

## TB237 (Rev1) - AD2 setup with 3.01+ or 2.69 rev 22 +

### AD2 Setup Menu

Pressing **F8 - AD2 Setup** from the Setup menu will bring up the AD2 Setup Menu. The AD2 Setup Menu provides a simplified way of choosing parameters for the advanced acceleration/deceleration module (AD2). AD2 is especially useful in controlling the amount of banging a machine experiences as it proceeds along the toolpath. AD2 is also able to (optionally) round part geometry, allowing for faster feedrates around corners.

WCS #1 (G54)    Current Position (Inches)    Job Name: a.cnc  
X                    +0.0000    Tool: T1 H---  
Y                    +0.0000    Feedrate: 100%    Part Cnt: 0  
Z                    +0.0000    Spindle: +0 A    Part # □: 10

406 Emergency stop detected  
301 Stopped

Press CYCLE START to start job

AD2 Setup Menu

**AD2 is ON by default**

Slower Curves	←	Faster Curves	Curve Feedrate Multiplier at 25% (P230)
Round All	←	Sharpen All	Angles < 90 degrees will be sharpened (P227)
Gentler Stops	←	Faster Stops	Acceleration Multiplier at 100% (P231)
Tolerance	0.00050	Inches	Accuracy vs. Speed (P221)

Quick Setups

Old Mode (Non-AD2) F1	Precision Mill F2	Contouring Mill F3	Precision Router F4	Contouring Router F5	Save F10
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By default, AD2 will be turned off. The Quick Setup keys (F1-F5), will allow the machine to be configured to use AD2 (or not use AD2 in the case of F1). Start by selecting the most appropriate Quick Setup.

**F1 - Old Mode (Non-AD2)** This option turns off AD2

**F2 - Precision Mill** Chooses AD2 with default settings for high precision work on a Mill.

**F3 - Contouring Mill** Chooses AD2 with default settings for a Mill, with looser tolerances for rounded geometry.

**F4 - Precision Router** Chooses AD2 with default settings for precision work on a Router.

**F5 - Contouring Router** Chooses AD2 with default settings for a Router, with looser tolerances for smooth geometry.

The slider bars and **Tolerance** allow the operator to further tweak the preset values provided by the Quick Setup function key choices. In most cases it is not necessary to "tweak" the values, and changing them could cause the machine to perform badly.

The **Tolerance** field determines the approximate amount of smoothing (rounding) that will occur on a typical corner. A higher value allows the machine to round corners, which translates into faster cutting time. Smaller tolerance values cause feedrates to slow down more in corners and jobs to run slower. Refer to the "Technical Background Description of AD2" (later in this bulletin) if more detail is desired on the parameters affected by the slider bars.

## AD2 Configuration Parameters

Parameter	Description	Recommended values	
220	Turn the AD2 feature ON or OFF	1 = AD2 (set to 0 to use the old AD1)	
221	<b>NBpts:</b> The number of points in the smoothing filter. The higher this value, the more rounded corners will become (see tolerance below)	For Milling Machines: 0 to 10	For Routers: 5 to 20
222	<b>STEP:</b> AD2 breaks up a G code program into segments of this vector size. Use this rule of thumb: Tolerance = (Nbpts*STEP)/2.	For Milling Machines: .001 inch / .025mm	For Routers: .01 inch / .25mm
223	<b>Umax:</b> Sustained safe throughput rate going to the CPU10/MPU11 card.	400	
226	<b>W:</b> Feature Width over which the Min Angle is determined.	10	
227	<b>Min_Angle:</b> Minimum angle to smooth in degrees. Settings of 95 to 100 degrees will come to a near stop and produce sharp right angles. 60 to 85 will move continuously while rounding angles.	For Sharp corners 95 to 100 degrees	For rounded corners 60 to 85 degrees
228	<b>S curve:</b> Produces extra gentle stops, starts and feedrate changes, but increases job run time and may appear to pause at corners.	0 = Off completely 1 = On completely Range 0.0 to 1.0	
229	<b>Backplot/AD2 mode :</b> AD2 may slow down the display of Backplot Graphics. This parameter allows a faster backplot by not showing AD2 induced smoothing.	0 = Faster Backplot, smoothing active but not shown 1 = Slower Backplot, smoothing effects shown.	
230	<b>AD2 Curve Feedrate Multiplier:</b> Reducing this value below 1.0 will cause the machine to move slower around curves and corners, minimizing "bangs" and overshoots. Increasing this value above 1.0 may allow you to run your machine faster if the feedrates in arcs and corners are still satisfactory.	1.0 (default value) 0.1 to 5.0 (Depending on user's preference for speed vs "bangs" and overshoots)	
231	<b>AD2 Acceleration Multiplier:</b> This parameter allows you to adjust the overall acceleration / deceleration rate as a means to reduce machine vibration, and noise during starting, stopping and feedrate changes. Reducing this value below 1.0 will cause more gentle accelerations and decelerations. Increasing this value above 1.0 will cause faster accelerations / decelerations.	1.0 (default value) 0.5 to 1.5 (Depending on user's preference for quickness of accelerations / decelerations)	

Note: STEP must be in the same units that the control is currently set to (Inches or MM). Once entered in, if you change units in the control from inches to mm or vice versa the AD2 parameters will automatically be converted to the other units for you, so you don't have to re-enter them once you've type them in properly.

# Technical Background description of AD2

AD2 performs several related functions:

## 1. Smoothing NBPTS (P221) and STEP (P222)

These parameters control smoothing of the user supplied G-code. Smoothing allows significantly higher feedrates to be achieved while reducing vibration, bumps and bangs at corners and angles. It is also great for smoothing over a CAD-CAM generated data with peculiar features. See Fig 1. Smoothing's strength is also a potential disadvantage, it modifies geometry and rounds corners. See Fig 2. When would you want to use smoothing? The user may want to run smoothly through rectangular Z movements created by "breakout tabs" on a router job. Smoothing will allow the job to run at high speed right through the breakout tabs, if the min angle P227 is set to less than 90 degrees. The Tolerance value in the AD2 Setup Menu affects both P221 and P222 .

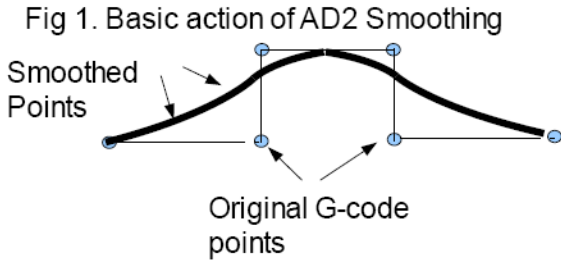


Fig. 2 Rule of thumb for estimating Smoothing tolerance  $\sim = (\text{NBPTS} * \text{STEP})/3$

Example: for NBPTS= 5 , and STEP= .001  
 $5 * .001 ; .005/3 \sim = .00167$  in Smoothing Tolerance

Gives an estimate of the smoothing tolerance  
When rounding a 90deg corner, assuming  
That the min angle P227 is less than 90deg

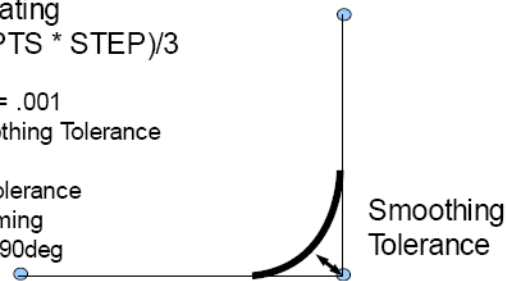
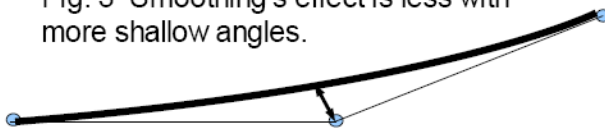


Fig. 3 Smoothing's effect is less with more shallow angles.



## 2. P230 Curve Feedrate multiplier Arcs and Corners

Low values produce lower feedrates in curves.



Fig. 4a: P230 determines speed around curves and arcs

Tighter arcs produce lower feedrates

### 3. P231 Acceleration Multiplier

Fig. 4b: Lower values produce lower accelerations.

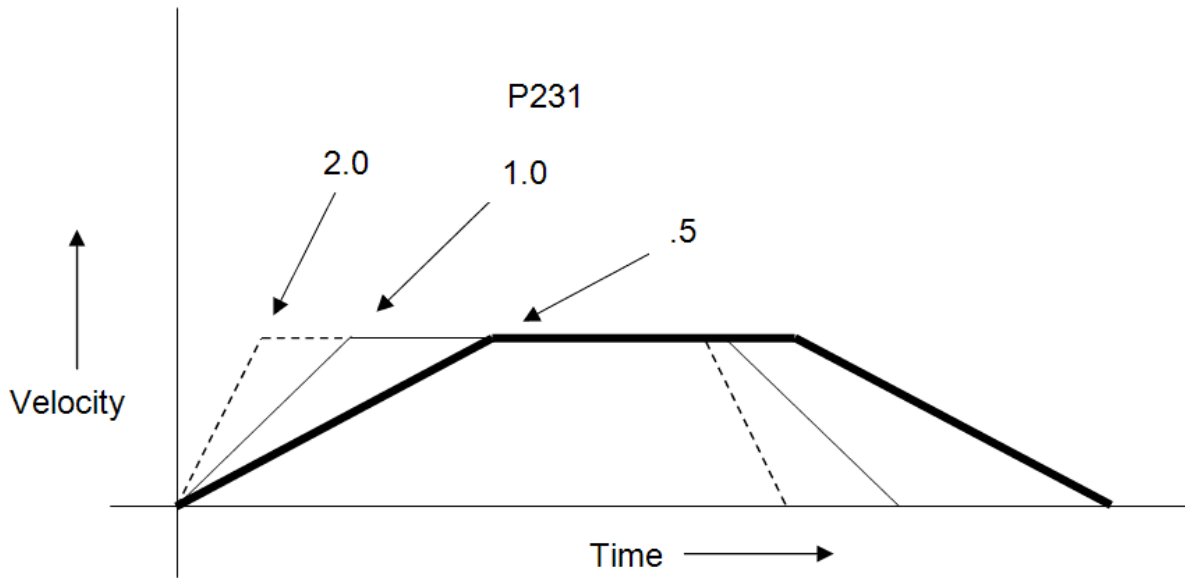
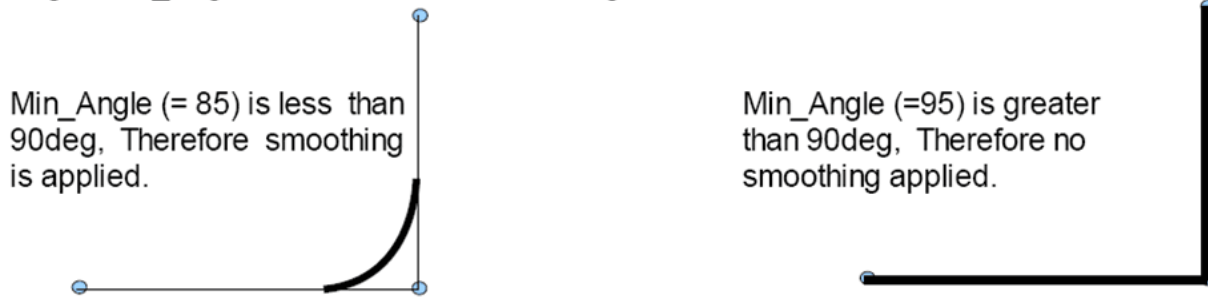


Fig. 4b: Lower values produce lower accelerations.

**4. Min\_Angle (P227)** defines the minimum angle to apply Smoothing to. All angles below the minimum angle will be sharp. For example if Min Angle is set to 95deg then all angles less than 95 right angle (including 90deg) corners will be sharp (not smoothed).

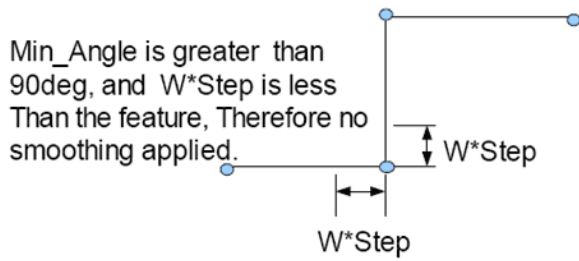
Fig. 5 Min\_Angle allows or inhibits smoothing



### 5. Feature width W (P226)

W and Min\_Angle work together to determine which angles will be "sharp" (not be smoothed). For example a Gcode file may contain small spikes, double backs or zig zags of less 1mm that may be causing unwanted slowdowns in an otherwise high speed stretch of toolpath. Given a STEP (P222) = .25mm, setting W (P226)= 4 ( $4 \times .25=1\text{mm}$ ) should reduce or eliminate decelerations across the problem toolpath. W does not itself smooth the offending data, that's the job of Smoothing (controlled by NBpts and STEP), but W does allow you to minimize slowdowns caused by small features, which is very helpful for running smooth thru jagged CAD/CAM generated G code.

Fig 6. W affects Min\_Angle

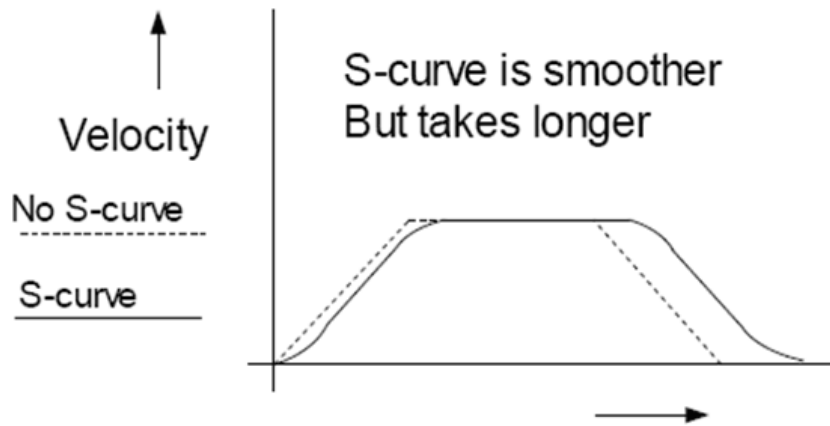


Min\_Angle is greater than 90deg, but  $W \cdot \text{Step}$  is less Than the feature, Therefore smoothing is applied.



**6. S curve (P228)** The S-curve feature changes acceleration rate more slowly and can be used to produce extra gentle stops, starts and speed changes . Its effect is most noticeable at direction changes.

Fig. 7 S-curve



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**Document History**

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