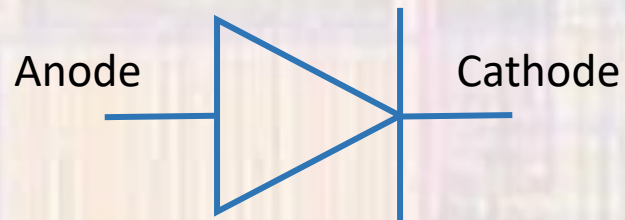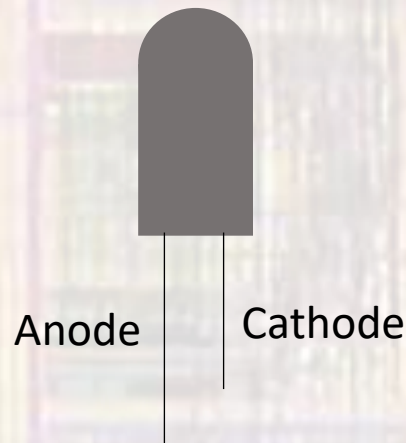# LED Basics

Last updated 11/4/20

LED Basics

- Light Emitting Diode

  - Light is emitted from special diodes when they are sufficiently forward biased

  - No light is emitted if the forward bias (voltage) is below the diode turn on voltage

  - No light is emitted if the diode is reverse biased

  - Typical LED "turn on" voltage is 1.6v – 2.4v

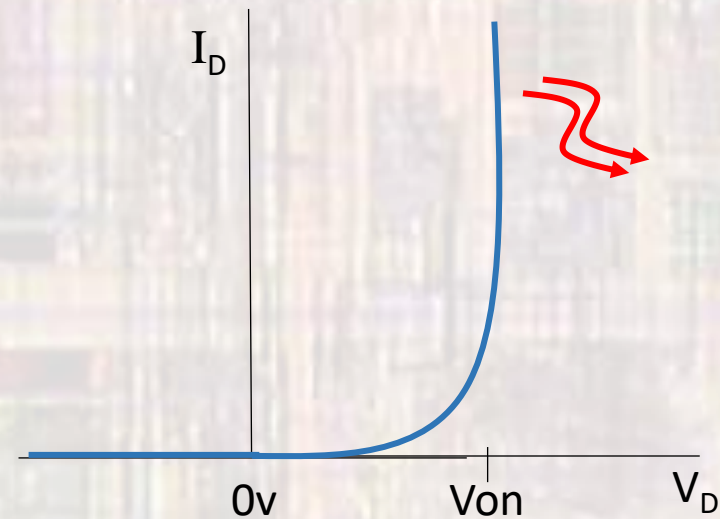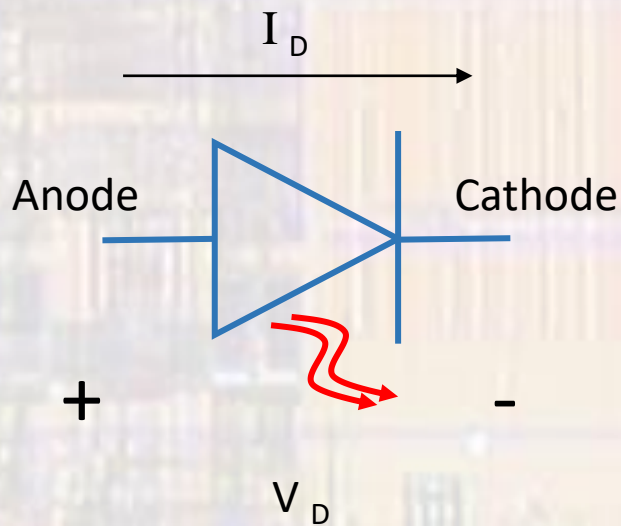# LED Basics

- Light Emitting Diode

  - Schematic symbol

    Anode ◁ Cathode

  - Physical construction

    Anode   Cathode

LED Basics

- Light Emitting Diode

  - Operation

I_D

Anode ▷|— Cathode

+ V_D −

I_D

0v   Von V_D

It requires a lot of current to have V_D greater than Von

LED Basics

- Light Emitting Diode
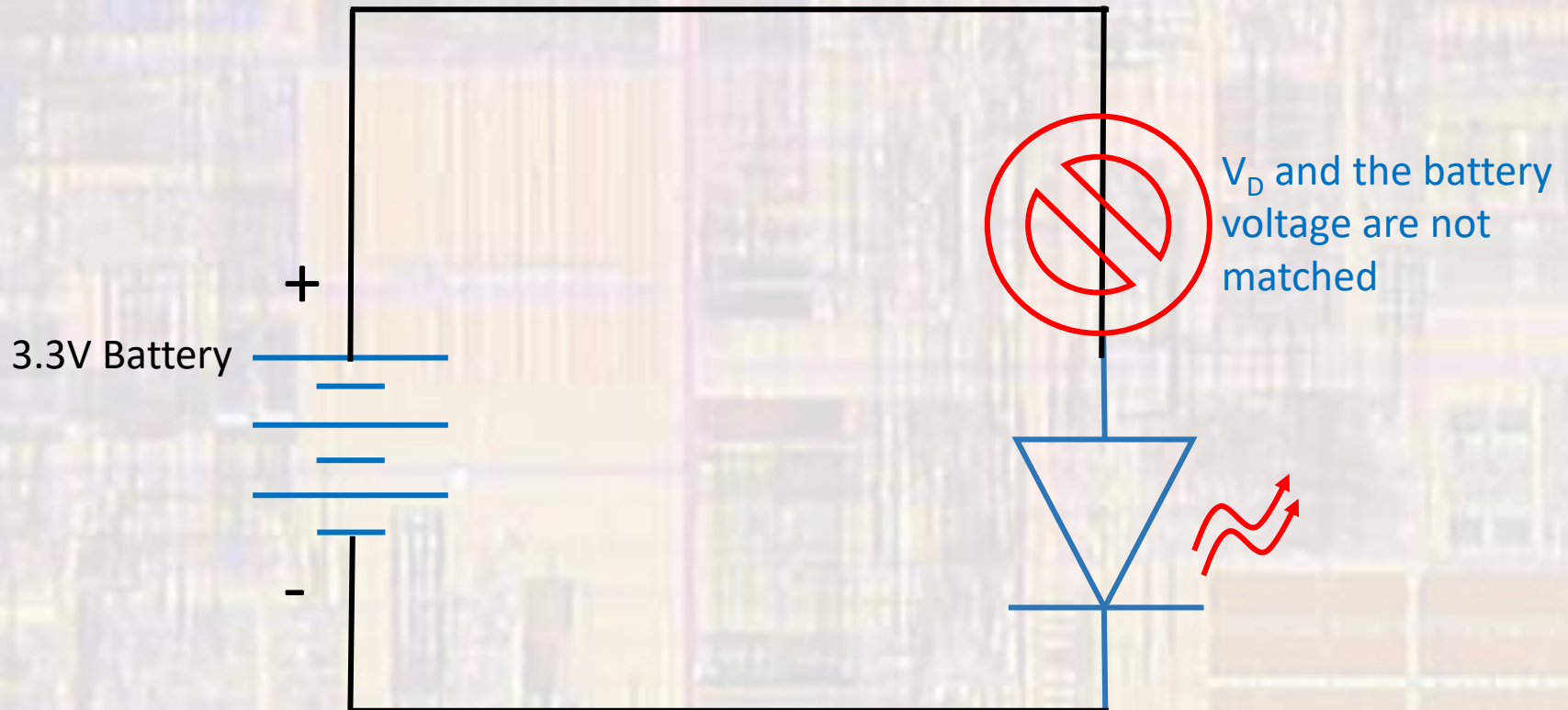
  - Operation

V_D and the battery voltage are not matched

3.3V Battery

+

-

LED Basics

- Light Emitting Diode

  - Operation

Some of the battery voltage is used across the resistor – allowing the diode voltage to be V_{ON}

R

3.3V Battery

+

-

I

+

Von

-

LED Basics

- Light Emitting Diode

  - Operation

Loop Equation:

-3.3v + I*R +Von = 0

I*R = 3.3v − Von

R = (3.3v − Von)/I

R

3.3V Battery

+

-

+

Von

-

LED Basics

- Light Emitting Diode

  - Operation

Von = 1.8v

Imax = 6mA

R = (3.3v − 1.8v)/6mA

R = 250Ω

3.3V Battery

+

-

R

+

Von

-

LED Basics

- Light Emitting Diode

  - Operation

We have 330Ω resistors

Solve for I

I = 4.5mA ✓

< Imax

3.3V Battery

+

−

R

I

+

Von

−

LED Basics

- Light Emitting Diode

  - Use our output pin instead of the battery

MSP432 Board

Digital
output
Pin 5

Output = "1" (3.3v) → ON
Output = "0" (0.0v) → OFF

gnd

330Ω

+

Von
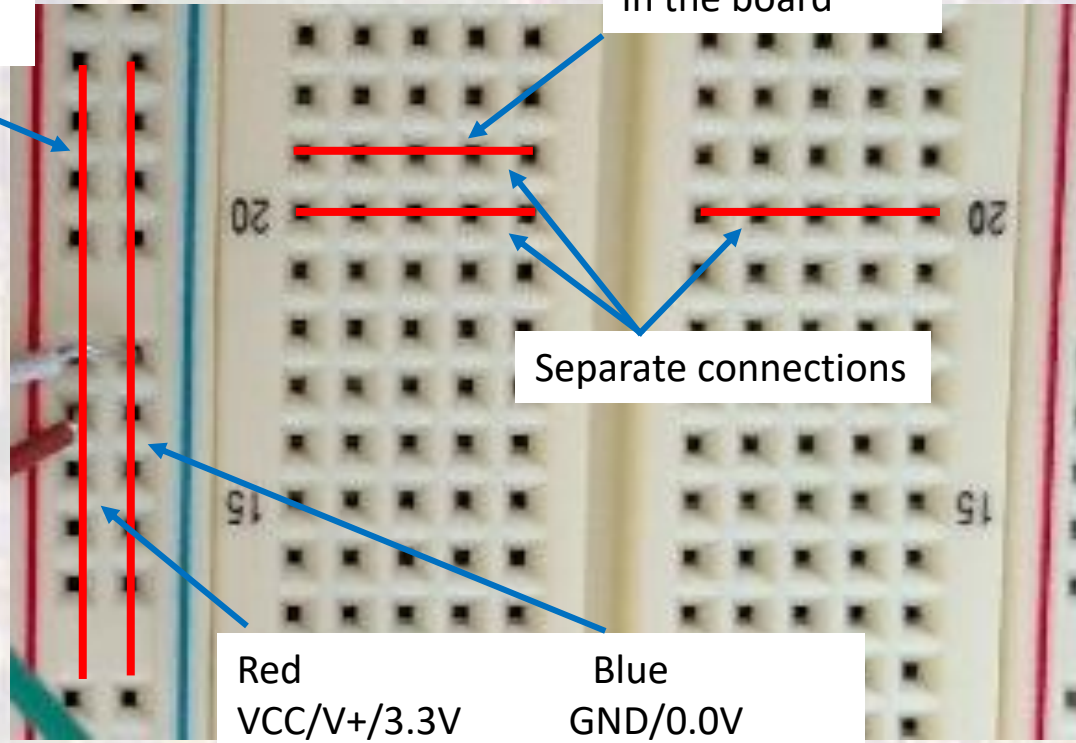
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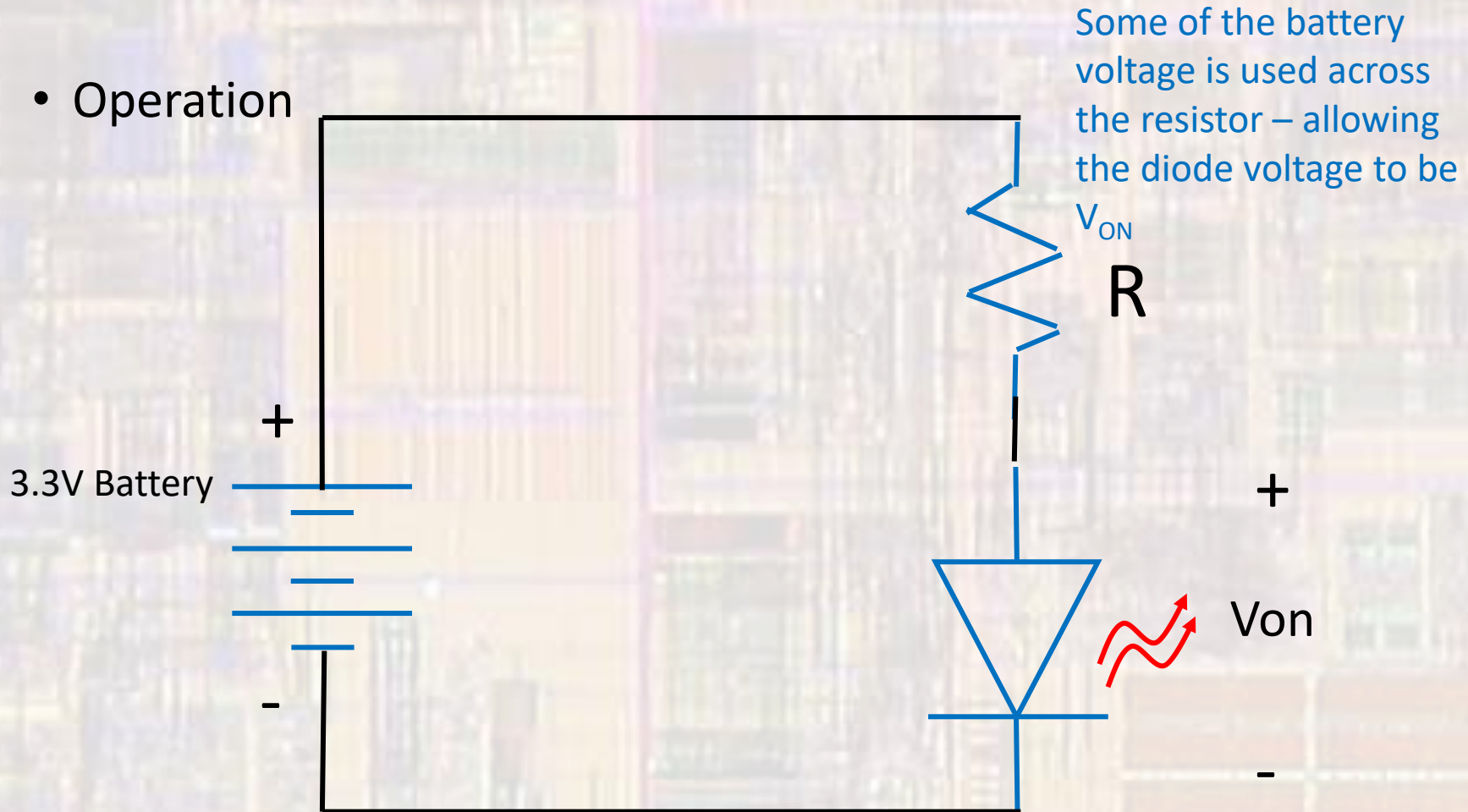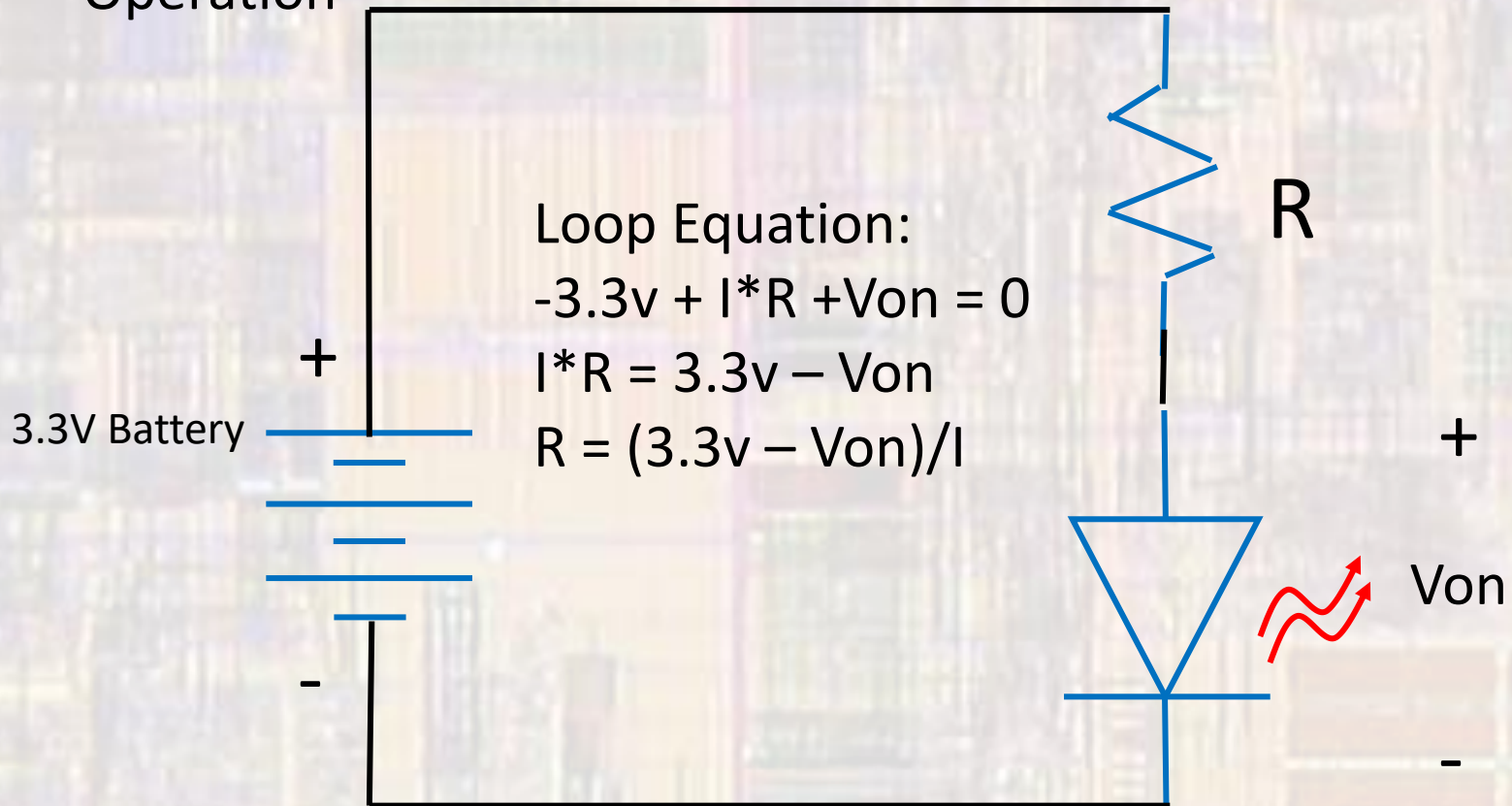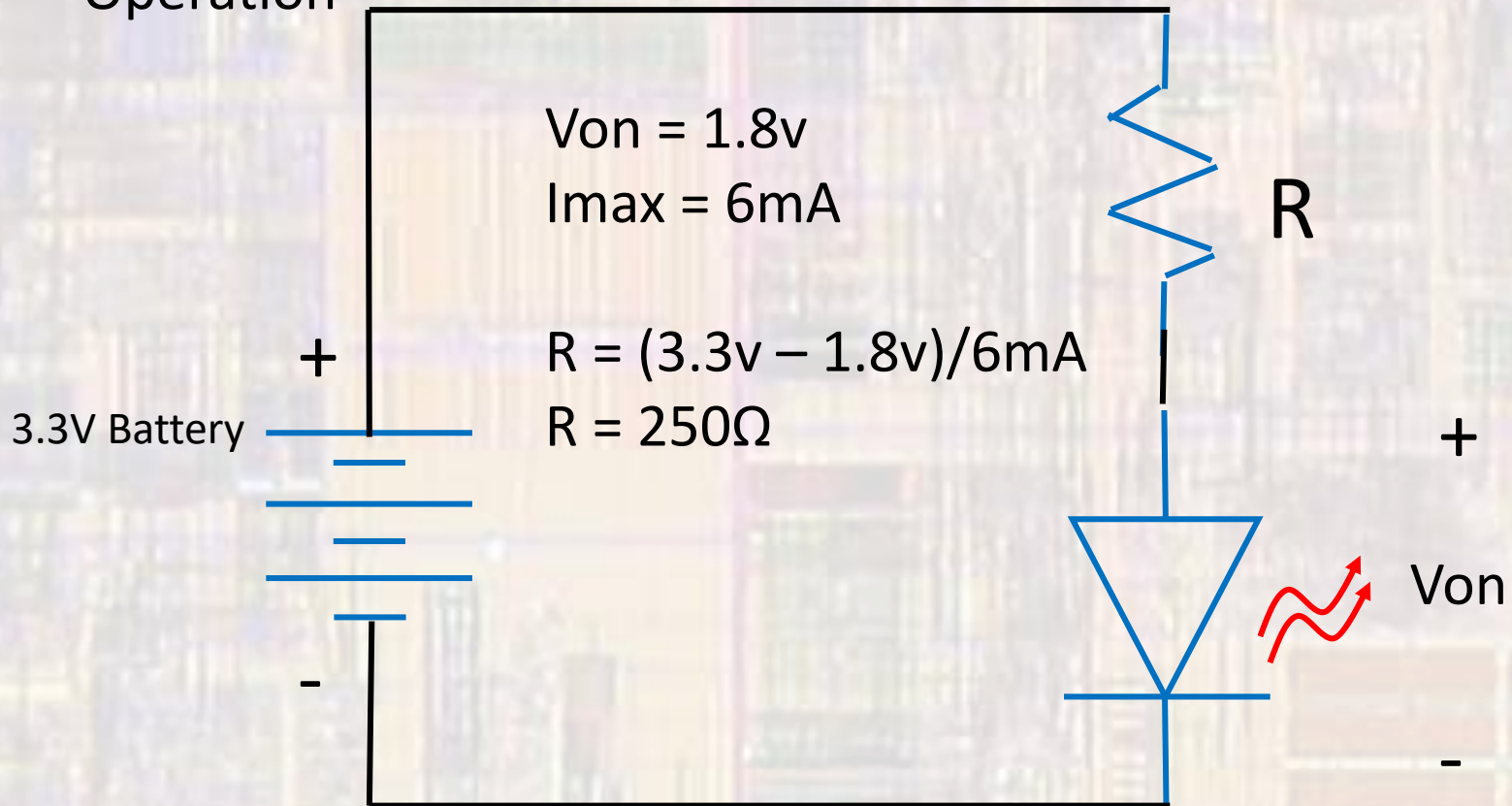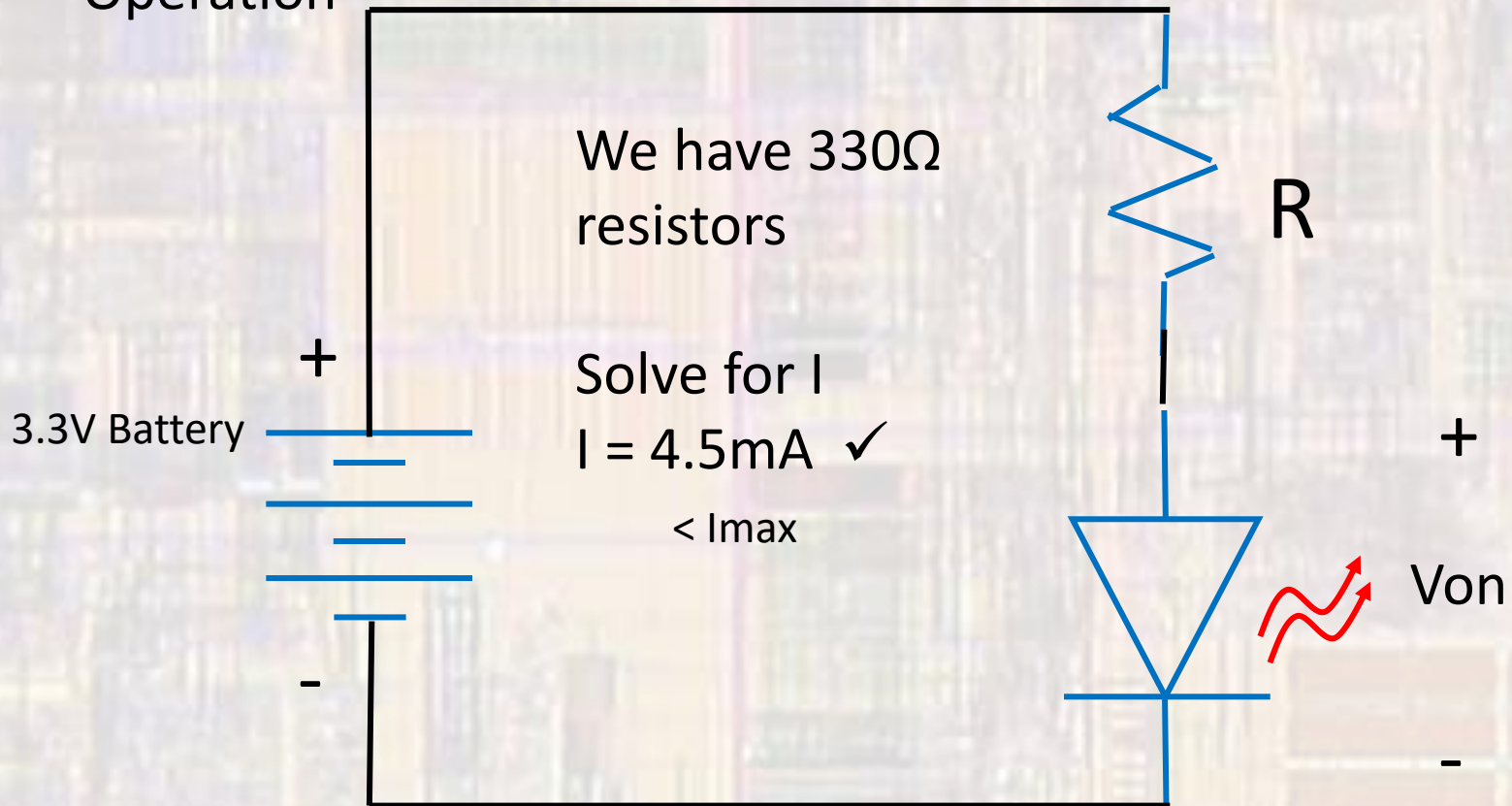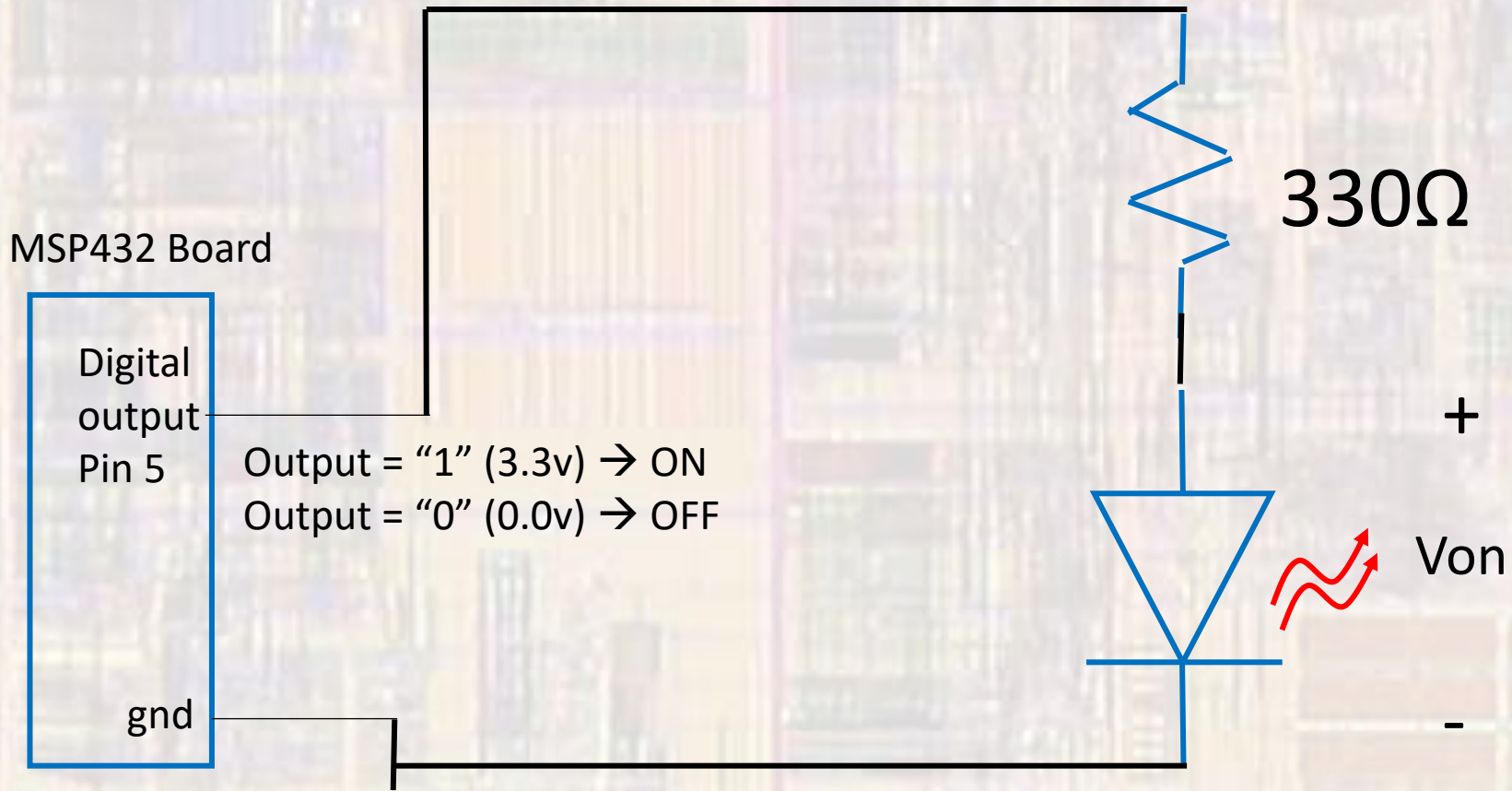
- Breadboard (protoboard) basics
  - Sockets are shorted together inside the board

Shorted together in the board

Shorted together in the board

Separate connections
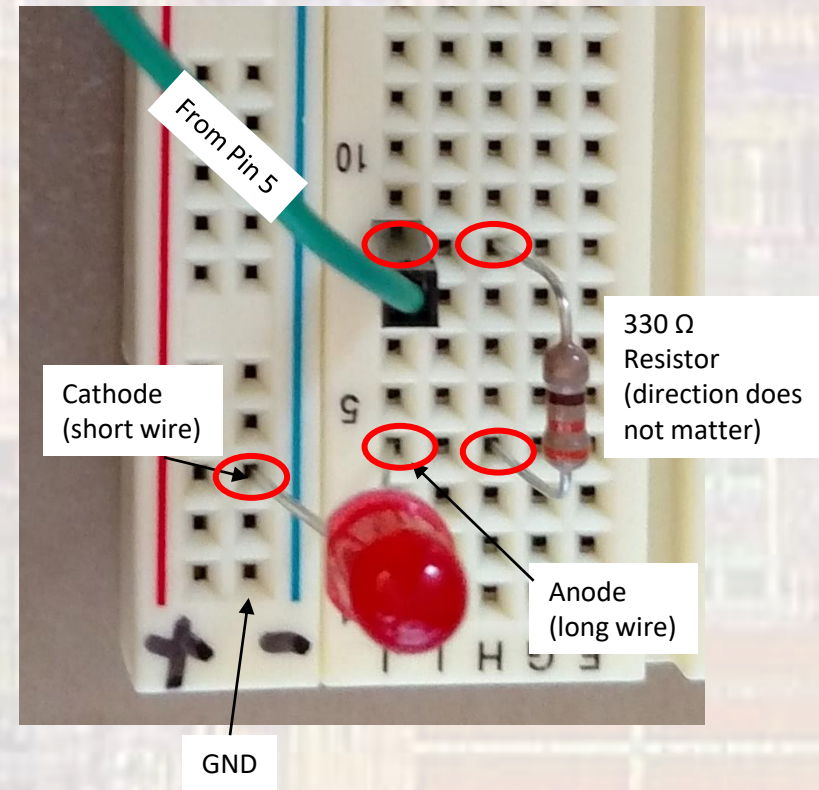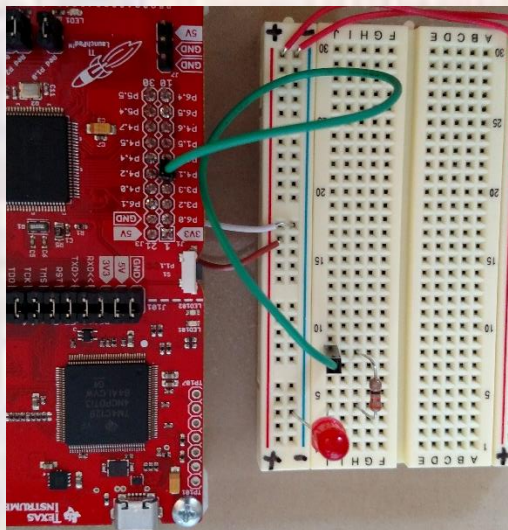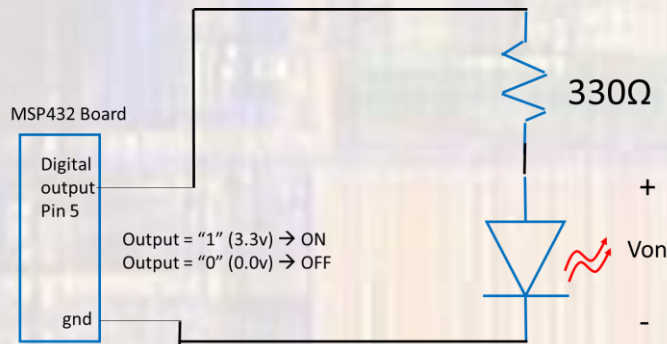
Shorted together in the board

Red   Blue
VCC/V+/3.3V   GND/0.0V
Assuming you wired up your board according to the instructions

LED Basics

- Light Emitting Diode
  - Use our output pin instead of the battery

MSP432 Board

Digital output Pin 5

Output = "1" (3.3v) → ON
Output = "0" (0.0v) → OFF

gnd

330Ω

+

Von

-

From Pin 5

330 Ω Resistor (direction does not matter)

Cathode (short wire)

Anode (long wire)

GND

LED Basics

- Light Emitting Diode
  - Alternate hookup A – change order of Resistor and diode

+

Von

MSP432 Board

Digital
output
Pin 5

Output = "1" (3.3v) → ON
Output = "0" (0.0v) → OFF

gnd

330Ω

-
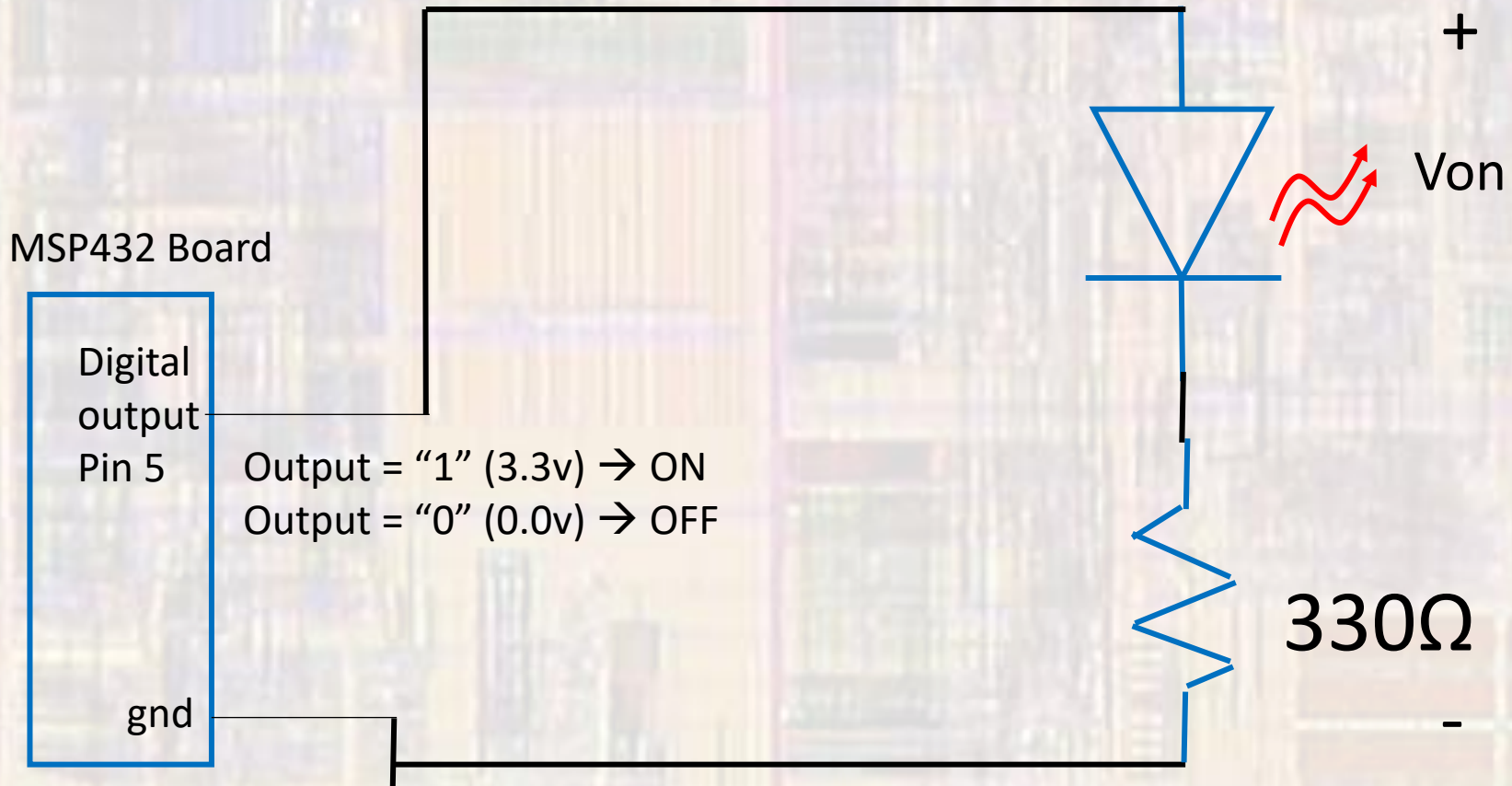
LED Basics

- Light Emitting Diode
  - Alternate hookup B – change to positive reference

330Ω

MSP432 Board

3.3v

Digital output Pin 5

Output = "1" (3.3v) → OFF
Output = "0" (0.0v) → ON

+

Von

−
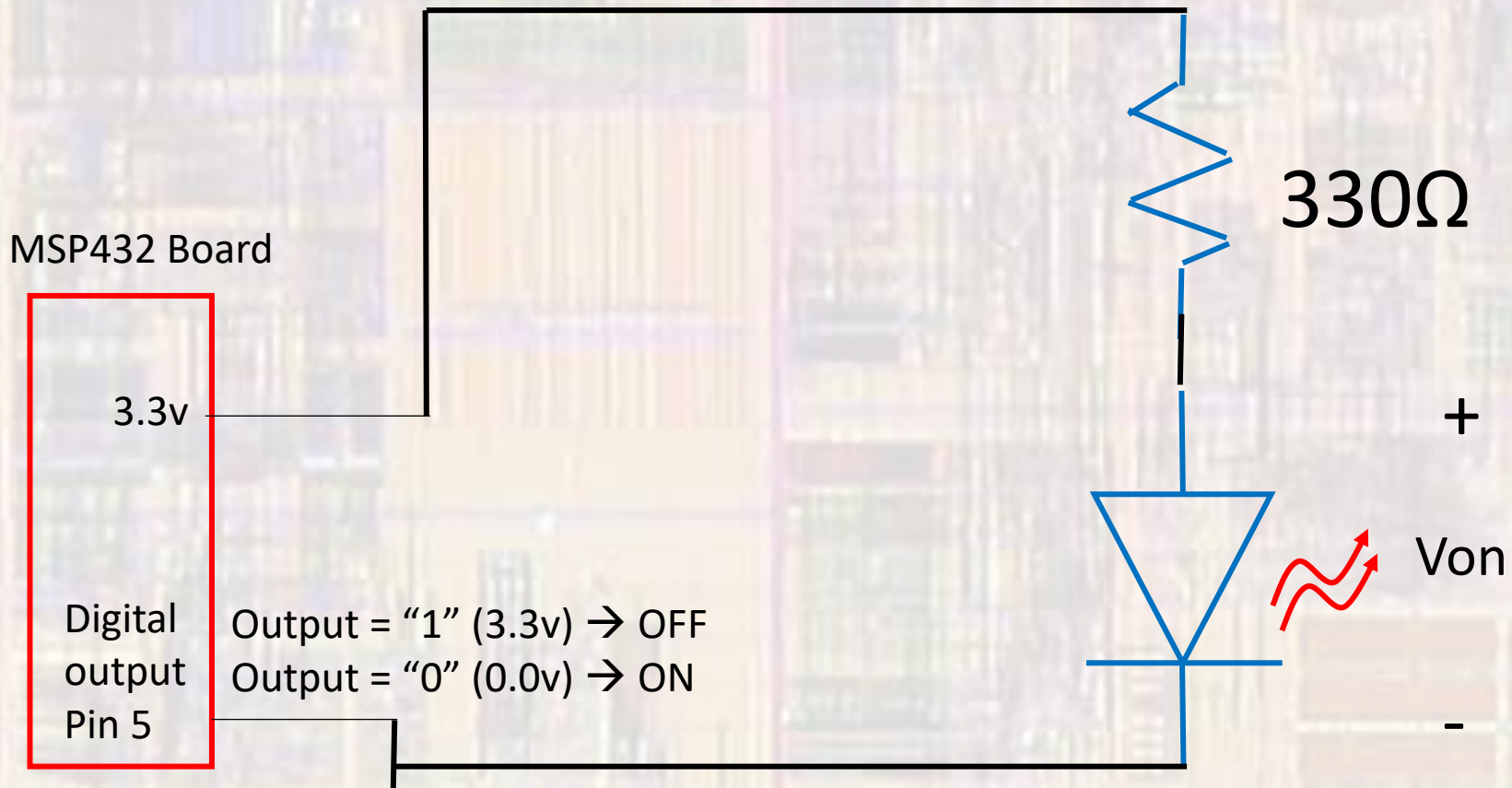
LED Basics

- ## Light Emitting Diode
  - ### Alternate hookup C – change to positive reference AND swap order of resistor and diode

+

Von

MSP432 Board

3.3v

Digital output Pin 5

Output = "1" (3.3v) → OFF
Output = "0" (0.0v) → ON

330Ω

-