# AKTU

GATEWAY CLASSES

# Digital System Design

## B.Tech. 3rd Sem

## EC & Allied



**Exam/Result Oriented Content**

- ✓ Recorded Video Lectures
- ✓ Pdf Notes
- ✓ PYQs

# DIGITAL SYSTEM DESIGN

## UNIT 4 : Logic families and semiconductor memories

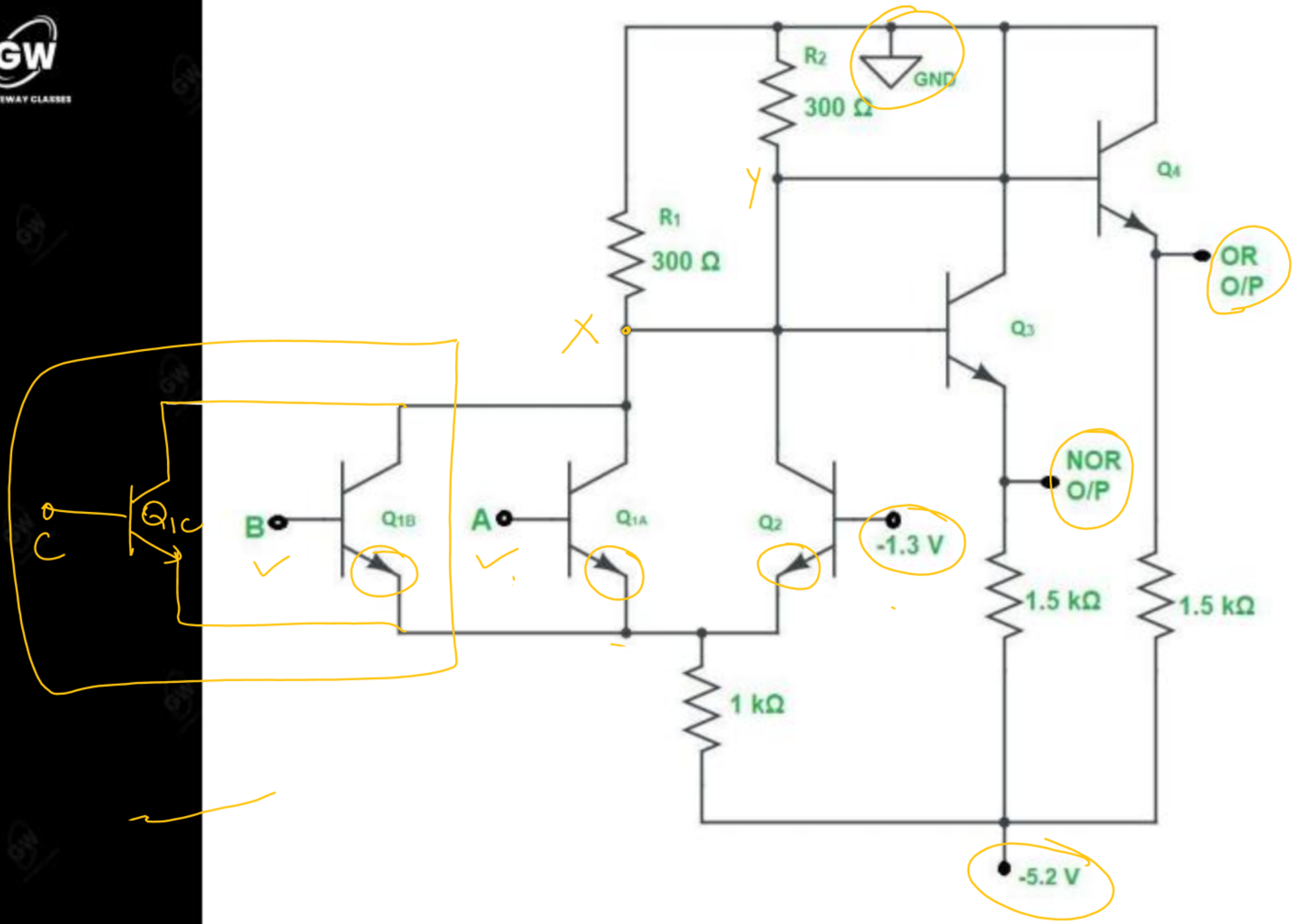
Lec 4

**Today's Target**

- Emitter-coupled logic
- University Questions

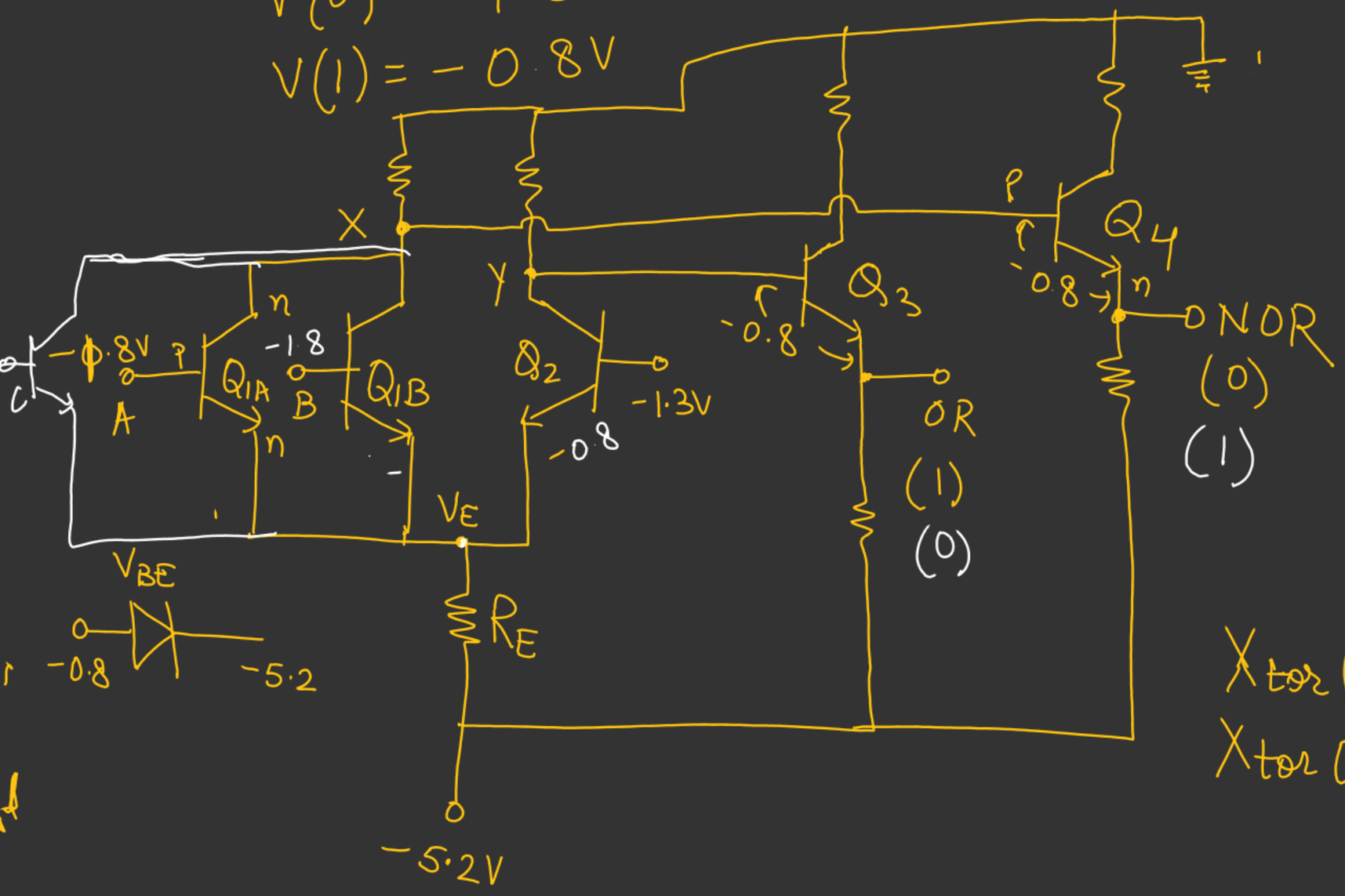
# Emitter-coupled logic

- high-speed integrated circuit
- bipolar transistor logic family
- uses an overdriven BJT differential amplifier with single-ended input
- limited emitter current to avoid the saturated (fully on) region of operation
- slow turn-off behavior
- As the current is steered between two legs of an emitter-coupled pair, ECL is sometimes called current-steering logic (CSL), current-mode logic (CML) or current-switch emitter-follower (CSEF) logic.
- Disadvantage: each gate continuously draws current, which means that it requires (and dissipates) significantly more power than those of other logic families, especially when quiescent.


R2
300 Ω
GND
Y
Q4
R1
300 Ω
OR
O/P
X
Q3
NOR
O/P
B
Q1B
A
Q1A
Q2
-1.3 V
1.5 kΩ
1.5 kΩ
1 kΩ
-5.2 V

$V(0) = -1.8V$

$V(1) = -0.8V$




| A | B | NOR | OR |
|---|---|---|---|
| 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 |
| 1 | 1 | 0 | 1 |

$X_{tor}$ OFF $\rightarrow V_C = 0V$

$X_{tor}$ ON $\rightarrow V_C = -1V$

## Case 1: When any 1 or all i/Ps are at logic 1

Respective $V_{BE_{Q_1}} = FB = -0.8V$

$V_E = -0.8 - 0.8 = -1.6V$

$V_{BE_{Q_2}} = -1.6 - (-1.3) = -0.3V$

So $Q_2$ = OFF (RB)

$Y = 0V$ $\quad X = -1V$

$V_{EQ_3} = 0 - 0.8V = -0.8V = \text{logic } 1$

$V_{EQ_4} = -1 - 0.8 = -1.8V = \text{logic } 0$

## Case 2: When all i/Ps are at logic 0

$Q_{1A}$ & $Q_{1B}$ = OFF $\quad Q_2$ = ON

$V_E = -1.3V - 0.8V = -2.1V$

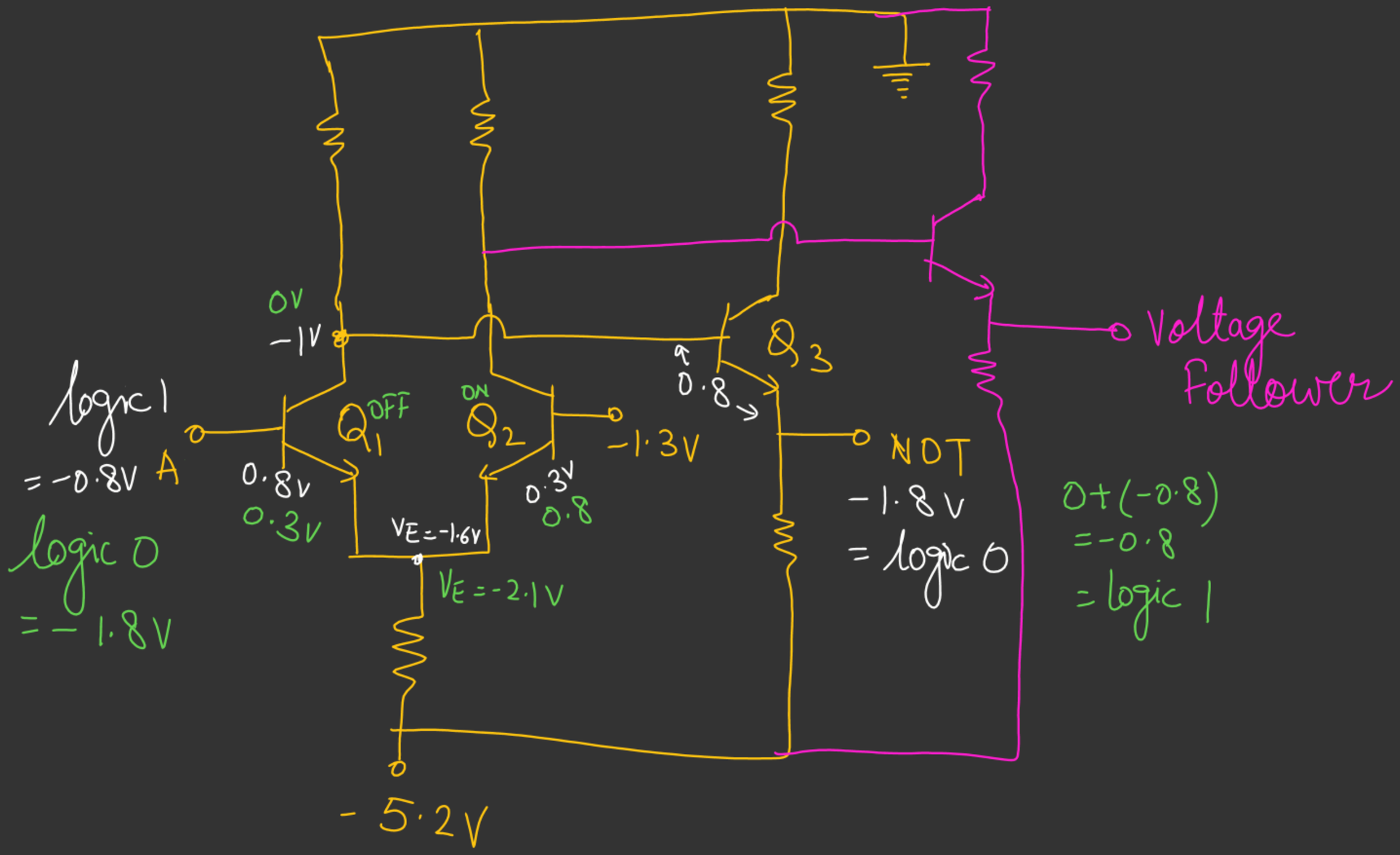
$V_{BEQ_1} = -2.1 - (-1.8) = -0.3V$

So $Q_{1A}$ & $Q_{1B}$ = OFF

$X = 0$ $\quad Y = -1V$

$V_{EQ_4} = X + (-0.8) = 0 + (-0.8) = -0.8 = \text{logic } 1$

$V_{EQ_3} = Y + (-08) = -1 + (-0.8) = -1.8 = \text{logic } 0$


0V
-1V
logic 1
= -0.8V
A
logic 0
= -1.8V
OFF
$Q_1$
ON
$Q_2$
$Q_3$
0.8V
0.3V
0.3V
0.8
-1.3V
$V_E$ = -1.6V
$V_E$ = -2.1V
- 5.2V
0.8
NOT
-1.8V
= logic 0
Voltage Follower
0+(-0.8)
= -0.8
= logic 1

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# Thank You

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