MicroPython Embedded Applications

DAY 5 : Electromechanical Relay Flasher

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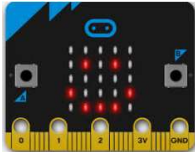- Participate in 'Group Chat' by maximizing the chat widget in your dock.

Don Wilcher

Visit 'Lecturer Profile' in your console for more details.

Course Kit:
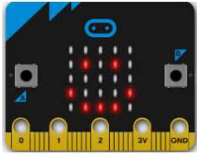**Keyestudio 37 in 1 Starter Kit with BBC micro:bit**
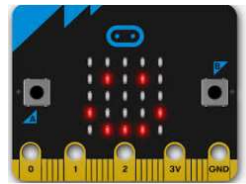
Agenda:

- Electromechanical Relay Construction
- Transistor Relay Driver Circuit
- MicroPython-micro:bit mini-Lab Activities
      a) micro:bit LED flasher
      b) micro:bit Animated Clock flasher
      c) reading an analog signal
- Lab Project: An adjustable electromechanical relay flasher
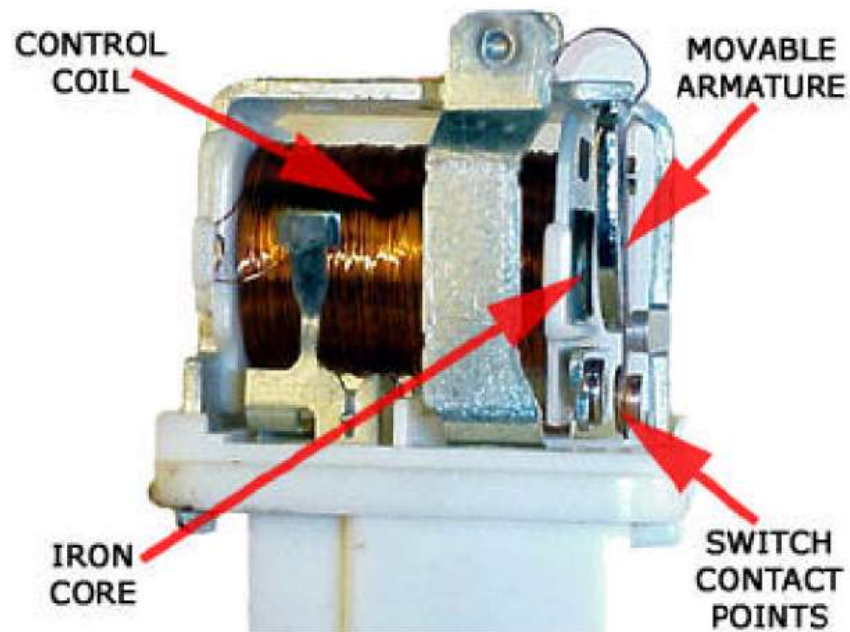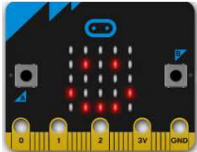
Electromechanical Relay Construction

An electromechanical switch that can be turned ON and OFF by a low current signal is called an electromechanical relay.

Source: https://www.omron-ecb.co.kr/relay-basics/basic
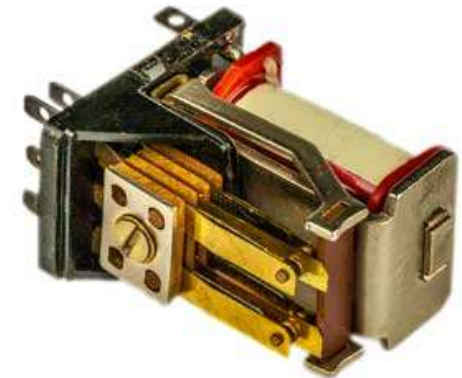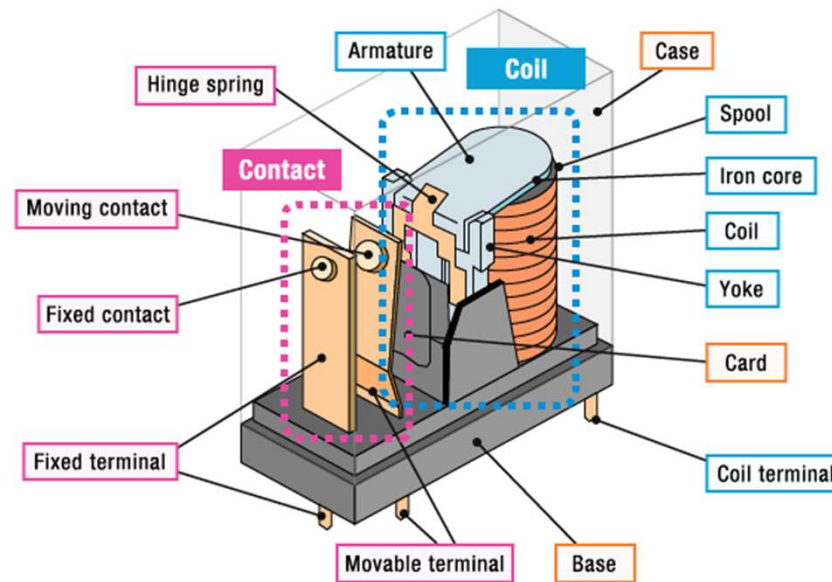
Electromechanical Relay Construction…

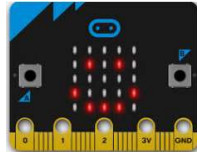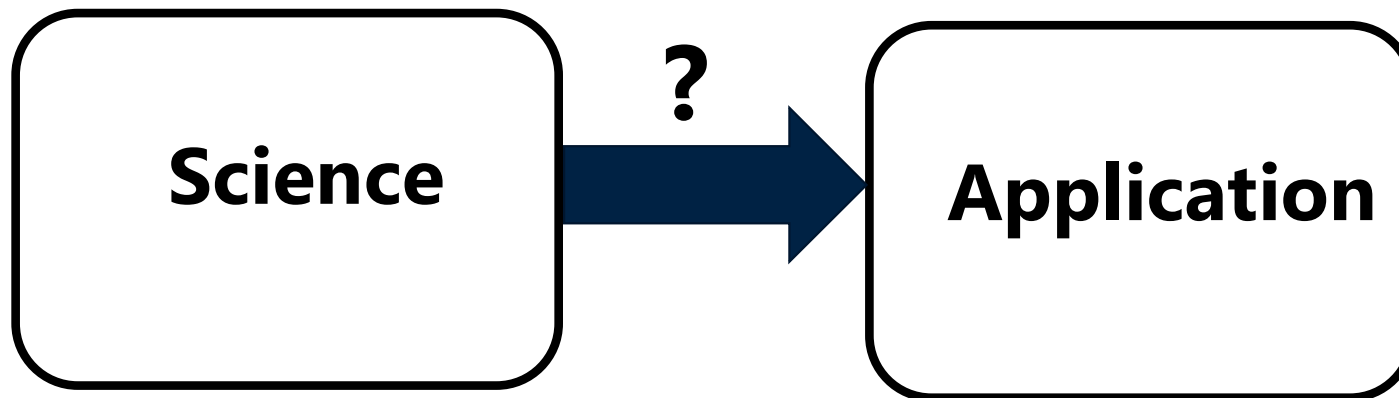**Source:** https://www.circuitstoday.com/working-of-relays

Question 1

Using slide 6, identify the part on the electromechanical relay that is typically called Common.
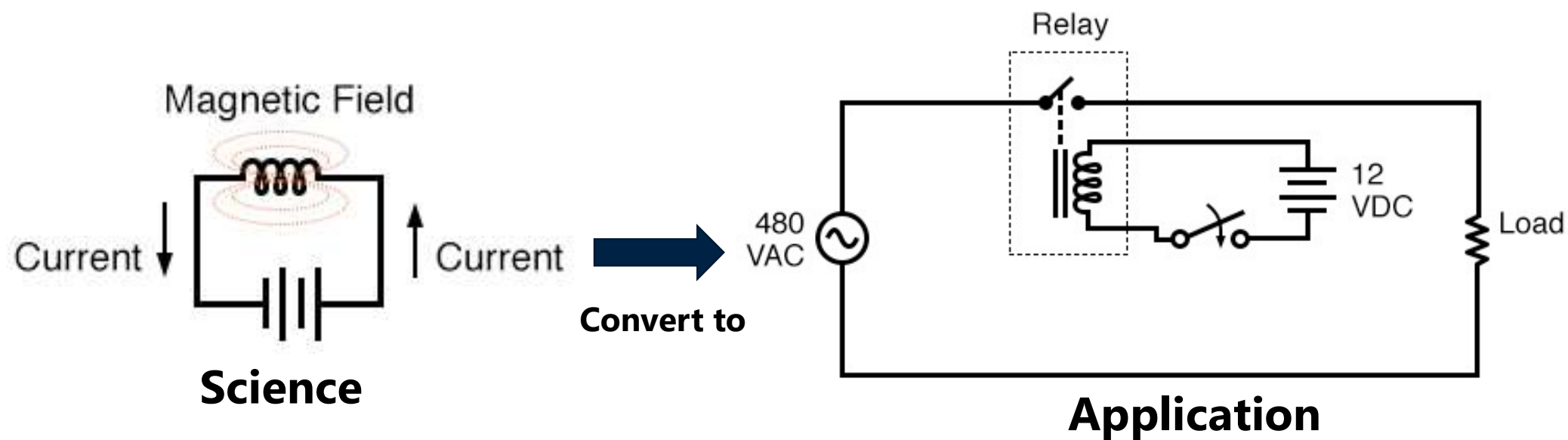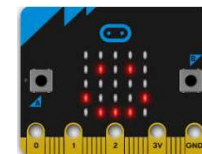
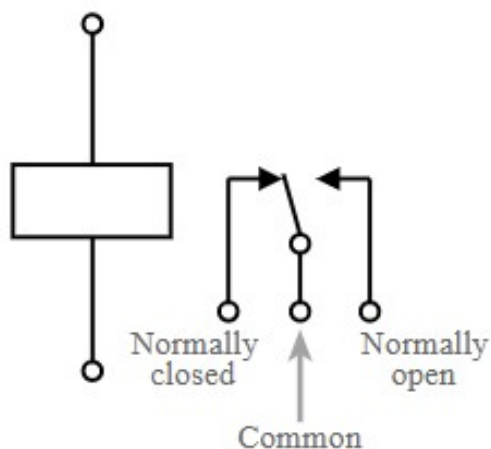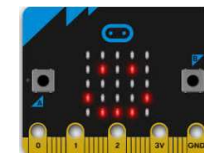## Electromechanical Relay Construction...

How do we take...

| Science | ? → | Application |

Source:

Electromechanical Relay Construction…

How do we take…

Science
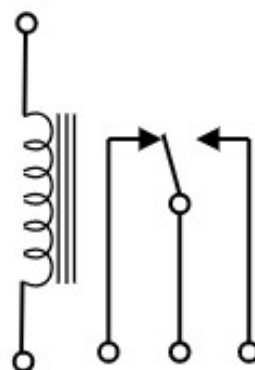
Convert to

Application

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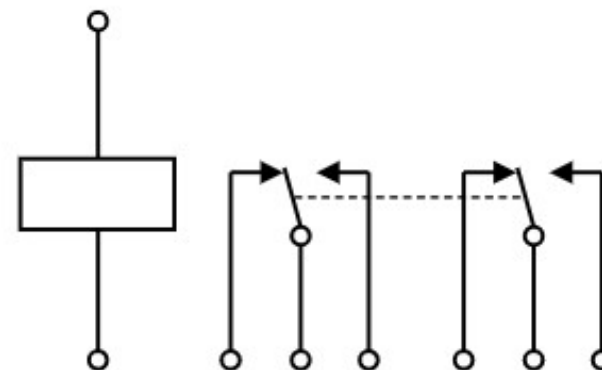# Electromechanical Relay Construction...

Typical Electromechanical Relay Symbols

New Symbol: SPDT device

Old Symbol: SPDT device

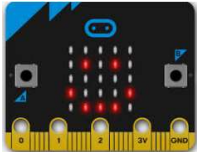Double Pole-Double Throw (DPDT) device

Question 2

How many electrical circuits or loads can be control by a SPDT electromechanical relay?

Transistor Relay Driver…
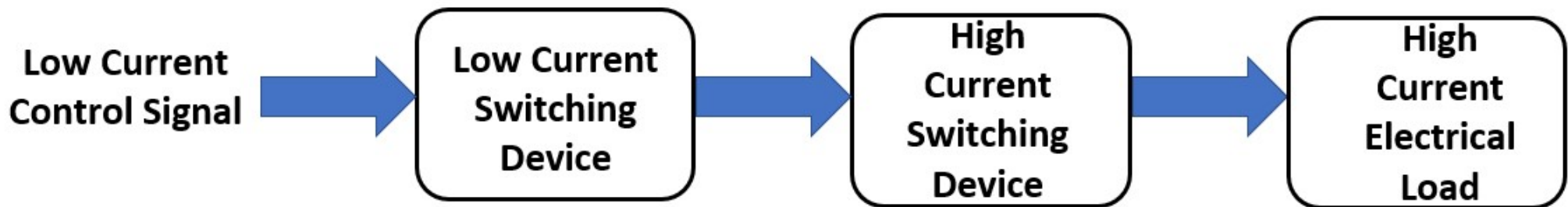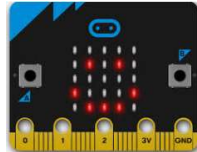
Controlling a High Current Electrical Load…

Transistor Relay Driver…
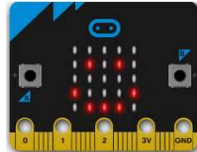
Controlling a High Current Electrical Load…

Low Current Control Signal → Low Current Switching Device → High Current Switching Device → High Current Electrical Load

Controlling a High Current Electrical Load with Low Current Switching

Transistor

Low Current Switching Device

Equation 1: $B = \dfrac{I_C}{I_B}$ or $h_{fe} = \dfrac{I_C}{I_B}$

Equation 2: $I_C = B I_B$

where:

$B =$ Beta

$I_c =$ Collector Current

$I_B =$ Base Current

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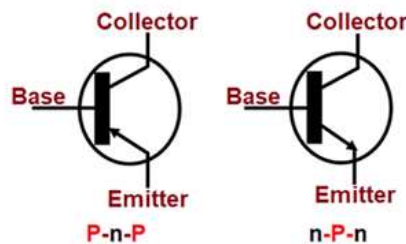**Transistor Relay Driver Circuit...**
Controlling a High Current Electrical Load with Low Current Switching...
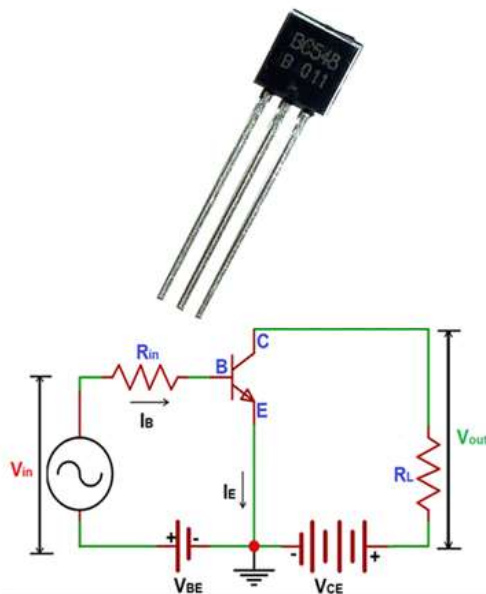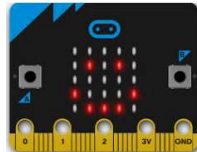
Transistor Family of Curves
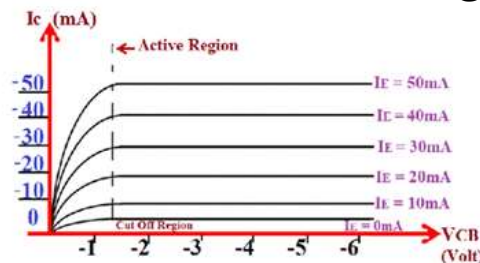
Equation 1: $B = \dfrac{I_C}{I_B}$ or $h_{fe} = \dfrac{I_C}{I_B}$

Equation 2: $I_C = B I_B$

where:

B = Beta

I_c = Collector Current
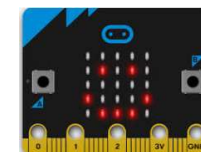
I_B = Base Current

Question 3

What electrical parameter is used to identify current gain of a typical transistor?

Transistor Relay Driver Circuit…

Example of a Partial Transistor Datasheet

ELECTRICAL CHARACTERISTICS (Ta=25°C, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Collector-Base Breakdown Voltage	BV$_{CBO}$	Ic=100µA, IE=0	30			V
Collector-Emitter Breakdown Voltage	BV$_{CEO}$	Ic=1mA, IB=0	20			V
Emitter-Base Breakdown Voltage	BV$_{EBO}$	IE=100µA, Ic=0	5			V
Collector Cut-Off Current	I$_{CBO}$	VCB=30V, IE=0			1	µA
Emitter Cut-Off Current	I$_{EBO}$	VEB=5V, Ic=0			100	nA
DC Current Gain(note)	hFE1	VCE=1V, Ic=1mA	100			
	hFE2	VCE=1V, Ic=150 mA	120	110	400	
	hFE3	VCE=1V, Ic=500mA	40			
Collector-Emitter Saturation Voltage	VCE(sat)	Ic=500mA, IB=50mA			0.5	V
Base-Emitter Saturation Voltage	VBE(sat)	Ic=500mA, IB=50mA			1.2	V
Base-Emitter Saturation Voltage	VBE	VCE=1V, Ic=10mA			1.0	V
Current Gain Bandwidth Product	fT	VCE=10V, Ic=50mA	100			MHz
Output Capacitance	Cob	VCB=10V, IE=0 f=1MHz		9.0		pF

Transistor Relay Driver Circuit...

Basic Transistor Switching Analysis
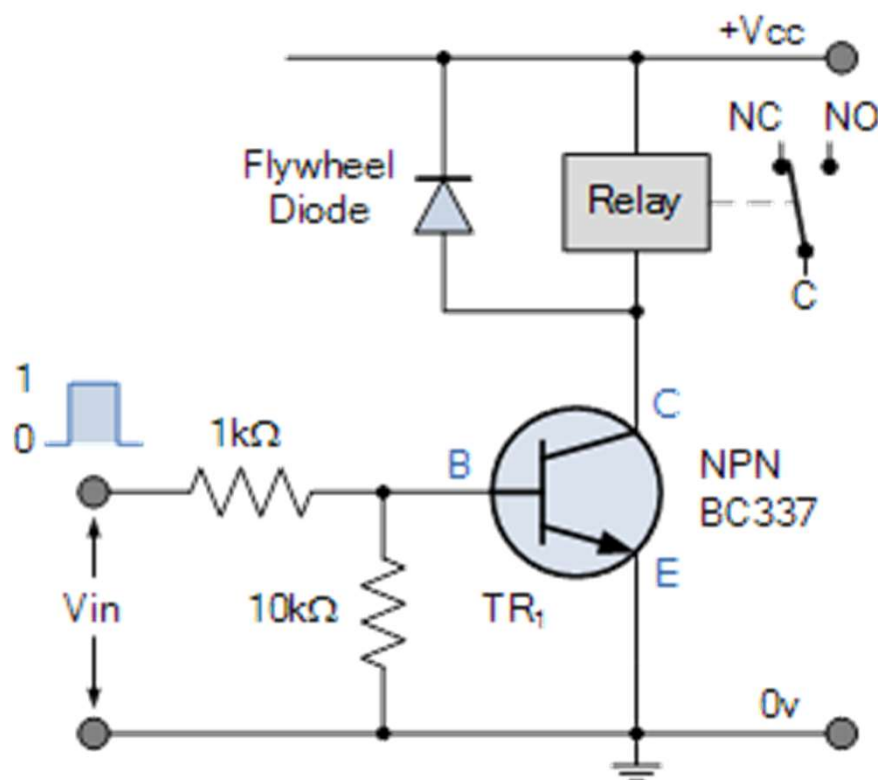
Equation 3: $v_B = \dfrac{v_{IN}R}{R_T}$

$$v_B = \dfrac{5v10k\Omega}{11k\Omega}$$

$$v_B = 4.5V$$
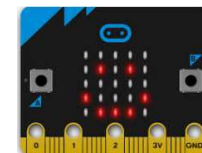
$$v_B > v_{BE}: v_{BE} = 0.7v$$

Transistor is ON

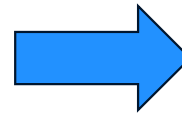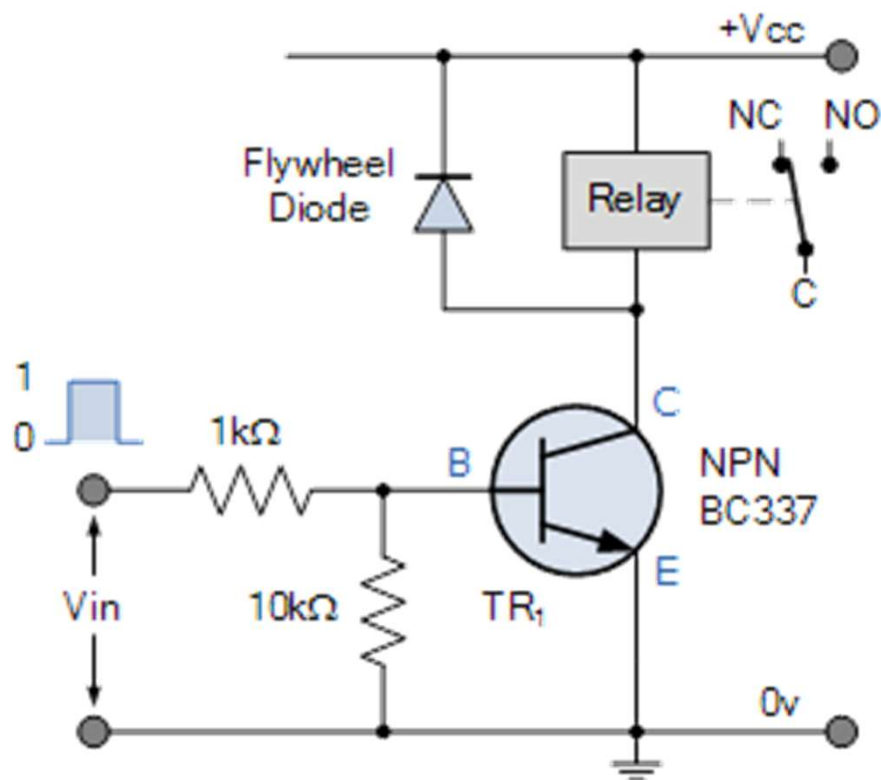$$v_B = \dfrac{v_{IN}R}{R_T}$$

$$v_B = \dfrac{0v10k\Omega}{11k\Omega}$$

$$v_B = 0V$$

$$v_B < v_{BE:}$$

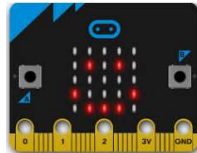**Transistor is OFF**

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Transistor Relay Driver Circuit…
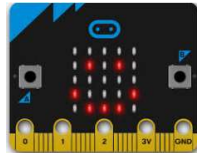

Relay Module

representative circuit

Transistor Relay Driver Circuit…

## Keyestudio 5V Relay Module Specification

- Type: Digital
- Rated current: 10A (NO) 5A (NC)
- Maximum switching voltage: 150VAC 24VDC
- Digital interface
- Control signal: TTL level
- Rated load: 8A 150VAC (NO) 10A 24VDC (NO), 5A 250VAC (NO/NC) 5A 24VDC (NO/NC)
- Maximum switching power: AC1200VA DC240W (NO) AC625VA DC120W (NC)
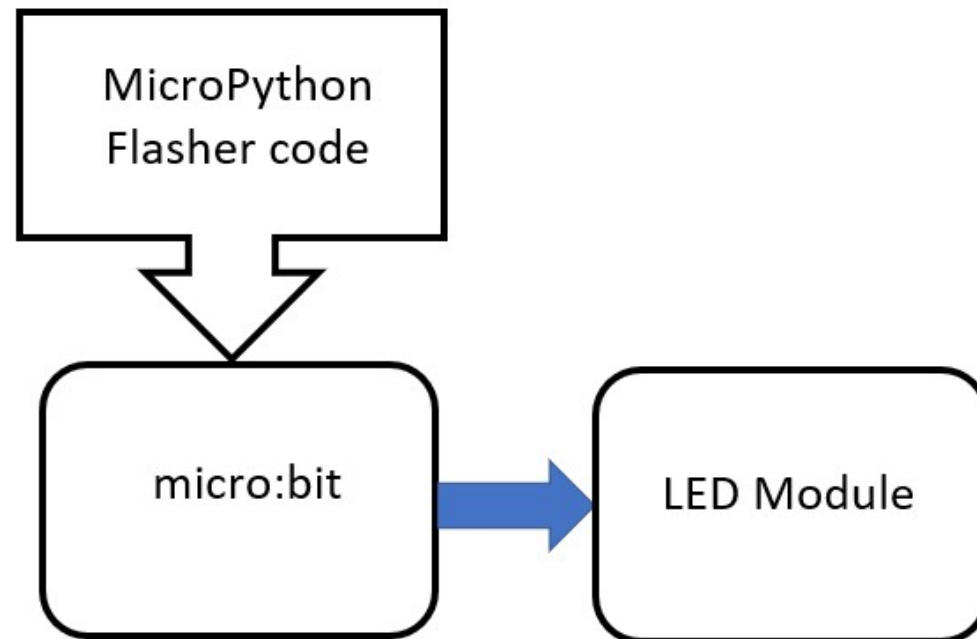- Contact action time: 10ms

-
+
S

Source: https://wiki.keyestudio.com/Ks0011_keyestudio_5V_Relay_Module

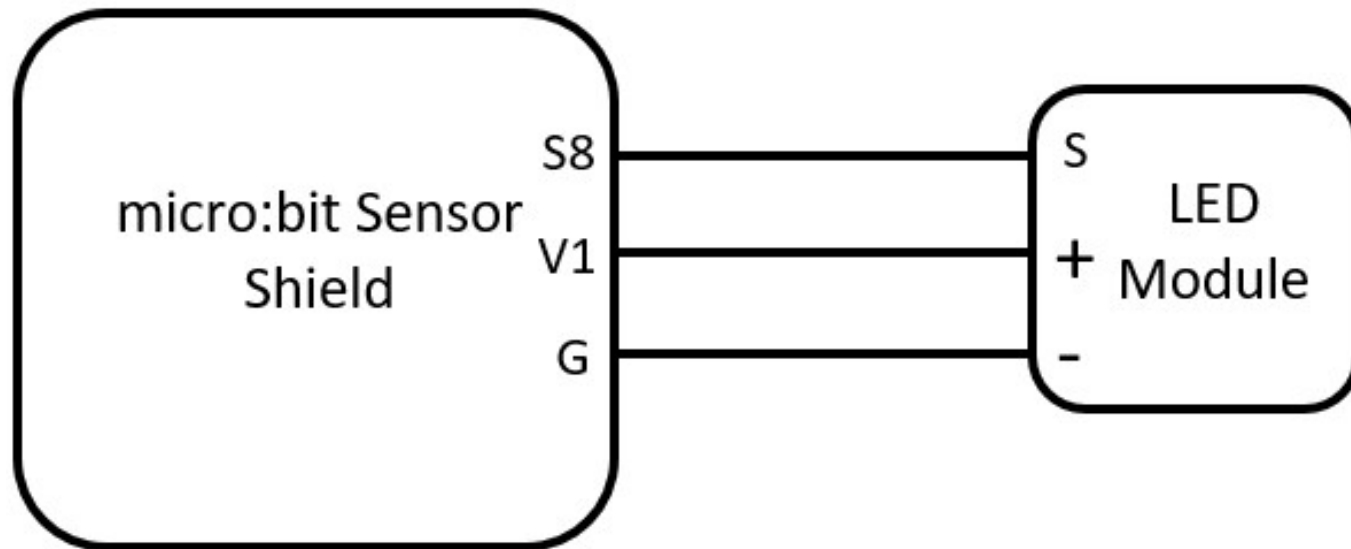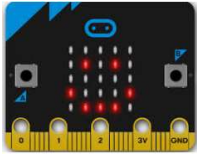# MicroPython micro:bit mini-Lab Activities
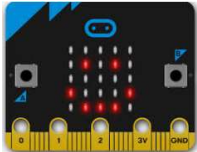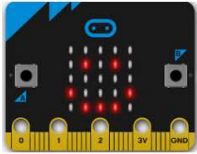
Simple Flasher

MicroPython micro:bit mini-Lab Activities

Simple Flasher Electrical Wiring Diagram

MicroPython micro:bit mini-Lab Activities. . .

Simple Flasher code

```
1  from microbit import *
2
3
4  while True:
5      pin8.write_digital(0)
6      sleep(100)
7      pin8.write_digital(1)
8      sleep(100)
```
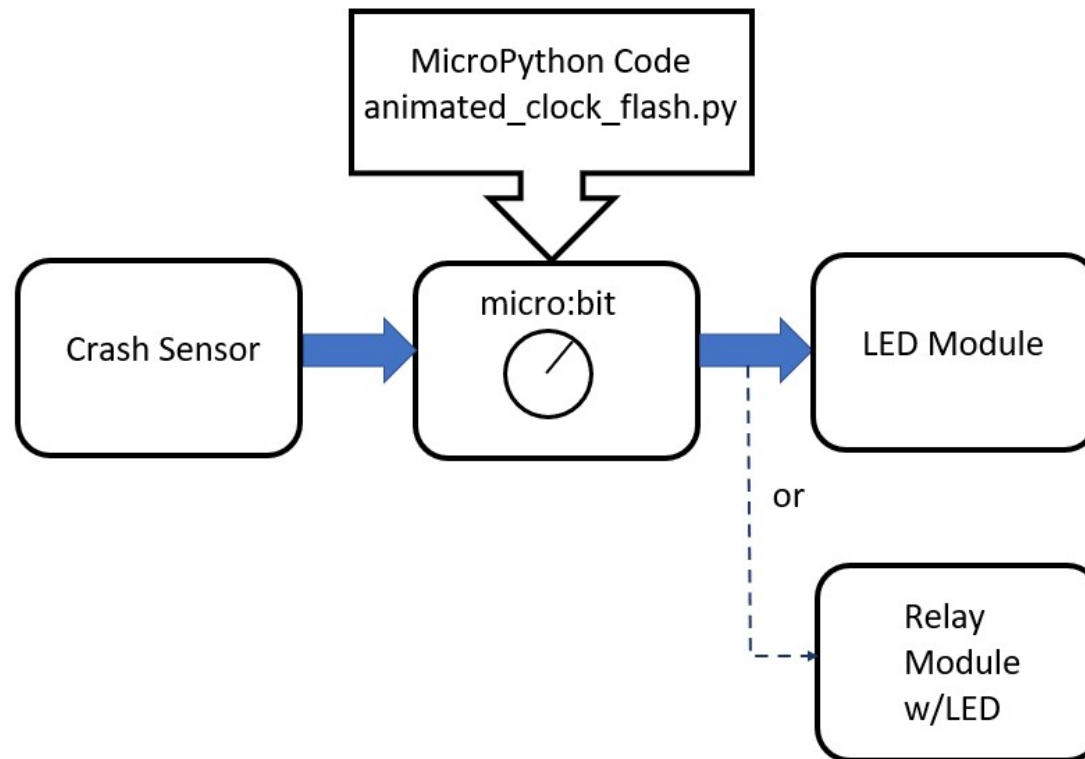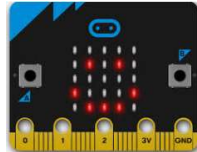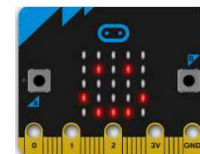
Question 4

Using slide 24, which MicroPython instruction imposes a time delay?

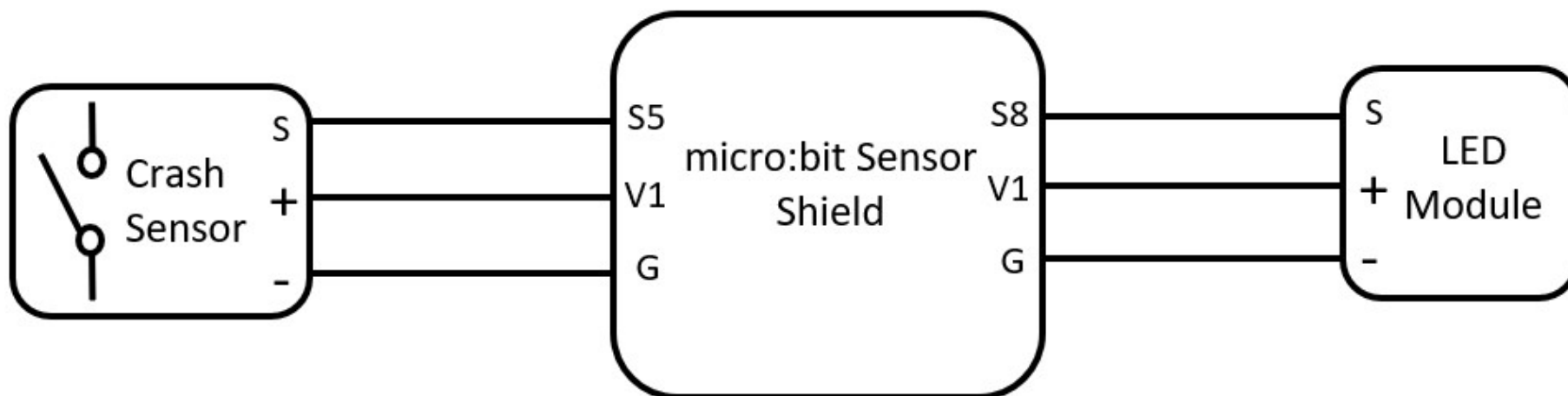# MicroPython micro:bit mini-Lab Activities

Animated Clock Flasher
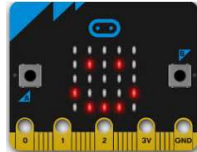
MicroPython micro:bit mini-Lab Activities

Animated Clock Flasher Electrical Wiring Diagram

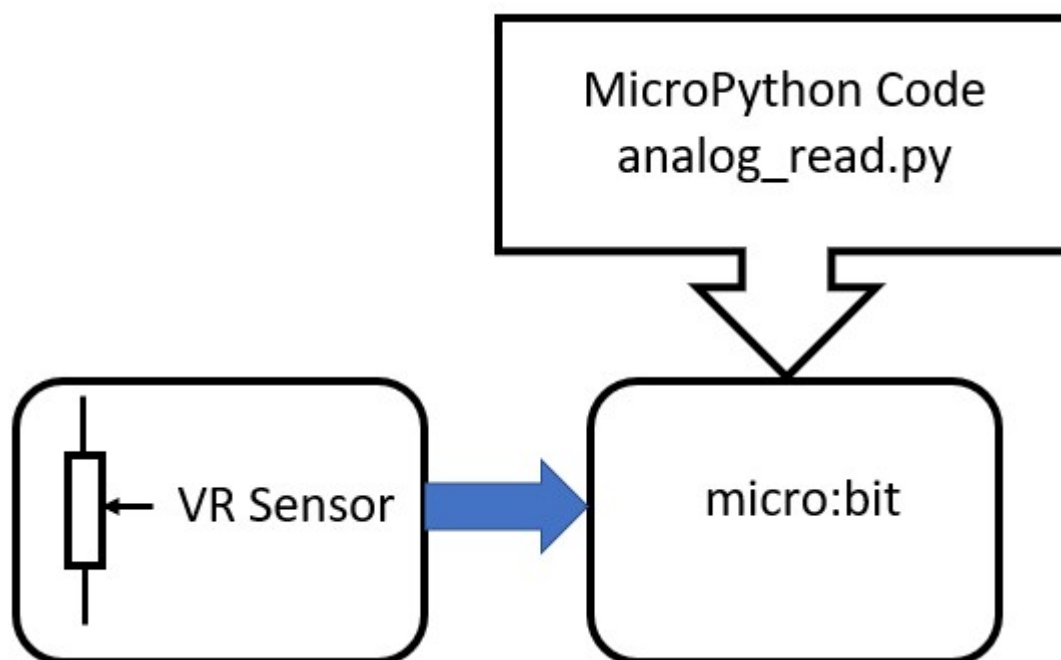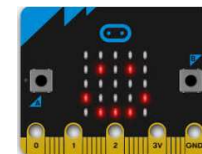# MicroPython micro:bit mini-Lab Activities

Animated Clock Flasher code

```python
1  from microbit import *
2  #input = pin5.read_digital()
3
4  while True:
5      if pin5.read_digital():
6          display.show(Image.CLOCK12)
7          sleep(1000)
8          display.show(Image.CLOCK3)
9          sleep(1000)
10         display.show(Image.CLOCK6)
11         sleep(1000)
12         display.show(Image.CLOCK9)
13         sleep(1000)
14         display.show(Image.CLOCK12)
15         pin8.write_digital(0)
16     else:
17         pin8.write_digital(1)
18         sleep(5)
```
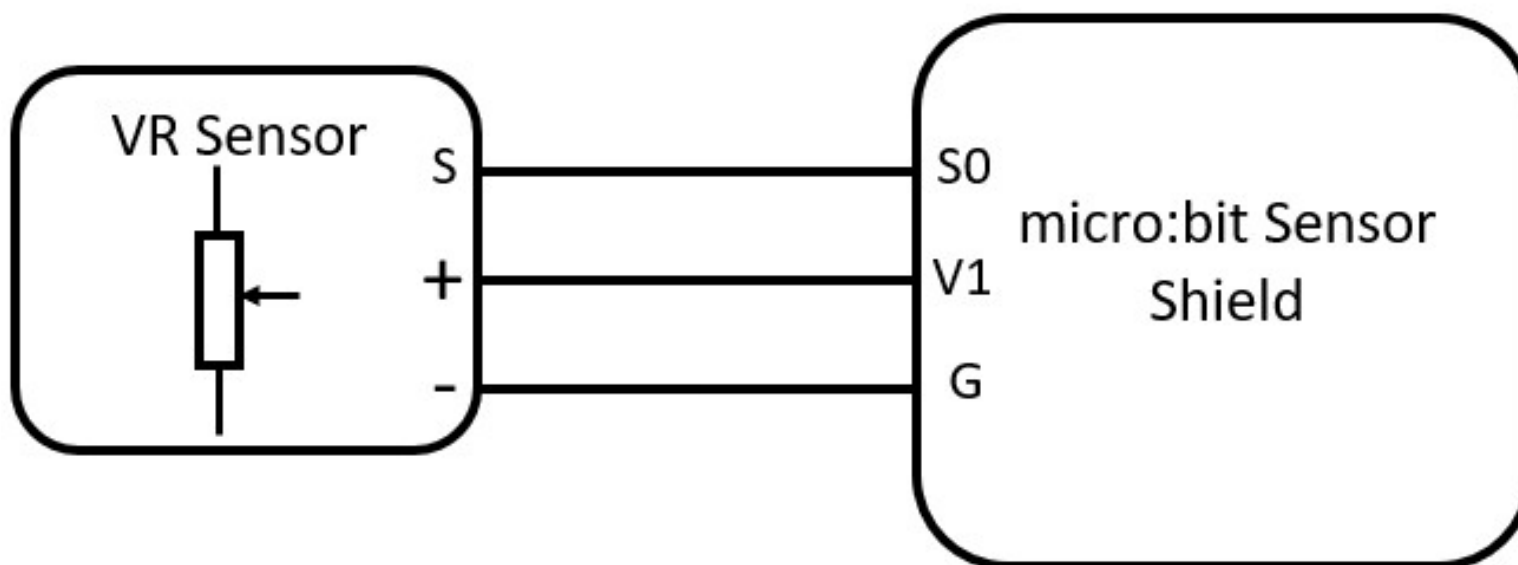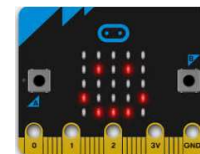
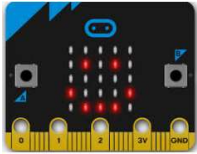# MicroPython micro:bit mini-Lab Activities

Reading an Analog Signal

MicroPython micro:bit mini-Lab Activities

Reading an Analog Signal Electrical Wiring Diagram

MicroPython micro:bit mini-Lab Activities
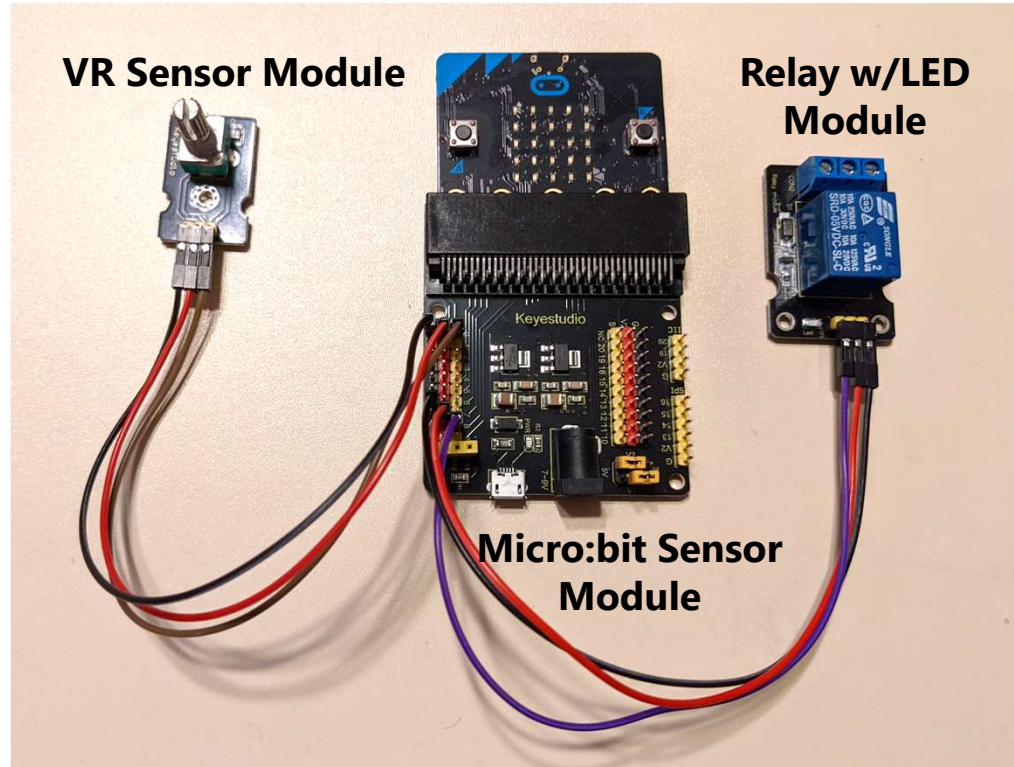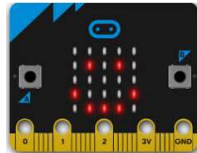
Reading an Analog Signal code

```
1  from microbit import*
2
3  sense = 0
4  while True:
5      sense = pin0.read_analog()
6      display.scroll(sense)
```
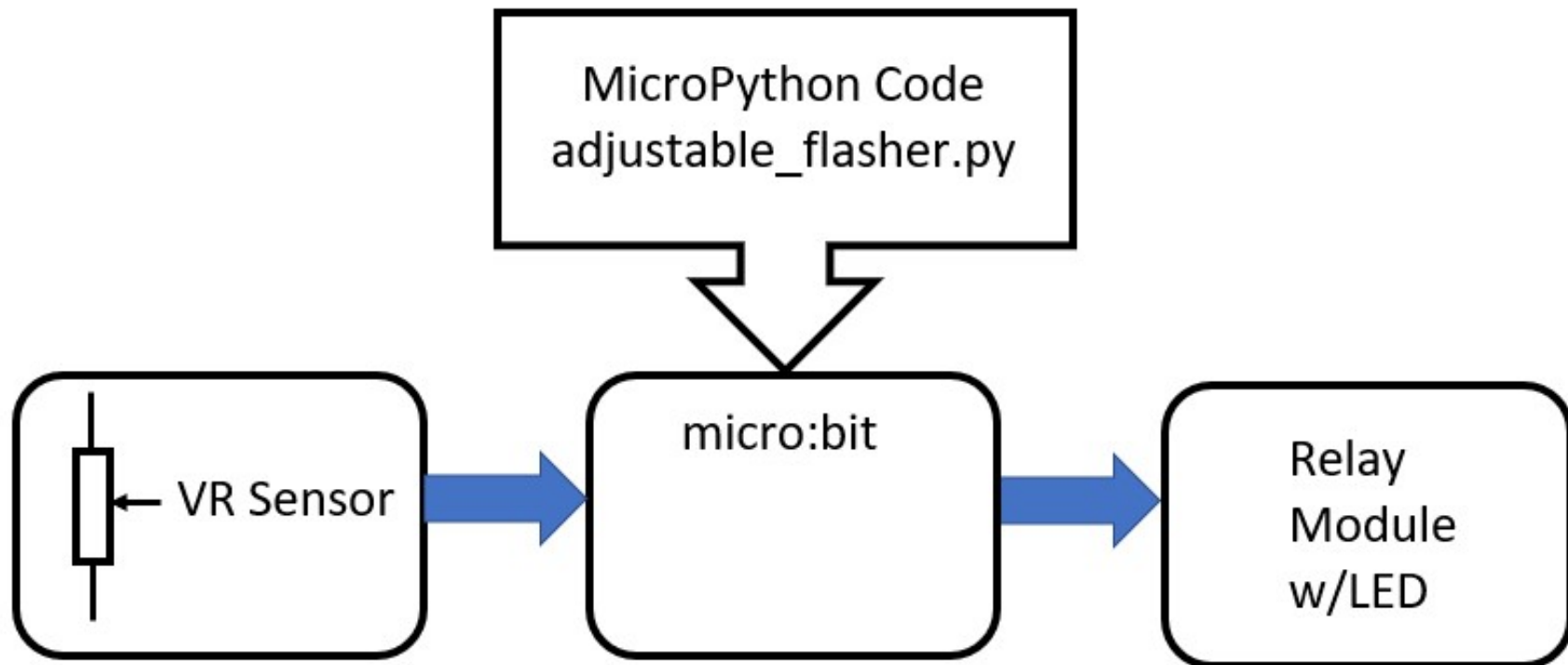
Question 5

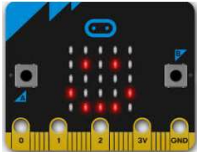# Using slide 31, which line number is used to initialize a variable?

Lab Project: An Adjustable Electromechanical Relay Flasher

VR Sensor Module
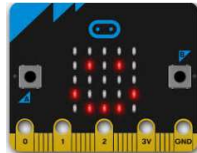
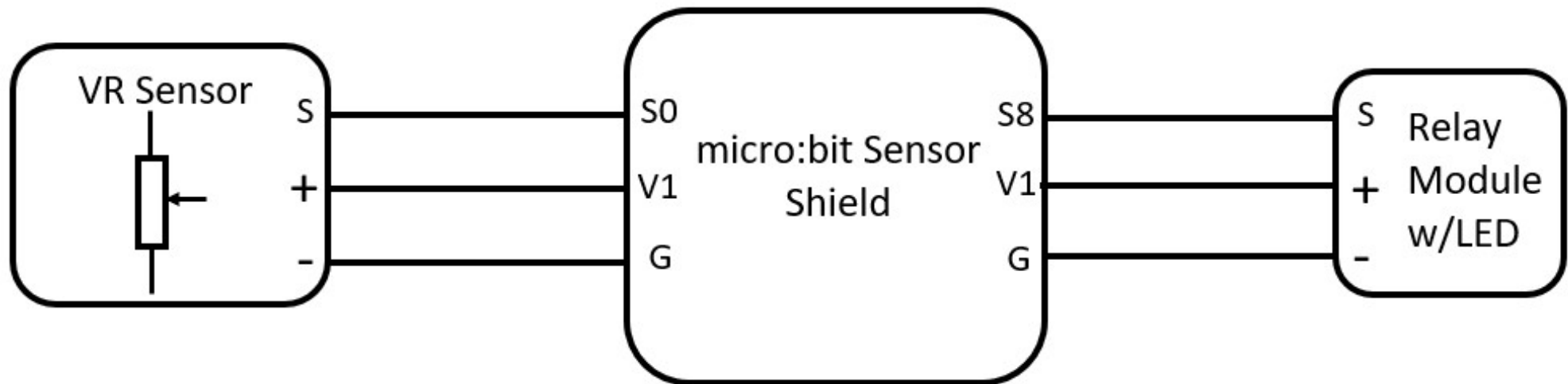**Relay w/LED Module**

Micro:bit Sensor Module

Lab Project: An Adjustable Electromechanical Relay Flasher

Lab Project: An Adjustable Electromechanical Relay Flasher

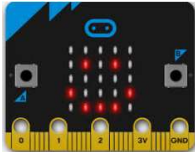## An Adjustable Electromechanical Relay Flasher Electrical Wiring Diagram

Lab Project: An Adjustable Electromechanical Relay Flasher . . .

Adjustable Electromechanical Relay Flasher code

```python
1  from microbit import *
2
3  sense = 0
4  while True:
5      sense = pin0.read_analog()
6      display.scroll(sense)
7      pin8.write_digital(0)
8      sleep(sense)
9      pin8.write_digital(1)
10     sleep(sense)
```

Question 6

Using slide 36, which line number is used to read the VR Sensor's varying voltage?

Thank you for attending

Please consider the resources below:

- Electromechanical Relay Construction
  https://www.omron-ecb.co.kr/relay-basics/basic

- Circuits Today: Electromechanical Relay Construction
  https://www.circuitstoday.com/working-of-relays

- Allabout Circuits: Electromechanical Relay Construction
  https://www.allaboutcircuits.com/textbook/digital/chpt-5/relay-construction/

- Keyestudio 5V Relay Module
  https://wiki.keyestudio.com/Ks0011_keyestudio_5V_Relay_Module

Thank You

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