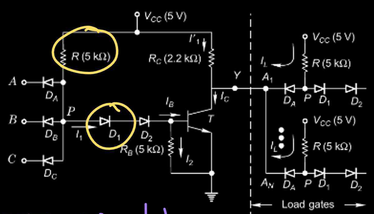
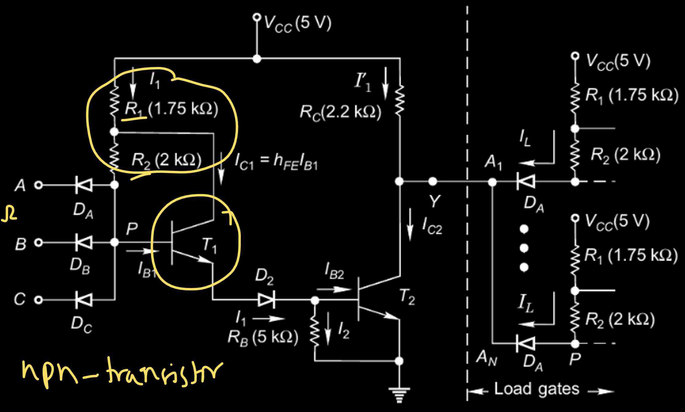
Modified DTL (Fanout Improvement)



(DTL Nand)

(Modified DTL Nand)

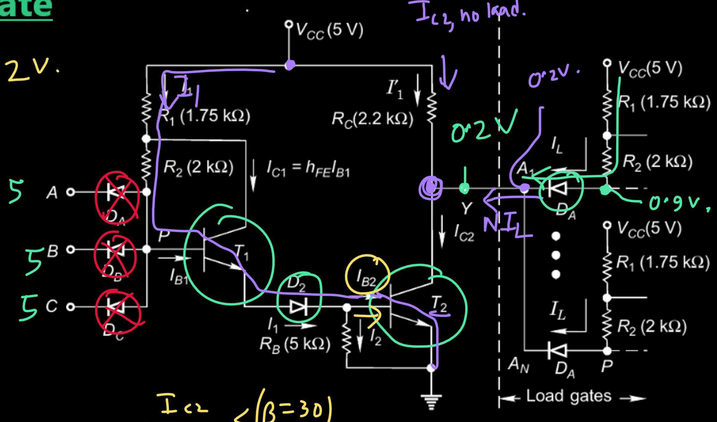


$R_1 + R_2 < R = 5\,k\Omega$

Max Fanout Calculation for Modified DTL Nand Gate

Case 1. Output, $V_y = 0.2\,V$.

N-load.



$I_{C2} = I_1' + N I_L$

$\frac{I_{C2}}{I_{B2}} < \beta$

$I_{C2} = I_1' + N I_L$

$= \frac{5 - 0.2}{2.2k} + N \cdot \frac{V_{CL} - 0.9}{(2 + 1.75)k}$

$= 2.182\,mA + N \times 1.093$

$\frac{I_{C2}}{I_{B2}} < (\beta = 30)$

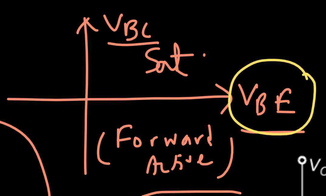
$\Rightarrow \frac{2.182 + N \times 1.093}{1.3831} < 30$

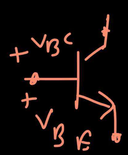
$N_{max} = \left\lfloor \frac{30 \times 1.3831 - 2.182}{1.093} \right\rfloor$

$\therefore N_{max} = 35$

I_{B2}

Check V_{BC}





KCL;

$I_1 = I_{C1} + I_{B1}$

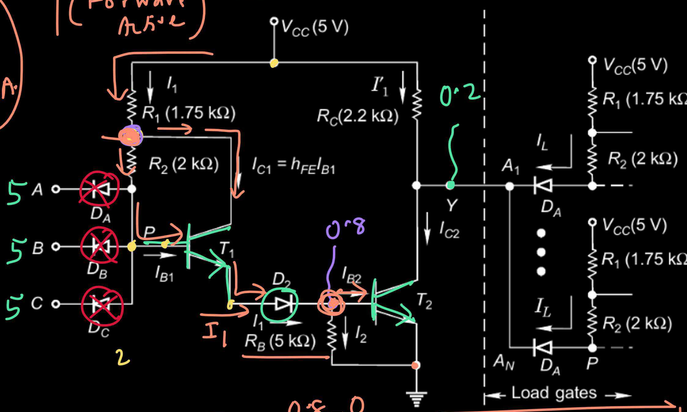
$I_1 = \frac{V_{CL} - V}{R_1} = 1.543\,mA$

$\Rightarrow \frac{V_{CL} - V}{1.75k} = \beta I_{B1} + I_{B1}$

$\Rightarrow \frac{V_{CL} - V}{1.75\,k} = (\beta + 1) \frac{V - 2.2}{2k}$

$(\beta = 30)$

$V = 2.3\,V$

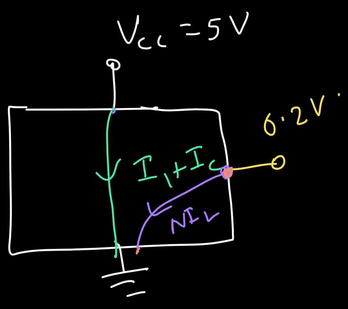


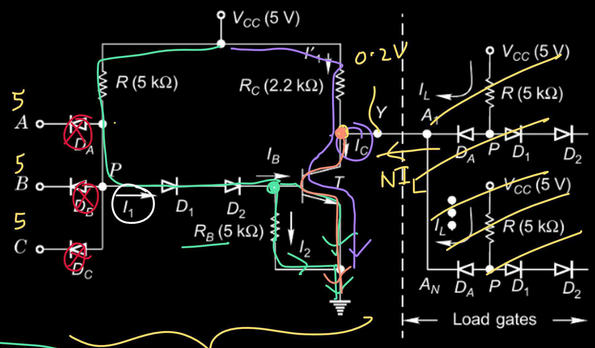
$I_1 = I_{B2} + I_2 = I_{B2} + \frac{0.8 - 0}{5\,k\Omega}$

$\therefore I_{B2} = 1.383\,mA$

Maximum Power Dissipation

Case 1 $V_Y = 0.2$ V.





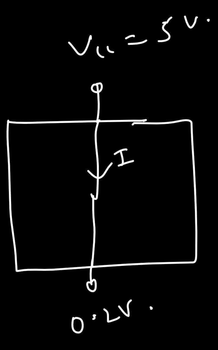
$\therefore P = \Delta V \times (I_1 + I_C)$

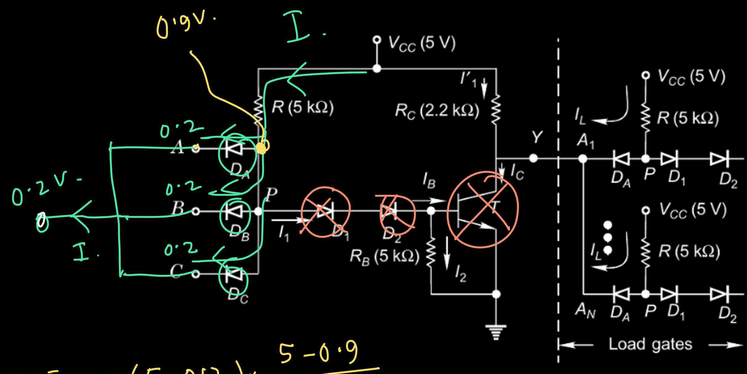
$= (5-0) \times (0.56 + 2.182)$ mA

$= 13.71$ mW

$+ (0.2-0) \times N I_L$

Case 2 $V_Y = 5$ V.

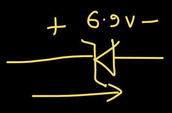




$P = \Delta V I = (5-0.2) \times \frac{5-0.9}{5\text{K}}$

$= 3.936$ mA

High Threshold Logic (HTL)



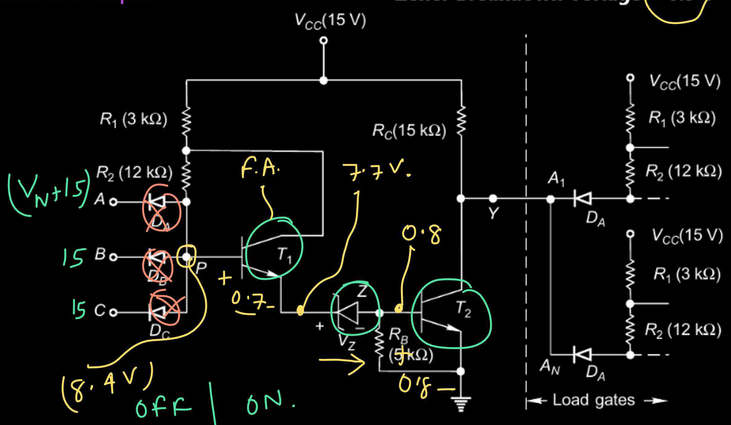
Q. If all the inputs are high, then what is magnitude of noise voltage at one of the input terminals which will cause the gate to malfunction? Assume no load connected to output.

Zener Breakdown Voltage = 6.9 V

$NM_H = 7.2\ V$

(7.8V.)
(V_N+15)
8.4V
P
A
D_A
− 0.6 V +
V_γ = (cut-in voltage.)

$V_N + 15 = 7.8 \quad \therefore V_N = -7.2\ V$



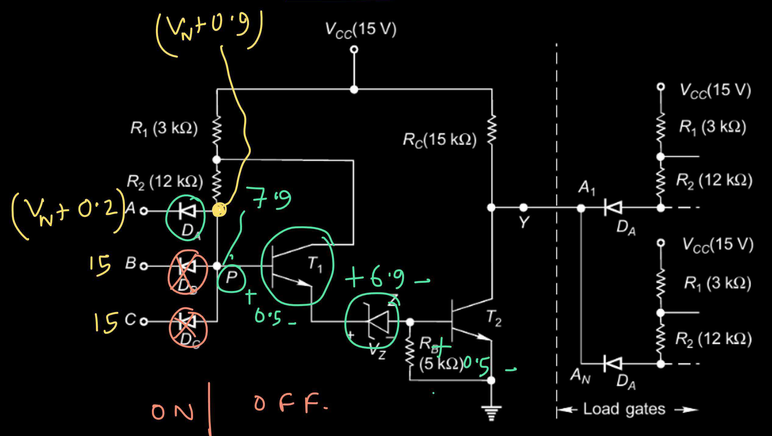
Q. If one of the inputs is low, then what is magnitude of noise voltage at low input terminal which will cause the gate to malfunction? Assume no load is connected to output.

$NM_L = 7$

$V_P = 0.5 + 6.9 + 0.5$
$= 7.9\ V$

$\therefore V_N + 0.9 = 7.9$
$\Rightarrow V_N = 7V$

$NM = \min(NM_H, NM_L)$
$= \min(7.2, 7)$
$= 7$



$NM = 0.8V$