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Pololu Zumo Shield for Arduino User's Guide



View document on multiple pages. [<https://www.pololu.com/docs/0J57>]

You can also view this document as a **printable PDF** [https://www.pololu.com/docs/pdf/0J57/zumo_shield_for_arduino.pdf].

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1. Overview

The Zumo Shield provides a convenient interface between our **Zumo chassis** [<https://www.pololu.com/product/1418>] and an **A-Star 32U4 Prime** [<https://www.pololu.com/category/165/a-star-32u4-prime>], **Arduino Uno** [<https://www.pololu.com/product/2191>], or **Arduino Leonardo** [<https://www.pololu.com/product/2192>] (it is not compatible with the Arduino Mega or Due, but it can be used with older Arduinos that have the same form factor as the Uno, such as the Duemilanove). The shield mounts directly to the chassis, connecting to its battery terminals and motors, and the Arduino plugs into the shield's male header pins, face down. The shield provides all the electronics necessary to power the motors and includes some additional fun components for making a more interesting robot, such as a buzzer for making sounds and inertial sensors including an accelerometer and gyro.

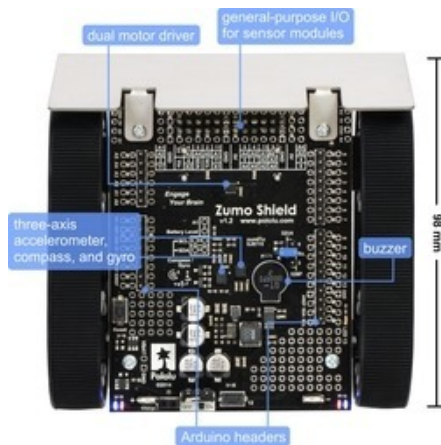


Zumo Shield for Arduino, v1.2, as it ships (assembled with surface-mount components only).

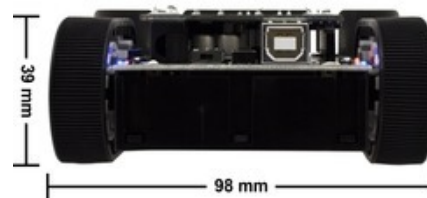


Assembled Zumo robot for Arduino with an Arduino Uno (with original white sprockets).

A Zumo chassis, Zumo Shield, and Arduino (or compatible board) can be combined to become a low-profile, Arduino-controlled tracked robot that is less than 10 cm on each side (small enough to qualify for Mini-Sumo competitions).



Main features of the Zumo Shield for Arduino, v1.2.



Zumo robot assembled with a Zumo Shield and Arduino Uno, back view.

The latest revision of the Zumo Shield is version **1.2**. This version adds an **L3GD20H** [<https://www.pololu.com/product/2129>] 3-axis gyroscope and upgrades the accelerometer and magnetometer chip to the newer **LSM303D** [<https://www.pololu.com/product/2127>]. It is available by itself, as part of a kit, or in a complete robot:

- **Zumo Shield, v1.2** [<https://www.pololu.com/product/2508>]
- **Zumo robot kit for Arduino, v1.2** [<https://www.pololu.com/product/2509>] with a **Zumo chassis** [<https://www.pololu.com/product/1418>] and a stainless steel **Zumo blade** [<https://www.pololu.com/product/1410>]
- **Zumo robot for Arduino, v1.2** [<https://www.pololu.com/product/2510>], fully assembled with **75:1 HP motors** [<https://www.pololu.com/product/2361>] and a **reflectance sensor array** [<https://www.pololu.com/product/1419>] installed.

The information in this user's guide also applies to the original Zumo Shield, which did not have a gyro and featured an **LSM303DLHC** [<https://www.pololu.com/product/2124>] accelerometer and magnetometer:

- **Zumo Shield** [<https://www.pololu.com/product/2504>]
- **Zumo robot kit for Arduino** [<https://www.pololu.com/product/2505>]
- **Zumo robot for Arduino** [<https://www.pololu.com/product/2506>]

July 10, 2015 update: The Zumo Robot for Arduino now features black, spoked sprockets in place of the original white ones (which can still be seen in some of the pictures in this guide).

1.a. Contacting Pololu

We would be delighted to hear from you about your experiences with the **Zumo Shield for Arduino** [<https://www.pololu.com/product/2508>], **Zumo robot kit for Arduino** [<https://www.pololu.com/product/2509>], or **Zumo robot for Arduino** [<https://www.pololu.com/product/2510>]. If you need technical support or have any feedback you would like to share, you can **contact us** [<https://www.pololu.com/contact>] directly or post on our **forum** [<http://forum.pololu.com/viewforum.php?f=29>]. Tell us what we did well, what we could improve, what you would like to see in the future, or anything else you would like to say!

1.b. Included components

The Zumo Shield is available:

- **by itself** [<https://www.pololu.com/product/2508>];
- as part of a **Zumo robot kit for Arduino** [<https://www.pololu.com/product/2509>] that also includes a **Zumo chassis** [<https://www.pololu.com/product/1418>] and a stainless steel **Zumo blade** [<https://www.pololu.com/product/1410>]; or
- as a fully-assembled **Zumo robot for Arduino** [<https://www.pololu.com/product/2510>] with **75:1 HP motors** [<https://www.pololu.com/product/2361>] and a **reflectance sensor array** [<https://www.pololu.com/product/1419>] installed.

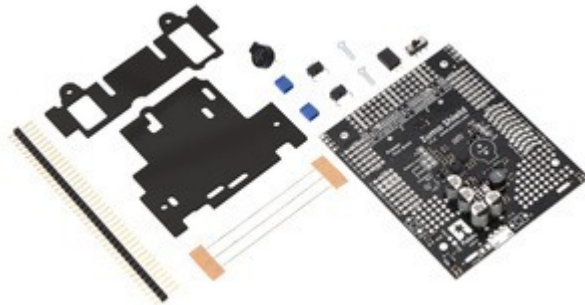


Fully assembled Zumo chassis with assembled Zumo Shield (v1.0).

Zumo Shield

The shield itself comes with the following components:

- right-angle slide switch
- two **pushbuttons** [<https://www.pololu.com/product/1400>]
- buzzer
- **2-pin battery-charging header** [<https://www.pololu.com/product/1012>]
- three jumper wires (for soldering motors to the shield)
- two 25-pin **0.1" straight breakaway male headers** [<https://www.pololu.com/product/965>]
- four **blue shorting blocks** [<https://www.pololu.com/product/968>]
- two 5/16" #2-56 machine screws (to be used instead of the 1/4" screws included with the chassis kit if you attach a Zumo blade)
- 1/16" black acrylic spacer plate (two pieces)



Zumo Robot Kit for Arduino

In addition to the shield and its included hardware, the Zumo robot kit for Arduino also includes these components:

- **Zumo chassis kit** [<https://www.pololu.com/product/1418>], which includes:
 - Zumo chassis main body
 - 1/16" black acrylic mounting plate (not used with the Zumo Shield)
 - Two drive sprockets
 - Two idler sprockets
 - Two 22-tooth silicone tracks
 - Two shoulder bolts with washers and M3 nuts
 - Four 1/4" #2-56 screws and nuts
 - Battery terminals
- **Basic sumo blade for Zumo chassis** [<https://www.pololu.com/product/1410>]





You will receive the black acrylic spacer and mounting plates with protective paper masking on both sides. You can peel this masking off to expose the acrylic surface, or you can leave it on to increase the thickness of the plates.



The shield and chassis kit include extra parts like jumper wires, screws, nuts, and washers, so do not be concerned if you have some leftover hardware after assembling your Zumo.

Zumo Robot for Arduino

The Zumo robot for Arduino is a fully-assembled robot platform built from the same components found in the Zumo robot kit for Arduino, along with these additions:

- **Two 75:1 HP micro metal gearmotors**
[<https://www.pololu.com/product/2361>]
- **Zumo reflectance sensor array**
[<https://www.pololu.com/product/1419>]



2. Assembly

If you have a **Zumo robot kit for Arduino** [<https://www.pololu.com/product/2509>] or a separate **Zumo Shield** [<https://www.pololu.com/product/2508>] and **chassis** [<https://www.pololu.com/product/1418>], this section will guide you through assembling them into a complete robot.

If you purchased an assembled **Zumo robot for Arduino** [<https://www.pololu.com/product/2510>], this assembly work has been done for you, although you might want to configure your Zumo by adding or removing some **jumper connections** [<https://www.pololu.com/docs/0J57/3.c>]. Otherwise, you can simply install four AA batteries and an Arduino (or compatible controller) and skip to **Section 3** to start learning how to use your Zumo!

2.a. What you will need

The Zumo Shield is designed to be mounted on a **Zumo chassis kit** [<https://www.pololu.com/product/1418>], which is included (along with a **Zumo blade** [<https://www.pololu.com/product/1410>]) if you have a **Zumo robot kit for Arduino** [<https://www.pololu.com/product/2509>]. In addition, you will require these items to construct a working Arduino-controlled Zumo robot:

Additional required components

- Two **micro metal gearmotors** [<https://www.pololu.com/category/60/micro-metal-gearmotors>] (we recommend 100:1, 75:1, or 50:1 gear ratio versions with **HP** [<https://www.pololu.com/category/173/6v-high-power-hp-micro-metal-gearmotors>] or **HPCB** [<https://www.pololu.com/category/174/6v-high-power-carbon-brush-hpcb-micro-metal-gearmotors>] motors). The **pre-assembled version of the Zumo robot** [<https://www.pololu.com/product/2510>] includes two **75:1 HP** [<https://www.pololu.com/product/2361>] micro metal gearmotors.
- An Arduino or compatible board (we recommend an **A-Star 32U4 Prime** [<https://www.pololu.com/category/165/a-star-32u4-prime>], **Arduino Uno R3** [<https://www.pololu.com/product/2191>], or **Arduino Leonardo** [<https://www.pololu.com/product/2192>])
- Four AA batteries (we recommend rechargeable **AA NiMH cells** [<https://www.pololu.com/product/1003>])

Please see the **product description for the chassis kit** [<https://www.pololu.com/product/1418>] for more information and recommendations about selecting these components.

Additional optional components

- **Zumo reflectance sensor array** [<https://www.pololu.com/product/1419>]
- **Basic sumo blade for the Zumo chassis** [<https://www.pololu.com/product/1410>]
- **Sensors** [<https://www.pololu.com/category/7/sensors>], such as our **QTR reflectance sensors** [<https://www.pololu.com/category/123/pololu-qtr-reflectance-sensors>]
- **Connectors and jumper wires** [<https://www.pololu.com/category/19/connectors>], for connecting additional sensors and components
- Battery charger (such as the **iMAX-B6AC** [<https://www.pololu.com/product/2588>]), if you are using rechargeable batteries

Assembly tools

- Soldering iron and solder (we recommend one with adjustable temperature control)
- Wire cutter

- Small Phillips screwdriver
- 3 mm Allen wrench (hex key)
- long-nose pliers (for bending the Zumo blade mounting tabs)

2.b. Assembling the Zumo Shield and chassis

Please follow these instructions carefully to assemble your Zumo Shield and chassis properly. (These pictures show the **original Zumo Shield** [<https://www.pololu.com/product/2504>], but the assembly process is the same for the **latest v1.2 version** [<https://www.pololu.com/product/2508>].)

Through-hole parts

1. Solder the included through-hole components to the shield:
 - power switch
 - reset pushbutton
 - user pushbutton
 - buzzer
 - charging connector (1×2-pin female header)

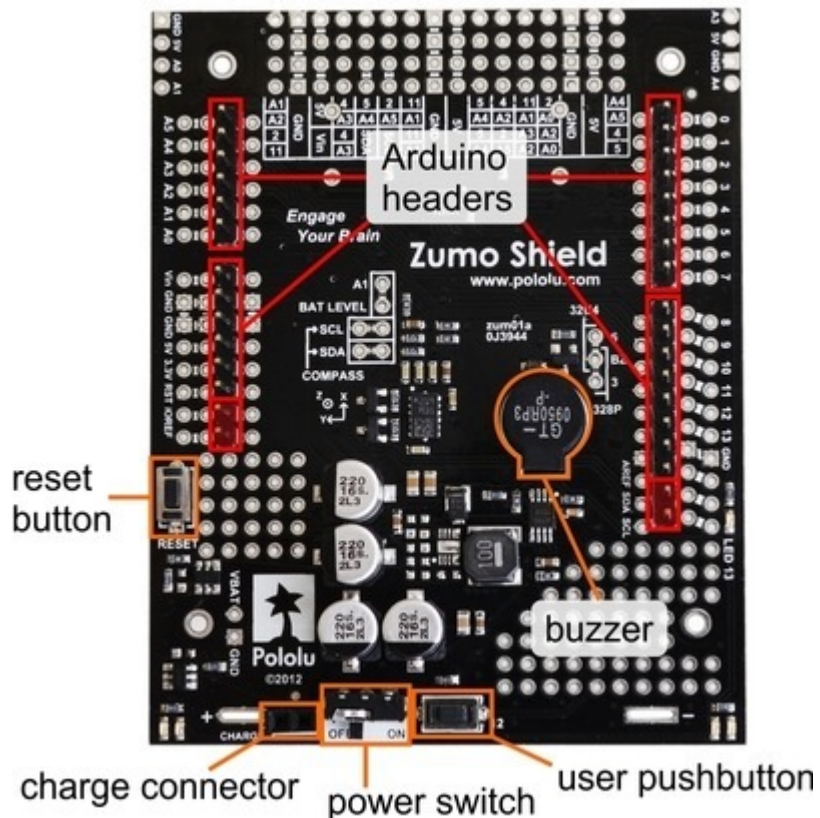
2. On the bottom of the board, trim any leads longer than 1/16" (the thickness of the spacer plate) so they do not prevent the shield from sitting flat on the spacer plate and chassis.

Arduino headers

3. Separate the 1×40-pin breakaway male header into the appropriate segments for connecting your Arduino and solder them to the shield. These header segments should be soldered to the sets of holes outlined with white rectangles on the top of the shield, with the pins facing up.

The A-Star 32U4 Primes and the newest Arduino boards, including the Uno R3 and the Leonardo, use one 1×10 header, two 1×8 headers, and one 1×6 header; older Arduino boards use two 1×8 headers and two 1×6 headers (the two pairs of pins highlighted above in red should not be populated if you are using this board with an older Arduino that does not support these additional pins). Please make sure you solder the appropriate headers for your particular Arduino!

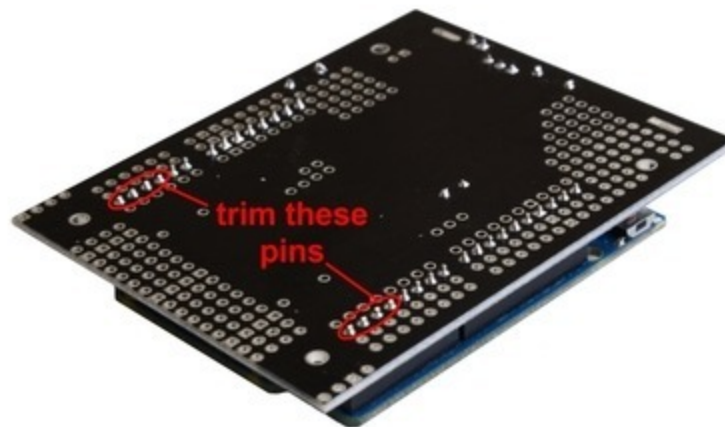
An easy way to line up the Arduino headers for soldering is to plug them into an Arduino, then place the shield upside-down on top of them, as shown in the picture below. Be careful to insert the header pins into the correct set of holes before you begin soldering. **Note:** if you use this alignment technique, make sure your soldering iron



temperature is not excessively hot and avoid holding the iron on a single pin for more than a few seconds as this could melt the Arduino's female headers.



4. On the bottom of the board, trim the four Arduino header pins closest to the front of the board on each side to prevent them from contacting the motor housings. If you think there is a chance these pins might still touch the motor cases, you can put some electrical tape on the motors to act as insulation.

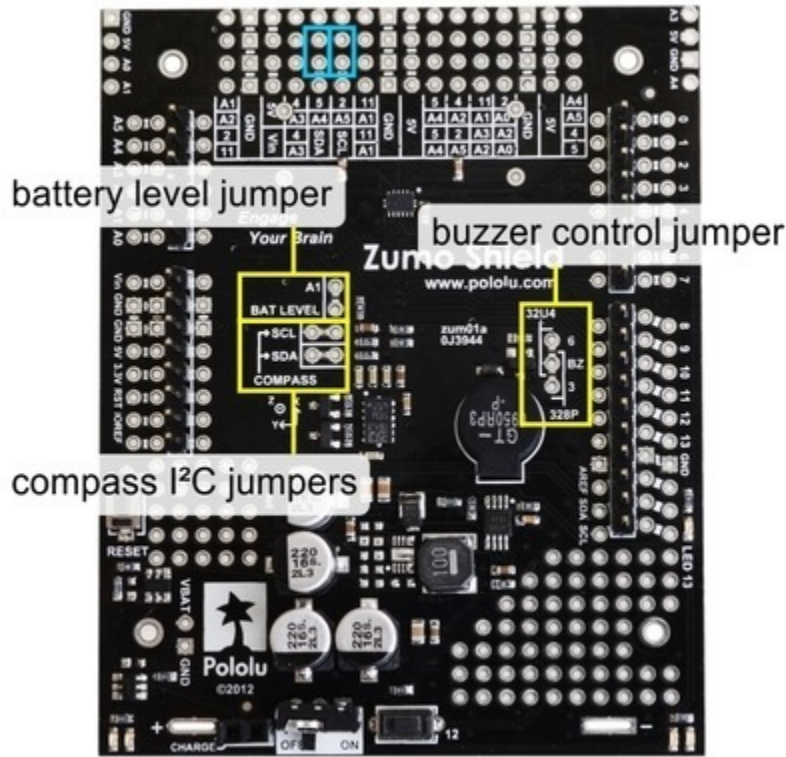


Jumpers and additional connections

5. **Optional:** If you want to enable the buzzer, enable the battery level input, or disable the compass, now is a good time to add and/or cut jumper connections to configure the shield to your liking. This can also be done later, though soldering to these pins is more difficult once the robot is assembled (especially if you decide later you want to add header pins for use with shorting blocks; this would require a lot of disassembly). The jumpers are explained in detail in **Section 3.c**. The buzzer and battery level jumpers can be connected by soldering in a short piece of wire between the two holes, while the compass I²C connections can be broken by cutting the trace on the top of the board between the holes. **Note:** there is not enough clearance to use male headers on the battery level and compass I²C jumpers if you are using an Arduino with a DIP (through-hole) microcontroller.



Instead of making a wire connection, you can solder a 1×3 male header to the buzzer jumper holes to allow the use of a shorting block for connecting the buzzer. You can also use male headers and shorting blocks for the battery level jumper and compass jumpers if you have an Arduino Uno with an SMD (surface mount) microcontroller, Arduino Leonardo, or A-Star 32U4 Prime. However, there is not enough clearance to use male headers on the battery level and compass I²C jumpers if you are using an Arduino with a DIP (through-hole) microcontroller.



6. **Optional:** At this point, you might consider soldering additional components (such as sensors), or headers or wires for connecting them, to the shield. If you do this, please check to make sure your part placement does not interfere with the shield's ability to mate with the Arduino or the chassis. In particular, note that only components in the outermost three rows of the front expansion area can extend below the board (the fourth front-expansion row can only be used for pins extending above the board), and if you add any through-hole parts to the prototyping areas on the shield, you will need to drill corresponding holes in the acrylic spacer plate for the leads to fit into.

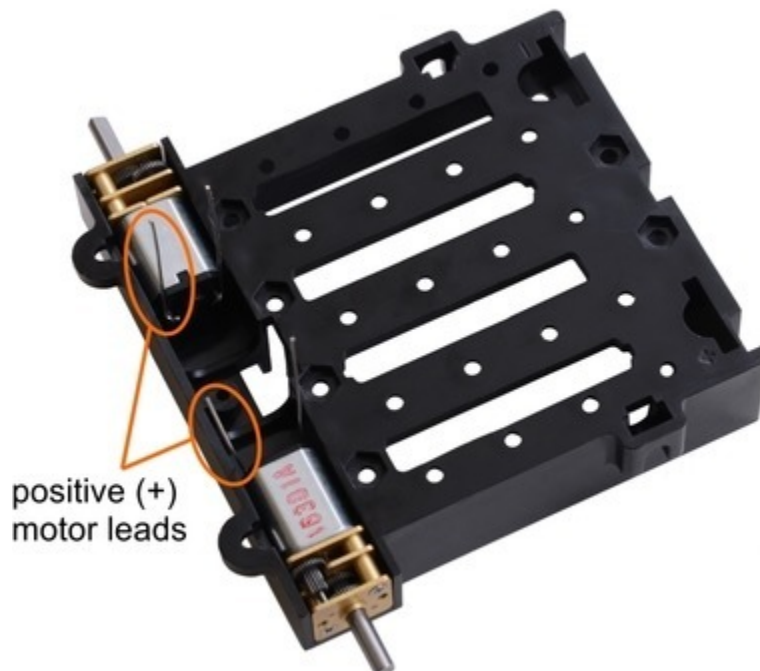
Motors

7. Cut two of the included jumper wires in half to form four segments, and trim off the ends that are covered in adhesive (the adhesive could interfere with making a good electrical connection to the motor). These wire segments will be used as motor leads.

8. Solder a pair of leads to each motor. You might find it helpful to make a small bend at the tip of each lead to hook into the hole in the motor lead tab to hold it in place for soldering. **Warning:** holding the soldering iron against the motor lead for more than a few seconds can start to damage the motor brushes, so try to be reasonably quick/efficient with this soldering; if the first attempt does not go well, remove the soldering iron and let the motor cool for a few seconds before trying again.



Each motor's positive terminal is indicated by a plus sign (+) in the black plastic end of the motor, visible at the bottom of the picture above. The motors should be soldered into the shield with the positive terminal closest to the front, so you should attach the leads to allow the motors to be oriented this way. (However, don't worry if you accidentally get the orientation of one or both motors wrong. You can later compensate for it in software with our **ZumoMotors library** [<https://www.pololu.com/docs/0J57/6>].)



9. Place the motors into the channel in the front of the chassis, aligning the gearbox with the grooves in the channel. The front plate of the gearbox should be even with the edge of the chassis.

Chassis and shield



To assemble the chassis with the Zumo Shield, you should use the two-piece acrylic spacer plate that is included with the shield. You will not need the one-piece mounting plate that is included with the Zumo chassis.

10. Place an M3 nut in each of the two side slots near the rear of the chassis. The slots are sized so that nuts will not be able to rotate within them. (These nuts will be used to mount the idler sprockets later.)
11. If you want, peel the protective paper masking off both sides of the acrylic spacer plate pieces (the spacer plates in our pictures show what they will look like with the masking peeled off). Alternatively, you can leave the masking on for additional thickness. If you leave the masking on, it will be mostly concealed when the robot is fully assembled.
12. Cover the chassis and motors with the spacer plate pieces and then the Zumo shield. The holes in the spacer plate should line up with the through-holes in the shield resting on top of it, and the motor leads should be aligned so they pass through the slots in the spacer as shown in the picture below. There is only one correct orientation for these plates. (The plate consists of two separate pieces to make it possible to disassemble the Zumo without having to desolder the motors or battery terminals.)



13. In each of the four mounting holes, insert a #2-56 machine screw through the shield, spacer plate, and chassis, and tighten it against a nut under the chassis. It is usually easier to place the nut into the recess first and hold it there with a finger or piece of tape while inserting the screw. Note that the kit includes two

different sizes of #2-56 machine screws: 1/4" and 5/16". The two longer screws are intended for use in the front holes (near the motors) if you are also mounting a sumo blade; otherwise, you can use the shorter 1/4" screws for all four mounting holes.

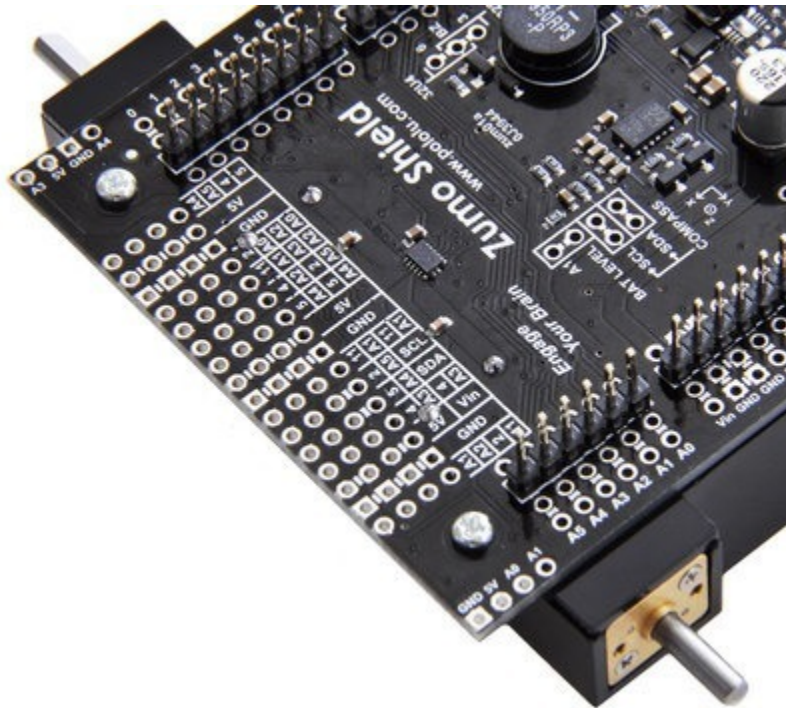
If you are also adding a basic sumo blade, you can either mount it now or add it later after you are done soldering the motors and battery contacts. (**Note:** If you intend to solder anything to the front expansion area of the shield, such as a Zumo reflectance sensor array, you will have more room to work if you do the soldering before adding the sumo blade.)

Note: There is a small chance the mounting tabs of the blade can cause shorts where it contacts the shield if the PCB solder mask is not thick enough, so we recommend adding some electrical tape or other insulating material between the blade and shield.

To install the blade, first bend its mounting tabs to the appropriate angle. Next, place them on top of the shield so that the holes line up with the two front mounting holes and insert the two *longer* (5/16") #2-56 machine screws (included with the shield) through the blade, shield, spacer plate, and chassis. Be careful when adjusting the angle of the sumo blade while it is mounted to the chassis, as this can crack the acrylic spacer plate if you apply sudden or excessive force. We recommend you do not try bending the blade while it is mounted to the chassis.

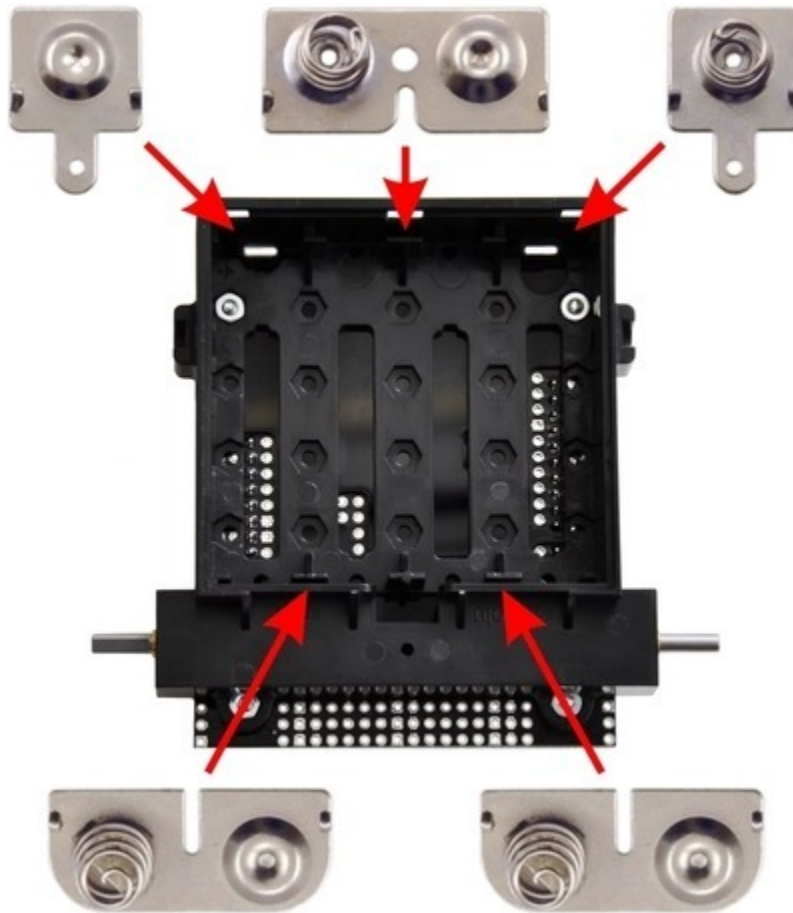


14. Solder each motor lead to the shield, then trim off the excess length of wire.

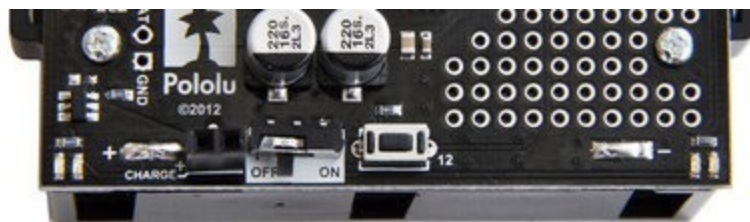


Battery contacts

15. Turn the chassis over and install the battery terminal contacts as shown in the picture below. The three double-contact pieces should be firmly pressed into place until they are flush with the interior surface of the battery compartment. The two individual contacts should be inserted into the battery compartment so that their solder tabs protrude through the holes in the top of the chassis; you might want to temporarily tape these two individual contacts in place until they have been soldered to the shield as described in the next step, or you can use a battery to temporarily hold them in place.



16. Solder the two individual contacts to the shield from the top. Note that if you are using a battery to hold the contact in place during soldering, the battery might act as a heat sink, making it more difficult to solder or requiring a higher soldering iron temperature. The battery terminal slot in the PCB should be completely filled with solder as shown in the picture below.

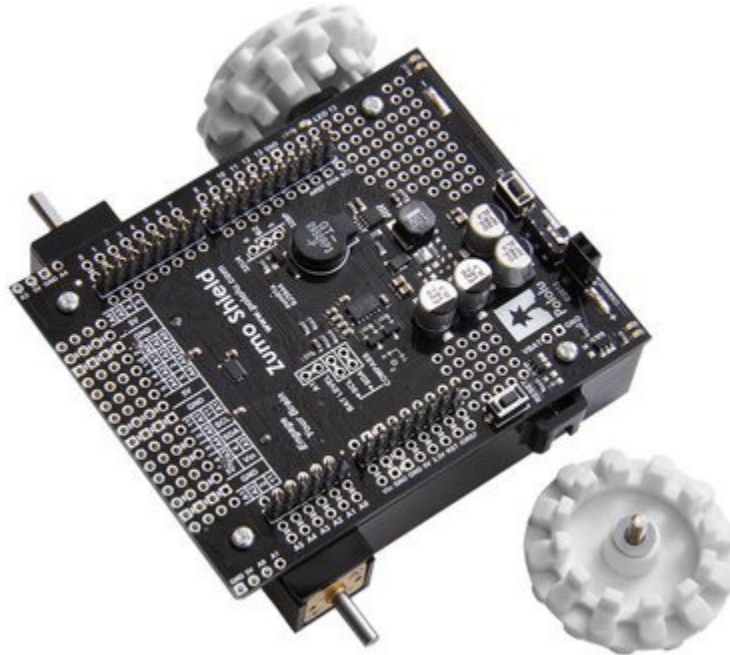


Sprockets and track

17. Place an idler sprocket on each shoulder bolt, followed by a washer. The side of the sprocket with “teeth” should face the same direction as the threaded end of the bolt, so that the teeth end up pointing in towards the chassis.

18. Insert the shoulder bolts through the side of the chassis into the nut. Use a 3 mm hex key (Allen wrench) to tighten the bolts until the washers are snug against the chassis. Be careful not to overtighten the

shoulder bolts as doing so can bend the washers. **Note:** Be careful if you use threadlocking adhesives like Loctite as these can corrode the chassis. You should first test any such adhesives on a concealed part of the chassis to ensure they will not damage it.



19. Press the output shafts of the motors into the drive sprockets, with the “teeth” of the sprockets facing the motor. The end of the gearbox shaft should end up flush with the outside of the sprocket. A good way to accomplish this is to set the wheel on a table top and press the motor shaft into the wheel until it contacts the table.

20. At this point, you can add the silicone tracks by stretching them around the sprockets on each side of the chassis. Your Zumo Shield and chassis are now complete; just add batteries and an Arduino to get your Zumo robot moving!



Disassembly

If you later decide you want to solder additional parts to the Zumo Shield, it is possible to remove it from the chassis with some careful effort.

1. Remove the tracks from the chassis and carefully pull the drive sprockets off the motors.
2. Remove the battery cover and batteries from the chassis.

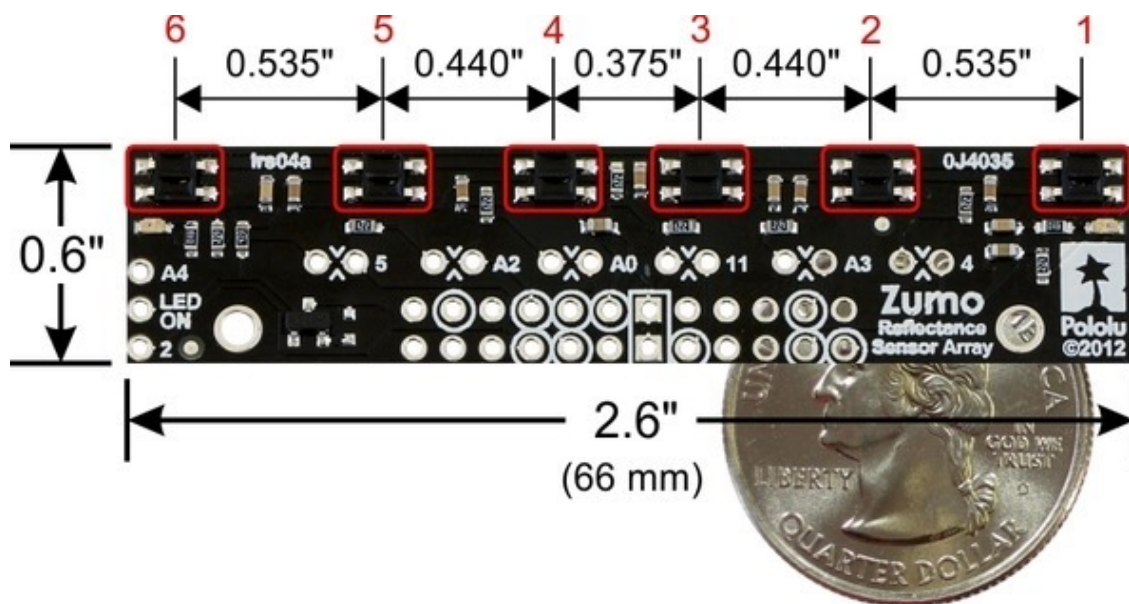
3. Unscrew all four sets of machine screws and nuts holding the shield to the chassis.
4. Squeeze the negative battery terminal spring and gently ease both battery terminals out through the holes in the chassis. The motors will stay attached to the shield as it separates from the chassis.
5. Carefully bend both motors away from the shield to allow the front piece of the spacer plate to be removed.

You can reassemble the Zumo afterwards by following this procedure in reverse. (Make sure to replace the spacer plate pieces properly.)

2.c. Adding a Zumo reflectance sensor array (optional)

Overview

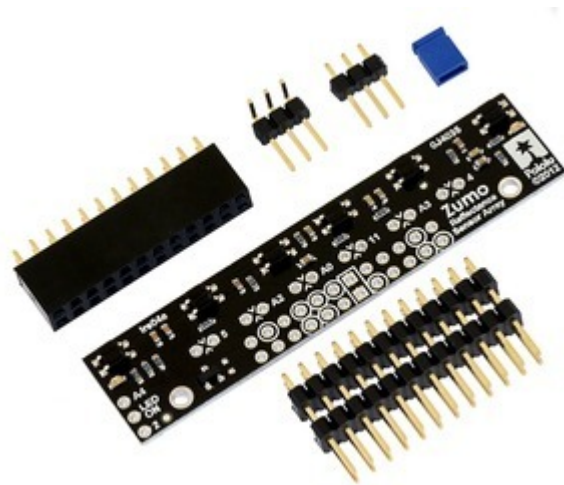
The **Zumo reflectance sensor array** [<https://www.pololu.com/product/1419>] is an easy way to add line-following and edge-detection capabilities to the Zumo robot. It is designed specifically to mount to the front expansion area of the Zumo shield, and it includes everything you need for installation. Note that the reflectance sensor array is not included with the Zumo shield or Zumo Robot Kit, and the Zumo robot can be used without it. For more information on the Zumo reflectance sensor's capabilities and how it works (including a schematic diagram), please see its **product page** [<https://www.pololu.com/product/1419>]. This section is devoted specifically to assembling the sensor and using it with the Zumo shield.



Assembling the sensor array

The Zumo reflectance sensor array ships with all of the components you need to connect it to a Zumo shield:

- sensor array PCB with the surface-mount parts pre-populated
- 2×12 extended 0.1" male header (will be soldered to sensor PCB)
- 2×12 0.1" female header (will be soldered to Zumo shield)
- 1×3 0.1" straight male header (optionally soldered to sensor PCB)
- 1×3 0.1" right-angle male header (optionally soldered to sensor PCB)
- blue shorting block



Before soldering in the main male header strip, we recommend soldering one of the two included 1×3 male headers into the set of three holes along the edge of the board. This step is optional but recommended because it allows dynamic control of the IR emitters (and red LEDs). By controlling when these LEDs are on, you can save power and make your programs easier to debug. If you skip this step, the IR emitters will just be on whenever the sensor array is plugged in and the Zumo is on. We recommend using the right-angle header mounted as shown in the picture below, but the straight 3-pin header will also work if you do not have anything already soldered to the Zumo shield's front expansion area that would interfere. If you choose to install this header, please make sure you are doing it in a way that will not prevent installation of the sensor array (e.g. by installing it on the wrong side or by installing the right-angle pins in the wrong orientation)! If you are going to install this 3-pin header, it is generally easier to do so before soldering the larger 24-pin header.

To enable dynamic control of the IR emitters, install the 3-pin header and use the included blue shorting block to connect the LEDON pin to the appropriate digital I/O pin. If you are using an Arduino **Uno** or older Arduino, you should use the shorting block to connect LEDON to **digital pin 2** (the position that puts it flush with the edge of the board); if you are using an Arduino **Leonardo** or **A-Star 32U4 Prime**, you should use the shorting block to connect LEDON to **analog pin 4 (A4)**.

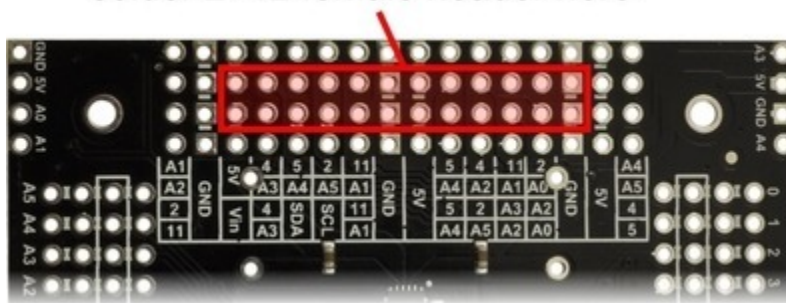


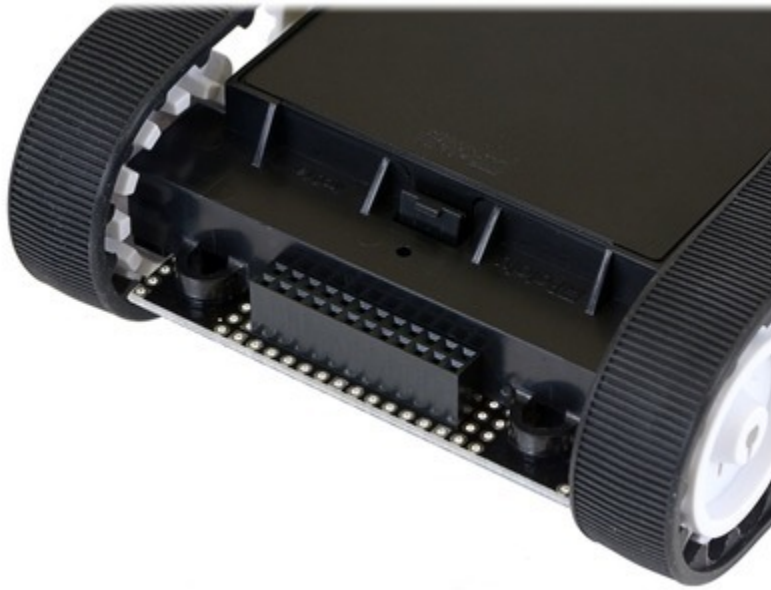
The extended 2×12 male header strip should be mounted to the sensor array PCB on the opposite side from the components. Make sure you solder the shorter side of the pins to the PCB, not the longer side! Note that only 12 of the 24 pins are actually used by the sensor array; these pins have silkscreen circles around them on the component side of the board, and these are the only pins that need to be soldered, though it is fine to solder all 24 pins.

Connecting to the Zumo shield

The 2×12 female header included with the reflectance sensor array should be soldered to the front expansion area of the Zumo shield so that it is centered in the expansion area and flush with the Zumo chassis (rows 2 and 3). While it is fine to solder all 24 pins to the shield, only the 12 pins required by the reflectance sensor array need to be soldered (see the *Array pinout* section below for more information on which pins are required).

solder 2×12 female header here





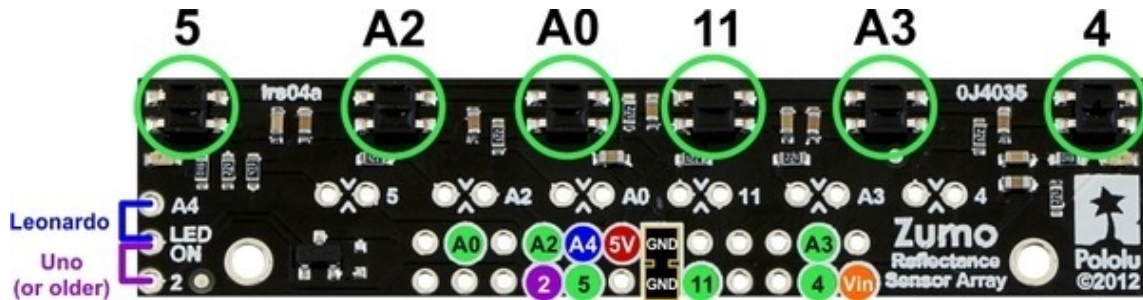
With the female header in place, the assembled sensor array can be plugged directly into the Zumo shield.



The reflectance sensor array features two visible (red) LEDs in series with the IR emitter LEDs, so you can use the red LEDs to tell when the emitters are on and off.

Array pinout

The Zumo reflectance sensor array gets all the necessary power and I/O connections from the 12 header pins that are circled on the silkscreen:



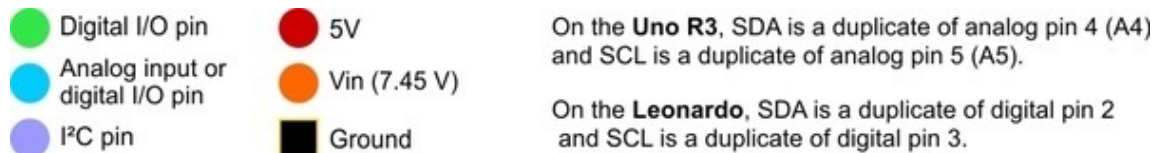
The default I/O connections are to pins that are otherwise unused by the Zumo shield. The shield uses one digital I/O pin for each sensor (5, A2, A0, 11, A3, and 4), and if you add the LEDON shorting block, one additional pin (either A4 or 2) is used. To configure the **ZumoReflectanceSensorArray** library [<https://www.pololu.com/docs/0J57/6>] to use this default pinout, simply call `init` with no arguments:

```
reflectanceSensors.init();
```



If you opt to leave off the LEDON shorting block, you should use the `QTR_NO_EMITTER_PIN` initialization parameter: `reflectanceSensors.init(QTR_NO_EMITTER_PIN)`. Otherwise, the library code will still be trying to do something with the emitter pin (A4 or 2, depending on which Arduino you are using), and this would interfere with your being able to use that pin for alternate purposes.

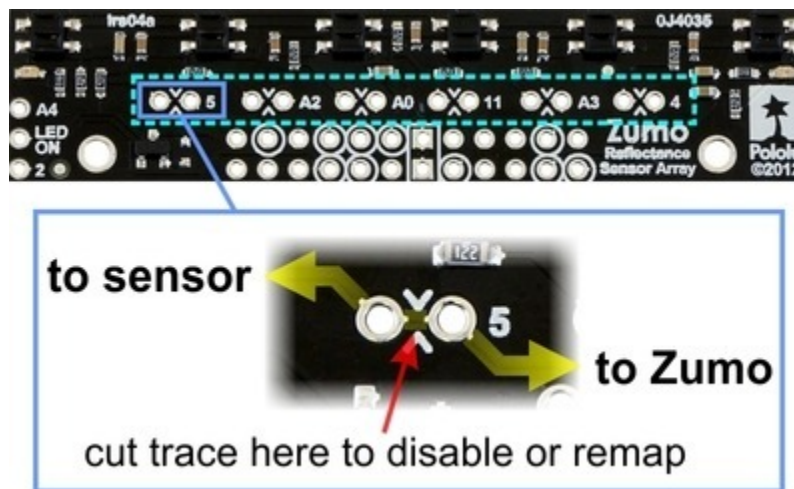
When soldering the male 2×12 header to the sensor array, you only need to solder those pins that you will be using. If you solder all 24 pins, the sensor array will be connected to additional pins from the Zumo shield's front expansion area, though the array does not do anything with them in its default configuration:



Disabling or remapping sensors

Many applications do not require all six reflectance sensors, and you might want additional I/O lines for other things (e.g. obstacle detectors). In such cases, you can disable specific sensors and free up their associated I/O lines. The array PCB has six pairs of through holes, each of which corresponds to a different sensor. The order of the pairs matches the order of the sensors. When viewing the component side of the PCB, the right hole of each pair connects to an Arduino I/O line and the left hole connects to sensor. There is a single trace on the component

side of the PCB between the two holes of each pair, and this trace can be cut to disable the sensor and free up the I/O line. The proper place to cut is marked on the silkscreen by carets.



For example, if you want to use your Zumo for solving a line maze, you can likely get by with just four sensors: you can use the middle two sensors for tracking the line and the outer two sensors for detecting intersections. To free up the I/O lines associated with the other two sensors, you could make the following modification:

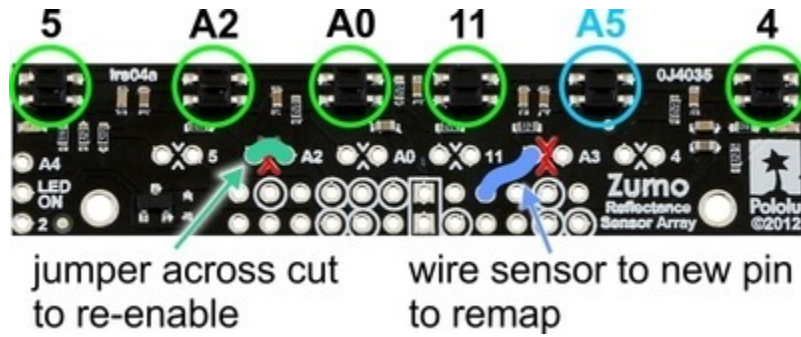


Now you effectively have a four-sensor array and analog pins A2 and A3 are available for general-purpose use. To configure the ZumoReflectanceSensorArray library to use this new configuration, call `init` with these arguments:

```
byte pins[] = {4, 11, A0, 5};
reflectanceSensors.init(pins, 4);
```

Alternatively, you could make two ZumoReflectanceSensorArray objects, one for the two exterior sensors and another for the two interior sensors, which might allow for cleaner code, but the drawback is that you can no longer read all four sensors in parallel with this approach.

If you later decide you want to re-enable those sensors, you can connect across the cut trace with a wire, or you can use a wire to remap the sensor to a different pin. The following example shows how you could re-enable the A2 sensor and remap the A3 sensor to pin A5 instead:



To configure the `ZumoReflectanceSensorArray` library to use this remapped configuration, call `init` with these arguments:

```
byte pins[] = {4, A5, 11, A0, A2, 5};  
reflectanceSensors.init(pins, 6);
```

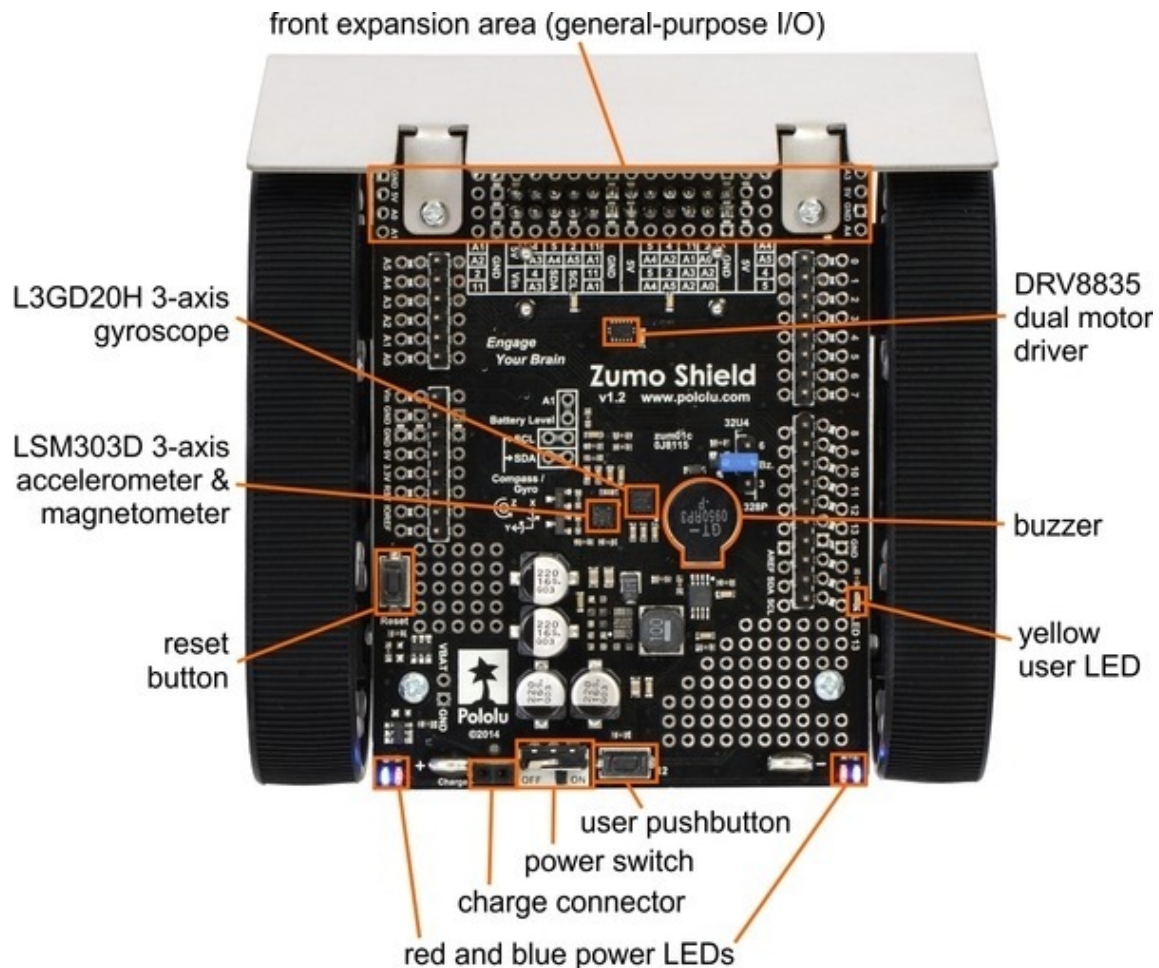
Or, if you are not using an I/O line to control the IR emitters:

```
byte pins[] = {4, A5, 11, A0, A2, 5};  
reflectanceSensors.init(pins, 6, 2000, QTR_NO_EMITTER_PIN); // 2000 = timeout after 2 ms
```

3. The Zumo Shield in detail

3.a. Features and components

The main features of the Zumo Shield (v1.2) are labeled in this diagram:



For the original Zumo Shield, a corresponding [diagram \[https://www.pololu.com/file/download/zumo-shield-v1.0-labeled-components.jpg?file_id=0J810\]](https://www.pololu.com/file/download/zumo-shield-v1.0-labeled-components.jpg?file_id=0J810) (206k jpg) is available (the only differences are the on-board inertial sensors).

Power

The Zumo chassis has an internal compartment for four AA batteries. We recommend using rechargeable **AA NiMH cells** [<https://www.pololu.com/product/1003>], which results in a nominal voltage of 4.8 V (1.2 V per cell). You can also use alkaline cells, which would nominally give you 6V.

A direct connection to the battery terminals is provided by the battery charger connector on the rear edge of the shield, which can be used to recharge the Zumo's batteries without removing them from the chassis. The positive pin of the charge connector, on the left, is indicated by a plus sign (+). A charger like the **iMAX-B6AC** [<https://www.pololu.com/product/2588>], connected by clipping its alligator clips to a pair of jumper wires inserted into the charge connector, works well for charging the Zumo.