



Texas Instruments Robotics System
Construction guide



TEXAS INSTRUMENTS



Construction guide

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Assembly guide



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Section I Assembly guide

This section will cover the basic assembly of the parts associated with the TI-RSLK MAX Robot. You will also learn how to install the TI MSP432 LaunchPad on the robot.

1.0 Needed Items

The following items included in your kit (Figure 1) will be needed to construct the TI-RSLK Max:

- One Romi chassis plastic base plate (black) with the TI-RSLK chassis board and battery installed
- One right and one left bumper assembly, along with four nuts and four 7/16th inch long bolts
- One 8-channel QTR reflectance sensor array
- Two Romi chassis motor clips
- Two Romi gear motors with encoders
- Two Romi wheels with tires
- One Romi ball caster kit
- One TI MSP432P401R LaunchPad development with the required headers (2x19 and 2x1) attached

You will also need a Phillips head screwdriver, which is not included in the kit.



Figure 1. Needed items shown above



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1.1 Installment of the two bumper switch boards

The following steps will be used to show how to install the two bumper switch boards at the front (curved) end of the TI-RSLK Max. For this step, you'll need the left and right bumper switch boards and a set of two 7/16" bolts and two nuts for each board as shown in Figure 2.

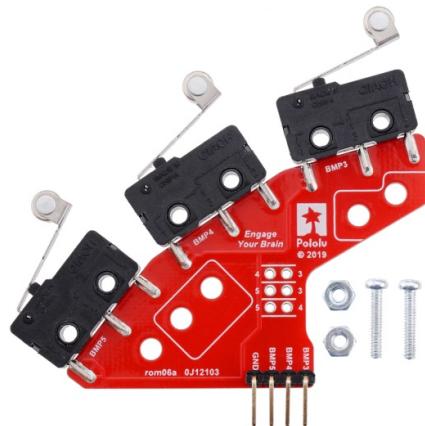
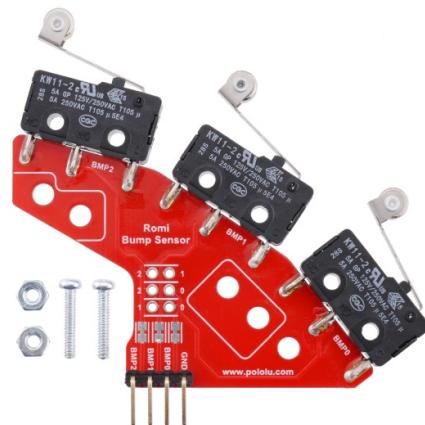


Figure 2. Required parts to install the left and right bumper



switch boards

Each bumper switch board has a 4-pin male header that needs to be inserted horizontally into a corresponding 4-pin female header on the

front, curved end of the TI-RSLK. These female headers can be found on the underside of the chassis board at the edge of the curved end see (Figure 3).

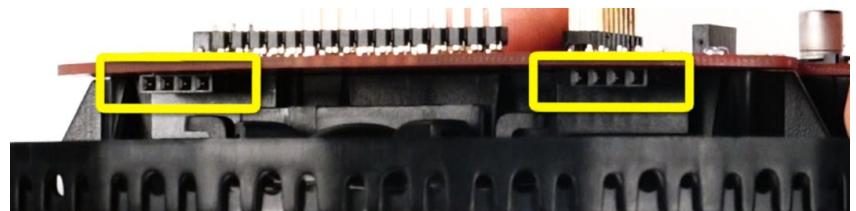


Figure 3. Location of the female headers for the bumper switch boards

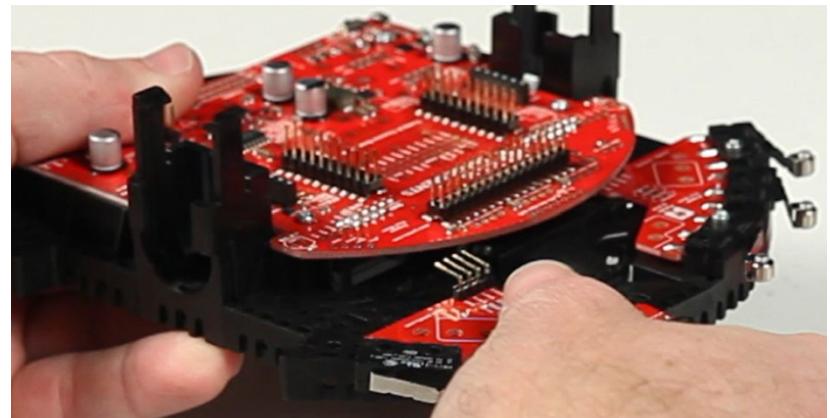


Figure 4. Insertion of bumper switch board into female header as shown in Figure 3



Construction guide

Next secure the bumper switch boards to the plastic chassis using the four 7/16" bolts and nuts. The required holes for these bolts are shown in Figure 5. Please note that we recommend inserting the bolts from the underside of the chassis rather than the top, unlike what is shown in Figure 5.

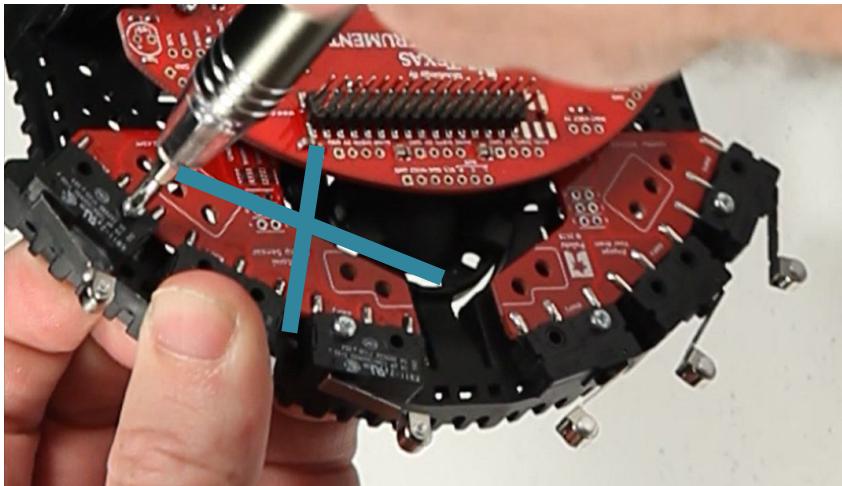


Figure 5. Location of holes to secure the bumper switch boards.

We recommend inserting the bolts for easier tightening of the screw due to the front lip of the chassis side.



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1.2 Installing the motor clips

The following steps will show you how to install the motor clips to the plastic chassis. This step should be done before inserting motors otherwise it will not fit. The motor clips are identical, so they can be installed on either side of the board.

The motor clips must be installed from underneath the chassis with the motor retaining barbs facing upwards. You'll notice that there are grooves in the plastic chassis and guide rails on the motor clips that will only allow you to orient and install the clips in one direction (Figure 6).

With the motor clip aligned with the grooves as just instructed, push the motor clip all the way up into the plastic base plate. You may hear clicks along the way, but it is not fully secured and correctly installed until the bottom of the motor clip is flush with the bottom of the plastic chassis plate (Figure 7). **Please double check this.** If the motor clip is not fully secured with the inner barb over the top of the plastic chassis plate, then you risk breaking this barb when you insert the motor.



Figure 6. View showing both sides of the motor clips and the 3 barbs and guide rails.

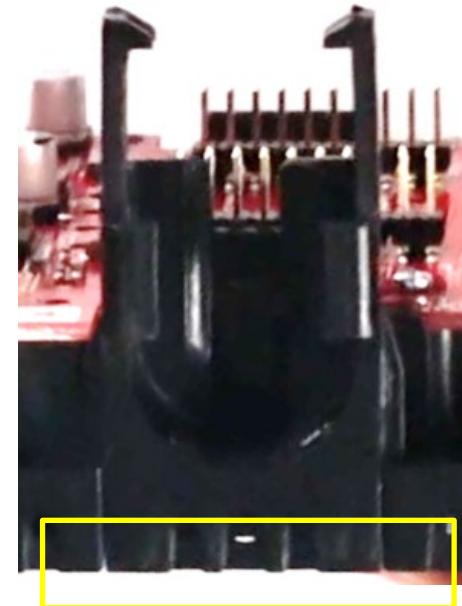


Figure 7. Motor clip is fully installed when the bottom is flush with the plastic chassis



Construction guide

1.3 Motor installment

The following steps will be used to show how to properly insert both motors into the motor clips. The motors are identical so either motor can be placed on either side of the board.

Align the motor assembly such that the motor's circuit board and pins point towards the chassis board and the metal motor shaft points outwards and away from the robot (Figure 8).

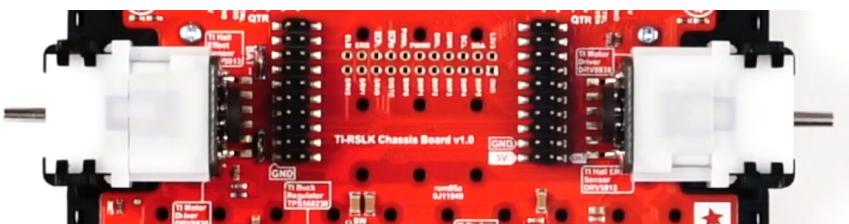


Figure 8. Picture showing properly motor alignment and black plastic barbs holding the motors in place.

Once aligned, begin to insert the motor into the motor clips by gently spreading apart the black plastic retaining barbs. Before pressing the motor down, ensure that the motor is aligned evenly within the motor clip and ensure that the pins of the header are properly aligned with the connector on the chassis board (Figure 9).

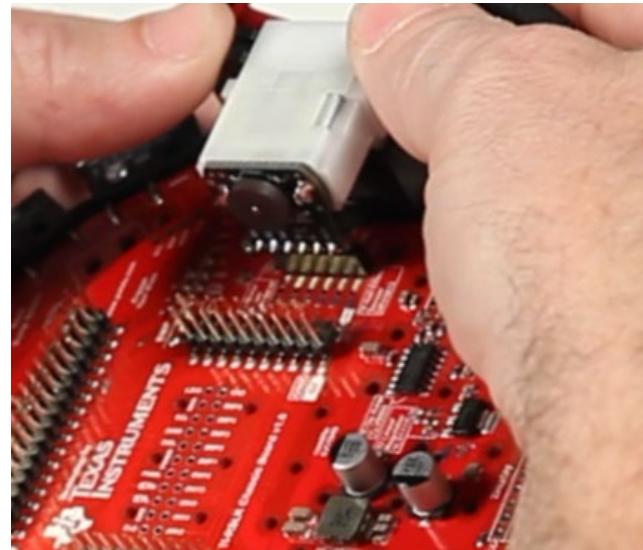


Figure 9. Ensure the motor is straight and pins are aligned before pressing down firmly.



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1.4 Tire and wheel installment

The following steps will be used to show how to assemble the tires onto the wheels and insert the wheel assembly onto the motors. The rubber tires first need to be installed onto the wheels as shown in Figure 10. This can be a challenging exercise since the tires must be stretched greatly to fit onto the wheels.



Figure 10. Tires properly installed onto the wheels. Notice the “D” shaped hole in the center of the wheel.

Before installing the wheels, please notice the “D” shaped hole in the center of the wheel. This shape aligns with the “D” shaped metal motor shaft on the motor assembly. Also notice that the plastic immediately surrounding the “D” shape on the wheel protrudes out on one side, while the other side is flat. The protruding side of the wheel should face the robot to create space away from the robot chassis and reduce any possible friction.

With the protruding end of the wheel pointing towards the robot, align the “D” shapes on the wheel and motor shaft, and then begin pressing the wheel onto the motor. It may require significant force to press the wheel fully onto the motor shaft while ensuring proper alignment. One technique to apply the required force is to put the chassis on its side and press the chassis down against the table to insert the wheel fully onto the motor shaft (Figure 11).

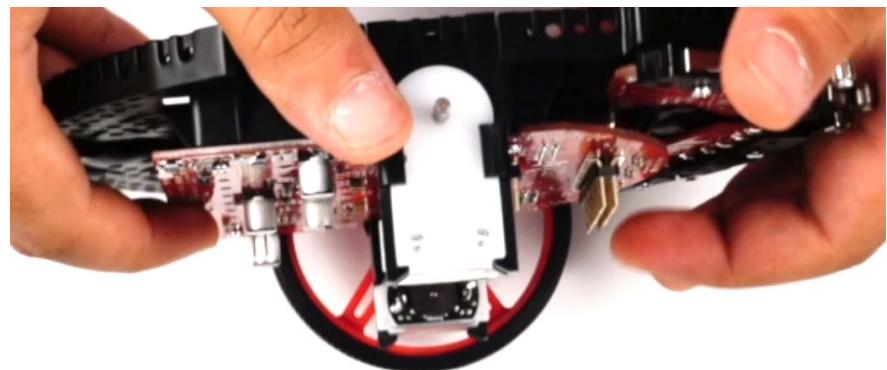


Figure 11. Applying force to insert the wheel onto the motor shaft



Construction guide

1.5 Ball caster installment

The following steps will be used to show how to assemble the ball caster (Figure 12) onto your robot.



Figure 12. Ball caster components

From the underside of your robot, notice that there are two locations where you can install a ball caster. We will use the location on the opposite end from where you installed the bumper switches (Figure 13). Once the batteries are installed, there will be more weight on the back of the robot to force it down, which is why this location has been chosen.

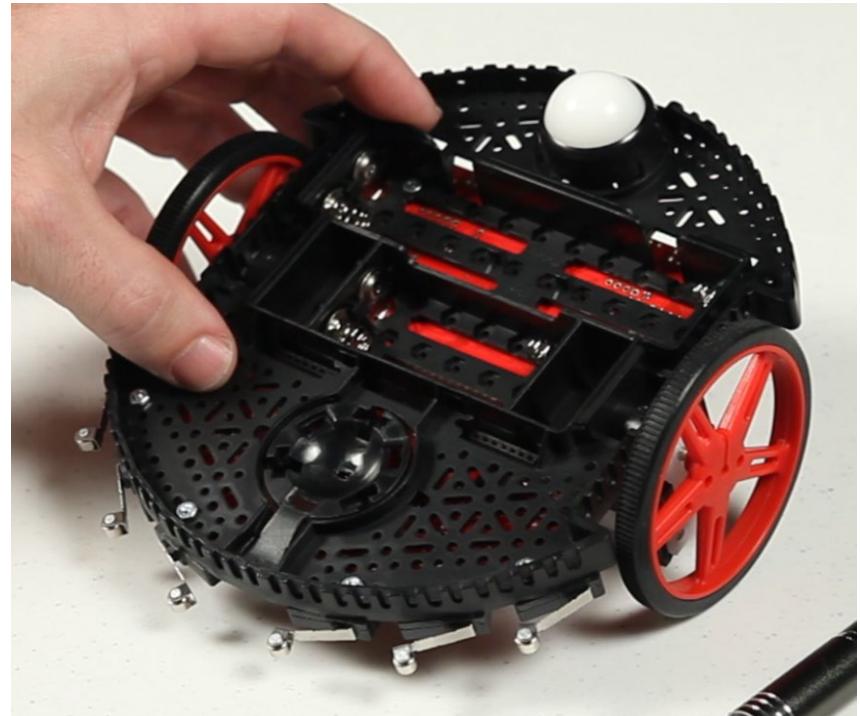


Figure 13. Proper location of ball caster



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The three rollers will then be installed so that the shafts rest in the plastic grooves and the larger wheel portion of the rollers are free to spin (Figure 14)

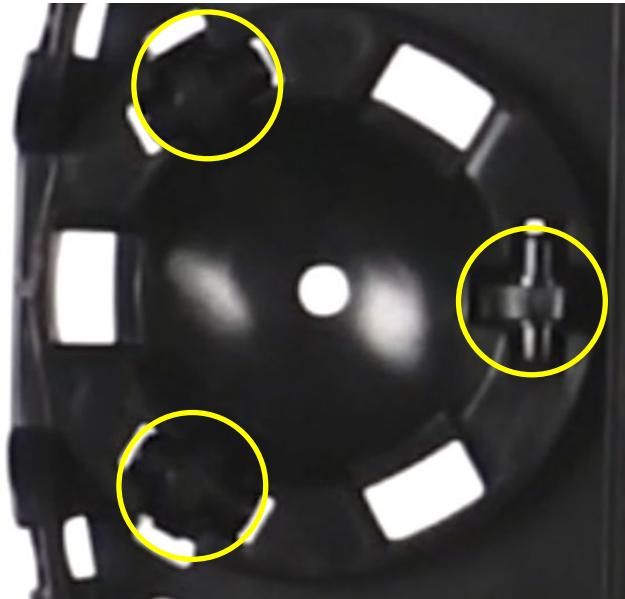


Figure 14. Location and orientation of the rollers

Now place the ball onto these rollers. Install the retention clip over the ball by pressing the three barbs of the retention clip (Figure 12) into the holes shown in Figure 15.

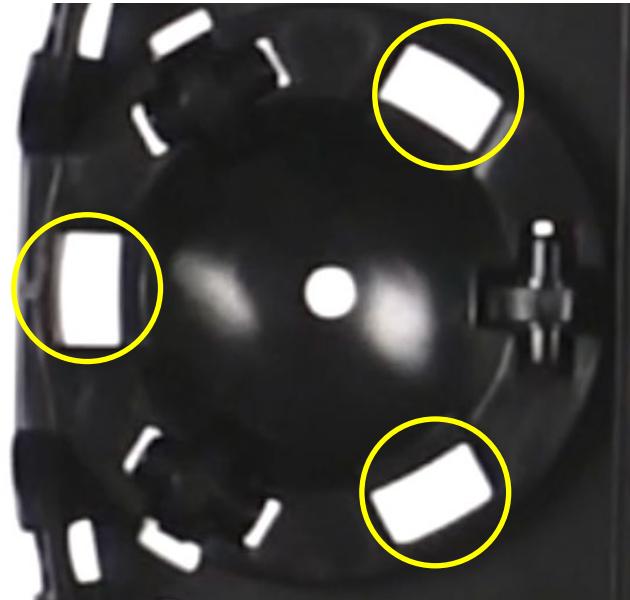


Figure 15. Location of the holes for the roller ball retention clips

When finished, the ball caster assembly should look like Figure 13 and the ball caster should spin with minimal effort.



Construction guide

1.6 The 8 channel QTRX line following sensor installment

The following steps will show you how to install the 8-channel QTRX line following sensor (Figure 16) to the underside of your TI-RSLK Max.



Figure 16. QTRX line following sensor

First identify the two 1x7 female headers on the underside of your chassis, directly next to the smaller side of the battery compartment (Figure 17).

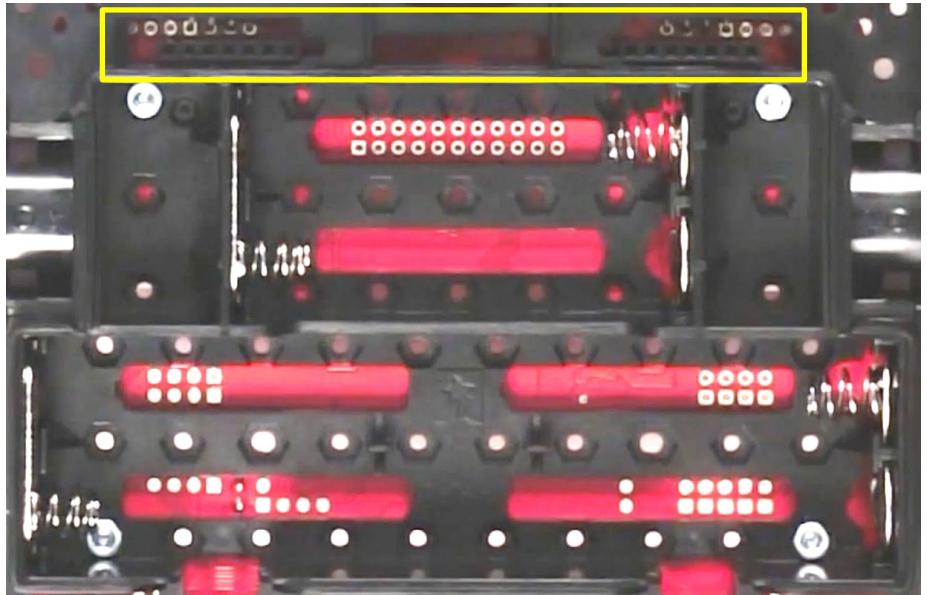


Figure 17. Location of two 1x7 female headers for the QTRX line following sensor



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Next, insert the pins of the QTRX sensor into these headers, making sure the bulk of the QTRX sensor board faces towards the front of the robot, towards the bump switches and away from the battery compartment (Figure 18).



Figure 18. Insert the QTRX sensor with the largest part of the board facing the front of the robot



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1.7 MSP432P401R LaunchPad installment

The following steps will describe how to install the LaunchPad onto your TI-RSLK Max robot. The LaunchPad should already have the 2x19 and 2x1 headers installed as shown in Figure 19. If not installed, please refer to the instructions for installing these headers at www.ti.com/rslk.

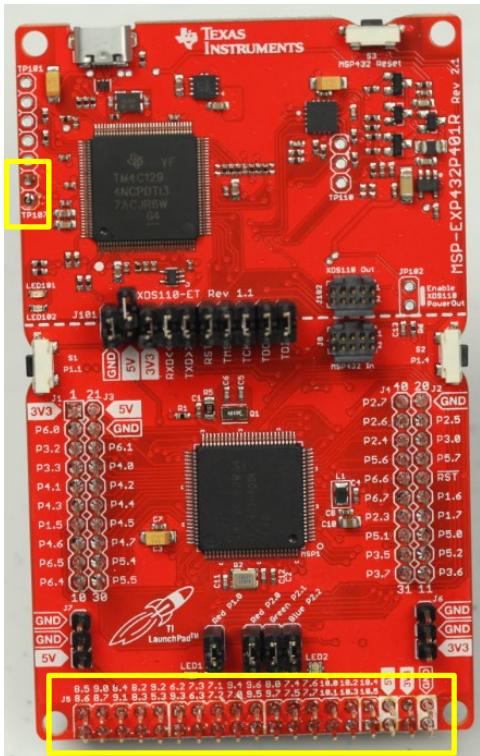


Figure 19. MSP432P401R LaunchPad with 2x19 and 2x1 headers installed

IMPORTANT: The 5V jumper in the middle of the MSP432P401R LaunchPad must be removed before installing it onto the chassis board. You will damage the robot if this 5V jumper isn't removed.



Figure 20. MSP432P401R LaunchPad with 5V jumper removed



Construction guide

Next identify the four mating headers on the TI-RSLK Max chassis board (Figure 21).

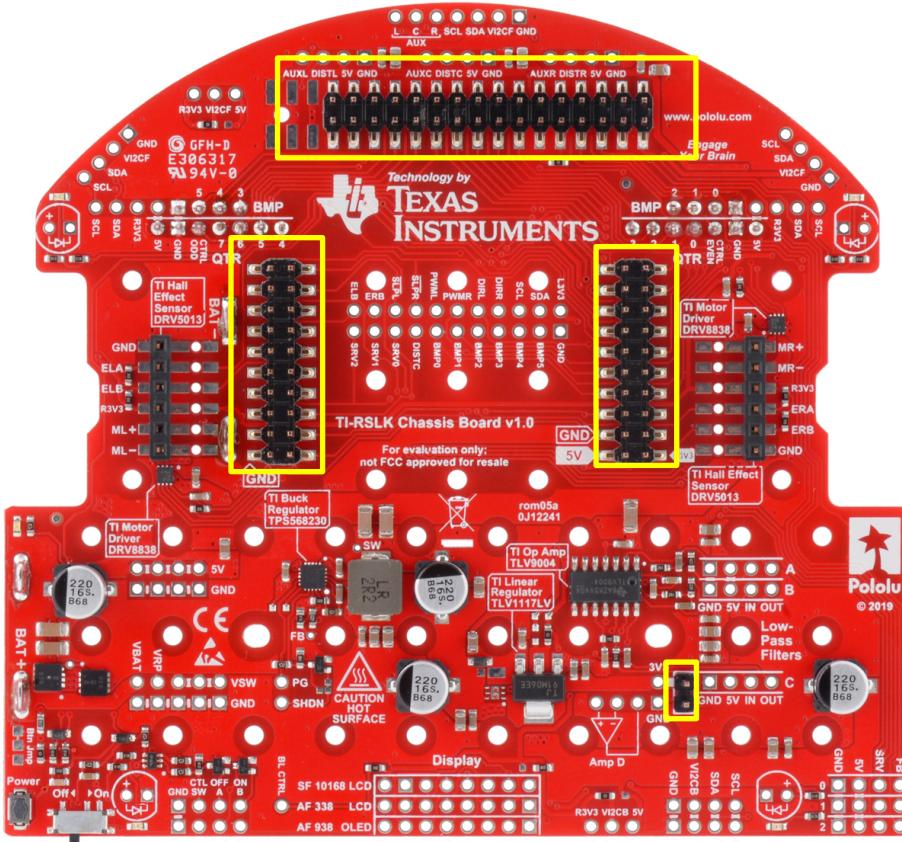


Figure 21. The four LaunchPad connectors on the TI-RSLK Max chassis board

Carefully place and align the LaunchPad onto these header pins and press down evenly, being careful not to bend or break any of the header pins (Figure 22).

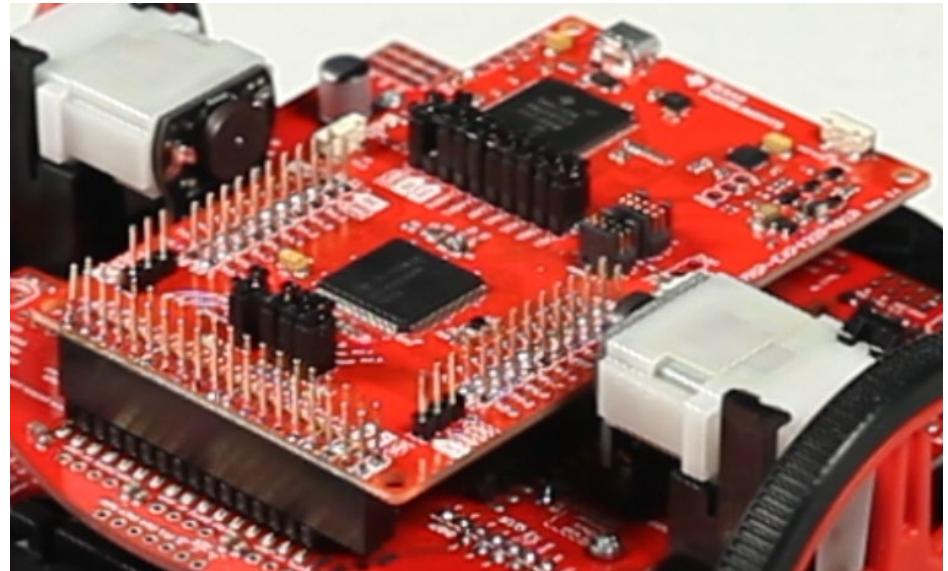


Figure 22. LaunchPad connected to the TI-RSLK Max chassis board headers



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1.8 Install six AA-sized batteries into the battery compartment

When you're ready to power up the TI-RSLK Max for the first time, the last step (Figure 23) will be to install six AA-sized batteries into the battery compartment.



Figure 23. Remove battery compartment cover to install six AA-sized batteries

Final Product

Congratulations! You've finished assembling your TI-RSLK Max!

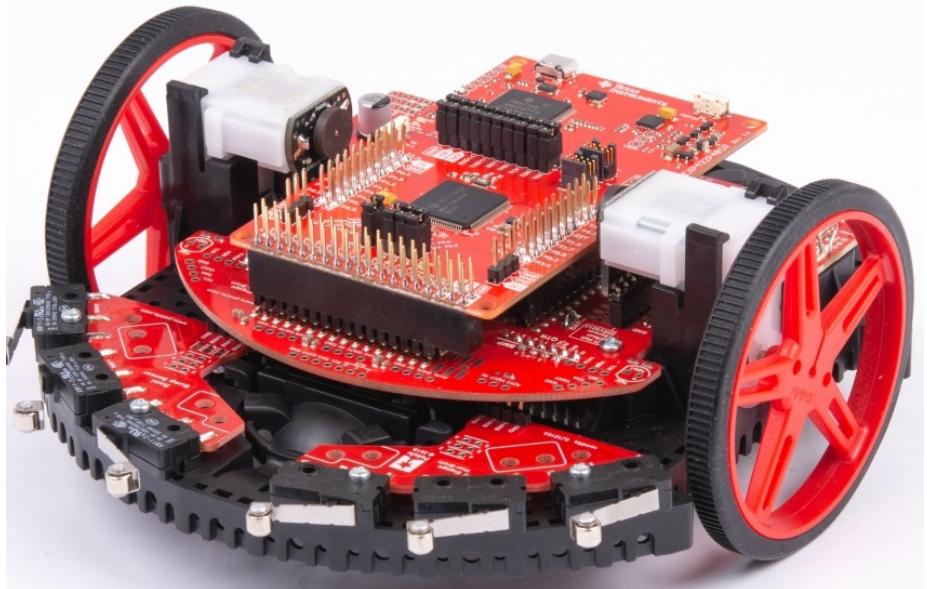


Figure 24. Final Product image



LaunchPad Preparation
(not needed if you purchased the kit)



Construction guide

Section II LaunchPad preparation

This section will cover how to prepare the MSP432P401R LaunchPad for use on the Texas Instruments Robotic Systems Learning Kit, also known as the TI-RSLK Max.

2.0 Needed Items

To follow along with this section, you'll need the following:

- One TI MSP-EXP432P401R LaunchPad board
- One 2x19 female-to-male header
- And one 2x1 female-to-male header
- Soldering iron
- Solder

Both of the headers mentioned above can be found by going to www.ti.com/rslk.



Figure 1. Needed Items

2.1 Install 2x19 header onto the LaunchPad

Insert the 2x19 header into the corresponding set of 2x19 vias at the far edge of the LaunchPad board, marked as J5 (Figure 2). The header pins need to be inserted from the underside of the board, similar to the other headers that are already soldered to the board. Now solder all of these pins to the board (Figure 3).

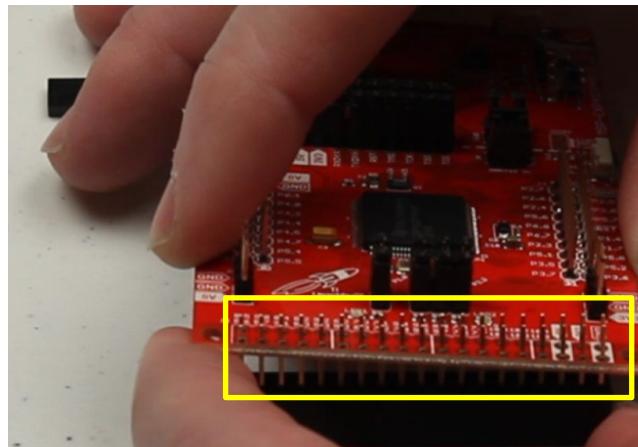


Figure 2. Insert the 2x19 header

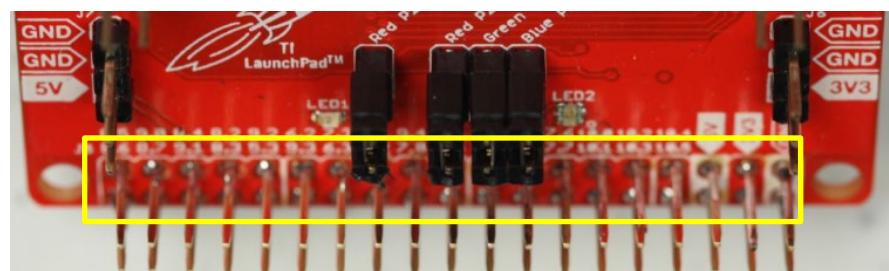


Figure 3. Solder the 2x19 header



Construction guide

2.2 Install 2x1 Header onto LaunchPad

Find the row of 7 vias by the MicroUSB connector of the LaunchPad. Insert the 2x1 header into the two vias furthest away from the MicroUSB connector, next to the via labeled as TP107 (Figure 4). The header pins need to be inserted from the underside of the board, similar to the other headers that are already soldered to the board. Now solder these pins to the board (Figure 5).

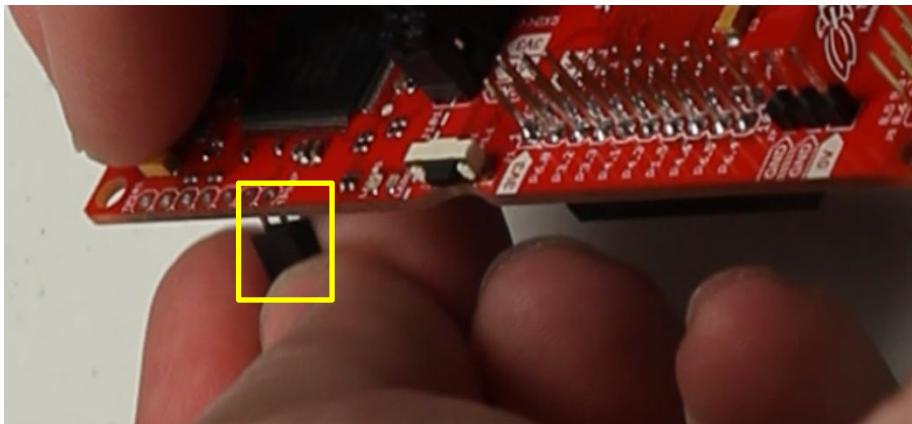


Figure 4. Insert the 2x1 header

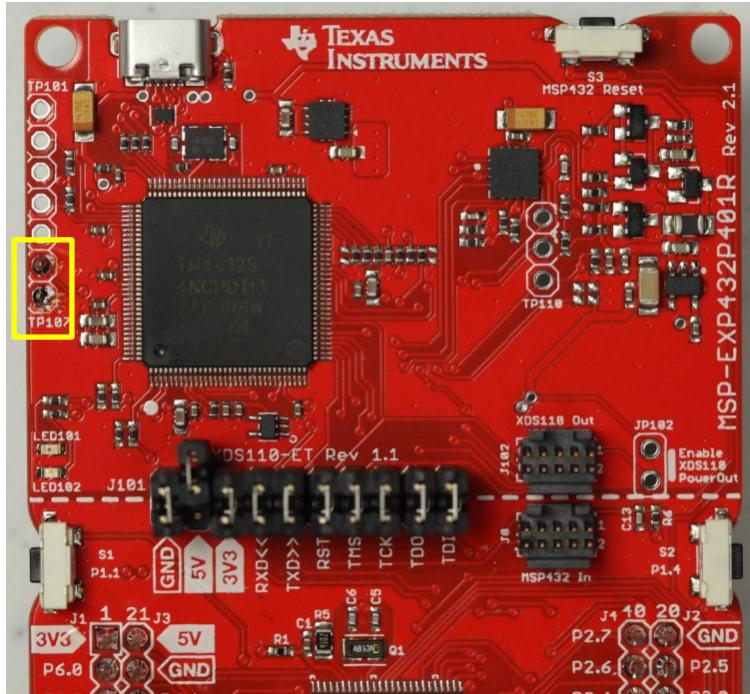


Figure 5. Solder the 2x1 header



Construction guide

2.3 Remove the 5V jumper

Lastly, it's important to remove the 5V jumper from the LaunchPad to prevent damage to the robot (Figure 6).

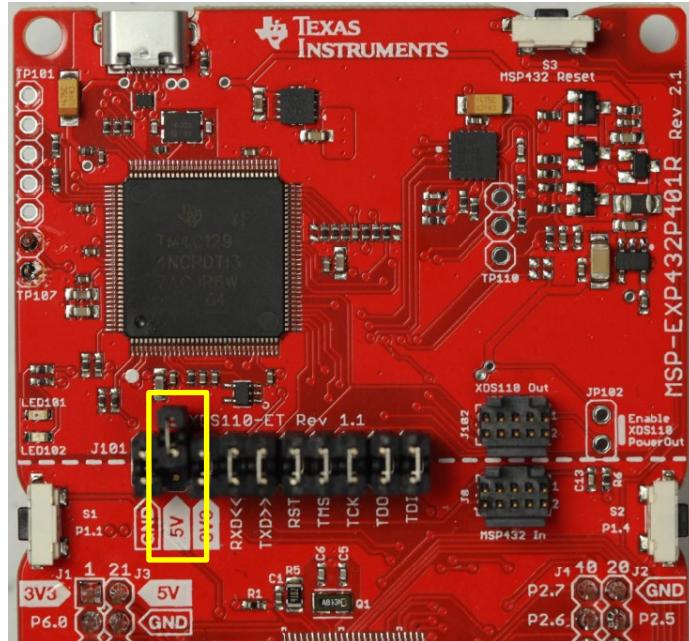


Figure 6. Remove the 5V jumper to prevent damage to the TI-RSLK Max!

Congratulations!

The LaunchPad is now ready for use with the TI-RSLK Max!



Disassembly guide



Construction guide

Section III: Disassembly guide

This section will cover the disassembly of the Texas Instruments Robotic Systems Learning Kit and show you how to separate the TI-RSLK Max into its individual components, with the primary purpose of removing the chassis board for modifications or additions.

3.0 Needed Items

Besides the TI-RSLK Max itself, you will also need a Phillips head screwdriver to disassemble the kit (Figure 1).

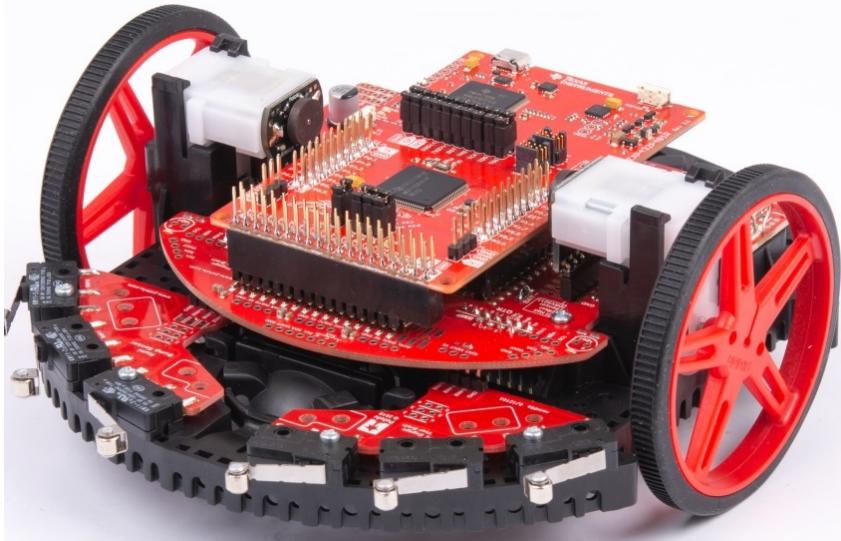


Figure 1. Needed Items

3.1 Remove batteries and QTRX line following sensor

The first step is to remove the batteries and the eight channel QTRX sensor array from the underside of the board. The sensor board will simply slide out and away from the robot chassis (Figure 2). The battery compartment will need to be removed to access the batteries by depressing the two plastic tabs located next to the location of line following sensor board (Figure 3).



Figure 2. Remove the QTRX sensor, next to the battery compartment



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Figure 3. Remove battery compartment cover to remove six AA-sized batteries

3.3 Remove MSP432P401R LaunchPad

Next, flip the robot over and remove the MSP432P401R LaunchPad mounted to the top of the robot. With a moderate amount of force, pull the LaunchPad board carefully and evenly so that the header pins of the chassis board do not get bent in the process. You may need to use a slight rocking motion to keep the force even and controlled (Figure 4).

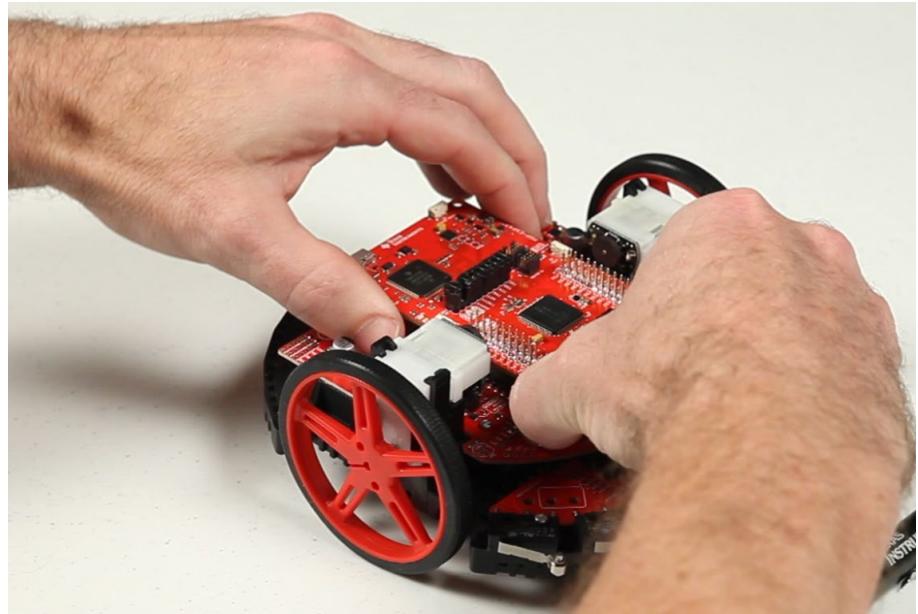


Figure 4. Remove the LaunchPad from the TI-RSLK Max chassis board



Construction guide

3.4 Remove the Motors

Now it's time to remove the motors with the wheels still attached. Pull the retaining tabs apart just enough so that the plastic motor casing is free to slide out (Figure 5) and push from the underside of the robot to disconnect the motors from the chassis board and remove (Figure 6). Repeat for the other side.



Figure 5. Pull the retaining tabs apart, just beyond white plastic motor casing

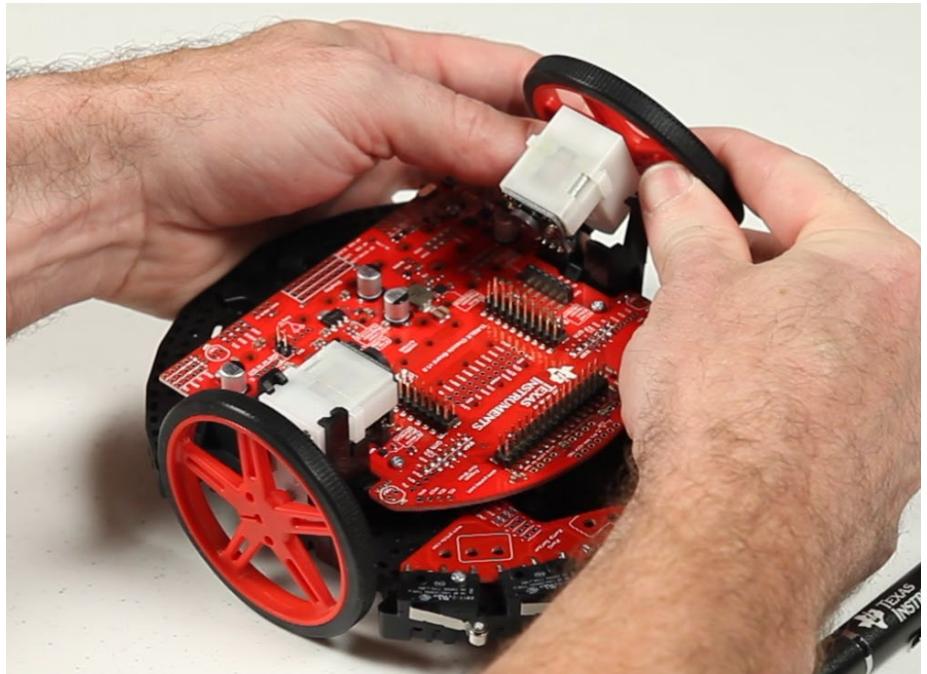


Figure 6. Push motor from underside of robot to remove



Construction guide

3.5 Remove the two bumper switch boards

From the front of the robot, remove each bumper switch board by first unscrewing the 2 bolts with nuts holding it in place (Figure 7). Next, slide the board out to disconnect it from the header (Figure 8).

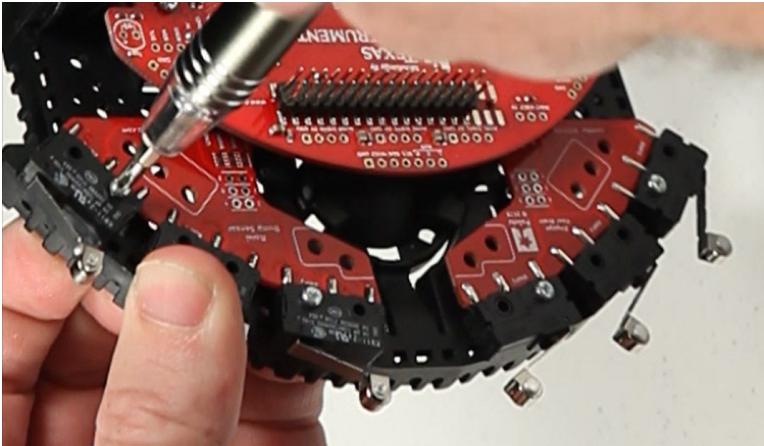


Figure 7. Unscrew two sets of bolts to remove both bumper switch boards

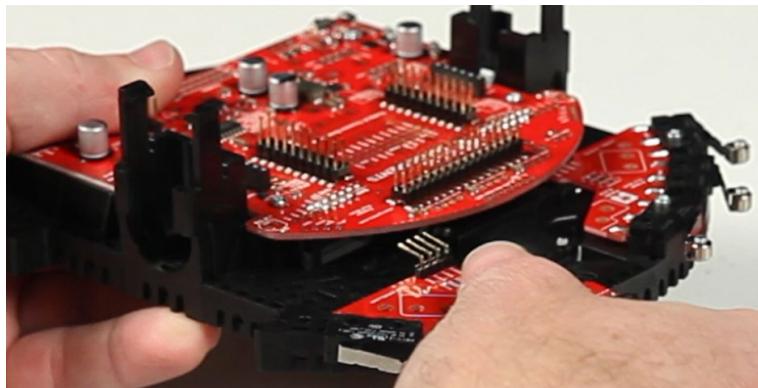


Figure 8. Slide the bumper switch board forward and away from robot to remove

3.6 Remove the chassis board

Lastly, flip the robot over and open up the battery compartment. You will need to remove the four bolts securing the chassis board onto the plastic chassis (Figure 9) while inserting your finger into the battery compartment to force the nut to stay within the plastic recess to keep it from spinning (Figure 10).

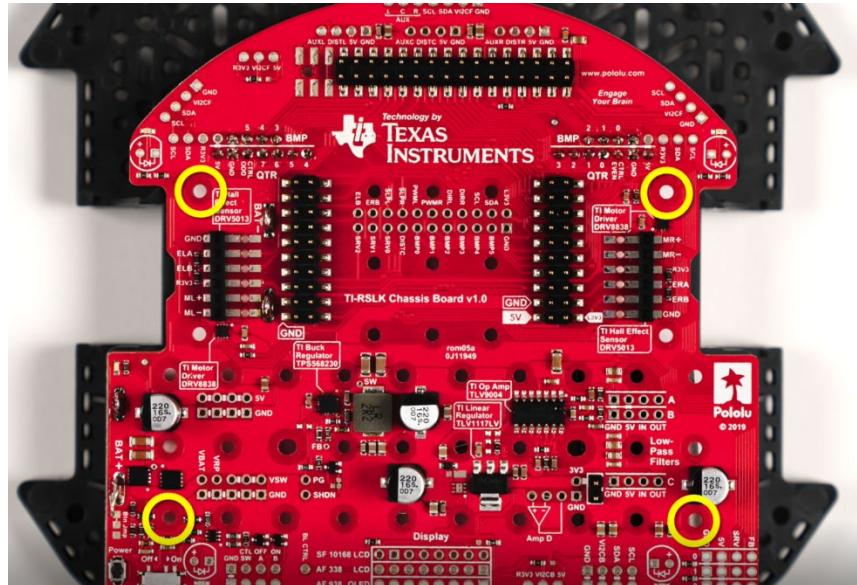


Figure 9. Location of four bolts securing the chassis board



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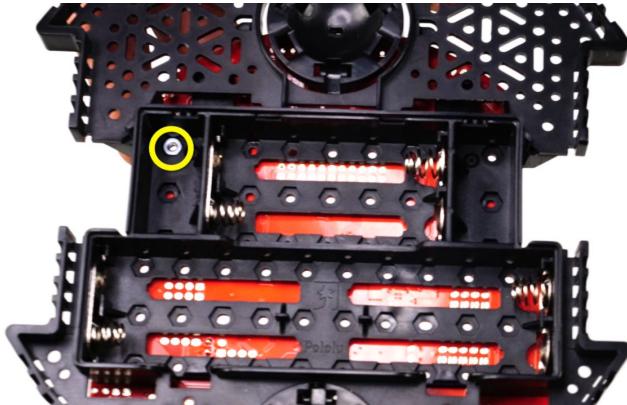


Figure 10. Depress each nut while unscrewing to prevent them from spinning

Lastly, compress the battery contact springs so they will pass through the plastic chassis. It may be useful to depress the springs with your fingers while using a screwdriver to push the chassis board away from the plastic chassis (Figure 11).

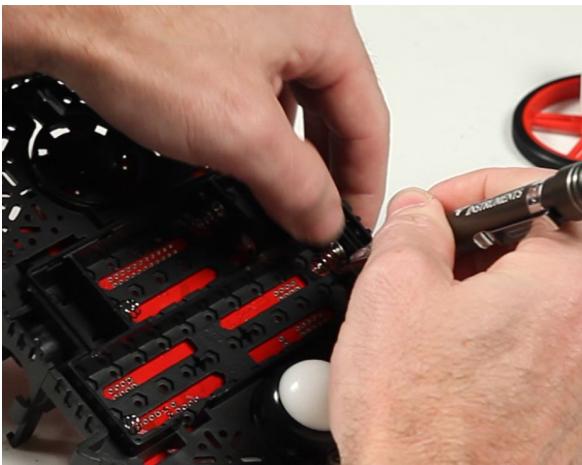


Figure 11. Compress the battery contact springs so they pass through

Congratulations !

The chassis board is now free and ready for modifications or additions (Figure 12)! When you're ready to re-assemble your TI-RSLK Max, please refer to the Construction section and/or video.



Figure 12. Chassis board is now free to be modified or replaced



Attaching the display (OLED, LCD)



Construction guide

Section IV: Attaching the display

This section will cover how to attach an optional display onto the chassis board of the Texas Instruments Robotic Systems Learning Kit, also known as the TI-RSLK Max.

If your chassis board is still attached to the Romi plastic chassis, please follow the Disassembly instructions section and/or video to remove it.

4.0 Needed Items

To follow along with this section, you'll need the chassis board along with a soldering iron, solder, and a 1x8 header (Figure 1). The chassis board of the TI-RSLK Max is pre-wired to support one of the following three displays:

- Sparkfun 10168 LCD with 84x48 resolution
- Adafruit 338 LCD with 84x48 resolution
- Adafruit 938 OLED with a higher resolution of 128x64

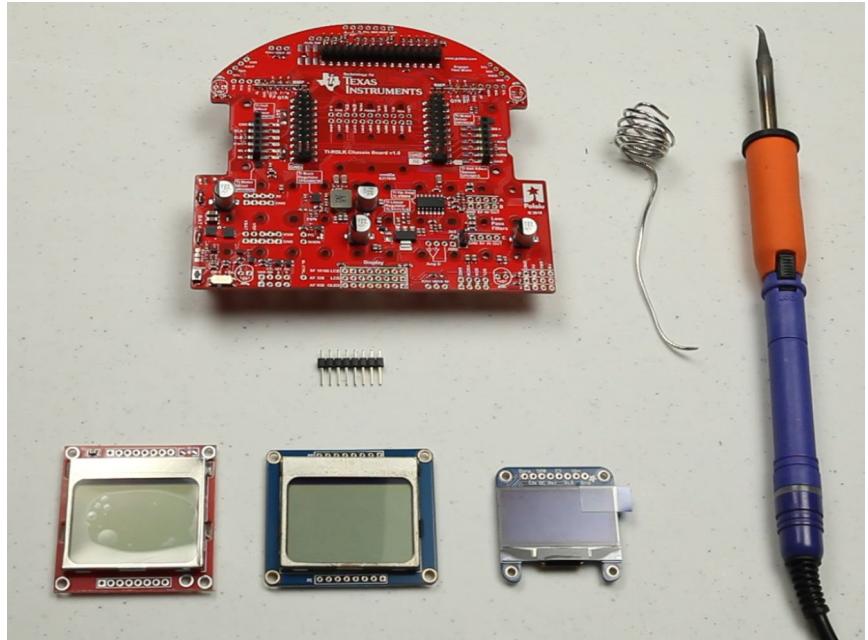


Figure 1. Needed Items



Construction guide

4.1 Install 1x9 header onto the TI-RSLK Max chassis board

To add the display to the chassis board, we first need to identify the appropriate pins at the rear of the chassis board. The board has been labeled to help identify the right section: the Sparkfun 10168 section is on top, followed by the Adafruit 338 and 938 sections. See Figure 2.

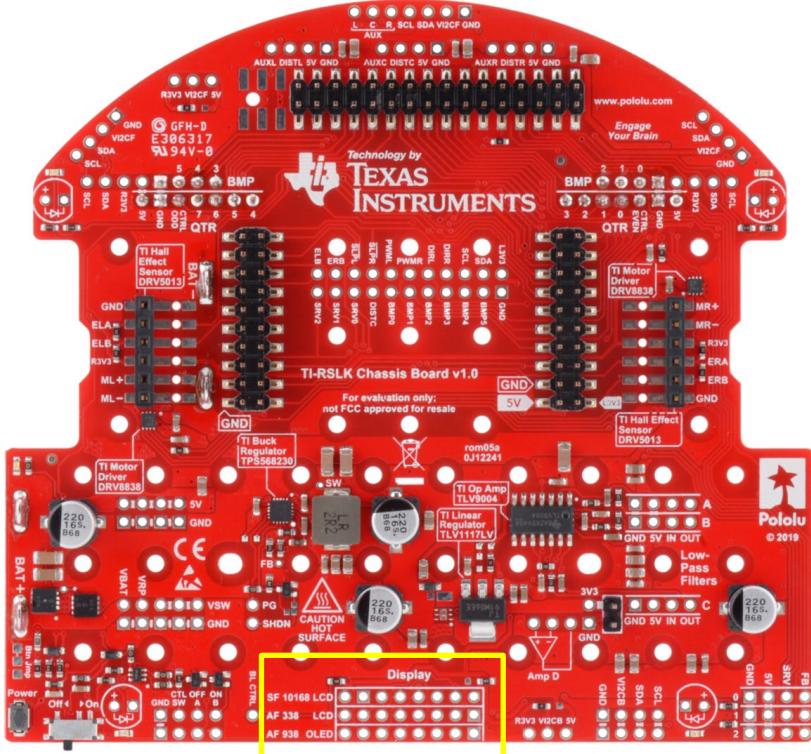


Figure 2. Identifying the pins for the three optional displays

Next, insert the 1x8 header into the holes for the appropriate section, with the shorter pins pointing down into the board and the longer pins and plastic portion resting on the top side of the board. See Figure 3.

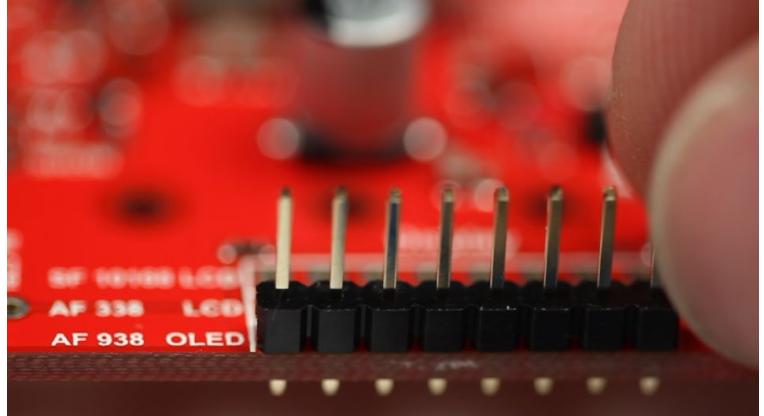


Figure 3. Insert the 1x8 header into the pins matching your display

Now flip the chassis board over and solder these pins to the back of the board, doing your best to keep the pins straight and the plastic portion of the headers flush to the board (Figure 4).

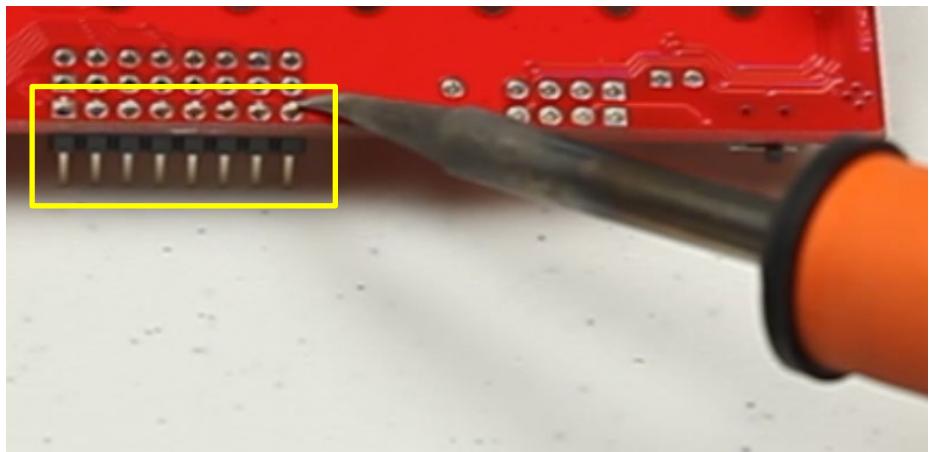


Figure 4. Solder the pins to the back side of the board



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4.2 Attach the display to the header

Once soldered, flip the board back over to the topside and place the display in the correctly oriented position (Figure 5). The LCD displays will have the large metal bar area of the display oriented towards the robot. The OLED display will have the side of the board with the pins oriented towards the robot.

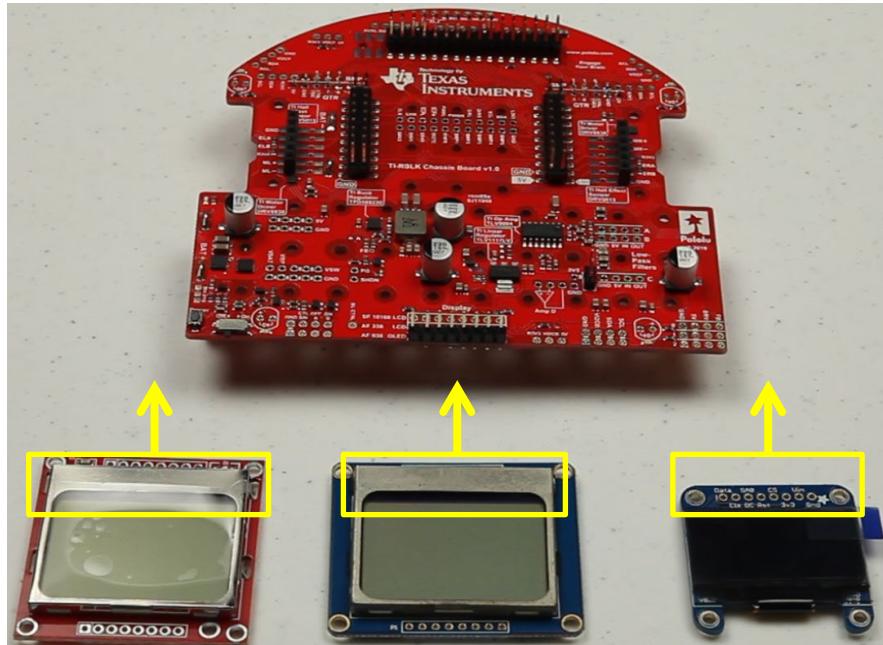


Figure 5. Correct orientation for putting the display onto the header pins

With your display oriented in the right direction, place the display so that the header pins protrude through the via holes and solder them to the board (Figure 6).

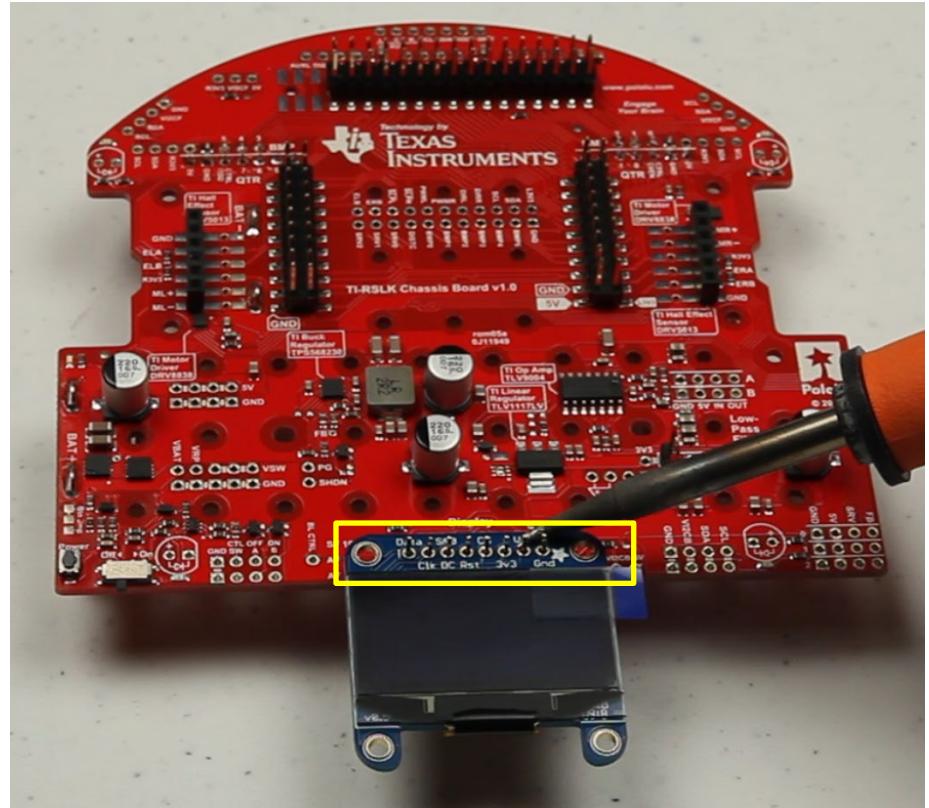


Figure 6. Solder the header pins once placed through the via holes, as shown

Congratulations!

Your display is now installed and ready for use. When you're ready to re-assemble your robot, please refer to the Construction section and/or video.

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