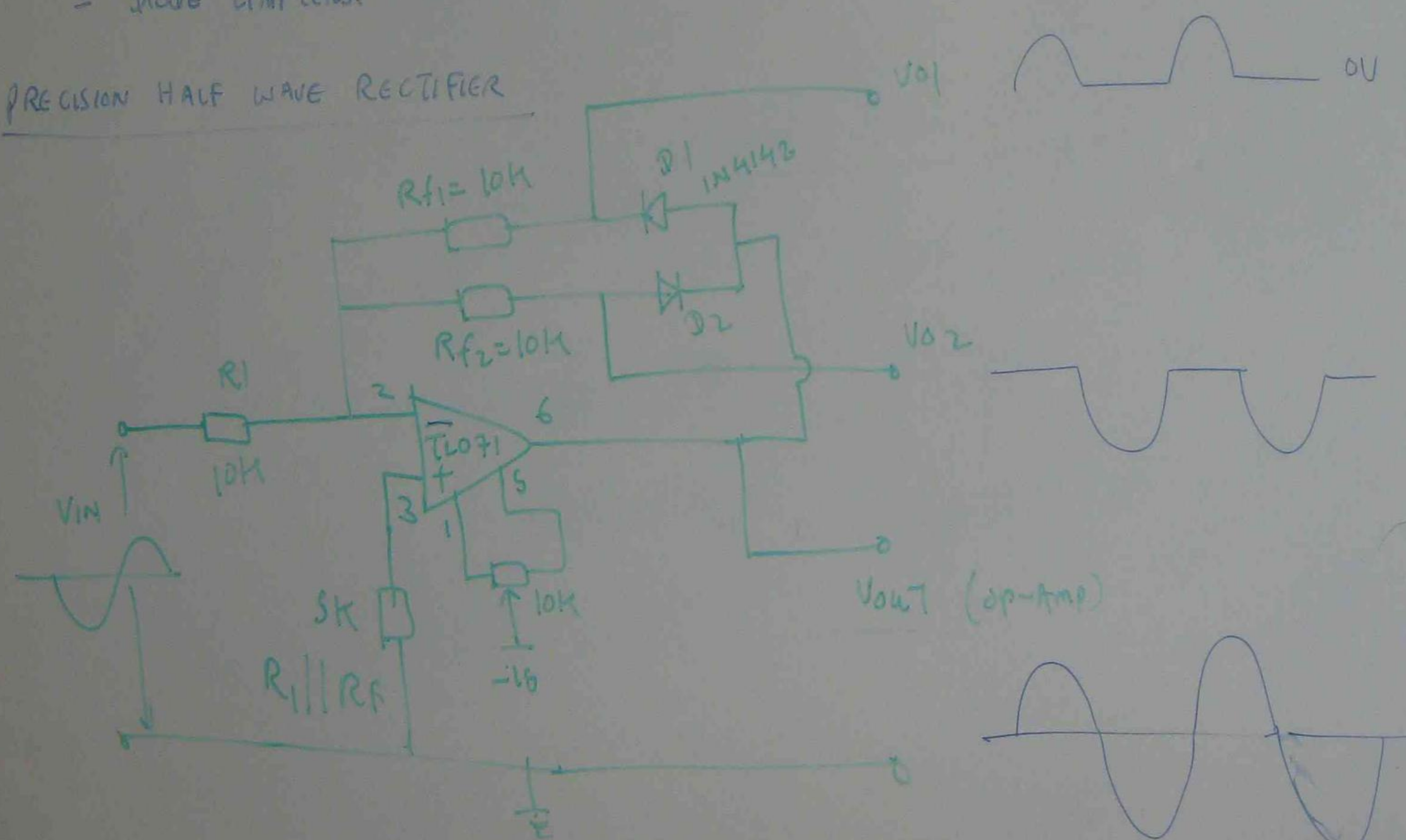
OP- AMP DIODE CIRCUITS

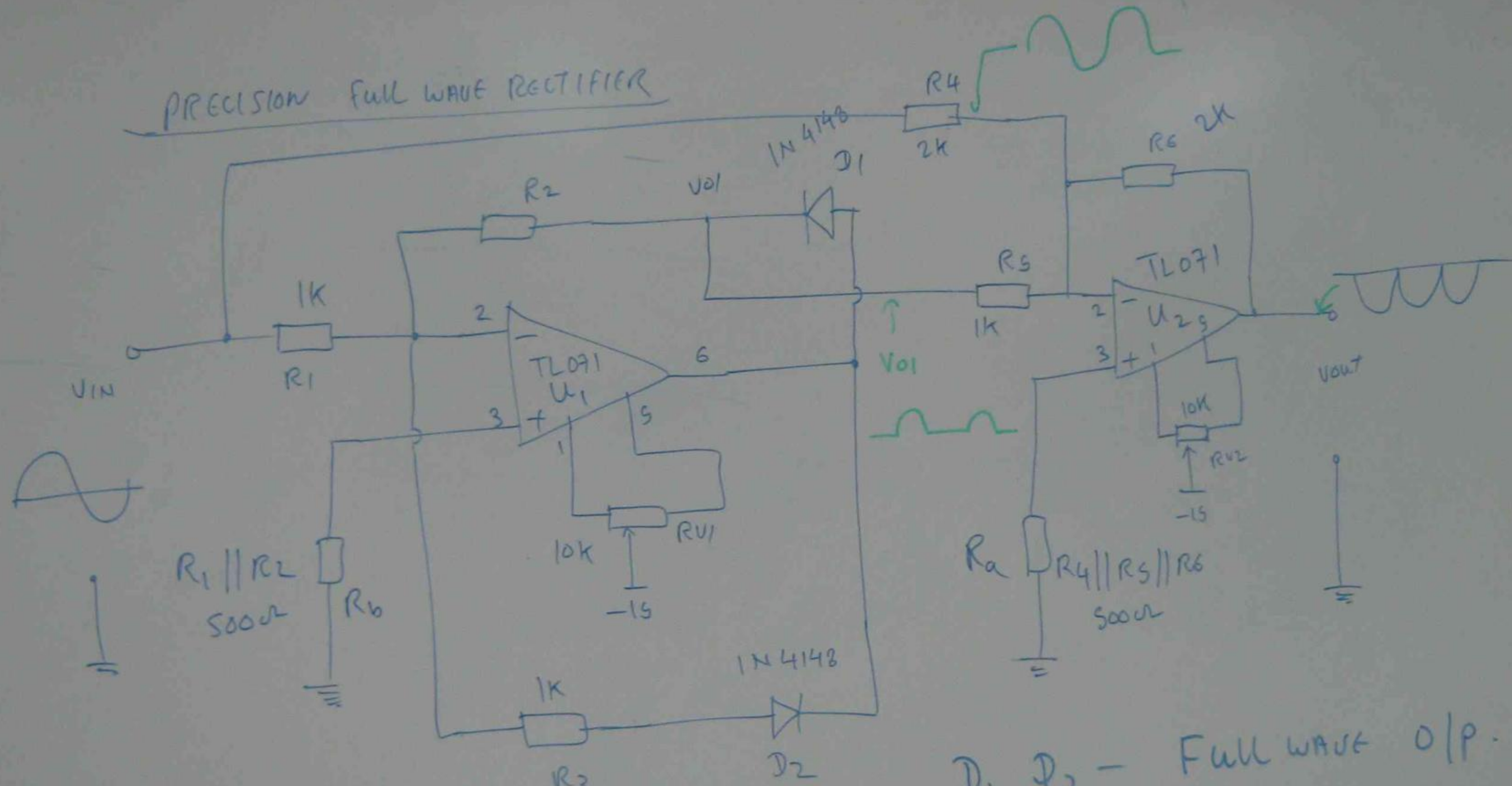
THERE ARE A WIDE RANGE OF OP-AMP CIRCUITS THAT USE DIODES IN THE FEED BACK PATH. IN GENERAL, THESE CIRCUITS FALL IN TO TWO BROAD CATEGORIES.

- PRECISION RECTIFIERS
- DIODE LIMITERS.

PRECISION HALF WAVE RECTIFIER



PRECISION FULL WAVE RECTIFIER



D_1, D_2 - FULL WAVE O/P.

RV_1 = OFFSET ADJUSTING
RV_2 RESISTOR

R_1, R_5 - INPUT INTO - TERMINAL

R_4, R_6 - FEED BACK RESISTOR
(TO MAINTAIN THE GAIN STABILITY

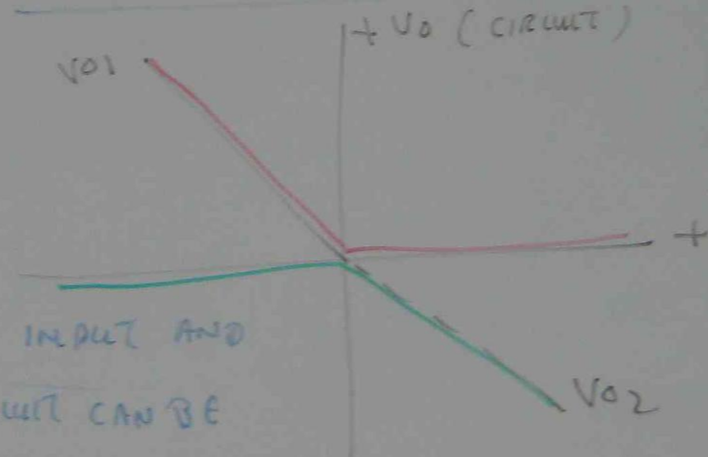
A PRECISION FULL WAVE RECTIFIER CAN BE CONSTRUCTED USING A SUMMING INVERTER WITH ONE OF IT'S INPUTS CONNECTED TO AN OUTPUT OF A PRECISION HALF WAVE RECTIFIER.

$$\frac{1}{R_a} = \frac{1}{R_4} + \frac{1}{R_5} + \frac{1}{R_6}$$

$$\frac{1}{R_b} = \frac{1}{R_1} + \frac{1}{R_2}$$

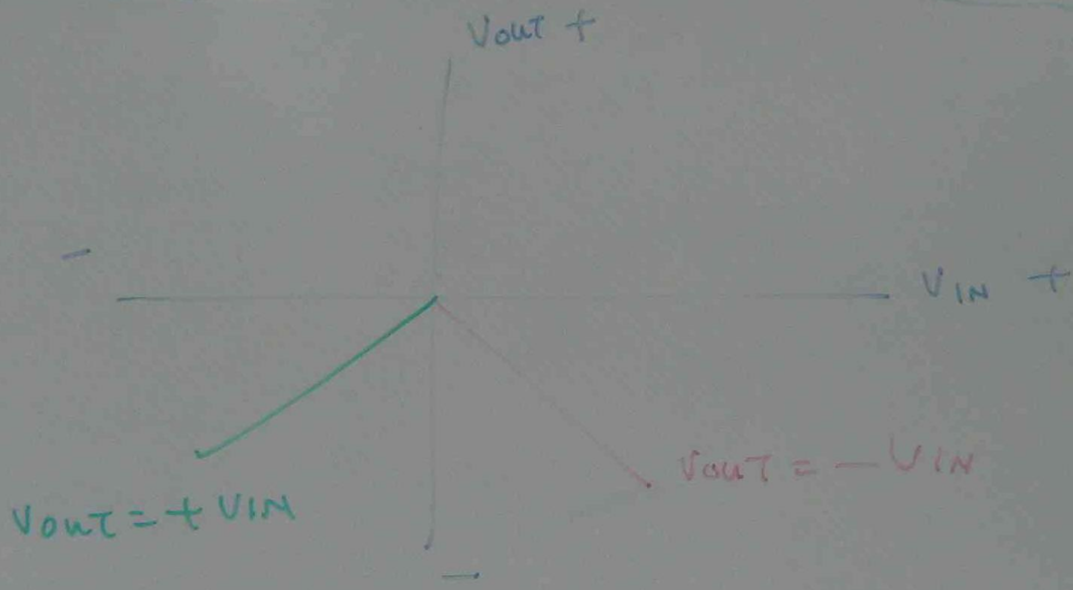
COMPENSATION

TRANSFER CHARACTERISTICS OF THE HALF WAVE RECTIFIER



THE RELATIONSHIP BETWEEN INPUT AND OUTPUT SIGNALS OF A CIRCUIT CAN BE GRAPHICALLY REPRESENTED BY A TRANSFER CURVE.

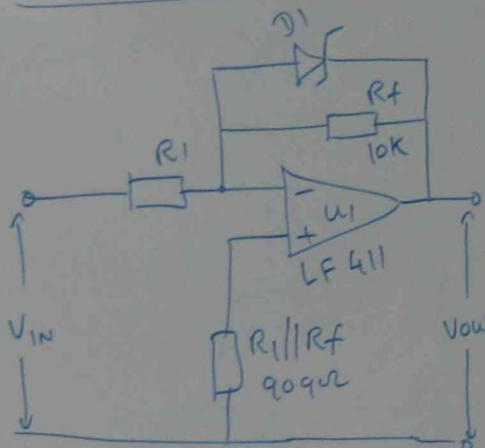
FULL WAVE PRECISION RECTIFIER TRANSFER CHARACTERISTICS

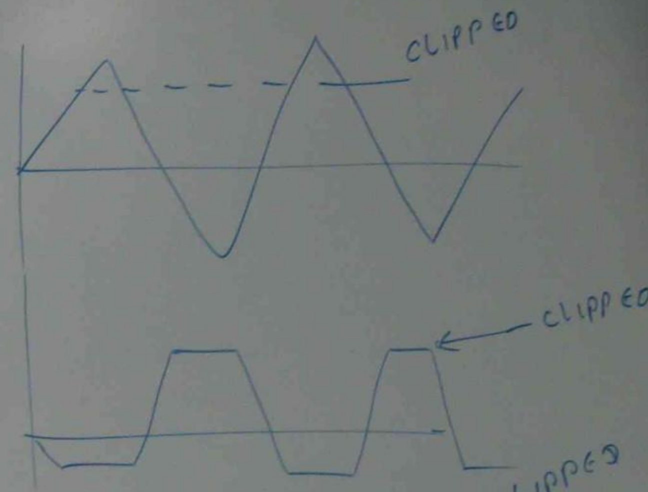


LIMITING CIRCUITS

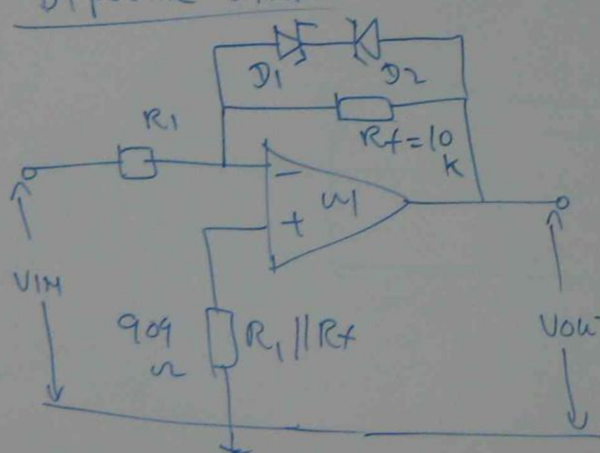
A LIMITING CIRCUIT (ALSO CALLED A CLIPPING CIRCUIT) LIMITS THE OUTPUT SIGNAL TO PRECISE LIMITS. TO ACHIEVE THIS, ZENER DIODES ARE TO BE INCLUDED IN FEEDBACK PATH.

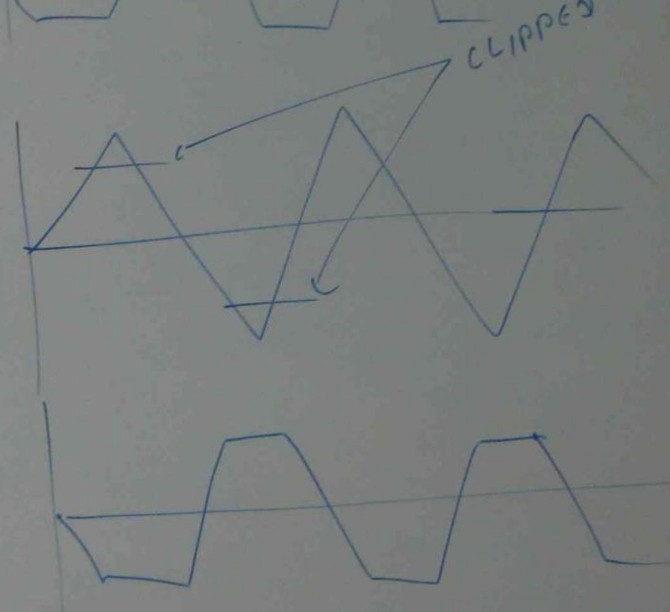
UNI POLAR LIMITER



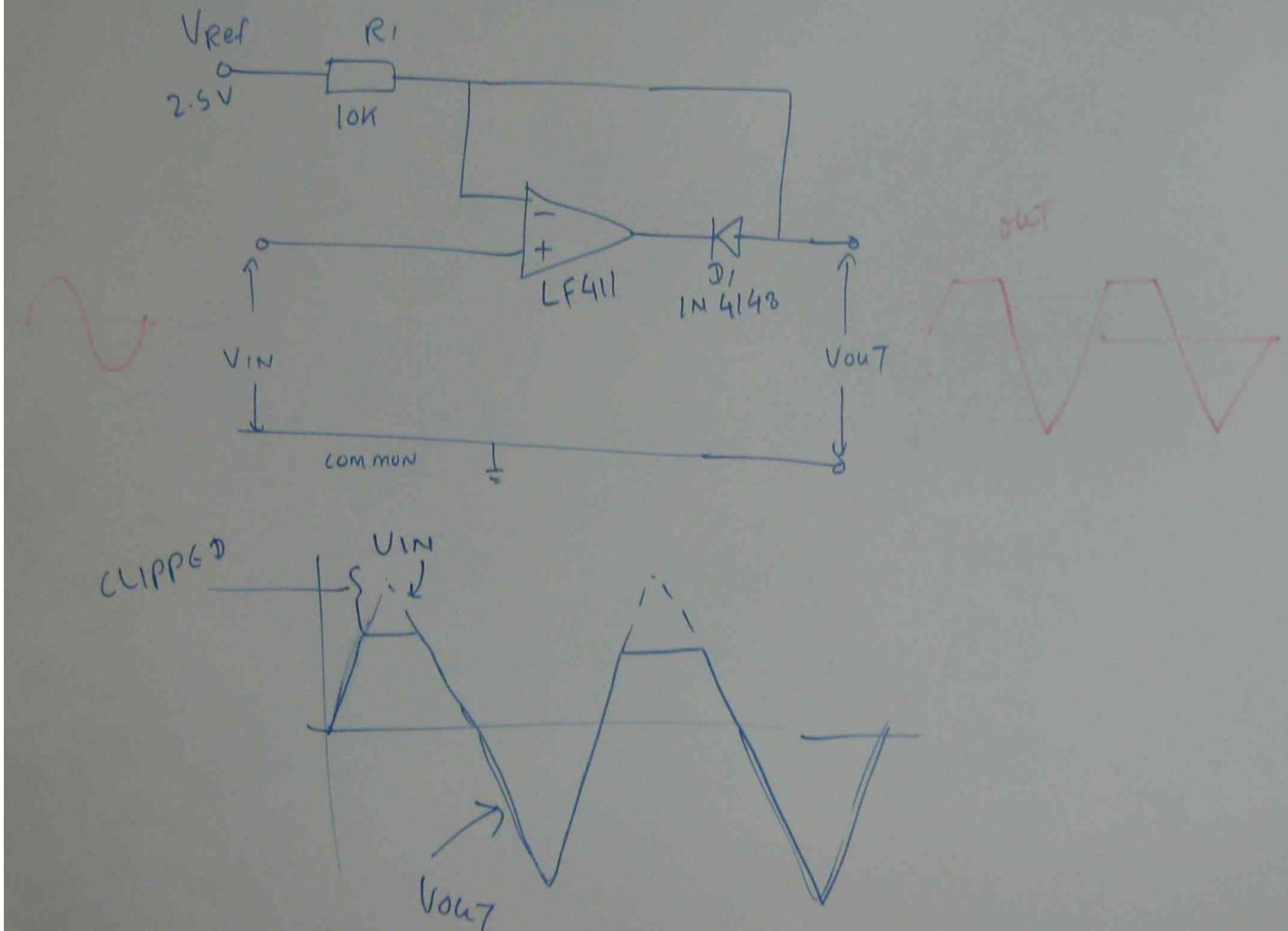


BIPOLAR LIMITER

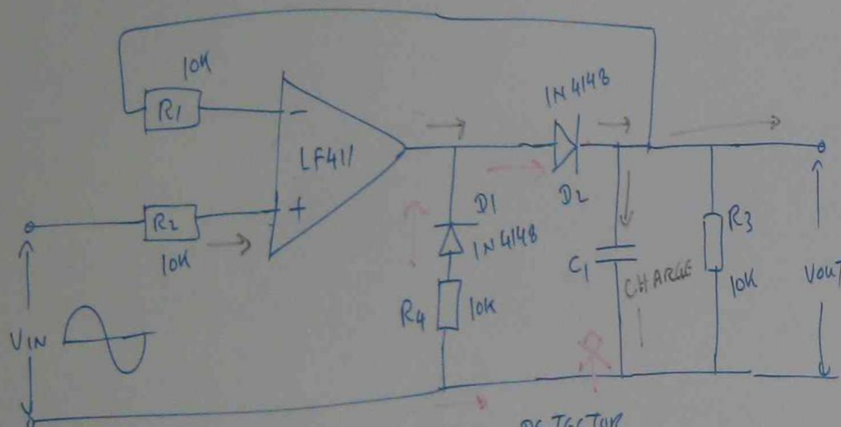




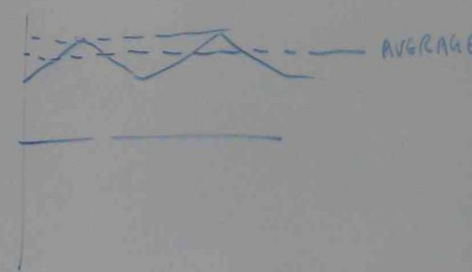
PRECISION CLIPPER



PEAK DETECTOR



POSITIVE PEAK DETECTOR

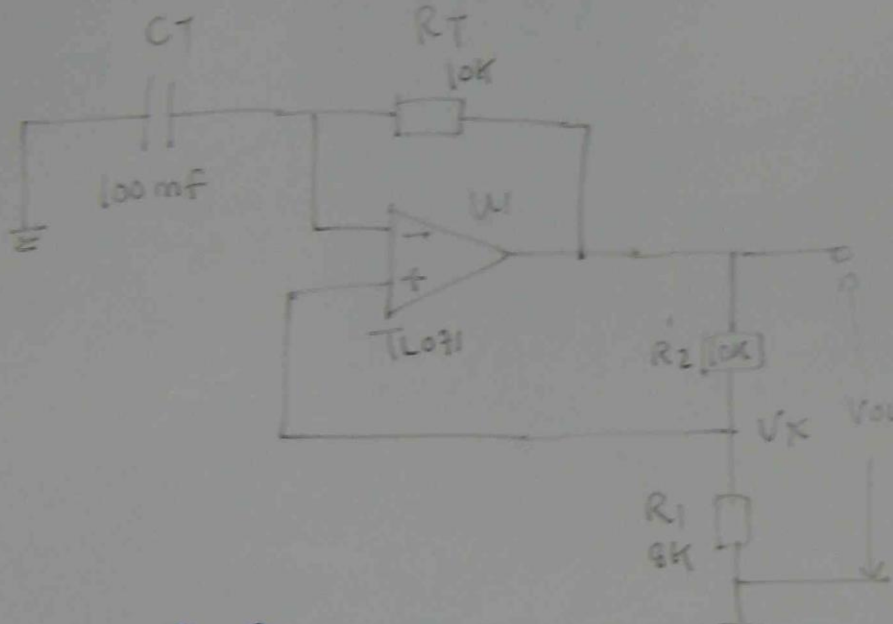


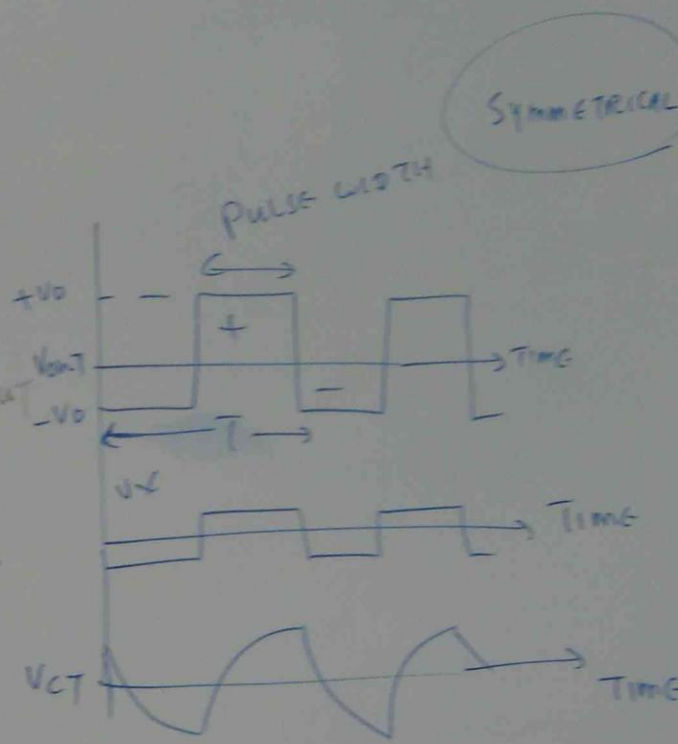
C_1 IS CHARGED

- A CONVENTIONAL AC VOLT METER IS USUALLY CALIBRATED TO DISPLAY THE RMS VALUE OF A SINE WAVE. THE PEAK DETECTOR ALLOWS A METER TO DISPLAY THE PEAK VALUE OF A WAVE FORM.
- DURING POSITIVE CYCLE, CAPACITOR C_1 IS CHARGED. IN NEGATIVE CYCLE, DIODE D_2 BLOCKS THE REVERSE CURRENT FLOWS IN TO CAPACITOR.
- THE CAPACITOR MAINTAINS THE PEAK VALUE OF VOLTAGE.
- THE PEAK VALUE IS FED TO OUTPUT DISPLAY.

SINE AND SQUARE WAVE OSCILLATORS

THE OP-AMP ASTABLE CIRCUIT PRODUCES SQUARE WAVE OUTPUT.



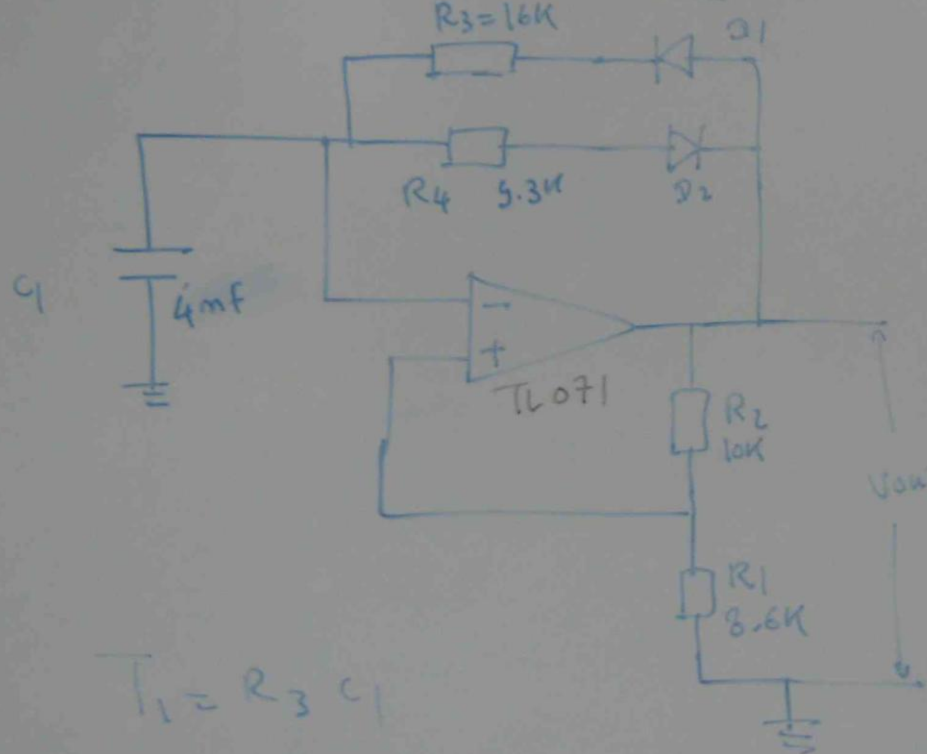


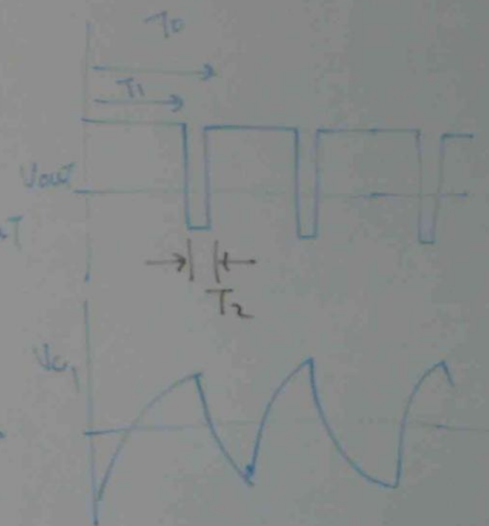
$$T = 2 R_T C_T$$

$$f = \frac{1}{2 R_T C_T}$$

+, − WAVES PORTIONS HAVE THE SAME PULSE WIDTHS.

NON SYMMETRICAL ASTABLE CIRCUIT

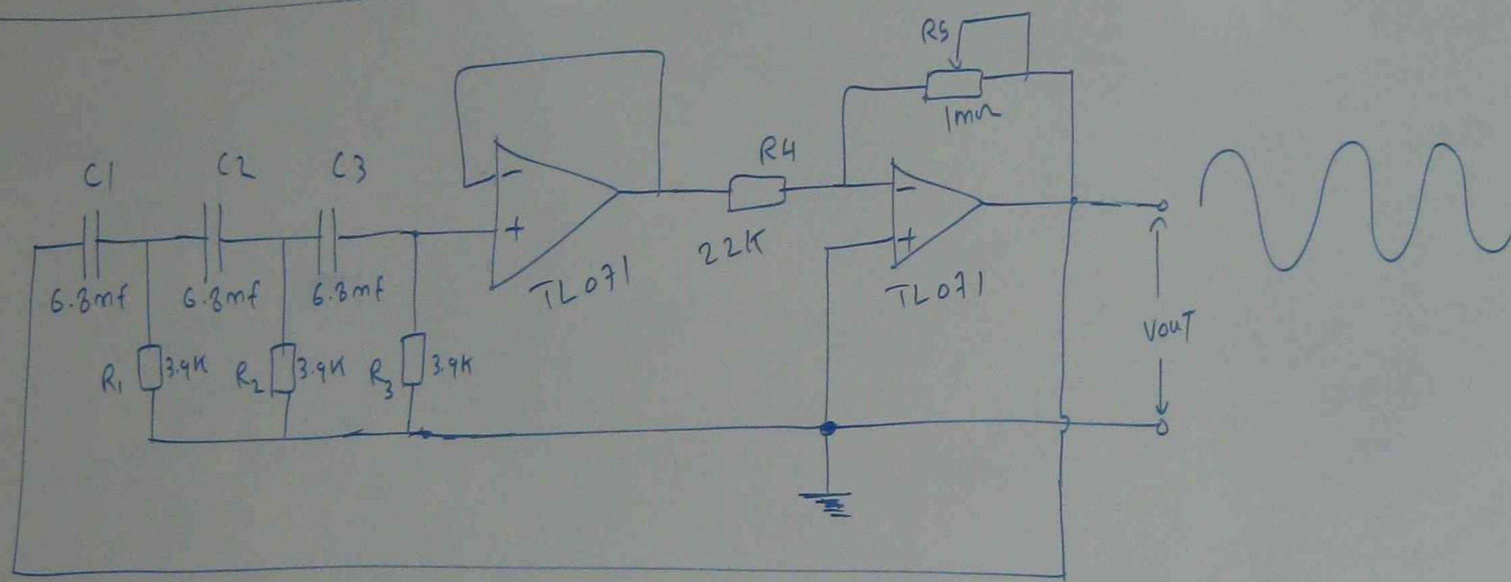




$T_1 = R_3 C_1$

$T_2 = R_4 C_1$

THE PHASE SHIFT OSCILLATOR

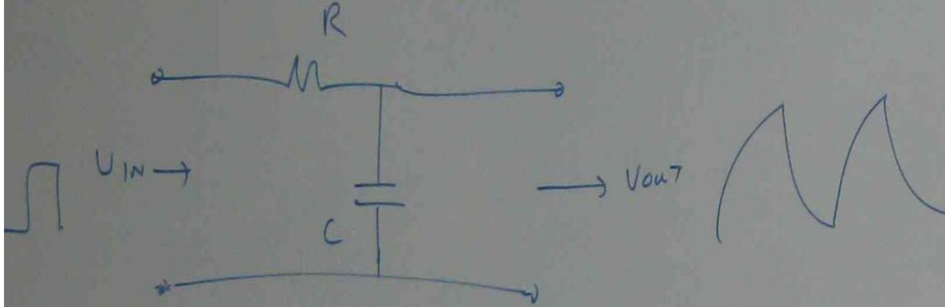


$$f_0 = \frac{1}{15.4RC}$$

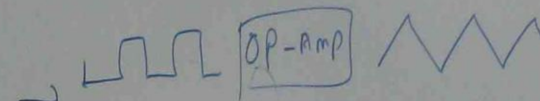
$$R = R_1 = R_2 = R_3$$

$$C = C_1 = C_2 = C_3$$

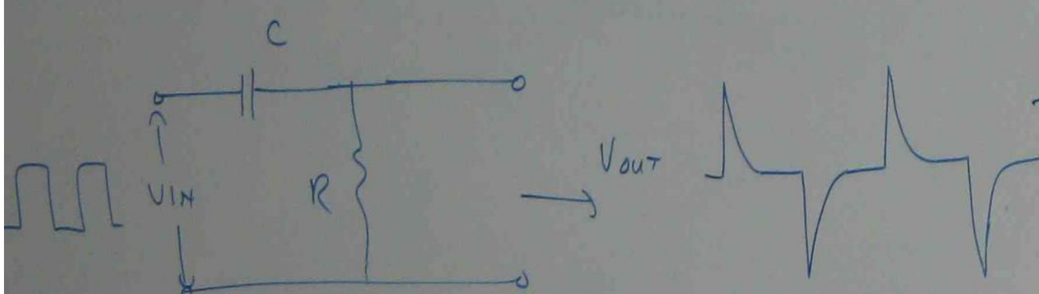
OP-AMP RC CIRCUITS



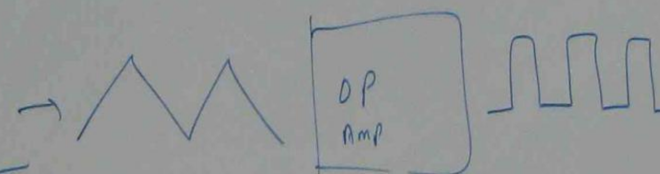
BASIC INTEGRATOR



INTEGRATOR



BASIC DIFFERENTIATOR



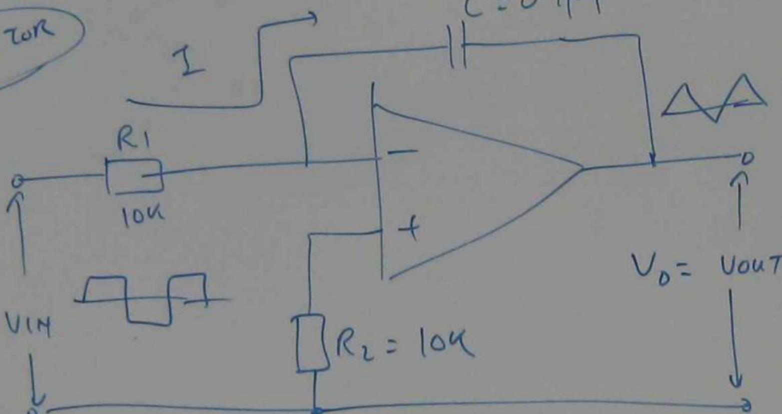
DIFFERENTIATOR

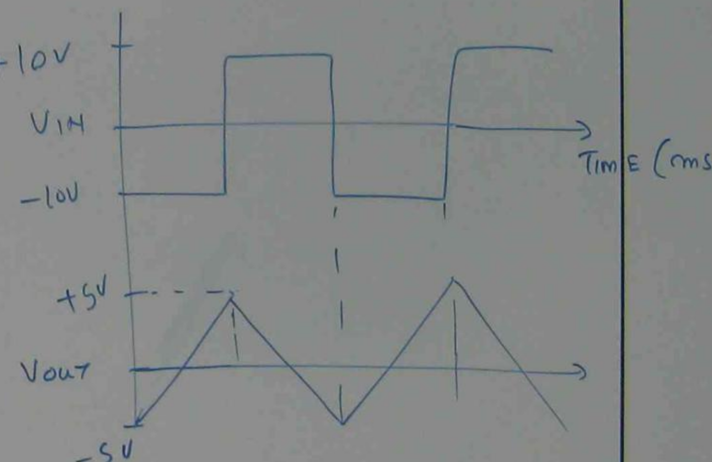
RC CIRCUITS CAN CONVERT SQUARE WAVE TO SAW TOOTH WAVE (INTEGRATOR)

AND SAW TOOTH WAVE TO SQUARE WAVE (DIFFERENTIATOR).

OP-AMP CAN PROVIDE FINELY ADJUSTED OUT PUT WAVE SHAPES.

INTEGRATOR



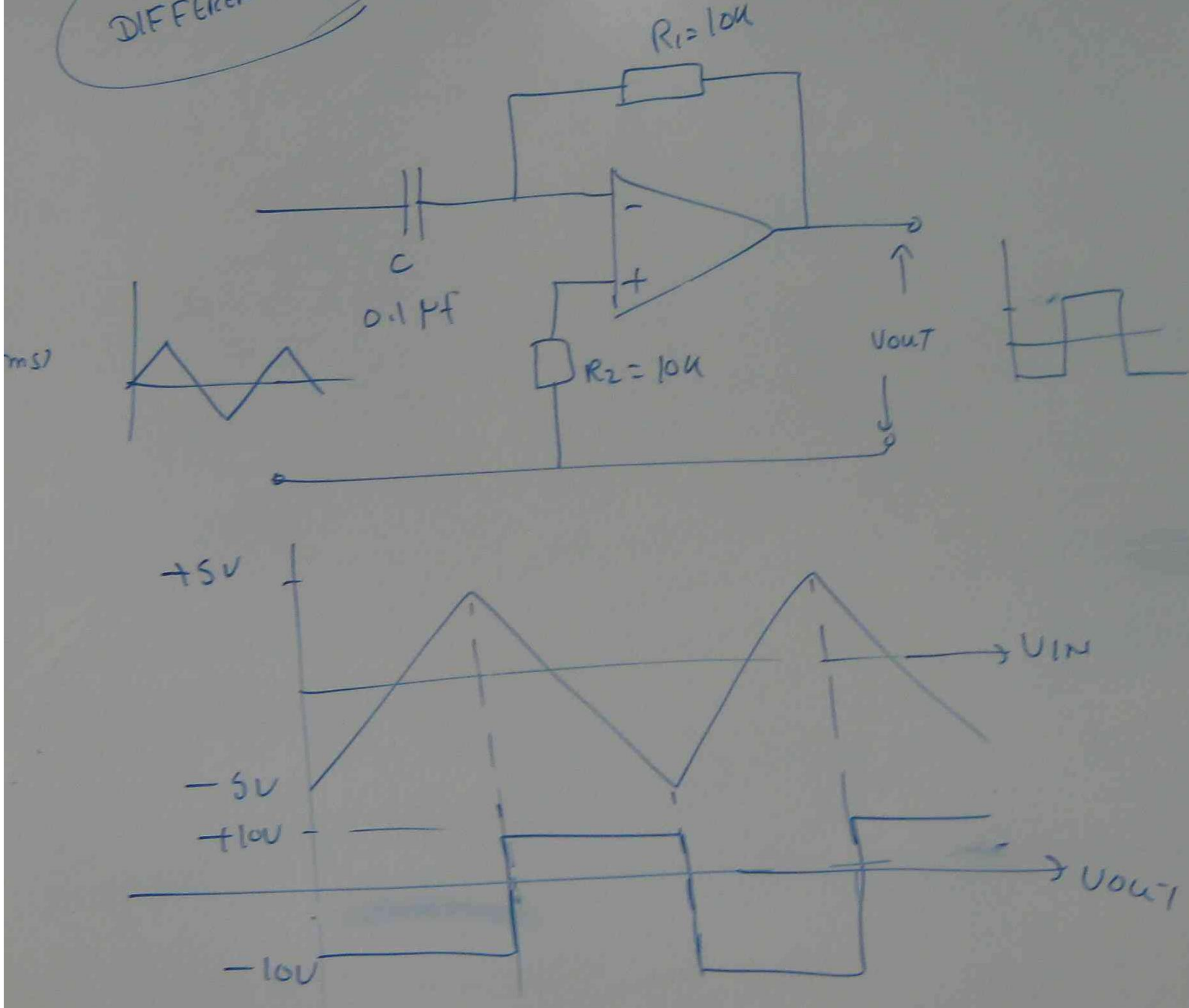


OP-AMP INTEGRATOR

$$V_0 = (-)V_{IN} \times \frac{1}{R_1 C} \times \text{TIME IN SECOND}$$

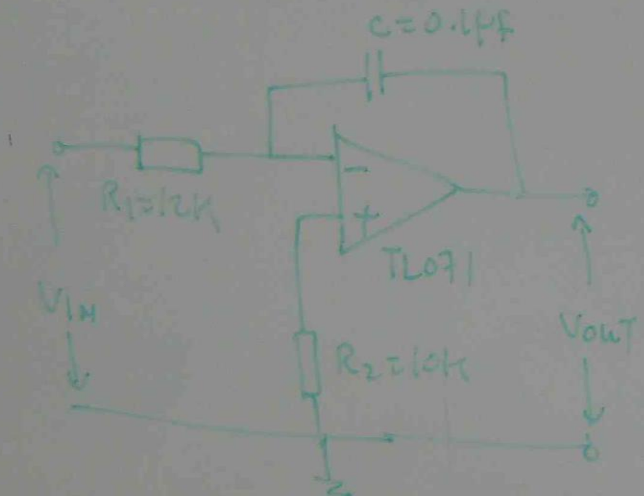
$$I = \frac{V_{IN}}{R_1}$$

DIFFERENTIATOR



$$V_{OUT} = (-)R_1 C \times \text{RATE OF CHANGE OF VIN } \left(\text{VOLTS}/\text{SECOND}\right)$$

Pb) FOR THE GIVEN CIRCUIT, CALCULATE THE OUTPUT VOLTAGE AFTER 2 ms. IF −5V IS APPLIED TO THE INPUT. ASSUME THE OUTPUT VOLTAGE WAS 0V PRIOR TO CONNECTING −5V INPUT.



$$V_o = (-)\,V_{IN} \times \frac{1}{R_1 C} \times \text{TIME IN SECOND}$$

$$= -(-5V) \times \frac{1}{12 \times 10^{3} \times 0.1 \times 10^{-6}} \times 2 \times 10^{-3}$$

$$= \frac{5 \times 2 \times \cancel{10^{-3}}}{1.2 \times \cancel{10^{-3}}} = \frac{10}{1.2} = 8.3V$$

FUNCTION GENERATOR