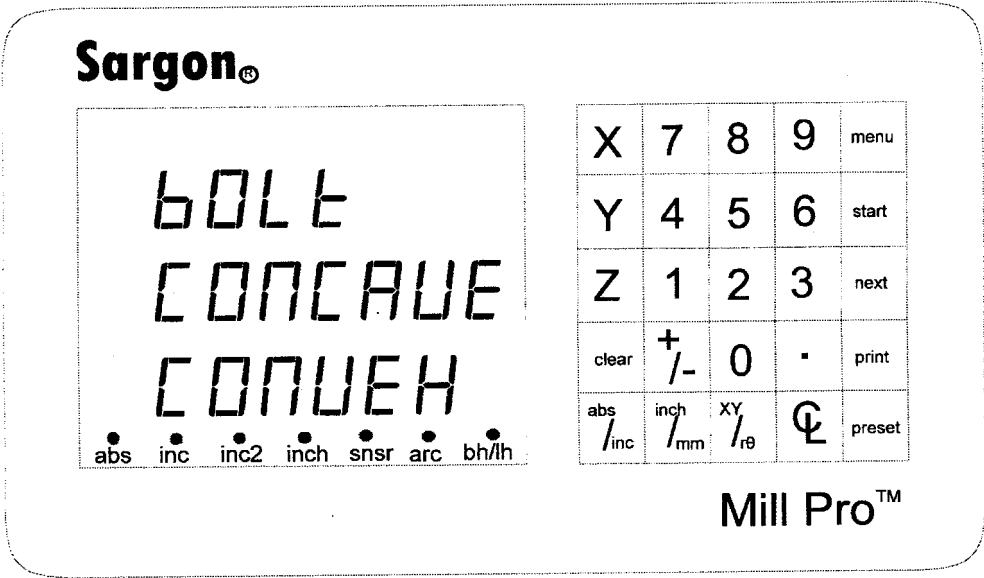


Mill Pro

PROGRAMMABLE MILL DISPLAY



1

Features and Capabilities

MANU contains:

NORmal mode;
BOLT hole mode;
CONCAVE mode;
CONVEX mode;
LINE hole mode;
REFerence mode;
SENsor mode (optional).

When power up while
8.8.8.8.8.8.8. is flashing
press any key to start from
the NORmal mode.

MEC switch on the rear panel
is used for setting the Machine
Error Compensation.

Bright, efficient LED display
with wide viewing angle.

Internal Nonvolatile Memory
maintains data when Power
is turned OFF.

Indicators for display modes:

Absolute;
Incremental;
Incremental 2;
Inch / mm;
Sensor;
Arc (concave, convex);
Bolt Hole / Line Hole.

Sargon®

BOLT
CONCAVE
CONVEX

abs inc inc2 inch snsr arc bh/lh

Power input module at rear has:
On/Off switch;
Fuse protection;
EMI filter for noise protection.

While MENU is displaying, press X, Y or Z to select an operating mode.

Press X, Y or Z to select an appropriate axis to enter numerical data.

Press and hold the clear key at power up while 8.8.8.8.8.8.8. is flashing to clear all memory.

In NORmal mode, press the menu key to display MENU.

In a selected operating mode (BOLT, CONCAVE CONVEX, LINE, REF or SENSOR,) press the menu key to return to NOR mode.

In a selected operating mode, press the start key to run.

In a selected operating mode press the next key to move to the next step.

While MENU is displaying, press the next key to scroll through MENU.

If the optional RS232 interface is installed, press and hold the print key at power up while 8.8.8.8.8.8.8. is flashing to set RS232 protocol.

Press the print key to send the displayed information to the connecting COMPUTER and/or PRINTER.

Press the +/- key to toggle between inc and inc2.

Preset a dimension if in an incremental mode; Set the DATUM of a workpiece if in the absolute mode.

Center a dimension-divided by 2.

Display Cartesian or polar coordinates.

X	7	8	9	menu
Y	4	5	6	start
Z	1	2	3	next
clear	+/-	0	.	print
abs / inc	inch / mm	XY / rθ	⊗	preset

Mill Pro™

Abolute or incremental display.

Inch or milimeter display.

Press and hold at power up while 8.8.8.8.8.8.8. is flashing to set Scale Resolution, Scale direction, Diameter Enable and Near Zero Warning.

2

Introduction

Scope

This manual covers operation of the Sargon Mill Pro Programmable Mill Display.

The Mill Pro can be used for basic DRO operations or for more advanced programmable operations.

Getting started

To rapidly gain familiarity with your system and to get the most out of it, the following is recommended:

1. Install the system as described in Section 3.
2. Set the Mill Pro scale resolutions, scale directions etc. as described in Section 5.
3. Once you have completed the setup and exited, the Mill Pro will be automatically switched to NORmal mode. Move the mill axes and verify the readout displays direction as expected. If not correct, repeat step 2.
4. Read the appropriate sections of this manual depending on the type of tasks to be performed and try out the various features.
5. Read this manual from cover to cover to become fully acquainted with all capabilities.

3

Preparation For Use

Unpacking

Inspect Shipping Containers. Inspect for obvious damage that would indicate mishandling during shipment. Make note of any indicators, such as: dented corners or torn sides.

Save Packing Material.

carefully to permit reuse in case it is necessary to return any portion of the equipment.

Notify Carrier In Case of Damage. If the display or other items show any external damage, or if parts have vibrated or broken loose, the carrier should be notified within ten days of receipt of shipment.

Check Packing List. Any discrepancy between the items received and the items listed on the shipment packing list should be reported immediately to the Sargon distributor.

General installation notes

WARNING HAZARDOUS VOLTAGES.
USE EXTREME CAUTION.

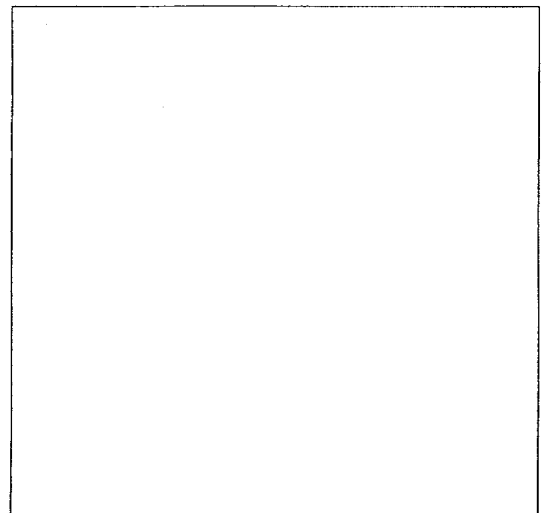
All required electrical work should be performed by a qualified electrician.

Mount the Mill Pro a minimum of 6 inches away from any motors. The Mill Pro may be mounted to the arm provided, or to a custom machined arm, mount, or stand.

Refer to the applicable manual for scale installation.

Typical display installation

1. Remove the large eye bolt located on top of the milling machine column (Index 1).
2. Mount the arm (Index 2) as shown.
3. Bolt the Mill Pro to the mounting arm with the 5/16-18 bolt (Index 4) provided in the hardware kit.



Grounding

The AC outlet should be a three prong grounded outlet (per article 250 of the US National Electrical Code). If it is not, use a grounded adapter and verify that the adapter is grounded.

Verify that the machine is grounded. If it is not, a ground must be installed.

Install a 14 AWG stranded wire (customer provided) from the ground lug located on the back of the Mill Pro to the machine power ground connection. If this is not possible, drill/tap at an alternate location on the machine. Secure the ground wire using star or split washers to ensure adequate connection. Use an approved anti-oxidation compound at the connection where the paint is scraped.

AC power

Do not use machine power lines for the Mill Pro. Use a separate 120 or 240 VAC outlet. If an outlet is not available, one should be installed near the MillPro mounting location.

The AC power outlet should be of the same voltage as that indicated on the identification/serial number label on the back of the Mill Pro.

Use the power cord supplied. Do not modify the power cord in any way.

Routing scale cables

Connect and secure the scale connectors to the Mill Pro. Using tie-wraps, secure the scale cables and dress any excess slack. Do not wrap any AC power lines with the scale cables. Maintain a minimum of 6 inch spacing from AC lines and cross at right angles.

4

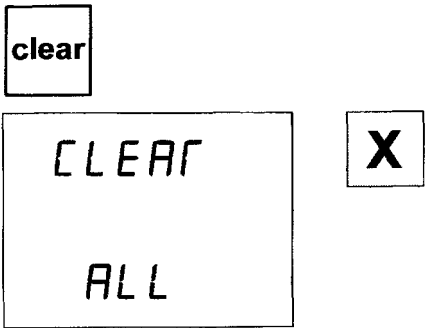
Clearing All Memory

CAUTION

The following will occur when memory is cleared:

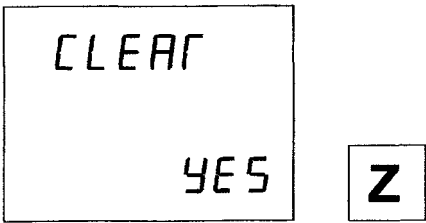
- Resolutions will be set to 0.0005 inches or 10 micron.
- Scale directions will be set to negative.
- Diameter will be disabled for all axes.
- Near Zero Warning window will be set to ± 0.2000 inch.
- Bolt hole, Concave, Convex and Line hole programs will be replaced by sample demo programs.
- Position information will be lost.
- MEC factors will be set to 1.0.
- All other stored information will be lost.

Selecting clear all



After power up and while the display is still flashing **8.8.8.8.8.8.8.**, press and hold the **clear** key to display the **CLEAR ALL** screen. To cancel the **CLEAR ALL**, press any key except the **X** key.

Press the **X** key. The Mill Pro will prompt with **CLEAR YES ?**



To CANCEL the **CLEAR ALL** operation, press any key except the **Z** key.

To CONTINUE the **CLEAR ALL** operation, press the **Z** key. **CLEARED** will be momentarily displayed and all memory will be cleared. The Mill Pro will then automatically go to the setup screens (Section 5.)

Exiting without clearing memory

To exit the clear all screen without clearing memory, press any key except the **X** and the **Z** key. The Gold Tracer will switch to the NORMAL mode automatically.

5

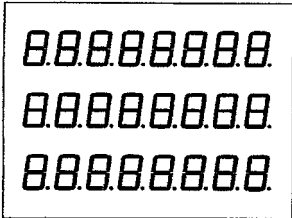
Setup Screens: Setting Scale Resolutions, Scale Directions, Diameter Enable, and Near Zero Warning Window

Description

Scale resolutions, scale directions, diameter enable, scale factors and near zero warning window are programmed from the Mill Pro's front panel.

They are stored in the Mill Pro's nonvolatile memory. Once set, the Mill Pro may be powered down. When powered up at a later time the settings will still be intact.

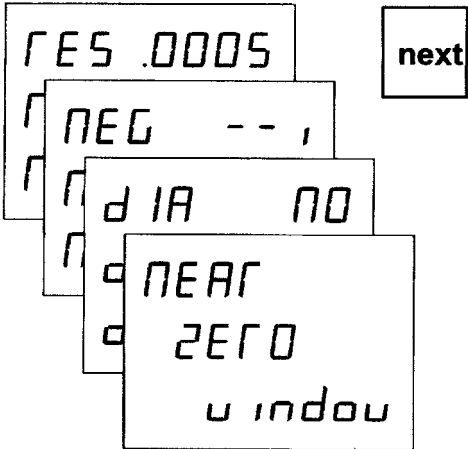
Entering the setup screens



Set the power switch at the rear of the Mill Pro to OFF (0) then back to ON (1). The display will flash **8.8.8.8.8.8.8.8**.

Press and hold the **abs/inc** key, one of the setup screens is displayed.

Selecting the desired setup screen



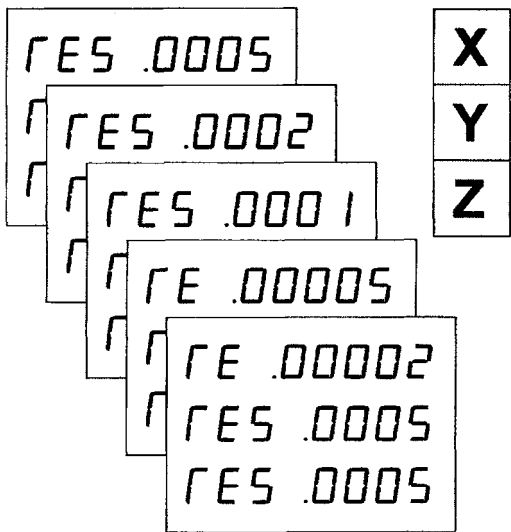
Press the **next** key until the desired setup screen is displayed.

Scale resolutions

MICRON, mm		INCH
10.0	0.01	0.0005
5.0	0.005	0.0002
2.0	0.002	0.0001
1.0	0.001	0.00005
0.5	0.0005	0.00002
0.2	0.0002	0.00001
0.1	0.0001	0.000005

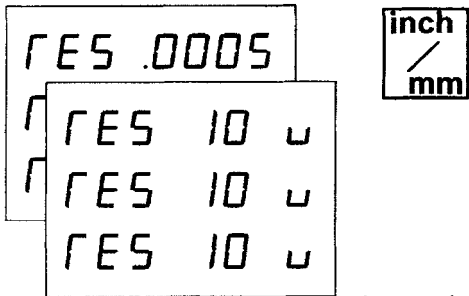
Each axis displayed on the Mill Pro must be set to the resolution that matches the scale being used for the axis. Resolutions available on the Mill Pro are shown to the left. The scales must be metric. When inch mode is selected, the metric scale inputs are converted by the Mill Pro to display in inches.

Scale
resolutions
(countinue)



Repeatedly press the **next** key until the resolution setup screen is displayed.

Repeatedly press the **X**, **Y** or **Z** key for the desired axis until the correct resolution is displayed.

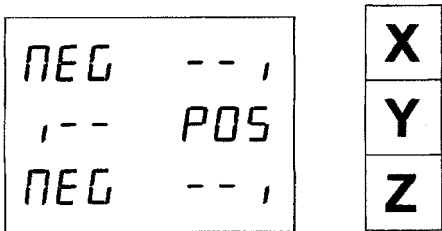


Press the **inch/mm** key to change between inch and metric displays. In mm mode the resolutions are displayed in microns (0.001 mm).

Exit setup mode by pressing any key except the **X**, **Y**, **Z**, **next** and **inch/mm**.

Scale directions

The display will count up or down, depending on the direction of table movement. Scale direction can be set, in the Mill Pro, for each axis, so that movements are properly displayed.



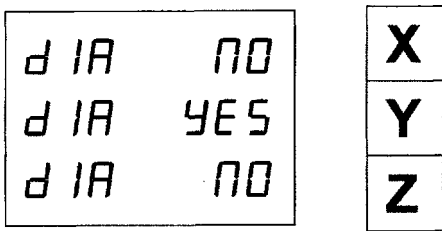
Repeatedly press the **next** key until the scale direction setup screen is displayed.

Press the **X**, **Y** or **Z** key for the desired axis to switch between positive and negative scale directions.

Exit setup mode by pressing any key except the **X**, **Y**, **Z**, **next** and **inch/mm**.

Diameter /
radius

When diameter is enabled (set to **YES**) for an axis, as described below, the scale input for that axis is doubled. In other words, the displayed dimension is twice the actual distance traveled. When diameter is disabled (set to **NO**) for an axis the displayed dimension tracks the actual scale movement.



Repeatedly press the **next** key until the **DIA YES/NO** screen is displayed.

Press the **X** or **Y** or **Z** key for the desired axis to switch between diameter enabled (**YES**) and disabled (**NO**).

Exit setup mode by pressing any key except the **X**, **Y**, **Z**, **next** and **inch/mm**.

Near Zero Warning

A near zero warning window is set for each axis as described below. The near zero warning indicator is set from the setup screens. When enabled, one of the following symbols will be displayed when the position is within the near zero warning window.



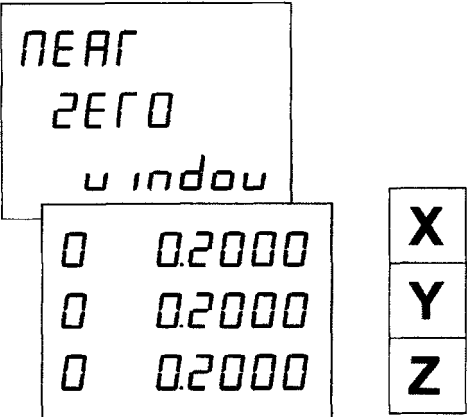
This symbol is displayed when zero is being approached from the positive direction.



This symbol is displayed when zero is being approached from the negative direction.

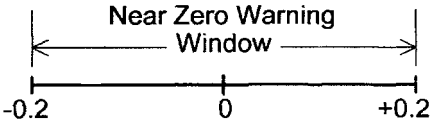
Setting the near zero warning window

The window setting indicates the range (plus or minus from zero) for which the near zero warning indicator will be displayed when enabled.



Press the **next** key until the **NEAR ZERO WINDOW** screen is displayed. The default value is 0.2 inches.

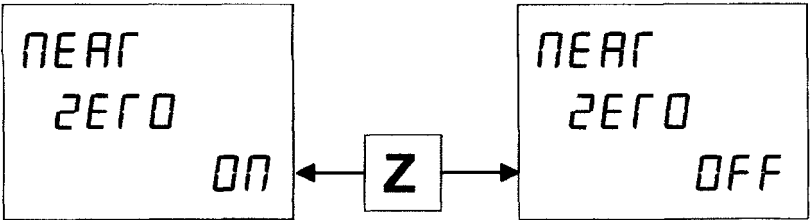
Press the **X**, **Y** or **Z** key to change the near zero window for each axis, as required.



Enabling and disabling the near zero warning indicator

The next setup screen is the **NEAR ZERO ON/OFF** screen. Press the **next** key until the **NEAR ZERO ON/OFF** screen is displayed. Press the **Z** key to toggle between near zero warning enabled (ON) and disabled (OFF).

Exit setup mode by pressing any key except the **X**, **Y**, **Z**, **next** and **inch/mm**.



Exiting the setup screens

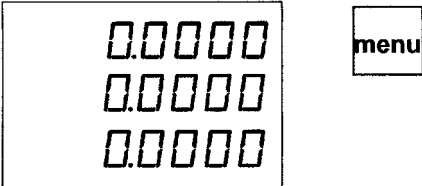
When scale resolutions, scale directions, dia/rad enable and near zero warning are **X**, **Y**, **Z**, **next** and **inch/mm**.

6

NOR mode and MENU

NOR mode

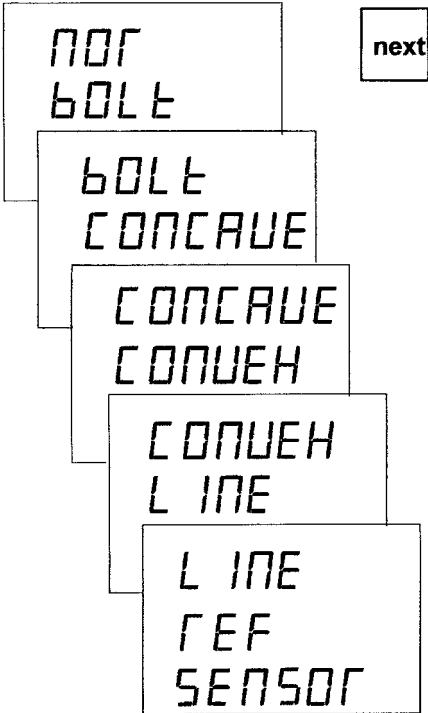
Press any key while power on and the 8.8.8.8.8.8.8. is flashing, the Mill Pro will be switched to its basic operating mode, the **NOR** mode.



In the **NOR** mode you can set the datum point, enter numerical data, use the dual incremental registers to machine a pocket ... etc.

Press the **menu** key will invoke the **MENU**, the entrance to all selectable operating modes.

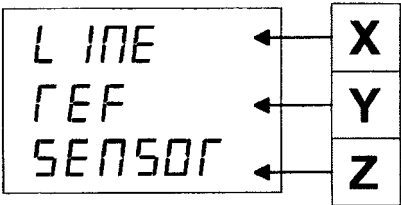
MENU



Press the **next** key, the **MENU** will be scrolled upward. The selectable operating modes are:

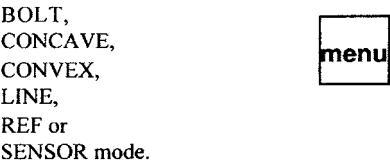
- NOR** (normal);
- BOLT**;
- CONCAVE**;
- CONVEX**;
- LINE**;
- REF** (reference);
- SENSOR***. * Optional

Selecting an operating mode



Refer to the **MENU** at left, press the **X**, the **Y** or the **Z** key, the Mill Pro will be switched to **LINE**, **REF** or **SENSOR*** mode respectively.

Return to the NOR mode



In any selected operating mode other than **NOR**, press the **menu** key, the MillPro will be switched back to the **NOR** mode.

7

Numerical Data Entry

Keys and their functions

select absolute or incremental mode;
select inc or inc2 while in the incremental mode;
select axis;
cancel;
change the sign of the input;
preset;
center line;

Set the datum point

absolute mode		data input	
---------------	--	------------	--

Cancel Input

All modes		data input	
-----------	--	------------	--

Preset Incremental

inc or inc2 mode		data input	
------------------	--	------------	--

Recall Preset Incremental

inc or inc2 mode		
------------------	--	--

Set Incremental (no recall)

inc or inc2 mode		data input	
------------------	--	------------	--

Clear current Increment

inc or inc2 mode		
------------------	--	--

Divid the Incremental by two

inc or inc2 mode		
------------------	--	--

Negat the Incremental

inc or inc2 mode		
------------------	--	--

8

Absolute and Dual Incremental Modes

The difference between absolute and incremental modes

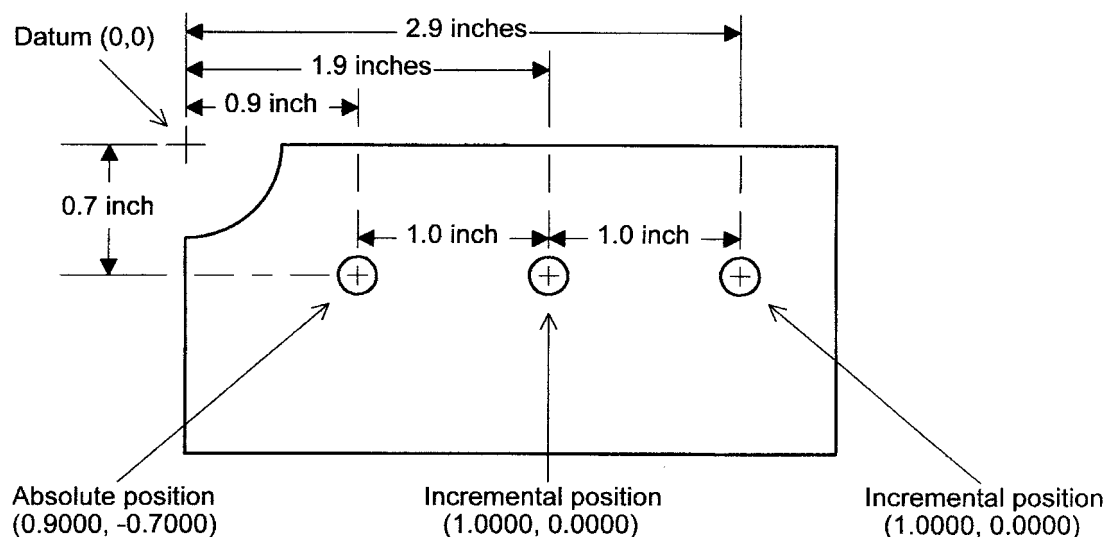
For each axis, the Mill Pro has one absolute position register and **two incremental position registers, inc and inc2**.

The absolute position is the distance between the **datum** point on the work piece and another point to which the machine has been moved. The incremental position refers to distances that are not measured with reference to the **datum** point, but instead, the distance is measured between the previous point and some new point.

Absolute and dual incremental registers are both updated during table movement regardless of which is currently displayed.

Absolute and dual incremental registers are otherwise independent; that is, updating one will not affect the other.

Absolute and incremental on a sample work piece



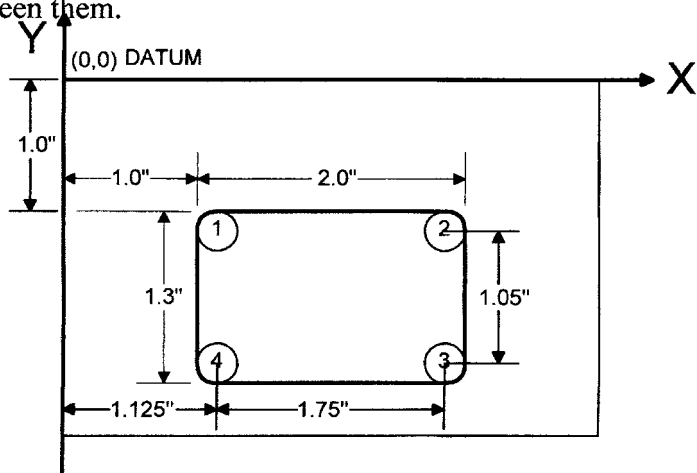
Switching between absolute and incremental display modes

Press the **abs/inc** key to switch between absolute and incremental position displays. LEDs behind the **abs** or **inc** or **inc2** indicate which mode is active.

Press the **+/-** key to switch between the two incremental position displays. LEDs behind the **inc** or **inc2** indicate which mode is active.

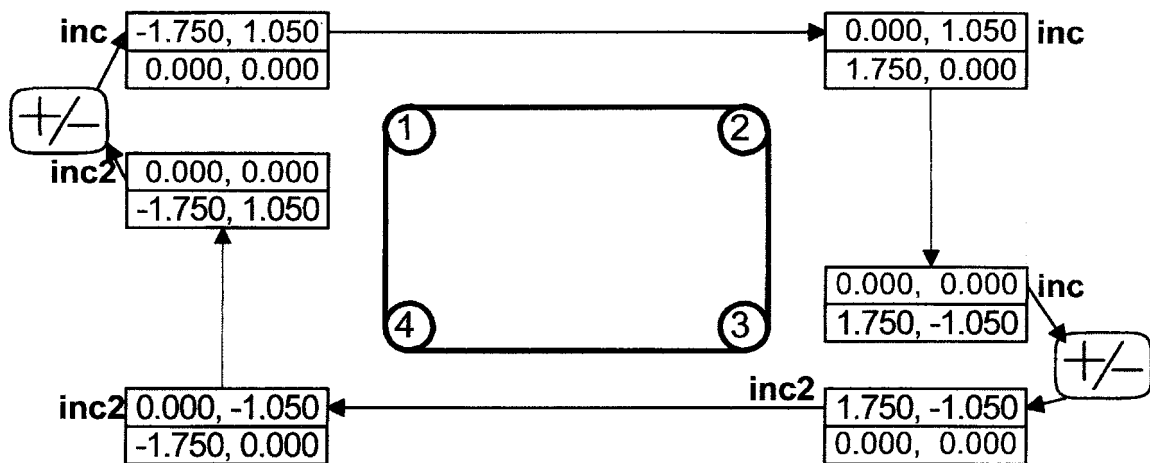
Double incremental registers

The dual incremental registers feature is specially implemented for machining rectangular shape pocket. In this, $\begin{bmatrix} -1.750 & 1.050 \\ 1.750 & 0.000 \end{bmatrix}$ represents the X and Y displays of **inc1** registers. Press the **+/-** key to toggle between them. $\begin{bmatrix} 1.750 & -1.050 \\ 0.000 & 0.000 \end{bmatrix}$ represents **inc2** registers. Press the **+/-** key to toggle between them.



Machine a pocket using double incremental registers

- Above is a sample workpiece with a pocket. The tool is a 0.25 inches end mill.
1. Position the end mill to the datum point(0, 0), **preset** the absolute X, Y displays to zero. Move the end mill to position ① (1.125, -1.125).
 2. Press **abs/inc** key to switch to **inc** mode, **preset** the X and Y to $\begin{bmatrix} -1.750 & 1.050 \\ 0.000 & 0.000 \end{bmatrix}$. With this setting, the **inc** both **inc** X and **inc** Y will be zero while reaching position ③ ; Press **+/-** key to switch to **inc2** mode, **preset** the X and Y both to zero. With this setting, the **inc2** X will be zero when the end mill reaches position ④ and both **inc2** X and **inc2** Y will be zero when position ① is reached;
 3. Press the **+/-** key to switch to **inc** path; Press the **+/-** key to switch to **inc2** mode and machining along the path. *All destination dimensions of the moving axis are zero as shown on the top of the box.*



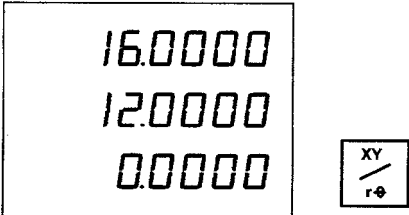
9

Cartesian and Polar Coordinates

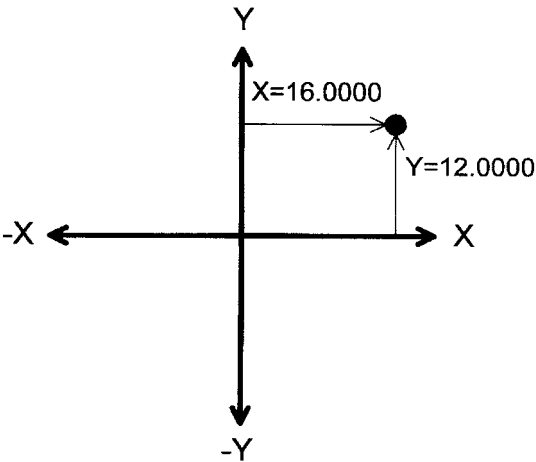
Description

Dimensions can be displayed as either Cartesian or polar coordinates.
These are best described by the figures shown below.

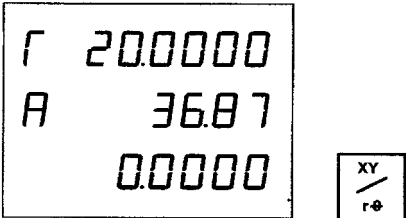
Cartesian coordinates



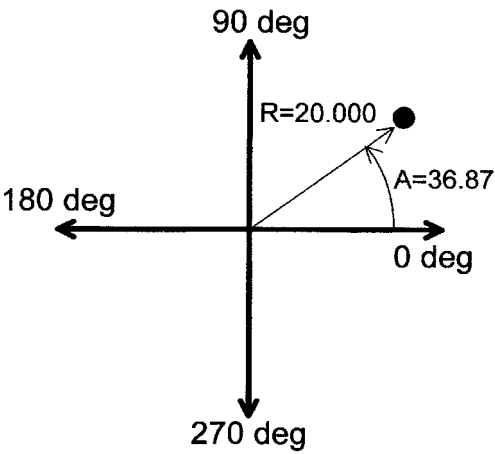
Press to switch from polar to Cartesian coordinates.



Polar coordinates



Press to switch from Cartesian to polar coordinates. Numbers cannot be entered while the Mill Pro is in polar mode.



10

Bolt Hole Programs

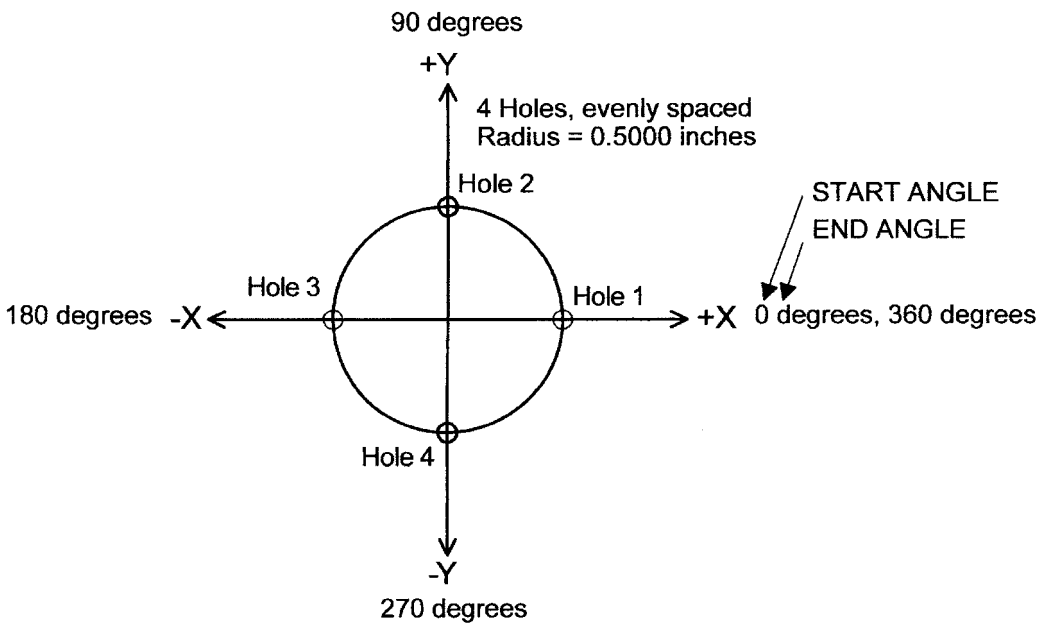
Description

A bolt hole pattern is a series of holes evenly spaced around the circumference of a circle. There is a sample demo bolt hole pattern in the Mill Pro's memory, you can change it to create a new pattern, it may then be used as many times as required by running the program. It will stay intact even when the Mill Pro is off.

The Mill Pro's memory hold one bolt hole program with up to 9999 holes.

Bolt hole pattern around the entire circumference of a circle

The following is the sample demo pattern, its start angle and end angle are the same, the Mill Pro will evenly space the holes around the circumference of the bolt hole pattern.

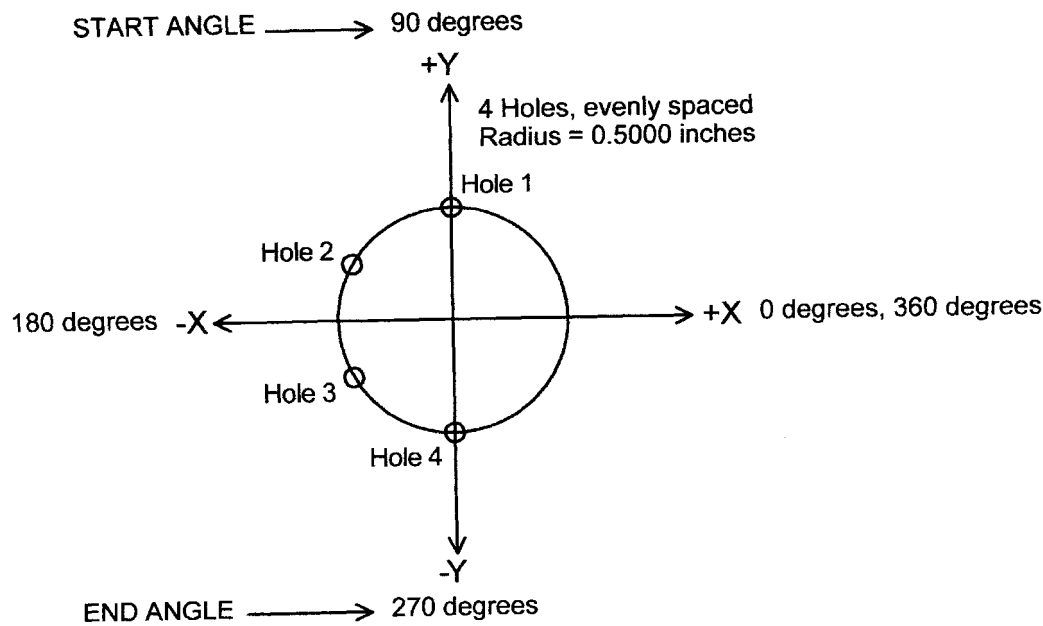


The following information have already been saved into the Mill Pro's memory:

RADIUS	0.5000 inches
START ANGLE	90 degrees
END ANGLE	90 degrees
NUMBER OF HOLES	4

Bolt hole pattern around a portion of the circumference of a circle

When the start angle and the end angle are not the same, the Mill Pro will place the first hole at the start angle position and the last hole at the end angle position. The remaining

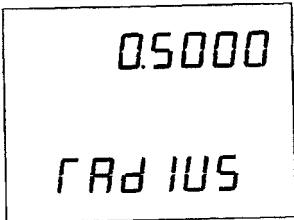


In order to create the bolt hole pattern shown above, the following information must be programmed into the Mill Pro:

RADIUS	0.5000 inches
START ANGLE	90 degrees
END ANGLE	270 degrees
NUMBER OF HOLES	4

Enter the BOLT mode

Press the **next** key to scroll the **MENU** (section 6, page 10) , until the **BOLT** is displayed on the screen. Press the **X**, the **Y** or the **Z** key whichever happen to coincide with the **BOLT** mode as below.



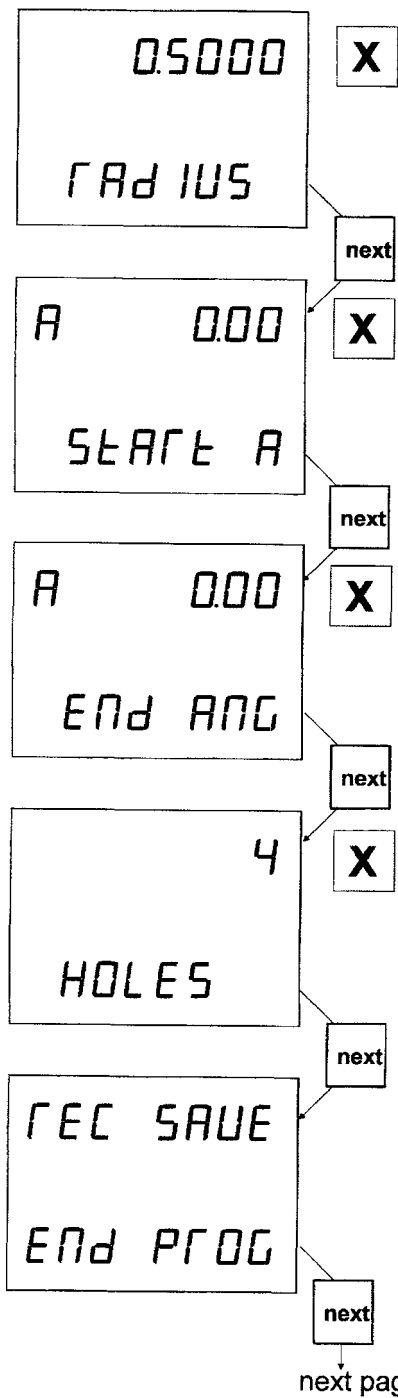
Once in **BOLT** mode, press the **next** key to view or edit the **BOLT** hole program or press the **start** key to run the current **BOLT** hole program.

Exit the BOLT mode

Press the **menu** or the **clear** key to exit bolt hole mode.

Creating a bolt hole program

You can change the parameters (radius, start angle, end angle and holes) on each screen to create a **BOLT** hole program, press the **next** key to get to the next screen. If you like to run the program in the Mill Pro's memory, press the **start** key.



Enter the desired **RADIUS** if different from the displayed value.

To view or change the next parameter press the **next** key.

Enter the desired **START ANGLE** if different from the displayed value. The first hole will be determined by the start angle.

To view or change the next parameter press **next** key

Enter the desired **END ANGLE** if different from the displayed value.

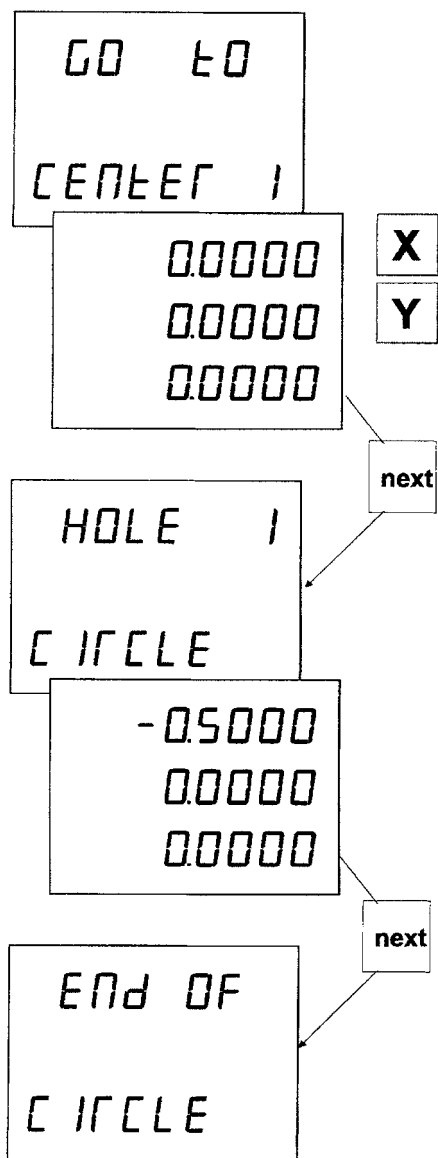
If the end angle is the same as the start angle, the holes will be equally spaced around the entire circumference of the bolt hole pattern.

If the end angle is not the same as the start angle, the holes will be equally spaced along a segment of the circumference of the bolt hole pattern. The final hole will be determined by the end angle.

Enter the desired number of **HOLES** if different from the displayed value.

When the **REC SAVE** screen is displayed, the newly changed parameters will be stored in the Mill Pro's memory. Press **next** key to run the program (continued on next page.)

Running a bolt
hole pattern



The **GO TO CENTER** screen is momentarily displayed.

Move the table to position the cutting tool at the center of the desired bolt hole pattern on the workpiece, then set both X and Y axes to 0.

OR

If this is the second time through the same bolt hole pattern around the same center, do not set X and Y axes to 0.

Press **next** key.

The **HOLE** number screen is momentarily displayed followed by the X and Y coordinates required for the next hole.

Move the table until the Mill Pro displays 0 on both X and Y axes, then perform the cutting operation.

Repeat the sequence of:

1. Press the **next** key.
2. Move the table, until X and Y both are zero.
3. Perform the cutting operation.

until the bolt hole pattern is complete.

The same bolt hole pattern may be run through as many times as required. For example: tapping, counter boring, etc.

Press the **menu** or the **clear** key to exit bolt hole mode.

11

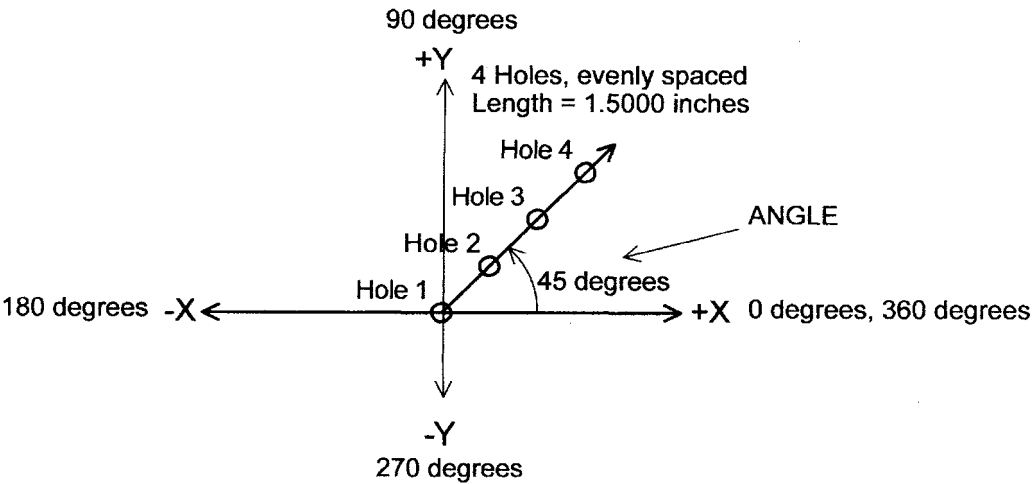
Line Hole Programs

Description

A line hole pattern is a series of holes evenly spaced along a line segment. There is a sample demo line hole pattern in the Mill Pro's memory, you can change it to create a new pattern, it may then be used as many times as required by running the program. It

The Mill Pro memory hold one hole program with up to 9999 holes.

Sample line hole pattern



Above is the sample demo line hole pattern, the following information have already been saved into the Mill Pro's memory.

LENGTH	1.5000 inches
ANGLE	45 degrees
NUMBER OF HOLES	4

Enter the line hole mode

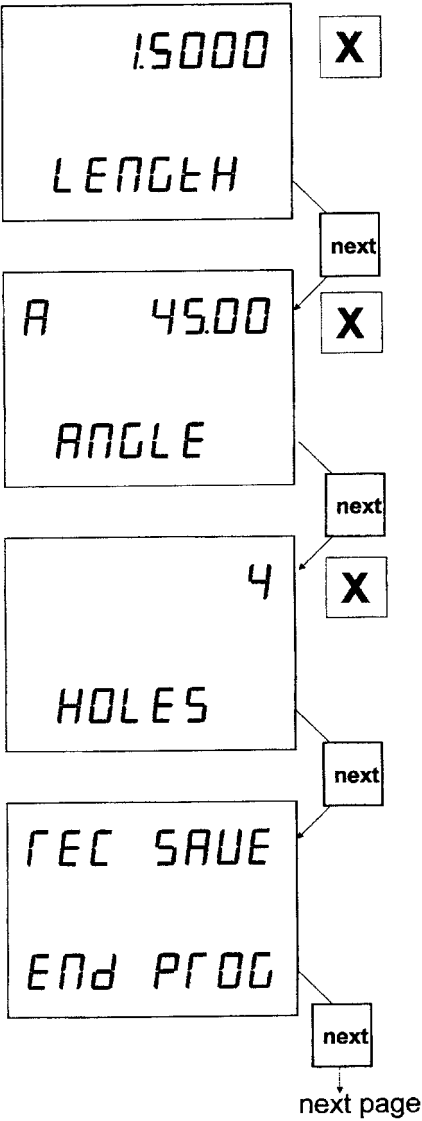
Press the **next** key to scroll the **MENU** (section 6, page 10) , until the **LINE** is displayed on the screen. Press the **X**, the **Y** or the **Z** key whichever happen to coincide with the **LINE** **LINE** hole mode.

Once in the **LINE** mode, press the **next** key to view or edit the line hole program or



**Creating a line
hole program**

You can change the parameters (length, angle and holes) on each screen to create a **LINE** hole program, press the **next** key to get to the next screen.
If you like to run the program in the Mill Pro's memory, press the **start** key.



Pressing the **X** to enter the desired **LINE** segment length from first hole to final hole if different from the displayed value.

To view or change the next parameter press the **next** key.

Pressing the **X** to enter the desired **ANGLE** of the line segment if different than the displayed value.

To view or change the next parameter press the **next** key

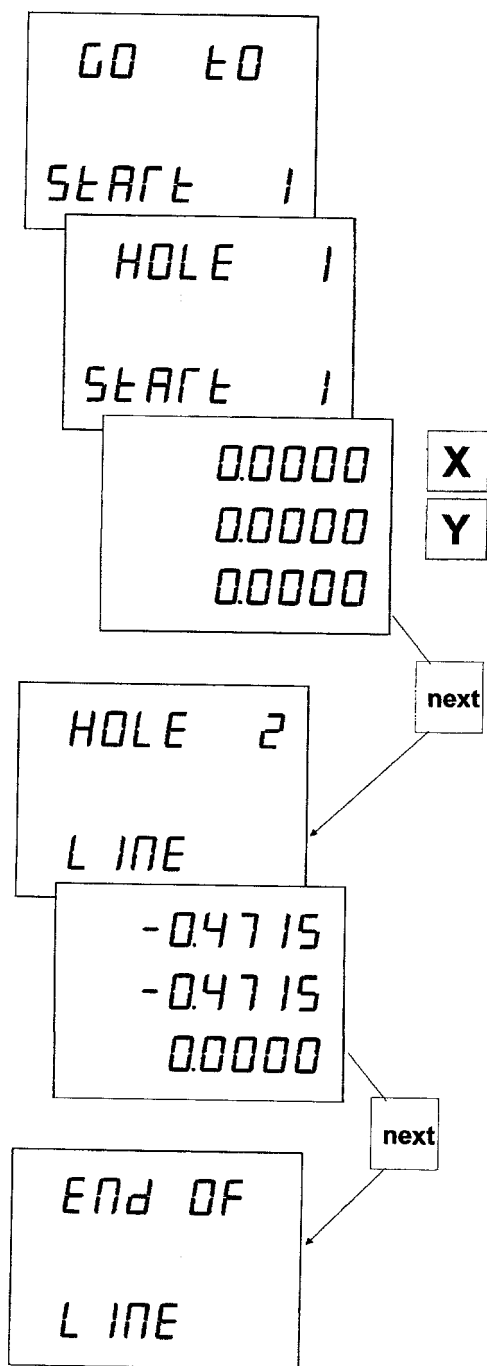
Pressing the **X** key to enter the desired number of **HOLES** if different than the displayed value.

Press the **next** key to save the program.

When the **REC SAVE** screen is displayed, the program has been stored in the Mill Pro's memory.

Press the **next** key to run the program(continued on next page.)

Running a line
hole pattern



The **GO TO START** and **HOLE** number screens are momentarily displayed.

Move the table to position the cutting tool at the first hole of the line hole pattern on the workpiece, then set both X and Y axes to 0. Perform cutting operation for first hole.

OR

If this is the second time through the same line hole pattern with the holes in the same position, do not set X and Y axes to 0. Move table until the Mill Pro displays 0 on both X and Y axes, then perform the cutting operation.

Press the **next** key.

The **HOLE** number screen is momentarily displayed followed by the X and the Y coordinates required for the next hole.

Move the table until the Mill Pro displays 0 on both X and Y axes, then perform the cutting operation.

Repeat the sequence of:

1. Press the **next** key.
2. Move the table, until X and Y both are zero.
3. Perform the cutting operation.

until the line hole pattern is complete.

The same line hole pattern may be run through as many times as required. For example: tapping, counter boring, etc.

Press the **menu** or the **clear** key to exit line hole mode.

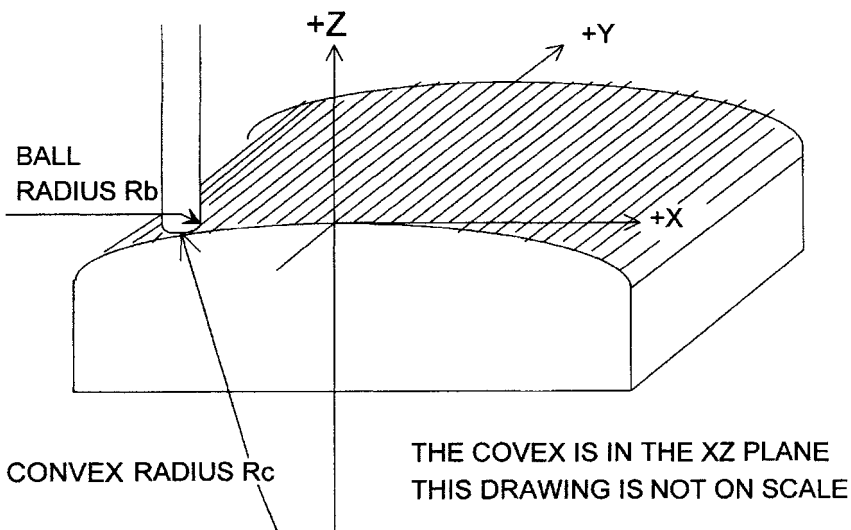
12

CONVEX

Description

A convex surface is shown in the following drawing. The curve is in the XZ plane (it can also be YZ plane.) We can calculate the Z coordinate with respect to X, then by using an appropriate ball mill machine the surface along the X axis. But the point by point calculation is very tedious and error prone.

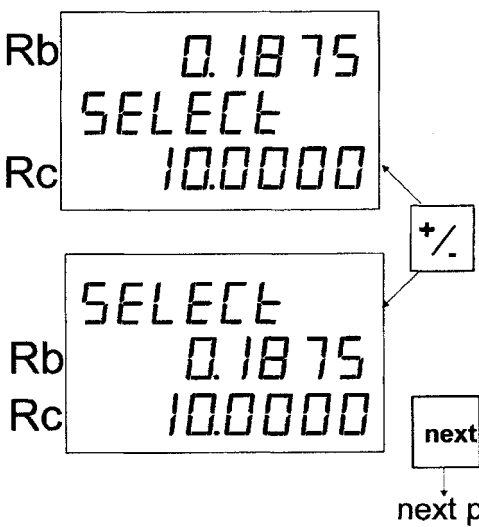
This CONVEX feature can automatically preset the Z coordinate with respect to X, if the convex radius and the ball radius is known.



Enter the CONVEX mode

Press the **next** key to scroll the **MENU** (section 6, page 10) , until the **CONVEX** is displayed on the screen. Press the **X**, the **Y** or the **Z** key whichever happen to coincide with the **CONVEX** mode.

Select one of the CONVEX plane



The first screen selects the **CONVEX** in the **XZ** plane; the second screen selects the **CONVEX** in the **YZ** plane.

Press the **+/-** key to change the selection.

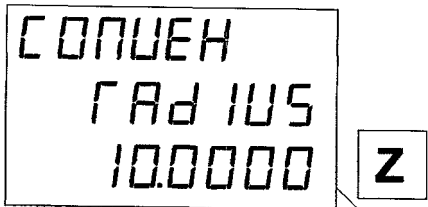
The small number is the ball radius **Rb**;
The big number is the convex radius **Rc**.

Press the **next** key to continue.

next page

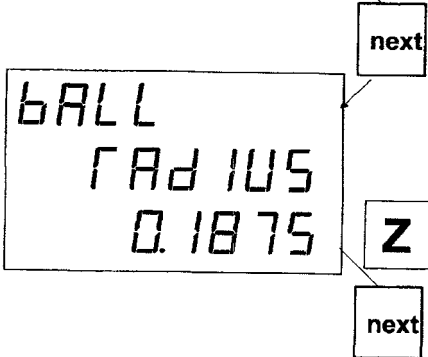
Creating a
CONVEX
program

There is a sample demo **CONVEX** program in the Mill Pro's memory, you can change it to create a new one, it may then be used as many times as required by running the



Pressing the **Z** key to enter the desired **CONVEX RADIUS** if different from the displayed value.

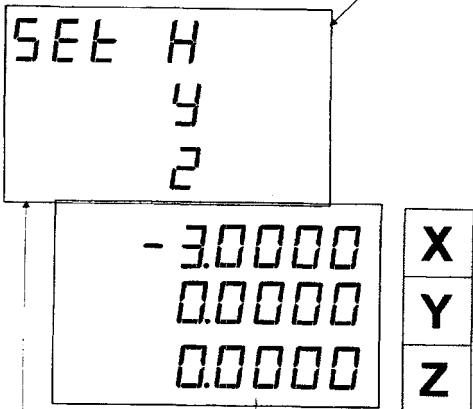
Press the **next** key to move to the next step.



Pressing the **Z** key to enter the desired **BALL RADIUS** if different from the displayed value.

Press the **next** key, the Mill Pro will display **SET X Y Z** momentarily, then it will display the **X, Y** and **Z** dimension which is the starting position of the ball mill that should be set before machining.

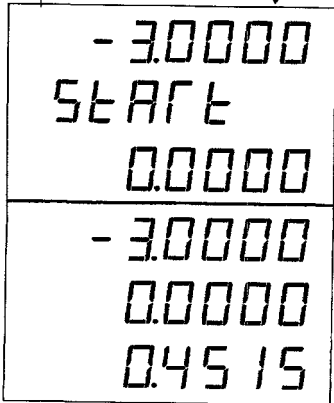
SET X Y Z



machining from its left front corner (-3.0000, 0.0000, 0.0000.)
set **X** dimension equals to -3.0000,
set **Y** dimension equals to 0.0000 and
set **Z** dimension equals to 0.0000.



START
machining

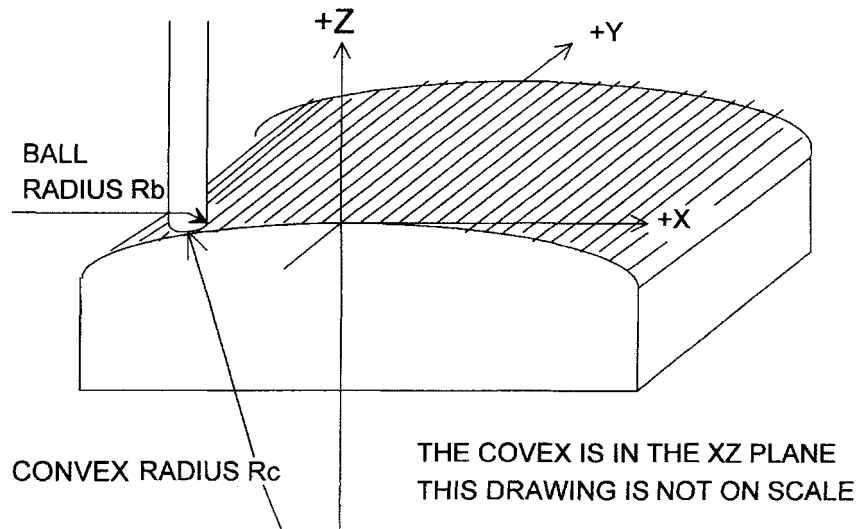


Press the **next** key, the Mill Pro will display **START** momentarily then will display the calculated **Z** dimension (0.4515.) This shows that the **CONVEX** edge is lower than its center, and 0.4515 inch of material should be cut along this edge.

Pressing the **start** key will make the Mill Pro to return to **SET X Y Z** screen, where you can set the starting coordinates.

Once **START**ed, the two axes of the **CONVEX** plane, **X** and **Z**, are linked together and no longer are changeable by pressing the keypad, the **Z** value will be changed with the **X** movement accordingly.

**START
machining
(continue)**



**Cut the surface
by slice**

Let us start machining the **CONVEX** surface.

1. Press the start key to return to the **SET X Y Z** screen. Move the table so that the spindle will be pointed to (X:0.0000, Y:0.0000), lower the spindle to just touch the work piece. Then, set the coordinates equals to (0.0000, 0.0000, 0.0000) on the **SET X Y Z** screen.
2. To start from the left edge of the work piece, move the table to (-3.0000, 0.0000, 0.0000), then press the **next** key, the **Z** display changed to 0.4515, this is the amount in **Z** need to be cut at **X** = -3.0000.
3. Machine the **CONVEX** surface along the **Y** axis till the end of the work piece to cut a slice, then back.
4. Depending upon the finishing requirement, move the table in small increments along the **X** axis. The Mill Pro will calculate the **Z** coordinate, once the **Z** dimension become positive, lower the spindle, repeat step 3.
5. As a sequence of X increment (step 4), Y movement and cutting (step 3) the Z dimension will be changed and the **CONVEX** surface will be done.

**Exit CONVEX
mode**

Press the **menu** key to exit **CONVEX** mode.

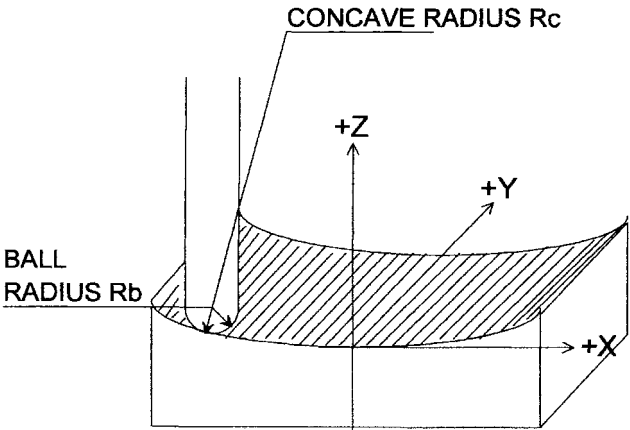
13

CONCAVE

Description

A concave surface is shown in the following drawing. The curve is in the XZ plane (it can also be YZ plane.) We can calculate the Z coordinate with respect to X, then by using an appropriate ball mill machine the surface along the X axis. But the point by point calculation is very tedious and error prone.

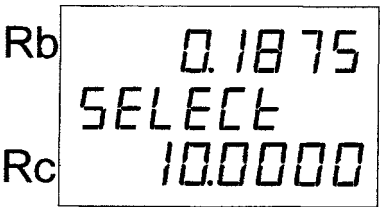
This CONCAVE feature can automatically preset the Z coordinate with respect to X, if the concave radius and the ball radius is known.



THIS DRAWING IS NOT ON SCALE

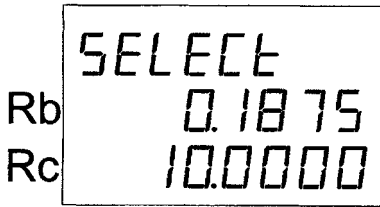
Enter the CONCAVE mode

Press the **next** key to scroll the **MENU** (section 6, page 10), until the **CONCAVE** is displayed on the screen. Press the **X**, the **Y** or the **Z** key whichever happen to coincide with the **CONCAVE** **CONCAVE** mode.



The first screen selects the **CONCAVE** in the **XZ** plane; the second screen selects the **CONCAVE** in the **YZ** plane.

Press the **+/-** key to change the selection.



The small number is the ball radius **Rb**;
The big number is the concave radius **Rc**.

Press the **next** key to continue.

Select one of the CONCAVE plane

next page

Creating a
CONCAVE
program

There is a sample demo **CONVEX** program in the Mill Pro's memory, you can change it to create a new one, it may then be used as many times as required by running the

Pressing the **Z** key to enter the desired **CONCAVE RADIUS** if different from the displayed value.

Press the **next** key to move to the next step.

Pressing the **Z** key to enter the desired **BALL RADIUS** if different from the displayed value.

Press the **next** key, the Mill Pro will display **SET X Y Z** momentarily, then it will display the **X, Y** and **Z** dimension which is the starting position of the ball mill that should be set before machining.

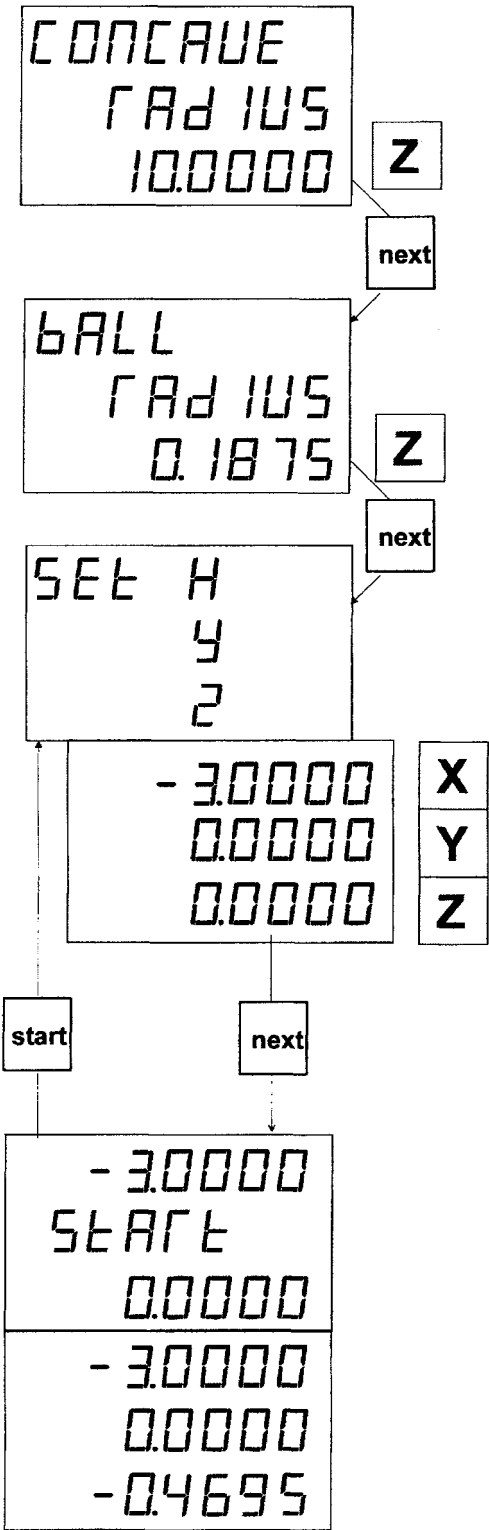
If the width of the work piece is 6 inches, we set **X** dimension equals to -3.0000, set **Y** dimension equals to 0.0000 and set **Z** dimension equals to 0.0000, to calculate the depth of the **CONCAVE**.

Press the **next** key, the Mill Pro will display **START** momentarily then will display the calculated **Z** dimension (-0.4695.) This shows that the edge of the **CONCAVE** is higher than its ceter and if we start machining from (-3.0000, 0.0000, 0.0000,) we need set the coordinate equals to (-3.0000, 0.0000, 0.4695) on the **SET X Y Z** screen.

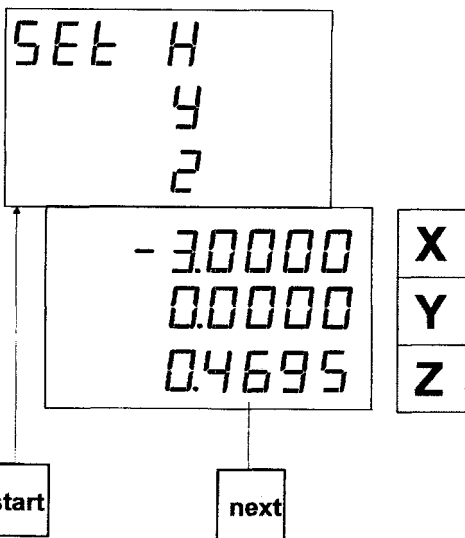
Pressing the **start** key will make the Mill Pro to return to **SET X Y Z** screen.

SET X Y Z

Caculate the
concave depth



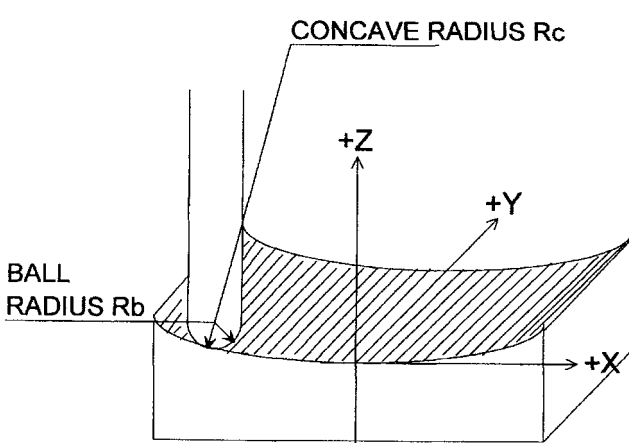
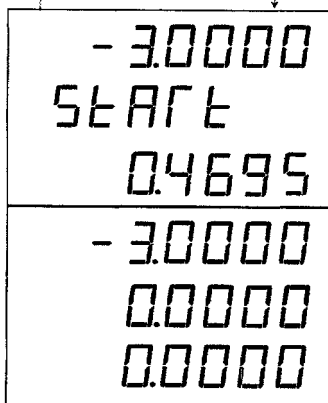
START
machining



start

next

Cut the surface
by slice



THIS DRAWING IS NOT ON SCALE

Exit **CONCAVE**
mode

Press the **menu** key to exit **CONCAVE** mode.

- Let us start machining the **CONCAVE** surface.
1. To start from the left edge of the work piece, move the table to (X:-3.0000, Y:0.0000),
 2. Press the start key to return to the **SET X Y Z** screen. Move the table so that the spindle will be pointed to (X:-3.0000, Y:0.0000), lower the spindle to just touch the left front corner of the work piece. Because the edge of the **CONCAVE** should be 0.4695 inch higher than **CONCAVE** center, set the coordinates equals to (-3.0000, 0.0000, 0.4695.) .
 3. Press the **next** key, the Mill Pro will display **START** momentarily and the **Z** display will be changed to 0.0000.
The two axes of the **CONCAVE** plane, **X** and **Z**, are linked together and no longer are changeable by pressing the keypad, the **Z** value will be changed with the **X** movement accordingly.
 4. Machine the **CONCAVE** surface along the **Y** axis till the end of the work piece to cut a slice, then back.
 5. Depending upon the finishing requirement, move the table in small increments along the **X** axis. The Mill Pro will calculate the **Z** coordinate, once the **Z** dimension become positive, lower the spindle, repeat step 4.
 6. As a sequence of X increment (step 5), Y movement and cutting (step 4) the Z dimension will be changed and the **CONCAVE** surface will be done.

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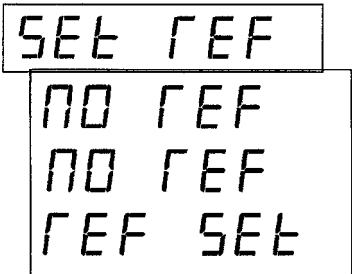
REFERENCE MARKER

Description

The Mill Pro can remember the position of the REFERENCE Marker for each axis. In case the machine table has been moved when the power was down, this feature can relocate the correct position.

Enter the SET REF mode

Set the power switch at the rear of the Mill Pro to OFF (0) then back to ON (1). While the display is flashing with **8.8.8.8.8.8.8.8.**, press and hold the **start** key, the Mill Pro will enter the **SET REF** mode.



clear

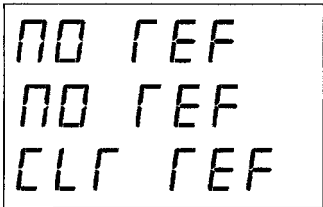
The screen display with **NO REF, REF SET**, the **NO REF** denotes that the REFERENCE Marker has not been set .

The **REF SET** denotes that the REFERENCE Marker has been set for the axis. If you need to reset the **REF SET** Marker, it is necessary to clear it first.

To clear the existing **REF SET** Marker:

1. Press the **clear** key, the **REF SET** will be change to **CLR REF**.
2. Press the axis' key (in this case, it is Z,) the display will flash with **REF CLRd**, then change to **NO REF**.

Clear the existing REF SET Marker



Z

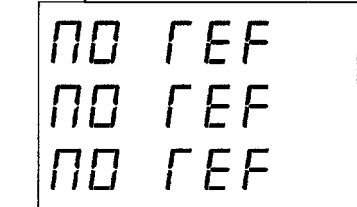


X

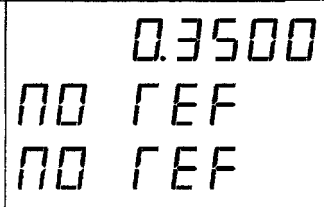
To search for a REFERENCE Marker:

1. Select an axis by pressing the X, Y or Z key. If the X axis is selected, it will flash with **SEARCH**, then **display the absolute dimension of this starting point**.
2. **To make the relocation of the starting point easier, it is better to preset (section 7, page 11) this dimension to zero.**
3. Make sure that the table movement for the selected axis is **in the positive direction**. Move the table slowly. When the Marker is detected, the Mill Pro will save the detected position immediately and flash the display with **FOUND**, then display the current position.

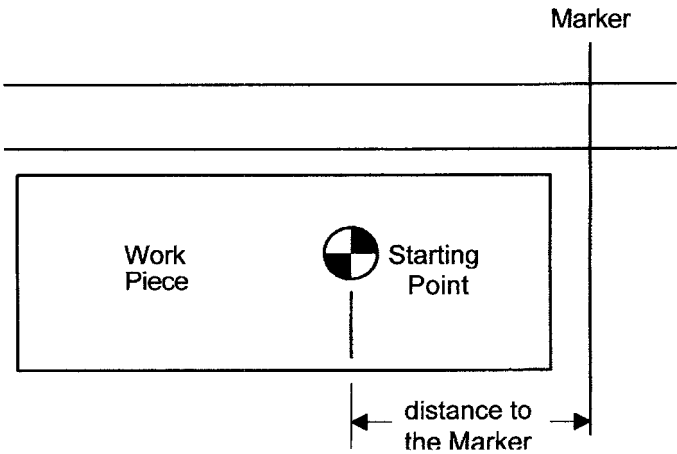
Searching the Reference Marker from a starting point



X



To view the saved REF SET Marker's Position Data



While in the **SET REF** mode, press the **print** key, the Mill Pro will display **NO DATA** if there is no data; otherwise it will display **REF DATA** follow by the saved data. Then display current position.

Note: If the starting point's coordinate did not reset to zero before searching, the distance to the Marker is the reminder of the saved data minus the starting point's coordinate.

Exit the SET REF mode

To exit from the **SET REF** mode, press **menu** or any number key.

Enter the REF mode

The function of **REF REF SET** Marker.

Press the **next** key to scroll the **MENU** (section 6, page 10) , until the **REF** is displayed on the screen. Press the **X**, the **Y** or the **Z** key whichever happen to coincide with the **REF** **REF** mode.

The **SELECT** denotes this axis' Marker data has been saved and the axis can be selected for searching.

Press the **X** key to select this axis, the Mill Pro flashes with **SEARCH** then displays its current position in absolute mode.

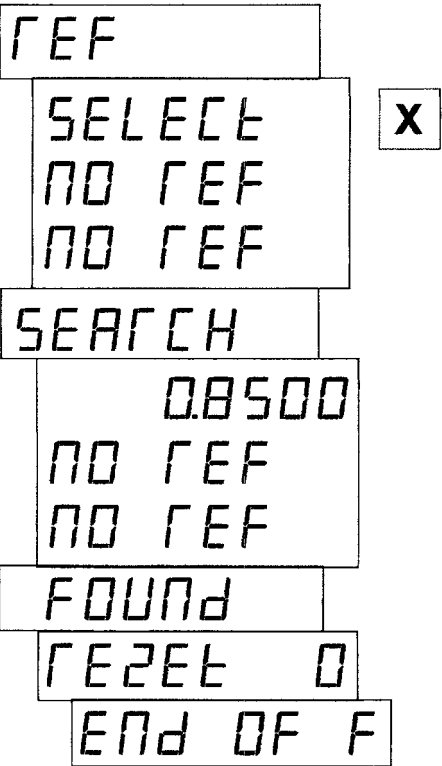
You can press the **print** key to view the saved **REF SET** Marker data.

Make sure that the table movement for the selected axis is **in the positive direction**. Move the table slowly. When the **REF SET** Marker is detected, the Mill Pro will **copy the saved data to the absolute display register immediately**, then flash the display with **FOUND, RESET 0, END OF F**, and return to **menu** screen (section 6, page 10.)

To relocate the starting point, select **NOR** mode at the **menu** screen and display in absolute mode; move the table, once the Mill Pro reaches the

the original starting point's position.

Searching the REF SET Marker



Relocate the Starting point

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Machine Error Compensation

Description

A standard vertical milling machine would have no error if its table movements followed perfectly straight lines. This, however, is not the case. There will always be some finite transfer error.

Definition: Transfer Error is the difference between displacement at the linear scale and displacement at the cutting tool.

Machine tool error is the difference between the actual length of a standard certified gauge block and the value displayed by a digital readout when the gauge block is measured using standard machine shop practices. This error will also be present in any work piece machined in that axis.

Machine Error Compensation (MEC) multiplies incoming scale signals by a factor such that the displayed value will be correct. This factor is stored in the Mill Pro's nonvolatile memory and is set at the factory to 1.000000.


Example: A 10.0000 inch standard gauge block is measured on a knee mill with a result of 9.9950 inches. MEC will re-proportion this dimension so that the correct value (10.0000 inches) is displayed. The 0.0050 inch error has been distributed over the 10.0000 inches of travel. Thus the "Machine Error" has been "Compensated" for.

$$MEC\ Factor = 10.0000 / 9.9950 = 1.000500$$

MEC should be a one time job. However, an operator may wish to recalibrate for a particular area on the machine table where work is to be performed.

Although MEC can improve machine table performance, it is not intended as a substitute for proper machine maintenance.

Viewing MEC factors

In **NOR** mode, press and hold the  key to view the MEC scale factors for all axes.

$$MEC = True_Value / Measured_Value$$

Clearing MEC factor

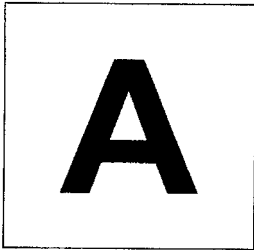
1. In **NOR** mode, press the **X** or **Y** or **Z** key to select the appropriate axis. All but the leading zero will be blanked and the decimal point will flash for the selected axis.
2. Set the **MEC** switch (at rear of unit) to **CAL**. The uncompensated dimension will be displayed for the cleared axis.
3. Return the **MEC** switch to **OFF**.

General MEC calibration notes

- The MEC procedure is performed on one axis at a time.
- For best results the Mill Pro should be calibrated in the units (inch or mm) in which it will be used.
- The Mill Pro should be calibrated on the table area that is most commonly used.
- Absolute and incremental modes have the same calibration factor for a given axis.

Calibrating MEC

1. Switch to **NOR** mode.
2. Clear the MEC factor as described above.
3. Measure the gauge block (with the Mill Pro) using standard machine shop procedures and practices.
4. Press the **X** or **Y** or **Z** key for that axis. All but the leading zero will be blanked and the decimal point will flash for the selected axis.
5. Use the numeric keypad to key in the true value (the actual certified gauge block length).
6. Set the **MEC** switch (at rear of unit) to **CAL**, then return it to **OFF**. The compensated dimension will be displayed for this axis.
7. Measure the gauge block again to ensure the Mill Pro is now properly calibrated.
8. Repeat the procedure for the remaining axes if required.



RS232 Functions (Option)

Description

The RS232 option consists of two serial ports designated "COMPUTER" and "PRINTER" installed on the back panel of the Mill Pro.

RS232 is the communication medium between the Mill Pro and the computer (and/or the printer). The communication code is ASCII.

The printer and the computer may be used independent of each other.

Information can be sent from the Mill Pro to the printer, using the Mill Pro keypad, whether a computer is connected or not.

If a computer is also connected, information can be sent from the Mill Pro to the printer using the computer keyboard

Information can also be sent from the computer, using the computer keyboard, to the Mill Pro.

Connector pin assignments

Both connectors on the DRO are female DB25, their pin assignments and signals are:

Pin Number	Function
2	Tx
3	Rx
4	RTS
5	CTS
7	Signal Ground

Cable

NULL MODEM CABLE with at least one male (for the Mill Pro) DB25 connector.

Computer setup

A Terminal or Personal Computer can interface with the Mill Pro through the serial port.

If using Microsoft Windows 3.x, choose Program Manager \ Accessories \ Terminal.

If using Microsoft Windows 95/98, choose Programs \ Accessories \ Hyper Terminal.

Printer setup

A serial printer can interface with the Mill Pro provided they have the same protocol settings.

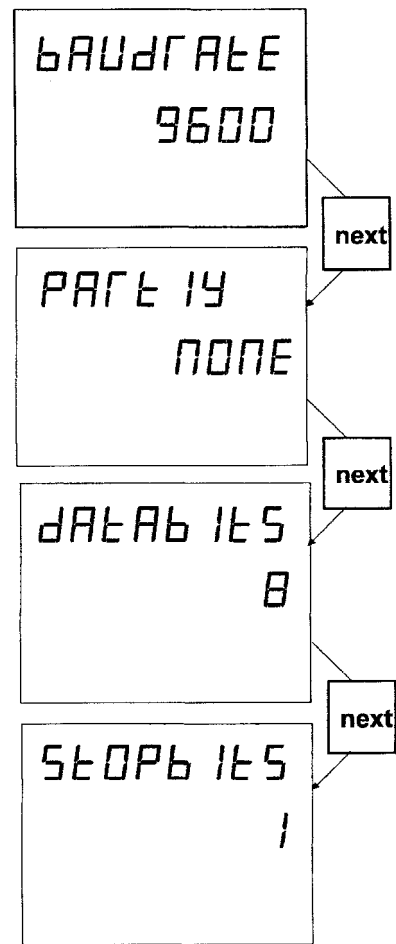
Setting RS232
protocol

Set the power switch at the rear of the Mill Pro to **OFF (0)** then back to **ON (1)**. The display will flash **8.8.8.8.8.8.8.8**.

Press and hold the **print** key until one of the setup screens is displayed.

Press the **next** key to move to the next setup screens.

Default protocol
settings



The Baud Rate options are: 19200, 9600, 4800, 2400, 1200, 600, 300, 150.
Default is 9600.

The Parity options are:
None, Odd, Even, Mark.
Default is None.

The Data Bits options are:
5, 6, 7, 8.
Default is 8.

The Stop Bits options are:
1, 2.
Default is 1.

When Baud Rate, Parity, Data Bits and Stop Bits are correctly set, they are stored in the Mill Pro's nonvolatile memory. Once set, the Mill Pro may be powered down. When

Changing
protocol
settings

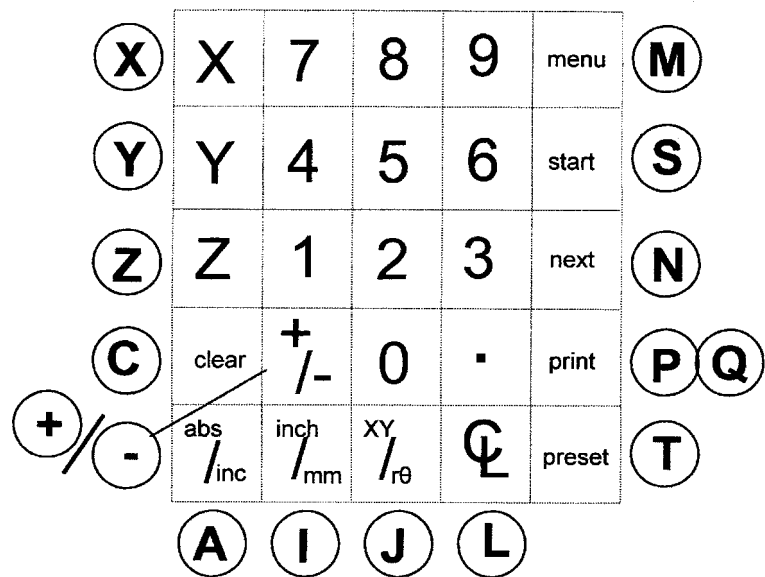
Keep pressing the **next** key until the desired setup screen is displayed.

Press the **Y** key to change a default setting.

Exit setup mode by pressing any key other than the **Y** key or the **next** key.

Keyboard equivalents

Most of the Mill Pro's functions can be performed through the computer keyboard.



- Number keys (**0 - 9 . + -**)
- Computer keys correspond to the remaining Mill Pro keys as shown.
- **P** = PRINTER ON, **Q** = PRINTER OFF.

Printing information

When the printer is on, information is printed as the Mill Pro is operated. The top axis information is displayed first, followed by the middle axis, then the bottom axis. Some examples are shown below.

```
CRT ON
PRNTR ON
NOR 2.0000 0.0000 0.0000
(X is entered with 0)
2.0000 0.0000
NOR BOLT CONCAVE
BOLT CONCAVE CONVEX
```

Dimensions are printed when a value is entered on any axis, or when the display mode is changed.

Function modes are printed when the **menu** key or the **next** key is pressed.

```
BOLT INCREMENT (change display mode)
RADIUS 0.5000
RUN BOLT GO TO CENTER 1
0.0000 0.0000 0.0000
HOLE 1 -0.5000 0.0000 0.0000
HOLE 2 0.0000 -0.5000 0.0000
HOLE 3 0.5000 0.0000 0.0000
HOLE 4 0.0000 0.5000 0.0000
END OF 0.0000 0.0000 0.0000
GO TO CENTER 2
```

Press and hold the **print** key to turn the printer off.

Press the **print** key to turn the printer back on.

Press the **print** key to print the current screen.

Sargon Mill Pro quick start-up guide

POWER UP: Turn the power switch on the back plan to ON (1),
the DRO will flash with 8.8.8.8.8.8.8.8.
Press any button to start NOR (normal) mode.
Press CLEAR button to reset all parameters.
Press A/I button to set parameters.
Press PRINT button to set RS232 protocol.

NOR (normal) mode:

16.0000
12.0000
00.0000

MENU:

At any mode press **menu** to invoke the MENU.

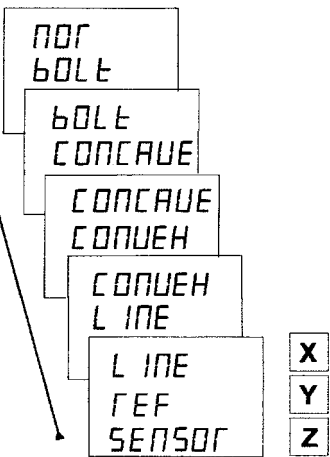
Once the MENU is displayed (as shown at right)

press **next** to rotate the MENU,

X

press **Y** to select the mode at its left.

Z



Numerical data enter sequences:

select axis

X

Y data input 0 ... 9 . +/-

Z

ended with

preset preset absolute or preset incremental.

clear cancel input.

X set X incremental.

Y set Y incremental.

Z set Z incremental.

select axis

X

Y

Z

ended with

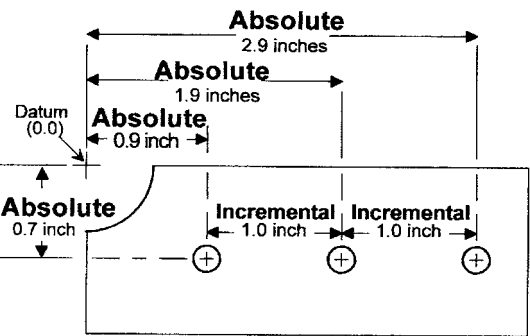
preset recall incremental preset.

clear clear current incremental.

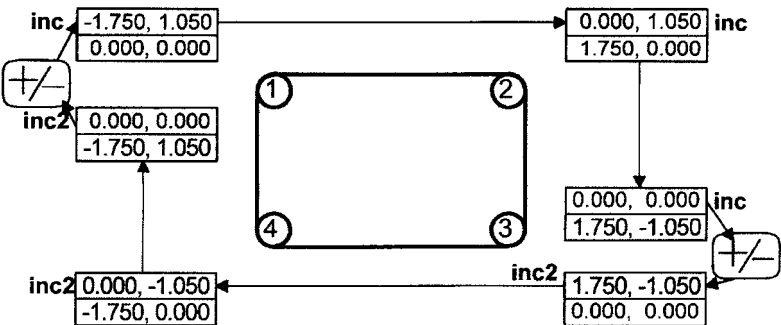
÷ divid incremental by two.

+/- negate incremental.

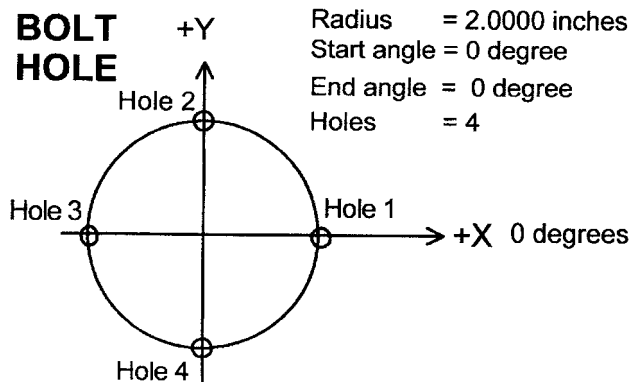
Absolute refers to the datum(0,0) point.
Incremental refers to the previous point.



Press **+/-** to toggle the inc(incremental) and the inc2 displays for machine a pocket.

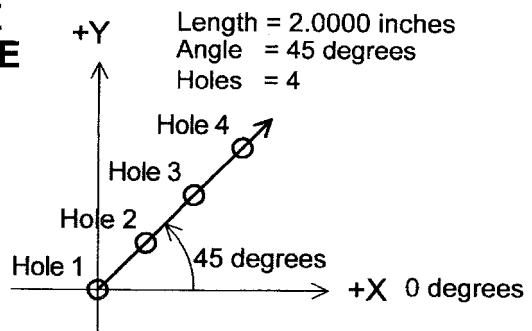


BOLT HOLE



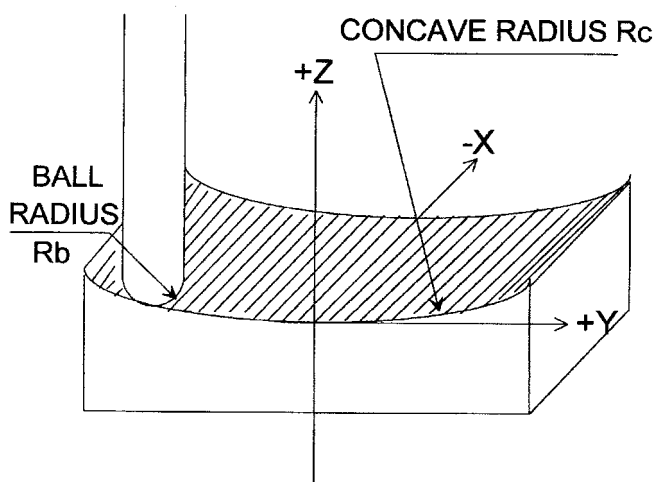
Select BOLT on the MENU to enter this mode, press **next** to view or edit the existing program or press **start** to run the program. Press **menu** or **clear** to exit.(see section 10)

LINE HOLE



Select LINE on the MENU to enter this mode, press **next** to view or edit the existing program or press **start** to run the program. Press **menu** or **clear** to exit.(see section 11)

CONCAVE:



Select CONVEX on the MENU to enter this mode, convex can be in the YZ plane (as shown left) or in the XZ plane.

Press **+/-** to select the plane.

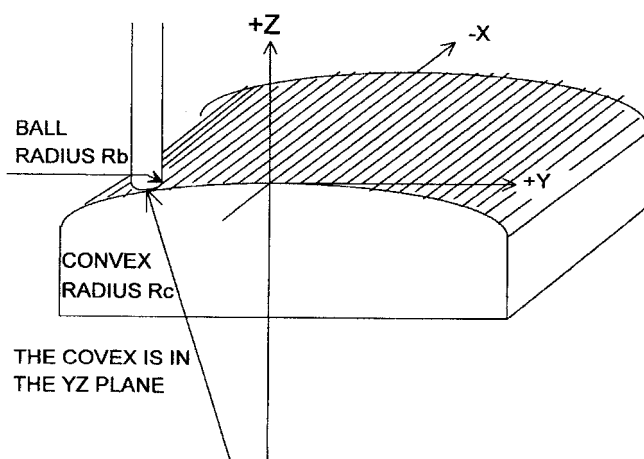
Press **next** to view or edit the ball radius and the convex radius.

After set the X, Y, and Z dimension, press **next** to start, the two axes of the convex plane (Y, Z as shown left) will be linked together.

Move the table in Y, the Z axis will show the dimension other than zero, move the table alone X axis to cut the work piece.

(see section 13)

CONVEX:



Select CONVEX on the MENU to enter this mode, convex can be in the YZ plane (as shown left) or in the XZ plane.

Press **+/-** to select the plane.

Press **next** to view or edit the ball radius and the convex radius.

After set the X, Y, and Z dimension, press **next** to start, the two axes of the convex plane (Y, Z as shown left) will be linked together.

Move the table in Y, the Z axis will show the dimension other than zero, move the table alone X axis to cut the work piece.

(see section 12)

