SERVICE MANUAL

ULS-25E / ULS-25ER
LASER SYSTEM

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*NOTE: A=Adjustment, C=Cleaning, R&I=Removal and Installation

BEAM WINDOW

Description, Cleaning, Removal, and Installation

Description

The laser light enters the engraving area through the Beam Window. The Beam Window (window for short) is made of a solid piece of Zinc Selenide (ZnSe). This material allows the beam to pass through with very little loss of power or beam absorption. The purpose of the window is to keep the #1 Mirror Assembly and the laser's sensitive optics from becoming contaminated with smoke or debris. The backside of the window should not get dirty because it is in a sealed environment. The front side can get dirty from engraving smoke.

Cleaning

If the window gets dirty, clean it by spraying lens cleaner directly onto the outer surface (flood it) and gently wiping it clean with a cotton swab. It is not necessary to remove the window to clean it. Replacement of the window is necessary only if it absorbs too much laser power. In this case, it would heat up, crack, and destroy itself from the heat of the laser. If the user keeps it clean, the window should last many years. Do not clean a clean window. If you cannot see dirt or debris on the surface, then do not clean the window. Over cleaning can cause scratches that can lead to excessive heat absorption and eventual failure. If the dirt is not visible, it will not absorb heat from the laser.

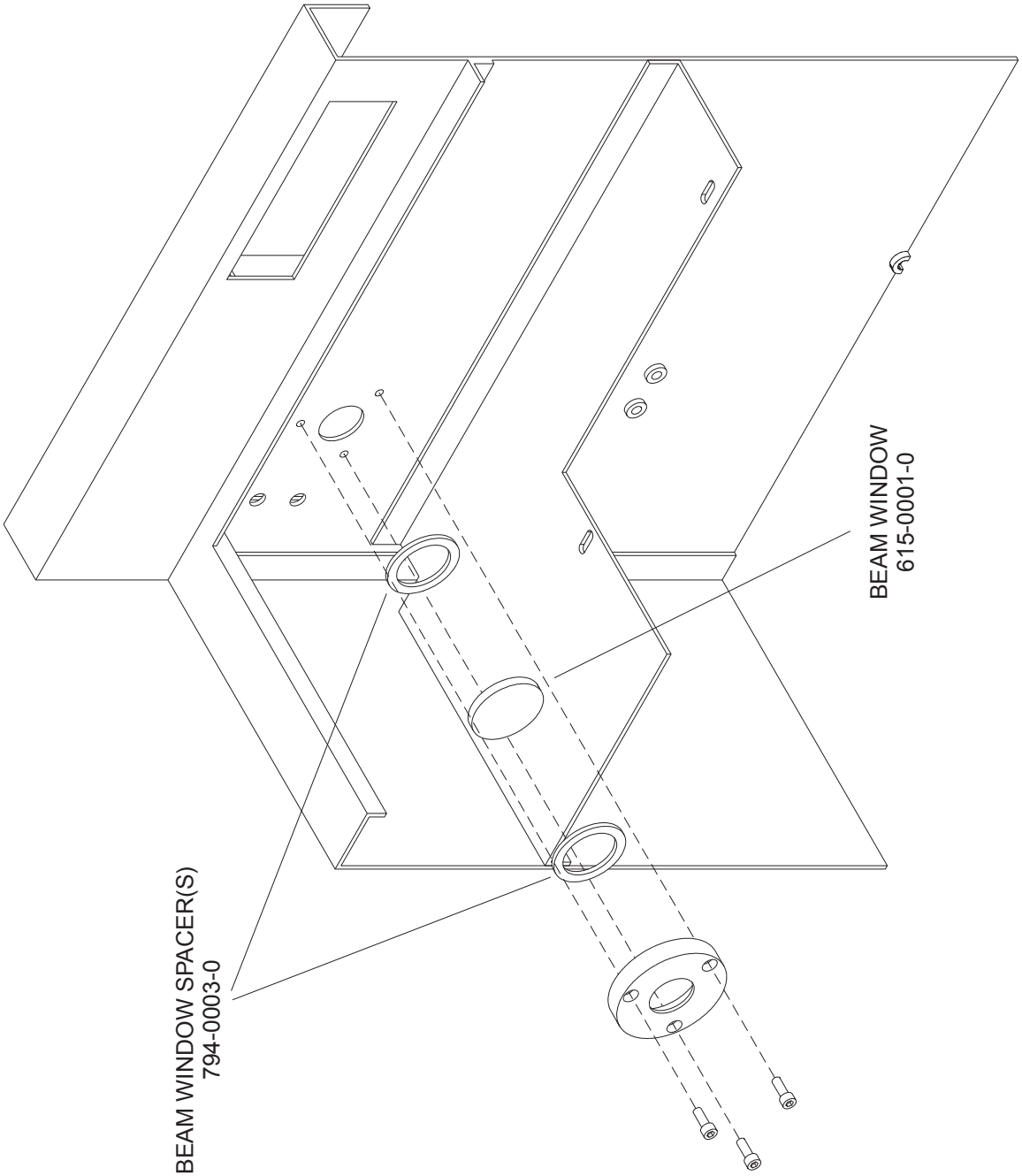
Removal

To replace the window, remove the three(3) socket head screws. When removing the window holder, place your hand underneath it because the lens is not secured to the inside of the window holder and the window can fall out.

Installation

When replacing the window, be careful to seat the window and the spacers properly otherwise forcing it to seat improperly can cause the window to break upon installation. The window is identical on both sides so you cannot install it backwards. Tighten down the three(3) socket heat screws evenly until they are snug. **DO NOT OVERTIGHTEN!** Overtightening the screws or tightening them unevenly can cause the window to break.

BEAM WINDOW



CART ASSEMBLY

Description, Assembly, Adjustment

Description

The laser system is normally mounted on the Cart Assembly. The Cart Assembly is the only part of the laser system that needs to be assembled, and adjusted if necessary.

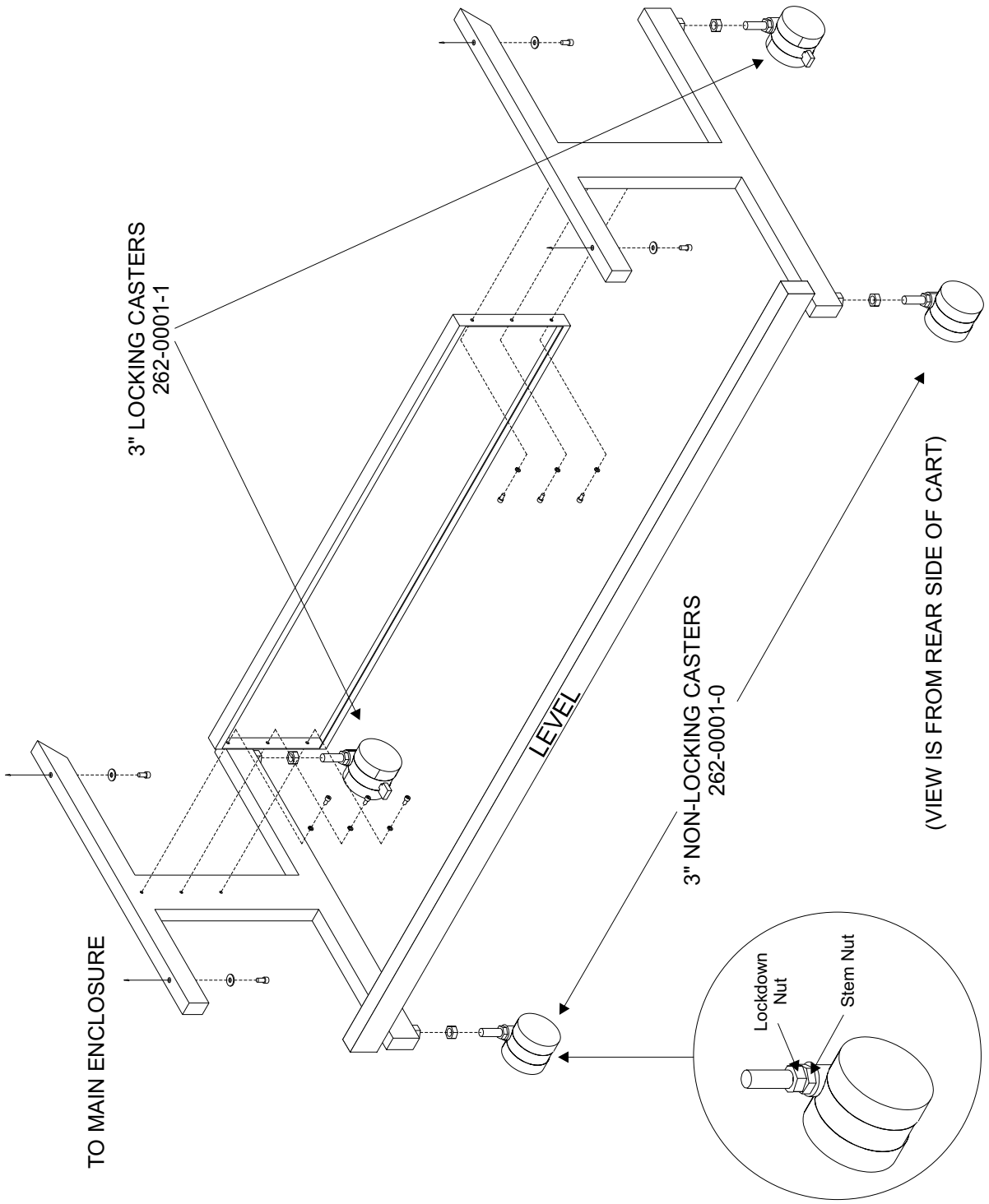
Assembly

Bolt the flat panel to the legs securely as the diagram indicates. The flat side of the panel faces the front. The front side of the cart legs is the side that has the beveled edge at the top. The locking casters go in the front. On each caster, screw the lockdown nut all the way down to the base of the stem. Now thread each caster stem all the way into the legs as far as they will go until they bottom out and tighten with a wrench. Place the laser system on top of the Cart Assembly and secure the four bolts and washers through the legs and into the Main Enclosure of the laser system. This might require some maneuvering to get the holes lined up so take your time. Be careful not to push the laser system off of the Cart Assembly. After securing the Cart Assembly to the Main Enclosure and positioning the laser system in it's final location the laser system should be leveled for the **greatest accuracy of the motion system**. Although this is not necessary most of the time, it is for installations where the floor that the laser system sits on is uneven. It is not necessary that the floor be perfectly level, it is more important that the floor does not rise or dip where the casters rest because this can twist the body of the laser system. A simple way to check if the floor is even is to use a long bubble level across the front and rear casters. Compare the bubble reading for the front two casters against the rear two casters bubble reading. If the bubble position is the same then no adjustment is necessary. If the bubble position is different, caster adjustment will be necessary.

Adjustment

Place a long level across the top of the front two legs right above the casters. Adjust either the left or right caster until the sight bubble or level is the same as the rear legs. Now, tighten the lockdown nut up against the base of the leg. The objective is to have the front the same as the back. This will make sure ensure that the laser system is sitting on a flat surface. Again, it is not important that the system is level with the ground (although you may want it to be), it is more important that it is on a flat surface.

CART ASSEMBLY



ELECTRONICS 1
Component Description

Description
These diagrams show the main electronic components of the laser system. Please refer to the Schematics section for the wiring diagram and the troubleshooting section for various troubleshooting procedures of these components. The following **ONLY** describes the function of each of the components:

POWER INLET
This receptacle is where the power cord plugs into the laser system.

POWER SWITCH
Turns the laser system on and off.

VARISTOR
This device will burn up and short out if there is an over voltage or voltage spike situation. This will prevent the electronics from being damaged should this occur. It is recommended to use an external surge suppresser in addition to this protection.

FUSES
These fuses are ceramic slow blow fuses and are the main fuses of the laser system. They are mounted to the Fuse Block. They are the main fuses to the system.

EMI FILTER
This device filters out electrical noise coming in from the power cord and going out of the laser system. This device is necessary in order to meet FCC and CE requirements.

28VDC POWER SUPPLY
This power supply converts AC supply voltage to 28VDC to power the laser tube and the laser cooling fans.

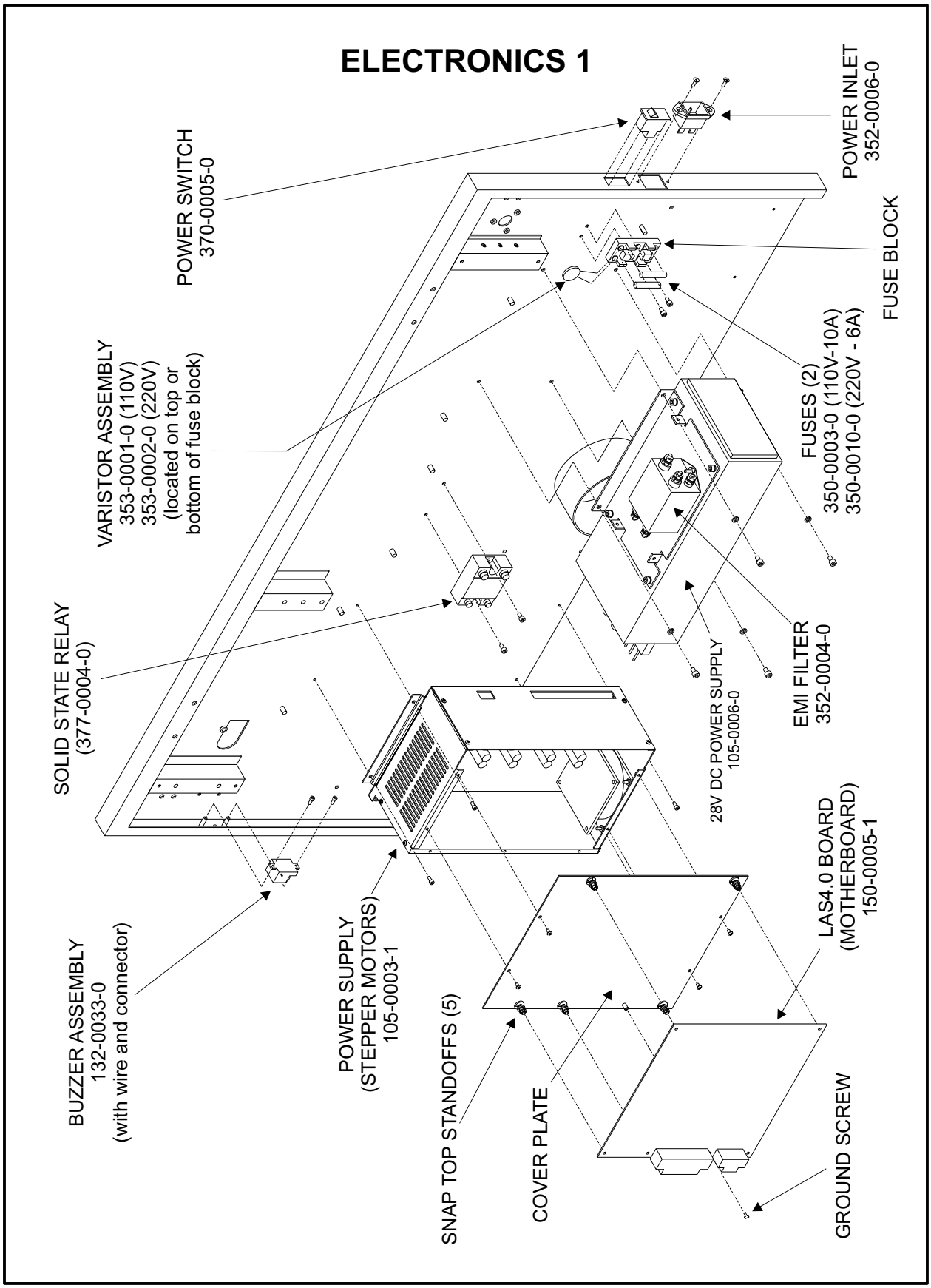
POWER SUPPLY (STEPPER MOTORS)
This power supply takes in AC voltage and turns it onto DC to power the stepper motors, the LAS4.0 Board , the Display Board, and the Optical Limit Switches for the Motion System(not shown).

LAS4.0 BOARD (MOTHERBOARD)
This circuit board is the main processing board for the laser system. It performs many functions and the main ones are:

- Receives and stores in its memory SIMMS incoming data from the computer
- Processes the data and issues appropriate commands to the stepper motor controller (the USTEP Board)
- Sends out a square wave TTL signal to the laser tube to fire the laser beam
- Controls the Standby mode by switching the 28VDC Power Supply on and off
- Works with the Display Board to display and manipulate the menu system
- Gathers input from the Safety Interlock System and controls the Solid State Relay

BUZZER ASSEMBLY
The buzzer is actually a beeper. The buzzer beeps when the laser system has finished and engraving job.

SOLID STATE RELAY
The Solid State Relay works together with the Safety Interlock System. This electronic switch opens and closes when either the Top Door or the Front Door is opened and closed respectively. If either door is opened, the LAS4.0 Board removes input power to the relay which opens the output circuit of the relay. This, in turn, shuts off the supply of DC power to the laser tube.


ELECTRONICS 1
POWER SWITCH
370-0005-0
POWER INLET
352-0006-0
FUSE BLOCK
VARISTOR ASSEMBLY
353-0001-0 (110V)
353-0002-0 (220V)
(located on top or
bottom of fuse block)
FUSES (2)
350-0003-0 (110V-10A)
350-0010-0 (220V - 6A)
SOLID STATE RELAY
(377-0004-0)
28V DC POWER SUPPLY
105-0006-0
EMI FILTER
352-0004-0
BUZZER ASSEMBLY
132-0033-0
(with wire and connector)
POWER SUPPLY
(STEPPER MOTORS)
105-0003-1
SNAP TOP STANDOFFS (5)
COVER PLATE
LAS4.0 BOARD
(MOTHERBOARD)
150-0005-1
GROUND SCREW

ELECTRONICS 2

Description, Diagnostics

Description

On the left side of the Power Supply, there are the receptacles for the stepper motors. Next to the receptacles are their respective Diagnostic Red LED's. On the right side of the Power Supply are the connectors for the Limit Switches, the LAS4.0 Board Data Link receptacle and the AC Power Inlet receptacle.

Diagnostics

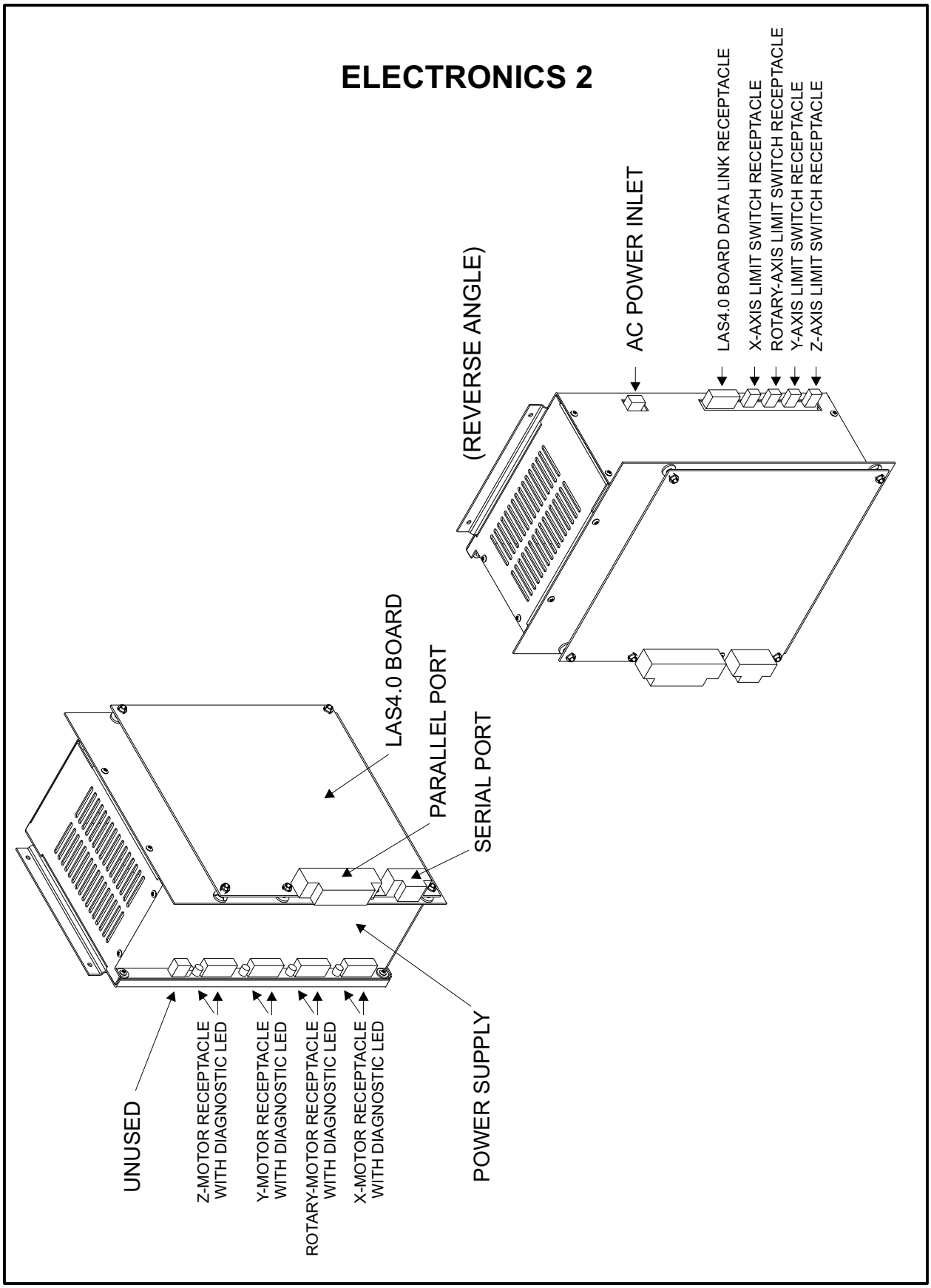
If a stepper motor is not functioning, check the Diagnostic LED next it's wire receptacle on the power supply. If the RED LED is not illuminated while the machine is ON and has initialized (homed), then there could be one of two problems. Either the Power Supply or the motor is blown. Refer to the following procedure to determine fault.

WARNING!

Do not plug or unplug any connector with the system ON. This can result is serious damage to the electronics.

Test Procedure

- Turn system OFF and unplug the power cord
- Unplug the motor wire connector at the Power Supply's receptacle (next to the Red LED)
- Turn laser system ON and wait for system to initialize
- Observe Red LED
- If LED has illuminated and stayed lit, motor is blown - replace motor
- If LED has failed to illuminate, Power Supply is blown - replace Power Supply


ELECTRONICS 2
(REVERSE ANGLE)
AC POWER INLET
LAS4.0 BOARD DATA LINK RECEPTACLE
X-AXIS LIMIT SWITCH RECEPTACLE
ROTARY-AXIS LIMIT SWITCH RECEPTACLE
Y-AXIS LIMIT SWITCH RECEPTACLE
Z-AXIS LIMIT SWITCH RECEPTACLE
LAS4.0 BOARD
PARALLEL PORT
SERIAL PORT
POWER SUPPLY
UNUSED
Z-MOTOR RECEPTACLE WITH DIAGNOSTIC LED
Y-MOTOR RECEPTACLE WITH DIAGNOSTIC LED
ROTARY-MOTOR RECEPTACLE WITH DIAGNOSTIC LED
X-MOTOR RECEPTACLE WITH DIAGNOSTIC LED

ELECTRONICS 3

Component Description, EEPROM Removal and Installation

Description

Inside the Power Supply is the USTEP Board. This board is the controller board for the Limit Switches and the stepper motors. It receives motion system commands from the LAS4.0 Board, processes them, and turns them into stepper motor movements.

EEPROM Removal and Installation

USTEP Board

Since there are many different version of the USTEP Board, a version upgrade will result in the exchange of the entire board, not individual EEPROMS like the LAS4 Board.

To replace the USTEP Board, remove the cover plate by removing the (4) socket head screws. Remember to have the power off and ground yourself by using an anti-static wrist strap. The LAS4.0 Board can remain attached

Replace the USTEP Board, with the newer version, by sliding it back into the Power Supply housing and lining up the socket on the bottom of the board to the pins on the receiving side. Do not force the board in. It is a tight fit but it should go in smoothly. Re-attach the cover plate.

LAS4 Board

The LAS4 Board has (2) EEPROMs, the IROM (Input Read Only Memory) and the OROM (Output Read Only Memory). The manufacturer can update the LAS4 Board simply by replacing one or both of these EEPROMs with newer firmware. The version of the EEPROMs are written on the white sticker that is on the surface of the chip. The version can also be found displayed in the Menu System of the laser. It is in the Preferences and Diagnostics submenus. There, the version #'s will be displayed. The first number is the OROM and the second one is the IROM.

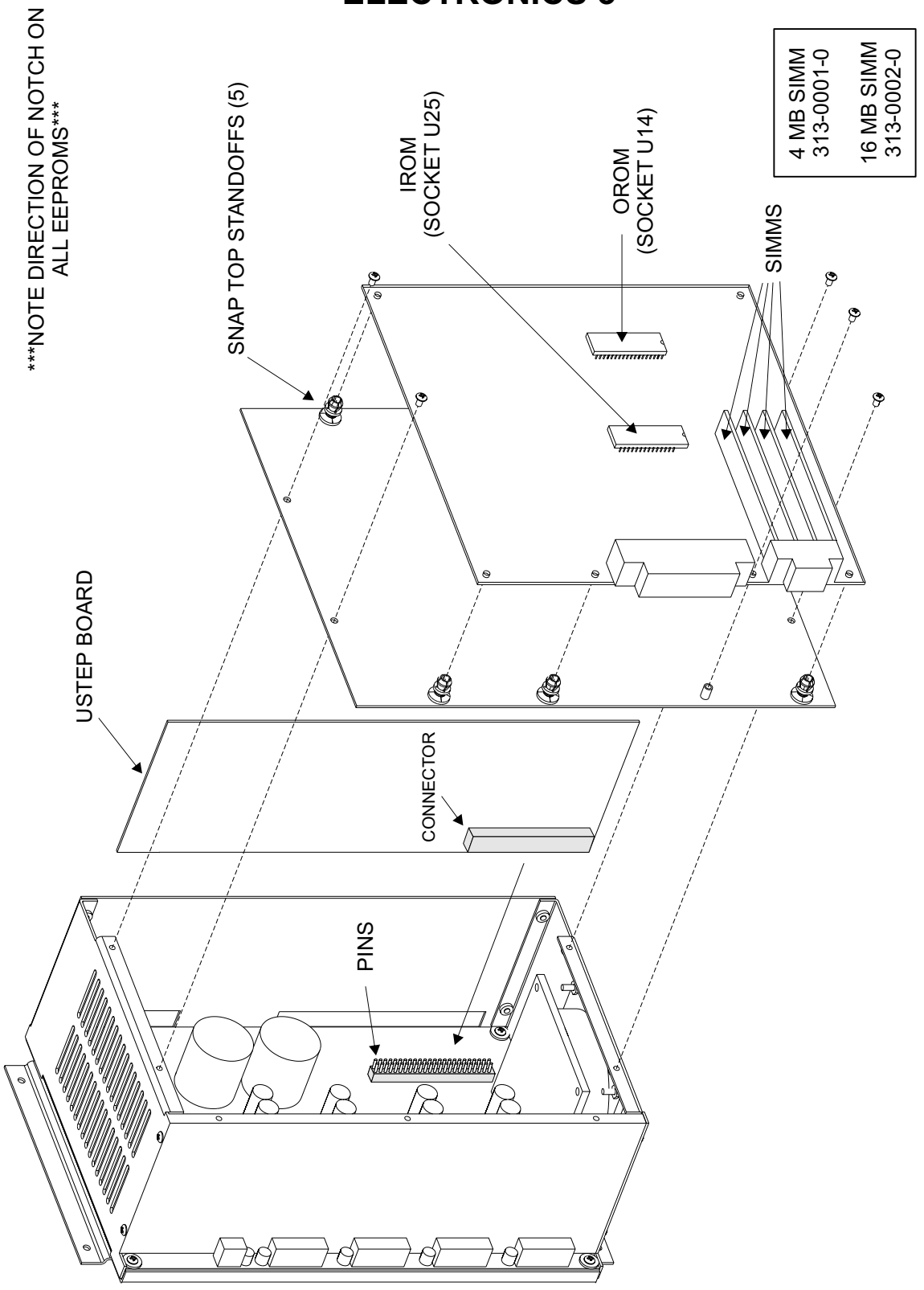
To change EEPROMs, power OFF the system and ground yourself by using an anti-static wrist strap. Locate the EEPROM you are going to replace. The OROM is in chip location U14 and the IROM is in chip location U25.

IMPORTANT - Note the location of the notch on the chip. The new chip **MUST** be installed in the same direction. If you install the chip upside down, it will destroy itself upon power up. Disregard the orientation of the white sticker on the chip. Only use the notch as a reference.

By using a chip puller, pull the EEPROMs straight out of the board. **DO NOT HANDLE THE NEW CHIP BY THE PINS, ONLY BY THE BODY OF THE CHIP.** Make sure of the orientation of the notch on the new chip as well as making sure that the pins align properly into the socket when installing. Make sure the new chip is firmly seated into the socket by pressing down on the body firmly. Remove and replace them one at a time to prevent them from getting mixed up.

Once installation is complete, the electronics will recognize the change and will re-initialize itself upon power up.

ELECTRONICS 3



EXHAUST ASSEMBLY

Removal, Cleaning, and Installation

Removal

If the exhaust plenum gets full of debris, it can be cleaned. In order to clean it, it must be removed. Remove the (4) screws, drop the engraving table all the way down, and pull out the plenum.

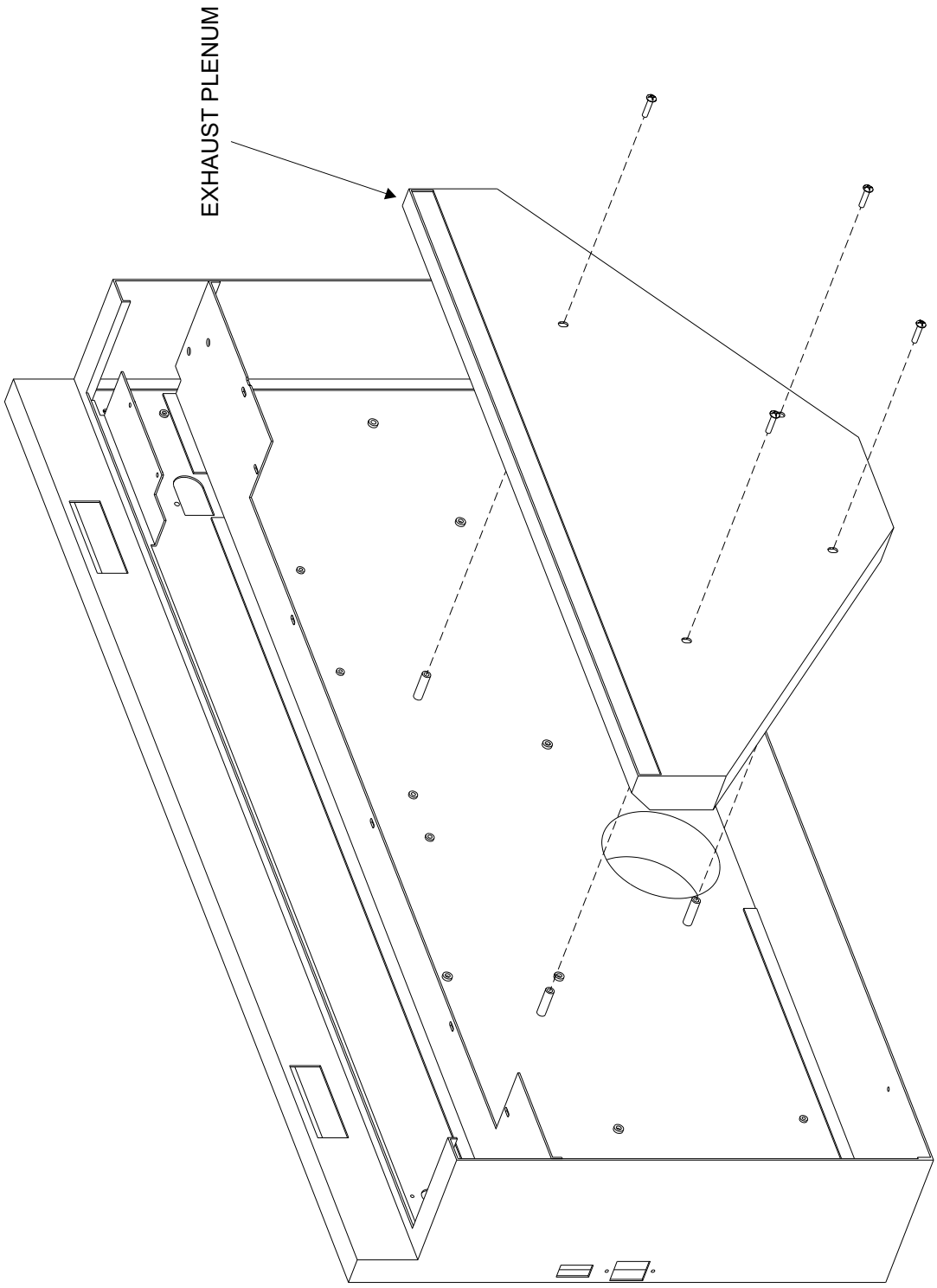
Cleaning

Clean it out with soap and water or ordinary household cleaners and dry it completely.

Installation

Installation is the opposite of removal.

EXHAUST ASSEMBLY



FOCUS TOOL
Calibration

NOTE: THE FOCUS TOOL THAT IS INCLUDED WITH THE LASER SYSTEM HAS ALREADY BEEN CALIBRATED AT THE FACTORY. THE FOLLOWING PROCEDURE IS ONLY NECESSARY IF THE TOOL COMES OUT OF ADJUSTMENT OR YOU ARE ADJUSTING THE TOOL TO A REPLACEMENT LENS.

WARNING: FOCUS TOOL CALIBRATION REQUIRES THE USE OF THE SAFETY INTERLOCK DEFEAT TOOL. WHEN PERFORMING THESE STEPS, THE APPROPRIATE LASER SAFETY GOGGLES MUST BE WORN AT ALL TIMES. READ AND FOLLOW ALL SAFETY PROCEDURES OUTLINED IN THE OWNER'S MANUAL BEFORE CONTINUING.

- With the laser system turned **OFF**, put on your laser safety goggles, open the Top Door, and insert the safety interlock defeat tool. Also make sure that the front door is closed.

- Turn the laser system and computer **ON**. Create a 2 inch x 2 inch black filled square with no outline, in your graphics program. In the Laser Systems Printer Driver, set the Power Settings to 3% Power, 10% Speed, 100 PPI, and 200 DPI Resolution. Now print the file to the laser system.

- Place a piece of anodized aluminum on the engraving table in the same location as you placed the graphic on screen.

- Adjust the Engraving Table either up or down to **APPROXIMATE** the distance from the bottom of the Focus Lens Holder to the anodized aluminum underneath by using another Focus Tool or ruler. The distance should be either 1.5, 2.0, 2.5, or 4.0 inches which is dependent on which Focus Lens you are calibrating.

- You are now going to engrave on the anodized aluminum with the Top Door Open and the Front Door closed.

WARNING: YOU WILL BE FIRING THE LASER BEAM WITH THE TOP DOOR OPEN. SINCE THE LASER BEAM IS INVISIBLE, BE CAREFUL NOT TO CROSS THE PATH OF THE BEAM WITH ANY BODY PART.

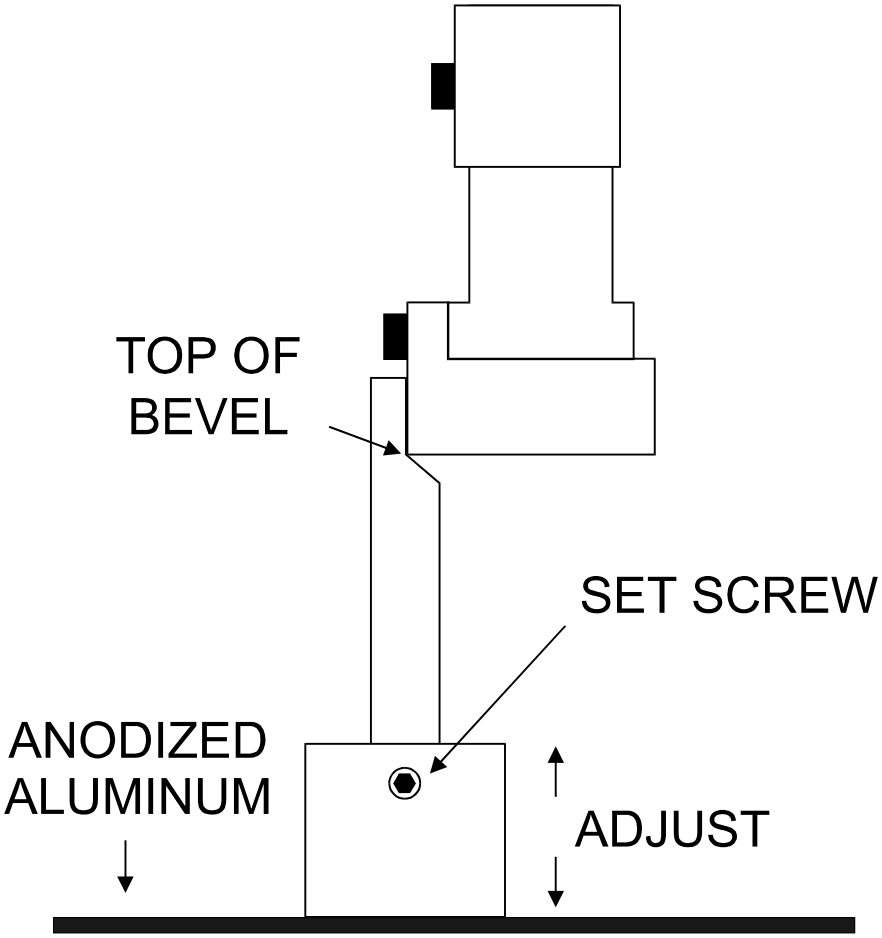
- Press the Start Button to begin engraving.

- Using your right hand, turn the Z-axis Adjustment Knob back and forth which brings the Engraving Table up and down until you start to see the light from the combustion of the anodized aluminum surface. Continue to turn the knob in the same direction, counting the number of turns until the light goes out. What you are doing is finding the point at where the focus is sharp enough to start engraving both above and below the Focal Point. If you take the number of turns that you made from the light **ON** point to the light **OFF** point with the Z-axis Adjustment Knob and divide it by 2, this is how many turns you will need to go backwards to bring the Focus Lens to the sharpest Focal Point distance. The sharpest Focal Point lies exactly halfway between the point where the combustion light appears to when it disappears.

- Turn **OFF** the entire laser system and remove the Interlock Defeat Tool.

- Place the Focus Tool on top of the anodized aluminum and up against the side of the Focus Lens Holder. Loosen the Set Screw on the base of the Focus Tool. Adjust the base so that the top part of the bevel is touching the bottom of the Focus Lens Holder. Finally, tighten down the Set Screw.

- Focus Tool Calibration is now complete. What you have done is adjusted the Focus Tool to obtain the smallest and hottest laser beam that the Focus Lens can produce.



FRONT DOOR

Component Description, Air Filter Removal, Cleaning, and Installation

Description

The Front Door is safety interlocked by the Proximity Sensors and the Actuators. The Proximity Sensor Actuators are simply magnets. When the Actuators are close enough to the Sensors, it closes the electrical connection inside the Sensor thus creating a closed circuit to energize the Solid State Relay which in turn applies DC power to the laser tube. The Hinges support the Front Door and the Door Latches keep the door closed. The Air Inlet Filter is located inside the main enclosure in a cavity just above the hinges. This device filters the incoming air into the laser system and if it becomes clogged, it will inhibit the effectiveness of the exhaust blower. A dirty filter can also cause a vacuum to be created by the exhaust blower which will make opening the top door difficult. Periodic cleaning of the filter is required.

Air Filter Removal

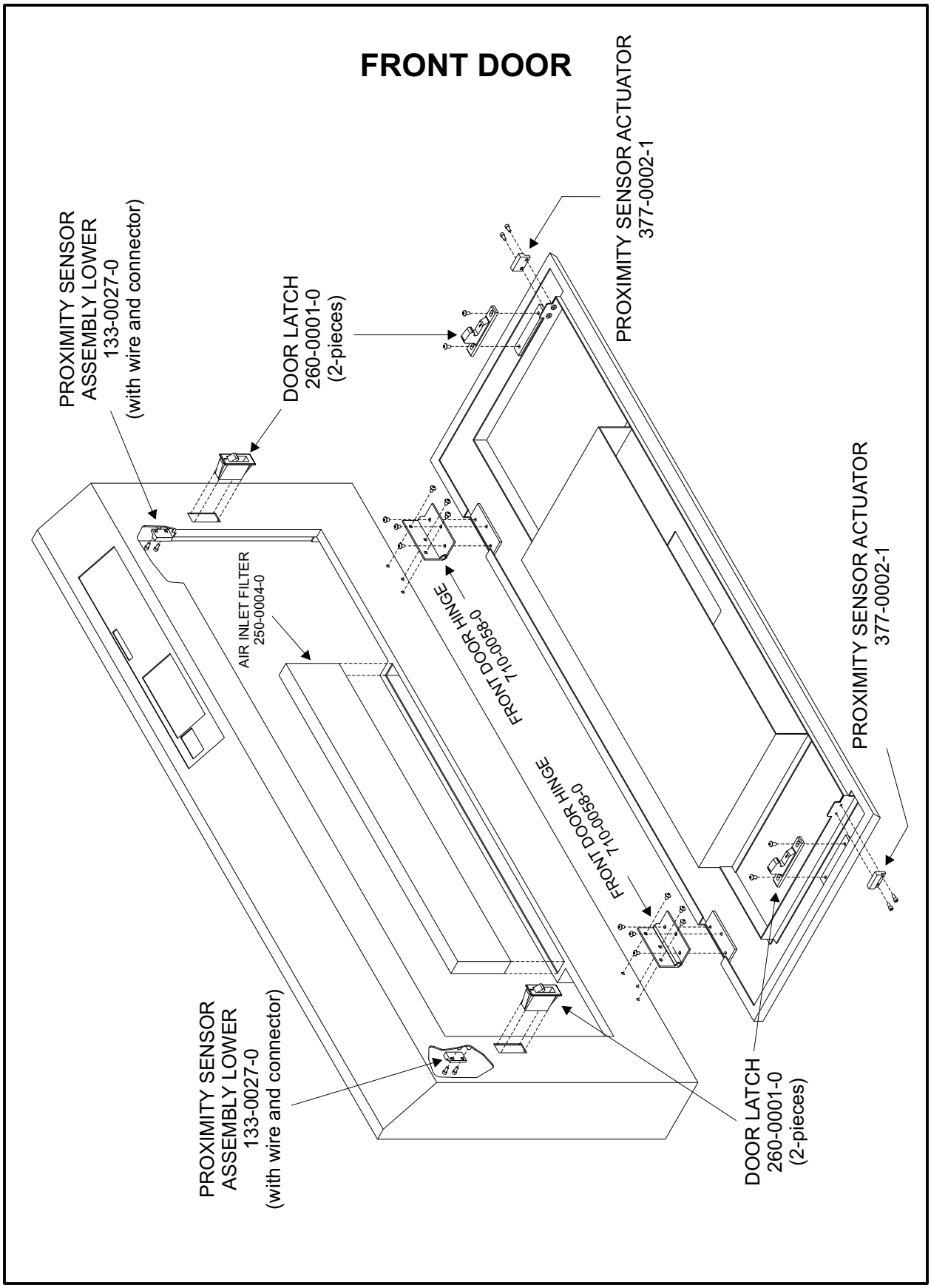
The Air Filter is easily removed for cleaning by opening the front door, reaching in with your fingers, and pulling it out.

Cleaning

Clean the filter with soap and water, wring out, and let it air dry.

Installation

Installation is opposite of removal.


FRONT DOOR
PROXIMITY SENSOR ASSEMBLY LOWER 133-0027-0 (with wire and connector)
DOOR LATCH 260-0001-0 (2-pieces)
PROXIMITY SENSOR ACTUATOR 377-0002-1
AIR INLET FILTER 250-0004-0
FRONT DOOR HINGE 710-0058-0
FRONT DOOR HINGE 710-0058-0
PROXIMITY SENSOR ACTUATOR 377-0002-1
PROXIMITY SENSOR ASSEMBLY LOWER 133-0027-0 (with wire and connector)
DOOR LATCH 260-0001-0 (2-pieces)

KEYPAD

Display Board Description, Removal, and Installation
Keypad Description, Removal, and Installation

Display Board

Description
The Display Board has and LED display that displays the menu system for the laser. It has a brightness/contrast control. To adjust, rotate the black knob on the back of the board while the laser system is on. Observe the display and adjust it as necessary.

Removal
The Display Board is located behind the Keypad. If the Display Board needs replacement, it simply snaps out like the LAS4.0 board. Disconnect the wire harness before removing the board. Gently pry the board away from the enclosure. Do not use any sharp objects as this can damage the traces of the circuit board.

Installation
Snap the Display Board back into it's original position and re-connect the wire harness

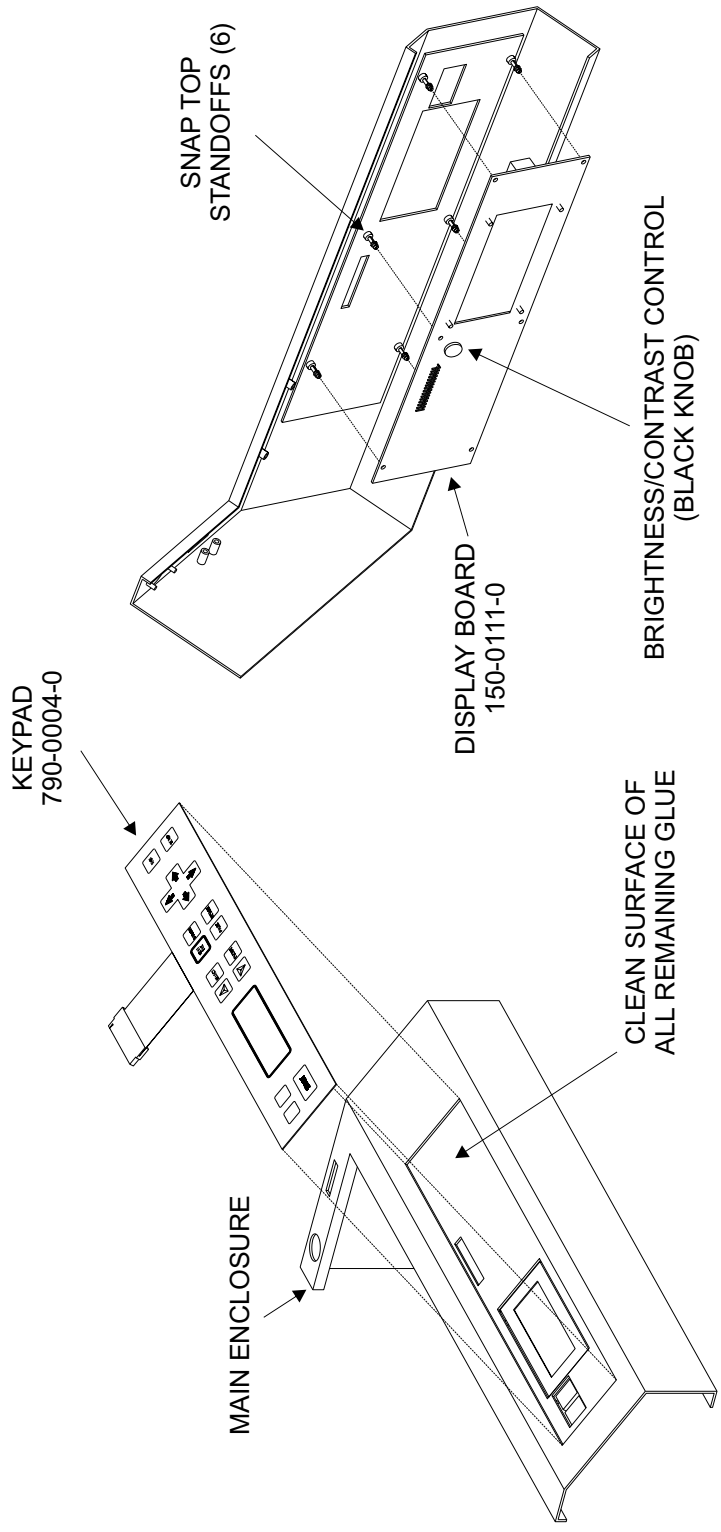
Keypad

Description
The Keypad is a membrane switch keypad meaning the buttons are a part of the Keypad itself. If a button malfunctions or the printed overlay becomes damaged, the entire Keypad must be replaced.

Removal
If the Keypad needs to be replaced, first remove the Display board and heat up the Keypad with a heat gun or hair dryer to loosen the adhesive. Now, gently pry out the Keypad. It helps to push it out from the back side. Clean the contact surface of the Main Enclosure of any remaining glue.

Installation
Remove the paper backing of the new Keypad, apply the Keypad to the Main Enclosure, and press firmly. Re-install the Display Board and re-connect the wiring harness.

KEYPAD


SNAP TOP
STANDOFFS (6)
BRIGHTNESS/CONTRAST CONTROL
(BLACK KNOB)
DISPLAY BOARD
150-0111-0
KEYPAD
790-0004-0
CLEAN SURFACE OF
ALL REMAINING GLUE
MAIN ENCLOSURE

LASER TUBE ASSEMBLY 1

Description, Fan Enclosure Removal and Installation
Fan Removal and Installation

Description

The laser beam is generated inside the Laser Tube Assembly. It has its own electronics located inside the assembly and are not user or technician serviceable. The Laser Tube is located inside the Laser Tube Assembly. Inside the Laser Tube itself is a mixture of CO2 gas and other gases. Over a period of time, usually several years, the laser will lose power and need to be recharged with fresh gas. The electronics inside the Laser Tube Assembly can also wear out from use. Regardless of what is causing a loss of power, the entire Laser Tube Assembly will need to be removed and replaced with a newly rebuilt one.

Fan Enclosure Removal

To get to the Laser Tube Assembly, you must first remove the Outer Fan Enclosure. This enclosure is held in place by four (4) socket head screws. Unplug laser system, remove all four screws, and gently lift the enclosure up and away from the Main Enclosure.

Surrounding the Laser Tube Assembly, you will find the Inner Fan Enclosure. Before removing the Inner Fan Enclosure, look underneath it, close to the Solid State Relay, to find a two wire connector with one red wire and one black wire. Disconnect this connector as it supplies power to the fans. Remove the four (4) socket head screws that hold down the Inner Fan Enclosure. Remove the bottom two first and then the top two. Hold on to the enclosure while removing the last screw because the Inner Fan Enclosure might slip off the Laser Tube Assembly. Pull the Inner Fan Enclosure straight out and put it in a safe place.

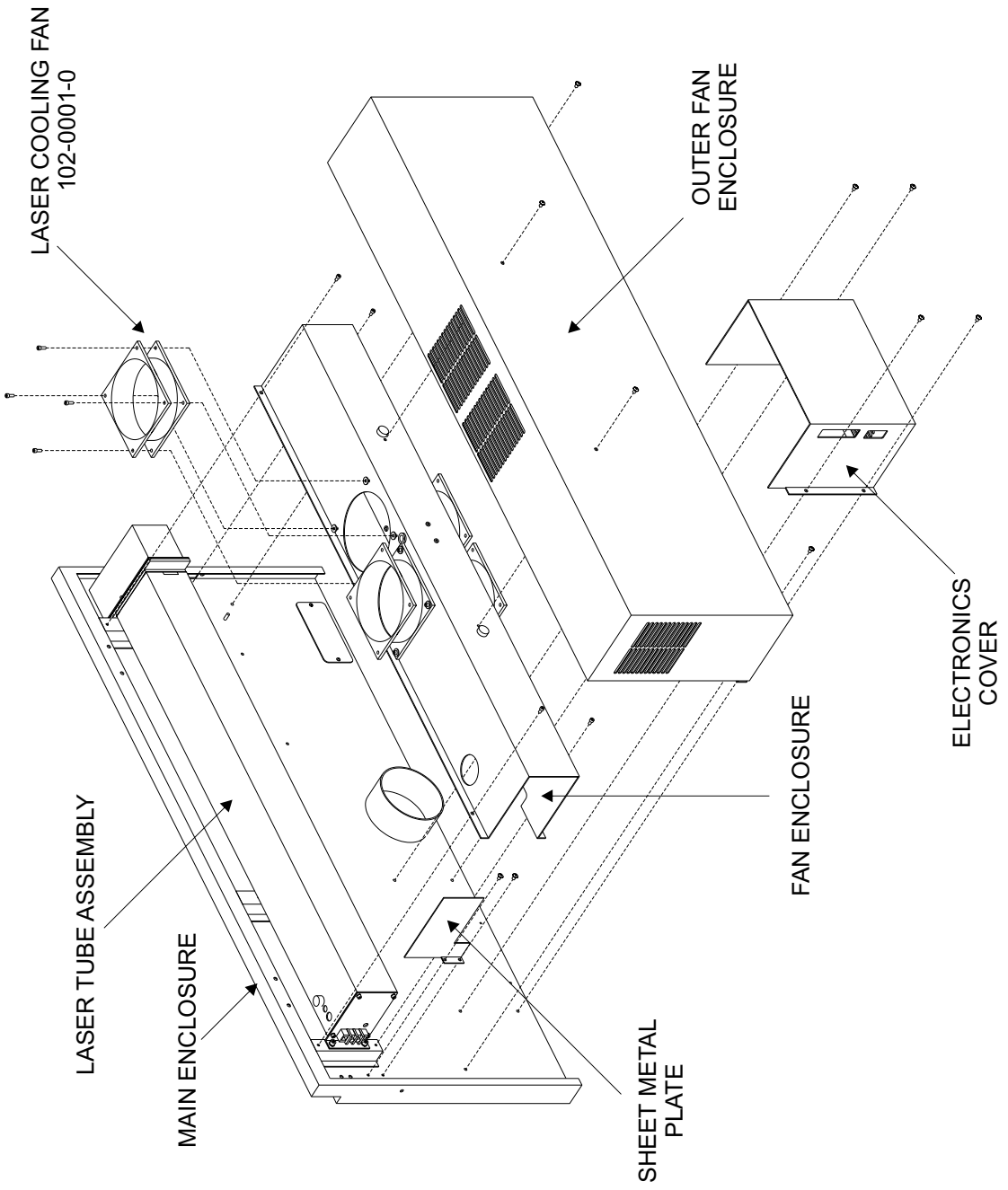
On the left side of the Laser Tube Assembly (looking from the rear of the laser system) you will see a sheet metal plate that covers Laser End Plate's terminal strip. Remove the sheet metal plate by removing the two (2) Socket Head Screws that attach it to the Main Enclosure.

Fan Removal & Installation

If a fan is not working, it can be replaced individually. First, follow the wires from the fan to the terminal strip located inside the Fan Enclosure. Disconnect the wires by loosening the terminal strip screws and pulling the wires out of the strip. It is possible that two, fan wire ends, have been soldered together. If this is the case, separate the two wires by cutting the soldered end off with a pair of wire cutters. Remove the old fan by removing the four(4) socket head screws that attach it to the Fan Enclosure. Installation of the new fan is opposite of removal although it is not necessary to solder the wires together with the other fan before inserting the wires into the terminal strip. Simply twist the wire ends together and insert them both into the terminal strip and tighten down the terminal strip screw. Be sure not to insert the wires into the terminal strip too far, otherwise the screw will not make good contact with the wire.

Refer to the procedure "Laser Assembly 2" for details on how to remove the Laser Tube Assembly.

LASER TUBE ASSEMBLY 1



LASER TUBE ASSEMBLY 2

Laser Tube Removal and Installation

Removal

NOTE: This diagram only shows the proper screws to remove when replacing the Laser Tube Assembly. The alignment of the beam itself and the proper way to adjust it is covered in the "Motion System 15" section.

- On the left side Laser End Plate, remove the (+ red) and the (- black) wires from the terminal strip and the TTL signal wire from the Phono Plug Receptacle. **DO NOT remove the terminal strip itself or the Laser End Plate on either side of the assembly. This will be supplied with the replacement Laser Tube Assembly.**

- Remove **ONE** of the two (2) Screws that attach the Laser End Plate to the Main Enclosure.

- On the right side of the assembly, remove the two (2) Socket Head Screws, the #1 Mirror Cover Plate, and the #1 Mirror Cover Gasket (if it is not glued to the cover).

- Remove **THREE (3)** of the four (4) Flat Head Screws.

- With someone holding on to the Laser Tube Assembly (it weighs about 20 lbs.), remove the one remaining Flat Head Screw and the one Socket Head Screw. The Laser Tube Assembly is now free to be removed from the Main Enclosure. Gently set it down on a table or anywhere safe so that it does not get kicked, dropped, or abused in any way.

CAUTION !

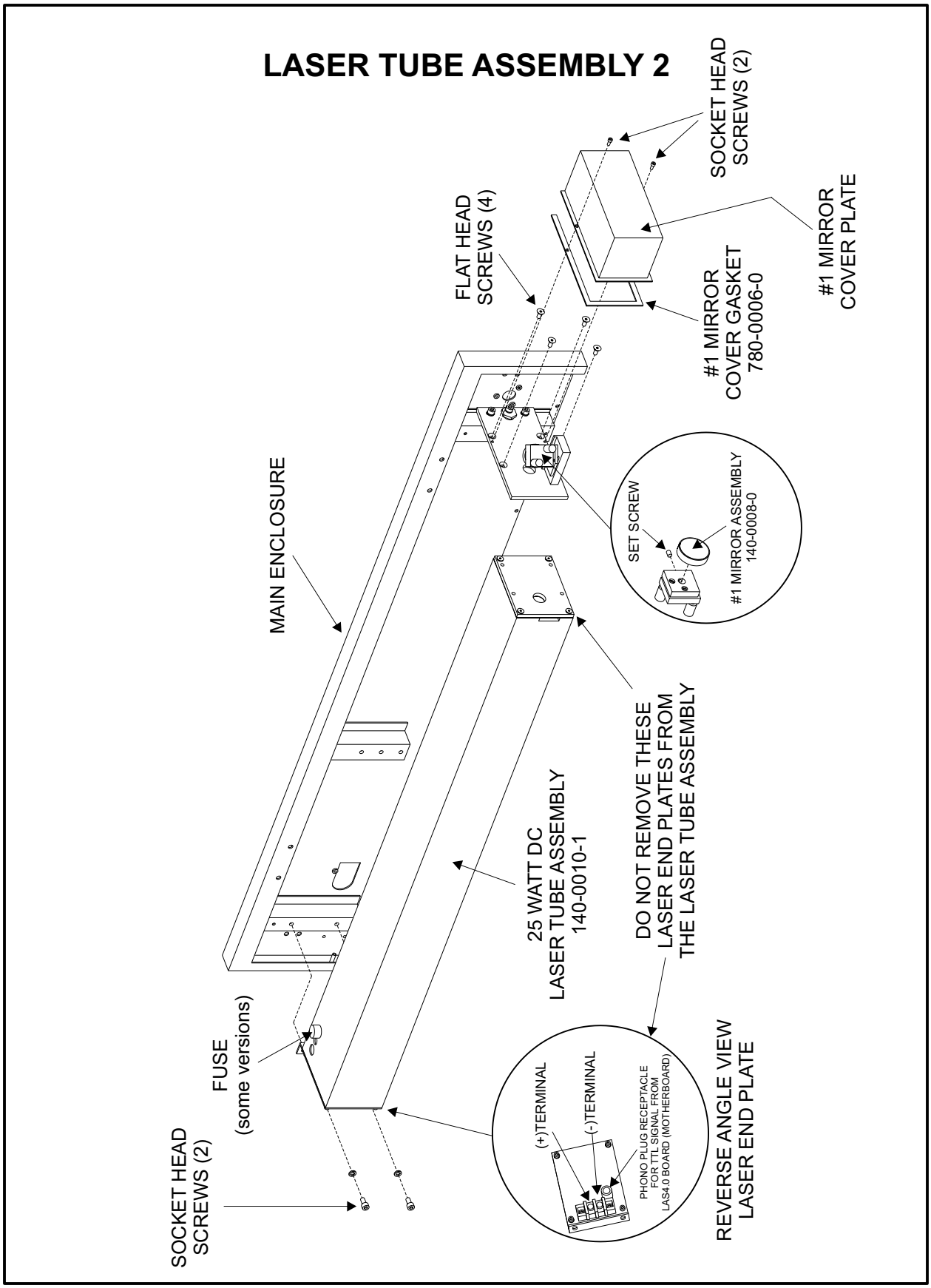
The Laser Tube Assembly is a very sensitive device so be careful when handling it.

Installation

To install the new Laser Tube Assembly, position the new assembly in place against the Main Enclosure and get **ALL OF THE SCREWS STARTED**. Tighten down the four (4) Flat Head Screws on the right hand side **FIRST** and then tighten down the (2) Socket Head Screws on the left side **SECOND**.

If the # 1 Mirror needs to be replaced (highly unlikely), loosen the Set Screw (not necessary to remove it), grasp the mirror by its side and pull it straight out of the base. To install, grasp new mirror by its side, insert it into the base, hold it firmly against the base, and tighten the Set Screw.

Chances are, the laser beam's alignment will be slightly different with a new Laser Tube Assembly or if the #1 Mirror is replaced so proceed to the "Motion System 15" section for the proper technique in aligning the beam.


LASER TUBE ASSEMBLY 2
SOCKET HEAD SCREWS (2)
#1 MIRROR COVER PLATE
#1 MIRROR COVER GASKET 780-0006-0
FLAT HEAD SCREWS (4)
MAIN ENCLOSURE
SET SCREW
#1 MIRROR ASSEMBLY 140-0008-0
25 WATT DC LASER TUBE ASSEMBLY 140-0010-1
DO NOT REMOVE THESE LASER END PLATES FROM THE LASER TUBE ASSEMBLY
FUSE (some versions)
SOCKET HEAD SCREWS (2)
(+)TERMINAL
(-)TERMINAL
PHONO PLUG RECEPTACLE FOR TTL SIGNAL FROM LAS4.0 BOARD (MOTHERBOARD)
REVERSE ANGLE VIEW LASER END PLATE

MOTION SYSTEM 1

Description, X&Y Bearing and Track Cleaning

Description

The lasers Motion System is an XY or plotter based, stepper motor motion system. The X-axis Motor drives the Focus Carriage left and right by means of the X-axis Belt. The Y-axis Motor drives the X-axis Arm towards the rear and front of the machine by the means of two Y-axis Belts. The laser beam comes from the Beam Window, reflects off the #2 Mirror, reflects off the #3 Mirror, and passes through the Focus Lens where it focuses the beam to a sharp point down onto the material surface.

The Motion System is an open loop system meaning that there is no position or coordinate feedback between the stepper motors and the laser systems electronics. The motherboard gives commands to the stepper motors to motor turn a certain amount of steps. If the Motion System binds up or does not reach it's destination, the motherboard has no way of knowing this and the Motion System will lose it position and possibly slam against the side rails.

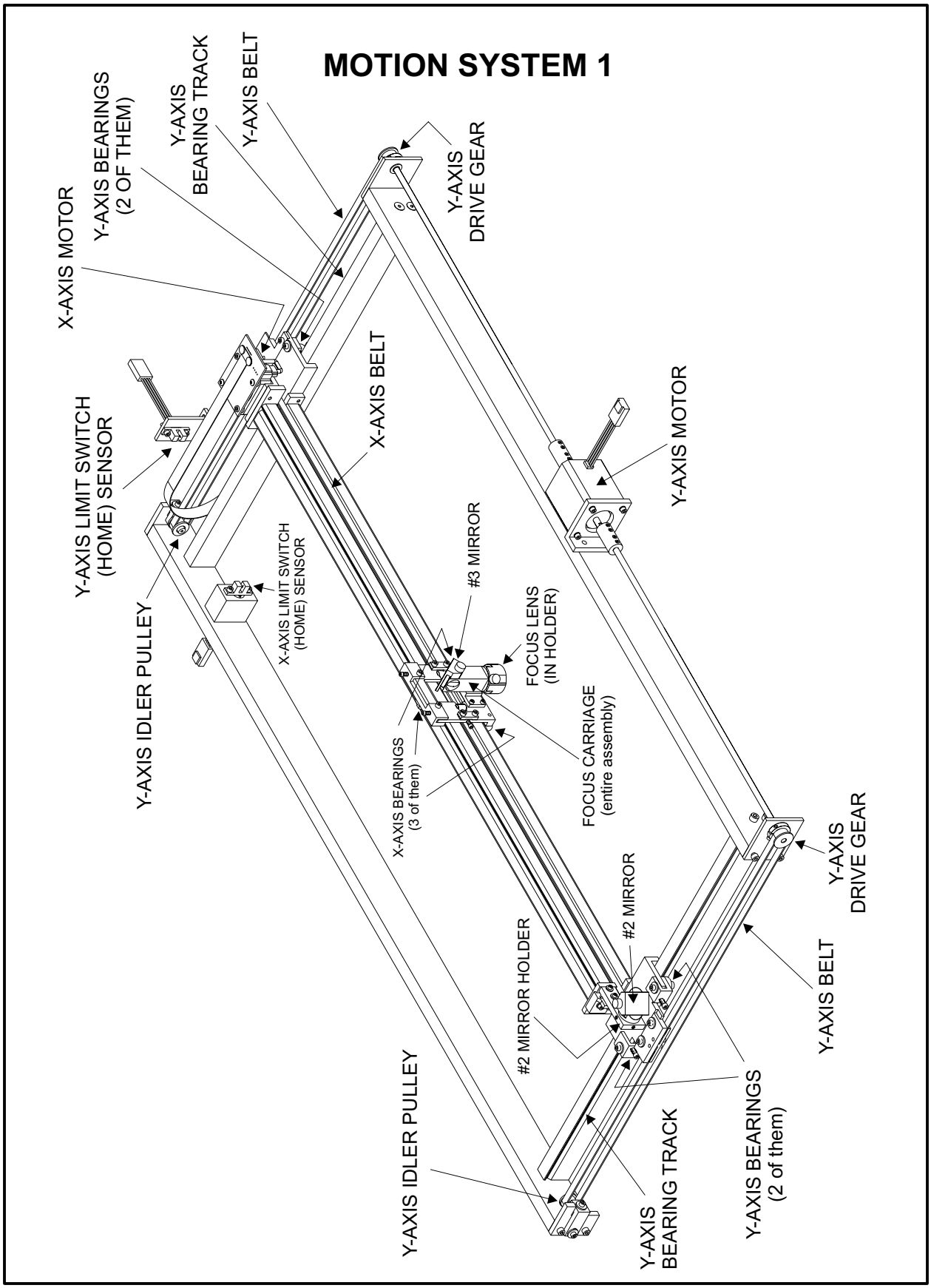
When the laser system is powered on it goes through a homing routine where the Focus Carriage moves to the upper right hand corner of the engraving area. Here is where the part Focus Carriage (X-axis Flag) and part of the X-axis Arm (Y-axis Flag) pass through the Limit Switch (Home) Sensors. The Home Sensors are optical sensors that sense when the Flags pass through the sensor. From this point on, every motion of the Motion System is a calculated position. When the Motion System has completed a job and moves to the upper right hand corner, the sensors do not read it's position again. The only time the Motion System truly homes (reads the sensor position) is when the laser system is powered on. If the Motion System loses position by either a physical obstruction or mechanical binding, the laser system will have to be powered down and then powered up again for it to home itself properly again.

X&Y Bearing and Track Cleaning

The Motion System bearing tracks must be kept clean of dirt or debris otherwise it can bind up and lose position during engraving. Dirty bearing tracks or bearings themselves can also reduce the engraving quality of the laser system. To clean the bearing tracks and the bearings, you must first power the system **OFF**. Use a typical household cleaner such as window cleaner, or kitchen surface cleaner/degreasers. Denatured or rubbing alcohol can also be used. Dampen a paper towel or soft cloth with cleaner and wipe the two X-axis and the two Y-axis bearing tracks clean. **NEVER** Spray any fluids into the machine directly, always dampen a cloth or paper towel outside of the machine. Make sure you clean the full track area by manually moving the Motion System out of the way. Clean the X-axis bearing surfaces by dampening a cloth or paper towel, grasping the Focus Carriage with one hand, pressing the cloth against the bearing surface and sliding the Focus Carriage back and forth. The bearing should be rolling over the cloth's surface and cleaning itself while it is rolling. Do not press the cloth so tightly against the bearing so that it cannot roll and only slides. Repeat the procedure for the other two bearings.

The same procedure applies for the Y-axis bearings, dampen a cloth, press it against the bearing surface and pull the entire X-axis Arm forwards towards you and away from you to clean the bearings while they roll. There are four(4) Y-axis Bearings (two on each side) so do not forget any of them.

The bearings are sealed and do not require lubrication.


MOTION SYSTEM 1
X-AXIS MOTOR
Y-AXIS BEARINGS (2 OF THEM)
Y-AXIS BEARING TRACK
Y-AXIS BELT
Y-AXIS DRIVE GEAR
Y-AXIS LIMIT SWITCH (HOME) SENSOR
X-AXIS BELT
Y-AXIS MOTOR
Y-AXIS IDLER PULLEY
X-AXIS LIMIT SWITCH (HOME) SENSOR
#3 MIRROR
FOCUS LENS (IN HOLDER)
X-AXIS BEARINGS (3 of them)
FOCUS CARRIAGE (entire assembly)
#2 MIRROR
#2 MIRROR HOLDER
Y-AXIS DRIVE GEAR
Y-AXIS BELT
Y-AXIS IDLER PULLEY
Y-AXIS BEARING TRACK
Y-AXIS BEARINGS (2 of them)

MOTION SYSTEM 2

Mirror Description, Removal, Cleaning, and Installation

Description

The Mirrors must also remain clean otherwise the laser systems engraving power (depth) will be reduced, and eventually, the Mirrors and Focus Lens will burn up and have to be replaced. Mirrors #2 and #3 (as well as the #1 Mirror) are frontal surfaced mirrors meaning that the reflective surface is on the outside surface of the mirror. Typical household mirrors have the reflective surface on the backside of the glass. Because they are frontal surfaced mirrors, they are very sensitive to dirt and scratches. **NEVER** touch the surface of the mirror with your fingers or any other object because it scratches very easily. The #1 Mirror should not get dirty because it is in a sealed environment and should not need to be cleaned.

Only clean a mirror if it is dirty. Do not clean a clean mirror. Excessive or compulsive mirror cleaning will eventually scratch the mirror or wear the reflective surface right off. If the mirror looks visibly clean, then it is. The laser does not see dirt that we cannot. How often someone should clean their mirrors and lens is user dependent. It depends on the quality of the exhaust blower, the type of material they are burning, the amount of time the laser is in operation, etc.. Inspect the mirrors periodically, we suggest every eight(8) hours of engraving, to start with. If the mirrors and lens remain clean, than extend the interval between cleanings. If they are dirty, increase the cleaning interval. If you can see the mirrors surface while it is attached to the Motion System and it is clean, leave it alone. If you cannot tell if it is dirty or not, it must be removed to be inspected and/or cleaned.

Removal

To remove a mirror, either #2 or #3, hold the mirror by its sides with one hand and with the other hand remove the thumbscrew. Pull the mirror straight away from its holder and be careful not to slide it around otherwise the surface of the mirror holder can scratch the mirrors surface. Inspect the mirror and if it is clean, re-install it. If it is dirty, clean it.

Cleaning

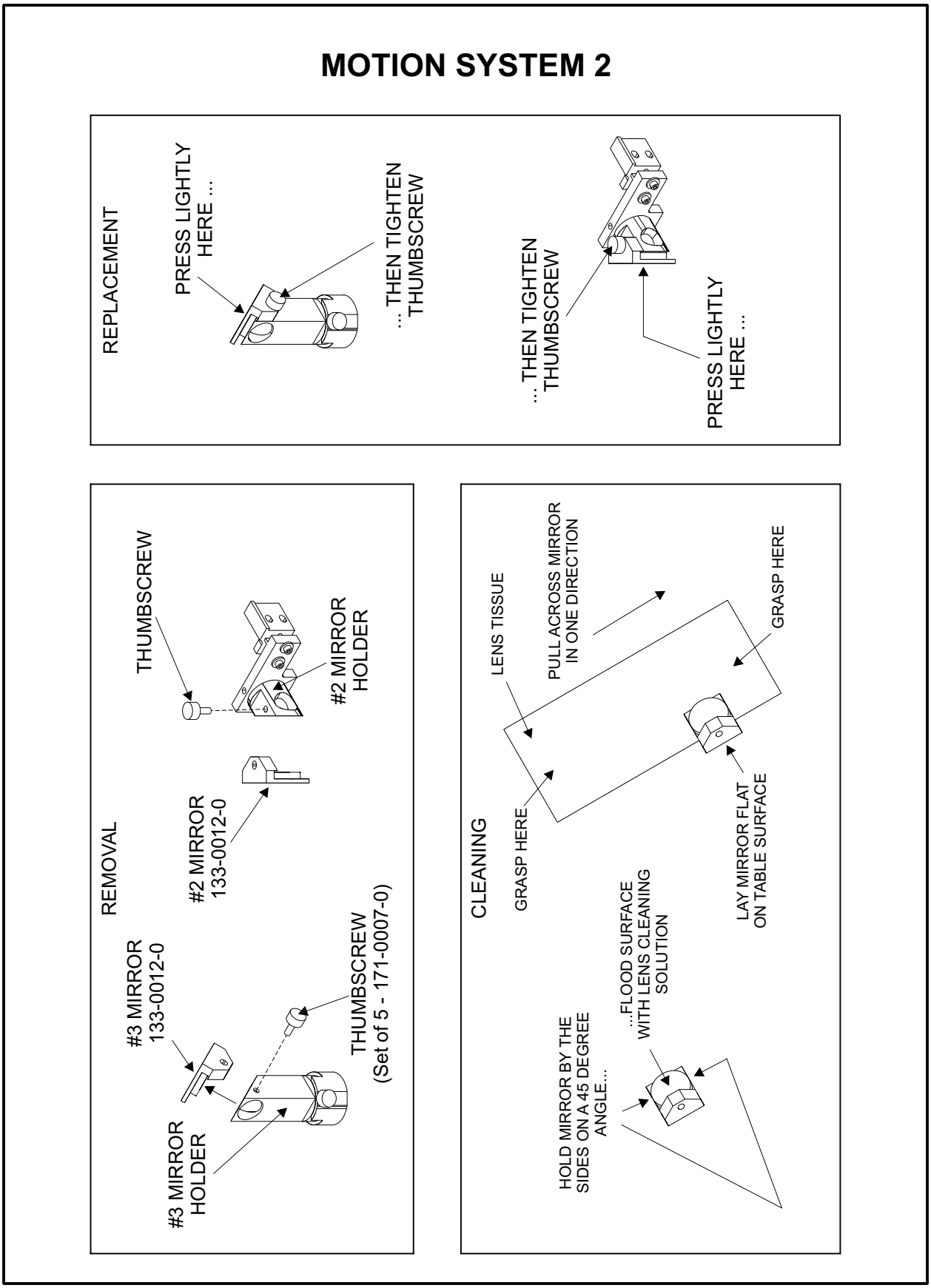
To clean a mirror, hold the mirror on a 45 degree angle, **BE CAREFUL NOT TO DROP IT**, and squirt (flood) lens cleaning solution onto the surface and let the excess drip off. Put it down on a table, and let it set for a minute. With a fresh piece of Lens Tissue (only), gently swipe the tissue across the surface of the mirror to absorb the fluid. Only swipe it in one direction. If fluid still remains on the surface, flip the tissue over and swipe it with the other (fresh) side. **NEVER** use the same tissue twice and only swipe in one direction. **DO NOT** put any finger pressure on the mirrored surface even if the lens tissue is between your finger and the mirror. Let the weight of the tissue be the only force exerted directly onto the mirrored surface. If it did not come clean the first time, repeat the procedure. **SCRATCHES WILL DEVELOP** around the outer surface of the mirror. This is **NORMAL** and it is due to the mirror holders surface being smaller than the mirror itself. It is important that the center of the mirror remain clean and free of scratches.

Installation

To re-install the mirror, hold it by the sides and place it onto the mirror holder surface. Again, be careful not to slide it around, otherwise the mirror holder can scratch the mirror. Once the mirror is in place, insert the thumbscrew and get it **STARTED**. Before tightening the thumbscrew all the way down, place your finger on the back of the mirror assembly, hold it down flat against the mirror holder, and then tighten the thumbscrew.

NOTE: This will ensure that the angle of the mirror maintains its integrity otherwise a misalignment of the laser beam can occur. A misaligned beam can cause weak engraving or no engraving at all.

MOTION SYSTEM 2



MOTION SYSTEM 3

Focus Lens Description, Removal, Cleaning, and Installation

Description

The Focus Lens is composed of Zinc Selenide (ZnSe). It is yellow in color and allows the beam to pass through with very little laser heat absorption. It also focuses the beam to a very small spot size compared to the size of the beam that enters the lens. The size of the spot is determined by the diameter of the beam at the entry point (in this case it is 3.5mm in diameter) and the Focal Length of the lens. The following applies (Focal Length / spot size). The lenses available are 1.5"/.003", 2.0"/.005", 2.5"/.007", 4.0"/.013".

The Focus Lens is located inside the Focus Lens Holder. It is sandwiched between two Nylon Spacers and held in place by the Focus Lens Retainer. The entire Focus Lens Assembly attaches to the Focus Carriage by a thumbscrew. The Focus Lens gets dirtier more often than the mirrors do because it is directly over the engraving material. As a preliminary step, the laser user should inspect the lens after every eight(8) hours of engraving. If it is dirty, clean it and increase the frequency of cleaning. If it is not dirty, do not clean it and decrease the cleaning frequency. The same rule applies for the Focus Lens as with the mirrors, do not clean a clean lens because dirt that you cannot see does not exist to the laser beam. If the Focus lens is dirty, it will reduce the life of the lens and reduce the overall power of the laser beams output.

Removal

To remove and inspect the Focus Lens, hold the Focus Lens Holder with one hand and remove the thumbscrew with the other. It is not necessary to remove the lens from the holder to clean it.

Cleaning

Spray Lens Cleaning solution on to the bottom surface of the lens(flood it) and let the fluid run off. Gently dry the remaining fluid with a cotton swab. DO NOT rub the cotton swab into the lens because you can scratch the lens, only use it to wipe up the fluid. If it did not come clean the first time, repeat the procedure. If it is necessary to remove the lens from the holder, place a piece of lens tissue on top of a soft cloth and place the cloth on a table. This will prevent the lens from breaking. Unscrew the Focus Lens Retainer and turn the Lens Holder Assembly over onto the lens tissue. Flood the Focus Lens with Lens Cleaning solution, flip it over, and flood the other side. Pick up the lens with a fresh lens tissue and gently dry it using extremely light finger pressure between your thumb and forefinger. **CAUTION: Do not drop the lens or squeeze it too hard because it can break.** Clean the inside of the Focus Lens Holder and the Nylon Spacers.

Installation

Re-install the Focus Lens into the holder by first installing the Nylon Spacer, then the lens, then the other Nylon Spacer, then finally screw in the Retainer until it is snug.

NOTE: The Focus Lens has a round side and a flat side. The round(convex) side of the lens points up at the #3 Mirror. If you install it upside down, it will not focus the beam properly. Secondly, make sure that when tightening down the Retainer that the Nylon Spacers remain centered in the holder. Do not over-tighten. Hold the Focus Lens Holder next to your ear and shake it to hear if it rattles. If it does, the lens is not seated properly so take it apart and try it again. **A rattling or loose lens in the holder will cause the engraving to appear like a double image.**

Reinstall the Focus Lens Holder Assembly by placing it onto the Focus Carriage and tightening the thumbscrew. There are two thumbscrew holes located on the Focus Carriage Assembly. Choose either one, there is no difference except for your comfort.

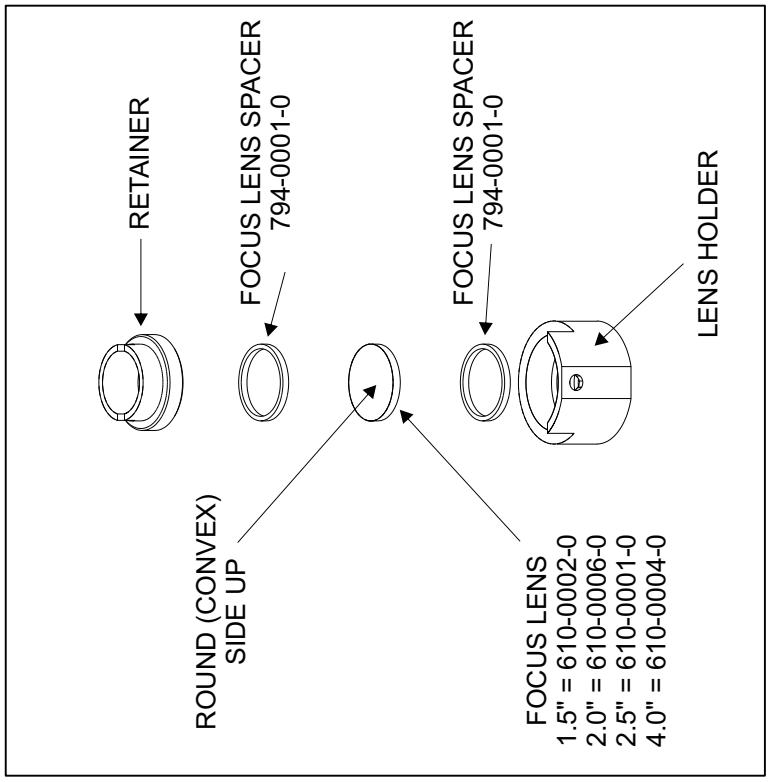
MOTION SYSTEM 3

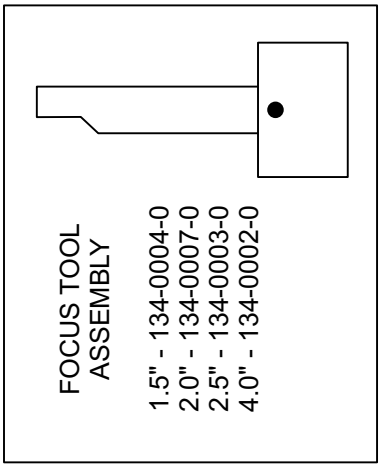
FOCUS LENS ASSEMBLY
(RETAINER,SPACERS,
HOLDER)

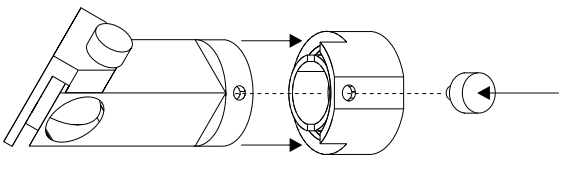
1.5" - 140-0001-1
2.0" - 140-0001-2
2.5" - 140-0001-3
4.0" - 140-0001-4

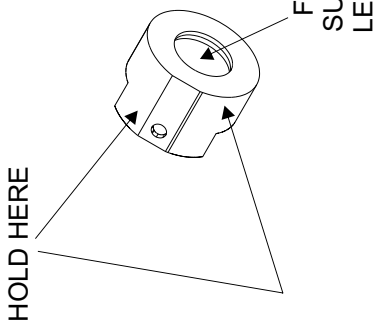
FOCUS LENS KIT
(RETAINER,SPACERS,
HOLDER,LENS,TOOL)

1.5" - 145-0004-0
2.0" - 145-0007-0
2.5" - 145-0005-0
4.0" - 145-0006-0









MOTION SYSTEM 4

Limit Switch Description, Cleaning, Installation, and Adjustment

Description

The X&Y-axis Limit Switch (Home) Sensors are optical sensors that sense when the Focus Carriage and the X-axis Arm are in the Home Position (upper right hand corner). This occurs **ONLY UPON POWER UP**. The Home Sensors have two opposing components, we will call them blocks. The Focus Carriage and the X-axis Arm both have metal plates(Flags). These Flags register the Focus Carriage and the X-axis Arms position when their Flags pass between the blocks **ONLY** during Homing.

During power up, the Focus Carriage and the X-axis Arm both move to the upper right hand corner of the Motion System, move back out a few inches, and then move back into the upper right hand corner. This completes the Homing procedure. The Limit Switches should **NEVER** need adjustment **UNLESS** they are replaced. **MOST** of the time, a simple replacement does not require sensor adjustment.

Diagnosis

- If the X-axis Limit Switch is dirty or the circuit has opened, the X-axis Arm will Home properly, but the Focus Carriage will move 2 inches to the left and stop.
- If the X-axis Limit Switch is shorted or the Y-axis Limit Switch is not adjusted properly or the Arm is out of square, then the Focus Carriage will slam and chatter to the right hand side of the Arm when Homing.
- If the Y-axis Limit Switch is dirty, or the circuit has opened, the X-axis Arm will move 2 inches towards the front of the machine and stop, and the Focus Carriage will slam to the right side of the Arm.
- If the Y-axis Limit Switch is shorted, both the X-axis Arm and the Focus Carriage will slam and chatter into the upper right hand corner.

Cleaning

To clean either Limit Switch, wet a lens tissue with plain water, and slide it across the blocks on the lower inside and the upper inside of the Sensor. Let it dry or blow it dry with compressed air from a can and try to Home it again. If it does not come clean , the Sensor will need replacement.

Removal

To replace a Limit Switch, turn off the laser system, unplug the Sensor, unscrew the screws and remove it.

Installation

Re-installation is opposite of removal.

Adjustment

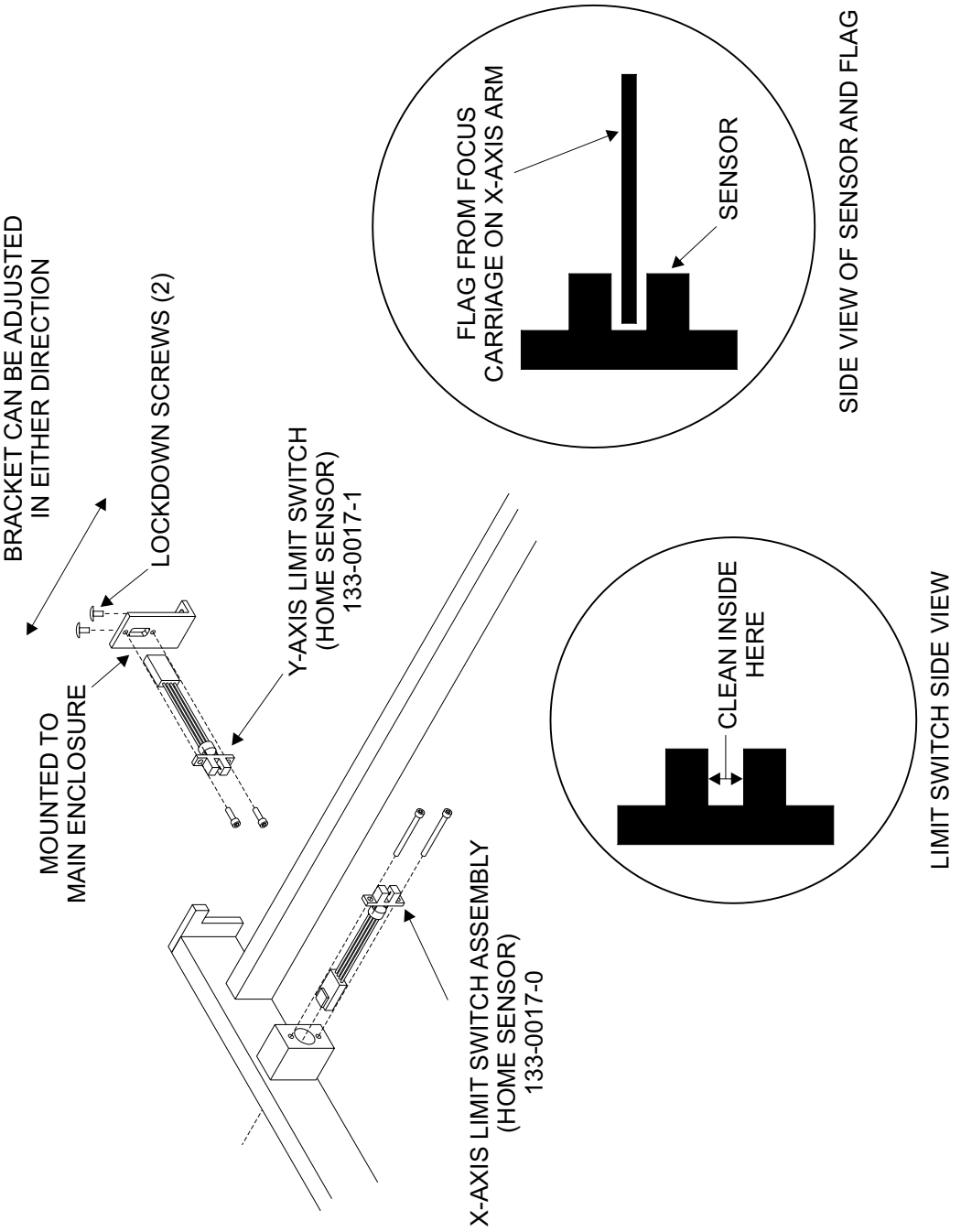
The primary cause of slamming to the upper right hand corner is that the X-axis Arm has come out of square.

To check if the Arm is square, turn off the laser and gently pull the X-axis Arm to the front of the machine until it touches the front rail. If the right side of the Arm and the left side of the Arm do not touch the front rail at the same time, the Arm need to be adjusted. Refer to the adjustment procedure later on in this manual. After squaring the Arm and it still slams against the side, continue to the next step.

If the Y-axis Limit Switch is not located close enough to the back rail, the X-axis Flag will not have the opportunity to pass through it's own Limit Switch. If the Y-axis Limit Switch is located too close to the rear rail, the X-axis Flag will bump into it's own Limit Switch. The objective is to adjust the Y-axis Sensor until the X-axis Flag passes through it's own Limit Switch far enough to register, but not too far to cause the Flag to physically run into the Switch. To adjust the Y-axis Sensor, loosen the two screws that mount the bracket to the main enclose, slide the Sensor in the appropriate direction, and re-tighten the screw. Be sure to keep the Y-axis bracket straight when adjusting.

If the Motion System is adjusted or the Limit Switches are re-positioned, then the Rulers on the engraving table will have to be adjusted. Please refer to the procedure "Z-Axis Assembly 2".

MOTION SYSTEM 4



MOTION SYSTEM 5

X-axis Bearing Description and Adjustment

Description

The Motion System has been designed in such a way that the outer surface of the bearings will eventually wear out instead of the metal parts of the Motion System. In this way, it will be much less expensive to replace bearings than an anodized aluminum extrusion. Something must wear out so the bearings are the best choice.

The X-axis Bearings will wear at a much higher rate than the Y-axis Bearings. This is due to significantly more motion in the X-axis direction than the Y-axis since most engraving utilizes the raster feature instead of the vector feature.

As the X-axis bearings wear, a looseness in the Focus Carriage will start to occur. This will cause a reduction in the quality of the image that the laser system produces because the Focus Carriage will rock back and forth as it reverses direction. To restore the quality periodic adjustment is necessary.

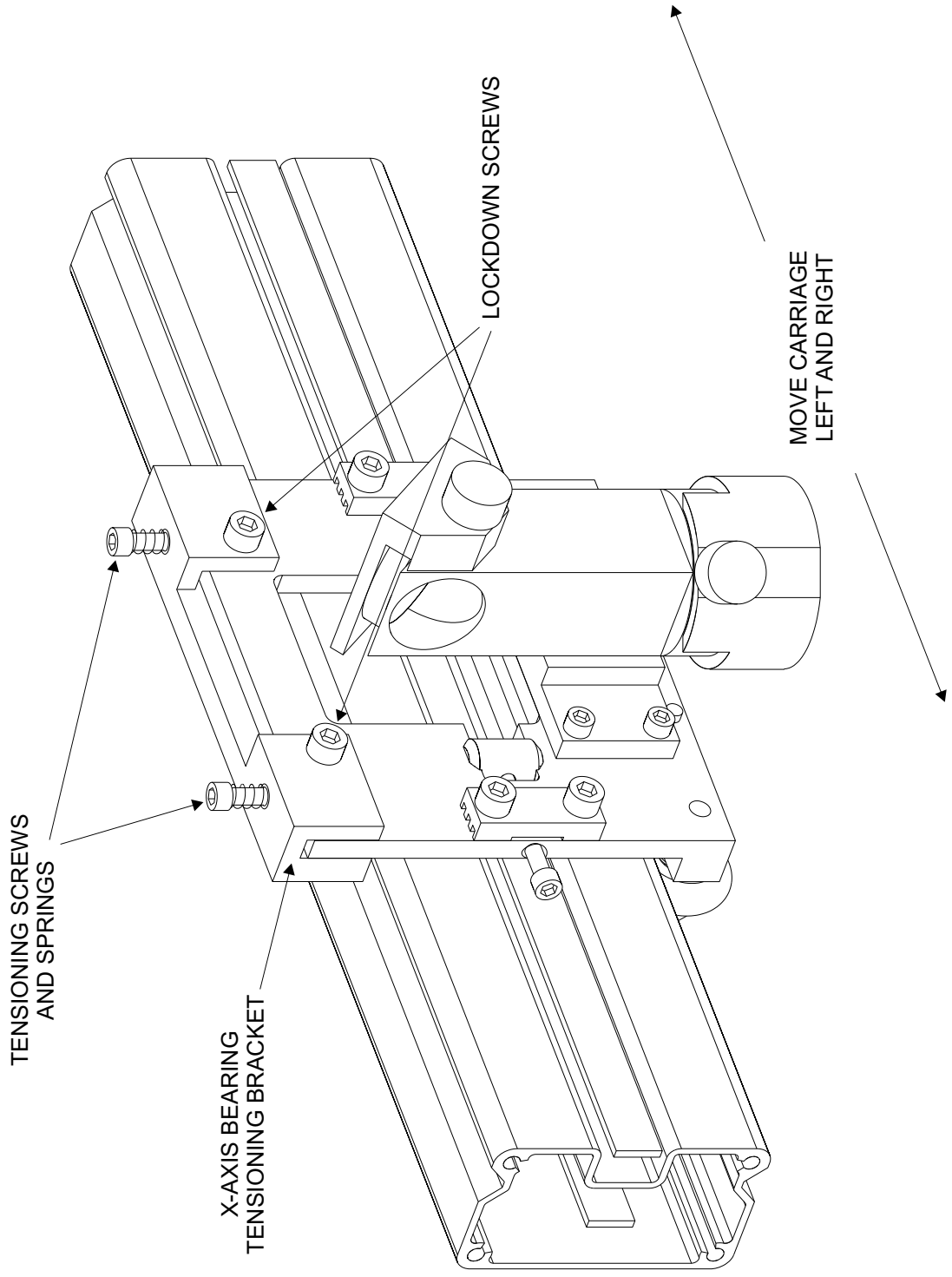
Adjustment

We can adjust the bearing clearance to remove the looseness. To do this, turn the laser system off and loosen the two(2) Lockdown Screws as the diagram indicates. Loosening the Lockdown Screws will allow the Tensioning Springs at the top of the Bearing Tensioning Bracket to push the bracket downwards. This downward push actually squeezes all three(3) bearings together to remove the clearance created by bearing wear. In other words, the bearings will self adjust when the Lockdown Screws are simply loosened. Now re-tighten the Lockdown Screws. Check to see if there is any more play in the Focus Carriage by grasping it and gently trying to rotate it in a clockwise and counterclockwise direction. If there is still clearance, repeat the procedure. It sometimes helps to move the Focus Carriage left and right a few times while the Lockdown Screws are loose to help settle the bearings in the bearing tracks then tighten the Lockdown Screws again.

CAUTION !

The objective is to remove the clearance between the bearing surface and the rail, not to make the bearings tight. If you tighten the Tensioning Screws and Springs too much, the outer surface of the bearing will wear very quickly and shorten the life of the bearing. To make sure that you have a good adjustment, slide the Focus Carriage back and forth to make sure that the Carriage rolls freely. Now, holding the Focus Carriage stationary with your thumbs, roll the two bottom bearings with your forefingers. You should feel a little resistance as you turn them but not too much. If one or both bearings roll freely as if they are not even touching the rail, it is too loose and the Focus Carriage need to be re-adjusted. The Tensioning Springs provide the force when making an adjustment. Tighten the Tensioning screws and springs more, if necessary, to provide a little more force. **NEVER** bottom out the springs and **NEVER** squeeze the Tensioning Bracket into the Focus Carriage by hand. This will provide too much force and can cause bearing damage or excessive wear. It is also important that the rolling resistance between the two bearings are even. If they are not, repeat the adjustment procedure until both bottom bearings resistance level, when you roll them with your fingers, are equal.

MOTION SYSTEM 5



MOTION SYSTEM 6

X-axis Bearing Removal, Installation, and Adjustment

Removal

To replace the X-axis Bearings, remove the Lockdown Screws, the Tensioning Screws and Springs, and then the X-axis Bearing Tensioning Bracket. The Bracket has the top X-axis Bearing attached to it. The Focus Carriage Assembly will now hang only by the X-axis Belt.

With a ¼ " nut driver or wrench, unscrew the X-axis Bearing Assembly from the Bracket. The screw is press fit into the X-axis Bearing Assembly so you cannot remove it. The new Bearing Assembly will include the Bearing with the screw already pressed into the Bearing and a new Washer. The bottom two(2) X-axis can be removed without loosening the X-axis Belt or removing the Focus Carriage Assembly at all. Simply tilt the Focus Carriage enough to get access to the remaining X-axis Bearings.

Installation

Place the new Washer between the new X-axis Bearing and the Bracket and tighten down the screw until it stops. It is very **IMPORTANT** that the washer remains aligned and centered while tightening down the screw. **A misaligned washer will cause poor engraving**. **DO NOT** overtighten the screw. Tighten it just enough to get it snug. The screw is a shoulder screw. Tightening it past its stopping point will not remove internal play from the bearing, it will strip the aluminum threads on the Bracket. Now, check the bearing by rolling it with your finger. If you made it too tight, it will fell very restrictive. It should roll smoothly and with little resistance. Change the remaining two X-axis Bearing Assemblies in the same manner.

Adjustment

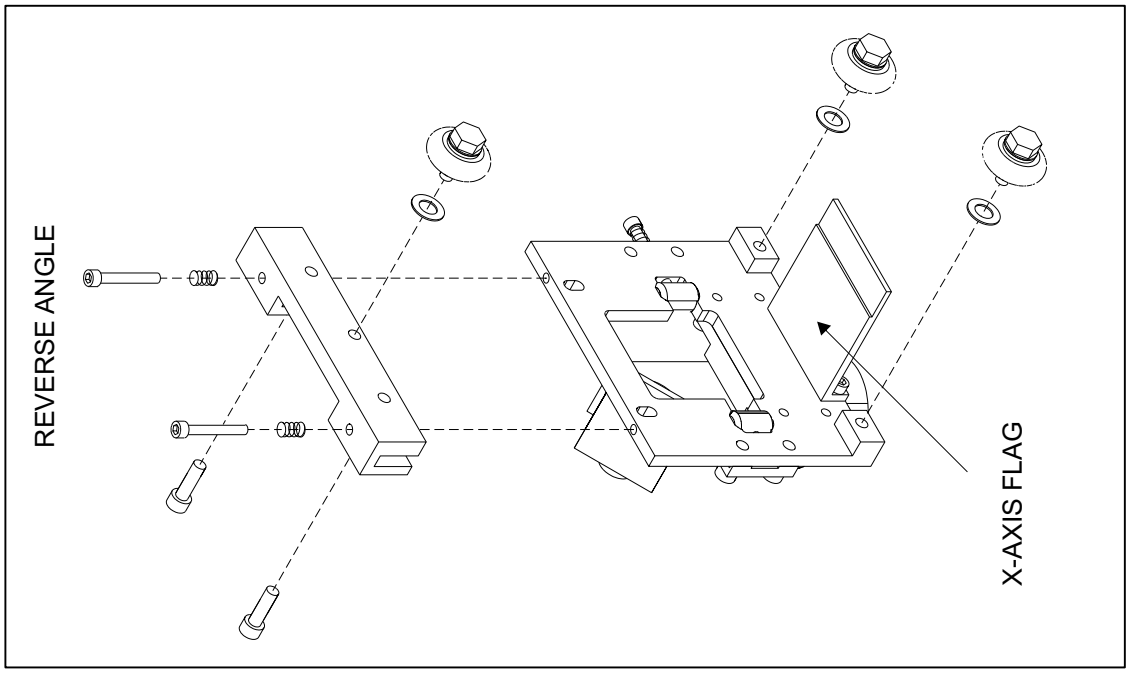
Once all X-axis Bearings have been replaced, re-install the X-axis Bearing Tensioning Bracket, the Lockdown Screws (do not tighten them yet), and the Tensioning Screws and Springs. **VERY IMPORTANT: only tighten the Tensioning Screws until the springs compress about ½ way to the bottom of it's travel. Over-tightening the Tensioning Screws can damage the bearings and/or cause excessive wear.** Make sure you tighten both Tensioning screws **EVENLY** so that the Tensioning bracket is sitting level on the Focus Carriage. Judge this simply by looking at it. Adjust as necessary to make it level. Finally, hold on to the Tensioning Bracket while tightening down the Lockdown Screws to ensure that the Bracket does not twist from the turning of the Lockdown Screws.

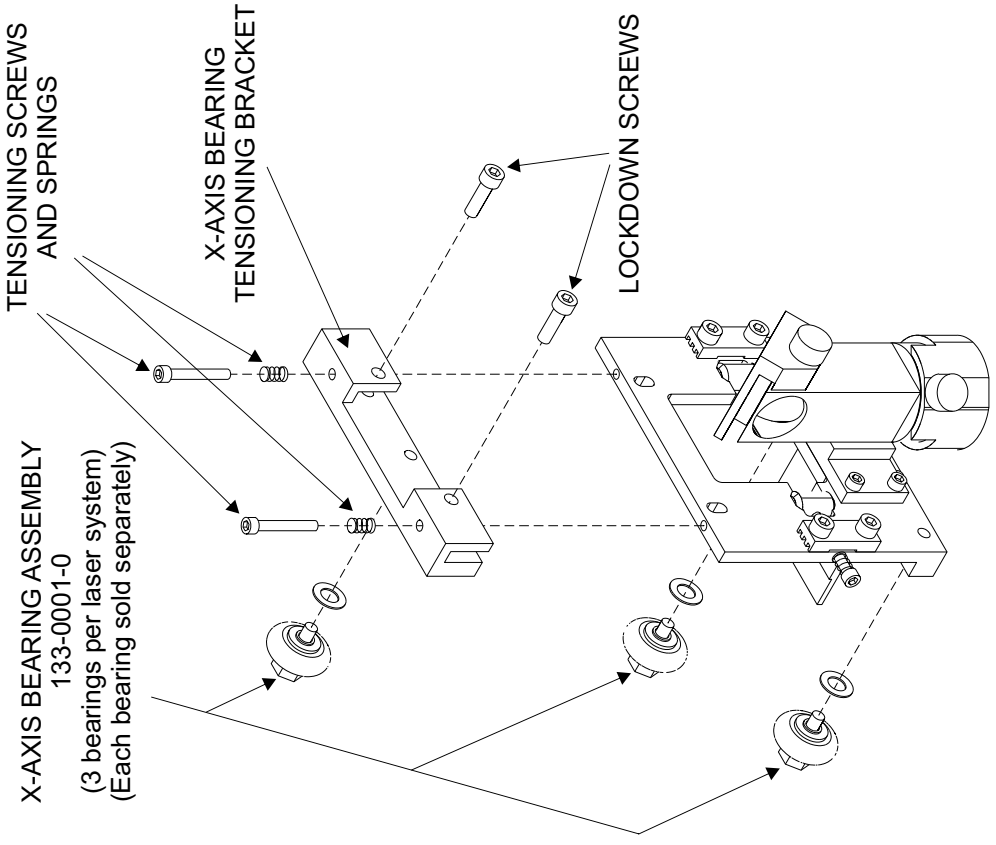
CAUTION !

The objective is to remove the clearance between the bearing surface and the rail, not to make the bearings tight. If you tighten the Tensioning Screws and Springs too much, the outer surface of the bearing will wear very quickly and shorten the life of the bearing. To make sure that you have a good adjustment, slide the Focus Carriage back and forth to make sure that the Carriage rolls freely. Now, holding the Focus Carriage stationary with your thumbs, roll the two bottom bearings with your forefingers. You should feel a little resistance as you turn them but not too much. If one or both bearings roll freely as if they are not even touching the rail, it is too loose and the Focus Carriage need to be re-adjusted. The Tensioning Springs provide the force when making an adjustment. Tighten the Tensioning screws and springs more, if necessary, to provide a little more force. **NEVER** bottom out the springs and **NEVER** squeeze the Tensioning Bracket into the Focus Carriage by hand. This will provide too much force and can cause bearing damage or excessive wear. It is also important that the rolling resistance between the two bearings are even. If they are not, repeat the adjustment procedure until both bottom bearings resistance level, when you roll them with your fingers, are equal.

Refer to the both the previous section and this section on the proper technique of X-axis Bearing Adjustment.

MOTION SYSTEM 6





MOTION SYSTEM 7

X-axis Belt Cleaning, Adjustment, Removal, and Installation

Cleaning

The X-axis Belt will need cleaning from time to time. Sometimes smoke or debris will settle on the teeth and that debris will transfer to the X-axis Drive Gear. If the X-axis Drive Gear accumulates too much debris, the X-axis Belt will start to slip. A good way to clean the belt is with a toothbrush. Gently pull the belt away from the X-axis Arm and clean the teeth. Move the Focus Carriage all the way to the left and right to make sure that you clean all of the teeth. If the X-axis Drive gear gets too much accumulation of debris, then it will need to be removed for cleaning. For X-axis Drive Gear removal instructions, please refer to the section on X-axis Motor Removal and Replacement later on in this manual. Turn laser system **OFF** before performing the following procedure.

Adjustment

The X-axis Belt is a Kevlar fiber reinforced belt. It will not stretch under normal usage. If a component such as the X-axis Idler Pulley, the X-axis Motor, or the X-axis Belt is replaced, the X-axis Belt must be re-tensioned. Push the Focus Carriage all the way to the right side. Hook the X-axis Belt with a Belt Tension Gauge directly in the middle of the belt (12 inches on the ruler scale). Place a ruler against the Arm and pull the belt out exactly ½ inch. The tension reading should be between 200 - 220 grams or 7 - 8 ounces of force. If it is not, the tension must be adjusted. To tighten the X-axis Belt, simply tighten the Belt Tensioner Screw and Spring Assembly that is attached to the Focus Carriage until the correct tension is achieved. To loosen the X-axis Belt, simply loosen the Screw. There is no need to lock it down, the springs take care of that. It will not turn or change its tension by itself.

Removal

Remove the sheet metal plate, that covers the right hand side of the motion system, by removing the two(2) thumbscrews and lifting it off. Remove the X-axis Belt Tensioner Screw and Spring. Disconnect the Belt from the Focus Carriage by removing the X-axis Belt Grip on both sides. **BE CAREFUL** not to let the Belt Tensioners slide off the Focus Carriage because they are difficult to get back on.

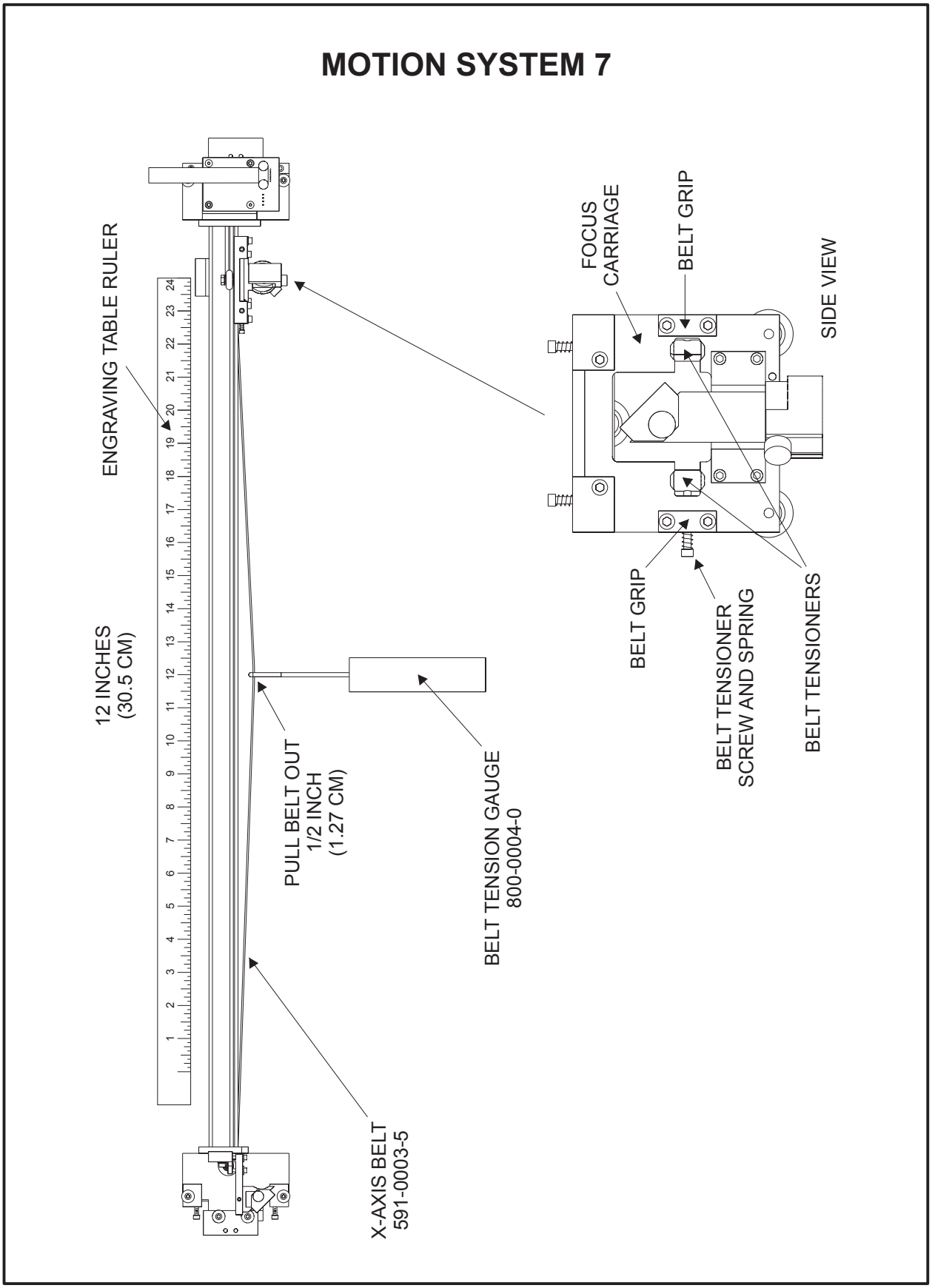
Since the X-axis Belt passes through the inside of the X-axis Arm Assembly, it is a good idea to staple the end of the old belt securely to the end of the new belt. Then, gently pull the old belt through the X-axis Arm and out the other side. This will also pull the new belt through the Arm and out the other side. Now remove the staple and discard the old belt.

Installation

Attach the new belt around the Belt Tensioner Cylinders on the right side **ONLY** and secure it by attaching and tightening down the Belt Grip. Leave about ½ " excess hanging off the right side. Now, thread the other side of the belt around the left side Belt Tensioner and pull on the belt slightly to remove any slack. Lock it down to the Focus Carriage by attaching and tightening down the Belt Grip. Leave the excess belt material hanging off the left side for now. Re-install the Tensioning Screw and Spring and re-tension the X-axis Belt.

After the Belt has been installed correctly, trim off any excess Belt material on both the left and right side.

MOTION SYSTEM 7



MOTION SYSTEM 8

X-axis Belt Idler Pulley Description, Removal, Installation, and Adjustment

Description

The X-axis Idler Pulley (Idler for short) is mounted on the left side of the X-axis Arm and underneath the #2 Mirror Holder Bracket. The X-axis Belt is wrapped around the Idler. The X-axis Motor, Drive Gear, Belt, X-axis Bearings, and Idler work together to drive the Focus Carriage left and right. After a long time of usage, the lubricant inside the Idler will wear out causing the Idler to either stop rotating or become too resistive to turning. This will cause the Focus Carriage to loose position or bind up as it travels left and right. This can also cause a very erratic looking left to right engraving or can even cause the Focus Carriage to slam into the left or right side of the arm. Once any of these symptoms occur, the Idler must be replaced. Turn laser system **OFF** before performing the following procedure.

Removal

- Back out the X-axis Belt Tensioner Screw until there is no tension on the X-axis Belt.
- Loosen the left side Belt Grip, on the Focus Carriage, just enough to release the Belt. Do not remove the Belt Grip from the Focus Carriage.
- Remove the #2 Mirror.
- Scribe a line where the #2 Mirror Holder Bracket attaches to the Arm. This will be our reference mark upon re-installation. This is necessary to prevent having to perform a beam alignment after this procedure.
- Remove the Bracket by removing the two screws that attach it to the Arm.
- Remove the E-clip that holds the Idler on the shaft and pull the Idler straight up.
- Replace the Shaft, if worn, by unscrewing its base with either a small wrench or needle nose pliers. Use some light threadlocker such as LockTite on the threads and install the new Shaft. It is not necessary to replace the Shaft if there is no visible signs of wear.

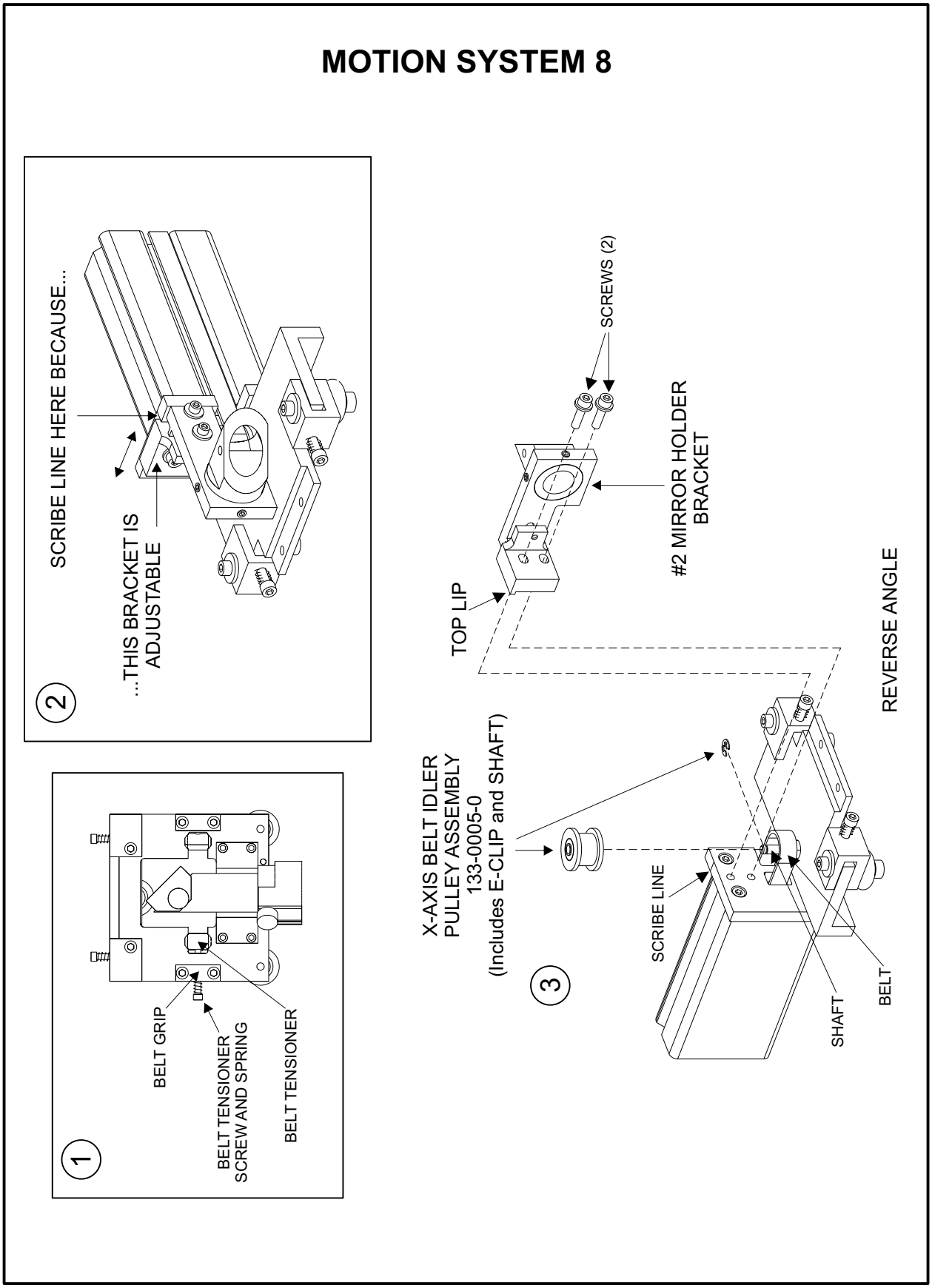
Installation

- Install the new Idler Pulley and E-clip. Note that the side of the Idler that has the recessed bearing goes downwards.
- Slip the X-axis Belt around the Idler and re-attach the Belt to the Belt Grip on the Focus Carriage. We will adjust Belt tension later.
- Install the #2 Mirror Bracket by lining it up with the scribe mark that you made earlier and installing the two screws. **Pay careful attention to making sure that the Bracket lines up with your scribe mark and the Bracket's Top Lip sits flat with respect to it's mounting surface. If you do not, the laser beam's alignment will be incorrect and will need to be adjusted.**
- Install the #2 Mirror.

Adjustment

Refer to the "Motion System 7" procedure on how to adjust X-axis Belt Tension.

MOTION SYSTEM 8



MOTION SYSTEM 9

X-axis Motor Removal, Installation, and Adjustment

Description

The X-axis Motor and Drive Gear, along with the Belt and Idler, drive the Focus Carriage left and right. If the X-axis Motor wears out, it must be replaced. If the Drive Gear gets clogged with dirt, the X-axis Motor must be removed to facilitate cleaning. If the X-axis Motor needs replacement, it might be a good idea to also install a new Drive Gear.

Removal

- Remove Thumbscrews on right hand side Cover Plate and remove Cover Plate.
- Back out and remove the Belt Tension Screw and Spring until there is no tension on the X-axis Belt.
- Loosen the left side Belt Grip to release the X-axis Belt from the Focus Carriage.
- Unplug the X-axis Motor from the circuit board above it by squeezing the tab on the plug and pulling it straight down.
- Remove the (4) screws and nylon spacers that hold down the X-axis Motor and the circuit board.
- Pull the X-axis Motor and Drive Gear Assembly straight up and out.
- If you are simply cleaning out the Drive Gear, clean out the grooves with a stiff nylon brush like a toothbrush or use a wooden toothpick to pick out the debris. Sometimes you might need to use a cleaning solution to assist in removing the debris. **DO NOT USE A SHARP METAL OR HARD OBJECT TO PICK OUT THE DEBRIS. IF THE GEAR BECOMES SCRATCHED, THIS WILL REDUCE THE LIFE OF THE BELT.**
- If installing a new Drive Gear, notice the position of the old Drive Gear on the shaft of the X-axis Motor. **IT IS VERY IMPORTANT THAT YOU INSTALL THE NEW DRIVE GEAR AT THE SAME VERTICAL POSITION ON THE SHAFT SO EITHER MARK THE SHAFT OR TAKE A MEASUREMENT OF THE DISTANCE FROM THE GEAR TO THE MOTOR HOUSING OTHERWISE THE BELT WILL NOT BE ALIGNED PROPERLY WHEN THE MOTOR GETS RE-INSTALLED.** Loosen the screw on the clamp that holds the gear onto the motor shaft. Pull the gear and clamp off of the shaft.

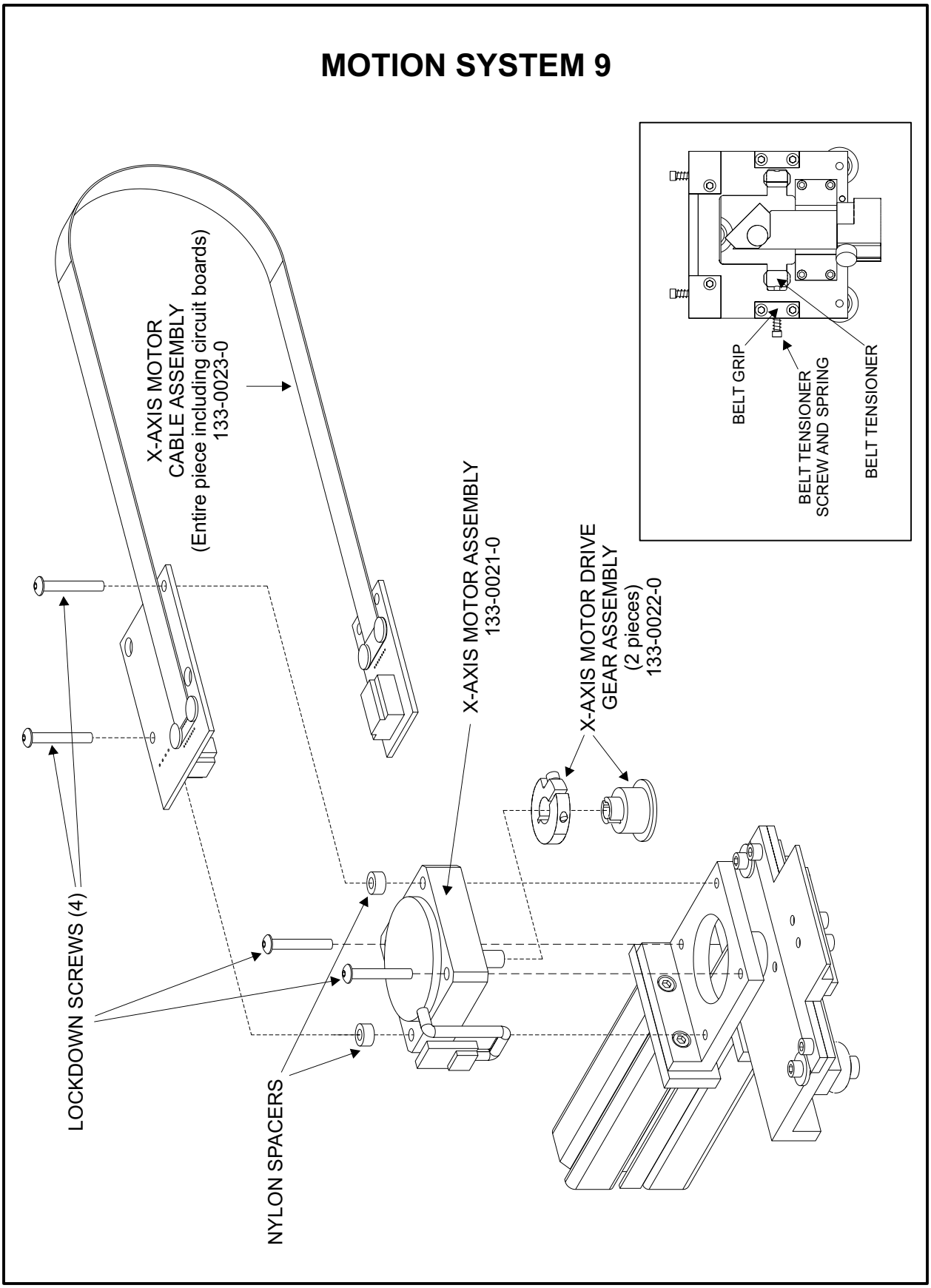
Installation

- Install the new Drive Gear (only if you removed the old one) by pressing the clamp and gear onto the shaft. Position the gear, on the shaft, at the same vertical position as the old gear for correct belt alignment and tighten down the clamp screw.
- Wrap the belt around the Drive Gear while installing the motor. Install the spacers and circuit board, back onto the mounting plate with the (4) screws. Plug in the motor to the circuit board.
- Attach the belt to the Focus Carriage and pull on the belt to remove any slack. Install and tighten the Belt Tension Adjustment Screw just enough to produce a little tension on the belt to prevent it from slipping on the Drive Gear.
- Slide the Focus Carriage all the way to the right and observe how the belt is aligned with the Drive Gear. It should be straight, if it is on an angle, you will need to go back and re-position the Drive Gear on the motor shaft until the belt alignment is good. Proceed to adjust belt tension

Adjustment

Refer to the “Motion System 7” procedure on adjusting X-axis Belt Tension.

MOTION SYSTEM 9



MOTION SYSTEM 10

X-axis Arm Squaring, Y-axis Bearing Clearance Adjustment

Description

Over a long period of time and a lot of engraving, the X-axis Arm can start to come out of square and/or the Y-axis Bearings will start to get loose. To check if the X-axis Arm is square to the Motion System Rails, turn the machine off and pull the arm towards you until the arm contacts the front rail. Observe the left side and the right side of the arm where it contacts the front rail. Both sides must contact the front rail. If both sides contact the rail, then the arm is square. If one side does not, this means that the X-axis Arm is not square (or parallel) to the front rail. To see if the Y-axis Bearings are loose, grab the arm gently, with both hands, like you were riding a motorcycle. **GENTLY** try to rotate the arm back and forth as if you were rotating the motorcycles hand grip to accelerate and decelerate it. If you feel that the arm has some clearance or feels loose, then the Y-axis Bearings need adjustment to eliminate the clearance. Follow the appropriate procedure to make any adjustments. The X-axis Arm **MUST** always be square before adjusting the Y-axis Bearing Clearance. Before making any adjustments, make sure that the laser system is **OFF**.

X-axis Arm Squaring

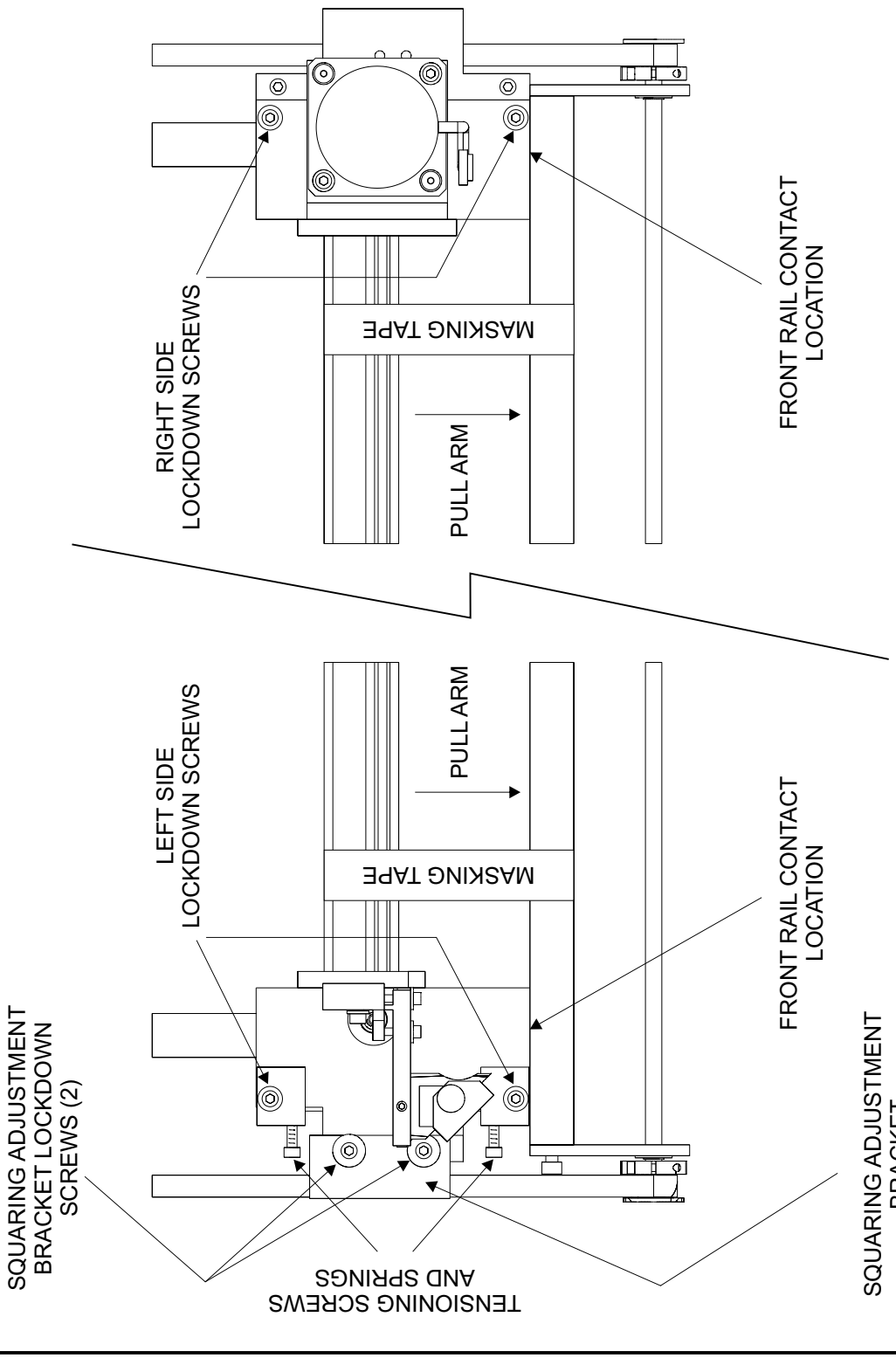
- To square the arm, you must first loosen the Left and Right Side Lockdown Screws.
- Loosen the Right Side Lockdown Screws **FIRST** only ¼ turn - **NO MORE**. Then, loosen the Left Side Lockdown Screws **ONE FULL TURN**.
- Loosen the Squaring Adjustment Bracket Screws ¼ turn - **NO MORE**.
- Pull the X-axis Arm towards you until the arm makes contact with both the right and left side of the front rail. You will see the Squaring Adjustment Bracket move. With some masking tape, tape the X-axis Arm firmly against the front rail on the left and right side of the Arm. Tighten down the Squaring Adjustment Bracket Screws **ONLY**. Do not tighten the Left and Right Side Lockdown Screws yet, we will tighten them later. Remove the masking tape.
- The X-axis Arm should now be square so proceed to adjust the Y-axis Bearing Clearance.

Y-axis Bearing Clearance Adjustment

- Assuming that the Left and Right Side Lockdown Screws are already loose, gently move the carriage back and forth from the top of the field to the bottom a few times. Now position the arm back to the middle of the field. Doing this allows the tensioning springs and screws to automatically adjust the bearings so that all clearances between the bearing outer race and the motion system rails have been eliminated. The objective is to remove any clearances, not have the bearings tight.
- Tighten down the **RIGHT** side lockdown screws **FIRST** and then the **LEFT** side lockdown screws **SECOND**. It is very important to do it in this order.
- Check your adjustment by rotating the X-axis Arm again as if you were riding a motorcycle. If you still feel looseness, go back and repeat the procedure.

Another way to check the Y-axis Bearing Clearance is to gently push the arm again from the top of the field down to the bottom while touching one of the bearings very gently with one of your fingers. If there is any clearance between the bearing surface and the rail, you will feel the bearing stop turning in your finger and you would feel the bearing sliding instead of rolling. The bearing should roll throughout the entire travel from the top of the field to the bottom. Check all four(4) bearings. If even one of the bearings is sliding instead of rolling, repeat the entire procedure.

MOTION SYSTEM 10



MOTION SYSTEM 11

Y-axis Bearing Removal, Installation, and Adjustment

Description

The Y-axis Bearings are mounted on the left and right side of the X-axis Arm. In order to change them, the X-axis Arm must be removed from the laser system. Turn the laser system **OFF** before performing this procedure.

Removal

- Detach the X-axis Motor Flexible Cable Assembly (not shown) from the Arm but do not remove the X-axis motor (see the Motion System 9 procedure).

- Disconnect the Y-axis Belts from the Arm by removing the four(4) screws, two(2) on the left and two(2) on the right side of the Arm, that attach the Belt Mounting Brackets. Detaching the brackets from the Arm allows the Arm to be removed without having to adjust Y-axis Belt Tension. The Arm should now roll freely from front to back.

- On the left side, remove the two(2) Tensioning Screws and Springs that are mounted horizontally on the left side of the Arm and remove the two(2) Lockdown Screws that hold the Y-axis Bearing Plate to the Arm. Remove the Y-axis Bearing Plate from the Arm.

- The Y-axis Bearing Assembly is mounted to the Y-axis Bearing Plate. Remove the shoulder screws and the Y-axis Bearings.

- On the right side, loosen the (2) two lockdown screws (one not shown) - **ONLY** ¼ turn. This will give the Y-axis Bearings enough clearance to be able to remove the Arm. You can now remove the entire Arm from the Motion System. Place the Arm on a clean, soft surface.

- The right side Y-axis Bearings attach to a plate that is attached to the Arm by a Pivot Screw. This screw allows the right side bearings to pivot themselves into riding parallel in their respective bearing track. **DO NOT** remove this screw. Simply remove the Bearing Assembly by removing it's shoulder screw. Put a drop of light household oil in the crack between the Bearing Plate and the Arm. Pivot the plate back and forth to work in the oil. This will help make the Y-axis Bearing Clearance Adjustment easier.

Installation

- Install the four(4) new Y-axis Bearing Assemblies and new shoulder screws into their respective Bearing Plates. **DO NOT** overtighten the shoulder screw, only tighten it enough that it is snug.

- Flip the Arm back over and place it onto the rails while guiding the right side bearings into it's track.

- Attach the Left Side Y-axis Bearing Plate to the Arm by loosely installing it's Lockdown Screws first, then installing the Tensioning Screws and Springs. **VERY IMPORTANT: only tighten the Tensioning Screws until the springs compress about ½ way to the bottom of it's travel. Over-tightening the Tensioning Screws can damage the bearings and/or cause excessive wear.** DO NOT tighten the two lockdown screws just yet. Make sure that all (4) four Y-axis Bearings are riding in their tracks by rolling the Arm from the front to the back of the laser system.

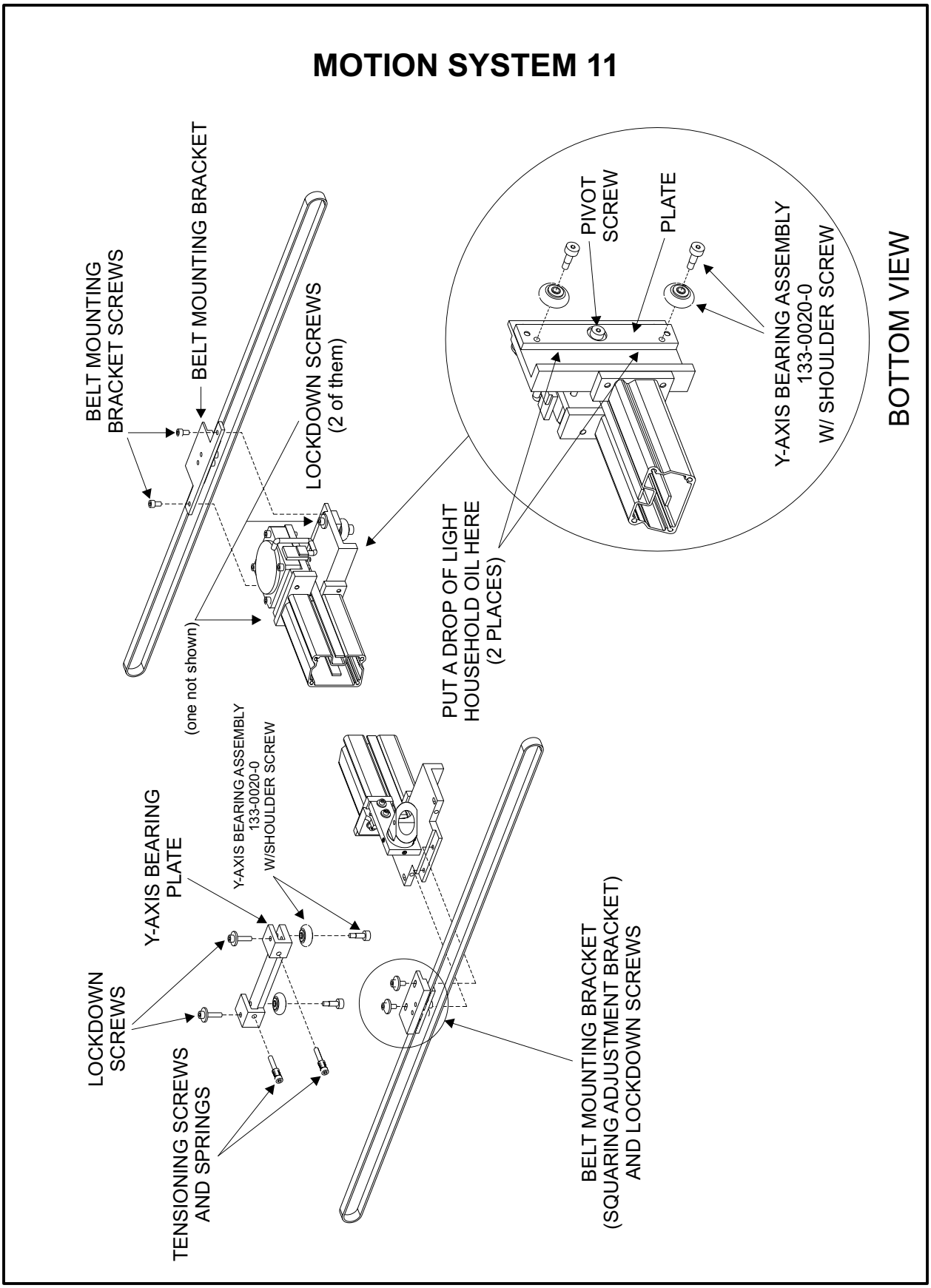
- Attach the Right Side Belt Mounting Bracket to the Arm and tighten it's screws. Attach the Left Side Belt Mounting Bracket to the Arm but leave it's Lockdown Screws loose.

- Attach the X-axis Motor Flexible Cable Assembly (see "Motion System 9").

Adjustment

Refer to the "Motion System 10" procedure on Squaring the X-axis Arm and Y-axis Bearing Clearance Adjustment.

MOTION SYSTEM 11



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MOTION SYSTEM 12

Y-axis Belt Removal, Installation, Adjustment
Y-axis Belt Idler Pulley Removal and Installation
Y-axis Drive Gear Removal and Installation
Y-shaft Bearing Removal and Installation

NOTE: Belts, Idlers, Drive Gears, and Shaft Bearings are the same on both sides of the Motion System. The following Procedure assumes that you will be changing all of the described parts. If not, skip over the procedure for the parts that you will not be changing.

Y-axis Belt Removal
Loosen the lockdown screw (about 1 turn) that secures the Y-axis Idler Pulley Bracket. Loosen the Belt Tensioning Screw a few turns - do not remove it. This will give the belt some slack. Remove the two(2) Belt Mounting Bracket Lockdown Screws to detach the plate from the Arm. Remove the entire Belt and the bracket from the laser system. Flip the plate over and remove the two(2) Belt Grip Screws and detach the Belt Grip. Lay the old Belt next to the new Belt on a flat surface and cut the new Belt, with a pair of sharp scissors or razor blade, the same length as the old Belt. Attach the new Belt to the Belt Mounting Bracket by connecting the ends to the Belt Grip and securing it with the Belt Grip Screws. Attach and center the Belt Mounting Bracket on the Arm and tighten the Lockdown Screws, but **DO NOT** wrap the Belt around the Drive Gear or Idler Pulley yet.

Y-axis Idler Pulley Removal and Installation
Remove the Shoulder Screw to release the Idler Pulley. Install the new Shoulder Screw and Idler Pulley with the recessed side of the Idler Pulley facing the head of the Shoulder Screw.

Y-axis Drive Gear Removal
Loosen the Drive Gear Clamp Screw and pull the Drive Gear and Drive Gear Clamp off of the Y-Shaft. If it is stuck, **GENTLY** try to pry it off with a screwdriver.

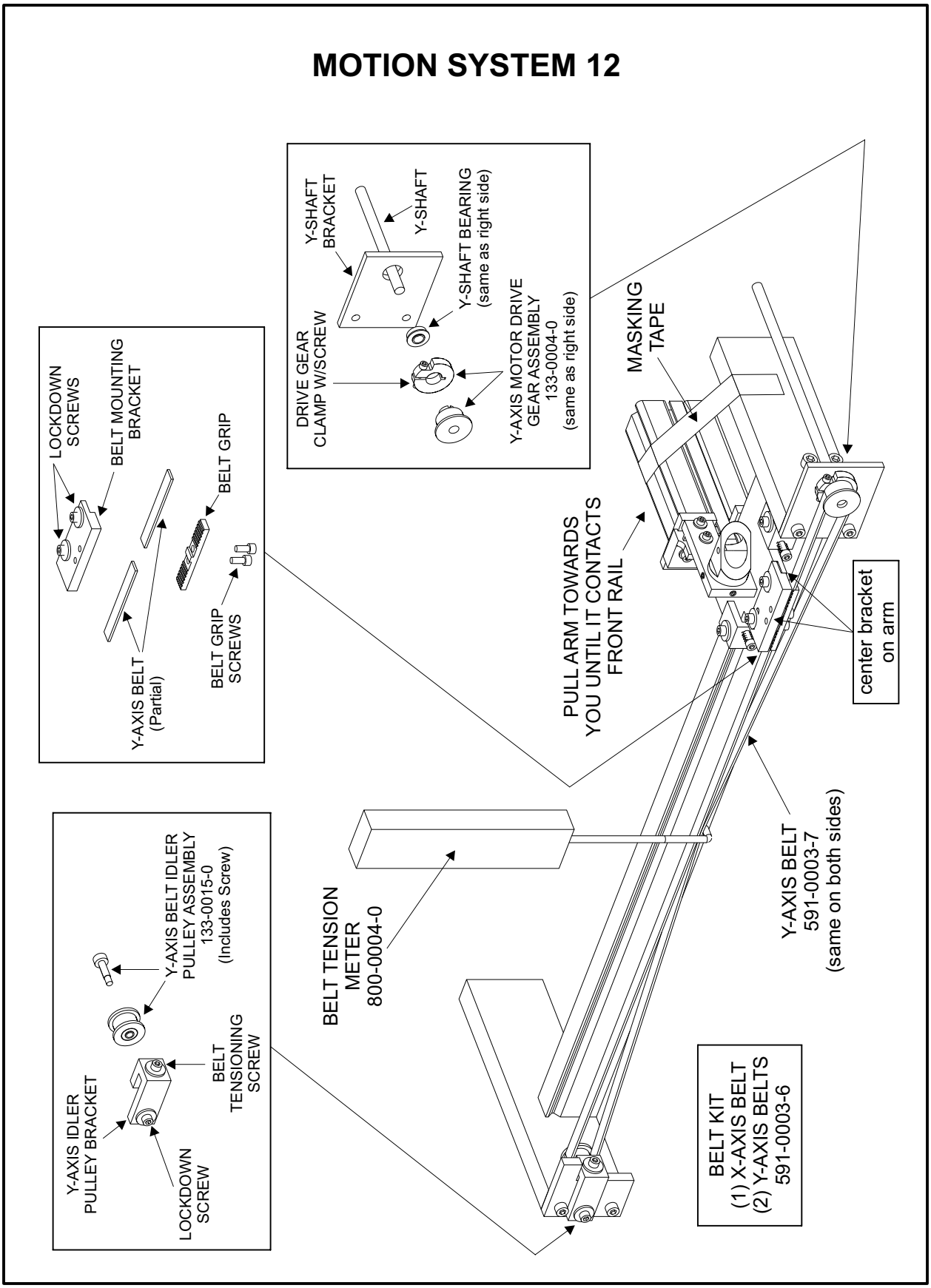
Y-shaft Bearing Removal and Installation
Push Y-shaft Bearing off the Y-shaft with a small screwdriver from the back side. Install new Y-shaft Bearing by sliding it on to Y-shaft as far as it will go. Make sure that it is seated properly into the Y-shaft bracket. **DO NOT** use any tools to push the new Y-shaft Bearing, it should slide on easily by hand. If not, use a drop of household oil on the shaft or clean off the debris that might be on the shaft.

Y-axis Drive Gear Installation
Install new Drive Gear and Drive Gear Clamp. Tighten down the Clamp Screw.

Y-axis Belt Installation
Pull the Arm to the front of the laser system until it makes contact with the front rail. Take some masking tape and tape the Arm to the front rail on both the left and right sides. Wrap the belt around the Drive Gear first and then the Idler Pulley second. You might see some belt slack between the Bracket and the Drive Gear, this is normal. Go back and loosen the Belt Mounting Bracket Lockdown Screws, this time only ¼ turn and observe that the Bracket will move slightly. Check to make sure that the Drive Gear is aligned with the Belt. If not, loosen drive Gear Clamp Screw, reposition the Drive Gear on the Y-Shaft, and tighten screw.

Y-axis Belt Adjustment
With the Belt Mounting Bracket Lockdown Screws still loose on the Arm, place a Belt Tension Meter in the center of the belt and pull the bottom part of the belt up until it makes contact with the top part of the belt. Adjust the tension by tightening the Belt Tension Screw until the Belt Tension Meter reads 7-8 ounces or 200-225 grams of force when the bottom part of the Belt just touches the top part of the belt. When tension is correct, tighten down the Idler Pulley Bracket Lockdown Screw. After adjusting tension, it is necessary to Square the X-axis Arm and adjust the Y-axis Bearing Clearance. Leave the Arm taped to the front rail and the Belt Mounting Bracket Lockdown Screws loose. Proceed to Motion System 10 to complete the procedure.

MOTION SYSTEM 12



MOTION SYSTEM 13

Y-axis Motor Description, Removal and Installation

Description

The Y-axis Motor has two shafts, one to drive the left side and one to drive the right side of the motion system. Most applications utilize the raster function which causes more wear on the X-axis Motor than the Y-axis Motor. Y-axis Motor replacement is very rare but not impossible.

Y-axis Motor Removal

- Disconnect the Motor Cable from the Wire Harness.
- Loosen the four(4) Set Screws on both Couplers and slide each Coupler away from the Motor and further onto the Y-shaft.
- Remove the two(2) screws that attach the Y-axis Motor Assembly to the Front Rail and pull the Motor out of the laser system.
- Remove the four(4) screws that attach the “L” shaped bracket to the Motor and install on the new Motor.

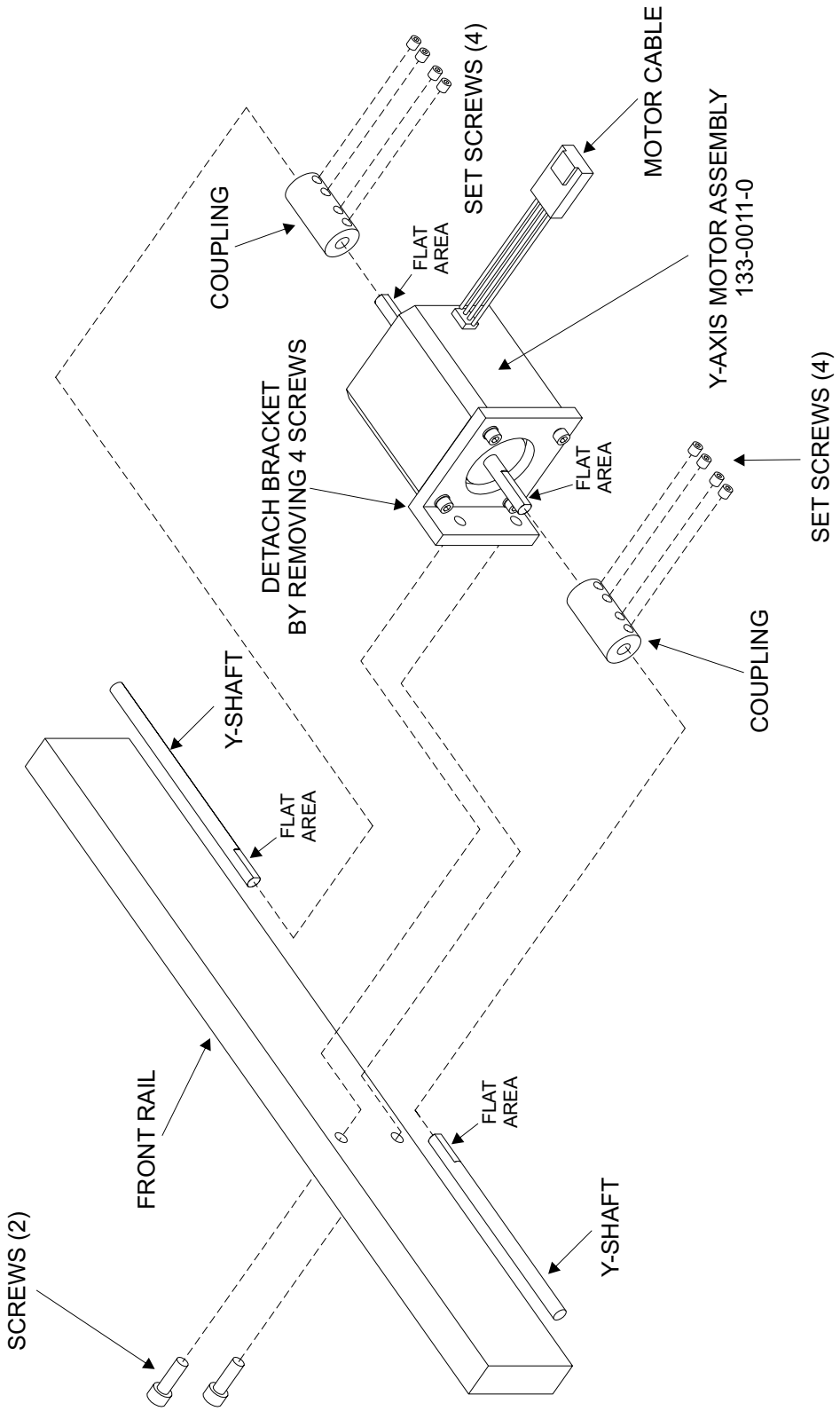
Y-axis Motor Installation

- Attach the new Y-axis Motor Assembly and Bracket to the Front Rail with the two(2) screws.
- Slide both Couplers onto the Shaft of the Motor. Rotate the Motor Shaft until the flat area lines up with the flat area on the Y-shaft.
- Position both Couplers so that the Set Screws, when tightened, will seat themselves on the flat part of the Shaft.
- Connect the Motor Cable to the Wire Harness.

Adjustment

Refer to the procedure “Motion System 10” to check the squareness of the X-axis Arm and the Y-axis Bearing Clearance.

MOTION SYSTEM 13



MOTION SYSTEM 14

X-axis Arm Description, Installation, Adjustment

Description

If installing a new X-axis Arm, the Assembly comes from the factory as shown. It does not include the #2 or # 3 mirrors or a focus lens in the holder as the diagram illustrates.

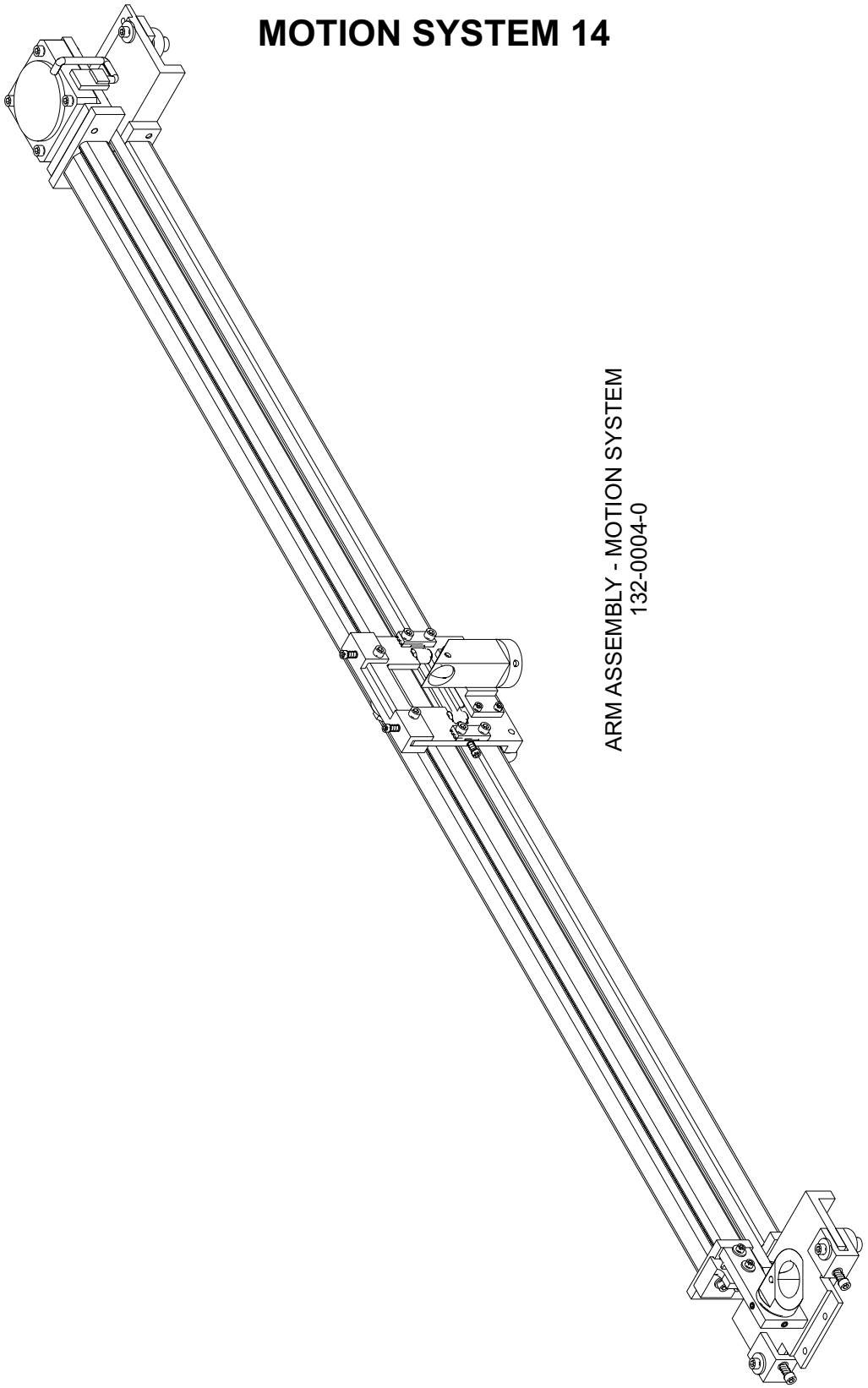
Installation

Refer to the procedure “Motion System 11” on how to install the X-axis Arm Assembly.

Adjustment

Refer to the procedure “ Motion System 10” on how to square the X-axis Arm Assembly and Adjusting the Y-axis Bearing Clearances.

MOTION SYSTEM 14



ARM ASSEMBLY - MOTION SYSTEM
132-0004-0

MOTION SYSTEM 15
Beam Alignment

Theory

The correct alignment between the Laser Beam and the Motion System is very critical to correct Laser System operation. The Laser Beam MUST strike each Mirror at a precise 45 degree angle to reflect 100% of the Laser Beam's energy to the other Mirrors and Focus Lens. If not, the Laser Beam can miss an entire Mirror and never reflect to the Focus Lens. If the Laser Beam never gets to the Focus Lens, then it will not be capable of engraving any material. If the alignment is slightly off and some of the Laser beam strikes the Focus Carriage instead of the Mirror, then a loss of Laser power will occur.

If the Laser System is experiencing no beam output or a reduced beam intensity (loss of power), then a few things should be checked before assuming that the Laser Tube or associated electronics are faulty. The first thing to check is the cleanliness of the Mirrors and Focus Lens as well as the Beam Window. If any of these optics are dirty, a loss of Laser power will occur. Secondly, check to see if the #2 and/or #3 Mirror is mounted correctly. An incorrectly mounted Mirror can cause a beam misalignment. A misaligned beam can cause a loss of power (or no power) as well as a shifted image in the engraving area. This can also cause a partial field engraving such as a good engraving in the upper left hand corner of the engraving area and lowered power or disappearing engraving in the lower right hand corner. If the Mirrors are mounted correctly and al the optics are clean, the alignment should be checked. Also, if the Laser Tube has been exchanged for a rebuilt one, then the Beam Alignment procedure is most likely necessary. It is important that we have correct alignment in all 5 positions of the Motion System. **We will abbreviate Mirror 1 as M1 and Position 1 as P1, etc., for all mirrors and positions.**

We do not need a special devices in order to check the Beam alignment except for a roll of masking tape, Safety Goggles, the interlock defeat tool, and a set of allen wrenches. Since the beam is invisible, we will use the masking tape to cover the area where the Laser Beam will travel through to hit the Mirror #2 (M2) and Mirror #3 (M3). We will burn a small spot in the masking tape to determine if the Laser beam is striking the center of the hole(the #2 Mirror mount and the #3 Mirror mount) in all 5 positions (P1 - P5) of the Motion System. If it strikes the center of the hole, this means that it will strike the center of the Mirror that is behind the hole. We will be testing the alignment with the Top Door open and the Safety Interlock Defeated.

CAUTION!

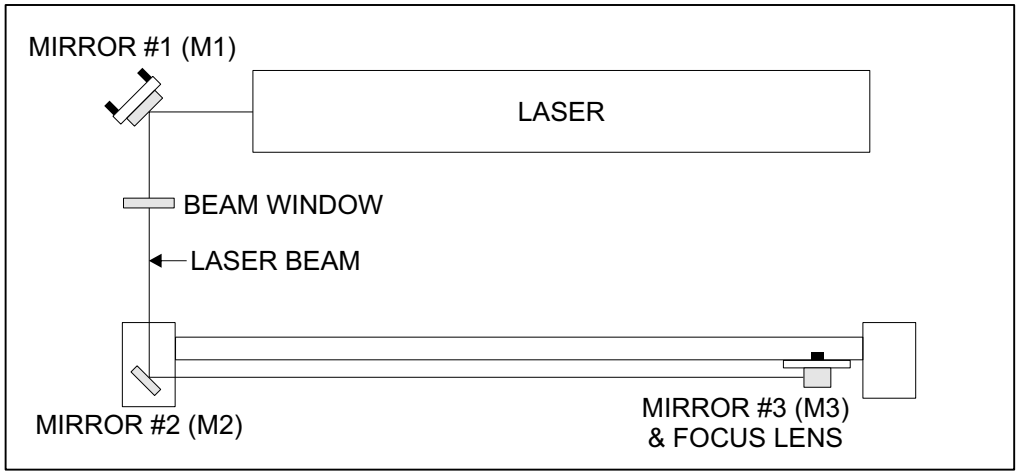
Before attempting to adjust the Laser Beam, it is very important that you understand these facts: The Laser Beam can produce an intense radiation of heat energy. Avoid eye or skin exposure to direct or scattered radiation. Always wear safety goggles and never cross the path of the beam with any body part. Although we will be testing the alignment of the Laser Beam at very low power levels, all safety precautions should be followed.

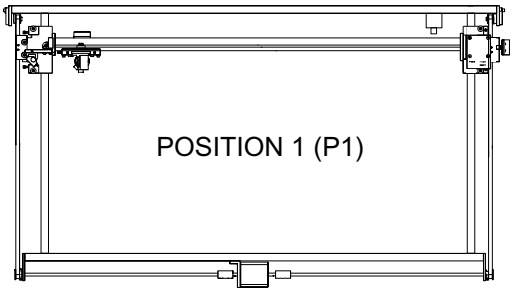
Alignment Mode

Make sure that the Laser System is **OFF. Remove M2, M3, and the Focus Lens. Put on your Safety Goggles**, open the Top Door, insert the Interlock Defeat Tool, and turn the Laser System ON. When "READY" appears on the display, press the "ESCAPE" key. Go down to "PREFERENCES" and then select "CONFIGURATION". Go to "ALIGNMENT MODE" and press "SELECT". There are two numbers that appear, they are POWER % and KHZ . These numbers have been pre-set at the factory for a very low setting. This setting should be just enough power to check alignment. While in this menu selection, press the left arrow directional key and observe the Focus Carriage move all the way to the left. Now press the other directional keys and watch the Motion System move to each corner of the engraving area respectively. Practice moving the Focus Carriage to simulate the 5 testing positions as the diagram indicates.

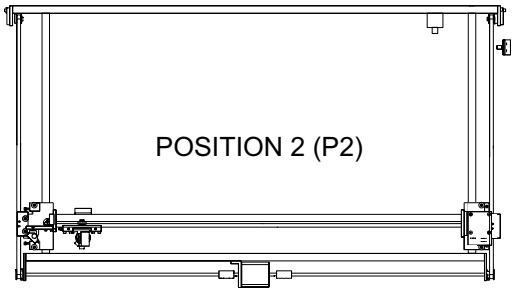
Before removing the Fan Enclosure and the Laser Endplate Cover, we will check the alignment between P1 and P2.

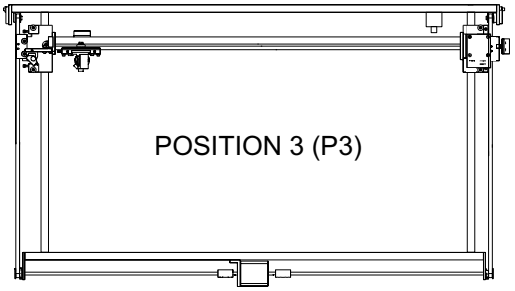
MOTION SYSTEM 15

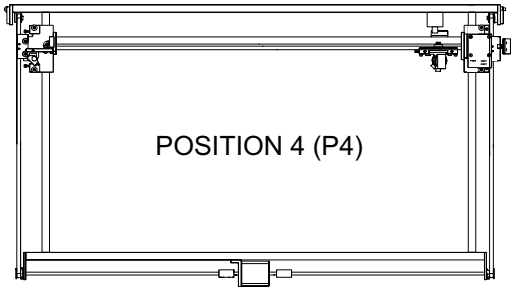


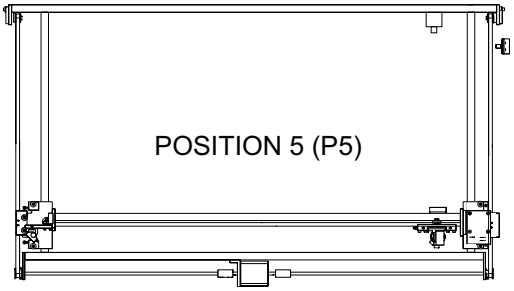


POSITION 1 & 3 ARE THE SAME









MOTION SYSTEM 16
(Beam Alignment continued)

Place a piece of Masking Tape over the #2 Mirror Holder and press the directional arrow key to position the Motion System at P1. Rub the masking tape with your finger, against the edge of the hole so that you can see an impression of the hole through the tape. With your right hand, place your finger on the "TEST" button. Press the button once to turn the Laser beam **ON** and once again to turn it **OFF**. It takes only a few seconds to start to see the Laser beam burn a hole through the Masking Tape. The objective is to have the Laser **ON** long enough to burn the smallest brown spot in the tape that is possible without burning through it. P1 is a difficult position to see because it so far into the upper left hand corner. Try counting to 3 after you press the "TEST" button then turn it **OFF**. Look at the spot and adjust your timing to get the smallest visible spot possible. After practicing, apply a fresh piece of tape and burn a dot (fire the Laser) at P1. Then, without removing the tape, burn a dot at P2 (as the diagram illustrates). Compare the two dots. If the two dots are directly on top of each other and in the center of the hole (imagine that the hole is a Bull's Eye), then the alignment from M1 to M2 is good. We can then go to the next procedure and check the alignment between M2 and M3. If the two dots are separated and/or the combined dots are not in the center of the hole, an alignment adjustment must be performed all the way back at M1. To get to M1, follow the procedure in "Laser Tube Assembly 1" to remove the outer fan enclosure and #1 mirror cover, and then return back to this section.

There are four(4) different ways to adjust M1. The vertical angle, horizontal angle, vertical displacement, and horizontal displacement adjustments.

- If the P1 dot and the P2 dots are **NOT** on top of eachother (combined), then an angular adjustment is required. Go to the "Separated Dots" section. **Always make all angular corrections before making any displacement corrections.**

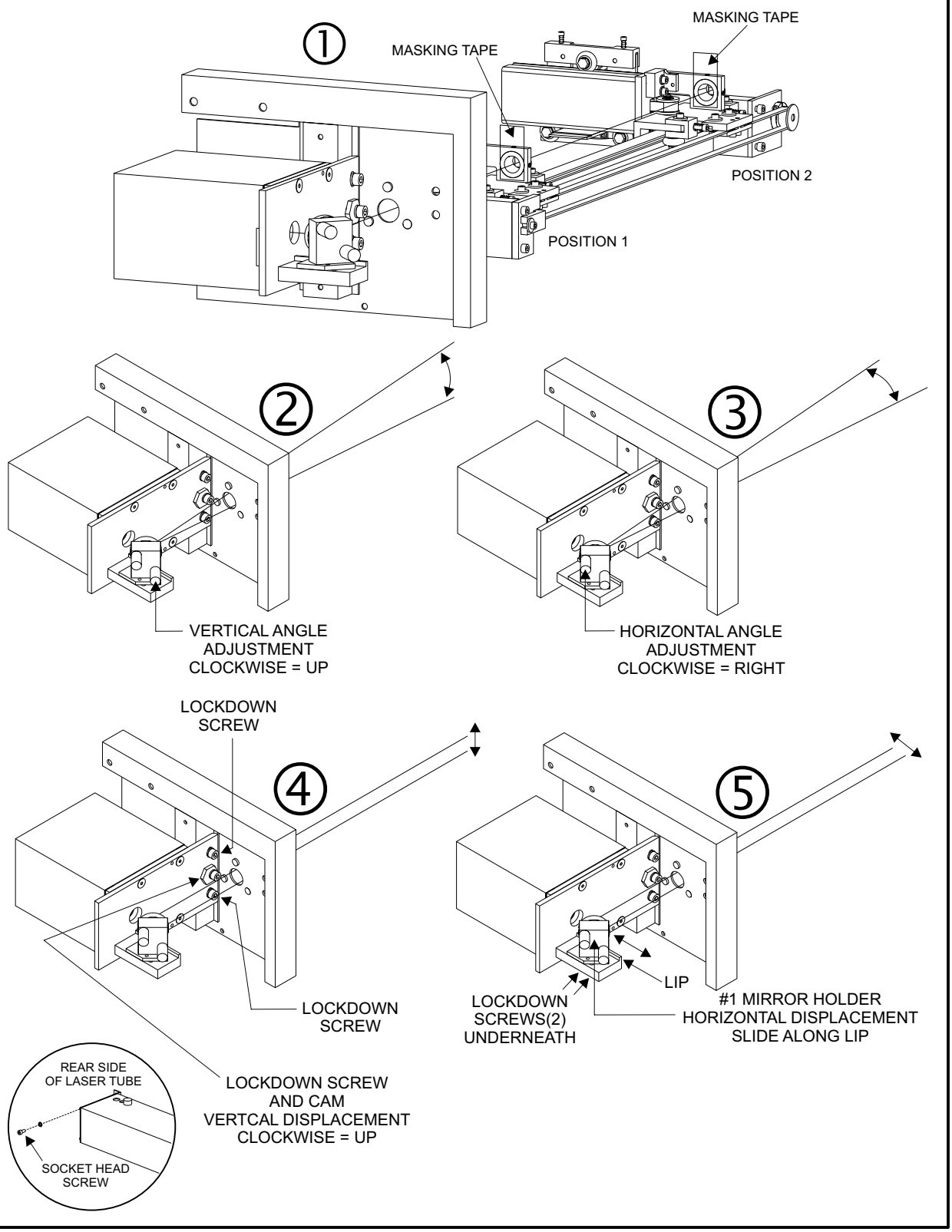
- If the P1 dot and the P2 dot are directly on top of eachother (combined), but the combined dots are **NOT** positioned in the direct center of the hole, then a displacement adjustment is necessary. Go to the "Combined Dots Not Centered" section.

Separated Dots - Horizontally and/or Vertically (P1 to P2)
Determine which dot is the P1 dot and which dot is the P2 dot. We will always adjust the P2 dot to meet the P1 dot regardless of whether the P1 dot is in the center of the hole or not. If the P2 dot is higher or lower than the P1 dot, turn the black knob (picture2), in the appropriate direction (very slightly), and re-check with a fresh piece of Masking Tape. Adjust and re-check until both the P2 and the P1 dots are on top of eachother. If dots are directly on top of eachother and perfectly centered in the hole, go to the next page (M2 to M3 alignment). If dots are directly on top of eachother(combined) but the combined dots are not perfectly centered in the hole, go to "Not Centered" section. If the P2 dot is to the left or to the right of the P1 dot, turn the black knob (picture 3), in the appropriate direction (very slightly), and re-check with a fresh piece of Masking Tape. Adjust and re-check until both the P2 and the P1 dots are combined into one dot. If both dots are combined and the combined dots are directly in the center of the hole then proceed to M2 to M3 alignment on the next page.

Combined Dots Not Centered in Hole Vertically (P1 to P2)
If the combined dots are too high or too low in the hole, then a vertical displacement adjustment is necessary. If the combined dots are too far to the right or too far to the left then a horizontal displacement adjustment is necessary. To adjust vertical displacement, **LOOSEN ONLY, DO NOT REMOVE,** the top socket head screw on the rear end of the laser tube (see diagram). Loosen, **ONLY ½ TURN**, the two(2) lockdown screws in front of M1 and also the lockdown screw that is attached to the cam nut. To raise the entire beam up, rotate the cam nut clockwise and observe the mounting plate slide upwards. Re-tighten **ALL** lockdown screws and re-check alignment between P1 and P2. If the combined dots are too high, loosen the lockdown screws ½ turn, rotate the cam nut counterclockwise, tighten **ALL** lockdown screws and re-test.

Combined Dots Not Centered in Hole Horizontally (P1 to P2)
If the combined dots are too far to the left, loosen the two(2) lockdown screws underneath M1 and slide M1 to the right the same amount that you need to move the dots. When doing this, make sure that M1's mounting plate remains flat up against the lip of the support bracket (to prevent the mirrors angle from

MOTION SYSTEM 16



MOTION SYSTEM 17
(Beam Alignment Continued)

changing). Tighten the lockdown screws and re-test alignment between P1 and P2. If the dots have separated, re-check to make sure that the M1 holder is flat against the lip of the mounting bracket. If not, re-adjust and re-test. Sometimes a re-adjustment of the black knobs may be necessary to bring the dots back together. **The black knobs are ONLY to be used to combine the two separated dots into one dot, never use them to center the combined dots in the hole.** If the combined dots are too far to the right, loosen the lockdown screws, and slide M1 to the left. Again, make sure that the M1 holder remains flat up against the lip of the support bracket. Re-tighten the lockdown screws and re-test. Once the P1 and P2 dots are exactly on top of eachother and the combined dots are perfectly centered it the hole, then install M2 back on it's holder and proceed to align the system between P2 and P3.

Separated Dots - Horizontally (P3 to P4)
Burn a dot at P3 (as diagram illustrates) and then at P4. Compare the dots. If dots are separated horizontally, adjust Horizontal Angle Adjustment Screw (Fig.2) to combine the P4 dot with the P3 dot. Turning the screw clockwise causes the beam to move towards the front of the laser system at the P4 position. There should be a significant amount of tightness to the Horizontal angle adjustment screw. This will prevent the screw from loosening during engraving. If it is not tight, tighten the Bracket Tension Screw (next to it) to create tension on the bracket. This will cause the bracket to bend slightly. After tightening this screw, you might need to go back a recheck the P4 dot because it might have moved. Re-adjust the Horizontal Angle Adjustment Screw if necessary. Sometimes it is better to simply loosen the Horizontal Angle Adjustment screw completely, tighten the Bracket Tension Screw until the dot at P4 is on the edge of the hole (towards the back of the laser system), and then go back and tighten the Horizontal Angle Adjustment screw to combine the dots between the P4 and P3 positions. What you are doing is actually bending the #2 mirror holder bracket around it's pivot stem located between the two adjustment screws. Doing this will ensure that both screws have enough pressure from the bracket so that the screws do not loosen. It is **OK** if the dots are split vertically, we wil adjust that later. If the combined dot's position in the hole is too far to the right (towards the front) or too far to the left (towards the rear) side of the hole, we will need to adjust Horizontal Displacement.

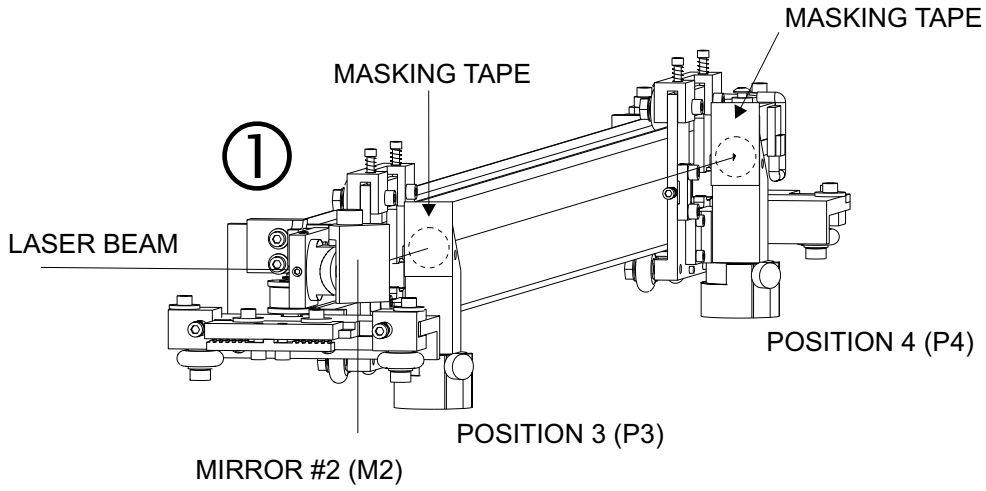
Combined Dots Not Centered in Hole Horizontally (P3 to P4)
Loosen, **ONLY ¼ TURN**, the two(2) Lockdown Screws that attach the #2 Mirror Bracket to the Arm (Fig.3). Slide the Bracket along the Arm in the direction you need to move the combined dots, making sure that the Lip of the Bracket remains in full contact with the Arm. Hold the Lip down while tightening the lockdown screws ensure that the bracket does not twist. Re-check and re-adjust if necessary until the combined dots are centered in the hole horizontally.

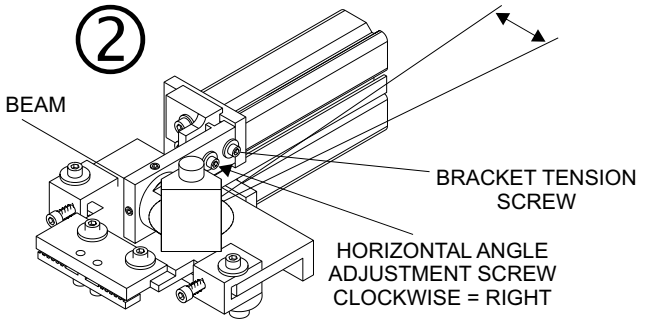
Separated Dots - Vertically (P3 to P4)
If the dots are not separated vertically then this step is not necessary, proceed to P5 position. If they are split, loosen the two(2) Nylon Tipped Set Screws, ONLY ¼ TURN, and rotate the Cylinder until the P4 dot is aligned with the P3 dot. **THIS IS A VERY SENSITIVE ADJUSTMENT, TURNING THE CYLINDER TOO MUCH CAN CAUSE A SEVERE MISALIGNMENT. MAKE EXTREMELY SMALL MOVEMENTS AND RE-CHECK DOTS FREQUENTLY.** When dots are aligned, tighten back the Nylon Tipped Set Screw until it is lightly snug. DO NOT OVERTIGHTEN! Overtightening can cause damage to the cylinder as well as disturbing the alignment adjustment that was just made.

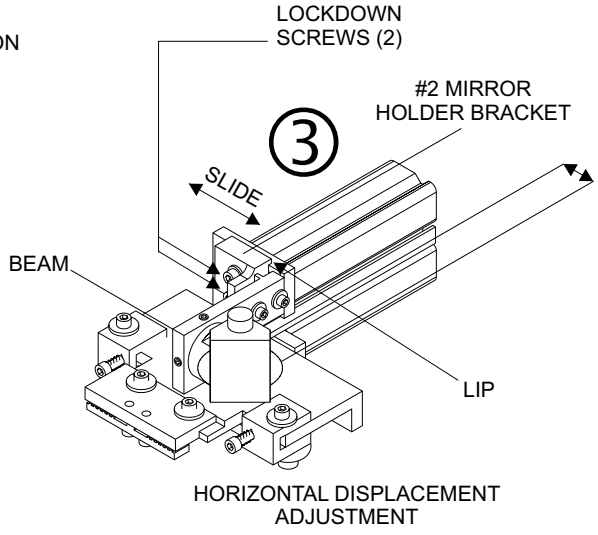
P5 Position (Final Position)
Using a fresh piece of tape, burn a dot at P3, P4, and P5. Compare the dots. If only the P5 dot is not centered in the hole, then go all the way back to M1 and adjust the black knobs until the P5 dot is centered in the hole. This will slightly effect the alignment at P3 and P4 only slightly. Re-burn all 3 dots on a fresh piece of tape and if all 3 dots are closer to the center of the hole than the edge of the hole, alignment is complete. The dots do not need to be exactly on top of eachother or exactly in the center of the hole, they just need to be closer to the middle than the edge. The P1 to P2 alignment needed to be perfect in order to make the adjustment at P5 much easier and precise.

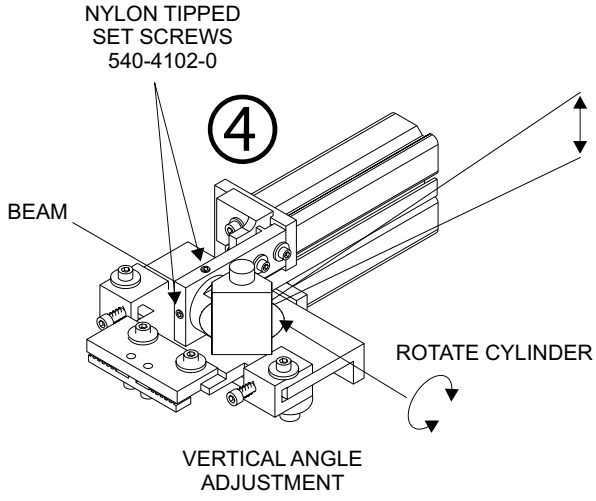
Alignment Quick Check
If simply checking an alignment, without removing any covers, burn a dot at the P5 position with M3 and the focus lens off. If dot is closer to the center of the hole than the edge of the hole, total alignment is good, re-install 3 and lens. If bad, do the alignment checks backwards until you find the problem.

MOTION SYSTEM 17

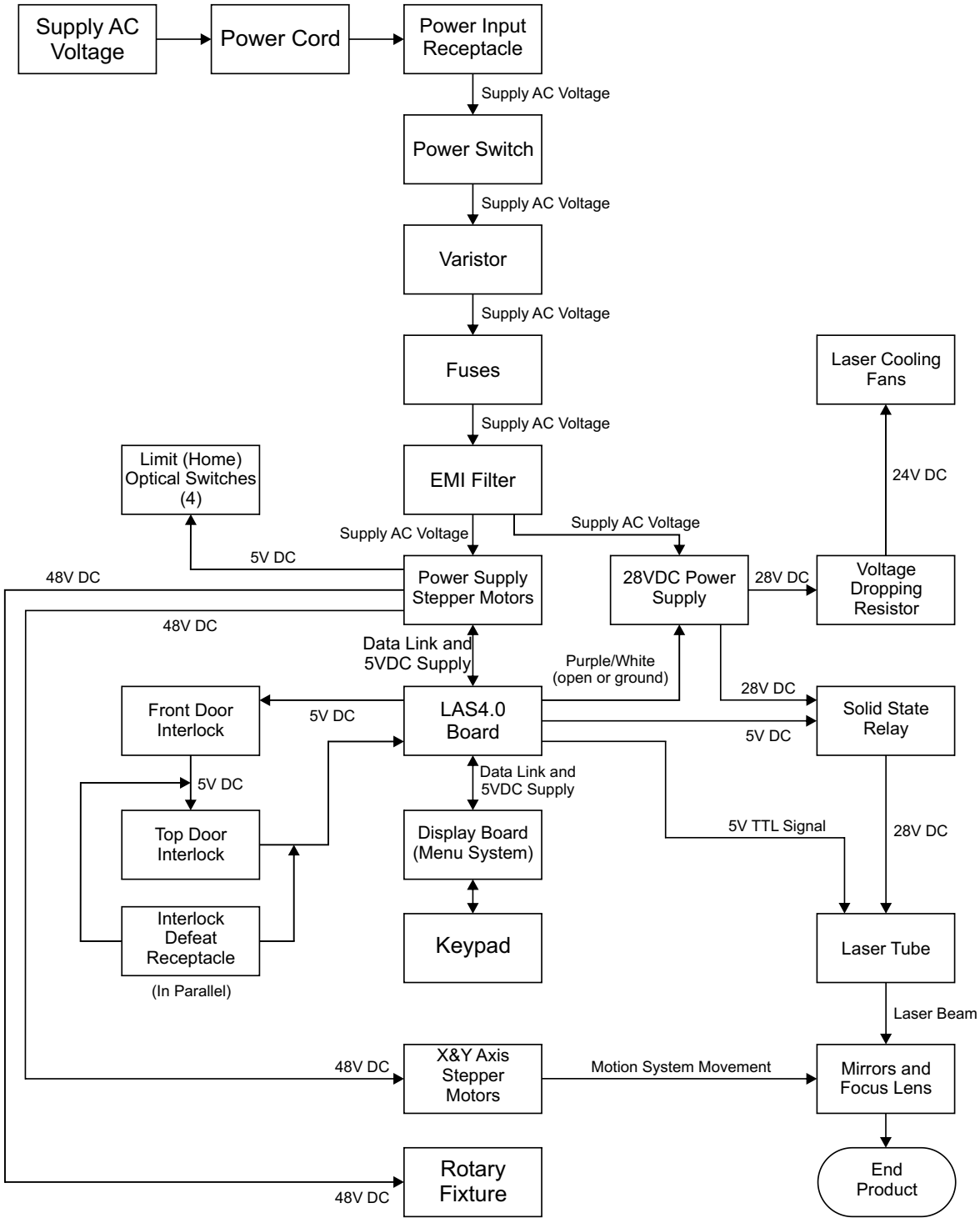




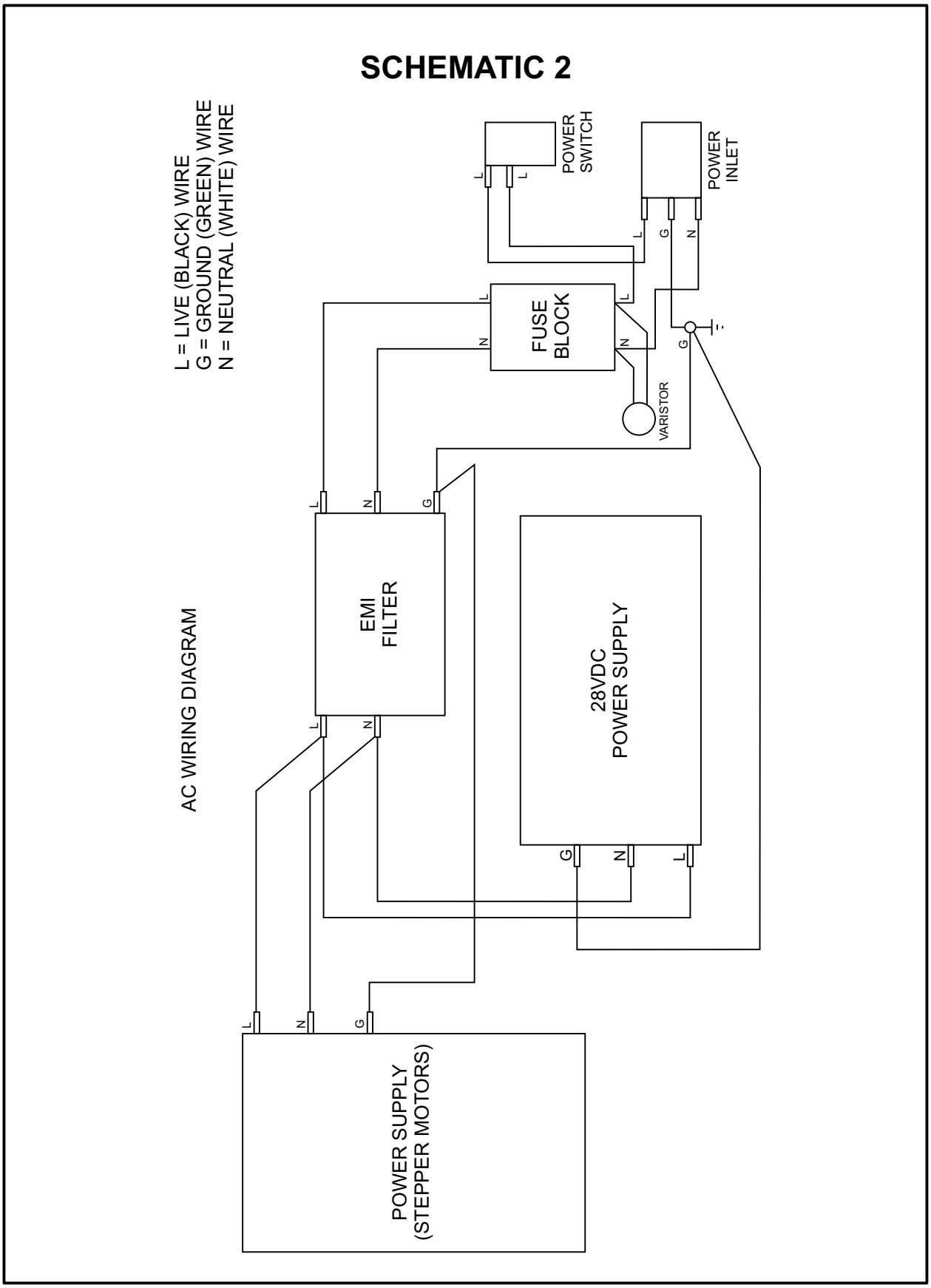




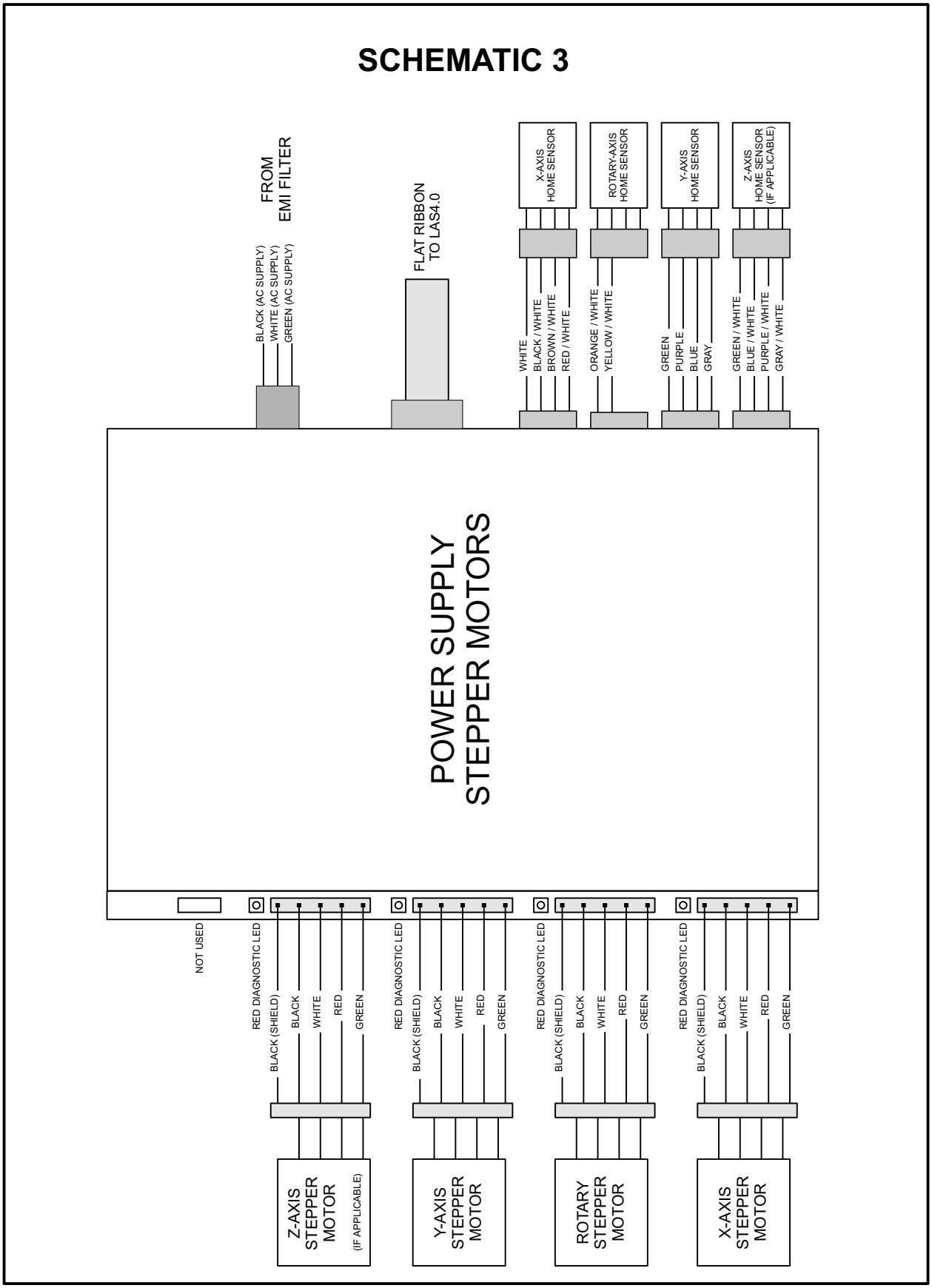
SCHEMATIC 1


Supply AC Voltage
Power Cord
Power Input Receptacle
Supply AC Voltage
Power Switch
Supply AC Voltage
Varistor
Supply AC Voltage
Fuses
Supply AC Voltage
EMI Filter
Limit (Home) Optical Switches (4)
5V DC
Supply AC Voltage
Supply AC Voltage
Power Supply Stepper Motors
48V DC
48V DC
28VDC Power Supply
28V DC
Voltage Dropping Resistor
24V DC
Laser Cooling Fans
Data Link and 5VDC Supply
Purple/White (open or ground)
28V DC
Front Door Interlock
5V DC
LAS4.0 Board
5V DC
Solid State Relay
5V DC
Data Link and 5VDC Supply
Top Door Interlock
Display Board (Menu System)
5V TTL Signal
28V DC
Interlock Defeat Receptacle
(In Parallel)
Keypad
Laser Tube
Laser Beam
48V DC
X&Y Axis Stepper Motors
Motion System Movement
Mirrors and Focus Lens
Rotary Fixture
48V DC
End Product

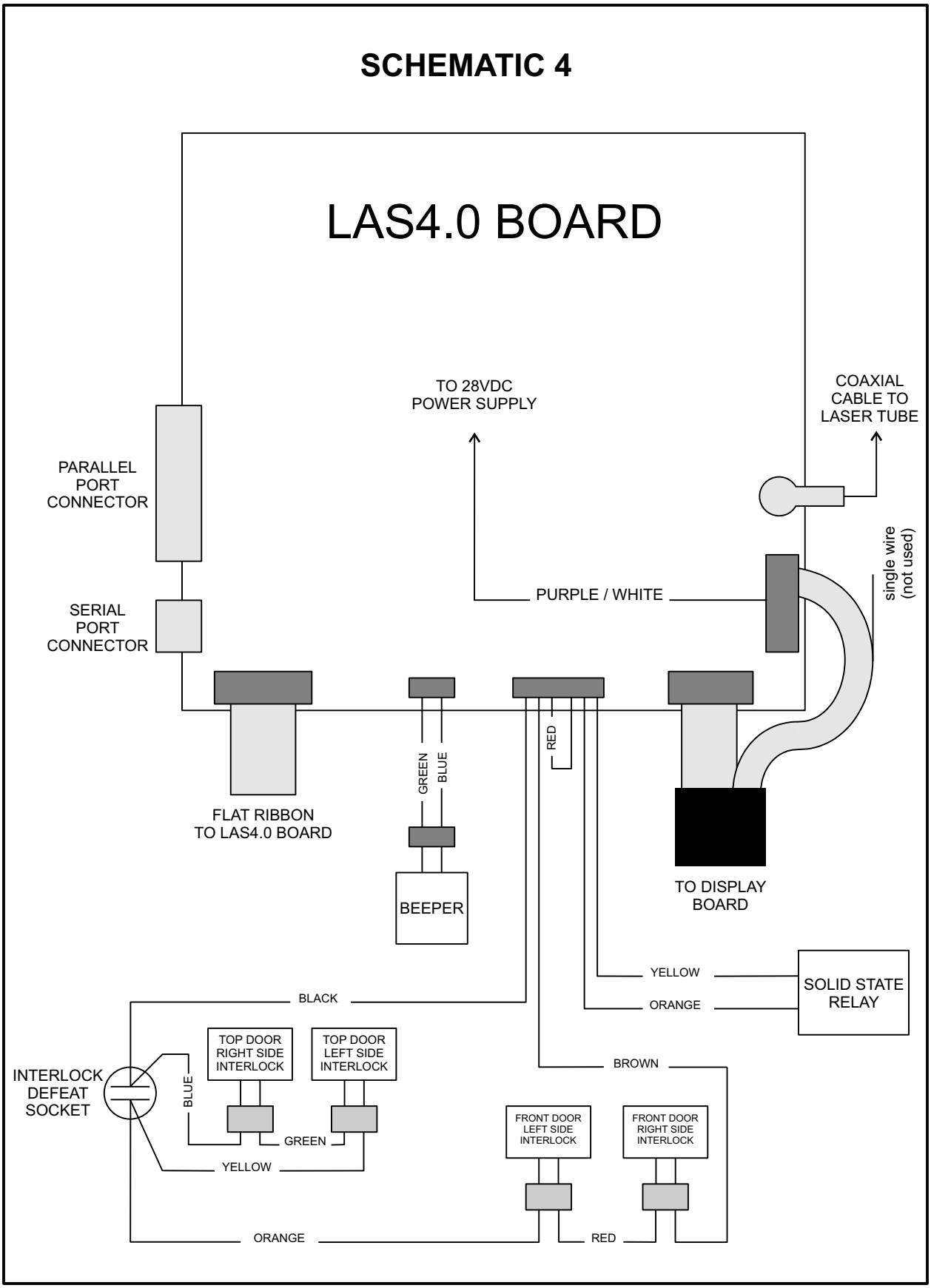
SCHEMATIC 2


L = LIVE (BLACK) WIRE
G = GROUND (GREEN) WIRE
N = NEUTRAL (WHITE) WIRE
AC WIRING DIAGRAM
POWER SWITCH
POWER INLET
FUSE BLOCK
VARISTOR
EMI FILTER
28VDC POWER SUPPLY
POWER SUPPLY (STEPPER MOTORS)
L
N
G

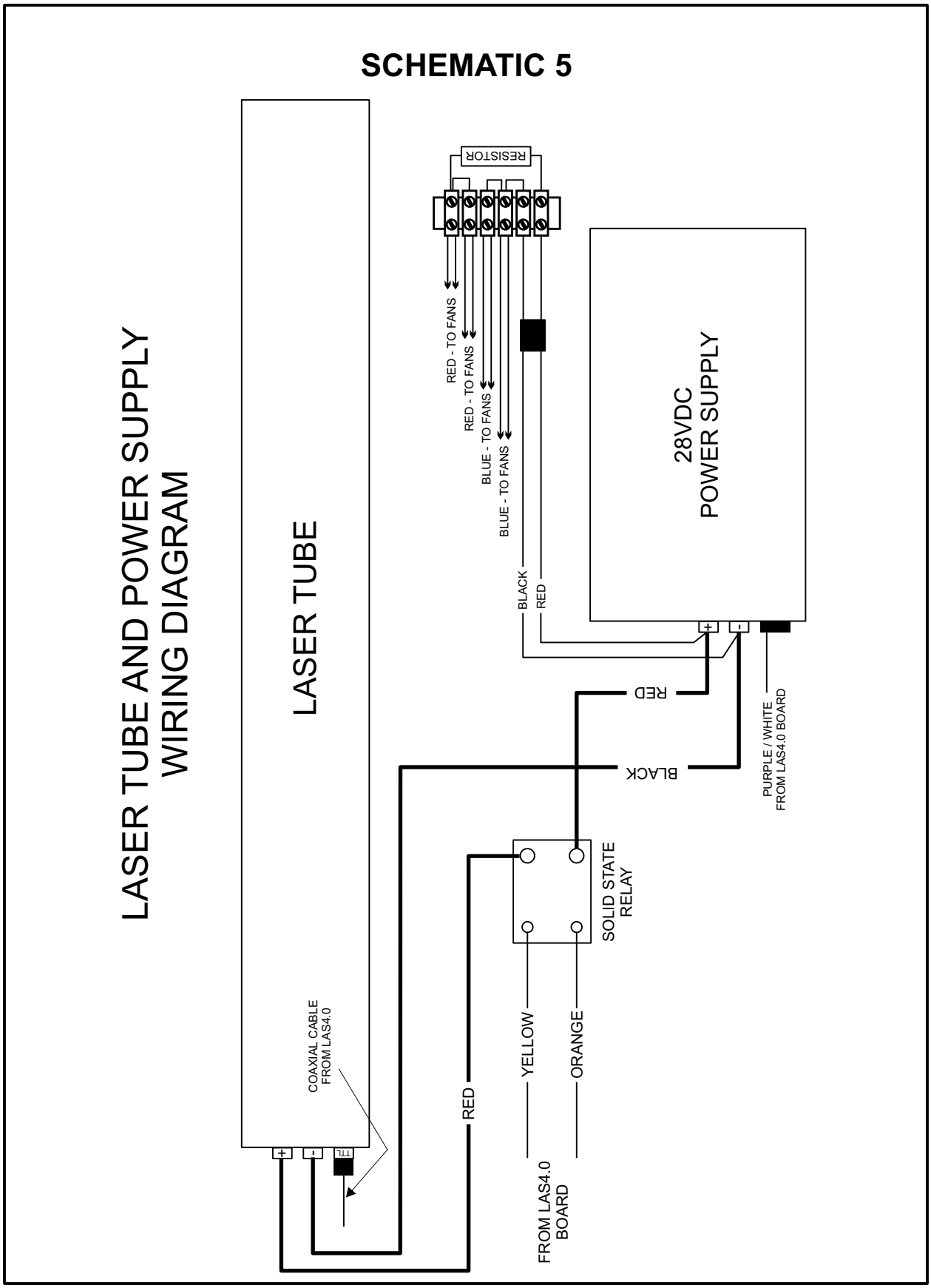
SCHEMATIC 3


FROM EMI FILTER
BLACK (AC SUPPLY)
WHITE (AC SUPPLY)
GREEN (AC SUPPLY)
FLAT RIBBON TO LAS4.0
X-AXIS HOME SENSOR
WHITE
BLACK / WHITE
BROWN / WHITE
RED / WHITE
ROTARY-AXIS HOME SENSOR
ORANGE / WHITE
YELLOW / WHITE
Y-AXIS HOME SENSOR
GREEN
PURPLE
BLUE
GRAY
Z-AXIS HOME SENSOR (IF APPLICABLE)
GREEN / WHITE
BLUE / WHITE
PURPLE / WHITE
GRAY / WHITE
POWER SUPPLY STEPPER MOTORS
NOT USED
RED DIAGNOSTIC LED
BLACK (SHIELD)
BLACK
WHITE
RED
GREEN
Z-AXIS STEPPER MOTOR (IF APPLICABLE)
Y-AXIS STEPPER MOTOR
ROTARY STEPPER MOTOR
X-AXIS STEPPER MOTOR

SCHEMATIC 4

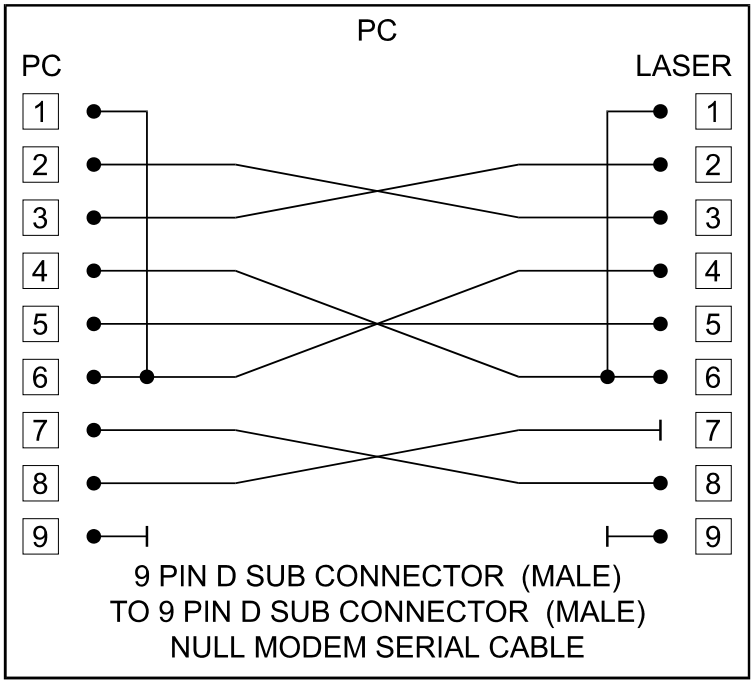

LAS4.0 BOARD
TO 28VDC
POWER SUPPLY
COAXIAL
CABLE TO
LASER TUBE
PARALLEL
PORT
CONNECTOR
SERIAL
PORT
CONNECTOR
PURPLE / WHITE
single wire
(not used)
FLAT RIBBON
TO LAS4.0 BOARD
GREEN
BLUE
RED
BEEPER
TO DISPLAY
BOARD
YELLOW
ORANGE
SOLID STATE
RELAY
BLACK
BROWN
INTERLOCK
DEFEAT
SOCKET
BLUE
TOP DOOR
RIGHT SIDE
INTERLOCK
TOP DOOR
LEFT SIDE
INTERLOCK
GREEN
YELLOW
FRONT DOOR
LEFT SIDE
INTERLOCK
FRONT DOOR
RIGHT SIDE
INTERLOCK
ORANGE
RED

SCHEMATIC 5

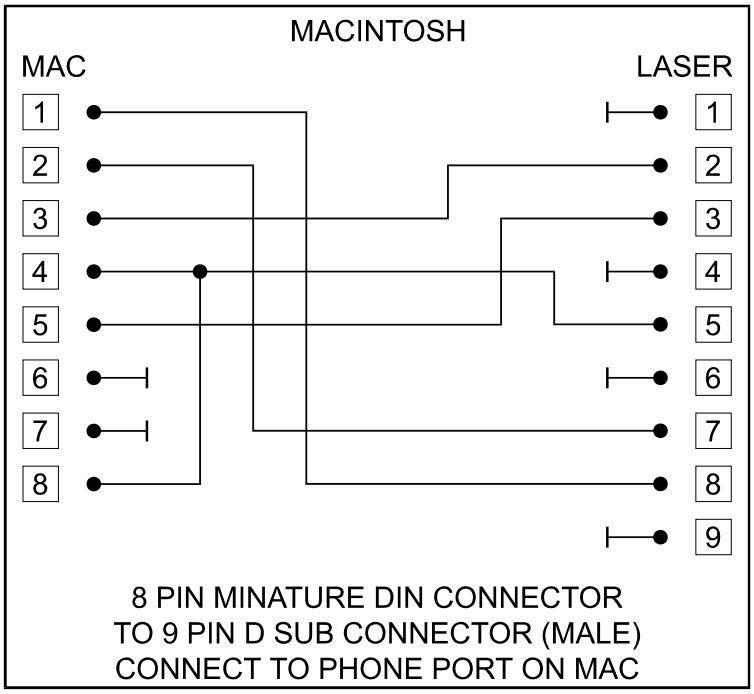

LASER TUBE AND POWER SUPPLY
WIRING DIAGRAM
LASER TUBE
+
-
HV
COAXIAL CABLE
FROM LAS4.0
RED
YELLOW
ORANGE
FROM LAS4.0
BOARD
SOLID STATE
RELAY
RESISTOR
RED - TO FANS
RED - TO FANS
BLUE - TO FANS
BLUE - TO FANS
BLACK
RED
28VDC
POWER SUPPLY
+
-
RED
BLACK
PURPLE / WHITE
FROM LAS4.0 BOARD

SCHEMATIC 6

SERIAL PORT CABLE REQUIREMENTS



9 PIN D SUB CONNECTOR (MALE)
TO 9 PIN D SUB CONNECTOR (MALE)
NULL MODEM SERIAL CABLE



8 PIN MINATURE DIN CONNECTOR
TO 9 PIN D SUB CONNECTOR (MALE)
CONNECT TO PHONE PORT ON MAC

TICKLE ADJUSTMENT

Description, Adjustment

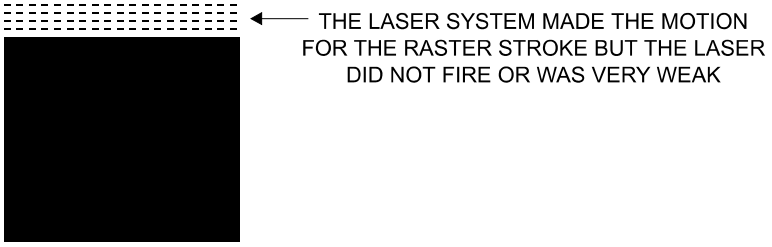
Description

For maximum laser performance, and instantaneous response time, the laser must be supplied with a small pulse width and pulse rate signal at all times. This is what we refer to, in the laser industry, as the "Tickle". Tickle is automatically sent to the laser while the system power is on and the laser is idle. This signal is required to keep the plasma, inside the laser tube, ionized continuously. Tickle keeps the laser "warmed up" at times when the laser system is powered on but the laser is not firing and the top and front doors are closed. We suggest keeping the doors closed at all times when the laser system is powered on, this keeps the laser warmed up. If the door(s) are open, the power to the laser tube itself is turned off and the tube will cool down. The laser runs best after being warmed up for 15-20 minutes. Optimally, we can adjust the Tickle to maintain the plasma excitation level at a threshold so that upon demand, the laser will fire instantaneously upon request from the computer, and at greater average power levels. Since every laser has its own personality, Tickle is adjustable through the control panel on the laser system. Tickle is set for each individual laser at the factory, but from time to time, the Tickle setting may need to be adjusted as the internal characteristics of the laser change over several months or several years of operation. Adjustment need only be done as necessary. There are 2 main symptoms of a laser that needs Tickle adjustment.

LOW TICKLE SETTING

If the Tickle setting is too low, the laser will appear to hesitate before firing. Vectored lines may appear to start off weak at the beginning of the line, get stronger in the middle of the line, then get weak again at the end of the line. If the setting is really off, parts of the line may be missing entirely. If you are rastering, the laser may make some raster strokes without firing then start to fire a couple of strokes later.

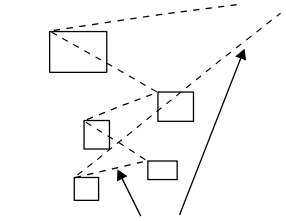
VECTORED LINES



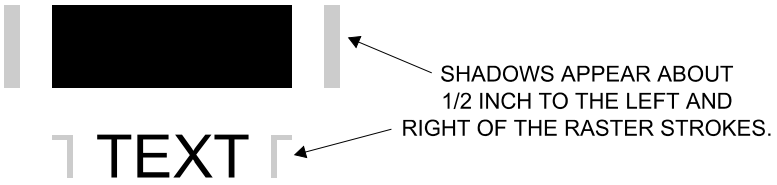
RASTERED SQUARE

HIGH TICKLE SETTING

If the Tickle setting is too high, shadows and extra faint lines will appear in blank areas. Vectored text, for example, will appear to be connected by very light lines from one letter to the next as if the laser was supposed to turn off but stayed on slightly. Rastered images will appear to have a shadow to the left and right of the raster stroke about 1/2" from the edge of the rastered area.



FAINT LINES APPEAR AS
IF LASER DID NOT SHUT
OFF COMPLETELY BETWEEN
OBJECTS



RASTERED OBJECTS

Adjustment

To set the Tickle, go to the Preferences menu in the Control Panel of the laser system, then select "Tickle". There are two numbers, the Tickle Rate in khz(or kilohertz) and the other is Tickle Width in us(or microseconds). The Tickle Rate is a fine adjustment and the Width is a more coarse adjustment. To set the Tickle, warm up the laser by running a graphic at full power and full speed on some scrap material for about 15 minutes. Then draw a rectangle and raster engrave that rectangle on a very sensitive material that will show the shadows of Tickle.

The objective is to raise the Tickle high enough to cause the shadows to appear, then back it off slightly until they disappear. We are trying to establish a threshold that is very high but not high enough to where the laser "leaks" out laser energy and causes shadows.

Tickle too high

If the Tickle setting started out too high, then shadows are already present. While the file is running, reduce the Rate setting until the shadows disappear. **NOTE: When changing the Tickle setting, you must bring the cursor back over to the left side of the display for the changes to take effect. Do this by pressing the "Select" key. If you leave the cursor on the right hand side where you are adjusting the numbers, the change will not take effect.**

If the Rate setting gets down to 2 and the shadows are still present, then put the Rate back to its original number and reduce the Width by one. If the shadows still appear, keep reducing the Rate again until it does disappear.

Tickle too low

If the setting is too low, keep increasing the Rate setting until the shadows appear, then back it off one or two numbers.

Retaining the Settings

Once the Tickle is set properly, escape out of the menu and "Retain Settings" which will make the changes permanent.

TOP DOOR 1

Proximity Sensor Removal and Installation
Top Door Window Cleaning
Top Door Removal and Installation

Proximity Sensor Actuator
The Proximity Sensor Actuators are magnets that will close the circuit of the Safety Interlock System. This will allow the laser beam to fire only if the doors are closed and the circuit is completed.

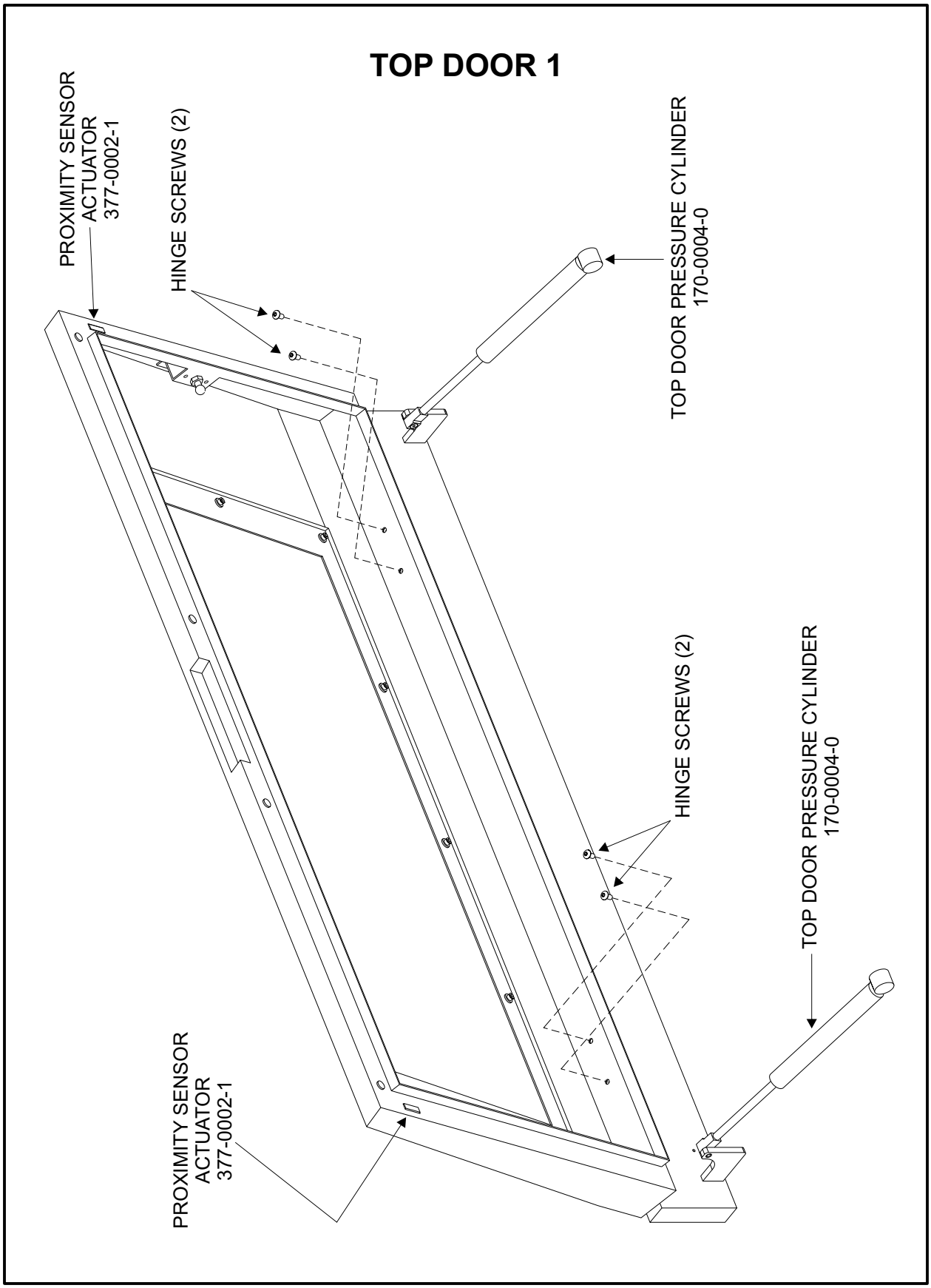
Removal
Unscrew the two(2) small nuts that attach the Actuator to the Top Door. Remove the Actuator.

Installation
Attach the new Actuator to the Top Door. Secure it with the two(2) small nuts that were removed off of the old Actuator.

Top Door Window Cleaning
The Top Door Window is made of acrylic. Only use a mild solution of soap and water, along with a soft cloth such as a Kleenex tissue, to clean it. Do not use paper towels because it will scratch the Window. Do not use window cleaner, lens cleaner, or anything that has alcohol, acetone, or any volatile liquid as this will crack the acrylic. Dupont actually recommends a solution of (1) tablespoon of Joy dishwashing liquid mixed with 1 quart of water in a spray bottle to be used as a cleaning solution.

Top Door Removal
It is recommended that the Top Door Window be replaced by factory personnel. Removal of the Window by itself is not possible due to tamper proof securing nuts. If the Top Door Window needs replacement, the entire door needs to be replaced as a unit. To remove the Top Door, first disconnect the top part of the Pressure Cylinders from the door (see Top Door 2 procedure). Remove the four(4) Hinge Screws and gently lift the Top Door off the Main Enclosure.

Installation
Align new Top Door to the Hinges with the help of another person, and install all four(4) Hinge Screws. Attach the Pressure Cylinders to the Top Door Ball End Studs (see Top Door 2 procedure).


TOP DOOR 1
PROXIMITY SENSOR ACTUATOR 377-0002-1
HINGE SCREWS (2)
TOP DOOR PRESSURE CYLINDER 170-0004-0
HINGE SCREWS (2)
TOP DOOR PRESSURE CYLINDER 170-0004-0
PROXIMITY SENSOR ACTUATOR 377-0002-1

TOP DOOR 2

Pressure Cylinder Removal and Installation

Description

The Top Door Pressure Cylinders help lift the Top Door when opening and also assist in keeping the door tightly closed when it is in the closed position. It also prevents the Top Door from slamming when closing it. After some time they can lose their lifting or holding power.

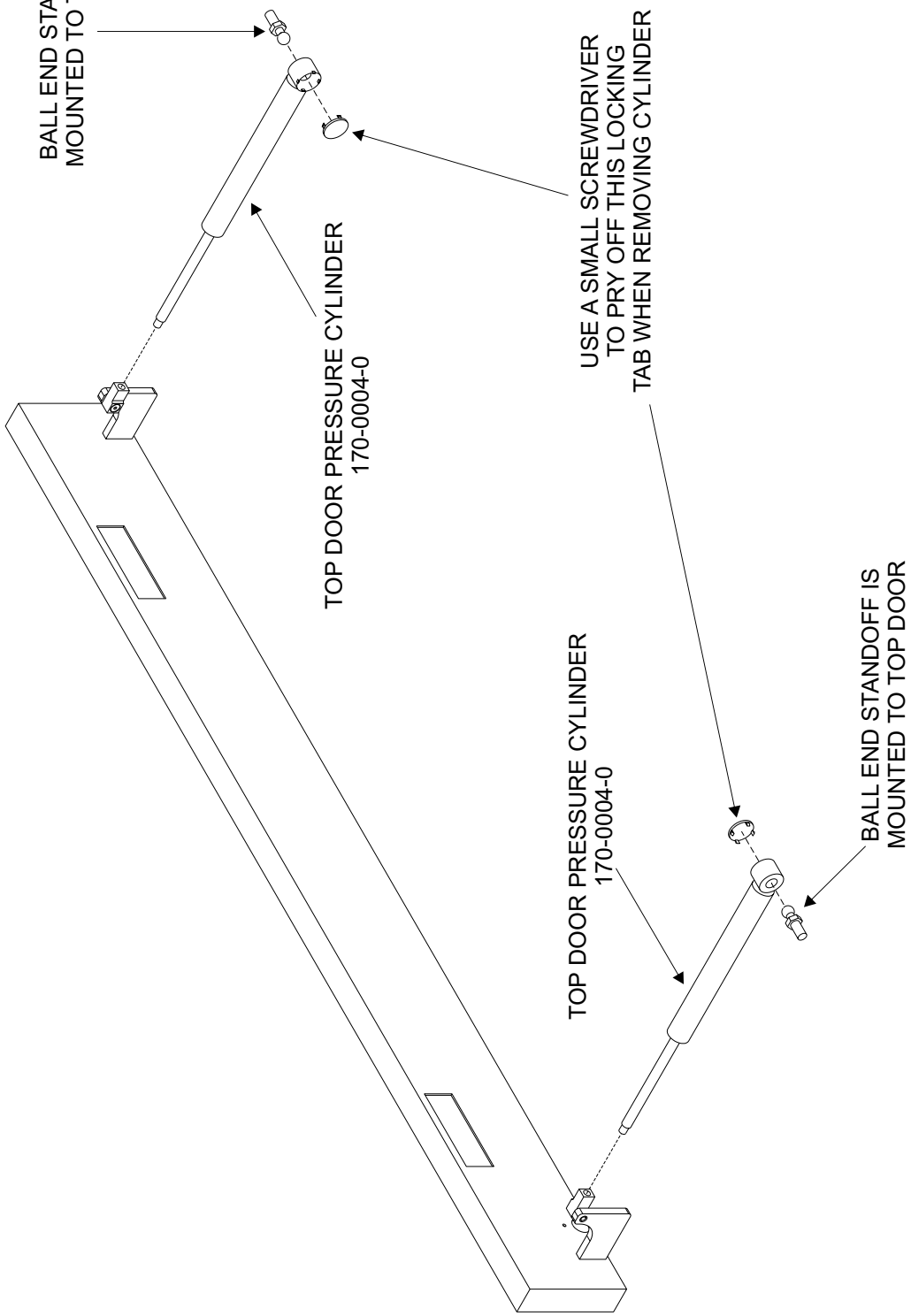
Removal

Use a small screwdriver to pry off the Plastic Locking Tabs as the diagram indicates. Grasp the Pressure Cylinder and pop it off the Ball End Standoffs (shown in the previous diagram) that are mounted to the Top Door. Unscrew the Cylinder from the Bracket by grabbing the Cylinder by hand (the black part) and rotating it counterclockwise. It is not tight so it should unscrew easily.

Installation

Install the new Pressure Cylinder, **BY HAND ONLY**, by screwing it into the Bracket until it stops. **NEVER TOUCH THE SHAFT OF THE CYLINDER WITH ANY TOOL. SCRATCHES ON THE SHAFT WILL DESTROY THE SEALS WHEN THE DOOR OPENS AND CLOSES WHICH WILL LEAD TO PREMATURE FAILURE.** If the other end does not line up properly with the Ball End Standoffs, then loosen the Cylinder by turning it counterclockwise until it lines up. It is not necessary to have the Pressure Cylinder screwed into the bracket completely. Push the end onto the Ball End Standoffs until it snaps into place. Push in the Plastic Locking Tabs until it bottoms out.

TOP DOOR 2


BALL END STANDOFF IS MOUNTED TO TOP DOOR
TOP DOOR PRESSURE CYLINDER 170-0004-0
USE A SMALL SCREWDRIVER TO PRY OFF THIS LOCKING TAB WHEN REMOVING CYLINDER
TOP DOOR PRESSURE CYLINDER 170-0004-0
BALL END STANDOFF IS MOUNTED TO TOP DOOR

TOP DOOR INTERLOCK

Proximity Sensor Description, Removal and Installation

Description

The Top Door is safety interlocked by the Proximity Sensors and the Actuators. The Proximity Sensor Actuators are simply magnets. When the Actuators are close enough to the Proximity Sensor Assembly (when the doors are closed), it closes the electrical connection inside the Sensor thus creating a closed circuit to energize the Solid State Relay. This, in turn, allows DC current to flow to the laser tube. When the doors are opened, is opens the electrical connection inside of the Sensor thus opening the Solid State Relay circuit. This opens the circuit between the DC Power Supply and the laser tube which shuts it off completely.

The Top Door Interlock System functions much the same as the Front Door Interlock with the exception that the Top Door Interlock can be overridden with the Interlock Defeat Tool. The Interlock Defeat Socket is wired in parallel to the Top Door Proximity Sensors. By plugging in the Interlock Defeat Tool into the Interlock Defeat Tool Socket, the Top Door Proximity Sensors are bypassed allowing the laser to fire with the Top Door Open. The Front Door is not overridden so it must be closed at all times to fire the beam even if the Interlock Defeat Tool is plugged in.

WARNING - The Safety Interlock Tool is only used for Beam Alignment purposes and should not be used for engraving. Installation of the Safety Interlock Tool changes the classification of the laser system from a Class I device to a Class 4 device. Safety goggles must be worn at all times while the laser system is powered on. Conscious awareness of the beam path must be observed at all times since the beam is invisible. Make sure that you do not cross the path of the beam with any part of your body.

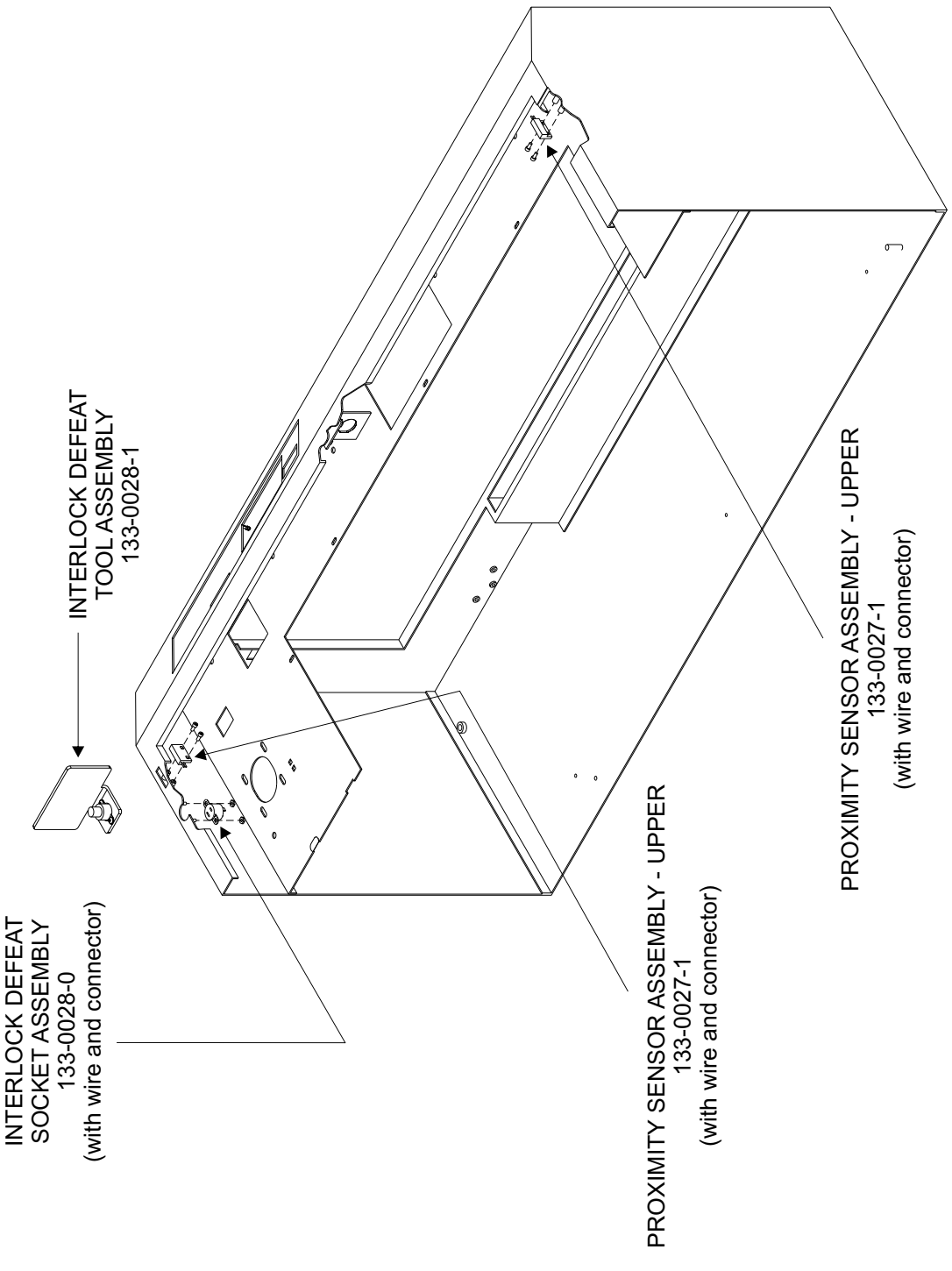
Removal

Unscrew the two(2) nuts that holds the Sensor in place and remove the Sensor. Disconnect Sensor Wire from Wiring Harness if you have not already done so.

Installation

Securely fasten the Sensor onto studs on the Main Enclosure with the two(2) nuts. Connect the Sensor Wire to the Wiring Harness

TOP DOOR INTERLOCK



TROUBLESHOOTING

REMINDER

Any removal of the electronic or electrical components of the laser system should be done with the power OFF and the system unplugged. Obviously, if you are testing voltages, you will need the system powered ON. This manual assumes that you have electrical and electronic skills. Please use common sense when servicing this equipment.

POWER INLET

This is simply a receptacle between the power cord and the AC wiring of the laser system. Failure of this component is highly unlikely if not impossible. If there is a problem (it is internally open) there will be AC voltage on the end of the power cord but no AC voltage coming out of the receptacle.

VARISTOR

If there is an over voltage situation that has occurred to the input power to the laser system, the Varistor will burn up and short out. This will cause the circuit breaker of the installation facility to trip. There will be a visible sign that the Varistor has burned. Re-setting the circuit breaker will only cause it to trip again once the laser is powered ON. It will be necessary to remove and replace the Varistor. The location of the Varistor at the top or the bottom of the fuse block does not matter and it is non-directional(polarized).

FUSES

If there is power coming through the power cord but the laser system does not turn ON, it is possible that the main fuses have blown. There may be no visible sign if the fuses have opened up. They must be either be removed and tested with an ohmmeter for continuity or AC voltage checked while on the laser system to chassis ground. If the fuses continue to blow when replaced, there is a component in the laser system that is drawing too much current that must be found and corrected. **DO NOT** replace the fuses with ones of a higher rating. Replace only with the same type and rating fuse otherwise damage to the electronics or a fire hazard can occur.

EMI FILTER

If this component should fail, an AC voltage check on the input versus the output will show this. There is a schematic diagram printed on the casing of the filter. Refer to this diagram for the proper electrical connections and voltage checks. If there is AC voltage present on the input side but not the output side, replace the component. Be sure to re-connect the wires in the same configuration as removal. Improper connections can damage the electronics.

28VDC POWER SUPPLY

If the laser does not fire and the cooling fans do not come on, there may be a problem with this component or the Standby Mode has been activated. There is one single purple/white striped wire that connects to the power supply from the LAS4.0 board. This is the Standby Mode trigger. When the Standby Mode has been activated, the LAS4.0 board sends this line to ground. This works just like a switch and turns off the Power Supply. This, in turn, turns off DC power to the laser tube and the cooling fans. To test, make sure the Standby Mode is not activated or simply turn the laser system OFF. Disconnect the purple/white striped wire by pulling out the connector to the Power Supply. Turn the laser system back ON again. If the Power Supply comes on, there is a problem with either the purple/white striped wire being shorted to ground or the LAS4.0 board itself. If the Power Supply does not come ON, check to see if there is input AC Voltage coming in. If there is proper AC voltage in but little or no DC voltage coming out, replace the Power Supply. Be sure to re-connect the wires in the same configuration as removal. Improper connections can damage the electronics. There is a connection diagram printed on the Power Supply and/or refer to the Schematics section if you are unsure of the connections.

SOLID STATE RELAY
The Solid State Relay (relay for short) is an electronic switch that is directly connected to the safety interlock system. If the top or front door is open, the input DC power to the relay is turned off thus opening the output circuit between the DC power supply and the laser tube. If the safety interlock system becomes shorted or bypassed, the relay will be energized and the laser can fire with the doors open thus violating it's Class I rating. When plugged in, the Interlock Defeat Tool creates a closed loop circuit that energizes the relay which allows DC power to the laser. This has nothing to do with turning on the 28VDC power supply. The relay is merely an electronic switch that is located between the DC output of the 28VDC power supply and the laser tube itself. The relay has an electrical schematic printed on the relay's casing. To test the relay, turn on the laser system, close all doors, and measure the DC voltage from the terminal 4 to terminal 3 on the relay. It should read approximately 5VDC. If it does not, there is a problem with the interlock system - inspect and repair. If there is approximately 5 volts present, test the DC voltage from terminal 2 on the relay to chassis ground. It should read approximately 28VDC. If it does not, there is a problem with the wire to terminal 2 or the 28VDC Power Supply - inspect and repair. If you have 28VDC on terminal 2, then check the DC voltage from terminal 1 to chassis ground. It should also read approximately 28VDC. If it does not, replace the Solid State Relay.

BUZZER
The buzzer is actually a beeper. The buzzer beeps when the laser system has finished and engraving job. If the buzzer fails, it will sound off faintly or not at all. Replacement is simple and the connection is keyed to prevent an improper connection.

POWER SUPPLY(STEPPER MOTORS)
Please refer to the procedure "Electronics 2" for troubleshooting.

LAS4.0 BOARD (MOTHERBOARD)
The LAS4.0 board controls the Display Board, receives and stores print files, and sends laser pulsing information directly to the laser tube. If the Laser system will not accept files from the computer and it is known that the computer, it's parallel port, and it's printer cable are all good, the LAS4.0 board needs replacing. If there is no DC voltage, while running a file, coming out of the modulation cable that goes to the laser, and the modulation cable is good, the LAS4.0 needs replacement. If there is a failure of the LAS4.0 board, remove the board by first disconnecting the wiring harness connections. Then remove the socket head grounding screw located between the parallel and serial ports. Gently pry the board out away from the cover plate at the location of the snap connectors. Replacement is opposite of installation. The wiring connectors are keyed so improper installation cannot occur.

FRONT and TOP DOOR INTERLOCKS
Disconnect the Sensor wire from the Wire Harness. With an Ohmmeter, test continuity between the leads. If there is continuity, Sensor is shorted - replace. If it is open, close the door so the Actuator makes contact with the Sensor and perform the continuity test again. If you have continuity with the door closed, but not with the door open, Sensor is good. If you have still no continuity with the door closed, sensor is burned open - replace.

AIR INTAKE FILTER
Remove and inspect the filter. If it is very dirty, air flow will be restricted and the exhaust system will not work properly. Clean the filter by rinsing it out with soap and water. Wring it dry and re-install.

Z-AXIS ASSEMBLY 1

Engraving Table Description, Adjustment, Removal, and Installation

Description

The Engraving Table (Z-axis Table or Stage) is a Honeycomb centered, aluminum laminated table. It is very lightweight and surface ground so that it is very flat. The levelness of the Engraving Table is a very important requirement for proper laser engraving. If, for any reason, the Table comes out of level (highly improbable) with the Focus Carriage, It must be adjusted. It is not important the Table is level with the ground, it is important that it is level with the Focus Carriage.

Adjustment

To check Table levelness, turn off the laser system. Manually move the Focus Carriage by hand to Position 1 which is at the top center of the Table. Using the Focus Tool, adjust the Table so that you are focused on the Table's surface. Now move the Focus Carriage to Position 2 and focus on the Table there. While focusing, count the number of turns you make with the Hand Crank. One complete turn of the Hand Crank moves the Table up or down .030 inches (.75mm). Perform the same test for Position 3 and Position 4. The difference in focus between Position 1 and Position 2 or between Position 3 and Position 4 should be no more than ½ turn of the Hand Crank.

To adjust the Table first remove the Z-axis Belt Cover Plates (2). If the Table is not level from front to back, loosen the lockdown screw on the bottom of the Front Left Pulley Wheel. Hold the Pulley Wheel with one hand, and with the other hand, rotate the Front Left Lead Screw that the Pulley Wheel is attached to. By rotating the lead screw by hand, and getting grease all over your fingers, you will notice that the front part of the Table will move either up or down depending on which way you turn the screw. The objective is to adjust the Front Left Lead Screw until the focus height from the front to the back of the Table is at the same level. Do this by using the Focus Tool. Once this is achieved, tighten down the Front Left Pulley Wheel's Lockdown Screw. Front to back Table level adjustment is now complete.

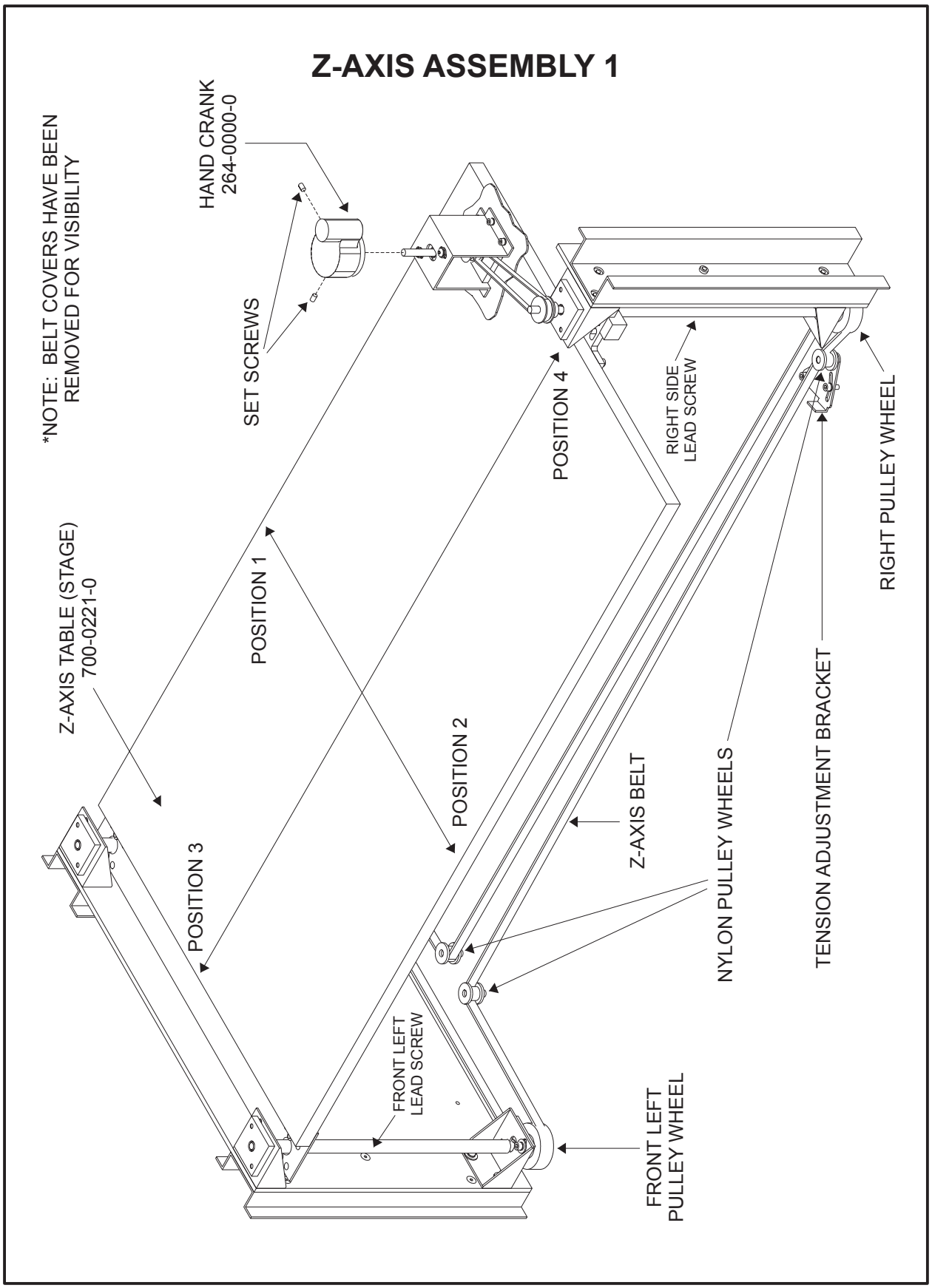
To adjust the Table level from left to right, perform the same procedure except adjust the Right Pulley Wheel and Lead Screw instead of the Left Front Pulley Wheel and Lead Screw. Always adjust front to back first (if needed) then adjust left to right second.

Removal

Bring Table up about ¾ of it's maximum. Open Front Door and find the three(3) screws that connect the Table to the left side bracket and the two(2) screws on the right side bracket. Remove all four(5) screws. Slide the Table out the Front Door.

Installation

If installing a new Table, remove the Rulers from the old Table. Install the new Table through the Front Door and bolt the three(3) screws on the left side down first. Then bolt down the remaining two(2) screws on the right side second. Table level adjustment should not be necessary but you can check it if you like. To install the Rulers, refer to the procedure "Z-axis Assembly 2".


Z-AXIS ASSEMBLY 1
*NOTE: BELT COVERS HAVE BEEN REMOVED FOR VISIBILITY
HAND CRANK 264-0000-0
SET SCREWS
Z-AXIS TABLE (STAGE) 700-0221-0
POSITION 1
POSITION 2
POSITION 3
POSITION 4
RIGHT SIDE LEAD SCREW
RIGHT PULLEY WHEEL
Z-AXIS BELT
NYLON PULLEY WHEELS
TENSION ADJUSTMENT BRACKET
FRONT LEFT LEAD SCREW
FRONT LEFT PULLEY WHEEL

Z-AXIS ASSEMBLY 2

Ruler Adjustment, Removal, and Installation

Adjustment

The rulers are bolted through the Engraving Table and secured on the back side with locknuts and washers. If a Beam Alignment has been performed, usually because the laser tube was replaced, or the Motion System had some components replaced, then the Rulers might need adjustment. The objective is to adjust the Rulers to the laser beam, not the laser beam to the Rulers.

If you loosen the top three(3) screws, for the X-axis Ruler, and the top two(2) screws for the Y-axis Ruler, you will notice that the Ruler can slide around a little. There is enough play to slide the X-axis Ruler back towards the laser and the Y-axis Ruler to the left side of the Engraving Table enough to get them out of the engraving area.

We need to find out where the edge of the engraving area will be. To do this, simply apply a strip of masking tape to where you think the edge of the field would be. Position the tape so that half of it would lie outside the engraving area and half on the inside. Do the same for the other axis.

In your Graphics software, create a vector rectangle that is exactly 24 x 12 inches in the Landscape mode. Set the Power settings to 100% power, 30% speed, 500 PPI and 1000 DPI resolution. Focus right on the tape, and engrave the file. The laser will cut out the rectangle which will cut the tape right down the middle. Remove the outside of the tape to leave a frame of the engraving area on the inside. Move the rulers up the edge of the tape and tighten them down (you might need to hold the nut with your hand on the bottom side of the table). Make sure that the 0,0 position is aligned correctly when tightening down the rulers. When you are finished, remove the remaining tape on the inside of the engraving area and ruler adjustment is now complete.

Removal

Sometimes debris builds up underneath the Rulers or you want to clean the table more thoroughly. In this case, it would be easier to remove the Rulers to clean them or to clean the table. To remove the Rulers, unscrew the three(3) screws that hold down the X-axis Ruler while holding on to the locknut underneath. Do the same for the two(2) Y-axis Rulers.

Installation

Perform the masking tape procedure defined earlier in this section. Install the Rulers by putting the screws through the table and attaching the washers and locknuts. Thread the locknuts up all the way but do not tighten them yet. Get all the screws and locknuts started and slightly snug but loose enough so that the Rulers can still slide around a little. Adjust the Rulers to the masking tape that you previously cut and tighten them down. Again, make sure that the 0,0 point of the Ruler intersection, lines up with the tape intersection in the upper left hand corner.

Z-AXIS ASSEMBLY 2