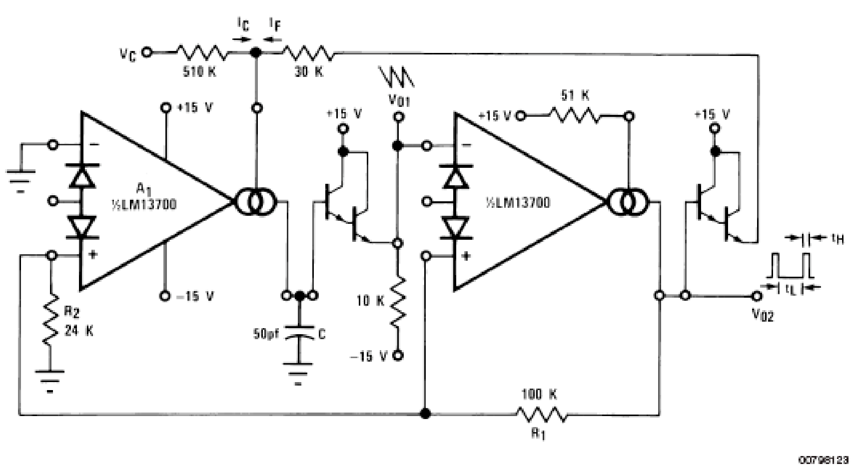
```
OTA_TRI_SQUAR
* dsauersanjose@aol.com  10/07/08
* www.idea2ic.com
*
*                               IABC1=.5m0
*        IABC0   = .1mA->0
*
*      ____|\      OUT0  |\   _______|\          |\ VOUT1
*   _|_  + | \/\/\______ |  \_|  INN1 |  \/\/\______|  \__
*   \\\  __| /\/\/  _|_  |  /     __| /\/\/   |  |  /
*      |   |/           |/      |    |/        |  |/
*      |  B_OTA0   _|_    200PF  |     B_OTA1   |
*      |           \\\ C0       |              |
*      |_______________________|______________|
*                             |   INP1
*        _/\  /\  /\__|
*      _|_   \/  \/
*      \\\           5K
*
.OPTIONS  GMIN=1e-18       METHOD=trap   srcsteps = 1  gminsteps = 1 trtol=1 VNTOL=1m
V_Iabc0   VIABC0      0      PWL     ( 0 .1m  1m 0 )
B_OTA0    OUT0        0      I =    -1*(v(VIABC0)+v(VHI))*tanh( v(INP1)/.052)
C0        OUT0        0      2000p    IC=1
B_BUF0    INN1        0      V =     v(OUT0)
V_Iabc1   VIABC1      0      DC .5m
B_OTA1    INP1        0      I =    -1*v(VIABC1)*tanh( (v(INP1)-v(INN1)) /.052)
R1        INP1        0      5k
B_BUF1    VOUT1       0      V =     v(INP1)
Cstray    INP1        0      15p
B_U       VHI         0      V =   u(V(INP1))*1m
.tran     .1u          1m     0       .1u    UIC

.control
run
set pensize = 2
plot  v(inp1) v(out0)
.endc

.end
```

=====================END_OF_SPICE============================

To Covert PDF to plain text click below
http://www.fileformat.info/convert/doc/pdf2txt.htm
This code works with winspice.



$$V_{PK} = \frac{(V^{+} \pm 0.8V) R_2}{R_1 + R_2}$$

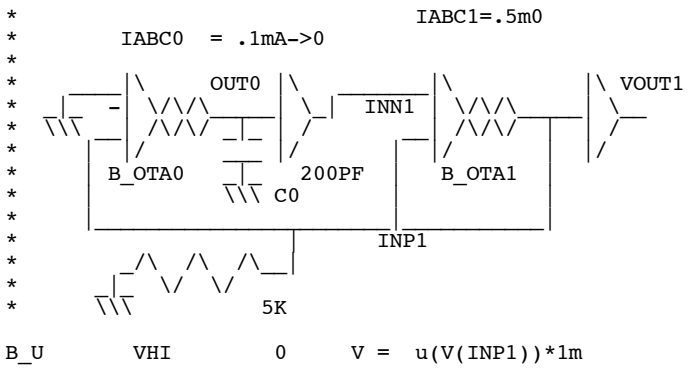
$$t_H \approx \frac{2V_{PK}C}{I_F}$$

$$t_L = \frac{2V_{PK}C}{I_C}$$

$$f_0 \approx \frac{I_C}{2V_{PK}C} \text{ for } I_C << I_F$$

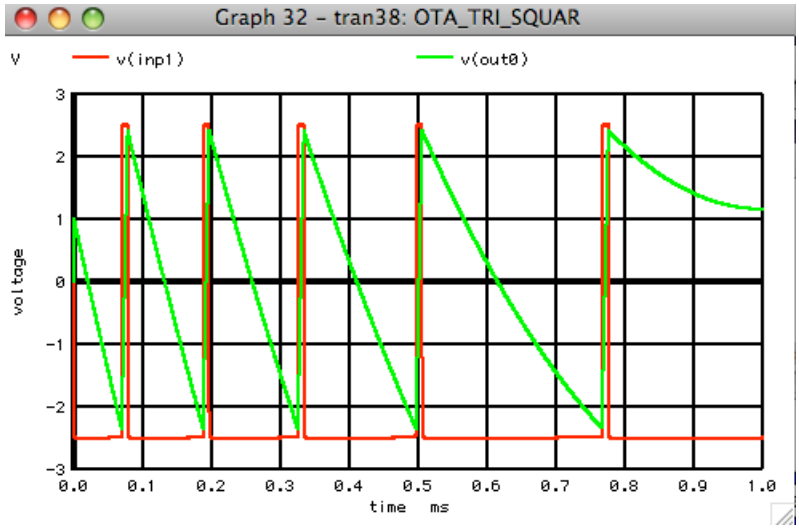
FIGURE 16. Ramp/Pulse VCO

The following is attempt to come close to the schematics in the LM13700 data sheet.




```
B_U       VHI        0     V =  u(V(INP1))*1m
```

While not the same, the circuit above may show a more straight forward view of what is going on. In this simulation the value at INP1 is being monitored as to when to goes positive. In this case the current to IABC0 is increased.



The LM13700 has the ability to linearly control all types of timing over six order of magnitude. Its frequency response is limited to the speed to lateral PNPs. In BiCMOS today, that can be twelve orders of magnitude up to the GHz range.