FCN 0 Sc - Type of Speed Compensation

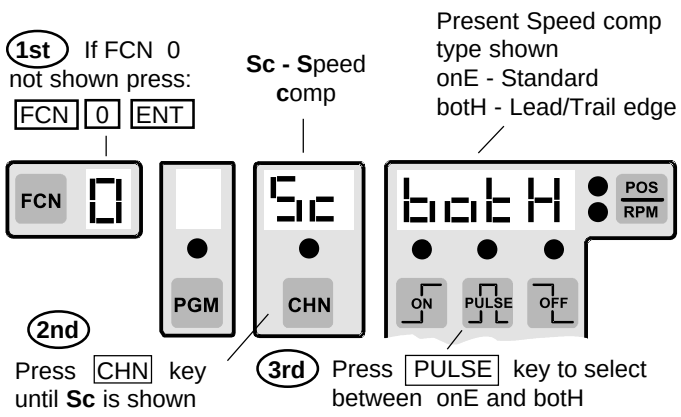
(units with "L" option only)

onE - Standard Speed Compensation: One value of speed compensation is programmed for each output channel. Both the leading and trailing edges of output pulses are compensated by the same amount. Controls that do not have the "L" option operate in this manner. A unique amount of speed comp can be programmed for each output channel.

botH - Leading and Trailing Edge Speed Compensation:

A different amount of speed compensation can be programmed for the Leading and Trailing pulse edges of each output channel. This allows proper compensation for output devices with different turn on and turn off responses.

Selecting the Type of Speed Compensation



FCN 4 - Leading/Trailing Edge Speed Compensation

(Setup or Master program enable must be active)

Speed Compensation is the ability of the control to automatically advance an output's setpoints as the machine speeds up, thus compensating for the response of the device being controlled. Each output can be individually compensated by a unique amount. This allows all output devices to be properly compensated, even though their responses may vary widely.

When the control is set for leading/trailing edge speed comp (FCN 0, Sc=botH), two speed compensation values may be programmed for each output channel - one for the leading pulse edges (turn on), one for the trailing pulse edges (turn off). The amount of speed compensation needed is determined in the same manner used for standard speed compensation, but two values will be needed for each output channel being compensated.

Speed compensation is set in units of Degrees/1000 RPM, regardless of the scale factor being used. If leading edge and/or trailing edge responses of output device are known, the amount of Speed Comp required can be calculated:

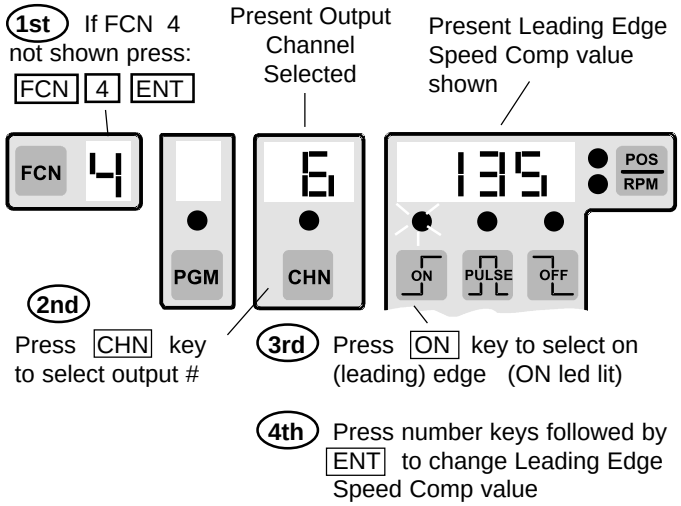
Speed Comp (Deg/1000 RPM) = 6 x response (in mSec)

EX: 20 mSec response; 6 x 20 = 120 (Deg/1000 RPM)

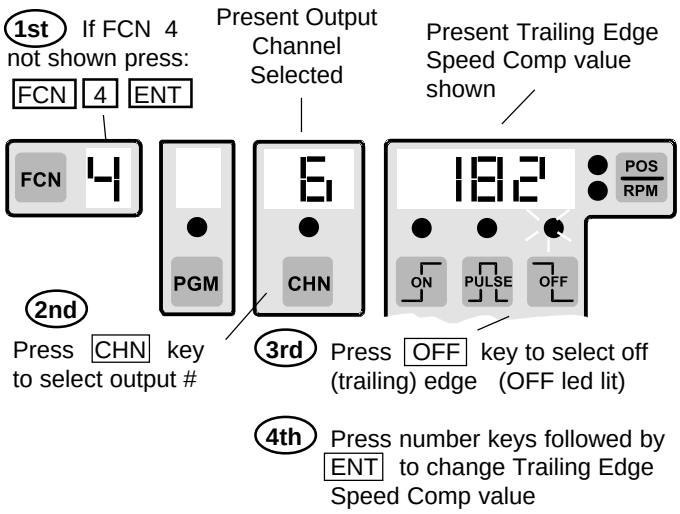
Program the output for the correct on and off setpoints at zero speed and then program speed comp values for the leading and trailing edges.

If the device response is not known, program output for the correct on and off setpoints at zero machine speed. Program the output with estimated speed comp values based on six times the estimated response in mSec (mSec = .001 Sec). Run machine at a typical speed and adjust leading and trailing edge speed comp values until output is properly synchronized to the machine.

Programming the Leading Edge Speed Comp Value



Programming the Trailing Edge Speed Comp Value



Note: Once programmed in a channel, this function will be present in that channel in all programs.

Analog Output: Option "-A"

FCN 1 Ao, Ah - Analog Output Signal

(Units with "A" option only)

The analog option allows PLµS controls to output an analog signal that is linearly proportional to the current machine RPM. Analog output modules are available with either 0-10 VDC or 4-20 mA output. The two parameters that define the operation of the Analog output are the Offset and the High RPM (speed at which full scale signal occurs).

Ao - Analog offset: The Analog offset is the analog signal level that will be output when the machine ºois at zero RPM. This allows the minimum analog signal to be greater than zero volts or 4 mA, which is required in many applications. The offset is programmed in terms of the number of 12 bit (4096) increments that the minimum signal level should be. Calculate the Offset value to be programmed as follows:

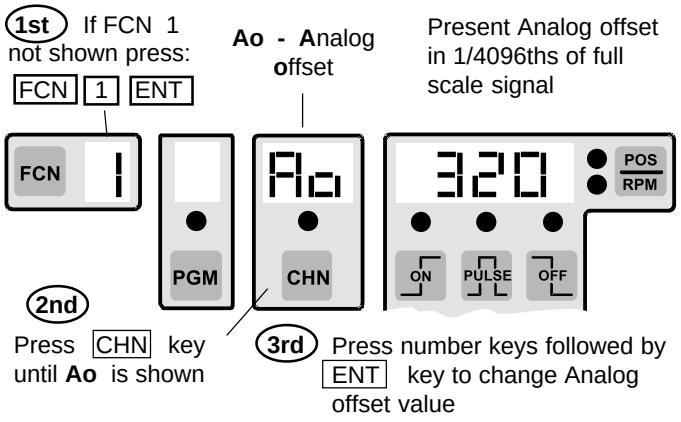
For 20 mA: ((Min Sig - 4) / (16)) x 4096
EX: 5 mA Min Sig Ao = ((5-4)/(16)) x 4096 = 256

For 10 VDC: (Min Sig /10) x 4096
EX: 2 VDC Min Sig Ao = (2 / 10) x 4096 = 819

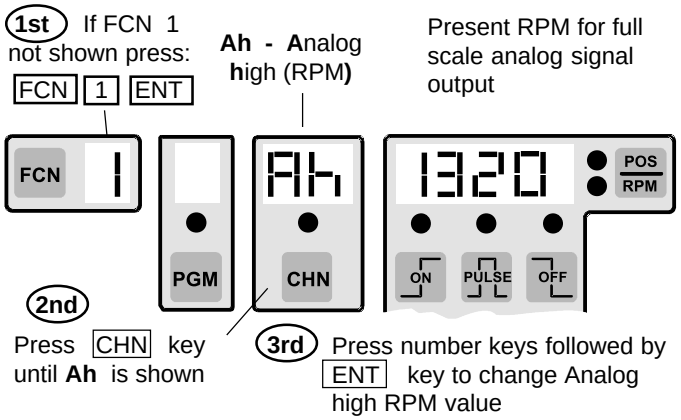
Ah - Analog high RPM: The Analog high RPM is the lowest speed at which full scale analog output will occur. It is programmed in whole RPM.

EX: Need 5 mA output at zero RPM and 20 mA output at 1200 RPM. Ao = 256 (mA example above) and Ah = 1200 RPM.

Programming the Analog Offset



Programming the Analog Full Scale Signal RPM

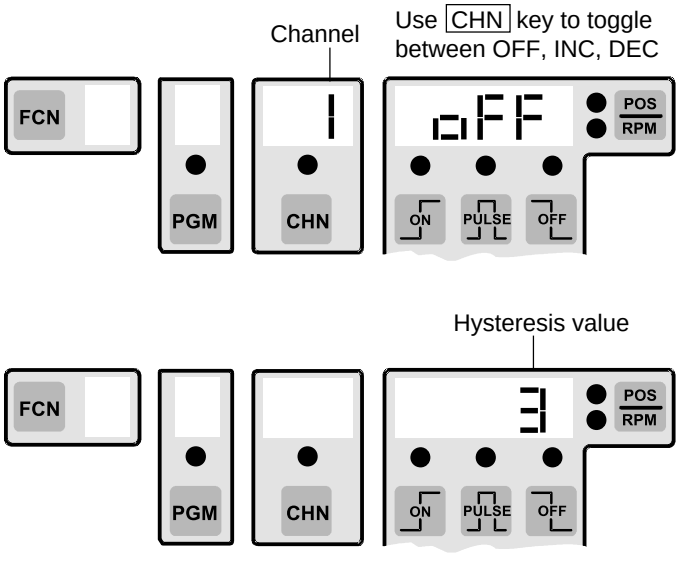


Outputs Based On Direction of Rotation: Option "-D"

In standard PLµS controllers without the "-D" option, outputs will turn ON/OFF based on resolver position, regardless of which direction the resolver is turning. With the "-D" option, outputs can be based on the direction the resolver is rotating. Outputs can be set individually to be based on direction.

Direction ANDing: To choose which channels are to be based on direction, select Alternate Function 5. This is accomplished by pressing the FCN key and POS/RPM key simultaneously, then pressing 5, then pressing ENTER. The number 1 will appear above the channel key (CHN). OFF will appear in the display on the right, next to the POS/RPM key.

Toggle through each channel by pressing the CHN key. Toggle the feature between OFF, increment direction ANDing (INC), and ON decrement (DEC) direction ANDing by pressing the PULSE key. The factory default will be OFF for all channels.



Direction Hysteresis: Direction hysteresis is used to specify how many counts in one direction the resolver must rotate before a change in direction ANDing occurs and affects the output ON/OFF status. This level is adjustable so that vibration in the machine will not cause outputs to switch that are direction ANDed. Select Alternate Function 6 to set this value. A value can be entered (1 to 9999) for the number of counts that must pass before a direction change affects the output status. The default is 3.

Gray Code Position Output -

(Units with the "G" Option)

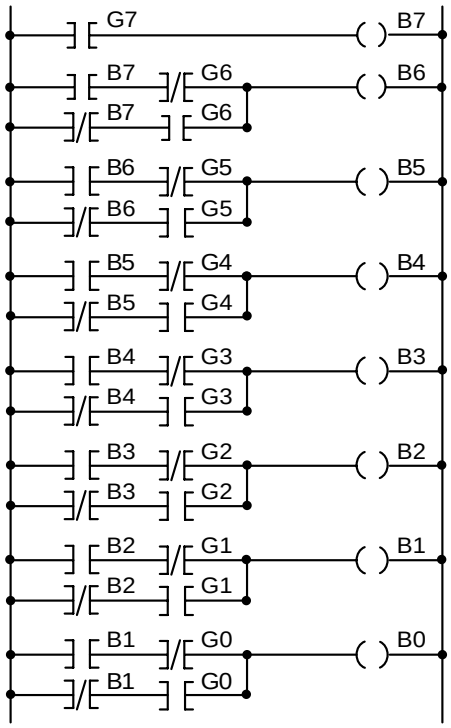
Plµs Controls with the Gray Code output option output eight bit Gray Code position information on the last eight outputs. The position output takes into account the control's Offset value. Therefore, the Gray Code position matches the position shown on the control's position display. The Gray Code position output can be Speed Compensated as a group of outputs as shown below.

The Ladder Diagram shown on the right will convert the eight bit Gray Code output signal (G0-G7) from the PLuS control to a binary number (B0-B7) during each scan of the PLC. Because only one bit changes state per Gray Code increment, the decoding process is error free and does not require the use of latching or handshaking circuitry. The value of the Binary result will always be in the range of zero to 255 because the eight bit Gray Code divides each revolution into 256 uniform increments. Ladder rungs which follow the conversion can compare the rotary position value to known positions for control of machine devices that must operate at specific positions within the overall machine cycle. The rotary position of the machine cycle can also be used to gate input sensors and shift register functions.

Converting Gray Code to Binary involves a sequence of "Exclusive OR" operations. It is simple to program this same conversion logic in other programming languages besides ladder logic. In addition to decoding the rotary position of the encoder, controls with arithmetic capability can be programmed to offset position if required.

16 outputs	CHN 9-16	9 = LSB, 16 = MSB
24 outputs	CHN 17-24	17 = LSB, 24 = MSB
48 outputs	CHN 41-48	41 = LSB, 48 = MSB

Gray Code Conversion Ladder



G0 - G7 = Gray Code Input Bits from PLuS control to PLC

B0 - B7 = Binary Equivalent of Gray Code Position from PLuS control

G0 = LSB, G7 = MSB

FCN 4 - Gray Code Speed Compensation

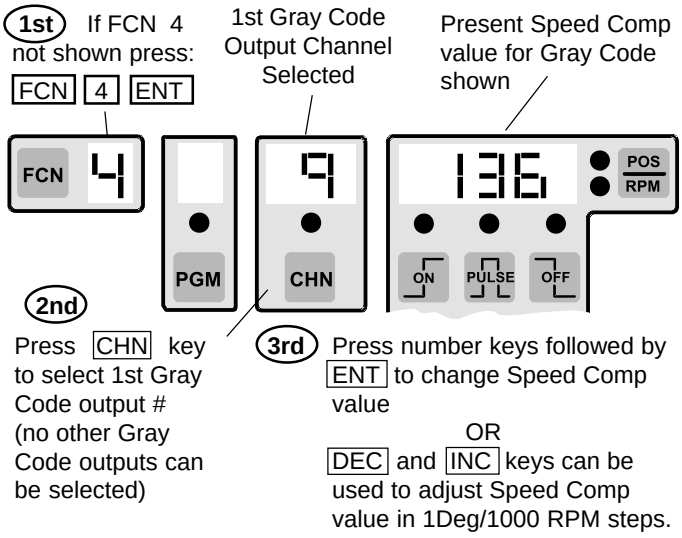
(Setup or Master program enable must be active)

Speed Compensation is the ability of the control to automatically advance an output's setpoints as the machine speeds up. The Gray Code position output can be Speed Compensated as a group by entering a speed comp value into the first channel of the Gray Code outputs (Least Significant Bit). All of the Gray Code output channels will be compensated by this same amount. The channels to enter Gray Code speed comp into are as follows:

16 output system:	output channel 9 (9 = LSB)
24 output system:	output channel 17 (17 = LSB)
48 output system:	output channel 41 (41 = LSB)

Speed compensation is set in Degrees/1000 RPM, regardless of the scale factor being used. If the response of the device is known, the amount of Speed Comp required can be calculated:

Speed Comp (Deg/1000 RPM) = 6 x response (in mSec)
EX: 20 mSec response: 6 x 20 = 120 (Deg/1000 RPM



Note: 1 Degree/1000 RPM resolution allows Speed Comp to be adjusted very accurately. However, it may be necessary to make larger changes to the Speed Comp value to see a change in machine performance. A change of 6 degrees/1000 RPM is needed to make a 1 mSec difference to the device being controlled.

Extra Program Storage: Option "-F"

PS-5000 Series PLµS controls containing the "F" option can store approximately four times as many output pulses (approximately 4500 pulses) in permanent memory as standard PS-5000 Series controls. The exact number of pulses that can be stored will vary between different models and features included.

An "F" option control can store as many as 992 different setpoint programs. Unlike other PLµS controls, a special "Pn" (program number) feature included in "F" controls allows direct access to any program by entering its 3-digit value. Also, the current active program number is displayed during normal operation as shown below.

Number of Pulses/Programs Available

The actual number of different programs that can be entered is determined by the total number of pulses that can be stored (approx. 4500) and the number of pulses needed for each program.

For example, if 14 outputs are being used and each output has 1 pulse per machine cycle, the total number of programs that could be stored would be:

$$\frac{\text{4500 total pulses (approx)}}{\text{14 pulses per program}} = \text{321 programs}$$

Special Alternate Functions have been included in the "F" option to report the total number of pulses that can be stored, and how many are currently programmed. See page A-16 for directions on accessing alternate functions.

ALT FCN 1010 displays exact total number of pulses available.

ALT FCN 1011 displays number of pulses presently programmed.

Pulses Remaining = ALT FCN 1010 minus ALT FCN 1011

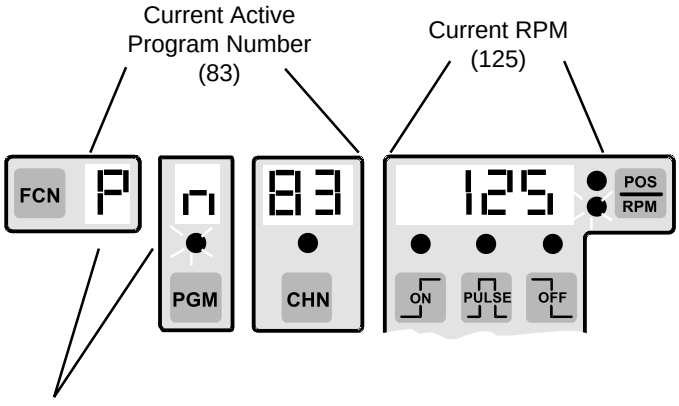
!! WARNING !!

PLµS controls continuously calculate a checksum value which represents all of the programmed contents in the permanent memory. **The control power must remain on a minimum of five seconds after any programming change is made to insure that the new checksum has been calculated.**

If power is turned off before the checksum is calculated, the control will have to check the validity of all programmed contents on the next power-up. This will take approximately 18-20 minutes. The control will not be able to run the machine during this time.

Active Program Number Displays

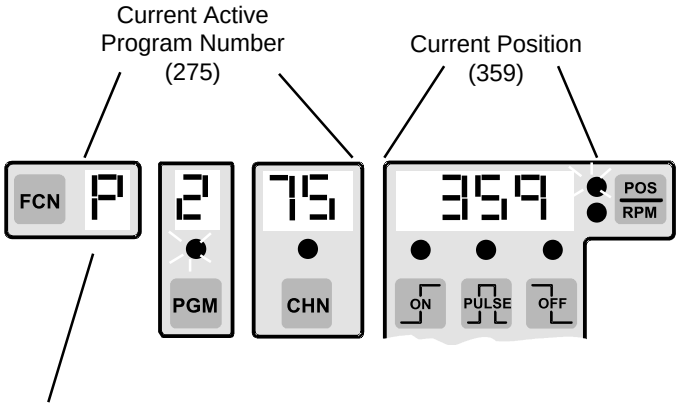
The current active program will always be displayed while RPM is displayed as shown below.



NOTE: Pn shown for 2 digit Program Numbers

The current active program will be displayed while position (POS) is displayed (shown below) if neither of the following two conditions exist:

1. An output channel is selected.
2. The control is a PS-5XX4 with more than 1 output group established.



NOTE: P shown for 3 digit Program Numbers

(Option "-F" continued next page)

FCN 3 - Program Number Changes

The "F" option can store up to 992 unique programs in memory. These program numbers can be created and accessed in random order.

A convenient Program number (Pn) feature allows the desired program number (1-992) to be entered directly without having to enter the corresponding values into the Program bank (Pb) and Active Program (AP) parameters. This is the method described below under "Changing Program Numbers from Keyboard."

If the hardware program select inputs are going to be used (they can be driven from a PLC or selector switch) to select programs, it may be necessary to program the Program bank (Pb) and Active Program (AP) from the keyboard. Follow the instructions given below under "Hardware Selection of Program Number."

Changing Active Program Number from Keyboard

Use the Program number (Pn) feature of FCN 3 to select any program directly by entering the corresponding number from 1-992. The corresponding "Pb" and "AP" values will automatically be calculated and selected. It will not be necessary to calculate or program "Pb" or "AP", but they can be viewed to verify that their values correspond to the selected program number.

Pn— Program number (1-992)
Pb— Program bank (1-124); 124 banks of eight programs each
AP— Active Program (1-8); active program within bank

Example:

If Program number (Pn) 94 is selected, "Pb" will equal 12 (12th bank of eight programs) and "AP" will equal six (6th program within this bank).

DO NOT enter values into "Pb" or "AP" if the keyboard program selection is being used. Simply program "Pn" to the desired program number from 1-992.

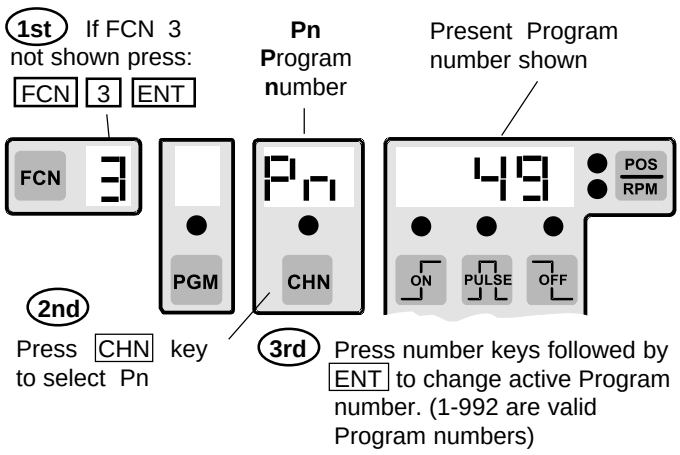
Hardware Selection of Program Number

The hardware program select inputs override the keyboard programmed Active Program (AP) value when any one or combination of the inputs is energized. When the hardware inputs are used to select the Active Program (AP), insure that "AP" is set equal to one.

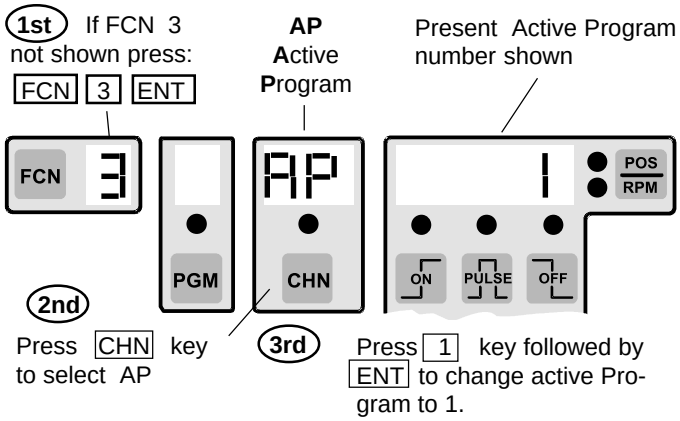
The hardware select inputs affect only the current "AP" value that is controlling the outputs. The "Pb" is not affected by the select inputs and has to be changed from the keyboard if more than 8 programs are used.

Note: Active Program and Program Bank can be changed through the serial communication port also.

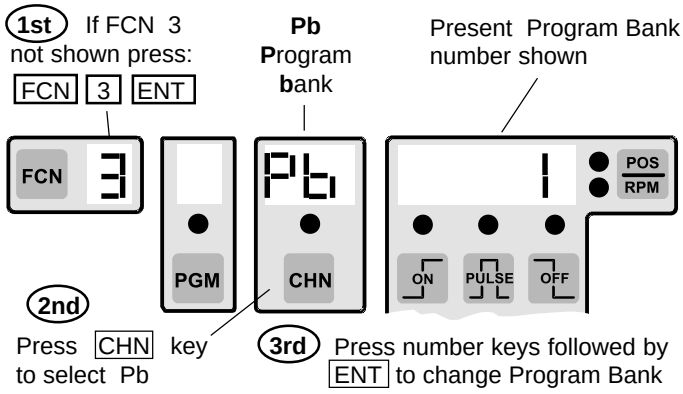
Viewing / Changing Program Number



Viewing / Changing the Active Program



Viewing / Changing Program Banks



(Option "-F" continued next page)

Viewing/Editing Inactive Program

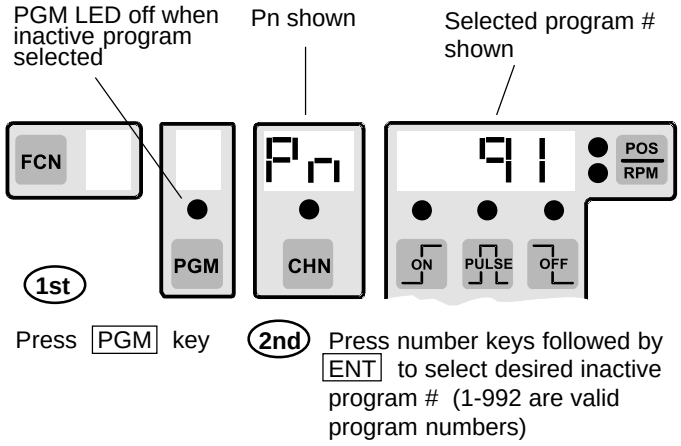
Any inactive program can be viewed or edited from the PLuS keyboard while the current active program controls the machine.

Pressing the PGM key will select any inactive program for viewing or editing. Press the number keys of the desired program number followed by ENT to select the desired inactive program. This program number will be shown in the setpoint display area to the right of "Pn" in the channel display (the PGM LED will be off while inactive programs are selected).

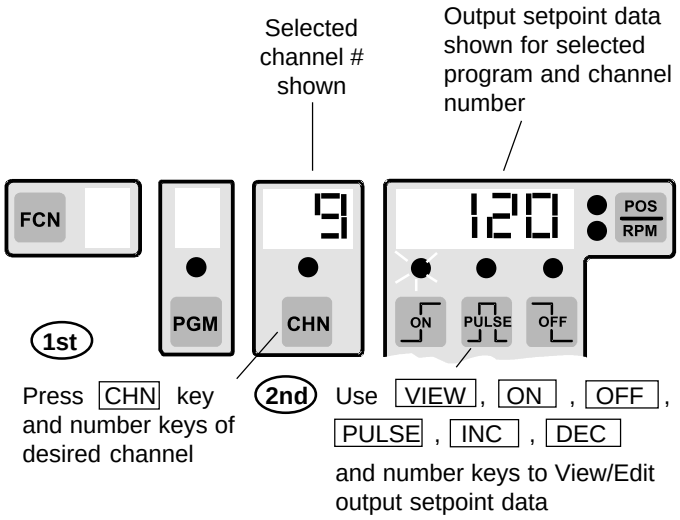
Specify which channel, within the selected program, will be viewed/edited by pressing the CHN key followed by the desired channel number and ENT (the Pn display will be replaced by the selected channel number and corresponding output setpoint information).

To exit the selected inactive program and return to normal active program displays press the POS/RPM key.

Select Inactive Program Number to be Viewed/Edited



Select Channel to be Viewed/Edited

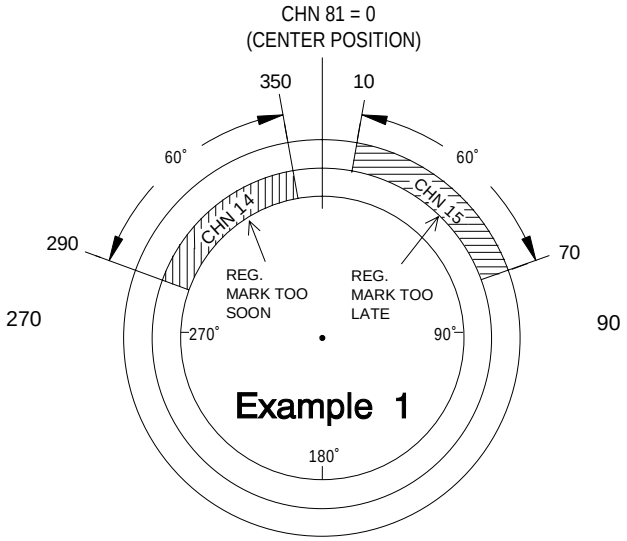


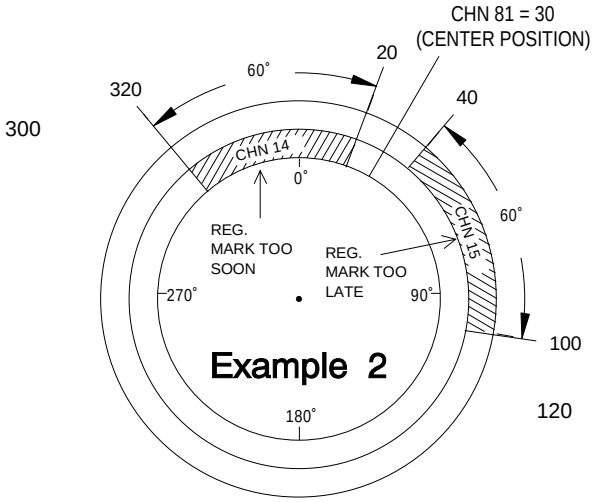
The "P" option (phase mark registration) dedicates two PLuS outputs—Channels 14 & 15—as registration inspection windows for input to registration controls or PLCs. In many cases, this can replace mechanically adjusted registration sensor mechanisms at far less cost, without sacrificing ease of adjustment. Registration adjustments can be made through keyboard commands or dedicated increase and decrease hardware inputs (push buttons, etc.).

Note: Substitute channels 7 & 8 for 14 & 15 on 9 output units.

Output channels 14 and 15 are programmed individually so they have the output duration and phase relationship required by the registration control system. Once both channels are programmed, their setpoints can be simultaneously moved to any machine position without altering their duration or their phase relationship to each other. This greatly simplifies registration setup and adjustment. Outputs 14 and 15 can be used interchangeably as "too soon" and "too late" signals, and their pulse durations do not have to be equal.

Registration Window Examples and Adjustment Methods





Example 1 illustrates the following:

CHN 14 - ON @ 290 OFF @ 350
CHN 15 - ON @ 10 OFF @ 70
CENTER POSITION = 0

If the registration mark is sensed while CHN 14 is on, the registration control will determine that the material should be retarded. If the registration mark is sensed while CHN 15 is on, the registration control will determine that the material should be advanced. If the registration mark is sensed between the CHN 14 and CHN 15 on pulses, the registration is within tolerance and no adjustment is needed.

Example 2 illustrates the following:

CHN 14 - ON @ 320 OFF @ 20
CHN 15 - ON @ 40 OFF @ 100
CENTER POSITION = 30

Although the channel 14 and 15 values in example 2 seem very different from example 1, they are actually the same pulses phase shifted so that the center between them is now 30 instead of 0. To get from example 1 to example 2, it was NOT necessary to go into channels 14 or 15 to make changes, only the center position had to be changed. The pulses in outputs 14 and 15 are automatically adjusted to correspond to the new center position.

The following methods change the center position:

Decrease/Increase Inputs (logic terminals 3 & 4)—Energize the Decrease or Increase input to shift the registration pulses and center position by one increment in the corresponding direction (remote push buttons).

Center Input (logic terminal 5)—Energize the Center Input on the logic input strip to change the registration center position to the current machine position.

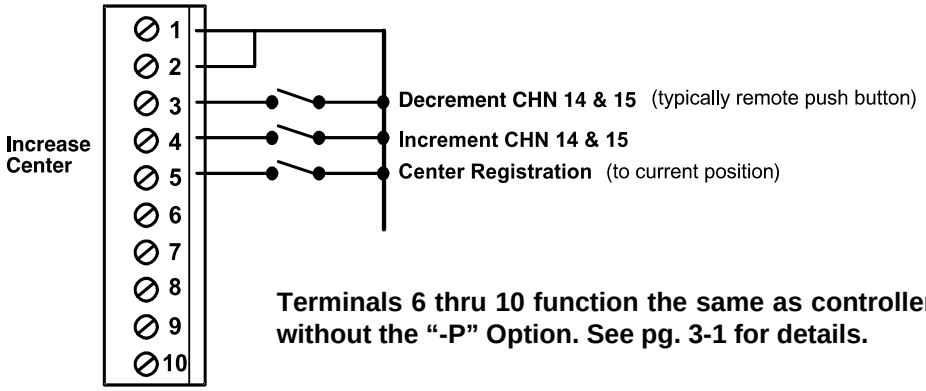
Channel 81—Select CHN 81 and the existing center value will be displayed. Press INC / DEC keys or key in a new center value and press ENT to change it.

Channel 80 - Select CHN 80 and press ENT to change the registration center position to the current machine position (machine was at 30 in example 2).

To accomplish registration control, it is necessary to wire channel 14 and 15 outputs, and the registration mark sensor, as inputs to a registration control system or PLC. Exact wiring is determined by the control system being used.

Some registration control systems will use the "off" portions of channels 14 and 15 as the registration windows. The "P" option can automatically handle these applications as well. Detailed explanation of this "Off" logic is on page 5-13.

Logic Terminal Strip (see pgs. 2-1 thru 2-3 for location)



Terminals 6 thru 10 function the same as controllers without the “-P” Option. See pg. 3-1 for details.

Input Information

Registration Input Terminals
Input terminals 3, 4, and 5 have special registration functions on “-P” option controls. It is not possible to use these terminals to change programs from hardware inputs, as on 5000 Series controllers, without the “-P” option. Keyboard program selection (FCN 3) or serial communication must be used to change programs on “-P” option controls.

Terminals 3, 4, and 5 are always active. To program CHN 80 or CHN 81 through the keyboard, the Master, Set-Up, or Operator access levels must be activated through the logic terminal strip inputs or the keyboard enable codes.

General Logic Input Information
The logic inputs are energized by a current sinking path to Logic Common. They can be switched to common through the use of mechanical switches, relays, or NPN transistor outputs. The inputs are held at approximately 12 VDC and conduct 4 mA of current to common when energized.

Note: Substitute channels 7 & 8 for 14 & 15 on 9 output units.

Decrease Input (Terminal 3; normally Program Select 1)
The decrease input is a one-shot that causes the programmed setpoints in both channels 14 and 15 to be decremented one step each time the input is energized (center decreases one step) . The control will display the new CHN 14 “on” value for two seconds after the input is energized.

Increase Input (Terminal 4; normally Program Select 2)
The increase input is a one-shot that causes the programmed setpoints in both channels 14 and 15 to be incremented one step each time the input is energized (center increases one step) . The control will display the new CHN 14 “on” value for two seconds after the input is energized.

Center Input (Terminal 5; normally Program Select 3)
The center input is a one-shot that causes the setpoints in channels 14 and 15 to automatically change so the current machine position becomes the registration center position. “SEt” will be displayed for two seconds after the input is energized (this function is equivalent to accessing CHN 80 or setting CHN 81 = current machine position).

Center Input will not function if outputs 14 and 15 do not each have a pulse programmed.

(Option “-P” continued next page)

CHN 80 - Auto-Center Registration

The gap between the output 14 and 15 pulses (registration OK area) can be automatically centered around the current machine position by accessing CHN 80. This allows the correct registration phase to be set up in a single operation.

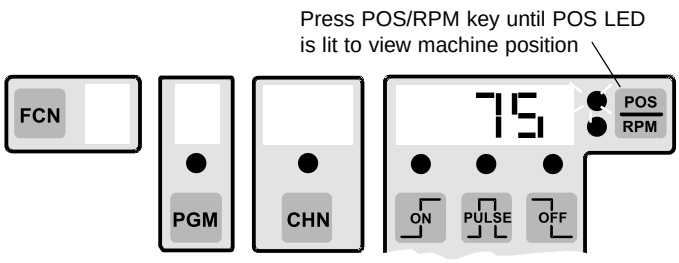
1. Move the machine (jog or move by hand) to the exact position where the registration mark should be detected by the sensor.
2. Access CHN 80 to center the current registration windows around the current machine position (machine should be stopped).
3. Display will show "SEt" after CHN 80 is entered to confirm that the centering operation has been accomplished.

Energizing the hardware Center Input causes the control to perform the same operation as CHN 80.

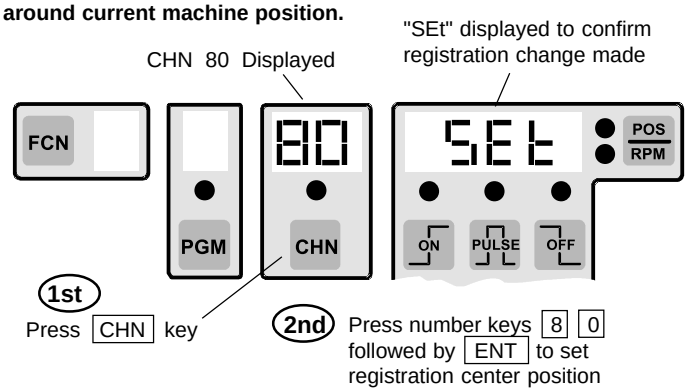
CHN 80 or the hardware Center Input will not function if outputs 14 and 15 do not each have a pulse programmed.

Note: Substitute channels 7 & 8 for 14 & 15 on 9 output units.

Jog machine to position where Registration mark should be sensed.



Access CHN 80 to center registration around current machine position.



CHN 81 - Display Adjust Registration Center

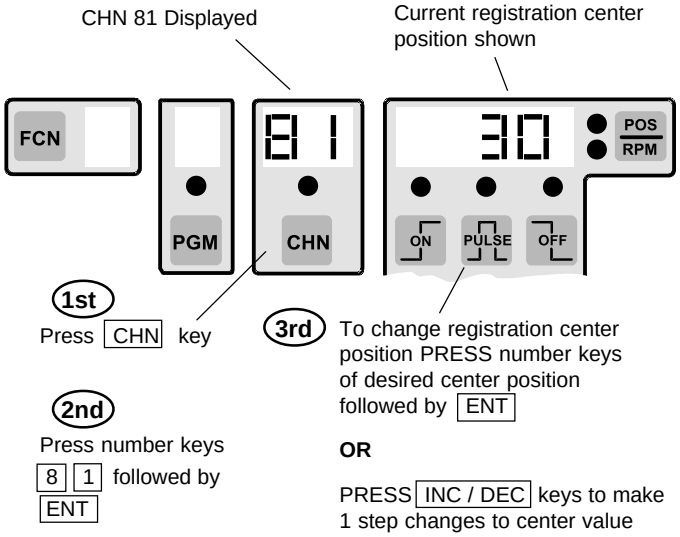
The center of the gap between the output 14 and 15 pulses (registration OK area) can be monitored and/or changed through CHN 81. Each time CHN 81 is accessed, its value is calculated from the current output 14 and 15 pulses. Therefore, CHN 81 can be a unique value within each program and is not a global value. For this reason, CHN 81 is **not** part of the PLuSNET ASCII file used to store, edit and load the control's programmed contents through serial communication.

Changes can be made by entering the new center position through the keyboard, eliminating the need to move the machine to a specific position.

1. Access CHN 81 to view the current registration center position value.
2. Key in the new desired center position and press "Enter" to change it; or Press "INC/DEC" keys to make one step changes to the center position. Each time the Increase or Decrease inputs are energized, the display will show the new registration center position (CHN 81) for 2 seconds. If no change is desired, press "POS/RPM" to return to the Position or RPM display, or access other programming operations in the normal manner.

CHN 81 will not function if outputs 14 and 15 do not each have a pulse programmed.

Access CHN 81 to view / change current registration center position



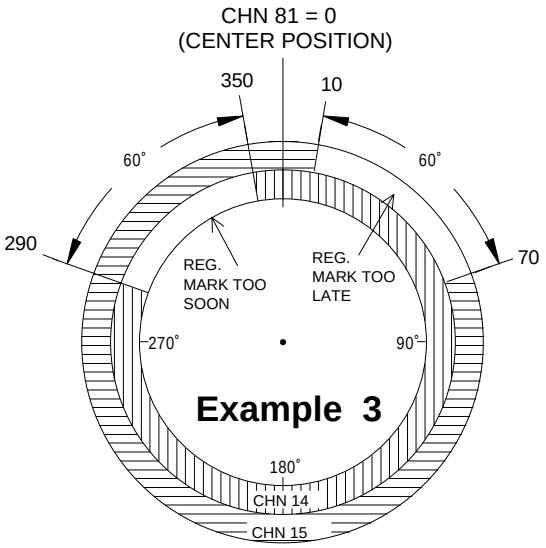
(Option "-P" continued next page)

Automatic Reversal of Centering Logic

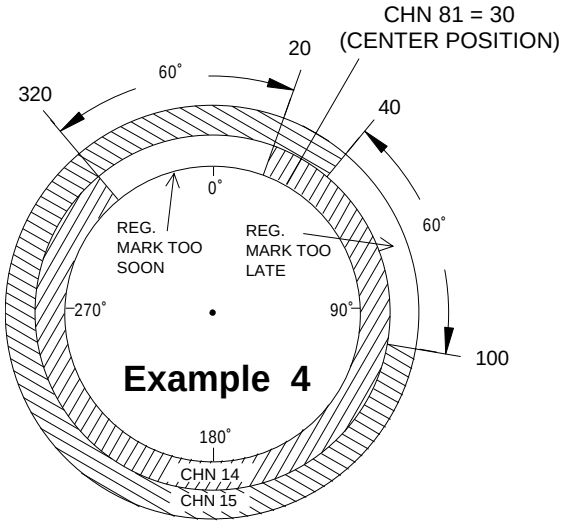
Some registration control systems use the “Off” portion of the input signals as the registration correction windows. In these cases, outputs 14 and 15 will each be “On” for most of the revolution, and off only during the registration correction windows. The “P” option logic automatically handles these situations.

The control assumes that “Off” registration logic is being used whenever the “On” duration of output 14 is greater than 180 degrees. In this “Off” logic mode, the registration centering functions (CHN 80, CHN 81 and the Center Input) are based on the smaller gap between the “Off” portions of outputs 14 and 15, rather than the smaller gap between the “On” portions. Examples 3 and 4 below are the “Off” logic equivalents of Examples 1 and 2 on page 5-5.

“OFF” Logic Registration Examples



CHN 14 - ON @ 350 OFF @ 290
CHN 15 - ON @ 70 OFF @ 10
CENTER POSITION = 0



CHN 14 - ON @ 20 OFF @ 320
CHN 15 - ON @ 100 OFF @ 40
CENTER POSITION = 30

In examples 3 and 4, output 14 has an on duration greater than 180. Therefore, the control automatically assumes “off” logic is being used. All center calculations and adjustments use the smaller gap between where outputs 14 and 15 are off.

The output 14 and 15 values in example 4 are the result of the values in example 3 being shifted by 30. CHN 80, CHN 81, and the center input can be used to adjust the center value as before. The pulses programmed in outputs 14 and 15 are automatically adjusted to correspond to the new center position.

Note: Substitute channels 7 & 8 for 14 & 15 on 9 output units.