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

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Revision 0.0

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LVDS Output Driver Netlist

```
** sch_path:
/home/saumeek/xschem_test/OutputDriverOffice_5v_sym.sch

**.subckt OutputDriverOffice_5v_sym Vinp Vinn Vop Von

*.ipin Vinp

*.ipin Vinn

*.opin Vop

*.opin Von

x2 Vss newVss

R1 Vcm Voutp 1.5k m=1

R2 Voutn Vcm 1.5k m=1

V3 Vref Vss 3

.save i(v3)

I0_bgr_ref net9 net10 500u

R4 net7 Voutp 10 m=1

R5 net5 Voutn 10 m=1

C1 net6 Vss 3p m=1

R6 Von net6 10 m=1

C2 Von Vss 3p m=1

C3 net8 Vcc 3p m=1

R7 Vop net8 10 m=1

C4 Vop Vss 3p m=1

R9 BGR net10 1k m=1

V4_bgr_ref net9 Vss 3.3

.save i(v4_bgr_ref)

R8 Von Vop 100 m=1

C5 C Vss 1p m=1

C6 net11 Vss 1p m=1

L1 net6 net5 4n m=1
```

```
L2 net8 net7 4n m=1

R11 Vcm net11 100 m=1

C7 Vcc Vss 500p m=1

V1 Vinp1 Vss pulse(0 1.8 0ns 0.1ns 0.1ns 0.4ns 1ns)

.save i(v1)

V2 Vinn1 Vss pulse(1.8 0 0ns 0.1ns 0.1ns 0.4ns 1ns)

.save i(v2)

XM27 net12 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 Voutp pu net12 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 Voutn 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'
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```
+ 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
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```
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 Vcc 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 Vcc Vcc 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 Vcc Vcc 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'
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+ sa=0 sb=0 sd=0 mult=1 m=1

XM17 E E Vcc Vcc 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 Vcc Vcc 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 Vcc Vcc 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 Vcc Vcc 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 Voutp Vinn A Vcc 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 Voutn Vinp A Vcc 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'
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+ 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 Vinn Voutn Vcc 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 Vinp Voutp Vcc 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 Vcc Vcc 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 Vcc Vcc 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 Voutp pu net2 Vcc 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 Voutn pd net13 Vcc 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 net13 D Vcc Vcc 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

x5 pd pu Vinp1 Vinn1 dnl dpl LevelShifter_5v

x3 Vcc newVcc_5

x1 Vinn Vinp_5

x4 Vinp Vinn1_5

**.ends


* expanding   symbol:
/home/saumeek/simulation_library/newVss.sym # of pins=1

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

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

.subckt newVss VSS

*.iopin VSS

R2 net1 GND 5 m=1

L1 VSS net1 2n m=1

C1 VSS GND 20p m=1

.ends


* expanding   symbol:  LevelShifter_5v.sym # of pins=6

** sym_path: /home/saumeek/xschem_test/LevelShifter_5v.sym
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```
** sch_path: /home/saumeek/xschem_test/LevelShifter_5v.sch

.subckt LevelShifter_5v Dn_H Dp_H vinp vinn Dn_L Dp_L

*.opin Dp_H

*.opin Dn_H

*.ipin vinp

*.ipin vinn

*.opin Dp_L

*.opin Dn_L

x1 VSS newVss

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'

+ 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 vinp PreEmphasisDriver_1v8_3v3

x3 Dn_L vinn PreEmphasisDriver_1v8_3v3
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```
x4 VCC5 newVcc_5
.ends


* expanding   symbol:
/home/saumeek/simulation_library/newVcc_5.sym # of pins=1
** sym_path: /home/saumeek/simulation_library/newVcc_5.sym
** sch_path: /home/saumeek/simulation_library/newVcc_5.sch
.subckt newVcc_5 Vcc
*.iopin Vcc
V1 net1 GND 4.5
.save i(v1)
R1 net2 net1 0.1 m=1
L1 Vcc net2 2n m=1
C1 Vcc GND 20p m=1
.ends


* expanding   symbol:  Vinp_5.sym # of pins=1
** sym_path: /home/saumeek/xschem_test/Vinp_5.sym
** sch_path: /home/saumeek/xschem_test/Vinp_5.sch
.subckt Vinp_5 Vinp
*.opin Vinp
x4 VSS newVss
V1 net2 VSS pulse(0 5.5 0ns 0.1ns 0.1ns 0.4ns 1ns)
.save i(v1)
x9 net2 net1 Vcc VSS inv_0_5_3v3
x1 net5 net3 Vcc VSS inv_0_5_3v3
x5 net6 net4 Vcc VSS inv_0_5_3v3
```

```
x7 net1 net5 Vcc VSS inv_1_5_3v3
x2 net3 net6 Vcc VSS inv_1_5_3v3
x6 net4 Vinp Vcc VSS inv_0_5_3v3
x3 Vcc newVcc_5
.ends


* expanding   symbol:  Vinn1_5.sym # of pins=1
** sym_path: /home/saumeek/xschem_test/Vinn1_5.sym
** sch_path: /home/saumeek/xschem_test/Vinn1_5.sch
.subckt Vinn1_5 Vinn
*.opin Vinn
x4 VSS newVss
V1 net3 VSS pulse(5.5 0 0ns 0.1ns 0.1ns 0.4ns 1ns)
.save i(v1)
x3 net2 net4 Vcc VSS inv_0_5_3v3
x1 net3 net1 Vcc VSS inv_0_5_3v3
x5 net6 net5 Vcc VSS inv_0_5_3v3
x8 net1 net2 Vcc VSS inv_1_5_3v3
x2 net4 net6 Vcc VSS inv_1_5_3v3
x6 Vcc newVcc_5
x7 net5 Vinn Vcc VSS inv_0_5_3v3
.ends


* expanding   symbol:  PreEmphasisDriver_1v8_3v3.sym # of pins=2
** sym_path:
/home/saumeek/xschem_test/PreEmphasisDriver_1v8_3v3.sym
```

```
** sch_path:
/home/saumeek/xschem_test/PreEmphasisDriver_1v8_3v3.sch

.subckt PreEmphasisDriver_1v8_3v3 dn DpH

*.ipin DpH

*.opin dn

x1 VSS DpH xor_out Buf_out Vcc xor

x5 VSS newVss

x4 Vcc newVcc

x10 Vcc DpH xor_out net2 VSS and

x2 VSS net1 Buf_out Vcc buf2

x3 VSS DpH net1 Vcc buf1

x6 net3 net2 dn VCC5 buf2_3v3

x8 net3 newVss

x7 VCC5 newVcc_5

.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/newVcc.sym # of pins=1

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

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

.subckt newVcc Vcc

*.iopin Vcc

V1 net1 GND 1.8

.save i(v1)

R1 net2 net1 5 m=1

L1 Vcc net2 2n m=1

C1 Vcc GND 20p 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


.GLOBAL GND

.end
```