

Making a Working Lower Third Playfield

In this tutorial, I'll walk through the exact steps I took to create a whitewood with working lower third mechanisms using the [FAST Pinball power starter bundle](#). This tutorial is meant to be supplemental to the already great tutorial provided by the wonderful people building and maintaining the Mission Pinball Framework (MPF). It contains the bits and pieces not covered by the [MPF tutorial](#) or FAST documentation.

After completing this tutorial, you'll have a whitewood with working flippers and slings. From there, you'll be able to begin prototyping the rest of your playfield.

Preparing a Playfield

1. Purchase a piece of 1/2 birch plywood. Cut to 20.25" x 45" (actual dimensions will vary depending on the cabinet you place your playfield in).
2. Cut out your playfield
 - a. Use the CNC files in my /!Public Files/ folder on google drive:
 - i. <https://drive.google.com/drive/folders/1jS786lw6Z3tvHhBRjR0z4r1F0p3Y6UbR?usp=sharing>
 - b. Or, Cut out the holes manually using the following images as cut guides:
 - i. <https://drive.google.com/file/d/1l8qnFsl6dYtUChms5NcRhi2cf5SWVDVz/view?usp=sharing>
 - ii. <https://drive.google.com/file/d/1exBwICfA1xJQOzajY-yUn--j-1VKkJLg/view?usp=sharing>
 - iii. https://drive.google.com/file/d/19JPIW_kk9qqcwCH9ykyZ_hzsYSeyEg2J/view?usp=sharing
 - iv. https://drive.google.com/file/d/1W_9bOq6cRMPiiTnWk9k2U7e935P4U3KD/view?usp=sharing
 - c. If you don't want to follow the provided template for whatever reason, here are a few of the key measurements for matching standard modern machine layouts:
 - i. Flipper bat posts should be 6 3/4" apart from each other (measuring from the center of each post). This will give you a gap of just over 2" between the ends of your flippers.
 - ii. Slingshot bottom posts should have a gap between 7 3/4" - 8 1/2" depending on your layout, number of inlanes, etc

1. For example, Stern's Jurassic Park has a 8 1/2" gap but Metallica has only a 7 3/4" gap (due to the extra inlane).
2. Note that the width of the slingshot rubber/plastic itself may also vary slightly.
- iii. Inlanes and other ball paths should be no narrower than 1 1/8" (1 1/4" is preferred) to prevent the ball from getting stuck against the slingshot rubbers, etc.
3. Install the metal playfield edge slide brackets
4. Install the metal playfield pivot brackets
5. Install the metal playfield hanger brackets

Setting up Power Supply Units

6. Run an AC power cord into your cabinet.
7. Mount a 48V switching power supply inside your cabinet
 - a. [Meanwell has a good option](#)
 - b. FAST pinball has a starter power bundle that includes everything you need. I also recommend purchasing the pins and connectors add-on that they sell.
8. Mount a 12V power supply inside your cabinet.
9. Connect the ground wire from the AC power cord directly to the 48V PSU.
 - a. Run another ground cable from the 48V PSU to the 12V PSU, so that both are connected to the ground wire.

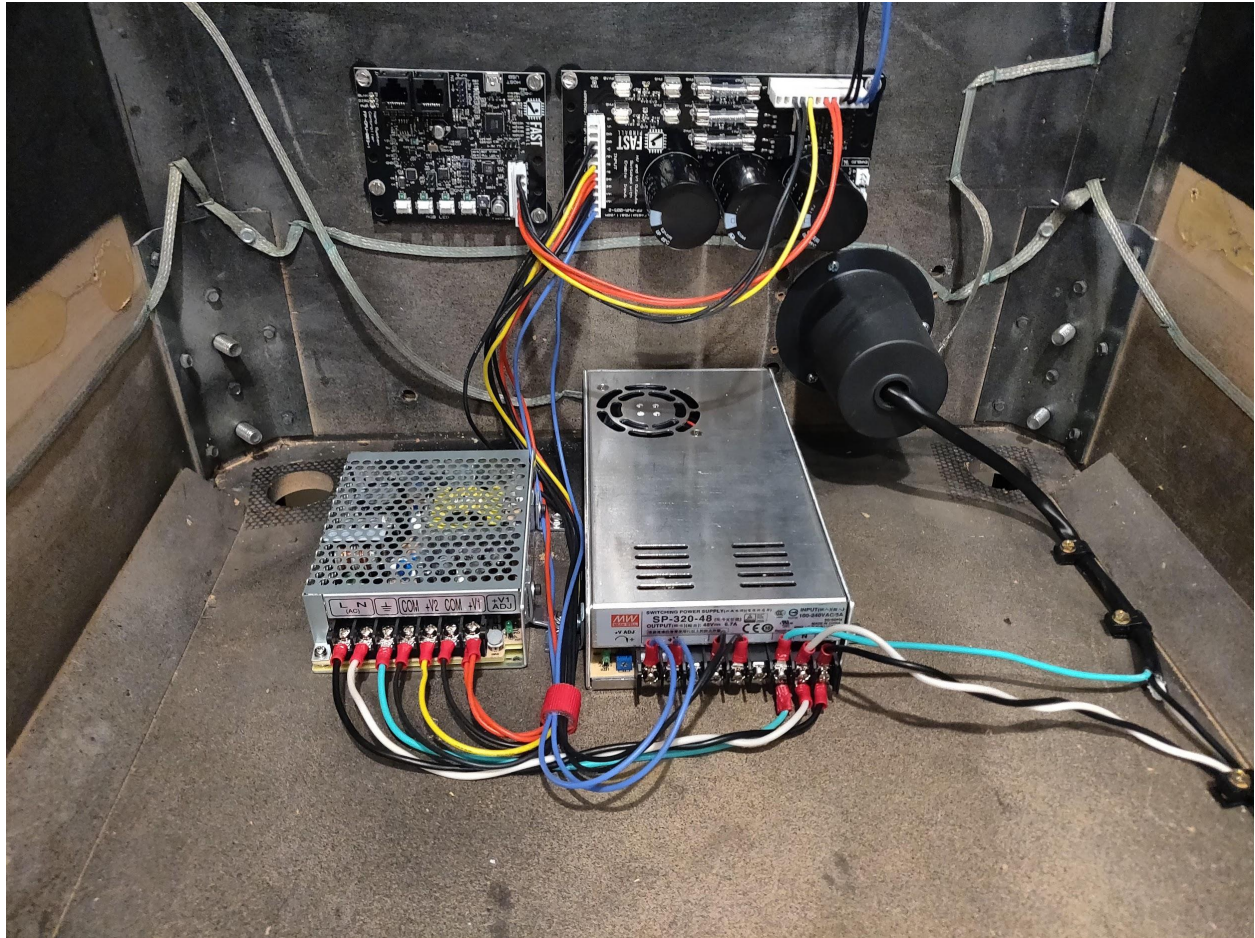
Here are some pictures of how I set them up:



You will also want to run a power switch with a 8A slow blow fuse (inside the blue box):

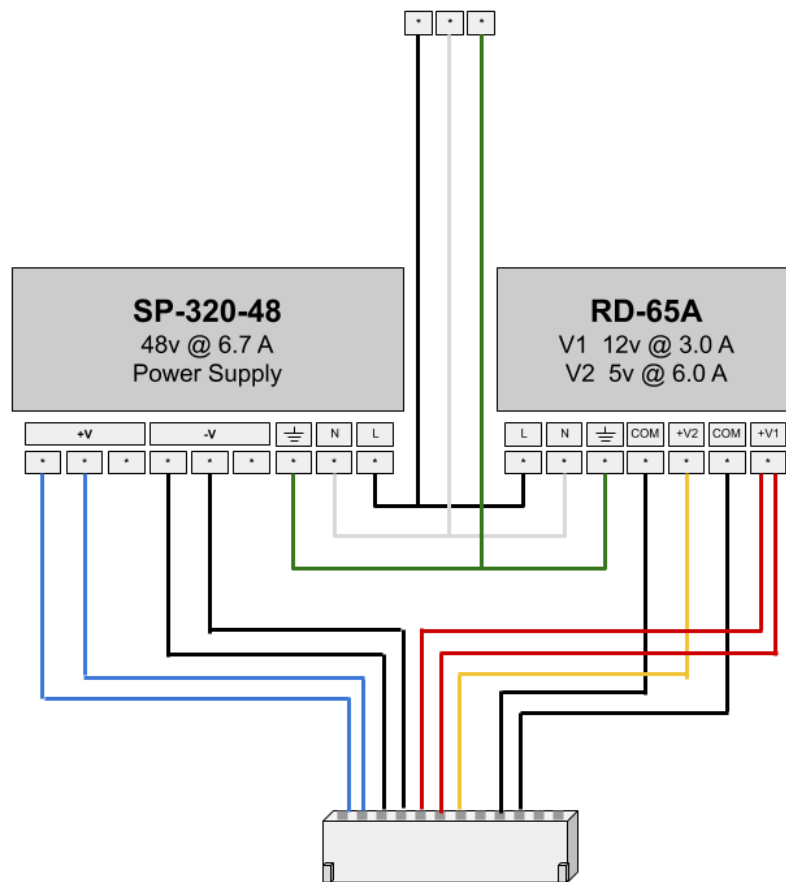
Do this by running the Load wire (typically black wire) of your AC power cord down the length of your cabinet to wherever you plan on putting the power switch. Connect the black wire to one end of the fuse holder. Then run a short length of black wire (16 or 18 gauge) from the other end of the fuse holder to one of the terminals on the power switch. If you're not familiar with power switches, I recommend this [switch](#). This one has a light that helps you know if you've wired it correctly or not. If you have wired it correctly, it will light up. Refer to the picture above. One set of terminals will have the black wires (1 from the fuse holder and another leaving the switch going to the 48V power supply). The other set of terminals will have white wires (1 direct from your AC power cord coming in, and a second white wire that leaves the switch and goes to your 48V power supply).

The next image is a closeup of the power supplies. Remember to run the green ground wire from your AC power cord directly to your 48V power supply. Then also run another green wire from that same ground connection on your 48V power supply to the 12V/5V power supply. **YOU MUST HAVE BOTH POWER SUPPLIES CORRECTLY GROUNDED!!**



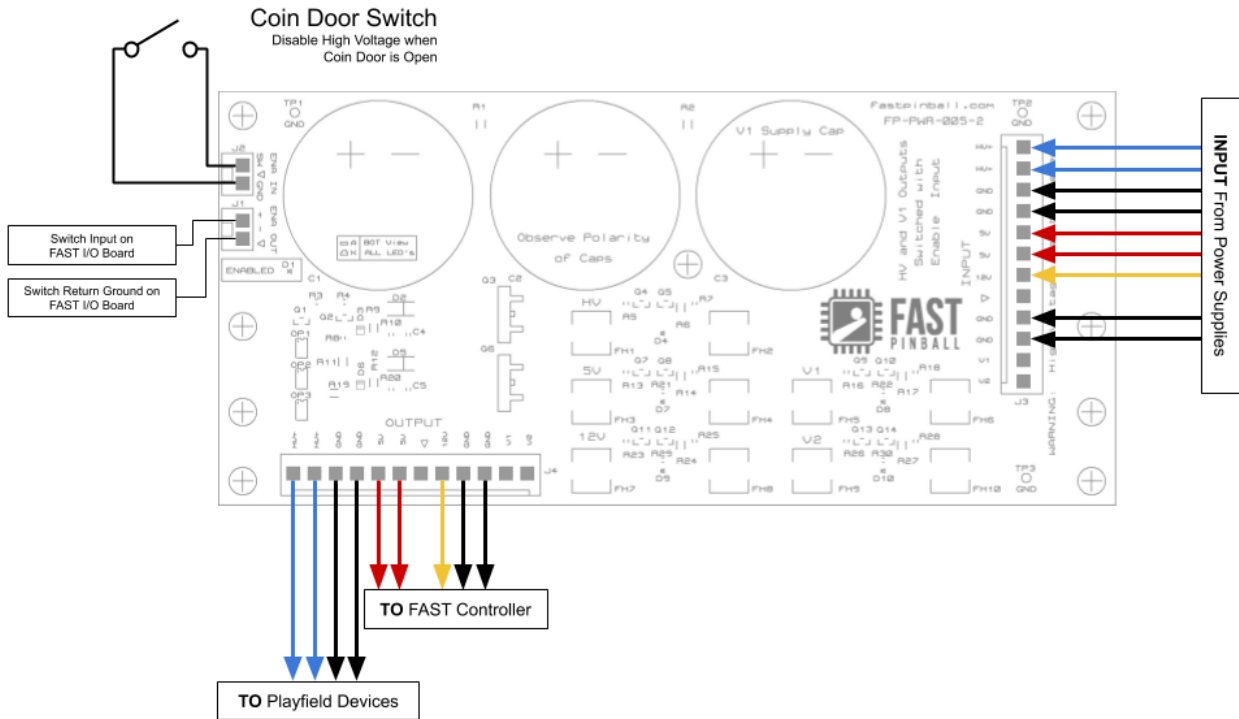
Next is using the pins and connectors that came with your FAST starter bundle to wire up power from the PSUs to the FAST power filter board. Use the following images to see which terminals on the back of your power supplies go where. The black, white and green wires from the top middle of the first diagram represent power coming in from your AC power cord and fused power switch.

FAST Power Supply - Wiring



Note the specific holes that each wire goes in and make sure to match that up with the plastic connector that came with your fast power filter board.

FAST Power Filter Board - Wiring



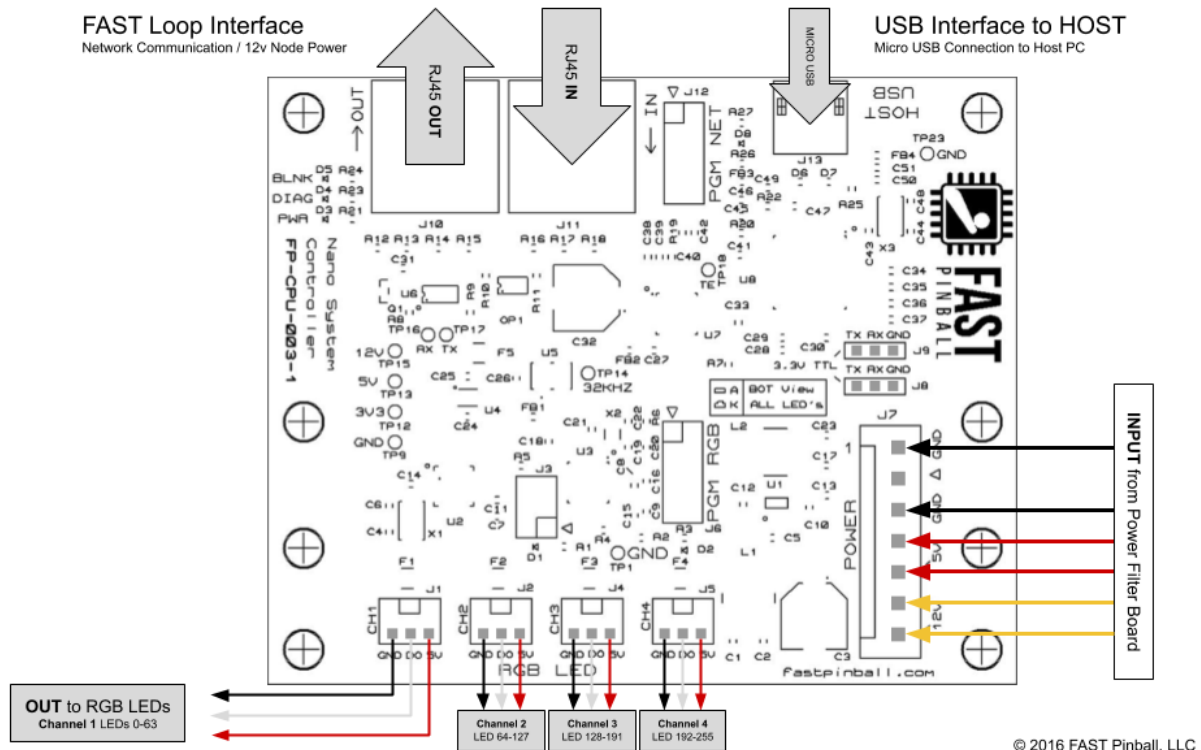
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The Power Filter board has a fail-safe for the High Voltage output that won't allow it to actually send any HV power out unless a jumper switch is closed. This is what gets connected to a coin door switch so that whenever the coin door is opened, the high voltage power will get cut. To get around that for now, we'll need to run two wires (ground and a switch wire) from the J2 jumper and either just use a connector to close that switch manually, or hook them up to an actual coin door switch.

10. FUSES: You'll need to put some fuses into the power filter boards fuse receptacles as well. You need to add fuses for the "HV", "5V", and "12V" fuse receptacles. I recommend a 5A slow blow fuse for the HV line, and then what you put in the other two lines will depend on what you end up connecting to the 5V and 12V lines. If you're unsure what you'll connect to them, you can simply add a 3A slow blow fuse in each receptacle for now. If you end up with more than 150-200 RGB LEDs connected to your 5V line, you'll likely need to increase that to a 5A slow blow fuse. But for now, you'll be good with a 3A slow blow fuse in the 5V and 12V lines.

After running power to the FAST power filter board, you will need to run power from there to the FAST Nano controller board. Again, follow the color coded diagram to see which wires need to go where in the connectors.

FAST Nano Controller - Wiring



Installing Lower Third Mechs

11. Attach flipper mechs to playfield
12. Attach flipper bats to flipper mechs
13. Attach slingshot mechs to playfield
14. Install posts for slingshot rubbers
15. Install ball lane guides

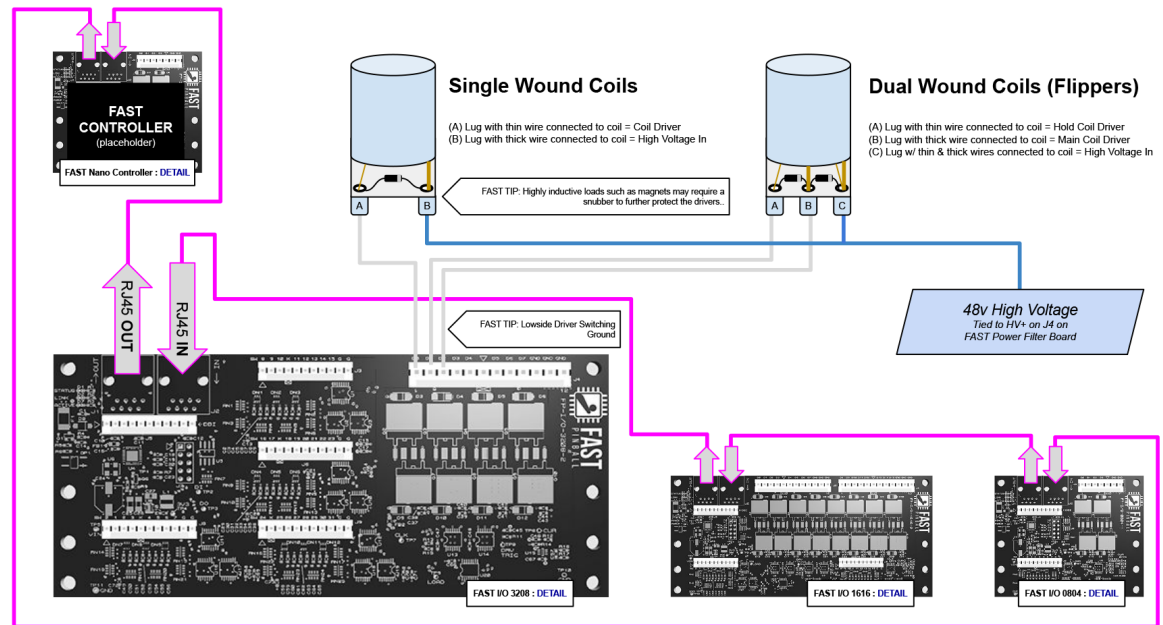
Wiring up power to your mechs

16. Remember the blue and black wires in the FAST Power Filter illustration that said "TO playfield devices"? The blue wires leaving the power filter board do actually go directly to your high voltage pinball coils, ie your flippers and slingshots. The black ones will go straight to your first FAST I/O controller board or node board (typically the 3208). You can just run long wires directly to your first mech (a flipper coil, etc), but I strongly recommend running wires to a male/female connector (something like this [molex connector](#)) that will allow you to easily disconnect the playfield entirely so that you can easily pull your playfield in and out while you prototype different setups. Do the same with those black (ground) wires instead of running straight to your 3208 IO board. The biggest reason is because you're going to end up moving things around on the bottom of your playfield as you begin to finalize your game. Boards will need to get moved, mechs will get rotated, etc. Give yourself extra wire length on each mech you connect as well to allow for this. After you have a final layout, you can come back through and create final wire harnesses that are neat and tidy. For now, you want flexibility so you can focus on experimenting. Hold wires out of the way with reusable zip ties or velcro tie-downs to keep things organized in the meantime.
17. The blue wires from the FAST Power Driver board which carry the load for the high voltage coils need to be ran straight to your flipper coils. Run the blue wire to your first flipper coil and attach it to the coil lug that's on the same side as the colored/grey stripe on the diode that runs between the two coil lugs. If you don't happen to have diodes on your coils, the other way to know is to look for the lug that has both a thin copper wire and a slightly thicker copper strand. This is the power input for the flipper coil.

18. Image for reference:

FAST I/O - Driver Wiring

FAST I/O Boards are connected to the FAST Controller via the FAST Loop Network.



"Should my coils have diodes?" YES. Although the FAST I/O boards do have protection for the mosfet drivers, this protection is different than that provided by the traditional diode. The cost of diodes is FAR less than the cost of repairing FAST I/O boards.

19. Then continue running another strand of blue wire from that coil to your right flipper coil and also connect it to the correct coil lug.
20. Then continue that strand of blue wire from the right flipper to the right slingshot mech and connect it to the correct coil lug.
21. Then continue that strand of blue wire from the right slingshot to the left slingshot coil and connect it to the correct coil lug.

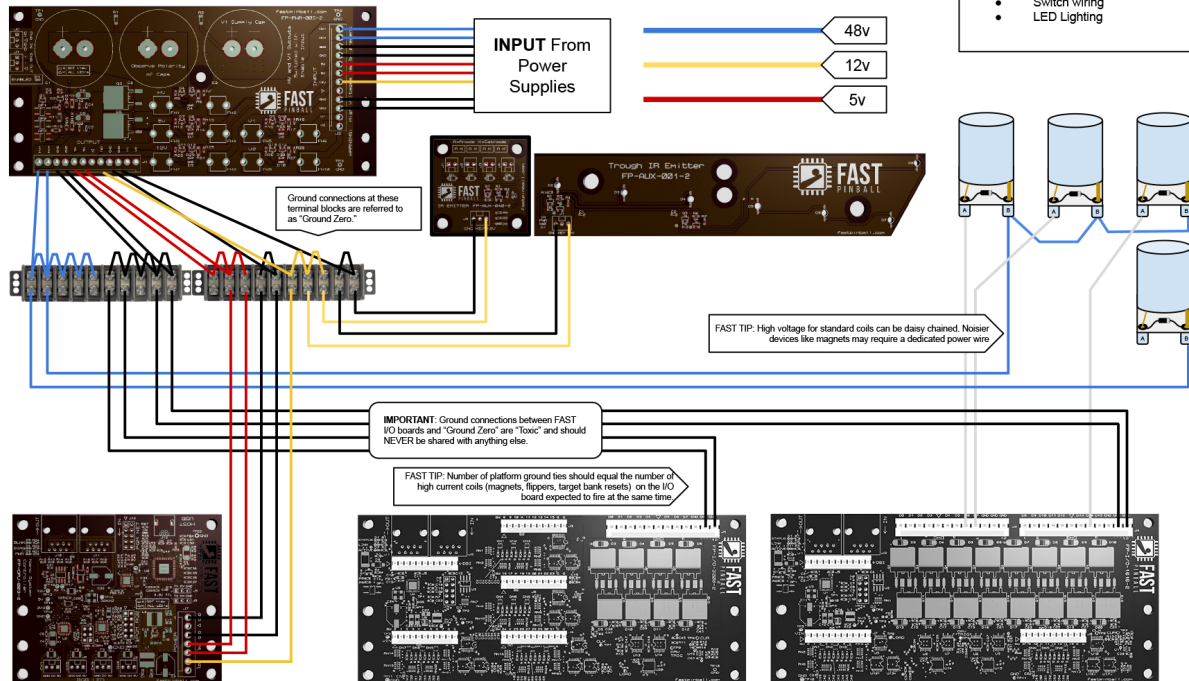
Wiring your mechs to the FAST IO Board (3208)

22. After you've ran your power wiring to each coil as explained above, you are now ready to connect the black ground wires from each mech coil to the FAST IO board terminal. The next illustration shows how to wire your high voltage coils to your IO driver board. I'm using the FAST 3208 board which has the inputs and outputs we need for a fully functional lower third playfield.
23. The first thing we'll do is connect the black ground wires that run from the FAST power filter board and connect them to the FAST 3208 IO board by

crimping on the connectors and sliding them into the molex connector in the two end spots (it doesn't matter which wire is in which of the two spots).

FAST I/O - Power Wiring

FAST Power Wiring Guidance



If there is more current available at the terminal block than the rated capacities of the wires then the line needs to be fused. The UL1007 wiring often used in pinball machines has a maximum current rating of 9amps at 18awg and 5.6amps at 22awg.

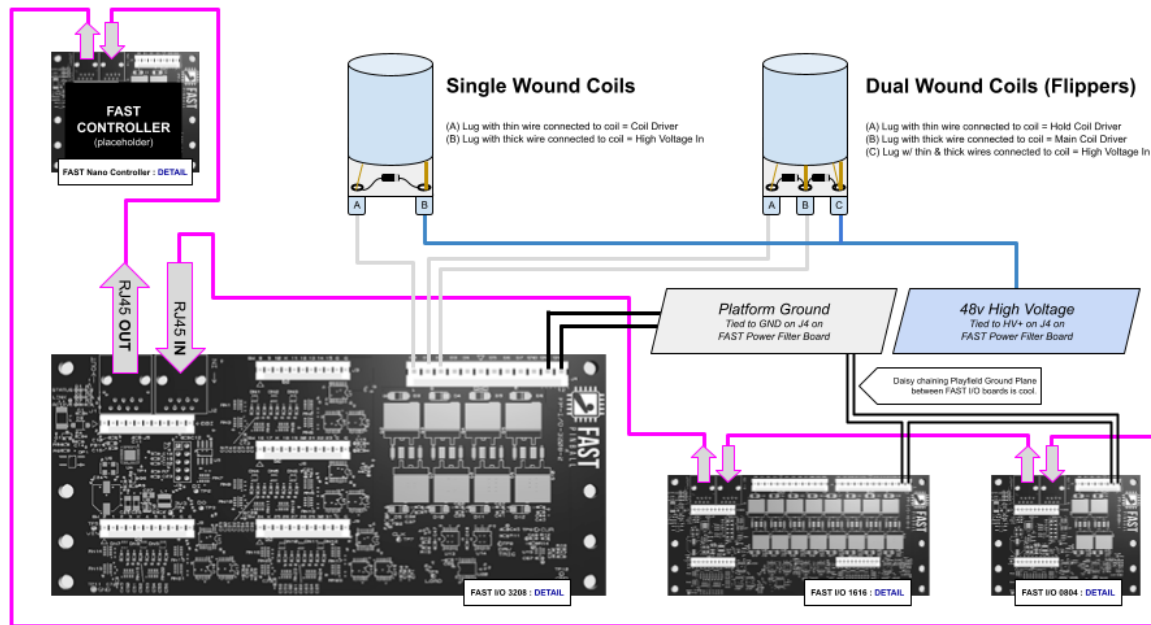
24. We also need to run a wire from your flipper and slingshot coils to the FAST 3208 driver board to complete the connections. I use black for these to denote them as the grounds (GND). These wires will connect onto the other lug(s) on your flipper coils and then be run directly back to the FAST 3208 IO board and into spots 00-07.

25. In order to use the provided config files, you'll need to connect these wires from your coils into the FAST 3208 IO board like this:

- Left flipper main power: driver number 00
- Left flipper hold power: driver number 01
- Right flipper main power: driver number 02
- Right flipper hold power: driver number 03
- Left slingshot: driver number 04
- Right slingshot: driver number 05

FAST I/O - Driver Wiring

FAST I/O Boards are connected to the FAST Controller via the FAST Loop Network. Each FAST I/O board is powered with 12v provided to the board using the RJ45 cables connected to the FAST Controller.

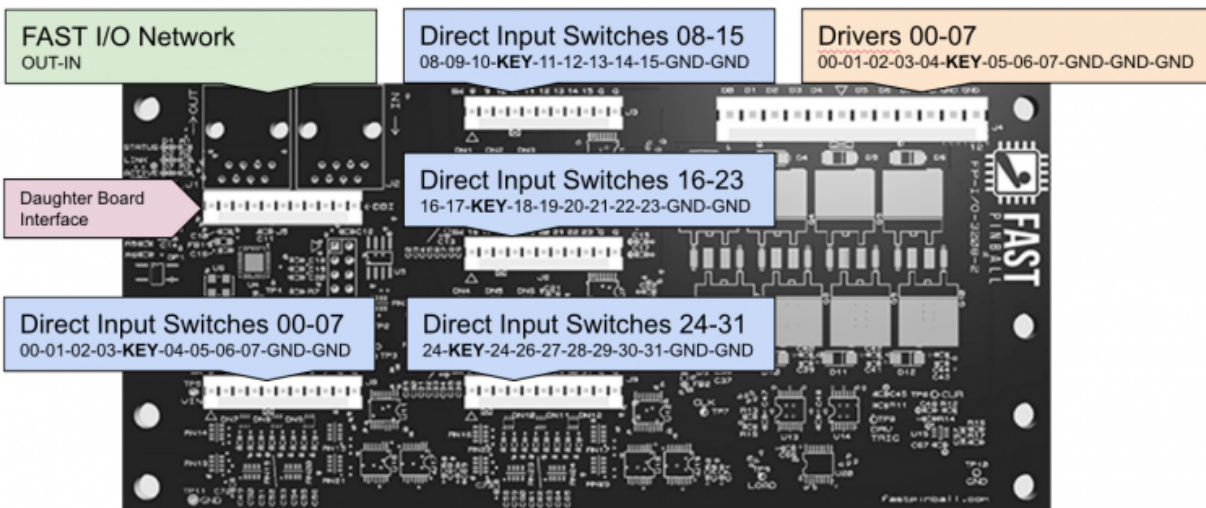


Note on Diodes: The FAST I/O boards do include diode protection on board. It is our opinion that including diodes on the coils also provides additional system protect (for cheap!) and lets the FAST I/O board onboard diodes act as a second line of defense.

Wiring up Flipper buttons and other switches

26. In order to allow for the most flexibility, you want to make sure your flipper switches are connected to the first bank of Direct Input Switches on your 3208 IO board (this **MUST** be the first board connected to your Nano controller board).
- This will allow for your flipper switches to control any flipper mechs you have anywhere else in your FAST Loop network of IO boards.
 - For example, if you want to have an upper right flipper, you'll have to connect it to a different IO driver board since the 3208 is already full of coils to drive. Normally, switches need to be connected to the same IO board that the coil they're going to control is connected to. But, the very first 8 switches (00-07) on the very first node board connected to the Nano controller board are special switch inputs that can power any coil on ANY IO board.

- c. Additional flipper coils are the primary things you'll want setup this way, because you'll use the same flipper button to control multiple flipper mechs (via a two stage flipper button for example).
27. Each switch has two lugs for wires as well, we need to run a black wire (GND) from one lug of the switch to the GND input on the first bank of switches on the 3208.
- a. This first bank is labeled as "Direct Input Switches 00-07" in the image below



28. In order to use the provided config file, you'll need to connect these wires from your switches into the FAST 3208 IO board like this:
- a. Left flipper button: switch number 00
 - b. Right flipper button: switch number 01
 - c. Left slingshot: switch number 06
 - d. Right slingshot: switch number 07

Development Computer

29. Figure out what computer system you want to use to develop your game. Everyone recommends that you use a decent computer for the design of your game in order to efficiently handle all the assets you'll be putting into your final game code (audio, video, etc.). Your final game can be run with a much more basic computer.
- a. I've been using a laptop with Windows OS installed on it.

Installing MPF

30. [Follow these instructions to install MPF](#) for the OS you choose.
 - a. Follow the steps carefully and precisely.
31. Create your machine folder anywhere you want: ie
"C:\Users\[USER]\Desktop\mpf\[MACHINE_NAME]"
 - a. My install is on windows, and my directory is
"C:\Users\skondris\Desktop\mpf\Led_Zeppelin"
 - b. Add the following directory folder:**
 - i. "C:\Users\[USER]\Desktop\mpf\[MACHINE_NAME]\dev\config"
32. Download the config file I have created here:
 - a. [MPF Config.yaml](#)
 - b. This file is the main config file needed for MPF to communicate with your pinball machine.
33. You'll then need to find which COM ports your computer assigns to the FAST controller. Typically, it's com3, com4, com5 and com6. But this often varies depending on each computer setup. With both your computer and pinball machine turned ON, connect your NANO controller board connected via USB to your computer. You should hear some tones and possibly see something on your screen to indicate that your computer has detected the NANO controller.
 - a. Open your Device Manager.
 - i. This can be done several ways, one of which is to right-click on the Windows "Start" button at the bottom left and then select "Device Manager"
 - b. Find the entry for "Ports (COM & LPT)" in your list. (If you don't see an entry for "Ports", go to the "View" menu at the top and select the "Show Hidden Devices" option
 - i. Expand this entry, if it's not already and find which COM ports are listed. You should see four. You want to write down the middle two.
 - ii. Open the MPF config.yaml file included in the downloads in Notepad++
 - iii. Edit line 7 to list out the two middle com ports you saw in your device manager (typically com4 and com5).
 - iv. Save the config.yaml file.
34. Paste the *config.yaml* file inside the "config" folder, like
this: "C:\Users\[USER]\Desktop\mpf\[MACHINE_NAME]\dev\config\config.yaml"

Setting up FAST Control System

This section heavily borrows from the MPF Tutorial section on [Installing Hardware Drivers & Configuring COM ports for FAST](#).

35. Once you have the hardware all setup and your wiring is ready, you should get your computer ready to communicate with the FAST boards. FAST Pinball controllers use a USB chip from FTDI, so you need to download and install the FTDI driver. Go to [this page](#) and scroll down to the VCP Drivers section and download the driver for your OS. If you're using Windows, just download and run the "setup executable" they link to in the comments.
 - a. After you run that installer, when you plug in and power on your FAST controller, you should see some kind of notification that new hardware has been detected. What exactly you see will depend on which FAST controller you're using and what OS you have.
 - b. The very first time you connect your FAST boards to your computer, you'll see a screen with a progress bar showing Windows configuring the drivers. This will only happen the first time you plug in the FAST boards to your computer.

Playtesting

At this point, you should be ready to get your flippers firing!

36. Turn on your computer
37. Connect the FAST Nano controller board to your computer via a micro USB cable
38. Turn on the power to you pinball machine
39. Start up MPF on your computer via the terminal (command prompt)
40. And START FLIPPING!!