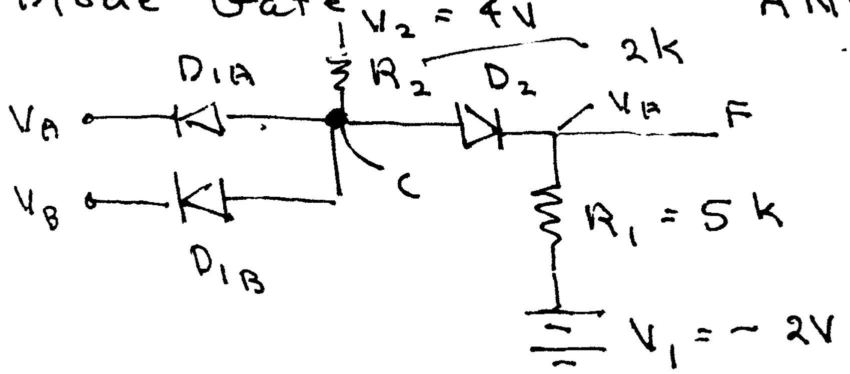
3) Diode Gate

AND Gate (Diode Gate)

$V_2 + V_1 > 0$



E 2,9 (G+S)

And Gate

Determine V_F for

a) $V_A = .2V$ $V_B = .2V$

D_{1A}, D_{1B} = on $V_C = .9V$ D_2 on

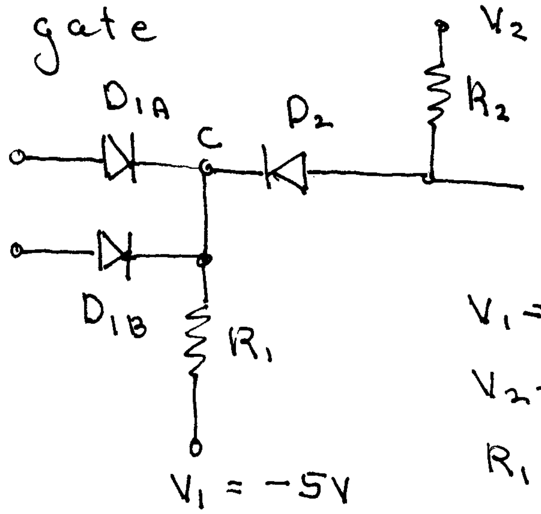
$V_F = .2V$ (low)

b) $V_A = 4 = V_B = 4V$ D_{1A}, D_{2A} = off.

$V_F = [(6 - .7)/7]5 - 2 = \frac{5.3}{7} \times 5 - 2 = \ldots - 2$

$= 1.785$ Volts

OR gate (Diode Gate)



$F = A + B$

$V_1 = -5V$

$V_2 = +5V$

$R_1 = R_2 = 1k\Omega$

$V_{D(on)} = .7$

A = 1V B = 1V – low D_{1A}, D_{1B} off

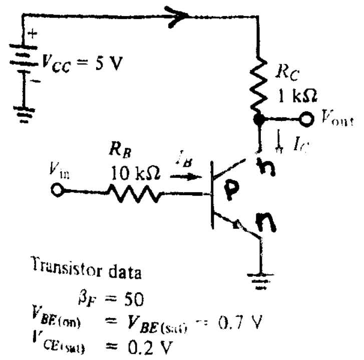
D_2 on current = $\frac{10}{2k\Omega} = 5mA$

$V_F = 5 - 5 = 0$

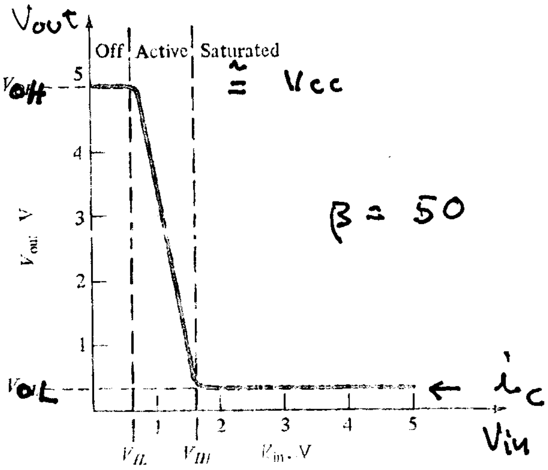
A = 4V, B = 1V – D_{1A} on D_{1B} off

$V_C = 3.3V$ $V_F = \underline{4V}$

Transistor Inverter - Digital Application



(a)



(b)

$\cong V_{cc}$

$\beta = 50$

$i_c \approx 5/10^3 = 5\,mA$

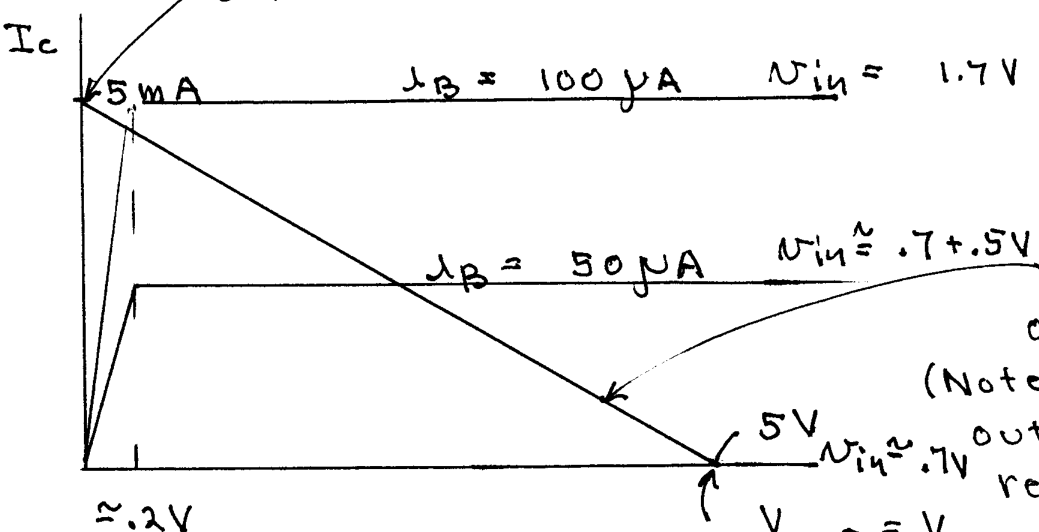
$i_c \approx i_B = 0$
base just barely on
$\therefore V_{in} \approx .7V$

$i_c \approx 5mA = i_B \beta$

$\therefore i_B \approx \frac{5mA}{50} = 100\mu A$

$V_{in} \approx .7 + 10k\Omega \times 100 \times 10^{-6}$

$\approx .7 + 1 \approx 1.7V$



The NOR (or NAND) Gate

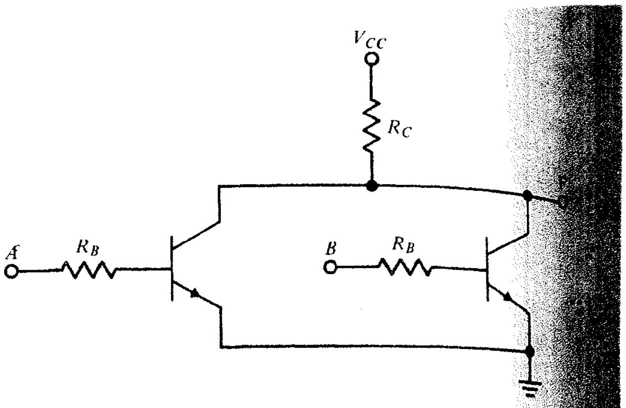


FIGURE 3.5
Circuit diagram of an RTL gate

Voltage level HIGH = H LOW = L		
A	B	F
L	L	H
L	H	L
H	L	L
H	H	L

(a)

Positive logic H = 1 L = 0		
A	B	F
0	0	1
0	1	0
1	0	0
1	1	0

(b)

NOR

Negative logic L = 1 H = 0		
A	B	F
1	1	0
1	0	1
0	1	1
0	0	1

(c)

NAND

$F = \overline{A + B}$ $\qquad$ $F = \overline{AB}$

By De Morgans Th $= \bar{A}\,\bar{B}$ $\qquad$ $= \bar{A} + \bar{B}$

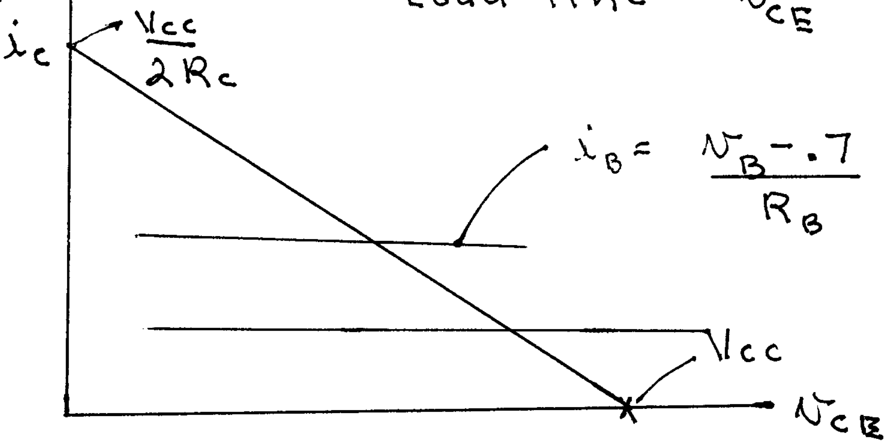
Example $V_{BE(sat)} = .7V$ $\qquad$ $\beta_F = 50$

$V_{CE(sat)} = .2V$

$R_B = 1k\Omega$ $\qquad$ $V_{cc} = 3V$

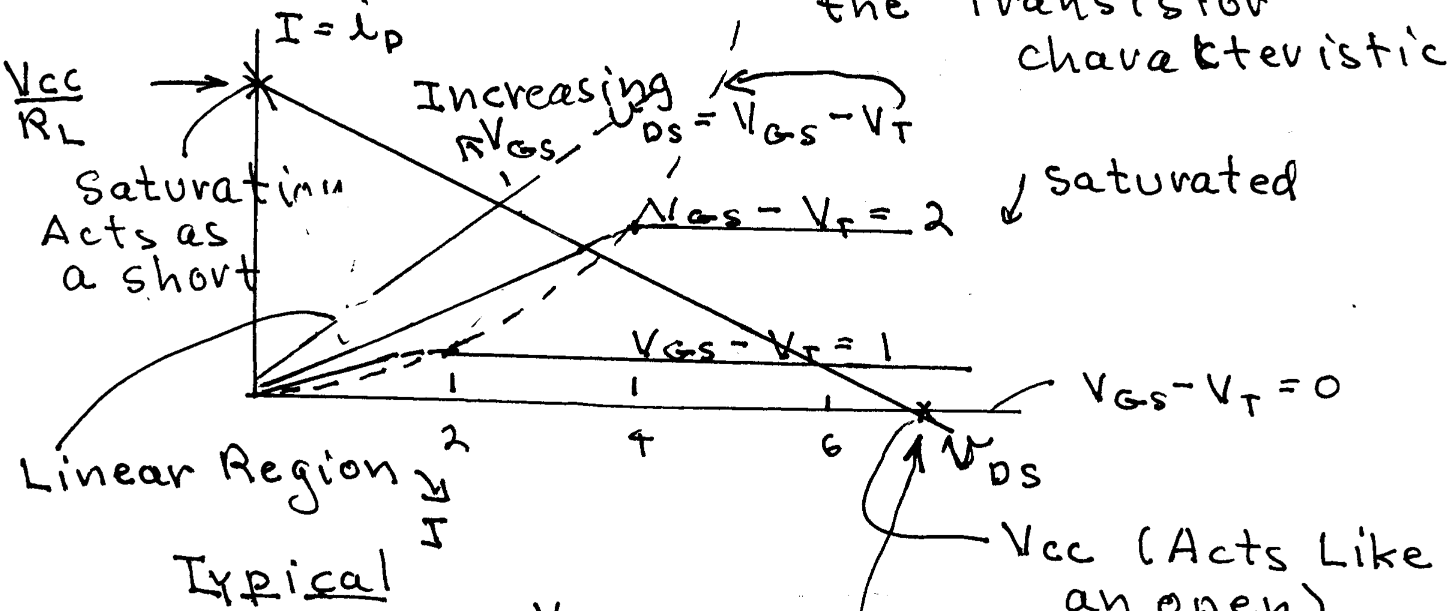
$R_c = 2k\Omega$

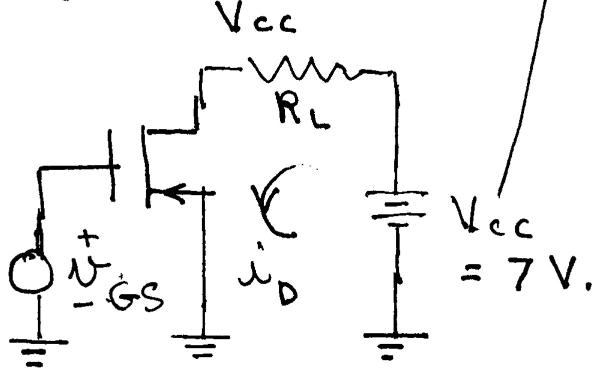
H, H $\qquad$ Load line $v_{CE} = -2 i_c R_c + V_{cc}$



MOS Inverter
Passive Load

Thevenin of Load on the Transistor characteristic





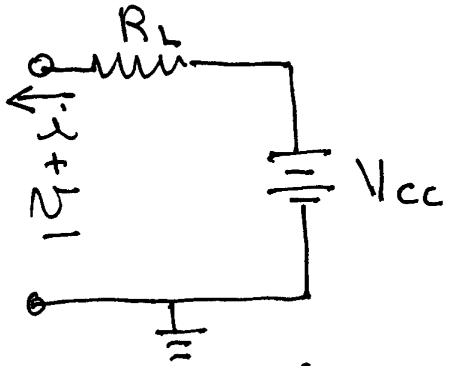
KVL

$v_{DS} = -R_L i_D + V_{CC}$

when $v_{DS} = 0$

$i_D = \frac{V_{CC}}{R_L}$

The line, which is the Thevenin equivalent of the load circuit is called the "load line". Its simply this



The negative slope is simply the opposite reference for current

The solution approach is the same as for the diode but we can now "move" the solution with v_{GS}