LABOE-18.3.2020.


```
.model MOSN08 NMOS vto=0.7 kp=110u lambda=0.04
.model MOSP08 PMOS vto=-0.7 kp=50u lambda=0.05
```
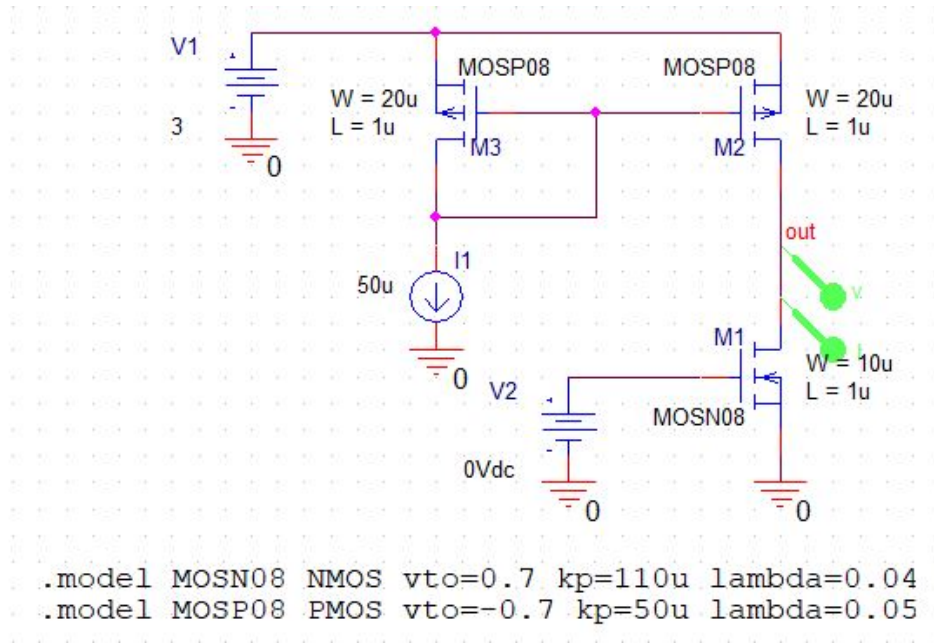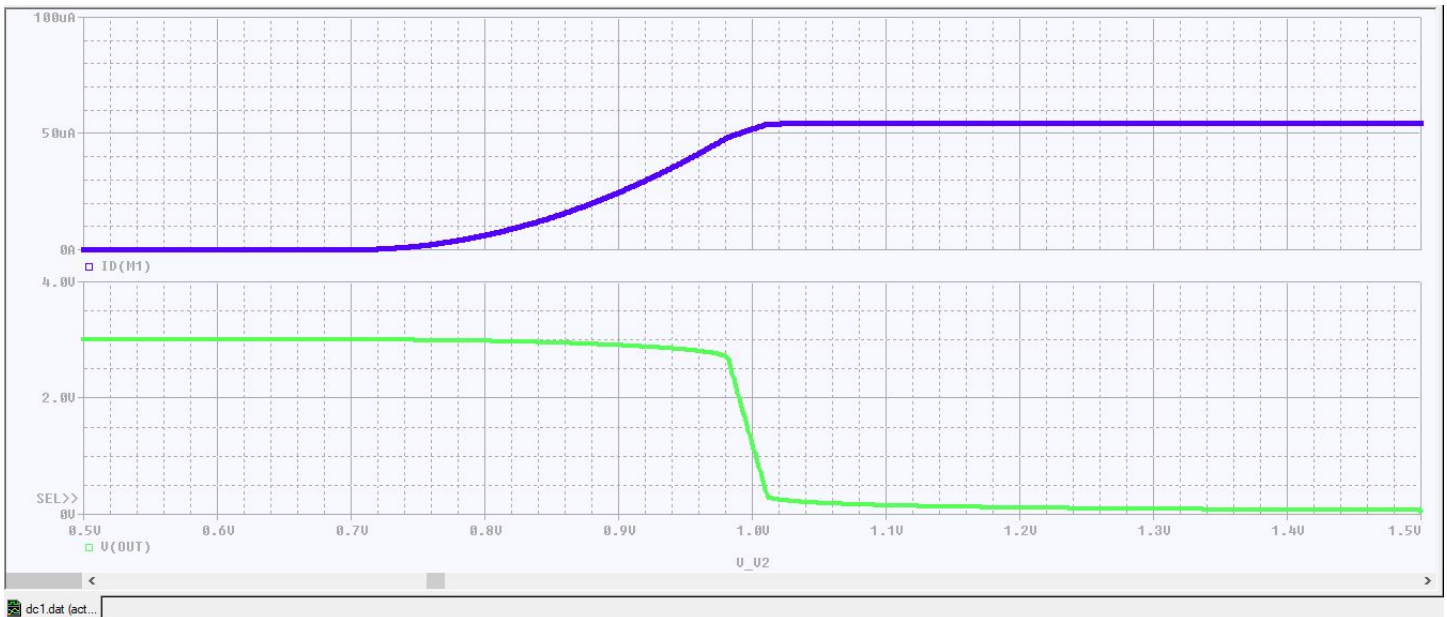
DC Sweep
V2 0.5V 1.5V 1m

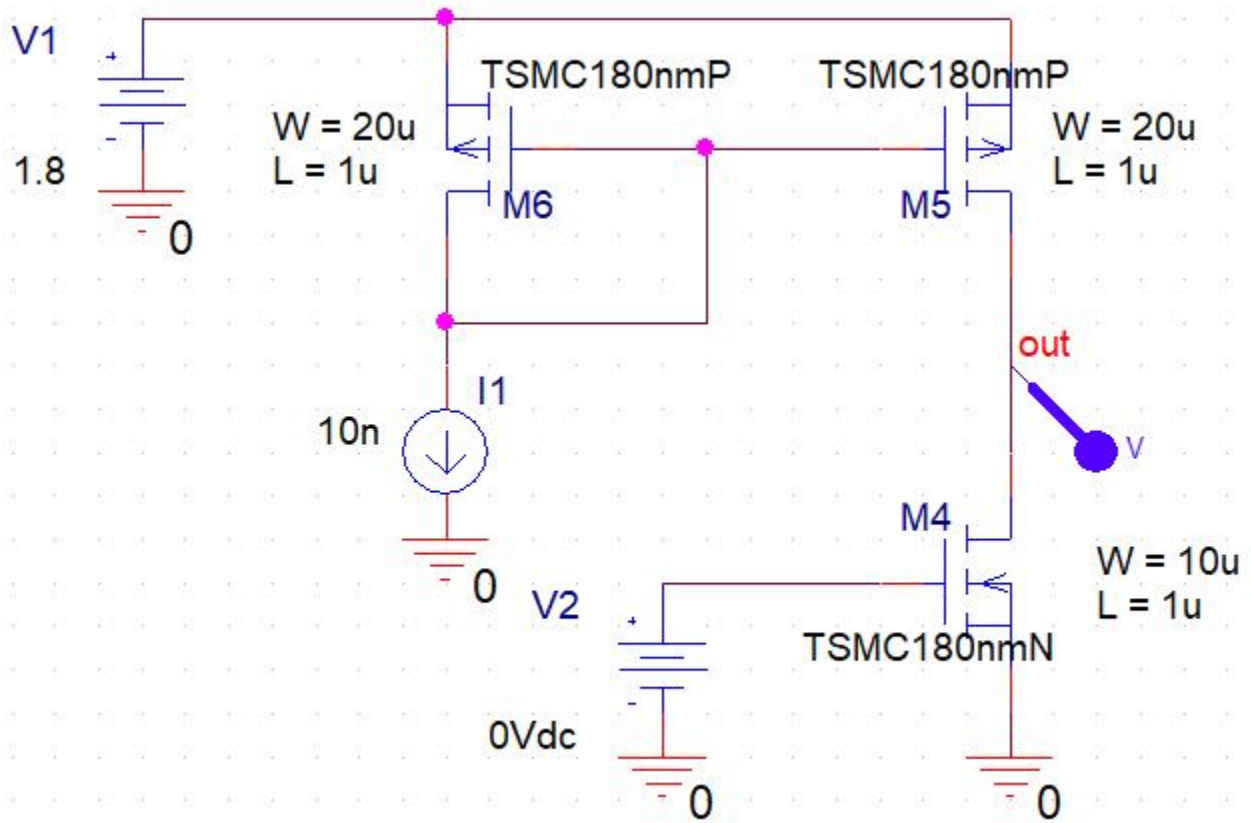Trace
Add Trace
Izvod funkcije V(out) u funkciji ulaznog napona=naponsko pojačanje, dV(out)/dV2: D(V(out))

CMOS pojačavač sa tranzistorima u TSMC 180nm tehnologiji:

Modele tranzistora iskopirati sa site-a predmeta, http://tnt.etf.bg.ac.rs/~laboe/index_files/2015/tsmc180nmcmos.lib

```
.MODEL TSMC180nmN NMOS (                                    LEVEL   = 7
+VERSION = 3.1          TNOM     = 27           TOX      = 4.1E-9
+XJ       = 1E-7        NCH      = 2.3549E17    VTH0     = 0.354505
+K1       = 0.5733393   K2       = 3.177172E-3  K3       = 27.3563303
+K3B      = -10         W0       = 2.341477E-5  NLX      = 1.906617E-7
+DVT0W    = 0           DVT1W    = 0            DVT2W    = 0
+DVT0     = 1.6751718   DVT1     = 0.4282625    DVT2     = 0.036004
+U0       = 327.3736992 UA       = -4.52726E-11 UB       = 4.46532E-19
+UC       = -4.74051E-11 VSAT    = 8.785346E4   A0       = 1.6897405
+AGS      = 0.2908676   B0       = -8.224961E-9 B1       = -1E-7
+KETA     = 0.021238    A1       = 8.00349E-4   A2       = 1
+RDSW     = 105         PRWG     = 0.5          PRWB     = -0.2
+WR       = 1           WINT     = 0            LINT     = 1.351737E-8
*+XL      = -2E-8        XW       = -1E-8
+ DWG     = 1.610448E-9
+DWB      = -5.108595E-9 VOFF    = -0.0652968   NFACTOR = 2.4901845
+CIT      = 0           CDSC     = 2.4E-4       CDSCD    = 0
+CDSCB    = 0           ETA0     = 0.0231564    ETAB     = -0.058499
+DSUB     = 0.9467118   PCLM     = 0.8512348    PDIBLC1 = 0.0929526
+PDIBLC2 = 0.01         PDIBLCB  = -0.1         DROUT    = 0.5224026
+PSCBE1   = 7.979323E10 PSCBE2   = 1.522921E-9  PVAG     = 0.01
+DELTA    = 0.01        RSH      = 6.8          MOBMOD   = 1
+PRT      = 0           UTE      = -1.5         KT1      = -0.11
+KT1L     = 0           KT2      = 0.022        UA1      = 4.31E-9
+UB1      = -7.61E-18   UC1      = -5.6E-11     AT       = 3.3E4
+WL       = 0           WLN      = 1            WW       = 0
+WWN      = 1           WWL      = 0            LL       = 0
+LLN      = 1           LW       = 0            LWN      = 1
+LWL      = 0           CAPMOD   = 2            XPART    = 0.5
+CGDO     = 7.7E-10     CGSO     = 7.7E-10      CGBO     = 1E-12
+CJ       = 1.010083E-3 PB       = 0.7344298    MJ       = 0.3565066
+CJSW     = 2.441707E-10 PBSW    = 0.8005503    MJSW     = 0.1327842
+CJSWG    = 3.3E-10     PBSWG    = 0.8005503    MJSWG    = 0.1327842
+CF       = 0           PVTH0    = 1.307195E-3  PRDSW    = -5
+PK2      = -1.022757E-3 WKETA   = -4.466285E-4 LKETA    = -9.715157E-3
+PU0      = 12.2704847  PUA      = 4.421816E-11 PUB      = 0
+PVSAT    = 1.707461E3  PETA0    = 1E-4         PKETA    = 2.348777E-3    )
*
```

```
.MODEL TSMC180nmP PMOS (                                          LEVEL   = 7
+VERSION = 3.1              TNOM     = 27           TOX      = 4.1E-9
+XJ       = 1E-7            NCH      = 4.1589E17    VTHO     = -0.4120614
+K1       = 0.5590154       K2       = 0.0353896    K3       = 0
+K3B      = 7.3774572       W0       = 1E-6         NLX      = 1.103367E-7
+DVT0W    = 0               DVT1W    = 0            DVT2W    = 0
+DVT0     = 0.4301522       DVT1     = 0.2156888    DVT2     = 0.1
+U0       = 128.7704538     UA       = 1.908676E-9  UB       = 1.686179E-21
+UC       = -9.31329E-11    VSAT     = 1.658944E5   A0       = 1.6076505
+AGS      = 0.3740519       B0       = 1.711294E-6  B1       = 4.946873E-6
+KETA     = 0.0210951       A1       = 0.0244939    A2       = 1
+RDSW     = 127.0442882     PRWG     = 0.5          PRWB     = -0.5
+WR       = 1               WINT     = 5.428484E-10 LINT     = 2.468805E-8
*+XL        = -2E-8          XW        = -1E-8
+DWG      = -2.453074E-8
+DWB      = 6.408778E-9     VOFF     = -0.0974174   NFACTOR = 1.9740447
+CIT      = 0               CDSC     = 2.4E-4       CDSCD   = 0
+CDSCB    = 0               ETA0     = 0.1847491    ETAB     = -0.2531172
+DSUB     = 1.5             PCLM     = 4.8842961    PDIBLC1 = 0.0156227
+PDIBLC2 = 0.1              PDIBLCB = -1E-3         DROUT   = 0
+PSCBE1   = 1.733878E9      PSCBE2   = 5.002842E-10 PVAG     = 15
+DELTA    = 0.01            RSH      = 7.7          MOBMOD  = 1
+PRT      = 0               UTE      = -1.5         KT1      = -0.11
+KT1L     = 0               KT2      = 0.022        UA1      = 4.31E-9
+UB1      = -7.61E-18       UC1      = -5.6E-11     AT       = 3.3E4
+WL       = 0               WLN      = 1            WW       = 0
+WWN      = 1               WWL      = 0            LL       = 0
+LLN      = 1               LW       = 0            LWN      = 1
+LWL      = 0               CAPMOD  = 2            XPART    = 0.5
+CGDO     = 7.11E-10        CGSO     = 7.11E-10     CGBO     = 1E-12
+CJ       = 1.179334E-3     PB       = 0.8545261    MJ       = 0.4117753
+CJSW     = 2.215877E-10    PBSW     = 0.6162997    MJSW     = 0.2678074
+CJSWG    = 4.22E-10        PBSWG    = 0.6162997    MJSWG   = 0.2678074
+CF       = 0               PVTH0    = 2.283319E-3  PRDSW   = 5.6431992
+PK2      = 2.813503E-3     WKETA    = 2.438158E-3  LKETA   = -0.0116078
+PU0      = -2.2514581      PUA      = -7.62392E-11 PUB      = 4.502298E-24
+PVSAT    = -50             PETA0    = 1E-4         PKETA   = -1.047892E-4   )
*|
```
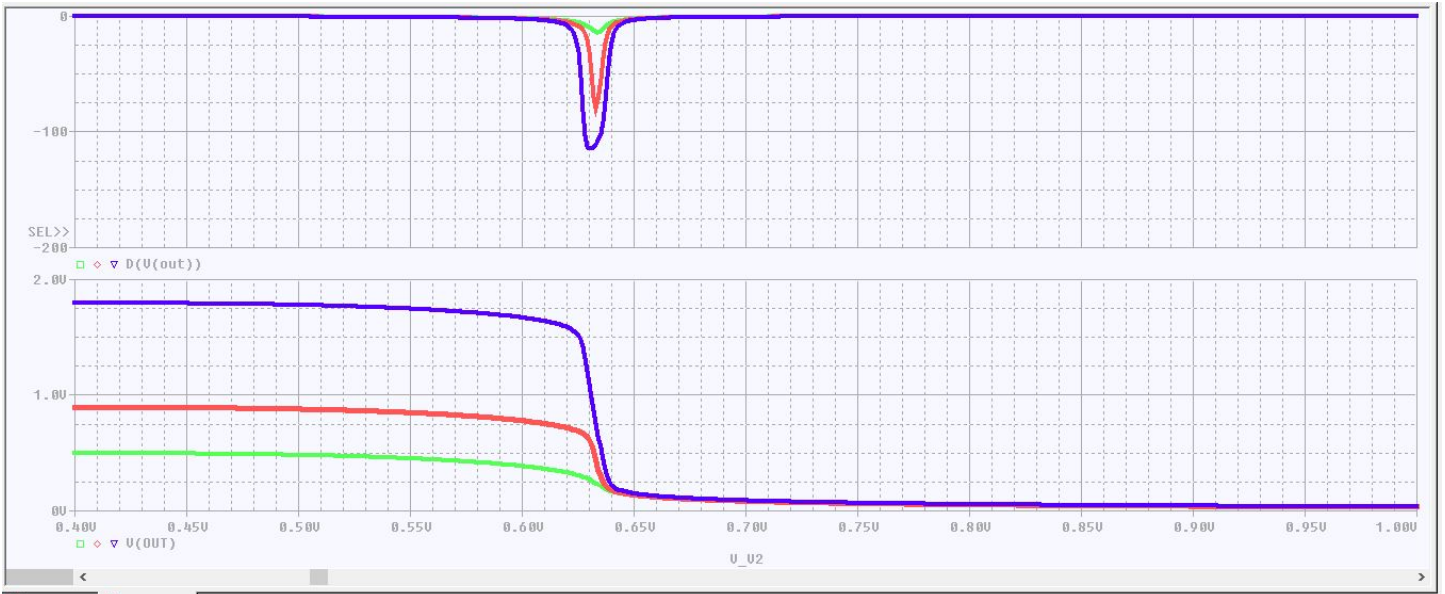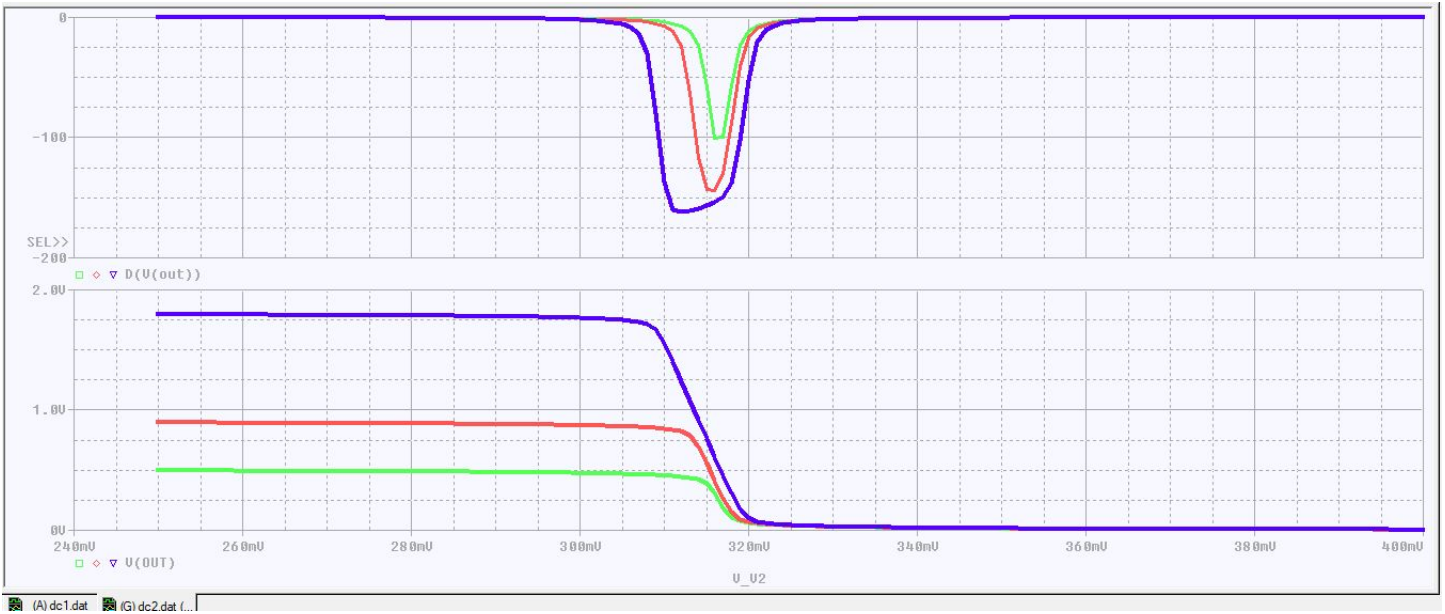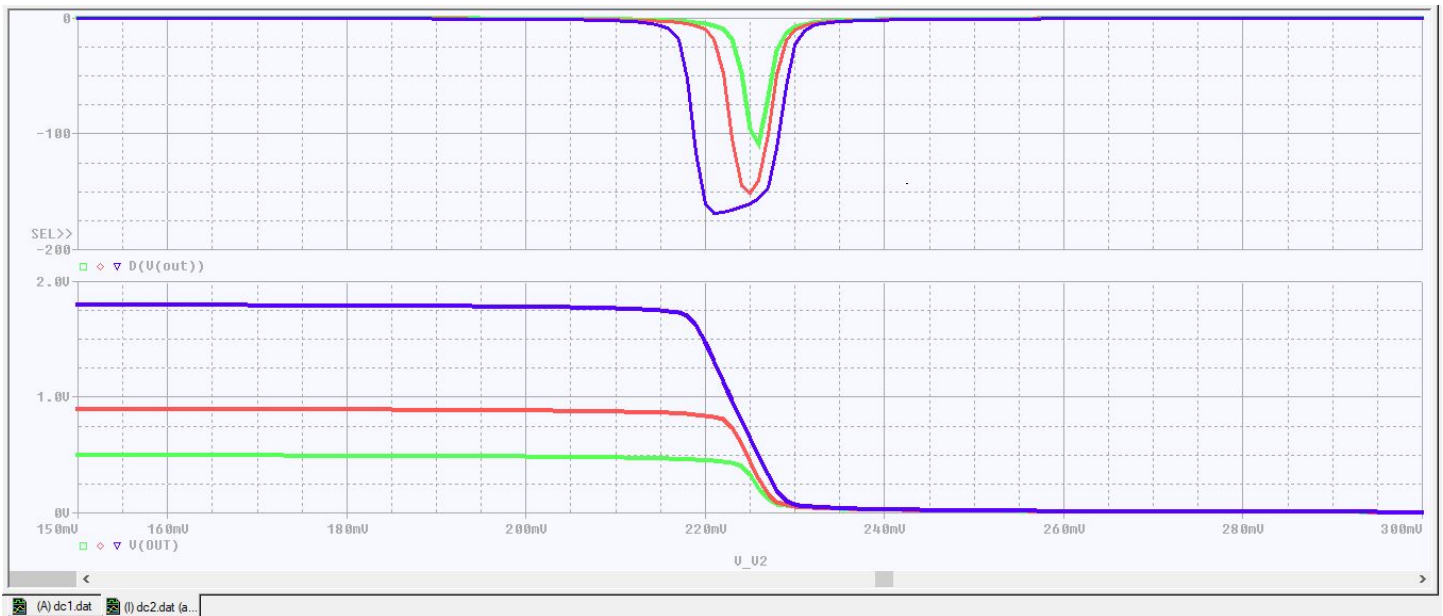
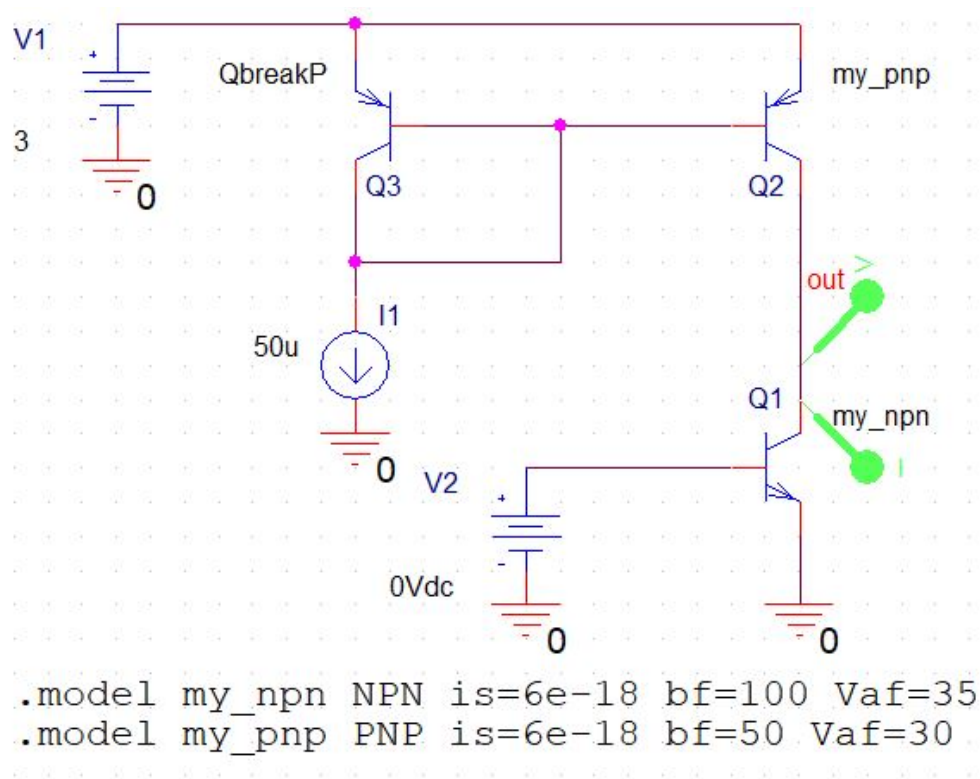I1=50u, V1 parametar sa listom vrednosti 1.8V 0.9V i 0.5V
DC sweep

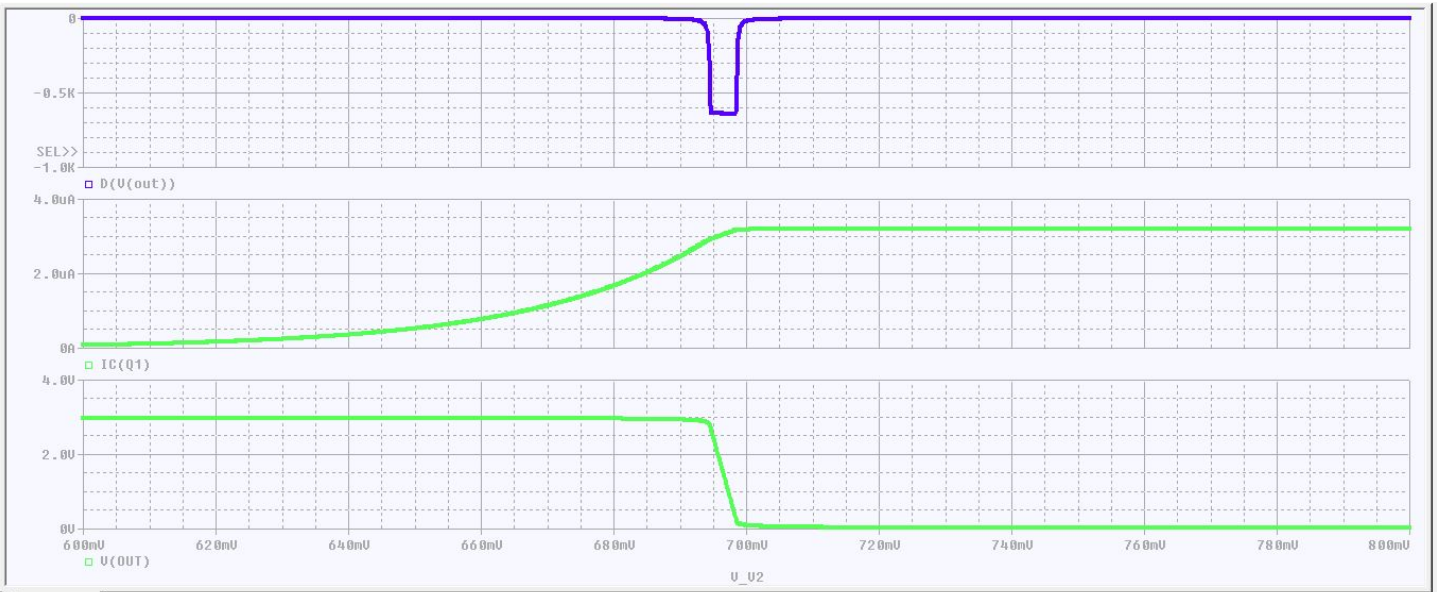I1=100n, V1 parametar sa listom vrednosti 1.8V 0.9V i 0.5V
DC sweep

I1=10n, V1 parametar sa listom vrednosti 1.8V 0.9V i 0.5V
DC sweep

Pojačavač sa integrisanim bipolarnim tranzistorima


```
.model my_npn NPN is=6e-18 bf=100 Vaf=35
.model my_pnp PNP is=6e-18 bf=50 Vaf=30
```

DC sweep V2 600m 800m 0.1mV