AB_BIAS_DIFF_Thd_MX

```
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*
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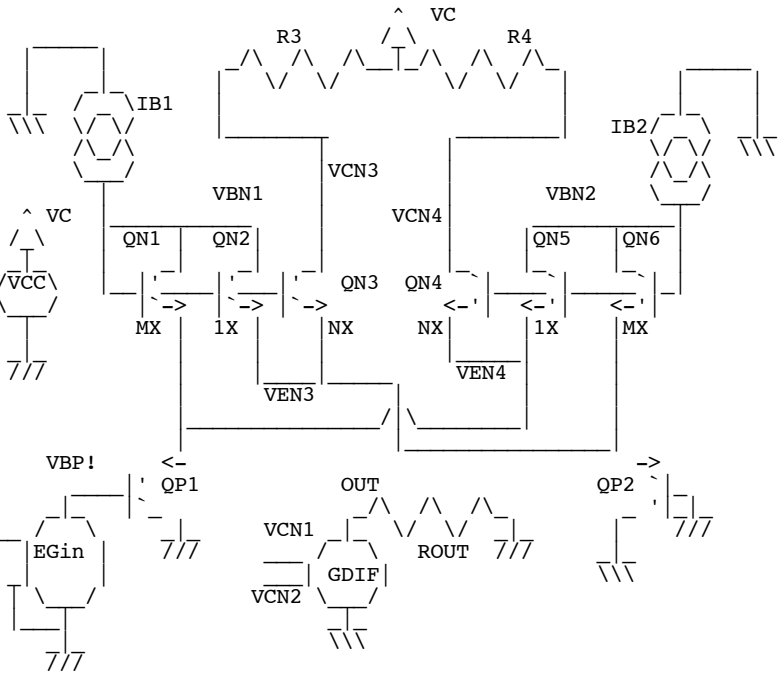


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*
*
*
.OPTIONS  GMIN=1e-18    METHOD=trap   srcsteps = 1  gminsteps = 1
*========= ====== ====== ====== ====== ====== ====== ======
VCC       VC      0              DC      10
VAC1      VIN     0              DC      0       SIN(    0       1    1000 )
IB1       0       VBN1           1u
IB2       0       VBN2           1u
QN1       VBN1    VBN1    VE4    NPN1    4.70
QN2       VBN1    VBN1    VE3    NPN1    1.00
QN3       VCN3    VBN1    VE3    NPN1    15.00

QN4       VCN4    VBN2    VE4    NPN1    15.00
QN5       VBN2    VBN2    VE4    NPN1    1.00
QN6       VBN2    VBN2    VE3    NPN1    4.70

QP1       0       VBP1    VE3    PNP1    1.00
QP2       0       0       VE4    PNP1    1.00
R3        VCN3    VC      1K
R4        VCN4    VC      1K
E_DIF     OUT     0       VCN3   VCN4    1
ROUT      OUT     O       1K
E_GAININ  VBP1    0       VIN    0       1m

.control
tran              25u                    5m          0     1u
plot              out
echo              "THD% versus VIN_vpk "
setplot           new
set               NameList =  (         Mx4 Mx4pt25 Mx4pt5 Mx5   )
compose           NxVals      values    4   4.25    4.5    5
compose           VinVals     values    10m 30m 35m 40m 60m 70m 80m 100m 110m 120m 140m 150m 170m 185m 200m
250m
settype           voltage     VinVals
let               NoOfNx  =   length(NxVals)
let               NoOfVin =   length(VinVals)

begin
unset             interrupt
* ===============Loop_Nx============
let               j         =  1
while             (j        <=  NoOfNx )
let               Nx         =  NxVals[j-1]
alter             QN1   area =  $&Nx
alter             QN6   area =  $&Nx
set               thisName  =  $NameList[$&j]
let               $thisName =  0*vector(NoOfVin)
```
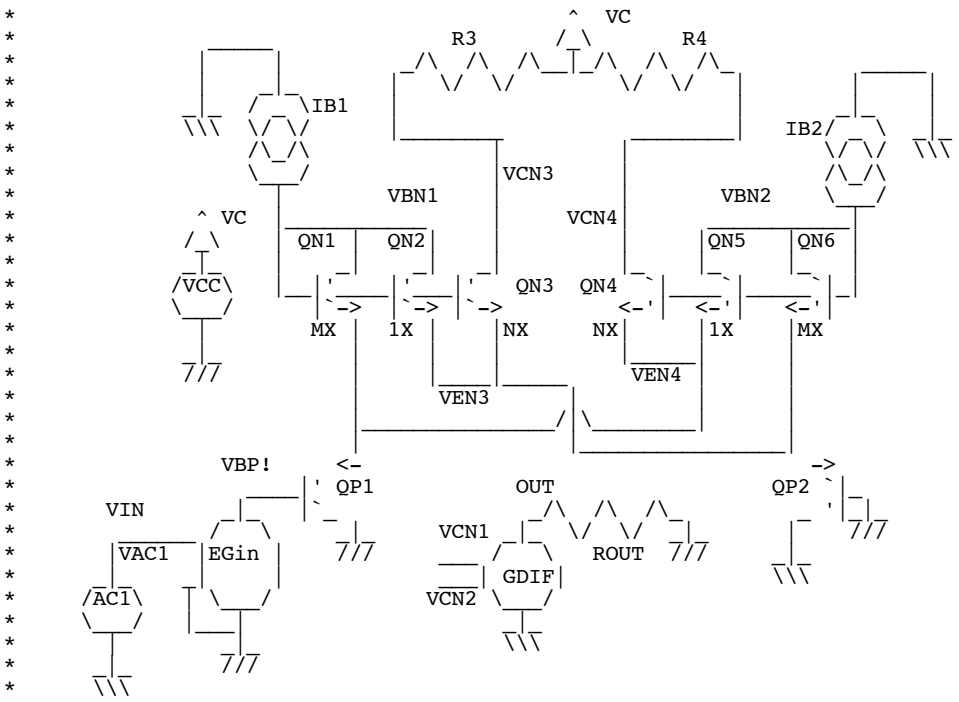

```
* ==============Loop_Vin==============
let               k              = 1
while             (k             <= NoOfVin )
let               Vin             = VinVals[k-1]
alter             e_gainin gain = $&Vin
tran              25u               5m        0     1u
linearize
set               specwindow=    "blackman"
spec              200     8k      200     v(out)
let               thdsq =mag(out[9])^2 +mag(out[14])^2  +mag(out[19])^2  +mag(out[24])^2
let               thd_percent= 100*sqrt(thdsq)/mag(out[4])
echo              "$&unknown.Vin       $&thd_percent"
let               unknown.{$thisName}[unknown.k-1] = thd_percent
repeat            3
destroy
end
if                ($?interrupt)
goto              bail
endif
let               k =          k + 1
endwhile
setscale          VinVals
plot              $NameList loglog title "AB_BIAS THD_% vs Vin_pK and Mx"
let               j =          j + 1
endwhile
label             bail
echo             "Done."
end
.endc

*======== ====== ====== ====== ====== ====== ====== ====== ======
.model    NPN1   NPN(    BF=2100 VAF=216 )
.model    PNP1   PNP(    BF=2100  VAF=21)
.end
```

======================END_OF_SPICE=======================

To Covert PDF to plain text click below
http://www.fileformat.info/convert/doc/pdf2txt.htm

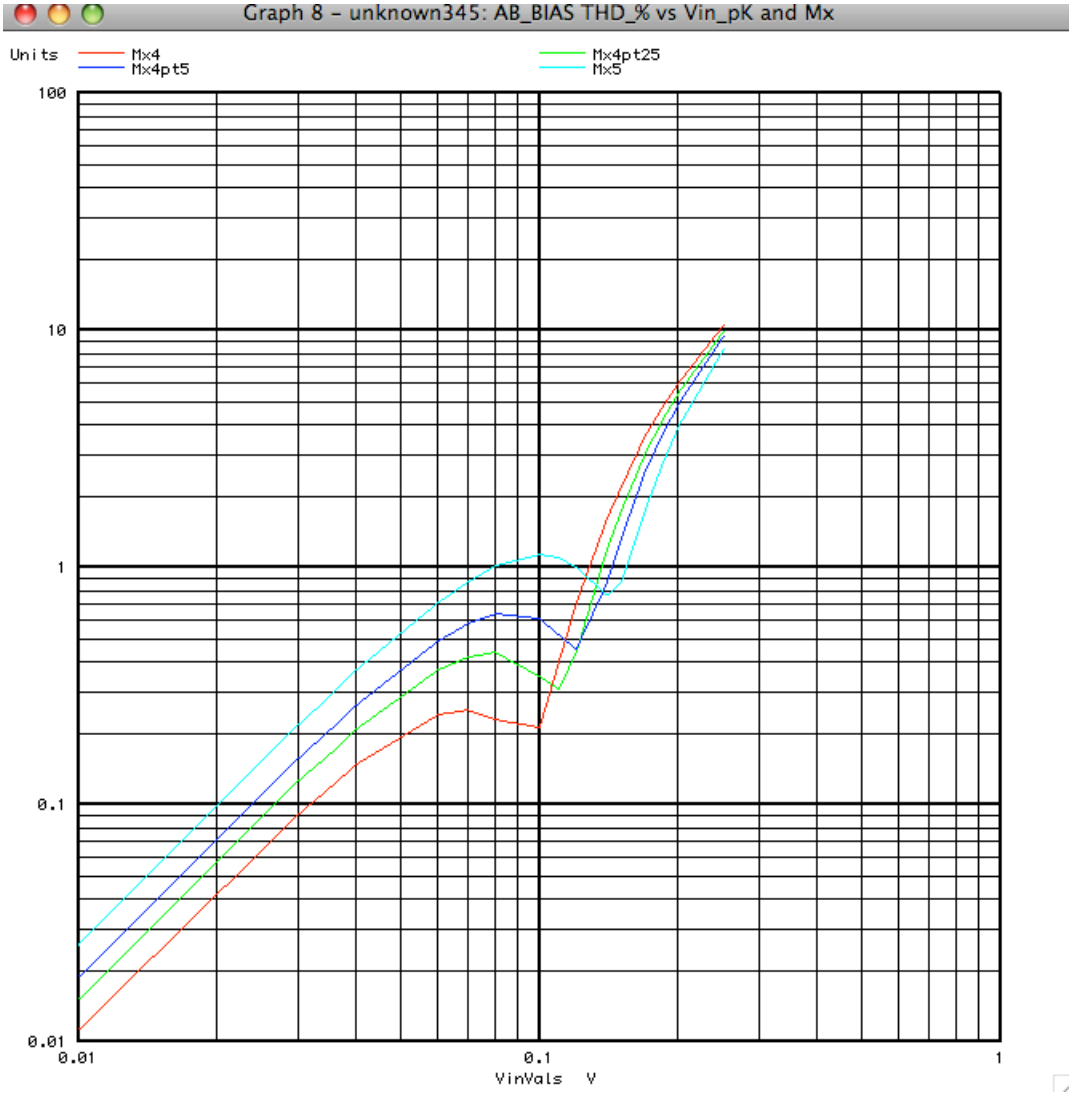
This simulation only works on MacSpice for now.
Data in spice apparently gets stored in vectors which are ready to be plotted.

The real goal to a OTA differential input is to actually be able to lower the overall offset and noise while at the same time improving the distortion performance.



A normal input stage actually has its noise defined by the number of electrons that flow through it. To be able to break this barrier, the input stage needs to be AB biased. That means that the differential input stage needs to be able to put out more differential output current than it is drawing DC wise.

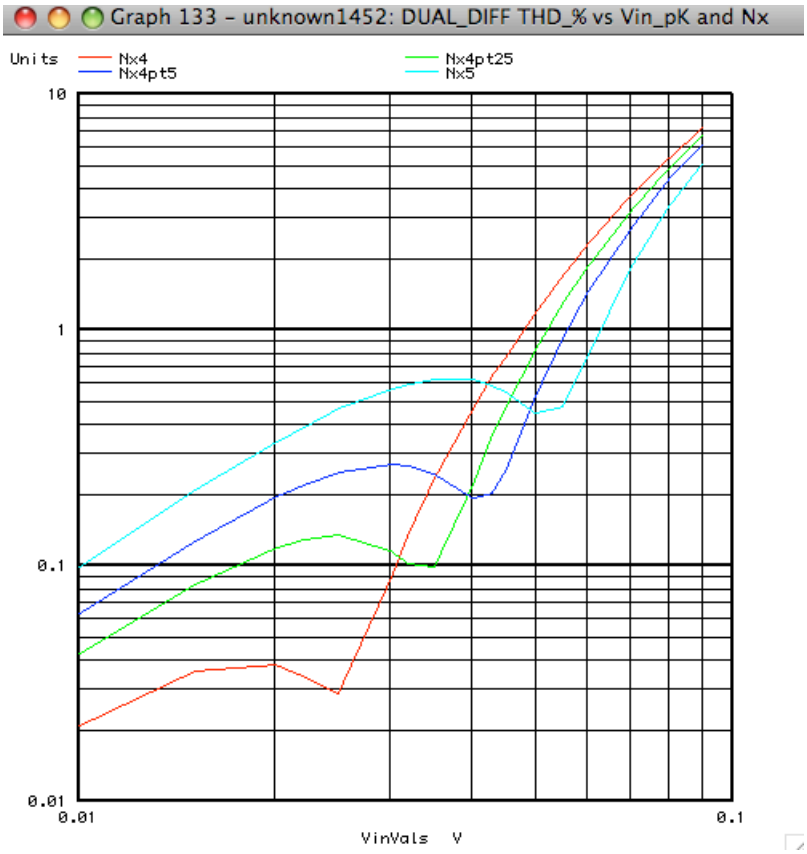
A invention above is doing this with two area ratios. The NX ratio term defines a current gain which is possible to take place in output transistors QN3 and QN4. The MX term defines what DC current is present with no input signal.



This simulation tests various sizes of the M area ratio. The larger the value of M, the more the AB_Biased input stage is B biased. Less current will flow with no signal. This will lower the overall effects of both offset and noise. However the input distortion will also be higher because it will introduce a type of crossover distortion.

A smaller value of M is a more A biased input stage. The distortion at low signals is better. But the performance of noise, offset, and maximum input signal are all reduced.

For a M value around 4.5, the 1% distort is about at the 150mV level compared to the 18mV level for a normal differential input stage. The distortion levels for the dual differential input stage are shown below.



There appears to be least a factor of two increase in the magnitude of input voltage signal. But really the dual differential input stage should be thought of as having 1% distortion at 62% of its maximum differential output current. The AB_Bias input is at about 75% of the maximum available output current at the same level of distortion.