

NGSPICE

```
.param temp=27
.options savecurrents reltol=1e-3 abstol=1e-12 gmin=1e-15
.control
save all
```

```
* Operating Point Analysis
op
remzerovec
write ota-improved_tb-loopgain.raw
set appendwrite
```

```
* AC Analysis
ac dec 101 1 100G
remzerovec
write ota-improved_tb-loopgain.raw
set appendwrite
```

```
* Middlebrook's Method
let tv=-v(vr1)/v(vf1)
let ti=-i(vr1)/i(vf1)
let tmb=(tv*ti - 1)/(tv + ti + 2)

plot db(tmb) ylabel 'Magnitude - Middlebrook'
plot 180/pi*cphase(tmb) ylabel 'Phase - Middlebrook'
```

```
* Tian's Method
* vtest=0, itest=1:
let A=1/(vmeas2)
let C=v(vmeas2)
```

```
* vtest=1, itest=0:
let B=1/(vmeas1)
let D=v(vmeas1)
let ttian=(A*D-B*C-A)/(2*(B*C-A*D)+A-D+1)

plot db(ttian) ylabel 'Magnitude - Tian'
plot 180/pi*cphase(ttian) ylabel 'Phase - Tian'
```

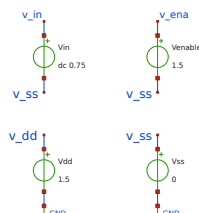
```
* Middlebrook vs. Tian
plot db(tmb) db(ttian) ylabel 'Magnitude'
plot 180/pi*cphase(tmb) 180/pi*cphase(ttian) ylabel 'Phase'

write ota-improved_tb-loopgain.raw

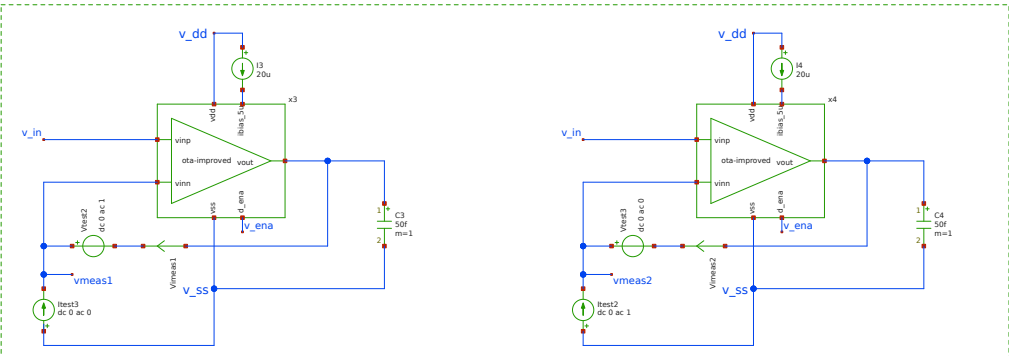
*quit
.endc
```

➡ Simulate

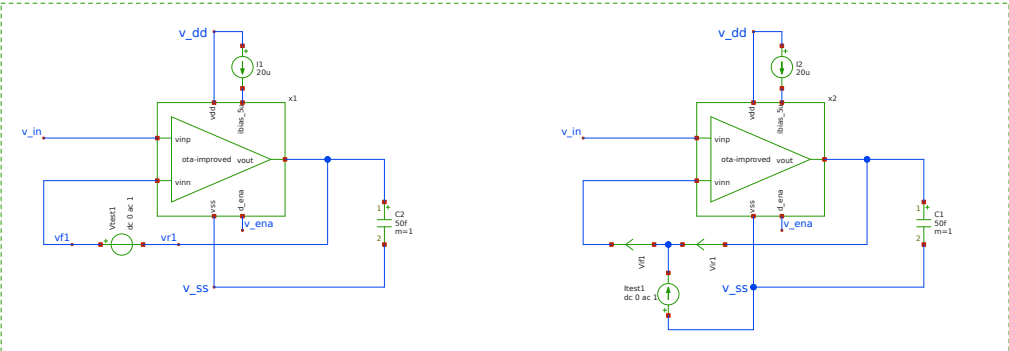
➡ Annotate OP



Tian's Method



Middlebrook's Method



MODEL

```
.lib cornerMOSlv.lib mos_tt
.lib cornerRES.lib res_typ
```

