

## 4 Using Digital Inputs

NAME: \_\_\_\_\_ Date: \_\_\_\_\_ Section: \_\_\_\_\_

### INTRODUCTION

Robotic arms need to be able to communicate with an operator so that you can tell it when to begin or end an operation. We can do this very easily with an input connected to the arm. This input can be something as simple as digital on/off switch.

In this activity, you will perform a pick and place with a robot arm using the air pump kit and a vacuum gripper or mechanical gripper. You will make the robot wait for an input on a switch before it starts, and eventually you will make the robot repeat this five times. Here is what you want your robot to do:

- Wait for the operator to hit the start switch
- Go home
- Pick up the object
- Place the object in another spot
- Return home
- Operator moves the part back to the start
- Repeat



*Suction cup gripper attached to the rotational servo.*



**Remember:** We always go to a position above the pick or place point first so that the robot places the object straight down, with no friction or interference. This will increase accuracy!

### KEY VOCABULARY

- TCP
- Loop
- Pull Down Resistor
- Normally Open
- Suction
- Vacuum
- Digital
- Normally Closed

## EQUIPMENT & SUPPLIES

- Dobot Magician
- Dobot Field Diagram
- ¾ inch wooden cylinders
- Servo extension cables
- Electrical tape
- Suction cup gripper
- Suction Cup or Mechanical Gripper
- DobotStudio software
- Digital Switch
- Jumper wire
- 3 prong male header pin
- Resistor 4.7KΩ to 15KΩ

## PROCEDURE



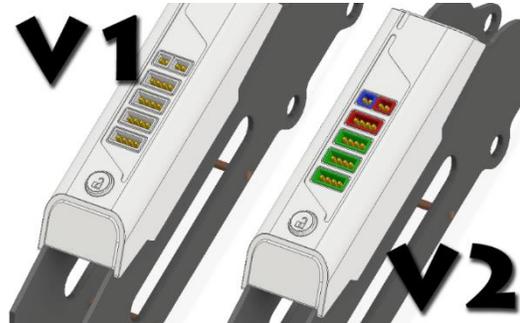
**Caution: NEVER wire anything to the Dobot Magician while it has power on. ALWAYS shutdown the Dobot before making connections or damage to the robot could occur.**

1. Attach the *Suction Cup or Mechanical Gripper* as done in previous activities to the *rotational servo* and then attach it to the robot and plug in the wires as shown below.
2. Add the switch as an input.

***Be sure to turn off power to the Dobot before continuing!***

**In order to properly wire your Dobot Magician we will first need to identify which Dobot you have.**

**V1** = All white plastic housings for inputs and outputs

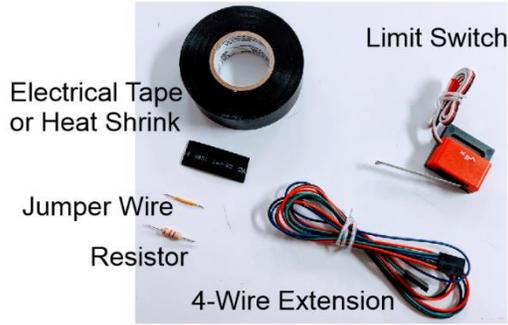


**V2** = Colored plastic housings for inputs and outputs

The Dobot Magician V1 needs a **PULL DOWN RESISTOR** installed on the ground side of the servo extension cable to work properly. The pull-down resistor will insure a well-defined logical level in our logic circuit. This resistor will help eliminate possible float values and will pull the input pin to a logical low state in all conditions. The pull-down resistor can have any value from 4.7KΩ to 15KΩ. The larger the resistance, the slower the input pins response will be to voltage in milliseconds.



# INPUT OPTION 1 - Direct Wire

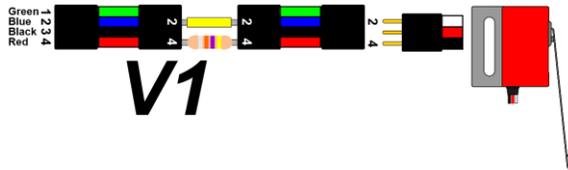


## Parts List

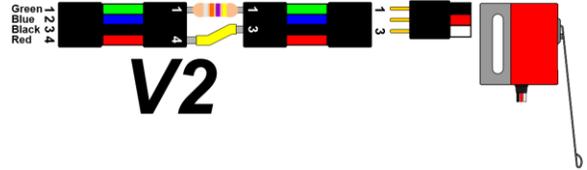
- 2 x 4-Wire Extension Cables
- 1 x Short Jumper Wire
- 1 x Resistor 4.7 $\Omega$  to 15k $\Omega$
- 1 x Digital Switch
- Electrical Tape or Heat Shrink



## Robot Magician V1 (All White IO Ports)



## Robot Magician V2 (Colored IO Ports)



### Step 1 - Install Jumper Wire and Resistor

\*The resistor need to be on the negative side to work as a pull down resistor

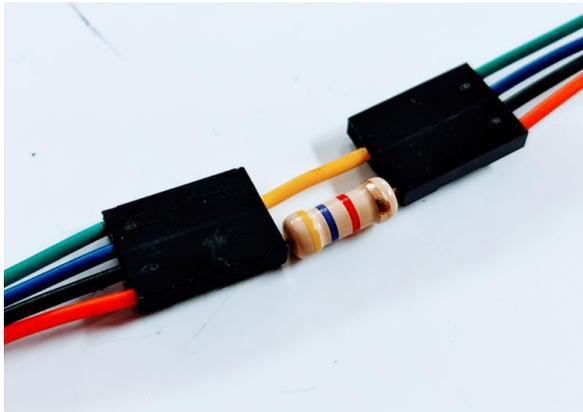
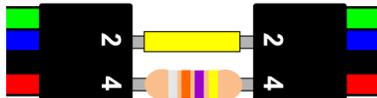


4.7k  $\Omega$  - GROUND SIDE

YELLOW	VIOLET	RED	GOLD
4	7	X100	5%

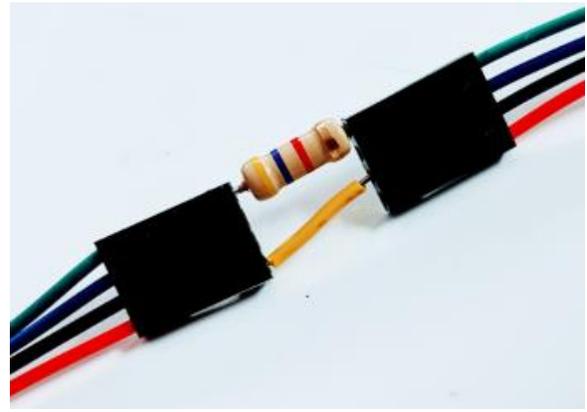
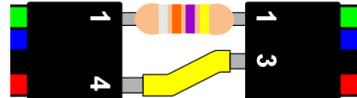
## Robot Magician V1 (All White IO Ports)

- Pull Down Resistor - 4Red to 4Red
- Jumper Wire - 2Blue to 2Blue



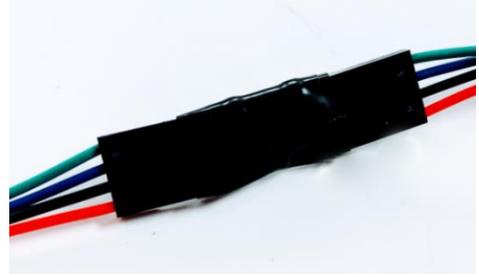
## Robot Magician V2 (Colored IO Ports)

- Pull Down Resistor - 1Green to 1Green
- Jumper Wire - 4Red to 3Black



**Step 2 - Secure the Components**

- Wrap the resistor and jumper wire with electrical tape or heat shrink to keep them from separating.
- Lightly tug on the assembly to ensure connection is stable

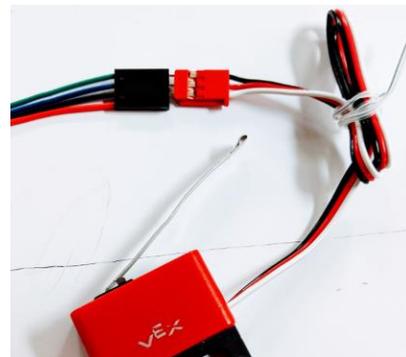
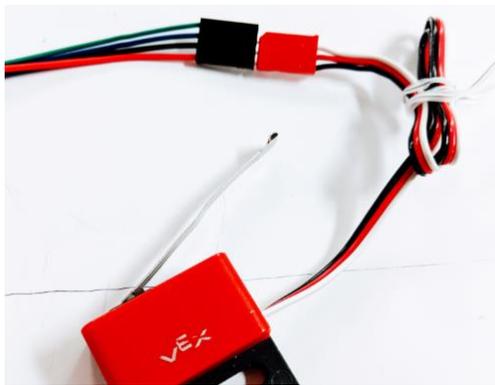
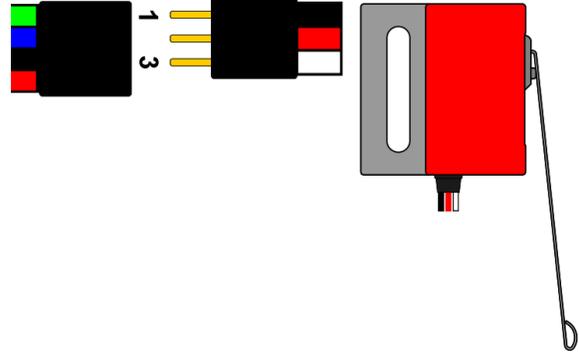
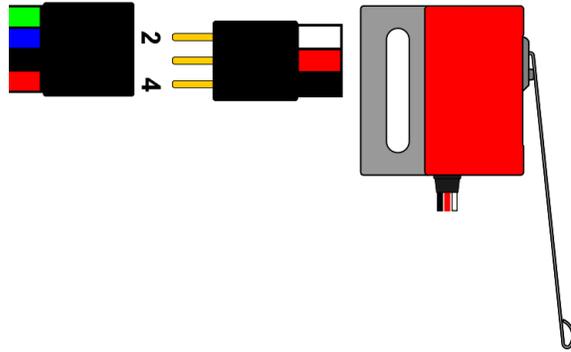


**Step 3 - Install Digital Switch**

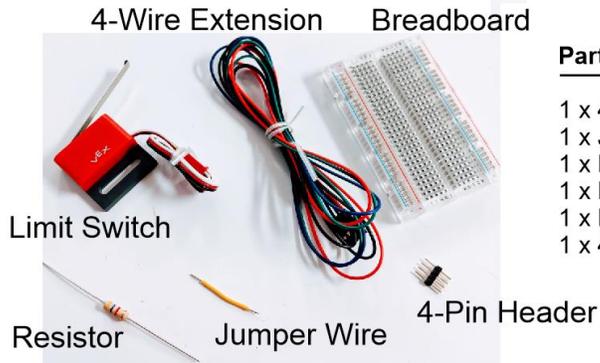
*\*Red wire is NOT active when using a VEX limit switch*

- 4Red to Limit Switch Black
- 2Blue to Limit Switch Red

- 4Red to Limit Switch Black
- 2Blue to Limit Switch Red



# INPUT OPTION 2 - Breadboard



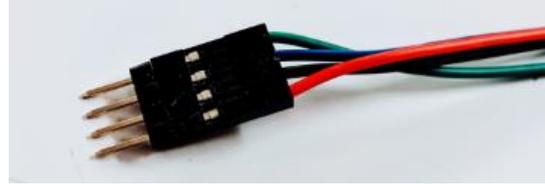
## Parts List

- 1 x 4-Wire Extension Cables
- 1 x Jumper Wire
- 1 x Resistor 4.7Ω to 15kΩ
- 1 x Digital Switch
- 1 x Breadboard
- 1 x 4-Pin Male Header



### Step 1 – Install the 4-Pin Male Header

-Insert the Header pins into one end of the 4 wire extension cable. This will allow the 4-wire cable to be attached to the bread board.



### Step 2 - Install Jumper Wire, Resistor, and Extension Cable

-Insert the resistor and jumper wire into the breadboard as shown in the illustrations below.



**4.7k Ω - GROUND SIDE**

YELLOW	VIOLET	RED	GOLD
4	7	X100	5%

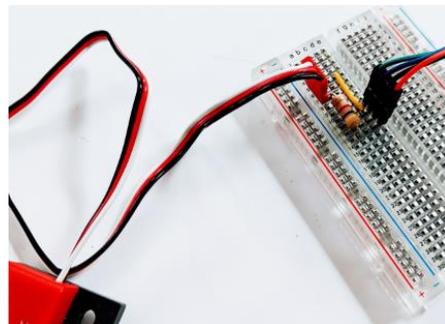
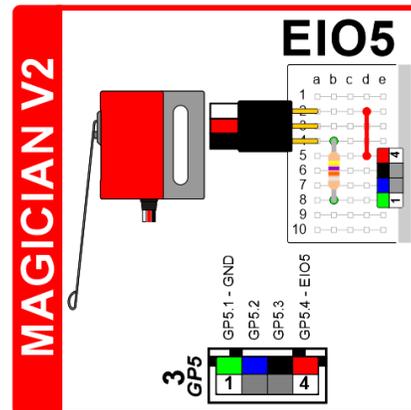
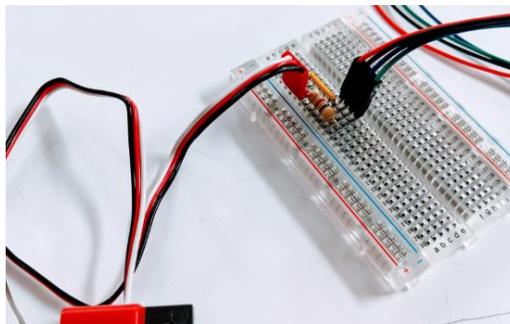
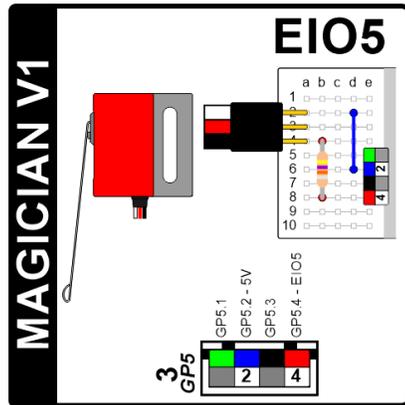
*\*Note that the 4-wire cable is not in the same orientation for both setups.*

### Robot Magician V1 (All White IO Ports)

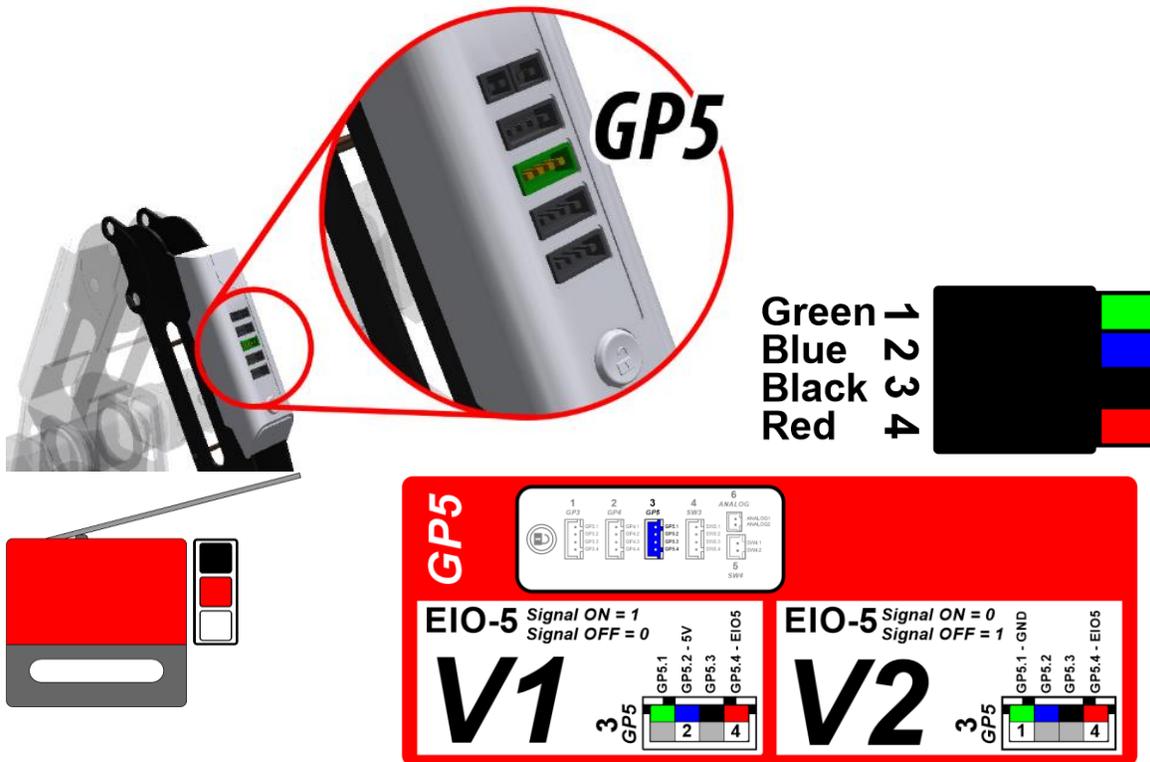
- 4Red to Limit Switch Black
- 2Blue to Limit Switch White

### Robot Magician V2 (Colored IO Ports)

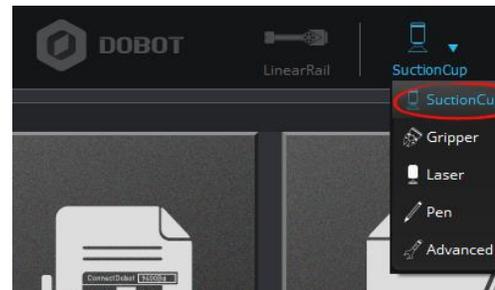
- 4Red to Limit Switch Black
- 2Blue to Limit Switch Red



**Attach the 4-Wire Extension cable to the Robot Arm**



3. Open Dobot Studio software, connect and home the robot, and be sure the *Suction Cup* is chosen



1. Next open the *Teach and Playback* module and perform a pick and place with a wooden cylinder as you did in a previous activity. The only difference is that this time you will use the Suction Cup to pick and place the object. Be sure to use “above” positions.



Try to use Jump commands where appropriate.

2. Save your program when finished. You may even be able to use a program you have already written and just touch up the points.

**Be sure to have your instructor check when completed.**



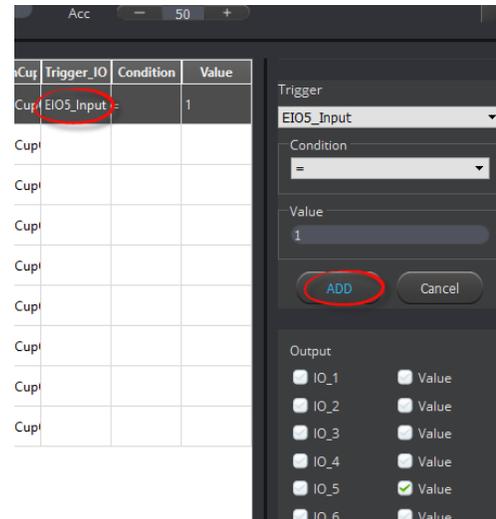
3. Be sure to turn on/off the suction when necessary

SuctionCup	
SuctionCupOff	EI
SuctionCupOff	
SuctionCupOn	
SuctionCupOn	
SuctionCupOn	
SuctionCupOn	

8. Be sure to add EIO5 as an Input on the first line of the program. This will ensure that when you hit the switch (Turn it on) the robot will start the rest of the program.



***You must be in Pro Mode to do this!***



9. Hit the *Play* button to run your program and see what happens.
10. *Did it work the first time? If not, what did you have to change to make it work?*

11. Now let's make the robot do this five times, as you did in the last activity.  
***Be sure to have your instructor check when completed.***
12. Be sure to save your work when done.



## CONCLUSION

1. *What is the purpose of the resistor in the wire that you made at the beginning of the procedure?*
2. *What might happen if you did not use this resistor?*
3. *What does it mean that the switch is DIGITAL?*
4. *What type of operation could this be simulating?*
5. *Is the switch you used Normally open, or Normally closed? How do you know?*

## GOING BEYOND

***Finished early? Try some of the actions below. When finished, show your instructor and have them initial on the line.***

- \_\_\_\_\_ 1. Look in the inputs and outputs manual and find another open input you might be able to use. Check with your instructor to be sure you choose an appropriate one, and then make the robot move the object to another predefined position when you hit that switch.
- \_\_\_\_\_ 2. Can you use something else as an input to the robot to make it do something? Check with your instructor and try something else.
- \_\_\_\_\_ 3. Wire a microcontroller to be an input for the robot.



Ask your instructor about what to use for this activity.

