Pro Router

User Manual

Welcome

Terms and Conditions

The terms and conditions set forth below and on the face side hereof constitute a complete and exclusive statement of the agreement between buyer and seller. All representations, promises, warranties, or statements by an agent or employee of seller that differ in any way from the terms and conditions hereof shall be given no force or effect, no modifications or additions there to shall be binding upon seller unless expressly consented to in writing. Any conflicting warranty terms and conditions in the purchase order or any other buyer's document are specifically rejected by the seller. No course of prior dealing or usage of trade shall supplement or explain any term used in this agreement.

PRICE

Prices quoted are valid for 30 days from the quoted date. For production orders that are accepted within the quoted 30 days the pricing for the active production order will be valid for 12 months.
(1) Pricing adjustments will be looked at the end of 15 months or
(2) if a production order is completed and the buyer wants to issue a new order or
(3) if material costs rise 20% or higher the seller and buyer will negotiate a new price or
(4) if buyer requests design or material modifications the seller and buyer will negotiate a new price.

30 DAY GUARANTEE

If Buyer is not satisfied with the performance of the Goods within 30 days from the day the Goods were shipped from the Seller, Buyer may return the Goods (in the original carton) that Seller has determined are in sellable condition for a full refund less Shipping, Handling, Damages and Freight Charges.

WARRANTY

Seller warrants Goods manufactured by it will be free of material defects and will conform and function consistent with the appropriate Seller specification(s) for a period of 1 year from the shipping date. If any of the Goods are found by Seller to be defective, such Goods will, at Seller's option, be replaced or repaired at Seller's cost. No defective goods are to be returned without written authorization of seller. The sole purpose of the stipulated exclusive remedy shall be to provide the Buyer with free repair and replacement of defective Goods in the manner provided herein. This exclusive remedy shall not be deemed to have failed of its essential purpose so long as the Seller is willing and able to repair or replace defective Goods in the prescribed manner. The foregoing warranty is in lieu of all other warranties, express or implied, including those of merchantability or fitness for any purpose not expressly set forth herein. No affirmation of Seller, by words or action, other than as set forth in this Section shall constitute a warranty. Seller's warranty does not apply to any Goods which have been subjected to misuse, mishandling, misapplication, neglect (including but not limited to improper maintenance), accident, improper installation, modification (including by not limited to use of unauthorized parts or attachments), or adjustment or repair performed by anyone other than Seller or one of Seller's authorized agents. When returning products to Seller packaging must be adequate or all warranty is null and void. Buyer will pay for the cost of shipping to and from the Seller for all warranty repairs. In the event travel is necessary for warranty repairs, Buyer will pay for the cost of all travel expenses to and from the Seller's location.Any claim by Buyer with reference to the Goods sold hereunder shall be deemed waived by the Buyer unless submitted in writing to seller within the earlier of (I) thirty (30) days following the date Buyer discovered or by reasonable inspection should have discovered, any claimed breach of foregoing warranty, or (ii) 12 months following the date of shipment. Any cause of action for breach of the foregoing warranty shall be brought within one year from the date the alleged breach was discovered or should have been discovered, whichever occurs first.

LIMITATION OF LIABILITY

Seller's liability (whether under the theories of breach of contract or warranty, negligence, or strict liability) for its Goods shall be limited to repairing or replacing Goods found by Seller to be defective, or at Seller's option, to refunding the purchase price of such Goods or parts thereof.

DISCLAIMER OF CONSEQUENTIAL DAMAGES

In no event shall seller be liable for consequential damages arising out of or in connection with this agreement, including without limitation, breach of any obligation imposed on seller hereunder. Consequential damages shall include without limitation, loss of use, income or profit, or loss sustained as the result of injury (including death) to any person, or loss of or damage to property (including without limitation property handled or processed by the use of the goods). Buyer shall indemnify seller against all liability, cost or expense which may be sustained by seller on account of any such loss, damage, or injury.

ACCEPTANCE AND TRANSPORTATION

Upon buyer's receipt of shipment, Buyer shall immediately inspect the Goods. Unless Buyer provides Seller with written notice of any claim for shortage, overcharge, or damage of Goods within ten (10) days from invoice date, such Goods shall be deemed finally inspected, checked and accepted by Buyer and no allowances shall be made thereafter. In absence of shipping and packaging instructions, Seller shall use its own discretion in the choice of carrier and method of packing. Seller shall not be responsible for insuring shipments unless specifically requested by Buyer and any insurance or special packaging so requested shall be at Buyer's expense and valuation.

TITLE AND RISK OF LOSS

Title to any Goods sold and risk of loss of such Goods passes to Buyer upon delivery by Seller to carrier and any claims for losses or damages shall be made by Buyer directly with carrier.

DELAYS

 Unless expressly specified to the contrary, Goods in stock will be shipped within 48 hours, and Goods not in stock will be shipped according to Seller's production schedule. However, all shipping dates are approximate, and are based upon current availability of materials, present production schedules, and prompt receipt of all necessary information. Seller will not be liable for any damage, loss, fault, or expense arising out of delays in shipment or other nonperformance of this Agreement caused by or imposed by:
(1) strikes, fires, disasters, wars, riots, acts of god;
(2) acts of Buyer;
(3) shortages of fuel, labor, power, materials, supplies, transportation, or manufacturing facilities;
(4) governmental action;
(5) sub- contractor delay; or
(6) any other cause or condition beyond Seller's reasonable control. In the event of any such delay or nonperformance, Seller may, at its option, and without liability, cancel all or any portion of this Agreement and/or extend any date upon which any performance hereunder is due.

TERMINATION AND CANCELLATION

Orders cannot be terminated, or modified, or shipment deferred after acceptance of Buyer's order by Seller, except with Seller's written consent. In the event of cancellation or termination by Buyer of this order before completion thereof, other than breach thereof by Seller, Buyer shall pay to Seller promptly upon receipt of invoice from Seller:
(a) Contract price for all products which shall have been completed prior to notice of termination
(b) All actual costs made or incurred by Seller in connection with the uncompleted portion of the order. Such costs shall include labor, overhead and costs of materials in process or purchased for processing the order, and which materials shall belong to the Buyer.
(c) Cancellation charges that the seller occurs from vendors and commitments made under the order.
(d) In the event a tooling charge is prorated over the cost of the order, balance of tooling charge not so prorated on previous shipments shall be billed as a cancellation charge.

ORDER CHANGES

Orders will be subject to a price increase or holding charge unless different terms are agreed in writing by the seller if:
(a) 15% of any new purchase order is not scheduled within the first 150 day period or 15% of the order is not scheduled quarterly thereafter
(b) An active order is placed on hold and not rescheduled within 60 days

GENERAL CONDITIONS

A. In addition to the rights and remedies conferred upon Seller by law, Seller shall not be required to proceed with the performance of any order or contract if the Buyer is in default in the performance of any order or contract with Seller, and in case of doubt as to Buyer's financial responsibility, shipments under this order may be suspended or sent sight draft with bill of lading attached by Seller.
B. No delay or omission by Seller in exercising any right or remedy provided for herein shall constitute a waiver of such right or remedy and shall not be constituted as a bar to or a waiver of any such right or remedy on any future occasion.
C. The sale of Goods pursuant to this order shall be governed by the laws of the State of Texas. Seller agrees to comply with all applicable laws of the United States.

SEVERABILITY

The invalidity or unenforceability of any one or more phrases, sentences, or sections shall not affect the validity or enforceability of the remaining portions of this Agreement

Policies and Procedures

RETURN PROCEDURE POLICY

Before returning any equipment in or out of warranty, the customer must first receive authorization number and packing instructions from Intelitek. No claim will be allowed nor credit given for products returned without such authorization. Proper packaging and insurance for shipping is solely the responsibility of the customer. Upon receiving approval from Intelitek, the product should be returned along with statement describing problem or defect with the Intelitek product with shipping prepaid. If upon examination by Intelitek, warranted defects exist, the product will be repaired or replaced at no charge and returned, prepaid, to the customer. Return will be by common carrier (e.g. UPS). Should the need for rapid, next day, or any other special shipping arise, this will be at customers' expense, not at that of Intelitek. Should an out of warranty situation exist, the customer shall be notified of any repair cost. At such time, the customer must issue to Intelitek a payment in full to cover the repair cost or authorize the return shipping of product as-is to the customer. A restocking fee of 30% will be charged on items returned to stock.

SERVICE POLICY

Repairs are ordinarily done at the Intelitek facility in Derry, NH were all necessary instrumentation is available. Service equipment is difficult to transport, and thereby limit these services to be performed at the discretion of Intelitek. Should Services be required and provided at the sole discretion of Intelitek, any and all relevant expenses incurred, including transportation, travel time, subsistence costs, and prevailing cost per hour (8 hour minimum) are the responsibility of the customer.*see Technical Support policy for details.*call for current pricing.

SHIPPING POLICY (TO CUSTOMER)

Shipments to customer will be received during regularly scheduled business hours unless other arrangements are necessary. Upon delivery to agreed customer location, it is solely the responsibility of the customer to **inspect the shipment for any damages incurred during transport**. **Damages to shipment must be noted on the bill of lading at the time of delivery**. Intelitek is not responsible for any damages to shipment during transport to the customer. The full value of the shipment must be recorded on the bill of lading in order to receive full compensation for damages incurred during transport to the customer.

TECHNICAL SUPPORT POLICY

Intelitek provides technical support service and assistance for its customers by (1) telephone (2) E-mail (4) technician on site. Technical support is no substitute for CNC System, or software training that is purchased separately by the customer. Technical support is provided at no charge to customer for diagnosing and assisting in the remedy (1) of mechanical problems. (2) Of electrical problems (3) of preventative maintenance issues, up to 1 hour per incident for any problem arising with Intelitek products which are covered by product the limited warranty. Customer will be charged if technical support or assistance is required if the problem is not covered by product limited warranty. For technical service by telephone the customer will be required to provide information about the Intelitek product and the problem. The technician will ask questions concerning the (1) nature of problem. (2) Age of product or system. (3) Type of product. Customers in need of technical service or assistance on product or system that not covered by the limited warranty will be required to provide the technician with a valid credit card number to cover technical support or assistance service charges. A base charge of $US (call for pricing) will be billed for the first 15 minutes of the service call. A charge of $US (call for Pricing) / minute will be billed after the first 15 minutes of the service call. Pricing will be explained at the time of service rendered. E-mail service will be provided without charge at the discretion of Intelitek. If technician on site service is required for customers less than 2 hours driving distance from the Intelitek factory, the customer will be billed a charge of $US (call for pricing) / hour. If technician on site service is required for customers more than 2 hours driving distance from the Intelitek factory, the customer will be billed a charge of $US (call for pricing) /day on site with a minimum of 4 hours service, and with maximum of 8 hours service for one day. All rooming, travel, and subsistence costs + $US (call for pricing) per diem will be at the customer expense. All parts will be billed in addition to service charges.

CNC SYSTEM AND SOFTWARE TRAINING

Intelitek offers to its' customers, training on ez Router's CNC Systems and Software. These training sessions do NOT attend to unsupported software.   Training classes are provided at the offices of Intelitek. in Derry, NH or at the customer's facility given the following circumstances: (1) the customer is financially responsible for all travel expenses, included rental car, food, motel, airfare, etc. (2) The customer understands the training session is exactly as stated, NOT equipment installation. The equipment must be in full working condition before the trainer arrives at the facility.

General Information:

- This manual has been prepared by the technical staff of Intelitek exclusively for its customers and contains reserved information. Therefore, any partial or total reproduction and/ or discloser to third parties of the content herein are strictly prohibited without the prior written consent of Intelitek. This manual is supplied as an integral part of the CNC system and constitutes, at the time of printing, the latest edition of documentation pertaining to the product.

- This manual is to be used by suitably trained personnel only. The information contained in this manual offers no guarantee against risk. The use of the content of this manual is the sole responsibility of the user. Intelitek cannot be held responsible or liable for any damage or injury resulting from incorrect use of this document.

- This manual describes the procedures for correct installation of the CNC system. In the case of conflict between these instructions and safety, electrical, or other standards/ codes, please contact L A Enterprise CNC Inc for any corrective and or adaptive measures. Under no circumstances can the instructions contained in this manual substitute technical, electrical, or safety standards/ codes.

GENERAL SAFETY SYMBOLS:
 • **Important instructions or precautions are marked with the following symbols.**
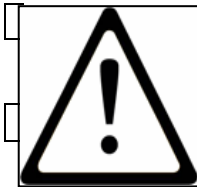
Warning: Identifies situations that could lead to personal injury.

Warning: Live electrical parts.

Safety Warnings and Rules

Fully read and understand this and any manual or other instruction provided with the CNC System. Become familiar with the function, operation, and hazards of the CNC System, its' parts, and accessories.

Personal Safety Rules

- **Only qualified personnel should operate the CNC System.**

- **Stand clear of moving machinery.**

- **Never run CNC equipment unattended.**

- **Stay alert, watch what you are doing and use good sense when operating the CNC System.**

- **Do not use the CNC System while tired or under the influence of drugs, alcohol, or medication**.

- **Keep long hair, clothing, jewelry and gloves away from moving parts.**

- **Always keep body parts away from cutting head.**

- **Always use personal protective equipment**

- **(PPE) as required by law including** – Safety glasses, hearing protection, dust or vapor protection, nonskid shoes, and hard hat.

- **Remove collet wrenches before operating the CNC System.**

Work Area Safety Rules

- **Keep work area clean and well lit**

- **Do not operate the CNC System in the presence of flammable liquids, gas, or dust.**

- **Keep bystanders, visitors, and children away while operating the CNC System.**

- **Remove unnecessary articles from work surface before operating the CNC System.**

- **Observe any caution or warning signs supplied with the CNC System.**

System Use and Care

- **Use clamps or other practical way to firmly secure and support the work piece.**

- **Maintain the CNC System with care.**

- **Always use recommended cutting speeds and feed rates.**

- **Keep all cutting tools sharp and clean.**

- **Do not force a tool.**

- **Always use the correct tool for the job.**

- **Check for misalignment or binding of moving parts, and any other condition that may affect the systems operation.**

- **Always keep the CNC System controls clean, and free from dirt, debris, grease, and oil**

- **Always know locations of E-stop or other emergency features on the CNC System.**

Warning: Some dust or fumes, created by power sanding, sawing, grinding, routing, burning, and other construction activities performed on certain materials, are known to be harmful. Personal risk from exposure to these can be significantly reduced by working in well ventilated area, using an adequate dust or fume removal system, working with approved safety and protection equipment.

Safety Warnings and Rules Continued

Fully read and understand this and any manual or other instruction provided with the CNC System. Become familiar with the function, operation, and hazards of the CNC System, its' parts, and accessories.

Electrical Safety Rules

- Any electrical work should be done by qualified, licensed, electrician.

- Always keep the system control box closed during operation.

- Always keep electrical guards and covers in place while power is supplied to the CNC System.

- Always disconnect power to the CNC System before performing any maintenance procedure.

- Always know the location of service disconnect breaker.

- Always keep cable and wire carriers clean from dust, dirt, debris, metal chips, oil, grease, water and other materials or fluids.

- Check any connectors, plugs, or other electrical device for proper connection before system operation.

- Do not operate the CNC System during electrical storms.

Electrical and Mechanical Service Rules

- Use only spare parts and accessories recommended by the manufacturer for your make and model.

- Repair or maintenance service must be performed only by trained, qualified, service technicians.

- Do not modify alter any mechanical or electrical part of the CNC System without prior instruction or authorization.

Warning: Care must be taken not damage any exposed electrical cabling (or connector), compressed air fitting (or line), vacuum piping, dust collection, fume extraction hoses, or any other connection during loading, unloading, or relocation of CNC equipment. All electrical cables, compressed air lines, vacuum piping, dust collection or fume extraction hoses must be disconnected before moving or relocating the CNC equipment.
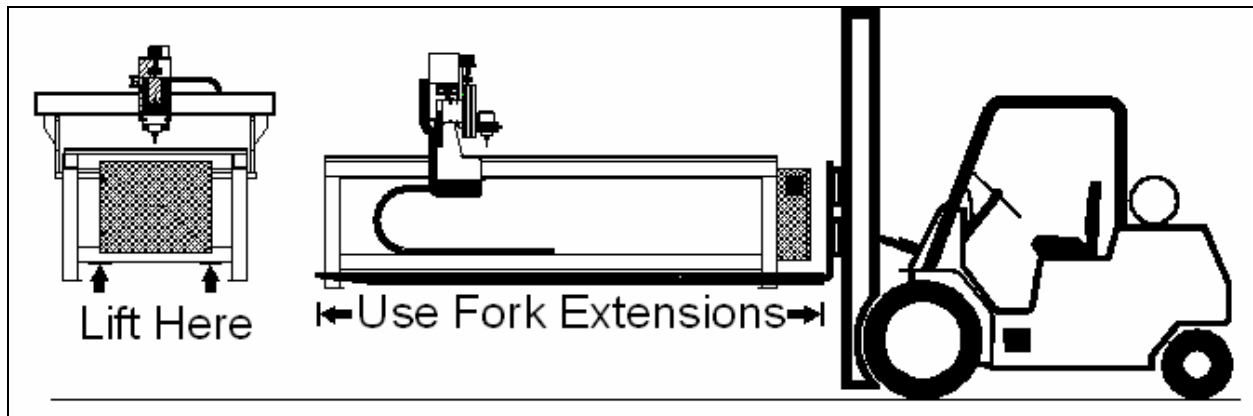
Handling CNC Equipment

Warning: Forklift or other equipment should be operated by trained, operating personnel only with good understanding of materials handling safety policy, and procedures. Any forklift or other equipment operator should be completely familiar with the equipment, its operation, and functions before unloading or moving any CNC system or equipment.

**Important:** Use fork lift with fork extensions for unloading and moving the CNC equipment when required. See picture.

Lift Here Use Fork Extensions

Warning: CNC equipment may not be balanced. Use caution when moving or unloading so as not to damage CNC equipment, fork lift, or operator. See picture.
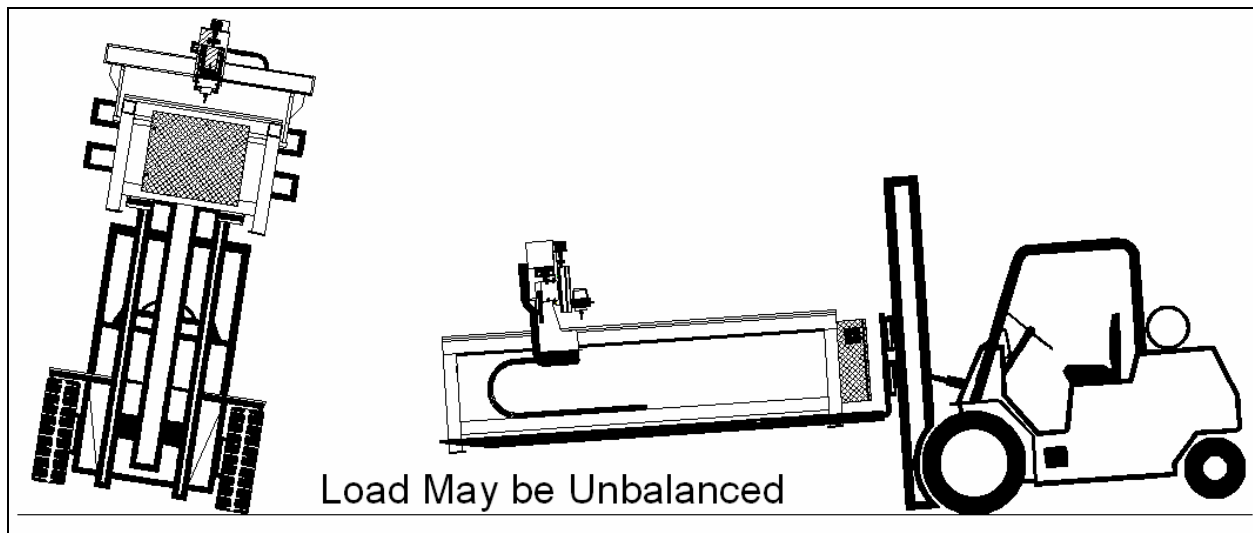
Load May be Unbalanced

Final Positioning of Equipment*

The final position of the equipment will depend greatly on customer's location. Allow for adequate spacing around the equipment for loading / unloading of materials, clamping material, access to vacuum valves. Intelitek recommends an access path of at least **3 feet** on three sides of the CNC Equipment and a material **staging area extending 8 or 9 feet** from the loading end of the equipment.
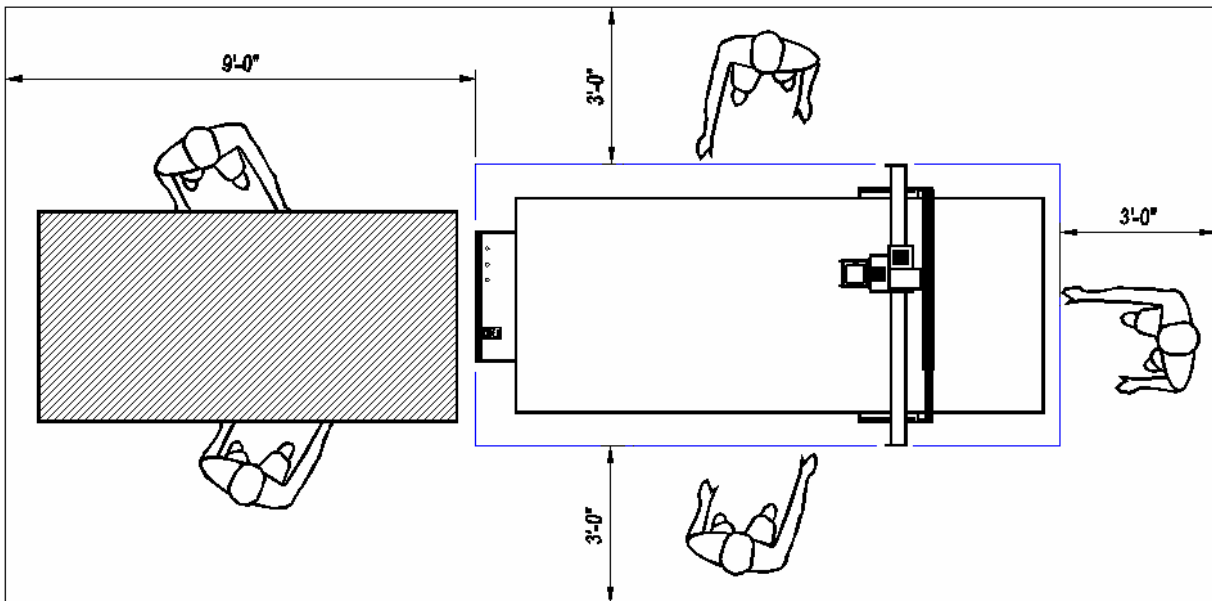
*Final positioning or location of any equipment will be by customer decision.

⚠ **Warning:** All moving parts must be clear of any obstruction to allow free movement at all times during system operation.

⚠ **Warning:** Emergency stop should be accessible at all times during system operation. Do not cover, block, or obstruct access to the Emergency Stop or any system controls.

⚠ **Warning:** Service disconnect should be accessible at all times during system operation. Service disconnect should never locked in during system operation.

Table of contents

Safety Warnings and Rules

Fully read and understand this and any manual or other instruction provided with the CNC System.
Become familiar with the function, operation, and hazards of the CNC System, its' parts, and accessories.

Personal Safety Rules

• Only qualified personnel should operate the CNC System.
• Stand clear of moving machinery.
• Never run CNC equipment unattended.
• Stay alert, watch what you are doing and use good sense when operating the CNC System.
• Do not use the CNC System while tired or under the influence of drugs, alcohol, or medication.
• Keep long hair, clothing, jewelry and gloves away from moving parts.
• Always keep body parts away from cutting head.
• Always use personal protective equipment (PPE) as required by law including – Safety glasses, hearing protection, dust or vapor protection, nonskid shoes, and hard hat.

• Remove collet wrenches before operating the CNC System.

Work Area Safety Rules

• Keep work area clean and well lit
• Do not operate the CNC System in the presence of flammable liquids, gas, or dust.
• Keep bystanders, visitors, and children away while operating the CNC System.
• Remove unnecessary articles from work surface before operating the CNC System.
• Observe any caution or warning signs supplied with the CNC System.

System Use and Care

• Use clamps or other practical way to firmly secure and support the work piece.
• Maintain the CNC System with care.
• Always use recommended cutting speeds and feed rates.
• Keep all cutting tools sharp and clean.
• Do not force a tool.
• Always use the correct tool for the job.
• Check for misalignment or binding of moving parts, and any other condition that may affect the systems operation.
• Always keep the CNC System controls clean, and free from dirt, debris, grease, and oil
• Always know locations of E-stop or other emergency features on the CNC System.

Electrical Safety Rules

• Any electrical work should be done by qualified, licensed, electrician.
• Always keep the system control box closed during operation.
• Always keep electrical guards and covers in place while power is supplied to the CNC System.
• Always disconnect power to the CNC System before performing any maintenance procedure.
• Always know the location of service disconnect breaker.
• Always keep cable and wire carriers clean from dust, dirt, debris, metal chips, oil, grease, water and other materials or fluids.
• Check any connectors, plugs, or other electrical device for proper connection before system operation.
• Do not operate the CNC System during electrical storms

Electrical and mechanical service Rules

• Use only spare parts and accessories recommended by the manufacturer for your make and model.
• Repair or maintenance service must be performed only by trained, qualified, service technicians.
• Do not modify alter any mechanical or electrical part of the CNC System without prior instruction or authorization.

WARNING:
Some dust or fumes, created by power sanding, sawing, grinding, routing, burning, and other construction activities performed on certain materials, are known to be harmful. Personal risk from exposure to these can be significantly reduced by working in well ventilated area, using an adequate dust or fume removal system, working with approved safety and protection equipment.

WARNING:
Care must be taken not damage any exposed electrical cabling (or connector), compressed air fitting (or line), vacuum piping, dust collection, fume extraction hoses, or any other connection during loading, unloading, or relocation of CNC equipment. All electrical cables, compressed air lines, vacuum piping, dust collection or fume extraction hoses must be disconnected before moving or relocating the CNC equipment

Handling CNC Equipment

WARNING:
Forklift or other equipment should be operated by trained, operating personnel only with good understanding of materials handling safety policies, and procedures. Any forklift or other equipment operator should be completely familiar with the equipment, its operation, and functions before unloading or moving any CNC system or equipment.

WARNING:
CNC equipment may not be balanced. Use caution when moving or unloading so as not to damage CNC equipment.

Important:
Use fork lift with fork extensions for unloading and moving the CNC equipment when necessary.

Final Positioning of Equipment

The final position of the equipment will depend greatly on many variables at the customer's location. Allow for adequate spacing around the equipment for loading / unloading of materials, clamping material, access to vacuum valves.
We recommend an access path of at least **3 feet** on three sides of the CNC Equipment and a material staging area for the loading/unloading of materials at the end of the equipment.

WARNING:
All moving parts must be clear of any obstruction to allow free movement at all times during system operation.

WARNING:
Emergency stop/stops should be accessible at all times during system operation Do not cover, block, or obstruct access to any of the Emergency Stops or any system controls.

WARNING:
Service disconnect should be accessible at all times during system operation. Service disconnect should never be locked during system operation.

Leveling CNC Equipment

The CNC machine must be leveled at several points across the machine. Shims of steel, plastic, or rubber may be used to bring machine to level across its span. The table should have no teeter in any direction. Should leveling feet be necessary, the customer may purchase these separately. Leveling feet are available from various machinery supply houses, or hardware centers.

Note:
Each table leg arrives with factory drilled ½" holes for leveling feet which are not included with the CNC System.

Important:
Table top surface may not be true. Milling is normally required for truing the table's surface. The customer is responsible for table milling, and truing on any of the equipment working surfaces. Table milling files are not included with the purchase of the CNC System.

Location of the Control PC

The control PC is part of the CNC system that requires an area for access by the system operator. The control PC, key board and mouse should be easily accessible and functional at all times during system operation. The control PC monitor should also be in plain view by the system operator. The control PC should be kept in a ventilated environment to prevent overheating, and/or malfunction. The CD Rom and USB ports should be easily accessible to the operator.

WARNING:
Protect and secure any cables, hoses or parts of the CNC system crossing any access path around or near the CNC equipment.

Connecting to Electricity

Electrical power to the CNC system is provided by the customer. System power should be supplied through an easily accessible fused service disconnect switch or circuit breaker. All system accessories such as vacuum hold down, dust collection, etc. should also be connected with an adequate service disconnect or breaker and on dedicated circuits. Input locations may vary by model and type.
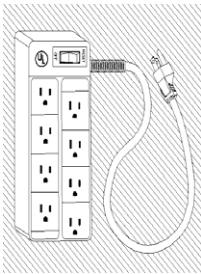
U.L. approved or equivalent **over current, spike, or surge protection should always be used to connect** equipment such as **the Control PC and other accessories** requiring 120v up to 15 amps. Any equipment requiring 120v over 15 amps should be supplied by fused service disconnect switch or breaker.

Important:
All circuits must be dedicated.

Important:
Any electrical work should be done by qualified, licensed, electrician.

Important:
All customer electrical inputs must meet NEC and local electrical codes.
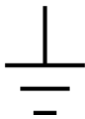
Important:
The CNC system should be properly grounded.
(Dedicated grounding may be required)

WARNING:
Service disconnect should be accessible at all times during system operation. Service disconnect should never be locked during system operation.

Connecting to Compressed Air

Compressed air connections are supplied by customer.
Standard CNC Systems do not require compressed air for operation.
Compressed air is required for Laser, Automatic Tool Change Systems (ATC), Plasma and some accessories.

Note:
Compressed air input for Laser, Automatic Tool Change Systems (ATC) and some accessories are located near the machine Control Box.

Compressed air for use on the CNC System should be:
Dry, filtered and regulated. The CFM rating and PSI will vary depending on the Model and Type of CNC system.

Important:
Drain all moisture traps daily to prevent damage equipment and other system components.

A separate compressed air line is necessary for general equipment maintenance.
An air nozzle should be used to blow off the equipment after each use. Exposed mechanical parts such as the geared rack and pinion gear require special attention to keep equipment clean and operating properly.
The table cutting surface should be cleared after each cutting job.

Computer connections

- Connect the network cable on to the control panel mounted on the machine. (Network cable may be intergrated depending on type of machine)

- Connect the other end of the network cable to the PC.

- Connect the remainder of the PC (monitor, mouse, keyboard, etc…) as manufacturer.
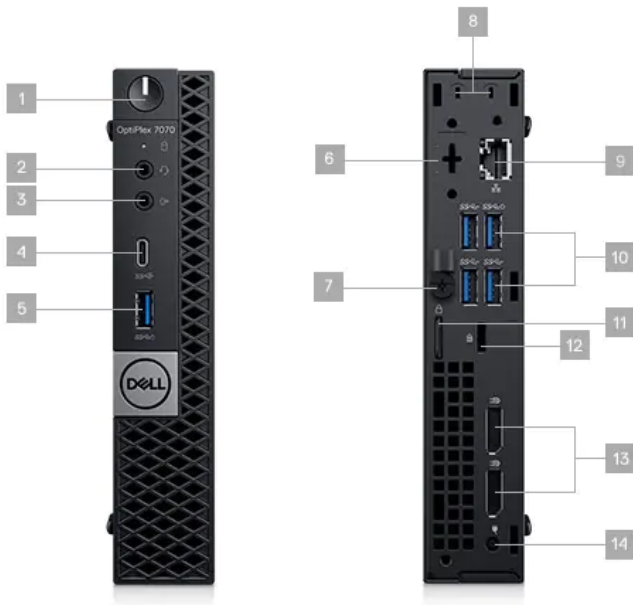
Connect to computer network port. Labled 9

Make sure power is off to all equipment before connecting or disconnecting any of the communication cables.

CNC System Start Up

- Power on the PC.

- After the PC has finished booting open Mach3.

- Turn on compressed air valve if the system requires compressed air.

Pull out the Emergency Stop button

- Pull out the Emergency Stop button. (Notice Picture)

- Turn the control box on/off button to the on position.

- Rotate the Dust collection switch to Automatic if equipped.

- Click the reset button on the Mach3 control screen.

- Jog each axis a few inches away from their home positions.

- Wait until the reference routine has completed

- Click the Ref All Home button.

CNC System Shut Down

- Make sure all files have stopped running.

- Turn off Vacuum pump, if equipped.

- Turn off the compressed air valve, if equipped.

- Turn the control box on/off switch to the off position

- Push in the Emergency Stop button.

- Exit the Mach3 Program.

- Shut down the Control PC.

- Turn off the main power to the Control PC after it has completely shut down.

Testing the CNC System Operation

- Touch the Z-Setter plate to the Collet of the spindle/router and digitize LED will illuminate on the screen.

- Place the Z-Setter plate back in its holder (the Z-Setter plate must be kept insulated from the machine at all times).

- Click the Program run button (page View).

- Jog the X and Y axis using the Arrow keys for X and Y movement.

- Jog the Z axis using the page up and page down keys for Z up and down movement.

System Maintenance

General:

- System maintenance should be performed regularly to keep any CNC System in good operating condition.

- Between cutting jobs clear the cutting area of debris, chips, and unused scrap material.

- Check the condition of the bit or cutting tool and replace if needed.

- Use air nozzle to blow off the equipment especially exposed mechanical parts on all axis.

- Clean up work area and access area around the CNC System.

- Drain moisture traps on compressed air lines.

- Inspect all compressed air regulators for correct air pressure regularly.

- Use air nozzle to clean out chips, dust, and debris from the wire and cable carriers.

- Lightly oil any exposed steel surfaces such as bearings, guide rails, geared racks, pinion gears, and ball screws. Use only light machine oil applied with a clean rag. Aluminum and painted surfaces do not require oiling.

- Clean or replace all dust filters as necessary.

Important:
- Back up all files including the XML parameters.

Monthly:

- Back up all files including the XML parameters.

- Inspect all equipment for excessive wear, or damage.

- Apply grease to any grease fittings located on the CNC system or accessories (vacuum pump, Drills, etc…)

- Open and inspect control box for chips, dust, and debris. If chips, dust, or debris are present, clean out with vacuum (not compressed air). Use care not damage wires, or any electrical components in the control box.

Important:
- Back up all files including the XML parameters.

Annually:

- Back up all files including the XML parameters.

- Inspect all equipment for excessive wear, or damage.

- Apply grease to any grease fittings located on the CNC system or accessories (vacuum pump, Drills, etc…)

- Open and inspect control box for chips, dust, and debris. If chips, dust, or debris are present, clean out with vacuum (not compressed air). Use care not damage wires, or any electrical components in the control box.

- Remove and disassemble all transmissions to inspect bearings and shafts for wear. Lubricate and reinstall transmissions.

- Inspect all belts for wear or damage.

- Check that all electric fans (inside controller, spindle, etc….) are working correctly when the machine is turned on.

Important:
- Back up all files including the XML parameters.

WARNING:
Always engage Emergency Stop Button before performing any maintenance procedure.

WARNING:
Do not use solvents or corrosive cleaners / lubricants on any part of your CNC system.

System maintenance should be performed regularly to keep any CNC system in good operating condition.

WARNING:
System must be completely powered down and locked out at the service disconnect before inspecting or cleaning near any electrical devices or inside the controller!!

Sheet Cam License

- Located on your Intelitek setup disc is the license for SheetCAM.

- Insert the disc and there will be a "SheetCAM" folder.

- Open the folder and inside of the folder is a "license".

- Copy that license to a safe location on your computer.

- Open the SheetCAM software and go to "Help" in the top menus then select "Open License". Go to the location that you saved the license at previously and select "open".

Installing Mach 3 License

- Copy and Paste the (Mach1lic file), located on your ez Setup Disc, into the Mach 3 folder located in the C:\

Button explanations
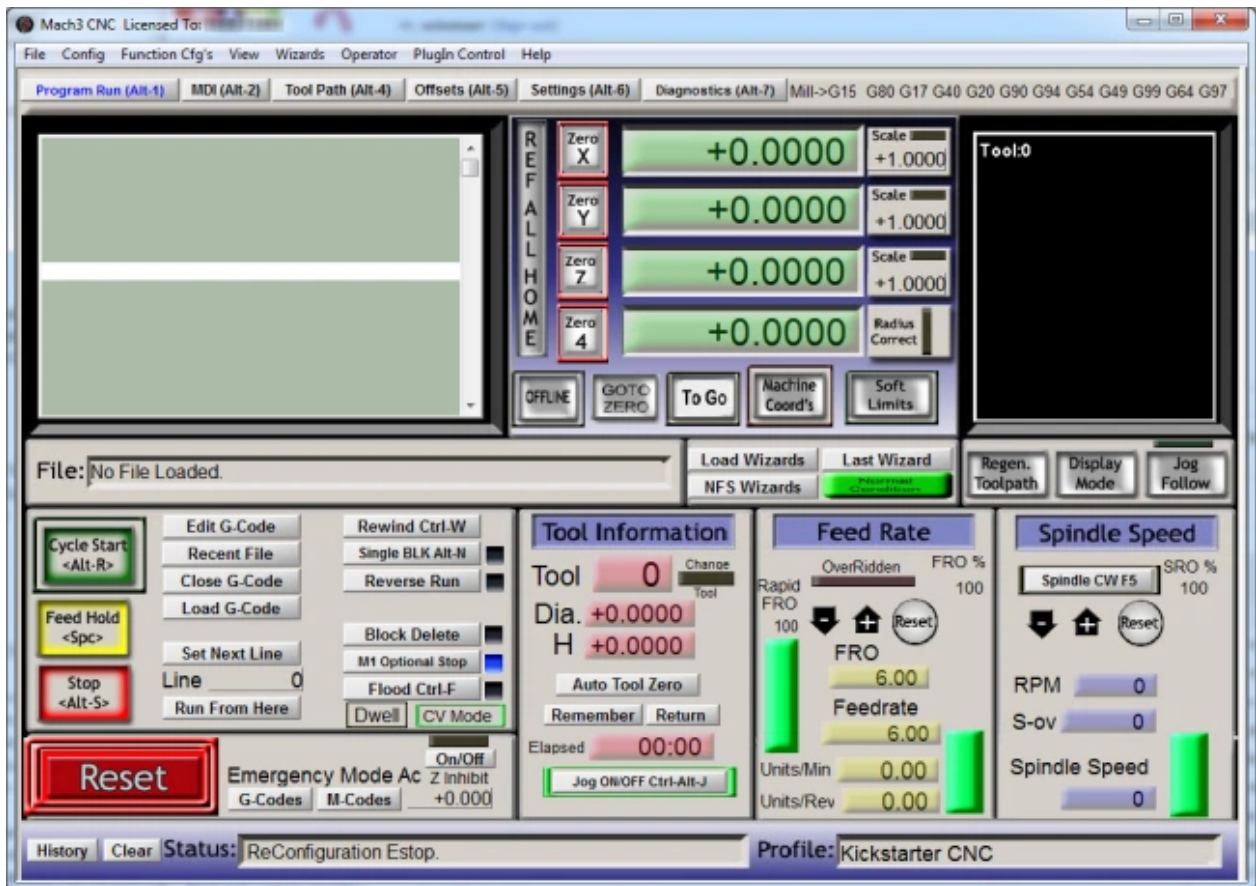
Screen Legend

1. **Cycle Start**
   Executes the G-Code loaded into memory.

2. **Feed Hold**
   Stops motion of all axis and outputs remain active
   Press Cycle start to resume motion.

3. **Stop**
   Stops all motion and turns off all outputs.

4. **Regen. Tool Path**

5. **Change Display**
   Toggles Tool Path view
   Machine boundary view
   Part View

6. **Jog Follow**
   Toggles Tool Path view
   Locks Tool Path to display
   Locks Tool to display

7. **Tool Path Display**
   Shows the Tool Paths of the currently loaded G-Code

8. **Zero X**
   Zeros the X axis DRO

9. **Zero Y**
   Zeros the Y axis DRO

10. **Zero Z**
    Zeros the Z axis DRO

11. **Zero 4**
    Zeros the 4 axis DRO

12. **Reference all home**
    Seeks all home switches
    Sets absolute machine coordinates to Zero
    Activates soft limits

13. **Coordinates**
    Toggles DRO view
    Absolute machine coordinates (red led)
    Relative machine coordinates (black led)

14. **Soft Limits**
    Minimum and Maximum travel distances set by the software
    Limitations on (green led)
    Limitations off (black led)

15. **Go to Zeros**
    Moves machine to current X and Y zero positions
    Moves Z axis to Safe Z height

16. **Go to Home**
    Moves machine to the defined Home position
    Moves Z axis to Safe Z height

17. **Spindle**
    Turns on spindle
    Spindle on (green led)
    Spindle off (black led)

18. **G-Code display**
    Displays the currently loaded G-Code

19. **Rewind G-Code**
    Rewinds current G-Code to the beginning.

20. **Close G-Code**
    Closes current G-Code that is loaded into memory.

21. **Load G-Code**
    Allows you to browse and select the G-code file.

22. **Single Block**
    Executes a single line of code and then enters feed hold
    Continues to the next line when cycle start is pressed

23. **Edit G-Code**
    Allows the currently loaded G-code to be manually edited.

24. **Recent G-Code**
    Opens recently opened G-Code files.

25. **G-Code line number**
    Current G-Code line number

28. **Run From Line**
    Starts the program at the current G-Code line
    Sets all modal states of the current G-Code
    Gives a preparatory move window for verification of position

29. **Set Next Line**
    Sets the start point of the G-Code

30. **Current Work offset**
    Sets the work offset table number

31. **Elapse Time**
    Total cycle time of the G-Code

32. **Reset**
    Activates controller (green led)
    Deactivates controller (green, red flashing led)

33. **Clear**
    Clears information from the status bar

34. **Settings Screen**
    Used for user settings

35. **Diagnostics Screen**
    Used for machine Diagnostics

36. **Jog On/Off**
    Enables Keyboard jogging (green led)
    Disables Keyboard jogging (black led)

37. **Auto Tool Probe**
    Automatic tool touch off for setting the Z axis Zero

40. **Manual Data Input**
    Used for Inputting and executing G-Code immediately

41. **Feed Rate Decrease**
    Decreases Feed rate of currently running G-Code

42. **Feed Rate Reset**
    Toggles the Feed rate override to 100%

43. **Profile Name**
    Parameter file name used when opening Mach3

44. **Feed rate increase**
    Increases Feed rate of currently running G-Code

45. **Spindle Speed decrease**
    Decreases the spindle speed of the currently running G-Code

46. **Spindle Speed Reset**
    Toggles the Spindle speed override to 100%

47. **Spindle Speed increase**
    Increases the spindle speed of the currently running G-Code

48. **Program Run Screen**
    Main Screen used for running the Machine

49. **Tool Path Screen**
    Used to display Tool Paths in a larger format

50. **Manual Data Input Screen**
    Used for Teach Mode

51. **Work Offsets Screen**
    Used for setting up work coordinate offsets

Mach3 controls

This chapter is intended for reference to explain the screen controls for Machine operation.

Although at first sight you may feel daunted by the range of options and data displayed by Mach3, this is actually organized into a few logical groups. By way of explanation of the term "control", this covers both buttons and their associated keyboard shortcuts used to operate Mach3 and the information displayed by DROs (digital read-outs), labels or LED's.

Reset

This button enables or disables communication between the Pc controller and the machine. When disabled the LED will be flashing red and green. When Enabled the LED will be solid green.

Jogging

Whenever the *Jog ON/OFF* button is displayed and on(green LED) in the current screen then the axis of the machine can be jogged using the Arrow Keys and Page Up/Page Down keys.
If the *Jog ON/OFF* button is not displayed or it is toggled to OFF (black LED) then jogging is not allowed.

There are two modes of Jogging.
Continuous and increment which are selected by the *Jog Mode* button and indicated by the LEDs. These two modes are switched using the Jog Mode button or holding down the Ctrl button in conjunction with the jogging keys.

Continuous mode: moves the axis at the defined slow jog rate while the hotkeys are depressed. The jogging speed used with hotkeys in Continuous mode is set as a percentage of the rapid Speed by the Jog Rate% DRO. This can be set in the range of 0.1% to 100% by typing into the DRO. This *Jog Rate%* can be overridden by holding down the Shift key before while using the Jog Keys. An LED beside the Cont. LED indicates this full speed jogging is selected

Step mode: moves the axis by one increment (as defined by the *Jog Increment* DRO) for each key press. The current feed rate (as defined by the F word) is used for these moves The size of increment can be set by typing it into the increment DRO or values can be set in this DRO by cycling through a set of 10 user definable values using the Cycle Jog Step button.
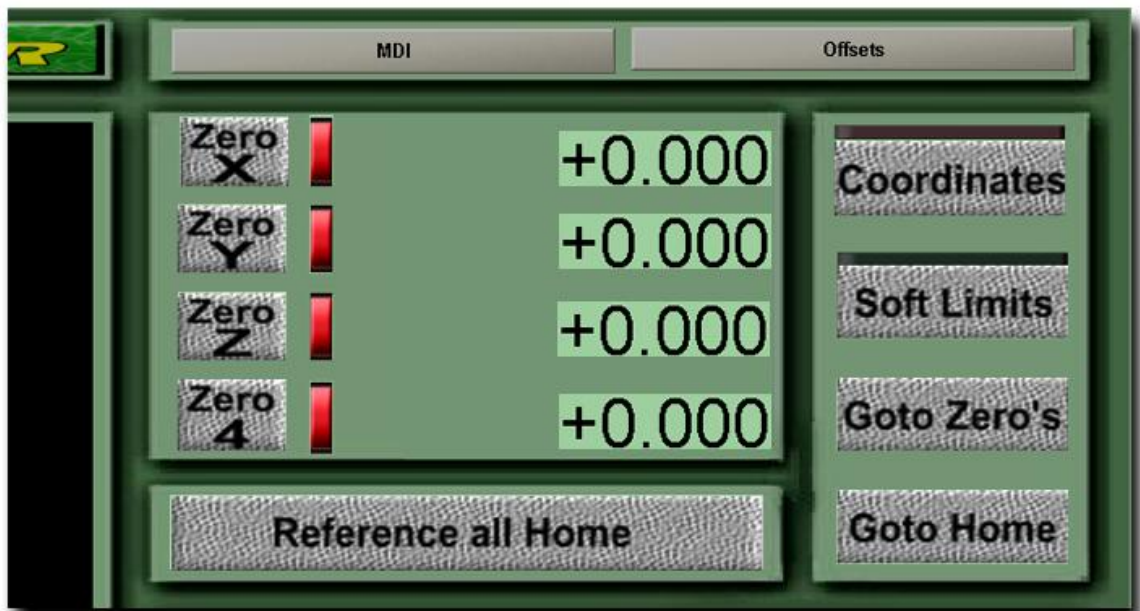
Messages

Labels

The "intelligent labels" display the last "error" message, the current modes, the file name of the currently loaded part program and the Profile that is in use.

Clear

Clear any messages that may be in the intelligent labels display.

Coordinate system

Coordinate DRO

These are displayed in the current units (G20/G21) unless locked to the setup units. The value is the coordinate of the controlled point in the displayed coordinate system. This will generally be the coordinate system of the current Work Offset (initially 1 - i.e. G54) together with any G92 offsets applied. It can however be switched to display Absolute Machine Coordinates. You can type a new value into any Axis DRO. This will modify the current Work Offset to make the controlled point in the current coordinate system be the value you have set. You are advised to set up Work Offsets using the Offsets screen until you are fully familiar with working with multiple coordinate systems.

Machine coordinates

The Coordinates button toggles the DRO's displays between absolute machine coordinates and relative machine coordinates. A red LED warns that absolute coordinates are being displayed.

Work Offset#

Displays the current work offset number being used. Work offset numbers can be from 0-255

Referencing the machine

Referenced LED's

The LED is green if the axis has been referenced.

Ref All Home

This moves all axis to their respective Home switches and zeros the Absolute Machine coordinates. All axis will be referenced using the Ref All Home button or Individual axes can be referenced on the Diagnostics screen.

Zeroing Axis

Zero X

Pressing this button zeros the relative coordinates for the X axis.

Zero Y

Pressing this button zeros the relative coordinates for the Y axis.

Zero Z

Pressing this button zeros the relative coordinates for the Z axis.

Zero 4

Pressing this button zeros the relative coordinates for the 4th axis. Commonly used as a rotary attachment.

Soft Limits

Soft limits

The Soft limits button enables (green LED) or disables (black LED) the soft limits values defined in the machine parameters.

Quick Move Positions

Goto Home

Moves the Z axis to its maximum height and then moves all remaining axis to their designated home location.

Goto Zero's

Moves the Z axis to its maximum height and then moves all remaining axis to their relative zero location.

Regen. Toolpath

The Regenerate button will regenerate the toolpath display from the G-code with the currently enabled fixture and G92 offsets.
Note: It is very important to regenerate the toolpath after changing the values of offsets both to get the correct visual effect and because it is used to perform calculations when using G42 and G43 for cutter compensation.
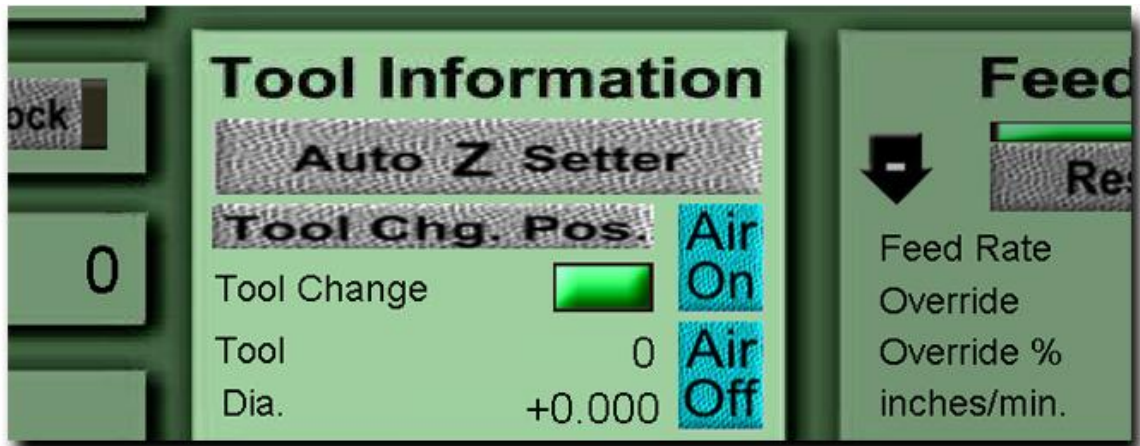
Change Display

Change display toggles between two different tool path views. (a)Zooms out to view the full machine cutting area or (b) Zooms in to view only the tool path area to be cut.

Jog Follow

When turned on (green LED) the lines representing the tool path will move relative to the window as the tool position is moved. In other words the tool position is fixed in the tool path display window.

Tool Information

Tool information

The Tool information displays the current tool number and tool diameter. When encountering an M6 command Mach3 will stop and begin flashing the Tool Change LED. You can then jog the cutter to a convenient location to change the tool and reset the Z height. Cutting can be resumed (after changing the tool) by clicking *Cycle Start*.
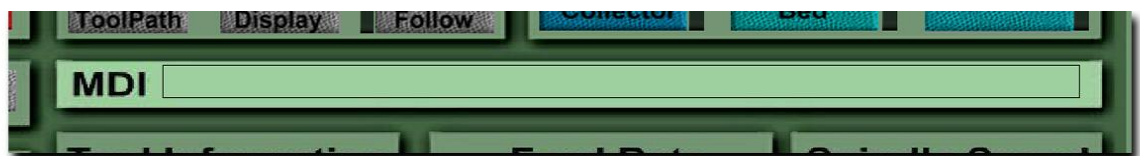
Tool Chg. Position

Moves the Z axis to its maximum height and then moves all remaining axis to their defined tool change position location.

Auto Z-setter

Moves the Z axis in a negative direction until coming into contact with the Z Setter plate then zero's the Z axis to the surface that the plate is sitting on and moves back to the maximum Z height.

MDI Line

MDI

G-code can be typed into this line. The enter key is used to execute the line. This is selected by clicking on the line. When the MDI line is active its color changes and a popup box showing the recently entered commands is displayed. The cursor up and down arrow keys can be used to select from the popup box so that you can reuse a line that you have already entered. The *Enter* key causes Mach3 to execute the current MDI line and it remains active for input of another set of commands. The *Esc* key clears the line and de-selects it. You need to remember that when it is selected all keyboard input is written in the MDI line rather than controlling Mach3. In particular, jogging keys will not be recognized.

Spindle Speed

Spindle Speed Box

Spindle RPM can be controlled in four ways:
(a) Speed is set by entering the RPM into the MDI line (example S18000)
(b) Pressing the up and down arrow keys in the spindle speed box
(c) Speed is set by the G-Code being executed
(d) Typing the RPM directly into the RPM DRO.

Spindle reset clears the RPM override amount back to the original value.

Spindle Override Displays the overridden RPM's value.

Feed Rate

Feed Rate Box

The Feed Rate can be controlled in three ways:

(a) It is set by the F word in a part program
(b) Pressing the up and down arrow keys in the Feed Rate DRO box
(c) Typing the Feed Rate directly into the Feed Rate DRO.

Feed Rate Displays the actual Feed Rate

Override Displays the overridden Feed Rate value

Override% displays the override amount as a percentage of the Feed Rate.

Inches/Min Displays the Actual travel speeds of the axis during operation.

Mach3 will aim to use this speed as the actual rate of the coordinated movement of the tool through the material. If this rate is not possible because of the maximum permitted speed of any axis then the actual feed rate will be the highest achievable.

Running a program

Cycle Start

Cycle start will execute the G-code.

> **SAFETY WARNING:** Note that the *Cycle Start* button will, in general, start the spindle and axis movement.

Feed Hold

The Feed hold button will stop the execution of the part program as quickly as possible but in a controlled way so it can be restarted by Cycle Start. The spindle and coolant will remain on but can be stopped manually if required. When in Feed Hold you can jog the axes, replace a broken tool etc. If you have stopped the spindle or coolant then you will generally want to turn them on before pressing cycle start again. Mach3 will remember the axis positions at the time of the Feed Hold and return to them before continuing the part program.

Stop

Stop halts axis motion and the spindle/router as quickly as possible. It may result in lost steps (especially on stepper motor systems) and restarting may not be valid.

Dwell

LED that indicates a dwell command is active.
When the machine is dwelling all axis motion is stopped for a specific amount of time. The most common use of dwell is for a spindle to get up to the specified RPM.

Single Block

When Single Block is active (yellow LED) Cycle Start will only execute the next single line of G-code and then enter Feed Hold. This cannot be toggled on and off during cutting operations.

Starting in the middle of a program

Run from line

Run from line performs a dummy run of the part program to establish what the modal state (G20/G21, G90/G91 etc) should be and then prompts for a move to put the controlled point into the correct position for the start of the line. You should not attempt to use Run from line in the middle of a subroutine.

Set Next Line

This specifies a line of code to be the start point of the part program when Cycle start is pressed.

Line Number

Line DRO is the ordinal number of the current line in the G-code display window (starting from 0). Note that this is not related to the "N word" line number.
You can type into this DRO to set the current line.

G-code

Edit G-code

Used for editing the opened part program.

Recent G-code

Allows the operator quick access to previously used programs.

Load G-code

Load G-code button opens a browser window for opening the part program to be used.

Close G-code

Close G-code button closes the current part program.

Rewind

This rewinds the currently loaded part program to the beginning.

Multiple Screens

Program Run

Screen used for most machine operations.

Toolpath

Screen for viewing toolpaths in a larger window.

MDI

Screen for manually input code or using teach functions.

Offsets

Screen for viewing and setting work offsets.

Settings

Screen for viewing and changing the current user controlled settings.

Diagnostics

Screen for diagnostic purposes.

Information

Elapsed time

Displays the elapsed time for the current job and is displayed in hours, minutes and seconds.

Profile

Display's the current Profile that is in use.

G Codes:

G0
Rapid Move
G0 [X#] [Y#] [Z#] [W#]
Moves to the position specified at Maximum velocity.
G0 is a modal command.
After a G0 is executed lines with no g-code command are executed as a G0.
Example: X1Y1 is equivalent to G0 X1Y1 if mode is G0

G1
Feed Move
G1 [X#] [Y#] [Z#] [F#]
Moves to the position specified at Feed velocity.
G1 is a modal command.
After a G1 is executed lines with no g-code command are executed as a G1.
Example: X1Y1 is equivalent to G1 X1Y1 F# if mode is G1

G2
Clockwise Arc
G2 [X#] [Y#] [I#] [J#] [F#]
Moves to the position specified at Feed velocity. I am the X distance to the center point. J is the Y distance to the center point.
Example: G3 X10 Y20 I0.0 J-1.5 F100 Cuts a 3" circle clockwise on the X at 10" and the Y at 20" with a feed rate of 100 inches per minute.

G3
Counter Clockwise Arc
G3 [X#] [Y#] [I#] [J#] [F#]
Moves to the position specified at Feed X1Y1velocity. I am the X distance to the center point. J is the Y distance to the center point.
Example: G3 X10 Y20 I0.0 J-1.5 F100 Cuts a 3" circle counter clockwise on the X at 10" and the Y at 20" with a feed rate of 100 inches per minute.

G4
Dwell
G4 [P#]
Stops movement for the time specified by the P value in seconds.
Example: G4 P5 Pauses movement for 5 seconds.

G20
Set Unit to Inches sets unit of measure to inches.

G21
Set Unit to Millimeter sets unit of measure to millimeter.

G28
Return to machine zero
G28 [X] [Y] [Z]

Moves specified axis to Limits for X, Y and Z axis.
All axis are moved if none are specified.

G31
Probe function
G31[X] [Y] [Z] [F]
Moves Z axis in a negative direction until probe has touched the target.

G40
Cancels all cutter compensation

G41
Cutter compensation left
G42 [X] [Y] [F]
Compensates the tool diameter to the Left

G42
Cutter compensation right
G42 [X] [Y] [F]
Compensates the tool diameter to the right

G43
Tool Length Offset On
G43 [H] [Tool #]
Sets tool length offsets to the values set in the Tool Table.
Example: G43 H3 Sets the tool offset to the value listed in the tool table for tool number 3.

G49
Tool Length Offset Off
Cancels tool length offsets.

G50
Scaling Mode Off
Resets all axis scaling to 1.0

G51
Scaling Mode On
G51 [X#] [Y#] [Z#]
Enables scaling of each axis
Scale each axis type based on the values specified by X# Y# Z#.
Example: G51 X2.0 Y2.0 Z0.0 X and Y axis size is doubled and Z is not scaled**.**

G53
Rapid Move
G53 [X#] [Y#] [Z#] [F#]
Moves to the position specified in Absolute coordinates at the speed specified by the F command.
Example: G53 X0.0 Y0.0 Z0.0 all axis are moved to their respective Home switch location

G54
Work offset
Shifts the relative work coordinates to zeros (used only by the Ref All Home sequence).

G55 – G59
Work offset
Shifts the relative work coordinates to zeros at the absolute coordinates stored in the Work offsets table

G61
Exact Stop Mode
Sets the machine to stop at the end of executed line of code before proceeding to the next

G64
Constant Velocity Mode
Sets the machine to blend lines of code together for smoother motion (**can cause rounding of corners**)

G73
Chip Break Cycle
G73 [X#] [Y#] [Z#] [R#] [Q#] F#]
Moves to XY specified at Rapid velocity.
On the first peck, moves to [R] retract height at Rapid velocity, moves to Q peck depth at [F] Feed velocity, lifts to [Q] at Rapid velocity to break the chip, moves to next peck depth at Feed velocity. The cycle repeats until Z depth is reached. Then moves back to retract height R at Rapid velocity.
Example: G73 X2.0 Y2.0 Z-0.1 R0.125 Q0.030 F25 Moves to X, Y and [R] Z position. Z moves down to [Q] peck depth, then Z moves to [R] retract height and continue until the total Z depth is achieved.

G80
End Drill Cycle
Cancels all canned cycles.

G81
Drill Cycle
G81 [X#] [Y#] [Z#] [R#] [F#]
Moves to XY specified at Rapid velocity. Moves to R (clearance height) at Rapid velocity Moves to Z specified by [F] Feed velocity. Moves back to R at Rapid velocity.
Example: G81 X2.0 Y2.0 Z-0.1 R0.125 F25 Moves to X, Y and [R] Z position. Z moves down until it has reached the specified depth, Then Z moves to [R] retract height.

G83
Peck Drill Cycle
G83 [X#] [Y#] [Z#] [R#] [Q#] F#]
Moves to XY specified at Rapid velocity.
On the first peck, moves to [R] retract height at Rapid velocity, moves to Q peck depth at [F] Feed velocity, lifts to [Q] at Rapid velocity to break the chip, moves to next peck depth at Feed velocity. The cycle repeats until Z depth is reached. Then moves back to retract height R at Rapid velocity.
Example: G83 X2.0 Y2.0 Z-0.1 R0.125 Q0.030 F25 Moves to X, Y and [R] Z position. Z moves down to [Q] peck depth, then Z moves to [R] retract height and continue until the total Z depth is achieved. Then Moves to the [R] retract height.

G90
Absolute Mode
XYZ values from the current line forward are read as absolute coordinates. G90 can be specified with other G Codes on any line.

G91
Relative Mode
XYZ values from the current line forward are read as relative coordinates. G90 can be specified with other G Codes on any line.

G92
Set Local Coordinates
G92 [X#] [Y#] [Z#] [F#]
Used to specify a new coordinate system for running a program in absolute mode
 Use G92 alone to restore the Machine Coordinates. G92 X0 Y0 Z0 sets the current position to zero. G92 then restores the Machine Coordinates values.
Example: G92 X1.0 Y3.0 sets the current work offset DRO's to X1.0"and Y3.0"

G98
Set canned cycle return level
Retract perpendicular to the selected plane to the position indicated by the R word

G99
Set canned cycle return level
retract perpendicular to the selected plane to the position that axis was in just before the canned cycle
started (unless that position is lower than the position indicated by the R word, in which case use the R word
position)

M Codes:

M0
Program stop
To stop a running program temporarily (regardless of the setting of the optional stop switch) program M0.

M1
Program stop
To stop a running program temporarily (but only if the optional stop switch is on), program M1.

M2
Program end
Ends the program and leaves the next line to be executed as the M2 line.

M30
Program end
Ends the program and rewinds the G-code file to the beginning.

M3
Spindle control
Start the spindle turning clockwise at the currently programmed speed.

M4
Spindle Control
Start the spindle turning counterclockwise at the currently programmed speed.

M5
Spindle Control
Stop the spindle from turning.

M6
Tool Change
Auto tool changer machines
Stops the program and automatically changes to the specified tool number.
Example: M6 T4, The machine will move and retrieve tool number 4.

Tool Change
Manual tool change machines
Stops the program and Waits for the operator to change the tool.
Example: M6

M7
Output 2
Dust Collection
Turns on dust collection (output 2)
Example: M7

M8
Output 3
Vacuum Bed
Turns on Vacuum Pump (output 3)
Example: M8

M9
Turns off output 2 and 3
Example: M9

M47
Re-run from first line
Begins running the program from the first line.
Example: M47

M48
Speed and Feed override
Enables Speed and Feed overrides.
Example: M48

M49
Speed and Feed override
Disables Speed and Feed overrides.
Example: M49

M98
Call Subroutine
This has two formats:

To call a subroutine program within the current part program file code M98 P3 L1 or M98 ~P ~Q The program must contain an O line with the number given by the P word of the Call. This O line is a sort of "label" which indicates the start of the subroutine. The O line may not have a line number (N word) on it. It, and the following code, will normally be written with other subroutines and followed M2, M30 or M99 so it is not reached directly by the flow of the program.

To call a subroutine which is in a separate file code M98 (*filename*) L~ for example M98 test.tap both formats: The L word (or optionally the Q word) gives the number of times that the subroutine is to be called before continuing with the line following the M98. If the L (Q) word is omitted its value defaults to 1. By using parameters values or incremental moves a repeated subroutine can make several roughing cuts around a complex path or cut several identical objects from one piece of material. Subroutine calls may be nested. That is to say a subroutine may contain a M98 call to another subroutine. As no conditional branching is permitted it is not meaningful for subroutines to call themselves recursively.

M99
Return from Subroutine
To return from a subroutine programming M99 will continue after the M98 which called the subroutine.
If M99 is written in the main program, then the program will start execution from the first line again.

Other Codes:

A
A axis of machine

B
B axis of machine

C
C axis of machine

D
Tool radius compensation number

F
Feed Rate
Example: F220

G
General function
Example: G03

H
Tool Length offset index
Example: H3

X
X axis offset for arcs or
X axis offset in G87 canned cycle

J
Y axis offset for arcs or
Y axis offset in G87 canned cycle

K
Z axis offset for arcs or
Z axis offset in G87 canned cycle

L
Number of repetitions in canned cycles/subroutines

M
Miscellaneous function

N
Line number
Example: N200

O
Subroutine label number

P
Dwell time in canned cycles or
Dwell time with G4
Example: G4 P6

Q
  Feed rate increment in G83 canned cycle or
  Repetitions of a subroutine call

R
  Arc Radius or
  Canned cycle retract level

S
  Sets the Spindle RPM
  Example: S12000

T
  Slot number of a tool
  Selects the tool number to pick up during a tool change
   Use in conjunction with M6
  Example: M06 T4

U
  Synonymous with A axis

V
  Synonymous with B axis

W
  Synonymous with C axis

X
  X axis of machine

Y
  Y axis of machine

Z
  Z axis of machine

Constant Velocity control

-**Motion Mode**

Constant Velocity "CV" – This mode attempts to maintain a constant velocity during ALL angular or arc moves while obeying the acceleration parameter. This is not possible during some moves...such as single axis moves that change direction (i.e. Motion must stop at some point during these moves). On moves where constant velocity can be maintained, the corners will be rounded depending on how high the acceleration is set combined with the *CV Distance Tolerance* (see below). Higher accelerations and smaller *CV Distance Tolerance* values will result in tighter corners and lower following errors. Note, this is NOT the same as servo following error and has nothing to do with PID control. Servo/Stepper following errors will be slightly WORSE than the CV induced following error depending on how "tight" the servo loop is. Stepper motors will lag as well (+- 1 full step), and will lose steps if pushed too far (VERY BAD).

Exact Stop – This mode accelerates and decelerates to each "point" in the g-code. Mach-3 only sees one move at a time and usually machines run somewhat rough and very slowly in this mode. Exact stop should only be used where a machine must not round any corners (inside or outside). However, remember that most CAM software will output many tiny G01 moves to form arcs. In exact stop mode this type of movement will leave very bad surface finishes and can be hard on tooling and machine components.

-General Configuration (LookaHead_____ Lines)
This is only applicable in CV mode. This determines how far "down the road" Mach-3's motion planner is looking. Setting this to a low number is like driving your car while being very nearsighted. A high setting is like 20/20 vision and using binoculars when necessary to see far down the road. This allows the software to better able to adapt to sudden changes in the motion path. It is recommended to keep this at around 200 for most cases. The maximum value is 1000, and setting this high may cause problems depending on the speed of your computer.

CV Dist Tolerance_____Units... - This value affects the amount of rounding at the corners. Setting this very high will allow the machine to run as fast as possible. Setting it to a low value will result in less rounding of corners as the machine will follow closer to the geometry while trading off some speed. This is the distance from the end of the line that it is cutting to where the arc starts rounding… So it is the distance from the intersection of the CV arc to "true" end of the move (if it was done with exact stop)

Stop CV on angles > _____Degrees – This is a really nice setting that automatically switches the machine from CV to Exact Stop mode depending on the approaching angle of the next line of code. Setting to 90 degrees is usually a good compromise because most g-code that has a 90 degree (or smaller) turn is usually indicative of where the user wants a nice sharp corner. However, some CAM software can output some REALLY bad code which represents an arc or angular move as a giant sequence of small 90 degree stair steps such as....