

WIRING INSTRUCTIONS FOR THE ROBOT PROJECT AND OTHER DETAILS (see Note 1 at end of section)

1-14-06

Wiring within each Control Unit

1. Connect the Red wire of the upper battery holder to terminals 1 and 4 (see drawing 006). Remove insulation and trim as required. (It may be easier to cut and skin the wire at terminal 4, then use a cut-off piece of wire as a jumper between terminals 4 and 1. Be sure to twist the strands first, then twist both wires together bending them clockwise around terminal 4). Apply a washer and a 4-40 nut, and tighten.
2. Connect the Black wire of the lower battery holder to terminals 2 and 3. Remove insulation and trim as required. (It may be easier to trim and skin the wire and connect it to terminal 3, then add another piece of wire as a jumper between terminals 3 and 2). Apply a washer and a 4-40 nut, and tighten.
3. Attach the Black wire of the upper battery holder and the Red wire of the lower battery holder to the Common bus (item 29) (this allows for the reversal of polarity of the batteries, and causes the motors to go the opposite way they were going before).

Wiring of Power Unit

4. For a 2-leg robot, remove the 24 AWG flexible wire from the 2 Control Unit bags, and cut four 5-foot lengths. Start with the Power Unit, and insert one end of each wire-pair through the four 3/16 holes in the wood block (drawing 001). Bring out the wires through the 3/8 hole at the rear of the block, leaving just 2 inches of wire sticking out at the two holes next to the two lateral motors, and 9 inches of wire* coming out of the end holes (see drawing 002-5). Considering that the Power Unit will operate upside down (the leg motor will be below the wood block), use pieces of masking tape to tie together and label the two pairs of wires that come from the left side of the robot and the 2 pairs coming from the right side. Mark them Left and Right. A 4-leg robot will be treated as 2 2-leg units at this stage.
5. Go back to the wood block, and for each of the 4 pairs of wires sticking out of the 3/16 inch holes, make a 1 inch long separation of the wire pairs with a sharp knife. Strip the ends of the wires so that 3/8 inch of copper is exposed. Be sure the strands are twisted tightly.
6. Connect the wires to each motor by twisting the wires to the terminals of each motor. Do NOT solder, as we have not yet established the correct motor direction.

Wiring to Control Unit

7. Pick up two Control Units, and label with masking tape one with the name Left, and the other Right. If you are building a 4-legged Robot, mark them Left Front and Right Front (the other Power Unit will have its Control Units marked Left Rear and Right Rear).

8. Take the 2 pairs of Left wires coming from the wood block and measure a distance of 3 foot 7 inches* from the end of the wood block with the 3/8 inch hole, and tie a single knot in each wire pair. Attach a masking tape label an inch above the knot with “LEFT Up/Down” for the shorter wire, and “LEFT Forward/Back” for the longer wire.

9. From the top side of the Left Control Unit, thread the shorter wire through the upper 1/8 inch diameter hole, then tie another knot beneath the plywood, so as to not accidentally overstrain the solder connections you’ll be making. Repeat for the longer wire-pair which should go through the lower hole. You should have a length of about 2 1/2 inches of wire below the plywood for the shorter wire pair, and about 8 inches more for the other. Trim the longer wire pair so that they are both the same length (if for any reason you do not get at least 2 inches of wire available for each below the plywood, retie both knots so make sure that you get at least this amount for both wire pairs).

10. Separate the wire pairs for about two inches from their ends with a sharp knife, then skin the wires so that 1/2 inch of copper is exposed. Attach one of the wires of each wire-pair to the Common bus (item 29) but do NOT solder.

11. Solder the remaining wire from the originally short wire-pair (labeled LEFT Up/Down) to the available tang of the upper round head fastener. Be sure all surfaces to be soldered are clean. It is important to apply the soldering iron to the brass tang of the round head fastener before applying the solder to the wire. A good joint does not require much solder, so remove the soldering iron after a few seconds, and be careful not to disturb the joint, which should be shiny after it cools.

12. Solder the remaining wire from the originally long wire-pair (labeled Forward/Back) to the available leg of the left hand round head fastener (see drawing 006). Be sure you do not disturb the soldering that was previously done to connect the horizontal and vertical tangs.

13. Solder all the wires going to the Common bus.

14. Repeat for the wires going from the Right side of the Power Unit to the Right Control Unit. If building a 4-leg robot, follow similar procedure for all the remaining Control units.

Check it out

15. Lift up with your fingernail and deform the paper clips slightly so that there is a gap of between 1/16 and 1/8 inch between the paper clips and the round head fasteners. Check very carefully that they are not touching normally, but that a light pressure will cause them to make contact.

16. Insert four D-cells in each Control Unit. Check for heating or smoke, or motors running.

17. If all OK, make contact with the paperclip in position 1 (up)(see drawing 004). If the leg motor goes up towards the wood block, the motor is connected correctly. Make contact in position 3 (down). The motor should do the opposite of what it did before.

18. Make contact with the paperclip in position 4 (backwards). If the leg moves towards where the wires come out of the block, it is connected correctly. Making contact with paperclip 2 should do the opposite of what it did before (forwards - towards the narrow part of the wood block).

19. If one or both were opposite in the above paragraph, reverse the wiring on the respective motors, check it again, and if now correct, solder the wires. (You may decide to delay soldering the wires to the up/down motors until you are confident that everything works as expected - but be aware that poor connections can cause overheating and loss of power).

Attach robot body to the power unit

20. You should now be ready to mount the Power Unit in the body of the Robot, though you will probably need to remove the Robot legs to do so. You may also need to disconnect the wiring to the leg motors. If you do so, label the wires carefully so that you can reconnect them correctly after threading them through the legs of the Robot. Also bear in mind that the wires should be wrapped around the threaded rod in a spiral manner, to allow the rod free movement (drawing 003-3). After all is done, check it out again.

21. You should now have a functional Power Unit and two Control Units. If this is a 2-legged Robot, you will need to make a wire skid for the rear legs. Measure the distance between the base of the wood block and the table, then shape the copper wire (item 13) in the manner suggested in drawings 002-5 and 002-6, and mount with the two 12 x 3/4 screws. Insert these screws carefully so that they do not crack the wood block - for every half turn, reverse direction for a quarter of a turn. The height of the skids should be about 1/2 inch less than that of the legs when fully extended. Trim wire as needed. You may need to add lead weights to make sure that the center of gravity is just behind the front legs (obtain these at your local service station - they're used to balance tires).

22. If you are building a four-legged Robot, you do not need skids to balance your robot, but you are allowed to use one set of skids if you chose. You will be building a second Power Unit that carries the rear legs, and the two Control units to operate them. You may need to devise one or two plates that can be mounted with screws (and epoxy) for holding the two Power Units together (we do not provide this plate, as you may choose to integrate this directly into the design of the Robot body).

23. The last step before the robot can begin to walk is to give the feet some traction. 1/2 x 1/2 inch pieces of rubber are provided for each foot (item 15) and should be stuck with epoxy to the sole of the foot in the place most likely to make contact with the table (note that the sole of the foot might be either the motor itself or it may be part of the body costume that covers the motor). Be sure the surface of the rubber pad is slightly rounded (convex), then coat it with a thick layer

of rubber cement, and let it dry. Be careful not to get any epoxy or rubber cement on the rear end of the shaft of the motor.

24. Two additional steps are needed to ensure the operation of your robot. A means of storing it safely, and a way to protect the batteries from getting discharged unintentionally. Since the legs of the robot can get bent quite easily, we have found that an empty 12-bottle wine box (with the partitions cut down to half their height), provides two rows of cavities for the legs and skids (adequate even for a 4-leg robot), while the 3rd row can be used to store the Control units. This can also be used as the shipping container, or a custom shipping container can be designed later.

25. While some may chose to remove all batteries when the robots are not in use, an easy alternate is to insert a 4 inch length of masking tape at a 45° angle between the paperclips and the heads of the brass fasteners. If the tape is 1 inch wide, one piece will cover all 4 contacts, and protects the paperclips from being accidentally pressed down during storage or shipping

* In the event the Robot leg is more than 5 inches high (as measured from the middle of the wood block to the extended leg position), add 1 inch more of wire length per extra inch of height over 5 inch, to the 9 inches specified in paragraph 4. Also subtract 1 inch per inch from the length of wire specified in paragraph 8.

Note 1. While we believe that it is easier to follow the sequence shown, a team that completes the Control Units first may prefer to skip paragraphs 4-5-6 and do them after paragraph 14. In this case the trimming of the wires should be done at the Power Unit end, such that all the wires between the rear of the Power Unit and the Control Units are the same length. Cut the 5 foot lengths of wire, thread them through the 1/8 inch holes in the Control Units, and tie the knots below and above the plywood as described in paragraphs 9 and 8, leaving a length of 2 1/2 inches for all the wires coming out the bottom. Continue with paragraphs 10 thru 14, and then paragraphs 4-5-6. Caution that the wires will be harder to thread into the wood block when done from the 3/8 inch hole end.