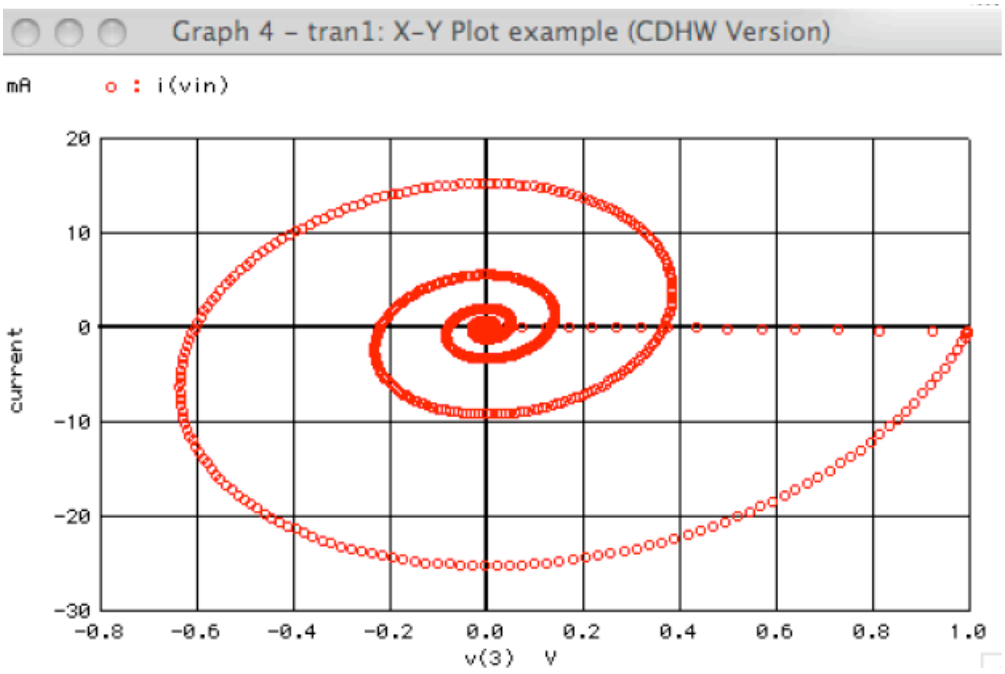
*==========Curve_Tracer_Tests==========

Sometimes both simulations and real silicon will give out the exact same unexpected result. This is what happened while building the following LapTop curve-tracer.

http://www.idea2ic.com/LapTop_CurveTracer/LaptopCurve/BiCMOS_LapTop_CurveTracer.html

While working with Charles Williams, who is the developer of MacSpice, it was discovered that plotting X vs Y plots in MacSpice did not behave the same as they did on an oscilloscope. There was this strange blanking of the X/Y curve. This meant that one needed to view 2 dimensional relationships by using only plotting points.



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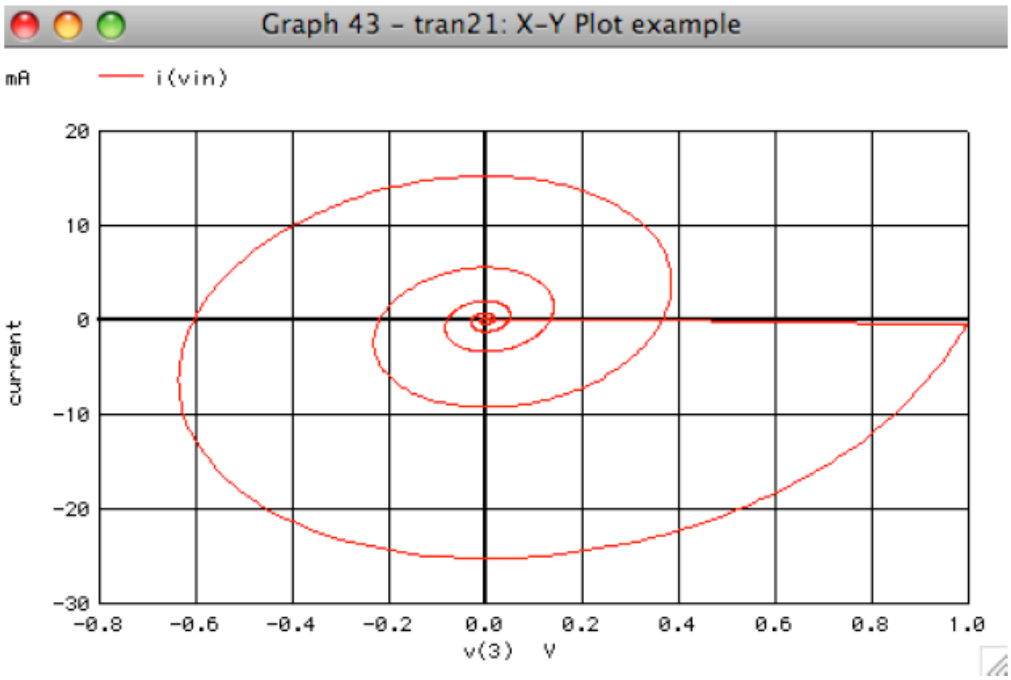
This blanking was removed quite a while ago to allow the X/Y plots to look much better.



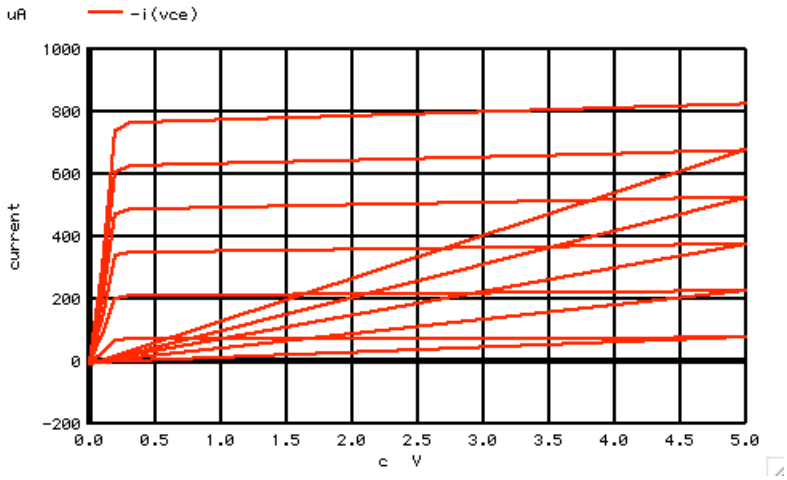
==========

Just recently, it became apparent why the line blanking feature was there in the first place. Now an old simulation of an NPN on the curve tracer no longer produces the same result.

==========

```
NPN_CurveTracer
*
*     _____
*    |     |   StairCase                 _________
*    |     |                            |         |  VCE
*    |    _|_                           |C        |_|_
*    |   /   \  IB                      |        /   \
*   _|_  \   /  |                     _|_       \2v /
*   ///  \_/\_/  V                    |   |npn1   \_/  Ramp
*    |    \_/     B                   |   |`->     |
*    |     |                          |   |        |
*    |_____|__________                |   |        |
*                     |               |___|________|
*                                       |
*                                      ///
*========SetUp=========================================================
VCE       C       0       DC      2V
IB        0       B       DC      10u
Q1        C       B       0       NPN1
*========Run_and_Plot==================================================
.control
*========Vsweep=Start=Stop==StepBy=Isweep=Start=Stop==StepBy=======
dc        vce     0V      5V      0.1V    ib      1uA     10uA    2uA
set       pensize = 2
plot      -i(vce)         vs      c
```

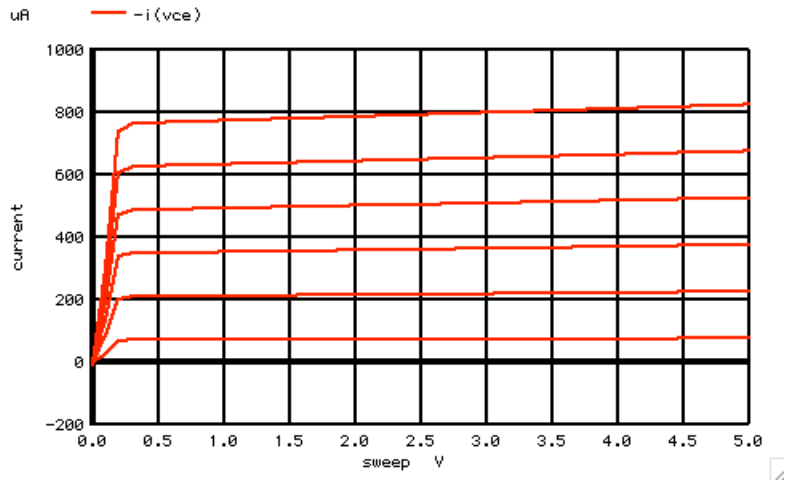
==========



The laptop curve tracer circuit produces the exact same result if the collector voltage is seeing a sawtooth.
It turns out that curve tracers don't sweep collector voltages with a sawtooth, but rather with half wave sine waves. The laptop curve tracer needed to be modified to use a triangle wave.

But spice creates something like a sweep voltage which does not have the flyback. This sweep voltage is set to be the default x axis for sweep plots.
Simply plotting only collector current produces the correct results.

```
================================================================================
plot     -i(vce)
```



The sweep is actually the collector voltage from the spice statment.

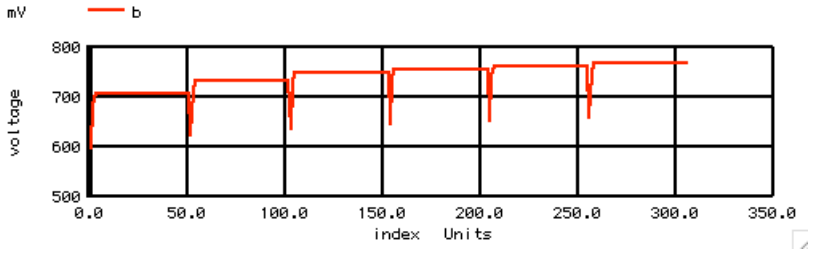
```
*========Vsweep=Start=Stop==StepBy=Isweep=Start=Stop==StepBy=======
dc       vce    0V    5V    0.1V   ib     1uA   10uA  2uA
```

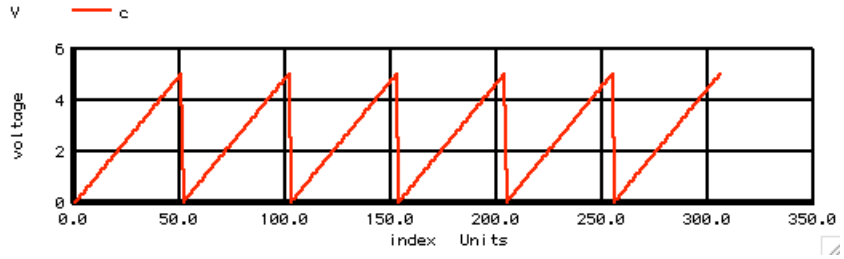
The display statement shows what waveforms get generated during an NPN curve-tracer sweep.

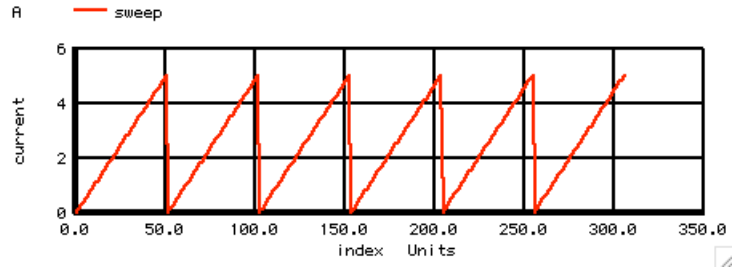
```
==========================================================================
display

==========================================================================
    b                   : voltage, real, 306 long
    c                   : voltage, real, 306 long
    sweep               : voltage, real, 306 long [default scale]
    vce#branch          : current, real, 306 long

==========================================================================
```

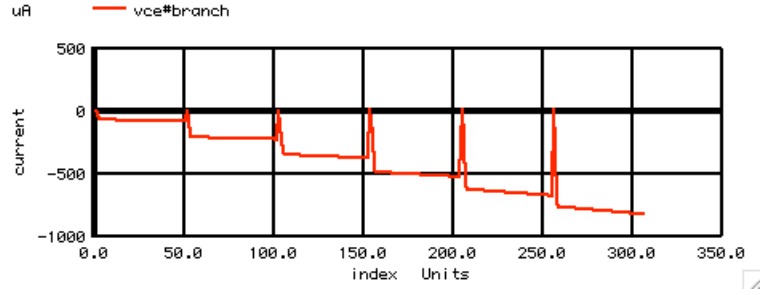
If one wants to take a better look at all the waveforms, one needs to construct an index array to be applied to the X direction.

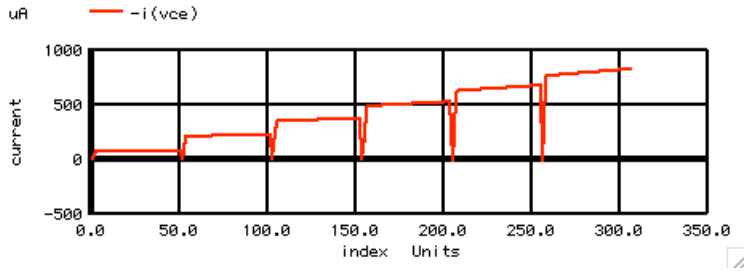
```
*=======Look_At_Array=============================================
let      num =        length(sweep)
compose  index        start = 1 stop = $&num step =1
plot     b            vs index
plot     c            vs index
plot     sweep        vs index
plot     vce#branch   vs index
plot    -i(vce)       vs index

==========================================================================
```











==========

```
NPN_CurveTracer
*
*      _____
*     |     |  StairCase                 _________
*     |     |_|_                        |         | VCE
*     |   /   _ \ IB                    |C        |_|_
*    _|_  \  / \/ |                   _|_        /2v \
*    ///  /\_/\ V                  __|'  npn1    \___/ Ramp
*         \___/      B           |  |`->
*           |                    |  |   0
*           |____________________|  |_________|
*                                  _|_
*                                  ///
```

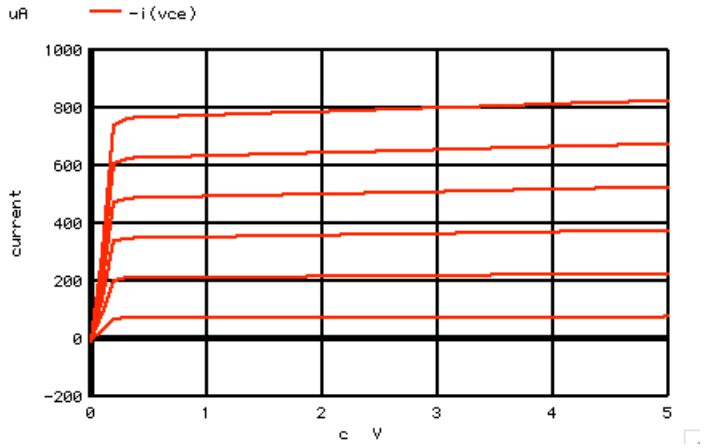
But as Charles suggested, perhaps the most correct thing to do is to assign the collector voltage as the default x scale.

==========

```
setscale   c
display
plot   -i(vce)
```

==========

```
    b                   : voltage, real, 306 long
    c                   : voltage, real, 306 long [default scale]
    index               : notype,  real, 306 long
    num                 : notype,  real, 1   long
    sweep               : voltage, real, 306 long
    vce#branch          : current, real, 306 long
```



This way the x axis gets correctly label as the collector voltage node.

==========Full_Netlist_For_Copy_Paste==========

```
NPN_CurveTracer
*
*      _____
*     |     |  StairCase                 _________
*     |     |_|_                        |         | VCE
*     |   /   _ \ IB                    |C        |_|_
*    _|_  \  / \/ |                   _|_        /2v \
*    ///  /\_/\ V                  __|'  npn1    \___/ Ramp
*         \___/      B           |  |`->
*           |                    |  |   0
*           |____________________|  |_________|
*                                  _|_
*                                  ///
```

```
*
*
*========SetUp=================================================
VCE       C       0      DC     2V
IB        0       B      DC     10u
Q1        C       B      0      NPN1
*========Run_and_Plot=========================================
.control
*========Vsweep=Start=Stop==StepBy=Isweep=Start=Stop==StepBy=======
dc        vce     0V     5V     0.1V   ib      1uA    10uA   2uA
*Plot====Collector_I==========================================
set       pensize = 2
plot      -i(vce)
display

*=======Look_At_Array=========================================
let      num = length(sweep)
compose index start = 1 stop = $&num step =1

plot     b            vs index
plot     c            vs index
plot     sweep        vs index
plot     vce#branch   vs index
plot    -i(vce)       vs index

plot    -i(vce)       vs c

setscale    c
display
plot    -i(vce)


.endc
.model    NPN1                NPN(    BF=70    VAF=60 )
.END
*plot      -i(vce)             vs      c      pointplot


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```