TRAK® DPME2
ProtoTRAK® Edge 3 CNC
Safety, Programming, Operating & Care Manual

Document:	P/N 23583
Version:	030404

Southwestern Industries, Inc.

2615 Homestead Place
Rancho Dominguez, CA 90220-5610 USA
T | 310.608.4422 | F | 310. 764.2668
Service Department: 800.367.3165

Table of Contents

1.0   Introduction

Congratulations! Your TRAK DPME2 milling machine with the ProtoTRAK Edge 3 CNC is an excellent toolroom machine. It features an easy-to-use interface and dozens of features that maximize machinist's productivity for any kind of toolroom job.

Manual machining is always available and made easier with features like 100 inch per minute rapids, tool offsets and all the best features of sophisticated DRO's.

Two-axis machining is available at the touch of a button for prototyping and moderately complex, low volume work.

2 1/2-axis machining is programmed and run with unprecedented flexibility. Programs may be entered at the control or imported from CAD/CAM files.

The operation of the ProtoTRAK Edge 3 CNC has been painstakingly refined to bring you the best in technology while retaining the ease of use that has made ProtoTRAK the top brand in controls for low volume production.

1.1   Manual Organization

Section 2 of this manual provides important safety information. It is highly recommended that all operators of this product review this safety information.

Section 3 provides a description of the TRAK DPME2 and the ProtTRAK Edge 3 CNC.

Section 4 describes the operation of the milling machine and some basic operations of the ProtoTRAK Edge 3 CNC.

Section 5 defines some terms and concepts useful in learning to program and operate the ProtoTRAK Edge 3 CNC.

The ProtoTRAK Edge 3 CNC is organized into six Modes of operation that are described in the following sections.

Section 6 DRO: Digital Readout, Jog and 2-axis Teach.

Section 7 Programming, covers some general programming information and instructions on starting new programs.

Section 8 Changing or Correcting Programs, covers some general information about editing programs and saving and erasing entire programs.

Section 9 Making Parts With the CNC: Instructions on running a program to machine your part and tool information.

Section 10 Math Help: Power Math Help functions to help you define your part.

Section 11 Program Memory and Storage: Storing and managing your programs.

Section 12 Service Codes: Service codes procedures and service code types.

.

2.0   Safety

The safe operation of the TRAK DPME2 depends on its proper use and the precautions taken by each operator.

- Read and study this 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.

2.1   Safety Publications

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

Safety Requirements For The Construction, Care And Use of Drilling, Milling, and Boring Machines (ANSI B11.8-1983). Available from The American National Standards Institute, 1430 Broadway, New York, New York 10018.

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 20210.

2.2   Danger, Warning, Caution, and Note Labels and 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 that *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.

ALWAYS WEAR SAFETY GLASSES AND SAFETY SHOES

PREVENT SERIOUS INJURY

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

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

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)

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

| MODEL | TRAK DPME2 |
| S/N | XXX AY XXXXX |

ELECTRICAL RATINGS:
220 VOLTS 8.5 AMPS 3 PHASE
60 Hz

FLA OF LARGEST MOTOR 8.5 AMPS
SHORT CIRCUIT INTERRUPT 200K AMPS
ELECTRICAL DRAWING #: 23630

CNC CONTROL ELECTRICAL RATINGS:
IF APPLICABLE
115 VOLTS 8 AMPS 1 PHASE
60 Hz

MACHINE (ONLY) MADE IN TAIWAN

i21214-DPME2

Safety & Information Labels Used On The TRAK DPME2

It is forbidden by OSHA regulations and by law to deface, destroy or remove any of these labels

DANGER

HIGH VOLTAGE

230 VOLTS

WARNING

IMPROPER INSTALLATION OR OPERATION OF THIS MOTOR MAY CAUSE INJURY TO PERSONNEL OR MOTOR FAILURE. READ OPERATING INSTRUCTIONS.

MOTOR MUST BE INSTALLED AND GROUNDED PER LOCAL AND NATIONAL ELECTRICAL CODES.

TO REDUCE POTENTIAL OF ELECTRICAL SHOCK DISCONNECT ALL POWER SOURCES BEFORE INITIATING ANY MAINTENANCE OR REPAIRS.

KEEP FINGERS AND FOREIGN OBJECTS AWAY FROM VENTILATION AND OTHER OPENINGS. KEEP AIR PASSAGES CLEAR.

EYEBOLTS OR LIFTING HOOKS, WHEN SUPPLIED, ARE INTENDED FOR LIFTING THE PRODUCT ONLY AND MUST NOT BE USED TO LIFT ADDITIONAL WEIGHT.

USE ONLY GRADE 5 SHOULDER EYEBOLTS WITH MINIMUM THREAD LENGTH OF 1 1/2 TIMES DIAMETER.

Safety & Information Labels Used On The
TRAK DPME2
It is forbidden by OSHA regulations and by law to deface, destroy or remove any of these labels

2.3   Safety Precautions

Do not operate this machine before the **TRAK DPME2 Safety, Installation, Maintenance, Service and Parts List Manual**, and the **TRAK DPME2 Safety, Programming, Operating & Care Manual** have been studied and understood.

1. 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.

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

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

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

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

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

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

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

9. Protect your hands. Stop the machine spindle and ensure that the CNC control is in the stop mode:

10. Before changing tools
11. Before changing parts
12. Before you clear away the chips, oil or coolant. Always use a chip scraper or brush
13. Before you make an adjustment to the part, fixture, coolant nozzle or take measurements
14. Before you open safeguards (protective shields, etc.). Never reach for the part, tool, or fixture around a safeguard.

15. Protect your eyes and the machine as well. Don't use a compressed air hose to remove the chips or clean the machine (oil, coolant, etc.).

16. Stop and disconnect the machine before you change belts, pulley, gears.

17. Keep work area well lighted. Ask for additional light if needed.

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

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

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

21. 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.

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

23. 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.

24. 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.

25. Check the direction (+ or -) of movement of the table when using the jog or power feed.

26. 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.

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

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

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

30. When working in manual mode (not CNC) make sure the computer control is switched to DRO or OFF.

3.0 Description

3.1 Display Pendant Front *(see Figure 3.1)*
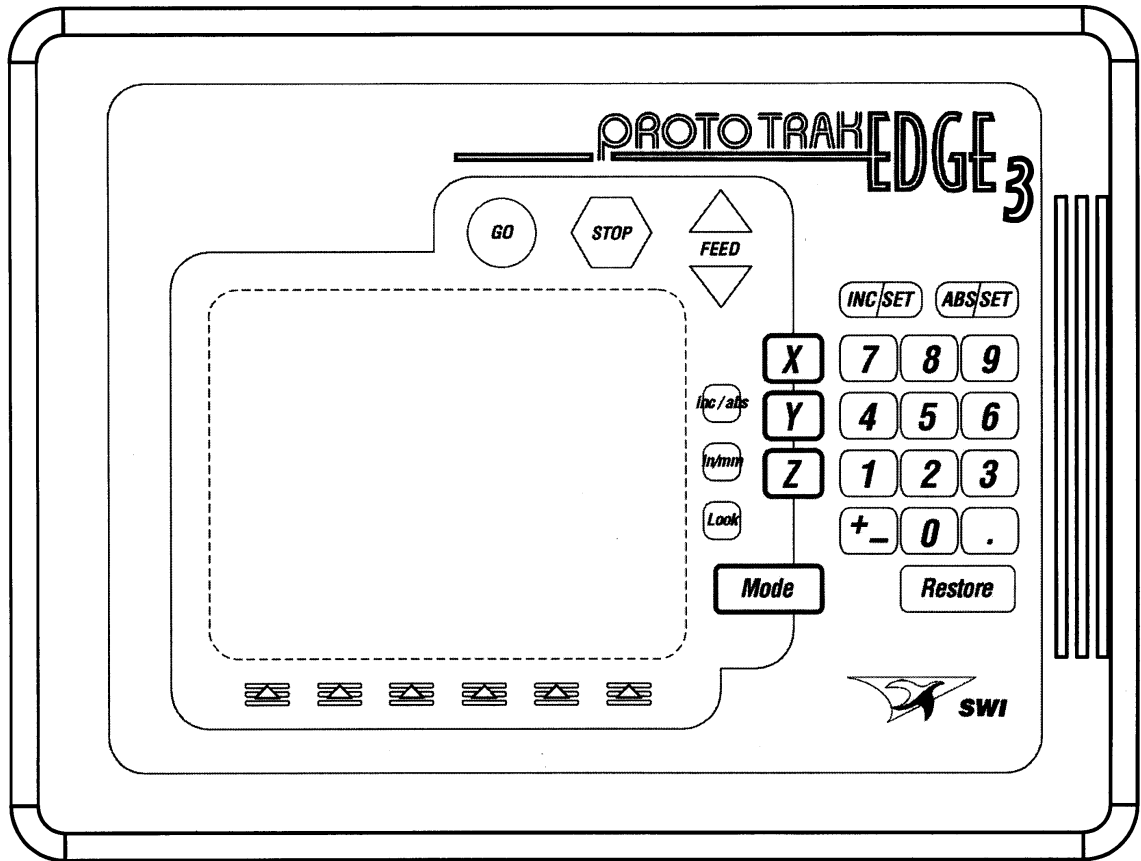
FIGURE 3.1 *The ProtoTRAK Edge 3 CNC front panel*   i01079

3.1.1 Keyboard Hard Keys

- **Feed Keys**

 GO: initiates motion in Run.

 STOP: halts motion during Run.

 FEED ↑: feedrate override to increase feedrate.

 FEED ↓: feedrate override to decrease feedrate.

 INC SET: loads incremental dimensions and general data

 ABS SET: loads absolute dimensions and general data

 INC/ABS: switches all or one axis from incremental to absolute or absolute to incremental

IN/MM: causes Inch to Metric or Metric to Inch conversion of displayed data

LOOK: part graphics in Program mode

X, Y, Z: selects axis for subsequent commands

RESTORE: clears an entry, aborts a keying procedure

0-9, +/-, . : inputs numeric data with floating point format. Data is automatically +
unless **+/-** key is pressed. All input data is automatically rounded to the system's
resolution.

MODE: to change from one mode of operation to another

3.1.2   Soft Keys

Beneath the LCD screen are 6 keys that are not labeled. These keys are called software
programmable or soft keys. A description of the function or use of each of these keys
will be shown at the bottom of the LCD screen directly above each key. If, at any time,
there is no description above a key, that key will not operate.

3.1.3   Emergency Stop Switch

The emergency stop (E-stop) switch kills all power to the ProtoTRAK's servomotors and spindle
motor. The pendant remains powered.

3.1.4   The Liquid Crystal Display (LCD)

The 7.4" LCD can be adjusted for viewing comfort in two ways. The viewing angle may be
changed (see Section 3.7) and the contrast may be adjusted using Special Code 160 (see
Section 12).

3.2   **Pendant Back Panel** *(see Figure 3.2)*

See Figure 3.2 for a description of the fuses, switches, and connectors on the pendant
back panel.
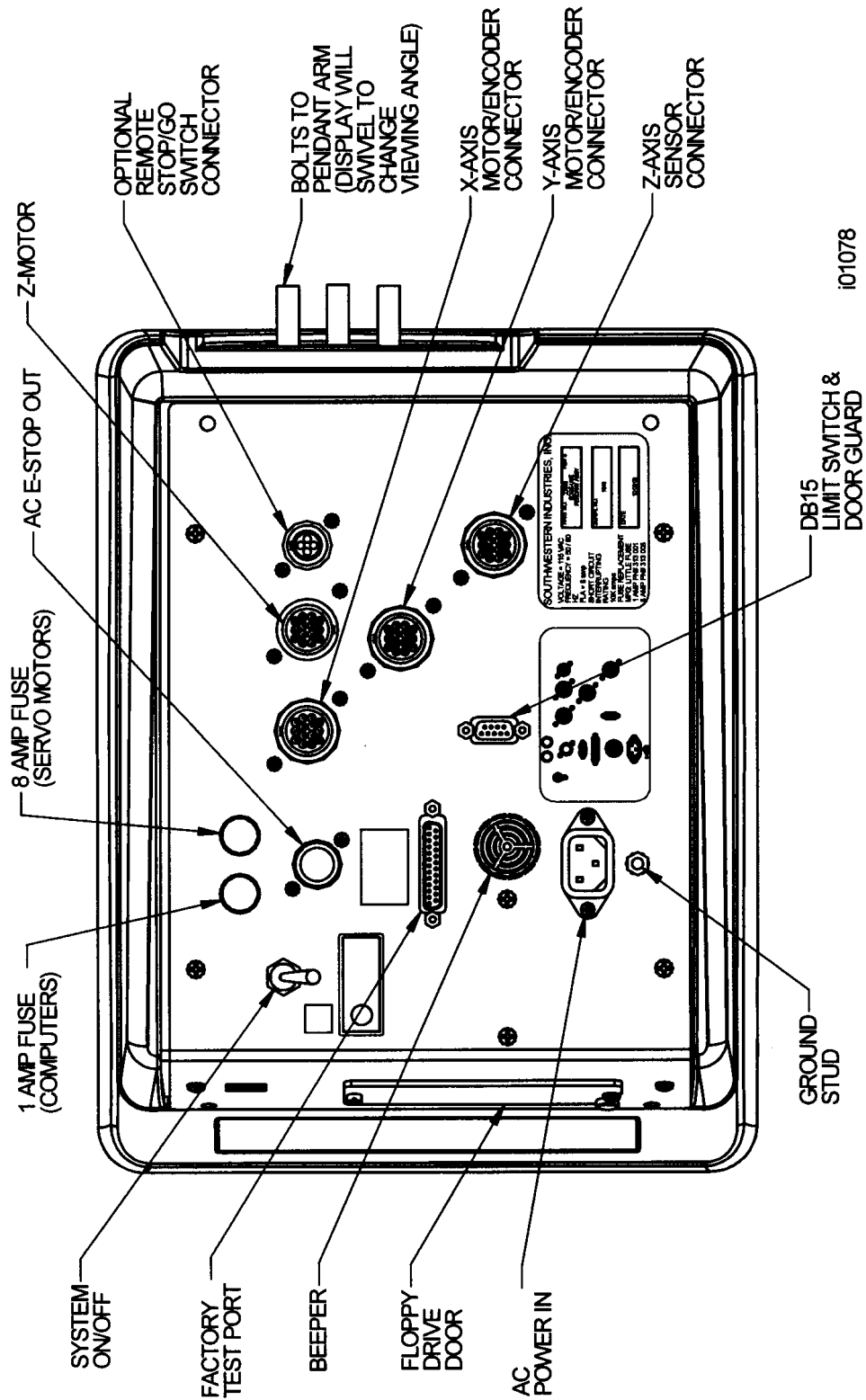
FIGURE 3.2 The ProtoTRAK Edge 3 CNC Back side with connectors labeled

Labels on figure:

OPTIONAL REMOTE STOP/GO SWITCH CONNECTOR

BOLTS TO PENDANT ARM (DISPLAY WILL SWIVEL TO CHANGE VIEWING ANGLE)

X-AXIS MOTOR/ENCODER CONNECTOR

Y-AXIS MOTOR/ENCODER CONNECTOR

Z-AXIS SENSOR CONNECTOR

Z-MOTOR

AC E-STOP OUT

8 AMP FUSE (SERVO MOTORS)

1 AMP FUSE (COMPUTERS)

DB15 LIMIT SWITCH & DOOR GUARD

GROUND STUD

SYSTEM ON/OFF

FACTORY TEST PORT

BEEPER

FLOPPY DRIVE DOOR

AC POWER IN

i01078

3.3 Machine Specifications *(See Figures 3.4.1 and 3.4.2)*
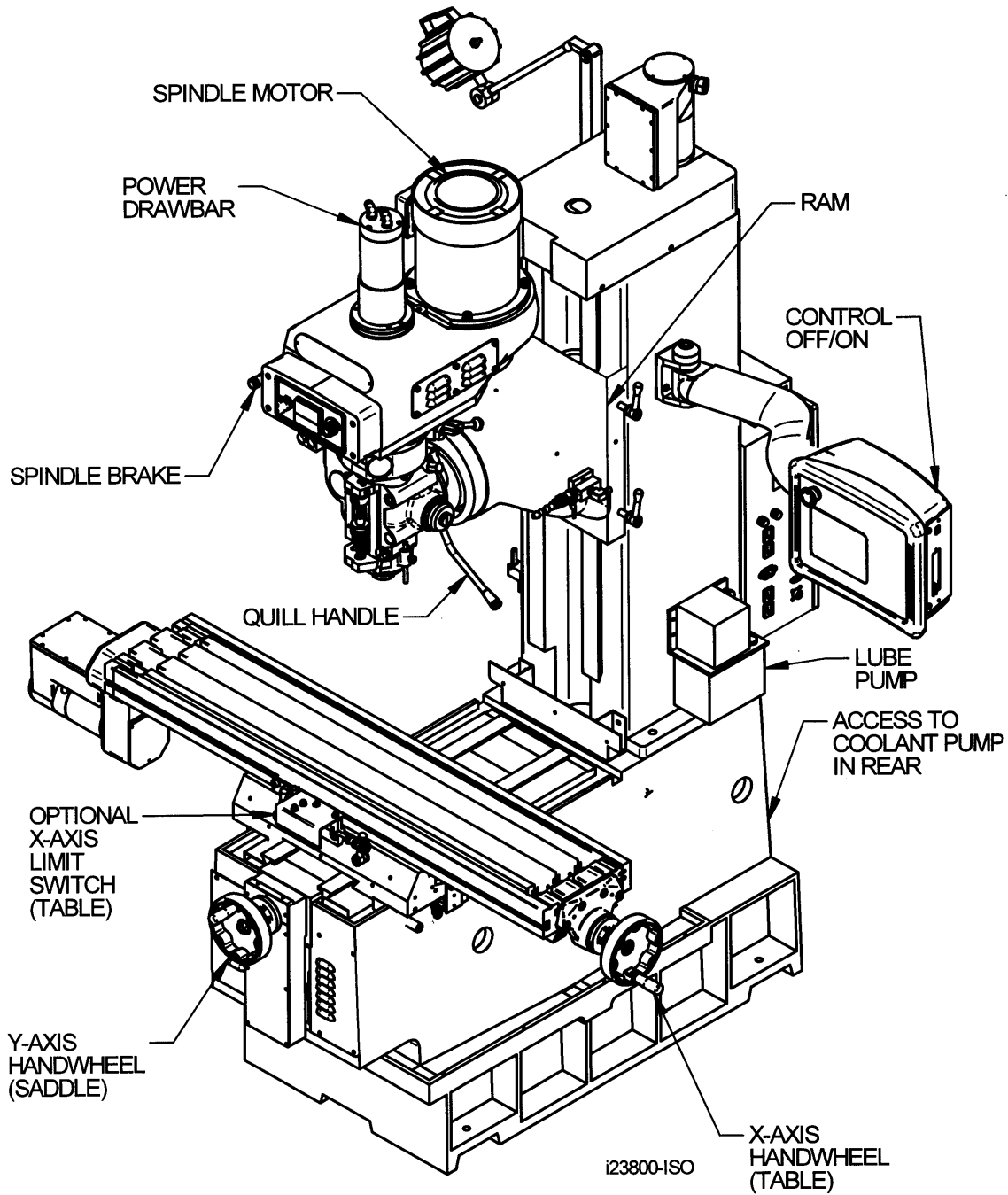
FIGURE 3.3.1 The TRAK DPME2 Series machine overview

TRAK DPME2

Table Size - 49" x 9"	Height of table from bottom of bed – 33 1/2″
T-Slots – 3 x .63″ x 2.50″	Maximum spindle nose to table – 27″
Travel (X, Y, Z) – 31 x 16 x 25″	Minimum height – 90″
Maximum quill travel – 5″	Maximum height – 98″
Quill diameter – 3 3/8″	Width of machine including table – 70″
Spindle Taper – R8	Length of electric box door closed – 64″
Spindle Speed Range - High – 550 – 5000 Low – 60 - 600	Overall width including full table traverse – 104″
Spindle Center to Column Face – 18″	Footprint of machine – 23″ x 40″
Spindle motor – 3 HP	Weight net/shipping lbs. – 3200/3500
Power Requirement control - 110V; 1P; 8A	Maximum Weight on Table - 1320 lb
Power Requirement machine – 220V; 3P; 8.5A	Maximum rapid feed – 100 ipm
Maximum work capacities in mild steel – drilling, 1″ dia; tapping, 5/8″; milling, 2 in³/min	
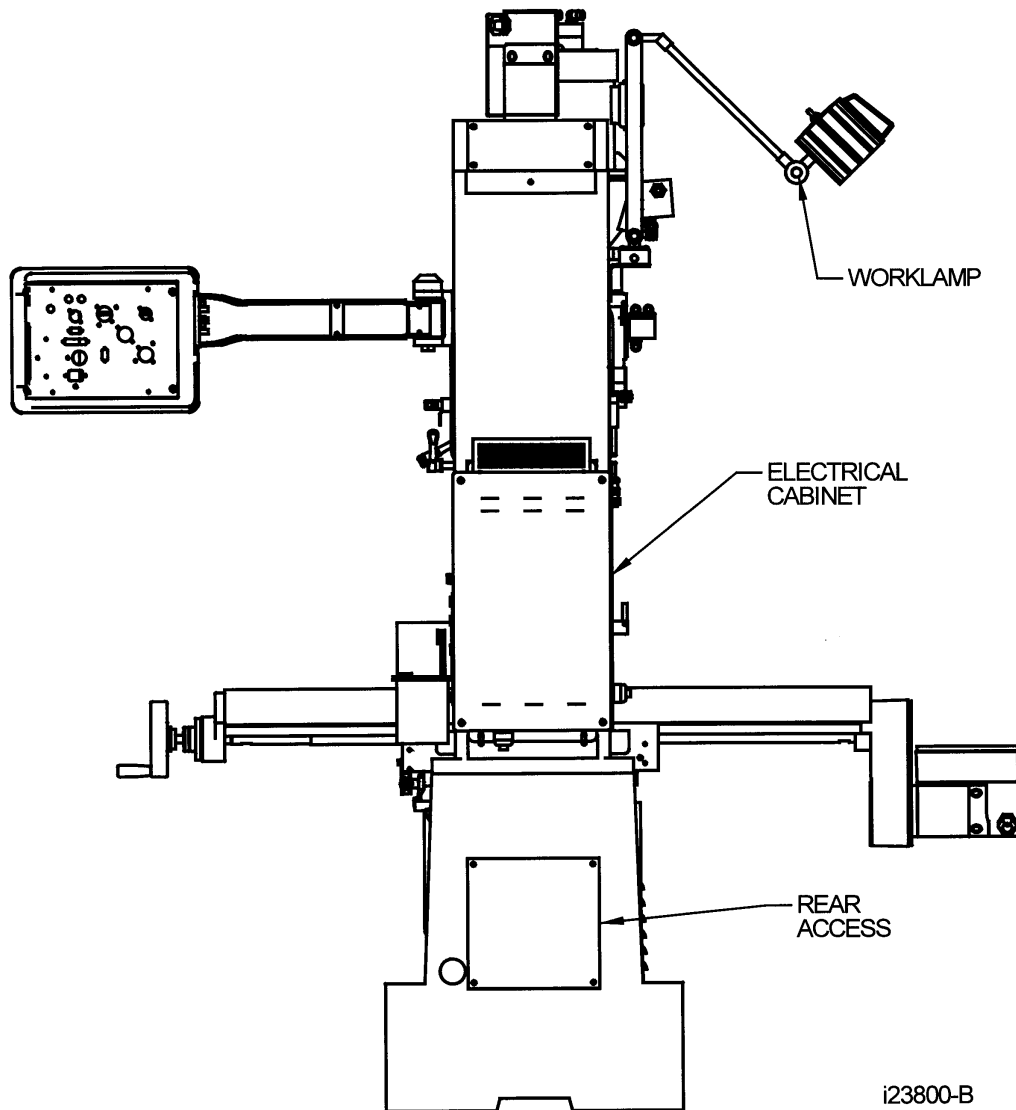
FIGURE 3.3.2 The TRAK DPME2 Series back view

3.4 Lubrication System

3.4.1 Factory Default Values

The auto lube system provides centralized automatic lubrication for the ways and ballscrews. The lube pumps 2-liter reservoir is serviced with S.A.E. 30 weight oil. The pump is factory set to pump oil for 10 seconds for every 60 minutes of spindle time.

CAUTION!
Failure to properly lubricate the mill will result in the premature failure of bearings and sliding surfaces.

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 DPME2 mill way surfaces and ballscrews.

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.

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 second.

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

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

Discharge Pressure – Approximately 100 – 150psi

3.5 Electrical Cabinet

The TRAK DPME2 uses two electrical inputs. Spindle 220V power is wired into the cabinet. A cord is supplied from the cabinet to a 110V power source for running the ProtoTRAK Edge 3 CNC.

3.6 The Floppy Drive

Access to the floppy drive is located on the right side of the ProtoTRAK Edge 3 display. A metal plate held by a thumbscrew protects the drive. To change disks, loosen the thumbscrew and swivel the plate up. Press the button on the floppy drive to eject the floppy diskette.

3.6.1 Edge 3 System Disk

Shipped in the floppy drive is the ProtoTRAK Edge 3 system disk. This disk contains the ProtoTRAK Edge 3 operating program and storage space for your part programs. This disk must be inside the floppy drive each time you turn on the control. Use additional disks for additional part program storage.

3.7 The Tilt Adjustment

On the left side of the ProtoTRAK Edge display, where the display contacts the pendant arm, are three bolts that allow you to adjust the tilt angle of the display by loosening the nuts. It is necessary to push aside the system cables while you are doing this. Adjust the angle so that the LCD is viewed comfortably and then retighten the nuts.

3.8 Servo Motors/Amplifiers

The ProtoTRAK Edge 3 servomotors and amplifiers have been combined into a single integrated package on each axis. The X and Y motors are rated 280 in-oz. maximum continuous torque and the Z is rated for 560 in-oz maximum continuous torque.

3.9 Integrated Ram and Quill Encoders

A glass scale for the Quill operation is standard. Ram motion is measured by an encoder on the ram servo motor. The feedback from these encoders is integrated and displayed in the Z-axis digital readout as one dimension.

3.10 Optional Equipment

3.10.1 Power Draw Bar

A manual draw bar comes standard with the machine. A power draw bar option may be ordered. This power draw bar option comes with an R8 draw bar to fit tool holders that have a threaded tang on the top.

3.10.2 Remote Stop Go Switch

For the convenience of operation while running the program, a Remote Stop/Go switch may be purchased. This switch is on a ten-foot cable and operates like the FEED Stop and Go keys on the display.

3.10.3 Work Light

An optional halogen work light is available. It mounts to the left side (facing) of the column and plugs into a 110v outlet in the electrical cabinet.

3.10.4 Transformer & Flange Fused Disconnect

This option allows the machine to run on 1 dedicated 220V power source. A transformer in the electrics box provides 110V power to run the pendant and accessories. The flange disconnect also allows power to the machine to be locked out for service reasons.

3.10.5 Limit Switches

X, Y and Z limit switches may be installed. Given the application, this option is not especially recommended. If the system overruns its travel, even at rapid speed, the resulting bump will normally be absorbed by the system without harm.

4.0   Basic Operation

One of the things that makes the TRAK DPME2 so easy to use is that most of the operations of the ProtoTRAK Edge 3 CNC are organized in Modes. Modes are logical groups of activities that naturally belong together. This eliminates the need to memorize operations – just select a mode and choose among the soft keys.

Most operations will be discussed within the section that treats the mode later in this manual. The operations described in this section either don't fit in a particular mode, or they are relevant to more than one mode.

4.1   Turning on the ProtoTRAK Edge 3

Turn the ProtoTRAK Edge System on by moving the on-off toggle switch on the display pendant back panel to the up position.

The display will read "Loading Edge" indicating that the system's operating software is being loaded from its floppy disk to its internal memory. This loading takes about one minute. When complete, the screen will show:

EDGE 3

Southwestern Industries, Inc.
Version
Copyright © 2003

SELECT MODE

DRO	PROG	RUN	MATH HELP	PROG IN/OUT	2 AXIS
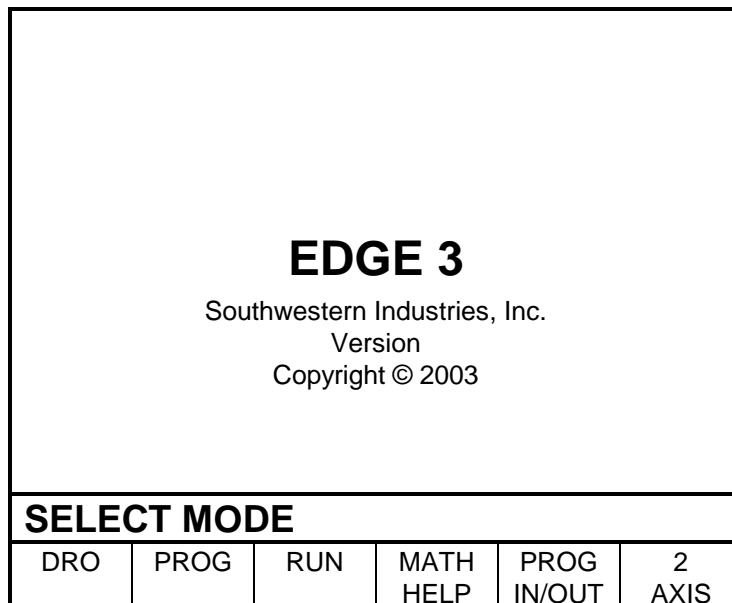
FIGURE 4.1 The main "select a mode" screen.

Select the Mode of operation by pressing the soft key beneath the labeled box.

If you wish to operate the system as a two-axis EDGE, press the 2 AXIS softkey. The system will reload the software.

If the system is not used (either by a keystroke or by counting) for 20 continuous minutes, the LCD will turn itself off. Press any key to bring the screen back to its previous display. The key you press will be ignored except to turn the screen on.

Note: When you turn the ProtoTRAK off, always wait a few seconds before turning it back on.

4.2   Spindle Control

4.2.1   Spindle Operation

The DPME2 is equipped with a 2-speed spindle with a maximum speed of 5000 RPM. The spindle speed is controlled through the use of the On/Off switch labeled *I-II-OFF* and a potentiometer, with the labels *L-H,* mounted on the front of the machine head. Hi and Lo gear are selected through the use of a lever labeled *Hi-Lo-Neutral,* located on the side of the spindle head.

i23698
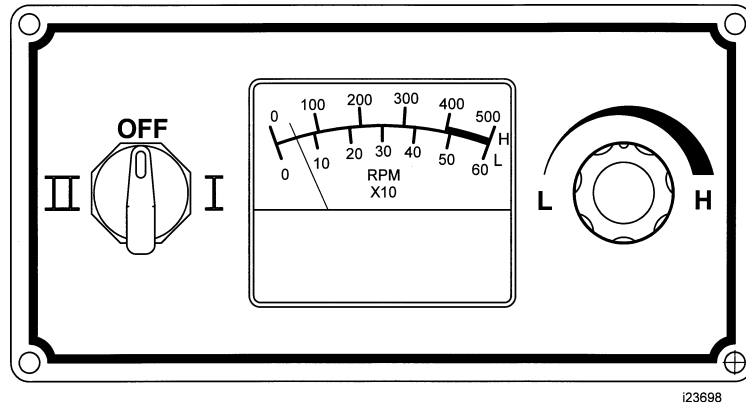
4.2.2   On, OFF, Clockwise, Counter-clockwise & E-Stop

To turn the spindle on, make sure that the gear selection lever is in either the *Hi* or *Lo* position, then turn the On/Off switch to either *I or II*. The gear and On/Off switch setting determine the spindles' direction of rotation. For example, in high gear, if your spindle rotates clockwise when the On/Off switch is set to *I*, switching the toggle to *II* will cause the spindle to rotate counter-clockwise. When in Lo gear, the spindle direction will be just the opposite of Hi gear. Setting the On/Off switch to the *OFF* position while spindle is in operation will shut the spindle off and will not allow it to operate until it is switched to either the *I* or *II* setting. Similarly, pressing E-stop while the spindle is in operation will shut the spindle off, however, de-pressing E-stop will not automatically turn the spindle back on. You must turn the On/Off switch to the *OFF* position, then back to either *I* or *II*. When the spindle is turned off by either the On/Off switch or E-Stop, it will coast to a rest, use the mechanical brake handle for a faster stop. Please note the rotation directions of your spindle prior to operation. This can vary from the factory.

4.2.3   Changing RPM

The DPME2 has an range of 60 – 600 RPM when in Lo gear and 550 – 5000 RPM when in Hi gear. Hi and Lo gear are selected through the use of a lever labeled *Hi-Lo-Neutral,* located on the side of the spindle head. When in Lo gear, the RPM is read off the bottom set of numbers on the spindle tachometer. When in Hi gear, the RPM is read off the top set of numbers located on the spindle tachometer. *Note that the tachometer numbers are multiplied by 10, so if you are in low gear and the tachometer is pointing to 50 the spindle is rotating at 500 RPM (50 x 10). To increase or decrease spindle speed, simply turn the potentiometer, with the labels L-H, toward the H to increase RPM and towards the L to decrease RPM.*

4.3 Manual Operation of the Ram, Table & Saddle

The TRAK Edge 3 may be used manually. The head/ram may be jogged to any location and the quill operated manually. Either motion will count in Z.

4.4 Emergency Stop

Press the button to shut off power to the spindle motor and axis motors. Rotate the switch to release.

4.5 Switching Between Two and Three Axis Operation

The control defaults to 3-axis operation. When in 3-axis, the last soft button to the right on the main select a mode screen will read 2-axis. Press this button to switch to 2-axis operation; the button will now change to read 3-axis. Press this button to return to 3-axis operation.

4.6 Coolant Pump

An optional coolant pump may be connected to your TRAK DPME2.

5.0 Definitions, Terms & Concepts

5.1 ProtoTRAK Edge 3 Axis Conventions

X Axis: positive X-axis motion is defined as the table moving to the left when facing the mill. Consequently, measurement to the right is positive on the workpiece.

Y Axis: positive Y-axis motion is defined as the table moving toward you. Measurement toward the machine (away from you) is positive on the workpiece.

Z Axis: positive Z-axis motion is defined as moving the head up. Measurement up is also positive on the workpiece.
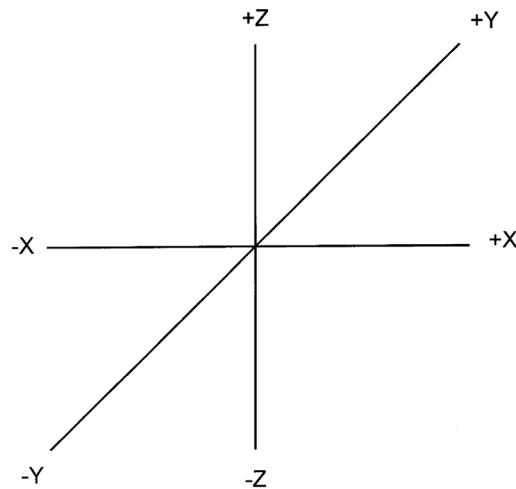
FIGURE 5.1 ProtoTRAK Edge 3 CNC conventions

The Z RAPID dimension is the position at which Z will stop rapid traversing and switch to its programmed Z feedrate. Z motion will continue until Z End depth has been reached.

5.2 Part Geometry Programming

Part Geometry programming is the popular programming style of the ProtoTRAK family of products. This is done by defining the final geometry of the part, and the ProtoTRAK Edge 3 CNC has the job of figuring out the tool path from the part dimensions and the tool set-up information. This is a great benefit compared to regular CNC because it doesn't force the programmer to do the difficult job of defining tool path.

5.3 2 ½ Axis

The Edge 3 CNC works like what is commonly referred to as 2 ½ axis. 2 ½ axis means that there is a third axis present (Z-axis), but you cannot program all three axes to move at the same time. In the case of the Edge 3 CNC, in any event, it will always move the Z-axis first and then X and Y. Because of this, you cannot program any type of part where you would need to move the Z-axis at the same time as X or Y.

5.4 Absolute & Incremental Reference

The ProtoTRAK Edge 3 CNC may be programmed and operated in either (or in a combination) of absolute or incremental dimensions. An absolute reference from which all absolute dimensions

are measured (in DRO and program operation) can be set at any point on or even off the workpiece.

To help understand the difference between absolute and incremental position, consider the following example:
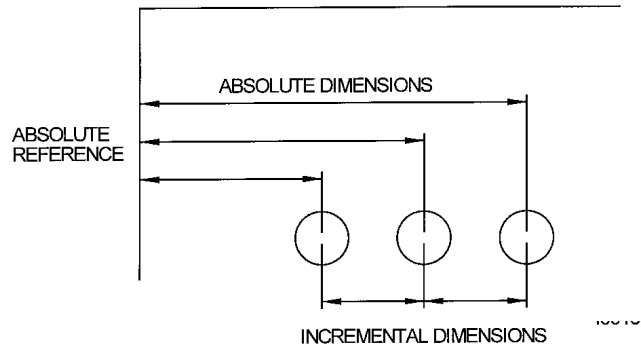
FIGURE 5.5 Each point has both an absolute and an incremental reference in the X axis. The ProtoTRAK Edge 3 CNC allows you to program using either.

5.5   Referenced & Non-Referenced Data

Data is always loaded into the ProtoTRAK Edge 3 CNC by using the INC SET or ABS SET key. X, Y, Z positions are referenced data. In entering any X, Y, or Z position data, you must note whether it is an incremental or absolute dimension and enter it accordingly. All other information (non-referenced data), such as tool diameter, feedrate, etc. is not a position and may, therefore, be loaded with either the INC SET or ABS SET key. This manual uses the term SET when either INC SET or ABS SET may be used interchangeably.

5.6   Incremental Reference Position in Programming

When X, Y, Z RAPID and Z data for the beginning position of any event are input as incremental data, this increment must be measured from some known point in the previous event. Following are the positions for each event type from which the incremental moves are made in the subsequent event:

Position: X, Y and Z-Rapid programmed

Drill: X, Y, Z RAPID, and Z END programmed

Bolt Hole: X CENTER, Y CENTER, Z RAPID and Z END programmed

Mill: X END, Y END, Z RAPID and Z END programmed

Arc: X END, Y END, Z RAPID and Z END programmed

Circle (POCKET or FRAME): X CENTER, Y CENTER, Z RAPID and Z END programmed

Rectangle (POCKET or FRAME): X1 and Y1 corner, Z RAPID and Z END programmed

Repeat: The reference position as defined for the specific events above for the event prior to the first event that was repeated.

5.7   Tool Diameter Compensation

Tool diameter compensation allows the machined edges shown directly on the print to be programmed instead of the center of the tool. The ProtoTRAK Edge 3 CNC then

automatically compensates for the programmed geometry so that the desired results are obtained.

Tool cutter compensation is always specified as the tool either right or left of the workpiece while looking in the direction of the tool motion.
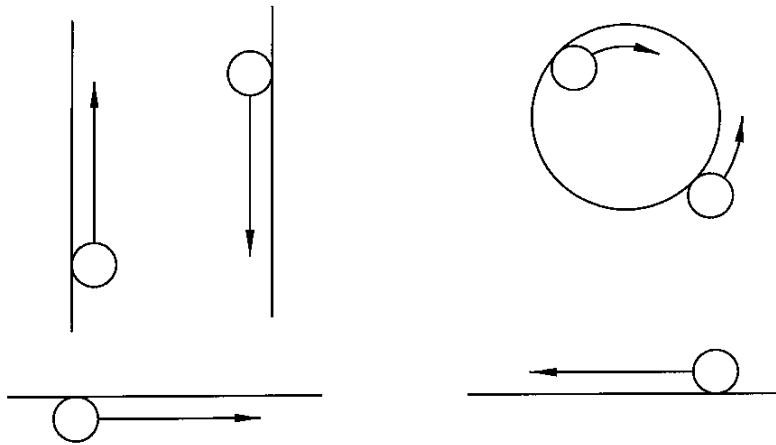
FIGURE 5.8.1 *Examples of tool right*
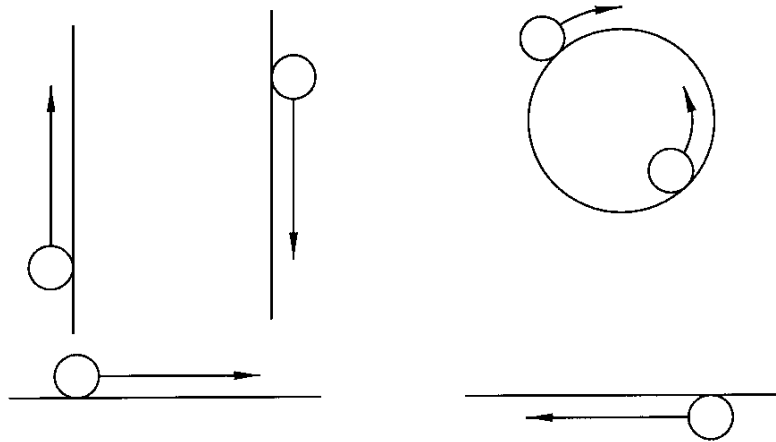
FIGURE 5.8.2 *Examples of tool left*

Tool center means no compensation either right or left. That is, the centerline of the tool will be moved to the programmed points.

5.8   Connective Events

Connective events occur between two milling events (either Mill or Arc) when the X, Y, and Z ending points of the first event are in the same location as the X, Y, and Z starting points of the next event. In addition, the tool offset and tool number of both events must be the same, and both events must lie in the XY plane.

5.9 Conrad

Conrad is a unique feature of the PROTOTRAK Edge 3 CNC that allows you to program a tangentially connecting radius between connective events, or tangentially connecting radii for the corners of pockets and frames without the necessity of complex calculations.

For the figure below, you program an Arc event from X1, Y1 to X2, Y2 with tool offset left, and another Arc event from X2, Y2 to X3, Y3 also with tool offset left. During the programming of the first Arc event, the system will prompt for Conrad at which time you input the numerical value of the tangentially connecting radius r=K3. The system will calculate the tangent points T1 and T2 and direct the tool cutter to move continuously from X1, Y1 through T1, r=k3, T2 to X3, Y3.
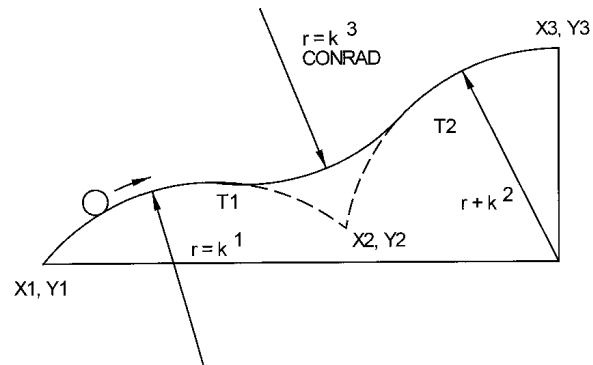
FIGURE 5.10 A Conrad is added between the two intersecting lines

Note: Conrad must always be the same as or larger than the tool radius for inside corners. If Conrad is less than the tool radius, and an inside corner is machined, the ProtoTRAK Edge 3 CNC will ignore the Conrad.

6.0 Using the ProtoTRAK Edge as a DRO

The ProtoTRAK Edge 3 operates in DRO Mode as a digital readout with jog.

6.1 Enter DRO Mode

Press MODE, select DRO soft key. The LCD screen will show:

```
DRO                                    INCH      > STATUS

    X  0.0000  ABS

    Y  0.0000  ABS                              > INFORMATION

    Z  0.0000  ABS


                                                > CONVERSATION

   JOG           RETURN   SERVICE               > SOFT KEYS
                 ABS 0    CODES
```

Note: the RETURN soft key is lit when in Jog.

6.2 DRO Functions

- **Clear Entry**: Press RSTR, then re-enter all keys.

- **Inch to MM or MM to Inch**: Press IN/MM and note LCD screen status line.

- **Reset One Axis**: Press X or Y or Z, INC SET. This zeros the incremental position in the selected axis.

- **Preset**: Press X or Y or Z, numeric data, INC SET to preset selected axis.

- **Reset Absolute Reference**: Press X or Y or Z, ABS SET to set selected axis absolute to zero at the current position. *Note: This will also reset the incremental dimension if the absolute position is being displayed when it is reset.*

- **Preset Absolute Reference**: Press X or Y or Z, numeric data, ABS SET to set the selected axis absolute to a preset location for the current machine position. *Note: This will also reset the incremental dimension if the absolute position is being displayed when it is preset.*

- **Recall Absolute Position of All Axes**: Press INC/ABS. Note the dimension for each axis is labeled INC or ABS. Press INC/ABS again to revert to the original reading.

- **Recall Absolute Position of One Axis**: Press X or Y or Z, INC/ABS. Note the INC or ABS label for each axis. Repeat to get selected axis back to original reading.

6.3   Jog

The servo motors can be used to jog the table, saddle or Z.

1.   Press the JOG soft key.

2.   The conversation line will read "JOG + 100 ipm" indicating the table will move in the X or Y positive direction at 100 inches per minute. This message will flash to warn you that JOG is activated.

3.   Press **+/-** to reverse direction. The conversation display will read "JOG - 100 ipm." Press **+/-** again to go back to JOG +.

4.   Press FEED ↓ to reduce the jog speed in 10 percent increments. The conversation line will show these reductions. Press FEED ↑ to increase the speed.

5.   Press and hold X or Y or Z to jog that axis. Note the status line will indicate "SERVO ON." Release the key to stop.

6.   To jog at a prescribed rate, for example, to use the jog feature to powerfeed a cut input the rate (for example, 25 for 25 inches per minute) and press X or Y. Press FEED ↑ or FEED ↓ to adjust. Press RSTR to return to 100 ipm. In metric this number represents the percent of the maximum, or 2540 mm/min.

7.   Press RETURN soft key to return to manual DRO operation.

6.4   Return to Absolute Zero

At any time during manual DRO operation you may automatically move the table to your absolute zero location in X and Y and the Z retract by pressing the RETURN ABS 0 softkey. When you do this in 2 axis, the conversation line will read "Check Z then press GO." Make sure your tool is clear and press the GO key. When you do in 3 axis, if Z-axis is below the retract position, the servos will turn on and move Z at rapid to Z retract and then move the table at rapid speed to your X and Y absolute zero position, and then turn off. If Z-axis is above retract position, the servos will turn on and move X and Y at rapid speed to their absolute zero position and then move Z at rapid to Z retract, and then turn off. You will be at zero and in manual DRO operation.

6.5   Using Teach (2 Axis Mode Only)

The Teach function allows you to input a program into the ProtoTRAK Edge 3 by remembering rapid position and feedrate milling events as you machine the first part, or portion of a part.

This can be useful for simple operations like facing off a part, clearing out excess material, or remembering a few hole locations.

To enter Teach, switch to 2-axis operation, enter DRO and press the TEACH softkey in the DRO Mode. The display will show:

```
DRO                                    INCH        > STATUS

    X  0.0000  ABS
    Y  0.0000  ABS                                 > INFORMATION
    Z  0.0000  ABS


                                                   > CONVERSATION

 SAVE    SAVE    RUN    ERASE          RETURN
 POSN    MILL   TEACH   TEACH                       > SOFT KEYS
```

The SAVE MILL softkey will only be activated once an initial position event has been saved.

6.5.1   Making a Teach Program

Only one Teach program can be contained in the ProtoTRAK Edge 3 at any given time. If an existing Teach program is not first erased, more "teaching" will simply add events or moves on to the end of the existing program.

Teach programs are made up of Position events, or moves, and Mill events. Position events are moves at rapid speed and are used to go to the beginning point of a milling move, or to position over a point like a hole for drilling. Mill events are straight line milling moves in the X or Y, or both directions at an input feedrate.

To make a Teach program, follow these procedures:

1.   The first event must be a Position move. Crank the X and/or Y handles to the desired position and press the SAVE POSN softkey. This point will be memorized as the beginning of the program. During Teach Run the machine will move at rapid speed to this first location and stop.

2.   If you wish to rapid to the next location, repeat Step a. If you wish to feed or mill, go to Step c.

3.   Mill the part along the X or Y (or both) path using the hand cranks. It's not important how you get to the end point. In Teach Run the machine will move at the programmed feedrate in a straight line from the beginning point to the end. When at the end point, press the SAVE MILL softkey. The conversation line will prompt "Feedrate 10.0." You may change the feedrate from the 10 inches per minute default to any value you wish through the numeric keyboard. When the feedrate in the conversation line is what you want, press INC SET or ABS SET to load into memory this position and feedrate.

4.   Repeat (a) or (c) above for all other rapid Position events, or feed Mill events you wish.

5.   In Teach Run the machine will continue from one Mill event directly along to the next Mill event. You must program a SAVE POSN if you want the machine to stop.

6. All events will automatically be saved with Tool Number 99.

7. All Mill events will be saved with Tool Center Offset (see Section 3.4).

6.5.2   Running a Teach Program

A Teach Program is run from the DRO Mode.

To run a Teach program, press the RUN TEACH softkey from the screen above. Follow the same procedures for running a regular program as described in Section 8.0.

Note: When you use Position to go to the beginning of a Mill move, you will have to hit GO twice to begin the milling move.

6.5.3   Erasing a Teach Program

The ProtoTRAK Edge may contain only one Teach Program. To input another, you must first erase the one that exists.

6.6   Manual Power Tapping

Please note that a minor noise may be evident from the spindle motor during power tapping. This noise will not cause any long-term problems with the motor and is considered normal. This noise is due to an electrical slip between the rotor in the motor and the counter directional electromagnetic field generated when the motor is required to change direction without first coming to a complete stop. Power tapping should only be done in low gear between 60 and 200 RPM.

7.0 Programming

The ProtoTRAK Edge 3 can be programmed to make just about any flat part or part in 2 ½ axes. A program is one or a series of **events**. It can either be a complete part, a set of operations on a side or only a small number of cuts. It is necessary to create a program when you want the CNC to machine the part for you.

7.1 Memory and Storage

Computers can hold information in two ways. Information can be in **current memory** or in **storage**. Current memory (also known as RAM) is where the ProtoTRAK Edge holds the operating system and any part program that is ready to run. While a program is being written, it is in current memory. Storage for the ProtoTRAK Edge 3 is the floppy disk. For programs to be saved for future use, they must be stored on the floppy disk in Program In/Out Mode.

When the ProtoTRAK Edge 3 is first turned on, it reads its operating system into its current memory from the floppy containing the system software. At your command, the ProtoTRAK Edge 3 will read any programs you have stored on the floppy disk into current memory for additional programming, editing or running.

If power is lost or turned off, programs that are in current memory are lost, but programs stored on the floppy disk are not.

7.2 Enter Program Mode and Assign a Part Number

To start programming, press MODE and select PROGRAM softkey. For a new program to be written, there cannot already be a program in the active or current program memory.

If a program does not already exist when you enter the Program Mode, the conversation line will read "Program Part Number." Enter a part number of your choice (up to 8 digits) and press INC SET or ABS SET.

Note: It is not necessary to enter a part number. If none is entered and the INC SET or ABS SET button is pushed, the system will assume a part number 0.

The ProtoTRAK Edge 3 automatically holds all of the completed events as you program in current memory. If there is already a program when the Program Mode is entered, the last event of this program will appear on the left side of the screen. Additional events may be added after the last event of this program. It will be necessary clear the program from current memory before creating a new program. See Section 10 for the procedures for saving and clearing programs.

When a new Part Number (for a new program) has been entered, the display will show the Select Event screen:

```
┌─────────────────────────────────────────────┐
│ PROG P/N 12345                    INCH  │  > STATUS
│                 ┌──────────────────────┐│
│                 │ EVENT1                ││
│                 │                       ││
│                 │                       ││  > INFORMATION
│                 │                       ││
│                 │                       ││
│                 │                       ││
│ SELECT EVENT    └──────────────────────┘│  > CONVERSATION
│ POSN  │ MILL │ ARC │ POCKET │ REPEAT │ PAGE │
│ DRILL │      │     │ FRAME  │        │ BACK │  >SOFTKEYS
└─────────────────────────────────────────────┘
```

7.3 Programming Strategy and Procedures

The ProtoTRAK Edge 3 makes programming easy by allowing you to program the actual part geometry as defined by the print. The Select Event screen is basically a list of all the types of geometry that can be machined with this control. The basic strategy is to select the softkey event type (geometry) and then follow all instructions in the conversation line. When an event is selected, all the prompts that need to be input will be shown on the right side of the information area. The first prompt will be highlighted and also shown in the conversation line. Input the dimension or data requested and press INC SET or ABS SET. For X or Y dimension data it is very important to properly select INC SET or ABS SET. For all other data either SET will do.

As data is being entered it will show in the conversation line. (If you make a mistake, for example, you press the wrong number key, you can clear the input by pressing RESTORE.) When SET, the data will be transferred to the information area, and the next prompt will be shown in the conversation line.

From the event data screen you may press the DATA FWD or DATA BACK softkeys to go back to edit any data within an event. Simply shift forward or back to get the prompt in the conversation line and re-input the data. At any time before the event is complete you may cancel the event by pressing the ABORT EVENT softkey.

You may also press the PAGE BACK softkey that will shift you back to the previous events so that you can make any changes you wish.

When all data for an event has been entered, the entire event will be shifted to the left side of the screen and the conversation line will ask you to select the next event.

7.4 Programmed Events

The following events are found in the ProtoTRAK Edge.

7.4.1 Posn Drill

This will position the table and saddle to the location you define. This event is used for drilling holes and other positioning moves.

When you press the POSN/DRILL key, you choose between:

- **Position:** a rapid position move
- **One Hole:** a single position.
- **Bolt Hole:** a series of positions spaced evenly around a circle.
- **Pause:** machine will pause with spindle running a prompt you to press GO to continue.

When the program is run at a Posn/Drill Event, the ProtoTRAK Edge will servo at rapid to the XY location defined, then rapid to the Z rapid height, then feed to the Z height, then rapid to Z rapid.

7.4.2   Mill Event

Use this to machine a straight line in any direction. The prompts you answer in this event will allow the ProtoTRAK Edge to calculate the complete tool path, including the starting position and tool offsets. It is not necessary to program a rapid move to the beginning position of the Mill Event.

When the program is run at a Mill Event, the ProtoTRAK Edge 3 will rapid to the beginning position, feed to the proper depth, move through the Mill Event at the speed you program and end at the ending position. (See the discussion on Continue below for the variation in tool motion if the event is connective).

7.4.3   Arc Event

This is any part of a circle. Like the Mill Event, the prompts you answer will allow the ProtoTRAK Edge to calculate the complete tool path.

When the program is run at an Arc Event, the ProtoTRAK Edge 3 will rapid to the beginning position, feed to the proper depth, move through the Arc Event at the speed you program and end at the ending position. (See the discussion on Continue below for the variation in tool motion if the event is connective).

7.4.4   Pocket/Frame Event

Use this event to machine a pocket or frame with a minimal amount of programming. When you press the Pocket/Frame key, you choose between the following:

- **Circle pocket:** a circle and all the material in the center. Includes finish cut.
- **Rectangular pocket:** a rectangle and all the material in the middle. Includes finish cut.
- **Circle frame:** a circular circumference. Includes finish cut.
- **Rectangular frame:** a square or rectangular circumference. Includes finish cut.

When the program is run at a Frame Event, the ProtoTRAK Edge will rapid from wherever it is to the nearest point on the circle or rectangle, feed to the proper depth, move through the first pass and then the finish cut at the programmed feedrate, move the cutter away from the part by the amount of the programmed finish cut and then move up to Z rapid. A Posn/Drill event may be inserted to change the beginning point of the machining.

The Pocket Event will rapid to the center of the circle or rectangle, feed to the proper depth, move in a logical path through the material (leaving the finish cut, if one is programmed), using 70% of the cutter diameter. After the center is cleared, it will do the finish cut, ramp away from the part at the end by the amount of the programmed finish cut and move up to Z rapid.

7.4.5 Repeat Events

This allows you to repeat an event or a group of events up to 99 times, with an offset in X, Y or Z. This can be useful for drilling a series of evenly spaced holes, duplicating some machined shapes or even repeating an entire program with an offset for a second fixture. Another use is to repeat a programmed set of drill events (without offsets) so you can center drill, drill, and counterbore without reprogramming the second and third operations.

Repeat events may be "nested" up to five deep. That is, you can repeat a Repeat Event, of a Repeat Event, of a Repeat Event of some programmed event(s). One new tool number may be assigned for each Repeat Event.

7.5   Prompts Used to Define the Events

The following prompts are encountered in programming the events.

 # Holes - the number of holes in the bolt hole pattern.

Angle - the location of the first hole to be machined in a Bolt Hole event. It is the angle from the positive X axis (that is, 3 o'clock) to the hole. The positive angle is measured counterclockwise from 0.000 to 359.999 degrees.

Conrad - There are two meanings to Conrad: 1. The connecting radius between line or arc being programmed and the next line or arc event. Simply enter the radius value at this prompt and the ProtoTRAK Edge will figure the tool path to go from one event to the next with a connecting radius. If no radius is desired, or if you are programming the last event, enter 0 by pressing the INC SET or ABS SET key without a number value.
2. The corner radius in a rectangular pocket or frame. The radius is tangential.

Continue - to tell the ProtoTRAK Edge if the event is continuous to the next event(s) to be programmed. This saves inputs needed to define a profile. If the event is programmed with a Yes, for continue, then X begin, Y begin,Z rapid, Z end, Tool Offset, Feedrates and Tool # will not be prompted in the next one.

Direction - for an arc or circle, the direction is clockwise or counterclockwise.

XY Feedrate - the milling feedrate in in/min from .1 to 99.9 or in mm/min from 5 to 2500.

Z Feedrate - the drilling or milling feedrate in Z moves in in/min from .1 to 99.9 or in mm/min from 5 to 2500.

Fin cut - for a pocket or frame, the width of the finish cut. If 0 is input, there will be no finish cut.

Radius - the radius of the bolt hole pattern, arc or circle.

Tool # - the number you assign to identify the tool.

Tool offset - the selection of the tool offset, right, left or center relative to the programmed edge or tool movement.

X or **Y** - the X or Y dimension, may be defined in absolute or incremental reference.

Z rapid – the Z dimension to transition from rapid to feed.

X Begin or **Y Begin** - the X or Y beginning point of the line or arc.

X Center or **Y Center** - the X or Y dimension of the center of the bolt hole pattern, arc or circle.

X End or **Y End** or **Z DEPTH** - the X, Y or Z ending point of the line or arc.

X1, **Y1**, and **X3**, **Y3** - the X and Y dimensions for the opposite corners on a rectangular pocket or frame.

Prompts unique to the Repeat event:

First Event # - the first event to be repeated.

Last Event # - the last event to be repeated. If only one event is to be repeated, the First and Last events will be the same number.

X Offset - the incremental X offset from the event to be repeated.

Y Offset - the incremental Y offset from the event to be repeated.

Z Offset - the incremental Z offset from the event to be repeated.

Z rapid Offset – the incremental Z rapid offset from the event to be repeated.

 # Repeats - the number of times the events are to be repeated up to 99.

 # Pecks – is the number of drill tool withdrawal cycles.

7.6   Assumed Tool Offset, Feedrate, and Tool

When the INC SET key is pressed, the ProtoTRAK Edge 3 will automatically program the following for these prompts:

TOOL OFFSET: for a Mill or Arc Event, same as the last event if that event was a Mill or Arc Event, otherwise, Tool Center.

FEEDRATE: same as last event if that event was a Mill, Arc, Pocket, or Frame, otherwise, 1.0 in/min or 25 mm/min.

TOOL #: same as last event, or Tool 1 in the first event.

You may change these assumed inputs by simply inputting the correct data when the event is programmed.

7.7   Incremental Reference Position

When X and Y data for the beginning position of any event are input as incremental data, this increment must be measured from some known point in the previous event. Following are the positions for each event type from which the incremental moves are made in the subsequent event:

POSITION/DRILL: X, Y and Z programmed

DRILL: X, Y, Z RAPID, and Z DEPTH programmed

BOLT HOLE: X CENTER, Y CENTER, Z RAPID and Z DEPTH programmed

MILL: X END, Y END, Z RAPID and Z DEPTH programmed

ARC: X END, Y END, Z RAPID and Z DEPTH programmed

CIRCLE POCKET or FRAME: X CENTER, Y CENTER, Z RAPID and Z DEPTH programmed

RECTANGLE POCKET or FRAME: X1, Y1, Z RAPID and Z DEPTH corner programmed position

REPEAT: The appropriate reference position for the event prior to the first event that was repeated.

7.8 Finish Cuts

The Pocket and Frame events are designed with built-in finish cut routines because they are complete, stand-alone pieces of geometry. Shapes machined with a series of Mill or Arc events don't have an automatic routine for making finish cuts.

Instead, it is very easy to get a finish pass by overstating the size of the tool for the events in the initial pass, and then using a Repeat Event and programming a new tool with the actual size of the tool.

For the first pass, the cutter will be positioned away from the final cut half the amount of the difference between the actual size of the cutter and the diameter you put in. When the Repeat Events are run, the same cutter will be positioned correctly to do the final pass to size.

7.9 Look

You can look at the XY view part graphics while in the Program Mode. At any time an event is finished programming and the Select Event prompt appears in the conversation line, simply press the LOOK hard key. The programmed events are automatically sized so that everything fits on the screen.

To return to the programming, press the RETURN softkey.

The part graphics are useful for checking what you have programmed so far. Certain kinds of programming mistakes are not caught by the graphics. These will surface when running the program.

7.10 A Sample Program

This simple part will be used to illustrate the process of programming.

Decide the order of machining. This part can be held in a vise. First we will drill the two holes and then we will mill the slot.

1. Decide the Absolute reference. In this case we will use the lower left corner as our 0 location for X and Y and the top of the part for Z.

2. Enter the Program Mode. If there is already a program in the current memory, go into the Program In/Out Mode to and press the CLEAR CURRENT softkey. (You may want to store the program in current memory first.)

3. Assign a part number. When there is no program in the current memory, the system will prompt for a program part number as soon as it goes into Program Mode. Enter a numeric part number (or not, if you don't want one) and press SET.
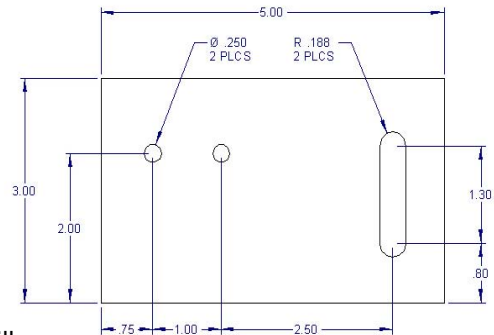
4. Program the first hole.

Event 1

Prompt	You push these keys
SELECT EVENT	POSN/DRILL
SELECT	ONE
X	.75 ABS SET
Y	2. ABS SET
Z Rapid	.1 ABS SET
Z End	-.2 ABS SET
# Pecks	2 INC or ABS SET
Z Feedrate	5. INC or ABS SET
Tool #	1 INC or ABS SET

Notes:
- *For the non-referenced data, either SET key will do.*
- *This first tool is a center drill. For the Position/Drill Event, the program will run without a tool diameter, but one may be entered as a reminder.*

5. Program the second hole.

Event 2

Prompt	You push these keys
SELECT EVENT	POSN/DRILL
SELECT	ONE
X	1. INC SET
Y	INC SET
Z Rapid	INC SET
Z END	INC SET
# Pecks	2 INC OR ABS SET
Z Feedrate	INC SET
Tool #	INC SET

Notes:
- *For the dimensions, it was handy to read these right off the print and put them in as incremental moves from the previous hole. We could have also programmed using X = 1.75 ABS SET and Y = 2.0 ABS SET.*
- *The INC SET entry for Y was taken as a 0 incremental move, you do not have to press 0.*
- *The INC SET for the Z Feedrate and Tool # were taken as "use the data from the previous event."*

6. Repeat the holes to drill to size.

Event 3

Prompt	You push these keys
SELECT EVENT	REPEAT
First Event #	1 INC or ABS SET
Last event #	2 INC or ABS SET
X offset	INC SET
Y offset	INC SET
Z Rapid Offset	INC SET
Z Offset	-.4 INC SET
No. of Repeats	1 INC or ABS SET
Tool #	2 INC or ABS SET

Note: We want to visit the same two holes, in the same place, with a different tool to do the final drilling.   We don't want to change our Z rapid height but we want the drill to go .4" deeper (-.6 Absolute) than the center drill.

.

7. Look at what you have programmed. Press the LOOK key. You will see two +
    marks on opposite sides of the screen to show where the holes have been
    programmed. Press RETURN to get back to the programming.

8. Program the slot.

Event 4

Prompt	You push these keys
SELECT EVENT	MILL
X Begin	4.25 ABS SET or 2.5 INC SET
Y Begin	.8 ABS SET
Z Rapid	.1 ABS SET
Z End	-.6 ABS SET
X End	INC SET
Y End	1.3, INC SET
Conrad	INC SET
Tool Offset	0, INC or ABS SET
XY Feedrate	7.5, INC or ABS SET
Z Feedrate	3. INC or ABS SET
Tool #	3, INC or ABS SET

9. Look at the program again. If all went well, you should now see the two holes
    and slot tool path in the same proportion as they appear on the print. If not,
    check your inputs and try again.

8.0   Changing or Correcting Programs

In the Program Mode, you can easily correct mistakes or make changes to the program.

8.1   Aborting a Partially Programmed Event

If you wish to not program an event (or start over) after you have started to program, press the ABORT EVENT softkey and the screen will revert to the "Select Event" prompt.

8.2   Editing Data while Programming an Event

All data is entered by pressing the appropriate numeric keys and pressing INC SET or ABS SET. If you enter an incorrect number before you press INC SET or ABS SET you may clear the number by pressing RESTORE. Then, input the correct number and press SET.

If incorrect data has been entered and SET, you may correct it as you are still programming that same event by pressing the DATA BACK or DATA FWD (Forward) softkey until the incorrect prompt and data are highlighted and shown in the conversation line. Enter the correct number and SET. The ProtoTRAK Edge will not allow you to skip past prompts (by pressing DATA FWD) that need to be entered to complete an event.

8.3   Editing Previously Programmed Events

From the Select Event screen you may press the PAGE BACK softkey and the program will move back one event. For example, if you have already programmed 10 complete events and you pushed the PAGE BACK key, Event 10 will move to the right side of the screen and Event 9 will be shown on the left. The softkey options are:

ADD EVENT	DELETE EVENT	DATA FWD	DATA BACK	PAGE FWD	PAGE BACK

Where:

ADD EVENT allows you to insert a new event between the two shown on the left and right side of the screen. When you press ADD EVENT the screen will revert to the Select Event screen and you may program the new added event as you would any other. Subsequent events will be renumbered accordingly.

DELETE EVENT allows you to delete the event on the right side of the screen. Subsequent events will be renumbered accordingly.

DATA FWD (Forward) steps the highlight and conversation line to the next prompt and data so it can be edited.

DATA BACK steps the highlight and conversation line to the previous prompt.

PAGE FWD (Forward) indexes the event forward by one.

PAGE BACK indexes the event back by one.

8.4   Changing the Feedrate

If the feedrate is edited in any event it will automatically be edited in every subsequent and contiguous event with the same tool number and feedrate. For example, let's say events 5 through 10, and 13 through 16 were all programmed with tool number 2, and 5 inches per minute feedrate. If you edit the feedrate in Event 7 to 3 inches per minute, it will automatically change Events 8, 9, and 10 also. Events 5, 6, 13, 14, 15, and 16 will not be affected

8.5   Changing a Part Number (making a copy of a program)

You may want to rename a part program, or make a copy of a program using a different name. The latter may be useful if you have a new part to do that is similar to a part that you already have programmed. Make a copy of the program by saving it under a new part number and then make the changes.

You can rename a part program when it is not yet stored on the floppy disk in the Program Mode by pressing the DATA BACK key past the first event until you are at the prompt for Program Part Number. Enter the new part number and press SET. If the program is long, it is better to rename it in the Program In/Out Mode. After pressing the PROG IN/OUT key, simply enter the new part number and press STORE.

If the previous part program is already stored on the floppy disk, it will remain in storage under the previous part number with the same information it had the last time it was stored.

8.6   Saving Changes to a Program

If a program is retrieved from storage and changes are made, the program must be stored again in Prog In/Out Mode for the changes to be preserved in the stored copy. Programs in current memory may be changed and run with the changes, but unless they are re-stored, the changes made will be lost when the program is cleared from current memory. If you intend to keep the changes made to your program it is a good practice to store the program occasionally in case a power loss causes the program to be ejected from current memory.

8.7   Erasing an Entire Program

To erase an entire program from *current memory*, go to the Program In/Out Mode and press CLEAR CURRENT. You will be prompted "Are you sure you want to erase this program?" You may want to store the program on the floppy disk before you clear it from current memory. If it is not stored on the floppy, pressing YES will permanently erase the program.

To erase an entire program from the *floppy storage*, input the part number and then press ERASE. Programs in current memory will not be affected by this operation. You could erase a part number on the floppy and the program in current memory will remain in current memory, even if it has the same part number as the one just erased.

Only programs with the .mx2 and .mx3 extension may be erased from the floppy by the ProtoTRAK Edge 3, CAM programs must be erased by another computer.

Programs in current memory will automatically be erased when another program is retrieved from storage.

9.0   Making Parts with the CNC

9.1   Setting Up

Before you can run your program, you must set your absolute position in the DRO Mode. The CNC will use this absolute position as a reference for running your program.

9.2   Run Mode

After setting up in the DRO Mode, go into the Run Mode. You will see this screen:

```
RUN  P/N 12345                                  INCH       > STATUS

   X         0.0000 ABS
   Y         0.0000 ABS                                     > INFORMATION
   Z         0.0000 ABS

FEEDRATE  100.00
OVERRIDE  100%                                             > CONVERSATION
SELECT
                    START                SET Z     TOOL    > SOFTKEYS
  START             EVENT #              RETRACT   DATA
```

The part number appears in the status line.

9.3   Setting Z Retract Position

In program run, this is the position that Z will move to at tool change and at the end of the run. It must be set before you can run a program.

To set Z Retract, move Z to the position you desire in the DRO mode. Go to RUN mode, press Z Retract soft key and then ABS SET. This position will only change when the EDGE is turned off or when you reset it.

9.4   Inputting Tool Data

Every program has a Tool Table comprised of these three items:

- Tool Diameter: used to calculate tool left or tool right adjustments
- Tool Offsets: used to adjust the quill (or ram) for the length differences from one tool to the next.
- Tool Modifiers: used to make small adjustments to the depth (Z rapid, Z begin and Z depth) for each tool. This is actually a modifier to the tool offset above.

Tool Diameters, Tool offsets and tool modifiers are not saved and stored with the program. To enter tool information, press the **TOOL DATA** soft key in RUN mode.

The display will show:

```
SET UP                              INCH              > STATUS
TL#  DIAM  OFFST  ZMOD    TL#  DIAM  OFFST  ZMOD
1    0.0   BASE   0.0
2    0.0   0.0    0.0
3    0.0   0.0    0.0
                                                      > INFORMATION




TOOL # 01  DIAM  0.0                                  > CONVERSATION
 PAGE    PAGE    DATA    DATA           RETURN
 FWD     BACK    FWD     BACK                          >SOFTKEYS
```

Where:

- Each tool number that is in program12345, as well as diameter and length offset and modifier are shown in the information area.

- The conversation line shows the tool number for which you may input data. If that tool number already has a diameter, it will be shown in the conversation line and may be changed and SET.

- The **DATA FWD** (forward) soft key indexes the conversation from Tool Diameter, to Tool Offset, to Tool Modifier, to Tool Diameter for the next tool.

- The **DATA BACK** soft key indexes the conversation back to the previous prompt for edit.

- The **PAGE FWD** (forward) soft key indexes the list forward if it is too long for one screen.

- The **PAGE BACK** soft key indexes the list back if it is too long for one screen.

- The **RETURN** soft key brings you back to RUN mode.

To input a tool diameter, when prompted enter the dimension and **SET**. To input a tool offset:

a. Load the tool into a fixed tool holder and insert in spindle.

b. Bring the quill down manually until the tool touches a fixed reference, e.g., the table, vice, part, etc.

c. Press **SET**. If this is for the tool in Event 1 the display will read "BASE". For any other tool it will automatically calculate and load the difference between that tool and the BASE tool.

d. It is critical that every tool touch the same reference as b.

To edit a tool offset:

a. Enter RUN mode and **DATA FWD** to the appropriate tool offset.

b. Load new tool

c. Bring the tool down to the same reference used to set the tool originally.

d. Press **SET**.

To enter a too length modifier, input the value when prompted and press **SET**. Fore example, a -.005 modifier will make the part .005″ deeper for all operations with this tool.

9.5   Starting

To start the program, select between START and START EVENT#.

- START – starts running the program from the beginning.

- START EVENT # – starts running the program from an event in the middle. If you press this key, the INPUT EVENT # prompt will appear for you to choose where to start.

9.6   Display Messages in Program Run

SERVO ON: appears in the status line when the servo motors are on.

IN POSITION: appears in the status line when the program has come to a pause.

EVENT # and type: appears above the X dimension. This is the current or next event to be run. If the IN POSITION message is not already on, the next move made by the ProtoTRAK Edge will be to rapid to the beginning of the event shown.

FEEDRATE: the actual table or XY feedrate.

OVERRIDE: the feedrate override, controlled by pressing the FEED hard keys.

9.7   Program Run Prompts

During Program Run, all messages that will help you to run the part will appear in the conversation line. The messages you will usually see are:

Load Tool __ __: Means to load the tool requested and press GO to continue.

Run Over: Means that the program run is complete. If you are running a second part that will be fixtured/clamped in the exact same position as the first part, you do not need to relocate the absolute 0 and restart. Instead, press the NEXT PART softkey when the conversation line states "Run Over" and the system will proceed directly to Event 1.

9.8   Stop

At any time, pressing the STOP key will halt the program. This freezes the program at that point. To continue, press the GO key.

9.9   Feedrate Override

The run feedrate may be changed at any time by pressing the FEED ↑ or FEED ↓ keys. Each press changes the programmed feedrate, and rapid in 10% increments. The maximum overrides are from 10% to 150% of programmed feedrates. Both XY Feedrates and Z Feedrates will be modified by this override.

9.10   Data Errors

A program must make sense geometrically. For example, you can't machine a .250 inch diameter circular pocket using a .500 inch end mill. Data errors will nearly always be detected when the ProtoTRAK Edge 3 runs through a program--either as a trial run or on an actual part run.

The Conversation Line displays the error number (not necessarily important to you) and the event where the error was detected. This is not necessarily the event that is in error since the system often "looks ahead" to make sure there is compatibility from one event to another.

In addition, an explanation is given for each data error type as well as a suggested solution.

9.11 Fault Messages

The ProtoTRAK performs a number of automatic checks or self-diagnostics. If problems are found it will signal you through the display. The conversation line will display "Fault __ __ __ __". The information area will display an explanation and suggested solution. Press the RETURN key to get back to the Select Mode screen.

10.0   Math Help

Prints are, unfortunately, not always drawn and labeled in such a way as to provide all of the points necessary for programming. To minimize this problem, the ProtoTRAK Edge 3 provides a graphic math help function which can be used to automatically calculate points of intersection, centers of arcs, trig functions, square roots, etc.

10.1   Procedure

To enter the Math Help Mode, press MODE and select the MATH HELP soft key. The screen will show:

MATH					INCH	> STATUS
A Line-Line Intersection B Line-Arc and Arc-Arc Intersection C Line-Arc Tangency D Centers, points, Radius, Angles of Circles E Polar-Cartesian Transformations						> INFORMATION
SELECT						> CONVERSATION
A	B	C	D	E	TYPE #	> SOFT KEYS
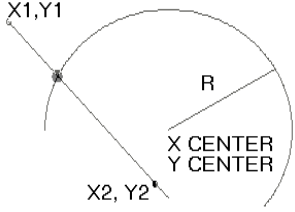
If you already know the math help type you want (see Section 10.2) press the TYPE # softkey and enter the number and SET.

If you do not know the type, select from A through E using the softkeys.

If, for example, you wish to find the intersection of a straight line and an arc or circle, press the B softkey. The screen will show:

MATH Line-Arc Intersection				INCH	> STATUS
TYPE 13 Find the intersection of a line and an arc when 2 points are known on the line, and the arc's center and radius are known TYPE 14 Find the intersection of a line and an arc when 2 points are known on the line, two points are known on the arc, and the arc radius is known					> INFORMATION
SELECT					> CONVERSATION
13	14			RETURN	> SOFT KEYS

If the information you know about the line and arc correspond to Type 13, then select the 13 softkey. The screen will then show:

```
┌─────────────────────────────────────────────────┐
│ MATH Line-Arc Intersection          INCH        │  > STATUS
├──────────────────────────┬──────────────────────┤
│  X1,Y1                   │  X1                   │
│    ○                     │  Y1                   │
│      ╲  ___              │  X2                   │
│       ●╱   ╲   R         │  Y2                   │
│        ╲    ╲            │  X CENTER             │  > INFORMATION
│         ╲   X CENTER     │  Y CENTER             │
│          ╲  Y CENTER     │  R1                   │
│    X2, Y2 ●╲___╱         │                       │
│                          │                       │
├──────────────────────────┴──────────────────────┤
│ X1                                               │  > CONVERSATION
├──────┬──────┬──────┬──────┬──────┬──────────────┤
│      │      │ DATA │ DATA │      │ ABORT         │
│      │      │ FWD  │ BACK │      │ TYPE          │  >SOFT KEYS
└──────┴──────┴──────┴──────┴──────┴──────────────┘
```

Input the known data in the same way you would program an event. When all of the data is entered, the solution (or solutions if there are more than one) will be shown on the left side of the information area.

There are often multiple solutions for geometry problems. For example, in the Type 13 example above, a line will often intersect an arc or circle in two places. In these cases all possible solutions will be calculated and displayed. In most cases a careful inspection of the print and some common sense will tell you which solution applies to your problem.

10.2   Math Help Types

Type #	What you need	What you know
10	Intersection of two lines	• 2 points on each line
11	Intersection of two lines	• 2 points on one line • 1 point on the other line • angle between the lines
12	Intersection of two lines	• 2 points on one line • 1 point on the other line • a radius tangent to both lines *when* one of the points on the two points known line is also on the radius
13	Intersection of a line and an arc	• 2 points on the line • arc center • arc radius
14	Intersection of a line and an arc	• 2 points on the line • 2 points on the arc • arc radius
15	Intersection of two arcs	• center of each arc • radius of each arc

Type #	What you need	What you know
16	Intersection of a line tangent to two arcs (line does not cross arc centers)	• center of each arc • radius of each arc
17	Intersection of a line tangent to an arc	• one point on the line • center of the arc • radius of the arc
18	Intersection of a line tangent to two arcs (line crosses arc centers)	• center of each arc • radius of each arc
19	Center and points of intersection of an arc tangent to two arcs	• 2 of the arc centers • all 3 radii
20	Center of an arc	• 2 points on the arc • radius of the arc
21	Point on an arc	• center of the arc • another point on the arc • angle between known and unknown points
22	Radius of an arc or circle	• 1 point on the arc • center of the arc
23	Center of an arc or circle	• 2 points on the arc • angle between the 2 points
24	Center and radius of an arc or circle	• 3 different points on the arc
25	Cartesian (X and Y) location	• polar (R and angle) coordinates
26	Angle in decimal	• angle degrees, minutes and seconds
27	Accurate X Y Center	• given X Y Center • 2 points on the arc
28	Sides and angles of a right triangle	• at least one side and another side or an angle

11.0   Program Memory & Storage

The ProtoTRAK Edge 3 can only have one program at a time in current memory. This is the program you see when you enter the program mode and is the one that is available to run.

Programs may be stored for future use on the floppy disk included with the ProtoTRAK Edge 3. The disk is accessible through the door on the side of the pendant.

Part programs are saved to the floppy or retrieved from the floppy in the Program In/Out Mode. When programs are transferred back and forth from current memory and storage, they stay in both locations unless erased or cleared. In other words, retrieving a program from the floppy disk into the current memory does not remove it from the floppy disk. Only erasing the program will remove it.

11.1 Cautions About Storing and Retrieving Programs

Care must be taken to keep from losing a program you wish to keep. This can happen two ways.

First, whenever a program is retrieved, it is loaded into the ProtoTRAK Edge 3's computer program memory. When this happens, your existing current program is erased. Therefore, if your current program is one you want to keep, be certain to store it before you retrieve another program.

Second, to store a program it must have a part number so that the ProtoTRAK Edge 3 can find it if you want it retrieved. However, no two programs can have the same part number (how would the system decide which to retrieve?). Therefore, if you store a program with any particular part number, it will automatically erase any other program with that same part number.

11.2 Program Formats and Labeling

The ProtoTRAK family of products has its own unique programming system--one that organizes the program into events rather than codes and blocks. Programs written on the ProtoTRAK Edge 3 will have the extension .MX3 when written in three-axis and .MX2 when written in two-axis.

The ProtoTRAK Edge 3 software will accept an RS274 CAD/CAM generated program (as configured through a post processor similar to a Fanuc 6) in 2-axis only and convert it to a 2-axis Edge 3 event type program. This can occur by generating the properly post processed program in your computer, copying it onto a spare Edge 3 floppy disk, and loading that disk into the ProtoTRAK (see Section 11.3).

Note: All CAD/CAM generated programs must be labeled at the computer with one to eight numerical digits followed by a decimal point, followed by CAM (for example, 123.CAM or 87654321.CAM). If these rules are not followed, the Edge will not recognize the program.

11.3 Storing & Retrieving Programs from the ProtoTRAK Edge 3 Built-In Floppy Disk Drive

Press MODE, and select the PROGRAM IN/OUT softkey. The display will show:

PROGRAM I/O FLOPPY						> STATUS
1 .MX3						
6 .MX3						
24 .MX3						
132 .MX3						> INFORMATION
841 .MX3						
2492 .MX3						
15029 .MX3						
28197 .MX3						
87132 .MX3						
252741 .MX3						
PART NUMBER 12345						> CONVERSATION
STORE	RETRV MX3	ERASE	PAGE FWD	RETRV CAM	CLEAR CURRENT	> SOFT KEYS

- All part numbers in the ProtoTRAK Edge 3 floppy disk are listed in the Information Area. The listing shows the part numbers followed by MX3 when in 3-axis.

PROGRAM I/O FLOPPY						> STATUS
7 .MX2						
9 .MX2						
18 .CAM						
73 .MX2						
152 .MX2						> INFORMATION
746 .MX2						
1439 .CAM						
6523 .MX2						
PART NUMBER 12345						> CONVERSATION
STORE	RETRV MX3	ERASE	PAGE FWD	RETRV CAM	CLEAR CURRENT	> SOFT KEYS

- When in 2-axis, the listing shows the part numbers followed by MX2 if they were generated through the ProtoTRAK Edge 3, or they are followed by CAM if they were generated through a CAD/CAM sytem.

- The part number of the current program (in current memory) is shown in the conversation line. You may change the part number at this screen by entering a new number and pressing STORE.

- The PAGE FWD (Forward) softkey will continue the part number list if there are too may to be shown on the screen.

- STORE will write the program in current memory to the floppy. You will see the program added to the list in the information area after it is stored.

- RETRIEVE MX3 will write a .MX3 program from the floppy to current memory. First input the part number and then press the RETRIEVE MX3 key.

- ERASE will erase a program from the floppy. First input the program number and then press the ERASE key.

  Note: You may not erase a CAM file using the ERASE key.

- CLEAR CURRENT will erase the program from current memory. You do this to clear current memory in order to write a new program.

- RETRIEVE CAM will write a .CAM program from the floppy to current memory. First input the part number and then press the RETRIEVE CAM key.

Notes:
- *You may have two programs with the same part number if one is .MX2 and the other is .CAM. The different extensions make them different programs.*
- *When CAM files are brought into the ProtoTRAK Edge 3, the information is converted (or parsed) into ProtoTRAK events. You may edit the program in this format.*
- *If a .CAM program is saved in the program IN/OUT Mode, the part number remains the same, but the extension is changed to .MX2.*

11.4 .CAM Converter (2-axis only)

The ProtoTRAK Edge 3 CNC can accept programs generated through a CAD/CAM system with the .CAM extension in 2-axis only. If a .CAM program containing Z-axis commands is opened on the Edge 3 CNC, the ProtoTRAK will disregard the Z commands and use the X and Y coordinates only.

Supported G-codes and format

G0 X x.xxx Y x.xxx
G1 X x.xxx Y x.xxx
G2 X x.xxx Y x.xxx I x.xxx J x.xxx
G3 X x.xxx Y x.xxx I x.xxx J x.xxx

All other G-codes are ignored.

Tool changes are specified by the "T" parameter.

T01 = Load tool 1

Feedrates are specified by the "F" parameter.

F15 = 15 IPM

Drill canned cycles will be turned into a position moves (G0), causing the ProtoTRAK DPME2 to move to the X and Y coordinates and stop. All other parameters, like dwell or number of pecks will be discarded.

11.5 Changing Floppy Disks

The 1.4 MB floppy disk drive is located in the ProtoTRAK Edge 3 pendant and is easily accessed through the door on the side of the display.

Each ProtoTRAK Edge 3 is shipped with a disk loaded in the drive to be used as storage space for your programs.

If you plan to generate and save a large number of programs, or if you plan to use CAD/CAM-generated programs, we strongly recommend you make several additional copies.

If you wish to **remove a disk**:

a. Rotate the cover away from the drive on the side of the display

b. Press the button on the drive to eject the disk.

c. Remove the disk.

If you wish to **load a disk**:

a. Rotate the cover away from the drive on the back panel.

b. b. Push the disk in gently until the eject button pops out.

If you wish to **load a CAD/CAM generated program**:

a. Write a program using your CAD/CAM and Edge compatible post processor. Be sure to label the program with one to eight numerical digits, followed by a decimal point, followed by CAM (for example 123.CAM).

b. Load any IBM compatible disk into your computer.

c. Load the program onto the above disk.

d. Insert the disk into the ProtoTRAK Edge 3 and retrieve the program as described in Section 11.3.

12.0   Service Codes

Service codes are special codes used infrequently for set-up or installation of the ProtoTRAK Edge 3.

12.1 Service Code Procedure

1. Go to the DRO Mode.

2. Press **SERVICE CODES**.

3. Input one of the codes from the list in Section 12.2

4. Press **SET**.

5. For some of the codes, there are additional instructions.

12.2 Service Code Types

Code	Description	Notes
12	Determine feed forward constant	Runs a routine that determines the system friction for setting feed forward constant. **Caution! Do not use this code unless you understand the consequences.** For more details, see SWI Publication No. 23584 "ProtoTRAK DPME2 Installation and Service Manual."
13	Reset the default feed forward constant	In case you ignored the warning above, this resets the default set at the factory.
22	Turn on simulation	For demo purposes, the ProtoTRAK Edge may be run in simulation mode where the control operates normally but does not send commands to the motors. If you use this code, don't forget to restore your CNC to normal operation with Service Code 89!
33	Software ID	Displays the version of software your ProtoTRAK Edge is using.
54	Continuous run mode	Keeps running the system through the program without stopping. It is used for testing.
66	Metric default	To have the ProtoTRAK Edge power up in Metric measurement.
67	Inch default	To have the ProtoTRAK Edge power up in Inch measurement.
68	0.01mm / 0.0005" display	DRO resolution.
69	0.01mm / 0.001" display	DRO resolution.
79	Turn on beeper	Factory setting.
80	Turn off beeper	For stealthy machining.
81	Keyboard test	For testing.
89	Cancel simulation	Cancel the Service Code 22 simulation.

Code	Description	Notes
97	Axis configuration	To orient the motor encoder. This should not need to be done except in a service situation.
99	Master reset and program clear	Resets all the values. **Be sure you understand the consequences before you use this code.** See SWI Publication No. 23584 "ProtoTRAK DPME2 Installation and Service Manual."
100	Axis open loop test	Runs selected axis at rapid for one second and displays values. **Caution! The machine will move. Be sure you understand the consequences before you use this code.** See SWI Publication No. 23584 "ProtoTRAK DPME2 Installation and Service Manual."
123	Calibration of each axis of measurement.	Detailed instructions are found in SWI Publication No. 22059 "ProtoTRAK Edge Installation and Service Manual."
125	Display calibration factors	See SWI Publication No. 23584 "ProtoTRAK DPME2 Installation and Service Manual."
127	Single encoder backlash calibration	Used to calculate a backlash value for entering in Code 128. See SWI Publication No. 23584 "ProtoTRAK DPME2 Installation and Service Manual."
128	Enter backlash value	Used to enter the backlash value calculated using Code 127. See SWI Publication No. 23584 "ProtoTRAK DPME2 Installation and Service Manual."
141	Load Control Parameters	Used to load your configuration file from a floppy disk to the control. The configuration file consists of items such as calibration and backlash constants.
142	Save control parameters	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. 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.
160	Adjust LCD contrast	For viewing comfort, the display LCD contrast may be adjusted.

Southwestern Industries, Inc.
Trav-A-Dial & TRAK

Warranty Statement
Trav-A-Dial and TRAK products are warranted to the original purchaser to be free from defects in workmanship and materials for the following periods:

Product	Warranty Period	
	Materials	Factory Labor
New Trav-A-Dial	1 Year	1 Year
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 its authorized distributor.

If a unit under warranty proves to be defective in workmanship or materials, 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.

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 obligation 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, even if SWI has been notified of the possibility of such damages.

♦ Trav-A-Dial/TRAK products are precision mechanical/electromechanical measurement systems and must be given the reasonable care that these types of instruments require:

◊ Proper shop facilities are the responsibility of the customer. This warranty does not apply if the facilities, e.g., flooring or electricity, are not adequate for the installation and use of the products.

◊ Proper use of shop equipment such as air hoses. Consequently, the warranty does not apply if the customer uses poor machine shop practices and blows chips into machine gibs, glass scale, and TRAK Sensor or control instruments.

◊ Proper maintenance and lubrication as directed in the product manual is the responsibility of the customer. This warranty does not apply if the customer does not properly maintain the unit.

♦ 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 use or 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.