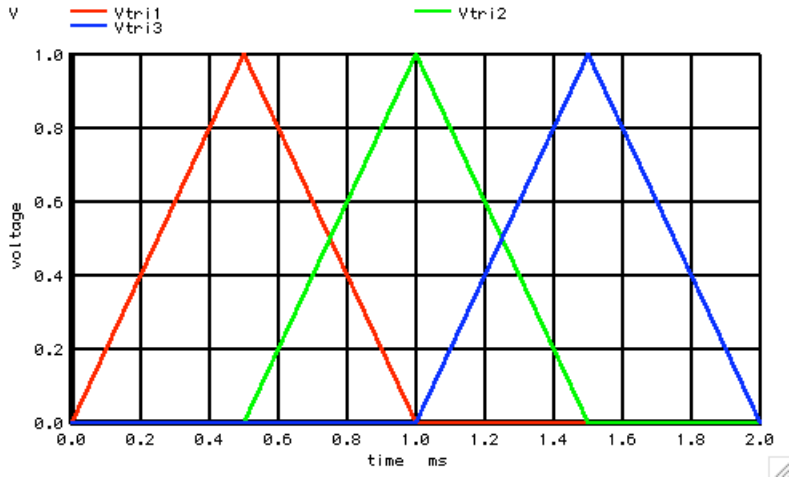
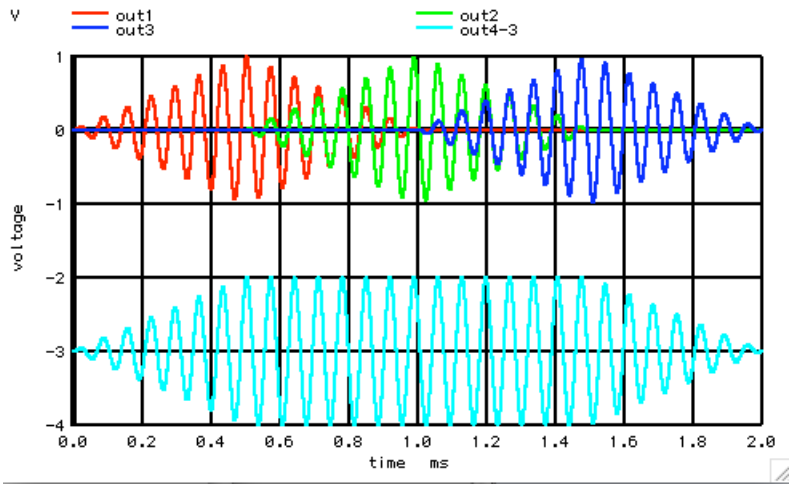
*==========Dual_Purpose_Windowing==========

The FFT transform has the disadvantage that most real signals have changing spectrums over time. Spectrums of voice or music really need to looked over short periods to time because much of the information is encoded as when the spectrum changes.

One convenient way to create small windows of time is to ramp up and ramp down a signal's amplitude.

```
=========================================================================
*V_SIN#    NODE_P  NODE_N DC     VALUE   SIN(    V_DC    AC_MAG FREQ    DELAY   FDamp)
Vsig       Vsig    0      DC     0       SIN(    0       1      14.4k       )
Vtri1      Vtri1   0      DC     0       PWL(    0       0                      .5m    1     1m    0  )
Vtri2      Vtri2   0      DC     0       PWL(    0       0      0.5m      0      1m    1     1.5m  0  )
Vtri3      Vtri3   0      DC     0       PWL(    0       0      1.0m      0      1.5m  1     2.0m  0  )
Btri1      OUT1    0      V =    V(Vsig)*V(Vtri1)
Btri2      OUT2    0      V =    V(Vsig)*V(Vtri2)
Btri3      OUT3    0      V =    V(Vsig)*V(Vtri3)
Btri4      OUT4    0      V =    V(OUT1) +V(OUT2) +V(OUT3)
```



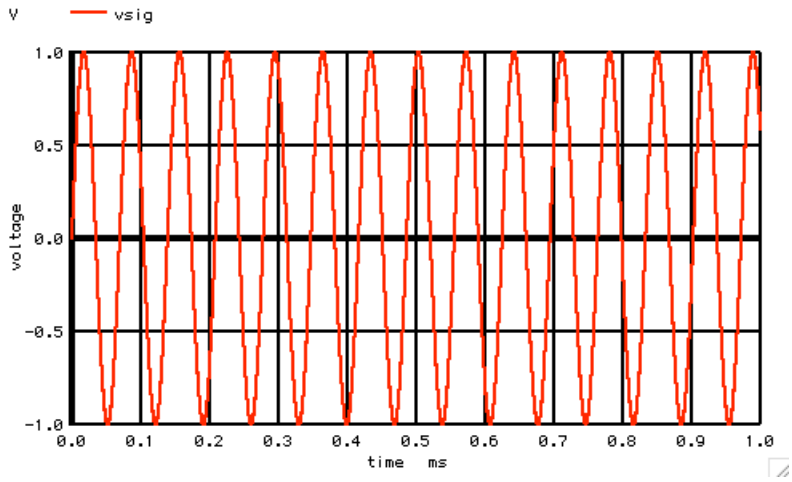


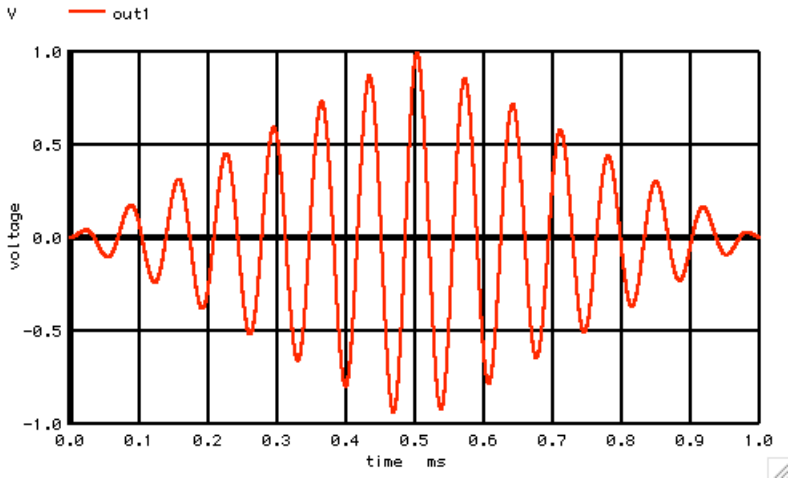
Overlapping the ramp up and down windows allows a signal to be split into separate time periods which can easily be put back together.

There is another problem if the signal does not contain a whole number of cycles in the sample period. This causes the spectrum output to leak across the whole spectrum.

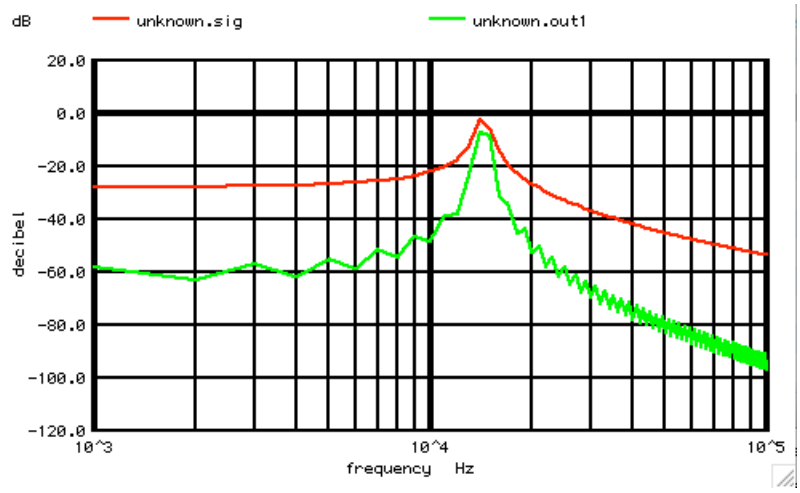
==========

```
*V_SIN#    NODE_P  NODE_N DC     VALUE  SIN(   V_DC   AC_MAG FREQ   DELAY  FDamp)
Vsig       Vsig    0      DC     0      SIN(   0      1      14.4k       )
```





The process of ramping up and down the input signal also tends to reduce this Spectrum Leakage as well.



The triangle window is good for overlapping simplicity.
And it also greatly improves the Spectrum leakage issues.
The Hanning window, which uses more of a cosine window,
can show in better detail what is going on.

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

```
Dual_Purpose_Windowing
.Option srcsteps = 1 set Gmin = 1.0000E-02
*=======Circuit_Netlist=========================
*V_SIN#    NODE_P  NODE_N DC     VALUE  SIN(   V_DC   AC_MAG FREQ   DELAY  FDamp)
Vsig       Vsig    0      DC     0      SIN(   0      1      14.4k       )
Vtri1      Vtri1   0      DC     0      PWL(   0      0                        .5m    1    1m    0  )
Vtri2      Vtri2   0      DC     0      PWL(   0      0      0.5m      0      1m    1    1.5m  0  )
Vtri3      Vtri3   0      DC     0      PWL(   0      0      1.0m      0      1.5m  1    2.0m  0  )
Btri1      OUT1    0      V =    V(Vsig)*V(Vtri1)
Btri2      OUT2    0      V =    V(Vsig)*V(Vtri2)
Btri3      OUT3    0      V =    V(Vsig)*V(Vtri3)
Btri4      OUT4    0      V =    V(OUT1) +V(OUT2) +V(OUT3)

.control
*TRAN      TSTEP   TSTOP  TSTART TMAX ?UIC?

tran       .1u     2m     0      .1u
set        pensize = 2
plot       Vtri1 Vtri2 Vtri3
plot       out1 out2 out3  out4-3

setplot    new
let       "sig"    =     0*vector(100)
let       "out1"   =     0*vector(100)

tran      .1u       1m    0      .1u
plot      vsig
set       specwindow=   "rectangular"
spec      1k        100k   1k     v(vsig)
let       unknown.sig =      dB(mag(v(vsig)))

tran      .1u       1m    0      .1u
plot      out1
set       specwindow=   "rectangular"
spec      1k        100k   1k     v(out1)
let       unknown.out1 =     dB(mag(v(out1)))

plot      unknown.sig   unknown.out1  vs frequency xlog ylimit -120 20

.endc
.end
```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