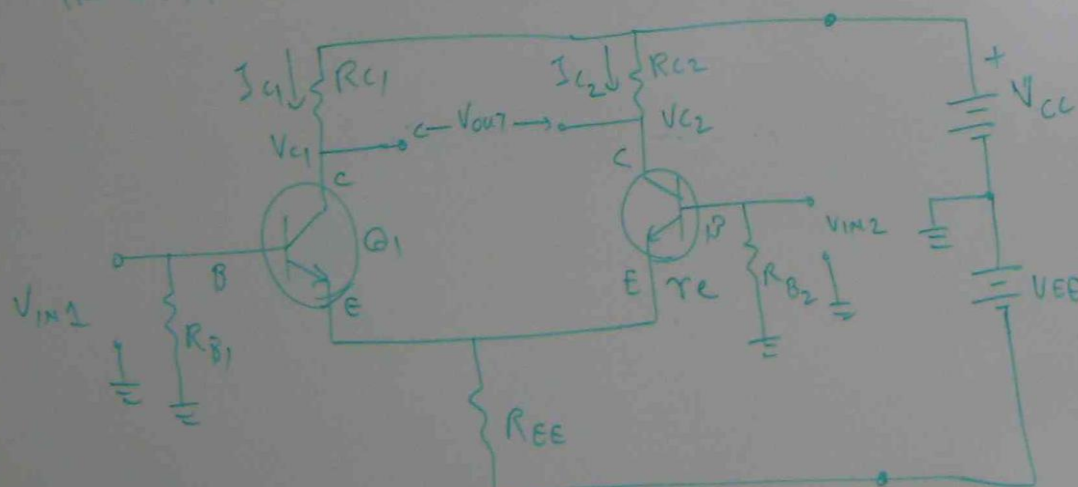
UEENEEH 025 B

PROVIDE SOLUTION TO fϕ ELECTRONICS POWER CONTROL PROBLEMS

+ 82732 VARIABLE SPEED DRIVES

DC CONDITION OF DIFFERENTIAL AMPLIFIER

THE DIFFERENTIAL AMPLIFIER IS A DC COUPLED AMPLIFIER THAT AMPLIFIES THE DIFFERENCE BETWEEN TWO INPUT VOLTAGES $V_{IN\,1}$ AND $V_{IN\,2}$



THE DIFFERENTIAL AMPLIFIER

$V_{BE} = 0.6V$ FOR SILICON TRANSISTOR

$$I_{EE} = \frac{V_{REE}}{R_{EE}}$$

$$I_{C_1} = I_{C_2} = \frac{I_{EE}}{2}$$

$$V_C = V_{CC} - I_C R_C$$

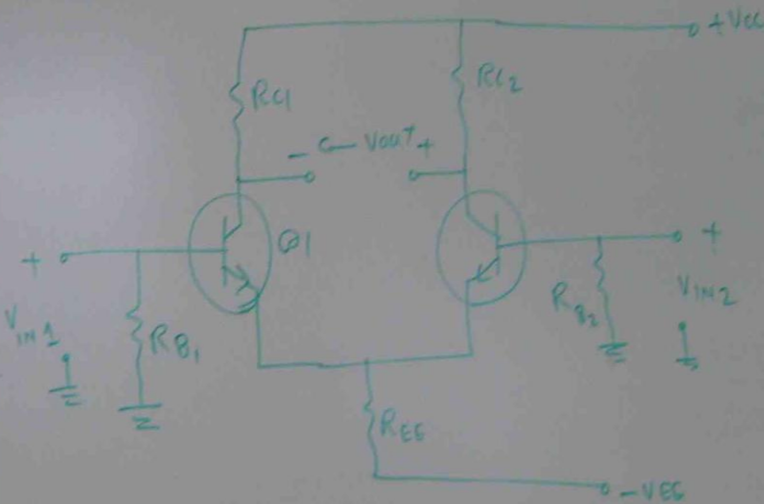
$$V_{C_1} = V_{CC} - I_{C_1} R_{C_1}$$

$$V_{C_2} = V_{CC} - I_{C_2} R_{C_2}$$

DIFFERENTIAL VOLTAGE GAIN (A_d)

$$A_d = \frac{R_C}{2 r_e} \qquad r_e = \frac{30\,mV}{I_E}$$

VOLTAGE GAIN FOR THE BALANCED INPUT, BALANCED OUTPUT DIFFERENTIAL AMPLIFIER

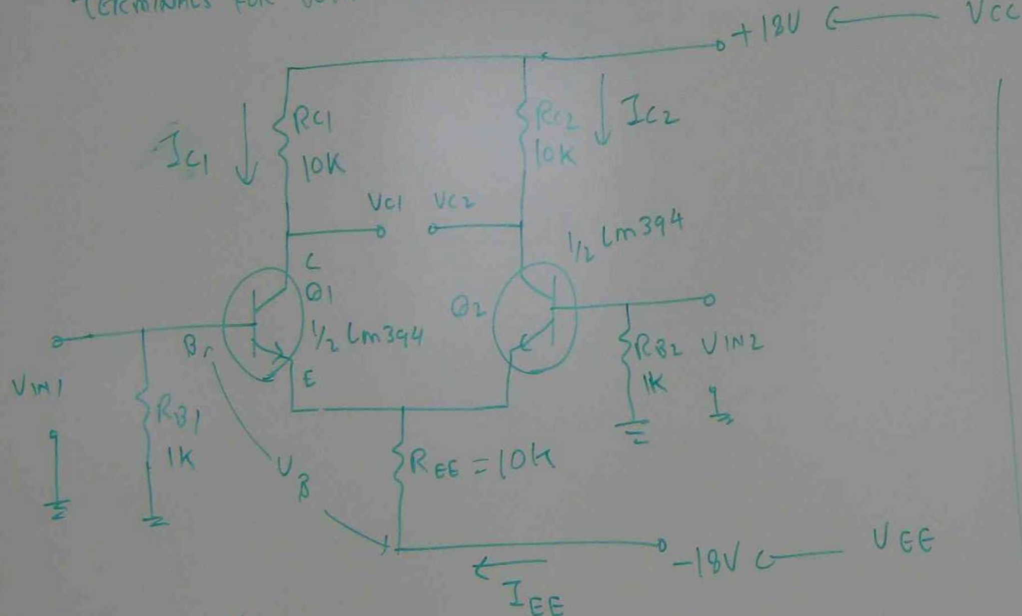


$$V_d = V_{IN_1} - V_{IN_2}$$

$$r_{in} = 2 \beta r_e$$

$$A_d = \frac{R_C}{r_e}$$

pb/ DETERMINE THE VOLTAGES PRESENT AT THE BASE, COLLECTOR AND EMITTER TERMINALS FOR BOTH TRANSISTORS IN THE CIRCUIT.



$$I_{EE} = \frac{V_{EE}}{R_{EE}} = \frac{18}{10k} = 1.8\,mA$$

$$I_{C_1} = I_{C_2} = \frac{I_{EE}}{2} = \frac{1.8}{2} = 0.9\,mA$$

$$V_{C_1} = V_{CC} - I_{C_1} R_{C_1}$$

$$= 18 - 0.9 \times 10^{-3} \times 10 \times 10^{3}$$

$$= 18 - 9$$

$$= 9V$$

$$V_{C_2} = 9V$$

$$V_B = V_{BE} + I_{EE} \times R_{EE}$$

$$= 0.6 + 1.8 \times 10^{-3} \times 10 \times 10^{3}$$

$$= 18.6\,V$$

COLLECTOR AND EMITTER

18V ←—— V_{CC}

—— V_{EE}

$V_{C_1} = V_{CC} - I_{C_1} R_{C_1}$

$= 18 - 0.9 \times 10^{-3} \times 10 \times 10^{3}$

$= 18 - 9$

$= 9V$

$V_{C_2} = 9V$

$V_B = V_{BE} + I_{EE} \times R_{EE}$

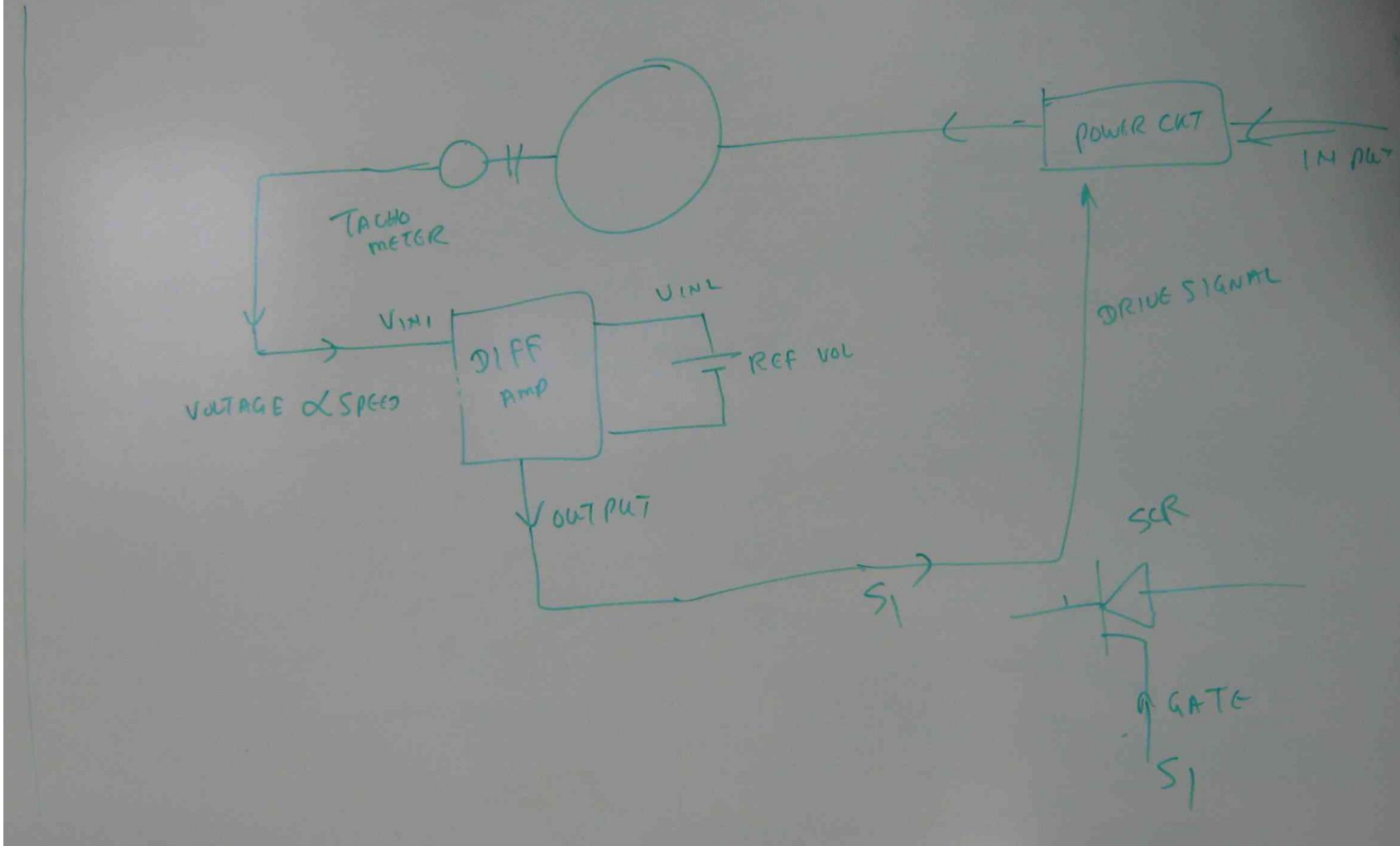
$= 0.6 + 1.8 \times 10^{-3} \times 10 \times 10^{3}$

$= 18.6\,V$

$V_E = I_{EE} \times R_{EE}$

$= 1.8 \times 10^{-3} \times 10 \times 10^{3}$

$= 18\,V$



TACHO METER
POWER CKT
INPUT
DRIVE SIGNAL
VIN1
VIN2
DIFF AMP
REF VOL
VOLTAGE ∝ SPEED
OUTPUT
SCR
S1
GATE
S1

NOISE REJECTION AND INTRODUCTION TO THE OPERATIONAL AMPLIFIER

DIFFERENTIAL AMPLIFIER CAN REJECT THE NOISE SIGNALS THAT ARE COMMON TO BOTH INPUTS.

COMMON MODE REJECTION ⟶ HOW MUCH OF COMMON MODE SIGNAL IS PRESENT IN THE OUTPUT OF THE AMPLIFIER

IT SHOULD BE IDEALLY ZERO

$$CMRR = \frac{A_d}{A_{cm}}$$

CMRR - COMMON MODE REJECTION RATIO

A_d - DIFFERENTIAL AMPLIFIER GAIN

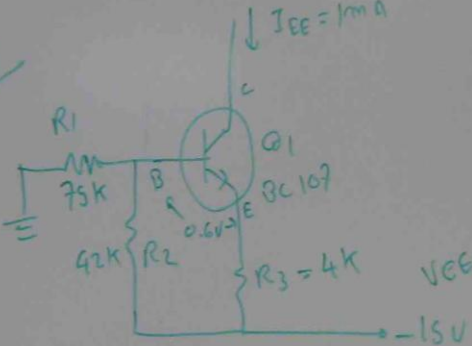
A_{cm} = COMMON MODE GAIN.

THE DISCRETE COMPONENT OF BJT CONSTANT CURRENT SOURCE

BIPOLAR JUNCTION TRANSISTOR

FIELD EFFECT TRANSISTOR FET

Pb



CALCULATE (a) V_{R2}, (b) V_{R3}

(c) I_c

$$V_{R_2} = \frac{R_2}{R_1 + R_2} \times V_{EE}$$

$$V_{R_3} = V_{R_2} - 0.6\ V$$

$$I_c = I_{EE} = \frac{V_{R3}}{R_3}$$

$$V_{R_2} = \frac{R_2}{R_1 + R_2} V_{EE}$$

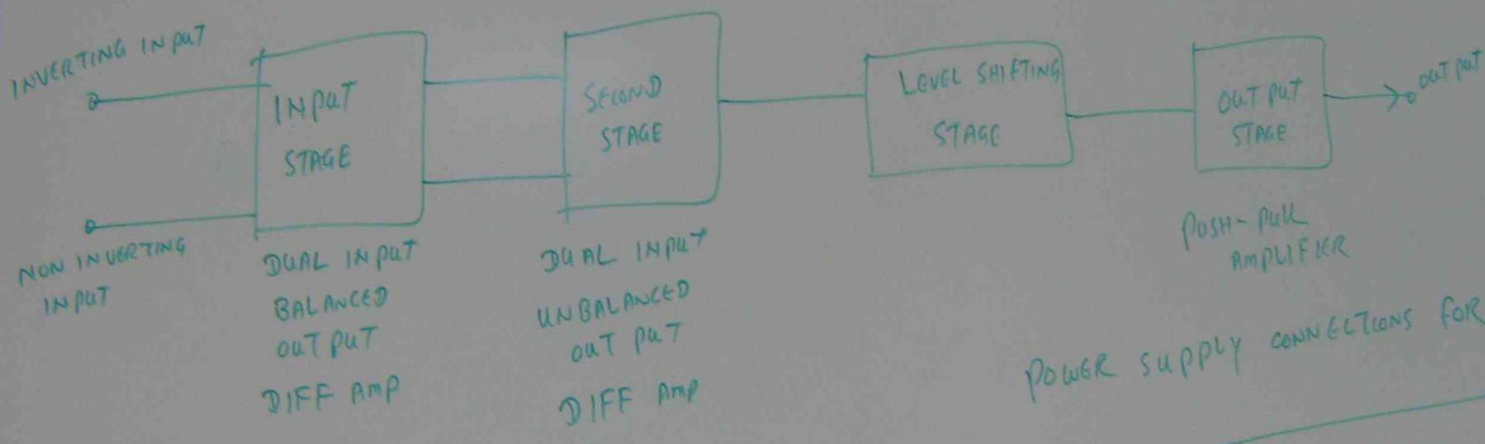
$$= \frac{42}{75+42} \times 15$$

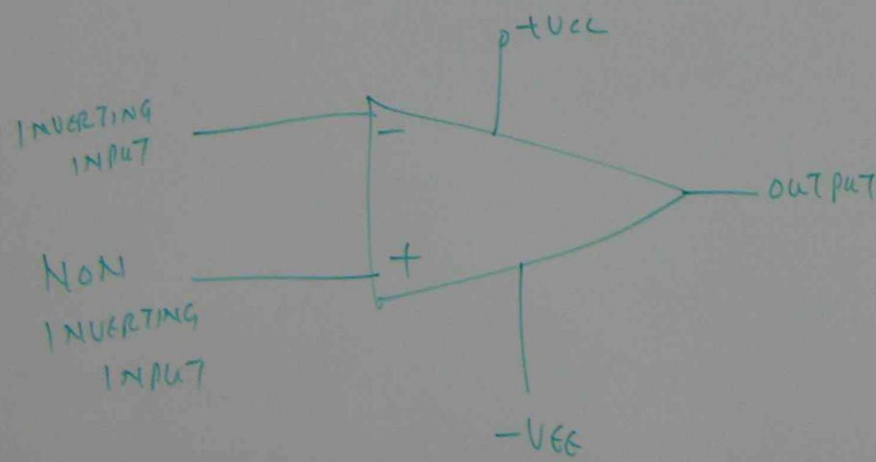
$$= 5.38V$$

$$V_{R_3} = V_{R_2} - 0.6 = 5.38 - 0.6 = 4.78V$$

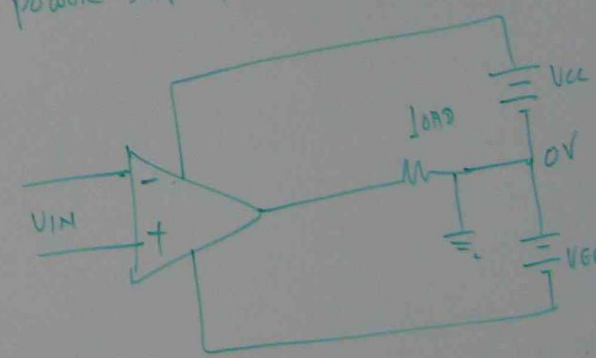
$$I_c = I_{EE} = \frac{V_{R3}}{R_3} = \frac{4.78}{4} = 1.195\ mA$$

INTRODUCTION TO THE OPERATIONAL AMPLIFIER



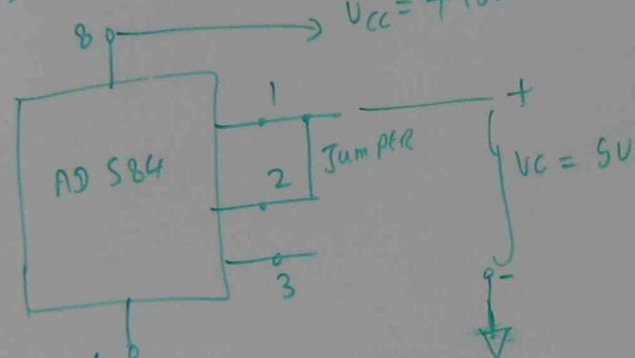


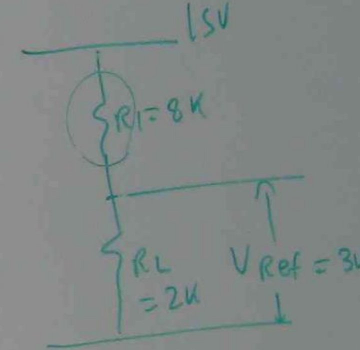
POWER SUPPLY CONNECTIONS FOR OP-AMP

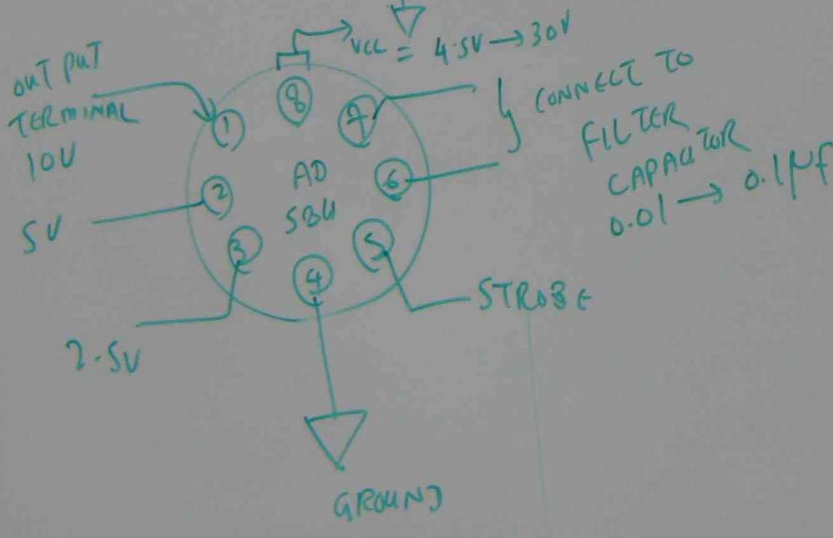


COMPARATORS

AD 584



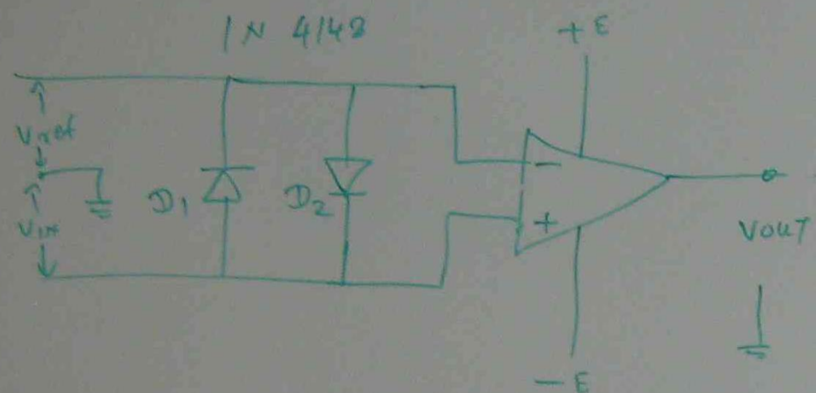


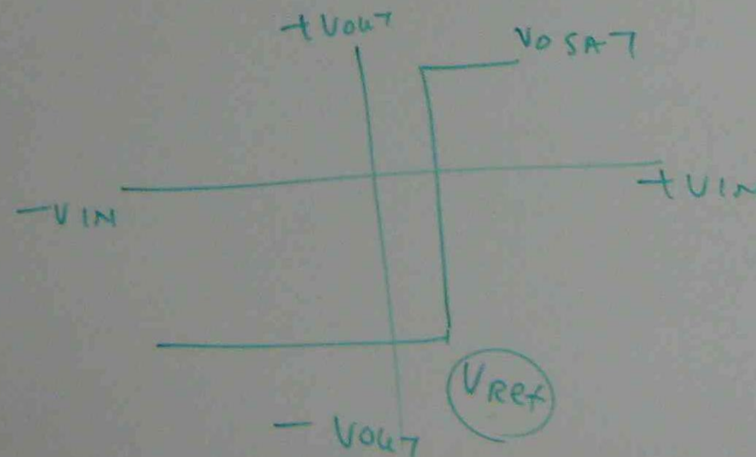


$$V_{OUT} = AV_{OL} \times V_{IN}$$

VOLTAGE GAIN

BASIC NON INVERTING COMPARATOR CIRCUIT





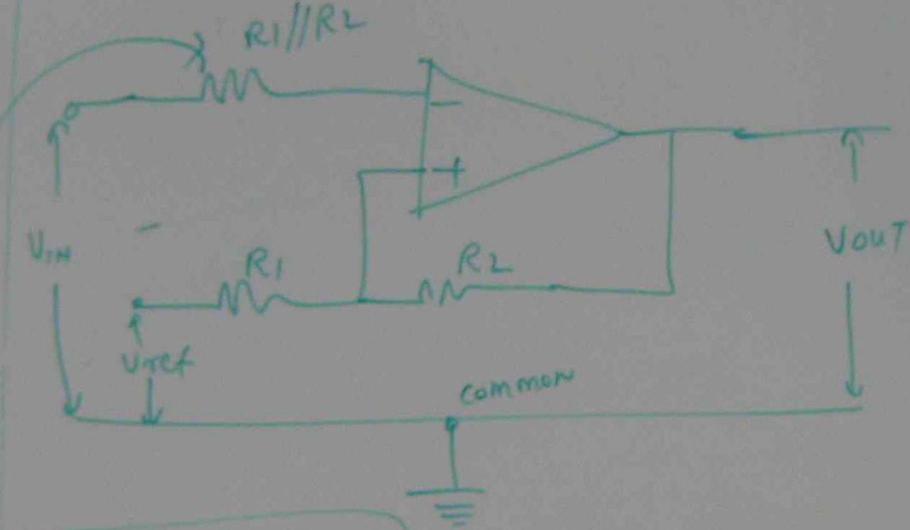
OPEN LOOP VOLTAGE GAIN (V_{IN})

$$V_{IN} = V_{ref} \pm \frac{2\,V_{o\,(SAT)}}{A_{VOL}} = V_{ref} \pm \frac{30V}{200{,}000}$$

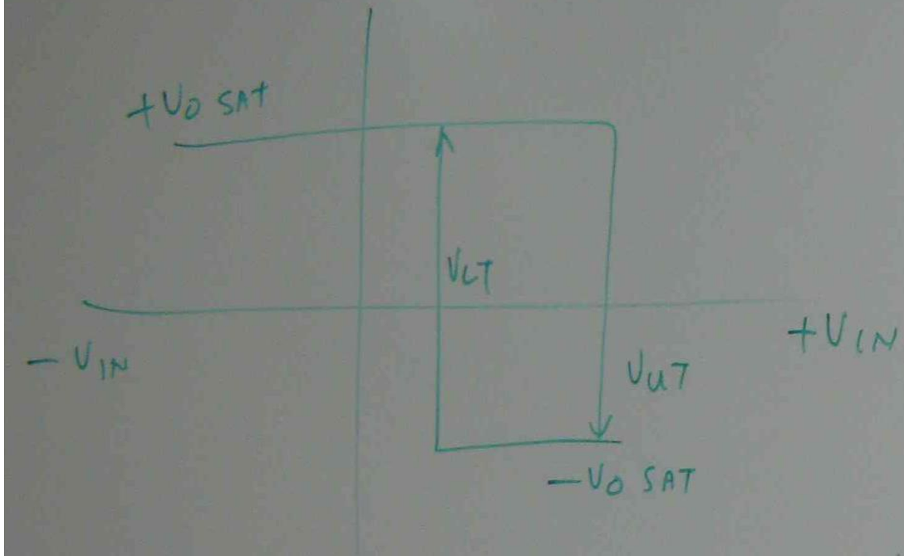
$$= V_{ref} \pm 150\,\mu V$$

THE DIFFERENTIAL COMPARATOR WITH VOLTAGE HYSTERESIS

INVERTING COMPARATOR WITH POSITIVE FEEDBACK



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

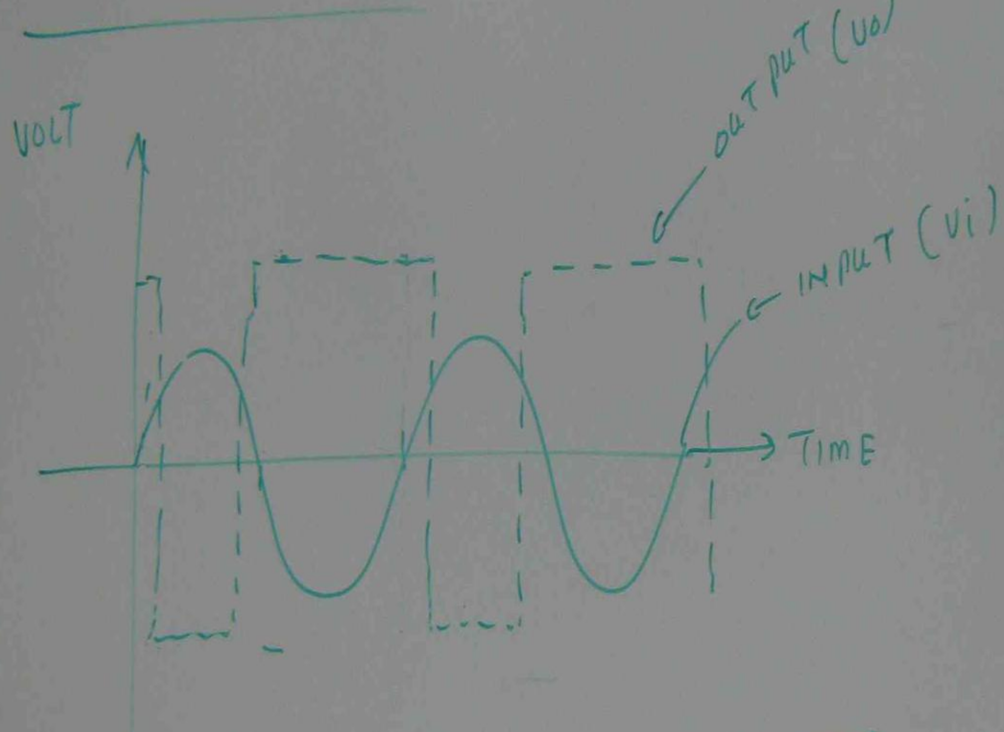


V_{UT} = UPPER THRESHOLD VOLTAGE $= V_{ref} + \left[1 + V_{o(SAT)} - V_{ref}\right] \times \frac{R_1}{R_1+R_2}$

V_{LT} = LOWER THRESHOLD VOLTAGE $= V_{ref} + \left[\left\{-V_{o(SAT)} - V_{ref}\right\} \times \frac{R_1}{R_1+R_2}\right]$

V_H = HYSTERESIS VOLTAGE $= V_{UT} - V_{LT}$

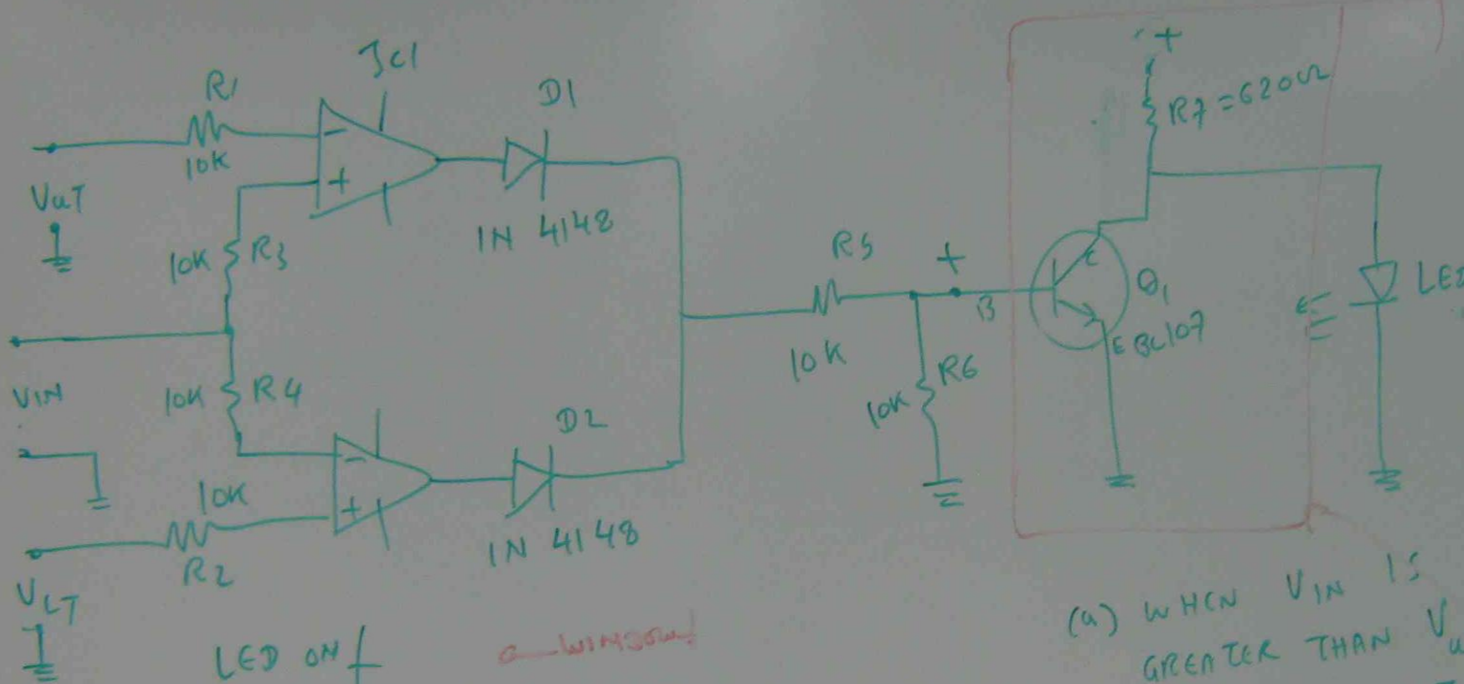
A SINE WAVE INPUT



OUTPUT WAVE FORM OF SCHMITT COMPARATOR

THE WINDOW COMPARATOR

A WINDOW COMPARATOR WILL DETECT WHEN AN INPUT VOLTAGE IS BETWEEN TWO SET LEVELS.

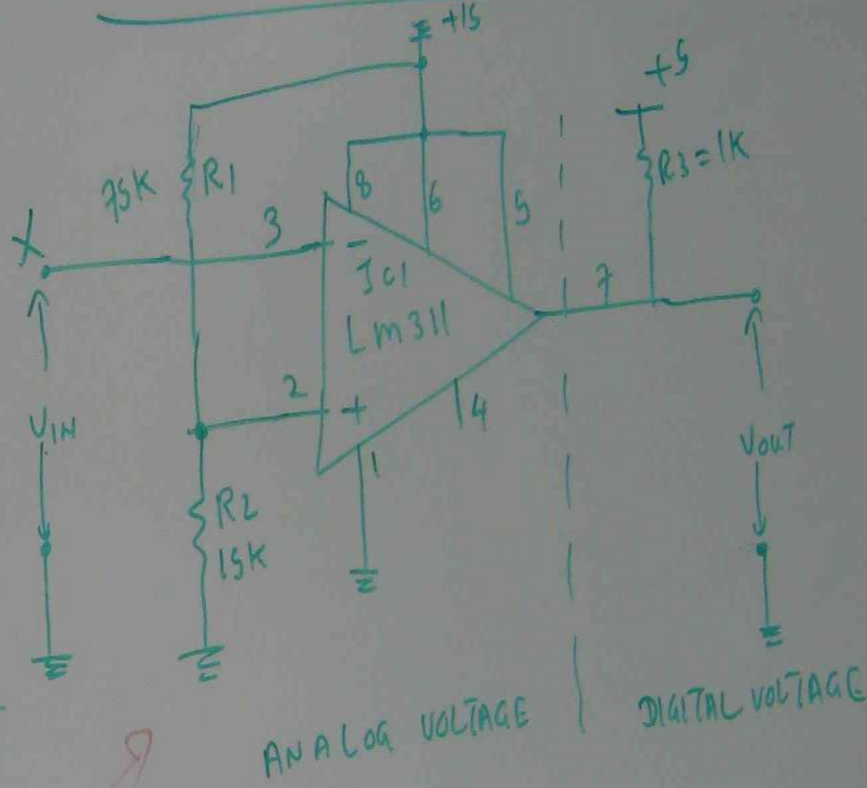


(a) WHEN V_{IN} IS GREATER THAN V_{UT} THE OUT PUT of IC_1 IS HIGH Q_1 IS ON THE LED IS off

(b) WHEN V_{IN} IS LESS THAN V_{LT}, THE OUT PUT of IC_2 IS HIGH, Q_1 IS ON LED IS off

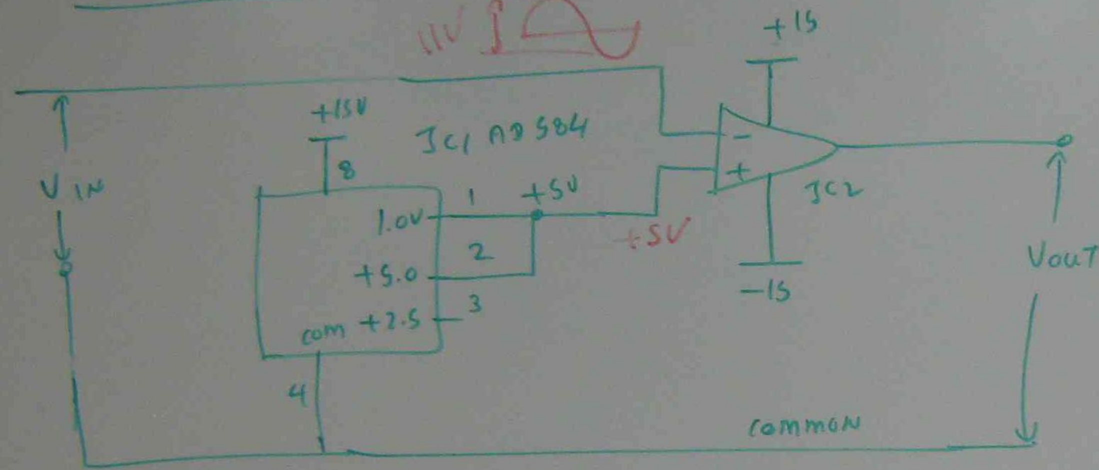
(c) WHEN V_{IN} IS GREATER THAN V_{LT} AND LESS THAN V_{UT}, THE OUTPUT OF IC_1 AND IC_2 WILL BE LOW CAUSING Q_1 TO TURN OFF, ALLOWING LED TO OPERATE.

INTERFACING TO DIGITAL LOGIC

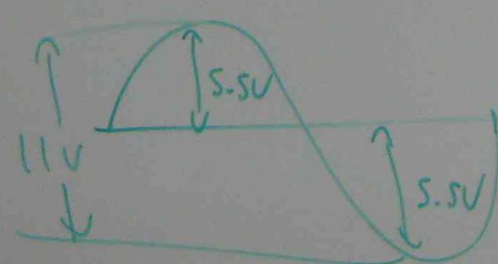


EXCRCISE

①



FOR THE ABOVE CIRCUIT, SKETCH THE INPUT AND OUTPUT WAVE FORMS ON A COMMON TIME SCALE IF 11 V_{P-P}, 1 KHZ SINE WAVE IS APPLIED TO INPUT



$$T = \frac{1}{f} = \frac{1}{10^3}$$

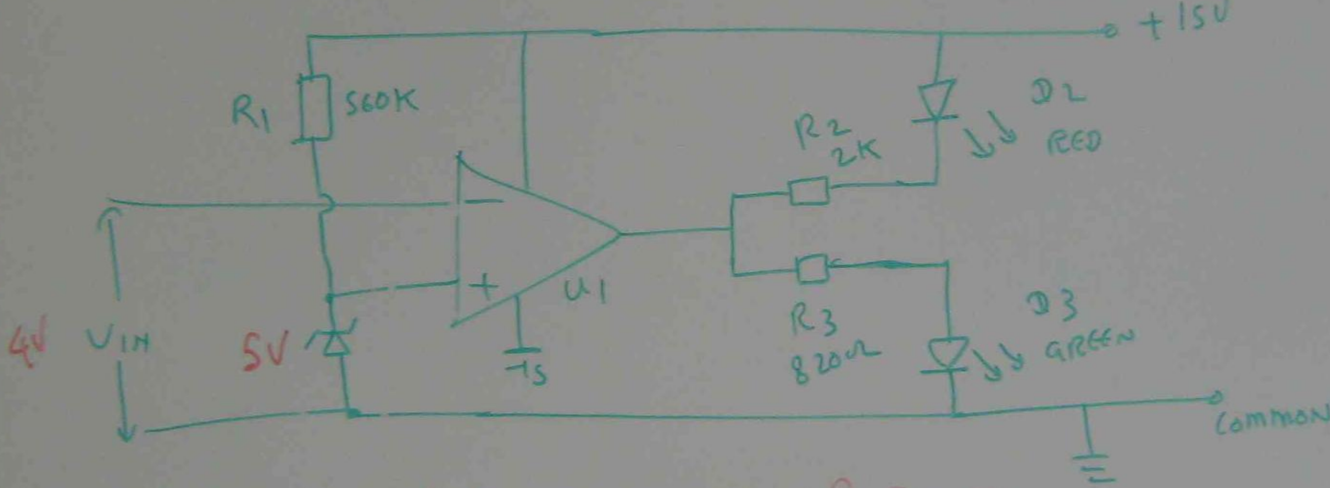
$= 1ms$

②

4V

(2) FOR THE CIRCUIT IN FIGURE, IDENTIFY WHICH LED IS ON UNDER THE FOLLOWING CONDITIONS.

(a) IF $V_{IN} = 4V$ (b) IF $V_{IN} = 8V$

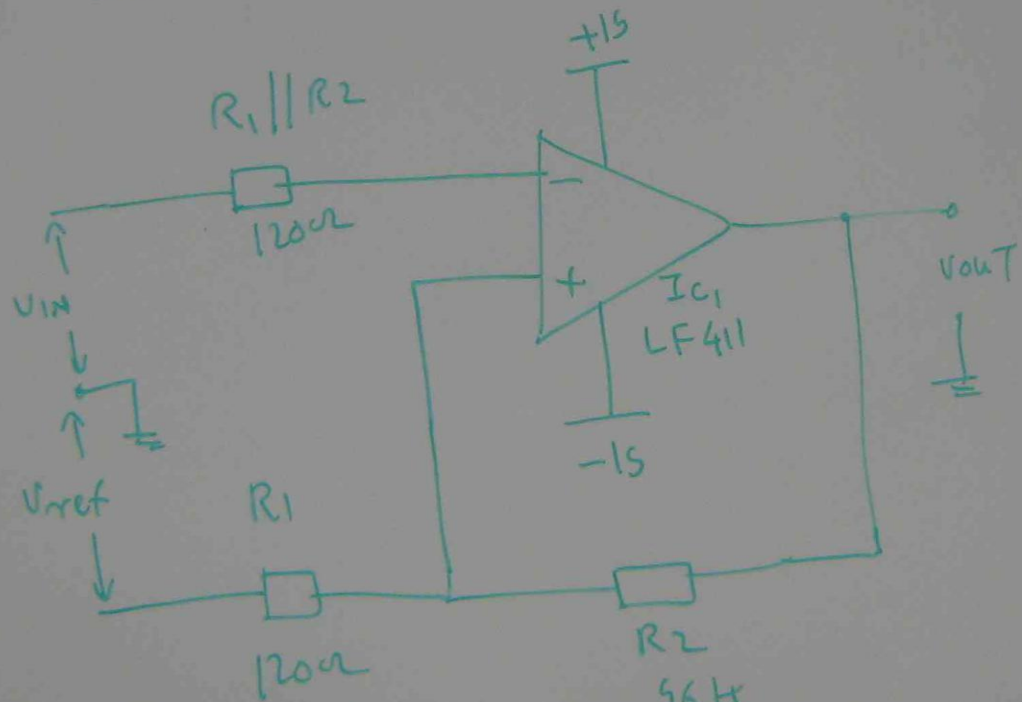


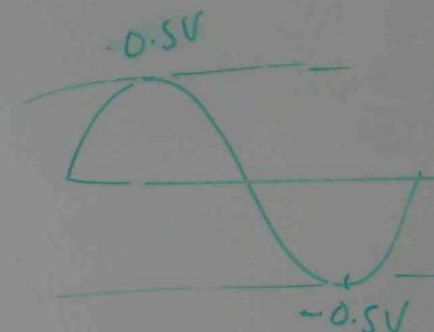
(a) D3 (b) D2

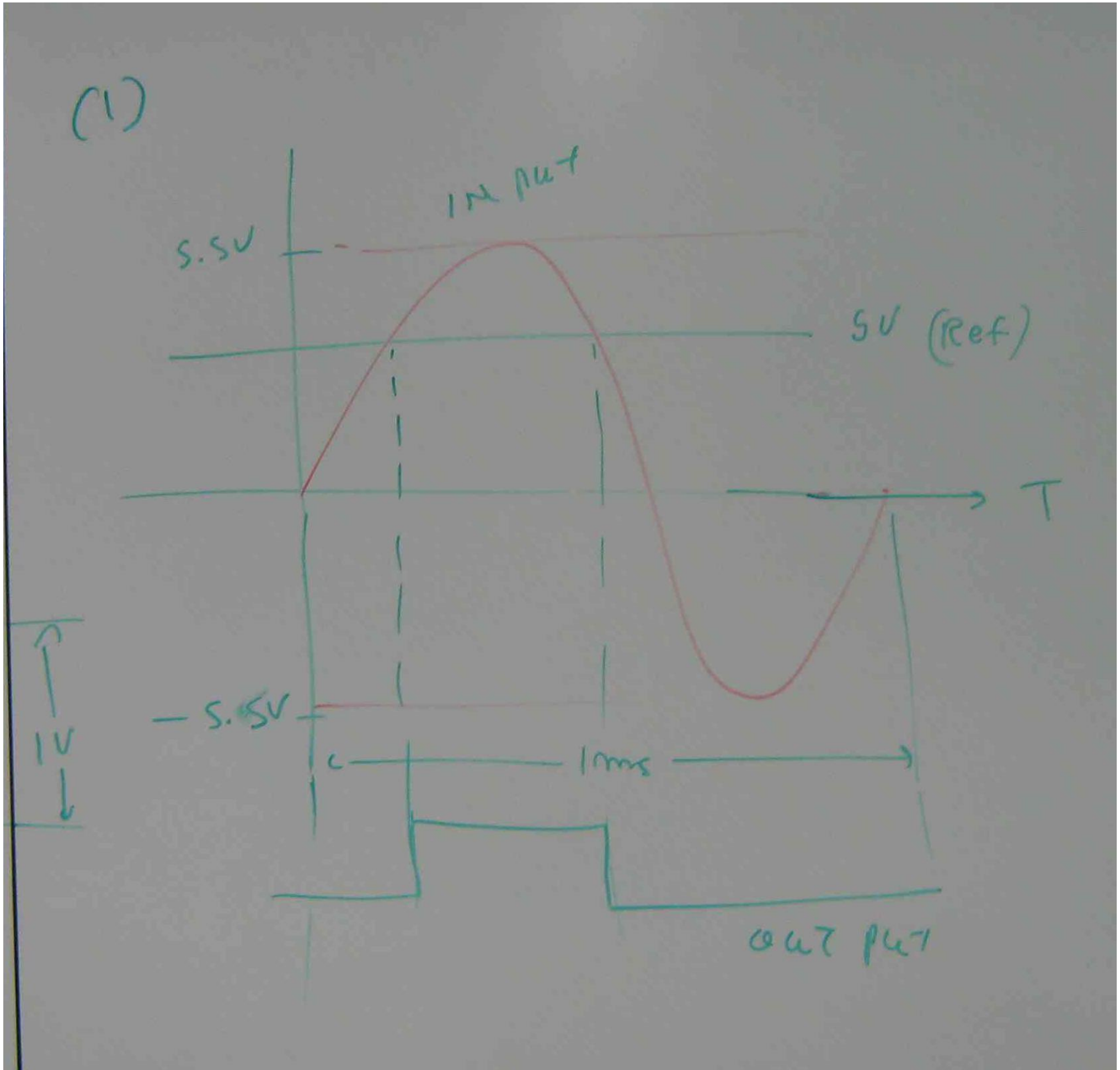
(3) THE CIRCUIT OF THE FIGURE IS A SCHMITT TRIGGER WITH V_{ref} SET TO 0 V.

CALCULATE THE UPPER AND LOWER THRESHOLD VOLTAGES AT WHICH SWITCHING WILL OCCUR

V_{IN} = 1 V P-P






(1)
INPUT
5.5V
5V (Ref)
T
-5.5V
1V
1ms
OUTPUT

(3) $V_{UT} = V_{ref} + \left[\left(V_{O(SAT)} - V_{ref} \right) \times \frac{R_1}{R_1 + R_2} \right]$

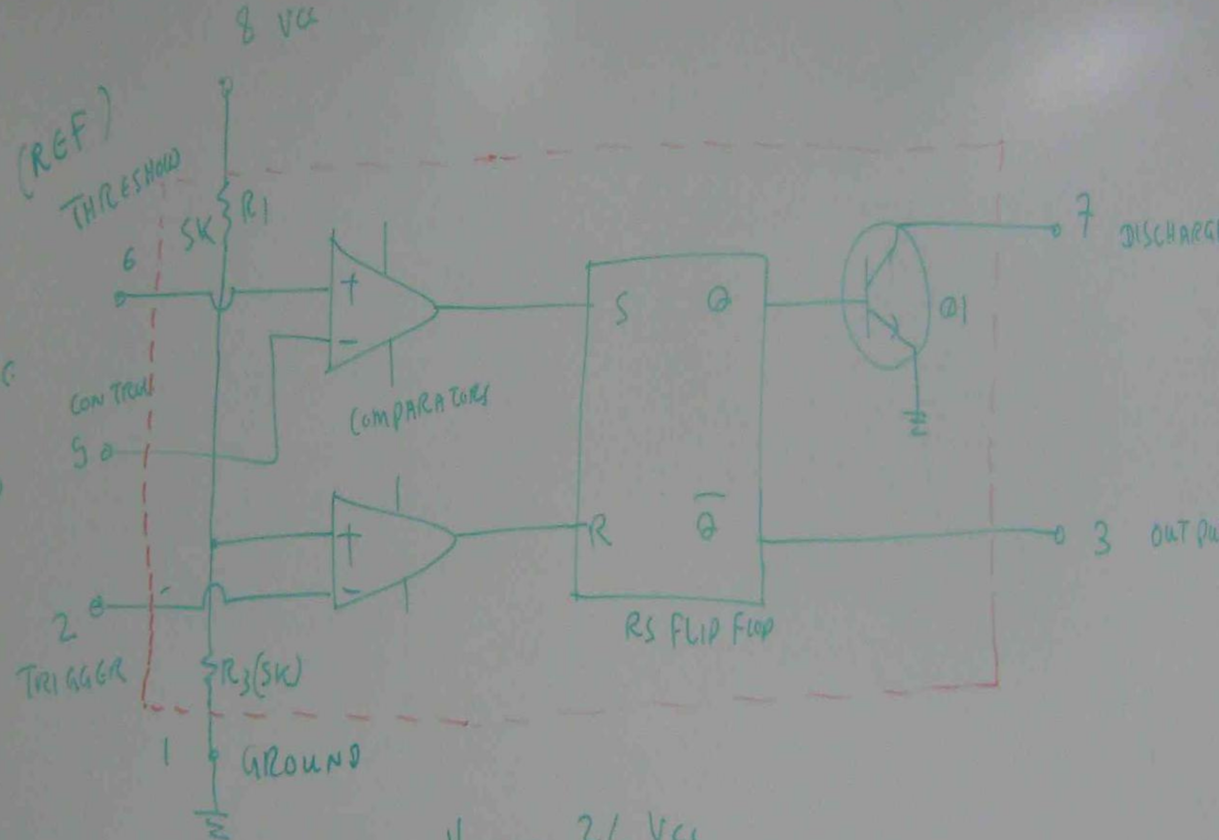
$V_{LT} = V_{ref} + \left[\left(-V_{OSAT} \right) - V_{ref} \right) \times \frac{R_1}{R_1 + R_2} \right]$

$V_{UT} = 0 + \left[(0.5 - 0) \times \frac{120}{120 + 56 \times 10^3} \right] = 0.5 \times \frac{120}{56120} = 1.07\,mV$

$V_{LT} = 0 + \left[\left\{ -(-0.5) - 0 \right\} \times \frac{120}{120 + 56 \times 10^3} \right] = 0.5 \times \frac{120}{56120} = 1.07\,mV$

TIMER ICS

555



$$V_{UT} = 2/3\ V_{cc}$$

$$V_{LT} = 1/3\ V_{cc}$$