

STEAMbot V1.3 User Guide

Introduction

Welcome to the world of STEAMbot robots! We at The STEAM Train want to thank you for getting a STEAMbot robot kit. We believe that any child that wants a robot should be able to afford one. This kit will help you learn more about Science, Technology, Engineering, Art and Math (STEAM). We hope you will have lots of fun putting your robot together and learning how to program it. Your efforts will be rewarded and give you opportunities for a better future.

This guide has the following chapters:

1. Assembly of Your STEAMbot – covers how to assemble your STEAMbot robot.
2. STEAMbot Controller – provides a description of the STEAMbot Controller, the heart of your robot.
3. Software Installation – tells you how to install the required software so you can program your STEAMbot robot.

Warning

Although the STEAMbot has been carefully designed and manufactured, the STEAMbot has fragile components. Dropping it or pushing on the Ultrasonic Sensor Bracket may cause it to crack or break. In addition, the header pins of the STEAMbot Controller can pierce your skin if you are not careful. The pins are also easy to bend. So please handle your STEAMbot with care.

Glossary

The following terms are used in this document.

Term	Meaning
BLE	Bluetooth Low Energy or Bluetooth 4.0
PCB	Printed Circuit Board
USS	Ultrasonic Sensor

Assembly of Your STEAMbot

Parts

Figure 1 shows you all the parts that should be in your kit. If any part is missing, please email us at support@thesteamtrain.cc.

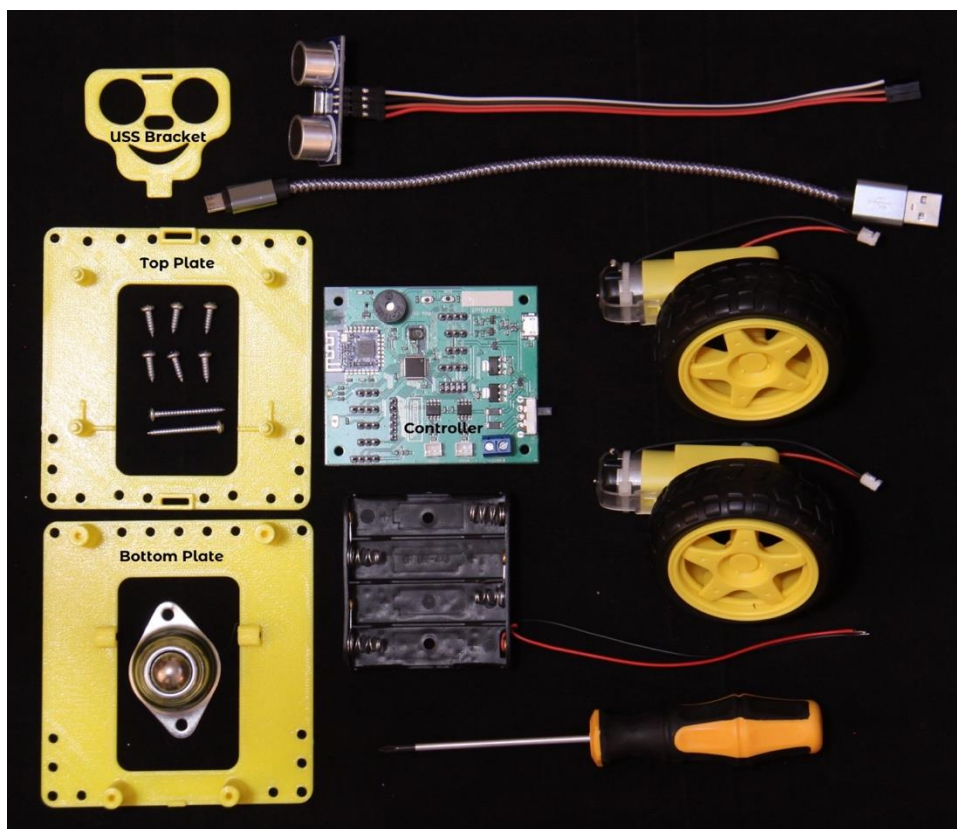


Figure 1, STEAMbot Kit Parts

The following table has the parts and quantities.

Part	Quantity
STEAMbot Top Plate	1
STEAMbot Bottom Plate	1
STEAMbot Controller	1
DC Motor and Wheel	2

Part	Quantity
Battery Holder	1
Ball Caster	1
Phillips Screwdriver	1
#4 1 inch screw	2
#4 3/8 inch screw	6 (or 8)
Ultrasonic Sensor and Wire	1
Ultrasonic Sensor Bracket	2
USB Cable	1

Note 1: the wire on the USS

Note 2: the USS Bracket shown is one of several that are available. When you placed the order for your STEAMbot, you had the option to pick two different brackets.

Parts Not Included

The following parts are needed but not supplied in the kit:

- Four AA batteries – please read the section on batteries on page 11.
- A smart phone with Bluetooth LE support. This is optional if you want to remotely control your STEAMbot.
- A small flat screwdriver. In the near future this screwdriver will not be required.
- A Windows or MacOS computer. Needed only if you want to program the STEAMbot using either the Arduino IDE or Google's Blockly.

Assembly Steps

It is highly recommended that you read through all the steps below and then perform the following steps to assemble your STEAMbot:

1. If the wheels are attached to the motors, remove the wheels by pulling them from the motor. The wheels fit tightly so be careful when pulling on the wheel to not break the axel.
2. Place the bottom plate flat on a table along with both motors and the two 1" screws, as shown in Figure 2.

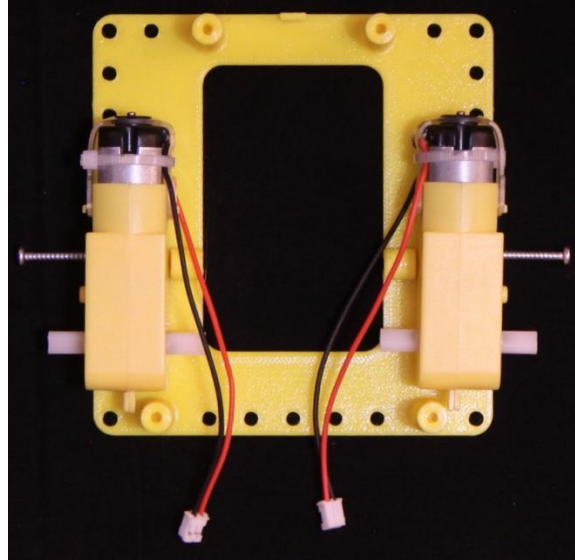


Figure 2, Bottom Plate with Motors

3. Use a 1" screw to attach each motor to the bottom plate. Be careful not to strip the plastic as you tighten.
4. Place the top plate over the bottom. Screw the top plate to the bottom plate using four 3/8" screws as shown in the following figure.

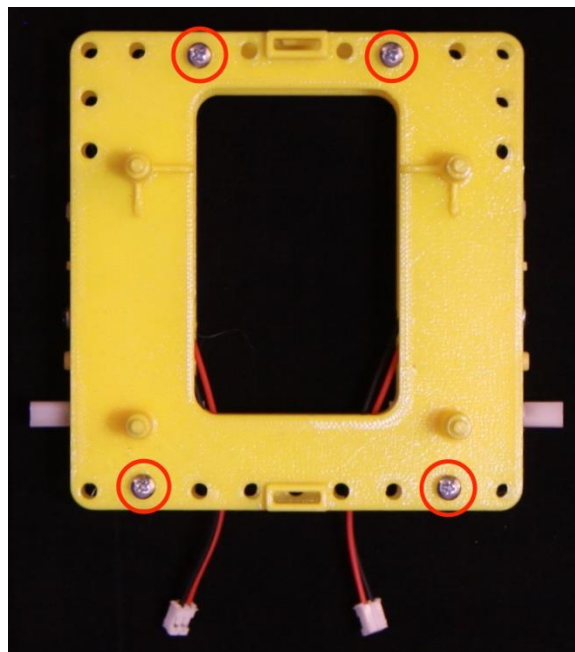
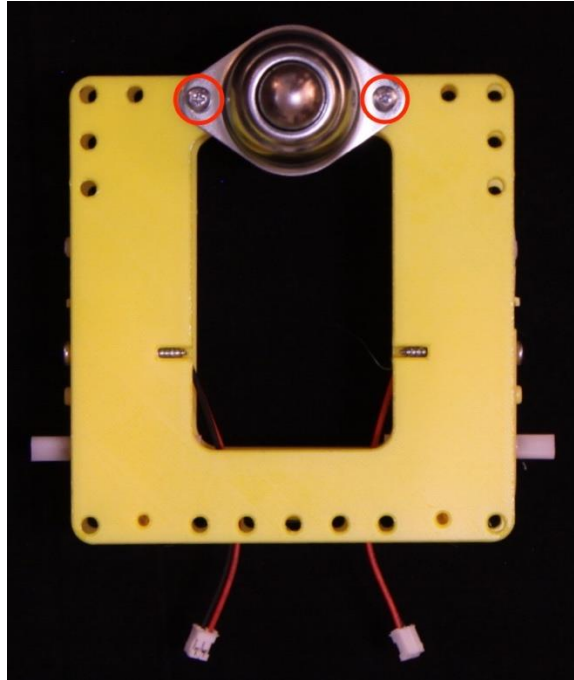


Figure 3, Top Plate

5. Flip the robot. Using two 3/8" screws, attach the roller ball to the bottom plate as shown in the following figure.



6. Take the wheels and attach them to the motors.
7. Flip the robot over so it is resting on the wheels and roller ball as shown in the following figure.

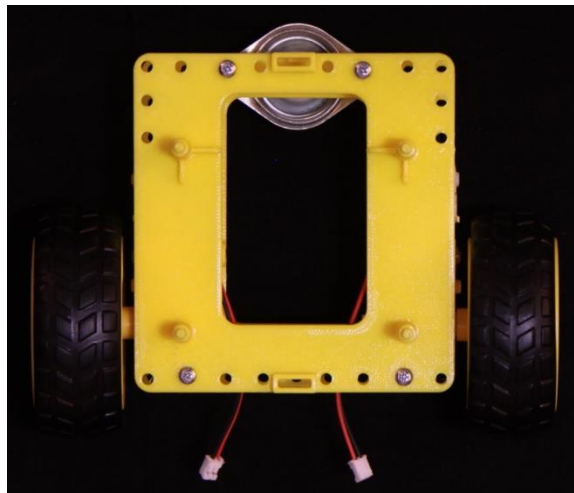


Figure 4, Chassis with Wheels

8. Add 4 AA batteries to the battery holder.
9. Place the battery holder on the top plate as shown in the following figure.

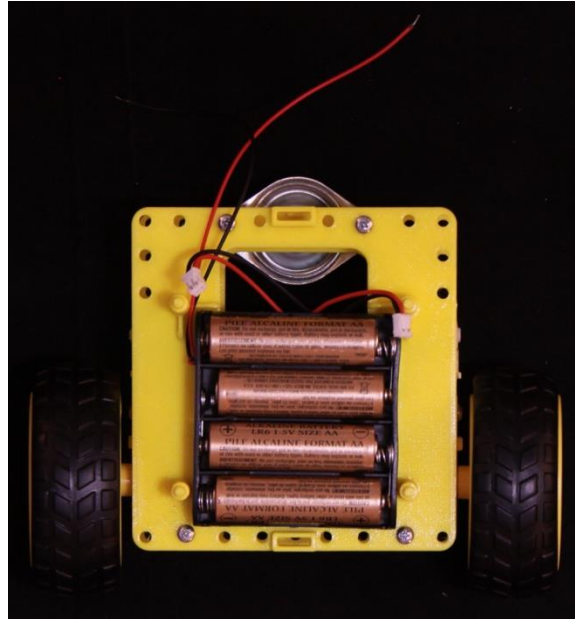


Figure 5, Battery Holder

10. Take the STEAMbot Controller and place it on the posts of the top plate. Note that some version may have two posts and two screw holes. If you have the screw holes, screw in the last two 3/8" screws to hold the STEAMbot Controller in place.
11. Loosen the screws of the blue battery terminal, labeled "+BATT-" with the small flat screwdriver.
12. Insert the red wire from the battery holder to the + battery terminal and tighten the screw.
13. Insert the black wire from the battery holder to the - battery terminal and tighten the screw.
14. Push the wire from the left motor onto the JST connector labeled "MTRA".
15. Push the wire from the right motor onto the JST connector labeled "MTRB".
16. Make sure the wiring is as shown in the following figure.



Figure 6, STEAMbot Controller

17. Pick an ultrasonic sensor bracket. As stated above, you received at least two different brackets when your STEAMbot was ordered.

18. Take the ultrasonic sensor (with the attached four conductor wire), align it with the holes on the ultrasonic sensor bracket and press fit the sensor into the bracket. The wire goes to the top.
19. Take the other end of the wire from the ultrasonic sensor and plug each conductor into the pins labeled “P5”. Note that the colors of the four-conductor wire differ between kits. The important thing to remember is to keep them in the same order on the sensor as on the pins of P5. Your robot should look similar to the following figure.

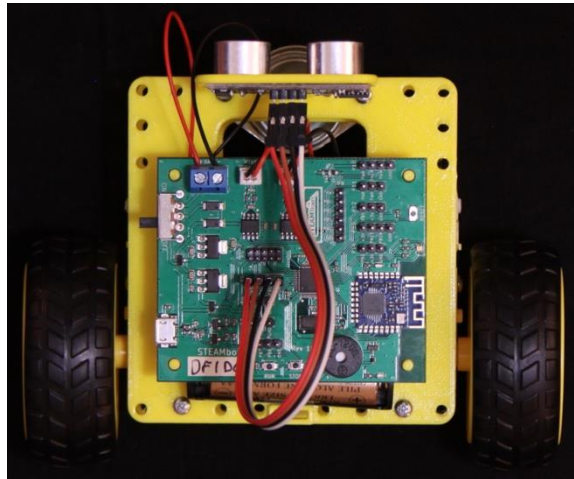


Figure 7, Completed STEAMbot

20. Push the power switch to the ON position (labeled on the PCB). A red LED near the speaker on the STEAMbot controller will turn red. The LED near the RESET button will blink green for about 1 second. You will hear a beep; the LED will turn several colors and then stay blue.
21. Congratulations, your STEAMbot is ready to be controlled via a smart phone (iPhone or Android) or to be programmed by you! If you don't have a smart phone, see below for the different modes. Now go have some fun with your STEAMbot robot!

Where Is the Front of The STEAMbot?

If you correctly followed the assembly steps above, the front of your STEAMbot is where the ball caster is. However, if you wish to flip this configuration so that the ball caster is the rear, just swap to which motor terminal blocks the wires from the motors are connected, i.e. push the wire from the left motor onto the JST connector labeled “MTRB” and push the wire from the right motor onto the JST connector labeled “MTRA”.

Batteries

The STEAMbot robot has been tested with alkaline batteries and with Ni-Zn rechargeable batteries. The STEAMbot does NOT support Ni-Cd or Ni-MH rechargeable batteries. These batteries only provide 1.2 volts each as compared to the 1.5 volts produced by alkaline batteries or the 1.6 volts provided by Ni-Zn batteries. Four Ni-Cd or Ni-MH provide only 4.8 volts which is not enough to reliably power the STEAMbot.

An alternative to AA batteries is to use a USB Power Bank that are commonly available. These are rechargeable and can be used multiple times. The power bank comes with a USB cable that is connected to the USB connector on the STEAMbot Controller. The downside to using a power bank is that the power switch is bypassed. To turn off your STEAMbot, remove the USB cable.

Removing or Adding Batteries

To remove or add batteries from the battery holder, carefully remove the STEAMbot Controller from the mounting posts. It's best to use a thumb and push up with the thumbnail. If the STEAMbot Controller was held in place with screws, first remove the screws and then push up the STEAMbot Controller from the two posts using your thumbs.

Modes

The default program that comes with the STEAMbot robot provides the following two modes:

1. Bluetooth mode – in this mode, the STEAMbot is controlled by a smartphone using the built-in Bluetooth LE module. When first powered on or after a reset, this is the mode the STEAMbot is in.
2. Cat mode – in this mode, the STEAMbot acts similar to a cat. Put an object in front of the STEAMbot (your hand, your shoe, a broom or something similar). At a certain distance, the STEAMbot will follow the object. However, if the STEAMbot gets too close to the object, it will back away from the object.

To change modes, push both the RUN and the STOP button. You will hear a single beep when transitioning from Cat mode to Bluetooth mode. You will hear a beep and then a higher pitched beep when transitioning from Bluetooth mode to Cat mode.

Programming Your STEAMbot

Google's Blockly

The easiest way to program your STEAMbot is with [Google's Blockly](#). Blockly is a “block programming” language, very similar to [MIT's Scratch](#). To you program with Blockly, you must have one of the following setups:

- A ChromeBook with BLE support
- A Macintosh (Mac) computer with BLE support and running Google's Chrome web browser

Using one of the setups above, start your Chrome browser and go to <https://thesteamtrain.cc/sbp>. When the page loads, along the top you will see a “Connect to” button next to a shaded “STEAMbot-” label and then a greyed out “ID” field. In this field, enter the alphanumeric information written on the STEAMbot Controller under “STEAMbot”. Turn on your STEAMbot and click the “Connect to” button.

See the highlighted figure below.

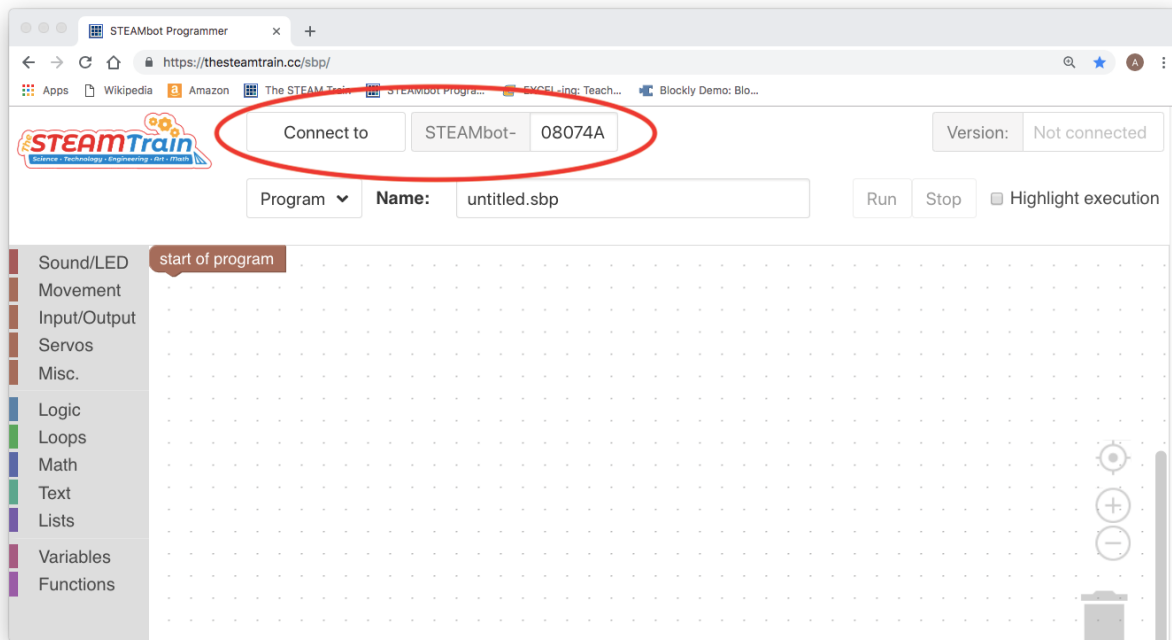


Figure 8, STEAMbot ID

A Blockly Programming Guide will be available soon.

Software Installation for Arduino IDE

You can program your STEAMbot with the Arduino Integrated Development Environment (IDE) and some additional software and libraries. You must know C/C++ in order to program your STEAMbot. In the near future, you will be able to program your STEAMbot with a drag-and-drop programming environment such as Scratch or other similar environment.

Please follow the following steps to install all the required software:

1. On Windows, install the software from the Microsoft Store. On a Mac, download the Arduino IDE from <https://www.arduino.cc/en/Main/Software>. Refer to the <https://www.arduino.cc/en/Guide/HomePage> for the instructions on how to install the software.
2. Start the Arduino IDE. Open up the Preferences dialog. On Windows it's under File → Preferences.
3. In the text field for Additional Boards Manager URLs enter "http://dan.drown.org/stm32duino/package_STM32duino_index.json". Click the OK button.
4. Click on Tools → Board → Boards Manager. When the Board Manager dialog box appears, enter "maple" into the "Filter your search..." text box.
5. Select the "STM32Fxx/GD32F1xx boards by stm32duino" option and click "Install".
6. The installation process may take several minutes. When completed, click "Close".

7. Click on Sketch → Include Library → Manage Libraries...
8. When the Library Manager dialog appears, enter "steambot" into the "Filter your search..." text field. Select the STEAMbot library and click install. Note that the version may be a later version. It will take a few seconds to install the library and you should see the following.

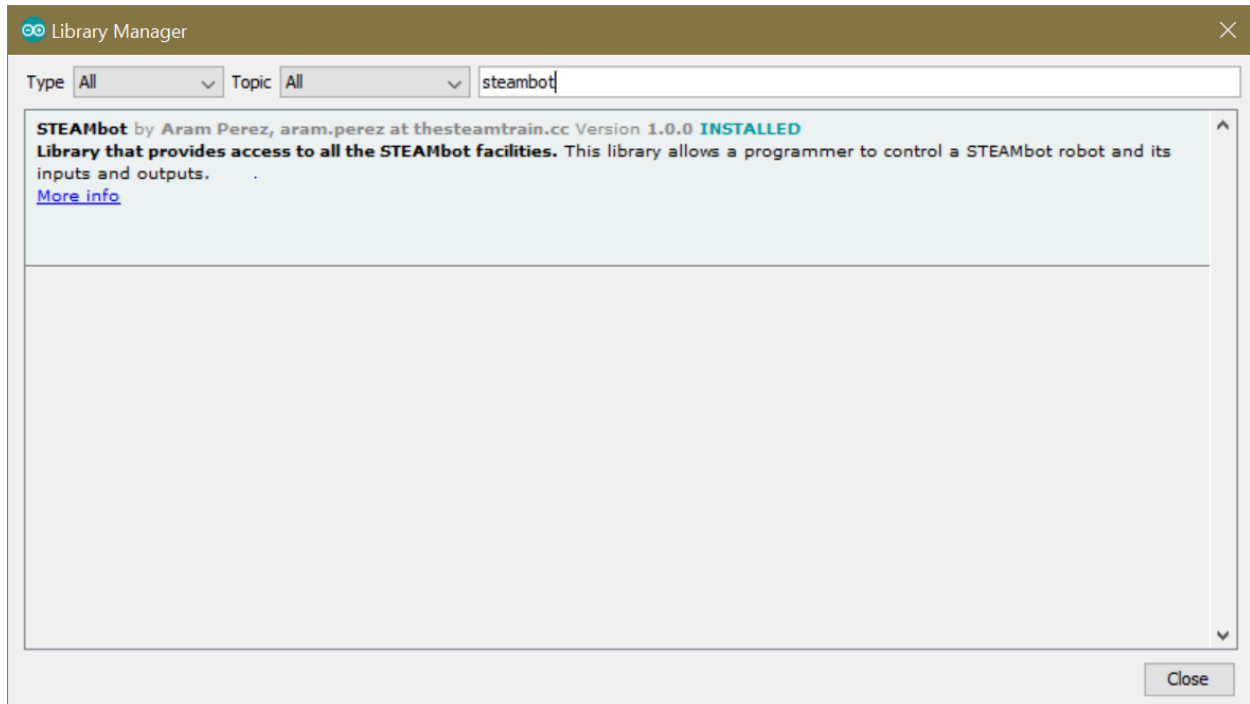


Figure 9, Arduino Library Manager

9. Click the Close button (see figure below).
10. Click on Tools → Board: and select "Maple Mini".
11. Click on Tools → Bootloader Version and select "Bootloader 2.0 (20k RAM, 120k Flash)".
12. On Windows, click on Tools → Port and select the COM port which has "(Maple Mini)" after it.
13. You can now look at the different examples we provide by selecting File → Examples → STEAMbot, including the DefaultSTEAMbot example which is the default program running when you first get your STEAMbot and power it up.
14. You are now ready to create your very own programs your STEAMbot to do other things! And please share them on our web site.

STEAMbot Controller

The STEAMbot is controlled by a controller board that provides all the required functions to control the robot but also allows you to expand your robot by adding additional sensor and/or actuators. It can easily be programmed by the Arduino IDE (see the next chapter). It has a 32-bit STM32F103CBT6 ARM microcontroller with 128 KB FLASH memory (to store your programs), 20 KB of RAM (used while running your program to store data that changes) and 17 general purpose

inputs and outputs (GPIOs). There are two GPIO that are assigned to the Ultrasonic Sensor that comes with the kit.

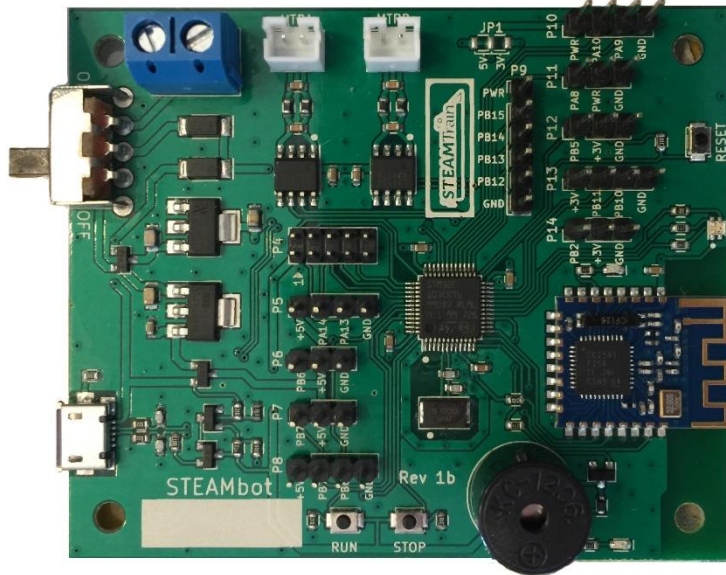


Figure 10, STEAMbot Controller

The following functionality is built into the controller:

- An RGB LED that supports 8 different colors.
- A speaker that can produce a variety of different notes and beeps.
- Two H-bridge controllers for controlling 2 DC motors.
- A Bluetooth LE module for communications with external devices such as smart phones.
- Two pushbuttons that can be used by programs you write.

General Purpose Input and Outputs

All the GPIOs are available on male pin headers, grouped in different connectors. Each connector has power and ground to make it easy to connect sensors and actuators. The following table lists the header and pins.

Header	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6
P5*	+5V	PA14	PA13	GND	-	-
P6	PB6 (SRV2)	+5V	GND	-	-	-
P7	PB7 (SRV1)	+5V	GND	-	-	-

P8	+5V	PB7	PB6	GND	-	-
P9	PWR**	PB15/MOSI2	PB14/MISO2	PB13/SCK2	PB12/SS2	GND
P10	PWR**	PA10/RX1	PA9/TX1	GND	-	-
P11	PA8	PWR**	GND	-	-	-
P12	PB5	3.3V	GND	-	-	-
P13	3.3V	PA11/RX3	PB10/TX3	GND	-	-
P14	PB2	3.3V	GND	-	-	-

* The default STEAMbot program expects the Ultrasonic Sensor to be connected on P5. If you write your own program and will not need the Ultrasonic Sensor, you can use the GPIO pins on P5.

** Default PWR is 5V but can be changed to 3.3V by cutting trace of JP1 to 5V and soldering wire to 3.3V (labeled “3V” on the board).

JTAG

The Controller board also has a JTAG connector (P4) that is useful for low level debugging. Very few persons will need to use this connector. The following table provides the pinouts.

Pin	Signal	Pin	Signal
1	3.3V	2	PA13/JTMS
3	GND	4	PA14/JTCK
5	PB4/NJTRST	6	PB3/JTD0
7	GND	8	PA15/JTDI
9	GND	10	NRST

This table is provided for completeness and can generally be ignored.