TRAK® DPMSX2, SX3 & SX5
Safety, Installation, Maintenance, Service & Parts List Manual

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Table of Contents

iii

1.0 Safety

The safe operation of the TRAK DPMSX2, DPMSX3 & DPMSX5 depends on its proper use and the precautions taken by each operator.

- Read and study this manual and the ProtoTRAK SMX Programming, Operating, and Care Manual. Be certain every operator understands the operation and safety requirements of this machine *before* its use.

- Always wear safety glasses and safety shoes.

- Always stop the spindle and check to ensure the CNC control is in the stop mode before changing or adjusting the tool or workpiece.

- Never wear gloves, rings, watches, long sleeves, neckties, jewelry, or other loose items when operating or around the machine.

- Use adequate point of operation safeguarding. It is the responsibility of the employer to provide and ensure point of operation safeguarding per OSHA 1910.212 - Milling Machine.

1.1 Safety Publications

Refer to and study the following publications for assistance in enhancing the safe use of this machine.

Safety Requirements for Manual Milling, Drilling and Boring Machines with or without Automatic Control (ANSI B11.8-2001). Available from The American National Standards Institute, 1819 L Street N.W., Washington D.C. 20036

Concepts And Techniques Of Machine Safeguarding (OSHA Publication Number 3067). Available from The Publication Office - O.S.H.A., U.S. Department of Labor, 200 Constitution Avenue, NW, Washington, DC 0210.

1.2 Danger, Warning, Caution, and Note Labels & Notices As Used In This Manual

DANGER - Immediate hazards that **will** result in severe personal injury or death. Danger labels on the machine are red in color.

WARNING - Hazards or unsafe practices that *could* result in severe personal injury and/or damage to the equipment. Warning labels on the machine are orange in color.

CAUTION - Hazards or unsafe practices, which *could* result in minor personal injury or equipment/product damage. Caution labels on the machine are yellow in color.

NOTE - Call attention to specific issues requiring special attention or understanding.

WARNING — ALWAYS WEAR SAFETY GLASSES AND SAFETY SHOES

ALWAYS STOP THE SPINDLE AND CHECK TO ENSURE THE CNC CONTROL IS IN THE STOP MODE BEFORE CHANGING OR ADJUSTING THE TOOL OR WORKPIECE

PREVENT SERIOUS INJURY

NEVER WEAR GLOVES, RINGS, WATCHES, LONG SLEEVES, NECKTIES, JEWELRY OR OTHER LOOSE ITEMS

USE ADEQUATE POINT OF OPERATION SAFEGUARDING. IT IS THE RESPONSIBILITY OF THE EMPLOYER TO PROVIDE AND ENSURE POINT OF OPERATION SAFEGUARDING. (OSHA 1910.212 MILLING MACHINES)

WARNING

DANGER
HIGH VOLTAGE

NOTICE: The manufacture is not liable (responsible) for any damages or injury of any kind to persons or property caused by or resulting from the improper or unauthorized use, operation, maintenance, alteration, modification, change in configuration of this machine or any of its component parts, or the use of this unit with any third party accessories or parts.

.i00775

Safety & Information Labels Used On The
TRAK DPMSX2, DPMSX3 & DPMSX5 Milling Machines
It is forbidden by OSHA regulations and by law to deface, destroy or remove any of these labels

DPMSX2
NO SPINDLE
CONTROL OPTION

SOUTH WESTERN INDUSTRIES
2615 HOMESTEAD PLACE,
RANCHO DOMINGUEZ, CA 90220

MODEL | TRAK DPMSX2
S/N

ELECTRICAL RATINGS:
220 VOLTS 8.5 AMPS 3 PHASE
60 Hz

FLA OF LARGEST MOTOR 8.5 AMPS
SHORT CIRCUIT INTERRUPT AMPS
ELECTRICAL DRAWING #: 20676

CNC CONTROL ELECTRICAL RATINGS:
IF APPLICABLE
115 VOLTS 8 AMPS 1 PHASE
60 Hz
MACHINE (ONLY) MADE IN TAIWAN

DPMSX3/DMPSX5
NO SPINDLE
CONTROL OPTION

SOUTH WESTERN INDUSTRIES
2615 HOMESTEAD PLACE,
RANCHO DOMINGUEZ, CA 90220

MODEL | TRAK DPMSX3 OR TRAK DPMSX5
S/N

ELECTRICAL RATINGS:
220 VOLTS 14.0 AMPS 3 PHASE
60 Hz

FLA OF LARGEST MOTOR 14 AMPS
SHORT CIRCUIT INTERRUPT AMPS
ELECTRICAL DRAWING #: 20676-1

CNC CONTROL ELECTRICAL RATINGS:
IF APPLICABLE
115 VOLTS 8 AMPS 1 PHASE
60 Hz
MACHINE (ONLY) MADE IN TAIWAN

DPMSX2
SPINDLE
CONTROL OPTION

SOUTH WESTERN INDUSTRIES
2615 HOMESTEAD PLACE,
RANCHO DOMINGUEZ, CA 90220

MODEL | TRAK DPMSX2
S/N

ELECTRICAL RATINGS:
220 VOLTS 11 AMPS 3 PHASE
60 Hz

FLA OF LARGEST MOTOR 11 AMPS
SHORT CIRCUIT INTERRUPT AMPS
ELECTRICAL DRAWING #: 24060-1

CNC CONTROL ELECTRICAL RATINGS:
IF APPLICABLE
115 VOLTS 8 AMPS 1 PHASE
60 Hz
MACHINE (ONLY) MADE IN TAIWAN

DPMSX3/DMPSX5
SPINDLE
CONTROL OPTION

SOUTH WESTERN INDUSTRIES
2615 HOMESTEAD PLACE,
RANCHO DOMINGUEZ, CA 90220

MODEL | TRAK DPMSX3 OR TRAK DPMSX5
S/N

ELECTRICAL RATINGS:
220 VOLTS 17.5 AMPS 3 PHASE
60 Hz

FLA OF LARGEST MOTOR 17.5 AMPS
SHORT CIRCUIT INTERRUPT AMPS
ELECTRICAL DRAWING #: 24060-2

CNC CONTROL ELECTRICAL RATINGS:
IF APPLICABLE
115 VOLTS 8 AMPS 1 PHASE
60 Hz
MACHINE (ONLY) MADE IN TAIWAN

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Safety & Information Labels Used On The
TRAK DPMSX2, DPMSX3 & DPMSX5 Milling Machines
It is forbidden by OSHA regulations and by law to deface, destroy or remove any of these labels

1.3 Safety Precautions

1. Do not operate this machine before the **TRAK DPMSX2, SX3 & SX5 Installation, Maintenance, Service and Parts List Manual**, and **ProtoTRAK SM Programming, Operating & Care Manual** have been studied and understood.

2. Do not run this machine without knowing the function of every control key, button, knob, or handle. Ask your supervisor or a qualified instructor for help when needed.

3. Protect your eyes. Wear approved safety glasses (with side shields) at all times.

4. Don't get caught in moving parts. Before operating this machine remove all jewelry including watches and rings, neckties, and any loose-fitting clothing.

5. Keep your hair away from moving parts. Wear adequate safety headgear.

6. Protect your feet. Wear safety shoes with oil-resistant, anti-skid soles, and steel toes.

7. Take off gloves before you start the machine. Gloves are easily caught in moving parts.

8. Remove all tools (wrenches, chuck keys, etc.) from the machine before you start. Loose items can become dangerous flying projectiles.

9. Never operate a milling machine after consuming alcoholic beverages, or taking strong medication, or while using non-prescription drugs.

10. Protect your hands. Stop the machine spindle and ensure that the CNC control is in the stop mode:
    - Before changing tools
    - Before changing parts
    - Before you clear away the chips, oil or coolant. Always use a chip scraper or brush
    - Before you make an adjustment to the part, fixture, coolant nozzle or take measurements
    - Before you open safeguards (protective shields, etc.). Never reach for the part, tool, or fixture around a safeguard.

11. Protect your eyes and the machine as well. Don't use compressed air to remove the chips or clean the machine.

12. Disconnect power to the machine before you change belts, pulley, and gears.

13. Keep work areas well lighted. Ask for additional light if needed.

14. Do not lean on the machine while it is running.

15. Prevent slippage. Keep the work area dry and clean. Remove the chips, oil, coolant and obstacles of any kind around the machine.

16. Avoid getting pinched in places where the table, saddle or spindle head create "pinch points" while in motion.

17. Securely clamp and properly locate the workpiece in the vise, on the table, or in the fixture. Use stop blocks to prevent objects from flying loose. Use proper holding clamping attachments and position them clear of the tool path.

18. Use correct cutting parameters (speed, feed, depth, and width of cut) in order to prevent tool breakage.

19. Use proper cutting tools for the job. Pay attention to the rotation of the spindle: Left hand tool for counterclockwise rotation of spindle, and right hand tool for clockwise rotation of spindle.

20. After an emergency stop, always turn the FORWARD/REVERSE switch to "Off" (STOP) before releasing or resetting the E-Stop.

21. Prevent damage to the workpiece or the cutting tool. Never start the machine (including the rotation of the spindle) if the tool is in contact with the part.

22. Check the direction (+ or -) of movement of the table, saddle and ram when using the jog or power feed.

23. Don't use dull or damaged cutting tools. They break easily and become airborne. Inspect the sharpness of the edges, and the integrity of cutting tools and their holders. Use proper length for the tool.

24. Large overhang on cutting tools when not required result in accidents and damaged parts.

25. Handwheels must have the crank folded inside when using CNC programmed machining or rapid feeds, power feed or jog.

26. Prevent fires. When machining certain materials (magnesium, etc.) the chips and dust are highly flammable. Obtain special instruction from you supervisor before machining these materials.

27. Prevent fires. Keep flammable materials and fluids away from the machine and hot, flying chips.

28. Changing the speed of rotation of the spindle must be done while the rotation is on. It is recommended to stop and start the spindle at a low rate of speed.

29. Interlocked Table Guards. Interlocked table guards may be purchased from Southwestern Industries, Inc. if deemed necessary by the user.

2.0 Installation

Read and understand this entire installation section before beginning the installation procedure.

2.1 Floor Plan, Layout & Space Requirements – DPMSX2, DPMSX3 & DPMSX5

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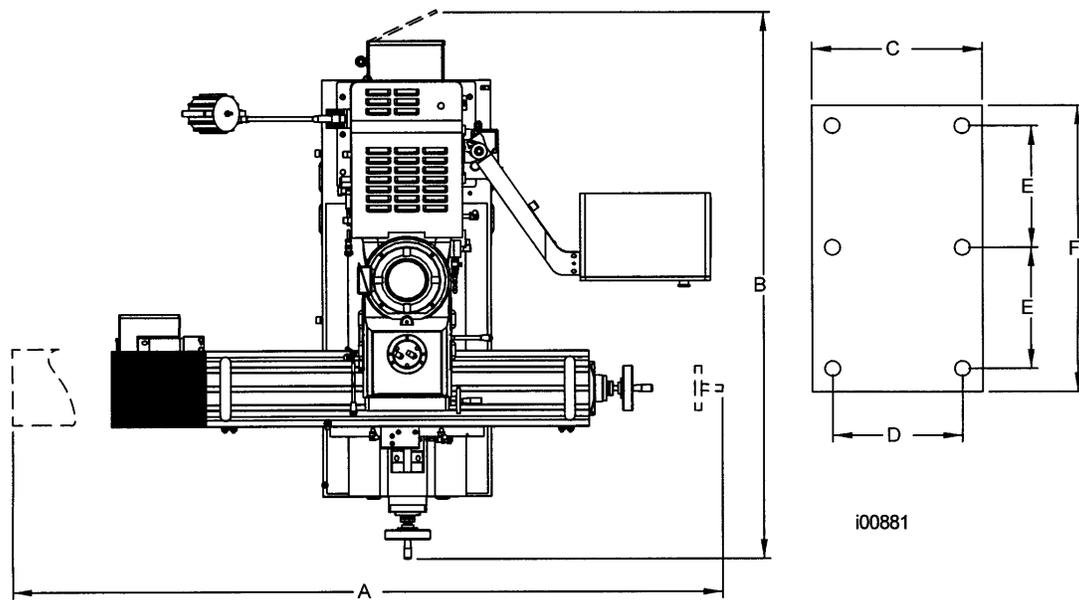
Figure 1
Machine Footprints

		DPMSX2	DPMSX3	DPMSX5
Footprint of Machine		23.1″ x 40.5″	24″ x 44″	24″ x 48.4″
Weight (approximate) net		3200 lbs.	4100 lb.	4400 lb.
Weight (approximate) shipping		3500 lbs.	4400 lb.	4700 lb.
Pallet Size		70″ x 70″	6′ x 6′	6′ x 6′
A	Overall width	101″	108″	136″
B	Overall length w/ electric box door open	72″	76″	81″
C	Bed width	23.125″	24″	24″
D	Bed width between leveling screws	20.5″	21.7″	21.7″
E	Distance between leveling screws	32.5″	18.1″	20.5″
F	Bed length	40.5″	43.3″	48.4″
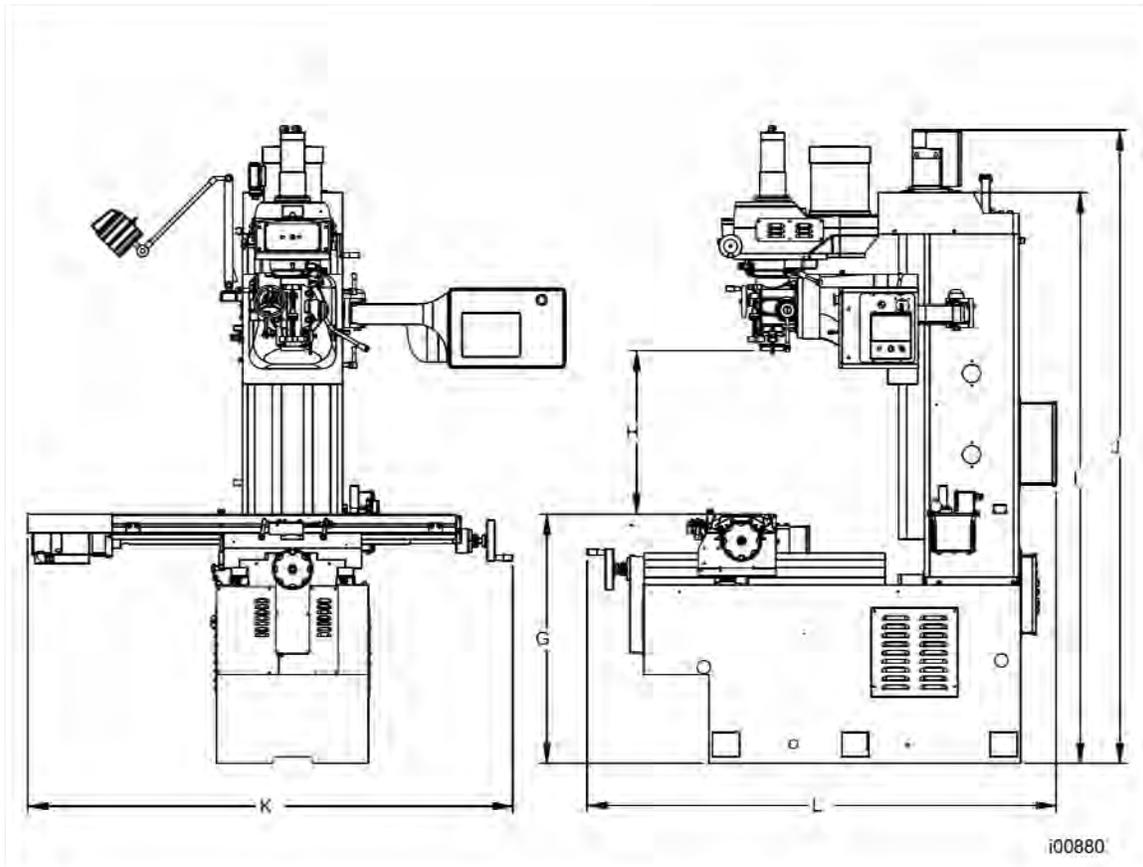
Figure 2
Overall Dimensions

		DPMSX2	DPMSX3	DPMSX5
G	Height of table from bottom of bed	34″	38″	41″
H	Maximum distance from spindle nose to table	23.5″	23.5″	23.5″
I	Maximum height of machine from bottom of bed to top of column cover.	78″	85″	87″
J	Height of machine from bottom of bed to top of spindle motor	89″	95″	98″
K	Width of machine including table	70″	73″	70″
L	Length of machine with electric box door closed	64″	66″	71″

2.2 Uncrating

Carefully remove the wood crate and protective packaging, paying attention not to scratch, damage, or mar any parts of the machine.

Remove the cardboard boxes with the PENDANT DISPLAY (handle carefully), the box containing the TOOL BOX and Z crank. The leveling pads and screws for the machine can be found in the toolbox. The Y way covers are shipped in a separate tube. The lower Z way cover can be found in a box as well.

Remove two steel bars - 1.0 inch in diameter. These items are necessary for lifting and moving the machine.

Loosen and remove 4 screws and nuts holding the machine to the wood pallet.

ATTENTION!
Immediately report, in writing, any damages observed at this time that can be attributed to the transportation or improper handling/moving of the machine.

2.3 Shortages: Inventory Checklist

_____ Machine (check model and serial number)

_____ Manual drawbar with washer

_____ Leveling pads (B239) and screws (B240). Note: 4 each for DPMSX2 and 6 each for DPMSX3 &SX5

_____ Table tray with rubber pad (assembled to machine) (DPMSX3 only) (15977)

_____ Pendant Display with four 1/4-20 screws for mounting

_____ Pendant Arm assembled to the column

_____ Toolbox with various tools

_____ ProtoTRAK SMX Safety, Operation & Programming Manual (P/N 24495)

_____ TRAK DPMSX2, SX3 & SX5 Safety, Installation, Maintenance, Service & Parts List Manual (P/N 24317)

_____ Table trays (DPMSX5 only)

_____ Manual Z-axis crank (16526) (DPMSX3 & SX5 only)

_____ Way covers DPMSX2 – front (23676) and rear (23677) of saddle

_____ Way covers DPMSX2 - bottom on column (23675), top on column (23675)

_____ Way covers DPMSX3 – front (B268) and rear (B267) of saddle

_____ Way covers DPMSX5 – front (B268) and rear (B267-1) of saddle

_____ Way covers DPMSX3 & SX5 - bottom on column (B202), top on column (B201)

In case of shortages, contact the representative from whom you purchased the machine.

2.4 Installation Instructions & Checklist

Installer: Use this checklist to assure a complete set-up of the DPMSX2, SX3 or SX5.

☐	1.	Shut off power to the machine.
☐	2.	Visually inspect the 220 or 440V -wiring going into the electrical panel. Visually verify the wiring is correct per our wiring diagram. Make sure a strain relief is being used where the wiring enters the cabinet. Have the customer repair any wiring discrepancies. **NOTE: Machine with Spindle Control Option is only available in 220V configuration.**
☐	3.	Clean the machine if needed and remove any remaining grease.
☐	4.	Unlock the table, saddle, and ram gib locks.
☐	5.	Use a 10mm socket to turn the Z-axis ball screw at the top of the column in order to lower the head until the counterweight is raised off of the counterweight support rods. (DPMSX2 only)
☐	6.	Install the manual Z-axis hand crank. (DPMSX3 & SX5 only)
☐	7.	Using the manual hand crank, lower the head until the counterweight is raised off of the counterweight support rods.
☐	8.	Remove the two (2) counterweight support rods.
☐	9.	Remove the manual Z-axis hand crank. (DPMSX3 & SX5 only)
☐	10.	Attach (2) wiper brushes to each table tray using (2) M5 X10 button head cap screws (supplied) per brush. Install (1) table tray on each end of the table (DPMSX5 only). NOTE: Make sure that the tray does not scrap the TURCITE. Check TURCITE for any damage.
☐	11.	Mount the pendant to the pendant arm using (4) 1/4-20 x 3/4" socket head cap screws.
☐	12.	Make and check all the proper electrical connections from the pendant to the electric box. See the pendant and electric box wiring diagrams.
☐	13.	If applicable, load TRAK sensors.
☐	14.	Turn on the power to the machine and to the pendant.
☐	15.	Lubricate all the way surfaces and the ball screws.
☐	16.	Jog the table, saddle, and ram back and forth until the way surfaces are well lubricated. Oil should be visible on all the way surfaces.
☐	17.	Check the level of the machine. The machine should be level to within 0.0005" front to back and 0.0005" side to side. Even though it is the responsibility of the customer, make any adjustments if necessary.
☐	18.	Check to make sure that the E-Stop button is functioning correctly.
☐	19.	Perform Service Code 12, Feed Forward Constant.
☐	20.	Perform Service Code 123 to calibrate the X and Y-axis using a 150mm standard.
☐	21.	Perform Service Code 11 to automatically calculate the backlash for the X and Y-axis of dual feedback machines (i.e. TRAK sensor or glass scale with a motor encoder).
☐	22.	Perform Service Code 127 and 128 to manually calculate the backlash for the X and Y-axis of single feedback machines (i.e. motor encoder only).
☐	23.	Check for positional accuracy and repeatability on the X and Y-axis using programs XREPEAT.PT4 and YREPEAT.PT4 respectively. Positioning and repeatability values should be less than or = to 0.0005″. Programs can be found on flash drive under the PT4 folder followed by the SWI TEST PROGRAMS folder.
☐	24.	Perform Service Code 123 and press Z to calibrate the Z-axis ram using a 75mm standard.
☐	25.	Perform Service Code 127 and 128 to manually calculate the backlash for the Z-axis ram.
☐	26.	Check for positional accuracy and repeatability on the Z-axis using program ZREPEAT.PT4 Positioning and repeatability values should be less than or = to 0.0005″.
☐	27.	Perform Service Code 123 and press QUILL softkey to calibrate the Z-axis quill using a 75mm standard.
☐	28.	Perform Service Code 100 in both directions for the X, Y, and Z-axis to verify that the feed

☐		rate shown on the display is at least 180 ipm.
☐	29.	Run the spindle at various speeds in both high and low gear for 15 minutes. Verify head shifts from high to low gear smoothly. Test quill feed and spindle brake.
☐	30.	Install the Z-axis upper way cover. Install the Z-axis lower way cover and its bracket.
☐	31.	Install the Y-axis front and rear way covers.
☐	32.	If machine has an auxiliary function option, then use accessory key on pendant and make sure the coolant pump or solenoid for the mister fires. The accessory key should be in the ON position to test coolant pump or solenoid. The control should be in DRO mode. Make sure air is hooked up to the machine during the test. If the machine has a separate coolant pump switch mounted on the pendant arm then turn this on and off to test.
☐	33.	If the machine has a power drawbar option, check to make sure that the tools load and unload properly.
☐	34.	Wipe down the machine prior to leaving.

2.5   Machine Specifications

Specifications	DPMSX2	DPMSX3	DPMSX5
Table Size	49″ x 9″	50″ x 10″	50″ x 12″
T-Slots (number x width x pitch)	3 x 16 mm x 64mm	3 x 16 mm x 64 mm	3 x 16 mm x 64 mm
Travel (X, Y, Z axis)	31 x 16 x 23.5″	31 x 17 x 23.5"	40 x 20 x 23.5″
Quill Diameter	86 mm	100 mm	100 mm
Spindle Taper	R8	#40 taper	#40 taper
Spindle Speed Range	70 – 4200 RPM	70 – 3950 RPM	70 – 3950 RPM
Optional Spindle Control Speed Range	Low: 40 – 600	Low: 40 – 600	Low: 40 – 600
	High: 300 – 5000	High: 300 – 5000	High: 300 – 5000
Spindle Nose to Table (max part height)	23.5″	23.5″	23.5″
Spindle Center to Column Face	18″	19"	20″
Spindle Motor Power	3 HP	5 HP	5 HP
Voltage	220/440 V	220/440 V	220/440 V
Machine with Optional Speed Control	220 V	220 V	220 V
Phase/Cycle	3 phase/60Hz	3 phase/60 Hz	3 phase/60 Hz
Current (Full load amps) Non-Spindle Control	8.5/4.25 FLA	14/7 FLA	14/7 FLA
Current (Full load amps)-Spindle Control	11 FLA	17.5 FLA	17.5 FLA
Machine Net Weight/Shipping Weight	3200 lbs/3500 lbs	4100 lbs/4400 lbs	4400 lbs/4600 lbs
Maximum Weight of Workpiece	1320 lbs	1320 lbs	1760 lbs

2.6   Maximum Work Capacities

	DPMSX2	DPMSX3	DPMSX5
Drilling Mild Steel	1″	1″	1″
Tapping Mild Steel	.75″	1″	1″
Milling (metal removal rate/mild steel)	2 inch^3/min	5 inch^3/min	5 inch^3/min

Maximum work capacities are dependent on a lot of variables that cannot be controlled by the machine manufacturer. Each one of the following will have an impact on the above numbers: speeds, feeds, cutter, cutter sharpness, material, setup, coolant and machine adjustments. The numbers above assume all conditions are optimal and may be higher or lower depending on material composition.

2.7   ProtoTRAK SMX Control Hardware

- 3-axis CNC, 3-axis DRO
- 400 MHz PC-based processor
- 128 MB of RAM
- D.C. Servo Motors rated at 560 in-oz continuous torque for X, Y and Z-axes
- Precision ground ballscrews in the table, saddle and ram to ensure smooth accurate contours without backlash
- Feedrate override of programmed feedrate and rapid
- Polycarbonate sealed membrane and gasket sealed control enclosure to lock out contamination
- 10 ½" color LCD for clear presentation of prompts, status information and part graphics
- Modular design simplifies service and maximizes uptime
- 256 MB flash drive
- Single floppy disk drive for additional part program storage
- Optional auxiliary function box for control of coolant pump or spray mist coolant, spindle off and a programmable rotary table or indexer

Figure 3   DPMSX Component Identification
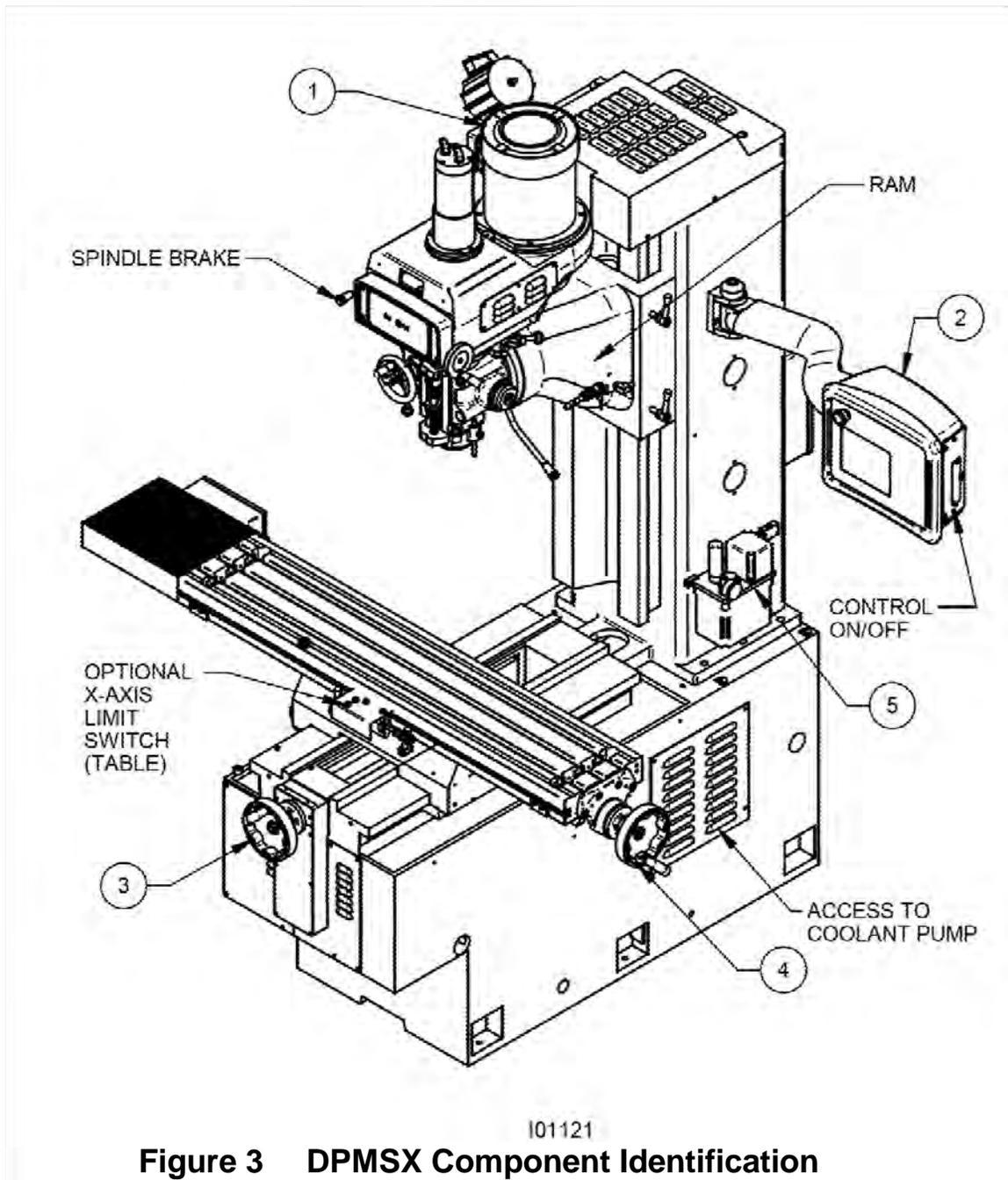
Item	Part Number				Description
	SX2	**SX2** Spindle Control	**SX3/SX5**	**SX3/SX5** Spindle Control	
1	20819-1	24162	20820-1	24163	Spindle Motor
2	24000-1				SMX Pendant
3	15616				Y-Axis Handwheel (Saddle)
4	15616				X-Axis Handwheel (Table)
5	21157-1				Lube Pump
	23198				X, Y or Z Motor

WORK LAMP

TOOL TRAY

REAR ACCESS

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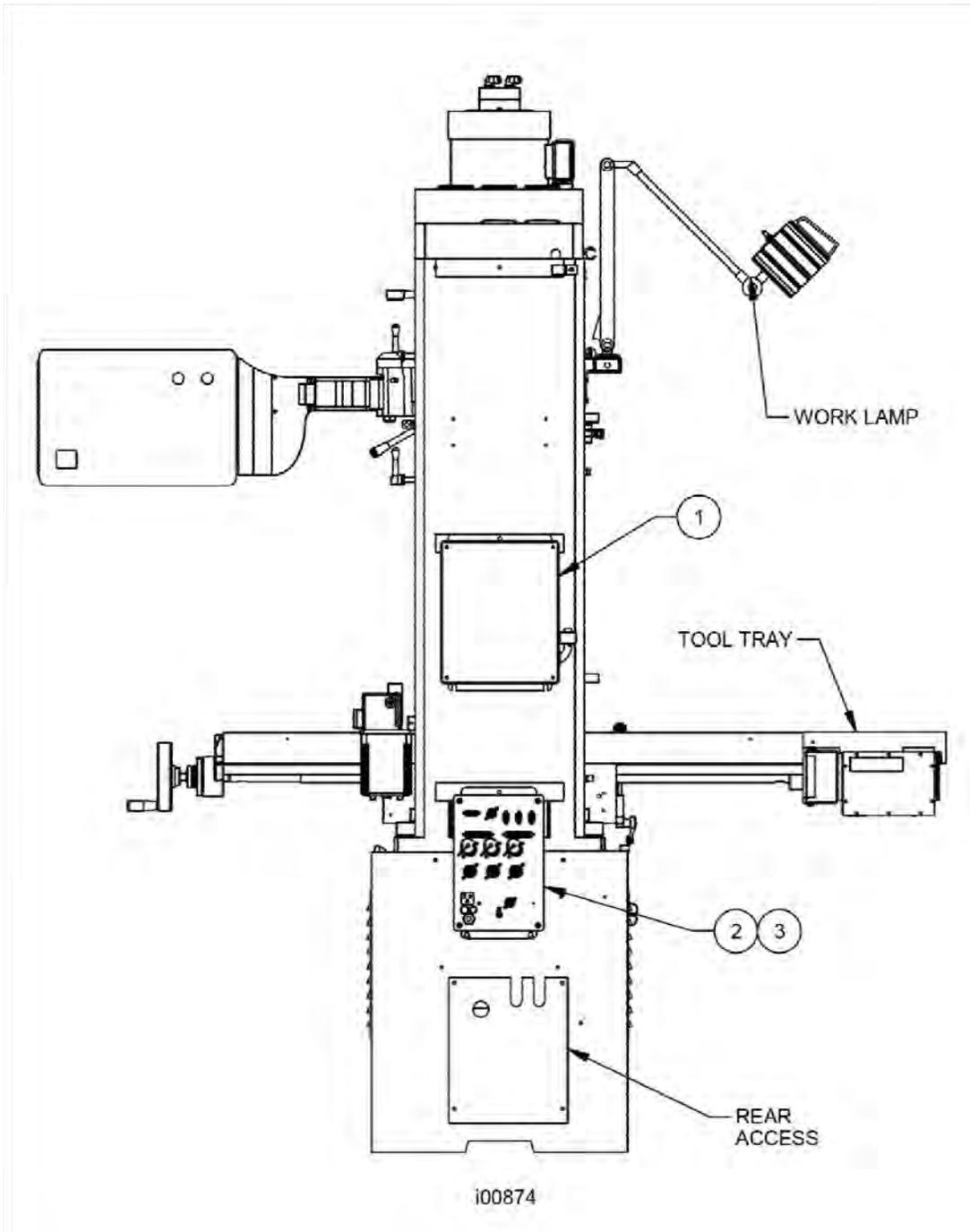
Figure 4—DPMSX Rear View

Item	Part Number				Description
	SX2	**SX2** Spindle Control	**SX3/SX5**	**SX3/SX5** Spindle Control	
1	220V=20676 440V=20676	24060-1 220V only	220V=20676-1 440V=20676	24060-2 220V only	Electrical Box
2	24999	24999	24999	24999	Cable Breakout Box
3	24999-1	24999-1	24999-1	24999-1	Cable Breakout Box with AUX Functions

2.8 Lifting and/or Moving the Machine

CAUTION!
The DPMSX2, SX3 & SX5 machines weigh approximately 3200, 4100 and 4400 lbs. respectively. Proper equipment of sufficient capacity must be used when lifting and/or moving the machine.

Method 1 *(see Figure 5)***:**
1. Insert a steel bar 1.0" dia x 36" long through the rear side holes of the bed (under column).

2. Use a steel cable (with protective sleeving) min. 3/4" dia. or a 3 ton sling.

3. Use cardboard pieces or other suitable protective sheets on both sides of the machine to prevent scratching.

4. Remove the 4 nuts and screws holding the machine to the wood skid.

5. Lift the machine (the front side of the machine should be lower than the back side).

6. Insert the 6 screws for leveling pads in their place in the bed. 4 screws for DPMSX2.

7. Place the machine in its location (see floor plan and bed footprint drawing) carefully positioning each leveling pad under each leveling screw.

8. Remove the lifting cable or sling, the steel bar and all protective cardboard.

STEEL CABLE
3/4" DIA OR
3 TON SLING

1" DIA.
STEEL
BAR

6 THREADED
HOLES FOR
LEVELING PADS

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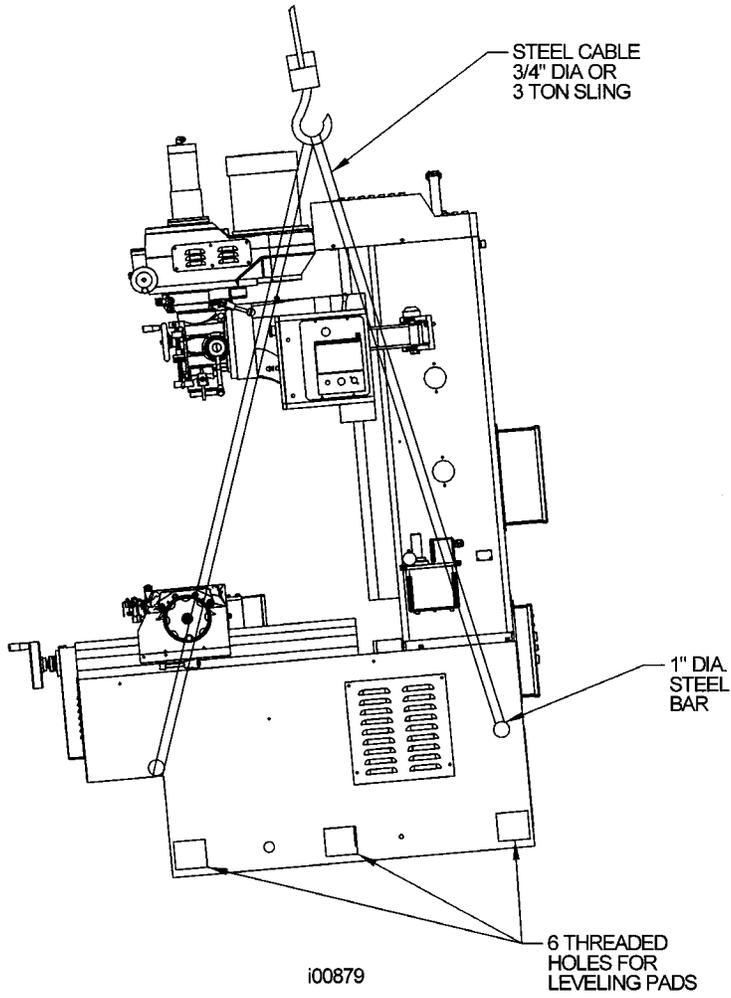
Figure 5
Lifting the Machine
Method 1

Method 2 *(see Figure 6)***:**

1. Insert 2 steel bars 1" dia x 36" long through both sides in the existing holes in the machine base (front and back).

2. Position 4 (two each side) wood vee blocks under the steel bars and over a suitable lift truck.

3. Lift the machine up (somewhat tilted towards the front) 4-6" from the ground and move it to its floor plan position.

WARNING!
The lift truck must have sufficient lifting capacity (3 tons) and be equipped with suitably long forks.

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4. Insert the 6 screws for the leveling pads in their place in the bed.

5. Place the machine in its location (see floor plan bed/footprint) carefully positioning each leveling pad under each leveling screw.

4" x 4" x 8" WOOD BLOCKS VEE GROVED
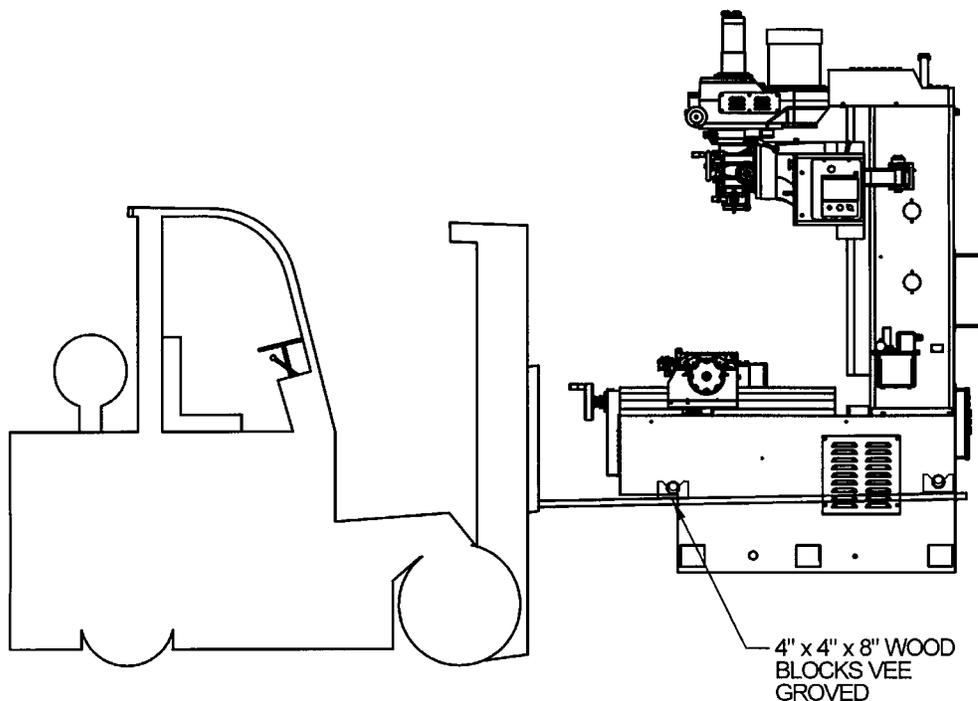
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Figure 6
Lifting the Machine
Method 2

2.9 Releasing the Head Counterweight Supports

In order to move (raise or lower) the spindle head/ram it is first necessary to remove the 2 steel rods (with flanges) inserted through the holes in the column. These rods support the counterweight during shipping to prevent damage to the counterweight chains and sprockets.

1. Release ram gib locks.

2. DPMSX2 – Lower the head slowly with a 10mm socket on the top end of the Z-axis ball screw until the chain between the ram and the counterweight is tight.

    DPMSX3 & SX5 - Lower the head slowly with the ram crank until the chain between the ram and counterweight is tight.

3. Lower a little further until the 2 support steel rods are loose. Remove the 2 steel rods and store them for future machine moves or transportation.

4. Do not continue to move the ram until all ways have been cleaned.

CAUTION!
Do not remove the steel rods unless they are loose.

2.10 Cleaning

1. Remove rust protective coating from the machine before moving any slideways (table, saddle, ram, etc.).

2. The coating is best removed with clean, dry rags. Do not use a cleaning solution that may damage the rubber way scrapers, plastic parts, or paint.

WARNING!
Do not use gasoline or other flammable cleaning agents for cleaning the machine.

3. It may be necessary to move back and forward, left and right, and up and down the table, saddle and the ram. Always release the clamp levers (two in front of the table, one underneath the saddle on each side, and two on the ram on the right side of the column) before attempting to move the above parts.

CAUTION!
Never move any of the above parts over ways that were not previously cleaned. Serious damage to the TURCITE surface of slideways can occur.

4. Be certain the table, saddle, ram, and spindle move freely and smoothly over their entire length.

2.11 Leveling: Leveling Tolerance for DPMSX is .0005"/10"

1. Set the machine on its 6 leveling pads on a solid, level floor prepared in accordance with the state and local rules for machine tool installation. The DPMSX2 only uses 4 leveling screws.

2. Put one or two precision Spirit Levels or Electronic Levels in the center of the table in the positions illustrated in Figure 7.

3. Adjust the 4 corner leveling screws on their pads until the machine is level to .0005 in/10 in. Snug the 2 middle leveling screws being careful to not affect the level for the DPMSX3 and DPMSX5.

4. If the machine must be anchored to the floor, follow the general instruction for installing machine tools and use for leveling any well-known methods: shims, etc.).

5. If the machine must be installed on vibration mounts/pads (rubber, commercially available leveling and vibration mounts, etc.) follow the instructions delivered with the mounts/pads, ordering them to satisfy the load of the machine and the maximum weight of the workpiece (6,000 lb.).

6. When machine is correctly level, lock the adjusting screws in place with their hex nuts.
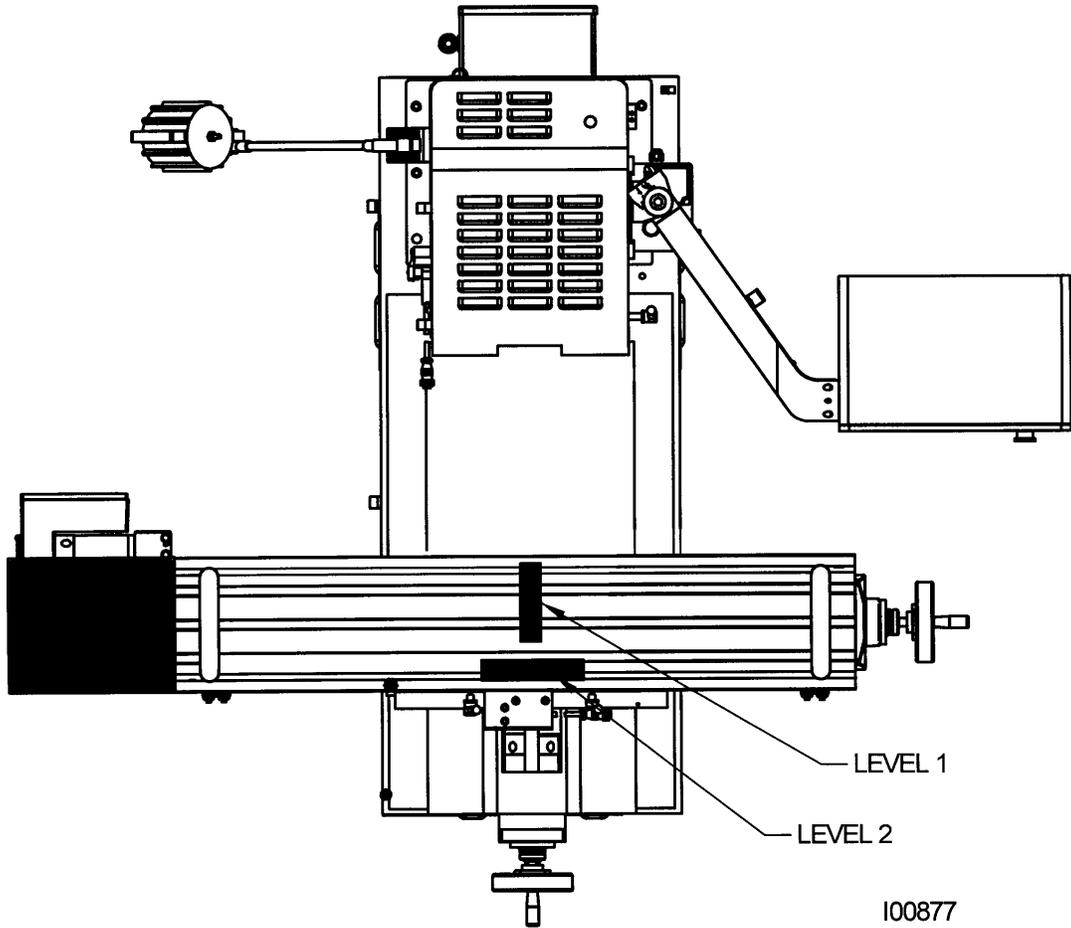
Figure 7
Placement of Levels
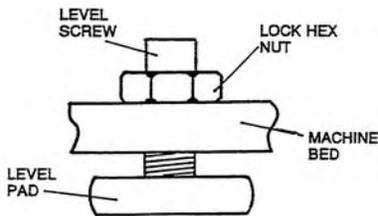
Figure 8
Leveling Screws

2.12   Electrical Connection

The DPMSX2, SX3 & SX5 Bed Mills can be configured for 220 or 440 volt 3 phase electricity. These machines also require a 110V power source to power the control.

Note: Machines with Optional Spindle Control is only available in 220V configuration.

DANGER!
Be certain that 200-volt electricity (typical range 208 – 240V) is used only with a machine labeled 220 volts at the motor and at the electrics box on the back of the column.
Be certain that 400-volt electricity (typical range 415 - 460V) is used only with a machine labeled 440 volts at the motor and at the electrics box on the back of the column.

DANGER!
The 220 or 440-volt line must originate from a dedicated and independent fused box with a manual shut-off lever. It is the responsibility of the purchaser to supply a wired box that meets all local codes and regulations.

Incoming 220 or 440 power connects to the machine through the electrical box located on the back of the column. The power cable enters the black box through a hole on the top of the box.

DANGER!
Only a qualified electrician should wire the 220 or 440 volt 3 phase electricity.

To convert a DPMSX2 machine from 220 to 440 volt power or vice versa 3 things must happen: spindle motor must be rewired, overload relay must be set to 8.5 amps for 220 V and 4.25 for 440 volts and the voltage stickers on the electric's box must be replaced.

To convert a DPMSX3 & SX5 machine from 220 to 440 volt power 3 things must happen: spindle motor must be rewired, overload relay must be replaced and set to 14 amps for 220 V and 7 for 440 volts and the voltage stickers on the electric's box must be replaced.

Note: Voltage conversion from 220V to 440V not applicable to machine fitted with Spindle Control Option.

See Section 5 for a diagram of how to rewire the spindle motor.
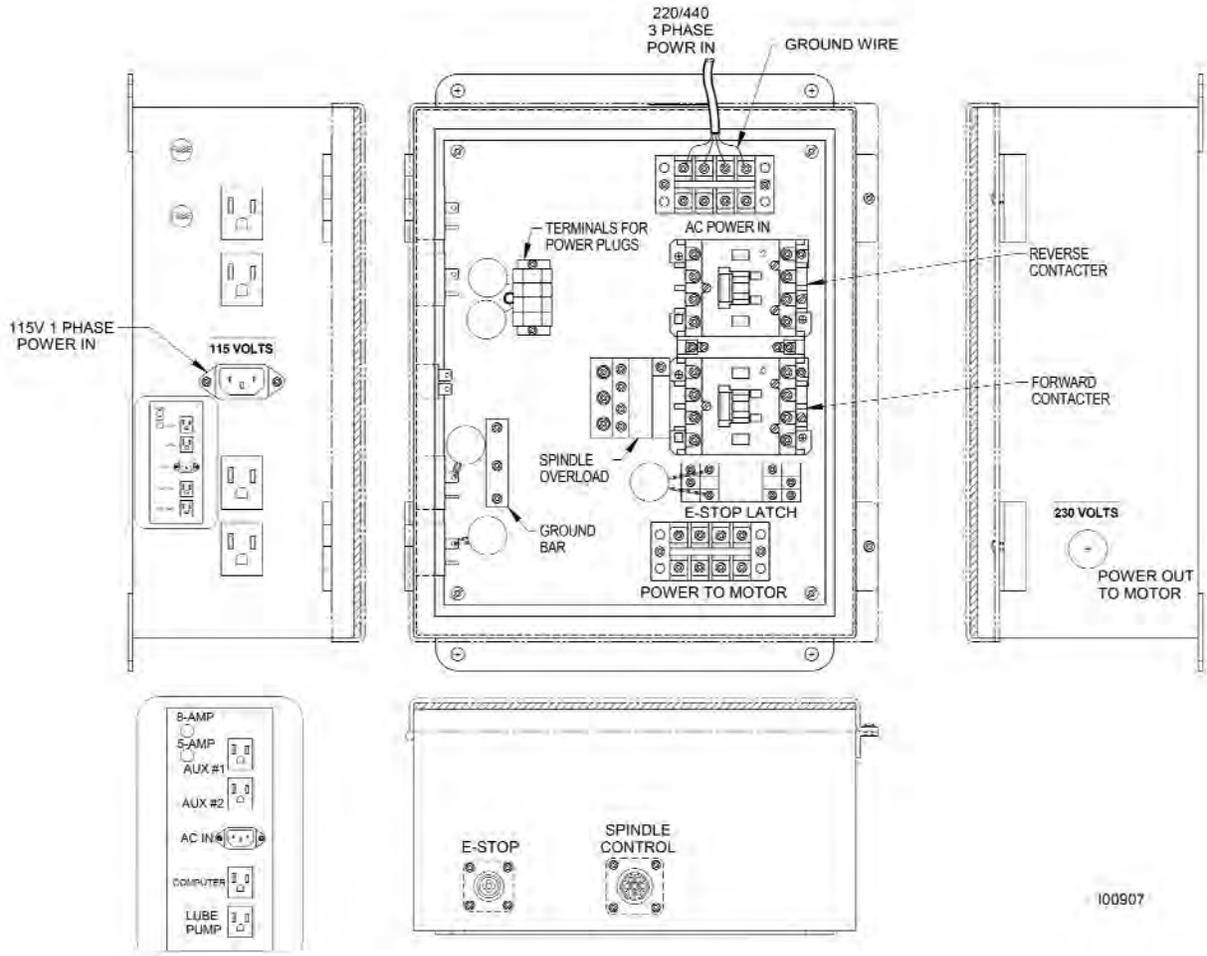
Figure 9
Wiring the DPMSX2, DPMSX3 or DPMSX5
Non-Spindle Control

Part Number	Description
SX2/SX3/SX5	
220V & 440V = 20676	Electrical Box
220V & 440V = 23438-3	Overload
23436	Contactor (Qty = 2) (Reverse or Forward)
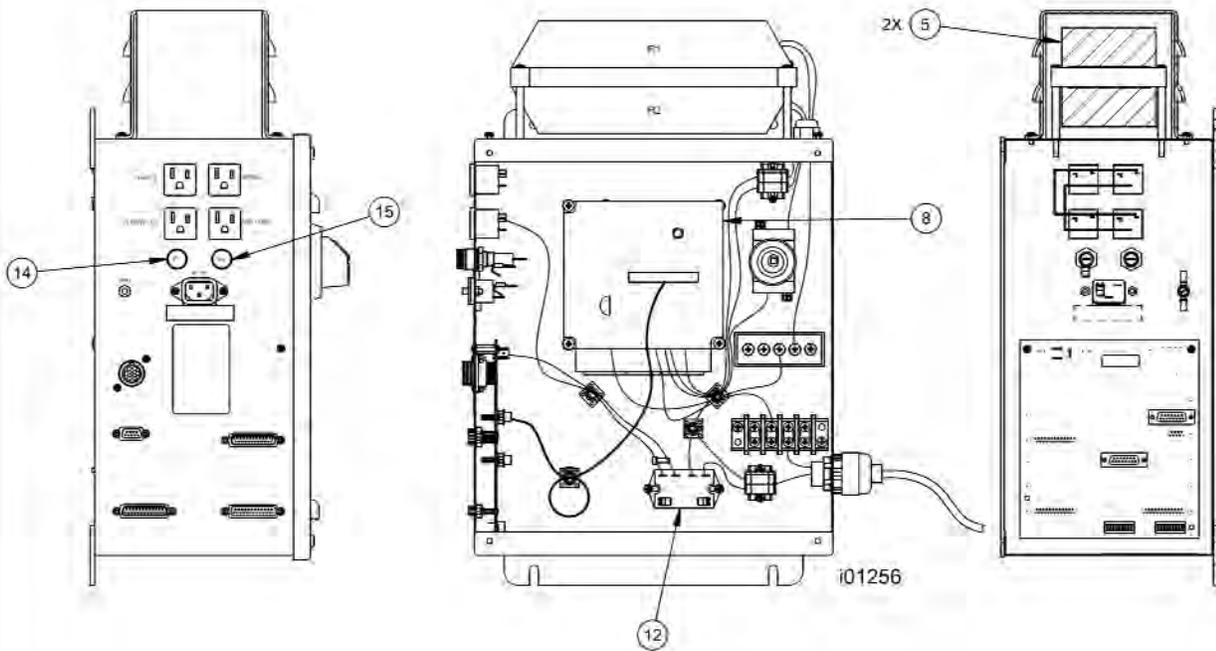
Figure 10-1
Wiring the DPMSX2, DPMSX3 or DPMSX5 – Spindle Control

Item	Part Number		Description
	SX2	**SX3/SX5**	
1	24060-1	24060-2	Electrical Box
5	22890-500-120	22890-500-64	Resistor (Qty = 2)
8	22127-DPMSX2	22128-DPMSX3/5	AC Drive - Mini Vector - 220V
12	22961		Relay - Power - 115V DPST
14	21824-5		Fuse - 3 AG - Slow Blow 5 AMP
15	21824-8		Fuse - 3 AG - Slow Blow 8 AMP

Southwestern Industries recommends the machine be earth grounded by driving a copper rod into the ground. It is the responsibility of the customer to install this rod.
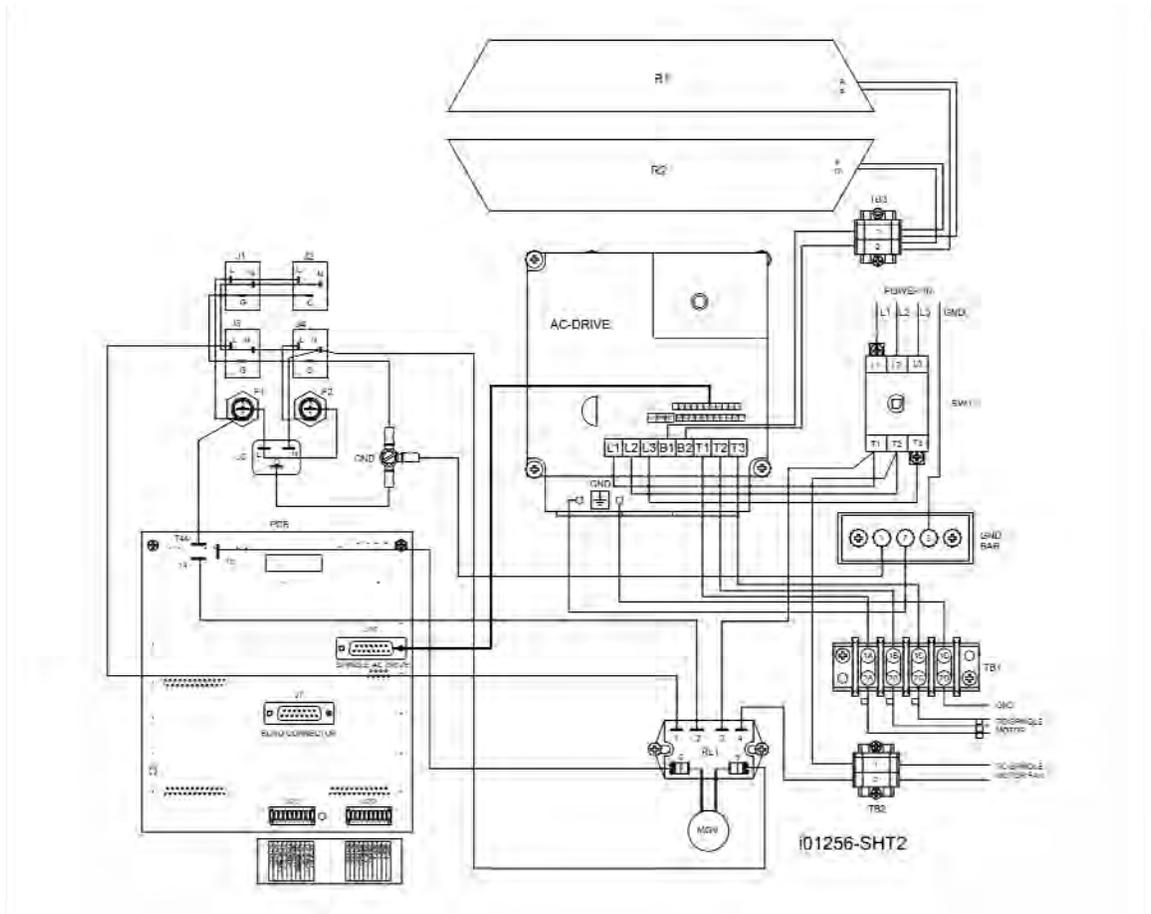
Figure 10-2
Wiring the DPMSX2, DPMSX3 or DPMSX5 – Spindle Control

2.12.1   Phase Converters

For those machines that will be run with a phase converter it is recommended that it is a rotary type rather than a static phase converters. Rotary phase converters allow for varying loads in the system. The electrical load on the machine will vary based on the type of cut taken. Static phase converters can only be used on machines with a non-varying load. The phase converter for the DPMSX machines must be rated at a minimum of 5 to 7 KVA for DPMSX2 and 7 to 10 KVA for DPMSX3 &SX5.

2.12.2   Flange Transformer (Optional)

The Flange Disconnect Option eliminates the need for the user to provide a power disconnect for the machine on their own, while the Transformer Option allows the user to provide one power source to the machine. **Note: This option is not available to machine fitted with the Spindle Control Option.**
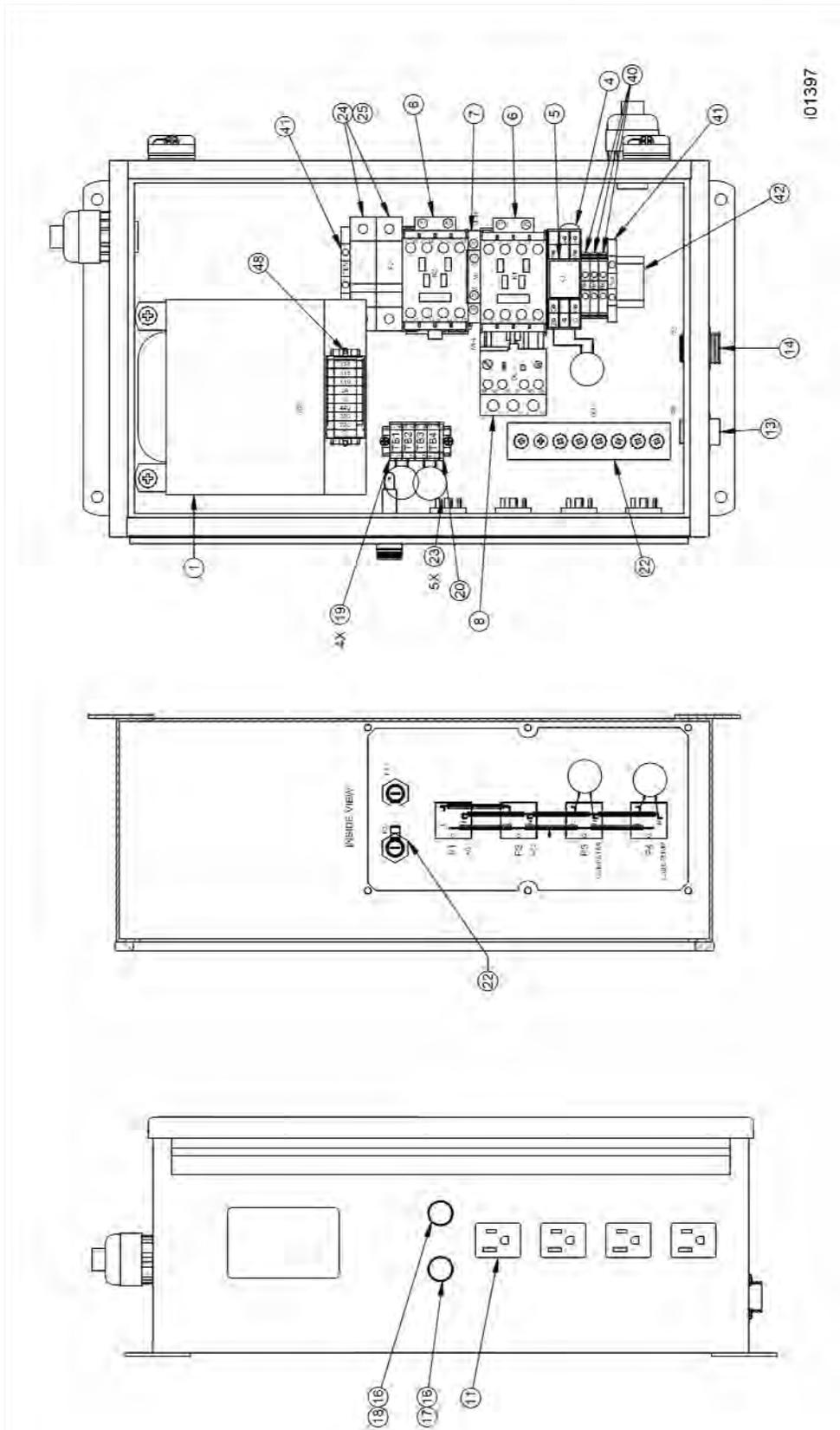
Figure 11
Flange Disconnect/Transformer Option, P/N: 23460-220/440

Parts List – Flange Disconnect/Transformer Option

Item	P/N	Title	Qty
1	21258	TRANSFORMER 1000VA EI	1
4	23434	SOCKET-RELAY	1
5	23435	RELAY-POWER-100-120 VAC-DPDT	1
6	23436	CONTACTOR-4 POLE	2
7	23437	MECHANICAL INTERLOCK	1
8	23438	OVERLOAD RELAY-220V TO 440V CONVERSION	1
11	22199-1	RECEPTACLE- PANEL MOUNT NEMA STD 15A 125V	4
13	21871	CONNECTOR-4 POSITION-SIZE 11	1
14	23297-1	CONNECTOR-REVERSE SEX-13-7-CPC	1
16	21820	FUSE HOLDER	2
17	21824-5	FUSE-3AG-SLOW BLOW	1
18	21830-12	FUSE-TYPE 3AB-12A-SLO BLO	1
19	22868	TERMINAL BLOCK	4
20	22869	END PLATE	1
22	21753-3	GROUND BAR- 6 HOLE	1
23	21901-150	MOV-V150LA20B	5
24	23036	FUSE HOLDER-32 AMP-690V	2
25	23153-3	FUSE-600 VAC-TIME DELAY-CLASS CC	2
26	22303-16G	WIRE-BUSS-16 GA AWG 12" STRAIGHT	12.25
40	22557-1	TERMINAL BLOCK - 6mm BLOCK	3
41	24299-3	TERMINAL BLOCK-RAIL END STOP/ GROUND	2
42	22571-8.125	RAIL-DIN	8.13
45	23429	SHEETMETAL-COVER PLATE LEFT-PT4-SM TRANSFORMER OPTION	1
48	24407	NAMEPLATE - TRANSFORMER	1
			i01397
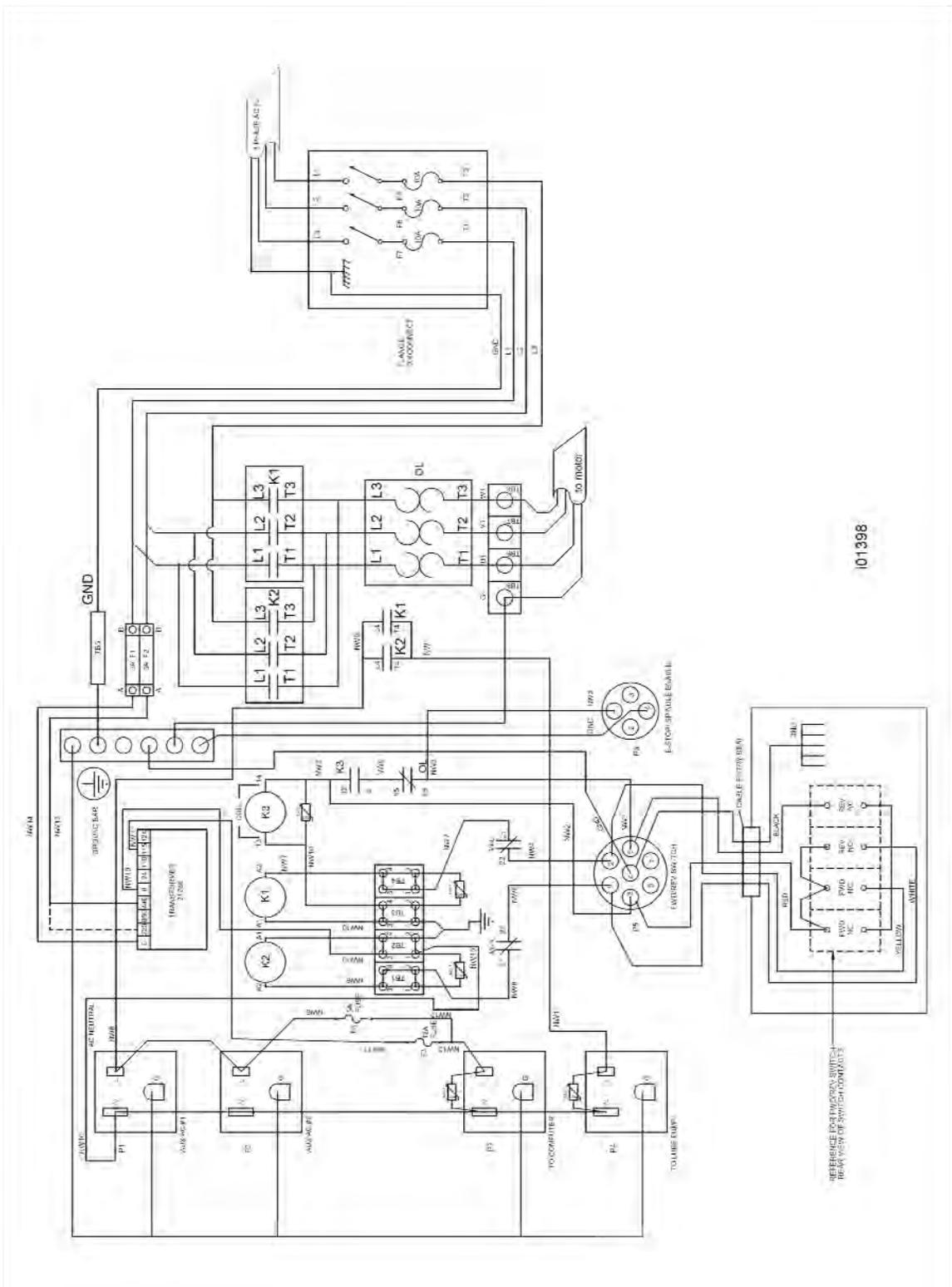
Figure 12
Transformer Option Schematic
P/N: 23440-220/440

2.13 Air Connection - Optional

The DPMSX machines have an air hookup in the rear of the machine if the machine has a power drawbar or auxiliary function option.

The drawbar option includes an air regulator, air manifold and an oiler. The auxiliary option includes an air regulator, air manifold and a solenoid. If both options are included on the same machine, a regulator, manifold, oiler and solenoid will be included. The air fitting is ¼" NPT. An additional air line port is on the manifold to be used for an optional mister. Remove the plug to gain access to this port. See Figure 13 below.

The air regulator is set to 90 PSI at the factory for the power drawbar unit and solenoid. See Section 5.1.8 for more information on the power drawbar unit. The air comes in through the manifold and passes through the air regulator. The regulator branches into two components--an oiler for the power drawbar unit and an air solenoid. The solenoid is used for a misting system that the user may install later on this machine. The mister air hose can be plugged into the ¼" quick disconnect air fitting on the solenoid. See the figure below for an illustration.
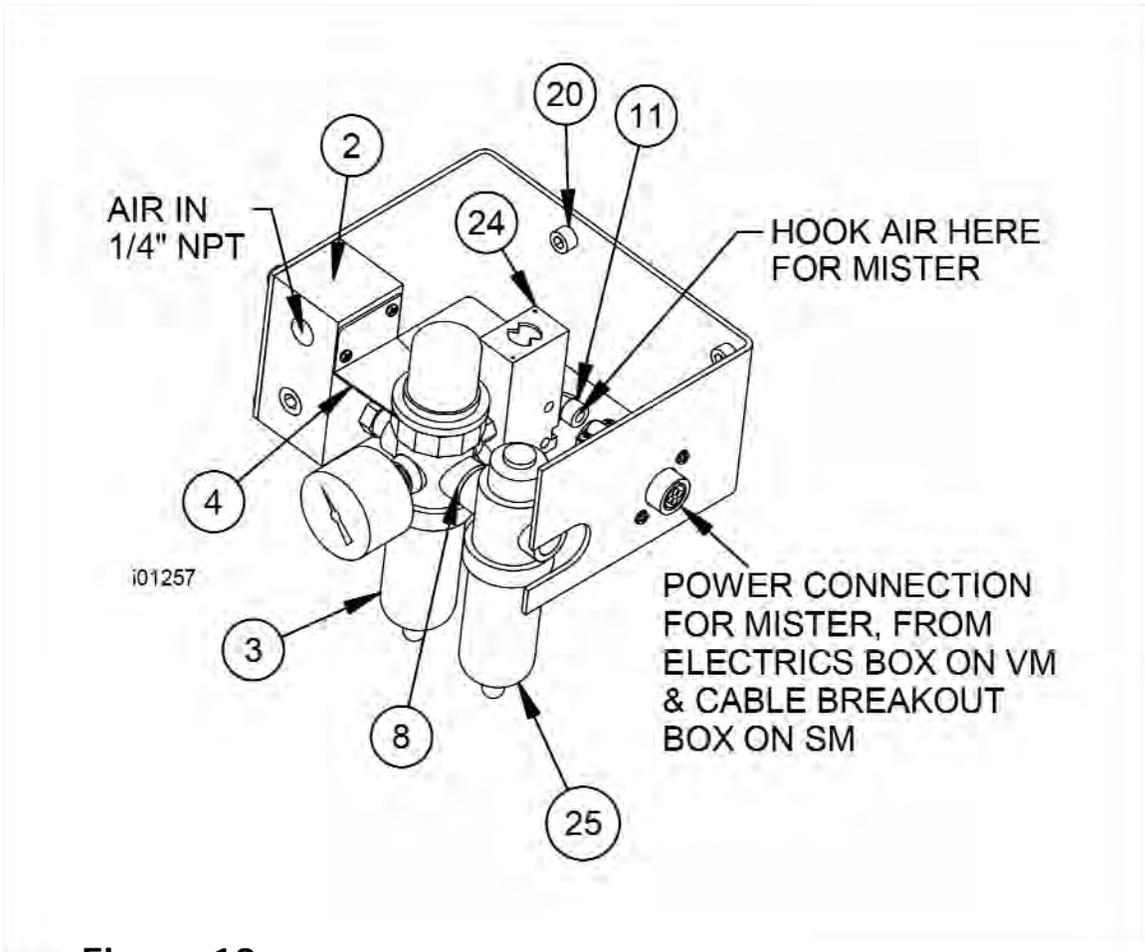
Figure 13
Air Regulator/Solenoid Assembly
P/N 22380-1

Item	P/N	Description
2	22378	MANIFOLD-PT4 AIR
3	22607	FILTER/REGULATOR-PT4
4	22607-1	BRACKET-MOUNTING KIT
8	22644-4	PLUG-1/4 NPT HEX SOCKET
11	22646-4	ADAPTOR-ELBOW MALE 1/4 x 1/8 NPT
20	M6-1.0X25 25B	SCREW-SHCS-STL-BO
24	22772	SOLENOID ASSY- AIR REGULATOR
25	22773	OILER

2.14 Mounting the Display Pendant

The ProtoTRAK SMX display pendant mounts to the pendant arm with four 1/4-20 x ¾ SHCS that are shipped screwed into the left side of the display. There is a locating screw on the pendant arm to help align the pendant with the mounting holes.

CAUTION!
The locating screw in the arm is used for positioning. Keep a hold of the pendant until the screws are fastened.

If the pendant arm rotates too freely, remove the painted cap on the bracket attached to the column and tighten the hex nut to adjust it. Replace the cap.

2.15 Cable Interconnections

All cable interconnections are made at the factory except for those connecting to the pendant display. There are a total of 4 cables that need to be connected to the pendant. See Section 6 for a complete illustration of cable interconnections for all components. There are 2 additional cables for the electronic handwheel option and 2 more cables for the spindle control option (digital I/O and spindle control parts).

With the main power to the machine turned off, plug in the connectors that are bundled on the pendant arm. Each cable mates to only one connector on the pendant display back panel. Use the label on the pendant to match the connectors with the correct port. The machine ID port and option key port (LPT1) will have keys plugged into them. The handwheel, spindle control and network ports will be left empty during installation.

Make sure there is sufficient slack in the cables for the pendant to rotate about the pendant arm. The worst case is when the pendant is all the way forward toward the operator. The following drawing describes all of the cable connections to the pendant.

Make sure that an option key is plugged into the option key port of the pendant. This key activates any converters or options ordered. The part # for this key is 22648-7. The key must be programmed according to the type of machine it is on and the options ordered.

The Machine ID port must have a key, or the machine may not run.

Note: Spindle Control machines use a different machine ID key then non-spindle control machines.

CAUTION!
Make sure the main power is turned off on the back of the electrical cabinet before plugging in the cables.
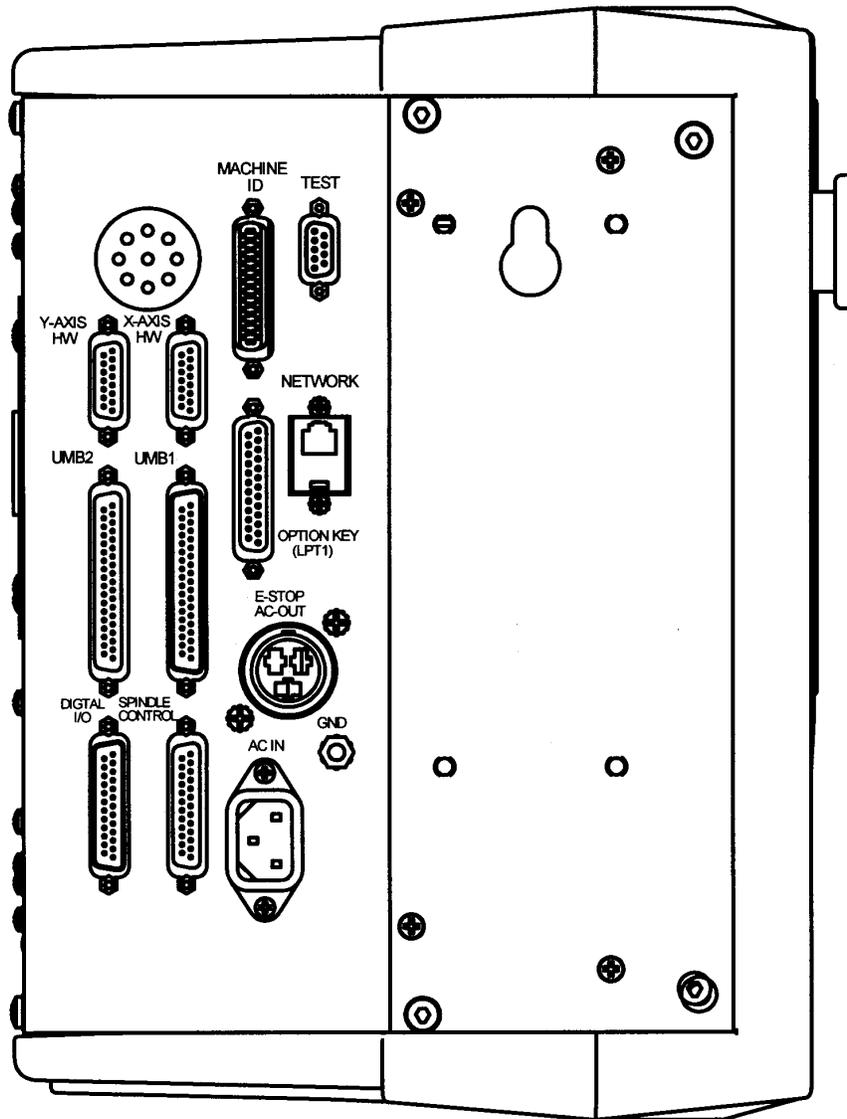
I01115

Figure 14
Pendant Cable Connections—Left Side
P/N: 24000-1
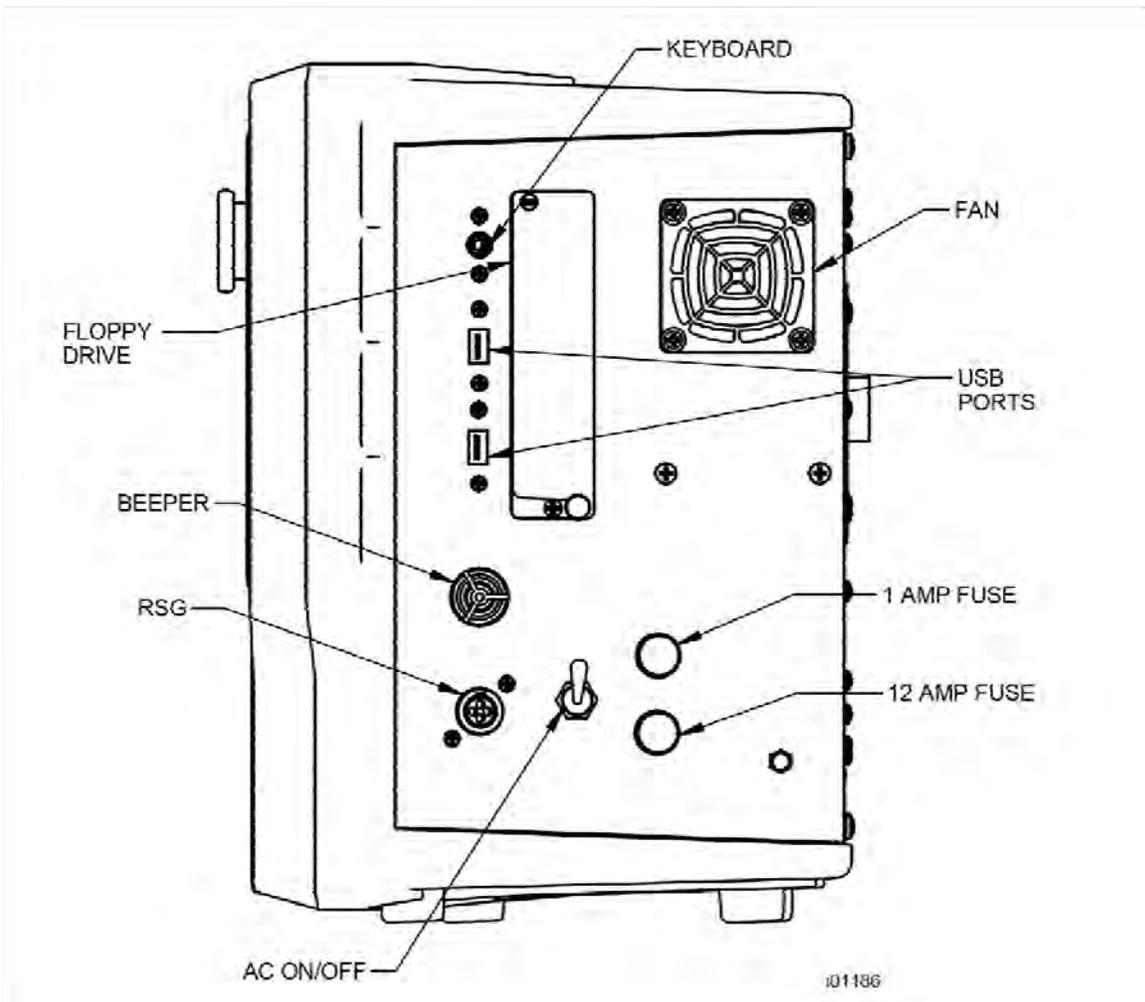
Figure 15
Pendant - Right Side
P/N: 24000-1
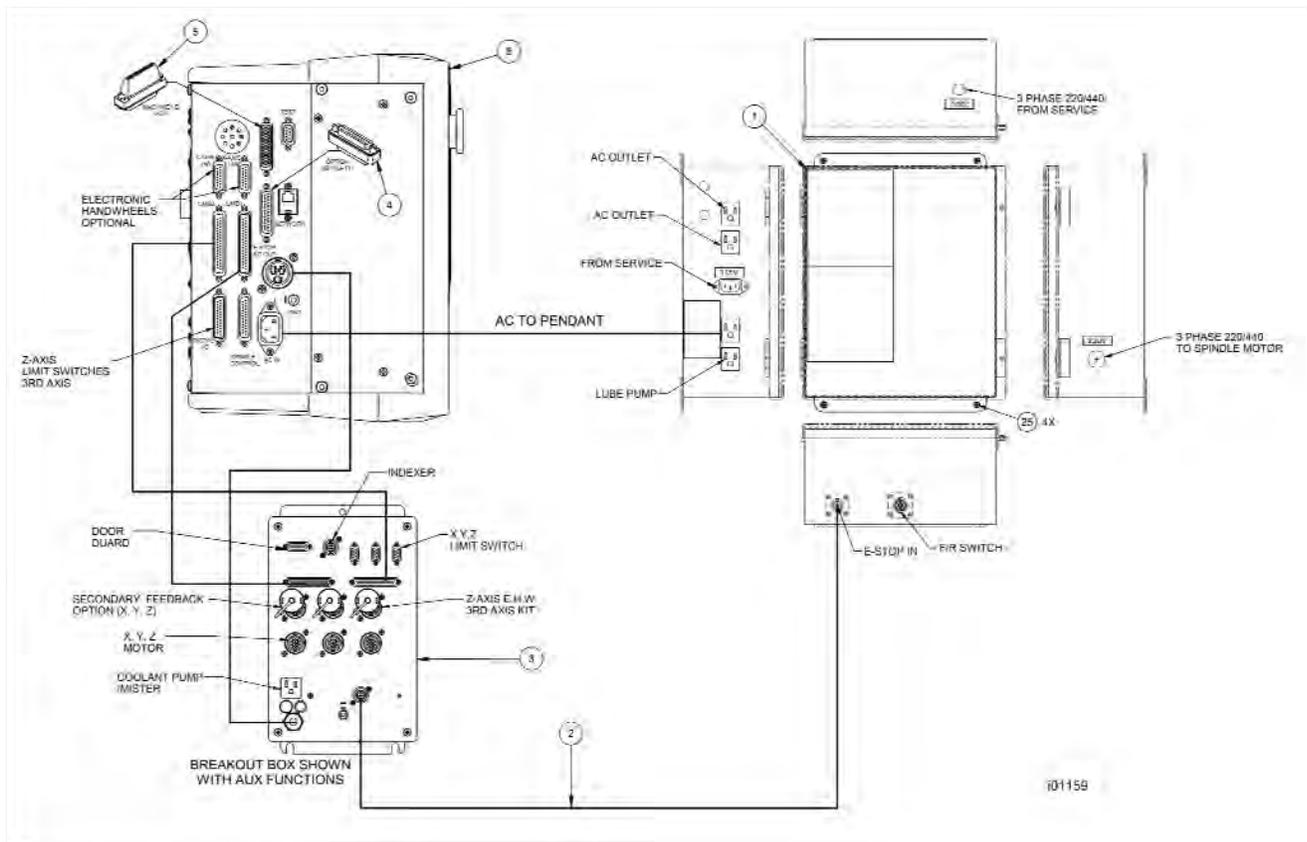
Figure 16
Cable Connection Diagram—Non-Spindle Control

Parts List – Cable Connection—Non-Spindle Control

Item	Part Number		Description
	SX2	**SX3/SX5**	
1	220V = 20676 440V = 20676	220V = 20676-1 440V = 20676	Electrical Box
2	21856		Cable Assembly
3	24999(-1)		Cable Breakout Box (-1 with AUX Functions)
4	22648-7		Option Key—SMX
5	22758-DPMSX(XXX)		Key—Machine ID
6	24000-1		SMX Pendant

Figure 17
Cable Connection Diagram with Spindle Control Option

Parts List – Cable Connection – Spindle Control

Item	Part Number	Description
1	24000-1	SMX Pendant Assembly
2	24060-1	Enclosure Assembly, SX2
2	24060-2	Enclosure Assembly, SX3 and SX5
3	23050	Cable Breakout Box
4	22555-15	Cable Assy - Logic
5	22555-15	Cable Assy - Logic
6	22556-15	Cable Assy - Parallel
7	22556-15	Cable Assy - Parallel
8	22608	Power Cord
9	20267	Cable Assy - AC to Computer

i01113

2.16 Lubrication

2.16.1 Way Lubrication – DPMSX2, DPMSX3 & DPMSX5

The auto lube system provides centralized automatic lubrication for the ways
and ballscrews. The lube pumps 2-liter reservoir is serviced with Mobil Vactra Oil No. 2 or equivalent. The pump is factory set to pump oil for 15 seconds for every 60 minutes of spindle time. There is an internal memory on the pump so that the
pump will not reset every time the spindle is turned off.

The pumping output can be regulated electronically to control the pause time between pumping cycles, and the duration of the pumping cycle. The following describes the buttons used to program the lube pump. In order to modify any of the settings the spindle must be on.

The pump has an alarm that will sound if any of the following problems arise:

- Oil line breakage
- Oil filter blockage
- Bad motor
- Low oil pressure
- No oil in tank

INT (Interval) - this button programs the interval between pumping cycles. Each press of the button increases the interval by one minute.

DIS (Discharge) - this button programs the amount of time the pump will discharge each pumping cycle. Each press of the button increases the discharge time by one minute.

FEED - this button is used to manually feed the ways and ballscrews.

RST - this button tells the pump to discharge for the time programmed.

Factory Default Values

Interval Time - 60 min.
Discharge Time - 15 sec
Discharge Pressure - Approximately 100 - 150psi

To adjust the amount of Discharge Pressure displayed on the lube pump gauge, loosen the jam nut and turn the adjustment screw located on the top right side of the lube pump while the lube pump is activated.

At the beginning of each day, check the oil level in the Auto Lube system. If low, fill with Mobil Vactra Oil No. 2 or equivalent.

CAUTION!
Failure to manually activate the pump at the beginning of each day, or allowing the Auto Lube to run dry may cause severe damage to the TRAK DPMSX2, DPMSX3 and DPMSX5 way surfaces and ballscrews.

2.16.2   Head Lubrication – TRAK Bed Mills

Once Each Week:
1. Fill the oil cup on the front of the head with SAE 30 or 30 W oil. This oil lubricates the Hi/Lo range shifter.

2. Fill the ball oiler located in the front lower right corner of the speed changer housing. This oil lubricates the speed changer shaft.

3. Extend the quill fully and apply a coating of SAE 30 or 30W oil to the outside diameter of the quill.

Every Four Months:
Apply a good grade of general-purpose grease through the grease fittings on the back of the head and on the left side of the head. This grease lubricates the Low range gear set and the feed change gears respectively. Also lubricate vari-disk on spindle motor by means of grease fitting on motor shaft.

Every Four Months (DPMSX5 X Handwheel Drive Mechanism):
Remove X handwheel drive cover and apply a general-purpose grease to the drive gears.

2.17 ProtoTRAK SMX Euclid Block Procedure

The test part should be machined at the completion of the installation.

The material for the Euclid block test part is found in the toolbox.

- Material Specification: Aluminum, 6061-T6 or T4
- Blank Size: (minimum dimensions) 3 x 3 x 1″, provided in tool box
- Tool: .750 end mill, 2 flute, high speed steel, *sharp*
- Coolant: Flood coolant, Cool-Tool or Kerosene

1. Mount vise and indicate the back jaw parallel to the table within .0005″.

2. Clamp material in vice with a minimum of .800″ above the vise jaws.

3. Load in the Euclid block program from the ProtoTRAK SM flash drive, it is part number euclid.PT4. It is found under the PT4 folder followed by the SWI TEST PROGRAMS folder.

4. Use an edge finder to set Absolute 0 on X and Y. Absolute zero is the front left corner of the block as viewed from in front of the machine.

5. Load the .750 end mill and set Z Absolute 0 at the top of the part, and set Z reference positions in the SET UP mode. Set Z-retract a few inches above the part.

6. Begin to run the program. The part will be machined in the following sequence:

   7. After the program run, the program will locate to the following position.
      - X = 1.318
      - Y = 1.318

Event(s) #	Description	Depth of Cut
1	circle pocket – cuts middle circle	-0.250″
2	circle frame – cuts outer 1.830 diameter circle	-0.250″
3	circle frame – cuts material from corners remaining on Euclid block	-0.250″
4	roughs material in upper right-hand corner	-0.500″
5-12	cuts triangle on Euclid block	-0.500″
13	rectangular frame – cuts outer 2.750″ rectangle	-0.7500″

8. Mount a dial indicator in the quill and check the circles.

9. Check the runout of the sides of the square frame.

10. Inspect the machined surfaces for smoothness.

Figure 18
Euclid Block

3.0   Troubleshooting by Symptom

Use this section to begin the process of resolving a service problem. Each symptom type is described in a few words and then more fully described in an explanatory paragraph. Following this is a chart that directs in the most logical steps.

3.1 Problems Relating To Machining Results

3.1.1 Poor Finish

The part finish is marred with scallops or is very rough.

Do the following Service Codes and document values:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service

- **Code 11** Measures backlash in the system (Only used on Dual Feedback systems)

- **Code 12** Feed Forward Constant

- **Code 127** Measures backlash in the system (Only used on Single Feedback systems)

- **Code 128** Enter backlash compensation

Possible Cause	Check This
Too much backlash entered for code 128 or calculated with code 11.	Verify nothing is mechanically loose and the backlash values are not higher than what physically is in the system.
Machine Tool & Setup problem	Check for any looseness in the setup (Tool, Tool holder, Part, Vise, or Fixture). Check the condition and type of cutter being used, type of material, RPM and Feedrate, etc. See Machine Tool & Setup Section 4.1
Table, Saddle, or Ram Locks are locked	Make sure the Table, Saddle, and Ram Locks are unlocked. Never use gib locks with a CNC machine.
Inadequate or no Lubrication to Ballscrews and Way surfaces	Make sure all the Way surfaces are getting proper lubrication. If not, check to make sure that the lube pump is functioning properly. Also check for any pinched or blocked oil lines. See Lubrication Section 4.1.3
X, Y, and Z-axis Gibs are not adjusted properly	Check the adjustment of the X, Y, and Z-axis Gibs. See X, Y, and Z-axis Gib Adjustments in Section 5.2.1.
X & Y-axis Drive Trains are loose	Check Repeatability using the Repeatability and Positional Accuracy procedure. Step by step, carefully inspect the Drive Train for any looseness. It may be necessary to disassemble and then reassemble the Drive Train. See Mechanical Drive Train (X, Y) Section 4.2
Way surfaces are pocked, scarred, or excessively worn	Visually check the condition of all the Way surfaces. For machines that may have excessively worn Way surfaces you may need to adjust the Gibs in this area. This will affect performance when using the machine outside of this area. Check lubrication to affected areas.

3.1.2 Circles Out of Round

Circles are not round within 0.002″ TIR over 3.0″ DIA. This is best measured by placing a dial indicator in the quill and sweeping around the part.

Note: The typical slideway-milling machine is not capable of achieving more precise results although careful adjustments to a new milling machine have produced better results. If more precise circles are required, then it is recommended to use a precision boring head/boring bar.

Do the following Service Codes and document values:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service

- **Code 11** Measures backlash in the system (Only used on Dual Feedback systems)

- **Code 12** Feed Forward Constant

- **Code 127** Measures backlash in the system (Only used on Single Feedback systems)

- **Code 128** Enter backlash compensation

Possible Cause	Check This
Torque values on X and Y-axis are too high.	Make sure torque is lower than 20 in-lbs. Normal values for a machine that is aligned and adjusted properly should be between 10 and 15 in-lbs. Make sure torque is consistent across axis travel.
Machine Tool and Setup problem	Check for any looseness in the setup (Tool, Tool holder, Part, Vise, or Fixture). See Machine Tool & Setup - Section 4.1
Machine not level	Verify that the machine is level to specification.
Head is not Trammed	Verify that the Head is Trammed to specification. See Tramming the Head
X, Y, and Z-axis Gibs are not adjusted properly	Check the adjustment of the X, Y, and Z-axis Gibs using the X, Y, and Z-axis Gib adjustment procedures.
Calibration or Backlash problem	Recalibrate the machine. Reset the Backlash. Check Repeatability and Positional Accuracy. See Calibration & Backlash Constants Section 5.2.2
TRAK Sensor or Glass Scale problem	Make sure that the Sensor or Glass Scale is installed correctly according to the Sensor or Glass Scale Installation procedures. Check for any loose brackets or misalignment etc. Also, check to make sure the Sensor or Glass Scale assemblies are functioning correctly. See TRAK Sensors or Glass Scales Sections 4.6 & 4.7.
X & Y-axis Drive Trains are loose	Check Repeatability using the Repeatability and Positional Accuracy procedure. Step by step, carefully inspect the Drive Train for any looseness. It may be necessary to disassemble and then reassemble the Drive Train. See Mechanical Drive Train (X, Y) Section 4.2
Head Bolts are loose	Verify that all the head bolts are tight.

3.1.3 Taper Cut on a Programmed Straight Line Move

An unwanted tapered cut occurs, when the machine is programmed to move in a straight line along either the X or Y-axis. The DRO shows motion of a few thousandths of an inch in the axis that is not supposed to be moving.

Explanation: For straight line cuts along the X or Y-axis, the control is designed to lock the motor of the axis that is not moving. A taper is created when there is play in the system. The force of the tool shoves the table or saddle out of position.

The system will respond to being pushed out of position by making an adjustment at the end of the move.

An unwanted tapered cut is the result of looseness in the system.

Do the following Service Codes and document values:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service

- **Code 11** Measure's the backlash in the system. Only used on machines with Dual Feedback systems

- **Code 12** Feed Forward Constant

- **Code 127** Measure's the backlash in the system. Only used on machines with Single Feedback

- **Code 128** Enter backlash compensation

Possible Cause	Check This
Machine Tool & Setup problem	Check for any looseness in the setup (Tool, Tool holder, Part, Vise, or Fixture). See Machine Tool & Setup Section 4.1
X, Y, and Z-axis Gibs are loose	Check the adjustment of the X, Y, and Z-axis Gibs using the X, Y, and Z-axis Gib adjustment procedures. See Section 5.2.1
X and Y-axis Drive Trains are loose	Check Repeatability using the Repeatability and Positional Accuracy procedure. Step by step, carefully inspect the Drive Train for any looseness. It may be necessary to disassemble and then reassemble the Drive Train. See Mechanical Drive Train (X, Y) Section 4.2

3.1.4 Parts Have Incorrect Dimensions

Parts are being machined with dimensions that are different than those programmed. Typical accuracy expectations should be:

- **Circles:** 0.002″ TIR over 3.00″ DIA

- **Positional Accuracy:** 0.0005"

- **Repeatability:** 0.0005"

Note: The typical slideway-milling machine is not capable of achieving more precise results although careful adjustments to a new milling machine have produced better results.

Furthermore, the system should be expected to repeat within the resolution of the displayed DRO numbers of 0.0005″.
Do the following Service Code:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service

- **Code 123** Calibration

- **Code 11** Measure's the backlash in the system. Only used on machines with Dual Feedback systems

- **Code 12 Feed** Forward Constant

- **Code 127** Measure's the backlash in the system. Only used on machines with Single Feedback

- **Code 128** Enter backlash compensation

3.1.4.1   Every Part Has the Same Error

Possible Cause	Check This
Machine Tool & Setup problem	See Machine Tool & Setup Section 4.1
Programming Error	In the program, look for common errors in programming such as transposing numbers, tool diameters, and pressing INC SET when ABS SET is meant. This is especially suspected if the dimensional errors are larger than a few thousandths. See the Controls Programming, Operations and Care manual.
Configuration file that contains calibration file and backlash constants has been erased or corrupted.	Verify configuration file (Code 313) does not read default values. Load saved configuration file from floppy disk in electrics cabinet with Code 141.
Calibration or Backlash problem	Recalibrate the machine. Reset the Backlash. Check Repeatability and Positional Accuracy. See Calibration & Backlash Constants

3.1.4.2   The Dimensional Errors Are Random or Accumulate in Size Over the Part Program Run

Possible Cause	Check This
Machine Tool & Setup problem	See Machine Tool & Setup Section 4.1
TRAK Sensor or Glass Scale problem	Make sure that the Sensor or Glass Scale is installed correctly according to the Sensor or Glass Scale Installation procedures. Check for any loose brackets or misalignment etc. Also, check to make sure the Sensor or Glass Scale assemblies are functioning correctly. See TRAK Sensors or Glass Scales Sections 4.6 & 4.7
X and Y-axis Drive Trains are loose	Check Repeatability using the Repeatability and Positional Accuracy procedure. Step by step, carefully inspect the Drive Train for any looseness. It may be necessary to disassemble and then reassemble the Drive Train. See Mechanical Drive Train (X, Y) Section 4.2

3.2   Problems Regarding the Motion of the Machine

3.2.1 Run Away Axis

The axis makes an unwanted move at rapid speed in one direction and faults out. This is usually caused by an encoder signal being interrupted.

Do the following Service Codes:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service

- **Code 100** Axis open loop test. Used to check the maximum feedrate of an axis and if the encoders are counting properly

Possible Cause	Check This
Sensors or glass scales are counting in opposite direction of motor encoder	Reverse directions with codes 321 and 322
The home positions or tools are not set correctly	See the Controls Programming, Operations and Care manual.
The Sensor or Glass Scale is not reading.	See TRAK Sensors or Glass Scales diagnostic Section 4.6 or 4.7
Bad Motor Encoder	See Motor diagnostics Section 4.4

3.2.2 Slow Down Axis

The axis slows down and moves at a feedrate that is lower than rapid or than the programmed feedrate.

Do the following Service Codes:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service

- **Code 100** Axis open loop test. Used to check the maximum feedrate of an axis and if the encoders are counting

- **Code 129** Set's the maximum allowable arc accuracy error. This applies to arcs only

Possible Cause	Check This
The maximum allowable Arc Accuracy is set too low.	This value will only slow down the machine during arc moves. The factory default is set at 0.001". Perform Code 129 to check or change this value. See Service Codes section
Incoming AC voltage is inadequate	Perform Code 100. See Service Codes - Section 4.9 and Electrical Section 4.8
Table, Saddle, or Ram Locks are locked	Make sure the Table, Saddle, and Ram Locks are unlocked.
Inadequate or no Lubrication to Ballscrews and Way surfaces	Make sure all the Way surfaces are getting proper lubrication. If not, check to make sure that the lube pump is functioning properly. Also check for any pinched or blocked oil lines. See Lubrication Section 4.1.3
X, Y, and Z-axis Gibs are not adjusted properly	Check the adjustment of the X, Y, and Z-axis Gibs using the X, Y, and Z-axis Gib adjustment procedures.
Binding in the Drive Train	Check Repeatability using the Repeatability and Positional Accuracy procedure. Check the torque reading of the Drive Train. Step by step, carefully inspect the Drive Train for any binding. It may be necessary to disassemble and then reassemble the Drive Train. See Mechanical Drive Train (X, Y) Section 4.2
Servo Drive failure	See Servo Drive Section 4.5
Motor failure	See Motor Section 4.4

3.2.3 Axis Will Not Jog

The system powers up but will not respond to the jog command.

Do the following Service Codes and procedures:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service

- **Code 100** Axis open loop test. Used to check the maximum feedrate of an axis and if the encoders are counting

Possible Cause	Check This
Improper Boot-up	Shut down the system and wait 10 seconds before rebooting
E-Stop is pressed in	Check E-Stop. Especially if both axes will not jog
Servo Drive failure	Especially, if only one axis will not jog; See Servo Driver Section 4.5
Shorted motor	See Motor Section 4.4
Poor cable or wiring connections	See Electrical Connection Section 2.12
Computer/Pendant failed	See Computer/Pendant diagnostics Section 4.3

3.2.4 Axis Motor Motion is not Smooth

While under motor power, the motion is not smooth. The motion appears to be "rough" or jerky".

Do the following Service Codes and procedures:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service
- **Code 11** Measure's the backlash in the system. Only used on machines with Dual Feedback systems
- **Code 12** Feed Forward Constant. High feed forward constants will cause an unstable servo system
- **Code 127** Measure's the backlash in the system. Only used on machines with Single Feedback
- **Code 128** Enter backlash compensation
- **Code 100** Axis open loop test. Used to check the maximum feedrate of an axis and if the encoders are counting

Possible Cause	Check This
X, Y, and Z-axis Gibs are not adjusted properly	Check the adjustment of the X, Y, and Z-axis Gibs using the X, Y, and Z-axis Gib adjustment procedures.
TRAK Sensor or Glass Scale problem	Make sure that the Sensor or Glass Scale is installed correctly according to the Sensor or Glass Scale Installation procedures. Check for any loose brackets or misalignment etc. Also, check to make sure the Sensor or Glass Scale assemblies are functioning correctly. See TRAK Sensors or Glass Scales Section 4.6 & 4.7
Calibration or Backlash problem	Recalibrate the machine. Reset the Backlash. Check Repeatability and Positional Accuracy. See Calibration & Backlash Constants section.
Binding in the Drive Train	Check Repeatability using the Repeatability and Positional Accuracy procedure. Check the torque reading of the Drive Train. Step by step, carefully inspect the Drive Train for any binding. It may be necessary to disassemble and then reassemble the Drive Train. See Mechanical Drive Train (X, Y) Section 4.2

3.2.5 Vibration in Motion

While axis is moving there is vibration or noise coming from the X or Y-axis.

Do the following Service Codes and procedures:

- **Code 11** Measure's the backlash in the system. Only used on machines with Dual Feedback systems
- **Code 12 Feed** Forward Constant. High feed forward constants will cause an unstable servo system
- **Code 127** Measure's the backlash in the system. Only used on machines with Single Feedback
- **Code 128** Enter backlash compensation
- **Code 123** Calibrate

Possible Cause	Check This
Too much backlash entered in Code 128 or Code 11.	Recheck the machines backlash.
Inadequate or no Lubrication to Ballscrews and Way surfaces	Make sure all the Way surfaces are getting proper lubrication. If not, check to make sure that the lube pump is functioning properly. Also check for any pinched or blocked oil lines. See Lubrication section
X, Y, and Z-axis Gibs are not adjusted properly	Check the adjustment of the X, Y, and Z-axis Gibs using the X, Y, and Z-axis Gib adjustment procedures.
Gibs not making good contact.	Pull gibs out and mark with a blue die to check where the gibs are making contact. It is recommended that the gibs uniformly contact at least 80% of the surface.
Binding or looseness in the Drive Train	Check Repeatability using the Repeatability and Positional Accuracy procedure. Check the torque reading of the Drive Train. Step by step, carefully inspect the Drive Train for any binding or looseness. It may be necessary to disassemble and then reassemble the Drive Train. See Mechanical Drive Train (X, Y) Section 4.2
Axis Motor belt too tight.	Loosen belt.
Misalignment of ball screw	See Mechanical Drive Train (X, Y) Section 4.2

3.2.6 Searching Axis

The handwheels are slowly turning back and forth when the servos are engaged. Several thousandths of motion are observed on the vernier dial and the frequency is one cycle every couple of seconds.

Do the following Service Code and procedures:

- **Code 11** Measures backlash in system. (Used only with glass scales and sensors.)
- **Code 12** Sets a feed forward power constant to drive axis motors
- **Code 127** Measure's the backlash in the system. Only used on machines with Single Feedback
- **Code 128** Backlash compensation on single feedback machines

Possible Cause	Check This
Most often causes by excess backlash compensation	Check physical backlash in system and re-enter in code 128. Run code 11 on dual feedback machines
High feed forward values	Check ball screw torque. Typical code 12 values should be between 10 to 15 in-lbs.
Excessive friction in the sliding ways	Lubrication, gib adjustments, gib locks. See Machine Tool & Setup - Section 4.1
Looseness in the drive train	The drive train of the axis that is searching, especially the tightness of the drive assembly. See Mechanical Drive Train (X, Y) - Section 4.2

3.3 Problems Relating to the Operation of the Control

3.3.1 Display Blanks

The display is completely blank.

Possible Cause	Check This
System flash drive loose	Make sure flash drive is seated properly
Screen saver has been activated	Press any key to turn back on. All LED keys on pendant will blink when the screen saver is on. Press any key to deactivate. Hitting this key will not activate any feature on the control.
The system has shut down	Turn the power switch off; check the computer/pendant fuses and cable connections. See Electrical Section 4.8
Poor cable connection from Computer Module to LCD (Liquid Crystal Display)	Double-check the connection from the computer module to the LCD.
Fuse blown in pendant	Remove fuse and check continuity
Computer/Pendant failed	See Computer/Pendant Section 4.3

3.3.2 Bad Picture on the Display

The display has strange characters, horizontal bars or other unfamiliar images, or the display continually rolls.

Possible Cause	Check This
Poor cable connection from Computer Module to LCD (Liquid Crystal Display)	Check connections on computer module.
Computer/Pendant failed	See Computer/Pendant Section 4.3

3.3.3 Keyboard Lockup

The screen display is normal, but the system will not respond to key presses.

Do the following Service Codes and procedures:

- **Code 81**   To check if the pendant keys are working properly, press each key. If the key is working, the corresponding key on the screen will light up. The pendant will also beep.

Possible Cause	Check This
Voltage drop/spike has occurred	Shut down the system and wait 10 seconds to reboot the system.
Remote Stop-Go (RSG) switch has a short (if connected)	Remove the RSG. Turn the system off and then on again. If the problem goes away and then re-appears when the RSG is plugged-in, replace the RSG.
Poor cable connections from the Computer Module to the Distribution Board and from the Distribution Board to the Keyboard	Re-seat cable connectors by pulling out and pushing back in.
Computer/Pendant failed	See Computer/Pendant Section 4.3
Electromagnetic interference has entered through the network cable (if connected); especially if intermittent	Especially suspected if the network cable is run near any electrical conduit. If the problem is chronic, remove the cable for a while to see if there is a difference.

3.3.4 Fault X, Y or Z

The program run or jogging operation is interrupted with a Fault Message on the display.

Do the following Service Codes and procedures:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service.

- **Code 11** Measure's the backlash in the system. Only used on machines with Dual Feedback systems.

- **Code 12 Feed** Forward Constant

- **Code 100** Axis open loop test. Used to check the maximum feedrate of an axis and if the encoders are counting.

Possible Cause	Check This
Cable connection problems	Check umbilical 1 and 2. Check #1 for X and Y-axis problems and #2 for the Z-axis.
Table, Saddle, or Ram Locks are locked	Make sure the Table, Saddle, and Ram Locks are unlocked. High torque on any axis may cause faulting problems during alignment routine.
X, Y, and Z-axis Gibs are adjusted extremely tight	Check the adjustment of the X, Y, and Z-axis Gibs using the X, Y, and Z-axis Gib adjustment procedures. See X, Y, and Z-axis Gib Adjustments Section 5.2.1
Excessive friction in the slideways	See Machine Tool & Setup Section 4.1
Binding or looseness in the Drive Train	See Mechanical Drive Train (X, Y) Section 4.2
Incoming electrical power	Incoming voltage. See Electrical Section 4.8
Measurement system not functioning properly	See Section 4.6 or 4.7
Servo Drive failure	See Servo Driver - Section 4.5
Motor failure	See Motor diagnostics, Section 4.4
Computer/Pendant failure	See Computer/Pendant diagnostics, Section 4.3

3.3.5 Problems Reading the Floppy Disk; Programs Not Saved Properly; The floppy drive will not read or write programs from a disk.

Possible Cause	Check This
Improper Boot-up	Shut down the system and wait 10 seconds before rebooting
Floppy Disk failure	The Floppy Disk may be bad. See if the Floppy Disk can be read by a Personal Computer. Does the green light on the floppy drive come on when you access the disk? If so, power is getting to the floppy drive. If not check connections of floppy drive inside the computer module. See Computer/Pendant Section 4.3 for more information.
Floppy Disk full	Put the Floppy Disk into a Personal Computer to see how many bytes remain. A floppy can typically hold 1.4 MB of information.

3.3.6 System Will Not Turn On or Boot-Up

Nothing happens when the switch is turned on or the system does not boot-up.

Possible Cause	Check This
110 V line is not plugged in	Check incoming 110 V power source to black electrical cabinet
Pendant On/Off switch is Off.	Check the Pendant On/Off switch
Fuse blown in pendant or electrical cabinet	Remove fuses and check continuity.
Flash Drive failure	When the Computer Module starts the boot-up process, look at the 8th line on the Display Screen. If the Mother Board of the Computer Module is communicating with the Flash Drive you will see "Detecting IDE Primary Master...Scan Disk SDCFB-64". If the Mother Board of the Computer Module is not communicating with the Flash Drive you will see "Detecting IDE Primary Master ... None". Also, check the wiring connection between the Flash Drive and the Mother Board. See Computer/Pendant diagnostics Section 4.3
Computer/Pendant has failed	See Computer/Pendant diagnostics Section 4.3

3.3.7 System Reboots by Itself

During operation, the screen suddenly blanks and then shows that the system has begun the boot-up sequence.

Possible Cause	Check This
Interruption of 110 V power to pendant	Using a Voltmeter, check the incoming 110VAC to the pendant.
Poor wiring and cable connections	Check for any loose wiring or cables
Computer/Pendant failed	See Computer/Pendant diagnostics Section 4.3

3.3.8 System Shuts Off

During operation, the system shuts off and will not turn back on.

Possible Cause	Check This
Fuse blown in pendant	Remove fuse and check continuity
Poor wiring and cable connections	Check for any loose wiring. Also, check the 110VAC Power Cable connection from the 110VAC Power Strip to the Pendant. See Electrical Section 4.8
Flash disk failure	Remove and reseat the flash disk
Computer/Pendant has failed	See Computer/Pendant diagnostics Section 4.3

3.3.9 Will Not Hold Calibration

The control will not hold calibration. Go to the "Configuration Values" screen and write down the calibration values for the motor encoders (Encoder) and the position feedback encoders (Scales). The calibration values are written in Hexadecimal. Recalibrate the system and see if the values change. Turn the system off and on and see if the values are held.

Do the following service codes and procedures:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service.
- **Code 313** Configuration Values
- **Code 123** Calibration Mode

Possible Cause	Check This
Configuration file corrupt	Load default configuration by going to code 313
Not saving Calibration values	Replace Computer/Pendant module. See Computer/Pendant

If calibration factors are being saved, but the measurements are not repeating or are not accurate:

- See Measurements Are Not Repeating
- See Measurements Are Not Accurate

3.3.10 Auxiliary Functions Not Working (Option on Machine)

The Auxiliary Functions will not turn on or off at the programmed times. There are 3 Auxiliary Functions:

1. Activates or deactivates a "110VAC Receptacle" typically used for a coolant pump or solenoid for mister.
2. Sends an electrical signal to rotate the turret on a "Haas Indexer".
3. Turns the "Spindle Off" at the end of a programmed event.

In order to run the above auxiliary functions in run mode the accessory key on the front of the pendant must be in the AUTO mode.

All of the auxiliary function signals are carried down to the cable breakout box through umbilical #2. Each function then has its own relay inside this box. If one of these relays fail then these features will not work.

Do the following service code and procedures:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service.

Possible Cause	Check This
Bad 110VAC "Coolant or solenoid" receptacle fuse	Check if the fuse light indicator next to the plug is lit. Verify that the fuses are good or bad by checking the resistance of the fuses using an Ohmmeter.
Poor cable connections	Check all the cable connections on the cable breakout box, Coolant Pump, and Air Solenoid (Located on the Air Regulator). In particular check umbilical # 2 cable, which carries the auxiliary function signals.
Faulty "Indexer" connector	Check for continuity between pins 3 and 4, when the output of the Haas Indexer connector is activated.
Bad cable breakout box	Check 110 V power coming out of the AC E-stop port with the E-stop in the out position. This will cause the spindle to not run.

3.3.11 E-Stop Error

The E-Stop turns the power off to the axis and spindle motors. This is done by stopping 110V power from reaching the cable breakout box through the use of a relay in the pendant.

Once power reaches the cable breakout box it distributes power to the axis motors, auxiliary functions and 110V power to the spindle contactor. If power does not reach the cable breakout box then none of these functions will work for non-spindle control machines.

Spindle Control Electrical Box
A 5-volt signal is sent to the spindle control board, which energizes a relay that enables the AC drive.

Non-Spindle Control Electrical Box
110V Power reaches the electrical box through the AC E-stop cable. It is used to energize the spindle motor contactor. If this contactor is not energized the spindle will not turn on.

If the E-Stop button is depressed, and no message is displayed on the screen, then either the E-Stop button or the Computer Module is at fault.

Possible Cause	Check This
Faulty E-Stop switch	Check the cable connections from the computer module to the E-Stop switch. Check the E-Stop switch for functionality.
Bad pendant	Does 110 V power come out of the cable breakout box power cord on the pendant? If yes, and the screen has an E-stop message, replace the pendant.

3.3.12   Limit Switch Error - Optional
Limit switches are installed on the table, saddle, and ram to prevent serious damage to the machine in the event of a crash. In the event a limit switch is triggered, a limit switch error will appear on the screen.

Critical Error 64: Servo Error
X-axis Limit Switch
Correct the fault condition and continue.

To return the machine to its normal state of operation, perform the following procedure:

1. Use mechanical handwheels on X and Y to move switch off of trigger. For the Z-axis, manually lift the arm on the trigger to return the limit switch to its normal position. Then jog the ram up or down as necessary.

2. Press the "Mode" or "Return" key to reset the control

3. Press the "DRO" key to enable the machine to once again jog.

Possible Cause	Check This
Limit switch jumpers in cable breakout box are making poor contact.	Remove and reseat jumpers.
Limit Switches are triggered	Reset the Limit Switches using the procedures described above.
Poor Limit Switch Cable connection	Check for any pins that are loose, pushed in, or bent. Verify that there is a good connection between the cables on the cable breakout box.
Limit Switch failure Try this Switch 2 limit switch cables on the cable breakout box.	Does the limit switch problem move to the other axis? If it does then the switch is most likely the problem. If it stays with the original axis then it could be the cable breakout box.

3.4   Problem with the Measurements

3.4.1 X, Y and Z-Axis Measurements Do Not Repeat

With a dial indicator mounted to the bottom of the spindle, touch off a fixed surface either in the X or Y-axis direction and then set the DRO equal to 0. Crank away several inches and then touch off again at the same place. If the reading has not returned to 0 on the DRO, zero the display and repeat the procedure. If the measurement does not repeat, you have a repeatability problem that must be resolved.

Test for accumulative error by moving the axis a number of times to see if the error gradually grows by a small amount. If so, it may be caused by a misaligned sensor or scale. If the error abruptly changes by a large amount it may be caused by a bad encoder.

Expected repeatability numbers should be 0.0005″ or less.

Do the following service codes and procedures:

* **Code 304** Toggle X sensor/glass scale on/off

* **Code 305** Toggle Y sensor/glass scale on/off

Possible Cause	Check This
Machine Tool & Setup problem	Check for any looseness in the setup (Tool, Tool holder, Part, Vise, or Fixture). Make sure there is sufficient contact between the tool holder and the spindle. See Machine Tool & Setup Section 4.1
X, Y, and Z-axis Gibs are loose	Check the adjustment of the X, Y, and Z-axis Gibs using the X, Y, and Z-axis Gib adjustment procedures.
TRAK Sensor or Glass Scale problem	Make sure that the Sensor or Glass Scale is installed correctly according to the Sensor or Glass Scale Installation procedures. Check for any loose brackets or misalignment etc. Also, check to make sure the Sensor or Glass Scale assemblies are functioning correctly. Use service codes 304 for X and 305 for Y to turn off the suspect encoder. Does problem still exist after turning it off?

Possible Cause	Check This
X and Y-axis Drive Trains are loose	Check Repeatability using the Repeatability and Positional Accuracy procedure. Step by step, carefully inspect the Drive Train for any looseness. It may be necessary to disassemble and then reassemble the Drive Train. See Mechanical Drive Train (X, Y) Section 4.2
Encoder Disk or Reader Head on motor are loose	Swap the motor in question with a known good motor. For example, swap the X-axis motor with the Y-axis motor. If the symptom stays with the motor in question, then replace the motor. If not, then the motor is not at fault and something else is causing the problem.
Spindle and/or Quill are loose	Use a Dial Indicator and check for side-to-side movement between the Spindle and the Head. Next, check for side-to-side movement between the Quill and the Head. There should be no more than 0.0003" of side-to-side movement. Make sure that there is a few thousandths gap between the Spindle Collar and the Quill after tightening.
Head bolts are loose	Tighten Ram bolts

3.4.2 X, Y, and Z-Axis Measurements are not Accurate

Measurements repeat, but with a dial indicator mounted to the bottom the spindle, traversing the length of a gage block or some other measurement standard, the measurement is not accurate.

Note: If your part has incorrect dimensions, see Parts Have Incorrect Dimensions, Section 3.1.4.

Note: First check for repeatability of the DRO: With a dial indicator mounted to the bottom of the spindle, touch off a fixed surface either in the X, Y, or Z-axis direction and set the DRO equal to 0. Crank away several inches and touch off again at the same place. If the reading has not returned to 0 on the DRO, zero the display and repeat the procedure. If the measurement does not repeat, you have a repeatability problem that must be resolved before the accuracy problem can be resolved. See Measurements That Do Not Repeat, Section 3.4.1.

Possible Cause	Do This
The Calibration is incorrect	Recalibrate the machine. See Calibration & Backlash Constants
Incorrect backlash values	If the machine does not repeat bi-directionally check the backlash on the axis in question. See Section 5.2.2.

3.4.3 The DRO is not Counting

The DRO for one axis is not counting when an axis is moved. Often times if this is the case the axis will fault. See Faulting Axis Section 4.7.1

Do the following Service Codes:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service.

- **Code 100** Axis open loop test. Used to check the maximum feedrate of an axis and if the encoders are counting.

- **Code 304 & 305** Turns off X and Y sensor or scale.

Possible Cause	Check This
Servo driver failure	See Servo driver Section 4.5
Motor Encoder not counting	See Motor diagnostics (not applicable with Glass Scale option)
Glass Scale or Sensor Failure	Does axis now count? If so, replace scale.
Computer/Pendant failure	See Computer/Pendant diagnostics

3.4.4 X, Y, and Z-Axis DRO Counting in Wrong Direction
The DRO is counting in the wrong direction.

The positive directions for each axis are:

- **X-axis** – Table moves to the left

- **Y-axis** – Saddle moves toward the front of the machine

- **Z-axis** – Ram moves up

Do the following service code and procedures:

- **Code 33** Software Identification. This is needed if you call SWI Customer Service.

- **Code 313** Check the line that specifies the product.

If the product does not match the machine then the machine ID key will need to be replaced.

3.4.5 X, Y, & Z-Axis Electric Handwheels Turn in Wrong Direction

The Electric Handwheels turn in the wrong direction.
The positive directions for each Electric Handwheel are:

- **X-axis** - Electric Handwheel turns clockwise

- **Y-axis** - Electric Handwheel turns counterclockwise

Do the following service code and procedures:

- **Code 308** Reverse X-axis Handwheel Direction

- **Code 309** Reverse Y-axis Handwheel Direction

3.5   Problems with the Machine Tool

3.5.1 Z-Axis Noisy
While jogging or cutting in the Z-axis direction, the axis makes unusual noises. See below for head noise.

Possible Cause	Check This
Machine Tool and Setup problem	Check for any looseness in the setup (Tool, Tool holder, Part, Vise, or Fixture). See Machine Tool & Setup Section 4.1

Ram Locks are locked	Make sure the Ram Locks are unlocked.
Inadequate or no Lubrication to the Ballscrew and Way surfaces	Make sure all the Way surfaces are getting proper lubrication. If not, check to make sure that the lube pump is functioning properly. Also check for any pinched or blocked oil lines. See Lubrication Section 4.1.3
Z-axis Gibs are not adjusted properly	Check the adjustment of the Z-axis Gibs using the Z-axis Gib adjustment procedure. See Z-axis Gib Adjustments Section 5.2.1
Mechanical Drive Train	Misalign ballscrew, or top and lower bearing failure.
Z-axis motor failure	Replace Z-axis motor See Motor Diagnostics Section 4.4

3.5.2 Spindle Stalls or Turns-Off During Machining

During machining, the spindle turns off and loses power. First check incoming voltage and connections.

Possible Cause	Check This
Machine Tool and Setup problem	Check the type of material being cut, type and size of cutting tool, RPM, and Feed rate. Also check the condition of the cutter to verify that the cutter is not dull. See Machine Tool & Setup Section 4.1
Drive Belt in the head is slipping	Check the alignment, condition, and tension of the Drive Belt.
Cut more than the machine is capable	Check width and depth of cut

3.5.2.1 Spindle Stalls or Turns-Off During Machining (for Machine with the Optional Spindle Control Drive)

During machining, the spindle turns off and loses power. First check incoming voltage and connections.

Possible Cause	Check This
Machine Tool and Setup problem	Check the type of material being cut, type and size of cutting tool, RPM, and Feed rate. Also check the condition of the cutter to verify that the cutter is not dull. See Machine Tool & Setup Section 4.1
Drive Belt in the head is slipping	Check the alignment, condition, and tension of the Drive Belt.
Cut more than the machine is capable	Check width and depth of cut
Spindle Drive Thermal Overload Relay has tripped	IOUT - Current Out (located on the Spindle Drive) cannot exceed 12.75A for DPMSX2 and 21A for DPMSX3/SX5 for more than a few minutes. When the Overload Relay is enabled, an "oL1" error occurs shutting off the Spindle Drive. The harder the Spindle Motor works trying to make heavy cuts, the more current the Spindle Motor utilizes. This can be caused by a cut so large that it exceeds the machine capability, or a problem with the spindle motor or AC drive.
Spindle Drive parameters are not correct	May need to re-download the Spindle Drive parameters. Contact Customer Service for assistance.
Spindle run command not reaching AC Drive	Verify spindle run LED is on Spindle Control Board.

3.5.3 Spindle Motor Hums or Will Not Run

The spindle motor makes a constant humming noise during operation or will not turn on. If the spindle does not run, you must make sure 110 V power is reaching the spindle motor contactors in the electrics box. Check your 110V power across terminals wire 3 and ground. If power is not reaching the electrical cabinet, but is reaching the cable breakout box, then most likely a relay has failed in the cable breakout box. The cable breakout box will need to be replaced. This relay is in series with the 110 V power in the E-stop circuit. See Section 3.3.11. If power has reached the electrical box then use the schematic in Section 4.8 for how the power is routed.

Possible Cause	Check This
Wrong voltage	Check the 220V/440V voltage to the machine
Poor wiring connections	Check all the wiring connections to the electric's box.
Defective cables or poor cable connections	Check all cable connections
Spindle Motor is faulty	Check the resistance of the spindle motor windings on the spindle motor between L1 (U) and L2 (V), L2 (V) and L3 (W), then L1 (U) and L3 (W) using a digital ohmmeter. If the ohmmeter reads more than one (1) ohm difference or "OL" (infinite) between any pair, replace the motor. The next check is for resistance to ground using a digital ohmmeter. Check L1 (U) to ground, L2 (V) to ground, and L3 (W) to ground. The meter reading in the display window should be "OL" (infinite) with reference to ground. Any other reading indicates a problem, and the motor should be replaced.
Spindle will not run because 110 V power is not reaching the spindle contactor	Check 110 V coming out of the AC e-stop port on the cable breakout box. Relay failure in cable breakout box. Replace cable breakout box.

3.5.3.1 Spindle Motor Hums or Will Not Run (for Machine with the Optional Spindle Control Drive)

The spindle motor makes a constant humming noise during operation or will not turn on.

Note: machines can only be wired for 220 volts. 440 volts will ruin electrical components in the machine. These components will not be covered under warranty.

Possible Cause	Check This
Wrong voltage	Check the voltage to the machine before and after the Spindle Drive with a Voltmeter. Also, check the voltage to the Spindle Drive (L1, L2, and L3).
Poor wiring connections	Check all the wiring connections to the Spindle Drive and Spindle Motor. See Electrical Connection
Improper wiring/jumper configuration on the Spindle Motor	Check to make sure that the Spindle Motor has the correct wiring/jumper configuration for 220VAC. See Electrical wiring section.
Spindle Drive may be in "Local Mode" and can not be run from the Pendant	On the Spindle Drive, push the "DSPL" button until "LO/RE" lights up. Use the "Up" and "Down" arrow

	keys to choose between "Lo"- <u>Local</u> (Run Spindle Motor from Spindle Drive) or "rE" - <u>Remote</u> (Run Spindle Motor from the Pendant).
Spindle Motor is faulty	Check the resistance of the spindle motor windings on the spindle motor between L1 (U) and L2 (V), L2 (V) and L3 (W), then L1 (U) and L3 (W) using a digital ohmmeter. If the ohmmeter reads more than one (1) ohm difference or "OL" (infinite) between any pair, replace the motor. The next check is for resistance to ground using a digital ohmmeter. Check L1 (U) to ground, L2 (V) to ground, and L3 (W) to ground. The meter reading in the display window should be "OL" (infinite) with reference to ground. Any other reading indicates a problem, and the motor should be replaced.
Spindle Drive contains incorrect parameters and is not programmed correctly	Contact customer service.
Spindle enable signal not reaching AC Drive	Verify LED on Spindle Control Board is on.
Forward/Reverse Switch is bad or Spindle Control Board	Verify Forward or Reverse LED on Spindle Control Board is lit.

3.5.4 Spindle Runs Backwards

The spindle motor runs in the opposite direction. The spindle will run in opposite directions from high to low gear.

Possible Cause	Check This
3-Phase wires backwards	Need to switch any 2 of the 3 wires either coming into the machine or motor. Note: For machine fitted with the optional Spindle Control, switch any 2 of the 3 wires either coming out of the AC Drive (T1, T2 & T3) or going into the Spindle Motor (U, V & W). Caution: Be sure to shut off all power to the machine before attempting to switch any wires.

3.5.5 Head Noise

Head noise pertains to any unusual noises coming from the head under load and no load situations. Most often head noise will only be noticeable under load situations. It is important to try to distinguish between problems with components in the head versus problems caused by the setup or tooling being used on a particular job. Use the table below to try to pinpoint the possible cause. Also try to pinpoint the noise by seeing if it exists in high, low or neutral. For example, if the noise is evident in neutral then this eliminates the spindle bearings.

Possible Cause	Check This
Machine setup or tooling problem	If the noise is most evident under load (cutting situations) then it is important to look at setup and tooling being used. Ask the following questions. Is the cutter dull? Is the tool loose in the holder? Am I taking a bigger cut then is possible on the machine? Is the part moving in the vice? Am I using realistic speeds and feeds?

	Any one of these can have a significant impact.
Upper spindle bearing is worn out.	Remove the upper bearing plate above the spindle. This will unload the bearing. If the noise goes away then this bearing should be replaced.
Verify nosepiece is tight on bottom of spindle.	To check if the nosepiece is bottomed out try to insert a piece of paper in between the nosepiece and the quill. If a piece of paper does fit then this may be the problem. Before tightening or loosening the nosepiece make sure to loosen the setscrew that holds it in place.
Spindle bearings are worn out	This is categorized by a high pitch sound and is most evident at high RPM's. It should also cause chatter under load. Replace the spindle if this is the case. See spindle replacement in Section 5.

3.5.5.1   Head Noise (for Machine with the Optional Spindle Control Drive)

Head noise pertains to any unusual noises coming from the head under load and no load situations. Most often head noise will only be noticeable under load situations. It is important to try to distinguish between problems with components in the head versus problems caused by the setup or tooling being used on a particular job. Use the table below to try to pinpoint the possible cause. Also try to isolate the noise by seeing if it exists in high, low or neutral speed range. For example, if the noise is evident in neutral then this eliminates the spindle bearings.

Possible Cause	Check This
Machine setup or tooling problem	If the noise is most evident under load (cutting situations) then it is important to look at setup and tooling being used. Ask the following questions. Is the cutter dull? Is the tool loose in the holder? Am I taking a bigger cut then is possible on the machine? Is the part moving in the vice? Am I using realistic speeds and feeds? Any one of these can have a significant impact.
Upper spindle bearing is worn out.	Remove the upper bearing plate above the spindle. This will unload the bearing. If the noise goes away then this bearing should be replaced.
Verify nosepiece is tight on bottom of spindle.	To check if the nosepiece is bottomed out try to insert a piece of paper in between the nosepiece and the quill. If a piece of paper does fit then this may be the problem. Before tightening or loosening the nosepiece make sure to loosen the setscrew that holds it in place.
Spindle bearings are worn out	This is categorized by a high pitch sound and is most evident at high RPM's. It should also cause chatter under load. Replace the spindle if this is the case. See spindle replacement in Section 5.
The belt is not lined up with the grooves on the pulleys.	Make sure the 10-ribs on the belt are lined up with the 10-grooves on the 2-pulleys. If the belt is frayed then replace the belt.

4.0   Diagnostics

This section explains the diagnostic procedures used to isolate service problems.

4.1 The Machine Tool & Set-Up

4.1.1 The Milling Machine Checklist

The following is a quick reference for the types of problems that may arise if problems are noticed in these areas.

Problems With:	Can Contribute To:	Most Suspect When (and why):
Spindle bearings See Spindle Replacement	Noisy head Parts incorrect Circles out of round	Older machines, machines that are pushed hard
Lubrication system	Premature wear of ball screws, wear surfaces Poor finish	New installations (may not be hooked up or line sheared)
Inadequate lubrication habits	Premature wear of ball screws, wear surfaces Poor finish	New installations (more motion than the machinist is used to with a manual mill) Lubricate machine every morning before use.
Gib locks - on X and Y axis	If locked can lead to axis faults.	*Note: when using the CNC to machine, never tighten the gib locks!*
X and Y gibs loose See Gib Adjustment - Section 5.2.1	Taper on straight Y moves Poor finish Circle out of round	When machine hasn't been serviced in a long while.
Gibs too tight	Not getting to position, does not repeat, axis faults Poor finish	N/A
Gibs floating	Not getting to position, does not repeat, axis faults Poor finish	Contact area of gibs. May need to be scraped. Very old machines may not have any more adjustments on gib. A new gib will need to be fit on the machine.
Gibs defective - bowed, scarred	Excess play when gib is checked side to side	Inadequate gib contact
Way surfaces pocked, scarred, or excessively worn	Poor finish Out of round circles Faulting	Inadequate lubrication
Ram gibs loose	Parts incorrect dimensions Head out of tram in Y direction.	Vibration or jerky motion in Z axis
Machine not level Weight not distributed evenly on all six screws See Leveling procedures	Parts incorrect Machine geometry off, i.e. tram.	New installation or heavy crash.
Head out of tram See Tramming Head - Section 5.2.3	Leaves uneven surfaces on bottom of pockets.	Machine not level, ram gibs loose.

4.1.2 A Special Word About X/Y/Z Gibs

The slideway surfaces are vital to the performance of the bed mill.

Gibs should be:

- flat

- free of twist

- free of burrs

- free of blockages in the oil passages and channels

Defective or scarred gibs must be replaced. Shimming of gibs will not yield acceptable results.

It is good machining practice to avoid the use of shop air to clean the chips off a machine. This risks blowing chips into the sliding way surfaces and compromising the performance of the machine.

Gibs that are not adjusted correctly will affect the performance of the machine. It will lead to positioning and repeatability problems. The gibs should be adjusted at least twice a year.

See Gib Adjustments Section 5.2.1.

4.1.3 Lubrication

Lubrication is one of the single, most important maintenance issues and plays a key role in assuring the performance and durability of the bed mill. At the beginning of each day manually supply oil to the way surfaces.

Lack of lubrication can lead to a variety of problems with your machine motion due to increased friction in the sliding ways. This increased friction may lead to part inaccuracies and decreased life expectancies of your ball screws and way surfaces.

4.1.4 Machining Set-Up

The machining set-up can greatly influence the performance of your mill. Be aware of the following:

Problems With	Can Contribute To:
Feed and Speeds (spindle rpm) See below	Poor finish Machine chatter Excessive speeds and feeds can break cutting tools or wear tools prematurely.
Tooling Using the wrong cutter for an application Entering the wrong size diameter and programming with tool compensation.	Poor finish Parts incorrect size
Cutting too deep	Part dimensions incorrect Driving and cutting forces cause deflections, since no material is totally rigid Machine chatter
No coolant	Poor finish, decrease the life of the cutter

4.1.4.1 Spindle Speeds

Spindle speeds are influenced by a number of variables:

- Material

- Rigidity of the Machine Setup

- Coolant

- Cutter type, material and diameter

- Cutting Depth

As a general rule:

- Lower spindle speeds are used to machine hard or tough material or where heavy cuts are taken.

- Higher spindle speeds are used to machine softer materials in order to achieve better surface finishes. Higher speeds also apply when using small diameter cutters for light cuts on frail work pieces and delicate setups.

Note: Cutter diameter greatly affects spindle speeds. The larger the diameter, the lower the spindle speed.

4.1.4.2 Feedrates

Factors that affect feedrates:

- Depth and width of cut

- Design or type of cutter

- Sharpness of the cutter

- Workpiece material

- Type of finish or accuracy required

- Climb or conventional milling

If a fine finish is required, reduce the feed rather than increase the spindle speed. Cutters are dulled by higher spindle speeds rather than high feedrates.

4.2 The Mechanical Drive Train (X, Y)

Indications:
- Troubleshooting instructions indicate that the drive train is potentially the problem and other (more easily checked variables) have been exhausted.

- Roughness, looseness, tightness or jamming movement in the table or saddle.

1. Check for machine considerations, especially gib locks and gib adjustments. See Gib Adjustments section

2. Check the torque of the axis in three places (both ends and center of ball screw) along the length of the ball screw. The torque should be within 2 or 3 in-lbs across the length of the ball screw. If it is not, chances are the ball screw is misaligned. A misaligned ball screw can lead to parts being out of round and servo problems at low feedrates. A bad ball screw can also cause high torque, although this is highly unlikely. See Sections 4.2.1 and 4.2.2 for more information.
   The following steps take you in logical sequence through the assemblies for the DPMSX2, DPMSX3 and DPMSX5. For drawings of these assemblies see Figures 29 through 37 in Section 5.

These instructions break the machine down from fully assembled and point out the areas to look at specifically.

3. Check that the belt is properly tightened. A loose belt can lead to excessive backlash compensation values on motor encoder only machines.

4. Check that the nut that tightens up against the ball screw pulley is tight. If this is loose the pulley may not run true on the ball screw.

5. Check that the tapered sleeve that seats the pulley has not clamped to the ball screw prematurely. It should be seated firmly against the pulley. Tightening the nut may not have ensured this. Also make sure the pulley is keyed to the ball screw.

6. DPMSX3 X-axis only - Ensure that the screws that hold the bearing housing in place to the bracket are not loose. This assembly should also contain an M6 flat washer and a ¼" serrated lockwasher. See Figure 38.

7. DPMSX5 X-axis, DPMSX3 and DPMSX5 Y axis bearing housings - Ensure that the bearing housing is clamped in place by the bracket. This design uses the bracket to secure the bearing housing in place. It should not allow the bearing housing to float between the bracket and machine.

8. Ensure that the Clamp Nut is secured. The following applies to the clamp nut:

   - When loosening, make sure to back out the 10-32 screw from the clamp nut.

   - When tightening, snug the 10-32 screw so the clamp goes onto the ball screw thread with some drag. Thread it onto the ball screw and torque the clamp nut to 50 ft/lbs and then tighten the screw down.

9. Take out the angular contact bearings and inspect them. They should roll smoothly and be lightly greased. If not, replace them. When putting the bearings back into the housing make sure to put them in correctly. Failure to do this will cause problems. The thin race of each bearing should be facing inward toward the spacer ring.

   Note: the bearing housing and spacer ring are matched sets - keep them together.

10. Check the ball screw mounting to the yoke. Make sure the SHCS are tight.

11. Inspect the ball screw, ball nut and yoke for the potential problems shown in the chart on the next page.

CAUTION!
Unlike a lead screw, do not unscrew the ball screw from its nut. This will destroy the ball screw!

Potential Problem:	Check By:
Bad ball screw	• Visually inspecting the ball nut - if the nylon seal is broken or deformed, if contamination has visibly entered the ball nut or if balls are out of the ball nut, replace the ball screw. • Cranking the ball screw through a significant part of its travel. If it jams, feel loose or has rough spots, replace the ball screw. • Using the dial indicator on a vertical flat of the ball screw to check for backlash between the ball screw and ball nut.
Potential Problem:	Check By:
Ball nut not tightened to	• Inspection for space between the head of the bolt and the ball nut i.e.

the yoke	the retaining bolt has bottomed out in its thread and is not securing the ball nut to the yoke properly.
Yoke loose in the saddle	• Inspection for any motion of the yoke or looseness in the Yoke mounting screws.
Oil lines sheared	• Visual inspection.
Oil line blockage	• Pump the oil and ensure that it flows evenly to the ways and ball screw.
Ball screws not aligned properly	• Measure from the ball screw to the back of the saddle on both sides of the yoke (the table must be removed). The measurements must be within ±.005″ end-to-end. See above explanations.

Note: Ball screws are inspected throughout their entire travel for backlash and consistent torque. A ball screw should be good for millions of inches of travel if installed properly. Do not be too quick to replace a ball screw if there is insufficient indication that it is bad; this will just be a costly delay to resolving the real problem.

4.2.1 DPMSX2 & DPMSX3 Ballscrew Alignment

- **X-axis** – there are 3 components that can cause misalignment: the yoke, the left side bearing housing bracket, and the right side bearing housing.

- **Yoke** – the yoke is aligned at the factory and pinned in place. It is aligned to within 0.0005″ with a precise alignment tool. The yoke most likely is not causing the problem. If this were the problem you would need to remove the pins and align the X ball screw with the back of the saddle. Drill new holes and pin the yoke in place. The Y-axis ball screw bore is machined perpendicular to the X bore. If the X-axis is aligned the Y-axis will also be aligned.

- **Left side table bearing housing** – this is most likely the cause of the misalignment. To align the bracket and bearing housing, move them as close to the yoke as possible. Loosen the bracket bolts and bearing housing bolts and then retighten. This should allow the bearing housing to align itself up with the yoke.

- **Right side table bearing housing** – once again move the bearing housing as close to the yoke as possible. Loosen the bearing housing and retighten. This should allow the bracket to align itself. If you do not move the table toward the yoke the ball screw will tend to bend down slightly and cause misalignment.

- **Y-axis** – the only component that can cause a misalignment problem is the motor mounting bracket. To align this bracket, move the saddle as far to the front of the machine as possible. Loosen the bracket and then retighten it. Once again moving the saddle forward allows the yoke to be as close to the bearing housing as possible.

4.2.2 DPMSX5 Ballscrew Alignment

- X-axis – there are 3 components that can cause misalignment: the yoke, the left side bearing housing bracket, and the right side bearing housing. This machine has 2 separate yokes for the X and Y-axis. The yoke is bolted to the table on the X-axis.

- X Axis Yoke – the yoke is aligned at the factory. If you suspect the yoke is misaligned, the bolts for the yoke can be accessed from an opening on the bottom left side of the saddle. Break these bolts free and move the table back and forth along its travel and then retighten the bolts.

- Left side table bearing housing – To align the bracket, move the yoke (table left) as close to the bracket as possible. Loosen the bracket bolts and then retighten. This should allow the bearing housing to align itself up with the yoke.

- Right side table bearing housing – once again move the yoke as close to the bearing housing as possible (table right). Loosen the bearing housing and retighten. This should allow the bracket to align itself. If you do not move the table toward the yoke the ball screw will tend to bend down slightly and cause misalignment. Make sure the mechanical handwheel is not causing the misalignment.

- Y-axis – the only component that can cause a misalignment problem is the motor mounting bracket. To align this bracket, move the saddle as far to the front of the machine as possible. Loosen the bracket and then retighten it. Once again moving the saddle forward allows the yoke to be as close to the bearing housing as possible. The yoke is pinned at SWI should not become misaligned unless the machine has been repeatedly crashed.

4.3   Computer/Pendant Diagnostics

The pendant consists of 2 separate modules: the computer module and LCD screen/enclosure.

In general, the pendant/computer module is best diagnosed by eliminating all other possible alternatives. The following table lists some problems and what these problems can lead to. Make sure to first unplug any accessories like the Remote Stop/Go switch, external keyboard, mouse, etc. to eliminate any interference.

Possible problems	Can lead to
Poor cable connections	There are 4 cable connections (6 spindle control) to the left side of the pendant. Make sure all cables are properly fastened.
Pendant locks up	Press the E-stop button and see if lock up clears if not then do the following: Turn the pendant off, wait at least 30 seconds, and turn it back on and check to see if the malfunction has been reset.
No voltage to RSG port	RSG will not work – should be 5 DC volts present Check with a voltmeter.
Low voltage to flash drive or slave board.	Can cause the system to lock up and the flash drive to act abnormally. Check voltage to power cable at flash drive module with voltmeter. It should be 4.8 DC volts and above. Lower values than this can cause problems.
Flash disk failure	If the flash disk fails, the system will not boot up or operate. It will need to be replaced. All programs and machine configurations will be lost. Make sure to back up your flash disk from time to time.
Floppy disk failure	Will not allow user to save or pull up programs from a floppy disk. Can the floppy drive format a disk? See Section 4.3.1.
LCD backlight burns out	Check all cable connections to LCD, distribution board and computer module. Make sure the power is turned off before doing so.

Possible Problems:	Can Lead to:
Faulty E-stop switch	It can be stuck open or closed (pressed). If it is stuck closed the pendant will need to be replaced because the user will have no way to get rid of the message. If it is open it will allow the machine to still operate but it will be unsafe for the user. The pendant will still need to be replaced.
Overlay failure (keys on pendant)	Certain buttons on overlay do not work. Do code 81 to verify each key beeps.
Low voltage to pendant or current spikes	1 amp fuse in pendant blows. Pendant will not turn on.

4.3.1 Checking Floppy Drive by Formatting a Disk

1. Find a new disk and install in floppy drive.
2. Install keyboard into middle port.
3. Press CTRL ESC to get to start menu.
4. Press R for run.
5. Type Format a: - press enter.
6. If the format works your disk drive is working. If format does not work, reboot control and see if it now works. If it does not work replace the computer module.
7. Press ALT ESC to get back to PT4 software.

4.4   Motor Diagnostics

The Motor subsystem is comprised of 2 parts: The Motor Encoder and the Motor. The motors are powered by 110 VAC voltage. The servo driver is also an integral part of servo system, which is discussed in detail in the next section.

WARNING!
Do not work with the motors unless the power is disconnected from the machine. The motors are run by 110 VAC.   There is possibility of death by electrocution!

Rarely do both the X and Y motor/servo systems fail at the same time and in the same way. So, if your problem is occurring on both axes, its source is probably somewhere else.

The motors on the X, Y and Z-axis are identical. The motors are heavy-duty motors.

4.4.1 Cable Connections
Check the motor cable connections on the cable breakout box. Verify there are no pushed in pins on the connector.

4.4.2 To Check the Motor Encoders
If the motor encoder inside the motor has failed or is not reading the machine will fault out on that axis.   Do the following to verify this problem:

Motor encoder only machines – run Service Codes 100 or 131. This will display on the DRO if the motor encoder is counting. If the axis does not count, the encoder is not counting. This means either the encoder or the cable is the problem. Visually check the cable for any problems. If the encoder has failed the motor must be replaced.

Motor encoder and secondary feedback machines – run Service Codes 100 or 131. Both the motor encoder and sensor or glass scale encoder should count on the DRO screen. The motor value should be displayed under the Z-axis and the sensor or glass scale under the X or Y-axis depending on which axis you are doing.

4.4.3 Encoder Counts to Pendant
Before replacing the motor due to a bad motor encoder it is a good idea to check the cables that take those signals back to the pendant. If these signals are not getting back to the pendant then the axis will fault. Check the following cable connections.

- Umbilical #1 and #2 at the cable breakout box

- Umbilical #1 and #2 at the pendant

- Umbilical #1 carries the X and Y-axis signals and Umbilical #2 carries the Z signals.

4.4.4 Moving Problem from One Axis to Another
Another way to troubleshoot a problem with a particular axis is to swap parts from 1 axis to another to see if the problem moves. If the problem moves then that component is faulty. See the example below.

Symptom – X Axis will not move and faults

This particular problem can happen because of any of following reasons: bad motor, servo driver, or computer module. In some cases it is not always obvious which component is causing the problem. This example will help us pinpoint the problem through a trial and error process.

Let's assume we have narrowed it down to the servo or electrical systems and the Y-axis has no problems. Lets also assume it is not an obvious problem like a loose connection. This particular example was done on a machine with motor encoders only.

Swap these components	Results
Physically switch the X and Y motors	Has problem moved to Y-axis? If yes, replace motor. If no, the motor is not the problem.

Note: motors are always replaced with the servo driver.

4.5 Servo Driver
Note: the Servo Driver is located in the black box on the side of each motor.

WARNING!
Do not work with the Servo Driver unless the power is disconnected from the machine. There is possibility of death by electrocution!

Indications:
- Problems moving just one axis, including hard turning in one direction.

Servo Types:
- X, Y and Z servos are identical

Objective:
- Isolate the problem to the particular Servo Driver

Steps:

1. Turn off and unplug the system.

2. Physically swap the servo module from the axis that is not working to one that is.

Note: To avoid pulling the wires out of the connector, use the loop to pull the connector from the Servo Driver.

If the problem moves to the other axis and clears up from the original axis, replace the Servo Driver.

4.6   Glass Scales

Glass scales are used on the X and Y-axis for secondary feedback. They are optional on the DPMSX machines. The Z glass scale comes standard with the machine.

4.6.1 Alignment of Scales

- **X Axis** - The X-axis scale must be aligned within 0.005″ in the up and down direction over the length of the scale for proper operation. Misalignment can cause the scale to not read in the certain areas of the scale that are not aligned with the reader head. If this happens, the axis will mostly likely fault out in this area. Also make sure the mounting hardware for the reader head is tight. Loose hardware can cause excess backlash when reversing direction.

  To align the scale, place a 0.001″ indicator on the bed ways and on top of the scale extrusion. Move the table along its full travel from one end to another to verify it is aligned. If the scale is misaligned loosen the 2 screws at either end to shift the scale up or down as needed. You will also need to loosen the center support bracket to allow the scale to pivot.

- **Y Axis** - The Y-axis must be aligned in the up and down direction and must be parallel to the Y-axis way surface. Both surfaces must be aligned to within 0.005″. Failure to align the scale properly could cause the same problems as mentioned above. Mount your 0.001″ indicator on the saddle and move the Y-axis back and forth along its travel.

- **Z Axis** – The Z scale must be aligned parallel with the quill. Make sure the gap on the readerhead is consistent along the length of travel. Align the scale within 0.005″ up and down.

See Figure 22 in Section 5 for an illustration of the Z glass scales.

4.6.2 Measurements Do Not Repeat

1. Determine if the error in repeatability is random or accumulating:

   - Mount a dial indicator in the quill.

   - Touch off a fixed point on the table and set the DRO to 0.

   - Traverse away approximately 6 inches.

   - Return the touch off again.

- Write down the reading on the DRO.

- Do not Re-zero the DRO, traverse away and return several times.

- Write down the DRO readings

Random error will be unpredictable and give scattered readings, adding and/or subtracting the error after each traverse with no pattern. See Step 2.

Accumulating error will add roughly the same amount to the reading after each traverse. See Step 3.

2. For random error, look for problems in the set-up of the glass scale that have resulted in a loss of rigidity. Common sources of random error include:

- Loose scale mounting hardware.

- Loose reader head.

- Very loose motion of the table or saddle.

3. Accumulating error is commonly the result of:

- Scale out of parallel to the axis travel.

- Dirt or chip on the glass scale.

- Broken glass.

4.7 TRAK Sensors

TRAK Sensors are used on the X and Y-axis for secondary feedback. They are optional on the DPMSX machines.   The following section talks about some of the common symptoms associated with a problem sensor and how to isolate or fix the problem.

Common symptoms

- Faulting Axis

- The DRO measurements do not repeat

- The DRO measurements are not accurate

Objectives:

- To determine if the TRAK Sensor is bad and needs to be replaced.

- To determine if there is a problem with the sensor set-up

4.7.1 Faulting Axis

If a sensor has stopped reading and you try to move an axis, the axis will run away and fault. Our control uses the counts from the sensor and motor when reading position. If either one of these signals is not working our system will fault.

1. The first thing that can be done to see if it is the sensor is to turn off the sensor on the axis in question. This will allow the system to run only on the motor encoders. If the fault continues then the sensor was not the problem. Turn the sensor back on. See the service code section for a codes needed to turn the sensors on and off.

2. The next thing to do is to visually inspect the sensor and base to determine if there has been a crash. A damaged base will usually have crinkles in the small, triangular plates on the front and back.

3. Next make sure the sensor is preloaded correctly against the running surface. There is a setscrew on the base that allows for adjustment.

4. If no outward signs of damage are present, remove the sensor from its base, and inspect the wheel for damage and wear.

   If the wheel is worn smooth in the center, replace the sensor.

Note: Sensors should not wear smooth for many years of normal operation.

5. If the sensor looks normal, it is probably OK and there is a mechanical obstruction somewhere in the set-up. Look for the following possible problems:

   - Broken sensor base

   - Broken bracket

   - Sensor tilted too much (so that the wheel is not engaging the running surface)

   - Sensor chip scraper has doubled back and is pushing the wheel away from the running surface

   - Sensor chip scraper is defective or has worn and is pushing the sensor unevenly

4.7.2 Measurements Do Not Repeat

1. Determine if the error in repeatability is random or accumulating:

   - Mount a dial indicator in the quill

   - Touch off a fixed point on the table and set the DRO to 0.

   - Traverse away approximately 6 inches

   - Return and touch off again

   - Write down the reading on the DRO.

   - Do not re-zero the DRO, traverse away and return several times

   - Write down the DRO readings

   Random error will be unpredictable and give scattered readings, adding and/or subtracting the error after each traverse with no pattern. See Step 2.

   Accumulating error will add roughly the same amount to the reading after each traverse. See Step 3.

2. For random error, look for problems in the set-up of the TRAK Sensor that have resulted in a loss of rigidity. Common sources of random error include:

   - broken base

   - broken bracket

   - loose puller screws

   - loose run bar

   - very loose motion of the table or saddle

   - loose clamp screw

3. Accumulating error is almost always the result of the wheel not traveling in a path parallel to the motion of the axis. This causes the wheel to skip at certain regular points in its travel.

- Inspect the base to determine if it has been damaged. A damaged base will usually have crinkles in the small, triangle-shaped plates on the front and back.
- Use a bubble level or an indicator to adjust the puller screws so that the base is parallel to the running surface.

- Inspect that the sensor is not cocked so that the case contacts the running surface.

- Inspect the wheel for chips that are adhered or for gouges.

4.8 Electrical

4.8.1 Checking A/C Voltage

This procedure tests for the 115V power for the control.
- Use a Voltmeter, reading A/C volts.
- Acceptable range is 100V to 130V.

Note: systems running consistently close to the low values may have problems when normal voltage fluctuations push the voltage out of the acceptable range.

Test the following in the order presented:

Problems Here:	May Indicate:
1. The wall outlet.	• Fuse blown in the shop electrical panel. • Incoming service from local utility is bad. Call the electric company.
2. The control power cord from the wall. Check the end that goes to the electrics box.	• Power cord defective.
3. Check the top fuse on the electrical cabinet. It should be an 8-amp fuse.	• If this is blown then power will not reach the 4 outlets on the electrical box.
3. Check the 110 power cord to the pendant.	• Power cord defective

4.8.2 Checking Fuses

There are 5 fuses to check in the system. There are 2 in the pendant and 2 in the electrical cabinet. The top fuse in the electrical cabinet is 8 amp and fuses power to the pendant. The bottom fuse is 5 amps and fuses power to the auxiliary 1, auxiliary 2 and lube pump outlets. The 2 fuses in the pendant are 1 amp and 8 amp. The 8 amp fuses the cable breakout box, and the 1 amp the pendant.

If you have the auxiliary function option then there is 1 more fuse to check on the cable breakout box for the coolant or mister option.

To check fuses:

1. Use a Volt/Ohmmeter; select "OHM".

2. Remove the fuse completely from the pendant, electrics box or cable breakout box.

3. Place a lead of the meter on each end of the fuse.
   - A good fuse reads 0 (zero) or close to it.
   - A bad fuse reads Open or Infinity.

4.8.3   Cable Breakout Box Connections

This module is located on the back side of the machine. It consists of 3 motor connections, 3 limit switch connections, 3 encoder connections and an E-stop connection.

Machines with an auxiliary function option have 2 more outlets. A 110 V outlet for a coolant pump or air solenoid and an indexer outlet.

The coolant pump signal and indexer signal comes down from umbilical #2.

4.8.4   Cable Connections

The DPMSX machines use 10+ cables to communicate between systems. It is often the case that what appears to be the failure of an electrical component is actually attributable to a poor connection.

Indications:

- Control problems, chronic or intermittent.

- Motor problems

- Measurement problems

Explanation:

1. Turn off and *unplug* the system from the wall.

WARNING!
Do not plug and unplug connectors with the system power on. This may cause damage to the connector board and harm to the technician.

2. Visually inspect the connections for excessive debris, moisture, or obvious damage.

3. Carefully clean any chips away from the connectors.

4. One-by-one, take out each connector and then plug them back in. Do the same at the computer/display.

5. Make sure to tighten up the screws on each of the connectors.
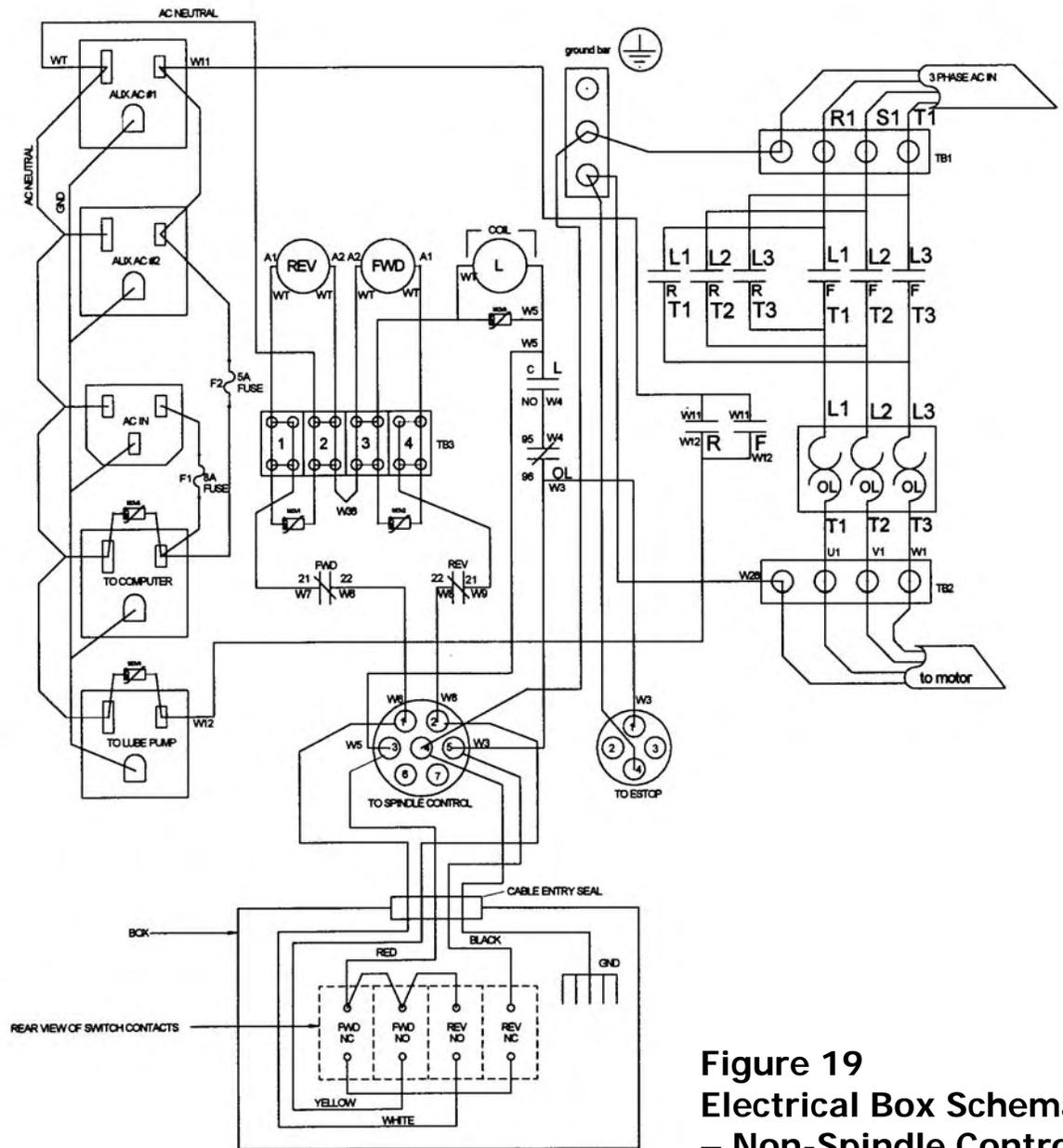
Figure 19
Electrical Box Schematic
– Non-Spindle Control
P/N: 20676

4.8.5 Spindle Control Electrical Box

The spindle control electrical box is made up of the following main components:

1. AC drive – used to control the spindle motor.

2. 4 output 110 volt outlets – 1 outlet is used to power the pendant, 1 is used to power the lube pump and is turned on based on the spindle being on, 2 additional outlets.

3. 2 braking resistors – used to brake the spindle motor. The mechanical brake should not be used to brake the spindle. To verify the resistors are good, measure the resistance across B1 and B2 of the AC drive. For 3 HP machines it should read 60 ohms and for 5 HP machines it should read 32 ohms. Values lower or higher than this could be one or both resistors are bad.

4. relay – used to turn on and off the lube pump and spindle motor fan.

5. Spindle control PCB board - controls the auxiliary signals from the pendant to the AC drive and electrical outlets. The following explains the LED lights on the spindle control board. There are (2) 10 LED segments on the board. Not all of the LEDs are used. See figure 21 for an illustration.

1st 10 LED Segment
4. LED labeled Gear 1 – this light should be on whenever the machine is in low gear. LEDs labeled Gear 2 thru Gear 4 are not used.
5. LED labeled SPD-FAULT – this light will be on whenever the AC drive is in a fault condition, which includes an E-stop message from the pendant.
6. LED labeled SPD-RUN – this light should be on whenever the spindle is on.
7. LED labeled SPD-ENABLE – this light should be on whenever you are in DRO, tool setup and RUN mode.

2nd 10 LED Segment
1. LED labeled E-STOP OUT – this light should be on whenever the E-stop is in the out position. When the E-stop is pressed, this light should go off.
2. LED labeled LATCH RELAY – this light should be on when the spindle is running or if the spindle is not running and the fwd/rev switch is in the off position when in DRO, tool setup or RUN mode. Note – if spindle won't turn on and the spindle is enabled and the e-stop is out, then either the fwd/rev switch is bad or the spindle control board is bad.
3. LED labeled TAP MODE – light should be on whenever you are not tapping. Light will be off when in the tap event. Not applicable to knee mills or retrofits.
4. LED labeled TAP REVERSE – this light will be on when the spindle changes direction at the bottom of a tap event and back off after the spindle changes direction once outside of the tap event. Not applicable to knee mills or retrofits.
5. LED labeled REV-RELAY – when fwd/rev switch is in reverse this light will be on. Note – this does not mean necessarily that the spindle will be running this direction.
6. LED labeled FWD-RELAY – when fwd/rev switch is in forward this light will be on. Note – this does not mean necessarily that the spindle will be running this direction.
7. LED labeled Z-LIMIT PLUS – this light will be on only when the Z axis plus limit switch is triggered. This only applies to a 3rd axis product.
8. LED labeled Z-LIMIT MINUS – this light will be on only when the Z axis minus limit switch is triggered. This only applies to a 3rd axis product.

Figure 20
Schematic Diagram of Spindle Control Option

TABLE 1		
		SPINDLE
ITEM 17	FUNCTION	PIN
PIN #		
1	SPD FWD	S1
2	SPD REV	S2
3	SPD E-STOP	S3
4	TAP MODE	S5
5	SPD RESET	S4
6	SPD GND	SC
7	A GND	FC
8	DAC OUT	FR
9	GND	MC
10	GND	PC
11	FAULT FDB	MA
12	RUN FDB EN	P1
13	-	-
14	-	-
15	A GND	FC

Figure 21
LEDs on Spindle Control Board

4.9 Service Codes

Service codes are broken down into the 4 following categories: software, machine setup, diagnostics and user options/defaults.

All Service Codes are accessed in the SET-UP Mode by pressing the soft key for "SERV CODES". The service codes can be found under one of the headings listed on the main screen. Press the heading you want to access the code in question. If you know code # you want press the CODE # softkey and it will take you directly to the code in question. Press CODE #, enter the number you want, press SET.

4.9.1 Software Codes

The following codes pertain to software functions in the control. To get to any of these codes go to Service Codes, press "A" and press the code you wish to view.

Note: If you are working with the SWI Customer Service Group, write the values down for Code 33 or Code 313. These values will be valuable for troubleshooting.

4.9.1.1   CODE 33: Software ID

The Code 33 is the software identification procedure. The two types of software in the control include:

- **Software Version** - the version of the system you have installed

- **Firmware Version** - the version of firmware software that is responsible for control to servo interface.

- **Converter Version** – the version of software that is responsible for converters and options.

- **Operating System Version** – shows the version of the XP operating system.

4.9.1.2   CODE 141: Load Configuration File from Floppy "A" drive

This code allows you to load your configuration file from the floppy disk to your hard drive. The configuration file consists of items such as calibration and backlash constants. This code is used when a computer module or hard drive has been replaced.

4.9.1.3   CODE 142: Save Configuration File to Floppy "A" drive

This code allows you to save your configuration file to a floppy disk. The configuration file consists of items such as calibration and backlash constants. This code is used when a computer module or hard drive needs to be replaced. This stores the configuration file from the hard drive to the floppy disk. It is a good idea to do this code after the machine is initially setup so these values can be saved and used in the future. If the computer or hard drive fails, then you will not have the ability to save the configuration file and the machine will need to be re-setup when the computer or hard drive is replaced.

Note: All machines will have a copy of the configuration file on the included parts program floppy disk.

4.9.1.4   CODE 313: Display Configuration File

This code displays the configuration file. This file contains pertinent information about the machine. The file will look similar to the following. If the file becomes corrupt you can load default values by pressing the F4 softkey.

Product = DPMSX3 (displays machine ID key of machine)
Motor encoder calibration constants   X=1143.9002   Y=1143.8982   Z=1143.7922
Secondary feedback calibration constants X=3302.6122   Y=3302.6045   Z=3302.7122

(These numbers above are typical numbers for the calibration constants, the numbers for secondary feedback are default numbers, which means no calibration has been done, or the machine does not have secondary feedback)

Arc accuracy – 0.001″

Secondary feedback – 0, 1, 2 or 3

       (0 = off, 1 = X on only, 2 = Y on only, 3 = XY both on)

Code 11 values X = 0.002   Y = 0.001″

Code 128   X=0.001″   Y=0.0014″   Z=0.0016″

Code 12 (+)   X=000005   Y=000006   Z=000006

      (-)   X=000005   Y=000005   Z=000006

Code 100 (+) X=210.5   Y=208.9   Z=200.1

      (-)   X=207.1   Y=208.4   Z=203.6

4.9.1.5 CODE 316: Update Master Software

Load upgrade disk in floppy drive and press this service code. New software will automatically download and control will reboot.

4.9.1.6 CODE 317: Update Slave Software

Load upgrade disk in floppy drive and press this service code. New software will automatically download.

4.9.1.7 CODE 318: Activate Converters or Options

See programming and operating manual. To turn software features on and off, see Service Code 334 in Section 4.9.4.6 of this service manual.

4.9.2 Machine Set-Up Codes

The following codes are used primarily when setting up a new machine. To get to any of these codes go to Service Codes, press "B" and press the code you wish to view.

4.9.2.1 CODE 11: Hysteresis

Note: This code is use only for systems with Sensors or Glass Scales on the table and saddle.

The Code 11 service routine checks the readings of the motor encoder against the sensor encoder. It is a measurement of how much motor motion is necessary to create table or saddle motion. This test helps us to look at two things:

- Play: How much backlash must be taken up when motion is reversed.

- Friction: How much the mechanical components must be "torqued up" in order to break the friction and create motion.

The Code 11 procedure is very useful and will help in diagnosing all types of motion and performance problems.

1. Position the table and saddle in the center of travel. *Note: You will lose your DRO position reference.*

2. Go into the Service Codes and input Code 11.

3. The system will run the checking routine automatically and then display the values in the position readout.

Explanation:

As an overall measure of the system hysteresis, we are looking for the X and Y values to be less than .004". A value greater than this indicates a problem with either excessive friction or play that may affect the finish or accuracy of machined parts.

4.9.2.2 CODE 12: Feed Forward Constant

The Code 12 procedure helps the control "learn" the friction characteristics of the machine by sending a graduated series of motor signals and observing the results. The process takes less than 30 seconds to run. It is both a diagnostic routine that displays values, and a routine that sets the parameters of the control for the particular machine.

The Code 12 is used for diagnosing and resolving:

- Problems with machine motion.

- Machined parts come out bad – especially poor finish.

Note: Code 12 routine will set the parameters for the particular machine and its particular situation. If the machine changes its friction characteristic, the Feed Forward Constant should change too, or the system will not servo properly. Whenever gibs are adjusted or a heavy workpiece has been added to the table, you should run a Code 12. When the heavy workpiece is removed, Code 12 should be run again.

1. Position the table and addle in the center of travel. *Note: You will lose your DRO position reference.*
2. Go into the Service Codes and input the Code 12.
3. Press Auto
4. The system will run the routine automatically and then display values on the position readout.

Explanation:

Typical values should be between 4.04 and 11.11 are considered normal for each axis. Higher values indicate excessive friction in the system. Lower values indicate a loose system and may mean a gib adjustment is necessary. Value 4.04 means the friction is a factor of 4 in one direction, and 4 in the other direction. The values should be within 3 or 4 of each other in both directions. A value of 6.08 would still be considered normal.

On S products, do not equate Code 12 values to torque on ballscrew. Measure friction in system with an in-lb torque wrench.

The feed forward gain can be adjusted manually by pressing the manual button. Choose the axis you would like to change and then enter values in the positive and negative direction to adjust. Adjusting the gain can help solve circularity problems. Default values can be set by pressing the Reset button. The manual feature should only be used in extreme cases where the AUTO routine did not solve the problem. Manual adjusts above 12 may lead to servo related problems.

4.9.2.3 CODE 100: Axis Open Loop Test

Code 100 procedure is used to diagnose problems with the configuration of the system, the encoders and incoming A/C voltage.

Note: You will lose the DRO reference position.

This procedure is to be run for each axis that is servo-driven, and for both the plus and minus direction for each axis.

1. Center the table and saddle and raise the head. Make sure the gib locks are released.

2. On the Pendant display, go into the Service Codes and input the Code 100.

3. The conversation line will say: "SELECT AXIS".   Input the axis. Either X, Y or Z.

4. In the conversation line it will say "WHICH DIRECTION? PLUS".

   - If you want to run in the plus direction, press INC SET.

   - If you want to run in the minus direction, press +/-, then INC SET

5. In the conversation line it will say "PRESS GO". Press Go after you are sure that the machine will not crash in the direction and axis that you have specified.

6. Afterward the screen will display values next to the DRO position axes. The table below assumes machine has secondary feedback. Machines with motor encoders only will display the reading next to the axis in question.

Your input	Display	Data displayed.
X +	X	table encoder reading
	Y	nothing (should be 0)
	Z	Motor encoder reading
	Feedrate	the maximum feedrate attained

Your input		
X -	X	table encoder reading
	Y	nothing (should be 0)
	Z	Motor encoder reading
	Feedrate	the maximum feedrate attained

Your input		
Y +	X	nothing (should be 0)
	Y	table encoder reading
	Z	Motor encoder reading
	Feedrate	the maximum feedrate attained
Your input	X	nothing (should be 0)
Y -	Y	table encoder reading
	Z	Motor encoder reading
	Feedrate	the maximum feedrate attained

Your input		
Z +	X	nothing (should be 0)
	Y	nothing (should be 0)
	Z	motor encoder reading
	Feedrate	the maximum feedrate attained
Your input	X	nothing (should be 0)

Z -	Y	nothing (should be 0)
	Z	motor encoder reading
	Feedrate	the maximum feedrate attained

Interpretation of the resulting values displayed:

The values for the encoder displays should be in the range of 3.0000″ to 5.0000″.

- If the motor encoder and sensor or glass scale reading is not within this value, then the one that is out of specification may be the problem. If one of the encoders is not reading then it will need to be replaced.

- The feedrate should be a minimum of 180 ipm.

- If the feedrate is less than 180 ipm and inconsistent in both directions, check the incoming AC voltage and mechanics of the drive train.

4.9.2.4 CODE 123: Calibration

See Section 5.22 for a further explanation of this code.

4.9.2.5 CODE 127 - Set X or Y Backlash Constant

See Section 5.22 for a further explanation of this code.

4.9.2.6 CODE 128: Input Backlash Constant

Code 128 allows you to enter the backlash values for each axis. It displays the value after it enters. This code is only used on machines with motor encoders only.

4.9.2.7 Code 304: Toggles X Sensor or Glass Scale On/Off

This service code toggles the X sensor or glass scale on or off. It is used to configure the machine and also is a useful tool for troubleshooting. Code 313 (configuration file) displays whether the sensors have been turned on or off. The line labeled secondary feedback explains which sensors or glass scales are turned on. This line can read any one of the following:

0 = sensors or glass scales turned off

1 = X sensor or glass scale turned on only

2 = Y sensor or glass scale turned on only

3 = both X and Y sensor or glass scale turned on

4.9.2.8 Code 305: Toggles Y Sensor or Glass Scale On/Off

This service code toggles the Y sensor or glass scale on or off. See Code 304 for further explanation.

4.9.2.9   Code 312: Toggles Limit Switch On/Off

4.9.2.10   Code 321: Reverse Y Position Sensor Direction

This service code reverses the direction of the encoder. It may be needed if sensors or glass scales are mounted on different sides of the machine.

4.9.2.11   Code 322: Reverse X Position Sensor Direction

This service code reverses the direction of the encoder. It may be needed if sensors or glass scales are mounted on different sides of the machine.

4.9.2.12 Code 325: Reverse Quill Sensor Direction
This service code reverses the direction of the encoder.

4.9.2.13 Code 337: Spindle calibration (for machines with programmable spindle)
This service code is used to calibrate a programmable spindle. You must also use a tachometer.

4.9.2.14 Code 338: Selects 1 or 2-input type limit switch

4.9.3 Diagnostic Codes
The following codes are used primarily when diagnosing a problem with the machine.
To get to any of these codes go to Service Codes, press "C" and press the code you wish to view.

4.9.3.1 Code 54: Program Continuous Run

This Code runs a program continuously without stopping for SET Z or CHECK Z commands. It is helpful in running a long period to identify an intermittent problem.
1. Prepare a program as you normally would.

2. Press **MODE**, **SET UP**, **"C"**, **Code 54**, **INC SET**. The program run will start automatically.

3. Press **STOP** to stop, and **GO** to continue.

4.9.3.2 Code 81: Keyboard Test

This code is used to check if the keyboard is functioning correctly. It allows you to test each key on the pendant individually. When you press the keys, the corresponding box for that key will highlight on the screen. The pendant will also beep, indicating that the key is working correctly. If one of the keys does not work the pendant assembly may need to be replaced. If none of the keys are working chances are that the computer module will need to be replaced.

4.9.3.3 Code 131: Manual DRO

A manual diagnostic routine to check the motor encoder and table encoders: Turn the X hand wheel to display the encoder readings. This code will display the actual DRO counts and the raw encoder counts before the calibration and backlash factors have been factors into the counts.

4.9.3.4 Code 314: Toggle Test Lights 'On' in Status Line

This code toggles on and off 2 test lights that appear in status line. The top light signifies if the master software is working. If functioning it should flash a green light. The bottom light signifies if the slave firmware is functioning. It will appear orange in run mode when it is processing information. Pressing the mode key will change this orange box to black. The orange box will also change to black when the program you are running reaches the 3rd event from the end of the program. If the firmware is locked up no keys will work. This code is useful for diagnosing intermittent problems with the control locking up.

Turn the X, Y, or Z-axis electronic hand wheel. The display should show movement as the hand wheel is being turned. There should be no skipping and it should count smoothly while the hand wheel is being turned. One revolution of hand wheel should read 0.2000".

4.9.3.5 Code 319: Error Log

This code when turned on captures the commands that were sent to the servo system. It includes items such as positioning commands, errors, stop and go commands, etc. It may be helpful for identifying problems between programmed commands and executed commands. To turn on the error log press the F6 softkey. The page forward and backward keys allow you to scroll through the file one page at a time. The data forward and data backward keys allow you to scroll through the file one line at a time. The data bottom key takes you to the bottom of the file and then changes to data top which will take you back to the top. The file will capture data until the file reaches a size of approximately 600 KB. At this time the file is saved to a backup file and the original file is cleared and data is once again captured. Once again as the file reaches a size of 600 KB it copies over the previous backup file. From here the user can save the file to the floppy drive by pressing the F8 softkey. Once this in done it prompts you for which file you want to save to disk. The F1 key saves the current file to disk and the F2 key saves the backup file to disk. To clear the files press the F7 softkey.

4.9.3.6 Code 324: Toggle Simulation Mode
Simulation Mode allows the control to run a program without actually moving the table. It is helpful in diagnosing Computer/display problems.

4.9.4 Operator Defaults/Options Codes

The following codes allow the user to set programming defaults or turn features on or off. To get to any of these codes go to Service Codes, press "D" and press the code you wish to view.

4.9.4.1 Code 66: Default Metric

This code causes the control to turn on in the metric mode.

4.9.4.2 Code 67: Default English

This code causes the control to turn on in the English mode.

4.9.4.3 Code 79: Beeper On

This turns on the beeper to the control keys.

4.9.4.4 Code 80: Beeper Off

This turns off the beeper to the control keys.

4.9.4.5 Code 129: Arc Accuracy

When the SMX control operates at high feedrates it may create small part machining errors as it goes around sharp corners. This exists on all CNC's and is commonly called a "following error." The control is factory preset to allow a maximum following error of 0.001 inch. The feedrate will automatically be adjusted around sharp corners so as to not violate this limit. This code only applies to arcs that are programmed and ones that are created in the tool path to generate the shape you want. This code will not make a difference on mill moves.

You may adjust the maximum following error to a value as small as .0001 inch. However, the smaller the value, the slower the feedrate around corners.

To input a new Following Error use the following procedure:

Follow the instructions on the screen and input the Following Error value (from .0001 to .0100) and press **INC SET**.

4.9.4.6   Code 334: Set Control Options

This code turns software features on and off.

4.9.4.7   Code 335: Toggles spindle on/off during pause events

4.9.4.8   Code 336: Enables spindle to stay on throughout all modes (2-axis mills ONLY)

5.0   Procedures for Replacements & Maintenance

5.1 Replacements

5.1.1 Servo Motor Replacement

WARNING!
Do not work with the Servo Motors unless the power is disconnected from the machine. The servomotors are run by 110 VAC.   There is possibility of death by electrocution!

---

1. Turn off power to the machine.

2. Each motor is mounted by the use of (4) ¼-20 screws. Be careful not to over-tighten these bolts and strip the threads.

5.1.2 Servo Driver Replacement

WARNING!
Do not work with the Servo Drivers unless the power is disconnected from the machine. The servo drivers are run by 110 VAC.   There is possibility of death by electrocution!

The Servo Driver for each axis is integrated into the servo motor casting.

DANGER!
Always engage (push in) the Emergency Stop switch, turn the ProtoTRAK SM Control off, and disconnect the servo motor/driver cable at the cable breakout box.

---

1. Press in the Emergency Stop.

2. Remove the servo motor/driver assembly from its mounting bracket (the Y axis assembly is located inside the front of the bed).

3. Remove the 10 cap screws that hold the servo driver and its heat sink plate to the motor casting.

4. Disconnect the cable connector. Do not pull on the wires.

5. Reinstall the new servo driver with its heat sink plate. Be certain the gasket properly seals the assembly.

6. Reinstall the motor/driver assembly. Make certain the belt is tight so that there is little play if pinched in the middle.
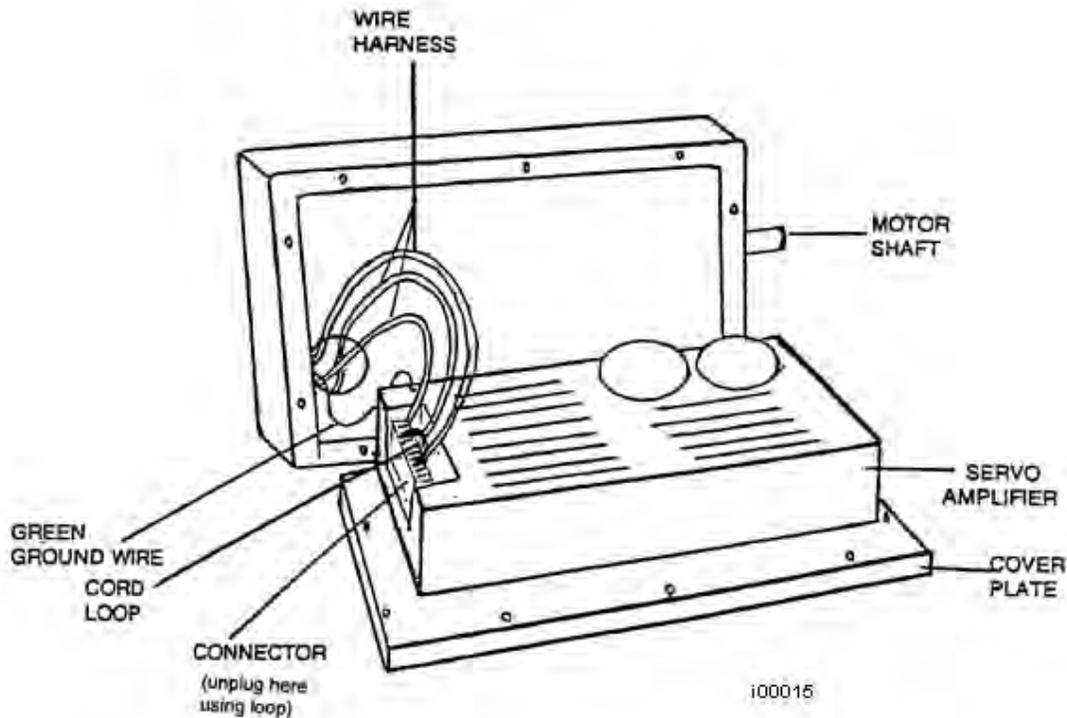
Figure 22
Servo Driver Replacement

Part #	Description
20327-2	X, Y or Z Servo Driver

5.1.3   Computer Module and LCD/Enclosure Replacement

1. Turn power off to the machine and control.

2. Unplug all the connectors on the pendant arm side of the pendant.

3. Remove the pendant from the pendant arm by removing the (4) ¼-20 x 3/4″ SCHS that secure it in place.

4. Place the pendant assembly on a clean and secured table with the display pointing away from you.

5. Remove the (6) 10-32 x 3/8″ Pan Phillips Head Screws and (4) 10-32 x 3/8″ FHCS securing the computer module to the LCD/enclosure.

6. Pull the computer module a few inches and stop. Pulling the computer module too far will damage the ribbon cables.

7. Now reach from the top and remove the 37-pin LCD cable, 37-pin distribution cable and the 9-pin E/Stop cables. The cables are to stay with the computer module.

8. Now slide the module about ½ way out of the LCD/enclosure.

9. Remove the ground wire from the LCD/enclosure side.

10. Lastly, slide the unit completely out of the LCD/enclosure.

11. Replace computer module or LCD/enclosure.

12. Follow the instructions in reverse order when reinstalling the new computer module or LCD/enclosure.

13. Make sure that all connectors are properly seated before fastening the unit back in place.
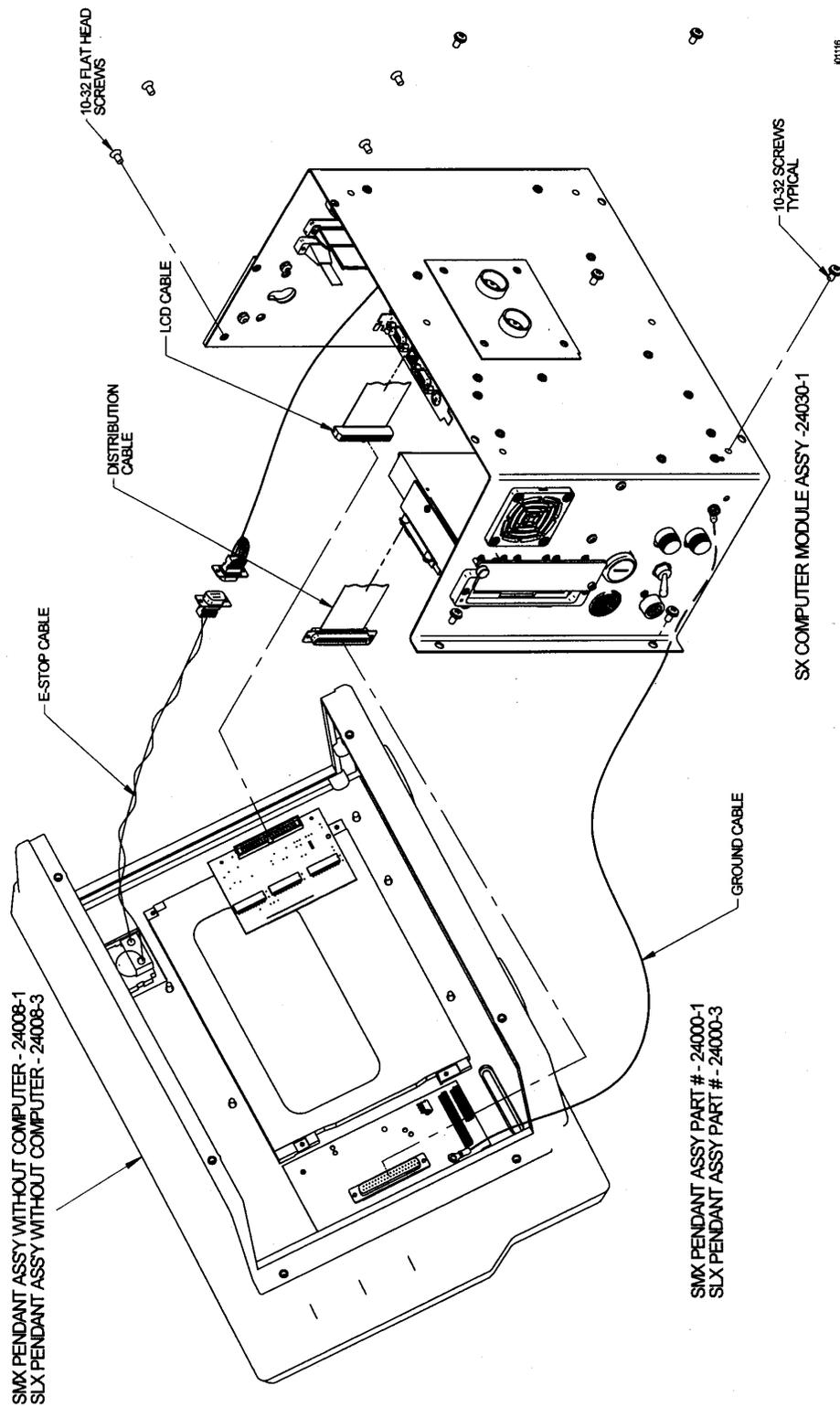
Figure 23
Computer Module & LCD/Enclosure Replacement

5.1.4   System Flash Disk Replacement

1. From the control, go to SETUP, SERV CODES, SECTION A, and then code 142 and save your Configuration file (calibration values, etc.) on a floppy disk. There is a disk in the electric's cabinet for this purpose. Label this disk as "Backup Configuration" and store it for later use.

2. Turn power off to the machine and control.

3. Unplug all the connectors on the pendant arm side of the pendant.

4. Remove the pendant from the pendant arm by removing the (4) ¼-20 x 3/4″ SCHS that secure it in place.

5. Place the pendant assembly on a clean and secured table with the display pointing away from you.

6. Remove the (6) 10-32 x 3/8″ Pan Phillips Head Screws and (4) 10-32 x 3/8″ FHCS securing the computer module to the LCD/enclosure.

7. Pull the computer module a few inches and stop. Pulling the computer module too far will damage the ribbon cables.

8. Remove the defective System Flash Disk (located on the back side of the mother board) by pushing the eject button on the flash drive.

9. Firmly insert the replacement System Flash Disk into the drive, making sure that the label with the serial number is pointing towards the motherboard.

10. Secure the computer module back to the LCD/enclosure by following the instructions in reverse order.

11. Make sure that all connectors are properly seated before fastening the unit back in place.

12. Turn power on to the machine and control.

13. When the system boots, you may get a message stating that the system cannot find your configuration file. Press NO if asked to load defaults.

14. Update the System Software by inserting the PT4 update disk into the floppy drive. Go to service codes 316 and 317 found in section A. Update the master and slave software.

15. Restore the Configuration file saved on your backup configuration disk with service code 141 found in section A of the service code section.
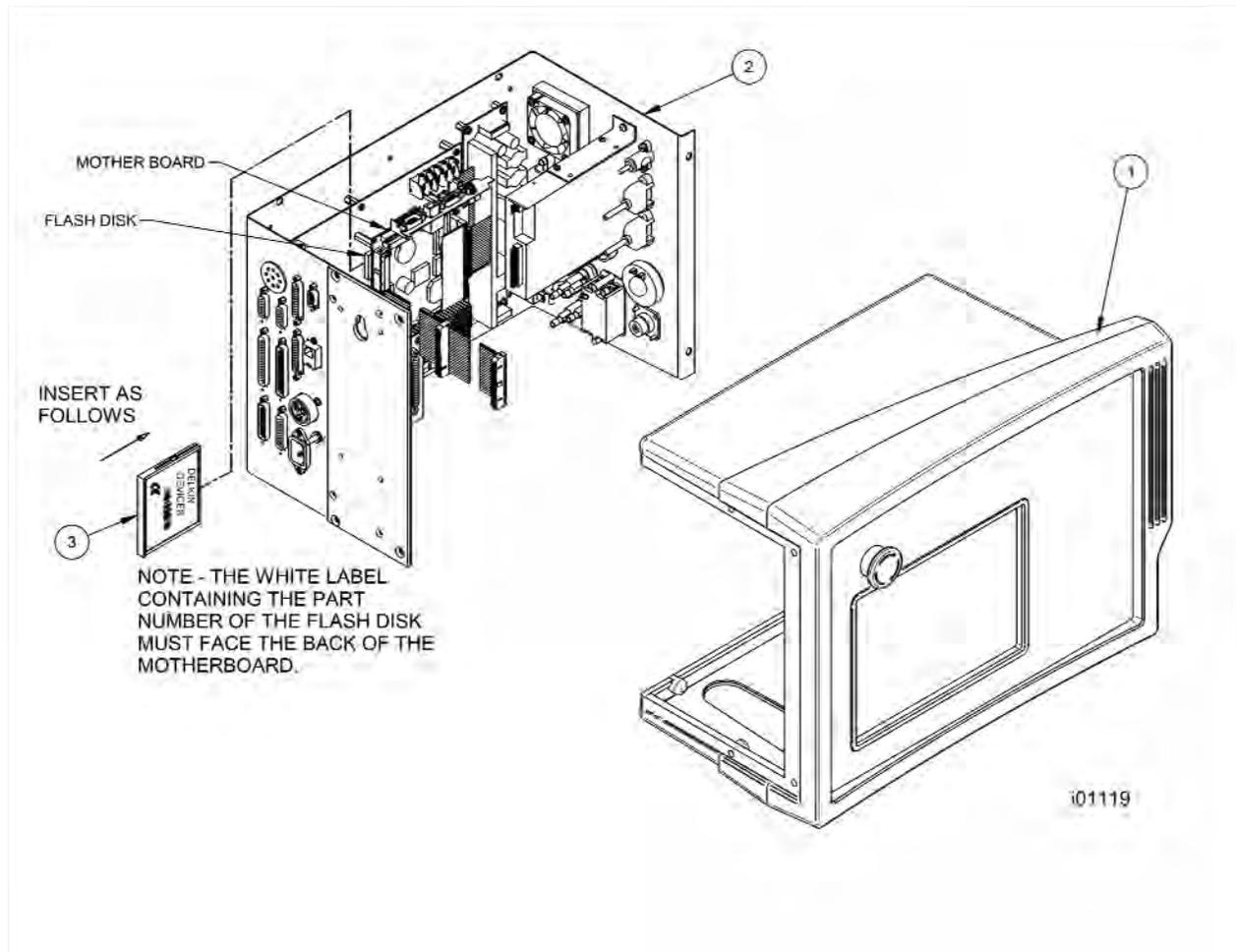
Figure 24
Flash Disk Replacement

Flash Disk Parts List

Item	P/N	Description
1	24008-1	PENDANT WITHOUT COMPUTER MODULE
2	24030-1	COMPUTER MODULE
3	25078	FLASH DISK (used on Revision D or later pendant)
4	25078-1	FLASH DISK (used on Revision C or earlier pendant)

5.1.5   Cable Routing on Machine

Whenever you replace a cable or reroute a cable it is very important to keep the power cables and logic cables separated from each other. The power cables consist of the (3) 110-volt motor cables and (2) 110-volt power cables for the pendant, and a coolant pump or solenoid power cable. The logic cables are used to carry encoder signals between the cable breakout box and computer module. Mixing of the power and logic cables may cause noise from the power cables to interrupt the signals in the logic cables. This can lead to intermittent axis faults or repeatability problems. See Figures 16 and 17 for a layout of the cable connections.

5.1.6   TRAK Sensor

5.1.6.1   Replacing the M5 Base

See Figures 25 and 26.

1. Remove the sensor by removing the clamp screw and then backing the load screw out a few turns. The sensor should lift off the base easily.

2. Remove the old M5 Base by removing the two 1/4-20 hex head screws that are threaded into the base.

3. Assemble the new base as per Figure 25.

4. Use a bubble level to align the raised bumps on the base with the table for X axis or saddle ways for Y-axis.

5. A dial indicator may be used to align the bumps on the base instead of a bubble level.
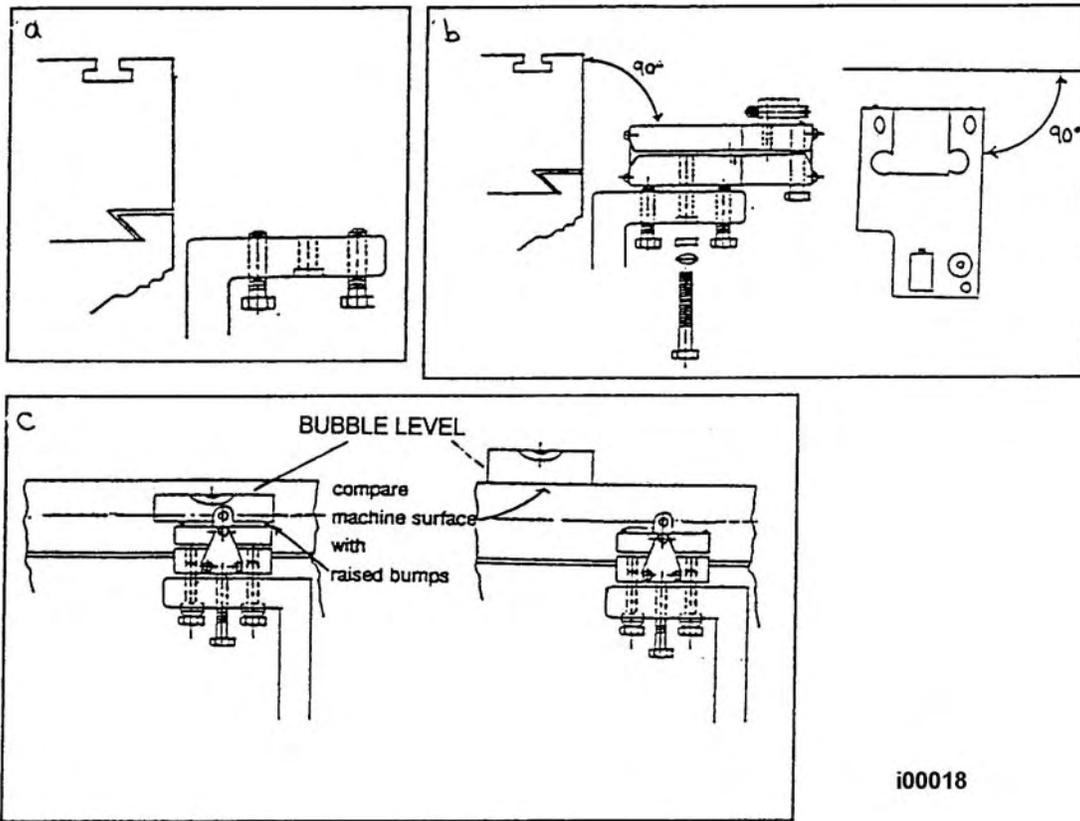
Figure 25
M5 Base Mounting

5.1.6.2   Replacing the TRAK Sensor

1. Remove the old sensor by removing the clamp screw and then backing the load screw out a few turns. The sensor should lift off the base easily.

2. Install the new sensor on the M5 base using the clamp screw.

3. Load the sensor against the running surface (table or run bar) using the load screw. The white lines on the side of the M5 base tell you when it is loaded correctly.

Note: You want to load the gage wheel against the running surface using the flat spring of the M5 base. Do not tighten the clamp screw fully until after loading the sensor.
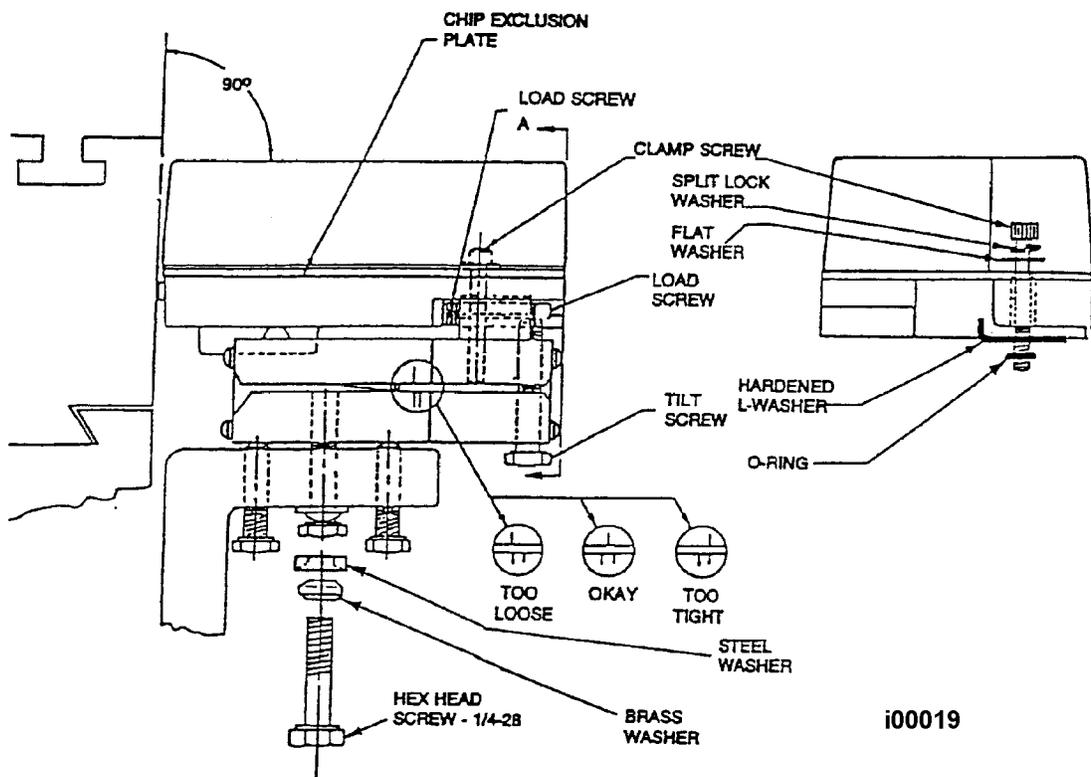
Figure 26
TRAK Sensor Mounting
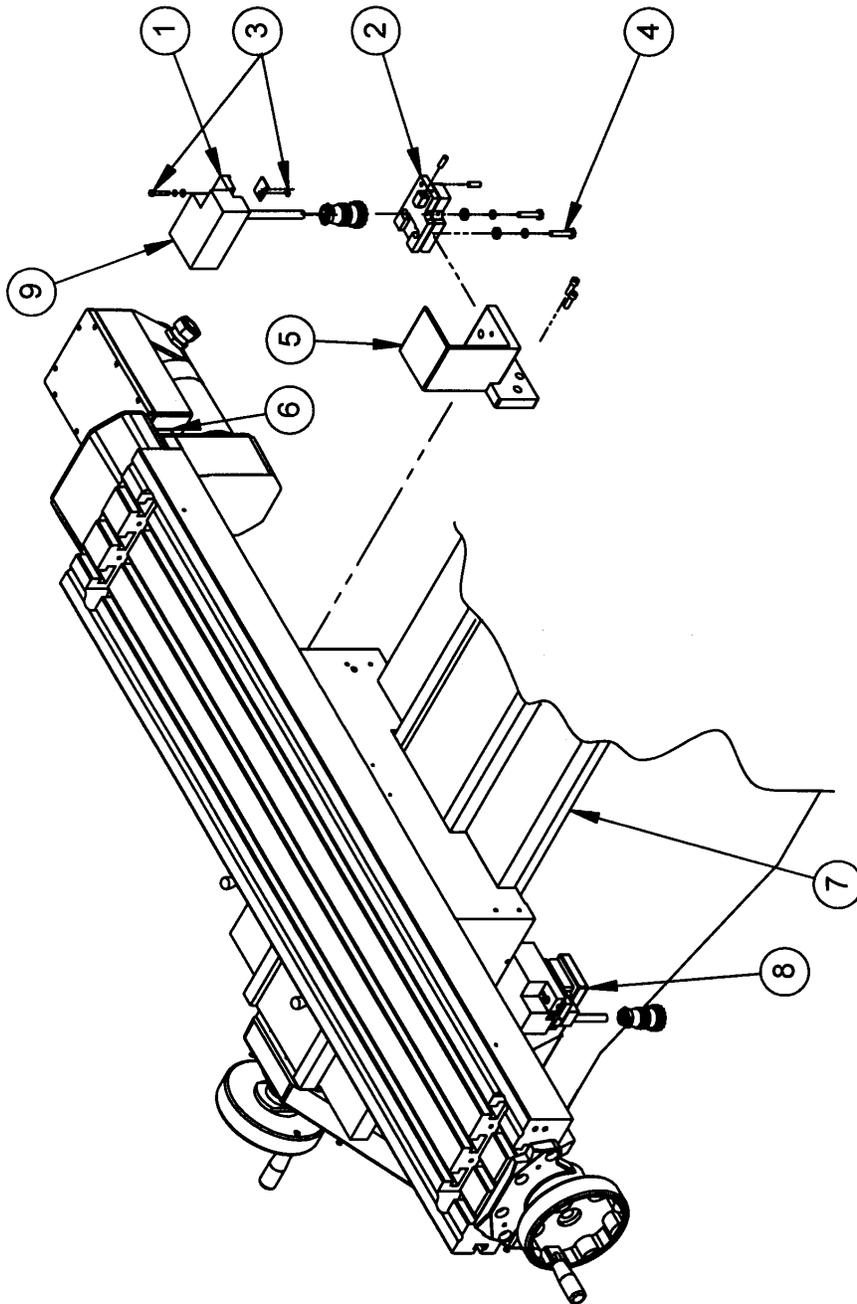
Figure 27
DPMSX2 Sensor Assembly

Parts List

Item	P/N	DESCRIPTION
1	M250C	SENSOR - ALL TRAK PRODUCTS
2	M5	M-5 BASE
3	LDCEL-C	LOADCELL - M250C
4	M5 HDWR	HARDWARE - M5 BASE
5	16023-1	BRACKET-SENSOR X-AXIS
6	21511	EXTENSION
7	24227	BAR-RUN Y-AXIS
8	13777-1	BRACKET-SENSOR Y-AXIS
9	13346-3PK	CHIP SCRAPER-M250C

I01160
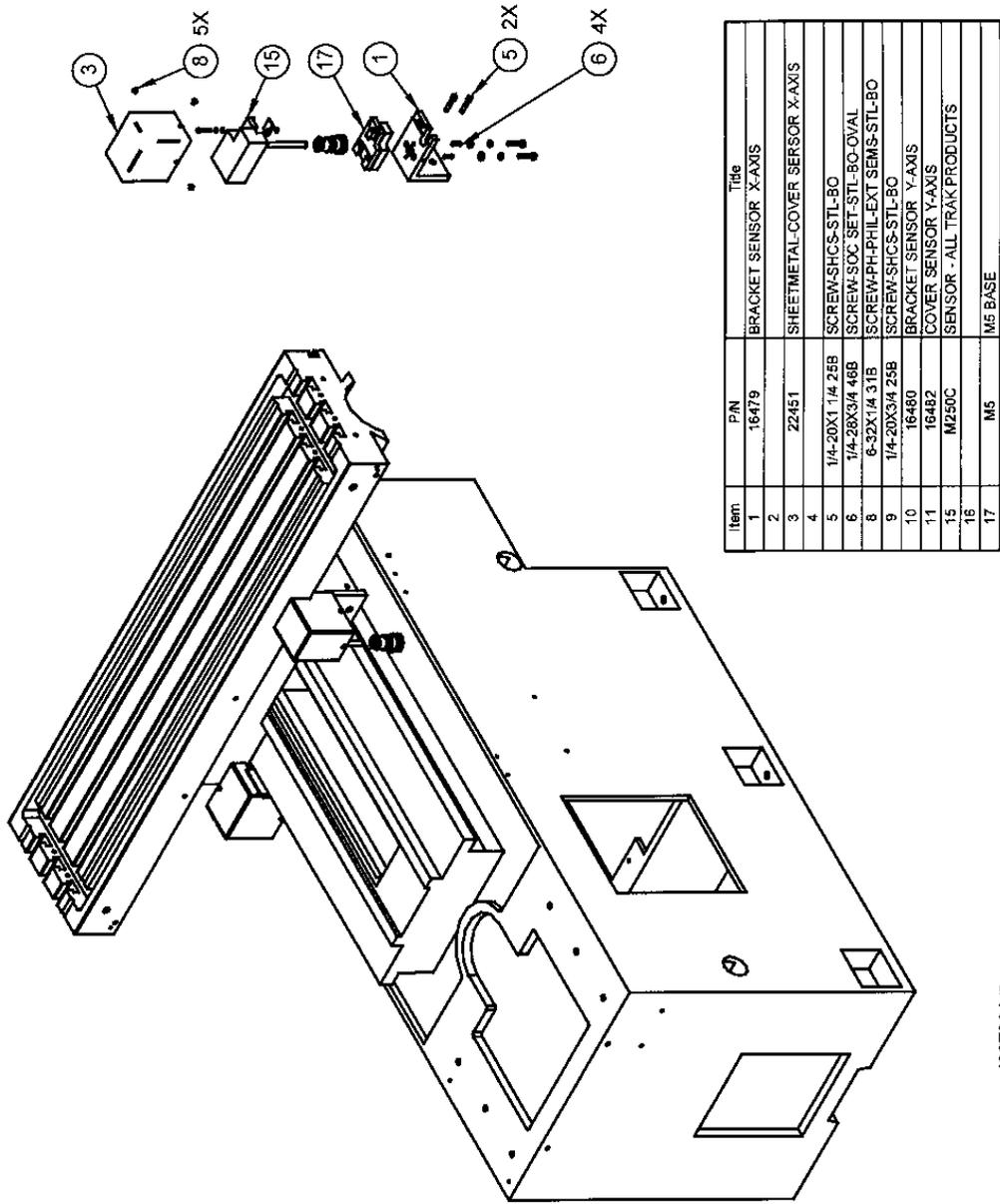
Figure 28
DPMSX3 Sensor Assembly

Item	P/N	Title
1	16479	BRACKET SENSOR X-AXIS
2		
3	22451	SHEETMETAL-COVER SERSOR X-AXIS
4		
5	1/4-20X1 1/4 25B	SCREW-SHCS-STL-BO
6	1/4-28X3/4 46B	SCREW-SOC SET-STL-BO-OVAL
8	6-32X1/4 31B	SCREW-PH-PHIL-EXT SEMS-STL-BO
9	1/4-20X3/4 25B	SCREW-SHCS-STL-BO
10	16480	BRACKET SENSOR Y-AXIS
11	16482	COVER SENSOR Y-AXIS
15	M250C	SENSOR - ALL TRAK PRODUCTS
16		
17	M5	M5 BASE
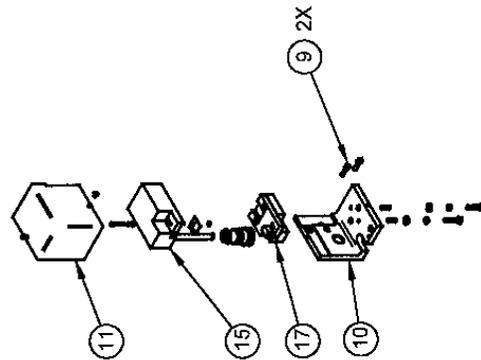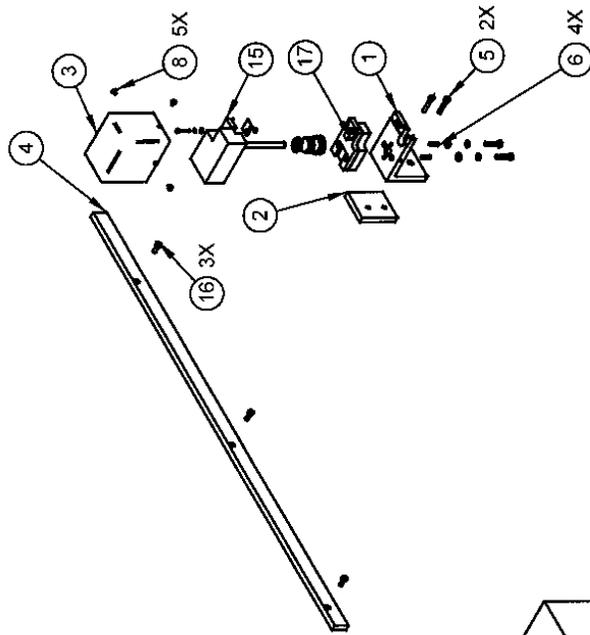
Item	P/N	Title
1	16479	BRACKET SENSOR X-AXIS
2	22410	PLATE-DPM5-SENSOR SPACER-X-AXIS
3	22451	SHEETMETAL-COVER SENSOR X-AXIS
4	22409	RUNBAR-DPM5-SENSOR
5	1/4-20X1 1/4 25B	SCREW-SHCS-STL-BO
6	1/4-28X3/4 46B	SCREW-SOC SET-STL-BO-OVAL
8	6-32X1/4 31B	SCREW-PH-PHIL-EXT SEMS-STL-BO
9	1/4-20X3/4 25B	SCREW-SHCS-STL-BO
10	16480	BRACKET SENSOR Y-AXIS
11	16482	COVER SENSOR Y-AXIS
15	M250C	SENSOR - ALL TRAK PRODUCTS
16	1/4-20X5/8 25B	SCREW-SHCS-STL-BO
17	M5	M5 BASE

i00786-V5
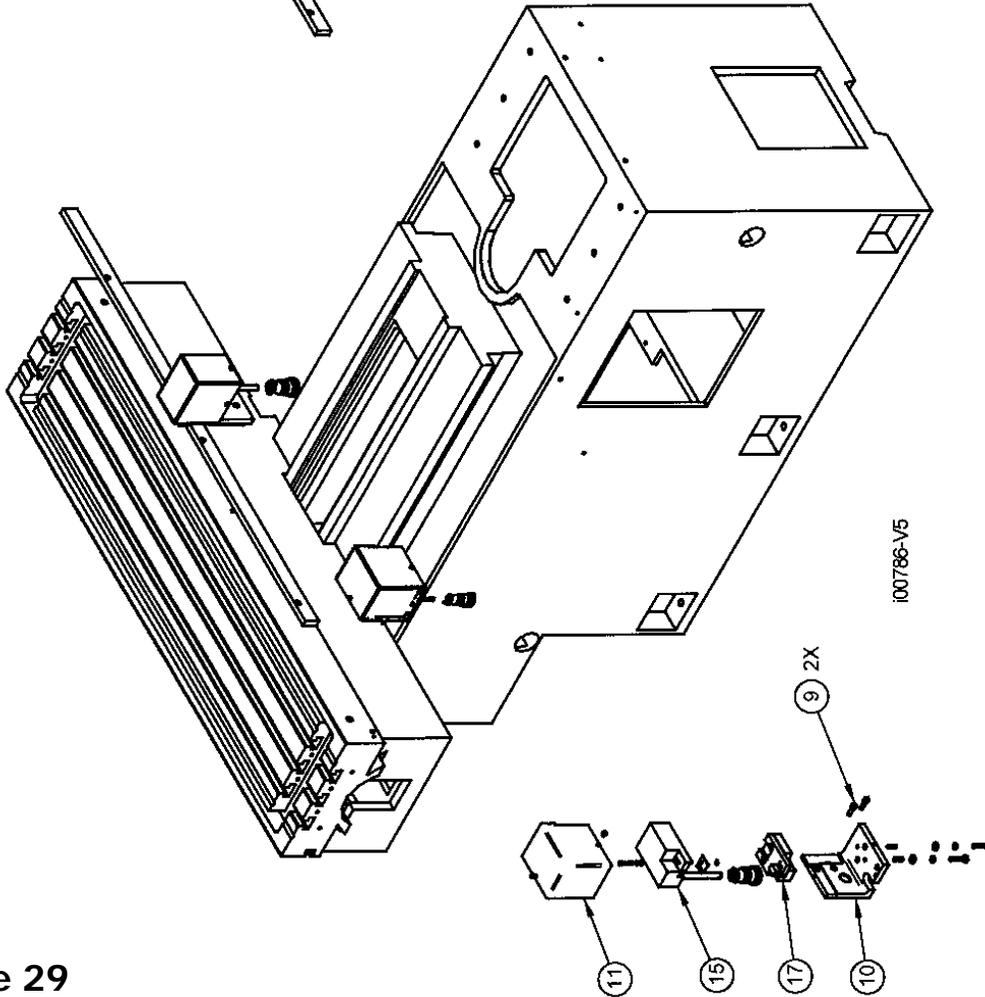
Figure 29
DPMS5 Sensor Assembly

5.1.7 Glass Scale Replacement

5.1.7.1 Remove the X, Y or Z Glass Scale

1. Unplug the glass scale connector from the cable breakout box.

2. Unbolt the reader head of the glass scale from its mounting surface.

3. Unbolt the glass scale enclosure from the table on X or the mounting spar on Y.

4. Install the head alignment bracket that came with the replacement scale to this scale to secure it for shipping back to SWI. Failure to do this may cause the glass scale to get damaged during shipment. The head alignment bracket secures the reader head so it cannot move and damage the glass in the scale.

Note: 1ˢᵗ align the reader head on the new scale before removing it to fasten the old scale.

CAUTION!
Once the head alignment bracket is installed, do not traverse the axis or the reader head will break.

5.1.7.2 Install the X or Y Replacement Scale

CAUTION!
If the scale is not long enough for the table, it will break when the machine is traversed past the scale travel.

1. Mount the scale to the back of the table or Y-axis mounting spar.

2. Align the sale so that it is within +/- 0.005" end to end.

Notes: For the Y-axis, the mounting spar should already be aligned. It must be parallel to the Y-axis travel within +/-.005" end to end both horizontally and vertically. The mounting spar can be aligned in and out by the use of the adjustment screw.

3. Line the reader head up with the mounting holes on the back of the saddle for the X-axis or the bracket on the Y-axis.

4. Install the reader head bolts but leave them loose.

5. Use the jackscrews on the reader head to compensate for some gap between the reader head and the reader head mounting bracket. Leave the alignment brackets attached to the reader head. This bracket assures the reader head is aligned to the glass scale.

6. Tighten each jackscrew until it touches the bracket and then back it off 0.001″ or 0.002″. Use a feeler gage to set the gap.

7. Tightening the reader head mounting screws. This ensures the reader head is aligned within a few thousandths.

8. Remove the shipping bracket that fixes the reader head to the scale for shipping.

WARNING!
After the reader head is attached to the reader head mounting bracket, do not move the machine axis until the shipping bracket is removed. This will break the reader head. This is not covered under warranty.

See Figure 31 and 32 for an illustration of how to align glass scales.

5.1.7.3   Install the Z-Axis Glass Scale (See Figure 30)

1. Check the tram of the head in the X direction. If it is within a few thousands then continue on. If not tram.
2. Assemble Z-axis glass scale mounting bracket and mount to head. Items 1, 2, 3 and 4. Tap items 3 and 4 together and tap item 3 into the quill stop knob. Leave the bolt loose. Use 2 screws (item 6) and mount item 4 to the side of item 2 using a spacer between both items to provide a gap of approximately 0.040″ between Items 2 and 4. This is to make sure item 2 does not rub against item 4.
3. Align the glass scale bracket (Item 2) with an indicator and tighten the mounting screws. Leave the quill stop knob screws loose. Remove the spacer and bolts from Item 4.
4. Unscrew the shipping protection screw from the scale.
5. Mount the glass scale to the mounting bracket and align it with an indicator. It needs to be aligned within 0.008" with respect to the quill. Tighten the screws down.
6. Fasten the readerhead to the readerhead bracket.
7. Move the readerhead up and down the glass scale and make sure the gap is consistent between the readerhead and the glass scale. Tighten the screw to the quill stop knob.
8. Remove the red head securing plate.
9. If the gap is not consistent between the readerhead and the glass scale when moving the quill up and down then adjust the angle of the scale to make the gap consistent.

WARNING
The gap must be no larger than 0.060″ between the readerhead and glass scale.

Part #	Description
22800-6	Z Glass Scale
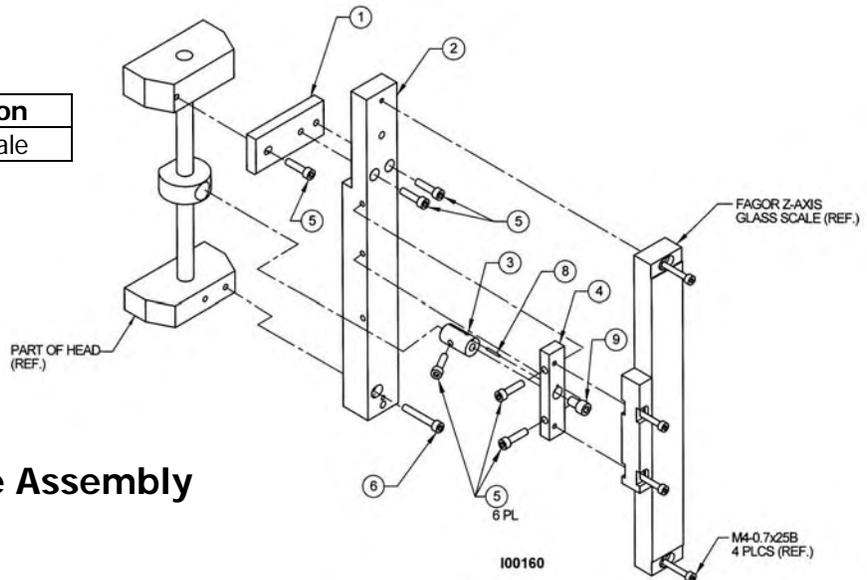
Figure 30
Z-Axis Glass Scale Assembly

Item	P/N	Description	Qty
1	20550	ARM- Z-AXIS MOUNTING PLATE	1
2	20551	MOUNTING PLATE-Z-AXIS GLASS SCALE	1
3	20548	ADAPTER-Z-AXIS GLASS SCALE	1
4	20549	ADAPTER PLATE- Z-AXIS GLASS SCALE	1
5	10-32X3/4 25B	SCREW-SHCS-STL-BO	4
6	10-32X1 1/4 25B	SCREW-SHCS-STL-BO	3
7	15759	WASHER-1/4 HARD BLK OX 1/8 THK	1
8	1/16X1/2 81B	SPRING PIN	1
9	1/4-28X3/8 25B	SCREW-SHCS-STL-BO	1
11	M4 70B	WASHER-FLAT USS-STL-BO	4
12	M4 75J	WASHER-EXT TOOTH-SS	4

Item	P/N	Title	Qty
1	20544	MOUNTING PLATE-Y-AXIS GLASS SCALE	1
2	20546-2	SPACER - Y-AXIS GLASS SCALE	1
3	20545	ADJUSTMENT SCREW - Y-AXIS GLASS SCALE	2
4	20537	MOUNTING BRACKET MACHINING	1
5	1/4-20X2 25B	SCREW-SHCS-STL-BO	2
6	1/4 73B	WASHER-SPLIT LOCK-STL-BO	2
7	1/4 79Z	WASHER-FENDER-0.25X1-STL-ZINC	2
8	1/4 71Z	WASHER-FLAT SAE-STL-BO	2
9	1/4 72Z	WASHER-SPHERICAL-STL-ZINC	2
10	1/4-20X1 25B	SCREW-SHCS-STL-BO	4
12			
13	8-32X3/8 27B	SCREW-BHCS-STL-BO	2
14	1/4-20X3/4 24B	SCREW-HEX HD-STL-BO	2
15	15759	WASHER-1/4 HARD BLK OX 1/8 THK	2
16	22800-16	GLASS SCALE-ENC 150 DIGITAL DIFF OUTPUT	1
17	22800-35	GLASS SCALE-ENC 150 DIGITAL DIFF OUTPUT	1
18	1/4-20X3/4 40B	SCREW SHSS-STL-BO	3

Figure 31
Glass Scale Alignment - DPMSX3

Part #	Description
22800-42	X Glass Scale

Item	P/N	Title	Qty
1	22879	MOUNTING PLATE-Y-AXIS GLASS SCALE	1
2	20546-2	SPACER - Y-AXIS GLASS SCALE	1
3	20545	ADJUSTMENT SCREW - Y-AXIS GLASS SCALE	2
4	22877	MOUNTING BRACKET MACHINING	1
5	1/4-20X2 25B	SCREW-SHCS-STL-BO	2
6	1/4 73B	WASHER-SPLIT LOCK-STL-BO	2
7	1/4 79Z	WASHER-FENDER-0.25X1-STL-ZINC	2
8	1/4 71Z	WASHER-FLAT SAE-STL-BO	2
9	1/4 72Z	WASHER-SPHERICAL-STL-ZINC	2
10	1/4-20X1 25B	SCREW-SHCS-STL-BO	4
11	22800-24	GLASS SCALE-ENC 150 DIGITAL DIFF OUTPUT	1
12	22800-42	GLASS SCALE-ENC 150 DIGITAL DIFF OUTPUT	1

Figure 32
Glass Scale Alignment – DPMSX5

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5.1.8 Power Drawbar

A power drawbar is an optional item on the DPMSX machine. It is bolted to the top of the head by the use of 3 SHCS. Some machines may require a washer to space the unit up to the proper height to allow the drawbar to engage properly.

Air Regulator and Oiler - This unit requires between 80 and 100 psi to operate properly. Some units work fine at 80 psi while others may need 90 or 100 psi. It is also important to make sure the oiler for this unit is kept filled with oil. Fill the reservoir about 2/3 full using AIR TOOL OIL ONLY. Failure to do this will not allow oil to lubricate the internal components of the unit and it may wear out prematurely. It is also important to make sure the oiler is set properly. To set the oiler, first close the adjustment screw (CW) on top of the oiler completely making sure to not over tighten. Then open the screw (CCW) between ½ to ¾ of a turn. Any more than this will cause too much oil to get into the unit and oil may come out of the exhaust port of the unit.

Tool Alignment Device - This unit also comes with a tool alignment device, which attaches to the bottom of the spindle. This device allows the tool to easily be aligned with the dogs when loading a tool.

CAUTION!

Some tools may not work with this device and the original spindle dogs will need to be used. The original spindle dogs are shipped with each machine in the toolbox. Some boring bar holders may not work with this device.
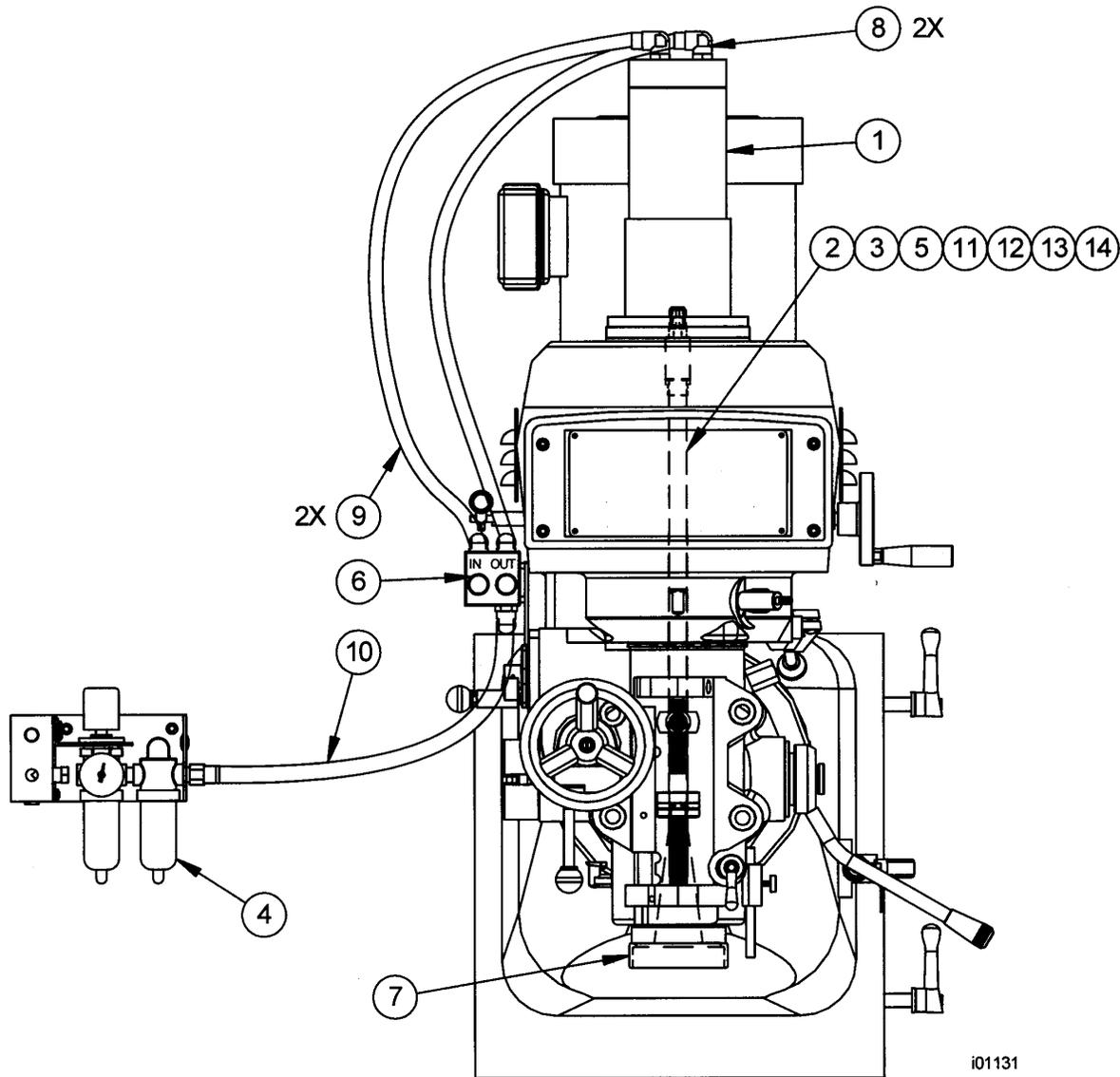
Figure 33
Power Drawbar Assembly

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Parts List

Item	P/N	DESCRIPTION
1	22581-1	AIR GUM ASSY ONLY- TORQUE RITE
2	22603-NST	DRAWBAR-DPMS3
3	20893	TOP WASHER
4	22380-2	AIR REGULATOR ASSY
5	22603-CAT	DRAWBAR-DPMS3
6	22581-2	SWITCH - CONTROL HEAD - TORQUE RITE
7	22581-4	NOSEPIECE FOR SPINDLE
8		1/4" NPT AIR FITTING 90°
9		3/8 O.D. TUBING 132" LG.
10		3/8 O.D. TUBING 27" LG.
11	22641-NMTB	DRAWBAR-DPMS5
12	22641-CAT	DRAWBAR-DPMS5
13	22605	DRAWBAR-DPMSX2
14	22604	SPACER-DRAWBAR-DPMSX2

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5.1.9 Ball Screw Replacement, X-Axis (Table) – DPMSX2

CAUTION!
Never screw a ball screw partially or totally out of its nut. They cannot be reassembled.

1. Position the table in the center of travel

2. Remove the X motor assembly.

3. Remove the motor mounting bracket and bearing housing.

4. Remove the right side bearing housing.

5. Loosen the table gibs. Slide the table to the right and on to a lift that will support the table's weight. Slide the table until the yoke is exposed.

CAUTION!
The weight of the table must be supported by the lift to prevent damage or breakage to the dovetails.

6. Remove the 5/16 x 1" screw holding the ball nut to the yoke and loosen the 4 screws that mount the yoke to the saddle. Remove the oil line.

7. Remove the Y-axis motor and bracket assembly. Tilt the yoke (it is pinned) to remove the X ball screw.

8. Remove the elbow and setscrew from the old ball screw flange and fit them similarly in the new ball screw.

9. Pump oil to be certain it flows through the oil line and then attach the oil line to the elbow.

10. Reassemble all assemblies.

   Important: The clamp nut must be reassembled as follows:

   - Install rear bearing and seal into bearing housing and slide housing onto the ball screw. *(Note: Letters on bearings must face each other in the housing.)*

   - Thread the split nut onto the ball screw and tighten the #10-32 clamp screw until you feel the split nut contact the ball screw threads. It should drag as you tighten the clamp nut.

   - Torque the split nut to 50 ft. lb.

   - Firmly tighten the #10-32 clamp screw to lock the clamp nut in place.

See the diagnostics section under Mechanical Drive Train for an explanation of how to align the ball screw.

See Figure 34 for an illustration of the X-axis drive train.

Electronic Handwheel Option

**Figure 34
DPMSX2 X-Axis Drive Assembly**

DPMSX2 X-Axis Drive Assembly Parts List

Item	P/N	Description	Qty
1	15621	DRIVE HOUSING	1
4	15624	FRONT COVER	1
5	15622	BACK COVER	1
6	15616	HANDWHEEL ASSY-MX	1
7	15614	TAB WASHER	1
8	15612	HOUSING - BEARING	1
9	15885	RING-BEARING HOUSING	1
10	15638	STOP - X-AXIS	1
11	15626	SEAL-BEARING HOUSING	1
12	16983-1	PULLEY-SOLID 44 TEETH W/O GUIDES	1
13	16452	NUT CLAMP-X, Y, & Z AXIS	1
14	16350	FERRULE-SPROCKET	1
15	98481A090	KEY WOODRUFF #404-1/8 X 1/2	1
16	14772	SPACER - .100" THICK	5
19	400-5M-15	BELT - TIMING 5MM POWERGRIP	1
20	23930	BEARING-ANGULAR CONTACT- 7204 BECBP	SET
22	14772-2	SPACER - .020" THICK	2
23	14772-5	SPACER - .050" THICK	2
41	8-32X3/8 25B	SCREW-SHCS-STL-BO	6
42	5/16-18X1 25B	SCREW-SHCS-STL-BO	1
45	M10-1.5X65 25B	SCREW-SHCS-STL-BO	4
46	1/4-20X1 24B	SCREW-HEX HD-STL-BO	7
47	8-32X3/8 20B	SCREW-RH-PHIL-STL-BO	3
48	10-32X3/4 25B	SCREW-SHCS-STL-BO	1
49	1/2-20 51Z	NUT-HEX JAM-STL-ZINC	2
52	15759	WASHER-1/4 HARD BLK OX 1/8 THK	7
54	M10 70P	WASHER-FLAT USS-STL-PLAIN	4
55	1/2 73B	WASHER-SPLIT LOCK-STL-BO	1
56	1/2 70P	WASHER-FLAT USS-STL-PLAIN	1
57	22008	BEARING- 204KTT	1

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DPMSX2 X-Axis Electronic Handwheel Option Parts List

Item	P/N	Description	Use As	Qty
57	22718	SPACER - 45 DEGREES X-AXIS	EA	1
58	21992	BUSHING-BALL SCREW	EA	1
59	14772	SPACER - .100” THICK	EA	1
60	M6-1.0X75 25B	SCREW – SHCS-STL-BO	EA	4
61	21946	ELECTRONIC HANDWHEEL	EA	1

5.1.10 Ball Screw Replacement, Y-Axis (Saddle) – DPMSX2

CAUTION!

Never screw a ball screw partially or totally out of its nut. They cannot be reassembled.

---

1. Position the saddle all the way forward.

2. Remove the hand wheel assembly and bracket.

3. Remove the sheet metal covers on the front of the machine bed and on the motor mounting bracket.

4. Remove the motor, then remove the motor mounting bracket.

5. Remove the rest of the parts on the ball screw journal. Note the orientation of the bearings for reassembly.

6. Remove the 5/16 x 1 inch screw that attaches the ball nut to the yoke.

7. Remove the ball screw and oil line attached to the elbow fitting on the ball nut.

8. Remove the elbow and setscrew from the old ball screw flange and fit them similarly in the new ball screw.

9. Pump oil to be certain it flows through the oil line, and then attach the oil line to the elbow.

10. Reassemble all assemblies.

    Important: The clamp nut must be reassembled as follows:

    - Install rear bearing and seal into bearing housing and slide housing onto the ball screw. *(Note: Letters on bearings must face each other in the housing.)*

    - Thread the split nut onto the ball screw and tighten the #10-32 clamp screw until you feel the split nut contact the ball screw threads. It should drag as you tighten the clamp nut.

    - Torque the split nut to 50 ft. lb.

    - Firmly tighten the #10-32 clamp screw to lock the clamp nut in place.

See the diagnostics section under Mechanical Drive Train for an explanation of how to align the ball screw.

See Figure 35 for an illustration of the Y-axis drive train.
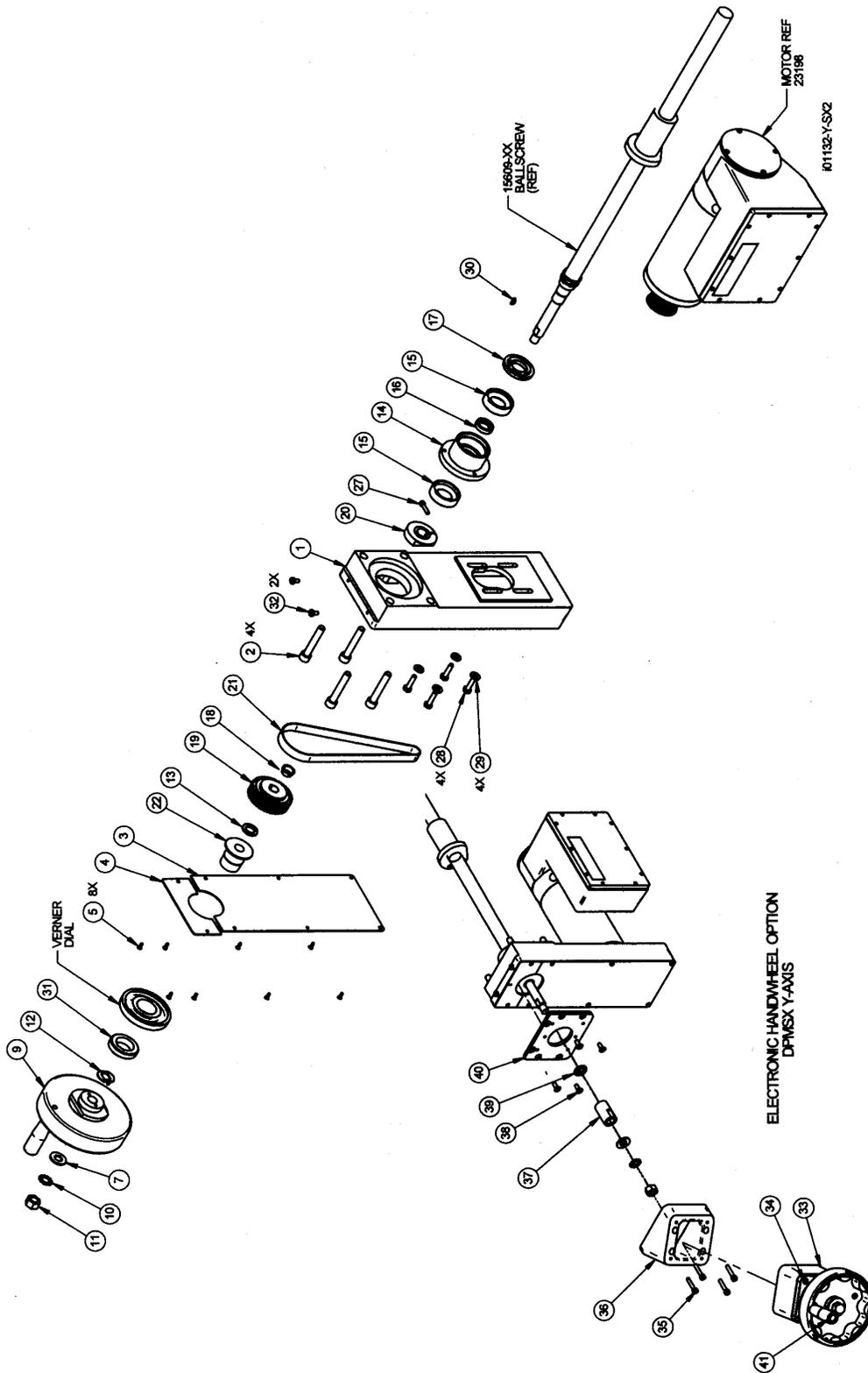
**Figure 35
DPMSX2 and DPMSX3 Y Drive Train**

DPMSX2 and DPMSX3 Y-Axis Drive Assembly Parts List

Item	P/N	DESCRIPTION	Qty
1	15966-3	BRACKET-Y AXIS MOTOR MOUNT	1
2	M10-1.5X60 25B	SCREW-SHCS-STL-BO	4
3	15968-2	LOWER COVER	1
4	15967-2	UPPER COVER	1
5	6-32X3/8 31Z	SCREW-PH-PHIL-EXT SEMS-STL-ZINC	8
7	1/2 70P	WASHER-FLAT USS-STL-PLAIN	1
8	30922	HANDLE FOLD-A-WAY	1
9	15616	HANDWHEEL ASSY-MX	1
10	1/2 75Z	WASHER-EXT TOOTH-STL-ZINC	1
11	1/2-20 51Z	NUT-HEX JAM-STL-ZINC	1
12	15614	TAB WASHER	1
13	14772	SPACER - .100" THICK	1
14	15980	BEARING HOUSING	1
15	20373	BEARING-ANGULAR CONTACT- 7204 BECBP	2
16	15885	RING-BEARING HOUSING	1
17	15626	SEAL-BEARING HOUSING	1
18	16350	FERRULE-SPROCKET	1
19	16983-1	PULLEY-SOLID 44 TEETH W/O GUIDES	1
20	16452	NUT CLAMP-X, Y, & Z AXIS	1
21	500-5M-15	TIMING BELT	1
22	15627-1	DIAL HOLDER	1
27	10-32X3/4 25B	SCREW-SHCS-STL-BO	1
28	1/4-20X1 24B	SCREW-HEX HD-STL-BO	4
29	15759	WASHER-1/4 HARD BLK OX 1/8 THK	4
30	98481A090	KEY WOODRUFF #404-1/8 X 1/2	1
31	15836	DIAL NUT	1
32	M5-0.8X10 10Z	SCREW-PH-PHIL-STL-ZINC	2
33	21946	ELECTRONIC HANDWHEEL-X & Y AXIS	1
34	M6-1.0X75 25B	SCREW-SHCS-STL-BO	4
35	M6-1.0X25 25B	SCREW-PH-PHIL-STL-ZINC	4
36	21985	SPACER - 30 DEGREE Y-AXIS DRIVE ASSY	1
37	21992-1	BUSHING-BALLSCREW	1
38	1/4-20X5/8 26B	SCREW-FHCS-STL-BO	4
39	14772-2	SPACER-.020" THICK	1
40	21984	WAY COVER FRONT Y-AXIS DRIVE	1
41	30922	HANDLE FOLD-A-WAY	1

I01132-Y-SX2

5.1.11   Z-Axis Ball Screw Removal & Replacement

CAUTION!
Never screw a ball screw partially or totally out of its nut. They cannot be reassembled.

1. Ensure that there is sufficient vertical clearance above the top of the machine to remove the ball screw. Minimum clearance required is 32 inches.

2. Remove vertical column top cover.

3. Remove servomotor, belt and Z motor mounting bracket.

4. Remove upper and lower Z-axis way covers.

5. Lower head to table. Place 1 or 2 inch wood board between spindle nose and table to protect.

6. Lower head until weight of head is supported by the table.

7. Tighten both ram locks on the right side of ram.

8. Remove locknut and lock washer from the top of the Z ball screw.

9. Remove pulley and woodruff key.

10. Loosen #10-32 socket screw on clamp nut.

11. Using wrench flats on clamp nut and wrench flats on ball screw remove clamp nut.

12. Remove the four cap screws from bearing housing flange.

13. Remove the clamp nut.

14. Remove bearing, nilos ring and bearing housing with matched spacer from ball screw.

15. Remove (6) M6 cap screws and lock washers from ball nut flange.

16. Extract ball screw assembly from machine until ball nut flange is above the top of the ram. Support ball screw and remove lubrication line from ball nut flange.

17. Raise the ball screw until the bottom end of the ball screw is above the ram. Angle the ball screw out and away from the head. Lower the ball screw on the right side of the machine until the top of the ball screw clears the support plate.

18. Reassemble all components in reverse order as shown above, except leave off the pulley, locknut and lock washer until ball screw is realigned. Torque clamp nut to 50 ft. lb.

19. With the ball screw assembly installed, loosen four 5/16-18 cap screws from bearing housing, raise head to the uppermost position, and re-tighten 5/16-18 cap screws. Note that there is .060 clearance between the bearing housing outside diameter and the inside diameter of the support plate to allow for realignment. Traverse the head to the extreme of the up and down travel manually to check for freedom of movement. Use torque wrench to make sure torque is consistent along length of screw. Use torque wrench to make sure torque is consistent along length of screw.

See Figure 36 for an illustration of the Z-axis drive train.

See Section 5.2.2 to properly measure and set the Z Backlash Compensation and calibration.

**Figure 36
DPMSX2
Z-Axis Drive Train**
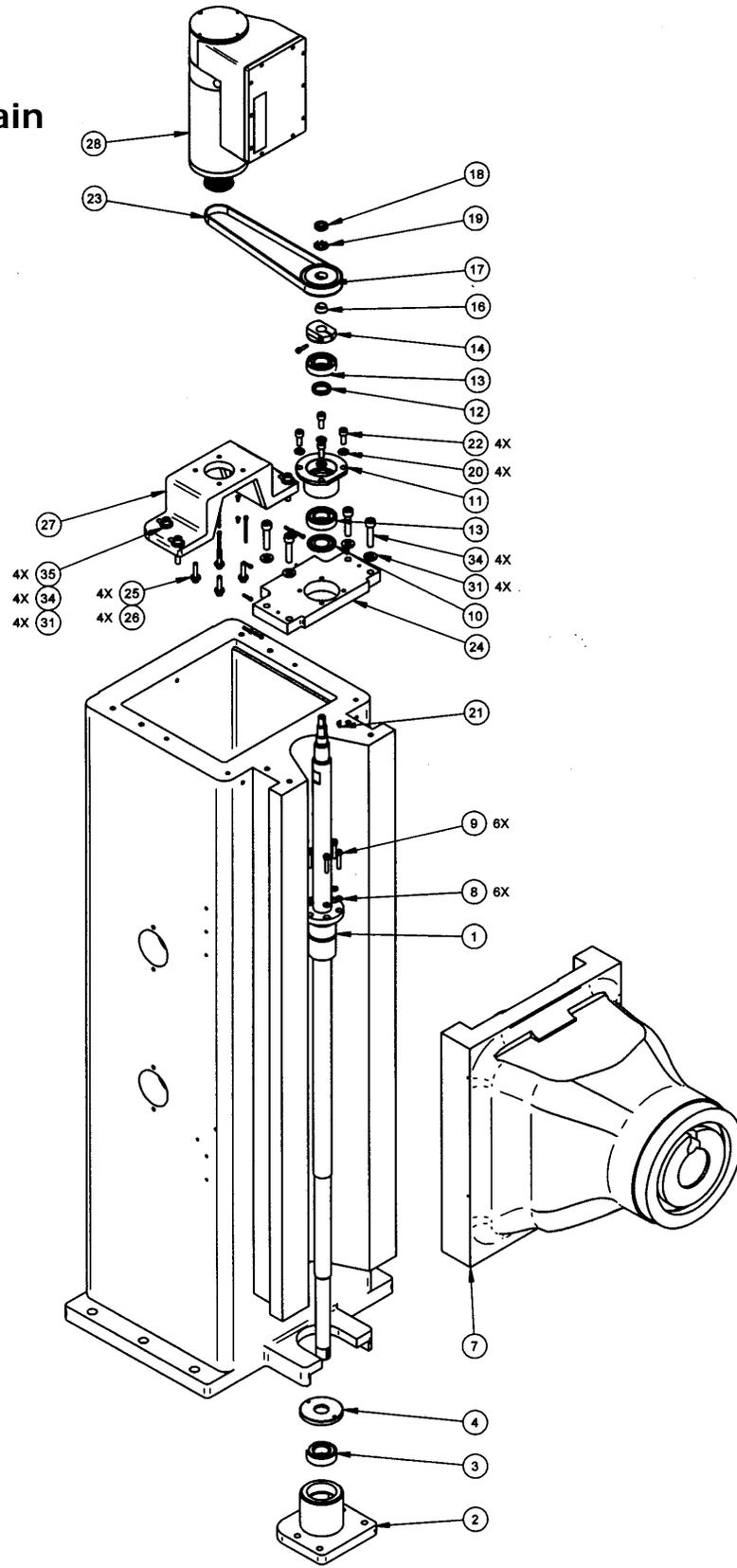
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Z-Axis Drive Train Parts List

Item	P/N	Title	UseAs	Qty
1	16806-M	BALLSCREW ASSY- Z-AXIS	EA	1
2	PJ540015	BRACKET LOWER ELEVATING BALL SCREW	EA	1
3	2205E-2RS1TN9	BEARING SELF ALIGNMENT SKF	EA	1
4	16774	COVER - BEARING	EA	1
5	16795	MODIFIED BEVEL GEAR BS1236-2A	EA	1
6	M10-1.5X10 40B	SCREW-SOC SET-STL-BO-CUP	EA	1
7	16770	MODIFICATION OF 3 HP RAM PING JENG PART	EA	1
8	M6 73B	WASHER-SPLIT LOCK-STL-BO	EA	6
9	M6-1.0X25 25B	SCREW-SHCS-STL-BO	EA	6
10	7205-AVH	NILOS RING-7205	EA	1
11	16295-1	HOUSING- BEARING Z-AXIS	EA	1
12	16302	RING-BEARING HOUSING	EA	1
13	20374	BEARING-ANGULAR CONTACT-7205 BECBP	EA	2
14	16773	NUT CLAMP-Z AXIS	EA	1
15	10-32X3/4 25B	SCREW-SHCS-STL-BO	EA	1
16	16350	FERRULE-SPROCKET	EA	1
17	16983	PULLEY-SOLID 44 TEETH Z-AXIS	EA	1
18	N01	LOCKNUT	EA	1
19	W01	LOCKWASHER	EA	1
20	M8 73B	WASHER-SPLIT LOCK-STL-BO	EA	4
21	98481A090	KEY WOODRUFF #404-1/8 X 1/2	EA	1
22	M8-1.25X20 25B	SCREW-SHCS-STL-BO	EA	4
23	710-5M-15	BELT - TIMING	EA	1
24	21944	PLATE BALLSCREW SUPPORT - Z AXIS	EA	1
25	1/4-20X1 1/4 25B	SCREW-SHCS-STL-BO	EA	4
26	15759	WASHER-1/4 HARD BLK OX 1/8 THK	EA	4
27	23197	BRACKET-Z AXIS MOTOR-DPMS	EA	1
28	23198	MOTOR DRIVER ASSY-PT4-DPM-SM-4050	EA	1
31	M10 73B	WASHER-SPLIT LOCK-STL-BO	EA	8
32	17030	LOUVRE- SPACER	EA	1
34	M10-1.5X45 25B	SCREW-SHCS-STL-BO	EA	8
35	M10 71B	WASHER-FLAT SAE-STL-BO	EA	4

i16790-XX

5.1.12 Ball Screw Replacement, X-Axis (Table) – DPMSX3

CAUTION!
Never screw a ball screw partially or totally out of its nut. They cannot be reassembled.

1. Position the table in the center of travel.

2. Remove the left side table tray by pulling it up, and remove the X motor.

3. Remove the motor mounting bracket and bearing housing.

4. Remove the right side bearing housing.

5. Loosen the table gibs. Slide the table to the right and on to a lift that will support the table's weight. Slide the table until the yoke is exposed.

CAUTION!
The weight of the table must be supported by the left to prevent damage or breakage to the dovetails.

6. Remove the (2) 5/16 x 1" screws holding the ball nut to the yoke and loosen the 4 screws that mount the yoke to the saddle. Remove the oil line.

7. Tilt the yoke (it is pinned) to remove the ball screw.

8. Remove the elbow and setscrew from the old ball screw flange and fit them similarly in the new ball screw.

9. Pump oil to be certain it flows through the oil line and then attach the oil line to the elbow.

10. Reassemble all assemblies.

   Important: The clamp nut must be reassembled as follows:

   - Install rear bearing and seal into bearing housing and slide housing onto the ball screw. *(Note: Letters on bearings must face each other in the housing.)*

   - Thread the split nut onto the ball screw and tighten the #10-32 clamp screw until you feel the split nut contact the ball screw threads. It should drag as you tighten the clamp nut.

   - Torque the split nut to 50 ft. lb.

   - Firmly tighten the #10-32 clamp screw to lock the clamp nut in place.

See the diagnostics section under Mechanical Drive Train for an explanation of how to align the ball screw.

See Figure 37 for an illustration of the X-axis drive train.

ELECTRONIC HANDWHEEL OPTION
DPMSX3 X-AXIS
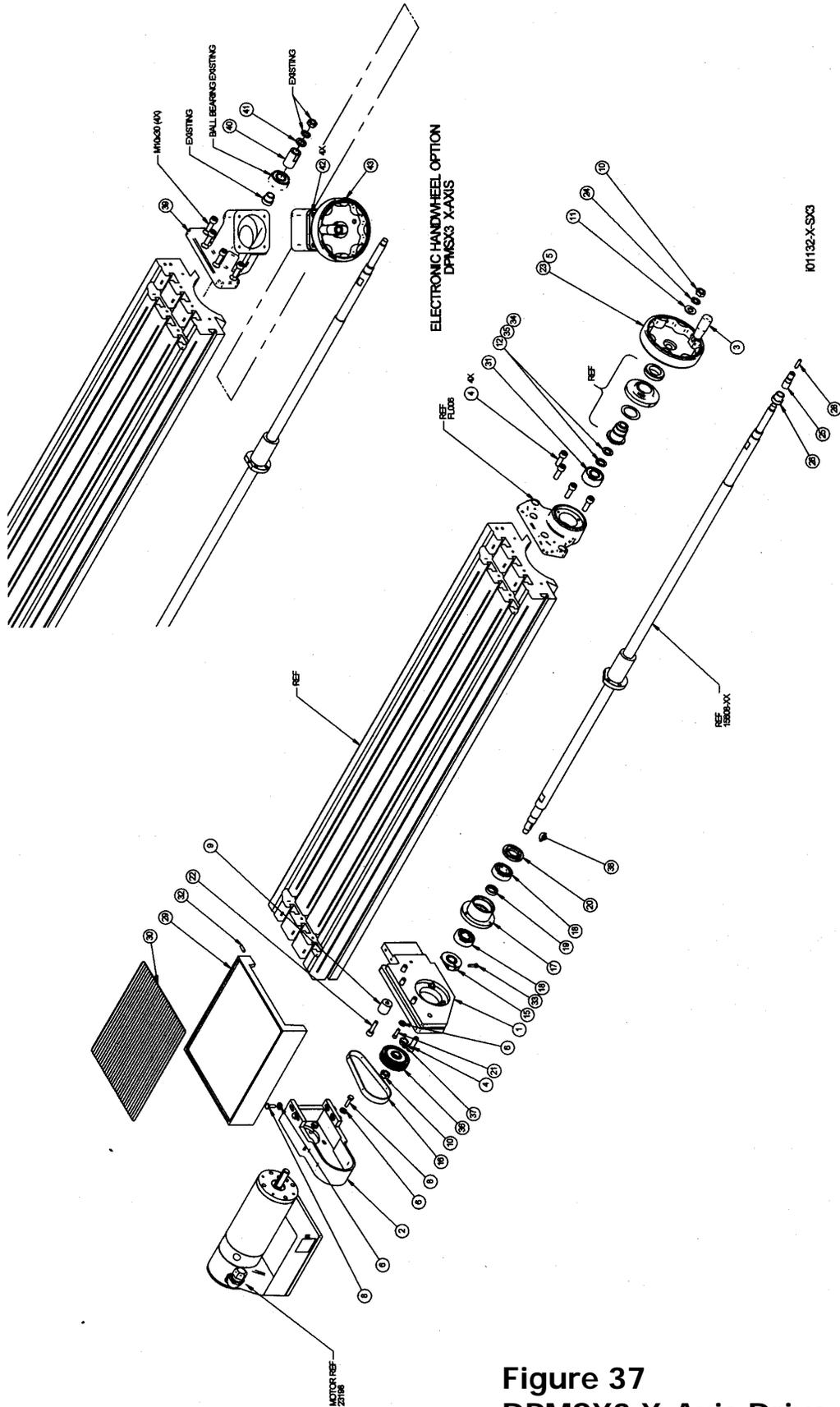
Figure 37
DPMSX3 X-Axis Drive Assembly

DPMSX3 X-Axis Drive Assembly Parts List

Item	P/N	DESCRIPTION	Qty
1	15974	END PLATE	1
2	15973	SERVO MOTOR ADAPTER	1
3	30922	HANDLE - FOLD - A-WAY	1
4	M10-1.5X30 25B	SCREW-SHCS-STL-BO	8
5	15614	TAB WASHER	1
6	15759	WASHER-1/4 HARD BLK OX 1/8 THK	11
8	1/4-20X1 24B	SCREW-HEX HD-STL-BO	8
9	15638	STOP - X-AXIS	1
10	1/2-20 51Z	NUT-HEX JAM-STL-ZINC	2
11	1/2 70P	WASHER-FLAT USS-STL-PLAIN	1
12	14772	SPACER - .100" THICK	4
15	16452	NUT CLAMP-X, Y, & Z AXIS	1
16	425-5M-15	BELT-TIMING 5MM POWERGRIP	1
17	15612	HOUSING - BEARING	1
18	23930	BEARING SET-ANGULAR CONTACT- 7204 BECBP	1
19	15885	RING-BEARING HOUSING	1
20	15626	SEAL-BEARING HOUSING	1
21	1/4-20X3/4 25B	SCREW-SHCS-STL-BO	3
22	5/16-18X1 1/4 25B	SCREW-SHCS-STL-BO	1
23	15616	HANDWHEEL ASSY-MX	1
24	1/2 75Z	WASHER-EXT TOOTH-STL-ZINC	1
25	15180	SHAFT-EXTENSION 1"	1
26	15058-.875	BUSHING	1
28	1/4-28X1 43B	SCREW-SOC SET-STL-BO-KNURLED	1
29	22069	TRAY-DPMV3 MACHINE	1
30	15977	TRAY PAD	1
31	22008	BEARING-204KTT	1
32	1/4-28X3/4 42B	SCREW-SOC SET-STL-BO-CONE	1
33	10-32X3/4 25B	SCREW-SHCS-STL-BO	1
34	14772-5	SPACER - .050" THICK	3
35	14772-2	SPACER - .020" THICK	1
36	16983-1	PULLEY-SOLID 44 TEETH W/O GUIDES	1
37	16350	FERRULE-SPROCKET	1
38	98481A090	KEY WOODRUFF #404-1/8 X 1/2	1
39	22718	SPACER 45° - MACHINE	1
40	21992	BUSHING - BALLSCREW	1
41	14772	SPACER - .100" THICK	1
42	M6-1.0X75 25B	SCREW-SHCS-STL-BO	4
43	21946	ELECTRONIC HANDWHEEL KIT - KNEE MILL	1

i01132-X-SX3

5.1.13 Ball Screw Replacement, Y-Axis (Saddle) – DPMSX3

CAUTION!
Never screw a ball screw partially or totally out of its nut. They cannot be reassembled.

---

1. Position the saddle all the way forward.

2. Remove the hand wheel assembly and bracket.

3. Remove the sheet metal covers on the front of the machine bed and on the motor mounting bracket.

4. Remove the motor, then remove the motor mounting bracket.

5. Remove the rest of the parts on the ball screw journal. Note the orientation of the bearings for reassembly.

6. Remove the (2) 5/16 x 1 inch screws that attach the ball nut to the yoke.

7. Remove the ball screw and oil line attached to the elbow fitting on the ball nut.

8. Remove the elbow and setscrew from the old ball screw flange and fit them similarly in the new ball screw.

9. Pump oil to be certain it flows through the oil line, and then attach the oil line to the elbow.

10. Reassemble all assemblies.

    Important: The clamp nut must be reassembled as follows:

    - Install rear bearing and seal into bearing housing and slide housing onto the ball screw. *(Note: Letters on bearings must face each other in the housing.)*

    - Thread the split nut onto the ball screw and tighten the #10-32 clamp screw until you feel the split nut contact the ball screw threads. It should drag as you tighten the clamp nut.

    - Torque the split nut to 50 ft. lb.

    - Firmly tighten the #10-32 clamp screw to lock the clamp nut in place.

See the diagnostics section under Mechanical Drive Train for an explanation of how to align the ball screw.

See 38 for an illustration of the Y-axis drive train.
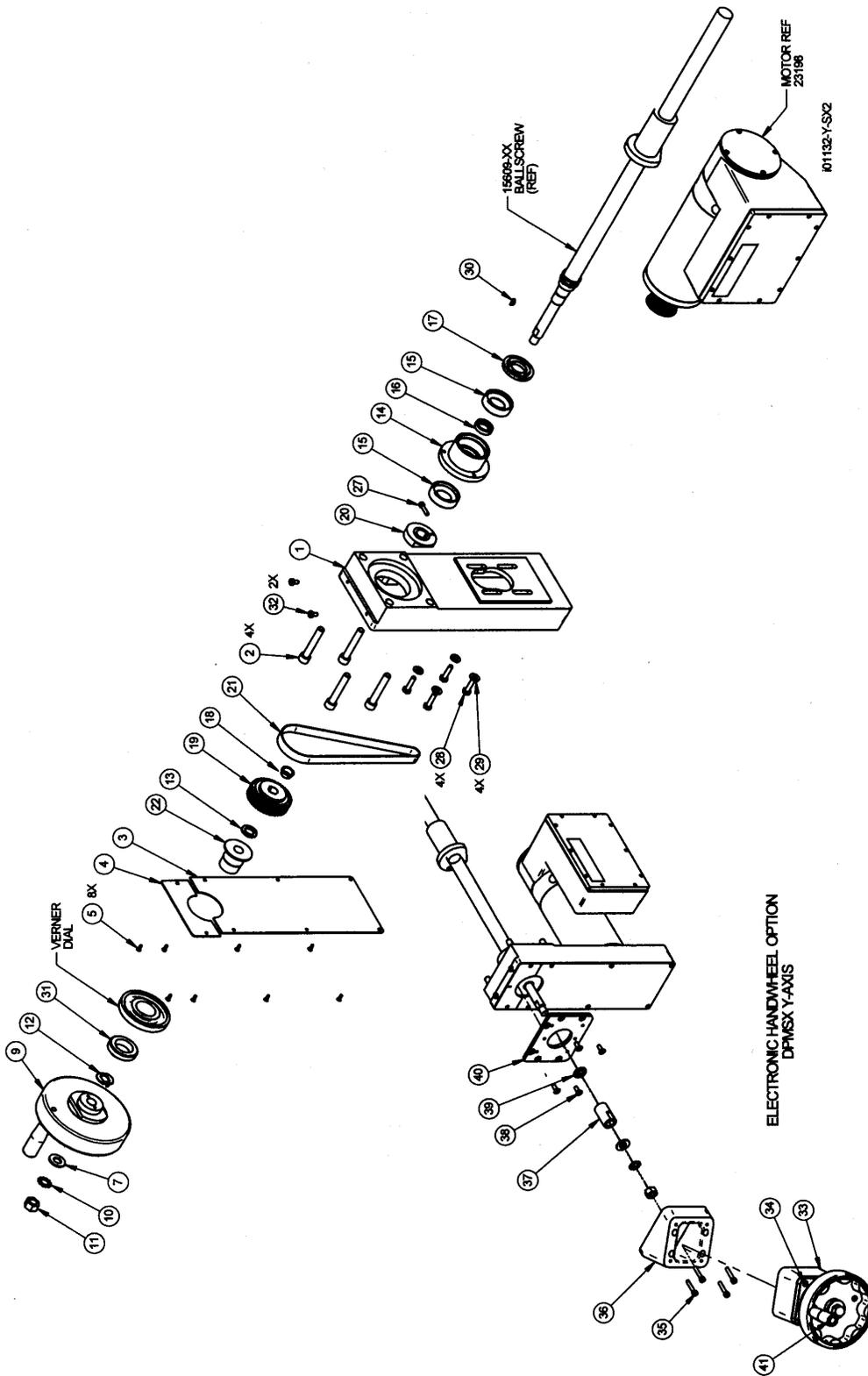
Figure 38
DPMSX3 Y-Axis Drive Assembly

DPMSX3 Y Axis Drive Assembly Parts List

Item	P/N	DESCRIPTION	Qty
1	15966-3	BRACKET-Y AXIS MOTOR MOUNT	1
2	M10-1.5X60 25B	SCREW-SHCS-STL-BO	4
3	15968-2	LOWER COVER	1
4	15967-2	UPPER COVER	1
5	6-32X3/8 31Z	SCREW-PH-PHIL-EXT SEMS-STL-ZINC	8
7	1/2 70P	WASHER-FLAT USS-STL-PLAIN	1
8	30922	HANDLE FOLD-A-WAY	1
9	15616	HANDWHEEL ASSY-MX	1
10	1/2 75Z	WASHER-EXT TOOTH-STL-ZINC	1
11	1/2-20 51Z	NUT-HEX JAM-STL-ZINC	1
12	15614	TAB WASHER	1
13	14772	SPACER - .100" THICK	1
14	15980	BEARING HOUSING	1
15	20373	BEARING-ANGULAR CONTACT- 7204 BECBP	2
16	15885	RING-BEARING HOUSING	1
17	15626	SEAL-BEARING HOUSING	1
18	16350	FERRULE-SPROCKET	1
19	16983-1	PULLEY-SOLID 44 TEETH W/O GUIDES	1
20	16452	NUT CLAMP-X, Y, & Z AXIS	1
21	500-5M-15	TIMING BELT	1
22	15627-1	DIAL HOLDER	1
27	10-32X3/4 25B	SCREW-SHCS-STL-BO	1
28	1/4-20X1 24B	SCREW-HEX HD-STL-BO	4
29	15759	WASHER-1/4 HARD BLK OX 1/8 THK	4
30	98481A090	KEY WOODRUFF #404-1/8 X 1/2	1
31	15836	DIAL NUT	1
32	M5-0.8X10 10Z	SCREW-PH-PHIL-STL-ZINC	2
33	21946	ELECTRONIC HANDWHEEL-X & Y AXIS	1
34	M6-1.0X75 25B	SCREW-SHCS-STL-BO	4
35	M6-1.0X25 25B	SCREW-PH-PHIL-STL-ZINC	4
36	21985	SPACER - 30 DEGREE Y-AXIS DRIVE ASSY	1
37	21992-1	BUSHING-BALLSCREW	1
38	1/4-20X5/8 26B	SCREW-FHCS-STL-BO	4
39	14772-2	SPACER-.020" THICK	1
40	21984	WAY COVER FRONT Y-AXIS DRIVE	1
41	30922	HANDLE FOLD-A-WAY	1

I01132-Y-SX2

5.1.14   Ball Screw Replacement, X-Axis (Table) – DPMSX5

1.   Remove table trays from each side of the table.

2.   Remove bearing housing from right side of table.

3.   Remove the sheet metal covers from the motor mounting brackets.

4.   Remove the X-axis motor and belt from the left side of the table.

5.   Remove the pulley and ferrule from the ball screw.

6.   Remove the motor mounting bracket.

7.   Loosen and remove the clamp nut. Loosen the setscrew on the clamp nut before loosening the clamp nut.

8.   Push the table to the left so the bearing housing moves away from the saddle.

9.   Remove the bearing housing. Note which way the bearings are in the bearing housing.

10.   Slide the table to the right and remove the oil line and the 4 screws holding the ball nut to the yoke.

11.   Pull the ball screw out.

Reassemble

12.   Install the new ball screw into the yoke.

13.   Slide table back to the left and assemble the left side of the X-axis.

14.   Install rear bearing and seal into bearing housing and slide housing onto the ball screw. *(Note: Letters on bearings must face each other in the housing.)* Slide spacer onto ball screw. Slide top bearing onto ball screw and seat with clamp nut. Be sure to clamp nut to at least 50 ft-lbs. Don't forget to tighten setscrew after clamp nut is tight.

15.   Install motor mounting bracket, motor spacer bracket, woodruff key, ferrule, pulley, star washer and nut. Before tightening down the motor mounting bracket move the table all the way to the left.

16.   Move table to the right and assemble right side bearing housing.

17.   Assemble motor to bracket. The servo should be facing toward the rear of the machine.

18.   Install belt. Tighten lower 2 bolts followed by the top 2 bolts to properly tension belt.

19.   Install mechanical hand wheel.

20.   Attach the sheet metal to the motor mounting bracket.

21.   Install the table trays.

See the diagnostics section under Mechanical Drive Train for an explanation of how to align the ball screw.

See Figure 39 for an illustration of the X-axis drive train.

5.1.15 DPMSX5 X-Axis Handwheel Box

(See Figure 40)

Teardown and Part Replacement
1. Remove top sheet metal cover (item #2).
2. Remove the manual hand wheel.
3. Release back cover hub (item #4).
4. Slide cover hub and shaft assembly (items # 12,3,9, and 4) out.
    4.a. Shaft assembly removal
        4.a.1. Slide shaft assembly (item #12, and # 3) off of back cover hub assembly (item #9 and #4).
        4.a.2. Loosen setscrew (item #14)
        4.a.3. Slide shaft gear off (item #12)
        4.a.4. Remove key (item #13)
5. Remove front hub assembly (item #5) from hand wheel box.
6. Remove gear (item # 11) at the end of the ballscrew.
    6.a. Remove extension cover (item #8), use Allen wrench on item #14 to help support ball screw from rotating, and back out the extension cover support screw.
    6.b. Loosen setscrew (item #14)
    6.c. Slide Left Gear out
    6.d. Remove key (item #13)
7. Remove hand wheel box (item #1).
8. Remove ballscrew extension (item #7)
    8.a. back out setscrews (item #14)
    8.b. back extension off by sliding a 3/16" Allen wrench through thru hole, pushing it up against the end of the ball screw pushing the extension slightly away from the bearing.
    8.c. Using two large screwdrivers pushing off the saddle, slide the extension off.
9. Use a mechanical puller to remove the bearing

Re-Assembly of Handwheel Box
1. Slide bearing on to the end of the ball screw (item #9), use a socket or piece of aluminum tubing and a dead blow hammer to tap bearing till it flushes up against the step of the ball screw.
2. Slide the extension on and flush it up against the bearing, lock down with both setscrews (item #14). Item 19 can be used to push the extension from the end of the ball screw to adjust the gear spacing.
3. Bolt the handwheel box (item # 1) down.
4. Bolt the front hub assembly (items #6, 10, and 5) on.
5. Slide the shaft assembly (items # 3, 12, 9, and 4) in through the backside and bolt the cover hub on.

CAUTION!
Assemble the hand wheel, move it back and forth, and see if there is some play in meshing the two gears together. If the gears mesh tightly against one another it can generate noise during movement of the X-axis. It is normal to have a small amount of backlash between the gears.

---

6. Screw top cover on.

SADDLE

BALL BEARING

47

M10-2x40

ELECRTONIC HANDWHEEL OPTION
DPMSX5 X - AXIS

GEARBOX
2321

MOTOR REF
23198

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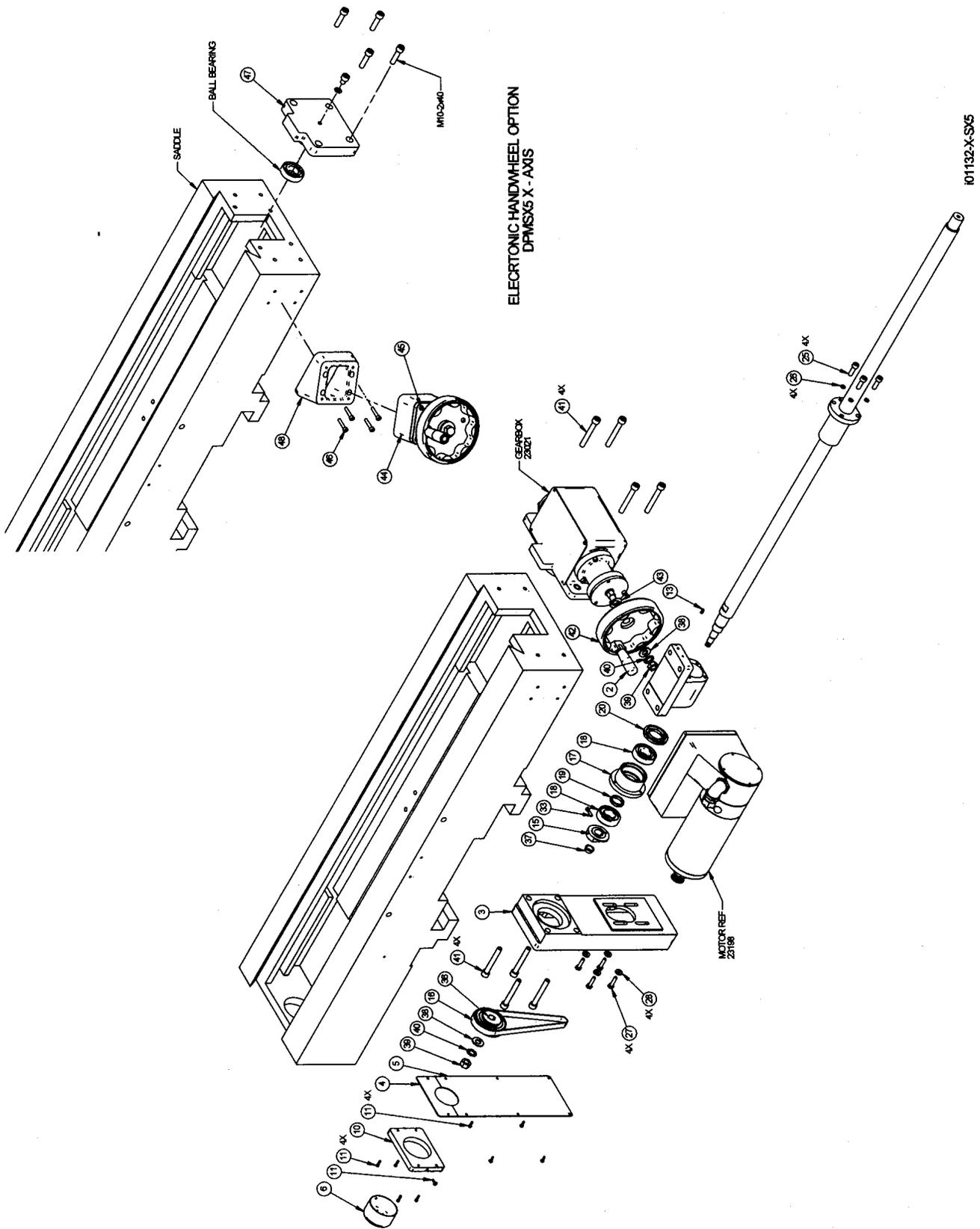
Figure 39
DPMSX5 X-Axis Drive Assembly

DPMSX5 X-Axis Drive Assembly Parts List

Item	P/N	DESCRIPTION	Qty
2	30922	HANDLE-FOLD-A-WAY	1
3	15966	BRACKET-Y AXIS MOTOR MOUNT	1
4	15967	COVER-UPPER	1
5	15968	COVER-LOWER	1
6	21585-1	COVER-BALLSCREW END	1
10	21584-1	PLATE-END COVER	1
11	6-32X1/2 10B	SCREW-PH-PHIL-STL-BO	9
13	98481A090	KEY WOODRUFF #404-1/8 X 1/2	1
15	16066	NUT CLAMP-X & Y AXIS	1
16	600-5M-15	BELT-TIMING	1
17	21662	BEARING HOUSING-	1
18	23940	BEARING SET-ANGULAR CONTACT	1
19	16302	RING-BEARING HOUSING	1
20	16078	SEAL-BEARING HOUSING	1
22	M10-1.5 50P	NUT-HEX-STL-PLAIN	2
23	M10 73B	WASHER-SPLIT LOCK-STL-BO	2
25	M8-1.25X25 25B	SCREW-SHCS-STL-BO	4
26	M8 74B	WASHER-EXT TOOTH-STL-BO	4
27	1/4-20X1 24B	SCREW-HEX HD-STL-BO	4
28	15759	WASHER-1/4 HARD BLK OX 1/8 THK	4
33	10-32X3/4 25B	SCREW-SHCS-STL-BO	1
36	16983-1	PULLEY-SOLID 44 TEETH W/O GUIDES	1
37	16350	FERRULE-SPROCKET	1
38	1/2 70P	WASHER-FLAT USS-STL-PLAIN	2
39	1/2-20 51Z	NUT-HEX JAM-STL-ZINC	2
40	1/2 75Z	WASHER-EXT TOOTH-STL-ZINC	2
41	M10-1.5X75 25B	SCREW-SHCS-STL-BO-FULLY THD	8
42	15616	HANDWHEEL ASSY-MX	1
43	15614	TAB WASHER	1
44	21946	ELECTRONIC HANDWHEEL KIT DPMS5	1
45	M6-1.0x75 25B	SCREW-SHCS-STL-BO	4
46	M6-1.0x25 25B	SCREW-SHCS-STL-BO	4
47	22348	BEARING HOUSING-	1
48	21985	SPACER - 30 DEGREE Y-AXIS DRIVE ASSY	1

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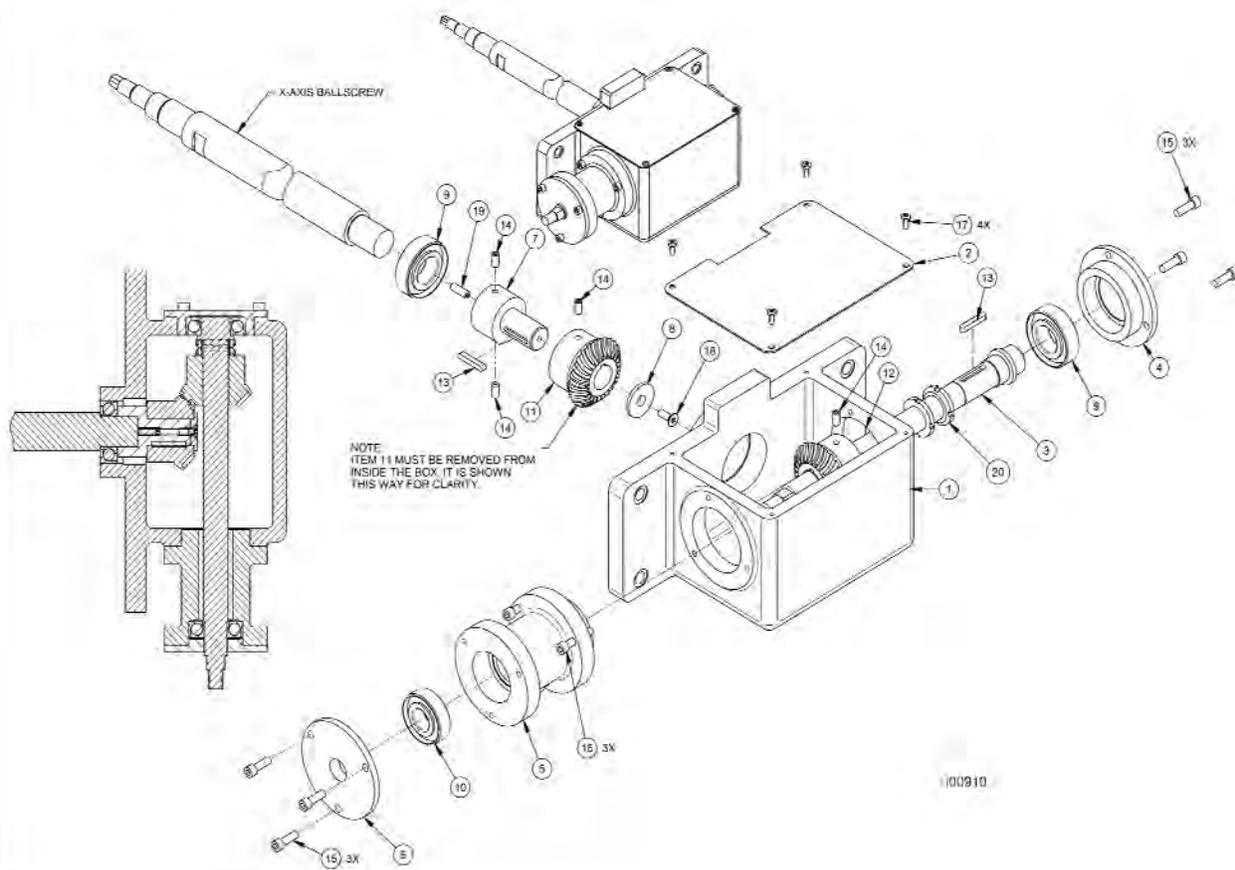
Figure 40
X Handwheel Drive Mechanism

Item	P/N	Description	Qty
	23021	GEAR BOX ASSEMBLY—X-AXIS	
1	23014	HANDWHEEL BOX-X AXIS	1
2	23015	SHEET METAL-PT4-COVER-X AXIS-HANDWHEEL BOX	1
3	23019	SHAFT-X AXIS-HANDWHEEL BOX	1
4	23017	COVER-HUB-X AXIS-HANDWHELL BOX	1
5	23018	HUB-X AXIS-HANDWHEEL BOX	1
6	23020	COVER-X AXIS-HANDWHEEL BOX	1
7	23027	EXTENSION-BALLSCREW-X AXIS-HANDWHEEL ASSY	1
8	23028	COVER-EXTENSION-BALLSCREW-X AXIS-HANDWHEEL ASSY	1
9	6205ZZ	BEARING-DEEP GROOVE	2
10	6204ZZ	BEARING-	1
11	23033-L	GEAR-HARDENED STEEL SPIRAL MITER-LEFT	1
12	23033-R	GEAR-HARDENED STEEL SPIRAL MITER-RIGHT	1
13	3/16X1	KEY-3/16X1	2
14	1/4-20X1/2 40B	SCREW-SOC SET-STL-BO-CUP	6
15	1/4-20X3/4 25B	SCREW-SHCS-STL-BO	6
16	1/4-28X1 1/4 25B	SCREW-SHCS-STL-BO	3
17	1/4-20X1/2 27B	SCREW-BHCS-STL-BO	4
18	1/4-20X5/8 26B	SCREW-FHCS-STL-BO	1
19	1/4-20X3/4 40B	SCREW-SOC SET-STL-BO-CUP	1

5.1.16   Ball Screw Replacement, Y-Axis (Saddle) – DPMSX5

1. Remove the sheet metal from the front of the machine and from the motor mounting bracket.

2. Move the saddle toward the front of the machine and remove the electronic hand wheel.

3. Remove the Y-axis motor and belt.

4. Remove the pulley and ferrule from the ball screw.

5. Remove the motor mounting bracket.

6. Loosen and remove the clamp nut. Loosen the setscrew on the clamp nut before loosening the clamp nut.

7. Remove the bearing housing. Note which way the bearings are in the bearing housing.

8. Remove the oil line and the 4 screws holding the ball nut to the yoke.

9. Pull the ball screw out.

Reassemble

10. Install Y ball screw to yoke and install oil line to ball nut

11. Install rear bearing and seal into bearing housing and slide housing onto the ball screw. *(Note: Letters on bearings must face each other in the housing.)* Slide spacer onto ball screw. Slide top bearing onto ball screw and seat with clamp nut. Slide top bearing onto ball screw and seat with clamp nut. Be sure to clamp nut to at least 50 ft-lbs. Don't forget to tighten setscrew after clamp nut is tight.

12. Install motor mounting bracket, woodruff key, ferrule, pulley, star washer and nut. Before tightening down the motor mounting bracket move the saddle to the front of the machine.

13. Assemble motor to bracket. The servo should be facing the right of the machine.

14. Install belt. Tighten lower 2 bolts followed by the top 2 bolts to properly tension belt.

15. Install electronic hand wheel.

16. Install all sheet metal.

See the diagnostics section under Mechanical Drive Train for an explanation of how to align the ball screw.

See Figure 41 for an illustration of the Y-axis drive train.

ELECTRONIC HANDWHEEL OPTION
DPMSX5 Y-AXIS

MOTOR REF
23198

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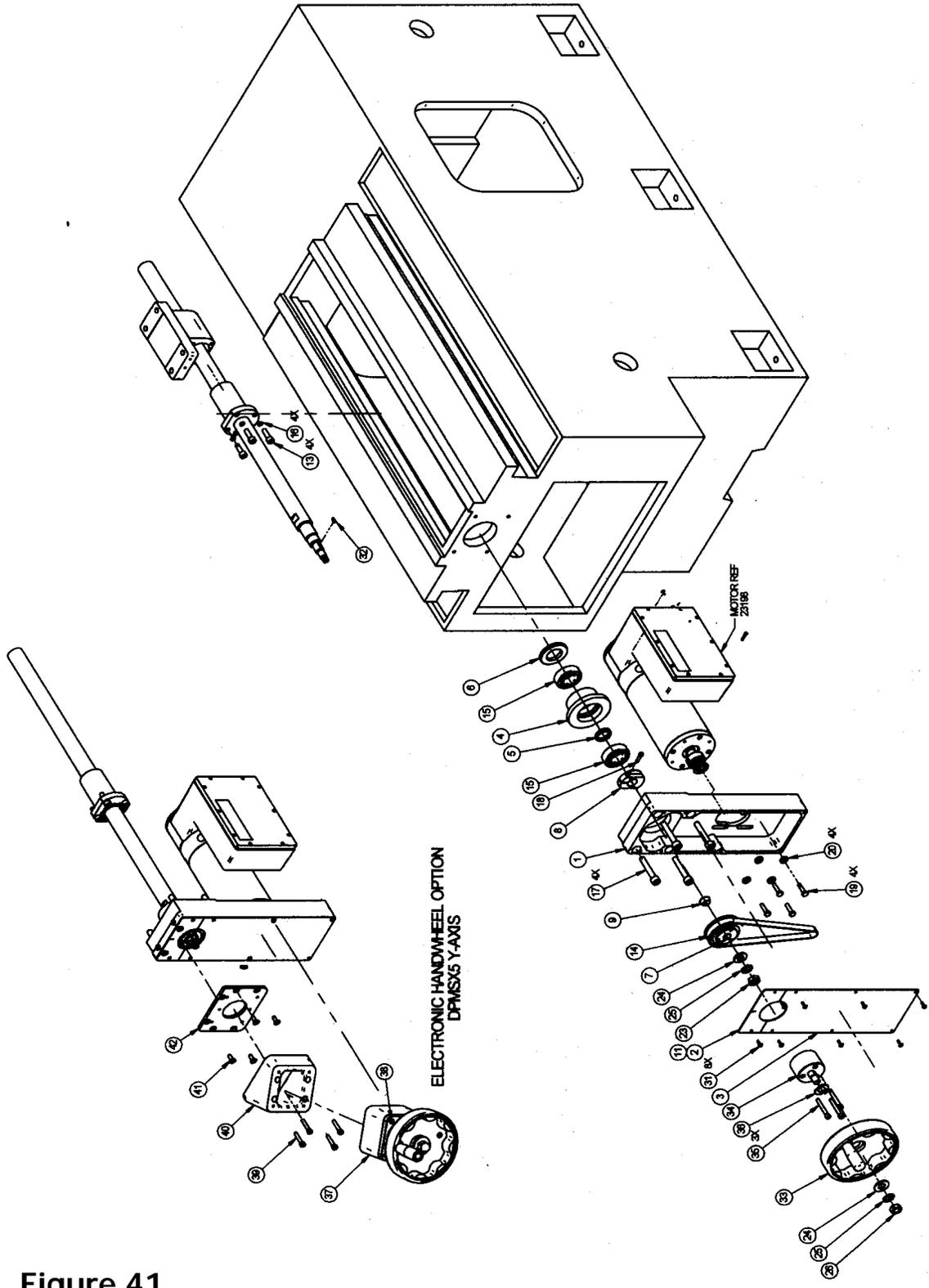
Figure 41
DPMSX5 Y-Axis Drive Assembly

Southwestern Industries, Inc.
TRAK DPMSX2, SX3 & SX5 Safety, Installation, Maintenance, Service & Parts List Manual

DPMSX5 Y-Axis Drive Assembly Parts List

Item	P/N	DESCRIPTION	Qty
1	15966	BRACKET-Y AXIS MOTOR MOUNT	1
2	15967	COVER-UPPER	1
3	15968	COVER-LOWER	1
4	21662	BEARING HOUSING-	1
5	16302	RING-BEARING HOUSING	1
6	16078	SEAL-BEARING HOUSING	1
7	23026	PULLEY-SOLID 44 TEETH	1
8	16066	NUT CLAMP-X & Y AXIS	1
9	16350	FERRULE-SPROCKET	1
11	15913	BRACKET-WAY COVER FRONT	1
13	M8-1.25X25 25B	SCREW-SHCS-STL-BO	4
14	600-5M-15	BELT-TIMING	1
15	23940	BEARING SET-ANGULAR CONTACT-7205 BECBP	1
16	M8 74B	WASHER-EXT TOOTH-STL-BO	4
17	M10-1.5X65 25B	SCREW-SHCS-STL-BO	4
18	10-32X3/4 25B	SCREW-SHCS-STL-BO	1
19	1/4-20X1 24B	SCREW-HEX HD-STL-BO	4
20	15759	WASHER-1/4 HARD BLK OX 1/8 THK	4
23	1/2-20 51Z	NUT-HEX JAM-STL-ZINC	2
24	1/2 70P	WASHER-FLAT USS-STL-PLAIN	2
25	1/2 75Z	WASHER-EXT TOOTH-STL-ZINC	2
28	3/16X1 1/2 81P	PIN-SPRING-STL-PLAIN	2
31	6-32X1/2 10B	SCREW-PH-PHIL-STL-BO	8
32	98481A090	KEY WOODRUFF #404-1/8 X 1/2	1
33	15616	HANDWHEEL ASSY-MX	1
34	23016	EXTENSION-BALLSCREW-Y AXIS-HANDWHEEL ASSY	1
35	1/4-20X1 3/4 25B	SCREW-SHCS-STL-BO	3
36	15614	TAB WASHER	1
37	21946	ELECTRONIC HANDWHEEL KIT DPMS5	1
38	M6-1.0x75 25B	SCREW-SHCS-STL-BO	4
39	M6-1.0x25 25B	SCREW-SHCS-STL-BO	4
40	21985	SPACER - 30 DEGREE Y-AXIS	1
41	1/4-20X1 5/8 26B	SCREW-SHCS-STL-BO	4
42	22348	BEARING HOUSING	1

I01132-Y-SX5

5.1.17   Z-Axis Ball Screw Removal & Replacement

CAUTION!
Never screw a ball screw partially or totally out of its nut. They cannot be reassembled.

1. Ensure that there is sufficient vertical clearance above the top of the machine to remove the ball screw. Minimum clearance required is 32 inches.

2. Remove vertical column top cover.

3. Remove servomotor, belt and Z motor mounting bracket.

4. Remove upper and lower Z-axis way covers.

5. Lower head to table. Place 1 or 2 inch wood board between spindle nose and table to protect.

6. Lower head using manual hand crank until weight of head is supported by the table.

7. Tighten both ram locks on the right side of ram.

8. Remove locknut and lock washer from the top of the Z ball screw.

9. Remove pulley and woodruff key.

10. Loosen #10-32 socket screw on clamp nut.

11. Using wrench flats on clamp nut and wrench flats on ball screw remove clamp nut.

12. Remove the four cap screws from bearing housing flange.

13. Remove the clamp nut.

14. Remove bearing, nilos ring and bearing housing with matched spacer from ball screw.

15. Remove (6) M6 cap screws and lock washers from ball nut flange.

16. Loosen setscrew from bevel gear. Rotate ball screw by hand, if necessary, to access setscrew. Extract ball screw assembly from machine until ball nut flange is above the top of the ram. Support ball screw and remove lubrication line from ball nut flange.

17. Raise the ball screw until the bottom end of the ball screw is above the ram.   Be careful to remove bevel gear as the ball screw is raised. Angle the ball screw out and away from the head. Lower the ball screw on the right side of the machine until the top of the ball screw clears the support plate.

18. Reassemble all components in reverse order as shown above, except leave off the pulley, locknut and lock washer until ball screw is realigned. Torque clamp nut to 50 ft. lb.

19. With the ball screw assembly installed, loosen four 5/16-18 cap screws from bearing housing, raise head to the uppermost position, and re-tighten 5/16-18 cap screws. Note that there is .060 clearance between the bearing housing outside diameter and the inside diameter of the support plate to allow for realignment. Traverse the head to the extreme of the up and down travel manually to check for freedom of movement. Use torque wrench to make sure torque is consistent along length of screw. Use torque wrench to make sure torque is consistent along length of screw.

    See Figure 42 for an illustration of the Z-axis drive assembly.

    See Section 5.2.2 to properly measure and set the Z Backlash Compensation and calibration.
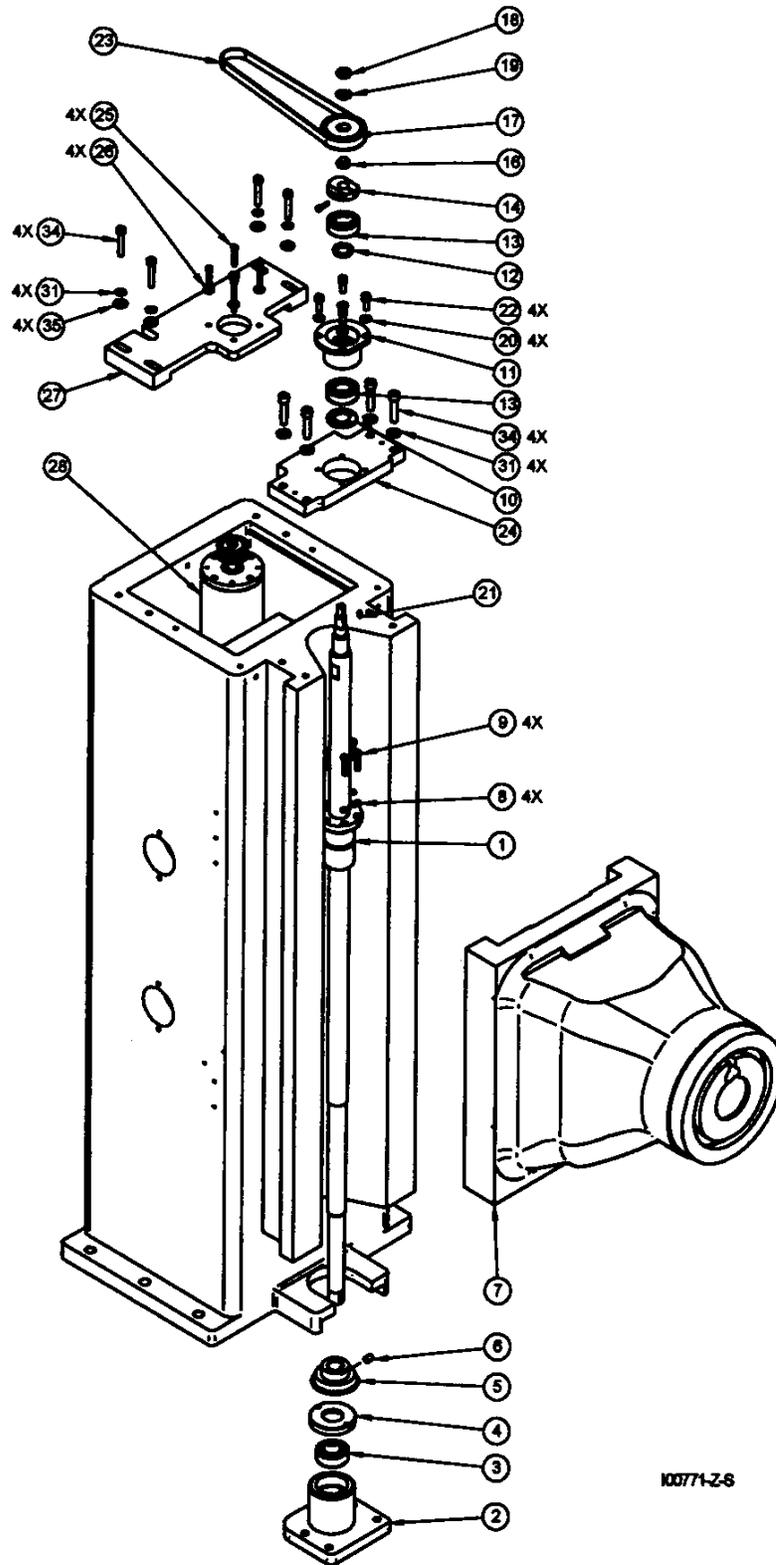
Figure 42
Z-Axis Drive Assembly

Z-Axis Drive Assembly Parts List

Item	P/N	Description
1	16806-M	BALLSCREW ASSY- Z-AXIS
2	PJ540015	BRACKET LOWER ELEVATING BALL SCREW
3	22583	BEARING SELF ALIGNMENT SKF 2205E-2RS1TN9
4	16774	COVER - BEARING
5	16795	MODIFIED BEVEL GEAR BS1236-2A
6	M10-1.5X10 40B	SCREW-SOC SET-STL-BO-CUP
7	16770	MODIFICATION OF 3 HP RAM PING JENG PART
8	M6 73B	WASHER-SPLIT LOCK-STL-BO
9	M6-1.0X25 25B	SCREW-SHCS-STL-BO
10	7205-AVH	NILOS RING-7205
11	16295-1	HOUSING- BEARING Z-AXIS
12	16302	RING-BEARING HOUSING
13	23940	BEARING SET-ANGULAR CONTACT-7205 BECBP
14	16773	NUT CLAMP-Z AXIS
15	10-32X3/4 25B	SCREW-SHCS-STL-BO
16	16350	FERRULE-SPROCKET
17	16983	PULLEY-SOLID 44 TEETH Z-AXIS
18	N01	LOCKNUT
19	W01	LOCKWASHER
20	M8 73B	WASHER-SPLIT LOCK-STL-BO
21	98481A090	KEY WOODRUFF #404-1/8 X 1/2
22	M8-1.25X20 25B	SCREW-SHCS-STL-BO
23	710-5M-15	BELT - TIMING
24	21944	PLATE BALLSCREW SUPPORT - Z AXIS
25	1/4-20X1 1/4 25B	SCREW-SHCS-STL-BO
26	15759	WASHER-1/4 HARD BLK OX 1/8 THK
27	23197	BRACKET-Z AXIS MOTOR-DPMS
28	23198	MOTOR DRIVER ASSY-PT4-DPM-SM-4050
31	M10 73B	WASHER-SPLIT LOCK-STL-BO
32	17030	LOUVRE- SPACER
34	M10-1.5X45 25B	SCREW-SHCS-STL-BO
35	M10 71B	WASHER-FLAT SAE-STL-BO
30	98481A090	KEY WOODRUFF #404-1/8 X 1/2

i00771-Z-S

5.1.18   Air Solenoid Replacement for Power Drawbar

1. Unhook the air from the machine.

2. Unplug the power cable that connects to the right side of the air regulator bracket.

3. Remove the 2 screws that hold the connector to the bracket.

4. Undo the airline that runs from the oiler to the power drawbar if that option is installed on the machine.

5. Remove the 2 screws on the left side of the bracket that holds the air manifold to the U shaped bracket.

6. With the assembly in hand unthread the solenoid from the rear of the air regulator. The solenoid and cable will be replaced as a unit.

See Figure 13 in Section 2 for an illustration of this assembly.

5.1.19   Spindle Motor Wiring

The DPMSX spindle motors are wired for 220 or 440 volts. See Figure 43 for how to wire the motor. **Note: Machine with the Spindle Control Option can only be wired for 220V.**
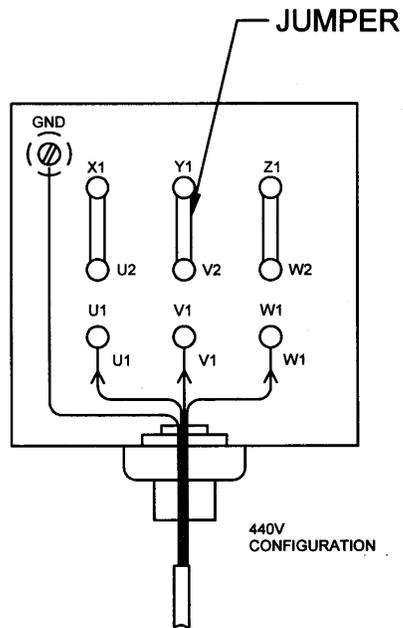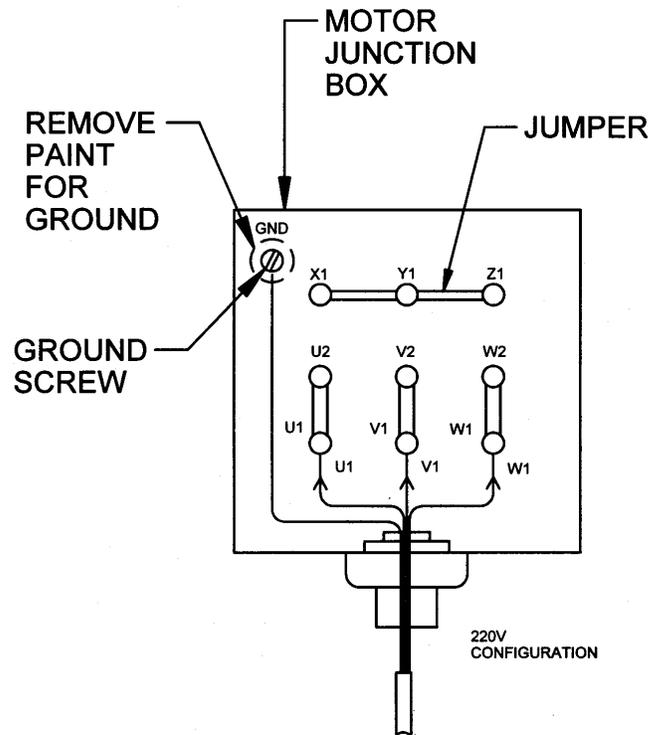
**Figure 43
Spindle Motor Wiring**

5.1.20 Feed Trip Adjustment

If the feed trip is adjusted too light it will inadvertently trip when drilling. If too heavy, it will not trip accurately and stress the mechanism. The correct adjustment depends on the operation to be performed. To adjust:

1. Release the lock nut.

2. Engage the trip handle--move it left.

3. Adjust the micrometer nut against the quill stop knob.

4. Slowly turn the adjusting screw until the handle trips.

5. Tighten the lock nut.

6. Check the reaction. If too sensitive, lower the adjusting screw slightly. If too heavy, raise it.

Figure 44
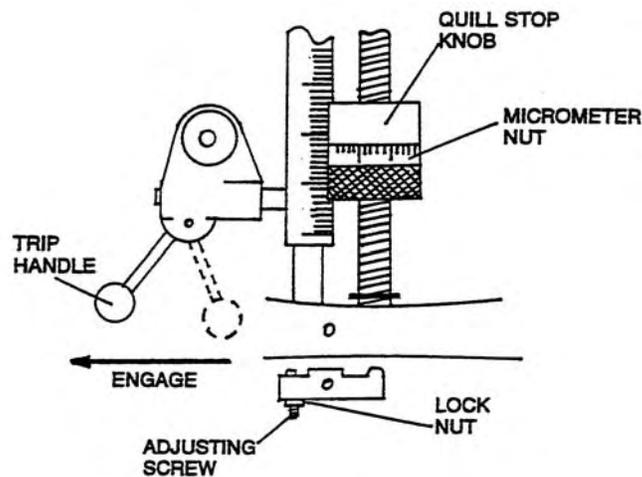
I00153

5.1.21 Quill Clock Spring Replacement and Adjustment

The quill Clock Spring counterbalances the weight of the quill and tool.

Figure 45
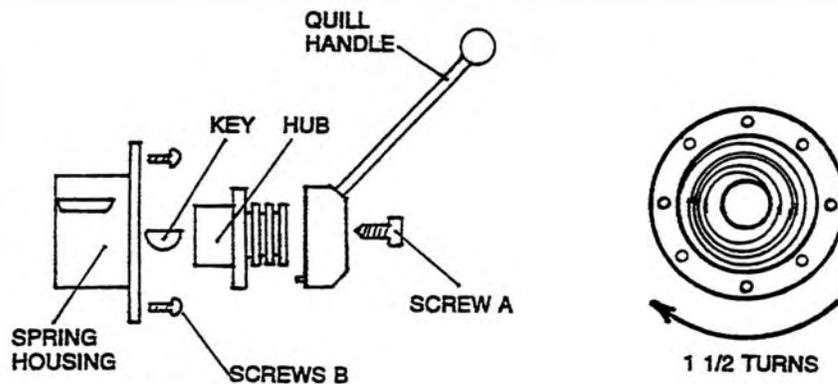
1. Move the quill to its top position and lock it in place.

2. Remove the quill handle, hub (by removing Screw A) and key.

3. Remove Screws B and allow the spring housing to unwind.

4. Remove the spring. It is held by a pin on the shaft and slot in the housing.

5. Replace the spring. Rotate the housing clockwise until the spring catches the shaft pin.

6. Rotate (wind up) the housing 1 1/2 turns, replace Screws B, key hub, Screw A, and handle.

5.1.22   Spindle Motor Removal and Replacement

CAUTION!
The motor is heavy--about 60 pounds. Be certain you have the proper equipment or assistance.

1. While the spindle is running, change the RPM to its lowest value.

2. Turn off spindle.

3. Disconnect power to the machine.

4. Remove motor pulley cover.

5. Screw a 4 x 20 mm SHCS into the bottom of the adjustable vari-disk to keep the vari-disk open.

6. With the power disconnected, manually crank the speed changer to its highest RPM value. This will allow the main drive belt enough slack to slide off the motor pulley.

7. Remove the four SHCS that fasten the motor to the belt housing.

8. Tilt the motor toward the rear of the machine, and remove the belt from the motor pulley. Remove the motor.

9. To reinstall motor, do these steps in reverse.

Figure 46
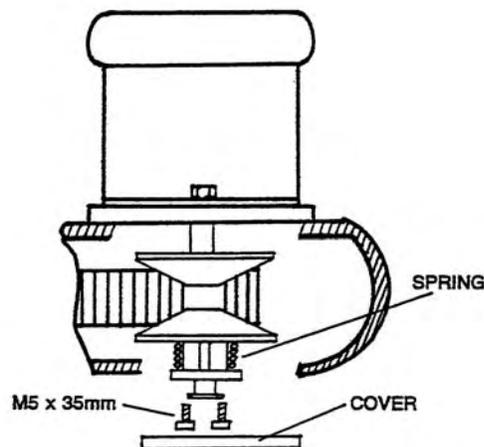
I00155

5.1.22.1 *Spindle Motor Removal and Replacement for Machine with the Spindle Control Option*

1. Disconnect the power to the motor. It is recommended that the power disconnect be made from the shop feeder box.

2. Disconnect the electrical connection in the conduit box attached to the motor.

3. Remove the three bolts that hold the motor pulley cover in place to gain access to the belt.

4. Remove the four bolts that mount the motor to the top head housing and slide motor forward and remove belt.

CAUTION!

The motor is heavy--about 80 pounds. Be certain you have the proper equipment or assistance.

---

5. Tilt the motor towards the back and remove the belt from the motor pulley. Remove the motor.

5.1.23 Drive Belt Replacement

1. Remove the motor.

2. Remove the draw bar and its bushing.

3. Remove the three Screws A and use M6 x 35mm screws in the adjacent tapped holes to remove the Bearing Cap.

4. Remove the nut from the fine speed adjustment Screw B and turn the screw all the way down through the casting. Catch it from the motor hole.

5. Remove six Screws C holding the belt housing to the subplate.

6. Remove the four screws holding the speed changer.

7. Remove the belt housing.

8. Replace the belt by sliding it over the speed changer.

9. In reassembly be certain the fine speed adjustment Screw B goes into the slot of the Speed Change Plate D in the area in which the screw is not threaded.

Figure 47
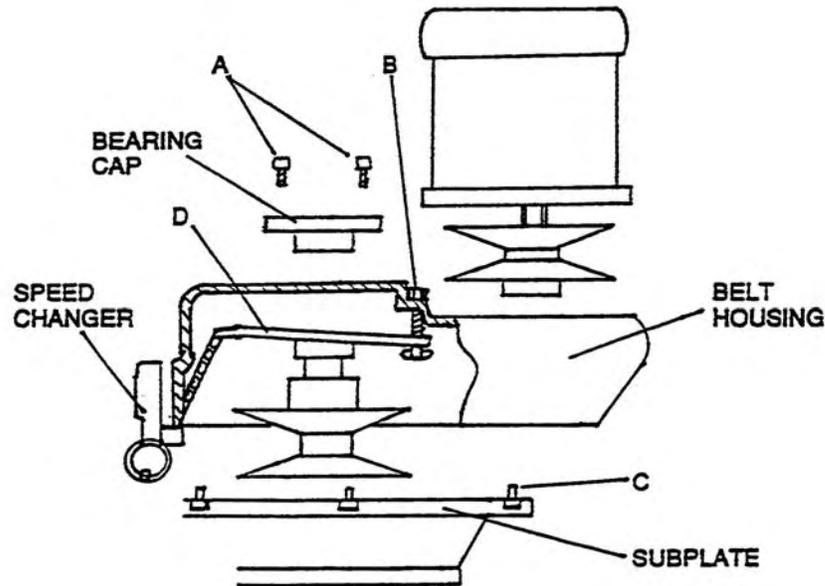
i00156

5.1.23.1 Drive Belt Replacement for Machine with the Spindle Control Option

1. Remove the draw bar and its bushing (remove power drawbar if present).

2. Remove the three Screws A and use M6 x 35mm screws in the adjacent tapped holes to remove the Bearing Cap (see Figure 47).

3. Follow instructions for spindle motor removal and remove motor so top head housing can be removed with ease.

4. Remove the six screws "C" that hold the belt housing to the subplate.

5. Disconnect the spindle control harness at the head control box.

6. Lift off the belt housing, then remove belt.

5.1.24 Timing Belt Replacement

1. Remove the motor and drive belt.

2. Slide the top or adjustable varidisc pulley assembly off the shaft.

3. Remove the three M8 screws holding the belt housing base to the gear housing.

4. Lower the quill about 4 inches.

5. Remove the belt housing base and lower or stationary varidisc pulley assembly.

6. Replace the timing belt.

5.1.25   Brake Shoe Replacement

1. Remove the motor, drive belt and complete Steps 1-5 of the timing belt replacement procedure.

2. Remove the two M6 cap screws from the bottom of the belt housing base.

3. Separate the belt housing base from the lower or stationary varidisc pulley. This is a slight press fit.

4. Remove the 2 springs.

5. Replace the brake shoes.

5.1.26   Spindle Replacement

1. Remove the draw bar and its bushing.

2. Lower the quill about 1 inch and lock.

3. Remove the setscrew from the back of the spindle.

4. Loosen (unscrew) the large black ring (nosepiece) with a spanner wrench.

    Note: The nosepiece has a left hand thread-- rotate counterclockwise to loosen.

5. Using a soft bar about 12 inches long, alternately tap on the top of the spindle and loosen a few threads on the nosepiece until fully unscrewed (the nosepiece will remain attached to the spindle).

6. Continue to tap the spindle out of the quill. The spindle bearings will come out with the spindle.

Figure 48

i00157
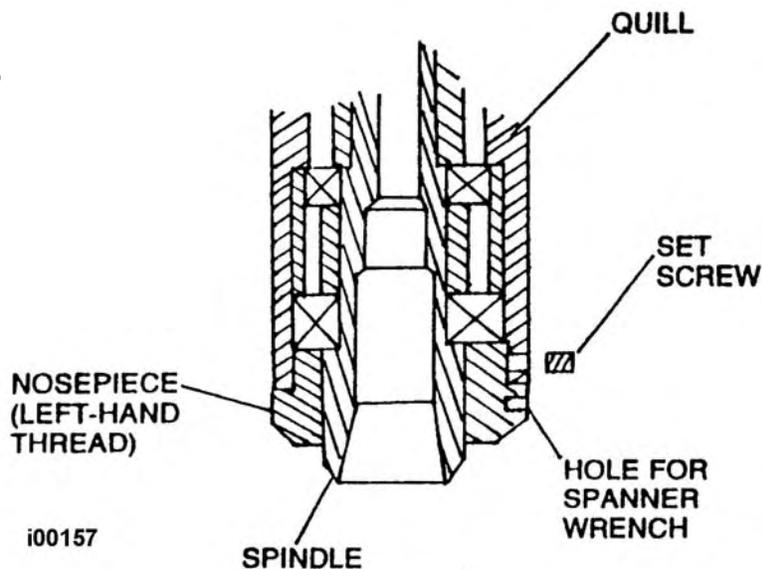
5.2 Maintenance

5.2.1 Gib Adjustments

The objective of adjusting the gibs is to eliminate as much play in the table, saddle and ram sliding surfaces as possible without having the tightness of the gib interfere with their free movement and cause a decrease in the accuracy and/or performance of the machine due to excessive friction.

5.2.1.1 Table Gib Adjustment, X-Axis – DPMSX2 & DPMSX3

See Figure 49.

1. Clean all chips, dirt and excess oil from the table and saddle.

2. Center the saddle on the bed ways.

3. Move the table fully to the left side of the saddle.

   Note: For machines that have excessive wear in the center of the table way, it will be necessary to center the table on the saddle. The resulting adjustment of the gib will be compromised to account for the varying clearance from the center to the ends of the table.

4. Attach a .0001 dial indicator with a magnetic base to the left front of the saddle. Place the indicator stylus on the front surface of the table as close to the indicator base as possible.
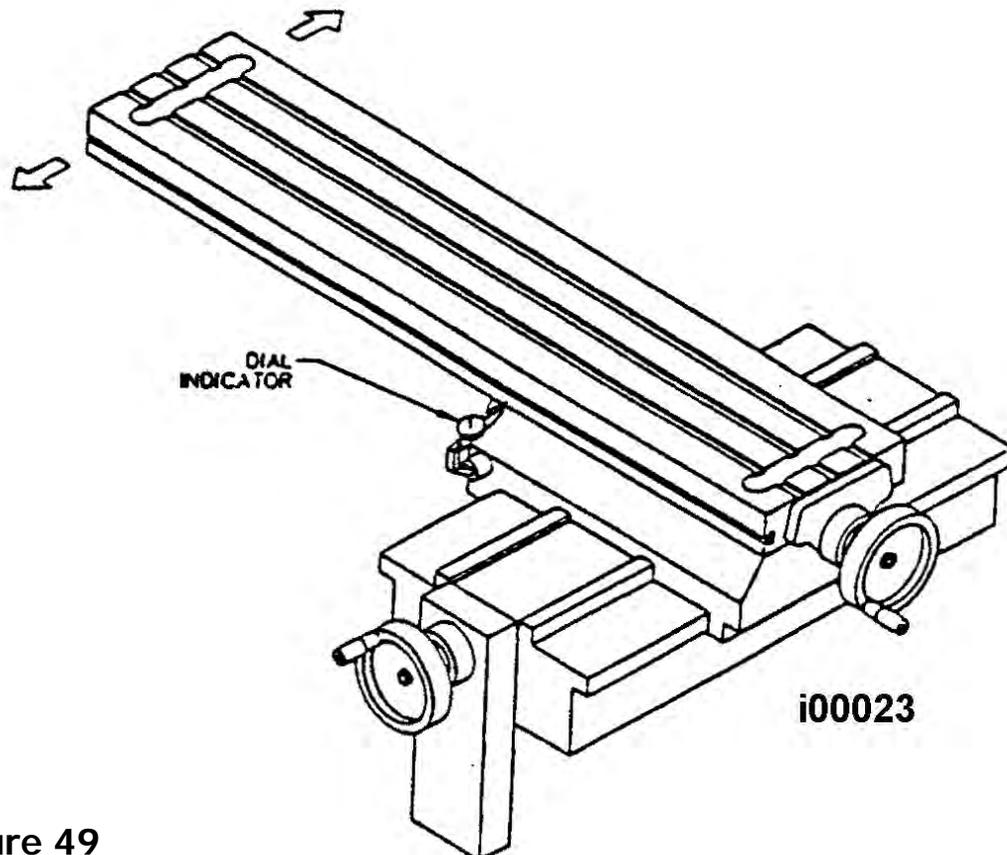
Figure 49
Table Gib Adjustment

5. Move the left end of the table back and forth and note the amount of movement on the dial indicator. Adjust the X-axis gib until the registered movement is .0010-.0015.

- To adjust the gib for excessive clearance: Loosen the gib lock screw on the right end of the saddle. Estimate the amount of gib lock screw adjustment required, and tighten the gib lock screw on the left end of the saddle. Tighten the gib lock screw on the right end of the saddle to lock the give in place, and recheck. Repeat as necessary.

- To adjust the gib for too small of a clearance: Loosen the gib lock screw on the left end of the saddle. Estimate the amount of gib lock screw adjustment required, and tighten the gib lock screw on the right end of the saddle. Tighten the gib lock screw on the left end of the saddle to lock the gib in place, and recheck. Repeat as necessary.
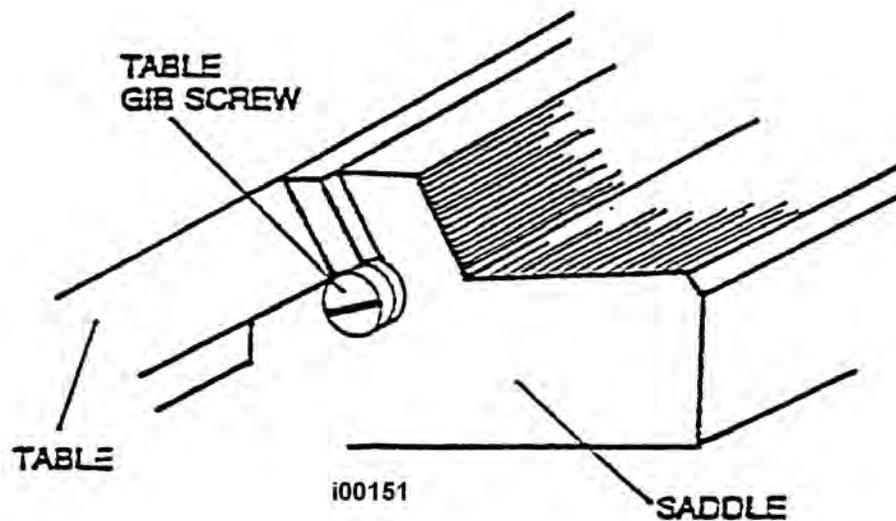
Figure 50
Table Gib Screw

5.2.1.2   Gib Adjustment, X-Axis – DPMSX5 only

The X-axis has 2 gibs for the table because of the length of the saddle. Each gib is adjusted from each end of the table. There are not 2 adjustment screws at either end of the gib like the Y-axis and Z-axis.

1. Clean all chips, dirt and excess oil from the table.

2. Remove the table trays.

3. Move the table to the left and mount the indicator at Point D and move the table back and forth. Note the amount of movement of the dial indicator. Adjust gib until the movement is between .0005-.001.

4. Move the table to the right and mount the indicator at Point A and move the table back and forth. Note the amount of movement of the dial indicator. Adjust gib until the movement is between .0005-.001.

- To adjust the gib for excess clearance: Loosen the nut closest to the table and tighten the nut furthest from the table. Once the clearance has been taken up tighten each nut against the gib bracket. Do this for each end of the table.

- To adjust the gib for too small of a clearance: Loosen the nut furthest from the table and tighten the inside nut up against the bracket to pull the gib away from the machine. Once the clearance has been taken up tighten each nut against the gib bracket. Do this for each end of the table.

5. Replace the table trays.

See Figure 51.
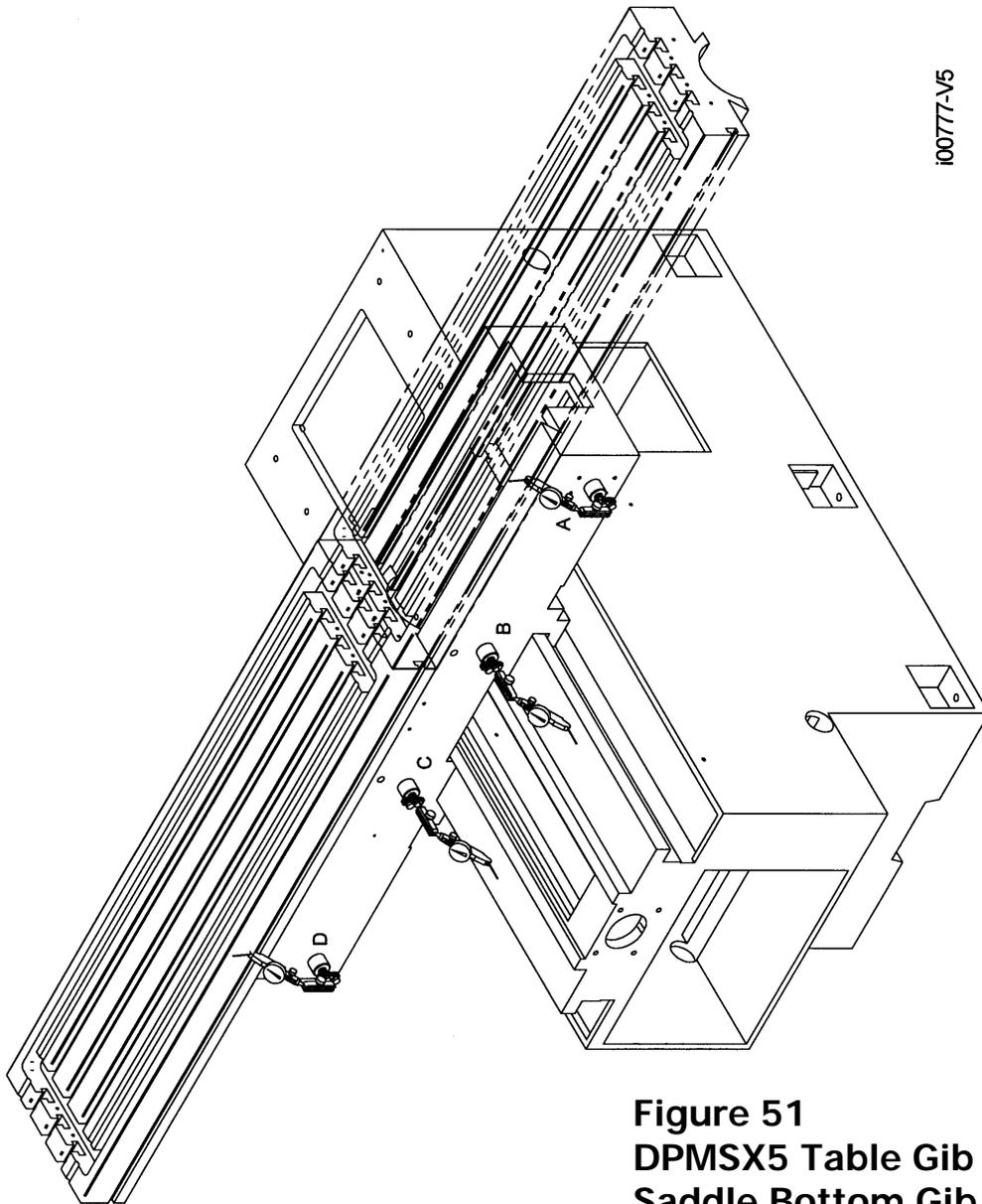
**Figure 51
DPMSX5 Table Gib &
Saddle Bottom Gib Adjustment**

5.2.1.3   *Saddle Side Gib Adjustment, Y-Axis – DPMSX2, SX3 & SX5*

See Figure 52

1. Clean all chips, dirt and excess oil from the table and saddle.

2. Center the saddle on the bed ways.

3. Move the table fully to the left side of the saddle.

4. Remove the chip wiper guard and chip wiper from the front and rear of the left side box way.

DIAL INDICATOR

i00024
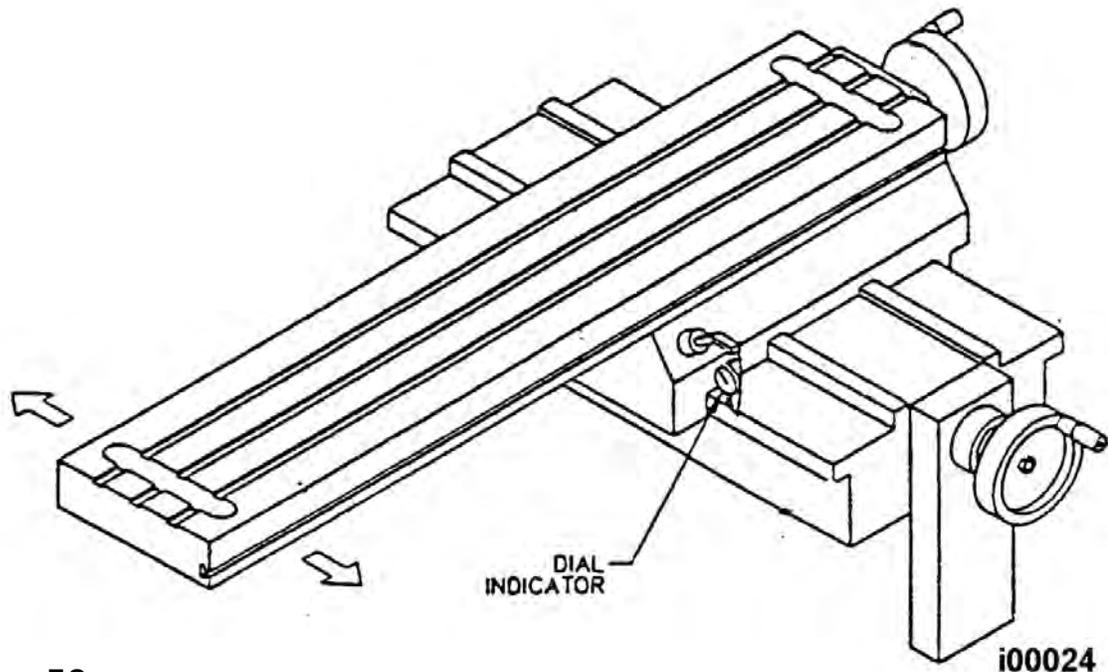
**Figure 52
Saddle Side Gib Adjustment**

5. Attach a .0001 dial indicator with a magnetic base to the left front of the saddle. Place the indicator stylus on the edge of the large box way.

6. Move the left end of the table back and forth and note the amount of movement on the dial indicator. Adjust the Y-axis side gib until the registered movement is .0010-.0015.

    - **To adjust the gib for excessive clearance**:
      Loosen the gib lock screw on the back of the saddle. Estimate the amount of gib lock screw adjustment required, and tighten the gib lock screw on the front of the saddle. Tighten the gib lock screw on the back end of the saddle to lock the gib in place, and recheck. Repeat as necessary

    - **To adjust the gib for too small of a clearance**:
      Loosen the gib lock screw on the front of the saddle. Estimate the amount of gib lock screw adjustment required, and tighten the gib lock screw on the back of

the saddle. Tighten the gib lock screw on the front of the saddle to lock the gib in place, and recheck. Repeat as necessary.

7. Replace the front and rear chip wiper, and chip wiper guard.

### 5.2.1.4 Saddle Bottom Gib Adjustment, Y-Axis (DPMSX2 & DPSX3 only)

See Figure 53.

1. Clean all chips, dirt and excess oil from the table and saddle.

2. Center the saddle on the bed ways.

3. Move the table fully to the left side of the saddle.

4. Attach a .0001 dial indicator with a magnetic base to the left front of the saddle. Place the indicator stylus on the top surface of the box way.

5. Lift the end of the table up and note the amount of movement on the dial indicator. Adjust the Y-axis left bottom gib until the registered movement is .0010-.0015.

6. Move the table fully to the right.

7. Reposition the indicator to the right front of the saddle.

8. Lift the right end of the table up and note the amount of movement on the dial indicator. Adjust the Y-axis right bottom gib until the registered movement is .0010-.0015.

- **To adjust the gib for excessive clearance**:
  Loosen the gib lock screw on the back of the saddle. Estimate the amount of gib lock screw adjustment required, and tighten the gib lock screw on the front of the saddle. Tighten the gib lock screw on the back end of the saddle to lock the gib in place, and recheck. Repeat as necessary.

- **To adjust the gib for too small of a clearance**:
  Loosen the gib lock screw on the front of the saddle. Estimate the amount of gib lock screw adjustment required and tighten the gib lock screw on the back of the saddle. Tighten the gib lock screw on the front of the saddle to lock the gib in place, and recheck. Repeat as necessary.

Figure 53
Saddle Bottom Gib Adjustment (DPMSX3 Only)

5.2.1.5 Saddle Bottom Gib Adjustment, Y-Axis (DPMSX5 only)

It is unrealistic to adjust the Y bottom ways the same way as we do on the DPMSX2 & DPMSX3 because of the extra weight of the saddle and table.

1. Clean all chips, dirt and excess oil from the table and saddle.

2. Center the saddle on the bed ways.

3. Mount your indicator on the left side of the saddle (Point C) with the table in the center of its travel and zero out your indicator.

4. Then move the table all the way to the right side. When the gibs are adjusted properly you should see no more than 0.0003″ movement on the indicator.

5. Do the same thing on the right side of the saddle (Point B) this time moving the table all the way to the left. The reading should be positive on the indicator because the saddle should rise where you are indicating.

Note: You can get better readings than 0.0003" but the torque on the Y ball screw may exceed our recommended levels. Remove the ball screw cover and check the torque with an in-lb torque wrench. Normally, the torque should be around 15 in-lbs. Do not exceed 20 in-lbs. Values higher than this may cause circularity problems.

See Figure 51 for an illustration.

- **To adjust the gib for excessive clearance**:
  Loosen the gib lock screw on the back of the saddle. Estimate the amount of gib lock screw adjustment required, and tighten the gib lock screw on the front of the saddle. Tighten the gib lock screw on the back end of the saddle to lock the gib in place, and recheck. Repeat as necessary.

- **To adjust the gib for too small of a clearance**:
  Loosen the gib lock screw on the front of the saddle. Estimate the amount of gib lock screw adjustment required and tighten the gib lock screw on the back of the saddle. Tighten the gib lock screw on the front of the saddle to lock the gib in place, and recheck. Repeat as necessary.

5.2.1.6   Ram Back Gib Adjustment - Z Axis

1. Clean all chips, dirt and excess oil from the table and saddle.

2. Disconnect one end of the upper and lower way cover where it is attached to the ram.

3   Position the milling head such that the table can be reached by extending the quill approximately 3/4 of its travel.

4. Place a wood block on the table underneath the spindle.

5. Attach a .0001 dial indicator with a magnetic base to the column near the base of the ram on the left side of the machine. Place the indicator stylus on the rear surface of the ram near the bottom.
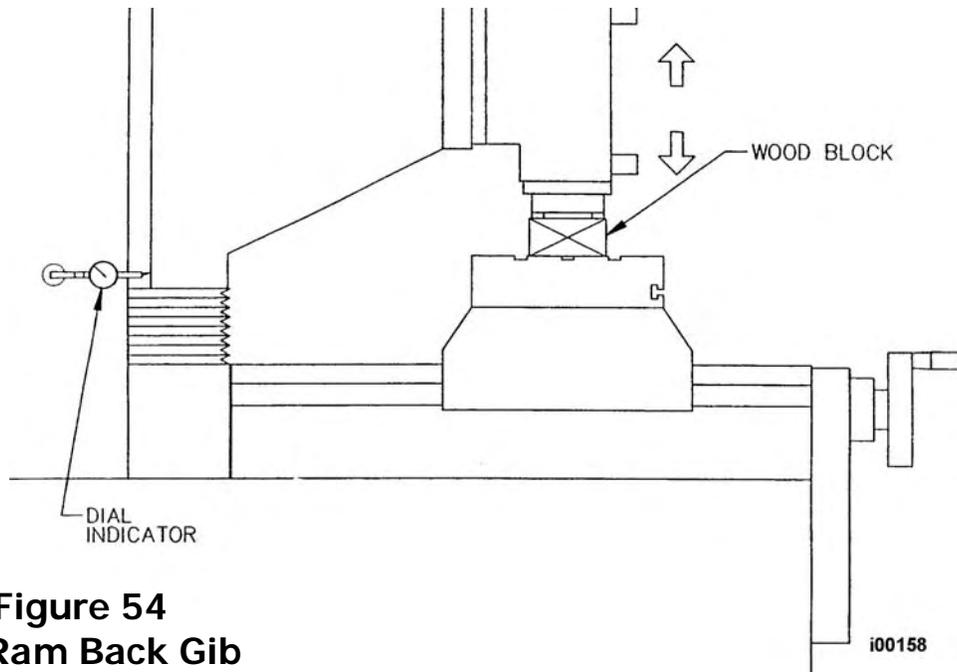
Figure 54
Ram Back Gib

i00158

6. Extend the quill until it touches the wood block. Using the quill handle, push the spindle nose against the wood block and note the amount of movement on the dial indicator. Adjust the left side gib until the registered movement is .001-.0015.

To adjust the gib for excessive clearance: Loosen the gib lock screw on the bottom of the ram. Estimate the amount of gib lock screw adjustment required and tighten the gib lock screw on the top of the ram. Tighten the gib lock screw on the bottom of the ram to lock the gib in place, and recheck. Repeat as necessary.

To adjust the gib for too small of a clearance: Loosen the gib lock screw on the top of the ram. Estimate the amount of gib lock screw adjustment required and tighten the gib lock screw on the bottom of the ram. Tighten the gib lock screw on the bottom of the ram. Tighten the gib lock screw on the top of the ram to lock the gib in place, and recheck. Repeat as necessary.

7. Run Service Code 12 to se the feed forward constant.

8. Repeat the procedure for the back gib on the right side of the machine.

5.2.1.7   Ram Side Gib Adjustment - Z Axis

1. Clean all chips, dirt and excess oil from the column ways.

2. Attach a .0001 dial indicator with a magnetic base towards the rear of the table on the right side of the ram. Place the indicator stylus on the ram in line and below the lower mounting bolt for the coolant hose connector block. (See Figure 55)

3. Lock and unlock the lower ram side gib lock and note the amount of movement on the dial indicator. Adjust the ram side gib until the registered movement is .0005-.0010.

To adjust the gib for excessive clearance: Loosen the gib lock screw on the bottom of the ram. Estimate the amount of gib lock screw adjustment required, and tighten the gib lock screw on the top of the ram. Tighten the gib lock screw on the bottom of the ram to lock the gib in place, and recheck. Repeat as necessary.

To adjust the gib for too small of a clearance: Loosen the gib lock screw on the top of the ram. Estimate the amount of gib lock screw adjustment required and tighten the gib lock screw on the bottom of the ram. Tighten the gib lock screw on the top of the ram to lock the gib in place, and recheck. Repeat as necessary.

4. Run Service Code 12 to set the feed forward constant.

5. Reattach the upper and lower way cover to the ram.

CAUTION!
Be careful not to over tighten the ram gibs. Over tightening may lead to faulting and repeatability problems. Double-check the gib adjustment by checking the torque on the Z-axis. Use an in-lb torque wrench on top of the ball screw and typical readings should be from 12 to 17 in-lbs and consistent across the Z travel.
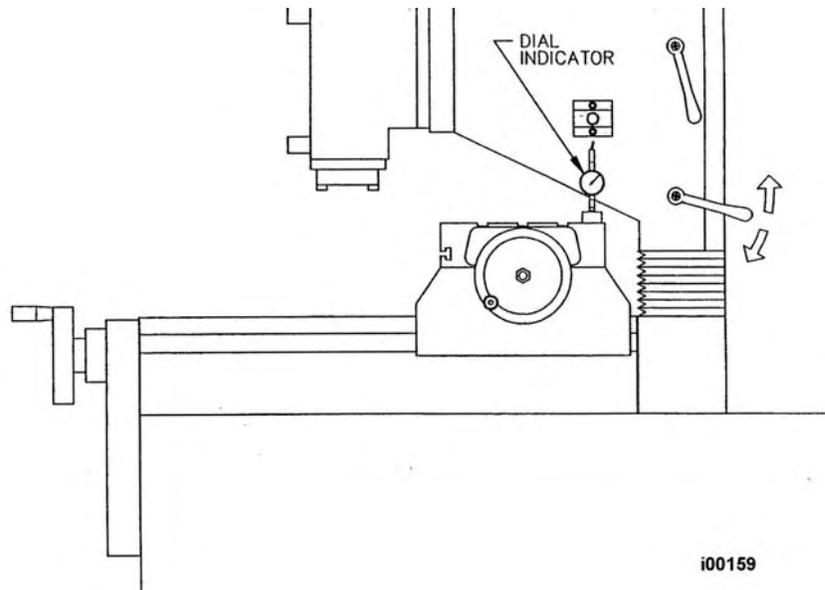
Figure 55
Ram Side Gib Adjustment

5.2.2 Calibration & Backlash Constants

Calibration and backlash constants were set as part of the installation and set-up of your system. They should be re-set when indicated in the Troubleshooting section or after the replacement of the Computer module, or any parts of the drive train.

5.2.2.1   X, Y, Z (Ram) and Quill Calibration

Calibration is used teach the machine a known distance. We typically calibrate our machines over a 150 mm distance. There is no limit to how far you can calibrate the machine.

1. If you have installed TRAK Sensors, move each axis through its travel 4-6 times in order to allow the gage wheel to establish its track.

2. Set-up a gauge block or standard and indicate it parallel to the axis you are calibrating.

    Note: Put the display in Inch or mm to match your gage block. Recommended gage blocks are:

    - X and Y -- 150mm or 6″

    - Z -- 75 mm or 3″

3. Set a 0.0001″ indicator in the spindle and move it up to one side of the gage block or standard.

4. Go to setup mode, go to section "B" and press CODE 123.

5. Select the axis you want to calibrate X, Y or Z. For the quill press the F1 key labeled QUILL.

6. Follow the instructions on the screen to complete calibration.
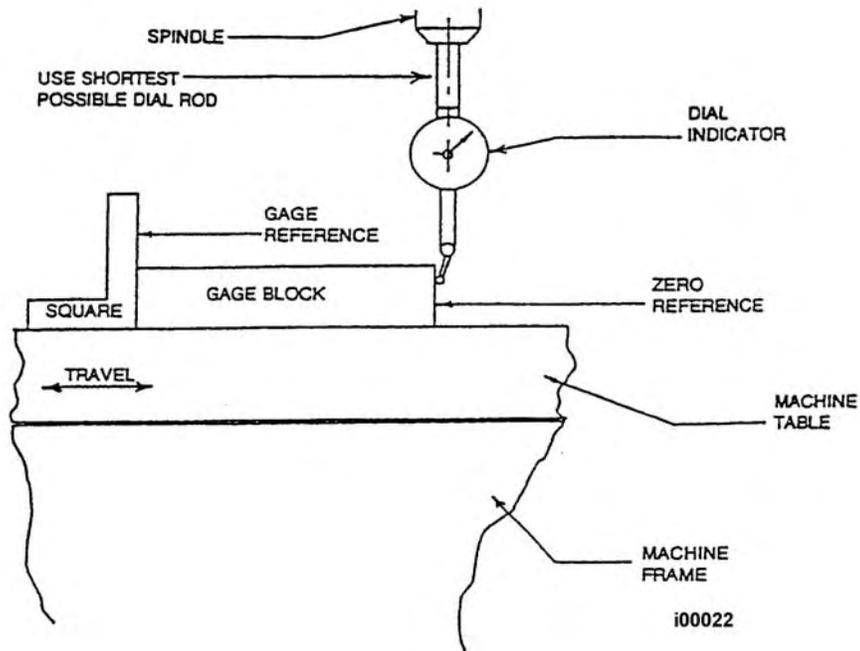
**Figure 56
Calibration Set-Up**

5.2.2.2   Backlash Compensation

Code 11: Set X or Y backlash constant

Note: this procedure is on systems with TRAK Sensors or Glass Scales only.

Go to setup mode, go to section "B" and press CODE 11. Refer to service code section for further explanation.

Code 127: Set X or Y Backlash Constant

Note: this procedure is only for systems without TRAK Sensors or Glass Scales.

Every mechanical system has at least a little backlash or lost motion. It is produced by the small amount of play between the gibs and ways, and mostly by the accumulative bending or elasticity of all the parts of the drive train under load. The backlash constant is factory set, but may need to be adjusted periodically.

1. Set a .0001-inch dial indicator in the spindle, and touch off on a block or the vise along the direction (X, Y or Z) you wish to check, or set the backlash constant.

2. Turn on the ProtoTRAK and at the Main Menu, follow the procedure below precisely:

Conversation Says	You Do
a. ---	a. Press MODE
b. Select Mode	b. Press SET UP
c. Select	c. Press SERV CODES
d. Select	d. Press "B"
e. Select Code 127	e. Press X or Y or Z
f. Backlash Value = _ _ _ _	f. What is shown is the current value. Follow the instruction on the screen and press the appropriate soft keys. Wait a few seconds between each INCR VALUE or DECR VALUE press.
g. The following is an example of what you might see when running this code.	For example, if the up and down "Oscillation Value" shown in the conversation line is .00278 inch, and the dial indicator is moving back and forth .0012, then the true backlash value is .00278 -.0012 = .00158 inch. Input this by pressing MODE, SET UP, SERV CODE, 128, SET and then .00158, SET, RETURN.

3. The X backlash identified and stored in Step 2 should be less than 0.003" on a new machine. If it is appreciably larger, inspect the drive train for loose bolts, brackets, bearings, etc.

   The backlash can also be found manually with a 0.0001" indicator with the following method.

   • Load the indicator to zero from one direction and zero out the DRO.

   • Move the indicator to 0.002" and then back to zero. Do not over shoot 0, otherwise start over.

- Whatever number appears on the screen is the backlash value.

- Enter this value into service code 128.

- After entering this number redo the process. The DRO and indicator should now both read 0.

CODE 128: Input Backlash Constant

Code 128 allows you to enter the backlash values for each axis. It displays the value after it enters. This code is only used on machines with motor encoders only.

5.2.3 Head Rotational and Tramming

The TRAK Bed Mills head is free to rotate up to 90 degrees to the right or left.

5.2.3.1 *To Rotate the Head:*

1. Loosen the four locknuts.

2. Rotate the head with the adjusting worm shaft.

3. Tighten the locknuts. Snug each locknut, then lightly tighten each locknut, then fully tighten each locknut in a crisscross pattern.

4. Use the method shown in the figure below and a parallel bar to square the head to the table.

5.2.3.2 *Tramming the Head*

The purpose of tramming the head is make sure the head is perpendicular to the top of the table from both side to side and back to front.

Side to side tolerance – 0.001″

Side-to-Side Alignment

1. Make sure the machine is level.

2. Make sure the table has been clean and the Z gibs are adjusted properly.
   Mount a dial indicator in a tool holder and mount in the quill.

3. Adjust the Y-axis so that the spindle is in the center of the table.

4. Adjust the Z ram so that the dial indicator will reach the table.

5. Move the dial indicator to 6 o'clock position and adjust the face so the needle is zero.

6. Do a series of sweeps from 3 o'clock to 9 o'clock and check for the repeatability of the setup. The head should be trammed with an 0.001″

7. If the head is out of tram from side to side then loosen the 4 head bolts and rotate the head with the worm shaft.

8. Once the head has been trammed tighten the 4 heads bolts. Be careful not to move the head while tightening. Tighten the bolts in a criss-cross pattern.
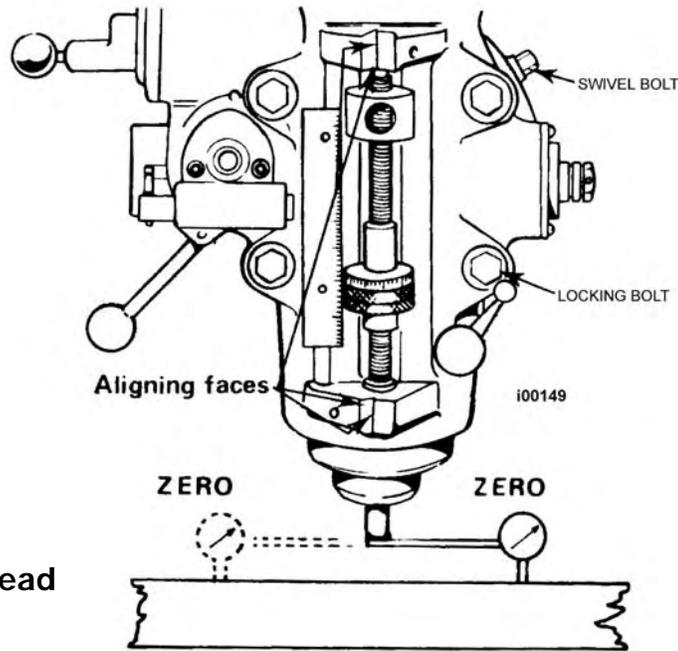
Figure 57
Tramming of Head

Back to Front Adjustment

Note: The head of the DPM bed mills machine is adjusted at the factory. This procedure should only be needed for a head replacement. It is placed in this section for continuity with the tramming discussion.

With the dial indicator sweep the table from 6 o'clock to 12 o'clock. The head should be trammed within 0.0000 to 0.0005″ from front to back. (Note: the head must droop down rather than up because tool pressure will take care of the extra 0.0005″.)

Note: Minor adjustments can be made with the back ram gibs. Tightening the gibs will tend to tilt the head up from the table. Loosening the gibs tends to allow the head to droop down toward the table. Over tightening or loosening can lead to other problems with the machine. Typical adjustments with the gibs is 0.0005" or less.

5.2.4 Limit Switch Option

5.2.4.1 X-Axis Limit Switch-Stop Installation and Adjustment

The limit switch-stops for the X-axis are mounted to the front side of the table. The limit switch-stop consists of a square bracket, which is fastened to the T-slot on the front side of the table. Each limit switch-stop must be set to a specific distance from the end of the table in order to maximize travel and simultaneously prevent serious damage to the machine in the event of a crash. All limit switches are set at the factory for maximum travel.

Procedure for Setting X Limit Switch

1. Loosen the X-axis square bracket on each side of the table.

2. Slide each X-axis square bracket within the T-slot to the end of the table.

3. Slowly move the table to one side by hand until the end of the travel is reached.

4. In DRO mode set X = 0 ABS.

CAUTION!
The limit switch must be triggered a minimum of ½" before the machine reaches its travel limits in both directions. This allows sufficient room for the servomotors to stop when the limit switch is hit at 150 ipm.

---

5. Using the DRO display, back the table off 1/2".

6. Lock the limit switch bracket in place.

7. Jog the table at 150ipm to each side and verify that the limit switch is working properly. Also, make sure that the table does not exceed its travel and crash.

5.2.4.2   Y & Z-Axis Limit Switch-Stops

The limit switch-stops for the Y-axis are mounted on the side of the bed. The limit switch is triggered by hitting the cam stop on the saddle. The cam is placed to ensure maximum travel.

The limit switch-stops for the Z-axis are mounted on the side of the column. The limit switch is triggered by hitting the trip lever. After contact is made with the limit switch, lift the trip lever and jog the head up or down to move the machine away from the limit. The trip levers are placed to ensure maximum travel.

6.0   Figures and Parts Lists

Figure 58
Top Housing Assembly
DPMSX3 & DPMSX5
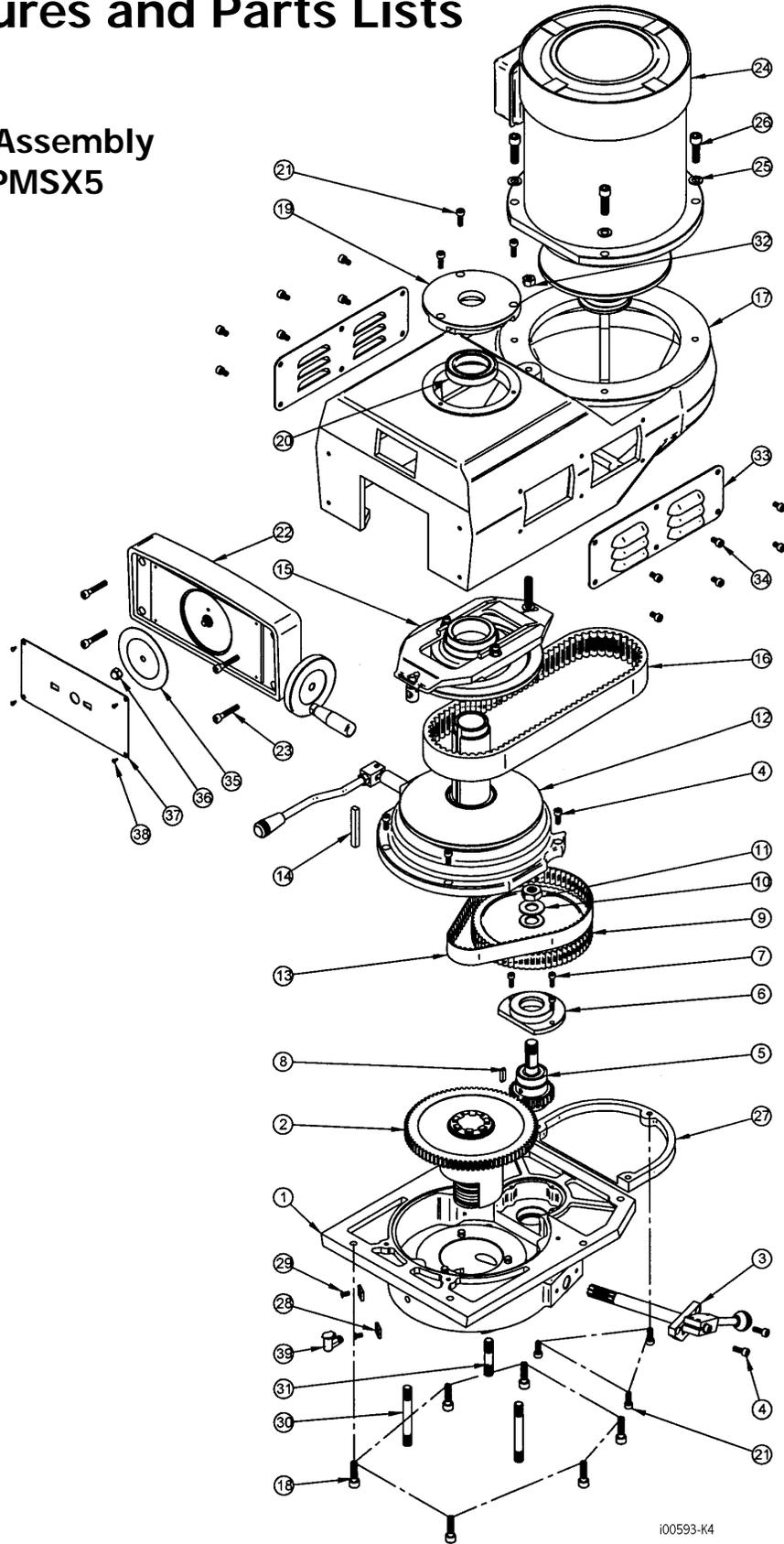
i00593-K4

Parts List - Top Housing Assembly

Item	P/N	DESCRIPTION	Qty
1	20697-1	FRU-SK4-GEAR HOUSING SUB-ASSY (4VK-A1)	1
2	20697-2	FRU-SK4-HI-LOW SHIFT CLUTCH SUB-ASSY (4VK-A2)	1
3	20697-3	FRU-SK4-HI-LOW SHIFT SUB-ASSY (4VK-A3)	1
4	FVS12	SOCKET CAP SCREW M6-P1.0x15L	2
5	20697-4	FRU-SK4-PULLY PINION SUB-ASSY (4VK-A4)	1
6	FVS64	BULL GEAR PINION BEARING CAP	1
7	FVS93	SCREW SOC HD M5-P0.8x15L	1
8	FVS117	KEY 5x520L	1
9	FVS62	TIMING BELT PULLEY	1
10	FVS126	WASHER Ø 5/8	1
11	FVS61	JAM NUT 5/8-11NC	1
12	20697-5	FRU-SK4-LOWER VARI-DISC DRIVE SUB-ASSY (4VK-A5)	1
13	FVS63	BELT 8YU-600L	1
14	FVS135	KEY 8x7x60L	1
15	20697-6	FRU-SK4-UPPER VARI-DISC DRIVE SUB-ASSY (4VK-A6)	1
16	FVS4	BELT	1
17	FVS1	BELT HOUSING	1
18	FVS17	SOCKET CAP SCREW M6-P1.0x35L	1
19	FVS13	TOP BEARING CAP	1
20	FVS15	BALL BEARING (6909VV)	1
21	FVS129	SCREW- SOC HD CAP M6-P1.0x18L	1
22	20697-7	FRU-SK4-SPEED CHANGE HANDWHEEL SUB-ASSY (4VK-A7)	1
23	FVS10	SCREW- SOC HD CAP M8-P1.25x30L	1
24	20820-1	MOTOR ASSY-DPM5-5HP-WHITE	1
25	FVS130	WASHER- FLAT Ø 10.2	4
26	FVS111	SOC HD SCREW- 3/8-16NCx32L	4
27	FVS11	MOTOR PULLEY COVER	1
28	FVS104	COPPER CHIP(2REQ.)	2
29	FVS131	SCREW- FLAT HD PHILIP M5-P0.8x10L	1
30	FVS132	STUD Ø 7/16-92L	2
31	FVS133	STUD Ø 7/16-56L	1
32	FVS96	JAM NUT 3/8-16NC	1
33	FVS101	VENTILATOR(2REQ.)	2
34	FVS136	SCREW- SOC HD CAP M6-P1.0x10L	12
35	FVS16-1	VARI-SPEED DIAL	1
36	FVS95	HEX CAP NUT 5/16-18NC	1
37	FVS16-2	NAME PLATE	1
38	FVS19	DRIVE SCREW	1
39	OIL-1	FRU-K3-OIL CUP	1

i00593-K4
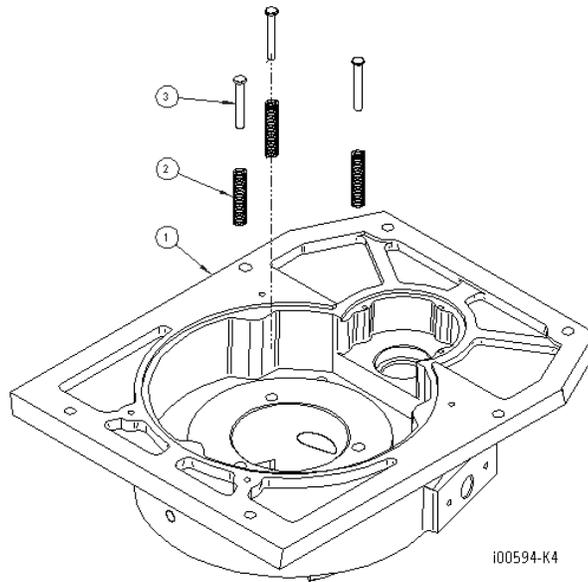
i00594-K4

Figure 59
Gear Housing Sub-Assembly, DPMSX3 & DPMSX5
P/N: 20697-1

Item	P/N	Description	Qty
1	FVS82	GEAR HOUSING	1
2	FV112	GUIDE SPRING	3
3	FV113	SPRING GUIDE PIN	3

i00594-K4

Item	P/N	DESCRIPTION	Qty
1	FVS75	BEARING SLIDING HOUSING	1
2	23943	BALL BAEARING (2 REQ.) 6910ZZ	1 SET
3	FVS78	BEARING SPACER	1
4	FVS79	BEARING SPACER	1
5	FVS80	SNAP RING R-75	1
6	FVS73	SPLINED GEAR HUB	1
7	FVS72	KEY 8x7x10L	1
8	FVS74	SPINDLE BULL GEAR	1
9	FVS114	WASHER	1
10	FVS115	EXTERNAL TOOTH WASHER Ø 50	1
11	FVS81	LOCK WASHER Ø 50-18NC	1
12	FVS76	RING	1
13	20818	SPACER, BEARING	1

i00595-K4

Figure 60
Hi-Low Slip Clutch
Sub-Assembly, DPMSX3 & DPMSX5
P/N: 20697-2

i00595-K4

i00596-K4
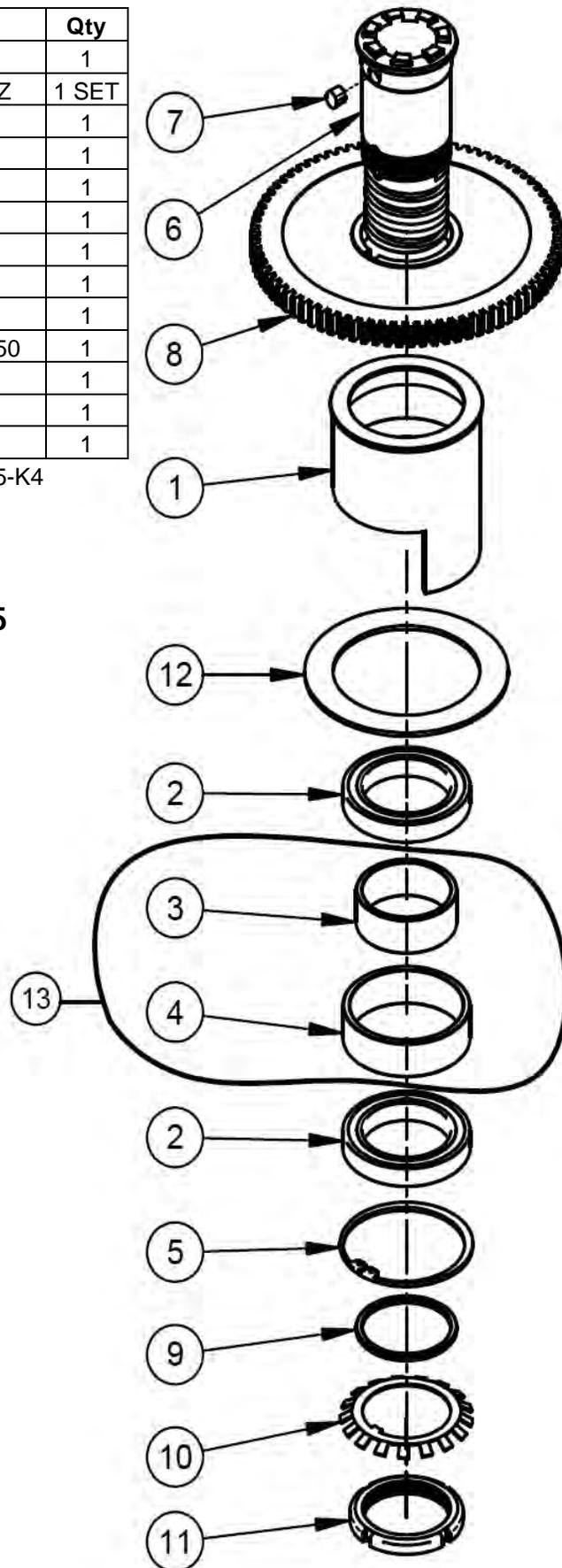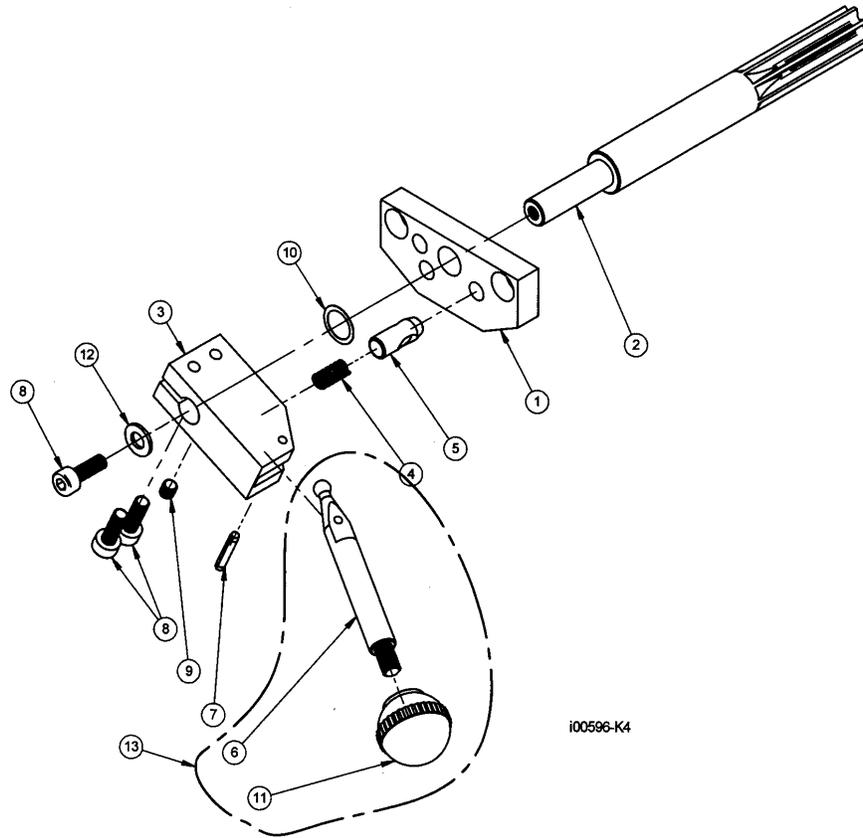
Item	P/N	DESCRIPTION	Qty
1	FVS89	HI-LOW DETENT PLATE	1
2	FVS87	CLUTCH GEAR SHAFT	1
3	FVS92	HI-LOW PINION BLOCK	1
4	FVS91	SPRING	1
5	FVS90	HI-LOW DETENT PLUNGER	1
6	FVS94	HI-LOW SHAFT CRANK	1
7	FVS88	PIN Ø 319L	1
8	FVS93	SCREW SOC HD M5-P0.8x15L	3
9	FVS92-1	SET SCREW M5-P0.8x5L	1
10	FVS92-2	WASHER- FLAT Ø 11	1
11	FVS57	BAKELITE BALL HANDLE	1
12	FVS116	WASHER- FLAT Ø 6	1
13	24083	SHAFT HI/LOW SHAFT ASSY	1

i00596-K4

Figure 61
Hi-Low Shift Sub-Assembly, DPMSX3 & DPMSX5
P/N: 20697-3
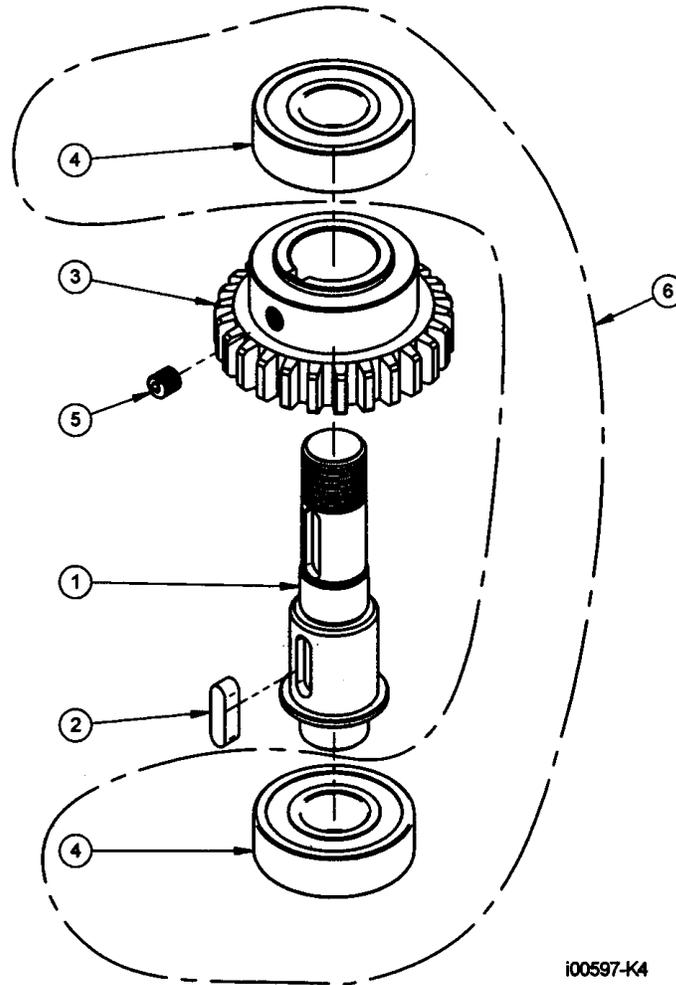
i00597-K4

Item	P/N	DESCRIPTION	Qty
1	FVS67	BULL GEAR PINION COUNTER SHAFT	1
2	FVS69	KEY 5518L	1
3	FVS66	BULL GEAR PINION	1
4	FVS65	BALL BEARING (2 REQ.) 6203ZZ	2
5	FVS3	SOCKET SET SCREW M6-P1.0x6L	1
6	23954	BEARING SET (2) -BEARINGS 6203ZZ	1

i00597-K4

Figure 62
Pulley Pinion Sub-Assembly, DPMSX3 & DPMSX5
P/N: 20697-4
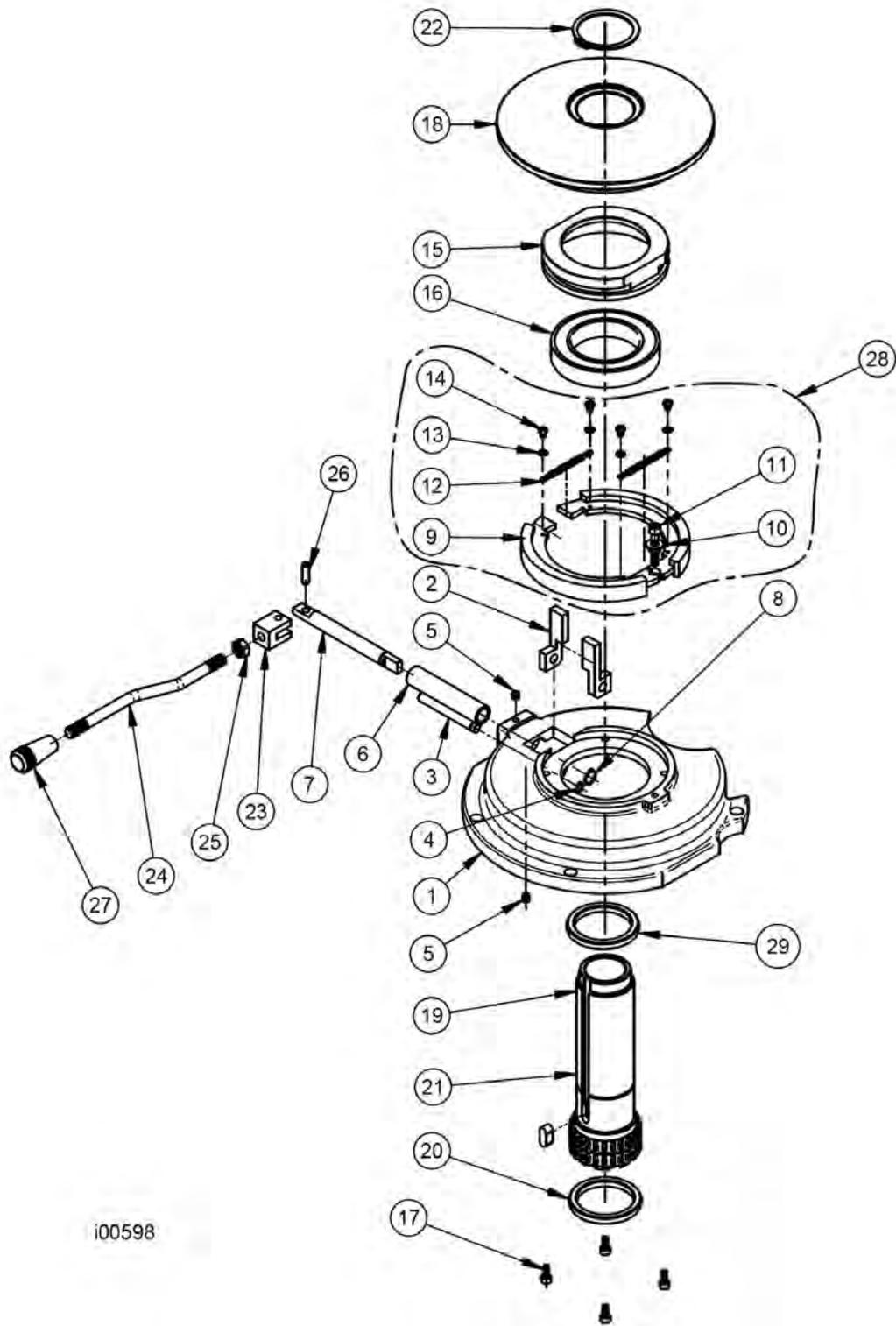
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Figure 63-a
Lower Vari-Disc Sub-Assembly, DPMSX3 & DPMSX5
P/N: 20697-5

Parts List - Lower Vari-Disc Sub-Assembly

Item	P/N	DESCRIPTION	Qty
1	FVS50	BELT HOUSING BASE	1
2	FVS59	BRAKE BLOCK	2
3	FVS58	TURNING BLOCK SHAFT	1
4	FVS103	RETAINING RING Ø 7	1
5	FVS51	SET SCREW M6-P1.06L	2
6	FVS53	BRAKE LOCK BUSHING	1
7	FVS52	BRAKE LOCK SHAFT	1
8	FSV119	RETAINING RING Ø 11	1
9	FVS47	BRAKE SHOE	2
10	FVS48	BRAKE SHOE PIVOT SLEEVE	1
11	FVS17	SOCKET CAP SCREW M6-P1.0x35L	1
12	FVS49	BRAKE SPRING	2
13	FVS122	WASHER Ø 6	4
14	FVS120	SCREW- PHILLIP PAN HD 3/16-24NC6L	4
15	FVS46	BRAKE BEARING CAP	1
16	FVS43-1	BALL BEARING 6012ZZ	1
17	FVS14	SOCKET CAP SCREW M 5-PO.8x12L	4
18	FVS45	STATIONARY DRIVEN VARIDISC	1
19	FVS70	SPINDLE PULLEY ASSY	1
20	FVS100	SPINDLE PULLEY SPACER	1
21	FVS71	KEY 8x8x20L	1
22	FVS97	SNAP RING Ø 50	1
23	FVS52-1	BRAKE LOCK SHAFT SWIVEL	1
24	FVS56	BRAKE LOCK HANDLE	1
25	FVS54	HANDLE FIX BLOCK 3/8-16NC	1
26	FVS55	SPRING PIN Ø 6x20L	1
27	FVS57-1	BAKELITE BALL HANDLE 3/8-16NC	1
28	24055	BRAKE SHOE ASSY	1
29	FVS98	CLUTCH WASHER	1

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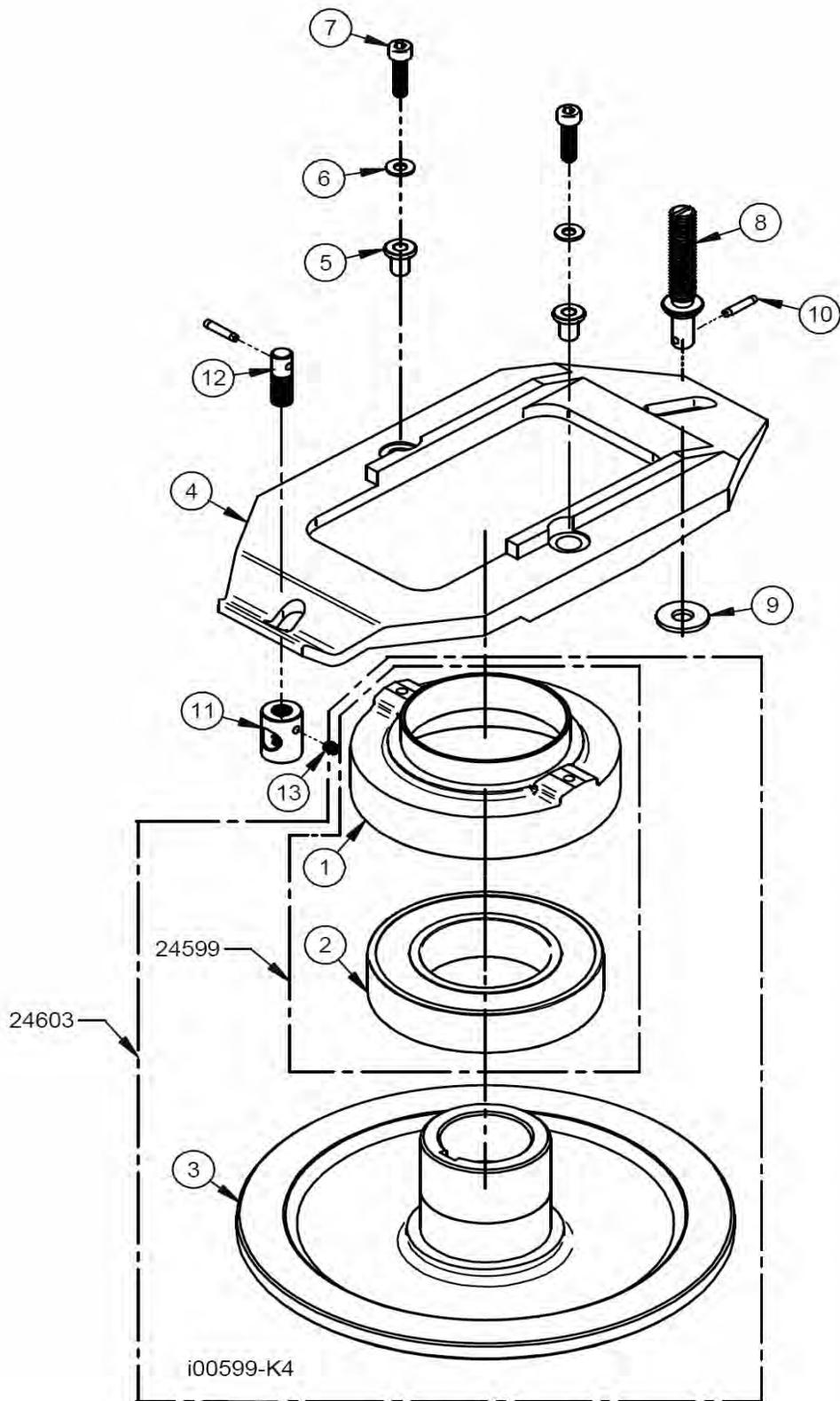
Figure 63-b
Upper Vari-Disc Sub-Assembly, DPMSX3 & DPMSX5
P/N: 20697-6

Parts List - Upper Vari-Disc Sub-Assembly

Item	P/N	DESCRIPTION	Qty
1	FVS42	SPINDLE PULLEY BEARING HOUSING	1
2	FVS43	BALL BEARING 6013ZZ	1
3	FVS44	ADJUSTABLE-DRIVEN VARIDISC	1
4	FVS36	SPEED CHANGE PLATE	1
5	FVS38	SOCKET CAP SCREW	2
6	FVS37	PIVOT SLEEVE Ø 5	2
7	FVS123	WASHER M5-P0.8x20L	2
8	FVS39	SPEED CHANGE PLATE PIVOT STUD	1
9	FVS41	WASHER Ø 8.2	1
10	FVS40	ROLL PIN Ø3x15L	2
11	FVS35	CHAIN END STUD	1
12	FVS34	ADJUSTMENT NUT	1
13	FVS33	CHAIN FRONT SCREW M4-P0.7x5L	1

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Parts List – 24599 Sub-Assy Bearing Housing K4

Item	P/N	Title	Qty
1	FVS42	SPINDLE PULLEY BEARING HOUSING	1
2	FVS43	BALL BEARING 6013ZZ	1

Parts List – 24603 Sub-Assy Vari Disc Adjustable

Item	P/N	Title	Qty
1	FVS42	SPINDLE PULLEY BEARING HOUSING	1
2	FVS43	BALL BEARING 6013ZZ	1
3	FVS44	ADJUSTABLE-DRIVEN VARIDISC W/ KEY	1

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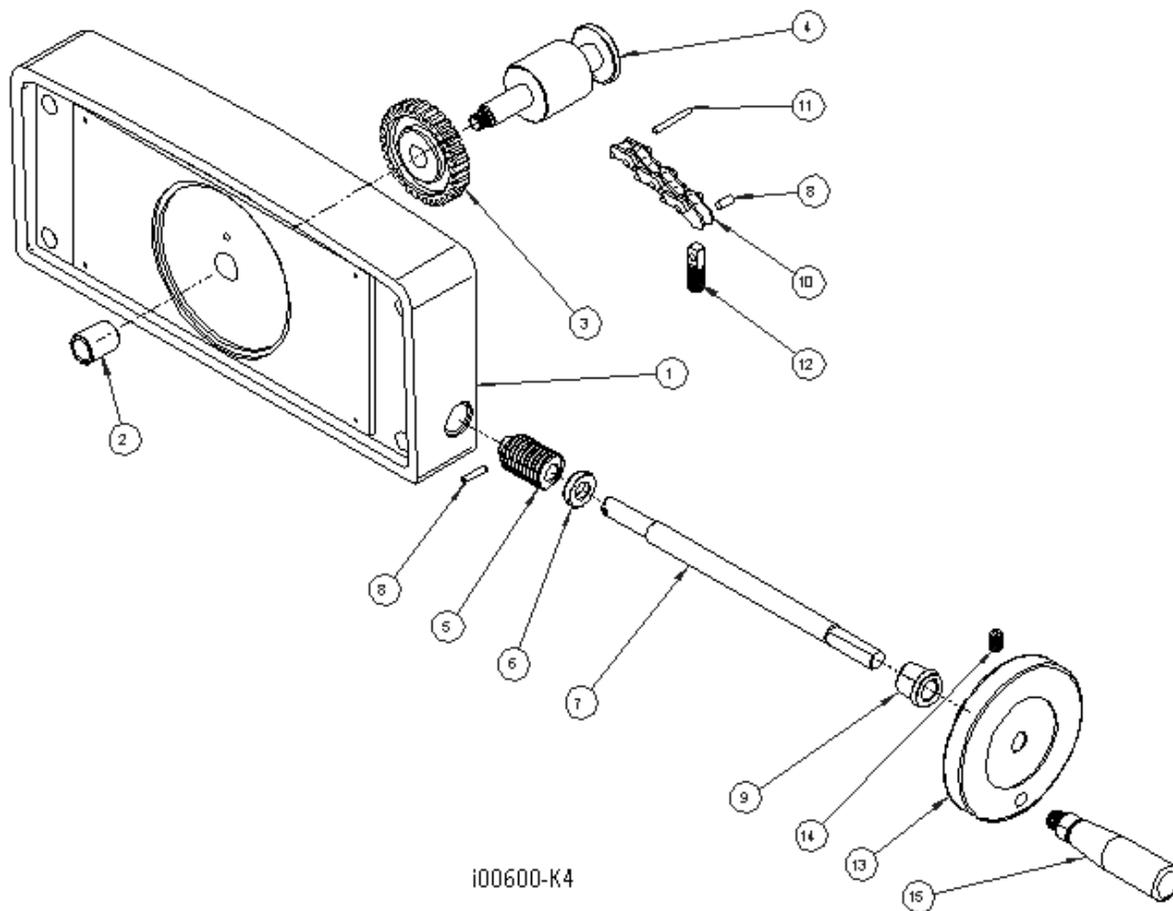
Item	P/N	Title	Qty
1	FVS16	SPEED CHANGE HOUSING	1
2	FVS20	BEARING SELF LUBRICATING	1
3	FVS22	SPEED CHANGER GEAR	1
4	FVS31	SPEED CHANGE CHAIN DRUM	1
5	FVS21	WORM	1
6	FVS125	WASHER	1
7	FVS25	SPEED CHANGE SHAFT	1
8	FVS40	ROLL PIN Ø3x15L	2
9	FVS24	COPPER BUSHING	1
10	FVS32	CHAIN #3109.525	1
11	FVS31-1	DOWEL PIN Ø3x25L	1
12	FVS30	SPEED CHANGE STUD	1
13	FVS27	SPEED CHANGE HANDWHEEL	1
14	FVS18	FULL DOG SOCKET SET SCREW M6-P1.0x10L	1
15	FVS28	HANDLE 3/8-16NC	1

i00600-K4

Figure 64
Speed Change Handwheel Sub-Assembly,
DPMSX3 & DPMSX5
P/N: 20697-7

i00601-K4
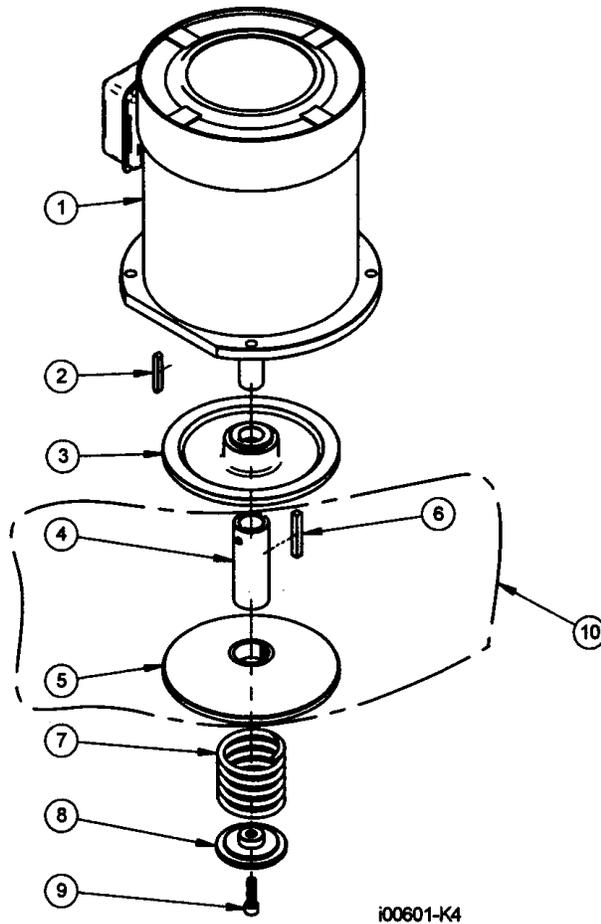
Item	P/N	Title	Qty
1	FVS110	MOTOR 5 HP	1
2	FVS3-1	KEY 6x6x45L	1
3	FVS2	STATIONARY MOTOR VARIDISC	1
4	FVS6	BUSHING	1
5	FVS5	ADJUSTABLE MOTOR VARIDISC	1
6	FVS6-1	KEY 7x7x50L	1
7	FVS8	SPRING FOR VARIDISC MOTOR SHAFT	1
8	FVS9	ADJUSTABLE VARIDISC SPRING COLLAR	1
9	FVS10	SCREW- SOC HD CAP M8-P1.25x30L	1
10	24054	VARIDISC ASSY	1

i00601-K4

Figure 65
Spindle Motor Sub-Assembly, DPMSX3 & DPMSX5
P/N: 20820-1
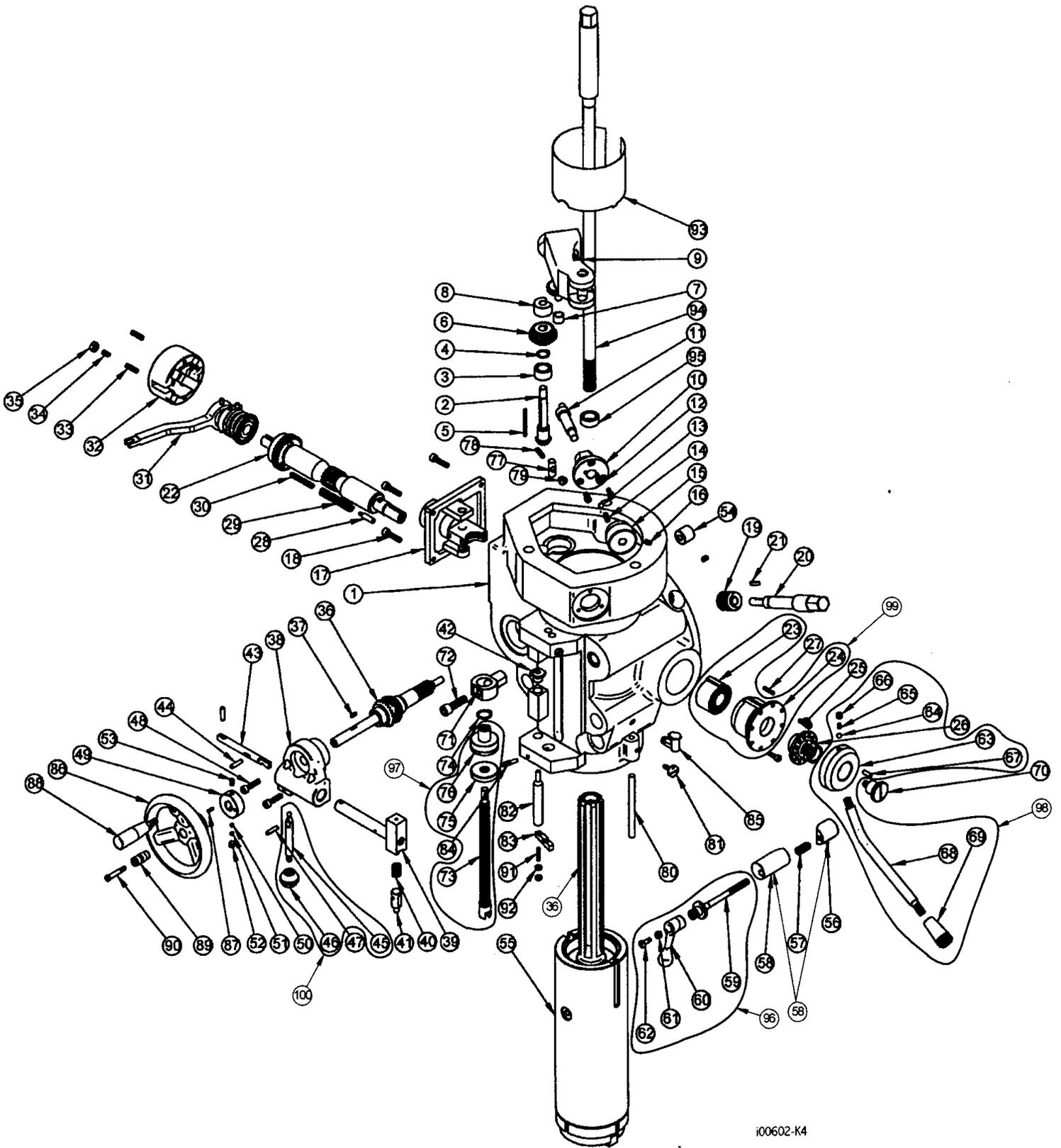
Figure 66
Bottom Housing Assembly, DPMSX3 & DPMSX5

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Parts List - Bottom Housing Assembly

Item	P/N	DESCRIPTION	Qty
1	FVS75	BEARING SLIDING HOUSING	1
2	23943	BALL BAEARING (2 REQ.) 6910ZZ	1 SET
3	FVS78	BEARING SPACER	1
4	FVS79	BEARING SPACER	1
5	FVS80	SNAP RING R-75	1
6	FVS73	SPLINED GEAR HUB	1
7	FVS72	KEY 8x7x10L	1
8	FVS74	SPINDLE BULL GEAR	1
9	FVS114	WASHER	1
10	FVS115	EXTERNAL TOOTH WASHER Ø 50	1
11	FVS81	LOCK WASHER Ø 50-18NC	1
12	FVS76	RING	1
13	20818	SPACER, BEARING	1
14	FB25-B	SPRING COVER	1
15	FB23	SHIFT CRANK	1
16	FB68	SET SCREW M6-P1.0x8L	1
17	20698-2	FRU-SK4-QUILL FEED SELECTOR SUB ASSY (4VK-H2)	1
18	FB67	CAP SCREW M6-P1.0x18L	4
19	FB186	WORM GEAR	1
20	FB189	ADJ WORM SHAFT	1
21	FB187	KEY 4x4x18L	1
22	20698-3	FRU-SK4-QUILL PINION SHAFT SUB-ASSY (4VK-H3)	1
23	FB178	CLOCK SPRING	1
24	FB177	SPRING COVER	1
26	FB176	PINION SHAFT HUB SLEEVE	1
27	FB171	KEY 3x3x20L	1
28	FB89	OVERLOAD CLUTCH LEVER SPRING PLUNGER	1
29	FB88	COMPRESSION SPRING	1
30	FB88-1	INTERNAL COMPRESSION SPRING	1
31	20698-4	FRU-SK4-OVERLOAD CLUTCH TRIP SUB-ASSY (4VK-H4)	1
32	FB99	CLUTCH ARM COVER	1
33	FB73	CAP SCREW M5-P0.8x40L	2
35	FB101	CHEM BLACKED LOCKNUT M6-P1.0	1
36	20698-5	FRU-SK4-FEED REVERSE CLUTCH SUB-ASSY (4VK-H5)	1
37	FB109	KEY 3x3x20L	1
38	FB106	FEED TRIP BRACKET	0
39	FB118	CAM ROD SLEEVE ASSY.	1
40	FB120	COMPRESSION SPRING	1
41	FB121	TRIP PLUNGER	1
42	FB123	TRIP PLUNGER BUSHING	1
43	FB103	CAM ROD	1
44	FB117	ROLL PIN Ø 3x15L	1
45	FB104	TRIP HANDLE	1
46	FB105	BLACK PLASTIC BALL	1
47	FB119-1	ROLL PIN Ø 3x20L	1
48	FB107	CAP SCREW M6-P1.0x25L	2
49	FB113	HAND WHEEL CLUTCH	1
51	FB115	COMPRESSION SPRING	1
53	FB108	SET SCREW M6-P1.0x8L	1

54	FB42	BUSHING	1
55	FB142	QUILL	1
56	20836-1	SPINDLE ASSY	1
57	FB148-1A	COMPRESSION SPRING	1
58	20844	QUILL LOCK SLEEVE ASSY	1 SET
59	FB152	QUILL LOCK BOLT	1
60	FB149	LOCK HANDLE	1
61	FB149-1	CONICAL COMPRESSIONAL SPRING	1
62	FB149-2	SCREW- PHILLIP HD	1
63	FB175	RACK FEED HANDLE HUB	1
64	FB114	STEEL BALL	2
65	FB175-2A	COMPRESSION SPRING	1
66	FB116	HANDWHEEL CLUTCH SPRING SCREW M8-P1.25x6L	2
67	FB175-3	DOWEL PIN	1
68	FB190	PINION SHAFT HUB HANDLE	1
69	FB191	PLASTIC BALL HANDLES	1
70	FB172	PINION SHAFT HUB SCREW	1
71	FB163	QUILL STOP KNOB	1
72	FB200	SCREW- SOC HD 3/8-24NF x 1 1/4	1
73	FB164	QUILL STOP MICRO-SCREW	1
74	FB160	SNAP RING Ø16	1
75	FB161	QUILL MICRO-STOP NUT	1
76	FB162	MICROMETER NUT	1
77	FB184	FEED REVERSE TRIP PLUNGER	1
78	FB183	REVERSE TRIP BALL LEVER	1
79	FB185	REVERSE TRIP BALL LEVER SCREW	1
80	FB202	INDICATOR ROD	1
81	FB201	INDICATOR ROD SCREW	1
82	FB124	FEED TRIP PLUNGER	1
83	FB145	FEED TRIP LEVER	1
84	FB144	SOCKET SET SCREW	1
85	OIL-1	FRU-K3-OIL CUP	1
86	FB125	HANDWHEEL	1
87	FB125-1	HANDWHEEL SPRING PIN - Ø 3x3x10L	1
88	FB125-2	HANDWHEEL HANDLE	1
89	FB111	REVERSE KNOB	1
90	FB100	SOCKET SET SCREW M6-P1.0x20L	2
91	FB124-1	FEED TRIP PLUNGER SOC SET SCREW M4-P0.7x20L	1
92	FB124-2	FEED TRIP PLUNGER NUT M4-P0.7x20L	2
93	FB128	QUILL SKIRT	1
94	FVS109	DRAWBAR 5/8-11NC	1
95	FVS109-1	SPACER	1
96	20846	QUILL LOCK HANDLE ASSY	1
97	20847	MICRO SCREW, MICRO-STOP NUT & MICROMETER NUT ASSY	1
98	20850	FEED HANDLE ASSY	1
99	24095	CLOCK SPRING ASSY	1
100	24099	TRIP HANDLE ASSY	1

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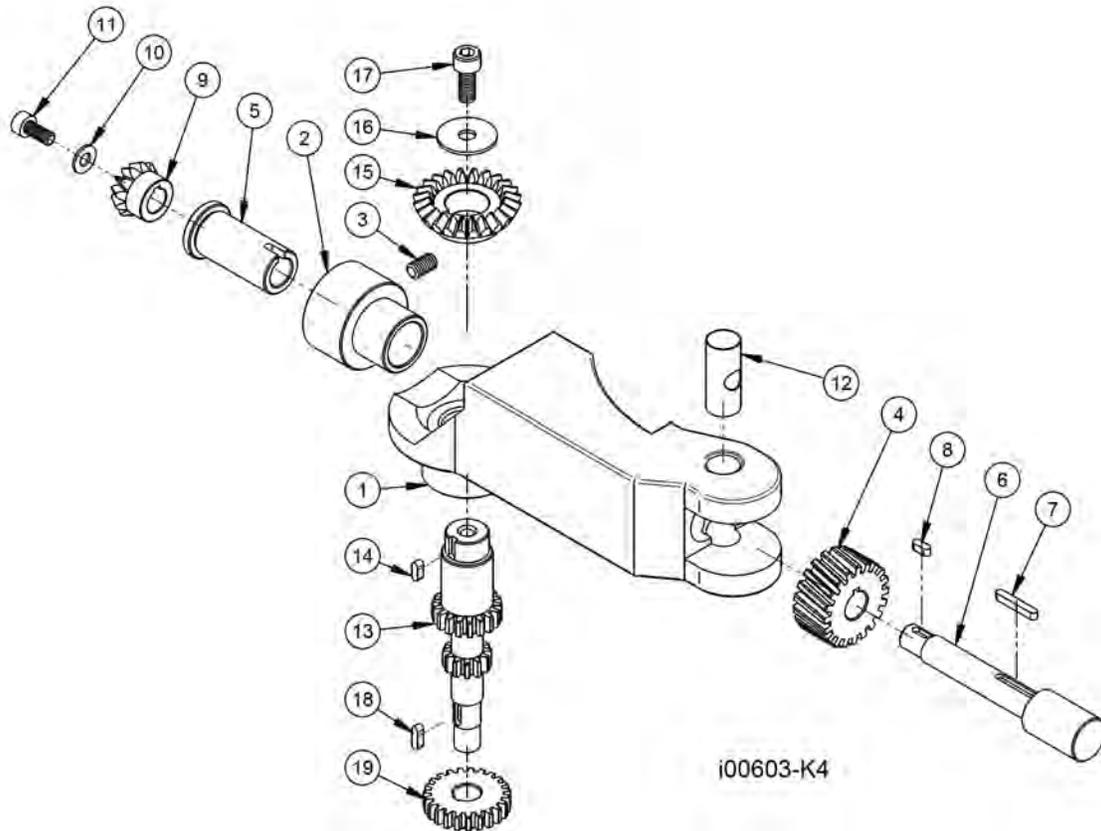
Item	P/N	Title	Qty
1	FB17	WORM GEAR CRADLE	1
2	FB5	WORM CRADLE BUSHING	1
3	FB6	SETSCREW M6-PP1.0x10L	1
4	FB8	FEED DRIVEWORM GEAR	1
5	FB4	FEED WORM GEAR SHAFT SLEEVE	1
6	FB9	FEED DRIVE WORM GEAR SHAFT	1
7	FB11	KEY 3x3x20L	1
8	FB10	WORM SHAFT KEY 3x3x8L	1
9	FB3	FEED BEVEL PINION	1
10	FB2	BEVEL PINION WASHER Ø 5	1
11	FB1	SOC.HD.SCREW M5-P0.8x10L	1
12	FB16	FEED ENGAGE PIN	1
13	FB36	FEED DRIVING GEAR	1
14	FB36-1	KEY 3x3x8L	1
15	FB15	FEED REVERSE BEVEL GEAR	1
16	FB13	WASHER Ø 6 Ø 22	1
17	FB14	SOC HD SCREW M6-P1.0x15L	1
18	FB37	KEY 3x3x10L	1
19	FB40	FEED DRIVE GEAR	1

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Figure 67
Worm Gear Cradle Sub-Assembly, DPMSX3 & DPMSX5
P/N: 20698-1

i00604-K4
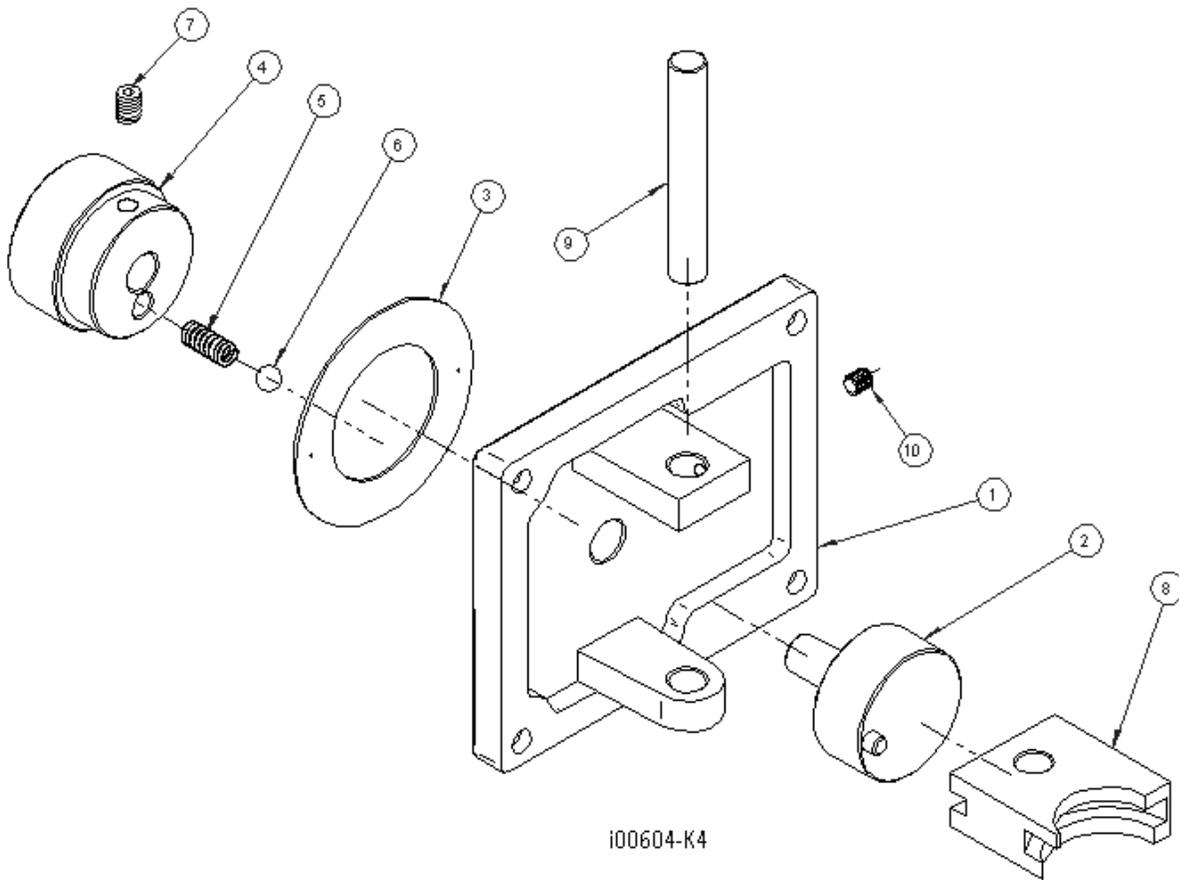
Item	P/N	DESCRIPTION	Qty
1	FB66	CLUSTER GEAR COVER	1
2	FB64	CLUSTER GEAR SHIFT CRANK	1
3	FB69-1	DIAL	1
4	FB69	SHIFT KNOB	1
5	FB71	SPRING	1
6	FB70	STEEL BALL	1
7	FB68	SET SCREW M6-P1.0x8L	1
8	FB63	FEED GEAR SHIFT FORK	1
9	FB60	FEED SHIFT ROD	1
10	FB61	KP.SET SCREW M5-P0.8x6L	1

i00604-K4

Figure 68
Quill Feed Selector Sub-Assembly, DPMSX3 & DPMSX5
P/N: 20698-2

i00605-K4
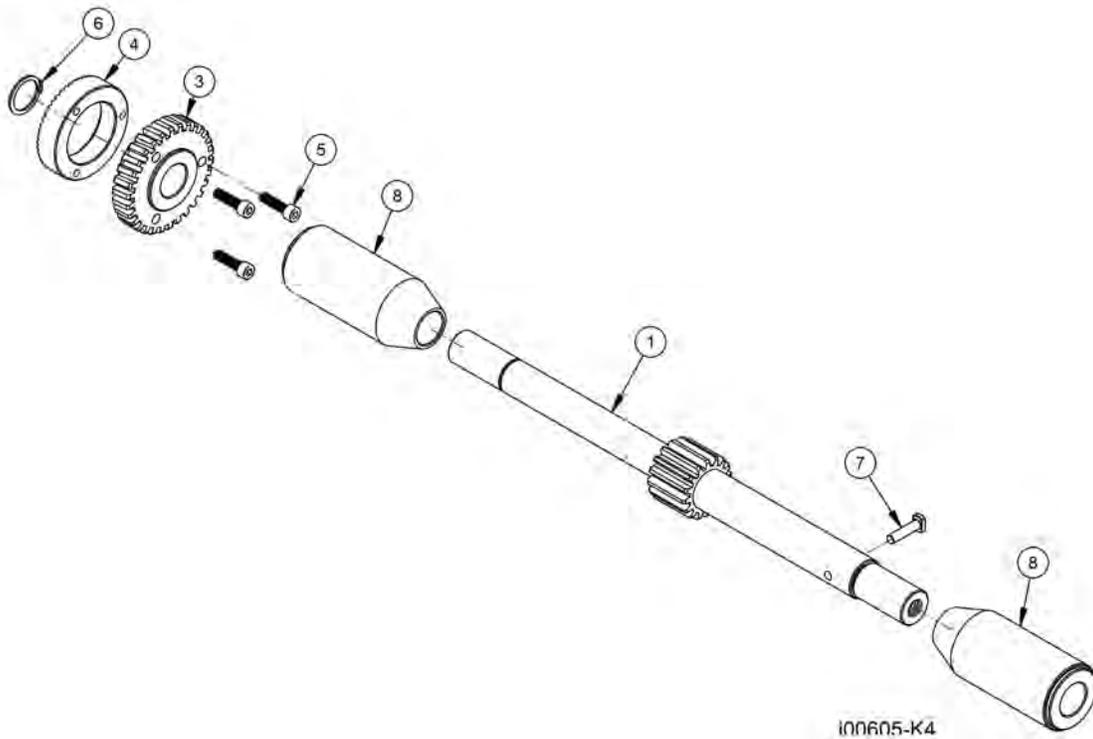
Item	P/N	DESCRIPTION	Qty
1	K-B166	FRU-K3-QUILL PINION SHAFT	1
3	K-B92	FRU-K3-OVERLOAD CLUTCH WORM GEAR	1
4	K-B93	FRU-K3-OVERLOAD CLUTCH RING	1
5	K-B92-1	FRU-K3-SCREW SOC HD CAP M4-P0.7x15L	3
6	K-B94	FRU-K3-SNAP RING 95 DOWEL PIN Ø 14	1
7	K-B168	FRU-K3-SCREW PIN	1
8	K-B90	FRU-K3-QUILL PINION SHAFT BUSHING- LEFT	2

i00605-K4

Figure 69
Quill Pinion Shaft Sub-Assembly, DPMSX3 & DPMSX5
P/N: 20698-3
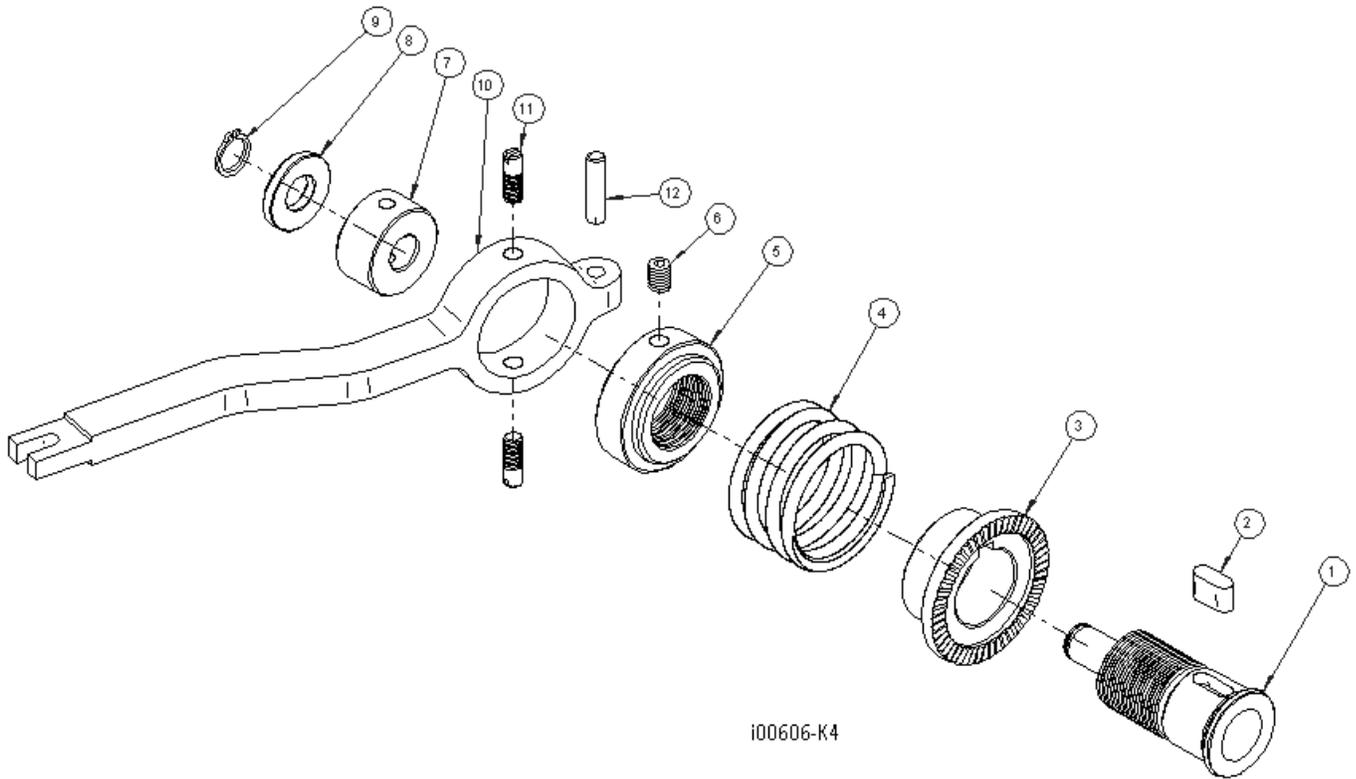
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Item	P/N	Title	Qty
1	FB81	OVERLOAD CLUTCH SLEEVE	1
2	FB81-1	KEY 5x8x13L	1
3	FB80	OVERLOAD CLUTCH	1
4	FB79	SAFETY CLUTCH SPRING	1
5	FB78	OVERLOAD CLUTCH LOCKNUT	1
6	FB76	SOCKET SET SCREW M6-P1.0x8L	1
7	FB75	CLUTCH RING	1
8	FB97	OVERLOAD CLUTCH WASHER	1
9	FB98	SNAP RING Ø 10	1
10	FB96	OVERLOAD CLUTCH TRIP LEVER	1
11	FB74	CLUTCH RING PIN (2REQ.)	2
12	FB77	BRASS PLUG	1

i00606-K4

Figure 70
Overload Clutch Trip Sub-Assembly, DPMSX3 & DPMSX5
P/N: 20698-4

i00607-K4
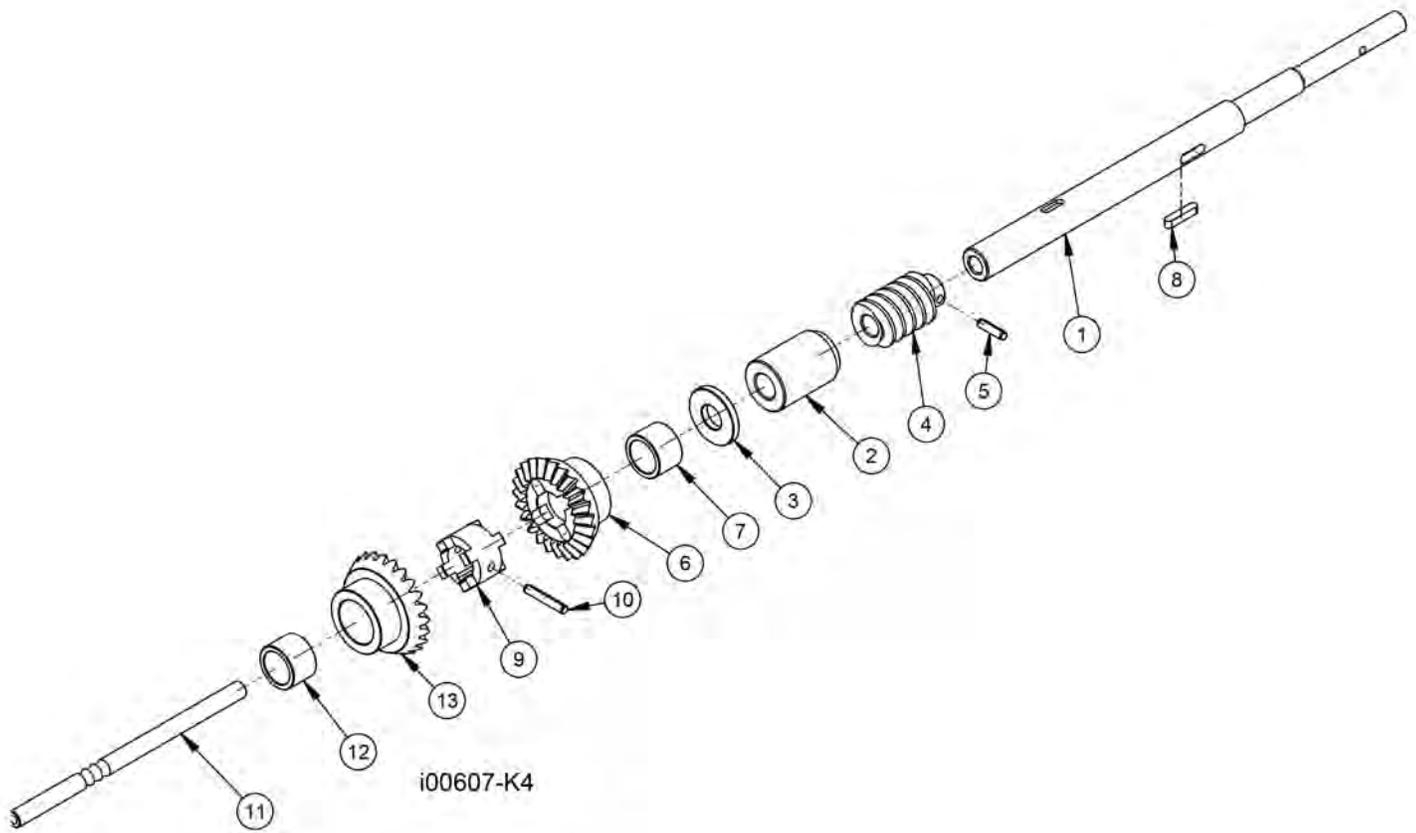
Item	P/N	Title	Qty
1	FB57	FEED WORM SHAFT	1
2	FB44	FEED WORM SHAFT BUSHING	1
3	FB47	FEED WORM SHAFT THRUST WASHER	1
4	FB43	WORM	1
5	FB59	PIN Ø 3x12L	1
6	FB49	FEED REVERSE BEVEL GEAR	1
7	FB48	BUSHING	1
8	FB62	KEY 3x3x15L	1
9	FB50	FEED REVERSE CLUTCH	1
10	FB50-1	PIN Ø 3x19L	1
11	FB55	REVERSE CLUTCH ROD	1
12	FB52	BUSHING	1
13	FB51	FEED REVERSE BEVEL GEAR	1

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Figure 71
Feed Reverse Clutch Sub-Assembly, DPMSX3 & DPMSX5
P/N: 20698-5

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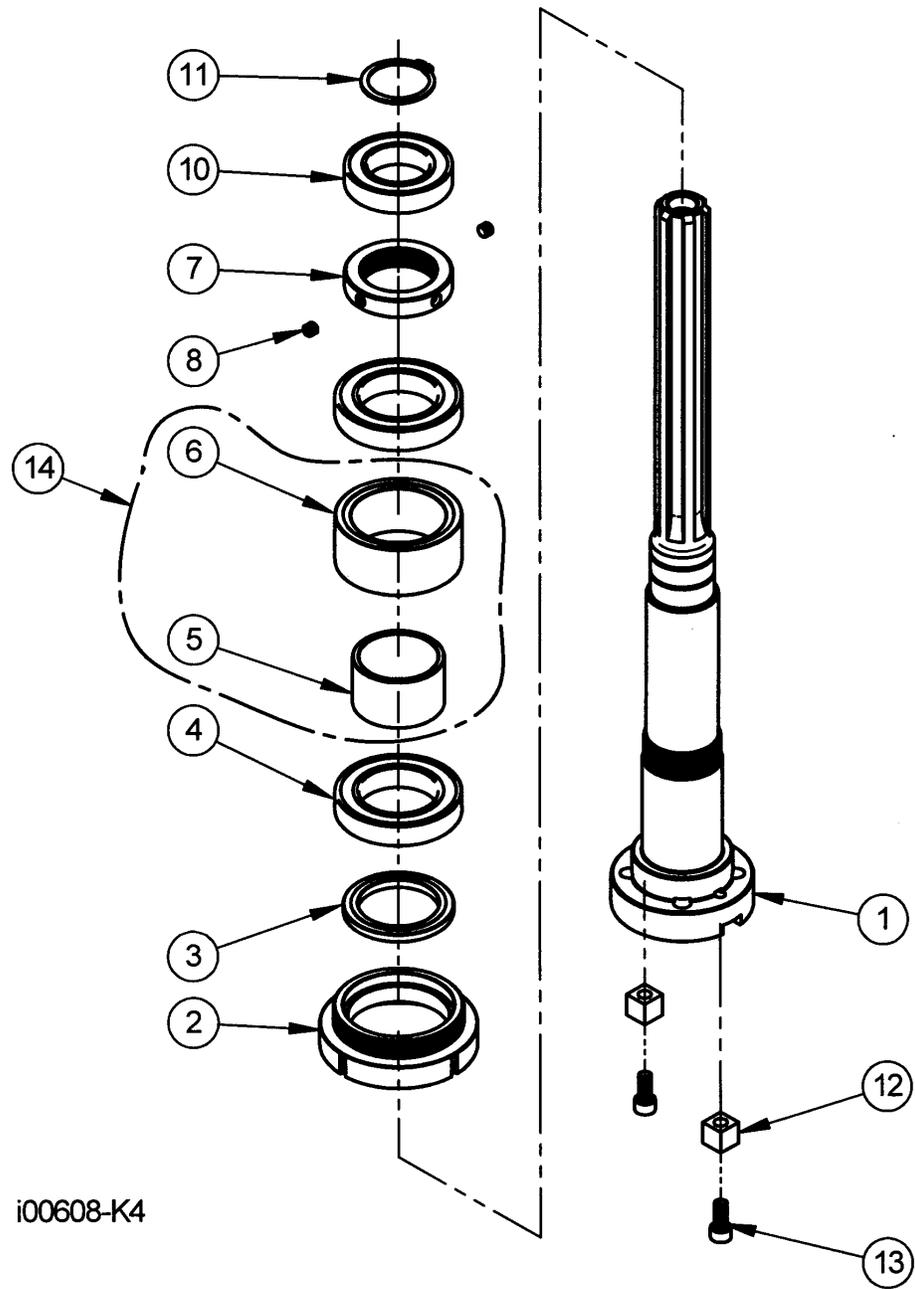
Figure 72
Quill Spindle Sub-Assembly, DPMSX3 & DPMSX5
P/N: 20836-1

Parts List - Spindle Sub-Assembly

Item	P/N	DESCRIPTION	Qty
1	FB127	SPINDLE BT-40	1
2	FB133	NOSE-PIECE	1
3	FB134	SPINDLE DIRT SHIELD	1
4	FB135	BEARING (7010CP4)	2
5	FB136	BEARING SPACER-LARGE	1
6	FB137	BEARING SPACER-SMALL	1
7	FB139	SPINDLE BEARING KNOCK NUT	1
8	FB139-1	SET SCREW M8-P1.25x6L	2
10	FB138	BEARING 6008ZZ	1
11	FB143	LOCK RING Ø 40	1
12	FB140	SPINDLE FIXED NUT	2
13	FB141	COLLET ALIGNMENT SCREW M8-P1.25x20L	2
14	20841	BEARING SPACER SET	1

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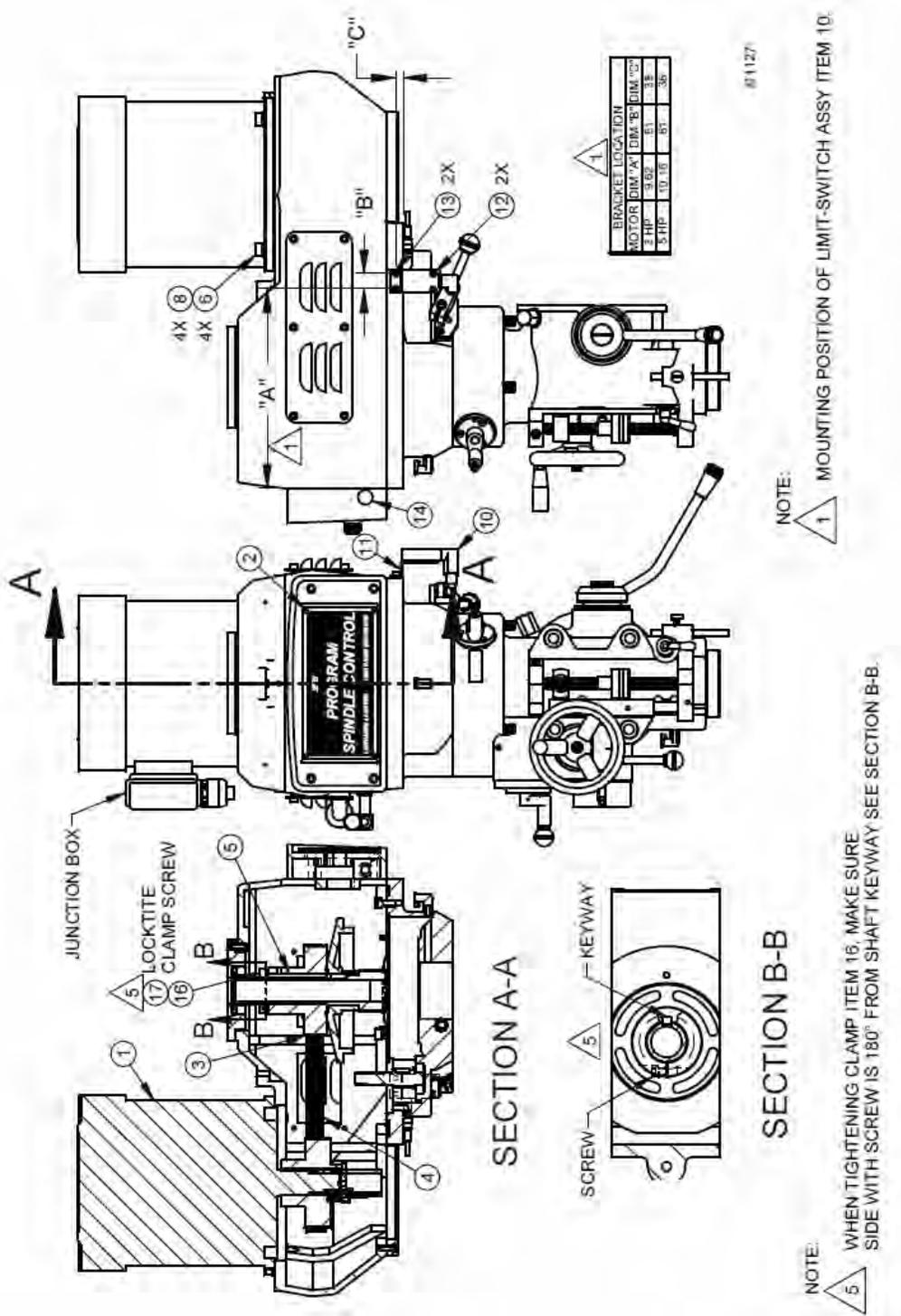
Figure 73
Head Top Assembly with Spindle Control Option
DPMSX2, DPMSX3 & DPMSX5

Parts List - Head Top Assembly – DPMSX3 & DPMSX5 with Spindle Control Option

Item	P/N	DESCRIPTION	Qty
1	24163	MOTOR ASSY-SPINDLE-5 HP	1
2	23965	NAMEPLATE - E-HEAD OPTION	1
3	23967	PULLEY - SPINDLE - NT 40	1
4	23597	BELT-MICRO-V-J PROFILE 10 RIBS "J"	1
5	24169	KEY 8 mm X 8 mm	1
6	3/8 70P	WASHER-FLAT USS-STL-BO	4
8	3/8-16X1 1/4 24B	SCREW-HEX HEAD-STL-BO	4
10	23968	SWITCH ASSY- LIMIT-HI/LOW	1
11	23969-2	BRACKET - GEAR SWITCH-5 HP	1
12	M4-0.7X16 25B	SCREW-SHCS-STL-BO	2
13	M5-0.8X12 25B	SCREW-SHCS-STL-BO	2
14	24164	PLUG-PRY-OUT	1
17	24172	COLLAR-LOCK CCM-050	1

I01127-K4

Parts List – Head Top Assembly – DPMSX2 with Spindle Control Option
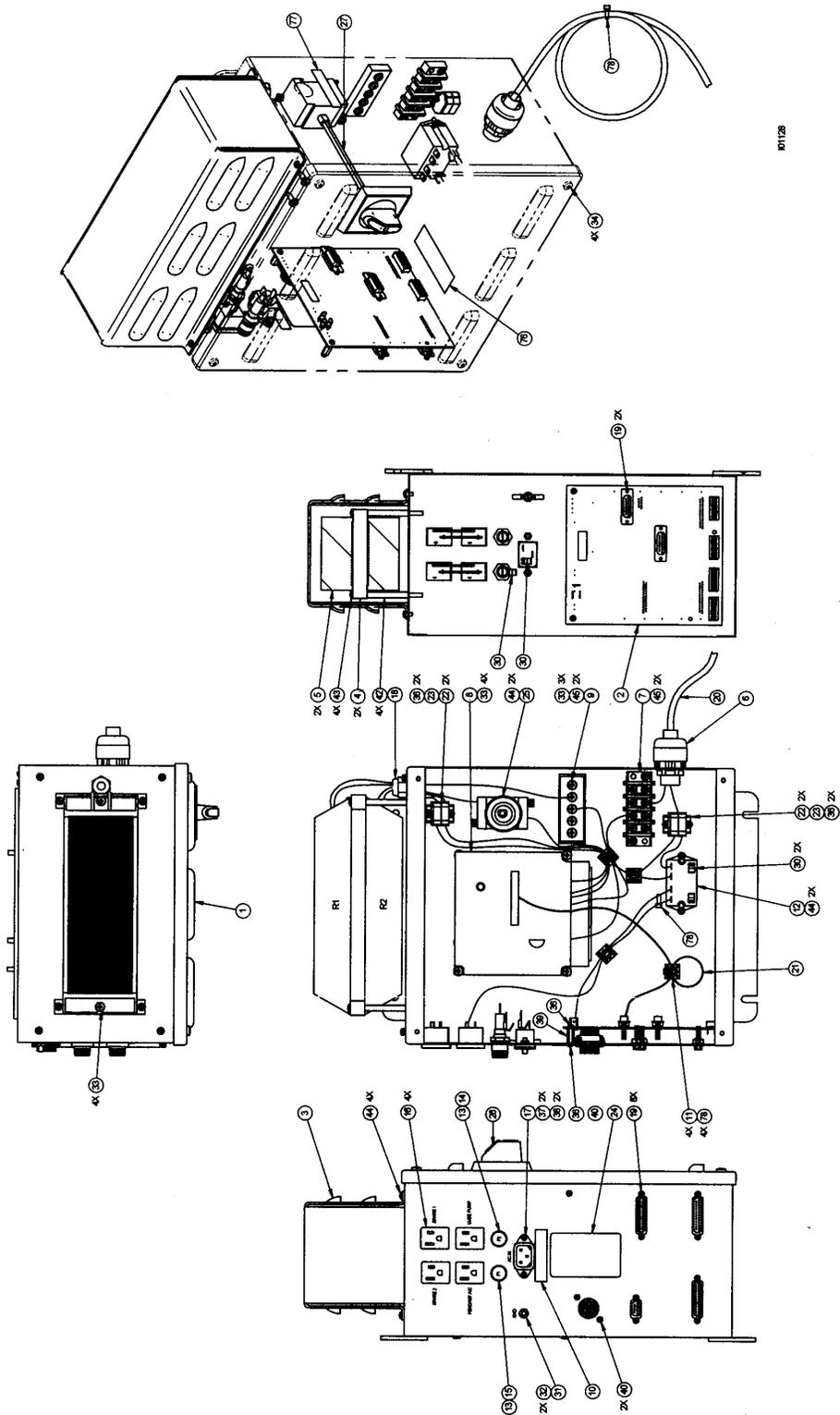
Figure 74
Electrical Enclosure-Spindle Control Option
DPMSX2, DPMSX3, DPSMX5

PART #	DESCRIPTION
24060-1	SPINDLE CONTROL-3HP
24060-2	SPINDLE CONTROL-5HP

i01128

Parts List – Electrical Enclosure – DPMSX3 & DPMSX5 with Spindle Control Option (See Figure 74)

Item	P/N	DESCRIPTION		Qty
2	24063-3	PCB ASSY-SMX-SPINDLE CONTROL		1
5	22890-500-64	RESISTOR-500W-64ohm (5 HP MACHINES)		2
7	23433-04	TERMINAL BLOCK 4 POLE		1
8	22127-SMX5HP	AC DRIVE - 5 HP MINI VECTOR-220V		1
12	22961	RELAY-POWER - 115V DPST		1
13	21820	FUSE HOLDER		2
14	21824-5	FUSE-3AG-SLOW BLOW	5 AMP	1
15	21824-8	FUSE-3AG-SLOW BLOW	8 AMP	1
16	22199	RECEPTACLE- PANEL MOUNT NEMA STD 15A 125V		1
17	21827	SNAP RING 35X1.5		1
21	22443	CABLE ASSY-PT4 VL/VM 15 PIN SPINDLE CONTROL		1
25	24182	DISCONNECT SWITCH		1
26	24183	ROD-DISCONNECT/HANDLE		1

i01128-K4

Parts List – Electrical Enclosure – DPMSX2 with Spindle Control Option

Item	P/N	DESCRIPTION		Qty
2	24063-3	PCB ASSY-SMX-SPINDLE CONTROL		1
3	24066	SHEETMETAL-RESISTOR COVER		1
5	22890-500-120	RESISTOR-500W-120ohm (3 HP MACHINES)		2
7	23433-04	TERMINAL BLOCK 4 POLE		1
8	22127-SMX3HP	AC DRIVE - 3 HP MINI VECTOR-220V		1
12	22961	RELAY-POWER - 115V DPST		1
13	21820	FUSE HOLDER		2
14	21824-5	FUSE-3AG-SLOW BLOW	5 AMP	1
15	21824-8	FUSE-3AG-SLOW BLOW	8 AMP	1
16	22199	RECEPTACLE- PANEL MOUNT NEMA STD 15A 125V		1
17	21827	RECEPTACLE-AC INPUT		1
21	22443	CABLE ASSY-PT4 VL/VM 15 PIN SPINDLE CONTROL		1
25	24182	DISCONNECT SWITCH		1
26	24183	DISCONNECT/HANDLE		1

i01128-K2-K3

Figure 75
Top Housing Assembly, DPMSX2

i00690 **-K2-K3**
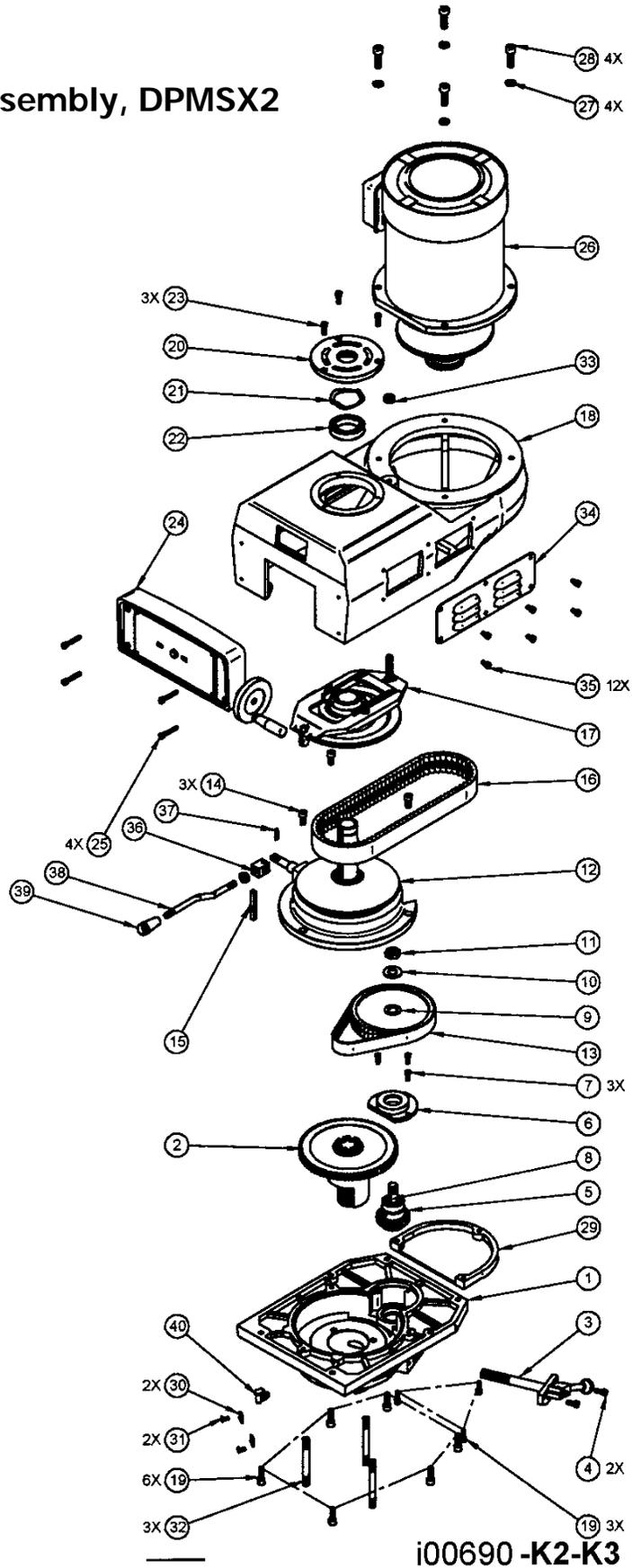
Parts List
Head Top Assembly – DPMSX2

Item	P/N	Title	Qty
1	20778-1	FRU-SK3-GEAR HOUSING SUB-ASSY (3VK-A1)	1
2	20778-2	FRU-SK3-HI-LOW SHIFT CLUTCH SUB-ASSY (3VK-A2)	1
3	20778-3	FRU-SK3-HI-LOW SHIFT SUB-ASSY (3VK-A3)	1
4	VS12	FRU-K3-SOCKET CAP SCREW M6-P1.0x15L	2
5	20778-4	FRU-SK3-PULLY PINION SUB-ASSY (3VK-A4)	1
6	VS64	FRU-K3-BULL GEAR PINION BEARING CAP	1
7	VS93	FRU-K3-SCREW M5-P0.8x15L	1
8	VS117	FRU-K3-KEY 5x525L	1
9	VS62	FRU-K3-TIMING BELT PULLEY	1
10	VS126	FRU-K3-WASHER Ø 5/8	1
11	VS61	FRU-K3-JAM NUT 5/8-11NC	1
12	20778-5	FRU-SK3-LOWER VARI-DISC DRIVE SUB-ASSY (3VK-A5)	1
13	VS63	FRU-K3-BELT 3/8"-#225	1
14	VS14-1	FRU-K3-SCREW M8-P1.25x18L	3
15	VS135	FRU-K3-KEY 8x7x60L	1
16	VS4	FRU-K3-BELT	1
17	20778-6	FRU-SK3-UPPER VARI-DISC DRIVE SUB-ASSY (3VK-A6)	1
18	VS1	FRU-K3-BELT HOUSING	1
19	VS137	FRU-K3-SOCKET CAP SCREW M8-P1.25x25L	1
20	VS13	FRU-K3-TOP BEARING CAP	1
21	VS13-1	FRU-K3-WAVE WASHER	1
22	VS15	FRU-K3-BALL BEARING (6908V)	1
23	VS129	FRU-K3-SCREW- SOC HD CAP M6-P1.0x18L	1
24	20778-7	FRU-SK3-SPEED CHANGE HANDWHEEL SUB-ASSY (3VK-A7)	1
25	VS07	FRU-K3-SCREW- SOC HD CAP M6-P1.0x35L	1
26	20819	FRU-SK2/SK3-MOTOR ASSY- K2 & K3- 3HP	1
27	VS130	FRU-K3-WASHER- FLAT Ø 10.2	4
28	VS111	FRU-K3-SOC HD SCREW- 3/8-16NCx32L	4
29	VS11	FRU-K3-MOTOR PULLEY COVER	1
30	VS104	FRU-K3-COPPER CHIP(2REQ.)	2
31	VS131	FRU-K3-SCREW- FLAT HD PHILIP M5-P0.8x10L	1
32	VS132	FRU-K3-STUD Ø 7/16-100L	2
33	VS96	FRU-K3-JAM NUT 3/8"-16NC	1
34	VS101	FRU-K3-VENTILATOR(2REQ.)	2
35	VS136	FRU-K3-SCREW- SOC HD CAP M6-P1.0x10L	12
36	VS54	FRU-K3-HANDLE FIX BLOCK	1
37	VS55	FRU-K3-SET SCREW	1
38	VS56	FRU-K3-BRAKE LOCK HANDLE	1
39	VS57	FRU-K3-BAKELITE BALL HANDLE	1
40	OIL-1	FRU-K3-OIL CUP	1

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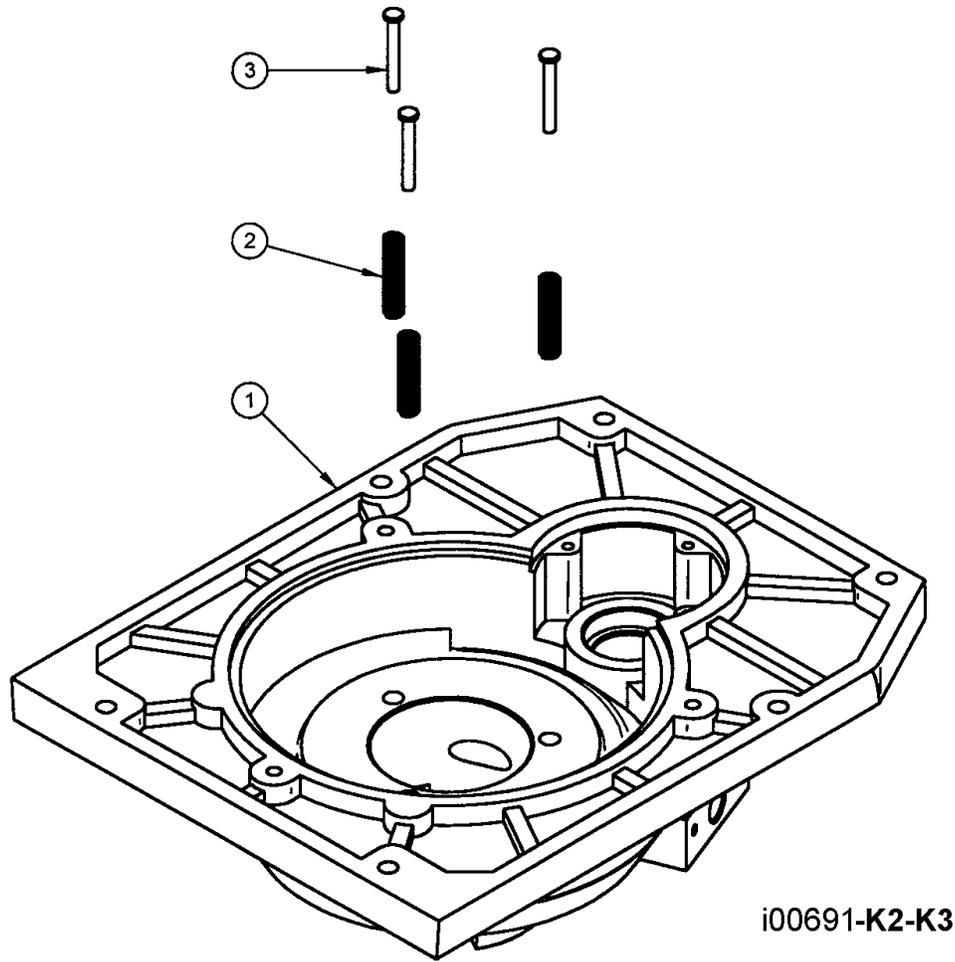
i00691-**K2-K3**

Item	P/N	Title	Qty
1	VS82	FRU-K3-GEAR HOUSING	1
2	VS112	FRU-K3-GUIDE SPRING	3
3	VS113	FRU-K3-SPRING GUIDE PIN	3

i00691-K2-K3

Figure 76
Gear Housing – DPMSX2
P/N: 20778-1

Figure 77
Hi-Low Shift Clutch
Sub-Assembly,
DPMSX2
P/N: 20778-2
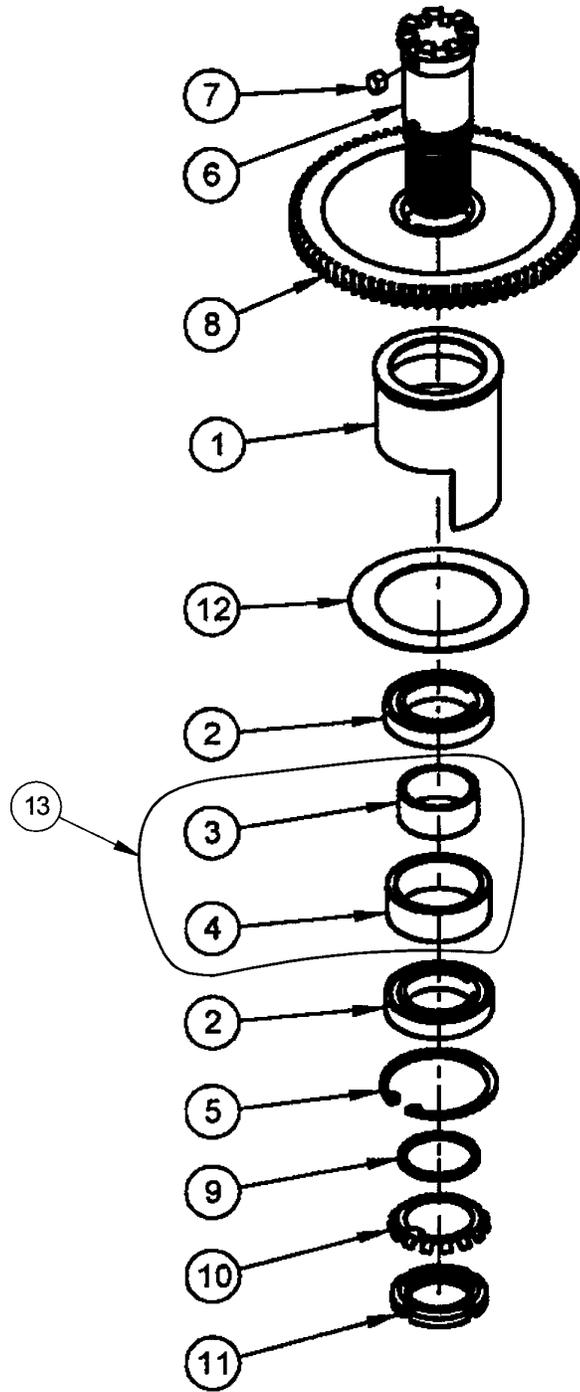
i00692-K2-K3

Parts List – High-Low Shift Clutch – DPMSX2

Item	P/N	DESCRIPTION	Qty
1	VS75	FRU-K3-BEARING SLIDING HOUSING	1
2	23970	FRU-K3-BALL BEARING 6908ZZ	1 SET
3	VS78	FRU-K3-BEARING SPACER	1
4	VS79	FRU-K3-BEARING SPACER	1
5	VS80	FRU-K3-SNAP RING R-65	1
6	VS73	FRU-K3-SPLINED GEAR HUB	1
7	VS72	FRU-K3-KEY 8x7x10L	1
8	VS74	FRU-K3-SPINDLE BULL GEAR	1
9	VS114	FRU-K3-WASHER	1
10	VS115	FRU-K3-EXTERNAL TOOTH WASHER Ø 40	1
11	VS81	FRU-K3-LOCK WASHER Ø 9/16-18NC	1
12	VS76	FRU-K3-RING	1
13	20817	SPACER-BEARING	1

i00692-K2-K3
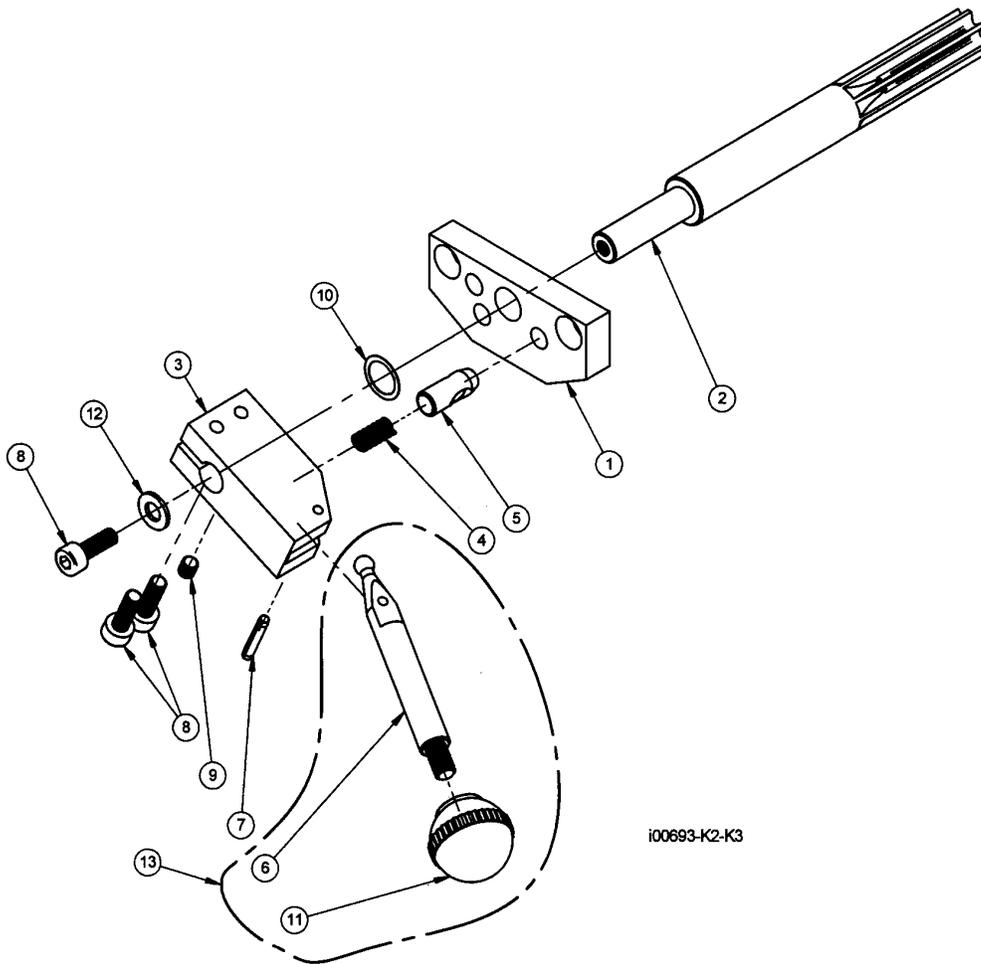
i00693-K2-K3

Figure 78
Hi-Low Shift – DPMSX2
P/N: 20778-3

Item	P/N	DESCRIPTION	Qty
1	VS89	FRU-K3-HI-LOW DETENT PLATE	1
2	VS87	FRU-K3-CLUTCH GEAR SHAFT	1
3	VS92	FRU-K3-HI-LOW PINION BLOCK	1
4	VS91	FRU-K3-SPRING	1
5	VS90	FRU-K3-HI-LOW DETENT PLUNGER	1
6	VS94	FRU-K3-HI-LOW SHAFT CRANK	1
7	VS88	FRU-K3-PIN Ø 3X19L	1
8	VS93	FRU-K3-SCREW M5-P0.8x15L	2
9	VS92-1	FRU-K3-SET SCREW M5-P0.8x5L	1
10	VS92-2	FRU-K3-WASHER- FLAT Ø 11	1
11	VS57	FRU-K3-BAKELITE BALL HANDLE	1
12	VS116	FRU-K3-WASHER- FLAT Ø M5	1
13	24083	SHAFT-HI/LOW SHAFT ASSY	1

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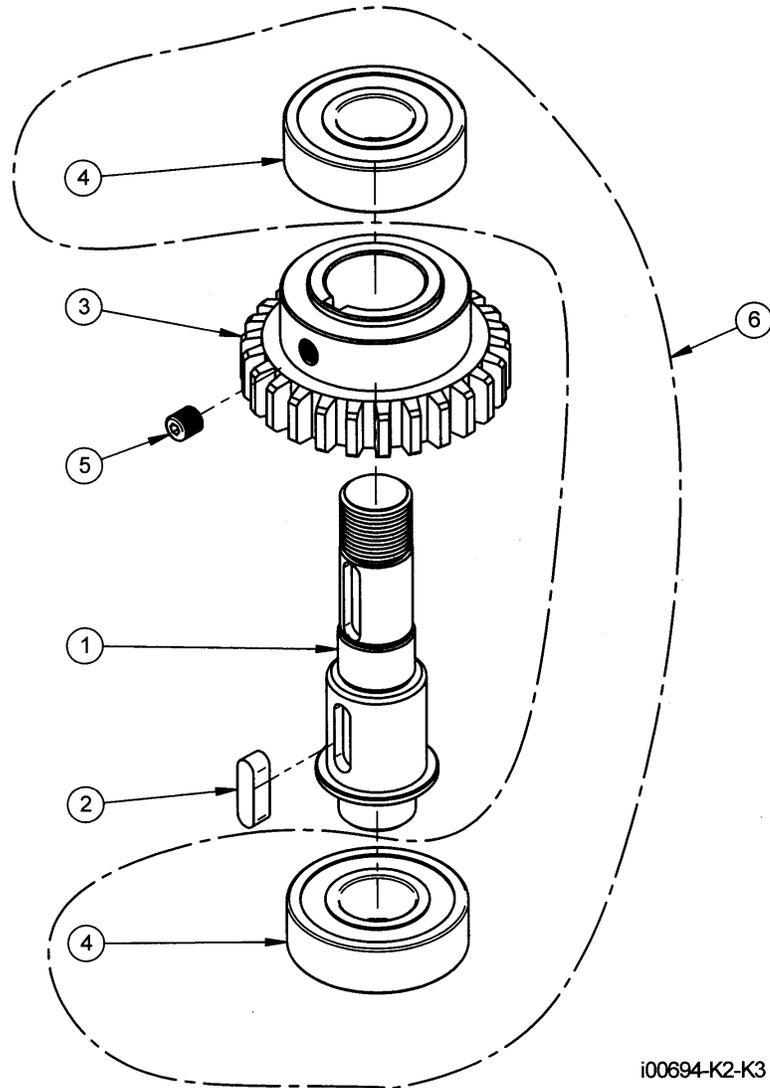
i00694-K2-K3

Item	P/N	DESCRIPTION	Qty
1	VS67	FRU-K3-BULL GEAR PINION COUNTER SHAFT	1
2	VS69	FRU-K3-KEY 5X5X18L	1
3	VS66	FRU-K3-BULL GEAR PINION	1
4	VS65	FRU-K3-BALL BEARING (2 REQ.) 6203ZZ	2
5	VS3	FRU-K3-SOCKET SET SCREW M6-P1.0x6L	1
6	23954	BEARING SET (2) BEARING 6203ZZ	1

i00694-K2-K3

Figure 79
Pulley Pinion – DPMSX2
P/N: 20778-4
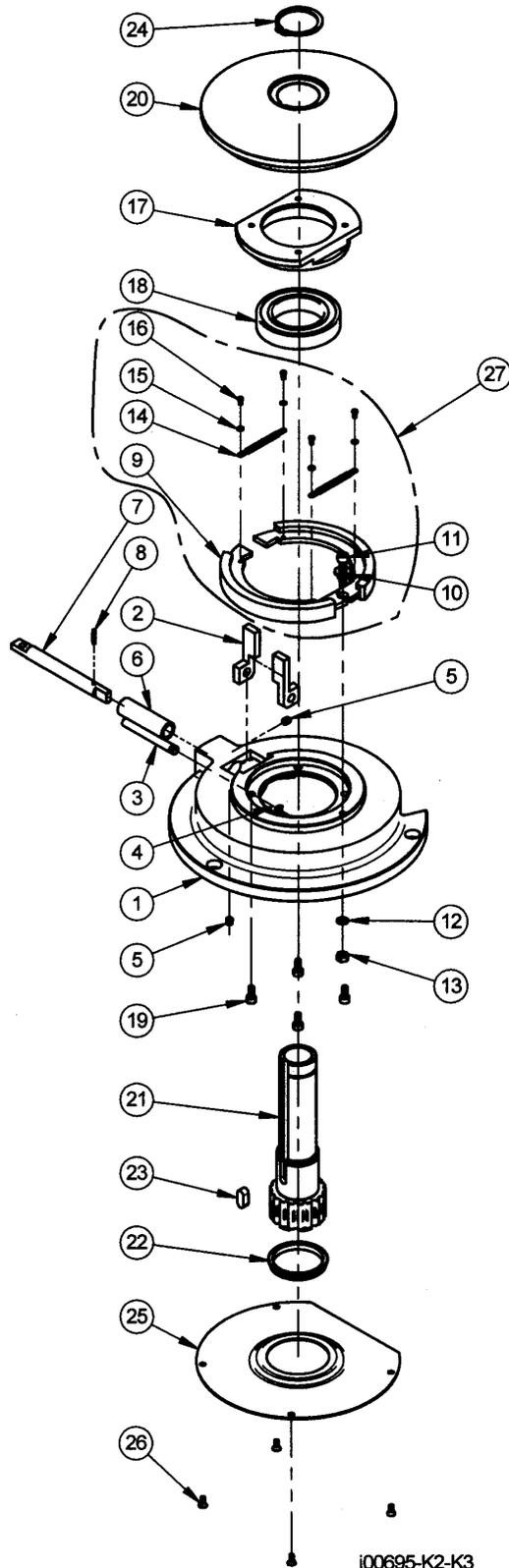
Figure 80-a
Lower Vari-Disc Drive
DPMSX2
P/N: 20778-5

i00695-K2-K3

Parts List – Lower Vari-Disc Drive – DPMSX2

Item	P/N	DESCRIPTION	Qty
1	VS50	FRU-K3-BELT HOUSING BASE	1
2	VS59	FRU-K3-BRAKE BLOCK	2
3	VS58	FRU-K3-TURNING BLOCK SHAFT	1
4	VS103	FRU-K3-RETAINING RING Ø 7	1
5	VS51	FRU-K3-SET SCREW M6-1.0X6L	2
6	VS53	FRU-K3-BRAKE LOCK BUSHING	1
7	VS52	FRU-K3-BRAKE LOCK SHAFT	1
8	VS52-2	FRU-K3-BRAKE LOCK PIN DIA 3 X 5/8"L	1
9	VS47	FRU-K3-BRAKE SHOE	2
10	VS48	FRU-K3-BRAKE SHOE PIVOT SLEEVE	1
11	VS17	FRU-K3-SOCKET CAP SCREW M6-P1.0x35L	1
12	VS17-1	FRU-K3-WASHER Ø 6	1
13	VS17-2	FRU-K3-NUT M6-P1.0	1
14	VS49	FRU-K3-BRAKE SPRING	2
15	VS122	FRU-K3-WASHER DIA 3.3	4
16	VS120	FRU-K3-SCREW-PAN HEAD PHILIP 5-40NC	4
17	VS46	FRU-K3-BRAKE BEARING CAP	1
18	VS43-1	FRU-K3-BALL BEARING 6010ZZ	1
19	VS14	FRU-K3-SOCKET CAP SCREW M5-0.8x12L	4
20	VS45	FRU-K3-STATIONARY DRIVEN VARIDISC	1
21	VS70	FRU-K3-SPINDLE PULLY ASSY	1
22	VS100	FRU-K3-SPINDLE PULLY SPACER	1
23	VS71	FRU-K3-KEY 8x7x20L	1
24	VS97	FRU-K3-SNAP RING Ø 40	1
25	VS50-1	FRU-K3-DUST COVER	1
26	VS50-2	FRU-K3-SCREW-FH-PH-STL-BO M6-1.0X6L	4
27	24055	BRAKE SHOE ASSY	1

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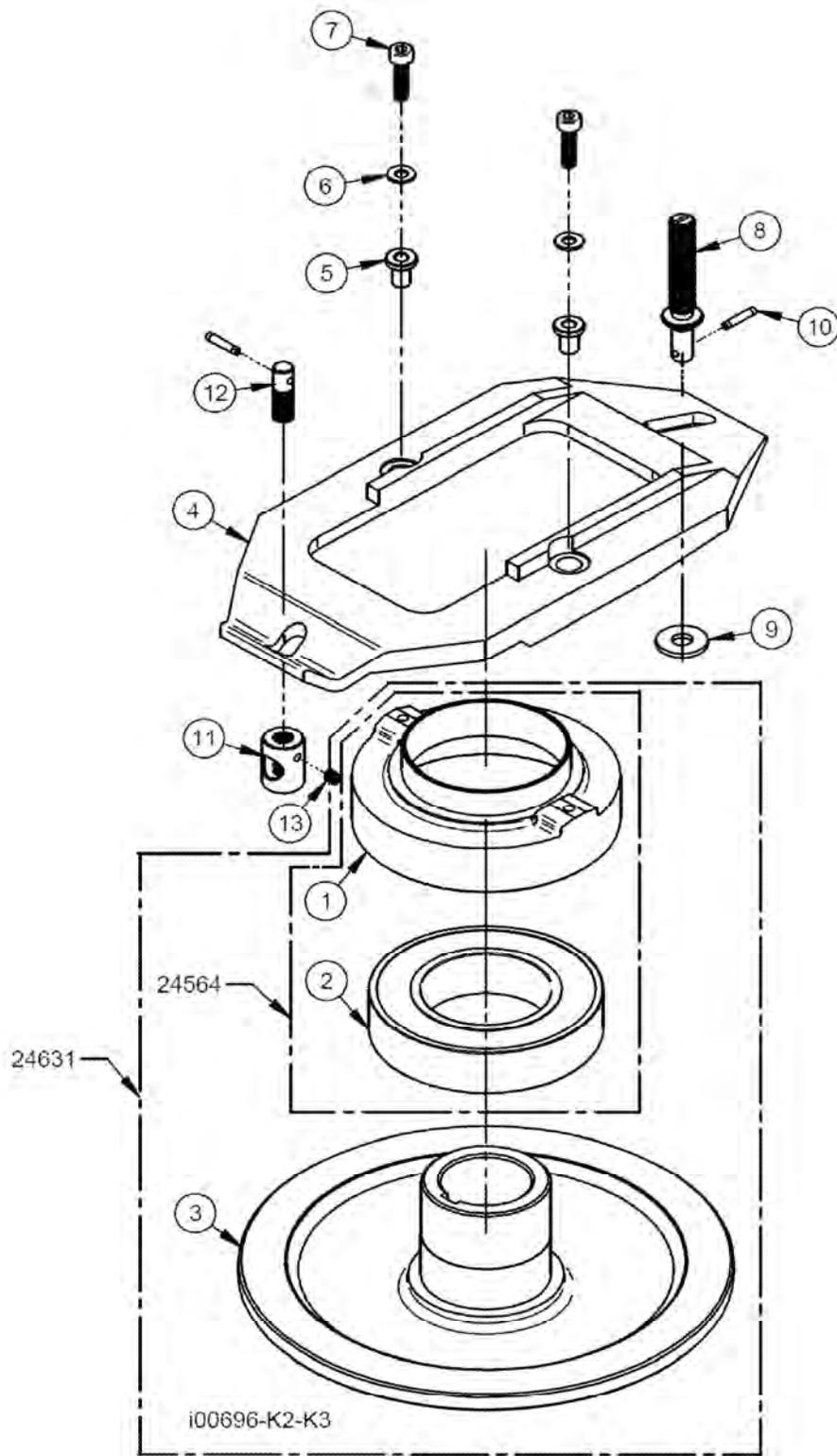
Figure 80-b
Upper Vari-Disc Drive Sub-Assy
DPMSX2 P/N: 20778-6

Parts List – Upper Vari-Disc Drive Sub-Assy – DPMSX2

Item	P/N	DESCRIPTION	Qty
1	VS42	FRU-K3-SPINDLE PULLEY BEARING HOUSING	1
2	VS43	FRU-K3-BALL BEARING 6210ZZ	1
3	VS44	FRU-K3-ADJUSTABLE-DRIVEN VARIDISC	1
4	VS36	FRU-K3-SPEED CHANGE PLATE	1
5	VS38	FRU-K3-WASHER M5-P0.8x20L	2
6	VS37	FRU-K3-PIVOT SLEEVE Ø 5	2
7	VS123	FRU-K3-SCREW-SHCS M5-0.8X20L	2
8	VS39	FRU-K3-SPEED CHANGE PLATE PIVOT STUD	1
9	VS41	FRU-K3-WASHER Ø 8.2	1
10	VS40	FRU-K3-ROLL PIN Ø3x15L	2
11	VS35	FRU-K3-ADJUSTMENT NUT	1
12	VS34	FRU-K3-CHAIN END STUD	1
13	VS33	FRU-K3-CHAIN FRONT SCREW M4-P0.7x5L	1

i00696-K2-K3

Parts List – 24564 Sub-Assy Bearing Housing

Item	P/N	Title	Qty
1	FVS42	SPINDLE PULLEY BEARING HOUSING	1
2	FVS43	BALL BEARING 6013ZZ	1

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Parts List – 24631 Sub-Assy Vari Disc Adjustable

Item	P/N	Title	Qty
1	VS42	FRU-K3-SPINDLE PULLEY BEARING HOUSING	1
2	VS43	FRU-K3-BALL BEARING 6210ZZ	1
3	VS44	FRU-K3-ADJUSTABLE-DRIVEN VARIDISC	1

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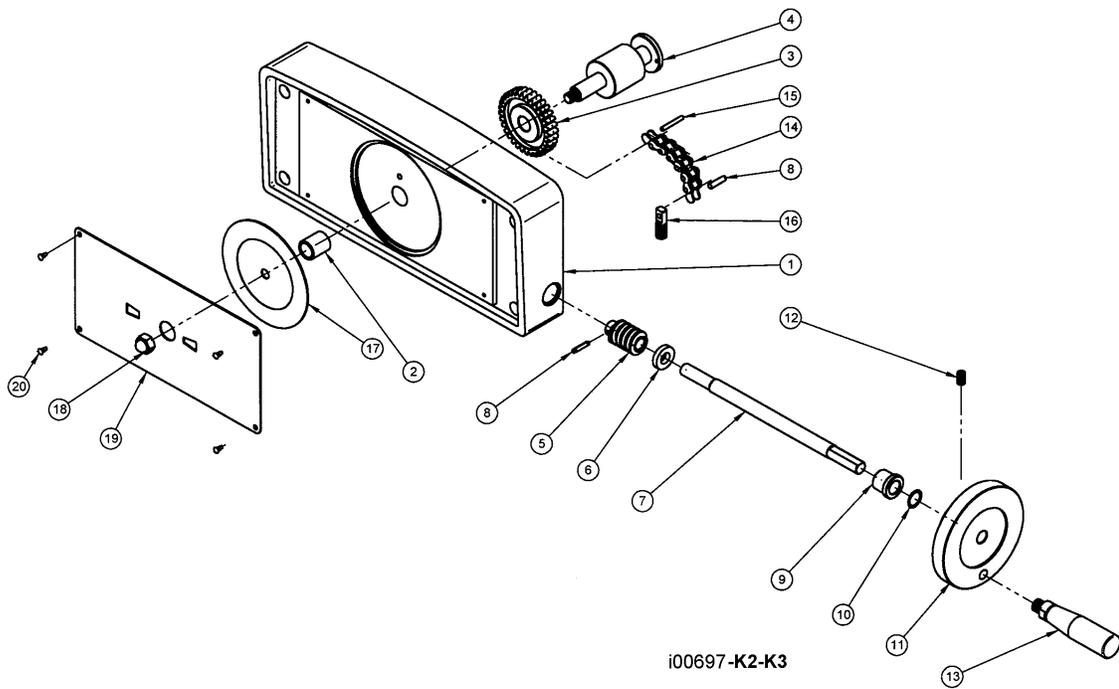
Item	P/N	DESCRIPTION	Qty
1	VS16	FRU-K3-SPEED CHANGE HOUSING	1
2	VS20	FRU-K3-BEARING SELF LUBRICATING	1
3	VS22	FRU-K3-SPEED CHANGER GEAR	1
4	VS31	FRU-K3-SPEED CHANGE CHAIN DRUM	1
5	VS21	FRU-K3-WORM	1
6	VS125	FRU-K3-WASHER	1
7	VS25	FRU-K3-SPEED CHANGE SHAFT	1
8	VS40	FRU-K3-ROLL PIN Ø3x15L	2
9	VS24	FRU-K3-COPPER BUSHING	1
10	VS24-1	FRU-K3-WASHER-WAVE	1
11	VS27	FRU-K3-SPEED CHANGE HANDWHEEL	1
12	VS18	FRU-K3-FULL DOG SOCKET SET SCREW M6-P1.0x10L	1
13	VS28	FRU-K3-HANDLE 3/8-16NC	1
14	VS32	FRU-K3-CHAIN #310X9.525	1
15	VS31-1	FRU-K3-DOWEL PIN Ø3x25L	1
16	VS30	FRU-K3-SPEED CHANGE STUD	1
17	VS16-1	FRU-K3-SPEED DIAL	1
18	VS95	FRU-K3-NUT-ACORN 5/16-18 NC	1
19	VS16-2	FRU-K3-NAME PLATE	1
20	VS19	FRU-K3-SCREW-DRIVE	1

i00697-K2-K3

Figure 81
Speed Change Handwheel
DPMSX2
P/N: 20778-7
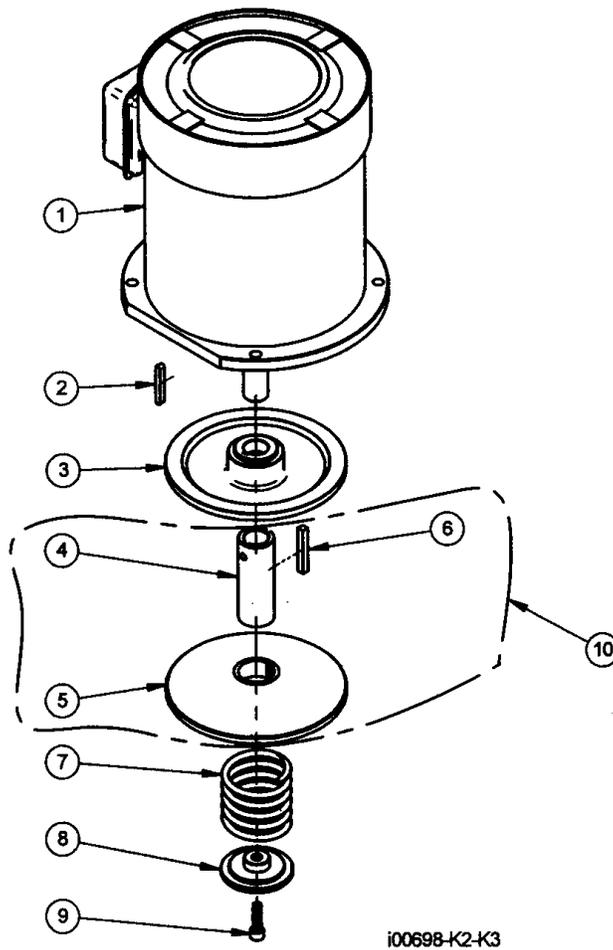
i00698-K2-K3

**Figure 82
Spindle
Motor –
DPMSX2
P/N: 20819-1**

Item	P/N	DESCRIPTION	Qty
1	VS110	FRU-K3-MOTOR 3 HP	1
2	VS3-1	FRU-K3-KEY 6x6x45L	1
3	VS2	FRU-K3-STATIONARY MOTOR VARIDISC	1
4	VS6	FRU-K3-BUSHING	1
5	VS5	FRU-K3-ADJUSTABLE MOTOR VARIDISC	1
6	VS6-1	FRU-K3-KEY 7x7x50L	1
7	VS8	FRU-K3-SPRING FOR VARIDISC MOTOR SHAFT	1
8	VS9	FRU-K3-ADJUSTABLE VARIDISC SPRING COLLAR	1
9	VS10	FRU-K3-SCREW- SOC HD CAP M8-P1.25x30L	1
10	23953	VARIDISC ASSY-ADJUSTABLE MOTOR VARIDISC ASSY	1

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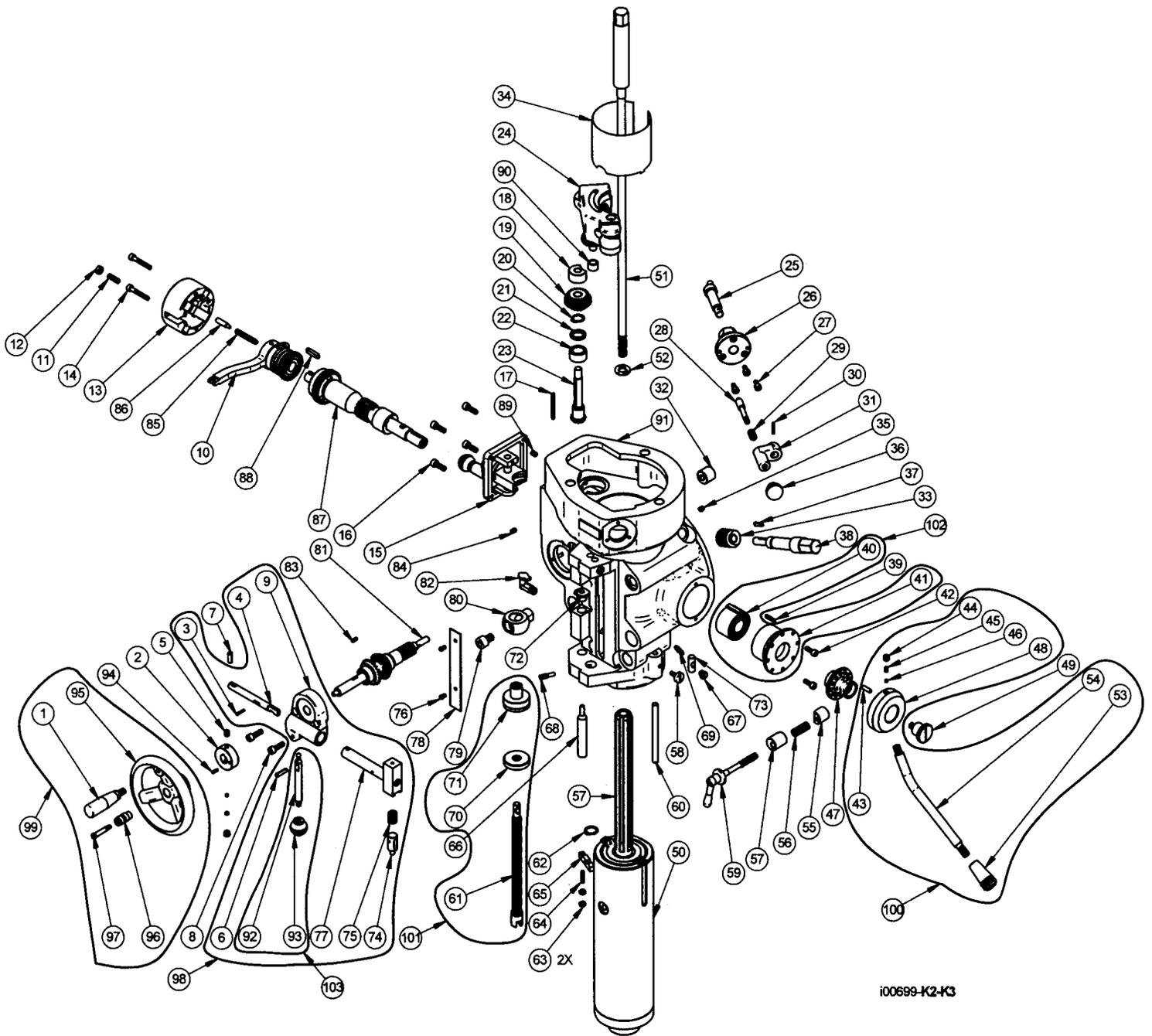
**Figure 83
Lower Head Assembly
DPMSX2**

Parts List – Lower Head Assembly – DPMSX2

| Item	P/N	DESCRIPTION	Qty
1	K-B125-2	FRU-K3-HANDWHEEL HANDLE (AVAILABLE ONLY IN ASSY. 20835)	1
2	K-B113	FRU-K3-HAND WHEEL CLUTCH	1
3	K-B117	FRU-K3-ROLL PIN Ø3x15L	1
4	K-B103	FRU-K3-CAM ROD	1
5	K-B108	FRU-K3-SOCKET SET SCREW M6-P1.0x8L	1
6	K-B119-1	FRU-K3-ROLL PIN Ø3x20L	1
7	K-B103-1	FRU-K3-CAM ROD PIN Ø6x15L	1
8	K-B107	FRU-K3-CAP SCREW M6-P1.0x25L	2
9	K-B106	FRU-K3-FEED TRIP BRACKET	1
10	20779-4	FRU-SK2/SK3-OVERLOAD CLUTCH TRIP SUB-ASSY (3VK-B4)	1
11	K-B73	FRU-K3-SOCKET SET SCREW M6-P1.0x20L	1
12	K-B101	FRU-K3-CHEM BLACKED LOCKNUT M6-P1.0	1
13	K-B99	FRU-K3-CLUTCH ARM COVER	1
15	20779-2	FRU-SK2/SK3-QUILL FEED SELECTOR SUB-ASSY (3VK-B2)	1
16	K-B67	FRU-K3-CAP SCREW M6-P1.0x18L	4
17	K-B29	FRU-K3-CLUSTER GEAR KEY 3x3x45L	1
18	K-B27	FRU-K3-CLUSTER GEAR SHAFT UPPER BEARING	1
19	K-B28	FRU-K3-CLUSTER GEARS ASSEMBLY	1
20	K-B94	FRU-K3-SNAP RING 95 DOWEL PIN Ø 14	1
21	K-B32	FRU-K3-BEVEL GEAR THRUST SPACER	1
22	K-B33	FRU-K3-BEVEL GEAR BEARING	1
23	K-B31	FRU-K3-CLUSTER GEAR SHAFT 6602BB	1
24	20779-1	FRU-SK2/SK3-WORM GEAR CRADLE SUB-ASSY (3VK-B1)	1
25	K-B18	FRU-K3-WORM GEAR CRADLE THROW-OUT	1
26	K-B19	FRU-K3-SHIFT SLEEVE	1
27	K-B25	FRU-K3-CAP SCREW(3REQ.) M5-P0.8x12L	3
28	K-B20	FRU-K3-GEAR SHIFT PLUNGER	1
29	K-B21	FRU-K3-COMPRESSION SPRING	1
30	K-B22	FRU-K3-ROLL PIN Ø3x20L	1
31	K-B23	FRU-K3-SHIFT CRANK	1
33	K-B186	FRU-K3-WORM GEAR	1
34	K-B128	FRU-K3-QUILL SKIRT	1
35	K-B189-1	FRU-K3-ADJ WORM SHAFT SET SCREW M6-P1.0x6L	1
36	K-B42	FRU-K3-BUSHING	2
37	K-B187	FRU-K3-KEY 4x4x18L	1
38	K-B189	FRU-K3-ADJ WORM SHAFT	1
39	K-B171	FRU-K3-KEY 3x3x20L	1
40	K-B178	FRU-K3-CLOCK SPRING	1
41	K-B177	FRU-K3-SPRING COVER	1
42	K-B169	FRU-K3-RD.HEAD SCREW(2REQ.) M5-P0.8x15L	2
43	K-B170	FRU-K3-ROLL PIN	1
44	K-B175-3	FRU-K3-SET SCREW M8-P1.25x6L	2
45	K-B175-2	FRU-K3-COMPRESSION SPRING	2
46	K-B175-1	FRU-K3-STEEL BALL	2
47	K-B176	FRU-K3-PINION SHAFT HUB SLEEVE	1
48	K-B175	FRU-K3-RACK FEED HANDLE HUB	1
49	K-B172	FRU-K3-PINION SHAFT HUB SCREW	1
50	K-B142	QUILL	0

51	VS109	FRU-K3-DRAWBAR 7/16-20UNF	1
52	VS109-1	FRU-K3-SPACER	1
53	K-B191	FRU-K3-BLACK PLASTIC BALL HANDLES	1
54	K-B190	FRU-K3-PINION SHAFT HUB HANDLE	1
55	K-B148	FRU-K3-QUILL LOCK SLEEVE ASSY	1
56	K-B148-1	FRU-K3-COMPRESSION SPRING	1
57	20836	SPINDLE ASSY	1
58	KB-201	FRU-K3-INDICATOR ROD SCREW	1
59	20845	FRU-K3-LOCK HANDLE ASSY	1
60	KB-202	FRU-K3-INDICATOR ROD	1
61	K-B164	FRU-K3-QUILL STOP MICRO-SCREW	1
62	K-B160	FRU-K3-SNAP RING Ø16	1
63	K-B124-2	FRU-K3-FEED TRIP PLUNGER NUT M40-P0.7	2
64	K-B124-1	FRU-K3-FEED TRIP PLUNGER SOC SET SCREW M4-P0.7x20L	1
65	K-B145	FRU-K3-FEED TRIP LEVER	1
66	K-B124	FRU-K3-FEED TRIP PLUNGER	1
67	K-B185	FRU-K3-REVERSE TRIP BALL LEVER SCREW	1
68	K-B144	FRU-K3-SOCKET SET SCREW	1
69	K-B183	FRU-K3-REVERSE TRIP BALL LEVER	1
70	K-B161	FRU-K3-QUILL MICRO-STOP NUT	1
71	K-B162	FRU-K3-MICROMETER NUT	1
72	K-B123	FRU-K3-TRIP PLUNGER BUSHING	1
73	K-B184	FRU-K3-FEED REVERSE TRIP PLUNGER	1
74	K-B121	FRU-K3-TRIP PLUNGER	1
75	K-B120	FRU-K3-COMPRESSION SPRING	1
76	K-B158	FRU-K3-CHEM BLACKED RD.HD.SCREWS(2 REQ.) M5-P0.8x8L	2
77	K-B118	FRU-K3-CAM ROD SLEEVE ASSY	1
78	K-B159	FRU-K3-MICROMETER SCALE	1
79	KB-200	FRU-K3-SCREW- SOC HD 3/8-24NFx15L	1
80	K-B163	FRU-K3-QUILL STOP KNOB	1
81	20779-5	FRU-SK2/SK3-FEED REVERSE CLUTCH SUB-ASSY (3VK-B5)	1
82	OIL-1	FRU-K3-OIL CUP	1
83	K-B109	FRU-K3-KEY 3x3x20L	1
84	K-B17-1	FRU-K3-WORM GEAR SET SCREW M6-P1.0x8L	1
85	K-B88-1	FRU-K3-COMPRESSION SPRING	1
86	K-B89	FRU-K3-OVERLOAD CLUTCH LEVER SPRING PLUNGER	1
87	20779-3	FRU-SK2/SK3-QUILL PINION SUB-ASSY (3VK-B3)	1
88	K-B167	FRU-K3-KEY 5x5x25L	1
89	K-B27-1	FRU-K3-SET SCREW M6-P1.0x8L	1
90	K-B41	FRU-K3-NEEDLE BEARING BA66 BEARING SIZE KO-BA66Z	1
91	K-B192	FRU-K3-QUILL HOUSING	1
92	K-B104	FRU-K3-TRIP HANDLE	1
93	K-B105	FRU-K3-BLACK PLASTIC BALL	1
94	K-B125-1	FRU-K3-HANDWHEEL SPRING PIN Ø3x3x10L	1
95	K-B125	FRU-K3-HANDWHEEL	1
96	K-B111	FRU-K3-REVERSE KNOB	1
97	K-B100	FRU-K3-CAP SET SCREW M5-P0.8x35L	3
98	20832	FEED TRIP ASSY	1
99	20835	HANDWHEEL ASSY	1
100	20849	HANDLE - FEEDS HANDLE ASSY	1
101	20847	MICRO SCREW, MICRO-STOP NUT &MICROMETER NUT ASSY	1
102	24051	CLOCK SPRING	1

| 103 | 24052 | TRIP HANDLE ASSY | 1 |

i00700-**K2-K3**
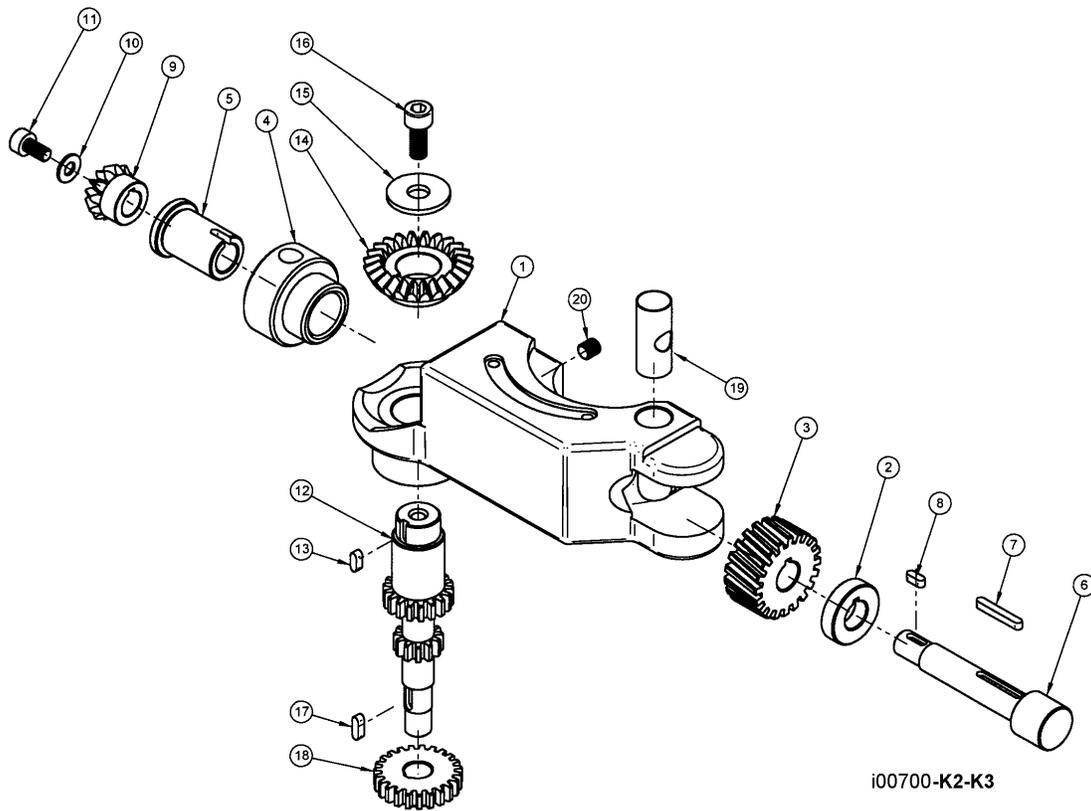
Item	P/N	Title	Qty
1	K-B17	FRU-K3-WORM GEAR CRADLE	1
2	K-B07	FRU-K3-WORM GEAR SPACER	1
3	K-B08	FRU-K3-FEED DRIVEWORM GEAR	1
4	K-B05	FRU-K3-WORM CRADLE BUSHING	1
5	K-B04	FRU-K3-FEED WORM GEAR SHAFT SLEEVE	1
6	K-B09	FRU-K3-FEED DRIVE WORM GEAR SHAFT	1
7	K-B11	FRU-K3-KEY 3x3x25L	1
8	K-B10	FRU-K3-WORM SHAFT KEY 3x3x8L	1
9	K-B03	FRU-K3-FEED BEVEL PINION	1
10	K-B02	FRU-K3-BEVEL PINION WASHER Ø 5	1
11	K-B01	FRU-K3-SOC.HD.SCREW M5-P0.8x10L	1
12	K-B36	FRU-K3-FEED DRIVING GEAR	1
13	K-B36-1	FRU-K3-KEY 3x3x8L	1
14	K-B15	FRU-K3-FEED REVERSE BEVEL GEAR	1
15	K-B13	FRU-K3-WASHER Ø 6, 22 OD	1
16	K-B14	FRU-K3-SOC HD SCREW M6-P1.0x15L	1
17	K-B37	FRU-K3-KEY 3x3x10L	1
18	K-B40	FRU-K3-FEED DRIVE GEAR	1
19	K-B16	FRU-K3-FEED ENGAGE PIN	1
20	K-B06	FRU-K3-SETSCREW M6-P1.0x6L	1

i00700-K2-K3

Figure 84
Worm Gear Cradle – DPMSX2
P/N: 20779-1

i00701-**K2-K3**
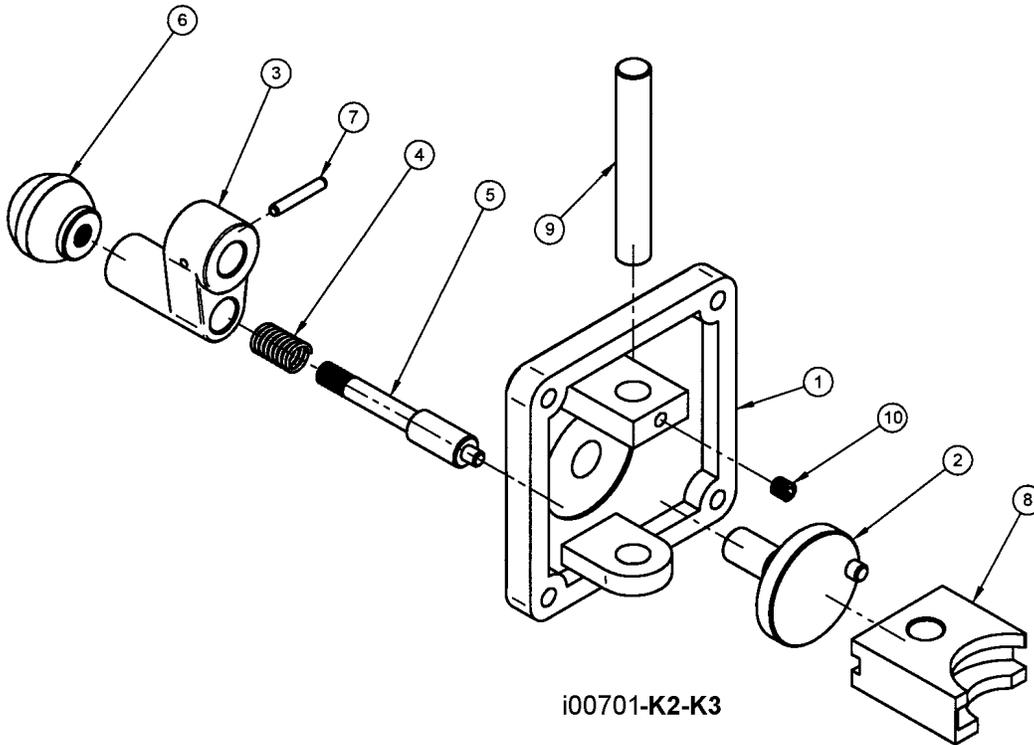
Item	P/N	Title	Qty
1	K-B66	FRU-K3-CLUSTER GEAR COVER	1
2	K-B64	FRU-K3-CLUSTER GEAR SHAFT CRANK	1
3	K-B70	FRU-K3-SHIFT CRANK	1
4	K-B69	FRU-K3-SPRING Ø 3 x 20L	1
5	K-B68	FRU-K3-GEAR SHIFT PLUNGER	1
6	K-B72	FRU-K3-SHIFT KNOB-5/16-18NC	1
7	K-B71	FRU-K3-ROLL PIN Ø 3 x 20L	1
8	K-B63	FRU-K3-FEED GEAR SHIFT FORK	1
9	K-B65	FRU-K3-SHAFT	1
10	K-B61	FRU-K3-CAP SET SCREW M5-P0.8x5L	1

i00701-K2-K3

Figure 85
Quill Feed Selector – DPMSX2
P/N: 20779-2

i00702-**K2-K3**
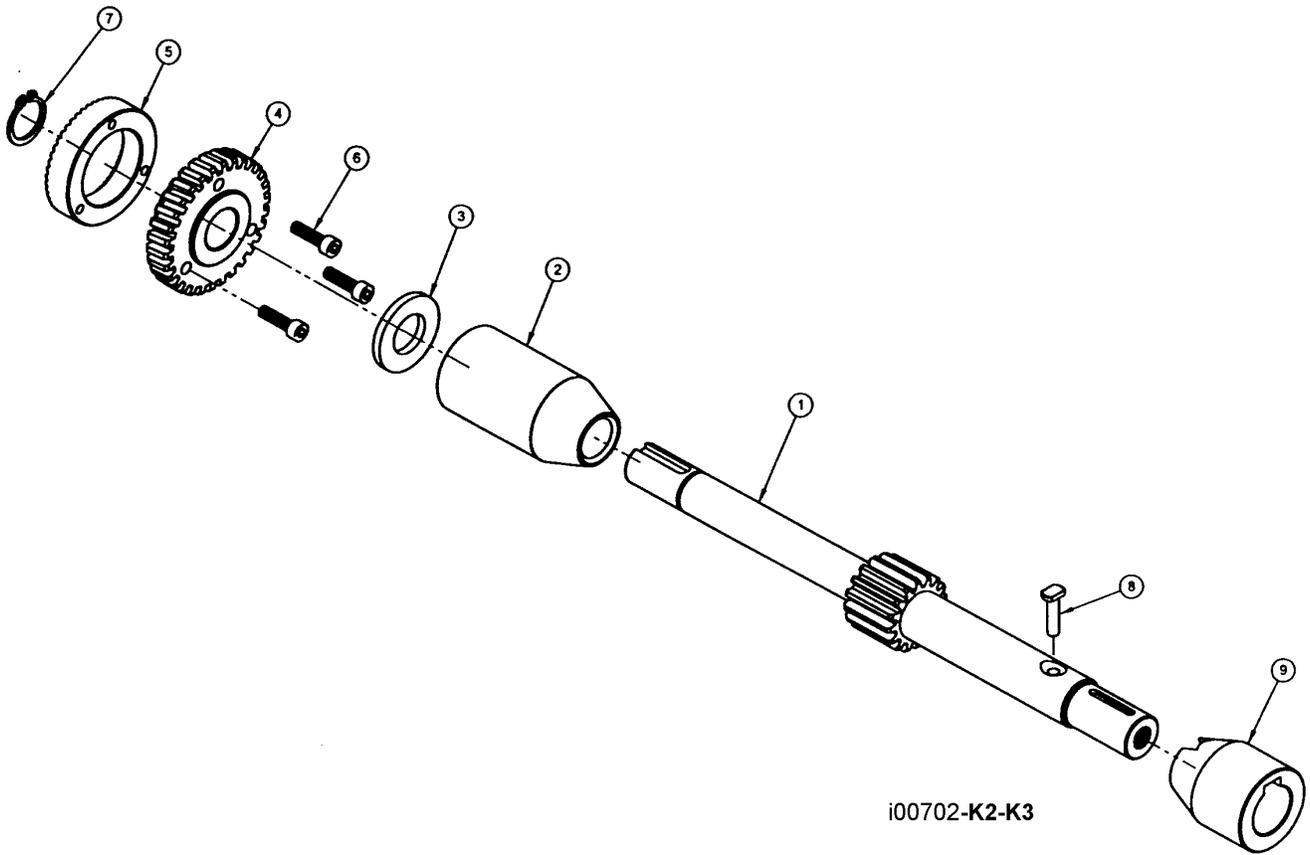
Item	P/N	Title	Qty
1	K-B166	FRU-K3-QUILL PINION SHAFT	1
2	K-B90	FRU-K3-QUILL PINION SHAFT BUSHING- LEFT	1
3	K-B91	FRU-K3-WASHER	1
4	K-B92	FRU-K3-OVERLOAD CLUTCH WORM GEAR	1
5	K-B93	FRU-K3-OVERLOAD CLUTCH RING	1
6	K-B92-1	FRU-K3-SCREW SOC HD CAP M4-P0.7x15L	3
7	K-B94	FRU-K3-SNAP RING 95 DOWEL PIN Ø 14	1
8	K-B168	FRU-K3-SCREW PIN	1
9	K-B90-1	FRU-K3-QUILL PINION SHAFT BUSHING- RIGHT	1

I00702-K2-K3

Figure 86
Quill Pinion Shaft – DPMSX2
P/N: 20779-3

i00703-**K2-K3**
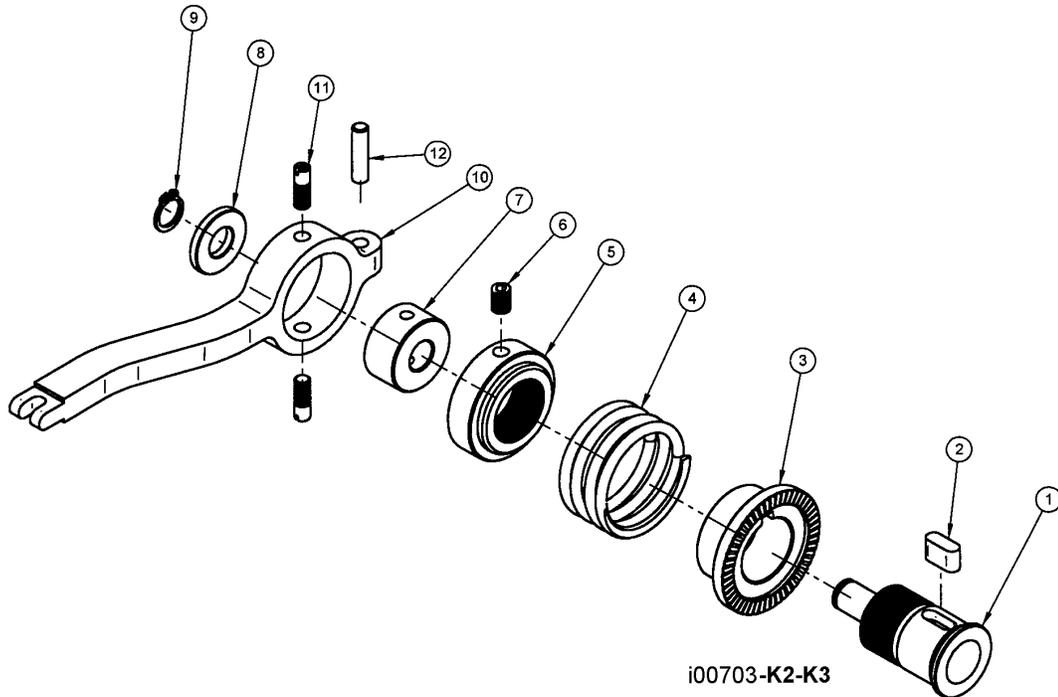
Item	P/N	Title	Qty
1	K-B81	FRU-K3-OVERLOAD CLUTCH SLEEVE	1
2	K-B81-1	FRU-K3-KEY 5x8x13L	1
3	K-B80	FRU-K3-OVERLOAD CLUTCH	1
4	K-B79	FRU-K3-SAFETY CLUTCH SPRING	1
5	K-B78	FRU-K3-OVERLOAD CLUTCH LOCKNUT	1
6	K-B76	FRU-K3-SOCKET SET SCREW M6-P1.0x8L	1
7	K-B75	FRU-K3-CLUTCH RING	1
8	K-B97	FRU-K3-OVERLOAD CLUTCH WASHER	1
9	K-B98	FRU-K3-SNAP RING Ø 10	1
10	K-B96	FRU-K3-OVERLOAD CLUTCH TRIP LEVER	1
11	K-B74	FRU-K3-CLUTCH RING PIN (2REQ.)	2
12	K-B77	FRU-K3-BRASS PLUG	1
		i00703-K2-K3	

Figure 87
Overload Clutch Trip – DPMSX2
P/N: 20779-4

i00704-**K2-K3**
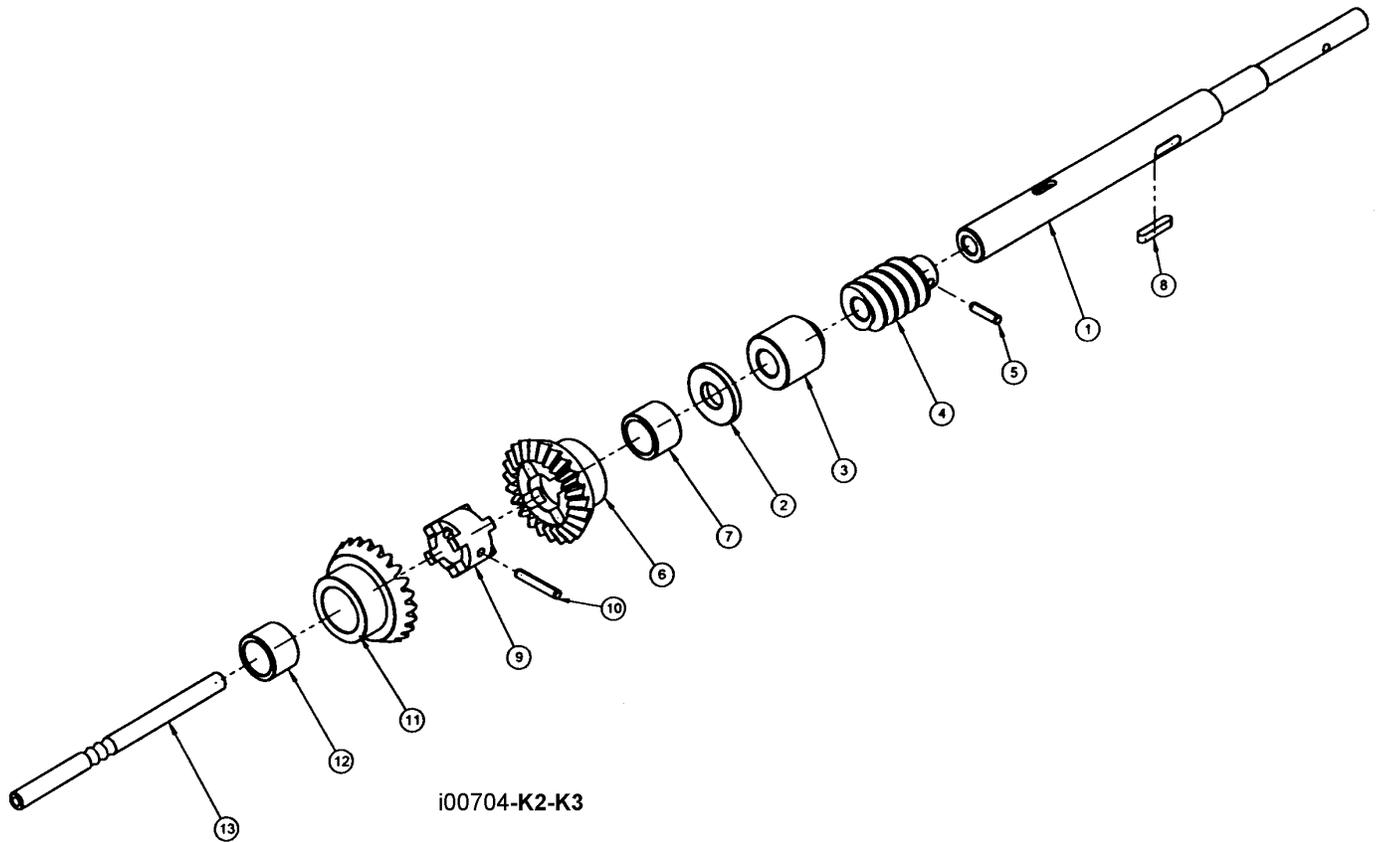
Item	P/N	Title	Qty
1	K-B57	FRU-K3-FEED WORM SHAFT	1
2	K-B47	FRU-K3-FEED WORM SHAFT THRUST WASHER	1
3	K-B44	FRU-K3-FEED WORM SHAFT BUSHING	1
4	K-B43	FRU-K3-WORM	1
5	K-B59	FRU-K3-PIN Ø 3x12L	1
6	K-B49	FRU-K3-FEED REVERSE BEVEL GEAR	1
7	K-B48	FRU-K3-BUSHING	1
8	K-B62	FRU-K3-KEY 3x3x15L	1
9	K-B50	FRU-K3-FEED REVERSE CLUTCH	1
10	K-B56	FRU-K3-PIN Ø 3x19L	1
11	K-B51	FRU-K3-FEED REVERSE BEVEL GEAR	1
12	K-B52	FRU-K3-BUSHING	1
13	K-B55	FRU-K3-REVERSE CLUTCH ROD	1

i00704-K2-K3

Figure 88
Feed Reverse Clutch – DPMSX2
P/N: 20779-5
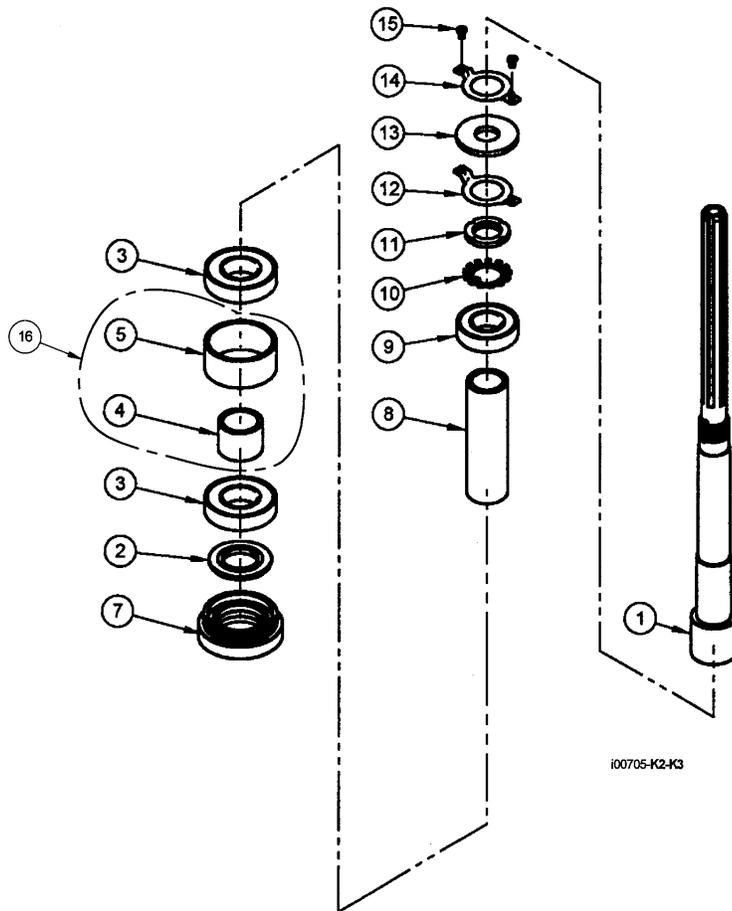
i00705-K2-K3

Item	P/N	DESCRIPTION	Qty
1	K-B127	FRU-K3-SPINDLE R8	1
2	K-B134	FRU-K3-SPINDLE DIRT SHIELD	1
3	20838	FRU-K3-BEARING 7207ZZ	1 SET
4	K-B136	FRU-K3-BEARING SPACER-SMALL	1
5	K-B137	FRU-K3-BEARING SPACER-LARGE	1
7	K-B133	FRU-K3-NOSE-PIECE	1
8	K-B132	FRU-K3-SLEEVE	1
9	K-B131	FRU-K3-BEARING-6206ZZ	1
10	K-B130	FRU-K3-BEARING LOCKWASHERØ 30	1
11	K-B129	FRU-K3-SPINDLE BEARING LOCK NUT- Ø30-20N	1
12	K-B150-1	FRU-K3-STRAIGHT LOWER CLAMP	1
13	K-B151	FRU-K3-FELT OIL STRAINER	1
14	K-B150-2	FRU-K3-STRAINER UPPER CLAMP	1
15	K-B139	FRU-K3-SCREW-PH-HD-M5-0.8X8L	2
16	20840	BEARING SPACER SET	1

i00705-K2-K3

Figure 89
Spindle Assembly – DPMSX2
P/N: 20836

NOTES: (UNLESS OTHERWISE SPECIFIED).

1. TO COLUMN (Z AXIS) RIGHT SIDE SLIDING SURFACE.
2. TO BACK SLIDING SURFACE OF THE COLUMN RIGHT SIDE.
3. TO COLUMN RIGHT SIDE GIB SLIDING SURFACE.
4. TO Z AXIS BALL SCREW.
5. TO BACK SLIDING SURFACE OF THE COLUMN LEFT SIDE.
6. TO COLUMN LEFT SIDE SLIDING SURFACE.
7. TO X Y & Z LUBRICATION SYSTEM.
8. ALL TUBES ARE Ø 4mm ALLUMINUM TUBE.

I00661-E2
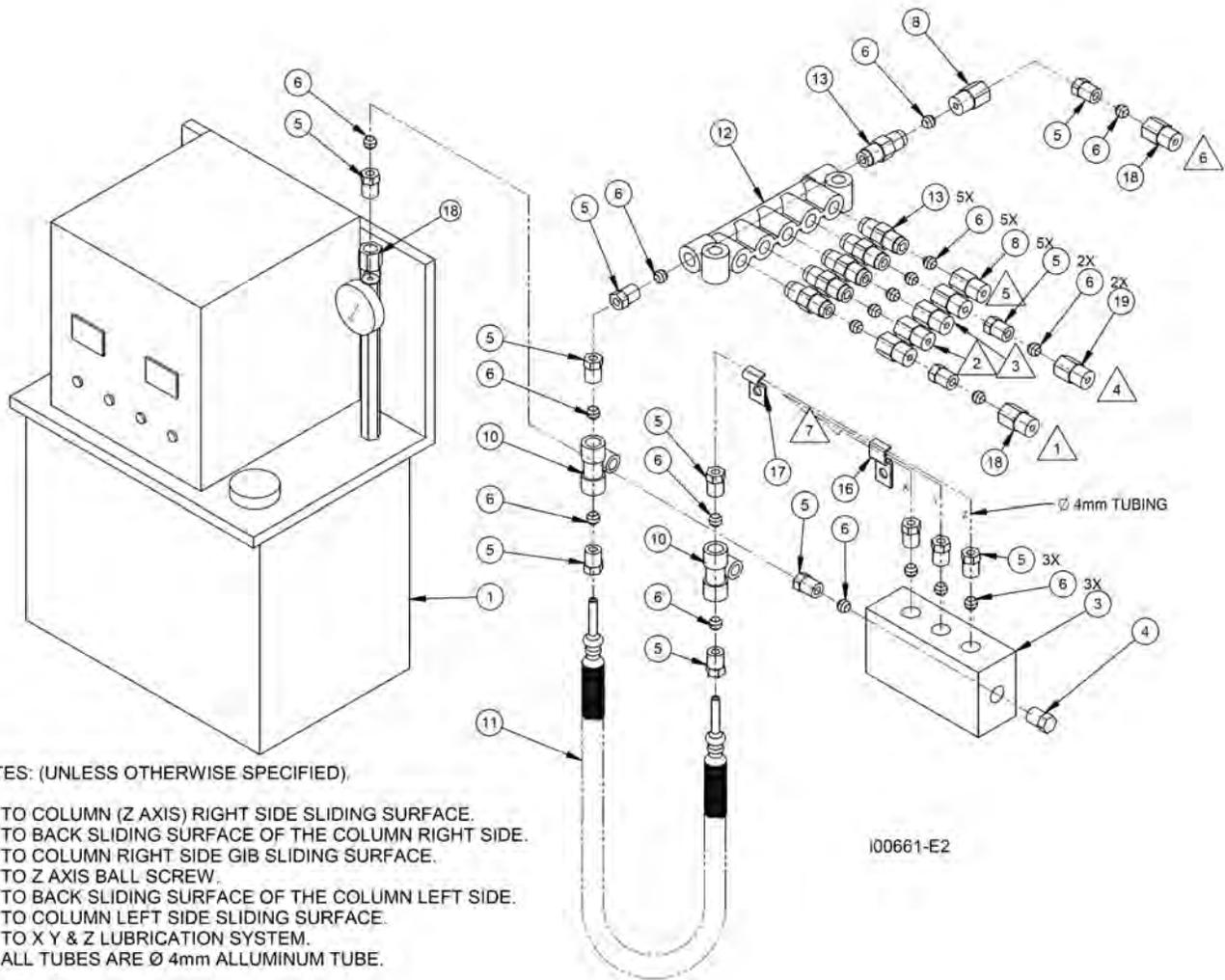
Figure 90
Lubrication Drawing – Pump & Lube System
DPMSX

Parts List
Lubrication Drawing – Pump & Lube System - DPMSX

Item	P/N	Title	Qty
1	21157-2	LUBRICATION PUMP-DPME2	0
3	B-3	DISTRBUTOR-OIL REGULATING B-3	0
4	PG004	PLUG- M8 X 1.0	0
5	PA4	BUSHING	13
6	PB4	SLEEVE-4 MM	19
8	PAN4	NUT	6
10	JD-4	2-WAY JUNCTION	1
11	L008	TUBE- STEEL ROPE & HOSE	1
12	DB7	DISTRIBUTOR	1
13	PSS4	OIL DISTRIBUTOR	6
14	A4	TUBING-4MM ALUM	A/R
16	PZ0204	CLAMP	1
17	PZ0104	CLAMP	1
18	PD401	ADPATER	3
19	PD408	ADAPTER	1

i00661
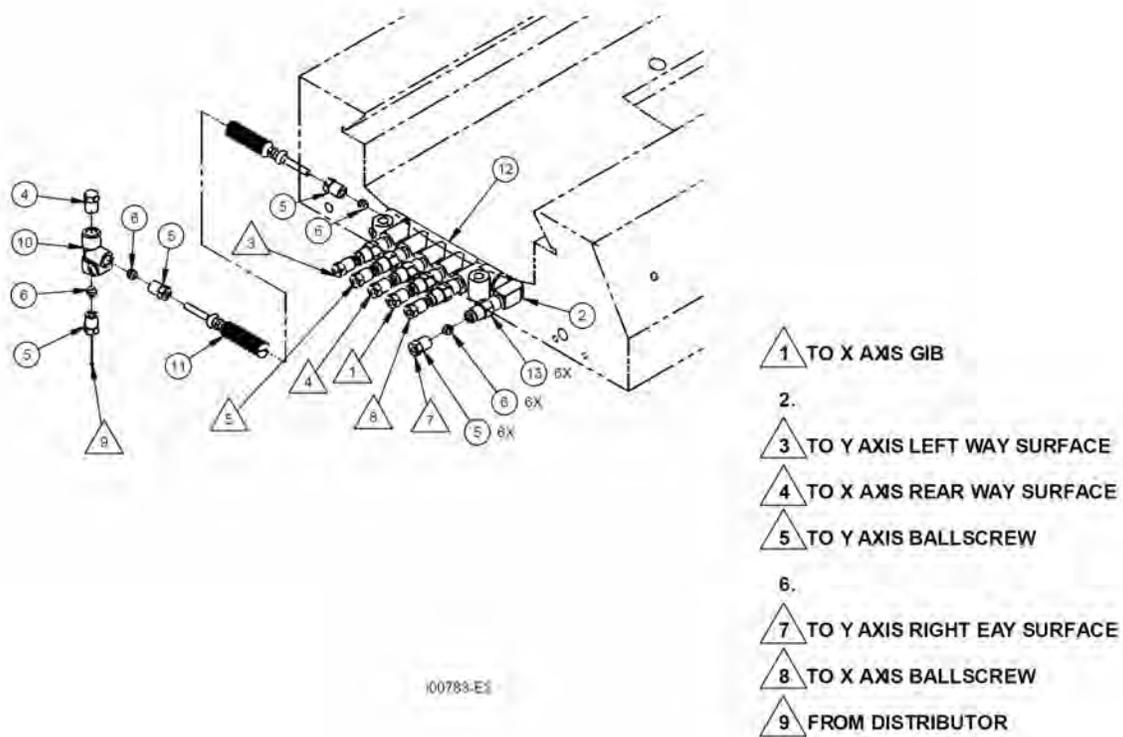
Figure 91
Lubrication Drawing – X & Y Axis – DPMSX

Item	P/N	Title	Qty
2	PH4-8	ELBOW	1
4	L015	PLUG- M8 X 1.0-PG004	1
5	L013	BUSHING-PA4	9
6	L014	SLEEVE-4 MM-PB4	9
10	L012	TEE ADAPTER-PKD4	1
11	FHC405	HOSE	1
12	L006	DISTRIBUTOR-DB10	1
13	PSS4	OIL DISTRIBUTOR	6
14	L005	TUBING-4MM ALUM-A4	XX

i00783-E2
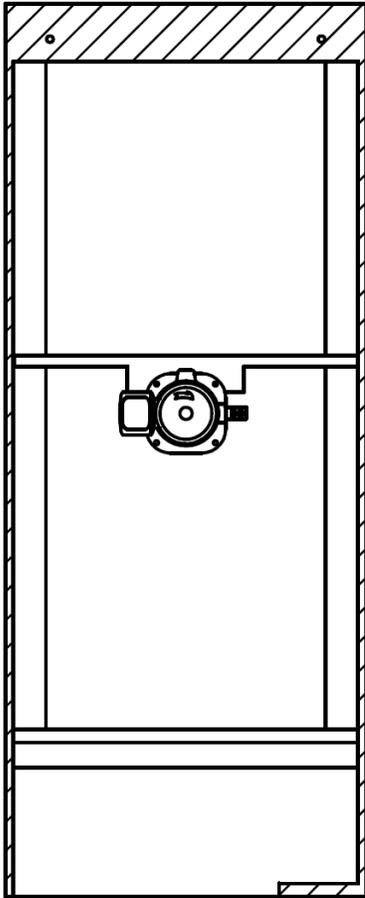
SECTION A-A

**Figure 92
Coolant Pump Mounting**

Item 1 – Coolant Pump, P/N 23265
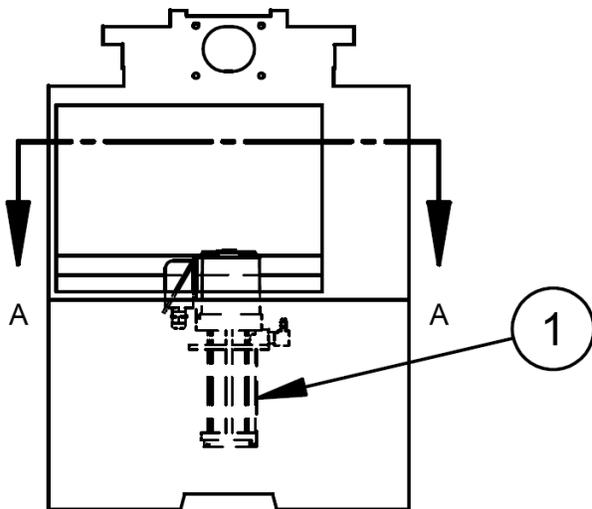
i00788
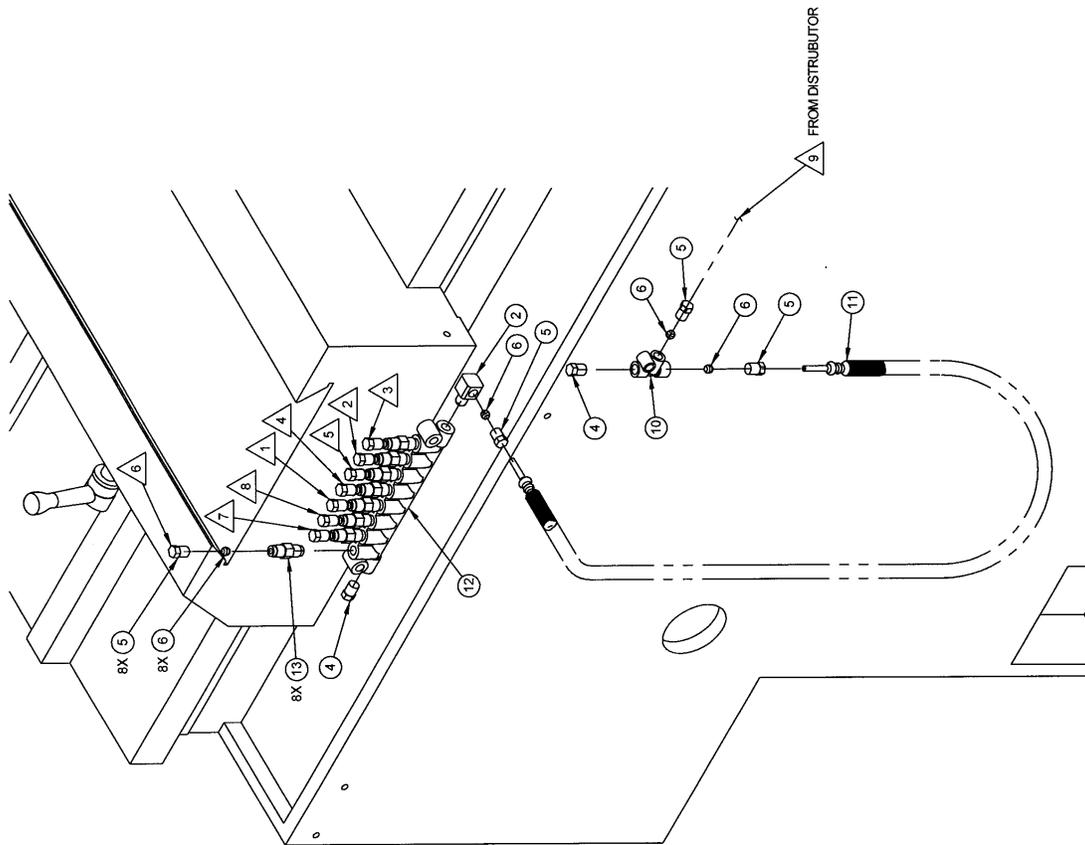
1 TO X AXIS GIB
2 TO Y AXIS LEFT BOTTOM GIB
3 TO Y AXIS LEFT WAY SURFACE
4 TO X AXIS REAR WAY SURFACE
5 TO Y AXIS BALLSCREW
6 TO Y AXIS RIGHT BOTTOM GIB
7 TO Y AXIS RIGHT WAY SURFACE
8 TO X AXIS BALLSCREW
9 FROM DISTRUBUTOR

i00783-V3

Figure 93
Lubrication Drawing – X & Y Axis
DPMSX3

Parts List
Lubrication Drawing – X & Y Axis
DPMSX3

Item	P/N	Title	Qty
2	PH4-8	ELBOW	1
4	L015	PLUG- M8 X 1.0-PG004	2
5	L013	BUSHING-PA4	11
6	L014	SLEEVE-4 MM-PB4	11
10	L012	TEE ADAPTER-PKD4	1
11	L008	HOSE	1
12	L006	DISTRIBUTOR-DB10	1
13	PSS4	OIL DISTRIBUTOR	8
14	L005	TUBING-4MM ALUM-A4	XX

i00783-V3-PL

NOTES: (UNLESS OTHERWISE SPECIFIED).

1. ALL TUBES ———— ARE Ø 4mm ALLUMINUM TUBE.
2. ALL TUBES ———— ARE Ø 4mm NYLON.

△3 PLACE ITEMS 5, 6, 20, 19, & 24 IN PLASTIC BAG, THEN PLACE IN SADDLE.

i00662
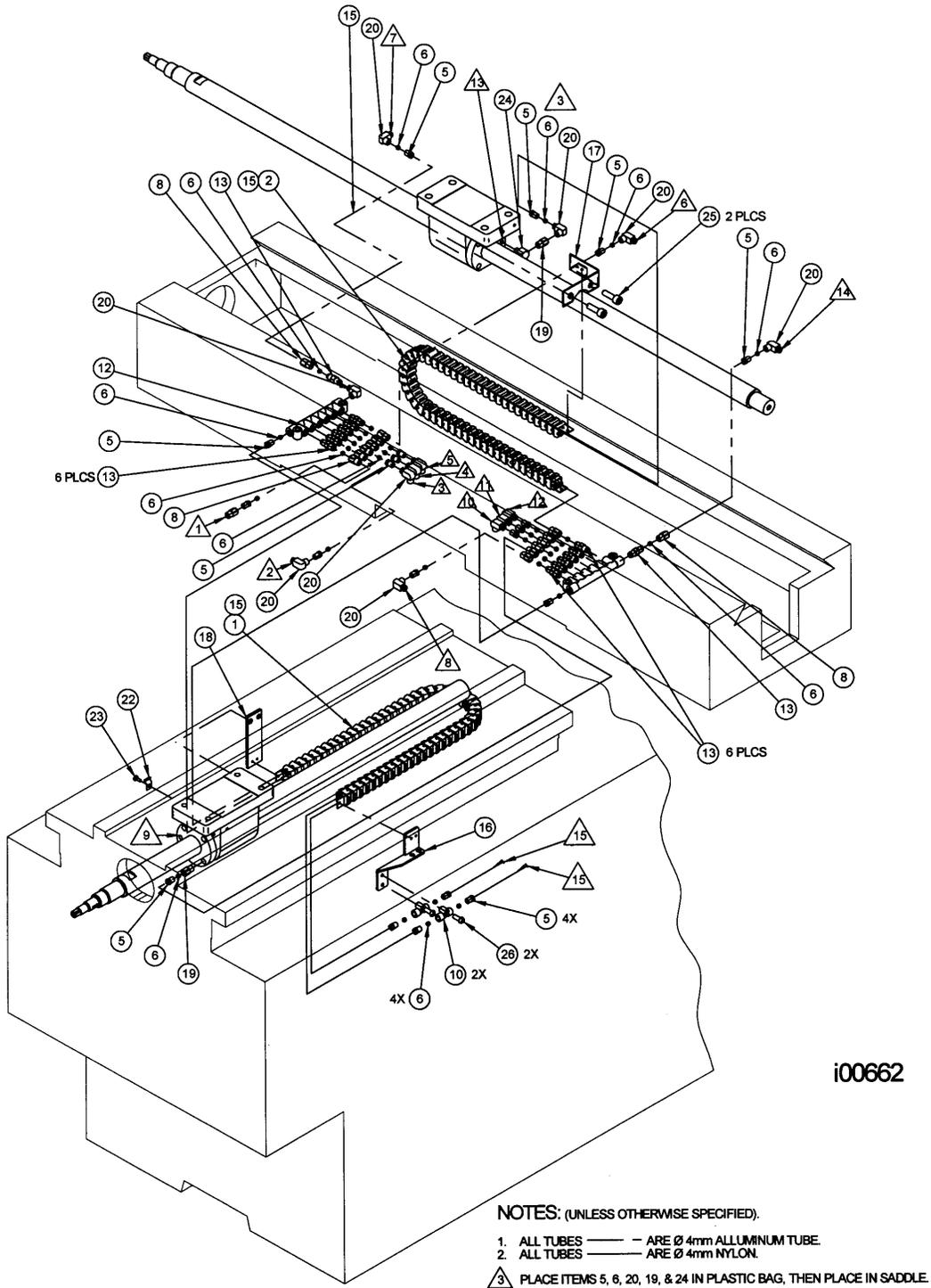
Figure 94
Lubrication Drawing X & Y Axis
DPMSX5

Parts List
Lubrication Drawing – X & Y Axis
DPMSX5

| Item	P/N	Title	Qty
1	P8011010	CHAIN 10MMX10MMX34 UNITS	1
2	P8621010	CHAIN 10MMX10MMX42 UNITS	1
5	PA4	BUSHING	22
6	PB4	SLEEVE-4 MM	36
8	PAN4	NUT	14
10	JD-4	2-WAY JUNCTION	2
12	DB8	DISTRIBUTOR	2
13	PSS4	OIL DISTRIBUTOR	14
14	A4	TUBING-4MM ALUM	144
15	P04	TUBING-4MM PLASTIC	108
16	23254	BRACKET- X & Y AXIS LUBRICATION	1
17	22346	BRACKET- LUBE X-AXIS BALLSCREW	1
18	21737	BRACKET- X & Y AXIS LUBRICATION	1
19	PD408	ADAPTER	2
20	PH408	ADAPTER- RIGHT ANGLE	13
22	PZ0104	CLAMP	1
23	M5-0.8X10 10B	SCREW-PH-PHIL-STL-BO	1
24	PH4-8	CONNECTOR-	1
25	M8-1.25X25 25B	SCREW-SHCS-STL-BO	2
26	M6-1.0X16 20B	SCREW-RH-PHIL-STL-BO	2
		i00662	

16793 ASSY

COLUMN

BED

i00233
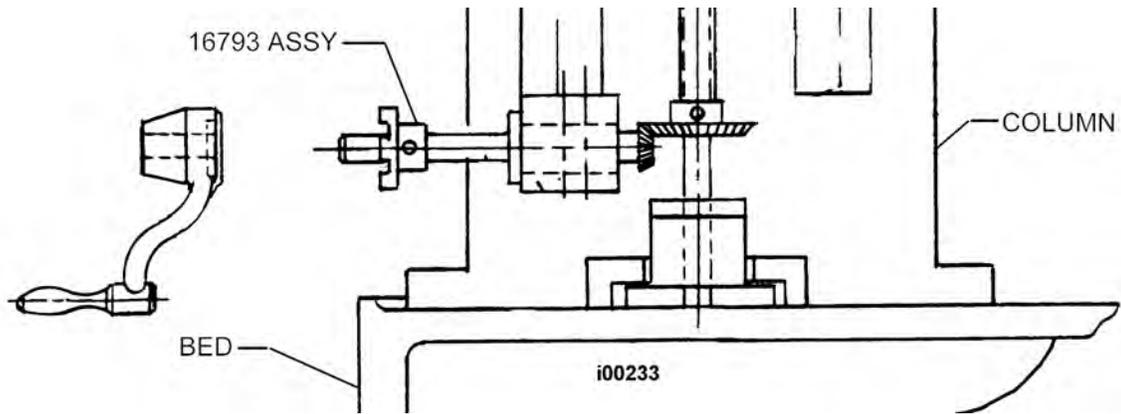
Figure 95
Manual Ram Elevation

Southwestern Industries, Inc

TRAK Warranty Policy

Warranty

TRAK products are warranted to the original purchaser to be free from defects in work-manship and materials for the following periods:

Product	Warranty Period	
	Materials	Factory Labor
New TRAK	1 Year	1 Year
Any EXCHANGE Unit	90 Days	90 Days

The warranty period starts on the date of the invoice to the original purchaser from Southwestern Industries, Inc. (SWI) or their authorized distributor.

If a unit under warranty fails, it will be repaired or exchanged at our option for a properly functioning unit in similar or better condition. Such repairs or exchanges will be made FOB Factory/Los Angeles or the location of our nearest factory representative or authorized distributor.

Disclaimers of Warranties

- This warranty is expressly in lieu of any other warranties, express or implied, including any implied warranty of merchantability or fitness for a particular purpose, and of any other obligations or liability on the part of SWI (or any producing entity, if different).

- Warranty repairs/exchanges do not cover incidental costs such as installation, labor, freight, etc.

- SWI is not responsible for consequential damages from use or misuse of any of its products.

- TRAK products are precision mechanical/electromechanical measurement systems and must be given the reasonable care that these types of instruments require:

- Replacement of chip scrapers and wipers is the responsibility of the customer. Consequently, the warranty does not apply if chips have been allowed to enter the mechanism.

- Accidental damage, beyond the control of SWI, is not covered by the warranty. Thus, the warranty does not apply if an instrument has been abused, dropped, hit, disassembled or opened.

- Improper installation by or at the direction of the customer in such a way that the product consequently fails, is considered to be beyond the control of the manufacturer and outside the scope of the warranty.