

Getting Started with mBot™

Computer and Chromebook™

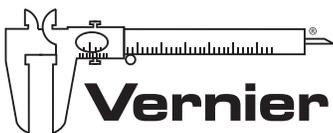
Contents

About mBot
Constructing mBot
mBot's Default Program
mBlock 5 Software
Programming mBot: 3 Easy Steps
Saving Your mBlock Programs
First mBot Program: Simple Obstacle Avoidance
Using mBlock Palettes and Blocks
Additional Resources

About mBot

mBot is an affordable STEM robot kit designed to help bring computer science education into the real world. mBot is made by Makeblock®, a leading DIY-robotics-construction and STEM-education platform for students, educators, and hobbyists. At the heart of mBot is the mCore, a microcontroller based on the Arduino™ Uno. mCore has four sensor ports and two motor ports. It also includes two RGB LEDs, a Buzzer, a Light Sensor, an IR Transmitter and Receiver, and an Onboard Button. Two of mBot's sensors, the Ultrasonic Sensor and the Line-Follower Sensor, are connected to mCore's sensor ports.

mBot comes loaded with a Default Program that has three modes: Mode A—Manual Mode, Mode B—Obstacle Avoidance, and Mode C—Line Following. In addition to these three modes, mBot can run a program uploaded directly to the robot via a USB cable. You can write these programs using mBlock software running on a Chromebook™ or a Windows® or macOS® computer.



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Vernier Software & Technology
13979 SW Millikan Way
Beaverton, OR 97005-2886

www.vernier.com
engineering@vernier.com

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Constructing mBot

To construct mBot, follow the building instructions included with mBot and keep these tips in mind:

- Construction typically requires 30 minutes.
- The only tool required is the included screwdriver.
- To power mBot, you need either four AA batteries or the optional 3.7 V rechargeable battery; batteries are not included with mBot.
- The IR Remote Control requires a CR2025 coin cell battery (not included). The remote is used to direct mBot.

mBot's Default Program

mBot comes pre-loaded with a Default Program that has three distinct modes.

MODE A—MANUAL DRIVE In Mode A, you can drive the robot forward or backward and turn it right or left by pressing the arrow keys on the IR Remote Control. Numbered keys correspond to sounds. In Mode A, the LEDs are white.

MODE B—OBSTACLE AVOIDANCE In Mode B, mBot drives forward until it detects an obstacle, such as a wall or chair, with the Ultrasonic Sensor. Then, mBot backs up, turns, and resumes driving forward. In Mode B, the LEDs are green.

MODE C—LINE FOLLOWING In Mode C, mBot will follow a black line while driving forward. It keeps track of the black line using the Line-Follower Sensor, mounted to the front of the mBot. In Mode C, the LEDs are blue.

mBot starts off in Mode A. There are two ways to change the mode:

- Select the mode by pressing the **A**, **B**, or **C** button on the IR Remote Control. Make sure there is a battery in the remote!
- Press the Onboard Button on mBot.

When you upload a program to mBot, your new program replaces the Default Program. You can return mBot to the Default Program at any time by following the "Return mBot to the Default Program" directions:

RETURN MBOT TO THE DEFAULT PROGRAM

Use mBlock 5 software to return mBot to the Default Program after uploading programs:

1. Turn on mBot and connect mBot to a computer or Chromebook with a USB cable (included with mBot).
2. Launch the mBlock 5 software, click the **+** button in the Devices tab, and select mBot as your device (see Figure 1).
3. Click Connect, , in the Devices tab. mBlock 5 will suggest the COM port to which mBot is connected. Click Connect again.
4. Click Setting, , in the Devices tab, and then click Update Firmware.
5. Select Factory Firmware as the Firmware Version, and then click Updates. When the process is complete, the Default Program will be restored on mBot.

mBlock 5 Software

You can use mBlock 5 software on a computer or Chromebook to write programs for mBot and upload your programs to the robot. **Note:** Makeblock regularly releases updates to their programs and the download process evolves quickly; contact Vernier for additional support. Also, note that there is an mBlock app available for Android and iOS; this guide covers mBlock 5 software.

COMPUTERS (WINDOWS AND MACOS)

Visit www.mblock.cc/mblock-software to download and install mBlock 5 software for Windows or macOS.

CHROMEBOOKS

To use mBlock on a Chromebook, you will run mBlock in the Chrome browser. Visit www.mblock.cc/mblock-software and follow the link to open mBlock in a browser.

The mBlock 5 is software based on Scratch 3.0, the graphical programming language developed by MIT's Lifelong Learning Lab. If you are familiar with Scratch, you will find mBlock easy to use. Even if this is your first time using a graphical programming language, you can pick it up quickly.

mBlock 5 converts your block code into Arduino C. You can observe this translation by clicking the "</>" symbol on the right side of the screen. This code is there so you can see what the C programming language is like; it is not necessary for you to understand it or do anything with it.

Programming mBot: 3 Easy Steps

The general process for programming mBot is

1. Set up mBlock for mBot.
2. Write your mBot program.
3. Upload and test the program.

Step 1 Set up mBlock for mBot

- a. Open mBlock 5.1 on your computer or Chromebook.
- b. Click the + in the Devices tab to add mBot as the device (see Figure 1). Select mBot as your device, and click OK. **NOTE:** You can leave the default device (Codey) as an option or delete it to avoid future confusion.
- c. Click the mode switch to activate Upload mode. This will ensure that the appropriate and necessary blocks required to upload the program to your mBot are available.

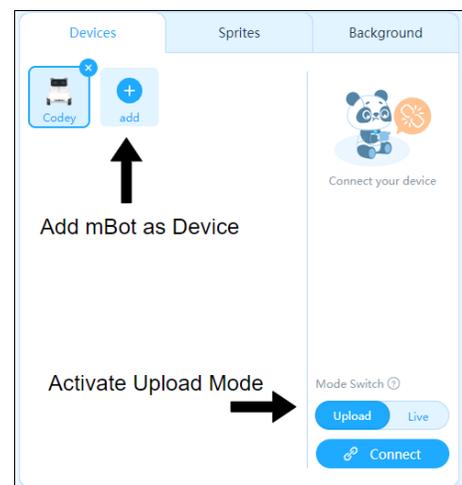


FIGURE 1 In mBlock, add mBot, and then activate Upload mode.

Step 2 Write your mBot Program

Creating a program for mBot is simple: drag and drop blocks into the programming area (the right pane in mBlock). When you create programs in mBlock 5 for mBot, always start with a "when mBot(mCore) starts up" hat block (found in the Events palette). See Figure 2 for an example program.

Step 3 Upload and test your program

When you are ready to test your program on mBot, you need to upload the program to mBot. There are two methods for accomplishing this; you can use a USB cable or the Makeblock[®] Bluetooth[®] Dongle. The Bluetooth Dongle is a special gadget that can be used to connect Makeblock products to a computer. For more information refer to <https://www.vernier.com/tit/4474>

METHOD 1 USB CABLE

- a. Use a USB cable (included with mBot) to connect mBot to your computer or Chromebook.
- b. Click  in the Devices tab (see Figure 1). mBlock 5 will suggest the port to which mBot is connected. Click Connect.
- c. Click , and the program will be loaded onto your mBot.

METHOD 2 BLUETOOTH

- a. Connect the Makeblock Bluetooth Dongle to a USB port on your computer. The Bluetooth LED will flash slowly.
- b. Press the Bluetooth symbol to pair mBot to the Adapter. The LED will flash quickly and then stay lit (without flashing).
- c. Click  in the Devices tab (see Figure 1). mBlock 5 will suggest the port to which the dongle is connected. Click Connect. **NOTE** Makeblock considers this a USB connection; do not switch to the Bluetooth 4.0 tab.
- d. Click , and the program will be loaded onto your mBot.

Once the upload is finished, you will see a message telling you the upload is complete. The program will start running as soon as the program has uploaded. **TIP** You can restart your program at any time by power-cycling mBot or pressing the Reset button on mBot.

Saving Your mBlock Programs

In mBlock 5, there are two ways to save and share your programs:

METHOD 1 SAVE TO YOUR COMPUTER/CHROMEBOOK

Click the File menu and choose **Save to your computer**. You can then share your mBlock program (.mblock) with classmates or your teacher.

METHOD 2 SAVE TO MAKEBLOCK'S ONLINE STORAGE (requires Makeblock account)

- a. In mBlock, create or log into your Makeblock account.
- b. After logging in, click the File menu and choose Save. You can access your program files on a different computer/device by logging into your account.

First mBot Program: Simple Obstacle Avoidance

The sample code in Figure 2 is for a simple obstacle-avoidance program. mBot drives forward at full speed. If the Ultrasonic Sensor detects something closer than 15 cm, mBot stops, backs up slowly, and then turns left. If the obstacle is no longer detected, mBot resumes driving forward; otherwise, mBot backs up and turns left again.

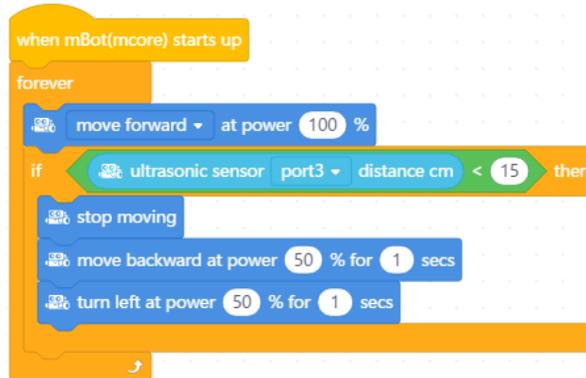


FIGURE 2 Obstacle Avoidance program

Build the Obstacle Avoidance program in mBlock and upload the code to mBot. Does mBot move as expected? Experiment with the code by doing the following:

- Start the program with a button push after you turn on mBot.
- Stop mBot long enough so you can easily turn off the robot.
- Increase or decrease the driving or turning speed.
- Increase or decrease the "wait" durations following the "run backward" or "turn left" blocks.
- Change the distance at which an obstacle is detected from 15 cm to a greater distance.
- Add commands so that sometimes mBot turns left to avoid an obstacle and other times turns right.

Improving Your Program

First of all, don't forget to save your code frequently! After you run your program you will undoubtedly find ways to improve it. As you change your code you will need to upload the new code to your mBot to test it. When you are ready to test your new program, follow these steps:

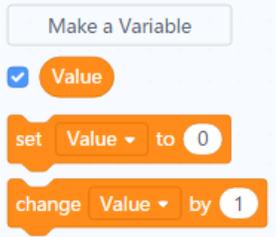
1. Use the USB cable or Bluetooth Dongle to connect mBot to your computer or Chromebook.
2. Click  **Connect** and confirm the port to connect to mBot in mBlock 5.
3. Click  **Upload**. When the upload is complete, test your new program.

Incorporating mBot Sensors and Outputs in Your Code

mBot has a variety of sensors and output devices built into the mCore board that can be incorporated into your program. There are several blocks to control these sensors and devices. We encourage you to become familiar with the palettes, blocks, and their functions.

Using mBlock Palettes and Blocks

When programming in mBlock, you will build your program out of blocks. Blocks are organized into different palettes, which are color coded. The list of available palettes updates for the Device or Sprite that you have selected. mBlock initially assumes you are programming a Codey Rocky robot. To program mBot, click the **+** in the Device tab, and select mBot as your device.

Palette	Description and use	Example blocks
Looks	Configure the LED Panel display.	
Show	Program the onboard sound generator and the onboard LEDs.	
Action	Control the motion of the mBot. Note: The blocks assume that you have the motors connected according to the mBot construction instructions.	
Sensing	Get information from onboard sensors, including the Ultrasonic sensor, the Line-follower Sensor, and the Onboard Button. This palette also includes blocks for the IR receiver, the IR transmitter, and a timer.	
Events	This palette contains the "when mBot(mCore) starts" block, which is required as the first block of any program that you want to run on mBot.	
Control	Guide the flow of your code using loops and other logic blocks.	
Operators	Use mathematical and comparison functions, such as "greater than" or "less than". In addition, there are blocks that allow you to evaluate and manipulate strings (as opposed to just numbers).	
Variables	Create variables and lists. NOTE Lists are not available when programming in Upload mode.	
My Blocks	Create and store your own blocks.	

Additional Resources

Activities and technical support can be found on the Vernier website, www.vernier.com/mBot

- *Coding with mBot: Life Hacks*, a STEM module with seven activities; free with the purchase of the STEM Classroom Kit (order code: MBOT-KIT)
- *Coding with mBot: Self-Driving Vehicles*, a STEM module with nine student activities (order code: MBOT-MSDV-E)
- mBot Troubleshooting and FAQs

These two books offer an in-depth dive into coding with mBot and include a variety of activities:

- *mBot for Makers: Conceive, Construct, and Code Your Own Robots at Home or in the Classroom* by Andrew Carle and Rick Schertle
- *A Gentle Introduction to Robotics: Volume 1: mBlock and the mBot* by Charles McKnight