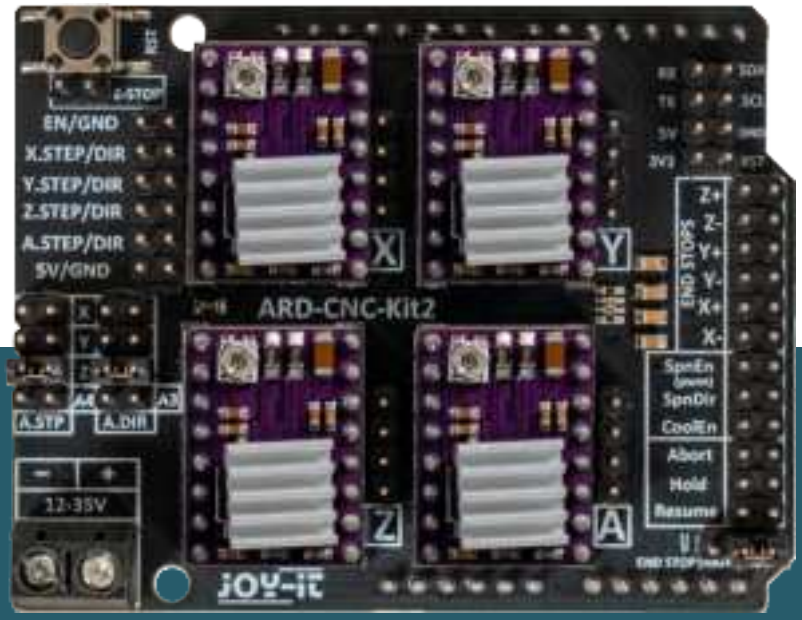


CONTROLLER BOARD CNC

4x DRV8825 motor driver for Arduino Uno

1. GENERAL INFORMATION & SAFETY INSTRUCTIONS

Dear customer
thank you for choosing our product. In the following we will show you what you need to bear in mind when commissioning and using.

Should you encounter any unexpected problems during use, please do not hesitate to contact us.

2. SAFETY INSTRUCTIONS

This set lays the foundation for installing a customised CNC router. The controller board is suitable for use with the Arduino Uno or Arduino Uno compatible boards and can be operated with 12 to 35 V as required. Up to 4 axes can be controlled with the supplied DRV8825 motor drivers.

The expansion board is easy to control as it is 100% **GRBL** 0.9 compatible.

As this expansion board can be used to control potentially dangerous machines, please observe the following safety instructions:

Never reach into the machining area while the machine is running.

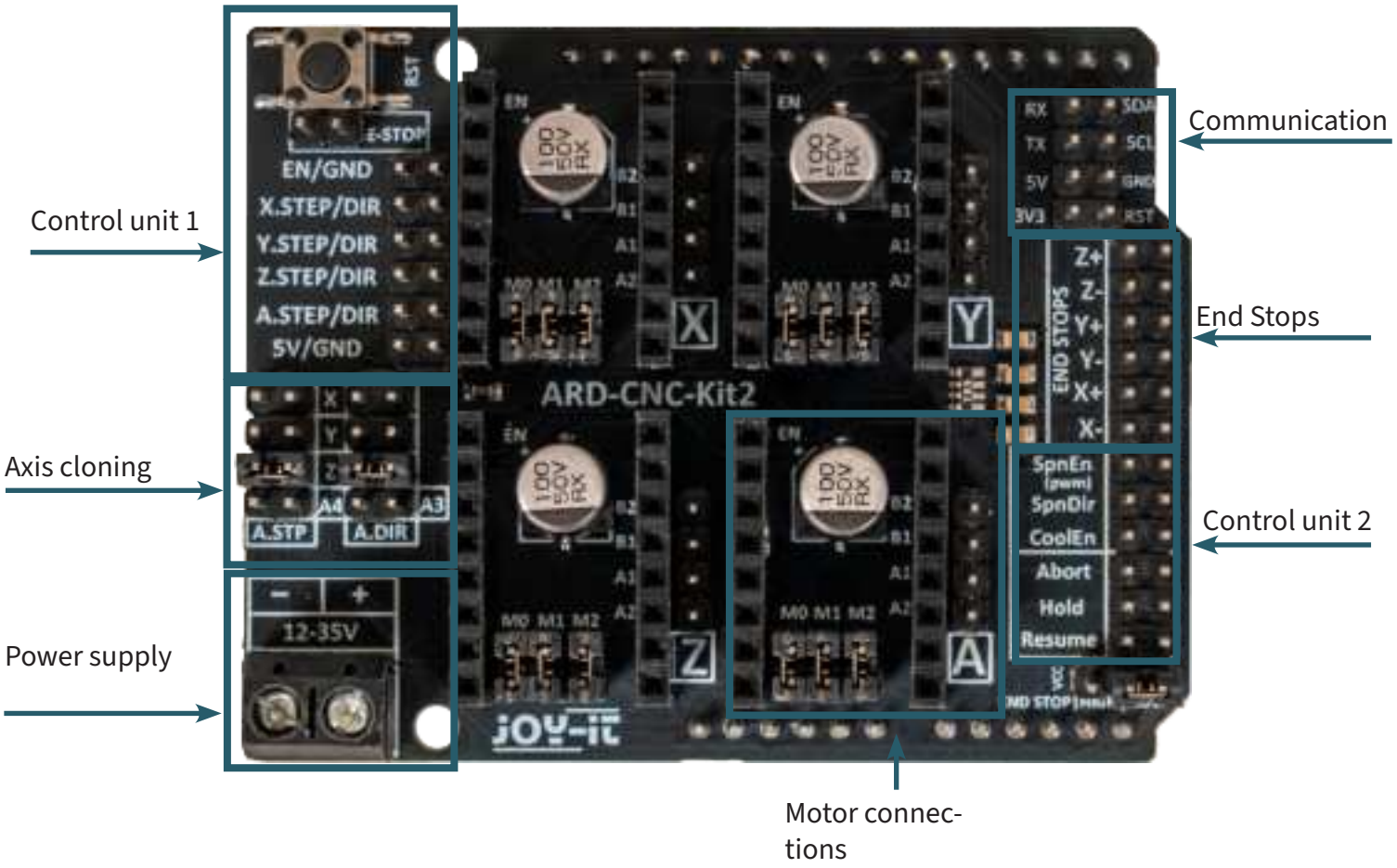
Do not remove any chips by hand. Use tools such as brushes, hand brushes or compressed air for this purpose. Tools and workpieces must never be changed while the tool spindle is running. Ensure that the workpieces are sufficiently secured so that the workpiece can never be moved out of position due to the resulting load, e.g. when drilling or milling. Never leave the machine running unattended! Always keep a safe distance from the running machine.

Only use the ARD-CNC-Kit2 in dry environments.

When using components from other manufacturers, please find out about their safety regulations and observe them.

We are not liable for damage caused by improper use.

3. PIN ASSIGNMENT



Control unit 1

- RST (reset button top left):
  Resets the board.
- E-STOP (emergency stop)
  Stops all movements immediately by resetting the controller.
  The E-Stop integrated on the CNC shield is sufficient for many cases, but is not a fully-fledged safety solution. An external emergency stop switch that directly interrupts the power supply is the safest option for machine operation.
- EN (Enable)
  Activates or deactivates all 4 stepper motor drivers.
- X.STEP/DIR, Y.STEP/DIR, Z.STEP/DIR, A.STEP/DIR
  These signals control the step and direction movements of the stepper motors for the respective axis. The left pin is for the step signal and the right pin for the direction signal of the respective axis.
- 5V/GND
  Supply voltage for the control logic.

Control unit 2

- SpnEn (PWM)
  Spindle switch-on via PWM control. Left pin PWM signal, right pin GND.
- SpnDir
  Direction of the spindle control. Left pin direction signal, right pin GND.
- CoolEn
  Control for a cooling system (e.g. fan, water pump). Left pin control signal, right pin GND.
- Abort
  Stops the machine, cancels the current job. To do this, connect the left pin (signal) to the right pin (GND).
- Hold
  Pauses the machine. To do this, connect the left pin (signal) to the right pin (GND).
- Resume
  Continues processing. To do this, connect the left pin (signal) to the right pin (GND).

Axis cloning

The ARD-CNC-Kit2 offers the option of using an additional A-axis by cloning another axis (X, Y or Z). This is particularly useful for machines with two motors per axis, e.g. a CNC milling machine with two motors for the Z axis. You can also control the A-axis separately via A4 and A3 if you set the jumpers to the lower positions. However, only if you do not control cooling via the board, as this is also controlled via A3.

END STOPS

The ARD-CNC-Kit2 provides connections for mechanical or optical limit switches, which are used for limiting and referencing the axes. There are two limit switch connections per axis: one for the minus direction and one for the plus direction.

These connections allow the installation of two limit switches per axis (one at each end of the travel path). However, they cannot be recognised separately, as both limit switches per axis are connected to the same signal input. This means that the system only recognises that a limit switch for the axis has been triggered, but cannot distinguish whether it is the positive or negative end point.

There is also a jumper at the bottom right of the board for setting the limit switch signal. This determines whether the limit switches output a HIGH or a LOW signal when they are actuated.

Motor connections
The ARD-CNC-Kit2 has a total of four slots for stepper motor drivers, one each for the X, Y, Z and A axes. Each slot is designed to be compatible with common stepper motor drivers such as A4988 or DRV8825.

Microstep settings
The step resolution of the motors can be configured individually for each axis using jumpers M0, M1 and M2. These jumpers are located directly below the respective driver slots. Please refer to the table in the next chapter for the exact assignment for setting the desired microstep resolution.

Inserting the motor drivers
The stepper motor drivers supplied are plugged directly into the slots provided on the shield. Ensure that the driver is correctly aligned. The enable pin (EN) is marked on both the CNC shield and the drivers and serves as a reference point. Incorrect alignment can damage the drivers or the board.

Connecting the stepper motors
To the right of the motor driver slots is a pin header for connecting the stepper motors. The four pins from top to bottom are assigned as follows:

B2
B1
A1
A2

As the exact wiring may vary depending on the stepper motor, we recommend consulting the documentation for your motor to ensure correct wiring. Incorrect wiring can result in the motor not moving or rotating in the wrong direction. If necessary, the A and B windings of the motor can be swapped to correct the direction of rotation.

If you have any questions about commissioning or selecting the optimum microstep setting, please refer to the next chapter for further details.

Here is an overview of which Arduino pins are used for the corresponding control signals:

ARDUINO UNO	CNC SHIELD
D2	X STEP
D3	Y STEP
D4	Z STEP
D5	X DIR
D6	Y DIR
D7	Z DIR
D8	ENABLE
D9	X LIMIT
D10	Y LIMIT
D11	SPN EN
D12	Z LIMIT
A0	ABORT
A1	HOLD
A2	RESUME
A3	COOLANT / A DIR
A4	A STEP

4. MICROSTEPS

To determine the step size for the motors, you can make a setting via jumpers on the main board. The corresponding pins are marked on the following image.

Jumper positioning for microsteps

M0	M1	M2	MICROSTEPS
No	No	No	Whole step
Yes	No	No	1/2 step
No	Yes	No	1/4 step
Yes	Yes	No	1/8 step
No	No	Yes	1/16 step
Yes	No	Yes	1/32 step
No	Yes	Yes	1/32 step
Yes	Yes	Yes	1/32 step

5. ADJUSTING THE MOTOR DRIVER

Setting the current for the DRV8825 motor driver is essential in order to operate the stepper motor safely and efficiently. If the current is set too high, the motor can overheat, which can damage the windings in the long term and lead to failure. If, on the other hand, the current is too low, the motor will not receive enough power, causing it to lose steps or not start at all. Correct current limiting also protects the driver itself from overloading and overheating, as it could switch off automatically if the current is too high. It is therefore important to set the maximum current so that it matches the specification of the motor.

To set the current, the so-called reference voltage (VREF) is measured and adjusted on the DRV8825 potentiometer. This voltage directly controls the maximum phase current of the motor. The DRV8825 uses resistors with a value of 0.1 Ohm to measure the current. The formula for calculating the motor current is as follows:

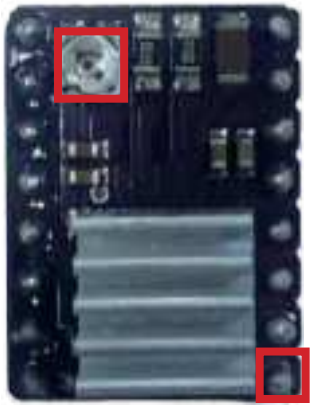
$$I_{\max} = \frac{Vref}{5 \times Rsense}$$

Since Rsense is 0.1Ω for our DRV8825, the formula is simplified:

$$I_{\max} = Vref \times 2$$

This means that a set VREF of 0.6V corresponds to a maximum motor current of 1.2A.

To set the reference voltage correctly, the driver is first plugged into the CNC board and supplied with a suitable supply voltage. The stepper motor should not yet be connected in order to avoid damage. A multimeter is used in DC voltage mode, with the black measuring tip connected to GND and the red measuring tip touching the measuring point of the potentiometer. Carefully turning the potentiometer clockwise increases VREF while turning it anticlockwise decreases it. The desired voltage is set using the previous calculation.



Once the current has been adjusted according to the motor specification, the motor can be connected and tested. During operation, it should be checked that the motor rotates smoothly, that no excessive heat is generated and that the driver does not go into overload protection. If the motor gets too hot or behaves unusually, the setting can be fine-tuned again.

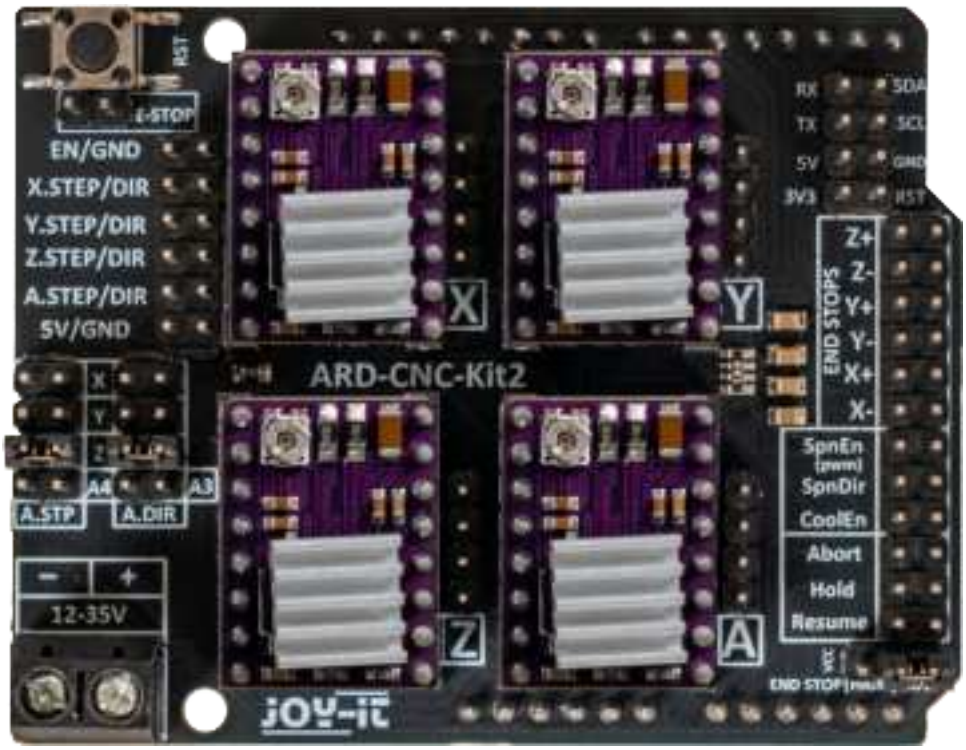
6. CONNECTING THE EXPANSION BOARD

The ARD-CNC-Kit2 supports the Arduino Uno and Arduino Uno compatible boards.

The CNC expansion board is simply plugged onto your Arduino Uno. It requires an additional power supply of between 12 V and 35 V.

ATTENTION!!!
Ensure that the motor driver is aligned correctly, otherwise it will be damaged. For the correct alignment, you can use the EN pin as a guide; this is marked EN on both the CNC board and the motor driver.

Place the motor drivers on your CNC board as shown in the following image.



7. EXAMPLE CODE

To control the CNC shield, we use the Arduino GRBL library, which you can download from the following link:
https://github.com/grbl/grbl

After downloading, unzip the downloaded ZIP file and copy the "grbl" folder, which is located inside the unzipped "grbl-master" folder, into the Arduino libraries folder. This is located by default in the directory:

Windows: C:\Users\YourUsername\Documents\Arduino\libraries
Mac: ~/Documents/Arduino/libraries/

Once the library has been installed correctly, you can open the GRBL upload sketch for the Arduino. To do this, navigate in the Arduino IDE to: File → Examples → grbl → grblUpload

Then upload the sketch to your Arduino to activate GRBL and make your CNC shield ready for operation.

Your CNC machine can now be controlled via GRBL commands. To do this, you need compatible G-code transmitter software that allows you to send commands to the Arduino and control the machine.

A proven and widely used solution is the Universal G-Code Sender (UGS), which you can download from the following link: Universal G-Code Sender (UGS) on GitHub
https://github.com/winder/Universal-G-Code-Sender

After installation, you can connect to your CNC machine, load G-code files and run your control system directly from the software.

8. FURTHER INFORMATION

Our information and take-back obligations under the German Electrical and Electronic Equipment Act (ElektroG)

Symbol on electrical and electronic equipment:

This crossed-out waste bin means that electrical and electronic appliances **do not** belong in household waste. You must return the old appliances to a collection point. Before handing them in, you must separate used batteries and accumulators that are not enclosed by the old appliance.

Return options:
As an end user, you can return your old appliance (which essentially fulfils the same function as the new appliance purchased from us) for disposal free of charge when purchasing a new appliance. Small appliances with no external dimensions greater than 25 cm can be disposed of in normal household quantities regardless of the purchase of a new appliance
become.

Returns can be made at our company location during the opening hours:
SIMAC Electronics GmbH, Pascalstr. 8, D-47506 Neukirchen-Vluyn

Return option in your neighbourhood:
We will send you a parcel stamp with which you can return the device to us free of charge. To do so, please contact us by e-mail at Service@joy-it.net or by telephone.

Information about the packaging:
Please pack your old appliance securely for transport. If you do not have suitable packaging material or do not wish to use your own, please contact us and we will send you suitable packaging.

9. SUPPORT

We are also there for you after your purchase. Should any questions remain unanswered or problems arise, we are also available to assist you by e-mail, telephone and ticket support system.

E-mail: **service@joy-it.net**
Ticket system: https://support.joy-it.net
Phone: +49 (0)2845 9360 - 50

For more information, please visit our website:
www.joy-it.net

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