1. Introduction

The purpose of this manual is to help you to learn the operation and programming of the ProtoTRAK Edge on Trak 1. It is a supplement to SWI Publication 22061, ProtoTRAK Edge Programming and Operation Manual.

If you have been running a knee mill with a DRO, the ProtoTRAK Edge is about to make your life a lot easier. Just stay with this program for a couple of hours and you'll be making more parts with less effort in no time.

1.1. The Training Exercises

The training starts in Section 2.0. There is reading and some questions to answer. You may want to get a pad of paper and pencil, and perhaps have a seat in a quiet place. This will take around 20 minutes.

In Section 3.0 are activities you do at the machine to orient you to operating the ProtoTRAK Edge.

In Section 4.0 is the first sample part. There are detailed instructions in programming and running this part.

1.2. What You Need for This Training Program

- The ProtoTRAK Edge installed on a mill.
- This manual.
- A 6”x 4”x $\frac{1}{2}$”HDPE.
- A 3/8”, two flute, bottom cutting end mill.
- A 1/4” drill bit and drill chuck
- $1\frac{1}{2}$" parallels
- Collet

1.3. What We Assume You Already Know

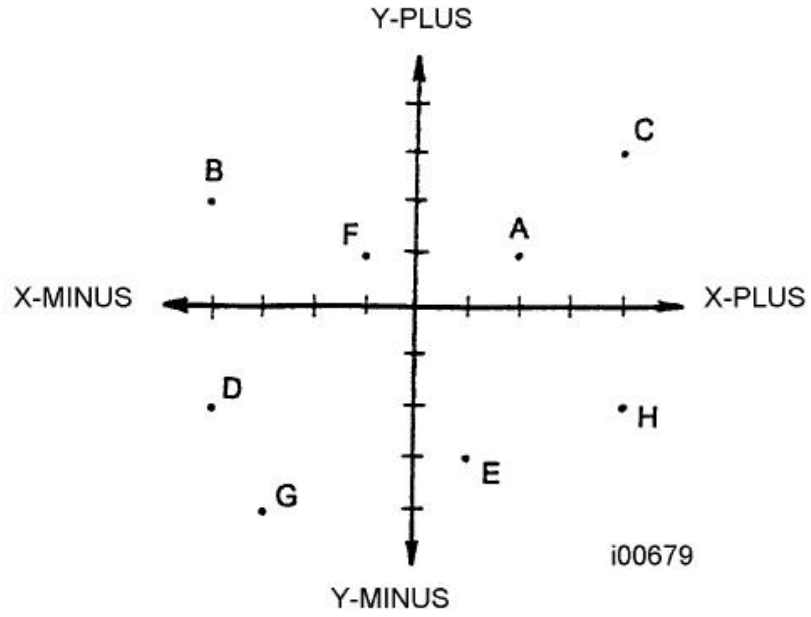
We assume you know how to run a knee mill, use an edge finder, know how to read a blueprint and have at least a little experience inputting information into a box like a digital readout or a computer.

NOTE: It is always good practice to run your program with a tool loaded **“ABOVE”** the vise/part to verify that the tool will not hit the vise or mounting hardware.

2. Definitions, Terms, and Conventions

2.1. X, Y, Plus (+), Minus (-)

The ProtoTRAK Edge works in the Cartesian Coordinate System. This is the common number line system that we can use to plot the location of a point in two dimensions, X and Y. Any given point may be located exactly by plotting its position on the X and Y axes. For example, the point A below is at point X = 2, Y = 1, or (2, 1).



The point where the X line and the Y line cross is the (0, 0) point. This is known as Absolute 0.

To the right of the Absolute 0 is the X plus. To the left is X minus. That is true for points whether or not they are actually on the X line or not.

Above the Absolute 0 is Y plus, below is Y minus. Again, that is true whether the point is actually on the Y line or not.

- Answer these questions about what you've just read. Check your answers at the back of this manual.
    1. Absolute 0 is the point where _____.
    2. Left of the Absolute 0 point is (X or Y) minus.
    3. Above the Absolute 0 point is (X or Y) plus.
    4. True or false. Any point in two dimensions can be plotted with the Cartesian Coordinate System.

Tip: If you have any problem with this part, take this manual out to your machine and put the drawing under the spindle so that the 0,0 point is lined up with the center of the spindle. Zero out the DRO on your display and crank the table different directions. Watch the DRO measurement count up and down, turning from positive to negative as you pass the (0, 0) point.

Quiz 1

Write down the X and Y dimensions (including + or – signs) of points A through H in the figure above:

	X	Y
A		
B		
C		
D		
E		
F		
G		
H		

Check your answers at the back of this manual.

2.2. Absolute (ABS) and Incremental (INC)

In the previous section we saw that the absolute dimension is the point at which both X and Y are 0. Every part we make with a ProtoTRAK Edge will have an absolute zero that you give it. We want to put the Absolute 0 where it will make it easy to define the other points we need to machine, so a corner or the center of a circular pattern are usually the best.

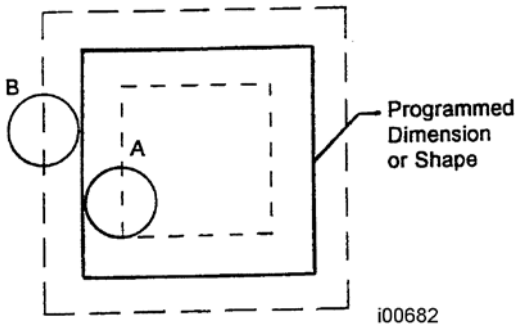
When we program, we need to tell the ProtoTRAK Edge what the reference point is for the numbers we put in. When your reference point is the (0, 0) we call that an Absolute Reference. That means that the number you put in is measured from (0, 0). There is another way to define a point and that is with Incremental dimensions.

Incremental dimensions are simply dimensions measured from the previous point.

Consider the print on the next page. If we say the bottom left corner is absolute zero (ABS 0) then the dimensions are absolute or incremental as shown.

2.3. Tool Compensation

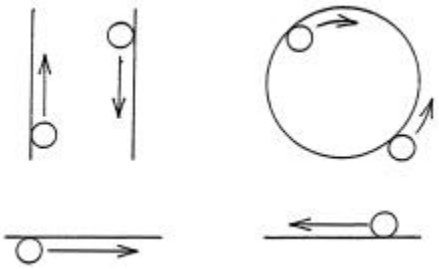
One of the things that makes the ProtoTRAK Edge so easy to use is that you get to program the dimensions of the finished work piece that are right on the print, instead of the centerline of the tool. Let’s say you programmed the square shape below shown as the solid line.



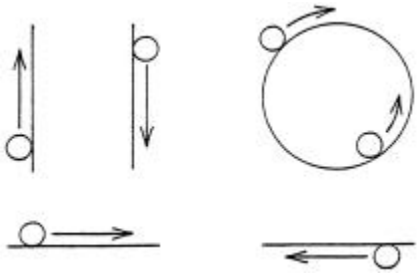
The ProtoTRAK has no way of knowing whether you want to cut a pocket out of the material, so you want your tool to follow Path A, or if you are squaring up a block so you want your tool to follow Path B. This is what tool cutter compensation (or cutter comp) is about.

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.

Examples of tool right are:



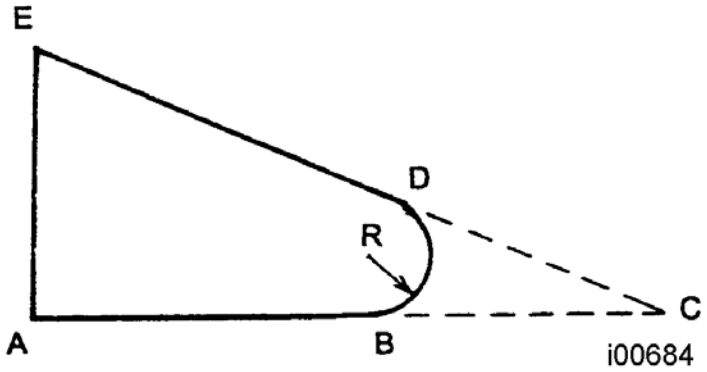
Examples of tool left are:



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

2.4. Conrad (Connecting or Corner Radius)

Conrad is another really nice feature of the ProtoTRAK Edge. In the example below you could machine a straight line from Point A to B, then an ARC with radius R from B to D, then another straight line from D to E.



The problem is that the arc is not easy to program because you often don't know where point D or B, or the center of R is located. However, you may know where Point C is, or you may be able to figure it out easily. In that case you can program the above part by programming a straight line from A to C, tell the control when it asks that you have a CONRAD equal to R, and then program another straight line from C to E. The ProtoTRAK will automatically blend the connecting radius (CONRAD R) between the two straight lines with no additional input.

For Rectangular Pockets or Frames, CONRAD stands for corner radius. You may input any value that makes sense considering the size of the pocket and the diameter of the tool.

This concludes the paper-and-pencil part of the training program. If you haven't checked your answers to the quizzes in the back of the book yet, do that now.

Next we move on to cover some basic operations. You may want to refer back to these concepts and conventions as you get familiar with the buttons and other operations.

3. Basic Operation

Take this manual out to the machine.

3.1. Turn the ProtoTRAK Edge On

On the back of the control is an on/off toggle switch. Flip it up to turn the ProtoTRAK on.

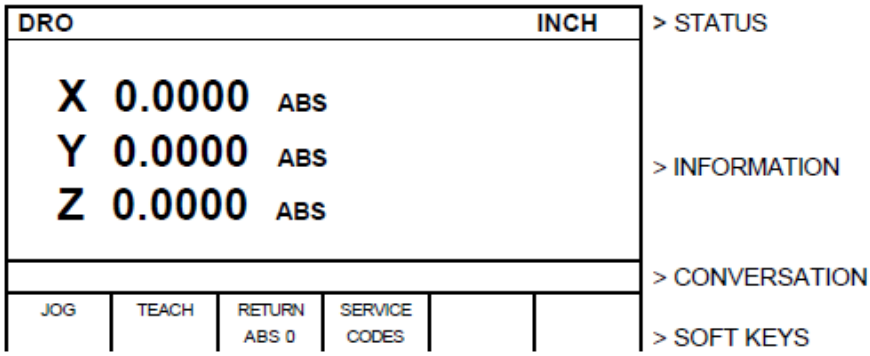
Each time you turn the ProtoTRAK on, it must "boot up" or read its operating software off the built-in floppy disk drive. This takes about one minute, so we recommend turning on in the morning and off once at the end of the day.

If you don't use the ProtoTRAK for 20 minutes, its screen will go blank. This is the screen saver. Press any key or turn the X or Y handwheels and it will come on immediately.

3.2. Screen Organization

When the system has booted and the screen shows a big "Edge," press the left most green and white arrow key under the screen. This key is directly under the box on the screen that says DRO.

The screen should show:



Almost every screen is organized like the one below and divided into four sections. The screen above will show a Z readout if purchased with that option.

The **STATUS** line is on the top. It tells you what mode of operation you are in, whether you're in inch or metric, if the servo motors are on, etc.

The **INFORMATION** area is below and is the largest part of the screen. It shows information or data depending on what you're doing. In DRO operation it shows the axis readout; in Programming it shows the program; when you press LOOK in programming it shows a picture of your part, etc.

The **CONVERSATION** line is below the information area. This is probably the most important line because this is where you input all the data and this is where the ProtoTRAK will prompt you for the information or activity that it wants.

The **SOFT KEY** definitions are shown in the 6 boxes on the bottom. These explain the function of the 6 green and white arrow keys directly to the right of each box. In this manual if we say press the JOG soft key, we mean press the green and white arrow key to the right of the JOG box on the screen.

3.3. Keyboard Organization

The keyboard is made up of three sections: the soft keys, the data input keys, and the motion control keys.

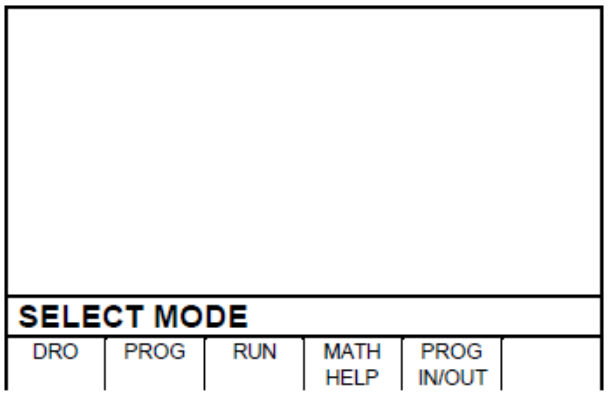
The **SOFT KEYS** are the 6 unlabeled keys on the right side of the screen. Their function is defined by what is written on the screen directly above the key. If there is nothing written, then the key will not work.

The **DATA INPUT** keys are the number keys and the other keys close to them. The operation of these keys is pretty obvious or will be explained in the next section. One thing to note at this point is the difference between the INC SET and the ABS SET keys directly above the number keys. If you are inputting an **X or Y dimension** it is important to set or load this into the system with the correct key. If it is an absolute-referenced number, press ABS SET; if it is an incremental number, press INC SET. If you are inputting any value other than an X or Y, you may press either ABS SET or INC SET. In this case the manual will simply say SET.

The **MOTION CONTROL** keys are the GO, STOP and FEED keys..

3.4. Modes

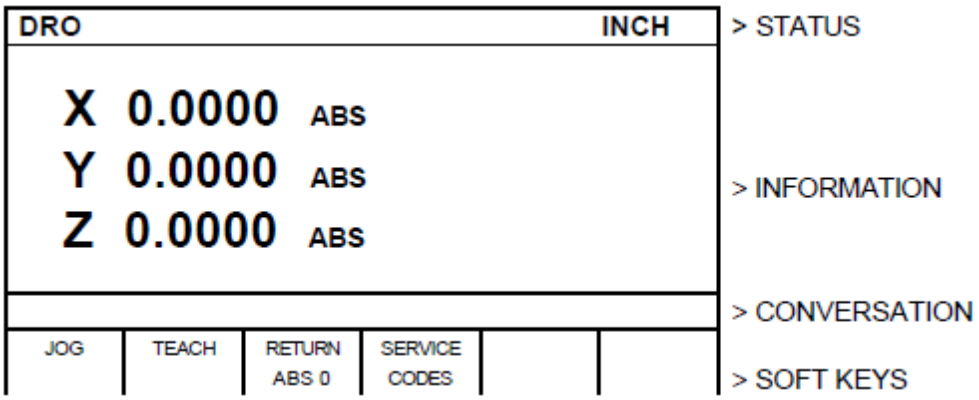
Press the MODE function key. The screen will show:



This is how you change from one mode of operation to another. After you press the MODE key, just press the soft key under the box describing the mode of operation you wish. If you ever get confused just press MODE to get back to this beginning screen.

3.5. Manual Operation

Now press the DRO soft key from the Select Mode screen above. The screen will once again show:



Do the following:

1. Press X, ABS SET, Y, ABS SET, X INC SET, Y, INC SET. This will zero or reset the absolute and incremental readouts.
2. Press the INC/ABS key to the left of the Y key. Notice the ABS on the screen changes to INC.
3. Manually crank the X handwheel so that the table moves left. Move the table so that the readout is X 1.0000 INC.
4. Manually crank the Y handwheel so that the saddle moves away from you. Move the saddle so that the readout is Y -1.0000 INC.
5. Press X, INC SET and Y, INC SET to reset the X and Y incremental readout to zero.
6. Move X another inch to 1.0000 INC and Y another inch to -1.0000 INC.
7. Press the INC/ABS function key to show your absolute position. That is, how far you have moved from Step 1 above where you set absolute. X should read 2.0000 ABS, and Y -2.0000 ABS.
8. Press X, ABS SET, Y, and ABS SET to reset absolute to the position you're at now.

3.6. JOG

Do the following:

1. Fold up the X and Y handwheels (pull out, and then fold up).

WARNING
Never operate the ProtoTRAK under servo motor control unless the handles are folded into their safety position.

9. Press the JOG soft key. The conversation line will say "JOG +100 ipm". This means the ProtoTRAK is ready to jog in the plus X or Y direction at 100 inches per minute (since you are in INCH mode).
10. Press and hold X. The table moves to the left at 100 ipm. Release the X key to stop.
11. Press and hold Y. The table moves towards you. Release.
12. Press the +/- key. Notice the "JOG +100 ipm" in the conversation line changes to "JOG -100 ipm".
13. Press and hold X. The table now moves right. Release.
14. Press and hold Y. The saddle now moves away. Release.
15. Press the FEED down key. Notice the "JOG -100ipm" changes to "JOG -90". Press the FEED down key several more times.
16. Press and hold X. Notice the table moves slower. Release.
17. Press the FEED up key several times until you are back to "JOG -100 ipm"
18. Press number key 9 and ABS SET. Notice that the conversation line now says "JOG -9.0".
19. Press either X or Y. The table or saddle now moves at 9 ipm. This is the way to get low feedrates for power feeding straight cuts in X or Y.
20. Press the RETN (Return) soft key to exit jog operation and go back to manual.

3.7. Return to Absolute Zero

Do the following:

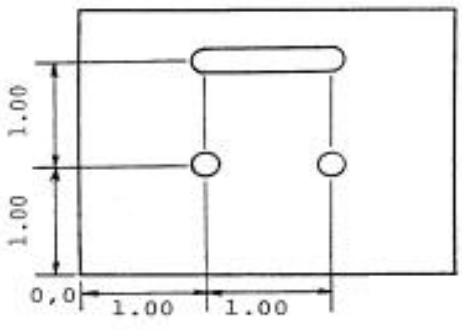
1. Make sure the readout is displaying absolute (ABS). If not, press the INC/ABS key.
2. Move the handwheels to make sure you're not at zero.
3. Press the RETURN ABS 0 soft key.
4. Press GO. The table and saddle will automatically move to the absolute zero you set earlier.

3.8. Teach

Teach allows you to machine a part by hand and command the ProtoTRAK Edge to remember the tool positions. This "taught" program can then be run for subsequent parts.

Imagine you have this simple job:

- Drill the two 1/4 inch holes
- Mill 1/4 inch slot

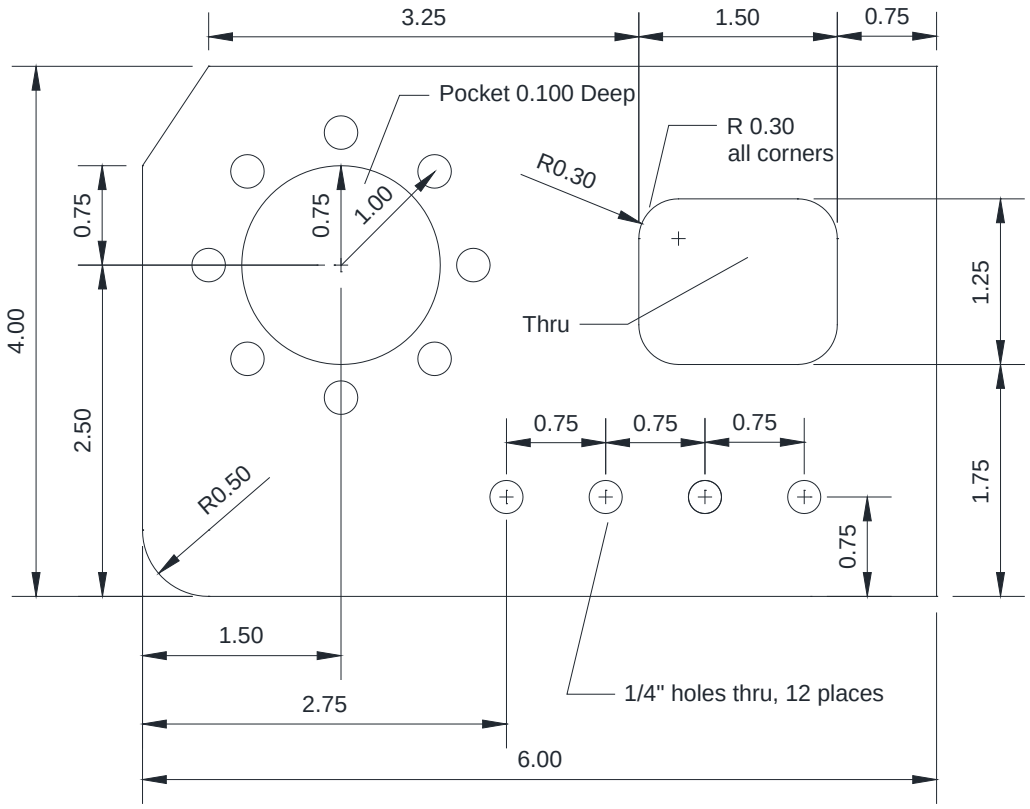


1. Position the table in X and Y so they are near the center of their travel.

2. Press TEACH.
3. Ensure ABS is displayed on the DRO. If not press INC/ABS.
4. Using the handwheels, move the table to X=1.0000 abs, Y=1.0000 abs. This is the position of the first hole.
5. Press SAVE POSN.
6. Move the table to X=2.0000 abs, Y=1.0000 abs. This is the second hole.
7. Press SAVE POSN.
8. Move the table to X=1.0000 abs, Y=2.0000 abs. This is the beginning of the slot.
9. Press SAVE POSN.
10. Move the table to X=2.0000 abs, Y = 2.0000 abs. This is the end of the slot.
11. Press SAVE MILL. The conversation line says “Feedrate 10.0”. Press 6. to change the federate, and press ABS SET.
12. You have now “taught” the program.
13. Press RUN TEACH, and GO. The table will move to the first hole position and the conversation line will read “SET Z.” You could then drill the hole.
14. Press GO. The table moves to the second hole position.
15. Pres GO. The table moves to the beginning of the slot. You would change tools and move the quill to the proper depth.
16. Press GO. The table moves to the end of the slot at 6 inches per minute.
17. Press ERASE TEACH to erase the program.

4. Sample Part 1

The purpose of this sample is to demonstrate most of the various event types or canned geometry's that can be programmed. Also to give you practice inputting data and running an actual part.



4.1. Preparation

You need the following to make this part and the part in Sample Part 2.

1. A vice (if the vise does not have step jaws you will also need 1 $\frac{1}{2}$parallels).
2. A ¼" drill bit and drill chuck.
3. A 3/8" 2 flute, bottom cutting end mill.
4. An edge finder or wiggler.
5. A piece of 6" x 4" x $\frac{1}{2}$" HDPE.
6. $1\frac{1}{2}$" parallels.
7. Collet

NOTE: It is always good practice to run your program with a tool loaded **"ABOVE"** the vise/part to verify that the tool will not hit the vise or mounting hardware.

4.2. Program Strategy

If you wish to place the part in the vise before programming consult section **4.5 Set up the Part Reference**. Before programming a part, it's important to figure out what you want to do and what order you want to do it.

The strategy for programming a ProtoTRAK Edge is pretty straightforward:

- Identify the geometry you want to machine from the print
- Select it on the control
- Answer the questions

Our plan for Sample Part 1 is:

1. Decide that the lower left corner of the part will be our absolute zeros, or absolute reference.
2. Drill the left most hole in the row using a Drill Event.
3. Drill the next 3 holes using a Repeat Event.
4. Drill the 8-hole bolt circle pattern using a Bolt Hole Event.
5. Mill the diagonal in the upper left corner using a Mill Event.
6. Mill the arc in the lower left corner using an Arc Event.
7. Mill the circular pocket with a Pocket Event.
8. Mill the through rectangle with a Frame Event.

4.3. Making and Inputting the Program

Press MODE and then press PROG soft key to enter the Program Mode.

4.3.1. The Program Part Number

- If there is a program already in the current memory, you can erase it by pressing MODE, PROG IN/OUT, CLEAR CURRENT. If no program is currently loaded, the conversation display says, "Program Part Number". You input 123, SET (INC SET or ABS SET).

4.3.2. Event 1 – The First Hole

- Conversation line says, "Select Event". You press POSN/DRILL soft key. Now, press ONE (the soft key next to the text ONE) to select the single hole.
- The right side of the information area shows that Event 1 is a Position/Drill and it lists what data is required. But keep your eye on the conversation line.
- Conversation says, "X". You press 2.75, ABS SET. Remember the lower left corner is our Absolute zero.
- "Y". You press .75, ABS SET.
- "TOOL #". You press 1, ABS SET.
- Tool number 1 is the 1/4 drill, so press .25, ABS SET.

4.3.3. Event 2 – The Next 3 Holes

- “Select Event”. You press the REPEAT soft key for Event 2 to make the next 3 holes in the row.
- Event 2 is a Repeat Event and the data needed is shown on the right of the information area. Notice Event 1 has shifted to the left.
- “First Event #”. You press 1, ABS SET because we want to repeat Event 1.
- “Last Event #”. You press 1, ABS SET because the only event we want to repeat is Event 1.
- “X Offset”. You press .75, INC SET because that’s the distance between the holes in the X direction.
- “Y Offset”. You press 0, INC SET because the other holes are not shifted in the Y direction.
- “# Repeats”. You press 3, ABS SET because we want 3 more holes each offset .75 inch.
- “Tool #”. You press 1, ABS SET because we’re using the same tool.
- "Tool Dia". You press 0.25, ABS SET because we don't want to change the diameter for this tool (we could have just pressed ABS SET to retain the tool diameter).

4.3.4. Event 3 – The Bolt Hole Pattern

- “Select Event.” You press POSN DRILL, then the BOLT HOLE soft key for Event 3.
- Event 2 has shifted to the left and the data you need to input is shown on the right.
- “# Holes”. You press 8, ABS SET because there are 8 holes.
- “X CENTER”. You press 1.5, ABS SET.
- “Y CENTER”. You press 2.5, ABS SET.
- “Radius”. You press 1. , ABS SET because the radius of the bolt hole pattern is 1.000 inch.
  NOTE: You must press 1, followed by a decimal point, otherwise the radius will become 0.0001” instead of the desired 1.0” This also goes for angles as well.
- “Angle”. You press 90. , ABS SET. This is the angle measured in the counterclockwise direction from 3:00 o’clock to the first hole you want to drill. We could have input 0 and then we would drill the right most hole first.
- “Tool #”. You press ABS SET. We’re still using tool number 1, but notice we didn’t press the 1. If you don’t input a number, the ProtoTRAK assumes the last tool is used again.
- "Tool Dia". You press ABS SET.

4.3.5. Event 4 – The Upper Left Diagonal

- "Select Event". You press MILL soft key for Event 4.
- "X Begin". You press 0, ABS SET to define the beginning of the milling cut at its lower left point on the diagonal.
- "Y Begin". You press 3.25, ABS SET to define the beginning of the milling cut.
- "X End". You press .5, ABS SET to define the end of the milling cut.
- "Y End". You press .75, INC SET to define the end of the milling cut. Notice we defined this as an incremental change of .75 inch from the beginning. We could have also input 4.0, ABS SET to also define the end point. Think about this and make sure you understand.
- "CONRAD". You press ABS SET because we don't want to blend this mill cut into another cut.
- "Tool Offset". You press 2, ABS SET because you're selecting that the tool is to the left of the work piece as it moves from beginning to end. If this is unclear, please refer back to the beginning of this training manual to review tool offset directions (page 6).
- "Feedrate". You press 5. , ABS SET to mill at 5 inches per minute.
- "Continue". You input 0, ABS SET because this is not continuous path milling.
- "Tool #". You input 2, ABS SET because we're calling the 3/8 end mill tool number 2.
- "Tool Dia." You press .375 ABS SET. For added accuracy it is a good idea to measure the actual diameter of your tool by spinning it in a caliper and noting the largest reading. This arises from the fact that sharpened tooling is often slightly smaller than the original tool size.

4.3.6. Event 5 – The Lower Left Radius

- "Select Event". You input soft key ARC for Event 5.
- "X Begin". You input 0, ABS SET because we're going to start at the top and mill down and to the right.
- "Y Begin". You input .5, ABS SET.
- "X End". You input .5, ABS SET.
- "Y End". You input 0, ABS SET.
- "X Center". You input .5, ABS SET, or we could have input 0, INC SET since the X Center is the same as the X End.
- "Y Center". You input .5, ABS SET.
- "CONRAD". You input 0, ABS SET.

- “Direction”. You input 2, ABS SET because we are milling in a counterclockwise direction.
- “Tool Offset”. You input 1, ABS SET because looking from beginning towards end (the direction of the tool cut) the tool is to the right of the work piece. Think about this to be sure you understand or refer back to page 6 to review tool offsets)
- “Feedrate”. You input 5. , ABS SET.
- “Continue”. You input 0, ABS SET because this is not a continuous milling path.
- “Tool #”. You input 2, ABS SET because that’s still our tool.
- "Tool Dia". You input .375 ABS SET (or INC SET).

4.3.7. Event 6 – The Circular Pocket

- “Select Event”. You press POCKET FRAME soft key for Event 6.
- “Select”. You press CIRCLE POCKET soft key because our pocket is circular.
- “X Center”. You press 1.5, ABS SET.
- “Y Center”. You press 2.5, ABS SET.
- “Radius”. You press .75, ABS SET defining the radius of the pocket.
- “Direction”. You press 2, ABS SET to select counterclockwise tool motion. We could have just as easily selected clockwise, however milling in a counterclockwise direction is known as climb milling and is preffered.
- “Fin Cut”. You press ABS SET. (To set finish cut to zero)
- “Feedrate”. You press 8., ABS SET.
- “Tool #”. You press ABS SET because we’re still using tool number 2.
- "Tool Dia". You press ABS SET.

4.3.8. Event 7 – The Through Rectangle

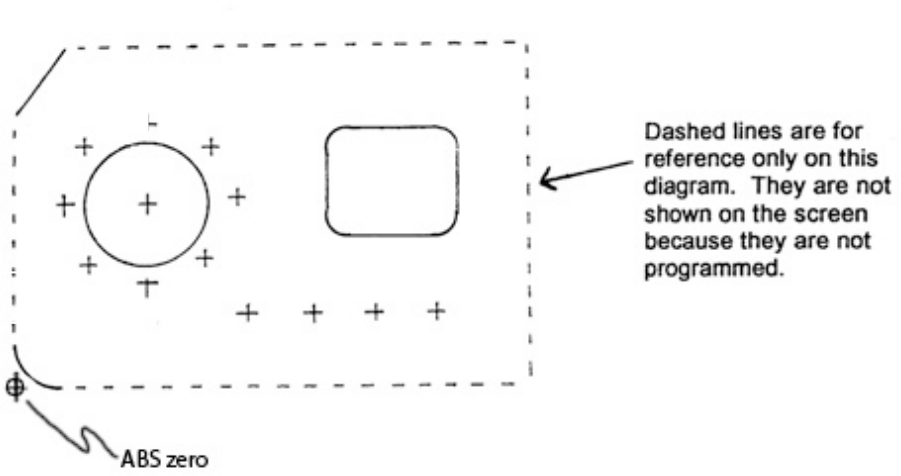
- “Select Event”. You press POCKET FRAME soft key for Event 7.
- “Select”. You press RECT FRAME soft key for the rectangular frame.
- “X1”. You press 3.75, ABS SET which is the distance to corner number 1, which we will say is the lower left corner of the frame.
- “Y1”. You press 1.75, ABS SET.
- “X 3”. You press 1.5, INC SET because corner number 3 is the opposite diagonal corner and it is 1.5 inches in the plus X direction from X1.
- “Y3”. You press 1.25, INC SET.
- “CONRAD”. You press .3, ABS SET because the corner radius of the frame is .300 inch.

- “Direction”. You press 2, ABS SET to choose counterclockwise.
- “Tool Offset.” You press 2, ABS SET because when the tool moves counterclockwise around the inside of the rectangle frame, it is to the left of the work piece.
- “Fin Cut”. You press ABS SET. (To set finish cut to zero)
- “Feedrate.” You press 5. , ABS SET.
- “Tool #”. You press ABS SET because we’re still using tool number 2.
- “Tool Dia”. You press ABS SET.

4.3.9. Look at the Program

- Press the LOOK hard key to see what your program looks like. You don't have to finish the programming to see what you've done so far. Any time you see the SELECT EVENT prompt in the Program Mode, you can look at the part graphics.

The drawn part should look like this:



If your part draw doesn’t look like this, don’t panic. See if you can figure out what piece of geometry, and therefore what event looks wrong. Go back to that part of your program and check your inputs against these instructions.

If the ProtoTRAK refused to draw your part and indicated a data error, read the explanation and solution and it will suggest the way to resolve the problem.

- Press RETURN. The program is complete

4.4. Program In/Out Mode

Now that we have a good program we want to save it. If you turn the ProtoTRAK off now the program will be lost. To prevent this, we will save it on the system’s hard drive where it will stay (even without power) until you consciously erase it.

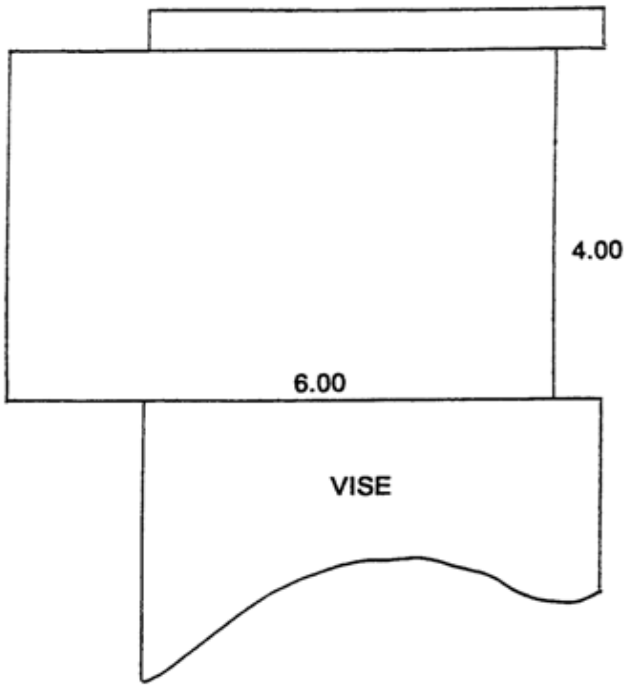
Do the following:

1. Press the MODE and select the PROG IN/OUT soft key.
2. The conversation line says, “Part Number 123”. If you want to change the part number you could just put in a new one at this time. You press STORE soft key and wait a few seconds until it’s complete. Notice your new part number, 123, is now in the list.

4.5. Program Run Preparation

4.5.1. Setup the Workpiece

Take a piece of 6” x 4” x $\frac{1}{2}$” HDPE and lock it into the vise as shown below. Use step jaws or parallels. Make sure the material sticks out to the left of the vise by about 1 1/2 inch.



4.5.2. Set up the Part Reference

1. Press MODE and select DRO soft key.
2. Press INC/ABS to be sure the display reads the absolute position (ABS).
3. X and Y ABS SET should be used to zero the DRO. Use the edge finder to position the center of the spindle over the lower left corner of your part.
4. The read out should display X 0.0000 ABS and Y 0.0000 ABS when the spindle is over the lower left corner.

4.6. Program Run

This is where we make the part. Do the following:

4.6.1. Enter the Run Mode

- Press MODE and select RUN soft key.
- The conversation line says, “Select”. You press START soft key. The START EVENT # soft key allows you to start in the middle of a program, but we don’t want to do that.

4.6.2. Drill the Holes

- “Load Tool 1 Dia 0.250”. You should load the 1/4 drill bit in the spindle, then start the spindle, and adjust the RPM.

  Note: You will probably want to center drill each hole first. Either switch drills every hole (the hard way), or run through the program first with the center drill and then with the 1/4" drill. To start the program over, press Mode then Run again.

- Fold the handles of both the x and y axis into the center of the handle. These axes will be moving automatically and quite rapidly between events and it is easy for them to hit you if not folded in.

- Ensure the drill bit is clear of your part and press GO. The tool will move (actually the table moves) to the first hole in the row.
- “Set Z”. You move the quill and drill the hole. After every drilling operation always make sure the tool is up to clear the work piece.
- Press GO and drill the remaining holes and in the bolt hole pattern each time the conversation line says “Set Z”. (Will complete events 1 thru 3)

4.6.3. Mill the Upper Left Diagonal

- When the last hole is drilled the conversation line says, “Load Tool 2 Dia .375”. You should stop the spindle, load the 3/8 end mill, start the spindle and adjust the RPM.
- Press GO. The tool will move to the upper left edge of the part where the diagonal cut begins.
- “Set Z”. You move the quill so the tool is slightly below the bottom of the plate to make the full depth cut. Lock the quill at this position.
- Press GO. The tool will move at 5 ipm and cut the diagonal.
- “Check Z”. This is a warning to raise the quill because the next move will be at rapid speed (100 ipm). You should raise the tool.

4.6.4. Mill the Lower Left Radius

- Press GO. The tool will rapid to the beginning position for the Arc cut.
- “Set Z”. Lower the tool to the correct depth and lock the quill.

- Press GO. The tool will move at 5 ipm and cut the arc.
- "Check Z". You should raise the tool.

4.6.5. Mill the Circular Pocket

- Press GO. The tool will rapid to about the center of the pocket.
- "Set Z." Bring the tool down (or the knee up) to .100 below the top of the part and lock the quill.
- Press GO. The tool will move at 8 ipm to machine the pocket. Press the FEED up key and FEED down keys while cutting the pocket to see how you can adjust the speed while you're cutting.
- "Check Z". You should raise the tool.

4.6.6. Mill Through-Rectangle

- Press GO. The tool will rapid to the beginning point to machine the rectangular frame thru.
- "Set Z". Move the quill down so that the tool is slightly below the bottom of the plate. Lock the quill.
- Press GO. The tool will move at 5 ipm (if you left the feedrate override at 100% when you adjusted FEED up and FEED down key) to machine the rectangle and make the finish pass.
- "Run Over". The part is finished. If you were making a second part and could locate it in the vise in the same place, you could now press the NEXT PART soft key and the whole program would be repeated.
- Press MODE to exit Run.

Congratulations. You made your first part!

5. Answers

Section 2.1

1. Absolute 0 is the point where the X and Y lines cross.
2. Left of the Absolute 0 point is X minus.
3. Above the Absolute 0 point is Y plus.
4. True. Any point in two dimensions CAN be plotted with the Cartesian Coordinate System.

Quiz 1

	X	**Y**
A	2	1
B	-4	2
C	4	3
D	-4	-2
E	1	-3
F	-1	1
G	-3	-4
H	4	-2