

# LV350D Plus Milling Machine Operator's Manual



[www.levil.com](http://www.levil.com)  
[techsupport@levil.com](mailto:techsupport@levil.com)  
**(407) 542-3971**

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## Introduction

This manual covers the safety, usage and maintenance of the tabletops CNC milling machines manufactured and sold by Levil Technology Corp.

Those who operate the machine should read and understand the rest of this manual in order to operate the machine efficiently, maintain a safe environment for themselves and others around, to avoid serious injury to oneself and damage/ loss of life of the machine.

## Safety

There are a number of safety facts the operator must know before operating the machine. Therefore the operator must read and understand every safety precaution needed in order to safely operate the machine.

Before approaching the machine, proper dress wear should be worn at all times such as safety glasses, toe steel boots, long pants and a shirt. Loose dress wear such as ties should be removed and shirts should be tucked in because they could get caught by a moving part and cause serious injury. Long hair has to be kept away from face and should be restrained by a hair tie and jewelry should be removed.

Before operating the machine, make sure there are no loose cables or components if visible. If a loose cable or component is detected, turn the main power off and disconnect the 110v cable from the machine before attempting to put the cable or component back to its designated position. If the operator is doubtful even for a second of where the cable or component should go, leave the machine alone and contact Levil support at [techsupport@levil.com](mailto:techsupport@levil.com) addressing the issue.

Do not turn switches on/off with wet hands.

When operating the machine, keep hands and any part of your body away from moving parts while the machine is working because it could get caught and result in serious injury.

If this is a wet machine, it could cause the floor around it to be wet and slippery. Make sure to keep the floor dry and clean.

Do not attempt to do jobs that go beyond the capabilities of the machine. This machine was designed to perform small jobs.

The operator should be knowledgeable about the material characteristics he is going to use before attempting to work with it.

The emergency button location should be well known so that it can be pushed easily during an emergency.

# Specifications

|                                  | Measurements  |   |
|----------------------------------|---|---|
|                                  | English   | Metric  |
| <b>General Specifications</b>    |   |   |
| Size                             | 20" L x 28" W x 30" H   | 510 x 710 x 750 mm  |
| Footprint                        | 20" x 28"   | 510 x 710 mm  |
| Machine Weight                   | 200 lbs   | 91 Kg   |
| Shipping Dimensions              | 32" x 34" x 26"   | 813 x 864 x 660 mm  |
| Work Capacities                  | Plastics, Woods, metals including steel                           |   |
| Maximum Weight on Table          | 180 lbs   | 81 kg   |
| <b>Table</b>                     |   |   |
| Table Size                       | 10" x 15"   | 250 x 380 mm  |
| Slots on Table, Qty.             | 5/16" 10 Slots  | 8 mm  |
| Table Travel X Axis              | 14"   | 350 mm  |
| Strusion                         | 7075 Anodized Aluminum  |   |
| <b>Spindle</b>                   |   |   |
| Motor HP Rating                  | 2 HP  | 2 HP  |
| Drive System                     | Direct Drive, Brushless Motor                                     | Direct Driven, Brushless Motor                                    |
| Minimum Speed                    | 100 RPM   | 100 RPM   |
| Maximum Speed                    | 17,000 RPM  | 17,000 RPM  |
| Quill Diameter                   | 0.787"  | 20 mm   |
| Spindle Bearings                 | Angular Contact Ceramic Bearings                                  | Angular Contact Ceramic Bearings                                  |
| Spindle to Column                | Not applicable  | Not applicable  |
| Spindle Taper                    | ER-16   | ER-16   |
| <b>Axis</b>                      |   |   |
| Guideways (X, Y, Z Axis)         | 0.6" Hiwin Linear guides  | 15 mm Hiwin Linear guides   |
| Travel X Axis                    | 14"   | 350 mm  |
| Travel Y Axis                    | 10"   | 250 mm  |
| Travel Z Axis                    | 8"  | 200 mm  |
| Ball Screws                      |   |   |
|                                  | Rolled Ball Screws w/ Backlash Adjustable Nuts                    | Rolled Ball Screws w/ Backlash Adjustable Nuts                    |
| Ball Screw Size (X, Y, Z Axis)   | 5/8"  | 16 mm   |
| Ball Screw Pitch                 | 0.197"  | 5 mm  |
| Rapid Traverse Speed             | 400 in/min  | 10 m/min  |
| Max Feed Rate                    | 236 in/min  | 6 m/min   |
| Resolution (X,Y,Z Axis)          | 0.00003"  | 0.0007 mm   |
| Precision (X,Y,Z Axis)           | 0.0004"   | 0.01 mm   |
| Repeatability (X,Y,Z Axis)       | 0.0002"   | 0.005 mm  |
| <b>Power</b>                     |   |   |
| Power Requirement                | 110 Volts AC  | 110 Volts AC  |
| Phase                            | Single  | Single  |
| Current                          | 15 Amps   | 15 Amps   |
| <b>Servo Motors (X,Y,Z Axis)</b> |   |   |
| Power                            | 100 Watts, 36 V   | 100 Watts, 36 V   |
| Servo Type                       | DC Brush-type servo   | DC Brush-type servo   |
| Feedback Encoder                 | Close Loop  | Close Loop  |
|                                  | 4000 counts/rev Encoder with differential output and index pulse. | 4000 counts/rev Encoder with differential output and index pulse. |
| Torque                           | 55 oz/inch  | 0.37 Nm   |
| Gear reduction                   | 1.5   | 1.5   |

## Accessories

These are the basic accessories your machine comes with when you buy the machine.

- 1 Oil can
- 1 Collet nut
- 1 Collet nut wrench
- 1 Set of ER-16 collets
- 1 Power cable
- 1 USB cable
- 1 Netbook computer
- 4 Tool holder
- 4 T-slot nut

# Software Navigation

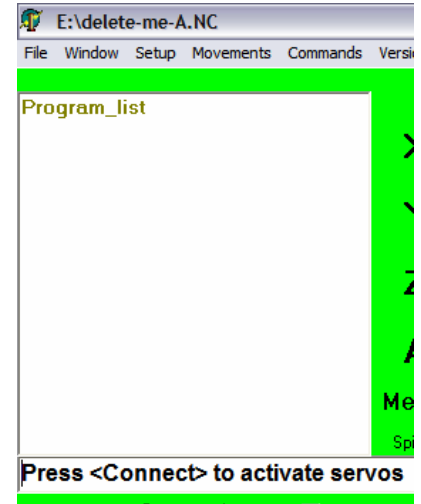
Open the software **LEVIL 10-MC**  that appears on your desktop.

The main screen is divided into 4 sections.

## 1. Program

This is where you will write or import the G-code to feed to the machine.

You can write the code manually in here, or load the file generated by a CAD program by clicking on File/ Open. When using a CAM program to generate your G code, make sure to use the FANUC Post-processor or HASS provided by your CAM software.



## 2. Machine Status

| Version | Work | Error | Machine |
|---------|------|-------|---------|
| X       | *    | *     | *       |
| Y       | *    | *     | *       |
| Z       | *    | *     | *       |
| A       | *    | *     | *       |

This is where the position (**X, Y, Z, A axis**) of the machine will appear once the machine is connected. When you open the software, click connect. You should hear a click of the relays and the background of the software should change from green to blue. If you do not hear the click, check if the Emergency Button is pushed and pull it rotating it clockwise. If the background is not Blue, check the USB cable connection and the comport setting.

The best way to troubleshoot the software is to close it, unplug and plug the USB cable, and reopen it to give it another try.

### 3. Spindle

This is where you manually control spindle speed, coolant, and tools.

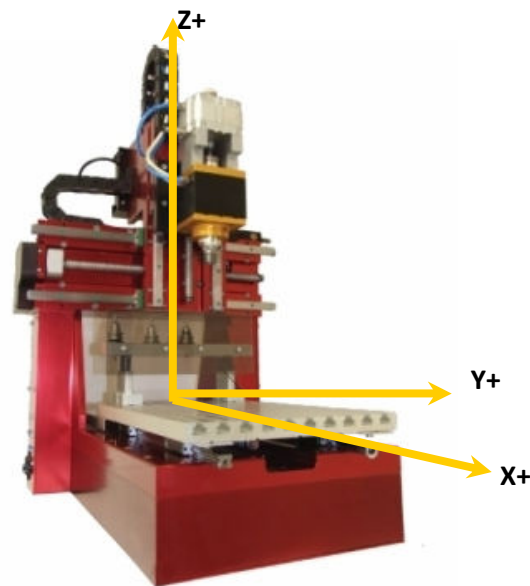
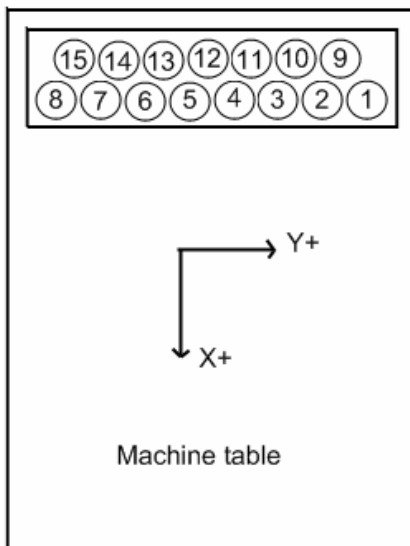
To set the speed of the spindle, specify the revolutions per minute on the textbox and then click on Spindle SET. Use the FWD and STOP buttons to turn on and off the spindle.

When you manually change the tools, click Unclamp for two seconds to retrieve the current tool. Insert new tool and click clamp for two seconds until tool holder is in place. **NOTE: It is important to tell the machine which tool you have installed. To do this, write which tool number is installed and click SET. Write 0 if there is no tool installed.**

You can also change the tool by clicking on the GET button. The machine will automatically change the tool by leaving the current tool in its corresponding tool position and then clamping the desired tool.

You should remember the position of the tools at all times. If you designated tool number 1 to be a spot drill of 5 mm, then every time you manually change tools, the spot drill should **ALWAYS** be placed in position 1 unless you modify the tool lengths accordingly for the new tool in position 1.

The default layout of the tool rack when you first receive your machine is as follows:



See Tool length Offsets instructions below when setting up your tools for the first time.

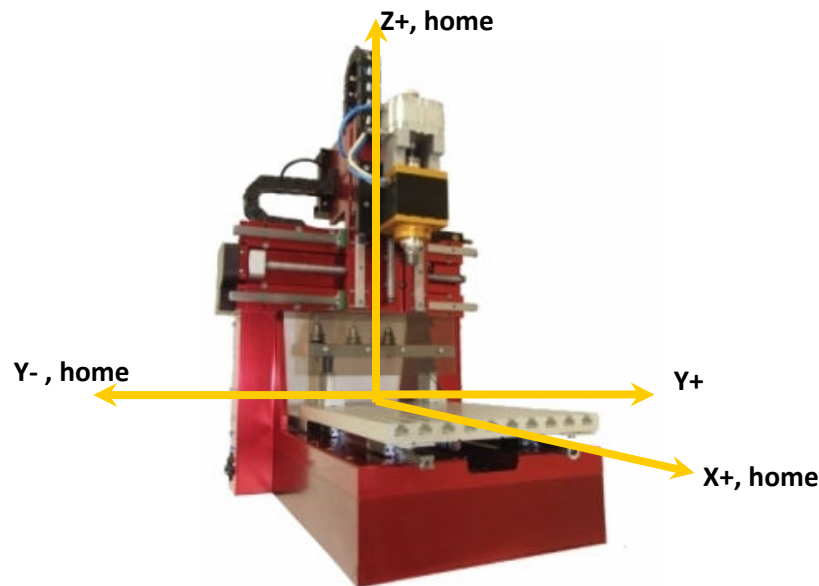
Although it is not recommended to reposition the tool rack, If you decide to move it you should follow these steps:

1. Go to Parameters under Setup and enter the password (1588).
2. Manually take the machine to the position of Tool number 1 or Home Tool in X Y and Z.
3. Click on HomeTool button
4. Specify the offset from the home tool to the following tool on the same row. The program will automatically create the offsets for the next tools. NOTE: The offsets should be very accurate to prevent the machine from breaking tools.
5. Specify the offset from the home tool to the next tool on the second row.
6. Click OK and close the parameters window.

#### 4. Axis Movement

This is where you control the machine. Use the manual settings to adjust Manual Step, Manual Speed, Cutting Feed and Rapid Feed.

If you check mark the Home box and you click any of the axis buttons, the machine will go to the home position on that axis. Make sure you know where the Home is in order to prevent the machine from going on the wrong direction and disconnecting. (The home of the LV350D Plus is to the right on the x axis, +X, to the top of the Z axis, +Z and to the left of the Y axis, -Y).



Make sure to learn all the buttons and their specific tasks so you don't have any trouble while operating the machine.

Tip: When pressing axis buttons to move the machine manually, it is recommended to use Keyboard short-cuts instead of mouse clicks (see commands tab). Sometimes the computer registers more than one click when using the mouse and the machine moves twice/three times the desired distance.

- **Manual Step** Establishes the distance the machine will move when an axis button is pressed. Ex: If manual step is 0.1 and +X is pressed, the machine will move 0.1 of a millimeter (or inch) in the positive X direction. Use Cont. manual step for smooth and continuous movement..
- **Manual Speed** Establishes the speed at which the machine will move when an axis button is pressed.
- **Rapid Feed %** Establishes the rapid feed percentage at G00 when running a program. When you first receive your machine, you might want to lower this percentage to 70% for the first couple of weeks for the break-in period.
- **Cutting Feed %** Adjusts the cutting feed established on the program running.

In the taskbar, under **WINDOW** you will find the following:

- **TEST** Test the connection of the servo-motors, and axis
- **GRAPHICS X, Y, Z** Projects a drawing of the G-code in file
- **ISOMETRIC GRAPH** Projects an isometric drawing of the G-code in file
- **RUN MDI**
- **DIGITIZE** Reverse engineer a part using this function
- **OFFSETS** Shows the offsets of the machine
- **PARAMETERS** Shows the parameter of the machine (Password Protected)

# Machine Start Up

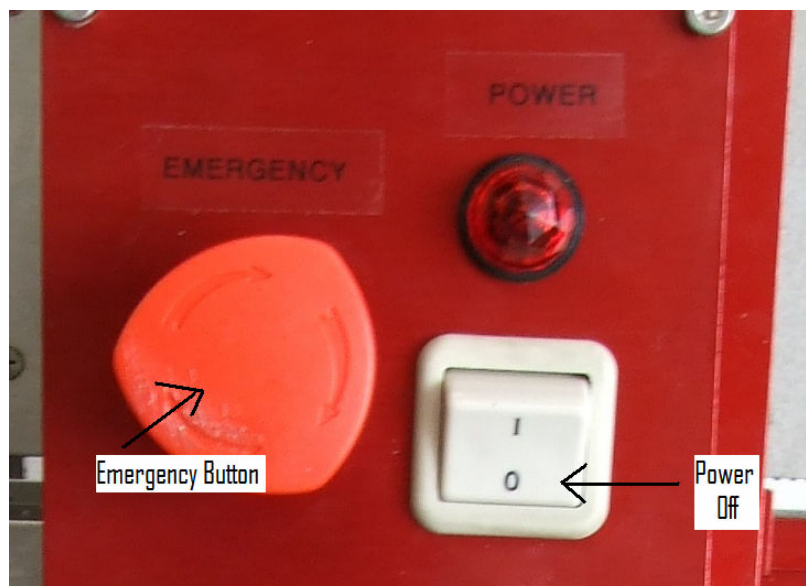
## Turn on Procedure

1. Push the emergency button (Big red button)
2. Make sure the **Power Switch** is on the off position
3. Plug in the **USB wire** from the computer to the machine
4. Plug in the **Power cable** from the wall outlet to the machine
5. Have the **Levil 11-MC** software closed
6. Turn the **Power Switch** to the on position
7. Open the **Levil 11-MC** software
8. Move each axis' ball screw by hand and look at the position of the machine in the software to check that numbers are changing in the specific axis that you are moving.
9. Release the emergency button (turn clockwise until it releases)
10. Click **Connect** in the upper right hand side of the software (Green background turns blue)
11. Click the **-X** button and make sure the machine moves on that direction, then click the **+X** button and make sure the machine moves in the opposite direction
12. Repeat the last two steps for every axis
13. Click the **Home** box and make sure it is checked marked
14. Click the **+Z** button and wait until the rectangle in the left reads **Home End**.
15. Click the **-Y** button and wait for the **Home End**
16. Click the **+X** button and wait for the **Home End**

These are all the steps you need to take the first time you turn on the machine, to make sure all axes are working properly.

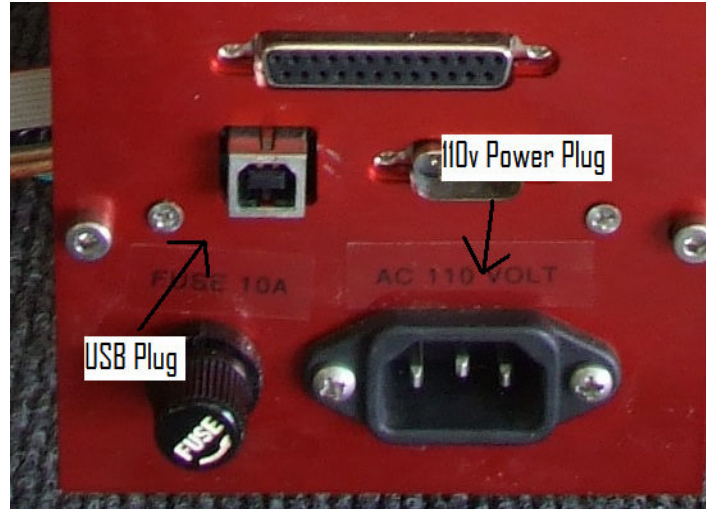
The following pages describe in detail what each step does.

**PUSH** the red mushroom button (Emergency Button) on the machine. It disconnects the power from the servo motors to avoid runaways since the control board has not been initialized. Also make sure the **Power Button** (white button) is on the **OFF** position.



Plug the USB wire from the machine to the computer, only use short wires.

Plug the machine to the 110volt wall outlet. **DO NOT** turn ON the machine yet.



With the computer on, switch the **Power Button** to the **ON** position (Red Emergency button still pushed in).

Run the **Levil 10-MC** program (Make sure the machine is on before you open the Levil 11-MC software or else it will not connect to the machine).

**NOTE:** Make sure you are running only **ONE** program of **Levil 11-MC**; otherwise there will be conflicts if more than one is running. Believe me, it happens frequently.

You should see the **MAIN SCREEN** opening with the **OFFSET** screen behind. If everything is in order, the X, Y and Z axis should appear with position numbers shown.

Move one axis by rotating a ball screw by hand, there should be numbers changing on that axis under **Machine**. If so, rotate the Red Emergency mushroom button clockwise to give power to the servos. Do not attempt to touch the ball screws after the servos are connected (Red button is pulled). This could result in an injury

Click the **CONNECT** button on the Machine Status window on the **MAIN SCREEN**; the green background should turn blue. If this happens, the machine is now on and ready to work.

Click the **X-** button located on the lower right corner to make sure the machine moves. Now click the **X+** button and make sure the machine moves in the opposite direction. Feel free to do the same with the **Y, Z axis**. If you hit end of travel as you move, the machine will automatically disconnect the power to the servos. Click **CONNECT** to recover and move that axis in the opposite direction.

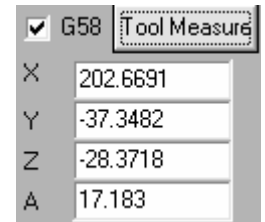
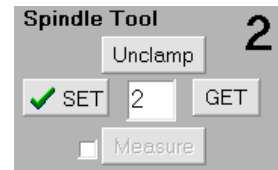
Last step to finish the start sequence is the home positioning. To do this, click the **HOME** box to check mark it.

Hit one axis (preferably Z+) and wait until it reaches home. Make sure the position number under **MACHINE** reads **.000** and the bar in the middle-left under the **PROGRAM LIST** box reads **END HOME**. If you hit the wrong direction, the machine will crash and disconnect. If this happens, simply reconnect the machine and repeat the process hitting the opposite direction. Repeat this step for the other axes. Make sure to remember which direction the **HOME ACT** is for each axis (The home of the LV350D Plus is to the right on the x axis, +X, to the top of the Z axis, +Z and to the left of the Y axis, -Y).

# Tool Length Offset

To Measure the tool length offsets for each tool:

1. Choose a reference tool, a tool that will always be the one to base the zero of your part, clamp it to the spindle and SET the designated number for that tool (i.e tool #2 is the reference tool)
2. Designate the zero at G58.
  - a. With your reference tool attached to the spindle, take the tip of the tool to a desired zero position (pick a smooth surface that will most likely never move such as the top of the vise, or a sensor if available)
  - b. Open the *Offset* window.
  - c. Check mark the *Tool Measure* work coordinate (or G58).
  - d. Click on Measure Z button
  - e. Click OK or close the offset window.



**NOTE:** Do this step only when setting up your tools for the first time, or when changing the zero to another position.

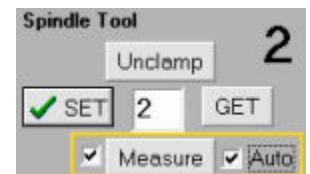
### 3. Measure the tool length offset

- Without Tool Length Sensor:

- a. With the tip of your reference tool at the designated zero (touching in Z), click on MEASURE.

- With Tool Length Sensor:

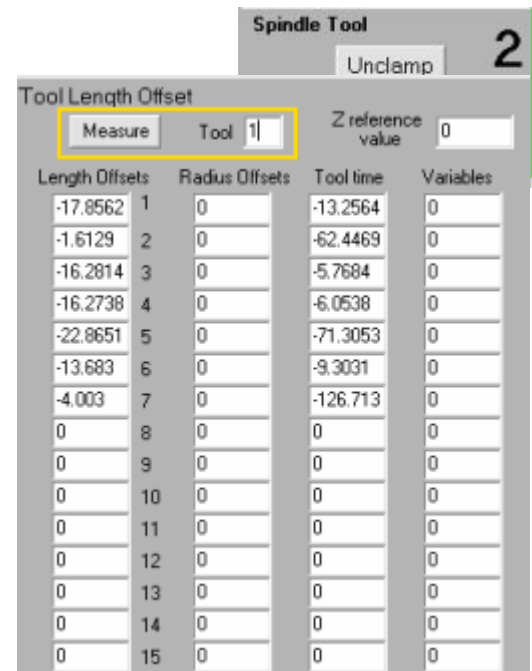
- a. Check mark the Auto checkbox next to Measure
- b. Align the tool with the tool length sensor (X and Y). Tool should not be touching the sensor in Z.
- c. Click on Measure. The tool will slowly approach the sensor twice, then will automatically go up.



### 4. Repeat Step 3 for all other tools

- a. Use the GET button to change tools or manually unclamp/clamp another tool
- b. Follow steps for Measuring tool length offsets (Step 3)
- c. When finished, verify the length offsets at the *Offset* window for each tool.

**NOTE:** The MEASURE button at the Tool Length Offset tab can also be used to manually measure tool length offsets.



| Length Offsets | Radius Offsets | Tool time | Variables |   |
|----------------|----------------|-----------|-----------|---|
| -17.8562       | 1              | 0         | -13.2564  | 0 |
| -1.6129        | 2              | 0         | -62.4469  | 0 |
| -16.2814       | 3              | 0         | -5.7684   | 0 |
| -16.2738       | 4              | 0         | -6.0538   | 0 |
| -22.8651       | 5              | 0         | -71.3053  | 0 |
| -13.683        | 6              | 0         | -9.3031   | 0 |
| -4.003         | 7              | 0         | -126.713  | 0 |
| 0              | 8              | 0         | 0         | 0 |
| 0              | 9              | 0         | 0         | 0 |
| 0              | 10             | 0         | 0         | 0 |
| 0              | 11             | 0         | 0         | 0 |
| 0              | 12             | 0         | 0         | 0 |
| 0              | 13             | 0         | 0         | 0 |
| 0              | 14             | 0         | 0         | 0 |
| 0              | 15             | 0         | 0         | 0 |

## Zero of a Part

1. Using your reference Tool take the machine to the Zero of your part
2. Open the OFFSETS window
3. Check mark your work offset reference (G54, G55..)
4. Click the MEASURE button for each axis (Measure X, Measure Y, Measure Z)
5. Click OK

### Detailed Explanation:

In order for the machine to know where to start cutting a work-piece, we have to tell it where it is. Let's call the point where the work-piece starts, the Zero point. This machine has 5 Zero points that we can use. G54 is the first Zero point, followed by G55, G56, G57, G58.

Since the Zero point tells the machine where to start cutting, you will write whichever Zero point you choose to use at the beginning of the code.

For Example

```
N10 G54           Here, I chose to use G54 coordinates to start working on the part
X0 Y0 Z0
X10 Y15
X30 Y45
Z10
M30
```

I can choose whichever Zero point I want, as long as I set the Zero point where it's supposed to be.

Under Levil 5 in **My documents**, there is a notepad file called **Zero Test 1**. Open it and take a look at it. G56 is the Zero point I chose so now we have to set the coordinate somewhere in the machine.

Now, take the machine to its home position if you have not done so already. You should choose a reference tool that you will use always when locating the zero of your part. Once you have installed your reference tool, manually take the machine to the center where it will not crash to anything on its sides when it starts moving. Once there, go to the offsets window.

On the top right side of the window you will see a box that reads G56 and its corresponding coordinates under it for each axis. If you click the box, a checkmark will appear. This tells us the machine is using G56 for coordinates.

Now go to the middle of the window where there are 4 boxes that read measure X, measure Y, measure Z, and measure A. Make sure that each square has a 0 written next to them. Now click on the measure X button, and look at the Main Screen, under work, it should read X 0. Repeat the same for the Y and Z axes (and the A if you have one) Once all the axes read 0, the G56 coordinate is set.

Click Run Program and watch as the machine performs its task from the point we chose. You can slow down the machine by lowering the cutting feed and the rapid feed to your convenience.

Once the machine is done, manually take it to another point of your choice and run the code again and watch it come back to the Zero point to start the code again.

No matter where the machine is, it will always go back to its Zero point before starting the code.

The following will explain how to define the Zero point of a part.

Manually take the X-axis, the Y-axis and the Z-axis to where you want your work piece's Zero point to be. Normally is at a corner of the work piece, like the following picture demonstrates.



This is a practical but inaccurate way to measure the Zero point of the work-piece, because it is an eye approximation. The error is big compared to what some measuring tools out in the market can eliminate. For precise cutting, this method is not recommended, but since this is a beginner's course, it will do just fine.

Make sure that wherever you decide your zero to be, there will be enough room on the work piece to create whatever you want to make. In other words, the machine will not move past the sides of the work piece.

When you are getting close to the work piece to measure the Zeros, make sure to move in small amounts (manual step reduced to 0.1 or less) and really slow until the bit touches the part, because it could break and damage the work piece.

Once you reach the Zero point, click the measure X, Y and Z to set the Zero.

Also, if you look under **G54 Check**, the numbers should match those under **Machine** in the main screen when the machine is centered on the Zero point.

If you choose to use G55 or G56 or any of the other ones, just make sure that the check mark is next to the G coordinate you wish to use before doing each axis measure.

## Changing Parameters

You might want to change the parameters of the machine such as tool rack position, units and other settings. In order to change settings, go to the Parameters window under setup tab.

**NOTE: Changing parameters may alter the performance of the machine.** Therefore, a password is always required when making any changes. Enter 1588 as password.

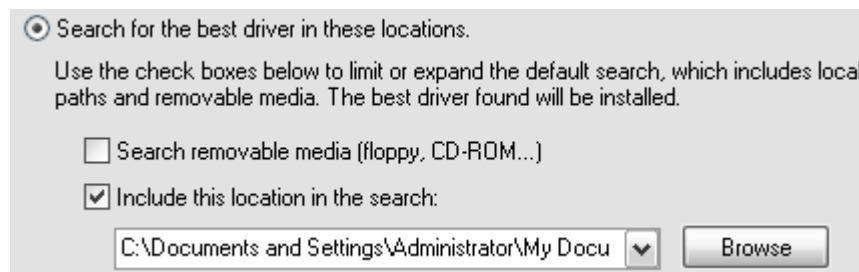
## Using an external computer

If you are planning on using a computer different than the one supplied with the machine please follow these instructions:

1. Make sure machine is OFF and USB cable disconnected.
2. Copy the Levil folder to a desired location on your computer
3. Turn ON the machine and connect the USB cable to your computer
4. Install Driver

### - Automatic Installation

- a. After connecting the USB cable, wait for the computer to recognize the device. Since the drivers are not installed, wait for the computer to run the Hardware Update Wizard.
- b. Select “YES, this time only” and click next
- c. Select “Install from a list or specific location”
- d. Select “Search for the best driver in these locations” and BROWSE the “Drivers” folder under the Levil folder you copied earlier to your computer.
- e. Click Next and wait for the wizard to install the drivers



**- Manual Installation**

If the Hardware Update Wizard was not automatically prompted, follow the instructions below, otherwise continue to step 5.

a. Open Device Manager

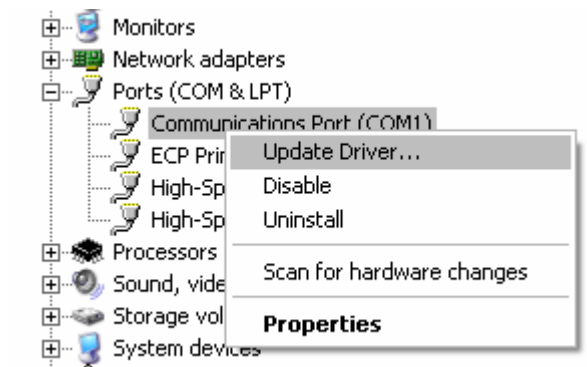
XP: (Start - Control Panel - System - Hardware - Device Manager)

Vista: (Start - Control Panel - System - Hardware - Device Manager)

Windows 7: Right Click on Computer - Properties - Device Manager

b. Extend the Ports (COM & LPT) tab

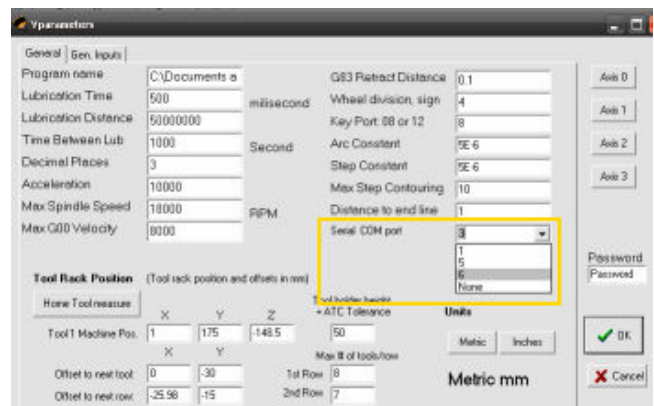
c. Right click on the "unknown STM virtual COM" and click Update driver



d. Follow steps (b. through - e.) on Automatic Installation above.

**5. Open the LV10-MC.exe software and Update COM port**

- a. Click on Setup - Parameters
- b. Select the COM Port being used by the machine
- c. Enter Password "1588" and click ok



**6. Close the LV10-MC.exe software**

**7. Disconnect the USB cable**

**8. Turn OFF the machine**

**9. Follow Machine Start-up procedures.**

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# Maintenance

## Guide-ways

If working with dust-generating materials keep the guides clean by using a vacuum system. Dust particles can easily enter the ball bearings inside the guide blocks and damage them. Make sure to grease the linear guide ways monthly if the machine will be used daily. If you will not be using the machine for some time, make sure to grease the guide ways and cover the machine until it will be used again.

The guide-blocks have small insertions on the sides where you can use an oil gun to insert some oil inside the ball bearings.

## Ball Screws

For the ball bearing screws, add a coat of oil all over the screw (10W40 is ok). Make sure to move that axis back and forth so the self-cleaning part of the screw absorbs all the oil and keeps cleaning the screw.

## Coolant System

If your machine uses a coolant system, the coolant should be aerated constantly to keep it from decomposing. If coolant starts decomposing, change it right away since it can damage the machine.

## Spindle

Warm up the spindle at 3500 RPM for 10 minutes if not used within the last 12 hours.

Keep your spindle Cool at all times by opening the air valve on the right side of the spindle. Overheating the spindle can severely damage the spindle bearings and other internal components. Keep the compressed air clean and dry

For other spindles, please read the instructions that came with your spindle and follow maintenance instructions.

If you have any questions, please contact us via phone at 407-542-3971 or via email at [techsupport@levil.com](mailto:techsupport@levil.com)