<u>Introduction</u> - A new feature has been added where the operator can override the cutter comp look ahead used when milling contours (LINES/ARCS) using the LEFT, RIGHT, PROFILE LEFT, and PROFILE RIGHT cutter comp types. This will allow the operator to customize how the blend ins/outs are performed. This document will first discuss some general theory on how cutter comp works and show how the operator can use the new feature to make adjustments to cutter comp.

<u>Cutter Comp Look Ahead Calculation</u> – The amount of look ahead used to cutter comp contours is dependent on the number of segments and whether the contour is open or closed.

For open contours: cutter_comp_look_ahead = number_of_segments - 3

  If cutter_comp_look_ahead is less than 2, then cutter_comp_look_ahead is set to 2.
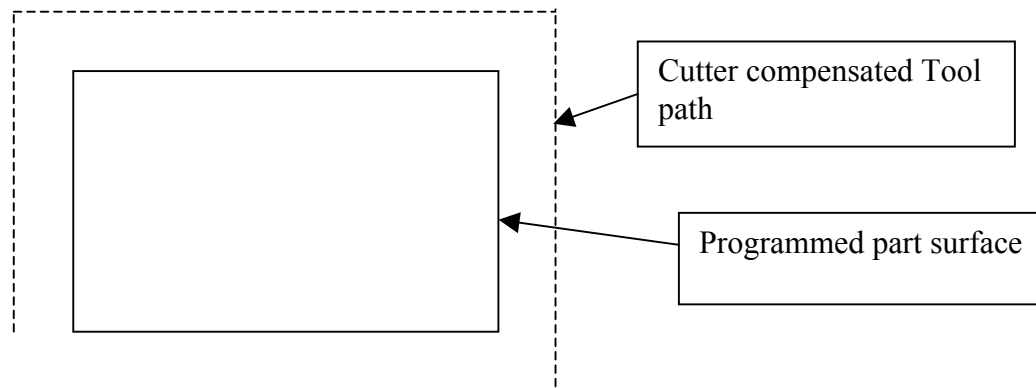 If cutter_comp_look_ahead is greater than 8, then cutter_comp_look_ahead is set to 8.

For closed contours: cutter_comp_look_ahead = number_of_segments - 1

  If cutter_comp_look_ahead is less than 3, then cutter_comp_look_ahead is set to 3.
  If cutter_comp_look_ahead is greater than 8, then cutter_comp_look_ahead is set to 8.

<u>Determination of Closed/Open Contours</u> - The determination whether a contour is open or closed is based on the programmed part surface and not the tool path. In the example below, the operator programmed a rectangular contour that is closed and has no overlap. The tool path is open in that the start of the tool path and the end of the tool path do not connect. This contour is considered a closed contour for the purpose of cutter compensation.

Cutter compensated Tool path

Programmed part surface

The calculation

 cutter_comp_look_ahead = number_of_segments - 1

is used for closed contours so the last segment and the first segment are not checked for intersections.

<u>General Cutter Compensation Theory</u> – The following information provides general information on how conversational cutter compensation works. In the following example, a contour of three line segments is programmed.
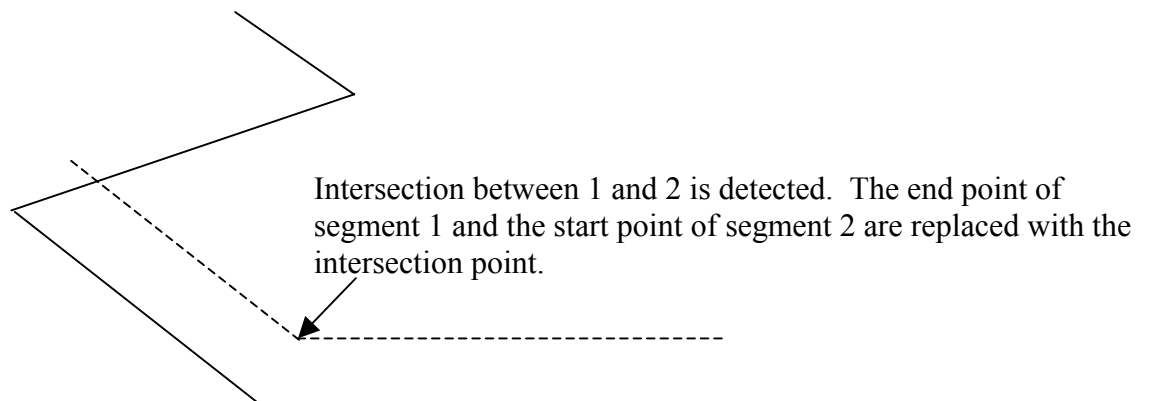
Step 1. First Segment 1 is offset by the tool radius offset. In this case, right cutter compensation is being performed.
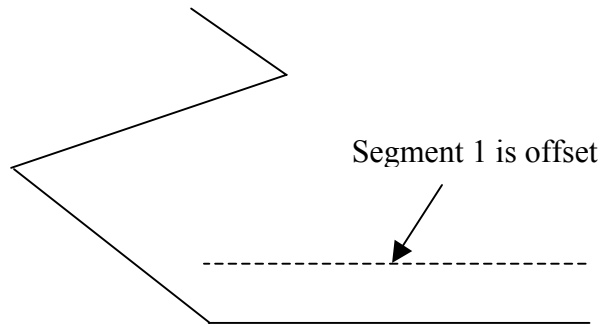
Segment 1 is offset

Step 2. First Segment 2 is now offset by the tool radius offset.

Segment 2 is now offset
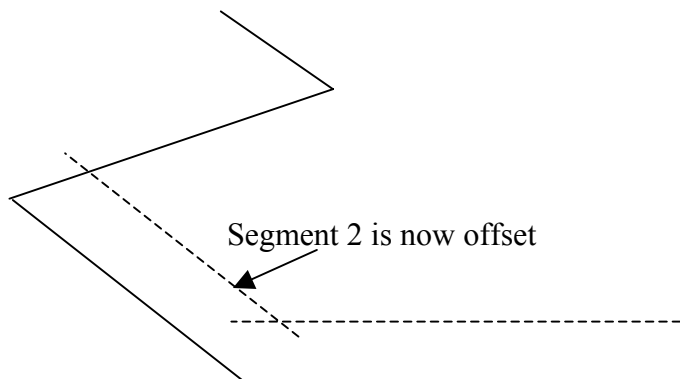
Step 3. A check for intersections is made. An intersection was found between segment 1 and 2 and the appropriate action is taken.

Intersection between 1 and 2 is detected. The end point of segment 1 and the start point of segment 2 are replaced with the intersection point.
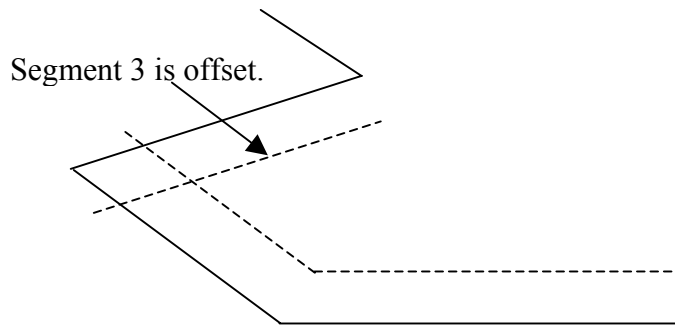
Step 4. Segment 3 is offset.

Segment 3 is offset.

Step 4. A check for intersections is made. An intersection was found between segment 2 and 3 and the appropriate action is taken.

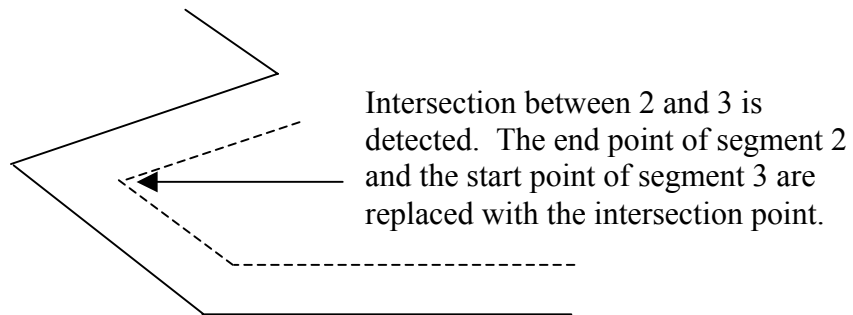Intersection between 2 and 3 is detected. The end point of segment 2 and the start point of segment 3 are replaced with the intersection point.

Step 5. Segment 4 is offset.

Segment 4 is offset.

Step 6. A check for intersections is made. There was no intersection between segments 3 and 4 and these segments are not tangent. In this case, an arc is inserted between these two segments.

Arc with a radius equal
to the offset is inserted
between segment 3 and 4
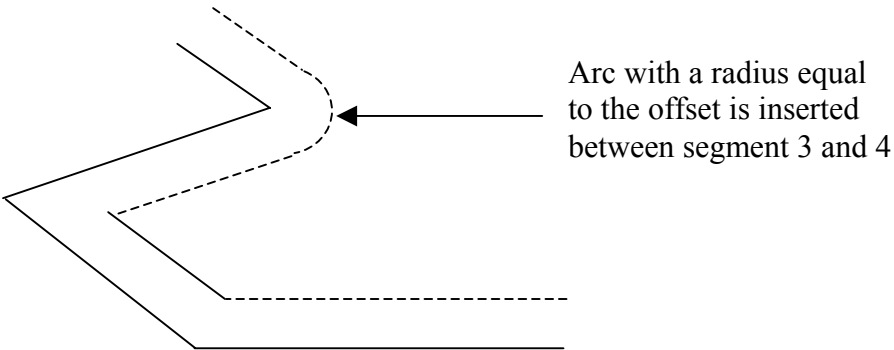
Example of Open Contour Look ahead - The following two pictures illustrate why 3 is subtracted from the segment count when determining the look ahead for open contours. In the first picture a look ahead of 4 was used so that no intersection was detected between segment 1 and segment 6. In the example, there are 7 segments. By using a look ahead of 4, problems with the blend in/out arcs will be prevented.
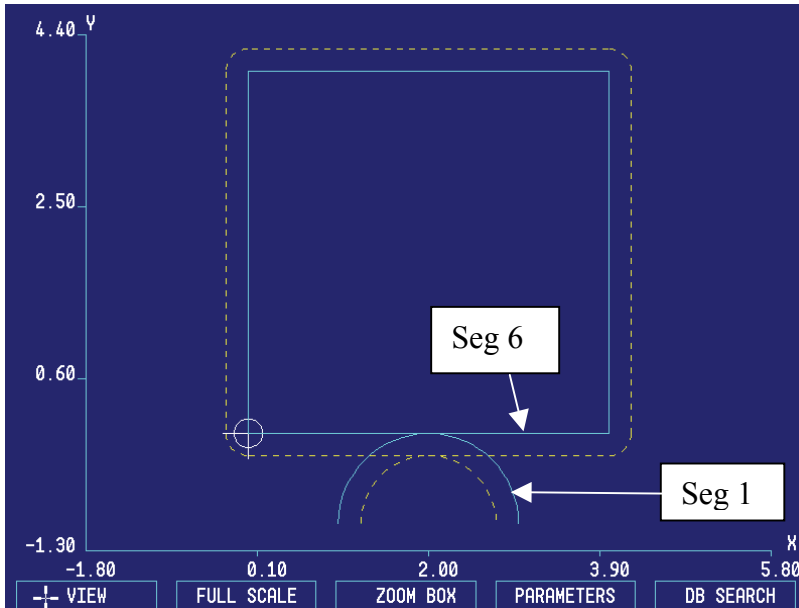
Look ahead of 4 used. This is the default value that Ultimax would have used. With a look ahead of 4, segments 1 and 6 will never be checked for intersections.
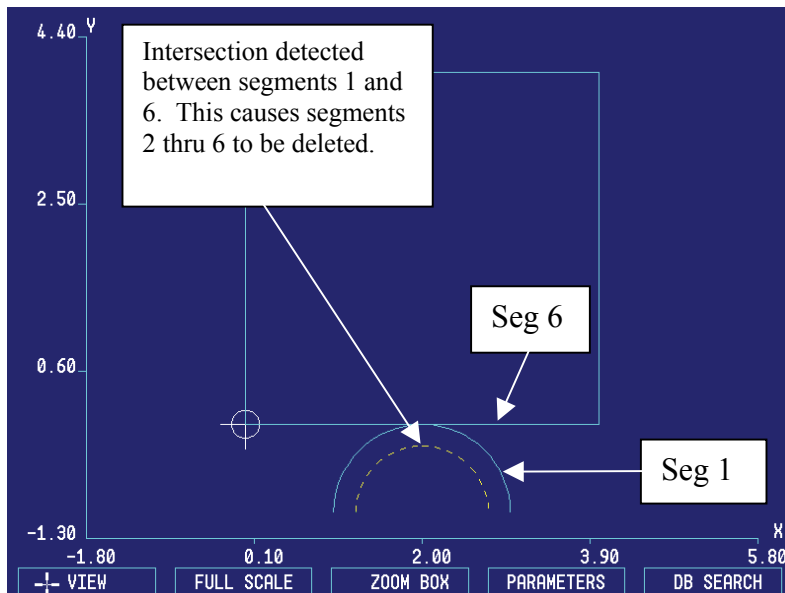
Look ahead of 5 used. When an intersection is detected, the segments between the segments that had the intersection are deleted.

When the CUTTER COMP field is set to LEFT, RIGHT, PROFILE LEFT, and PROFILE RIGHT, a new field labeled CUTCOMP LOOKAHEAD appears. This field def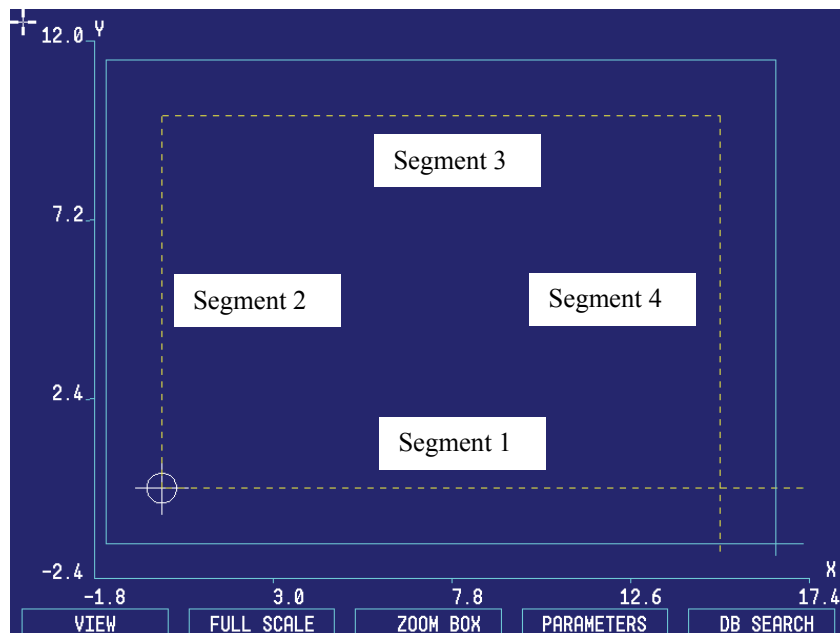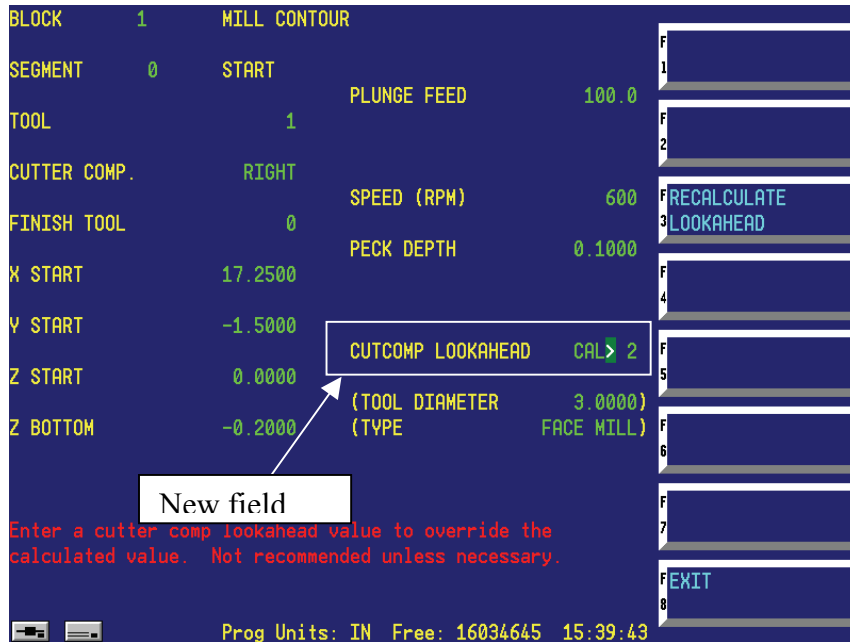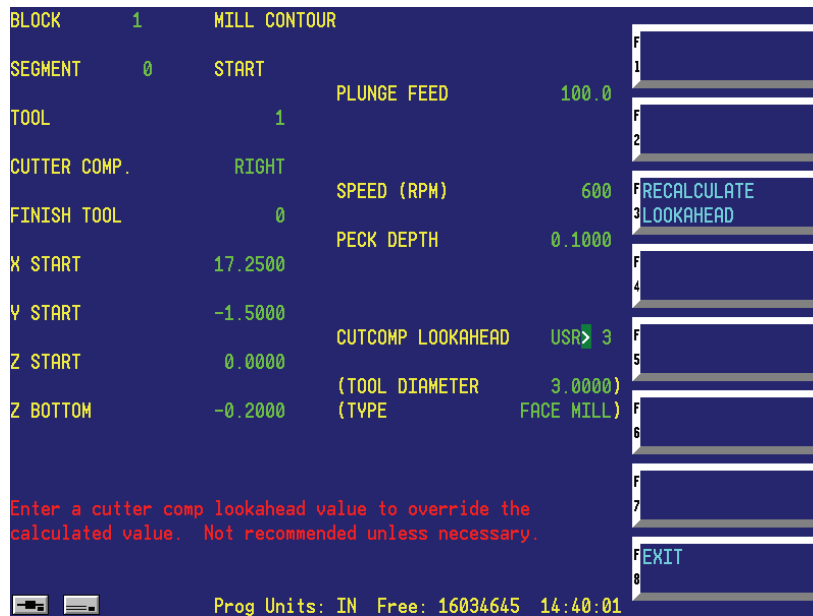aults to the calculated value based on number of segments and whether the contour is open or closed. There is a small label to the left of the data field that indicates whether the data was calculated or user defined. If calculated, CAL appears to the left of the data, if user defined, USR appears. The RECALCULATE LOOKAHEAD soft key (F3) is used to force the calculation of the cutter comp after the user entered a value. The current range for the user-defined look ahead is 1-20. The maximum limit may be raised later if turns out to be needed.

BLOCK	1	MILL CONTOUR		
SEGMENT	0	START		F1
		PLUNGE FEED	100.0	
TOOL		1		F2
CUTTER COMP.		RIGHT		
		SPEED (RPM)	600	F3 RECALCULATE LOOKAHEAD
FINISH TOOL		0		
		PECK DEPTH	0.1000	
X START		17.2500		F4
Y START		-1.5000		
Z START		0.0000	CUTCOMP LOOKAHEAD CAL▷ 2	F5
Z BOTTOM		-0.2000	(TOOL DIAMETER 3.0000)	
			(TYPE FACE MILL)	F6

New field

Enter a cutter comp lookahead value to override the calculated value. Not recommended unless necessary.

F7

F8 EXIT

Prog Units: IN Free: 16034645 15:39:43

12.0 Y

Segment 3

7.2

Segment 2   Segment 4

2.4

Segment 1

-2.4
   -1.8   3.0   7.8   12.6   17.4   X

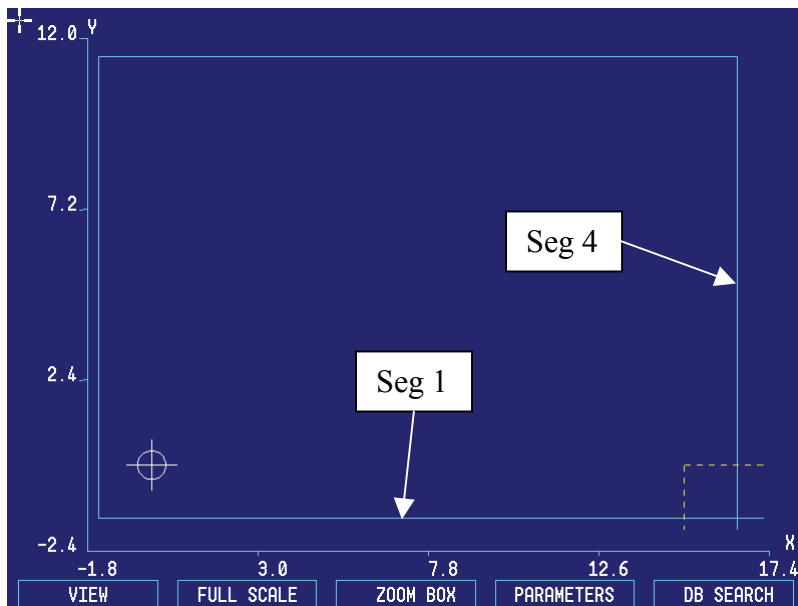| VIEW | FULL SCALE | ZOOM BOX | PARAMETERS | DB SEARCH |

6

The operator enters a look ahead value of 3 into the CUTCOMP LOOKAHEAD field to override the calculated value.

```
BLOCK      1        MILL CONTOUR
                                                        F
SEGMENT    0        START                               1
                            PLUNGE FEED          100.0
TOOL                  1                                 F
                                                        2
CUTTER COMP.        RIGHT
                            SPEED (RPM)          600   FRECALCULATE
FINISH TOOL          0                                3LOOKAHEAD
                            PECK DEPTH         0.1000
X START           17.2500                              F
                                                        4
Y START           -1.5000
                            CUTCOMP LOOKAHEAD   USR> 3 F
Z START            0.0000                              5
                            (TOOL DIAMETER      3.0000)
Z BOTTOM          -0.2000   (TYPE          FACE MILL) F
                                                      6

                                                       F
                                                        7
Enter a cutter comp lookahead value to override the
calculated value.  Not recommended unless necessary.  FEXIT
                                                        8
                            Prog Units: IN  Free: 16034645  14:40:01
```

Changing the look ahead to 3 causes most of the tool path to be deleted. The end point of segment 1 and the start point of segment 4 are replaced with the intersection point. The segments between 1 and 4 are also deleted.
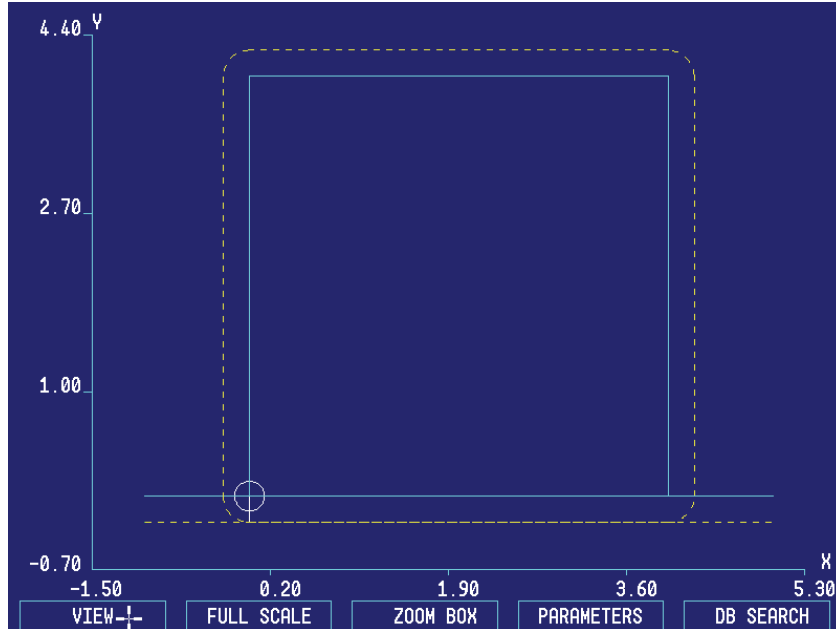
```
BLOCK      1      MILL CONTOUR                           F DELETE SEGMENT
                                                         1
SEGMENT  >   0      START
                          PLUNGE FEED          20.0      F INSERT SEGMENT
TOOL                  1                                  2 BEFORE

CUTTER COMP.        RIGHT                                F
                          SPEED (RPM)           300      3
FINISH TOOL           0
                          PECK DEPTH         0.0000      F PROGRAM
X START          -1.0000                                4 PARAMETERS

Y START           0.0000                                F PART SETUP
                          CUTCOMP LOOKAHEAD   USR  4     5
Z START           0.0000
                          (TOOL DIAMETER      0.5000)    F TOOL SETUP
Z BOTTOM         -0.2500  (TYPE                     )    6


                                                         F
Enter a segment number, use ENTER to edit segment, or use   7
left arrow (back), right arrow (advance), or softkey.
                                                         F EXIT
                                                         8
              Prog Units: IN  Free: 16034847  16:51:52
```
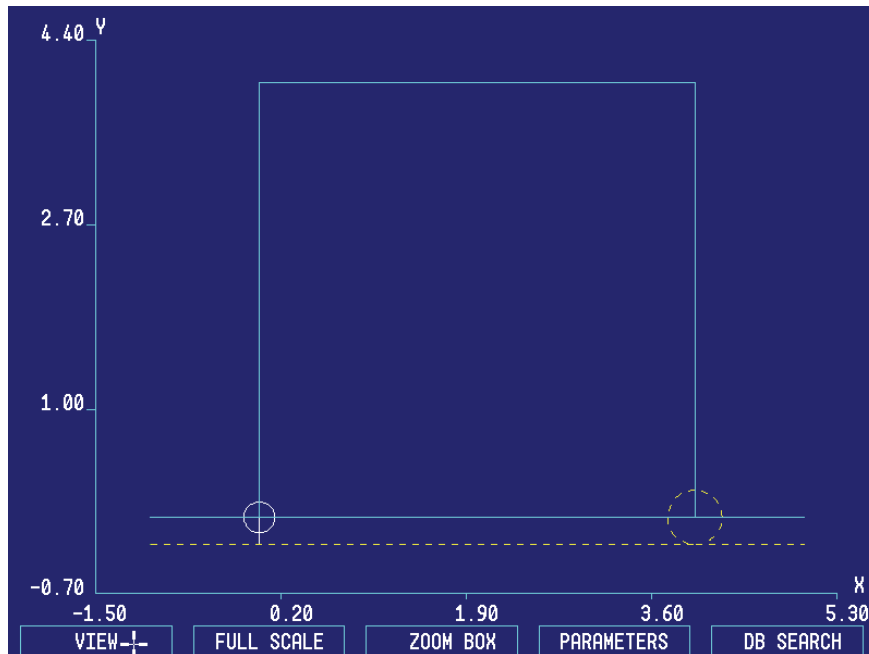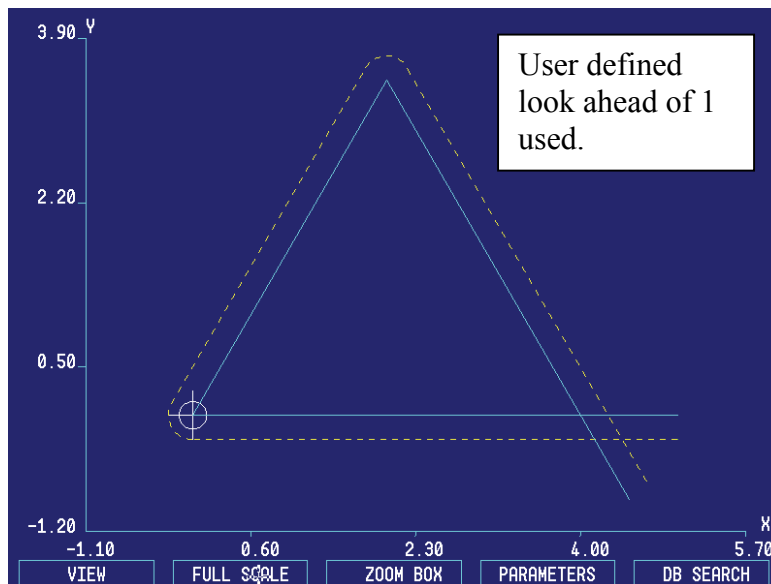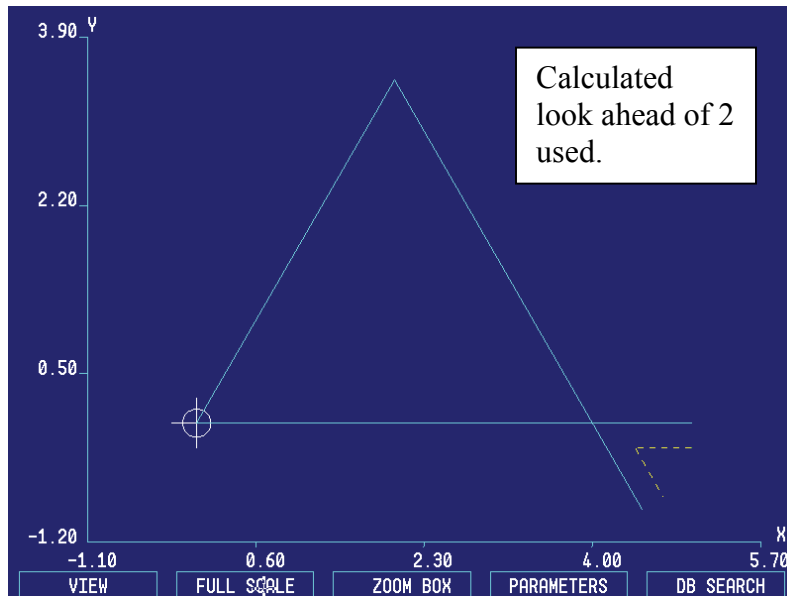
When to use a user defined cutter comp look ahead - The user defined cutter comp can be used with specific application problems such as contours with only a few segments that overlap or with unusual types of lead ins/outs.

Calculated look ahead of 2 used.

User defined look ahead of 1 used.

Calculated look ahead of 6 used.

User defined look ahead of 2 used.