LVDS (Tx/Rx) Design
With 5V Devices in Sky130nm Process
Output Driver Netlist

November 2023
Revision 0.1

LVDS Output Driver Netlist

```
** sch_path:
/home/saumeek/xschem_test/OutputDriverNetlist_5v.sch
```

```
**.subckt OutputDriverNetlist_5v Vinp Vinn Vop Von VCC5 Vss
VCC_1v8 BGR Vref Vinp1v8 Vinn1v8
```

```
*.ipin Vinp
```

```
*.ipin Vinn
```

```
*.opin Vop
```

```
*.opin Von
```

```
*.iopin VCC5
```

```
*.iopin Vss
```

```
*.iopin VCC_1v8
```

```
*.ipin BGR
```

```
*.ipin Vref
```

```
*.ipin Vinp1v8
```

```
*.ipin Vinn1v8
```

```
R1 Vcm Vop 1.5k m=1
```

```
R2 Von Vcm 1.5k m=1
```

```
C5 C Vss 1p m=1
```

```
C6 net5 Vss 1p m=1
```

```
R11 Vcm net5 100 m=1
```

```
XM27 net6 H Vss Vss sky130_fd_pr__nfet_g5v0d10v5 L=0.5 W=25 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
```

```
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
```

```
+ sa=0 sb=0 sd=0 mult=1 m=1
```

```
XM8 net1 H Vss Vss sky130_fd_pr__nfet_g5v0d10v5 L=0.5 W=25 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
+ sa=0 sb=0 sd=0 mult=1 m=1

XM25 Vop pu net6 Vss sky130_fd_pr__nfet_g5v0d10v5 L=0.5 W=10
nf=1 ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
+ sa=0 sb=0 sd=0 mult=1 m=1

XM7 Von pd net1 Vss sky130_fd_pr__nfet_g5v0d10v5 L=0.5 W=15 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
+ sa=0 sb=0 sd=0 mult=1 m=1

XM6 B C Vss Vss sky130_fd_pr__nfet_g5v0d10v5 L=0.5 W=80 nf=6
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
+ sa=0 sb=0 sd=0 mult=1 m=1

XM11 H H Vss Vss sky130_fd_pr__nfet_g5v0d10v5 L=0.5 W=88 nf=2
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
+ sa=0 sb=0 sd=0 mult=1 m=1

XM13 C C Vss Vss sky130_fd_pr__nfet_g5v0d10v5 L=0.5 W=68 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
```

+ sa=0 sb=0 sd=0 mult=1 m=1

XM15 K Vcm F Vss sky130_fd_pr__nfet_g5v0d10v5 L=0.5 W=50 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

XM19 F BGR Vss Vss sky130_fd_pr__nfet_g5v0d10v5 L=0.5 W=55 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

XM16 E Vref F Vss sky130_fd_pr__nfet_g5v0d10v5 L=0.5 W=50 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

XM23 net3 BGR Vss Vss sky130_fd_pr__nfet_g5v0d10v5 L=0.5 W=10
nf=1 ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

XM24 D BGR Vss Vss sky130_fd_pr__nfet_g5v0d10v5 L=0.5 W=20 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

XM26 BGR BGR Vss Vss sky130_fd_pr__nfet_g5v0d10v5 L=0.5 W=5.88
nf=1 ad='int((nf+1)/2) * W/nf * 0.29'

+ as='int((nf+2)/2) * W/nf * 0.29' pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) * (W/nf + 0.29)'

+ nrd='0.29 / W' nrs='0.29 / W' sa=0 sb=0 sd=0 mult=1 m=1

XM21 D net3 net4 VCC5 sky130_fd_pr__pfet_g5v0d10v5 L=0.5 W=60 nf=1 ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf * 0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) * (W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

XM20 net4 D VCC5 VCC5 sky130_fd_pr__pfet_g5v0d10v5 L=0.5 W=30 nf=1 ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf * 0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) * (W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

XM22 net3 net3 VCC5 VCC5 sky130_fd_pr__pfet_g5v0d10v5 L=0.5 W=5 nf=1 ad='int((nf+1)/2) * W/nf * 0.29'

+ as='int((nf+2)/2) * W/nf * 0.29' pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) * (W/nf + 0.29)'

+ nrd='0.29 / W' nrs='0.29 / W' sa=0 sb=0 sd=0 mult=1 m=1

XM17 E E VCC5 VCC5 sky130_fd_pr__pfet_g5v0d10v5 L=0.5 W=50 nf=1 ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf * 0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) * (W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

XM18 K K VCC5 VCC5 sky130_fd_pr__pfet_g5v0d10v5 L=0.5 W=50 nf=1 ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf * 0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) * (W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

```
XM14 C K VCC5 VCC5 sky130_fd_pr__pfet_g5v0d10v5 L=0.5 W=68 nf=3
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
+ sa=0 sb=0 sd=0 mult=1 m=1
XM12 H D VCC5 VCC5 sky130_fd_pr__pfet_g5v0d10v5 L=0.5 W=85 nf=4
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
+ sa=0 sb=0 sd=0 mult=1 m=1
XM1 Vop Vinn5 A VCC5 sky130_fd_pr__pfet_g5v0d10v5 L=0.5 W=50
nf=4 ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
+ sa=0 sb=0 sd=0 mult=1 m=1
XM4 Von Vinp5 A VCC5 sky130_fd_pr__pfet_g5v0d10v5 L=0.5 W=50
nf=4 ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
+ sa=0 sb=0 sd=0 mult=1 m=1
XM3 B Vinn5 Von VCC5 sky130_fd_pr__pfet_g5v0d10v5 L=0.5 W=40
nf=2 ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
+ sa=0 sb=0 sd=0 mult=1 m=1
XM2 B Vinp5 Vop VCC5 sky130_fd_pr__pfet_g5v0d10v5 L=0.5 W=40
nf=2 ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
```

+ sa=0 sb=0 sd=0 mult=1 m=1

XM5 A E VCC5 VCC5 sky130_fd_pr__pfet_g5v0d10v5 L=0.5 W=80 nf=6
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

XM10 net2 D VCC5 VCC5 sky130_fd_pr__pfet_g5v0d10v5 L=0.5 W=60
nf=1 ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

XM9 Vop pu net2 VCC5 sky130_fd_pr__pfet_g5v0d10v5 L=0.5 W=30
nf=4 ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

XM28 Von pd net7 VCC5 sky130_fd_pr__pfet_g5v0d10v5 L=0.5 W=30
nf=4 ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

XM29 net7 D VCC5 VCC5 sky130_fd_pr__pfet_g5v0d10v5 L=0.5 W=60
nf=1 ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

x2 pd pu dnl dpl Vinp1v8 Vinn1v8 VCC_1v8 Vss VCC5
LevelShifterNetlist_5v

x3 Vinp5 Vss VCC5 Vinn1_5Netlist

x1 Vinn5 Vss VCC5 Vinp_5Netlist

**.ends

* expanding   symbol: LevelShifterNetlist_5v.sym # of pins=9

** sym_path:
/home/saumeek/xschem_test/LevelShifterNetlist_5v.sym

** sch_path:
/home/saumeek/xschem_test/LevelShifterNetlist_5v.sch

.subckt LevelShifterNetlist_5v Dn_H Dp_H Dn_L Dp_L vinp vinn
VCC_1v8 VSS VCC5

*.opin Dp_H

*.opin Dn_H

*.ipin vinp

*.ipin vinn

*.opin Dp_L

*.opin Dn_L

*.iopin VCC5

*.iopin VSS

*.iopin VCC_1v8

XM1 Dn_H Dp_H VCC5 VCC5 sky130_fd_pr__pfet_g5v0d10v5 L=0.5 W=15
nf=1 ad='int((nf+1)/2) * W/nf * 0.29'

+ as='int((nf+2)/2) * W/nf * 0.29' pd='2*int((nf+1)/2) * (W/nf +
0.29)' ps='2*int((nf+2)/2) * (W/nf + 0.29)'

+ nrd='0.29 / W' nrs='0.29 / W' sa=0 sb=0 sd=0 mult=1 m=1

XM2 Dp_H Dn_H VCC5 VCC5 sky130_fd_pr__pfet_g5v0d10v5 L=0.5 W=15
nf=1 ad='int((nf+1)/2) * W/nf * 0.29'

+ as='int((nf+2)/2) * W/nf * 0.29' pd='2*int((nf+1)/2) * (W/nf +
0.29)' ps='2*int((nf+2)/2) * (W/nf + 0.29)'

+ nrd='0.29 / W' nrs='0.29 / W' sa=0 sb=0 sd=0 mult=1 m=1

XM5 Dn_H Dp_L VSS VSS sky130_fd_pr__nfet_g5v0d10v5 L=0.5 W=50
nf=10 ad='int((nf+1)/2) * W/nf * 0.29'

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+ as='int((nf+2)/2) * W/nf * 0.29' pd='2*int((nf+1)/2) * (W/nf +
0.29)' ps='2*int((nf+2)/2) * (W/nf + 0.29)'

+ nrd='0.29 / W' nrs='0.29 / W' sa=0 sb=0 sd=0 mult=1 m=1

XM3 Dp_H Dn_L VSS VSS sky130_fd_pr__nfet_g5v0d10v5 L=0.5 W=50
nf=10 ad='int((nf+1)/2) * W/nf * 0.29'

+ as='int((nf+2)/2) * W/nf * 0.29' pd='2*int((nf+1)/2) * (W/nf +
0.29)' ps='2*int((nf+2)/2) * (W/nf + 0.29)'

+ nrd='0.29 / W' nrs='0.29 / W' sa=0 sb=0 sd=0 mult=1 m=1

x2 Dp_L VSS VCC_1v8 VCC5 vinp PreEmphasisDriverNetlist_1v8_3v3

x3 Dn_L VSS VCC_1v8 VCC5 vinn PreEmphasisDriverNetlist_1v8_3v3

.ends




* expanding   symbol:  Vinn1_5Netlist.sym # of pins=3

** sym_path: /home/saumeek/xschem_test/Vinn1_5Netlist.sym

** sch_path: /home/saumeek/xschem_test/Vinn1_5Netlist.sch

.subckt Vinn1_5Netlist Vinn VSS VCC5

*.opin Vinn

*.iopin VCC5

*.iopin VSS

x3 net2 net3 VCC5 VSS inv_0_5_3v3

x1 Vinn net1 VCC5 VSS inv_0_5_3v3

x5 net5 net4 VCC5 VSS inv_0_5_3v3

x8 net1 net2 VCC5 VSS inv_1_5_3v3

x2 net3 net5 VCC5 VSS inv_1_5_3v3

x7 net4 Vinn VCC5 VSS inv_0_5_3v3

.ends




* expanding   symbol:  Vinp_5Netlist.sym # of pins=3
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```
** sym_path: /home/saumeek/xschem_test/Vinp_5Netlist.sym

** sch_path: /home/saumeek/xschem_test/Vinp_5Netlist.sch

.subckt Vinp_5Netlist Vinp VSS VCC5

*.opin Vinp

*.iopin VCC5

*.iopin VSS

x9 Vinp net1 VCC5 VSS inv_0_5_3v3

x1 net4 net2 VCC5 VSS inv_0_5_3v3

x5 net5 net3 VCC5 VSS inv_0_5_3v3

x7 net1 net4 VCC5 VSS inv_1_5_3v3

x2 net2 net5 VCC5 VSS inv_1_5_3v3

x6 net3 Vinp VCC5 VSS inv_0_5_3v3

.ends



* expanding   symbol:  PreEmphasisDriverNetlist_1v8_3v3.sym # of
pins=5

** sym_path:
/home/saumeek/xschem_test/PreEmphasisDriverNetlist_1v8_3v3.sym

** sch_path:
/home/saumeek/xschem_test/PreEmphasisDriverNetlist_1v8_3v3.sch

.subckt PreEmphasisDriverNetlist_1v8_3v3 dn VSS Vcc VCC5 DpH

*.ipin DpH

*.opin dn

*.iopin VSS

*.iopin Vcc

*.iopin VCC5

x1 VSS DpH xor_out Buf_out Vcc xor

x10 Vcc DpH xor_out net2 VSS and

x2 VSS net1 Buf_out Vcc buf2
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x3 VSS DpH net1 Vcc buf1

x6 VSS net2 dn VCC5 buf2_3v3

.ends




* expanding   symbol:
/home/saumeek/simulation_library/inv_0_5_3v3.sym # of pins=4

** sym_path: /home/saumeek/simulation_library/inv_0_5_3v3.sym

** sch_path: /home/saumeek/simulation_library/inv_0_5_3v3.sch

.subckt inv_0_5_3v3 Vin Vout Vcc Vss

*.ipin Vin

*.opin Vout

*.iopin Vcc

*.iopin Vss

XM3 Vout Vin Vss Vss sky130_fd_pr__nfet_g5v0d10v5 L=0.5 W=10
nf=1 ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

XM1 Vout Vin Vcc Vcc sky130_fd_pr__pfet_g5v0d10v5 L=0.5 W=20
nf=1 ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

.ends




* expanding   symbol:
/home/saumeek/simulation_library/inv_1_5_3v3.sym # of pins=4
```

```
** sym_path: /home/saumeek/simulation_library/inv_1_5_3v3.sym

** sch_path: /home/saumeek/simulation_library/inv_1_5_3v3.sch

.subckt inv_1_5_3v3 Vin Vout Vcc Vss

*.ipin Vin

*.opin Vout

*.iopin Vcc

*.iopin Vss

XM3 Vout Vin Vcc Vcc sky130_fd_pr__pfet_g5v0d10v5 L=0.5 W=80
nf=1 ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

XM4 Vout Vin Vss Vss sky130_fd_pr__nfet_g5v0d10v5 L=0.5 W=40
nf=1 ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

.ends




* expanding   symbol:  /home/saumeek/simulation_library/xor.sym
# of pins=5

** sym_path: /home/saumeek/simulation_library/xor.sym

** sch_path: /home/saumeek/simulation_library/xor.sch

.subckt xor Vss A Vo B Vcc

*.iopin Vcc

*.iopin Vss

*.ipin A

*.opin Vo
```

```
*.ipin B

XM1 net3 Ab Vcc Vcc sky130_fd_pr__pfet_01v8 L=0.15 W=35 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
+ sa=0 sb=0 sd=0 mult=1 m=1

XM2 net4 A Vcc Vcc sky130_fd_pr__pfet_01v8 L=0.15 W=35 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
+ sa=0 sb=0 sd=0 mult=1 m=1

XM3 Vo Ab net1 Vss sky130_fd_pr__nfet_01v8 L=0.15 W=17 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
+ sa=0 sb=0 sd=0 mult=1 m=1

XM4 net1 Bb Vss Vss sky130_fd_pr__nfet_01v8 L=0.15 W=17 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
+ sa=0 sb=0 sd=0 mult=1 m=1

XM5 Vo A net2 Vss sky130_fd_pr__nfet_01v8 L=0.15 W=17 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
+ sa=0 sb=0 sd=0 mult=1 m=1

XM6 net2 B Vss Vss sky130_fd_pr__nfet_01v8 L=0.15 W=17 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
```

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

x1 A Ab Vcc Vss inv111

x2 B Bb Vcc Vss inv111

XM7 Vo B net3 Vcc sky130_fd_pr__pfet_01v8 L=0.15 W=35 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

XM8 Vo Bb net4 Vcc sky130_fd_pr__pfet_01v8 L=0.15 W=35 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

.ends

* expanding   symbol: /home/saumeek/simulation_library/and.sym
# of pins=5

** sym_path: /home/saumeek/simulation_library/and.sym

** sch_path: /home/saumeek/simulation_library/and.sch

.subckt and Vcc B A C VSS

*.opin C

*.iopin Vcc

*.iopin VSS

*.ipin A

*.ipin B

```
XM1 net1 A Vcc Vcc sky130_fd_pr__pfet_01v8 L=0.15 W=45 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
+ sa=0 sb=0 sd=0 mult=1 m=1
XM2 net1 B Vcc Vcc sky130_fd_pr__pfet_01v8 L=0.15 W=45 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
+ sa=0 sb=0 sd=0 mult=1 m=1
XM3 net1 A net2 VSS sky130_fd_pr__nfet_01v8 L=0.15 W=60 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
+ sa=0 sb=0 sd=0 mult=1 m=1
XM4 net2 B VSS VSS sky130_fd_pr__nfet_01v8 L=0.15 W=60 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
+ sa=0 sb=0 sd=0 mult=1 m=1
XM5 C net1 Vcc Vcc sky130_fd_pr__pfet_01v8 L=0.15 W=65 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
+ sa=0 sb=0 sd=0 mult=1 m=1
XM6 C net1 VSS VSS sky130_fd_pr__nfet_01v8 L=0.15 W=25 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
```

```
+ sa=0 sb=0 sd=0 mult=1 m=1
.ends



* expanding    symbol:  buf2.sym # of pins=4
** sym_path: /home/saumeek/xschem_test/buf2.sym
** sch_path: /home/saumeek/xschem_test/buf2.sch
.subckt buf2 Vss Vin Buf_out Vcc
*.iopin Vcc
*.iopin Vss
*.ipin Vin
*.opin Buf_out
x1 Vin net1 Vcc Vss inv2
x2 net1 Buf_out Vcc Vss inv22
.ends



* expanding    symbol:  buf1.sym # of pins=4
** sym_path: /home/saumeek/xschem_test/buf1.sym
** sch_path: /home/saumeek/xschem_test/buf1.sch
.subckt buf1 Vss Vin Buf_out Vcc
*.iopin Vcc
*.iopin Vss
*.ipin Vin
*.opin Buf_out
x1 Vin net1 Vcc Vss inv1
x2 net1 Buf_out Vcc Vss inv11
.ends
```

```
* expanding   symbol:  buf2_3v3.sym # of pins=4

** sym_path: /home/saumeek/xschem_test/buf2_3v3.sym

** sch_path: /home/saumeek/xschem_test/buf2_3v3.sch

.subckt buf2_3v3 Vss Vin Buf_out Vcc

*.iopin Vcc

*.iopin Vss

*.ipin Vin

*.opin Buf_out

x1 Vin net1 Vcc Vss inv2_3v3

x3 net1 Buf_out Vcc Vss inv22_3v3

.ends




* expanding   symbol:
/home/saumeek/simulation_library/inv111.sym # of pins=4

** sym_path: /home/saumeek/simulation_library/inv111.sym

** sch_path: /home/saumeek/simulation_library/inv111.sch

.subckt inv111 Vin Vout Vcc Vss

*.ipin Vin

*.opin Vout

*.iopin Vcc

*.iopin Vss

XM2 Vout Vin Vcc Vcc sky130_fd_pr__pfet_01v8 L=0.15 W=6 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1
```

```
XM1 Vout Vin Vss Vss sky130_fd_pr__nfet_01v8 L=0.15 W=3 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
+ sa=0 sb=0 sd=0 mult=1 m=1
.ends




* expanding   symbol:  /home/saumeek/simulation_library/inv2.sym
# of pins=4
** sym_path: /home/saumeek/simulation_library/inv2.sym
** sch_path: /home/saumeek/simulation_library/inv2.sch
.subckt inv2 Vin Vout Vcc Vss
*.ipin Vin
*.opin Vout
*.iopin Vcc
*.iopin Vss
XM1 Vout Vin Vss Vss sky130_fd_pr__nfet_01v8 L=0.17 W=2 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
+ sa=0 sb=0 sd=0 mult=1 m=1
XM2 Vout Vin Vcc Vcc sky130_fd_pr__pfet_01v8 L=0.17 W=16 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
+ sa=0 sb=0 sd=0 mult=1 m=1
.ends
```

* expanding   symbol:
/home/saumeek/simulation_library/inv22.sym # of pins=4

** sym_path: /home/saumeek/simulation_library/inv22.sym

** sch_path: /home/saumeek/simulation_library/inv22.sch

.subckt inv22 Vin Vout Vcc Vss

*.ipin Vin

*.opin Vout

*.iopin Vcc

*.iopin Vss

XM1 Vout Vin Vss Vss sky130_fd_pr__nfet_01v8 L=0.17 W=20 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

XM2 Vout Vin Vcc Vcc sky130_fd_pr__pfet_01v8 L=0.17 W=5 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

.ends

* expanding   symbol: /home/saumeek/simulation_library/inv1.sym
# of pins=4

** sym_path: /home/saumeek/simulation_library/inv1.sym

** sch_path: /home/saumeek/simulation_library/inv1.sch

.subckt inv1 Vin Vout Vcc Vss

*.ipin Vin

```
*.opin Vout

*.iopin Vcc

*.iopin Vss

XM1 Vout Vin Vss Vss sky130_fd_pr__nfet_01v8 L=0.17 W=1.7 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

XM2 Vout Vin Vcc Vcc sky130_fd_pr__pfet_01v8 L=0.17 W=3 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

.ends



* expanding   symbol:
/home/saumeek/simulation_library/inv11.sym # of pins=4

** sym_path: /home/saumeek/simulation_library/inv11.sym

** sch_path: /home/saumeek/simulation_library/inv11.sch

.subckt inv11 Vin Vout Vcc Vss

*.ipin Vin

*.opin Vout

*.iopin Vcc

*.iopin Vss

XM1 Vout Vin Vss Vss sky130_fd_pr__nfet_01v8 L=0.17 W=3 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
```

```
+ sa=0 sb=0 sd=0 mult=1 m=1

XM2 Vout Vin Vcc Vcc sky130_fd_pr__pfet_01v8 L=0.17 W=6.5 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

.ends




* expanding   symbol:
/home/saumeek/simulation_library/inv2_3v3.sym # of pins=4

** sym_path: /home/saumeek/simulation_library/inv2_3v3.sym

** sch_path: /home/saumeek/simulation_library/inv2_3v3.sch

.subckt inv2_3v3 Vin Vout Vcc Vss

*.ipin Vin

*.opin Vout

*.iopin Vcc

*.iopin Vss

XM3 Vout Vin Vss Vss sky130_fd_pr__nfet_g5v0d10v5 L=0.5 W=15
nf=4 ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

XM1 Vout Vin Vcc Vcc sky130_fd_pr__pfet_g5v0d10v5 L=0.5 W=3 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'

+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'

+ sa=0 sb=0 sd=0 mult=1 m=1

.ends
```

```
* expanding   symbol:
/home/saumeek/simulation_library/inv22_3v3.sym # of pins=4

** sym_path: /home/saumeek/simulation_library/inv22_3v3.sym

** sch_path: /home/saumeek/simulation_library/inv22_3v3.sch

.subckt inv22_3v3 Vin Vout Vcc Vss

*.ipin Vin

*.opin Vout

*.iopin Vcc

*.iopin Vss

XM3 Vout Vin Vcc Vcc sky130_fd_pr__pfet_g5v0d10v5 L=0.5 W=20
nf=5 ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
+ sa=0 sb=0 sd=0 mult=1 m=1
XM4 Vout Vin Vss Vss sky130_fd_pr__nfet_g5v0d10v5 L=0.5 W=5 nf=1
ad='int((nf+1)/2) * W/nf * 0.29' as='int((nf+2)/2) * W/nf *
0.29'
+ pd='2*int((nf+1)/2) * (W/nf + 0.29)' ps='2*int((nf+2)/2) *
(W/nf + 0.29)' nrd='0.29 / W' nrs='0.29 / W'
+ sa=0 sb=0 sd=0 mult=1 m=1
.ends


.end
```