CONGRATULATIONS!

You have just purchased **MILL*PWR*** by ACU-RITE, a versatile and flexible 2-axis Control/
3-axis Readout system that effectively combines powerful features and functionality with ease of use at an affordable price.

MILL*PWR* satisfies the needs of the milling market where manual and automated operation are both useful and needed. **MILL*PWR*** also maximizes your throughput by significantly reducing set-up time, scrap and other non-productive operations thereby increasing your efficiency, productivity and profitability.

MILL*PWR* is designed and manufactured in the United States at ACU-RITE's ISO-9001 registered facility. **MILL*PWR*** is a complete system that includes ground and hardened ball screws, powerful DC servo motors, a user friendly operator console with a built-in floppy disk drive, a controller cabinet containing an electronics module (which includes a large hard disk drive) and a motor control module. The system is closed-looped with positioning feedback provided by the use of ACU-RITE's precision glass scales (2µm/.0001" resolution).

MILL*PWR* utilizes a conversational, menu prompted format that makes it easy for you to learn and quick for you to program. No prior programming experience or training is necessary. All you have to do is simply enter part dimensions directly from the print. **MILL*PWR*** automatically calculates the tool path... with immediate part view graphic feedback providing program verification. **MILL*PWR***'s intuitiveness allows you to learn how to operate **MILL*PWR*** and begin making parts, and profits, in a matter of hours.

MILL*PWR* is backed by a comprehensive 1-year warranty, with nationwide support provided by a factory trained and certified distribution network.

Thank you for choosing ACU-RITE. We're confident you'll be more than glad you did.

Sincerely,

ACU-RITE INC.

MILL*PWR* **System Setup Access Code**

An access code must be entered before the system setup parameters can be set or changed. This prevents inadvertently resetting parameters.

IMPORTANT
The access code is **8891**

Refer to section 7, "System Setup."

IMPORTANT
Supervisors may wish to remove this page from the **MILLPWR** manual after initially setting up the system parameters. Keep it in a safe place for future use.

TABLE OF CONTENTS

Section 4. Demonstration

Section 5. Program Steps

TABLE OF CONTENTS

Section 8. Remote Storage

387900-167 Software Version 1.3 Ed G

INTRODUCTION

System Overview

Machine Layout
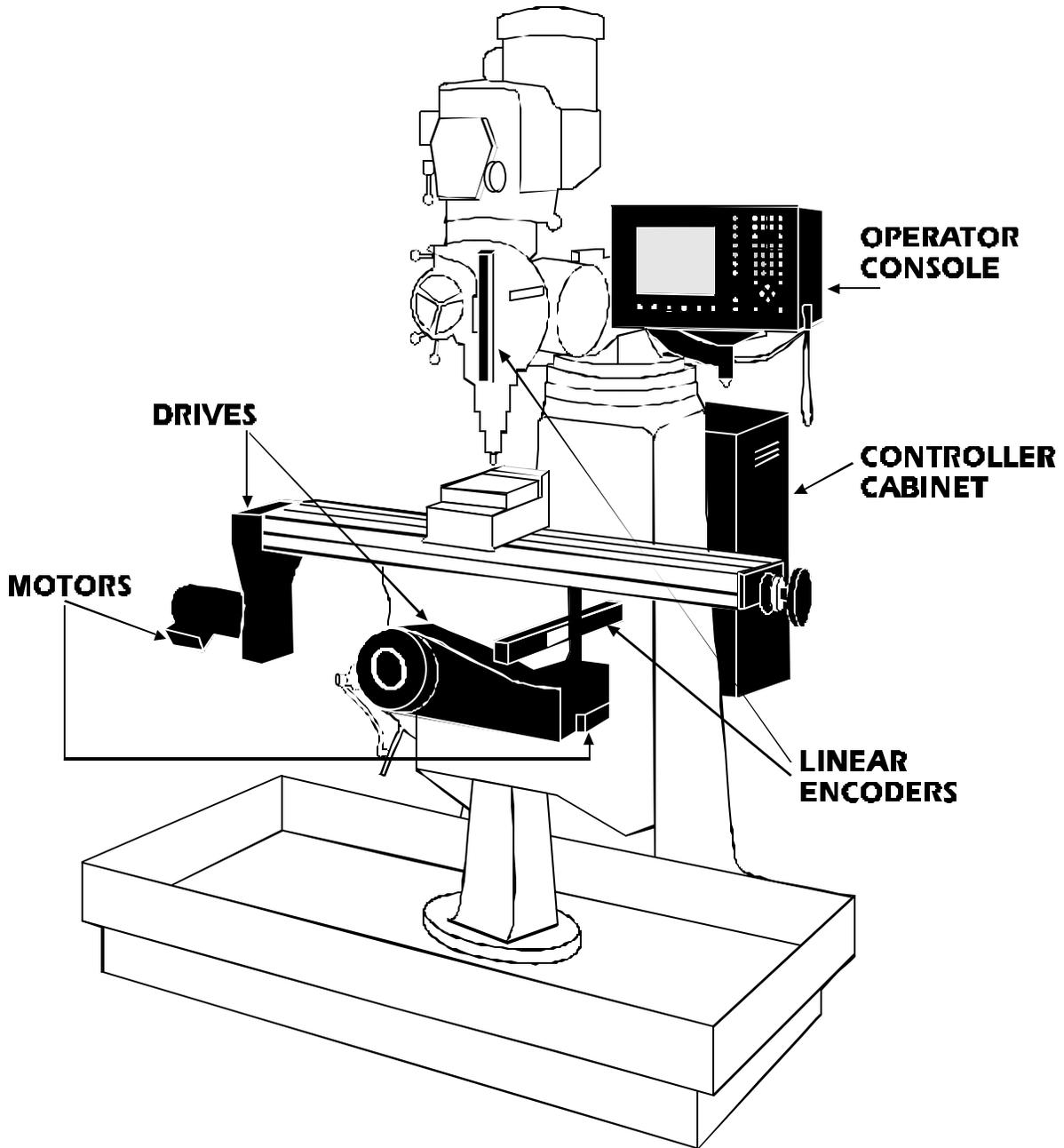
Front View of Operator Console

Floppy diskette inside

Keypad

Emergency TABLE STOP

Softkeys
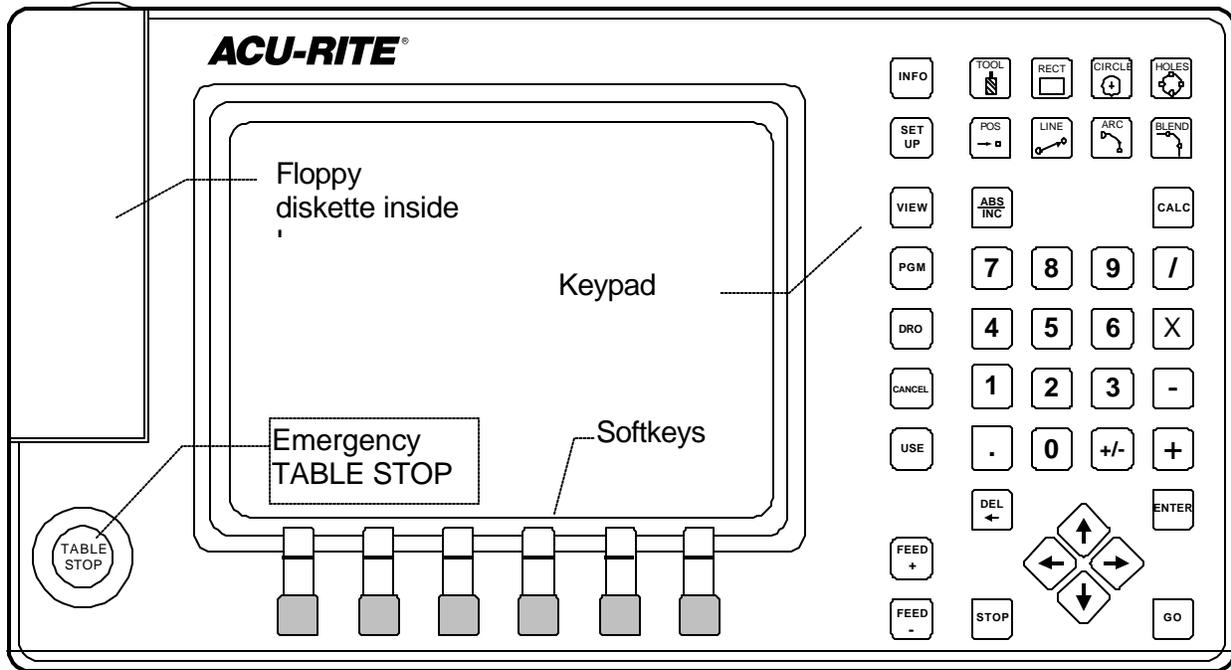
Rear of Operator Console
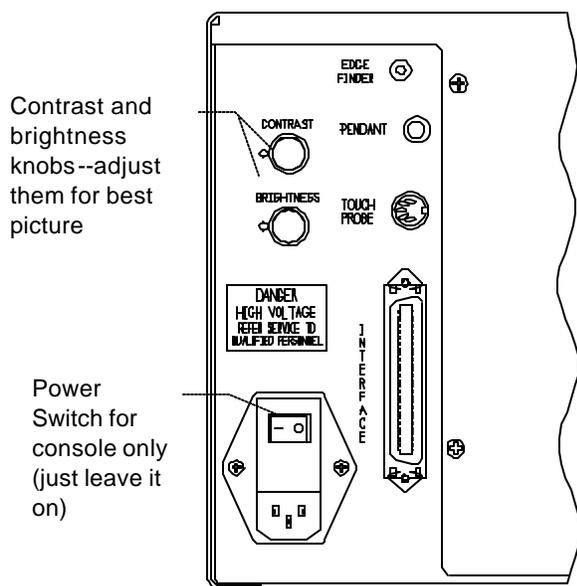
Side of Controller Cabinet

Contrast and brightness knobs --adjust them for best picture

Power Switch for console only (just leave it on)

Main power switch. Use this to turn MILLPWR on and off.

Keypad Layout

Milling Functions

Main Function Keys

| TOOL | RECT | CIRCLE | HOLES |

| POS | LINE | ARC | BLEND |

With these keys, you define the operations you want MILLPWR to perform. These operations end up as "steps" in a program, or you can run just one of them at any time.

INFO

These let you set up the MILLPWR, get information about what you are doing, switch between program (PGM) and DRO, and "USE" the milling functions as steps in a program.

SET UP

VIEW

Numeric Keypad and Calculator

| ABS INC | | | CALC |

| 7 | 8 | 9 | / |

| 4 | 5 | 6 | X |

| 1 | 2 | 3 | - |

| . | 0 | +/- | + |

| DEL ← | | | ENTER |

PGM

DRO

CANCEL

USE
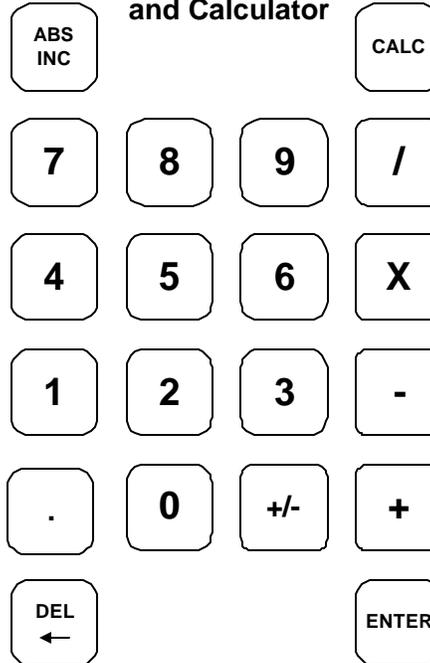
Enter all numerical values with these keys. When you're entering dimensions, you can specify absolute or incremental.

The handy 4-function calculator can be used at any time. Trig and geometry assistance is available with a press of the CALC key.

Cursor and Motion Control Keys
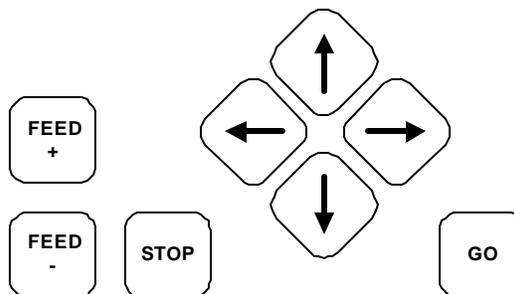
Press GO to run your program, and STOP to stop it. The FEED keys let you adjust the cutting speed on the fly.

| FEED + |

| FEED - | STOP | | GO |

The cursor keys help you navigate around the screen while you are using MILLPWR.

Screen Layout

The **MILLPWR** display screen is divided into four sections.

| SERVO OFF | FEED | 0 | 100% | TOOL: | | SCALE | 1.0000 | INCH |

| ZERO X | ZERO Y | ZERO Z | | DATUM | MOVE TABLE |
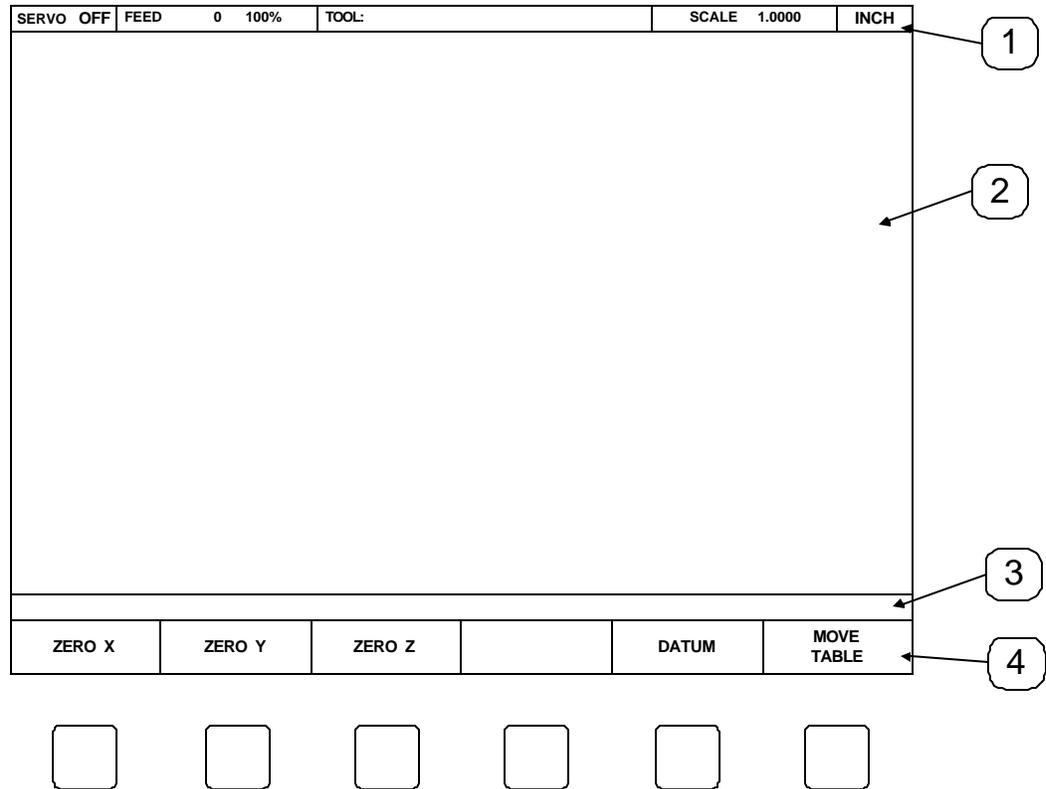
Status bar - displays the servo motor status (on/off), feed rate, current tool, scale, and inch/mm display view.

Information screen - displays information for the job being performed.

- Used as a **readout**, the screen will display the current location for each axis.

- When **programming**, a list of milling operations and part view graphics will be displayed.

- To **calculate** data geometrically, lines and arcs can be constructed and displayed.

Message line - operator prompts and messages will appear here.

Softkeys - variable key functions appear here; functions are selected by   pressing the hard key directly below the softkey message.

Saving, Backing Up, and Creating Directories for Programs

If you're writing a long program, don't wait until the end to save your work. Frequent saving reduces the risk of losing work due to a power interruption.

When you begin to create programs for your **MILLPWR** to run, you can *save* your programs in any of three places—on **MILLPWR**'s internal hard disk drive, on a 3 ½" floppy disk, or on your PC's hard disk drive. Saving your work means it will not be lost if the **MILLPWR** is turned off or if there is a power failure.

Your **MILLPWR** is also equipped with a *backup* feature that enables you to make duplicate copies of your saved programs. We recommend backing up your work as an extra precaution against accidental deletions, hard disk drive failures, or other problems that may prevent you from recovering your original files. Backing up your programs takes only a few moments—and will save you valuable time if a problem does occur.

And as you save and back up your programs, you can neatly organize them in any of the three default directories ("MILLPWR," "A:," and "REMTSTOR") or in personalized directories you create on your own.

For more details about how to save programs, back up files, and create directories, refer to the **Programming** section.

Note: Before you save or back up programs on your PC's hard disk drive, refer to the **Remote Storage** and **System Setup** sections for setup instructions.

Emergency Table Stop Button

The large red button on the front of the **MILLPWR** operator console is the emergency **TABLE STOP**. In the event of a malfunction or programming error, press the emergency **TABLE STOP** button to disengage the servo motors. *Disengaging the servos will cause all table movement to stop.*

WARNING

Pressing the emergency **TABLE STOP** button will **NOT** stop the rotation of the cutting tool unless your machine has been specifically wired to do so. Therefore, in the event of an emergency, if your machine has not been wired to stop the rotation of the cutting tool, be prepared to raise the quill in addition to pressing the emergency **TABLE STOP** button.

Conventions

Axis Conventions

Cartesian Coordinates

When programming a part using **MILLPWR**, table movement and tool motion are determined by the use of positive or negative numbers. **MILLPWR** has been factory set with the following positive and negative directions for X, Y, and Z:

X-axis: the table will move to the left, with tool motion to the right, for positive positions.

Y-axis: the table will move toward you while tool motion is away from you for positive positions.

Z-axis: quill movements up (away from the table surface) are for positive positions.
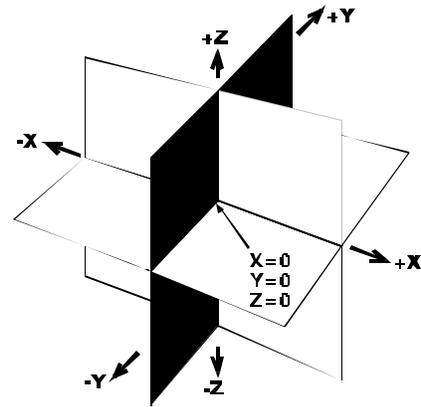
Polar Coordinates

The polar radius (R), is the distance from datum (absolute zero) to a point. The polar angle (A), is formed by the X-axis and the radius, positive counter- clockwise. The angle is always measured from the positive X-axis.
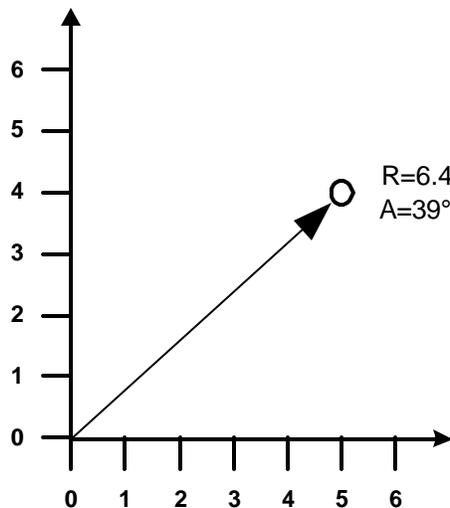
Absolute / Incremental

Dimensions you enter from the print can be either *absolute* or *incremental*.

Absolute dimensions are measured from the *datum* which is the workpiece zero.

Incremental dimensions are measured from one point to another.
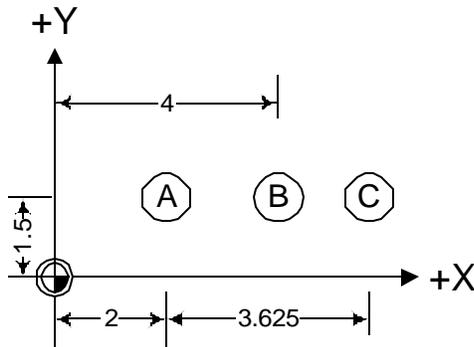
Holes A and B are dimensioned as *absolute*, but hole C is dimensioned *incrementally from A*.

When entering these dimensions in the **MILLPWR**, we would say:

> Hole A: X = 2.000 ABS
> Hole B: X = 4.000 ABS
> Hole C: X = 3.625 INC from hole A

It will often be easier to describe a location in terms of incremental dimensions than it would be to calculate   the absolute coordinates of a point.

Both absolute and incremental dimensions can be used on the same workpiece. For example, Hole C has the dimensions X = 3.625 INC from hole A, Y = 1.5 ABS.

Example: Polar and Incremental

Here is how to enter the angle of a line:

If your drawing provides the angles from one end, you need to use polar and incremental. The *end* of the line is measured *incrementally* from the *beginning* of the line.
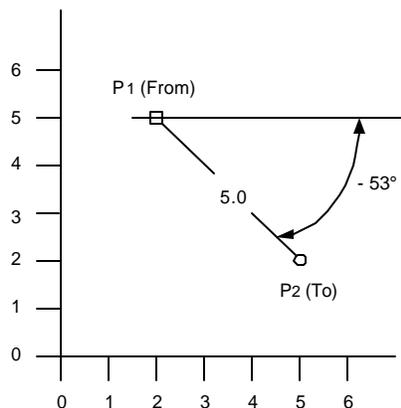
Notice that if you don't use incremental coordinates, Point 2 will be incorrect because it will be measured from the datum instead of from Point 1.

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DRO FUNCTIONS

Start-Up

Power Up
- Make sure the power switch on the back of the Operator's Console is on.
- Turn the on/off switch on the side of the controller cabinet ON.

After the program has loaded, the following screen will appear:

SERVO **OFF**	FEED	**0** **100%**	TOOL:		SCALE **1.0000**	**INCH**

$$X \quad {}_{\text{INC}}^{} \quad 0.0000 \; {}^{\text{ABS}}$$
INC 0.0000

$$Y \quad {}_{\text{INC}}^{} \quad 0.0000 \; {}^{\text{ABS}}$$
INC 0.0000

$$Z \quad {}_{\text{INC}}^{} \quad 0.0000 \; {}^{\text{ABS}}$$
INC 0.0000

ZERO **X**	ZERO **Y**	ZERO **Z**		DATUM	**MOVE TABLE**

DRO stands for "digital readout".

This is called the "DRO" screen. It shows you the current tool position. Here you can use several DRO functions to set up your job. In fact, you can use this as a normal DRO when you use your machine manually.

Finding Home

The ACU-RITE's ENC150 precision glass scales included with your **MILLPWR** system are different from standard ENC150 glass scales because they have only one reference mark. The reference mark will be located between five and eight inches from the centerline of your scale. The reference mark will most likely be found in the positive count direction for both the X and Y axes; however, it may be found in the negative count direction depending upon how the scale(s) are mounted.

MILLPWR must find these reference marks after power-up in order to establish the farthest table travel, so you won't crash the table. You must find home before you can run a program.

Once you are familiar with where the reference marks are, you can use the "MOVE TABLE" function to get close to them before you press "FIND HOME".

To find home, press the **DATUM** softkey, then the **FIND HOME** softkey. The table will move, one axis at a time, to find the reference positions.

If the table moves until it hits the hard stops and the servo motor stops, it means the table was already positioned past the home position. Use the handcranks to move the table away from the end and press **FIND HOME** again. Should the **FIND HOME** softkey be pressed immediately after home has been found, the table will move to the hard stops and the servo motors will disengage.

After home has been found, the DRO display will change. The absolute display shows the tool position from the most recent *datum*.

DATUM is a term for "workpiece zero" or "absolute zero".

DRO Functions

Reset an Axis

Pressing the **ZERO X, ZERO Y, or ZERO Z** softkey will zero the incremental position of that axis.

Inch - Metric

You can't change to metric if you have an "inch" program active, and vice versa.

To change the measurement system between inches and metric units, press the **SETUP** key to get the **INCH** and **MM** softkeys. Select the system you want, and press **USE NEW SETTINGS**.

Move Table

This function lets you move the table rapidly using the arrow keys. Pressing the **MOVE TABLE** softkey will caution you that the arrow keys no longer move around the screen, but will instead move the table.

Note that the arrow keys will move the table!

| SERVO **ON** | FEED | 0 | 100% | TOOL: | | SCALE | 1.0000 | **INCH** |

X   INC 0.000   0.0000 ᴬᴮˢ

Y   INC 0.000   0.0000 ᴬᴮˢ

Z   INC 0.000   0.0000 ᴬᴮˢ

⚠ **CAUTION**

ARROW KEYS
WILL MOVE TABLE

↑ ← → ↓

PRESS CANCEL WHEN FINISHED MOVING TABLE.
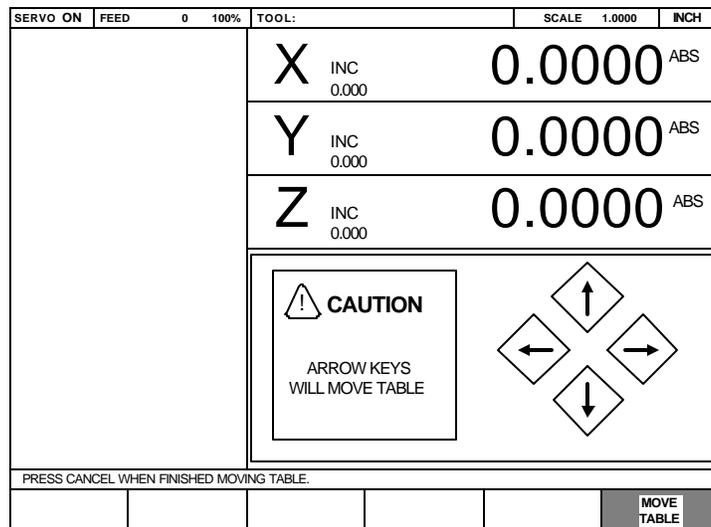
MOVE TABLE

The table moves in the direction of the arrows. You can move in both X and Y at the same time.

It's a *REALLY* good idea to fold in the handcrank handles before moving the table!

MOVE TABLE AWAY
FROM YOU

MOVE
TABLE
LEFT

MOVE
TABLE
RIGHT

MOVE TABLE
TOWARDS YOU
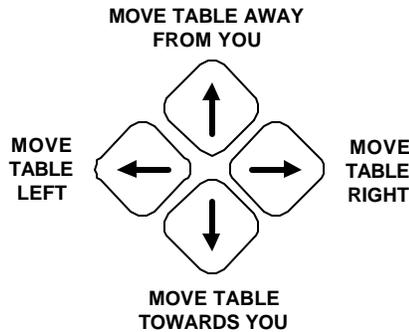
While the **MOVE TABLE** softkey is pressed, the servo motors are on. Press it again to turn them off.

Establishing a Datum

A *datum* is a reference point that you establish as the workpiece zero. You need to set a datum for each job. The location on the workpiece that is to be used as the datum will be determined by the way the part is dimensioned on the blueprint. In general, you should select a datum location so that you may enter most dimensions directly, without calculations.

The datum position is not lost at power-down, so you can quit in the middle of a job at night and easily resume it the next morning.

The simplest datum location to set is where you can position the tool exactly at that location in all three axes.

- Position the workpiece so that the datum point is directly beneath the tool. This point might be a corner, the center of a bolt hole pattern, etc.

- Press the **DATUM** softkey and the Set Datum entry form will appear.

- Press the **X=0, Y=0,** and/or **Z=0** softkey(s) to establish workpiece zero.

- Press **USE** to lock in the workpiece zero.

| SERVO **OFF** | FEED | 0 | 100% | TOOL: | | SCALE 1.0000 | **INCH** |

SET DATUM

X:

Y:

Z:

X   INC   0.0000   ^ABS
     0.0000

Y   INC   0.0000   ^ABS
     0.0000

Z   INC   0.0000   ^ABS
     0.0000

ENTER THE NEW ABSOLUTE POSITION OF THE TOOL CENTER.

| X = 0 | Y = 0 | Z = 0 | FIND HOME | USE PROBE | MOVE TABLE |

If you can't position the tool center right at the datum, you'll need to enter a value for each axis. The value to use is the absolute position of the tool center from the new datum. For one axis at a time, position the tool to a known location, such as the edge of the workpiece. Without moving the tool, enter the desired location of the tool center and press **ENTER**. Then move to position the next axis. When all are entered, press **USE**.

The MILLPWR calculator helps a lot here---To set the datum for the X axis, enter: 0.3875/2+.005. Then, since the tool center is left of the datum, change the sign.

DISTANCE TO ENTER

.005 SHIM

0.3875 TOOL

+
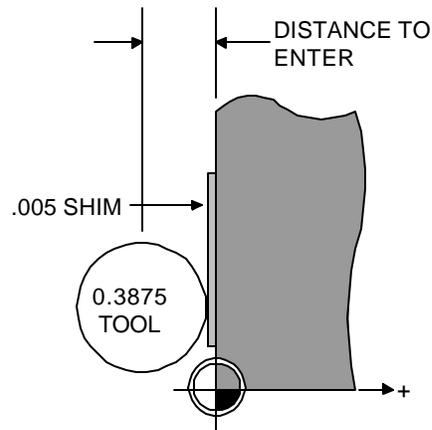
While you are setting the datum, you can use the **MOVE TABLE** softkey to help you with long moves.

Using A Probe

You may use a touch probe or edge finder to get very accurate edge locations. Make sure the diameter of the probe is correct (it's found in the **SET-UP** list). Install the probe and connect it to the back of the Operator Console. Then, for one axis at a time, enter the absolute position of the edge to be touched into the datum form, press the **USE PROBE** softkey, and move the table slowly until the probe touches the workpiece. When the probe touches, the **USE PROBE** softkey will release. Press the **USE** key to set the absolute position of each axis.

TIP: Right after you find home, you can move quickly to your previous datum using the position function:

POS
→•ο

GO

One Time Milling Functions

Any of the milling functions, except **BLEND**, can be used "one time" without creating a program. Press the desired milling function key, fill in the information, and press **GO**.

The information for each function will be remembered for the next time you use it.

Each function is described in the **Program Steps** section.

For many of the milling functions, such as a pocket, you will need to set the proper tool diameter. You can use the **TOOL** key as a one-time function to do this.

PROGRAMMING

Programming Considerations

Depth of Cut

Since the vertical Z-axis is not controlled by a servo motor, you must make changes to the depth of cut manually.

You don't have to program the depth, but if you do, **MILLPWR** will preset the programmed value into the DRO for you. Then, when it's time, **MILLPWR** will show you the DRO and ask you to set the depth.

If you are not programming depth, leave it set to 0.

Tool Offset

With **MILLPWR**, you never have to worry about the actual tool path. Because of **MILLPWR**'s tool radius compensation capability, you program only the actual part dimensions. When you program a line, arc, or frame, use the **TOOL OFFSET** field to tell **MILLPWR** which side of the cut you want the tool to be on.

Picture yourself standing behind the tool as it is moving. If the tool is on the left of the workpiece, use "left" offset. If the tool is to the right of the workpiece, use "right" offset.

By using left and right offsets, you can program the dimensions of the part as found on the blueprint. **MILLPWR** will take care of all cutter radius compensation. You do <u>not</u> have to program the tool path.

LEFT OFFSET   RIGHT OFFSET

If you use "center" offset, the programmed dimensions are for the center of the tool.

For some milling functions, like Frame and Arc, "inside" and "outside" offsets help you visualize where the tool is.
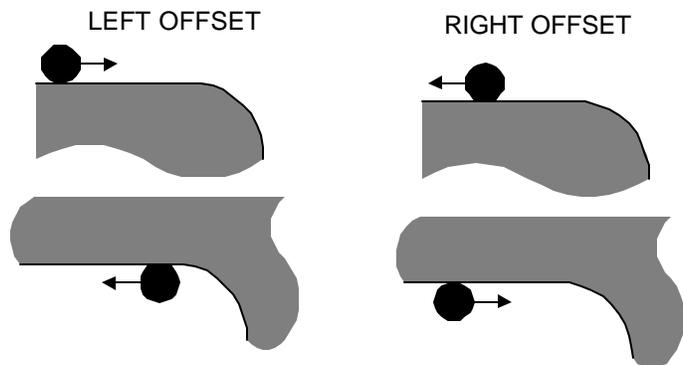
"From" and "To" Points

MILLPWR lines and arcs are defined by both **FROM** and **TO** points. **MILLPWR** will automatically go to the start point before it asks you to set the depth.

FROM		TO

FROM	
X1	ABS
Y1	ABS

TO	
X2	ABS
Y2	ABS

Datum Selection

The datum is the point where all absolute dimensions are measured from. You must look at the blueprint of the part and decide what to use as a datum. You should pick a point which will let you enter most of the dimensions directly, without calculations. However, any point you select will give the same results.

Absolute and Incremental Dimensions

To help you enter dimensions directly from the blueprint, **MILLPWR** allows direct entry of both absolute and incremental dimensions. Any dimension measured   from the point you select as the datum is called *absolute*.

A dimension measured from <u>any other point</u> is called *incremental*. This "other point" is called the *incremental reference point*.

For the part drawn below, if we put the datum in the center of the hole (point F), all dimensions are absolute.

Point	X		Y	
A	-7.123	ABS	-3.936	ABS
B	3.421	ABS	-3.936	ABS
C	3.421	ABS	3.603	ABS
D	-4.893	ABS	3.603	ABS
E	-7.123	ABS	1.011	ABS
F	0.00	ABS	0.00	ABS
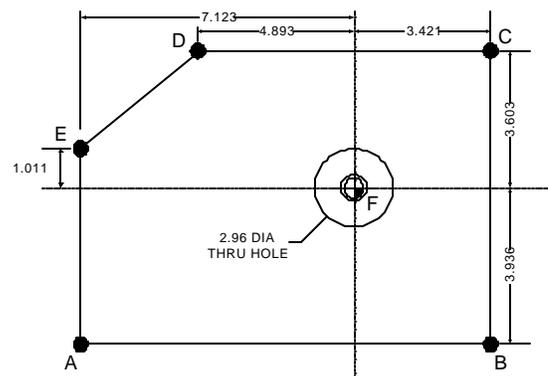
If we use point A as our datum, many of the given dimensions are incremental because they are measured from the incremental reference point F and not from the datum.

Point	X		Y	
A	0.00	ABS	0.00	ABS
B	3.421	INC F	0.00	ABS
C	3.421	INC F	3.603	INC F
D	-4.893	INC F	3.603	INC F
E	0.00	ABS	1.011	INC F
F	7.123	ABS	3.936	ABS
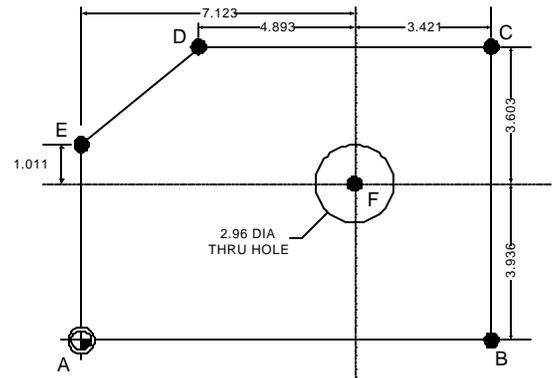
Continuous Milling

MILLPWR will display marks to the right of each program step number for continuous contours.

When you program a *continuous contour* made up of lines and arcs, **MILLPWR** will mill the contour without stopping. **MILLPWR** will detect a continuous contour automatically. There are no special keypresses or different functions to learn.

For lines and arcs to be continuous, they must:

- have the same Z depth,

- be cut with the same tool,

- be cut on the same side,

- and, of course, they must "touch"--the end of one must be the same as the start of the next.
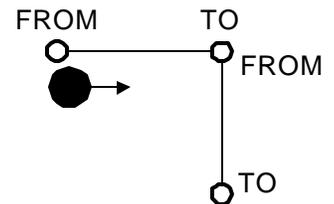
When you follow one line (or arc) with another, **MILLPWR** assumes that you want them to be connected. It automatically fills in the **FROM** point, Z depth, and tool offset. All you have to do is fill in the **TO** point, and press **USE.**

You can have different feedrates within a continuous contour by entering the feedrates you want in each step of the contour.

Creating a Program

Press the **PGM** key, and the following program screen appears.

SERVO **OFF**	FEED	0	100%	TOOL:			SCALE	1.0000	INCH

CURRENT PROGRAM

END OF 0

PROGRAM FUNCTIONS	CLEAR PROGRAM	EXPLODE	MORE STEPS		RUN OPTIONS

You create a program by creating a list of milling steps to be performed. As you   add to your list, each step will be drawn immediately on the screen so you can see   a picture of your part in progress.

- To enter a milling step, press the appropriate milling function key. The function you select will appear in the program listing, and you can enter the information

SERVO **OFF**	FEED	0	100%	TOOL:			SCALE	1.0000	INCH

CURRENT PROGRAM   MILL ARC   002

001   SET TOOL
002 X MILL ARC

Program Step Listing

FROM
X1 _____ ABS
Y1   ABS

TO
X2   ABS
Y2   ABS

DEPTH
Z   ABS

RADIUS

DIRECTION
        CCW

TOOL
        0.500   DIAMETER
    FL END ML   TYPE
       CENTER   OFFSET
FEED   10   IPM

2 OF 2

Enter information about the arc into this form.

			TEACH POSITION	POLAR	MORE

describing the step into the form.

- After entering all the data for a step, press the **USE** key to accept the data. This updates the picture and moves down for the next step.

SERVO	OFF	FEED	0	100%	TOOL:		SCALE	1.0000	INCH

CURRENT PROGRAM

```
001    SET TOOL
002    MILL  ARC
```

END OF 2

PROGRAM FUNCTIONS	CLEAR PROGRAM	EXPLODE	MORE STEPS		RUN OPTIONS

- To change a step, use the arrow keys to move to the step and press **USE** or **ENTER**. When you have made your changes, press **USE** to put the changed   step back into the program.

- To delete a step, move to the step and press the **DEL** key.

- To insert a step, move to where you want the new step to go, and press the new milling function key.

If you decide not to use a milling function that you have selected, press the **CANCEL** key.

In addition to the milling functions, the **MORE STEPS** softkey lets you pick from   a number of other useful steps, such as **REPEAT** and **ROTATE**. All steps are described in the **Program Steps** section.

The View Key

If you need to see more detail of the picture, press the **VIEW** key. This brings up the following softkeys:

		ZOOM IN	ZOOM OUT	RESTORE	

The **ZOOM IN** softkey magnifies the picture, and the arrow keys move the picture up, down, left, and right. The **ZOOM OUT** softkey will de-magnify the picture, and the **RESTORE** softkey brings back the original view.

Press **VIEW** again (or **CANCEL**) to see the normal programming softkeys.

Running a Program

When you are ready to run a program, you must make some preparations. This includes fixturing the workpiece, setting or finding the datum, and deciding on the tools to use.

Setting the Datum

From the DRO, select the **DATUM** softkey. There are two ways to find the datum: "touching off" with a tool and using a touch probe or edge finder.

To touch off with a tool:

- Move the tool to touch the edge of the workpiece.

- Key in the new absolute position of the tool center in this axis. Be careful of the polarity.

- Before you move the table, press **ENTER** or an arrow key. At this time, **MILLPWR** remembers the scale position and will use it to determine the datum for this axis.

For the last axis, you can press USE instead of ENTER.

- Repeat for the second and, if desired, the third axis. Be sure to press **ENTER** while the tool is in position.

- Press **USE** to establish the datum.

Testing Your Program

Before you run your program, you might want to test it for things like tool path, directions, feed rates, and sequence of operations. **MILLPWR** provides several run-time options to assist you. In the program screen, press **RUN OPTIONS** to display the following softkeys.

SINGLE STEP	DRY RUN	GRAPHICS ONLY	MANUAL POSITIONING	DISABLE LOOK AHEAD	RUN OPTIONS
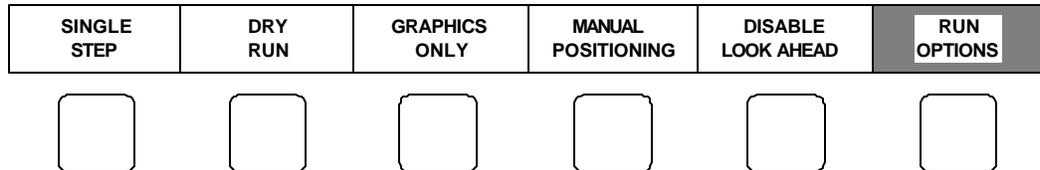
Press any key to activate the option; press it again to release it.

SINGLE STEP

> Normally, a continuously milled contour will be cut without stopping. With single step activated, **MILLPWR** will stop after <u>each</u> step.

DRY RUN

Using DRY RUN and GRAPHICS ONLY at the same time is especially handy.

> With this activated, **MILLPWR** will run your entire program <u>at high speed</u> and <u>without stopping for anything.</u> You can follow the sequence of steps and see if the part fits entirely on the workpiece. The dry run speed is determined in **SETUP.**

GRAPHICS ONLY

> With this activated, the program is run normally, except that the table does not move. You can see all normal feedrates, tool changes, and so on.

MANUAL POSITIONING

> Activate this option if you want to move the table by hand. The **MILLPWR** acts just like a programmable DRO. Each target position is preset into the DRO, and you are prompted to operate the table by hand.

DISABLE LOOK AHEAD

> Normally, each cut in a contour is compared to every other cut to determine if the tool will interfere with the part. This is called *look ahead*. If you press the **DISABLE LOOK AHEAD** key, your program will run without doing this. Except for custom pockets, selecting this option will make the tool path calculation much faster.

Pressing the GO Key

To run a program, with or without any of the run options, move to step 1 and press **GO**.

Most **MILLPWR** program steps will cause the tool to move rapidly to the start point of the step. You then set the tool to the proper depth, press **GO**, and **MILLPWR** performs the action required for the step.

Before any rapid move, **MILLPWR** will display a warning message that the table is about to move at high speed and that you should check for tool clearance:

⚠️**ATTENTION**

RAPID MOVE

RAISE QUILL

PRESS "GO"

.**WARNING**

Whenever you are about to run a program, be sure the handcrank handles are recessed. Rapid spinning of the manual handwheels could cause injury.
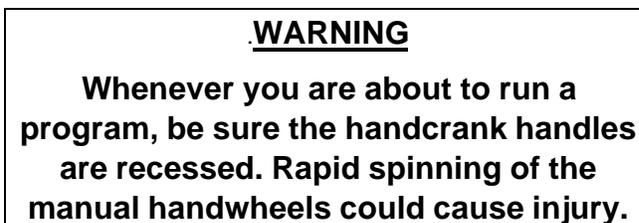
When the **GO** key is pressed again, the table will move in a straight line to the new position where you will be asked to drill or set the tool to the desired depth.

⚠️ **ATTENTION**

Z AXIS

**SET TO
0.0000**

PRESS "GO"

The remote button acts as **STOP** if you are going and as **GO** if you are stopped.

During any rapid or feed move, you may press the **STOP** key or the emergency **TABLE STOP** button to disengage the power feed for any reason. This will stop the table motion *but will not stop the rotating cutting tool unless your machine has been specifically wired to do so*.

If you press the emergency **TABLE STOP** button, the program stops running immediately.

If you use the **STOP** key, the following prompt will appear:

⚠ **ATTENTION**

PAUSE
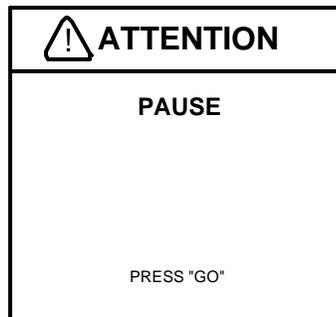
PRESS "GO"

Press **GO** again when ready to continue running, or **STOP** to stop running the program.

To move quickly to a step, key in its number (look in the message bar), and press ENTER.

To re-start a program, move to the step you wish to start with, and press **GO**. **MILLPWR** will always go to the beginning of a step, even if it had been started.

Feed Rate Override

The **FEED+** and **FEED-** keys will change the *override percentage* by a certain amount for each keypress.

The override percentage is shown next to the **FEED** rate in the status bar at the top of the screen. An override percentage of 100% means that actual feed rates will be at 100% of the programmed feed rates. If the override percentage is 50%, actual feed rates will be half of programmed values.

You can press the feedrate override keys at any time, even while the machine is moving.

Machining to Zero

MILLPWR is factory set in a *distance to go* display view. This way, any dimension you have programmed will be "preset" into the DRO display. Every move will start at the preset value and end at zero.

If you have programmed a Z depth, when it is time for you to position the Z axis, **MILLPWR** will preset the depth value into the DRO Z-axis, and the following Z- axis prompt will appear:

```
┌─────────────────────────────┐
│  ⚠ ATTENTION                │
├─────────────────────────────┤
│                             │
│         Z  AXIS             │
│                             │
│                             │
│          SET TO             │
│          0.000              │
│                             │
│                             │
│        PRESS "GO"           │
│                             │
└─────────────────────────────┘
```

Move the quill until the absolute Z display is zero.

If you wish, you can set **MILLPWR** to the *incremental travel* display view (see **System Setup**). In this view, every move will start at 0.000 and end at the programmed value. For example, if you have programmed a depth of -0.500, when it's time to move the quill, the Z-axis display will show the current tool position, and the prompt will be:

```
┌─────────────────────────────┐
│  ⚠ ATTENTION                │
├─────────────────────────────┤
│                             │
│         Z  AXIS             │
│                             │
│                             │
│          SET TO             │
│          -0.500             │
│                             │
│                             │
│        PRESS "GO"           │
│                             │
└─────────────────────────────┘
```
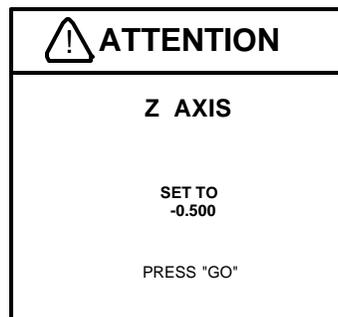
Program Functions

Accessing the Load, Save, Delete, and Backup Options

MILLPWR offers you several versatile features for loading, saving, deleting, and backing up information. Plus, built-in organizational tools make it easy to categorize—and later retrieve—the programs you've stored.

To access these features, press the **PROGRAM FUNCTIONS** softkey.

SERVO **OFF**	FEED 0 100%	TOOL:		SCALE 1.0000	**INCH**

CURRENT PROGRAM

001   SET TOOL
002 Π MILL ARC
003 ΙΙ MILL LINE
004 ΙΙ MILL LINE
005 ΙΙ MILL LINE
006 ΙΙ BLEND
007 ΙΙ MILL LINE
008 ΙΙ MILL LINE
009 Ụ MILL LINE
010   SET TOOL
011   BOLT CIRCLE

END OF 11

PROGRAM FUNCTIONS	CLEAR PROGRAM	EXPLODE	MORE STEPS		RUN OPTIONS
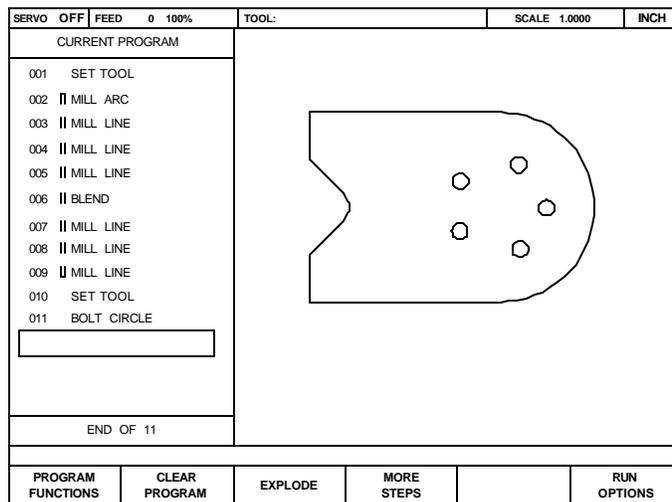
A prompt will ask you to select a program function. You may load a saved file, save the program you have been working on, delete files, create backup copies, or work with directories.

SELECT A PROGRAM FUNCTION.

LOAD	SAVE	DELETE		BACKUP	DIRECTORY
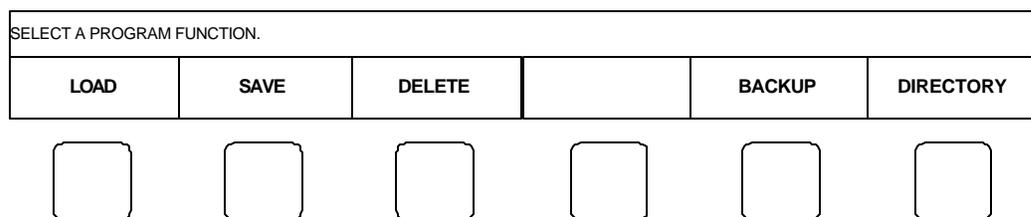
Saving a Program

You can save your programs in any of three places—on **MILLPWR**'s internal hard disk drive, on a 3 ½" floppy disk, or on your PC's hard disk drive. It is always a good idea to save your programs for later reference *and* as a preventative measure against accidental loss due to a power failure. As a rule of thumb, save your programs often to avoid losing valuable information.

- After choosing the PROGRAM FUNCTIONS option, select the directory where you want to save your program. Otherwise, your program will be saved in the last directory that was selected. (Refer to the **Selecting a Directory** and/or **Creating a Directory** section(s).)

- Return to the "Current Program" screen, then press the **SAVE** softkey. A "Program Name" prompt will appear:

SERVO **OFF**	FEED	0	100%	TOOL:		SCALE	1.0000	**INCH**

CURRENT PROGRAM	SAVE PROGRAM
001 SET TOOL	┌─ PROGRAM NAME ─┐
002 ∏ MILL ARC	
003 ‖ MILL LINE	
004 ‖ MILL LINE	
005 ‖ MILL LINE	
006 ‖ BLEND	
007 ‖ MILL LINE	
008 ‖ MILL LINE	
009 ⊔ MILL LINE	
010 SET TOOL	
011 BOLT CIRCLE	

END OF 11

ENTER A NAME FOR THE PROGRAM.

SAVE		ALPHABET	TEXT FORMAT	USE FLOPPY	REMOTE STORAGE

If you want to save your program as a text file, press the **TEXT FORMAT** softkey.

Note: Information is stored as a numeric file (i.e., program.nsf) unless you indicate otherwise. By saving the program as a text file (i.e., program.mpt), you will enjoy more flexibility later—such as editing the program on a PC or printing a hard copy of the program steps.

- Name the program. (Refer to the **Naming a Program** section.)

- Press the **SAVE** softkey. The program's name should now appear in the left column above the program steps.

Note: If you make any changes, make sure that you save the program again.

Directories

One of the best ways to keep programs organized is to save them in directories. Directories are like file folders—they should be clearly labeled and contain closely related projects. They can be used to categorize programs by job, operator, customer, or any other method you prefer.

- Press the **PROGRAM FUNCTIONS** softkey, then press the **DIRECTORY** softkey.

SELECT A DIRECTORY FUNCTION.					
SELECT DIRECTORY	CREATE DIRECTORY	DELETE DIRECTORY			

Now you can create a directory, open an existing directory, or delete a directory that you no longer need.

Creating a Directory

The best approach to take when creating a directory (or "subdirectory") is to decide first where to file it. You can file it under a main heading ("MILLPWR," "A:," or "REMTSTOR") or layer it within subdirectories that you have already created.

Let's look at an example. The illustration on the next page shows "MILLPWR" and four subdirectories that we created to keep our programs better organized. In this case, we designated the MILLPWR directory as our miscellaneous programs folder and created specific folders for three of our biggest customers.

"COMPANY1," our largest client, has placed several part orders for a single month. To help us find those part programs quickly and easily, we save them in subdirectory "JULY1998."

When we created the subdirectories COMPANY1, COMPANY2 and COMPANY3, we selected MILLPWR as the directory we wanted to file each one under.

When we created the JULY1998 folder, we selected COMPANY1 as the directory we wanted to file the new subdirectory under. If we want, we can create another

subdirectory under JULY1998, layer another one under that, one under that and so on. How many directories you create and how you layer them is up to you.

Follow the steps below to create directories for your own programs.

- After you have selected the PROGRAM FUNCTIONS and DIRECTORY options, press the **SELECT DIRECTORY** softkey.

SERVO OFF	FEED	0 100%	TOOL:		SCALE 1.0000	INCH

CURRENT PROGRAM	DIRECTORY

```
001    SET TOOL              MILLPWR
002  ⫾ MILL  ARC             COMPANY1
003  ‖ MILL  LINE              JULY1998
004  ‖ MILL  LINE            COMPANY2
005  ‖ MILL  LINE            COMPANY3
006  ‖ BLEND
007  ‖ MILL  LINE
008  ‖ MILL  LINE
009  ⫾ MILL  LINE
010    SET TOOL
011    BOLT  CIRCLE
```

END OF 11	1 OF 5

SELECT A WORKING DIRECTORY.

SELECT DIRECTORY	PAGE UP	PAGE DOWN		USE FLOPPY	REMOTE STORAGE

- Indicate where you want to store your new subdirectory.

  On **MILLPWR**'s internal hard disk drive:

    Check that the **USE FLOPPY** and **REMOTE STORAGE** softkeys are *not* selected. "MILLPWR" and any subdirectories should appear under the "Directory" heading.

  On a 3 ½" floppy disk:

    Press the **USE FLOPPY** softkey. "A:" and any subdirectories should appear under the "Directory" heading.

  On your PC's hard disk drive:

    Press the **REMOTE STORAGE** softkey. "REMTSTOR" and any subdirectories should appear under the "Directory" heading.

- Highlight the folder you want to put your new directory in. (In our example, we highlighted "MILLPWR," then created a subdirectory "COMPANY1.")

- Press the **SELECT DIRECTORY** softkey again to verify your choice. The "Directory" screen will disappear.

- Now press the **DIRECTORY** softkey.

- Select the **CREATE DIRECTORY** softkey. You will be asked to name the directory.

- Name the directory using the numeric keys on the operator console or by selecting letters from the ALPHABET option. If you open the alphabet menu, use the arrow keys to scroll from row to row, then press the **ENTER** key to make each selection. All program names are limited to eight characters or less, consisting of numbers and/or letters.

- After you have named the directory, press the **CREATE DIRECTORY** softkey again to verify your choice. The "Directory" screen will disappear.

Additional directories (and subdirectories) may be added at any time.

IMPORTANT!

Creating a directory does not mean the directory is *selected.* If you plan to save your current program in the directory you just created, you must select the new directory first. Otherwise, your program will be saved in the last directory that was opened.

To select the directory now, press the **DIRECTORY** softkey, then the **SELECT DIRECTORY** softkey. Using the arrow keys, highlight the new directory. Press the **SELECT DIRECTORY** softkey again to select the directory and return to your current program.

Selecting a Directory

The **SELECT DIRECTORY** softkey allows you to open any of the established directories on **MILLPWR**'s internal hard disk drive, on a 3 ½" floppy disk, or on your PC's hard disk drive—whichever one you've chosen. You will use this feature anytime you save or load a program.

- After you have selected the PROGRAM FUNCTIONS and DIRECTORY options, press the **SELECT DIRECTORY** softkey. The last directory that was opened will appear.

SERVO **OFF** FEED	0	100%	TOOL:		SCALE	1.0000	**INCH**

CURRENT PROGRAM	DIRECTORY	
001 SET TOOL	MILLPWR	
002 ⊓ MILL ARC	COMPANY1	
003 ‖ MILL LINE	JULY1998	
004 ‖ MILL LINE	COMPANY2	
005 ‖ MILL LINE	COMPANY3	
006 ‖ BLEND		
007 ‖ MILL LINE		
008 ‖ MILL LINE		
009 ‖ MILL LINE		
010 SET TOOL		
011 BOLT CIRCLE		
END OF 11	1 OF 5	

SELECT A WORKING DIRECTORY.

SELECT DIRECTORY	PAGE UP	PAGE DOWN		USE FLOPPY	REMOTE STORAGE

- Indicate where the directory you want to select is located.

    On **MILLPWR**'s internal hard disk drive:

        Check that the **USE FLOPPY** and **REMOTE STORAGE** softkeys are *not* selected. "MILLPWR" and any subdirectories you have created should appear under the "Directory" heading.

    On a 3 ½" floppy disk:

        Insert the 3 ½" floppy disk containing the directory into the disk drive (located in the upper-left corner on the front of the **MILLPWR** operator console) and press the **USE FLOPPY** softkey. "A:" and any

subdirectories you have created should appear under the "Directory" heading.

On your PC:

Press the **REMOTE STORAGE** softkey. "REMTSTOR" and any subdirectories you have created should appear under the "Directory" heading.

- Using the arrow keys, highlight the directory you want to open. (If the list is long, use the **PAGE UP/PAGE DOWN** softkeys to scroll through the list more quickly.)

- Press the **SELECT DIRECTORY** softkey again. The "Directory" list will disappear.

You can now save your current program in the directory you have chosen (refer to the **Saving A Program** section); or if no program was running, load an established program from the directory you selected (refer to the **Loading a Program** section).

Deleting a Directory

Note: **MILLPWR** will not delete directories that contain programs. You must delete each program stored within the directory before continuing. Refer to the **Deleting a Program** section.

To delete an empty directory:

- After you have selected the PROGRAM FUNCTIONS and DIRECTORY options, press the **DELETE DIRECTORY** softkey.

- Identify where the directory you want to delete is located**.**

    On **MILLPWR**'s internal hard disk drive:

    Check that the **USE FLOPPY** and **REMOTE STORAGE** softkeys are *not* selected. "MILLPWR" and any subdirectories you have created should appear under the "Directory" heading.

    On a 3 ½" floppy disk:

    Insert the 3 ½" floppy disk containing the directory into the disk drive (located in the upper-left corner on the front of the **MILLPWR** operator console) and press the **USE FLOPPY** softkey. "A:" and any subdirectories you have created will appear under the "Directory" heading.

    On your PC:

    Press the **REMOTE STORAGE** softkey. "REMTSTOR" and any subdirectories you have created will appear under the "Directory" heading.

- Using the arrow keys, highlight the directory you want to delete.

- Press the **ENTER** key. You will be asked if you are sure that you want to delete the program. Press the "Yes" softkey to continue or the "No" softkey to cancel the operation.

Other Program Functions

Naming a Program

Before you save a program, **MILLPWR** requires that you name it.

- If you want to use alpha characters, press the **ALPHABET** softkey. An alphabet will appear just below the "Program Name" area.

  - Using the arrow keys, you can scroll from one letter to the next. Press the **ENTER** key to make a selection.

  - To add numbers to the name, simply press the number keys on the operator console. You may choose up to eight characters, mixing numbers and letters if you wish.

- Press the **SAVE** softkey. **MILLPWR** will store your program in the directory you have selected for use at a later time.

A message will alert you if the file was not saved properly, or if the name that you have chosen has already been assigned.

Sidebar: If you have accidentally selected the wrong letter or number, simply press the DEL key and rename the program.

Figure (right side):

SAVE PROGRAM

PROGRAM NAME
PLATE 12

ALPHABET

CHARACTERS

A B C
D E F G H
I J K L M
N O P Q R
S T U V W
X Y Z

Deleting a Program

You can remove any program that has already been saved. To delete a program, follow these steps:

- Select the directory that contains the program you want to delete. (Refer to the **Selecting a Directory** section.)

- After you return to the "Current Program" screen, press the **DELETE** softkey.

SELECT A PROGRAM FUNCTION.					
LOAD	**SAVE**	**DELETE**		**BACKUP**	**DIRECTORY**

- Using the arrow keys, highlight the program you want to delete.

- Press the **ENTER** key. You will be asked if you are sure that you want to delete the program. Press the "Yes" softkey to continue or the "No" softkey to cancel the operation.

IMPORTANT!

By answering "Yes," you will permanently erase the highlighted program from memory. Deleted programs cannot be recovered unless a backup file was created.

Backing Up a Program

The **BACKUP** softkey gives you the opportunity to make backup copies of programs that you have already saved on **MILLPWR**'s internal hard disk drive. Remember, you should keep backup copies on hand in case a program is accidentally deleted, your hard disk drive fails, or you are unable to recover the original files for any other reason.

It's best to save and clear the final version of a running program before creating a backup copy. Otherwise, you'll have to back up the program again after you've made any changes.

* After you have selected the PROGRAM FUNCTIONS option, select the directory containing the program(s) you want to back up. (Refer to the **Selecting a Directory** section.)

* Return to the "Current Program" screen, then press the **BACKUP** softkey. The following softkey options should appear:

ALL PROGRAMS	SELECT PROGRAMS		TEXT FORMAT	USE FLOPPY	REMOTE STORAGE

* Indicate where you want to back up your program(s): onto a floppy disk or onto your PC. Choose either the **USE FLOPPY** softkey or the **REMOTE STORAGE** softkey.

    * If you want to back up text programs, select the **TEXT FORMAT** softkey. Otherwise, a list of numeric programs will appear by default.

    * Choose the number of program(s) you want to back up.

        To back up *all* of the programs in the directory:

            Press the **ALL PROGRAMS** softkey. **MILLPWR** will highlight and store a backup copy of each program in the directory you've selected.

        To back up only *one* or just a *few* programs:

            Press the **SELECT PROGRAMS** softkey. Highlight each program you want to back up and press the **ENTER** key. An arrow will appear beside each program name you've selected.

Now press the **BACKUP PROGRAMS** softkey. **MILLPWR** will highlight the program(s) and save a backup copy in the directory you've selected.

Note: If a program with the same name is already stored in the directory you've chosen, **MILLPWR** will ask you if you want to replace the old copy with the latest one. Choose the "Yes" softkey to continue or the "No" softkey to cancel the operation.

• After the backup copies are made, the programs list will disappear.

Loading a Program

The **LOAD** softkey allows you to open programs that have already been saved. The steps below tell you how to retrieve a program from **MILLPWR**'s internal hard disk drive, a 3 ½" floppy disk, or your PC's hard disk drive.

```
┌───────────────────────────────────────────────────────┐
│                                                        │
│                     IMPORTANT!                         │
│                                                        │
│      Save and clear any running programs before continuing. │
│            Otherwise, your work will be lost when       │
│                 another program is loaded.             │
│                                                        │
└───────────────────────────────────────────────────────┘
```

From MILLPWR's internal hard disk drive:

- After you have selected the PROGRAM FUNCTIONS option, press the **LOAD** softkey. The last directory that was selected and any programs it contains will appear.

SERVO OFF	FEED	0	100%	TOOL:		SCALE 1.0000	INCH

```
CURRENT PROGRAM              MILLPWR

                          ┌──────────┐
                          │ MILL1    │
                          └──────────┘
                            MILL2
                            BOLTPRGM
                            PART242




                              1 OF 4
PICK A PROGRAM TO LOAD.
```

LOAD	PAGE UP	PAGE DOWN	TEXT FORMAT	USE FLOPPY	REMOTE STORAGE

In the sample screen on the previous page, the MILLPWR directory contains four numeric (i.e., program.<u>mpt</u>) programs. You can retrieve any text programs (i.e., program.<u>txt</u>) you have saved by pressing the **TEXT FORMAT** softkey.

If the program is saved in the MILLPWR directory:

- "MILLPWR" should appear at the top of the left column. If it doesn't, check that the **USE FLOPPY** and **REMOTE STORAGE** softkeys are *not* selected.

- Using the arrow keys, highlight the program you want to load, then press the **LOAD** softkey. The program you've selected should appear on your screen.

If the program is saved in another directory on MILL*PWR*'s hard disk drive:

- Press the **CANCEL** softkey to return to the "Current Program" screen. The right-hand directory column should disappear.

- Press the **DIRECTORY** softkey.

- Press the **SELECT DIRECTORY** softkey. The "Directory" screen should appear.

SERVO **OFF**	FEED	0	100%	TOOL:			SCALE	1.0000	**INCH**

CURRENT PROGRAM   DIRECTORY

MILLPWR

COMPANY1

COMPANY2

COMPANY3

2 OF 4

SELECT A WORKING DIRECTORY.

SELECT DIRECTORY	**PAGE UP**	**PAGE DOWN**		**USE FLOPPY**	**REMOTE STORAGE**

- Using the arrow keys, highlight the directory that contains the program you want to load.

- Press the **SELECT DIRECTORY** softkey again. The "Directory" screen will disappear. Now that you've opened the appropriate directory, you can load your program.

- Press the **LOAD** softkey. The directory name you chose should appear at the top of the right-hand column.

- Highlight the program you want to open, then press the **LOAD** softkey. The program you selected should now appear on your screen.

From a 3 ½" floppy disk:

- Save and clear any running programs before continuing. (Refer to the note at the beginning of the **Loading a Program** section.)

- After you have selected the PROGRAM FUNCTIONS option, press the **LOAD** softkey.

- Insert the 3 ½" floppy disk containing the file you want to load into the floppy disk drive (located in the upper left-hand corner of the **MILLPWR** operator console).

- Press the **USE FLOPPY** softkey. The A: directory and any programs it contains should appear.

  Note: If your program is saved as a text file, select the **TEXT FORMAT** softkey.

- Using the arrow keys, highlight the program you want to load.

- Press the **LOAD** softkey. The program you selected should now appear on your screen.

From your PC:

- Save and clear any running programs before continuing. (Refer to the note at the beginning of the **Loading a Program** section.)

- After you have selected the PROGRAM FUNCTIONS option, press the **LOAD** softkey.

- Press the **REMOTE STORAGE** softkey. A "Programs" directory and any programs it contains should appear.

  If the **REMOTE STORAGE** softkey does not appear, then it is likely that **MILLPWR** and the PC have not been properly set up. (Refer to the **Remote Storage** and/or **System Setup** sections.)

  Note: If your program is saved as a text file, select the **TEXT FORMAT** softkey.

- Using the arrow keys, highlight the program you want to load.

- Press the **LOAD** softkey. The program you selected should now appear on your screen.

BLANK PAGE

A DEMONSTRATION PROGRAM

The following steps and key stroke sequences will guide you through creating a program to machine the part illustrated below:
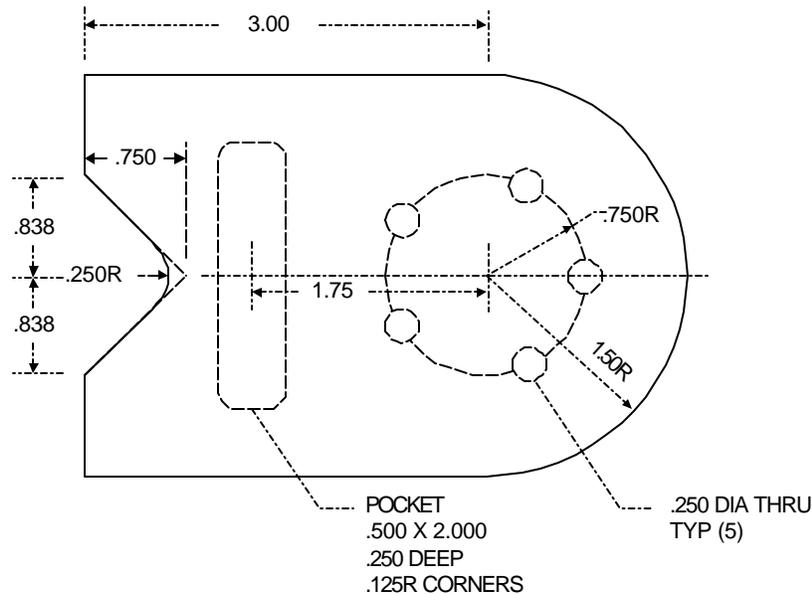
Selecting the Datum

Although there is no clear "zero point" on this drawing, we're going to use the center of the bolt hole pattern as our datum. The advantages of using this point include:

- it is the center of the bolt hole pattern,

- it is the center of the large arc, making it easy to calculate the arc's start and end points,

- the pocket is dimensioned from this point,

- the length of the straight side of the part is dimensioned from this point.

The workpiece can also be correctly programmed using another point (for example, the lower left corner) as the datum.

When we are ready to run the program, we will actually set the datum.

Beginning The Program

Begin by pressing the program key.

PGM

Selecting A Tool

A logical first step for most programs is to choose the tool that you want to start with. Let's use a ¼" **FLAT END MILL**.

Press the **TOOL** key.

```
SERVO OFF  FEED      0    100%   TOOL:                        SCALE   1.0000    INCH
            CURRENT PROGRAM        SET TOOL          001

  001    SET TOOL              ┌ TOOL ─────────
                               │            ┌──────────┐ INCH
                               │            └──────────┘ TYPE




              1 OF 1

    ┌──────┐
    │ INCH │      MM                                      TOOL
    └──────┘                                             LIBRARY
```

Enter .25 followed by the enter key.

. **2** **5** **ENTER**

You can select a tool from the Tool Library if you like.

```
┌ TOOL ─────────
│          0.250  INCH
└──────────────  TYPE
```

Press the **TOOL TYPES** softkey.

TOOL TYPES

↓ To FLAT END MILL

Arrow down to FLAT END MILL and press enter.

ENTER

USE

Press **USE** to complete the **SET TOOL** step.

Milling the Workpiece Contour

This part could be started at several different places. We'll start at the bottom of the semi-circle on the right end of the workpiece, and we'll cut in a counterclockwise (CCW) direction.
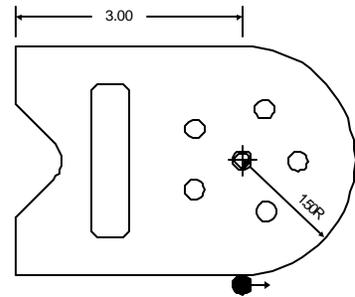
Press the **ARC** key.

SERVO **OFF**	FEED	0	100%	TOOL:			SCALE	1.0000	**INCH**

```
        CURRENT PROGRAM          MILL  ARC              002

   001      SET TOOL              ┌ FROM ─────────
   002  X  MILL  ARC              X1  [        ]  ABS
                                  Y1            ABS
                                  ┌ TO ───────────
                                  X2            ABS
                                  Y2            ABS
                                  ┌ DEPTH ────────
                                  Z             ABS
                                  ┌ RADIUS ───────
                                  
                                  ┌ DIRECTION ────
                                          CCW
                                  ┌ TOOL ─────────
                                       0.250   INCH
                                    FL END ML  TYPE
                                       CENTER  OFFSET
                                  FEED     10  IPM
            2  OF  2
```

			TEACH POSITION	POLAR	MORE

Enter the following dimensions:

To enter a negative number, use the +/– "CHANGE SIGN" key, not the "MINUS" key. The "MINUS" key will subtract the number you enter from the number that's already there.

FROM: X1 = 0

Y1 = -1.5

[0] [ENTER]

[+/-] [1] [.] [5] [ENTER]

TO: X2 = 0   ⬡ 0   ⬡ ENTER

              Y2 = 1.5   ⬡ 1   ⬡ .   ⬡ 5   ⬡ ENTER

DEPTH: Z = -.25   ⬡ +/-   ⬡ .   ⬡ 2   ⬡ 5   ⬡ ENTER

RADIUS: 1.5   ⬡ 1   ⬡ .   ⬡ 5   ⬡ ENTER
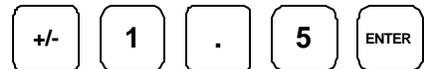
DIRECTION: CCW   ⬡ CCW
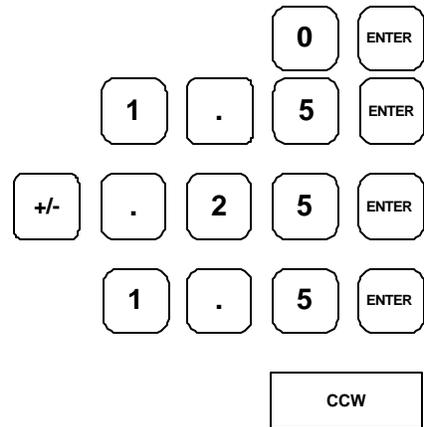
Since we are starting the arc on the bottom and moving around
to the top, we picked CCW for the direction.

The tool specifications will be filled in automatically based on the
previously selected tool.

```
┌ TOOL ──────────────────┐
│           0.2500  INCH  │
│        FL END ML  TYPE  │
│          CENTER  OFFSET │
│ FEED        10  IPM     │
└────────────────────────┘
```
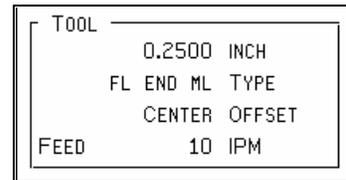
Now move to **OFFSET** and select **RIGHT** or **OUTSIDE** from the softkey choices.

⬦ ↓

To OFFSET

⬡ RIGHT

Page 4-4   Pick CCW from the   Operation Manual
                                    softkeys that appear
                                    when you're in the
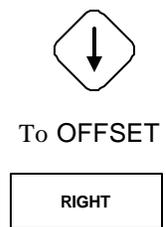
Finally, move to **FEED** and enter the FEED RATE you
would like to use.

To FEED

MILLPWR has
been factory set
with a feed rate of
10 IPM.

1 **0** ENTER

USE

SERVO **OFF** FEED 0 100%	TOOL:	SCALE 1.0000	**INCH**

CURRENT PROGRAM

001   SET TOOL

002   MILL ARC

END OF 2

PROGRAM FUNCTIONS	CLEAR PROGRAM	EXPLODE	MORE STEPS		RUN OPTIONS

Next, we will enter the 3" line which starts at the

top of the
arc and
goes left.

The FROM point of this line is
automatically set to the end of
the arc programmed before.

| | | 3.00 | | |

SERVO **OFF**	FEED	0	100%	TOOL:		SCALE	1.0000	**INCH**

CURRENT PROGRAM	MILL LINE	003

001   SET TOOL
002   MILL ARC
003 X MILL LINE

┌ FROM
X1   0.000   ABS
Y1   1.500   ABS
├ TO
X2   [   ]   ABS
Y2   ABS
├ DEPTH
Z   0.2500   ABS
├ TOOL
        0.250   INCH
      FL END ML TYPE
        RIGHT   OFFSET
  FEED   10   IPM

3 OF 3

			TEACH POSITION	POLAR	

Press the **LINE** key.

Enter the TO field: **TO:**   X2 = -3.0 ABS

Notice the marks
connecting steps
002 and 003. This
means that the line
and arc form a
continuous contour,
and MILLPWR will
cut them without
stopping.

1.5

SERVO **OFF**	FEED	0	100%	TOOL:		SCALE	1.0000	**INCH**

CURRENT PROGRAM	

001   SET TOOL
002 ┌ MILL ARC
003 └ MILL LINE

Y

2

=

END OF 3

PROGRAM FUNCTIONS	CLEAR PROGRAM	EXPLODE	MORE STEPS		RUN OPTIONS

LINE

+/-	3	ENTER

1	.	5	ENTER

USE

Press the **LINE** key to add another line.The FROM
dimensions, DEPTH dimension, and TOOL specifications will
carry forward from the previous line.
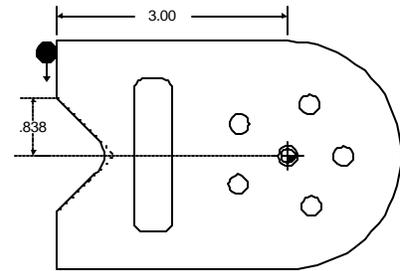
Press the **LINE** key.

Enter the following TO dimensions:

TO:	X2 = -3.0 ABS	**+/-** **3** **ENTER**

Notice that you
don't have to use
the ENTER key
after the last
value – just
press USE.

Y2 = 0.838 ABS   **.**   **8**   **3**   **8**   **USE**

SERVO **OFF**	FEED	0	100%	TOOL:		SCALE	1.0000	**INCH**

CURRENT PROGRAM

001   SET TOOL
002   ⌐ MILL ARC
003   ╎ MILL LINE
004   ╎ MILL LINE

END OF 4

PROGRAM FUNCTIONS	CLEAR PROGRAM	EXPLODE	MORE STEPS		RUN OPTIONS

Now we will program the two diagonal lines. Notice that in the x-axis the end of the first diagonal line is .750 *from the beginning of the line.*

This means we can use incremental dimensioning.

We say that "X2 is .750 incremental from X1."

FROM (X1, Y1)

TO (X2, Y2)

.75
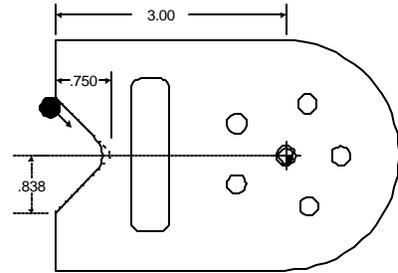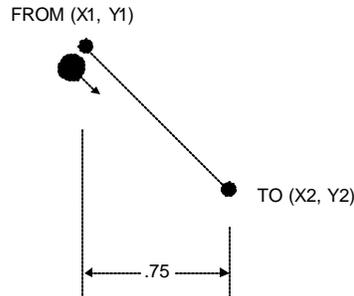
Press the **LINE** key.

LINE

In the TO point, enter

X2 = .750

. 7 5 ABS INC

Then press the **ABS/INC** key. ABS changes to INC, and **MILLPWR** assumes that you want to use the X coordinate of the **FROM** point, X1, as your incremental reference.

X2 = 0.750 INC X1

LINE	005
FROM	
X1	-3.000 ABS
Y1	0.838 ABS
TO	
X2	0.750 INC X1
Y2	ABS

Now finish the **TO** point:

To Y2

Y2 = 0.000 ABS

0 USE

Press the **LINE** key again for the second diagonal line:

X2 = -3.000 ABS

+/-   3   ENTER

Y2 = -0.838 ABS

+/-   .   8   3   8   USE

SERVO **OFF**	FEED	0	100%	TOOL:		SCALE	1.0000	**INCH**

CURRENT PROGRAM

001   SET TOOL
002 ⌐ MILL ARC
003 │ MILL LINE
004 │ MILL LINE
005 │ MILL LINE
006 └ MILL LINE

END OF 6

PROGRAM FUNCTIONS	CLEAR PROGRAM	EXPLODE	MORE STEPS		RUN OPTIONS
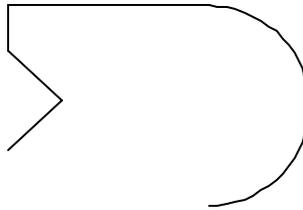
We can see that lines 005 and 006 should be connected with an arc. We'll go back and insert a BLEND step between them. Using the up arrow key, select the last step, 006 MILL LINE.

To Step 006

Press the **BLEND** key.

BLEND

We could just as easily have put the BLEND step in right after we did LINE 005. The BLEND step would then show up in the listing, but it would not show in the graphics until we put in the second line.

```
SERVO OFF  FEED      0    100%  TOOL:                    SCALE  1.0000   INCH
        CURRENT PROGRAM        BLEND          006

  001    SET TOOL              ┌ STEPS ─────────────┐
  002  ┌ MILL ARC                FROM        5
  003  │ MILL LINE                TO         7
  004  │ MILL LINE              ┌ RADIUS ───────────┐
  005  │ MILL LINE

  006  X BLEND                  ┌ FEED RATE ────────┐
  007  └ MILL LINE                          10   IPM


               6  OF  7

                                              CLOSE
                                             CONTOUR
```

. 2 5 USE

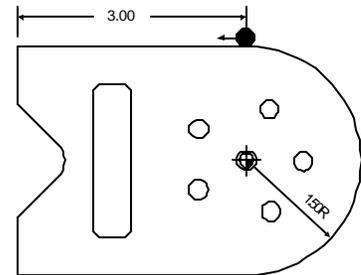Enter a radius of   0.250**.**

```
SERVO OFF  FEED      0    100%  TOOL:                    SCALE  1.0000   INCH
        CURRENT PROGRAM

  001    SET TOOL
  002  ┌ MILL  ARC
  003  │ MILL  LINE
  004  │ MILL  LINE
  005  │ MILL  LINE
  006  │ BLEND
  007  └ MILL  LINE




               7 OF 7

  PROGRAM    CLEAR                 MORE                 RUN
  FUNCTIONS  PROGRAM   EXPLODE     STEPS              OPTIONS
```

3.00

1.50R

Notice how the last two lines are now "blended" together
with a radius.
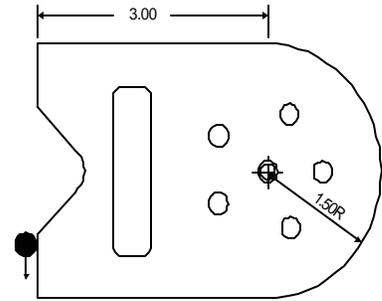
Press the down arrow key to move to the end of the program
to continue entering more steps.

To End of Program

Press the **LINE** key.

LINE

In the **TO** point enter:

X2 = -3.0 ABS   +/-   3   ENTER

Y2 = -1.5 ABS   +/-   1   .   5   USE

SERVO **OFF** FEED 0 100%	TOOL:	SCALE 1.0000	**INCH**

CURRENT PROGRAM

001   SET TOOL
002 ⌐ MILL ARC
003 │ MILL LINE
004 │ MILL LINE
005 │ MILL LINE
006 │ BLEND
007 └ MILL LINE

7 OF 7

PROGRAM FUNCTIONS	CLEAR PROGRAM	EXPLODE	MORE STEPS		RUN OPTIONS

Press the **LINE** key. In the **TO** point enter:

LINE

Second line TO: X2 = 0 ABS

0   ENTER

Y2 = -1.5 ABS

+/-   1   .   5   USE
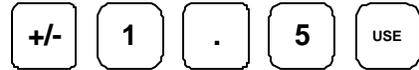
Notice how the marks to the right of the step numbers have changed to indicate that the contour is now closed.

SERVO **OFF**	FEED	0 100%	TOOL:		SCALE 1.0000	**INCH**

CURRENT PROGRAM

```
001     SET TOOL
002  ⊓ MILL  ARC
003  ‖ MILL  LINE
004  ‖ MILL  LINE
005  ‖ MILL  LINE
006  ▮ BLEND
007  ‖ MILL  LINE
008  ▮ MILL  LINE
009  ▮ MILL  LINE
```

END OF 9

PROGRAM FUNCTIONS	**CLEAR PROGRAM**	**EXPLODE**	**MORE STEPS**		**RUN OPTIONS**
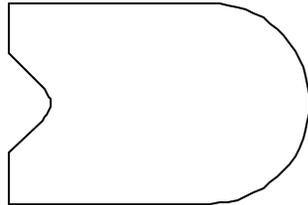
Programming the Bolt Circle

First, we want to change the tool to a drill. Press the
TOOL key and enter the data for a 0.250" drill.
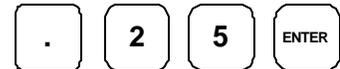
Select DRILL and press **ENTER**. Press **USE** to
complete the SET TOOL step.

To DRILL

Now, press the **HOLES** key to see a series of hole
pattern choices. Choose the **BOLT CIRCLE** softkey.

SERVO **OFF**	FEED	0	100%	TOOL:		SCALE	1.0000	**INCH**

CURRENT PROGRAM	BOLT CIRCLE	011

```
001     SET TOOL
002  ⊓ MILL  ARC
003  || MILL  LINE
004  || MILL  LINE
005  || MILL  LINE
006  || BLEND
007  || MILL  LINE
008  || MILL  LINE
009  |] MILL  LINE
010     SET TOOL
011  X  BOLT  CIRCLE


         11  OF  11
```

```
CENTER
X        0.00   ABS
Y        0.00   ABS

DEPTH
         THRU

RADIUS
         1.500

DIRECTION
         CCW

HOLES


TOOL
        .2500  DIAMETER
        DRILL  TYPE
```

			TEACH POSITION	POLAR	MORE

The **CENTER** and **DIRECTION** are carried forward from the
previous arc. All we need to do is change the radius and enter
the number of holes.

CENTER:	0.0	
	0.0	

The value of "THRU" for the
depth is entered by a softkey. We
could choose not to program a
depth, since we can easily tell
when we drill through the part.

DEPTH: THRU

↓
To RADIUS

RADIUS: 0.75

[.] [7] [5] [ENTER]

DIRECTION: CCW

HOLES: 5

↓
To HOLES

[5]

When all dimensions are entered, press **USE** to view the
graphics screen.

[USE]

SERVO **OFF**	FEED	0	100%	TOOL:		SCALE	1.0000	**INCH**

CURRENT PROGRAM

001   SET TOOL
002 ⫼ MILL ARC
003 ‖ MILL LINE
004 ‖ MILL LINE
005 ‖ MILL LINE
006 ‖ BLEND
007 ‖ MILL LINE
008 ‖ MILL LINE
009 ⫼ MILL LINE
010   SET TOOL
011   BOLT CIRCLE

END OF 11

PROGRAM FUNCTIONS	CLEAR PROGRAM	EXPLODE	MORE STEPS		RUN OPTIONS

Programming the Pocket

First we program the tool that we'll use for the pocket. Press **TOOL** and enter the data for a 0.125" diameter flat end mill.

To FLAT END MILL
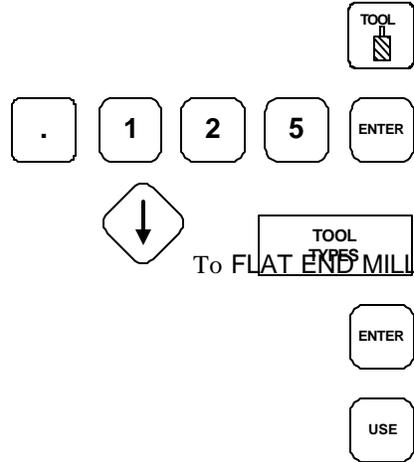
Press the **RECT** (rectangle) key, then select the softkey for **POCKET.**

SERVO **OFF**	FEED	0	100%	TOOL:			SCALE	1.0000	**INCH**

```
       CURRENT PROGRAM          RECTANGLE POCKET      011

  001     SET TOOL           ┌─ CENTER ─────────┐
  002  ∏ MILL  ARC           │ X      0.00  ABS  │
  003  ‖ MILL  LINE          │ Y      0.00  ABS  │
  004  ‖ MILL  LINE          ┌─ SIZE ────────────┐
  005  ‖ MILL  LINE          │               IN X │
  006  ‖ BLEND               │               IN Y │
  007  ‖ MILL  LINE          ┌─ DEPTH ───────────┐
  008  ‖ MILL  LINE          │      0.0000   ABS  │
  009  ‖ MILL  LINE
  010  ‖ SET TOOL            ┌─ CORNER BLEND RADIUS ─┐
  011  ‖ BOLT  CIRCLE        │       .2500           │
  012     SET TOOL
  013   X RECTANGLE POCKET   ┌─ DIRECTION ───────┐
                             │       CCW          │

                             ┌─ TOOL ─────────────┐
                             │       .1250   INCH  │
         13 OF 13            │  FL END ML  TYPE    │
                             │         10  IPM     │
```

			TEACH POSITION	**POLAR**	**MORE**

Enter the following dimensions for the rectangular pocket:

CENTER: X = -1.75

| +/- | 1 | . | 7 | 5 | ENTER |

Some of these dimensions are already here so we can down arrow past them.

Y = 0.0

⬇ To Size

SIZE: X = 0.5

| . | 5 | ENTER |

Y = 2.0

| 2 | ENTER |

DEPTH: Z = -0.25

⬇ To Corner Radius

CORNER BLEND RADIUS: .125

| . | 1 | 2 | 5 |

DIRECTION: CCW

Press the **USE** key.

| USE |

As with previous tool changes, the tool specifications will be automatically entered from the

010 SET TOOL step.

| SERVO **OFF** | FEED | 0 | 100% | TOOL: | | SCALE | 1.0000 | **INCH** |

CURRENT PROGRAM

001	SET TOOL
002	⊓ MILL ARC
003	‖ MILL LINE
004	‖ MILL LINE
005	‖ MILL LINE
006	‖ BLEND
007	‖ MILL LINE
008	‖ MILL LINE
009	⊔ MILL LINE
010	SET TOOL
011	BOLT CIRCLE
012	SET TOOL
013	RECTANGLE POCKET

END OF 13

| PROGRAM FUNCTIONS | CLEAR PROGRAM | EXPLODE | MORE STEPS | | RUN OPTIONS |
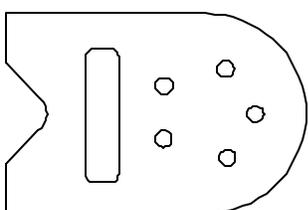
Saving Your Program

The sample part is now completely programmed. Press the softkey labeled **PROGRAM FUNCTIONS.**

> **PROGRAM FUNCTIONS**

Press the **SAVE** softkey.

> **SAVE**

Key in program name.

Name your program by pressing the numeric keys or by selecting the **ALPHABET** softkey, highlighting a letter, then pressing the **ENTER** key. You may select up to eight characters, mixing numbers and letters if you wish. After you've selected a name, press the **USE** key to save the program. You will be warned if there's already a program by that name.

Saving the program means it is stored and will not be lost if there is a power interruption.

At a later time, you can recall the program by pressing the **PROGRAM FUNCTIONS** and **LOAD** softkeys.

Testing Your Program

If you're new to **MILLPWR** programming, you might want to test your program before you run it. Press **RUN OPTIONS**, and select both **DRY RUN** and **GRAPHICS ONLY**. Move to the start of the program by pressing the 1 key followed by the **ENTER** key, and press **GO**. Watch as **MILLPWR** shows you how the part program will be run.

> **RUN OPTIONS**

> **DRY RUN**   **GRAPHICS ONLY**

> **1**   **ENTER**

If you are past the last step, MILLPWR will automatically go to step 1 when you press GO.

> **GO**

Under **RUN OPTIONS**, de-select the **DRY RUN** and **GRAPHICS ONLY** options before proceeding.

> **RUN OPTIONS**

> **DRY RUN**   **GRAPHICS ONLY**

Running the Program

The first step in running a new program is to set the datum point on the workpiece. Remember that we chose the center of the bolt circle as the datum.

- Mount the workpiece in a vise.

- Press **DRO** and use the **MOVE TABLE** function to position the quill over the workpiece where you think the bolt circle center might be.

DRO

MOVE TABLE

Move the table to the workpiece datum.

MOVE TABLE

- Release the **MOVE TABLE** function.

- Press the **DATUM** softkey.
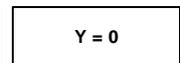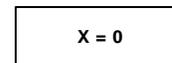
DATUM

- Press the **X = 0** and **Y = 0** keys to establish the current tool center as the datum.

X = 0	Y = 0

- Press **USE** to use this datum, and return to the program view by pressing the **PGM** key.

USE

PGM

We'll do a dry run to see if the part will fit on the workpiece.
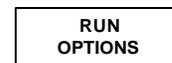
- Press **RUN OPTIONS** and then **DRY RUN**.

RUN OPTIONS	DRY RUN

- Now press **GO**, clear the tool and press **GO** again. The **MILLPWR** will run each of the steps without stopping so you can see the tool path.

GO

GO

If the part falls entirely within the workpiece, you can now
actually cut the part.

- Press **RUN OPTIONS**, then deselect the **DRY RUN** softkey
  to turn off dry run.

| RUN OPTIONS | DRY RUN |
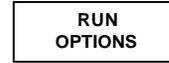
Now when you press the **GO** key, you can follow the
instructions **MILLPWR** gives you and make the part.

GO

Tool Changes

You may wish to consider using a POS step before a tool step to allow room for changing the tool.

Whenever **MILLPWR** encounters a **SET TOOL** step, it shows you the DRO and tells you which tool to load.

- Use the **MOVE TABLE** function to clear the workpiece.

| MOVE TABLE |

- Load the required tool.

Load tool.

- Using the move table function, position the tool over a surface of known depth.

Use move table function to position the tool.

| MOVE TABLE |

| DATUM |

- Press the **DATUM** softkey.

- Touch the end of the tool to the surface, key the known depth into the Z axis.

If the surface is at 0, use the Z = 0 key.

Touch end of tool to surface.

Key in depth of Z axis.

Press the **USE** key.

| USE |

Raise tool.

- Raise the tool and press **GO** to resume the program.

- Follow the instructions on the **MILLPWR** screen.

| GO |

Clearing the Program

Select **PROGRAM FUNCTIONS** again.

| PROGRAM FUNCTIONS |

Select the softkey marked **CLEAR** to clear the program from the screen.
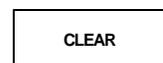
| CLEAR |

Answer **YES** and the screen will be cleared for another program.

YES

PROGRAM STEPS

Simple Milling & Drilling

Set Tool

TOOL

This step causes **MILLPWR** to suspend the program and ask you to change the cutting tool.

You have several options for filling in this step:

- Leave it blank; just press **USE** to insert an "empty" tool step in the program. When you run the program, **MILLPWR** will ask you what tool diameter to use.

- Type in a DIAMETER.

- Type in the DIAMETER <u>and</u> select a TOOL TYPE. Now **MILLPWR** will let you know what kind of tool you had in mind when you wrote the program.

Tool Types and the Tool Library are opened with softkeys.

- Select a tool from the Tool Library.

SET TOOL	001
TOOL	
	INCH
	TYPE

Any time you are entering the tool diameter, a softkey will let you change   between inches and mm.

Position/Drill

POS

This operation is used to move the table at high speed to a specified position and drill to a programmed depth.

POINT is the X and Y position you want the tool to move to.

DEPTH is normally **THRU** for holes, but you can set it to a specific depth.

The TOOL information is from the most recent SET TOOL step; you can't change it here.

POSITION/DRILL	001
POINT	
X	ABS
Y	ABS
DEPTH	
Z 0.0000	ABS
TOOL	
	INCH
	TYPE

Mill Line

This function moves rapidly to the starting point and mills a line to the end point at the programmed feed rate.

FROM and TO are the beginning and ending points of the line.

TOOL OFFSET is set with softkeys **LEFT**, **CENTER**, or **RIGHT**.

FEED must be programmed or it will default to the last feedrate used or from the value entered in setup.

MILL LINE	001

```
 FROM
 X1               ABS
 Y1               ABS
 TO
 X2               ABS
 Y2               ABS
 DEPTH
 Z       0.0000   ABS
 TOOL
                  INCH
                  TYPE
         CENTER   OFFSET
 FEED       10    IPM
```

Mill Arc

This operation performs an arc cut at a given depth and feed rate.

The usual arc definition uses the FROM and TO points, the RADIUS of the arc and the DIRECTION of the arc. The direction of the arc is either clockwise (CW) or counter-clockwise (CCW).
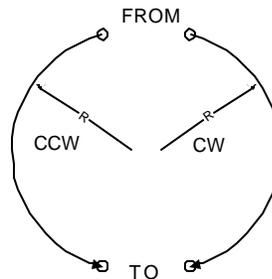
MILL ARC	001

```
 FROM
 X1               ABS
 Y1               ABS
 TO
 X2               ABS
 Y2               ABS
 DEPTH
 Z       0.0000   ABS
 RADIUS

 DIRECTION
         CCW
 TOOL
                  INCH
                  TYPE
         CENTER   OFFSET
 FEED       10    IPM
```

In some cases, it may be necessary to enter the CENTER, a 3RD POINT, or a SWEEP ANGLE to define the arc. Press the **MORE** softkey for additional input fields.

```
 CENTER
 X                ABS
 Y                ABS
 3RD POINT
 X3               ABS
 Y3               ABS
 SWEEP ANGLE
```
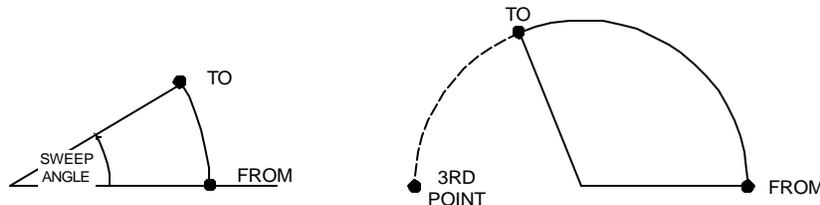
Blend

BLEND

A blend is a circular fillet (connecting radius) which connects two lines, two arcs, or a line and an arc. Just give the RADIUS of the blend, and **MILLPWR** will calculate the exact tangent points for you.

The STEPS are filled in automatically; the FROM step is the one before the blend, and the TO step is the one after the blend. You can program the blend right after the FROM step, before you have entered the TO step. Or, you can enter the lines and arcs first, then go back and insert the blend.

The two lines or arcs which are being blended do not need to touch, or they can overlap. As long as the blend radius will fit somewhere, it will work.

BLEND	001

STEPS
FROM
TO

RADIUS

FEED RATE
10 IPM

LINES 1 AND 3 TOUCH
LINE 1

001 LINE 0,6 TO 8,6
002 BLEND R=2
003 LINE 8,6 TO 8,0

LINE 3

LINES 1 AND 3 OVERLAP
LINE 1

001 LINE 0,6 TO 8,6
002 BLEND R=2
003 LINE 8,7 TO 8,0

LINE 3

LINES 1 AND 3 DO NOT TOUCH
LINE 1

001 LINE 0,6 TO 8,6
002 BLEND R=2
003 LINE 8,2 TO 8,0

LINE 3
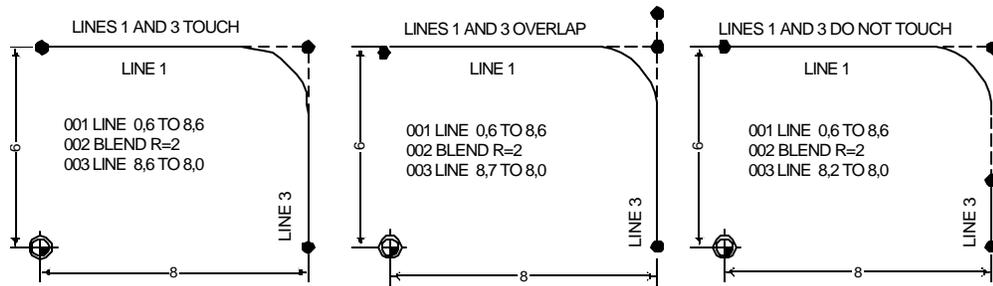
If you have a closed contour, like a triangle, and you want to blend the last line to the first line, put a blend step immediately after the last step in the contour and, while in the RADIUS field, press the **CLOSE CONTOUR** softkey. The TO step number will be set to the first step in the contour.
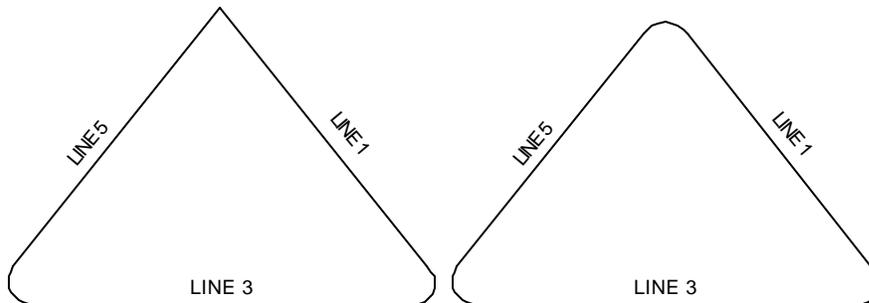
LINE 5   LINE 1

LINE 3

001 ‖ LINE
002 ‖ BLEND   001 TO 003
003 ‖ LINE
004 ‖ BLEND   003 TO 005
005 ‖ LINE

LINE 5   LINE 1

LINE 3

001 ‖ LINE
002 ‖ BLEND   001 TO 003
003 ‖ LINE
004 ‖ BLEND   003 TO 005
005 ‖ LINE
006 ‖ BLEND   005 TO 001

Rectangular Milling Functions

RECT

MILLPWR has several "canned cycles" to let you program pockets, frames, and slots with a single step. There is also a step to let you face off a workpiece.

Pressing the **RECT** key on the front panel will display these softkeys.

POCKET	FRAME	FACE	SLOT		
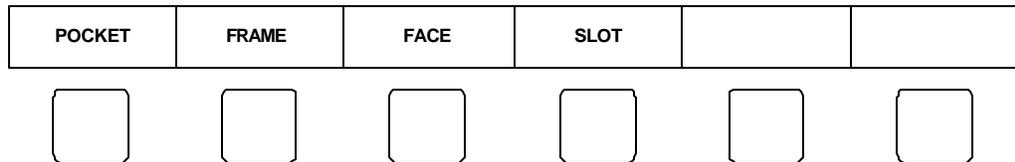
Pocket

A pocket is defined by its CENTER point and its SIZE. You can specify a CORNER RADIUS. You can also specify the DIRECTION, which will determine whether you are climb milling or conventional milling.

The tool must be able to fit into the pocket or the **MILLPWR** will not run the step.

The **MORE** softkey brings up the TILT ANGLE and FINISH CUT fields.

```
RECTANGLE POCKET        001
  ┌ CENTER ───────────────┐
  │ X                 ABS  │
  │ Y                 ABS  │
  ┌ SIZE ─────────────────┐
  │                  IN  X │
  │                  IN  Y │
  ┌ DEPTH ────────────────┐
  │ Z        0.0000  ABS   │
  ┌ CORNER BLEND  RADIUS ──┐
  │          0.0000        │
  ┌ DIRECTION ────────────┐
  │          CCW           │
  ┌ TOOL ─────────────────┐
  │                  INCH  │
  │                  TYPE  │
  │ FEED        10   IPM   │
```

MILLPWR will arc on and arc off the last cut.

SIZE IN X

FINISH ALLOWANCE

SIZE IN Y

Z DEPTH
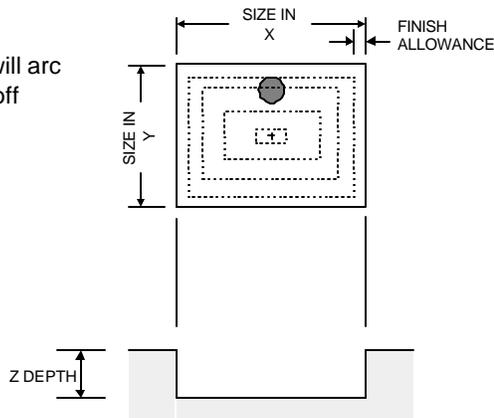
If you enter a finish feed rate of 0, MILLPWR will not perform a finish cut.

```
  ┌ TILT ANGLE ───────────┐
  │        0° 00' 00"      │
  ┌ FINISH ───────────────┐
  │          0.0000  CUT   │
  │ FEED         0   IPM   │
  │ DIR              CCW   │
  │ STEPOVR     80   %     │
```

When tilted, the pocket is rotated about its center point.

TILT ANGLE

+X
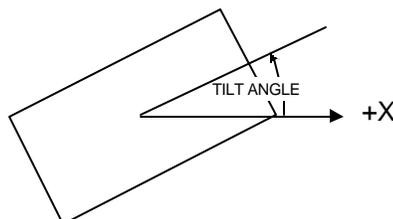
Rectangular Frame

A frame step takes one cut in a rectangular shape. The frame is defined by its CENTER and SIZE. As with a pocket, you can have rounded corners, and the DIRECTION determines the milling type.

You decide if it's an inside or an outside frame with the tool offset: **LEFT** with a **CCW** direction or **RIGHT** with **CW** will give you an inside frame cut; **RIGHT** with a **CCW** direction or **LEFT** with **CW** will give an outside frame cut.

Of course, it's much easier to use the INSIDE and OUTSIDE softkeys!

The **MORE** key shows you the TILT ANGLE and FINISH CUT fields.

RECTANGLE FRAME	001

```
┌ CENTER ──────────────┐
│ X              ABS    │
│ Y              ABS    │
├ SIZE ────────────────┤
│              IN  X    │
│              IN  Y    │
├ DEPTH ───────────────┤
│ Z      0.0000 ABS     │
├ CORNER BLEND  RADIUS ─┤
│         0.0000        │
├ DIRECTION ───────────┤
│         CCW           │
├ TOOL ────────────────┤
│              INCH     │
│              TYPE     │
│   CENTER    OFFSET    │
│ FEED     10 IPM       │
└──────────────────────┘
```

```
┌ TILT ANGLE ──────────┐
│     0° 00' 00"        │
├ FINISH ──────────────┤
│        0.0000  CUT    │
│ FEED        0  IPM    │
│ DIR           CCW     │
└──────────────────────┘
```


FINISH ALLOWANCE

SIZE IN Y

SIZE IN X

Z DEPTH

OUTSIDE FRAME

FINISH ALLOWANCE

SIZE IN Y

SIZE IN X

Z DEPTH

INSIDE FRAME
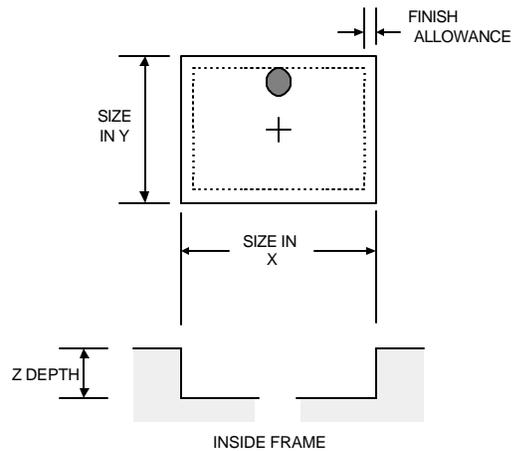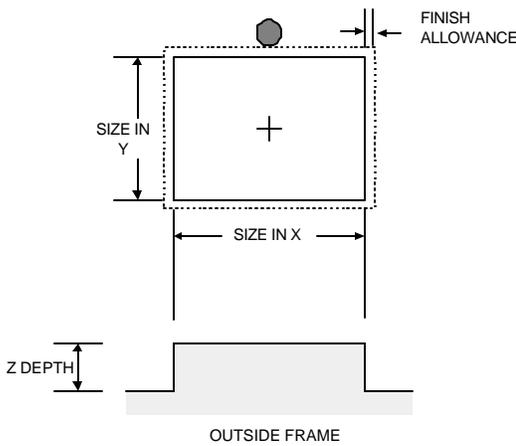
Face

This step provides a quick way to face off a workpiece. Enter the CENTER location and the SIZE of the area to be faced. **MILLPWR** will start at the lower left of the area and zigzag upwards.

The **MORE** softkey brings up fields to let you TILT the face rectangle, and to change the tool STEPOVER.
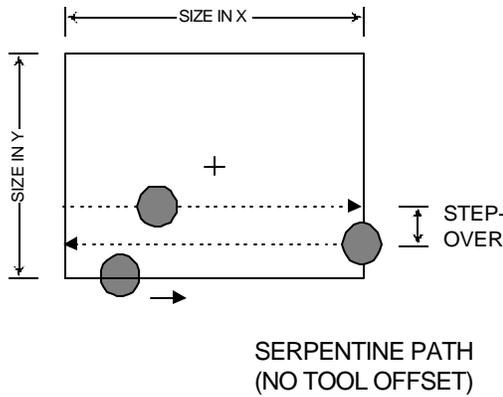
FACE	001

```
┌ CENTER ──────────────┐
│ X                ABS  │
│ Y                ABS  │
└───────────────────────┘
┌ SIZE ────────────────┐
│                  IN X │
│                  IN Y │
└───────────────────────┘
┌ DEPTH ───────────────┐
│ Z         0.0000  ABS │
└───────────────────────┘
┌ TOOL ────────────────┐
│                 INCH  │
│                 TYPE  │
│ FEED      10  IPM     │
└───────────────────────┘
```


SIZE IN X

SIZE IN Y

STEP-OVER

SERPENTINE PATH
(NO TOOL OFFSET)

```
┌ TILT ANGLE ──────────┐
│         0° 00' 00"    │
└───────────────────────┘
┌ FINISH ──────────────┐
│ STEPOVR        %      │
└───────────────────────┘
```

Slot

For a slot, enter the CENTER of each arc and the SLOT WIDTH. You can enter the SLOT LENGTH and ANGLE instead of the 2ND ARC CENTER.

The **MORE** softkey displays fields which let you specify the ANGLE of the slot (it rotates about the FIRST ARC CENTER) and enter a FINISH CUT.
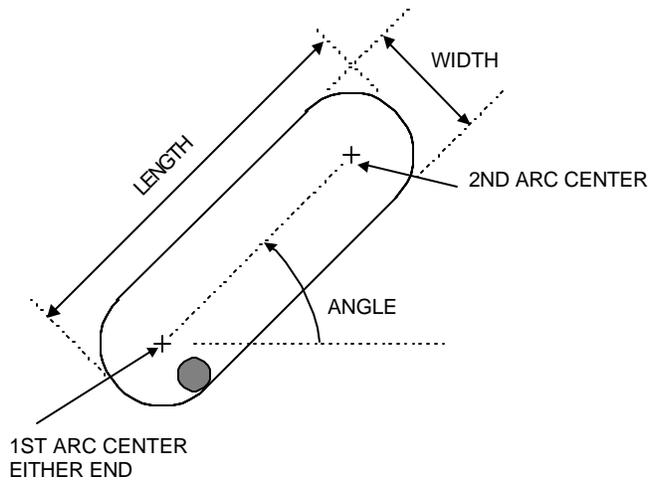
SLOT	001

FIRST ARC CENTER
X1   ABS
Y1   ABS

SECOND ARC CENTER
X2   ABS
Y2   ABS

DEPTH
Z   0.0000 ABS

DIRECTION
        CCW

SLOT WIDTH

TOOL
                INCH
                TYPE
FEED   10   IPM

SLOT LENGTH

ANGLE

FINISH
        0.0000 CUT
FEED   0   IPM
DIR   ccw
STEPOVR   80   %

Circular Milling Functions

CIRCLE
(+)

MILLPWR has several "canned cycles" to let you program pockets, frames, and rings with a single step.

Pressing the **CIRCLE** key on the front panel will display these softkeys.

POCKET	FRAME	RING			
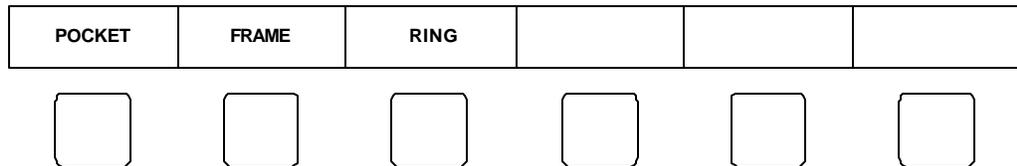
Circular Pocket

Enter the CENTER and RADIUS of the pocket. The DIRECTION will determine whether you are climb or conventional milling.

The MORE key brings up the FINISH CUT option.

CIRCLE POCKET	001

CENTER
X   ABS
Y   ABS

DEPTH
Z   0.0000 ABS

RADIUS

DIRECTION
CCW

TOOL
INCH
TYPE
FEED   10 IPM

FINISH
0.0000 CUT
FEED   0 IPM
DIR   CCW
STEPOVR   80 %

STEPOVER   FINISH ALLOWANCE

RAD

Z DEPTH

Circular Frame

Enter the frame's CENTER and RADIUS. The DIRECTION, coupled with the TOOL OFFSET, will determine whether you are climb or conventional milling, and whether you are cutting an inside or outside frame.

The INSIDE and OUTSIDE softkeys can help you with the Tool Offset.

The **MORE** softkey brings up fields to let you enter a FINISH cut.
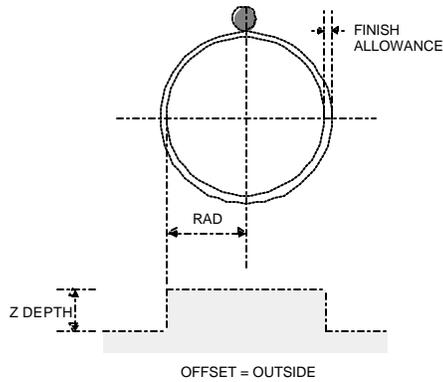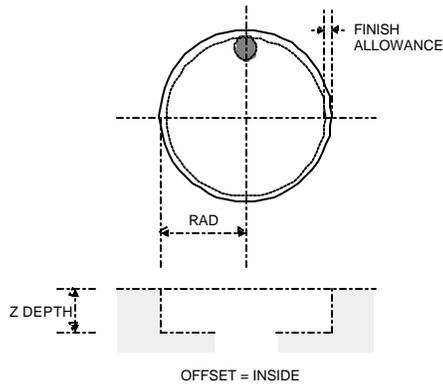
```
CIRCLE FRAME          |    001

  CENTER
  X                ABS
  Y                ABS

  DEPTH
  Z        0.0000  ABS

  RADIUS

  DIRECTION
         CCW

  TOOL
                    INCH
                    TYPE
           CENTER   OFFSET
  FEED        10    IPM
```

```
  FINISH
            0.0000  CUT
  FEED          0   IPM
  DIR            CCW
```

FINISH
ALLOWANCE

RAD

Z DEPTH

OFFSET = INSIDE

FINISH
ALLOWANCE

RAD

Z DEPTH

OFFSET = OUTSIDE

Ring

A ring is actually a circular pocket with a circular island in the center.

Enter the CENTER position, the radius of the pocket (OUTSIDE RADIUS), and the radius of the island (INSIDE RADIUS).

The DIRECTION of cut on the *inside* radius will determine whether you are climb milling or conventional milling. **MILLPWR** will reverse the tool movement direction on the outside radius so the milling direction stays the same.

The **MORE** softkey brings up the FINISH CUT entry field.

RING	001

```
┌ CENTER ─────────────
│ X              ABS
│ Y              ABS

┌ DEPTH ──────────────
│ Z     0.0000  ABS

┌ RADIUS ─────────────
│              OUTSIDE
│              INSIDE

┌ DIRECTION ──────────
│      CCW

┌ TOOL ───────────────
│              INCH
│              TYPE
│ FEED      10  IPM
```
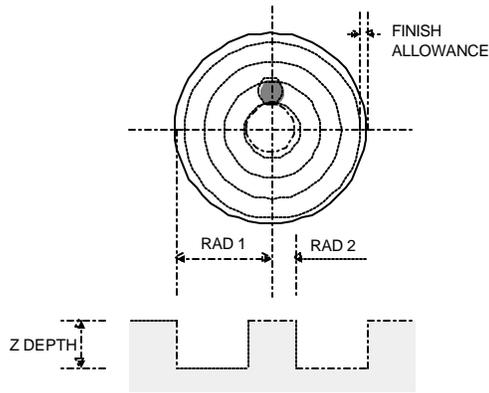
```
┌ FINISH ─────────────────
│           0.0000  CUT
│ FEED         0    IPM
│ DIR               CCW
│ STEPOVR      80   %
```

Hole Patterns

HOLES

MILLPWR has several "canned cycles" to let you program patterns of holes.

Pressing the **HOLES** key on the front panel will display these softkeys.

ROW	FRAME	ARRAY	BOLT CIRCLE		

Row of Holes

The FROM point is the center of the first hole, and the TO point is the center of the last hole. Enter the number of holes in the HOLES field.

Instead of the TO point, you can enter the HOLE SPACING and ANGLE.
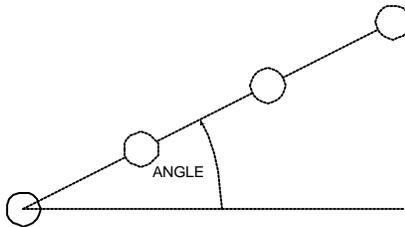
ROW OF HOLES	001

FROM
X1   ABS
Y1   ABS

TO
X2   ABS
Y2   ABS

DEPTH
Z   THRU   ABS

HOLES

TOOL
              INCH
              TYPE

HOLE SPACING
              BETWEEN

ANGLE

Hole Frame and Hole Array

The frame and the array hole patterns need the same information. Arrays have holes in the middle of the rectangular pattern, while frames have holes only on the outside edge of the rectangle.

Enter the rectangle's CENTER and SIZE, and the number of HOLES in each direction.

The **MORE** softkey brings up fields to let you TILT the frame or to enter the hole-to-hole SPACING.

```
┌─────────────────────────────────┐
│ HOLE FRAME           │    001    │
│  ┌ CENTER ───────────────────    │
│  X                    ABS        │
│  Y                    ABS        │
│  ┌ SIZE ─────────────────────    │
│                       IN  X      │
│                       IN  Y      │
│  ┌ DEPTH ────────────────────    │
│  Z        THRU        ABS        │
│  ┌ HOLES ────────────────────    │
│  X                               │
│  Y                               │
│  ┌ TOOL ─────────────────────    │
│                       INCH       │
│                                  │
│                       TYPE       │
│                                  │
└─────────────────────────────────┘
```

```
┌─────────────────────────────────┐
│  ┌ HOLE SPACING ────────────     │
│  X                    BETWEEN    │
│  Y                    BETWEEN    │
│  ┌ TILT ANGLE ─────────────      │
│            0° 00' 00"            │
│                                  │
└─────────────────────────────────┘
```


FRAME   ARRAY
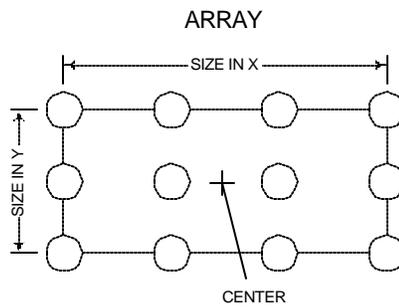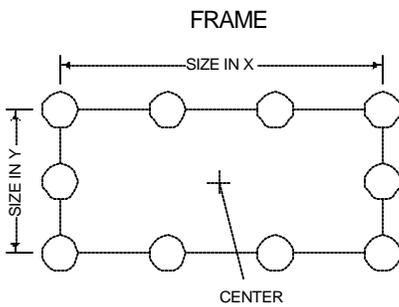
Bolt Circle

Enter the CENTER and the RADIUS of the bolt circle, and the number of HOLES you want.

The **MORE** softkey brings up the START ANGLE and END ANGLE entry fields, which let you do partial circles. The number of holes you entered will be spaced evenly between the angles.

The DIRECTION field is useful if you have a clamp or fixture that you need to avoid.
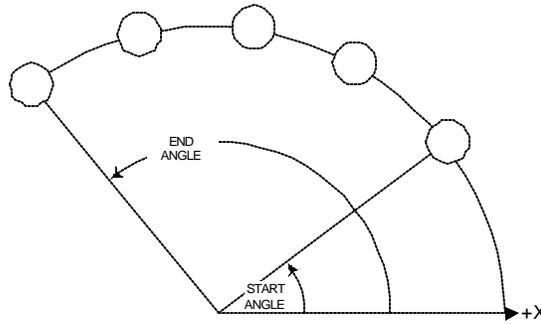
BOLT CIRCLE	001

```
┌ CENTER ─────────────────┐
│ X                    ABS │
│ Y                    ABS │
└──────────────────────────┘
┌ DEPTH ──────────────────┐
│ Z      THRU     ABS      │
└──────────────────────────┘
┌ RADIUS ─────────────────┐
│                          │
└──────────────────────────┘
┌ DIRECTION ──────────────┐
│          CCW             │
└──────────────────────────┘
┌ HOLES ──────────────────┐
│                          │
└──────────────────────────┘
┌ TOOL ───────────────────┐
│               INCH       │
│               TYPE       │
└──────────────────────────┘
```



```
┌ START ANGLE ─────────────┐
│                          │
└──────────────────────────┘
┌ END ANGLE ───────────────┐
│                          │
└──────────────────────────┘
```

More Steps

MORE STEPS

Additional steps are available that extend the capabilities of your **MILLPWR**. Select the **MORE STEPS** softkey to see a menu of the following extended functions:

CUSTOM POCKET	REPEAT	ROTATE	MIRROR	ENGRAVE	REFERENCE POINT

Repeat

Using this step you can repeat whole parts, or sections of parts, horizontally, vertically, or both.

Enter the STEP RANGE (the numbers of the first and last steps) that you want to repeat and the OFFSET, in either X or Y, or both directions. Then enter the number of REPEATS you want in *addition* to the original. The *offset* is the distance between repeats.

Example:

```
001 ∏  MILL LINE
002 ‖  MILL LINE
003 ⊔  MILL LINE
004    POSITION/DRILL
```
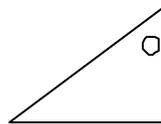
```
REPEAT              005
 ┌ STEP RANGE ─────────┐
 │ FIRST               │
 │ LAST                │
 ┌ OFFSET ─────────────┐
 │ X                   │
 │ Y                   │
 ┌ REPEAT ─────────────┐
 │                MORE │
```

To repeat the above program once, 6 inches to the right, fill in the REPEAT form like this:

```
REPEAT              005
 ┌ STEP RANGE ─────────┐
 │ FIRST      001      │
 │ LAST       004      │
 ┌ OFFSET ─────────────┐
 │ X      6.000        │
 │ Y                   │
 ┌ REPEAT ─────────────┐
 │         1   MORE    │
```

ORIGINAL   REPEAT

6
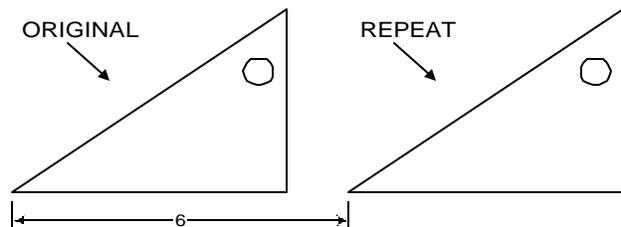
Rotate

Just as you can repeat sections of a program, you can also rotate sections.

Enter the CENTER of rotation and the ANGLE of rotation.

Example:

```
001 ⊓  MILL LINE
002 ‖  MILL LINE
003 ⊔  MILL LINE
004    POSITION/DRILL
```

To rotate the part twice at 30° each, fill in the ROTATE form like this:
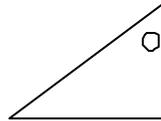
```
ROTATE              005

  STEP RANGE
  FIRST
  LAST

  CENTER
  X                    ABS
  Y                    ABS

  ANGLE


  REPEAT
                     MORE
```

```
ROTATE              005

  STEP RANGE
  FIRST      001
  LAST       004

  CENTER
  X       1.000    ABS
  Y       0.000    ABS

  ANGLE
          30

  REPEAT
             2  MORE
```
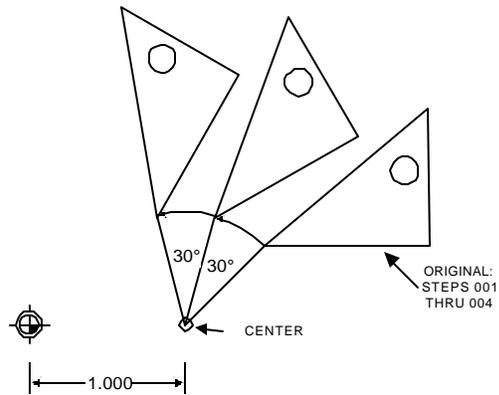
Mirror

You can make a mirror image of any section of your program using this step. Enter the **RANGE** of steps you want to mirror, and the end points of the "mirror line," called the *axis of reflection*. The axis does not have to be vertical or horizontal; you can use any line.

Example:

```
001 ∏  MILL LINE
002 ‖  MILL LINE
003 Ⅱ  MILL LINE
004    POSITION/DRILL
```
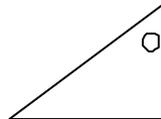
MIRROR	005
STEP RANGE	
FIRST	
LAST	
1ST AXIS POINT	
X1	ABS
Y1	ABS
2ND AXIS POINT	
X2	ABS
Y2	ABS

To make a "left handed" part 2 inches away, put a vertical axis 1 inch to the left of the original part.

MIRROR	005
STEP RANGE	
FIRST	001
LAST	004
1ST AXIS POINT	
X	-1.000 ABS
Y	0.000 ABS
2ND AXIS POINT	
X	-1.000 ABS
Y	1.000 ABS

AXIS OF
REFLECTION

LEFT HAND PART

ORIGINAL
STEPS 001 THRU 004

|←1.0→|

|←——2.0——→|
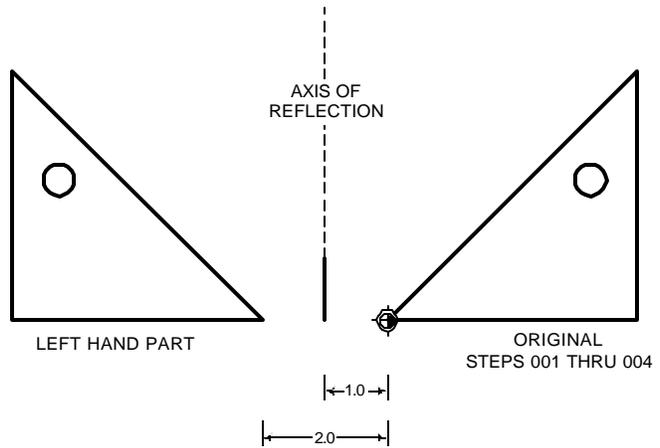
The axis line
doesn't have to be
very long--this one
is only 1".

Custom Pocket

You can create a pocket from any *closed contour*. A closed contour is any shape made of lines, arcs, and/or blends, where the last step ends at the start point of the first step. **MILLPWR** will indicate a closed contour with double lines to the right of the applicable steps in the program list.

The CUSTOM POCKET step must be placed immediately following the last step in the closed contour.

MILLPWR will arc on and arc off the last cut.

In the CUSTOM POCKET step, the STEP RANGE is filled in automatically. You need to fill in the ENTRY POINT, which is the plunge point for the tool. **MILLPWR** will mill at the feed rate from the ENTRY POINT to the start of the first step in the contour.

Set the FEED RATE if you want to override what is in each of the contour steps.

The FINISH CUT will be done after the inside of the pocket has been cleared out.

The direction of cut is determined by the order in which you programmed the elements of the contour.

```
┌──────────────────────────────────┐
│ CUSTOM POCKET     005             │
│  ┌ STEP RANGE ─────────────────┐  │
│  │ FIRST          2            │  │
│  │ LAST           4            │  │
│  ┌ ENTRY POINT ────────────────┐  │
│  │ X                    ABS    │  │
│  │ Y                    ABS    │  │
│  ┌ RATE ───────────────────────┐  │
│  │ FEED          10  IPM       │  │
│  └─────────────────────────────┘  │
│  ┌ FINISH ─────────────────────┐  │
│  │           0.0000  CUT        │  │
│  │   FEED         0  IPM        │  │
│  │   DIRECTION       CCW        │  │
│  │   STEPOVR     50  %          │  │
│  │                              │  │
│  └─────────────────────────────┘  │
└──────────────────────────────────┘
```

Engrave

You can engrave part numbers and other text into a part using this feature. The ENGRAVE feature has two parts. First, specify the characteristics of the text, such as where it goes and how large it is. Then you need to select the actual text characters (alpha or numeric) that you want to engrave.

The text that you specify will occupy a rectangular area called a *text block*.

EXAMPLE:

```
┌─────────────────────────┐
   AMERICAN WIDGET
  PART NUMBER 4562-001033VJ
      MADE IN USA
└─────────────────────────┘
```
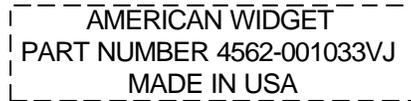
To get the ENGRAVE TEXT step, press the **MORE STEPS** softkey, then the **ENGRAVE** softkey.

First, enter the location on the part for the UPPER LEFT CORNER of the text block, then the CHARACTER HEIGHT.

If you enter a TILT ANGLE, the entire text block will be rotated around the upper left corner.

The way the text letters and numbers look is called *style*. STYLE has two parts: FONT and MODIFIER.

You may select the FONT from the list available under the **ENGRAVER FONTS** softkey. The *font* determines the shapes of the characters. In the **MILLPWR** STICK font, characters are formed with straight lines. In the SIMPLE font, both lines and arcs are used to form characters. Some fonts have more characters to choose from than others.

ENGRAVE TEXT	001

UPPER LEFT CORNER
X   ABS
Y   ABS

CHARACTER HEIGHT

TILT ANGLE
        0° 00' 00"

DEPTH
Z   0.000 ABS

STYLE
     STICK   FONT
    NORMAL   MODIFIER

TOOL
          INCH
          TYPE
FEED   10   IPM

Use "mirrored" if you're making a mold.

The MODIFIER field lets you select between *normal* and *mirrored* text using softkeys.

The second part is to enter the text characters. Press the **EDIT TEXT** softkey to see the **ENGRAVE TEXT EDITOR**.

This is the "insertion point", where the next character will go.
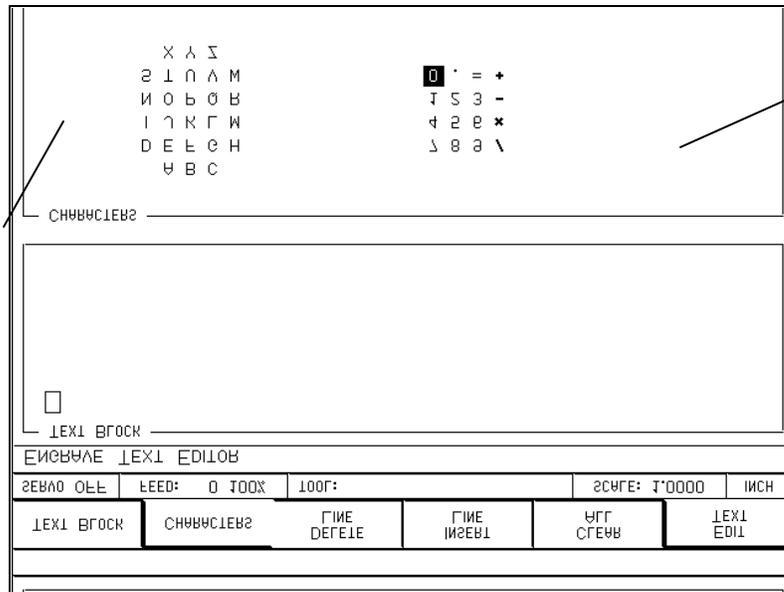
This area will hold the contents of the text block.

The screen is divided into the TEXT BLOCK area and the CHARACTERS area. The TEXT BLOCK area is where you see the text that you will engrave. The CHARACTERS area contains all the different characters that are available in the font you have selected.

With the **CHARACTERS** softkey pressed, use the arrow keys to select the character you want, then press **ENTER**. That character is put into the **TEXT BLOCK** area at the insertion point. You can leave a space between characters by using a blank "character".

With the **TEXT BLOCK** softkey pressed, you can use the arrow keys to move the insertion point. This is how you place text on more than one line.

If you place the insertion point over an existing character, the **DEL** key will erase it.

The **DELETE LINE** softkey will erase the entire line of text that the insertion point is in, and move all following text lines up. The **INSERT LINE** softkey will insert a blank text line, moving existing text lines down. The **CLEAR ALL** softkey will erase all the text in the TEXT BLOCK area.

When you have the text block set up the way you want, release the **EDIT TEXT** softkey (or press **USE**) to get back to the ENGRAVE step. **MILLPWR** will draw the text block for you to inspect. Press the **EDIT TEXT** softkey if you want to make changes, or press **USE** to enter the step into your program.

Explode

Strictly speaking, EXPLODE is not a step, but it can create steps.

Any *repetitive* type of step causes **MILLPWR** to create copies of one or more simpler steps. For example, the ROTATE step below creates 2 copies of the contour-with-hole shape, yet it only takes one step. Similarly, a single BOLT CIRCLE step causes **MILLPWR** to drill several holes.


```
002    MILL LINE
003    MILL LINE
004    MILL LINE
005    POSITION / DRILL
006    ROTATE (002 - 005)
```
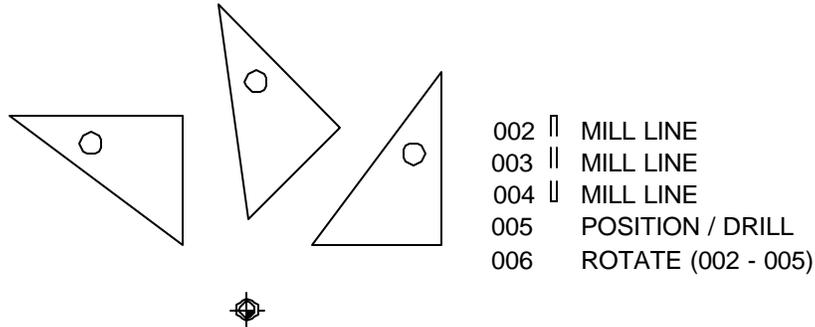
Repetitive type steps include **REPEAT, ROTATE, MIRROR, ROW OF HOLES, HOLE FRAME, HOLE ARRAY,** and **BOLT CIRCLE.**

The EXPLODE function will take one of these repetitive type steps and replace it with the individual steps. This is useful when you need to change or eliminate one of the individual steps.

For example, to program an eight-hole bolt circle without the third hole:

1. Program the eight-hole bolt circle.

2. Highlight the BOLT CIRCLE step.

3. Press EXPLODE. The BOLT CIRCLE step is removed and eight POSITION / DRILL steps are inserted in its place.

4. Move to the third hole and press the **DEL** key.
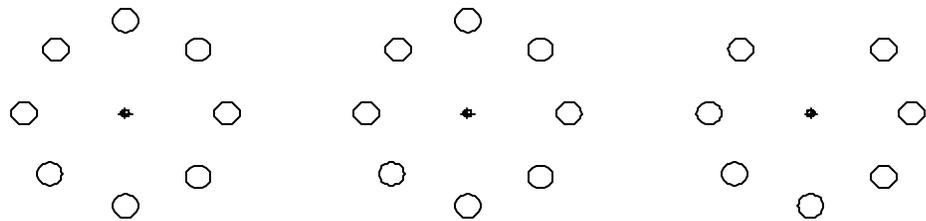

```
┌──────────────────────┐
│ 002    BOLT CIRCLE   │      002    POSITION / DRILL        002    POSITION / DRILL
└──────────────────────┘      003    POSITION / DRILL        003    POSITION / DRILL
                              004    POSITION / DRILL        004    POSITION / DRILL
       EXPLODE STEP 002       005    POSITION / DRILL        005    POSITION / DRILL
       TO GET 8 POS /         006    POSITION / DRILL        006    POSITION / DRILL
       DRILL STEPS.           007    POSITION / DRILL        007    POSITION / DRILL
       HIGHLIGHT THE          008    POSITION / DRILL        008    POSITION / DRILL
       THIRD HOLE AND         009    POSITION / DRILL
       PRESS THE
       DEL KEY.
```

CALCULATOR

Four Function Arithmetic

The four arithmetic keys, [**+**] [**-**] [**X**] [**/**] , are available when you are in any numeric entry field, such as X, Y, CENTER, or RADIUS. Just use these keys as you would any calculator.

KEY	**2**	**+**	**5**	**ENTER**
RESULT	2	2 +	5	7

The keys will act on a number that is already in the field. For example, if you move to a radius field which already has a value of 3.125, and you want to double it, just press:

[**X**] [**2**] [**ENTER**] to get 6.250.

When you have more than one calculation in a field, the calculator will perform multiplication and division before it does addition and subtraction. This means that you can enter 3 + 1 / 8 to get three and one-eighth (the 1 / 8 is done before the 3 is added).

Trig and Math Functions

When you're entering data for a milling or positioning function, part dimensions will not always be given. In some cases, it will be possible to calculate the dimensions using the *trig calculator*. If the unknown coordinate can be expressed as a trig function, a square root or the square of a number, **MILLPWR** can calculate it.

While in a point entry field such as X, Y, or CENTER, press the **CALC** key. The following trig function softkeys are shown.

SHIFT	COS	SIN	TAN	SQR ROOT	(
	ARC COS	ARC SIN	ARC TAN	SQR	)

Most of the calculator softkeys are divided in half. At first, the top half is "active", while the bottom half is "inactive". Select the **SHIFT** softkey and the bottom half of the calculator options becomes active:

SHIFT	COS	SIN	TAN	SQR ROOT	(
	ARC COS	**ARC SIN**	**ARC TAN**	**SQR**	**)**

| **X** | | | | | |

Typically, a result is calculated by entering a number and then selecting the appropriate math function. For example, to enter a RADIUS whose value is the square root of 2, press the 2 key, the **CALC** key and then select the **SQR ROOT** softkey. A value of 1.4142 (the square root of 2) will be displayed.

2		CALC

SQR ROOT
SQR

```
 ┌─ RADIUS ──────────┐          ┌─ RADIUS ──────────┐
 │          2         │          │          1.4142    │
 └────────────────────┘          └────────────────────┘
```
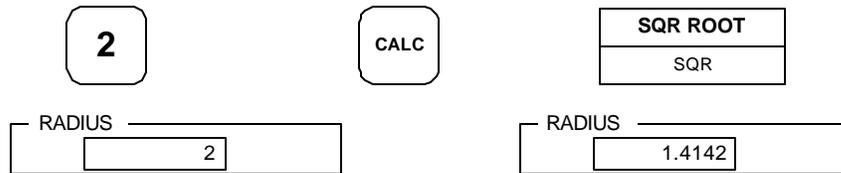
Trig functions are calculated by entering the angle first and then the appropriate trig function. For example, enter 30, then select the **SIN** softkey. A value of 0.5000 (SIN 30°) will be displayed.

Notice that you can press the CALC key first, and just stay in the calculator.

CALC	3	0

SIN
ARC SIN

```
 ┌─ RADIUS ──────────┐          ┌─ RADIUS ──────────┐
 │          30        │          │          0.5000    │
 └────────────────────┘          └────────────────────┘
```
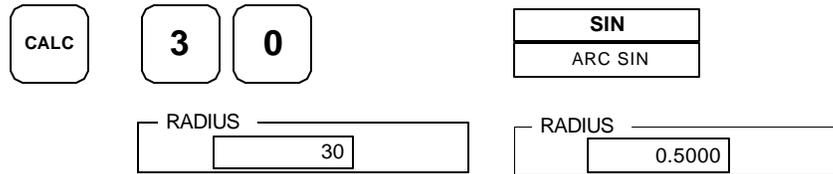
Typically, a trig value must be multiplied by another number to calculate an actual dimension. In the example above, assume the 0.5000 must be multiplied by the length of a triangle's hypotenuse, say 4, to calculate the side opposite the 30° angle.

X	4	ENTER

0.5000	0.5000 X	4	2.000
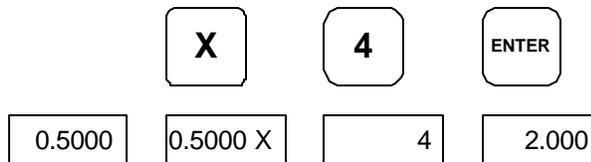
The parentheses softkeys can be used to group certain calculations within an arithmetic statement. For example,

2 + 1 / 16 gives two and one-sixteenth, but

(2 + 1) / 16 gives three-sixteenths.

The parentheses are not always displayed during the key stroke sequence, but they are remembered by the **MILLPWR** as it calculates the correct answer.

Geometry Calculator

Why We Need a Geometry Calculator

Occasionally, a drawing will not have enough information to program a part in the usual way.

An example is the illustration below. The part is uniquely defined by the given information. However, the coordinates of points **C** and **D**, where the arc is tangent to the sides, are unknown. These coordinates are needed to define lines 002 and 004, as well as the **FROM** and **TO** points of the arc.

001	LINE, from A to B
002	LINE, from B to C
003	ARC, from C to D
004	LINE, from D to A
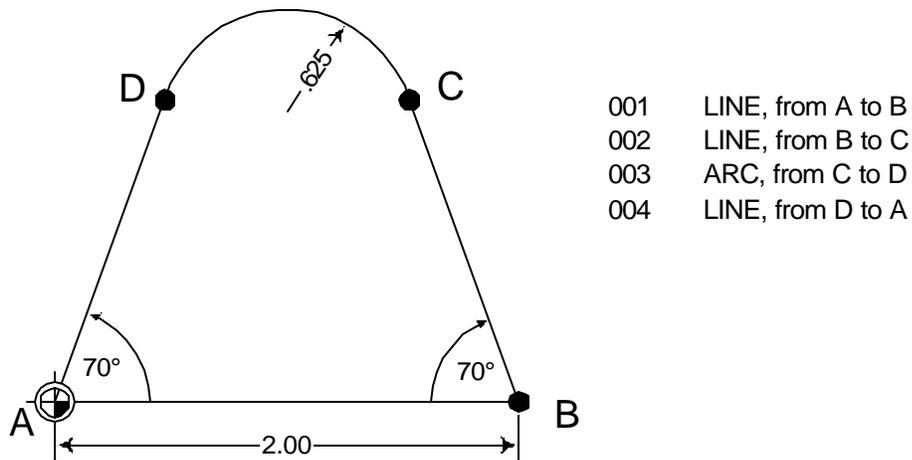
MILLPWR's *geometry calculator* can be used to calculate the unknown points for this problem and for many others.

Working with the Geometry Calculator

To open the geometry calculator, referred to as GeoCalc, press the **CALC** key. If you are not in a numeric field, the GeoCalc screen appears. If you are in a numeric field and the trig calculator softkeys appear, press the **CALC** key again to get the GeoCalc screen.

```
SERVO  OFF  FEED        0    100%    TOOL:                    SCALE   1.0000    INCH
                                                       GEOMETRY CALCULATOR




              DRAWING AREA                        CALCULATOR
                                                     LIST




                                                        END OF 0

```

The strategy for using GeoCalc is to find a point, which is not given on the blueprint, that you need for the FROM, TO, or CENTER point for a line, arc, or any other program step.

The basic operating procedure is:

1. Use the **POS**, **LINE**, and **ARC** keys to enter points, lines, arcs. These *features* are drawn in the drawing area and are listed in the calculator list area.

2. Using the **SELECT FEATURE** softkey, select either one or two features.

3. Press **FIND POINT**, **FIND LINE**, or **FIND ARC**.

   The calculator automatically finds all "interesting" points, lines, or arcs, as shown in the table on the next page.

4. Using softkeys, keep one or more of the results.

5. Repeat steps 2 - 4 until you have the features you need.

6. Using the **RETURN FEATURE** softkey, return features to the program.

The kinds of "interesting" things that GeoCalc finds depend on the features you *select* and whether you ask for a point, line, or arc. The table below lists all of the points, lines, and arcs found by the GeoCalc.

Items Selected	Find Point	Find Line	Find Arc
2 Points	Midpoint between the given points	Line between the given points	Given a radius, all arcs thru the given points
1 Point 1 Line	Point on the given line which, with the given point, would form a line perpendicular to the given line	Lines thru the given point, one parallel and one perpendicular to the given line	Given a radius, all arcs thru the given point and tangent to the given line
1 Point 1 Arc	Points which, with the given point, would form lines tangent to the given arc and the shortest line from the given point to the given arc	Lines thru the given point tangent to the given arc, and the shortest line thru the given point to the given arc	Given a radius, all arcs thru the given point and tangent to the given arc
1 Line	End points of the given line	Given a distance, lines parallel to the given line; lines perpendicular to the given line thru its end points	
2 Lines	Intersection point of the given lines	Line that bisects the angle formed where the given lines intersect; line perpendicular to the bisector	Given a radius, all arcs tangent to both given lines
1 Line 1 Arc	Points where given line intersects given arc	Lines perpendicular to the given line and tangent to the given arc; shortest line to the given arc which is perpendicular to the given line	Given a radius, all arcs tangent to the given line and the given arc
1 Arc	Center point, end points		
2 Arcs	Intersection points	Lines tangent to arcs; shortest line between arcs	Given a radius, all arcs tangent to both arcs

When the GeoCalc uses lines and arcs, it will extend them. Lines are extended in both directions and arcs are treated as circles. This means that you do not have to specify lines and arcs exactly; just enter enough information to get the line or arc "started", and GeoCalc will fill in the rest when needed.

Example Problem

We'll use the example below to demonstrate how to use GeoCalc.

Strategy

We can program the line from A to B directly. Then we'll use GeoCalc.

Our strategy will be:

- Enter the line from A to D.

- Enter the line from B to C.

- Select the two lines, and use the FIND ARC function.

- Get points C and D, the endpoints of the arc. Then, transfer them into the program from GeoCalc.

Starting the Program

Point **A** is shown as the datum with absolute coordinates of 0,0. In the part program, enter the line from A to B.

MILL LINE		002
FROM		
X1	0.0000	ABS
Y1	0.0000	ABS
TO		
X2	2.000	ABS
Y2	0.000	ABS
DEPTH		
Z	-0.250	ABS
TOOL		
	0.125	INCH
	FLT END ML	TYPE
	RIGHT	OFFSET
FEED	10	IPM

SERVO	OFF	FEED	0	100%	TOOL:		SCALE	1.0000	INCH

CURRENT PROGRAM

001   SET TOOL

002   MILL LINE

END OF 2

PROGRAM FUNCTIONS	CLEAR PROGRAM	EXPLODE	MORE STEPS		RUN OPTIONS

Now, according to our strategy, we'll go to GeoCalc to find the two points we need.

Entering the Lines

Press the **CALC** key on the front display panel to enter the GeoCalc screen. Press the **LINE** key and construct the line from A to D. Although we will <u>mill</u> this line in the other direction (<u>towards</u> the datum), in the GeoCalc, a line is just a line, and its direction doesn't matter.

Here's how we do it:

- We know the start point: X = 0, Y = 0.

"From the datum" means we can use absolute dimensioning.

- We know the angle of the line <u>from the datum</u> is 70°. In the TO field, press the **POLAR** softkey. The field now looks like this:

```
┌─ TO ─────────────────────┐
│ R2  ┌──────────┐  ABS     │
│ A2  └──────────┘  ABS     │
└──────────────────────────┘
```

GEO LINE	001

```
┌─ FROM ───────────────────┐
│ X1          0.000   ABS   │
│ Y1          0.000   ABS   │
└──────────────────────────┘

┌─ TO ─────────────────────┐
│ R2          5.000   ABS   │
│ A2      70° 00' 00"  ABS  │
└──────────────────────────┘
```

- The polar coordinates are R2 (radius) and A2 (angle).

- We don't know the length of the line, but GeoCalc doesn't need it. Just guess and put in 5, which appears to be longer than we need.

- Go down to the A2 field and enter 70°.
- Press **USE** and the line is drawn.

SERVO **OFF**	FEED	**0**	**100%**	TOOL:		SCALE **1.0000**	**INCH**

GEOMETRY CALCULATOR

001　　GEOLINE

END OF 1

SELECT FEATURE	FIND POINT	FIND LINE	FIND ARC	RETURN FEATURE	CLEAR CALC

"From its own start point" means we can't use absolute dimensioning. We need to use "incremental".

Next, we'll put in the other side line. This line starts at X = 2, Y = 0, and goes out <u>from its own start point</u> at a 110° angle.

Again, since we know the angle, we can use polar coordinates. But because the angle (and the length) will be measured from point B, not from the datum, we need to use *incremental* dimensioning, not absolute.

```
        R2
          A2
   70°   110°
        +X
  2.00   B
INCREMENTAL
  ZERO
```
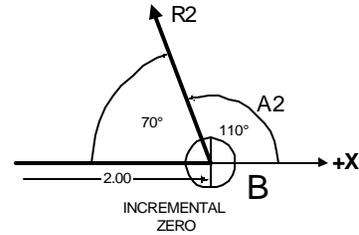
- Press the **LINE** key. In the FROM point, put X = 2 and Y = 0.

- In the TO point, press the **POLAR** softkey. Guess at 5 for R2.

```
FROM
X1        2.000 ABS
Y1        0.000 ABS
TO
R2        5.000 ABS
A2              ABS
```

- Since this is the length of the line from its start point, B, and not from the datum, we'll need to use incremental dimensioning instead of absolute. Press the **ABS/INC** key to bring up the INC reference field.

```
TO
R2        5.000 INC  R1
A2              ABS
```

Because the FROM point (X1/Y1, or R1/A1 in polar) is the "incremental zero", we want R1 in the INC field, **MILLPWR** puts it there automatically. The R2 field now says "R2 is 5.000 measured incrementally from the FROM point, R1/A1".

- Move to the A2 field. Enter 110° for the angle. Since the angle is measured from point B, the incremental zero, we must press the **INC/ABS** key again, and we see A1 is automatically put in the INC field. The A2 field now reads "A2 is 110° from the FROM point, R1/A1".

```
TO
R2        5.000 INC  R1
A2        110°  INC  A1
```

- Press **USE** to see the line.

```
SERVO OFF  FEED  0  100%   TOOL:              SCALE 1.0000  INCH
                           GEOMETRY CALCULATOR
                           001   GEOLINE
                           002   GEOLINE

                                  END OF 2
SELECT    FIND    FIND    FIND    RETURN    CLEAR
FEATURE   POINT   LINE    ARC     FEATURE   CALC
```
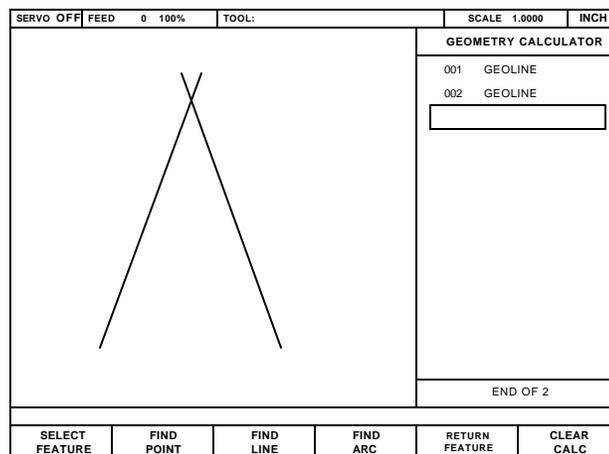
Finding the Arc

First, move to 001 GEOLINE and press the **SELECT FEATURE** key. Repeat for 002
GEOLINE. Notice that an arrow appears to signify that the lines have been selected.
Also, the message line above the softkeys tells you which features are selected.

*The white
highlighting lets
you know which
line you're
pointing to.*

Press the **FIND ARC** softkey. A field for the arc radius will be displayed in the
message bar. Enter 0.625, press **USE**, and GeoCalc displays all possible 0.625
radius arcs tangent to the two selected lines.

SERVO OFF	FEED 0 100%	TOOL:		SCALE 1.0000	INCH

GEOMETRY CALCULATOR

001 → GEOLINE
002 → GEOLINE
GEOARC
GEOARC
GEOARC
GEOARC
GEOARC
GEOARC
GEOARC
GEOARC

3 OF 10

CURRENT SELECTIONS: 001 GEOLINE AND 002 GEOLINE

	KEEP ONE		KEEP ALL		CLEAR RESULTS
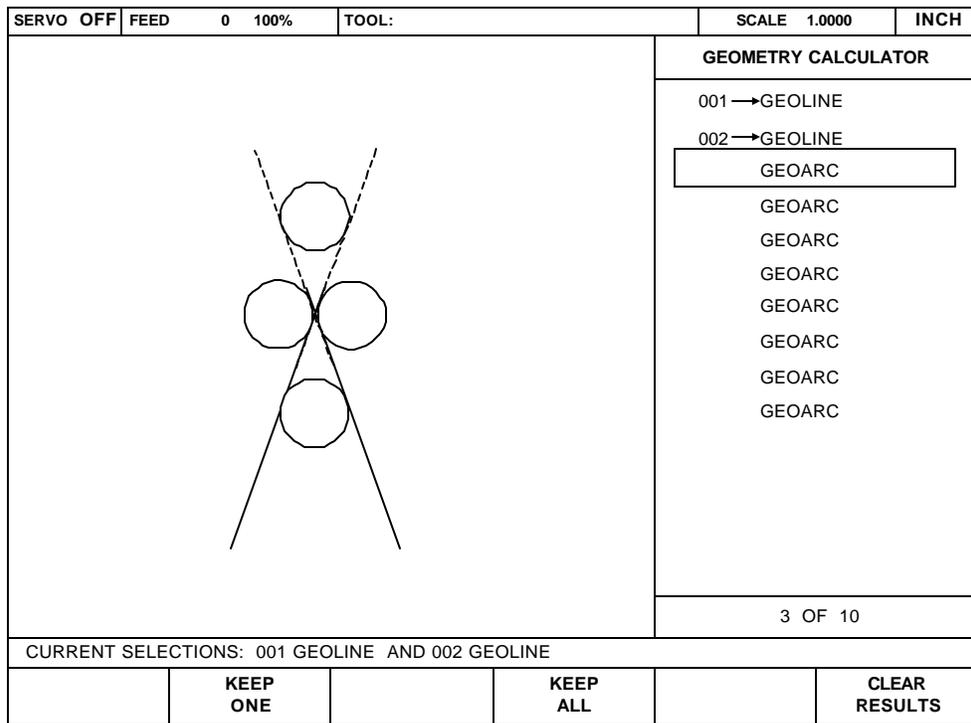
The four circles are actually eight arcs. The ends of the arcs are where they are tangent
to the lines. Move down through the list of GeoArcs and watch the corresponding arcs
highlight.

The arcs are the results of the **FIND ARC** calculation. They are not numbered in the list
as the GeoLines are because they are temporary. You will keep the one you want and
clear the rest.

Highlight the arc that forms the top of the part. Press the **KEEP ONE** softkey, and GeoCalc makes that arc number **003**. Then press the **CLEAR RESULTS** softkey to erase the remaining arcs.

SERVO OFF	FEED	0	100%	TOOL:		SCALE	1.0000	INCH

GEOMETRY CALCULATOR

001 ⟶ GEOLINE

002 ⟶ GEOLINE

003   GEOARC

END OF 3

CURRENT SELECTIONS: 001 GEOLINE AND 002 GEOLINE

SELECT FEATURE	FIND POINT	FIND LINE	FIND ARC	RETURN FEATURE	CLEAR CALC

Finding the Points of Tangency

Keep in mind that the ultimate goal is to have GeoCalc determine the points of tangency between the lines and the arc. Since the FIND ARC function calculates the arcs which are tangent to the two selected lines, the ends of the arcs are the points we need. We just have to select the arc and have GeoCalc find the end points.

- Select 001 GEOLINE and press the **SELECT FEATURE** softkey. This will de-select the line.

- Move down to 002 GEOLINE and de-select it.

- Move down to 003 GEOARC and select it.

- Press the **FIND POINT** softkey.

The three resulting points are the center and the ends of the arc. The end points are the ones we are after; they are points C and D in our drawing.

- Select one end point. Press **KEEP ONE**.

- Move to the other end point. Press **KEEP ONE**.

- Press **CLEAR RESULTS** to erase the arc's center point.

We now have the tangent points, 004 and 005, stored in the calculator.

SERVO OFF	FEED 0 100%	TOOL:		SCALE 1.0000	INCH

GEOMETRY CALCULATOR

001	GEOLINE
002	GEOLINE
003 →	GEOARC
004	GEOPOINT
005	GEOPOINT

5 OF 5

CURRENT SELECTION: 003 GEOARC

SELECT FEATURE	FIND POINT	FIND LINE	FIND ARC	RETURN FEATURE	CLEAR CALC
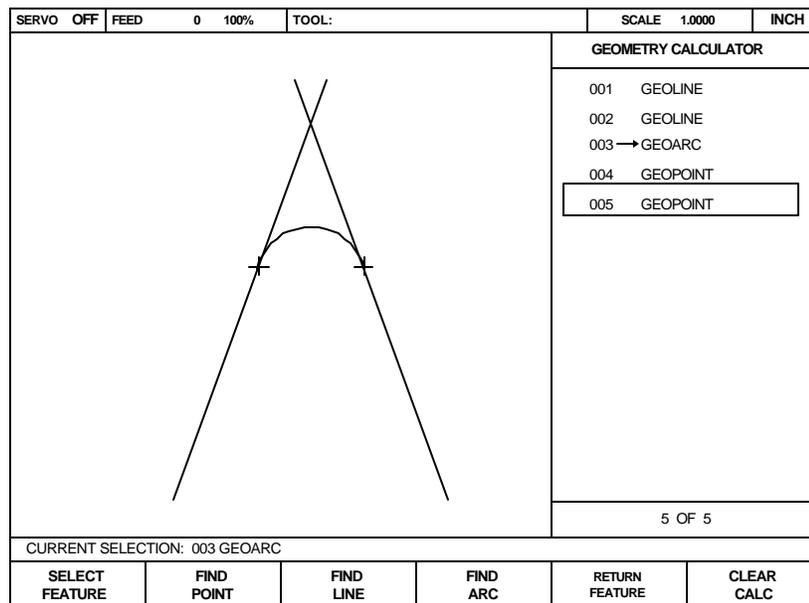
Returning Features

GeoCalc will return features to the part program by pressing the **RETURN FEATURE** key. We will now program the second line, the arc, and the last line.

Press **CANCEL** to return to the program. Make sure you are after the first MILL LINE step.

The features in the calculator will not be lost until the MILLPWR is turned off or until you clear the calculator.

- Press **LINE** to get a new MILL LINE form. The FROM point is automatically set to point B.

| SERVO | OFF | FEED | 0 | 100% | | TOOL: | | SCALE | 1.0000 | INCH |

CURRENT PROGRAM

001   SET TOOL
002   MILL LINE

END OF 2

| PROGRAM FUNCTIONS | CLEAR PROGRAM | EXPLODE | MORE STEPS | | RUN OPTIONS |

(Diagram: trapezoidal shape with points D, C at top and A, B at bottom. Top arc labeled R.625. Bottom side labeled 2.00. Interior angles at A and B are 70°.)
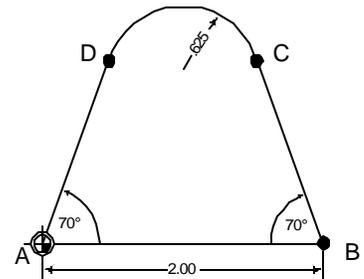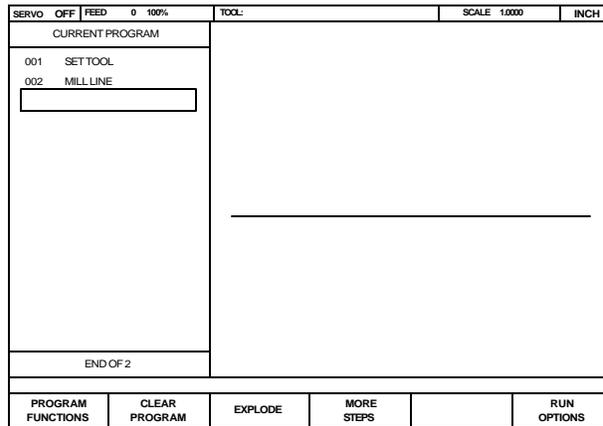
- You are in the X2 field in the TO point. This is point C, one of the points we have in GeoCalc.

- Press the **CALC** key twice to get to the GeoCalc screen.

- Select the GeoPoint representing point C. Press the **RETURN FEATURE** softkey. This moves the coordinates of point C to the part program and returns to the program. Press **USE** to put the line into the part program.

| SERVO | OFF | FEED | 0 | 100% | | TOOL: | | SCALE | 1.0000 | INCH |

CURRENT PROGRAM

001   SET TOOL
002 ⌐ MILL LINE
003 ∟ MILL LINE

END OF 3

| PROGRAM FUNCTIONS | CLEAR PROGRAM | EXPLODE | MORE STEPS | | RUN OPTIONS |
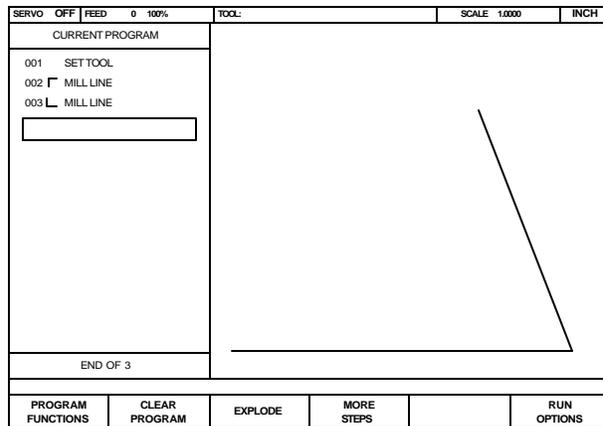
- Press **CALC** to get to GeoCalc.

- Highlight the arc.

- Press the **RETURN FEATURE** softkey. **MILLPWR** automatically adds an arc step to the program and places the arc's information into the form.

- Press **USE** to put the arc into the program.

- Press the **LINE** key. The end of the line is at the datum, so enter X2 = 0, Y2 = 0 in the TO point, and press **USE** to keep the line.

The program is now complete.

SETUP

SETUP

Pressing the **SETUP** key displays information about the system that you can adjust. This is the OPERATOR SETUP list.

SERVO OFF	FEED	0	100%	TOOL:		SCALE 1.0000	INCH

```
         OPERATOR SETUP

 ┌──────────────────────┐
 │ TOOL  LIBRARY        │
 └──────────────────────┘
   SCALE  FACTOR
   DISPLAY  OPTIONS
   TOUCH  PROBE
   FEED RATE SETTINGS
   SYSTEM SETUP




         1 OF 6
```

INCH	MM			USE NEW SETTINGS	CANCEL CHANGES

Select the item you wish to change and press **ENTER**. After you have made any desired changes to the settings, press the **USE NEW SETTINGS** softkey to activate them.

Pressing the **CANCEL CHANGES** softkey will restore your previous settings.

Inch or Metric

Press the **INCH** or **MM** softkey to use either English or metric dimensions. Press the **USE NEW SETTINGS** softkey to keep the change.

If you have a program loaded, you cannot change the units. The units cannot be converted because the program was already entered either in inches or in millimeters.

Operator Setup

Tool Library

A list of tools is available to you for convenient selection during programming and/or operation of the **MILLPWR** . There are 99 "slots" in the Tool Library. You can organize tools any way you wish. One way is to keep all your flat end mills together in a group, all drills in a group, and so on. Another way is to group them by size.

Put your most commonly used tools first!

Move to TOOL LIBRARY, and press **ENTER**.

SERVO OFF	FEED	0	100%	TOOL:			SCALE	1.0000	INCH

TOOL LIBRARY

1				
2				
3				
4				
5				
6				
7				
8				
9	0.0625	INCH	DRILL	
10	0.1250	INCH	DRILL	
11	0.3875	INCH	DRILL	
12	0.5000	INCH	DRILL	
13				
14				

1 OF 99

SORT BY NUMBER	SORT BY TYPE			USE NEW SETTINGS	CANCEL CHANGES

To add a tool to the tool library, select an unused slot and press **ENTER**. Fill in the DIAMETER, the UNITS, and the TYPE (press the **TOOL TYPES** softkey to see the available list). Press **USE** to enter the tool into the library.

To change an existing tool, move to that tool and press **ENTER**. Make any changes and press **USE**. The changed tool will now appear in the library.

You can see the library in numerical order, or, if you press the **SORT BY TYPE** softkey, by tool type.

Scale Factor

The scale factor can be set to scale the workpiece up or down from the programmed size. All programmed dimensions will be multiplied by this scale factor when the program is run. The numbers in your program are **not** changed.

A scale factor of 1.000 causes the **MILLPWR** to use programmed dimensions exactly. Values greater than 1 cause the **MILLPWR** to make parts larger than the programmed dimensions; values less than 1 to make parts smaller.

```
┌─────────────────────────────────┐
│         SCALE FACTOR            │
│  ┌─ SCALE ──────────────────┐   │
│  │                  1.0000  │   │
│  └──────────────────────────┘   │
│                                 │
│                                 │
│                                 │
└─────────────────────────────────┘
```

Display Options

Select DISPLAY OPTIONS and press **ENTER**.

For each of the settings, a series of softkeys gives you the available options.

ANGLES lets you show angles as decimal degrees, radians, or degrees-minutes-seconds (DMS)

INC DISPLAY will let you see INCREMENTAL TRAVEL or DISTANCE TO GO in the DRO incremental display. *Incremental travel* is the distance from the start of the line to the tool; it reads 0 at the start. This is equivalent to "zero and go" operation. If you're milling a line, *distance to go* is the distance from the tool to the end of the line; it reads 0 when you're at the end. This is equivalent to presetting a target and machining to zero.

```
┌──────────────────────────────┐
│       DISPLAY OPTIONS         │
│                              │
│  ┌─ ANGLES ────────────────┐  │
│  │                   DMS    │  │
│  └──────────────────────────┘  │
│  ┌─ INC DISPLAY ───────────┐  │
│  │          DISTANCE TO GO  │  │
│  └──────────────────────────┘  │
│  ┌─ DISPLAY RESOLUTION ────┐  │
│  │                NORMAL    │  │
│  └──────────────────────────┘  │
│  ┌─ POINT ENTRY ───────────┐  │
│  │              CARTESIAN   │  │
│  └──────────────────────────┘  │
│  ┌─ FROM POINT ────────────┐  │
│  │                ABSOLUTE  │  │
│  └──────────────────────────┘  │
└──────────────────────────────┘
```

DISPLAY RESOLUTION is the smallest increment of motion shown in the DRO.

VERY HIGH	= .0001"	or .002 mm
HIGH	= .0002"	or .005 mm
NORMAL	= .0005"	or .01 mm
LOW	= .001"	or .02 mm

POINT ENTRY lets you select Cartesian for X-Y coordinates, or polar if you have a job which has most of the dimensions in polar coordinates (radius and angles).

FROM POINT lets you determine how **MILLPWR** will show the coordinates of the start of a line (or arc) when it connects to the previous line. The INCREMENTAL setting will show the FROM points like this:

Line 004, FROM:
X1 0.0000 INC 003
Y1 0.0000 INC 003

The ABSOLUTE setting will show the FROM points like this:

Line 004, FROM:
X1 4.0050 ABS
Y1 -3.2000 ABS

Touch Probe

The diameter of the probe or edge finder, used for finding the workpiece edge during datum setting, is set by selecting TOUCH PROBE and entering the diameter.

Feed Rate Settings

Here you can change the settings for various speeds and feeds.

STEP OVERRIDE % is the size of the percent step used when you press the FEED+ and FEED- keys.

MAX % is the most you can override the programmed feed rate with the FEED+ key.

MIN % is the lowest you can override the programmed feed rate with the FEED- key.

*DRY RUN SPEED is the speed used during dry run testing of a program. It is also the speed used when you use MOVE TABLE with the arrow keys.

*DEFAULT FEED RATE is what appears automatically in the first milling step of a new program in the FEED RATE field.

```
┌─────────────────────────────────┐
│        FEED RATE SETTINGS        │
│  ┌─ STEP OVERRIDE % ──────────┐  │
│  │                          5 │  │
│  └────────────────────────────┘  │
│  ┌─ MAX OVERRIDE % ───────────┐  │
│  │                        150 │  │
│  └────────────────────────────┘  │
│  ┌─ MIN OVERRIDE % ───────────┐  │
│  │                         50 │  │
│  └────────────────────────────┘  │
│  ┌─ DRY RUN SPEED ────────────┐  │
│  │                        100 │  │
│  └────────────────────────────┘  │
│  ┌─ DEFAULT FEED RATE ────────┐  │
│  │                         10 │  │
│  └────────────────────────────┘  │
│  ┌─ UNIT(/MIN) ───────────────┐  │
│  │                       INCH │  │
│  └────────────────────────────┘  │
│                                  │
└─────────────────────────────────┘
```

UNIT/(MIN) lets you set the system feedrate to operate in inches per minute or millimeters per minute.

> **Note that the DRY RUN SPEED and FEED RATE DEFAULT are not converted. A speed of 100 will be 100 in/min or 100 mm/min, depending on units.*

System Setup

When you select SYSTEM SETUP from the OPERATOR SETUP list, you are asked for a passcode. The passcode is defined on page 2 of this manual. Enter it to bring up the following list of settings.

SERVO **OFF**	FEED	**0**	**100%**	TOOL:		SCALE **1.0000**	**INCH**

SYSTEM SETUP

```
 PROTECTION

 ERROR COMPENSATION

 ENCODER DIRECTION

 SERIAL PORT
```

1 OF 4

PREVIOUS MENU				USE NEW SETTINGS	CANCEL CHANGES

Protection

MILLPWR gives you the ability to prevent changes to part programs and to the tool library without first entering into the system setup and removing the protection.

With program protection set to YES, programs cannot be changed or saved. This prevents an inexperienced machine operator from making bad parts by mistakenly changing or deleting a step.

```
          PROTECTION

   PART PROGRAM
                      NO

   TOOL LIBRARY
                      NO
```

A TOOL step can always be changed.

If you protect the tool library, it can't be mistakenly changed either.

Error Compensation

If the milling machine shows signs of wear, actual part dimensions may differ from programmed dimensions. A correction factor can be entered for the axis that is not holding accurate dimensions.

SERVO OFF	FEED	0	100%	TOOL:		SCALE 1.0000	INCH

```
            SYSTEM  SETUP                    ERROR COMPENSATION

        PROTECTION                   ┌ X: STANDARD LENGTH (INCH) ┐
        ┌─────────────────────┐      │                    0.0000 │
        │ ERROR COMPENSATION  │      └───────────────────────────┘
        └─────────────────────┘
        ENCODER DIRECTION            ┌ X: COMPENSATION PPM ───────┐
                                     │                          0 │
        SERIAL PORT                  └────────────────────────────┘

                                     ┌ Y: STANDARD LENGTH (INCH) ┐
                                     │                    0.0000 │
                                     └───────────────────────────┘

                                     ┌ Y: COMPENSATION PPM ───────┐
                                     │                          0 │
                                     └────────────────────────────┘




                  2  OF  4
```

ENTER LENGTH OF STANDARD. INCLUDE TOOL DIAMETER IF REQUIRED.

FIRST POINT	SECOND POINT			USE NEW SETTINGS	CANCEL CHANGES

If you know the error correction value in *parts per million* (PPM), you can type it in directly. Otherwise, use the following procedure to find it for each axis:

- Set up a standard gage block of known length.

- Enter the standard length. If you need to touch each end of the block, using opposite edges of the probe or tool, include the diameter of the tool in the length of the standard. If you are using the kind of gage where you use the same edge of the tool for both ends, just enter the block's actual length.

- Touch one end of the block and press the **FIRST POINT** softkey.

- Touch the other end and press the **SECOND POINT** softkey.

- **MILLPWR** calculates and enters the correction in parts per million.
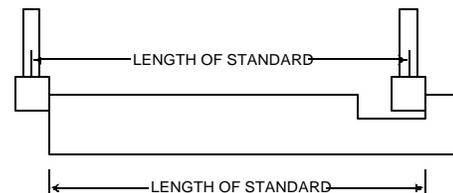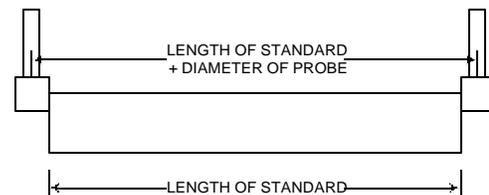
Encoder Direction

If you don't like the plus and minus directions that **MILLPWR** has chosen for you, you can change them. This might happen if you prefer to have the quill-down direction be positive, or if the X-axis scale is mounted to the front of the table instead of to the back.

Changing an axis from POSITIVE to NEGATIVE changes the count direction. Use the softkeys to make the changes.

Be careful about changing this and then running an old program--you could get some pretty strange results!

```
ENCODER  DIRECTION

  X AXIS
                    POSITIVE

  Y AXIS
                    POSITIVE

  Z AXIS
                    POSITIVE
```

Serial Port

After you have created a part program, you can store it any of three ways: on **MILLPWR**'s internal hard disk drive, on a 3 ½" floppy disk, or on the hard disk drive of your PC using **MILLPWR**'s serial port. Storing programs on your PC is often a good idea, because doing so frees up **MILLPWR**'s hard disk drive space, allowing **MILLPWR** to perform faster.

Before you save a program on your PC using **MILLPWR**'s serial port, you'll need to configure the parameters for the serial port. To do so, follow these simple steps:

- Using the arrow keys, highlight **SERIAL PORT** and press the **ENTER** key.

SERVO OFF	FEED	0	100%	TOOL:		SCALE	1.0000	INCH

SYSTEM SETUP	SERIAL PORT

PROTECTION

ERROR COMPENSATION

ENCODER DIRECTION

SERIAL PORT

FUNCTION

OFF

BAUD RATE

9600

4 OF 4

OFF	REMOTE STORAGE			USE NEW SETTINGS	CANCEL CHANGES

- Press the **REMOTE STORAGE** softkey to change the FUNCTION setting from "OFF" to "REMOTE STORAGE."

SERIAL PORT

FUNCTION

REMOTE STORAGE

BAUD RATE

9600

- Using the arrow keys, highlight the BAUD rate.

- Define the BAUD rate by using the **HIGHER** and **LOWER** softkeys. The BAUD rate you select must match the BAUD rate of your PC.

If you are unsure
which BAUD rate
to select, start
with 2400. You
can adjust it later
on if you need to.

```
                    SERIAL PORT
        ┌ FUNCTION ─────────────────────
        │        ┌──────────────────────┐
        │        │   REMOTE STORAGE     │
        │        └──────────────────────┘
        ┌ BAUD RATE ─────────────────────
        │        ┌──────────────────────┐
        │        │         2400         │
        │        └──────────────────────┘
```

- When you are finished, press the **USE NEW SETTINGS** softkey. If you want to change the information you have entered, press the **CANCEL CHANGES** softkey and edit the settings.

REMOTE STORAGE

When you create programs using **MILLPWR**, you can save them on the hard disk drive of your PC using the remote storage feature. The remote storage feature enables you to free up **MILLPWR**'s internal hard disk drive space. Plus, your PC is the ideal place to back up important files and organize them in one convenient location.

Equipment

To set up the remote storage program, you will need the following items:

- **MILLPWR**

- IBM-compatible PC

- Serial cable

- Remote Storage installation disk

Choosing a Serial Cable

Before **MILLPWR** and your PC can communicate with each other, they need to be connected with a serial cable. The graphic below illustrates how the cable's wires must be attached to the end connectors for successful transmission. Check that the cable you purchase follows this wiring diagram:
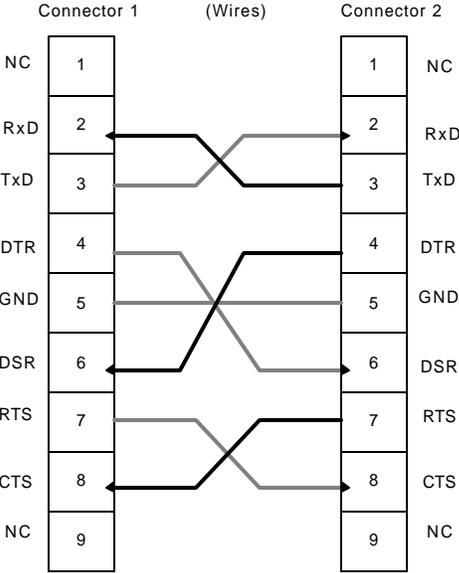
Connecting MILLPWR *to Your PC*

Before you can save programs remotely, you need to connect **MILLPWR** to your PC.

<table>
<tr><td>⚠</td><td>CAUTION</td></tr>
<tr><td colspan="2">To avoid the possibility of electrical shock, power down both MILLPWR and your PC before connecting the serial cable.</td></tr>
</table>

- Connect one end of the cable into the serial port located on the side of **MILLPWR**'s controller cabinet. Connect the opposite end of the cable into an available COM port on the back of your PC.
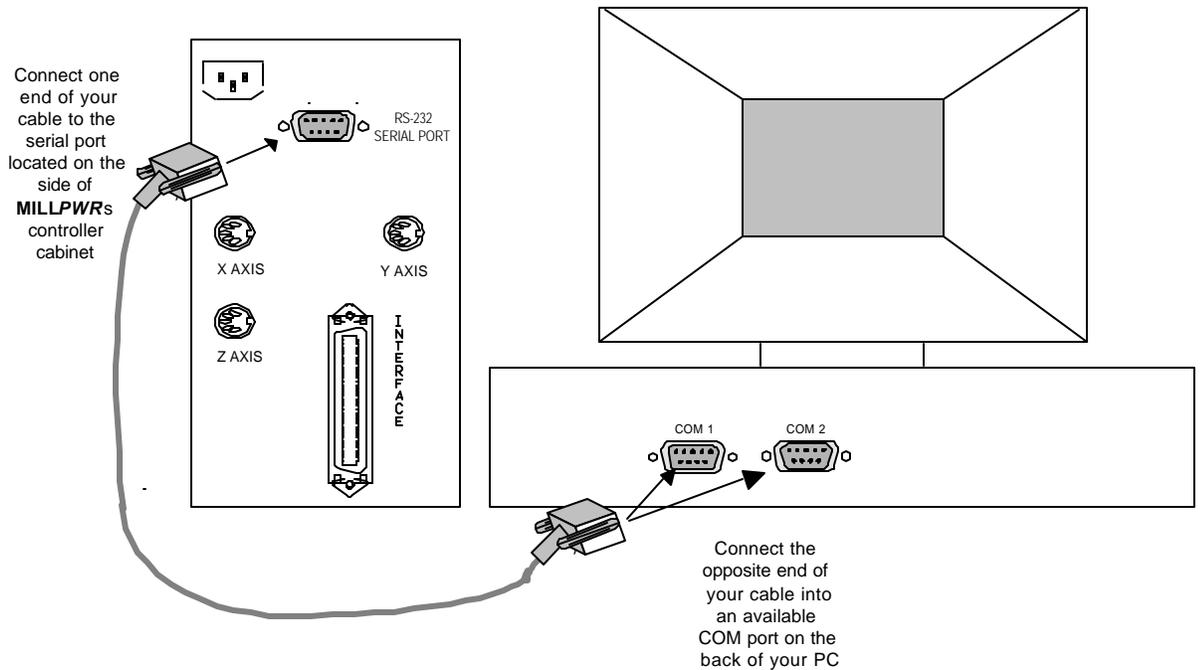
- Note that the COM port must be *available*—that is, not already assigned a piece of hardware by the PC. You cannot simply disconnect a piece of hardware and connect the cable. If there's no COM port recognized as being available by the PC, then you will need to make one accessible (consult your PC owner's manual).

Installing the Remote Storage Program

You can install the Remote Storage program on your PC using either Microsoft®
Windows® 95 or DOS® operating systems. Choose the system you will use, then follow
the applicable steps below.

For Windows 95:

1. Boot up your PC.

2. Insert the "Remote Storage" disk into your PC's floppy disk drive.

3. Click on "START."

4. Click on "Run," then type **a:install** and click "OK." This copies all of the files from
   the disk into a folder on your PC's hard disk drive.

5. Instructions on how to use Remote Storage will be displayed on the screen.

6. Close the DOS window. A Remote Storage icon should now appear on your PC
   screen. Double-click on the icon to run the Remote Storage program.
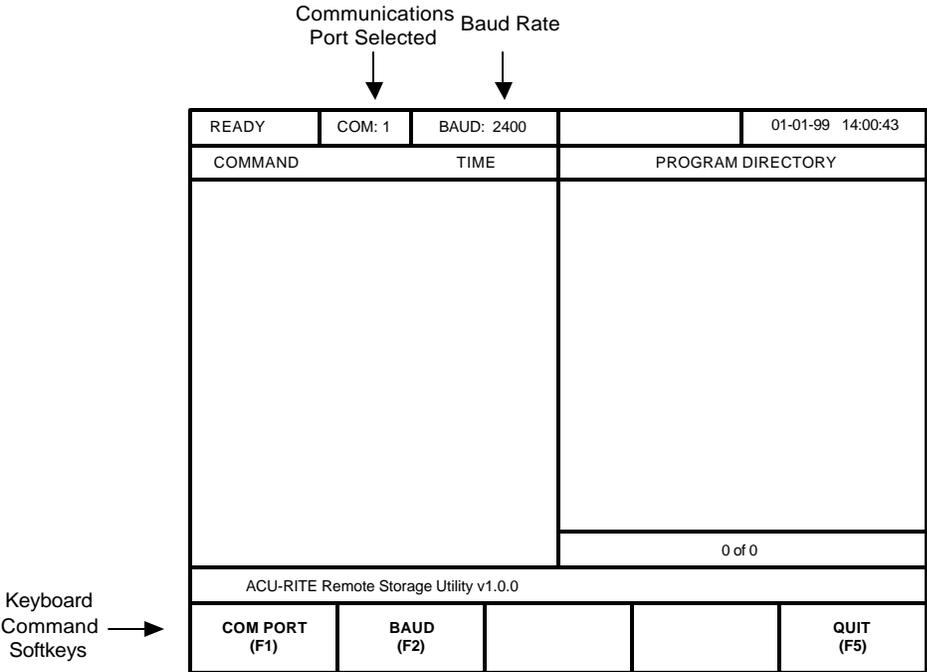
For DOS:

1. Boot up your PC.

2. Insert the "Remote Storage" installation disk into your PC's floppy disk drive.

3. At the C:\. prompt, type **a:** then press **ENTER**.

4. After the A:> prompt, type **install**, and press **ENTER** again. This command tells
   the PC to copy all the files from the disk into a folder on your PC's hard disk drive.

5. At the next prompt, type **c:** then press **ENTER**.

6. After the C:\ prompt, type **cd remtstor** and press **ENTER**.

7. C:\REMTSTOR\> will appear. Type **remtstor** and press **ENTER**.

Your PC should now display the Remote Storage Utility screen.

Setting the PC's COM Port and BAUD Rates

After the Remote Storage software has been loaded, the following screen will appear on your PC:

Communications Port Selected   Baud Rate

READY	COM: 1	BAUD: 2400		01-01-99 14:00:43
COMMAND		TIME	PROGRAM DIRECTORY	

0 of 0

ACU-RITE Remote Storage Utility v1.0.0

Keyboard Command Softkeys →

COM PORT (F1)	BAUD (F2)			QUIT (F5)

Now you need to identify your COM port and set the BAUD rate.

- **COM Port** – COM (short for "communication") port 1 is the program's default setting. You can switch to COM port 2 by pressing the F1 key on your PC's keyboard. Remember that the COM port setting must be available, and it must correspond with the PC port that you connected the serial cable to.

- **BAUD Rate** – Set the BAUD rate by pressing the F2 key on your PC's keyboard and scrolling through the pre-determined rates until the correct value appears. Use the same rate you entered on the **MILLPWR** "Serial Port" screen. (Refer to the **System Setup** section.)

After the proper COM port has been identified and the BAUD rate selected, you can begin storing **MILLPWR** programs on your PC using **MILLPWR**'s serial port. (For more information about creating, saving, and deleting programs, refer to the **Programming** section.)

Common Error Messages

If the communication lines between `MILLPWR` and your PC are disrupted, an error message will appear on the `MILLPWR` screen. Settings that do not match and a faulty serial cable connection are the most common problems and are easiest to correct.

Error	Cause	Solution
BAUD rate error	`MILLPWR` and PC BAUD rate settings do not match.	Change one of the settings so that `MILLPWR` and the PC BAUD rates are the same.
Checksum error	`MILLPWR` and PC BAUD rate settings do not match.	Change one of the settings so that `MILLPWR` and the PC BAUD rates are the same.
	BAUD rate is too slow.	Increase the BAUD rates on both the `MILLPWR` and the PC.
No response from PC	Serial cable connection and COM port setting do not match.	If the COM port setting (1 or 2) on the PC screen does not correspond with the port the serial cable is connected into: a) Change the setting; -OR- b) Disconnect the cable from the COM port that it is connected to and connect it to a different COM port.
	Incorrect serial cable	Verify that you are using a serial cable and that it is not a NULL modem cable. Replace the cable if necessary.
	`MILLPWR` and PC BAUD rate settings do not match.	Change one of the settings so that the BAUD rates for `MILLPWR` and your PC are the same.

Error	Cause	Solution
No response from PC (cont'd)	The selected COM port is disabled.	a) Change the PC's COM port setting and connect the serial cable into the appropriate port; -OR- b) Exit the remote storage program on your PC, then refer to your Microsoft® Windows® operating system's and PC operator's manuals for instructions on how to enable a COM port.
Timeout error	Loose serial cable	Check that each end of the serial cable fits snugly into the **MILLPWR** serial port and your PC's COM port.

387900-904 Ed G

Troubleshooting Guide

Introduction:

This **Troubleshooting Guide** is intended to assist you with diagnosing problems should you experience any difficulties with your **MILL*PWR*.**

Using the Table:

This **MILL*PWR* Troubleshooting Guide** is arranged in three columns entitled: **Symptom**, **Problem** and **Recommendation**. The **Symptoms** are listed in the order of most common, easiest to check, and least expensive to correct. First, locate the **Symptom** that best describes the problem which needs to be corrected. Then, identify the **Problem** that most closely matches what the **MILL*PWR*** system is experiencing and implement the corresponding **Recommendation** as stated.

This **MILL*PWR* Troubleshooting Guide** pertains to the **MILL*PWR*** system specifically and on occasion the machine tool itself. It does not fully address problems relating to improper tooling, incorrect feeds and speeds, etc.

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*NOTE: This **MILLPWR** Troubleshooting Guide is based upon a system which has been properly installed by a factory trained and certified technician and that has had all startup system checks performed.*

<u>Symptom</u>	<u>Problem</u>	<u>Recommendation</u>
Operator Console Displays a Blank Screen	Brightness/Contrast Intensity is Too Low.	Adjust Brightness/Contrast knob located on the back of the operator's console.
	No Power	Check that the power switch located on the back of the operator console is on.
		Ensure that the power cord between the operator console and the controller cabinet is properly connected.
		Ensure that the interface cable between the operator console and the controller cabinet is properly connected.
		Check that the power switch located on the right side of the controller cabinet and the red light next to it is on.
		Ensure that the source power meets the specifications required of the system and that there are no blown fuses or tripped break-ers. For information regarding source power specification, contact your ACU-RITE **MILL*PWR*** representative.
		Ensure that there is no floppy disk in the floppy disk drive located in the upper left corner of the front of the operator console.
	CRT failure	Contact your ACU-RITE **MILL*PWR*** representative for repair or replacement procedures.

Symptom	Problem	Recommendation
Operator Console Keyboard Does Not Function	**MILL**_PWR_ System Needs to be Reset	Turn the system off. Wait at least one minute. Then turn the system back on. Should the above recommendation not correct the problem, contact your ACU-RITE **MILL**_PWR_ representative for repair or replacement procedures.
System Powers Up But Motor(s) Will Not Move Table	Emergency Table Stop Button is Activated	Release the Emergency Table Stop Button.
	Programming Error	No Tool in program. Graphics Only selected in program mode. Manual Positioning selected in program mode.
	No Oil in Oil Reservoir or Oil Lines are Blocked or Disconnected.	Check that there is sufficient oil in the oil reservoir. Should the above recommendation not correct the applicable problem, contact your ACU-RITE **MILL**_PWR_ representative for repair or replacement procedures.
	Stiff Table Movement	Refer to: Table has stiff movement. (p. 9-5)
	Beyond Set Table Limits	Contact your ACU-RITE **MILL**_PWR_ representative.
	No Power to Motors	Contact your ACU-RITE **MILL**_PWR_ representative for repair or replacement procedures.

<u>Symptom</u>	<u>Problem</u>	<u>Recommendation</u>
System Powers Up But Motor(s) Will Not Move Table (cont.)	Temperature	Check that the fan is operating. Check that the controller cabinet filter is not blocked. The filter may need to be replaced. Check that the door Louver filter is not blocked. The filter may have to be replaced. If the fan and filter are operational, leave the controller cabinet door open for approximately 10 minutes with the power on. Let the cabinet cool down and then try moving the table again. Should the above recommendation not correct the problem, contact your ACU-RITE **MILLPWR** representative for repair or replacement procedures.
Table Run Away	X and/or Y Axis Linear Encoders Stopped Counting	While in the DRO mode, move each axis manually to check that the linear encoder counts. If the linear encoder does not count, perform the following procedure: - Ensure that each linear encoder is properly connected to the controller cabinet and recheck that the linear encoders count. - Swap the X and Y linear encoder input connections and recheck that the linear encoders count. - If the problem follows the linear encoder swap, the linear encoder and/or reading head which demonstrated the symptom should be repaired or replaced.

<u>Symptom</u>	<u>Problem</u>	<u>Recommendation</u>
Table Run Away (cont.)	X and/or Y Axis Linear Encoders Stopped Counting (cont.)	Should the linear encoder count in certain areas only, contact your ACU-RITE **MILL***PWR* representative Should the above recommendation not correct the problem, contact your ACU-RITE **MILL***PWR* representative for repair or replacement procedures.
	Improper Tachometer Wire Connections	Contact your ACU-RITE **MILL***PWR* representative for repair or replacement procedures.
	No Signal. The motor will turn very slowly and always in one direction.	Contact your ACU-RITE **MILL***PWR* representative for repair or replacement procedures.
Table Has Stiff Movement	Table is Locked	Ensure that the table is not locked.
	Gibs Out of Adjustment	Refer to the machine tool manual.
	No Oil in Oil Reservoir or Oil Lines are Blocked or Disconnected.	Check that there is sufficient oil in the oil reservoir. Should the above recommendation not correct the applicable problem, contact your ACU-RITE **MILL***PWR* representative for repair or replacement procedures.
System Not Repeating or Circles Out of Round	Machine Tool Related Problems	Ensure that the knee, ram, head bolts, turret to column bolts and head to knuckle bolts are properly secured. Check the gib adjustments (refer to the machine tool manual).

Symptom	**Problem**	**Recommendation**
System Not Repeating or Circles Out of Round (Cont.)	Machine Tool Related Problems (Cont.)	Tram the head. Lower the quill full travel with a sturdy tool in the spindle. Set up a dial indicator to check movement of the spindle; then move the tool side-to-side. Total movement should be within the machine tool manufacturers' specifications between the spindle and the spindle bearing and between the quill and the bore. Replace the spindle bearing if necessary.
	Linear Encoders	Check each linear encoder and reading head for proper install-ation and that the mounting brackets are secured.
	Servo Motor Module Out of Adjustment	Contact your ACU-RITE **MILL*PWR*** Representative. Should the above recom-mendation not correct the applicable problem, contact your ACU-RITE **MILL*PWR*** representative.
Incorrect Dimensions	Programming Error	Verify the dimensions for each step of the program. Check that the correct tool num-ber and diameter are being used for each step of the program. Measure the tool diameter to check for tool wear. Ensure that the correct scale factor (multiplier) is being used. Also refer to: System not Repeating or Circles Out of Round. (p. 9-5)

Symptom	Problem	Recommendation
Poor Finish	Dull Tool	Replace the tool.
	Incorrect Feeds and/or Speeds	Ensure that the correct feeds and/or speeds are being used and/or programmed.
	Gibs Out of Adjustment	Refer to the machine tool manual.
	Worn Spindle Bearings	Lower the quill full travel with a sturdy tool in the spindle. Set up a dial indicator to check movement of the spindle; then move the tool side-to-side. Total movement should be within the machine tool manufacturers' specifications between the spindle and the spindle bearing and between the quill and the bore. Replace the spindle bearing if necessary.
	Servo Motor Module Out of Adjustment	Contact your ACU-RITE **MILLPWR** Representative. Also refer to: System not Repeating or Circles Out of Round. (p. 9-5)
Screen Flickers	**MILLPWR** in Screen Saver Mode	**MILLPWR** not used for approximately 10 minutes. Push any key on the front panel of the operator's console or move any axis to restore stability to the display screen. Should the above recommendation not correct the problem, contact your ACU-RITE **MILLPWR** representative for repair or replacement procedures.

387900-905 Ed H

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