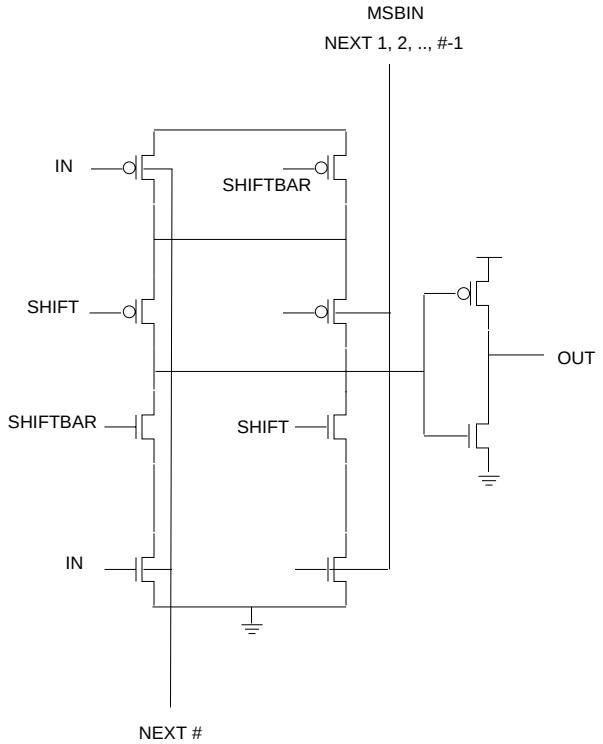
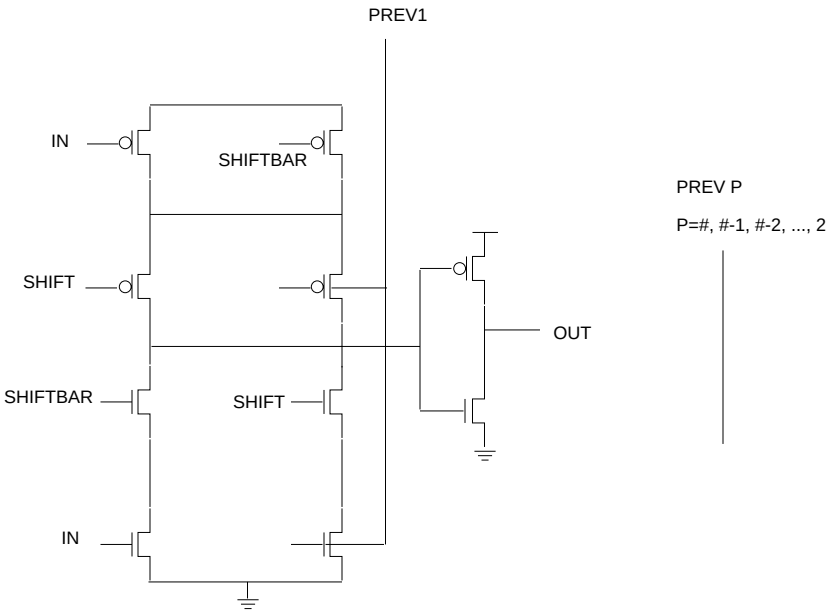


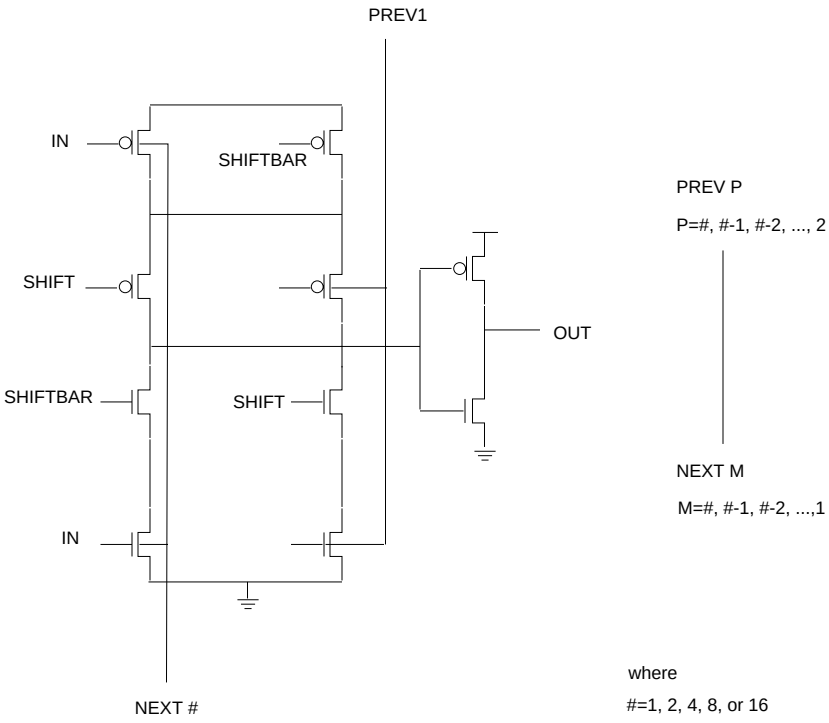

where
#=1, 2, 4, 8, or 16

**down#msb**

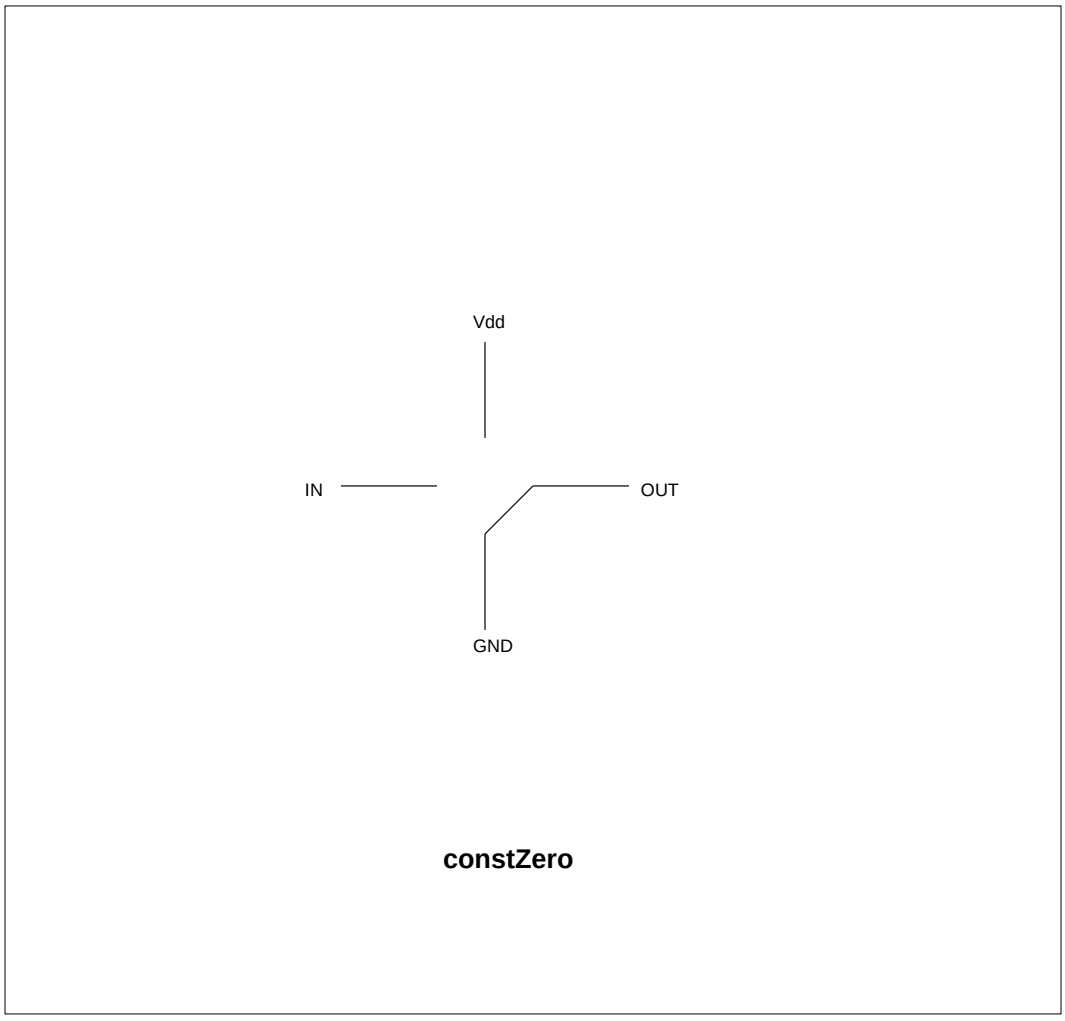

PREV1
IN
SHIFTBAR
SHIFT
SHIFTBAR
SHIFT
IN
OUT
PREV P
P=#, #-1, #-2, ..., 2
where
#=1, 2, 4, 8, or 16

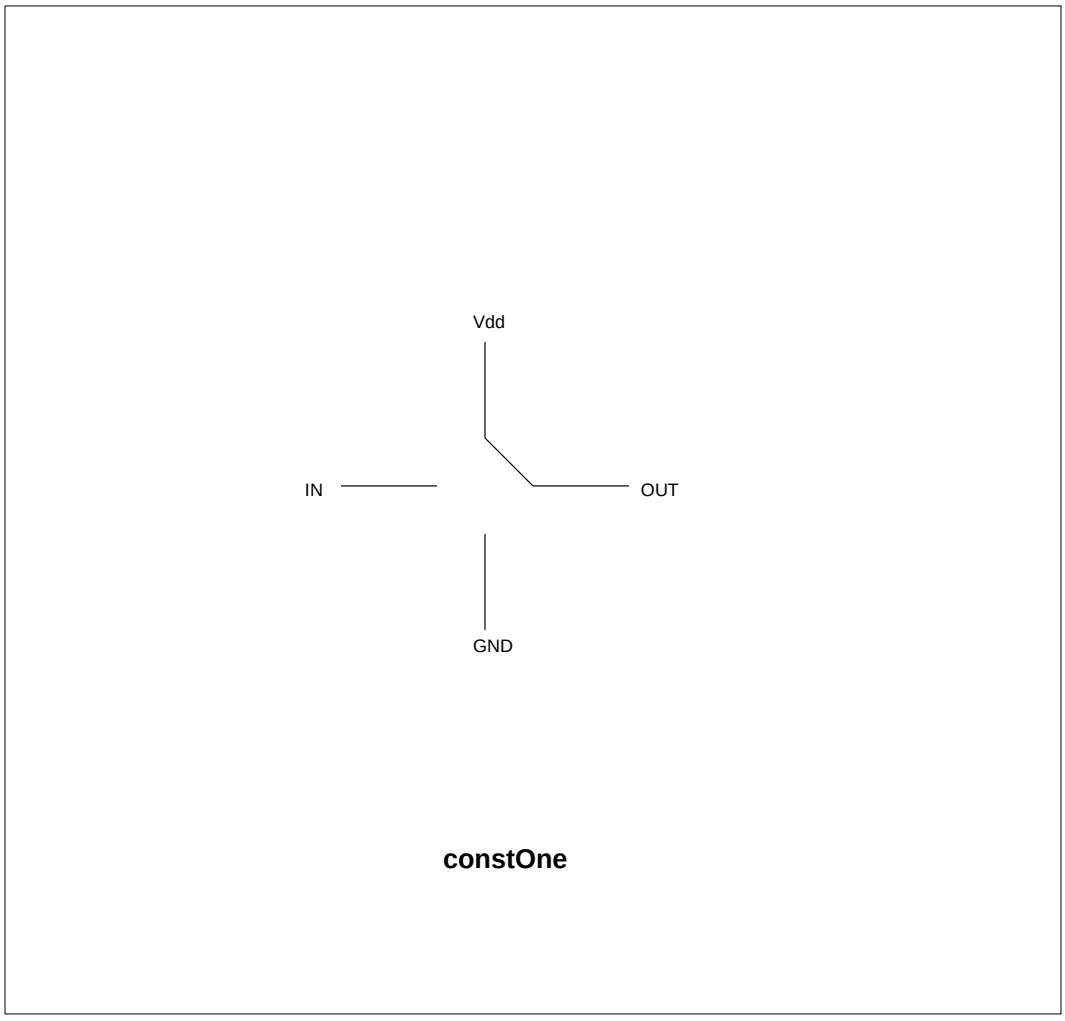
**down#lsb**

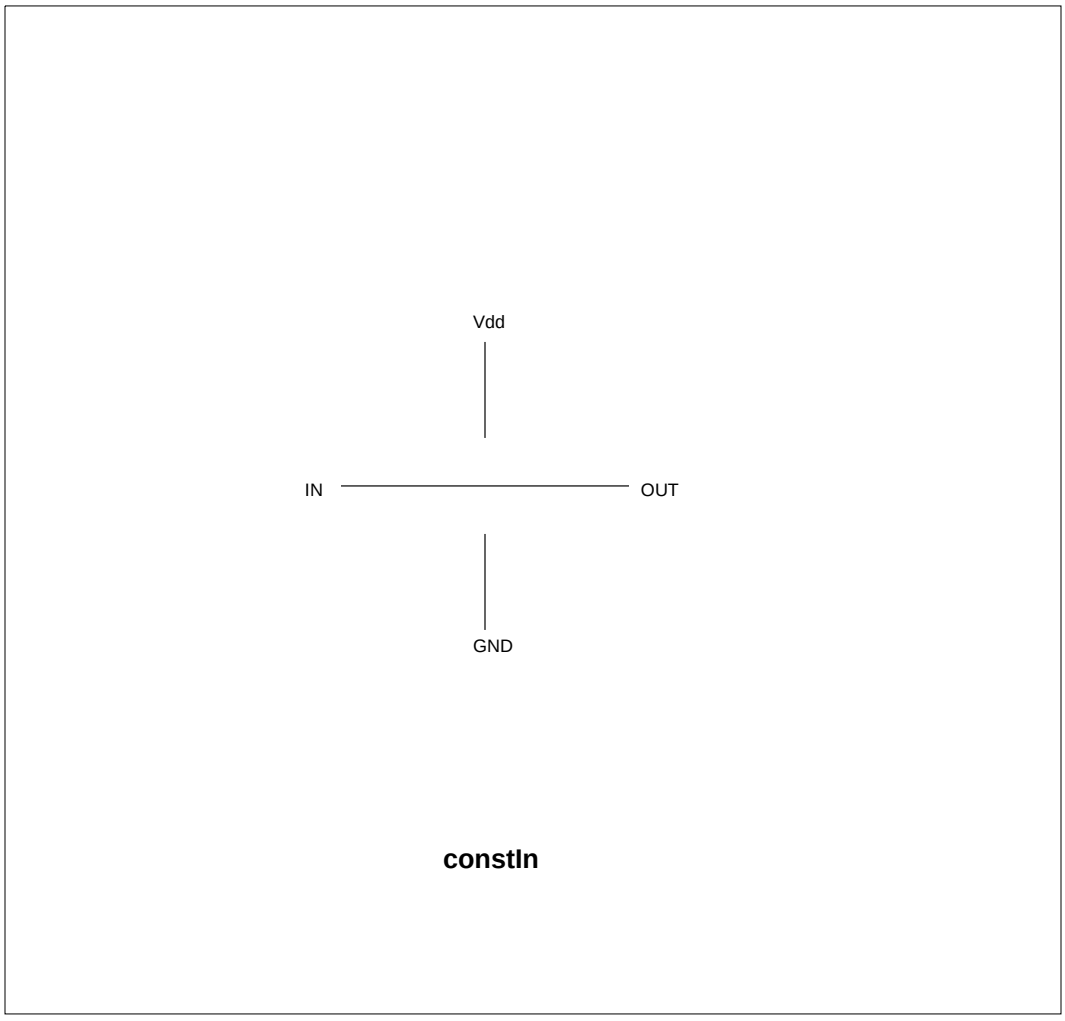
| Leafcell Propagation Delays | | | | | | | |
|---|---|---|---|---|---|---|---|
| IN | OUT | Conditions | Load (pF) | Tplh (ns) | Tphl (ns) | Tlh (ns) | Thl (ns) |
| IN | OUT | SHIFT=0, SHIFTBAR=1 | 0.1 | 1.45 | 1.55 | 1.55 | 1.09 |
| | | | 0.5 | 2.91 | 2.61 | 4.49 | 3.29 |
| | | | 1.0 | 4.71 | 3.84 | 8.37 | 5.72 |
| | | | 2.5 | 9.89 | 7.34 | 20.59 | 11.80 |
| PREV | OUT | SHIFT=1, SHIFTBAR=0 | 0.1 | 1.27 | 1.25 | 1.43 | 1.26 |
| | | | 0.5 | 2.68 | 2.34 | 4.51 | 3.19 |
| | | | 1.0 | 4.47 | 3.51 | 8.43 | 5.57 |
| | | | 2.5 | 9.67 | 7.06 | 20.52 | 11.85 |
| SHIFT | OUT | IN=1, PREV=0 | 0.1 | 1.51 | 1.33 | 1.61 | 1.25 |
| | | | 0.5 | 2.95 | 2.43 | 4.47 | 3.21 |
| | | | 1.0 | 4.75 | 3.62 | 8.35 | 5.62 |
| | | | 2.5 | 9.92 | 7.14 | 20.59 | 11.83 |
| SHIFT | OUT | IN=0, PREV=1 | 0.1 | 1.27 | 1.25 | 1.43 | 1.27 |
| | | | 0.5 | 2.69 | 2.34 | 4.51 | 3.21 |
| | | | 1.0 | 4.48 | 3.52 | 8.42 | 5.59 |
| | | | 2.5 | 9.68 | 7.07 | 20.52 | 11.85 |


PREV1
IN
SHIFTBAR
SHIFT
OUT
SHIFTBAR
SHIFT
IN
NEXT #
PREV P
P=#, #-1, #-2, ..., 2
NEXT M
M=#, #-1, #-2, ...,1
where
#=1, 2, 4, 8, or 16

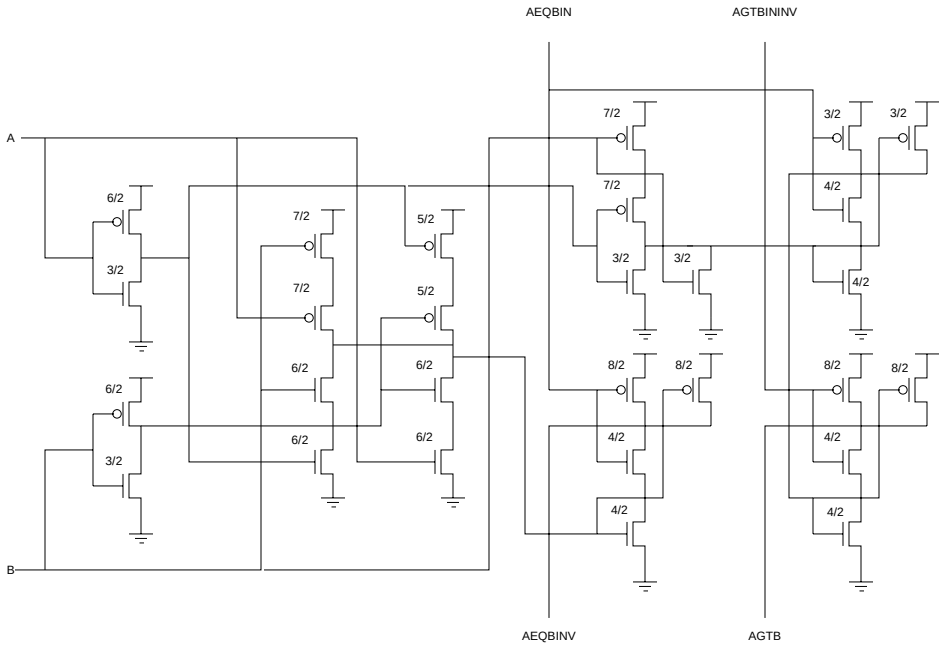
**down #**


Vdd
IN
OUT
GND
constZero


Vdd
IN
OUT
GND
constOne

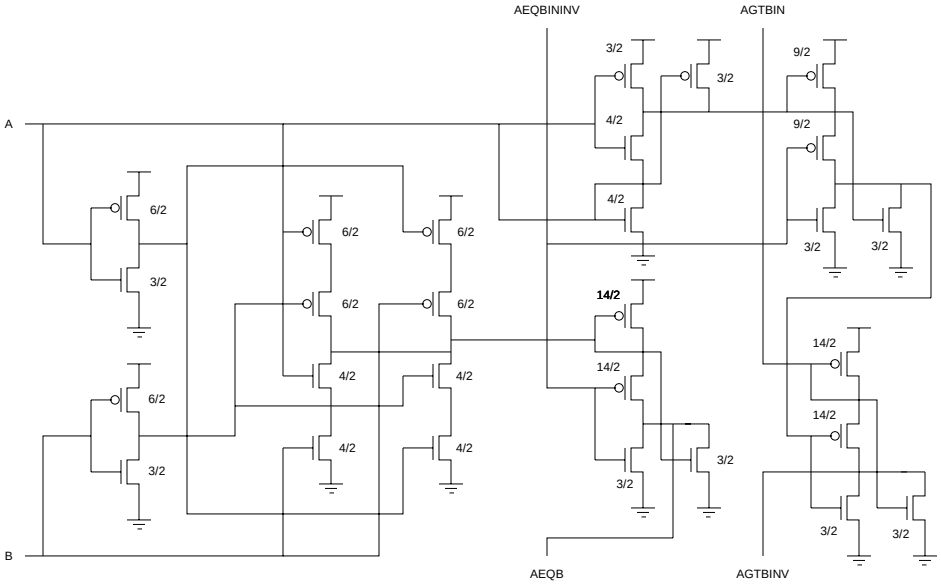

Vdd
IN
OUT
GND
constIn

| comparator_odd Leafcell Propagation Delays | | | | | | | |
|---|---|---|---|---|---|---|---|
| IN | OUT | Conditions | Load | Tplh | Tphl | Tlh | Thl |
| AEQBIN/ | AEQBINV | A=1 B=1 | 0.10 | 0.65 | 0.99 | 1.22 | 1.69 |
| AGTBINI NV | | | 0.50 | 2.20 | 3.57 | 4.76 | 7.01 |
| | | | 1.00 | 4.16 | 6.81 | 9.30 | 13.70 |
| | | | 2.50 | 10.03 | 16.51 | 22.99 | 33.79 |
| | AGTB | | 0.10 | 0.65 | 0.98 | 1.22 | 1.69 |
| | | | 0.50 | 2.20 | 3.56 | 4.76 | 7.00 |
| | | | 1.00 | 4.16 | 6.80 | 9.30 | 13.70 |
| | | | 2.50 | 10.03 | 16.51 | 22.99 | 33.79 |
| B | AEQBINV | AEQBIN=1 A=1 | 0.10 | 1.51 | 2.71 | 1.27 | 1.93 |
| | | AEQBINI NV=1 | 0.50 | 3.08 | 5.32 | 4.83 | 7.08 |
| | | | 1.00 | 5.07 | 8.58 | 9.52 | 13.85 |
| | | | 2.50 | 10.83 | 18.23 | 23.04 | 33.78 |
| | AGTB | | 0.10 | 1.57 | 2.21 | 1.25 | 1.73 |
| | | | 0.50 | 3.14 | 4.81 | 4.83 | 7.01 |
| | | | 1.00 | 5.15 | 8.05 | 9.52 | 13.79 |
| | | | 2.50 | 10.90 | 17.65 | 23.04 | 33.77 |



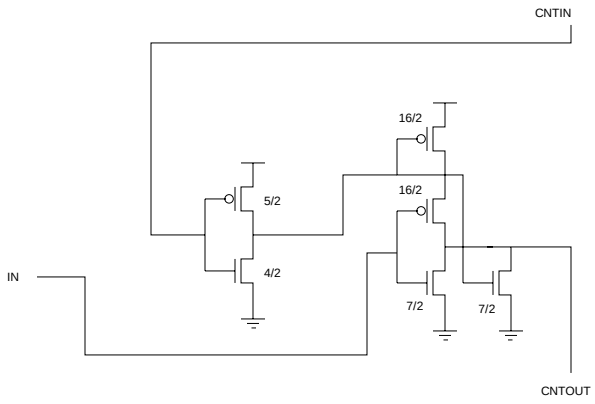

**comparator_odd**

| comparator_even Leafcell Propagation Delays | | | | | | | |
|---|---|---|---|---|---|---|---|
| IN | OUT | Conditions | Load | Tplh | Tphl | Tlh | Thl |
| AGTBIN/ | AEQB | A=1 B=1 | 0.10 | 0.97 | 0.90 | 1.99 | 1.35 |
| AEQBINTINV | | | 0.50 | 3.60 | 3.14 | 8.18 | 5.63 |
| | | | 1.00 | 6.93 | 5.94 | 15.98 | 11.06 |
| | | | 2.50 | 16.87 | 14.35 | 39.40 | 27.28 |
| | AGTBINV | | 0.10 | 0.71 | 1.08 | 1.40 | 1.62 |
| | | | 0.50 | 2.45 | 3.32 | 5.45 | 5.89 |
| | | | 1.00 | 4.63 | 6.12 | 10.57 | 11.32 |
| | | | 2.50 | 11.13 | 14.53 | 26.01 | 27.54 |
| B | AEQB | AEQBINTINV=0 | 0.10 | 1.63 | 2.17 | 2.02 | 1.78 |
| | | AGTBIN=0 A=1 | 0.50 | 4.28 | 4.47 | 8.19 | 5.90 |
| | | | 1.00 | 7.58 | 7.28 | 15.97 | 11.25 |
| | | | 2.50 | 17.52 | 15.66 | 39.39 | 27.44 |
| | AGTBINV | | 0.10 | 2.42 | 2.42 | 1.43 | 1.45 |
| | | | 0.50 | 4.16 | 4.69 | 5.46 | 5.69 |
| | | | 1.00 | 6.37 | 7.49 | 10.58 | 11.10 |
| | | | 2.50 | 12.87 | 15.91 | 26.00 | 27.32 |



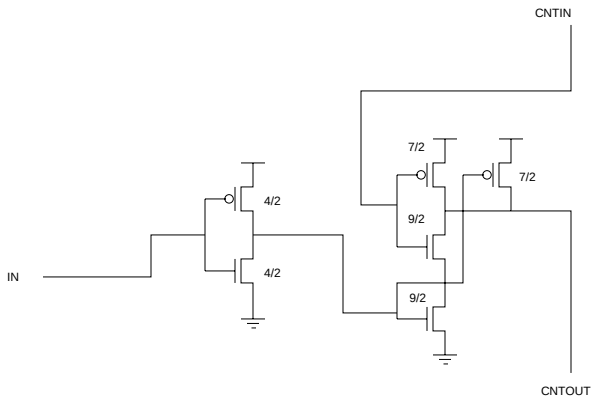

**comparator_even**

| conxonQ_Znsb Leaf cell Propagation Delays | | | | | | | |
|---|---|---|---|---|---|---|---|
| IN | OUT | Conditions | Load | Tplh | Tphl | Tlh | Thl |
| IN | CNIOUT | CNIIN=1 | 0.10 | 0.85 | 0.61 | 1.56 | 0.99 |
| | | | 0.50 | 2.33 | 1.58 | 4.95 | 2.53 |
| | | | 1.00 | 4.23 | 2.74 | 9.43 | 4.70 |
| | | | 2.50 | 9.95 | 5.76 | 23.06 | 11.47 |
| CNIIN | CNIOUT | IN=0 | 0.10 | 1.10 | 1.27 | 1.32 | 0.91 |
| | | | 0.50 | 2.62 | 2.23 | 4.90 | 2.59 |
| | | | 1.00 | 4.53 | 3.39 | 9.43 | 4.81 |
| | | | 2.50 | 10.27 | 6.89 | 23.05 | 11.59 |



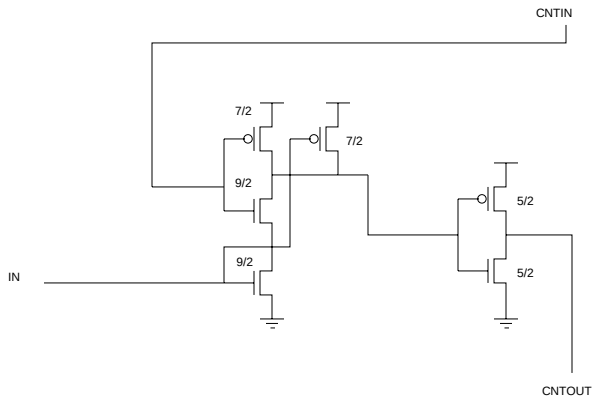

**comconO_Zmsb**

| cmrcmonOLZ Leafcell Propagation Delays | | | | | | | |
|---|---|---|---|---|---|---|---|
| IN | OUT | Conditions | Load | Tplh | Tphl | Tlh | Thl |
| IN | CMOUT | CMOIN=1 | 0.10 | 1.15 | 1.07 | 1.48 | 0.88 |
| | | | 0.50 | 2.92 | 2.20 | 5.58 | 3.13 |
| | | | 1.00 | 5.15 | 3.60 | 10.77 | 6.06 |
| | | | 2.50 | 11.77 | 7.79 | 26.33 | 14.88 |
| CMOIN | CMOUT | IN=0 | 0.10 | 0.97 | 0.59 | 1.58 | 1.17 |
| | | | 0.50 | 2.71 | 1.74 | 5.50 | 3.23 |
| | | | 1.00 | 4.92 | 3.13 | 10.66 | 6.08 |
| | | | 2.50 | 11.61 | 6.41 | 26.21 | 14.93 |



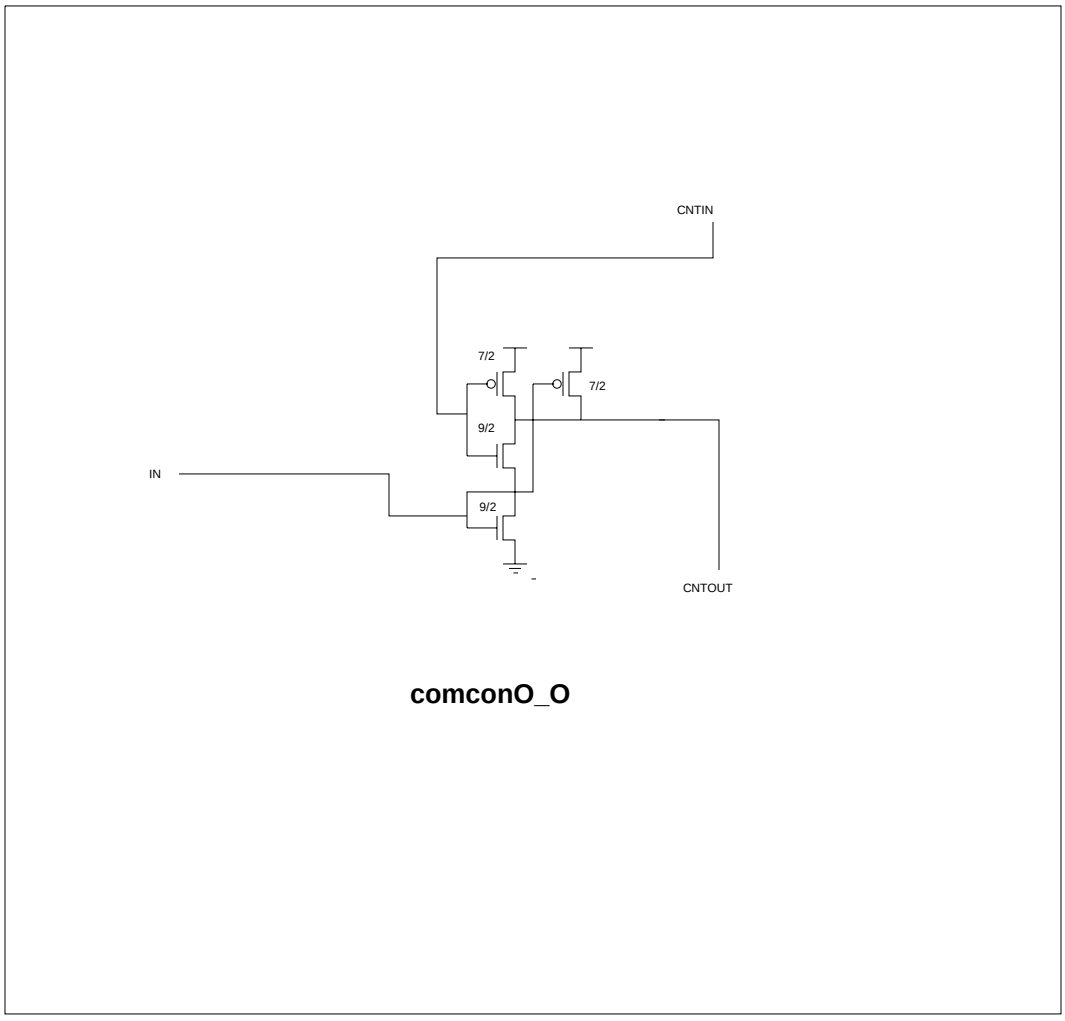

**comconO_Z**

| conconQ_Cmsb Leaf cell Propagation Delays | | | | | | | |
|---|---|---|---|---|---|---|---|
| IN | OUT | Conditions | Load | Tplh | Tphl | Tlh | Thl |
| IN | CNTOUT | CNTIN=1 | 0.10 | 1.04 | 1.17 | 1.73 | 0.88 |
| | | | 0.50 | 3.52 | 2.49 | 7.46 | 3.32 |
| | | | 1.00 | 6.63 | 4.14 | 14.67 | 6.49 |
| | | | 2.50 | 15.86 | 9.07 | 36.31 | 16.06 |
| CNTIN | CNTOUT | IN=1 | 0.10 | 1.08 | 1.08 | 1.73 | 0.86 |
| | | | 0.50 | 3.56 | 2.40 | 7.46 | 3.32 |
| | | | 1.00 | 6.67 | 4.04 | 14.67 | 6.49 |
| | | | 2.50 | 15.91 | 8.98 | 36.31 | 16.06 |



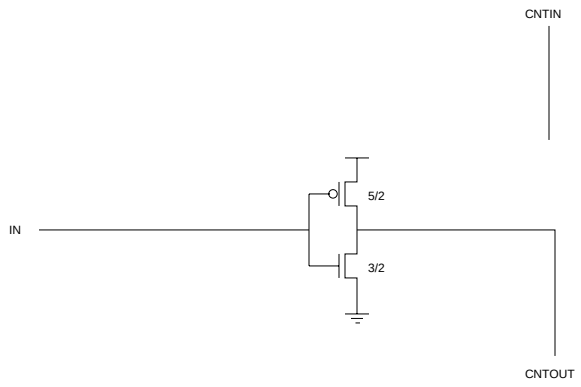

**comconO_Omsb**

| comtonQ2OLeafcell Propagation Delays | | | | | | | |
|---|---|---|---|---|---|---|---|
| IN | OUT | Conditions | Load | Tplh | Tphl | Tlh | Thl |
| IN | CNIOUT | | 0.10 | 1.03 | 0.52 | 1.69 | 1.09 |
| | | | 0.50 | 2.75 | 1.68 | 5.60 | 3.20 |
| | | | 1.00 | 4.97 | 2.93 | 10.76 | 6.10 |
| | | | 2.50 | 11.63 | 6.33 | 26.32 | 14.95 |
| CNIIN | CNIOUT | | 0.10 | 0.97 | 0.59 | 1.58 | 1.16 |
| | | | 0.50 | 2.71 | 1.74 | 5.50 | 3.23 |
| | | | 1.00 | 4.92 | 3.00 | 10.66 | 6.11 |
| | | | 2.50 | 11.60 | 6.40 | 26.21 | 14.96 |



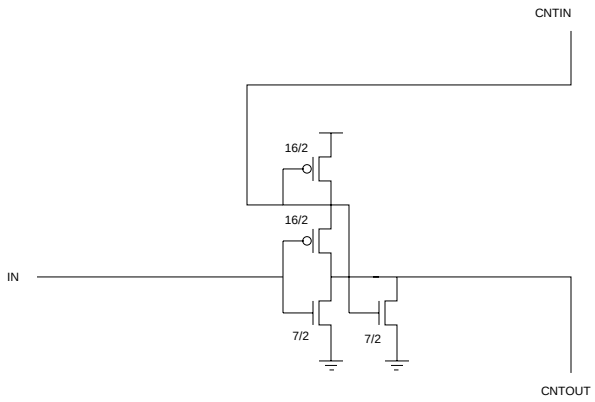

**comconO_O**

| conconEZlsb Leafcell Propagation Delays | | | | | | | |
|---|---|---|---|---|---|---|---|
| IN | OUT | Conditions | Load | Tplh | Tphl | Tlh | Thl |
| IN | CNTOUT | | 0.10 | 1.07 | 1.00 | 1.93 | 1.52 |
| | | | 0.50 | 3.52 | 3.22 | 7.47 | 5.61 |
| | | | 1.00 | 6.61 | 6.01 | 14.65 | 11.02 |
| | | | 2.50 | 13.81 | 14.43 | 36.34 | 27.24 |

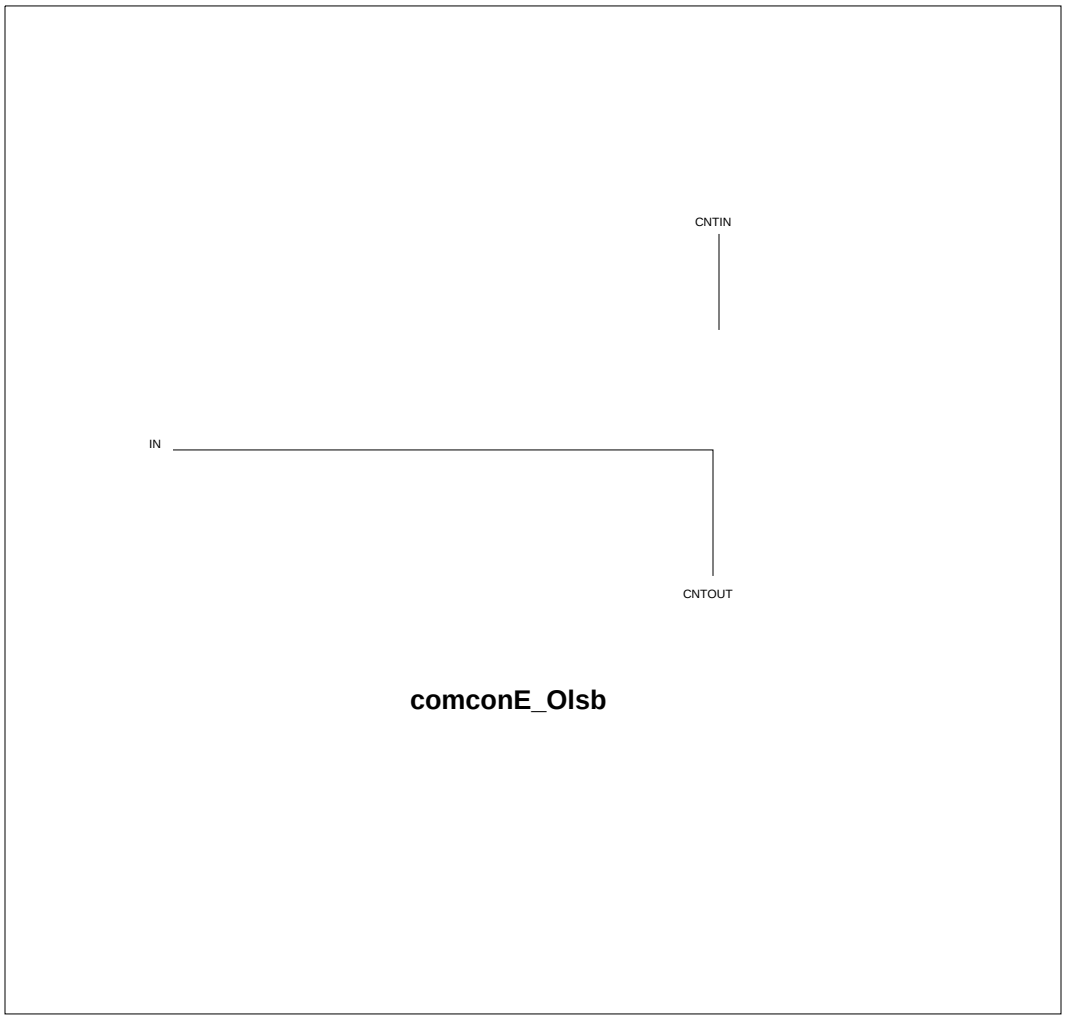



**comconE_Zlsb**

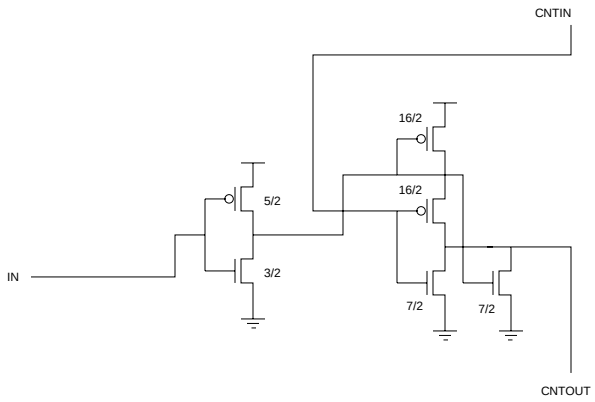
| conconEZ Leaf cell Propagation Delays | | | | | | | |
|---|---|---|---|---|---|---|---|
| IN | OUT | Conditions | Load | Tplh | Tphl | Tlh | Thl |
| IN | CNIOUT | CNIIN=0 | 0.10 | 0.85 | 0.61 | 1.55 | 0.99 |
| | | | 0.50 | 2.32 | 1.57 | 4.94 | 2.53 |
| | | | 1.00 | 4.21 | 2.67 | 9.42 | 4.71 |
| | | | 2.50 | 9.93 | 5.96 | 23.04 | 11.47 |
| CNIIN | CNIOUT | IN=0 | 0.10 | 0.77 | 0.67 | 1.50 | 1.10 |
| | | | 0.50 | 2.26 | 1.62 | 4.92 | 2.64 |
| | | | 1.00 | 4.16 | 2.71 | 9.42 | 4.81 |
| | | | 2.50 | 9.88 | 6.00 | 23.04 | 11.57 |




**comconE_Z**

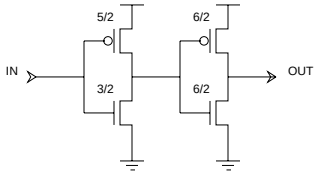

CNTIN
IN
CNTOUT
comconE_Olsb

| conconE_OLeafcell Propagation Delays | | | | | | | |
|---|---|---|---|---|---|---|---|
| IN | OUT | Conditions | Load | Tplh | Tphl | Tlh | Thl |
| IN | CNIOUT | CNIIN=0 | 0.10 | 1.24 | 1.21 | 1.35 | 0.92 |
| | | | 0.50 | 2.76 | 2.16 | 4.92 | 2.59 |
| | | | 1.00 | 4.67 | 3.33 | 9.45 | 4.82 |
| | | | 2.50 | 10.38 | 6.82 | 23.07 | 11.61 |
| CNIIN | CNIOUT | IN=1 | 0.10 | 0.86 | 0.62 | 1.58 | 1.00 |
| | | | 0.50 | 2.33 | 1.58 | 4.97 | 2.54 |
| | | | 1.00 | 4.23 | 2.74 | 9.45 | 4.71 |
| | | | 2.50 | 9.95 | 6.23 | 23.08 | 11.49 |



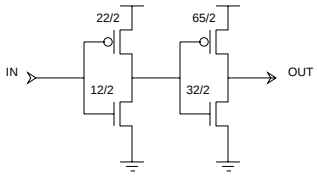

**comconE_O**

| Leafcell Propagation Delays | | | | | | | |
|---|---|---|---|---|---|---|---|
| IN | OUT | Conditions | Load (pF) | Tplh (ns) | Tphl (ns) | Tlh (ns) | Thl (ns) |
| IN | OUTINV | | 0.1 | 1.24 | 1.13 | 2.42 | 2.05 |
| | | | 0.5 | 3.72 | 3.33 | 8.02 | 6.20 |
| | | | 1.0 | 6.89 | 6.15 | 15.35 | 11.79 |
| | | | 2.5 | 10.48 | 14.33 | 36.97 | 27.99 |
| IN | OUT | | 0.1 | 1.32 | 1.06 | 2.07 | 1.36 |
| | | | 0.5 | 4.48 | 3.28 | 2.47 | 2.98 |
| | | | 1.0 | 5.94 | 3.48 | 12.50 | 6.34 |
| | | | 2.5 | 13.88 | 7.67 | 30.78 | 14.22 |



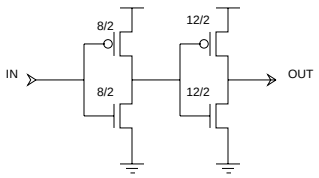

**buffersmall**

| Leafcell Propagation Delays | | | | | | | |
|---|---|---|---|---|---|---|---|
| IN | OUT | Conditions | Load (pF) | Tplh (ns) | Tphl (ns) | Tlh (ns) | Thl (ns) |
| IN | OUTINV | | 0.1 | 0.83 | 0.69 | 1.59 | 1.31 |
| | | | 0.5 | 1.39 | 1.25 | 2.92 | 2.45 |
| | | | 1.0 | 2.12 | 1.93 | 4.72 | 3.87 |
| | | | 2.5 | 4.45 | 3.99 | 9.65 | 8,32 |
| IN | OUT | | 0.1 | 0.64 | 0.63 | 1.03 | 0.99 |
| | | | 0.5 | 1.04 | 1.07 | 1.24 | 1.05 |
| | | | 1.0 | 1.32 | 1.33 | 1.93 | 1.52 |
| | | | 2.5 | 2.15 | 2.10 | 4.19 | 3.33 |




**bufferhuge**

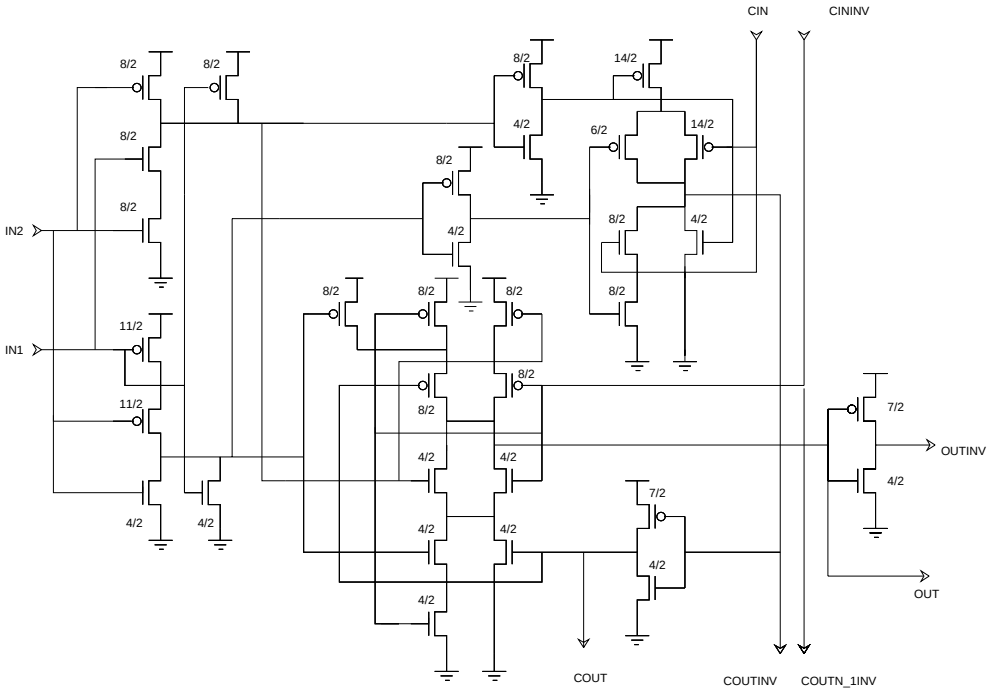
| Leafcell Propagation Delays | | | | | | | |
|---|---|---|---|---|---|---|---|
| IN | OUT | Conditions | Load (pF) | Tplh (ns) | Tphl (ns) | Tlh (ns) | Thl (ns) |
| IN | OUTINV | | 0.1 | 1.10 | 0.58 | 1.88 | 1.32 |
| | | | 0.5 | 2.62 | 1.44 | 5.37 | 2.74 |
| | | | 1.0 | 4.60 | 2.47 | 9,92 | 4.82 |
| | | | 2.5 | 10.48 | 5.53 | 23.92 | 11.35 |
| IN | OUT | | 0.1 | 0.93 | 0.95 | 1.23 | 0.95 |
| | | | 0.5 | 1.75 | 1.50 | 3.70 | 1.98 |
| | | | 1.0 | 3.09 | 2.18 | 7.11 | 3.42 |
| | | | 2.5 | 8.09 | 8.51 | 5.76 | 6.22 |




**bufferbig**

| adder_odd_nsb Leaf cell Propagation Delays | | | | | | | |
|---|---|---|---|---|---|---|---|
| IN | OUT | Conditions | Load | Tplh | Tphl | Tlh | Thl |
| CIN | OUT | IN1=0, IN2=0 | 0.10 | 1.93 | 2.04 | 4.52 | 3.86 |
| | | | 0.50 | 5.03 | 5.10 | 11.19 | 10.07 |
| | | | 1.00 | 8.77 | 8.82 | 20.00 | 17.94 |
| | | | 2.50 | 19.89 | 19.71 | 46.18 | 41.49 |
| | | IN1=1, IN2=0 | 0.10 | 4.22 | 3.43 | 4.49 | 3.12 |
| | | | 0.50 | 12.44 | 10.45 | 12.34 | 9.65 |
| | | | 1.00 | 22.12 | 19.23 | 20.79 | 16.58 |
| | | | 2.50 | 51.72 | 44.76 | 48.42 | 38.18 |
| | OUTINV | IN1=0, IN2=0 | 0.10 | 3.28 | 3.15 | 3.11 | 2.86 |
| | | | 0.50 | 9.55 | 9.08 | 8.61 | 8.44 |
| | | | 1.00 | 16.94 | 16.57 | 15.49 | 14.07 |
| | | | 2.50 | 39.18 | 38.83 | 35.84 | 31.97 |
| | | IN1=1, IN2=0 | 0.10 | 4.66 | 4.97 | 3.10 | 3.78 |
| | | | 0.50 | 14.82 | 16.35 | 7.99 | 9.11 |
| | | | 1.00 | 26.98 | 29.91 | 14.84 | 13.95 |
| | | | 2.50 | 63.24 | 70.55 | 34.36 | 31.84 |
| | COUT | IN1=1, IN2=0 | 0.10 | 1.73 | 2.00 | 2.00 | 1.97 |
| | | | 0.50 | 5.71 | 6.58 | 6.81 | 6.45 |
| | | | 1.00 | 10.25 | 11.80 | 12.85 | 11.45 |
| | | | 2.50 | 23.83 | 27.81 | 29.54 | 26.55 |
| | COUTINV | IN1=1, IN2=0 | 0.10 | 1.02 | 0.81 | 2.22 | 1.49 |
| | | | 0.50 | 2.77 | 2.09 | 6.26 | 4.06 |
| | | | 1.00 | 4.98 | 3.67 | 11.34 | 7.48 |
| | | | 2.50 | 11.51 | 8.45 | 26.61 | 17.10 |

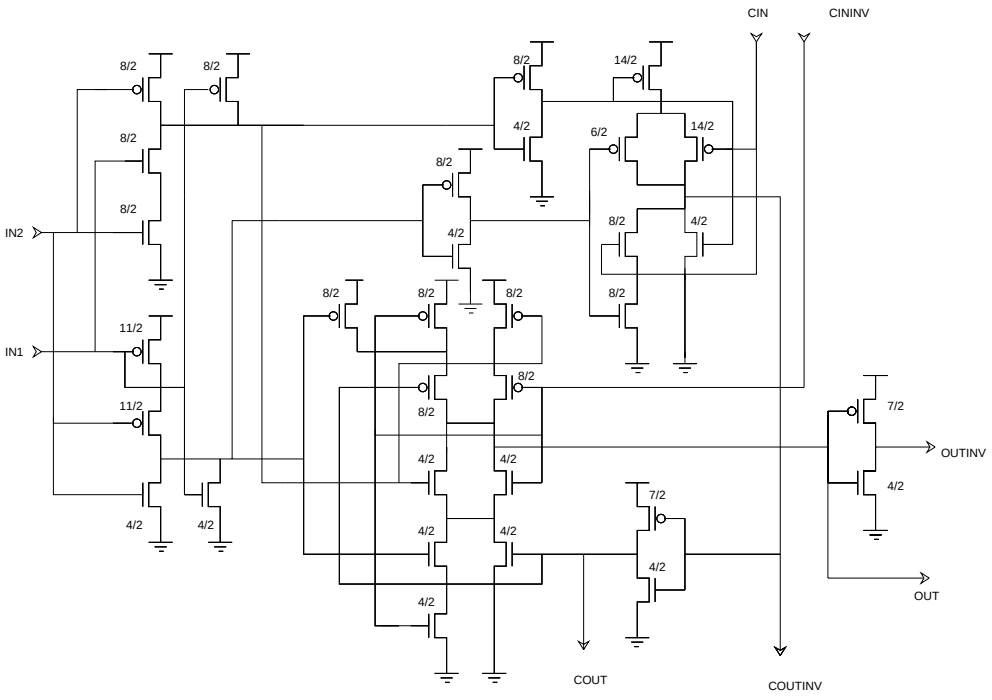
| adder_odd_msb Leafcell Propagation Delays | | | | | | | |
|---|---|---|---|---|---|---|---|
| IN | OUT | Conditions | Load | Tplh | Tphl | Tlh | Thl |
| IN1 | OUT | IN2=0, CIN=0, CININV=1 | 0.10 | 2.54 | 2.71 | 4.08 | 3.98 |
| | | | 0.50 | 5.68 | 5.76 | 10.81 | 10.12 |
| | | | 1.00 | 9.38 | 9.49 | 19.48 | 17.95 |
| | | | 2.50 | 20.50 | 20.40 | 45.64 | 41.48 |
| | | IN2=0, CIN=1, CININV=0 | 0.10 | 6.50 | 4.87 | 5.66 | 4.07 |
| | | | 0.50 | 15.96 | 11.84 | 12.92 | 9.94 |
| | | | 1.00 | 27.47 | 20.05 | 21.83 | 16.80 |
| | | | 2.50 | 63.06 | 45.54 | 49.70 | 38.16 |
| | OUTINV | IN2=0, CIN=0, CININV=1 | 0.10 | 3.97 | 3.62 | 3.16 | 3.31 |
| | | | 0.50 | 10.25 | 9.61 | 8.52 | 8.60 |
| | | | 1.00 | 17.60 | 17.09 | 15.41 | 13.84 |
| | | | 2.50 | 39.87 | 39.36 | 35.89 | 31.80 |
| | | IN2=0, CIN=1, CININV=0 | 0.10 | 6.18 | 7.93 | 4.47 | 4.14 |
| | | | 0.50 | 16.14 | 19.89 | 9.03 | 9.17 |
| | | | 1.00 | 27.77 | 35.24 | 14.77 | 14.20 |
| | | | 2.50 | 64.02 | 81.98 | 34.42 | 32.01 |
| | COUT | IN2=0, CIN=1, CININV=0 | 0.10 | 2.66 | 3.95 | 2.12 | 3.17 |
| | | | 0.50 | 6.41 | 9.63 | 7.16 | 7.79 |
| | | | 1.00 | 10.99 | 16.82 | 12.98 | 13.70 |
| | | | 2.50 | 24.60 | 38.72 | 29.65 | 31.22 |
| | COUTINV | IN2=0, CIN=1, CININV=0 | 0.10 | 2.63 | 1.59 | 3.52 | 1.35 |
| | | | 0.50 | 5.50 | 2.90 | 10.11 | 4.47 |
| | | | 1.00 | 9.14 | 4.48 | 18.39 | 7.81 |
| | | | 2.50 | 20.05 | 9.22 | 43.81 | 16.97 |




**adder_odd_msb**

| adder_odd Leafcell Propagation Delays | | | | | | | |
|---|---|---|---|---|---|---|---|
| IN | OUT | Conditions | Load | Tplh | Tphl | Tlh | Thl |
| CIN | OUT | IN1=0, IN2=0 | 0.10 | 1.94 | 2.05 | 4.54 | 3.90 |
| | | | 0.50 | 5.04 | 5.12 | 11.19 | 10.10 |
| | | | 1.00 | 8.78 | 8.84 | 20.00 | 17.96 |
| | | | 2.50 | 19.90 | 19.73 | 46.19 | 41.51 |
| | | IN1=1, IN2=0 | 0.10 | 3.07 | 2.77 | 3.91 | 3.28 |
| | | | 0.50 | 5.96 | 5.38 | 10.79 | 8.50 |
| | | | 1.00 | 9.71 | 8.55 | 19.23 | 15.01 |
| | | | 2.50 | 20.90 | 18.21 | 45.60 | 34.83 |
| | OUTINV | IN1=0, IN2=0 | 0.10 | 3.27 | 3.15 | 3.10 | 2.79 |
| | | | 0.50 | 9.55 | 9.07 | 8.59 | 8.40 |
| | | | 1.00 | 16.94 | 16.56 | 15.46 | 14.05 |
| | | | 2.50 | 39.18 | 38.82 | 35.81 | 31.94 |
| | | IN1=1, IN2=0 | 0.10 | 3.86 | 4.46 | 3.47 | 3.12 |
| | | | 0.50 | 9.44 | 10.19 | 8.92 | 7.74 |
| | | | 1.00 | 16.22 | 17.47 | 14.69 | 13.82 |
| | | | 2.50 | 36.62 | 39.73 | 34.18 | 31.39 |
| | COUT | IN1=1, IN2=0 | 0.039 | 1.17 | 1.30 | 1.55 | 1.29 |
| | COUTINV | IN1=1, IN2=0 | 0.034 | 0.72 | 0.61 | 1.72 | 1.20 |

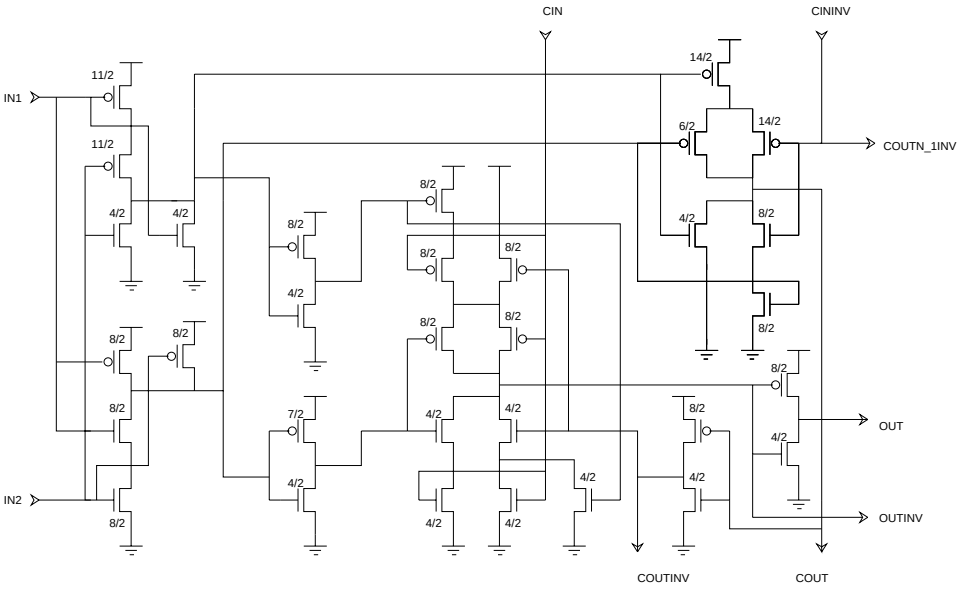
| adder_odd Leafcell Propagation Delays | | | | | | | |
|---|---|---|---|---|---|---|---|
| IN | OUT | Conditions | Load | Tplh | Tphl | Tlh | Thl |
| IN1 | OUT | IN2=0, CIN=0, CININV=1 | 0.10 | 2.56 | 2.73 | 4.10 | 4.01 |
| | | | 0.50 | 5.69 | 5.78 | 10.82 | 10.15 |
| | | | 1.00 | 9.39 | 9.50 | 19.48 | 17.98 |
| | | | 2.50 | 20.51 | 20.42 | 45.64 | 41.50 |
| | | IN2=0, CIN=1, CININV=0 | 0.10 | 5.05 | 3.74 | 5.03 | 3.74 |
| | | | 0.50 | 7.90 | 6.41 | 11.55 | 8.13 |
| | | | 1.00 | 11.60 | 9.66 | 20.21 | 15.02 |
| | | | 2.50 | 22.78 | 19.44 | 46.30 | 34.98 |
| | OUTINV | IN2=0, CIN=0, CININV=1 | 0.10 | 3.96 | 3.61 | 3.15 | 3.27 |
| | | | 0.50 | 10.25 | 9.60 | 8.49 | 8.58 |
| | | | 1.00 | 17.60 | 17.08 | 15.38 | 13.83 |
| | | | 2.50 | 39.87 | 39.36 | 35.85 | 31.77 |
| | | IN2=0, CIN=1, CININV=0 | 0.10 | 5.30 | 5.98 | 4.01 | 3.23 |
| | | | 0.50 | 10.54 | 11.77 | 8.62 | 8.89 |
| | | | 1.00 | 17.38 | 19.39 | 15.03 | 14.10 |
| | | | 2.50 | 37.86 | 41.67 | 34.19 | 31.99 |
| | COUT | IN2=0, CIN=1, CININV=0 | 0.039 | 2.04 | 2.82 | 1.43 | 1.94 |
| | COUTINV | IN2=0, CIN=1, CININV=0 | 0.034 | 2.09 | 1.39 | 1.93 | 1.25 |




**adder_odd**

| adder_even_msb Leafcell Propagation Delays | | | | | | | |
|---|---|---|---|---|---|---|---|
| IN | OUT | Conditions | Load | Tplh | Tphl | Tlh | Thl |
| CIN | OUT | IN1=0, IN2=0 | 0.10 | 3.10 | 3.93 | 2.62 | 3.36 |
| | | | 0.50 | 8.52 | 10.70 | 8.29 | 8.77 |
| | | | 1.00 | 14.80 | 19.13 | 13.90 | 14.95 |
| | | | 2.50 | 34.21 | 44.64 | 31.28 | 34.52 |
| | | IN1=1, IN2=0 | 0.10 | 4.93 | 5.66 | 3.91 | 3.70 |
| | | | 0.50 | 14.92 | 16.41 | 8.85 | 8.52 |
| | | | 1.00 | 26.43 | 29.18 | 14.08 | 13.82 |
| | | | 2.50 | 61.58 | 69.20 | 31.73 | 31.40 |
| | OUTINV | IN1=0, IN2=0 | 0.10 | 2.53 | 1.97 | 5.01 | 3.33 |
| | | | 0.50 | 6.16 | 4.65 | 13.71 | 8.98 |
| | | | 1.00 | 10.72 | 7.87 | 24.24 | 15.42 |
| | | | 2.50 | 24.23 | 17.60 | 56.23 | 35.24 |
| | | IN1=1, IN2=0 | 0.10 | 4.04 | 3.80 | 4.16 | 3.82 |
| | | | 0.50 | 12.38 | 11.12 | 11.60 | 10.52 |
| | | | 1.00 | 21.41 | 19.41 | 20.78 | 17.59 |
| | | | 2.50 | 50.12 | 44.82 | 47.63 | 39.58 |
| | COUT | IN1=1, IN2=0 | 0.10 | 1.09 | 0.83 | 2.23 | 1.65 |
| | | | 0.50 | 2.80 | 2.11 | 6.27 | 4.35 |
| | | | 1.00 | 5.05 | 3.73 | 11.25 | 7.73 |
| | | | 2.50 | 11.47 | 8.47 | 26.69 | 17.29 |
| | COUTINV | IN1=1, IN2=0 | 0.10 | 1.69 | 2.08 | 1.89 | 2.14 |
| | | | 0.50 | 5.25 | 6.44 | 6.46 | 7.08 |
| | | | 1.00 | 9.61 | 11.92 | 11.80 | 11.91 |
| | | | 2.50 | 22.33 | 27.98 | 26.60 | 26.68 |

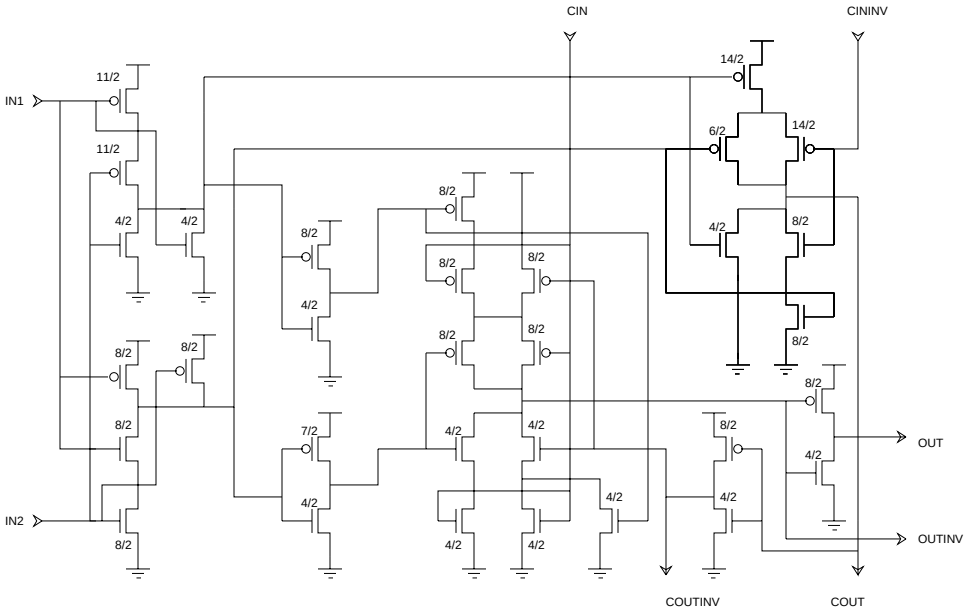
| adder_even_msb Leaf cell Propagation Delays | | | | | | | |
|---|---|---|---|---|---|---|---|
| IN | OUT | Conditions | Load | Tplh | Tphl | Tlh | Thl |
| IN1 | OUT | IN2=0, CIN=0, CININV=1 | 0.10 | 3.94 | 4.79 | 3.58 | 3.51 |
| | | | 0.50 | 9.38 | 11.55 | 8.67 | 9.16 |
| | | | 1.00 | 15.82 | 20.16 | 13.92 | 15.40 |
| | | | 2.50 | 35.23 | 45.68 | 31.42 | 34.49 |
| | | IN2=0, CIN=1, CININV=0 | 0.10 | 6.36 | 6.01 | 5.14 | 2.60 |
| | | | 0.50 | 16.33 | 17.09 | 9.05 | 8.79 |
| | | | 1.00 | 28.74 | 29.95 | 13.92 | 14.08 |
| | | | 2.50 | 65.62 | 69.90 | 31.68 | 31.60 |
| | OUTINV | IN2=0, CIN=0, CININV=1 | 0.10 | 3.61 | 3.01 | 5.62 | 4.16 |
| | | | 0.50 | 7.35 | 5.65 | 13.80 | 8.87 |
| | | | 1.00 | 11.80 | 8.86 | 24.38 | 15.57 |
| | | | 2.50 | 25.23 | 18.56 | 56.18 | 35.53 |
| | | IN2=0, CIN=1, CININV=0 | 0.10 | 4.85 | 5.27 | 3.96 | 4.87 |
| | | | 0.50 | 13.21 | 12.60 | 11.85 | 10.20 |
| | | | 1.00 | 22.18 | 21.73 | 20.78 | 17.22 |
| | | | 2.50 | 50.81 | 48.90 | 47.72 | 39.48 |
| | COUT | IN2=0, CIN=1, CININV=0 | 0.10 | 1.73 | 2.10 | 2.36 | 2.19 |
| | | | 0.50 | 3.52 | 3.84 | 5.91 | 5.84 |
| | | | 1.00 | 5.78 | 5.85 | 11.42 | 9.71 |
| | | | 2.50 | 12.22 | 12.13 | 26.72 | 21.34 |
| | COUTINV | IN2=0, CIN=1, CININV=0 | 0.10 | 3.15 | 2.91 | 2.80 | 2.16 |
| | | | 0.50 | 7.38 | 7.28 | 7.45 | 6.80 |
| | | | 1.00 | 12.15 | 12.65 | 11.93 | 11.78 |
| | | | 2.50 | 26.70 | 28.68 | 27.46 | 26.57 |




**adder_even_msb**

| adder_even Leafcell Propagation Delays | | | | | | | |
|---|---|---|---|---|---|---|---|
| IN | OUT | Conditions | Load | Tplh | Tphl | Tlh | Thl |
| CIN | OUT | IN1=0, IN2=0 | 0.10 | 3.00 | 3.82 | 2.32 | 3.33 |
| | | | 0.50 | 8.43 | 10.66 | 8.17 | 8.71 |
| | | | 1.00 | 14.70 | 19.16 | 13.85 | 14.95 |
| | | | 2.50 | 34.11 | 44.86 | 31.25 | 34.59 |
| | | IN1=1, IN2=0 | 0.10 | 4.06 | 4.14 | 3.20 | 3.73 |
| | | | 0.50 | 9.23 | 10.14 | 7.96 | 8.53 |
| | | | 1.00 | 15.65 | 17.62 | 13.69 | 13.91 |
| | | | 2.50 | 34.88 | 40.03 | 31.59 | 31.52 |
| | OUTINV | IN1=0, IN2=0 | 0.10 | 2.47 | 1.90 | 4.93 | 3.29 |
| | | | 0.50 | 6.14 | 4.57 | 13.65 | 8.91 |
| | | | 1.00 | 10.76 | 7.79 | 24.33 | 15.31 |
| | | | 2.50 | 24.41 | 17.53 | 56.62 | 35.14 |
| | | IN1=1, IN2=0 | 0.10 | 3.20 | 2.82 | 4.13 | 3.84 |
| | | | 0.50 | 6.18 | 5.38 | 10.62 | 8.97 |
| | | | 1.00 | 9.87 | 8.63 | 19.27 | 15.27 |
| | | | 2.50 | 20.98 | 18.21 | 45.42 | 35.49 |
| | COUT | IN1=1, IN2=0 | 0.034 | 0.80 | 0.59 | 1.60 | 1.36 |
| | COUTINV | IN1=1, IN2=0 | 0.040 | 1.12 | 1.39 | 1.27 | 1.53 |

| adder_even Leafcell Propagation Delays | | | | | | | |
|---|---|---|---|---|---|---|---|
| IN | OUT | Conditions | Load | Tplh | Tphl | Tlh | Thl |
| IN1 | OUT | IN2=0, CIN=0, CININV=1 | 0.10 | 3.83 | 4.75 | 3.46 | 3.37 |
| | | | 0.50 | 9.29 | 11.50 | 8.63 | 9.10 |
| | | | 1.00 | 15.70 | 20.17 | 13.90 | 15.40 |
| | | | 2.50 | 35.12 | 45.90 | 31.32 | 34.55 |
| | | IN2=0, CIN=1, CININV=0 | 0.10 | 5.19 | 4.83 | 4.13 | 2.90 |
| | | | 0.50 | 10.68 | 10.79 | 8.33 | 8.38 |
| | | | 1.00 | 16.98 | 18.33 | 13.82 | 13.78 |
| | | | 2.50 | 36.25 | 40.82 | 31.35 | 31.47 |
| | OUTINV | IN2=0, CIN=0, CININV=1 | 0.10 | 3.48 | 2.92 | 5.42 | 4.01 |
| | | | 0.50 | 7.32 | 5.57 | 13.76 | 8.82 |
| | | | 1.00 | 11.82 | 8.77 | 24.45 | 15.46 |
| | | | 2.50 | 25.40 | 18.48 | 56.66 | 35.40 |
| | | IN2=0, CIN=1, CININV=0 | 0.10 | 3.74 | 4.47 | 3.58 | 4.19 |
| | | | 0.50 | 6.87 | 6.95 | 10.43 | 8.99 |
| | | | 1.00 | 10.57 | 10.01 | 19.28 | 15.32 |
| | | | 2.50 | 21.76 | 19.67 | 45.43 | 35.15 |
| | COUT | IN2=0, CIN=1, CININV=0 | 0.034 | 1.42 | 1.75 | 1.77 | 1.82 |
| | COUTINV | IN2=0, CIN=1, CININV=0 | 0.040 | 2.48 | 2.07 | 1.63 | 1.20 |


CIN
CININV
IN1
IN2
11/2
11/2
4/2
4/2
8/2
8/2
8/2
8/2
8/2
4/2
7/2
4/2
8/2
8/2
8/2
8/2
8/2
8/2
4/2
4/2
4/2
4/2
4/2
14/2
6/2
14/2
4/2
8/2
8/2
8/2
8/2
4/2
OUT
OUTINV
COUTINV
COUT

**adder_even**

# Leafcell Circuit Diagrams and Simulation Results

This documentation contains the transistor-level circuit diagrams for the leafcells used in the blocks described in the previous sections, as well as simulation results for cell performance under various loading conditions.

In general, the loads chosen were 0.1, 0.5, 1.0, and 2.5 pF, placed at the outputs of the leafcells. Supply voltages were set a 5V; inputs were pulsed between low to high values with 2nsec rise/fall times. In cases where the leafcells are to be cascaded in multiple stages (eg. the adder), output loading was also simulated with the input gate capacitance of the "next" stage.

For the tables, all "Load" values are in pF, all time values are in nsec. The interpretation of the delay values is as follows:

- Tplh: time from 50% at the input (2.5V) to 50% of rise at the output (2.5V)
- Tphl: time from 50% at the input (2.5V) to 50% of fall at the output (2.5V)
- Tlh: time from 10% to 90% rise at the output (.5V to 4.5V)
- Thl: time from 10% to 90% fall at the output (4.5V to .5V)

All simulations were done with the SPICE circuit simulator. The following spice model was used:

```
*
* Typical model
*
.option reltol=.01 abstol=1.0e-8 pivtol=1e-18 vntol=1mv chgtol=1e-11
+ gmin=1e-8 limtim=500 cptime=900 limpts=1000
+ tnom=65 nomod lvltim=1
.width out=80
* remove LDEL and WDEL from models
* and add their values to the L and W of all devices.
*
.model n nmos level=2 vto=0.7 tox=490e-10 nsub=4.5e15 xj=0.35e-6 ld=0.31e-6
+ uo=690 ucrit=0.82e5 uexp=0.16 vmax=5.0e4 neff=4.4 delta=3.6 rsh=22
+ cgso=2.20e-10 cgdo=2.2e-10 cj=90e-6 cjsw=675e-12 mj=0.45 mjsw=0.35 pb=0.60
*+ ldel=-0.1e-6
*+ wdel=-0.90e-6
*
.model p pmos level=2 vto=-0.7 tox=490e-10 nsub=4.3e15 xj=0.10e-6 ld=0.4e-6
+ uo=255 ucrit=0.71e5 uexp=0.28 vmax=3.2e4 neff=2.7 delta=0.95 rsh=86
+ cgso=2.8e-10 cgdo=2.8e-10 cj=195e-6 cjsw=385e-12 mj=0.51 mjsw=0.36 pb=0.70
*+ ldel=-0.1e-6
*+ wdel=-0.90e-6
*
.end
```

# LagerIV Datapath Leafcell Library Documentation

University of California, Berkeley

December 3, 1988

*This report documents the datapath leafcells used by datapath blocks described in the block library documentation.*