The Centimani Servo Power Board

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Abstract

This document discusses the procedure required to build a Centimani Servo Power Board and the capabilities of the board. This board allows the designer of a large, servo based project to separate the servo power supply from the electronics power supply. It is built to accommodate up to 32 servos, with a maximum current draw of 3 amps per group of 8 servos.

Introduction

The Centimani Servo Power Board (CSPB) is a high current and low cost solution to powering servos. Many microcontroller development boards come with onboard regulators to provide power. Such boards include the Parallax Board of Education and the Parallax Propeller Professional Development Board. However, these regulators are usually rated at up to one amp. When running many servos, the current draw may be too large and problems will arise. The CSPB provides four additional 3A regulators to power your servos from an external power supply. Note that the CSPB does not generate any sort of servo signal. Please also note that the CSPB requires a power supply that can source up to 12 amps and that is within a few volts of 5V. A 7.2 volt RC car battery would work very well in this application.

Procedure

The following discusses the required steps to build the CSPB. If you are a bit rusty in your soldering skills, the pin headers make a good place to practice. A good solder joint should look like a circus tent: a pole in the middle, with half-u shaped sides. A bad solder joint is one that looks like a bead on the end of a stick. To fix this, simply make sure the component is *hot* and add a bit more solder. The ideal temperature is reached when the solder "twitches" and flows into the joint. For placement purposes, the top of the board is the side that has the alphabet (ABC) in the order of left to right. The bottom of the board is the side with the long silver traces (strips of silver colored metal). For all pin headers, you may shorten the length with a pair of snippers and place the shortened section anywhere within the ranges mentioned for a full size header.

Required Assembly Steps:

1. **Preconstruction**
    a. The following tools are required:
        i. Soldering iron (at least ~50W)
        ii. Wire strippers or sharp knife
        iii. Rotary tool with grinding wheel or a sharp knife
        iv. Needle nose pliers

v. Small snippers
vi. Masking tape
vii. Solder
viii. (Optional) small file
ix. (Optional)Multimeter with continuity function

b. Check for the following components:
i. 1 Gadget Gangster full size board
ii. 1 barrel jack
iii. 1 green LED
iv. 1 resistor (green-brown-brown)
v. 1 length of black wire
vi. 1 length of red wire
vii. 4 regulators
viii. 4 heatsinks
ix. 8 10 µF capacitors
x. 8 single row headers
xi. 8 double row headers

2. Basic Mechanical

a. Remove the following traces from the bottom of the board. You can use a rotary tool with a grinding wheel (fast), or you can use an Xacto knife(slow). The important part is to remove *only* the square given by the coordinates. Avoid removing any other metal. Remove the following to the extent that the plain board shows through:
i. Row 2, between:
1. AD and U
2. N and G
ii. 6-R
iii. 7-R
iv. 18-R
v. 19-R

b. Solder in the headers.
i. Flip the board so that you are looking at the top
ii. Place the two row headers in the following locations:
1. G though N in the following rows:
a. 1&2
b. 6&7
c. 12&13
d. 18&19
2. V through AC in the following rows:
a. 1&2
b. 6&7
c. 12&13
d. 18&19

iii. Place the two single row headers in between each pair of double row headers. When finished, your board should have eight distinct blocks of pins in four pairs.
iv. Tape the headers into place with masking tape. This is to allow you to turn the board over without having all the headers fall out. When taping, be sure to keep all headers as straight as possible.
v. Flip the board over and solder the pins. Do not bridge the gaps with solder.

3. Electronics

a. Place the capacitors through the top of the board. For the capacitors near the middle of the board, you should be able to seat them on the board. For the outer capacitors, the legs are a bit more splayed. Use some pliers to pull them tight and get a good seat, but do not pull too hard. Place capacitors in the following locations:
   i. Long leg through AE-5, short leg through AE-7
   ii. Long leg through AE-17, short leg through AE-19
   iii. Long leg through T-6, short leg through T-7
   iv. Long leg through T-18, short leg through T-19
   v. Long leg through P-6, short leg through P-17
   vi. Long leg through P-18, short leg through P-19
   vii. Long leg through E-5, short leg through E-7
   viii. Long leg through E-17, short leg through E-19
b. Flip the board over, and bend the pins to hold the capacitors in place as tightly as possible (finger tight!). Solder the capacitors, but do not clip the leads.
c. Place the regulators through the top of the board. Attach the heatsinks to the regulators before placing them on the board. This will help you get a square mechanical connection. Place each regulator so that the tab side (the side with the silver colored metal) is facing towards the A side of the columns. Place a regulator in each of the following locations:
   i. Column A:
      1. Row 5 through 7
      2. Row 17 through 19
   ii. Column AI:
      1. Row 5 through 7
      2. Row 17 through 19
d. Without letting the regulators fall from the board, flip the board over and place it on a flat surface. Make sure the regulators are seated squarely. Move the unclipped leads from the capacitors as follows. You will be soldering these shortly:
   i. AE-5 to AI-5
   ii. AE-17 to AI-17
   iii. E-5 to A-5
   iv. E-17 to A-17
e. Solder the regulators and capacitor leads. Once you have them solidly in place, you may remove the heatsinks until the board is completely assembled.

4. **Connection Wires**

a. Create a flat wire. This will be the input voltage bus (VIN Bus):
    i. Strip a length of the #16 wire completely bare, and twist the strands tightly together. Using a hammer, pound it into a flat strip. This works best if you have an anvil to work on, however, any hard, smooth surface should work. Avoid getting contaminants such as dirt into the wire.
    ii. Flip the board so that the bottom is face up. Place the strip onto row 24 of the board, starting at the left hand side. Do not cross over into column U.
    iii. Solder the strip down at approximately row M. This will hold it in place while you work with it. Be patient! Working with this much metal requires quite a bit of heat, so don't rush.
b. Place the battery jack on the top of the board. It fits at the bottom of columns RSTU. Make sure that it's square to the board, and tape it down.
c. Solder the jack in. Use just enough solder to hold it in place. The pins should still be visible.
d. Cut four lengths of red wire. These red wires go on the bottom of the board. Be sure to cut long, and strip both ends with plenty of open wire. When cutting and stripping, you should try to get the red plastic to get as close as possible to the target. This will prevent short circuits. The VIN Bus is the flat strip of wire, and when sizing, you should not place anything to the right of H (that's row 24 H through A)These red wires should go to the following locations:
    i. VIN Bus to AI-5
    ii. VIN Bus to AI-17
    iii. VIN Bus to A-5
    iv. VIN Bus to A-17
e. Solder the red wires. It is easiest if you solder the ends at the regulators first, and then work on soldering them as a group to the VIN Bus. These wires do not need to go through the holes, but can be soldered directly on top of the appropriate tab.
f. Take the tail of the flat wire (row 24 H through A and beyond) and fold it over the other half. Try to get it to conform as closely as possible to the existing topography. Begin soldering this part down from the right hand side (row 24, ~H) and keep going through column T. Let it cool, and cut off the remainder so that there is no connection to the row U or beyond row 24.
g. Cut the black wires to fit, with about 1" of stripped wire on either end. More is okay, less is not. The black wires go from the following approximate locations (more on that later) to the ground bus. The ground bus will be the six holes in a row to under columns W though AH. These black wires go on the top of the board. Cut the black wires to fit as follows so that the length of shielding fits between:
    i. Ground Bus to C-7
    ii. Ground Bus to C-19
    iii. Ground Bus to R-1
    iv. Ground Bus to R-12
    v. Ground Bus to AG-7

h. On one end of each of the wires, separate the strands into three, smaller groups. Twist each of these groups tightly. Align the groups so that they are spaced in a row, and will fit three sequential holes. Now, thread the three groups simultaneously into their assigned positions as given in the previous step. That coordinate is for the middle group, and the group on either side should be in the same row but different column. For example:
    i. The wire from Ground Bus to C-7
        1. One group should go through B-7
        2. One group should go through C-7
        3. One group should go through D-7

i. Pull the wire though as best as possible. You may get spaghetti from the wires that won't go through the top: that's okay. Use pliers to push this together so that it forms a tight mass.

j. Solder each group from the bottom, then go to the top and solder there. Feed enough solder in to get a nice, solid mass. It should be pulled in by capillary action into the mess of strands.

k. Place the remaining ends of the wires into the holes of the Ground Bus. Like the VIN Bus, it doesn't matter which order you put them in.

l. Strip and twist tightly a length of wire to about 4". Place this wire from the two connected holes of the power jack, along each of the inserted wires, around the end, and back down the other side. Fold the inserted wires down tightly to hold everything in place.

m. Solder the Ground Bus. Again, be patient: there is quite a bit of metal to heat up, and it will take time.

n. (Optional) Place the resistor and LED as follows on the top of the board:
    i. LED long leg into U-6, short leg into U-9
    ii. Resistor leg into U-10, other leg into U-12

o. (Optional, cont.) Solder the LED and resistor into place

p. Clip all extra leads and wire from the bottom of the board. Use a file to smooth out rough spots if desired.

5. **Operation**
    a. Type A (Standard):
        i. Plug in a three wire cable from your microcontroller setup to the CSPB. You should plug into the rows that are not in line with the regulators. The signal line (white for most setups) should face towards the power jack.
        ii. Plug your servo into the opposite side (in a mirror image configuration) that you plugged the three wire cable in. The signal line should face away from the power jack.
        iii. Use your microcontroller to control the servo as you normally would. You do not need to change any code to use the CSPB.
    b. Type B (Many Servos):

i. Plug a three wire cable into an input ground side. For example, plug it in row 1, columns G though I. On the other end, connect this to ground on the same board that your microcontroller is on.
ii. Plug a three wire cable into the input signal header. For example, plug it in row 3, G through I. Connect the other end of the cable to your microcontroller I/O lines.
iii. Connect your servos as normal, opposite the three pin headers.
iv. Repeat as needed. Each group of eight on the CSPB needs only one ground cable, and up to 3 I/O cables.

Discussion

The Centimani Servo Power Board is a board that will allow you to power your servos from a separate power supply. It uses four 5V, 3A regulators as the main component, along with support capacitors and LED/resistor pair to indicate power status. Some precautions to take when operating the board:

1. The higher the input voltage, the less current that you should draw.
2. When placing the servo connectors, alternate between one block and another to evenly distribute power requirements.
3. This board is not designed to have 32 servos drawing maximum current at the same time. It is intended for light use of 32 servos simultaneously, medium use of 16 servos simultaneously, or heavy use of 8 servos simultaneously.
4. When powered, this board should not be placed on a conductive surface.
5. Operation without the heatsinks will increase regulator temperature, thereby reducing maximum current.
6. The optional LED indicates that the board is receiving power. It should not be considered a status report for the health of the board.

In addition to powering servos, the CSPB can also power other devices that use a three wire power/signal format. Such devices include the Parallax Ping))) and the Parallax GPS receiver.

Conclusion

The Centimani Servo Power Board will allow roboticists to expand on their servo quantity without worrying about power supplies or regulated voltage. The regulators are rated for up to 12 Amps continuous, however, you should avoid drawing that much current if possible to prevent damage to the board. The CSPB is ideal for separating the power supply of your motors from that of your sensitive electronics.

If you have any questions, comments or need technical support please feel free to email me at:

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