



```

echo      n=   $&n   out_rise= $&t
let      n =   n +1
endif
if      ( vpm1[i] > 0 & vpm1[i+1] < 0)
let      t =   time[i]
let      anysize[n]= t
echo      n=   $&n   out_fall= $&t
let      n =   n +1
endif
let      i =   i +1
endrepeat
let      n3 =  n -1

```

---

The MacSpice printout is as follows.

Circuit: Period\_Jitter\_Plot

```

n = 0  out_fall = 0.0091024
n = 1  out_rise = 0.0602024
n = 2  out_fall = 0.112902
n = 3  out_rise = 0.167002
n = 4  out_fall = 0.222202
n = 5  out_rise = 0.277702
n = 6  out_fall = 0.332902
n = 7  out_rise = 0.387002
n = 8  out_fall = 0.439702
n = 9  out_rise = 0.490802
n = 10 out_fall = 0.540402
n = 11 out_rise = 0.588502
n = 12 out_fall = 0.635402
n = 13 out_rise = 0.681602
n = 14 out_fall = 0.727202
n = 15 out_rise = 0.772702
n = 16 out_fall = 0.818302
n = 17 out_rise = 0.864502
n = 18 out_fall = 0.911402
n = 19 out_rise = 0.959502
n = 20 out_fall = 1.0091
n = 21 out_rise = 1.0602
n = 22 out_fall = 1.1129
n = 23 out_rise = 1.167
n = 24 out_fall = 1.2222
n = 25 out_rise = 1.2777
n = 26 out_fall = 1.3329
n = 27 out_rise = 1.387
n = 28 out_fall = 1.4397
n = 29 out_rise = 1.4908
n = 30 out_fall = 1.5404
n = 31 out_rise = 1.5885
n = 32 out_fall = 1.6354
n = 33 out_rise = 1.6816
n = 34 out_fall = 1.7272
n = 35 out_rise = 1.7727
n = 36 out_fall = 1.8183
n = 37 out_rise = 1.8645
n = 38 out_fall = 1.9114
n = 39 out_rise = 1.9595

```

---

Now that the number of edge data points are known, some new arrays can be created to store and plot the results.

This further can get processed to find time periods which can then be plotted.

```

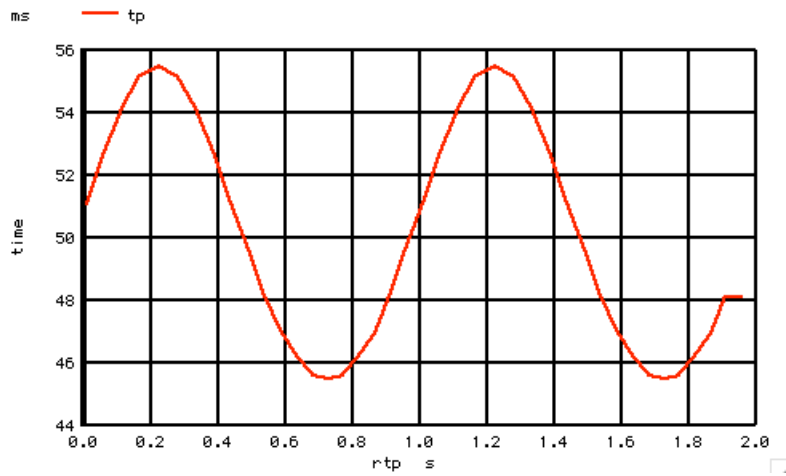
*=====Create_Edge_Time_Arrays=====
compose tp      start = 0 stop = $&n3 step =1
compose tpac    start = 0 stop = $&n3 step =1
compose td      start = 0 stop = $&n3 step =1
compose tdac    start = 0 stop = $&n3 step =1
compose rtp     start = 0 stop = $&n3 step =1
*=====Transfer_Arrays=====
let      i = 0
repeat  $&n
let      rtp[i] = anysize[i]
let      i = i +1
endrepeat
let      i = 0

```

```

let      n2 = n -1
repeat  $&n2
let      tp[i] = rtp[i+1] -rtp[i]
let      i = i +1
endrepeat
let      tp[n2] = tp[n2-1]
plot     td vs rtp

```



In this case **rtp** stands for **time reference point**. That is the time between when the transitions happen. The value **tp** stands for **time period**. This is the actual time between edges.

The edge to edge period for a 10Hz square wave is 50msec on the average.

It is easy to do some further math on the data.

```

*=====Remove Average Time Period=====

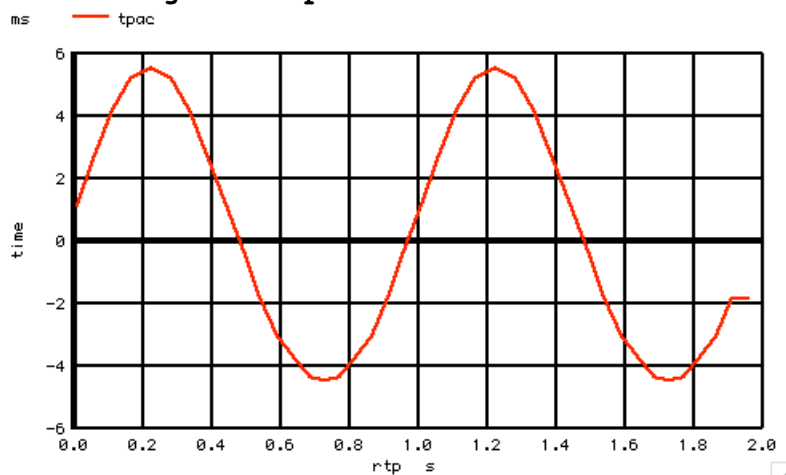
```

```

let      tpave = mean(tp)
let      tpac = tp -tpave
plot     tpac vs rtp

```

The average time period can be subtracted out.



Note, modulating the time period is in effect Frequency modulation.

```

*=====Convert FM to PM=====

```

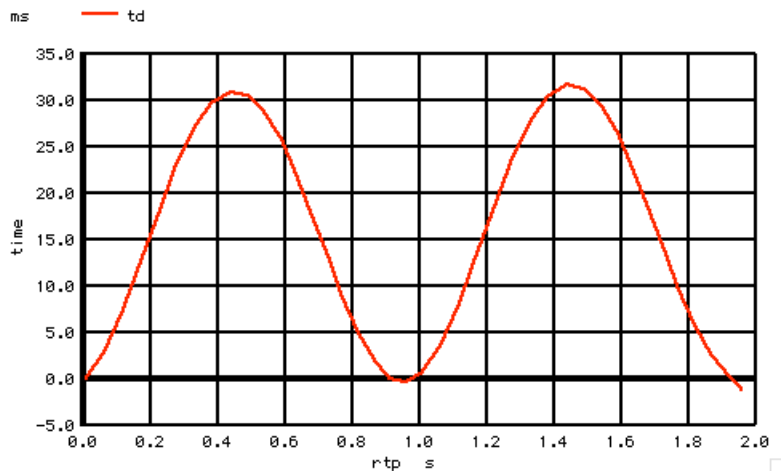
```

let i = 1
let n2 = n -1
repeat  $&n2
let      td[i] = td[i-1] +tpac[i]
let i = i +1

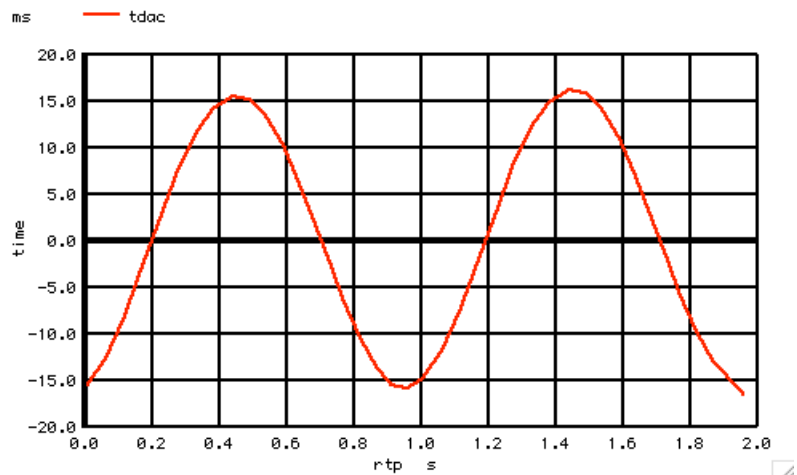
```

```
endrepeat
plot    td    vs    rtp
```

To see the resulting phase shift in terms of time, all the time periods need to be added up.



```
=====Remove Average Phase=====
let    tdave = mean(td)
let    tdac  = td -tdave
plot   td    vs    rtp
plot   tdac  vs    rtp
=====
.endc
.end
=====
```



Here **rtp** stands for a reference time point. This is the time when either a rising or falling edge happens.

The delay **tdac** represents the time between the actual edge compared to a perfect 10Hz square wave.

Math says that the delay should be about **+/- 1 radians** which should be about **+/- 16msec**. The plot shows about the same number.

```
Period_Jitter_Plot
* dsauersan jose@aol.com 2.15.10 4.38PM
* www.idea2ic.com        replace(OPT-SPACE)=>SPACE
*
* [OUT] +/- 1radian/6.28318 = +/- 16% of 100msec
* [ ]
* [ ]
```



```
let      tpac = tp -tpave
plot     tpac vs rtp
*=====Convert_FM_to_PM=====  
let i = 1  
let n2 = n -1  
repeat  $&n2  
let     td[i] = td[i-1] +tpac[i]  
let i = i +1  
endrepeat  
plot    td     vs rtp  
*=====Remove_Average_Phase=====  
let     tdave = mean(td)  
let     tdac  = td -tdave  
plot    tdac  vs rtp  
  
.endc  
.end
```

2.12.10\_2.55PM  
dsauersanjose@aol.com  
Don Sauer  
<http://www.idea2ic.com/>