# Report- 15

#### **Shantonu Debnath**

# Department of CST, IIEST, Shibpur

## Show Deference Between Without Trojan and with Trojan Circuit

### 1. Job statistics summary

No	Without Trojan	With Trojan
01	tnom= 25.000	tnom= 25.000
02	temp= 25.000	temp= 25.000

#### 2. HSPICE Threads Information

No	Without Trojan	With Trojan	
01	Command Line Threads Count:1	Command Line Threads Count :1	
02	Available CPU Count :8	Available CPU Count :8	
03	Actual Threads Count:1	Actual Threads Count :1	

#### 3. Circuit Statistics

No	Without Trojan	With Trojan
01	nodes = 31	nodes $=$ 43
02	elements = 8	elements = 10
03	mosfets = 6	mosfets = 8
04	volt_srcs = 2	$volt\_srcs = 2$

### 4. Without Trojan:

\*\*\*\*\* Runtime Statistics (seconds) \*\*\*\*\*\*

	analysis	time	# points	tot. iter	conv.iter
(	op point	0.00	1	23	
1	ransient	0.01	201	655	125  rev = 13
]	readin	0.03			
(	errchk	0.01			
9	setup	0.00			
	output	0.00			
	1	momoryu	cod /	19 61 mag	hytos

peak memory used 48.61 megabytes total cpu time 0.02 seconds total elapsed time 0.21 seconds

### With Trojan:

\*\*\*\*\* Runtime Statistics (seconds) \*\*\*\*\*

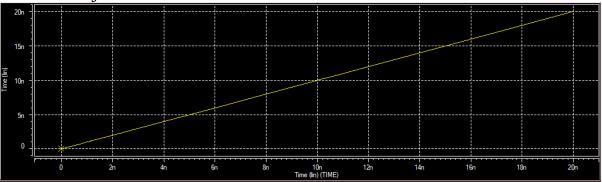
analysis	time	# points	tot. iter	conv.iter	
op point	0.00	1	21		
transient	0.03	201	737	131 rev=	33
readin	0.02				
errchk	0.01				
setup	0.00				
output	0.00				
1		1	10.50	1 .	

peak memory used 48.59 megabytes total cpu time 0.03 seconds total elapsed time 0.19seconds

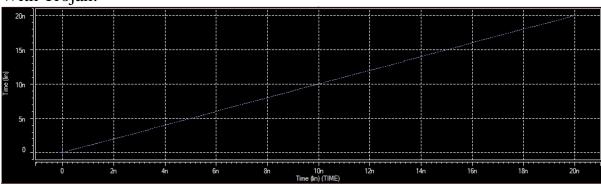
## **Graph Difference**

#### 1. Time

Without Trojan:



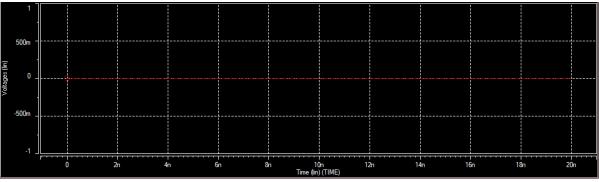
With Trojan:



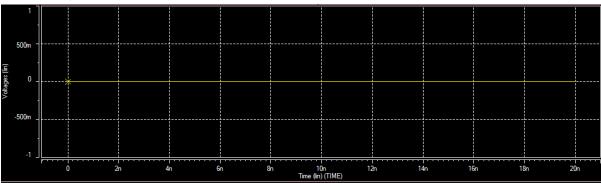
Remarks: Same

# 2. Voltage [v(0)]

Without Trojan:



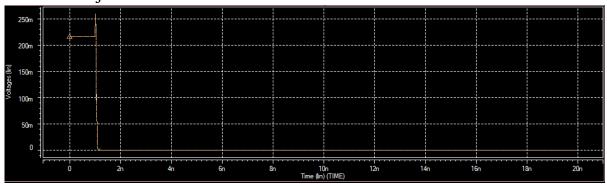
With Trojan:



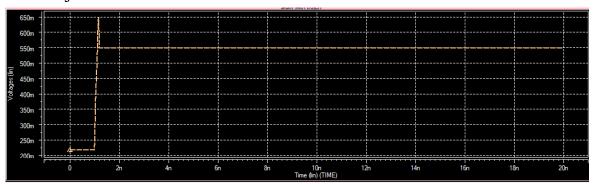
Remarks: Same

### 3. Voltage [v(bl)]

## Without Trojan:



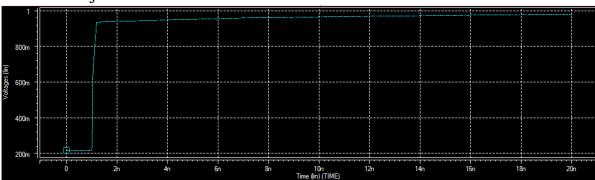
## With Trojan:



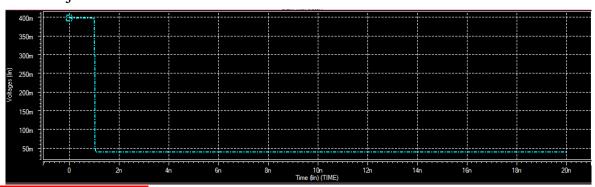
Remarks: Not Same

## 4. Voltage [v(blb)]

## Without Trojan:



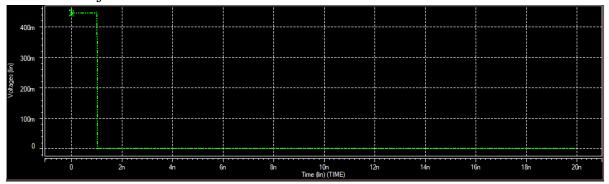
## With Trojan:



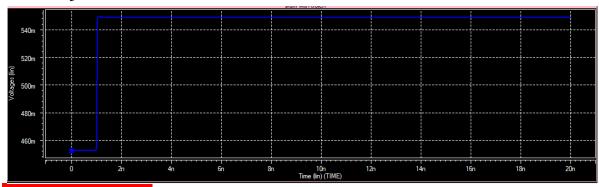
Remarks: Not Same

### **5.** Voltage [v(q)]

## Without Trojan:



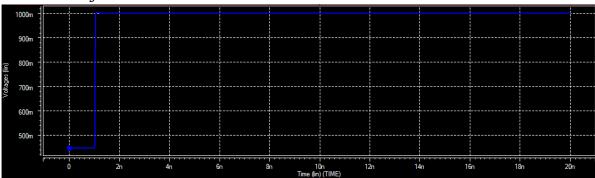
## With Trojan:



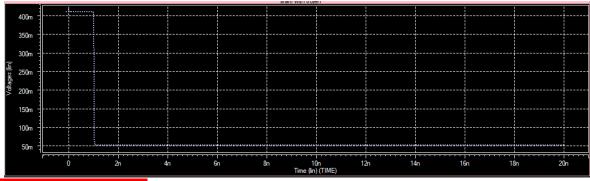
Remarks: Not Same

## 6. Voltage [v(qr)]

## Without Trojan:



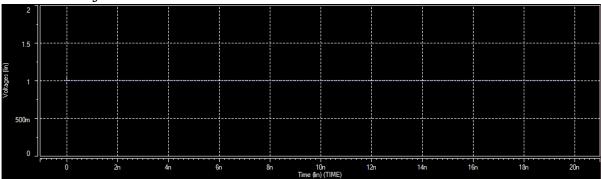
## With Trojan:



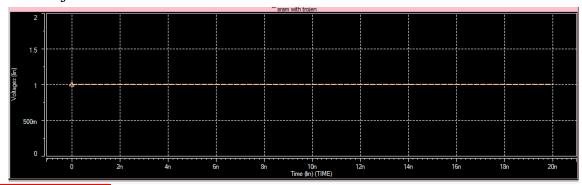
Remarks: Not Same

## 7. Voltage [v(vdd)]

Without Trojan:



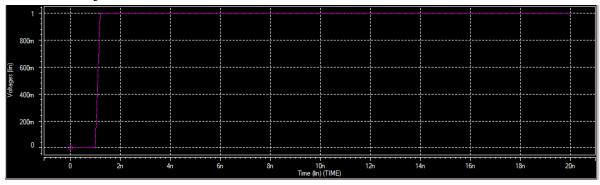
## With Trojan:



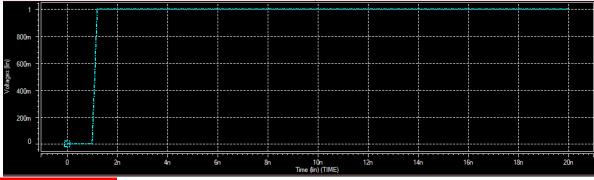
Remarks: Same

## 8. Voltage [v(wl)]

Without Trojan:



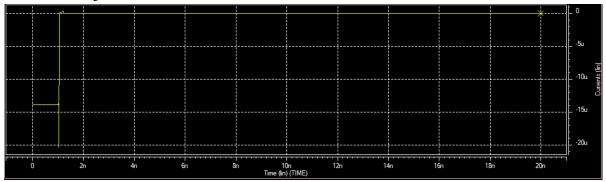
With Trojan:



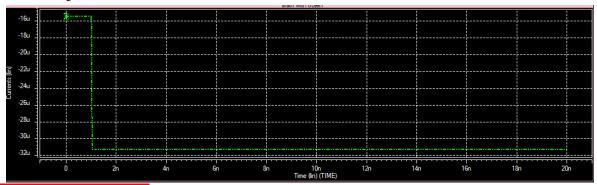
Remarks: Same

## 9. Current [i(vvdd)]

## Without Trojan:



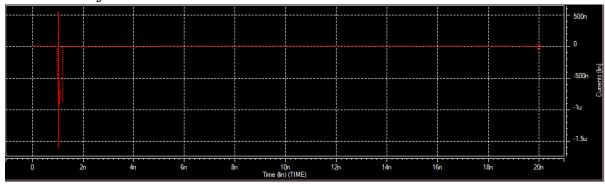
## With Trojan:



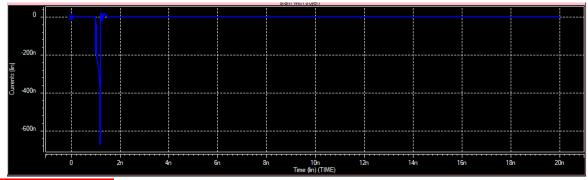
Remarks: Not Same

## 10.Current [i(vwl)]

### Without Trojan:



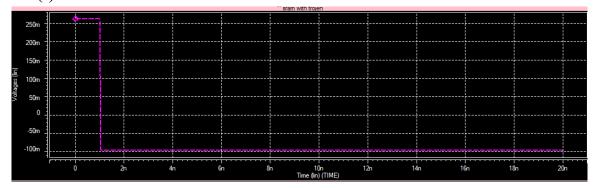
# With Trojan:



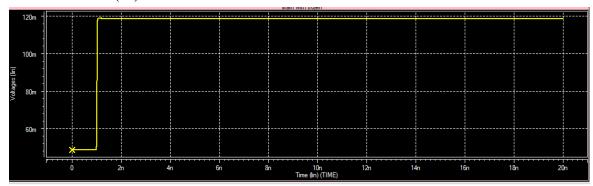
Remarks: Same

# Some voltage which show only with Trojan SRAM

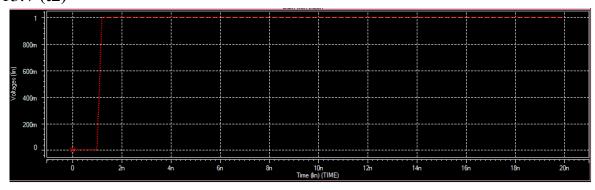
## $11.\mathbf{V}(\mathbf{t})$



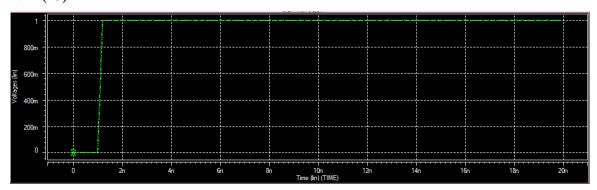
# 12. V(t1)



## 13.**v** (**t2**)

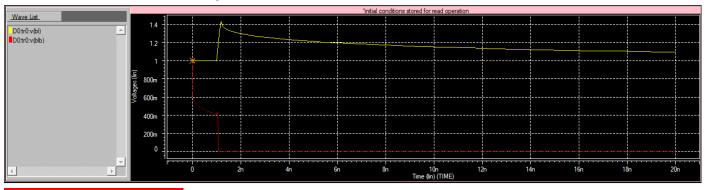


## 14. V(i6)



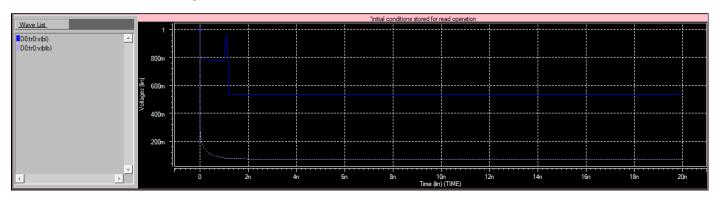
# Read

# 15. Without Trojan



Read 1 Successfully

# 16. With Trojan



Read Error

### **Netlist Without Trojan**

```
** SRAM without trojen
M1 Q X 0 0 nmos w=90n l=45n
M2 Q X vdd vdd pmos w=90n l=45n
M3 QR Y 0 0 nmos w=90n l=45n
M4 QR Y vdd vdd pmos w=90n l=45n
Mi5 Q wl bl bl nmos w=90n l=45n
M6 blb wl QR blb nmos w=90n l=45n
** Voltage source
Vvdd vdd 01
**Access Control
Vwl wl 0 pwl(0 0 1n 0 1.2n 1 5n 1)
.tran 0.1n 20n
.model nmos nmos level = 54
+version = 4.0 binunit = 1 paramchk= 1 mobmod = 0
+capmod = 2
             igcmod = 1 igbmod = 1 geomod = 1
+diomod = 1
              rdsmod = 0 rbodymod = 1 rgatemod = 1
+permod = 1
              acnqsmod= 0 trnqsmod= 0
* parameters related to the technology node
+tnom = 27 epsrox = 3.9
+eta0 = 0.0049 nfactor = 2.1 wint = 5e-09
+cgso = 1.1e-10 cgdo = 1.1e-10 xl = -2e-08
* parameters customized by the user
+toxe = 1.75e-09 toxp = 1.1e-09 toxm = 1.75e-09 toxref = 1.75e-09
+dtox = 6.5e-10 lint = 3.75e-09
+vth0 = 0.469  k1 = 0.528  u0 = 0.04372  vsat = 147390
+rdsw = 155 ndep = 3.28e+18 xj = 1.4e-08
* secondary parameters
     = 0
+11
               wl
                    =0
                             lln
                                  = 1
                                            wln
                                                  = 1
+lw
      =0
               ww
                      = 0
                               lwn = 1
                                               wwn = 1
+lwl
     =0
                wwl
                      = 0
                               xpart = 0
+k2
      = 0.01
                k3
+k3b = 0
                      = 2.5e-006
                w0
                                  dvt0 = 1
                                                  dvt1 = 2
```

+dvt2 = -0.032

dvt0w = 0

dvt1w = 0

dvt2w = 0

```
+dsub = 0.1
                 minv = 0.05
                                  voffl = 0
                                                 dvtp0 = 1.0e-009
+dvtp1 = 0.1
                 lpe0 = 0
                                lpeb = 0
+ngate = 2e+020
                   nsd = 2e + 020
                                     phin = 0
+cdsc = 0.000
                 cdscb = 0
                                 cdscd = 0
                                                 cit = 0
+voff = -0.13
                 etab = 0
+vfb
      = -0.55
                      = 6e-010
                                       = 1.2e-018
                 ua
                                  ub
      =0
                     = 1.0
                                    = 1e-020
+uc
               a0
                              ags
      =0
               a2
                     = 1.0
                              b0
                                    =0
                                             b1
                                                   =0
+a1
+keta = 0.04
                 dwg = 0
                                dwb = 0
                                                pclm = 0.04
+pdiblc1 = 0.001
                   pdiblc2 = 0.001
                                    pdiblcb = -0.005
                                                       drout = 0.5
                  delta = 0.01
                                   pscbe1 = 8.14e + 008 \quad pscbe2 = 1e-007
+pvag = 1e-020
+fprout = 0.2
                 pdits = 0.08
                                 pditsd = 0.23
                                                  pdits1 = 2.3e + 006
+rsh = 5
               rsw = 85
                               rdw = 85
+rdswmin = 0
                  rdwmin = 0
                                   rswmin = 0
                                                    prwg = 0
                                  alpha0 = 0.074
                                                    alpha1 = 0.005
+prwb = 6.8e-011
                   wr
                         = 1
+beta0 = 30
                 agid1 = 0.0002
                                  bgidl = 2.1e+009
                                                     cgidl = 0.0002
+egidl = 0.8
+aigbacc = 0.012
                  bigbacc = 0.0028
                                     cigbacc = 0.002
+nigbacc = 1
                 aigbinv = 0.014
                                   bigbinv = 0.004
                                                     cigbinv = 0.004
+eigbinv = 1.1
                 nigbinv = 3
                                  aigc = 0.012
                                                   bigc = 0.0028
+cigc = 0.002
                 aigsd = 0.012
                                  bigsd = 0.0028
                                                    cigsd = 0.002
                                 pigcd = 1
+nigc = 1
                poxedge = 1
                                                 ntox = 1
+xrcrg1 = 12
                 xrcrg2 = 5
+cgbo = 2.56e-011 cgdl = 2.653e-10
+cgsl = 2.653e-10 ckappas = 0.03
                                     ckappad = 0.03
                                                       acde = 1
+moin = 15
                 noff = 0.9
                                 voffcv = 0.02
      = -0.11
                 kt11 = 0
                                kt2
                                     = 0.022
+kt1
                                                ute
                                                    = -1.5
     = 4.31e-009 ub1 = 7.61e-018 uc1 = -5.6e-011 prt = 0
+ua1
     = 33000
+at
+fnoimod = 1
                  tnoimod = 0
                                  jswgs = 1e-010
+iss
     = 0.0001
                 isws = 1e-011
                                                     nis
                                                          =1
+ijthsfwd = 0.01
                 ijthsrev=0.001
                                   bvs = 10
                                                   xibvs = 1
+isd
    = 0.0001
                 jswd = 1e-011
                                   jswgd = 1e-010
                                                     nid = 1
                                    bvd = 10
+ijthdfwd = 0.01
                  ijthdrev = 0.001
                                                    xibvd = 1
+pbs = 1
                cis = 0.0005
                                mis = 0.5
                                                pbsws = 1
```

```
pbswgs = 1
+cjsws = 5e-010
                   mjsws = 0.33
                                                       cjswgs = 3e-010
+mjswgs = 0.33
                   pbd = 1
                                   cid = 0.0005
                                                     mid = 0.5
+pbswd = 1
                  ciswd = 5e-010
                                     mjswd = 0.33
                                                       pbswgd = 1
+cjswgd = 5e-010
                    mjswgd = 0.33
                                       tpb = 0.005
                                                        tci = 0.001
                                     tpbswg = 0.005
+tpbsw = 0.005
                   tcisw = 0.001
                                                        tcjswg = 0.001
+xtis = 3
                xtid = 3
                    dmci = 0e-006
                                      dmdg = 0e-006
                                                          dmcgt = 0e-007
+dmcg = 0e-006
+dwi = 0.0e-008
                   xgw = 0e-007
                                      xgl = 0e-008
                 gbmin = 1e-010
+rshg = 0.4
                                    rbpb = 5
                                                    rbpd = 15
                                 rbsb = 15
+rbps = 15
                 rbdb = 15
                                                  ngcon = 1
.model pmos pmos level = 54
+version = 4.0 binunit = 1 paramchk= 1 mobmod = 0
+capmod = 2
               igcmod = 1 igbmod = 1
                                         geomod = 1
+diomod = 1
               rdsmod = 0 rbodymod= 1 rgatemod= 1
               acngsmod = 0 trngsmod = 0
+permod = 1
* parameters related to the technology node
+tnom = 27 epsrox = 3.9
+eta0 = 0.0049 nfactor = 2.1 wint = 5e-09
+cgso = 1.1e-10 cgdo = 1.1e-10 xl = -2e-08
* parameters customized by the user
+\text{toxe} = 1.85\text{e-}09 \quad \text{toxp} = 1.1\text{e-}09 \quad \text{toxm} = 1.85\text{e-}09 \quad \text{toxref} = 1.85\text{e-}09
+dtox = 7.5e-10 lint = 3.75e-09
+vth0 = -0.418 k1 = 0.488 u0 = 0.00439 vsat = 70000
+rdsw = 155 ndep = 2.5e+18 xj = 1.4e-08
*secondary parameters
+11
     = 0
               wl
                    =0
                              lln = 1
                                             wln
                                                   = 1
+lw
      =0
                       =0
                                lwn = 1
                ww
                                                wwn = 1
                       =0
                                xpart = 0
+lwl
      =0
                wwl
      = -0.01
                       =0
+k2
                 k3
+k3b
      =0
                 w0
                       = 2.5e-006
                                   dvt0 = 1
                                                   dvt1 = 2
+dvt2 = -0.032
                  dvt0w = 0
                                   dvt1w = 0
                                                    dvt2w = 0
+dsub = 0.1
                 minv = 0.05
                                   voffl = 0
                                                   dvtp0 = 1e-009
+dvtp1 = 0.05
                  lpe0 = 0
                                  lpeb = 0
+ngate = 2e+020
                   nsd = 2e + 020
                                      phin = 0
+cdsc = 0.000
                  cdscb = 0
                                   cdscd = 0
                                                   cit
                                                        =0
```

```
+voff = -0.126
                 etab = 0
+vfb
      = 0.55
                      = 2.0e-009
                                  ub
                                       = 0.5e-0.18
                ua
      =0
               a0
                     = 1.0
                                   = 1e-020
+uc
                              ags
                              b0
                                   = -1e-020
                                                    =0
+a1
      =0
               a2
                    = 1
                                               b1
+keta = -0.047
                 dwg = 0
                                 dwb = 0
                                                 pclm = 0.12
+pdiblc1 = 0.001
                  pdiblc2 = 0.001
                                    pdiblcb = 3.4e-008
                                                       drout = 0.56
+pvag = 1e-020
                  delta = 0.01
                                   pscbe1 = 8.14e+008 \quad pscbe2 = 9.58e-007
+fprout = 0.2
                 pdits = 0.08
                                 pditsd = 0.23
                                                  pdits1 = 2.3e + 006
+rsh = 5
               rsw = 85
                               rdw = 85
+rdsymin = 0
                  rdwmin = 0
                                   rswmin = 0
                                                    prwg = 3.22e-008
                                  alpha0 = 0.074
                                                    alpha1 = 0.005
+prwb = 6.8e-011
                   wr
                         = 1
                 agid1 = 0.0002
                                  bgidl = 2.1e+009
                                                     cgidl = 0.0002
+beta0 = 30
+egidl = 0.8
+aigbacc = 0.012
                  bigbacc = 0.0028
                                     cigbacc = 0.002
+nigbacc = 1
                 aigbinv = 0.014
                                   bigbinv = 0.004
                                                     cigbinv = 0.004
+eigbinv = 1.1
                                  aigc = 0.69
                                                  bigc = 0.0012
                 nigbinv = 3
+cigc = 0.0008
                  aigsd = 0.0087
                                   bigsd = 0.0012
                                                     cigsd = 0.0008
+nigc = 1
                poxedge = 1
                                 pigcd = 1
                                                 ntox = 1
+xrcrg1 = 12
                 xrcrg2 = 5
+cgbo = 2.56e-011 cgdl = 2.653e-10
+cgs1 = 2.653e-10 ckappas = 0.03
                                     ckappad = 0.03
                                                       acde = 1
                 noff = 0.9
+moin = 15
                                voffcv = 0.02
+kt1
      = -0.11
                 kt11 = 0
                               kt2 = 0.022
                                                ute = -1.5
+ua1 = 4.31e-009 ub1 = 7.61e-018 uc1 = -5.6e-011 prt = 0
+at
     = 33000
+fnoimod = 1
                  tnoimod = 0
                 jsws = 1e-011
                                  jswgs = 1e-010
+iss
     = 0.0001
                                                     njs
                                                          = 1
+ijthsfwd = 0.01
                 ijthsrev=0.001
                                  bvs
                                         = 10
                                                   xibvs = 1
                                   jswgd = 1e-010
+isd
    = 0.0001
                 jswd = 1e-011
                                                     nid = 1
+ijthdfwd = 0.01
                  ijthdrev=0.001
                                    bvd = 10
                                                    xibvd = 1
                cis = 0.0005
                                mis = 0.5
+pbs = 1
                                                pbsws = 1
                  misws = 0.33
                                    pbswgs = 1
+cisws = 5e-010
                                                     ciswgs = 3e-010
+mjswgs = 0.33
                  pbd = 1
                                  cid = 0.0005
                                                   mid = 0.5
                 cjswd = 5e-010
+pbswd = 1
                                   mjswd = 0.33
                                                     pbswgd = 1
+ciswgd = 5e-010
                   mjswgd = 0.33
                                     tpb = 0.005
                                                      tci = 0.001
```

+tpbsw = 0.005tcisw = 0.001tpbswg = 0.005tcjswg = 0.001+xtis = 3xtid = 3+dmcg = 0e-006dmci = 0e-006dmdg = 0e-006dmcgt = 0e-007= 0.0e-008xgw = 0e-007= 0e-008+dwi xgl gbmin = 1e-010+rshg = 0.4rbpb = 5rbpd = 15rbdb = 15+rbps = 15rbsb = 15ngcon = 1

.options POST=2

.options AUTOSTOP

.options INGOLD=2 DCON=1

.options GSHUNT=1e-12 RMIN=1e-15

.options ABSTOL=1e-5 ABSVDC=1e-4

.options RELTOL=1e-2 RELVDC=1e-2

.options NUMDGT=4 PIVOT=13

.options runlvl=6

.end

## **Netlist with Trojan**

#### \*\* SRAM with trojen

M1 Q QR 0 0 nmos w=90n l=45n

M2 Q QR vdd vdd pmos w=90n l=45n

M3 QR Q 0 0 nmos w=90n l=45n

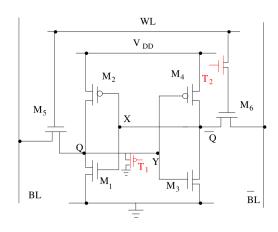
M4 QR Q vdd vdd pmos w=90n l=45n

M5 Q wl bl bl nmos w=90n l=45n

Mi6 blb T QR blb nmos w=90n l=45n

MT i6 T2 wl wl nmos w=90n l=45n

MTr Q T1 0 0 pmos w=90n l=45n



#### \*\* Voltage source

Vvdd vdd 0 1

#### \*\*Access Control

Vwl wl 0 pwl(0 0 1n 0 1.2n 1 5n 1)

.tran 0.1n 20n

+voff = -0.13

+vfb = -0.55

+uc

+a1

= 0

= 0

+keta = 0.04

etab = 0

a0 = 1.0

a2 = 1.0

dwg = 0

ua = 6e-010 ub = 1.2e-018

ags = 1e-020

dwb = 0

b1 = 0

pclm = 0.04

b0 = 0

```
.model nmos nmos level = 54
+version = 4.0 binunit = 1 paramchk= 1 mobmod = 0
             igcmod = 1 igbmod = 1 geomod = 1
+capmod = 2
+diomod = 1 rdsmod = 0 rbodymod= 1 rgatemod= 1
+permod = 1 acnqsmod= 0 trnqsmod= 0
* parameters related to the technology node
+tnom = 27 epsrox = 3.9
+cgso = 1.1e-10 cgdo = 1.1e-10 xl = -2e-08
* parameters customized by the user
+toxe = 1.75e-09 toxp = 1.1e-09 toxm = 1.75e-09 toxref = 1.75e-09
+dtox = 6.5e-10 lint = 3.75e-09
+vth0 = 0.469 k1 = 0.528 u0 = 0.04372 vsat = 147390
+rdsw = 155 ndep = 3.28e+18 xj = 1.4e-08
* secondary parameters
+II = 0
            wI = 0
                        lln = 1
                                    wln = 1
                          lwn = 1
+lw
     = 0
           ww = 0
                                       wwn = 1
+lwl = 0
            wwl = 0
                          xpart = 0
+k2
     = 0.01
              k3
                  = 0
             w0 = 2.5e-006 dvt0 = 1
                                          dvt1 = 2
+k3b = 0
+dvt2 = -0.032 dvt0w = 0
                            dvt1w = 0
                                            dvt2w = 0
+dsub = 0.1
             minv = 0.05
                            voffl = 0
                                          dvtp0 = 1.0e-009
+dvtp1 = 0.1
              lpe0 = 0
                            lpeb = 0
+ngate = 2e+020 nsd = 2e+020
                                phin = 0
+cdsc = 0.000
             cdscb = 0
                             cdscd = 0
                                          cit = 0
```

```
pdiblc2 = 0.001 pdiblcb = -0.005
+pdiblc1 = 0.001
                                                   drout = 0.5
+pvag = 1e-020
                 delta = 0.01
                                pscbe1 = 8.14e+008 pscbe2 = 1e-007
                pdits = 0.08
+fprout = 0.2
                               pditsd = 0.23
                                              pditsl = 2.3e + 006
+rsh = 5
              rsw = 85
                            rdw = 85
+rdswmin = 0
                 rdwmin = 0
                                rswmin = 0
                                                prwg = 0
+prwb = 6.8e-011 wr = 1
                                alpha0 = 0.074
                                                alpha1 = 0.005
+beta0 = 30
                agidl = 0.0002
                                bgidl = 2.1e+009 cgidl = 0.0002
+egidl = 0.8
+aigbacc = 0.012
                 bigbacc = 0.0028
                                   cigbacc = 0.002
+nigbacc = 1
                aigbinv = 0.014
                                bigbinv = 0.004
                                                 cigbinv = 0.004
               nigbinv = 3
                               aigc = 0.012
                                              bigc = 0.0028
+eigbinv = 1.1
+cigc = 0.002 aigsd = 0.012 bigsd = 0.0028
                                                cigsd = 0.002
+nigc = 1
              poxedge = 1
                              pigcd = 1
                                            ntox = 1
+xrcrg1 = 12
               xrcrg2 = 5
+cgbo = 2.56e-011 cgdl = 2.653e-10
+cgsl = 2.653e-10 ckappas = 0.03
                                  ckappad = 0.03
                                                   acde = 1
               noff = 0.9
+moin = 15
                             voffcv = 0.02
+kt1 = -0.11
               kt1l = 0
                             kt2 = 0.022
                                            ute = -1.5
+ua1 = 4.31e-009 ub1 = 7.61e-018 uc1 = -5.6e-011 prt = 0
+at = 33000
+fnoimod = 1
                tnoimod = 0
+jss = 0.0001 jsws = 1e-011
                                jswgs = 1e-010
                                                 njs = 1
+ijthsfwd= 0.01
                ijthsrev= 0.001
                                 bvs = 10
                                               xjbvs = 1
+jsd = 0.0001 jswd = 1e-011
                                jswgd = 1e-010
                                                  njd = 1
+ijthdfwd= 0.01
                 ijthdrev= 0.001
                                  bvd = 10
                                                xjbvd = 1
+pbs = 1
              cis = 0.0005 mis = 0.5
                                           pbsws = 1
+cjsws = 5e-010
                 mjsws = 0.33
                                  pbswgs = 1
                                                 ciswgs = 3e-010
+mjswgs = 0.33
                 pbd = 1
                               cid = 0.0005
                                               mid = 0.5
+pbswd = 1
                ciswd = 5e-010
                                 mjswd = 0.33
                                                 pbswgd = 1
```

```
+cjswgd = 5e-010
                 mjswgd = 0.33
                                tpb = 0.005
                                               tcj = 0.001
+tpbsw = 0.005
                tcjsw = 0.001
                               tpbswg = 0.005
                                               tcjswg = 0.001
+xtis = 3
            xtid = 3
+dmcg = 0e-006
                                dmdg = 0e-006
                dmci = 0e-006
                                                dmcgt = 0e-007
+dwj = 0.0e-008 \quad xgw = 0e-007
                               xgl = 0e-008
+rshg = 0.4
              gbmin = 1e-010
                              rbpb = 5
                                           rbpd = 15
+rbps = 15
              rbdb = 15
                            rbsb = 15
                                         ngcon = 1
.model pmos pmos level = 54
+version = 4.0 binunit = 1 paramchk= 1 mobmod = 0
             igcmod = 1 igbmod = 1 geomod = 1
+capmod = 2
+diomod = 1 rdsmod = 0 rbodymod= 1 rgatemod= 1
+permod = 1
             acnqsmod= 0 trnqsmod= 0
* parameters related to the technology node
+tnom = 27 epsrox = 3.9
```

+cgso = 1.1e-10 cgdo = 1.1e-10 xl = -2e-08

#### \* parameters customized by the user

+toxe = 1.85e-09 toxp = 1.1e-09 toxm = 1.85e-09 toxref = 1.85e-09

+dtox = 7.5e-10 lint = 3.75e-09

+vth0 = -0.418 k1 = 0.488 u0 = 0.00439 vsat = 70000

+rdsw = 155 ndep = 2.5e+18 xj = 1.4e-08

#### \*secondary parameters

$$+II = 0$$
  $wI = 0$   $IIn = 1$   $wIn = 1$   
 $+Iw = 0$   $ww = 0$   $Iwn = 1$   $wwn = 1$   
 $+IwI = 0$   $wwI = 0$   $xpart = 0$   
 $+k2 = -0.01$   $k3 = 0$   
 $+k3b = 0$   $w0 = 2.5e-006$   $dvt0 = 1$   $dvt1 = 2$ 

```
dvt2w = 0
+dvt2 = -0.032 dvt0w = 0
                             dvt1w = 0
+dsub = 0.1
             minv = 0.05
                             voffl = 0
                                           dvtp0 = 1e-009
+dvtp1 = 0.05
                lpe0 = 0
                             lpeb = 0
+ngate = 2e+020 nsd = 2e+020
                                  phin = 0
+cdsc = 0.000
              cdscb = 0
                              cdscd = 0
                                            cit = 0
+voff = -0.126 etab = 0
+vfb = 0.55
                  = 2.0e-009 ub = 0.5e-018
              ua
                           ags = 1e-020
     = 0
             a0
                 = 1.0
+uc
+a1
     = 0
             a2 = 1
                          b0
                               = -1e-020 b1
                                              = 0
+keta = -0.047
                dwg = 0
                              dwb = 0
                                            pclm = 0.12
+pdiblc1 = 0.001
                 pdiblc2 = 0.001
                                 pdiblcb = 3.4e-008 drout = 0.56
+pvag = 1e-020 delta = 0.01
                                pscbe1 = 8.14e+008 pscbe2 = 9.58e-007
+fprout = 0.2
               pdits = 0.08
                              pditsd = 0.23
                                             pditsl = 2.3e + 006
+rsh = 5
             rsw = 85
                           rdw = 85
                rdwmin = 0
                                rswmin = 0
                                              prwg = 3.22e-008
+rdswmin = 0
+prwb = 6.8e-011 wr = 1
                               alpha0 = 0.074
                                               alpha1 = 0.005
+beta0 = 30
               agidl = 0.0002 bgidl = 2.1e+009 cgidl = 0.0002
+egidl = 0.8
+aigbacc = 0.012
                 bigbacc = 0.0028 cigbacc = 0.002
+nigbacc = 1
               aigbinv = 0.014
                                bigbinv = 0.004
                                                cigbinv = 0.004
               nigbinv = 3
                              aigc = 0.69
                                             bigc = 0.0012
+eigbinv = 1.1
+cigc = 0.0008
                aigsd = 0.0087
                                bigsd = 0.0012
                                                cigsd = 0.0008
+nigc = 1
              poxedge = 1
                             pigcd = 1
                                           ntox = 1
+xrcrg1 = 12
               xrcrg2 = 5
+cgbo = 2.56e-011 cgdl = 2.653e-10
+cgsl = 2.653e-10 ckappas = 0.03 ckappad = 0.03
                                                  acde = 1
               noff = 0.9
+moin = 15
                             voffcv = 0.02
               kt1l = 0
                            kt2 = 0.022
+kt1 = -0.11
                                           ute = -1.5
+ua1 = 4.31e-009 ub1 = 7.61e-018 uc1 = -5.6e-011 prt = 0
+at = 33000
```

```
+fnoimod = 1
                tnoimod = 0
+jss = 0.0001
               jsws = 1e-011
                                jswgs = 1e-010
                                                 njs = 1
+ijthsfwd= 0.01
                ijthsrev= 0.001
                                 bvs = 10
                                               xjbvs = 1
+jsd = 0.0001 jswd = 1e-011
                                 jswgd = 1e-010
                                                  njd = 1
                                  bvd = 10
+ijthdfwd= 0.01
                 ijthdrev= 0.001
                                                xjbvd = 1
+pbs = 1
              cjs = 0.0005
                             mjs = 0.5
                                            pbsws = 1
+cjsws = 5e-010
                 mjsws = 0.33
                                  pbswgs = 1
                                                 cjswgs = 3e-010
                 pbd = 1
                               cjd = 0.0005
                                               mjd = 0.5
+mjswgs = 0.33
+pbswd = 1
                cjswd = 5e-010
                                 mjswd = 0.33
                                                  pbswgd = 1
+cjswgd = 5e-010
                  mjswgd = 0.33
                                   tpb = 0.005
                                                   tcj = 0.001
+tpbsw = 0.005
                 tcisw = 0.001
                                 tpbswg = 0.005
                                                  tcjswg = 0.001
+xtis = 3
             xtid = 3
+dmcg = 0e-006
                  dmci = 0e-006
                                  dmdg = 0e-006 dmcgt = 0e-007
+dwj = 0.0e-008 \quad xgw = 0e-007
                                  xgl = 0e-008
+rshg = 0.4
                                               rbpd = 15
               gbmin = 1e-010
                                 rbpb = 5
+rbps = 15
               rbdb = 15
                              rbsb = 15
                                            ngcon = 1
.options POST=2
.options AUTOSTOP
.options INGOLD=2 DCON=1
.options GSHUNT=1e-12 RMIN=1e-15
.options ABSTOL=1e-5 ABSVDC=1e-4
```

.end

.options RELTOL=1e-2 RELVDC=1e-2

.options NUMDGT=4 PIVOT=13

.options runlvl=6

## THE END