

ELFSHL1 - Stepper Shield

Rev 1.0

electroFUN LTD

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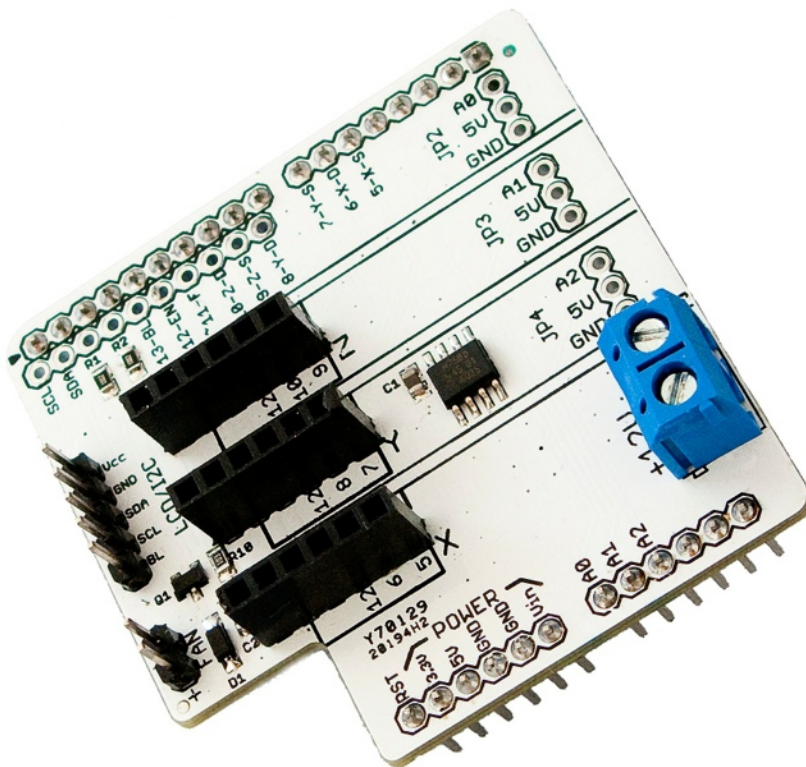
BRIEF

The ELFSHL1 is a simple stepper driver carrier board that can drive up to 3 ELFDRV1 or ELFDRV2 stepper drivers, easy-to-use with a compact footprint to minimize space on your CNC or stepper motor projects.

Description

The ELFDRV1 is compact carrier board/shield and when connected to 3 ELFDRV1 or ELFDRV2 makes it the most compact and cost effective solution to drive a CNC machine. Its modular design makes it a versatile, flexible and maintainable solution that can discreetly drive any entry level and semi-professional 3 axis CNC machine. The whole driving solution (controller, shield and driver) will fit in a 60mm x 60mm x 60mm cube.

The mother board can host up to 3 ELFDRV1 or ELFDRV2 micro-stepping drivers with indexer. The board has 3 general purpose IOs or analog inputs broken out, on-board thermistor and fan driver for active temperature control and an I2C bus expansion break out where you can connect different I2C devices such as an LCD.



Features

FEATURES

1. Capable of driving up to 3 ELFDRV1s or ELFDRV2 micro-stepper drivers with indexer.
2. On board thermistor based on the LM75B for active thermal control.
3. 2.5 A fan driver.
4. I2C expansion bus interface to chain other devices such as IO expansion boards, additional thermistors for off board temperature monitoring, LCDs, LED drivers, etc.
5. 3 broken out general purpose IOs or analog inputs, user defined.
6. +12 V input supply that can power both the mother board/shield and micro-controller.
7. Compatible with the vinciDuino, Arduino UNO Rev3 and Arduino Leonardo.
8. Breadboard friendly.

The ELFSHL1 ships with all SMD components soldered on board, tested and with all the pin headers soldered ready to use.

Combined with the vinciDuino or any compatible Arduino makes it an ideal and compact solution for driving a CNC machine in a 53mm x 53mm footprint.

Specifications

Dimensions

Size: 53 mm x 53 mm

Weight: 10g

General specifications

Total current drive capability: 8 A

Supply voltage range: 8 V - 24 V

Connectivity:

micro-stepper driver: 3 (ELFDRV1 or ELFDRV2)

Broken out IOs (user defined): 3

I2C bus out: 1

FAN:

Continuous fan current driver: up to 2.5 A

Voltage range: 8 V - 24 V

Thermistor:

Temperature accuracy: +/-2 C (between -25 C and 100 C)

Temperature resolution: 0.125 C

PCB: FR4, 35um

2 layer

white solder resist

USER GUIDE

CONFIGURATION AND USAGE

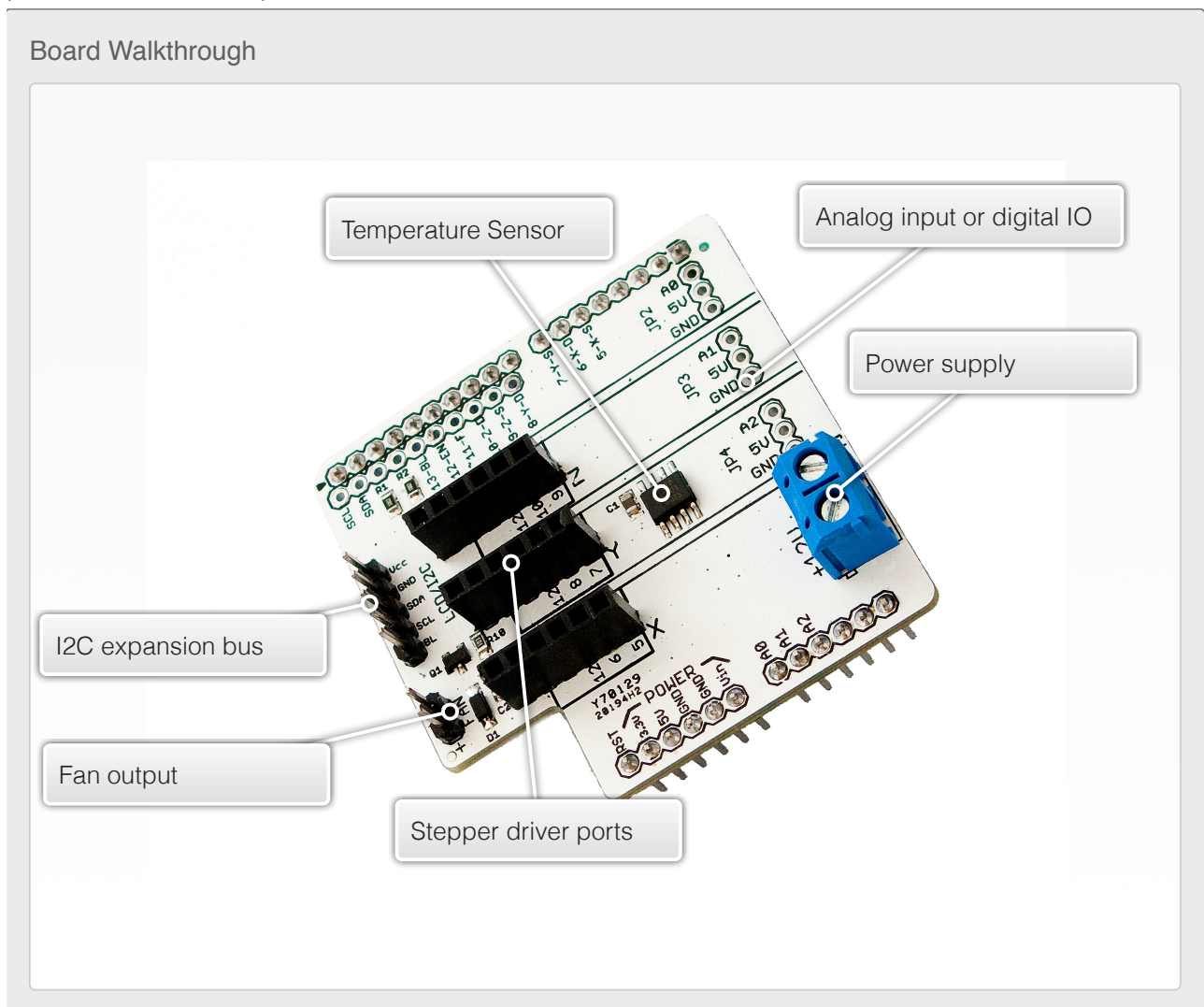
1. Mother board walkthrough
2. Wiring
3. Using the mother board/shield
4. Software and libraries
5. Precautions

Mother board walkthrough

The ELFSHL1 has been designed for minimum configuration and wiring; simply connect to a vinciDuino, Arduino UNO Rev3 or Arduino Leonardo, connect the micro-stepper drivers (ELFDRV1 or ELFDRV2), load the application/sketch and start CNCing.

Arduino compatible shield

The board has been designed to be used as a shield with the vinciDuino, Arduino Leonardo or Arduino UNO Rev 3. Older versions of Arduinos do not have the I2C SCL-SDA pins separated from their control pin. If you have one of those older Arduino revisions, you will need to connect the shield's SCL and SDA pins as follows: A4 to SDA pin and A5 to SCL pin.



The board has an additional row of pins to make it breadboard friendly.

Micro-stepper drivers

The carrier board can host up to 3 ELFDRV1 or ELFDRV2, using any of the 6 pin female header connectors. They simply slot into the non polarized 6 pin header connector (please refer to the wiring section of this guide).

External connectors

The board has broken out connectors to control several external peripherals:

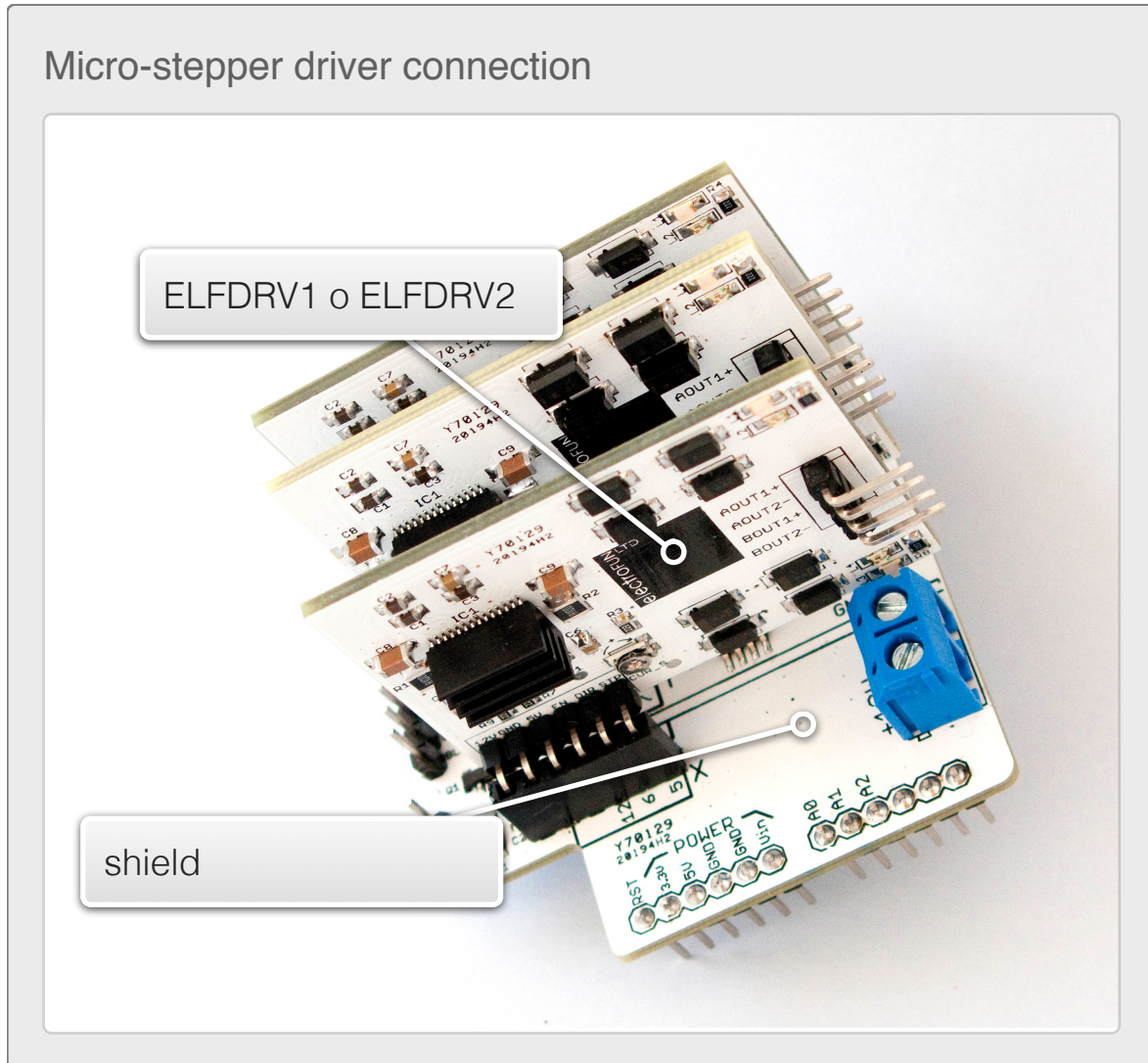
- 3 analog inputs or 3 digital IOs with regulated power supply outputs. These connectors can be used for inputs (end of feed switches, buttons, etc.), outputs (relays to control the spindle, emergency stop, etc.), analog inputs (thermistors, analog keyboard or end of feed switches, etc.).
- 1 fan driver: capable of driving a fan from Vin (+12 V connector, within the input supply range) at up to 2.5 A.
- 1 I2C broken out bus with regulated power supply outputs and an additional general purpose IO pin. This connector can be used to interface additional I2C peripherals to the shield such as: I2C LCDs, thermistors, IO expansion boards, etc.

On-board thermistor

The board has an LM75B I2C thermistor for active temperature regulation. The thermistor has been placed between two micro-stepper drivers slots to read the local temperature while the board is operational. This provides an idea of the power being dissipated and be able to decide by software if forced air cooling is required and how much.

Wiring

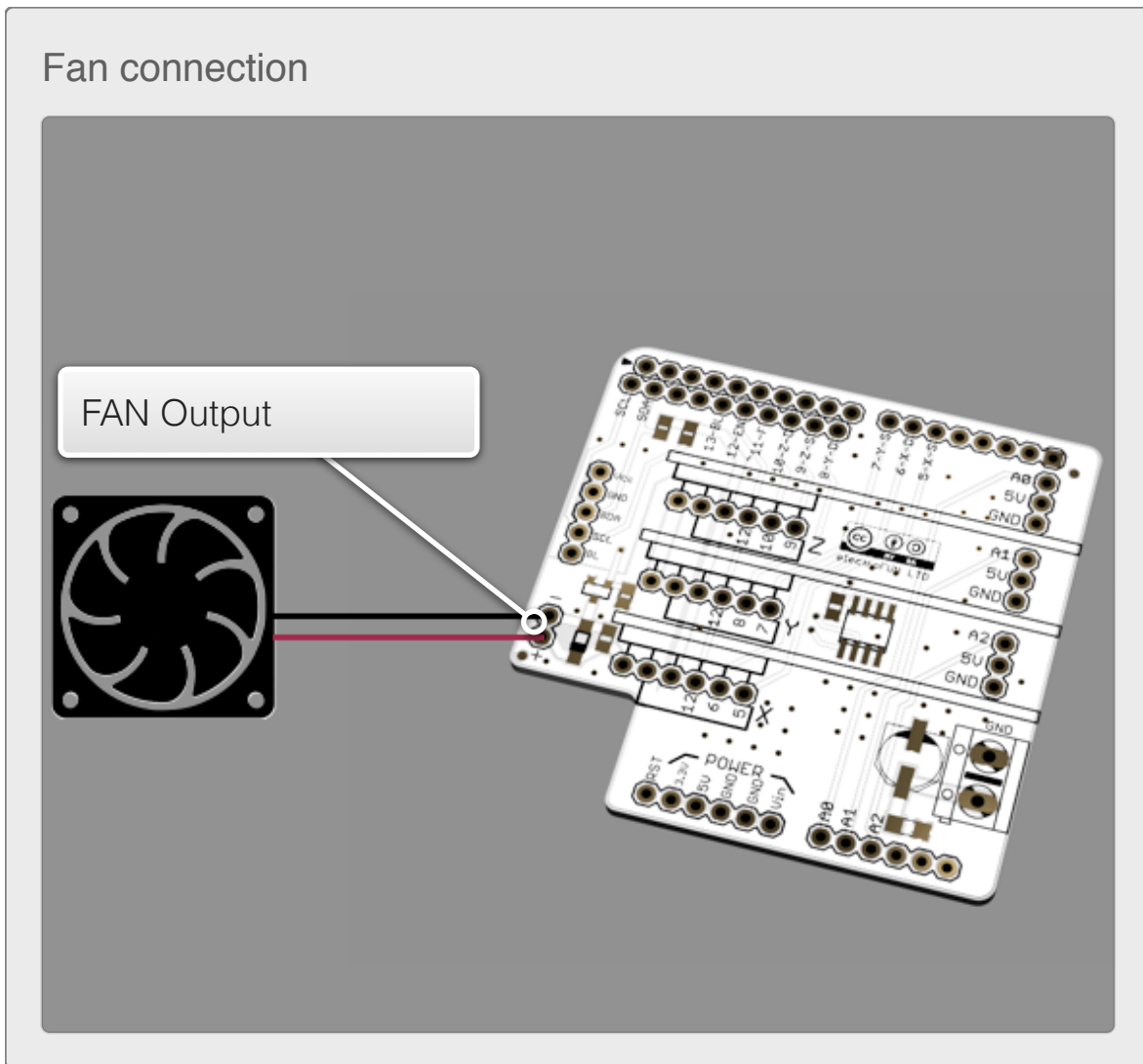
Micro-stepper drivers



The mother board can host, and drive, up to 3 ELFDVR1 or ELFDVR2, using any of the 6 pin female header connectors. While the 6 pin header is not polarized, the driver can only be connected in one direction: motor connector pins facing to the rear of the board. Each driver will be vertically mounted to improve their thermal dissipation, force air cooling must be used if driving loads above 2.0 A. Air will circulate through the channels created between boards. Vertical mounting not only improves heat dissipation but also reduces the over all footprint of the overall solution.

Warning: Connecting or disconnecting the stepper motor drivers while the board is powered will cause permanent damage to your drivers (in general, rewiring anything while it is powered is asking for trouble). Before inserting or removing the drivers, ensure that the board is powered off.

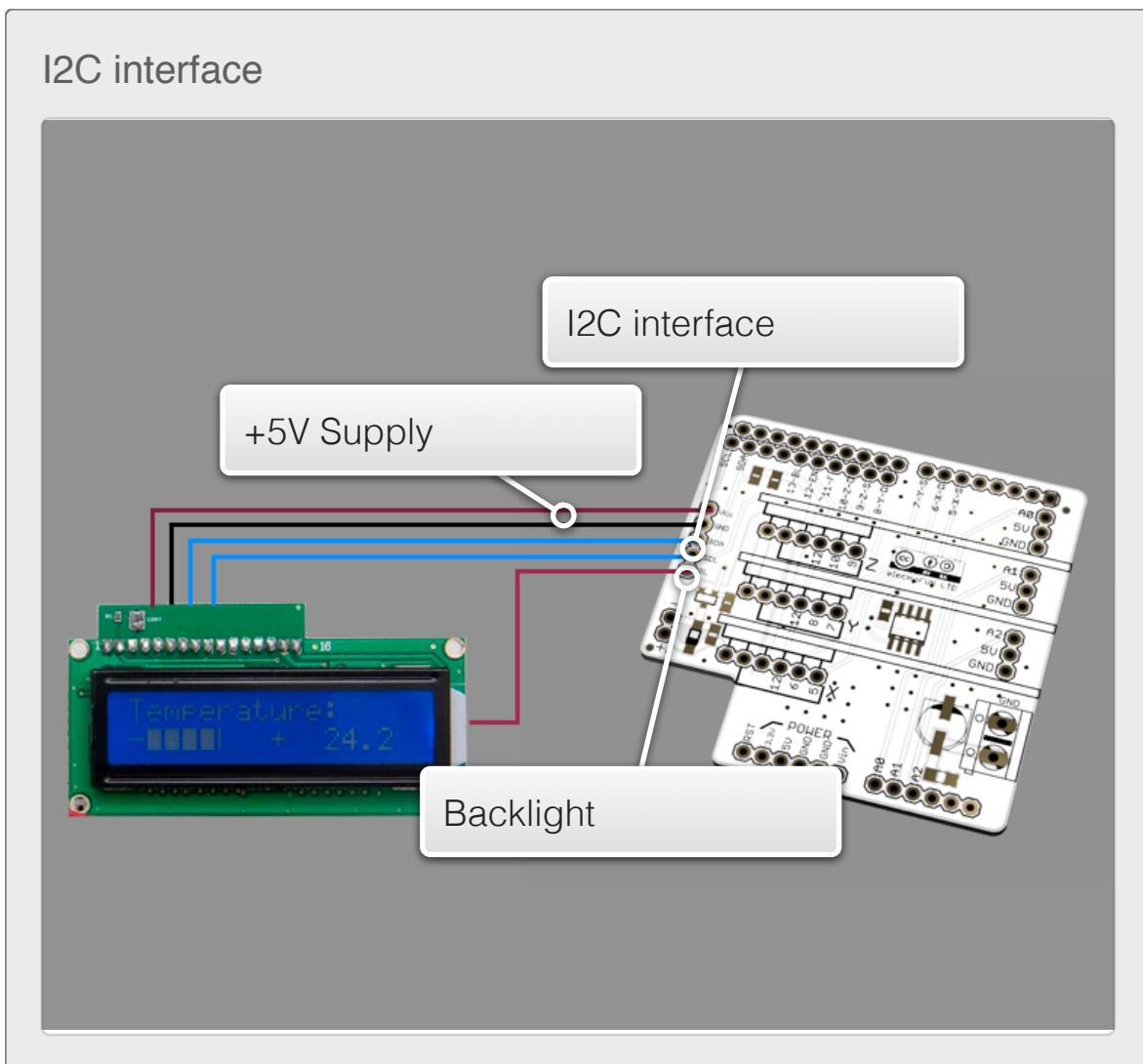
Fan



An external fan can be driven using the two pin male header. It is a standard 2.54mm non polarized connector, therefore care must be taken when connecting the fan. Please observe the markings on the PCB.

The fan supply is directly connected to the Vcc (+12 V) input supply, therefore, please observe your fan ratings prior to driving connecting it to the board.

I2C breakout connector

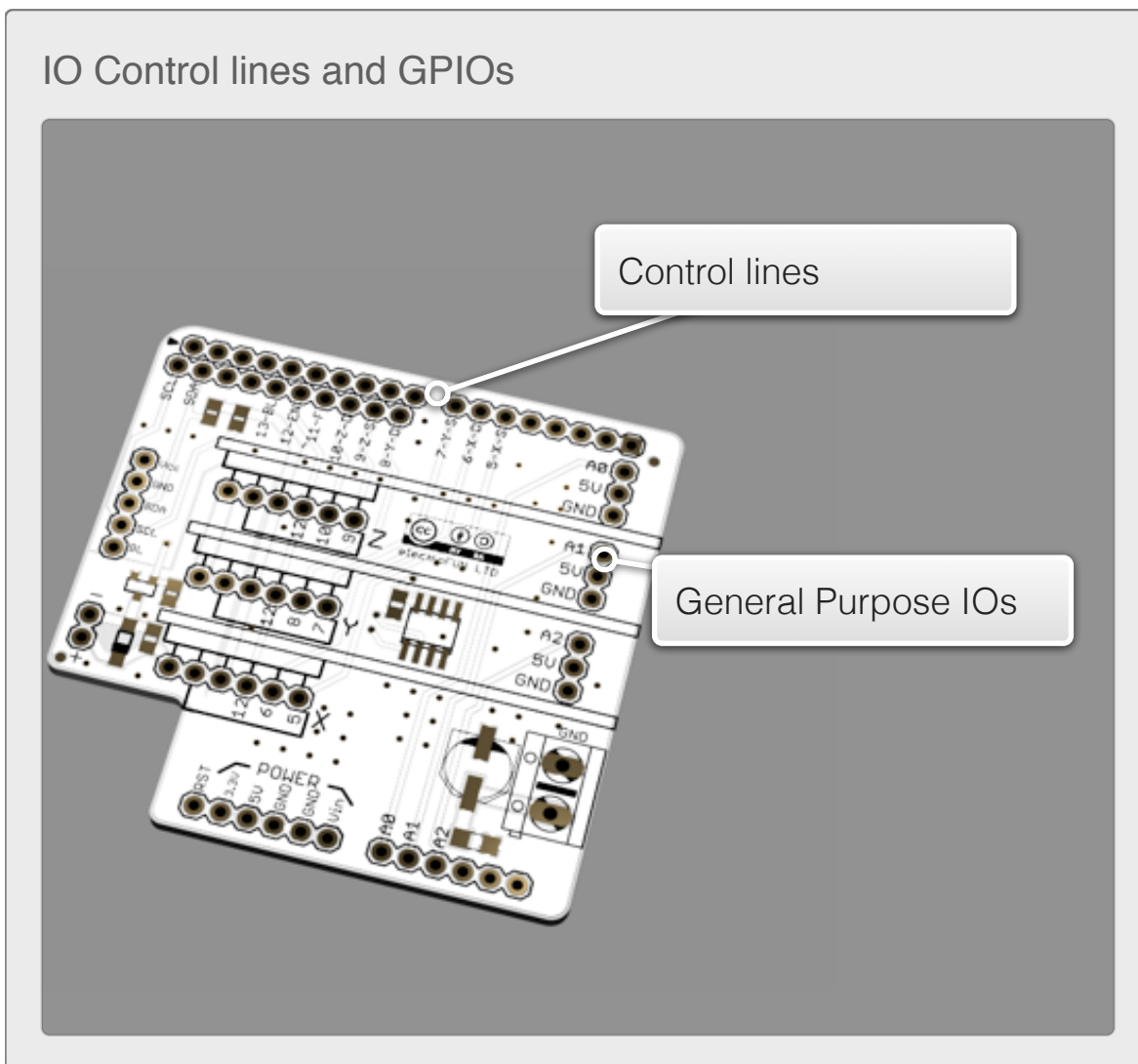


An I2C connector has been added to enable the addition of expansion modules to your CNC controller. The I2C breakout has +5V regulated power supply pins to conveniently power external modules, as well as the I2C's SCL and SDA pins. In addition, this header has IO pin 13 broken out, marked as 13 - BL on the board's silk screen edge (this pin can be used to control a LCD backlight, for example).

This header is pin-to-pin compatible with the LCD I2C extra IO module from electroFUN, it can be mounted directly on board with a straight 5 wire cable.

General purpose IOs

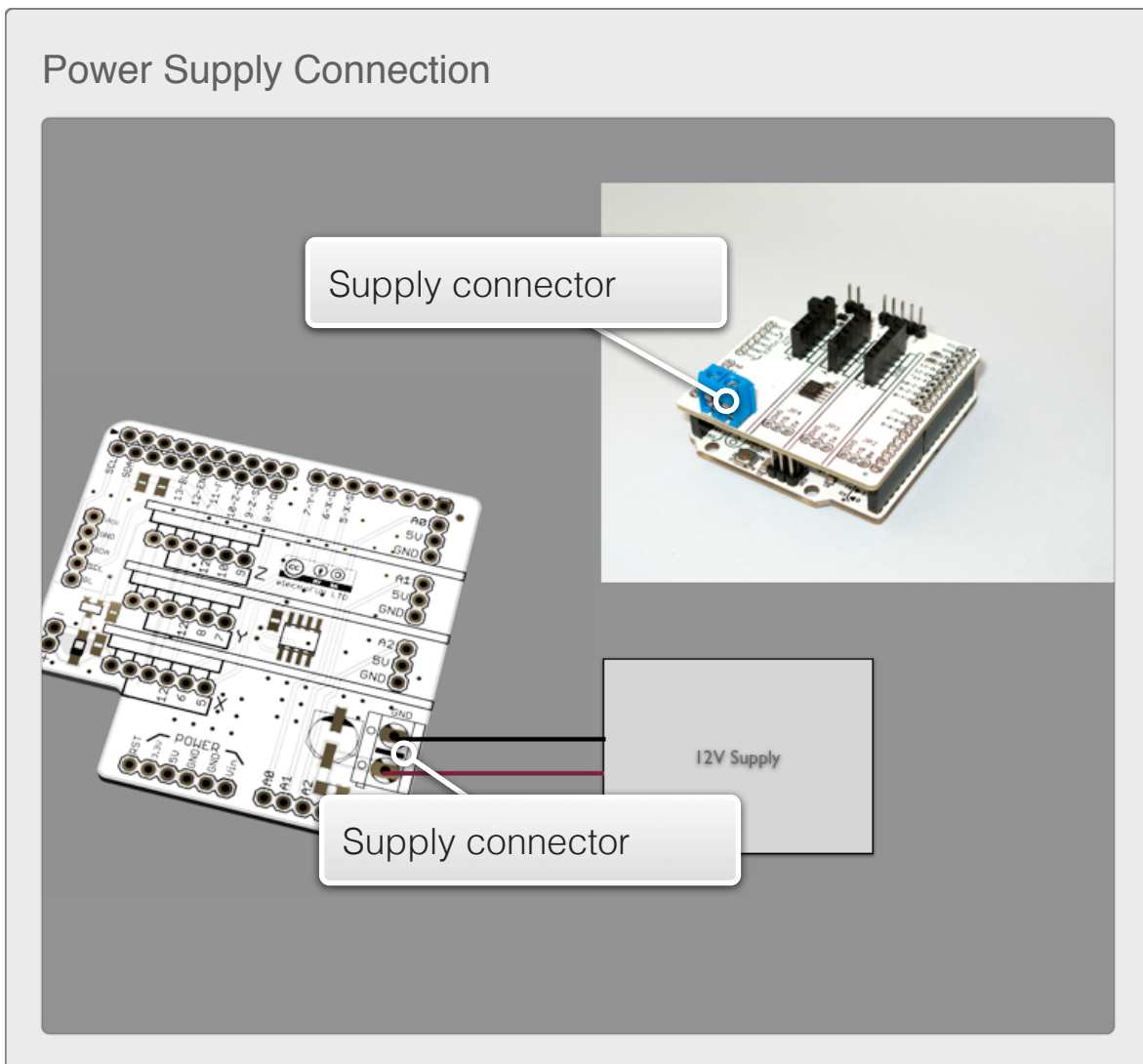
At the back of the board, 3 IOs with +5V regulated power supply (output voltage levels depend on the +5V of your main controller board) and ground (GND) to conveniently supply an interface board with sensors, switches or actuators. These connectors can be used as general purpose IO or as analog inputs to the main controller board.



Power supply

The board is powered through a screw connector at the rear (+12 V) rated to withstand the current demands from the motors it drives. This connector is also connected to the Vin pin of the Arduino and hence the main controller board can also be supplied through this connector.

You can supply the board with a voltage between 8 V - 24 V (please refer to your main controller board to see its input voltage range ratings).



Pin 12 (identified as EN-12) has been dedicated to enabling and disabling all micro-stepper driver outputs. The enable/disable is very dependent of the driver it controls, however, in the ELFDRV1 and ELFDRV2 are active low.

fan control

The fan is controlled using the pin marked as ~11 - F on the board's silk screen edge. The pin corresponds IO 11 on the Arduino IDE.

You can use the built-in Arduino PWM on pin 11 to control the fan speed.

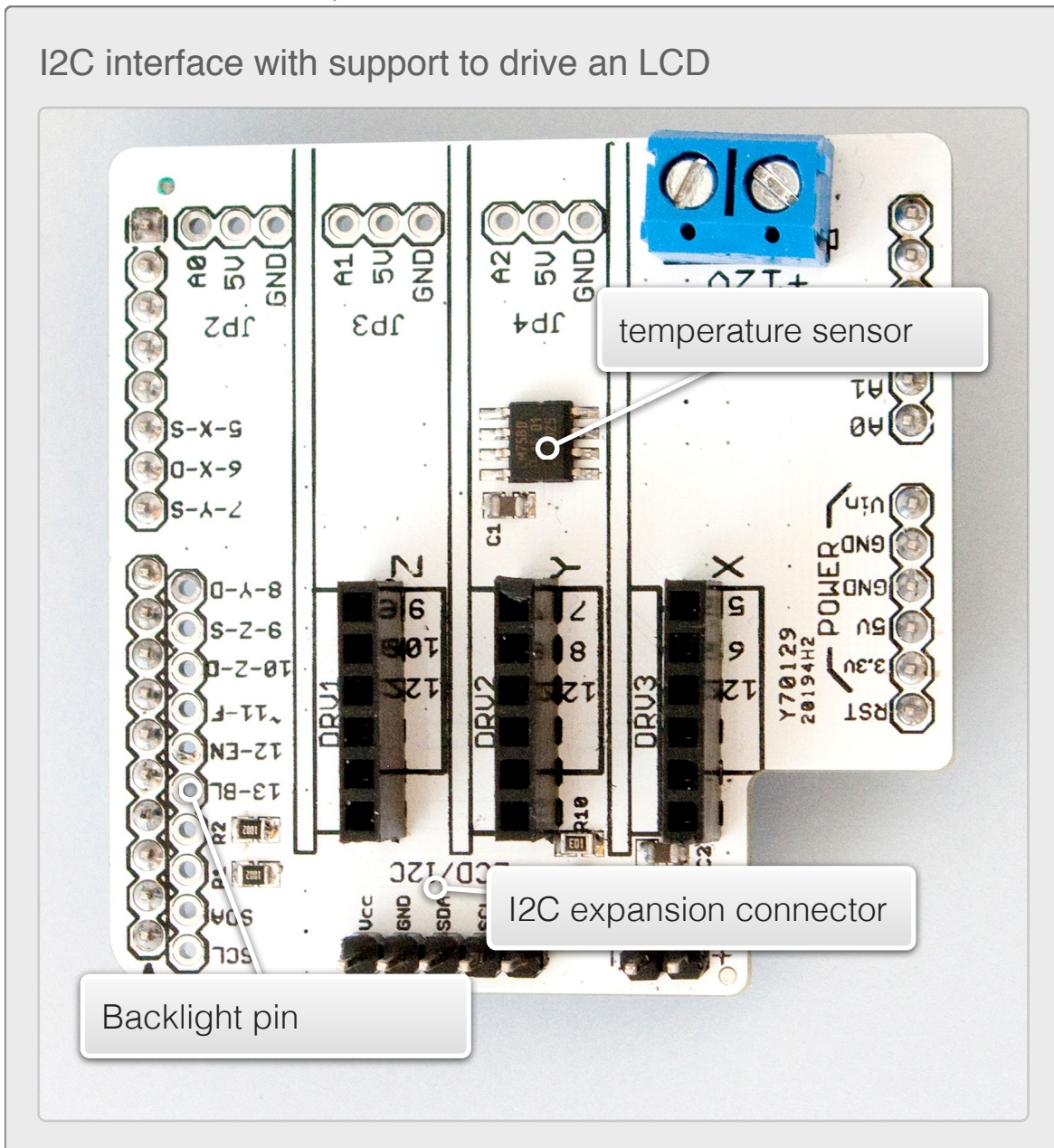
external general IOs

The three IOs on the rear of the board are mapped to analog pins A0, A1 and A2 on the Arduino environment and are adequately marked on the board's silk screen. The IOs can be configured by software to be used as digital inputs, outputs or as analog inputs.

I2C LCD or IO control

The I2C bus can be used to connect any I2C device that doesn't use the same I2C base address as the thermistor (0x48).

The LCD I2C extra IO from electroFUN is a nice fit, the board can be used to drive an LCD or use it as an IO expansion module.



To simplify the usage of the LCD, please download the "new Liquidcrystal library" (perhaps the most performant and versatile general purpose LCD driver library out there) from the download section.

on-board temperature sensor

The onboard temperature sensor is connected to the I2C bus. Simply go to the download section of the board and download the thermistor library to start reading temperatures from it, examples provided. The LM75B uses 0x48 I2C base address.

Software and Libraries

You can download the following libraries from www.electrofunltd.com:

- CNC controller: complete program that controls the 3 axis of the CNC machine compatible with: replicatorG, printrun and Txapuzas CNC.
- LM75B temperature sensor library to read the LM75B temperature sensor.
- The New LiquidCrystal library: to control the I2C LCD
- Stepper library: stepper control library with some helper routines to schedule stepper motor movements.

Precautions

We are dealing with a lot of current here, therefore please follow these precautions before powering up you unit.

Never connect or disconnect drivers while the board is powered.

Before connecting and wiring anything to the board make sure that the power is off. Manipulating the electronics while the board is powered is a good way of permanently damaging the carrier board or the electronics you are connecting.

Never power the board to anything higher than its voltage ratings (8V - 24V).

Never plug the shield to an vinciDuino or Arduino while it is powered.

Before powering up

Make sure that the supply leads are correctly connected, secured and tight.

Make sure that the drivers are inserted correctly on the carrier board.

Follow your driver manual (ELFDRV1 or ELFDRV2 stepper driver) to connect the motors.

Make sure that the shield is securely fitted on your vinciDuion, Arduino UNO Rev3 or Leonardo.

If you have a fan, make sure that it is correctly wired and respect its voltage ratings.

HARDWARE

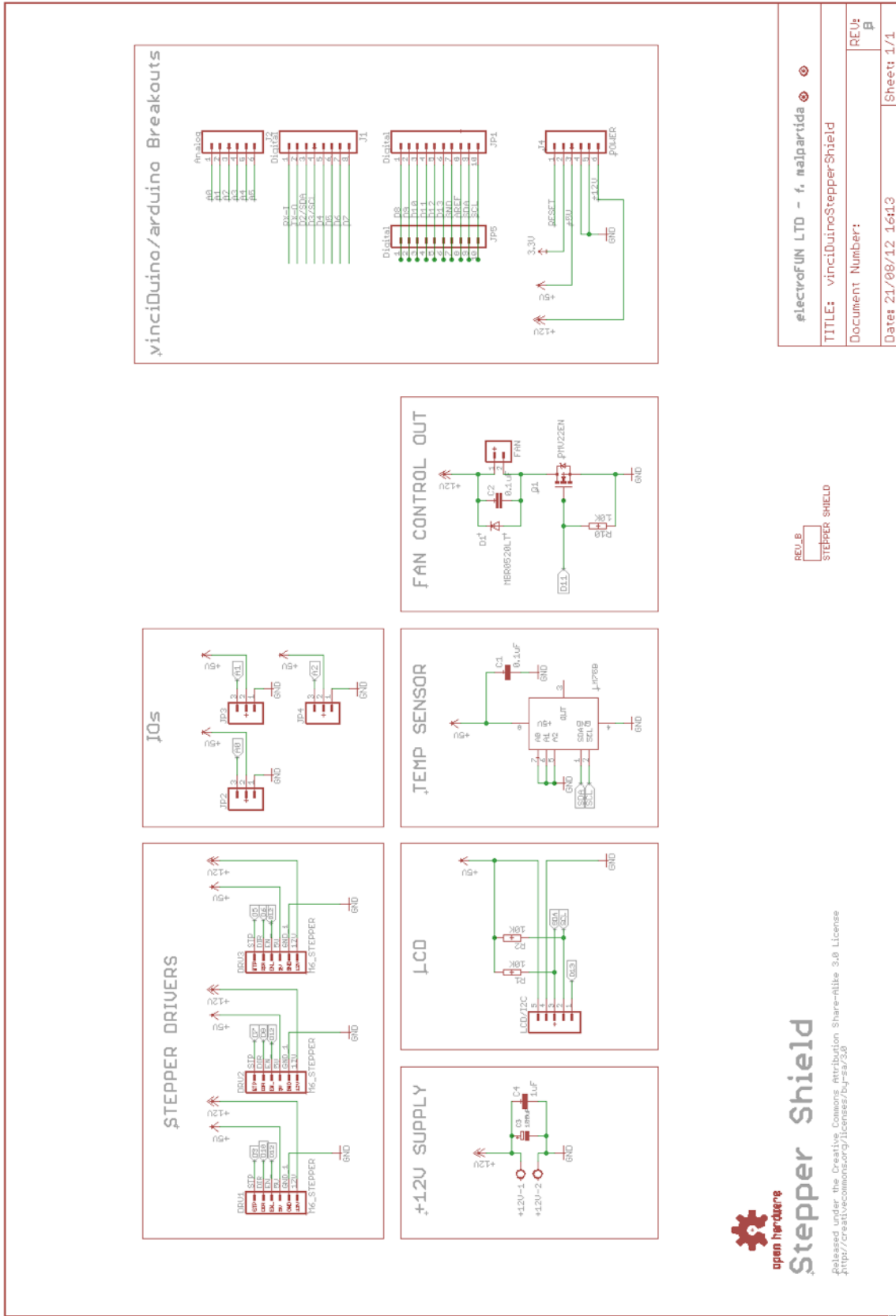
HARDWARE FILES

1. Schematic
2. Board layout
3. Board dimensions

Main hardware related section with the board schematics, board layout and components, mechanical drawings with board dimensions.

Original files can be download from www.electrofunLTD.com

Schematic



Stepper Shield

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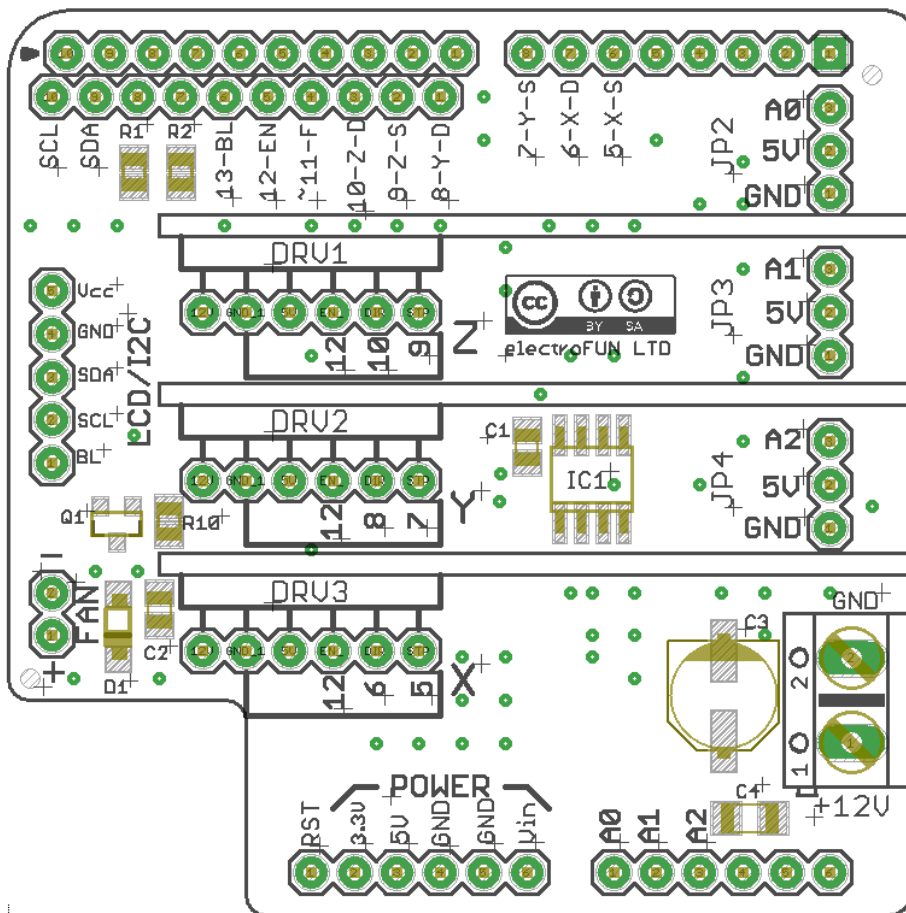
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Board Layout

ELFDRV1 - stepper driver board layout

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stepperShield⁺

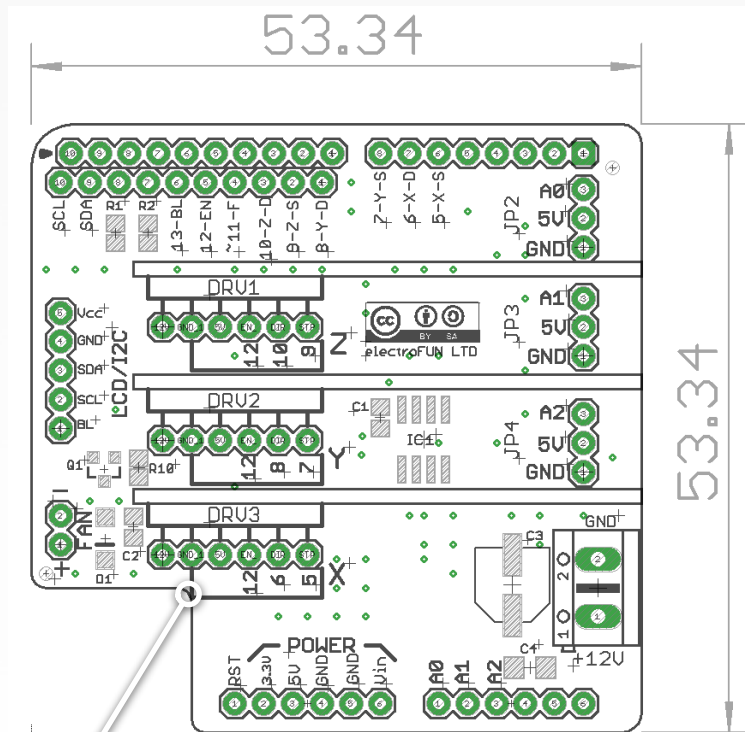


Components

Part	Value	Package
+12V		AK500/2
C1, C2	0.1uF	C-EUC0805
FAN	2.54mm header	M02PTH
JP2, JP3, JP4	2.54mm header	M03PTH
LCD/I2C	2.54mm header	M05PTH
R1, R2, R10	10K	R-EU_R0805
C4	1uF	C-EUC1206
C3	100uF	CAP_ELECPANASONIC_D
J2	2.54mm header	M06SIP
J1	2.54mm header	M081X08
Header 10	2.54mm header	M10";1X10"
IC1	LM75	LM75
DRV1, DRV2, DRV3	2.54mm header	M6_STEPPER
D1	MBR0520LT	MBR0520LT
Q1	PMV22EN	MOSFET-NCHANNEL
J4	2.54mm header	M06SIP

Board Dimensions

ELFDRV1 - stepper driver board dimensions



board dimensions

Fully assembled shield on vinciDuino - CNC Cube

