OPERATOR'S MANUAL

Original Instructions

Version 1223A

TORMACH® 1300PL®

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To the Reader

We're dedicated to continually improving our documentation and products, and welcome any clarifications, corrections, or suggestions.

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ABOUT THIS DOCUMENT

SAVE THESE INSTRUCTIONS!

This document contains important safety warnings and operating instructions for your machine. Before operating this machine in any way, you and all other operators must read and understand all instructions. If you don't, there's a risk of voided warranty, property damage, serious injury, or death.
Keep these instructions with your machine so that they're readily accessible.

PURPOSE AND SCOPE

This document is intended to provide sufficient information to allow you to install, configure, and use your machine. It assumes that you have appropriate experience and/or access to training for any computer-aided design or manufacturing software for use with the machine.

GETTING HELP

We provide no-cost technical support through multiple channels. The quickest way to get the answers you need is normally in this order:

1. Read this document.
2. Read related documents at tormach.com/support.
3. If you still need answers, gather the following information so that we may help you as quickly as possible:
   - Your phone number, address, and company name (if applicable).
   - Machine model and serial number, which are located next to the Main Disconnect switch.
   - The version of PathPilot that you're running.
   - Any accessories that you have for your machine.
   - A clear and concise description of the issue.
   - Any supporting media and information that you can share with us. For example, you could:
     - Analyze what might have changed since the machine last worked correctly.
     - Record a short video.
     - Take a picture of a part.
     - For software, share log data .zip files, screen captures, or program files.
       For information, see "Share Log Data .zip Files" (below).
     - From the PathPilot interface, on the Status tab, record any available information.
     - Use a digital multimeter for voltage readings.
4. Once you've gathered the information in Step 3, contact us in the following ways:
   a. Create a support ticket: Go to tormach.com/how-to-submit-a-support-ticket
   b. Phone: (608) 849-8381 (Monday through Friday, 8 a.m. to 5 p.m. U.S. Central Standard Time)

SHARE LOG DATA .ZIP FILES

The controller keeps log data on how the machine has been working, which you can export as a .zip file. This information helps us troubleshoot software situations much faster.
To share log data .zip files:

1. Put a USB drive into the PathPilot controller.
2. From the PathPilot controller, on the **Status** tab, select **Log Data**.
   PathPilot creates a file called **logdata_[*TODAY'S-DATE*].zip**, and saves it on your USB drive.
3. Remove the USB drive from the controller. Create a support ticket with Tormach Technical Support at tormach.com/how-to-submit-a-support-ticket for guidance on how to proceed.

ADDITIONAL INFORMATION

For additional technical information and support videos, see tormach.com/support.

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This document provides guidance on safety precautions and techniques, but because the specifics of any one workshop or other local conditions can vary greatly, we accept no responsibility for machine performance or any damage or injury caused by its use. It's your responsibility to verify that you fully understand the implications of what you're doing and comply with any legislation and codes of practice applicable to your city, state, or nation.

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SAFETY

IN THIS SECTION, YOU'LL LEARN:

- About the standards and safety precautions associated with this machine.

Before operating the machine in any way, you must read and understand this section.

Safe operation of the machine depends on its proper use and the precautions you take. Only trained personnel — with a clear and thorough understanding of its operation and safety requirements — shall operate this machine.

CONTENTS

1.1 INTENDED USE

This machine is intended for general-purpose, computer numerical control (CNC) machining in the following applications:

- Educational environments
- Hobby applications
- Light production
- Prototyping
- Research and development
- Secondary operations

The intended use includes:

- Appropriate workholding, toolholding, tooling, systems, and machining parameters.
- Plasma cutting and engraving of ferrous and non-ferrous metals.

The intended use **does not** include machining materials that:

- Are abrasive, carcinogenic, explosive, flammable, radioactive, or toxic
- Produce aerosols or fine particulates when machined

The intended use **does not** include the following materials (not a full list):

- Beryllium and its alloys
- Ceramics
- Fiberglass
- G10 fiberglass laminate
- Graphite
- Magnesium and its alloys

To safely operate products, you must obey all safety precautions and warnings that are on the machines and in the documentation.

1.2 MACHINE STANDARDS

When installed and operated as intended (see "Intended Use" (above)), this machine complies with the following standards. You must follow the requirements listed in the standards so that the machine remains compliant.

1.2.1 American National Safety Institute (ANSI)

- **ANSI B11.TR3-2000** *Risk Assessment and Risk Reduction — A Guideline to Estimate, Evaluate, and Reduce Risks Associated with Machine Tools*
- **ANSI Z49.1:2005** *Safety in Welding, Cutting, and Allied Processes*

1.2.2 Occupational Safety and Health Administration (OSHA)

- **OSHA 1910.212** *General Requirements for All Machines*

1.3 SAFETY OVERVIEW

Any machine tool is potentially dangerous. A CNC machine's automation presents added risk not present in a manual machine.

Before operating the machine in any way, you must read and understand this section.

- Read and understand all safety messages used in this document.
- Locate and understand all safety decals on the machine.
- Locate and become familiar with all information decals on the machine.

1.3.1 Safety Messages

The following examples show the standard safety message types used to draw your attention to important information. The standards distinguish between personal injury safety messages and property damage warning messages.

Personal Injury

Personal injury safety messages have safety alert symbols and the following hazard level labels:

DANGER! Indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.

WARNING! Indicates a hazard with a medium level of risk which, if not avoided, can result in death or serious injury.

CAUTION! Indicates a hazard with a low level of risk which, if not avoided, can result in minor or moderate injury.

Property Damage

> ***NOTICE!*** Indicates a hazard which, if not avoided, can cause property damage.

1.3.2 Safety Decals

Before operating the machine in any way, you must read and understand all installed safety decals on the machine and equipment. Do not remove any safety decals. If any safety decals become worn or damaged, contact Tormach Technical Support for guidance on receiving replacement decals.
The following types of safety symbols are on the decals:

- **Warning** ⚠ This symbol indicates a hazard which, if not avoided, can result in personal injury or property damage.
- **Prohibition** 🚫 This symbol indicates an action that shall not be taken or that shall be stopped.
- **Mandatory Action** 🔵 This symbol indicates an action that you must take to avoid a hazard.

On the Electrical Cabinet Door

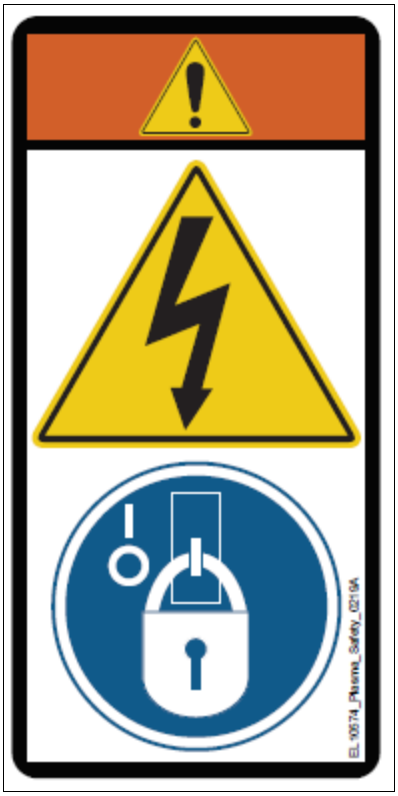

Figure 1-1: Example of a safety decal on the electrical cabinet door.

1. **WARNING! Electrocution Hazard.** Points in the electrical cabinet contain high voltages, which can electrocute or shock you, causing death or serious injury. Even after the machine is powered off, electronic devices in the electrical cabinet can retain dangerous electrical voltages. Use caution when servicing the machine inside the electrical cabinet.
2. **Lockout/Tagout.** Before servicing the machine, you must power off the machine and use an approved lockout/tagout device to secure the Main Disconnect switch in the **OFF** position. Points in the electrical cabinet contain high voltages, which can electrocute or shock you, causing death or serious injury.

On the Front of the Bed

Figure 1-2: Example of a safety decal on the front of the bed.

1. **WARNING! Arc Flash Hazard.** The plasma arc process produces very bright ultraviolet and infrared rays, which can injure your eyes and burn your skin. Always wear appropriate personal protective equipment to avoid damage to your eyes and skin.
2. **Don't Operate with an Active Implanted Cardiac Device.** If you wear an implanted cardiac device, you must consult with your doctor before operating this machine. The machine-generated electromagnetic fields could either interfere with or damage an implanted cardiac device.
3. **WARNING! Fire Hazard.** The machine is not designed to contain fire or explosions. Only use materials and coolants that are intended for the specific machining operation. Never use flammable or explosive items. Before operating the machine in any way, you must read all Safety Data Sheets (SDSs) for any workpiece materials, coatings, coolants, lubricants, and other consumables used.

4. **WARNING! Inhalation Hazard.** The machine does not protect you from airborne particulates. Chips, dust, and vapors from certain materials can be toxic or otherwise harmful. Before operating the machine in any way, you must read all Safety Data Sheets (SDSs) for any workpiece materials, coatings, coolants, lubricants, and other consumables used.
5. **Personal Protective Equipment: Eyes.** Prevent injury by always wearing protective safety eyewear. Before operating this machine in any way, you must verify that your eyewear is impact-resistant and rated for ANSI 787+.
6. **Operator Knowledge.** Before operating this machine in any way, you and all other operators must read and understand all instructions. If you don't, there's a risk of voided warranty, property damage, serious injury, or death.

On the Gantry and the Plasma Head

Figure 1-3: Example of safety decals on the plasma head.

- **WARNING! Crush Hazard.** Moving parts can entangle, pinch, or cut you, causing death or serious injury. Before operating this machine in any way, you must verify that all body parts, long hair, and clothes are clear of the machine's extent of motion.

1.3.3 Information Decals

Before operating the machine in any way, you must locate and become familiar with all installed information decals on the machine and equipment.

Serial Number Plate

The serial number plate is on the side of the electrical cabinet, near the Main Disconnect switch.

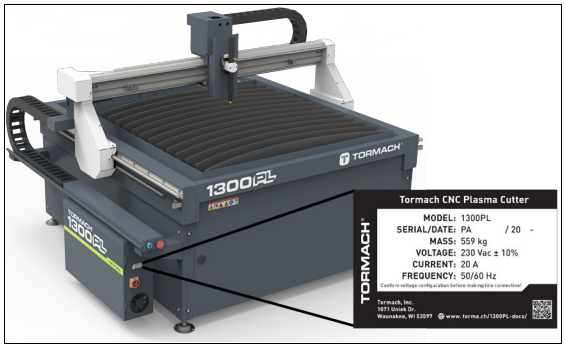

Figure 1-4: Example of the serial number plate on the side of the electrical cabinet.

1.4 MACHINE SAFETY

Before operating the machine in any way, you must read and understand this section.

Safe operation of the machine depends on its proper use and the precautions you take. Only trained personnel — with a clear and thorough understanding of its operation and safety requirements — shall operate this machine.

1.4.1 General Shop Safety

- Verify that only qualified machinery maintenance professionals install, set up, or perform maintenance on this machine.
- Keep the work area well-lit. Use additional lighting if needed. The work area should be illuminated to a minimum of 500 lx.
- Keep the work area temperature- and humidity-controlled.
- Remove loose-fitting clothing, neckties, gloves, and jewelry.
- Tie up long hair and secure it under a hat.
- Wear safety eye protection rated for ANSI Z87+.
- Wear safety eye protection with a shade number of 6 or greater when the torch is operating.
- Wear closed-toed safety shoes.

- Wear ear protection when you expect the machine or the machining processes to exceed safe exposure limits.
- Wear suitable work gloves when loading or unloading workpieces or stock that may be sharp or hot.
- Wear respiratory protection appropriate for the material being cut.
- Use welding blankets and screens to protect people and equipment outside of the machine's work area.
- Keep a clearly labeled fire extinguisher close by the machine's work area. The fire extinguisher should be rated for solid, combustible liquid, and electrical fires (NFPA Type ABC). The fire extinguisher should be inspected on a periodic basis as recommended by the manufacturer.
- Remain near the machine after use for at least one half hour to detect and extinguish any possible smoldering fires.
- Keep the work area clean and free of clutter. Machine motion can occur if controls are accidentally activated.
- Immediately clean up spills after they occur.
- Never operate the machine after consuming alcohol or taking medication that could prevent you from safely operating the machine.
- Never operate the machine while tired or otherwise impaired.
- Never operate the machine in an explosive (ATEX) atmosphere. Such explosive atmospheres include explosive gases, vapors, mists, powders, and dusts.
- Never wear synthetic or synthetic-blend fabrics while operating the machine. Synthetic and synthetic-blend fabrics can melt causing severe injury. Only wear natural fiber fabrics.
- Keep flammable materials out of the machine's work area. Ensure that the walls, ceilings, and work surfaces of the workshop are suitably protected from sparks and hot materials.

1.4.2 Operational Safety

General

- Understand that the machine is automatically controlled and can start at any time.
- Become familiar with all physical and software controls.
- Always use a chip scraper or brush when clearing away chips, oil, or coolant.
- Examine all tools, fixtures, workpieces, and guarding for signs of damage. Replace any damaged components as soon as you find them.
  Guards may not stop all types of projectiles, like broken or loose workpieces.
- Stop the machine and verify that all machine motion has completely stopped before doing any of the following:
  - Adjusting a part, fixture, or coolant nozzle.
  - Changing or parts.
  - Clearing away chips, oil, or coolant.
  - Reaching into any part of the machine's motion envelope.
  - Removing protective shields or safeguards.
  - Taking measurements.
  - Doing any other action inside the machine's motion envelope.
- Use flood or MQL (mist) coolant as required by the machining operation.
- Only use coolants designed for metal working applications such as soluble oils, semi-synthetic, or synthetic coolants.
- Read the Safety Data Sheet (SDS) for all workpiece materials, coatings, coolants (flood or MQL), lubricants, and other consumables. Chips, dust, and vapors from certain materials can be toxic or otherwise harmful.
- Dispose of scrap and swarf according to local regulations and guidelines.
- Thoroughly read all safety precautions and instructions.
- When machining an unproven program, use feed, speed, and maximum velocity overrides, Distance-to-Go (DTG) displays, single block, feed hold, and other control features.
- Never reach around a guard.
- Never allow the machine to run unattended.
- Never obstruct the Emergency Stop button or any other controls.
- Never allow untrained operators to install, operate, or maintain the machine.
- Never modify, defeat, or bypass safety devices or interlocks.

- Never machine abrasive, carcinogenic, explosive, flammable, radioactive, or toxic materials. Such materials include, but are not limited to:
  - Beryllium and its alloys
  - Ceramic
  - Fiberglass
  - G10 fiberglass laminate
  - Graphite
  - Lead and its alloys
  - Magnesium and its alloys
- Never allow swarf to accumulate on or within the machine.
- Never use flammable liquids (like alcohol, diesel fuel, or kerosene) in the machine's coolant system.
- Never use water, coolants without rust inhibitors, or straight cutting oil in the machine's coolant system.

Workholding

- Secure workpieces with appropriate workholding devices.
- Verify that the workpiece is adequately secured.
- Monitor cutting operations for "tip-ups" or warped workpieces that could collide with the machine.
- Remove cutoff workpieces and other large chips before starting the machine.
- Never leave tools, stock, or other loose items inside the machine.

1.4.3 Electrical Safety

> ⚠ **WARNING!** Electrical Shock Hazard: You must power off the machine before making any electrical connections. If you don't, there's a risk of electrocution or shock.

- Power off the machine before servicing.
- Understand that certain electrical components can retain dangerous electrical voltages, even after the machine is powered off and all power is removed from the system.
- Understand that certain installation, maintenance, and troubleshooting procedures — for the machine and certain accessories — require access to or modification of wiring inside of the electrical cabinet. Only qualified electrical machinery technicians shall perform these procedures.
- Confirm that the mains voltage conforms to requirements before connecting the machine.
  For more information, see "Electrical and Power Requirements" (page 20).
- Confirm that the machine installation meets all codes and regulations of your locality.
- Confirm that electrical connections are performed by a certified electrician.
- Lock the electrical cabinet door and remove the keys when the machine is not being serviced to prevent unqualified or unauthorized personnel from accessing the electrical cabinet.
- Never operate the machine with the electrical cabinet door open.
- Never reach into the electrical cabinet with the machine powered on.
- Never modify the machine's electronics.
- Never drill into the electrical cabinet.

ABOUT YOUR MACHINE

IN THIS SECTION, YOU'LL LEARN:

- About this machine's specifications.

CONTENTS

2.1 PERFORMANCE EXPECTATIONS REFERENCE

2.1.1 Cutting Performance Reference

This machine is capable of cutting any metal that can be cut with a plasma torch at or near the recommended feeds and speeds. Verify that the programmed cuts do not exceed the maximum feed rate in X and Y.

- **Maximum Feed Rate** 1000 IPM (25.4 m/min)

2.1.2 Torch Height Control Reference

Success using torch height control depends largely on the voltage setting selected at run time, and its relation to cutting feed rate. Make sure that your material is flat enough that vertical movement of the torch would not exceed the maximum Z Torch Lifter feed rate.

- **Maximum Vertical Feed Rate** 120 IPM (3.0 m/min)

> **Tip!** For a cut programmed at 140 IPM where the material rises 1" vertically over a 10" cut, the required vertical feed rate would be (1/10) * 140 = 14 IPM.

2.1.3 Resolution and Accuracy Reference

Accuracy is heavily influenced by the techniques that the machinist uses. A skilled machinist can deliver accuracy that exceeds the specified accuracy from the manufacturer; an inexperienced machinist may have difficulty delivering the specified accuracy. We can't predict operator accuracy, but the specified accuracy is an important reference point.
The accuracy and overall quality of plasma-cut parts depends on plasma torch settings, air supply quality, workpiece material properties, toolpath parameters, and other dynamic factors. As such, the following accuracy specifications are for the machine's motion control system only.

- **Resolution** 0.0005" (.0127 mm)

  > **Note:** The resolution of motion is the minimum discrete positional move.

- **Repeatability** ±0.001" (±0.0254 mm)
- **Positional Accuracy** ≤0.005 in./ft (130 micron / 300 mm)

> **Note:** Positional accuracy takes into account items like backlash in the drive system and total composite error of the gear rack.

2.2 SPECIFICATIONS REFERENCE

2.2.1 Machine Specifications

Travels	
X-Axis	50" (1270 mm)
Y-Axis	51.5" (1308 mm)
Z-Axis	3.9" (100 mm)
Maximum Feed Rate	
X- and Y-Axis	1000 IPM (25.4 m/min)
Z-Axis	120 IPM (3.0 m/min)
Power	
Primary Power Required	Single-Phase 230 Vac, 50/60 Hz
Recommended Circuit Amperage	20 A breaker
Table Specifications	
Table Size	51.2" x 51.2" (1300 mm x 1300 mm)
Table Type	Water Table
Weight Capacity (Excluding Water)	750 lb (340 kg)
Water Capacity	59 US gallons (223 liters)
Machine Specifications	
Gantry Clearance	7.0" (177 mm)
Machine Footprint	78" x 70" (1.95m m x 1.7 m)
Overall System Height	55" (1.4 m)
Typical System Weight	1232 lb (559 kg)
Linear Motion Components	
X and Y Axis Motor	Servo Driven
Z Axis Motor	NEMA 23 Stepper
Guideways	Precision Linear Guideway
Power Transmission	Planetary Gear (X Axis) 5mm HTD Belt (Y Axis)
Machine Construction	
Water Table	Welded Steel
Machine Base	Welded Steel
Gantry Bridge	Aluminum

Gantry Supports	Steel
Controller	
Control System	PathPilot (v2.4.x or newer)
Resolution and Accuracy	
Resolution	0.0005" (.0127 mm)
Repeatability	±0.001" (±0.0254 mm)
Positional Accuracy	≤0.005 in./ft (130 micron / 300 mm)

SITE REQUIREMENTS

IN THIS SECTION, YOU'LL LEARN:

- About the site requirements of this machine (including electrical and power requirements).

Before operating the machine in any way, you must read and understand this section.

CONTENTS

3.1 GENERAL SITE AND SPACE REQUIREMENTS

When choosing a location for your machine, you must verify that it meets all requirements outlined in this section.

3.1.1 Site Requirements

You must verify that the area:

- Allows for unrestricted access to machine controls.
- Conforms to the following:
  - **Primary Power Required** Single-Phase 230 Vac, 50/60 Hz
  - **Recommended Circuit Amperage** 20 A breaker

> **Note:** For more information, see "Electrical and Power Requirements" (below).

- Has a fire extinguisher within the work area.
- Is a dry, properly ventilated, and well-lit internal space.
- Provides for unobstructed machine motion and operation.

3.1.2 Space Requirements

The area must meet the following space requirements. Allow more space to access the rear of the machine for maintenance and repairs.

- **Machine Size** 78" x 70" (1.95m m x 1.7 m)
- **Machine Height** 55" (1.4 m)

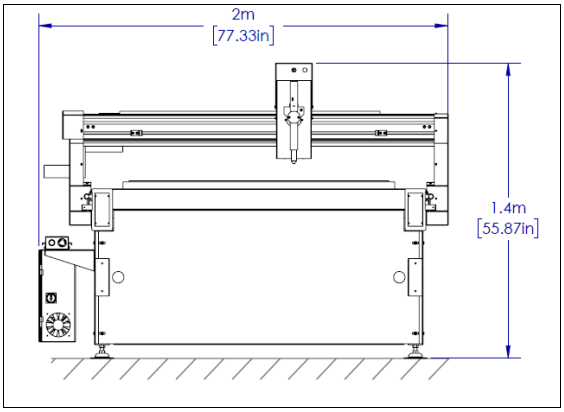

Figure 3-1: Dimensions of the machine itself, as viewed from the front.

- **Typical System Footprint** 89" × 67" (2.3 m × 1.7 m)

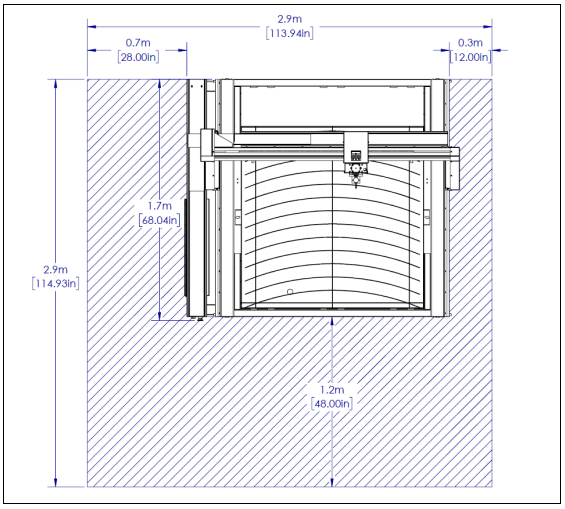

Figure 3-2: Dimensions of the machine and it's required added space, as viewed from above.

3.2 ELECTRICAL AND POWER REQUIREMENTS

You must verify that the site conforms to the following electrical and power requirements.

3.2.1 Electrical Requirements

A certified electrician must make all electrical connections, and it's your responsibility to verify that the electrical installation of the machine meets all local regulations and electrical codes.

- **Primary Power Required** Single-Phase 230 Vac, 50/60 Hz
- **Recommended Circuit Amperage** 20 A breaker

3.2.2 Power Requirements

If the site conforms to the electrical requirements, verify that it meets the following power requirements:

- **Proper Grounding** You must properly ground the power input to the machine. Examine the continuity between bare metal on the machine frame and true earth ground (a water pipe or similar) to verify that it's properly grounded.
- **Correct Plug Pattern** The machine is shipped with a NEMA 6-20P plug, designed for use with a NEMA 6-20R receptacle.

3.2.3 Plasma Source Power Requirements

In addition to the requirements listed above for the machine itself, make sure that you have a separate circuit available to power your plasma source. For example, when using 220V

single-phase power the Hypertherm Powermax 45 XP requires the following:

- **Primary Power Required** 200 Vac – 240 Vac
- **Recommended Circuit Amperage** 50 A
- **Plug Pattern** NEMA 6-50P

Check with the manufacturer documentation for the specific plasma source you are using before installation.

3.2.4 Options for Non-Conforming Sites

For sites that don't conform to the specified "Electrical and Power Requirements" (on the previous page), you may consider the following. You must consult with an electrician to determine the suitability for your site.

- **Buck-Boost Transformer** Used to adjust line voltages. While the machine can run on line voltages between 200 to 240 Vac, performance is reduced on line voltages below 230 Vac, and damage to electrical components is possible on line voltages above 240 Vac. To prevent reduction in performance or damage to electrical components, we recommend the Buck-Boost Transformer (PN 32554).

3.3 AIR REQUIREMENTS

You must verify that the site conforms to the following air supply requirements.

- **Air Pressure** Between 90 psi and 120 psi (620 kPa to 825 kPa).
  If the air supply is more than 120 psi (825 kPa), you must use a regulator.
- **Air Volume** At least 6 CFM at 90 psi. Check with your plasma source manufacturer in case your model requires more volume.
- **Dry Air** We recommend using a compressed air dryer, desiccator, or filter between the air compressor and the machine.

3.4 PLASMA SOURCE REQUIREMENTS

Tormach recommends either the Hypertherm Powermax 45 XP or the Powermax 65 plasma sources for use with the 1300PL. Plasma sources ordered directly from Tormach will include the correct CNC control interface and cables.
If you would like to use your own plasma source, the minimum requirements are as follows:

- Blowback style arc-start. The 1300PL is not recommended for use with high-frequency style arc-start units. The electrical noise spike generated by high-frequency arc starts can interfere with the axis control signals.
- An internal voltage divider outputting a 50:1 torch voltage signal.
- An input for plasma arc start compatible with dry contact closure to activate (the 1300PL uses an open relay for torch off and closed relay for torch on)
- (Optional but recommended) Arc-ok output. Closed contacts when arc is active.


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INSTALLATION

IN THIS SECTION, YOU'LL LEARN:

- About the installation process required for this machine.

Before operating the machine in any way, you must read and understand this section.

CONTENTS

4: INSTALLATION

4.1 BEFORE YOU BEGIN

1. Read the packing list to see if there are any items that have not yet been delivered. We recommend waiting until you've received all shipments to begin installing the machine. Depending on the product and options ordered, the system may arrive in one or more shipments of:
   - Accessories (if applicable)
   - Machine

   > **Note:** The machine system and large accessories are sent by freight carrier. Smaller accessories may be sent by parcel service.

2. Inspect the item(s):
   - Photograph any damage that may have occurred during shipping.
   - Note any damage on the delivery receipt before signing for the shipment.
   - Verify the received goods against the packing list.

   If there is any damage or shortages, you must contact Tormach within 30 days of receipt. Create a support ticket with Tormach Technical Support at tormach.com/how-to-submit-a-support-ticket for guidance on how to proceed.

4.1.1 Installation Tools and Items

Before uncrating and installing your machine, collect the following tools and items.

- Tin snips
- Flat-blade screwdriver
- Pliers
- 3mm, 4mm, 5mm, 6mm Allen key
- Dead-blow hammer
- Utility knife
- Adjustable crescent wrench
- Pallet jack
- Engine hoist, forklift, or gantry crane
- Lifting sling (2200lb / 1000kg minimum rating)

4.2 MOVE THE PALLET

Tools and Items Required

- Pallet jack

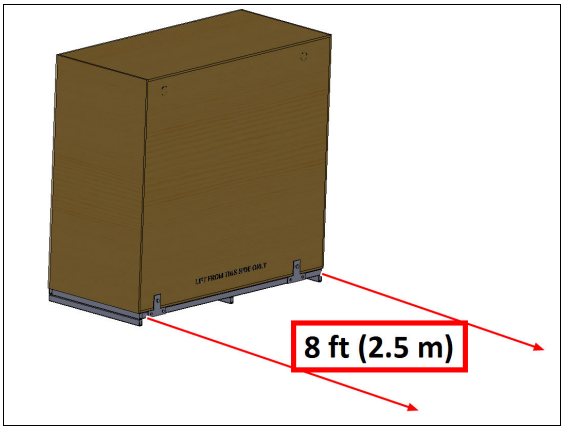
Shipments arrive in crates loaded on pallets, which the freight carrier unloads onto the curb or loading dock.

> **WARNING!** Transportation and Lift Hazard: Before moving the machine, you must confirm that all persons are clear of the area below the machine. Qualified professionals must transport, lift, and move the machine. Moving parts can entangle, pinch, or cut you, causing death or serious injury.

- Verify that the ground surface is smooth and clean of debris, and then use a pallet jack to move the pallet(s) to the desired installation location.

  > **Note:** If the ground is not smooth, you may need to use a forklift (or similar lifting equipment rated for uneven surfaces) to move the pallet(s).

  One side of the crate is labeled **Lift from this side only**. Verify that there's at least 8 ft (2.5 m) of free space behind this side of the crate so that you can lay the machine down flat on the ground.



4.3 UNPACK THE MACHINE CRATE

Tools and Items Required

- Pallet jack
- Flat-blade screwdriver
- Pliers
- Tin snips
- Safety eyewear that meets ANSI Z87+
- Work gloves

> ⚠ **CAUTION!** Sharp Objects Hazard: Before opening the shipping crate, you must put on work gloves and safety eyewear that meets ANSI Z87+. If you don't, the shipping crate and steel straps could cut you, causing serious injury.

4.3.1 Open the Crate

1. Put on work gloves and eye protection.
2. Pry up the tabs holding the lid on to the sides of the crate. You may need to use pliers to fully straighten them so the lid can be removed.
3. With a helper, lift the lid off of the crate and set aside.
4. Remove the screws from the base of the crate on all four sides.
5. Straighten the tabs holding one of the panels on to the crate. The front panel is opposite the side of the crate stenciled "Lift from this side only".
6. Remove the front panel from the crate and set aside.
7. With a helper, lift the remaining three sides from the crate as a unit.
8. Inspect the item(s):
   - Photograph any damage that may have occurred during shipping.
   - Verify the received goods against the packing list.

   If there is any damage or shortages, you must contact Tormach within 30 days of receipt. Create a support ticket with Tormach Technical Support at tormach.com/how-to-submit-a-support-ticket for guidance on how to proceed.

4.3.2 Unpack the Machine

1. Cut the strap holding the electrical cabinet to the crate and unwrap the plastic from it. Set it aside in a safe area.
2. Remove the Hypertherm control cable and package of small parts from the crate.
3. Unstrap and remove the cable tray and cable tray cover.
4. Unstrap and remove the cable tray support brackets.
5. Unstrap and remove all four legs.
6. Remove the four side panels from underneath the machine frame.

> ⚠ **CAUTION!** Be careful not to hit the torch lifter head while removing panels from the crate.

7. Remove all plastic overwrap from the machine frame and water table except for the Y axis energy chain (it will be unwrapped later).

4.4 REMOVE FRAME FROM CRATE

This potion of the installation requires at least two people. Make sure that you have a partner before beginning the lifting procedure.

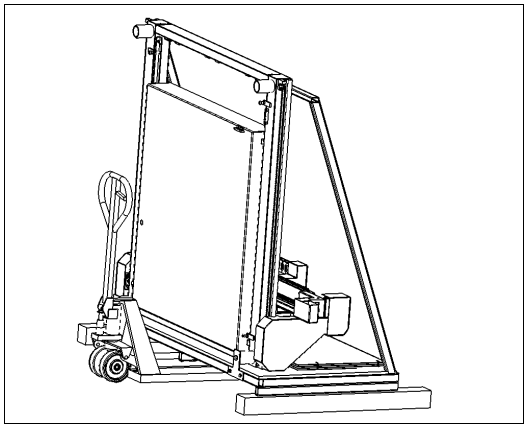
Tools and Items Required

- Engine hoist or gantry crane rated for 825 lb (375 kg)
- Pallet jack
- 4x4 lumber (4ft long)
- Lifting strap
- Pry bar
- Allen keys
- Safety eye-wear that meets ANSI Z87+
- Work gloves

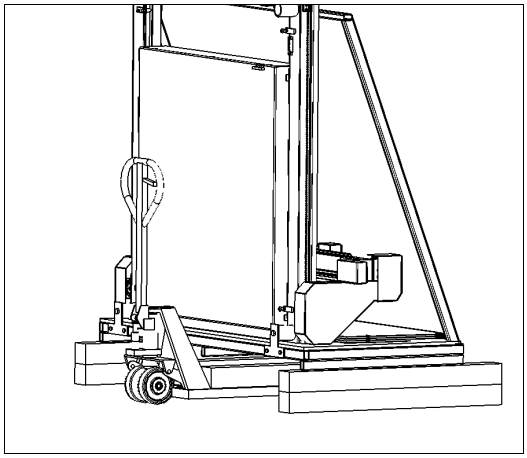
> ⚠ **CAUTION!** Lifting a machine can be dangerous if you are unfamiliar with your equipment. Make sure to know the load ratings of your lifting equipment and hire a qualified rigging company if you are not confident in its safe operation.

4.4.1 Lifting Frame

1. If using an engine hoist, perform the following steps to lift the crate for clearance underneath. If using a forklift or gantry, proceed to the next step.
   a. Position a pallet jack under the machine and lift high enough to place a 4x4 under the side supports.



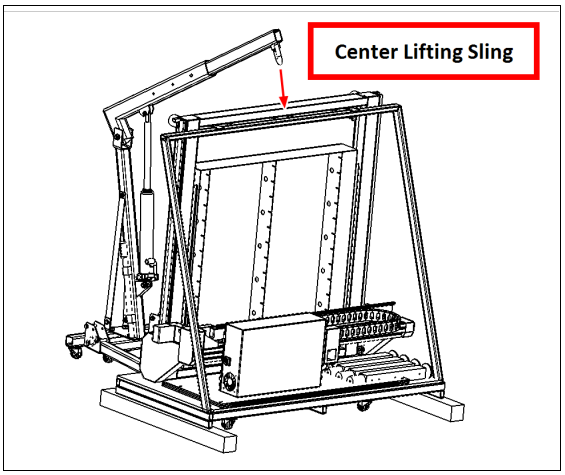
b. Place two 4x4 pieces on the pallet jack legs and repeat the lift. Place another 4x4 under the side supports.



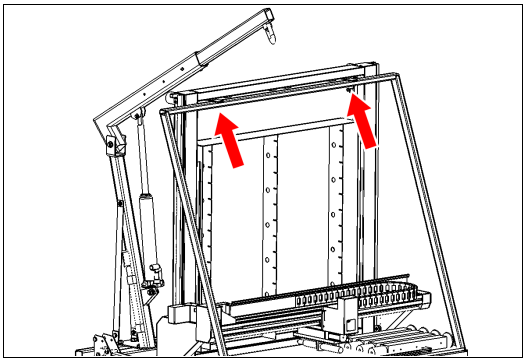
c. Repeat the above steps until the crate clears the front legs of your engine hoist.

2. Attach a sling to the top frame rail of the plasma. Make sure the sling is positioned securely between two of the raised accessory mounting pads to prevent side-to-side slippage of the frame.

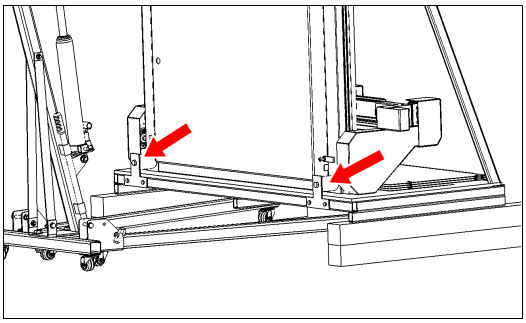
> ⚠ **WARNING!** Make sure that the lifting device you are using is rated for the weight of the machine frame - 825 lb (375 kg).



3. Position your engine hoist, crane or forklift above the sling and put light tension on it, just enough to hold the frame upright when it is released.
4. Remove the top two bolts holding the A-frame support of the crate to the machine frame.

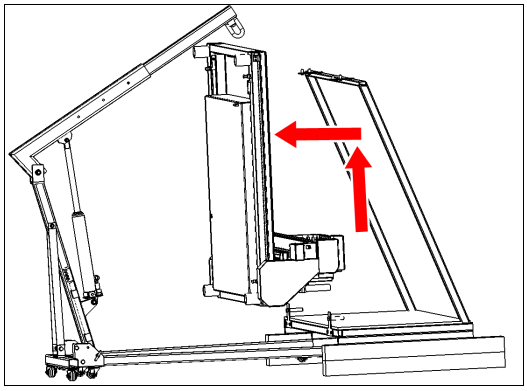


5. Remove the two bottom bolts connecting the crate frame to the machine leg mounting pockets.



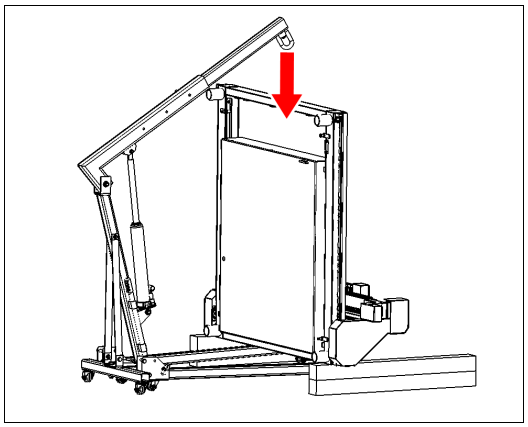
6. Use your lifting device to put enough upwards pressure on the machine that it will be fully supported. Use a pry bar to push the lower leg mounting pockets off of the crate mounting bosses.

7. Lift the machine frame enough to clear the crate and use a pallet jack to remove the crate from the area.

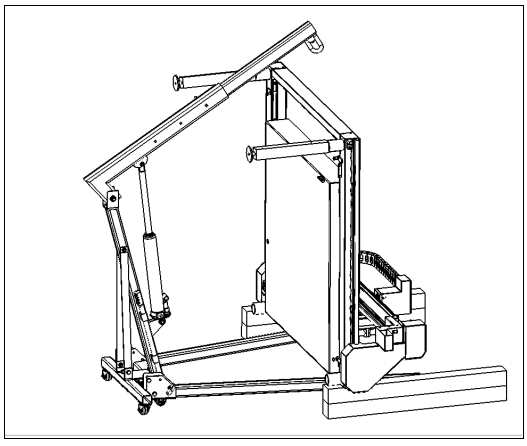


4.4.2 Installing Legs and Righting Machine

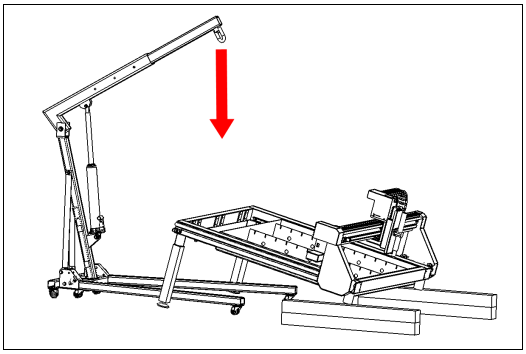
1. Lower the bottom end of the frame down on to 4x4 blocks to protect the paint and clear the engine hoist legs (if present).



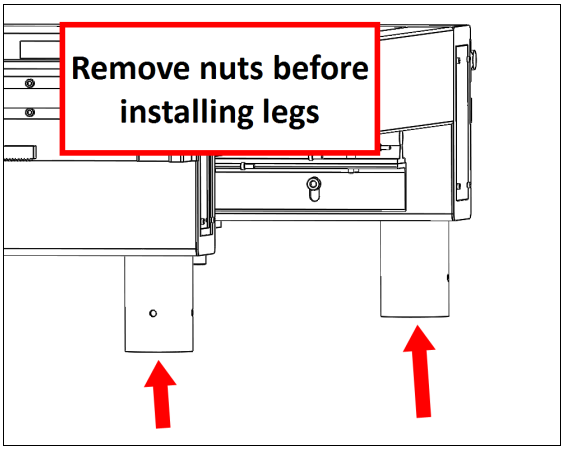
2. Install the top two legs on the machine on the end supported by the lifting sling.



3. Using gantry crane, slowly lower the top side of the machine frame until the two legs are on the ground.



4. Move the lifting sling to the same position on the opposite end of the frame.
5. Lift the remaining end of the frame off of the 4x4 blocks.
6. Remove the two nuts (used to bolt to the crate frame) from inside the leg mounting holes. Do not discard the socket head cap screws attaching the nuts, these are used to attach the last two legs.



7. Install the last two legs.

4.5 LEVEL THE MACHINE FRAME AND WATER TABLE

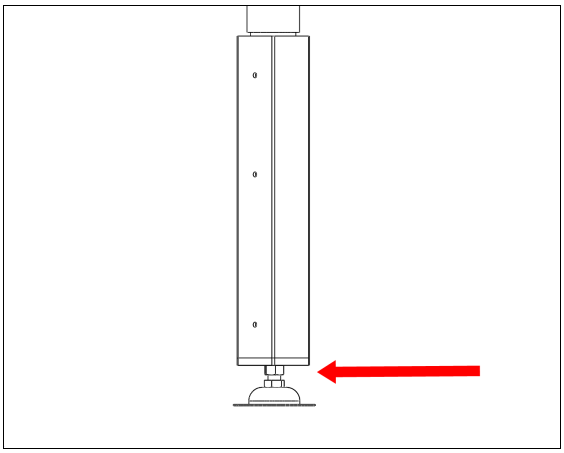
Tools and Items Required

- Carpenter's Level
- Crescent Wrench
- Allen Key

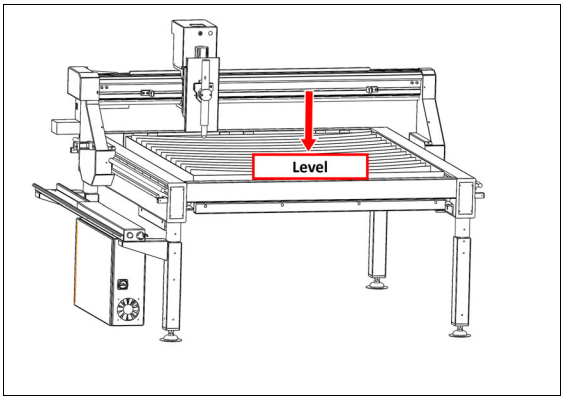
The water table can be leveled at any time, but it is easiest to do before the side panels have been installed.

4.5.1 Level the Machine Frame

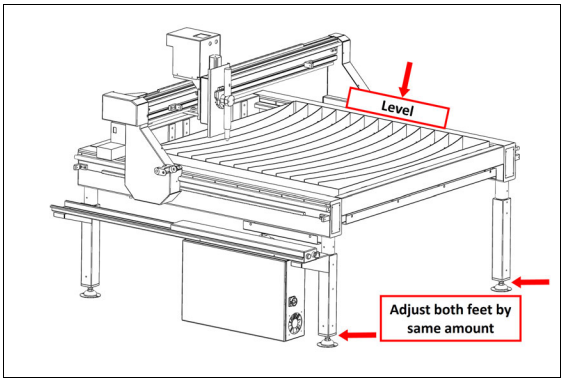
1. Loosen the jam nuts on all machine feet



2. Place a carpenters level across the front frame rail of the machine and level it side-to-side using the threaded feet.



3. Perform the same procedure on the rear of the machine, leveling it side-to-side.
4. Place the level one of the side rails of the machine frame and level it front to rear.
   You must adjust both front or rear feet the same number of turns while doing this to avoid losing side-to-side level from the step above.

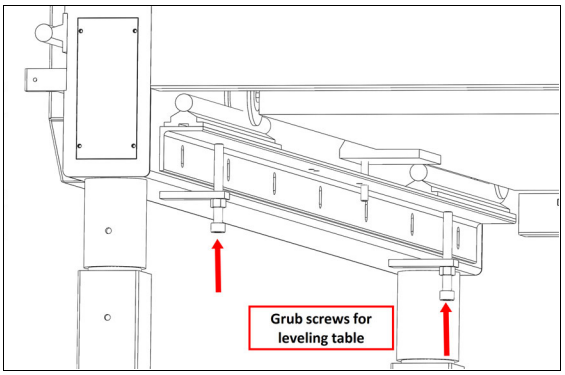


5. Tighten all the jam nuts for the machine feet.

4.5.2 Level the Water Table

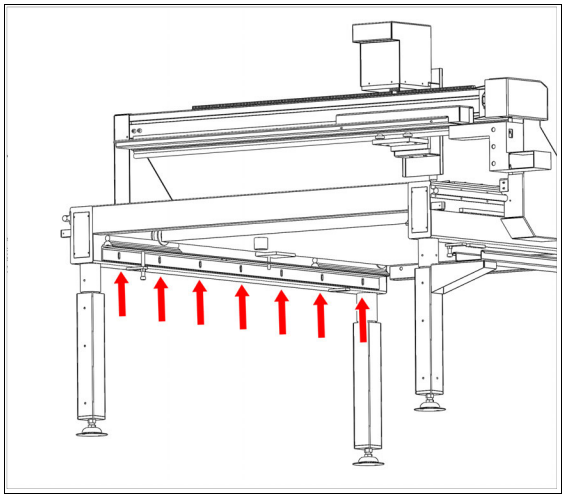
Note: If the water tank ball valve is not already installed, apply sealant tape to the water tank drain threads and install the ball valve onto the water tank.

1. Examine the level on the water table to determine if you must make adjustments. The water table on the 1300PL is supported on two adjustable rails, one on each side of the table. The frame has grub screws to adjust the height of these rails, leveling the water table to the machine frame.

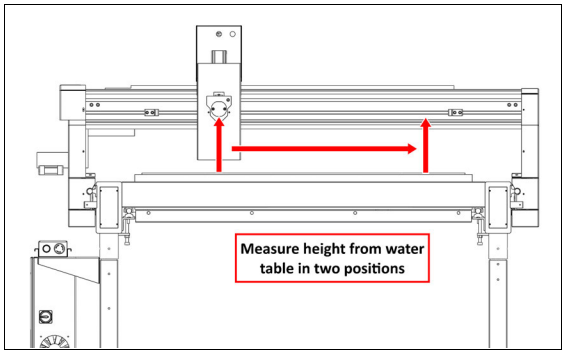


2. Depending on what you determined in Step 1, do one of the following:
   - If the water table is level, proceed to the next section.
   - If the water table isn't level, go to Step 3.

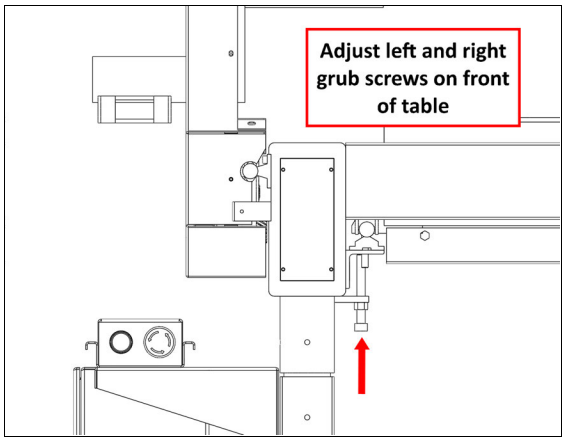
3. Loosen the socket head cap screws holding the water table support rails to the machine frame, just enough that the rail can move vertically.



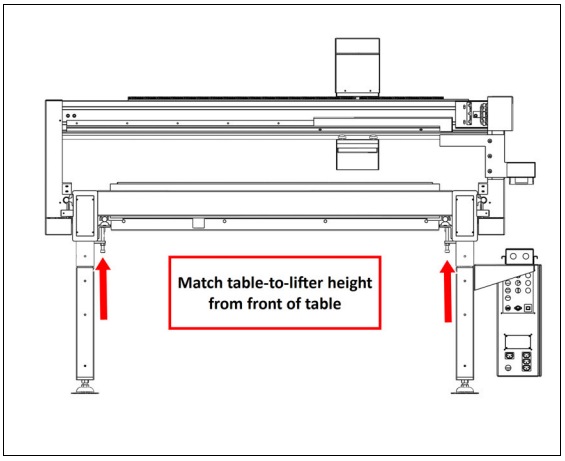
4. By hand, move the torch carriage to the front left and right corners of the water table. Measure the vertical distance from the torch holder to the water table slats.



5. Using the two grub screws underneath the machine frame, lift the water table rails so that the front two corners are level.



6. Move the torch carriage to the rear of the water table and repeat the procedure for the rear grub screws.



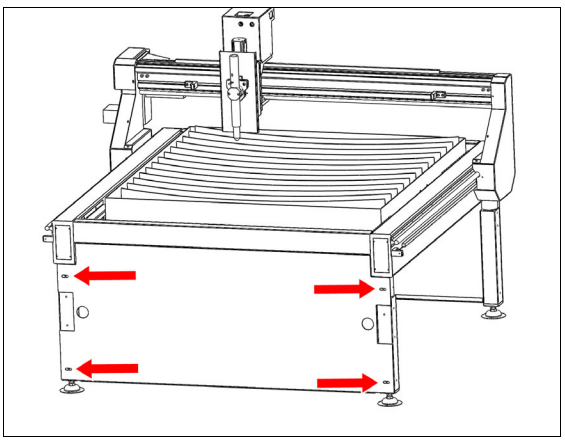
7. Re-check the front corners and iterate the leveling process if needed until your table-to-lifter height matches in all four spots.

> **Note:** Small variations in level will be compensated for by torch height control. A table leveled to within 1/4" (6 mm) will perform well with THC.

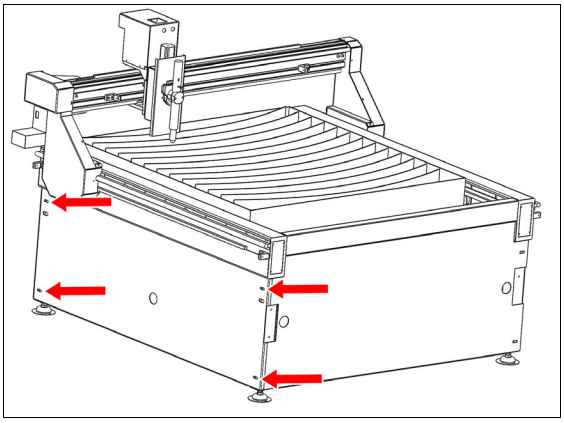
8. Tighten all the socket head cap screws holding the water table rails to the frame.

4.6 INSTALL SIDE PANELS AND CABLE CARRIERS

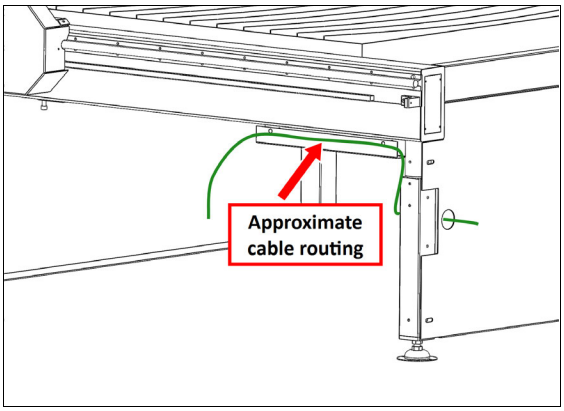
1. Install the front and rear panels using the M8 button head cap screws and washers from the small parts package. To prevent vibration, use one of the included flat washers and then one lock washer for the top two mounting screws on each of the panels.



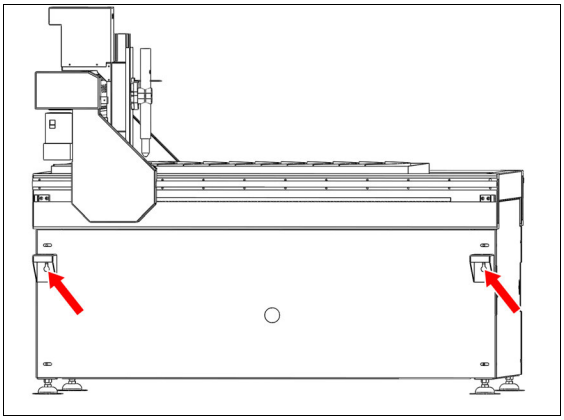
2. Install the left side panel (viewed from the front), with the flanges overlapping the front and rear panels. The right side panel will be left off for now to allow access to the bottom of the machine.



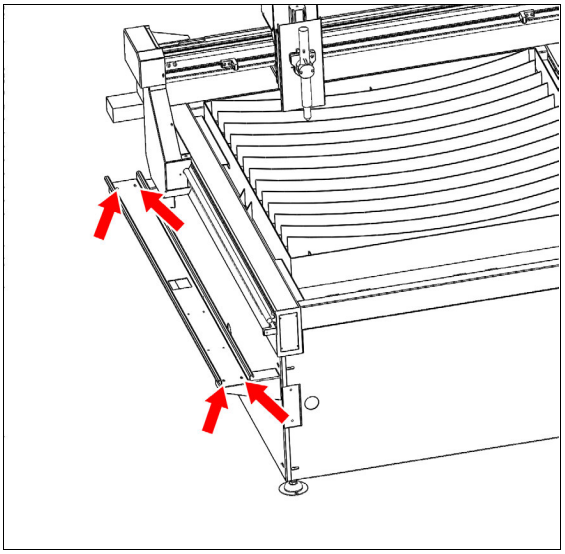
Note that this side panel has a small cable carrier on the inside of the frame to carry cables from the machine arm to the electrical cabinet.



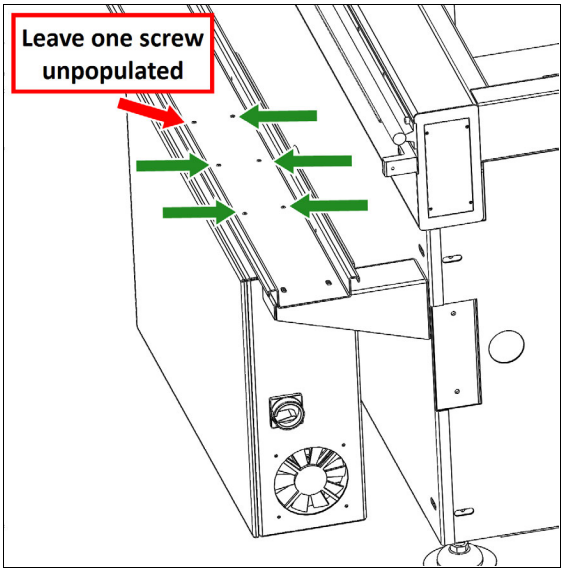
3. Hang the cable track mounts on the two M8 button head mounting screws.



4. Remove the top cover from the cable track (4x M3 screws). It will be reinstalled after hanging the electrical cabinet.
5. Install the cable track to the mounts with four M6 button head cap screws.



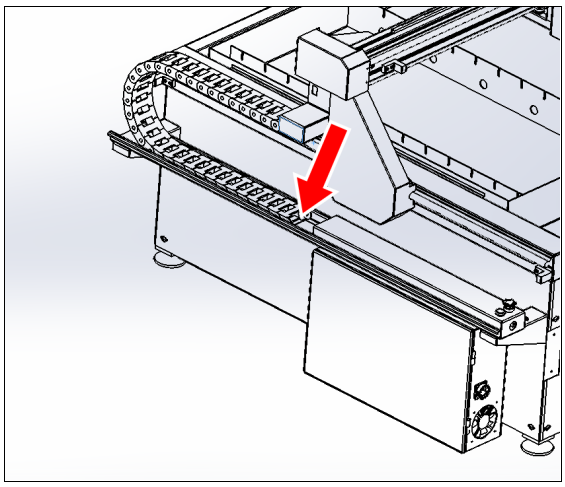
6. Hang the electrical cabinet from five M6 screws, leaving the one nearest the pass-through hole for electrical wires off (this is where a ground wire will be attached).



4.7 ATTACH THE CABLE GUARD

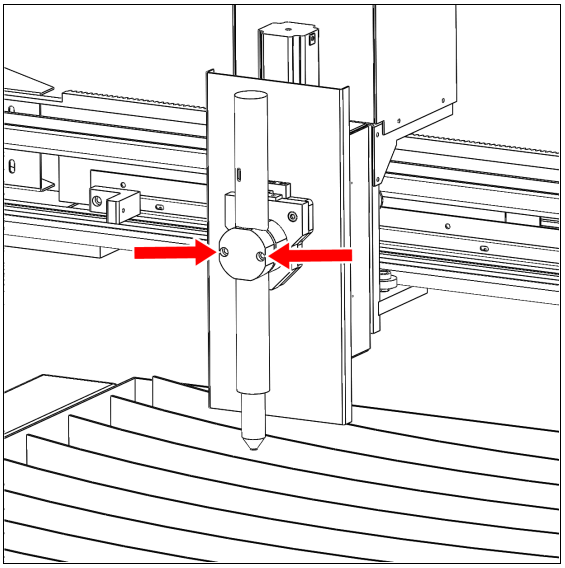
1. Unwrap the flexible black cable guard from where it is bundled on the side of the gantry and lay it out onto the cable track above the electrical panel.

2. Pass the bundle of connectors from the flexible cable guard down through the rectangular cutout in the cable track.
3. Attach the cable guard to the cable track using 4 M6 socket head cap screws.



4.8 INSTALL PLASMA TORCH AND LEAD

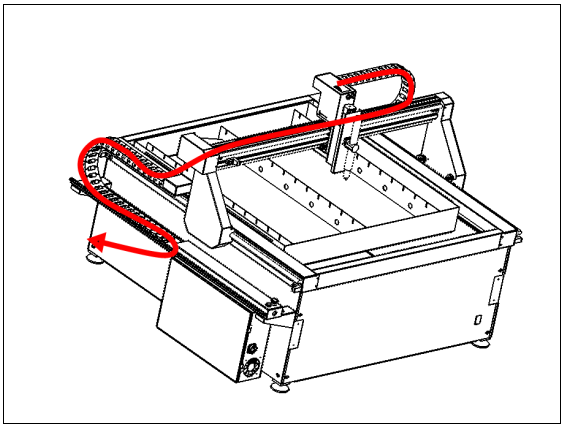
1. Install the cable retention loop into the base plate.
2. Locate the ohmic torch wire inside the X-axis motor cover. Pull it out and let it hang down for now.
3. To prepare for the installation of the torch lead, remove all of the side-to-side covers from one side of the flexible cable guard using a flat-blade screwdriver.
4. Remove the plasma power supply unit from its packaging.
5. Put the plasma power supply at the back left of the machine. Then, locate the torch lead.
6. Remove the brass gear from the torch body. Depending on which torch you have, do one of the following:
   - Unthread the body and slide the gear out of the housing.
   - Remove the two screws securing the gear.
7. Using the manufacturer's instructions, install the torch consumables.
8. Install the plasma torch into the breakaway torch holder using the two socket head screws. Only tighten these screws enough to securely hold the torch, do not overtighten.



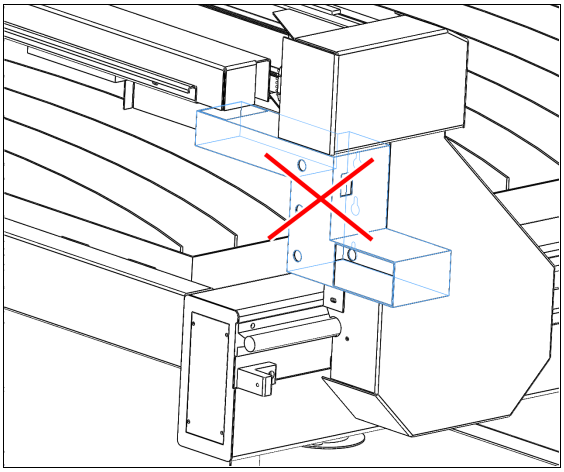
Tip! We recommend positioning the torch nose about 1" below the Z-axis cover plate to start.

9. Attach the ohmic probing spade connector to your torch cap.

10. Install plasma torch lead into the cable guard from the X carriage to the electrical cabinet and pass it through the rectangular access hole to bottom of track.



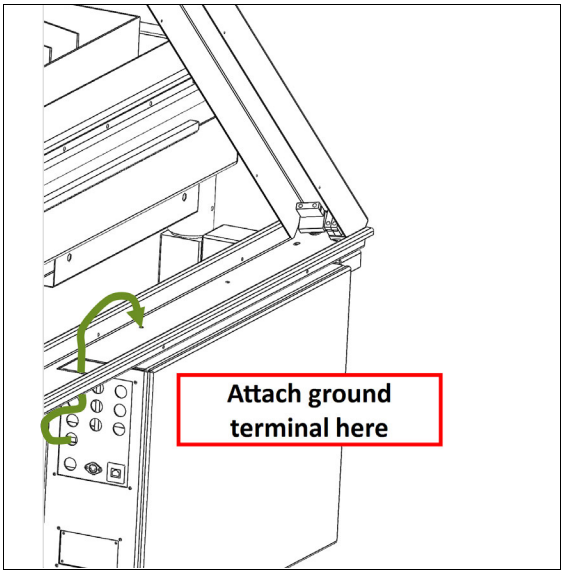
Note: Do not try to pass the torch lead through the stepped section between the Y and X axis cable guards. Simply run the torch lead along the outside.



11. Plug the torch leads into the plasma power supply.
12. Plug in the ground cable, and route the loose end of the cable under the back of the machine and up to the water table.
13. Connect the included Hypertherm control cable to the electrical cabinet and plasma source (this cable is a 14-pin CPC connector on one end and a 7-pin threaded -body connector on the other). For more information on this cable see "Plasma Source Control" (page 45).
14. Reinstall the cable guard covers that you removed in Step 3.

4.9 MAKE ELECTRICAL CONNECTIONS

1. Locate the cable cover with the integrated E-Stop and Reset button. The cable for the Reset button and E-Stop contains a green and yellow ground lead with a ring terminal on the end. Attach this ground lead for the reset panel to the fourth M6 mounting screw on the electrical cabinet that you left unpopulated earlier.



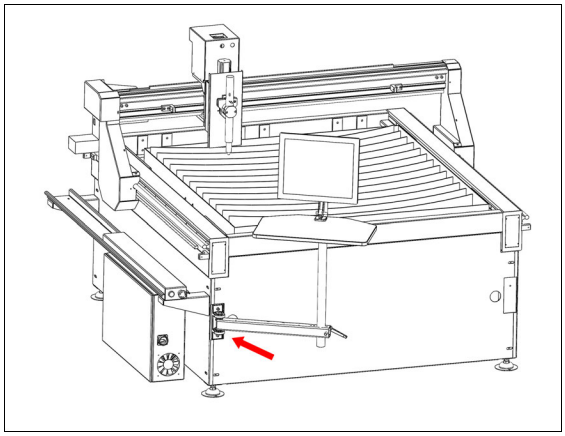
2. Pass the connector for the reset panel down through cable track.
3. Install the reset panel / cable cover using four M4 socket head cap screws.

Note: The two inboard screws are slightly longer.

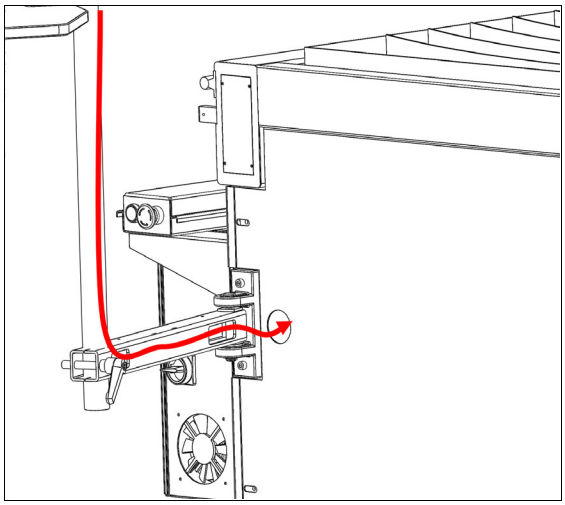
4. Plug in all connectors at rear of cabinet, following the "Connectors Reference" (page 43) guide in the "System Basics" (page 41) section.
5. Pass the ground wire through the hole in the side panel, and then connect it to the ground block on the underside of the water table.

4.10 INSTALL MACHINE ARM AND CONNECT CONTROLLER

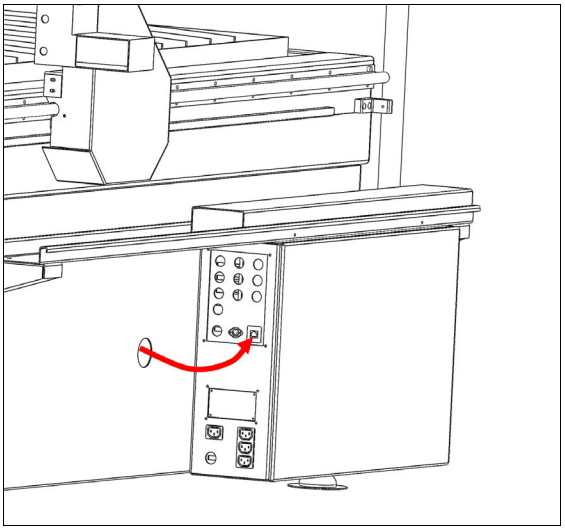
1. Bolt your machine arm to the mounting pad on either the left or right hand leg of the machine.



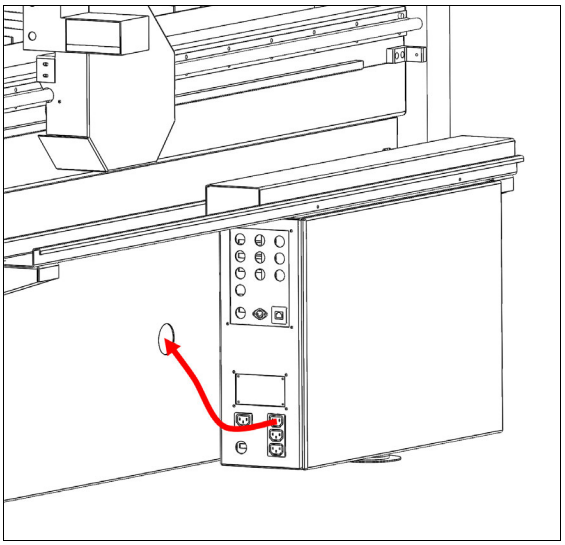
2. Install the monitor, keyboard tray and controller mount on the machine arm.
3. Mount the controller PC to the back of the monitor using the PathPilot Controller VESA Mount (PN 50382).
4. Connect a keyboard and mouse to the controller PC.
5. Run the Ethernet cable included in your machine owner's kit down from the controller and through the hole in the front panel of the plasma table.



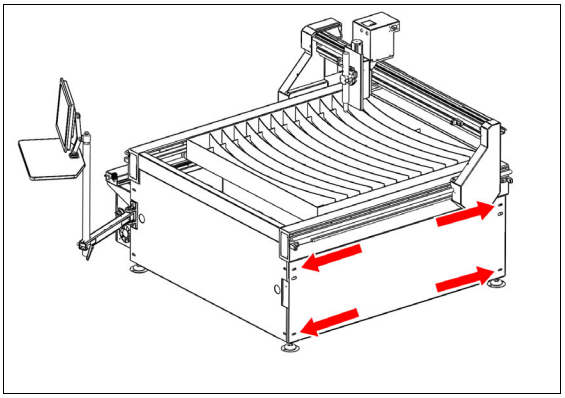
6. Connect the Ethernet cable to the port on the rear of the electrical cabinet.



7. Run a power cable from the rear of the electrical cabinet to the power supply for the controller PC in the same way. Use the block of three IEC ports designated for Accessory Power in "Connectors Reference" (page 43). Repeat for the display's power cable.



8. Now that all connections have been made inside the machine frame, the right side panel can be installed. Before installing the panel, check that the drain valve on the water table is fastened securely and in the closed position.



9. Install all end panels on the frame rails.

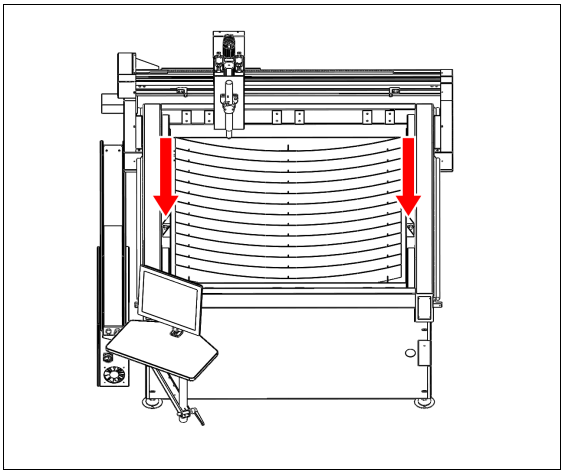
4.11 FILL WATER TABLE

Tools and Items Required

- Hose or bucket
- Plasma cutting fluid (rust inhibitor such as GreenCut or similar)

A properly filled water table is critical for safe operation of the 1300PL. The water table traps a majority of the metal particulates released in the cutting process and keeping it filled is important for maintaining good air quality in your shop space.

1. Ensure that the drain valve on the bottom of the water table is in the closed position.
2. Check that the two lock bolts that hold the table in place on the front-to-back tracks are in place.



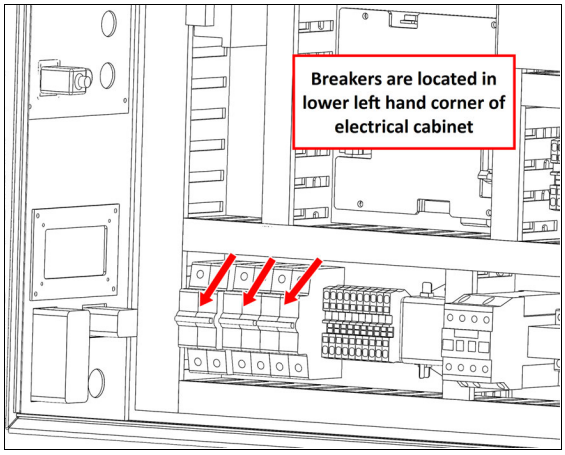
3. Using a hose or buckets, fill the table with tap water until the level is about 1" below the top of the slats.
4. Add cutting fluid to the water to inhibit corrosion. Use the ratio recommended by the cutting fluid manufacturer. For reference, full water table capacity on the 1300PL is 59 US gallons (223 liters).
5. Top the water table off to 0.5" below the top of the slats after adding cutting fluid if desired.

4.12 VERIFY THE INSTALLATION

After installing the base machine, you must verify the installation. Complete the following steps in the order listed:

4.12.1 Check Machine Breakers

Check that all breakers in the electrical cabinet are switched on (up position).



4.12.2 Power On the Machine

1. Use a multimeter to verify that the electrical service in your location meets the following requirements. If your location does not meet these requirements, do not install the machine. Instead, you must consult with a local electrician about your options.
   - **Primary Power Required** Single-Phase 230 Vac, 50/60 Hz

- **Recommended Circuit Amperage** 20 A breaker

2. Connect the machine's mains power cable to the verified electrical service.
3. Find the Main Disconnect switch, and then remove the hang tag (if present).

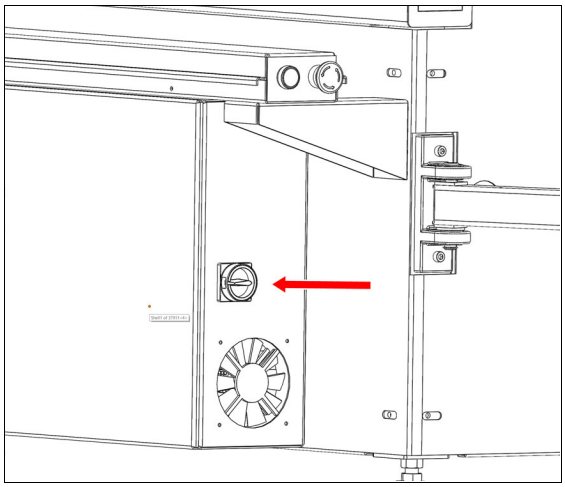


Figure 4-1: The Main Disconnect switch on the side of the machine's electrical cabinet.

4. Turn the Main Disconnect switch to **ON**.

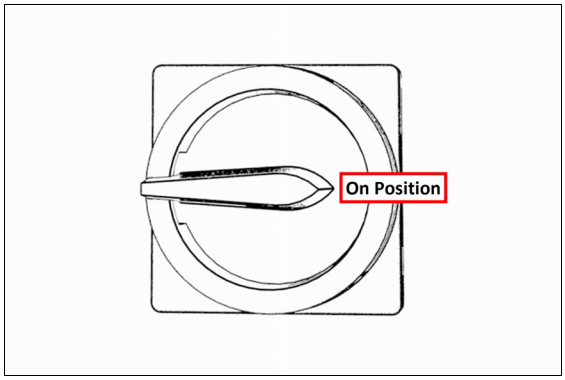


Figure 4-2: Example of the Main Disconnect switch in the On position.

Mains power is now connected to the machine.

5. Push the Power button on the PathPilot controller, if it's not already powered on.
6. Push the Power button on the monitor, if it's not already powered on.
7. Follow the on-screen instructions to configure the PathPilot operating system and PathPilot controller. When configuration is complete, the PathPilot operating system launches.

> **Note:** After you first configure PathPilot, the operating system automatically launches whenever it's powered on.

8. Depending on which monitor you have, do one of the following:
   a. **Standard Monitor** Go to the next step.
   b. **Touch Screen Monitor** You must first make sure that the monitor is configured and calibrated. From the PathPilot interface, in the **MDI Line** DRO field, type `ADMIN TOUCHSCREEN`. Then, select the **Enter** key, and follow the on-screen instructions.
9. Rotate the Emergency Stop button on the operator box one-quarter turn clockwise to release it.

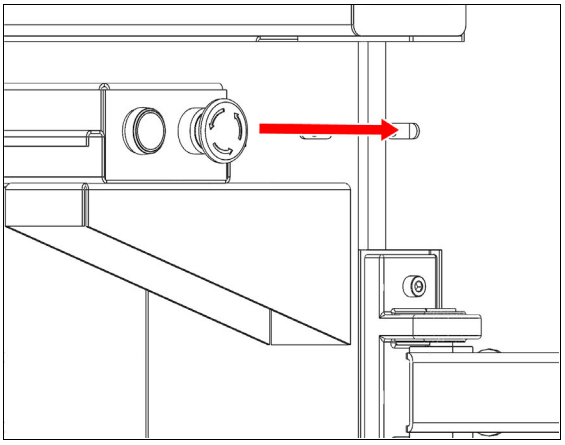


Figure 4-3: The Emergency Stop button on the operator box.

10. Push the blue Reset button to enable the machine.

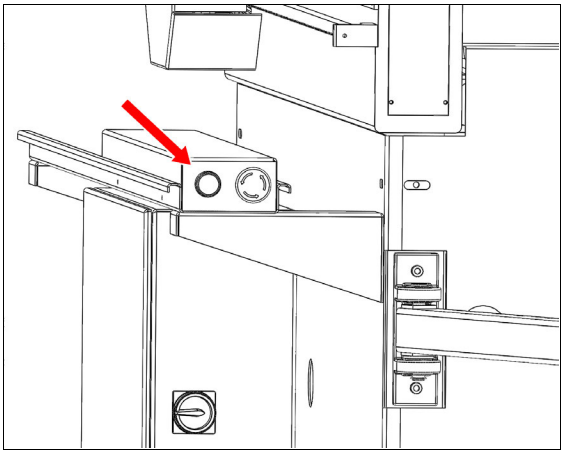


Figure 4-4: The Reset button on the operator box.

The axis drives are now powered on.

11. Verify that the blue Reset LED on the operator box comes on. From the PathPilot interface, on the **Status** tab, verify that the **Machine OK** light changes from yellow to green.
    Once both are on, the machine is powered on and ready to operate.

Figure 4-5: Machine OK light on the Status tab.

12. Select **Reset**.

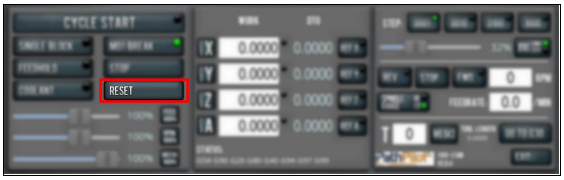


Figure 4-6: Reset button.

4.12.3 Power Off the Machine

1. Push the Emergency Stop button on the operator box to lock it into the disabled position.

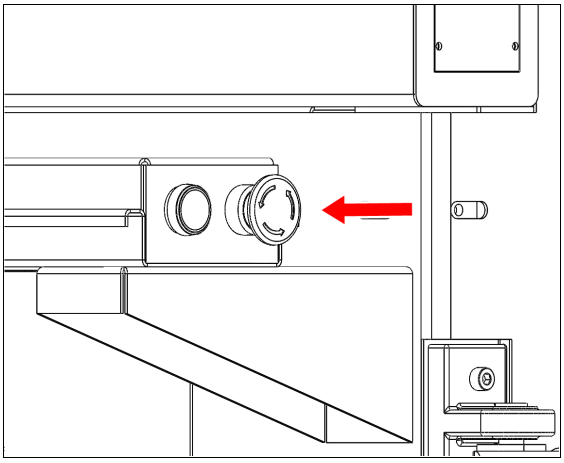


Figure 4-7: Example of the Emergency Stop button locked in the disabled position.

With the Emergency Stop button in the disabled position all motion function stops, and the Reset button is disabled. On the operator box, the blue Reset LED goes off. From the PathPilot interface, on the **Status** tab, the **Machine OK** light illuminates yellow.

2. From the PathPilot interface, select **Exit**.
3. When prompted, select **OK**.
4. Once the PathPilot interface indicates that it's safe to power off the machine, turn the Main Disconnect switch to **OFF**.

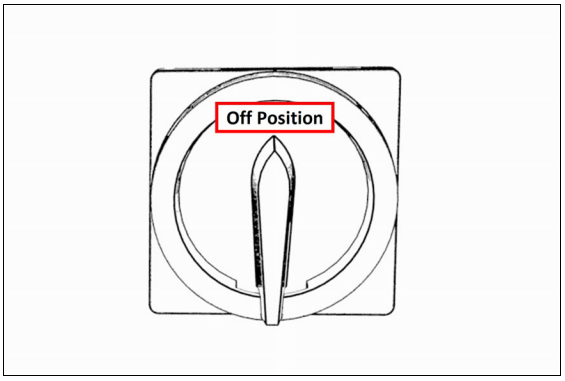


Figure 4-8: Example of the Main Disconnect switch in the Off position.

Mains power is disconnected from the machine.

4.12.4 Verify Axes Function

You must confirm that the axes correctly operate.

1. Power on the machine and bring it out of Reset.
2. Reference the axes: from the PathPilot interface, select **Ref Z**, **Ref X** and **Ref Y**.

Figure 4-9: Ref Z, Ref X, and Ref Y buttons.

The machine moves to the reference position.

3. Use the keyboard to verify axes motion:
   - Select the **Right Arrow** key and then the **Left Arrow** key.
     The torch carriage moves right (X+), then left (X-).
   - Select the **Up Arrow** key and then the **Down Arrow** key.
     The gantry moves toward the back end of the table (Y+), then toward the front (Y-).
   - Select the **Page Down** key and then the **Page Up** key.
     The torch lifter moves down (Z-), then up (Z+).

4. If applicable, verify the optional Jog Shuttle:
   - Press any axis button on the Jog Shuttle — **X**, **Y**, **Z**, or **A** — to select an axis.

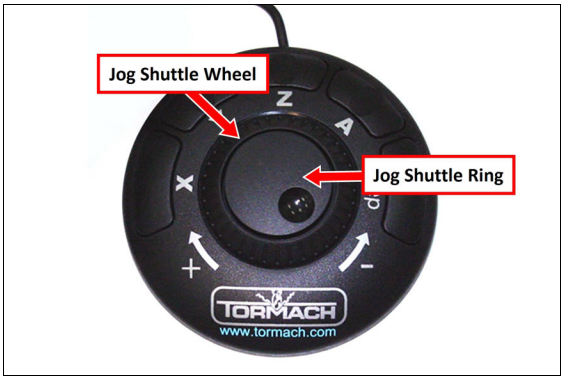


Figure 4-10: Functions on the optional Jog Shuttle.

From the PathPilot interface, on the **Main** tab, the corresponding green **Axis** light comes on.

Figure 4-11: Axis lights.

   - Turn the **Jog Shuttle Ring** in any direction to move the selected axis, then turn it in the opposite direction to reverse the direction.

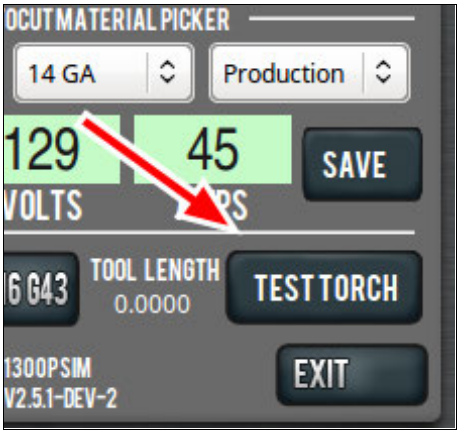
4.12.5 Check Belt Tension

Since brand new drive belts have a tendency to stretch slightly after first use, your Y-axis drive belts might need re-tensioning. If you notice that the Y axis gantry seems to have excessive backlash or that the servo is struggling to hold a consistent position, follow the maintenance procedure for "Adjust Belt Tension" (page 58)

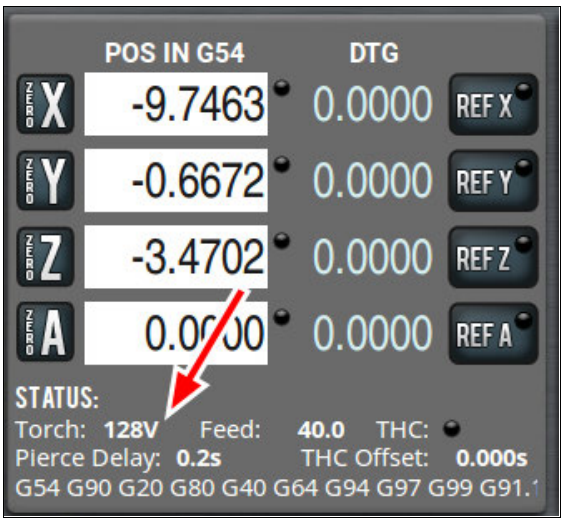
If Y-axis gantry movement seems normal and there is no noticeable backlash belt tension adjustment can be deferred until the time defined in the "Maintenance Schedules" (page 58).

4.12.6 Testing Plasma Source Control

1. Using the "Connectors Reference" (page 43) verify that the Hyperthem control cable is connected to the correct spot on the rear of your electrical cabinet.
2. Jog the torch to a location several inches above the water table so that you can safely test the arc.
3. Activate the plasma source and create a pilot arc by pressing the **TEST TORCH** button in PathPilot.



4. Verify that your plasma source activates and creates a pilot arc (you may have to press the button twice to bypass the "warning puff" function on some plasma sources).
5. While the pilot arc is active, watch the "Torch Voltage" readout at the bottom of your control screen.



You should see an open-circuit voltage of above 100V. If you do not see a voltage reading, follow the "Voltage Feedback" (page 66) section of the Troubleshooting guide.

4.12.7 Testing Ohmic Probing

1. Make sure that the ohmic probing spade connector is connected to your torch cap.

> **Note:** You must be using shielded consumables where the torch cap extends below the nozzle. If the nozzle contacts the workpiece before the torch cap, ohmic probing will not work.

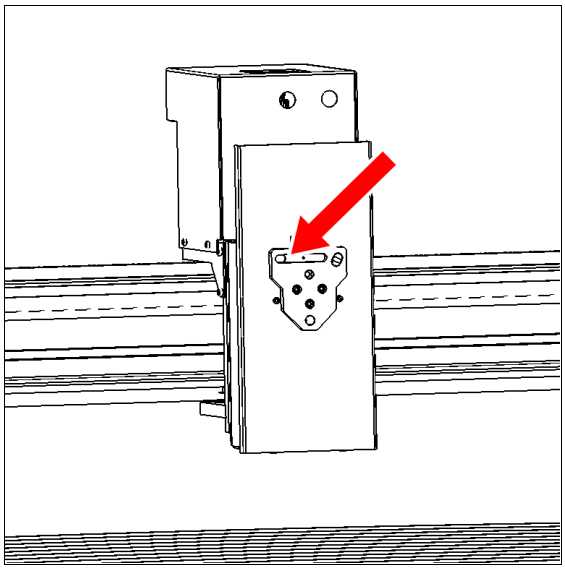
2. Switch to the Status tab on your PathPilot controller and locate the **OHMIC TOUCH** led. It should be off initially.

3. Touch the ground clamp lead from the plasma source to the torch cap. You should see the LED switch to green.

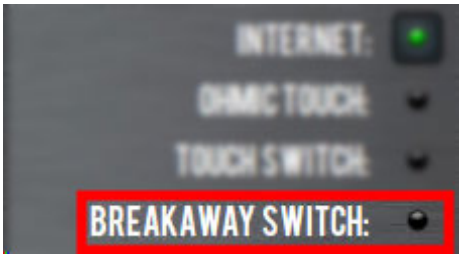
If you your ohmic probe input is not responding the way described above, check the "Ohmic Probing" (page 62)

4.12.8 Testing Torch Breakaway

Your Tormach 1300PL is equipped with torch breakaway detection to stop motion in the event that a tip-up during cutting causes a collision with the torch. A proximity sensor is located in the touch mounting base to detect when the mounting clamp has been knocked off.



1. Make sure that the machine is on and PathPilot is running.
2. Switch to the Status tab on your PathPilot controller and locate the **BREAKAWAY SWITCH** led. It should be off initially.



3. Pull the torch clamp away from the base. You should see the LED light up when the torch clamp is removed and extinguish when it is replaced.

4.13 SET TORCH HOME POSITION (G30)

The plasma torch will move up in Z to its home position (`G30`) between each cut, when the `M205` command is executed. It is important to set the `G30` position before running the machine, to ensure that the torch has a known position to return to.

1. Bring the machine out of E-Stop and reference all axes.
2. Move the torch to a safe Z position, higher than the slats of the water table.
3. Click the Offsets tab in PathPilot.
4. Click the "Set G30" button to save the current torch position.

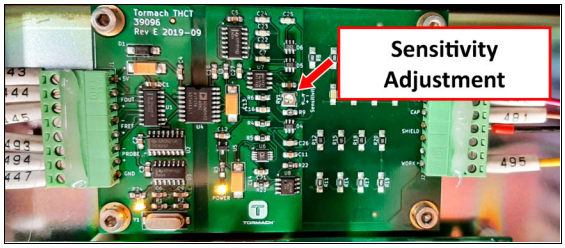
In the future, when you execute an `M205` or `G30` command in G-Code, the torch will return to this height.

4.14 CALIBRATE INITIAL HEIGHT SENSING

4.14.1 Set Ohmic Probing Sensitivity

The ohmic probing system on the 1300PL relies on a calibrated resistance value between the torch cap and the workpiece. If you do not calibrate your ohmic probe, you may find that it is triggered by water on the work piece or inside the torch cap.

1. Open the electrical cabinet and identify the Tormach THCT Board (PN 39096).

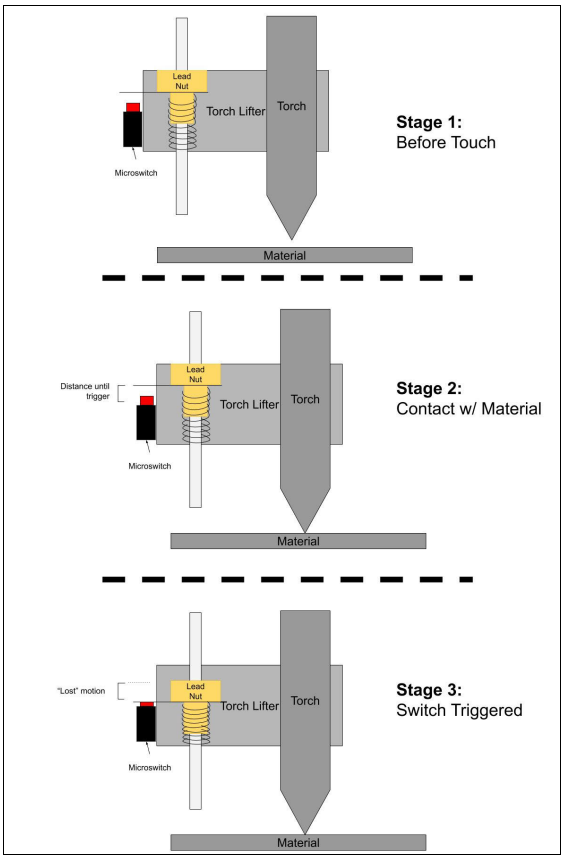


2. Select a piece of sheet metal to use as a test workpiece. Connect it to the ground clamp.
3. Jog the torch downwards in Z until the torch cap contacts the workpiece. Watch LED D8 on the bottom left of the board. If the LED lights up when the workpiece contacts the torch cap, the THCT board is measuring contact between the cap and ground as intended.
4. If the LED did not light up, identify adjustment screw RV1 on the THCT board (indicated by the arrow in the image above). Increase the sensitivity by rotating the screw clockwise, 1/16th turn at a time until the workpiece is detected.
5. Splash a small puddle of water onto your workpiece. Jog the torch cap down until it is contacting the water **but not** the workpiece itself. If the LED is on, your THCT sensitivity is too high. Decrease the sensitivity 1/16th of a turn at a time until the LED goes out.

If you have trouble adjusting the ohmic probing system or the LED never comes on, go to "Ohmic Probing" (page 62) in the Troubleshooting section.

4.14.2 Set Physical Touch Switch Trigger Depth

The torch lifter head on the 1300PL contains a spring-loaded switch to serve as a backup for ohmic probing or to be used when ohmic probing is inconvenient. The spring compresses a certain distance in Z before triggering. This distance must be measured and input on the **Settings** tab in PathPilot.



Use the procedure in "Plasma Settings Reference" (page 46) to measure and set the trigger depth.

4.15 SET UP THE PATHPILOT CONTROLLER

Before operating your machine, configure in PathPilot the date, time, keyboard language, and — if applicable — the optional Touch Screen Kit (PN 35575).

4.15.1 Specify the Date and Time

1. From the PathPilot interface, on the **Main** tab, in the **MDI Line** DRO field, type `ADMIN DATE`. Then select the **Enter** key.
   The **Time and Date Settings** dialog box displays.
2. Complete the fields in the **Time and Date Settings** dialog box, and then select **Close**.

4.15.2 Specify the Keyboard Language

By default, the keyboard language is set to English.
To specify a different keyboard language:

1. From the PathPilot interface, on the **Main** tab, in the **MDI Line** DRO field, type `ADMIN KEYBOARD`. Then select the **Enter** key.
   The **Keyboard Preferences** dialog box displays.
2. Select the **Layouts** tab and select the desired language. If the language you want is not listed, select **Add** to specify the language. Then, select **Close**.

4.15.3 Configure the Optional Touch Screen Kit

Before using a touch screen, you must make sure that it's configured and calibrated. To calibrate it:

1. From the PathPilot interface, on the **Main** tab, in the **MDI Line** DRO field, type `ADMIN TOUCHSCREEN`. Then select the **Enter** key.
2. Follow the on-screen instructions.

4.15.4 Update PathPilot

We're constantly updating PathPilot to bring you more features. Before operating your machine, update to the latest version.

- From the **Status** tab, select **Update**.

SYSTEM BASICS

IN THIS SECTION, YOU'LL LEARN:

- About the main components of the machine and how it moves.

Before operating the machine in any way, you must read and understand this section.

CONTENTS

5.1 SYSTEM REFERENCE

5.1.1 Water Table

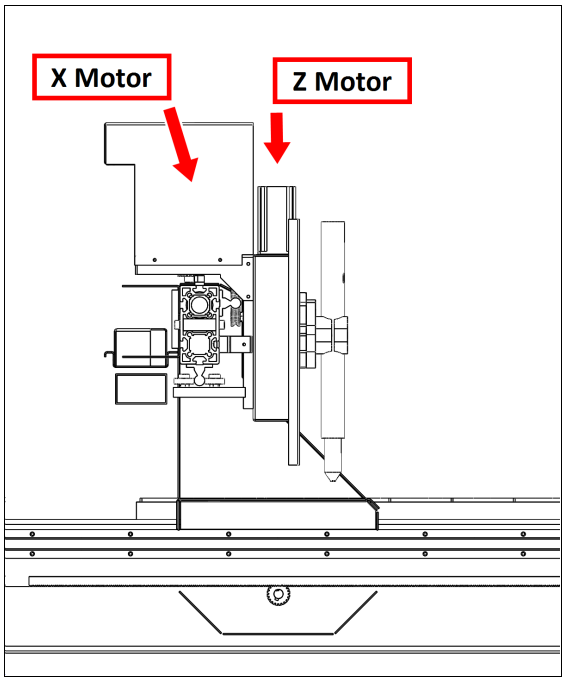
The machine table is 51.2" x 51.2" (1300 mm x 1300 mm). It can be moved backwards in the frame by up to 10" (250 mm) to provide an open area for cutting large or bulky objects that do not fit on top of the water table (items like large pipes or weldments).

> **Note:** Make sure you do not forget to connect the ground clamp to the workpiece when cutting something that is too large for the water table.

The water table has an internal depth of about 5.2" (132 mm) and a maximum water capacity of 59 US gallons (223 liters). Don't put more than 750 lb (340 kg) on the machine table (excluding water). Always verify that the workpiece and work-holding devices are centered on the machine table.
Always lock the water table in the forward or backwards position before running a program.

5.1.2 Z Torch Head

The Z Torch head is responsible for control of torch height during cutting. It also contains the magnetic torch breakaway head and the proximity sensor required to detect a breakaway. The Z head can travel 3.9" (100 mm) vertically, which allows for cutting bulky items or even changing the height of the slats in the water table if cutting conditions require it.



The Z head is also responsible for material touch-off at the start of a cut. Touch-off on the material can occur one of two ways:

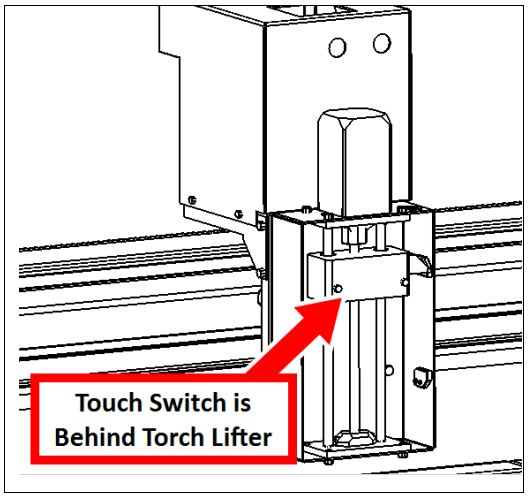
- Ohmic Touchoff
- Physical Touch Switch

Ohmic Touchoff

Ohmic Touchoff is a sensitive and precise method of Z positioning for initial cut height. The cap on the end of the torch is made of a conductive material (usually copper) that is linked to the machine's control system through a removable lead.
When the head touches the workpiece during the initial probing move before a cut, continuity between the torch cap and ground (through the plasma ground clamp) is detected by the control system.
This system works well for thin workpieces like 20 ga. (1 mm) and thinner sheet metal, where the weight of the torch during probing could otherwise deform the sheet metal before the probe switch triggers.

Physical Touch Switch

The physical touch switch acts as a backup to the ohmic touch system. It consists of a micro-switch inside the lifter head that detects when the spring-loaded lead nut on the Z lifter is pushed back by contact with the workpiece.



The physical touch switch will automatically be used when the ohmic touch switch does not trigger first. This can be useful in situations like cutting painted metal, where no continuity with the workpiece is possible.

Note: Even though the physical touch switch allows you to touch off on painted metal, you will still need to grind away enough paint for the ground clamp to make contact!

5.2 BASIC CONTROLS REFERENCE

To safely and effectively operate your machine, you must become familiar with how it moves. The machine has two forms of basic controls: machine controls and the PathPilot interface.

5.2.1 Machine Controls

The following controls energize the machine's control electronics:

- The Main Disconnect switch, located on the front of the electrical cabinet.
  The Main Disconnect switch has two positions: **OFF** and **ON**. When it's in the **OFF** position, it separates the other machine control electronics from the mains electrical supply. When it's in the **ON** position, the other machine control electronics are able to receive power.

  WARNING! Before opening the electrical cabinet for maintenance or troubleshooting, you must lockout the mains power: Turn the Main Disconnect switch to the **OFF** position, and secure an approved lockout device through the lockout rings at the bottom of the switch.

- The operator box — which contains the blue Reset button and the red Emergency Stop button — located on the front of the machine.
  When pushed in, the Emergency Stop button interrupts power to the axis drives, and stops the machine's motion. When the Emergency Stop button is twisted out, press the blue Reset button to enable the machine, allowing axis motion. The Reset button's LED turns on when the machine is enabled and the axis drives receive power.

5.2.2 PathPilot Interface

PathPilot is the primary means by which you interact with your machine. PathPilot controls all of the automatic motion of the machine axes and spindle, as well as some accessories. The PathPilot control system consists of one of the following:

- Controller Arm
  - Controller
  - *(Optional)* Jog Shuttle
  - Keyboard
  - Monitor or *(Optional)*Touch Screen Kit
  - Mouse
- Operator Console
  - Console (with integrated touch screen)
  - *(Optional)* Keyboard
  - *(Optional)* Mouse
  - Jog pendant

5.3 CONNECTORS REFERENCE

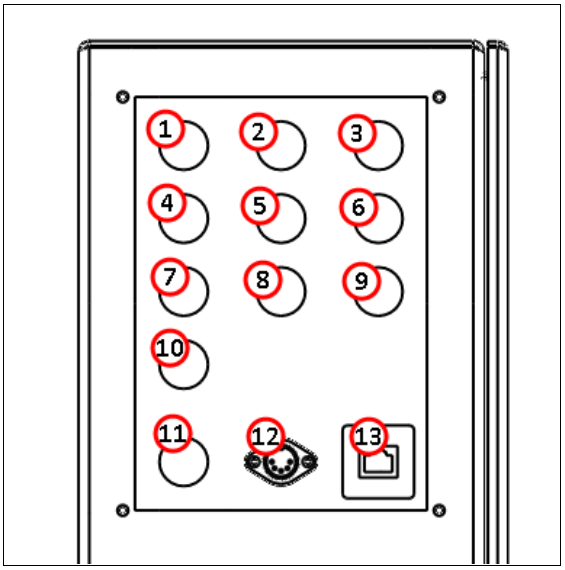


Figure 5-1: Connector panel on the upper rear of the electrical cabinet.

1. **X-Axis Motor Power Connector**
   Two pin power connector for the X-axis servo.
2. **Y-Axis Motor Power Connector**
   Two pin power connector for the Y-axis servo.
3. **Ohmic Cap Connector**
   Input for the ohmic probing circuit. Also connects machine grounds to the cabinet ground.

4. **X-Axis Motor Control Connector**
   Eight pin control connector for the X-axis servo.
5. **Y-Axis Motor Control Connector**
   Eight pin control connector for the Y-axis servo.
6. **Limit Switch Inputs**
   Limit switch inputs from the Z Touch Lifter. Also contains the input for the torch breakaway and touch switches.
7. **Z-Axis Motor Connector**
   The Z-Axis stepper motor output.
8. **A-Axis Motor Connector**
   The A-axis motor connector is used to connect to a rotary 4th axis (used for indexing or continuous 4th axis machining).
9. **24v Accessory Output**
   24v outputs used to control things like pneumatic solenoids for air engravers or lifters.
10. **Emergency Stop Input**
    Input cable from the operator panel containing the reset button and emergency stop.
11. **Plasma Source Control**
    Control signals for the plasma source. Outputs an arc on-off signal. Torch voltage and arc-ok feedback are received here. Reference "Plasma Source Control" (on the next page)
12. **Accessory Input**
    The accessory input is used to connect accessories (like probes, tool setters, and tool touch plates) to the machine.
13. **Controller Communications Port**
    The controller communications port is used to connect the PathPilot controller to the machine. The controller communications port (and the cable that connects to it) sends all communication between the PathPilot interface and the machine.

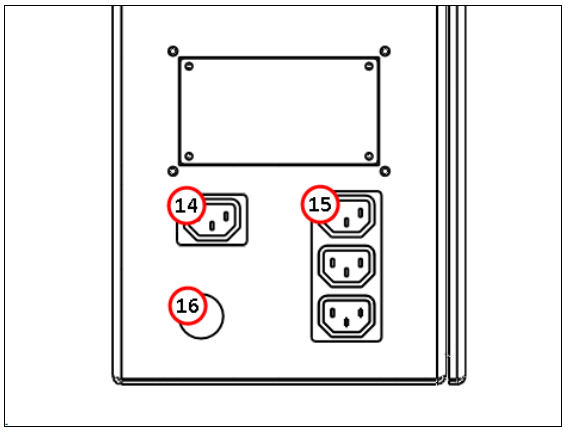


Figure 5-2: Connector panel on the lower rear of the electrical cabinet.

14. **Switched Power Port**
    The IEC-320 switched power port is used to supply power to accessories that can be controlled by PathPilot such as a downdraft extractor fan. This outlet outputs the same voltage as the machine input voltage (230 VAC).
15. **Accessory Power Port**
    The IEC-320 accessory power ports are used to supply power to peripheral accessories (like the PathPilot controller and monitor). These outlets output the same voltage as the machine input voltage (230 VAC).
16. **Electrical Power Input**
    Input power lead for the electrical cabinet.

5.4 PLASMA SOURCE CONTROL

The 1300PL uses a 7-pin connector for controlling the plasma source. A 7-pin to 14-pin cable is included with your machine to control Hypertherm plasma sources.

The pin-out of the 7-pin connector on the electrical cabinet is as follows:

Pin	Type	Signal	Notes
1	Output	Start Plasma	Dry contact closure. Closed relay signals plasma on.
2			
3	Input	Arc Voltage -	An internal 50:1 voltage divider in the plasma source is **required**.
4		Arc Voltage +	
5	Input	Arc-Ok	Expects dry contact closure at plasma source. Closed contacts signal arc-ok.
6			
7	Not Used		

The pin-out of the 14-pin Hypertherm connector on the end of the cable is as follows:

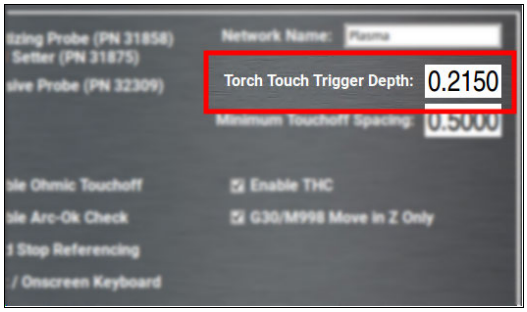
Pin	Type	Signal	Notes
3	Output	Start Plasma	Dry contact closure. Closed relay signals plasma on.
4			
5	Input	Arc Voltage -	An internal 50:1 voltage divider in the plasma source is **required**.
6		Arc Voltage +	
12	Input	Arc-Ok	Expects dry contact closure at plasma source. Closed contacts signal arc-ok.
14			

5.5 PLASMA SETTINGS REFERENCE

PathPilot for the 1300PL has several machine-specific settings that you might need to adjust after setting up your machine.

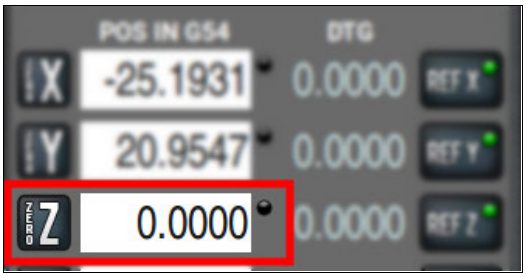
> **Note:** For a full overview of how to use PathPilot, refer to the PathPilot manual at tormach.com/support.

5.5.1 Touch Switch Trigger Depth



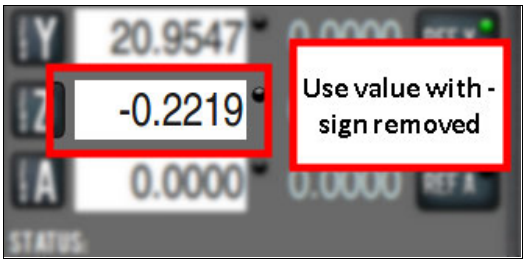
When using the physical touchoff switch for material height sensing, there's a certain amount of lost motion in the Z-axis between when the torch head touches the material and when the micro-switch in the torch lifter triggers.
It's important to set an accurate value for the distance between torch touch and touch switch triggering so that the initial pierce height can be correctly computed.
To set torch touch trigger depth:

1. Power on the machine and reference all axes.
2. From the PathPilot interface, on the **Settings** tab, disable **Ohmic Touchoff**.
3. Put a piece of material on the machine table and position the torch above it.
4. Using a slow jog speed (~5 IPM), jog the torch down until it's just contacting the material.
5. Zero your Z-axis at this position.



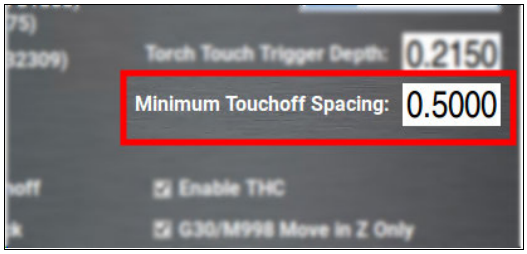
6. Switch to the **Status** tab and watch the **Touch Switch** LED. Very slowly, jog downwards until the LED comes on.

7. Note the value in the **Z** DRO field. This is your Torch Touch Trigger Depth. Convert this value to a positive number and enter it on the **Settings** tab.



8. Re-enable **Ohmic Touchoff** on the **Settings** page.

5.5.2 Minimum Touchoff Spacing



Minimum touchoff spacing is a time saving setting designed to avoid unnecessary probing during programs with a large number of individual cuts.
After the machine has probed for initial cut height, if the next cut begins within this distance it will be assumed that the material height is the same. This allows the machine to skip the probing routine and proceed straight to pierce height.
If your material is very flat and uniform, you can use a large distance for this setting (>2 in.). If your material is uneven or you would simply prefer to probe for height every time a cut begins, enter zero for this value.

5.5.3 Enable Ohmic Touchoff

This setting disables the ohmic sensing system entirely and relies solely on the physical touch switch for height sensing. This can be useful for cutting programs that result in water being repeatedly splashed into the torch nozzle, causing spurious probing trips.

> **Note:** Do not disable ohmic touch-off when cutting very thin material. The weight of the torch will bend the material during probing and cause inaccurate pierce height.

5.5.4 Enable THC

Disabling this setting stops all dynamic height adjustment during cutting. The torch will stay at the same height for the length of a cut and not adjust to follow the contours of the material.

5.5.5 Enable Arc-Ok Checking

Hypertherm plasma sources supply an arc-ok signal to PathPilot when the cutting arc is fully established. When this setting is enabled, the machine will pause during a `G16` pierce until is receives an arc-ok signal.
Disable this setting if your plasma source does not supply an arc-ok signal.


TORMACH

BASIC OPERATIONS

IN THIS SECTION, YOU'LL LEARN:

- About the basic operations required for most projects, organized as a suggested project workflow.

CONTENTS

6.1 SELECT A METHOD FOR INITIAL HEIGHT SENSING (IHS)

Because plasma cutting workpieces are prone to heat-induced warping, it's common practice to probe the workpiece height before each cut using the initial height sensing (IHS) system. This guarantees a consistent pierce height, which prolongs consumable life.

The 1300PL has two methods of detecting the Z location of the workpiece before a cut. Choose which method to use based on your workpiece, cutting situation, and machine setup.

To select an IHS method:

➢ From the PathPilot interface, on the **Settings** tab, select or clear the **Enable Ohmic Touchoff** checkbox.
For more information, see "Plasma Settings Reference" (page 46).

6.1.1 Physical Touch Switch

The first (and simplest) IHS method is the physical touch off switch in the torch lifter. A spring-loaded switch on the Z lead screw is triggered when the torch is pressed against the workpiece.

Use the physical touch switch when:

- Your workpiece is thicker than 18 ga (1.2 mm).
- Making many small cuts, where water is splashed into the torch head between cuts.

6.1.2 Ohmic Probing

The second, and more accurate, method of IHS is ohmic probing. Ohmic probing uses the conductivity of the workpiece to detect when the torch cap is touching it. Ohmic probing requires a very light touch and is very accurate, but can be incorrectly triggered by water splashing into the torch head.

Use ohmic probing when:

- Your workpiece is thinner than 18 ga (1.2 mm).
- Cutting large workpieces, where the torch is not crossing over open water between cuts.

6.2 MAKE YOUR FIRST CUTS

Once you've verified all subsystems of the machine and plasma source, we recommend making a simple test program to test the cutting and torch height control systems. This is also a good quick-start tutorial on NC programming for the 1300PL.

6.2.1 Test G-Code

The following code will probe, set feeds from the AutoFS system, and then cut a 4" line from (0, 0) to (0, 4).

Open a text editor on your computer (like Notepad++), and save the following code in a file named `test.nc`.

```
G90 (Absolute Distance Mode)
G64 P 0.0050 Q 0.0050 (PathBlending)
G17 (XY Plane)
G54 (Set Work Offset)
T 1 M6 G43 H 1

G30 (Move Home)
G0 X0 Y0

M200 (AutoFS)
G15 (probe)
G16 (pierce)

G1 X0 Y4

M205 (Torch Off)
G30 (Move Home)
```

6.2.2 Code Breakdown

Preamble: This code block resets the modal state of the machine. It places the interpreter in absolute distance mode, sets reasonable values for smoothing, and selects the G54 work offset. For more detail on these G-codes, see the full PathPilot manual.

```
G90 (Absolute Distance Mode)
G64 P 0.0050 Q 0.0050 (PathBlending)
G17 (XY Plane)
G54 (Set Work Offset)
```

Tool Selection: Selects Tool 1 from the offsets table. On the plasma, convention is to use Tool 1 for the plasma torch.

```
T 1 M6 G43 H 1
```

Initial Move: Moves the torch to the home (`G30`) position in Z for safety and then performs a rapid move to coordinate (0, 0).

```
G30 (Move Home)
G0 X0 Y0
```

AutoFS: Uses the AutoFS material selector on the Main tab of PathPilot to set feed rate, pierce delay, pierce height and

plasma amperage. No explicit feedrate needs to be specified for G1 moves since AutoFS sets this for you.

```
M200 (AutoFS)
```

Probe and Pierce: Probe the material surface using ohmic sensing. Once the torch detects the surface, `Z0` for the current Work Coordinate System is set at the surface. After probing, `G16` moves the torch to the pierce height set by AutoFS, fires the torch, waits for the AutoFS pierce delay and then moves to cutting height.

```
G15 (probe)
G16 (pierce)
```

Cut and Turn Torch Off: Performs a feed move from the current position (0, 0) to (0, 4). After the cutting move is complete, the torch is shut off and returned to the `G30` home position.

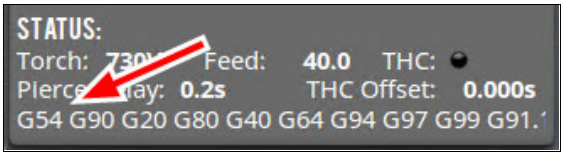
Note: You might notice that your torch pauses and continues to blow air for 10-20 seconds. This is a cool down procedure designed by the plasma source manufacturer.

```
G1 X0 Y4
M205 (Torch Off)
G30 (Move Home)
```

6.2.3 Run the Test Program

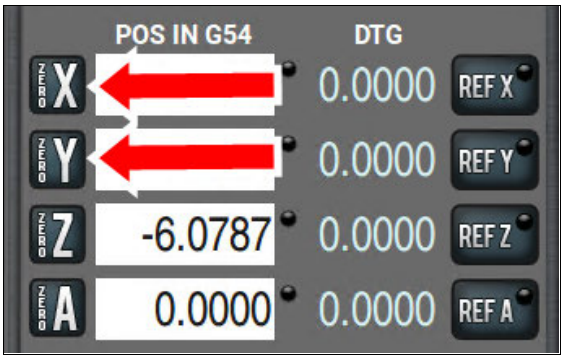
IMPORTANT! Before running your test program, make sure you have completed all steps in "Verify the Installation" (page 34).

1. Find a piece of scrap sheet steel large enough to make a 4" test cut.
2. Put the metal on the cutting table and connect the ground clamp to it.
3. Bring PathPilot out of the Reset state and home the machine.
4. Power on plasma source.
5. Jog the cutting torch to a place at least 5" past the edge of the plate in Y- (towards the operator side of the machine).
6. Check that your current Work Coordinate System is `G54` to match the test cutting code.

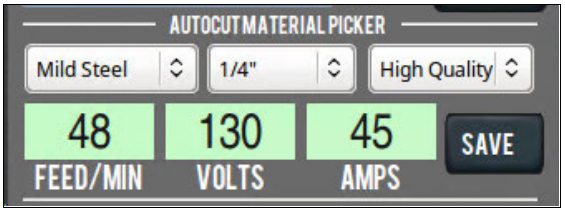


If it isn't, type `G54` into the **MDI Line** DRO field. Then select the **Enter** key.

7. Select **Zero X** and **Zero Y** to set your work coordinate system zeros.



8. Copy your G-code from a USB drive and load it into PathPilot.
9. Select the material you're using for your cut test in the AutoFS dropdown on the **Main** tab.



10. Adjust your plasma source to the amperage shown in the **AMPS** DRO field.
11. Select **Cycle Start**.
    The machine performs the test cut that you programmed.

6.3 USE THE AUTOFS MATERIAL PICKER

PathPilot on the 1300PL is designed so that you don't need to manually program feeds and speeds in your G-code. Instead, feed rate, amperage, pierce parameters, and torch height control voltage are all set at program run-time using automatic look-up tables based on the material you're cutting. AutoFS is designed so that you can export a program once from your post-processor and run it multiple times with different materials, all without re-posting. All material-specific machine parameters are set by the M200 AutoFS M-code (rather than directly programmed in the G-code).

6.3.1 Writing G-Code with AutoFS

A standard block of G-code before a cutting operation might look like this:

```
M210 P123 (Set THC voltage to 123v)
M211 P45 (Set plasma source to 45A)
M207 P0.15 (Set pierce height to 0.15")
M208 P0.08 (Set cut height to 0.08")
M209 P2 (Set a two second pierce delay)
F225 (Set cutting feed rate of 225 IPM)

G15 (Perform ohmic probe)
G16 (Pierce and start cutting)
```

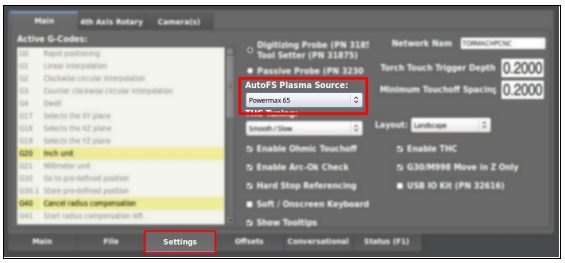
The block of code shown above is totally valid and can be used if you prefer to hard code your cutting parameters. Alternatively, the code shown above can be replaced with the following when AutoFS is being used:

```
M200 (Set cutting parameters from AutoFS tables)

G15 (Perform ohmic probe)
G16 (Pierce and start cutting)
```

6.3.2 Using AutoFS

1. On the **Settings** tab, select which plasma source you're using from the **Auto FS Plasma Source** drop-down menu.



2. Before running your program, select the material you're cutting from the AutoFS dropdowns on the **Main** tab of PathPilot.
   The DROs turn green, which indicates that they were automatically set.

With a material selected, the next time an `M200` code is encountered in a program, PathPilot will set all of the cutting parameters for that material.

6.3.3 Creating Custom AutoFS Presets

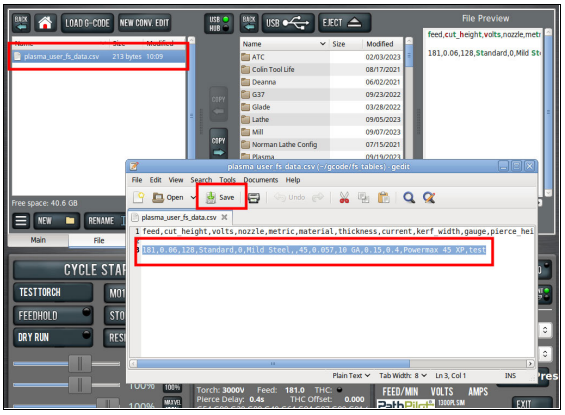
Since your shop air supply and cutting conditions might differ from those used to create the AutoFS presets, you can save your own custom settings for a material at any time.

To create new AutoFS presets:

1. From the **Main** tab, select the material you're cutting from the AutoFS dropdowns, and then type your cut parameters into the DRO fields.
2. Select **Save**.
   The values are stored as a new preset for that material.

6.3.4 Deleting Custom AutoFS Presets

1. From the File tab, navigate to the fs_tables folder, and open the plasma_user_fs_data.csv file.
2. Highlight the line of the preset you want to delete and delete it. Then, save the file.



Note: This file is read on boot only, so the preset remains visible until the controller is power cycled.

PROGRAMMING

IN THIS SECTION, YOU'LL LEARN:

- About the languages that are understood and interpreted by PathPilot.

CONTENTS

7.1 PLASMA SPECIFIC G-CODES

Note: For information on all other supported G-codes, refer to the PathPilot manual at tormach.com/support.

G-Code	Name	Description
G15	Workpiece Probe	Probe vertically downwards towards the end of travel until the ohmic cap contacts the work piece. Once the workpiece has been located, the Z coordinate of the current coordinate system is set to zero. G15 will trigger on either the ohmic cap making continuity with the workpiece or the physical touch switch in the torch lifter detecting upwards pressure on the torch from the material.
G16	Pierce	Raise the torch to the pierce height set in the variable #<_PierceHeight>. The torch is turned on and the program pauses for the pierce delay value set by AutoFS or M209. After the pierce delay, Torch Height Control (THC) is enabled and the program continues.

7.2 PLASMA SPECIFIC M-CODES

M-Code	Description	Set by M200	Parameters
M200	AutoFS - Apply the automatically generated feed, speed and cutting values for the material selected in the main PathPilot UI. AutoFS will set feedrate, THC voltage, and pierce delay.		
M203	Start Torch		
M205	Stop Torch and return to G30 Z Height		
M207	Set Pierce Height used when executing a G16 pierce. Set automatically when using M200 AutoFS.	Yes	P (Required): Pierce height in the current unit system (in. or mm.)
M208	Set Cut Height used when executing a G16 pierce. Set automatically when using M200 AutoFS.	Yes	P (Required): Cut height in the current unit system (in. or mm.)
M209	Set Pierce Delay used when executing a G16 pierce. Set automatically when using M200 AutoFS.	Yes	P (Required): Pierce delay in seconds
M210	Set THC voltage. Does not enable or disable THC.	Yes	P (Required): Desired THC Voltage
M211	Set plasma source cut current. If a Hypertherm adapter is not installed on the system, program run will be paused with an M01 break to allow the user to set the specified cut current.	Yes	P (Required): Desired Cut Current in Amps
M212	Set plasma source cut mode. If a Hypertherm adapter is not installed on the system, program run will be paused with an M01 break to allow the user to set the specified cut mode.	No	P (Required): Cut mode: Normal = 1 CPA = 2 Gouge = 3 Note: For the Hypertherm Powermax 45 Normal Mode and CPA Mode (Continuous Pilot Arc) are the same.

M-Code	Description	Set by M200	Parameters
M213	Set plasma source air pressure. If a Hypertherm adapter is not installed on the system, program run will be paused with an M01 break to allow the user to set the specified air pressure.	No	P: Desired Cut Pressure in PSI Note: When the pressure is omitted or set to 0, the pressure control is set to Automatic.


TORMACH

MACHINE MAINTENANCE

IN THIS SECTION, YOU'LL LEARN:

- About the required maintenance procedures that you must do so that this machine operates as designed.

Before operating the machine in any way, you must read and understand this section.

CONTENTS

8: MACHINE MAINTENANCE

8.1 MAINTENANCE SAFETY

Read and understand the following safety messages before beginning any maintenance procedures.

8.1.1 All Maintenance Procedures

- Understand that the machine is automatically controlled and can start at any time.
- Power off the machine and disconnect the pneumatic supply before doing any maintenance procedures.
- When appropriate, lockout/tagout the and the pneumatic supply line before doing any maintenance procedures.
- Wear safety eye protection rated for ANSI Z87+.

8.1.2 Swarf Maintenance Procedures

- Wear work gloves.

8.2 MAINTENANCE SCHEDULES

To keep your machine running as smoothly as possible, you must regularly do the following maintenance procedures.

> **Note:** Before you begin any maintenance procedures, read and understand "Maintenance Safety" (above).

If you disassemble any components, refer to the machine's reference drawings when you've completed the maintenance procedure. For information, see "Diagrams and Parts Lists" (page 71). For any additional support, we can help. Create a support ticket with Tormach Technical Support at tormach.com/how-to-submit-a-support-ticket for guidance on how to proceed.

8.2.1 Daily

- ☐ Clean the machine of any dust or abrasive particle buildup with a vacuum and brushes.
- ☐ Wipe dust off of the linear rails with a clean cloth.

8.2.2 Weekly

- ☐ Clean all exterior surfaces with a clean rag.
- ☐ Examine the water table's level and, if necessary, add water / rust inhibitor.
- ☐ Check your plasma torch consumables for wear and replace if needed.

8.2.3 Monthly

- ☐ Clean the electrical cabinet vents of dust with a clean cloth or compressed air.
- ☐ Remove the slats and clean sediment buildup from the bottom of the water table.

8.2.4 Semi-Annually

- ☐ Check drive belts for wear and re-tension if needed.
- ☐ Remove faceplate from torch lifter and clean lead screw with a lint-free cloth.

8.2.5 As Needed

- ☐ Replace the water table's slats when they have been worn away too much to hold stock securely.

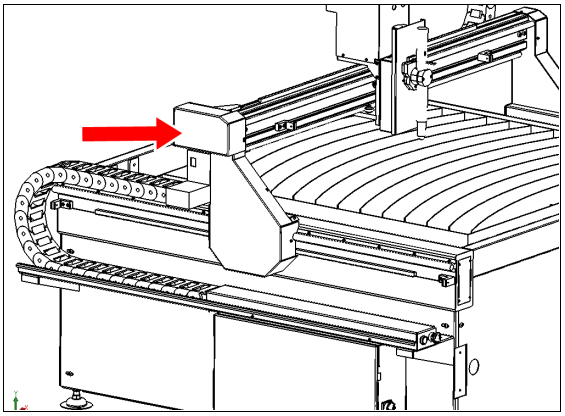
8.3 ADJUST BELT TENSION

Tools and Items Required

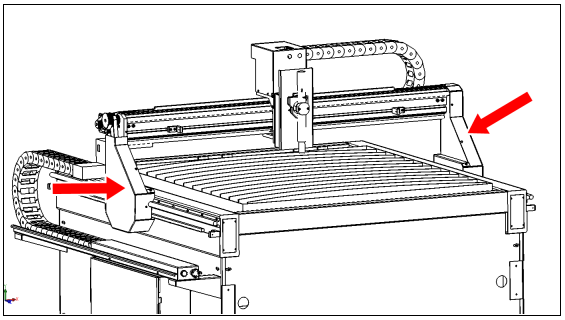
- Allen Key Set

The drive belts on the 1300PL should be checked for wear and tensioned several times a year to avoid lost motion and reduced machine accuracy.

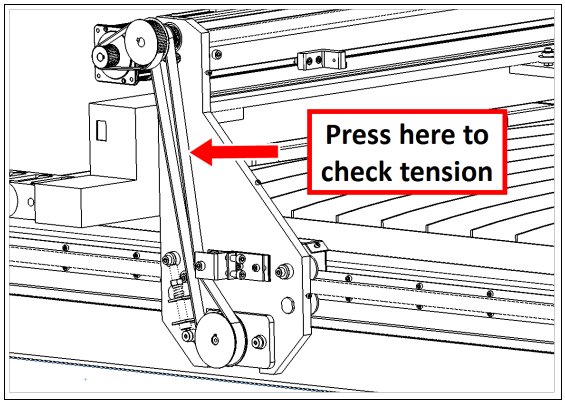
1. Remove the motor belt cover over the servo motor pulley.



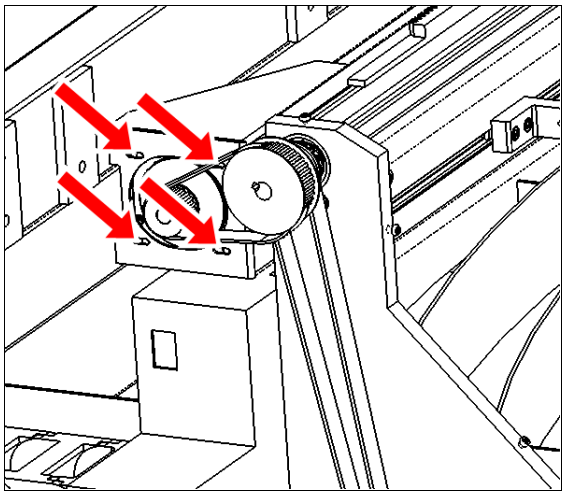
2. Remove the belt covers from both sides of the gantry.



3. Loosen the two mounting bolts holding the belt tensioner. Adjust the tensioner until the belt is tight enough to only deflect 0.125" (3 mm) when pressed with one finger.



4. Tighten the tensioner mounting hardware and repeat for the other side of the gantry.
5. Loosen the mounting hardware for the servo motor.



6. Slide the servo back in its mounting slots until the belt is taught. It should deflect about 1/16" (1.5 mm) when pressed with one finger.
7. Tighten all mounting hardware and re-install belt covers.

8.4 ADJUST RACK AND PINION PRELOAD

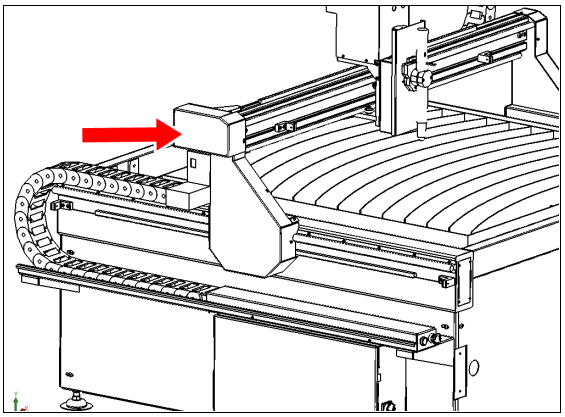
Tools and Items Required

- Allen Key Set
- Crescent Wrench

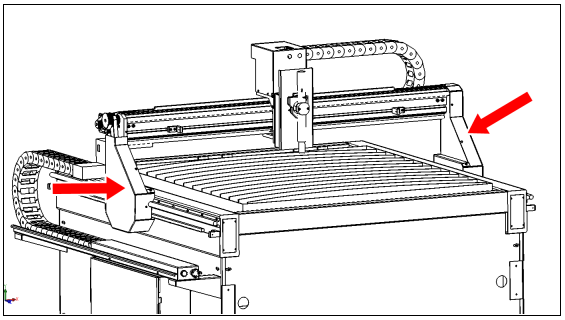
The rack and pinion gear drive on the 1300PL uses a spring preload to allow the pinion gear to self adjust to compensate wear on the rack and reduce backlash. It is preset at the factory and will not need frequent adjustment.

8.4.1 Y-Axis

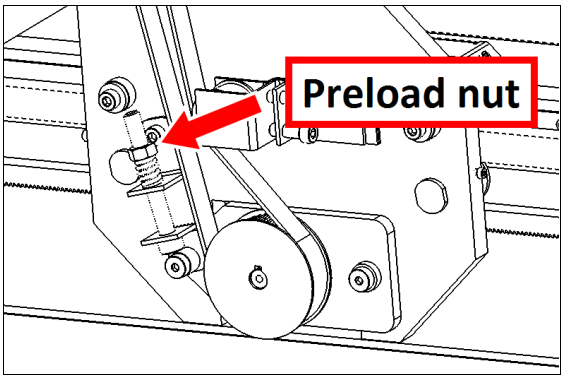
1. Remove the motor belt cover over the servo motor pulley.



2. Remove the belt covers from both sides of the gantry.



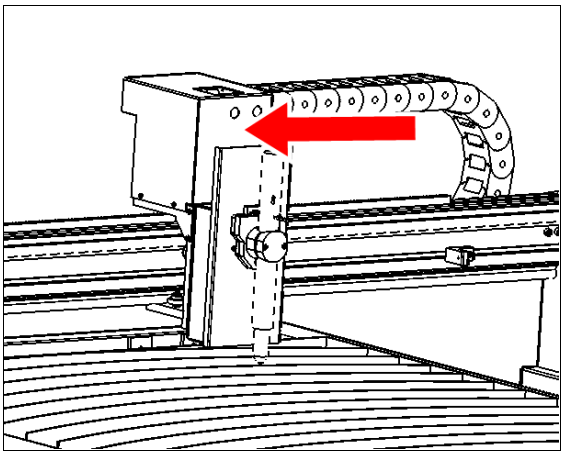
3. Adjust the preload nut on the pinion mount assembly until the spring is compressed approximately 1/4" (6 mm) from its fully slack position.



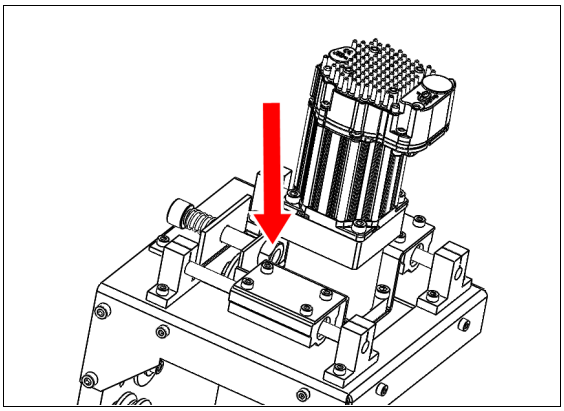
4. Reinstall all belt covers and guards.

8.4.2 X-Axis

1. Remove the motor cover on the X-axis carriage.



2. Locate and tighten the preload nut for the X motor assembly until the spring is compressed approximately 1/4" (6 mm) from its fully slack position.



3. Reinstall all belt covers and guards.

TROUBLESHOOTING

IN THIS SECTION, YOU'LL LEARN:

- About common causes of failure in this machine, and our recommendations for diagnosing and correcting them.

WARNING! Electrocution Hazard - Electrical Cabinet: Do not make or disconnect connections under power.

Before operating the machine in any way, you must read and understand this section.

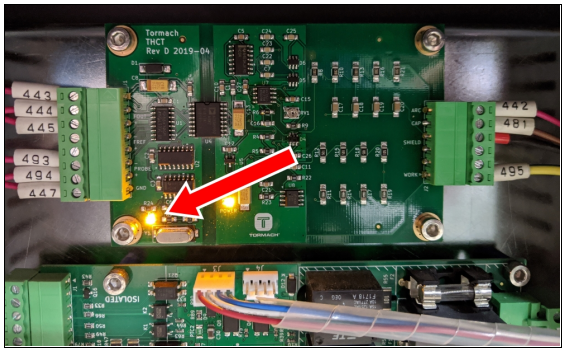
CONTENTS

9.1 OHMIC PROBING

9.1.1 Ohmic Probe Does Not Trigger

How to test ohmic probing:

Open the electrical cabinet and locate the Tormach THCT Board (PN 39096). Have a helper touch the ground clamp to the torch cap and watch LED D8 on the bottom left of the board. If the LED lights up when the ground clamp contacts the torch cap, the THCT board is measuring contact between the cap and ground as intended.



Switch to the Status tab in PathPilot and repeat the test with the ground clamp. Watch the status LED for ohmic touch. If it turns green when the ground clamp makes contact, the THCT board is communicating with PathPilot correctly.

Cause: Faulty Connection Between Workpiece Clamp and Plasma Source		
Probability	**How-To Steps**	**Need More?**
High	➢ Check that your ground clamp is connected to your workpiece and plasma source.	Ohmic probing detects continuity between the torch cap and the ground connection of the work piece. If this connection is not solid, ohmic probing will not trigger.

Cause: Faulty Work Clamp Connection Between Plasma Source and THCT Board		
Probability	**How-To Steps**	**Need More?**
Low	1. Open the electrical cabinet and locate the Tormach THCT board (PN 39096). 2. Using a multimeter in continuity mode, measure continuity between J2 Pin 1 (WORK) on the Tormach THCT Board (PN 39096) and the workpiece clamp. 3. If there is not continuity, check that the plasma source control cable is connected at the rear of the electrical cabinet. Pin 4 on this connector is used for the workpiece clamp signal.	Continuity to the workpiece clamp is measured through the plasma source control cable Arc+ pin (since the torch operates at a negative voltage relative to the workpiece). If this connection is faulty or high resistance the probe will not trigger.

Cause: Ohmic Probe Wire Disconnected From the Torch Cap		
Probability	**How-To Steps**	**Need More?**
Medium	1. Check that the ohmic probe wire (481 on the electrical diagram) coming from the X axis carriage is connected to the torch cap. 2. Check that the connector on the rear of the electrical cabinet (X27 on the electrical diagram) is connected.	To test the wire for breaks, use a multimeter in continuity mode to measure between the torch cap and Pin 5 on connector J2 (labeled CAP) on the Tormach THCT board in the electrical cabinet.

Cause: Ohmic Touch Sensitivity Adjusted Incorrectly		
Probability	**How-To Steps**	**Need More?**
Low	1. Open the electrical cabinet and locate the Tormach THCT board (PN 39096). 2. Adjust the "RV1" potentiometer clockwise to increase the sensitivity, until a ground clamp touched to the torch nose triggers the probe.	Sensitivity is adjustable to account for different workpiece materials and situations (wet metal). See "Calibrate Initial Height Sensing" (page 39).

Cause: THCT Board Disconnected From the Machine Control Board		
Probability	**How-To Steps**	**Need More?**
Low	1. Open the electrical cabinet and locate the Tormach THCT board (PN 39096). 2. Using a multimeter on continuity mode, check the connection between THCT J1 Pin 6 (PROBE-) and J9 Pin 5 on the main control board. 3. Perform the same check between THCT J1 Pin 7 (PROBE+) and J9 Pin 6 on the main control board. 4. If both connections measured good, switch the multimeter to DC Voltage mode and measure the voltage between J9 Pin 6 and 7 on the main control board. The reading should be -3.5v without the probe tripped, and +3.5v with the probe tripped.	

9.1.2 Ohmic Probe Triggers Early or Between Cuts

Cause: Plasma Torch Cap Is Wet		
Probability	**How-To Steps**	**Need More?**
High	1. Use the TEST TORCH button to purge the torch cap. Make sure to jog away from the workpiece first. 2. Using compressed air, blow any water out of your torch cap. 3. Adjust ohmic touch sensitivity as detailed below.	Water in the torch cap can cause ohmic probing to trigger because it creates a circuit between the torch nozzle (Arc-) and cap. Since the nozzle is electrically connected to the workpiece clamp (Arc+) by the arc voltage divider, this can trigger the ohmic probe.

Cause: Ohmic Touch Sensitivity Adjusted Incorrectly		
Probability	**How-To Steps**	**Need More?**
High	1. Position the torch in above the workpiece in a small puddle of water, so that the torch cap is touching the water but not the workpiece. 2. Open the electrical cabinet and locate the Tormach THCT board (PN 39096). 3. Adjust the "RV1" potentiometer counterclockwise to decrease the sensitivity until the ohmic probe is not triggered by the water but is still triggered if you lift the workpiece to touch the torch cap.	Ohmic touch sensitivity may need to be adjusted when you switch between styles of consumable or torch cap.

9.2 TOUCH OFF

9.2.1 The Torch Pierces Too High

Cause: Torch Touch Trigger Depth Set Incorrectly		
Probability	**How-To Steps**	**Need More?**
High	➢ Open the Settings tab and set the Torch Touch Trigger Depth as described in "Plasma Settings Reference" (page 46).	Torch touch trigger depth is the difference between the Z location where the torch touches the material and the Z location where the touch switch in the floating Z head registers a touch-off.

Cause: M207 Pierce Height Set Incorrectly		
Probability	**How-To Steps**	**Need More?**
High	➢ If using `M200` AutoFS, ensure that you have selected the correct material on the Main tab of PathPilot.	Using the `M200` AutoFS system chooses a pierce height appropriate for the material selected on the Main tab.
Medium	➢ If not using `M200` AutoFS to set pierce height automatically, make sure that you have a call to `M207`in your program to explicitly set a pierce height.	Check "Plasma Specific M-Codes" (page 54) for more information.

9.2.2 The Torch Bends the Workpiece During Touch-off

Cause: Ohmic Probing Disabled		
Probability	**How-To Steps**	**Need More?**
High	➢ Open the Settings tab and ensure that the check-box for ohmic probing is enabled.	If ohmic probing is disabled the plasma table will rely on the switch in the floating torch head to detect touch-off. This can be useful for painted materials, but you need to make sure that Torch Touch Trigger Depth is set correctly as noted above. If necessary to work around a bending workpiece, the workpiece or work coordinate system can be relocated to a position where the workpiece is better supported by the table's slats.

9.3 CUTTING

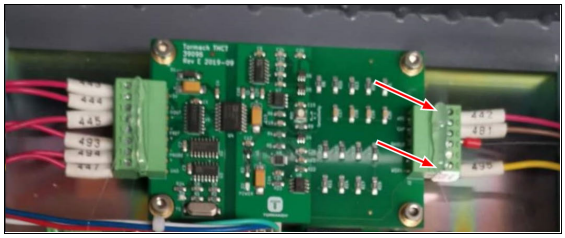
9.3.1 Torch Shuts Off During Cut

Cause: Air source cannot keep up with demand		
Probability	**How-To Steps**	**Need More?**
High	➢ Check the specifications for your compressor to make sure that it can supply the CFM needed by your plasma source. ➢ Check for restrictive fittings or hoses on the air path to your plasma source.	The Hypertherm plasma sources can detect inadequate air flow and will shut off the plasma arc if not enough air is being provided to the unit.

Cause: Gaps in material being cut		
Probability	**How-To Steps**	**Need More?**
High	➢ If you are trying to cut across gaps or expanded metal, make sure your plasma source is in "expanded metal mode" and disable Torch Height Control in the PathPilot Settings menu.	Most plasma sources will automatically shut off the arc when they encounter a gap while cutting unless placed in expanded metal / continuous pilot arc mode.

9.4 VOLTAGE FEEDBACK

9.4.1 No Voltage Reading in PathPilot

Cause: Bad control connection to plasma source		
Probability	**How-To Steps**	**Need More?**
High	Measure voltage input to THCT board in electrical cabinet: 1. Using a multimeter set to DC volts, probe wires **442** and **495** on the THCT board with the torch off.  You should read close to 0 VDC. 2. Have a helper press the **TEST TORCH** button in PathPilot and check the voltage. You should read your plasma source's open circuit voltage divided by 50 or around 2.5 VDC. 3. If you do not read a voltage, you may need to replace your plasma source control cable. If you do read a voltage, proceed to checking THCT communication with the Machine Control Board.	Your plasma source is required to have an internal voltage divider. By default, PathPilot is configured for a 50:1 divider.

Cause: THCT not communicating with Machine Control Board		
Probability	**How-To Steps**	**Need More?**
Low	1. Verify that the THCT board power LED is on  2. Using a multimeter that can measure frequency, measure the signal between wires **444** and **445**. You should read a value between 80 kHz and 120 kHz. • If you don't read any frequency, you may have a faulty THCT board. Contact Tormach Technical Support. 3. Have a helper press the **TEST TORCH** button in PathPilot and check the frequency. You should read a frequency above 200 kHz (usually about 450 kHz). 4. If you read a frequency in both tests, check the connections for wires **444** and **445** at the Machine Control Board. Reference the machine wiring diagram to make sure they are in the correct terminal blocks and firmly seated.	The THCT communicates measured voltage from the plasma source back to the Machine Control Board using a differential frequency signal. This is much more immune to noise than a analog voltage.

9.5 TORCH HEIGHT CONTROL

9.5.1 Torch Cuts Too High

Cause: M210 Torch Height Control Voltage Set Too High		
Probability	**How-To Steps**	**Need More?**
High	➢ If using `M200` AutoFS, ensure that you have selected the correct material and consumables on the Main tab of PathPilot. ➢ If you are manually specifying voltage using the `M210` M-Code, verify that the P value in your G-Code is appropriate for the feed rate, cut current and consumables you are using according to the manufacturer's cut charts.	THC target voltage is set automatically when you select a material on the main PathPilot screen and use the `M200` AutoFS function in your G-Code.

Cause: Incorrect Consumables Being Used		
Probability	**How-To Steps**	**Need More?**
Medium	➢ If you have both FineCut and standard consumables, verify that the correct nozzle is installed for the cut settings you have selected.	Standard consumables can require a THC voltage setting of up to 50V higher than FineCut consumables for the same cut current. Mixing up the two can produce a cut height error of more than 1" (25mm).

Cause: Bad Workpiece Clamp Connection		
Probability	**How-To Steps**	**Need More?**
High	➢ Make sure that the workpiece clamp is securely fastened to your material and plugged in to the plasma source. ➢ If you have your workpiece clamp cable routed through any terminal blocks, make sure that all connections are firmly tightened down.	A bad workpiece clamp connection can produce an additional voltage drop that will cause higher than usual THC voltage values. This will effect the cutting height.

Cause: Plasma Source Amperage Set Too High		
Probability	**How-To Steps**	**Need More?**
High	➢ If you are using the AutoFS Material Picker, make sure that you have your plasma source cut current set to match the value suggested on the main page of PathPilot. ➢ If you are using the Hypertherm control kit to allow PathPilot to control cut current and air pressure, verify that the adapter is connected to the controller's USB port and the RS485 cable is plugged in to the back of the plasma source.	

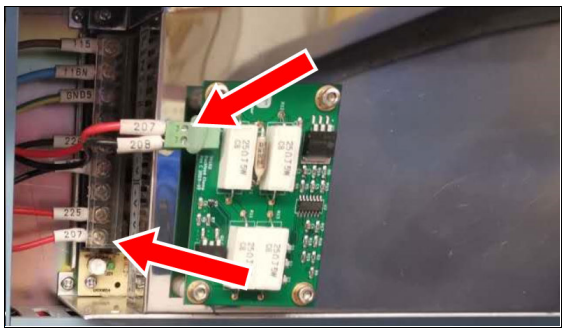
9.5.2 Torch Drags on the Material When Cutting

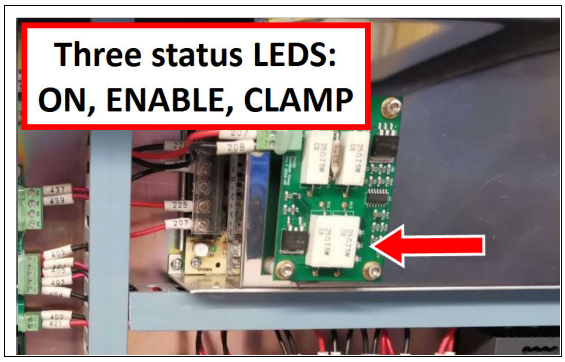
Cause: M208 Cut Height Set Too Low		
Probability	**How-To Steps**	**Need More?**
High	➢ If using `M200` AutoFS, ensure that you have selected the correct material and consumables on the Main tab of PathPilot. ➢ If you are manually specifying a cut height in your G-Code with `M208` make sure that the P value for height matches the consumables being used, cut current, and material.	After executing a `G16` pierce, PathPilot will move the torch to the height specified by `M208` or the AutoFS system. If this height is too low, Torch Height Control may not be able to activate and take over control of the Z axis because of safety limits on torch voltage.

Cause: Plasma Source Amperage Set Too Low		
Probability	**How-To Steps**	**Need More?**
High	➢ If you are using the AutoFS Material Picker, make sure that you have your plasma source cut current set to match the value suggested on the main page of PathPilot. ➢ If you are using the Hypertherm control kit to allow PathPilot to control cut current and air pressure, verify that the adapter is connected to the controller's USB port and the RS-485 cable is plugged in to the back of the plasma source.	

9.6 SERVO DRIVES

9.6.1 Servos Fault on Fast Direction Changes

Cause: Power Supply not Connected to Backfeed Clamp		
Probability	**How-To Steps**	**Need More?**
High	Check for loose wires between the power supply and backfeed clamp (PN **39102**). • Power off the main breaker. • Measure the continuity between the V+ terminal of the power supply and the + terminal on the backfeed clamp (follow wire **207**).  • Perform the same check for the V- terminal of the power supply to the - terminal of the backfeed clamp (wire **208**). • Power on the main breaker, release the E-Stop button and press the blue Reset button. • You should see a green power LED on the power supply and an orange **ON** LED on the backfeed clamp if they are connected correctly.	The servos used in the 1300PL feed a significant amount of energy back into the power supply when braking. This energy is dissipated by the backfeed clamp.

Cause: Faulty Backfeed Clamp		
Probability	**How-To Steps**	**Need More?**
Low	Check that the backfeed clamp is enabling itself. • Power on the main breaker, release the E-Stop button and press the blue Reset button. • Watch the status LEDs on the backfeed clamp. You should immediately see the **ON** LED.  • After about 1.5 sec, you should see the **ENABLE** LED light. If you do not see the **ENABLE** LED light, your backfeed clamp is not sensing input voltage and needs to be replaced.	

Cause: Backfeed Clamp Not Triggering		
Probability	**How-To Steps**	**Need More?**

Low	Check that the backfeed clamp is triggering on hard braking.
	• Create a new G-Code program with the following test snippet:
	`G1 Y20 X20 F1000`
	`G1 Y0 X0 F1000`
	`M99 (Repeat until Stop button is pressed)`
	• Jog your machine to the -X, -Y corner and ZERO the X + Y axes and then run the test program.
	⚠ **WARNING!** The test program will run continuously until the Stop button is pressed. Make sure you are in a safe position away from the motion envelope.
	• Watch the orange **CLAMP** LED on the backfeed clamp when the axes are slowing down. You should see a momentary flicker (<5 ms).
	• If you see no activity from the **CLAMP** LED and either axis faults during the test, replace your backfeed clamp.
		The braking energy is only dissipated in the backfeed clamp under very high braking situations, which is why a G-Code program is used to test it instead of simply jogging the machine back and forth.

DIAGRAMS AND PARTS LISTS

IN THIS SECTION, YOU'LL LEARN:

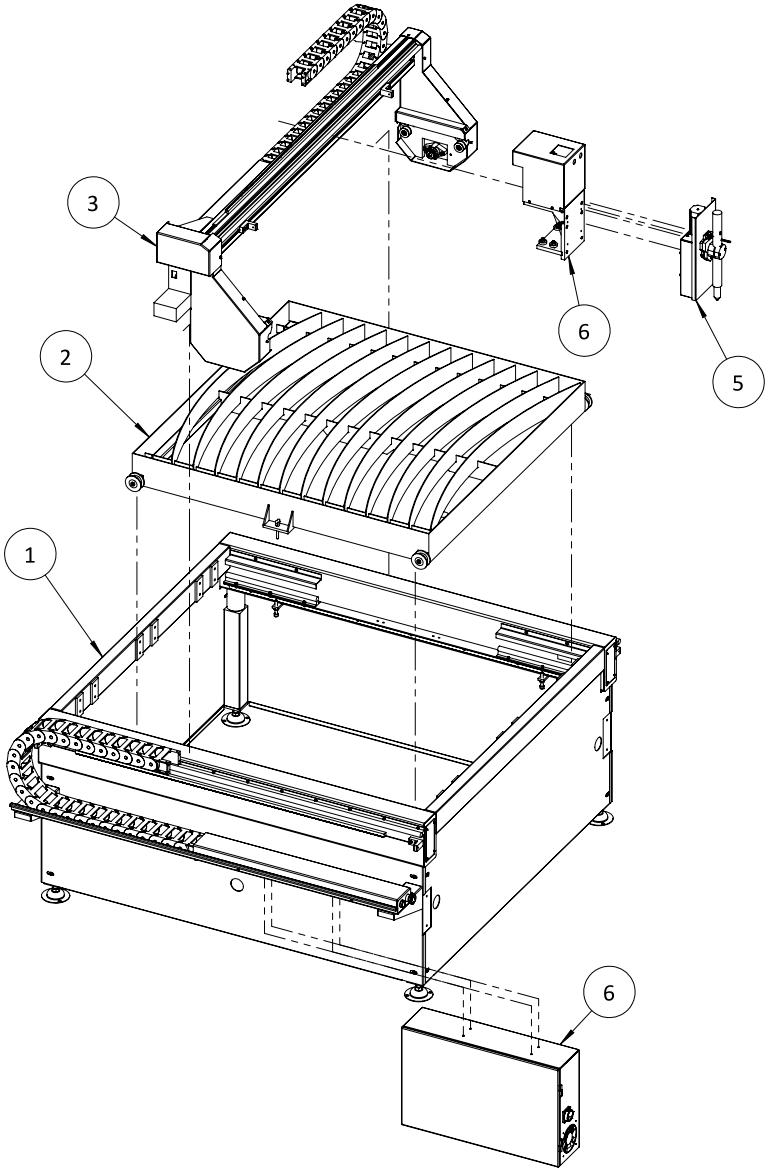
- About this machine's components.

> ***NOTICE!*** Only use Tormach-approved parts when making replacements. If you don't replace parts with those listed in this section, you may void your warranty.

CONTENTS

10: DIAGRAMS AND PARTS LISTS

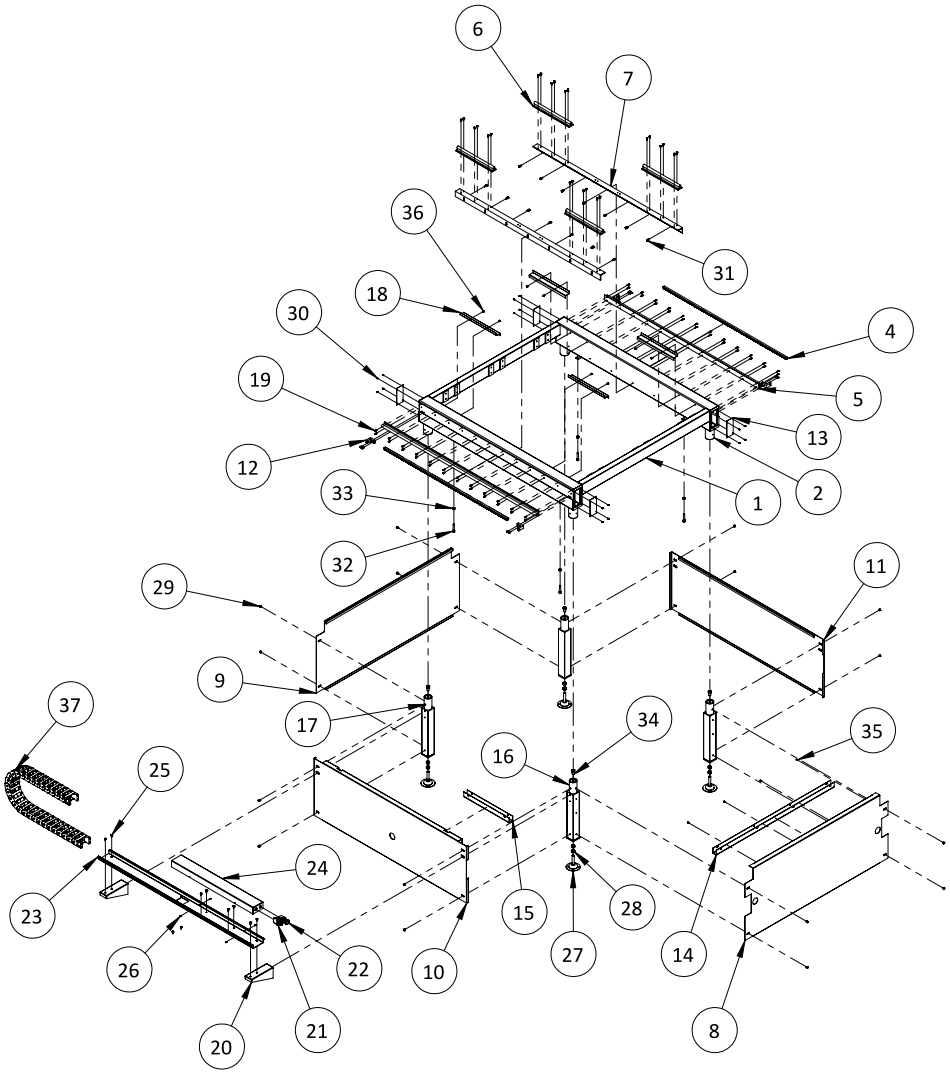
10.1 BASE MACHINE EXPLODED VIEW



10.2 BASE MACHINE PARTS LIST

ID	Description	Quantity
1	Frame Assembly (PN 50001)	1
2	Electrical Cabinet Assembly (PN 50002)	1
3	Water Table Assembly (PN 50003)	1
4	Y-Axis Gantry Assembly (PN 50004)	1
5	X-Axis Carriage Assembly (PN 50005)	1
6	Z-Axis Lifter Assembly (PN 50006)	1

10.3 FRAME ASSEMBLY EXPLODED VIEW

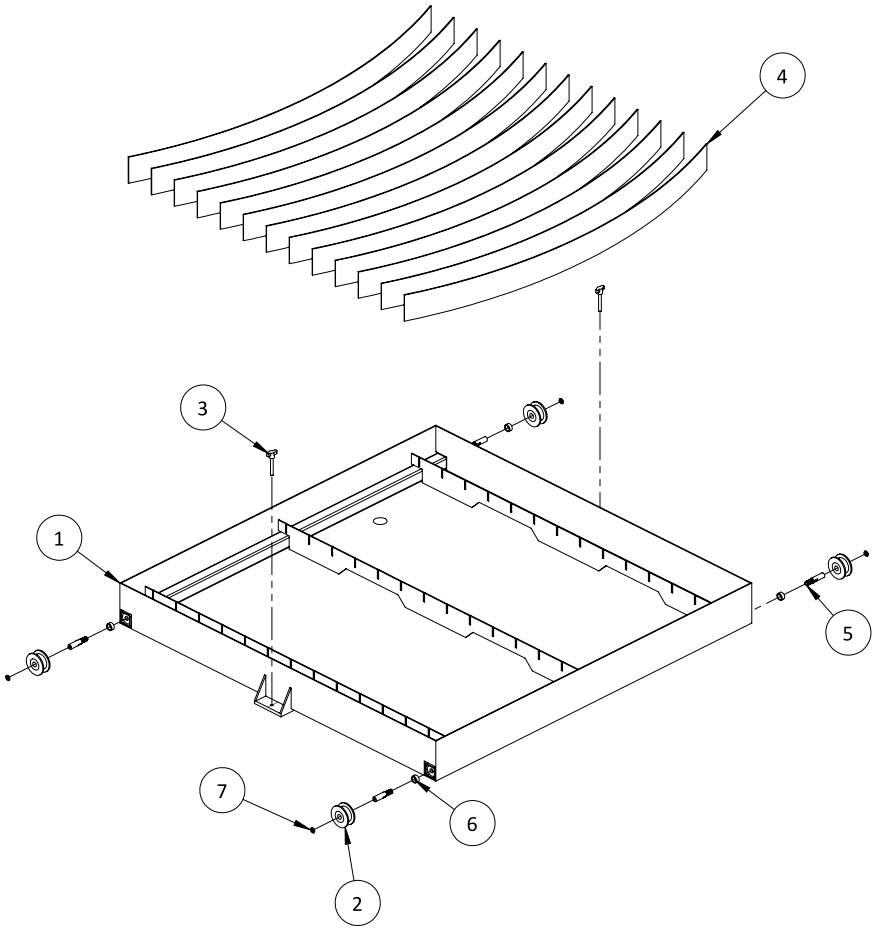


10.4 FRAME ASSEMBLY PARTS LIST

ID	Description	Quantity
1	Frame X Tube (PN 50010)	2
2	Frame Y Tube (PN 50011)	2
3	Grounding Bar (PN 39097)	1
4	Rack, Module 1, 1400 mm (PN 50047)	2
5	Linear Rail for 1300P Y (PN 50020)	2
6	Linear Rail, 20 mm (PN 50033)	4
7	Water Table Rail Support (PN 50129)	2
8	Front Panel Sheet Metal (PN 50015)	1
9	Rear Panel Sheet Metal (PN 50016)	1
10	Left Panel Sheet Metal (PN 50018)	1
11	Right Panel Sheet Metal (PN 50019)	1
12	Gantry Hard Stop, X-Axis (PN 50061)	4
13	Frame End Cap X (PN 50013)	4
14	Front Cable Tray (PN 50130)	1
15	Side Cable Tray (PN 50131)	1
16	1300P Frame Leg (PN 50009)	2
17	Frame Leg, B (PN 50133)	2
18	Water Table Track Shield (PN 50111)	4
19	Screw, Socket Head Cap, M05 × 0.8 × 015 (PN 20001)	72
20	Side Cable Tray Bracket (PN 50071)	2
21	Push Button (Blue LED) (PN 37342)	1
22	Emergency Stop Switch (PN 30462)	1
23	Side Cable Tray Base (PN 50021)	1
24	Side Cable Tray Top (PN 50022)	1
25	Screw, Socket Head Cap, M06 × 1 × 015 (PN 20001)	18
26	Screw, Socket Head Cap, M04 × 0.7 × 006 (PN 20001)	4
27	Machine Foot, Leveling, M16 × 2 Thread (PN 50119)	4
28	Nut, Hex, M16 (PN 20001)	8
29	Screw, Button Head Cap, M08 × 1.25 × 010 (PN 20001)	18
30	Screw, Socket Head Cap, M03 × 0.5 × 006 (PN 20001)	16

ID	Description	Quantity
31	Screw, Socket Head Cap, M08 × 1.25 × 016 (PN 31681)	14
32	Screw, Socket Head Cap, M10 × 1.5 × 060 (PN 20001)	4
33	Nut, Hex, M10 (PN 36008)	4
34	Screw, Socket Head Cap, M16 × 1.75 × 025 (PN 20001)	4
35	Screw, Socket Head Cap, M04 × 0.7 × 010 (PN 30924)	4
36	Screw, Button Head Cap, M05 × 0.8 × 010 (PN 35774)	8
37	Energy Chain Link, Wide (PN 50017)	28
38	Energy Chain End Link, Wide, Internal Tabs (PN 50819)	1
39	Energy Chain End Link, Wide, External Tabs (PN 50820)	1

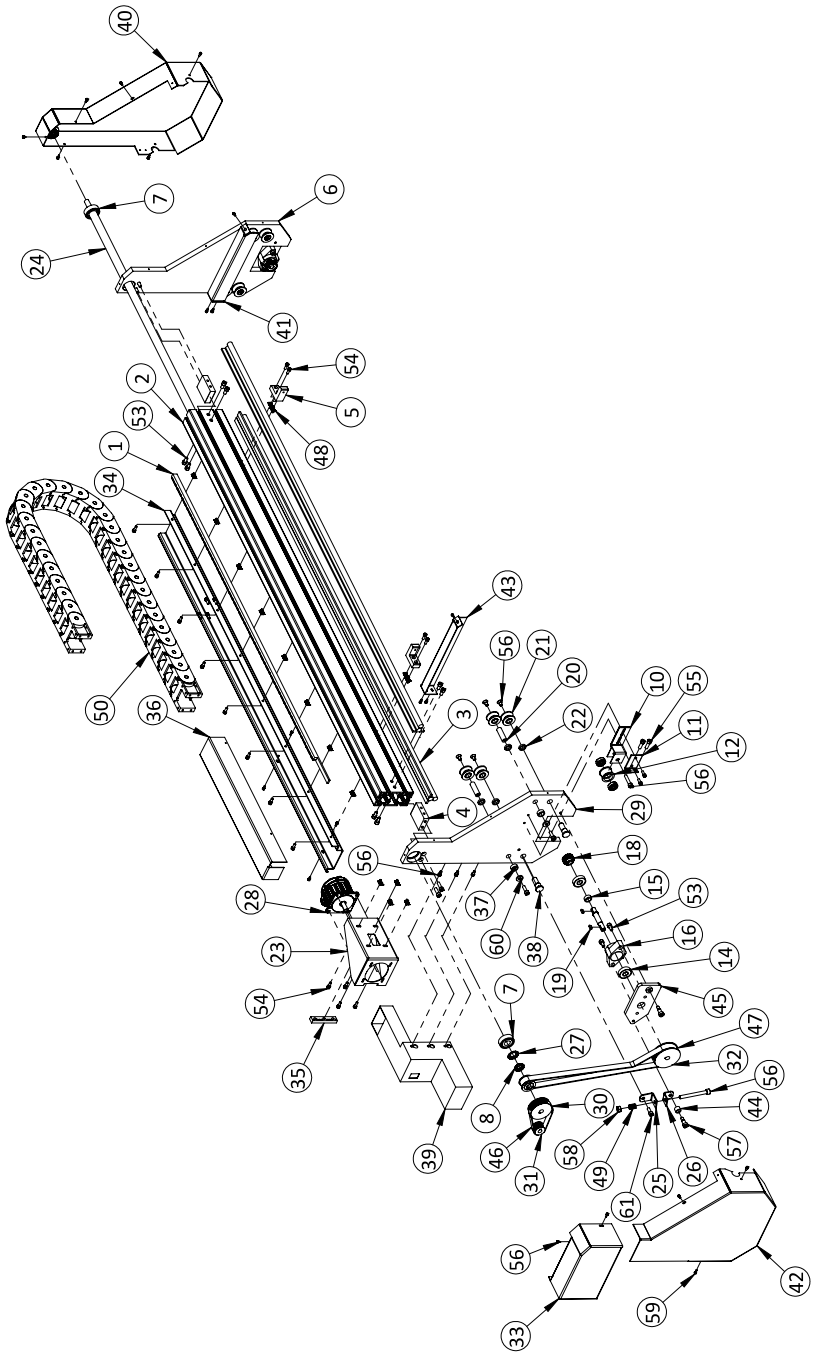
10.5 WATER TABLE EXPLODED VIEW



10.6 WATER TABLE ASSEMBLY PARTS LIST

ID	Description	Quantity
1	Water Table Sheet Metal (PN 50030)	1
2	Water Table Roller (PN 50036)	4
3	Screw, Thumb, M8 × 1.25 - 60, 2 Arm Plastic Head (PN 50117)	2
4	Water Table Vertical Divider (PN 50032)	13
5	Water Table Roller Axle (PN 50118)	4
6	Water Table Roller Spacer (PN 50034)	4
7	Washer, Flat, M8 (PN 30531)	4

10.7 Y-AXIS GANTRY ASSEMBLY EXPLODED VIEW

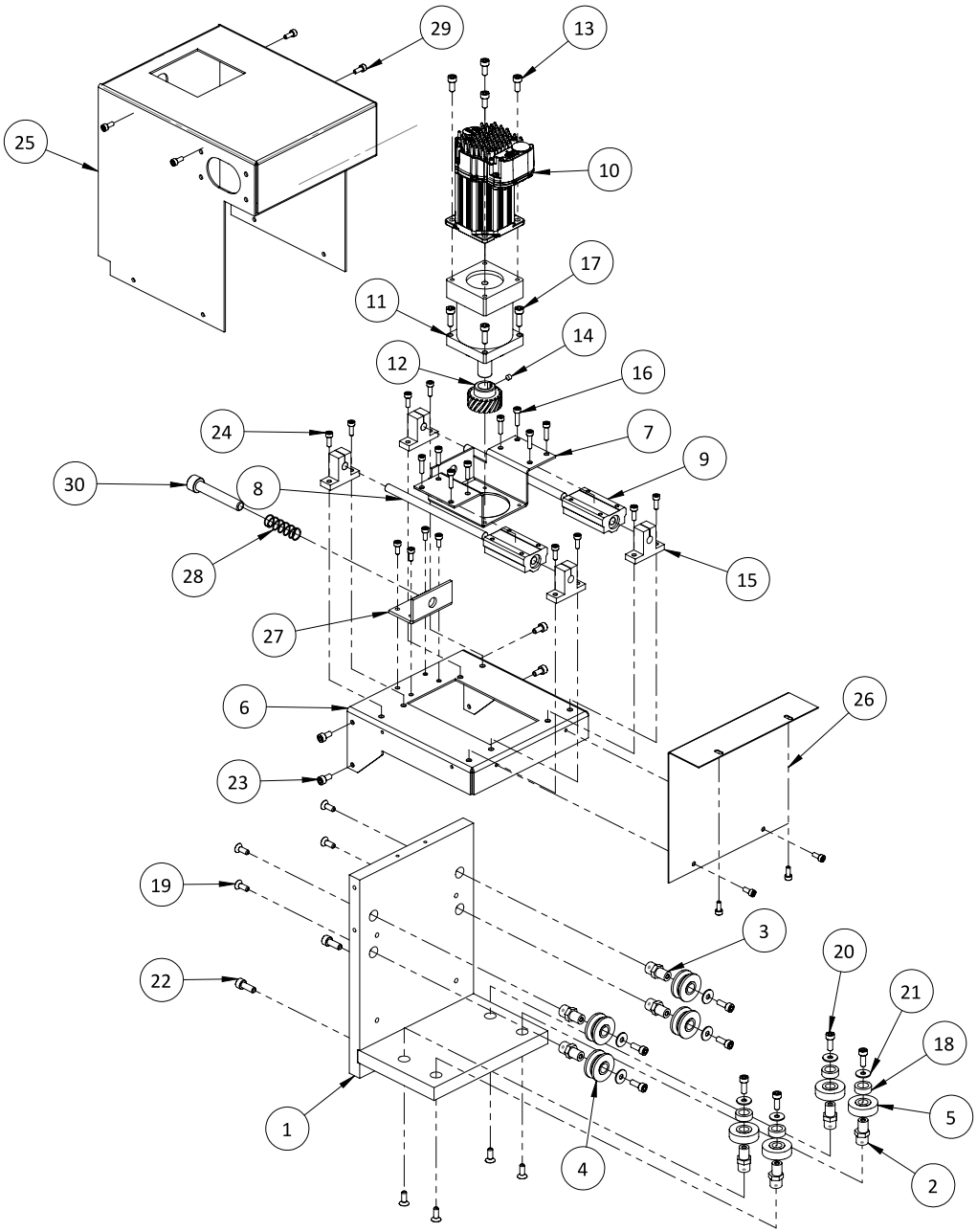


10.8 Y-AXIS GANTRY ASSEMBLY PARTS LIST

ID	Description	Quantity
1	Rack, Module 1, Plasma X-Axis (PN 50046)	1
2	Gantry Cross Beam Extrusion (PN 50044)	1
3	Linear Rail, 16 mm (PN 50045)	2
4	Cross Beam Mount Block (PN 50043)	2
5	Gantry Hard Stop, X-Axis (PN 50061)	2
6	Y-Axis Pulley Mount Plate X+ (PN 50037)	1
7	Y-Axis Drive Bearing (PN 50064)	2
8	Y-Axis Drive Lock Nut (PN 50063)	2
9	Timing Pulley, HTD-5, 25 Tooth, 14 mm Taper Lock (PN 50078)	2
10	Y-Axis Belt Tensioner (PN 50073)	2
11	Y-Axis Belt Tensioner L Bracket (PN 50134)	2
12	Y-Axis Belt Tensioner Wheel (PN 50074)	2
13	Y-Axis Belt Tensioner Wheel Bearing (PN 50135)	4
14	Y-Axis Pinion Bearing (PN 50137)	4
15	Y-Axis Pinion Bearing Spacer (PN 50138)	2
16	Y-Axis Pinion Mount Block (PN 50080)	2
17	Y-Axis Pinion Shaft (PN 50081)	2
18	Pinion, Module 1, 23T (PN 50072)	2
19	Key Stock, 5 mm × 15 mm (PN 50143)	4
20	Pin, 15 mm × 50 mm (PN 50049)	4
21	Linear Rail Roller, 20 mm Rail (PN 50050)	8
22	Y-Axis Roller Inner Spacer (PN 50069)	8
23	Y-Axis Motor Mount, NEMA 34 (PN 50082)	1
24	Y-Axis Drive Shaft (PN 50062)	1
25	Y-Axis Rack and Pinion Tensioner Bracket, Top (PN 50052)	2
26	Y-Axis Rack and Pinion Tensioner Bracket, Bottom (PN 50051)	2
27	Y-Axis Drive Lock Washer (PN 50065)	2
28	Plasma Y-Axis Servo, Clearpath CPM-SDSK-3411S-ELN (PN 39104)	1
29	Y-Axis Pulley Mount Plate X- Mirrored (PN 50038)	1
30	Timing Pulley, HTD-5, 40 Tooth, 14 mm Taper Lock (PN 50076)	1

ID	Description	Quantity
31	Timing Pulley, HTD-5, 25 Tooth, 14 mm ID (PN 50077)	1
32	Timing Pulley, HTD-5, 50 Tooth, 14 mm Shaft (PN 50079)	2
33	Y-Axis Motor Pulley Cover (PN 50056)	1
34	Gantry Cable Tray Base (PN 50059)	1
35	Grounding Bar (PN 39097)	1
36	Gantry Cable Tray Cover (PN 50060)	1
37	Y-Axis Roller Outer Spacer (PN 50070)	4
38	Y-Axis Roller Eccentric Adjust (PN 50066)	4
39	Gantry Cable Tray Connector (PN 50041)	1
40	Y-Axis Pulley Cover, X+ (PN 50039)	1
41	Y-Axis Linear Roller Cover, X+ (PN 50140)	1
42	Y-Axis Pulley Cover, X- (PN 50040)	1
43	Y-Axis Linear Roller Cover, X- (PN 50141)	1
44	Y-Axis Tensioner Bracket Retainer (PN 50142)	2
45	Y-Axis Tensioner Pinion Mount (PN 50057)	2
46	Timing Belt, HTD-5, Motor to Drive Shaft (PN 50112)	1
47	Timing Belt, HTD-5, Drive Shaft to Pinion (PN 50113)	1
48	T-Nut, M6, 8 mm WD (PN 50048)	16
49	Compression Spring, 10.5 mm ID, 20 mm LG (PN 50053)	2
50	Energy Chain Link, Narrow (PN 50055)	29
51	Energy Chain End Link, Narrow, External (PN 50817)	1
52	Energy Chain End Link, Narrow, Internal Tabs (PN 50818)	1
53	Screw, Socket Head Cap, M8 × 1.25 - 16 (PN 31681)	12
54	Screw, Socket Head Cap, M6 × 1 - 16 (PN 33117)	26
55	Screw, Socket Head Cap, M8 × 1.25 - 25 (PN 31618)	12
56	Screw, Socket Head Cap, M4 × 0.7 - 6 (PN 20001)	17
57	Screw, Shoulder, M6 × 1 - 10 (PN 35926)	4
58	Nut, Hex, M10 (PN 36008)	2
59	Screw, Socket Head Cap, M4 × 0.7 - 10 (PN 30924)	19
60	Washer, Flat, M8 (PN 50821)	4
61	Screw, Socket Head Cap, M8 × 1.25 - 20 (PN 31895)	2

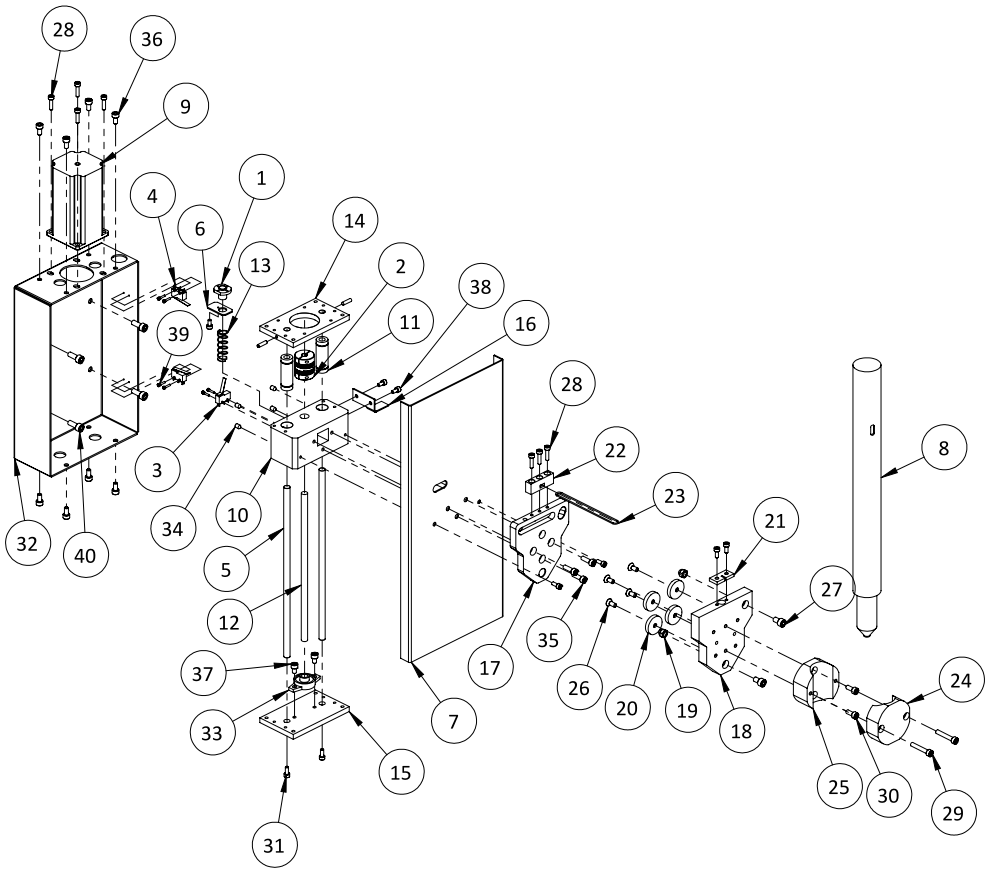
10.9 X-AXIS CARRIAGE ASSEMBLY EXPLODED VIEW



10.10 X-AXIS CARRIAGE ASSEMBLY PARTS LIST

ID	Description	Quantity
1	X-Axis Carriage (PN 50083)	1
2	X Linear Rail Roller Shaft Support Plate, Eccentric (PN 50087)	4
3	X Linear Rail Roller Shaft, Support Plate (PN 50086)	4
4	Linear Rail Roller, 16 mm Rail (PN 50092)	4
5	Linear Rail Roller, 16 mm Rail Flat (PN 50093)	4
6	X-Axis Linear Rail Mounting Bracket (PN 50149)	1
7	X-Axis Motor Bracket (PN 50115)	1
8	Lead Screw, 8 mm × 170 mm (PN 50094)	2
9	Linear Bearing, 8 mm (PN 50102)	2
10	X-Axis Motor, ClearPath CPM-SDSK-2321S-EQN (PN 39105)	1
11	Planetary Gear Box, NEMA 23, 5:1 (PN 50088)	1
12	Pinion, Module 1, 23T (PN 50072)	1
13	Screw, Socket Head Cap, M5 × 0.8 - 12 mm (PN 31353)	4
14	Screw, Cone Point Set, M5x5 120° (PN 20001)	1
15	Linear Rail Clamp, 8 mm (PN 50101)	4
16	Screw, Socket Head Cap, M4 × 0.7 - 16 (PN 37751)	8
17	Screw, Socket Head Cap, M5 × 0.8 - 16 (PN 30546)	4
18	X-Axis Linear Roller Washer (PN 50148)	4
19	Screw, Socket Head Countersunk, M5 × 0.8 - 14 (PN 20001)	8
20	Screw, Socket Head Cap, M5 × 0.8 - 14 (PN 31563)	8
21	Washer, Flat, M5 (PN 50822)	8
22	Screw, Socket Head Cap, M6 × 1 - 16 (PN 33117)	2
23	Screw, Socket Head Cap, M5 × 0.8 - 10 (PN 31641)	4
24	Screw, Socket Head Cap, M4 × 0.7 - 12 (PN 31360)	8
25	X Carriage Top Sheet Metal (PN 50085)	1
26	X Carriage Back Cover Plate (PN 50084)	1
27	X-Axis Tensioner Bracket (PN 50116)	1
28	Z-Axis Compression Spring (PN 50122)	1
29	Screw, Socket Head Cap, M4 × 0.7 - 10 (PN 30924)	12
30	Screw, Socket Head Cap, M10 × 1.5 - 60 (PN 20001)	1

10.11 Z-AXIS LIFTER ASSEMBLY EXPLODED VIEW



10.12 Z-AXIS LIFTER ASSEMBLY PARTS LIST

ID	Description	Quantity
1	Lead Screw Nut, 8 mm (PN 50107)	1
2	Lead Screw Coupler, 8 mm (PN 50108)	1
3	Z-Axis Limit Switch Vertical Trigger (PN 50105)	1
4	Z-Axis Limit Switch (PN 50104)	2
5	Linear Rail, 8 mm × 225 mm (PN 50100)	2
6	Z-Axis Lifter Touch Switch Trigger Plate (PN 50103)	1
7	Z-Axis Motor Mount Front Cover (PN 50099)	1
8	Duramax Torch	1
9	Stepper, NEMA 23, 3 Stack, 8 mm Shaft (PN 39106)	1
10	Z-Axis Linear Bearing Carrier (PN 50120)	1
11	Linear Bearing, Round, 10 mm (PN 50146)	2
12	Lead Screw, 8 mm × 170 mm (PN 50106)	1
13	Z-Axis Compression Spring (PN 50122)	1
14	Z-Axis Upper Linear Rail Mounting Plate (PN 50124)	1
15	Z-Axis Lower Linear Rail Mounting Plate (PN 50125)	1
16	Z-Axis Limit Switch Flag (PN 50121)	1
17	Magnetic Breakaway Base (PN 50096)	1
18	Magnetic Breakaway Kinematic Plate (PN 50126)	1
19	Magnetic Breakaway Torch Holder Acorn Nut (PN 50703)	2
20	Magnetic Breakaway Torch Holder Magnet (PN 50702)	4
21	Magnetic Breakaway Torch Holder Tether Clamp (PN 50701)	1
22	Magnetic Breakaway Torch Holder Tether Base (PN 50700)	1
23	Magnetic Breakaway Torch Holder Tether (PN 50704)	1
24	Magnetic Breakaway Torch Top Clamp (PN 50699)	1
25	Magnetic Breakaway Torch Bottom Clamp (PN 50150)	1
26	Screw, Socket Head Countersunk, M5 × 0.8 - 12 (PN 38894)	4
27	Screw, Socket Head Cap, M6 × 1 - 10 (PN 20001)	2
28	Screw, Socket Head Cap, M4 × 0.7 - 16 (PN 37751)	7
29	Screw, Socket Head Cap, M5 × 0.8 - 30 (PN 31602)	2
30	Screw, Socket Head Cap, M5 × 0.8 - 12 mm (PN 31353)	2
31	Screw, Socket Head Cap, M4 × 0.7 - 10 (PN 30924)	6

ID	Description	Quantity
32	Z-Axis Motor Mount Sheet Metal (PN 50098)	1
33	Lead Screw End Support (PN 50123)	1
34	Screw, Cone Point Set, M5 × 8 90° (PN 30337)	4
35	Screw, Socket Head Cap, M5 × 0.8 - 16 (PN 30546)	3
36	Screw, Socket Head Cap, M5 × 0.8 - 10 (PN 31641)	8
37	Screw, Socket Head Cap, M5 × 0.8 - 8 (PN 30844)	2
38	Screw, Socket Head Cap, M4 × 0.7 - 8 (PN 30891)	3
39	Screw, Socket Head Cap, M2 × 0.4 - 10 (PN 20001)	6
40	Screw, Socket Head Cap, M6 × 1 - 16 (PN 33117)	4
41	Screw, Cone Point Set, M4 × 16 90° (PN 20001)	2

ELECTRICAL SCHEMATICS

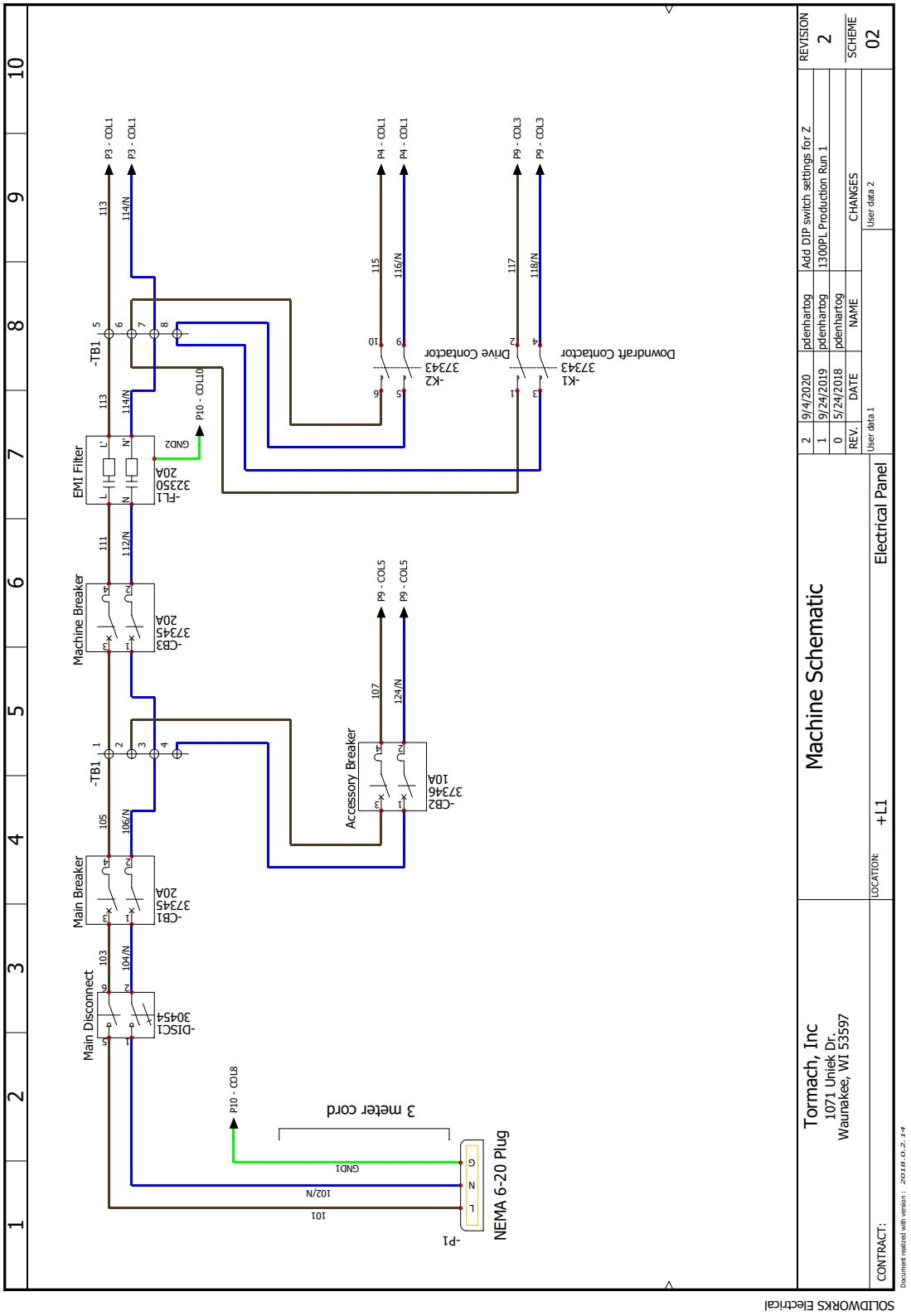
IN THIS SECTION, YOU'LL LEARN:

- About the electrical schematics for this machine's electronics.

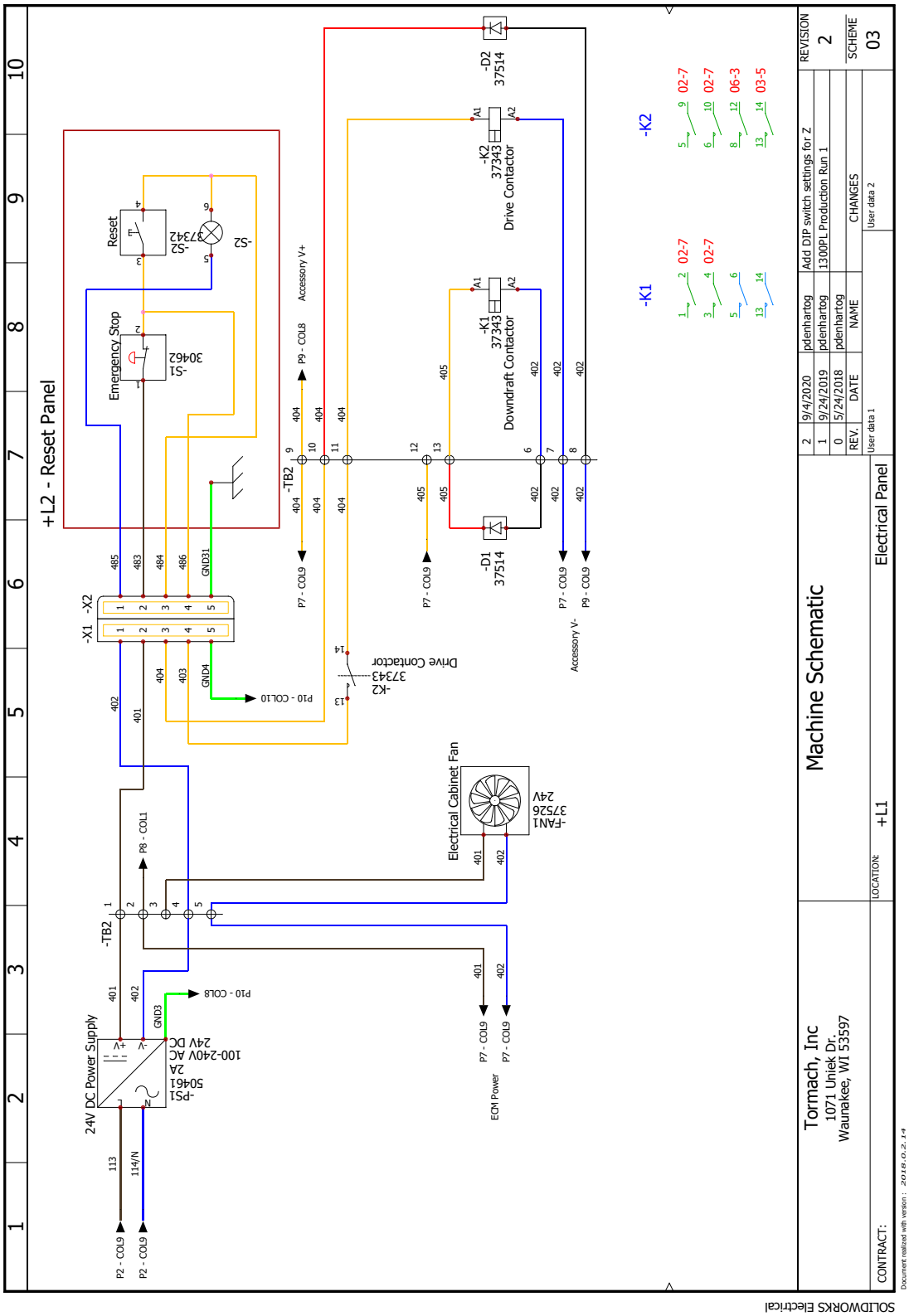
CONTENTS

11: ELECTRICAL SCHEMATICS

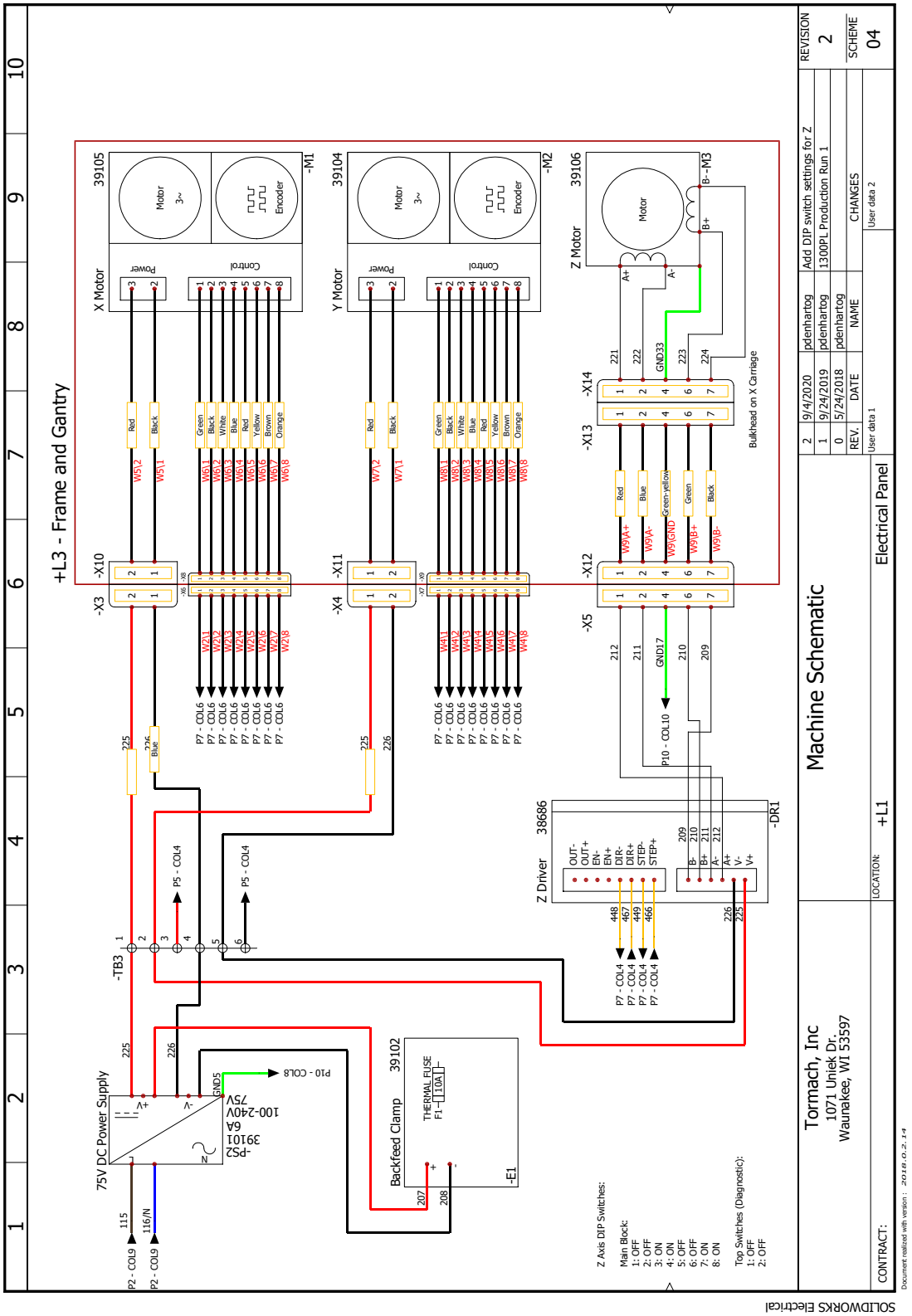
11.1 230 VAC POWER (SHEET 2)



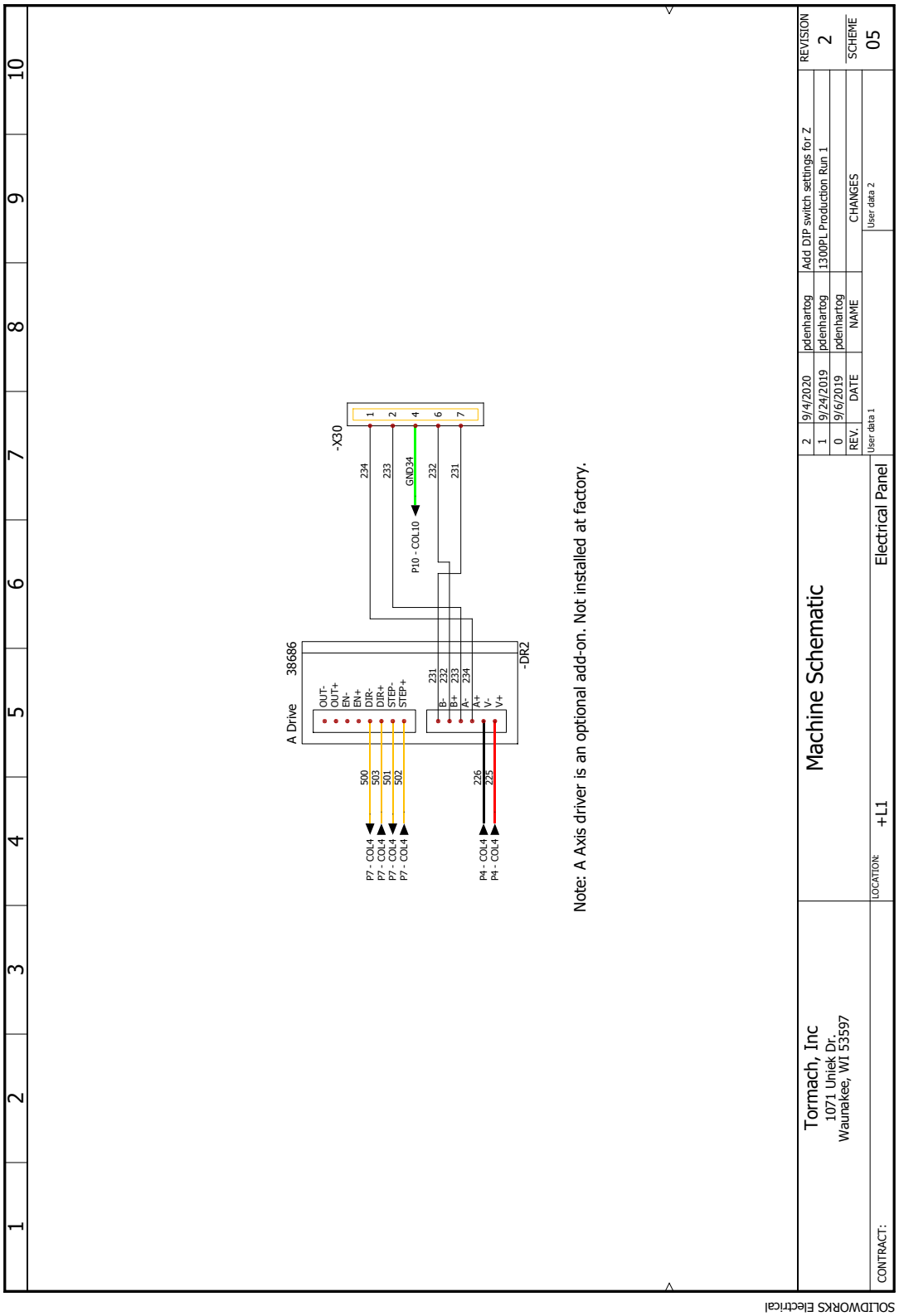
11.2 24 VDC CONTROLS (SHEET 3)



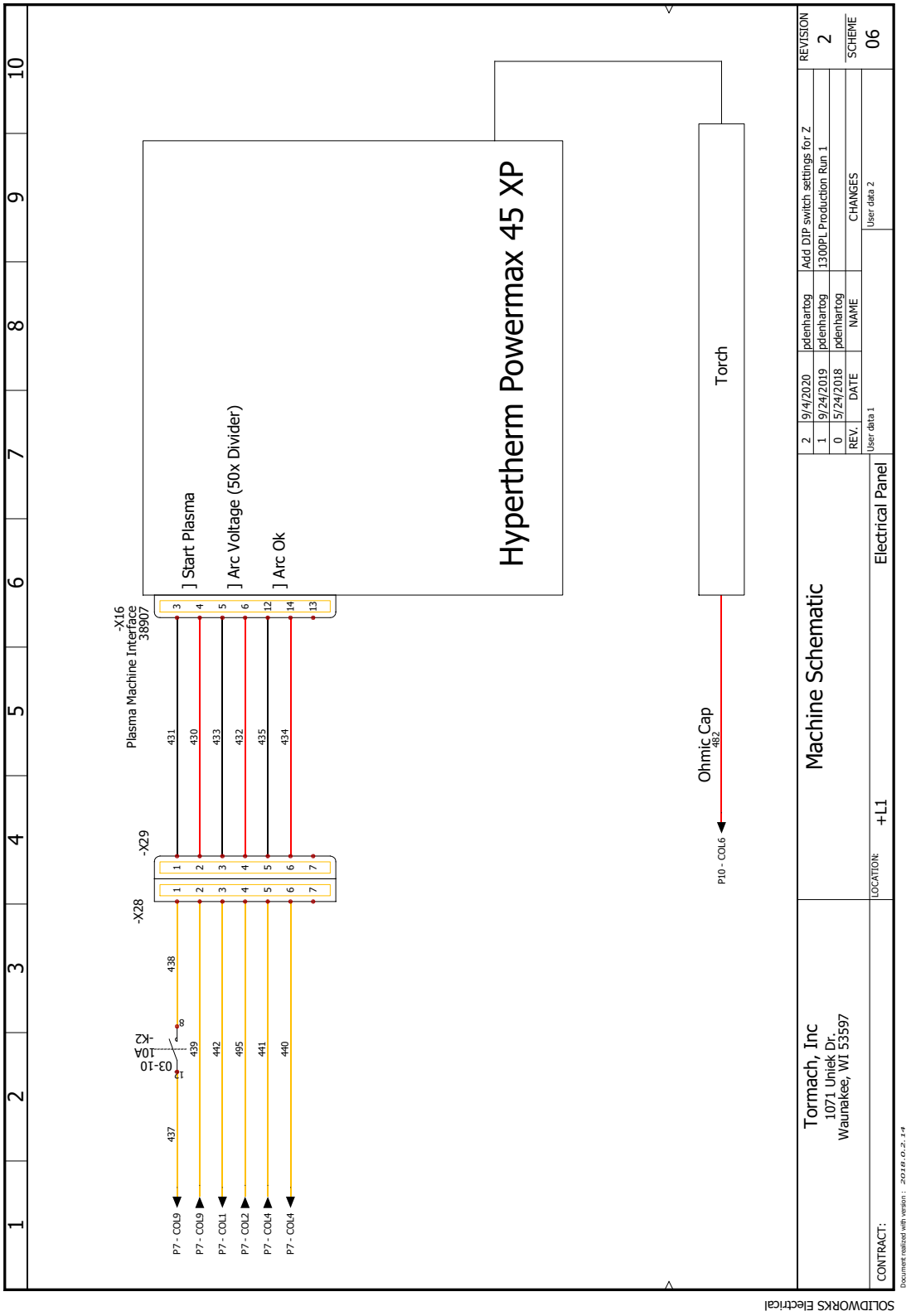
11.3 AXIS DRIVE CONTROL (SHEET 4)



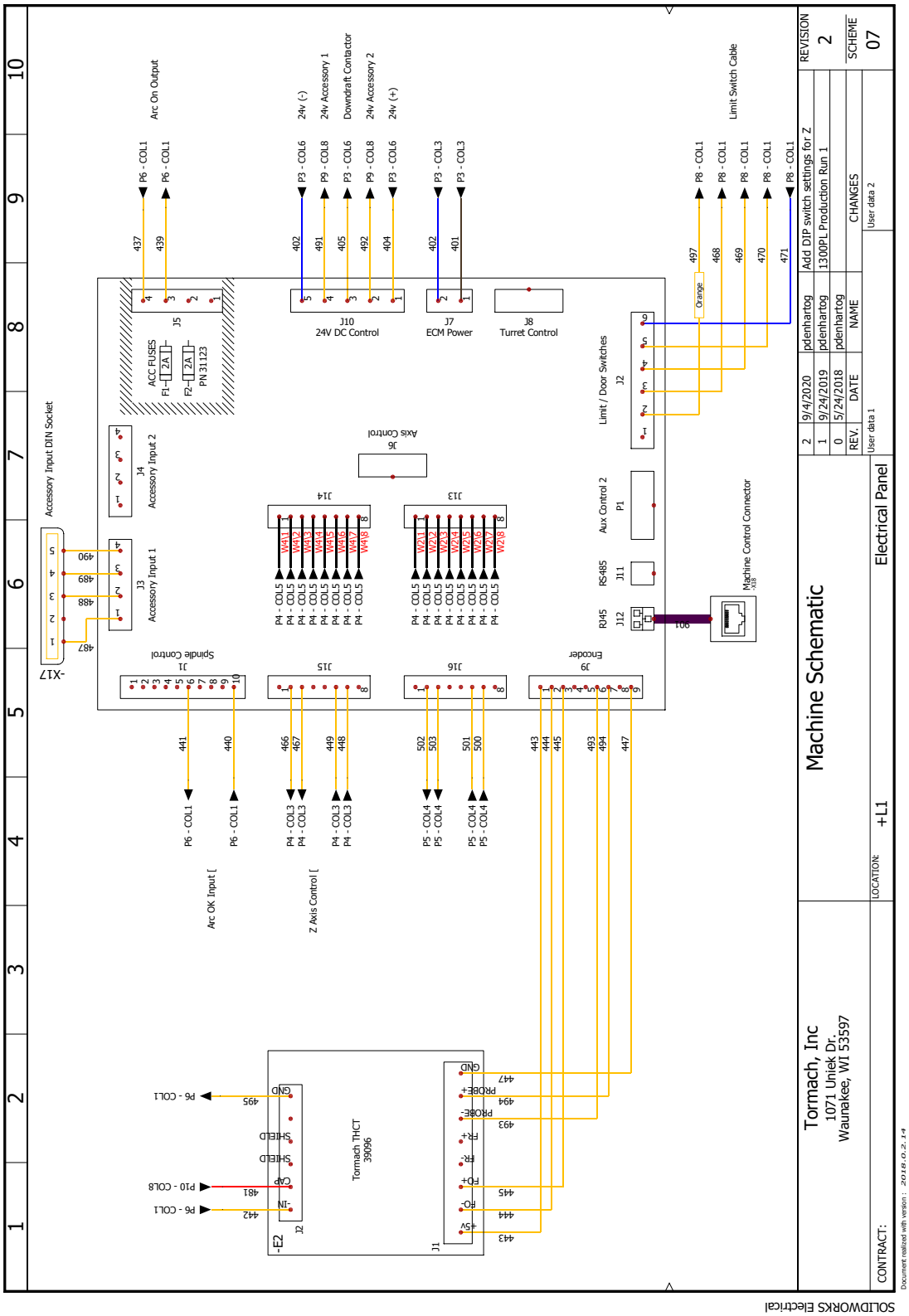
11.4 A-AXIS DRIVER (SHEET 5)



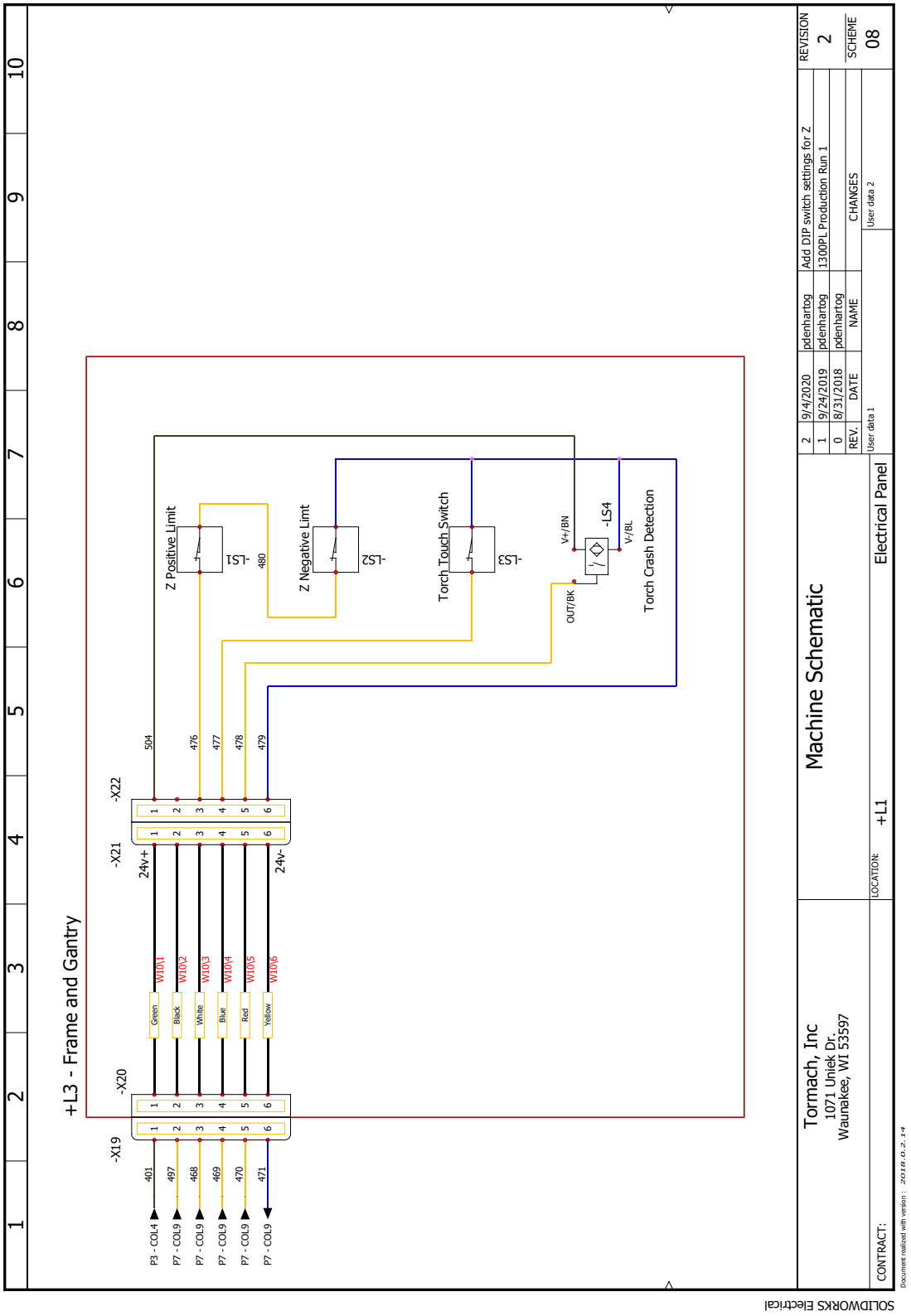
11.5 PLASMA SOURCE CONTROL (SHEET 6)



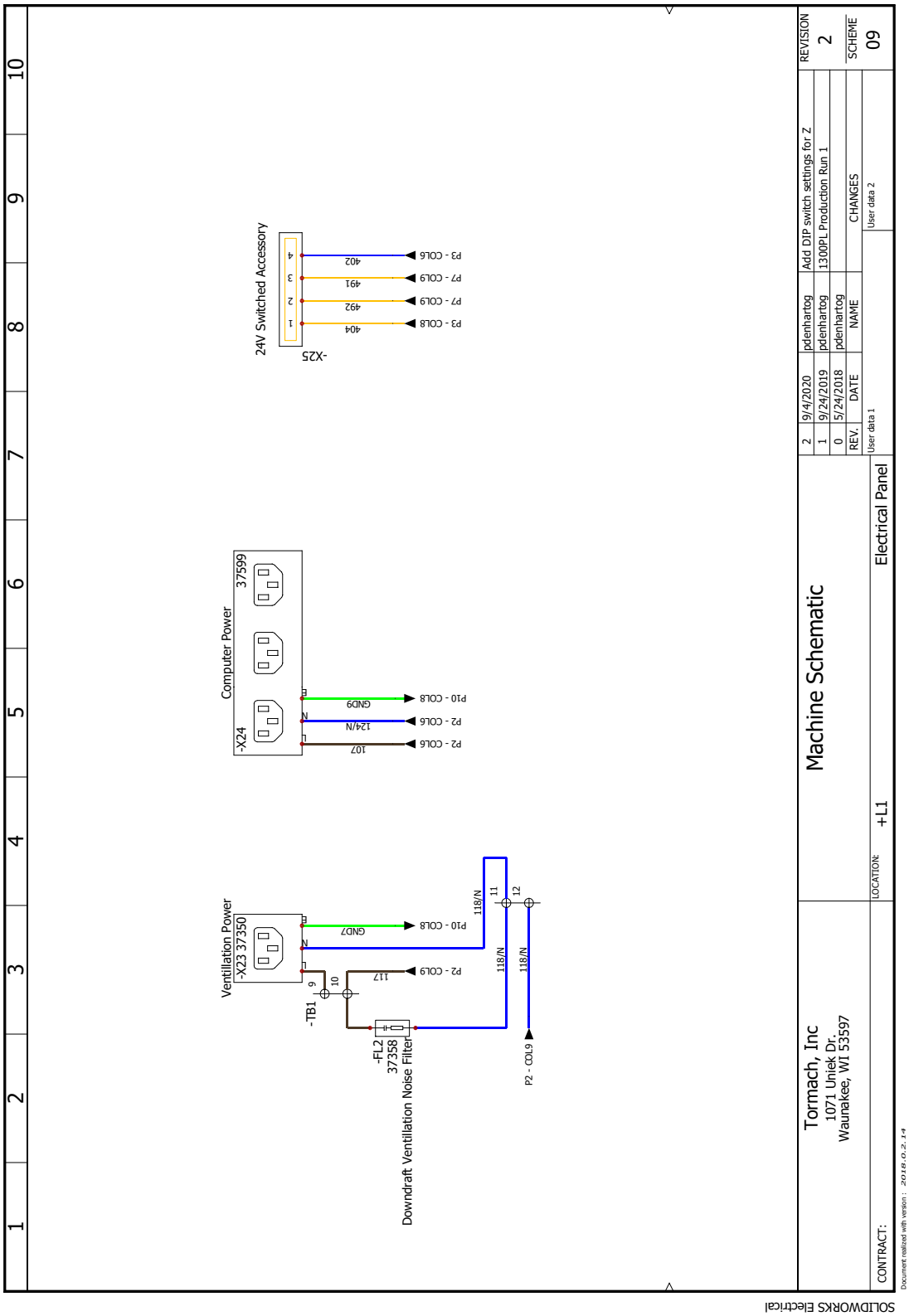
11.6 MACHINE CONTROL BOARD (SHEET 7)



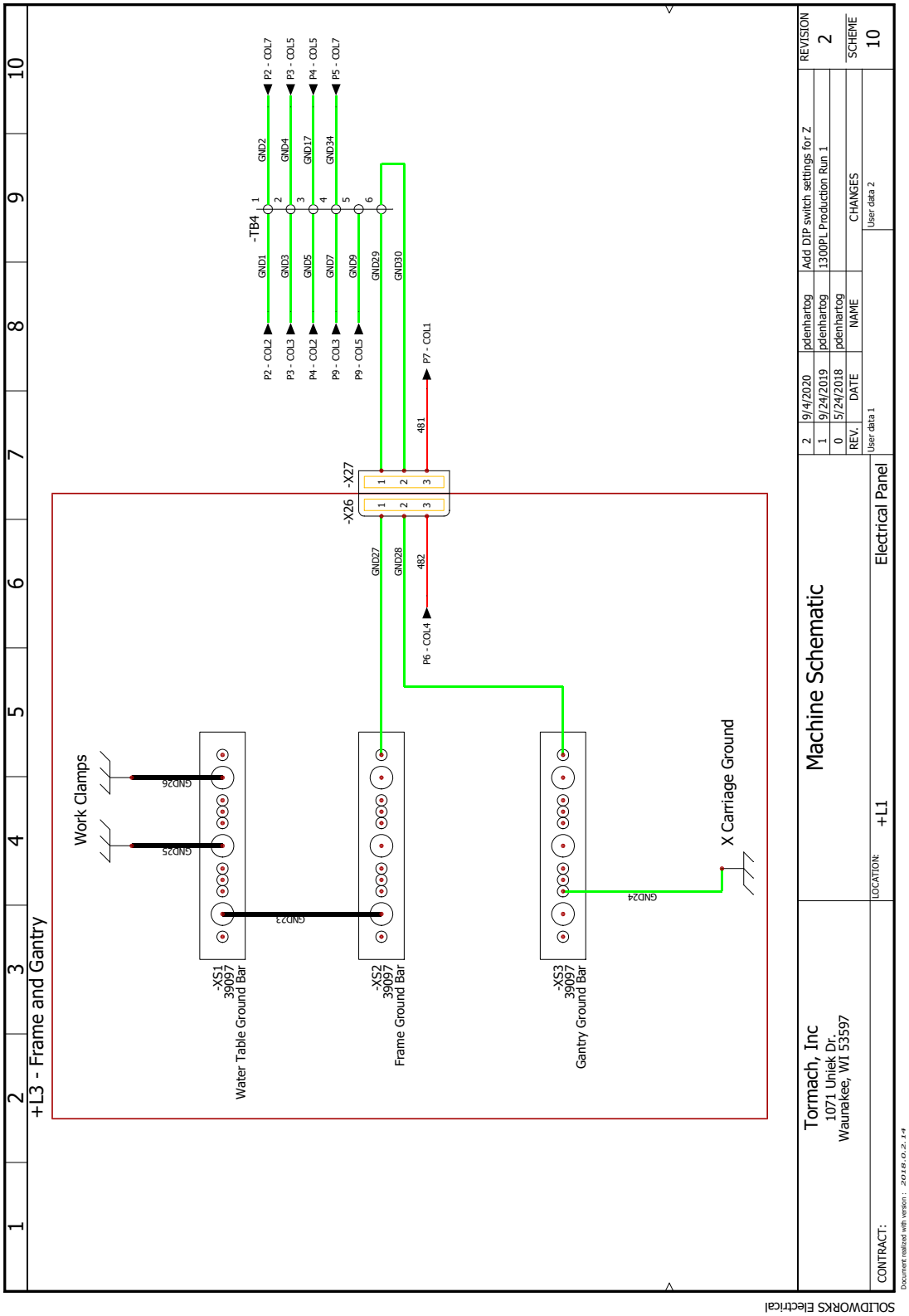
11.7 TORCH LIMIT AND BREAKAWAY SWITCHES (SHEET 8)



11.8 ACCESSORY AND AUXILIARY POWER (SHEET 9)

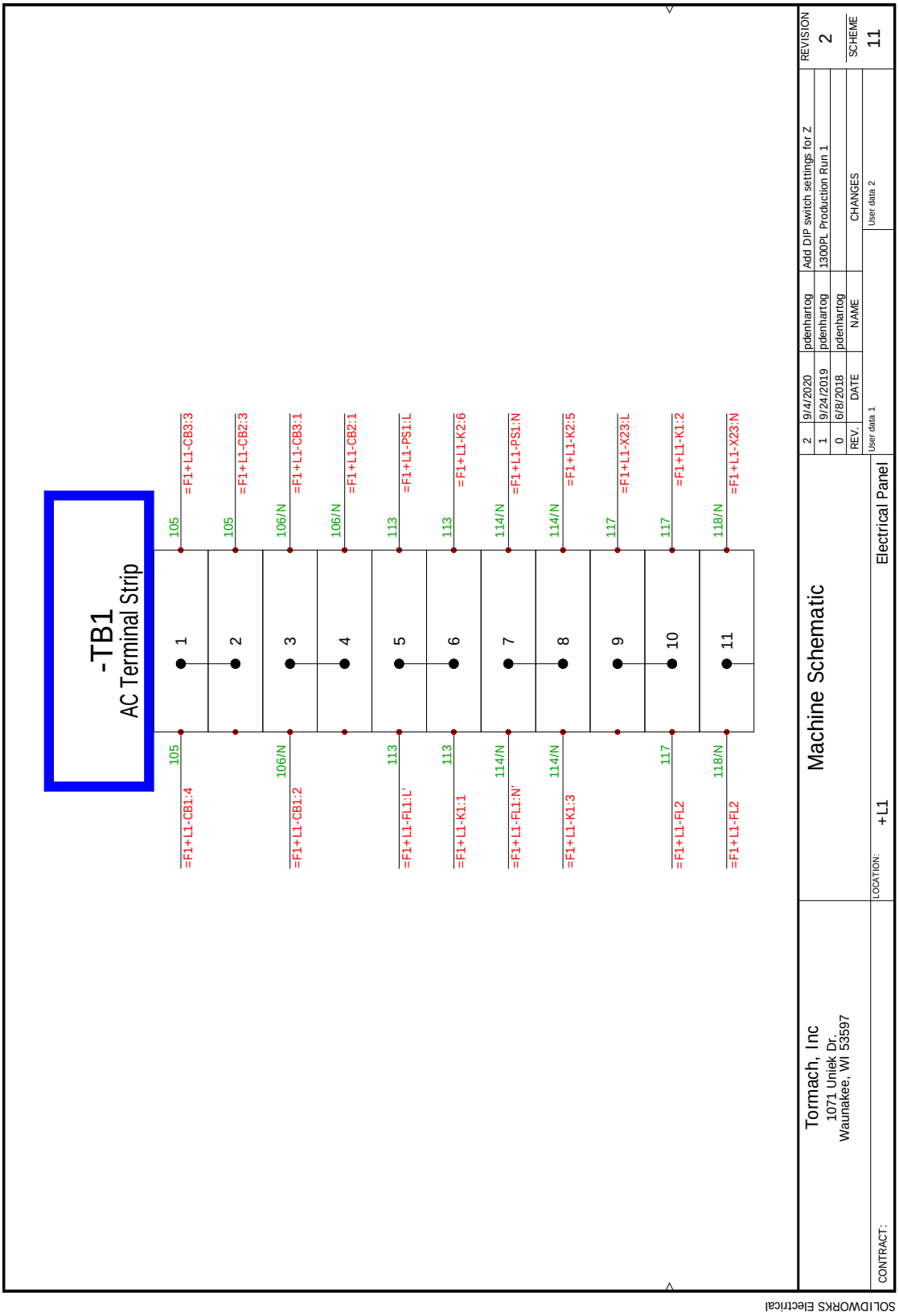


11.9 GROUNDS (SHEET 10)

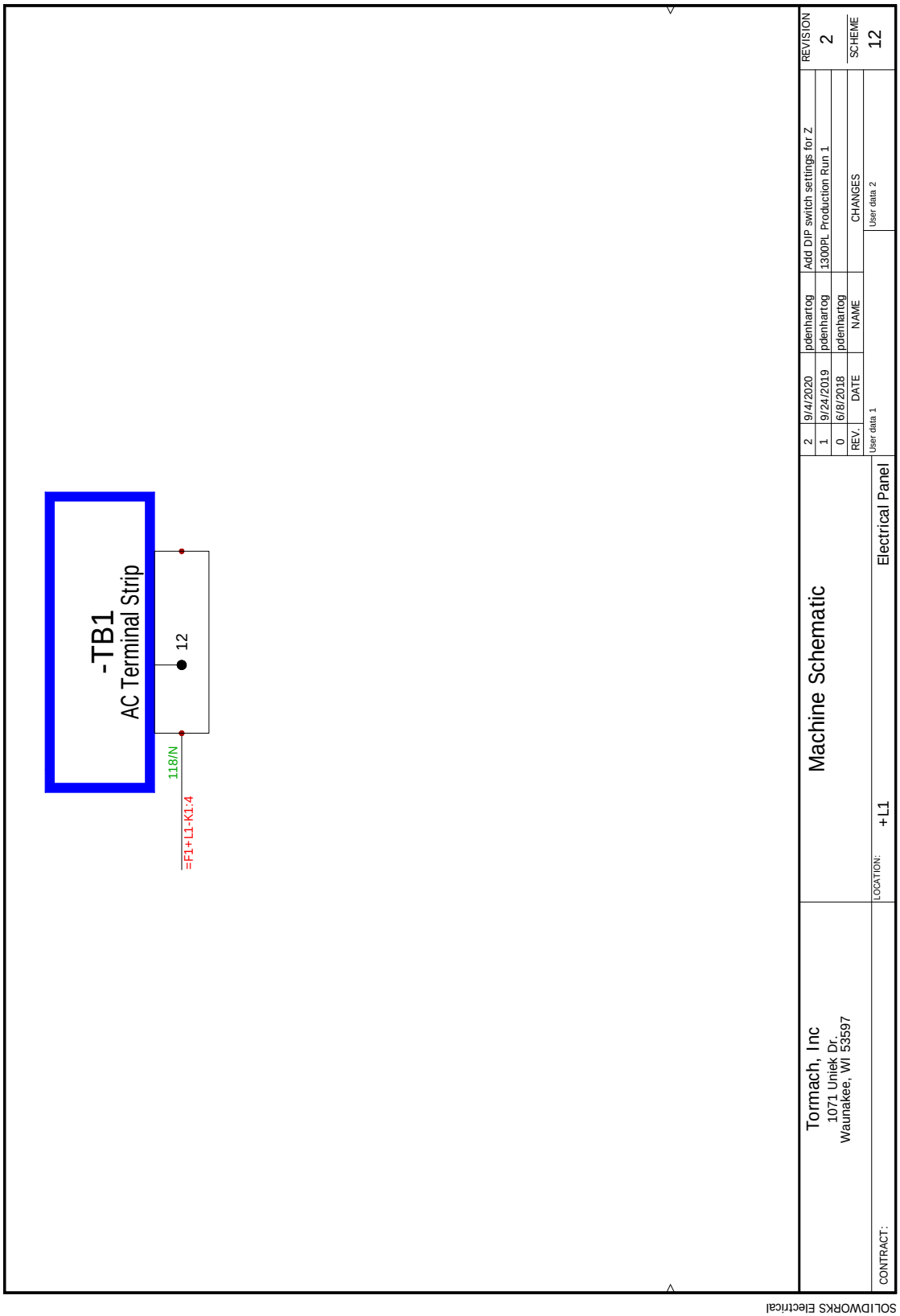


11.10 TERMINAL STRIPS (SHEETS 11-16)

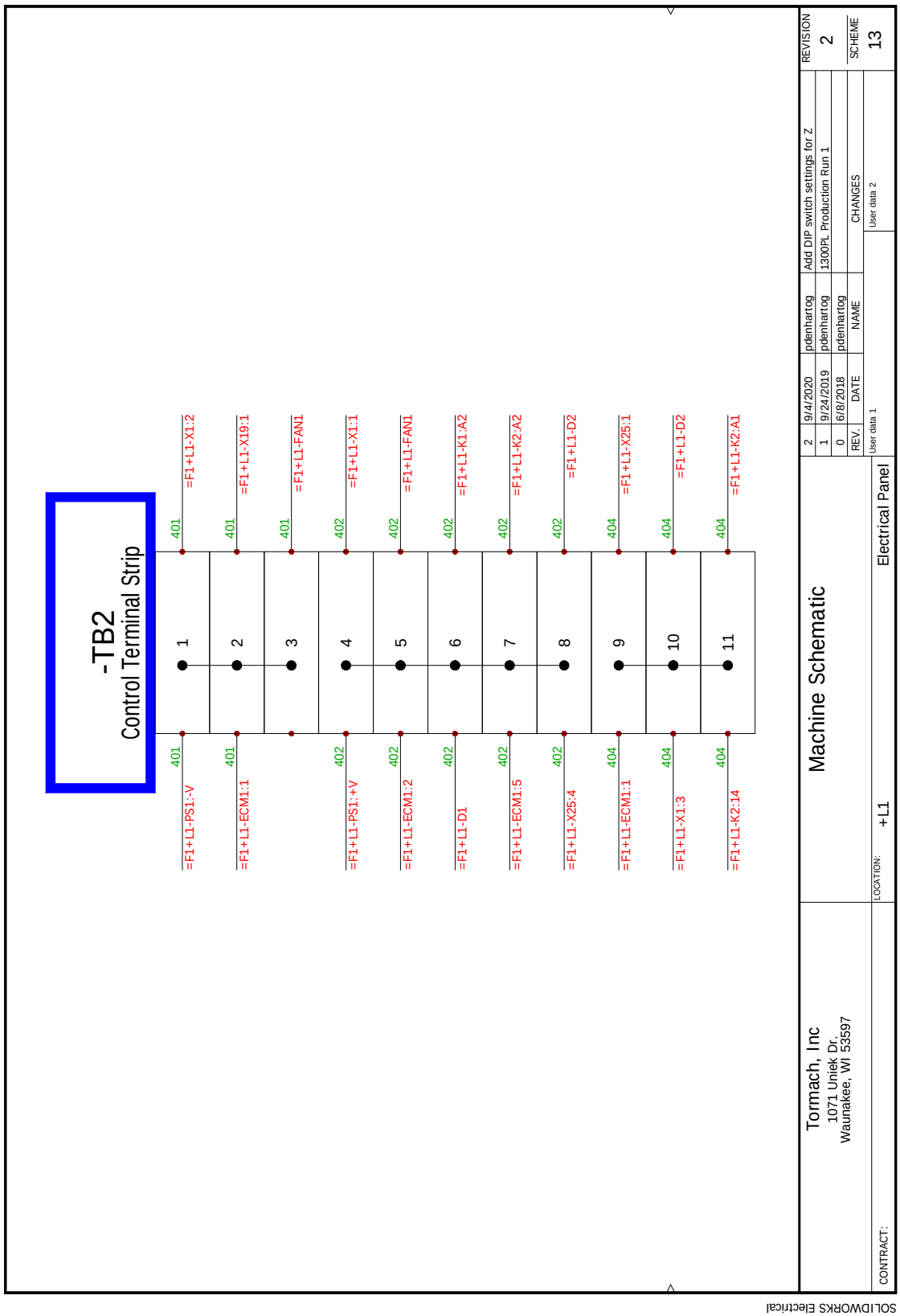
11.10.1 TB1: AC Terminal Strip (Sheet 11)



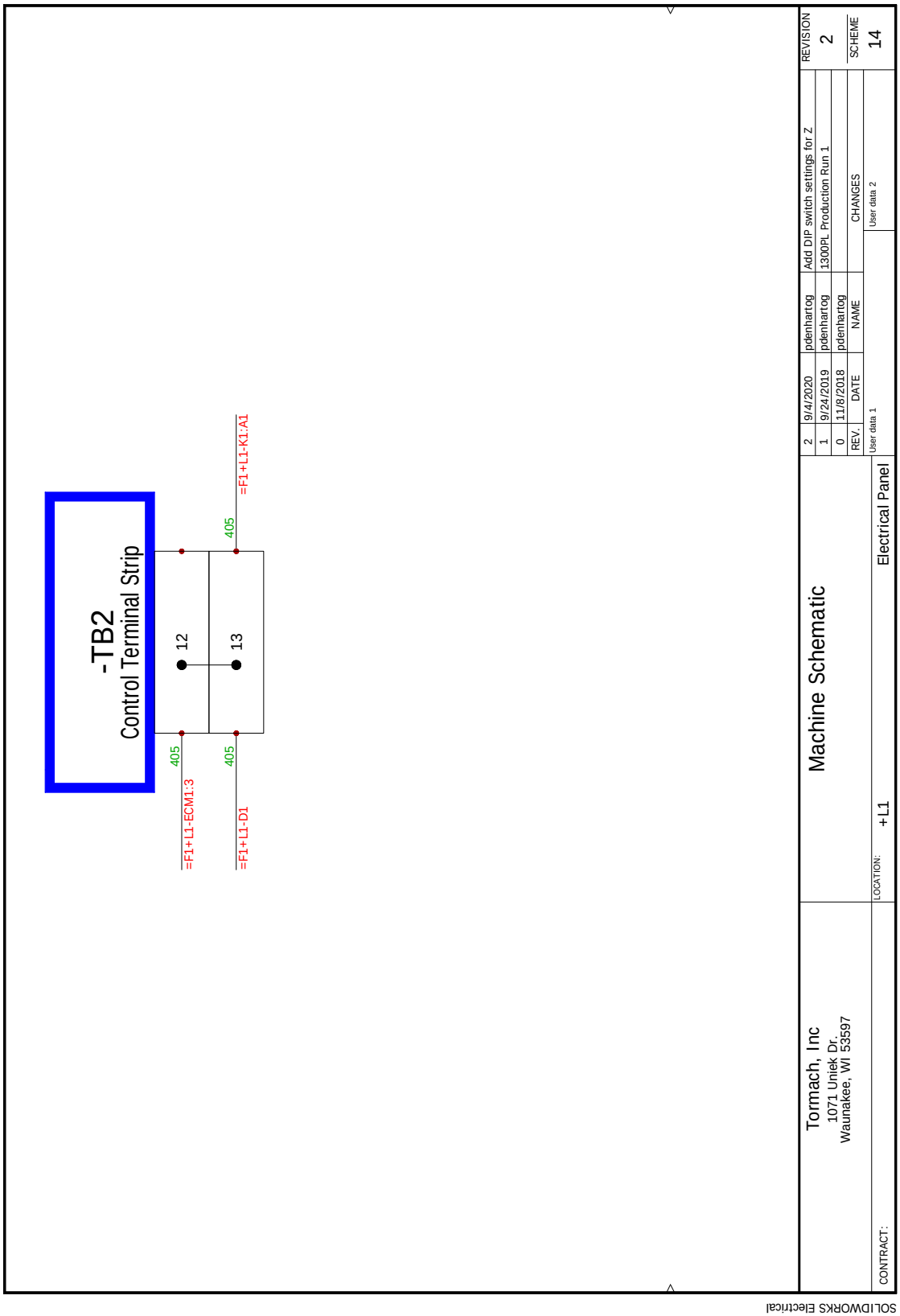
11.10.2 TB1: AC Terminal Strip (Sheet 12)



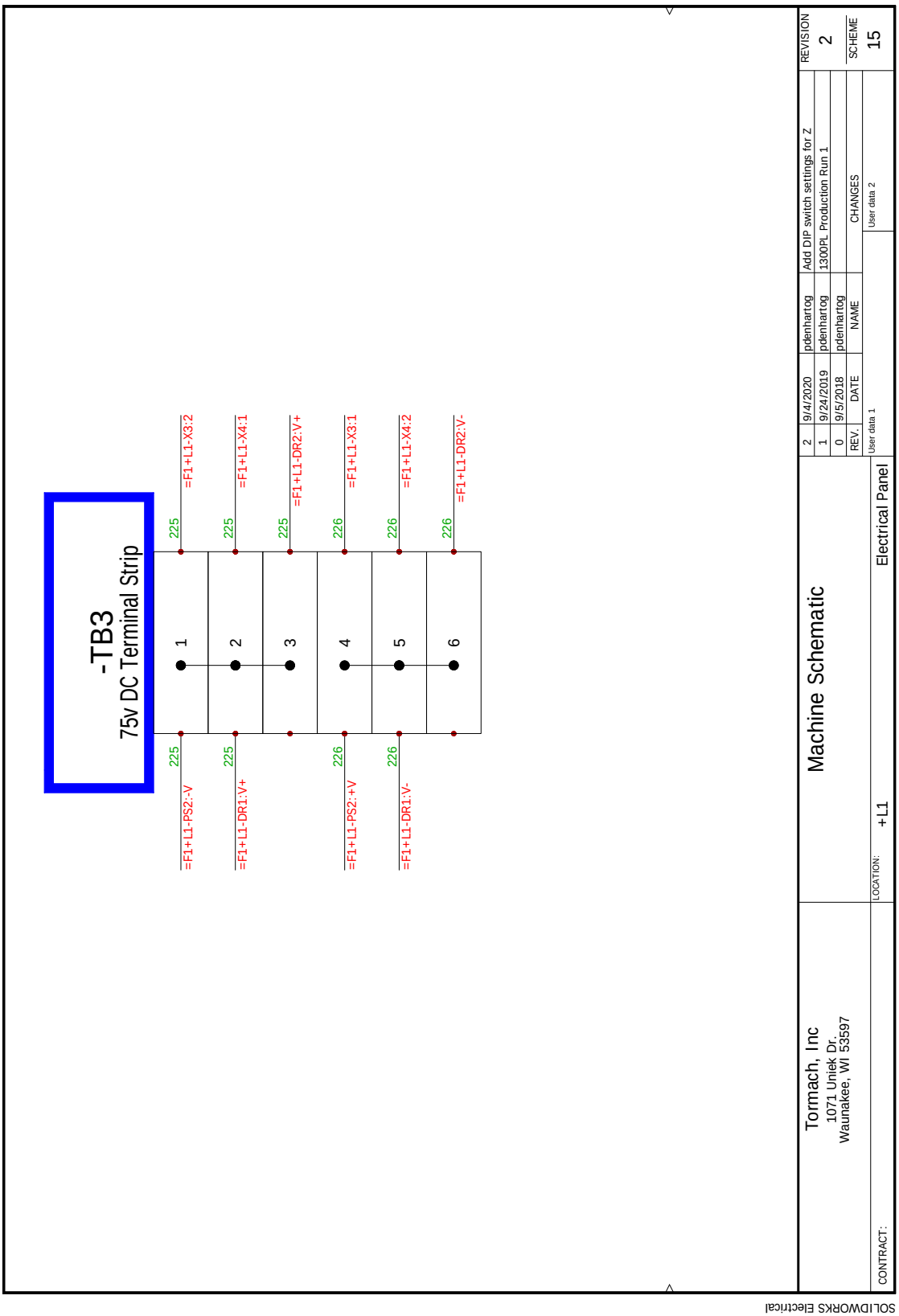
11.10.3 TB2: Control Terminal Strip (Sheet 13)



11.10.4 TB2: Control Terminal Strip (Sheet 14)



11.10.5 TB3: 75 Vdc Terminal Strip (Sheet 15)



11.10.6 TB4: Ground Terminal Strip (Sheet 16)