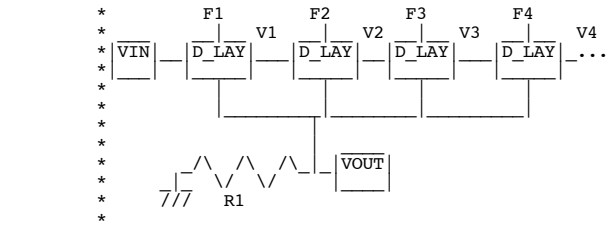
==========FIR_Hilbert_SquareWave==========

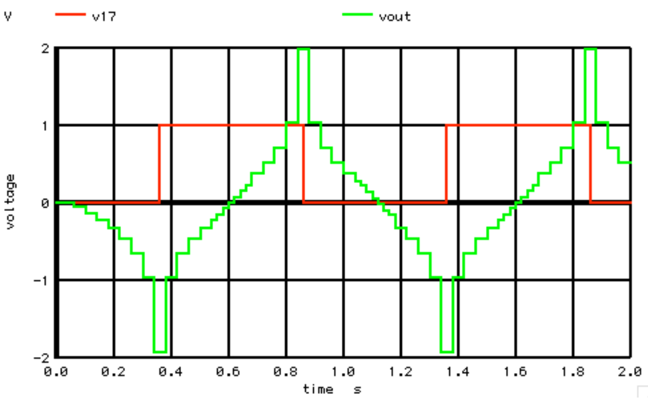


The sanity check for the Hilbert response is a correct square wave response.

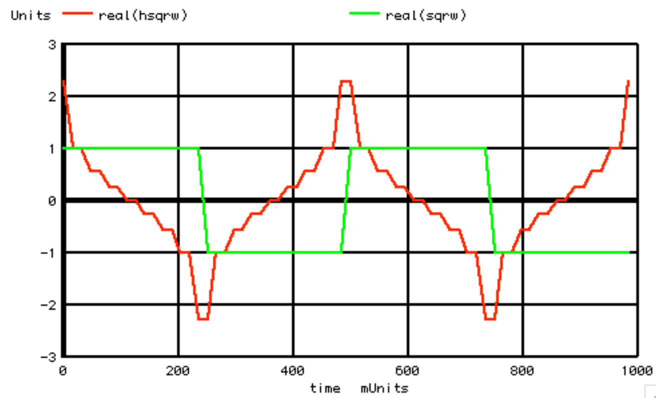
```
XZ_DLAY    VIN    VINZ   CLK              Z_DLAY
XS_DLAY1   VINZ   V1     VOUT   CLK  F17N S_DLAY
XS_DLAY2   V1     V2     VOUT   CLK  F16N S_DLAY
XS_DLAY3   V2     V3     VOUT   CLK  F15N S_DLAY
XS_DLAY4   V3     V4     VOUT   CLK  F14N S_DLAY
XS_DLAY5   V4     V5     VOUT   CLK  F13N S_DLAY
XS_DLAY6   V5     V6     VOUT   CLK  F12N S_DLAY
XS_DLAY7   V6     V7     VOUT   CLK  F11N S_DLAY
XS_DLAY8   V7     V8     VOUT   CLK  F10N S_DLAY
XS_DLAY9   V8     V9     VOUT   CLK  F9N  S_DLAY
XS_DLAY10  V9     V10    VOUT   CLK  F8N  S_DLAY
XS_DLAY11  V10    V11    VOUT   CLK  F7N  S_DLAY
XS_DLAY12  V11    V12    VOUT   CLK  F6N  S_DLAY
XS_DLAY13  V12    V13    VOUT   CLK  F5N  S_DLAY
XS_DLAY14  V13    V14    VOUT   CLK  F4N  S_DLAY
XS_DLAY15  V14    V15    VOUT   CLK  F3N  S_DLAY
XS_DLAY16  V15    V16    VOUT   CLK  F2N  S_DLAY
XS_DLAY17  V16    V17    VOUT   CLK  F1   S_DLAY
XS_DLAY18  V17    V18    VOUT   CLK  F2   S_DLAY
XS_DLAY19  V18    V19    VOUT   CLK  F3   S_DLAY
XS_DLAY20  V19    V20    VOUT   CLK  F4   S_DLAY
XS_DLAY21  V20    V21    VOUT   CLK  F5   S_DLAY
XS_DLAY22  V21    V22    VOUT   CLK  F6   S_DLAY
XS_DLAY23  V22    V23    VOUT   CLK  F7   S_DLAY
XS_DLAY24  V23    V24    VOUT   CLK  F8   S_DLAY
XS_DLAY25  V24    V25    VOUT   CLK  F9   S_DLAY
XS_DLAY26  V25    V26    VOUT   CLK  F10  S_DLAY
XS_DLAY27  V26    V27    VOUT   CLK  F11  S_DLAY
XS_DLAY28  V27    V28    VOUT   CLK  F12  S_DLAY
XS_DLAY29  V28    V29    VOUT   CLK  F13  S_DLAY
XS_DLAY30  V29    V30    VOUT   CLK  F14  S_DLAY
XS_DLAY31  V30    V31    VOUT   CLK  F15  S_DLAY
XS_DLAY32  V31    V32    VOUT   CLK  F16  S_DLAY
XS_DLAY33  V32    V33    VOUT   CLK  F16  S_DLAY
VF1        F1     0      DC     0
VF2        F2     0      DC     +0.318
VF3        F3     0      DC     +0.000
VF4        F4     0      DC     +0.106
VF5        F5     0      DC     +0.000
VF6        F6     0      DC     +0.064
VF7        F7     0      DC     +0.000
VF8        F8     0      DC     +0.045
VF9        F9     0      DC     +0.000
VF10       F10    0      DC     +0.035
VF11       F11    0      DC     +0.000
VF12       F12    0      DC     +0.029
VF13       F13    0      DC     +0.000
VF14       F14    0      DC     +0.025
VF15       F15    0      DC     +0.000
VF16       F16    0      DC     +0.020
VF17       F17    0      DC     +0.000
VF1N       F1N    0      DC     0
VF2N       F2N    0      DC     -0.318
VF3N       F3N    0      DC     -0.000
VF4N       F4N    0      DC     -0.106
VF5N       F5N    0      DC     -0.000
VF6N       F6N    0      DC     -0.064
VF7N       F7N    0      DC     -0.000
VF8N       F8N    0      DC     -0.045
VF9N       F9N    0      DC     -0.000
VF10N      F10N   0      DC     -0.035
VF11N      F11N   0      DC     -0.000
VF12N      F12N   0      DC     -0.029
VF13N      F13N   0      DC     -0.000
VF14N      F14N   0      DC     -0.025
VF15N      F15N   0      DC     -0.000
VF16N      F16N   0      DC     -0.020
VF17N      F17N   0      DC     -0.000
*TRAN      TSTEP  TSTOP  TSTART TMAX   ?UIC?
.tran      30u    1      0      30u    UIC
.control
run
set        pensize = 2
plot       v17    vout
.endc
```

```
*         F1        F2       F3        F4
*        __|__ V1   __|__ V2 __|__ V3  __|__  V4
*|VIN|__|D_LAY|___|D_LAY|__|D_LAY|___|D_LAY|_...
*|___|  |_____|   |_____|  |_____|   |_____|
*
*          |_________|________|_________|
*                    |
*                    |
*     _/\  /\  /\_|_|VOUT|
*    _|_   \/  \/    |____|
*    ///    R1
*
```

In this case, care was not given to both phase and magnitude of the impulse response. The actual FIR square wave response is shown on the left. The FFT square wave response is shown on the right.

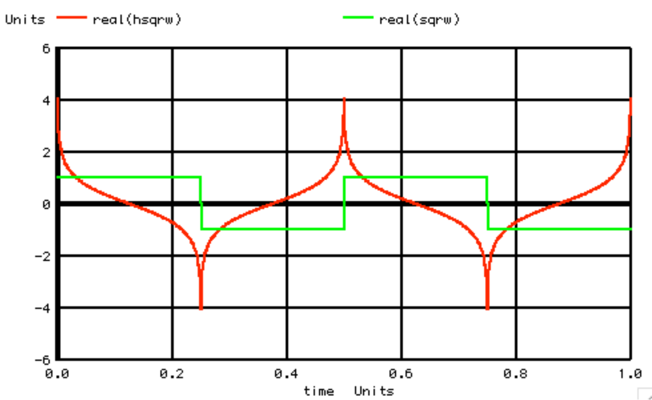


Finite Impulse Response



64 point FFT/IFFT

So if care was not given to both phase and magnitude of the impulse response, it will display its self as a difference in gain and phase as expected.

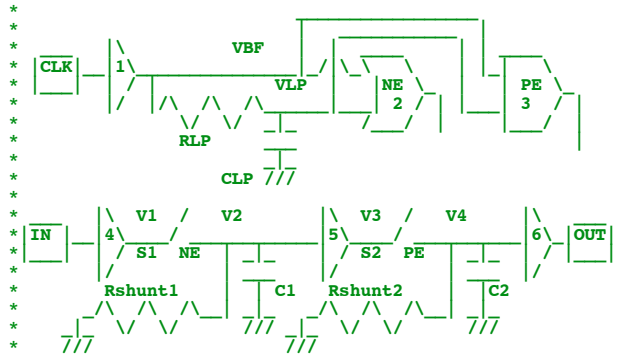


Add enough delay elements, and the square way response will approach perfection.

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

```
FIR_Hilbert_Squarewave
*         F1        F1       F1        F1
*
*        __|__ V1   __|__ V2 __|__ V3  __|__  V4
*|VIN|__|D_LAY|___|D_LAY|__|D_LAY|___|D_LAY|_...
*|___|  |_____|   |_____|  |_____|   |_____|
*
*          |_________|________|_________|
*                    |
*                    |
*     _/\  /\  /\_|_|VOUT|
*    _|_   \/  \/    |____|
*    ///    R1
*


*=========Create_Signal=================
*V_PULSE  NODE_P NODE_N DC     VALUE  PULSE( VINIT  VPULSE TDELAY TRISE  TFALL  PWIDTH PERIOD )
VIN       VIN    0      DC     0      PULSE( 0      1      10u    10u    10u     .5    1 )
VT        VT     0      DC     0      PWL(   0      0      100    100)
VFIN      FIN    0      DC     1
VFC       FC     0      DC     1
VFS       FS     0      DC     50

BVCLK     CLK    0      V      =  u(sin(6.283*V(FS)*V(VT)))
BF12      F12A   0      V      =  2*sin(3.14*V(FC)/V(FS))

VF1       F1     0      DC     0
VF2       F2     0      DC     +0.318
VF3       F3     0      DC     +0.000
VF4       F4     0      DC     +0.106
```

```
VF5       F5     0      DC     +0.000
VF6       F6     0      DC     +0.064
VF7       F7     0      DC     +0.000
VF8       F8     0      DC     +0.045
VF9       F9     0      DC     +0.000
VF10      F10    0      DC     +0.035
VF11      F11    0      DC     +0.000
VF12      F12    0      DC     +0.029
VF13      F13    0      DC     +0.000
VF14      F14    0      DC     +0.025
VF15      F15    0      DC     +0.000
VF16      F16    0      DC     +0.020
VF17      F17    0      DC     +0.000
VF1N      F1N    0      DC     0
VF2N      F2N    0      DC     -0.318
VF3N      F3N    0      DC     -0.000
VF4N      F4N    0      DC     -0.106
VF5N      F5N    0      DC     -0.000
VF6N      F6N    0      DC     -0.064
VF7N      F7N    0      DC     -0.000
VF8N      F8N    0      DC     -0.045
VF9N      F9N    0      DC     -0.000
VF10N     F10N   0      DC     -0.035
VF11N     F11N   0      DC     -0.000
VF12N     F12N   0      DC     -0.029
VF13N     F13N   0      DC     -0.000
VF14N     F14N   0      DC     -0.025
VF15N     F15N   0      DC     -0.000
VF16N     F16N   0      DC     -0.020
VF17N     F17N   0      DC     -0.000


XZ_DLAY   VIN    VINZ   CLK               Z_DLAY
XS_DLAY1  VINZ   V1     VOUT   CLK  F17N S_DLAY
XS_DLAY2  V1     V2     VOUT   CLK  F16N S_DLAY
XS_DLAY3  V2     V3     VOUT   CLK  F15N S_DLAY
XS_DLAY4  V3     V4     VOUT   CLK  F14N S_DLAY
XS_DLAY5  V4     V5     VOUT   CLK  F13N S_DLAY
XS_DLAY6  V5     V6     VOUT   CLK  F12N S_DLAY
XS_DLAY7  V6     V7     VOUT   CLK  F11N S_DLAY
XS_DLAY8  V7     V8     VOUT   CLK  F10N S_DLAY
XS_DLAY9  V8     V9     VOUT   CLK  F9N  S_DLAY
XS_DLAY10 V9     V10    VOUT   CLK  F8N  S_DLAY
XS_DLAY11 V10    V11    VOUT   CLK  F7N  S_DLAY
XS_DLAY12 V11    V12    VOUT   CLK  F6N  S_DLAY
XS_DLAY13 V12    V13    VOUT   CLK  F5N  S_DLAY
XS_DLAY14 V13    V14    VOUT   CLK  F4N  S_DLAY
XS_DLAY15 V14    V15    VOUT   CLK  F3N  S_DLAY
XS_DLAY16 V15    V16    VOUT   CLK  F2N  S_DLAY
XS_DLAY17 V16    V17    VOUT   CLK  F1   S_DLAY
XS_DLAY18 V17    V18    VOUT   CLK  F2   S_DLAY
XS_DLAY19 V18    V19    VOUT   CLK  F3   S_DLAY
XS_DLAY20 V19    V20    VOUT   CLK  F4   S_DLAY
XS_DLAY21 V20    V21    VOUT   CLK  F5   S_DLAY
XS_DLAY22 V21    V22    VOUT   CLK  F6   S_DLAY
XS_DLAY23 V22    V23    VOUT   CLK  F7   S_DLAY
XS_DLAY24 V23    V24    VOUT   CLK  F8   S_DLAY
XS_DLAY25 V24    V25    VOUT   CLK  F9   S_DLAY
XS_DLAY26 V25    V26    VOUT   CLK  F10  S_DLAY
XS_DLAY27 V26    V27    VOUT   CLK  F11  S_DLAY
XS_DLAY28 V27    V28    VOUT   CLK  F12  S_DLAY
XS_DLAY29 V28    V29    VOUT   CLK  F13  S_DLAY
XS_DLAY30 V29    V30    VOUT   CLK  F14  S_DLAY
XS_DLAY31 V30    V31    VOUT   CLK  F15  S_DLAY
XS_DLAY32 V31    V32    VOUT   CLK  F16  S_DLAY
XS_DLAY33 V32    V33    VOUT   CLK  F16  S_DLAY

R1        VOUT   0      3

*TRAN     TSTEP  TSTOP  TSTART TMAX   ?UIC?
.tran     30u    2     0      30u    UIC

.control
run
set       pensize = 2
plot      v17 vout

.endc
*=========Switch_Model==========================================

.MODEL    SW      SW(    VT=.5 VH=.1  RON=100m ROFF=100MEG)

*=========SCALED_DELAY==========================================
*            CLK
*
*           __|__                  ____
*  |VIN|____|D_LAY|_____________|VOUT|
*  |___|    |_____| |             |____|
*                   |      | F1
*                   | |\  V         ____
*                   |_|1\/\/\___|IOUT|
*                     |  /\/\/     |____|
*                     |/
*

.SUBCKT   S_DLAY VIN    VOUT  IOUT  CLK  F1
 XZ_DLAY  VIN    VOUT   CLK  Z_DLAY
 BOUT     IOUT   0      I  = -V(VOUT)*V(F1)
.ENDS     S_DLAY


*=========Z_DLAY=========================================
```




```
.SUBCKT   Z_DLAY VIN    OUT    CLK
 B1       VBF    0      V =    u( v(CLK )-.5 )
 RLP      VBF    VLP    10k
 CLP      VLP    0      50n    IC=0
 BNOR2    NE     0      V =    1-u( u(v(VBF )-.5)+u(.5 -v(VLP ) ) -.1)
 BAND3    PE     0      V =      u( u(v(VBF )-.5)*u(.5 -v(VLP ) ) -.1)
 B4       V1     0      V =    V(VIN)
 S1       V1     V2     NE     0    SW
 R1       V2     0      100Meg
 C1       V2     0      1u
 B5       V3     0      V =    V(V2)
 S2       V3     V4     PE     0    SW
 R2       V4     0      100Meg
 C2       V4     0      100u
 B6       OUT    0      V =    V(V4)
.ENDS     Z_DLAY

.end
```

6.7.11_1.04PM
dsauersanjose@aol.com
Don Sauer