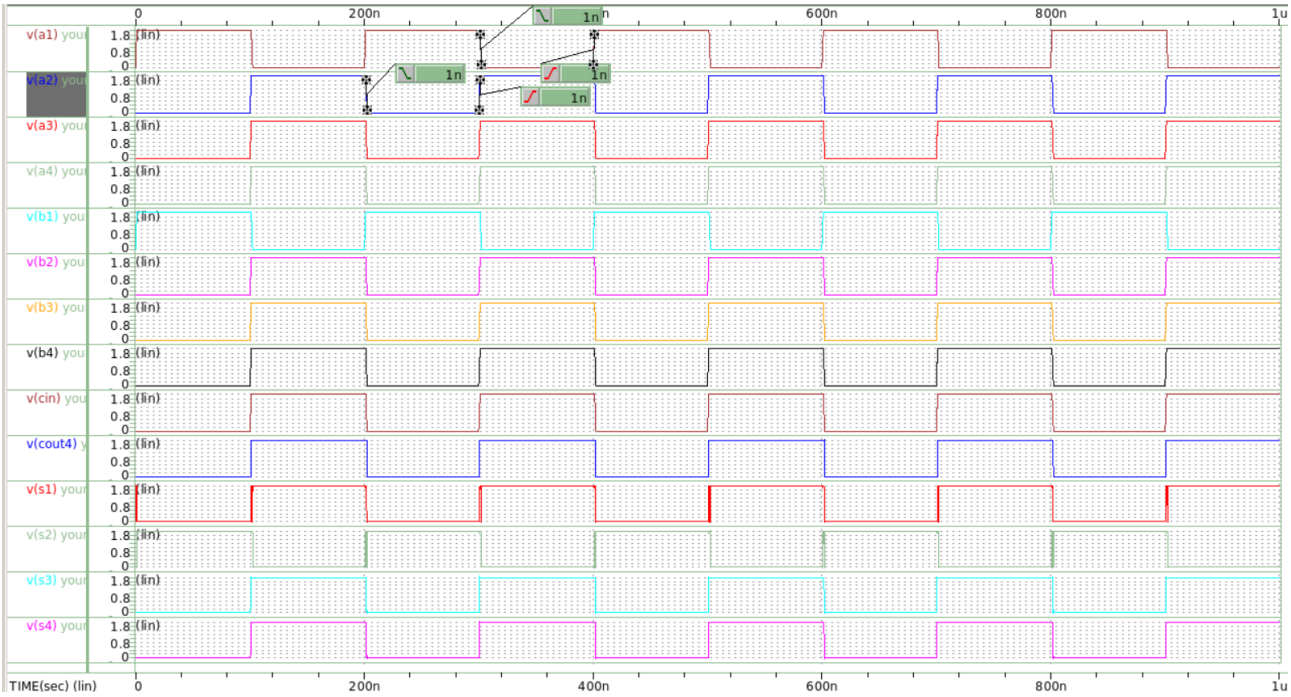
1.

```
*full_adder spice
.lib 'cic018.l' tt
*********full_adder**************
.subckt full_adder A B CIN     COUT S vdd gnd

MPM1 N1 A vdd vdd P_18 l=0.18u w=0.75u m=1
MPM2 N1 B vdd vdd P_18 l=0.18u w=0.75u m=1
MPM3 C0 CIN N1 vdd P_18 l=0.18u w=0.75u m=1
MPM4 N2 A vdd vdd P_18 l=0.18u w=0.75u m=1
MPM5 C0 B N2 vdd P_18 l=0.18u w=0.75u m=1
MPM6 N3 A vdd vdd P_18 l=0.18u w=0.75u m=1
MPM7 S0 C0 N3 vdd P_18 l=0.18u w=0.75u m=1
MPM8 N3 B vdd vdd P_18 l=0.18u w=0.75u m=1
MPM9 N3 CIN vdd vdd P_18 l=0.18u w=0.75u m=1
MPM10 N4 A vdd vdd P_18 l=0.18u w=0.75u m=1
MPM11 N5 B N4 vdd P_18 l=0.18u w=0.75u m=1
MPM12 S0 CIN N5 vdd P_18 l=0.18u w=0.75u m=1

MNM1 N6 A gnd gnd N_18 l=0.18u w=0.25u m=1
MNM2 N6 B gnd gnd N_18 l=0.18u w=0.25u m=1
MNM3 C0 CIN N6 gnd N_18 l=0.18u w=0.25u m=1
MNM4 N7 A gnd gnd N_18 l=0.18u w=0.25u m=1
MNM5 C0 B N7 gnd N_18 l=0.18u w=0.25u m=1
MNM6 S0 C0 N8 gnd N_18 l=0.18u w=0.25u m=1
MNM7 N8 A gnd gnd N_18 l=0.18u w=0.25u m=1
MNM8 N8 B gnd gnd N_18 l=0.18u w=0.25u m=1
MNM9 N8 CIN gnd gnd N_18 l=0.18u w=0.25u m=1
MNM10 N9 A gnd gnd N_18 l=0.18u w=0.25u m=1
MNM11 N10 B N9 gnd N_18 l=0.18u w=0.25u m=1
MNM12 S0 CIN N10 gnd N_18 l=0.18u w=0.25u m=1

********INVERTER1******************
MM1 COUT C0 gnd     gnd N_18 l=0.18u w = 0.25u m=1
MM2 COUT     C0 vdd     vdd P_18 l=0.18u w=0.75u m=1
*********INVERTER2************************************
MM3 S     S0 gnd     gnd N_18 l=0.18u w = 0.25u m=1
MM4 S     S0 vdd     vdd P_18 l=0.18u w=0.75u m=1
.ends
```

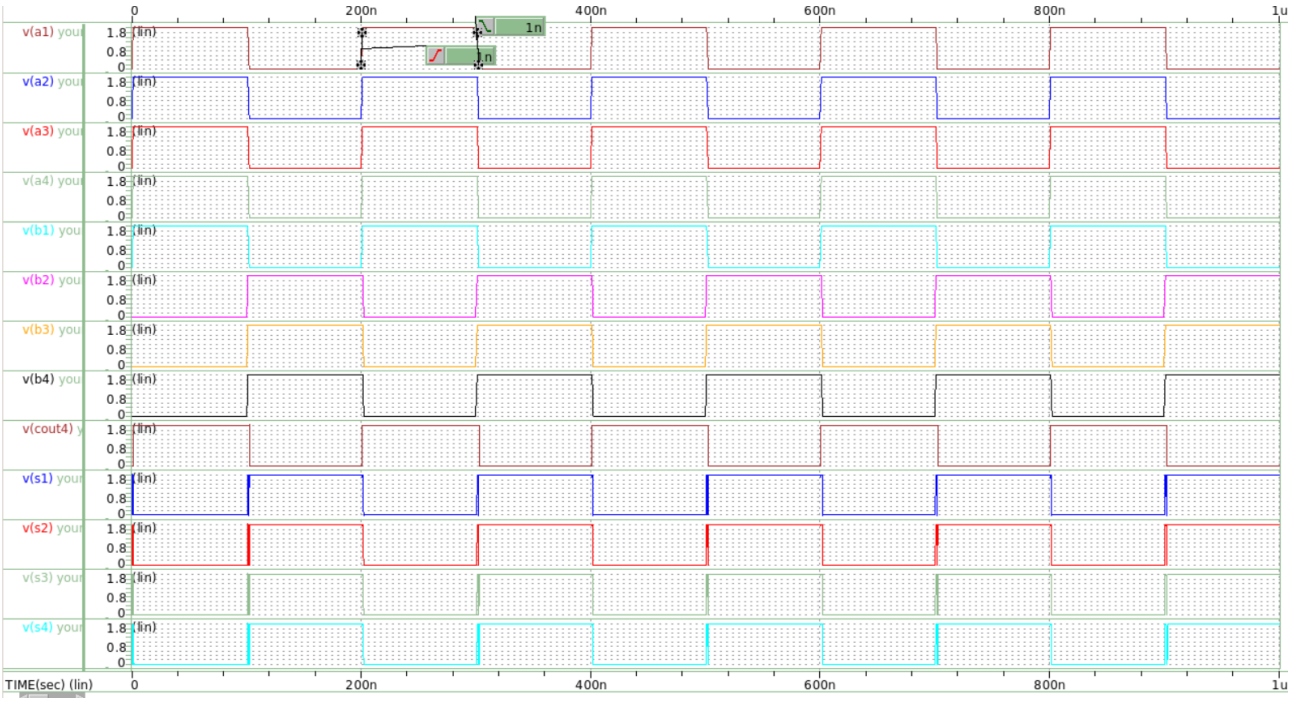
```
**********SUBckts**********************************

XFA1 A1 B1 CIN COUT1 S1 vdd gnd full_adder
XFA2 A2 B2 COUT1 COUT2 S2 vdd gnd full_adder
XFA3 A3 B3 COUT2 COUT3 S3 vdd gnd full_adder
XFA4 A4 B4 COUT3 COUT4 S4 vdd gnd full_adder
********************Independent source*******************************

Vdd vdd 0 dc 1.8
Vgnd gnd 0 dc 0
VCIN CIN 0 pulse (0 1.8 100n 1.25n 1.25n 100n 200n)
VA1 A1 0    pulse(0 1.8 0 1.25n 1.25n 100n 200n)
VB1 B1 0    pulse(0 1.8 0 1.25n 1.25n 100n 200n)
VA2 A2 0    pulse(0 1.8 100n 1.25n 1.25n 100n 200n)
VB2 B2 0    pulse(0 1.8 100n 1.25n 1.25n 100n 200n)
VA3 A3 0    pulse(0 1.8 100n 1.25n 1.25n 100n 200n)
VB3 B3 0    pulse(0 1.8 100n 1.25n 1.25n 100n 200n)
VA4 A4 0    pulse(0 1.8 100n 1.25n 1.25n 100n 200n)
VB4 B4 0    pulse(0 1.8 100n 1.25n 1.25n 100n 200n)
***********************************************
.op
.option post

.tran 1n 1u
.probe I(XFA1.MPM1) I(XFA2.MPM1) I(XFA3.MPM1) I(XFA4.MPM1) I(XFA1.MPM2) I(XFA2.MPM2)
I(XFA3.MPM2) I(XFA4.MPM2) I(XFA1.MPM3) I(XFA1.MM3) I(XFA2.MM3) I(XFA3.MM3)
I(XFA4.MM3) I(XFA4.MM1)
*A1 A2 A3 A4 B1 B2 B3 B4 CIN S1 S2 S3 S4 COUT


.end
```

2.

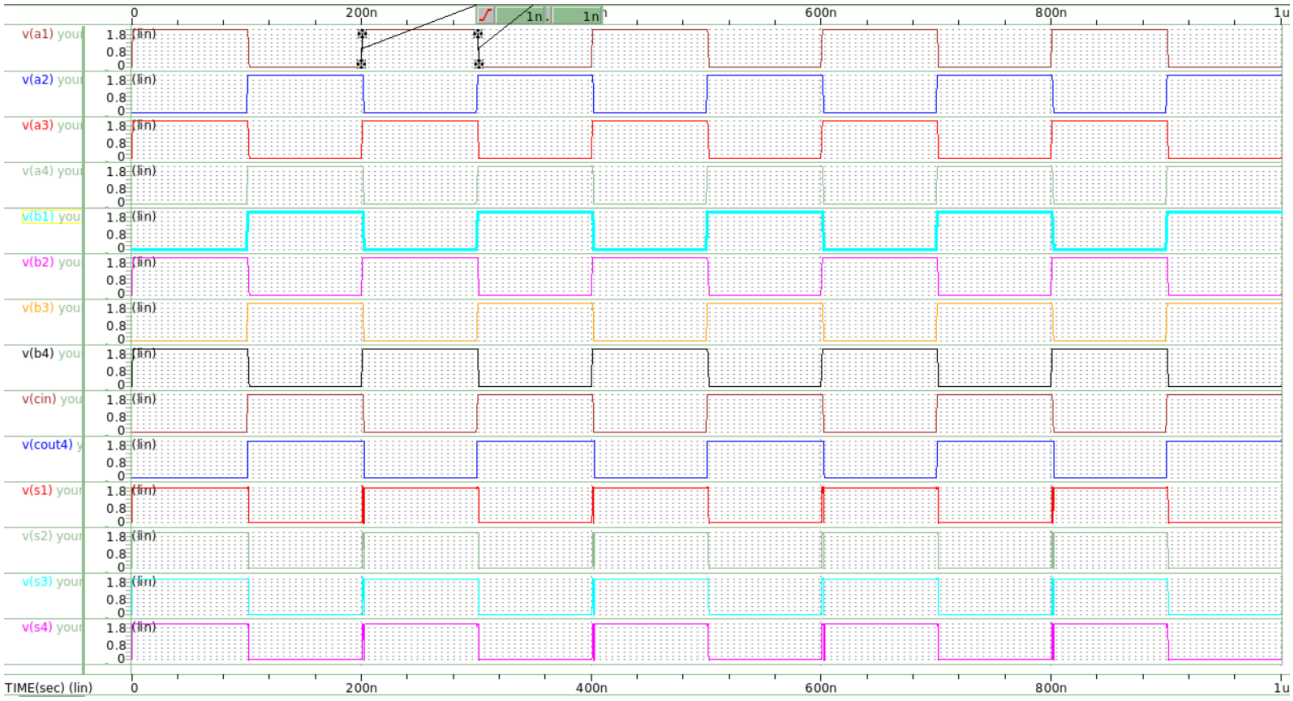
(1)


0
200n
400n
600n
800n
1u
v(a1)
v(a2)
v(a3)
v(a4)
v(b1)
v(b2)
v(b3)
v(b4)
v(cin)
v(cout4)
v(s1)
v(s2)
v(s3)
v(s4)
1.8 (lin)
0.8
0
1n
TIME(sec) (lin)

(2)


0
200n
400n
600n
800n
1u
v(a1)
v(a2)
v(a3)
v(a4)
v(b1)
v(b2)
v(b3)
v(b4)
v(cout4)
v(s1)
v(s2)
v(s3)
v(s4)
1.8 (lin)
0.8
0
1n
TIME(sec) (lin)

(3)



3.

（a）484p

（b）885p


v(a1) yout
(lin)
v(cout4) y
(lin)
Delay:885p
TIME(sec) (lin)
0
5n
10n
15n
20n
25n
30n

（c）143p


v(a1) yout
(lin)
v(s4) yout
(lin)
Delay:143p
TIME(sec) (lin)
0
10n
20n
30n
40n
50n
60n
70n