

CARVERA

Smart Desktop CNC Machine

INSTRUCTION MANUAL



FOR THE ERA OF MAKERS



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Welcome

Hi! We are so excited to welcome you to join our Carvera world! Whether you are an expert or completely new to CNC, with amazing functions such as auto tool changing, auto probing and auto-leveling, which significantly reduce the difficulty of learning and operating, you will experience the extraordinary machining capabilities that Carvera brings you with ease.

This manual does not include CAD and CAM tutorials but focuses on the instruction of this machine and its control software. Carvera supports standard G-Code and is compatible with most CAD/CAM software.

For specifications and more information, please visit our official website:
www.makera.com

If you have any problems with Carvera, please contact us directly:
support@makera.com

Also, join in the Facebook group to discuss and share your experience with other Carvera users:
www.facebook.com/groups/carvera

We will keep updating video tutorials and sample making cases on the YouTube channel, do not forget to subscribe!
www.youtube.com/c/Makera

In this manual, you will have a quick walk-through of how to use your Carvera and know its powerful abilities.



Safety

Disclaimer

Please read this manual carefully before using the Carvera. Failure to read the manual may lead to personal injury, inferior results, or damage to the Carvera products.

This manual is provided for reference purposes only. We reserve the right to modify or revise this manual, users can download the most up-to-date version of this manual on our website.

Carvera is equipped with multiple sensors (Motor stall sensor, Spindle abnormal sensor, etc.). However, you should always pay attention in operation that milling cutters revolving in high-speed, unstable components or laser in operation are dangerous to people without protection. Please carefully read the safety instructions below to avoid unnecessary casualties.

Safety Instructions

1. Always wear safety goggles when operating Carvera, especially when the protective cover is open.
2. Always wear laser protection goggles when using laser function.
3. Please wear hearing protection when Carvera is machining on the hard materials.
4. Do not put your hands close to the spindle or machining area. Keep the protective cover closed when operating Carvera.
5. Do not leave your Carvera unattended while it is machining.
6. Please be aware of the sharpness of the milling bits during installation, dust collection, and other operations.
7. Milling and laser carving will generate heat. Inappropriate parameters will cause fire hazards. Make sure an extinguisher is in your vicinity.
8. Some materials are harmful to people when machining or laser carving, such as carbon fiber and epoxy resin. Please wear a face mask and turn on the automatic dust collection.
9. Do not expose this machine to rain or wet conditions.
10. Keep children and bystanders away while operating this machine. It requires supervision and the assistance of an adult when children use this machine.

If an emergency occurred in machining, such as the workpiece being loose from holding, components damaging, unusual light or sound coming from the machine, etc. Press the main button or E-Stop button, all ongoing procedures will stop immediately, or cut off the power to shut it down. Carvera is built by closed-loop servo motors, and it saves the coordinates and status at each step. Therefore, no need to recalibrate after reboot, just restart the job.

Carvera has a safety option that allows the machine to automatically stop working when opening the cover, which is useful for schools or work environments where children may reach.

FCC Compliance

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio / TV technician for help.

Caution: Any changes or modifications to this device not explicitly approved by manufacturer could void your authority to operate this equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

ISED Compliance





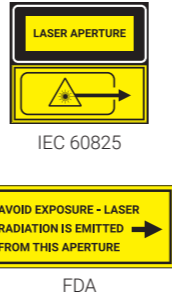
This device complies with Innovation, Science and Economic Development Canada License exempt RSS standard(s). Operation is subject to the following two conditions:

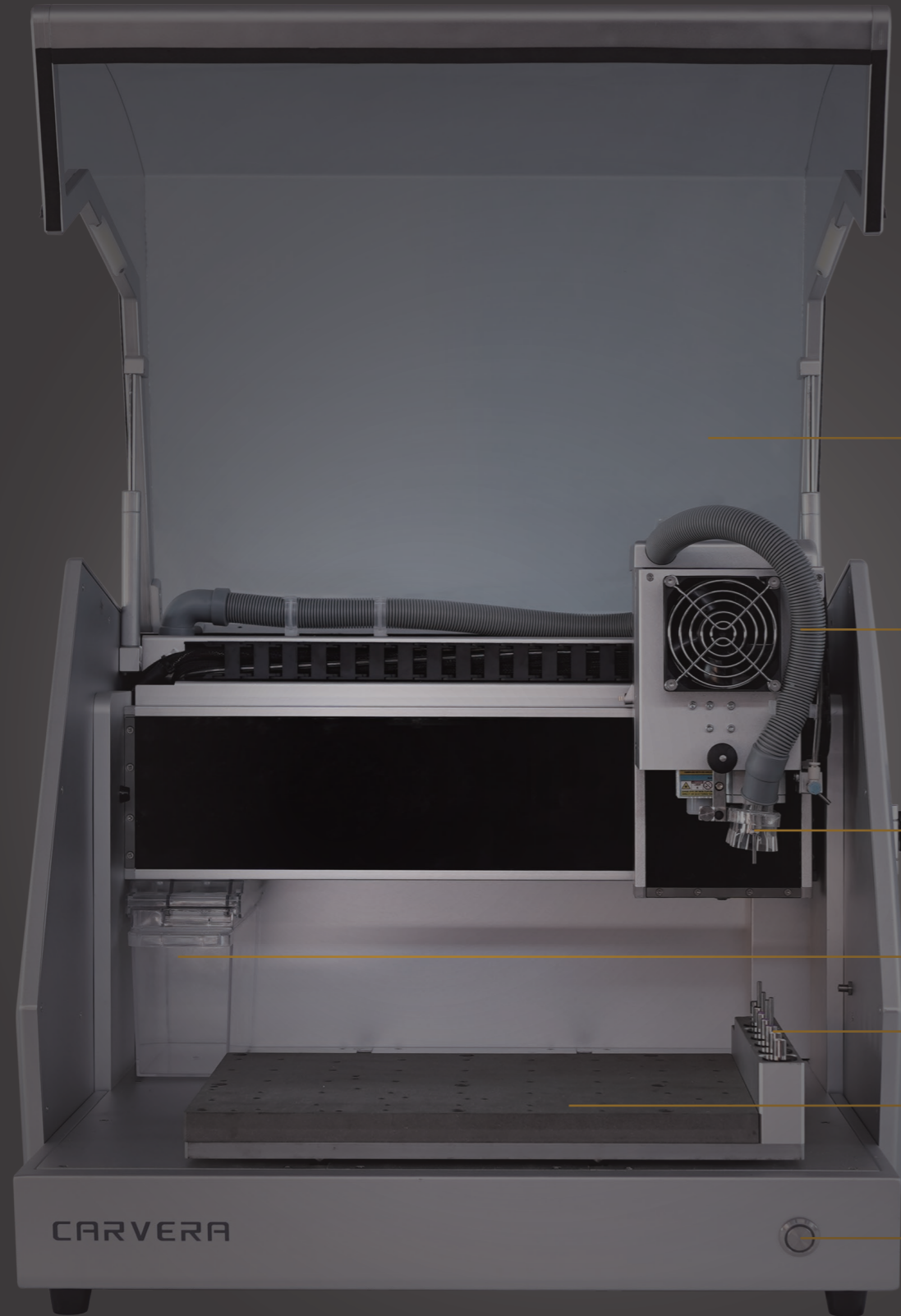
(1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

The device is compliance with RF exposure guidelines, users can obtain Canadian information on RF exposure and compliance. The minimum distance from body to use the device is 20cm. Le présent appareil est conforme Après examen de ce matériel aux conformité ou aux limites d'intensité de champ RF, les utilisateurs peuvent sur l'exposition aux radiofréquences et compliance d'acquérir les informations correspondantes. La distance minimale du corps à utiliser le dispositif est de 20cm.

Safety Labels

Safety Labels	Meaning	Location
	Keep hands clear of moving parts: machine axis, spindle, etc.	On the machining cover
	Wear safety goggles when operating the CNC function or laser goggles when operating the laser.	On the machining cover
	Caution sharp cutters when installing milling bits and doing dust collection.	On the machining cover
	Laser radiation - Class 4 laser product, avoid eyes or skin exposure to direct or scattered radiation.	On the Laser module cover
	Laser aperture - Laser radiation is emitted from this aperture.	On the Laser module



Machine Cover

Dust Pipe

Dust Shoe

Dust Bin

Tool Rack

Machine Bed

Main Button

The mass of the box weighs more than 70Kg/ 154lb. The net weight of the Carvera CNC desktop milling machine is around 50Kg/110lb. We suggest moving this machine by at least two people (with gloves) to ensure both personal and machine's safety. Please make sure your desk is sturdy enough and has no less than 60 x 60 cm space to place this machine.

Unpack



Unpack

1. Pry up buckles as shown at bottom of the crate, open the upper part.



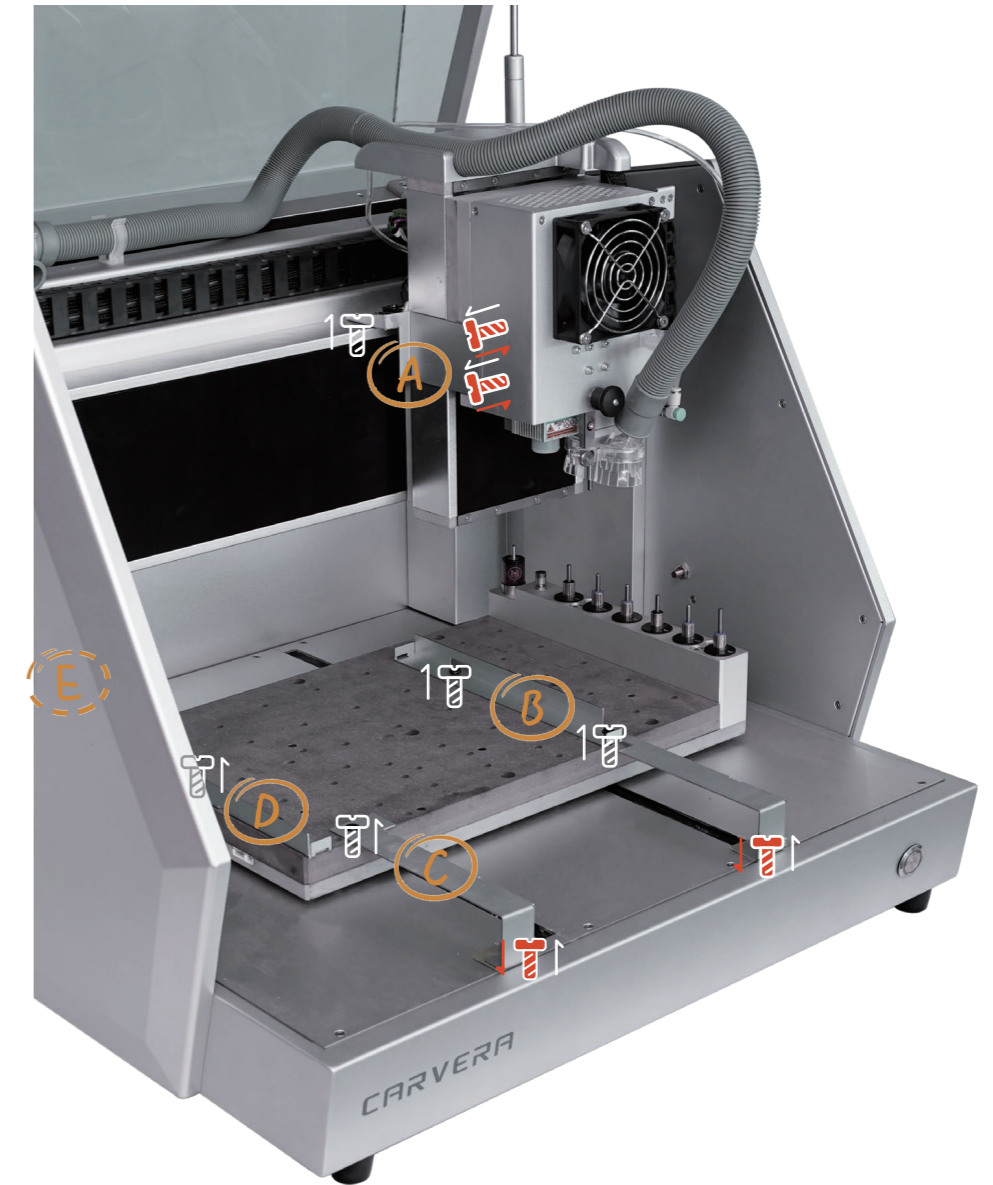
2. Put the machine on a solid, flat and horizontal surface by two people. Keep at least 10 centimetres distance from the wall to ensure no obstacle for protective cover or plugs.

3. Remove the plastic bag and printed materials.



4. Cut off the zip ties and take off the packing boxes inside the machine.

5. Remove the fixing structures at positions A, B, C, and D as shown in the figure, and restore 4 counter sink screws (in a plastic bag) to the red indication at positions A, B, and C.






6. Tear off the protective tape at position E that is used to fix the dust bin.


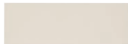

7. All sorted! Let's commence!

Note: Please keep the wooden box, foam, plastic bag, fixing structures, and screws in a safe place for future use.

Parts list

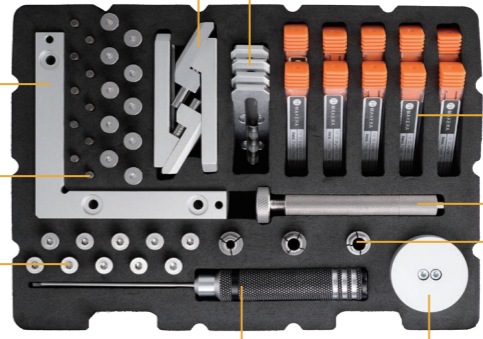
- Spare 1/8" bit collar x 30
- Spare tool bit x 30
- Laser goggles x 1
- Safety goggles x 1
- Emergency stop button x 1
- Manual tool setter x 1
- Spare dust filter x 1
- USB cable x 1
- Power cable x 1
- Phone/Pad holder x 1


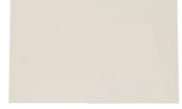


- 4th Axis x 1
- Epoxy tooling board for 4th Axis x 2
- 4th Axis chuck wrench x 2




- 4th Axis (optional) x 1
- PCB Fabrication Pack (optional) x 1



- Side clamp x 2
- Top clamp x 4
- L bracket x 2
- Spare tool bit x 10
- 4mm Dowel pin x 10
- Bit collar installer x 1
- M5 Screws x 20
- Spindle collet (optional)
- Screw driver x 1
- Spindle collet installer x 1

- Sand block x 2
- Epoxy tooling board x 2
- LED light assembly kit x 1
- Mini hand saw x 1
- Single side PCB x 2
- Acrylic plate x 2
- MDF Waste board x 4
- ABS Plastic board x 1
- Double side PCB x 2
- Aluminum plate x 2













- UV curable solder mask paint x 5
- UV solder mask roller x 1
- 1/8" 60degree 0.1mm V-Bit x 2
- 1/8" 30degree 0.2mm V-Bit x 2
- UV solder mask removal tool x 2
- Double side machining dowel pin x 20
- PCB milling / drilling bits x 20
- Through hole rivet(0.2mm-1mm) x 1000
- Single side PCB(10*15cm) x 10
- Double side PCB(10*15cm) x 10
- UV cure lamp x 1

Preparation

Power On

1. Plug the power cable and turn on the power switch.
2. Carvera homes all 3 axes automatically and turn on the work lights.

Tool Preparation

For easy transportation, the tools are not loaded by default. Please put the wireless probe and milling bits into right positions as shown in the figure. You can find the wireless probe in the accessory box, milling bits in the tool box and the optional solder mask removal tool in the PCB pack. The default tool installed is a test rod (No 6 tool).

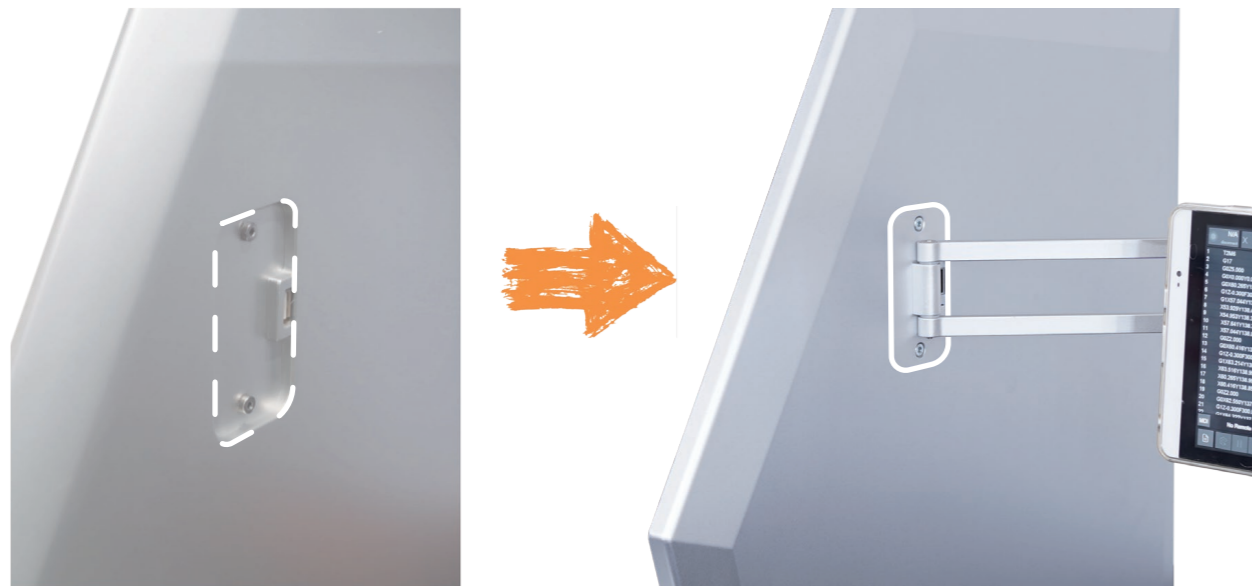
This 1-6 tool positions are for the examples. If you run your own toolpath in the future, you should layout your tools accordingly.



Phone/Pad Stand Installation

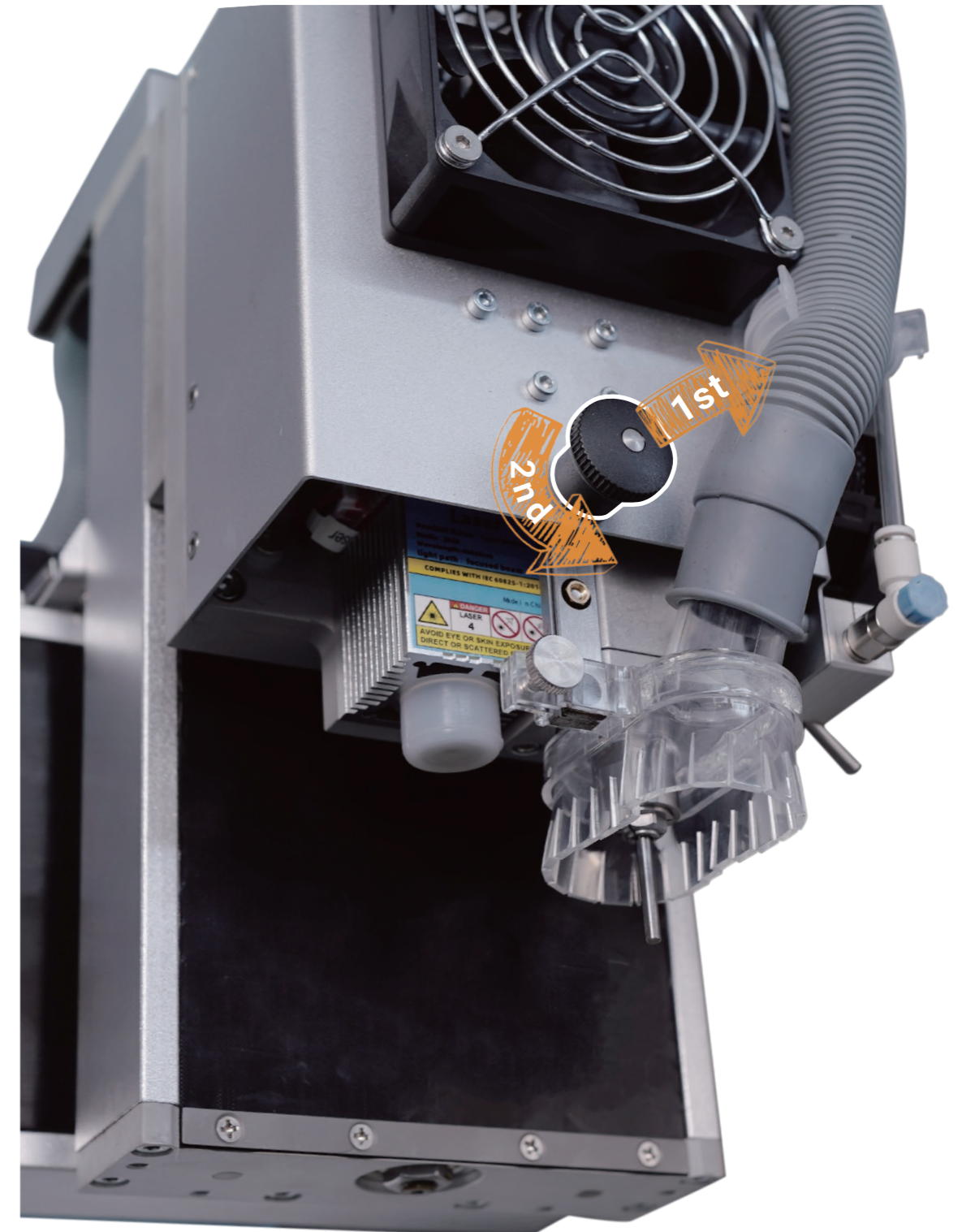
For the sake of transportation, the phone/pad stand has not been preinstalled. To install it, remove the screws at the stand base, put the stand on and screws it. Please note that the notch should be in the same direction as the USB port (charging only).

For your convenience, the phone/tablet stand can be installed on either the right or left side of the machine. The default is the right side.



Adjust Dust Shoe

The default state of the dust shoe is locked. To use the vacuum system correctly you need to unlock the dust shoe first. Pull the plug outwards, rotate it for about 30 degree, make sure it is unlocked, thus the dust shoe can go up and down freely (Locking and unlocking modes are toggled every 30 degrees of rotation). For other instructions on the vacuum system, please turn to Chapter 6.



Charge Wireless Probe

The wireless probe is one of the main components of Carvera. It is an indispensable component for Z-axis tool setting and automatic leveling. Please fully charge it before using it for the first time.

1. After the device is turned on, the yellow indicator light will light up as the wireless probe automatically starts charging.
2. Please charge the wireless probe for at least 30 minutes or the yellow indicator light runs out which means it's fully charged. If the machine is used frequently (at least once a week), then there is no need to charge it every time.



Control Software Installation

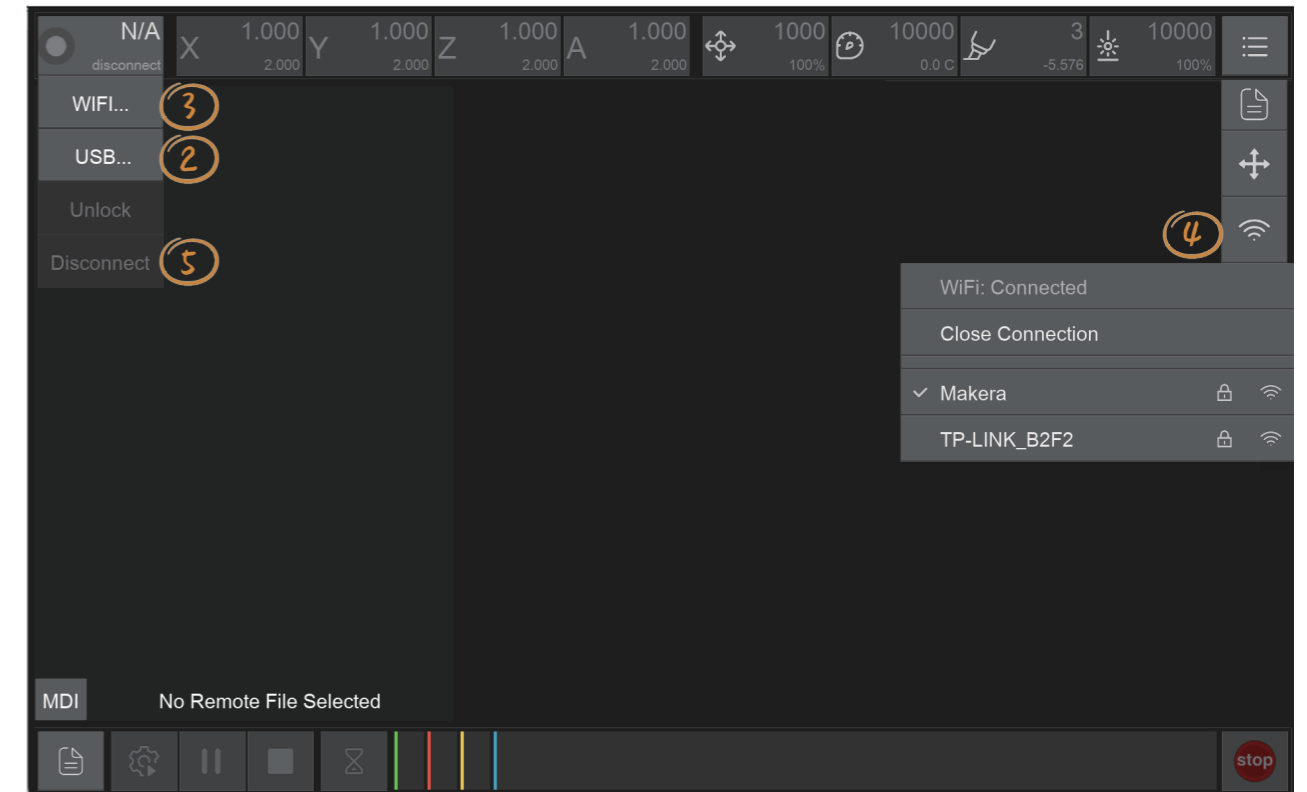
1. Goto www.makera.com, download and install the Carvera control software (Now support computer/pad/phone with Windows/Mac/Android system, will add IOS/Linux support later) . We suggest using computer version control software for the first time. Please turn to the next chapter for the software instruction.
2. Download and install the Carvera USB driver if you intend to use the USB connection method.

WiFi Configuration

Recommended

The purpose of configuring WIFI is to allow Carvera to join the network at your workplace so that your computer can control the machine without being restricted.

1. The network can be configured via a USB cable or the machine's built-in WiFi accessing point.

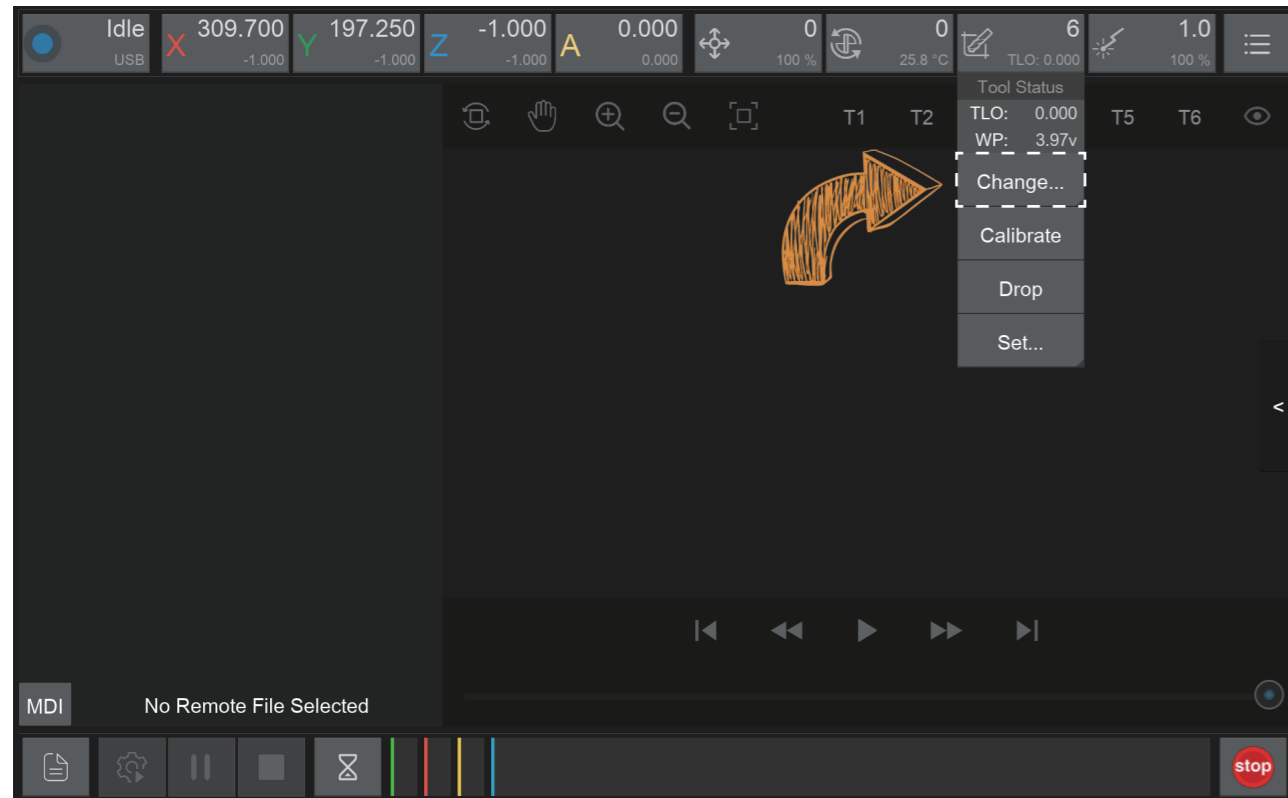


2. Connect via USB: Connect the USB cable and open the Carvera control software. Click the status button in the status bar, click "USB...", you will see your USB device and choose one to connect. Then the status button will be updated, displaying machine is connected in USB mode.
3. Connect via accessing point: Open the WiFi setting on your computer, find the accessing point named CARVERA_WIFI_XXXXX and connect (No password). After successfully connected, open the Carvera control software; click the status button in the status bar; click "WIFI..."; Carvera will automatically search connectable devices. Please refresh it if Carvera cannot find any devices. After connecting to the device, the status button will be updated; displaying machine is connected in WiFi mode.
4. WiFi configuration: Click the "more" button (end of the status bar) in the status bar; click the WIFI icon, the system will start searching WIFI in the workplace. Select a WIFI, enter the password and connect. Please retry if the connection failed.
5. Disconnect: Click the status button; click "Disconnect"; Switch back to your WiFi.
6. Redo step 3 from Click "WIFI" to connect Carvera through WIFI.

Test Auto Tool Changer

Auto tool changing is one of the key features of Carvera and also the base of all the automated function. Please test it at the first time.

1. Open the control software and connect to Carvera.



2. Change to tool 1. The tools that pre-installed in the machine is tool 6. Click tool status; click "Change..."; choose "Tool: 1", it will automatically change to tool 1. Please observe the process to see if there is any error.

3. Change to wireless probe. If no error occurred, then test wireless probe. Click tool status; click "Change"; select "Probe", it will automatically change to wireless probe and check its signal. Please observe the process to see if there is any error.

4. Change back to tool 1. Please follow step 2.

Note: If you decide not to use Carvera for a long time, please keep a tool clamped in the spindle, but do not use the wireless probe. It will reduce the elasticity of the tool clamp without a tool for long time. The wireless probe cannot be charged automatically if it is not in the tool holder.

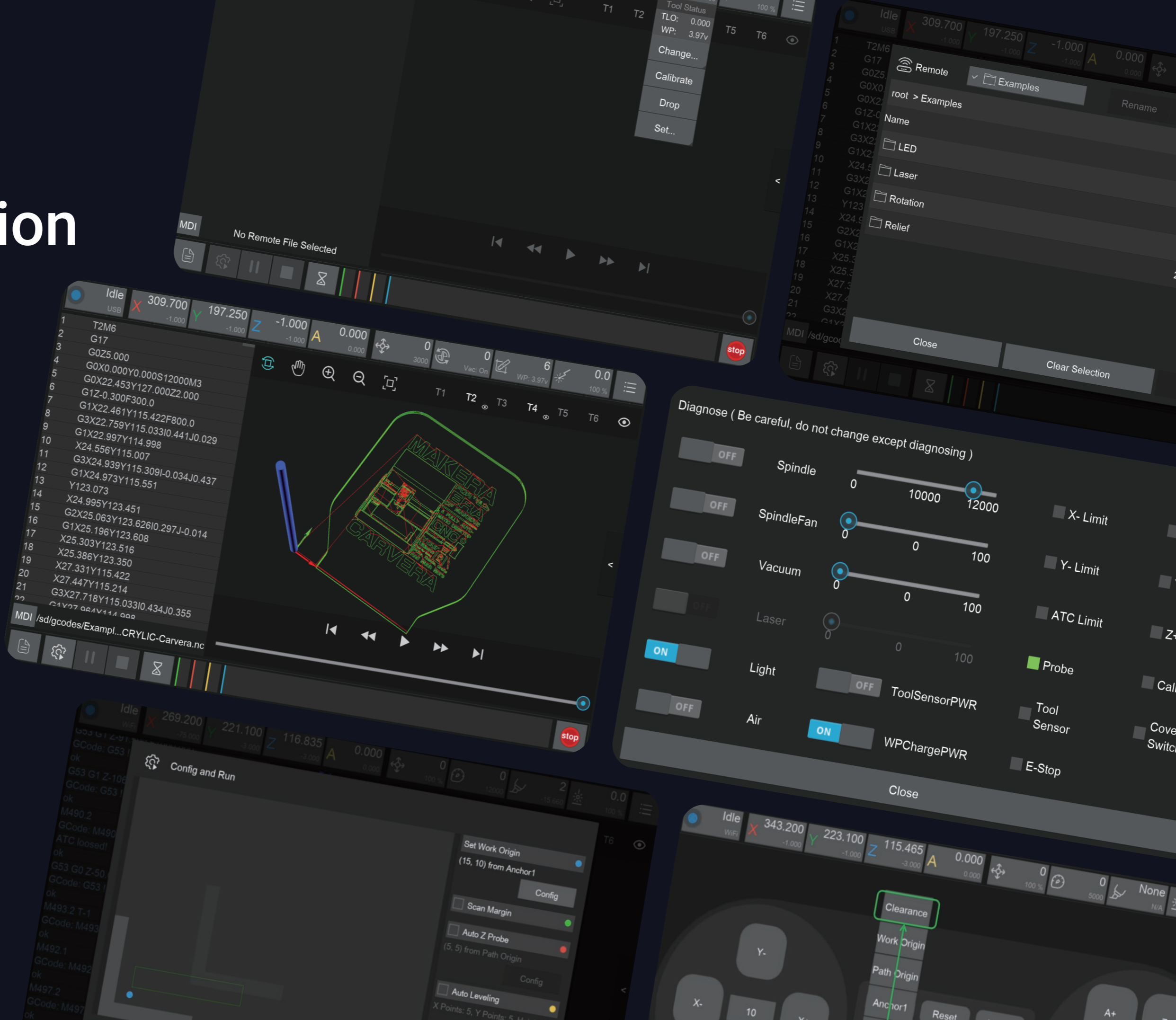


If you have any problems or enquiries, please feel free to contact us:

support@makera.com

CARVERA

Software Introduction



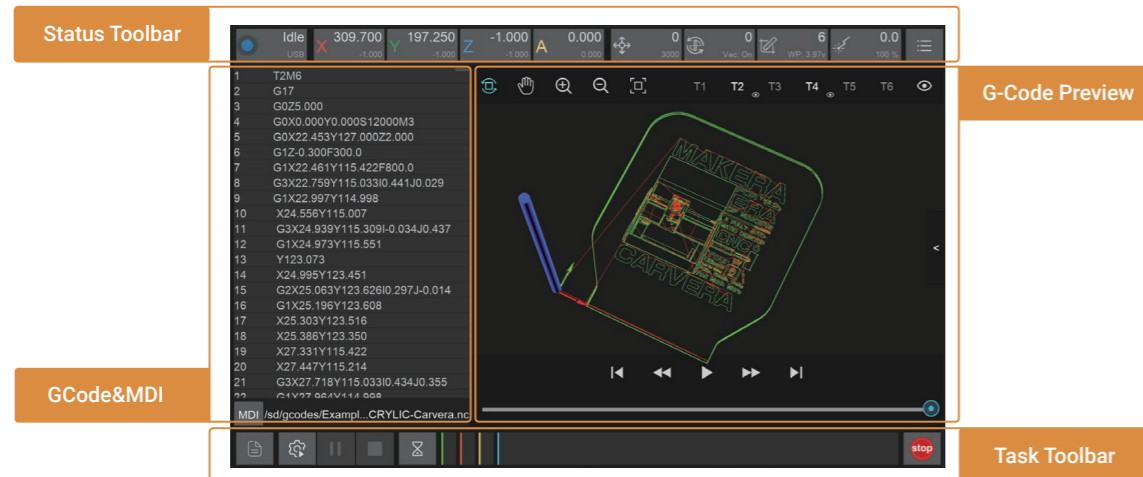
Overview

1. Status Toolbar

The status toolbar is on top of the interface. It shows the real-time data of key indicators and can be used to control these indicators.

2. Task Toolbar

Task toolbar is at the bottom of the interface. In the task toolbar, you can manage G-Code files, configure, track and control machining process.



3. G-Code & MDI

By default, this interface displays the G-Code of the currently opened file. It can be switched to the command information sent/received by the machine.

4. G-Code Preview

The G-Code preview graphically displays the currently opened file G-Code..



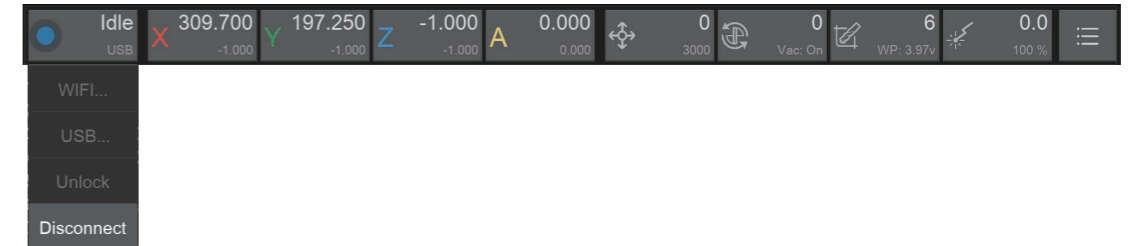
5. Manual Operation

Manually control Carvera's movement and execute other commands. Because Carvera does most of the jobs automatically, the manual control interface is hidden by default. Click the arrow on the right side of the interface to switch whether to display it.

Status Toolbar

All indicators include 3 items: a symbol, main data and sub-data. Click the button can open the corresponding drop-down list.

1. Machine status and control



1.1. Symbol: A unique colour to distinguish the status.

1.2. Main data: Explanation of device status.

1.3. Sub-data: Current connection mode.(No connection, WiFi or USB)

1.4. Drop-down list:

1.4.1. WIFI: Connecting Carvera via WiFi.

1.4.2. USB: Connecting Carvera via USB.

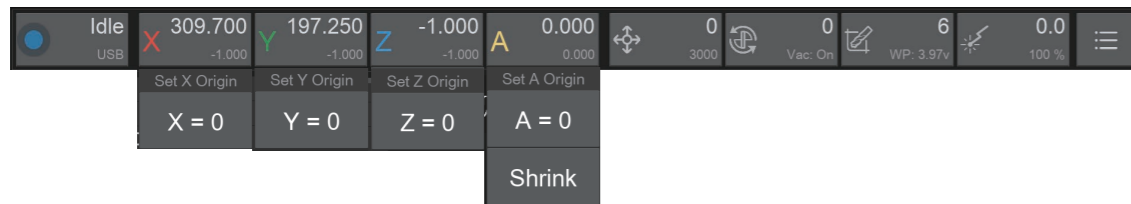
1.4.3 Unlock/Reset: Unlock or reset Carvera.

1.4.4. Disconnect: Disconnect Carvera from your device.

Explanation of different Carvera statuses :

Colour	Status	How it been triggered/How to quit
	Idle	Carvera is idle
	Run	Carvera is working
	Alarm	Carvera has an alarm/Unlock it to restore
	Home	Carvera is resetting the coordinate
	Hold	Click the hold button/Click again to resume
	Wait	Carvera is emptying the buffer
	Disable	No device has been connected
	Sleep	Timeout/Reboot Carvera to restore
	Pause	Click the pause button/Click again to resume

2. Coordination status and control



2.1. Symbols: X/Y/Z/A

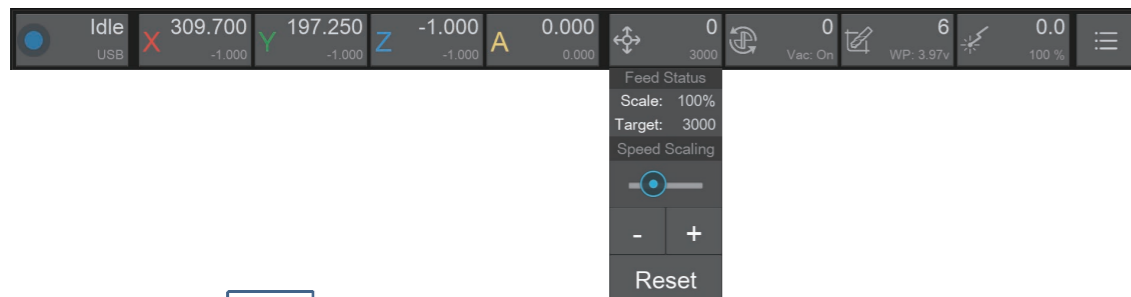
2.2. Main data: Work coordinate (The position of the tool relative to the work zero point). The position depends on where you put your workpiece and where you want to start on the workpiece.

2.3. Sub-data: Machine coordinates (The position of the tool relative to the machine's zero point). The position is fixed and located in the upper right corner of the machine, so the coordinates are generally negative.

2.4. Drop-down list:

2.4.1 Set Origin: The working coordinates of four axes - X/Y/Z/A can be set to zero. Carvera usually uses 2 fixed anchor points to set the starting point automatically, so we do not recommend setting the origin point by yourself.

2.4.2 Rotary axis (A axis) does not distinct work coordinates and machine coordinates, and there is a "Shrink" function in the drop-down list, which can calculate the remainder according to 360 when having large rotation angles.



3.1. Symbol: Feed icon



3.2. Main data: Real-time feeding speed

3.3. Sub-data: Target feeding speed/Feeding speed scale(moving message)

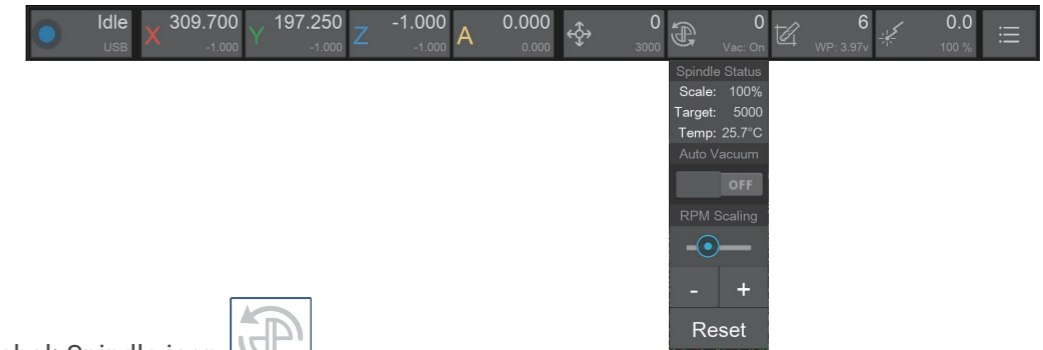
3.4. Drop-down list:

3.4.1. Feed Status: Target feeding speed /Feeding speed scale

3.4.2. Speed Scaling: Set the feed rate by percentage. For safety reasons, the adjustment range is limited to 50% to 200%

Note: Adjusting the feed rate will not take effect immediately. Generally, it will take a few seconds to wait for the current command to finish.

4. Spindle status and control



4.1. Symbol: Spindle icon



4.2. Main data: Real-time spindle rotary speed (RPM)

4.3. Sub-data: Target spindle rotary speed/ Spindle speed scale/Real-time spindle temperature (moving message)

4.4. Drop-down list:

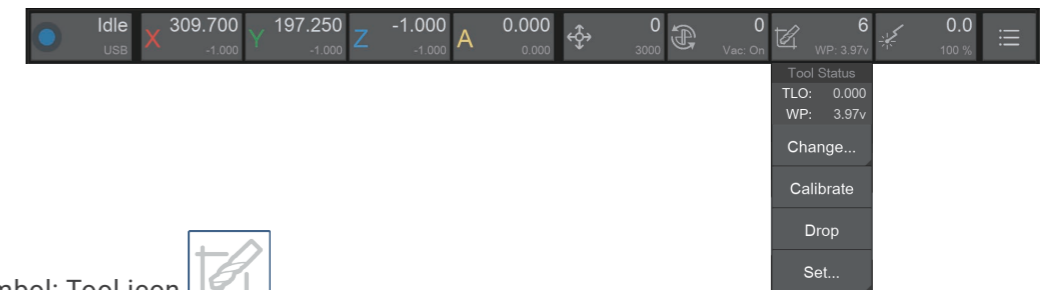
4.4.1. Spindle Status: Target spindle rotary speed/ Spindle speed range /Real-time spindle temperature summary display

4.4.2. Auto Vacuum: Choose to turn on/off auto vacuum while the spindle is rotating. Default - on.

4.4.3. RPM Scaling: Set the spindle speed range by percentage. For safety reasons, the adjustment amount range is limited from 50% to 200%.

Note: Turn on the Vacuum or adjust the spindle rotary speed will not take effect immediately. Generally, it will take a few seconds to wait for the current command to finish.

5. Tool status and control



5.1. Symbol: Tool icon



5.2. Main data: Display the number 1 to 6 of the current tool on the spindle, no tool - "None", wireless probe - "Probe"

5.3. Sub-data: Current Tool Length Offset (TLO) /Wireless Probe Power(moving message)

5.4. Drop-down list:

5.4.1 Tool Status: TLO/Wireless Probe Power summary display

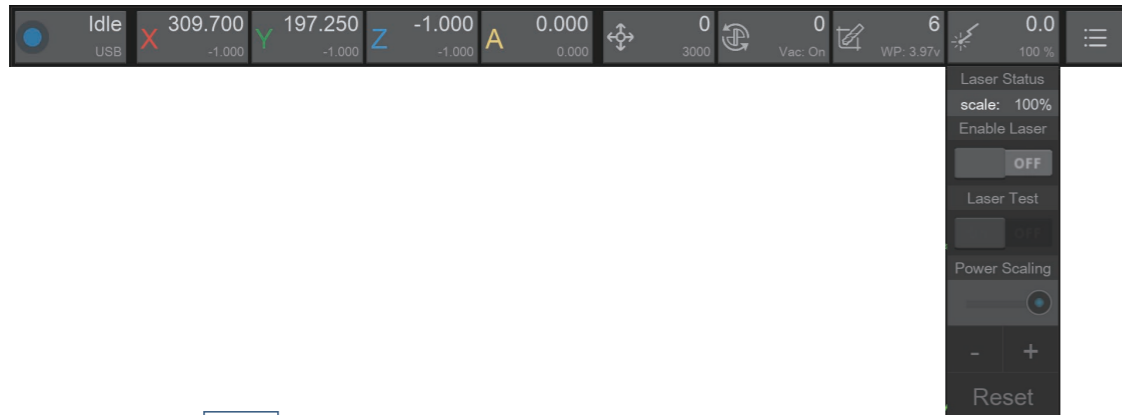
5.4.2. Change tool: Change to the selected tool or wireless probe, and perform automatic calibration.

5.4.3. Calibrate tool: Automatically calibrate the current tool and set TLO.

5.4.4. Drop tool: Drop the current tool.

5.4.5. Set tool: Manually set the current tool number. Only use when the tool number is wrong.

6. Laser status and control



6.1. Symbol: Laser icon



6.2. Main data: Current laser rate

6.3. Sub-data: Laser power scale

6.4. Drop-down list:

6.4.1. Laser Status: Laser power scale

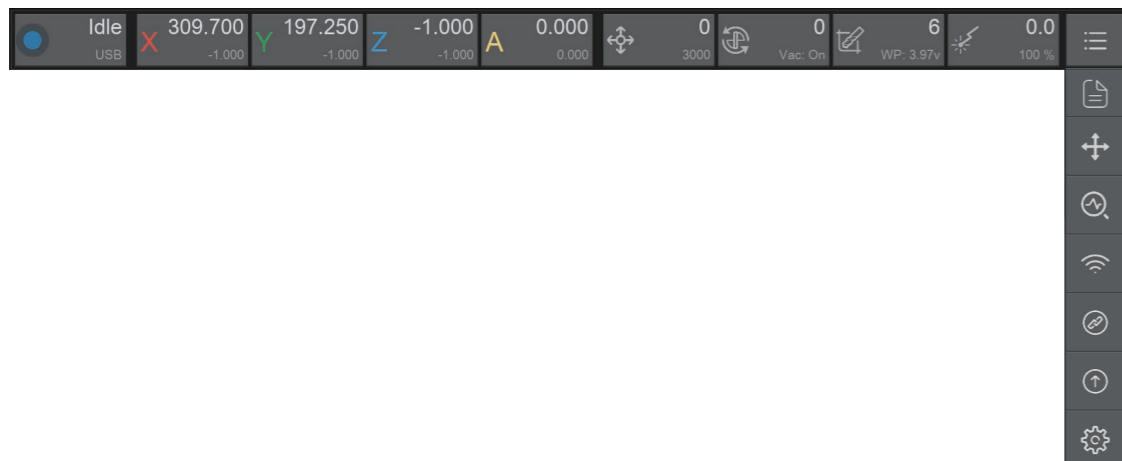
6.4.2. Enable Laser: Switch to laser mode. The working coordinates will be automatically updated according to the preset offset. If there is a tool on the current spindle, Carvera will drop it first and calibrate again to check the laser head's height.

6.4.3. Laser Test: Performing a laser test after turn on the laser mode will trigger a low-power laser beam for focus calibration.

6.4.4. Power Scaling: Set the laser power range by percentage. For safety reasons, the adjustment amount range is limited from 50% to 200%.

Note: Carvera has already set the coordinate offset of the laser before delivery, only reset it when the coordinates deviate. We will add relevant tutorials in the online instructions.

7. Other functions



7.1. Manual control: Same function as the arrow button on the right side of the interface. Switch to display manual control interface and file preview interface .

7.2. Device status diagnose: Check and your Carvera in detail and debug. No need to use it when Carvera runs in good condition. We will add a tutorial in the formal version of the instruction manual.

7.3. WiFi configuration: Refer to the previous WiFi setting instruction in chapter 4.

7.4. Wireless Probe Pairing: See the next chapter for detailed information.

7.5. Software Upgrade:

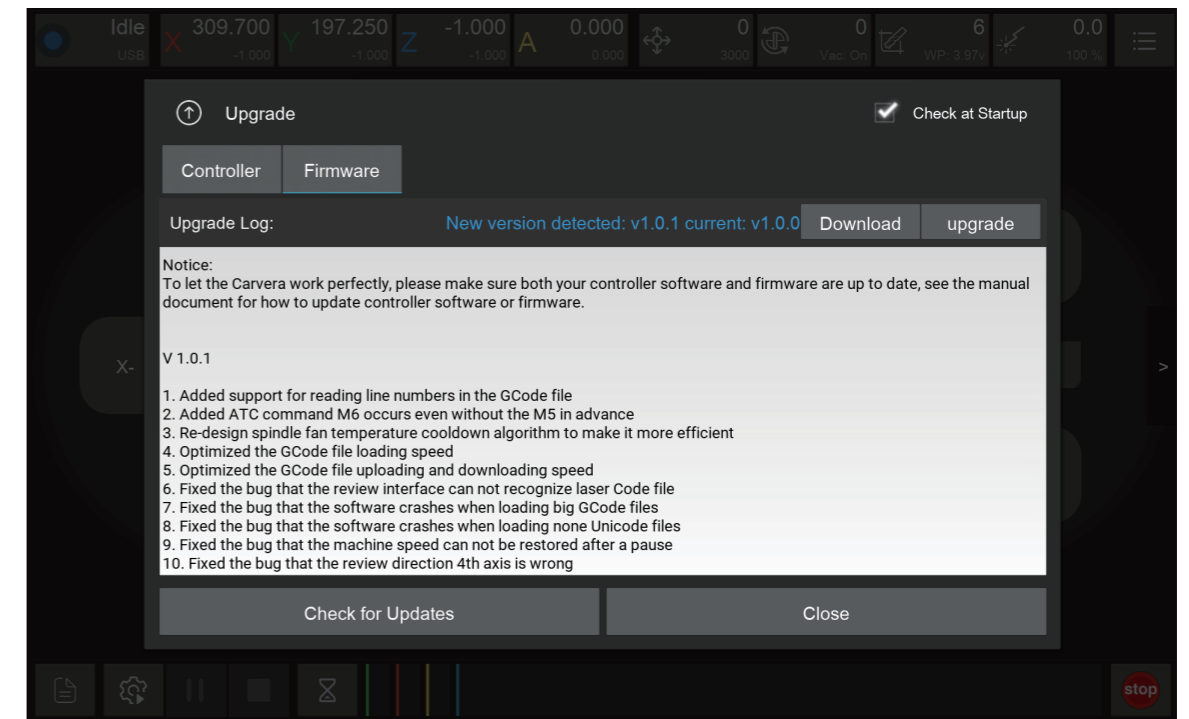
7.5.1. Controller: Controll software upgrade

7.5.2. Firmware: Firmware upgrade

7.5.3. Download: Link to the download page

7.5.4. Upgrade: For control software, just install the new version and you are ready to use. For firmware, you need to upload it to the machine using the control software

7.5.5. Check at Startup: Check software updates and notice at the startup



8.1. Parameters settings:

8.1.1. Basic parameters: Adjust functional parameters by requirements.

8.1.2. Advanced parameters: System-level of the machine. All set in the factory generally does not need to be changed. Do not change it unless it has to.

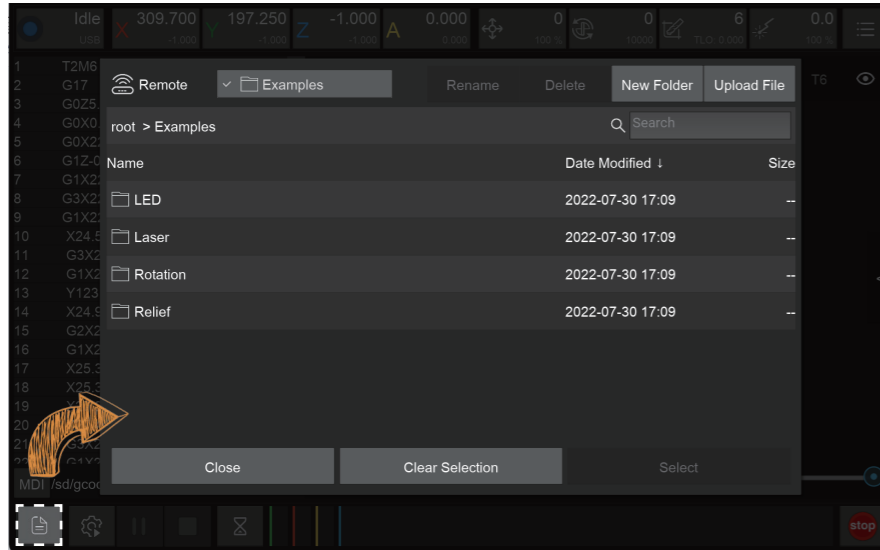
8.1.3. Restore setting: Restore factory setting, or save current setting as factory setting.

Note: You need to click the Apply button to save all parameters after changing them and rebooting the machine to apply changes. Parameter introduction and recommended settings are provided in the parameter list. We will add more detailed parameter introductions and setting suggestions in the online instruction manual.

Task Toolbar

1. File management and selection

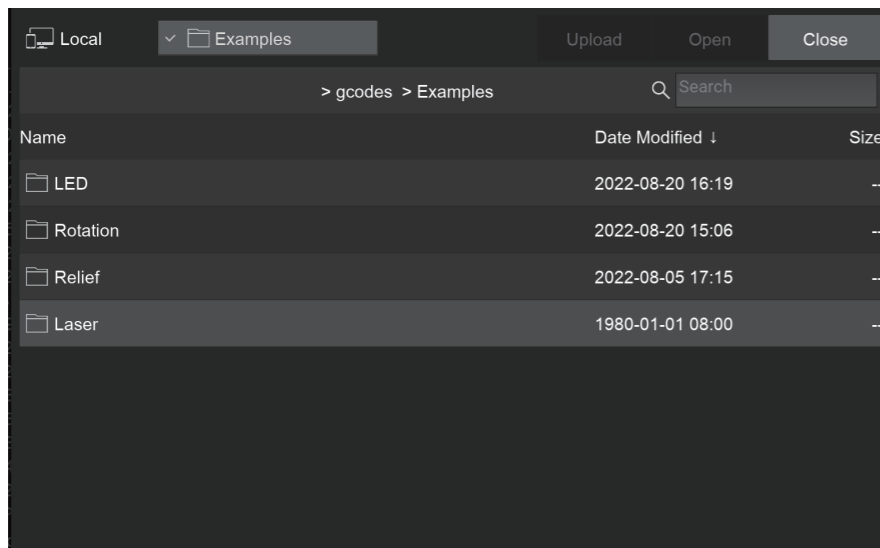
Carvera's G-Code is executed in the controller to ensure the task's efficiency and stability and avoid task failures caused by WiFi or USB connection instability. Therefore, the G-Code file needs to be uploaded to the machine before running the program. We have created examples folder on the machine and have already uploaded sample G-Code files.



1.1. Remote file management:

- 1.1.1. Rename: Rename files or folders in the machine.
- 1.1.2. Delete: Delete files or folders in the machine.
- 1.1.3. New Folder: Create a new folder under the current file path.
- 1.1.4. Upload File: Switch to local file interface for uploading.
- 1.1.5. Close: Close the file management interface.
- 1.1.6. Clear Selection: Clear the currently selected G code file.
- 1.1.7. Select files: Select the G-Code file to run.
- 1.1.8. Recent Places: Short cut for recently used directories.

1.2. Local file browsing:



It opens the gcodes subdirectory under the local program installation directory by default. Therefore, we recommend putting your G-Code files here for easy management.

Upload: Select and upload local files.

Open: Open the file and preview it without uploading it (you can also do this without connecting the Carvera).

Close: Back to the remote file management interface.

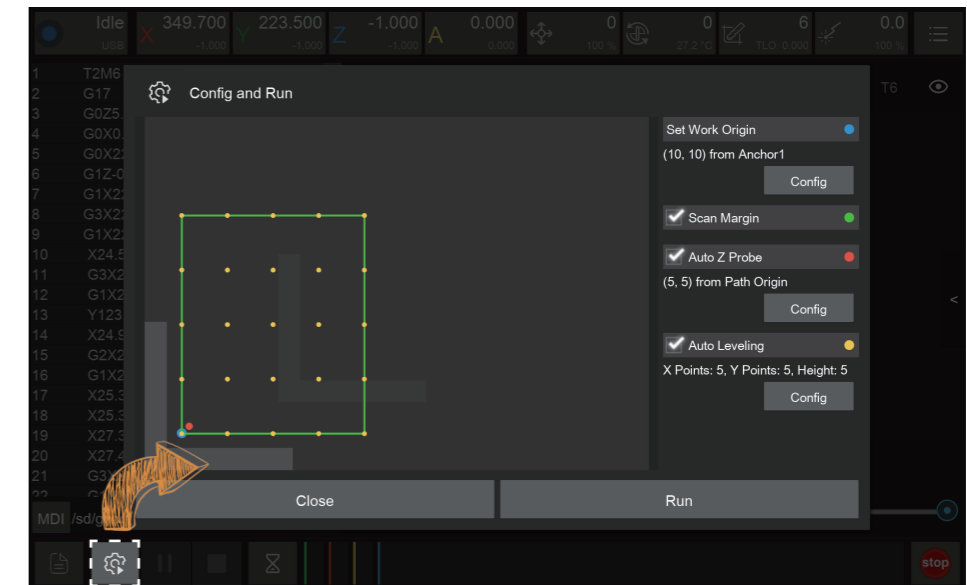
Recent Places: Short cut for recently used directories.

2. Task configuration and execution

If you have used CNC before, you definitely know that a CNC machining task requires a lot of preparation work, including setting the work coordinates (XY axis tool setting), Z-axis tool setting, workpiece levelling (PCB processing) and so on.

Because Carvera has automatic detection and leveling functions, we have integrated these settings and task execution into one interface.

We provide an innovative method that using "anchor points" for work coordinate setting, allowing you to locate XY-axis positions accurately through easy configuration.



2.1. Machining area preview: Display the preview of the machining area according to the current work coordinates and G-Code file.

L-shaped gray symbol: Anchor point position. You can choose to install the L-shaped bracket to be located either to point 1 or point 2.

Blue Circle: Zero position of work coordinate.

Green line area: G-Code file machining range.

Green Bold line area: Indicates that Scan Margin is activated to automatically scan the area before machining.

Red Circle: Z probe position when Auto Z Probe is selected.

Yellow Circle matrix: Levelling matrix when Auto Levelling is selected.

2.2. Set Work Origin: Set the work coordinates zero point relative to anchor points - the X/Y axis distance relative to anchor point 1 or 2. (Only X distance is needed when performing 4-Axis machining). Please note that the work coordinate settings will take effect immediately.

2.3. Scan Margin: Scan the rectangle path area before machining. When scanning, machine will switch to the wireless probe and turn on the red laser for observation. We recommend new users turn on this while running job.

2.4. Auto Z Probe: Z-axis tool setting is required after changing the workpiece or the zero points of the work coordinate. When doing Z probe, machine will automatically switch to the wireless probe and do probe at the set position.

Work Origin: Perform Z axis probe at a certain distance related to the X/Y axis of the working coordinate zero point.

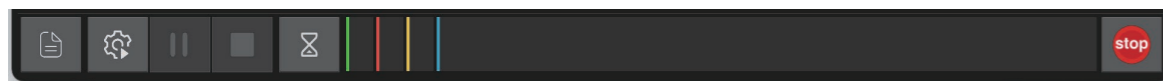
Path Origin: Perform Z axis probe at a certain distance related to the actual X/Y machining starting point (lower left corner). This method is selected by default.


2.5. Auto Leveling: If requiring uniform machining depth, please select the automatic leveling option such as PCB engraving. You can set the leveling matrix size and the lifting height when moving horizontally during the leveling process. The less the flatness, the higher the lifting height needs to be. The higher the requirement for machining consistency, the denser the matrix. For PCB engraving, it is better to have matrix dots spaced about 1 cm apart.

2.6. Run: Click to start machining process. If you set the scanning area, Z-axis tool setting or automatic leveling, the G-Code file will be executed after the automatic detection is completed.


Note: The wireless probe is a precise device that integrates mechanics and electronics, which is easy to damage. Please be careful when using it. Make sure no obstacles can block its way. We suggest new users turn on the scan margin function to preview the route. It is recommended to leave sufficient margin between L bracket position and path start point, greater or equal to 10/10mm.


3、Task control




3.1. Task pause: Pause the running G-Code task and you can manually control the machine afterwards. But if you want to resume the task, please remember to turn on the spindle, or it may damage the tool if it resumes without rotating the spindle. 

3.2. Task stop: Terminate the current G-Code task. 

3.3. Task hold: Similar to task pause, but the pause speed is faster and cannot control the machine manually during holding. 

3.4. Task track: Display the current G-Code task name, running time, percentage and other information. 

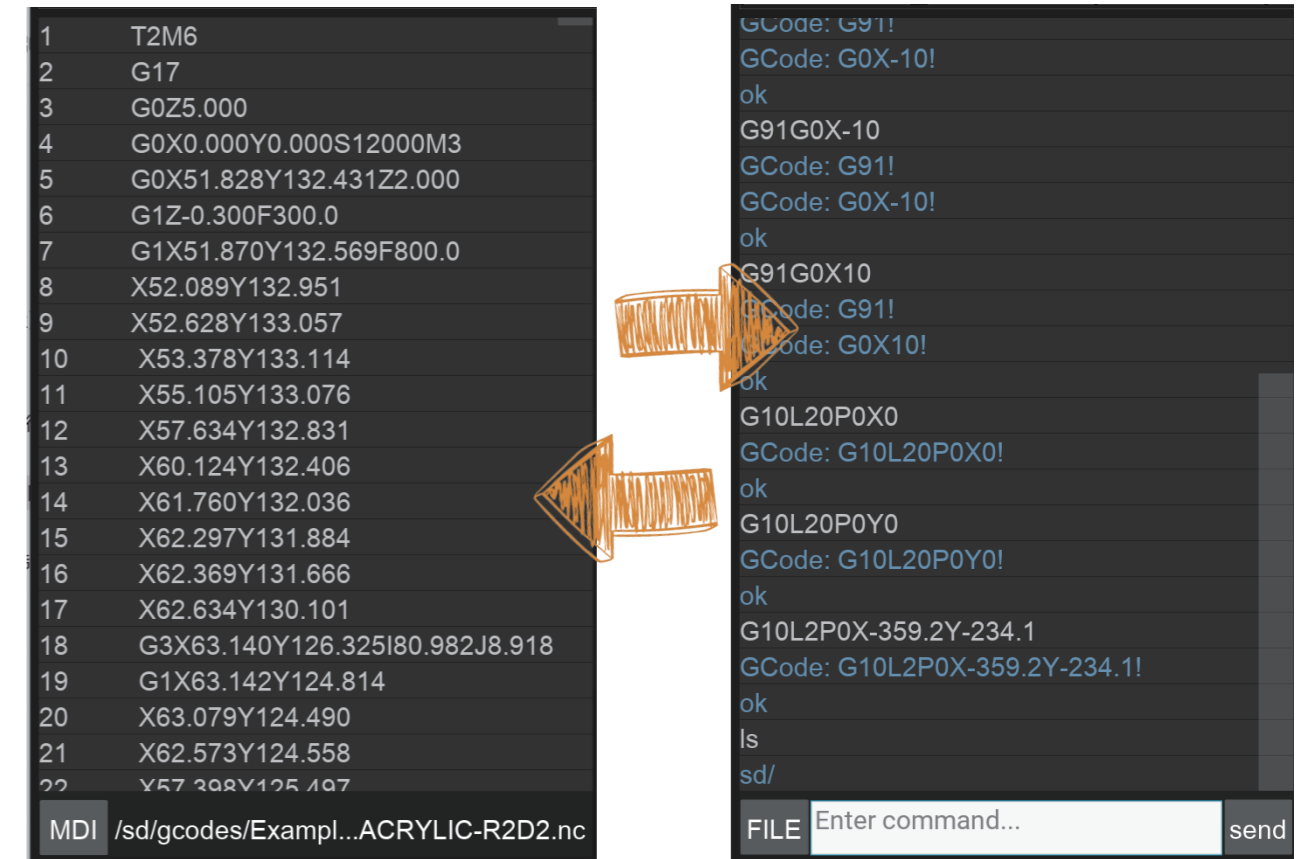
3.5. Emergency stop: Immediately stops the current task, turn off the spindle, the same function as the physical button in front the machine. 

Note: The current task cannot be stopped immediately when the task is paused or held. It has to wait for the buffer zone finish. If emergency occurs that needs to stop the machine immediately, please click the emergency stop button in the software or press the physical emergency stop button on the front panel of the machine. Carvera is built by closed-loop servo motors, and it saves the coordinate and status at each step. Therefore, no needs to reset the tool after reboot/unlock.

G-Code/MDI

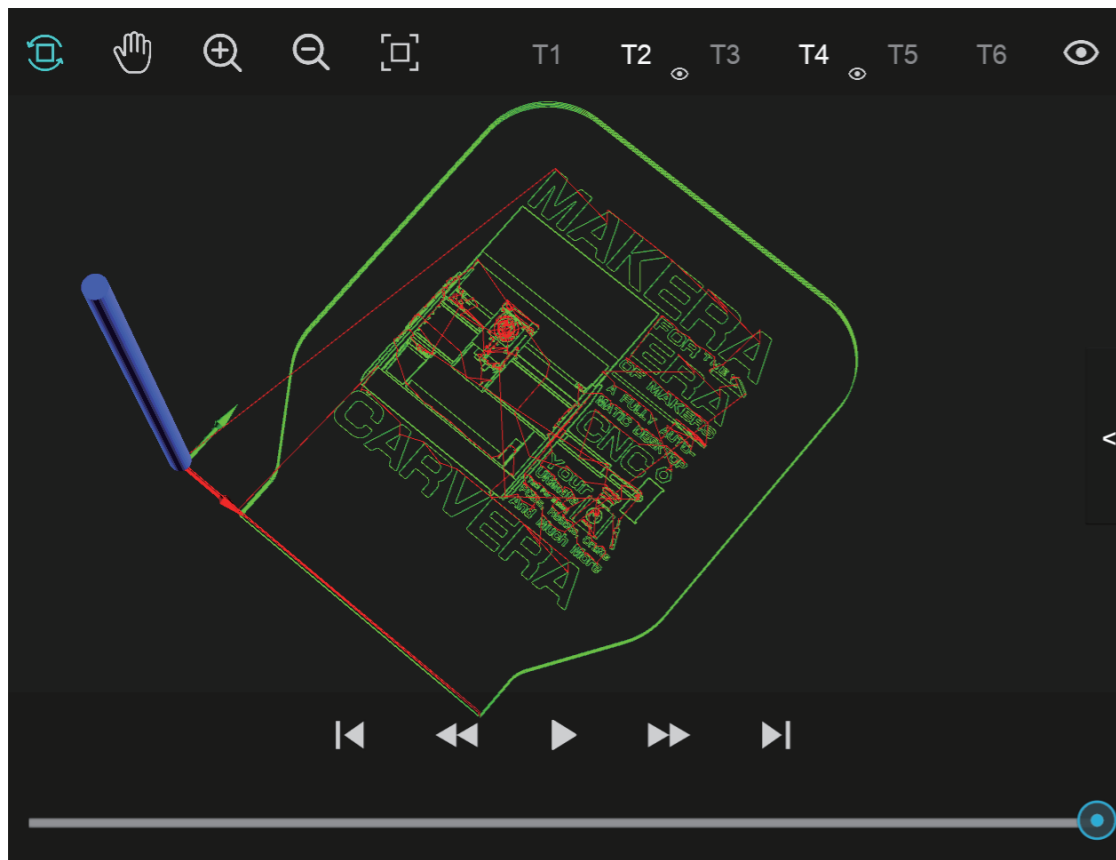
1. G-Code interface: Display the currently opened remote or local G-Code file. When the task is running, it will track and highlight the running line in real-time.

2. MDI: Display detailed send/receive commands, similar to the log information. In specific cases, you can manually enter the g-code for operation and diagnosis. Enter "clear" to clear the current command area.



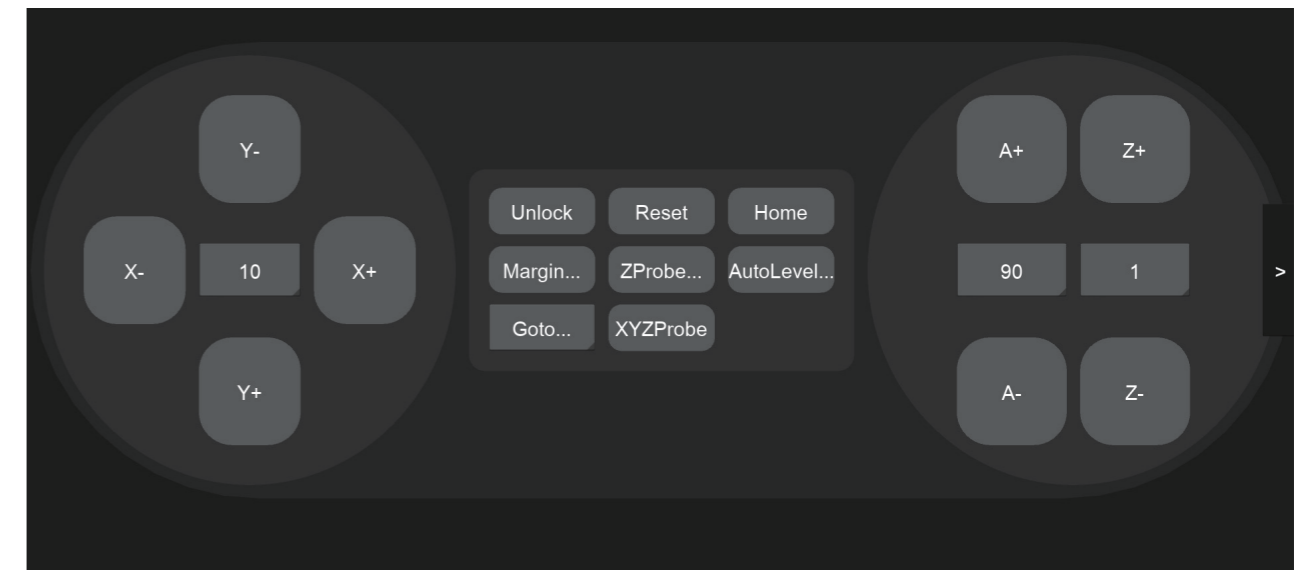
G-Code Preview

1. Graphical preview: Open the G code file to preview the G code graphics in the tool path preview area. Green lines are G1/G2/G3 code, and red lines are fast moving G0 code.
2. Display control toolbar: You can pan (right mouse button), rotate (left mouse button), zoom in (scroll wheel up), zoom out (scroll wheel down), and restore the preview (double-click) . You can also select to show/hide the G-Codes for for different tools.
3. Playback toolbar: When the task is not running, you can play, fast forward, or backward the preview. When the task is running, the preview graph shows the real-time machining trace.



Manual Operation

1. Jogging control: Manually control the movement of the X/Y/Z axis and rotate the A axis at G0 fast speed (3000mm/min by default). You can set movement distance. The
2. Status control: You can unlock, reboot or reset the device.
3. Automatic detection: Automatically scan the machining area; perform Z-axis probe or automatic leveling. The difference between here and the task configuration is that you can just apply one-time detection, without executing the G code file.
4. Move to the specified location: Provide a shortcut to quickly move to the specific location; including anchor points 1, 2, working zero points, G-code starting point, and clearance point (the upper right corner next to the machine zero points by default). You can quickly move the machine to there before cleaning the working surface after machining process end).
5. XYZ Probe: Use the manual probe to do x/y/z axis probing. See detailed introductions in the next chapter.



Errors

The device triggers an alarm when encountering an abnormal. Some alarms can be closed by unlocking. Some require rebooting the machine.

Alarm Type	Reboot	Causes
Halt Manually	No	Press emergency button on the machine or software
Home Fail	No	The return zero limit switch did not trigger
Probe Fail	No	Exceeded the maximum detection distance but has no signal
Calibrate Fail	No	Tool calibration probe malfunction
ATC Home Fail	No	Return zero limit switch failure
ATC invalid tool number	No	Unsupported tool number
ATC Drop Tool Fail	No	Unsuccessfully drop the milling cutter
ATC Position Occupied	No	The position for tools is occupied
Spindle Overheated	No	Spindle overheating
Cover opened	No	The protective cover is opened during machining (cover detection enabled)
Wireless Probe Error	No	No response from the wireless probe
Emergency Stop	No	Emergency stop is pressed
Hard Limit Triggered	Yes	Motion out of range
X/Y/Z Motor Error	Yes	X/Y/Z Servo motor block
Spindle Error	Yes	Spindle stall or other errors
SD card Error	Yes	SD card reading error
Machine Is Sleeping	Yes	Machine is sleeping

General Steps

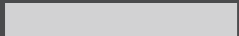
Different from the cumbersome operation process of general CNC, Carvera greatly simplifies the machining process. The general operation steps are as follows:

1. Turn on the Carvera device and wait for the homing to end.
2. Fix the workpiece to the anchor point.
3. Place the tools.
4. Open the control software and connect to the device.
5. Upload and open the G-Code file.
6. Open the task setting box, set the working zero point and automatic detection rules.
7. Start and wait until the machining process ends.

Note: After completing the sample case, you will understand how smooth the machining process is when using the Carvera.



Tool Kit Instruction



Wireless Probe

1. Charging: The wireless probe needs to be charged when it is used for the first time or after the machine has not been used for a long time (more than a week). The wireless probe will automatically start charging after turn on the machine. The charging indicator yellow light will be on and go out when it is full. You may start using it after the voltage reach 3.7v, no need to wait for full charge.

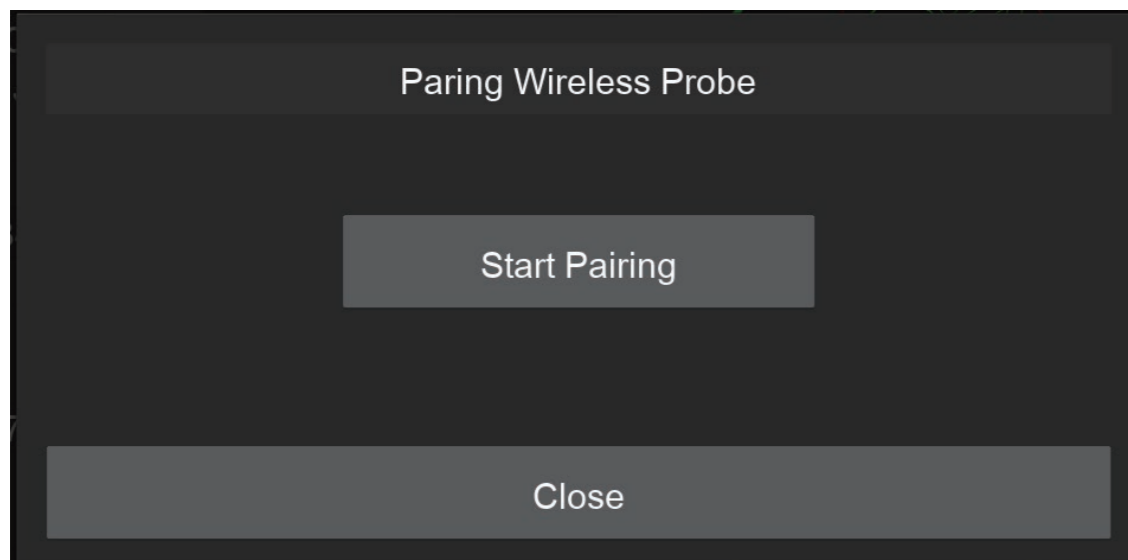


2. Probing: When the wireless probe is triggered, the green indicator light turns on.

3. Laser indicator: Press the wireless probe twice to turn on the laser indicator (used for manual tool setting of the XY axis). The laser indicator will also be turned on automatically when scanning the path area.

4. Pairing: The wireless probe that comes with the machine has already been paired to the machine by default, you can use it directly. For optional backup wireless probes, you need to pair it first:

4.1. Open the pairing wireless probe popup window in the control software.



4.2. Click the "Start Pairing" button, and the machine will enter pairing mode. (You have 30 seconds to finish the pairing, need to do it again in case time is out)

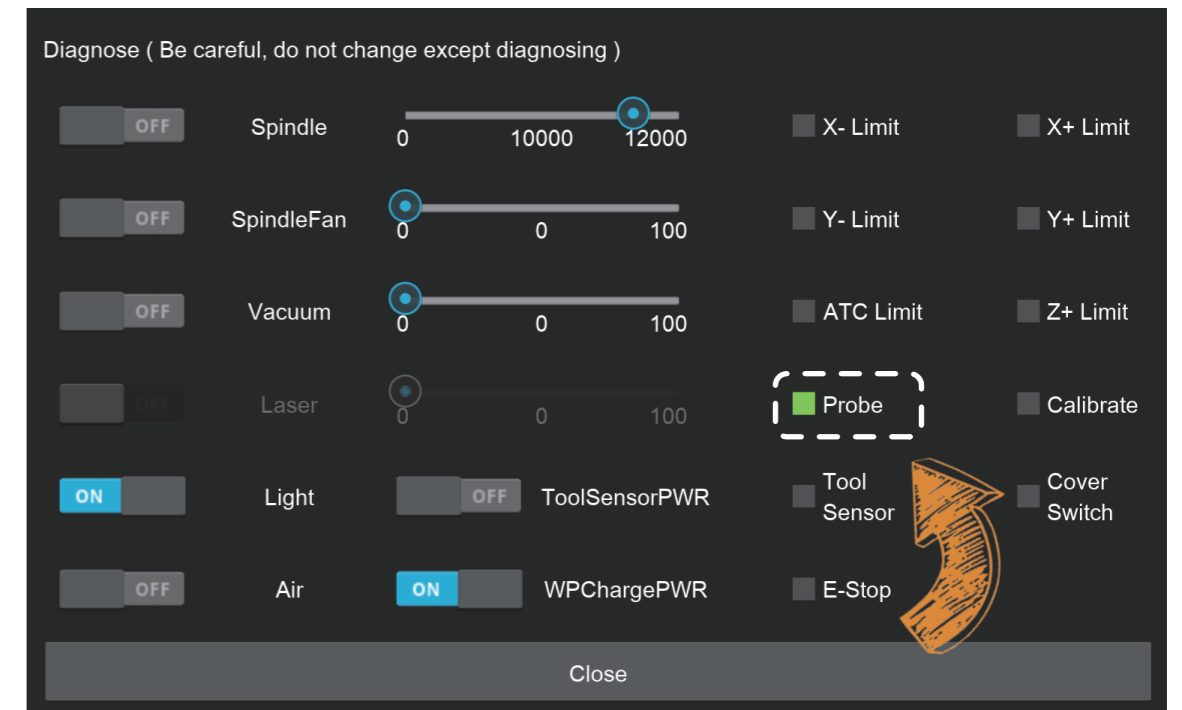
4.3. Trigger the wireless probe for around 10 seconds until the green LED start to blink quickly, which means the wireless probe enters pairing mode.

4.4. If pairing succeeds, the green LED will blink 5 times slowly.

4.5. If pairing fails, the LED will be switched off. Please do it again.

4.6. You can go to diagnose the window to check if the wireless probe was paired successfully.

5. Test: Open the drop-down list in status toolbar and select the diagnostic function, the diagnostic status dialog box will pop up. Press the wireless probe and you can see the Probe signal is triggered, indicating the wireless probe is working.



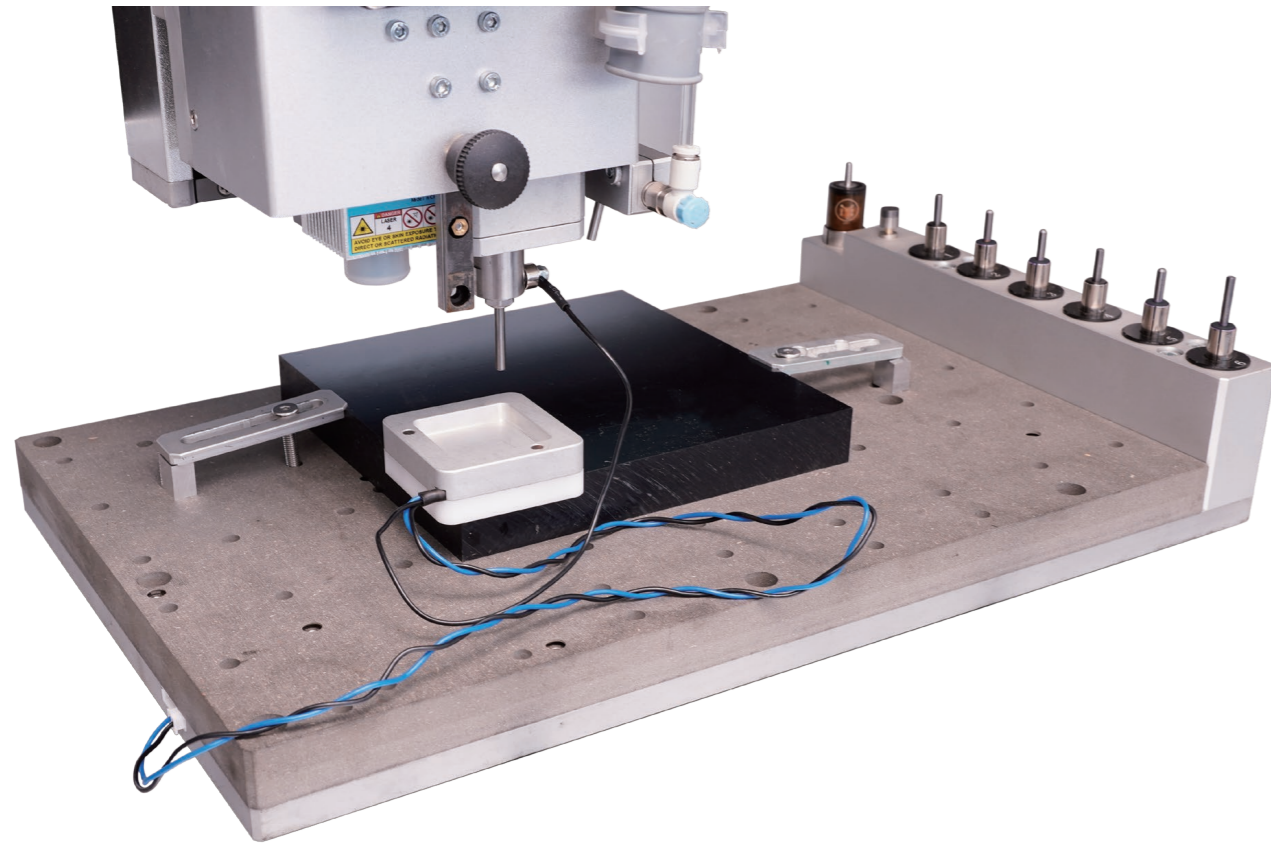
Note: Unlike crash of milling bits, the crash of wireless probe may cause serious damage to the probe. Please use the wireless probe with caution. Always observe its traveling path, and stop the machine when finding any obstacles to protect the wireless probe.

Manual Probe

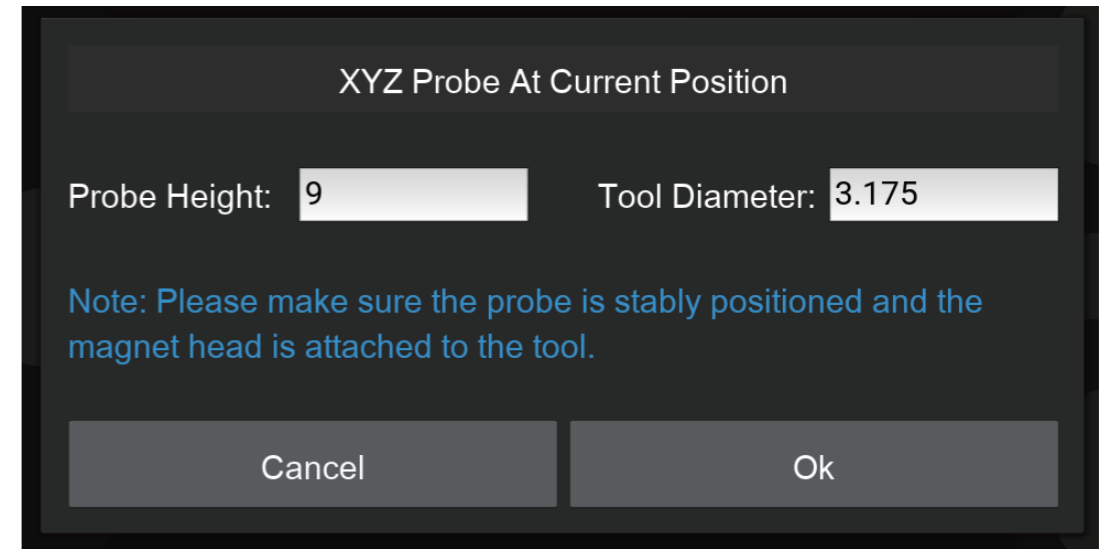
Use case: Normally, using the wireless probe and the anchor-based positioning system is quite enough for most jobs. But when you need to place the workpiece not at the anchor point and need to accurately find the origin, you can use the manual probe.

Usage:

1. Plug the manual probe into the 2-pin socket on the left side of the machine bed.



2. Place the manual probe (white plastic side) against the lower left corner of the workpiece firmly.
3. Move the machine and let the milling bit be positioned in the square area of the manual probe.
4. Attach the magnetic end of the manual probe to the spindle shaft as shown.
5. Click the "XYZ Probe" function, and set the height offset and the diameter of the milling bit. (It is recommended to use the 3.175mm diameter test rod we provided for probing so that the default parameters can be applied directly)



6. Click OK to start the probing process.

Note: Tip: The manual probe process will automatically set the origin of X, Y, and Z axes. There is no need to set them again.

Emergency Stop Button

Just like the main button in front of the Carvera machine, when any unexpected situation occurs, you can quickly press the emergency stop button to stop the machine, and the machine will stop immediately and enter the alarm state. You need to go to the control software to unlock the machine before continuing to use it. The emergency stop button has a self-locking function, just turn the emergency stop button clockwise to unlock it.



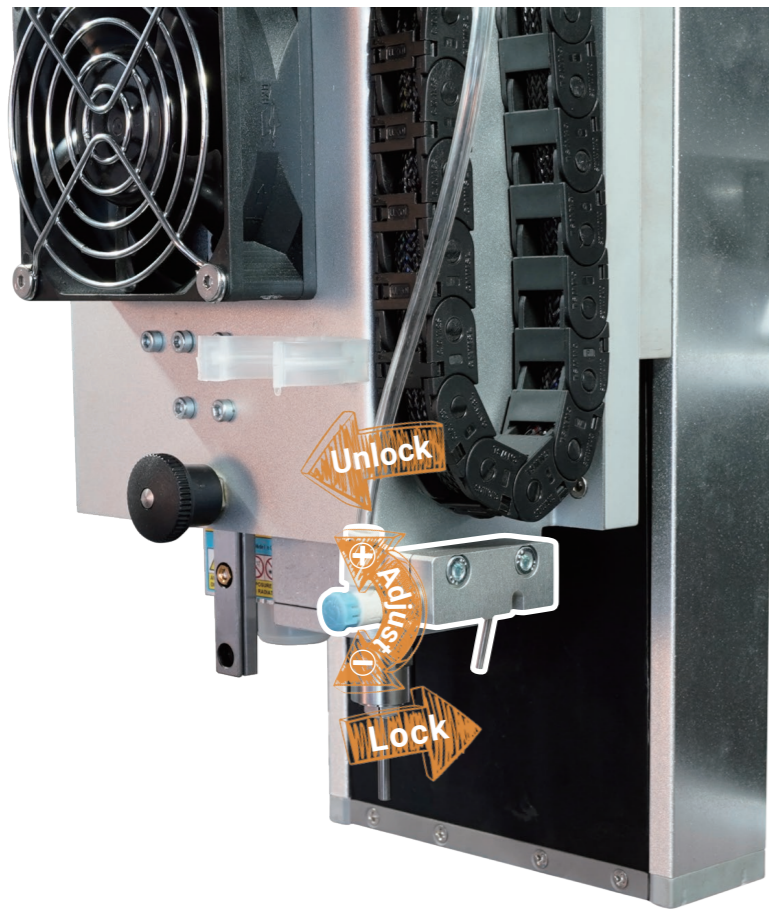
Air Assist Module

Use case: There are two main use cases for the air assist module. One is for chip removal and cooling during CNC machining, especially when machining metal materials. The second is to prevent the material from burning during laser engraving to improve the engraving quality.

Installation: An normal small air pump is more than enough for the Carvera air assist module, insert the 8 mm pipe into the plug at the back of the machine, and ensure that the air pipe is firmly fixed.

Air control:

1. Use GCode commands M7 and M9 to control the opening and closing of the main air switch.
2. Adjust the blue knob at the end of the air assist module to control the airflow, pull the knob to adjust, and press the blue knob to lock. Turn the knob clockwise to decrease the flow and counterclockwise to increase the flow.

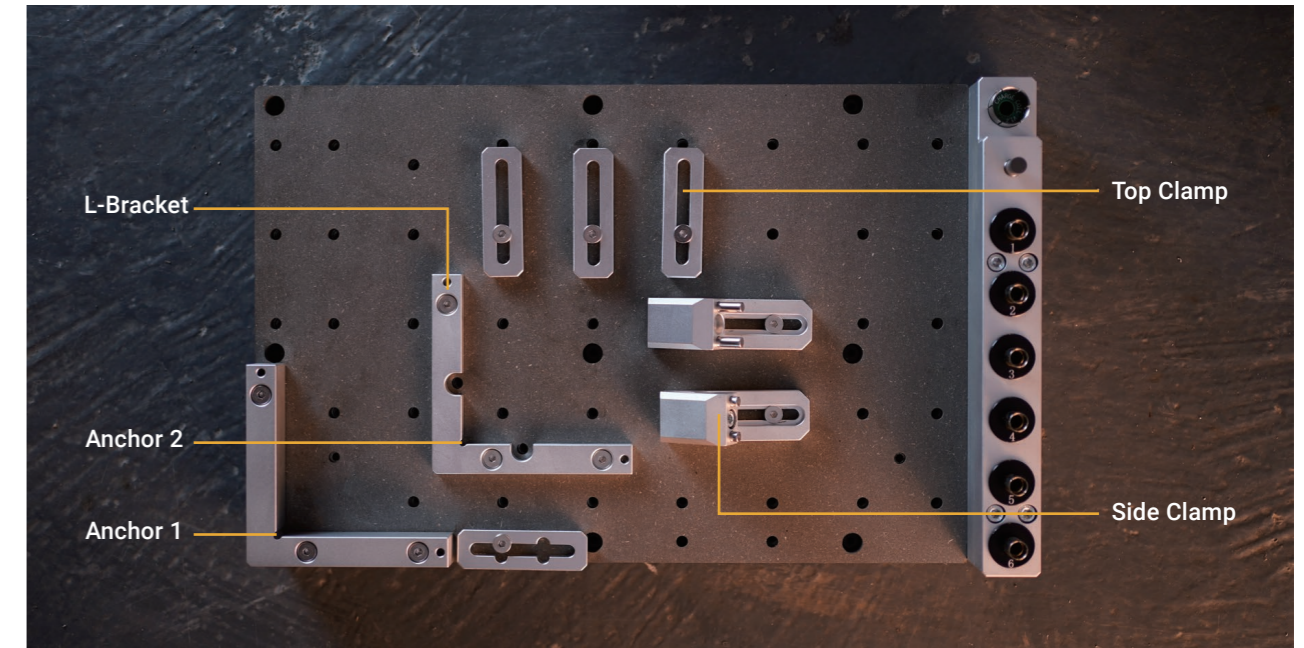


3. The angle of the air nozzle can be adjusted to match different tool lengths and laser focus position.

Note: The air assist module and the dust collection module cannot work at the same time, so remove the dust shoe and turn off the automatic dust collection before using the air assist module. When the air assist module is not used for a long time, please turn off the air pump. Be careful that the air nozzle does not interfere with the dust shoe and auto tool changer mechanism.

Workholding Tools

Workholding is one of the most important steps when using a CNC machine. Carvera provides two different workholding methods and corresponding tools to adapt to different types, shapes, sizes of workpieces. While holding the workpiece, you can also locate the workpiece to the pre-defined position accurately by using Carvera's anchor based system.



1. L-Brackets: Carvera provides two types of L-shaped brackets, a thin one and a thick one, as shown in the figure. The L-Bracket can be fixed at one of the two anchor points with two 4mm dowel pins and three M5 screws(thick bracket uses long screws). The lower left corner is anchor 1, and the middle position is anchor 2. There are two semi-circular openings of the thin positioner, you can put two M5 screws to fix the lower-left corner of the workpiece there.

2. Top Clamps: The top clamp usually fixes the workpiece with a thickness of less than 2 cm together with the thin L-Bracket. The purpose of the top clamp with a cross groove is to facilitate the use of long sides to fix the workpiece. We recommend using shims at the end of top clamps to fix workpieces greater than 1 cm.

3. Side Clamps: The side clamp is usually work with the thick L-Bracket together to fix the workpiece with a thickness greater than 2 cm. The side clamp can also be used with the top clamp to fix a thin workpiece to process the surface, as shown in the figure.

Note: The top clamp is not very thick, so please do not screw too tight.

Note: If you need to cut through a workpiece, we highly recommend placing a 1-2mm thick waste board (as the complimentary one) under the workpiece. This can avoid damage to the workbench.

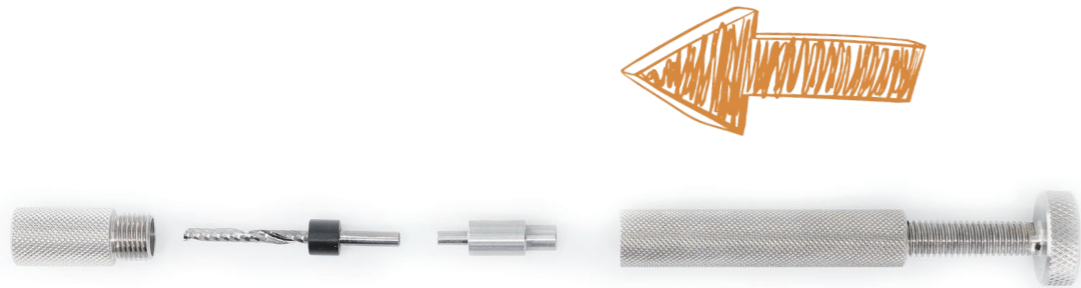
Note: Please select corresponding length screws to fix different workpieces, you do not want to scratch the plate under workbench.

Bit Collar Installer

To cooperate with Carvera's auto tool changing mechanism, you need to use the collar installer to install the collar when replacing new milling bits. The collar installer can do both installation and removal. (the collar is reusable).



Collar installation: As shown in the figure, unscrew the front part of the installer. Insert the collar and the tool. Put in the installation metal ring (support 3.175/4/6/6.35mm). Loosen the tail pressure screw, screw back the front part, and tighten the tail pressure screw to complete the installation. After the installation is complete, the collar will be embedded with the tool, leaving a length of about 12mm at the tail for clamping.



Collar removal: As shown in the figure, unscrew the front part of the installer, put the tool with the collar. Put in the removal thimble, loosen the tail pressure screw, screw back the front part, tighten the tail pressure screw, and the removal is complete.

Note: The milling bits are sharp, be careful when install and uninstall collars.

Dust Collection Module

Chip evacuation is an important part of CNC but is usually ignored by other desktop-level CNC machines. Carvera has a built-in dust collecting and filtering system that can literally achieve dust-free machining process when doing light weight task and highly reduce the mess level when doing long time jobs .

1. Use case: The key factor in deciding whether to use the dust collection system is the interference situation. If the machining path has obstacles that block the dust shoe, do not use it. Generally, the dust collection could be used for machining thin and flat workpieces, such as plates. We suggest moving and locking the dust shoe to the highest position when machining thick and irregular work-pieces. And remove the dust shoe entirely when using the 4th axis.



2. Lock/Unlock: To fit Carvera's automatic tool change function, we designed the dust shoe to be able to slide up and down. As described earlier in the manual, pull out the black knob, and you can switch between lock and unlock states by rotating it every 30 degrees.

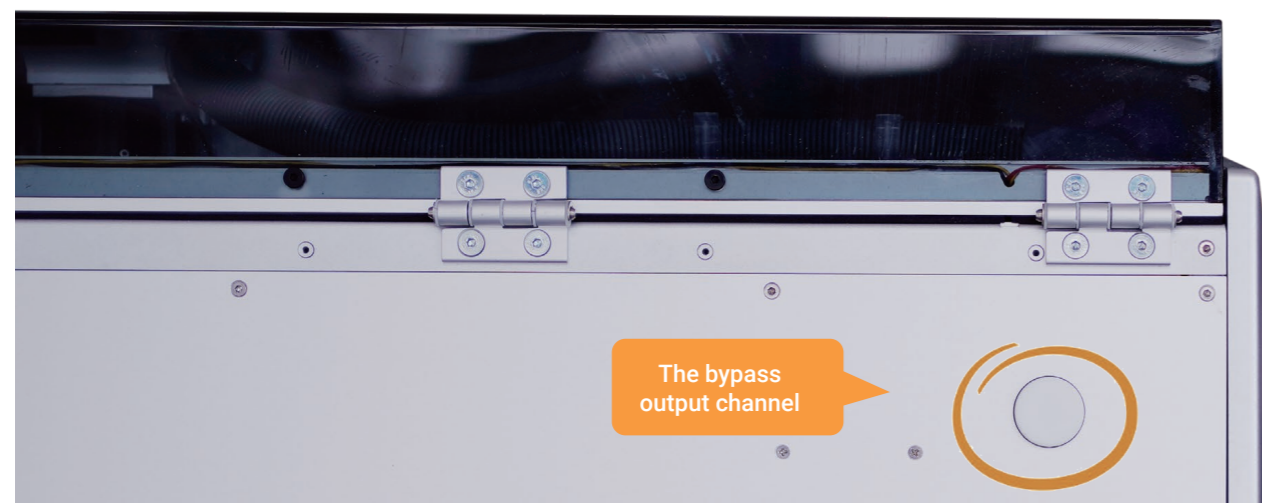
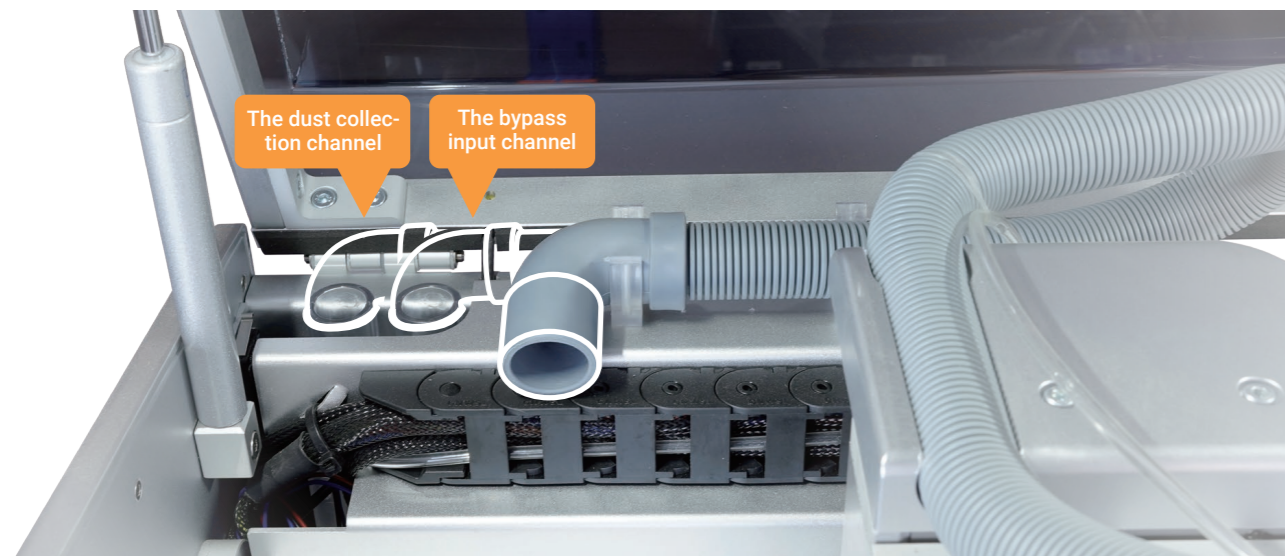
3. Install/uninstall: When dust collection is not needed, you can move the dust shoe to the highest position and lock it, or you can loose the hand screw that fixes the dust shoe to the linear rail and remove the dust shoe. Use the pipe holder as shown in the figure to fix the dust pipe.

4. Dust bin: Clean the dust bin in time when the milling job is done.

5. Dust bypass: The built-in dust collection system is not very powerful and the capacity of the dust bin is limited, the Carvera supports the bypass of dust to external dust collection devices such as a vacuum cleaner:

5.1. Switch the end of the dust pipe (L-shape) to the bypass input channel as shown.

5.2. Connect your vacuum cleaner to the bypass output channel on the back of the machine, the inner diameter is 22mm.



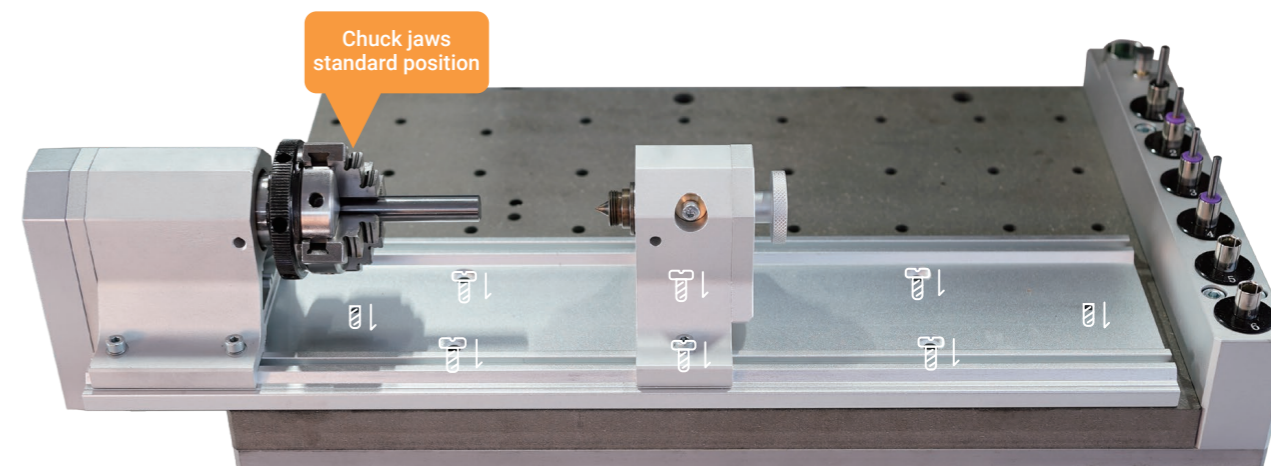
Note: Do not lock the dust shoe at the bottom to avoid affecting the automatic tool change function.

Note: The built-in vacuum power is limited, bring your own vacuum cleaner to clean.

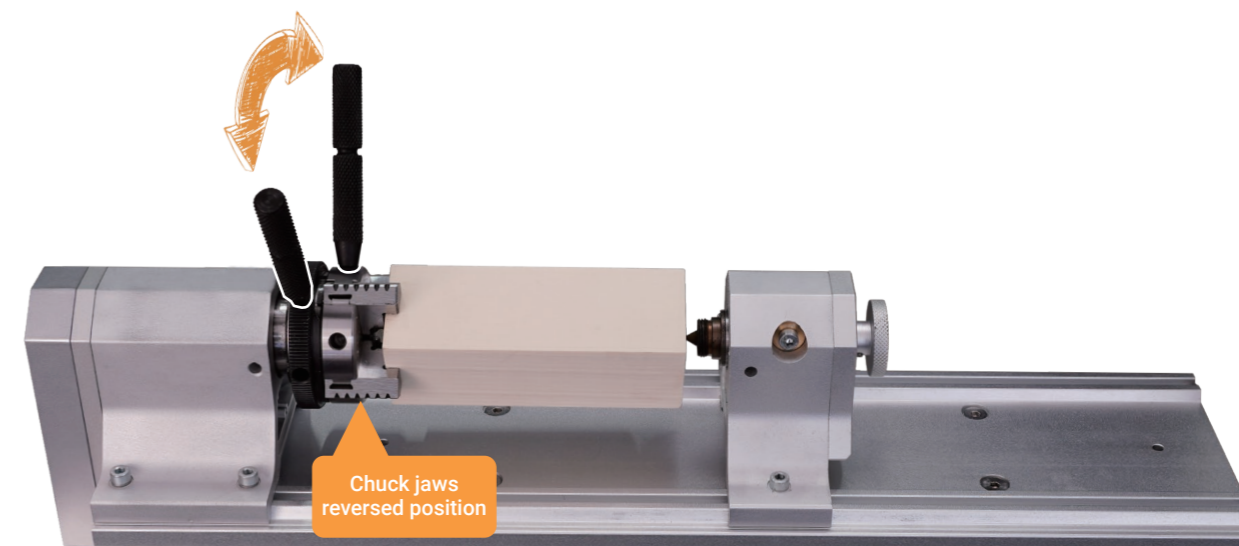
Note: When using 4th axis, remove the dust shoe and dust bin for interference free.

Rotary Module

1. Installation: As shown in the figure, fix the rotary module with two 4mm dowel pins and six M5*20 screws. Plug the motor cable into the 4 pin socket on the left side of machine bed. Please reboot the machine to enable the rotary module.

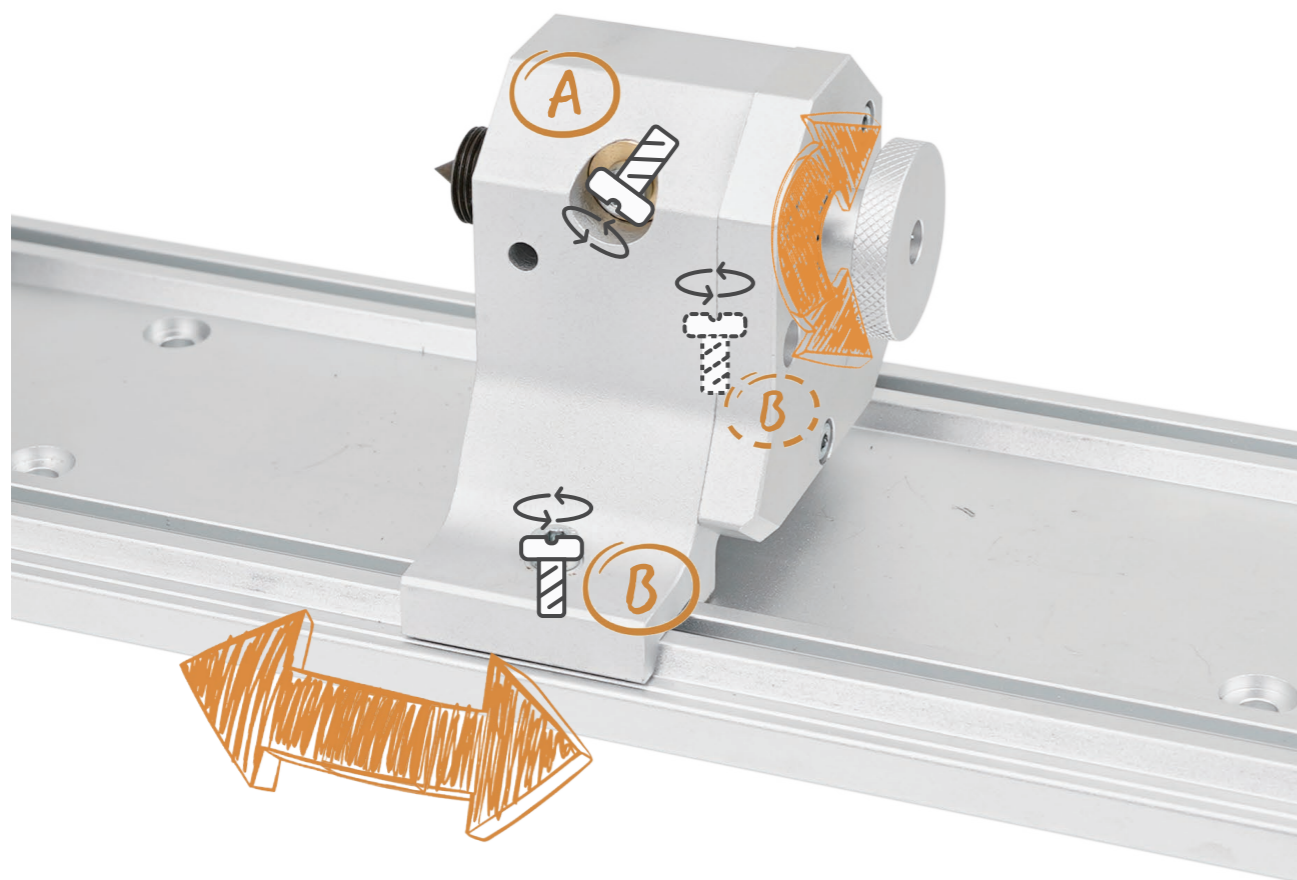


2. Chuck Jaws Assembly: As shown in the figure, there are two assembly positions. The standard position is suitable for small workpieces, and the reversed position is suitable for bigger-diameter workpieces. The default position is reversed to fit our 4th axis example. You can change it to standard according to your needs. The assembly order should refer to the '1, 2, 3, 4' numbers marked on the jaws.



3. Workpiece holding:

- 3.1. Loosen the locking screw at position A on the tail stock as shown in the figure, adjust the tail stock tip to the right side by turning the knob counterclockwise.
- 3.2. Loosen the 2 fixing screws at position B.
- 3.3. Use two wrenches to adjust the opening size of the chuck and place the workpiece in.
- 3.4. Align the tail stock tip to the end of the workpiece, and tighten the two fixing screws at position B.
(We highly recommend drilling a small hole at the end of the block tail for better holding strength, especially for hard materials.)
- 3.5. Use two wrenches to tighten the chuck, push the tail stock tip close to the workpiece by turning the knob clockwise, and lock the locking screw at position A. (Don't push too hard to the workpiece, it's ok when there is no gap and backlash, better drill a small hole first at the center of the workpiece tail for fixing.)



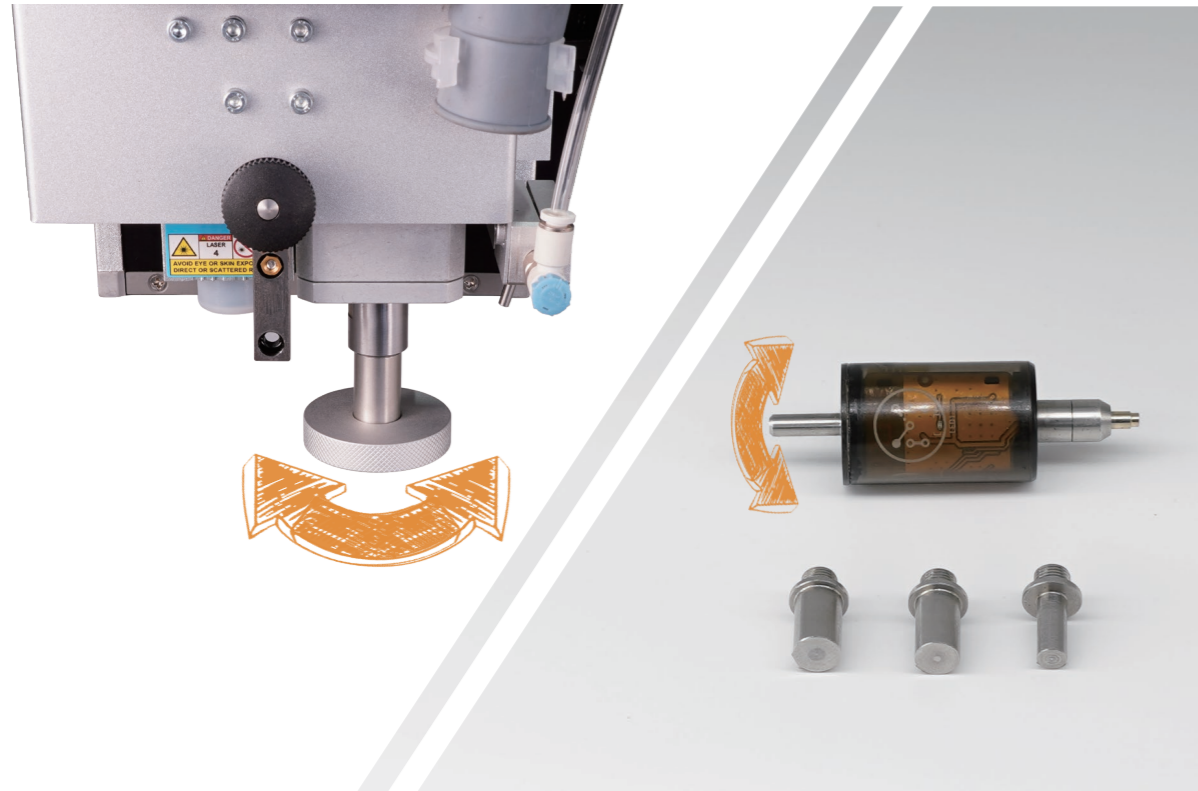
4. Software Settings: The right edge of the headstock is the reference point for setting the working coordinates of the rotary module. When performing rotary machining, you only need to set the distance between the X axis and the reference point and set Y to 0.



Note: Usually, you don't need to move the head stock, because the reference point on the head stock should be fixed for precise positioning. Ensure that the holding position/size/G-Code/work coordinate of the workpiece match with each other, otherwise it may cause damage to the module or tool bit.

Spindle Collet Installer

Carvera comes with a 1/8 inch(3.175mm) tool clamp. This is the common used size for desktop level CNC machines, which can meet most machining requirements. For special sizes such as 4mm/6mm/6.35mm, you can change the tool clamp and the tail shaft of the wireless probe.

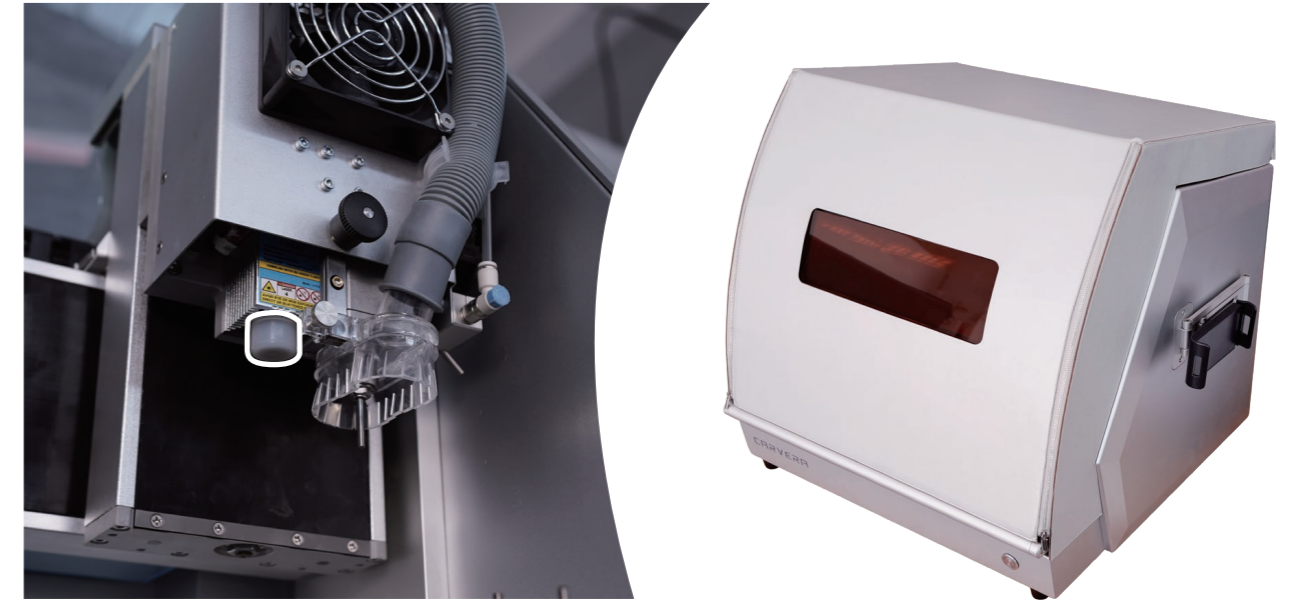


1. Change spindle collet: Use the control software to drop the current tool, insert the spindle collet installer into current collet, rotate counterclockwise to remove current collet. Use the same way to install the new collet.(don't tighten too much for future exchange)

2. Change tail shaft of wireless probe: Rotate the wireless probe's tail shaft counterclockwise to remove. Use the same method to change the new tail shaft.(don't tighten too much for future exchange)

Laser Module

The Carvera machine has a built-in 2.5W diode laser module, which can engrave wood, plastic, and other materials, an excellent complement to the CNC function. You don't need to adjust the focus or offset of the laser module by default because we have done that before leaving the factory. But if you encounter any problem with them, we will explain the detailed adjustment method in the specific tutorial on our website.



The Carvera machine has an optional laser protective cover which can greatly reduce the laser radiation. It's suitable for people who intend to use laser function a lot and operate at spaces where children or bystanders can reach easily. You can choose this accessory at our online store.

Note: A lens protective cover is installed by default. Make sure to remove it before using the laser function and install it back when not in use.

Note: To use the Carvera laser function, you must first enter the laser mode. The commands for entering and exiting the laser mode are: M321 and M322, please add them in the G code post-processing.

Note: Always wear laser protection goggles when using laser function.

CARVERA



Feed & Speed

The following recommended parameters are based on current tests. The machining speed with small diameter tools/hard materials should be slow and fast in the opposite. We will conduct more tests and provide more detailed parameter recommendations in the future on our website.

Material	Tools	Milling depth (mm)	Feed Speed (mm/min)	Plunge speed (mm/min)	Spindle speed (RPM)
PCB	V-bit	0.1	200-500	200	12000
Wood	Single flute spiral bit	0.5-2	500-1000	300	10000
Plastic	Single flute spiral bit	0.5-2	500-1000	300	10000
Carbon/ Glass fiber	Corn bit	0.3-0.5	500-1000	300	10000
Aluminum/ copper	Single flute spiral bit for metal	0.1-0.2	300-500	200	12000



Note: Please start the test from the lower limit of the parameter, and adjust them based on the test results.

CAM

1. Summary

Carvera adapt standard G-Codes and is compatible with the open-source GRBL rules. Therefore, when using CAM software, select GRBL or standard G-Code should be all right. For laser engraving, you need to add sentences in front of the G-Code to switch to laser mode (M321), and return to the laser Z focus point (G0Z0), and add (M322) to exist laser mode after finished.

2. Software recommendation:

The followings are the CAD/CAM software used in our examples. It is completely OK to use other CAM software you were already familiar with or would like to.

Fusion360: Three-dimensional mechanical parts machining.

CopperCAM: PCB milling.

DeskProto: STL format file three-axis / 4th-axis relief machining.

LightBurn: Laser engraving.

We will introduce the up to date information for software recommendations and post-processing methods in our online tutorial on the website. And we are also developing our own CAM software, and we look forward to introducing it to you as soon as possible.

Instruction Manual | www.makera.com | support@makera.com

