



**AFF Software**

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**Fadal**

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The advanced feed forward option is designed to satisfy the needs of high speed machining. Normally the gain, acceleration rate, deceleration rate, and detail factor on a machine tool is established to satisfy a large range of customer needs. Until now this did not directly target the specific needs of high speed contouring on surfaces. AFF allows the user to tune the machine to specific needs.

Production rate is important! AFF allows the machine to cut loose and fast for roughing cuts, tighter for semi-finish cuts, and very close tracking for finish cuts.

One method for controlling surface integrity is feed rate. Other controls will use what is termed "look ahead" to analyze angular change in a series of moves. The more dramatic a change, the lower the feed rate. This results in lower cycle times. AFF differs in that the feed rate is constant resulting in faster cycle times.

### **AFF allows five factors to be altered:**

- Gain
- Deceleration
- Acceleration
- Detail
- Feed Rate

These factors can be altered on-the-fly, can be hard coded in the program, or the parameters can be used from and stored in a parameter page.

- Use the DFF command to access the parameter page.
- Use the background edit menu to alter the parameters and change them on-the-fly.
- Use parametric variables to hard code the parameters in the program.

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**Effects of Each Parameter**

- 1) **Gain** has a “multiplying” effect on the servo system. The higher the Gain setting, the faster the response of the axis motors. An excessively high gain setting (above 150) causes an audible noise from the machine. The lower the setting, the softer or more sluggish the reaction time becomes. The normal setting is 100. Each increase or decrease is stated as a percentage. For example 120 is a 20% increase and 90 would represent a 10% decrease. The higher gain settings reduce the cycle time, but a gain that is too high (above 150) could cause over travel.
- 2) **Deceleration** affects the time for the axes slow down at the end of each programmed move. This is more commonly called the decel ramp. It is measured in milliseconds. The adjustable range is from 5 to 1000 milliseconds with the typical setting being at 400. Increasing the deceleration time will add time to the cycle; however, this insures a “soft landing” at the end of a move. If this time is too short with a high feed rate, over travel may occur.
- 3) **Acceleration** affects the time the axes take to accelerate to feed rate at the beginning of a move. This is more commonly referred to as the accel ramp. This is measured in milliseconds. The adjustable range is from 5 to 500 milliseconds with the typical setting falling between 10 and 40. Increasing the value of the acceleration ramp lengthens the cycle time. One reason to lengthen this would be when the mass on the table is excessive and the machine reports motor over load messages from trying to quickly accelerate the large mass.
- 4) **Detail** affects the allowable deviation from the specified tool path. The adjustable range is .0002” to .250” (or .005mm to 6.35mm in the metric mode). This factor has a dramatic effect on cycle time. The closer the detail, the longer the cycle time. For rough cuts this parameter can be large, resulting in a savings in time. It can then be adjusted to a smaller window for finer detail when needed. The control will start the next move when the tool is positioned within the detail distance from the end of the current move. With a large detail window, the control can begin the next move sooner than if a smaller window is selected.

**Effects of other factors on Detail:**

- a. Gain—"drives" the axes to meet the Detail; too high and the machine will emanate a banging sound and over travel.
  - b. Deceleration—helps the axes to softly move from the programmed feed rate to the end of a move. If this factor is too low, over travel may occur because the velocity would be too high at the end of a move.
  - c. Acceleration—has no effect on Detail.
  - d. Feed rate—can cause over travel when the rate is too high. Surfaces that have sharp changes in angle need slower feed rates. Consider an attempt to drive a car around a corner too fast.
- 5) Feed Rate affects the rate of motion from the start of a move to the end of a move. Having this factor available in AFF allows a larger range of adjustment over the feed rate potentiometer.

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**How to Activate  
Advanced Feed  
Forward**

- 1) Code an M94.2 and its parameters on a line subsequent to an M6 T#. This will read the deceleration, acceleration, detail, and feed rate parameters from the DFF table. The T# corresponds with the parameter page line numbers to use.

**EXAMPLE: EXAMPLE WITH T#:**

```
M94.2
M6 T1 The T# determines which parameters to use
(TOOL #1, 1 INCH ROUGH EM 3FL
G0 G90 S12000 M3 E1 X-.6 Y-.5
H1 Z-.5
G4 P1000
2. Code an M94.2 R2+# to select any line from the parameter page.
```

**EXAMPLE: EXAMPLE WITH R2+#:**

```
M6 T1
(TOOL #1, 1 INCH ROUGH EM 3FL
G0 G90 S12000 M3 E1 X-.6 Y-.5
H1 Z-.5
G4 P1000
M94.2 R2+12. The R2+# determines which parameters to use
```

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## Advanced Feed Forward During Tool Changes

AFF remains in effect during a tool change. The M94.2 is modal and will remain in effect until the M95.2 code is used.

The T# establishes which parameter line to use from the DFF table. If a different line is needed, use the M94.2 R2+# to determine which line from the DFF table to use.

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## How to Deactivate Advanced Feed Forward

- 1) Code an M95.2 on a separate line to deactivate AFF.
- 2) Code an M91 to return to normal gain.

**EXAMPLE:** *G90 G0 Z.1*  
*M5 M9*  
*M95.2 Deactivate AFF*  
*M91 Return to normal gain*  
*G49 Z0*  
*M6 T2*

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## How to Enter Parameters Into the Parameter Page

NO.	GAIN	DECEL	ACCEL	DETAIL	FEED
1	100.0000	400.0000	10.0000	0.0100	125.0000
2	100.0000	400.0000	10.0000	0.0020	100.0000
3					
4					
5					
6					
7	100.0000	400.0000	10.0000	0.0002	80.0000
8					
9					
10					
11					
12					

FEED FORWARD TABLE.....PRESS MANUAL TO ABORT..  
 1-NEW VALUE  
 ENTER- NEXT PAGE    BACKSPACE- PREVIOUS PAGE    SPACE- NEXT TABLE

- 1) From the command mode type DFF and press the ENTER button to display the feed forward page. Press the number one to enter a new value into the table.
- 2) Follow the menu prompt. Type the number of the tool to modify and press the ENTER button.

- 3) Each parameter will display. Press the ENTER button to bypass any parameter or type the desired number and then press the ENTER button to change the number.

## How to Alter Parameters On-the-Fly

- 1) From the Auto mode press the space bar.

```
X      1.00000      0
Y      0            0
Z      0            0 C
X      0            S100000 T1 G0 G17 G70 G91 HO =0
Y      0            F3 7    G8 G40 G80 G98 DO =0
Z      0 C          M9      G0                        00:00:13
                                09998 SPINDLE BREAK IN

N22 M5
N23 X0.1
<N24 M3
N25 X0.8
N26 M2
BACKGROUND EDIT-----SPACE BAR TO RETURN TO AUTO-
1-DRYRUN OPTIONS          3-HELP
2-OFFSETS                 4-FEED FORWARD OPTIONS
```

- 2) Follow the menu and press the four button to select the feed forward options.
  - a. Select any of the parameters by pressing its corresponding number.
  - b. Alter the number by turning the manual pulse generator.
  - c. Save the changes by pressing the six button. The parameters will correspond to the T# or the M94.2 R2+# in the program.

```
X      1.00000      0
Y      0            0
Z      0            0 C
X      0            S100000 T1 G0 G17 G70 G91 HO =0
Y      0            F3 7    G8 G40 G80 G98 DO =0
Z      0 C          M9      E0                        00:00:13
                                09998 SPINDLE BREAK IN

N22 M5
N23 X0.1
<N24 M3
N25 X0.8
N26 M2
BACKGROUND EDIT-----SPACE BAR TO RETURN TO AUTO-
1-GAIN          2-DECELERATION          3-ACCELERATION  4-DETAIL
5-FEED RATE     6-SAVE SETTINGS
GAIN: 100  DECEL: 50  ACCEL: 50  DETAIL: 0.0010  FEED: 65
```

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**How to Code  
Parameters Into the  
Program**

- 1) Along with the M94.2
  - a. The R1+# represents the Deceleration value.
  - b. The P# represents the Acceleration value.
  - c. The Q# represents the Detail value.
- 2) Along with the M90 the P# represents the Gain value.
- 3) The F word in the program will establish the feed rate.

**EXAMPLE:** *M6 T1  
(TOOL #1, 1 INCH ROUGH EM 3FL  
GO G90 G8 S12000 M3 E1 X-.6 Y-.5  
H1 Z-.5  
G4 P1000  
M94.2 R1+40. P10. Q.01  
M90 P120.  
F120.*

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**Machine Setup**

- 1) From the command mode, type SETP and press the ENTER button.
- 2) Press the space bar to the second page of the SETP menu.
  - a. Cursor over to BINARY BUFFERS.
  - b. Select 1) 15

Doing this reduces the look-ahead buffer. When altering the AFF parameters on-the-fly, the changes become effective almost while the changes occur.

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**Suggested AFF  
Settings**

**Rough Cuts:** 1) To use this setting, program with at least .005 stock on all surfaces.

2) Gain—100, Deceleration—400, Acceleration—10, Detail—.005

**Semi-Finish Cuts:** 1) To use this setting, program at least .002 stock on all surfaces.

2) Gain—100, Deceleration—400, Acceleration—10, Detail—.002

**Finish Cuts:** 1) To use this setting, program with at least .0001 surface tolerance.

2) Gain—100, Deceleration—400, Acceleration—10, Detail—.0002