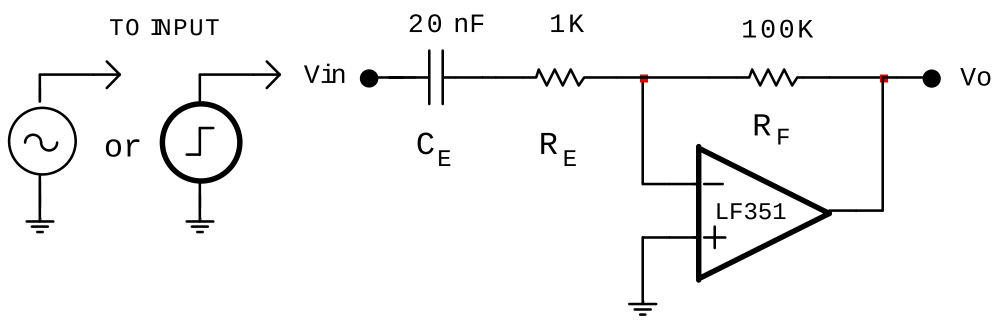
DIFFERENTIATOR AND INTEGRATOR CIRCUITS

PART 1 DIFERENTIATOR



LF351 OP AMP DATA: V_{sat} = ±13,5V typical at V_{sup} = ±15V, I_{limit} = ±20 mA typical

PRE-LAB

1. If V_{in} is a 0,3 V_{pp} triangular wave, determine the ouput waveform relative to V_{in}, at frequencies of 100, 200 and 300 Hz.

2. If V_{in} is a 0,3 V_{pp} sine wave, determine the ouput waveform relative to V_{in}, at frequencies of 100, 200 and 300 Hz.

3. If V_{in} is a 0,3 V_{pp} square wave, determine the ouput waveform relative to V_{in}, at frequencies of 100, 200 and 300 Hz – also calculate the time constant of the exponential edges of V_o.

LAB

1. Set V_{off} and I_{off} to 0 in the op amp model - double click on op amp and edit model parameters.

2. Edit the pulse source or the sine source to obtain the proper input.- see page 3 to learn how to edit the pulse source to obtain a square wave or a triangular wave.

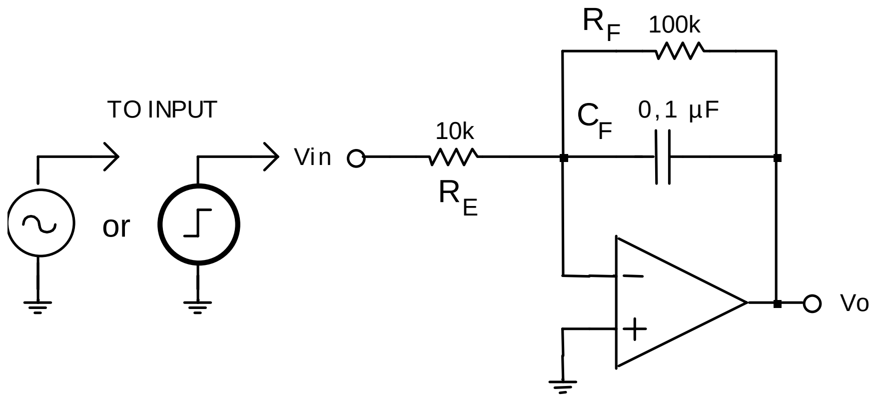
3. Verify all of your pre-lab predictions - label all Microcap waveforms with peak values and relevant times. Also write your name right on the graph and include in your lab report.
   For the squarewave input case, display V_{in}, V_o and V^- and then measure the time constant of the exponential edges of V_o – to do so, measure two points (t_1,V_1) and (t_2,V_2) and V_F on the exponential edges of V_o then calculate $\tau = (t_2 - t_1) \Big/ Ln\left(\frac{V_1 - V_F}{V_2 - V_F}\right)$

4. Input a 0,3 V_{pp} triangular wave with a frequency of 5 kHz and look at the output waveform. Explain what happens here. Include waveform in lab report.

5. Change the 1K resistor to 100 and input a 0,3 V_{pp} triangular wave with a frequency of 200 Hz and look at the output waveform. Explain what happens here. Include waveform in lab report.

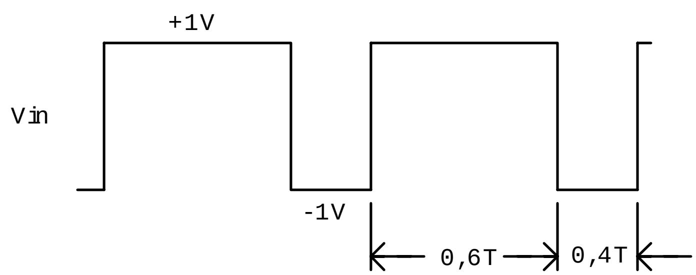
6. Repeat step 5 with a square wave input.

PART 2 INTEGRATOR



PRE-LAB

1. Draw O/P waveform with respect to V_{in} shown for frequencies of 50 Hz, 100 Hz, 1 kHz and 10 kHz - label waveforms with AC and DC values as well as PW and SW.



2. If V_{in} is a 4 V_{pp} squarewave with a 75% duty cycle, calculate the frequency of V_{in} that will produce V_o = 1 V_{pp}

3. If V_{in} is a 10 V_{pp} triangular wave with a frequency of 5 kHz, draw the expected O/P waveform with respect to V_{in}.

LAB

Verify all waveforms predicted in the pre-lab with Microcap and explain any major discrepancies. For step 1 of pre-lab, ensure that you include 50 Hz and 100 Hz in the measurements to observe the behavior of the integrator when it does not integrate: draw the "unexpected" waveforms and explain them – measure the time constant of V_o for the 50 Hz and 100 Hz cases and verify that $\tau = R_F C_F$. V_{in} is not integrated when the period of V_{in} is not much smaller than $\tau = R_F C_F$.

Include all µCap simulations in your lab report.

LAB REPORT

Compare all pre-lab waveforms/values to the µCap results, highlight discrepancies and explain.
Include all µCap simulations in report and answer all questions in lab procedure.

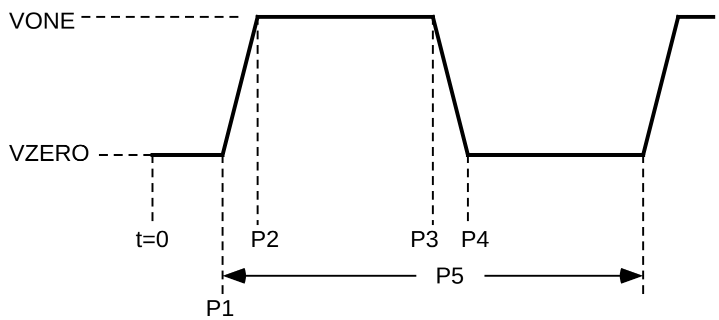
EDITING THE PULSE SOURCE

SQUARE WAVE

To edit the pulse source parameters, double-clicking the source symbol in the "select" mode and use the following values:

VONE=5V VZERO=-5V P1=0 P2=1n P3=1m P4=1m+1n P5=2m

The above parameters define a $10V_{pp}$ 500 Hz squarewave with 1ns rise and fall times and 50% duty cycle. The parameters of the pulse source are defined on the waveform shown below.



TRIANGULAR WAVE

VONE=0.15V VZERO=-0.15V P1=0 P2=1m P3=1m P4=2m P5=2m

The above parameters define a 500 Hz triangular wave with A 0,3 V_{PP} amplitude.