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Function Programming

Function programming on the PLuS controllers allows access to the extra features that rotary cam limit switches do not include. These features include: Motion dection output, position offset, program selection and speed compensation. This section includes detailed descriptions of these features and how they are accessed from the keyboard. (There is a programming “quick referrence” page in the appendix which is helpful once the concepts of these features are understood)

MOTION DETECTION

A motion detection output and LED indication is provided on the PLuS controller. The user may set both high and low motion detection setpoints. When the rpm of the PLuS is equal to or greater than the low motion setpoint, and less than or equal to the high motion setpoint, the motion output on the back terminal strip will turn on and the motion LED on the keyboard will be illuminated .

The rpm display on the front panel is updated once every second. The motion detection output on the back panel terminal strip and the Motion LED on the front panel are updated ten times every second. The numeric display provides an easy to read, stable indication of rpm; the motion detection output reacts more quickly.

Program the motion detection setpoints as follows:

LOW MOTION SETPOINT (FCN #1)

The low motion setpoint may be programmed whenever the program enable input is energized (encoder turning or stationary).

EXAMPLE:
Set the low motion setpoint to 100 rpm.

To display the present Low Motion setpoint press:

To clear the display and enter 100 press:

HIGH MOTION SETPOINT (FCN #2)

The high motion setpoint may be programmed whenever the program enable input is energized (encoder turning or stationary).

EXAMPLE:
Set the high motion setpoint to 200 rpm.

To display the present High Motion setpoint press:

FCN 2 ENT

To clear the display and enter 200 press:

CLR 2 0 0 ENT

OFFSET PROGRAMMING

The PLuS controllers provide a straightforward and flexible means to adjust the offset. Two functions (methods) are provided for this purpose: 1) Offset: Absolute (FCN #3), and 2) Offset: Relative (FCN #4).

NOTE:
The Absolute offset programming method (FCN #3) displays the actual value of the offset. The Relative offset programming method (FCN #4) displays the current controller position in real time.

ABSOLUTE OFFSET (FCN #3)

The Absolute Offset function is used to directly change the offset value. The offset should be recorded when the machine is running properly. If the offset is then ever programmed incorrectly, simply reloading the known “good” value will restore the machine to its previous state.

EXAMPLE: Assume that in the process of changing tooling, the indicated position has been incorrectly adjusted through FCN #4. Previously, the offset value had been recorded at 94. The present offset value is indicated at 245. Change the offset back to the known correct value.

To display the present absolute offset value press:.

FCN 3 ENT

To clear the value of 245 and enter a new value of 94 press:.

CLR 9 4 ENT

Numeric Entry of the Absolute Offset value can only be done when the encoder is NOT turning. However, increment and decrement adjustments of the offset value can be made while the encoder turning or stationary (“fine tuning”).

RELATIVE OFFSET (FCN #4)

The Relative Offset function indirectly changes the offset value. It is used to set the controller position to a known value with respect to the current encoder position (machine position). This function would be used during setup when the controller position does not correspond to the known machine position. Changes made to the controller position using FCN #4 will automatically adjust the offset value.

Assume the controller has been installed on a machine and that the machine is at rest with the "tooling" in a position that corresponds with a "known" degree reading on the machine timing diagram. It is unlikely that the PLuS encoder shaft has been adjusted so that the indicated position corresponds exactly with the machine position. Use function #4 to set the indicated position to agree with the machine position.

EXAMPLE:
Assume the machine has been brought to a position that is "known" to be 38 degrees. The controller position is displayed as 145 degrees. Change the indicated encoder shaft position to correspond to the known machine position.

To display the present controller position press:

FCN 4 ENT

To clear value of 145 and enter the new position of 38 press:.

CLR 3 8 ENT

Numeric Entry of the Relative Offset value can only be done when the encoder is NOT turning. However, increment and decrement adjustments of the Relative Offset value can be made while the encoder turning or stationary ("fine tuning"). To increment or decrement the offset value while the encoder is turning with a stable display, use the Absolute Offset function (FCN #3).

ACTIVE PROGRAM (FCN #5) (Models PS-4001/4011)

This function allows the "active" program to be selected from the keyboard as well as from the logic inputs on the back of the controller. The "Active Program" select function is available on all PS-4001/4011 model controllers.

The value programmed into FCN #5 is the program number that will be active when there are NO Program select inputs active. Program select inputs will OVERRIDE the value programmed into FCN #5. This allows the active program to be selected through the keyboard without using an external Program Select Switch.

NOTE:
If the program select inputs are being used, FCN #5 must be set equal to 1 to allow program #1 to be selected from the select inputs. Because program #1 requires all program select inputs to be de-energized, the controller selects the program specified by FCN #5. Therefore, if FCN #5 is not set equal to 1, it is impossible to select program #1 from the program select inputs.

EXAMPLE:
Select program #4 to be the active program.

To display the program number presently selected to be active press:

FCN **5** **ENT**

The currently active program will appear in the display above the PGM key. To clear the display and enter 4 press:

CLR **4** **ENT**

SPEED COMPENSATION (Models PS-4001/4011)

Speed compensation is available on all PLuS PS-4001/4011 model controllers. This function allows the controller to automatically advance channel setpoints as the encoder RPM increases. This automatic compensation for speed is similar to the "centrifugal advance" on an automobile engine; it "advances" channel pulses in time proportional to the encoder RPM.

This feature may be used to compensate for valve turn-on or turn-off time, cylinder actuation speed, mechanical relay delays, etc. It will allow you to set your machine up at a low speed, and then have the controller automatically advance channel setpoints to take care of those delays at higher speeds.

Speed compensation is LINEAR and AUTOMATIC. Program (through FCN #6) the number of channels that are to be compensated. Program (through FCN #7) the amount of "advance" desired (in DEGREES PER 100 RPM). The PLuS controller then automatically applies the correct advance for any encoder speed (up to the controller's specified maximum RPM).

EXAMPLE:
Assume that a PLuS controller has been set up as follows:
FCN #7: 10 (Degrees / 100 RPM)
Channel 1: ON at 60 degrees, OFF at 120 degrees

The following illustration shows how the pulse is shifted at various RPM readings. The PLuS controller automatically takes into account "+" RPM (encoder rotation that causes controller position to increase) and "-" RPM (encoder rotation that causes controller position to decrease). In both cases, the controller advances the pulse in TIME.

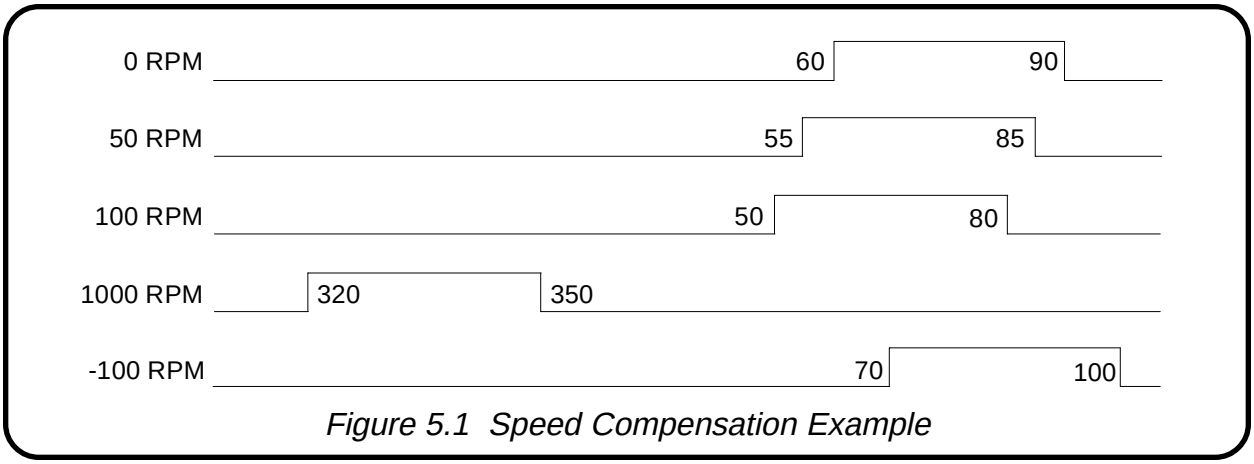


Figure 5.1 Speed Compensation Example

There are three functions that control automatic speed compensation: FCN #6 - Number of Compensated Channels, FCN #7 - Compensation Value (Degrees/100RPM), and FCN #8 - RPM Ramp Limit. The first (FCN #6) specifies how many channels are to be compensated. The second (FCN #7) specifies how much "advance" is to be applied to the compensated channels. The third (FCN #8) determines how large of a speed change is needed to cause an immediate update of the speed compensated set points (Speed compensated setpoints are normally updated every 1 second).

NUMBER OF COMPENSATED CHANNELS (FCN #6) (MODELS PS-4001/4011)

The number of compensated channels may be programmed to be any number between 0 and the number of channels available on the unit. Compensated channels start with channel #1 and continue with consecutive channel numbers. Therefore, if 3 channels are specified to be speed compensated, channels 1,2 and 3 would be affected.

This function may only be programmed when the encoder is NOT turning.

EXAMPLE:
Set channels 1,2,3 and 4 to be compensated.

To display the number of channels currently compensated press:

FCN 6 ENT

The number of compensated channels will appear in the display area above the CHN key. To clear the display and enter 4 press:

CLR 4 ENT

COMPENSATION: DEGREES / 100 RPM (FCN #7) (Models PS-4001/4011)

The compensation value may be programmed to any value. The value entered will be the number of degrees the compensated channels will be advanced at 100 RPM. At other RPM values the amount of advance will be directly proportional.

EXAMPLE:
Set the compensation value to 10 degrees / 100 RPM.

To display the present compensation value press:

FCN 7 ENT

The present compensation value will appear in the rightmost display. To clear the displayed value and enter 10 press:

CLR 1 0 ENT

The amount of Speed Compensation may be changed while the encoder is turning through the increment/decrement keys.

EXAMPLE: Increase the compensation value 3 degrees / 100 RPM using INC/DEC mode.

To display the present compensation value press:

The present compensation value will appear in the right most display. Use the INC key to increase the compensation value by 3.

NOTE:
At low compensation values, it may take 2 seconds for the controller to complete its calculations when a new value is entered or an existing value incremented or decremented.

RPM RAMP LIMIT (FCN #8) (PS-4001 Model Controllers Date Codes 8808 and Later, All PS-4011's)

(Note: FCN #8 is not called out on the face of the keyboard because it is a function that is set only once for a particular type machine.)

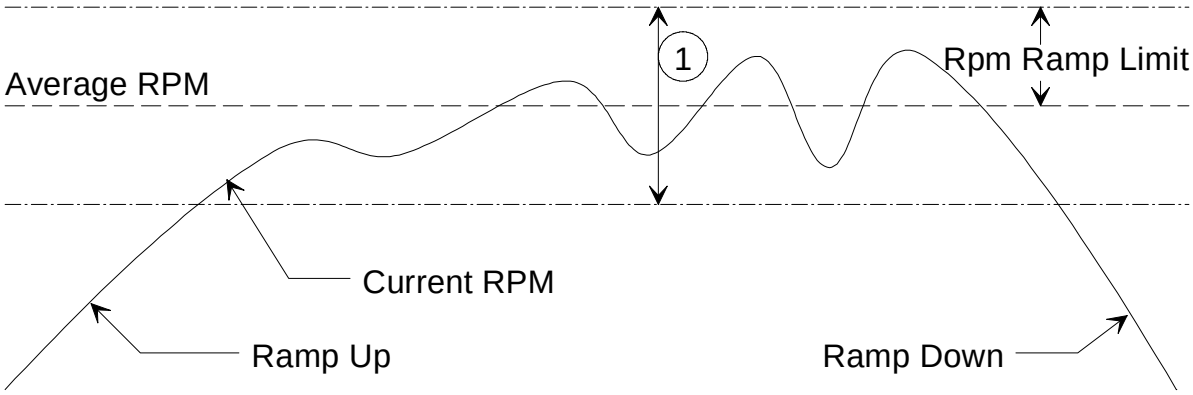
During normal operation, most machines will show some variation in RPM during each "machine cycle". Though the RPM display will vary by only 1 or 2, the instantaneous RPM may vary 5 or more, depending on the pattern of loading.

PLuS controllers calculate the CURRENT RPM every 100 milliseconds (.1 Sec). The displayed value of RPM is updated every second, and shows the AVERAGE of 10 consecutive CURRENT RPM calculations. The amount (degrees) of compensation advance depends on the RPM and the value programmed through FCN #7 (Degrees/100 RPM). In order to avoid "jitter" on the compensated outputs, the amount of advance is normally calculated using the AVERAGE RPM (displayed RPM).

When a machine is being ramped up or down, it is necessary to update the speed compensation more often. This keeps compensated outputs synchronized with other machine functions as the machine makes large changes in RPM.

The "RPM Ramp Limit" allows you to establish a "normal" variation in RPM, within which the amount of compensation advance is based on the AVERAGE RPM. When the RPM of the machine changes by more than the specified "RPM Ramp Limit", the amount of compensation is immediately updated based on the CURRENT RPM.

As the machine ramps up or down, the AVERAGE RPM will change every second, but probably will not be close to the CURRENT RPM. As long as the CURRENT RPM differs from the AVERAGE RPM by more than the RPM Ramp Limit, the amount of compensation advance will be based on the CURRENT RPM.



(1) When current RPM is within this range, speed compensation is updated on a one second interval.

When current RPM is outside of this range, speed compensation is updated each .1 sec.

Figure 5.2 RPM Ramp Limit

The above illustrates that the amount of compensation advance during the “Ramp Up” and “Ramp Down” phases of machine operation is based on the CURRENT RPM. The amount of compensation advance is based on the AVERAGE RPM when the CURRENT RPM is within “RPM Ramp Limit” of the AVERAGE RPM.

EXAMPLE:
Set the RPM Ramp Limit to be +/- 10 RPM.

To display the present RPM Ramp Limit press:

FCN **8** **ENT**

The present RPM Ramp Limit will appear in the rightmost display. Use numeric entry to set the RPM Ramp Limit to 10 RPM by pressing:

CLR **1** **0** **ENT**

NOTE:
Only numeric entry may be used to set the RPM Ramp Limit. The RPM Ramp Limit may be changed while the encoder is turning.