MCU Car Kit, Ver. 5.1

# Body Assembly Manual (Version for RX62T)

Version 1.02 [ANDTR100]
March 2014
Renesas MCU Car Rally Secretariat

# Important Notice (Revision 1.2)

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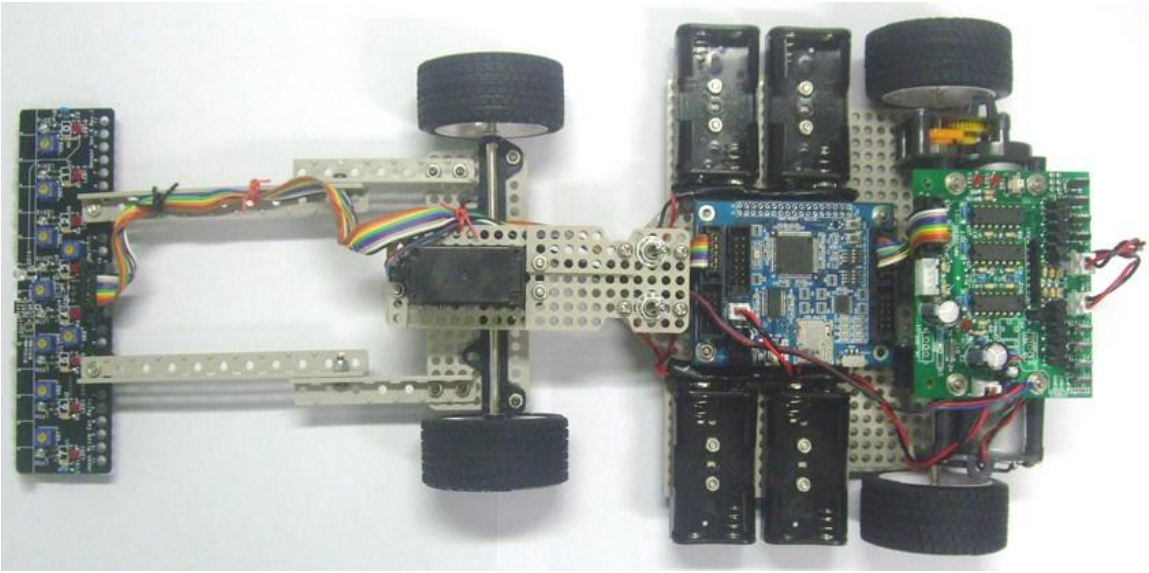
# Contents

# 1. Outline

The MCU Car Kit, Ver. 5.1, fabrication manual supports the RMC-RX62T board, the motor drive board, Ver. 5, and the sensor board:

| Name | **MCU Car Kit, Ver. 5.1** |
|---|---|
| MCU board | RMC-RX62T |
| Motor drive board | Motor drive board, Ver. 5 |
| Sensor board | Sensor board, Ver. 5 **(Note: Polyester pile tape added.)** |
| Support for 10-degree gradients | Supported without modification |



MCU Car Kit, Ver. 5.1

Note: Photo shows assembled kit with silicon sheeting (sold separately) applied to the tires.

# 2. Parts to Be Assembled

## 2.1. MCU Car Kit, Ver. 5.1, Contents

The box contains the items listed below.

Table 1

| No. | Name | Description | Q'ty |
|---|---|---|---|
| 1 | Plate set | Universal plate L<br>(18 black screws and 18 nuts included) | 1 |
| 2 | Gearbox | High-speed gearbox<br>(13 tapping screws, 4 nuts, and 2 flat washers included) | 2 |
| 3 | Wheel set | Sport wheel set<br>(6 screws and 14 nuts included) | 2 |
| 4 | Parts related to MCU car kit, Ver. 5.1 | See tables 2.1 to 2.3 for detailed listings of related parts. | |

The screws and nuts used are packed together with the plate set, gearbox, and wheel set listed in the above table.

Note: Be careful not to lose any of the nuts, as no extras are provided.

Table 2.1 MCU Car Kit, Ver. 5.1, Related Parts List

| No. | Name | Description | Q'ty |
|---|---|---|---|
| 1 | Motor drive board set | Motor drive board, Ver. 5 | 1 |

Note: See *Motor Drive Board (Ver.5) Fabrication Manual* for a detailed parts list for the motor drive board set.

| No. | Name | Description | Q'ty |
|---|---|---|---|
| 2 | Sensor board set | Sensor board, Ver. 5 | 1 |

Note: See *Sensor Board, Ver. 5, Fabrication Manual* for a detailed parts list for the sensor board set.

Table 2.2 Body-Related Set—Parts List

| No. | Name | Description | Q'ty |
|---|---|---|---|
| 3 | Battery box | Battery box for 2 AA cells | 4 |
| 4 | Battery snap | 006P-I-120 | 4 |
| 5 | Servo | HS-430BH | 1 |
| 6 | Motor | RC-260RA18130 | 2 |
| 7 | Pinion gear | 8T pinion gear set | 1 |
| 8 | Stud | Dia. 3 mm, H 30 mm, female-female | 4 |
| 9 | Stud | Dia. 3 mm, H 8 mm, female-male | 8 |
| 10 | Screw and washer assembly | Dia. 3 mm × 8 mm, flat washer dia. 6 mm | 6 (4) |
| 11 | Screw and washer assembly | Dia. 3 mm × 12 mm, flat washer dia. 6 mm | 2 |
| 12 | Screw and washer assembly | Dia. 3 mm × 15 mm, flat washer dia. 6 mm | 4 |
| 13 | Screw and washer assembly | Dia. 3 mm × 15 mm, flat washer dia. 8 mm | 4 |
| 14 | Nylon nut | 3 mm | 2 |
| 15 | Spring washer | Dia. 3.2 mm | 60 (2) |
| 16 | Heat-shrinkable tubing | Dia. 10 mm, approx. 250 mm long | 1 |
| 17 | Flathead screw | Dia. 3 × 8 mm | 20 |
| 18 | Flat washer | Dia. 8 mm | 10 (2) |

Note: Figures in parentheses ( ) indicate quantity of spares.

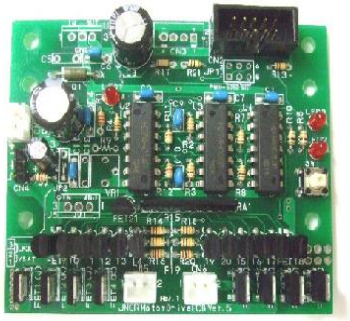
Table 2.3 Connector/Cable-Related Set—Parts List

| No. | Name | Description | Q'ty |
|---|---|---|---|
| 20 | Electrical wire | KQE0.5, red | 1 m |
| 21 | Electrical wire | KQE0.5, black | 1 m |
| 22 | 10-colour flat cable | 1.27 mm pitch | 0.6 m |
| 23 | 10-pin female connector | PS10SEND4P1-1C | 4 |
| 24 | XH female connector (2-pin) | XHP-2 | 3 |
| 25 | XH connector contact pin | SXH-011T-P0.6 | 10 |
| 26 | Toggle switch | MS-500K-B | 2 |

## 2.2. Sensor Board, Motor Drive Board, and MCU Board

The sensor board and motor drive board are included as standard components of the kit. In this manual, it is assumed that the sensor board and motor drive board are already completed and ready for use.

- Motor drive board, Ver. 5 (completed board)

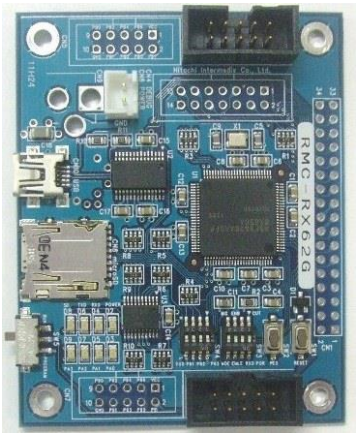


In order to assemble the MCU car kit, a motor drive board Ver. 5 (completed board) is necessary. In the description presented here, the motor drive board configuration does not use the LM350 add-on set or free add-on set.

- Sensor board, Ver. 5 (completed board)

In order to assemble the MCU car kit, sensor board Ver. 5 (completed board) is necessary.

- MCU board (sold separately)




The RMC-RX62T board, with an MCU manufactured by Renesas Electronics mounted on it, is used as the MCU board. (The MCU board is sold separately.)

## 2.3. Tools

The following tools are used to carry out the steps described in this manual.

Nippers

Radio pliers

Phillips screwdriver

Wire stripper

Soldering iron

Ruler

Stanley knife

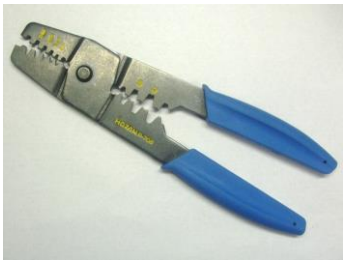
Scissors

Hacksaw

File

Vice

Tabletop drill press
(the following drill bits are used:
dia. 3 mm, dia. 3.5 mm, dia. 6 mm)



Crimp tool

Dryer

# 3. Universal Plate (Fashioning of Plate Parts)

This section describes how to make the plate pieces used to build the chassis of the MCU car.

## 3.1. Contents of Universal Plate Set

The universal plate set includes the following items:

Photo 3.1

- 1 universal plate
- 2 sets of angle pieces
- 18 black screws
- 18 nuts (used for temporary fastening when fashioning the plates)

Note: Be careful not to lose any of the nuts, as no extras are provided.

## 3.2. Making the Sensor Arms

In this section, we will make the sensor arms. You will need the two angle piece sets.

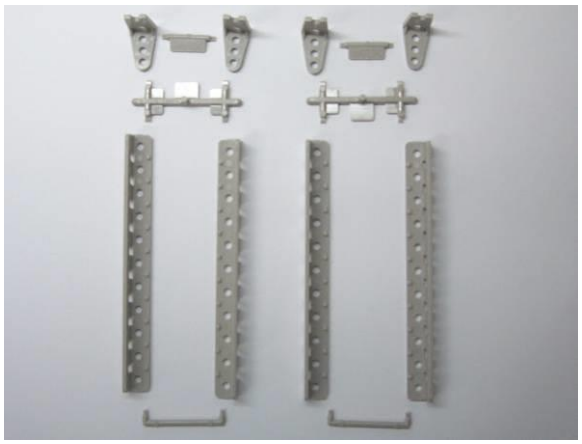


Photo 3.2

Use nippers to separate the parts of the two sets of angle pieces.

Parts needed in addition to angle pieces:

- 2 nylon nuts (in separate bag)
- 2 black screws

Photo 3.3

Note: Be careful not to mix up the nylon nuts and regular nuts. For comparison, a photo of regular nuts is shown below:

Nuts
(not used in sensor arms)

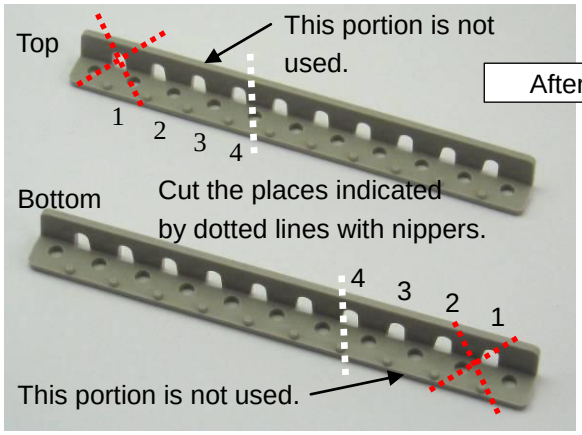



Photo 3.4

Take two of the angle pieces and place them as shown in photo 3.4. Use nippers to cut off the portion of the top angle piece from the left end to the fourth hole. Cut off the portion of the bottom angle piece from the right end to the fourth hole.

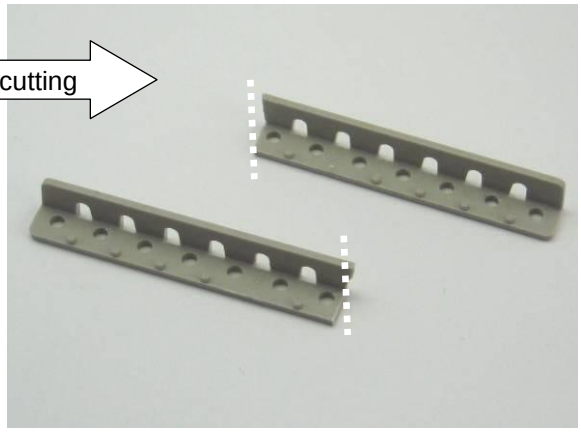



Photo 3.5

We will use the remaining long portions of the angle pieces. They should appear as shown in photo 3.5.

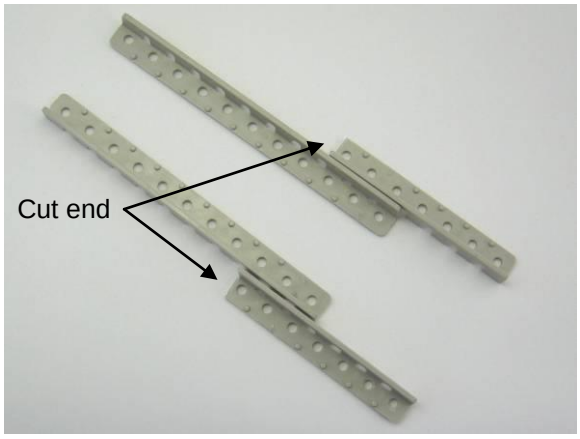



Photo 3.6

Align the remaining two uncut angle pieces with the two cut angle pieces, with the cut ends arranged as shown in photo 3.6.

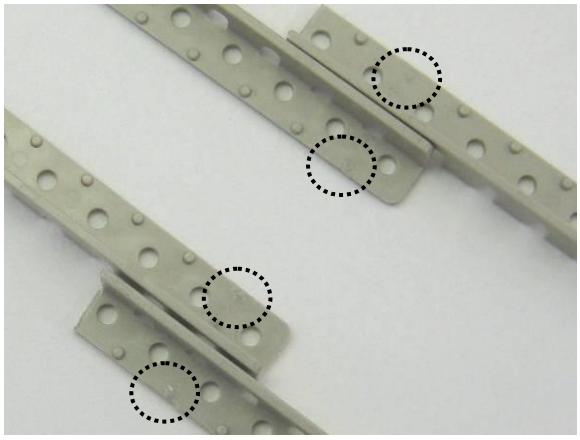


Photo 3.7

Use nippers to cut off the round protrusions indicated by the dotted circles in photo 3.7. Removing these protrusions will make it easier to secure the angle pieces with screws.

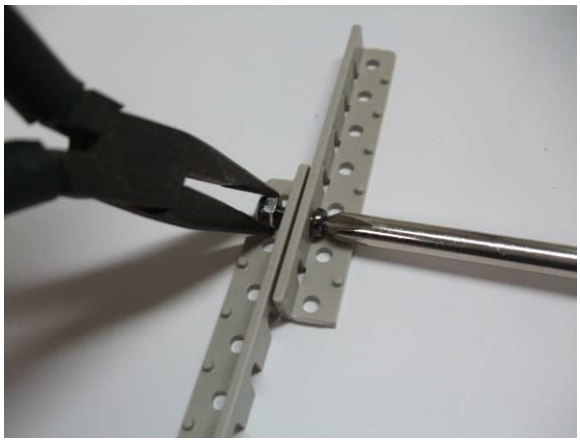


Photo 3.8

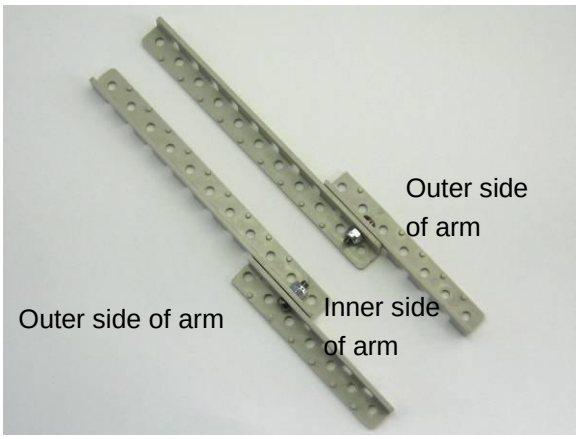



Photo 3.9

In the places where you removed round protrusions, secure the angle pieces using nylon nuts and black screws. The nylon nut should be on the inner side. Use radio pliers and a Phillips screwdriver to tighten the screws.

Note: The angle pieces will not be able to move if you tighten the screws too much. (Do not tighten the screws all the way so that the angle pieces can turn, using the screw as a fulcrum.)

## 3.3. Universal Plate Cutting Pattern

Use a felt-tip pen with oil-based ink to draw a cutting pattern on the universal plate as shown in photo 3.10. The parts named below will all be made out of the universal plate.

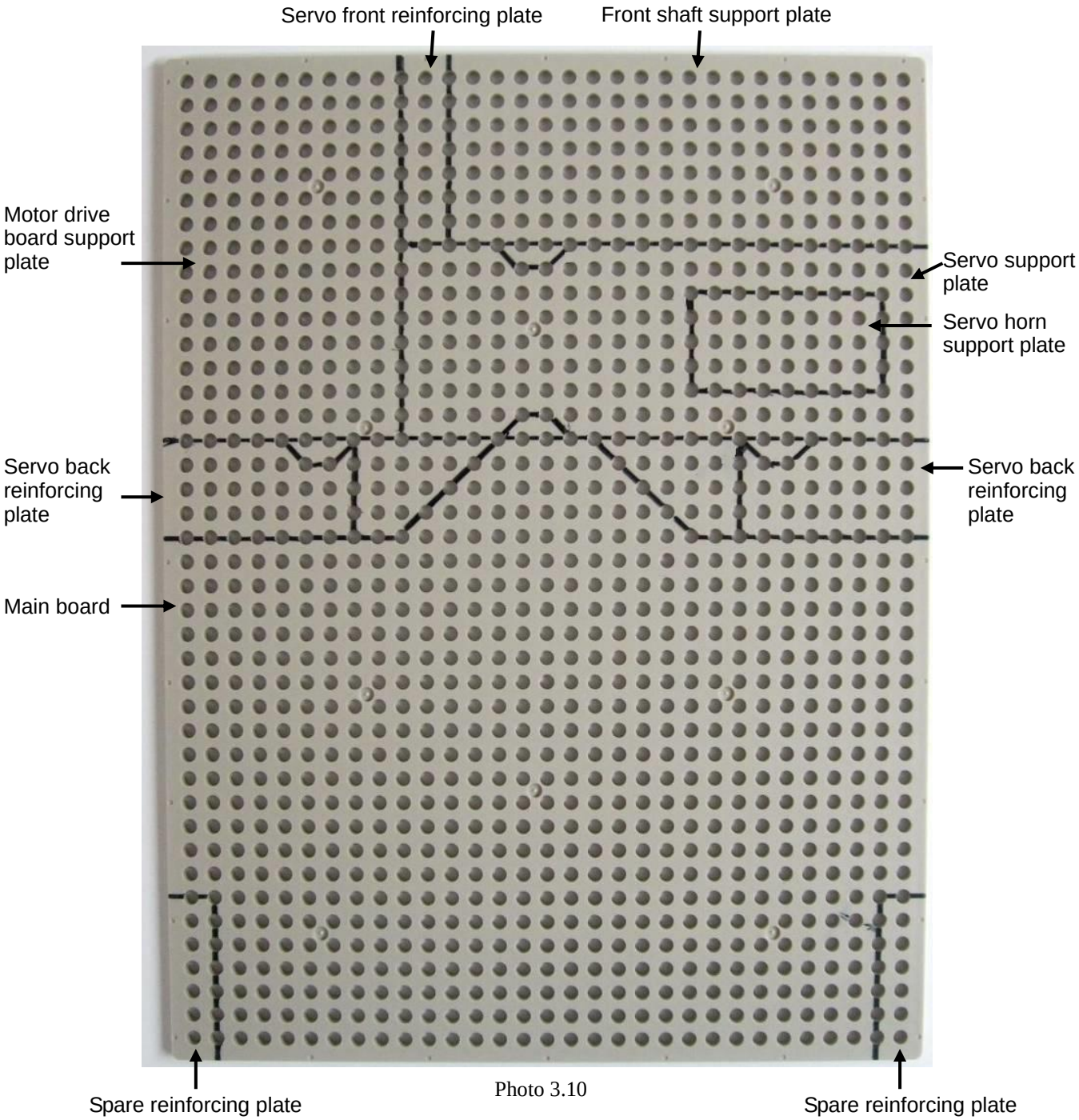



Photo 3.10

## 3.4. Cutting up the Universal Plate

In this section, we will cut up the universal plate to create several plates used in the MCU car.

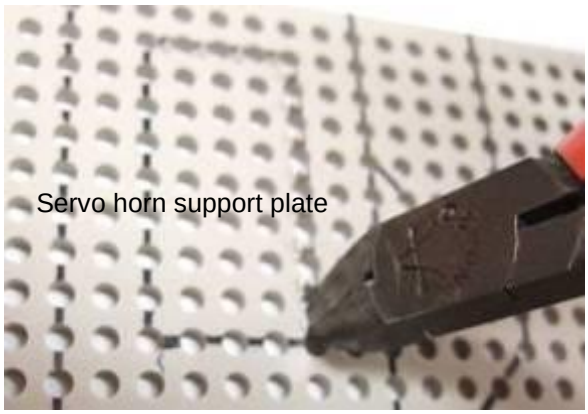



Photo 3.11

Cut out the servo horn support plate. Follow the lines and use nippers to cut partially through along the edges of plate.

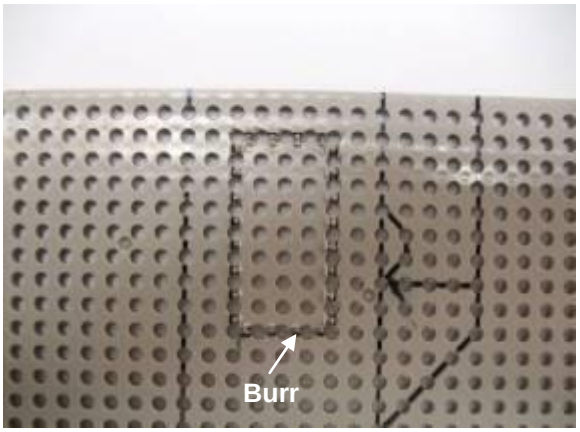



Photo 3.12

Once you have partially cut through along the lines, burrs will be visible between the holes.

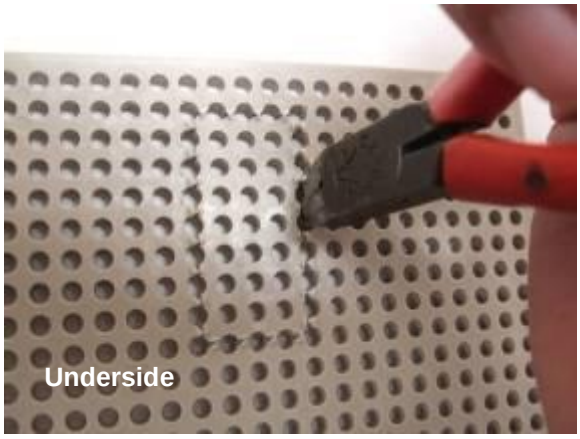



Photo 3.13

Use the nippers to cut partially through from the underside as well.

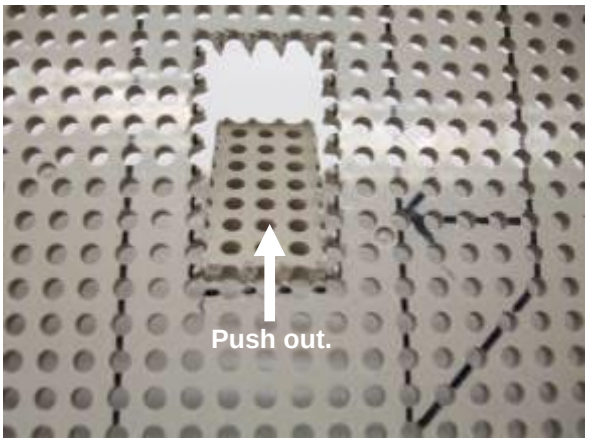



Photo 3.14

Push on the section you cut out to separate it from the universal plate. This section will be used as the servo horn support plate.

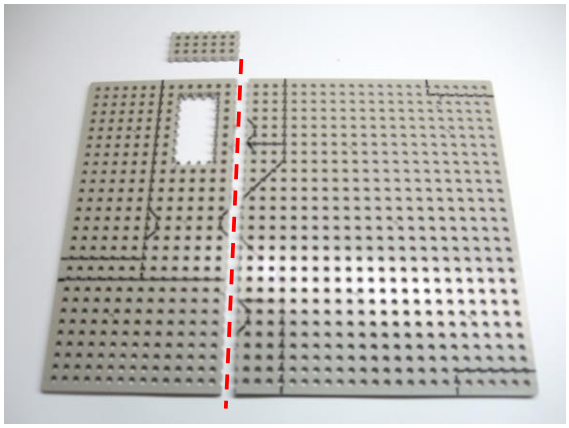


Photo 3.15

Use a hacksaw to cut through the universal plate along the dotted line.

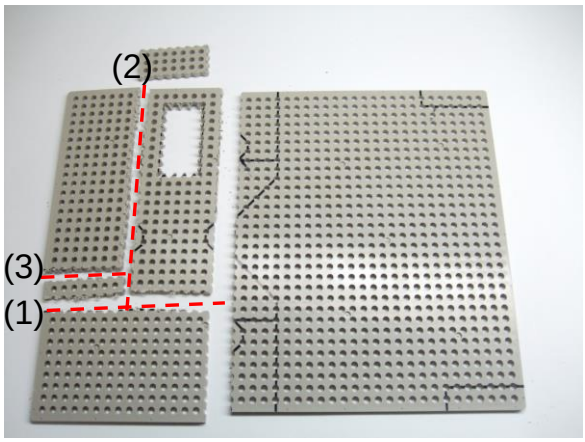



Photo 3.16

Next, cut the universal plate along the dotted lines shown in the above photo.

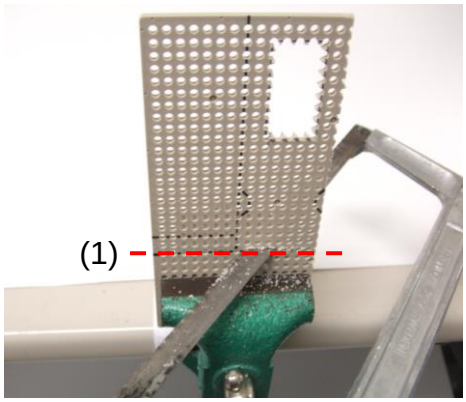



Photo 3.17

Use the hacksaw to cut through line (1).

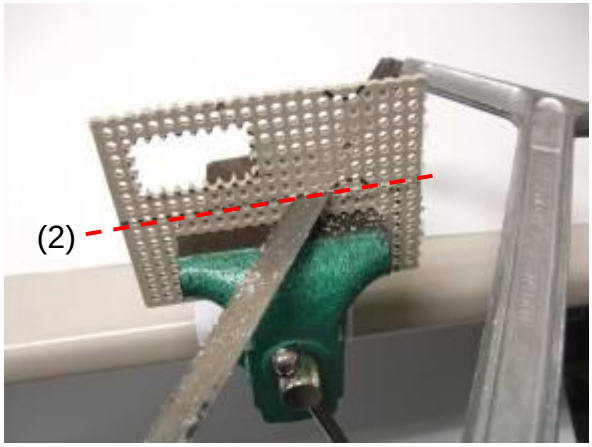



Photo 3.18

Use the hacksaw to cut through line (2).

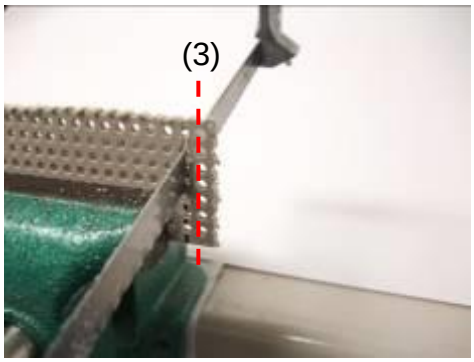



Photo 3.19

Use the hacksaw to cut through line (3).

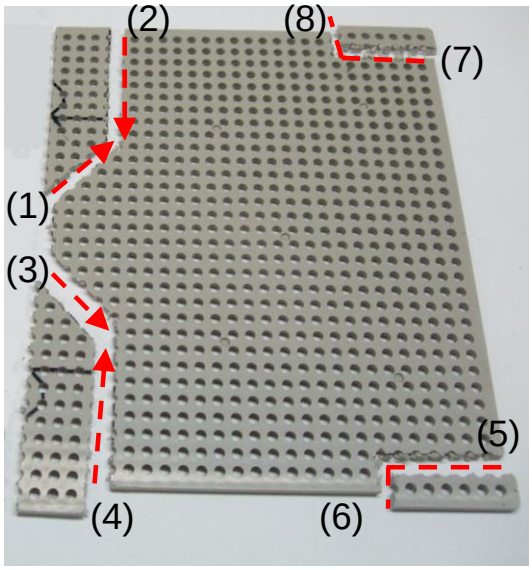



Photo 3.20

Use the hacksaw to cut through the dotted lines in the sequence indicated by the numbers.

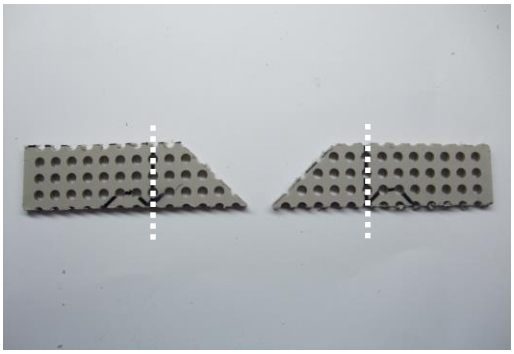


Photo 3.21

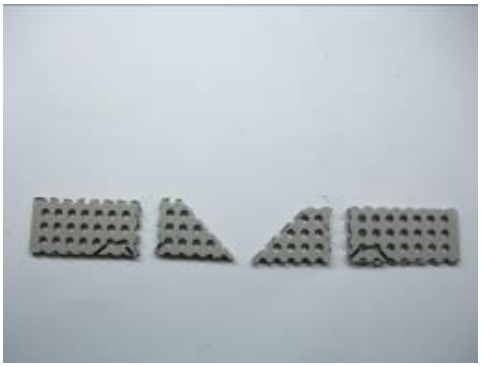


Photo 3.22

Use the hacksaw to cut through the dotted lines shown in photo 3.21.

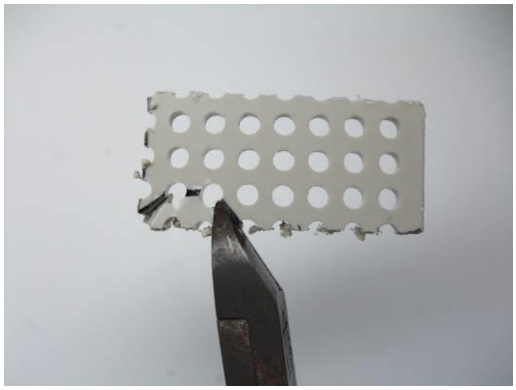


Photo 3.23

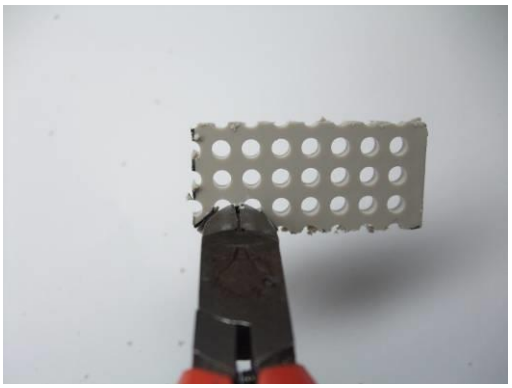


Photo 3.24

Use the nippers as shown in photos 3.23 to photo 3.25 to cut away the sections indicated by the cutting pattern lines.

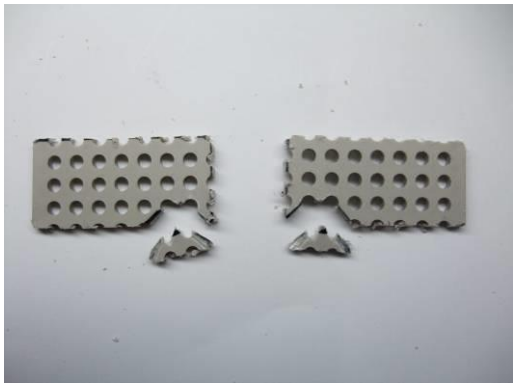


Photo 3.25

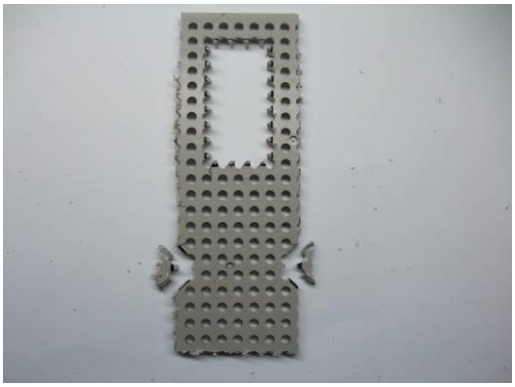


Photo 3.26

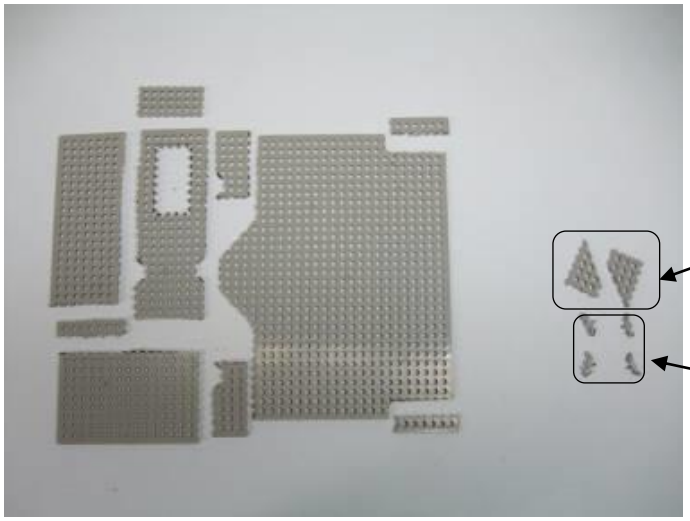



Photo 3.27

In like manner, use the nippers as shown in photo 3.26 to cut away the sections of the servo support plate indicated by the cutting pattern lines.

This completes the task of cutting up the universal plate.

## 3.5. Filing the Edges of the Plates

In this manual, a vice is used to secure the individual plates for filing.
Regardless of the method you use, be careful not to file away too much.

### 3.5.1. Finishing the Servo Back Reinforcing Plates

Photo 3.28

Use black screws and nuts to fasten together the two servo back reinforcing plates in two places (photo 3.28).

Photo 3.29

As shown in photo 3.29, clamp the pair of servo back reinforcing plates in a vise.

Photo 3.30

File flat the edges of the servo back reinforcing plates, as shown in photo 3.30.

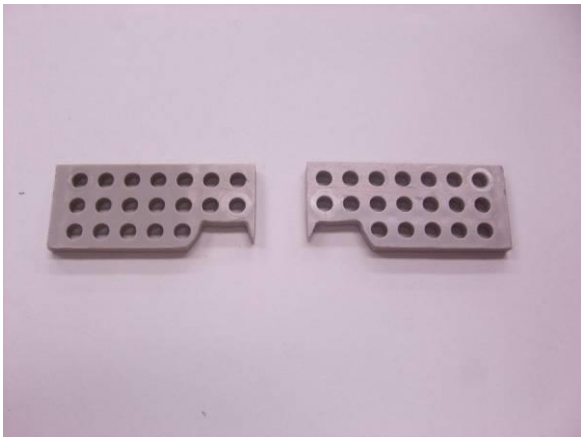


Photo 3.31

The task is complete when the edges are flat, as shown in photo 3.31.

### 3.5.2. Finishing the Servo Support Plate

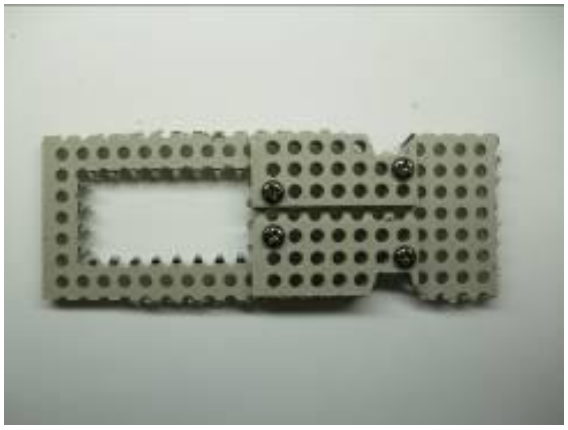


Photo 3.32

As shown in photo 3.32, use black screws and nuts to fasten servo back reinforcing plates to the servo support plate in four places.

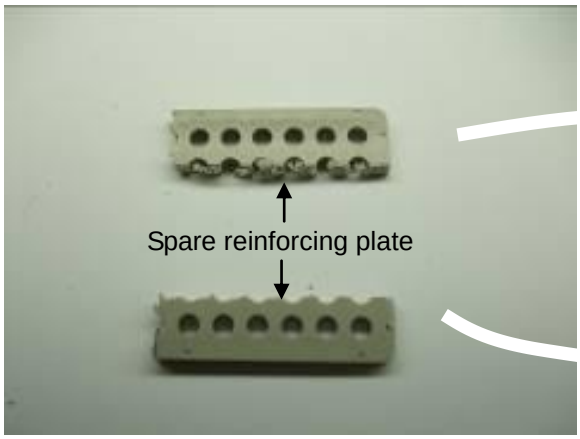



Photo 3.33

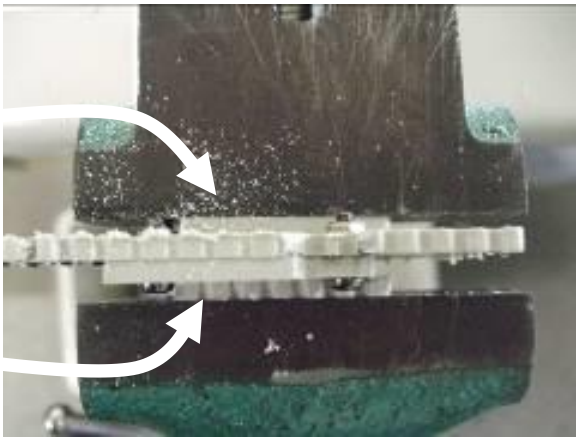


Photo 3.34

To prevent the black screws and nuts between the servo support plates and the clamps of the vice from coming into contact with the vice, place the pieces shown in photo 3.33 (spare reinforcing plates) between the servo support plate and the vice as shown in photo 3.34.

Photo 3.35

File flat the edge of the portion secured by the vise as shown in photo 3.35 (the portion indicated by the dotted line).

Note: Exercise caution when performing this step, because filing the portion other than that indicated by the dotted line (the portion not secured by the vise) could cause the plate to crack.

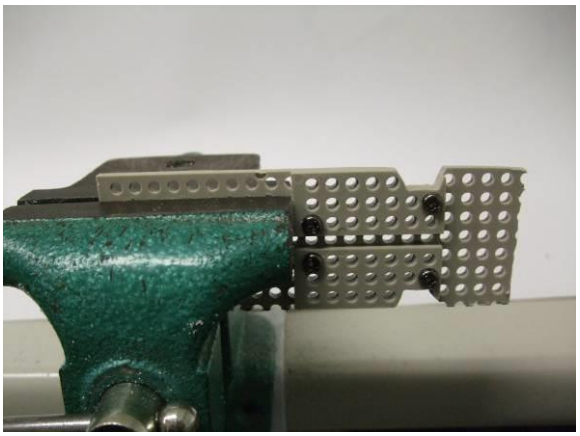


Photo 3.36

Reclamp the work piece in the vise as shown in photo 3.36, and file flat the bumps on the remaining portion of the edge.

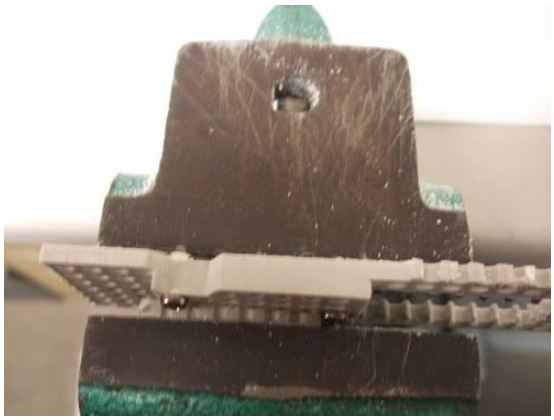


Photo 3.37

File the edge of the opposite side in the same manner as shown in photos 3.35 and 3.36.

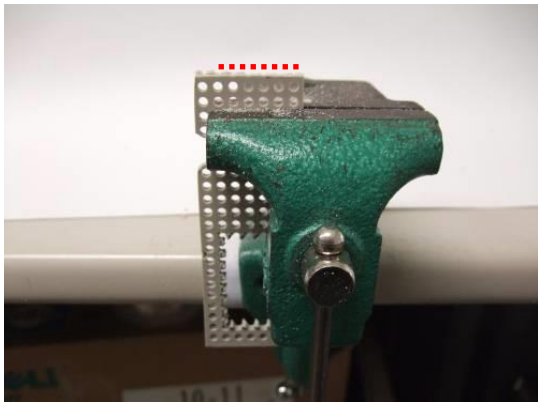


Photo 3.38

Remove the black screws and servo back reinforcing plates, then reclamp the plate as shown in photo 3.38. File flat the edge indicated

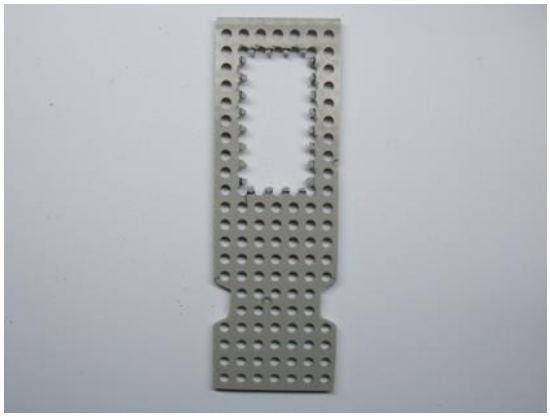


Photo 3.39

The outer edges of the servo support plate are all flat.

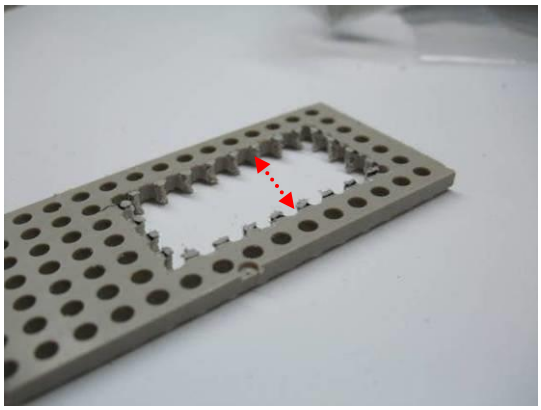


Photo 3.40

Next, we will adjust the width of the frame into which the servo motor fits. Since the inside was cut out using nippers, it is a little too narrow. Gradually file down the edges to adjust the width so that the servo motor fits snugly.

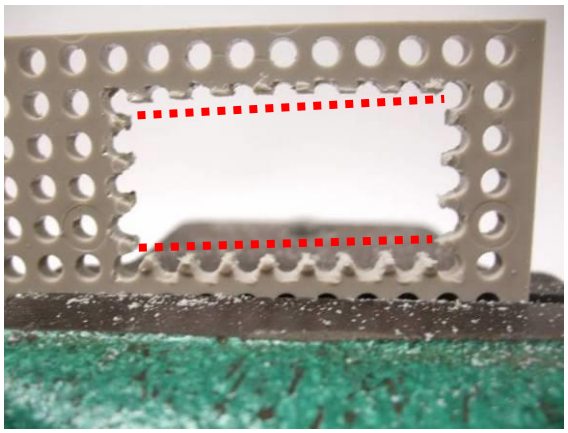


Photo 3.41

In photo 3.41 there are burrs visible inside the frame. File down the edges indicated by the dotted lines a little at a time, alternating between the sides.

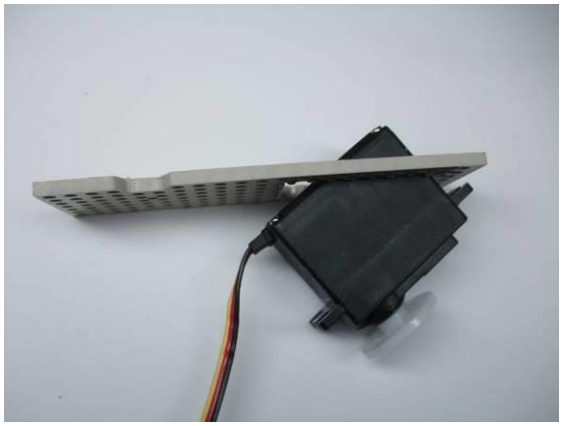


Photo 3.42

File the edges until the width roughly matches that of the servo motor, as shown in photo 3.42. Check periodically if the servo motor fits while adjusting the width.

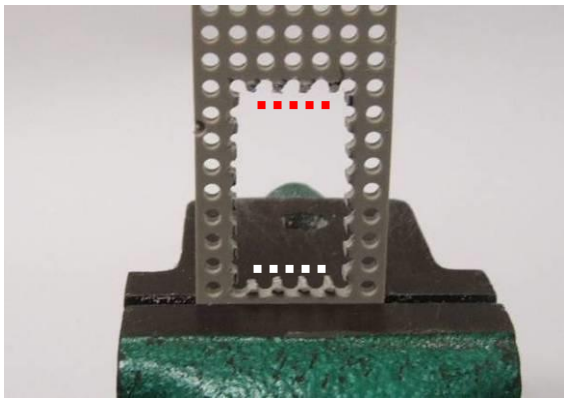


Photo 3.43

File down the top and bottom edges indicated by the dotted lines in photo 3.43 a little at a time.

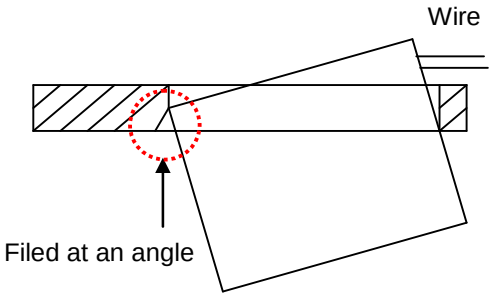



Figure 3.1

Photo 3.44

Once the opening is just large enough for the servo motor, file away the portion indicated by the arrow in figure 3.1. This will make it easier to fit in the motor (photo 3.44).

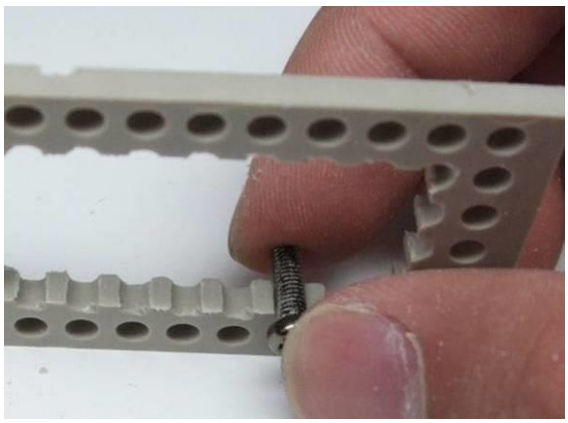


Photo 3.45

After filing, burrs may remain in the gaps. If so, place a black screw in the gap as shown in photo 3.45 and move it up and down to remove the burrs.

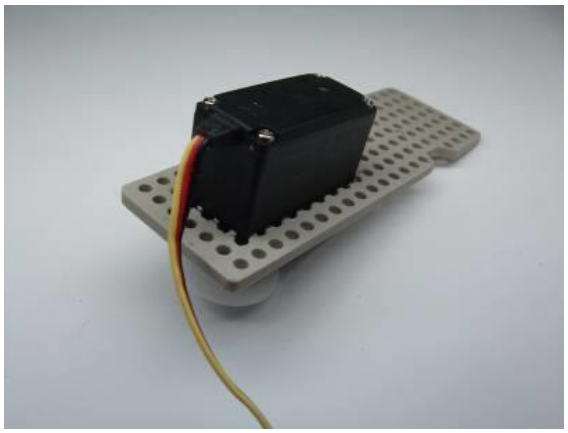


Photo 3.46

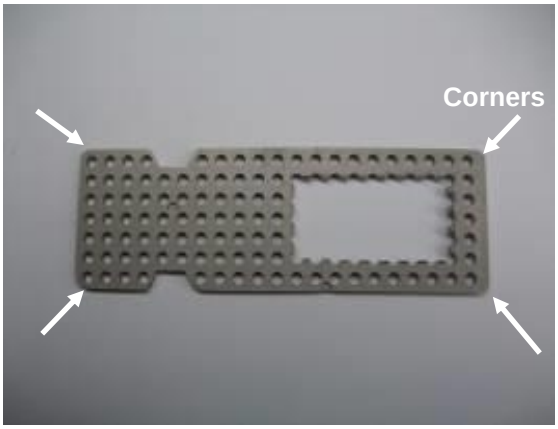



Photo 3.47

Once the servo motor fits into the opening, as shown in photo 3.46, file the corners (indicated by arrows) of the servo support plate round to complete the task in photo 3.47.

### 3.5.3. Finishing the Servo Front Reinforcing Plate

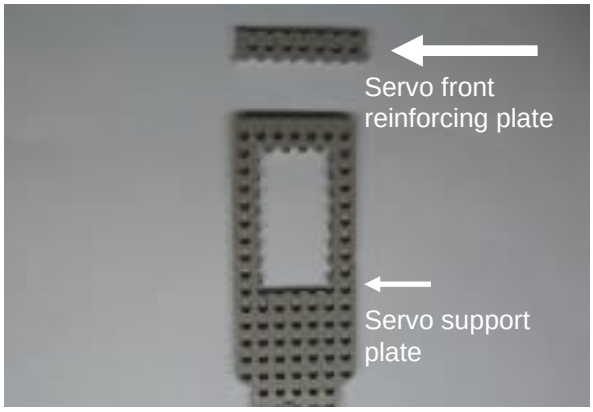



Photo 3.48

For this task you will need the servo front reinforcing plate and servo support plate shown in photo 3.48.

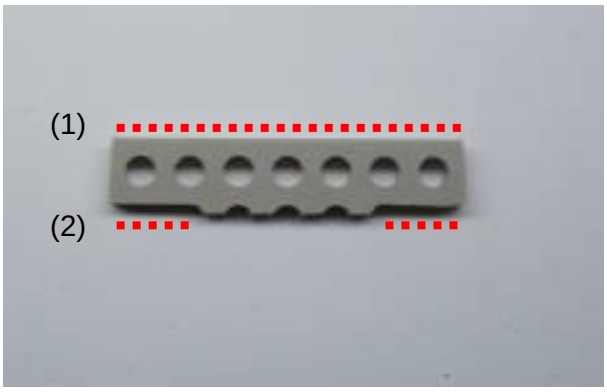



Photo 3.49 (complete)

File flat the edges indicated by the dotted lines in photo 3.49.

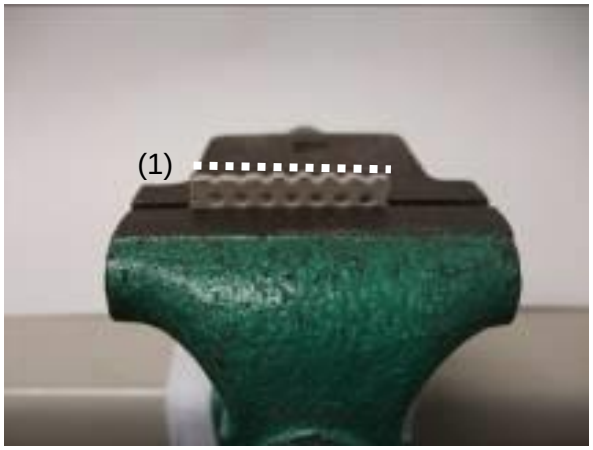



Photo 3.50

As shown in photo 3.50, clamp the plate in the vise and file flat the edge indicated by dotted line (1).

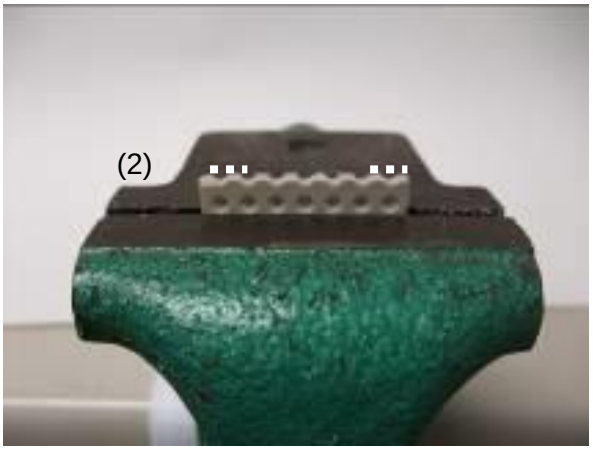



Photo 3.51

Rather than filing flat the entire side indicated by dotted lines (2) in photo 3.49, file flat the portions on each end up to the second indentation. File flat the portions indicated by dotted lines in photo 3.51.

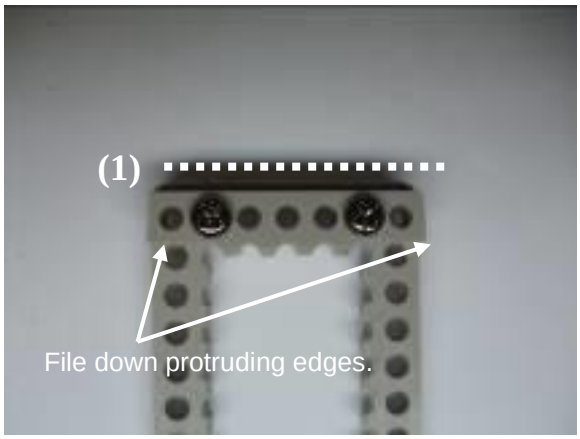



Photo 3.52

As shown in photo 3.52, secure the servo front reinforcing plate to the servo support plate with black screws and nuts. Edge (1) in photo 3.49 should line up with edge (1) in photo 3.52.

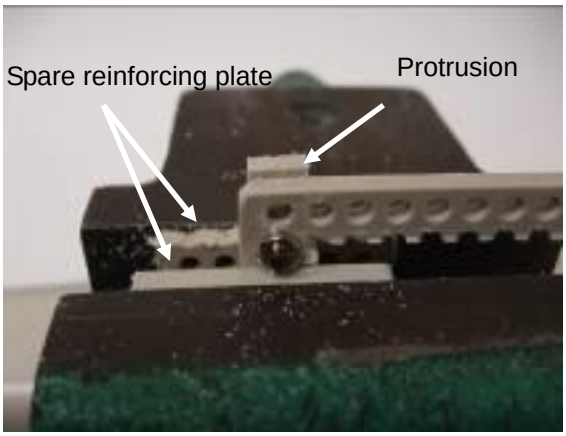



Photo 3.53

Insert the spare reinforcing plates next to the black screws and nuts to prevent them from coming into contact with the vise. File down the protrusion. (See photo 3.33 regarding the spare reinforcing plates.)

Photo 3.54

Once the top is flat, the task is finished.

### 3.5.4. Finishing the Front Shaft Support Plate and Motor Drive Board Support Plate

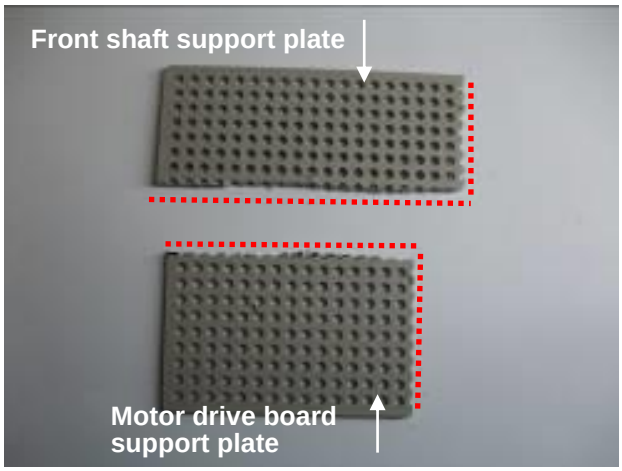



Photo 3.55

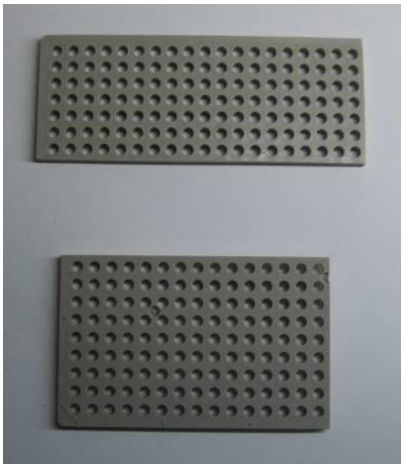


Photo 3.56

File flat the edges indicated by the dotted lines in photo 3.55 so that the result looks like photo 3.56.

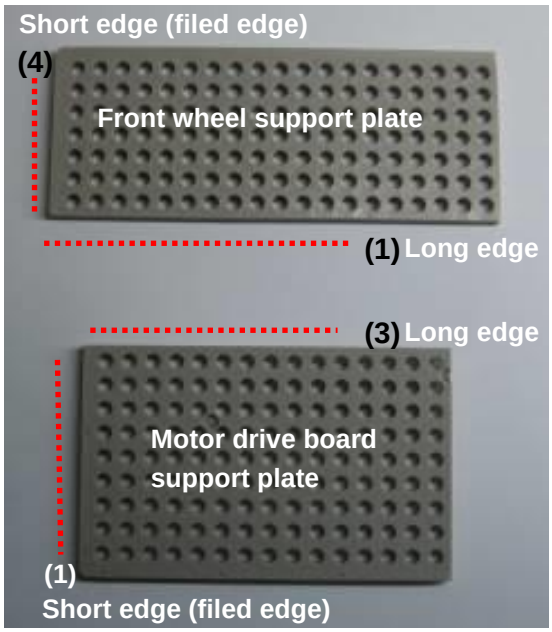



Photo 3.57

File flat the short edges of the front wheel support plate (4) and motor drive board support plate (1).

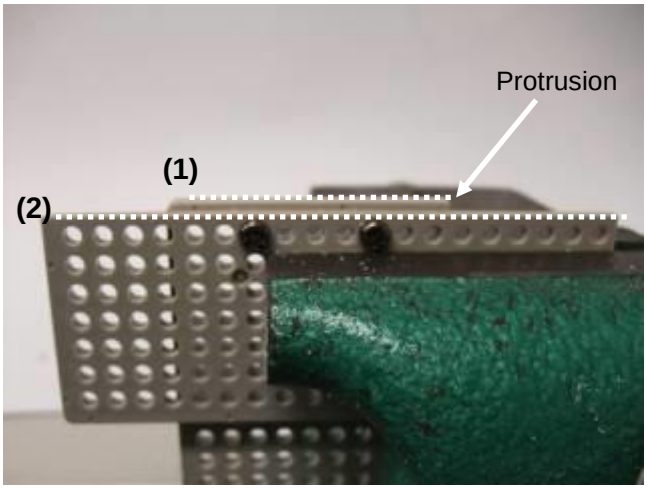



Photo 3.58

File flat the short edge (1) of the motor drive board support plate shown in photo 3.57. Align the long edge (2) of the front wheel support plate and the short edge (1) of the motor drive board support plate as shown in photo 3.58 and secure them together in two places with black screws and nuts. File until edge (1) and edge (2) are the same height.

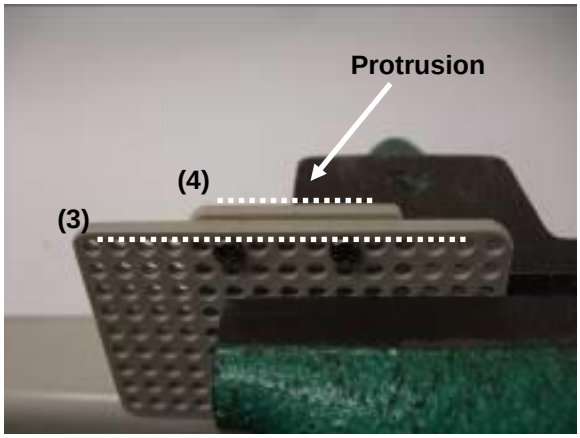



Photo 3.59

File flat the short edge (4) of the front wheel support plate shown in photo 3.59. Align the long edge (3) of the motor drive board support plate and the short edge (4) of the front wheel support plate as shown in photo 3.59 and secure them together in two places with black screws and nuts. File until edge (4) and edge (3) are the same height.

Photo 3.60

File the corners round, as shown in photo 3.60, to complete the task.

### 3.5.5. Preparing the Servo Horn Support Plate

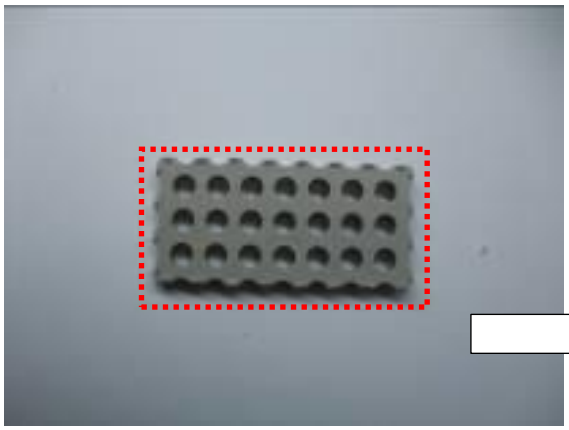


Photo 3.61

File flat the edges of the servo horn reinforcing plate.

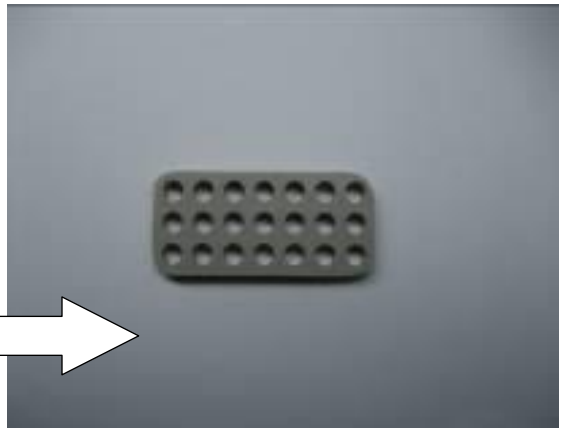


Photo 3.62

File round the corners of the servo horn reinforcing plate to complete the task.

### 3.5.6. Finishing the Main Board

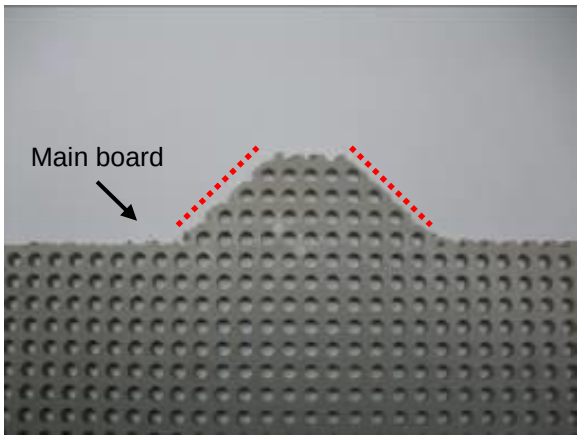



Photo 3.63

Filing down the edges indicated by the dotted lines until no grooves remain could end up opening up some of the inner holes, which would reduce the strength of the board. Therefore, file until grooves about 1 mm wide remain.
File down the sides other than those indicated by the dotted lines in photo 3.63 until no grooves remain.

Note: Holes will be drilled later to accommodate the flathead screws. If the edges are filed down too far, this could open up some of the inner holes, making it impossible to secure them using flathead screws and weakening the strength of the board.

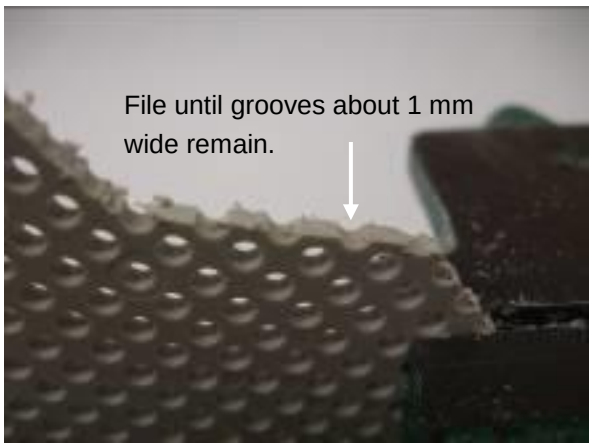



Photo 3.64

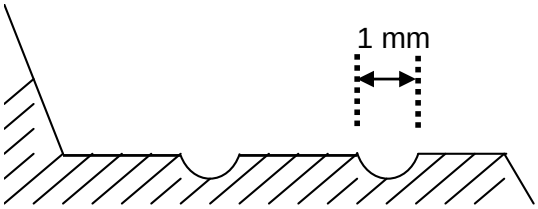



Figure 3.2 (Side View of Groove)

File down the edge shown in photo 3.64 a little at a time. Eventually, the grooves (arrow) should be about 1 mm wide, as shown in photo 3.65. Do the same on the other side.

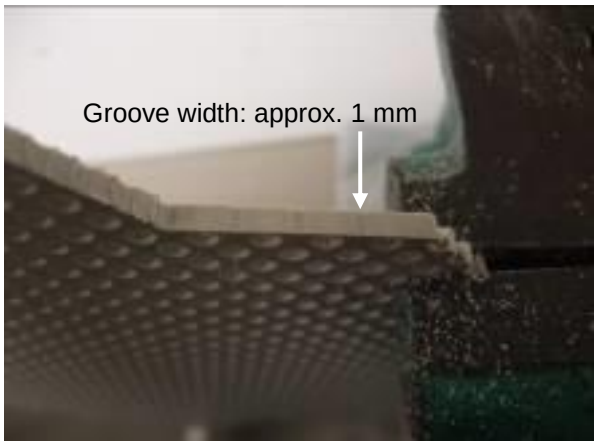



Photo 3.65

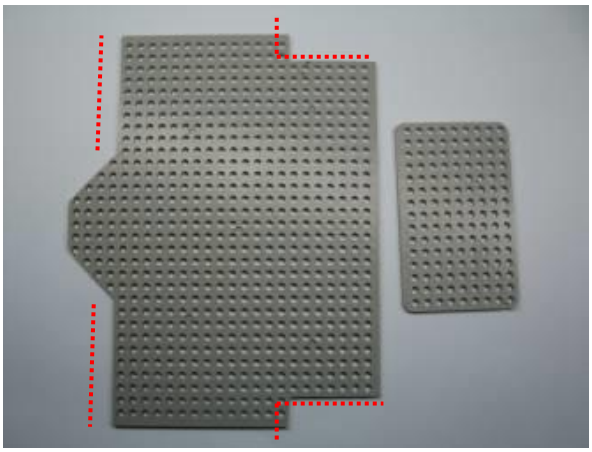


Photo 3.66

File flat the edges indicated by the dotted lines in photo 3.66 to complete the task.

### 3.5.7. Completion of File Finishing

Once filing of the edges is finished, the resulting parts should look as shown below:

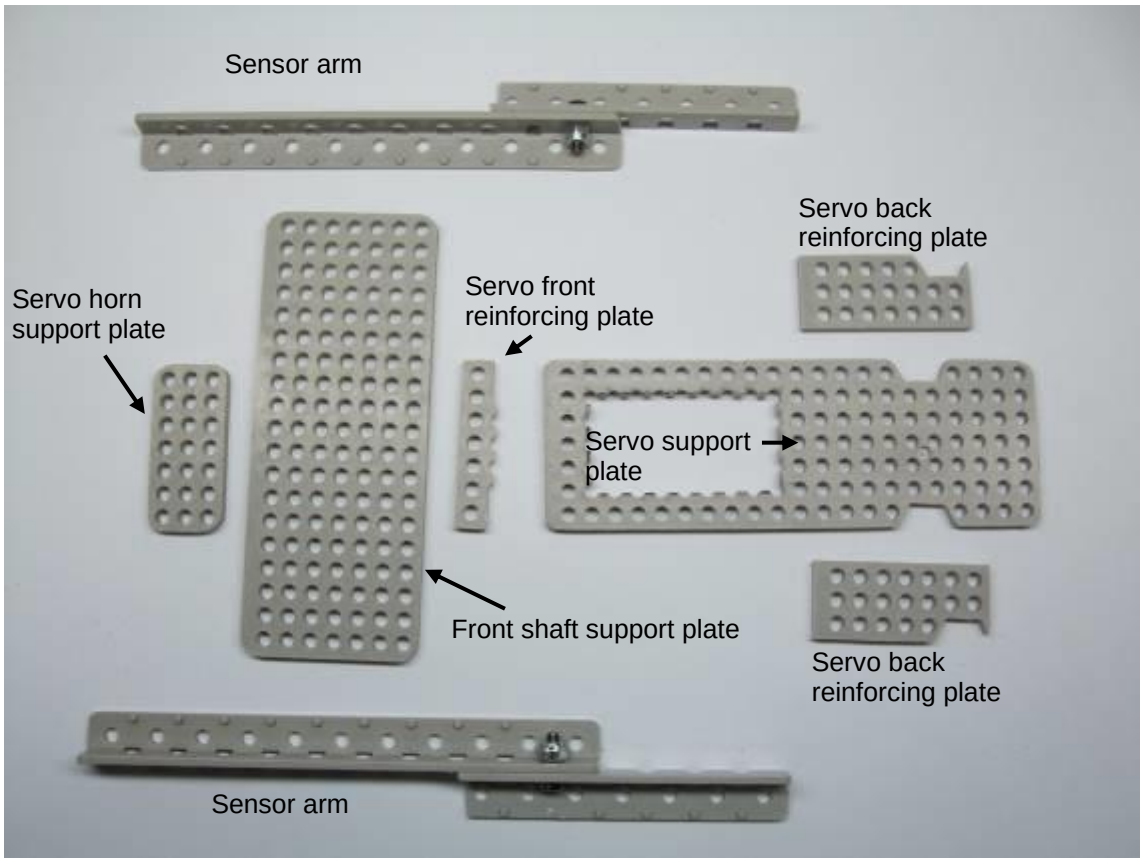



Photo 3.67

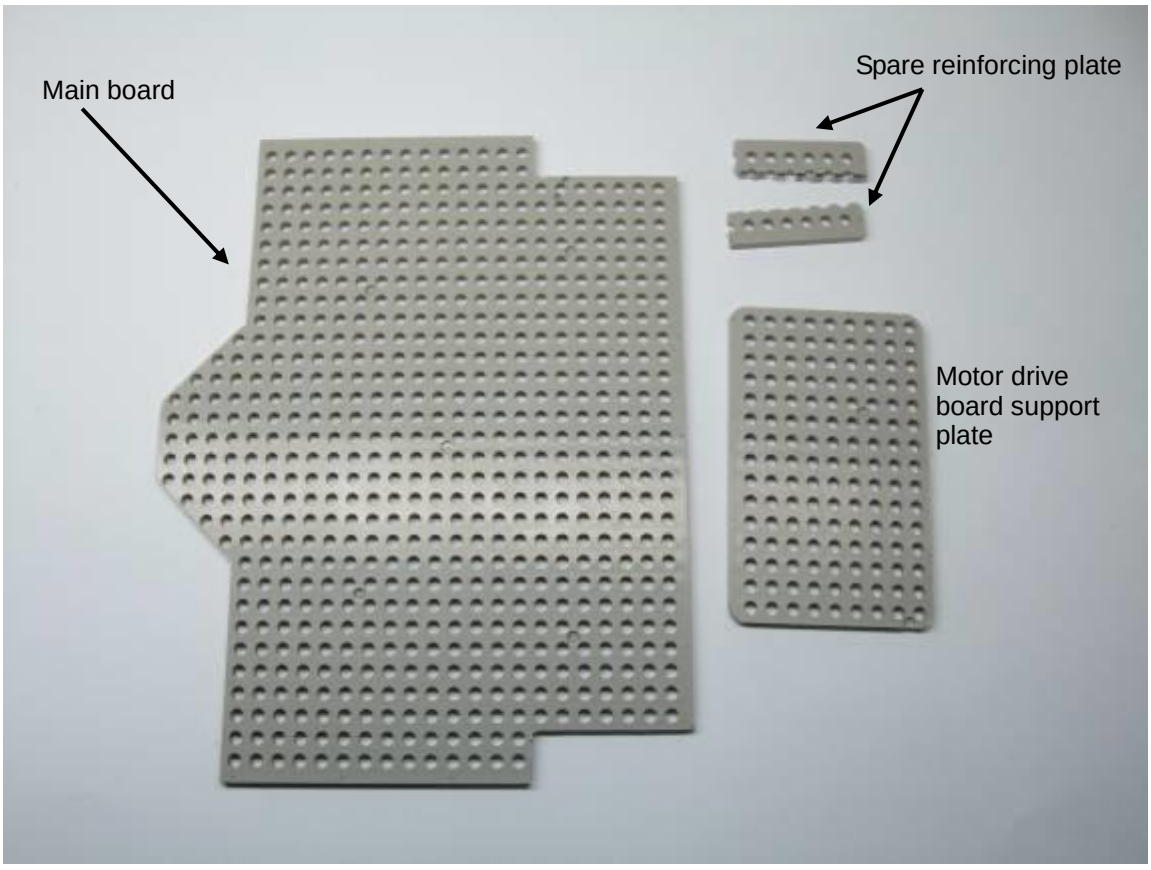



Photo 3.68

# 4. Drilling and Preparing Holes for Flathead Screws

Before we can proceed with assembly, holes must be drilled in the servo support plate for the toggle switches and holes in the main board and motor drive board support plate must be prepared for flathead screws.
If no tabletop drill press is available, the tasks in this section can be accomplished using a hand drill.

## 4.1. Drilling Holes for Toggle Switches

In this section, we will drill mounting holes for the toggle switches in the servo support plate.

Photo 4.1

Prepare a tabletop drill press as shown in photo 4.1. We will use a drill bit with a **diameter of 6 mm**.
(Photo 4.1 shows a tabletop drill with a dia. 6 mm drill bit mounted.)

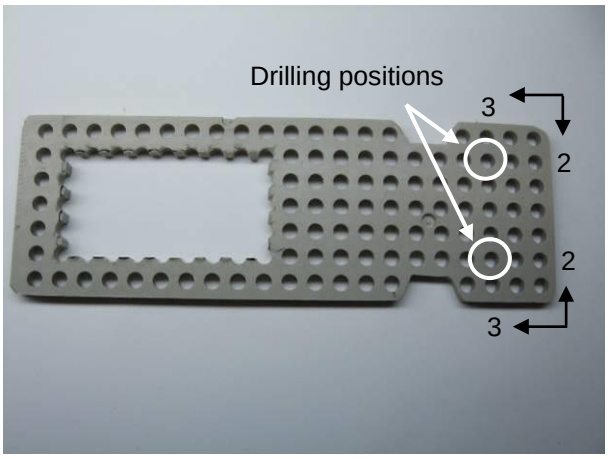



Photo 4.2

The circles in photo 4.2 indicate the holes that need to be widened using the drill.

Note: Be careful to make sure you drill in the correct positions.

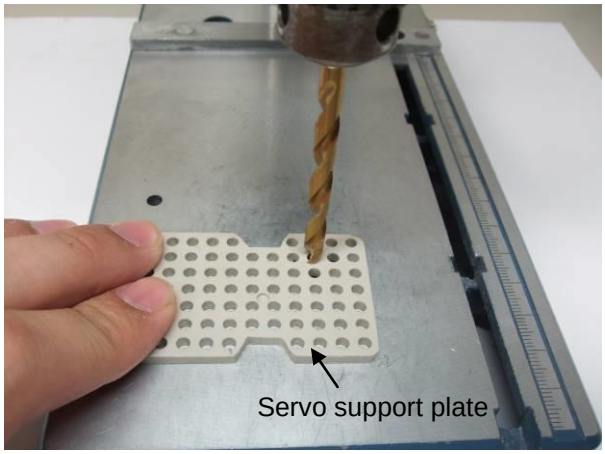



Photo 4.3

As shown in photo 4.3, hold the servo support plate firmly in place and align the drill bit with the center of the hole. Lower the drill slowly.

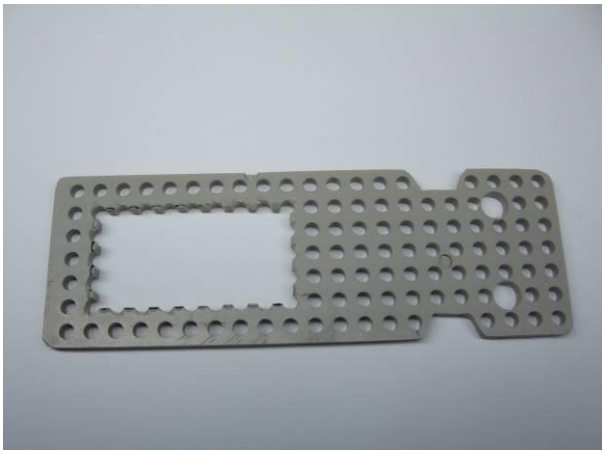


Photo 4.4

Photo 4.4 shows the servo support plate after drilling the two holes, completing the task.

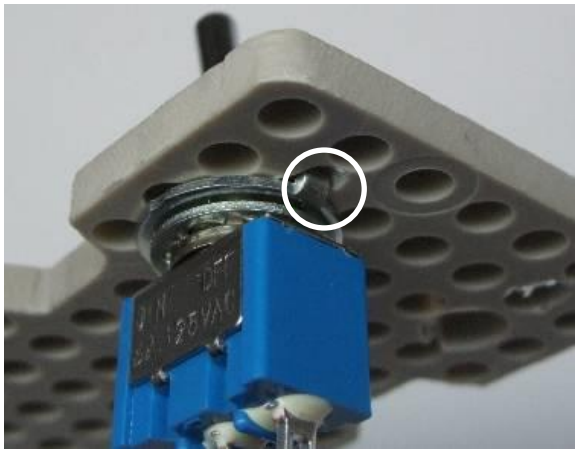


Photo 4.5

Each toggle switch is equipped with a flat washer to prevent it from turning in the hole. This washer has a protrusion to prevent turning.
When the toggle switch is mounted, the protrusion fits into the indentation indicated by the circle in photo 4.5.

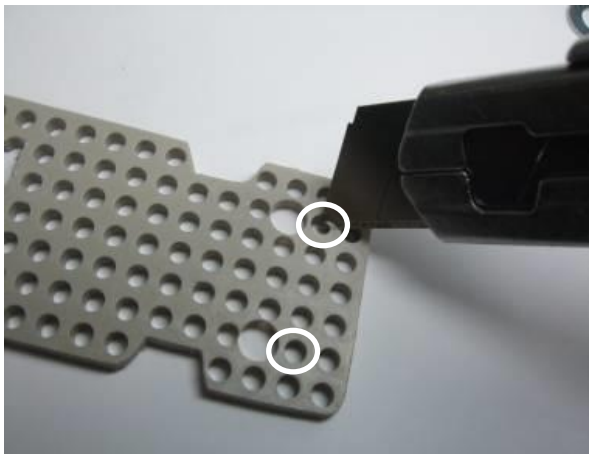


Photo 4.6

Use a Stanley knife to cut grooves into the back of the servo support plate.

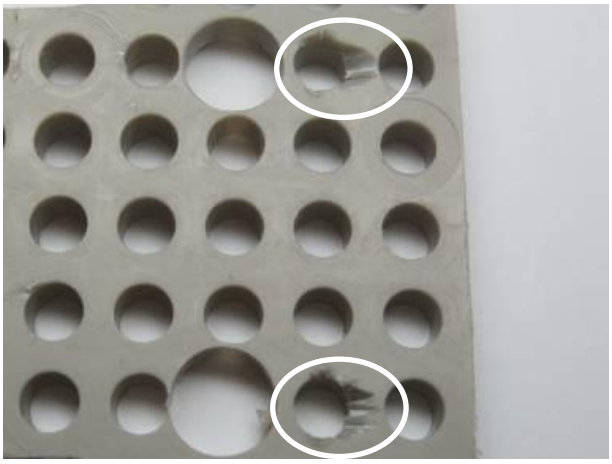


Photo 4.7

The grooves look like this when finished.

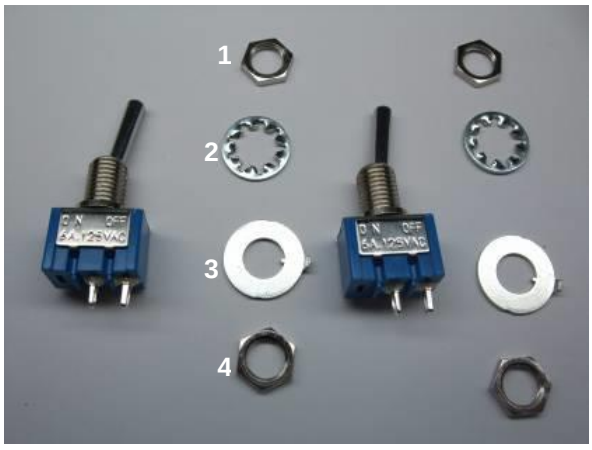



Photo 4.8

Names of parts
1: Nut
2: Shake-proof washer
3: Flat washer to prevent turning
4: Nut (not used)

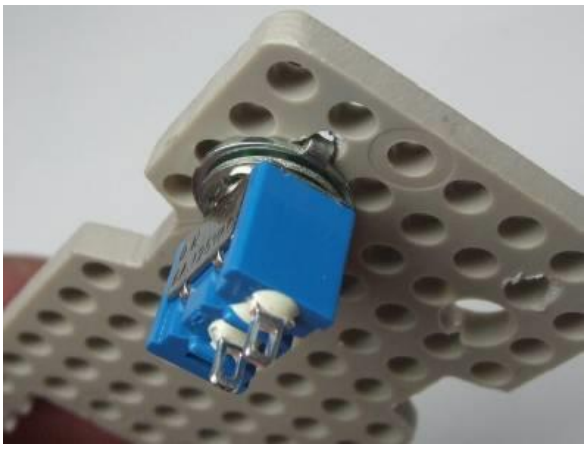


Photo 4.9

Fit the flat washer to prevent turning onto the toggle switch. Insert the toggle switch into the 6 mm diameter hole drilled in the servo support plate, making sure that the protrusion of the flat washer to prevent turning fits into the groove in the plate, as shown in photo 4.9.
After checking, remove the toggle switch. Attach the parts that came with it to the toggle switch so that they won't get lost.

## 4.2. Preparing Holes for Flathead Screws

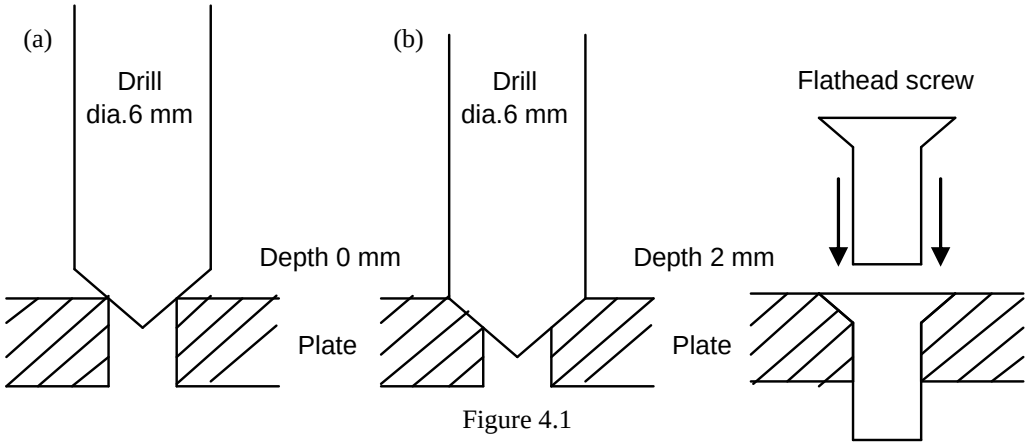



Figure 4.1

The holes are prepared for flathead screws so that the screw head will not stick out above the surface of the board, as shown in figure 4.1. It requires that the drill cut only partway into the plate. Here we describe a method that uses the stopper of a tabletop drill press to accomplish this.

### 4.2.1. Height Adjustment of Drill Bit

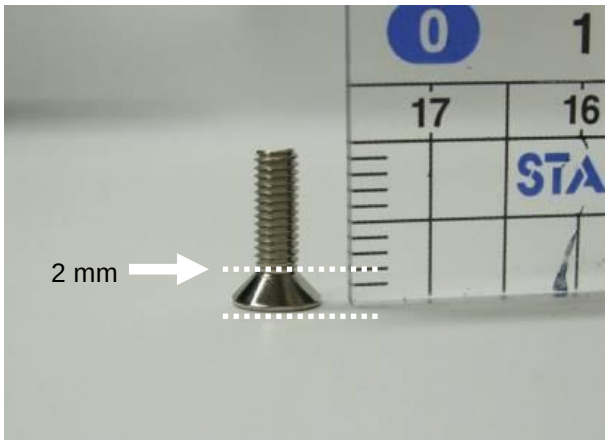



Photo 4.10

The head portion of each flathead screw (arrow) is 2 mm deep (photo 4.10).

If the point at which the drill bit meets the work piece is 0 mm (figure 4.1 (a)), we need to lower the drill a distance of 2 mm (4.1 (b)).

As when drilling the holes for the toggle switches, we will use a dia. 6 mm drill bit for this task, so there is no need to change the drill bit.

(Note: This description assumes that a drill bit (dia. 6 mm) is already mounted in the drill.)

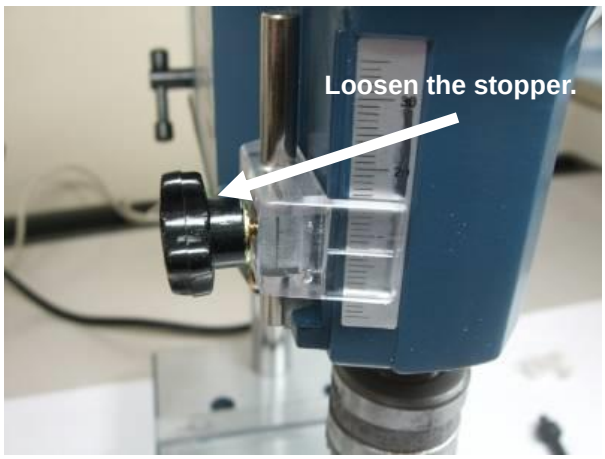



Photo 4.11

Loosen the stopper as shown in photo 4.11.

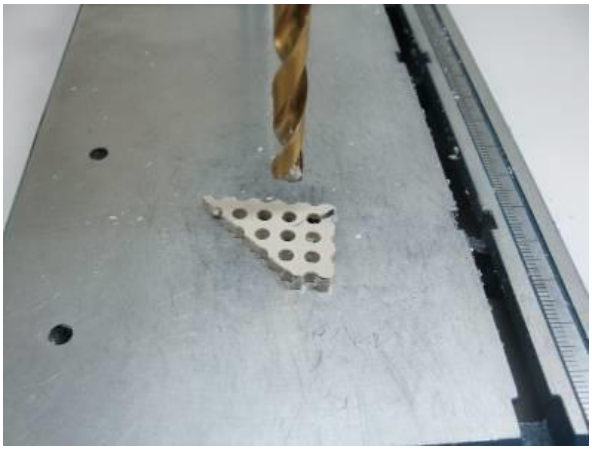


Photo 4.12

Use a leftover piece of the plate to adjust the drill height.

Photo 4.13


Photo 4.14

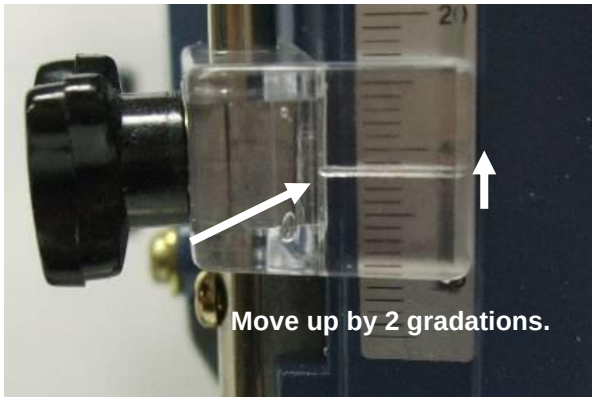



Photo 4.15

Gently bring the drill bit into contact with the plate, then tighten the stopper to mark the position shown in figure 4.1 (a) (photos 4.13 and 4.14).

(Note: If the drill bit is brought into contact with the work piece too forcefully, the position will not be the true 0 mm position.)

Raise the drill, then move the slider on the gauge indicated by the arrow in photo 4.15 up by 2 mm.

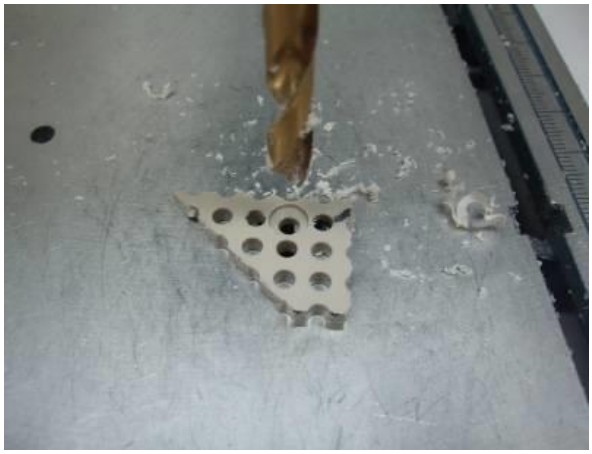


Photo 4.16

Test preparing a hole for a flathead screw. The stopper is now adjusted, so lower the drill all the way. The bit should stop before it passes all the way through the work piece. Photo 4.16 shows what the work piece looks like after preparing a hole for a flathead screw.

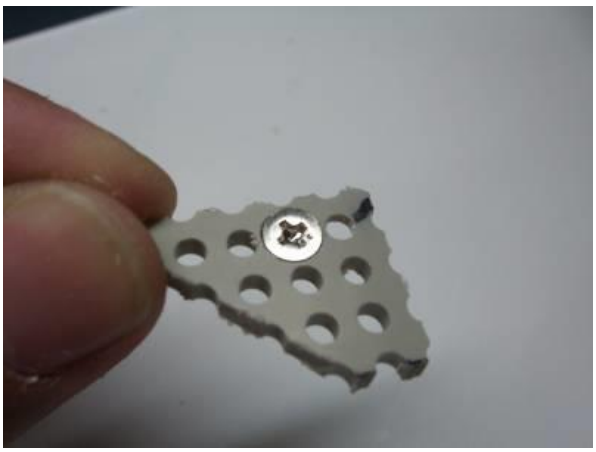


Photo 4.17

If the drill bit goes all the way through the work piece, you moved the slider more than 2 mm. Adjust the slider position a little bit at a time.

When a flathead screw fits neatly into the hole as shown in photo 4.17, the task is complete.

### 4.2.2. Preparing Holes in Main Board for Flathead Screws

The positions of the holes that must be prepared for flathead screws are indicated by circles in photo 4.19. Prepare the holes in the main board corresponding to the positions shown in photo 4.19 (16 places).

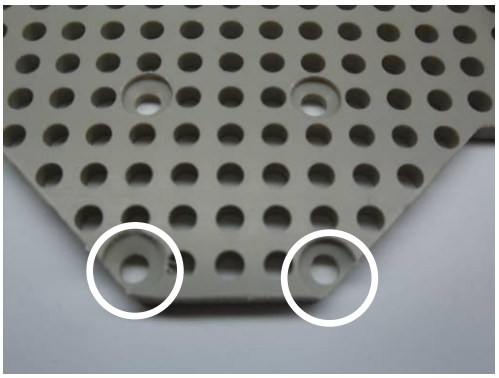


Photo 4.18

When drilling the locations indicated by circles in photo 4.18, be careful not to open up the edges of the holes.

1. Preparation for mounting the RMC-RX62T board

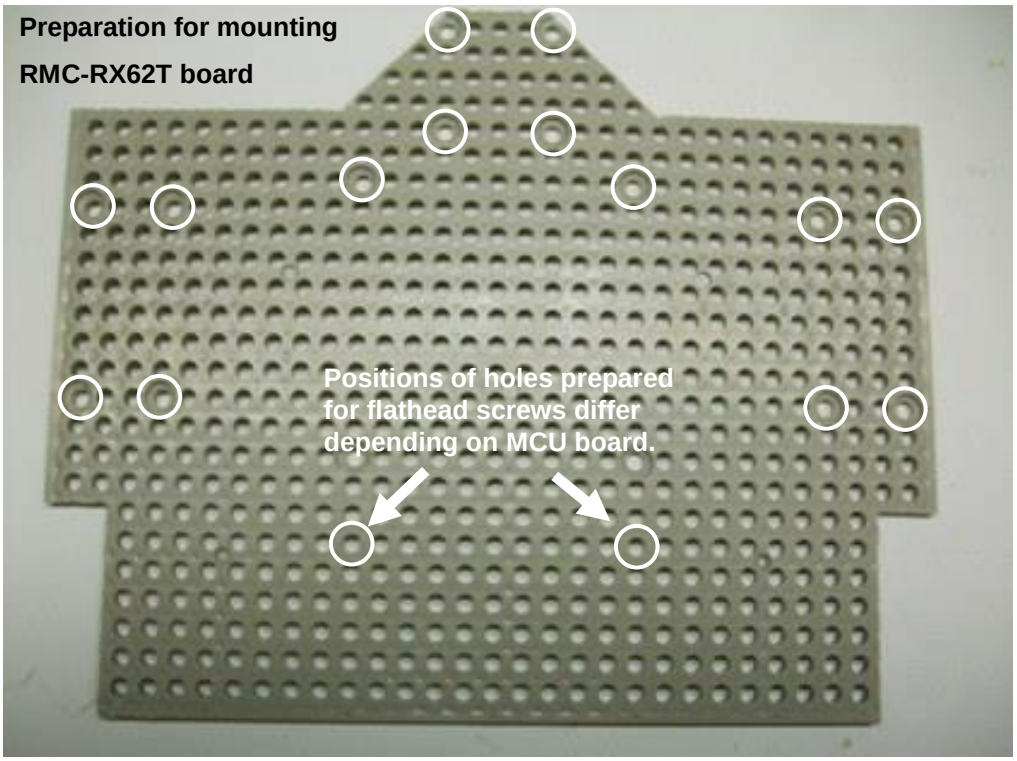



Photo 4.19

### 4.2.3. Preparing Holes on Motor Drive Board Support Plate for Flathead Screws

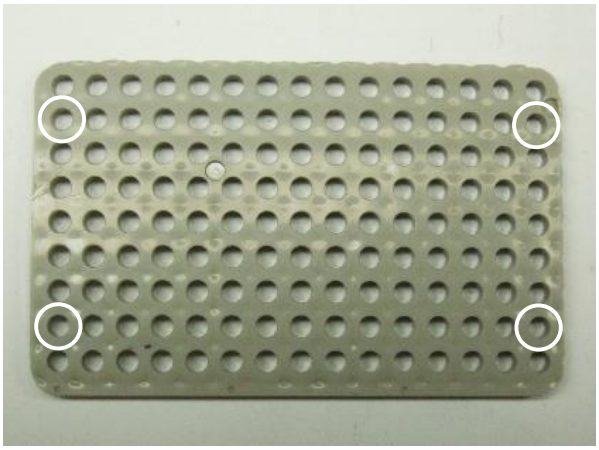


Photo 4.20

Partially drill the portions indicated by the circles in the photo to prepare the holes for flathead screws.

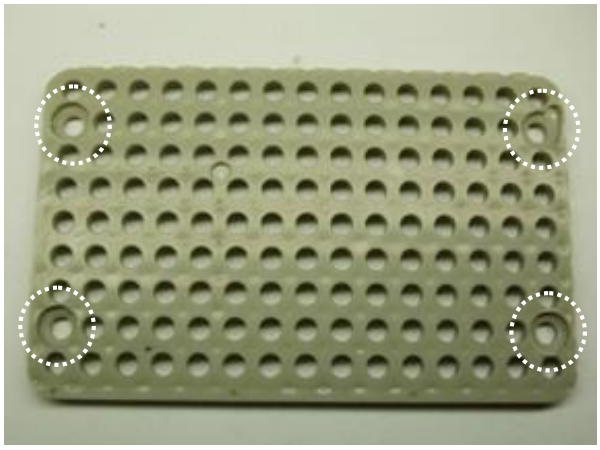


Photo 4.21

The motor drive board support plate after the holes have been prepared for flathead screws appears as shown.

# 5. Assembling the Sensor Arms and Front Wheel Support Plate


Photo 5.1

Photo 5.2

From the high-speed gearbox (photo 5.1), remove the parts shows in photo 5.2. Remove the parts indicated by dotted ovals in photo 5.2.

Photo 5.3

Once cut from the frame, the parts look as shown in photo 5.3.

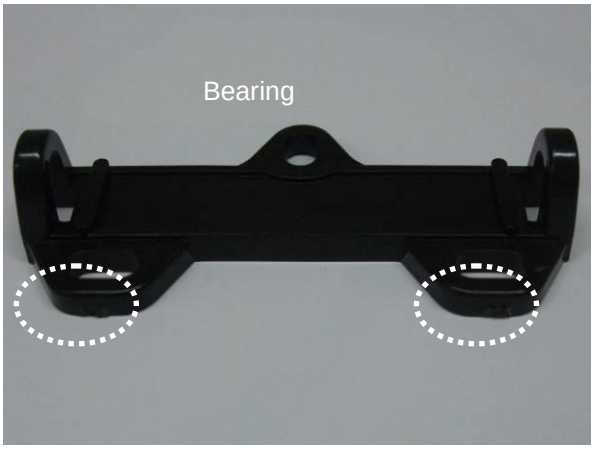



Photo 5.4

Remove burrs from the locations indicated by dotted ovals in photo 5.4. Do the same for the other parts.

Photo 5.5

As shown in photo 5.5, cut away the unneeded portion of each spacer.

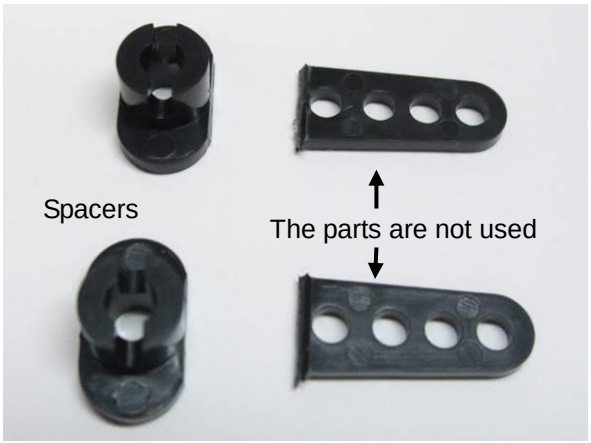



Photo 5.6

Prepare both spacers, as shown in photo 5.6.

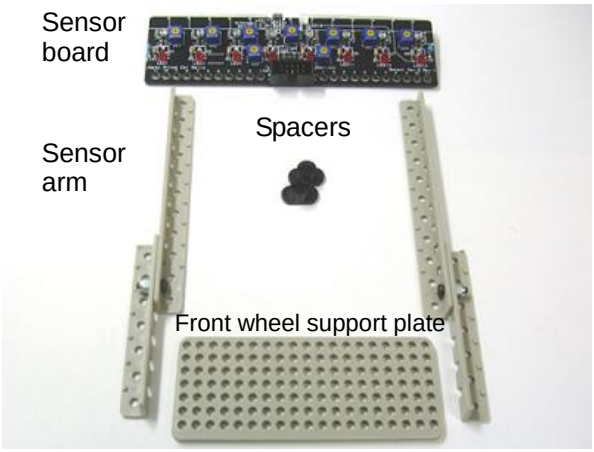



Photo 5.7


Photo 5.8

Prepare the parts shown in photo 5.7 and the quantity of screws, nuts, etc., shown in photo 5.8.

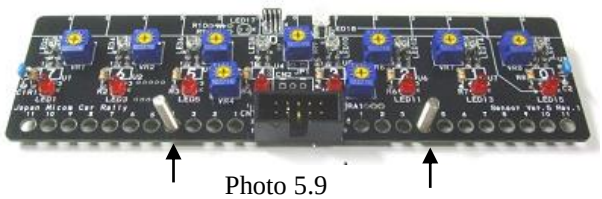


Photo 5.9

As shown in photo 5.9, insert from the underside of the sensor board two screw and washer assemblies (dia. 3 × 15 mm flat washer dia. 6 mm), one into each of the holes marked 4 on the sensor

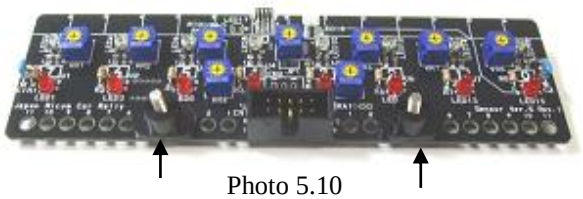


Photo 5.10

As shown in photo 5.10 place a spacer over the end of each screw, with the large side on the bottom.

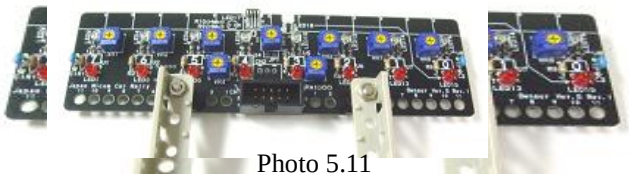


Photo 5.11

As shown in photo 5.11, fit the hole at the end of the long portion of each sensor arm over the end of each screw and secure it with a nut.


Photo 5.12

Once the sensor arms have been attached as shown in photo 5.12, the next step is to attach the front wheel support plate.

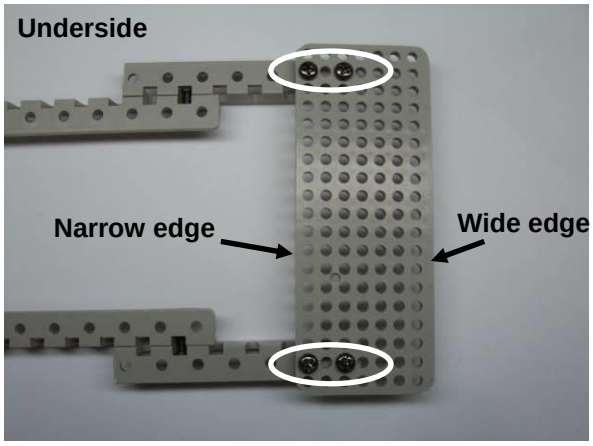



Photo 5.13

As shown in photo 5.13, place the front wheel support plate with the side having a narrow edge (the cut side) on the left and the side having a wide edge on the right. Then insert black screws into the holes indicated by ovals in the photo.

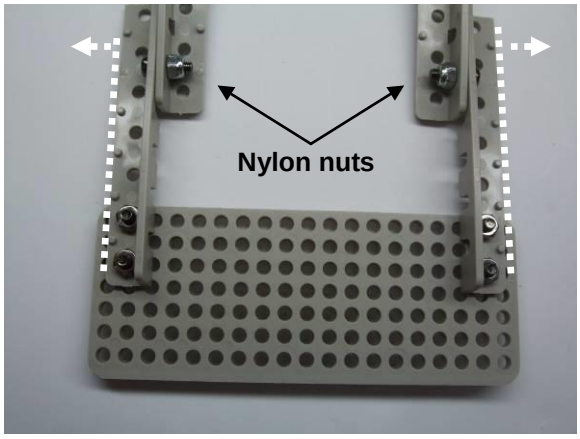



Photo 5.15

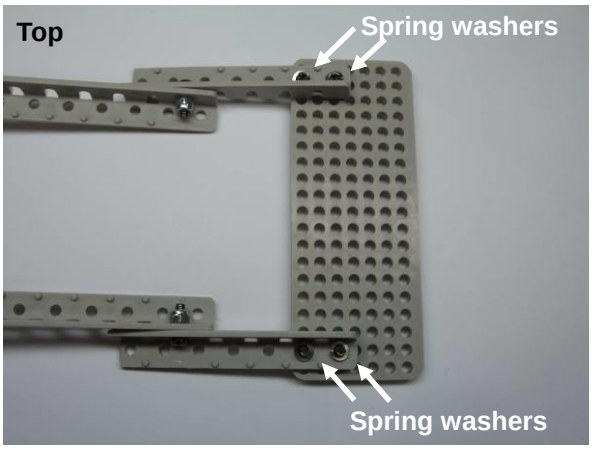



Photo 5.14

Turn over the assembly as shown in photo 5.14. Place spring washers over the ends of the screws indicated by arrows and then screw on and tighten nuts over them.

Once the nuts are tightened and the assembly appears as shown in photo 5.15, the task is complete.
Confirm that the arms can move up and down at the joints secured by nylon nuts. If the movement is not free, move the parts (arms) indicated by dotted lines in photo 5.15 slightly outward.
If the sensor arms still cannot move, loosen the nylon nuts slightly to allow them to move freely.

# 6. Assembling the Tires, Wheels, and Shafts

## 6.1. Assembling the Tires and Wheels


Photo 6.1

Photo 6.2

From the sports tire set shown in photo 6.1, remove the parts shown in photo 6.2.

Photo 6.3

Photo 6.4

Photo 6.5

Fit the tires onto the wheels as shown in photos 6.3 to 6.5. There are a total of four wheels.

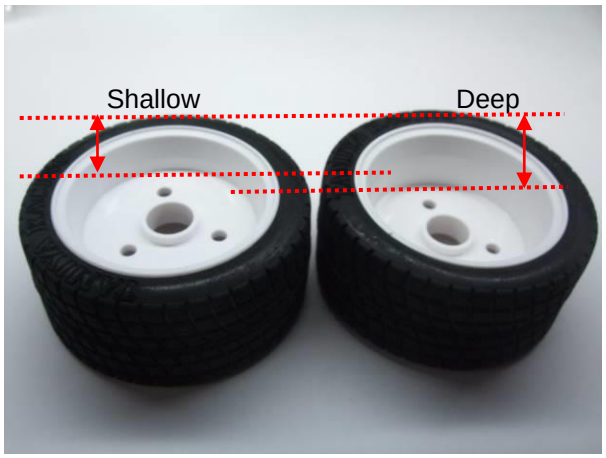



Photo 6.6

As shown in photo 6.6, each wheel has a shallower indentation on the outer side and a deeper indentation on the inner side.

Photo 6.7

Cut the parts from the frames.

Photo 6.8

Cut the parts from the frames shown in photo 6.7 so that the result looks like photo 6.8. Remove any burrs.

Photo 6.9

The parts shown in photo 6.9 are not needed.

Photo 6.10 (nut tighteners)

The nut tighteners are used to tighten nuts. These will be used later, so put them aside in a safe place.

Photo 6.11 (hubs)

Each of the wheels (total four) needs to have one of the hubs shown in photo 6.11 mounted on it.


Photo 6.12

Prepare the quantity of screws, nuts, and spring washers shown in photo 6.12. Note that the screws and nuts to be used are included in the sports tire set, while the spring washers are included in the body-related parts set.

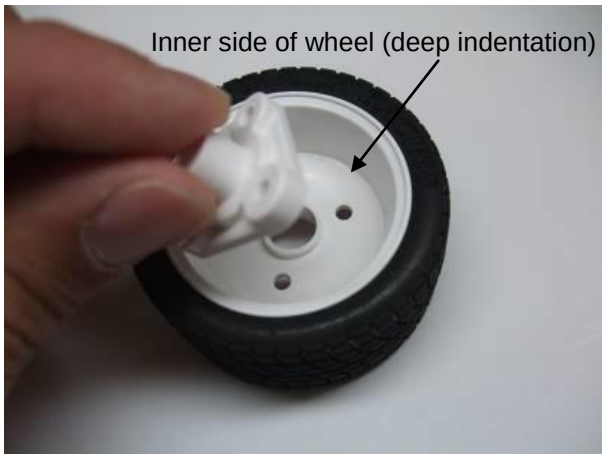



Photo 6.13

Place a hub on the inner side (deep indentation) of the wheel (photo 6.13).


Photo 6.14

Insert a screw into a hole in the outer side (shallow indentation) of the wheel (photo 6.14).

Photo 6.15

As shown in photo 6.15, place a spring washer over the end of the screw.

Photo 6.16

As shown in photo 6.16, screw on a nut.

Photo 6.17

Photo 6.18

As shown in photos 6.17 and 6.18, securely tighten the nut using a nut tightener. If you cannot tighten the nut sufficiently, use a Phillips screwdriver on the opposite side to prevent the screw from turning when you rotate the nut tightener.

Photo 6.19

As shown in photo 6.19, secure the hubs on the wheel using a total of three sets of screws and nuts. Then repeat the same procedure for the remaining wheels and hubs.

Photo 6.20

The sports tire set includes 16 spare nuts. These nuts will be used later, so **be careful not to lose them**.

## 6.2. Preparing the Shafts for the Front Wheels

Photo 6.21

Remove the bags shown in photo 6.21 from the high-speed gearbox box. Then remove the shafts from the bags.

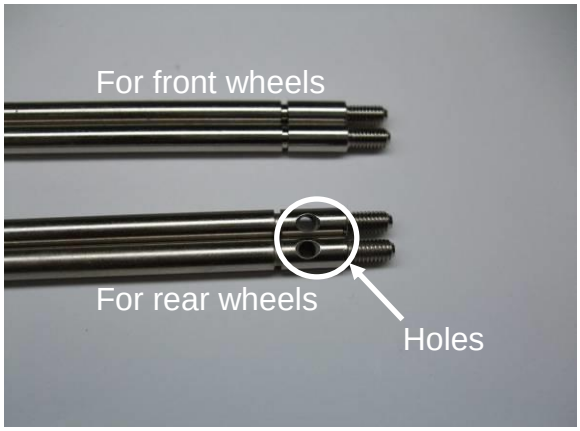



Photo 6.22

As shown in photo 6.22, the shafts with holes in them will be used for the rear wheels, and those without holes in them will be used for the front wheels.

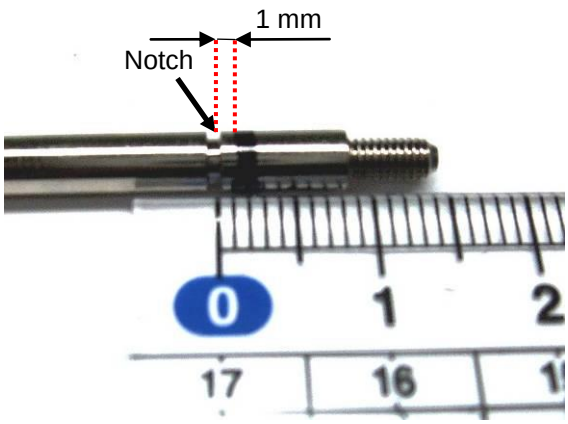



Photo 6.23

For this task you will need the two shafts without holes in them that will be used for the front wheels. Use a felt-tip pen to make a mark about 1 mm from the notch indicated by the arrow in photo 6.23.

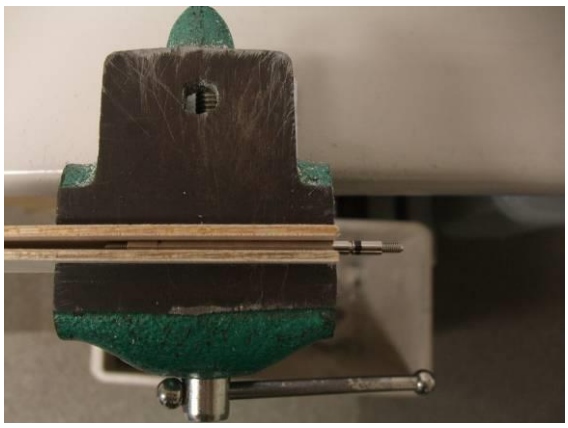


Photo 6.24

Clamp the shaft in the vise. Clamping the shaft directly could damage it, so place pieces of wood or cardboard between the shaft and the vise.

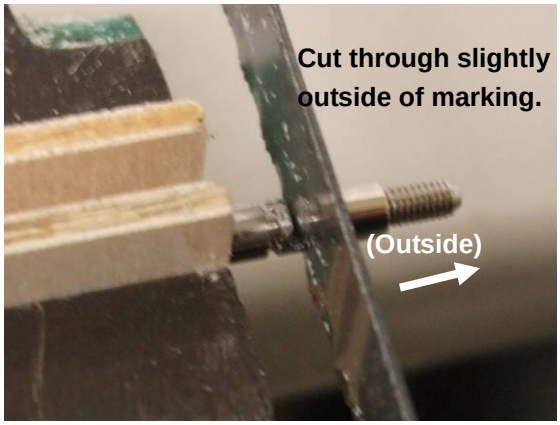



Photo 6.25

As shown in photo 6.25, use the hacksaw to cut through the shaft slightly to the outside (arrow) of the marking.

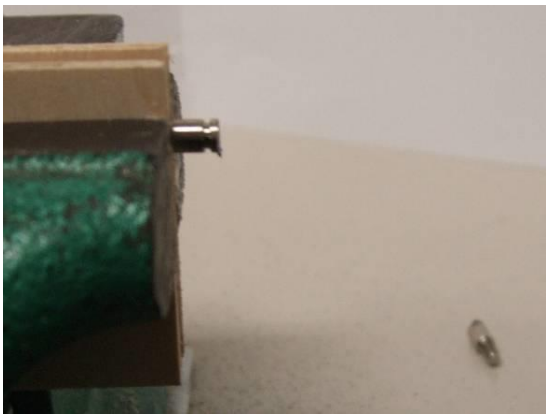


Photo 6.26

After sawing off the end of the shaft as shown in photo 6.26, **be careful handling the pieces because they will remain hot for some time after you finish sawing**.

Photo 6.27

Cut off the end of the second front wheel shaft in the same manner.

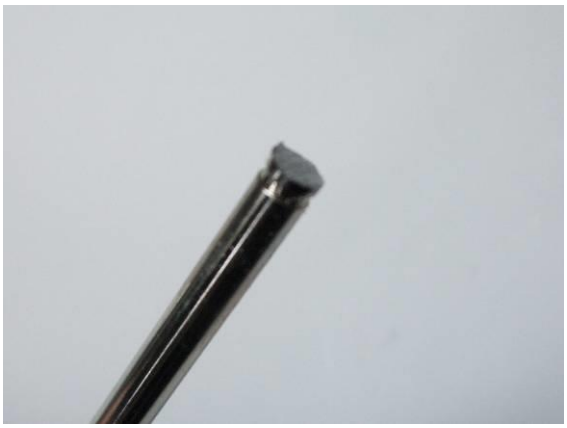


Photo 6.28

As shown in photo 6.28, burrs remain after sawing off the end of the shaft.

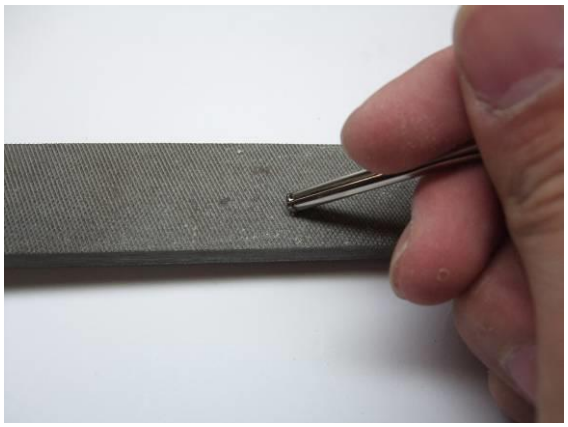


Photo 6.29

File the end flat as shown in the photo.

Photo 6.30

Once the burrs have been removed as shown in photo 6.30, preparation of the front wheel shafts is complete.

## 6.3. Mounting the Bearings


Photo 6.31

Prepare the parts shown in photo 6.31 (parts: 2 front wheel shafts, 4 E-rings).

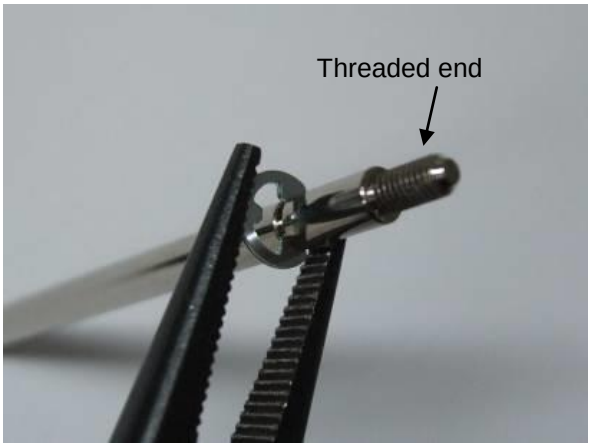



Photo 6.32

As shown in photo 6.32, use the radio pliers to fit an E-ring onto the groove in a front wheel shaft on the threaded end.


Photo 6.33

Fit another E-ring onto the groove in the other front wheel shaft on the threaded end (photo 6.33). Do not install E-rings on the other end of the shafts yet.

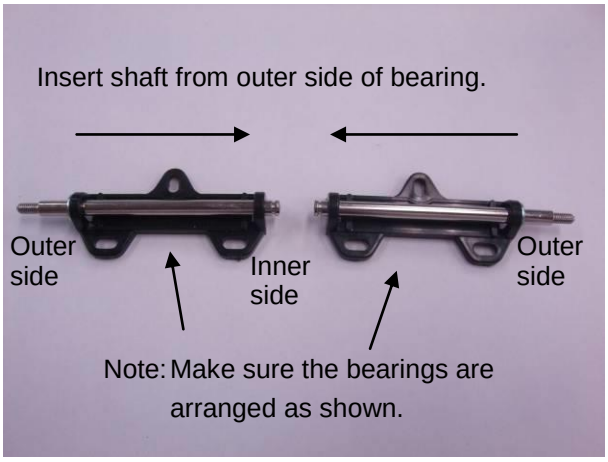



Photo 6.34

With the bearings arranged as shown in photo 6.34, insert a shaft (photo 6.33) into each bearing from the outer side and install an E-ring.


Photo 6.35

Once the front wheel shafts have been inserted into the bearings and secured with E-rings, the task is complete.

## 6.4. Mounting the Front Wheel Shafts

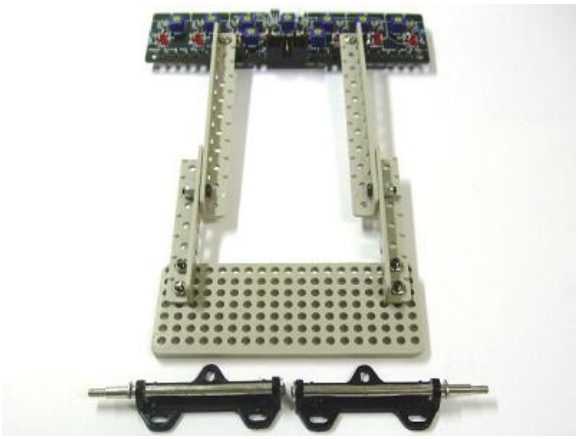


Photo 6.36

The next task is mounting the front wheel shafts.

Photo 6.37

As shown in photo 6.37, prepare four each of black screws, spring washers, and nuts.

Photo 6.38

As shown in photo 6.38, fit the spring washers over the black screws.

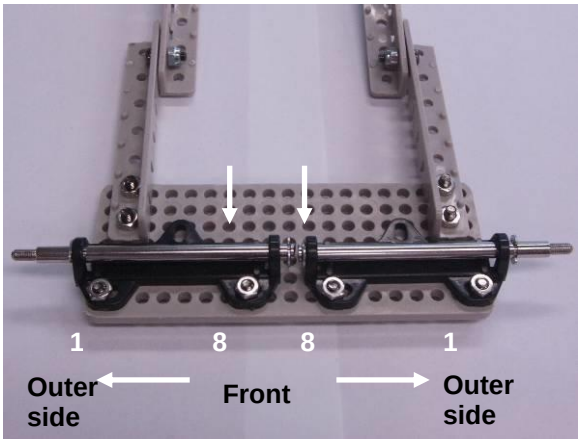



Photo 6.39

Insert the black screws prepared as shown in photo 6.38 into the assembly from the underside, as shown in photo 6.39, and screw on nuts loosely to hold them in place. While pushing on the bearings in the direction indicated by the arrows (forward and outward), tighten the nuts securely. While doing this, **be careful to ensure that the left and right shafts do not make contact in the center. If the shafts touch in the center, file down the ends some more to shorten the length.**

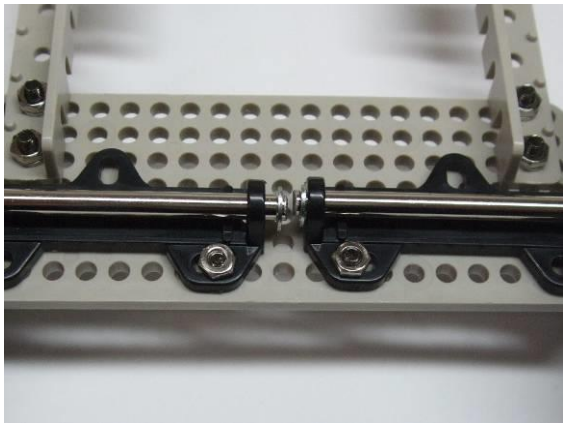


Photo 6.40

The narrower the distance between the end of the shaft and the notch, the better. However, if you file off too much the wall of the notch will disappear, and the E-ring will fall off. If you file off too little, the opposing shafts will make contact in the center, as shown in photo 6.40. Try to leave about 1 mm between the notch and the end of the shaft to ensure that the opposing shafts do not touch and the E-rings remain securely in place.

# 7. Mounting the Servo Motor

## 7.1. Preparing the Servo Horn


Photo 7.1

Photo 7.2

For this task you will need the contents of the servo motor package, as shown in photo 7.1. The parts we will use are the red servo horn, the servo motor itself, and, as shown in photo 7.2, two screw and washer assemblies (dia. 3 × 15 mm, flat washer dia. 6 mm) and two nuts.


Photo 7.3

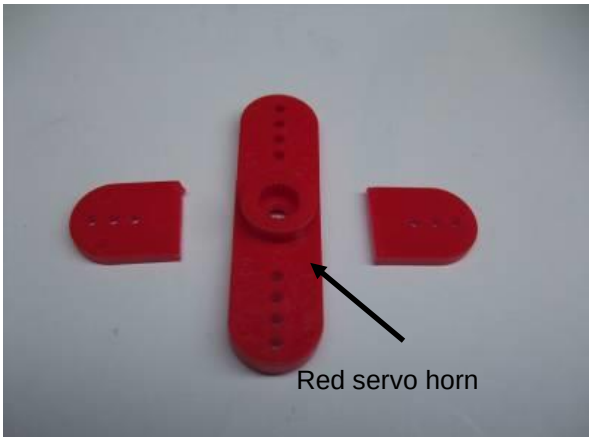



Photo 7.4

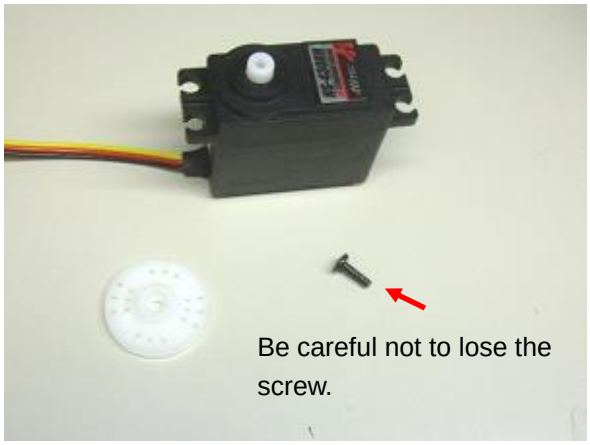



Photo 7.5

Use nippers to cut off at the indentation lines the two side pieces of the servo horn. The result should look as shown in photo 7.4 after the two pieces are cut off.

Remove the white servo horn attached to the servo motor (photo 7.5).

Note: Be careful not to lose the screw you removed to take off the white servo horn because it will be used to secure the red servo horn in place.

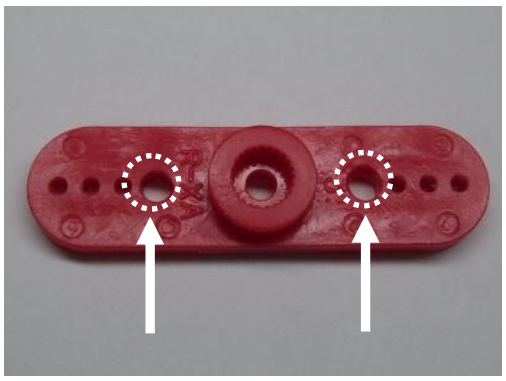


Photo 7.6 (complete)

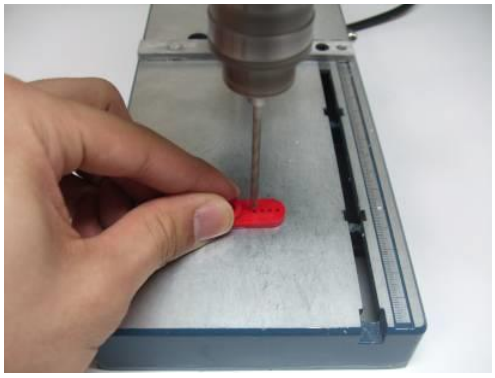


Photo 7.7

Using a dia. 3 mm bit, drill holes in the two places indicated by arrows in photo 7.6 (photo 7.7).
(Note: Hold the servo horn firmly in place while drilling.)

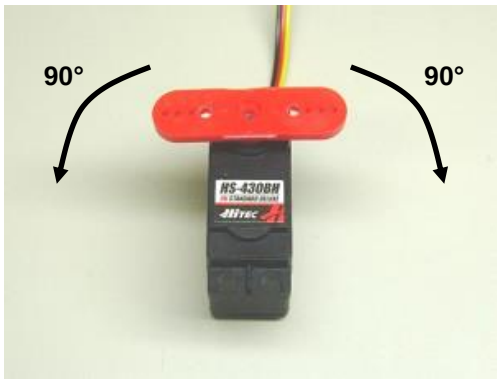



Photo 7.8

Confirm that the servo horn can turn about 90 degrees to the right and to the left.

Photo 7.9

Once you have confirmed that it can turn 90 degrees to the right and left, secure the servo horn in place with the screw you removed earlier.

## 7.2. Adjusting the Servo Centre

Here we explain how to adjust the servo if it cannot turn 90 degrees to both the right and left. The servo motor can rotate over a range of about 270 degrees. Fine adjustment must be performed in software, but here we will show you how to adjust the sensor so the servo can physically turn about the same amount to the right and left.


Photo 7.10


Photo 7.11


Photo 7.12

- Place the servo horn on the servo motor as shown in photo 7.10.
  Note: Do not secure it with the screw.
- Turn the servo horn counterclockwise as far as it will go.
- The servo is now stopped in the position shown in photo 7.11.
  Note: This position will differ from case to case.
- Remove the servo horn. Then replace the servo horn in the orientation shown in photo 7.12.
- This completes the adjustment to enable the servo horn to turn 90 degrees to the right and left, as shown in photo 7.8.

## 7.3. Mounting the Servo Horn on the Front Wheel Support Plate

Photo 7.13

For this task you will need the parts shown in photo 7.13.

Parts:

- Front wheel assembly
- Servo motor
- Servo horn support plate
- 2 screw and washer assemblies (dia. 3 × 15 mm, flat washer 6 mm)
- 2 nuts

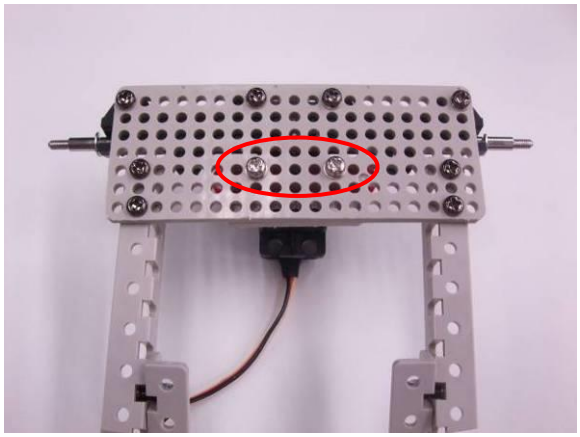


Photo 7.14

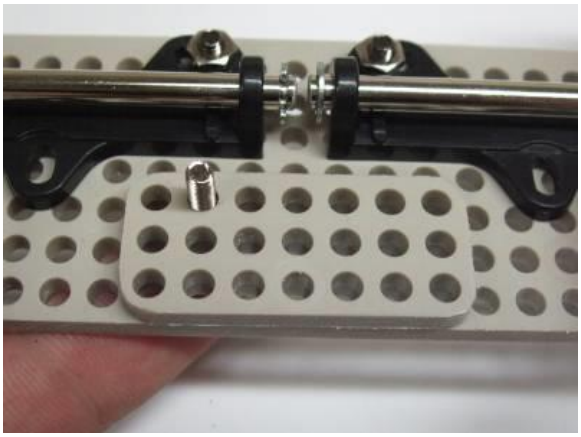


Photo 7.15

Insert the screw and washer assemblies (dia. 3 × 15 mm, flat washer dia. 6 mm) from the underside.

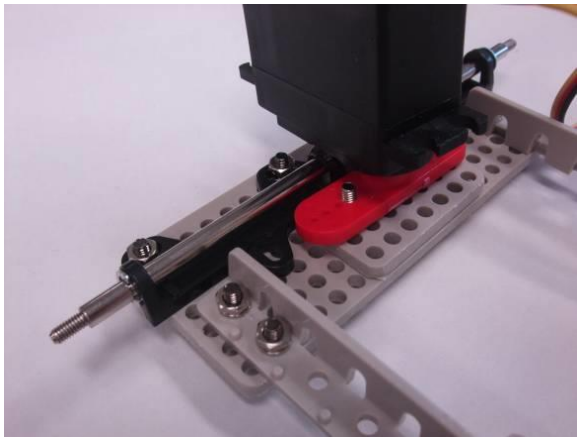


Photo 7.16

As shown in photo 7.16, fit the servo horn over the ends of the screws.

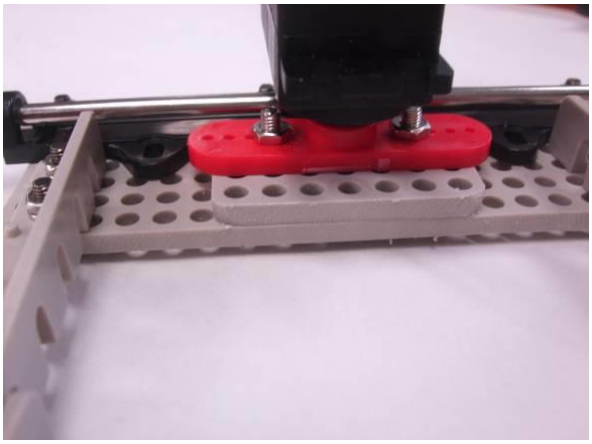
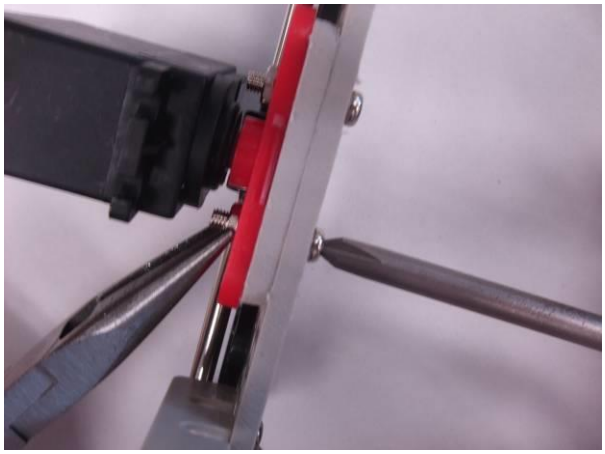


Photo 7.17

As shown in photo 7.17, screw nuts onto the ends of the screws to fix the servo horn in place.



As shown in photo 7.18, use radio pliers and a Phillips screwdriver to tighten the screws and nuts.

Photo 7.18

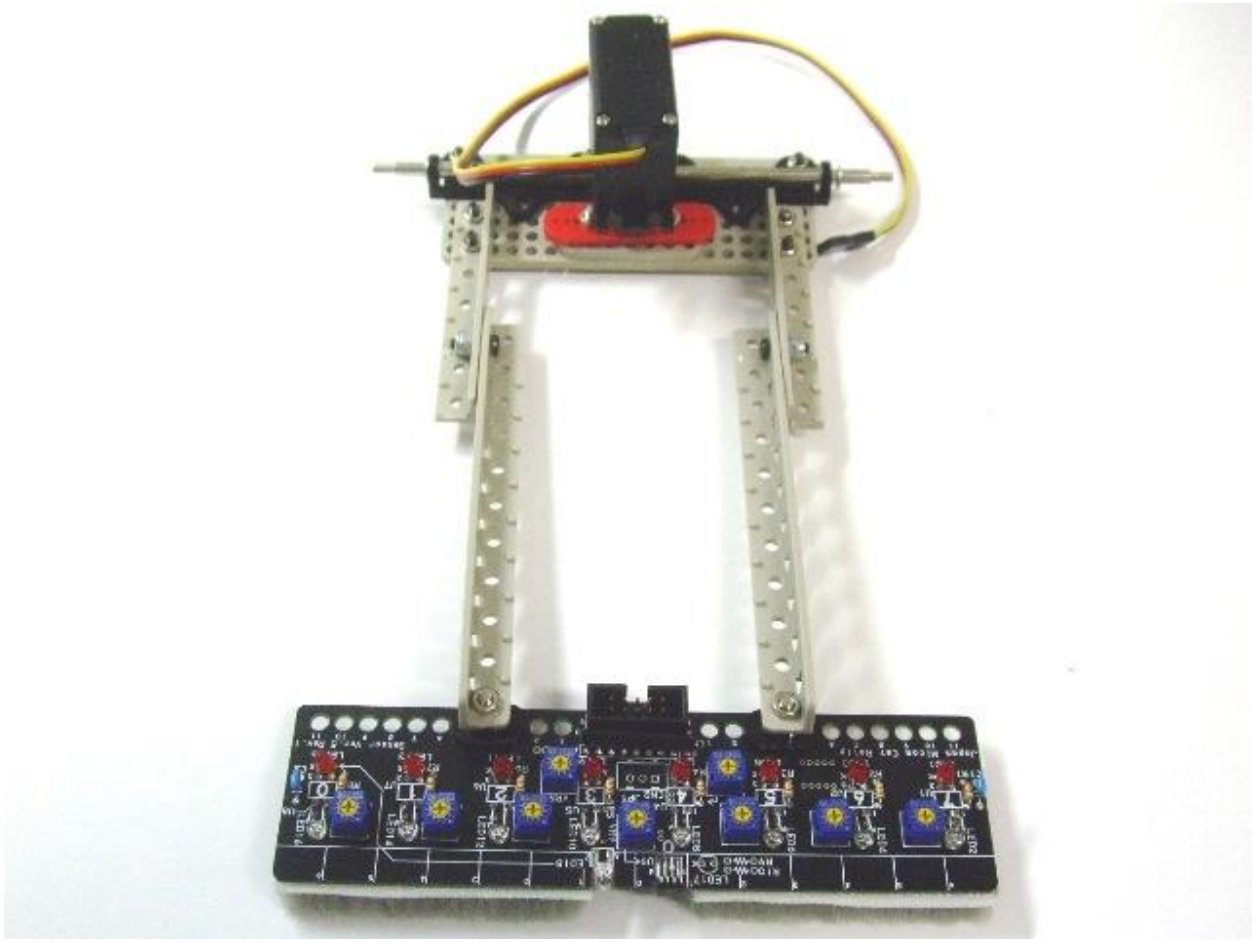


Photo 7.19

This completes the task of mounting the servo motor on the front wheel support plate.

# 8. Assembling the Gearbox

## 8.1. 8.1 Assembling the Gearbox

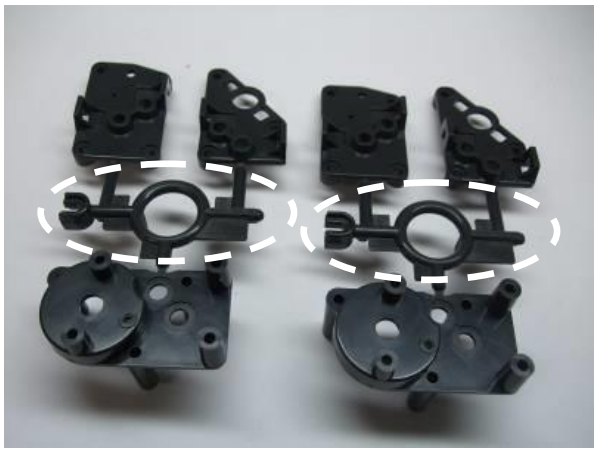


Photo 8.1

Remove the parts shown in photo 8.1 from the high-speed gearbox box, and use nippers to cut them apart as shown. Save the frame portions within the dotted ovals as they will be used later.

Photo 8.2

Remove any burrs from the parts that have been cut from the frames.

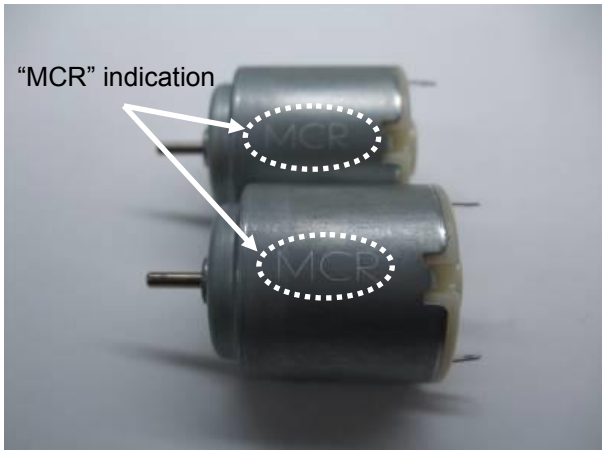



Photo 8.3

Next, prepare the two motors. The motors we will use have “MCR” printed on them. (Note: We will not be using the motors contained in the gearbox set.)


Photo 8.4

Photo 8.4 shows four metal pinion gears, but we will only use two. The remaining two are spares.

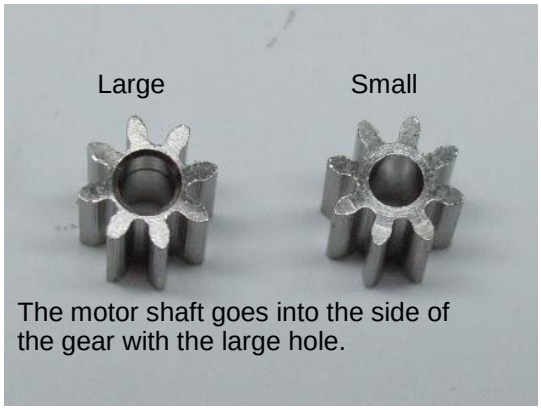



Photo 8.5

Each metal pinion gear has a large hole on one side and a small hole on the other (photo 8.5). The motor shaft goes into the side of the gear with the large hole.

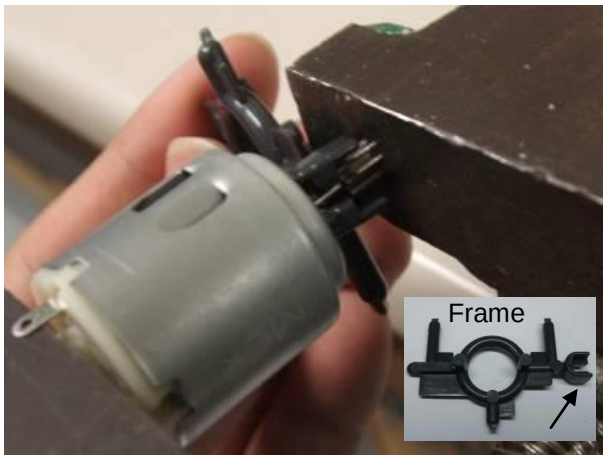



Photo 8.6

As shown in photo 8.6, press the shaft into the metal pinion gear using a small vise, taking care not to damage the motor terminals. Make sure the motor shaft is horizontal and take care not to bend it when operating the vise. During this process, use a piece of the part frame to check the amount the gear has been pushed onto the shaft.

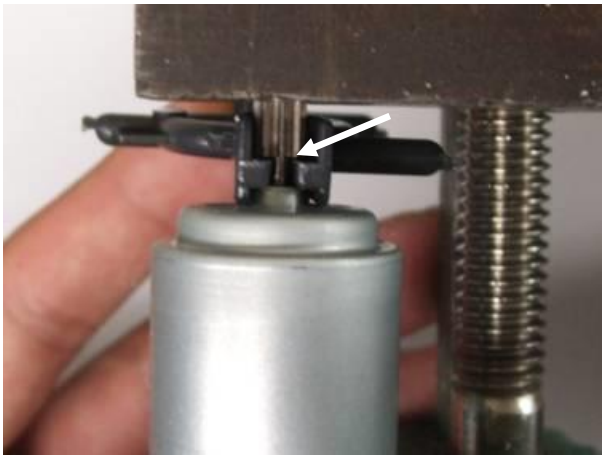


Photo 8.7

As indicated by the arrow in photo 8.7, stop closing the vise at a point right before the gear touches the piece of the part frame. Now repeat the procedure for the other motor.

Photo 8.8

Note

You must stop closing the vise at a point at which the shaft is still slightly recessed inside the metal pinion gear, as shown in photo 8.8. Continuing until the shaft is flush with the side of the gear or starts to extend out from the gear would result in force being applied directly to the shaft, causing it to bend. This is why you should check your progress using a U-shaped piece of the part frame.

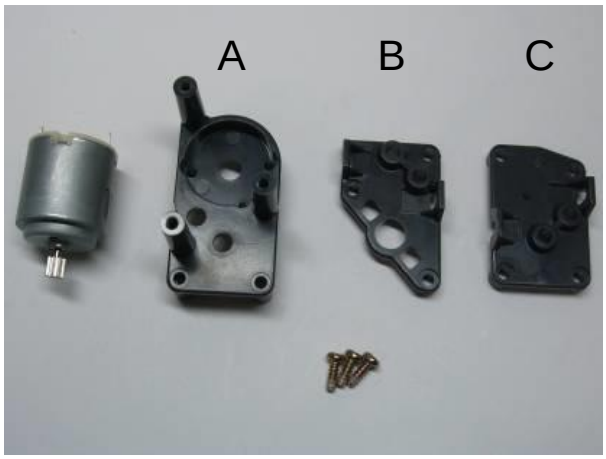



Photo 8.9

Prepare the items shown in photo 8.9: parts cut from the frames earlier, motors with metal pinion gears, and three tapping screws.

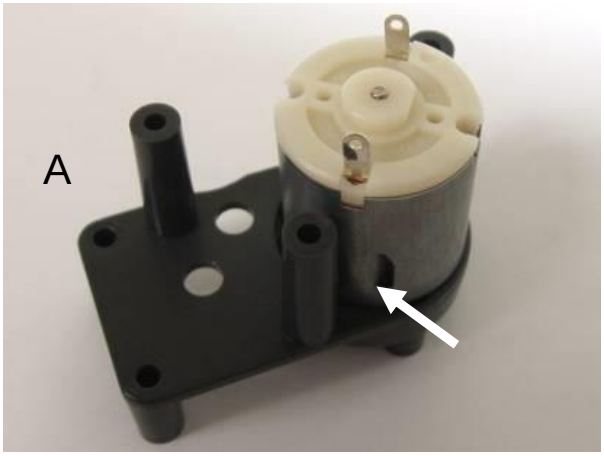



Photo 8.10

Mount a motor on part A as shown in photo 8.10, using the hole in the motor indicated by the arrow as a guide.

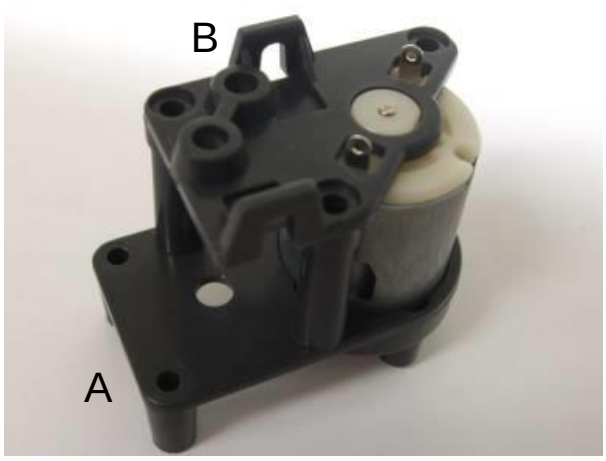



Photo 8.11

Add part B as shown in photo 8.11.

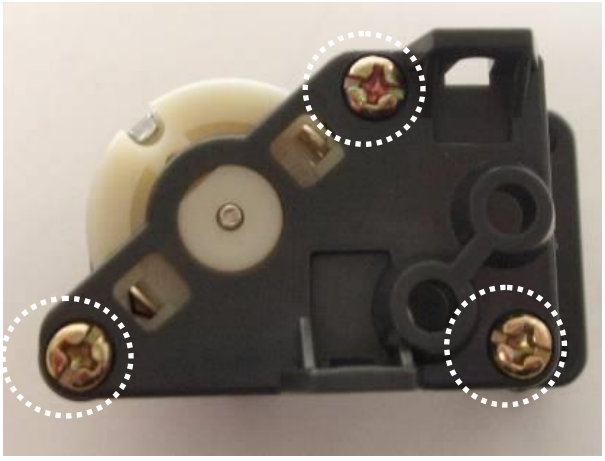


Photo 8.12

Secure with three tapping screws as shown in photo 8.12.

Photo 8.13

Note: Be careful not to tighten the screws too far. It is sufficient to tighten the tapping screws to the point shown in the photo at left (arrow).

Photo 8.14

Mount motors in two gearboxes as shown.

### 8.1.1. Assembling the Gearbox for the Left Motor

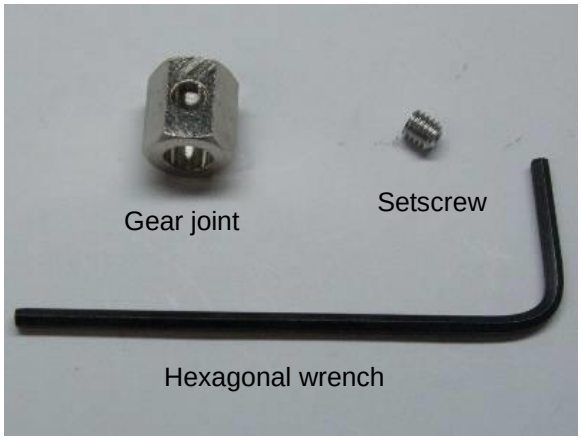



Photo 8.15

Prepare a hexagonal wrench, setscrew, and gear joint, as shown in photo 8.15.

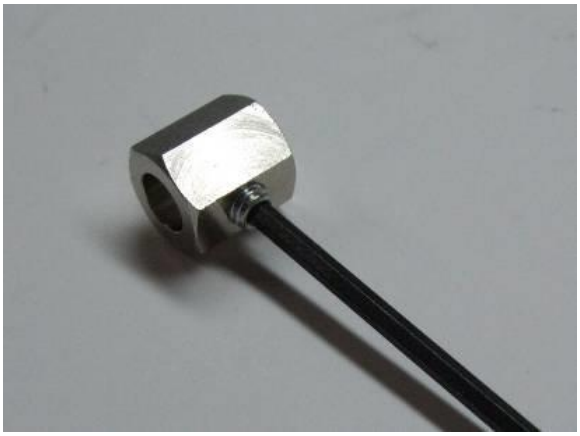


Photo 8.16

As shown in photo 8.16, insert the hexagonal wrench into the hole in the setscrew, and screw the setscrew partway into the gear joint.

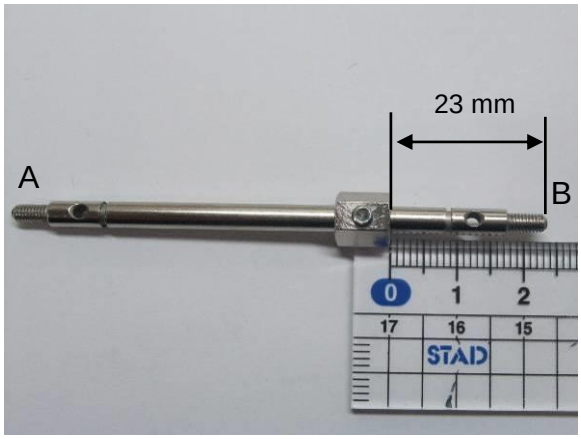



Photo 8.17

Prepare a rear wheel shaft. Slide the gear joint to a position 23 mm from the end of the shaft and secure it with the setscrew.

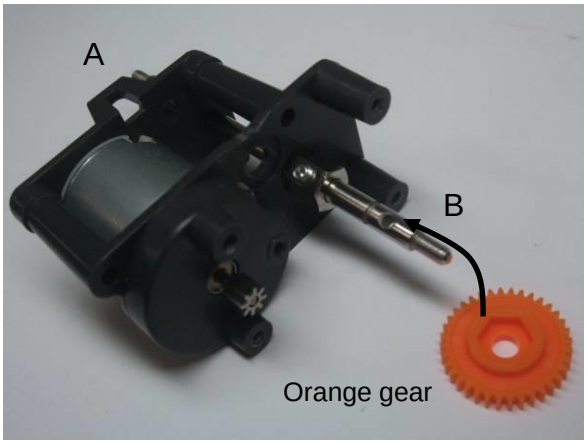



Photo 8.18

Insert the shaft into the gearbox as shown in photo 8.18. Insert the shaft such that ends A and B, as indicated in photo 8.17, are positioned as indicated by A and B in photo 8.18. Fit the hexagonal opening in the orange gear over the gear joint.


Photo 8.19

The gearbox and shaft with the orange gear attached appears as shown.

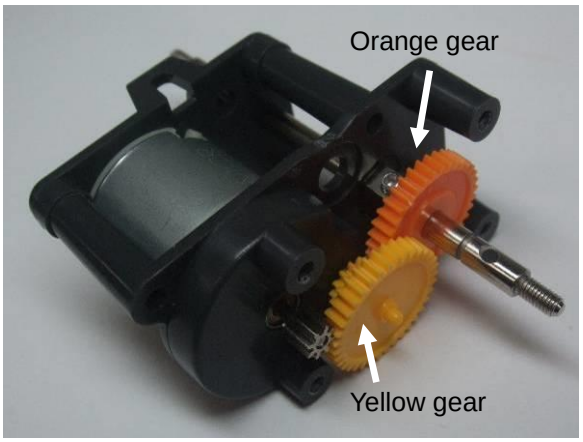



Photo 8.20

Add the yellow gear so that it meshes with the orange gear and metal pinion gear.

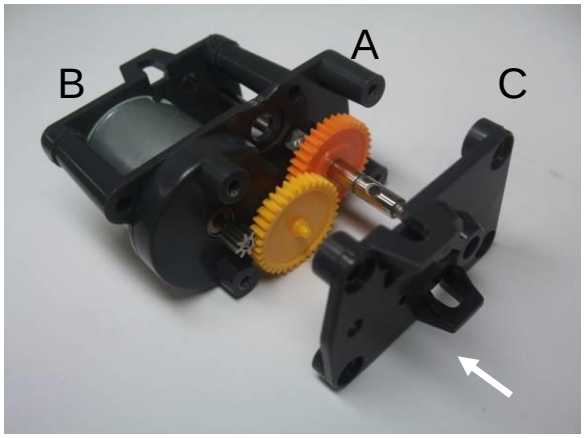



Photo 8.21

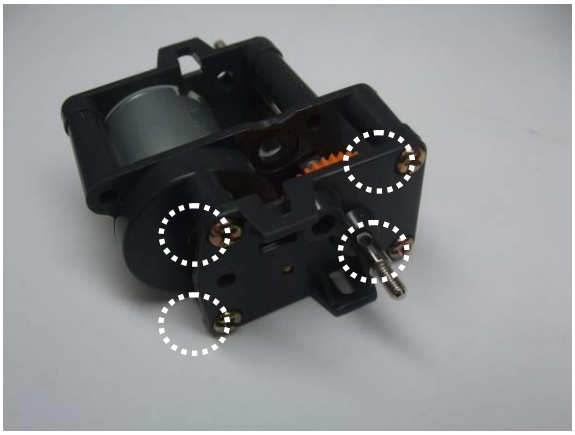


Photo 8.22

Add part C as indicated by the arrow in photo 8.21 and secure it in place with four tapping screws.
Note: Do not tighten the screws too far.

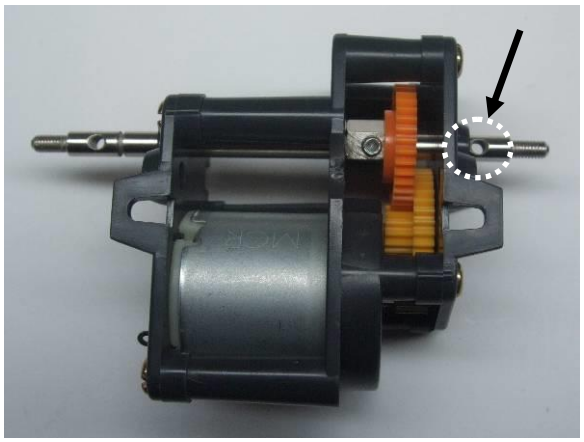


Photo 8.23

When the hole in the shaft indicated by the arrow in photo 8.23 is visible beyond the edge of the gearbox, assembly of the gearbox for the left motor is complete. Also, please understand that is the gearbox for the left motor.

### 8.1.2. Assembling the Gearbox for the Right Motor

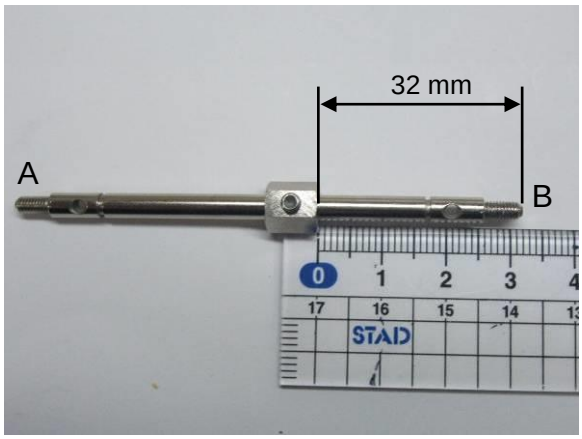



Photo 8.24

Prepare a rear wheel shaft. Slide the gear joint to a position 32 mm from the end of the shaft and secure it with the setscrew.

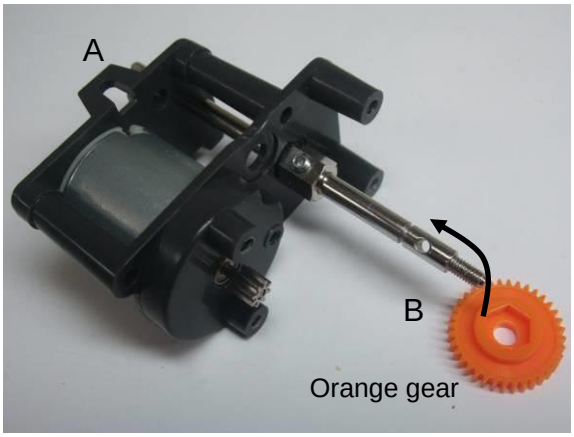



Photo 8.25

Insert the shaft into the gearbox as shown in photo 8.25. Insert the shaft such that ends A and B, as indicated in photo 8.24, are positioned as indicated by A and B in photo 8.25. Fit the hexagonal opening in the orange gear over the gear joint.


Photo 8.26

The gearbox and shaft with the orange gear attached appears as shown.

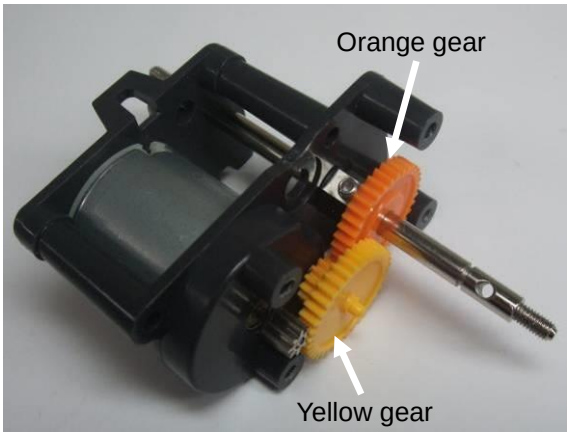



Photo 8.27

Add the yellow gear so that it meshes with the orange gear and metal pinion gear.

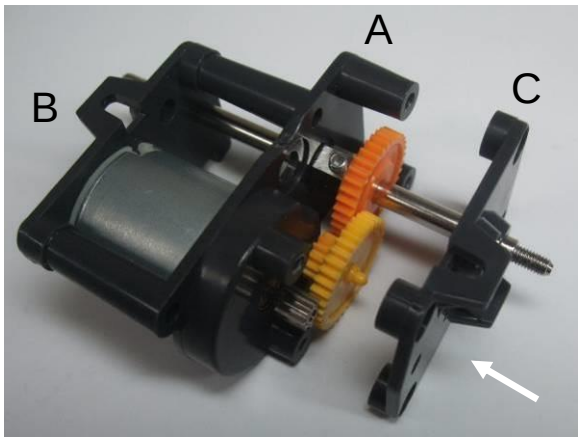



Photo 8.28

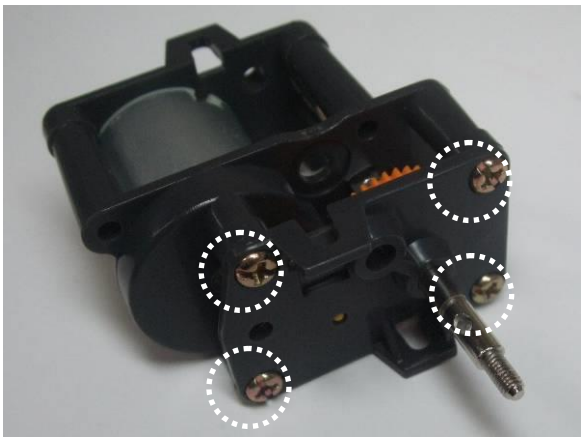


Photo 8.29

Add part C as indicated by the arrow in photo 8.28 and secure it in place with four tapping screws.

Note: Do not tighten the screws too far.

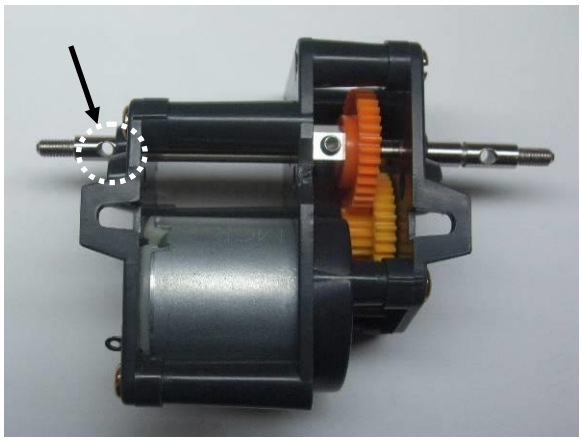


Photo 8.30

When the hole in the shaft indicated by the arrow in photo 8.30 is visible beyond the edge of the gearbox, assembly of the gearbox for the right motor is complete.

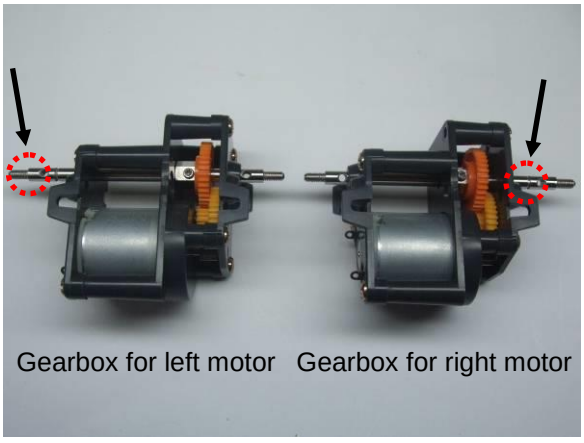



Photo 8.31

Insert spring pins into the holes indicated by the arrows in photo 8.31.

### 8.1.3. Inserting the Spring Pins

Photo 8.32

For this task you will need two spring pins. Four spring pins are included with the kit, but two of them are spares.

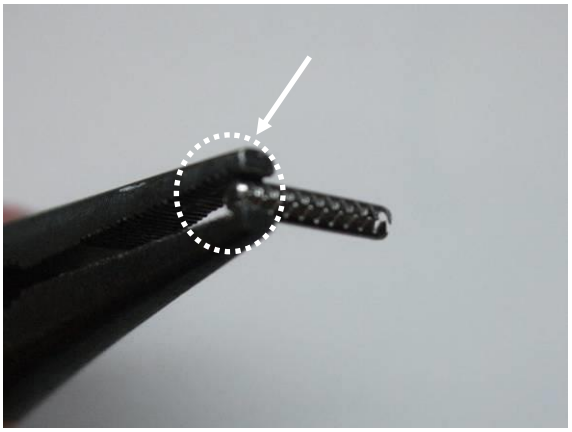


Photo 8.33

Slightly crimp the end of a spring pin.


Photo 8.34

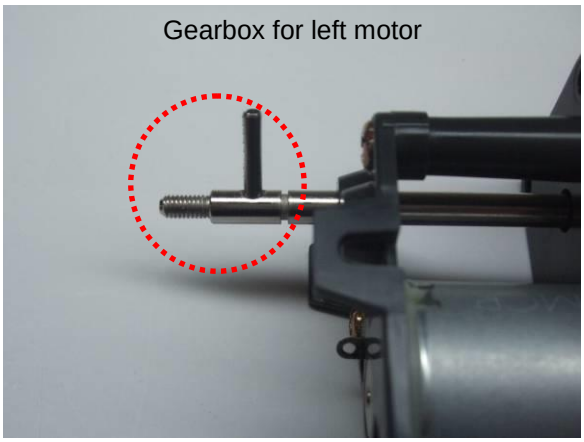



Photo 8.35

Insert the slightly crimped end of the spring pin into the hole in the shaft of the gearbox for the left motor.

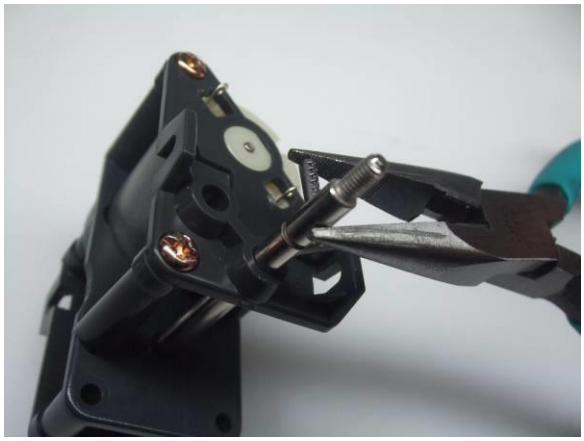


Photo 8.36

As shown in photo 8.36, use radio pliers to grip the spring pin and push it into the hole.

Photo 8.37

As shown in photo 8.37, insert the spring pin about halfway.

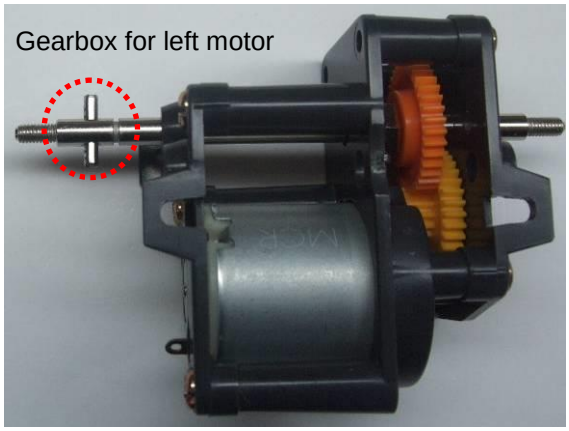



Photo 8.38

When insertion is complete, the spring pin appears as shown in photo 8.38.

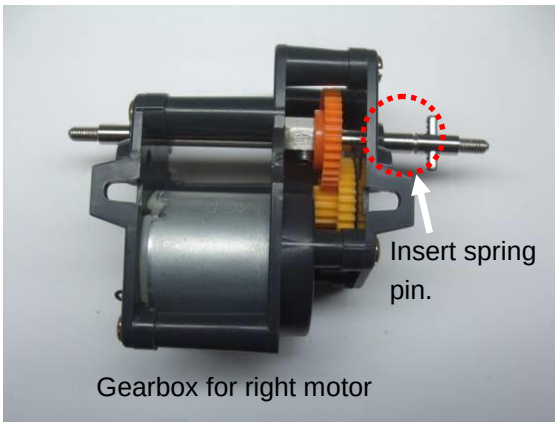



Photo 8.39

In the same manner, insert a spring pin into the hole in the shaft of the gearbox for the right motor.

Photo 8.40

This completes the gearbox assembly task.

## 8.2. Installing the Ceramic Capacitors (for Noise Suppression)

In this section we will install ceramic capacitors (0.01 μF) to absorb noise generated by the motors.

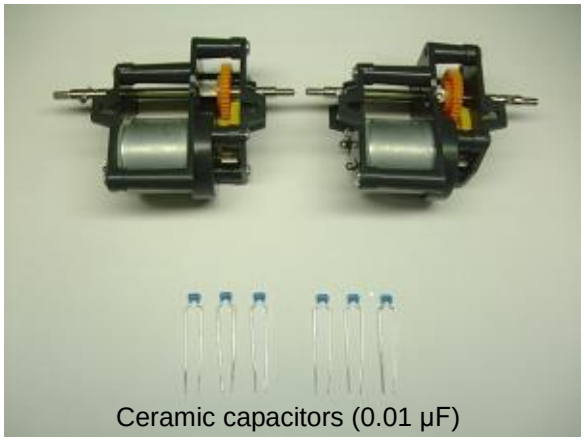



Photo 8.41

Prepare six ceramic capacitors with “103” printed on them. (There should be six unused ceramic capacitors remaining after fabricating the motor drive board.)

Photo 8.42

As shown in photo 8.42, feed the leads of a ceramic capacitor through the holes in the motor terminals.

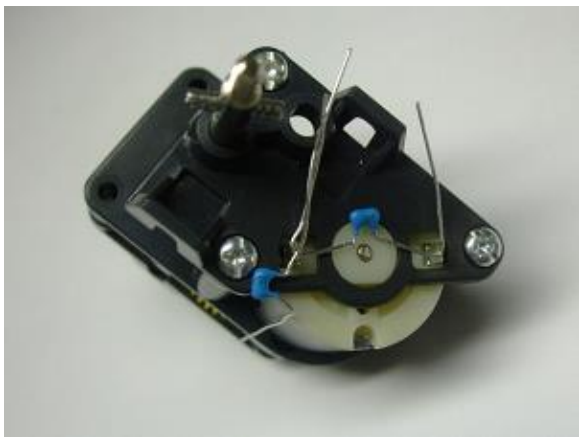


Photo 8.43

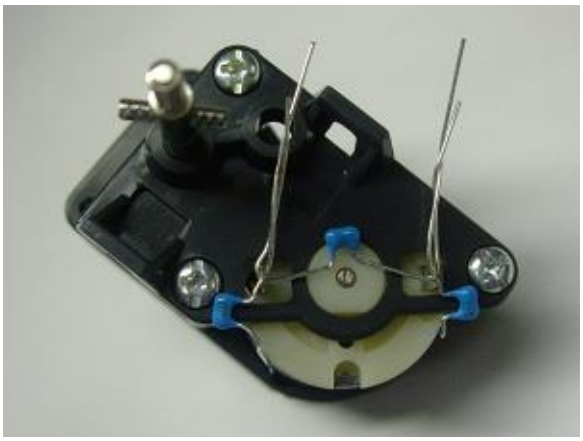


Photo 8.44

As shown in photos 8.43 and 8.44, attach two more ceramic capacitors for a total of three, feeding their leads through the holes in the motor terminals.

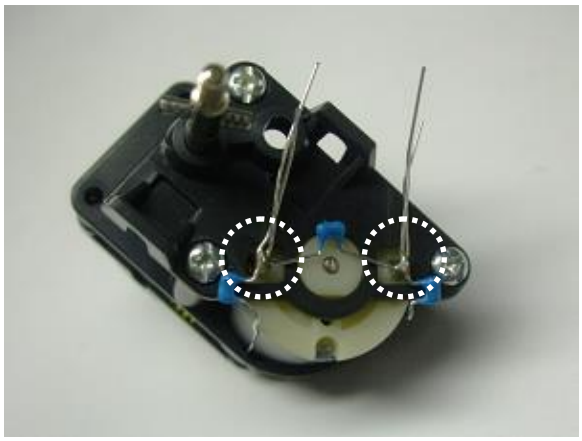


Photo 8.45

Apply solder to the locations indicated by circles in photo 8.45. Apply solder such that the capacitor leads are as short at possible (photo 8.46). If the leads are too long, the capacitors will not be very effective in absorbing noise. For this reason, the leads should be kept as short as possible.

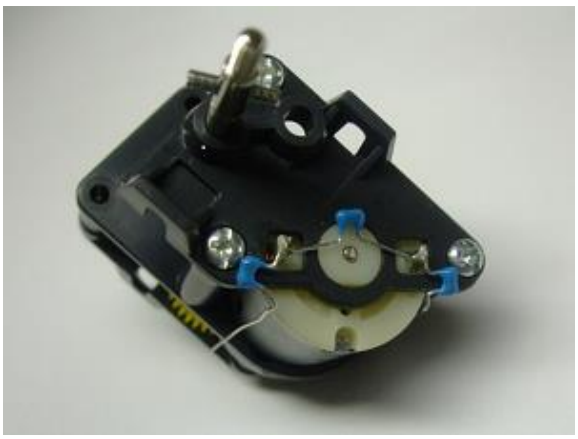


Photo 8.46

Use nippers to snip off the excess portion of the capacitor leads, so the result looks as shown in photo 8.46.

Photo 8.47

Next, we will solder the remaining capacitor leads, shown in photo 8.47, to the side of the motor.

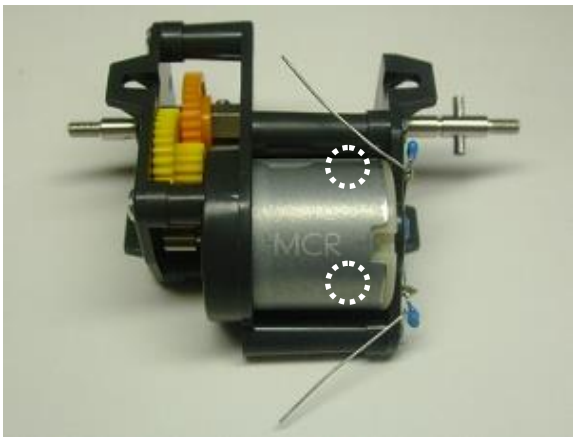


Photo 8.48

The outside of the motor is oxidized, making it difficult for solder to adhere so it is necessary to file the oxidation away in the spots where solder will be applied. File the spots, indicated by circles, on the outside of the motor to achieve short capacitor leads.

Photo 8.49

Apply solder the filed locations as shown in photo 8.49. Since it takes a while for heat to transfer to the motor surface, touch each filed area with the soldering iron for about five seconds before flowing solder onto it.

Photo 8.50

As shown in photo 8.50, hold down the capacitor lead with a screwdriver or the like. Then touch it with the tip of the soldering iron to melt the solder and provide easy adhesion. Try to keep the capacitor leads as short as possible.

Photo 8.51

Photo 8.52

Finally, snip off the excess portion of the capacitor leads. Repeat the entire procedure for the other gearbox.

## 8.3. Attaching the Motor Power Wires

Photo 8.53

Prepare the red and black electrical wire.

Photo 8.54

For this task you will need three XH connectors and six contact pins.

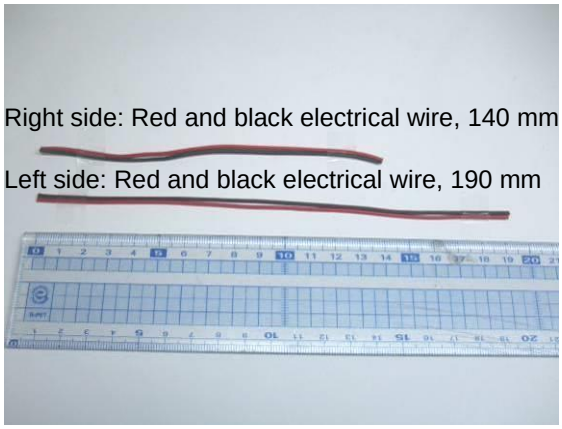



Photo 8.55

As shown in the photo, cut pieces of red and black electrical wire to a length of 140 mm for the right side and 190 mm for the left side.


Photo 8.56

Prepare crimping pliers and a wire stripper.

Photo 8.57

Next, we will attach the power wires to the right motor. (140 mm lengths of red and black electrical wire, one 2-pin female connector, and two contact pins)

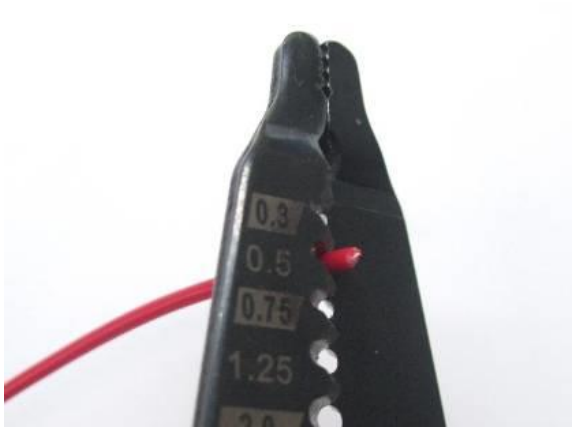



Photo 8.58

As shown in photo 8.58, use the wire stripper to remove about 2 mm of insulation from the ends of the red and black electrical wires. Use the 0.5 hole of the wire stripper to remove the insulation.

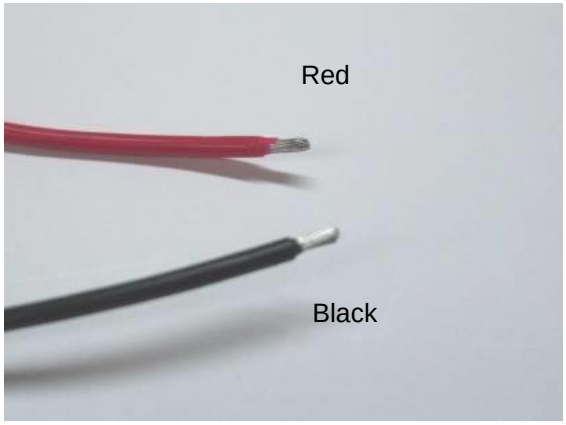



Photo 8.59

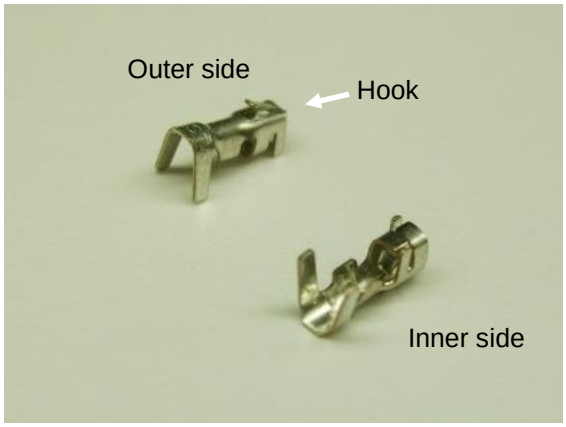



Photo 8.60

After stripping about 2 mm of insulation from the ends of the wires as shown in photo 8.59, we will attach the contact pins.

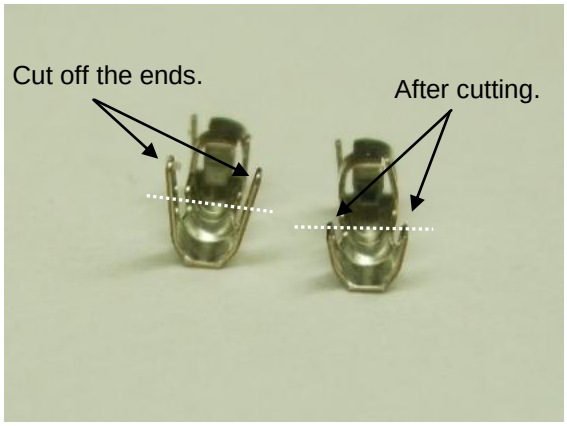



Photo 8.61

Use the nippers to cut off the ends of the crimping prongs of a contact pin, as indicated by the dotted lines in the photos.

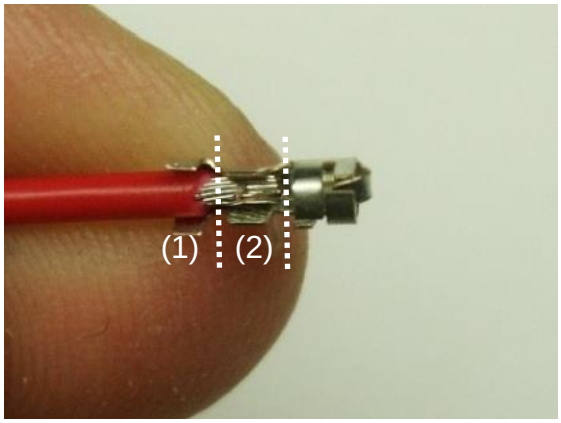



Photo 8.62

Insert the stripped portion of the electrical wire into the area between the dotted lines (2) as shown in the photo. If the stripped portion does not fit, clip off a bit from the end of the wire to make it fit.


Photo 8.63

Crimp section (2) with the crimping pliers at position 1.7L.

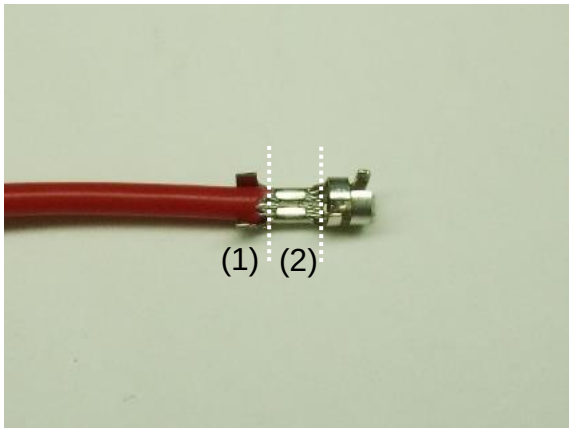



Photo 8.64

After section (2) is crimped the result should look as shown in the photo. Make sure that the contact pin does not come off when you pull on the electrical wire.

Photo 8.65

Crimp section (1) with the crimping pliers at position 1.7H.

Photo 8.66

After section (1) is crimped the result should look as shown in the photo. Next, attach a contact pin to the other electrical wire.

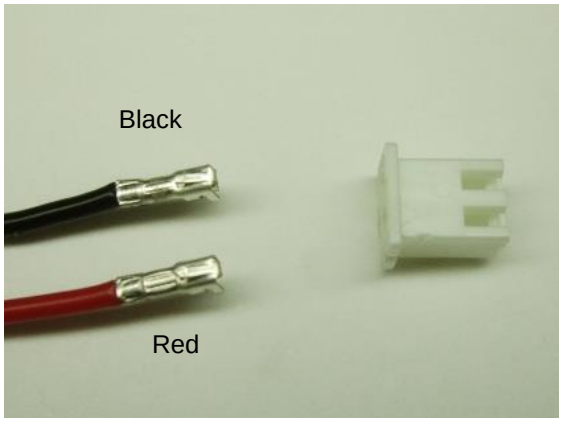



Photo 8.67

Insert the ends of the electrical wires, with the contact pins attached, into an XH connector.

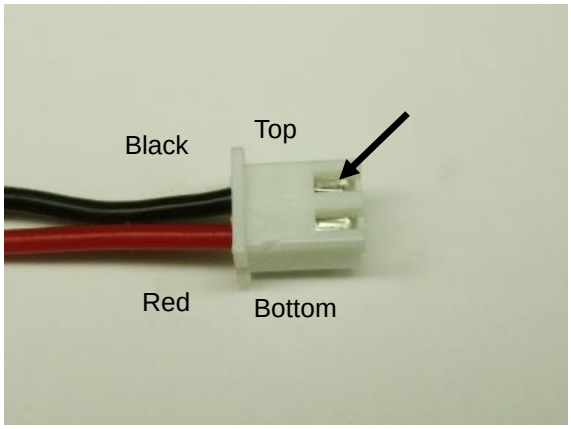



Photo 8.68

As shown in the photo, insert the red wire on the bottom and the black wire on the top. Insert until the hook of each pin connector reaches the point indicated by the arrow.

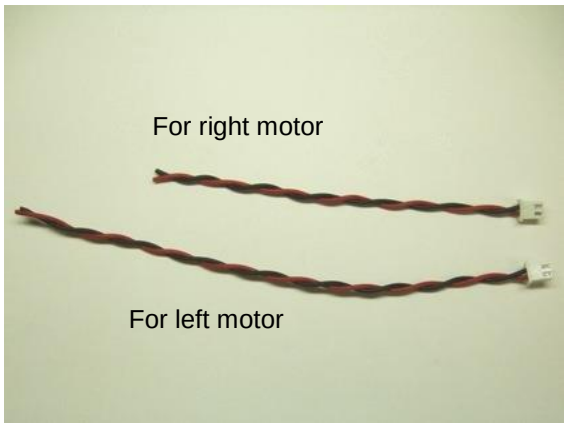



Photo 8.69

Repeat the above steps to attach pin connectors to the power wires for the left motor. After attaching the connectors, twist the red and black wires as shown in the photo.

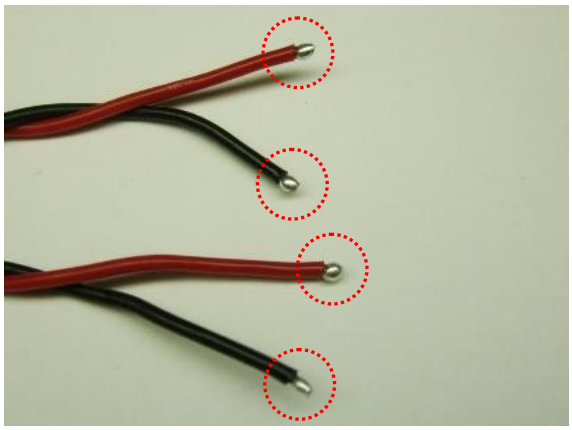


Photo 8.70

Use the wire stripper to remove about 2 mm of insulation from the ends of the red and black electrical wires opposite the connectors, and apply solder to the exposed strands as shown in the photo.

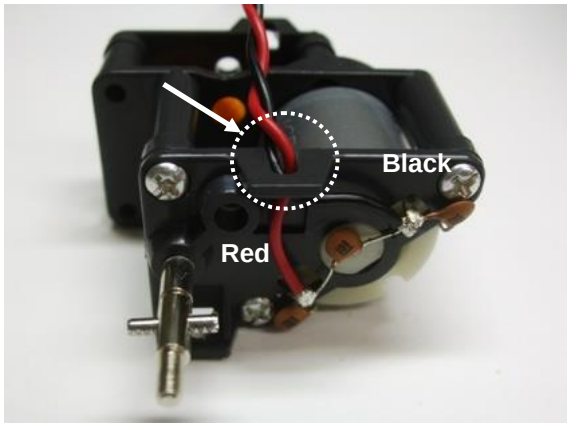



Photo 8.71

For the left motor, feed the power wires (**long wires**) through the portion indicated by the arrow in the photo. Solder the tips of the power wires to the motor terminals.

Note: Be careful not to reverse the red and black wires when soldering them to the terminals.

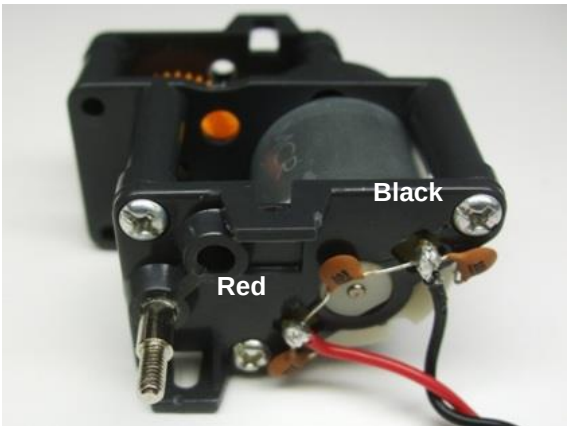



Photo 8.72

For the right motor, solder the tips of the power wires (**short wires**) to the motor terminals as shown in the photo.

Note: Be careful not to reverse the red and black wires when soldering them to the terminals.

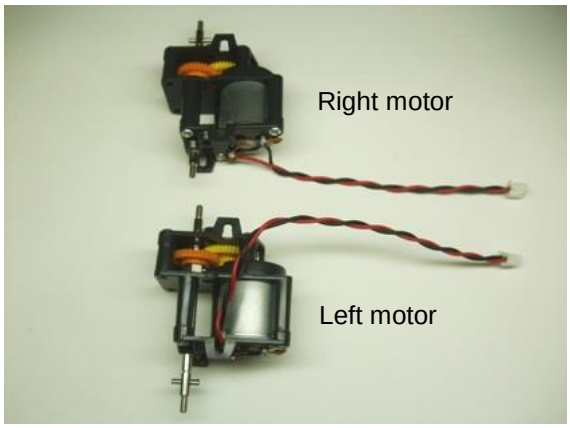



Photo 8.73

When the task is complete, the gearboxes appear as shown in the photo.

## 8.4. Mounting the Gearboxes on the Main Board

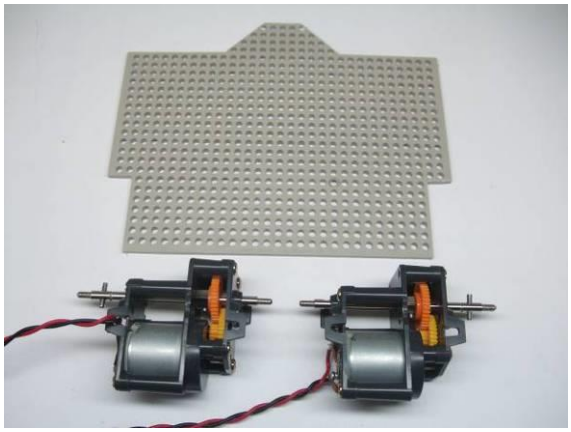


Photo 8.74

Photo 8.75

Prepare the items shown in the photos: the gearboxes, the main board cut from the universal plate, four black screws, four spring washers, and four nuts.

Photo 8.76

Fit the spring washers onto the black screws as shown in the photo.

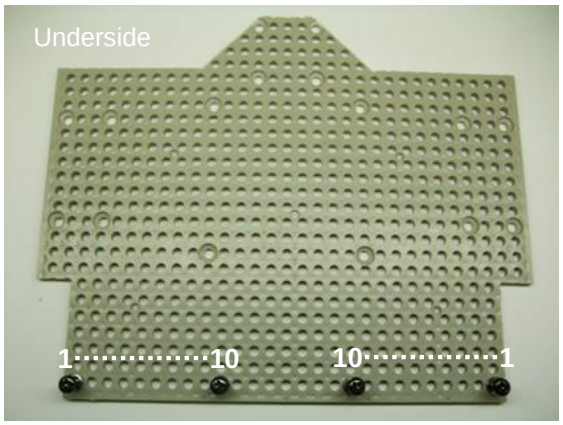



Photo 8.77

Place the main board so that the side with the indentations for flathead screws (the underside) is facing upward. As shown in the photo, insert black screws in the first and tenth holes from the ends of the bottom portion of the board.

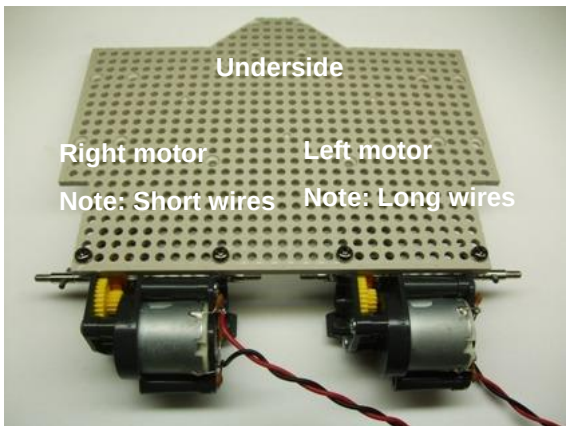



Photo 8.78

Be careful not to confuse the right motor and the left motor.

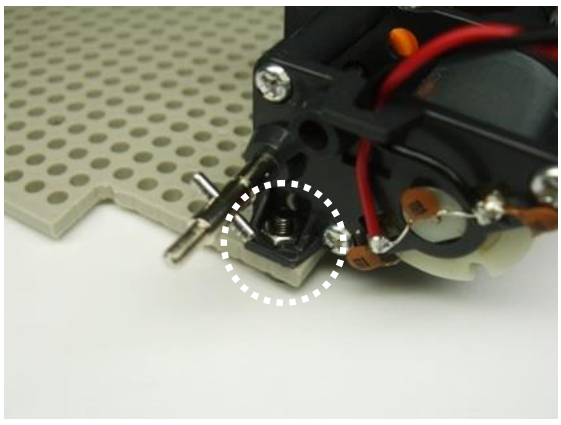


Photo 8.79

Secure the motors in place by tightening nuts in the locations indicated by the circle.

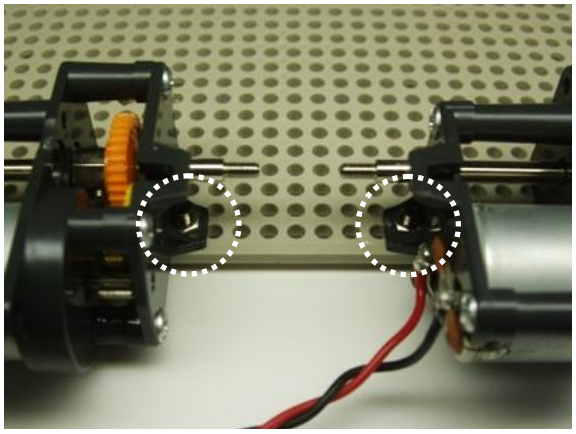


Photo 8.80

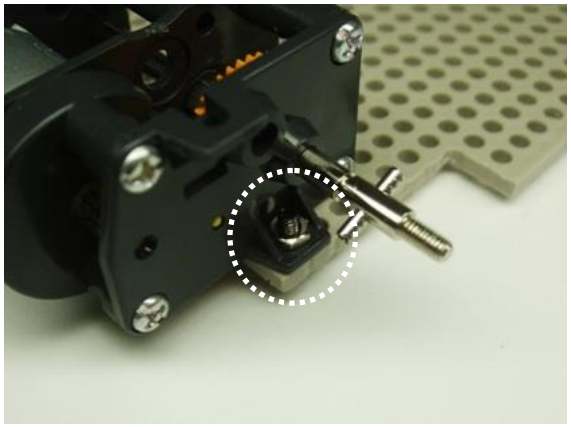


Photo 8.81

Tighten the nuts in the remaining three locations indicated by circles in the photos to secure the motors.

## 8.5. Mounting the Motor Drive Board Support Plate

Photo 8.82

For this task you will need four studs, four flathead screws, six spring washers, two nuts, and two black screws as shown in the photo.

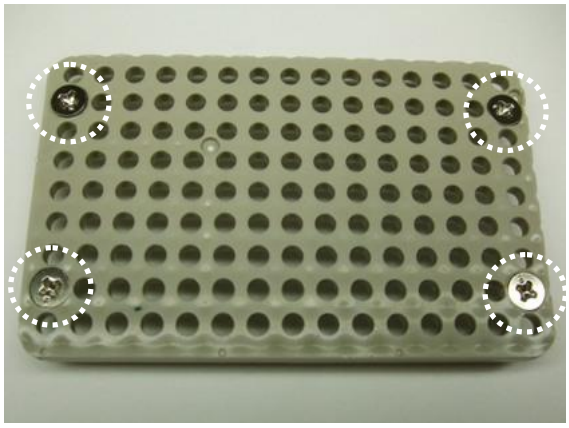


Photo 8.83

Insert the flathead screws into the four holes in the motor drive board support plate that were previously prepared for them.

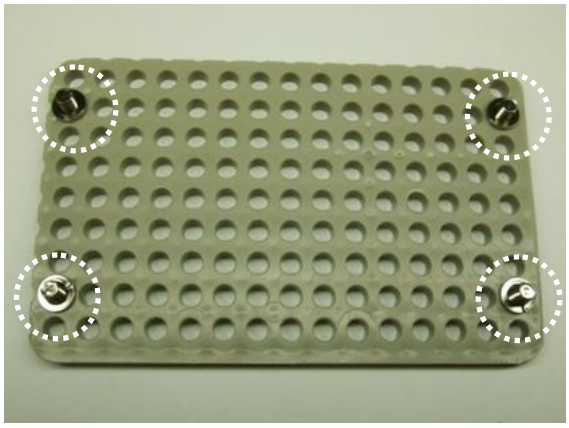


Photo 8.84

Turn over the motor drive board support plate and place spring washers over the ends of the flathead screws, as shown in the photo.

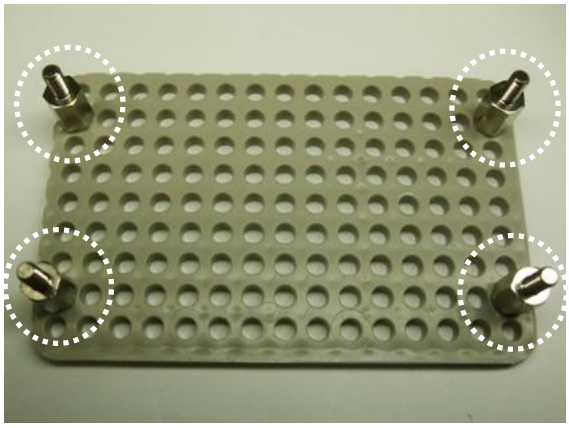


Photo 8.85

Mount the studs as shown in the photo.

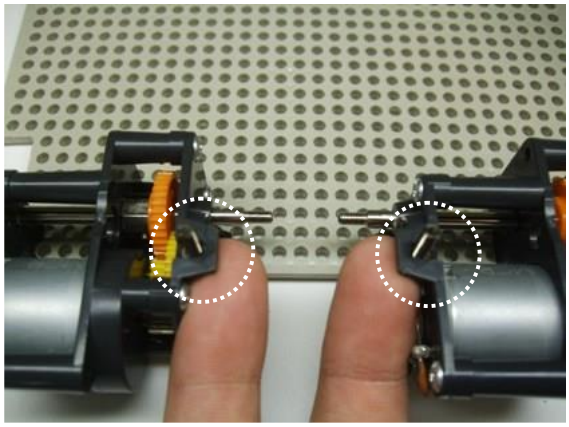


Photo 8.86

Insert black screws from below through the holes in the gearboxes, as shown in the photo.

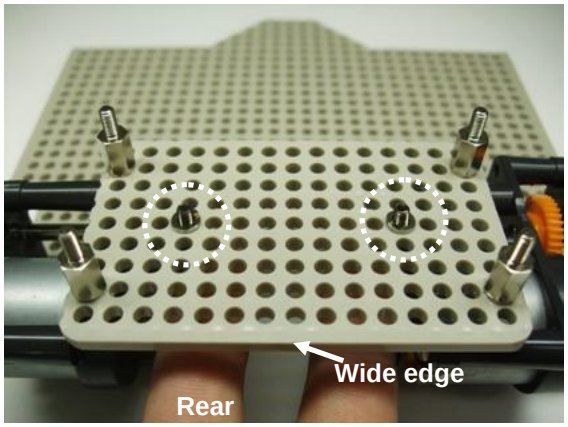



Photo 8.87

Orientate the plate with the side indicated by the arrow (wide edge) toward the rear. Match up the positions of the black screws as shown in the photo in order to mount the motor drive board support plate. Place spring washers over the ends of the black screws.

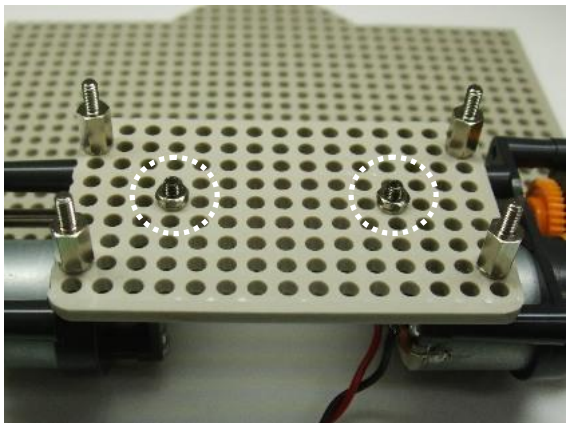


Photo 8.88

Tighten the two nuts to secure the motor drive board support plate.

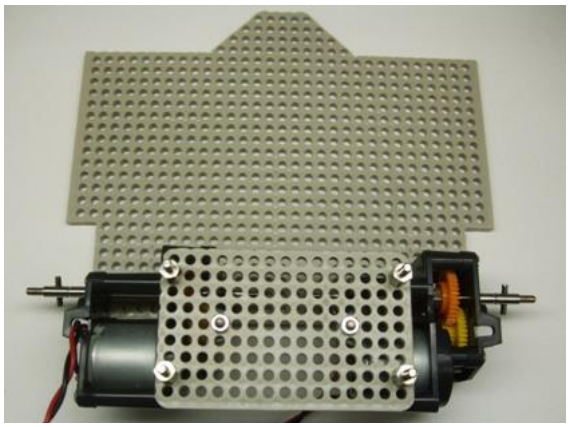


Photo 8.89

Once mounted, the motor drive board support plate appears as shown.

# 9. Power Supply Wiring

## 9.1. Preparing the Battery Snaps

In this section we will prepare the battery snaps and fashion power cables for the MCU board and motor drive board power cables.

### 9.1.1. Fashioning Power Cables for Use with the RMC-RX62T Board

A wiring diagram of the power cable for the RMC-RX62T board is shown below:

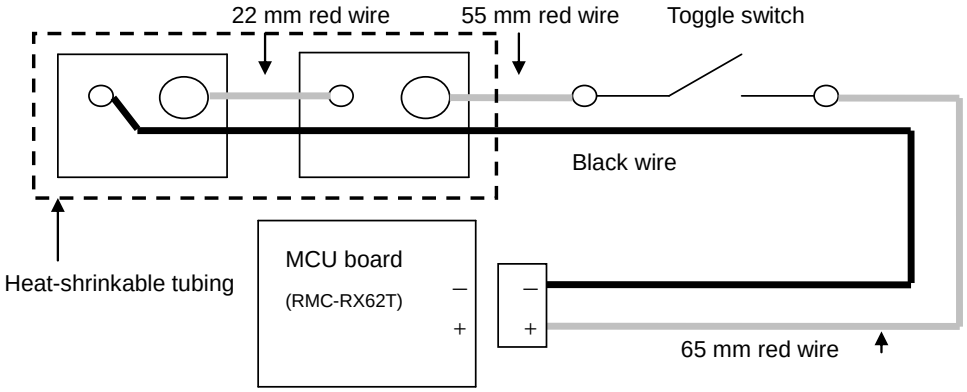



Figure 9.1 (Wiring Diagram)

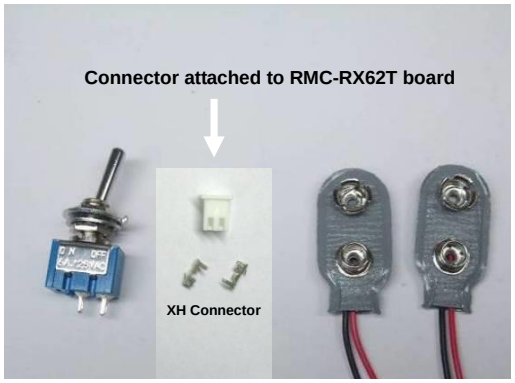



Photo 9.1

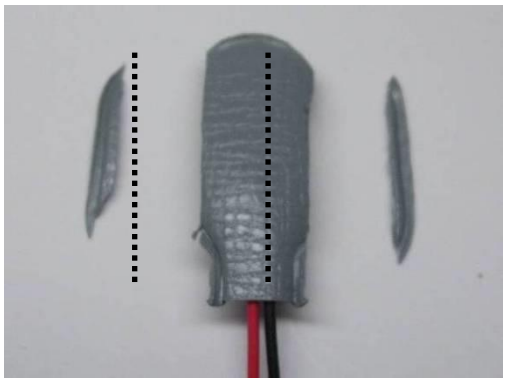


Photo 9.2

Here we will fashion the MCU board power cable. Prepare the parts shown in photo 10.1.

- Toggle switch
- Electrical wire (We will use the wires included with the MCU board.)
- Battery snaps (In addition, we will need heat-shrinkable tubing (dia. 10 mm).)

Use scissors to trim the sides of a battery snap as shown in photo 9.2.

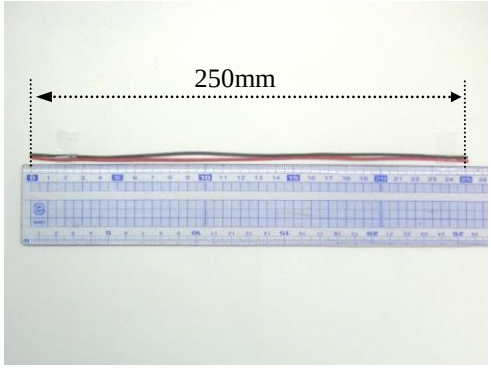



Photo 9.3

Prepare a red and black electrical wire of 250mm.

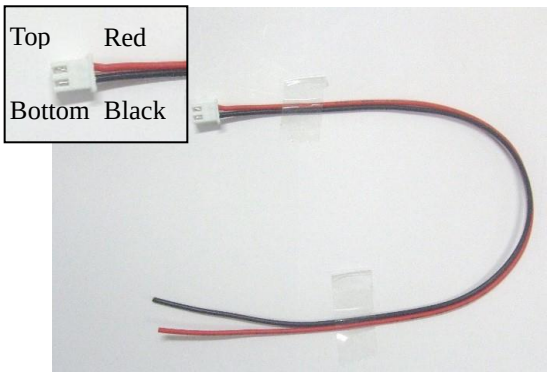



Photo 9.4

As shown in the photo, plug the red wire into the top opening and the black wire into the bottom opening of the connector.

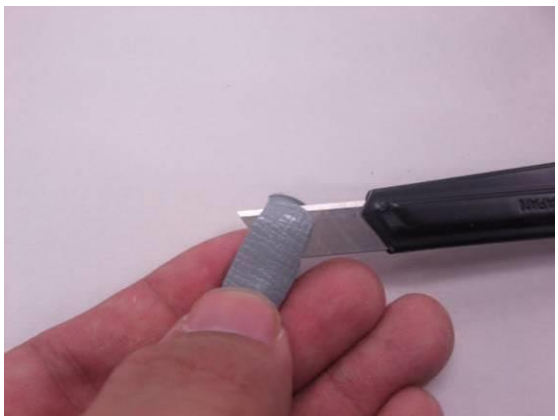


Photo 9.5

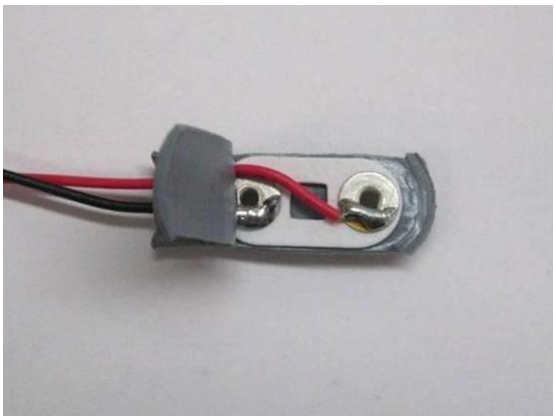


Photo 9.6

As shown in photo 9.5, slip the tip of a Stanley knife into the battery snap and open it as shown in photo 9.6.

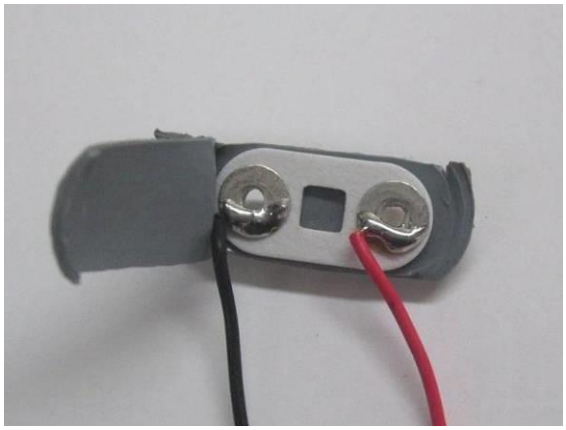


Photo 9.7

Change the arrangement of the red and black wires from that shown in photo 9.6 to that shown in photo 9.7.

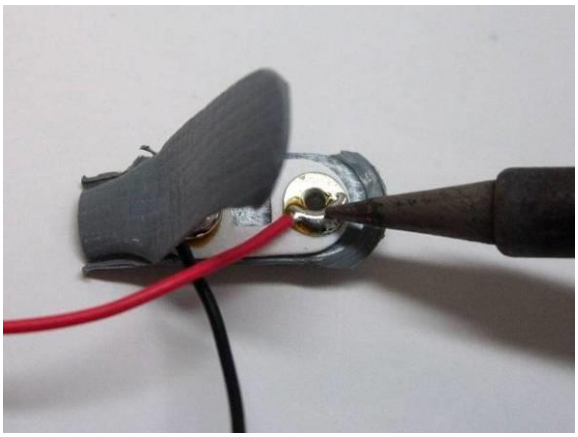


Photo 9.8

Touch the solder with a soldering iron to melt it and remove the red and black wires.

Note: Save the wires removed from the battery snap as they will be needed later on.

Photo 9.9

Prepare all four battery snaps in the same way, so they appear as shown in photo 9.9. The tasks described in Fashioning the MCU Board Power Cable and Fashioning the Motor Drive Board Power Cable each require two of these battery snaps.

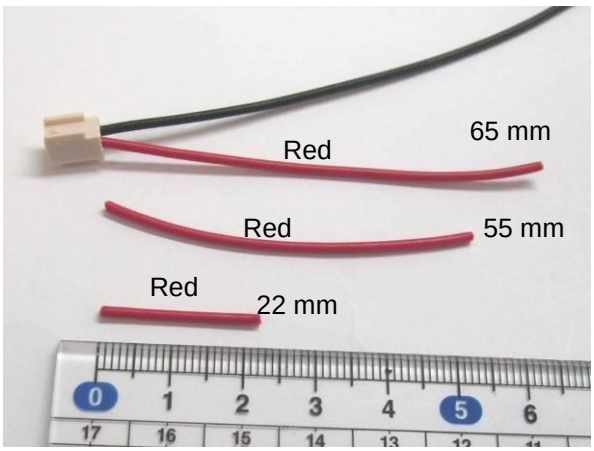



Photo 9.10

As shown in photo 9.10, cut the red electrical wire from the MCU board into pieces 65 mm, 55 mm, and 22 mm long. Make sure to measure the 22 mm piece of wire accurately so that it will be positioned correctly relative to the battery box. The lengths of the 65 mm and 55 mm pieces of wire need only be accurate to within a few millimeters.

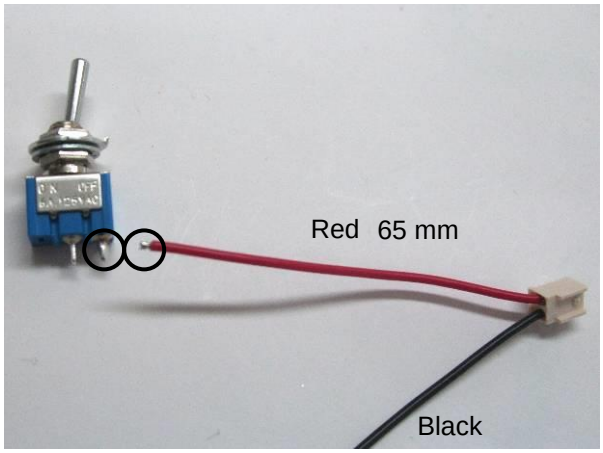



Photo 9.11

As shown in photo 9.11, remove about 2 mm of insulation from the end of the 65 mm (red) piece of wire and solder together the places indicated by the circles.

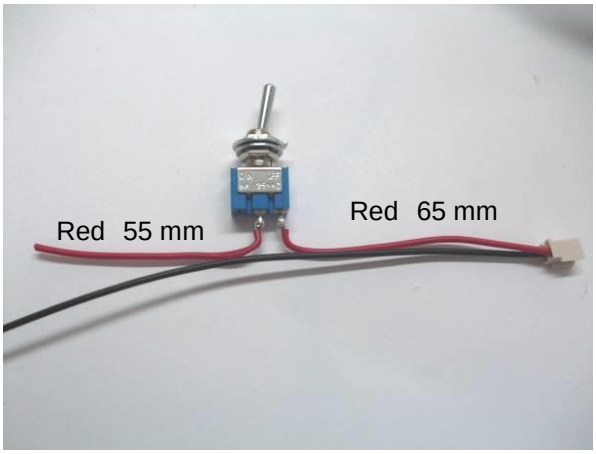



Photo 9.12

As shown in photo 9.12, solder the 55 mm (red) piece of wire to the center terminal of the toggle switch. This is easiest if you apply solder first and then attach the wire.

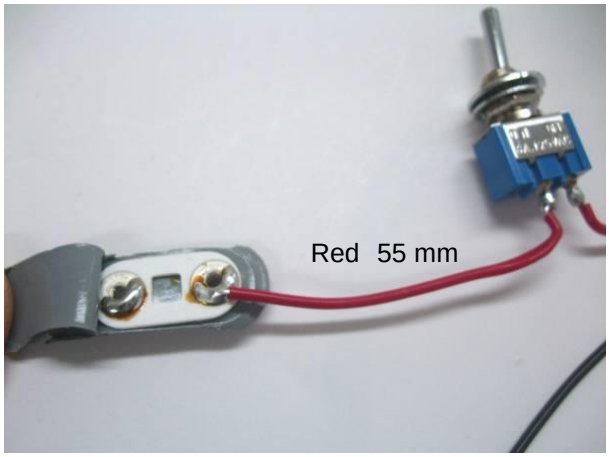



Photo 9.13

Solder the other end of the 55 mm red piece of wire to the battery snap as shown in photo 9.13.

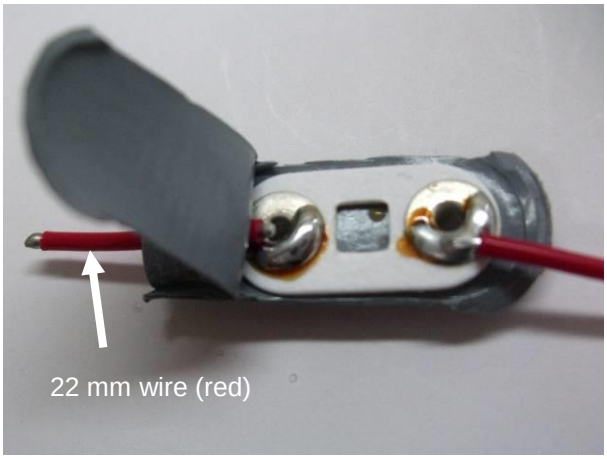



Photo 9.14

Remove the insulation from both ends of the 22 mm red piece of wire, apply solder to them, and insert one end into the battery snap as shown in photo 9.14.

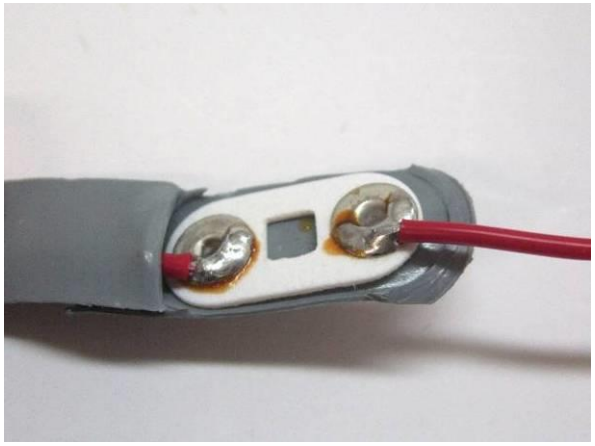


Photo 9.15

Solder the end of the 22 mm wire to the battery snap as shown in photo 9.15.

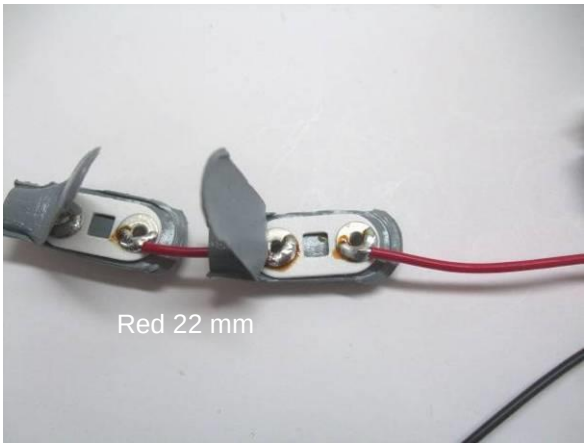



Photo 9.16

As shown in photo 9.16, solder the other end of the 22 mm (red) wire to a second battery snap.

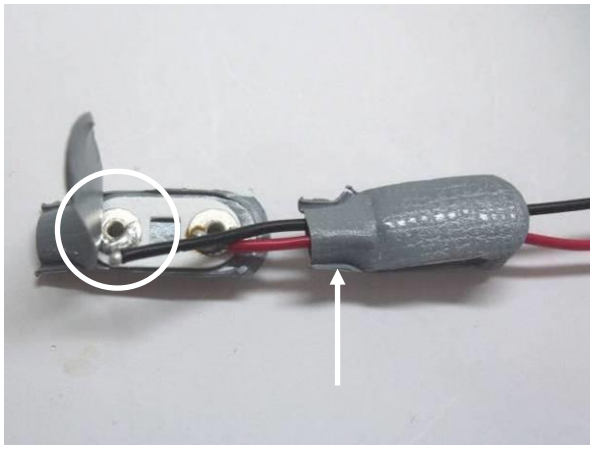


Photo 9.17

As shown in photo 9.17, feed the black wire from the connector through the portion of the battery snap indicated by the arrow and solder the end of it to the place indicated by the circle.

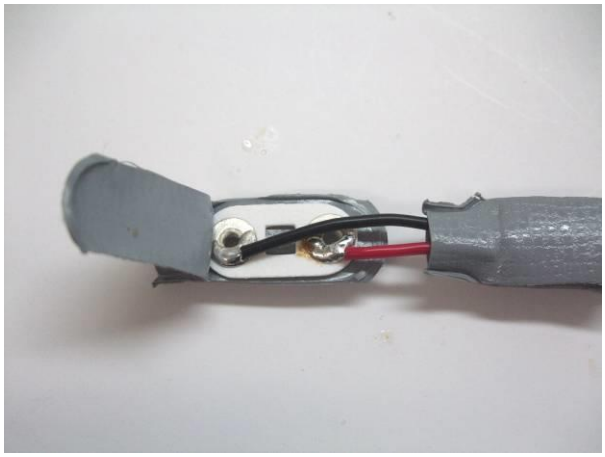


Photo 9.18

Photo 9.18 shows what the result looks like with the black wire attached.

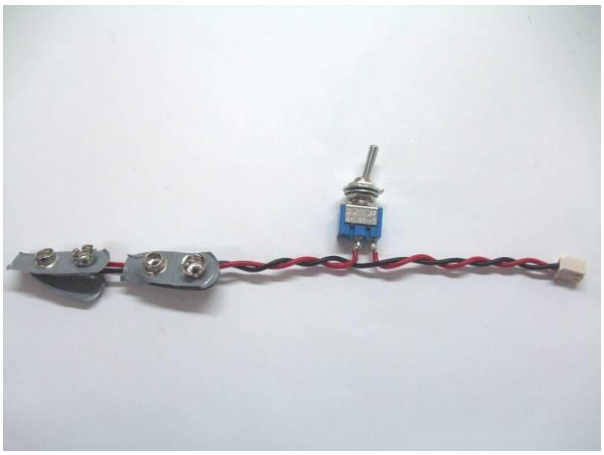


Photo 9.19

Twist the red and black wires as shown in photo 9.19.

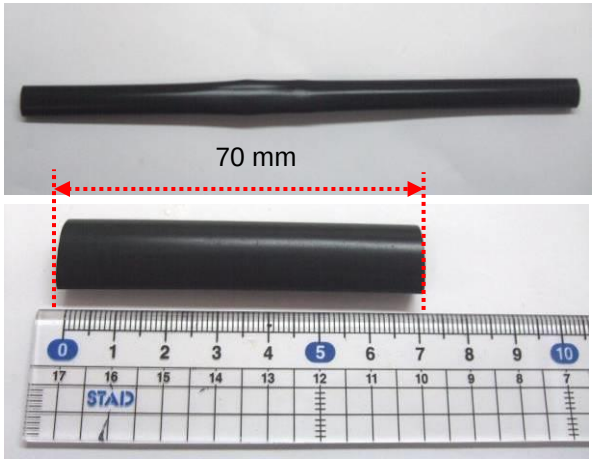



Photo 9.20

Cut a 70 mm section of heat-shrinkable tubing (dia. 10 mm), as shown in photo 9.20.

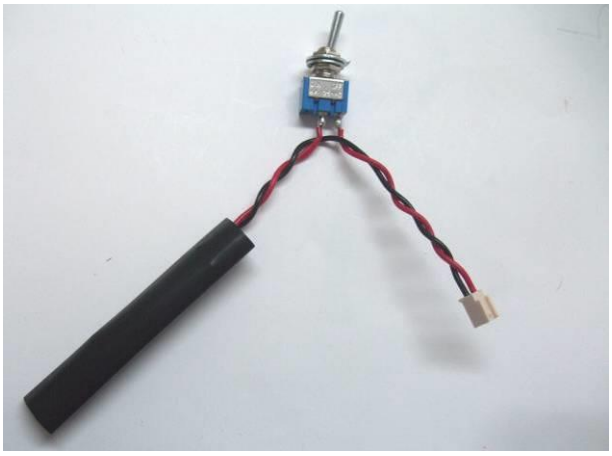


Photo 9.21

Slide the battery snaps into the heat-shrinkable tubing, as shown in photo 9.21.

Photo 9.22

Use a hair dryer or the like to warm up the heat-shrinkable tubing, so that it shrinks as shown in photo 9.22.

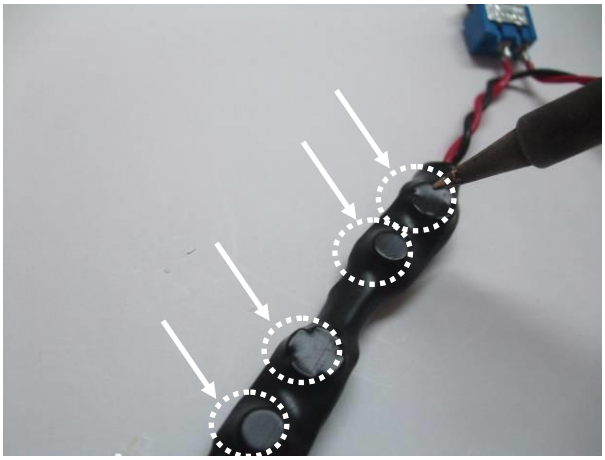


Photo 9.23

Use the tip of a hot soldering iron to make holes at the centers of the terminals (indicated by arrows).

Photo 9.24

Using a Stanley knife, work out from the holes in the center as shown in photo 9.24 to widen the openings until the terminals of the battery snaps are exposed, as shown in photo 9.25.

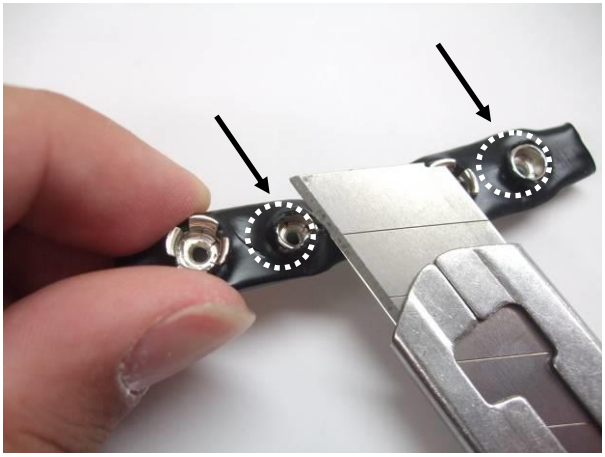


Photo 9.25

The portions indicated by the arrows will need to fit into the battery box, so use the Stanley knife to cut away a little more of the tubing around the terminals.

Photo 9.26

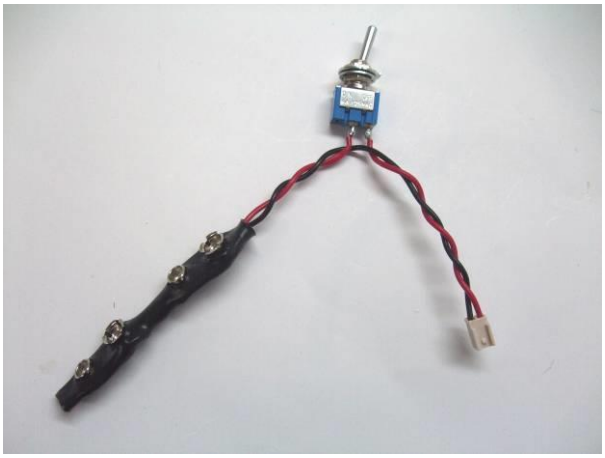


Photo 9.27 (complete)

The task is finished when all four terminals are exposed, as shown in photo 9.26.

### 9.1.2. Fashioning the Motor Drive Board Power Cable

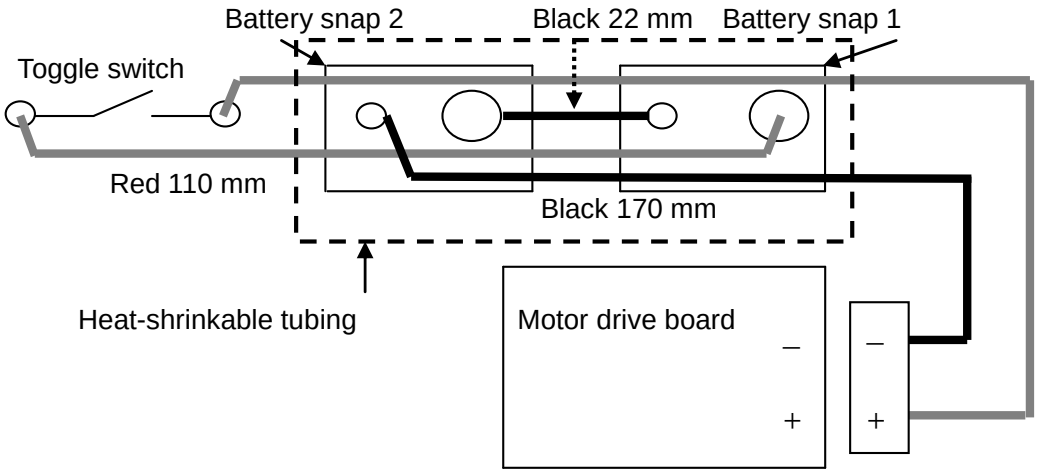



Figure 9.2 (Wiring Diagram)

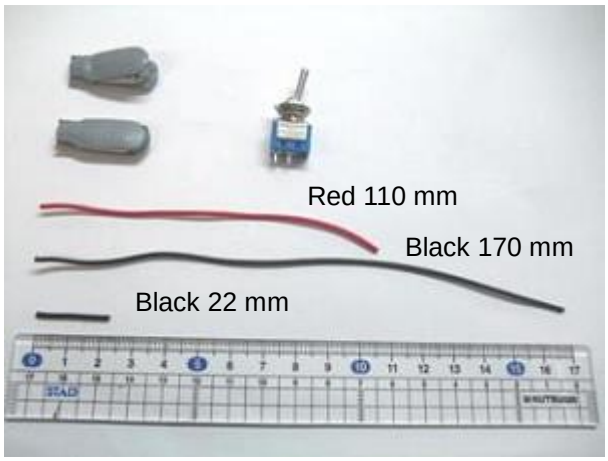



Photo 9.28

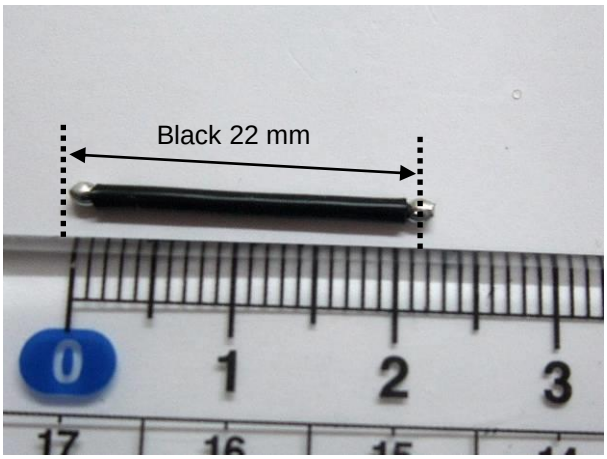



Photo 9.29

Here we will fashion the motor drive board power cable. Prepare the parts: battery snaps, XH female connector, pin connectors, toggle switch, 110 mm red electrical wire, 170 mm black electrical wire, and 22 mm black electrical wire. Make sure to measure the 22 mm piece of wire accurately so that it will be positioned correctly relative to the battery box. The lengths of the 110 mm and 170 mm pieces of wire need only be accurate to within a few millimetres. Remove the insulation from both ends of the 22 mm black piece of wire and apply solder to them as shown in the photo.

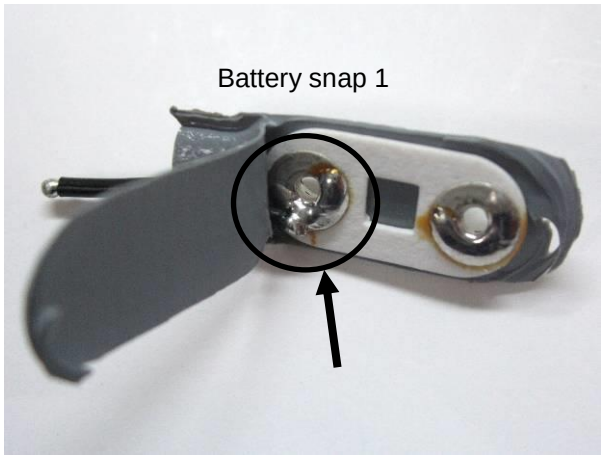



Photo 9.30

As shown in photo 9.30, solder one end of the 22 mm black wire to battery snap 1.

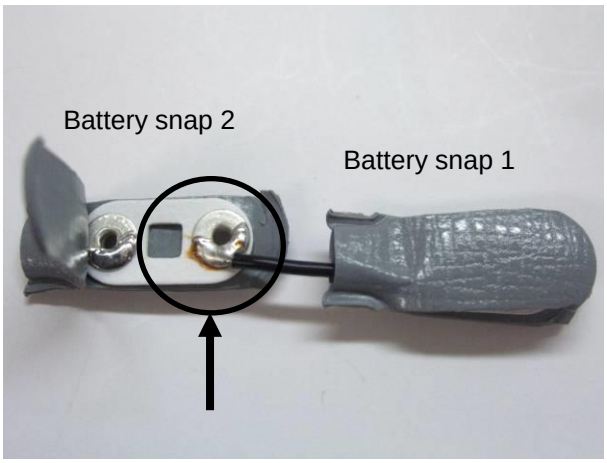



Photo 9.31

Solder the other end of the wire to battery snap 2 as shown in the photo.

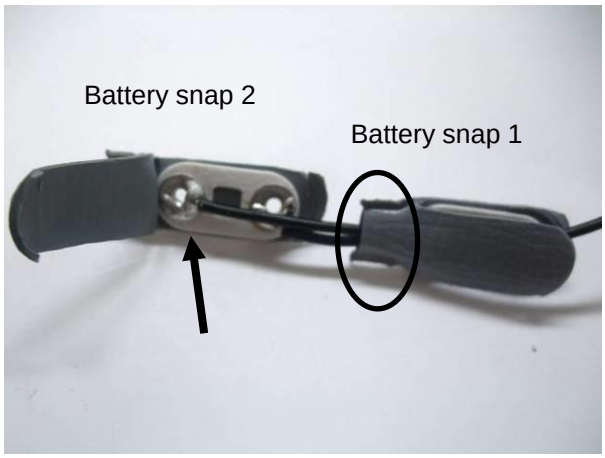



Photo 9.32

As shown in the photo, feed the 170 mm black wire through the portion of battery snap 1 indicated by the oval and solder the end of it to battery snap 2 in the place indicated by the arrow.

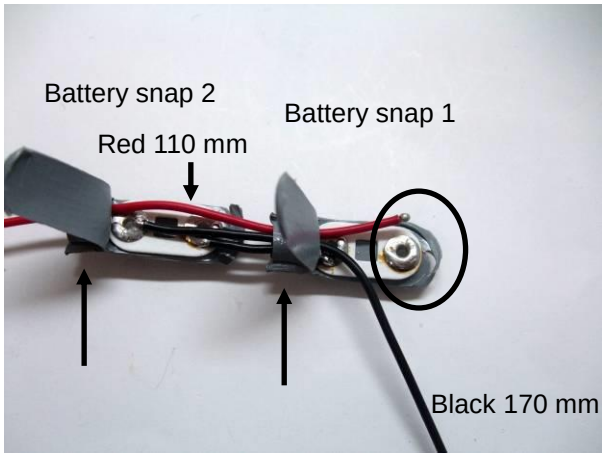



Photo 9.33

As shown in the photo, feed the 110 mm red wire through the two places indicated by arrows and solder the end of it to the place indicated by the oval.

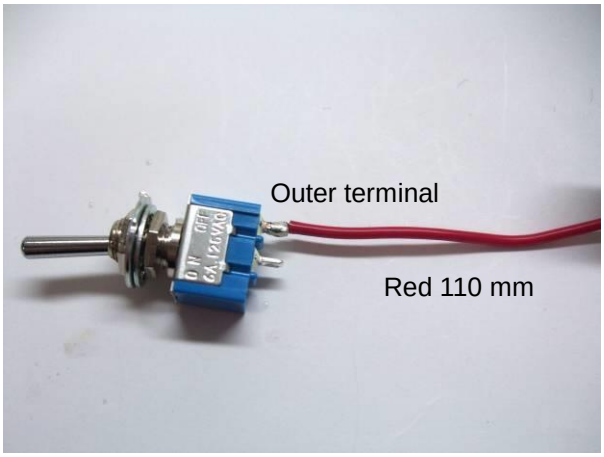



Photo 9.34

As shown in the photo, solder the other end of the red wire to the outer terminal of the toggle switch.

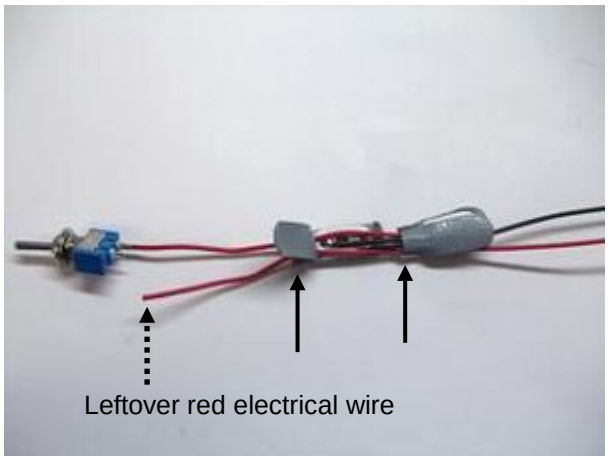



Photo 9.35

Pass the leftover red electrical wire through the places indicated by (solid black) arrows in the photo.

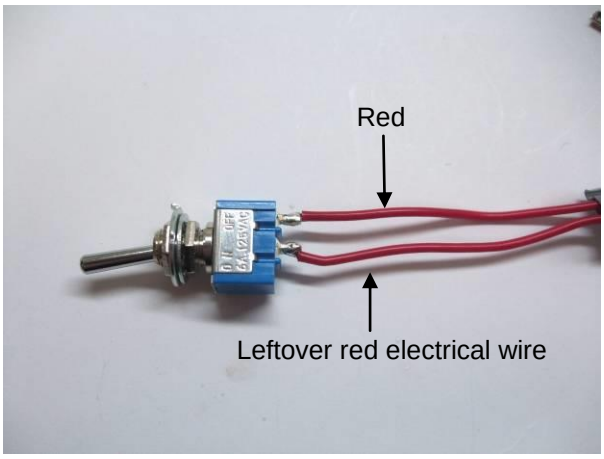



Photo 9.36

As shown in the photo, solder the end of the leftover red electrical wire to the center terminal of the toggle switch.

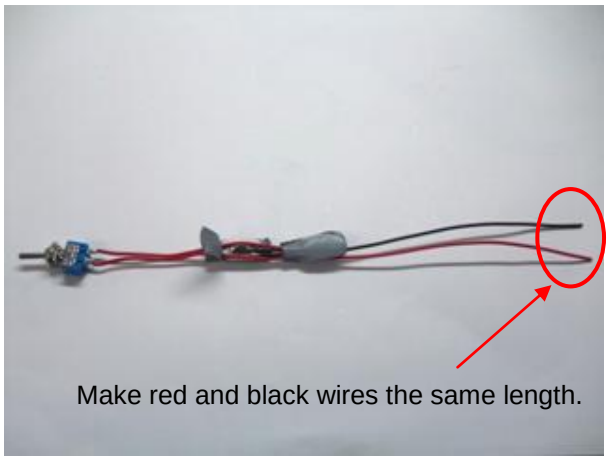



Photo 9.37

As shown in the photo, cut off a portion of the red wire so that it matches the length of the black wire.

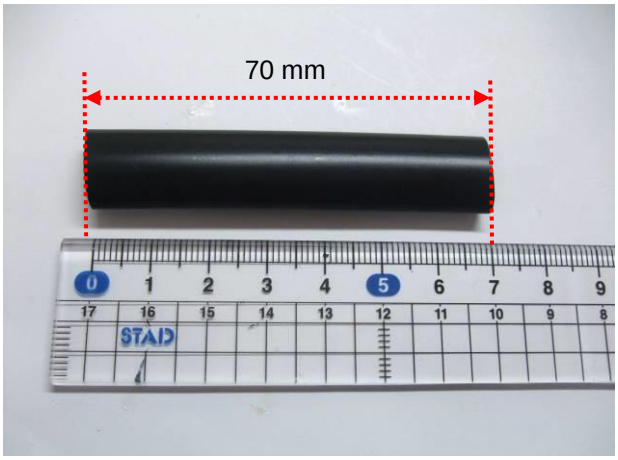



Photo 9.38

Cut a 70 mm section of heat-shrinkable tubing as shown in the photo.

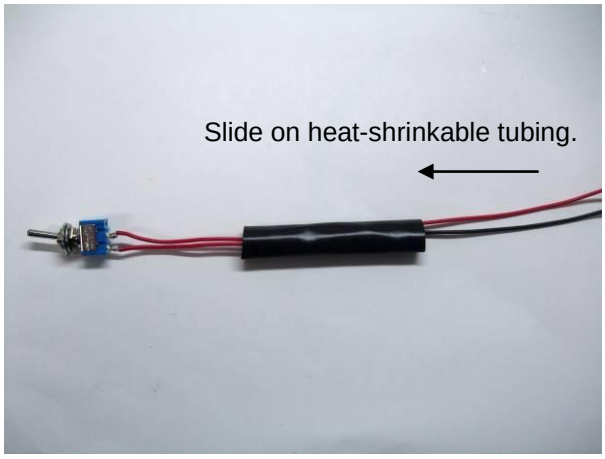



Photo 9.39

Slide on the heat-shrinkable tubing as shown in the photo.

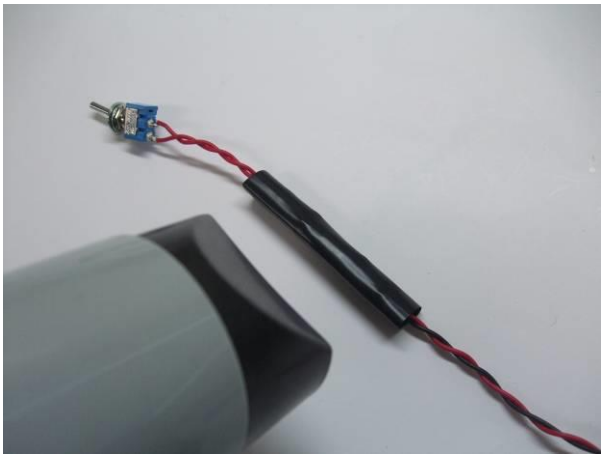


Photo 9.40

First, twist the red and black wires. Next, use a hair dryer or the like to warm up the heat-shrinkable tubing.

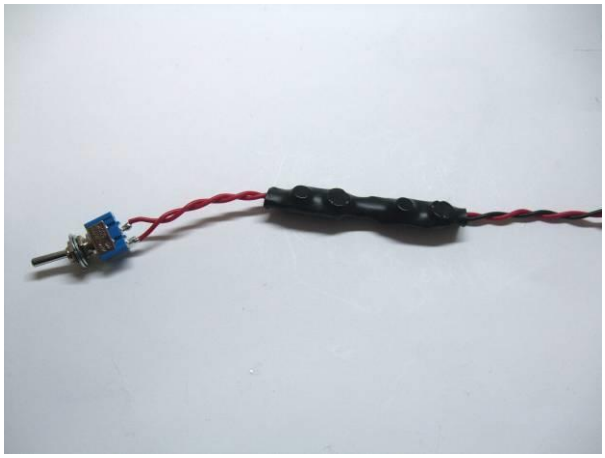


Photo 9.41

Once the heat-shrinkable tubing has shrunk as shown in the photo, expose the four terminals in the same manner as the MCU board power cable.
(See photos 9.22 to 9.26.)

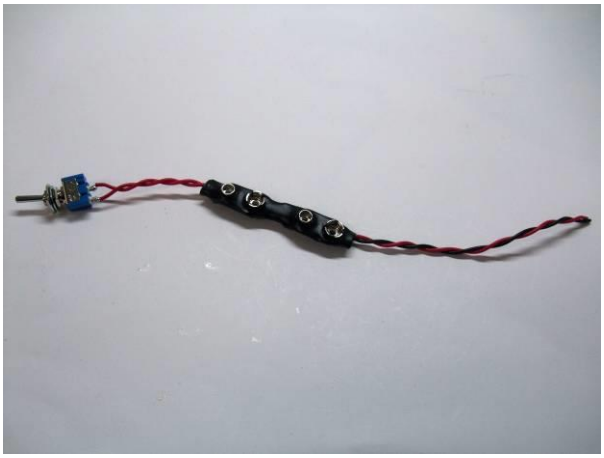


Photo 9.42

The task is finished when all four terminals are exposed.

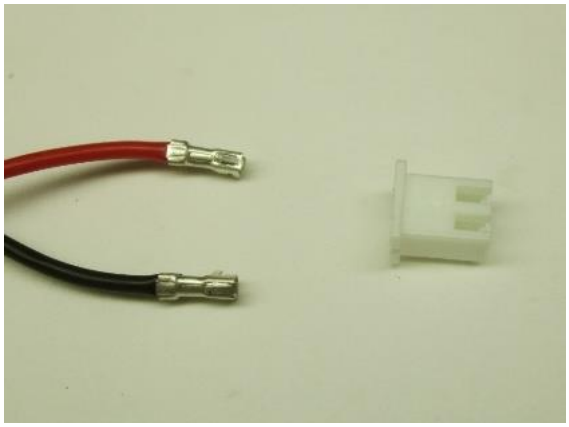


Photo 9.43

Strip about 2 mm of insulation from the ends of the red and black wires and use crimping pliers to attach pin connectors, as shown in the photo.

Note: For a description of the procedure, see 8.3, Attaching the Motor Power Wires.

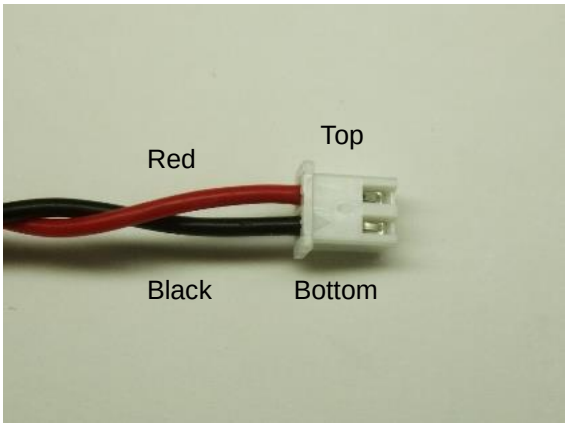



Photo 9.44

As shown in the photo, plug the red wire into the top opening and the black wire into the bottom opening of the connector.

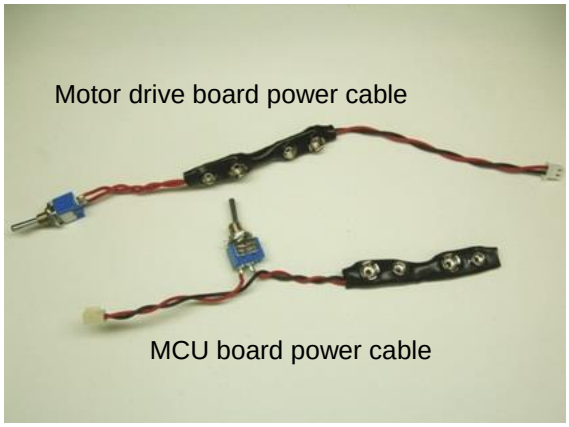



Photo 9.45

The power cables of the MCU board and motor drive board are now complete.

## 9.2. Mounting the Toggle Switches

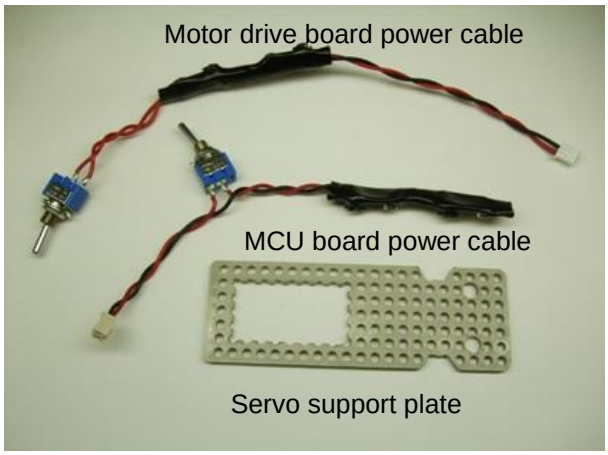



Photo 9.46

For this task you will need the power cables and servo support plate shown in the photo.

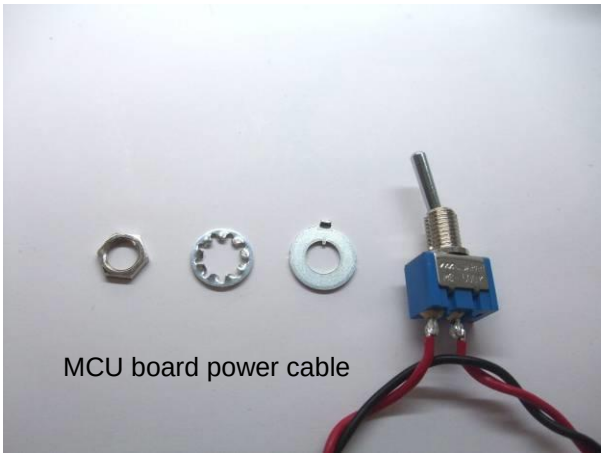



Photo 9.47

First, we will mount the MCU board power cable toggle switch. Remove the parts attached to the toggle switch, as shown in the photo.

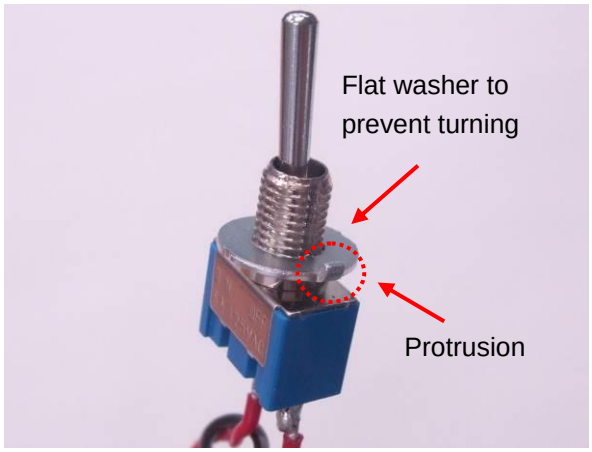



Photo 9.48

Orientate the flat washer to prevent turning with the protrusion facing upward, as shown in the photo.

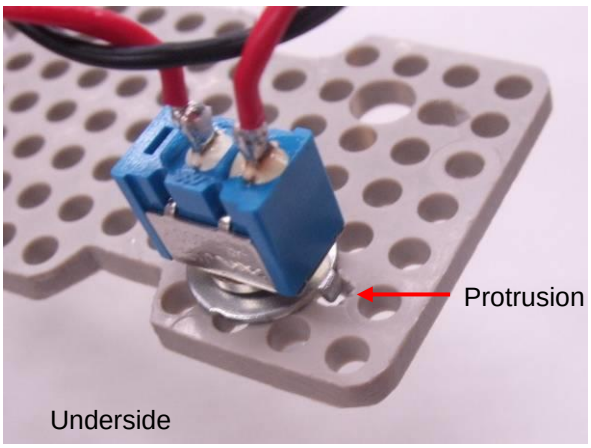



Photo 9.49

With the underside of the servo support plate facing upward, align the protrusion of the flat washer to prevent turning as shown in the photo.

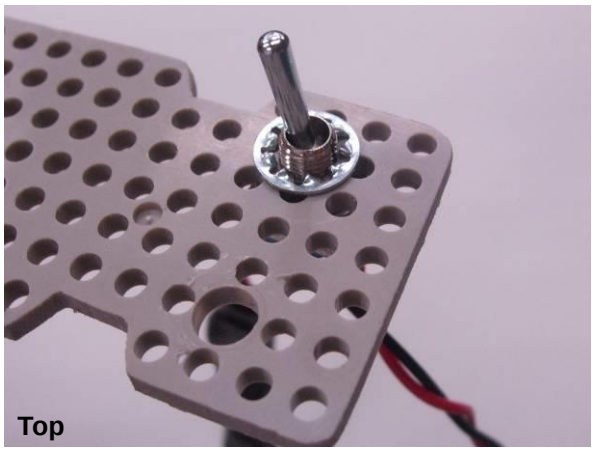



Photo 9.50

Turn over the servo support plate so the top is facing upward. Place a shake-proof washer over the threaded portion of the toggle switch, with the protrusions facing upward.

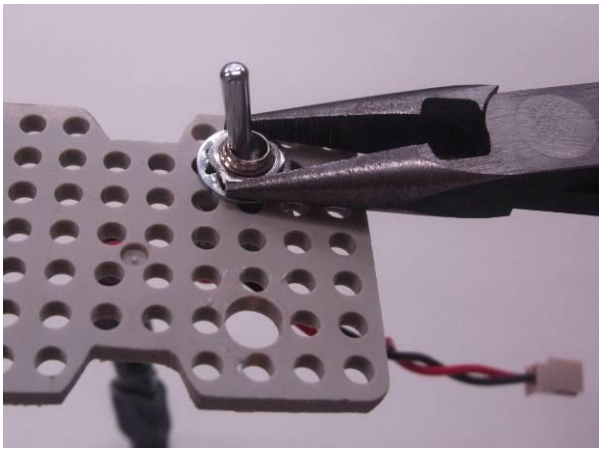


Photo 9.51

Screw on a nut. Finally, use radio pliers to tighten the nut.

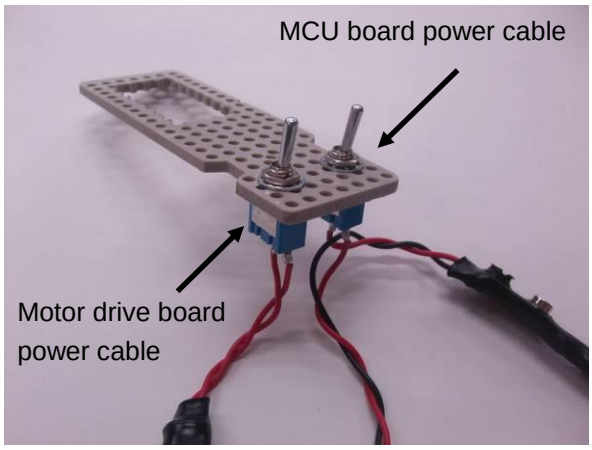



Photo 9.52

Mount the toggle switch of the motor drive board power cable in the same manner.
The task is finished when the two toggle switches have been mounted as shown in the photo.

# 10. Body Assembly

## 10.1. Mounting the Servo Support Plate

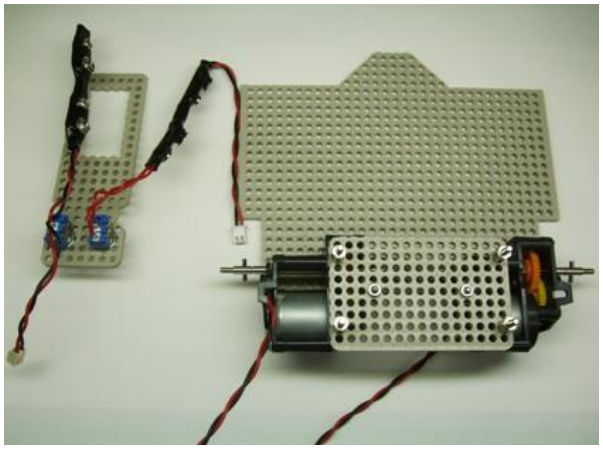


Photo 10.1

Photo 10.2

For this task you will need the items shown in photo 10.1. In addition, prepare the parts shown in photo 10.2: four 30 mm studs, four flathead screws, and four spring washers.

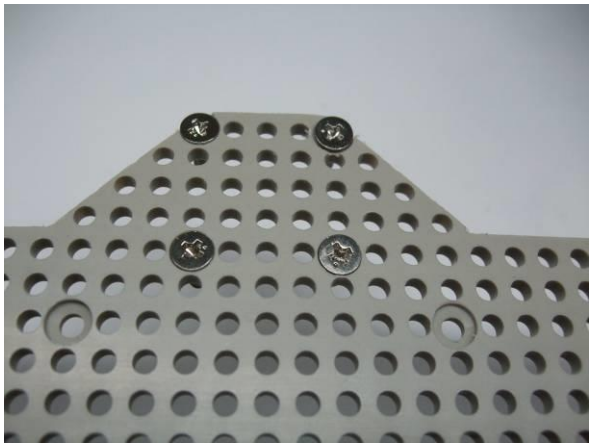


Photo 10.3

As shown in photo 10.3, insert four flathead screws from the underside of the main board (into the holes previously prepared for flathead screws).

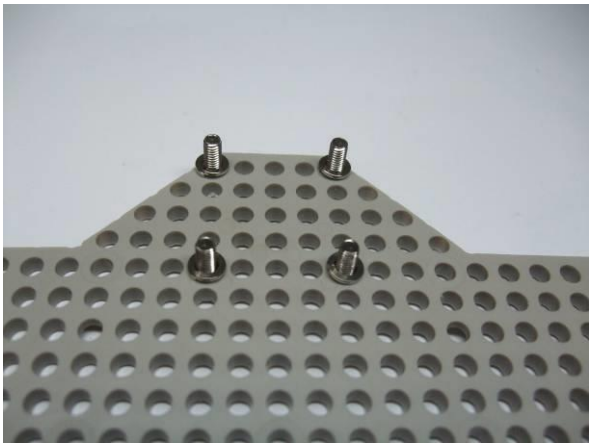


Photo 10.4

Turn over the main board and fit four spring washers over the exposed ends of the flathead screws, as shown in photo 10.4.

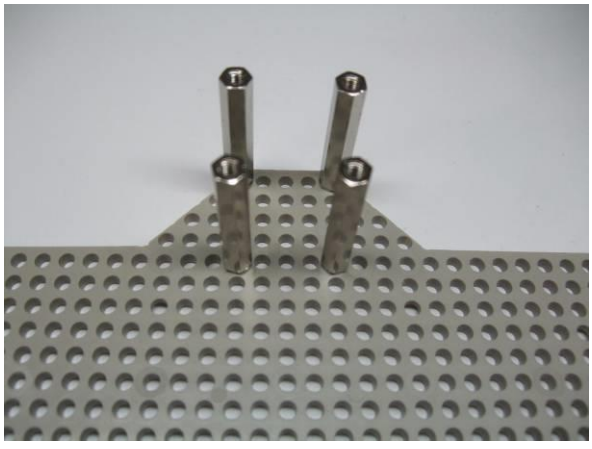


Photo 10.5

Screw on four 30 mm studs, as shown in photo 10.5.

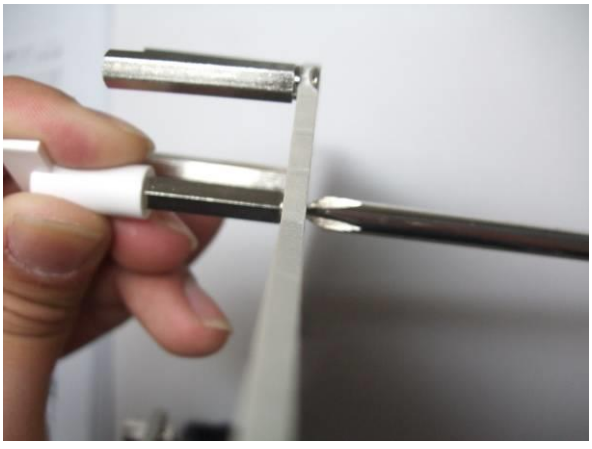


Photo 10.6

Use one of the nut tighteners included with the sports tire set to tighten each flathead screw, as shown in photo 10.6.


Photo 10.7

Prepare two screw and washer assemblies (dia. 3 × 8 mm, washer dia. 6 mm) and two studs (8 mm) (photo 10.7).

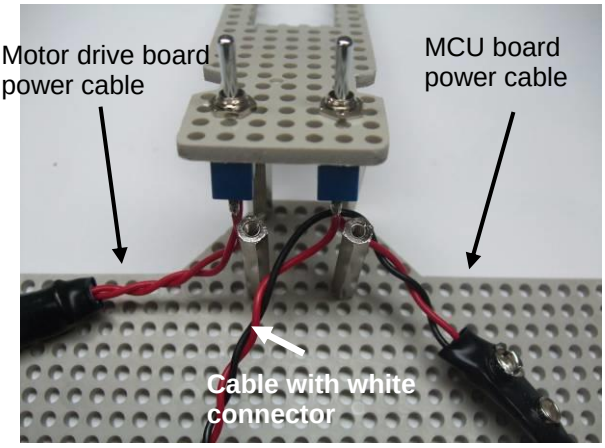



Photo 10.8

Position in the center the cable from the MCU board power supply (with white connector attached), indicated by the white arrow, and arrange the battery snaps as shown in photo 10.8.

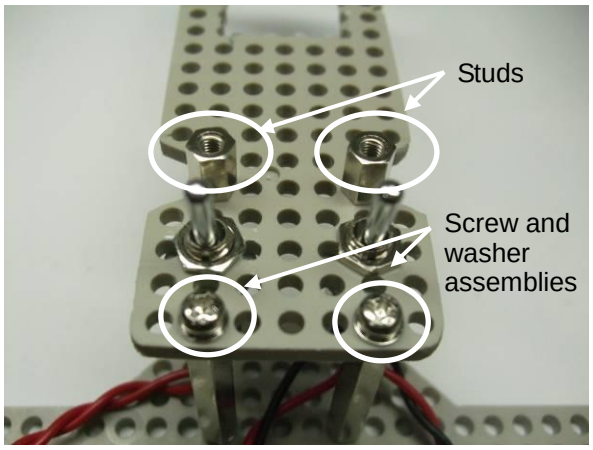



Photo 10.9

As shown in photo 10.9, fasten screw and washer assemblies (dia. 3 × 8 mm, washer dia. 6 mm) and studs in the locations indicated by ovals. Do not tighten the studs completely. They will be replaced

## 10.2. Mounting the Battery Boxes

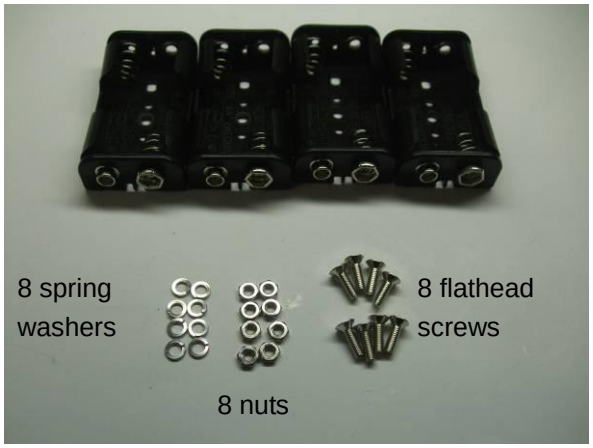



Photo 10.10

As shown in photo 10.10, prepare four battery boxes, eight flathead screws, eight nuts, and eight spring washers.

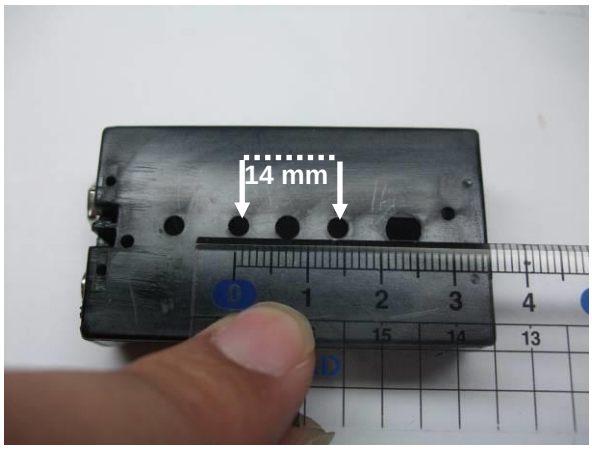



Photo 10.11

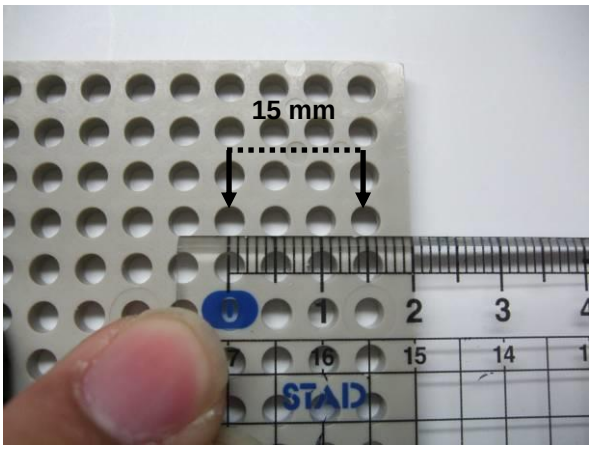



Photo 10.12

Next, we will mount the battery boxes. The gaps between the mounting holes in the battery box (photo 10.11) and the mounting holes in the universal plate (photo 10.12) differ. Therefore, we will use a dia. 3.5 mm drill bit to enlarge the mounting holes in the battery boxes.

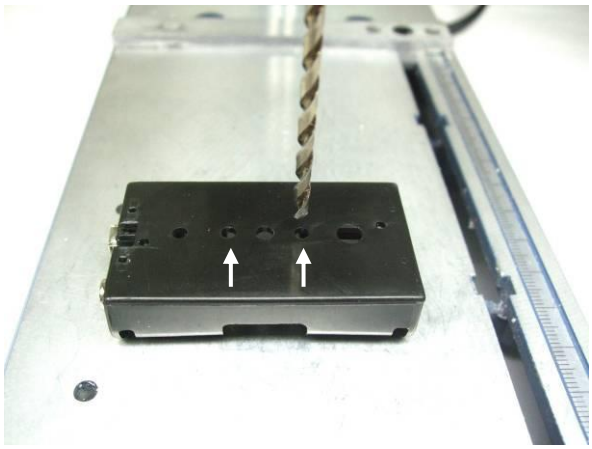


Photo 10.13

Use a dia. 3.5 mm drill bit to enlarge the two holes indicated by arrows in photo 10.13.

Photo 10.14

Do the same for the remaining three battery boxes.

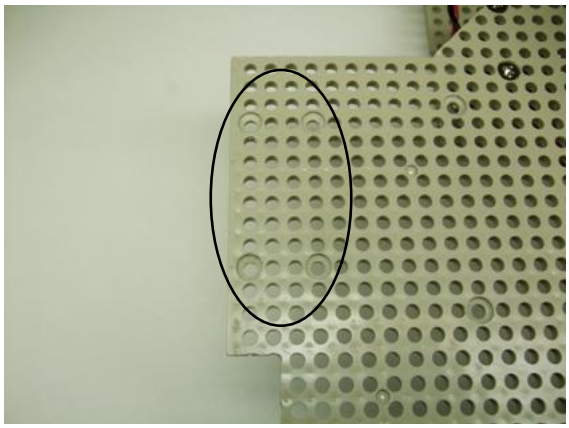


Photo 10.15

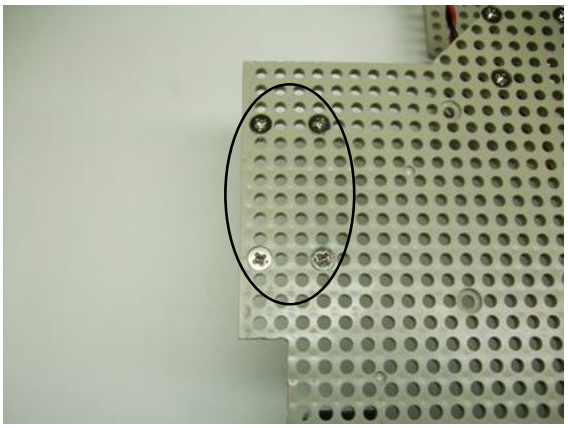


Photo 10.16

From the underside of the main board, insert flathead screws into the holes previously prepared for flathead screws.

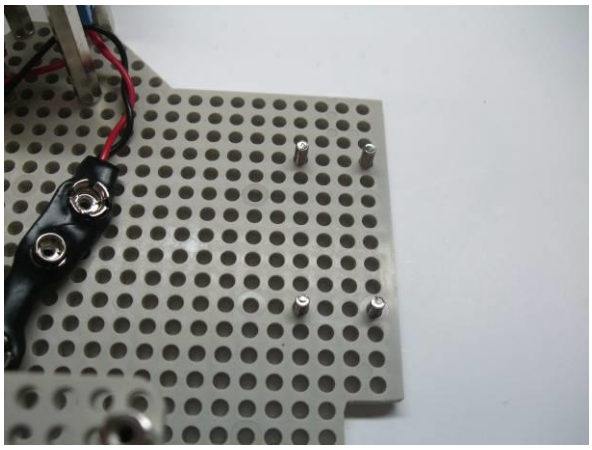


Photo 10.17

Turn the main board over so the top is facing upward.

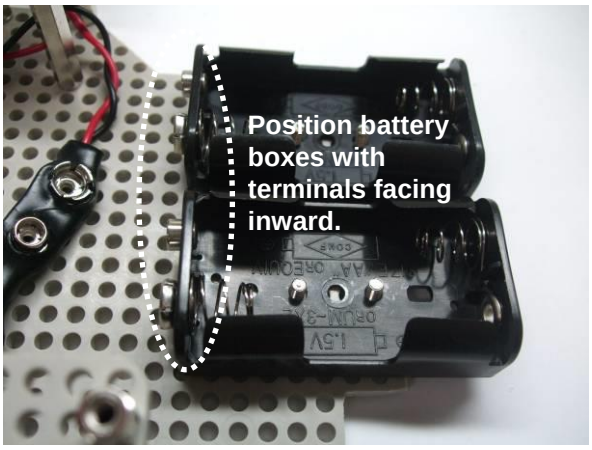



Photo 10.18

As shown in photo 10.18, position the battery boxes with their terminals facing inward.

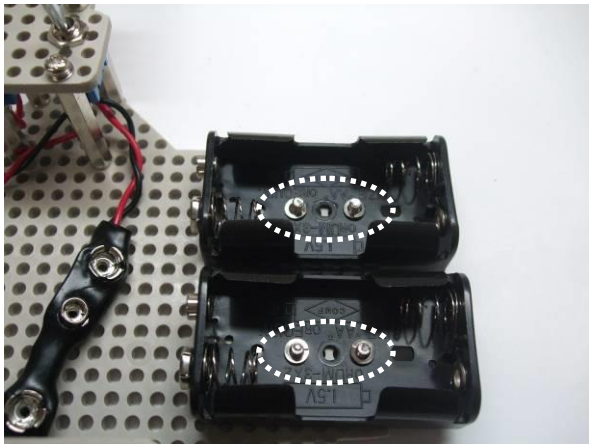


Photo 10.19

Place spring washers over the end of the flathead screws, as shown in photo 10.19.

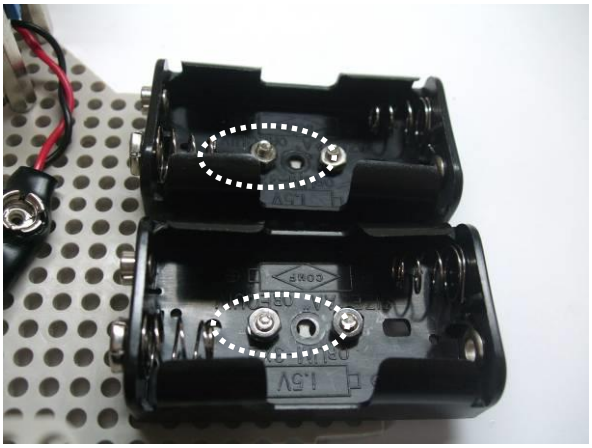


Photo 10.20

Screw on nuts.

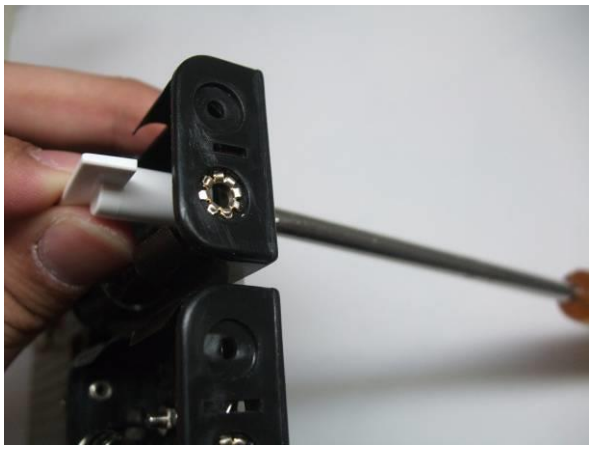


Photo 10.21

As shown in photo 10.21, use a nut tightener and screwdriver to tighten the nuts. Repeat the above steps to mount the two battery boxes on the other side.

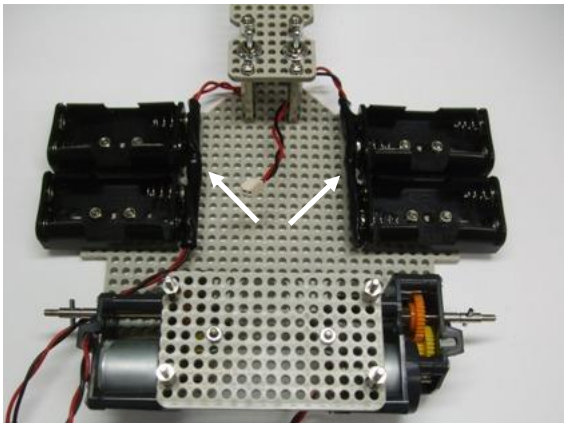


Photo 10.22

Connect the power cable battery snaps to the battery boxes, as shown in photo 10.22, to complete the task.

## 10.3. Mounting the Servo

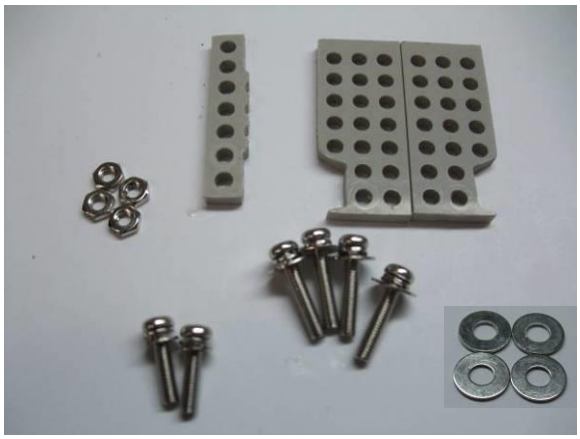


Photo 10.23

In this section we will mount the servo on the body of the MCU car. Prepare the parts shown in photo 10.23:

- Servo front reinforcing plate
- 2 servo back reinforcing plates
- 2 screw and washer assemblies (dia. 3 × 12 mm, washer dia. 6 mm)
- 4 screw and washer assemblies (dia. 3 × 15 mm, washer dia. 8 mm)
- 4 nuts, 4 flat washers

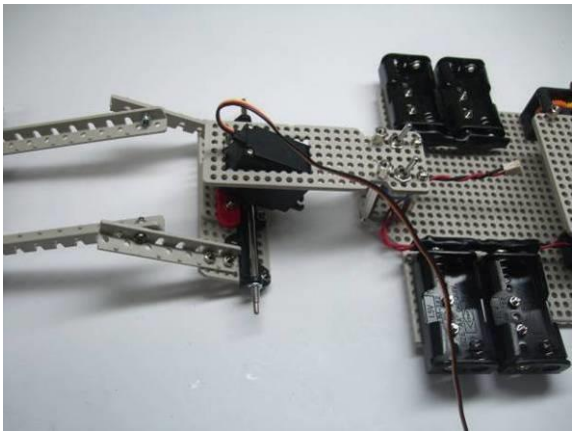


Photo 10.24

As shown in photo 10.24, fit the servo motor into the opening in the servo support plate.

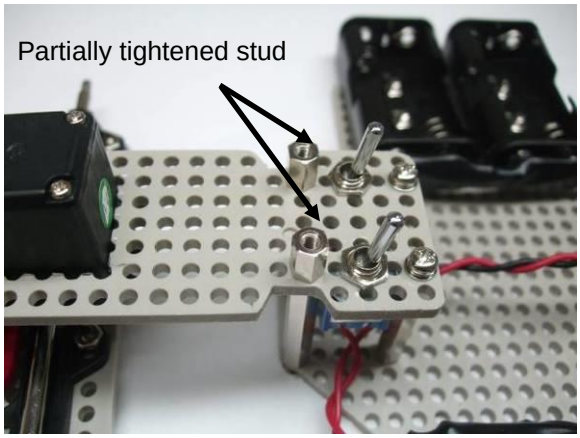



Photo 10.25

Remove the studs that were partially tightened earlier (photo 10.9).

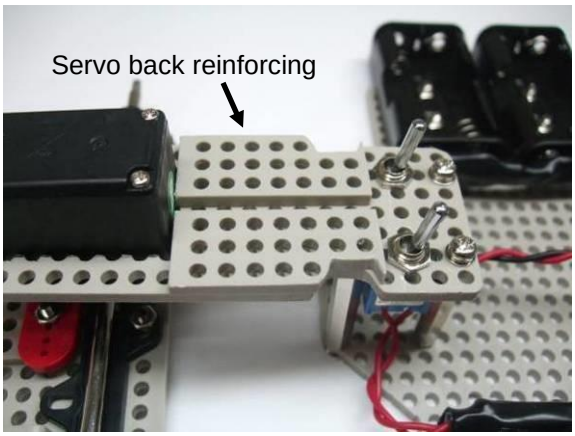



Photo 10.26

Position the servo back reinforcing plates as shown in photo 10.26.

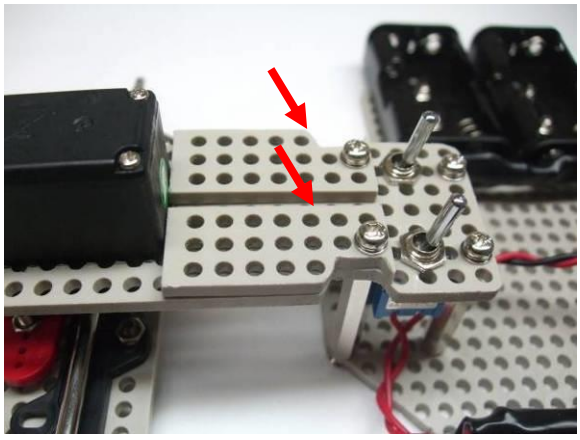


Photo 10.27

Screw in screw and washer assemblies (dia. 3 × 12 mm, washer dia. 6 mm) at the locations indicted by arrows in photo 10.27.

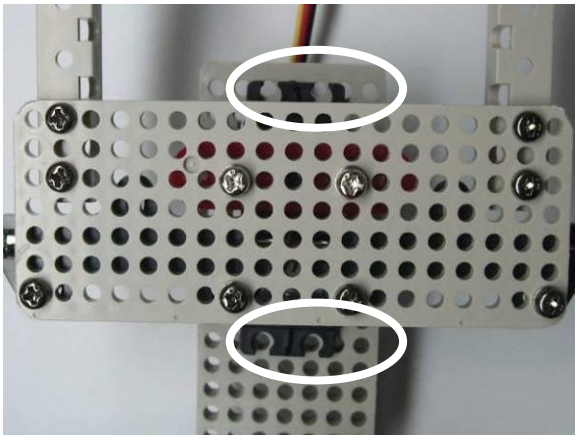


Photo 10.28

Turn over the MCU car body in order to insert screw and washer assemblies (dia. 3 × 15 mm, washer dia. 8 mm) in the locations indicated by ovals in photo 10.28.

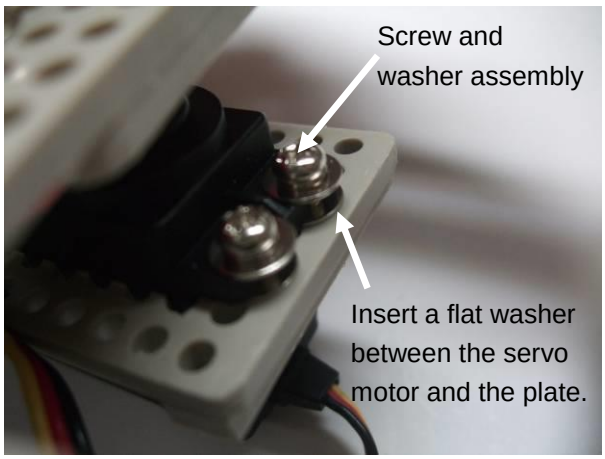



Photo 10.29

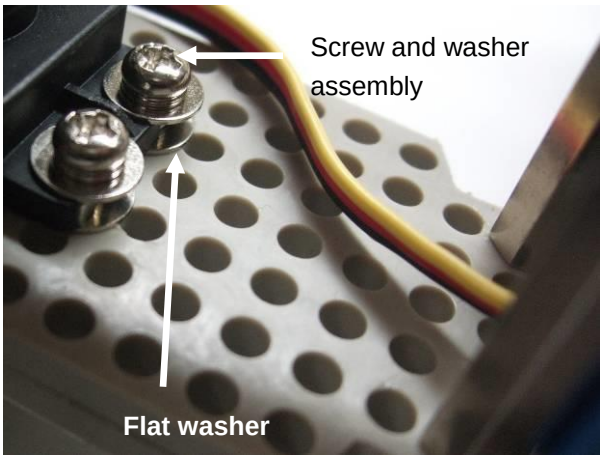



Photo 10.30

Secure the servo with screw and washer assemblies (dia. 3 × 15 mm, flat washer dia. 8 mm) as shown in photo 10.29. At this time, insert a flat washer between the servo motor and the plate. Do this in all four places where the servo is secured.

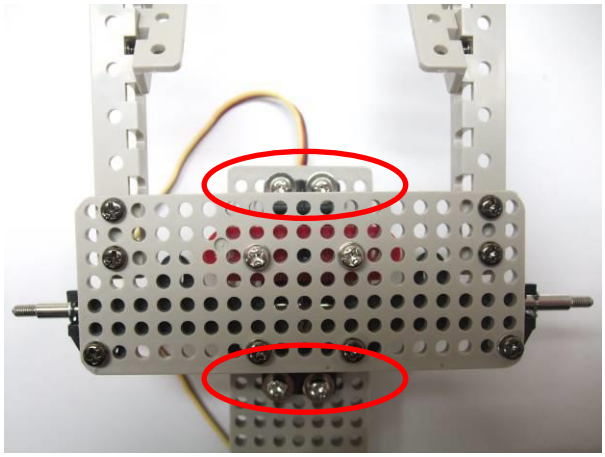


Photo 10.31

The four screw and washer assemblies have been inserted.

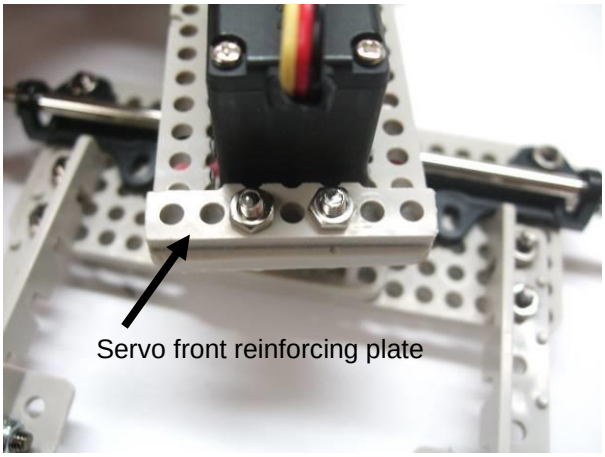



Photo 10.32

Position the servo front reinforcing plate as shown in photo 10.32 and screw four nuts onto the ends of the screw and washer assemblies.

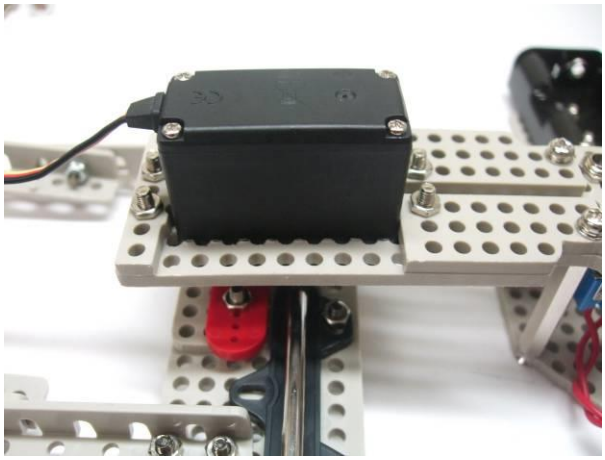


Photo 10.33

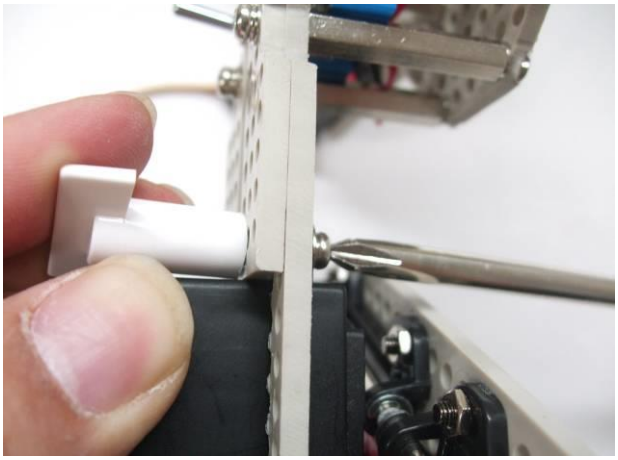
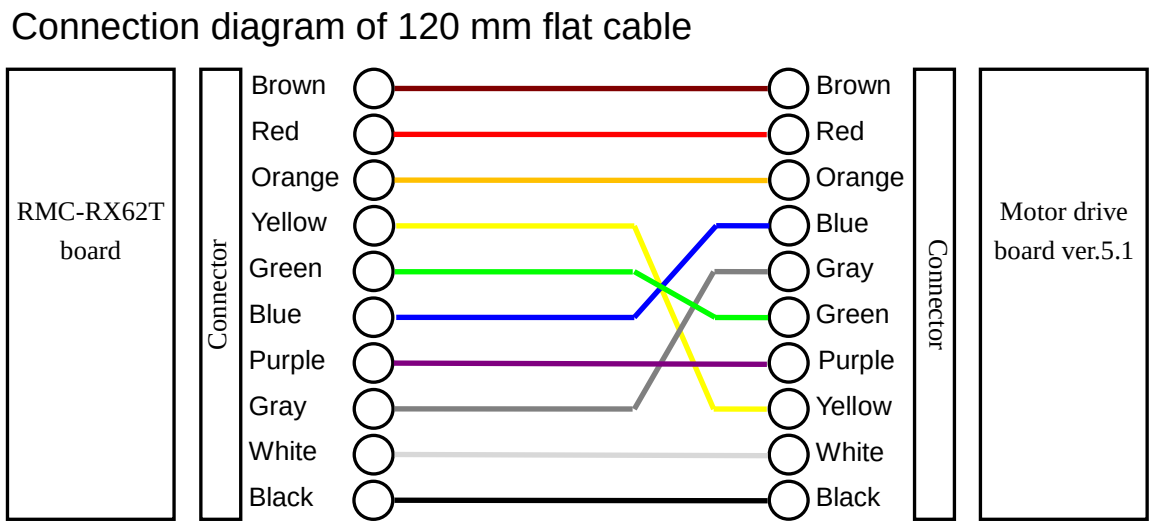


Photo 10.34

Once the nuts have been screwed on as shown in photo 10.33, finally use a nut tightener and screwdriver to tighten the nuts (photo 10.34).

## 10.4. Preparing the Flat Cable

In this section we will prepare a 120 mm flat cable to connect the MCU board and motor drive board.



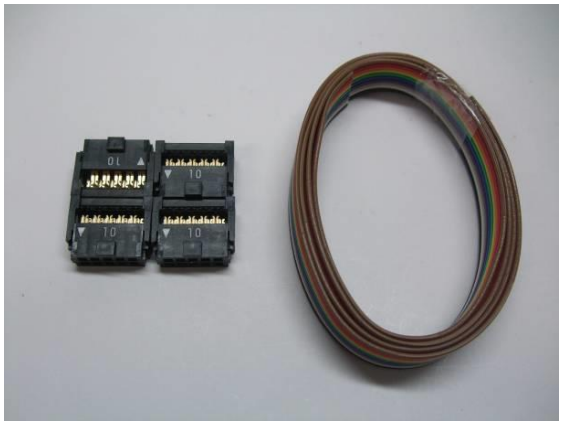



Photo 10.35

You will need four 10-pin female connectors and the approximately 600 mm flat cable shown in photo 10.35.

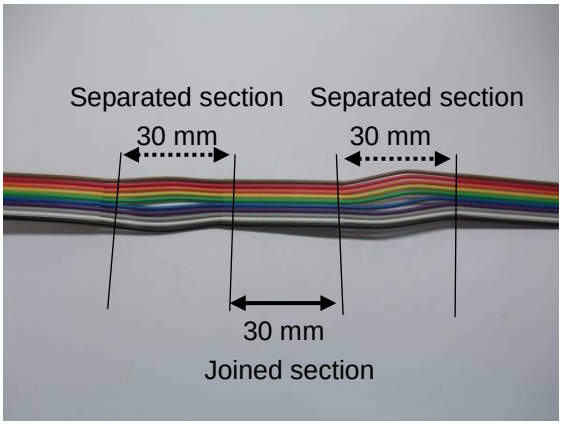



Photo 10.36

As shown in photo 10.36, the flat cable has separated sections and joined sections. Each section is about 30 mm long.

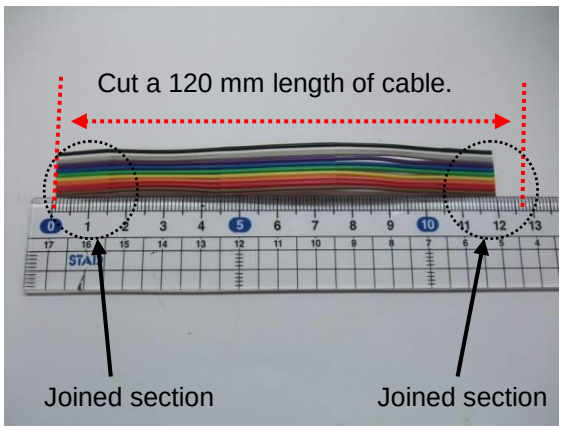



Photo 10.37

Since each section is about 30 mm long, four sections is about 120 mm of cable. Cut a length of cable as shown in photo 10.37, with joined sections at both ends. Always cut the flat cable at the center of a joined section.

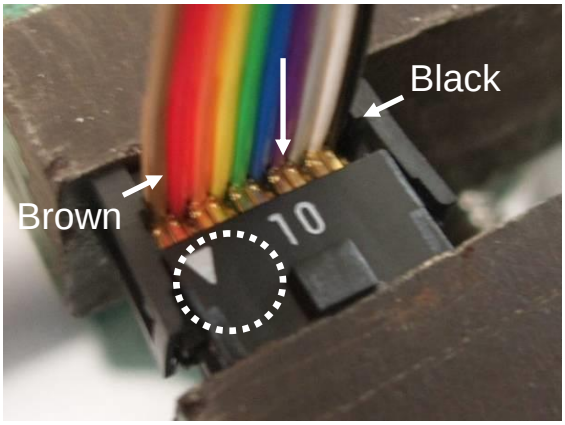



Photo 10.38

Attach a 10-pin female connector to one end of the cable. Insert the end of the flat cable so that the triangle mark indicated by the dotted circle in photo 10.38 corresponds to the brown wire. Be careful not to insert the cable the wrong way.

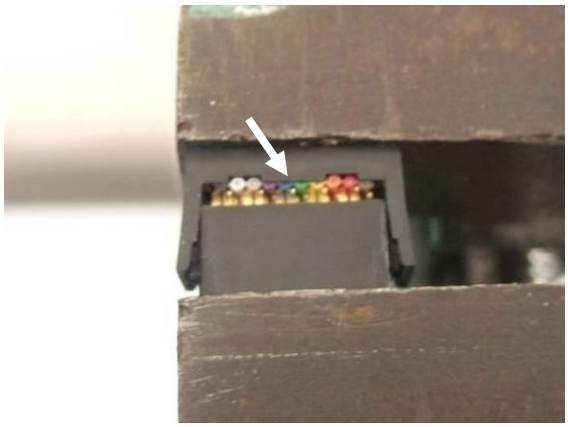


Photo 10.39

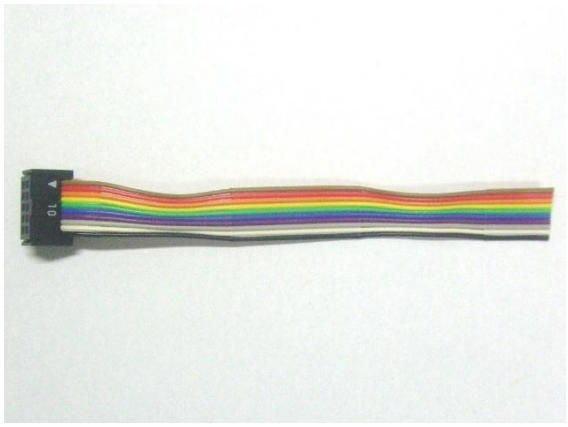


Photo 10.40

As shown in photo 10.39, insert the end of the flat cable until it comes up to the base portion indicated by the arrow. If the cable is not inserted all the way to the base, connection faults may result. Current will not flow through the cable. With the cable inserted all the way to the base, compress the connector in a vice.

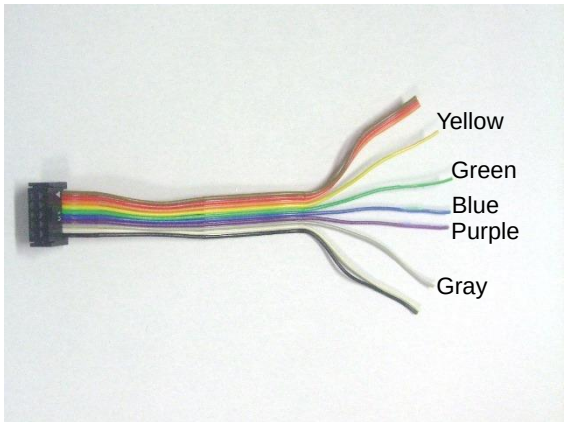



Photo 10.41

Divide the yellow, green, blue, purple and grey cables one by one.

Photo 10.42

Prepare the tapes (I.e. scotch tape).

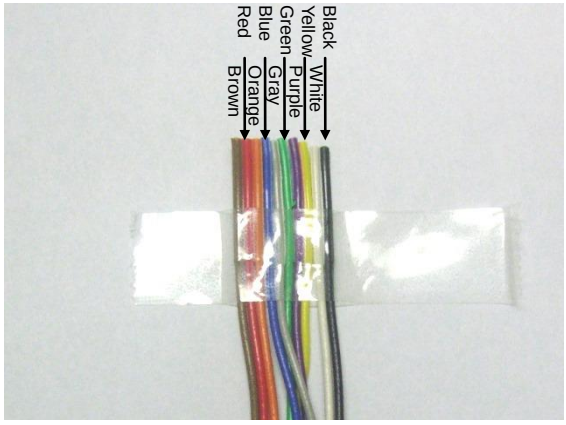



Photo 10.43

Arrange them in order of brown, red, orange, blue, grey, green, purple, yellow, white and black from the left.

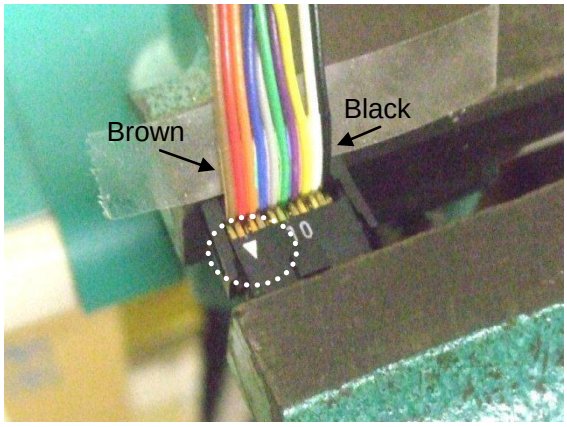



Photo 10.44

Attach a 10-pin connector.

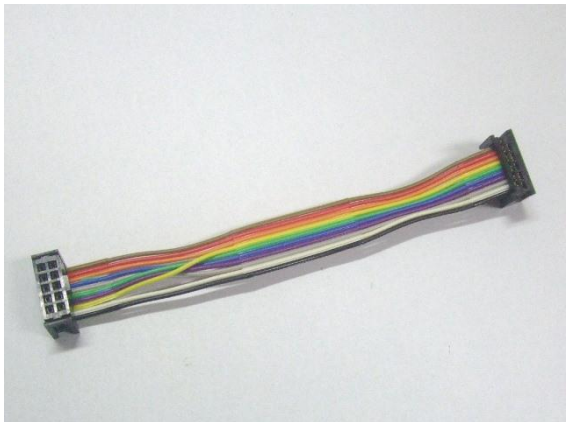


Photo 10.45

120mm flat cable is completed.

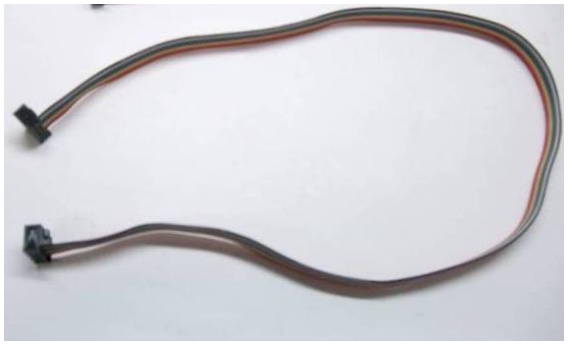


Photo 10.46

Attach 10 pin connectors to the both ends of the remaining flat cable (approximately 480mm) and it is complete.

## 10.5. Mounting the MCU Board

Photo 10.47

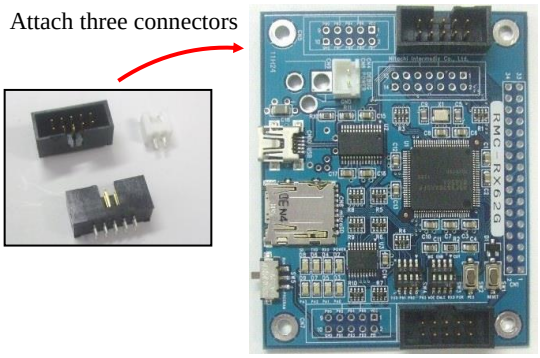



Photo 10.48

For this task you will need four studs, two nuts, four spring washers, two flat washers, two flathead screws, and the RMC-RX62T board. Also, solder three connectors to RMC-RX62T board in advance.

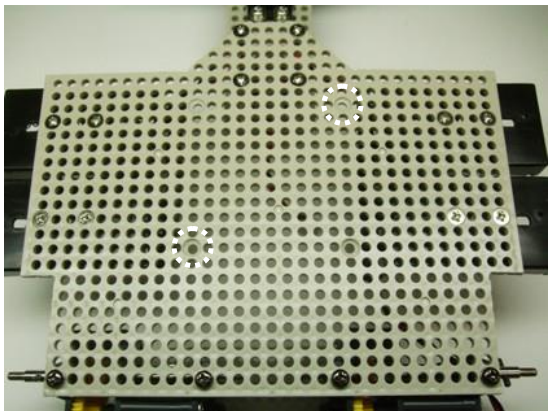


Photo 10.49

Insert two flathead screws into the holes indicated by the circles.

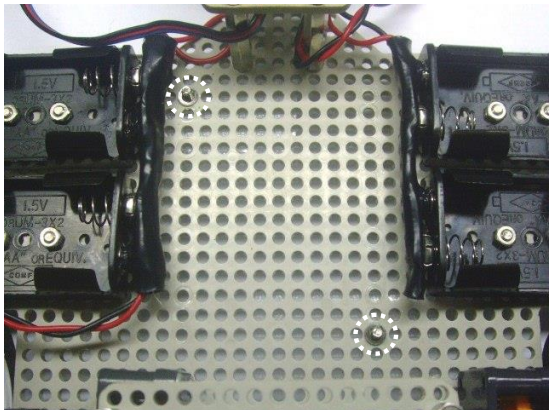


Photo 10.50

Turn the board over and place spring washers over the ends of the two screws, as shown in the photo.

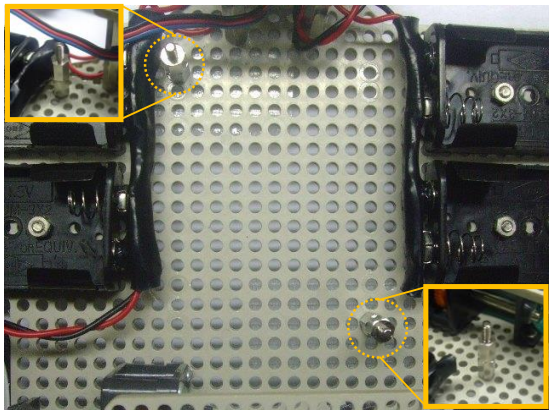


Photo 10.51

**Onto the screws, mount four stud bolts on the parts circled – two on each screw.**

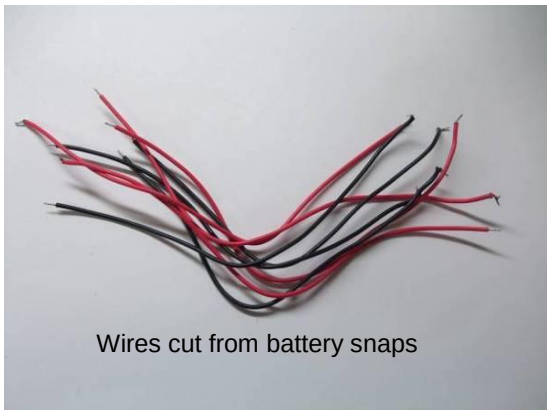



Photo 10.52

The wires cut from the battery snaps when preparing the power cables will be used for binding the cables.

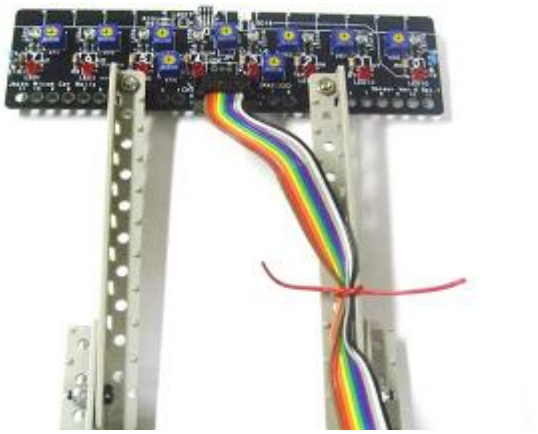


Photo 10.53

As shown in the photo, attach to the sensor board the long flat cable (480 mm) prepared for the sensor board. Bind the cable to one of the sensor arms.

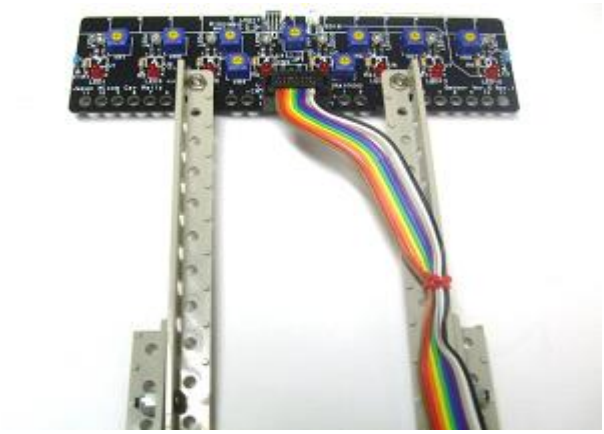


Photo 10.54

Knot the wire a second time and cut off the excess portion, as shown in the photo.

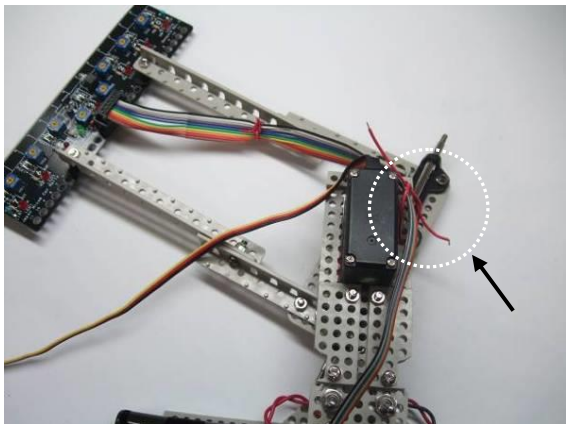


Photo 10.55

As shown in the photo, turn the front wheel assembly all the way to the left and bind up the cable in the location indicated by the arrow.

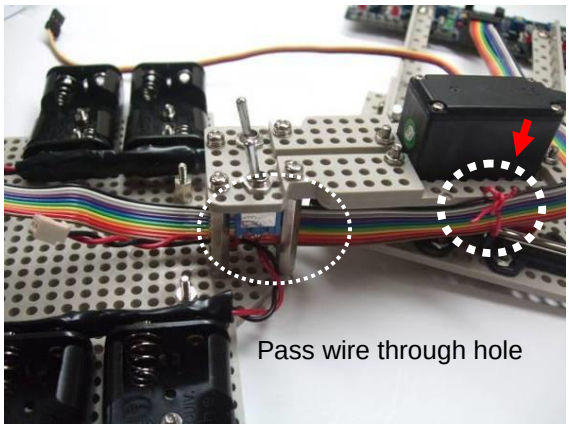



Photo 10.56

Pass a wire through the hole, as indicated by the arrow in the photo, and tie it around the sensor board flat cable to secure it.
Pass the sensor board flat cable through the opening between the toggle switches.

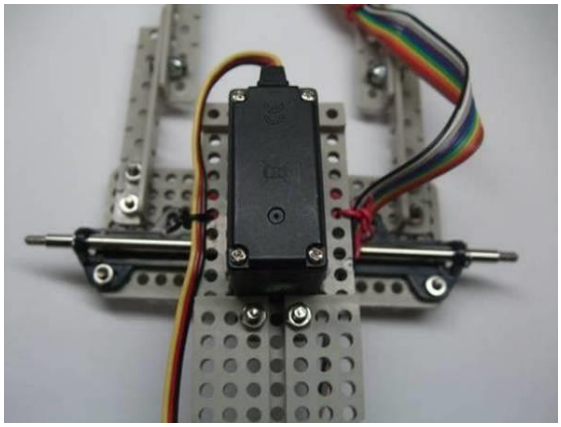


Photo 10.57

Bind the servo cable in like manner, as shown in the photo.

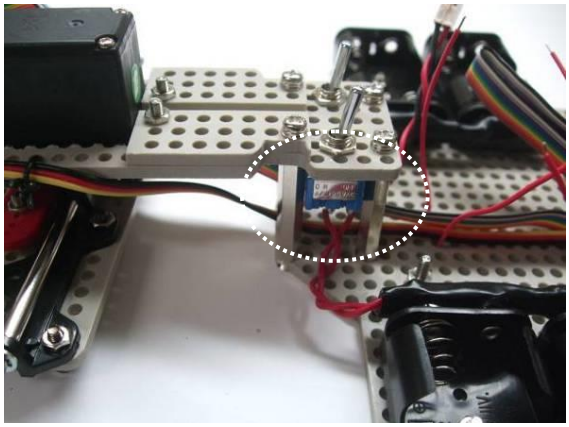


Photo 10.58

As shown in the photo, pass the servo motor cable as well through the opening between the toggle switches.

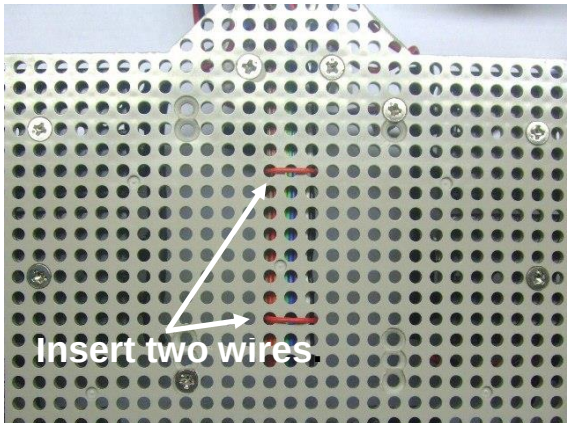



Photo 10.59

Insert two wires into holes in the board, as indicated by arrows in photo 10.59.

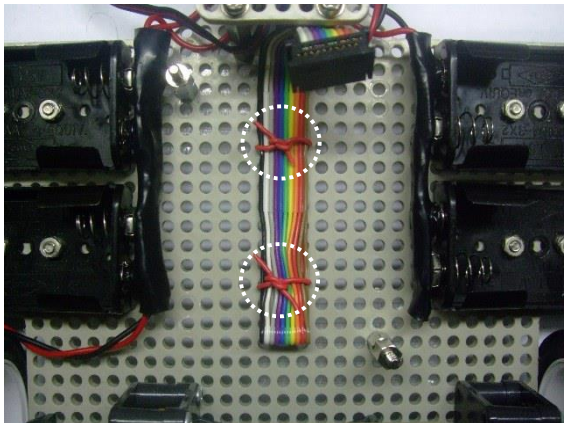


Photo 10.60

Bind together the sensor board flat cable and servo motor cable.

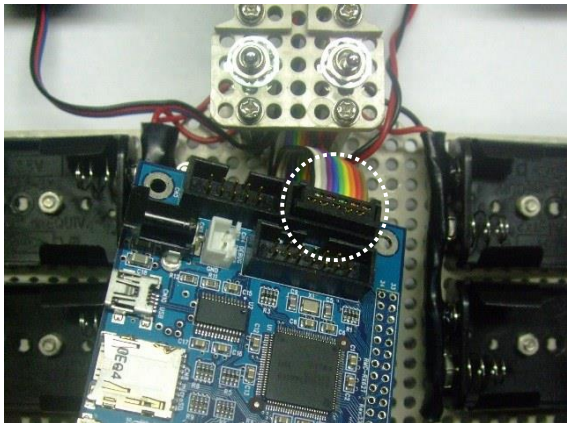


Photo 10.61

As shown in photo 10.61, plug the sensor board flat cable into port 0 of the MCU board.

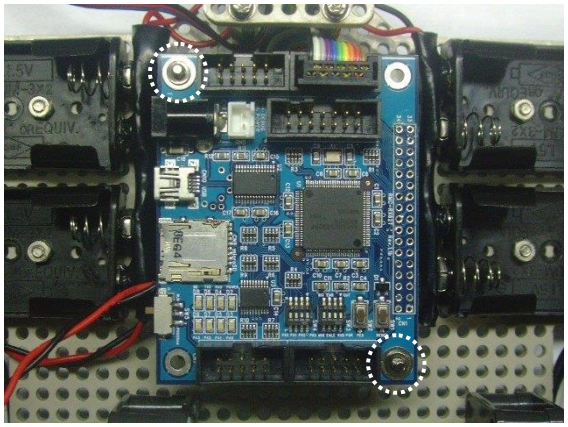


Photo 10.62

As shown in 10.62, position the MCU board to match the stud positions. Place a flat washer and a spring washer, in that order, over the end of each of the studs.

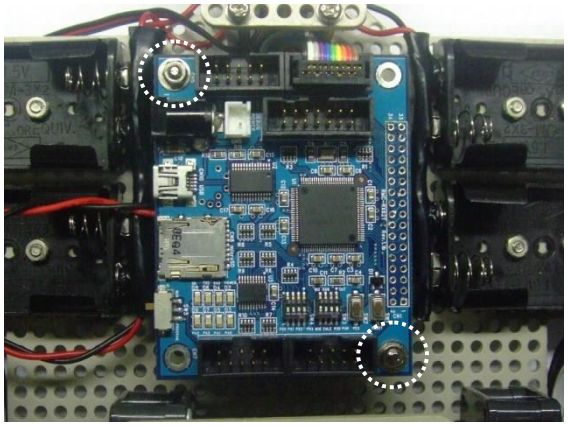


Photo 10.63

Screw on the nuts and tighten them securely in the two locations, as shown in the photo.

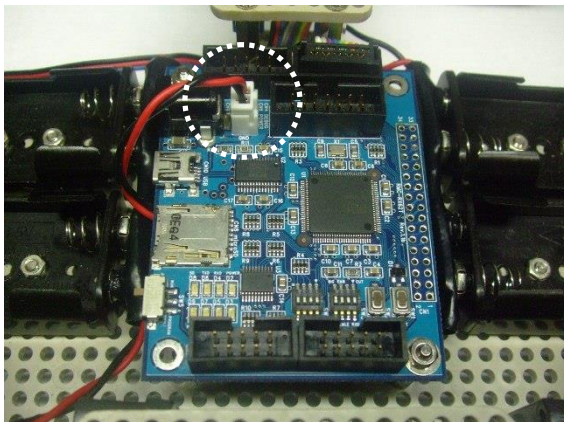


Photo 10.64

Connect the white connector of the MCU board power cable as shown in the photo. This completes the task of mounting the MCU board.

## 10.6. Mounting the Motor Drive Board

### 10.6.1. Mounting Motor Drive Board, Ver. 5.1

Photo 10.65

For this task you will need four flat washers, four spring washers, and four nuts.

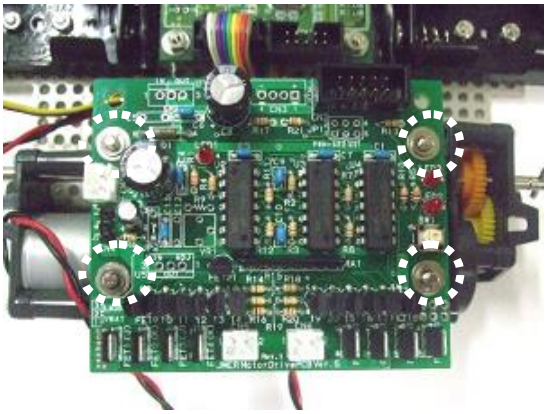


Photo 10.66

Position the motor drive board as shown in the photo and place a flat washer and a spring washer, in that order, over the end of each of the studs in the locations indicated by the circles.

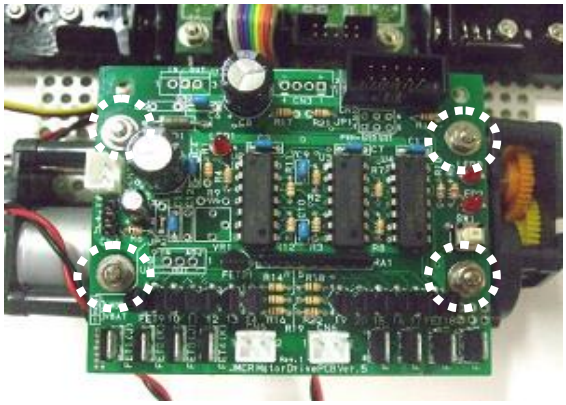


Photo 10.67

Screw on and tighten the nuts in the four locations indicated by the circles.

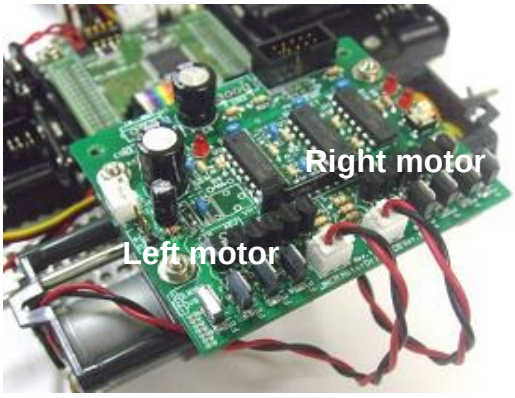



Photo 10.68

Connect the motor cables, taking care not to mix up the left and right motor connections.

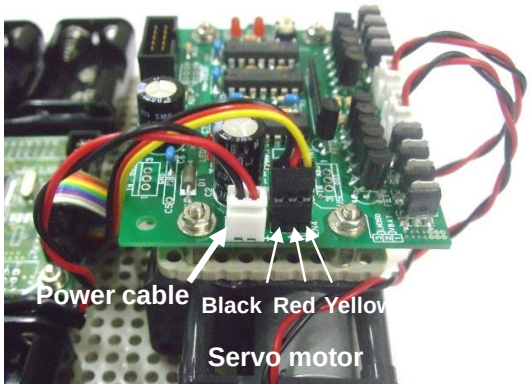



Photo 10.69

Connect the power cable of the motor drive board and the servo motor cable. Take care not to reverse the orientation of the servo motor cable connector.

(For reference: Servo motor wires—black (–), red (+), yellow (signal))

### 10.6.2. Connecting the Flat Cables

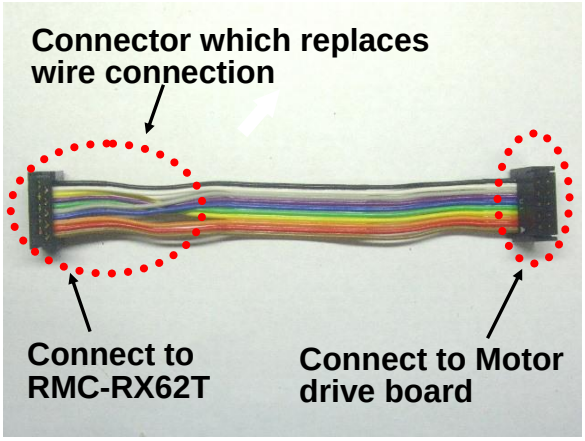



Photo 10.70

Insert the flat cable connector with the reconfigured wire connection to the CN3 socket on the RMC-RX62T board. The opposite side of the connector inserts into the motor drive board.

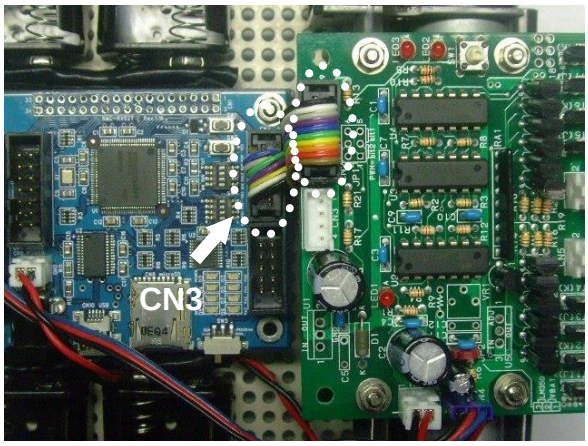



Photo 10.71

**RMC-RX62T board:** Connector (CN3) to the motor drive board with a flat cable (120 mm).

# 11. Mounting the Wheels

## 11.1. Mounting the Front Wheels

Photo 11.1

For this task you will need two wheels, two spring washers, two nuts, and a nut tightener.

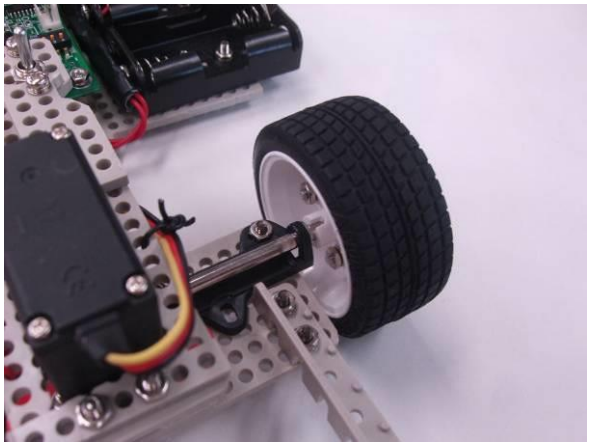


Photo 11.2

Fit the wheel onto the shaft.

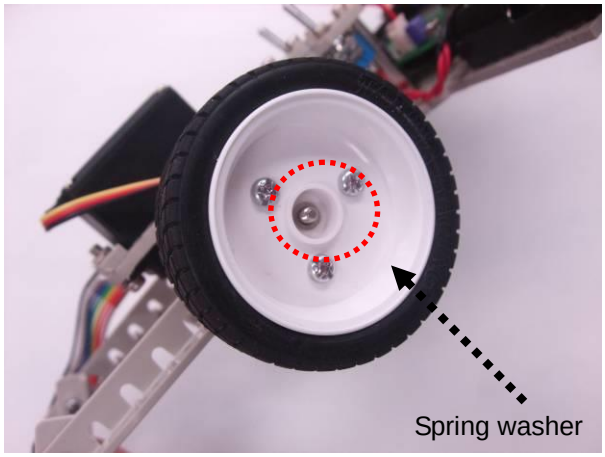



Photo 11.3

Place a spring washer over the end of the shaft, indicated by the arrow in photo 11.3.

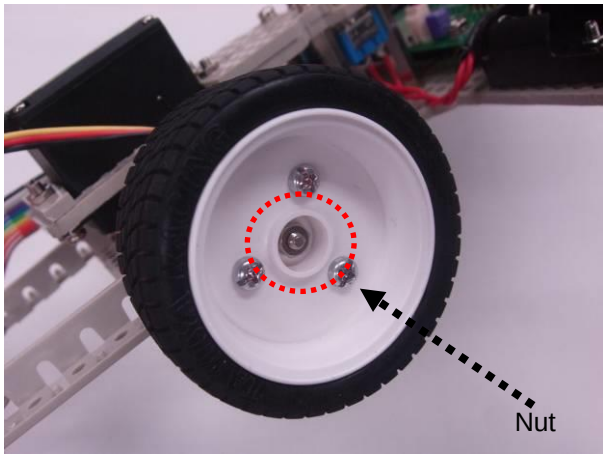



Photo 11.4

Screw on a nut as shown in photo 11.4.

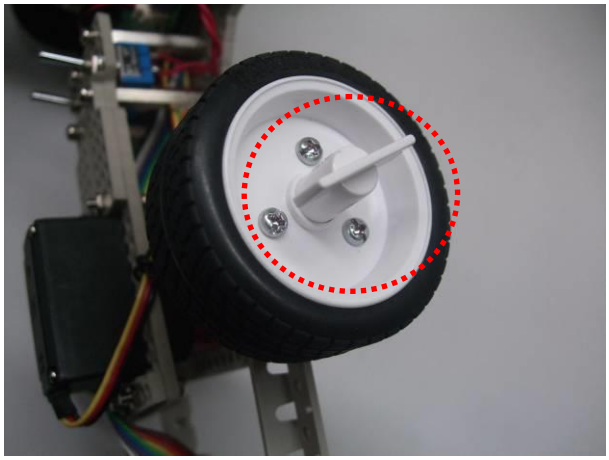


Photo 11.5

Use the nut tightener to tighten the nut securely.

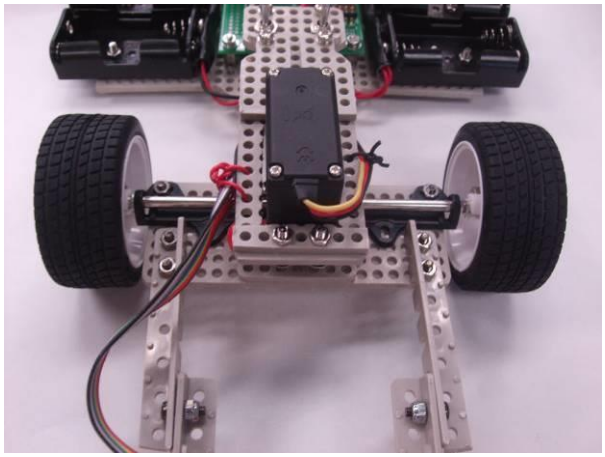


Photo 11.6

Do the same for the other front wheel.

## 11.2. Mounting the Rear Wheels

Photo 11.7

Next, you will need two wheels, two spring washers, and two nuts.

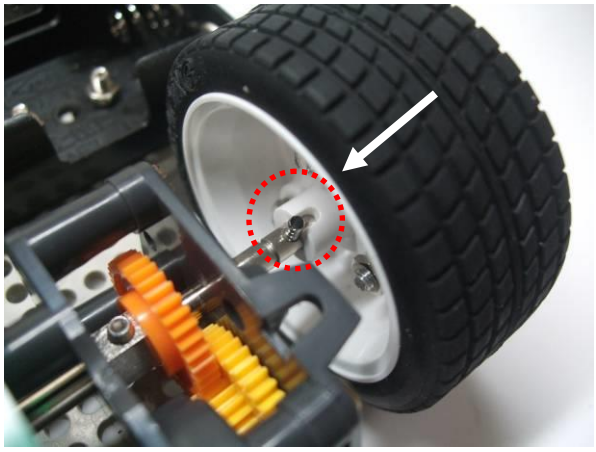


Photo 11.8

Mount the right wheel first. Fit the wheel onto the shaft, making sure the spring pin fits into the notch in the hub.

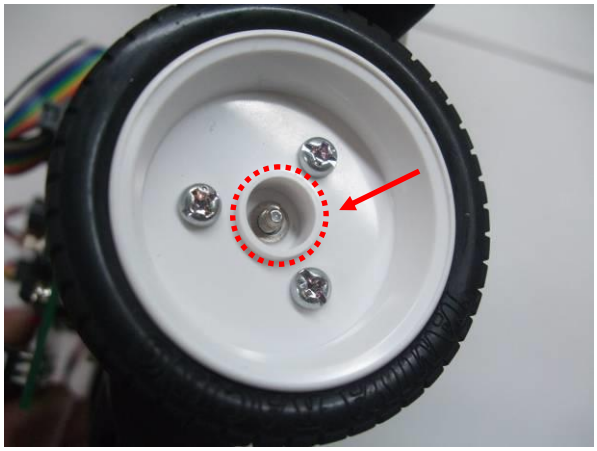


Photo 11.9

Place a washer over the end of the shaft, as shown in the photo.

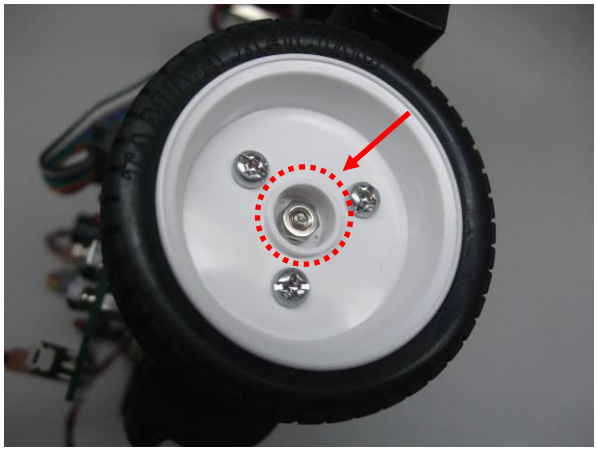


Photo 11.10

Screw on a nut, as shown in the photo.

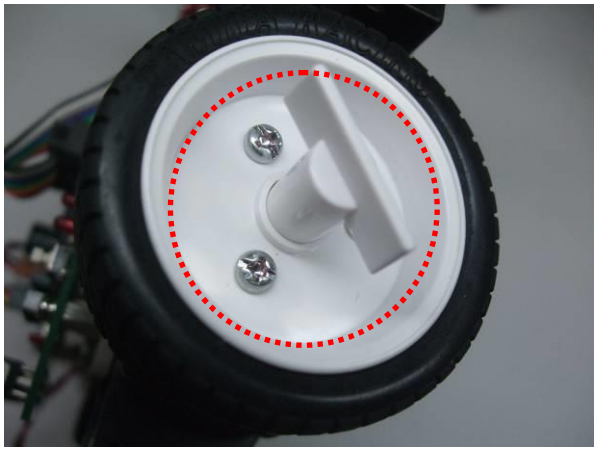


Photo 11.11

Use the nut tightener to tighten the nut securely, as shown in the photo.

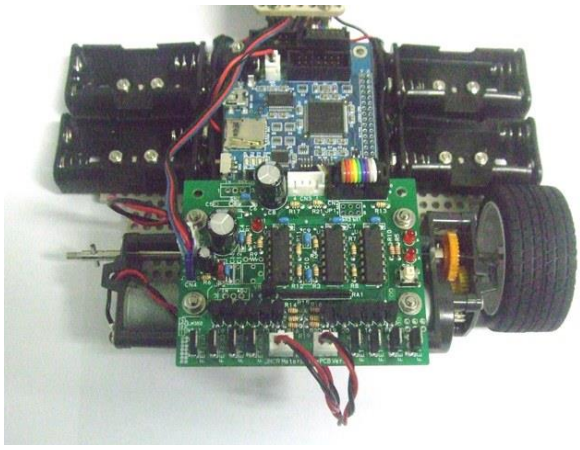


Photo 11.2

The right wheel appears as shown when mounting is complete. Next, mount the left wheel in the same manner as the right wheel.

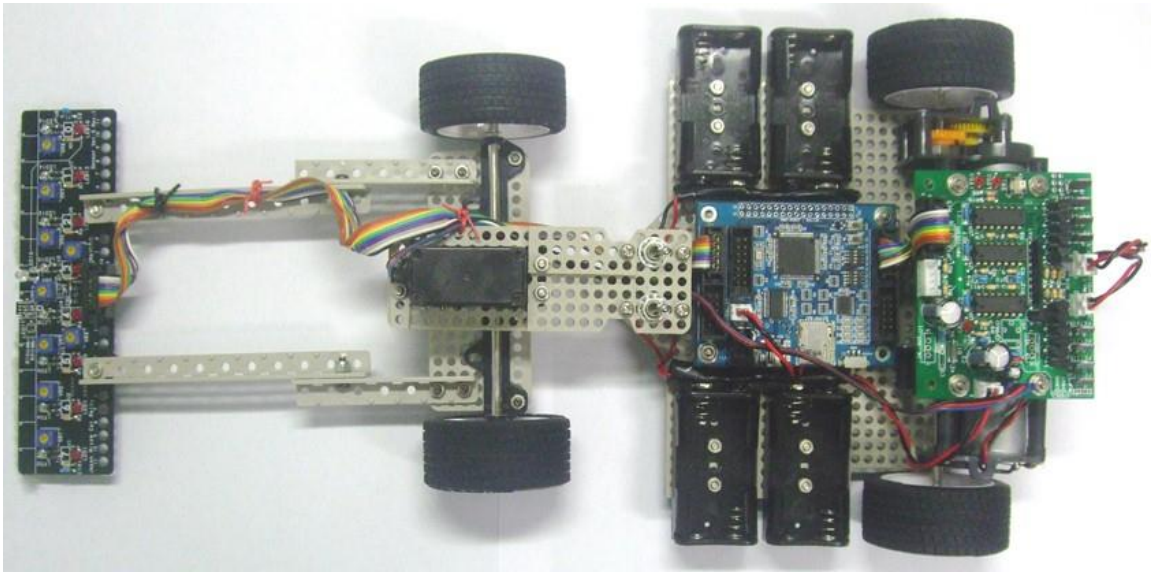


Photo 11.13

After the left wheel is mounted, assembly of the MCU car body is complete.

Note: See *Operation Test Manual: MCU Car Kit, Ver. 5.1* for instructions on writing the software to the RMC-RX62T board.