Create® 2 Battery Power

Summary:

This procedure describes how to power your project from the battery in Create.

Introduction

So you have a project for your robot and you want to power that project from the robot battery. There are generally two approaches, draw power from the serial port or from one of the motor drivers.

SERIAL PORT
Ratings
Voltage   20.5V – 10V
Current   0.2A
Power   2W

Always On: 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.

MOTOR DRIVES
Ratings
Voltage   16V – 12V
Current   MB 1.45A, SB 0.54A, VAC 0.56A
Power   MB 17W,   SB 6.5W, VAC 6.7W

Normally Off: The motor drivers are powered directly from the battery but are off when the robot is not moving. 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 OI, see the OI manual opcodes for "motors" and "PWM motors" here.

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.

Tools Needed

#1 point Philips head screw driver
Soldering iron
Wire cutters/strippers
Hot melt glue gun (optional)

Supplies

Wire
Hot melt glue
Inductor main brush 2.2mH 1.5A

Murata   1422514C

Inductor side brush or vacuum 2.2mH 0.5A

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

Procedure

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

Main Brush:
To draw power from the main brush driver you will need to access the main brush connector and add an inductor

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 screw driver 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:
To draw power from the side brush driver you will need to solder directly to the side brush spring contacts and add an inductor.

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.

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

Theory
Why is the inductor necessary?

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 directly to the motor driver output then it effectively shorts the power supply input capacitor to the battery voltage when the motor driver turns on. Since the capacitor is initially discharged, a very large current flows quickly and causes the motor driver to trip the current limit and turn off to protect itself. 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 decreasesover 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.