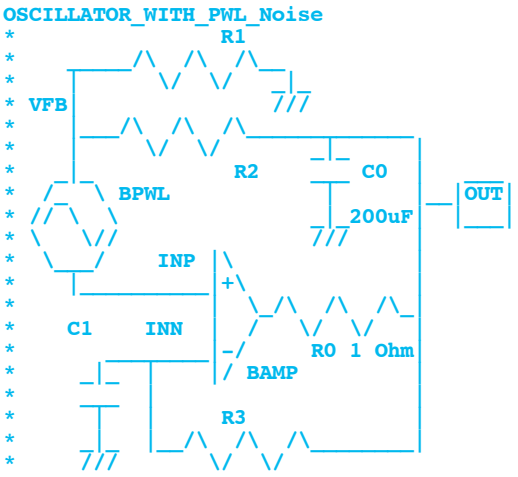
*=======TRANSIENT_OSCILLATOR_PHASE_NOISE_SPECTRUM==========

Adding a piece wise linear noise source to a free running oscillator can show how the noise maps to jitter or PM or to a spectrum.

In this case a 2second/1kHz BW random PWL file is created.

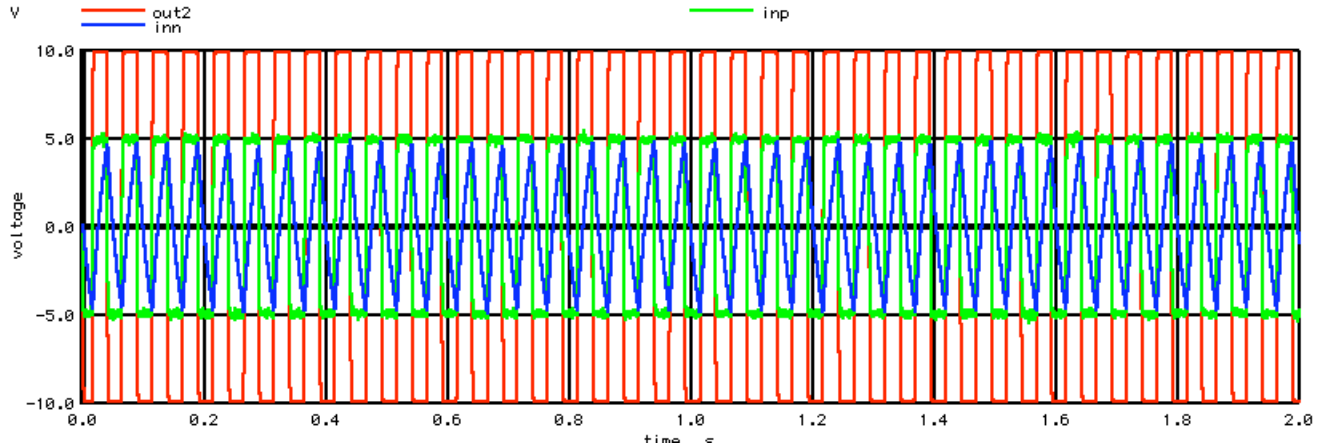



```
* VpwlT OUT 0        PWL( + 0.0005 0.988835 +.....
*=========Include_Noise_File=================================================
.include  PWL_File.inc
Rload     OUT    0       1k
BAMP      OUT1   0       V =    9.9*tanh( (V(INP)-V(INN))*10)
R0        OUT1   OUT2    1
C0        OUT2   0       500u
R1        VFB    0       1K
R2        VFB    OUT2    1K
R3        INN    OUT2    2.49K
BPWL      INP    VFB     V =    .1*V(OUT)
C1        INN    0       9.415u IC= .1
*=========Run_Simulation=====================================================
*TRAN     TSTEP  TSTOP   TSTART TMAX      ?UIC?
.tran     5u     2       0      5u        UIC
.control
run
set       pensize =      2
plot      out2   inp     inn
*============================================================================
```

Noise from BPWL is applied to one of the inputs of the amplifier BAMP. Amplifier BAMP is clipping its output at +/- 10Volts.

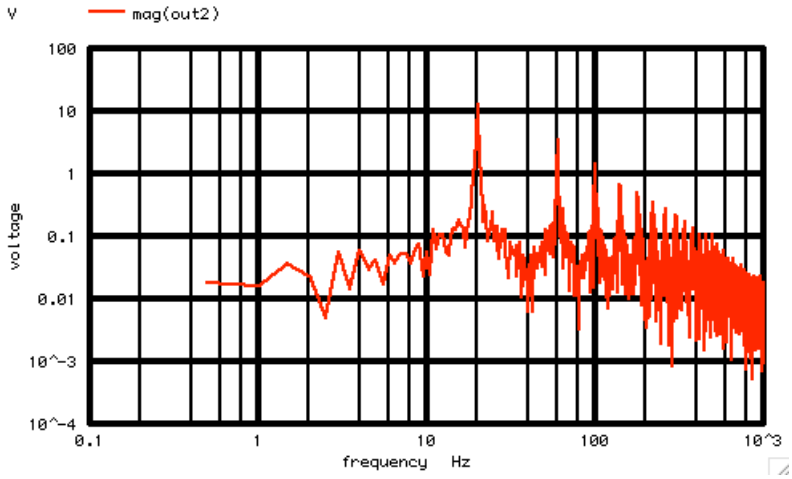
Capacitor C1 is toggling between +/- 5volts. Noise source BPWL is messing up the timing. So in this case C1 has been adjusted to produce 40 whole cycles within 2 seconds.

Noise source BPWL is receiving a random 1VRMS signal with a bandwidth of 1KHz. This has been scaled down to +/- 100mV rms.



The Noise source BPWL can be seen on the inp input. But its PM effects are hard to see. A spectrum can show the details.

```
*=========Find_Spectrum=================================================
linearize
set        specwindow=    "none"
spec       .5     1k      .5     v(out2)
plot       mag(out2)  loglog
plot       mag(out2)  loglog xlimit 10 100 ylimit  .001 100
*=========Wrap_Up=======================================
.endc
.end
*=======================================================================
```



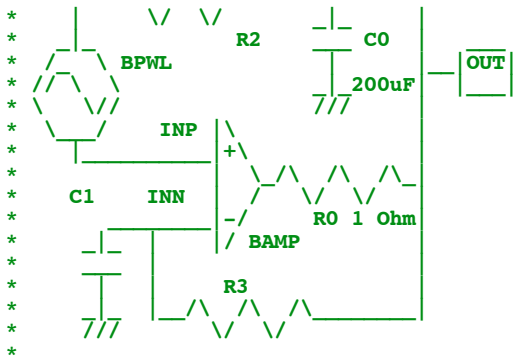
The actual noise is appearing close to the peak signals at 20Hz and 60Hz and 100Hz, etc. Since white noise was applied, the slope of the adjacent noise sidebands around 20Hz drop in power to the 1/f^2 as they get farther away from 20Hz. The same is true for all the odd harmonics.

But it is also possible to get the same plot by doing a jitter plot on this oscillator, and then creating a PWL file which will be used to phase modulate a 20Hz signal. This will produce a spectrum which is very close.

And it is possible to map how the noise gets around to producing its sidebands at its magnitude and at its frequency.

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

```
OSCILLATOR_WITH_PWL_Noise
*                R1
*          _____/\  /\  /\__
*     ____|     \/  \/    _|_
* VFB|                    ///
*    |___/\  /\  /\_____________
```




```
* Vpwl1 OUT 0        PWL( + 0.0005 0.988835 +.....
*=========Include_Noise_File=========================================================
.include  PWL_File.inc
Rload     OUT    0      1k
BAMP      OUT1   0      V =    9.9*tanh( (V(INP)-V(INN))*10)
R0        OUT1   OUT2   1
C0        OUT2   0      500u
R1        VFB    0      1K
R2        VFB    OUT2   1K
R3        INN    OUT2   2.49K
BPWL      INP    VFB    V =    .1*V(OUT)
C1        INN    0      9.415u IC= .1
*=========Run_Simulation=============================================================
*TRAN     TSTEP  TSTOP  TSTART TMAX      ?UIC?
.tran     5u     2      0      5u        UIC
.control
run
set       pensize =     2
plot      out2   inp    inn
*=========Find_Spectrum==============================================================
linearize
set       specwindow=   "none"
spec      .5    1k      .5    v(out2)
plot      mag(out2)  loglog
plot      mag(out2)  loglog xlimit 10 100 ylimit  .001 100
*=========Wrap_Up=====================================================
.endc
.end
```

2.18.10_12.15PM
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