Qspice KSKelvin Symbol Explanation

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Ideal Opamp

Qspice : Opamp_Ideal.qsym

Ideal Operation Amplifier - Overview

Qspice : ComptrOD_Ideal.qsym

- Ideal Opamp Sub-Circuit
  - opamp.sub in LTspice library

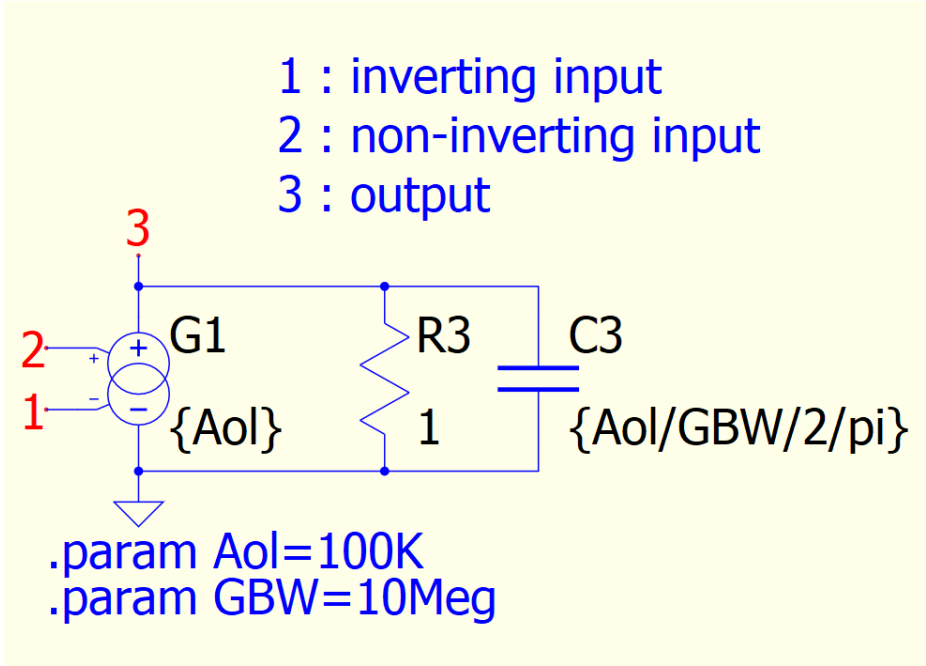

```
.subckt opamp 1 2 3
G1 0 3 2 1 {Aol}
R3 3 0 1.
C3 3 0 {Aol/GBW/6.28318530717959}
.ends opamp
```

- Opamp equivalent formula

$$V_{output} = Z(R_3, C_3) \times Aol \times I_{G1}$$

$$V_{output} = (R_3 \,//\, \frac{1}{j\omega C_3}) \times Aol \times (V_p - V_n)$$

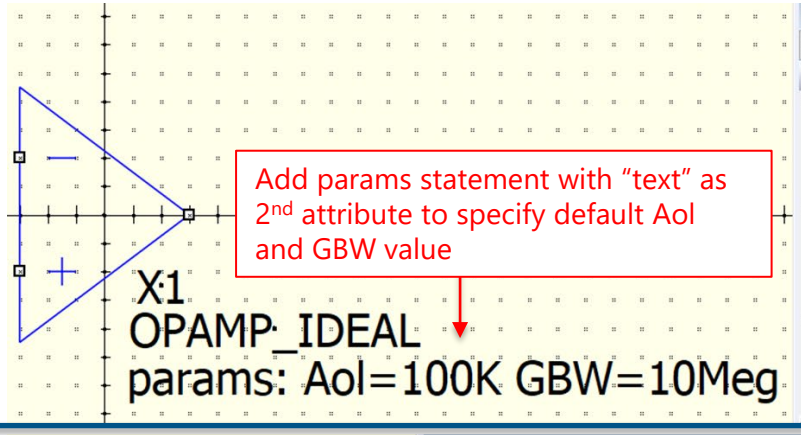
Opamp.sub Equivalent Schematic



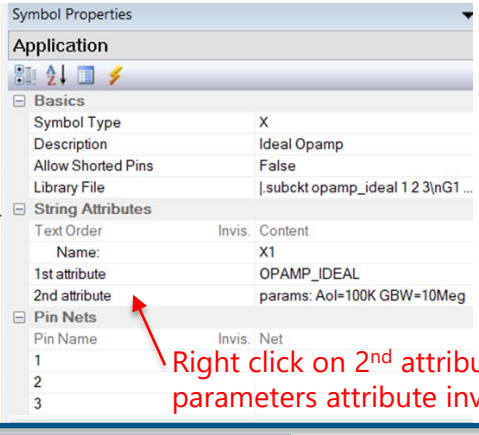
Ideal Operation Amplifier – Parameters of Symbol

Qspice : ComptrOD_Ideal.qsym

Method #1

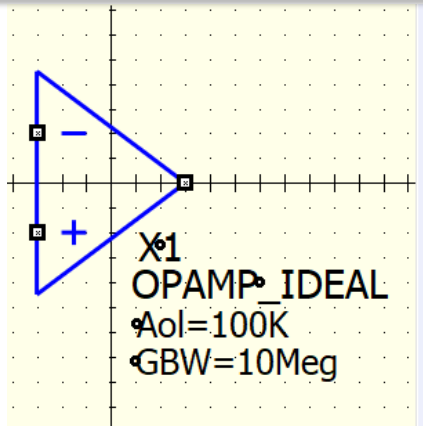


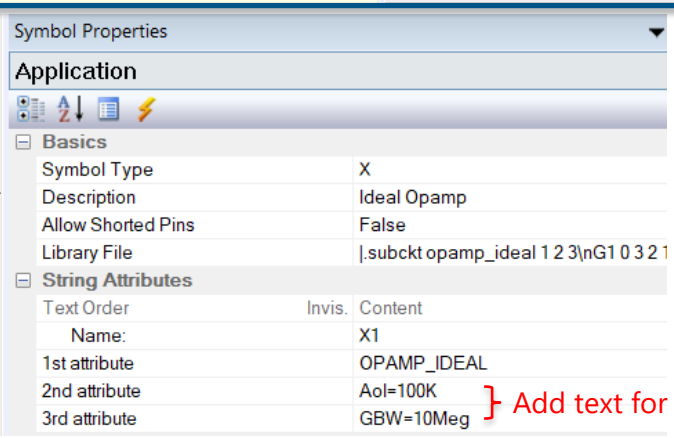
Add params statement with “text” as 2nd attribute to specify default Aol and GBW value



Right click on 2nd attribute and make parameters attribute invisible in symbol if needs

Method #2

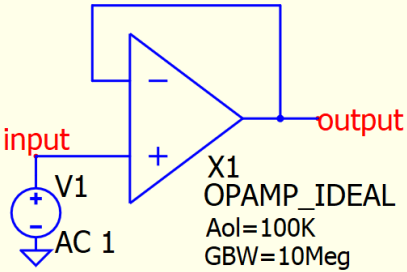




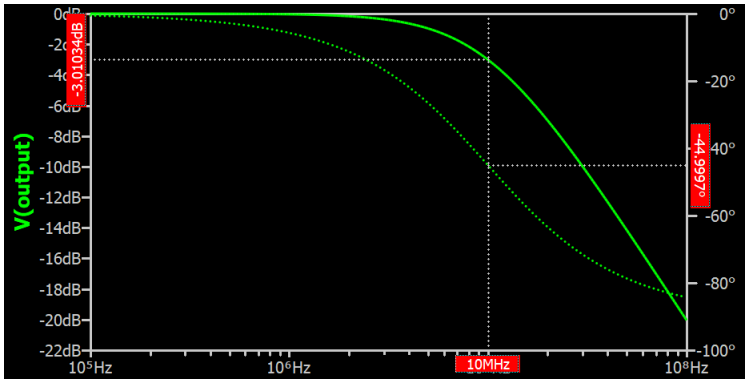
Add text for extra attribute Aol and GBW

Ideal Operation Amplifier - Simulation Example

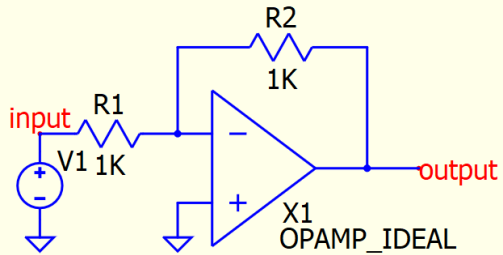
Parent - opamp_ideal (.ac).qsch



.ac dec 100 100K 100Meg
.plot ac V(out)

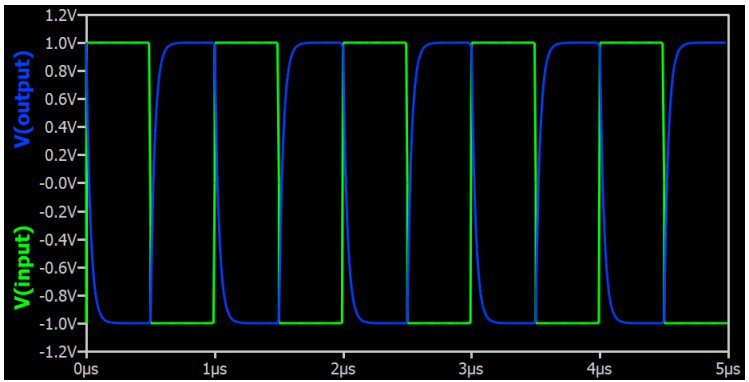


Parent - opamp_ideal (.tran).qsch



pulse -1 1 0 0 0 0.5µ 1µ

.tran 5µ .plot V(input) V(output)



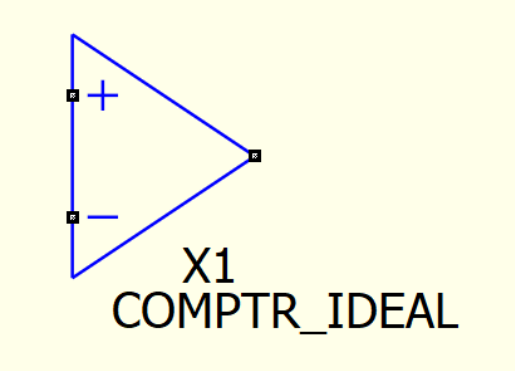
Ideal Comparator

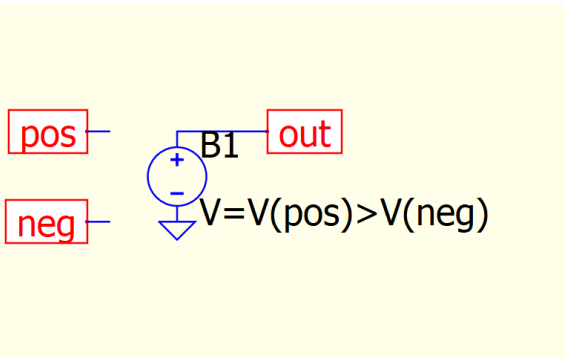
Qspice : Comptr_Ideal.qsym
Qspice : ComptrOD_Ideal.qsym
Qspice : Comptr_Ideal_Supply.qsym

3 type of Ideal Comparators Overview

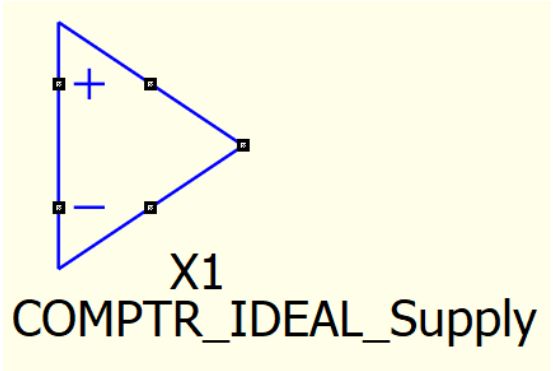
Qspice : Comptr_Ideal.qsym / Comptr_Ideal_Supply.qsym / ComptrOD_Ideal.qsym

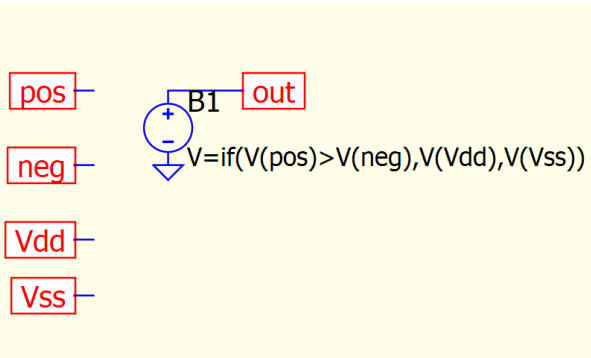
Ideal Comparator (Output 0/1)
Comptr_Ideal.qsym



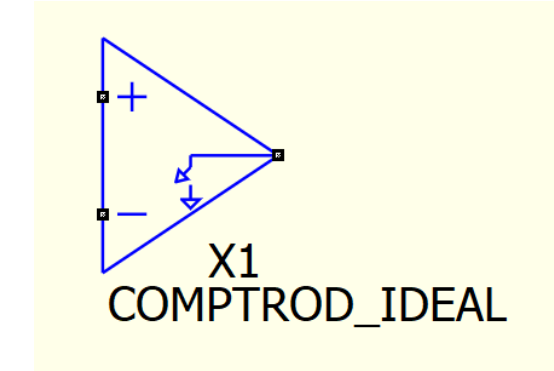


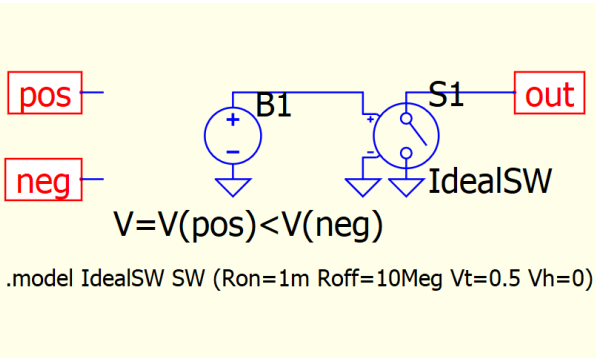
Ideal Comparator (Vdd/Vss)
Comptr_Ideal_Supply.qsym





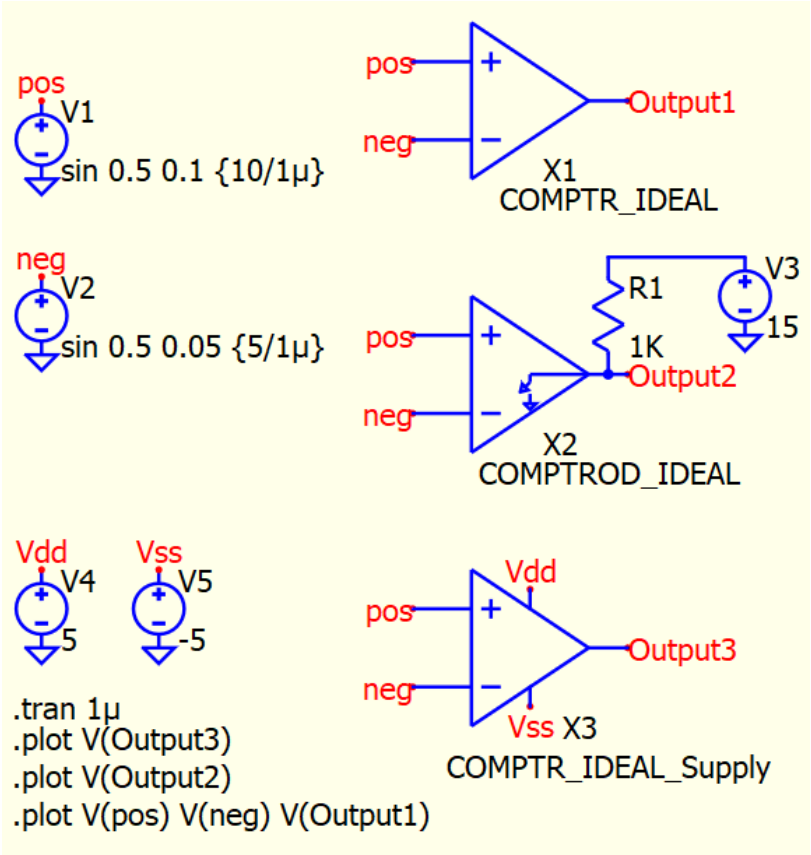
Ideal Comparator (Open Drain)
ComptrOD_Ideal.qsym

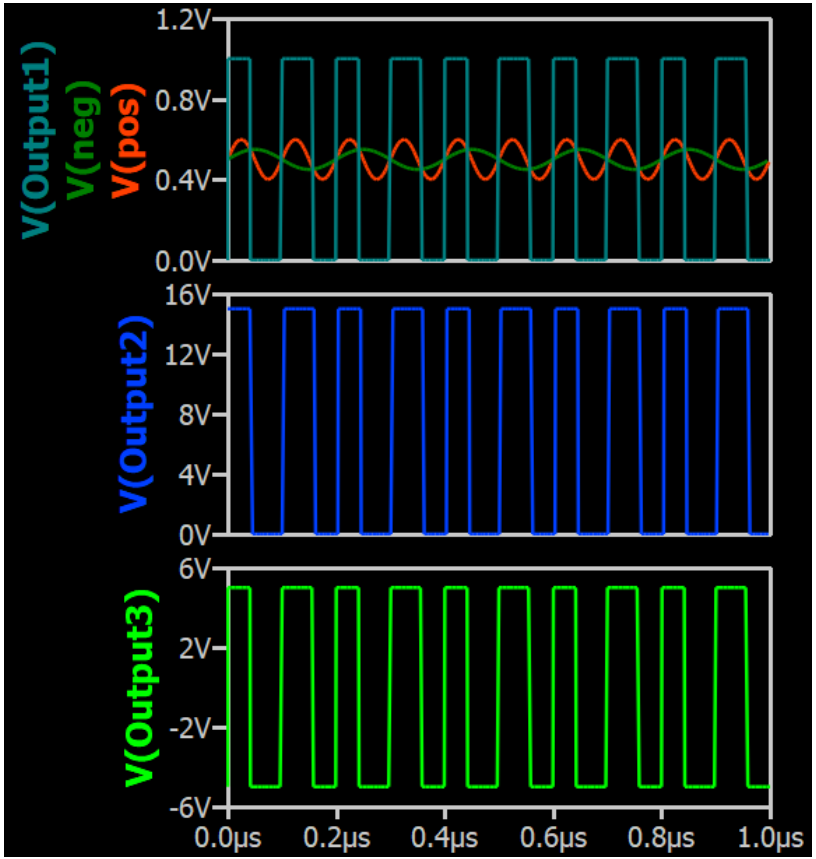




3 type of Ideal Comparators – Simulation Results

Qspice : Parent - Comparator.qsch





Control System

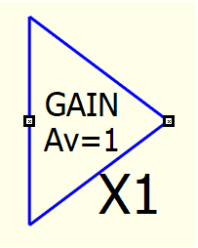
Gain, Different, PID and Signal Limiter

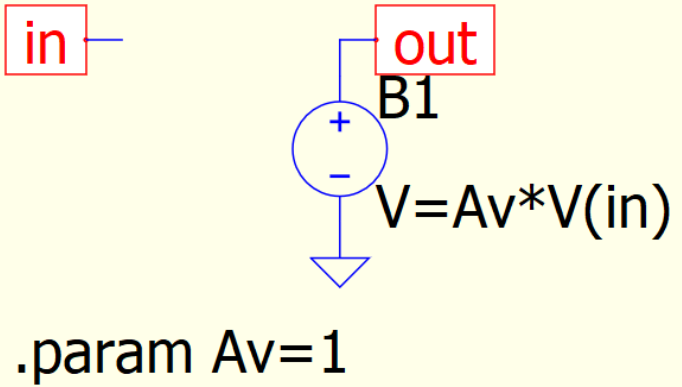
Qspice : Gain.qsym
Qspice : Different.qsym
Qspice : PID.qsym
Qspice : Signal_Limiter.qsym

Gain and Different

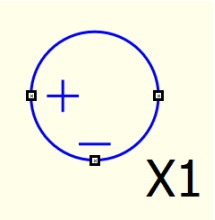
Qspice : Gain.qsym / Difference.qsym

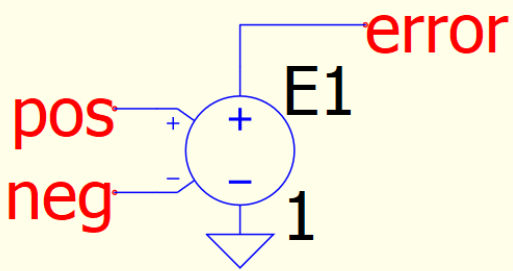
- Gain
  - $V_{out} = Av \times V_{input}$





- Difference
  - $V_{out} = V_+ - V_-$

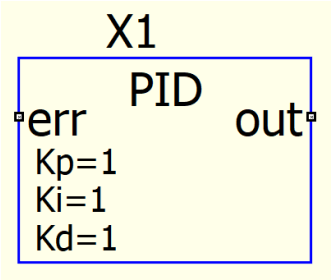


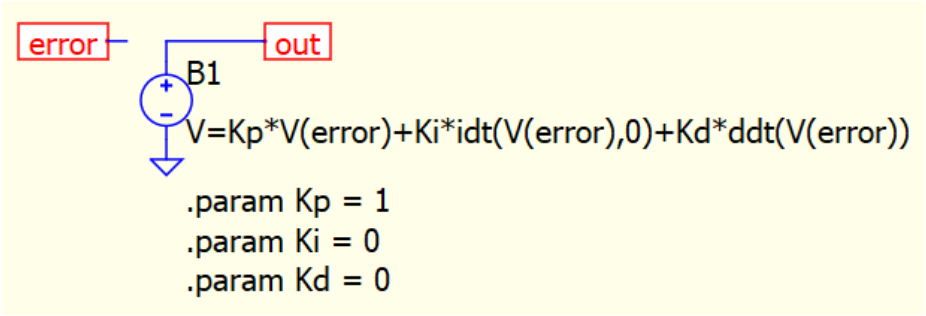


PID Controller and Signal Limiter

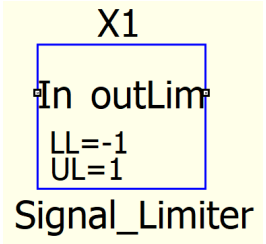
Qspice : PID.qsym / Signal_Limiter.qsym

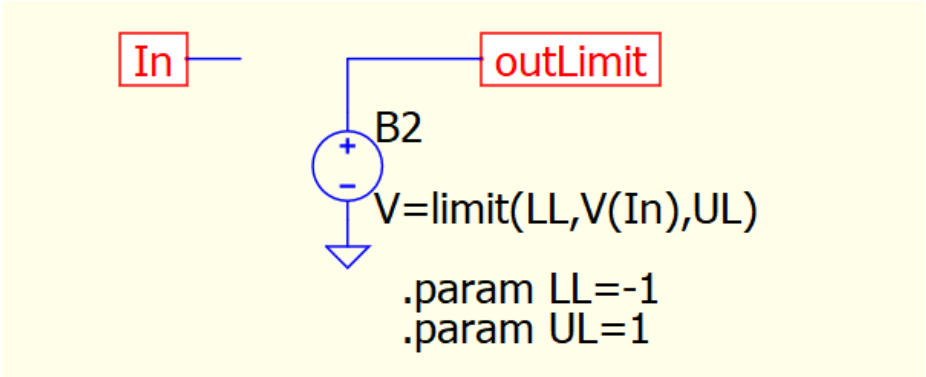
- PID Controller
  - $V_{out} = K_p V_{error} + K_i \int V_{error}\, dt + K_d \frac{dV_{error}}{dt}$





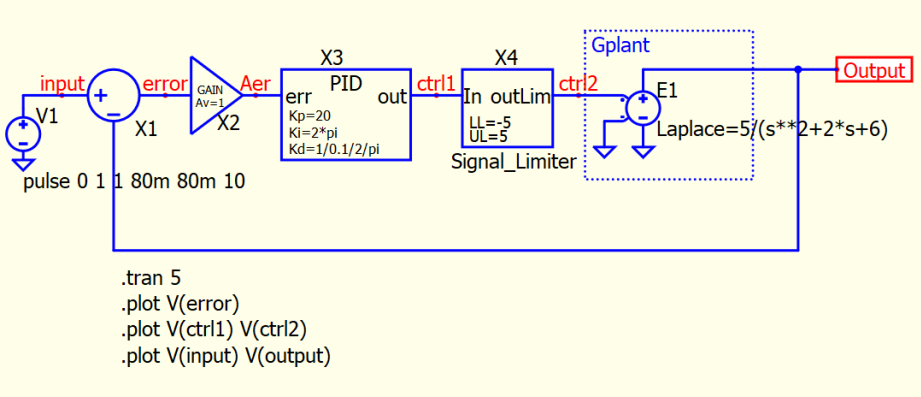
- Signal Limiter
  - limit(x,y,z) | intermediate value of x, y, and z, equivalent to min(max(x,y),z)

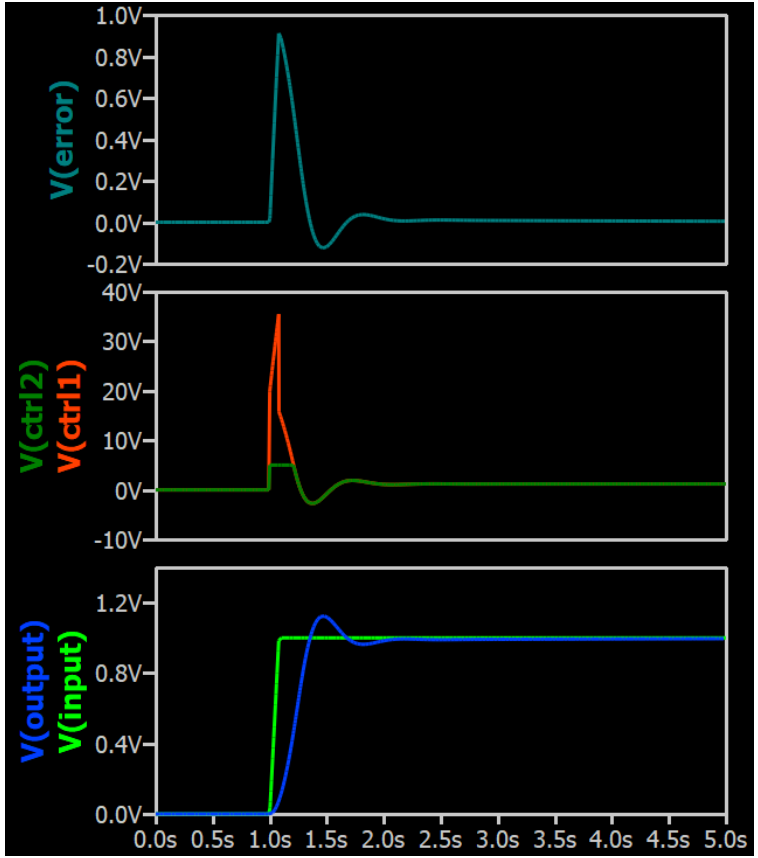




Control System Symbol : Transient Simulation Example

Parent - PID CloseLoop (.tran).qsch



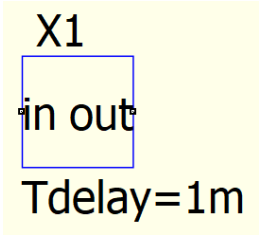


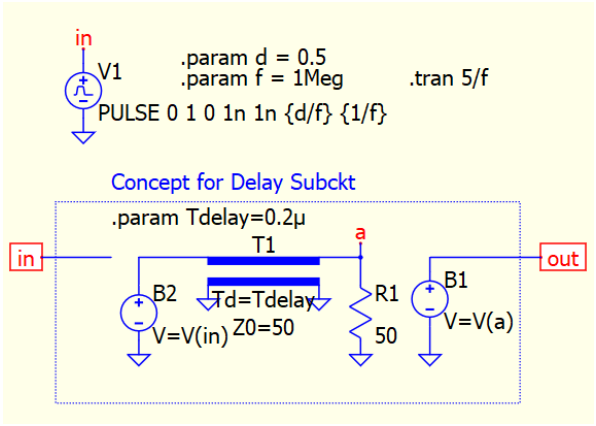
General Purpose

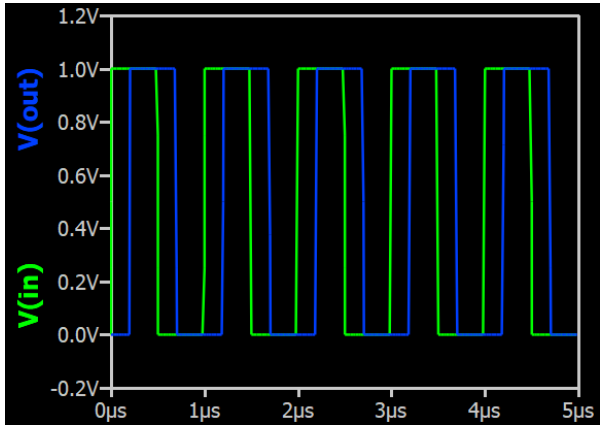
Delay

Qspice : Delay.qsym

- Delay
  - Reason for Implementation
    - Qspice B-source not offers delay function before 09/22/2023, but after that, Mike Engelhardt implemented delay(input,time) for arbitrary behavioral sources.
  - Concept of Design
    - T1 : Td (delay) in ideal transmission line determines signal delay time
    - R1 : To prevent signal reflection, transmission line must terminate with Zo
    - B1 : To prevent loading effect when using delay block
  - Symbol of delay.qsym



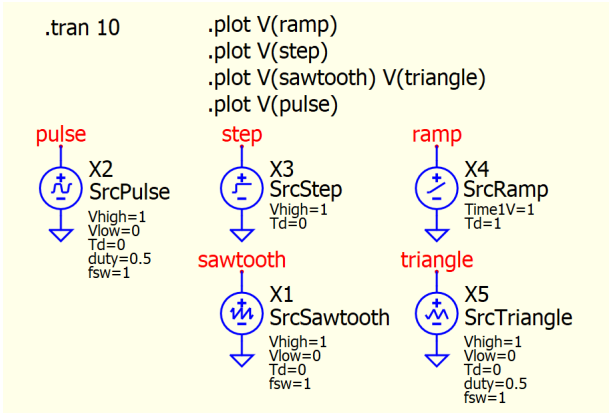


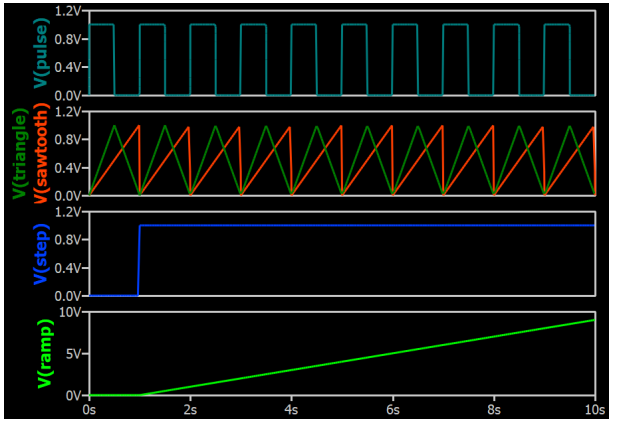


SrcXXX Special Voltage Source and Potentiometer

Qspice : Scrxxxx.qsym / Potentiometer.qsym

- ScrXXX
  - SrcPulse.qsym
  - SrcSawtooth.qsym
  - SrcTriangle.qsym
  - SrcStep.qsym
  - SrcRamp.qsym





- Potentiometer
  - Symbol : Potentiometer.qsym
  - Ratio is limited to [1m,0.999]
  - Sub-circuit script

```
.subckt VR + - m params: Rt=1k ratio=0.5
.param w = limit(1m,ratio,0.999)
R1 + m (1-w)*Rt
R2 m - (w)*Rt
.ends VR
```