

## Sensing

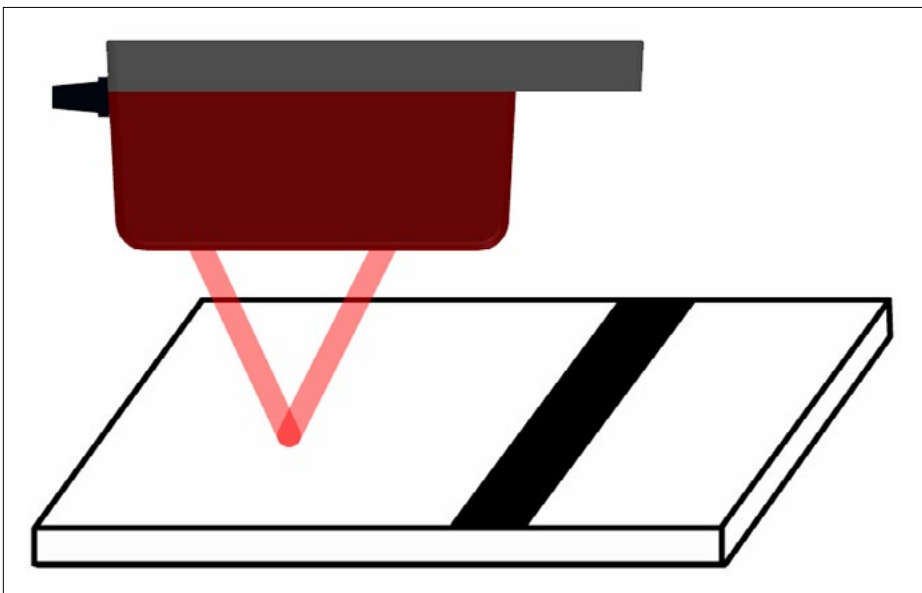
# Forward until Dark

*In this lesson, you will use a VEX Line Tracking Sensor and the Threshold you calculated to cause the robot to move forward until it detects a dark surface, and then stop.*

Let's review. Below is a set of three VEX Line Tracking Sensors. Each contains an infrared LED and an infrared light sensor.

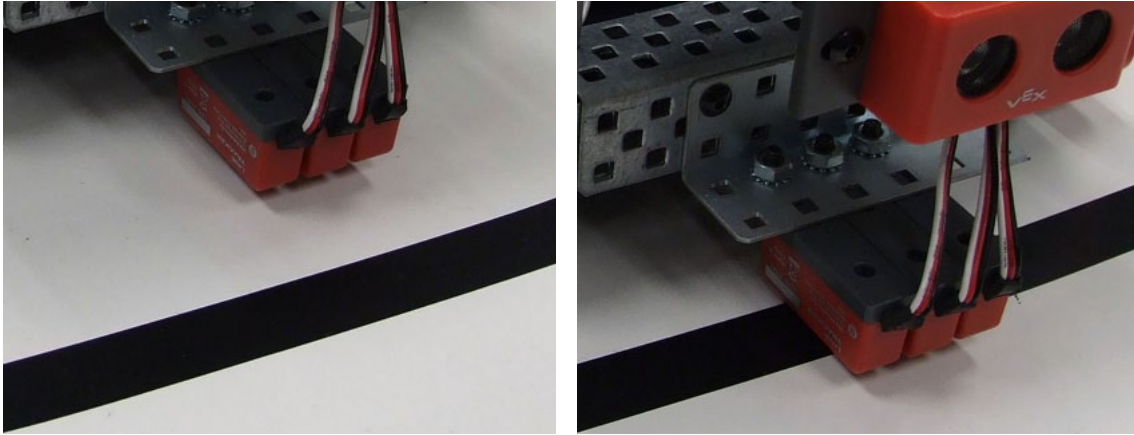


The Line Tracking Sensors can detect the basic colors of objects and surfaces by aiming directly at them at close range. They do so by illuminating a surface with its infrared LED and then measuring how much light is reflected back.



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### Forward until Dark (cont.)

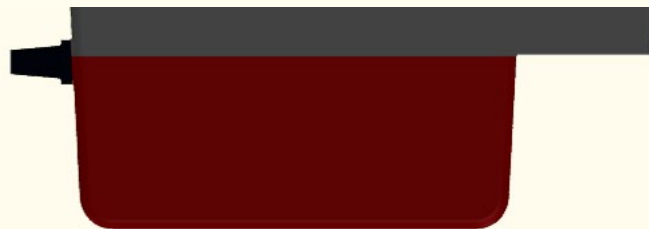


Light-colored surfaces, like the bright white table, reflect a large amount of the light, and produce a **low** sensor reading. Dark-colored surfaces, like the strip of black electrical tape, reflect very little light, and produce a **high** sensor reading.



#### **Important Information - Programming Tip**

When using the Line Tracking sensors, remember that **high sensor readings are caused by dark surfaces**, and **low sensor readings are caused by bright surfaces**.



0

4095

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High readings vs. low readings can therefore be used to distinguish light surfaces from dark ones. To make these values meaningful to the robot, we calculated a threshold value to create a “cutoff” point between light and dark.

#### Light Values:

L: 165

C: 167

R: 160

---

+ 492

#### Average Light:

$492 / 3 = 164$

#### Dark Values:

L: 2795

C: 2822

R: 2835

---

+ 8452

#### Average Dark:

$8452 / 3 = \sim 2817$

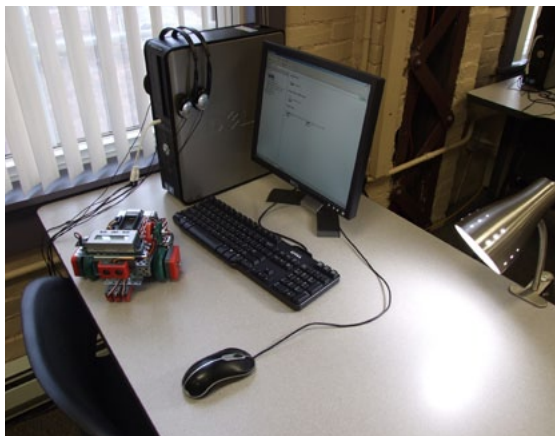
#### Threshold Value:

$2817 + 164 = 2981$

$2981 / 2 = \sim 1491$

Each sensor gives a light intensity reading of 0-4095. Unlike the Ultrasonic Rangefinder, where the number was in centimeters, the Line Tracking Sensor’s values are relative only, and do not correspond to any set system of units.

Any light source – lamps, sunlight, shadows – and even the height of the light sensor off the table can affect how much light they “see” for the same surface.



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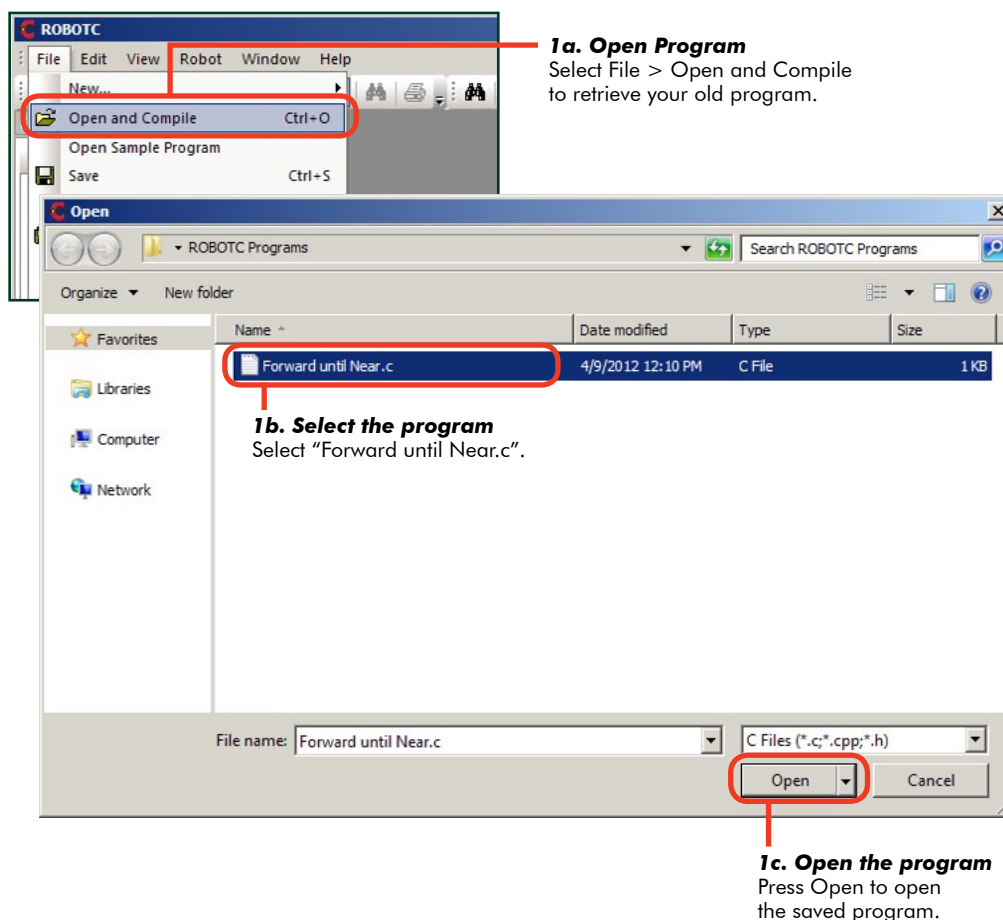
### Forward until Dark (cont.)

**Reminder!** Sensor readings and other numbers used in this guide may not be right for your environment. Your room's lighting and the position of the sun and shadows will cause light sensor readings to vary. Measure often!

When we say we want the robot to move forward until it detects a dark line, what we really mean is that we want it to move forward **while** it sees a bright surface, and then stop. In these terms, the behavior is very similar to the Forward until Near behavior we developed using the Ultrasonic Rangefinder, where the robot moved forward **while** it was far away from a detectable object.

We'll begin by opening our Forward until Near program from the earlier lessons, and modifying it to use the center Line Tracking Sensor.

#### 1. Open the "Forward until Near" program.



**1a. Open Program**  
Select File > Open and Compile to retrieve your old program.

**1b. Select the program**  
Select "Forward until Near.c".

**1c. Open the program**  
Press Open to open the saved program.

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### Forward until Dark (cont.)

**Checkpoint.** The program should look like the one below.

```

1  #pragma config(Sensor, dgt18, sonarSensor, sensorSONAR_cm)
2  #pragma config(Motor, port2, rightMotor, tmotorSer
3  #pragma config(Motor, port3, leftMotor, tmotorSer
4  /**!Code automatically generated by 'ROBOTC' configuration wiza
5
6  task main()
7  {
8      while(SensorValue[sonarSensor] > 25)
9      {
10         motor[rightMotor] = 63;
11         motor[leftMotor] = 63;
12     }
13 }
14

```

2. We're going to change the program, so save it under the new name "Forward until Dark".

**2a. Save program as...**  
Select File > Save As... to save your program under a new name.

**2b. Browse**  
Browse to and/or create an appropriate folder.

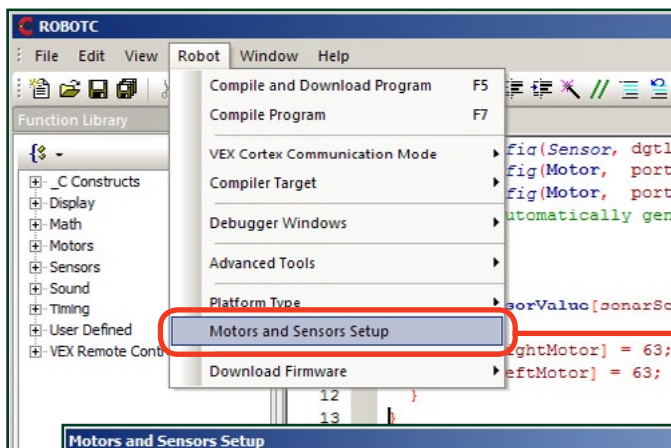
**2c. Name the program**  
Give this program the name "Forward until Dark".

**2c. Save the program**  
Press Save to save the program with the new name.

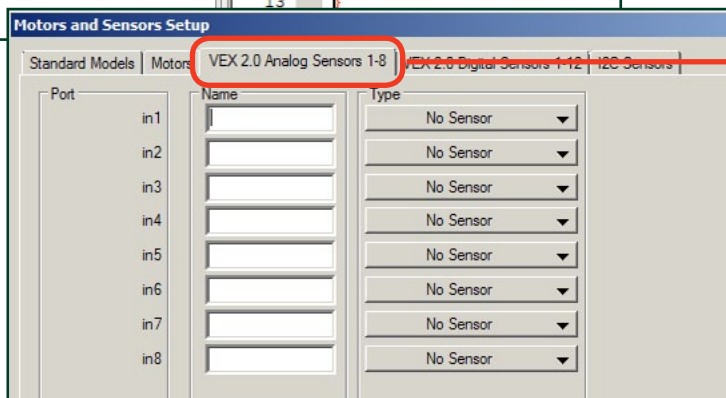
## Sensing

## Forward until Dark (cont.)

3. Open the Motors and Sensors Setup menu, and go to the Analog Sensors tab.

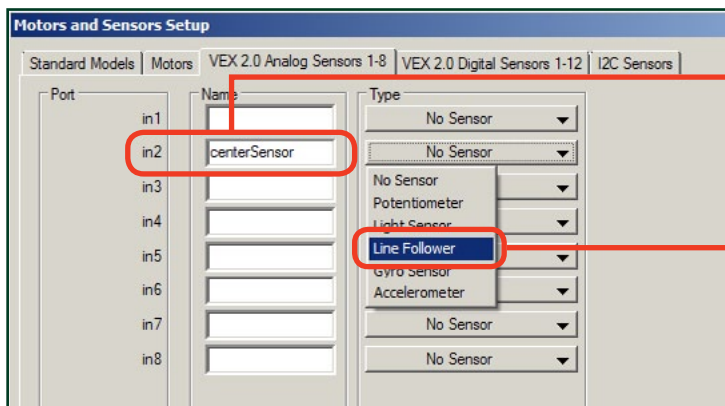


**3a. Open "Motors and Sensors Setup"**  
Select Robot > Motors and Sensors Setup to open the Motors and Sensors Setup menu.



**3b. Select the Analog Sensors Tab**  
Click the "VEX 2.0 Analog Sensors 1-8" tab on the Motors and Sensors Setup menu.

4. Use the Motors and Sensors Setup menu to name the in2 sensor "centerSensor", then select "Line Follower" as its type. Note that we only need to use one of the three line tracking sensors for the Forward until Dark behavior. The center sensor is a logical choice, but any of the three sensors would work.



**4a. Name sensor "centerSensor"**  
Enter the name "centerSensor" in the in2 Name box.

**4b. Make type "Line Follower"**  
Use the dropdown list to make "Line Follower" the sensor type.



## Sensing

### Forward until Dark (cont.)

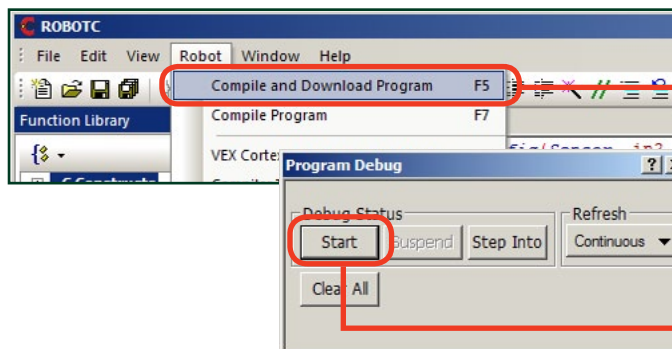
5. Modify the (condition) in the while() loop to watch for the centerSensor value to be less than (brighter than) the threshold.

```

1 #pragma config(Sensor, in2, centerSensor, sensorLineFollower)
2 #pragma config(Sensor, dgt18, sonarSensor, sensorSONAR_cm)
3 #pragma config(Motor, port2, rightMotor, tmotorServoConti...
4 #pragma config(Motor, port3, leftMotor, tmotorServoConti...
5 /*!Code automatically generated by 'ROBOTC' configuration ...
6
7 task main()
8 {
9   while(SensorValue[centerSensor] < 1491)
10  {
11     motor[rightMotor] = 63;
12     motor[leftMotor] = 63;
13  }
14 }
```

**5a. Modify this code**  
Change the while() loop condition's value so that it will check whether the **Line Tracking Sensor**'s value is less than the **threshold value** you calculated in the Thresholds lesson.

6. Download and Run the program.



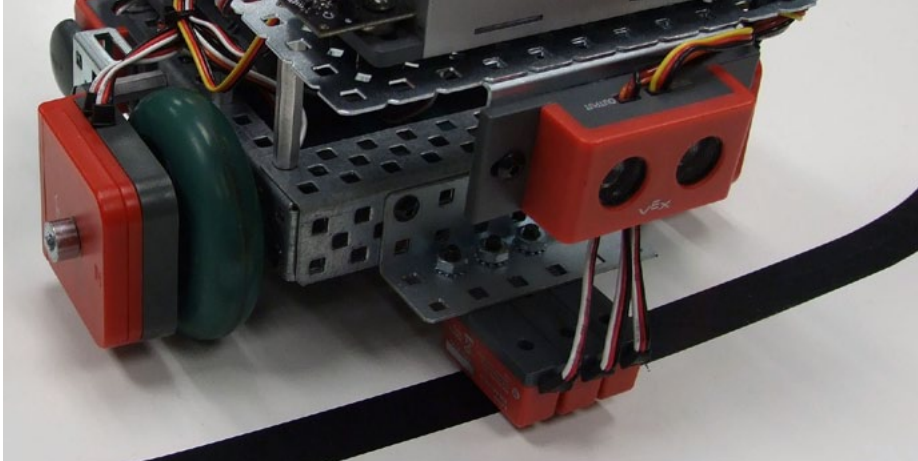
**6a. Download the program**  
Click Robot > Download Program.

**6b. Run the program**  
Click "Start" on the Program Debug window.

**Tip:** If your robot stops immediately or runs past the line without stopping, check your sensor values using the Sensor Debug Window. Lighting conditions (position of the sun, room lighting) may have changed, and your threshold may need to be adjusted.

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### Forward until Dark (cont.)



#### End of Section

When the robot sees “dark” (a value above the threshold), the (condition) is no longer satisfied, and the program ends, causing the robot to stop at the dark line.

#### Build Your Understanding

1. Consider what would happen if you were to turn the lights off (or on) in the room where the robot is running. Make your prediction, test it, and record your results.
  
2. How would you program the robot to move forward until it saw a bright surface on a dark table? Write the pseudocode for that program here, then convert it into real code and test it in ROBOTC.