



Link  Motion™

by Solustan, Inc.

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User's Manual

December 5, 2018

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7. LinkMotion Lite software is protected with a software protection key. The protection key is tied to your specific PC computer using appropriate Microsoft Operating System. If the technology was not available to transfer the license to another PC, **you will be required to buy another license at a full price** of the software in case of a PC failure beyond normal repair. **It is very important to safeguard the PC with the license.**

8. Support is available free of charge for 30 days from purchase date. Normal support charges will apply after 30 days of purchase date.

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LinkMotion Lite Detail Installation and Setup Instructions

LinkMotion Lite works with Windows 10, 8, 7, XP for 64 and 32 bit operating system.

LinkMotion will only work on the computer with USB port 2.0 or higher and does not work with USB 1.1. Do not attach other USB devices like keyboard and mouse that has USB 1.1 otherwise LinkMotion will not work.

If you just purchased USB Controller board and the software, you may want to refer to the document - Connecting and Wiring AGNI USB Controller for the recommended wiring of the controller board in your system. Make sure and understand which controller you have to follow separate instructions for 32 bit controller or older 16 bit controller.

Installation required for LinkMotion Lite and USB controller:

Part 1 – Installing LinkMotion Lite for CNC applicaion on Windows 10, 8.1, 8, 7 or XP for 64 or 32 bit operating system.

Part 2 – Installing USB driver for AGNI Controllers:

A: Install WinUSB Driver for New AGNI Controller Series 20000 on Win 8 and 10:

New AGNI Controller Series 20000 now uses windows standard WinUSB driver. Windows 8 and 10 operating system provides windows USB driver for recognizing all USB devices. If you do not have this driver you can go to Microsoft's web site and download this driver. Then follow Confirming the WinUSB driver Installation instructions. Follow all the details from this manual.

B: Install WinUSB Driver for New AGNI Controller Series 20000 on Win 7:

Win 7 requires for you to download this driver from Microsoft's website. Follow the detail instructions from the Part 2 of installation instructions in this manual.

Warning for USB Controller Serial Numbers: If USB Controller's serial number is either not recognized (not certified) or not found when LinkMotion is launched it will display a message “Unrecognized serial number ____”. When user clicks on OK button it will also display a message “The maximum working area is 1'x1” or 25.4mm x 25.4mm”. If controller is not purchased from Solustan or Solustan approved dealer it can display this message “Your controller is not certified. Please contact Solustan for help”. Contact Solustan for resolving this problem. G-Code Files tab(menu) also will not be available for processing previously generated gcode files.

USB Controllers serial numbers can be programmed for limited table size output for testing the software in demo mode. When testing this demo software it will not allow the user to enter and save any larger table size in Machine properties area. It will not allow the user to send any jobs larger than the available table size. Make sure to test the jobs that fit within that available area.

Part 1 - Installation Procedure for LinkMotion Lite:

Note that you must have administrative privileges on the computer in order to install LinkMotion. Most of the installation process is self-explanatory by following the instructions from the screen. You can stop the installation at any time by clicking "Cancel".

If you selected to receive the driver software on a CD, Go to the step (1A) and skip (1B).

If you selected to receive the driver software by internet, Go directly to the step (1B) and skip (1A).

(1A) Insert the LinkMotion installation CD into your CD-ROM drive. If the Auto-run feature is enabled in your PC, Windows will start the Installation automatically. If the Auto-run feature is not enabled, browse the CD drive in Windows explorer and double-click on the **“LinkMotion_Lite64_Setup.exe” for 64 bit version or “LinkMotion_Lite32_Setup.exe” for 32 bit version or “Setup.exe”** and installation will begin.

(1B) After downloading the LinkMotion driver software, unzip the files and save by creating a folder name LinkMotion. Now **double click on the file name “LinkMotion_Lite64_Setup.exe” for 64 bit version or “LinkMotion_Lite32_Setup.exe” for 32 bit version or “Setup.exe”** and installation will begin.

(2) Click on the Next Button.



(3) Click on the **Next Button**.

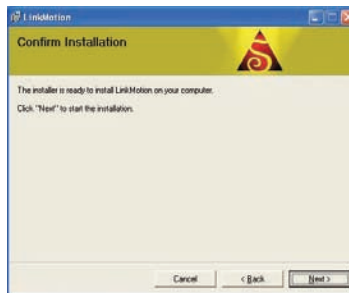


(4) When you get to the License Agreement dialog (see above), **you must read the agreement. If you agree, go ahead and click the radio button "I Agree" for the installation process to continue and Click on the Next Button.**



(5) After you have read and agreed to the License Agreement, you will be asked to specify the installation folder. In most cases you can leave this as the default setting.

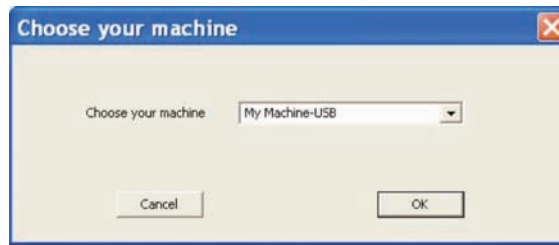
(6) Click on the Next button once again.



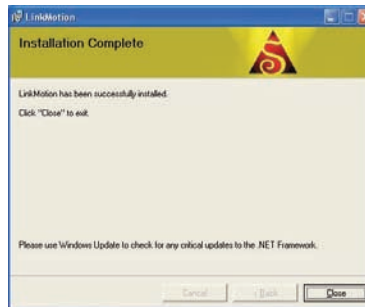
(7) Later during the installation you will see **Choose your machine** for installation. Machine is **My Machine** as default. Scrolling arrow on the right will allow you to choose your different machine name. LinkMotion Litmay not have more then ne name.

If you wish to add your machine name that you do not see here, Please contact us.

Do not create or write your own new machine name here at the time of this installation.



(8) Click on "Close" when the installation is complete.



(9) Icon shown below should show up in system tray at the bottom right.

If LinkMotion icon does not show up in the systems stray in case of Win 7 follow directions from below and setup to view that icon all the time.

Go to **Control Panel** of windows from the **Start button**. Click on the **Appearance and Personalization**. Go to the **Taskbar and Navigation(Win 10)**, **Taskbar(Win 8)**, **Taskbar and Start Menu(Win 7 and XP)**. Click on the **(Notification area on Win 10) Customization on the taskbar**. **Win 10** - Click on **Select which icons appear on the taskbar**. Here check **LinkMotion** icon to be on. **Win 8, 7** - Here click on the box at the bottom left for **Always show all icons and notifications on the taskbar**. Click on the **OK button**.



To view all different files and folders that is installed for LinkMotion one more setup is necessary using following directions in Win 7:

Go to **Control Panel** and click on the **Appearance and Personalization**.

Under folder Options Click on the **Show Hidden files and folders**.

In the View section, look for **Hidden files and folders**.

If not checked already, check the button for **Show hidden files, folders and drives**.

Click on the **Apply button**. Click on the **OK button**.

(10) Power Option Settings:

Windows 10, 8 and 7: Windows 10, 8 and 7 operating system disables USB port connections when it is in power save or screen saver mode. Following settings will keep USB port always active. Please make sure to set this up properly. Power save mode can be turned off.

Go to **Control Panel > Click on Hardware and Sound > Under Power Options Click on Change when the computer sleeps(Win 10, 8 or 7), Change Power-Saving Settings(Win 10, 8 or 7) > Balanced** is selected by default. On the right **Click on Change Plan Settings(Win 10, 8 or 7) > Select Never** for put the Computer to sleep by scrolling on the arrow. **Click on the Change advanced power settings** from below **> Double click on the USB Settings > Double click on the USB Selective Suspend Setting > Click on the Settings and Select Disable** (for Desktop computers) **or Select Disable** for **On battery** as well as **Plugged in** (for Laptops) **> Click on the Apply button and Click OK.**

Windows XP: Go to **Control Panel > Power Options > Under Power Schemes** select **Never** for **System Standby** as well as **System hibernates** and **Ok** will save this setting.

(11) Multiple users:

Under Windows 10, 8.1, 8 and 7 LinkMotion version 4.06 onwards allows multiple users to use LinkMotion for the same computer. Installation of the LinkMotion.INI and temp.txt file locations have been moved in the following locations:

C:/ProgramData folder > Solustan folder > LinkMotion folder > LinkMotion.INI file and bmp files.

C:/ProgramData folder > Solustan folder > LinkMotionUSB folder > Tempfiles folder > temp.txt file.

Previous user should always log off before another user logs on and starts using LinkMotion.

Under Windows XP version 4.06 onwards, LinkMotion.INI and temp.txt files are installed in the following locations:

C:/Document and Settings folder > All Users folder > Solustan folder > LinkMotion folder > LinkMotion.INI file.

C:/Document and Settings folder > All Users folder > Solustan folder > LinkMotionUSB folder > tempfiles folder > temp.txt file.

Windows XP has the limitation to allow only one user to use LinkMotion properly. Please make sure to install properly for one user only.

(12) International Customers need to check following:

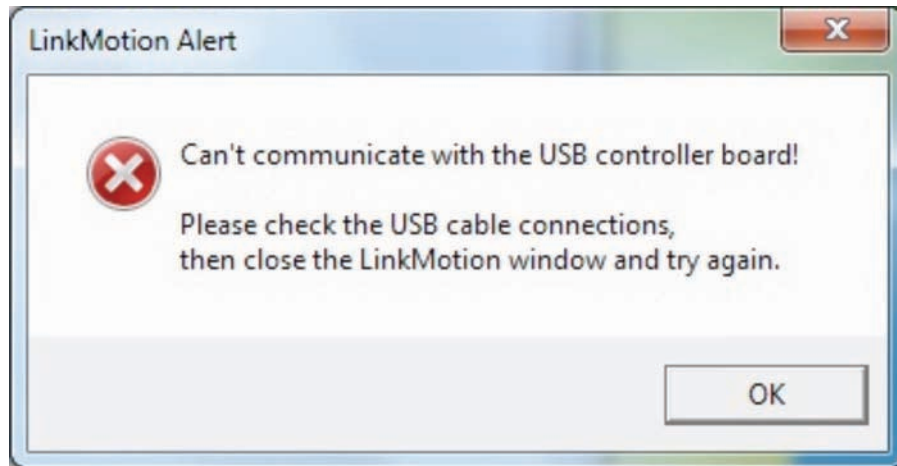
If you are using Windows operating system for other languages please make sure that following settings are selected for LinkMotion to work properly.

Win XP: Go to the **Start button > Control Panel > Regional and Language Options > Click on the Customize button.** Here Decimal Symbol should be **.(Full stop or Period)** selected. Do not select **,(Comma)**. If you had to change **click on the Apply button and Click OK.**

Win 10, 8 users need to figure out to see the Control Panel and then follow Win 7 instructions.

Win 7 32/64: Go to the **Start button > Control Panel > Clock, Language, and Region > Click on Change input methods(Win8) or Change keyboards or other input methods(Win7) > Select Format tab(menu) > Click on the Additional settings button.** Here Decimal Symbol should be **.(Full stop or Period)** selected. Do not select **,(Comma)**. If you made any change it is important to **click on the Apply button and Click OK.**

You are done with all settings for windows. LinkMotion installation procedure is complete and **now follow the USB controller driver installation procedure.** When USB controller driver is not installed, LinkMotion will not find the controller so you will see the following message if you launch LinkMotion. Once the USB Controller driver is installed properly you will not see this message when you launch LinkMotion.



Re-Launch LinkMotion:

It is extremely important to Re-Launch LinkMotion first time after installing and then if you replace or change LinkMotion.INI file for it to be effective. It is also important to Re-launch when you change the machine's table size or DPI selection for LinkMotion USB Laser product.

Exit the LinkMotion (icon) applet by right mouse click from the systems tray at the bottom right. LinkMotion icon should go away from the systems tray.

Now launch it back again by following and selecting the path Windows Start button>Program Files or All Programs >Solustan>LinkMotion by the arrow of your mouse.

LinkMotion icon should appear again in the systems tray at the bottom right.

Uninstalling LinkMotion:

Please make sure of the following before you uninstall:

Your specific machine related settings are saved as **LinkMotion.ini** file. This file can be **saved** from **General Options Menu** and simply click on the **Save button**. It is preferred that you give this file a unique name and save it properly to make it easy to retrieve it in future. Different users can save under different names. Similarly you can **Load** that file back after another installation of LinkMotion by going to the General Options menu in LinkMotion and clicking on the **Load button**. Restore Default button allows you to load default original INI file that is supplied with LinkMotion. **It is very important to exit LinkMotion applet and Re-launch the applet when you make any changes for it to be effective. Understand the definition of Re-Launch from below.**

Uninstall LinkMotion Procedure:

Make sure the LinkMotion applet is closed. Open the **Start menu** and select the **Control Panel**. Double-click on **Add or Remove Programs**. Look for LinkMotion entry in the list and click on that. Select **"Remove"** and answer **"Yes"** when it asks you if you really want to remove LinkMotion.

LinkMotion.INI file (configuration file) does not get deleted with uninstall procedure.

If you want to delete your existing INI file following is the procedure for Win 10, 8 or 7:

LM version 4.06 and higher: C:/ProgramData folder > Solustan folder > LinkMotion folder > LinkMotion.INI file and bmp files.

LM Version 4.05 and lower: In the C:\ hard drive Find folder name **Users> Folder with users (your own name) name> Folder name AppData> Folder name Roaming>Folder name Solustan> Folder name LinkMotion> LinkMotion.INI. Delete this file.**

If you want to delete your existing INI file following is the procedure for Win XP:

LM version 4.06 and higher: C:/Document and Settings folder > All Users folder > Solustan folder > LinkMotion folder > LinkMotion.INI file.

LM Version 4.05 and lower: In the C:\ hard drive Find folder name **Document and Settings> Folder with users (your own name) name> Folder name Application Data> Folder name Solustan> Folder name LinkMotion> LinkMotion.INI. Delete this file.**

Read and understand detail from the full manual before operating your LinkMotion Lite software for CNC machine product.

Warnings for LinkMotion Control Pad:

1. Use the 'Zero (Ins)' key on your Numeric Key Pad or quickly press 'Space Bar' to Pause the machine operation. LinkMotion needs to be in the foreground and in an active mode when Pause operation is exercised using PC keyboard. Space bar pressed for a longer time will also pause the job but it will pause in a momentary mode where job will continue when Space bar is released. When Pause activated with zero or quickly pressed space bar, a message box will come up for a decision to Continue or Quit the job. (Sometimes this message box is in the back of your Control pad and you may have to bring it to the front simply by clicking on the system tray's active LinkMotion application.) At this point, make the necessary selection. Click YES to continue the job or No to stop the job completely. After you select NO you will see another dialog box asking you if wish to quit and stay in the position you are or you wish to go back to X, Y (0, 0) position. Make your selection and park your tool head properly.
2. When pause is called for during a raster (engrave) operation, the pause will not take place until the laser beam reaches one of the ends of the active scanning line. LinkMotion lite does not have this feature.
3. Control Pad for LinkMotion allows only one direction movement at a time. Only use your computer keyboard (numeric keypad) for these movements. Do not use mouse and click on the arrows of your Control pad screen. If you do, it will activate the 'nudge' feature.
4. A single mouse click is used to exercise the 'nudge' feature. Mouse may be used for just a few Control Pad functions. These are,
 - Click Home button to activate home sequence.
 - Click Repeat button to repeat the previous job.
 - Click one of the Pause buttons to pause the job processing operation
5. Once a job is sent or you have activated the LinkMotion applet, it shows up in the bottom bar where active applications are displayed.
6. **Repeat Key** from Control Pad (either of the Enter keys from computer keyboard) will process immediately the last job sent to the controller without sending the job again from the PC to the controller.
7. **Wireless keyboard and wireless mouse should be checked fully before using them. One of the possible problems with the wireless keyboards is that Control pad keys may not send out information fast enough for machine to move properly.**
8. We have done preliminary testing with wireless control pad and most keys function well when an individual key is pressed. When two keys are pressed together, it may not work properly. An example is pressing one directional key 6 to move the X axis going to the right and then try pressing key 5 while holding down the key 6 to make it go faster may not work well.
9. **Design using plate size in the Materials Properties Tab is fully tested only with Corel Draw. If you are using any other design application you need to test before you start using the feature. LinkMotion lite does not have this feature.**
10. **How to use LinkMotion with different design applications:**
Zero or thinnest line (hairline) width and No fill are the most important things to remember when you are designing a file for Vector output. Do not fill the shape for any vector output. Thicker lines or filled object can be used only for raster output from LinkMotion Laser products.

Visit www.solustan.com/support and Download documents for your product.
LinkMotion and Corel Draw or Design application you are using.....

Control Pad for LinkMotion

LinkMotion version 4.05 and higher with new AGNI controller now uses these two keys when Control Pad is launched on the screen. Pressing those keys will display the default Spindle speed and pressing up and down keys will increase or decrease that speed.. Click on the OK button or the Enter key to apply and that will save the speed you desire.

Pressing this key is Effective only when Machine is in Motion for job output. It can slow the speed down and up but not higher then job feed rate declared.



All the keys are active when LinkMotion Control Pad is in foreground on the screen **except the keys for Speed + (Up) and Speed - (down)**. Speed Up and Speed Down keys are effective when job is in process and machine is moving. Speed up key will not go to any higher speed then what you have declared in the Job feed rate of Materials Menu.

When jogging X and Y axis and pressing the Fast Key at the same time will double the speed of jogging. Typically, when jogging action takes place, the jogging speed will be 50% of the declared jogging speed in the Materials Menu of LinkMotion. Upon depressing Fast Key while holding down the directional key for jogging, the machine will jog at full speed or twice the speed of normal jogging.

Use Zero key or Quickly pressed Space Bar of your keyboard to Pause. Control Pad needs to be in the foreground and active mode for pause to be effective for LinkMotion product. Space bar pressed for a longer time will also pause the job but it will pause in a momentary mode where job will continue when Space bar is released. When Pause activated with zero or quickly pressed space bar, you will see a message box asking you if you want to **Continue or Quit the job**. Sometimes this message box is in the back of your Control Pad and you can bring it to the front simply by clicking on the systems tray's active LinkMotion application. **Click Yes to continue the job or no to stop the job completely**. If you selected no and job was stopped, it will also ask you if you wish to stop where you are or you can select to go back to the starting position. **Repeat Key** will process immediately the last job sent to the controller without generating and then sending the job again from the PC to the controller.

WARNING: Do not use the arrow keys elsewhere on the keyboard in place of the Control Pad Keys. It may cause unpredictable results. Do not keep Num Lock key pressed or do not click many times at a fast speed. You need to gently press and release and observe the speed increase or decrease.

Wireless keyboard and mouse are not recommended. In case of wireless, Control pad keys do not send out information fast enough for machine to move properly. We have done preliminary testing with wireless control pad and most key functions work well when individual key is pressed. When two keys are pressed together it does not work. An example - Press one directional key 6 to move the X axis going to the right and then press 5 key to make it go faster. **Test your wireless devices like keyboard, mouse or numeric key pads fully before using them for production work.**

Part 2 – Installing USB driver for AGNI Controllers:

A: Installing WinUSB driver on Windows OS 8 and 10 for New AGNI Controller Series 20000:

Windows 8 and Windows 10 are shipped with proper and flexible USB drivers.

1. Connect the new Agni Series 20000 Controller to a USB connection on the PC with one of the above operating systems.
2. The operating system will inform you that it is looking for the proper USB drivers to invoke and install necessary resources.
3. It may take a while based on the speed of the PC. It will announce that the resources are found and the USB device is ready for the operation.
4. That is all there is to it.

Once the USB driver is installed, the name USB device will change to Machine Link II. This name is assigned to Solustan's controller. From now on, every time the controller is connected to the USB connector of the PC, the Device Manager will bring up the Machine Link II and will establish the connection at the USB level. This procedure only needs to be done once.

The LinkMotion printer driver will use the USB device driver to communicate with the Agni controller. It is important to understand that various parts are installed for the LinkMotion to perform its tasks.

1. USB Device Driver
2. LinkMotion Printer Driver
3. LinkMotion User Interface and Control Pad.
4. Corel Draw type design application.

Now follow **Confirming the USB Driver installation after the Win7 USB Diver instructions.**

B: Installing WinUSB driver on Windows OS 7 for New AGNI Controller Series 20000:

Win7 ships with the correct 'winusb.sys' file, but is missing an updated '.inf' file that associates the driver with "usb\ms_comp_winusb" devices. Normally if the USB device supports Microsoft OS descriptors, then it will allow Windows to automatically install the WinUSB driver. This mechanism is supported "in-box" for Win8 and newer. For Win7 the mechanism is supported through Windows update. Depending on the update policy for the Win7 machine, the appropriate driver may or may not be already available on the machine. If it is not already on the machine, user can use the following manual procedure to install the driver if necessary.

1. Search for "windows phone winusb" at [Microsoft®Update Catalog|<https://www.catalog.update.microsoft.com/Home.aspx>].
2. Download "Windows Phone - Other hardware - WinUsb Device".

NOTE:

Solustan took care of the above two steps. Downloaded the software and attached it herewith.

3. Extract the contents of the downloaded '.cab' file to a temporary folder. In other words unzip it.
4. Open the Windows Device Manager on the PC screen.
5. Connect the Agni II controller to any USB port on the PC. Note that a new USB Device is added under the listings of the USB (Universal Serial Bus) controllers.
6. Right Click the mouse to the new Device line in the Device Manager and select "Update driver software ..." -->
7. When choices show up, select "Browse my computer for driver software".
8. Navigate to the temporary folder with the downloaded driver to complete the installation.

Once the USB driver is installed, the name USB device will change to Machine Link II. This name is assigned to Solustan's controller. From now on, every time the controller is connected to the USB connector of the PC, the Device Manager will bring up the Machine Link II and will establish the connection at the USB level. This procedure only needs to be done once.

The LinkMotion printer driver will use the USB device driver to communicate with the Agni controller.

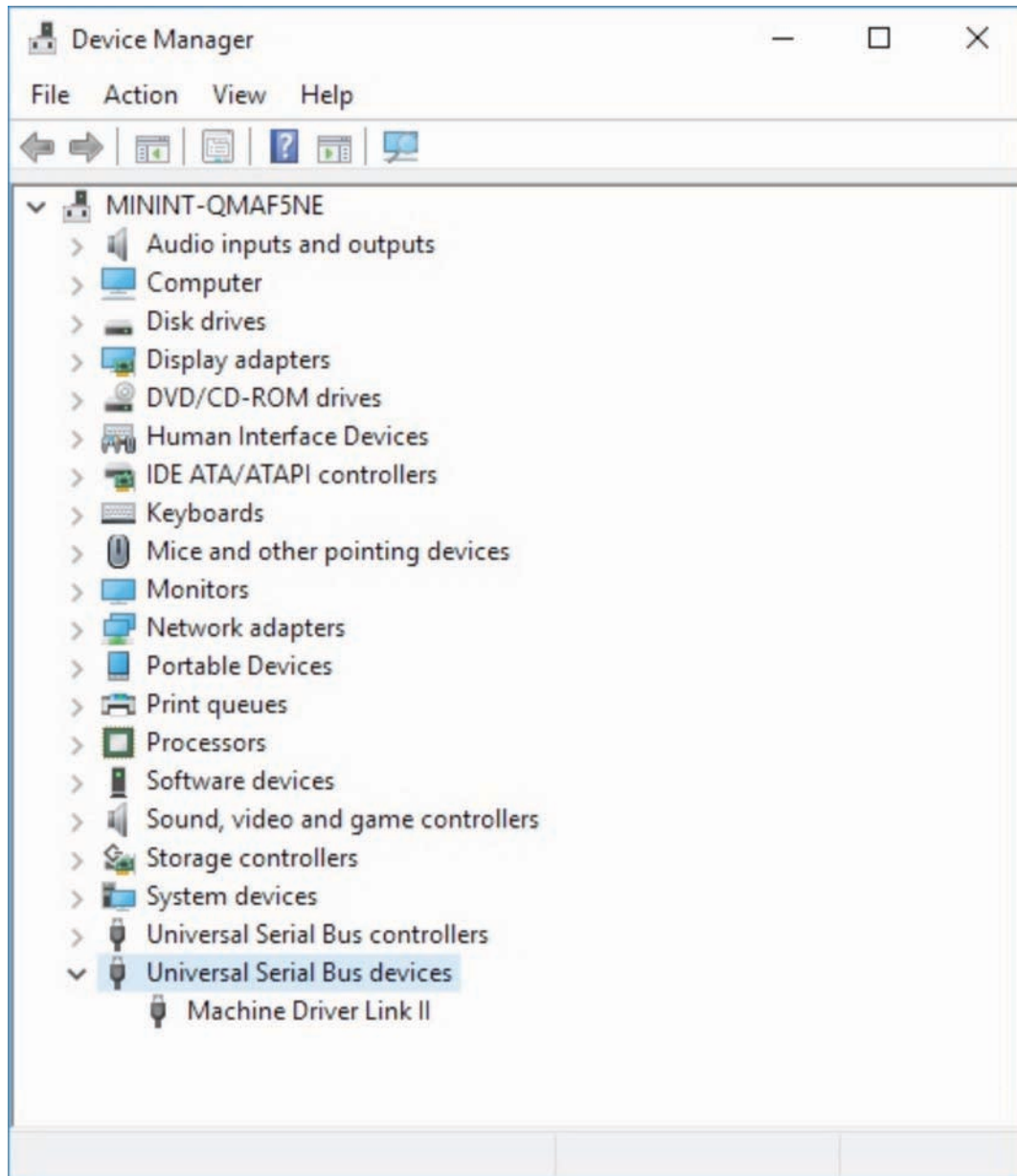
It is important to understand that various parts are installed for the LinkMotion to perform its tasks.

5. USB Device Driver
6. LinkMotion Printer Driver
7. LinkMotion User Interface and Control Pad
8. Corel Draw type design application.

Now follow Confirming the USB Driver installation from the next page.

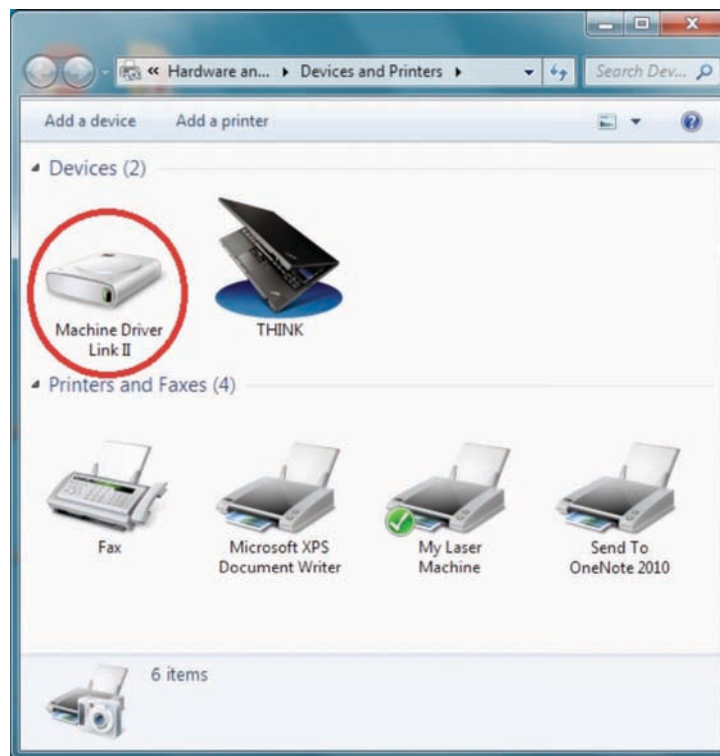
Confirming the WinUSB driver installation for new AGNI Controllers Series 20000:

Now confirm proper connection to this new USB Controller device by going to the Device Manager of Windows as shown in the following picture.



Name of the device once installed will show as **“WinUsb Device”** and it will show the proper name **“Machine Driver Link II”** after the restart of the operating system. As long as it is connected properly it will display any one name. **If windows standard USB device driver is not properly installed it will not display this name and will not communicate with new AGNI USB Controller.** Please make sure and install proper driver for USB device.

Another way to confirm under Devices of Windows Devices as shown in the picture below:



IMPORTANT INFORMATION:

After installation of LinkMotion software and proper USB device driver, when you connect the AGNI USB controller it should display a windows standard message about recognizing new USB device. Always make sure you see this message, close that message and then launch LinkMotion. It will not connect with this USB Controller properly if you do not follow proper procedure.

Also, refer to the proper warning from this manual under Connecting AGNI USB Controller series 20000 for wiring and using it properly.

Re-Launch LinkMotion means exit LinkMotion Icon from the systems tray on the bottom right by right mouse click and then launch it back on the systems tray by going to the Windows start button and All programs, Solustan, LinkMotion.

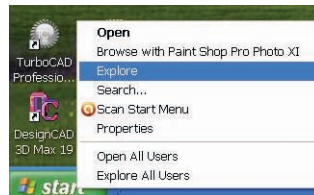
C: Installing Older AGNI Controller driver for Series 10000 and under - Install 32bit AGNI USB Controller Driver:

Do not plug the USB controller using the USB cable until it is asked for in the instructions. Always plug the controller directly into your computer's USB 2.0 connection when instructed.

If the controller is plugged into the PC via USB hub or other extension devices, it is important to note that the third party devices should meet USB 2.0 specifications. If the hubs or other extension devices cause problems, connect the controller directly to the PC to isolate USB related problems.

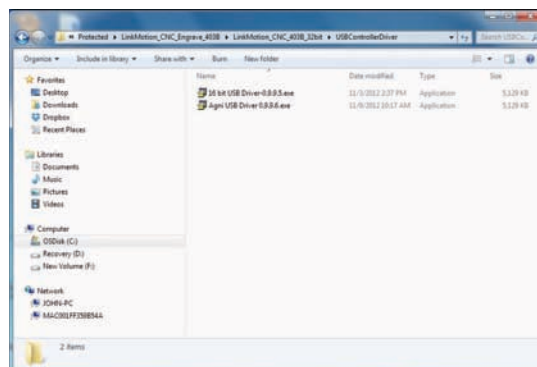
(1) Installing 32 bit AGNI USB Controller driver for Win 10, 8, 7 - 32 or 64 and Win XP operating System:

Make sure your LinkMotion CD is in the computer. If you receive the software by internet you should unzip and find a folder name **USB Controller Driver** and follow the instructions from step (3).



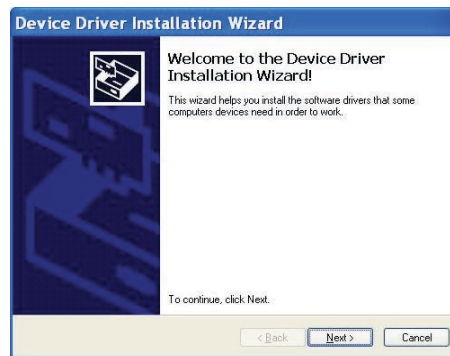
1. Go to the start button of Windows at the bottom left and Click with the right mouse button and select Explore.

2. Navigate and select LinkMotion CD or downloaded folder and find the folder name USBControllerDriver and open this folder. There are two files in this folder. Use 32 bit AGNI USB Driver 1.0.0.0.exe for AGNI USB Controller installation.

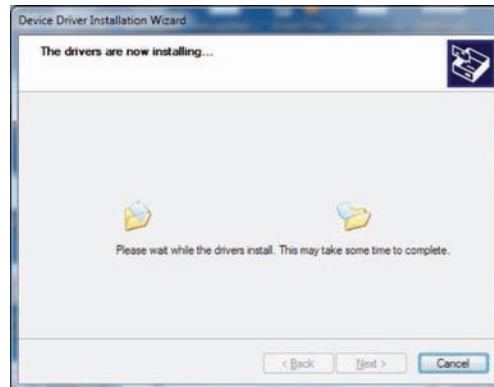


3. Double click on the AGNI USB Driver 1.0.0.0.exe file for AGNI 32 bit controller. Your computer setup may ask for special permission to install unknown vendor and you can click on the Yes button to start.

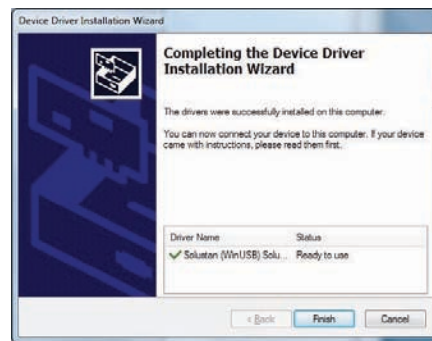
Click on the Next button when following screen is displayed.



4. You will see the following two screens as installation is in process. Click on **Install button** on the second screen for Windows Security.

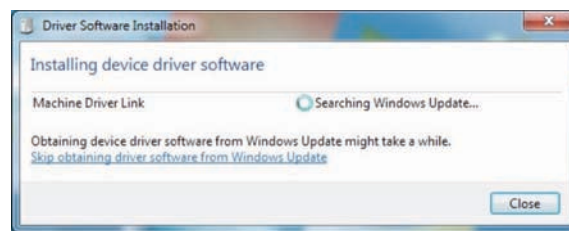


5. When you see the dialog box for Device Driver Installation Wizard, **click on the Next button**. It just takes a few seconds to install the USB driver. When installation is finished you will see the following screen and click on the **Finish button**.



6. Now plug in the USB cable. When you plug the USB cable in the computer you will see a message for found new hardware at the bottom right in the systems tray or the screen. Double Click and open it.

Dialog box shown in Windows 10, 8, 7:



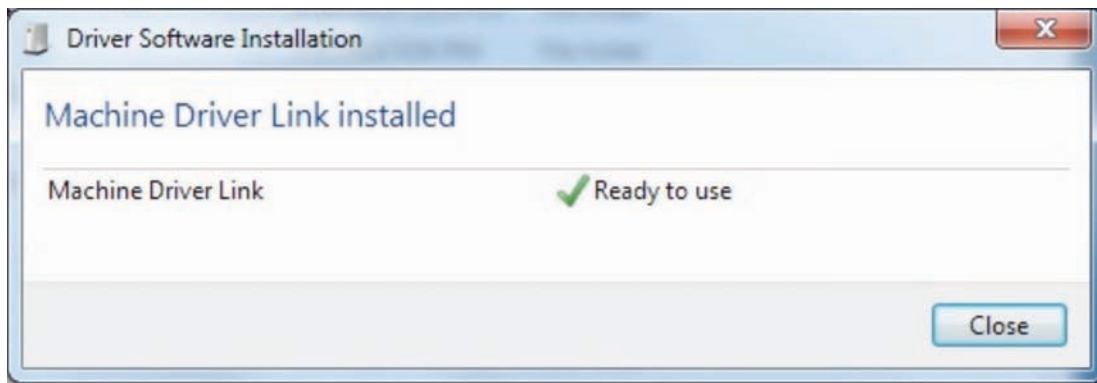
Dialog box shown in Windows XP:



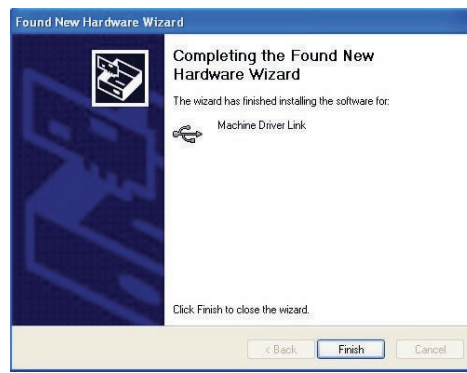
7. On Win 8 and 7 first dialog box shown above will be displayed and it can automatically search and then install the driver from your computer. User can save time by clicking on the message **Skip obtaining driver software from Windows Update** and click Yes on the next message (picture not shown). On Win XP Found new hardware wizard dialog box shows up and make sure to check the button for **Install software automatically (Recommended)**. **Click on the Next button.**

You will see the installation procedure collecting and installing the necessary files in proper locations.

Dialog box shown in Windows 10, 8, 7:



Dialog box shown in Windows XP:

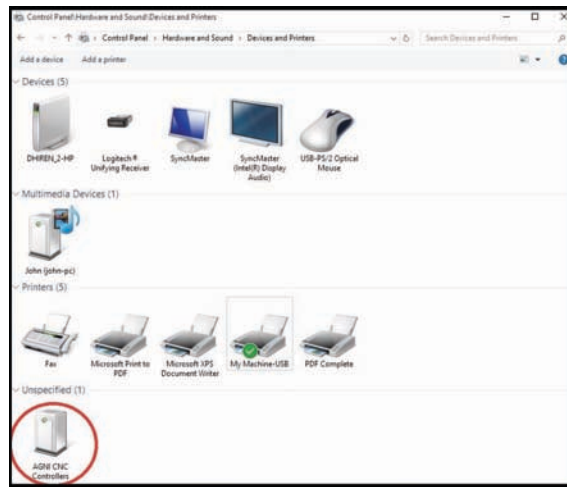


8. When it finishes automatic installation you will see the message shown above for Win 7, 8 and 10. **Click on the Close button. On Win XP it displays different display and click on the Finish button** here.

9. The proper installation of 32 bit AGNI USB Controller driver “**AGNI USB Controller**” driver can be checked and confirmed if device will work properly in the **Windows Device Manager**.

Properly installed **AGNI USB Controller** under **Device Manager** will show as **Solustan Machine Controller** and **Machine Driver Link** under that. Double click on **Machine Driver Link** and it should show you a message **This device is working properly** if it is installed properly. **This is a driver for Communication with the USB Controller and it is not a printer driver.**

Under Win 10, 8 and 7 user can see it installed as shown in the picture below in Hardware and printers area. This driver does not display on the Windows XP operating system.



If it is not installed properly please make sure to check your cable connection, follow proper procedure or contact Solustan.

10. Remember to plug in the compatible SD memory card into the USB Controller card.

Approximately 1minute of machine work uses 1MB of memory. This controller supports up to 2GB Memory. We have provided the list of SD memory we have done testing with.

If you are installing for the first time you do not need to worry about next step for updating the firmware. We ship all USB controller boards with latest firmware.

11. Firmware update for AGNI USB Controller board:

This procedure may be necessary only when we send you an updated firmware or updated LinkMotion driver software to work with latest firmware properly.

Exit LinkMotion from the bottom right by right mouse click on the LinkMotion Icon. Now disconnect USB cable from the computer end, wait for a minute and re-connect back one time. Firmware update requires USB controller board connected to the computer.

Double click on the file name **AGNI UpdaterV3084.exe** or with the latest number that we have provided. Click on the big button **AGNI FirmwareUpdaterV3084**. This will take a few seconds and when it is done updating it will give you a message **Update Successful**. Click on the **OK** button and **unplug and replug the USB cable to recycle the power for USB Controller** and you are done with the firmware update.

If you are simply updating the USB controller board firmware or updating the LinkMotion driver version then you will simply need to exit the LinkMotion applet by right mouse click and Re-Launch it from the Start menu and start working with it again.

Make sure and understand the LinkMotion driver features and then start working with your machine.

Warnings for Older USB Controller board Series 10000 and under:

1. Plug the LinkMotion controller cable directly into your computer's USB 2.0 connection.
2. It is important to experiment and determine that the USB controller works with the USB hub or extension device, if the user plans to use such a device.
3. This USB controller does not work with USB1.1 connections. If you connect other USB devices compatible only with 1.1, it may cause problems. All the USB devices including keyboard and mouse in the system shall comply with 2.0 specifications. Always check compatibility for wireless USB devices, if you are using one.
4. Power saver and Screen Saver modes on your computer should be turned off. If these modes are activated, it can cause problems in recognizing the USB connection on a continuous basis.
5. The LinkMotion USB controller can be configured to power either from the USB connection of the PC or from an external 5 VDC power supply. There is a jumper on the controller board that allows the selection of the power supply for the controller.
6. In case of Laptop computers AC power unit shall be connected to an AC outlet while operating external USB devices. Sometimes, aggressive power save mode settings under battery operations could activate the disconnection of USB devices. Re-Launching LinkMotion will re-activate the communication in such a situation.
7. Approximately 1 minute of machine operation uses 1MB of SD memory for vector work. This controller supports up to 4GB Memory. If you are using LinkMotion version 3.5 or higher, you could use either SD or SDHC memory cards.
8. It is impossible to test all the available SD Memory cards in the market but we have listed in the following lists ones that work and ones that do not work with this USB controller.

Memory chips tested and working with this controller: Sandisk (1 gb, 512 mb, 256 mb), Topram 1gb, PNY 1gb, PNY 4gb SDHC, Samsung 1gb, Transcend 1gb and 'Made in China Generic' 1gb.

Memory chips found not working with this controller: Kingston 2gb (non SDHC) and 4gb SDHC.

9. If serial number of the controller is not recognized by LinkMotion then user will see a message "Unrecognized serial number ____". Once you click on OK button it will display a second message as "The maximum working area is 1"x1" or 25.4mm x 25.4mm. Linkmotion software can output only 1"x1" jobs at that point. Unauthorized controller bought from unauthorized vendors can cause this kind of problem. Get in touch with Solustan to verify your serial number. Not making proper USB connection with the controller can also display this kind of message and simply disconnecting USB cable from computer end and reconnect and re-launch LinkMotion should resolve it.

10. USB Controller Board Lights:

Older AGNI USB Controllers / Series 10000 - There are three LED lights available to attach to the Agni Controller board – Blue, Amber, and Red. These lights behave in the following manner when connections are made and the board is powered:

Blue LED Flashing Slowly – No USB Connection

Blue LED Steady – USB powered up and ready

Amber LED Flashing Slowly – Waiting for firmware update

Amber LED Flashing Fast – No SD (Memory) card

Amber LED Steady – USB ready with SD card

Red LED – Turns on when board is powered. It turns off when it makes proper connection with LinkMotion. It also turns on every time when any machine motion is detected.

Red LED Flashing – If hardware switch for Repeat is installed on the Laser/Agni controller and LinkMotion.INI file is setup properly, then, Red LED starts flashing after a job is processed one time. Pressing the Repeat switch will send the job again to the machine. After a job is processed one time it is ready to repeat the last job using the repeat button on the USB controller as many times as user wishes.

LinkMotion Lite with USB Controller for processing M&G Codes:

LinkMotion Lite works with Windows 10, 8, 7 64 or 32 bit and XP Operating system. It allows the user to control and setup a machine and process the M & G Codes to send it to the machine.

Major function of this product is to drive your machines with USB connection of your computer without locking up any computer functions. Your computer and the design programs are free and available to you while the previous job is being processed.

Your computer should have Win 10, 8 or 7 32/64 or Win XP operating system.

Win XP operating system with Service Pak 2 or higher installed and two USB 2.0 connections.

Also you should install Microsoft .NET Framework Version 2.0 or higher. This is available from Microsoft's web site for you to download freely:

Microsoft.com>Downloads & Trials>Download Center>Microsoft .NET Framework 2.0 (version)

Do not use any USB 1.1 devices like keyboard or mouse. Make sure all USB devices used are 2.0 or higher in order for LinkMotion to work properly.

Install LinkMotion Lite for CNC Version 4.05 or higher by following the instruction that you received with LinkMotion Lite software. Latest version now does not require any license key. User can install on any computer to work with USB Controller.

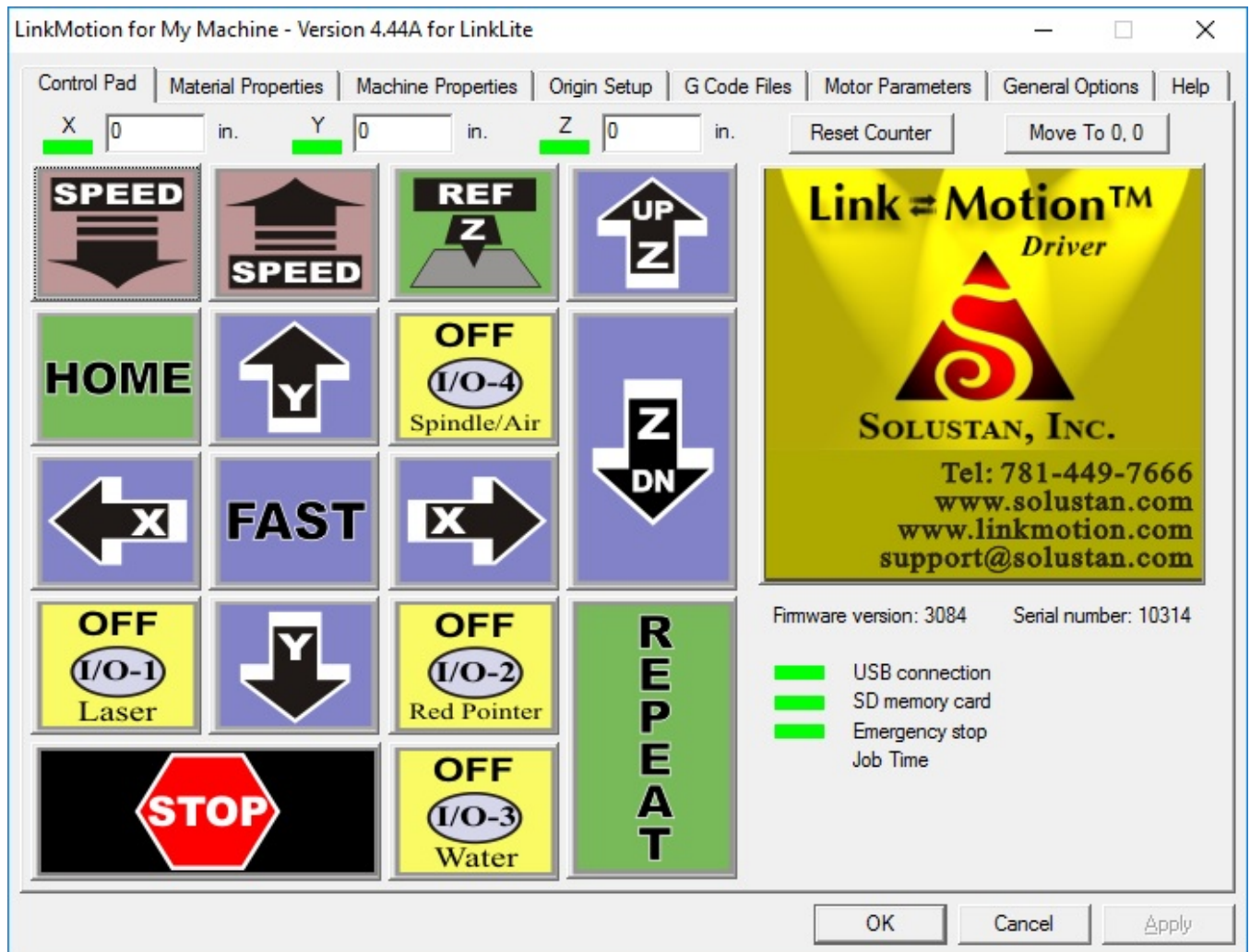
Make sure to check all the necessary cable connections between your computer, machine and the USB Board. Micro SD memory card should be plugged into the USB controller card. Check for compatibility list in installation section of this manual.

It is always a good idea and a good practice to turn on the PC first and your driver module after the Windows is loaded. LinkMotion should be Re-Launched after operating system is completely up. In the same manner, it is always a good Idea to turn off the PC last when you switch off the system. It is advisable to turn the spindle motor off and keep it off during the installation of the LinkMotion and during the process of turning the PC ON and OFF. This should be true whether the decision was made to power the USB controller from the USB port of the PC or from external 5 VDC power supply.

LinkMotion Lite Control Pad Explanation:

Users can setup this Control Pad to view in **English, Spanish or Symbol**. This setup is available in General Options tab. Following explanation will explain the function of each keys.

Control Pad in the English language:



The Control Pad is operated using the numeric keypad on the right side of the extended PC keyboard. The screen design of the Control Pad mimics the actual numeric keypad. This is the main user interface for the LinkMotion driver software on the PC. Besides controlling the movement of the machine using the Control Pad, it supports many different tabs for customizing LinkMotion machine settings.

Click on the Apply button after any changes you make on each tabs. Changes are effective only when you click on the APPLY button while you still have the changed tab open. Do not enter any zero '0' value in any area (specific like Motor Parameter, Linear Travel, Maximum Travel and Speed area) even if you are not using that Axis or the section. LinkMotion is active when it is launched on the screen. User needs to launch LinkMotion in order to use mobile device for Control Pad to work

properly. Please read and understand the instruction for using the mobile devices to control your machine before you start any motion of the machine.

Home (Limit) switches (green or red lights) show up at the top of the Control Pad for each axis:

If switches are present and properly configured, you will see green lights when the switch is not tripped. Home switch selection can be either **Normally Open or Normally Closed swicthes in Origin Setup tab**. Making proper selection for the type of switches used for your machine should give you the green light on the Control Pad. Red light indication could mean that user has selected incorrect type of switch.

We protect you from driving into the end of an axis where you have already tripped the Home switch. Move the toolhead in any one of the axis until the switch is tripped, the green color will change to red. If the Z axis is a solenoid (non-motorized) or if there is not a home switch on the Z axis you need to go to the Origin Setup menu and under Home switches select “None” for the Z axis. Counters for each axis will display the position of the tool on respective axis. **Refer to the explanation in Origin Setup area for positive or negative values displayed. Counter may not display any information if cylindrical option is checked with certain condition. Refer to detail cylindrical option explanation in the Machine Properties tab.**

Reset Counter and Move To 0,0:

Following two buttons for **“Reset Counter”** and **“Move To 0,0”** does not show if you activate home switches in Origin Setup of LinkMotion. These two buttons can be active only if you **check and Apply** “Disable Home Switches” and go back to Control Pad screen.

Reset Counter:

This will Reset the Counter for the X and Y axes to zero. If you move the tool anywhere on the table, the X, Y and Z axis counters will display the actual positions of the tool. If you then click on the Reset Counter it will make X and Y display 0. This is useful for machines without a Home switches or for selecting a new starting position. **Counter position displayed for each axis is rounded up to two digits for cm/mm and it is for general understanding. Keep in mind that Z axis counter does not reset.**

Move To 0,0:

Clicking on this button will make your machine move your X and Y position to 0, 0 when the counters show values other than 0, 0. **This is a useful function for resetting the start position for the machines without Home switches. Speed used for moving to 0,0 position is same as homing speed declared in the Origin setup.**

Clicking on the **Solustan logo** will take you to Solustan web site, if the computer is online and connected to Internet.

**All the blue colored keys are designed to move X, Y, and Z axis as follows:
X left (4), X Right (6), Y Up (8), Y Down (2), Z Up (-), Z Down (+) and Fast (5).**

X Axis travels from left to right and Y Axis from back to front of the machine with the Jog speed declared in the Material Properties. Jogging Acceleration is declared separately for each axis in the LinkMotion.INI file as MAX_MM_PER_SEC_PER_SEC_JOG= _____.

In case of LinkMotion CNC/Engraving software, the default **Z Feed (Down)** value and **Z feed Up** can be made active simply by setting the speed value in the **Materials Properties** section. This will allow you to bring the Z axis up and down using the Control Pad of LinkMotion. **LinkMotion uses Z Feed UP speed when simply jogging to bring the Z Axis up or down using the Control Pad. When a job is sent to the machine, LinkMotion will make Z axis travel up and down using the different speeds declared for Z Feed(Down) and Z Feed Up. (When Z Ref key is pressed it uses higher of the two speeds (Z Feed or Z Feed Up) declared.**

Z Feed(Down) Speed is setup in each material related settings individually in the LinkMotion.INI file with the following line.

ZFeed_in=1.0 or ZFeed_cm=2.5 or ZFeed_mm=25.00

Z Feed Up Speed is setup in your selected machine related settings of the LinkMotion.INI file with following line.

Speed_ZFeedUp_in=1.0 or Speed_ZFeedUp_cm=2.5 or Speed_ZFeedUp_mm=25.00

Soft Limits for the Machine movement:

The structure is designed to prevent running into the end of travel. First of all, we used to decelerate very slowly and over a relatively long distance. Now, when you set up typical acceleration of 100 inches/sec, the jogging will stop almost immediately, within a mm or two. Also, if you have limit switches wired into Agni controller, it will stop immediately when the switches are breached.

Driving X or Y axis with two motors:

LinkMotion driver software has been designed to drive the **X or Y axis with two motors**. X axis can work with A axis and Y axis can work with B axis. Your hardware should be wired properly to use this feature as explained in Connecting USB Controller part of the document. Software support is available in the LinkMotion.INI file by changing the value from zero to one in following line in your selected machine related part of the LinkMotion.INI file. Your LinkMotion.INI file is in following location:

Windows 10, 8, 7 32/64:

In the **C:\ProgramData > Solustan > LinkMotion > LinkMotion.INI**.

Windows XP:

In the **C:\Documents and Settings > All Users > Solustan > LinkMotion > LinkMotion.INI**

Double click on this file and windows Note Pad should open it. This is a configuration file and it has the number of machines listed at the beginning and go down until you find more information for your selected machine name (example) "My Machine-USB". Please find following lines within your machine's data information by scrolling down:

XDuplicateA=0

YDuplicateB=0

Important procedure for activating XDuplicateA=1 and YDuplicateB=1:

You can activate by changing XDuplicateA=1 or YDuplicateB=1 depending on how your machine is designed. Save this file from the File menu after you make the change and close everything. **An extra procedure is necessary since this feature is not available in user interface.** Launch Linkmotion and highlight one of the values in **Linear travel per revolution** under **Machine Properties setup tab** and retype the same number again and click on the **Apply** button. Now remember to Re-Launch LinkMotion by exiting from the system's tray at the bottom right and then Re-launch it from the Start button of windows on the bottom left for this to be effective.

Following G-Code example files of a simple rectangle will give you an idea of files generated with X DuplicateA and YduplicateB being active as well as not active.

G-code generated where XDuplicateA=0 and YDuplicateB=0

```
G94
G90
G20
G64 P0.004
G01 Z0.000 F60.000
G00 X1.000 Y-1.000 F60.000
G01 Z-0.153
G04 P0.100
G01 X4.000 Y-1.000 F120.000
X4.000 Y-3.000
X1.000 Y-3.000
X1.000 Y-1.000
G01 Z0.000 F60.000
G00 X0.000 Y0.000 F60.000
M02
```

G-code generated where XDuplicateA=1 and YDuplicateB=1

```
G94
G90
G20
G64 P0.004
G01 Z0.000 F60.000
G00 X1.000 Y-1.000 A1.000 B-1.000 F60.000
G01 Z-0.153
G04 P0.100
G01 X4.000 Y-1.000 A4.000 B-1.000 F120.000
X4.000 Y-3.000 A4.000 B-3.000
X1.000 Y-3.000 A1.000 B-3.000
X1.000 Y-1.000 A1.000 B-1.000
G01 Z0.000 F60.000
G00 X0.000 Y0.000 A0.000 B0.000 F60.000
M02
```

Fast Key (5):

Key can be pressed while holding down any one directional key for the X or Y axis to make it move faster. The faster key will jog the axis at double the Jog speed declared under Material Properties.

HOME Key (7):

Home key will move the machine to its Home position, if the machine is equipped with Home switches and will reset the counter to 0, 0. Machines may have Home switches in X and Y axis or all the three axis.

Home key now also has Z Reference function included for the machine built with home switches for all the three axis and activated in LinkMotion. User can bring the Z down to touch the material and instead of Z Reference key if you **click on the Home Key** it will do the calculation for the Z Reference as well as it will sense all the three home switches and park the tool in home position selected in Origin Setup.

User can deactivate this function or protection by checking “disable home switches” in origin setup and Re-Launch Linkmotion.

Home Key in Absolute Mode - The LinkMotion now manages the working area of the machine in an absolute mode. LinkMotion will keep track of the position of the tool (laser head in case of a laser machine or spindle in case of a CNC/Engraving machine) and will not allow the machine to travel outside the working area. It is necessary to have home switches on the machine and it is also necessary to home the machine when LinkMotion is launched. Upon launching LinkMotion, handshaking with the Controller takes place. LinkMotion notes the starting position when it finds the home switches. From there on, LinkMotion will track the absolute position of the machine and will prevent the machine from traveling outside the declared working area in the Machine Properties Tab.

This above mentioned function is not be effective using LinkMotion Lite for processing gcode file.

Z axis soft limit is an additional feature that will respect the travel distance declared in the Maximum Travel for Z axis declared in the Machine Properties. **It will be effective when home switches are activated in the Origin setup area. It is also effective when Z Ref Key is used.** User can use either automatic homing feature with all three axis to home properly at the launch of Linkmotion or manual homing can be done by pressing the home key of the control pad and also separately use ZRef key for homing the Z axis. In both cases Z axis will limit the travel distance declared for Z axis under Machine Properties.

I/O Keys (1), (3), (Del) and (9):

These keys are available for I/O 1, I/O 2, I/O 3 and I/O4 controls. These could be used to control Z axis movement in case Z axis is not motorized but it is solenoid and is controlled by air valve, for example. Can also be used for lubrication of tools, vacuum control, laser control, red diode, air, water etc. All four I/O keys can behave as momentary contacts (Click and hold down to change the status. Let go of the key and the status is back to original) or toggle contacts (Click once to change the state. Click again to change it back to original state). Toggle settings are done in the LinkMotion.INI file. USB Controller with serial number below 4600 and above 4600 have different I/O settings so please read, wire it properly and use it with proper understanding. Serial number of your controller is displayed at the bottom of the **Help** tab(menu).

Output settings for 32 bit AGNI USB controller

The AGNI USB controller has many output lines. Five of the outputs are programmed as defined below in the chart. **Here is how to control them from your G code job files.** Some of the I/O's for outputs can be controlled in two different ways as explained below.

Following Output pins are shown for new Agni-IIP and II as output 1---7 and PWM.

Refer to Connecting AGNI controller for more details.

OUTPUT	I/O's	Control logic High	Control logic Low
OUT 1	I/O 1	M64 P1 M7	M65 P1 M9 (alternate controls for the same output)
OUT 2	I/O 2	M64 P2	M65 P2
OUT 3	I/O 3	M64 P3 M8	M65 P3 M9 (alternate controls for the same output)
OUT 4	I/O 4(Spindle)	M64 P4	M65 P4
OUT 5			
OUT 6			
OUT 7			
PWM	Spindle PWM	PWM output straight or inverted	

PWM can be inverted by changing the value in the LinkMotion.INI file under your machine related settings, save this file and Re-Launch LinkMotion Incon for it to be effective.

InvertPWM=0 (Value 1 inverts the pulse for Laser) Available with LM Version 4.27

I/O's toggle setting and Invert setting: This setting is available in LinkMotion.INI file.

LinkMotion.INI file can be found in the following location:

Windows 10, 8, 7 32/64:

In the C:\ProgramData > Solustan > LinkMotion > LinkMotion.INI

Windows XP:

In the C:\Document and Settings > All Users > Solustan > LinkMotion > LinkMotion.INI

Open LinkMotion.INI file by double clicking on the file. It is a text file. You will see all the different machine names at the beginning. Specific machine related controls are further down in the file. Find the specific settings for your machine and you can make changes there. Remember to save the file after you make changes. Also, remember to ReLaunch LinkMotion for your changes to take effect.

Toggle Mode for I/O Keys:

To switch I/O keys from momentary keys to toggle keys find the following lines:

Key1Toggle=0

Key3Toggle=0

Key9Toggle=0

KeyDeleteToggle=0

These lines control the toggle or no toggle nature of the four I/O keys on the Control Pad. The four keys correspond to keys 1, 3, 9, and Del. Any key with a declared value of zero is a momentary key while a **declared value of 1 becomes a toggle key.**

Invert Mode for I/O Keys:

LinkMotionUSB product also has the capability to invert the I/O's. Values can be 0 or 1. Zero value does not invert and one value inverts the I/O. If I/O's turn on and off in reverse order then what you want you need to change the values from 0 to 1 or 1 to 0 in the LinkMotion.INI file.

Save the file and Re-Launch the LinkMotion.

InvertOutput1=0	(I/O 1 in LinkMotion for CNC-Engraving)
InvertOutput2=0	(I/O 2 in LinkMotion for CNC-Engraving)
InvertOutput3=0	(I/O 3 in LinkMotion for CNC-Engraving)
InvertOutput4=0	(I/O 4 Spindle for LinkMotion or CNC-Engraving)
InvertPWM=0	(Value 1 inverts the pulse for Laser) Available with LM Version 4.27

Zero INS (0) Key or Space Bar for STOP/PAUSE:

Zero key on the numeric keypad or quickly pressed Space Bar will Pause processing of the job at any time. Space bar pressed for a longer time will also pause the job but it will pause in a momentary mode where job will continue when Space bar is released. Control Pad needs to be in the foreground for the machine to Pause. If Control Pad goes in the background user is unable to Pause. User can bring LinkMotion in the foreground when job is in process by simply one click of a mouse on the active LinkMotion icon in the middle in systems tray.

When a job is paused you will see the following messages:

First message - Continue Job? Click **Yes** or **No**. Second message displayed only if you select No.

Second message - Move to home position? Click **Yes** or **No**. Tool will move to home or 0,0 position if Yes is selected. Tool will not move at all if No is selected.

HardwarePause and CycleStart:

Warning:

Make sure you understand the function for Z Axis travel properly before you start using this Hardware Pause and Cycle start function. It may cause unreliable results if it is not setup properly in the Linkmotion.INI file or your generated g-code file is not proper for the first Z axis movement.

32 bit new AGNI USB Controllers:

The **Hardware Pause and the Cycle Start** functions are enhanced to improve its functionality. New **Agni USB controllers** have screen printed information for wiring PAUSE, ESTOP and CYCLE along with the GND information. **User needs to wire both, Hardware Pause and Cycle Start switches (hardware switch installed without the cycle start switch will not work properly) to work properly along with the activation in the Linkmotion.INI file as explained on the following page.**

32 bit older AGNI USB Controllers:

Agni-I controllers with the black metal enclosure and three DB-25 connectors, please, note an error in screen printing. The screen printing shows as follows:

Connector 2 of Agni-I
Pin 1 – Pause
Pin 2 – E-Stop
Pin 3 – Cycle start

The correct pin numbers are as follows:

Connector 2 of Agni-I
Pin 1 – Pause
Pin 2 – E-Stop
Pin 3 –
Pin 4 – Cycle start

Software settings for Hardware Pause and CycleStart connections for 32 bit Agni USB controllers:

Software settings for Hardware Pause and Cycle Start connections should be activated by proper changes in the **LinkMotion.INI** file as explained below. This settings are for each of the machine so user will need to find the settings under their selected machine name. **After making the proper changes user will need to Save the INI file, close it and re-launch LinkMotion to make the changes effective.**

HardwarePause= -1, 2 or 3

Set the INI value to -1 to disable or deactivate this feature.

Set the INI value to 2 to enable HardwarePause if your switch polarity is normally closed.

Set the INI value to 3 to enable HardwarePause if your switch polarity is normally open.

CycleStart= -1, 2 or 3

Set the INI value to -1 to disable or deactivate this feature.

Set the INI value to 2 to enable CycleStart feature if your switch polarity is normally closed.

Set the INI value to 3 to enable CycleStart feature if your switch polarity is normally open.

Activating the HardwarePause switch also requires activating the CycleStart switch for it to work properly. **Only Hardware pause switch will not work properly by itself.** If the hardware Pause switch is

activated, it will pause the job immediately but Z axis does not lift up. Now activating the CycleStart switch will allow for the job to continue. **Do not press the Enter/Repeat Key on the keyboard to continue to finish the job when job was paused using the HardwarePause switch since Enter/Repeat key pressed at this point sends the full job again from this Pause position.**

When Pause(Stop) is used with zero key or the space bar of the keyboard not only a job is paused but it will also lift up the Z axis and if you choose to continue the job then Z axis will travel down and then continue the job.

Activating the CycleStart switch allows the user to either continue the job after user has paused the job using the HardwarePause switch or Start or Repeat the previously sent job. This switch can be activated by itself.

Once the Cycle start switch is activated it will prohibit the automatic starting of a job when 'Printed' from a job design software. The job will be transferred to the SD memory card on the Agni controller. However, the job will not start until the Cycle start switch is pressed or activated.

Num Lock and /(slash) keys in active machine motion (job output) mode: (This function is available for 16 bit USB and 32 bit Agni USB Controller)

Num Lock and /(slash) keys are available only when the machine is in motion.

These keys can decrease or increase the speed of the X, Y movements of the machine. Do not keep this key pressed for a long time. Simply press and release gently. Each click of the key will decrease or increase the speed by a percentage set in the LinkMotion.INI file. OnTheFlySpeedChange=4 is the default INI file value. This number is the percentage change to the original speed specified in the Job feed rate with F value in Gcode job you sent to the machine. When the machine is in motion you can decrease the speed by pressing Num Lock Key. You will not be able to increase the speed by pressing the / Key. For safety reasons, you cannot increase the speed to more than what you have declared in the job you processed. Once the job is done you can change the job and send it again.

Num Lock and /(slash) keys for Spindle speed setup using Control Pad mode: (This function is available only for 32 bit AGNI USB Controller and LinkMotion version 4.24 and higher)

This is available with LinkMotion Lite for your testing purpose only by using the ControlPad of LinkMotion. User should create proper code file for actual output.

Solustan is offering a sophisticated spindle speed control for the first time. A spindle speed control unit shall have at least two different inputs.

One is an On/Off control for turning the spindle on or off. The On/Off control is typically a TTL compatible or a +5 VDC signal required.

Second is an input for controlling the speed of the spindle. Popular inputs can be,

- Zero to +5 VDC analog voltage. Higher the voltage, higher the speed.
- Zero to +10 VDC analog voltage. Higher the voltage, higher the speed.
- A more precise PWM input at a frequency required by the spindle speed control unit.

The AGNI controller provides On/Off TTL signal. It is the output 4. It also provides PWM signal. A frequency can be chosen to match with the requirements of the spindle control unit.

If the speed control unit is less expensive and less sophisticated, it may accept only 0 to 5 or 10 VDC.

Since the PWM signals are TTL signals (5 VDC), a simple external passive RC filter circuit will convert from PWM to 0 to 5 VDC.

For a requirement of 0 to 10 VDC, an external active circuit will be required to convert from PWM to 10 VDC signals.

If the spindle speed control unit requires only the speed control voltage or PWM but does not require On/Off capability, it is required to build an external circuit to use the On/Off control to manage the output to a single input point. AGNI may choose to keep the PWM on all the time. However, the On/Off switch controls the spindle being on or off. Typically, the sophisticated speed control units require both the signals.

The flexibility of settings are as follows:

Please, note the following settings in the [GENERAL] section of the LinkMotion.INI file.

[GENERAL]

NUMBER_OF_AXES=6

INTERPOLATION_PERIOD_IN_MILLISECONDS=1

IS_STEP_INVERTED=True settings per color.

IS_G20_APPLIED_TO_ABC=TRUE

PWM_FREQUENCY=5000 (*Set up the require frequency for generating PWM signals per the Spindle Speed Control unit.*)

DIVERT_C_TO_A=FALSE

SPINDLE_MAX_RPM=5000 (*Set the Maximum RPM required by the Spindle system*)

SPINDLE_MIN_RPM=100 (*Set the minimum RPM required by the spindle system*)

SPINDLE_MAX_PWM=100 (*Set the corresponding PWM values for Max*)

SPINDLE_MIN_PWM=10 (*Set the corresponding PWM values for Min*)

SPINDLE_RPM=1000 (*This is the default RPM selected by the user. It can be changed easily using speed UP and speed Down keys on the Control Pad while I/O 4 key is pressed and activated.*)

Once these values are set for your machine and your spindle, you can vary them using color for the vector lines in your design. Please, note that the Material Tab now shows two different settings per color. These are, feed rate and spindle speed. Both are percentage of the declared speeds. Also, these values can vary from material to material. You can save lots of information and use it again and again. Solustan provides readymade RGB color palettes for the 10 colors and CYMK for 7 colors that are used for the user's convenience. There will be one to one correspondence between your selection for the color and proper feed rate and spindle speeds will be maintained for the jobs.

What is a simple example of using these techniques?

Let us say that after marking a few shapes on the material, it is required to cut out the material.

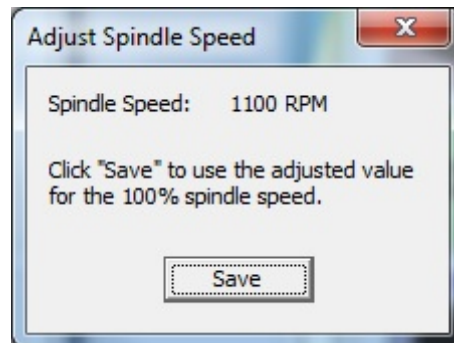
Select one color for the shapes and select appropriate feed rate and spindle speed percentages.

Draw the out side shape that is required to cut the materials through in a different color. Make sure it is the last in the sequence of shapes sent out by Corel Draw.

Change the feed rate to slower number and increase the spindle speed for the second color.

The Control Pad accommodates the spindle settings in the following manner:

When the machine is stationary and the operation is set and checked using Control Pad, all the other keys are active as before except for the three - Speed Up, Speed Down, and Enter keys.



Normally, Speed Up and Speed Down keys are used to change the feed rate during the processing of a job when your machine is in motion. This is still true. **However, when Control Pad is up on the screen and Enable Spindle is checked in the Machine properties tab user can press first the I/O 4 or number 9 key for spindle along with up or down key and a screen will open up a dialog box as shown in the picture above. Now, pressing those Speed Up and Speed Down keys while keeping the I/O 4 key pressed will change the Spindle Speed RPM number. Click on the Save button with your mouse or Enter Key on the Keyboard or Numeric pad will save this value.**

User can also setup I/O 4(number 9) key in the toggle mode and then do the settings for the Spindle speed. Read the toggle mode setup information in earlier section for I/O setup and follow proper directions.

Normally, Enter key will process a previous job. However, once Speed Up or Down keys are touched while not processing a job, an additional user interface will show up and provide a feed back on changing of the spindle speed. Either clicking Save with the mouse or clicking Enter key will register your new speed selection and update the value in SPINDLE_RPM= a new value in the [GENERAL] section of the INI file. This will be your new default speed.

Once the temporary user interface box closes with the new speed information, the Control Pad and the Enter key will go back to normal operation.

This design makes it very useful to set things up while using wireless devices as Control Pad and being close to the machine and the spindle. It is possible to use Numeric keypad with a long cable as the most inexpensive solution for Control Pad. Other possibilities are,

- Wireless numeric keypad
- Wireless iPhone, iPad
- Wireless Android phone, Android tablets

Z Ref key (*):

Z Ref key is clicked after the tool is brought down to touch the material using the Z down key. LinkMotion will remember the top of the material when a tool touching the material to be the reference surface for the

job which is Z axis zero (0) position. Pressing the Z Ref key will make the Z axis travel up to the parking position, away from the material. This value will displayed on the Z axis counter and it will be positive value. It will use the Z reference to calculate the moves in the Z axis for the depth and the lift as it processes the job. Depth and lift values are taken from depth and lift declared in the material properties.

If your machine has the home switches and all three home switches are activated in the Origin setup tab, Z Reference value is automatically calculated when Home key is pressed and you do not need to use Z Ref key seperately. If your machine does not have the home switch then user needs to setup home switch none for Z axis and then you should declare the Z Reference value in the Origin setup in the Z offset under Start Position. Now when you press the Home it will go up by that distance declared to park the tool up in the air and then park properly for X and Y axis. However, you can use Z Ref key idependently for Z surfacing as well. It is an useful function when you are processing gcode files.

If your machine does not have any home(Limit) switches and home switches are disabled in Origin setup then use this method. Make your machine move in X and Y direction somewhere in the middle of the machine and then bring the Z axis down to touch the material. Now press Z Ref key and tool will travel up by the distance declared in the Z offset under Start offset in Origin setup tab. You should go back to the park position for X and Y axis only by clicking on the button on the Control Pad 'Move To 0, 0'.

If your Z stroke is 3 inches or more and you do not care to travel the full stroke while seeking the home switch during homing operation, you could declare Z home switch not enabled and declare your own Z-up stroke in the Z-offset in start position of Origin setup menu.

Z axis soft limit is an additional feature that will respect the travel distance declared in the Maximum Travel for Z axis declared in the Machine Properties. **It will be effective when home switches are activated in the Origin setup area. It is also effective when Z Ref Key is used.** User can use either automatic homing feature with all three axis to home properly at the launch of Linkmotion or manual homing can be done by pressing the home key of the control pad and also seperatly use ZRef key for homing the Z axis. In both cases Z axis will limit the travel distance decared for Z axis under Machine Properties.

Enter Key (Repeat Key):

It is extremely important to setup Z axis properly before using this Enter/Repeat Key function. There are two ways to repeat the job last sent to the LinkMotion USB controller

1. Press either of the 'ENTER' keys on the PC keyboard.
2. Attach a hardware switch directly to the LinkMotion USB controller

The Cycle Start switch will immediately process the last job sent to the controller without sending the job again from the PC.

The LinkMotion Control Pad should be active in the foreground of your computer screen. This function can be activated in four ways.

- (1) Press the Enter key of the computer keyboard
- (2) Press the Enter key from the numeric keypad of the computer keyboard,

- (3) Click on the Repeat key (on your computer screen) with the left mouse button.
- (4) Press the hardware switch connected to the LinkMotion controller for Repeat.

Read and follow the detailed explanation for hardware switch connection and how you can enable it with LinkMotion.INI file settings. The red LED will be flashing on the USB controller if the controller is equipped with a repeat key and if the SD memory card is holding a job.

Hardware Pause and Cycle Start switches can be connected to USB controller and that information is provided in the STOP/PAUSE/Zero Key or Space bar explanation area in earlier pages. Please read and understand those functions properly for your USB controller prior to using them.

Firmware Version:

USB ontroller has the Firmware that may need to be upgraded as and when necessary with newer version of LinkMotion software. Existing Firmware is always displayed on the Control Pad. Please follow necessary upgrade procedure descible in the installation area when Firmware needs an upgarde. When LinkMotion is Re-Launched after the Firmware upgrade you can confirm on your Control Pad to read the newer version of the Firmware.

Serial Number:

LinkMotion reads the serial number of the controller when it is launched. USB Controller needs to be powered either from the USB connection of the PC or Power on the USB Controller box that you purcased from us. Power on the USB controller needs to be on for it to read this serial number.

When the LinkMotion is launched and if the serial number of the attached controller is not recognized by the driver software, it will change the available working area of the table in Machine Properties to 1 inch X 1 inch. The software will run in a demo mode and will not allow the user to output the file size larger than 1 X 1 inch. User can re-Launch LinkMotion if you think this was an error. Please contact Solustan if it keeps giving you the same 1x1 inch working area. Solustan will need to varify your serial number and guide you properly.

You will also loose the capabilities of processing pre generated gcode files. User will not see the GCode Files tab with LinkMotion. Fully authorized USB Controller Serial numbers will have all functions working properly.

If you did not have your USB controller connected ahead of time then you need to remember and change these values in X and Y axis maximum travel ara of Machine properties and then Re-Launch your LinkMotion. Design applications read these table size available from the LinkMotion driver when design application is launched. User should launch design application again if any changes were made in LinkMotion's maximum travel area of X and Y axis of Machine properties.

USB connection, SD memory, Emergency stop and Job Time:

USB connection, SD memory, Emergency stop and Job Time are four items just below the Solustan Logo in the Control Pad. There are three lights in front of first three items showing green or red. These lights show up if following lines are there in LinkMotion.INI file. This file is located in your hard drive in following location:

Windows 10, 8, 7 32/64:

In the C:\ProgramData > Solustan > LinkMotion > LinkMotion.INI.

Windows XP:

In the C:\Document and Settings > All Users > Solustan > LinkMotion > LinkMotion.INI

You need to check and re-launch LinkMotion in order for these status indicators to work properly if for any reason PC disconnected the LinkMotion USB controller.

status1=USB connection

Check your **USB (cable) connection** if this First light is Red. Some times simply disconnecting and connecting the cable back along with exiting LinkMotion and Launching it back will bring back the Green light.

status2=Memory card

Check your (SD) Memory card in the USB Board if the Second light is Red. SD card is properly plugged and working well then it should show you the green light. Approximately 1minute of work uses 1MB of memory. This controller supports up to 4GB Memory. We have listed the memory we have tested with and user can make sure to use proper SD memory.

status3=Emergency stop

Emergency stop is activated by emergency switch that you might have connected to your machine then this Third light is Red. LinkMotion will recognize this and should pause the job and delete the remaining file. You will have to exit and re-launch the LinkMotion application to start again. This is activated in the LinkMotion.INI file.

Estop

1. Normally, the LinkMotion software is shipped with E-Stop sensing disabled via the INI file. Search for the line EStop=-1 in the section of the INI file for your machine (Name of the machine you selected when installing).

EStop=-1 disables the function.

ESTop=0 enables emergency stop function for normally open E-Stop switch.

ESTop=1 enables emergency stop function for normally close E-Stop switch.

2. Additionally, when the LinkMotion Control Pad is displayed you will see a **green or a red light to the right of the control buttons indicating the status of the E-Stop.**

3. E-Stop wiring information is printed on the newer new AGNI boards. Older Agni with three DB25 connectors has Pin 2 of the Connector 2 for E-Stop as well as all safety switches. Older 16 bit board has Input 2 for Estop along with GND(ground) on the same input connector.

4. The sensing voltage must be limited to +5 VDC when connecting lines to the E-Stop pin on our controller. **Applying higher voltage will damage the controller.**

5. New version of 32 bit AGNI boards are opto isolated using opto isolation circuits and a jumper is provided to use either internally available +5 VDC or externally provided higher voltage.

Maximum allowable external voltage is 24 VDC.

Older 32 bit Agni with three DB25 connectors has 12 input lines on connector 2, pins 1 through 12. All of them are opto isolated using opto isolation circuits on the breakout board (BOB). At this point, actively used lines are pins 1, 2, 3, 7, 8, and 9. The BOB is equipped with a jumper to use either internally available +5

VDC or externally provided higher voltage using pin 13. **Maximum allowable external voltage is 24 VDC.**

6. On sensing the fault on the E-Stop line, the controller will halt any motion in progress, display a red light for Emergency Stop on the Control Pad screen, terminate any profile that is running in the controller.

Using new 32 bit AGNI Controller user needs to first deactivate the Estop switch, home the machine and send the job again.

Job will never be processed if Estop is active showing the red light on the LinkMotion Control pad.

Firmware 3074(32bit controller) and LinkMotion version 4.20 and higher allows you to see the Light for Estop becoming green when Estop switch is not pressed(Released). User can jog the machine and home the machine for starting a new job without relauching LinkMotion. Previous version of the all the firmware (prior to 3074 for 32 bit controller and 2078 for 16bit controller) and Linkmotion required for user to Re-launch Linkmotion before it allowed you to jog and home the machine.

8. There is no internal circuit designed to take the power off of the AC to DC power supply. The step motor will still be powered. However, there will be no movement.

status4=Job Time

This function will display the time when a job is prepared and sent to the machine by LinkMotion driver. It will display approximate time in minutes and seconds. This Job time also is displayed when a job is sent using the Repeat(Enter) Key. However, job time will not be displayed if the user has re-launched LinkMotion for any reason and then uses the repeat key. User will need to generate the job again using the Print command for it to display proper Job time.



USB Controller Board Lights:

There are three LED lights on the USB Controller board Blue and Amber. These lights behave in the following manner:

Blue LED Flashing Slowly – No USB Connection

Blue LED Steady – USB powered up and ready

Amber LED Flashing Slowly – Waiting for firmware update

Amber LED Flashing Fast – No SD (Memory) card

Amber LED Steady – USB ready with SD card

Red LED Steady – Turns on when board is powered. It turns off when it makes proper connection with LinkMotion. It should turn on every time when any machine motion is detected.

Red LED Flashing – If hardware switch for Repeat is installed on the USB controller and LinkMotion.INI file is setup properly then Red LED starts flashing after a job is processed one time. Pressing the Repeat switch will send the job again to the machine. After a job is processed one time it is ready to repeat the last job using either of the Enter key on the PC keyboard as many times as user wishes.

Customizing Control Pad Keys:

LinkMotion installs a folder name **Button Graphics** under Program Files in following location:

Win 10, 8, 7-64: C:\Program Files(x86) > Solustan > LinkMotion > Button Graphics > Down and UP folders with same file names

Win 10, 8, 7-32 and XP: C:\Program Files > Solustan > LinkMotion > Button Graphics > Down and UP folders with same file names for all keys.

Folder name Up has all ControlPad keys that you see when keys are not pressed. **Folder name Down** has all ControlPad keys that you see when keys are pressed. All names for the keys are same in each folder. User can design their own keys and give the same names and replace these files.

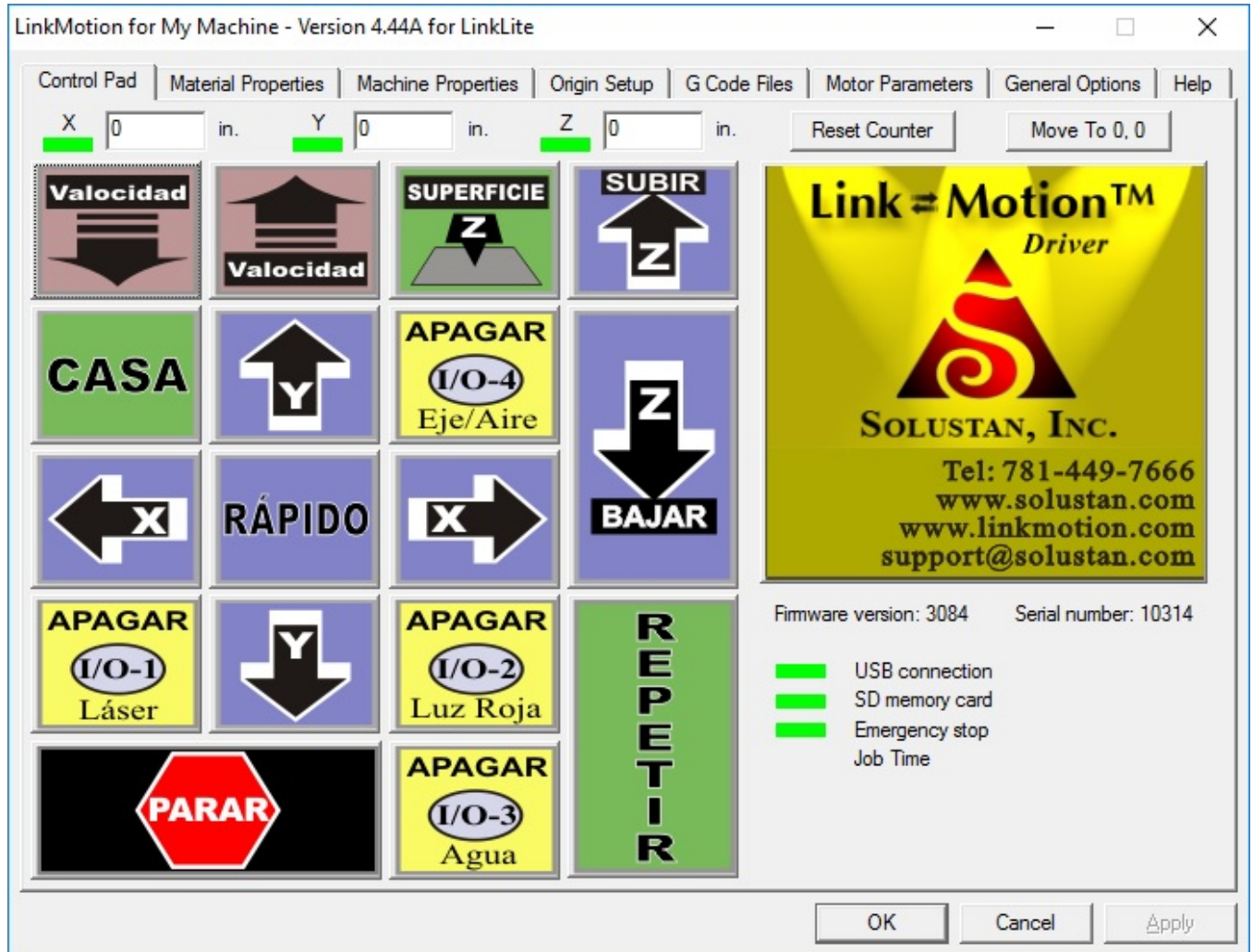
(1) All small keys like X Right, X Left, Y Up, Y Down, Z Up, Fast, I/O 1, I/O 2, I/O 3, I/O 4, Home, Speed Down, Speed Up and Z Ref(Surface) should be designed with 91x73 pixel size bmp files.

(2) Z Down and Repeat keys are designed with 91x154 pixel size bmp files.

(3) Stop(Pause) key is designed with 192x73 pixel size bmp file.

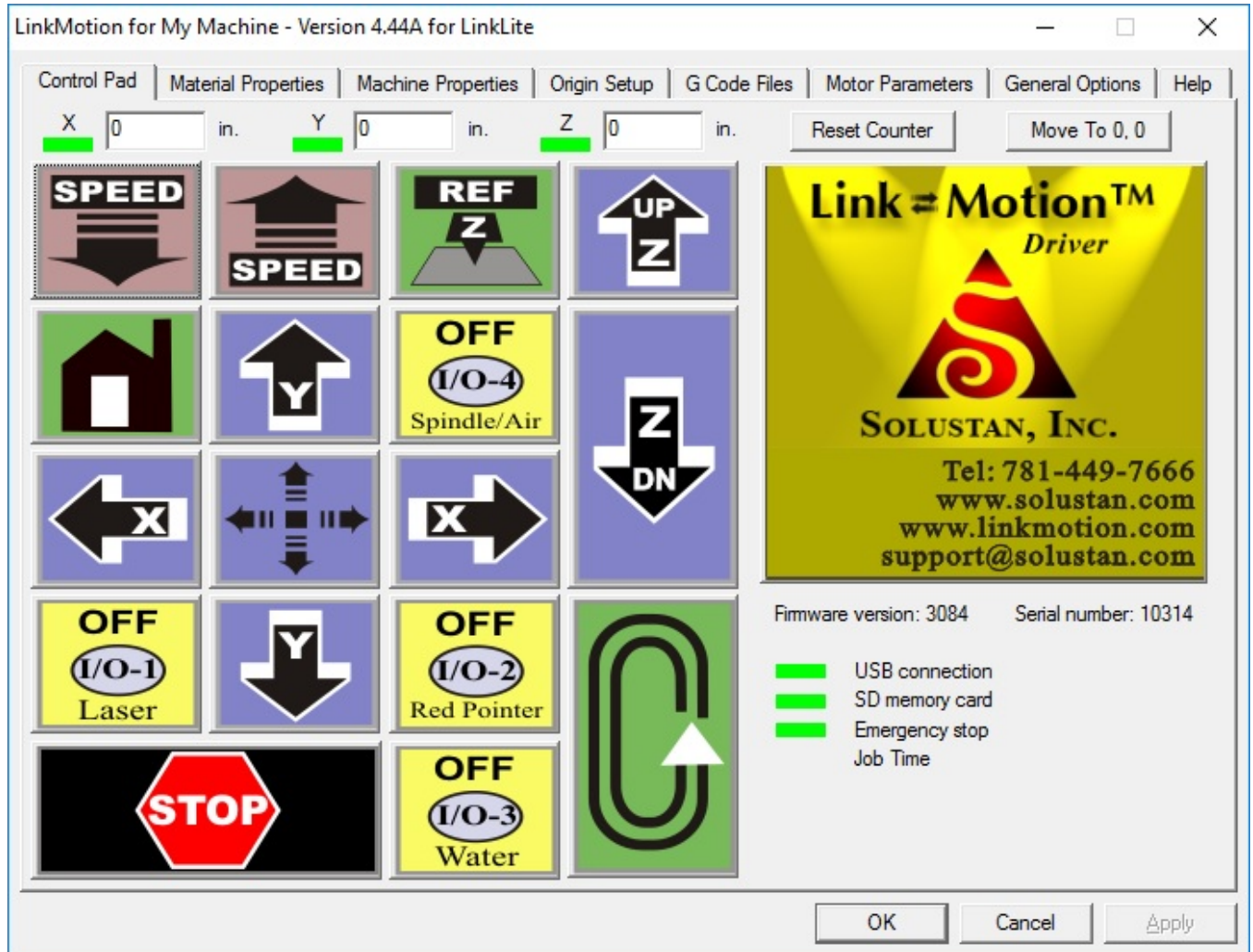
One last thing to make these custom keys visible and active is to go to the LinkMotion.INI file. Find a line **CustomButtons=0**. **Change this value from zero to number 1**. It should read **CustomButtons=1** Save that file and Re-Launch LinkMotion and you will see your own custom designed keys.

Control Pad in the Spanish language:



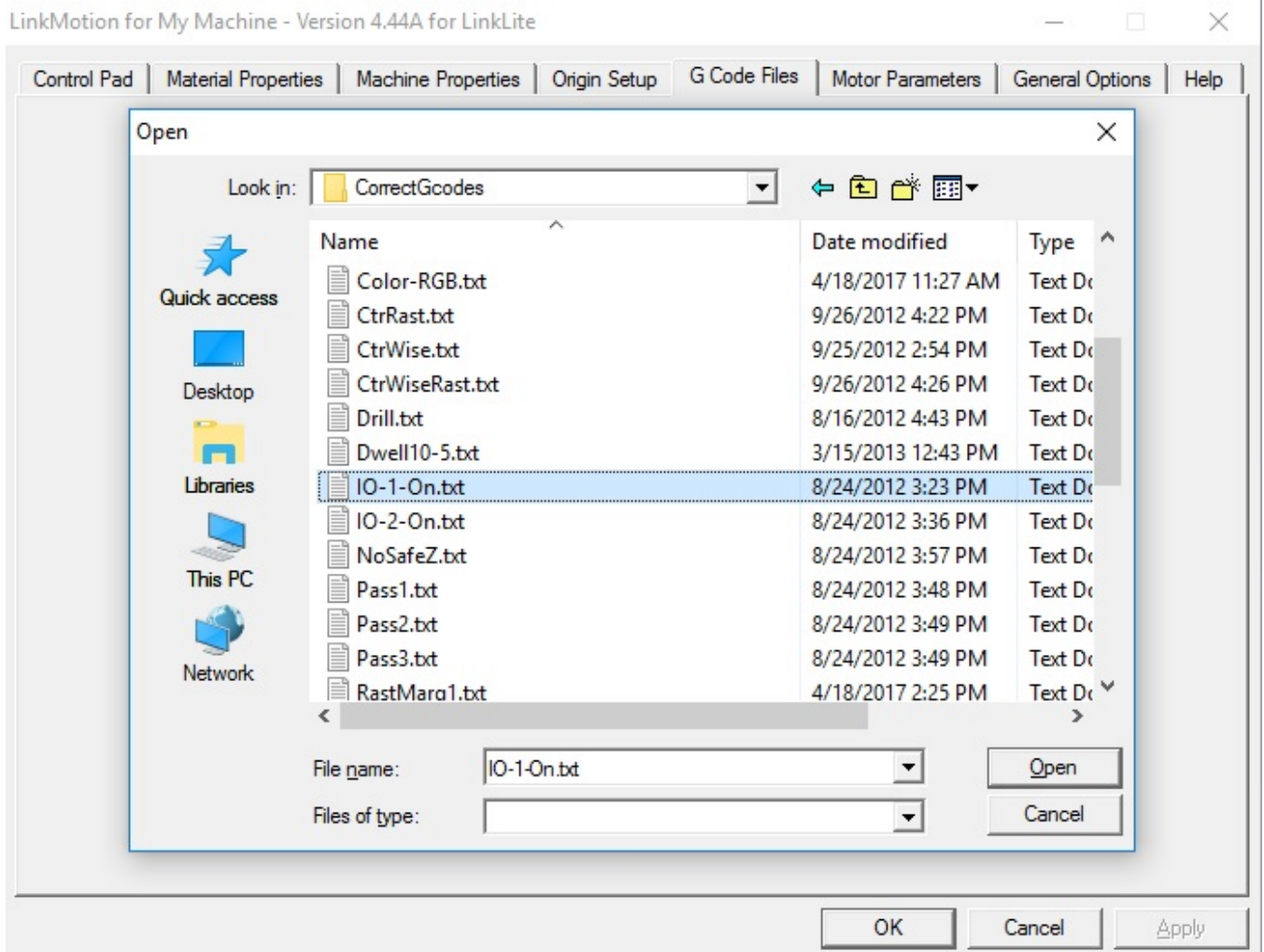
Go into **General Options** menu. Look at **Control Pad Labels**. Arrow to the right will show you the choices you have. Here select the **Spanish** Control pad and click on **Apply** button. Now you will see the **Spanish control pad**.

Control Pad with Symbols:



Go into **General Options** menu. Look at **Control Pad Labels**. Arrow to the right will show you the choices you have. Here select the **Symbol Control pad** and click on **Apply button**. Now you will see the **Symbol control pad**.

G Code Files:



This allows you to output previously generated G-Code and 3D G-Code files of other applications to your machine from LinkMotionUSB driver. If you send 3D G-Code files make sure that your machine is capable of handling 3D files. **User needs to make sure that you have setup all the parameters for your machine properly by going to the Machine Properties, Material Properties, Motor Parameters, Origin setup and Motion Control Boards before sending the file from here.**

LinkMotion software in demo mode or if USB Controller serial number is not authorized you may loose this G Code processing tab.

User simply can click on the **G Code Files menu** and it will show you the dialog box to select your file from where it is on your computer. You simply navigate to the file and click on the **Open** button and it should output on your machine.

LinkMotion USB uses EMC2 interpreter with following Supported M and G codes:

User can download the manual from www.linuxcnc.org/docs/EMC2_User_Manual.pdf. This has complete

explanation for M and G-Codes.

G0 Rapid linear motion – program X-Y-Z-A-B-C- all 6axis motion commands

G1 Linear motion at feed rate

G2 Arc at feed rate clockwise

G3 Arc at feed rate counterclockwise

G4 Dwell

G10 Select Coordinate Offset System

G17, G18, G19 Select Plane

G20 for inch, **G21** for mm works with LinkMotion. Some G-Code generating programs use **G70, G71** and user should replace these with **G20** for inches and **G21** for mm.

G40, G41, G42 Cutter Compensation (requires pre-defined tool table file)

G43, G49 Tool Length Offsets (requires pre-defined tool table file)

G53 Position Move without regard to current Coordinate Offset

G54, G55, G56, G57, G58, G59, G59.1, G59.2, G59.3 Set Coordinate Offset (requires coordinate parameter file)

G61, G61.1, G64 Set Path Control Mode (Control radius at corners like **P0.004**) It is important to have **P** in front of the value.

G80 Cancel Modal Motion

G81-Drilling, **G82**-Drilling with Dwell, **G83**-Peck Drilling / Canned Cycles

G90-Absolute mode, **G91**-Incremental mode

G92, G92.1, G92.3 Coordinate System Offsets

G93, G94 Set Feed Rate Mode – **G94** to start units per minute mode. **G93** to start inverse time mode.

G98, G99 Canned Cycle Return Level

M1 – Stop running program temporarily (not sure) **M2 or M30** to end the Program.

M3-Spindle start Clockwise, **M4**-Spindle start Anticlockwise,

M5-Stop Spindle / Spindle Control (Do not include S commands for spindle speed)

M7 and **M8**-Coolant on, **M9**-Coolant Off / Coolant Control

M6 – Tool Change command – T(X)

M62 Turn on digital Output synched with motion, **M63** Turn off digital output synched with motion

M64 Turn on digital output immediately, **M65** Turn off digital output immediately.

If your software generates F commands for feed rate it should always have proper number values like F2.0 for job feed rate. If you have 0.00 value or no value after F it will not process your file.

You also need to have end of the file command with either M02 or M30. Files will not be processed if end of the file command is missing.

The process requirement using M & G codes will be as follows:

1. User will set the tool at X=0, Y=0, and Z=0. Typically, the user may bring the tool to lower left of the machine and bring the tool down to where it touches the top of the surface. Also, the material may also be set to the lower left of the machine.
2. If there is a jig set up, the user may bring the tool to one of the corners of the material and bring the tool to the top surface of the material. This will be 0, 0, 0.
3. The CAM program shall have the facility to declare a very first move command to be a tool lift distance defined by the user.
4. The processing will start at this point. Including spindle on, turning on of the I/O's, G rapids, and the rest of the job.

5. If the CAM program does not have the facility to lift the Z axis at the beginning of the job, the user will be required to edit the file and insert appropriate tool lift command.
6. Assuming X axis to be the axis from left to right as the user faces the machine, X axis moving right is a positive number and X axis moving left is a negative number.
7. Assuming Y axis to be the axis from front to back as the user faces the machine, Y axis moving away from the user is a positive number and Y axis moving toward the user is a negative number.
8. For the Z axis, Z axis moving up is a positive number and Z axis moving down is a negative number.

How to use G54 to G59.3 commands for Set coordinate offset:

A. If working with inches and if you use G10 L2 command, you need to program the offset values in user units. If your user units are in mm, you need to declare offsets in mm. Similarly, if your user units are in inches, you need to declare the offsets here in inches.

B. However, if you are working with 52XX parameter commands to set your offsets, these parameters shall always be declared in mm, no matter what the user units are.

C. It is always a good idea to set G54 to coincide with machine home in order to bring it back to machine home at the end of a job. At this point, we restart G-code compiler at the end of every job. Whatever the offset settings were, were reset. We may choose to change that in future. It will be a good practice to set G54 for machine home and bring it back. This will allow you to operate your saved jobs in future, even if we make changes to the compiler in future. Please, note the additional command G00 X0 Y0 Z0 after issuing G54 to bring the machine back. See following examples.

Example 1 - Using G10 L2 P1 command:

```
G94
G90
G20
G10 L2 P1 X0.0 Y0.0 Z0.0
G10 L2 P2 X2.0 Y-2.0 Z0.0
G10 L2 P3 X4 Y-4 Z0
G64 P0.004
G55
G00 X0.005 Y-0.011 F60.000
G01 Z-1.272
G04 P0.100
G01 X1.186 Y-0.011
X1.186 Y-0.601
X0.005 Y-0.601
X0.005 Y-0.011
G01 Z-1.119
G00 X0.202 Y-0.798 F60.000
G01 Z-1.272
G04 P0.100
G01 X1.383 Y-0.798
X1.383 Y-1.389
X0.202 Y-1.389
X0.202 Y-0.798
```

```

G01 Z0.000
G00 X0.000 Y0.000 F60.000
G56
G00 X0.005 Y-0.011 F60.000
G01 Z-1.272
G04 P0.100
G01 X1.186 Y-0.011
X1.186 Y-0.601
X0.005 Y-0.601
X0.005 Y-0.011
G01 Z-1.119
G00 X0.202 Y-0.798 F60.000
G01 Z-1.272
G04 P0.100
G01 X1.383 Y-0.798
X1.383 Y-1.389
X0.202 Y-1.389
X0.202 Y-0.798
G01 Z0.000
G00 X0.000 Y0.000 F60.000
G54
G00 X0 Y0
M02

```

Example 2 - Using G54 to G59.3:

```

G94
G90
G20
#5221=0
#5222=0
#5241=50
#5242=-50
#5261=100
#5262=-100
G64 P0.004
G55
G00 X0.005 Y-0.011 F60.000
G01 Z-1.272
G04 P0.100
G01 X1.186 Y-0.011
X1.186 Y-0.601
X0.005 Y-0.601
X0.005 Y-0.011
G01 Z-1.119
G00 X0.202 Y-0.798 F60.000
G01 Z-1.272
G04 P0.100
G01 X1.383 Y-0.798

```

```

X1.383 Y-1.389
X0.202 Y-1.389
X0.202 Y-0.798
G01 Z0.000
G00 X0.000 Y0.000 F60.000
G56
G00 X0.005 Y-0.011 F60.000
G01 Z-1.272
G04 P0.100
G01 X1.186 Y-0.011
X1.186 Y-0.601
X0.005 Y-0.601
X0.005 Y-0.011
G01 Z-1.119
G00 X0.202 Y-0.798 F60.000
G01 Z-1.272
G04 P0.100
G01 X1.383 Y-0.798
X1.383 Y-1.389
X0.202 Y-1.389
X0.202 Y-0.798
G01 Z0.000
G00 X0.000 Y0.000 F60.000
G54
G00 X0 Y0
M02

```

G-Code File Processing with Safe Z:

When processing G-Code files user needs to follow proper procedure for setting up tool for Z axis at the surface of the material. This surface of the material should be “0”(zero) before you process any G-Code file. G-Code example files are also given at the end of the safe Z process explanation.

(1) Manual Safe Z setup process with LinkMotion - Machines that do not have home (limit) switches or home switches are disabled.

(2) GCodeZMove=1 – This setup in LinkMotion.INI file will send immediate command for Z axis to move down to “0” (zero) or Surface of the material position before any G-code file is processed.

(1) Manual Safe Z setup process with LinkMotion - Machines that do not have home (limit) switches or home switches are disabled.

(A) Prepare your G-Code file. (We have done testing with the file names with .txt, .cnc.tap and .ncd)

(B) Open and edit the G code file and insert Z up command (positive value) at the beginning of the file to move the tool to a Safe Z value and similar Z up command (positive value) at the end of the file to move the tool up after it finishes the job and save the file. This value cannot be higher then total Z travel available on your machine. Some CadCAM softwares allow you

declare this Z up move in their software and generate this automatically. In that case you do not need to edit the file.

- (C) Now, **go to the Origin setup** of LinkMotion and check the button for **Disable Home Switches** if you have that option available. Declare the same positive value (same as in no 2. above) in **Start Offset of Z axis in Start Position. Click on the Apply button.**
- (D) Now, go to the **General Options** tab of LinkMotion and declare the same positive value (same as in no 2. above) in **Nudge. Click on the Apply button.**
- (E) **Park the tool at X0, Y0 tool's parking position** (start position) using the **Control Pad keys.** For example, if you have selected Bottom Left Start position in LinkMotion's Origin setup, Start position selection then tool should be parked at the bottom left of the table.
- (F) **Click on the Reset counter button on the control pad and X and Y axis counter should set to 0, 0.**
- (G) **Bring the Z axis down until it touches the material.** Now **press Z-Ref (*) key** on the key board and Z axis should travel up by declared value in Z offset of start position.
- (H) Now last thing you need to do is to **bring the arrow of your mouse on the screen where it shows Z down key. Click on this with the left mouse button** and Z should travel down to the surface of the material and **you should see X0, Y0 and Z0 value** on the counter of each axis on the screen of LinkMotion Control pad.
- (I) Now you are ready to process your G-Code file. Open the G-Code file tab and select your file and click on the open button. This should process the G-Code.
- (J) **Remember to bring Z axis down to 0 (zero) value before sending another job.**

Example File 1 is generated without activating Safe Z in Linkmotion or SafeZ=0 value in Linkmotion.INI file:

```
G94
G90
G20
(Insert job start commands here)
G64 P0.1 Q15
G01 Z0.000 F30.000
M64 P1
S800.000
G04 P1.000
G15 X30.00 Y30.00 Z30.00 A30.00 B30.00 C30.00
G00 X1.0 Y-1.0
(Pen change to pen 1)
S800.000
G01 Z-0.750
(Insert start shape commands here)
G01 X3.0 Y-1.0 F60.000
X3.0 Y-2.0
X1.0 Y-2.0
X1.0 Y-1.0
G01 Z-0.350 F30.000
(Insert end shape commands here)
G00 X2.0 Y-3.0
G01 Z-0.750
(Insert start shape commands here)
G01 X4.0 Y-3.0 F60.000
```



```

X4.0 Y-4.0
X2.0 Y-4.0
X2.0 Y-3.0
G01 Z0.000 F30.000
M65 P1
S0.000
(Insert end shape commands here)
G00 X0.000 Y0.000
(Insert end job commands here)
M02

```

Example File 2 is generated by editing GCode file:

```

G94
G90
G20
(Insert job start commands here)
G64 P0.1 Q15
G01 Z0.500 F30.000
M64 P1
S800.000
G04 P1.000
G15 X30.00 Y30.00 Z30.00 A30.00 B30.00 C30.00
G00 X1.0 Y-1.0
(Pen change to pen 1)
S800.000
G01 Z-0.250
(Insert start shape commands here)
G01 X3.0 Y-1.0 F60.000
X3.0 Y-2.0
X1.0 Y-2.0
X1.0 Y-1.0
G01 Z0.150 F30.000
(Insert end shape commands here)
G00 X2.0 Y-3.0
G01 Z-0.250
(Insert start shape commands here)
G01 X4.0 Y-3.0 F60.000
X4.0 Y-4.0
X2.0 Y-4.0
X2.0 Y-3.0
G01 Z0.500 F30.000
M65 P1
S0.000
(Insert end shape commands here)
G00 X0.000 Y0.000
(Insert end job commands here)
M02

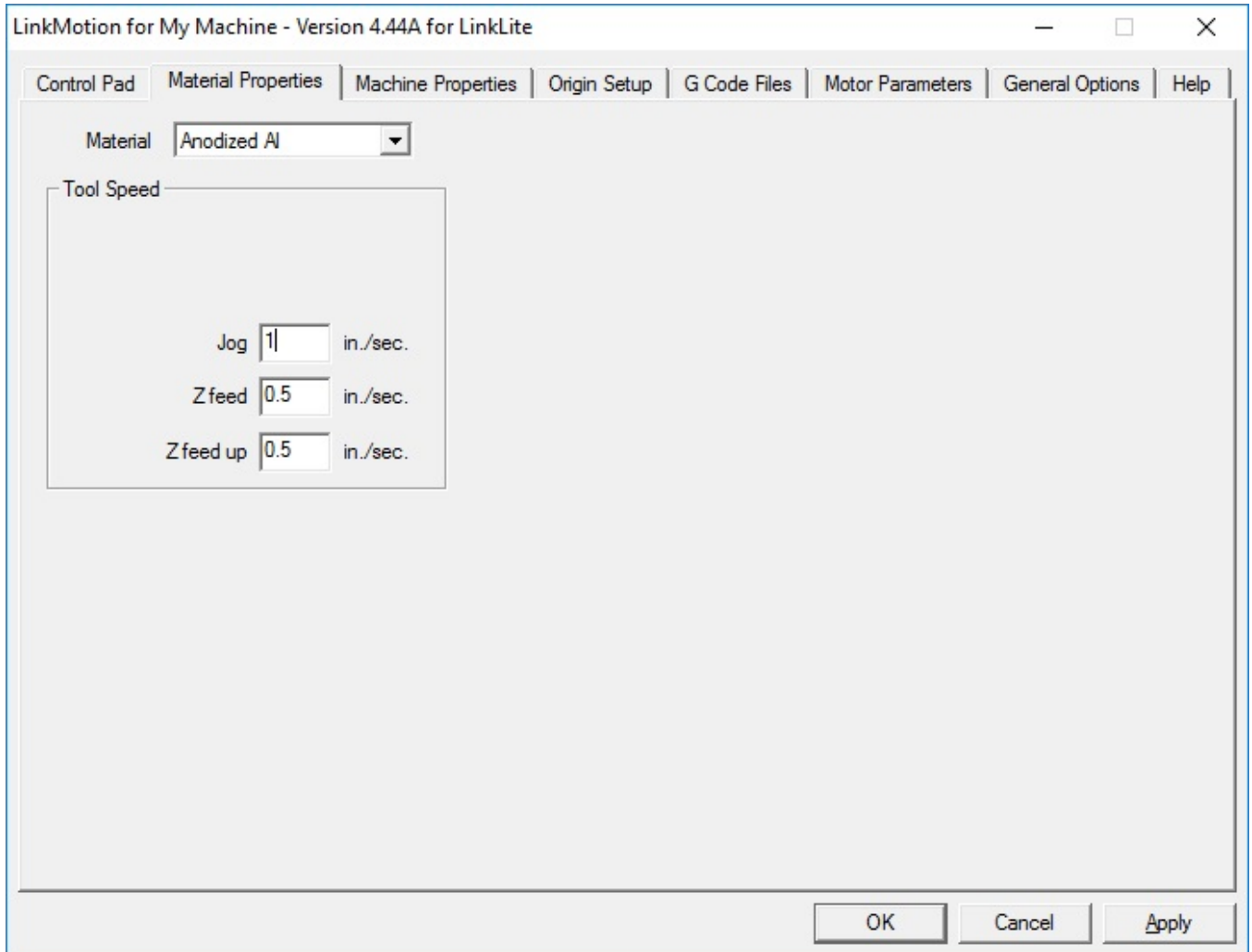
```

(2) GCodeZMove=1 – This setup in LinkMotion.INI file will send immediate command for Z axis to move down to “0” (zero) or Surface of the material position before any G-code file is processed.

GCodeZMove = 0 or 1 is a setting in your LinkMotion.INI file. 1 value activates this feature and 0 value does not activate this feature. Refer to locate the LinkMotion.INI file as explained in Safe Z area in number 2 earlier.

- (A) This feature should be activated and used only to Process G-Code files previously saved.**
- (B) Do not activate this feature if you are sending a file from your design application with simply a print command using LinkMotion driver.**
- (C)** Previously saved G-Code files then should be sent to the machine by selecting G-Code File Menu (tab) from LinkMotion and selecting that file.
- (D)** Using LinkMotion Control Pad user should bring the Z down to the touch the surface of the material and then send the tool to **home position pressing the home key** (Z Ref key can be used also for only Z axis parking position) when home switches are activated. Now the tool should be parked away from the material sensing the home switch in Z axis as well as X and Y axis. Now when you process the previously generated Gcode file following should happen.
- (E)** LinkMotion will first move Z axis down to “0” (zero or surface of the material) location by sending an immediate command and then process your G-Code file that you selected.
- (F) Remember to press Z Ref key each time before sending the next job so Z travels away from the surface of the material (this should be the parking position for Z axis).
Refer to the Example File 1 in the Manual Safe Z description from the earlier pages is the kind of file user should use.**
- (G)** If your Gcode generating software has the function where it can generate first Z move up and the last Z move up command for parking the Z axis away from the surface of the material then user can park Z axis at ‘0’ (zero) and process the gcode file without pressing the Z Ref key. Look at the example file 2 in the earlier page for Gcode file that is generated using the Safe Z function activated.

Materials Properties:



Material:

Pull down the **Material Properties menu** to observe a selection of various materials. Pre-select the values of speed and tool positions for each of the materials. LinkMotion can be employed to work with many different types of machines. Hence, there is no single value appropriate for all different machines. User's experience will dictate the values for his/her machines.

The values can be inches per second or millimeters per second or centimeters per second. General Options menu allows you to make your selection for this measure of units. You can override the any setting by changing it while the material is selected. Click the 'Apply' button to make the new value effective.

Tool Speed:

Jog Speed:

Jog Speed is preset and can be changed in the Jog value under Tool Speed. Hold down any directional key while the Control Pad is in the foreground on the screen and the respective axis will move in the direction at the speed of the declared jog speed. **The jog speed can be higher than the Job feedrate speed. These numbers are dependent on the motors capacity and the load it carries. Please experiment and place reasonable numbers.**

Maximum Jogging Acceleration value is declared in GENERAL section separately for each of the axis in the LinkMotion.INI file under [AXIS_0] for X axis, [AXIS_1] for Y axis, [AXIS_2] for Z axis, [AXIS_3] for A axis, [AXIS_4] for B axis, [AXIS_5] for C axis using the following line:

MAX_MM_PER_SEC_PER_SEC_JOG= _____.

User needs to Save the LinkMotion.INi file after changing this value in above shown line and then Re-Launch LinkMotion applet for it to be effective.

Numeric keypads on the PC extended keyboard are the best way to use the Control Pad. If you use mouse clicks to try to jog any of the axes, you will actually end up using the nudge feature as explained in the General Options Tab section of this document.

Numeric keypads on a laptop: There are two ways to use the numeric keypad on a laptop. Generally, laptop keyboards have an additional key that invokes the numeric keypad as a third level of keys. Refer to the documentation for your laptop. Alternately, inexpensive numeric keypads can be attached to an available USB port. Make sure and buy a keypad that is USB 2.0 compatible. Wireless numeric keypads are also available but these devices may not work properly.

Z feed (down) and Z feed up Speed:

In case of LinkMotion CNC/Engraving software, the default **Z Feed (Down)** value and **Z feed Up** can be made active simply by setting the speed value in the **Materials Properties** section. This will allow you to bring the Z axis up and down using the Control Pad of LinkMotion. **LinkMotion uses Z Feed UP speed when simply jogging to bring the Z Axis up or down using the Control Pad. When a job is sent to the machine, LinkMotion will make Z axis travel up and down using the different speeds declared for Z Feed(Down) and Z Feed Up. (When Z Ref key is pressed it uses higher of the two speeds (Z Feed or Z Feed Up) declared.**

Z Feed(Down) Speed is setup in each material related settings individually in the LinkMotion.INI file with the following lines.

ZFeed_in=1.0 or ZFeed_cm=2.5 or ZFeed_mm=25.00

Z Feed Up Speed is setup in your selected machine related settings of the LinkMotion.INI file with following lines.

Speed_ZFeedUp_in=1.0 or Speed_ZFeedUp_cm=2.5 or Speed_ZFeedUp_mm=25.00

Machine Properties:

The screenshot shows the 'Machine Properties' tab in the 'LinkMotion for My Machine - Version 4.78 for CNC_LinkLite' application. The window has a menu bar with 'Control Pad', 'Material Properties', 'Machine Properties', 'Origin Setup', 'G Code Files', 'Motor Parameters', 'General Options', and 'Help'. The main area contains three checkboxes: 'Reverse X direction' (unchecked), 'Reverse Y direction' (unchecked), and 'Reverse Z direction' (checked). Below these are two grouped sections. The first section, 'Linear Travel Per Revolution', contains three input fields: 'X axis' with '2.54' mm, 'Y axis' with '2.54' mm, and 'Z axis' with '2.54' mm. The second section, 'Cut (Vector) Backlash', contains two input fields: 'X axis' with '0' mm and 'Y axis' with '0' mm. At the bottom right are 'OK', 'Cancel', and 'Apply' buttons.

Reverse X, Y, or Z direction:

Directions for X, Y and Z can be set properly here by checking or un-checking the direction button. If the axis movements are opposite to the intended directions, the direction or directions can be reversed without changing the wiring.

Linear travel per revolution for X, Y, and Z:

Linear travel per revolution can be changed here if necessary. You may not know all the specifications of your system. The specifications include the pitch of the screw (2 turns per inch, 5 turns per inch, etc.) or belt and pulley movement for a complete turn of the step motor, the full step angle of a step motor (200 full steps for a 360 degree turn, etc.), and the micro stepping of the driver. If you know any two of the three, the third one can be determined using the nudging feature of the Control Pad. Typically, the Control Pad is activated by pressing with your finger on the physical keys of the keyboard. The nudge feature is activated using a

single click of the mouse on the appropriate key on the screen. The nudge distance is set in the General Options. Measure the actual distance moved by the machine and compare it to the nudge distance setting. Make the necessary correction of the value for the unknown parameter to get the specified nudge distance. . **Do not declare zero value even if your machine does not have Z axis. User should leave the default value.**

Machine Calibration(setup) Test:

There is one simple test you can do using the **nudge** value in the **General Options** tab. Default nudge value is 1 inch when you install LinkMotion. User can change this nudge value (0.25 or 0.5 inches) for Z axis if your machine is designed to travel very small distance overall.

Now when you bring up the control pad and bring the arrow of your mouse on the x axis right movement arrow and click with the left mouse button and X Axis of your machine should move 1 inch to the right. If it does not move 1 inch then your values declared as explained above is not correct and you need to get the proper values.

Using that nudge value you can do this test for all of the three axis to determine if your settings are proper in **Linear Travel per revolution of Machine Properties** as well as **Microstep per full step in Motor parameters**.

Following two values are important for getting proper size output.

(1) Linear Travel per revolution in Machine Properties

The pitch of the screw in all three axis determines the linear movement of the axis per single rotation of the step motor.

(2) Microstep per full step in Motor Parameters

Amplifier Drivers used for the motors of your machine determine this value.

Cut (Vector) Backlash Settings:

The LinkMotion has the capability to handle the backlash for each of the axis individually for vector work. Machines may have backlash and may change with the aging of the belts and pulleys and screws. In the vector mode, you try to output a circle and if it does not come back to the same starting point of the circle when it finishes the job, it may need ‘tuning’, also known as backlash correction in one or both the axis. Measure that distance in x and y directions for both the axis and enter that value for X and Y axis separately in the user interface available in Machine Properties and click on the Apply button. You need to enter in inches or mm depending on what you have selected as default in LinkMotion setup.

Motor Parameters:

The screenshot shows a software window titled "LinkMotion for My Machine - Version 4.44A for LinkLite". It has a menu bar with "Control Pad", "Material Properties", "Machine Properties", "Origin Setup", "G Code Files", "Motor Parameters" (which is selected), "General Options", and "Help". The main area contains four groups of input fields:

- Full Steps per Revolution:**
 - X axis: 200
 - Y axis: 200
 - Z axis: 200
- Maximum Toolhead Acceleration:**
 - X axis: 30 in/sec²
 - Y axis: 30 in/sec²
 - Z axis: 30 in/sec²
- Microsteps per Full Step:**
 - X axis: 16
 - Y axis: 16
 - Z axis: 16
- Maximum Motor RPM:**
 - X axis: 2500
 - Y axis: 2500
 - Z axis: 2500

At the bottom right are three buttons: "OK", "Cancel", and "Apply".

Full steps per revolution:

Above values are determined by the motor manufacturer. Enter **Full steps per revolution** values for each axis depending upon the motor and the lead screw size specifications.

Maximum Toolhead Acceleration:

Declare Maximum Toolhead Acceleration values for the motors in each of the axis in in/sec². You may need to adjust this numbers to get proper acceleration constants for smooth motion. Check with your machine manufacturer for the correct numbers required for the machine. In absence of that, a safe starting range is between 10 and 100 inches/sec or 250 to 2540mm/sec.

Microsteps per full Step:

Set the **Microsteps per full Step** for your system for each of the axis. This is necessary only if you are using step motors in your system. This number is derived from the Amplifier driver used for your motors. In case of servo motors, you need to make sure that the multiplication of numbers in this area as well as in the number of full steps per revolution of the motor in the Motor parameters match your encoder number for the feedback. Generally, it would be a good idea to declare number 1 as the number in microsteps per every full step and the encoder resolution number in the number of full steps per revolution in the motor parameters location.

Machine Calibration(Setup) Test:

There is one simple test you can do using the **nudge** value in the **General Options** tab. Default nudge value is 1 inch when you install LinkMotion. User can change this nudge value (0.25 or 0.5 inches) for Z axis if your machine is designed to travel very small distance overall.

Now when you bring up the control pad and bring the arrow of your mouse on the x axis right movement arrow and click with the left mouse button and X Axis of your machine should move 1 inch to the right. If it does not move 1 inch then your values declared as explained above is not correct and you need to get the proper values.

Using that nudge value you can do this test for all of the three axis to determine if your settings are proper in **Linear Travel per revolution of Machine Properties** as well as **Microstep per full step in Motor parameters**.

Following two values are important for getting proper size output.

(1) Linear Travel per revolution in Machine Properties

The pitch of the screw in all three axis determines the linear movement of the axis per single rotation of the step motor.

(2) Microstep per full step in Motor Parameters

Amplifier Drivers used for the motors of your machine determine this value.

Maximum Motor RPM:

Maximum Motor RPM should be specified by your motor manufacturer. Most step motors lose torque significantly after 2,500 RPM. LinkMotion will use your RPM and other motor settings to limit your maximum speed settings in the Material Properties tab.

Origin Setup:

LinkMotion for My Machine - Version 4.44A for LinkLite

Control Pad | Material Properties | Machine Properties | **Origin Setup** | G Code Files | Motor Parameters | General Options | Help

☒ Return to 0, 0 after job ☐ Disable Home Switches Offset Polarities and Directions

Home Switches Position

Top Left

Offsets from home switches

X offset: 0.15 in.

Y offset: 0.15 in.

Z offset: 0.15 in.

Start Position

Top Left

Offsets from home position

X offset: 0 in.

Y offset: 0 in.

Z offset: 0 in.

Homing Speed

X axis: 0.5 in./sec.

Y axis: 0.5 in./sec.

Z axis: 0.5 in./sec.

Home switches

	N/O	N/C	None
X axis	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Y axis	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Z axis	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>

OK Cancel Apply

Return to 0, 0 after job:

If you have not checked this box then, after finishing the job, the tool will travel up on the Z axis and stop at the XY position where it finished the last shape. It does not move from the final XY position. It does not go back to the start position. Checking this box makes your tool go back to the starting position (parking position) for the X, Y and Z axes.

Most of the time, the parking position for X and Y is 0, 0. If you need to sense the home switches again then you should first make sure that your surfacing value in the Z axis is proper by checking Origin Setup and Z offset values in Start Position. Then click on the Control Pad Home key to place your tool in the home position. If you need to change the surfacing value then you need to surface the tool again and then go home.

Disable Home (Limit) Switch:

Checking this box disables the limit switches. Un-checking this box activates the limit switches. If limit switches are present, you must select normally open or closed for the home switch polarity.

If disable home switch button is not checked then homing is activated and user should fully understand the function of homing using home key as well as automatic homing when LinkMotion is launched. Please refer to Home Key as well as Z Ref key functions in Control Pad explanation before using it.

Offset Polarities and Directions:

Offset polarities and direction diagram is shown to display how Machine's travel for X and Y axis works using LinkMotion software. It also displays positive or negative values respectively on the control pad of LinkMotion.

(1) Positive and Negative Direction Explanation:

If your tool is parked on the top left area of your machine then X axis travel to the right is positive values and Y axis travel towards front has negative values.

(2) If your tool is parked on the bottom left area of your machine then X axis travel to the right is positive values and Y axis travel towards the back has positive values.

(3) If your tool is parked on the top right area of your machine then X axis travel to the left is negative values and Y axis travel towards front has negative values.

(4) If your tool is parked on the bottom right area of your machine then X axis travel to the left is negative values and Y axis travel towards back has positive values.

General Z down travel is negative and Z up travel is positive values. Z axis values are calculated after Z axis is surfaced on the table (Either using Z Ref or Homing key as explained in the Control pad explanation) and surfacing value is considered to be zero position.

Home Switches Position:

This is the parking position of the tool of your machine. **Bottom Left, Bottom Right, Top Left and Top Right** are the choices. It is important to understand the setting of the origin for the machine. If the machine has home switches, it will have a defined **Home position**. It should be selected. The offsets from the home switch sensing serve two purposes:

- A. It is advisable to get off the switch once sensed. The **offset value** will allow the machine to move back by the declared distance after reaching the switch.
- B. The offset values can be adjusted to get to a specific position such as the very corner of the table where the user may want to start every job.
- C. This position shall be recalibrated every six months or anytime the sensor is replaced, or as often as necessary to maintain the integrity of home position.

Homing Speed:

The Homing speed for going home is separate from the jogging and move speeds. The machine starts out traveling at the set homing speed. Once reaching home, the machine travels 0.25 inch back into the working area of the table and hunts for home again at a slower speed. This sets the table with the exact home position every time. The Home key is key 7 on the Control Pad. Different homing speed settings for Z, X and Y are available here.

Start Position:

Bottom Center, Bottom Left, Bottom Right, Center, Top Center, Top Left and Top Right are the choices. If your Home Position and Start Positions are the same following are the necessary selection:

Home Position Selection	Start Position Selection
Bottom Left	Bottom Left
Bottom Right	Bottom Right
	Center
	Top Center
Top Left	Top Left
Top Right	Top Right

The job start position can be different than the Home position. The Job start position may be, Where the jig is positioned (Home Position)

The Center of a machine, with offset values in X and Y, in the case of a vise-type machine where both jaws move.

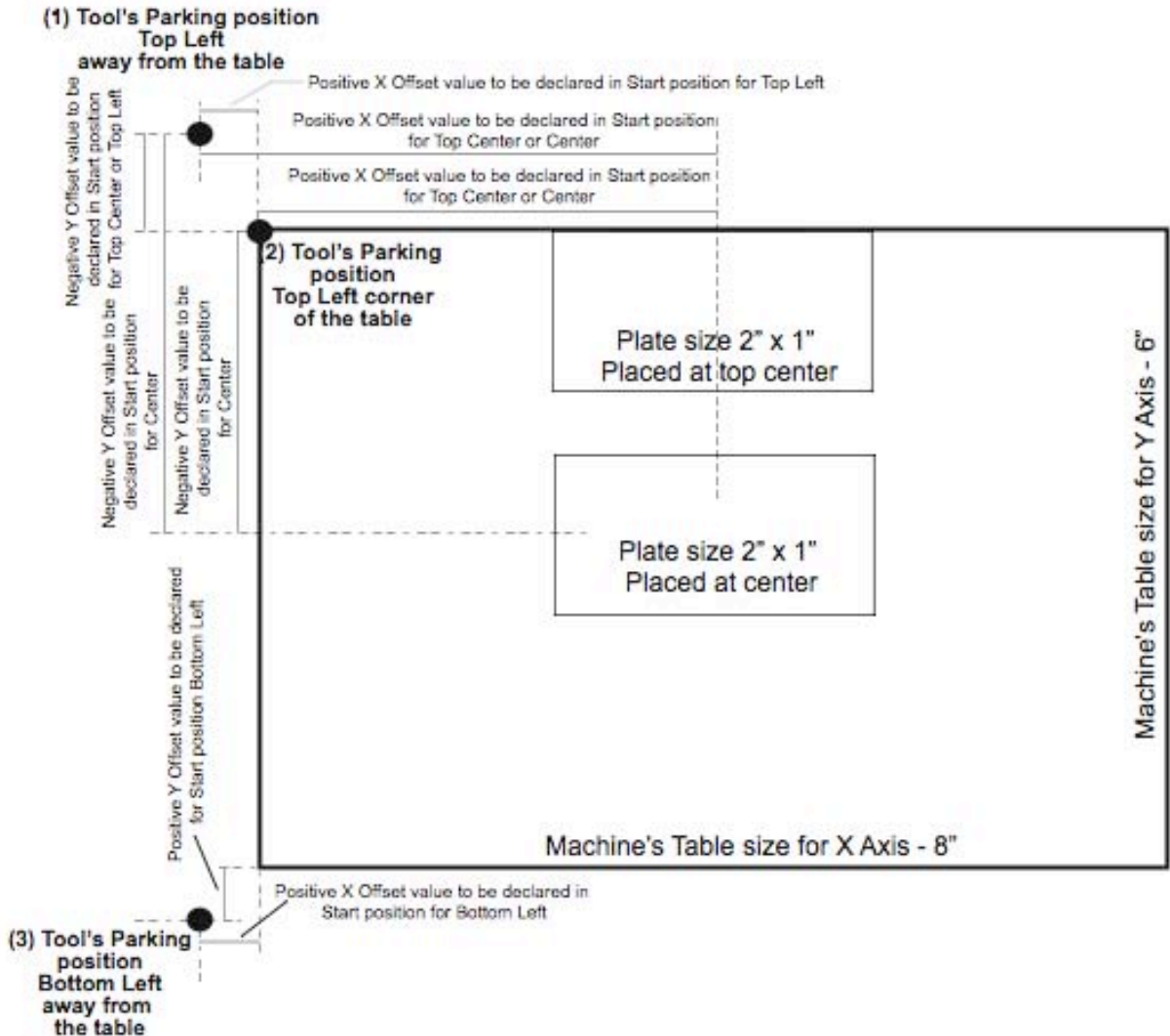
Top center of a machine with an offset value in X only, in the case of a a vise-type machine where only the bottom jaw moves.

In the situations above and others, it is necessary to select a Start Position and declare offset values for X and Y appropriately. Please see the diagrams on the following pages.

Offset from Home Postion:

Offset values under the Start Position have been explained using the diagrams in following few pages. This values can be positive or negative depending on your selection for the Home Position. Make sure to understand and set it properly before starting your production work.

Start Position Explanation



Three different Home Positions are shown in the above diagram.

(1) Top left away from the table, (2) Top left at the corner of the table and (3) Bottom left away from the table. Start position offset values are shown in the diagram above after you have parked the tool in those positions.

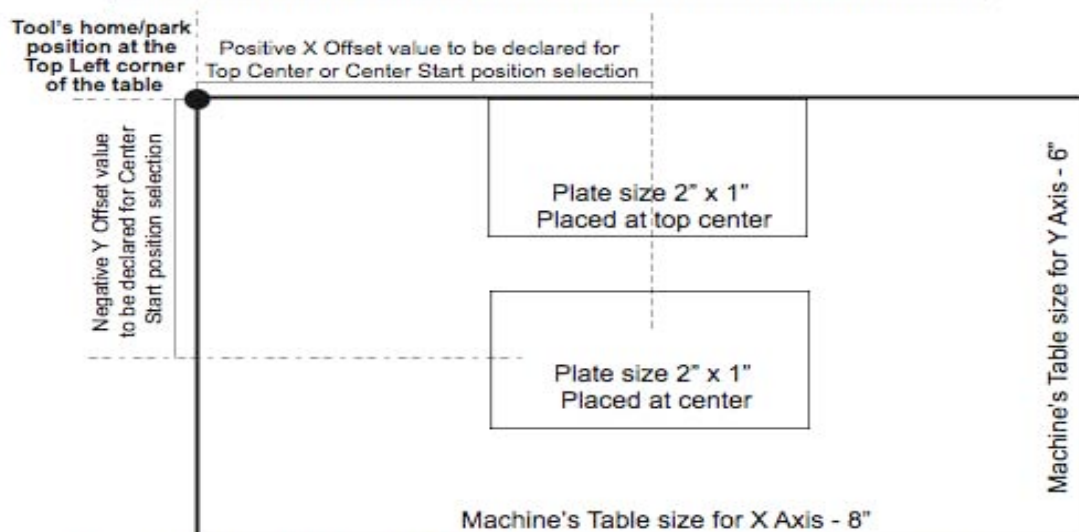
Home Switch Position values for X, Y and Z offset are the values where you want to park the tool after it senses the home switches and parks away from those switches

Start position offsets are declared when tool is parked away from the table or Top Center or Center is selected to be the Start position. Above diagram explains how to setup and enter positive or negative values for Start Position in Origin Setup of Linkmotion.

If your machine is designed to use other home position for parking of the tool then measure the distance from those locations and decide the proper values to declare in positive or negative numbers in the origin setup accordingly.

If you are using engraving design software where design is done in actual plate size then it is better to declare your table size to be same as your plate size and re-launch your design software to get the proper output in proper location.

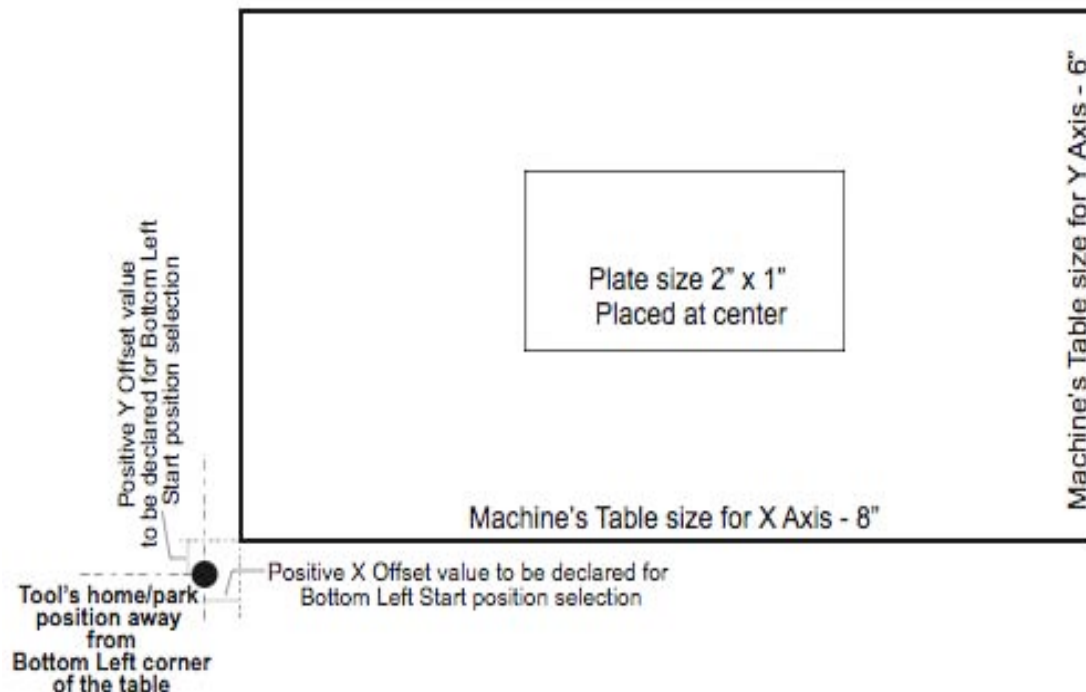
Tool's Home/Park position at the top left corner of the table



Tool is parked at the Top Left corner of the table(machine) and home position selection should be Top Left. Following three choices are available for Start position and respective offset values to enter:

- (1) Top Left - X and Y offset values should be 0 (zero).
 - (2) Top Center - Positive X offset value and Y offset value is 0 (zero).
 - (3) Center - Positive X offset value and Negative Y offset value.
- Top Center and Center selection used for vise type machines.

Tool's Home/Park position at the bottom left and away from the table

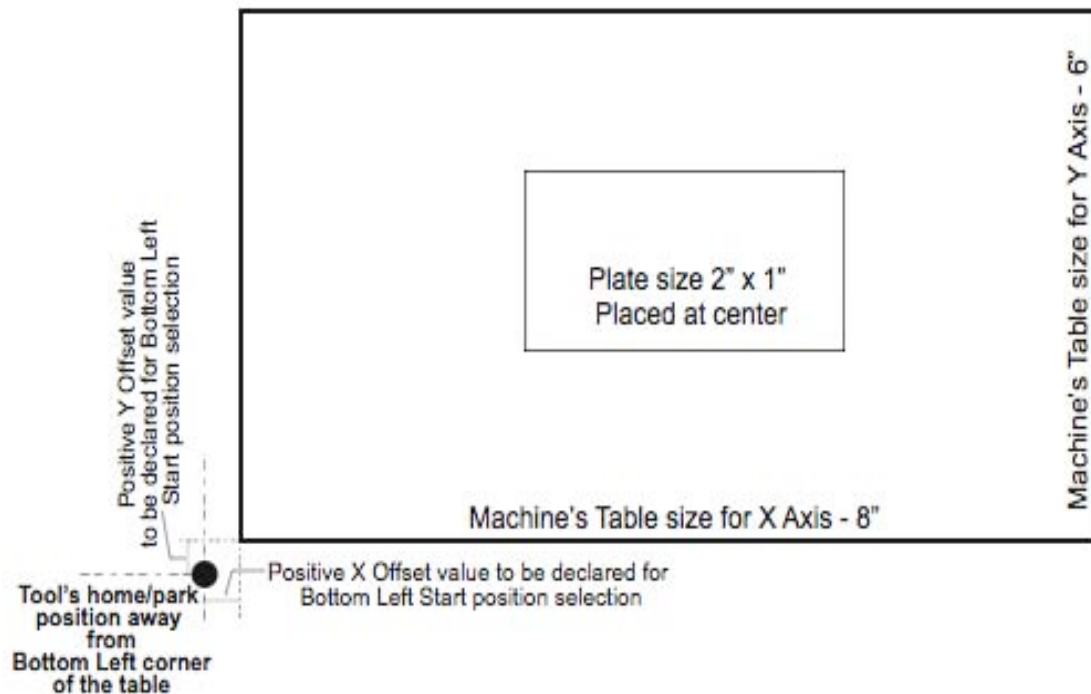


Tool is parked at the Bottom Left and away from the table(machine) and home position should be Bottom Left.

Following choice is available for Start position and respective offset values to enter:

- (1) Bottom Left - Positive X and Y offset value. (X and Y offsets are small)

Tool's Home/Park position at the bottom left and away from the table



Tool is parked at the Bottom Left and away from the table(machine) and home position should be Bottom Left.

Following choice is available for Start position and respective offset values to enter:

(1) Bottom Left - Positive X and Y offset value. (X and Y offsets are small)

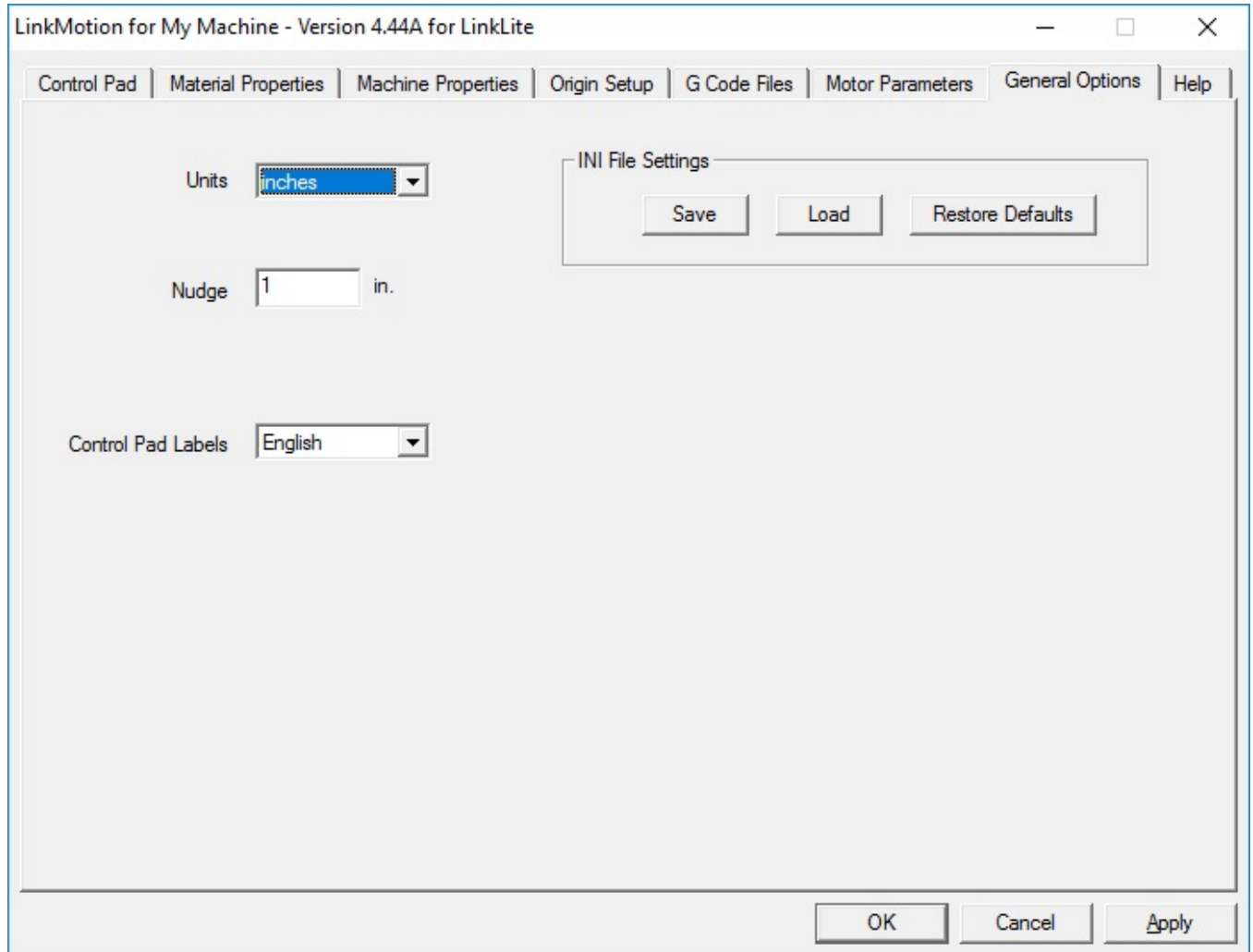
Home Switches:

Home Switches for each axis can be selected individually by checking **X, Y or Z axis enabled**. This depends on how your machine is built. Some machines have home switches for all three axis and some have for X and Y but not for Z axis. Make proper selection for your machine.

Home Switch Polarity selection is available for **Normally Open** as well as **Normally Closed** and it depends on how the wiring is done for your home switches. LinkMotion will sense those switches and show you **green lights on the control pad** (next to X, Y and Z movement boxes) when we sense proper switches. If you do not know how your machine is wired then try selecting one after another and when the lights are green you have made the proper selection.

LinkMotion version 2.8 and higher supports home switches of any kind used for different axis. User can check normally open on two axis and normally closed on the third axis. If machine does not have home switches then none can be selected.

General Options:



Units:

There are just a few things in the General Options screen. Units gives you the choice to display measurements in inches, millimeters, or centimeters. If you have switched from one unit to another you need to check the settings in all the tabs of LinkMotion to make sure that the settings are correct for your machine and correct for your job. The Linkmotion.INI file keeps separate settings for inches and metric values. **The values are not necessarily converted directly from one to the other.**

Nudge:

The Nudge value determines how far each axis will move with a single mouse click on the Control Pad keys that move the X, Y and Z axes.

There is a protection added for nudge value. Nudge will not move the machine more than “Maximum Travel” value declared in the Machine Properties for X and Y Axis when home switches are activated and machine’s homing procedure is followed to park the the tool in home position. User can deactivate this fuction by checking “disable home switches” in origin setup and Re-Launch LinkMotion.

Control Pad Labels:

Your choices here are **English, or Spanish or Symbol**. Click on the Apply button and you will see the Control Pad using the labels you have selected.

INI File Settings:

Following buttons are available for saving and loading different INI files but we highly suggest for you to write down your setting numbers from each of the menu(tab) of Linkmotion if newly released version of LinkMotion is loaded. This is most suitable to take advantage of new features added in the new version of Linkmotion.INI file.

Save:

Once the machine is properly configured and working well, we advise you to save a copy of your settings on the hard disk drive. This file will serve as a backup for the LinkMotion.INI that is automatically saved by LinkMotion.

Click on the Save button and you will be asked to choose a file name and location. Make sure to remember the file name and where you are saving it. You can navigate to the directory where you want to save your file. You can name the file anything that will be easy for you to remember. Most of our customers rename their settings file with their machine name.

Load:

If LinkMotion needs to be reinstalled, or if you load an upgraded version of LinkMotion, you can reload all you INI file settings without wasting time reentering settings for each tab. To reload the settings select the Load button and navigate to your saved INI file and click on Apply and OK. Now exit LinkMotion by clicking with the right mouse button on the LinkMotion icon in the System Tray and exit the program. Go to the Start button and relaunch LinkMotion. You will now see all your saved settings.

Restore Defaults:

Clicking on this button will load default LinkMotion.INI file that we supply with the LinkMotion Lite software.

You must relaunch LinkMotion when you change and select another INI file to make the changes effective.

LinkMotion.INI File: LinkMotion keeps a copy of all your settings in a file named LinkMotion.INI. To find this file please check the following instructions for your operating system.

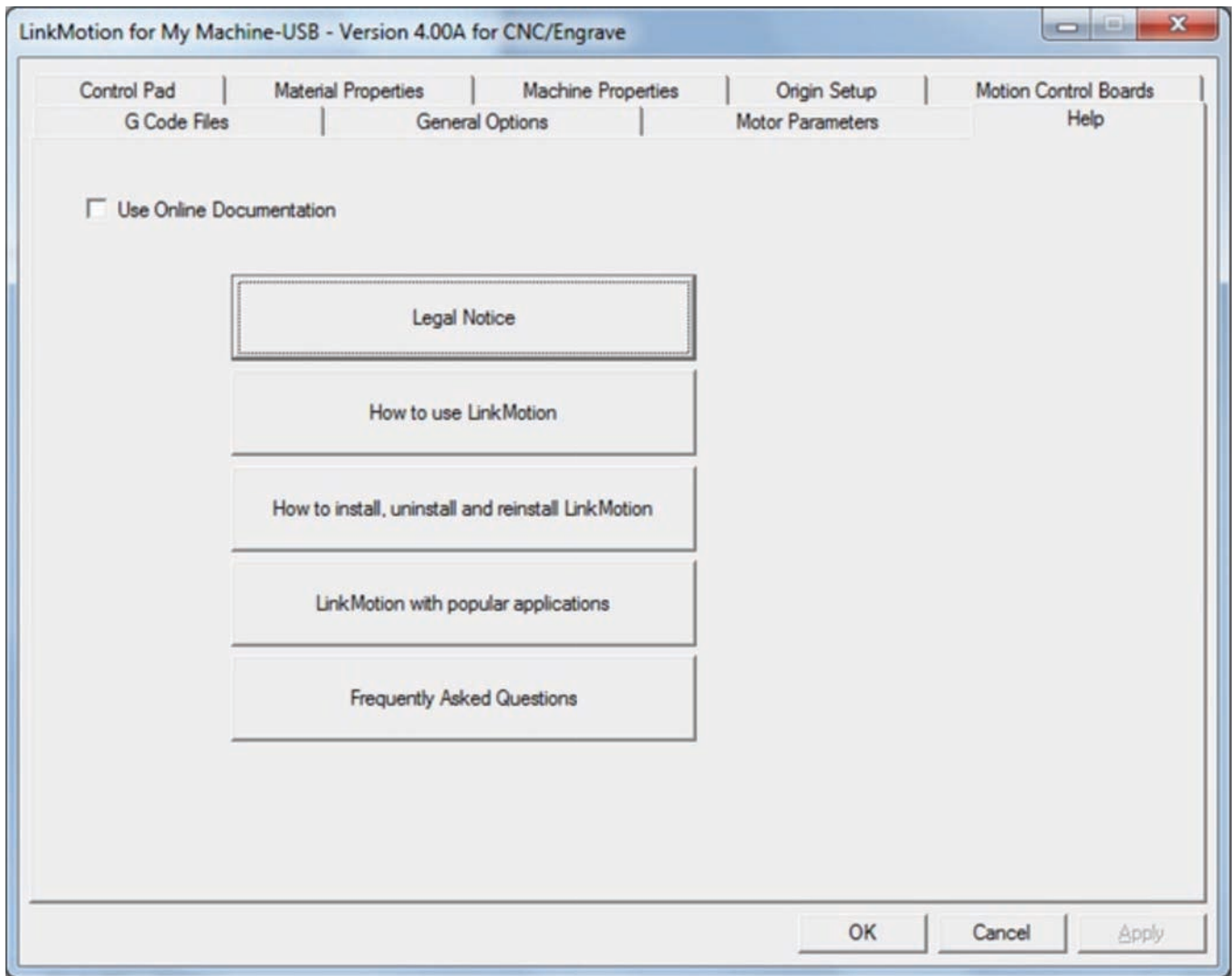
Windows 10, 8, 7 32/64: C:\ProgramData > Solustan > LinkMotion > LinkMotion.INI

Select Computer from the Start button. Select the C: hard drive from the left side. Double click on the folder name ProgramData. Double click on the folder name Solustan. Double click on the folder name LinkMotion. You should see a file name LinkMotion.INI here.

Windows XP: C:\Document and Settings > All Users > Solustan > LinkMotion > LinkMotion.INI

Select the C: hard drive and double click the folder named Document and Settings. Double click on the folder name All Users. Double click on the folder name Solustan. Double click on the folder name LinkMotion. You should see a file name LinkMotion.INI here.

Help:



Use Online Documentation

Checking this button takes you to our website where you can get most PDF documents for support.

Different buttons are created for help however more up-to-date manuals in PDF formats are provided with the respective LinkMotion version you receive.

Connecting and Wiring the USB Controller Board:

Newest Controller information is first and older controller information in the following pages.

Advantages of our USB controller board:

- (1) New 32 bit AGNI Controller Series 20000 has high speed and higher step rate up to 250,000 and FAT or FAT32 formatted SD memory available.**
- (2) The major function of this product is to drive your machines with USB connection to your computer without locking up any computer functions. Your computer and the design programs are free and available to you while the previous job is being processed.**
- (3) The controller is compatible with USB 2.0 specification. It allows transfer of job at a very high speed. It is not compatible with USB 1.1. **Do not use any USB 1.1 devices on the computer where you install LinkMotion software.****
- (4) Old Agni Series 10000 and uner has a slot for SD card memory. It is used as a job buffer and a spooler. The processing of a job on a machine can go on while the PC can be used for other purposes simultaneously. Approximately 1 minute of machine operation for a job uses 1MB of memory and this controller supports up to 4GB of micro memory. **The new version of LinkMotion 3.0 and higher now supports SDHC memory and we have done testing with following ones.****

Memory chips tested and working with this controller: Sandisk 1 GB, 512 MB, 256 MB, Topram 1gb, PNY 1gb, PNY 4gb SDHC, Samsung 1gb, Transcend 1gb and 'Made in China Generic' 1gb.

Memory chips not working with this controller: Kingston 2gb (not SDHC), Kingston 4gb SDHC

- (5) The USB controller solution is equipped with EMC2 (The Enhanced Machine Control 2) compatible M&G code capability. EMC (the Enhanced Machine Control) is a software system for computer control of machine tools such as milling machines, lathes, engraving machines, torch cutting machines, water jet cutting machines, laser machines, and other multi-axis machines. EMC has been available under Linux and has a very large user base. Now, it is available under Microsoft Windows environment with the same capabilities, precision, and flexibility. Please, visit <http://www.linuxcnc.org/> for additional information.**
- (6) The LinkMotion can accept the jobs in the following manner:**

2D jobs, 2 1/2D, 3D, 4D, 5D, or 6D jobs created elsewhere using M&G format can be sent to the USB controller using LinkMotion. In other words, the USB controller is totally compatible with M&G codes, one of the most popular command structure for machine control. A list of implemented M&G codes from the complete list of EMC commands is available elsewhere in this document.
- (7) The board will generate step and direction commands for up to 6 drivers for controlling 6 motors. The standard explanation is for 3 axes and refers to **Additional axis control** information if your machine has more than 3 motors.**

- (8) The USB controller is capable of sensing Home switches, E-Stop, and other inputs.
- (9) The USB controller has 6 output connectors. The functions are described later in this document.
- (10) It is advisable to mount the controller board in your enclosure such that the USB connector residing on the controller board and the SD memory card slots are accessible without opening the enclosure.
- (11) Optionally, Solustan provides small, standalone enclosure with or without the wiring for the output connector (DB-25 female) for the convenience of initial testing and/or for an on-going configuration. An optional, external 5 VDC power supply is also available along with the enclosure if required.
- (12) **New Agni Series 20000 Controllers** has the capacity for 250,000 steps per second capacity.
- (13) **Old Agni Series 10000 and uner Controller** has the capacity for 125,000 steps per second maximum specified limit. 75,000 steps per second are the maximum specified limit of the older 16 bit USB controller.

IMPORTANT WIRING SUGGESTIONS:

We have tested it in our labs and we are convinced that the wiring is the weakest link in any machinery. Just like User Interface, the wiring is almost always an afterthought in assembling a machine. We cannot stress more that you should look into the following while wiring your laser machine:

- (1) Coming out of the Agni's connectors, use twisted and shielded pairs to wire the controller to the machine.
- (2) Use metal or metalized shells for the cables ending into the connectors.
- (3) The shield should be grounded only on one side of the cable, preferably on the machine side. Should not be connected to the controller side.
- (4) The home or limit switches have two wires, use a twisted pair.
- (5) All the I/O's require a ground wire, use a twisted pair.
- (6) Step motors have a pulse (step) and direction wires, use a twisted pair for each of the axes.
- (7) PWM signal wire for the spindle power also has a ground wire for return, use a twisted pair.
- (8) American style, 22 or 20 gauge wires with multi-strands are just fine.

What could happen in an electrically noisy environment?

- The controller may sense a noise pulse as reaching home on home wires. If you see the lights on the limit switches on the Control Pad fluctuating between red and green colors while the machine is not even trying to go home, it is the electrical noise that may be a culprit.
- After finishing a job, a good machine does not go back to (0,0) position, steps are added or subtracted during operation due to electrical noise.
- If the Spindle power is fluctuating even while cutting a straight line, it may be the noise again.

Warnings for USB Controller board:

1. Plug the LinkMotion controller cable directly into your computer's USB 2.0 connection.
2. It is important to experiment and determine that the USB controller works with the USB hub or extension device if the user plans to use such a device.
3. This Laser/Agni controller does not work with USB1.1 connections. If you connect other USB devices compatible only with 1.1, it may cause problems. All the USB devices including keyboard and mouse in the system shall comply with 2.0 specifications. Always check compatibility for wireless USB devices, if you are using one.
4. Power saver and Screen Saver modes on your computer should be turned off. If these modes are activated, it can cause problems in recognizing the USB connection on a continuous basis.
5. **New AGNI USB Controller / Series 20000** can use 24 VDC - The LinkMotion Agni controller can be configured to power either from the USB connection of the PC or from an external 5 VDC or 24 VDC power supply. There is a jumper on the controller board that allows the selection of the power supply for the controller.
6. **Old AGNI USB Controller / Series 10000** - The LinkMotion Agni controller can be configured to power either from the USB connection of the PC or from an external 5 VDC power supply. There is a jumper on the controller board that allows the selection of the power supply for the controller.
7. In case of Laptop computers, AC power unit shall be connected to an AC outlet while operating external USB devices. Sometimes, aggressive power save mode settings under battery operations could activate the disconnection of USB devices. Re-Launching LinkMotion will re-activate the communication in such a situation.
8. Approximately 1 minute of machine operation uses 1MB of SD memory for vector work. This controller supports up to 4GB Memory. If you are using LinkMotion version 3.5 or higher, you could use either SD or SDHC memory cards.
9. **New AGNI USB Controller / Series 20000** uses FAT or FAT32 formatted SD memory.
10. **Old AGNI USB Controller / Series 10000** - It is impossible to test all the available SD Memory cards in the market but we have listed in the following lists ones that work and ones that do not work with this USB controller.

Memory chips tested and working with this controller: Sandisk (1 GB, 512 MB, 256 MB), Topram 1gb, PNY 1gb, PNY 4gb SDHC, Samsung 1gb, Transcend 1gb and 'Made in China Generic' 1gb.

Memory chips found not working with this controller: Kingston 2gb (not SDHC) and 4gb SDHC.

11. If serial number of the controller is not recognized by LinkMotion then user will see a message "Unrecognized serial number ____". Once you click on OK button it will display the second message as "The maximum working area is 1"x1" or 25.4mm x 25.4mm. LinkMotion software can output only 1"x1" jobs at that point. Unauthorized controller bought from unauthorized vendors can cause this kind of problem. Get in touch with Solustan to verify your serial number. Not making proper USB connection with the controller can also display this kind of message and simply disconnecting USB cable from computer end and reconnect and re-launch LinkMotion should resolve it.

12. USB Controller Board Lights:

New AGNI USB Controller / Series 20000 - There is only one LED lights available to attach to the new Agni Controller board Series 20000 – Blue. This light will behave in the following manner when connections are made and the board is powered:

Blue LED – Steady Blue light means USB powered up and ready. If blue light flashes fast it means it is waiting to make the USB connection. At this point, If you launch LinkMotion app it should become steady. If Blue light is flashing slowly it means it is in boot load mode.

We have an additional programmable LED connections available. We will inform you as we add more LED and its functions.

Older AGNI USB Controllers / Series 10000 - There are three LED lights available to attach to the Agni Controller board – Blue, Amber, and Red. These lights behave in the following manner when connections are made and the board is powered:

Blue LED Flashing Slowly – No USB Connection

Blue LED Steady – USB powered up and ready

Amber LED Flashing Slowly – Waiting for firmware update

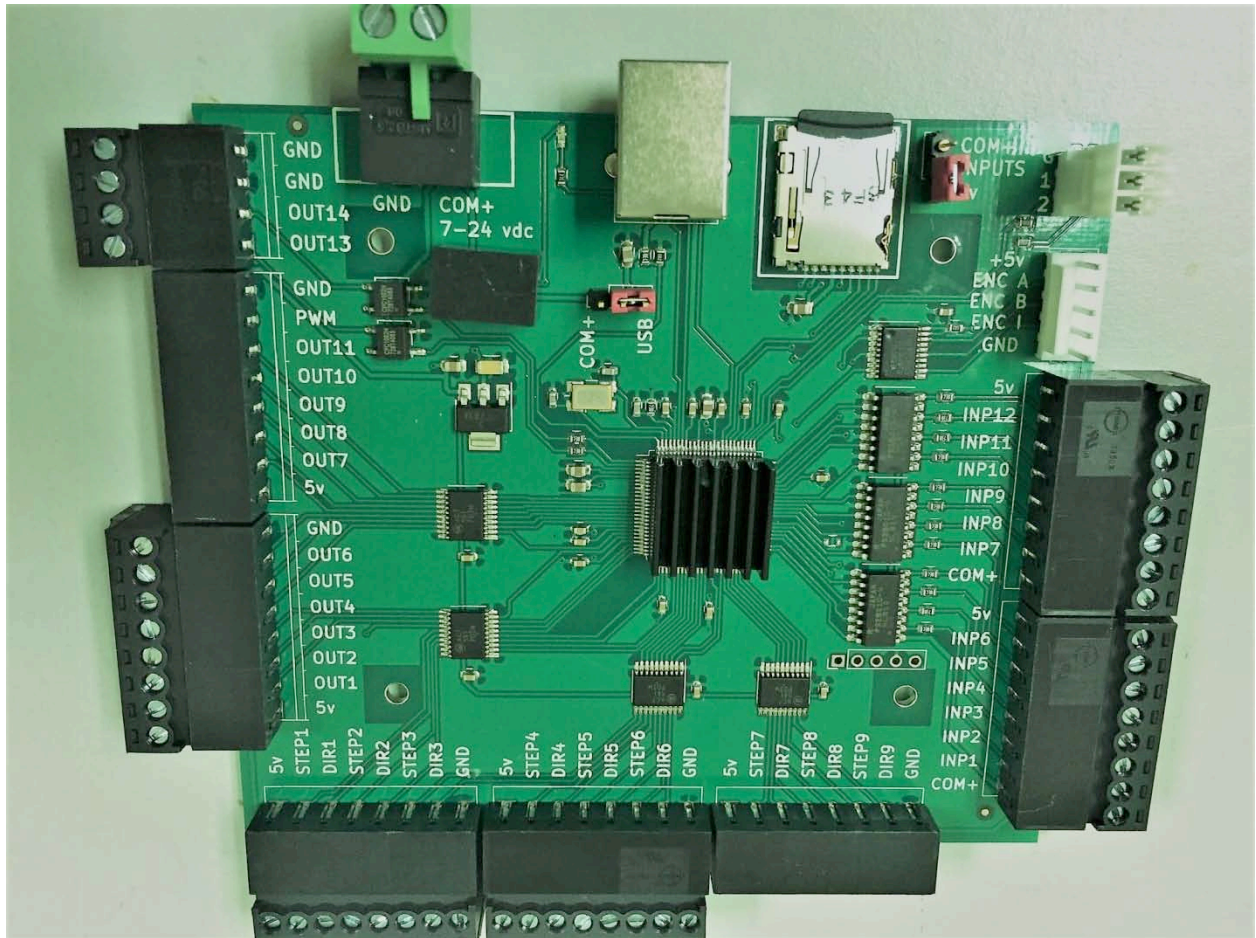
Amber LED Flashing Fast – No SD (Memory) card

Amber LED Steady – USB ready with SD card

Red LED – Turns on when the board is powered. It turns off when it makes a proper connection with LinkMotion. It also turns on every time when any machine motion is detected.

Red LED Flashing – If hardware switch for Repeat is installed on the Laser/Agni controller and LinkMotion.INI file is set up properly, then, Red LED starts flashing after a job is processed one time. Pressing the Repeat switch will send the job again to the machine. After a job is processed one time it is ready to repeat the last job using the repeat button on the USB controller as many times as user wishes.

The New High Speed Controller – Agni III - Series 20000

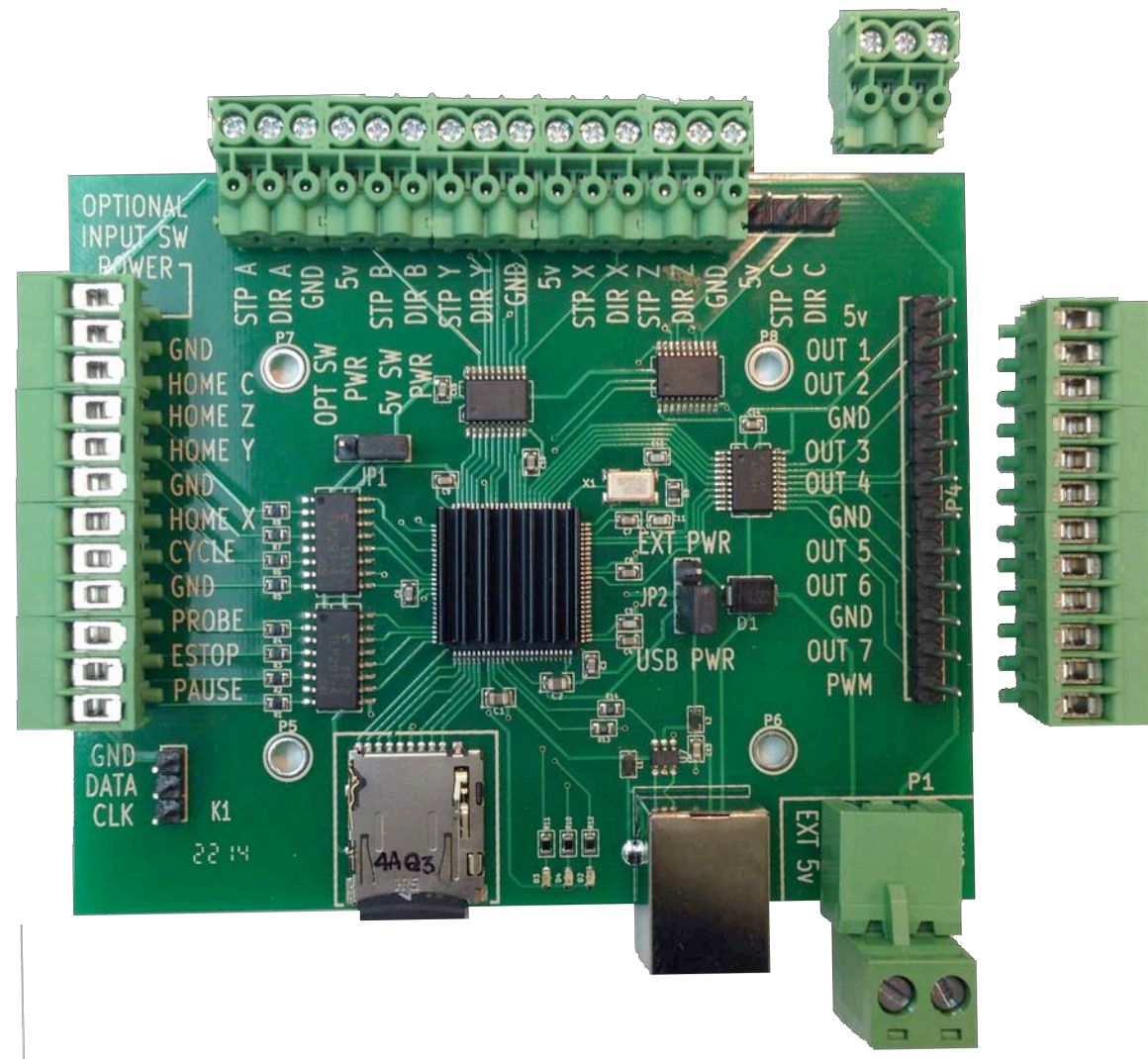


The hardware details of the Agni III controller:

1. Our previous controller Agni II had the maximum step rate of 125,000 steps per second. The Agni III controller doubles the speed to 250,000 steps per second.
2. It offers up to 9 axes control, M&G code processing, and lot more inputs and outputs.
3. The SD memory cards are used as formatted cards for improved reliability of stored information. Use a PC to format the SD memory card using FAT or FAT32 method.
4. The controller can be powered directly from the USB port by taking power from a PC.
5. Alternately, it can also be powered externally with an on-board power supply regulator. The external power supply can be as low as 7 VDC and as high as 24 VDC. There is only one jumper on the controller to select the power source. The jumper is positioned close to the USB connector.
6. Place the jumper toward the COM+ side to accept external power through the 2 pin Green connector. The picture shows the COM+ side (7 to 24 VDC) and the GND side for the connections.
7. Place the jumper toward the USB side in order to accept the power from the USB port of the PC. With this selection, the 24 VDC output will not be available through outputs 13 and 14.
8. All the outputs are driven through line driver IC's. Each output can source or sink up to 20 ma current.
9. All inputs are opto-isolated to reduce noise and interference.

10. Of the 9 axes, the very first axis, X axis can work with step or a servo motor. However, the servo motor driver is required to be able to handle pulse and direction inputs. A special connector is setup for encoder feedback.
11. The 9 axes are X(1), Y(2), Z(3), A(4), B(5), C(6), U(7), V(8), and W(9). The G code file shall have the alphabet values for it to be processed properly.
12. The controller is equipped with one blue LED on-board for USB connections and other functions like firmware updates. The 3 pin white connector is equipped with connections for two more LED's. Many different indications can be programmed. We are looking to bring these LED's to a Control Panel that can be implemented on a machine. We would like to have feedback from users describing the features they want to see implemented using the LED's for appropriate feedback.
13. The second jumper is placed by the SD memory card. The input lines can be TTL (+5 VDC) or they are allowed to be as high as 24 VDC. Some active home switches may send signals anywhere from 5 to 24 VDC. The jumper allows the selection of TTL or higher input levels. Input lines are programmed based on the selection here.
14. Outputs 1 will work with Output 13. Both of them will turn ON and OFF at the same time. However, Output 1 is a TTL output while Output 13 switches an SSR (Solid State Relay) to switch either +5 VDC or 7 to 24 VDC with the capability to drive a load requiring up to 500 ma current.
15. Outputs 2 will work with Output 14. Both of them will turn ON and OFF at the same time. However, Output 2 is a TTL output while Output 14 switches an SSR (Solid State Relay) to switch either +5 VDC or 7 to 24 VDC with the capability to drive a load requiring up to 500 ma current.
16. Outputs 1, 13, 2, and 14 turn ON when the laser is ON or the CNC tool is cutting and they turn OFF when the laser is OFF or the CNC tool is not cutting during a job.
17. Outputs 3 and 4 turn ON and stay ON throughout a job and turn OFF at the end of a job.
18. Outputs 5 through 11 are not controlled by the LinkMotion application at this point. However, they can be turned ON and OFF using M commands in the G codes. M64P(x) to turn ON and M65P(x) to turn off the output.
19. Here are the Input settings:
 - Input 1 is for the X axis Limit Switch
 - Input 2 is for the Y axis Limit Switch
 - Input 3 is for the Z axis Limit Switch
 - Input 4 is for the A axis Limit Switch
 - Input 5 is for the B axis Limit Switch
 - Input 6 is for the C axis Limit Switch
 - Input 7 is for the Cycle Start or Start
 - Input 9 is for the E-Stop
 - Input 10 is for the Pause
20. Solustan plans to design a Control Panel using Cycle Start, E-Stop, Pause, and the two LED's for additional feedback.

AGNI-IIP 32 bit USB Controller board for CNC

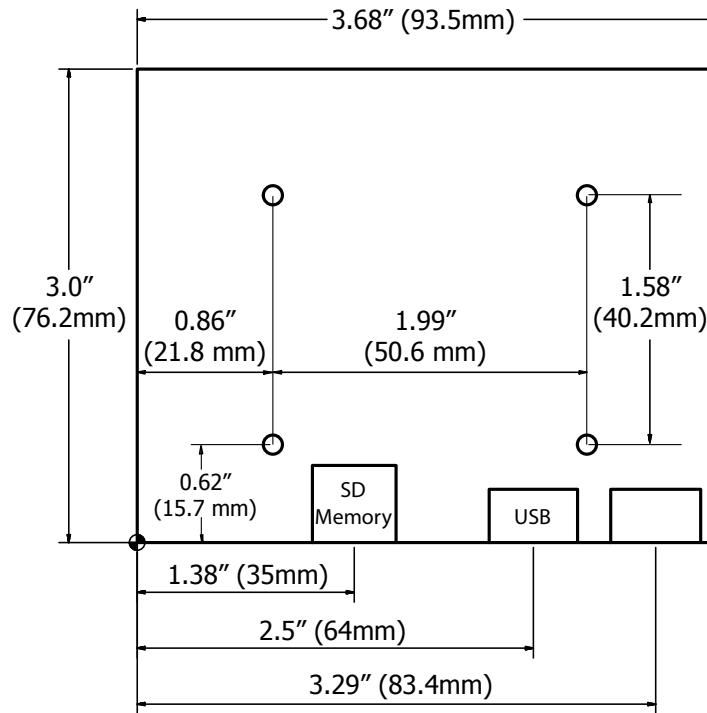


This newest **AGNI-IIP controller** has plugin Phoenix-type connectors that can be plugged in two different ways compare to earlier AGNI II version that had screw terminals. Two different plugin positions are available such that wires can come out either from the sides or from the top. It is slightly smaller in size and all dimensional details are given on the following page. **Wiring information is printed on the board and remaining other technical information is similar to AGNI-II controller that is provided after the AGNI-II pictures. Please follow it properly.**

Four plastic standoffs may be provided with the controller. They require 0.125" or 3.2mm holes on the mounting surface. The material thickness of the mounting surface should not be greater than 0.062". If you have thicker material then you should use screws with spacers.

The physical dimensions of the controller board are as follows:

1. The size of the controller board is 93.5 mm X 76.2 mm (3.68 in X 3.0 in)
2. There are 4 holes for mounting the controller. The holes are 3 mm in diameter (1/8 inch)
3. Horizontally, the distance between holes is 50.6 mm (2 inches)
4. Vertically, the distance between holes is 40.2 mm (1.57 inches)



Specifications:

The USB connector protrudes by 5 mm outside the board.

The connector for external power supply when connected will extend outward by about 12 mm. (The external +5 VDC connector is NOT required if the jumper is set to accept the power for the controller board from the USB port of a PC.)

The Agni controller has a processor running at 96 MHz with 6 axis controls. It comes with an SD memory card holding a capacity of up to 4 GigaBytes of storage.

Caution:

Controller board is equipped with integrated circuits and high-frequency processors. The components are susceptible to static electricity. We tend to build a static charge on our body while simply walking around in a less than ideal humidity in the environment. It is easy to damage the circuits on the board with a slight touch. It is recommended that a grounding strap on the wrist or other methods to neutralize the build-up of static electricity before handling the controller board. Keep yourself grounded while you continue to work with the controller board.

Connections and configuration of the Agni-IIP controller:

1. Take a look at the above picture of the controller and note that there are only two jumper settings required for physical connections.

Jumper JP1 relates to voltage requirement for the Home (Limit) switches. If the Home switches in your machine only require +5 VDC, you do not need to do anything. The default setting of the jumper JP1 is set to use the internal power. On the other hand, some machines use active home sensing switches that may require higher than +5 VDC for proper operation. In such a case, move the jumper JP1 to the optional power input for home switches. The optional power and Ground input points are at the top left of the board. Connect the switch appropriate power supply here. The voltage of the external power for the Home switches shall not exceed 24 VDC. All the input lines are protected with optoisolators.

Also, refer to more detail description for connecting home (limit) switches along with output connections in following pages after the general description.

Note the second jumper JP2 situated to the right of the main processor chip in the center of the Agni controller. The Agni controller needs little power. It is possible to power the controller directly from the USB port of the PC. The default setting of the jumper is for the Agni to receive the power from the USB port. If it is necessary to power the controller from external sources, move the jumper JP2 toward the EXT power side. The optional power and Ground inputs are at the bottom right of the controller. Note a removable, 2 pin, green connector. Required voltage is 5 VDC. The voltage of the external power of the Agni controller shall not exceed 6 VDC.

2. Connecting Agni to a machine:
 - 2.1 X, Y, Z, and cylindrical axis motors
 - 2.2 The Agni controller generates Step (sometimes called Pulse) and Direction pulses for each of the axis. Maximum step rate is 125,000 per second.
 - 2.3 Ground and +5 VDC connections are available along with step and direction commands for the connections to step motors managing different axis.
 - 2.4 There may not be a need for all four connections. In fact, some step motor drivers require a step, direction, and either ground or +5 VDC connections. Use whatever is necessary to make connections to the step motor drivers.
 - 2.5 If the machine is equipped with servo motors, please, make sure that the servo motor drivers are capable of accepting step and direction commands.
 - 2.6 The Agni controller is equipped to connect up to 7 outputs and one PWM (pulse width modulation) output for spindle control. Out of the 7 outputs, 4 are connected into the LinkMotion driver settings. If and when required, additional outputs can be made available.
Output 1 is for I/O 1 (Can be used for Z axis with solenoid and not motorized)
Output 2 is for I/O 2 (Can be used for Z axis with solenoid and not motorized)
Output 3 is for I/O 3
Output 4 is for I/O 4 Spindle Control

Output 1 and 2 turn on at the beginning of every shape to be cut and turn off at the end of the shape. While output 3 and 4 turn on at the beginning of a job and stay on throughout the job and turn off at the end of the job.

PWM output is available for Spindle control. Please refer to the detail explanation under LinkMotion Control Pad explanation.

Invert PWM capability is available from Linkmotion V4.27 onwards with a following line in the Linkmotion.INI file under each machine related settings.

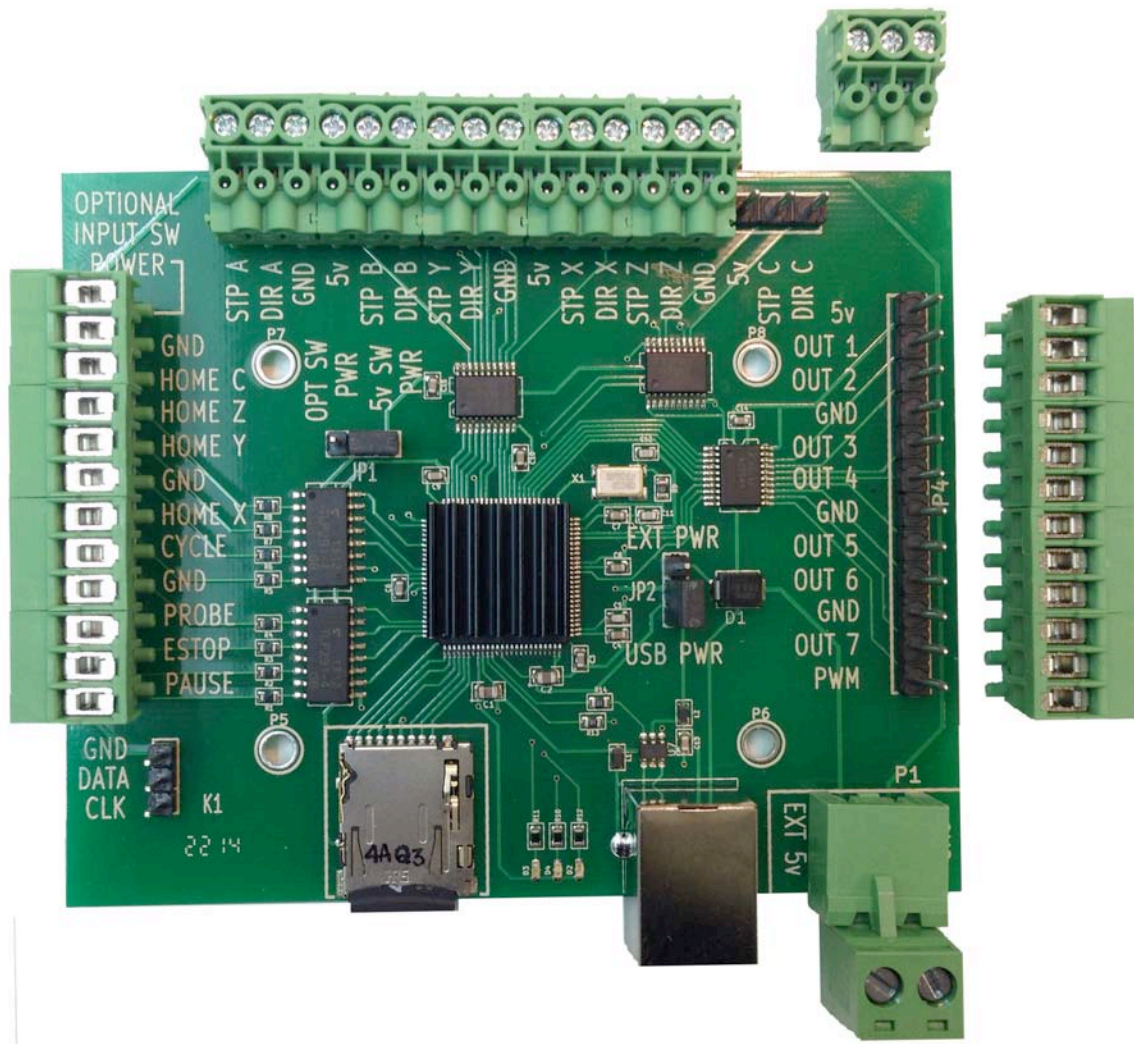
InvertPWM=0 or 1

The default value is 0(zero) and the user can change it 1 if required. Change is effective after saving the INI file and Re-launch Linkmotion.

- 2.7 The Home switch connections are self-explanatory. Appropriate settings are available in the LinkMotion software configuration.
- 2.8 The controller is equipped with soft Control Pad that shows up on the PC screen with many useful features. Please, refer to our main document, the LinkMotion USB for machines. In addition, Solustan provides additional connections for hardware Control Pad that may be required for installing it right on the machine. Please, contact us for protocol information as well as command strings.
- 2.9 Often overlooked, but the important part is the wiring between the controller and the rest of the machine. This ounce of prevention will go a long way. All the signals going in and out of the controllers are just that, signals.
 - You do not need thicker than 22 gauge of wire.
 - Twisted and shielded pairs of wires are the best way to go.
 - If possible, use three twisted wires in a shield for each of the step motor connections.
 - If possible, use a twisted pair of wires in a shield for each of the I/O's, and home switches.
 - Use multistrand copper wires.
 - Connect the shield to a ground on only one side of the wire cluster, preferably on the machine side.
 - The laser machine shall be connected to the earth ground, if not already.
 - When you reduce the effect of the electrical noise on the controller, you are going to have fewer problems with step accuracy, home sense, and better performance of the system.

Input and Output connections including Home/Limit switches:

This description is for AGNI controller hardware. AGNI controller is available with a USB interface (2.0 and higher) and an SD memory card to spool a job coming from USB connection. Here is a picture of the controller:



Note that there are two jumpers on the board JP1 and JP2.

1. The jumper (JP2) to the right of the main processor selects the power required to run the controller from either the USB port of the PC or from external 5 VDC. The total requirement is maximum 200 milliamp when operating and driving all six axes. When the jumper shorts the two pins closest to the USB connector, it takes the power from the USB port.

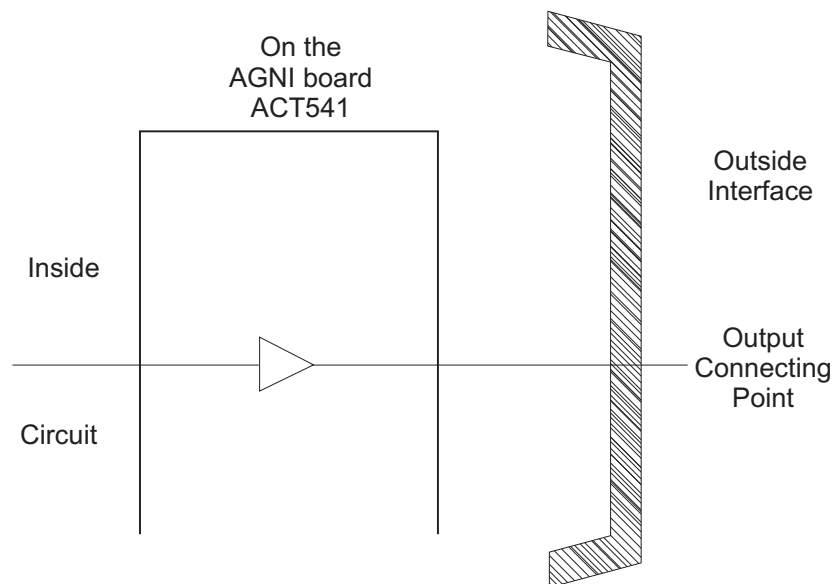
There are ample ground connections on all the connectors in order to connect signal grounds and completing circuits.

2. The second jumper (JP1) is close to the upper left of the processor as shown in the picture. It determines the availability of the power from either internal 5 VDC or externally supplied power for the home/limit switches.

With the above information in mind, let us take a look at the ways to connect the controller to the outside world. The outside world includes step motor drivers for up to 6 axes, either output including PWM, and the following inputs:

- Home/Limit switches for axis X, Y, Z, and C (cylindrical axis).
- Cycle start
- Probe
- E-Stop
- Hardware Pause

3. Here is a circuit of all the outputs:



The controller is equipped with output line drivers IC's ACT541.

Each line is capable of **sourcing or sinking 20 milliamp**. This makes it very nice to directly connect to step motor drivers. An output can connect directly to a solid state relay for controlling the heavy load.

The output connections are;

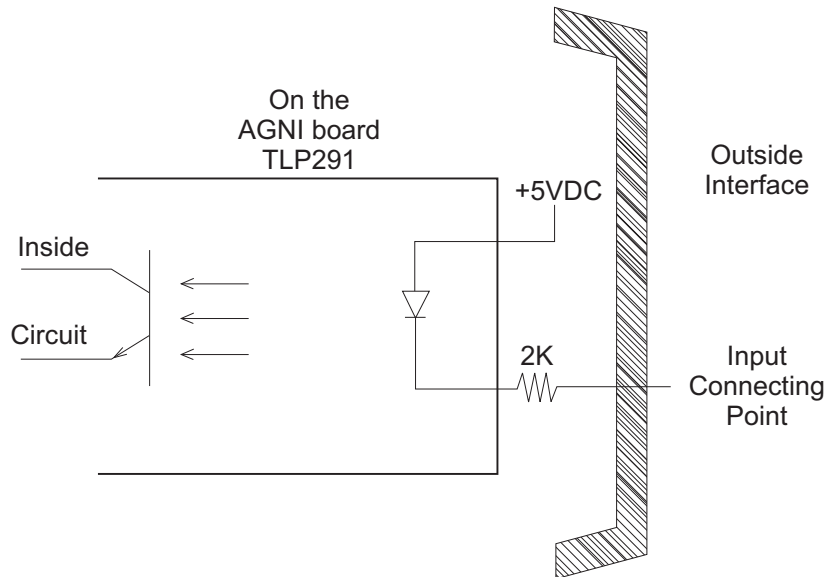
Step X, Y, Z, A, B, and C

Direction X, Y, Z, A, B, and C

Output 1, 2, 3, 4, 5, 6, 7, and PWM

Both, ground as well as 5 VDC output pins are made available along with step and direction commands for the step motor drivers. Step motor drivers may require either ground pin or 5 VDC pin for completing the circuit.

4. Here is a circuit of all the inputs:

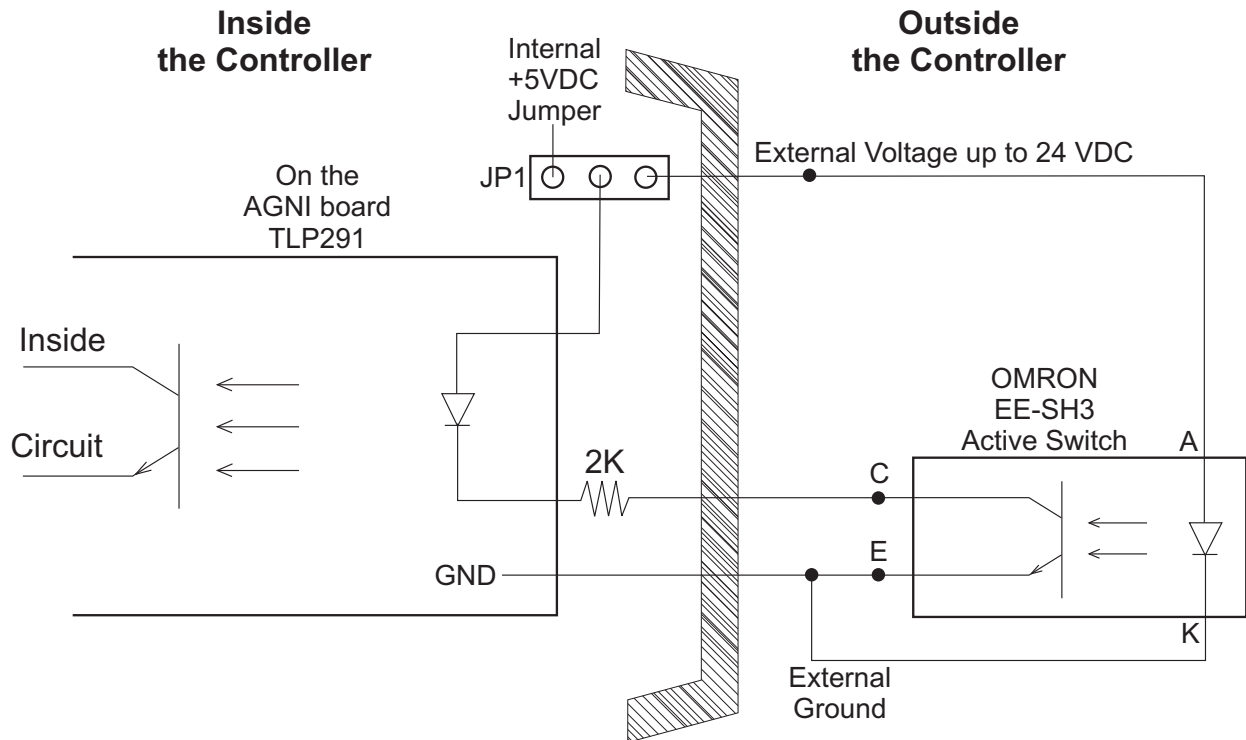


All the inputs are optically isolated with a 2K resistor to limit the current flowing through the diode. Each of the inputs is equipped with the above circuit.

Note that the optoisolator part of the circuit is equipped with its own internal 5 VDC. The outside connections require a signal and a reference ground line. This is totally adequate for either passive Home/Limit switches or active switches that require 5 VDC to operate.

Here is the cool part. If the machine is equipped with active Home/Limit switches that require and use higher than 5 VDC, switch the position of jumper JP1. Apply the appropriate voltage to the optional input power switch at the top left pin on the input side of the connections and its associated ground line to the next pin. The same voltage will be applied to the Home/Limit switch circuit with optoisolation for proper operation. Most of the popular active switches work anywhere from 5 VDC to 24 VDC. **It is important to note that the Optional Input Voltage for Home/Limit switches shall be limited to 24 VDC. Higher voltage may damage the circuits on the controller board.**

To further illustrate a possible circuit connection using an active switch, we studied and created a circuit for an Omron EE-SH3 active switch. Here is a possible circuit:



It is important to understand that the AGNI controller board contains sensitive electronic circuits. Proper care must be taken to handle the controller board. It is recommended that the person handling and/or wiring the AGNI controller shall use the ground strap and necessary precautions to keep the static voltage away from the controller. Static electricity can easily damage the controller.

E-Stop Switch settings:

1. By default, the LinkMotion software is shipped with E-Stop sensing disabled with an entry in the LinkMotion.INI file.

To change the default, search for the line EStop=-1 in the section of the INI file matching the name of the machine you selected when installing.

EStop=-1 disables the function.

EStop=0 enables the emergency stop function for a normally open E-Stop switch.

EStop=1 enables the emergency stop function for a normally closed E-Stop switch.

2. On sensing a signal on the E-Stop line, the controller will halt any motion in progress, display a message on the PC screen, and terminate any profile that is running on the controller. You will need to reset and restart LinkMotion and then prepare and send the job again.

Laser machines have many safety switches to make sure that all the doors of the cabinets are closed before the laser power turns ON. All of these safety switches must be connected to the E-Stop pin of the controller.

If all switches are normally closed, the switches must be connected in series. Any switch activated will break the circuit and the E-Stop line will become active, stopping laser operations.

If all switches are normally open, the switches need to be connected in parallel. Any switch activated will close the circuit and the E-Stop line will become active, stopping laser operations.

3. There is one jumper on the board. The sensing voltage for the home switches and E-Stop are normally limited to +5 VDC (TTL logic). The controller requires only +5 VDC for its operations. However, home switch sensing may need a voltage higher than +5 VDC.

An external voltage is required for switches that are designed to use higher than 5 VDC. In no case, higher than 24 VDC shall be applied.

The jumper needs repositioning in addition to applying the external voltage for higher voltage.

The jumper position is normally set to the two pins away from the connector 2. For using higher voltages, move the jumper to the pins closest to the DB-25, connector 2. The higher voltage shall be connected to pin 13 on connector 2. The return or the ground for the higher voltage shall be connected to any of the ground lines on connector 2, pin 14-23.

4. There is one jumper on the Agni controller. The jumper is the tallest component of the controller board. When the jumper is in place Agni takes its power from the USB port of the PC. If it is required to provide external power connect it to the +5 VDC power connector on the breakout board, the jumper should be removed before powering the controller. It is very important to make sure that the Agni controller is not powered from both sources: the USB port of a PC and the external +5 VDC power supply.

E-Stop Switch settings:

1. Normally, the LinkMotion software is shipped with E-Stop sensing disabled via the INI file. Search for the line EStop=-1 in the section of the INI file for your machine (Name of the machine you selected when installing).

EStop=-1 disables the function.

EStop=0 enables emergency stop function for the normally open E-Stop switch.

EStop=1 enables emergency stop function for the normally close E-Stop switch.

2. Additionally, you will note an indication on the PC screen and to the right of the Control Pad, when the LinkMotion Control Pad is displayed, a green or red light for the E-Stop configuration.

3. We do not bring out the connections for E-Stop in our current controller enclosure (Upgrade engraving machine kit or USB controller with enclosure option is purchased). There is a slot for a spare DB-25 connector in the back of the controller. It should be simple to bring the E-Stop sensing and ground wire out through the connector.

4. The sensing voltage shall be limited to +5 VDC (TTL logic) when connecting lines to the E-Stop sensing on our controller. Applying higher voltage may damage the controller.

5. On sensing the fault on the E-Stop line, the controller will halt any motion in progress, display a message on the PC screen, terminate any profile that is running in the controller, and will force the user to reset and restart LinkMotion and prepare and send the job again. There is no internal circuit designed to take the power off of the AC to DC power supply. The step motor will still be powered. However, there will be no movement.

LinkMotion USB uses EMC2 interpreter with following Supported M and G codes:

G0 Rapid linear motion – program X-Y-Z-A-B-C- all 6axis motion commands

G1 Linear motion at feed rate

G2 Arc at feed rate clockwise

G3 Arc at feed rate counterclockwise

G4 Dwell

G10 Select Coordinate Offset System

G17, G18, G19 Select Plane

G20 for inch, **G21** for mm works with LinkMotion. Some G-Code generating programs use **G70, G71** and user should replace these with **G20** for inches and **G21** for mm.

G40, G41, G42 Cutter Compensation (requires pre-defined tool table file)

G43, G49 Tool Length Offsets (requires pre-defined tool table file)

G53 Position Move without regard to current Coordinate Offset

G54, G55, G56, G57, G58, G59, G59.1, G59.2, G59.3 Set Coordinate Offset (requires coordinate parameter file)

G61, G61.1, G64 Set Path Control Mode (Control radius at corners like **P0.004**) It is important to have **P** in front of the value.

G80 Cancel Modal Motion

G81-Drilling, **G82**-Drilling with Dwell, **G83**-Peck Drilling / Canned Cycles

G90-Absolute mode, **G91**-Incremental mode

G92, G92.1, G92.3 Coordinate System Offsets

G93, G94 Set Feed Rate Mode – **G94** to start units per minute mode. **G93** to start inverse time mode.

G98, G99 Canned Cycle Return Level

M1 – Stop running program temporarily (not sure) **M2 or M30** to end the Program.

M3-Spindle start Clockwise, **M4**-Spindle start Anticlockwise,

M5-Stop Spindle / Spindle Control (Do not include S commands for spindle speed)

M7 and **M8**-Coolant on, **M9**-Coolant Off / Coolant Control

M6 – Tool Change command – T(X)

M62 Turn on digital Output synched with motion, **M63** Turn off digital output synched with motion

M64 Turn on digital output immediately, **M65** Turn off digital output immediately.

If your software generates F commands for feed rate it should always have proper number values like F2.0 for job feed rate. If you have 0.00 value or no value after F it will not process your file.

You also need to have the end of the file command with either M02 or M30. Files will not be processed if the end of the file command is missing.

The process requirement for beginning will be as follows:

1. The user will set the tool at X=0, Y=0, and Z=0. Typically, the user may bring the tool to lower left of the machine and bring the tool down to where it touches the top of the surface. Also, the material may also be set to the lower left of the machine.
2. If there is a jig set up, the user may bring the tool to one of the corners of the material and bring the tool to the top surface of the material. This will be 0, 0, 0.
3. The CAM program shall have the facility to declare a very first move command to be a tool lift distance defined by the user.
4. The processing will start at this point. Including spindle on, turning on of the I/O's, G rapids, and the rest of the job.

5. If the CAM program does not have the facility to lift the Z axis at the beginning of the job, the user will be required to edit the file and insert appropriate tool lift command.
6. Assuming X axis to be the axis from left to right as the user faces the machine, X-axis moving right is a positive number and X-axis moving left is a negative number.
7. Assuming Y axis to be the axis from front to back as the user faces the machine, Y-axis moving away from the user is a positive number and Y-axis moving toward the user is a negative number.
8. For the Z axis, Z axis moving up is a positive number and Y-axis moving down is a negative number.

Frequently Asked Questions:

Section I - Microsoft Windows configuration and computer related questions:

1. What is the minimum configuration required for the PC?

Windows 8, 7 32 or 64 bit operating system or

Windows XP operating system with Service Pak 2 or higher and Microsoft .NET 2.0 or higher Framework installed and USB 2.0 port,

Processor speed of at least 800 Mhz, minimum RAM memory 512 MB, 4 GB or more preferred specifically for raster work.

40 MB of Hard drive free space, Screen resolution of at least 800 x 600.

Service Pak and .NET 2.0 Framework are (free) downloadable from Microsoft's website.

CD-ROM drive is not required, if the driver software was down loaded from the web site.

CD-ROM drive is necessary, if the software was received on a CD.

2. How to check if I have installed Service Pak2 or higher on my computer for Win XP?

Go to the **Start** button. Select **Control Panel**. Select **System**. Now in **General** menu it should show if **Service Pak 2** is installed. Also you can install and uninstall by windows standard Add/Remove program procedure. Make sure you install LinkMotion after you install windows operating system related update first.

3. How to check if I have installed .NET Framework 2.0 or higher on my computer with Win XP?

Go to the **Start** button. Select **Control Panel**. Select **Add/Remove programs**. Here you should see if you have installed the **.NET Framework 2.0** of Microsoft. **This is required to work with our new version of LinkMotion.**

4. How can I check the processor speed and RAM memory on my PC?

Go to the Start button on the System Tray on the bottom left and select Control Panel. Select System from the Control panel. Here you should see information for the version of your operating system and under Computer you should see the processor speed and the RAM memory installed on your computer.

5. How to see hidden files and folders in Windows XP?

Go to the Start button. Select Control Panel. Select Tools Menu and select Folder option. Click on the View menu. You should see a folder called Hidden files and folders. Here select the button for Show

hidden files and folders. **Click on the Apply button. Now you will see all the folders. This is useful to see the configuration file name LinkMotion.INI for LinkMotion driver application.**

6. How to see hidden files and folders in Windows 8 or 7?

Go to Control Panel and click on the Appearance and Personalization. Under folder Options Click on the Show Hidden files and folders. Here check the button for Show hidden files, folders and drives in the middle section under Hidden files and folders. Click on the Apply button. Click on the OK button. This is useful to see the configuration file name LinkMotion.INI for LinkMotion driver application.

7. How to setup under Windows 8 or 7 for viewing the LinkMotion icon in systems tray at the bottom right?

Go to Control Panel of windows from the Start button. Click on the Apperance and Personalization. Click on the Taskbar and Start Menu. Click on the Customize icons on the taskbar. Here make the selection for Always show all icons and notifications on the taskbar. Click on the OK button.

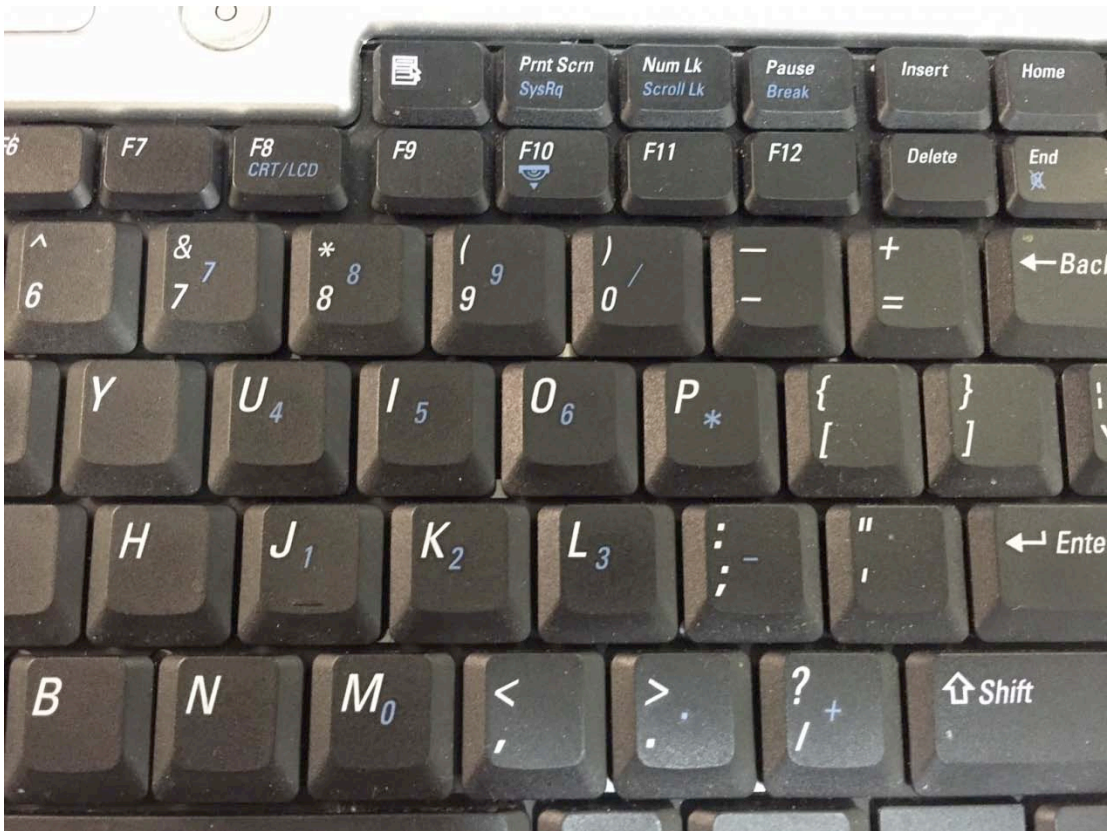
8. How can I tell if my computer has USB 2.0 or 1.1 for Win XP? What is the difference?

This is necessary to check only for older Windows XP computer. Newer computers always come with USB 2.0 ports. USB 1.1 transfers data around at 12mbps, with each new device added to your system taking up progressively more of the available transfer pipe until you hit a point where your USB gets overloaded. USB 2.0 is a massive speed increase to 480mbps, which leaves plenty of room for most device operations.

Finding out if you have USB 1.1 or 2.0 is complicated because some motherboards don't accurately identify your device as USB 2.0. To find out which version you have, open the Device Manager by right-clicking My Computer and choosing Properties (or with Windows key + Pause/Break on the keyboard). Click the Hardware tab and then click on the Device Manager. Scroll down until you locate the Universal Serial Bus controllers and expand the list of controllers. If you have a USB 2.0 controller in your computer, the word Enhanced will be listed somewhere in one of those names. In some case it might say USB2 and some other case it might say Enhanced as well. The word Enhanced may appear without any reference to USB2 or USB 2.0. If it says Enhanced, it doesn't matter what additional details are included along with it. It's also important to make sure you know which USB ports on your computer is connected to the USB 2.0 transfer bus. You may have a computer with USB ports on the front which interface with USB 1.1 and transfer data slowly compared to the USB ports on the back of the computer, which are USB 2.0.

9. How to use laptop computer with numeric keys for LinkMotion Control Pad ?

Laptop computers mostly do not have numeric keypad like regular keyboard. User can observe the regular keyboard and as shown on the following picture they have numeric keys printed in blue color along with regular keys like 7, 8, 9, U, I, O, P, J, K, L etc.



These keys are available to use in NumLock mode. Either pressing Num Lock (NumLk or Num) key by itself or using the shift key + Num Lock key brings that numeric mode. Numeric mode also can be conformed in most computers by a display of a light with a lock symbol and number '9' in it. Now, to use these numeric keys user will have to press Fn key along with any one of the numeric keys. Fn key is located on the left side of the keyboard near the Ctrl and Alt keys.

Remember to disable Num Lock key by pressing it again to use regular functions of your computer when you are done using it with LinkMotion Control Pad.

Using numeric key like one for I/O 1 for laser testing it will require special handling since a mouse click is necessary on the Ok button of the message on the screen for it to work properly.

Section II - LinkMotion Driver:

1. Do I need to access LinkMotion driver software once loaded?

Generally, you simply deal with your job design software and your machine. We do provide an accompanied settings application. This application can be invoked from its icon in the System Tray area. This application will allow you to choose a few settings by going to different tabs (menu) like Material Properties, Machine parameters, Origin setup and Motion Control Boards. Make proper selection, click on the apply button and then start the design application.

2. How do I know if my LinkMotion is installed properly?

When you launch LinkMotion applet does it show the title “**LinkMotion for My Machine-USB – Ver. X.XX**” (version that you have). If this is not proper you may have installed for the wrong machine. You need to **uninstall and re-install LinkMotion again** by windows standard uninstall procedure.

If you had a trial version you need to purchase the full working version.

3. How to see the file for my LinkMotion related configuration settings?

This file is named **LinkMotion.INI** and user can locate the file from the following location:

Under Windows 8 or 7:

In the C:\ hard drive Find folder name Users> Folder with users (your own name) name> Folder name ApplData> Folder name Roaming>Folder name Solustan> Folder name LinkMotion> LinkMotion.INI.

Under Windows XP:

Go to your C:\ > Documents and Settings > Folder with computer User’s name (how ever you have set up your computer) > Application Data > Total Graphics Network > LinkMotion > LinkMotion.INI.

This file has all your machine related settings. You can save this file under different name as well as reload this file from where you might have saved this file.

4. LinkMotion is installed but the lights on Control Pad are red, Why?

These lights will show only if you have wired them.

There are three lights on the Control Pad of LinkMotion under Solustan logo.

USB connection, SD memory card and Emergency stop.

USB Connection light remains red until the USB controller and LinkMotion will establish proper connection by loading the driver for USB Controller. User needs to follow instructions from the document name **Install USB Controller driver.**

SD Memory card needs to be plugged in and the light should be green.

Emergency stop light should be green if proper wiring is done for emergency switch and it should be red only when you press the emergency switch.

Please refer to the help section or LM&USB.PDF for more detail explanation.

There are also three more lights on the Control Pad of LinkMotion next to the X, Y and Z axis counter on top area. These lights are for home(limit) switches of your machine. Check if you see all three lights to be

green. Home switches are available by using normally open or normally close mode. Origin setup of LinkMotion has the selection available for both the modes. You can try reversing this mode click on the Apply button and see if home switches lights changed from red to green. You can temporarily disable them by checking the check mark for disable home switches under Origin Setup of LinkMotion. Please refer to the help section or LM&USB.PDF for more detail explanation.

5. When I connect the cable from USB Controller card to my computer's USB connection it gives me a message that I have USB 1.1 and it will not work. I know that I have USB 2.0 connection on my computer. Why?

Even though you have USB 2.0 connection on your computer but if you are using any hub or extension devices to have more USB ports they can bring you USB connection down to 1.1 level. It is extremely important to plug this cable directly into your computer's USB 2.0 connection. Some wireless devices like wireless mouse or keyboard may have this kind of effect also so you need to check and make sure that you have proper devices.

6. LinkMotion for USB working with USB Controller is not moving any of the axis. Why?

First important thing to check is all of your cable connections. Make sure nothing is loose. Second thing is to check if SD card is plugged in the USB controller board properly.

Third problem can be Emergency Stop may be activated. Control Pad of LinkMotion also shows you three green lights if all three are properly recognized. These lights may be red if any one of those has problem and you need to correct this to make it work properly. Activate Disable home switches check button in Origin setup and click on the apply button. Now see if your axis moves.

Please read and understand UsingLM on help section or LM&USB.PDF file.

7. When I launch LinkMotion it is telling me that I do not have proper firmware. What should I do?

We keep improving the AGNI USB controller board with rich features regularly. We also improve LinkMotion capability to take advantage of those features. This is why you may be required to update the firmware. This is generally available with us and we can send you the firmware updater by email. Instruction on how to update the firmware is at the end of the documents of **Install AGNI Controller.pdf**.

8. What G-Codes are supported with LinkMotionUSB?

Please refer to help section or LM&USB.PDF document where we have listed all the G-Codes compatible by this USB Controller board and LinkMotion working together.

9. Can I output 3D G-Codes?

Yes you can output 3D G-Codes as long as your machine is capable of handling 3D work and you have G Code Files handling option with LinkMotion.

10. LinkMotionUSB behaves in a strange way if I have not used it for a while and come back to my computer. Why?

Power saver and Screen Saver mode on your computer should be turned off. **This can cause problems in recognizing the USB connection on a continuous basis. If the USB controller board is powered by the PC's USB port power supply it may be necessary to unplug and plug it back again the USB cable every time you turn on the computer and re-launch LinkMotion.**

11. I want to design in millimeters and not inches. How do I change?

Simply go to the **General Options tab** and change from **inches to mm or cm** by clicking on the scroll down arrow and then **click on the Apply button**. It is that easy. Values of units are stored individually in the LinkMotion.INI file so if you go back and forth selecting inches , mm or cm, do check the values in all different setting tabs (menus) of LinkMotion. Simply convertin may not give you the proper values needed for your machine.

12. I am sending file for printing and nothing is happening. Why?

This situation may occur due to any of the following:

(A) There are three lights on the Control Pad of LinkMotion under Solustan logo. USB connection, SD memory card and Emergency stop. Check if you see all three lights to be green on the Control Pad screen of LinkMotion. If any of the lights are red the job will not go out. Please refer to the help section or LM&USB.PDF for more detail explanation.

(B) There are also three more lights on the Control Pad of LinkMotion next to the X, Y and Z axis counter on top area. These lights are for home(limit) switches of your machine. Check if you see all three lights to be green. You can temporarily disable them by checking the check mark for disable home switches under Origin Setup of LinkMotion. If any of the lights are red the job will not go out. Please refer to the help section or LM&USB.PDF for more detail explanation.

(C) Check if you have given the Print command from your design application.

(D) Check the print queue for any extraneous documents and remove them.

(E) Check the job feed rates and other settings to make sure that they are all correct.

(F) Printer driver installed for your machine may not have been selected as **DEFAULT DRIVER**. Please check in **Control Panel>Printers and Faxes>Your Machine Driver (this should be selected as default driver)**.

(G) You might have selected thick outline or filled object in your design. **White fill is also not proper to send the job to a machine. Use only Hairline any job you design with graphics or text for vector (cut) work. All thick lines and filled shapes will do only Raster engraving job.**

(H) If **Service Pak 2** was not installed on your **Windows XP operating system** you may see the problem of LinkMotion not sending anything to the machine. You need to **uninstall the LinkMotion** and then **install the Service Pak 2** and **re-install the LinkMotion driver**.

(J) Make sure to design the job within the size of plotting area available with your machine table size.

(K) If you are using Windows operating system under different language you need to check the settings. Go to **Control Panel> Regional and Language Options>**

13. Can I preset or change the values for the speeds of operation for different materials? Where and How?

Launch LinkMotion from Systems Tray. Go to Material Properties. Set values for **Job Feed Rate** of operation for different materials. Click Apply and then send the file again to the machine. Read more details in the HELP tab under the chapter **Using LinkMotion or LM&USB.PDF**.

14. I have setup and customized LinkMotion for my needs. Now, you sent me information for new version of LinkMotion. How can I preserve my settings while upgrading to a new version?

It is very easy. Remember to first save your older configuration file and then uninstall. Follow the uninstall instruction (from the end of the document) from installation instructions. Now install the new version and bring back your older configuration file from General Options tab by Load button. Re-Launch LinkMotion driver one time and then work with your new version.

15. Under Windows XP using LinkMotion version 2.93A or lower, Checking the button for Design using Plate size function under Material properties of LinkMotion and file output is not proper, what should I do?

Design using Plate size function allows you to design your job in Corel draw with page size same as the plate size declared in LinkMotion under Material Properties. If this function is not checked user needs, to design the job with page size to be the same as table size declared in Machine properties of LinkMotion.

If you check the button for Design using Plate size function, make sure to use following method to output the file.

First make sure that LinkMotion USB printer driver has proper setup from following procedure. Go to the **Start button** and **Printer and Faxes**.

Here you should see your **LinkMotion USB printer driver with your machine name**.

Click on that printer driver with the right mouse button and select **Properties**.

Click on the **Advance Tab**.

Click on the **Printing Default button**.

Here make sure **Portrait or Landscape** is selected depending on your machine's table size declared in under Machine properties.

If X Axis is larger than Y Axis it should be Landscape and if Y Axis is larger than X Axis it should be Portrait mode.

Click on the **Advance button** here.

Under paper size select **Table size** by scrolling on the arrow.

Click **OK** until it is saved and close all the tabs.

Now launch LinkMotion and go to the **Material properties**.

Check the selection for **Design using material size**. Enter the **width** and **height** of the material you are planning to use. It should be smaller than the table size declared in Machine properties.

Click on the **Apply button** and Click **OK**.

Following procedure is necessary every time before you send the file to the machine since windows XP does not save proper page size information for a printer driver.

Now launch Corel Draw and create same **page size same as your Design Plate size.**

Create your job within your plate design.

Go to the file menu and select **Print**. Print dialog box should be open.

Click on the **Properties button**.

Click on the **Advance button**.

Select **Table Size** under Page size.

Click on the **OK button**. Click on the **OK button** on the next screen.

Now Click **Print button**.

If you had your printer driver in Landscape mode and your plate size also had landscape mode then job will output properly.

If you had your printer driver in Portrait mode and your plate size in landscape mode then you will see the following message:

“Printer Orientation does not match one or more document pages. Adjust printer automatically?”

Click **No**.

Click on the **Properties button**.

Click on the **Advance button**.

Select **Table Size** under Page size.

Click on the **OK button**. Click on the **OK button** on the next screen.

Now Click **Print button**. Now you will get the proper output.

Similarly, if your machine’s table size has portrait dimensions and you have checked **portrait mode for printer driver and your plate design is landscape mode** then follow the same instructions from above before the **clicking on the final Print button**.

16. Quite often, we hear from the customers that the multi axis machines like engraving, routing, CNC mill, and other similar type machines lose steps in the middle of a job. The evidences may be;

- **Sudden unpredictable move in either the X or Y axis in the middle of a job.**
- **Big and unusual scratching sound.**
- **Unnecessary move in one of the axis while the tool is going up or coming down in the Z axis.**
- **Z axis unable to hold its positions in the up and down positions.**

Following are some of the things to check out to get to the bottom of the problem:

(1) If it happens repeatedly in the same area of the machine, check the part of the lead screw in X or Y axis for damage, collection of dirt, and/or any obvious problems including wear and tear.

(2) It is always a good idea to check and tighten, if necessary, the couplers between step motors and the lead screw about every six months to a year based on the usage of the machine.

(3) It is always a good idea to check and adjust the anti-backlash nut in each of the axis periodically.

(4) Lubricate the machine on a regular basis. Some lead screws are coated. If they are, do not lubricate them. Simply, clean them.

(5) Check the acceleration in Motor Parameters tab of LinkMotion applet and try reducing the number for Toolhead Maximum Acceleration.

(6) Check the speed in Materials Properties and try reducing Job feed rate as well as move speed. Remember, job feed rate is the speed of the tool while it is engaged in the material. Move speed is when the tool is moving from one character to the next and the tool is retracted. If either of the speeds are too high for the design of the machine, it could result in losing steps.

(7) If the problem seen is more prevalent when spindle motor is ON then it is possible that spindle motor is generating electrical noise (white noise of all frequencies) and could possibly be disturbing the step patterns for the axis movement. Certain spindle motors are notorious for causing these problems. Following are inexpensive solutions:

- Enclose the spindle motor in a metal casing to cut down on the white noise radiation.
- We recommend highly that the cables for step motors, spindle motor, and home switches be replaced with twisted and shielded pairs type cables to cut down on such noise problem. This is also an effective solution if the home switches show sensitivity to the noise.
- It is important to make sure that the shield of the cables shall be terminated at one end. (not both ends)