

Big Idea



This How-To provides instructions on how to create a printed circuit board using the Fritzing (<http://fritzing.org/>) open-source design tool and then prepare that design for fabrication by OSH Park (<http://oshpark.com/>), which provides an economical fabrication service well suited for small volumes.

Background:

The reason for this How-To is that the production files Fritzing produces are not a perfect match to the requirements of OSH Park. This document provides step-by-step instructions for modifying the Fritzing files and then uploading the results to OSH Park for production. The instructions assume the circuit-board designer has an account with OSH Park; accounts are free and easy to set up on the website.



IMPORTANT: This How-To does not include information about using the Fritzing software to design a circuit board. The Fritzing website provides excellent tutorials for this purpose. Keep in mind that circuit-board design is both an art and a science. Fritzing will help with the science, but the art is mastered only with practice.

Fritzing is unusual in that it allows a designer to begin with an interactive pictorial of a breadboard, jumper wires, components, and an Arduino single-board computer. The user can enter her breadboard experiment, then edit the schematic diagram generated by Fritzing, and finish by laying out the resulting circuit board.

Table HT2-1. Vocabulary

Term	Definition
pictorial (bread-board)	An actual photograph or drawing of an electronic circuit that shows each component as it appears in real life. This includes the wires that connect these components.
schematic	An abstract representation of an electronic circuit where components are illustrated with symbols. Properly drawn, a schematic is an efficient representation of the flow of electricity through the components.
circuit-board layout	A drawing to scale of the resulting circuit board. This includes the copper paths to conduct electricity, the holes to be drilled for mounting



and soldering components, and information printed on the board to identify it and the individual components.

Some users prefer to go directly to the circuit-board layout and bypass the bread-board and schematic views. Most of the circuit boards shown on the LearnCSE.com website were designed beginning with a hand-drawn schematic in order to allow for a layout that is easily managed by beginners. The copper paths are wide, with the components spaced far enough apart to simplify soldering. The wide copper paths also can conduct more electricity than narrow paths, making the boards more tolerant of wiring errors resulting in high current that might damage a narrow path.

Figure HT2-1 shows the three views of a circuit as seen inside the Fritzing software. They are of an early version of the Motor Controller Shield now used in these lessons.

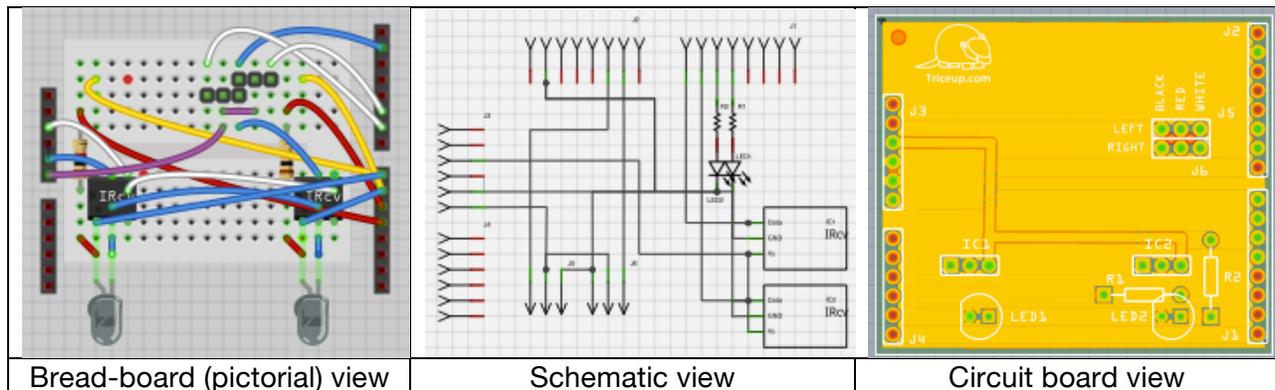


Figure HT2-1. Three views of the motor controller shield as seen inside Fritzing software

The Fritzing design file for the current version of this circuit board can be found in the DIY Useful Files section of the [How-To](#) page on [LearnCSE.com](#). (The materials on LearnCSE.com, like those on Fritzing, are open source. Readers are free to use, adapt, and modify this design without fee, provided the purpose is noncommercial.)

Procedure:

1. Design the circuit board using Fritzing. (Instructions and tutorials for Fritzing are found on the organization's website, <http://fritzing.org>.)
2. Create a set of Gerber files by exporting for production. The menu path is:
File -> Export -> for Production -> Extended Gerber (RS-274X...)



A set of nine files will be created. For the IR Navigation board, the files are:

```
MotorControllerShield_contour.gml  
MotorControllerShield_copperBottom.gbl  
MotorControllerShield_copperTop.gtl  
MotorControllerShield_maskBottom.gbs  
MotorControllerShield_maskTop.gts  
MotorControllerShield_silkBottom.gbo  
MotorControllerShield_silkTop.gto  
MotorControllerShield_drill.txt  
MotorControllerShield_pnp.txt
```

This listing was taken from a Macintosh computer. The listing on a Windows computer will be similar, but the `.txt` file suffix for the `_drill` file might not be visible.

3. Look for the file that ends with `_drill`. On a Macintosh it will also have the suffix `.txt`, indicating it is a text file. Change this suffix to `.xln`. Thus, in this example,

```
MotorControllerShield_drill.txt
```

becomes

```
MotorControllerShield_drill.xln
```

For a Macintosh computer, simply editing the file name is sufficient.

On Windows computers, the `.txt` suffix exists but is hidden from the user. (The file would be named `MotorControllerShield_drill`.) Windows computer users, then, will open the file with a good text editor, such as Notepad++. Then save the file as a `*.*` type and add the file extension `.xln` to the name. This will result in two files ending in `_drill`. Delete the one without the `.xln` suffix.

4. Locate the file that specifies the top silk screen. It will end with `_silkTop`, followed by the suffix `.gto`. Make a copy of this file but change the suffix to `.gko`. This will result in two files for the top silk screen, one with the suffix `.gto` and the other with the suffix `.gko`.
5. Zip the following Fritzing files into a single file:

```
boardname.gtl  
boardname.gbl  
boardname.gts  
boardname.gbs
```



boardname.gto
boardname.gbo
boardname.gko
boardname.g2l - only if a four-layer board
boardname.g3l - only if a four-layer board
boardname.xln

In this example, since the board name is Motor Controller Shield, the files to be zipped are:

MotorControllerShield_copperTop.gtl
MotorControllerShield_copperBottom.gbl
MotorControllerShield_maskTop.gts
MotorControllerShield_maskBottom.gbs
MotorControllerShield_silkTop.gto
MotorControllerShield_silkBottom.gbo
MotorControllerShield_silkTop.gko
MotorControllerShield_drill.xln

The zip file can be given any valid name. In the example the name is:

MotorControllerShield.zip

6. Go to <http://oshpark.com/>, click the [Get Started Now] button, and follow the instructions.