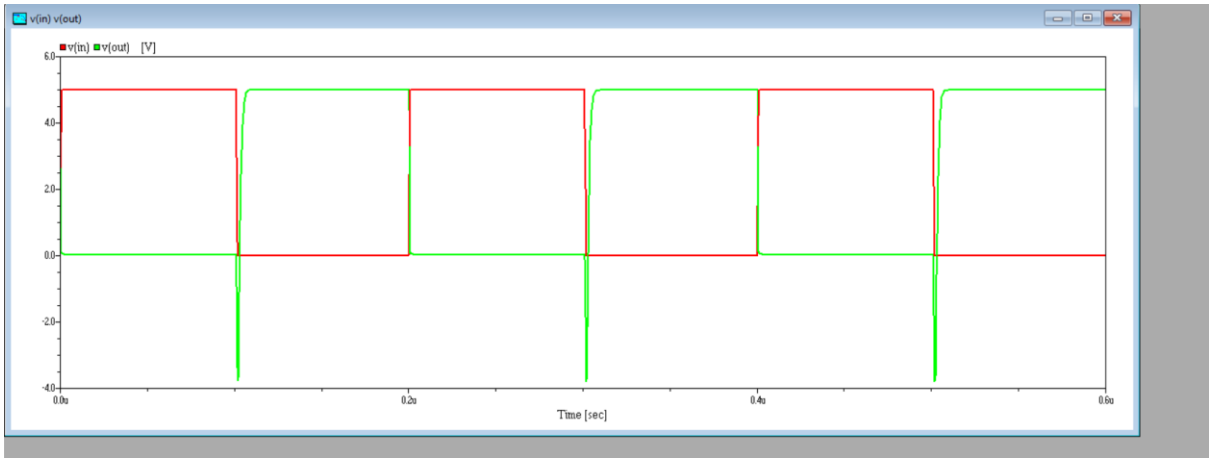
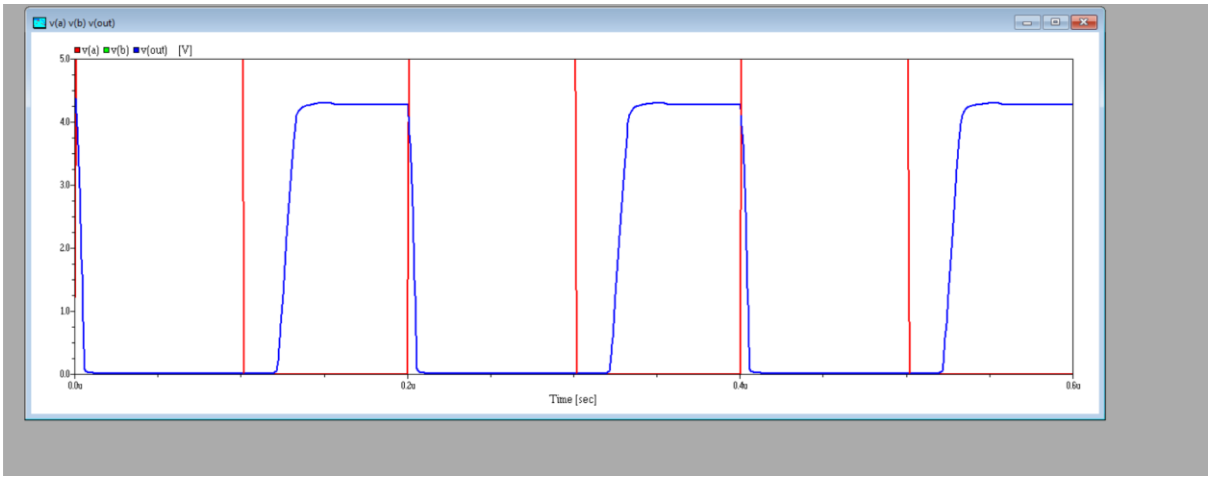
C:\lab5.cir

```
inverter with bipolar transistor
!TR analysis 1e-9 step size and 6e-7 final
Vin in 0 DC 0 PULSE( 0 5 0 1E-9 1E-9 1E-7 2E-7)
Vec cc 0 DC 5
R1 in b 1k
Rc cc out 1k
Q1 out b 0 Tranz
.MODEL Tranz NPN TR=5E-9 TF=8E-9
Veb eb 0 DC -1
Rb b eb 7k
C1 in b 100p !speed-up capacitor 15p and 70p
Cout out 0 1p !filter component
```



C:\TTL.cir

```
comment
Q1A 2 1 a tr
Q1B 2 1 b tr
Q3 5 3 6 tr
Q2 3 2 4 tr
Q4 out 4 0 tr
D1 0 b di
D2 0 a di
D3 6 out di
R1 cc 1 4k
R2 cc 3 1.6k
R4 cc 5 130
R3 4 0 1k
.model tr npn tr=5e-9 tf=8e-9
.model di d tt=5e-9
va a 0 dc 0 pulse(0 5 0 1e-9 1e-9 1e-7 2e-7)
vb b 0 dc 5
vcc cc 0 dc 5
cp out 0 5p
```


v(a) v(b) v(out)
v(a) v(b) v(out) [V]
5.0
4.0
3.0
2.0
1.0
0.0
0.0u
0.2u
0.4u
0.6u
Time [sec]