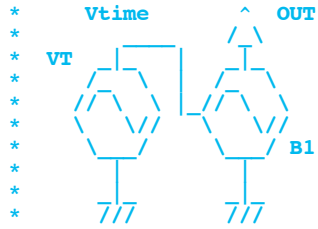


=====**PWM\_WithOut\_PM\_Spectrum**=====

Being able to view pure AM or pure PM spectrums makes it possible to see that there might be a way to perform Pulse Width Modulation on a square wave which actually does not introduce any Phase Modulation.

```
PWM_Without_PM_spec
* dsauersanjose@aol.com 2.12.10_1.26PM
* www.idea2ic.com
*
```

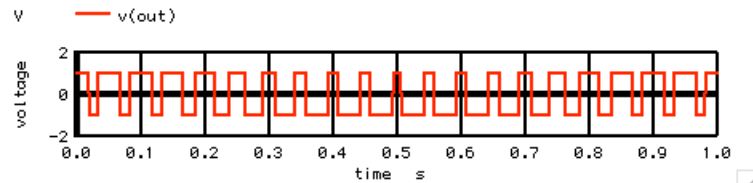


```
VP      VP      0      DC      3.141592653589793
VT      VT      0      PWL      ( 0 0 1 1 )
B1      TRI     0      V =     acos(cos(2*v(VP)*20*v(VT)))/v(VP)
B2      OUT     0      V =     2*u(1-v(TRI)*2 + .5*cos(2*v(VP)*1*v(VT)) )-1
```

=====**Run Simulation**=====

```
.tran .1m 1 0 .1m
.control
run
set pensize = 2
plot v(out)
```

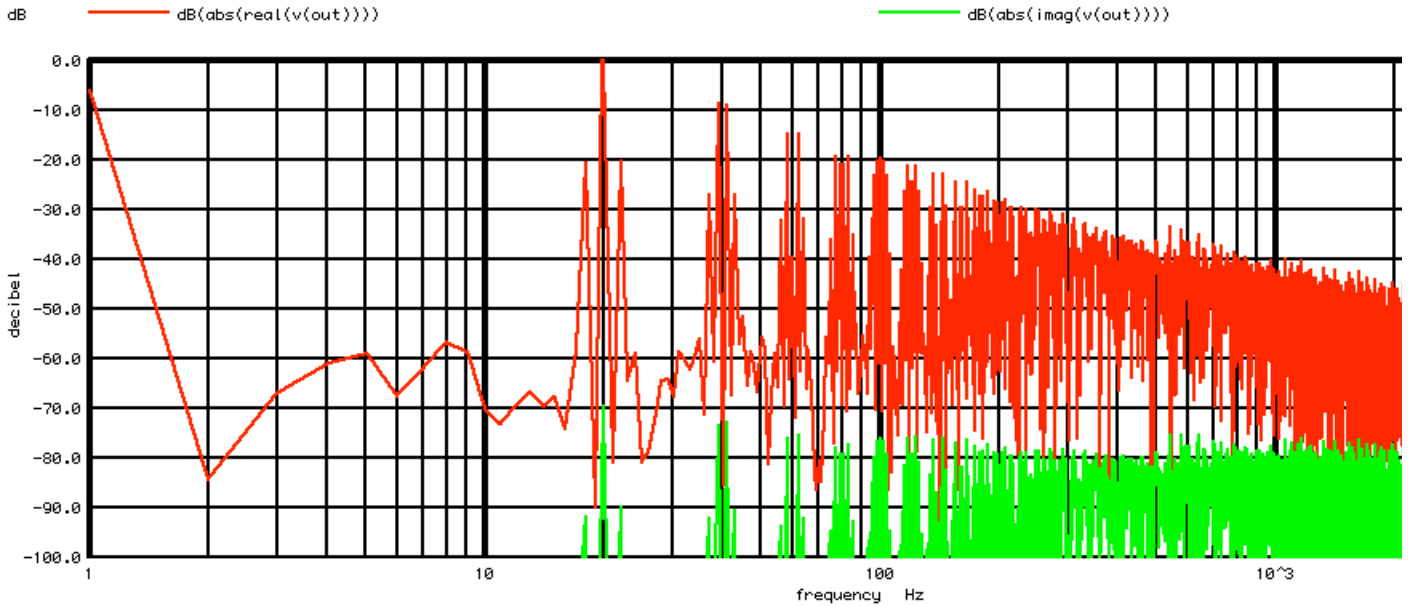
In this case, a **20Hz** square wave is PWM with a **1Hz** sine wave.



=====**Find Spectrum**=====

```
linearize
set specwindow= "none"
*SPEC FSTART FSTOP FSTEP VECTOR
spec 1 5k 1 v(out)
set pensize = 2
plot dB(abs(real(v(out)))) dB(abs(imag(v(out)))) xlog ylimit -100 0
```

=====



This simulation is designed to output most everything on the spectrum as real.

```

=====Print Spectrum=====
foreach ii 1 2 3 4 5 18 19 20 21 22 38 39 40 41 42 58 59 60 61 62 78 79 80 81 92 98 99 100 101 102
let i = $ii
let fr= frequency[i-1]
let vfftr = real(v(out)[i-1])
let vffti = imag(v(out)[i-1])
echo freq= $&fr real= $&vfftr imag= $&vffti
end
=====

```

All of the sidebands are performing amplitude modulation. Most of the PWM is being done by the second harmonic of the output square wave under going amplitude modulation. And there is some 1Hz signal in the output as well.

Most of the other sidebands appear to be under going AM to keep the square shape of the PWM output.

Circuit: PWM\_Without\_PM\_spec

```

freq = 1 real = 0.50062 imag = 7.54917E-06
freq = 2 real = -6.00044E-05 imag = -1.80969E-09
freq = 3 real = 0.000454372 imag = 2.05553E-08
freq = 4 real = 0.000881114 imag = 5.31475E-08
freq = 5 real = 0.0011215 imag = 8.45587E-08
freq = 18 real = -0.0924626 imag = -2.50969E-05
freq = 19 real = -3.18749E-05 imag = -9.13247E-09
freq = 20 real = 1.08389 imag = 0.000326885
freq = 21 real = 9.01494E-05 imag = 2.85469E-08
freq = 22 real = -0.0947299 imag = -3.14259E-05
freq = 38 real = 0.000943628 imag = 5.40676E-07
freq = 39 real = -0.361751 imag = -0.000212728
freq = 40 real = -5.32073E-05 imag = -3.20906E-08
freq = 41 real = -0.360042 imag = -0.000222579
freq = 42 real = -0.000429113 imag = -2.71747E-07
freq = 58 real = 0.179944 imag = 0.00015735
freq = 59 real = -0.000618368 imag = -5.50045E-07
freq = 60 real = -0.0102989 imag = -9.3162E-06
freq = 61 real = 0.000252182 imag = 2.31919E-07
freq = 62 real = 0.180187 imag = 0.000168424
freq = 78 real = -0.000738199 imag = -8.67956E-07
freq = 79 real = 0.0910715 imag = 0.000108451
freq = 80 real = 0.000338961 imag = 4.08754E-07
freq = 81 real = 0.0891658 imag = 0.000108868

```

So does this mean there is **No Phase Modulation** using this method of PWM?

=====**Full\_Netlist\_For\_Copy\_Paste**=====

PPWM\_Without\_PM\_spec

\* dsauersanjose@aol.com 2.12.10\_1.26PM

\* www.idea2ic.com

\*

\*

\* Vtime OUT

\* VT

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VP VP 0 DC 3.141592653589793

VT VT 0 PWL ( 0 0 1 1 )

B1 TRI 0 V = acos(cos(2\*v(VP)\*20\*v(VT)))/v(VP)

B2 OUT 0 V = 2\*u(1-v(TRI)\*2 + .5\*cos(1\*v(VP)\*2\*v(VT)) )-1

\*=====**Run\_Simulation**=====

.tran .1m 1 0 .1m

.control

run

set pensize = 2

plot v(out)

\*=====**Find\_Spectrum**=====

linearize

set specwindow= "none"

spec 1 5k 1 v(out)

set pensize = 2

plot dB(abs(real(v(out)))) dB(abs(imag(v(out)))) xlog ylimit -100 0

\*=====**Print\_Spectrum**=====

foreach ii 1 2 3 4 5 18 19 20 21 22 38 39 40 41 42 58 59 60 61 62 78 79 80 81 92 98 99 100 101 102

let i = \$ii

let fr= frequency[i-1]

let vfftr = real(v(out)[i-1])

let vffti = imag(v(out)[i-1])

echo freq= \$&fr real= \$&vfftr imag= \$&vffti

end

.endc

.end

2.12.10\_3.00PM

dsauersanjose@aol.com

Don Sauer

<http://www.idea2ic.com/>