Battery Power from Create

iRobot Education

You can use the robot battery to power your project. You can source power thru the serial port or directly from the various motor drivers in the robot. You can even power your cell phone!

Introduction to the Serial Port

Voltage	10 V – 20.5 V
Current	0.2 A
Rated Power	2 W

The serial port power comes from either the charger when the robot is on the dock or from the battery while the robot is running. _Serial port power is always on._ We recommend installing an on/off switch between the serial port and your project.

Remember to turn off your project when you're done. If you leave your project on and don't return the robot to the dock to charge you will eventually deeply discharge the battery and damage it.

Introduction to the Motor Drivers

	Main Brush	Side Brush	Vacuum
Maximum Current	1.45 A	0.54 A	0.56 A
Rated Power (at 12 V)	17 W	6.5 W	6.7 W

The motor drivers are powered directly from the battery but _motor drivers are off when the robot is not moving._

STEM Subject(s):
Soldering

Experience Level:
Advanced

Supplies:
- #1 Philips Head Screwdriver
- Needle Nose Pliers or Tweezers
- Soldering Iron
- Wire Strippers
- Hot Glue Gun (optional)
- Wire
- Zero or more inductors (see below; depends on power demand)

Additional Resources:

The drivers turn on when the robot moves or can be turned on through the OI. By default the motor drivers are not on continuously but switch on and off at 10kHz.

The motor drivers use a technique called Pulse Width Modulation (PWM) to compensate for the battery voltage decreasing during a mission. The duty cycle (switch on time/switch period) is varied to maintain an effective constant voltage on the motors.

You can command the motor drivers on and adjust the duty cycle through the Open Interface Spec. Look for the OI manual opcodes for motors and PWM Motors. If the computer or processor that runs your project draws too much power to run from the serial port you can run it from one of the motor drivers but you will need to provide external power initially to "jump start" your project enough to get it to command the motor drivers to turn on.

Introduction to Inductors

The motor drivers were designed to drive inductive loads (motors have a lot of inductance). The input to a power supply is a large capacitor. If you were to connect the input of your project directly to the motor driver output, when the driver "switch" is turned on, the robot's protection circuitry sees this as an effective short circuit (since the project's input capacitor is initially discharged – lots of current flows from the robot's battery to charge the capacitor).

Installing the inductor between the motor driver and the power supply adds the inductance back into the circuit and limits the rate of current rise so that the input capacitor can be charged without tripping the current limit.

How do inductors work?

An inductor obeys the following formula: $V = L * di/dt$

V	Voltage across the inductor (Volts)
L	Value of inductance (Henrys)
di	Change in current (Amps)
dt	Change in time (seconds)

If a positive voltage is applied across an inductor then the current flowing through it increases over time. There is also energy stored in the inductor. If a negative voltage is applied across the same inductor then the current flowing through the inductor decreases over time and the energy stored in the inductor is transferred to the other circuitry. Inductors are used in power supplies to control current and store energy.

Instructions

Serial Port

To draw power from the serial port see the serial port pinout in the OI Spec. For examples see the serial cable instructions Serial to USB, Serial to 3.3V logic, Serial to 5V logic, Serial to Bluetooth.

Main Brush Motor Driver

To draw power from the main brush driver you will need to access the main brush connector and add an inductor. We recommend a 2.2 mH, 1.5A inductor. An appropriate example of such an inductor is a Murata 1422514C.

1) Remove the vacuum bin from the robot

2) Flip the robot so the wheels are facing up

3) Remove side brush screw and side brush (1 screw)

4) Remove the bottom cover (4 screws)

5) Remove side brush module (2 screws), if desired

6) Remove main brush module (4 screws) lift straight up

7) Disassemble cleaning head from main brush frame

   A) At the back of the cleaning head on each side use your Philips head screwdriver to push the grey cleaning head pivot point in as you pull the blue frame out to dislodge the pivots

   B) At the front of the cleaning head remove the sticker over the cable anchor

   C) Using your needle nose pliers or tweezers push up on the cable until the anchor is free from the recess and remove the cable from the slot

   D) Cut the red and black motor wires close to the motor

   E) Cut the dirt detect wires close to the dirt detect sensor

   F) The cleaning head should now be free from the frame, set aside the cleaning head

8) Install the cleaning head frame back into the robot chassis (4 screws)

9) The red motor wire is plus, the black motor wire is minus, when driving the motor forward

10) Solder one lead of the inductor to the red wire and hot melt glue the inductor to a convenient place in the cleaning head frame

11) Solder a wire from the other lead of the inductor to the plus input of your project

12) Solder the black motor wire to the minus input of your project

13) You may want to insert a connector on the wires to make it easy to remove and install your project (optional)

Side Brush Motor Driver

To draw power from the side brush driver you will need to solder directly to the side brush spring contacts and add an inductor. We recommend a 2.2 mH, 0.5 A inductor. A few appropriate examples are:

- Abraco Corporation AIAP-03-222-K
- TDK Corporation TSL1315RA- 222JR55-PF
- TDK Corporation SL1720-222KR60-PF
- Vishay Dale IHD3EB222L
- Bourns Inc. 5900-222-RC

1) Remove the side brush screw and side brush (1 screw)

2) Remove the bottom cover (4 screws)

3) Remove the side brush module (2 screws) and set aside

4) Solder a wire from the front spring to one lead of the inductor

5) Solder a wire from the other lead of the inductor to the positive input of your project

6) Solder a wire from the back spring to the negative input of your project

7) Hot melt glue the inductor in the side brush well or some other handy place

8) Take care when routing the wires from the side brush springs to your project such that the wires don't get caught on obstacles as the robot is driving

Vacuum

To draw power from the vacuum bin driver, you will need to connect to the vacuum bin connector and add an inductor. We recommend a 2.2 mH, 0.5 A inductor, just like the side brush.

1) Remove the vacuum bin from the robot and flip it upside down

2) Use your #1 Phillips screwdriver to remove the six screws holding the bin together and set them aside

3) Separate the upper and lower bin housings

4) Remove the screw holding the vacuum fan in place and slide it out of the bin

5) Cut the red and black motor wires close to the motor

6) Using your wire cutters cut a notch in one or both sides of the vacuum fan assembly and route the wires through the notch(es)

7) Re-assemble the latch, spring, and vacuum fan assembly in the upper bin housing and secure with the screw

8) Solder the inductor to the black wire (this is the opposite instruction from the main brush and side brush drivers)

9) Hot melt glue the inductor into the upper bin housing

10) Solder the red wire to the positive input of your project, solder a wire from the other inductor lead to the negative input of your project (you may want to add a connector to make it easy to remove your project)

11) Re-install the grill (optional)

12) Re-assemble the lower bin housing to the upper bin housing and secure with the six screws

13) Re-install the bin in the robot

Example Project

Pokémon Go Egg Hatching

You can charge your phone through the serial port! Remember the Pokémon Go App and hatching eggs? We designed this cheat so the iRobot Create® 2 can aid in hatching your Pokémon™ Go eggs. While your Create® is running it can rack up some serious "walking" kilometers that will be valuable in getting those eggs hatched. So here's how to charge your phone using your Create® at the same time!

Supplies

- Tensility 10-00543 Cable ($7.39 at DigiKey.com)
- A 5V DC to DC Converter (UBEC Adaptor DC/DC Step-Down Converter was used for this project (~$10))
- USB Extension Cable (~$5)
- A two- or three- pin male 0.1" Pitch Rectangular Connector, Header
- Phone Specific USB Charger cord

* Do not use the USB to Serial cable supplied with the Create 2, it will not work.

Instructions

1) Remove the face plate of the Create® to access the serial port. The 7-pin MINI-DIN Cable will be able to plug into the serial port at the 3 o'clock position. We will need one of the battery voltage pins and one of the ground pins. We used pin 1 (red on the Tensility cable) and pin 6 (yellow on the Tensility cable). The others can be cut short to keep out of the way.

2) The UBEC Adaptor has an input and an output side. The input will have a red and black wire that have exposed ends. Solder the red wire to the battery voltage on the 7-pin MINI-DIN Cable and the black wire to ground on the 7-pin MINI-DIN Cable.

3) Take the USB Extension Cable and cut it in half; you will only need the female end. There should be four exposed wires of colors: black, red, green, and white. The green and white wires should be tied together. Solder them together in order to maintain a stable connection. Take the male connector header and wrap the exposed ends of the black and red wires around two separate pegs on the header. You should solder these connections as well.

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4) Insert the male connector header into the UBEC output. Make sure that the pins are inserted such that connections are made between like color wires.

5) Cover any exposed wires with heat shrink tubing, electrical tape, or hot glue.

6) Use Velcro© or tape to fasten your phone and wire assembly to the top of your Create® to keep it from falling off.

7) Plug the cable you made into your Create® serial port, connect your phone charger line, and sit back and relax as you hatch some brand new Pokémon™!