



```
;dc V1 1 20 0.1
.tran 3000

.option abstol=1e-1
.option cshunt=1e-13
.option gmin=1e-7
.option reltol=0.001
```

```

.meas TRAN Rd AVG V(Vrt1,br
.meas TRAN Rd2 AVG V(Vrt1,br

```

```
.model bjt1 AKO:BCW60D (Bf=
.model sw1 SW(Roff=1G Ron=
.model zen AKO:BZX384B6V2
```

```
.param kp=0.5*ku  
.param kd=3*ku*tu/80  
.param ki=0.1*ku/tu/1  
.param ki=3  
.param tu=0.5  
.param ku=4.1  
.param noisetime 10  
.param noiselevel 5000
```

