AB_BIAS_DIFF_Thd_MX

```
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*
```
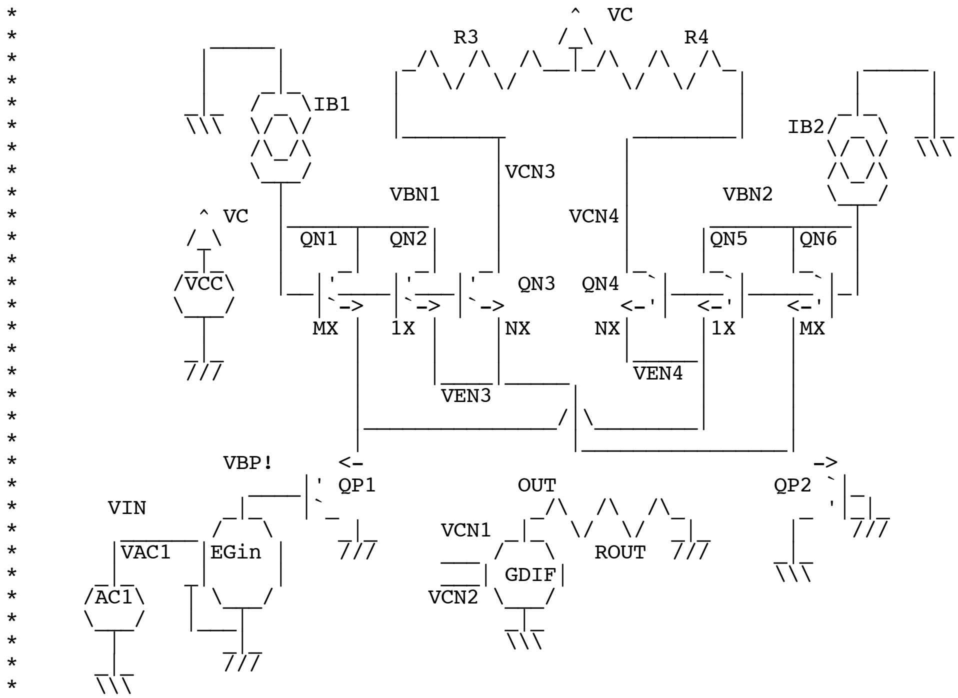




```
*
*

.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

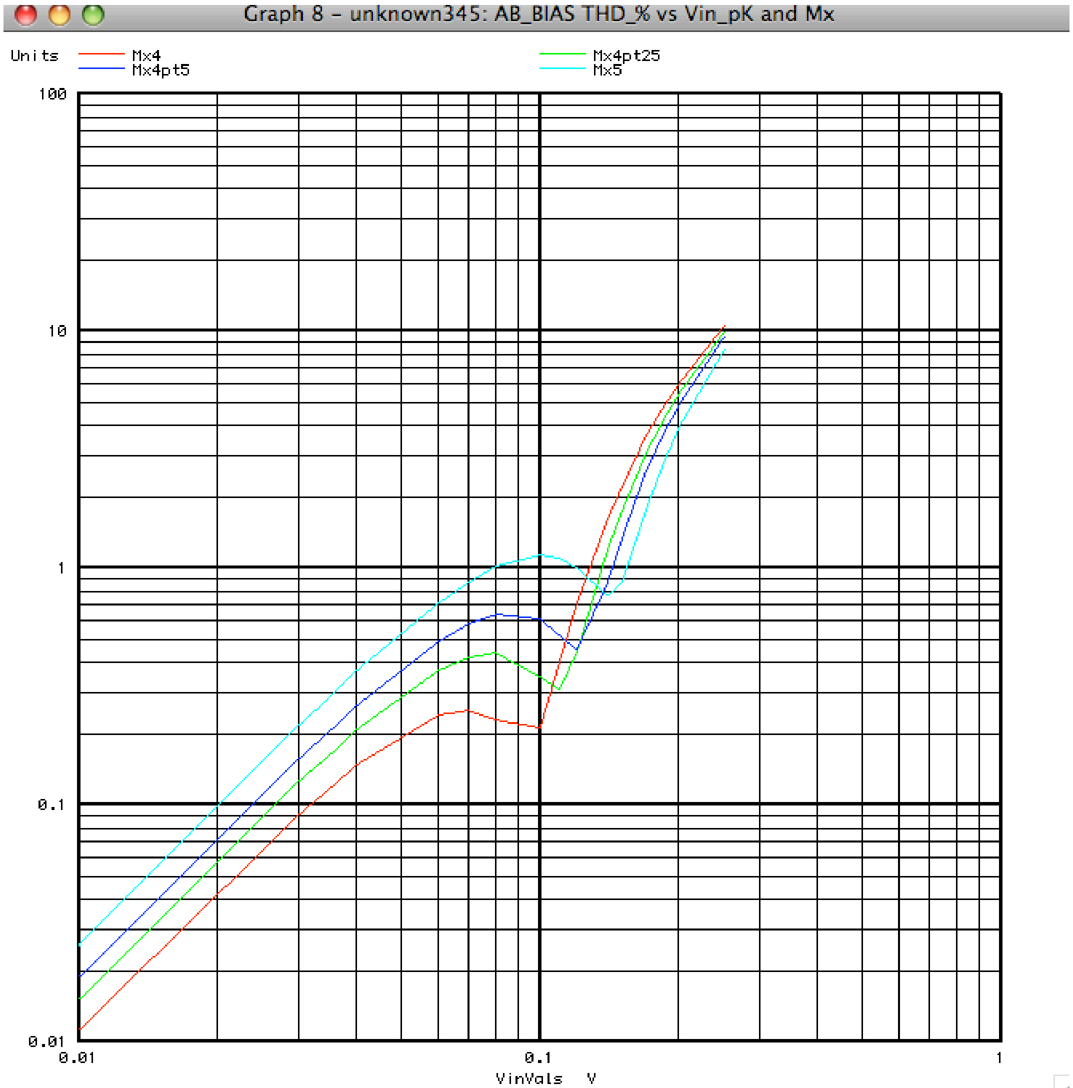
This simulation only works on MacSpice for now.
Data in spice apparently gets stored in vectors which
are ready to be plotted.

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.

```
*
*                                           ^  VC
*               _____              R3      /_\       R4
*              |     |         _/\  /\  /\__|_/\  /\  /\_          _____
*              |    _|_       |  \/  \/        \/  \/  |        |     |
*             _|_  / _ \IB1   |                          |       _|_    |
*             \\\  \/ \/      |________          ________|   IB2/ _ \  _|_
*                  /\_/\              |          |              \/ \/  \\\
*                  \___/              |VCN3      |              /\_/\
*                    |       VBN1     |          |      VBN2    \___/
*              ^ VC  |___________     |     VCN4|      ___________|
*             /_\    | QN1 |  QN2|    |         |     |QN5   |QN6 |
*             _|_    |    _|    _|   _|         |_    |_     |_   |
*            /VCC\   |__|'____|'___|'   QN3  QN4  `|____`|_____`|_|
*            \___/      |`->  |`-> |`->         <-'|  <-'|   <-'|
*              |        MX |  1X |    |NX     NX|     |1X    |MX
*             _|_          |     |    |         |_____|      |
*             ///          |     |____|_____     VEN4 |      |
*                          |      VEN3      |         |      |
*                          |_______________/|\________|      |
*                          |                |________________|
*                VBP!     <-                                   ->
*                  ____|' QP1           OUT                 QP2 `|_
*       VIN      _|_   |`_               _/\  /\  /\_         _ '|_|_
*        ______ /   \     _|_     VCN1 _|_  \/  \/  _|_      |    ///
*       |VAC1  |EGin |    ///     ___ /   \   ROUT  ///      |
*      _|_    _|     |            ___| GDIF|                _|_
*     /AC1\   | \___/            VCN2 \___/                 \\\
*     \___/   |___|                    _|_
*       |        _|_                   \\\
*      _|_       ///
*      \\\
```

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.

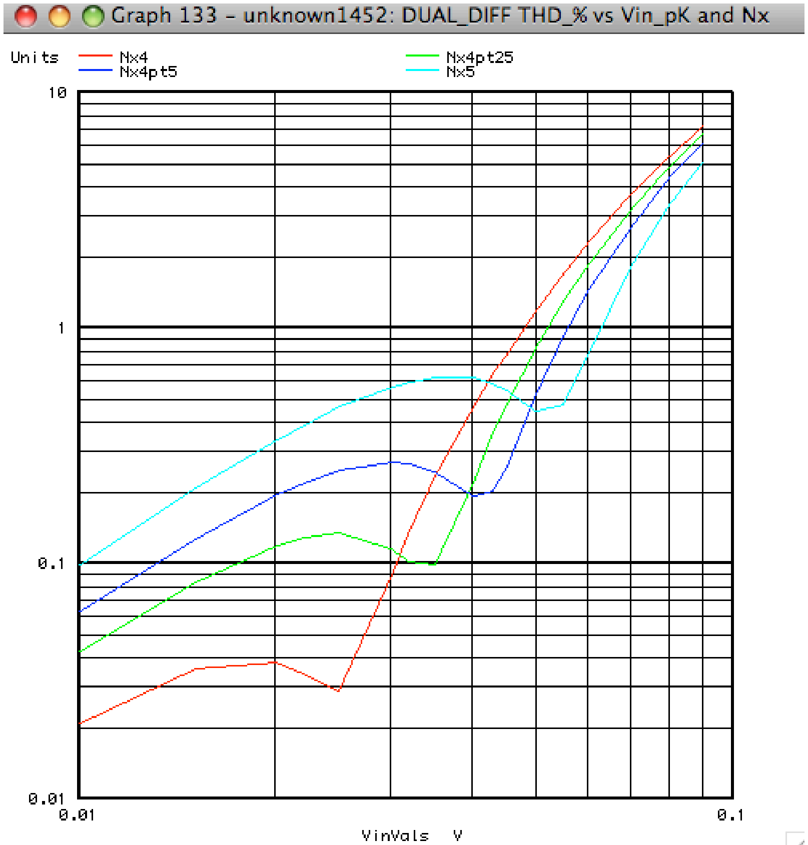
A invention above is doing this with two area ratios. The NX ratio term defines a current gain which is possible to take place in output transistors QN3 and QN4. The MX term defines what DC current is present with no input signal.



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.