UNIVERSAL
LASER SYSTEMS INC.

ULS-25E Laser System Service Manual

Revision A September 1996

Notice

Universal Laser Systems Inc. does not assume any liability arising out of the application or use of any products, circuits or software described herein. Neither does it convey a license under its patent rights nor the patent rights of others. Universal Laser Systems Inc. further reserves the right to make any changes in any products described herein without notice. This document is subject to change without notice.

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 indefinitely. 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.

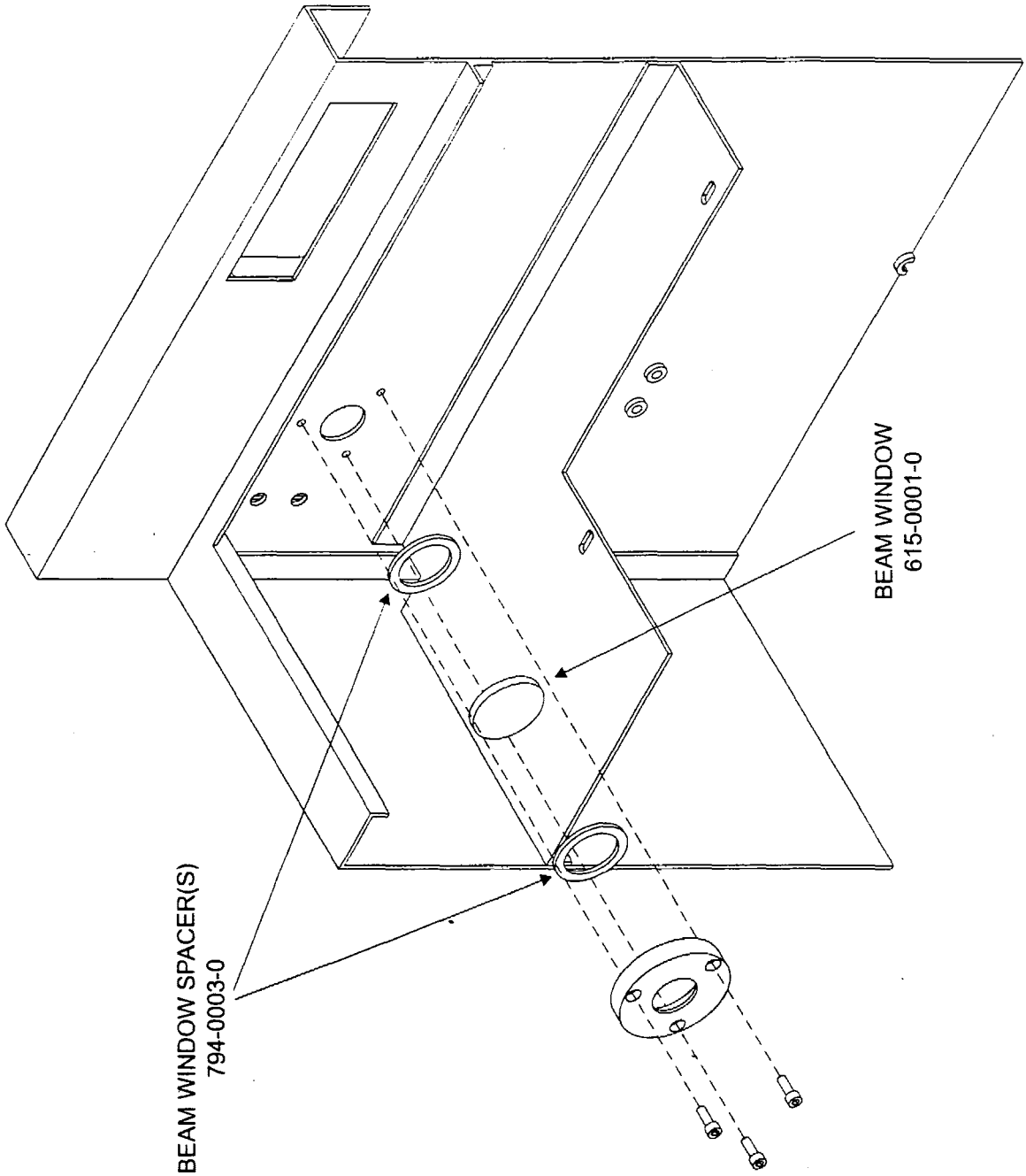
Removal

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.

BEAM WINDOW



CART ASSEMBLY

Description, Assembly, Leveling

Description

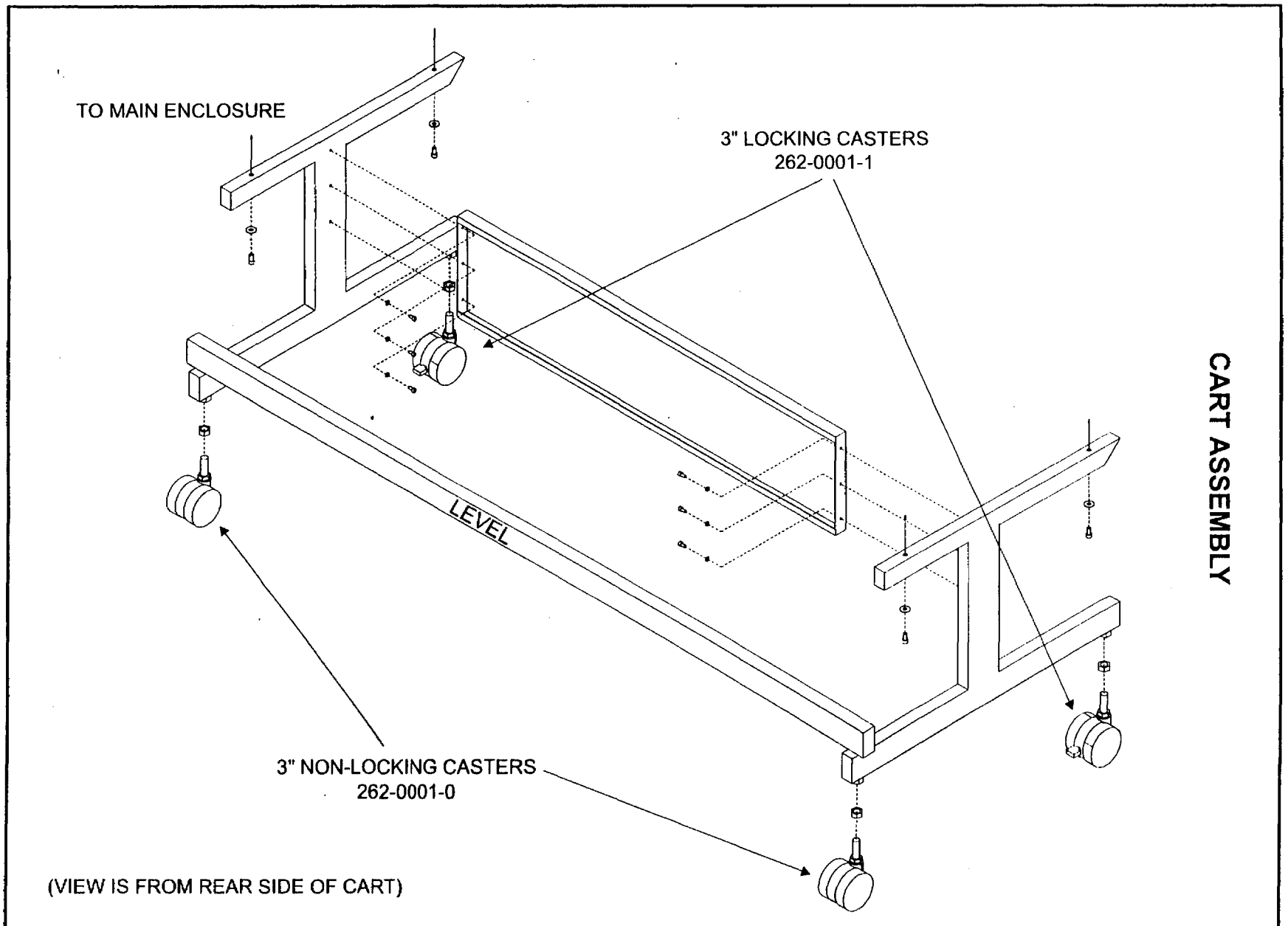
The laser system is normally mounted on the Cart Assembly. The Cart Assembly is the only part of the laser system that needs to be assembled and then adjusted until the laser system is level.

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. Thread the casters 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**.

Leveling

Place a long level across the top of the front two legs right above the casters. Adjust either the left or right caster until it is level. Now place the level across the back legs and level the back wheels. Then, re-check the front casters to make sure that it's level has not changed and that it is the same as the rear casters. It is not necessary to level the system from front to back, only left to right.


TO MAIN ENCLOSURE
3" LOCKING CASTERS
262-0001-1
LEVEL
3" NON-LOCKING CASTERS
262-0001-0
(VIEW IS FROM REAR SIDE OF CART)
CART ASSEMBLY

ELECTRONICS 1 & 2

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.

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.

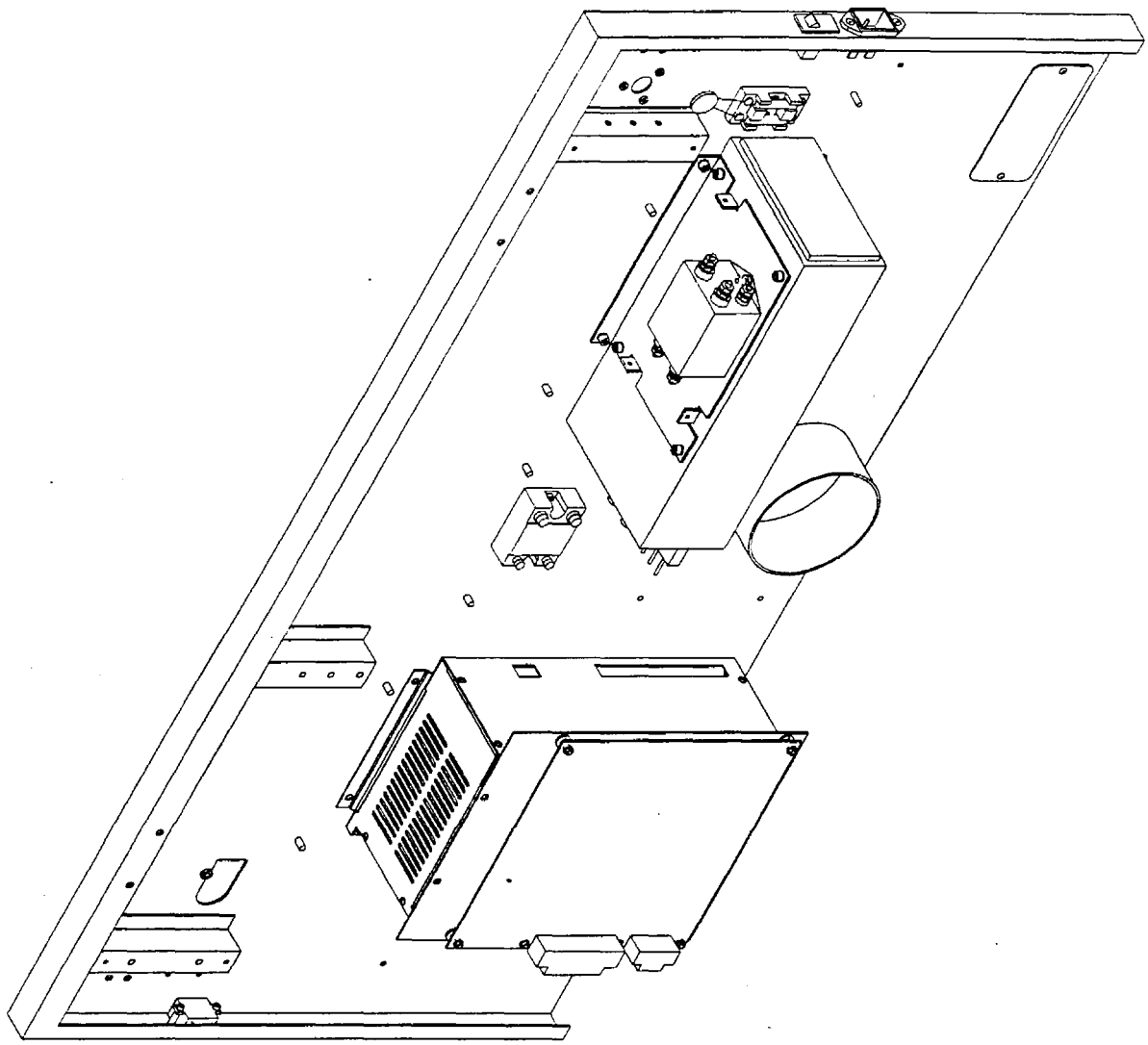
28VDC POWER SUPPLY

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).

ELECTRONICS 1



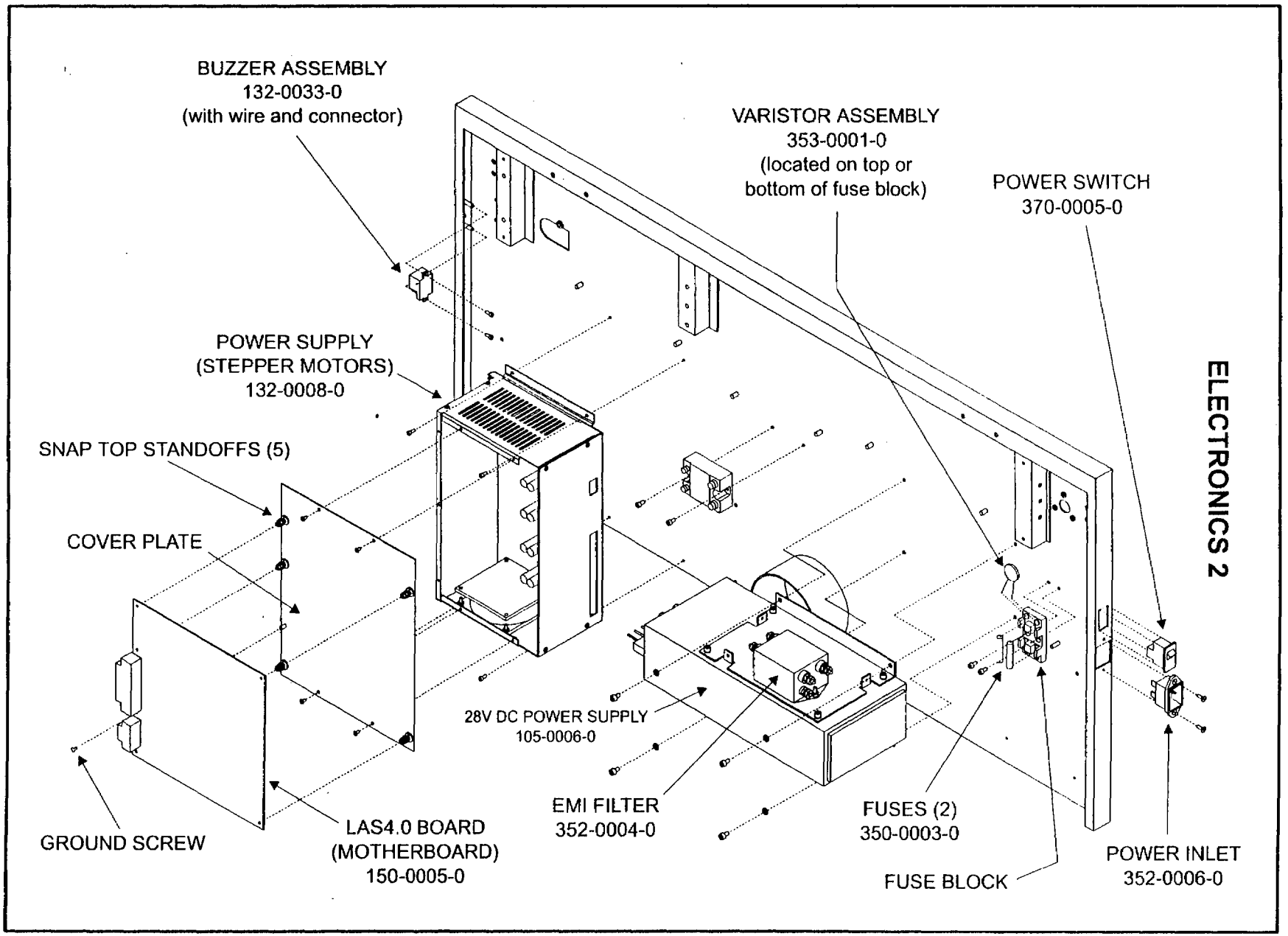
ELECTRONICS 1 & 2
(Continued)

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.

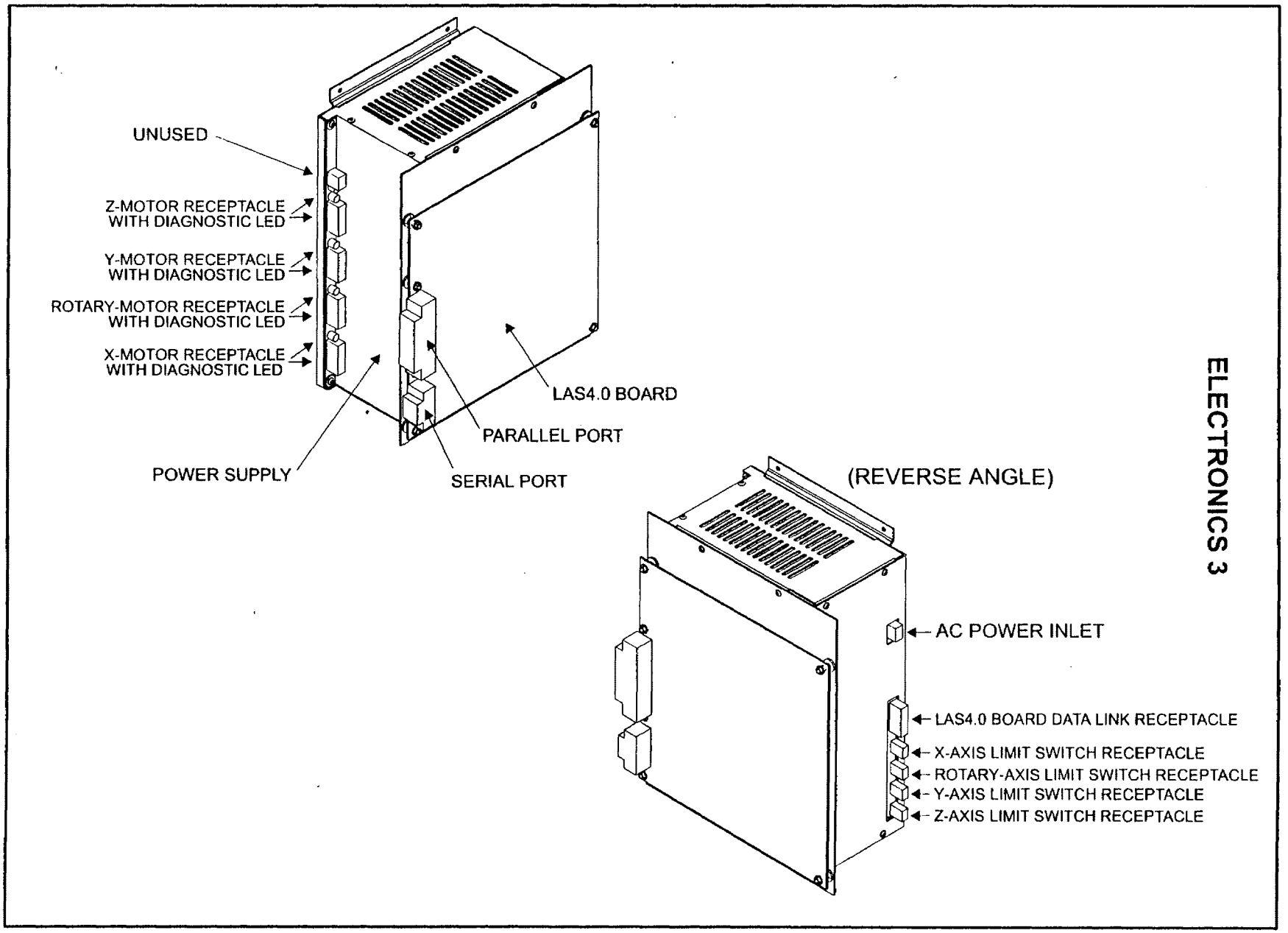

BUZZER ASSEMBLY
132-0033-0
(with wire and connector)
VARISTOR ASSEMBLY
353-0001-0
(located on top or
bottom of fuse block)
POWER SWITCH
370-0005-0
POWER SUPPLY
(STEPPER MOTORS)
132-0008-0
SNAP TOP STANDOFFS (5)
COVER PLATE
28V DC POWER SUPPLY
105-0006-0
EMI FILTER
352-0004-0
FUSES (2)
350-0003-0
FUSE BLOCK
POWER INLET
352-0006-0
GROUND SCREW
LAS4.0 BOARD
(MOTHERBOARD)
150-0005-0
ELECTRONICS 2

ELECTRONICS 3

Component Description

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.


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
POWER SUPPLY
SERIAL PORT
PARALLEL PORT
LAS4.0 BOARD
(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
ELECTRONICS 3

ELECTRONICS 4

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

The USTEP Board has an EEPROM called the USTEP EEPROM. If the manufacturer updates the motion controls to the stepper motors, usually just replacing this EEPROM with the newest version will update the system. This EEPROM might need to be replaced if the IROM and the OROM are replaced. To replace the USTEP EEPROM, 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 to the cover plate along with its wires. Pull the USTEP board straight out of the Power Supply housing. Locate the USTEP EEPROM in chip location U23. It is also labeled with a white sticker. The version of this EEPROM is written on the sticker and it is not found anywhere else.

There **might** be a situation that you will have 3 possible USTEP EEPROMS available for replacement. One might have an "R" following the version number, one might have an "N" following the version number, or one might simply have a number with nothing after it. This refers to the socket location U30. If there is a computer chip located in Socket U30 then use the USTEP EEPROM with the "R" suffix. If there is a single jumper wire located in the U30 location, then use the USTEP EEPROM with the "N" suffix. If there is no U30 then use the USTEP EEPROM with just a number and no letters following it. Older versions of the USTEP Board have the computer chip located in the U30 location. Later versions have the single jumper wire located in the U30 socket. The latest version of the USTEP Board has neither the chip nor the jumper wire.

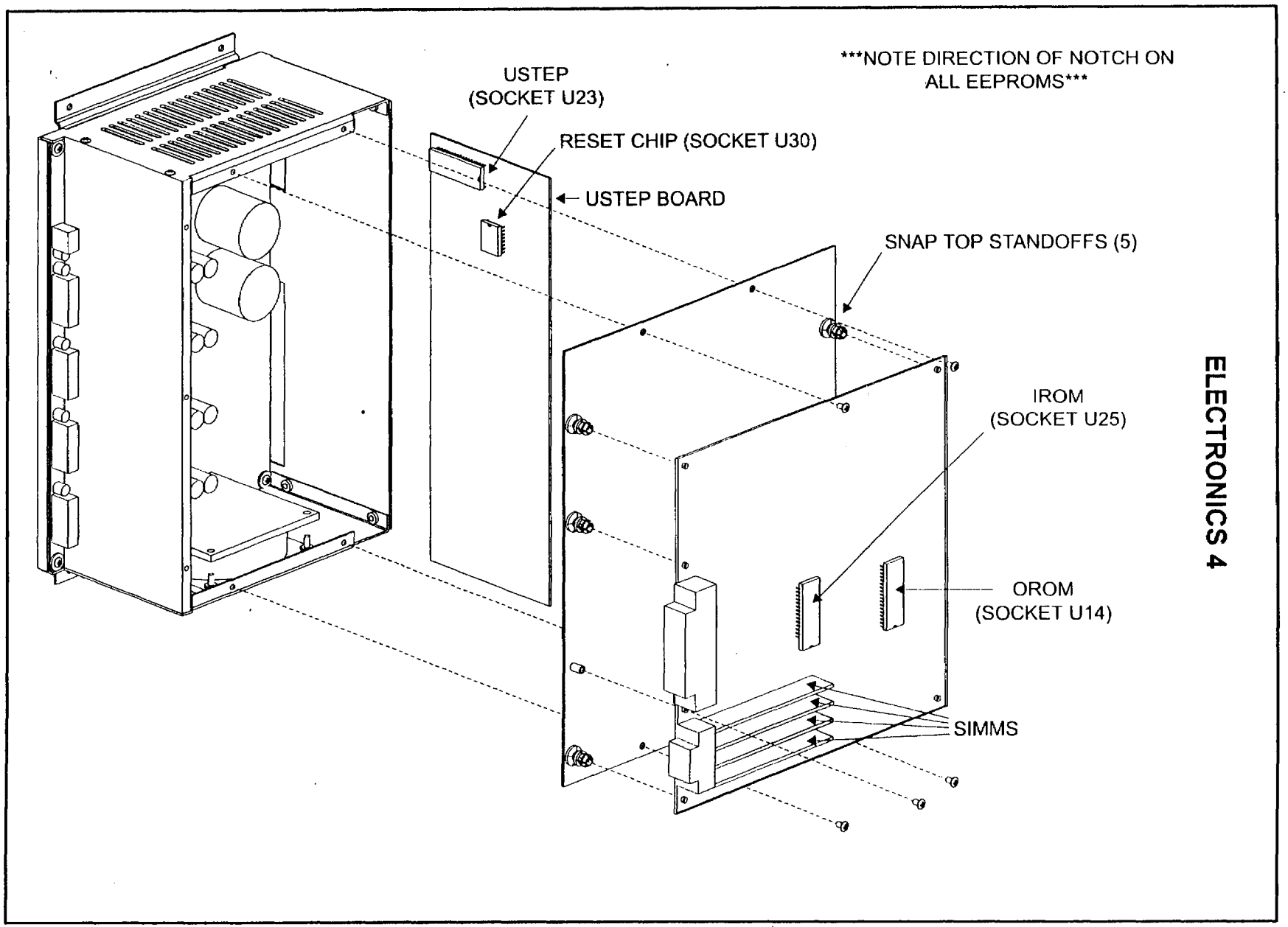
Using a chip puller, remove the USTEP EEPROM and replace it with the newest and appropriate version. Please observe the orientation of the notch on the chip. If you install the chip upside down, it will destroy itself upon power up and possibly damage the circuit board.

Replace the USTEP Board 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.

The LAS4.0 board has (2) EEPROMs, the IROM (Input Read Only Memory) and the OROM (Output Read Only Memory). The manufacturer can update the LAS4.0 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. With the laser powered on, go to 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 down the system and ground yourself by using an anti-static wrist strap. By using a chip puller, remove the EEPROMs and replace them with the newer versions.

***NOTE** - The OROM is in chip location U14 and the IROM is in chip location U25. Remove and replace them one at a time to prevent them from getting mixed up. Again, take note of the notch location on the chip. Installing the chips upside down will destroy them.



ELECTRONICS 4

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.

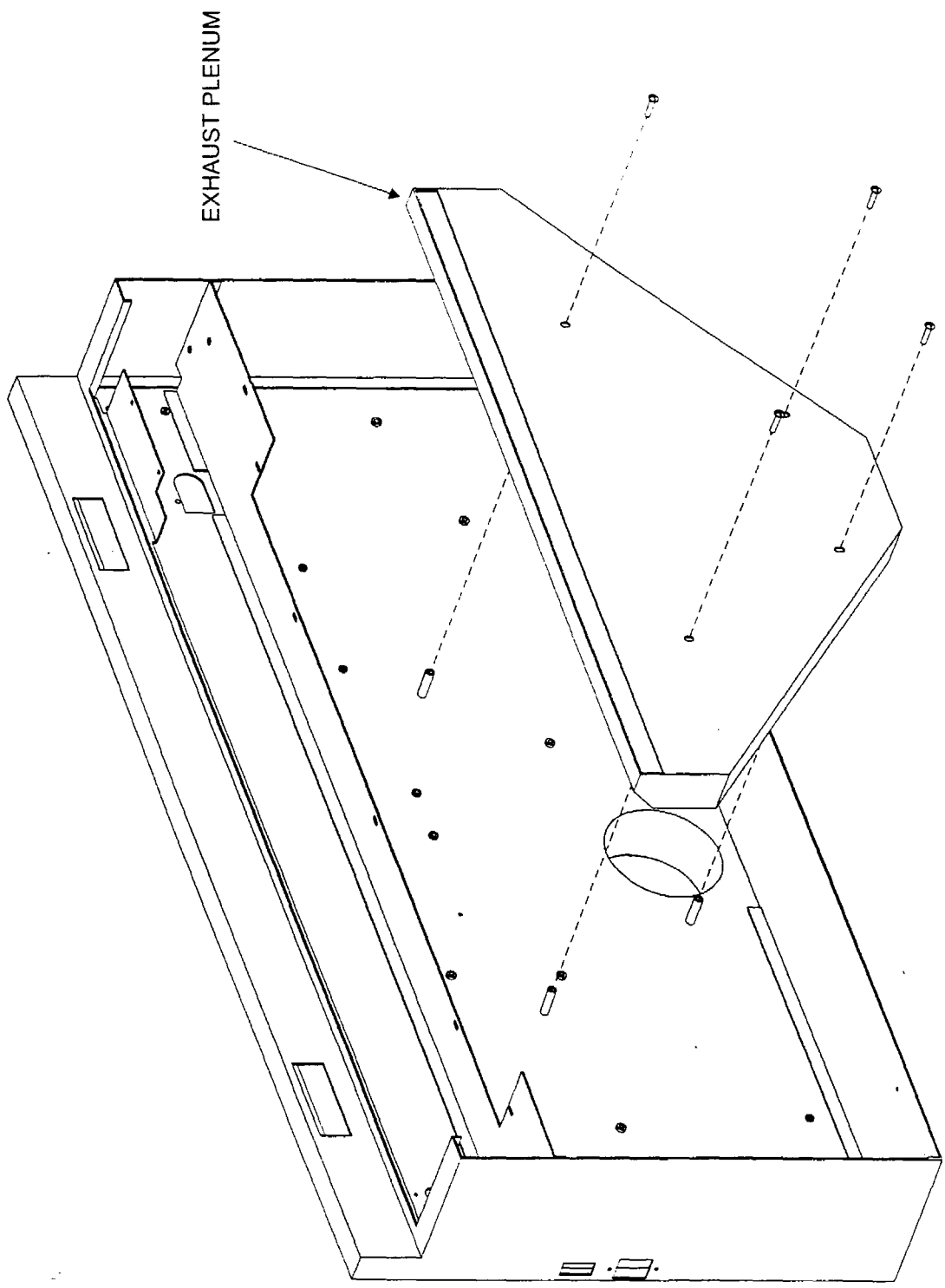
Cleaning

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

Installation

Installation is the opposite of removal.

EXHAUST ASSEMBLY



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.

Air Filter Removal

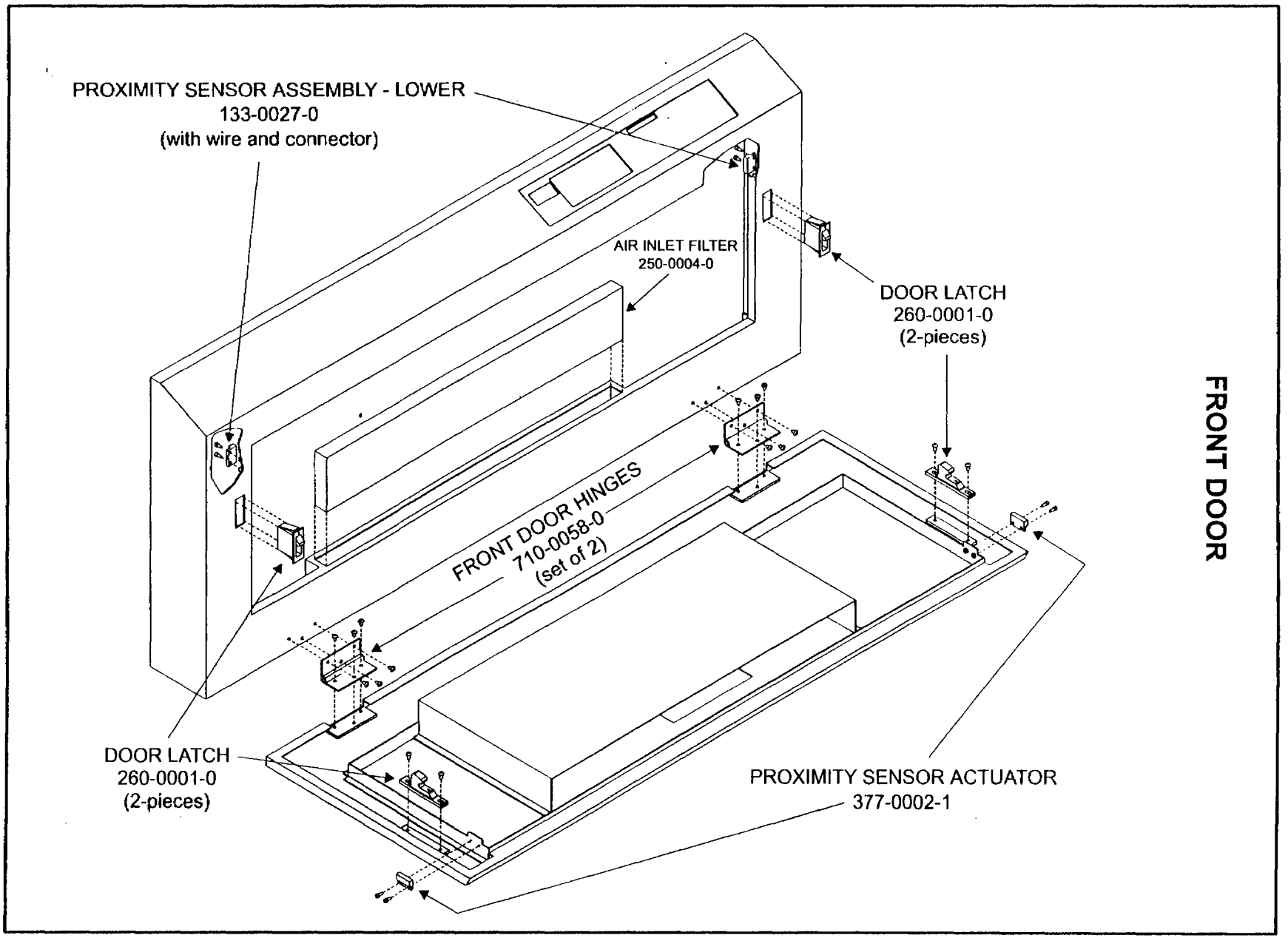
The Air Filter is easily removed for cleaning by opening the front door, reaching in with your fingers, and pulling it out.

Cleaning

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

Installation

Installation is opposite of removal.


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

KEYPAD

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

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.

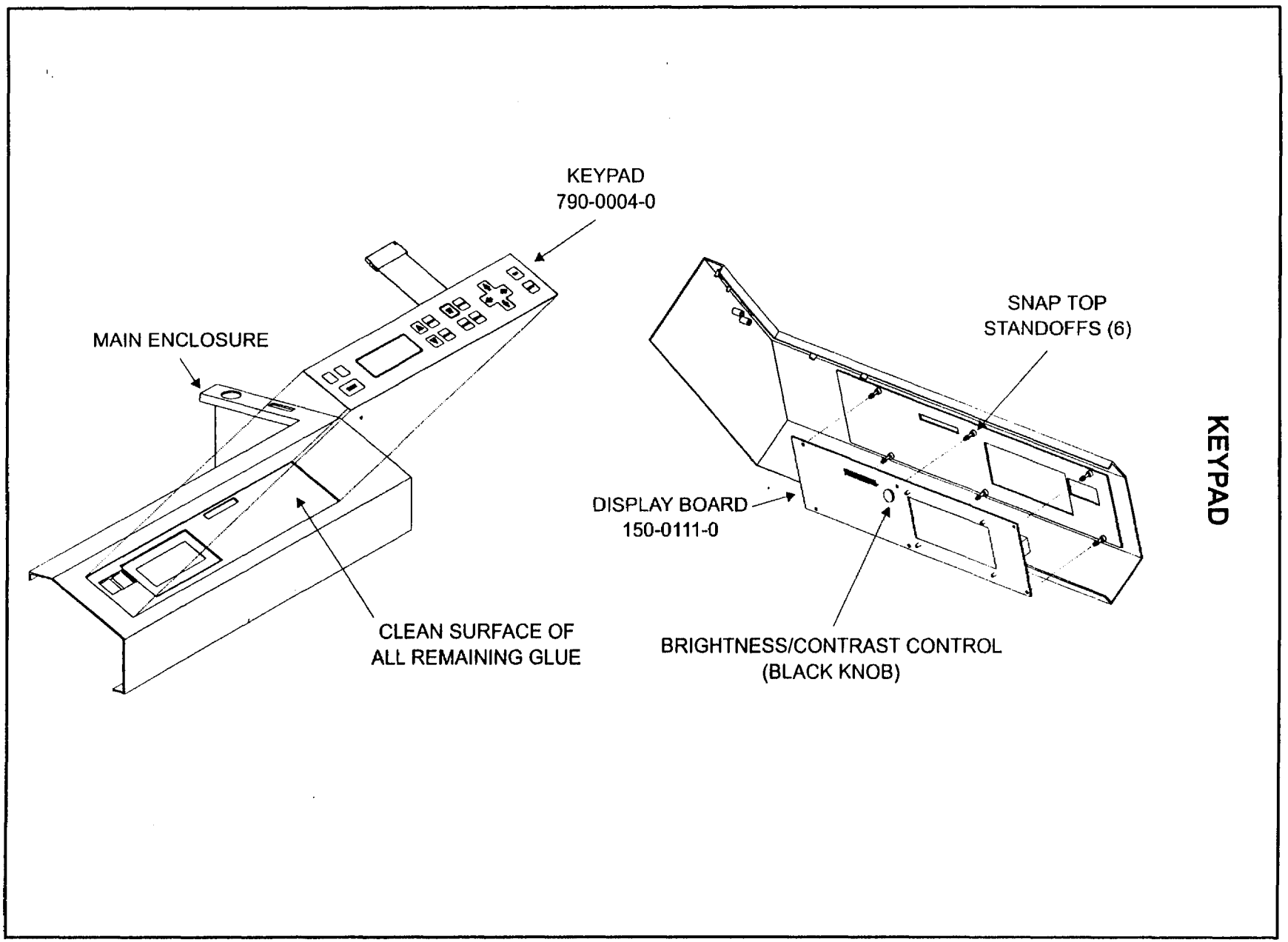
Removal
The Display Board is located behind the Keypad. If the Display Board needs replacement, it simply snaps out like the LAS4.0 board. Disconnect the wire harness before removing the board.

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

Keypad
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.

Replacement
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. Clean the contact surface of the Main Enclosure of any remaining glue.

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


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

LASER TUBE ASSEMBLY 1

Description and Fan Enclosure Removal

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

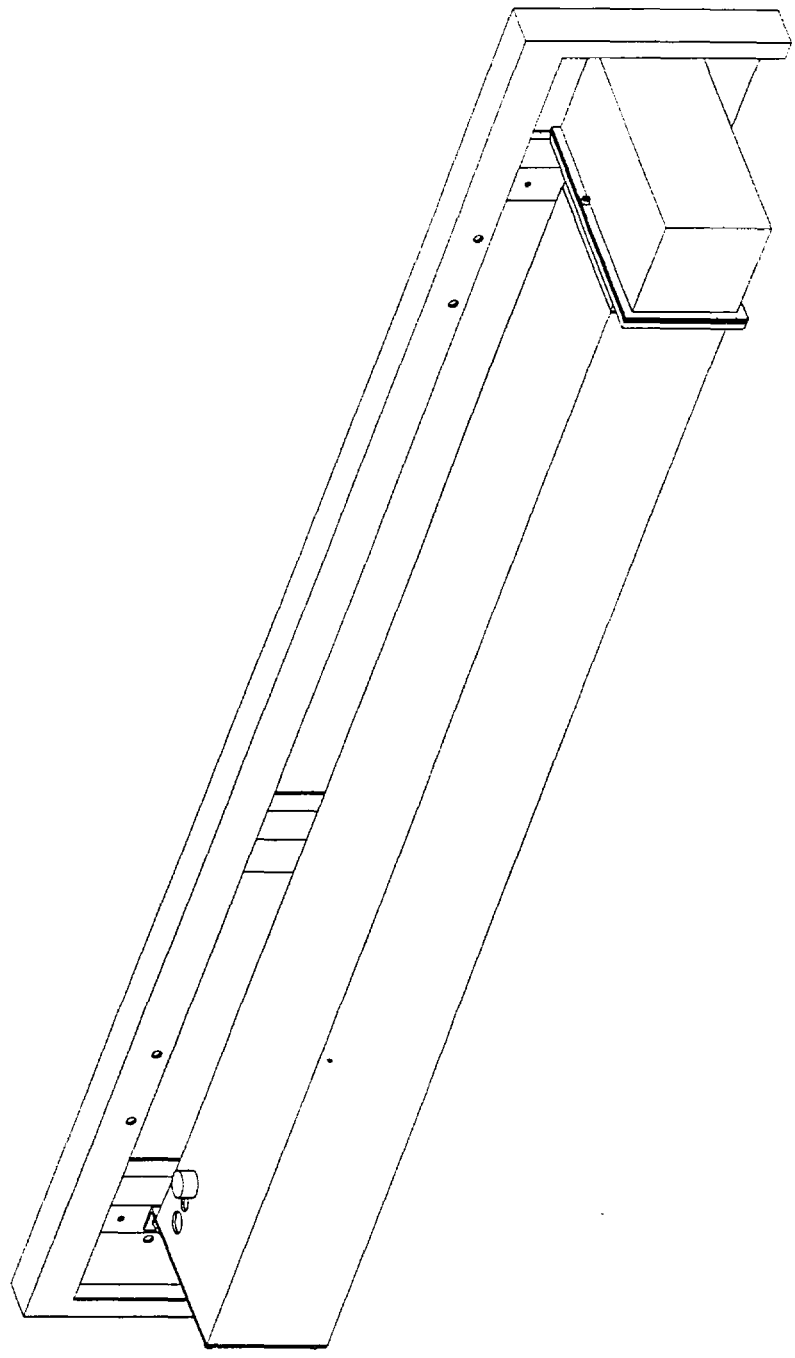
To get to the Laser Tube Assembly, you must first remove the Outer Fan Enclosure (not shown). This enclosure is held in place by four (4) socket head screws. Unplug laser system, remove all four screws, and gently lift the enclosure up and away from the Main Enclosure.

Surrounding the Laser Tube Assembly, you will find the Inner Fan Enclosure (not shown). 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 (not shown) 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.

Refer to the next diagram for details on how to remove the Laser Tube Assembly.

LASER TUBE ASSEMBLY 1



LASER TUBE ASSEMBLY 2

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 sections.

- On the left side of the assembly, 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) Socket Head 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.

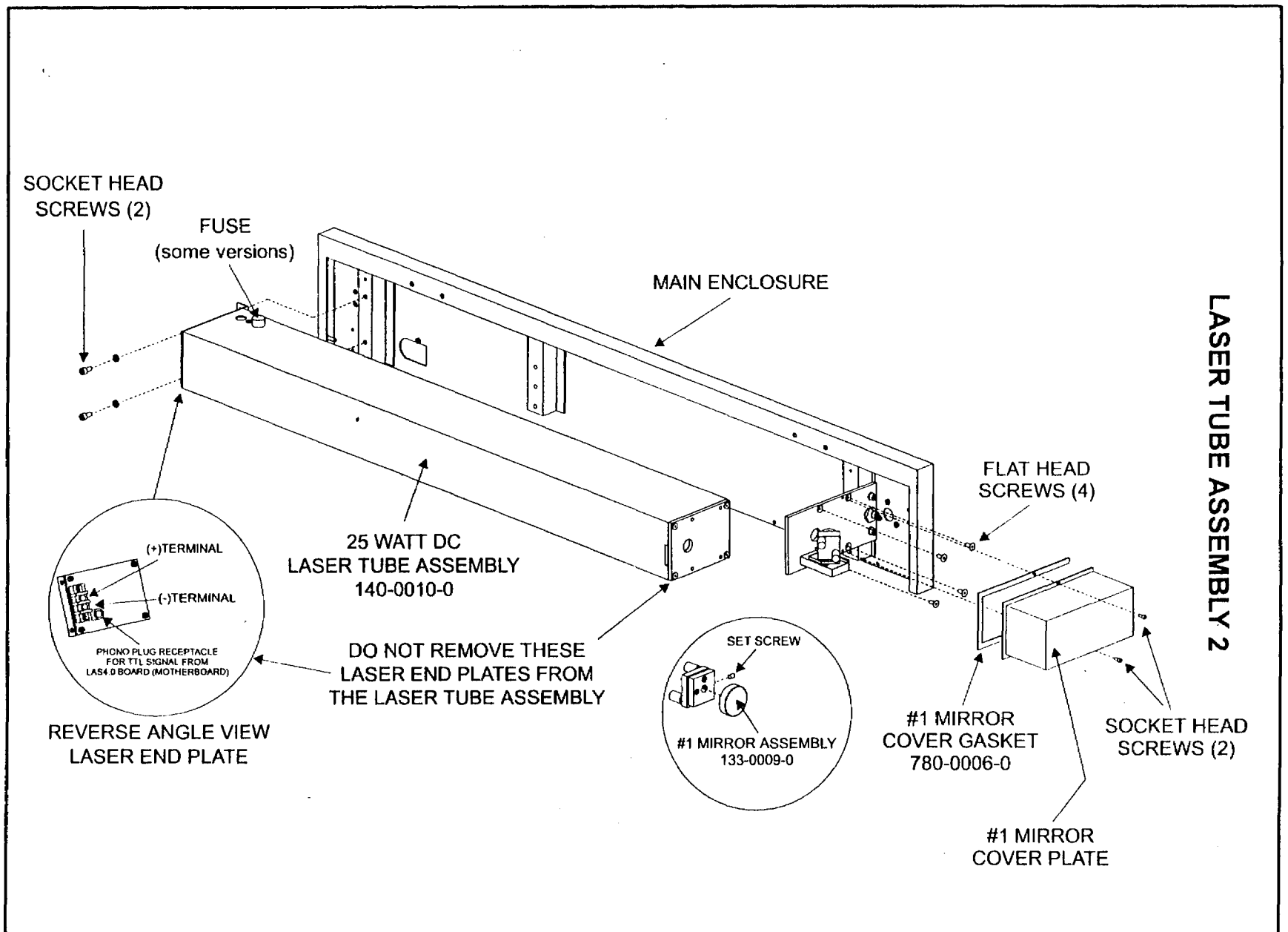
- With someone holding on to the Laser Tube Assembly (it weighs about 20 lbs.), remove the one remaining Flat Head Screw and the one Socket Head Screw. The Laser Tube Assembly is now free to be removed from the Main Enclosure. Gently set it down on a table or anywhere safe so that it does not get kicked, dropped, or abused in any other way. It 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 first and then tighten down the (2) Socket Head Screws.

If the # 1 Mirror needs to be replaced (highly unlikely), remove the Set Screw, 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 sections for the proper technique in aligning the beam.


SOCKET HEAD
SCREWS (2)
FUSE
(some versions)
MAIN ENCLOSURE
FLAT HEAD
SCREWS (4)
25 WATT DC
LASER TUBE ASSEMBLY
140-0010-0
(+)TERMINAL
(-)TERMINAL
PHONO PLUG RECEPTACLE
FOR TTL SIGNAL FROM
LAS4.0 BOARD (MOTHERBOARD)
REVERSE ANGLE VIEW
LASER END PLATE
DO NOT REMOVE THESE
LASER END PLATES FROM
THE LASER TUBE ASSEMBLY
SET SCREW
#1 MIRROR ASSEMBLY
133-0009-0
#1 MIRROR
COVER GASKET
780-0006-0
SOCKET HEAD
SCREWS (2)
#1 MIRROR
COVER PLATE
LASER TUBE ASSEMBLY 2

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.

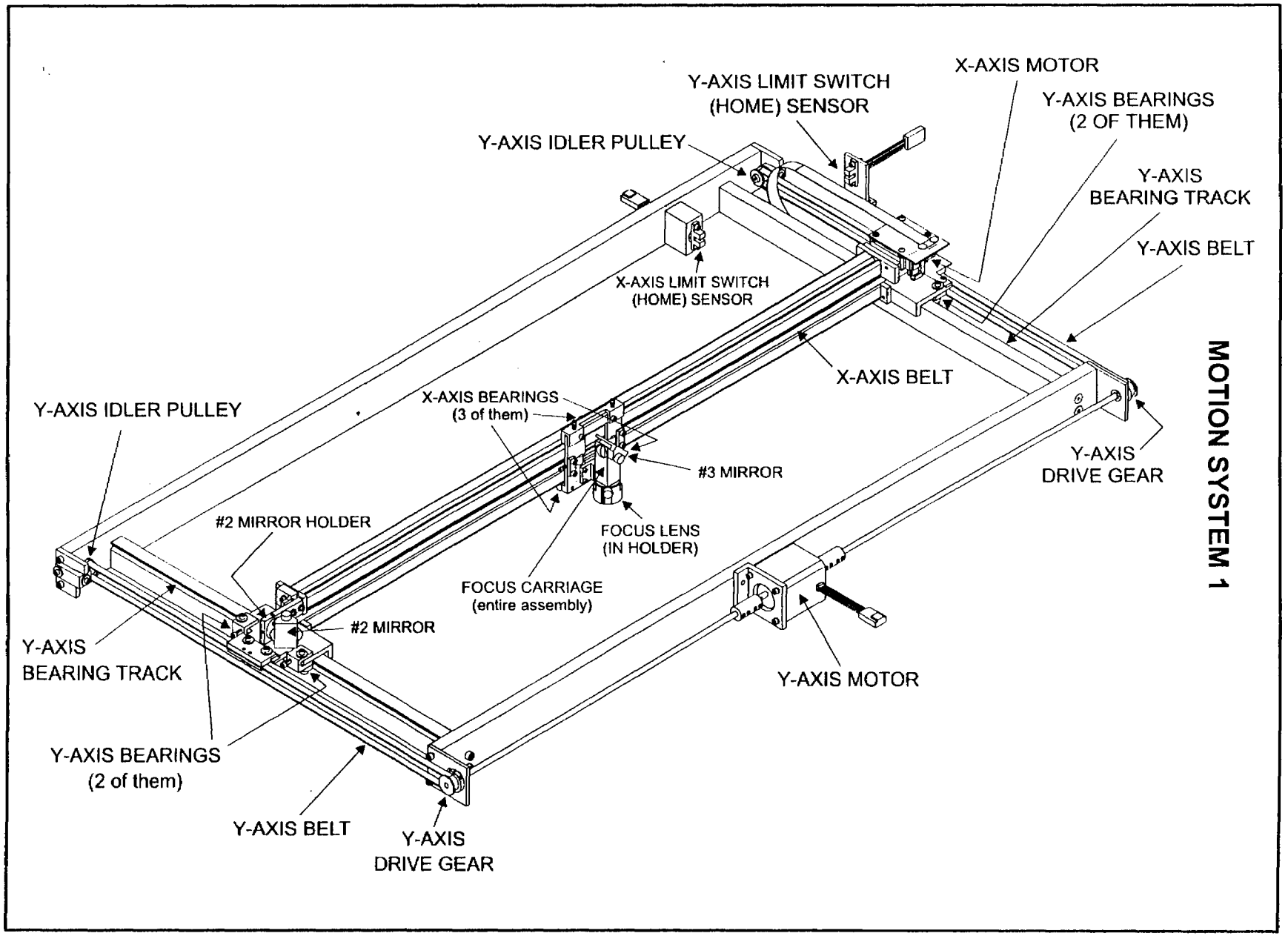
When the laser system is powered on it goes through a homing routine where the Focus Carriage moves to the upper right hand corner of the engraving area. Here is where the part Focus Carriage (X-axis Flag) and part of the X-axis Arm (Y-axis Flag) pass through the Limit Switch (Home) Sensors. The Home 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 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.


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

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

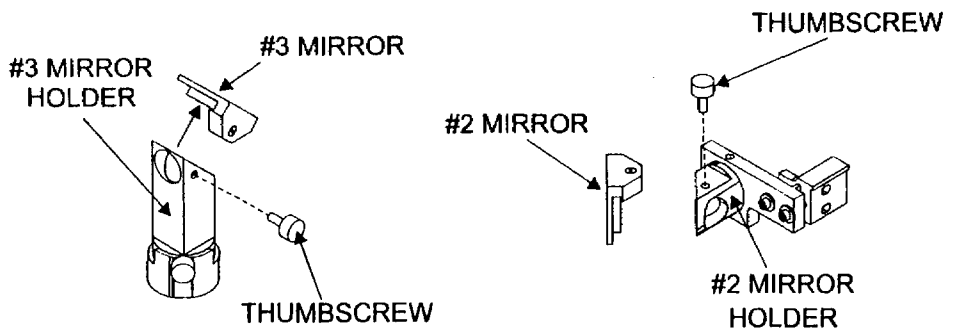
To clean a mirror, hold the mirror on a 45 degree angle, **BE CAREFUL NOT TO DROP IT**, and squirt (flood) lens cleaning solution onto the surface and let the excess drip off. Put it down on a table, and let it set for a minute. With a fresh piece of Lens Tissue (only), gently swipe the tissue across 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 that 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

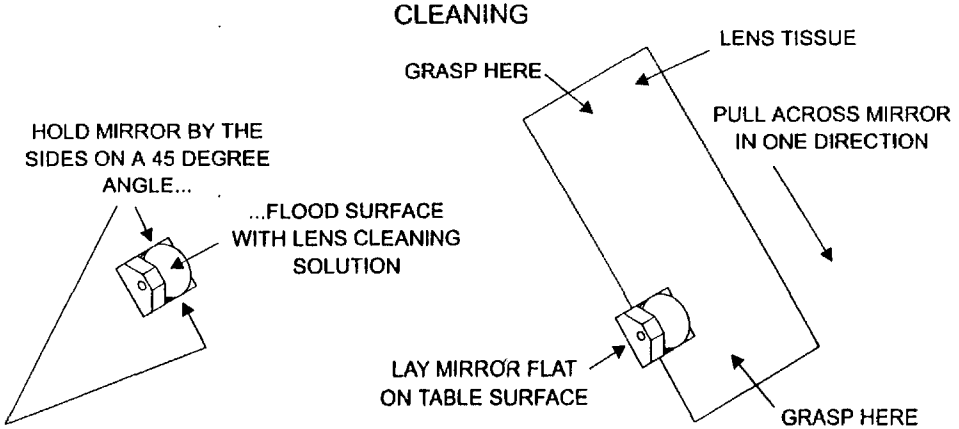
To re-install the mirror, hold it by the sides and place it onto the mirror holder surface. Again, be careful not to slide it around, otherwise the mirror holder can scratch the mirror. Once the mirror is in place, insert the thumbscrew and get it started. Before tightening the thumbscrew all the way down, put you 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.

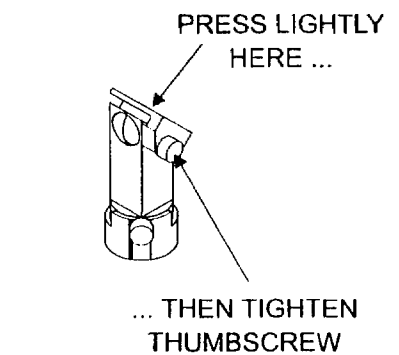
REMOVAL



CLEANING



REPLACEMENT



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 in inches = spot size in inches). 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, have the laser user 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

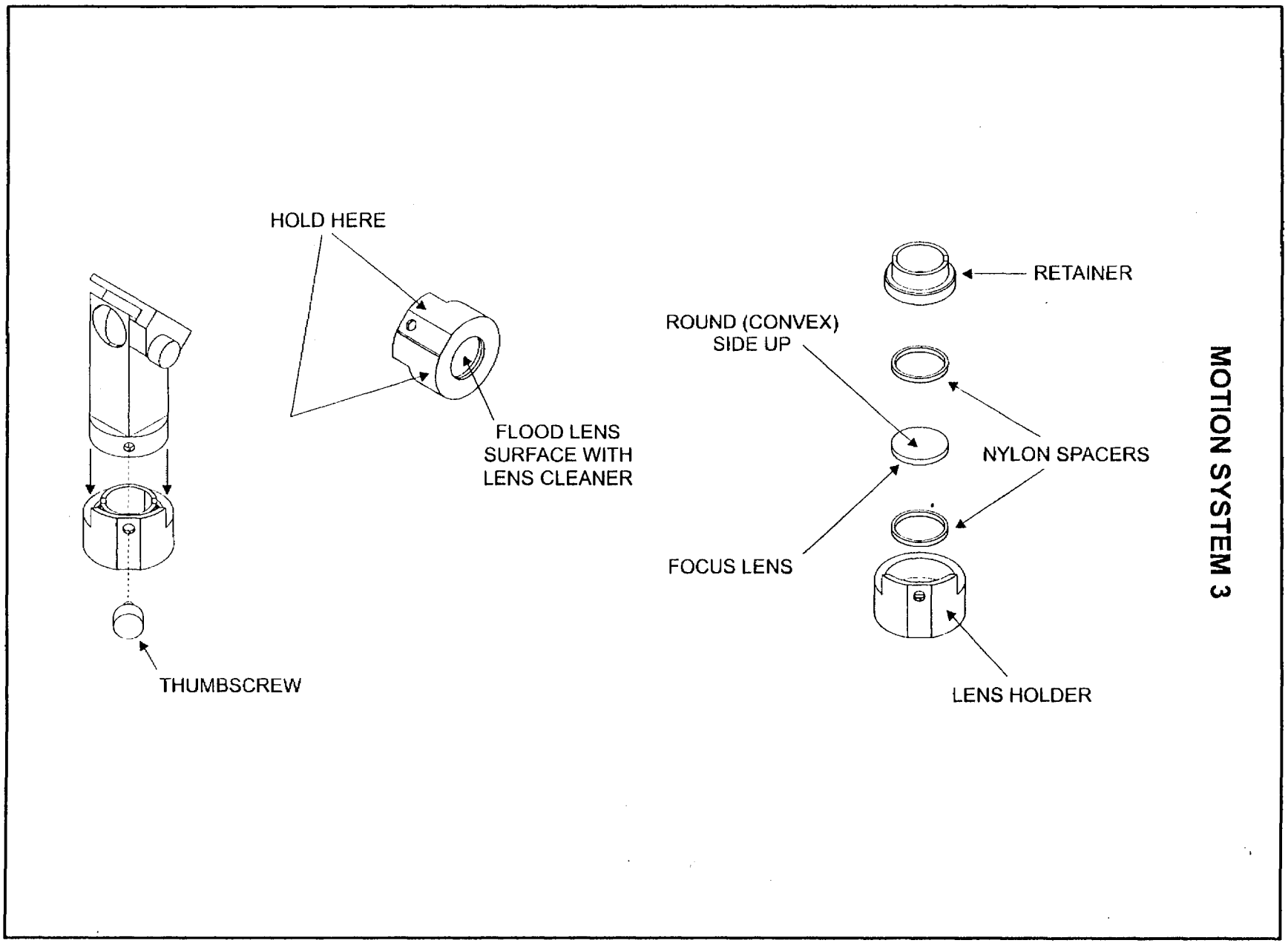
Spray Lens Cleaning solution on to the bottom surface of the lens(flood it) and let the fluid run off. Gently dry the remaining fluid with a cotton swab. DO NOT rub the cotton swab into the lens because you can scratch the lens, only use it to wipe up the fluid. If it did not come clean the first time, repeat the procedure. If it is necessary to remove the lens from the holder, unscrew the Focus Lens Retainer and turn the Lens Holder Assembly over onto a clean lens tissue that is placed on a soft cloth. This will prevent the lens from breaking if dropped onto a hard surface. Flood the 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 stops.

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.


HOLD HERE
FLOOD LENS SURFACE WITH LENS CLEANER
THUMBSCREW
RETAINER
ROUND (CONVEX) SIDE UP
NYLON SPACERS
FOCUS LENS
LENS HOLDER
MOTION SYSTEM 3

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 parts of the X-axis Arm pass through them. The parts of the arm (Flags) block the infrared light that is generated by one part of the sensor and picked up by the other. Note that the Sensor has two opposing components, we will call them blocks. One block is the light transmitter and the other is the receiver. When the laser system is powered up, and the Flags pass in between the blocks, the light path is broken and the Sensor recognizes that the arm is in the Home Position. It then signals the arm to go out again slightly into the engraving field and come back in to re-register. When this happens, the Motion System will stop and the Homing procedure is finished. The Sensors can get dirty from engraving smoke. If an individual Sensor is dirty, the Sensor will think that the Flag is already located between the transmitter block and the receiver block of the Sensor. It will then signal the motors to move the arm or Focus Carriage into the engraving area to clear the Flag away from the Sensor, see light, and pull the arm or the Focus Carriage back through the Sensors blocks. Since it never sees light, because it is dirty, it continues to move into the engraving area direction where it will stop after 2 inches. To put it another way, if you turn on the laser system and the Focus Carriage moves to the left 2 inches and stops, the X-axis Limit Switch is dirty. If it moves 2 inches to the front of the machine and stops, then the Y-axis Limit Switch is dirty.

Cleaning

To clean either Sensor, 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 Sensor, turn off the laser system, unplug the Sensor, unscrew the screws and remove it.

Installation

Re-installation is opposite of removal.

Adjustment

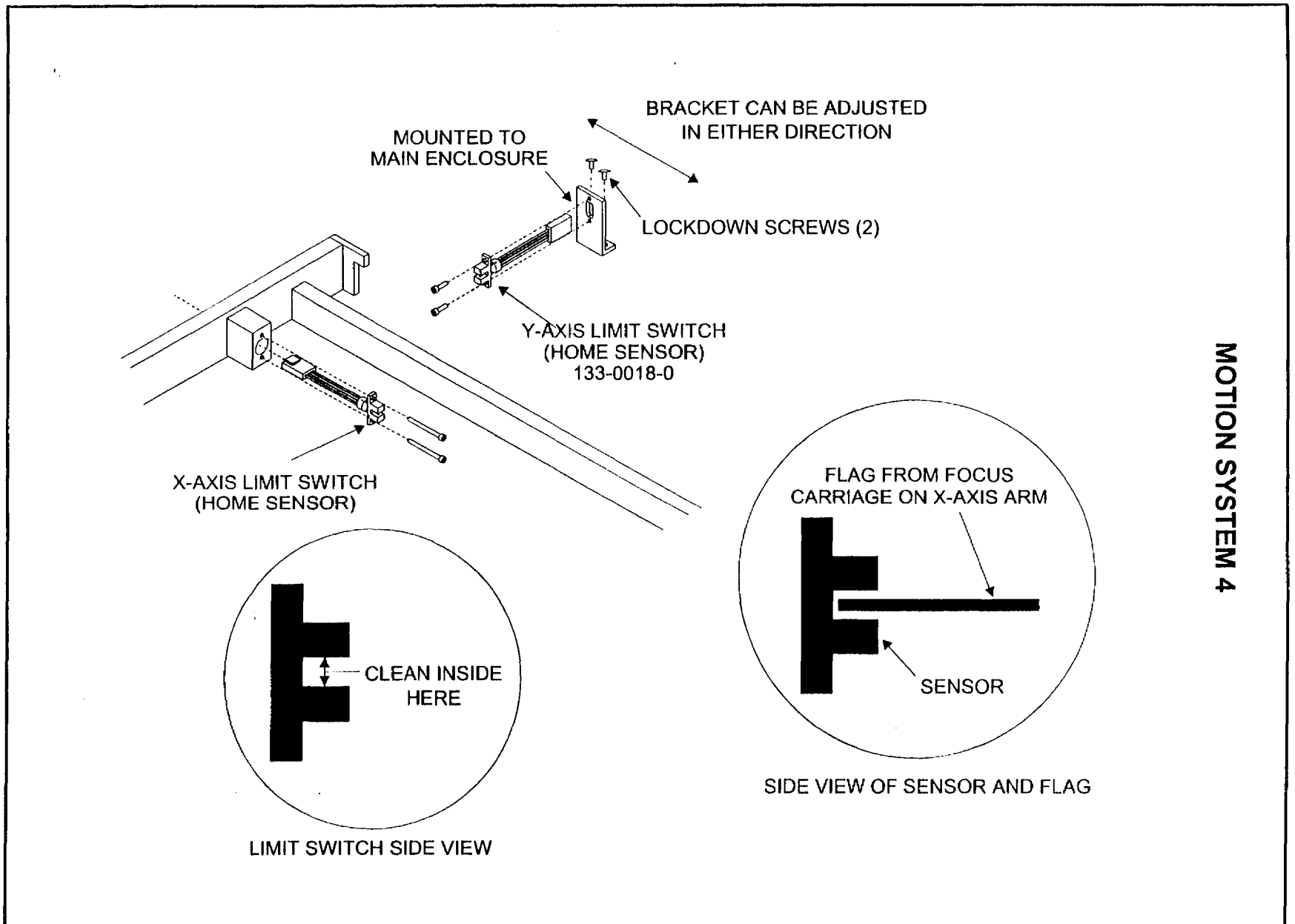
If the Flags are misaligned by a misaligned Motion System Arm and do not pass through the Sensor correctly, the Focus Carriage will slam into the side or top rails of the Motion System or make a chattering noise. In this case, we would either have to find out the cause and repair the misalignment of the arm or re-position either the Sensor so that the Flags on the Motion System Arm pass through the Sensors properly. There are several possibilities that can cause the Focus Carriage to slam against the right side of the X-axis Arm:

- The X-axis Sensor is broken on the inside and it does not work at all.
- The X-axis Sensor is OK but the connection to the power supply is bad or the wires are loose.
- The X-axis Arm is not square. This will cause it to home correctly in the Y-axis direction but since the arm is on an angle, the X-axis Flag does not pass through the Sensor properly.

First check if the Arm is square by turning the laser off and pulling 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 Sensor is not located close enough to the back rail, the X-axis Flag will not pass through it's Sensor. If the Y-axis Sensor is located too close to the rear rail, the X-axis Flag will bump into it's Sensor. The objective is to adjust the Y-axis Sensor until the X-axis Flag slides in between it's Sensor blocks. It needs to be far enough into the Sensor that it registers but not too deep otherwise the Flag will hit the inside of the Sensor block. 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 that section later on in this manual.


BRACKET CAN BE ADJUSTED
IN EITHER DIRECTION
MOUNTED TO
MAIN ENCLOSURE
LOCKDOWN SCREWS (2)
Y-AXIS LIMIT SWITCH
(HOME SENSOR)
133-0018-0
X-AXIS LIMIT SWITCH
(HOME SENSOR)
CLEAN INSIDE
HERE
LIMIT SWITCH SIDE VIEW
FLAG FROM FOCUS
CARRIAGE ON X-AXIS ARM
SENSOR
SIDE VIEW OF SENSOR AND FLAG
MOTION SYSTEM 4

MOTION SYSTEM 5

X-axis Bearing Description and Adjustment

Description

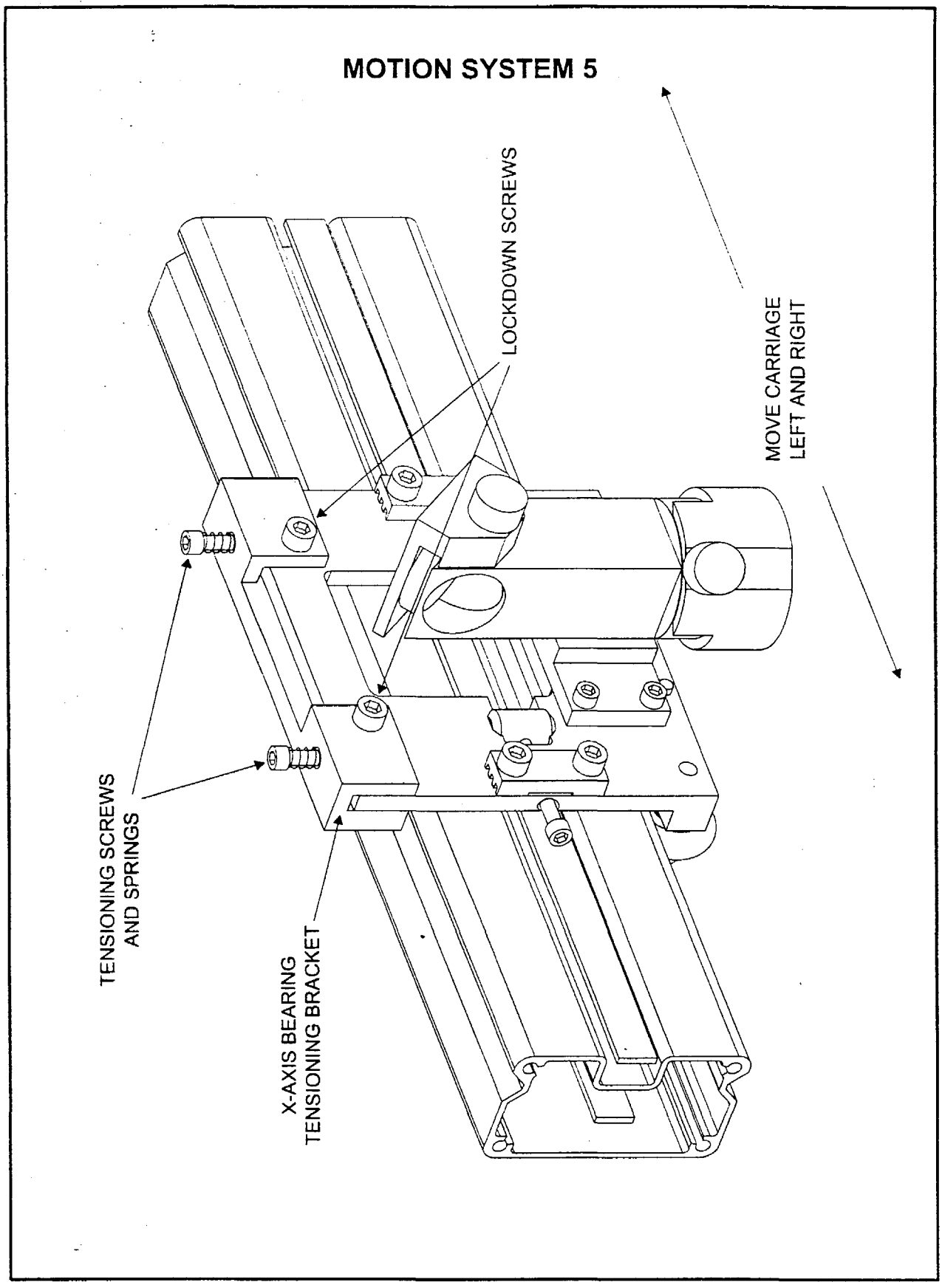
The Motion System has been designed in such a way that the outer surface of the bearings will eventually wear out instead of the metal parts of the Motion System. In this way, it will be much less expensive to replace bearings than an anodized aluminum extrusion. Something must wear out so the bearings 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 produces because the Focus Carriage will rock back and forth as it reverses direction.

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.


MOTION SYSTEM 5
LOCKDOWN SCREWS
MOVE CARRIAGE
LEFT AND RIGHT
TENSIONING SCREWS
AND SPRINGS
X-AXIS BEARING
TENSIONING BRACKET

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 in nut driver or wrench, unscrew the X-axis Bearing 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

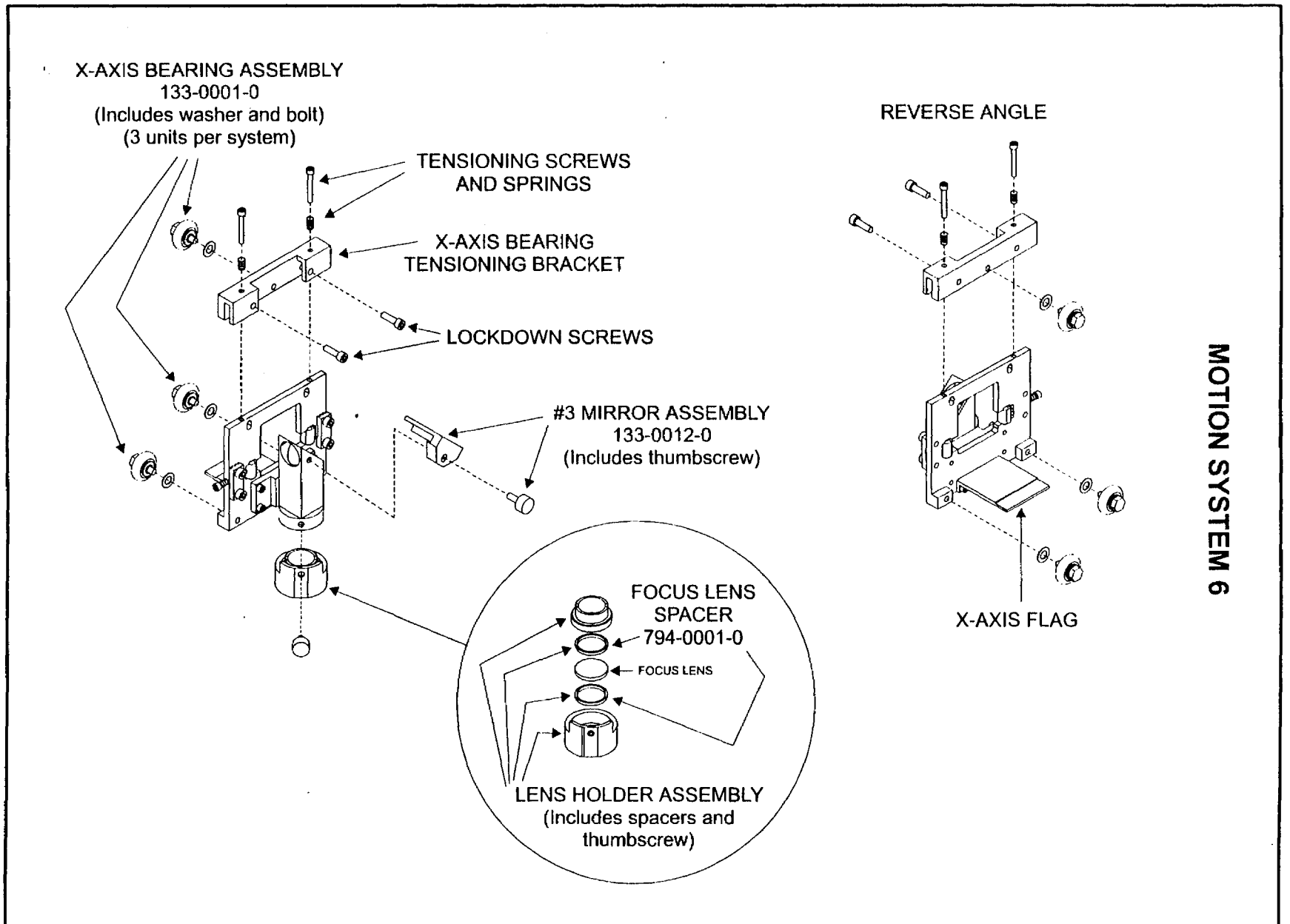
Place the new Washer between the new X-axis Bearing and the Bracket and tighten down the screw until it stops. **DO NOT** overtighten the screw. Tighten it just enough to get it snug. The screw is a shoulder screw. Tightening it past its stopping point will not remove internal play from the bearing, it will strip the aluminum threads on the Bracket. 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.

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. Tighten the Tensioning Screws until you can see the springs compress to the point where you cannot see any gap between the coils in the springs. Make sure you tighten both Tensioning screws evenly so that the Tensioning bracket is sitting level on the Focus Carriage. Adjust as necessary to make it level. Now, back off the Tensioning Screws two(2) complete revolutions. This will set the proper spring tension for the Bracket. 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.

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. It is also important that the rolling resistance between the two bearings are even. If they are not, re-adjust the Focus Carriage 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.


X-AXIS BEARING ASSEMBLY
133-0001-0
(Includes washer and bolt)
(3 units per system)
TENSIONING SCREWS
AND SPRINGS
X-AXIS BEARING
TENSIONING BRACKET
LOCKDOWN SCREWS
#3 MIRROR ASSEMBLY
133-0012-0
(Includes thumbscrew)
FOCUS LENS
SPACER
794-0001-0
FOCUS LENS
LENS HOLDER ASSEMBLY
(Includes spacers and
thumbscrew)
REVERSE ANGLE
X-AXIS FLAG
MOTION SYSTEM 6

MOTION SYSTEM 7

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

Cleaning

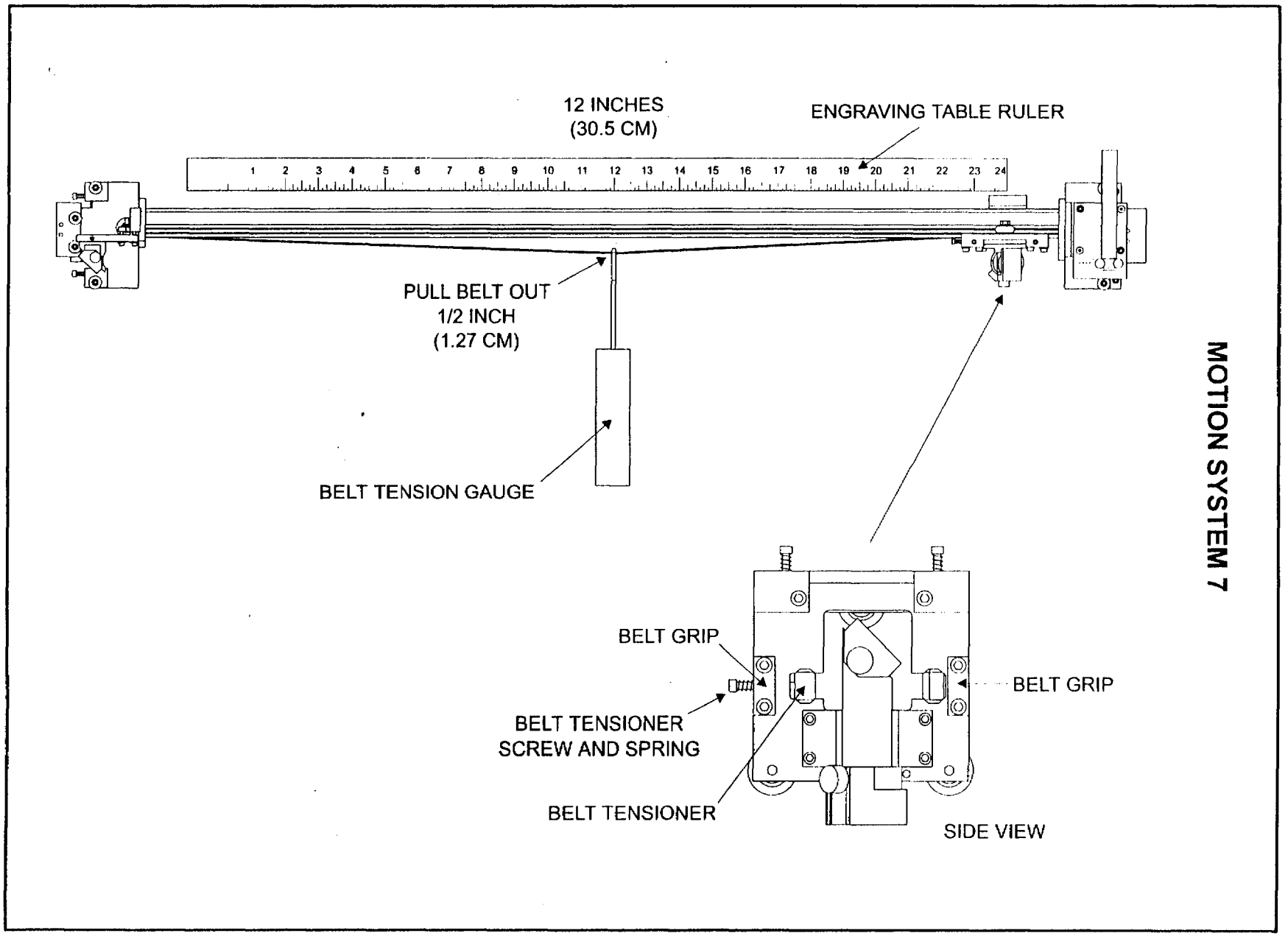
The X-axis Belt will need cleaning from time to time. Sometimes smoke or debris will settle on the teeth and that debris will transfer to the X-axis Drive Gear. If the X-axis Drive Gear accumulates too much debris, the X-axis Belt will start to slip. A good way to clean the belt is with a toothbrush. 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.

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. To set the correct X-axis Belt tension, first turn the laser system off. 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.

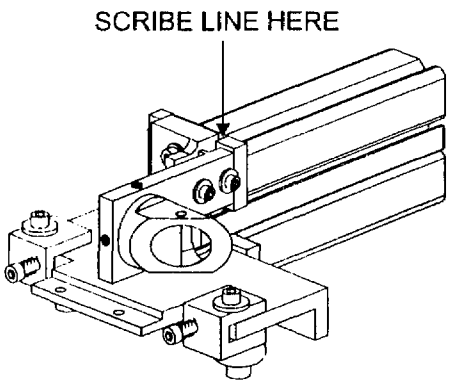
Removal and Installation

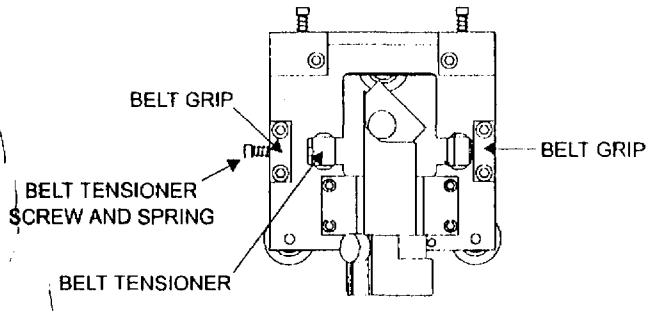
If the X-axis Belt needs replacement, loosen the X-axis Belt Tensioner Screw and disconnect the Belt from the Focus Carriage by removing the X-axis Belt Grip on both sides. Since the X-axis Belt passes through the inside of the X-axis Arm Assembly, it is a good idea to tape the end of the old belt securely 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 disconnect the old belt. Attach the new belt around the Belt Tensioner Cylinders and into the Belt Grip Assembly. Lock it down to the Focus Carriage by tightening the Belt Grip Screws and re-tension the X-axis Belt.

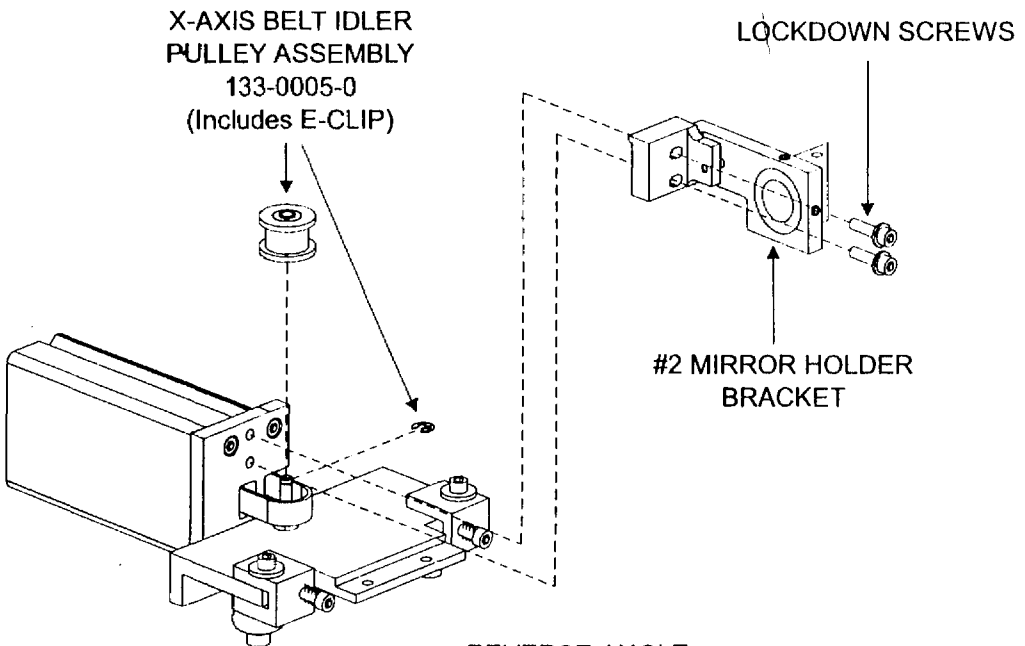

12 INCHES
(30.5 CM)
ENGRAVING TABLE RULER
PULL BELT OUT
1/2 INCH
(1.27 CM)
BELT TENSION GAUGE
BELT GRIP
BELT GRIP
BELT TENSIONER
SCREW AND SPRING
BELT TENSIONER
SIDE VIEW
MOTION SYSTEM 7

MOTION SYSTEM 8

X-axis Belt Idler Pulley Removal and Replacement



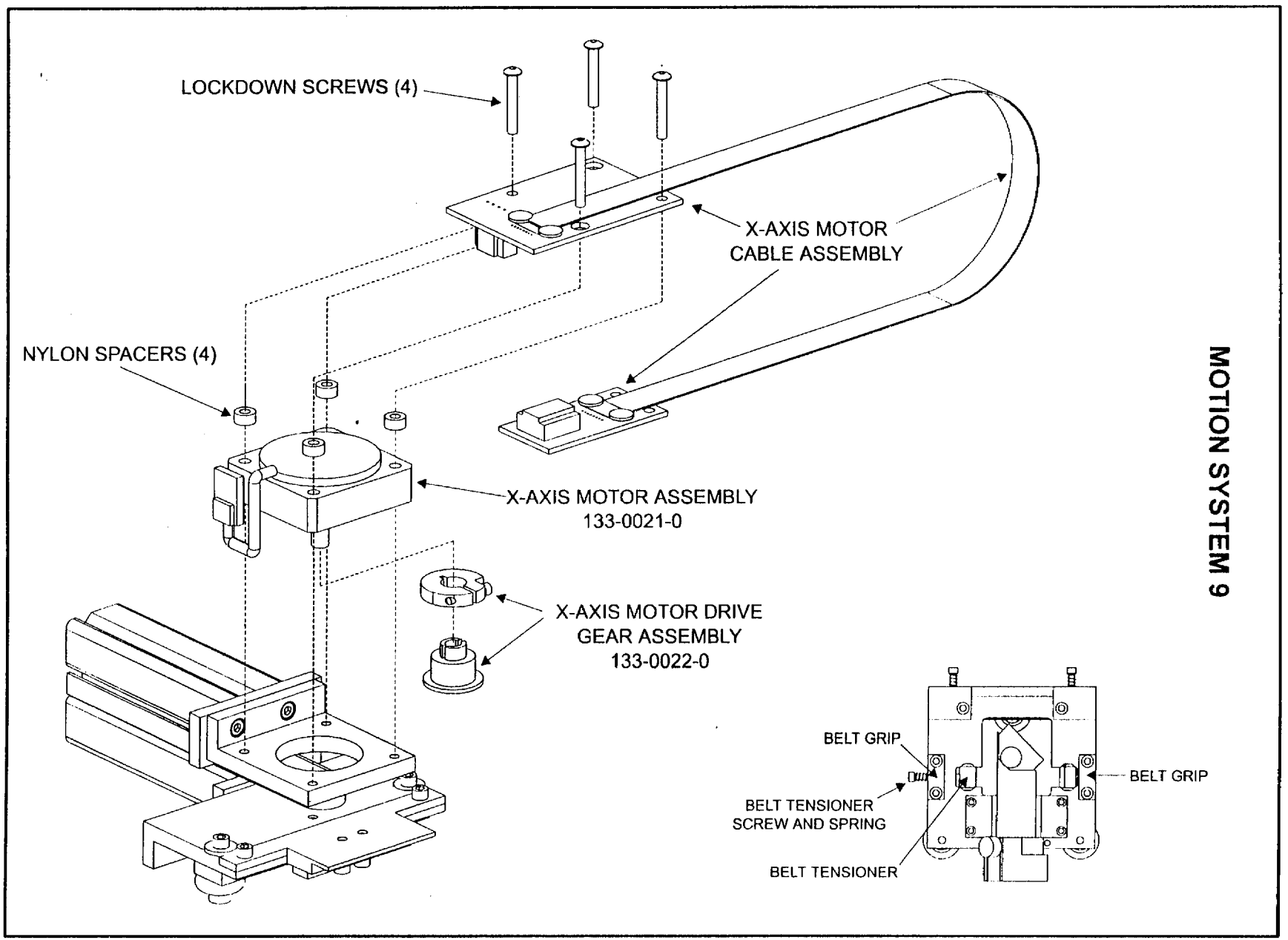




MOTION SYSTEM 8

MOTION SYSTEM 9

X-axis Motor Removal and Replacement


LOCKDOWN SCREWS (4)
X-AXIS MOTOR
CABLE ASSEMBLY
NYLON SPACERS (4)
X-AXIS MOTOR ASSEMBLY
133-0021-0
X-AXIS MOTOR DRIVE
GEAR ASSEMBLY
133-0022-0
BELT GRIP
BELT GRIP
BELT TENSIONER
SCREW AND SPRING
BELT TENSIONER
MOTION SYSTEM 9

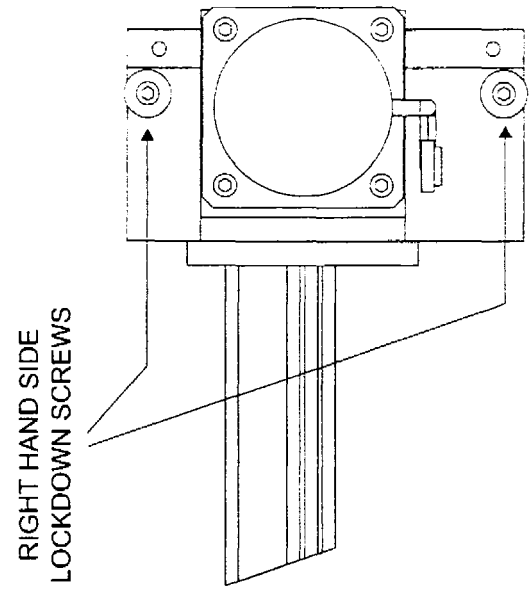
MOTION SYSTEM 10

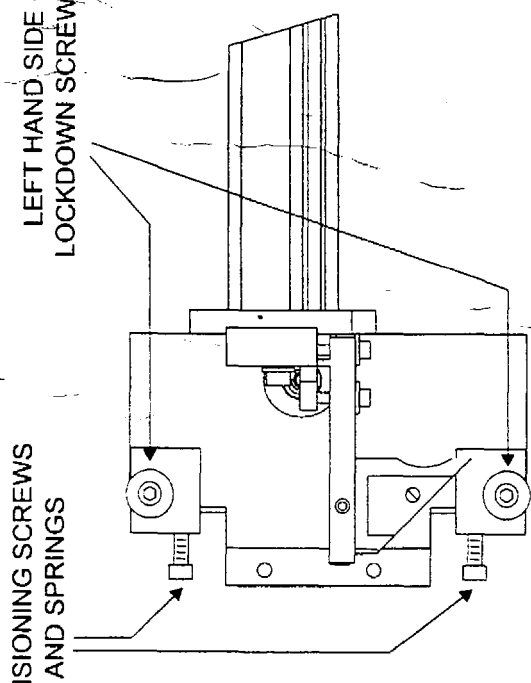
Y-axis Bearing Adjustment

To adjust the Y-axis Bearings, first make sure that the system is off. Move the arm manually to the middle of the field. Loosen all four(4) lockdown screws one half turn. Gently move the carriage back and forth from the top of the field to the bottom. 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. Now tighten the lockdown screws on the right hand side first. Then tighten the lockdown screws on the left hand side.

To check your adjustment, 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 sort of slide instead of roll. 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 slides instead of rolls, repeat the entire loosening and tightening of the lockdown screws procedure.

MOTION SYSTEM 10

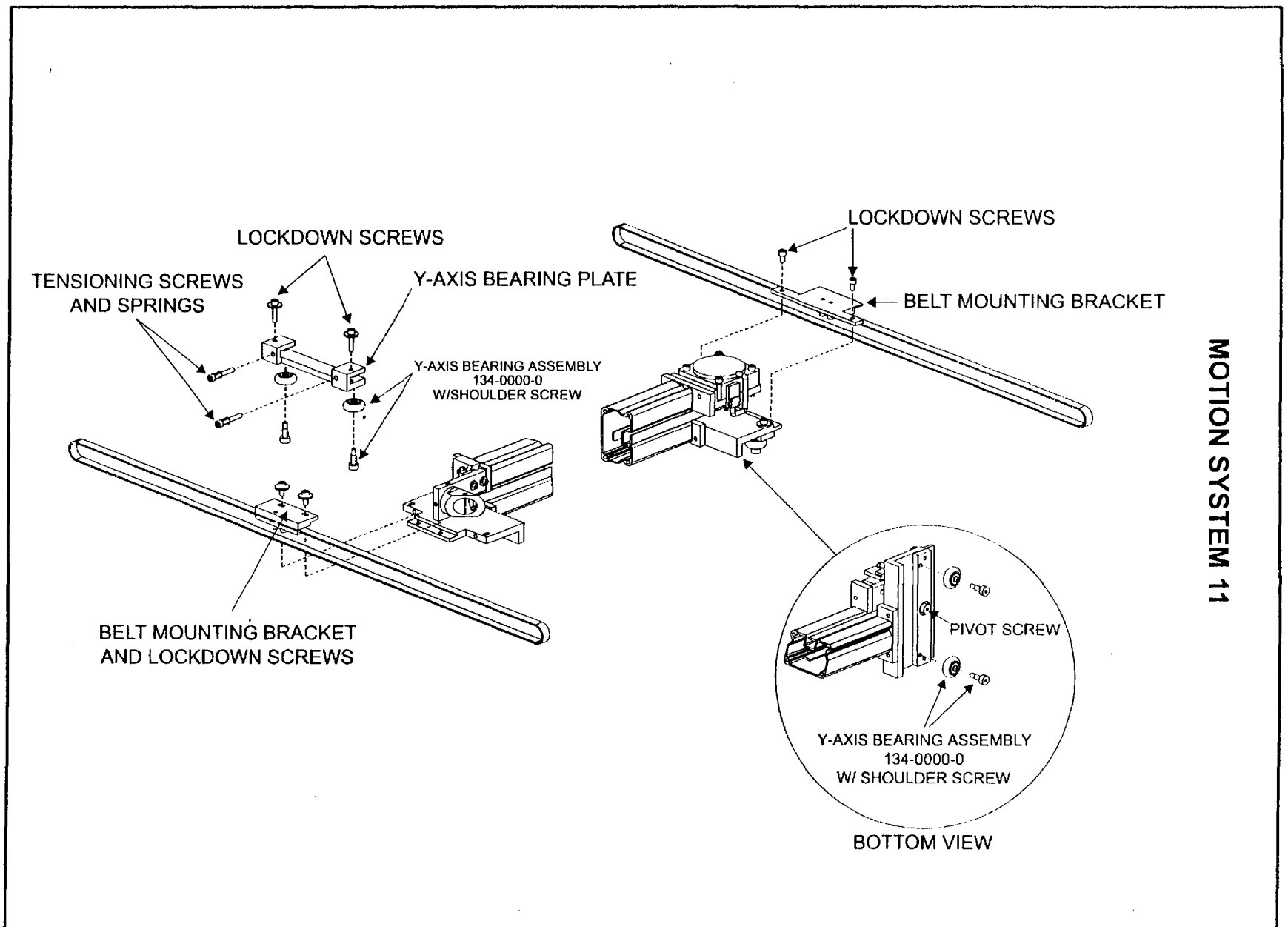




MOTION SYSTEM 11

Y-axis Bearing Removal and Replacement

(INCOMPLETE)


LOCKDOWN SCREWS
TENSIONING SCREWS
AND SPRINGS
Y-AXIS BEARING PLATE
Y-AXIS BEARING ASSEMBLY
134-0000-0
W/SHOULDER SCREW
BELT MOUNTING BRACKET
AND LOCKDOWN SCREWS
LOCKDOWN SCREWS
BELT MOUNTING BRACKET
PIVOT SCREW
Y-AXIS BEARING ASSEMBLY
134-0000-0
W/ SHOULDER SCREW
BOTTOM VIEW
MOTION SYSTEM 11

MOTION SYSTEM 12

Y-axis Belt Adjustment, Removal and Replacement, Y-axis Belt Idler Pulley Replacement, Y-axis Drive Gear Replacement, Y-shaft Bearing Replacement, and X-axis Arm Squaring

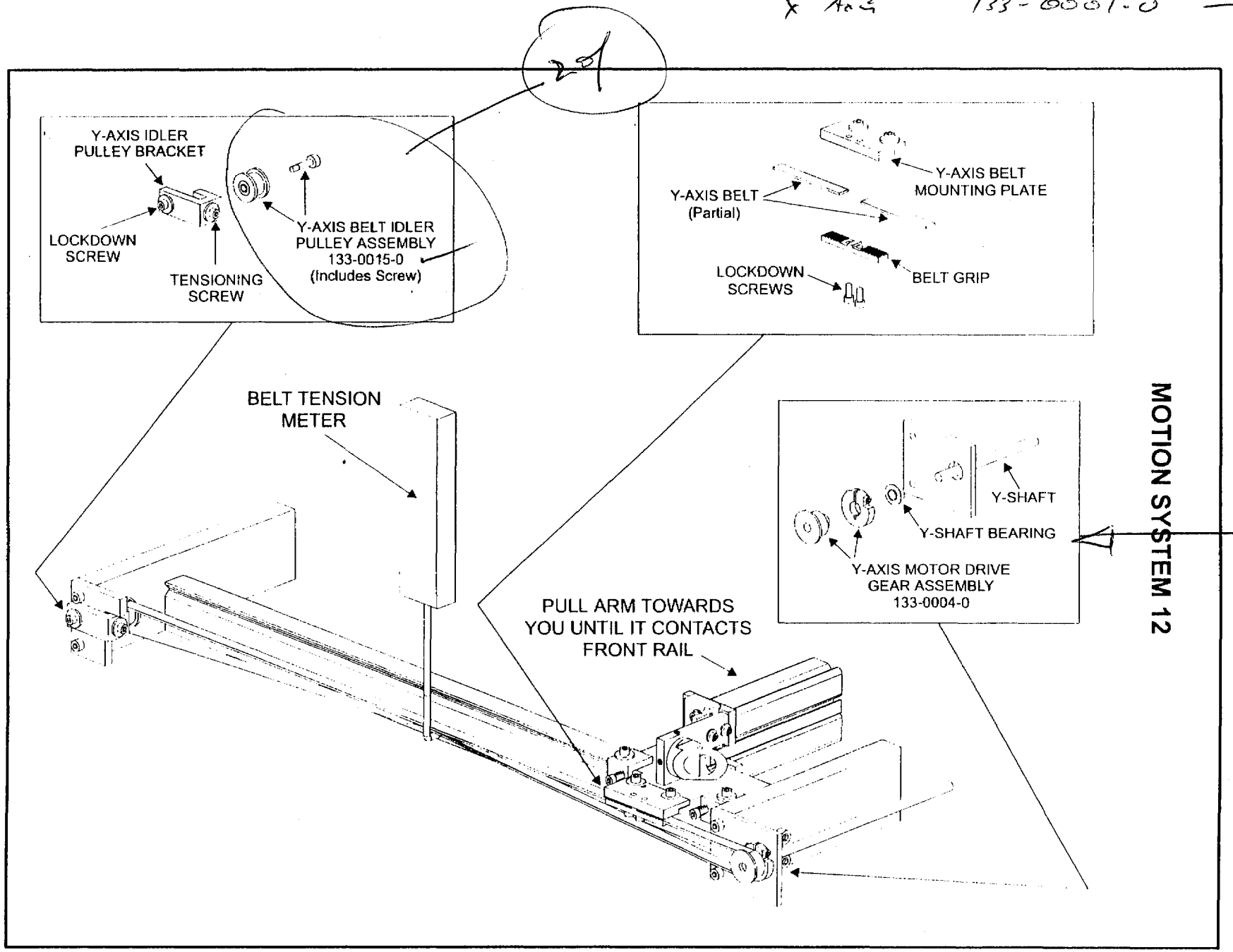
Each section here is defined as a separate procedure. If replacing a belt, perform all procedures. If making an adjustment, refer to that procedure.

Y-axis Belt Removal and Replacement.
Loosen the lockdown screw that holds down the Y-axis Idler Pulley Bracket. Only loosen it, it is not necessary to remove it. Back off or loosen the Belt Tension Adjustment Screw, again only loosen, it is not necessary to remove. This will give the belt some slack. Next, remove the Belt Mounting Plate Lockdown Screws to detach the plate from the Arm. Flip the plate over to access the Belt Grip. Remove the Lockdown Screws and Belt Grip to release the Y-axis Belt. Attach the new Y-axis Belt by connecting the ends to the Belt Grip and securing it with the Lockdown Screws. Now attach the belt around the Y-axis Drive Gear and the Y-axis Idler Pulley. Do not attach the Belt Mounting Plate to the Arm just yet. Pull the Arm to the front of the machine until it contacts the front rail. Now try to position the Y-axis Belt on the Y-axis Drive gear so that the Belt Mounting Plate Lockdown Screw holes line up with the part of the Arm that it attaches to. You will notice that the Belt Mounting Plate has oval shaped holes for the Lockdown Screws. This will allow us to adjust for Squaring later on. Install the Lockdown Screws but do not tighten them down yet because we will adjust Belt Tension next.

Y-axis Belt tension Adjustment
To adjust Y-axis Belt tension, you will need a belt tension gauge. With the laser system off, pull the Motion System Arm towards the front of the laser system until it can go no further. With a Belt Tension Gauge, hook the bottom part of the belt and pull it up until it touches the top part of the belt and check the reading of the gauge. It should be 200 - 220 grams or 7 - 8 ounces of force. If it is not, loosen the Lockdown Screw on the side of the Y-axis Idler Pulley Bracket and tighten or loosen the adjustment Screw respectively. One the proper tension is achieved, re-tighten the Lockdown Screw. Check tension once again to verify. The other Y-axis Belt tension is adjusted in the same manner. It is important that the belt tension be equal between both Y-axis Belts. You must now proceed to squaring the X-axis Arm.

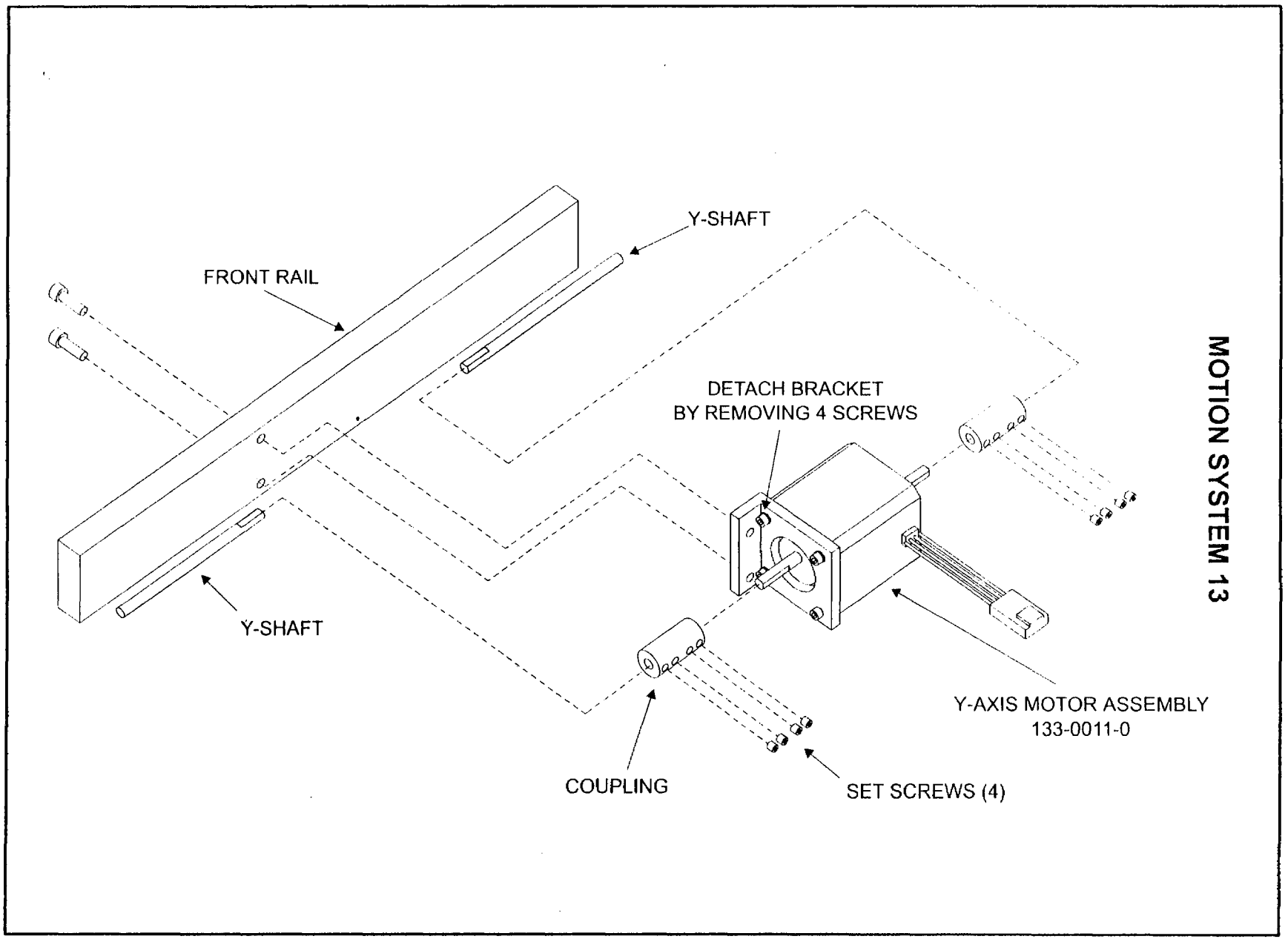
X-axis Arm Squaring
Loosen the Belt Mounting Plate Lockdown Screws (if they are not loose already), and pull the Arm towards you until it contacts the Front Rail. It important that the left side and the right side of the X-axis Arm contact the Front Rail at the same time. Hold the Arm against the Front Rail while tightening down the Lockdown Screws. Squaring the X-axis Arm is now complete.

NOTE: After making any adjustments to the Y-axis Belts or Squaring the X-axis Arm, you MUST perform a Y-axis Bearing Adjustment. Please refer to that section of this manual.


Y-AXIS IDLER PULLEY BRACKET
LOCKDOWN SCREW
TENSIONING SCREW
Y-AXIS BELT IDLER PULLEY ASSEMBLY 133-0015-0 (Includes Screw)
Y-AXIS BELT (Partial)
Y-AXIS BELT MOUNTING PLATE
LOCKDOWN SCREWS
BELT GRIP
BELT TENSION METER
PULL ARM TOWARDS YOU UNTIL IT CONTACTS FRONT RAIL
Y-SHAFT
Y-SHAFT BEARING
Y-AXIS MOTOR DRIVE GEAR ASSEMBLY 133-0004-0
MOTION SYSTEM 12

MOTION SYSTEM 13

Y-axis Motor Removal and Replacement



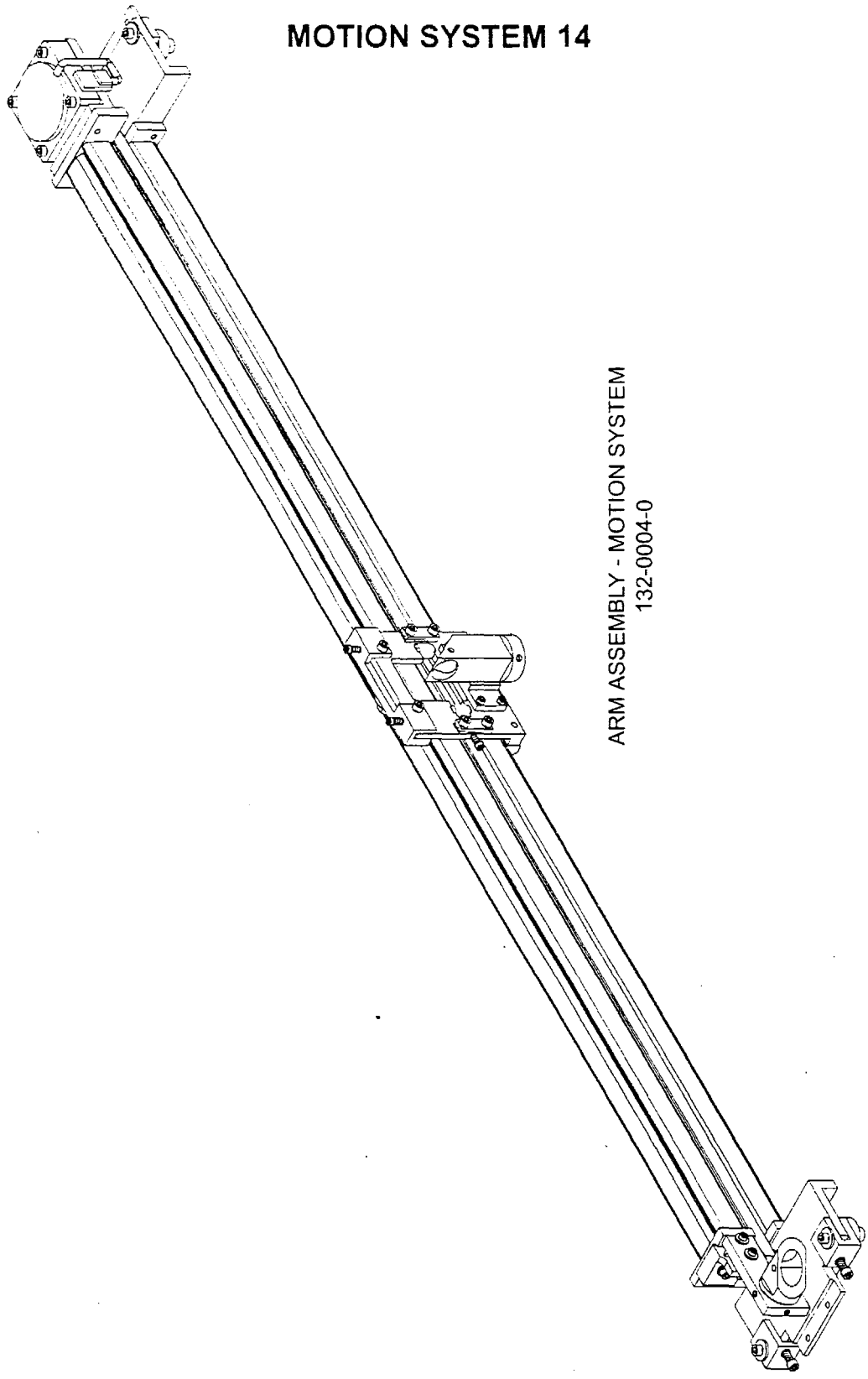
MOTION SYSTEM 13

MOTION SYSTEM 14

X-axis Arm 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.

MOTION SYSTEM 14



ARM ASSEMBLY - MOTION SYSTEM
132-0004-0

MOTION SYSTEM 15

Beam Alignment

MOTION SYSTEM 15

MOTION SYSTEM 16

(Beam Alignment continued)

MOTION SYSTEM 16

MOTION SYSTEM 17
(Beam Alignment continued)

MOTION SYSTEM 17

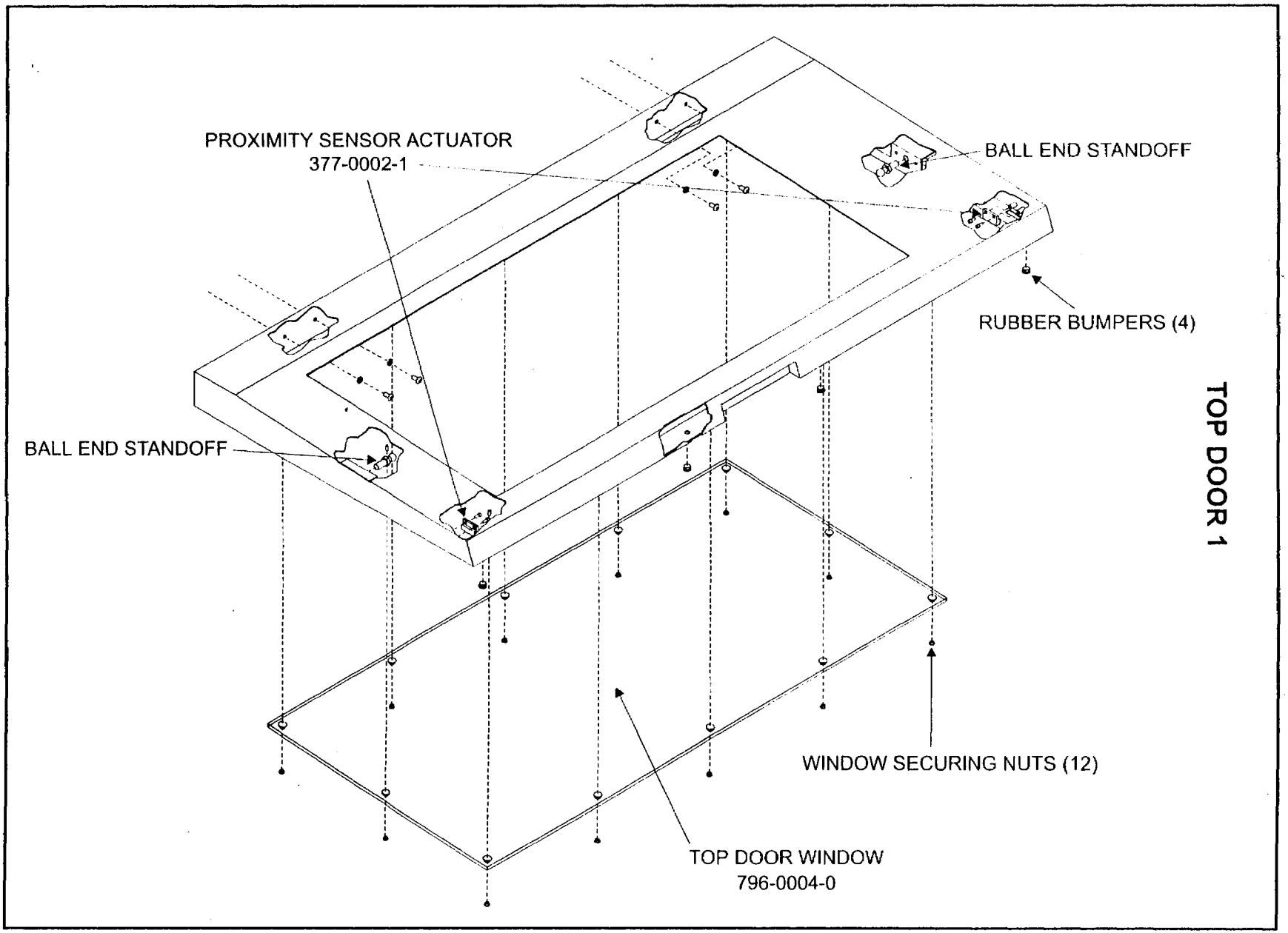
TOP DOOR 1

Top Door Description and Cleaning
Proximity Sensor Removal and Replacement

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.

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. If the window becomes damaged and/or optically unclear and it would like to be replaced, remove the securing nuts (12) that hold it in place. This is a little difficult because the bolts are very thin and not easy to get a grip on. I suggest using a needle nose pliers to loosen the bolts and then unthreading them by hand.

The Rubber Bumpers prevent metal to metal contact when the Top Door is shut.

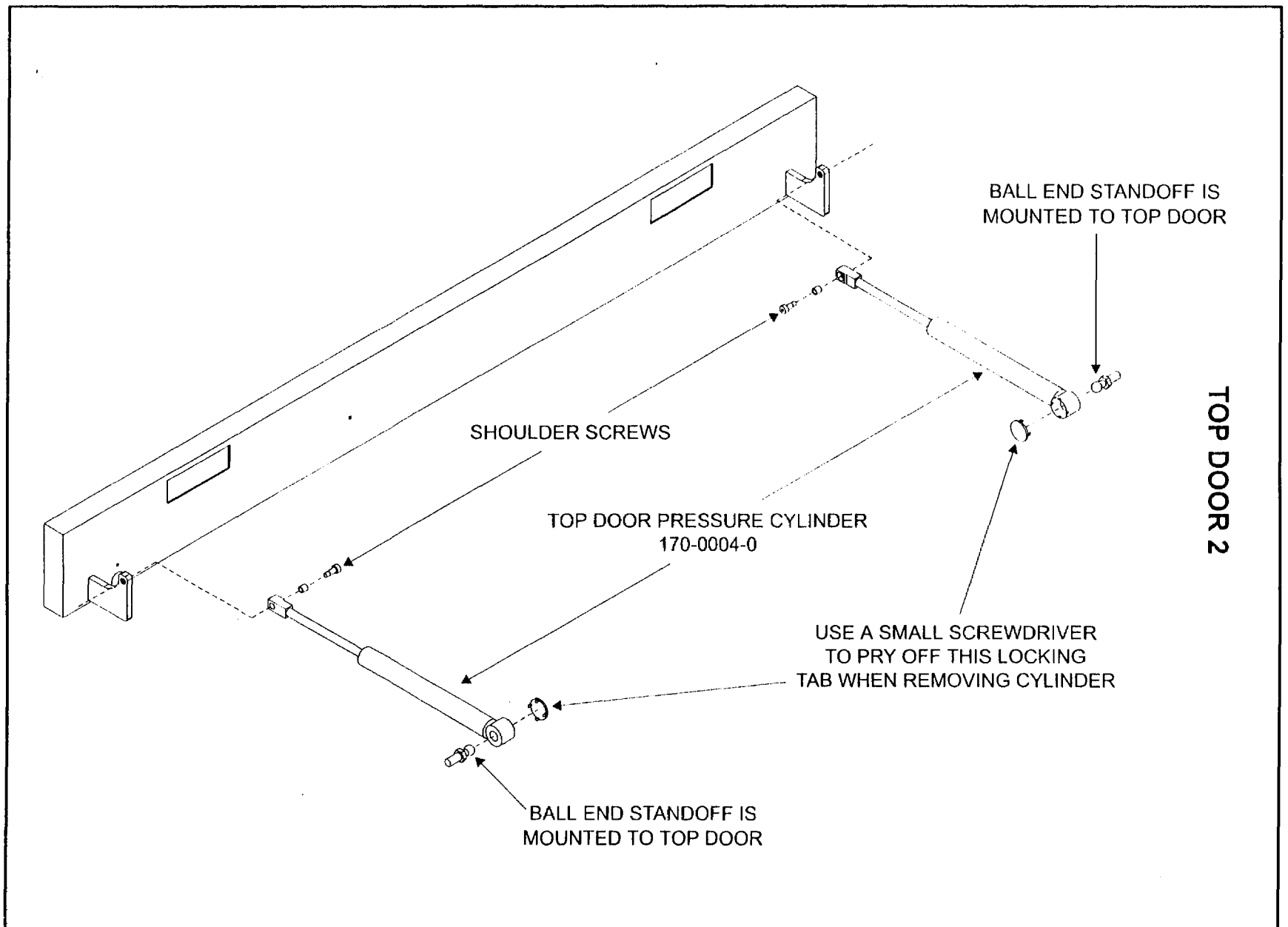

PROXIMITY SENSOR ACTUATOR
377-0002-1
BALL END STANDOFF
RUBBER BUMPERS (4)
BALL END STANDOFF
WINDOW SECURING NUTS (12)
TOP DOOR WINDOW
796-0004-0
TOP DOOR 1

TOP DOOR 2

Pressure Cylinder Removal and Replacement

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. To replace them, use a small screwdriver to pry off the plastic locking tabs as the diagram indicates. Grasp the cylinder and pop it off the Ball End Standoffs (shown in the previous diagram) that are mounted to the Top Door. Now remove the Shoulder Screw. Replacement is opposite of removal.


BALL END STANDOFF IS
MOUNTED TO TOP DOOR
SHOULDER SCREWS
TOP DOOR PRESSURE CYLINDER
170-0004-0
USE A SMALL SCREWDRIVER
TO PRY OFF THIS LOCKING
TAB WHEN REMOVING CYLINDER
BALL END STANDOFF IS
MOUNTED TO TOP DOOR
TOP DOOR 2

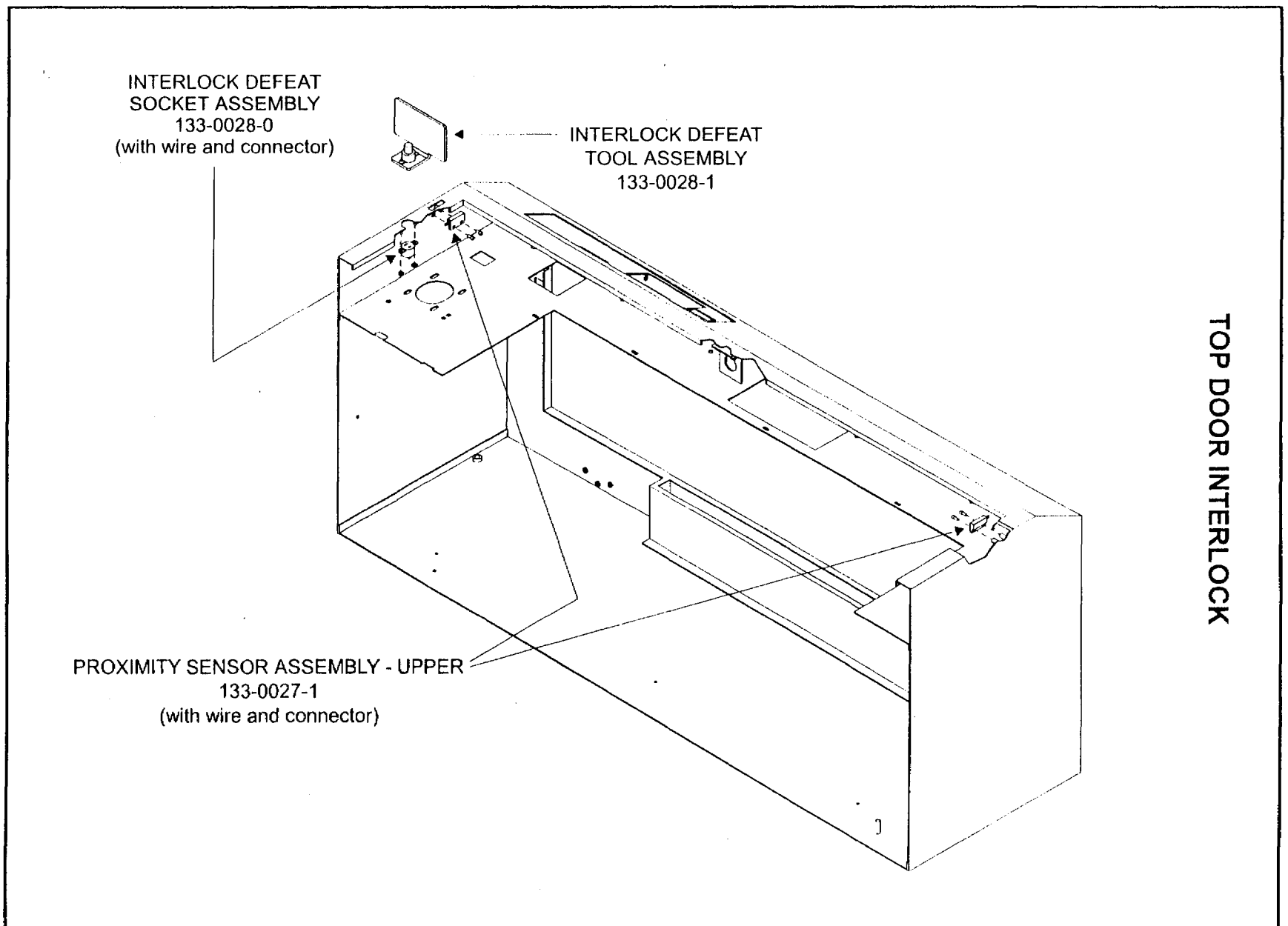
TOP DOOR INTERLOCK

Proximity Sensor Description, Removal and Replacement

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, 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.

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.


INTERLOCK DEFEAT
SOCKET ASSEMBLY
133-0028-0
(with wire and connector)
INTERLOCK DEFEAT
TOOL ASSEMBLY
133-0028-1
PROXIMITY SENSOR ASSEMBLY - UPPER
133-0027-1
(with wire and connector)
TOP DOOR INTERLOCK

Z-AXIS ASSEMBLY 1

Engraving Table Description and Adjustment

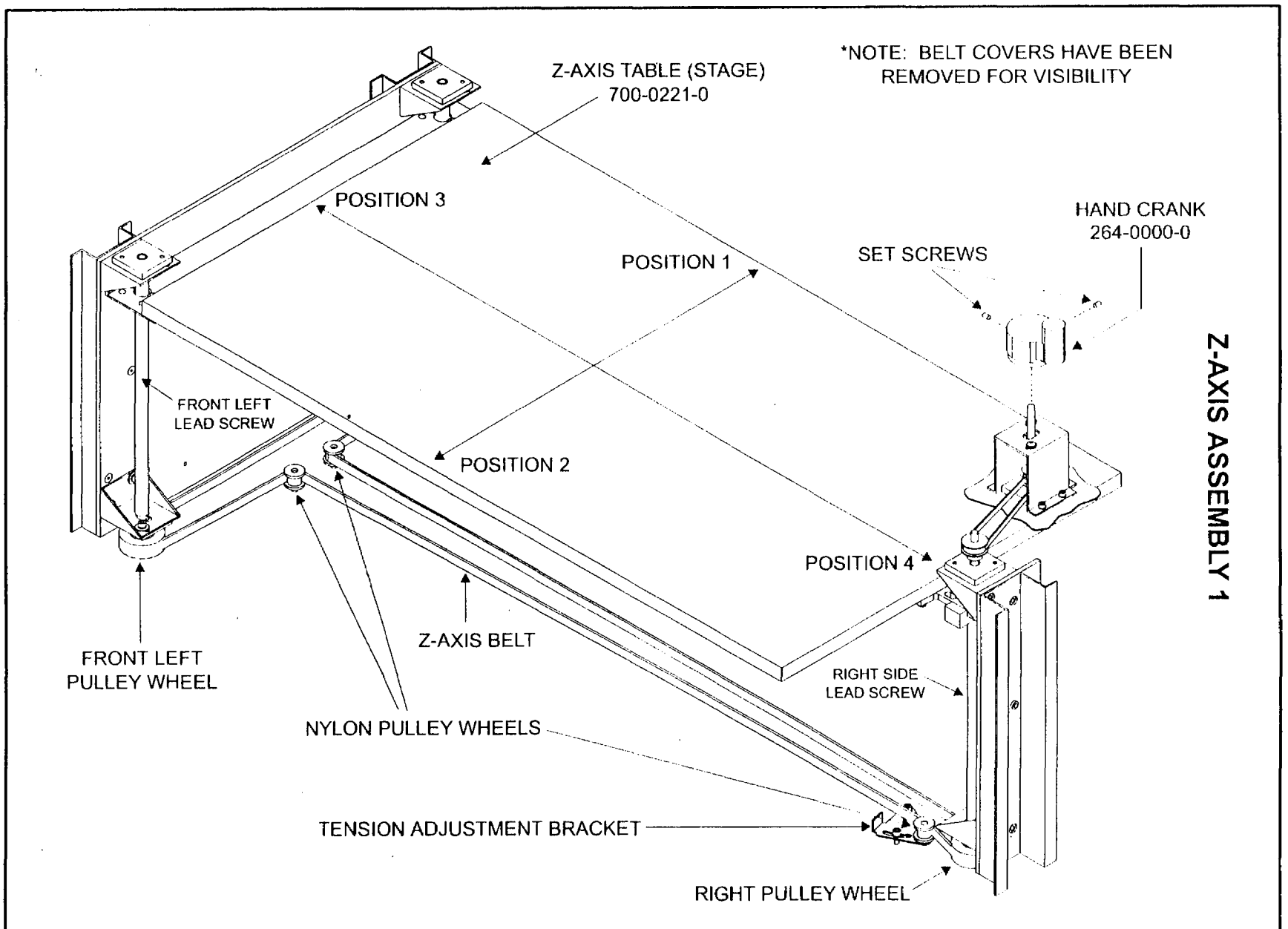
The Engraving Table (Z-axis Table or Stage) is a Honeycomb centered, aluminum laminated table. It is very lightweight and surface ground and polished so that it is very flat. The levelness of the Engraving Table is a very important requirement for proper laser engraving. If, for any reason, the Table 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.

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.


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

Z-AXIS ASSEMBLY 2

Ruler Adjustment, Removal, and Replacement

(INCOMPLETE)

Z-AXIS ASSEMBLY 2

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.

Step 1: 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.

Step 2: 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.

Step 3: Place a piece of anodized aluminum on the engraving table in the same location as you placed the graphic on screen.

Step 4: 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.

Step 5: 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.

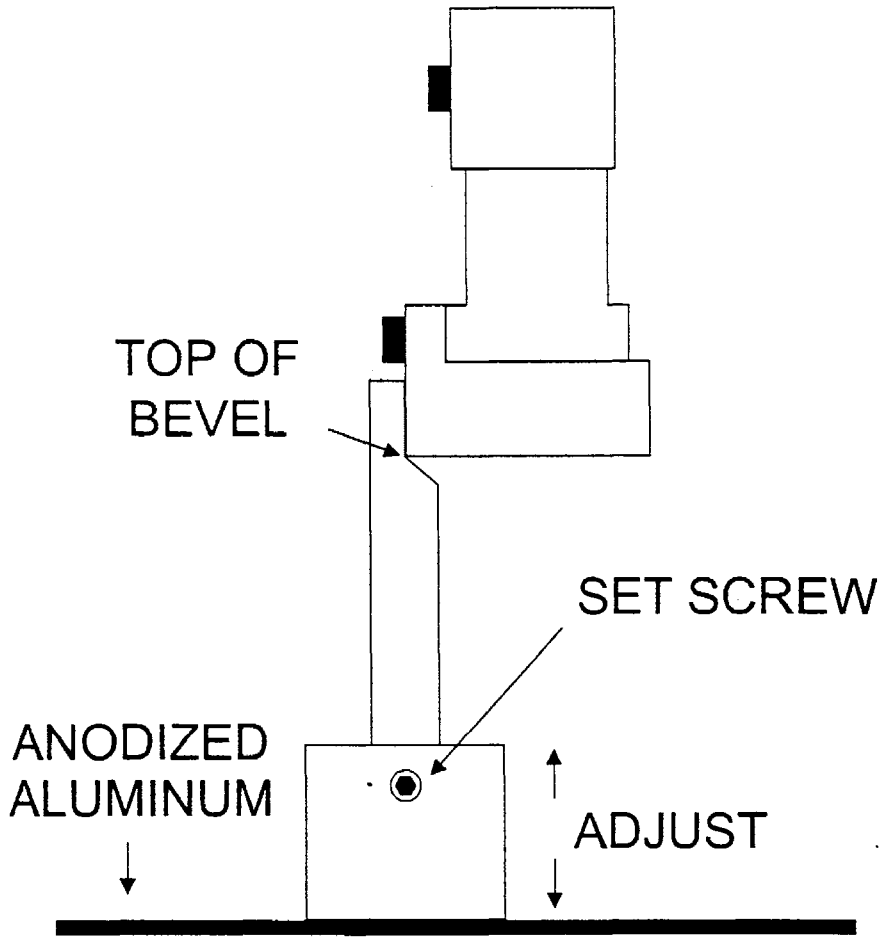
Step 6: Press the Start Button to begin engraving.

Step 7: 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.

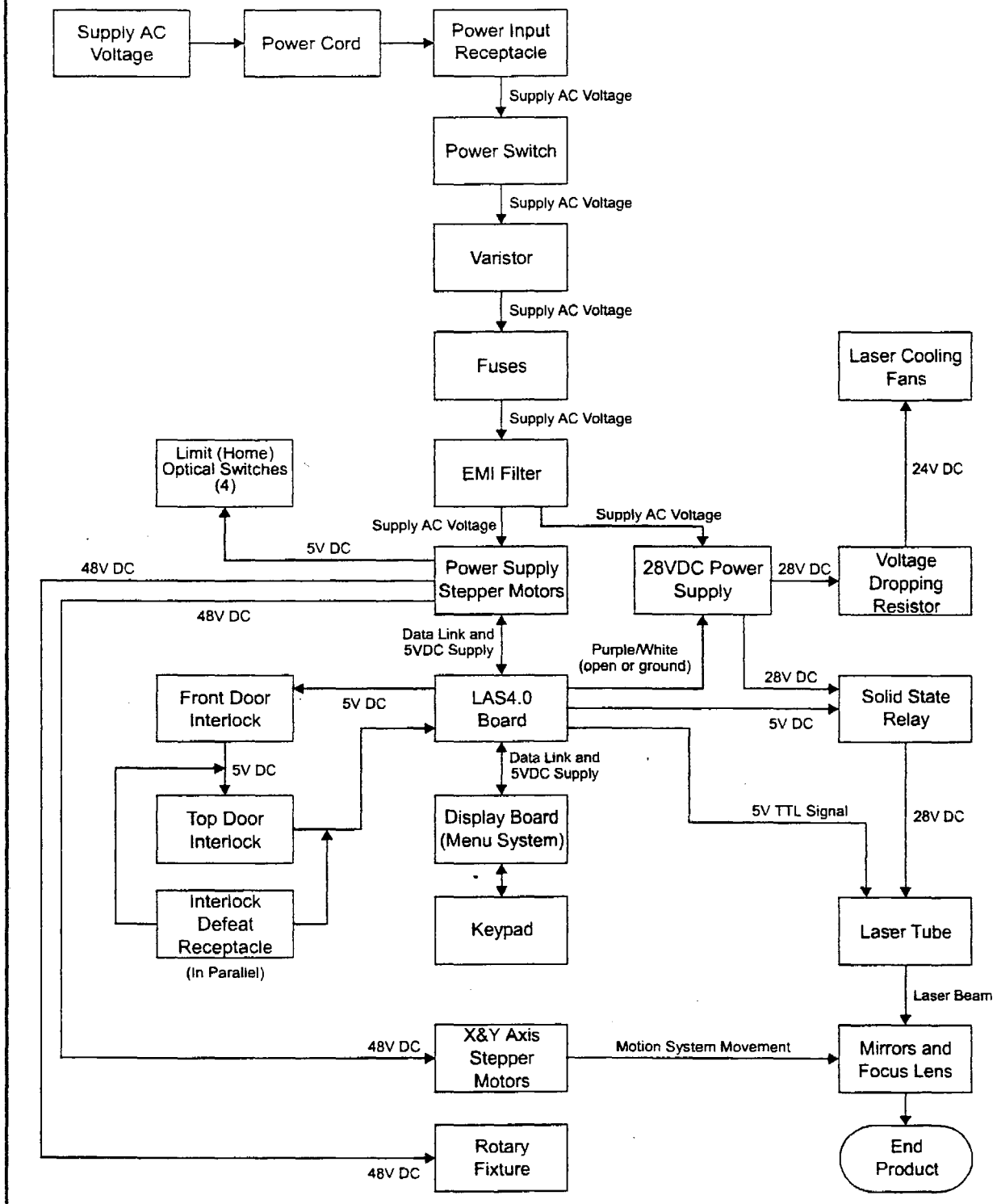
Step 8: Turn off the entire laser system and remove the Interlock Defeat Tool.

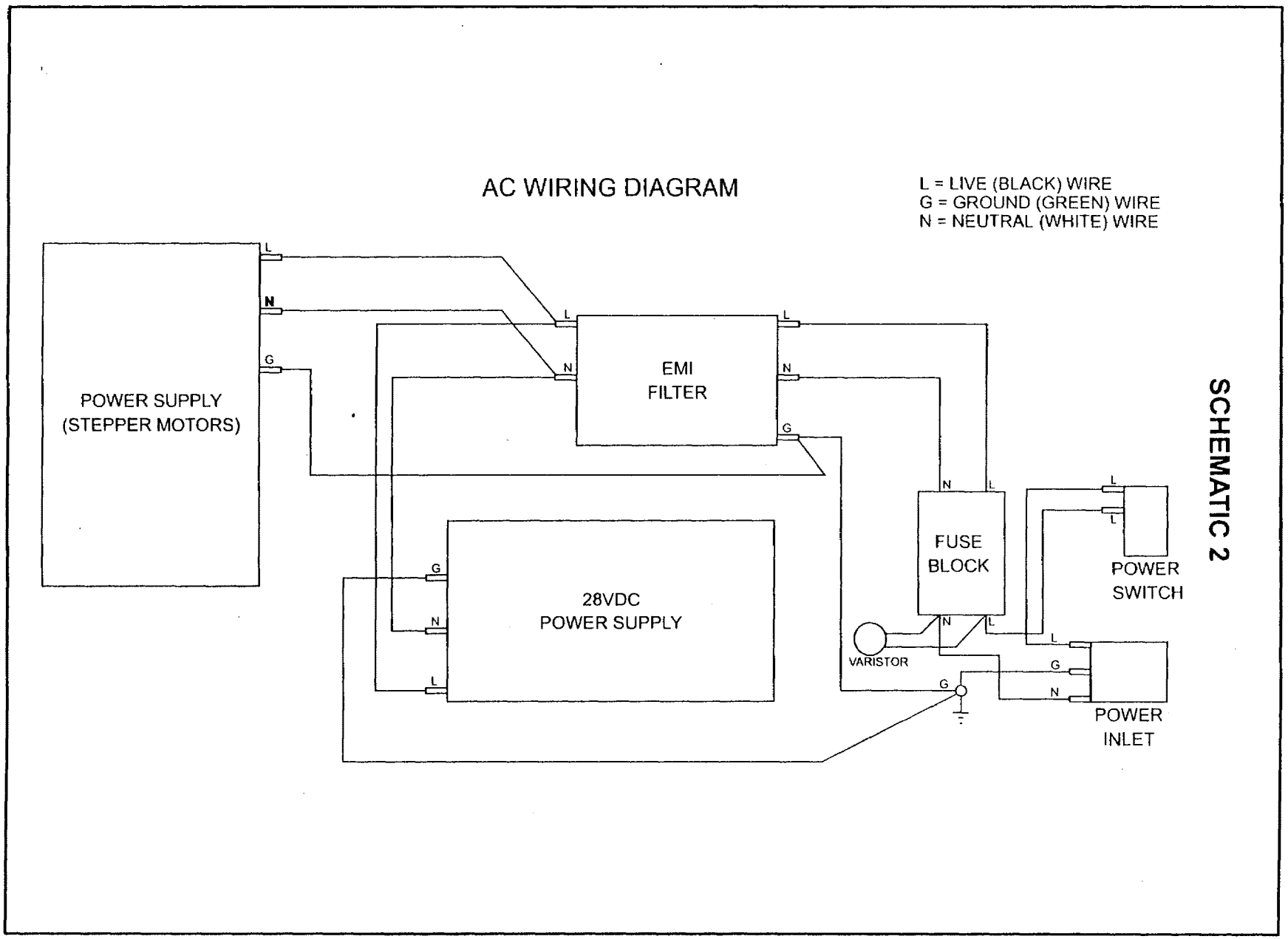
Step 9: Place the Focus Tool on top of the anodized aluminum and up against the side of the Focus Lens Holder. Loosen the Set Screw on the base of the Focus Tool. Adjust the base so that the top part of the bevel is touching the bottom of the Focus Lens Holder. Finally, tighten down the Set Screw.

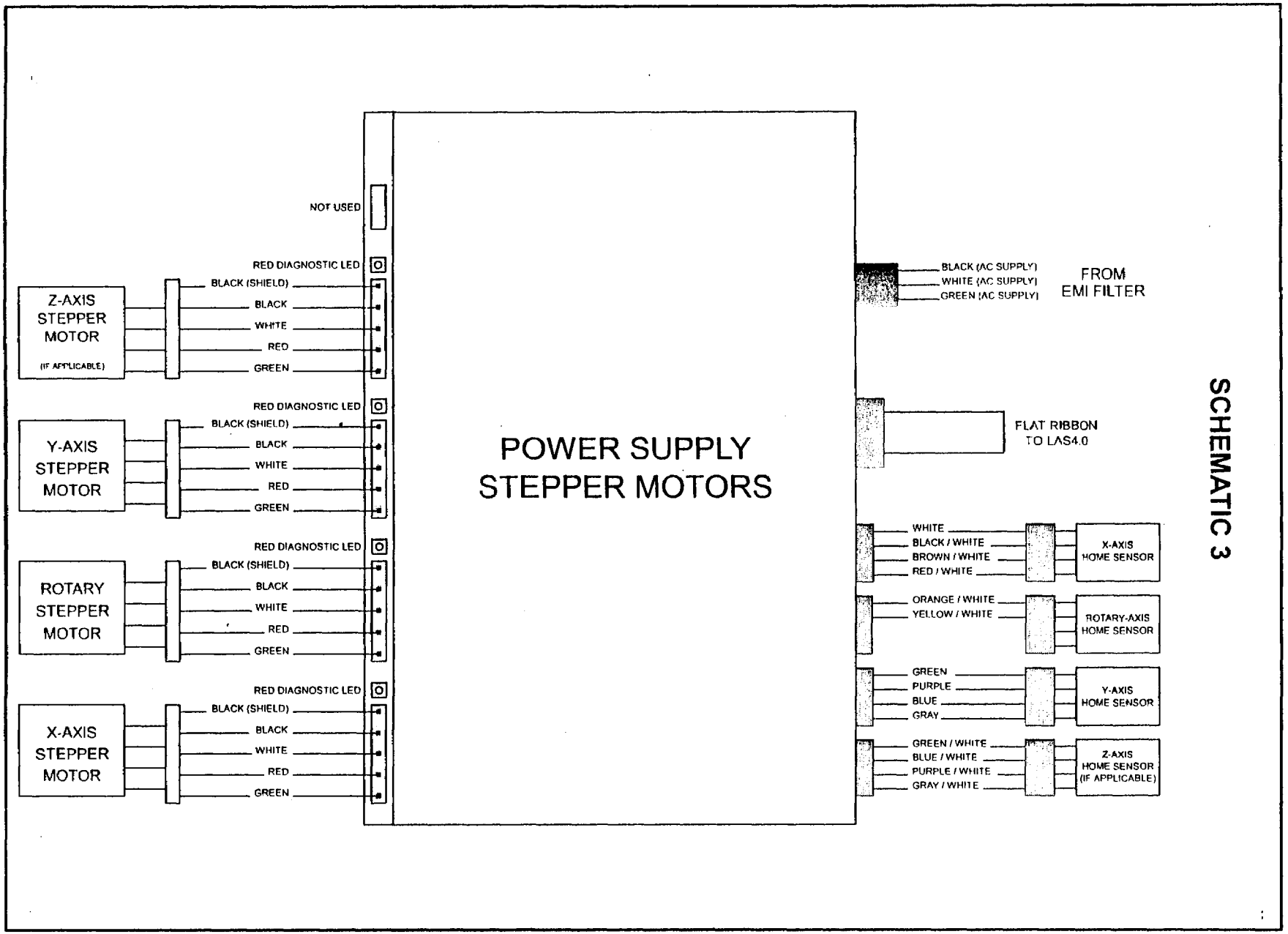
Step 10: Focus Tool Calibration is now complete. What you have done is adjusted the Focus Tool to obtain the smallest and hottest laser beam that the Focus Lens can produce.



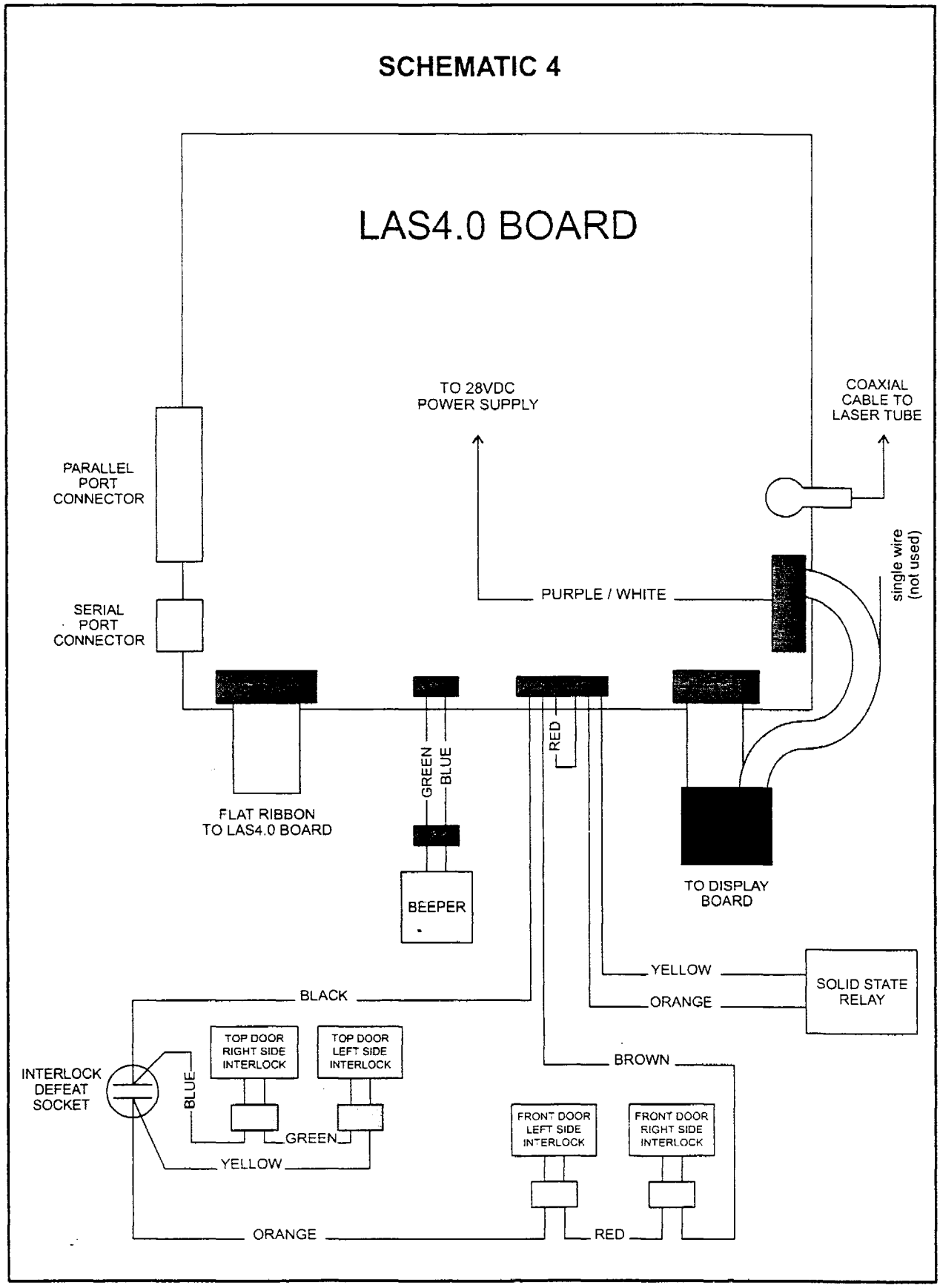
SCHEMATIC 1


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
48V DC
Power Supply Stepper Motors
28VDC Power Supply
28V DC
Voltage Dropping Resistor
Laser Cooling Fans
24V DC
48V DC
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

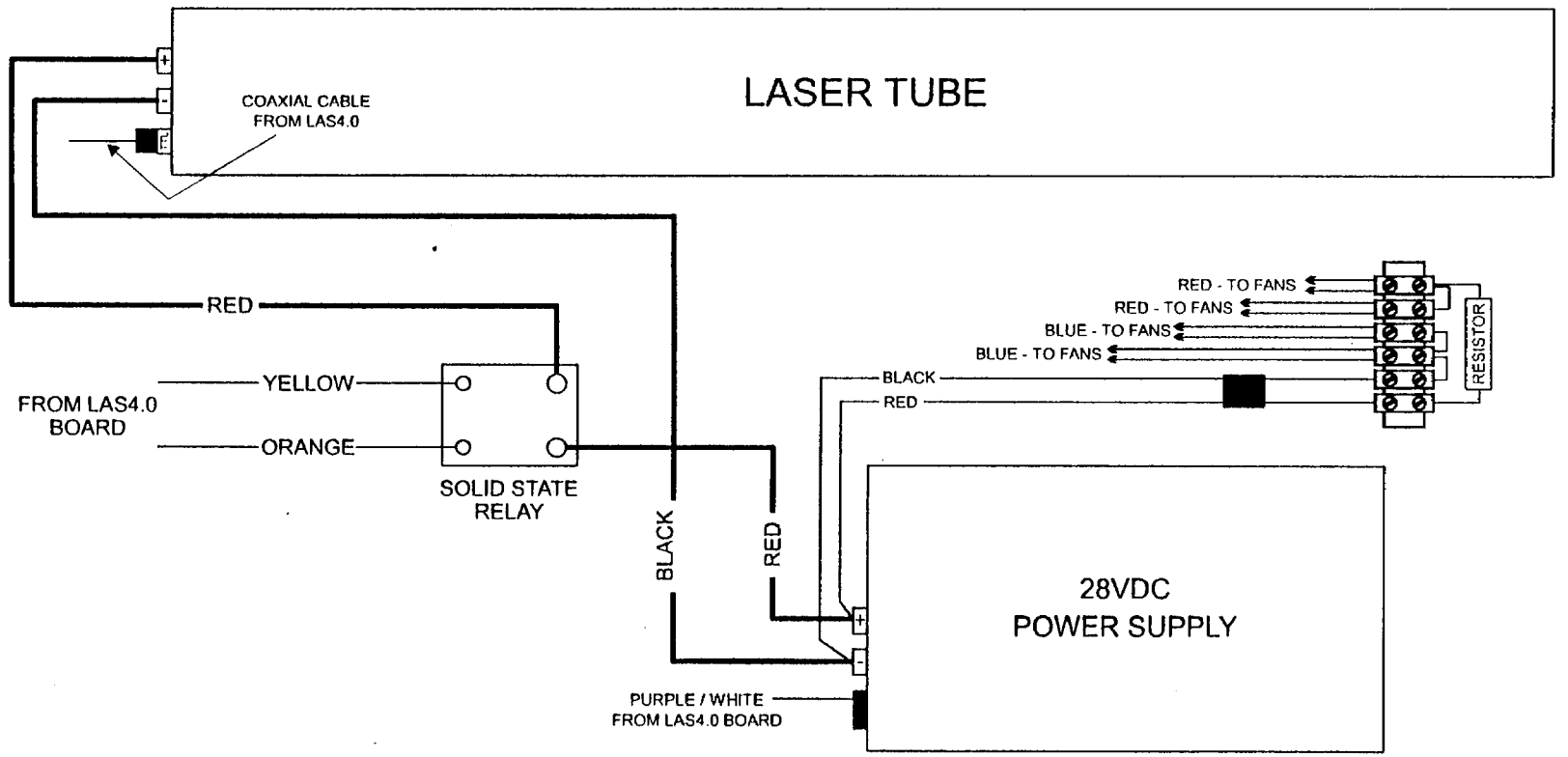

AC WIRING DIAGRAM
L = LIVE (BLACK) WIRE
G = GROUND (GREEN) WIRE
N = NEUTRAL (WHITE) WIRE
POWER SUPPLY
(STEPPER MOTORS)
EMI
FILTER
28VDC
POWER SUPPLY
FUSE
BLOCK
VARISTOR
POWER
SWITCH
POWER
INLET
SCHEMATIC 2


NOT USED
RED DIAGNOSTIC LED
BLACK (SHIELD)
BLACK
WHITE
RED
GREEN
Z-AXIS STEPPER MOTOR
(IF APPLICABLE)
RED DIAGNOSTIC LED
BLACK (SHIELD)
BLACK
WHITE
RED
GREEN
Y-AXIS STEPPER MOTOR
RED DIAGNOSTIC LED
BLACK (SHIELD)
BLACK
WHITE
RED
GREEN
ROTARY STEPPER MOTOR
RED DIAGNOSTIC LED
BLACK (SHIELD)
BLACK
WHITE
RED
GREEN
X-AXIS STEPPER MOTOR
POWER SUPPLY
STEPPER MOTORS
BLACK (AC SUPPLY)
WHITE (AC SUPPLY)
GREEN (AC SUPPLY)
FROM EMI FILTER
FLAT RIBBON TO LAS4.0
WHITE
BLACK / WHITE
BROWN / WHITE
RED / WHITE
X-AXIS HOME SENSOR
ORANGE / WHITE
YELLOW / WHITE
ROTARY-AXIS HOME SENSOR
GREEN
PURPLE
BLUE
GRAY
Y-AXIS HOME SENSOR
GREEN / WHITE
BLUE / WHITE
PURPLE / WHITE
GRAY / WHITE
Z-AXIS HOME SENSOR (IF APPLICABLE)
SCHEMATIC 3

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

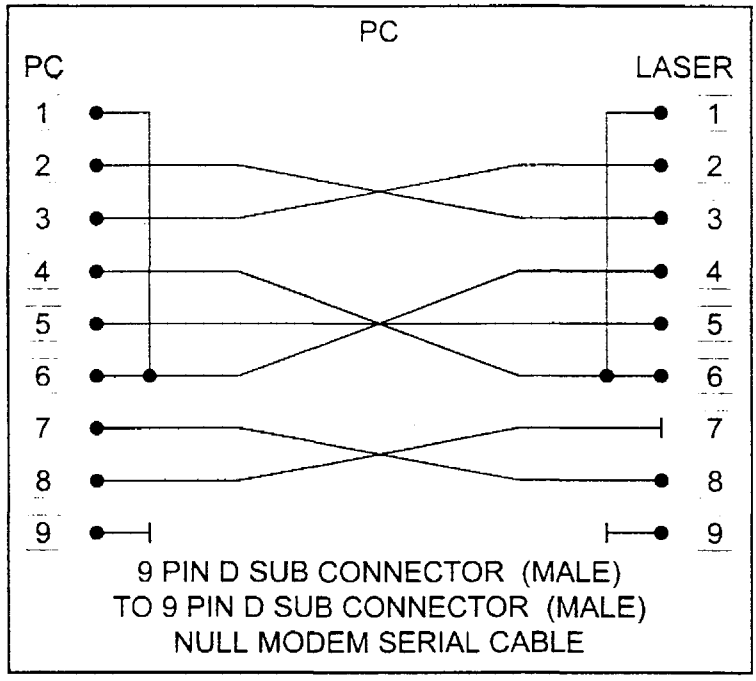
LASER TUBE AND POWER SUPPLY WIRING DIAGRAM



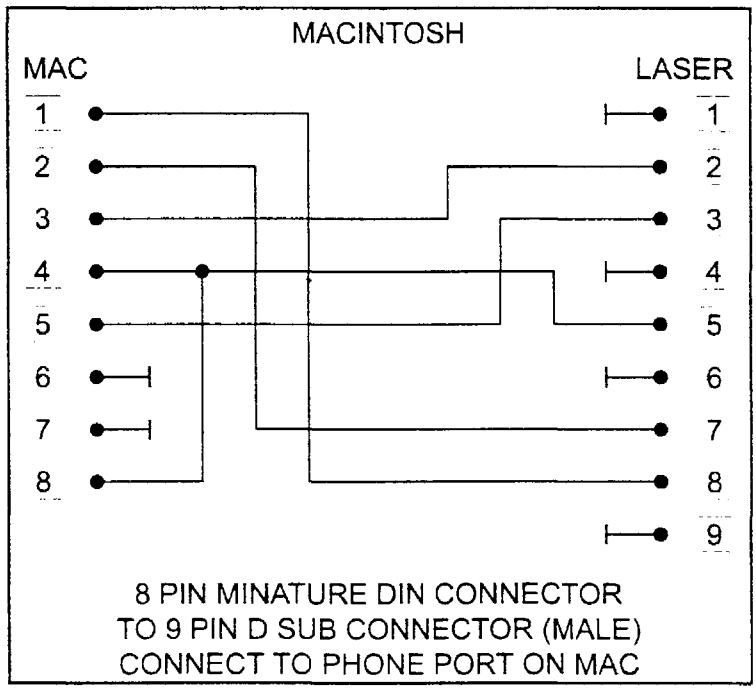
SCHEMATIC 5

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

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 tube, inside the laser, 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 machine. 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.

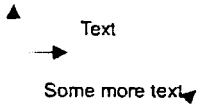
HIGH TICKLE SETTING

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.

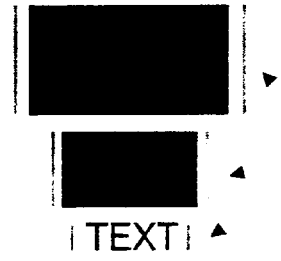
Vectored lines (Low Tickle)

Rastered square (Low Tickle)

The laser made the motion for the raster stroke but the laser did not turn on.



Faint lines as if the laser did not turn off completely (High Tickle)



Rastered objects (High Tickle)

Shadows about 1/2 " to the left and right of the raster strokes.

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 if it is set too high. If the Tickle setting is too high, reduce the Rate setting, while observing the file as it is running, until the shadows disappear. If the Rate setting gets down to zero 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. If the setting is too low, increase the Rate setting until the shadows appear, then back it off one or two numbers. Once the Tickle is set properly, escape out of the menu and "Retain Settings" which will make the changes permanent.

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

Troubleshooting: 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

Troubleshooting: 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

Troubleshooting: 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

Troubleshooting: 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

Troubleshooting: 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 LAS40 board. This is the Standby Mode trigger. When the Standby Mode has been activated, the LAS40 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 LAS40 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. This is how the Interlock Defeat Tool works. 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, the relay is probably OK. Now test DC voltage from terminal 2 on the relay to chassis ground. It should read approximately 28VDC. If it does not, the relay is probably OK but the 28VDC power supply and its wiring should be checked.

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)

If the Power Supply circuit fails to any of the stepper motors, the corresponding LED will not illuminate. In this case, the Power Supply must be replaced.

LAS4.0 BOARD (MOTHERBOARD)

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 DOOR

You can test the sensors by removing both actuators and apply them directly to the sensors. Remove them one at a time to see if the interlock opens and closes. Make sure the top door is closed when performing this test. If a sensor is shorted the interlock will remain closed regardless of the actuator. If the sensor is open, the actuator will not close the interlock regardless of the actuator.

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.