

i)s1

```
.MODEL MOSN NMOS LEVEL=2 LD=0.15U TOX=200.0E-10
+ NSUB=5.36726E+15 VTO=0.743469 KP=8.00059E-05 GAMMA=0.543
+ PHI=0.6 U0=655.881 UEXP=0.157282 UCRIT=31443.8
+ DELTA=2.39824 VMAX=55260.9 XJ=0.25U LAMBDA=0.0367072
+ NFS=1E+12 NEFF=1.001 NSS=1E+11 TPG=1.0 RSH=70.00
+ CGDO=4.3E-10 CGSO=4.3E-10 CJ=0.0003 MJ=0.6585
+ CJSW=8.0E-10 MJSW=0.2402 PB=0.58
```

```
.MODEL MOSP PMOS LEVEL=2 LD=0.15U TOX=200.0E-10
+ NSUB=4.3318E+15 VTO=-0.738861 KP=2.70E-05 GAMMA=0.58
+ PHI=0.6 U0=261.977 UEXP=0.323932 UCRIT=65719.8
+ DELTA=1.79192 VMAX=25694 XJ=0.25U LAMBDA=0.0612279
+ NFS=1E+12 NEFF=1.001 NSS=1E+11 TPG=-1.0 RSH=120.6
+ CGDO=4.3E-10 CGSO=4.3E-10 CJ=0.0005 MJ=0.5052
+ CJSW=1.349E-10 MJSW=0.2417 PB=0.64
```

\* D G S B

```
M1 3 2 1 1 MOSP W=3.6u L=1.2u
M2 2 4 5 5 MOSP W=3.6u L=1.2u
M3 4 2 5 5 MOSP W=3.6u L=1.2u
```

```
M4 3 2 0 0 MOSN W=1.8u L=1.2u
M5 3 4 5 5 MOSN W=1.8u L=1.2u
M6 5 3 4 4 MOSN W=1.8u L=1.2u
```

```
vdd 1 0 5V
v2 2 0 0v
v4 4 0 0v
```

```
*Vin1 2 0 pulse(0V 5V 0 0ns 0ns 100ns 200ns)
*Vin2 4 0 pulse(0V 5V 0 0ns 0ns 200ns 400ns)
```

```
.control
tran 0.05n 500n
plot v(2) v(4) v(5)
```

```
.endc
.end
```

ii)s1

```
.MODEL MOSN NMOS LEVEL=2 LD=0.15U TOX=200.0E-10
+ NSUB=5.36726E+15 VTO=0.743469 KP=8.00059E-05 GAMMA=0.543
+ PHI=0.6 U0=655.881 UEXP=0.157282 UCRIT=31443.8
+ DELTA=2.39824 VMAX=55260.9 XJ=0.25U LAMBDA=0.0367072
+ NFS=1E+12 NEFF=1.001 NSS=1E+11 TPG=1.0 RSH=70.00
+ CGDO=4.3E-10 CGSO=4.3E-10 CJ=0.0003 MJ=0.6585
+ CJSW=8.0E-10 MJSW=0.2402 PB=0.58
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.MODEL MOSP PMOS LEVEL=2 LD=0.15U TOX=200.0E-10
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+ PHI=0.6 U0=261.977 UEXP=0.323932 UCRIT=65719.8
+ DELTA=1.79192 VMAX=25694 XJ=0.25U LAMBDA=0.0612279
+ NFS=1E+12 NEFF=1.001 NSS=1E+11 TPG=-1.0 RSH=120.6
+ CGDO=4.3E-10 CGSO=4.3E-10 CJ=0.0005 MJ=0.5052
+ CJSW=1.349E-10 MJSW=0.2417 PB=0.64
```

```
* D G S B
```

```
M1 3 2 1 1 MOSP W=3.6u L=1.2u
M2 2 4 5 5 MOSP W=3.6u L=1.2u
M3 5 2 4 4 MOSP W=3.6u L=1.2u
```

```
M4 3 2 0 0 MOSN W=1.8u L=1.2u
M5 3 4 5 5 MOSN W=1.8u L=1.2u
M6 4 3 5 5 MOSN W=1.8u L=1.2u
```

```
vdd 1 0 5V
v2 2 0 0v
v4 4 0 5v
```

```
*Vin1 2 0 pulse(0V 5V 0 0ns 0ns 100ns 200ns)
*Vin2 4 0 pulse(0V 5V 0 0ns 0ns 200ns 400ns)
```

```
.control
tran 0.05n 500n
plot v(2) v(4) v(5)+0.1
```

```
.endc
.end
```

```
iii)s1
```

```
.MODEL MOSN NMOS LEVEL=2 LD=0.15U TOX=200.0E-10
+ NSUB=5.36726E+15 VTO=0.743469 KP=8.00059E-05 GAMMA=0.543
+ PHI=0.6 U0=655.881 UEXP=0.157282 UCRIT=31443.8
+ DELTA=2.39824 VMAX=55260.9 XJ=0.25U LAMBDA=0.0367072
+ NFS=1E+12 NEFF=1.001 NSS=1E+11 TPG=1.0 RSH=70.00
+ CGDO=4.3E-10 CGSO=4.3E-10 CJ=0.0003 MJ=0.6585
+ CJSW=8.0E-10 MJSW=0.2402 PB=0.58
```

```
.MODEL MOSP PMOS LEVEL=2 LD=0.15U TOX=200.0E-10
+ NSUB=4.3318E+15 VTO=-0.738861 KP=2.70E-05 GAMMA=0.58
+ PHI=0.6 U0=261.977 UEXP=0.323932 UCRIT=65719.8
+ DELTA=1.79192 VMAX=25694 XJ=0.25U LAMBDA=0.0612279
+ NFS=1E+12 NEFF=1.001 NSS=1E+11 TPG=-1.0 RSH=120.6
+ CGDO=4.3E-10 CGSO=4.3E-10 CJ=0.0005 MJ=0.5052
+ CJSW=1.349E-10 MJSW=0.2417 PB=0.64
```

\* D G S B

M1 3 2 1 1 MOSP W=3.6u L=1.2u  
M2 2 4 5 5 MOSP W=3.6u L=1.2u  
M3 4 2 5 5 MOSP W=3.6u L=1.2u

M4 3 2 0 0 MOSN W=1.8u L=1.2u  
M5 5 4 3 3 MOSN W=1.8u L=1.2u  
M6 5 3 4 4 MOSN W=1.8u L=1.2u

vdd 1 0 5V  
v2 2 0 5v  
v4 4 0 0v

\*Vin1 2 0 pulse(0V 5V 0 0ns 0ns 100ns 200ns)  
\*Vin2 4 0 pulse(0V 5V 0 0ns 0ns 200ns 400ns)

.control  
tran 0.05n 500n  
plot v(2) v(4) v(5)+0.1

.endc  
.end

iv)s1

.MODEL MOSN NMOS LEVEL=2 LD=0.15U TOX=200.0E-10  
+ NSUB=5.36726E+15 VTO=0.743469 KP=8.00059E-05 GAMMA=0.543  
+ PHI=0.6 U0=655.881 UEXP=0.157282 UCRIT=31443.8  
+ DELTA=2.39824 VMAX=55260.9 XJ=0.25U LAMBDA=0.0367072  
+ NFS=1E+12 NEFF=1.001 NSS=1E+11 TPG=1.0 RSH=70.00  
+ CGDO=4.3E-10 CGSO=4.3E-10 CJ=0.0003 MJ=0.6585  
+ CJSW=8.0E-10 MJSW=0.2402 PB=0.58

.MODEL MOSP PMOS LEVEL=2 LD=0.15U TOX=200.0E-10  
+ NSUB=4.3318E+15 VTO=-0.738861 KP=2.70E-05 GAMMA=0.58  
+ PHI=0.6 U0=261.977 UEXP=0.323932 UCRIT=65719.8  
+ DELTA=1.79192 VMAX=25694 XJ=0.25U LAMBDA=0.0612279  
+ NFS=1E+12 NEFF=1.001 NSS=1E+11 TPG=-1.0 RSH=120.6  
+ CGDO=4.3E-10 CGSO=4.3E-10 CJ=0.0005 MJ=0.5052  
+ CJSW=1.349E-10 MJSW=0.2417 PB=0.64

\* D G S B

M1 3 2 1 1 MOSP W=3.6u L=1.2u  
M2 5 4 2 2 MOSP W=3.6u L=1.2u  
M3 5 2 4 4 MOSP W=3.6u L=1.2u

M4 3 2 0 0 MOSN W=1.8u L=1.2u

M5 3 4 5 5 MOSN W=1.8u L=1.2u

M6 4 3 5 5 MOSN W=1.8u L=1.2u

vdd 1 0 5V

v2 2 0 5v

v4 4 0 5v

\*Vin1 2 0 pulse(0V 5V 0 0ns 0ns 100ns 200ns)

\*Vin2 4 0 pulse(0V 5V 0 0ns 0ns 200ns 400ns)

.control

tran 0.05n 500n

plot v(2)+0.1 v(4)

plot v(5)

.endc

.end