ns)
A0 (HL)	Y (LH)	0.0778447	0.00103698	0.162159	0.124471
A0 (LH)	Y (HL)	0.0778447	0.00103698	0.091997	0.113079
A1 (HL)	Y (LH)	0.0778447	0.00103698	0.195498	0.161144
A1 (LH)	Y (HL)	0.0778447	0.00103698	0.101589	0.113557
B (HL)	Y (LH)	0.0778447	0.00103698	0.163017	0.160679
B (LH)	Y (HL)	0.0778447	0.00103698	0.053543	0.046408
C (HL)	Y (LH)	0.0778447	0.00103698	0.107839	0.153007
C (LH)	Y (HL)	0.0778447	0.00103698	0.040542	0.030509

Pin Capacitance

Pin	Type	Capacitance (pf)
A0	input	0.003278
A1	input	0.003335
B	input	0.003200
C	input	0.003281

AOI221

Timing Characteristic (Worst Case)

Input Pin	Output	Tin (ns)	Out Load (pf)	Delay (ns)	Tout (ns)
A0 (HL)	Y (LH)	0.0778447	0.00103698	0.122235	0.181051
A0 (LH)	Y (HL)	0.0778447	0.00103698	0.064157	0.057847
A1 (HL)	Y (LH)	0.0778447	0.00103698	0.152995	0.220437
A1 (LH)	Y (HL)	0.0778447	0.00103698	0.072045	0.058098
B0 (HL)	Y (LH)	0.0778447	0.00103698	0.226304	0.190415
B0 (LH)	Y (HL)	0.0778447	0.00103698	0.139462	0.148650
B1 (HL)	Y (LH)	0.0778447	0.00103698	0.258143	0.227166
B1 (LH)	Y (HL)	0.0778447	0.00103698	0.148804	0.148418
C (HL)	Y (LH)	0.0778447	0.00103698	0.226300	0.227009
C (LH)	Y (HL)	0.0778447	0.00103698	0.076757	0.064450

Pin Capacitance

Pin	Type	Capacitance (pf)
A0	input	0.003283
A1	input	0.003340
B0	input	0.003282
B1	input	0.003339
C	input	0.003241

OAI211

Timing Characteristic (Worst Case)

Input Pin	Output	Tin (ns)	Out Load (pf)	Delay (ns)	Tout (ns)
A0 (HL)	Y (LH)	0.0778447	0.00103698	0.143828	0.145693
A0 (LH)	Y (HL)	0.0778447	0.00103698	0.149302	0.131093
A1 (HL)	Y (LH)	0.0778447	0.00103698	0.118600	0.145509
A1 (LH)	Y (HL)	0.0778447	0.00103698	0.111280	0.086625
B (HL)	Y (LH)	0.0778447	0.00103698	0.059641	0.054922
B (LH)	Y (HL)	0.0778447	0.00103698	0.135283	0.131195
C (HL)	Y (LH)	0.0778447	0.00103698	0.049255	0.043366
C (LH)	Y (HL)	0.0778447	0.00103698	0.116673	0.131027

Pin Capacitance

Input	Type	Capacitance (pf)
A0	input	0.003340
A1	input	0.003342
B	input	0.003360
C	input	0.003312

OAI221

Timing Characteristic (Worst Case)

Input Pin	Output	Tin (ns)	Out Load (pf)	Delay (ns)	Tout (ns)
A0 (HL)	Y (LH)	0.0778447	0.00103698	0.113224	0.154831
A0 (LH)	Y (HL)	0.0778447	0.00103698	0.164380	0.185213
A1 (HL)	Y (LH)	0.0778447	0.00103698	0.087471	0.153801
A1 (LH)	Y (HL)	0.0778447	0.00103698	0.125634	0.142231
B0 (HL)	Y (LH)	0.0778447	0.00103698	0.171988	0.171353
B0 (LH)	Y (HL)	0.0778447	0.00103698	0.205679	0.185062
B1 (HL)	Y (LH)	0.0778447	0.00103698	0.146568	0.171098
B1 (LH)	Y (HL)	0.0778447	0.00103698	0.165903	0.142654
C (HL)	Y (LH)	0.0778447	0.00103698	0.072862	0.068296
C (LH)	Y (HL)	0.0778447	0.00103698	0.192980	0.185393

Pin Capacitance

Pin	Type	Capacitance (pf)
A0	input	0.003281
A1	input	0.003284
B0	input	0.003340
B1	input	0.003342
C	input	0.003363

Power Characterization

AOI211

Logic Combination	Leakage Power (nW)
!C!B!A1!A0	0.0345118
!C!B!A1A0	0.0526986
!C!BA1!A0	0.0350716
!C!BA1A0	0.051068
!CB!A1!A0	0.0272163
!CB!A1A0	0.0272251
!CBA1!A0	0.0272251
!CBA1A0	0.0272252

Logic Combination	Leakage Power (nW)
C!B!A1!A0	0.0112543
C!B!A1A0	0.011266
C!BA1!A0	0.0112689
C!BA1A0	0.0112605
CB!A1!A0	0.0112615
CB!A1A0	0.012609
CBA1!A0	0.0112673
CBA1A0	0.012603

Average Leakage Power	0.0232713

AOI221

Logic Combination	Leakage Power (nW)
!C!B1!B0!A1!A0	0.0339915
!C!B1!B0!A1A0	0.0521519
!C!B1!B0A1!A0	0.0345249
!C!B1!B0A1A0	0.0225310
!C!B1B0!A1!A0	0.0521695
!C!B1B0!A1A0	0.0703416
!C!B1B0A1!A0	0.0527146
!C!B1B0A1A0	0.022534

Logic Combination	Leakage Power (nW)
!CB1!B0!A1!A0	0.0345161
!CB1!B0!A1A0	0.0527029
!CB1!B0A1!A0	0.0350759
!CB1!B0A1A0	0.0225281
!CB1B0!A1!A0	0.0702349
!CB1B0!A1A0	0.0702991
!CB1B0A1!A0	0.070299
!CB1B0A1A0	0.0225438

Logic Combination	Leakage Power (nW)
C!B1!B0!A1!A0	0.0463525
C!B1!B0!A1A0	0.0465038
C!B1!B0A1!A0	0.0465096
C!B1!B0A1A0	0.0225144
C!B1B0!A1!A0	0.0463584
C!B1B0!A1A0	0.0465126
C!B1B0A1!A0	0.0465155
C!B1B0A1A0	0.0225186

Logic Combination	Leakage Power (nW)
CB1!B0!A1!A0	0.0463642
CB1!B0!A1A0	0.0465184
CB1!B0A1!A0	0.0465126
CB1!B0A1A0	0.0225156
CB1B0!A1!A0	0.0463588
CB1B0!A1A0	0.0465093
CB1B0A1!A0	0.0465074
CB1B0A1A0	0.0225152

Average Leakage Power	0.0427108

OAI211

Logic Combination	Leakage Power (nW)
!C!B!A1!A0	0.0111338
!C!B!A1A0	0.0111572
!C!BA1!A0	0.0111455
!C!BA1A0	0.01158
!CB!A1!A0	0.0112891
!CB!A1A0	0.0117024
!CBA1!A0	0.0117024
!CBA1A0	0.0117021

Logic Combination	Leakage Power (nW)
C!B!A1!A0	0.0290714
C!B!A1A0	0.0293381
C!BA1!A0	0.0293264
C!BA1A0	0.0293243
CB!A1!A0	0.0560189
CB!A1A0	0.049769
CBA1!A0	0.0338039
CBA1A0	0.0338013

Average Leakage Power	0.023839

OAI221

Logic Combination	Leakage Power (nW)
!C!B1!B0!A1!A0	0.0221953
!C!B1!B0!A1A0	0.0487794
!C!B1!B0A1!A0	0.0487765
!C!B1!B0A1A0	0.048964
!C!B1B0!A1!A0	0.0221953
!C!B1B0!A1A0	0.0490549
!C!B1B0A1!A0	0.0490402
!C!B1B0A1A0	0.0492403

Logic Combination	Leakage Power (nW)
!CB1!B0!A1!A0	0.0345161
!CB1!B0!A1A0	0.0527029
!CB1!B0A1!A0	0.0350759
!CB1!B0A1A0	0.0225281
!CB1B0!A1!A0	0.0702349
!CB1B0!A1A0	0.0702991
!CB1B0A1!A0	0.070299
!CB1B0A1A0	0.0225438

Logic Combination	Leakage Power (nW)
C!B1!B0!A1!A0	0.0223829
C!B1!B0!A1A0	0.0756917
C!B1!B0A1!A0	0.0756888
C!B1!B0A1A0	0.0759582
C!B1B0!A1!A0	0.0233824
C!B1B0!A1A0	0.0657048
C!B1B0A1!A0	0.0497519
C!B1B0A1A0	0.0497487

Logic Combination	Leakage Power (nW)
!C!B1!B0!A1!A0	0.0233794
!C!B1!B0!A1A0	0.0497661
!C!B1!B0A1!A0	0.0338073
!C!B1!B0A1A0	0.0338025
!C!B1B0!A1!A0	0.0233706
!C!B1B0!A1A0	0.0497602
!C!B1B0A1!A0	0.0338014
!C!B1B0A1A0	0.0337944

Average Leakage Power	0.0436594

Thanks!